

J21 I2

DESIGN REPORT

Temporary Sedimentation Structure

J21-I2

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



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INTRODUCTION

Sedimentation Structure J21-I2 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 J21 disturbed surface mining area at the Kayenta Mine. The location of Structure J21-I2 and its watershed boundary are shown on Drawing No. 85400 (Sheet M-11) 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 J21-I2 that is in series with sedimentation structures J21-I1 & J21-I. J21-I2 is the most upstream 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".

INSPECTION

The construction site of the proposed Structure J21-I2 was inspected in January, 2000 by a Registered Professional Engineer from Peabody Western Coal Company, 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.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J21-I2 will be constructed in series with proposed Structures J21-I1 and J21-I. Structure J21-I2 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. J21-I2 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 J21-I2 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 Dinnebito Wash.

The following parameters were used in the hydrologic analysis, (see Appendix B & C):

1.	Water Course length, L	<u>J21-I2</u> 1.258 mi.
2.	Elevation Difference, H	225 ft
3.	Time of Concentration, T _c	0.420 hr
4.	SCS Curve Number	84
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in
	25-year, 6-hour storm	1.9 in
6.	Drainage Area	539.9 acres

Values reported represent the watershed, which drains directly to Pond J21-I2. Hydrologic input parameters for structure J21-I1 and J21-I 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.

J21-I2 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	373.6	425.9
Volume	ac-ft	36.69	30.32
Storage			
Peak Stage	msl	N/A	6849.1
Emerg. Spillway Elev.	msl	6846.5	6846.5
Peak Storage	ac-ft	N/A	26.7
Storage Capacity	ac-ft	19.8	19.8
Outflow			
Peak Flow	cfs	N/A	303.3
Spillway Elevation	msl	6846.5	6846.5
Embankment Crest Elev.	msl	6851.0	6851.0
Peak Stage	msl	--	6849.1
Freeboard	ft	--	1.4
Emergency Spillway Channel			
Flow Depth	ft	--	2.6
Critical Velocity	fps	--	6.6
Mannings "n"	--	--	0.03
Width	ft	--	25
Outflow Channel			
Slope	%	--	16
Normal Velocity	fps	--	9.9
Normal Depth	ft	--	1.1
Mannings "n"	--	--	0.059
Riprap D ₅₀	in	--	9

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 J21-I2 does not have sufficient storage to contain the 10-year, 24-hour storm, however, the storage of all three ponds (J21-I2, J21-I1, & J21-I) 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.

Combined Storage for Structures J21-I2, J21-I1 and J21-I

	J21-I2	J21-I1	J21-I	COMBINED
Total Storage Capacity	19.8	19.3	18.6	57.7 acre-ft.
10-Year, 24-Hour Storm Inflow	36.69	6.08	0.05	42.82 acre-ft.
Available Sediment Storage Capacity	-	-	-	14.88 acre-ft.
Sediment Inflow Rate/Year	4.54	1.03	0.02	5.59 acre-ft.
Sediment Storage Life	-	-	-	2.7 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- J21-I2, J21-I1, & J21-I Proposed Sedimentation Ponds

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

**PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA**

PROJECT: J21 AREA

STRUCTURE: J21-I2 Upper Pond

TIME OF CONCENTRATION:

Start Elevation (ft) = 7052
 End Elevation (ft) = 6827
 Elevation Difference, E (ft) = 225

Watercourse Length (ft) = 6640
 Watercourse Length, L (mi) = 1.258

$T_c = (11.9L^3/E)^{0.385} = \underline{\underline{0.420 \text{ hours}}}$

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	C	78	14.9	1162.2
Pinyon Juniper	D	83	128.9	10698.7
Sagebrush	D	79	51.1	4036.9
Disturbed - Mine		90	100.7	9063
Disturbed - Spoil		86	115.2	9907.2
Reclaimed	C	81	129.1	10457.1
TOTAL:			539.9	45325.1

Weighted CN = Total CN*Area/ Total Area = 84

DRAINAGE BASIN AREA:

539.9 Acres

PROJECT: J21-12 Upper 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%	143.8	0.22	31.64	1.00	143.80
Sagebrush/Grass	20%	25%	51.1	0.20	10.22	1.00	51.10
Disturbed	0%	0%	100.7	1.00	100.70	1.00	100.70
Spoil	0%	0%	115.2	1.00	115.20	0.80	92.16
Reclaimed	40%	0%	129.1	0.15	19.37	0.40	51.64
TOTAL:			539.9		277.12		439.40

Weighted C = Total C*Area/ Total Area = 0.513

Weighted P = Total P*Area/ Total Area = 0.814

RAINFALL FACTOR:

R = 40

J21-12 SPILLWAY CRITICAL VELOCITY
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	T
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.012118 ft/ft	
Left Side Slope	3.000000 H : V	
Right Side Slope	3.000000 H : V	
Bottom Width	25.00	ft
Discharge	303.30	cfs

Results		
Depth	1.55	ft
Flow Area	46.13	ft ²
Wetted Perimeter	34.83	ft
Top Width	34.33	ft
Critical Depth	1.55	ft
Critical Slope	0.012118 ft/ft	
Velocity	6.58	ft/s
Velocity Head	0.67	ft
Specific Energy	2.23	ft
Froude Number	1.00	
Flow is subcritical.		

APPENDIX B

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

PEABODY WESTERN
KAYENTA MINE
PONDS J21-I2, J21-I1, & J21-I

10-Year, 24-Hour Storm

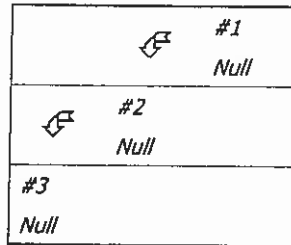
DJK

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

Phone: 303 763-5140

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	#2	0.025	0.401	J21-I2 Spillway
Null	#2	==>	#3	0.001	0.449	J21-I1 Spillway
Null	#3	==>	End	0.000	0.000	J21-I Spillway



Structure Detail:

Structure #1 (Null)

J21-I2 Spillway

Structure #2 (Null)

J21-I1 Spillway

Structure #3 (Null)

J21-I Spillway

APPENDIX C

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

PEABODY WESTERN
KAYENTA MINE
POND J21-I2

25-Year, 6-Hour Storm

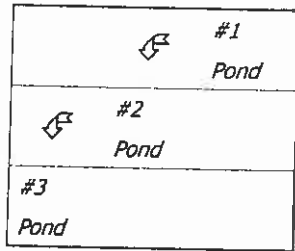
DJK

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Pond	#1	==>	#2	0.025	0.401	J21-I2 Spillway
Pond	#2	==>	#3	0.001	0.449	J21-I1 Spillway
Pond	#3	==>	End	0.000	0.000	J21-I Spillway



Structure Detail:

Structure #1 (Pond)

J21-I2 Spillway

Pond Inputs:

Initial Pool Elev:	6,846.50
Initial Pool:	19.84 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,846.50	40.00	3.00:1	3.00:1	25.00

Pond Results:

Peak Elevation:	6,849.07
Dewater Time:	0.33 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)
6,827.00	0.160	0.000	0.000	
6,827.50	0.186	0.087	0.000	
6,828.00	0.215	0.187	0.000	
6,828.50	0.246	0.302	0.000	
6,829.00	0.278	0.433	0.000	
6,829.50	0.313	0.581	0.000	
6,830.00	0.350	0.746	0.000	
6,830.50	0.384	0.930	0.000	
6,831.00	0.419	1.131	0.000	
6,831.50	0.456	1.349	0.000	
6,832.00	0.495	1.587	0.000	
6,832.50	0.535	1.845	0.000	
6,833.00	0.577	2.123	0.000	
6,833.50	0.620	2.422	0.000	
6,834.00	0.665	2.743	0.000	
6,834.50	0.711	3.087	0.000	
6,835.00	0.758	3.454	0.000	

SEDCAD 4 for Windows

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Civil Software Design

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,827.00	0.000	0.000
6,827.50	0.000	0.000
6,828.00	0.000	0.000
6,828.50	0.000	0.000
6,829.00	0.000	0.000
6,829.50	0.000	0.000
6,830.00	0.000	0.000
6,830.50	0.000	0.000
6,831.00	0.000	0.000
6,831.50	0.000	0.000
6,832.00	0.000	0.000
6,832.50	0.000	0.000
6,833.00	0.000	0.000
6,833.50	0.000	0.000
6,834.00	0.000	0.000
6,834.50	0.000	0.000
6,835.00	0.000	0.000
6,835.50	0.000	0.000
6,836.00	0.000	0.000
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
6,846.50	0.000	0.000

SEDCAD 4 for Windows

Copyright 1998 Pamela J. Schwab
Civil Software Design

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,804.50	0.538	1.834	0.000	
6,805.00	0.570	2.111	0.000	
6,805.50	0.601	2.404	0.000	
6,806.00	0.633	2.713	0.000	
6,806.50	0.666	3.037	0.000	
6,807.00	0.700	3.379	0.000	
6,807.50	0.735	3.738	0.000	
6,808.00	0.770	4.114	0.000	
6,808.50	0.806	4.508	0.000	
6,809.00	0.843	4.920	0.000	
6,809.50	0.881	5.351	0.000	
6,810.00	0.920	5.801	0.000	
6,810.50	0.963	6.272	0.000	
6,811.00	1.006	6.764	0.000	
6,811.50	1.051	7.279	0.000	
6,812.00	1.096	7.815	0.000	
6,812.50	1.143	8.375	0.000	
6,813.00	1.190	8.958	0.000	
6,813.50	1.239	9.566	0.000	
6,814.00	1.288	10.198	0.000	
6,814.50	1.339	10.854	0.000	
6,815.00	1.390	11.536	0.000	
6,815.50	1.430	12.241	0.000	
6,816.00	1.470	12.966	0.000	
6,816.50	1.510	13.711	0.000	
6,817.00	1.551	14.476	0.000	
6,817.50	1.593	15.262	0.000	
6,818.00	1.635	16.069	0.000	
6,818.50	1.678	16.898	0.000	
6,819.00	1.722	17.748	0.000	
6,819.50	1.765	18.619	0.000	
6,819.90	1.801	19.333	0.000	Spillway #1
6,820.00	1.810	19.513	10.634	4.25
6,820.50	1.887	20.437	63.752	2.10
6,821.00	1.965	21.400	116.870	0.85
6,821.50	2.045	22.403	242.583	0.55
6,821.74	2.085	22.904	311.289	0.20 Peak Stage
6,822.00	2.127	23.446	385.505	
6,822.50	2.210	24.530	559.274	
6,823.00	2.295	25.656	767.119	
6,823.50	2.381	26.825	1,007.791	

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs) ~
6,815.50	0.000	0.000
6,816.00	0.000	0.000
6,816.50	0.000	0.000
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
6,819.90	0.000	0.000
6,820.00	10.634	10.634
6,820.50	63.752	63.752
6,821.00	116.870	116.870
6,821.50	242.583	242.583
6,822.00	385.505	385.505
6,822.50	559.274	559.274
6,823.00	767.119	767.119
6,823.50	1,007.791	1,007.791
6,824.00	1,277.620	1,277.620
6,824.50	1,566.956	1,566.956
6,825.00	1,886.875	1,886.875

Structure #3 (Pond)

J21-I Spillway

Pond Inputs:

Initial Pool Elev:	6,804.90
Initial Pool:	18.60 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,804.90	32.00	3.00:1	3.00:1	55.00

Pond Results:

Peak Elevation:	6,806.53
Dewater Time:	0.34 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,804.50	1.841	17.860	0.000	
6,804.90	1.880	18.604	0.000	Spillway #1
6,805.00	1.890	18.792	12.797	4.40
6,805.50	1.939	19.750	76.720	2.30
6,806.00	1.989	20.732	140.642	0.80
6,806.50	2.039	21.739	280.553	0.55
6,806.53	2.043	21.802	290.442	0.05 Peak Stage
6,807.00	2.090	22.771	441.493	
6,807.50	2.142	23.829	638.353	
6,808.00	2.194	24.913	873.216	
6,808.50	2.247	26.024	1,137.829	
6,809.00	2.301	27.161	1,432.512	
6,809.50	2.355	28.325	1,750.074	
6,810.00	2.410	29.516	2,098.482	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,785.00	0.000	0.000
6,785.50	0.000	0.000
6,786.00	0.000	0.000
6,786.50	0.000	0.000
6,787.00	0.000	0.000
6,787.50	0.000	0.000
6,788.00	0.000	0.000
6,788.50	0.000	0.000
6,789.00	0.000	0.000
6,789.50	0.000	0.000
6,790.00	0.000	0.000
6,790.50	0.000	0.000
6,791.00	0.000	0.000
6,791.50	0.000	0.000
6,792.00	0.000	0.000
6,792.50	0.000	0.000
6,793.00	0.000	0.000
6,793.50	0.000	0.000
6,794.00	0.000	0.000
6,794.50	0.000	0.000

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	539.900	0.420	0.000	0.000	84.000	F	425.88	30.323
Σ		539.900						425.88	30.323
#2	1	183.500	0.225	0.000	0.000	74.000	F	77.08	4.653
Σ		723.400						336.22	34.976
#3	1	7.700	0.028	0.000	0.000	60.000	F	0.16	0.028
Σ		731.100						311.44	35.004