J21 F

DESIGN REPORT

Temporary Sedimentation Structure
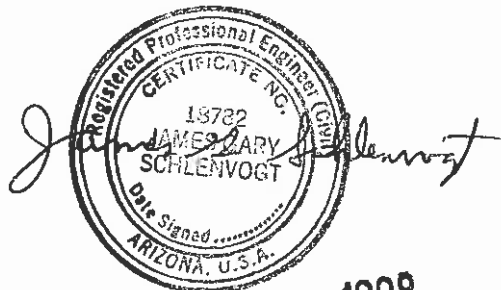
J21-F

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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INTRODUCTION

Sedimentation Structure J21-F 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-F and its watershed boundary are shown on Drawing No. 85400 (Sheet N-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-F, which is in series with sedimentation structure J21-F1. 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-F was inspected in August, 1997 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 SEDCAD+ (see Appendices A, B, and C). Structure J21-F will be constructed in series with proposed upstream Structure J21-F1. Structure J21-F 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 two structures have a combined capacity greater than 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. Structures J21-F and J21-F1 were conservatively assumed to be full to the emergency spillway at the time of 100-year storm event. The storage capacity of structure J21-F 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 and C):

		J21-F
1.	Water Course length, L	0.275 mi.
2.	Elevation Difference, H	120 ft
3.	Time of Concentration, T_c	0.092 hr
4.	SCS Curve Number	81
5.	Rainfall Depth, 10-year, 24-hour storm	2.1 in
	100-year, 6-hour storm	2.4 in
6.	Drainage Area, 10-year, 24-hour storm	16.5 acres
	100-year, 6-hour storm	317.9 acres

Values reported represent the watershed, which drains directly to Pond J21-F. Hydrologic input parameters for upstream structure J21-F1 is presented in the Design Report for J21-F1.

Muskingum routing parameters were utilized to route the 100-year hydrographs between the J21-F and J21-F1 structures. The routing parameters are presented in Appendices A, B, and C, and are shown on a sub-watershed basis.

J21-F 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	cfs	12.2	284.8
Volume	ac-ft	0.92	28.8
Storage			
Peak Stage	msl	N/A	6874.4
Emerg. Spillway Elev.	msl	6872.5	6872.5
Peak Storage	ac-ft	N/A	26.1
Storage Capacity	ac-ft	19.93	19.93
Outflow			
Peak Flow	cfs	N/A	216.9
Spillway Elevation	msl	6872.5	6872.5
Embankment Crest Elev.	msl	6876	6876
Peak Stage	msl	—	6874.4
Freeboard	ft	--	1.6
Emergency Spillway Channel			
Flow Depth	ft	--	1.9
Critical Velocity	fps	--	5.8
Mannings "n"	--	—	.031
Width	ft	—	30
Outflow Channel			
Slope	%	—	23
Normal Velocity	fps	—	9.0
Normal Depth	ft	—	0.8
Mannings "n"	--	--	.062
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-F has sufficient storage to contain the 10-year, 24-hour storm and has excess capacity to store additional flow from J21-F1. The combined sediment storage capacity was determined for the two structures in series and the results of the analysis are presented in the following table.

<u>Combined Storage for Structures J21-F and J21-F1</u>

	J21-F	J21-F1	Combined
Total Storage Capacity	19.93	19.97	39.90 acre-ft
10-Year, 24-Hour Storm Inflow	0.92	21.83	22.75 acre-ft
Available Sediment Storage Capacity	--	--	17.15 acre-ft
Sediment Inflow Rate/Year	0.17	3.35	3.52 acre-ft
Sediment Storage Life	--	--	4.9 years

*   *   *

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

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) 100-Year, 6-Hour Storm Event

Exhibit #1- J21-F and J21-F1 Temporary Proposed Sediment Ponds

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J21 AREA

STRUCTURE: J21-F

TIME OF CONCENTRATION:

Start Elevation (ft) =	6990
End Elevation (ft) =	6870
Elevation Difference, E (ft) =	120
Watercourse Length (ft) =	1450
Watercourse Length, L (mi) =	0.275

$Tc = (11.9L^3/E)^{0.385} =$ 0.092 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
Pinyon Juniper	C	78	12.9	1006.2
Disturbed	C	91	3.6	327.6
TOTAL:			16.5	1333.8

Weighted CN = Total CN*Area/ Total Area =   81

DRAINAGE BASIN AREA:

16.5 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J21-F 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	0.24	
Length Slope Factor	6.25	
Cover Factor	0.39	
Practice Factor	1.00	
Gross Annual Sediment Yield	23.76	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0116	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0104	acre-feet/acre/year
Watershed Area	16.5	acres
Watershed Annual Sediment Yield	0.17	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.17	acre-feet

Project Description

Project File	untitled.fm2
Worksheet	J21
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.031	
Channel Slope	0.014068	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	30.00	ft
Discharge	216.90	cfs

Results

Depth	1.13	ft
Flow Area	37.75	ft²
Wetted Perimeter	37.15	ft
Top Width	36.78	ft
Critical Depth	1.13	ft
Critical Slope	0.014068	ft/ft
Velocity	5.75	ft/s
Velocity Head	0.51	ft
Specific Energy	1.64	ft
Froude Number	1.00	
Flow is subcritical.		

APPENDIX B

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : PONDS F & F1 (10 YEAR, 24-HR)

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0400\SEDCAD\J21F10

Date: 01-21-1998

APPENDIX C

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : POND F & F1 (100 YEAR, 6-HR)

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0400\SEDCAD\J21FH

Date: 01-16-1998

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: ACZ, INC.
Filename: J:\861\0400\SEDCAD\J21FH   User: D. GLEASON
Date: 01-16-1998 Time: 15:34:40
PEABODY WESTERN COAL COMPANY : POND F & F1 (100 YEAR, 6-HR)
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE
==

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	301.40	85	F	0.277	0.000	0.000	0.0	27.61	399.49
		Type: Pond			Label: J21-F1 POND					
111	Structure	301.40							27.61	
111	Total IN	301.40							27.61	399.49
111	Total OUT								27.61	279.88
11˄	1	16.50	81	F	0.092	0.000	0.000	0.0	1.20	23.61
		Type: Pond			Label: J21-F POND					
1	Structure	16.50							28.81	
112	Total IN	317.90							28.81	284.83
112	Total OUT								28.81	216.84
111 to 112 Routing					0.005	0.424				

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	27.61	399.49
OUT	27.61	279.88

Peak Elevation	Hydrograph Detention Time (hrs)
6891.2	0.23

****

J1, B1, S2
J21-F POND

Drainage Area from J1, B1, S2, SWS(s)1:	16.5 acres
Total Contributing Drainage Area:	317.9 acres

DISCHARGE OPTIONS:

	Emergency Spillway
P' ·er Diameter (in)	----
ser Height (ft)	----
.rel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	6872.5
Crest Length (ft)	40.0
(Left and Right)	3 3
:om Width (ft)	30.0

POND RESULTS:

Permanent
Pool
(ac-ft)

Company Name: ACZ, INC.
Filename: J:\861\0400\SEDCAD\J21FH   User: D. GLEASON
                Date: 01-16-1998 Time: 15:34:40
    PEABODY WESTERN COAL COMPANY : POND F & F1 (100 YEAR, 6-HR)
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
            Hydrograph Convolution Interval: 0.1 hr

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ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
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J1, B1, S1
J21-F1 POND

Drainage Area from J1, B1, S1, SWS(s)1:   301.4 acres
        Total Contributing Drainage Area: 301.4 acres

SW#1:   Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6880.00	0.00	1.68	0.00	0.00	
6881.00	1.00	1.78	1.73	0.00	
6882.00	2.00	1.88	3.56	0.00	
6883.00	3.00	1.98	5.49	0.00	
6884.00	4.00	2.09	7.52	0.00	
6885.00	5.00	2.20	9.67	0.00	
6886.00	6.00	2.38	11.96	0.00	
6887.00	7.00	2.57	14.43	0.00	
6888.00	8.00	2.77	17.10	0.00	
6889.00	9.00	2.97	19.97	0.00	Stage of SW#1
6889.70	9.70	3.12	22.10	30.80	
6889.80	9.80	3.14	22.41	40.29	
6889.90	9.90	3.16	22.73	50.68	
6890.00	10.00	3.18	23.05	61.92	
6890.50	10.50	3.37	24.68	136.90	
6891.00	11.00	3.55	26.41	229.05	
6891.24	11.24	3.64	27.29	279.88	Peak Stage
6891.50	11.50	3.74	28.23	334.84	
6892.00	12.00	3.93	30.15	472.05	
6892.50	12.50	4.13	32.17	629.82	
6893.00	13.00	4.33	34.28	819.57	

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J1, B1, S2
J21-F POND

Drainage Area from J1, B1, S2, SWS(s)1:   16.5 acres
        Total Contributing Drainage Area: 317.9 acres

SW#1:   Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6865.00	0.00	2.28	0.00	0.00