ATTACHMENT H

Sedimentation and Impoundment Structures

Inspection and Design Reports

DESIGN REPORT

Permanent Impoundment Structure

J27-RA

Black Mesa Mine

Navajo County, Arizona

for

PEABODY WESTERN COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
18782
JAMES GARY
SCHLENVOGT
Date Signed
ARIZONA, U.S.A.

FEB 23 1998

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INTRODUCTION

Structure J27-RA is an existing earthen embankment structure constructed by Peabody Western Coal Company in the J-27 reclamation area and proposed as a permanent structure to impound a maximum of approximately 2.63 ac.-ft. of runoff from the adjacent reclaimed areas of the Black Mesa Mine. The location of structure J27-RA and its watershed boundary are shown on Drawing No. 85400 (Sheet L-10) and Drawing No. 85405. The existing structure and the site-specific general construction plans addressing the existing embankment configuration and spillway designs are shown on the attached Exhibit 1.

This design report contains information specific to structure J27-RA, which is in series with Structure J27-RC. 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 existing structure J27-RA was inspected by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the existing structure is stable and no adverse conditions existed to prevent successful construction of the spillway structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized to evaluate embankment design.

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SITE DESCRIPTION

LAND USE

The J27-RA structure has a 45.8-acre tributary drainage area and is located on a tributary to Moenkopi Wash. The 45.8 acre watershed contributing to the J27-RA structure is classified as 19% Post-Law reclaimed and 81% Pre-Law reclaimed.

DESIGN ANALYSES

GENERAL

Structure J27-RA 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 1997 for Peabody Western Coal Company and was used in the analysis of the structure.

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STABILITY

Structure J27-RA is conservatively assumed to be a Category A-5 embankment. A homogeneous earthen embankment approximately 15 feet wide on top currently exists. The upstream slope will be constructed to 2.5:1 (horizontal to vertical) or flatter slope and the downstream slope will be constructed to 3.5:1 or flatter slope. Based on the total embankment height of approximately 13 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 10-foot wide riprap-lined trapezoidal channel.

WATER PERSISTENCE

Pond J27-RA is a relatively small pond with an adequate contributing drainage area. As a result, there is standing water in the pond over a significant portion of the year with an average depth ranging from 3 to 7 feet. Both PWCC personnel and the OSM Inspectors have observed water occurrence in the pond over a period of several years.

In addition, to determine water persistence for Structure J27-RA, runoff from average annual precipitation was compared to evaporation and infiltration rates on a monthly basis. Initially, the pond was assumed to be empty. Runoff for the first month was determined using the SCS Curve Number Method and the mean monthly precipitation for January, as presented in Appendices C and described in subsequent sections. The runoff volume was added to the pond and a water elevation and surface area were determined from the pond stage storage curve found on Appendix C. Once the water surface area was determined, the total evaporation and infiltration for the first month were calculated. The calculated evaporation and infiltration losses were subtracted from the total runoff for the first month to determined the average water increase or decrease to the pond. The final volume was then used as the starting volume for the next month and the same steps were repeated for each subsequent month. This analysis proceeded until the pond elevation and surface area stabilized, which occurred in year 2. The inputs and results are shown in Appendix C in both graphical and tabular formats. As shown by the graph and table in Appendix C, the water elevation of the

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pond should stabilize between elevation 6539.5 and the spillway invert, depending on the time of year. This is the point at which runoff rates equal the evaporation and infiltration rates and or runoff discharges through the spillway and corresponds to approximately 1.5 to 2.6 ac-ft of water in the impoundment.

In 1982 and 1983, Water, Waste and Land (WWL), Consultants, also prepared a study for PWCC and OSM which is included in Volume 27, Appendix E. They evaluated and determined these types of impoundments located in areas reclaimed in the late 1970's and early 1980's were stable.

WATER QUALITY

Water in the J27-RA Permanent Impoundment comes primarily from surface water runoff from the J27 reclamation area. Given that the spoils in the J27 area do not contain material which is potentially acid- or toxic-forming and could adversely impact surface runoff water quality, Peabody Western Coal Company does not anticipate any significant water quality problems. The structure has been containing water for many years and no adverse condition from the water has been noted in the wildlife or domestic animals observed in the area.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, and B). Structure J27-RA is constructed in series with downstream Structure J27-RC. Structure J27-RA is classified as a low hazard structure (see Drawing No. 85408). The mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and is less than 20 vertical feet in height from the upstream toe of embankment of the natural stream elevation to the emergency spillway invert elevation. The structure is located upstream of Structure J27-RC; and although the cumulative capacity of these impoundments is less than 20 acre-feet, the spillway was analyzed using the 100-year, 6-hour storm event given the potential for flow between structures. Structure J27-RA was conservatively assumed to be full to the invert of the emergency spillway at the time of 100-year storm event.

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The following parameters were used in the hydrologic analysis for the 100-yr., 6-hr storm (see Appendix B):

		J27-RA
1.	Water Course length, L	0.456 mi.
2.	Elevation Difference, H	142 ft
3.	Time of Concentration, T_c	0.156 hr
4.	SCS Curve Number	86
5.	Rainfall Depth, 100-year, 6-hour storm	2.4 in
6.	Drainage Area	45.8 acres

HYDRAULICS

The SEDCAD+ 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, and B).

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J27-RA SEDIMENTATION POND HYDRAULICS TABLE

	Units	100-Yr., 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	73.7
Volume	ac-ft	4.4
Outflow		
Peak Flow	cfs	59.7
Spillway Elevation	msl	6541.0
Embankment Crest Elev.	msl	6544.0
Peak Stage	msl	6542.6
Freeboard	ft	1.4
Emergency Spillway Channel		
Flow Depth	ft	1.6
Critical Velocity	fps	5.0
Mannings "n"	--	.035
Width	ft	10
Outflow Channel		
Maximum Slope	%	16.7
Normal Velocity	fps	7.4
Normal Depth	ft	0.7
Mannings "n"	--	.057
Riprap D_{50}	in	6

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J27-RA will be a trapezoidal channel, the alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

Minimum Channel Depth	(Spillway)	3.0	ft
	(Outflow)	1.7	ft
Channel Width		10	ft
Channel Length	(Spillway)	40	ft
	(Outflow)	125	ft
Sideslopes (Horizontal to Vertical)		3:1 or flatter	
Average Slope	(Spillway)	0.0	%
Maximum Slope	(Outflow)	16.7	%
Spillway Elevation		6541.0 ft	

A minimum 15-foot long riprap lined channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1997 aerial topography mapping conducted for Peabody Western Coal Company. Structure J27-RA is designed to contain approximately 2.63 acre-feet.

The calculations for the sediment load entering structure J27-RA were made utilizing the Revised Universal Soil Loss Equation with the following input parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.38
3.	Slope Factor, LS	1.88
4.	Cover Factor, C	0.22
5.	Erosion Control Factor, P	1.00

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To determine the potential life of the structure, the results of the sediment storage capacity for the J27-RA pond are presented in the following table.

J27-RA STORAGE

Total Available Storage Capacity	2.63	acre-feet
Sediment Inflow Rate/Year	0.13	acre-feet/year
Sediment Storage Life	20	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) 100-Year, 6-Hour Storm Event
Appendix C	-Water Persistence Calculations
Exhibit #1	- J27-RA Permanent Impoundment Design

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: J27-RA

TIME OF CONCENTRATION:

Start Elevation (ft) =	6680
End Elevation (ft) =	6538
Elevation Difference, E (ft) =	142
Watercourse Length (ft) =	2410
Watercourse Length, L (mi) =	0.456
Tc = (11.9L^3/E)^0.385 =	0.156

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
Pre-Law Reclaimed	C	87	37.1	3227.7
Post-Law Reclaimed	C	81	8.7	704.7
TOTAL:			45.8	3932.4

Weighted CN = Total CN*Area/ Total Area = 86

DRAINAGE BASIN AREA:

45.8 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J27 AREA

STRUCTURE: J27-RA

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
EH#35	0.38	45.8	17.40
TOTAL:		45.8	17.40

Weighted K = Total K*Area/ Total Area = 0.38

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
300	20	6.7%	0.5	3.8	1.52
100	20	20.0%	0.6	11.3	3.39
150	20	13.3%	0.6	7.6	2.66
340	30	8.8%	0.5	5.0	2.12
200	15	7.5%	0.5	4.3	1.39
250	10	4.0%	0.4	2.3	0.76
400	20	5.0%	0.5	2.9	1.34

Average LS = 1.88

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*

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COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pre Law	20%	0%	37.1	0.24	8.90	1.00	37.10
Post Law	40%	0%	8.7	0.15	1.31	1.00	8.70
TOTAL:			45.8		10.21		45.80

Weighted C = Total C*Area/ Total Area = 0.223

Weighted P = Total P*Area/ Total Area = 1.000

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J27 AREA

STRUCTURE: J27-RA

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	0.38	
Length Slope Factor	1.88	
Cover Factor	0.22	
Practice Factor	1.00	
Gross Annual Sediment Yield	6.37	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0031	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0028	acre-feet/acre/year
Watershed Area	45.8	acres
Watershed Annual Sediment Yield	0.13	acre-feet/year
mber of years	1	years
Calculated Sediment Volume	0.13	acre-feet

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SEDCAD+ RIPRAP CHANNEL DESIGN

J27-RA OUTFLOW CHANNEL

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	59.70 cfs	
Slope	16.70 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	10.00 feet	
Freeboard	None	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.68 ft
with Freeboard	0.00 ft
Top Width	14.06 ft
with Freeboard	10.00 ft
Velocity	7.34 fps
Cross Sectional Area	8.13 sq ft
Hydraulic Radius	0.57 ft
Manning's n	0.057
Froude Number	1.70
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

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J27-RA Spillway
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	J27-RA Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.019996	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	10.00	ft
Discharge	59.70	cfs

Results		
Depth	0.94	ft
Flow Area	12.01	ft²
Wetted Perimeter	15.93	ft
Top Width	15.62	ft
Critical Depth	0.94	ft
Critical Slope	0.019996	ft/ft
Velocity	4.97	ft/s
Velocity Head	0.38	ft
Specific Energy	1.32	ft
Froude Number	1.00	
Flow is supercritical.		

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APPENDIX B

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

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

J-27 AREA

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0500\J-27-2II

Date: 12-12-1997

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

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	705.15	8.57	8.78	0.02	0.022	0.418
1	2	2	1	8	1304.92	6.15	7.44	0.05	0.048	0.406
2	1	1	1	8	52.00	20.00	13.42	0.00	0.001	0.443

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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	45.80	86	F	0.156	0.000	0.000	0.0	4.44	73.66
Type: Pond Label: J27-RA									
111 Structure	45.80							4.44	
111 Total IN	45.80							4.44	73.66
111 Total OUT								4.44	59.70
112 1	31.10	84	F	0.182	0.000	0.000	0.0	2.69	44.08
Type: Null Label: NULL 1									
112 Structure	31.10							7.13	
112 Total IN/OUT	76.90							7.13	103.07
111 to 112 Routing					0.022	0.418			
121 1	10.80	84	F	0.078	0.000	0.000	0.0	0.94	17.78
Type: Pond Label: J27-RB									
121 Structure	10.80							0.94	
121 Total IN	10.80							0.94	17.78
121 Total OUT								0.94	10.35
122 1	40.90	85	F	0.098	0.000	0.000	0.0	3.75	70.35
Type: Null Label: NULL 2									
122 Structure	40.90							4.68	
122 Total IN/OUT	51.70							4.68	80.59
121 to 122 Routing					0.048	0.407			
211 1	14.80	85	F	0.095	0.000	0.000	0.0	1.36	25.46
Type: Pond Label: J27-RC									
211 Structure	14.80							13.17	
211 Total IN	143.40							13.17	188.24
211 Total OUT								13.17	158.90
112 to 211 Routing					0.001	0.443			

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6541.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	10.0

POND RESULTS:

Permanent Pool (ac-ft)
2.6

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	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	4.44	73.66
OUT	4.44	59.70

Peak Elevation	Hydrograph Detention Time (hrs)
6542.6	0.20

****

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6562.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	10.0

POND RESULTS:

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Permanent Pool (ac-ft)

=========
1.4

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.94	17.78
OUT	0.94	10.35

Peak Elevation	Hydrograph Detention Time (hrs)
6562.7	0.00

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6467.0
Crest Length (ft)	40.0
Z1 (Left and Right)	3 3
Bottom Width (ft)	20.0

POND RESULTS:

Permanent

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Pool (ac-ft)
2.1

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	13.17	188.24
OUT	13.17	158.90

Peak Elevation	Hydrograph Detention Time (hrs)
6469.0	0.17

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6532.00	0.00	0.01	0.00	0.00	
6533.00	1.00	0.07	0.04	0.00	
6534.00	2.00	0.17	0.16	0.00	
6535.00	3.00	0.22	0.36	0.00	
6536.00	4.00	0.27	0.61	0.00	
6537.00	5.00	0.32	0.91	0.00	
6538.00	6.00	0.37	1.25	0.00	
6539.00	7.00	0.43	1.66	0.00	
6540.00	8.00	0.48	2.11	0.00	
6541.00	9.00	0.55	2.63	0.00	Stage of SW#1
6541.70	9.70	0.60	3.04	10.90	
6541.80	9.80	0.61	3.10	14.42	
6541.90	9.90	0.62	3.16	18.33	
6542.00	10.00	0.62	3.22	22.63	
6542.50	10.50	0.66	3.54	52.82	
6542.59	10.59	0.67	3.60	59.70	Peak Stage
6543.00	11.00	0.70	3.88	92.64	
6543.50	11.50	0.74	4.25	141.13	
6544.00	12.00	0.78	4.63	207.48	

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J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6554.50	0.00	0.00	0.00	0.00
6555.50	1.00	0.04	0.01	0.00
6556.50	2.00	0.10	0.08	0.00

6557.50	3.00	0.15	0.21	0.00	
6558.50	4.00	0.20	0.39	0.00	
6559.50	5.00	0.25	0.61	0.00	
6560.50	6.00	0.30	0.89	0.00	
6561.50	7.00	0.34	1.21	0.00	
6562.00	7.50	0.37	1.39	0.00	Stage of SW#1
6562.50	8.00	0.41	1.58	7.79	
6562.66	8.16	0.43	1.65	10.35	Peak Stage
6562.70	8.20	0.43	1.67	10.90	
6562.80	8.30	0.44	1.71	14.42	
6562.90	8.40	0.45	1.76	18.33	
6563.00	8.50	0.46	1.80	22.63	
6563.50	9.00	0.51	2.05	52.82	
6564.00	9.50	0.58	2.32	92.64	
6564.50	10.00	0.64	2.62	141.13	
6565.00	10.50	0.71	2.96	207.48	

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6460.80	0.00	0.00	0.00	0.00	
6461.80	1.00	0.17	0.06	0.00	
6462.80	2.00	0.27	0.28	0.00	
6463.80	3.00	0.34	0.58	0.00	
6464.80	4.00	0.43	0.97	0.00	
6465.80	5.00	0.52	1.44	0.00	
6466.80	6.00	0.63	2.02	0.00	
6467.00	6.20	0.66	2.15	0.00	Stage of SW#1
6467.70	6.90	0.74	2.63	20.85	
6467.80	7.00	0.75	2.71	27.35	
6467.90	7.10	0.76	2.78	34.50	
6468.00	7.20	0.77	2.86	42.27	
6468.50	7.70	0.83	3.26	94.82	
6468.80	8.00	0.86	3.52	132.58	
6468.99	8.19	0.89	3.68	158.90	Peak Stage
6469.00	8.20	0.89	3.69	160.74	
6469.50	8.70	0.95	4.15	237.78	
6469.80	9.00	0.98	4.44	296.72	
6470.00	9.20	1.00	4.64	339.41	

****

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APPENDIX C

Water Persistence Calculations

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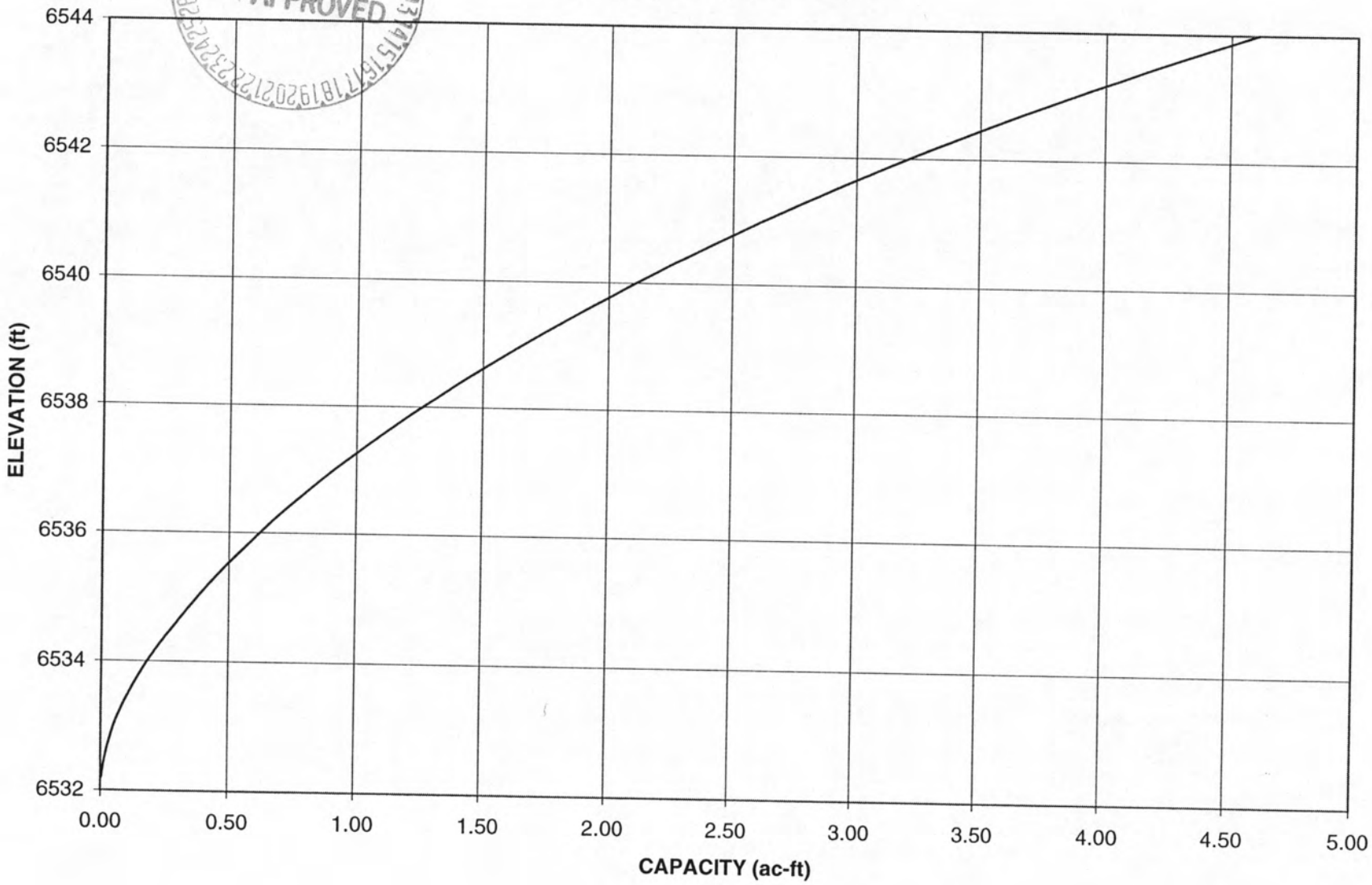
PERMANENT IMPOUNDMENTJ27-RA
ELEVATION /CAPACITY CURVE



Chart

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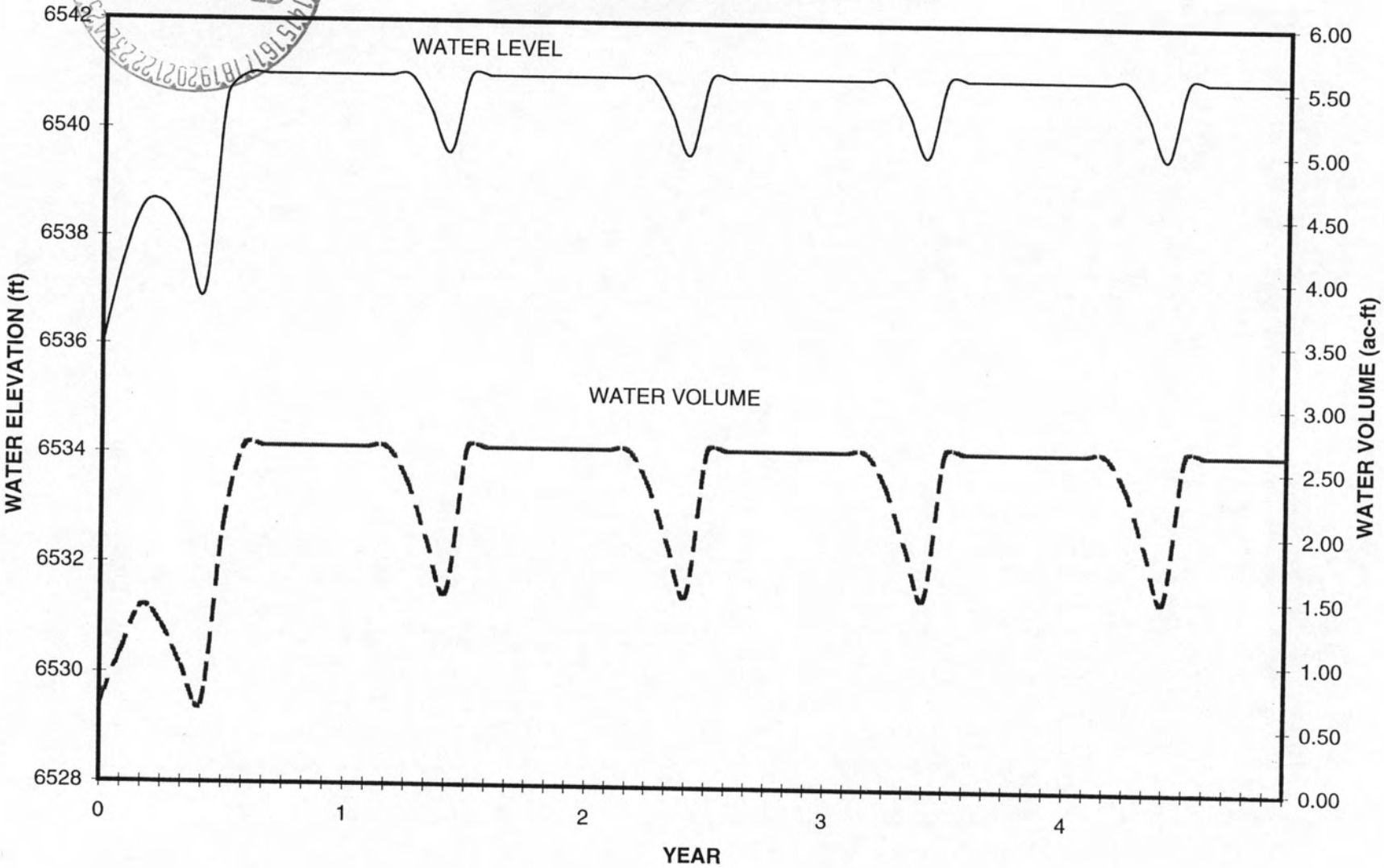
J27-RA PERMANENT IMPOUNDMENT
WATER PERSISTENCE EVALUATION



PEABODY WESTERN COAL COMPANY
PERMANENT IMPOUNDMENT POND WATER PERSISTENCE EVALUATION

	January	February	March	April	May	June	July	August	September	October	November	December	End of Year2	End Of Year 3	End Of Year 4	End Of Year 5
Average Precipitation (inch)	0.95	0.86	0.89	0.58	0.45	0.46	1.49	1.49	0.95	1.09	0.98	1.08	1.08	1.08	1.08	1.08
Area (acres)	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8	45.8
Curve Number	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
S	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Run-Off (inches)	0.17	0.13	0.15	0.03	0.01	0.01	0.49	0.49	0.17	0.24	0.19	0.24	0.24	0.24	0.24	0.24
Run-Off (ac-ft)	0.66	0.50	0.55	0.13	0.03	0.04	1.85	1.85	0.66	0.93	0.72	0.91	0.91	0.91	0.91	0.91
Starting Pond Volume (ac-ft)	0	0.62	1.02	1.38	1.23	0.90	0.63	2.00	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
Pond Volume + Runoff (ac-ft)	0.66	1.12	1.57	1.51	1.26	0.94	2.48	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
Water Elevation (ft)	6536	6537.6	6538.6	6538.6	6538	6537	6540.6	6541	6541	6541	6541	6541	6541	6541	6541	6541
Water Surface Area (acres)	0.27	0.35	0.40	0.40	0.37	0.32	0.52	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Evaporation Rate (inches/month)	0.87	2.63	4.68	7.38	10.54	10.77	9.95	8.49	7.08	4.68	2.82	1.46	1.46	1.46	1.46	1.46
Evaporation (ac-ft)	0.02	0.08	0.16	0.25	0.32	0.29	0.43	0.39	0.32	0.21	0.13	0.07	0.07	0.07	0.07	0.07
Infiltration Rate (inches/month)	1.054	0.952	1.054	1.02	1.054	1.02	1.054	1.054	1.02	1.054	1.02	1.054	1.054	1.054	1.054	1.054
Infiltration (ac-ft)	0.02	0.03	0.04	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Total Water Loss (ac-ft)	0.04	0.10	0.19	0.28	0.36	0.31	0.48	0.44	0.37	0.26	0.18	0.12	0.12	0.12	0.12	0.12
Total Water Change (ac-ft)	0.62	0.40	0.36	-0.15	-0.32	-0.28	1.37	1.42	0.29	0.67	0.54	0.80	0.80	0.80	0.80	0.80
Ending Pond Volume	0.62	1.02	1.38	1.23	0.90	0.63	2.00	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63	2.63
Volume through Spillway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.29	0.67	0.54	0.80	0.80	0.80	0.80	0.80

Notes:

1) Run-off volumes based on SCS Runoff Curve Number method: Q = (P-0.2S)^2/(P+0.8S)

P= Accumulative Precipitation
S= (1000/CN)-10

2) Evaporation and infiltration rates based on data presented in the report entitled " Hydrologic and Engineering Studies at the Peabody Coal Company Mines" in Permit AZ-0001 Volume 27.

3) Maximum Pond Volume 2.63 ac-ft

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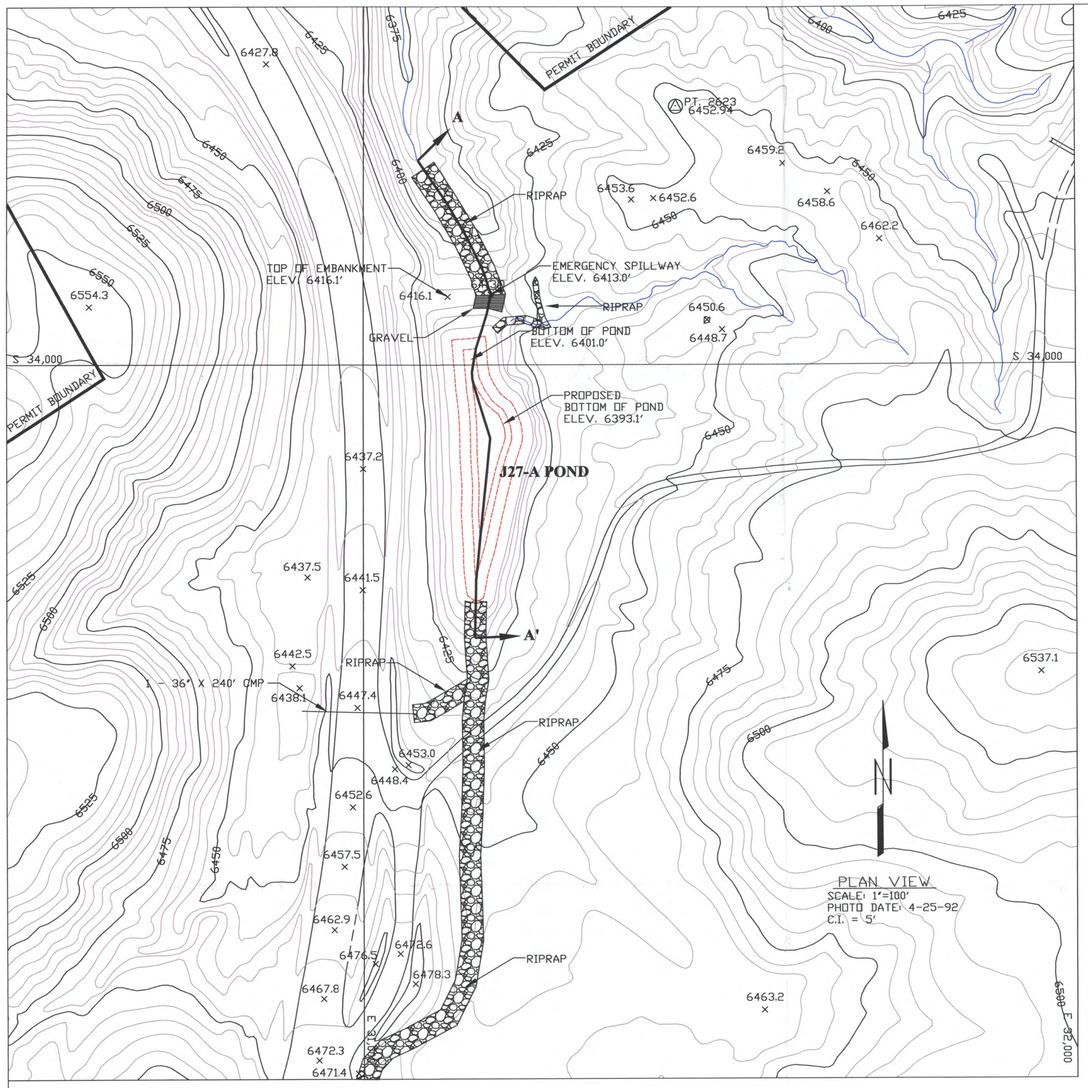
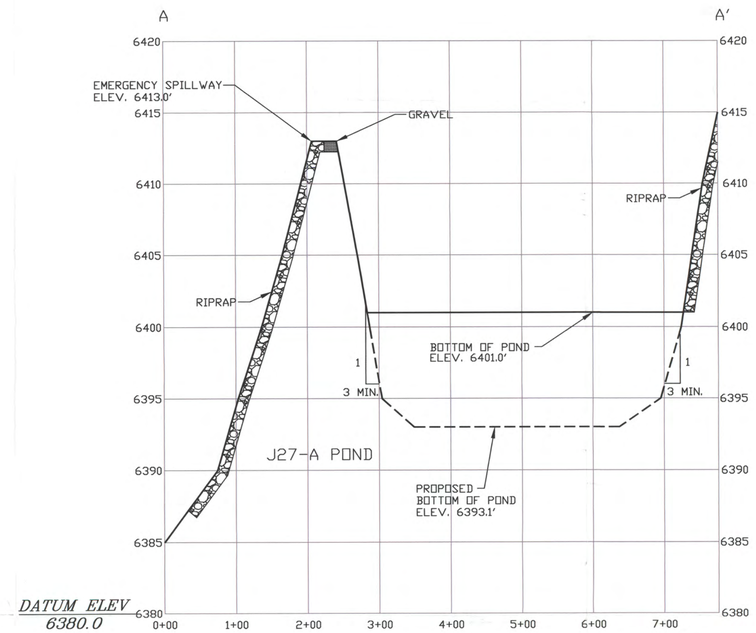




PROFILE SECTION A-A'

SCALE: HORIZ. 1"=100'
VERT. 1"=5'

J27-A POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAPACITY (AC.-FT.)	TOTAL CAPACITY (AC.-FT.)	DESCRIPTION
6393.1	0.0	0.16	0.00	0.00	BOTTOM OF POND
6395.0	1.9	0.23	0.37	0.37	
6400.0	6.9	0.49	1.80	2.17	
6405.0	11.9	0.79	3.20	5.37	
6410.0	16.9	1.00	4.48	9.85	
6413.0	19.9	1.13	3.20	13.04	EMERGENCY SPILLWAY
6416.1	23.0	1.29	3.75	16.79	TOP OF EMBANKMENT

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil)
CERTIFICATE NO. 37842
GARY ALTSISI
Date Signed 2-22-11
ARIZONA, USA

EXPIRES: 09/30/2011

Gary Altsisi
Reclamation Supervisor
Peabody Western Coal Company

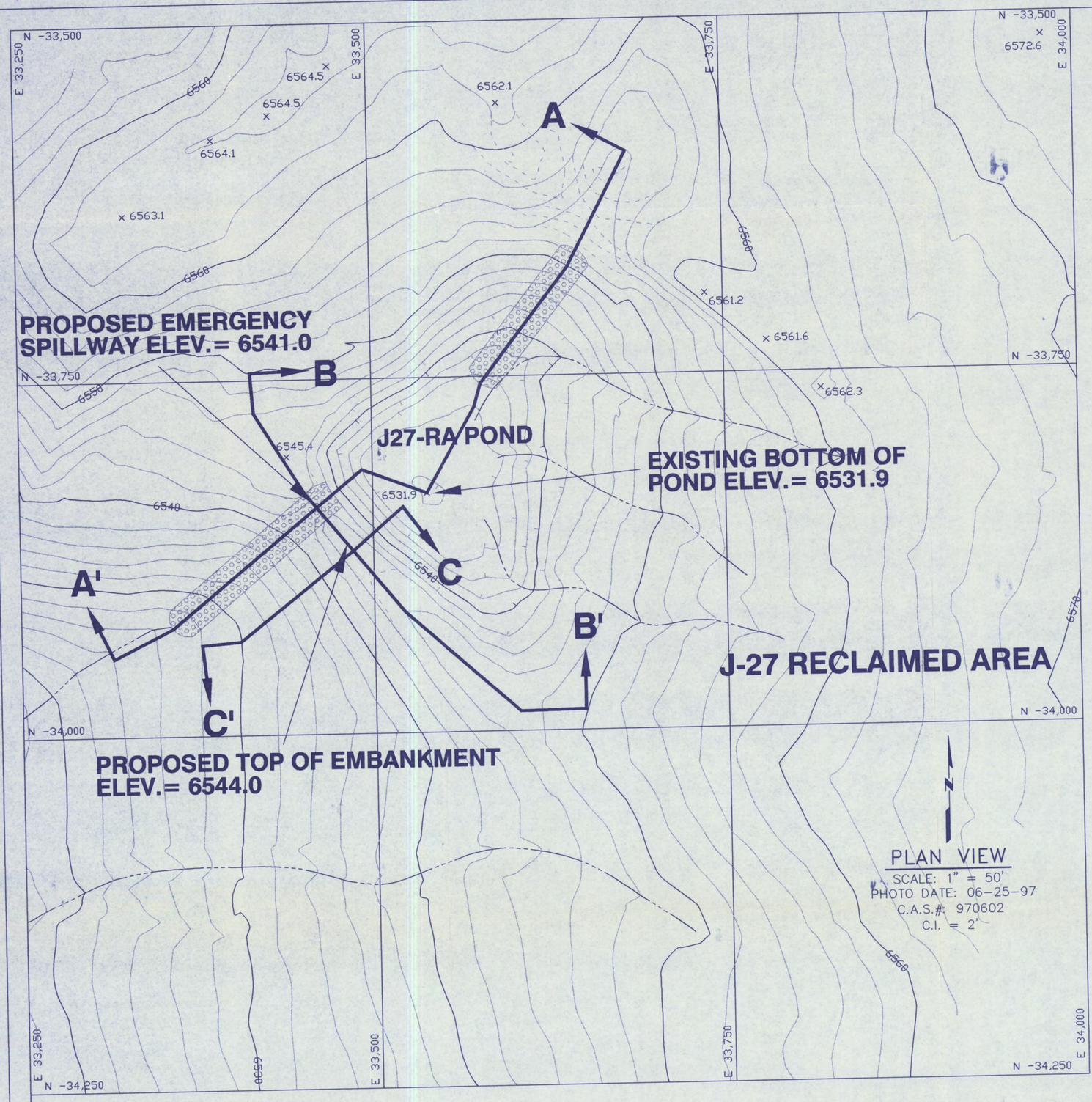
Arizona P.E. 37842

APPROVED
AUG 2011

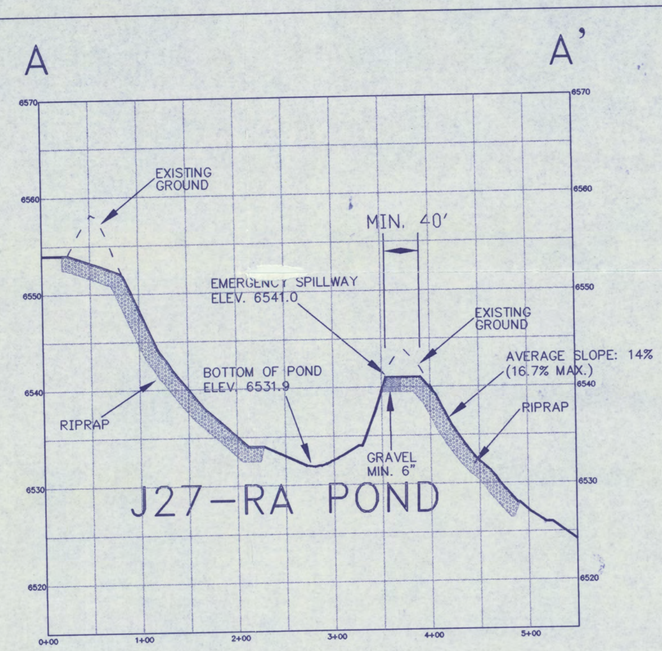
EXHIBIT #1
J27-A POND
REMEDIAL DESIGN

BLACK MESA MINE
PEABODY WESTERN COAL P.O. BOX 650 KAYENTA, AZ 86033

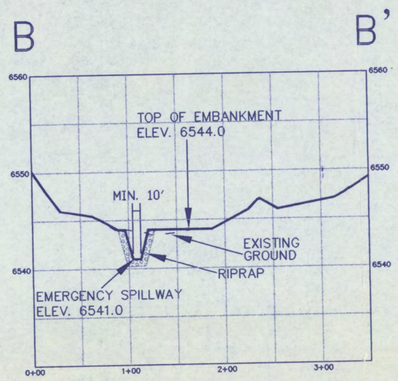
DESIGNED BY: G.A.	SCALE: AS SHOWN
DRAWN BY: G.A.	DRAWING DATE: 2-22-11
CHECKED BY: G.A.	PHOTO DATE: 4-25-92
CONTOUR INTERVAL: 5'	DWG FILE: J27-A REMEDIAL FEB 2001.DWG



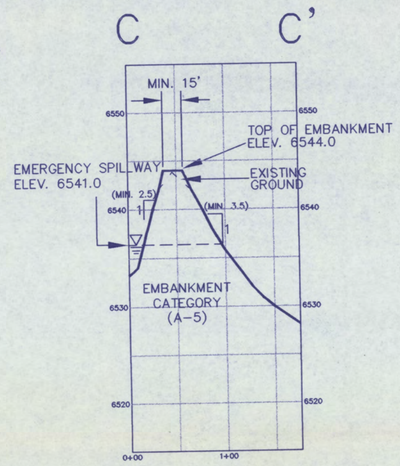
PLAN VIEW
SCALE: 1" = 50'
PHOTO DATE: 06-25-97
C.A.S.#: 970602
C.I. = 2'



SECTION A – A'
VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'

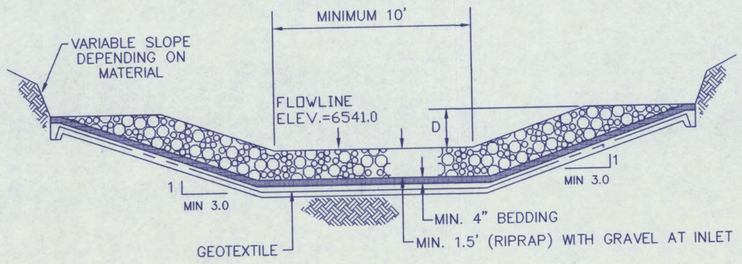


SECTION B – B'
VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'



SECTION C – C'
VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'

NOTES:
1) General location, see Drawing No. 85400, Sheet L-10 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into recl topography.



SPILLWAY D=MINIMUM 3.0'
OUTFLOW CHANNEL D=MINIMUM 1.7'

J27-RA POND DESIGN
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY
(NOT TO SCALE)

J27-RA POND DESIGN STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6531.9	0.0	0.00	0.00	0.00	BOTTOM OF POND
6532.0	0.1	0.01	0.00	0.00	
6534.0	2.1	0.17	0.18	0.18	
6536.0	4.1	0.27	0.44	0.62	
6538.0	6.1	0.37	0.64	1.26	
6540.0	8.1	0.48	0.85	2.11	
6541.0	9.1	0.55	0.52	2.63	EMERGENCY SPILLWAY
6542.0	10.1	0.62	0.59	3.21	
6544.0	12.1	0.78	1.40	4.61	TOP OF EMBANKMENT

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOIGT Expires 12/31/98 ARIZONA, U.S.A.

JAMES G. SCHLENVOIGT
COMPLIANCE ENGINEERING MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: FEB 20 1998

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REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J27-RA PERMANENT IMPOUNDMENT DESIGN

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
1300 SOUTH YALE ST. FLAGSTAFF, ARIZONA 86

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: SMM	DRAWING DATE: 02
CHECKED BY: JGS	PHOTO DATE: 06-2
CONTOUR INT.: 2'	DWG FILE: J27-RA DE

DESIGN REPORT

Permanent Impoundment Structure

J27-RB

Black Mesa Mine

Navajo County, Arizona

for

PEABODY WESTERN COAL COMPANY

NOV 1998 APPROVED

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOGT Date Signed ..... ARIZONA, U.S.A.

FEB 23 1998

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LAND USE 2

DESIGN ANALYSES 2
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HYDRAULICS 5
EMERGENCY SPILLWAY and OUTLET CHANNEL 7
STORAGE CAPACITY 7

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event
APPENDIX C Water Persistence Calculations
EXHIBIT #1 J27-RB Permanent Impoundment Design

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INTRODUCTION

Structure J27-RB is an existing earthen embankment structure constructed by Peabody Western Coal Company in the J-27 reclamation area and proposed as a permanent structure to impound a maximum of approximately 1.40 ac.-ft. of runoff from the adjacent reclaimed areas of the Black Mesa Mine. The location of structure J27-RB and its watershed boundary are shown on Drawing No. 85400 (Sheet L-10) and Drawing No. 85405. The existing structure and the site-specific general construction plans are shown on the attached Exhibit 1.

This inspection report contains information specific to structure J27-RB, which is in series with Structure J27-RC. 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 existing structure J27-RB was inspected by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the existing structure is stable and no adverse conditions existed to prevent the successful construction of the spillway structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized to evaluate embankment design.

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SITE DESCRIPTION

LAND USE

The J27-RB structure has a 10.8-acre tributary drainage area and is located on a tributary to Moenkopi Wash. The 10.8 acre watershed contributing to the J27-RB structure is classified as 57% Post-Law reclaimed and 43% Pre-Law reclaimed.

DESIGN ANALYSES

GENERAL

Structure J27-RB 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 1997 for Peabody Western Coal Company and was used in the analysis of the structure.

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STABILITY

Structure J27-RB is conservatively assumed to be a category A-5 embankment. A homogeneous earthen embankment approximately 15 feet wide on top currently exists. The upstream slope will be constructed to 2:1 (horizontal to vertical) or flatter slope and the downstream slope will be constructed to 3:1 or flatter slope. Based on the total embankment height of approximately 10 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 10-foot wide riprap-lined trapezoidal channel.

WATER PERSISTENCE

Pond J27-RB is a relatively small pond with an adequate contributing drainage area. As a result, there is standing water in the pond over a significant portion of the year with an average depth ranging from 2 to 5 feet. Both PWCC personnel and the OSM Inspectors have observed water occurrence in the pond over a period of several years.

In addition, to determine water persistence for Structure J27-RB, runoff from average annual precipitation was compared to evaporation and infiltration rates on a monthly basis. Initially, the pond was assumed to be empty. Runoff for the first month was determined using the SCS Curve Number Method and the mean monthly precipitation for January, as presented in Appendices C and described in subsequent sections. The runoff volume was added to the pond and a water elevation and surface area were determined from the pond stage storage curve found on Appendix C. Once the water surface area was determined, the total evaporation and infiltration for the first month were calculated. The calculated evaporation and infiltration losses were subtracted from the total runoff for the first month to determined the average water increase or decrease to the pond. The final volume was then used as the starting volume for the next month and the same steps were repeated for each subsequent month. This analysis proceeded until the pond elevation and surface area stabilized, which occurred in year 2. The inputs and results are shown in Appendix C in both graphical and tabular formats. As shown by the graph and table in Appendix C, the water elevation of the

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pond should stabilize between elevations 6558 and 6560 depending on the time of year. This is the point at which runoff rates equal the evaporation and infiltration rates and corresponds to approximately 0.1 to 0.7 ac-ft of water in the impoundment.

In 1982 and 1983, Water, Waste and Land (WWL), Consultants, also prepared a study for PWCC and OSM which is included in Volume 27, Appendix E. They evaluated and determined these types of impoundments located in areas reclaimed in the late 1970's and early 1980's were stable.

WATER QUALITY

Water in the proposed J27-RB Permanent Impoundment comes primarily from surface water runoff from the J27 reclamation area. Given that the spoils in the J27 area do not contain material which is potentially acid- or toxic-forming and could adversely impact surface runoff water quality, Peabody Western Coal Company does not anticipate any significant water quality problems. The structure has been containing water for many years and no adverse condition from the water has been noted in the wildlife or domestic animals observed in the area.

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, and B). Structure J27-RB is constructed in series with downstream Structure J27-RC. Structure J27-RB is classified as a low hazard structure (see Drawing No. 85408). The mine area is sparsely populated with no one living in the downstream floodplain. The earthen embankment structure impounds less than 20 acre-feet and is less than 20 vertical feet in height from the upstream toe of embankment, at the centerline of the natural drainage, to the emergency spillway invert elevation. The structure is located upstream of Structure J27-RC; and although the capacity of these impoundments is less than 20 acre-feet, the spillway was analyzed using the 100-year, 6-hour storm event given the potential for flow between structures. Structure J27-RB was conservatively assumed to be full to the invert of the emergency spillway at the time of 100-year storm event.

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The following parameters were used in the hydrologic analysis for the 100-yr., 6-hr storm (see Appendix B):

		J27-RB
1.	Water Course length, L	0.189 mi.
2.	Elevation Difference, H	60 ft
3.	Time of Concentration, T_c	0.078 hr
4.	SCS Curve Number	84
5.	Rainfall Depth, 100-year, 6-hour storm	2.4 in
6.	Drainage Area	10.8 acres

HYDRAULICS

The SEDCAD+ 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, and B).

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J27-RB SEDIMENTATION POND HYDRAULICS TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	17.8
Volume	ac-ft	1.0
Outflow		
Peak Flow	cfs	10.4
Spillway Elevation	msl	6562.0
Embankment Crest Elev.	msl	6565.0
Peak Stage	msl	6562.7
Freeboard	ft	2.3
Emergency Spillway Channel		
Flow Depth	ft	0.7
Critical Velocity	fps	3.04
Mannings "n"	--	.031
Width	ft	10
Outflow Channel		
Maximum Slope	%	16.7
Normal Velocity	fps	4.6
Normal Depth	ft	0.2
Mannings "n"	--	.046
Riprap D_{50}	in	3

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J27-RB will be a trapezoidal channel; the alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

Minimum Channel Depth	(Spillway)	3.0	ft
	(Outflow)	1.6	ft
Channel Width		10	ft
Channel Length	(Spillway)	40	ft
	(Outflow)	90	ft
Sideslopes (Horizontal to Vertical)		3:1 or flatter	
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	16.7	%
Spillway Elevation		6562.0 ft	

A minimum 15-foot long riprap lined channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1997 aerial topography mapping conducted for Peabody Western Coal Company. Structure J27-RB is designed to contain approximately 1.4 acre-feet.

The calculations for the sediment load entering structure J27-RB were made utilizing the Revised Universal Soil Loss Equation with the following input parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.38
3.	Slope Factor, LS	2.56
4.	Cover Factor, C	0.188
5.	Erosion Control Factor, P	1.00

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To determine the potential life of the structure, the results of the sediment storage capacity for the J27-RB pond are presented in the following table.

J27-RB STORAGE

Total Available Storage Capacity	1.4	acre-feet
Sediment Inflow Rate/Year	0.03	acre-feet
Sediment Storage Life	46	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) 100-Year, 6-Hour Storm Event
Appendix C	- Water Persistence Calculations
Exhibit #1	- J27-RB Permanent Impoundment Design

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: J27-RB

TIME OF CONCENTRATION:

Start Elevation (ft) =	6630
End Elevation (ft) =	6570
Elevation Difference, E (ft) =	60
Watercourse Length (ft) =	1000
Watercourse Length, L (mi) =	0.189
Tc = (11.9L^3/E)^0.385 =	0.078 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
Pre-Law Reclaimed	C	87	4.6	400.2
Post-Law Reclaimed	C	81	6.2	502.2
TOTAL:			10.8	902.4

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

DRAINAGE BASIN AREA:

10.8 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J27-RB Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
EH#35	0.38	10.8	4.10
TOTAL:		10.8	4.10

Weighted K = Total K*Area/ Total Area = 0.38

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
220	30	13.6%	0.6	7.8	3.44
80	10	12.5%	0.6	7.1	1.68

Average LS = 2.56

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*

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I::

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pre Law	20%	0%	4.6	0.24	1.10	1.00	4.60
Post Law	40%	0%	6.2	0.15	0.93	1.00	6.20
TOTAL:			10.8		2.03		10.80

Weighted C = Total C*Area/ Total Area = 0.188

Weighted P = Total P*Area/ Total Area = 1.000

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J27-RB 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	0.38	
Length Slope Factor	2.56	
Cover Factor	0.19	
Practice Factor	1.00	
Gross Annual Sediment Yield	7.33	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0036	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0032	acre-feet/acre/year
Watershed Area	10.8	acres
Watershed Annual Sediment Yield	0.03	acre-feet/year
nber of years	1	years
Calculated Sediment Volume	0.03	acre-feet

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SEDCAD+ RIPRAP CHANNEL DESIGN

J27-RB OUTFLOW CHANNEL

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	10.35 cfs	
Slope	16.70 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	10.00 feet	
Freeboard	None	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.21 ft
with Freeboard	0.00 ft
Top Width	11.29 ft
with Freeboard	10.00 ft
Velocity	4.54 fps
Cross Sectional Area	2.28 sq ft
Hydraulic Radius	0.20 ft
Manning's n	0.046
Froude Number	1.78
Dmax	0.313 ft (3.75 in)
D50	0.250 ft (3.00 in)
D10	0.083 ft (1.00 in)

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J27-RB Spillway
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\sierrita.fm2
Worksheet	J27-RB Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.021471	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	10.00	ft
Discharge	10.35	cfs

Results		
Depth	0.31	ft
Flow Area	3.41	ft^2
Wetted Perimeter	11.97	ft
Top Width	11.87	ft
Critical Depth	0.31	ft
Critical Slope	0.021472	ft/ft
Velocity	3.04	ft/s
Velocity Head	0.14	ft
Specific Energy	0.45	ft
Froude Number	1.00	
Flow is subcritical.		

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APPENDIX B

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

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

J-27 AREA

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0500\J-27-2II

Date: 12-12-1997

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

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	X
1	1	2	1	8	705.15	8.57	8.78	0.02	0.022	0.418
1	2	2	1	8	1304.92	6.15	7.44	0.05	0.048	0.406
2	1	1	1	8	52.00	20.00	13.42	0.00	0.001	0.443

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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	45.80	86	F	0.156	0.000	0.000	0.0	4.44	73.66
		Type: Pond Label: J27-RA								
111	Structure	45.80							4.44	
111	Total IN	45.80							4.44	73.66
111	Total OUT								4.44	59.70
112	1	31.10	84	F	0.182	0.000	0.000	0.0	2.69	44.08
		Type: Null Label: NULL 1								
	Structure	31.10							7.13	
112	Total IN/OUT	76.90							7.13	103.07
111 to 112 Routing						0.022	0.418			
121	1	10.80	84	F	0.078	0.000	0.000	0.0	0.94	17.78
		Type: Pond Label: J27-RB								
121	Structure	10.80							0.94	
121	Total IN	10.80							0.94	17.78
121	Total OUT								0.94	10.35
122	1	40.90	85	F	0.098	0.000	0.000	0.0	3.75	70.35
		Type: Null Label: NULL 2								
122	Structure	40.90							4.68	
122	Total IN/OUT	51.70							4.68	80.59
121 to 122 Routing						0.048	0.407			
211	1	14.80	85	F	0.095	0.000	0.000	0.0	1.36	25.46
		Type: Pond Label: J27-RC								
211	Structure	14.80							13.17	
211	Total IN	143.40							13.17	188.24
211	Total OUT								13.17	158.90
112 to 211 Routing						0.001	0.443			

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6541.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	10.0

POND RESULTS:

Permanent Pool (ac-ft)
2.6

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	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	4.44	73.66
OUT	4.44	59.70

Peak Elevation	Hydrograph Detention Time (hrs)
6542.6	0.20

****

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6562.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3
Bottom Width (ft)	10.0

POND RESULTS:

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Permanent Pool (ac-ft)

=========
1.4

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.94	17.78
OUT	0.94	10.35

Peak Elevation	Hydrograph Detention Time (hrs)
6562.7	0.00

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6467.0
Crest Length (ft)	40.0
Z1 (Left and Right)	3 3
Bottom Width (ft)	20.0

POND RESULTS:

Permanent

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Pool (ac-ft)
2.1

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	13.17	188.24
OUT	13.17	158.90

Peak Elevation	Hydrograph Detention Time (hrs)
6469.0	0.17

****

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 12-12-1997 Time: 13:46:21
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6532.00	0.00	0.01	0.00	0.00	
6533.00	1.00	0.07	0.04	0.00	
6534.00	2.00	0.17	0.16	0.00	
6535.00	3.00	0.22	0.36	0.00	
6536.00	4.00	0.27	0.61	0.00	
6537.00	5.00	0.32	0.91	0.00	
6538.00	6.00	0.37	1.25	0.00	
6539.00	7.00	0.43	1.66	0.00	
6540.00	8.00	0.48	2.11	0.00	
6541.00	9.00	0.55	2.63	0.00	Stage of SW#1
6541.70	9.70	0.60	3.04	10.90	
6541.80	9.80	0.61	3.10	14.42	
6541.90	9.90	0.62	3.16	18.33	
6542.00	10.00	0.62	3.22	22.63	
6542.50	10.50	0.66	3.54	52.82	
6542.59	10.59	0.67	3.60	59.70	Peak Stage
6543.00	11.00	0.70	3.88	92.64	
6543.50	11.50	0.74	4.25	141.13	
6544.00	12.00	0.78	4.63	207.48	

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J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6554.50	0.00	0.00	0.00	0.00
6555.50	1.00	0.04	0.01	0.00
6556.50	2.00	0.10	0.08	0.00

6557.50	3.00	0.15	0.21	0.00	
6558.50	4.00	0.20	0.39	0.00	
6559.50	5.00	0.25	0.61	0.00	
6560.50	6.00	0.30	0.89	0.00	
6561.50	7.00	0.34	1.21	0.00	
6562.00	7.50	0.37	1.39	0.00	Stage of SW#1
6562.50	8.00	0.41	1.58	7.79	
6562.66	8.16	0.43	1.65	10.35	Peak Stage
6562.70	8.20	0.43	1.67	10.90	
6562.80	8.30	0.44	1.71	14.42	
6562.90	8.40	0.45	1.76	18.33	
6563.00	8.50	0.46	1.80	22.63	
6563.50	9.00	0.51	2.05	52.82	
6564.00	9.50	0.58	2.32	92.64	
6564.50	10.00	0.64	2.62	141.13	
6565.00	10.50	0.71	2.96	207.48	

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6460.80	0.00	0.00	0.00	0.00	
6461.80	1.00	0.17	0.06	0.00	
6462.80	2.00	0.27	0.28	0.00	
6463.80	3.00	0.34	0.58	0.00	
6464.80	4.00	0.43	0.97	0.00	
6465.80	5.00	0.52	1.44	0.00	
6466.80	6.00	0.63	2.02	0.00	
6467.00	6.20	0.66	2.15	0.00	Stage of SW#1
6467.70	6.90	0.74	2.63	20.85	
6467.80	7.00	0.75	2.71	27.35	
6467.90	7.10	0.76	2.78	34.50	
6468.00	7.20	0.77	2.86	42.27	
6468.50	7.70	0.83	3.26	94.82	
6468.80	8.00	0.86	3.52	132.58	
6468.99	8.19	0.89	3.68	158.90	Peak Stage
6469.00	8.20	0.89	3.69	160.74	
6469.50	8.70	0.95	4.15	237.78	
6469.80	9.00	0.98	4.44	296.72	
6470.00	9.20	1.00	4.64	339.41	

****

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APPENDIX C

Water Persistence Calculations

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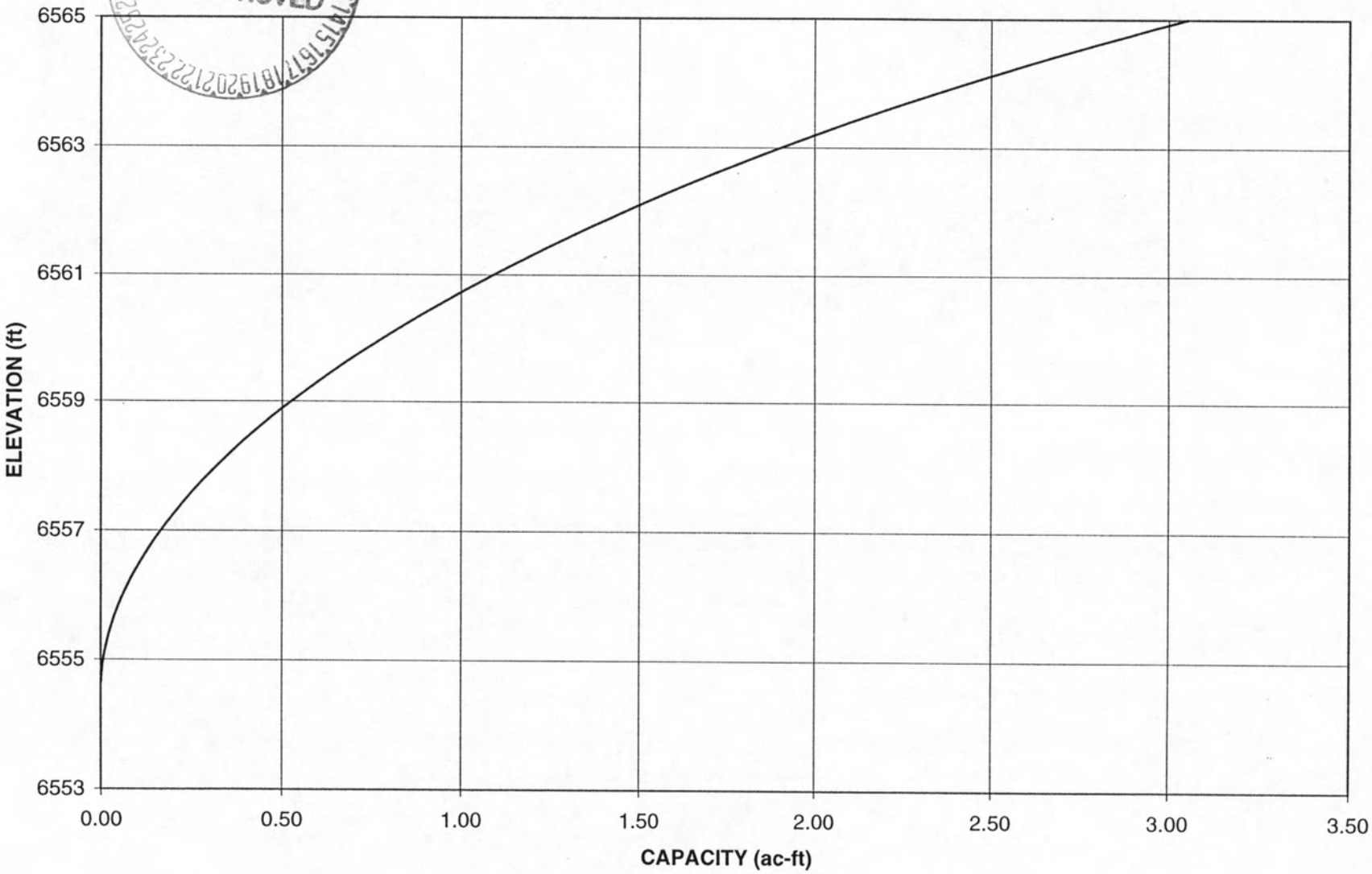
PERMANENT IMPOUNDMENTJ27-RB
ELEVATION /CAPACITY CURVE



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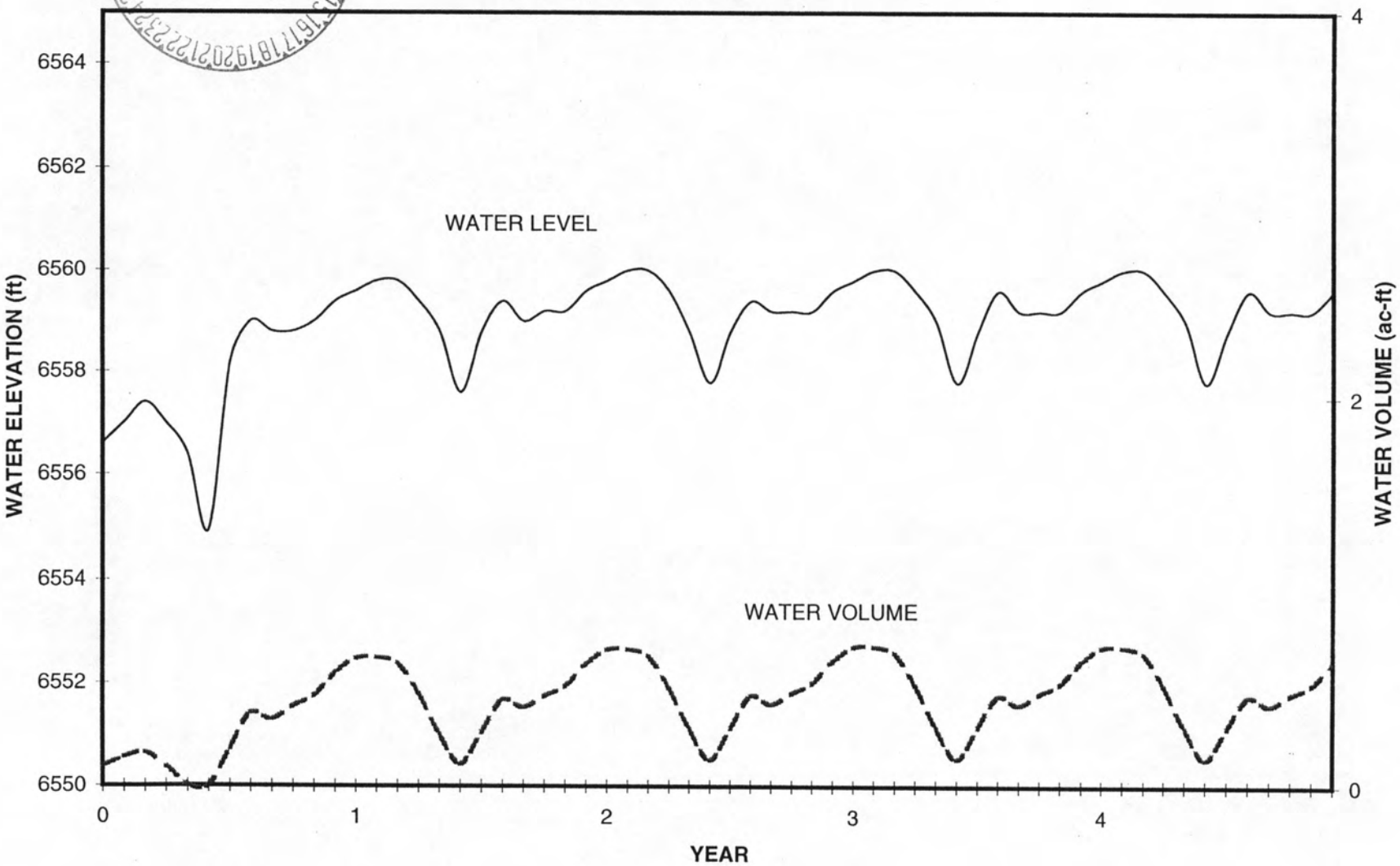
J27-RB PERMANENT IMPOUNDMENT
WATER PERSISTENCE EVALUATION



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PEABODY WESTERN COAL COMPANY
PERMANENT IMPOUNDMENT POND WATER PERSISTENCE EVALUATION

	January	February	March	April	May	June	July	August	September	October	November	December	End of Year2	End Of Year 3	End Of Year 4	End Of Year 5
Average Precipitation (inch)	0.95	0.86	0.89	0.58	0.45	0.46	1.49	1.49	0.95	1.09	0.98	1.08	1.08	1.08	1.08	1.08
Area (acres)	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Curve Number	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
S	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
Run-Off (inches)	0.13	0.10	0.11	0.02	0.00	0.00	0.41	0.41	0.13	0.19	0.14	0.19	0.19	0.19	0.19	0.19
Run-Off (ac-ft)	0.12	0.09	0.10	0.02	0.00	0.00	0.37	0.37	0.12	0.17	0.13	0.17	0.17	0.17	0.17	0.17
Starting Pond Volume (ac-ft)	0	0.10	0.15	0.17	0.10	0.00	0.00	0.19	0.38	0.35	0.41	0.47	0.52	0.54	0.53	0.53
Pond Volume + Runoff (ac-ft)	0.12	0.19	0.24	0.19	0.10	0.01	0.37	0.56	0.50	0.52	0.54	0.64	0.69	0.71	0.70	0.70
Water Elevation (ft)	6556.6	6557	6557.4	6557	6556.4	6554.95	6558.2	6559	6558.8	6558.8	6559	6559.4	6559.6	6559.6	6559.6	6559.6
Water Surface Area (acres)	0.11	0.13	0.15	0.13	0.10	0.02	0.19	0.23	0.22	0.22	0.23	0.25	0.26	0.26	0.26	0.26
Evaporation Rate (inches/month)	0.87	2.63	4.68	7.38	10.54	10.77	9.95	8.49	7.08	4.68	2.82	1.46	1.46	1.46	1.46	1.46
Evaporation (ac-ft)	0.01	0.03	0.06	0.08	0.09	0.02	0.16	0.16	0.13	0.09	0.05	0.03	0.03	0.03	0.03	0.03
Infiltration Rate (inches/month)	1.054	0.952	1.054	1.02	1.054	1.02	1.054	1.054	1.02	1.054	1.02	1.054	1.054	1.054	1.054	1.054
Infiltration (ac-ft)	0.01	0.01	0.01	0.01	0.01	0.00	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total Water Loss (ac-ft)	0.02	0.04	0.07	0.09	0.10	0.02	0.17	0.18	0.15	0.11	0.07	0.05	0.05	0.05	0.05	0.05
Total Water Change (ac-ft)	0.10	0.05	0.02	-0.07	-0.09	-0.02	0.19	0.18	-0.03	0.07	0.06	0.12	0.11	0.11	0.11	0.11
Ending Pond Volume	0.10	0.15	0.17	0.10	0.00	0.00	0.19	0.38	0.35	0.41	0.47	0.59	0.64	0.65	0.65	0.65

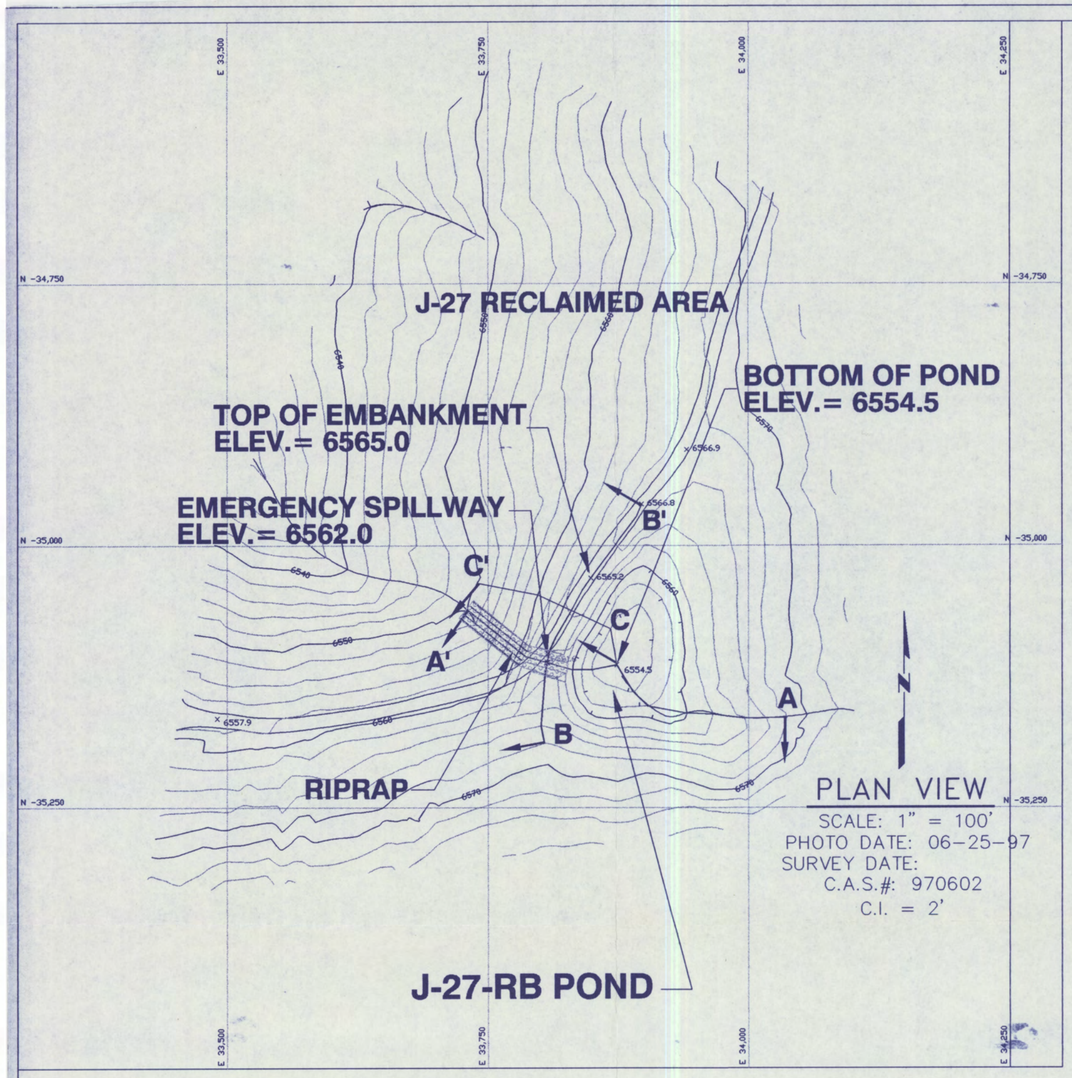
Notes:

1) Run-off volumes based on SCS Runoff Curve Number method: Q = (P-0.2S)^2/(P+0.8S)

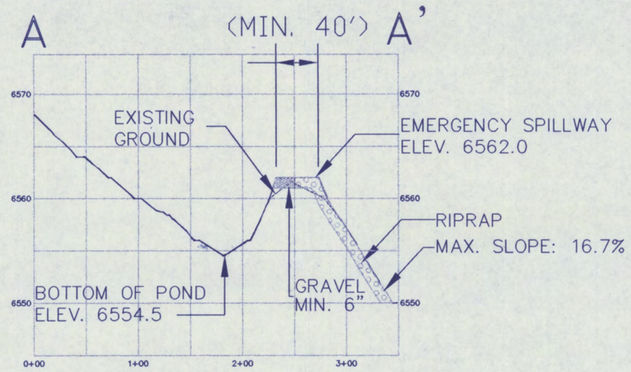
P= Accumulative Precipitation
S= (1000/CN)-10

2) Evaporation and infiltration rates based on data presented in the report entitled " Hydrologic and Engineering Studies at the Peabody Coal Company Mines" in Permit AZ-0001D Volume 27.

3) Maximum Pond Volume 1.4 ac-ft



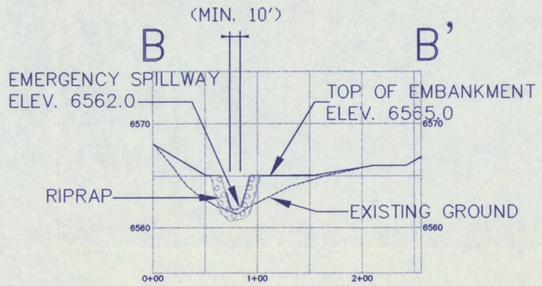
PLAN VIEW
SCALE: 1" = 100'
PHOTO DATE: 06-25-97
SURVEY DATE:
C.A.S.#: 970602
C.I. = 2'



J27-RB POND

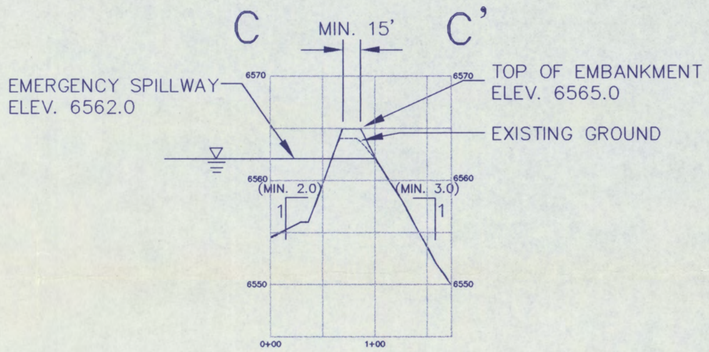
SECTION A - A'

VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'



SECTION B - B'

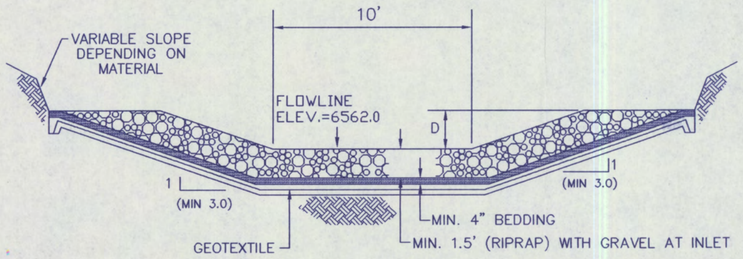
VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'



EMBANKMENT
CATEGORY
(A-5)

SECTION C - C'

VERTICAL SCALE: 1" = 10'
HORIZONTAL SCALE: 1" = 100'



SPILLWAY D=MINIMUM=3.0'
OUTFLOW CHANNEL D=MINIMUM=1.6'

J27-RB POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY
NOT TO SCALE

J27-RB POND STAGE-CAPACITY TABLE

Elevation (ft-msl)	Stage (ft)	Area (Acres)	Capacity (ac-ft)	Total Capacity (ac-ft)	Description
6554.5	0.0	0.00	0.00	0.00	BOTTOM OF POND
6556.0	0.0	0.08	0.00	0.00	
6558.0	2.0	0.18	0.26	0.26	
6560.0	4.0	0.28	0.46	0.72	
6562.0	6.0	0.40	0.68	1.40	EMERGENCY SPILLWAY
6564.0	8.0	0.57	0.97	2.37	
6565.0	9.0	0.71	0.64	3.01	TOP OF EMBANKMENT

NOTES:
1) General location, see Drawing No. 85400, Sheet L-10 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the disturbed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into reclaimed topography.

CERTIFICATION

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOGT ARIZONA U.S.A.

JAMES G. SCHLENVOGT
COMPLIANCE ENGINEERING MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: FEB 20 1998

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REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J27-RB PERMANENT
IMPOUNDMENT DESIGN

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
1300 SOUTH YALE ST. FLAGSTAFF, ARIZONA 86001

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: A. B.	DRAWING DATE: 02-13-98
CHECKED BY: JGS	PHOTO DATE: 06-25-97
CONTOUR INT.: 2'	DWG FILE: J27-RB DESIGN.DWG

DESIGN REPORT

Permanent Impoundment Structure

J27-RC

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

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Registered Professional Engineer (Civil) CERTIFICATE NO. 18792 JAMES GARY SCHLENVOGT Date Signed ARIZONA, U.S.A.

JUL 29 1998

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WATER PERSISTENCE	3
WATER QUALITY	4
HYDROLOGY	4
HYDRAULICS	5
EMERGENCY SPILLWAY and OUTLET CHANNEL	7
STORAGE CAPACITY	7

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event
APPENDIX C Water Persistence Calculations
EXHIBIT #1 J27-RC Permanent Impoundment Design

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INTRODUCTION

Structure J27-RC is an existing earthen embankment structure constructed by Peabody Western Coal Company in the J-27 reclamation area and proposed as a permanent structure. PWCC will add approximately 6 feet to the height of the existing embankment to increase the impoundment capacity to approximately 7.35 ac.-ft. The impoundment will collect runoff from the adjacent reclaimed areas of the Black Mesa Mine. The location of structure J27-RC and its watershed boundary are shown on Drawing No. 85400 (Sheet L-10) and Drawing No. 85405. The existing structure and the site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to structure J27-RC, which is in series with Structures J27-RA and J27-RB. 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 existing structure J27-RC was inspected by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the location was suitable and no adverse conditions existed to prevent the successful construction of the spillway structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized to evaluate embankment design.

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SITE DESCRIPTION

LAND USE

Structures J27-RA, J27-RB and J27-RC have a combined tributary drainage area of 143.4 acre and are located on a tributary to Moenkopi Wash. The 143.4 acre watershed contributing to the J27-RC structure is classified as 32% Post-Law reclaimed and 68% Pre-Law reclaimed.

DESIGN ANALYSES

GENERAL

Structure J27-RC 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 1997 for Peabody Western Coal Company and was used in the analysis of the structure.

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STABILITY

Structure J27-RC is conservatively assumed to be a Category A-5 embankment. A homogeneous earthen embankment approximately 12 feet wide on top currently exists. The upstream slope will be constructed to 3:1 (horizontal to vertical) or flatter slope and the downstream slope will be constructed to 4.5:1 or flatter slope. Based on the total embankment height of approximately 16 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 20-foot wide riprap-lined trapezoidal channel.

WATER PERSISTENCE

Pond J27-RC is a relatively small pond with an adequate contributing drainage area. As a result, there is standing water in the pond over a significant portion of the year with an average depth ranging from 3 to 6 feet. Both PWCC personnel and OSM Inspectors have observed water occurrence in the pond over a period of several years.

To determine water persistence for Structure J27-RC, runoff from average annual precipitation was compared to evaporation and infiltration rates on a monthly basis. Initially, the pond was assumed to be empty. Runoff for the first month was determined using the SCS Curve Number Method and the mean monthly precipitation for January, as presented in Appendices C and described in subsequent sections. The runoff volume was added to the pond and a water elevation and surface area were determined from the pond stage storage curve found on Appendix C. Once the water surface area was determined, the total evaporation and infiltration for the first month were calculated. The calculated evaporation and infiltration losses were subtracted from the total runoff for the first month to determined the average water increase or decrease to the pond. The final volume was then used as the starting volume for the next month and the same steps were repeated for each subsequent month. This analysis proceeded until the pond elevation and surface area stabilized, which occurred in year 2. The inputs and results are shown in Appendix C in both graphical and tabular formats. As shown by the

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graph and table in Appendix C, the water elevation of the pond should stabilize between elevation 6471 and the spillway invert depending on the time of year. This is the point at which runoff rates equal the evaporation and infiltration rates and/or discharge through the spillway and corresponds to approximately 4.5 to 7.35 ac-ft of water in the impoundment.

In 1982 and 1983, Water, Waste and Land (WWL), Consultants, also prepared a study for PWCC and OSM which is included in Volume 27, Appendix E. They evaluated and determined these types of impoundments located in areas reclaimed in the late 1970's and early 1980's were stable.

WATER QUALITY

Water in the proposed J27-RC Permanent Impoundment will come primarily from surface water runoff from the J27 reclamation area. Given that the spoils in the J27 area do not contain material which is potentially acid- or toxic-forming and could adversely impact surface runoff water quality, Peabody Western Coal Company does not anticipate any significant water quality problems. The structure has been containing water for many years and no adverse condition from the water has been noted in the wildlife or domestic animals observed in the area. In addition, between 1981 and 1997 approximately 22 water quality analyses have been performed on samples taken from ponds in the reclaimed J-27 area. The comparison between the pond water quality and the various proposed livestock and wildlife drinking water standards suggests the pond water quality is suitable for the intended postmining land use.

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HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, and B). Structure J27-RC is constructed in series with upstream Structures J-27-RA and J27-RB. Structure J27-RC is classified as a low hazard structure (see Drawing No. 85408). The mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and is less than 20 vertical feet in height from the upstream toe of embankment of the natural stream elevation to the emergency spillway invert elevation. The structure is located

downstream of Structures J27-RA and J27-RB; and although the cumulative capacity of these three impoundments is less than 20 acre-feet, the spillway was analyzed using the 100-year, 6-hour storm event. Structure J27-RC was conservatively assumed to be full to the invert of the emergency spillway at the time of 100-year storm event.

The following parameters were used in the hydrologic analysis for the 100-yr., 6-hr storm (see Appendix B):

		J27-RC	Null 1	Null 2
1.	Water Course length, L	0.256 mi.	0.587	0.35
2.	Elevation Difference, H	90 ft	200	216
3.	Time of Concentration, T_c	0.095 hr	0.182	0.098
4.	SCS Curve Number	85	85	85
5.	Rainfall Depth, 100-year, 6-hour storm	2.4 in	2.4	2.4
6.	Drainage Area	14.8 acres	31.1	40.9

Values reported represent the watersheds, which drain directly to Pond J27-RC. Hydrologic input parameters for upstream structures J27-RA and J27-RB are presented in the Design Reports for J27-RA and J27-RB, respectively.

Muskingum routing parameters were utilized to route the 100-year hydrographs between structures using the SEDCAD+ computer program. The routing parameters are presented in Appendices A, and B, and are shown on a sub-watershed basis.

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HYDRAULICS

The SEDCAD+ 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, and B).

J27-RC SEDIMENTATION POND HYDRAULICS TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	188.3
Volume	ac-ft	13.2
Outflow		
Peak Flow	cfs	145.6
Spillway Elevation	msl	6472.5
Embankment Crest Elev.	msl	6476.0
Peak Stage	msl	6474.4
Freeboard	ft	1.6
Emergency Spillway Channel		
Flow Depth	ft	1.9
Critical Velocity	fps	5.6
Mannings "n"	--	.035
Width	ft	20
Outflow Channel		
Maximum Slope	%	16.7
Normal Velocity	fps	8.7
Normal Depth	ft	0.8
Mannings "n"	--	.054
Riprap D_{50}	in	6

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EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J27-RC will be a trapezoidal channel, the alignment and dimensions are shown on Exhibit 1 and includes the following dimensions:

Minimum Channel Depth	(Spillway)	3.0	ft
	(Outflow)	2.0	ft
Channel Width		20	ft
Channel Length	(Spillway)	40	ft
	(Outflow)	140	ft
Sideslopes (Horizontal to Vertical)		3:1 or flatter	
Average Slope	(Spillway)	0.0	%
Maximum Slope	(Outflow)	16.7	%
Spillway Elevation		6472.5	ft

A minimum 15-foot long riprap lined channel will be constructed beyond the toe of the embankment as a transition into the downstream natural channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1997 aerial topography mapping conducted for Peabody Western Coal Company. Structure J27-RC is designed to contain approximately 7.35 acre-feet.

The calculations for the sediment load entering structure J27-RC were made utilizing the Revised Universal Soil Loss Equation with the following input parameters:

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1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.38
3.	Slope Factor, LS	2.87
4.	Cover Factor, C	0.21
5.	Erosion Control Factor, P	1.00

To determine the potential life of the structure, the results of the sediment storage capacity evaluation for the J27-RC pond are presented in the following table.

J27-RC STORAGE

Total Available Storage Capacity	7.35	acre-feet
Sediment Inflow Rate/Year	0.35	acre-feet/year
Sediment Storage Life	21	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) 100-Year, 6-Hour Storm Event

Appendix C -Water Persistence Calculations

Exhibit #1 - J27-RC Permanent Impoundment Design

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APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: J27-RC

TIME OF CONCENTRATION:

Start Elevation (ft) =	6550
End Elevation (ft) =	6460
Elevation Difference, E (ft) =	90
Watercourse Length (ft) =	1350
Watercourse Length, L (mi) =	0.256
Tc = (11.9L^3/E)^0.385 =	0.095 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
Pre-Law Reclaimed	C	87	9.7	843.9
Post-Law Reclaimed	C	81	5.1	413.1
TOTAL:			14.8	1257

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

14.8 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: NULL 1

TIME OF CONCENTRATION:

Start Elevation (ft) =	6680
End Elevation (ft) =	6480
Elevation Difference, E (ft) =	200
Watercourse Length (ft) =	3100
Watercourse Length, L (mi) =	0.587
Tc = (11.9L^3/E)^0.385 =	0.182 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
Pre-Law Reclaimed	C	87	22.7	1974.9
Post-Law Reclaimed	C	81	8.4	680.4
TOTAL:			31.1	2655.3

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

31.1 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J27 AREA

STRUCTURE: NULL 2

TIME OF CONCENTRATION:

Start Elevation (ft) =	6696
End Elevation (ft) =	6480
Elevation Difference, E (ft) =	216
Watercourse Length (ft) =	1850
Watercourse Length, L (mi) =	0.350
Tc = (11.9L^3/E)^0.385 =	0.098 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
Pre-Law Reclaimed	C	87	24	2088
Post-Law Reclaimed	C	81	16.9	1368.9
TOTAL:			40.9	3456.9

Weighted CN = Total CN*Area/ Total Area = 85

DRAINAGE BASIN AREA:

40.9 Acres

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J27-RC

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
EH#35	0.38	86.8	32.98
TOTAL:		86.8	32.98

Weighted K = Total K*Area/ Total Area = 0.38

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
550	45	8.2%	0.5	4.7	2.51
550	50	9.1%	0.5	5.2	2.81
400	35	8.8%	0.5	5.0	2.28
200	15	7.5%	0.5	4.3	1.39
500	25	5.0%	0.5	2.9	1.49
350	25	7.1%	0.5	4.1	1.76
250	65	26.0%	0.6	14.6	7.83

Average LS = 2.87

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*

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COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Pre Law	20%	0%	56.4	0.24	13.54	1.00	56.40
Post Law	40%	0%	30.4	0.15	4.56	1.00	30.40
	TOTAL:		86.8		18.10		86.80

Weighted C = Total C*Area/ Total Area = 0.21

Weighted P = Total P*Area/ Total Area = 1.00

RAINFALL FACTOR:

R = 40

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PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J27-RC

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	0.38	
Length Slope Factor	2.87	
Cover Factor	0.21	
Practice Factor	1.00	
Gross Annual Sediment Yield	9.08	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0044	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0040	acre-feet/acre/year
Watershed Area	86.8	acres
Watershed Annual Sediment Yield	0.35	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	0.35	acre-feet

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SEDCAD+ RIPRAP CHANNEL DESIGN

POND J27-RC OUTFLOW

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	145.60 cfs	
Slope	16.70 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	20.00 feet	
Freeboard	1 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.75 ft
with Freeboard	1.75 ft
Top Width	24.52 ft
with Freeboard	30.52 ft
Velocity	8.69 fps
Cross Sectional Area	16.75 sq ft
Hydraulic Radius	0.68 ft
Manning's n	0.054
Froude Number	1.85
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

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J27-RC SPILLWAY
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	J27-RC SPILLWAY
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.018331	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	20.00	ft
Discharge	145.60	cfs

Results		
Depth	1.11	ft
Flow Area	26.00	ft²
Wetted Perimeter	27.05	ft
Top Width	26.68	ft
Critical Depth	1.11	ft
Critical Slope	0.018331	ft/ft
Velocity	5.60	ft/s
Velocity Head	0.49	ft
Specific Energy	1.60	ft
Froude Number	1.00	
Flow is subcritical.		

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APPENDIX B

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

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

J-27 AREA

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0500\J-27-2II

Date: 07-16-1998

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

Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

GENERAL INPUT TABLE

Detailed Between Structure Routing:

J	B	To S	Seg. #	Land Flow Condition	Distance (ft)	Slope (%)	Velocity (fps)	Segment Time (hr)	Muskingum K (hr)	Muskingum X
1	1	2	1	8	705.15	8.57	8.78	0.02	0.022	0.418
1	2	2	1	8	1304.92	6.15	7.44	0.05	0.048	0.406
2	1	1	1	8	52.00	20.00	13.42	0.00	0.001	0.443

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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	45.80	86	F	0.156	0.000	0.000	0.0	4.44	73.66
		Type: Pond Label: J27-RA								
111	Structure	45.80							4.44	
111	Total IN	45.80							4.44	73.66
111	Total OUT								4.44	59.70
112	1	31.10	84	F	0.182	0.000	0.000	0.0	2.69	44.08
		Type: Null Label: NULL 1								
	Structure	31.10							7.13	
112	Total IN/OUT	76.90							7.13	103.07
111 to 112 Routing						0.022	0.418			
121	1	10.80	84	F	0.078	0.000	0.000	0.0	0.94	17.78
		Type: Pond Label: J27-RB								
121	Structure	10.80							0.94	
121	Total IN	10.80							0.94	17.78
121	Total OUT								0.94	10.35
122	1	40.90	85	F	0.098	0.000	0.000	0.0	3.75	70.35
		Type: Null Label: NULL 2								
122	Structure	40.90							4.68	
122	Total IN/OUT	51.70							4.68	80.59
121 to 122 Routing						0.048	0.406			
211	1	14.80	85	F	0.095	0.000	0.000	0.0	1.36	25.46
		Type: Pond Label: J27-RC								
211	Structure	14.80							13.17	
	Total IN	143.40							13.17	188.24
	Total OUT								13.17	145.63
112 to 211 Routing						0.001	0.443			

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6541.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	10.0

POND RESULTS:

	Permanent Pool (ac-ft)
	2.6

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	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	4.44	73.66
OUT	4.44	59.70

Peak Elevation	Hydrograph Detention Time (hrs)
6542.6	0.20

****

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6562.0
Crest Length (ft)	40.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	10.0

POND RESULTS:

	Permanent Pool (ac-ft)

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==========
1.4

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.94	17.78
OUT	0.94	10.35

Peak Elevation	Hydrograph Detention Time (hrs)
6562.7	0.00

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

DISCHARGE OPTIONS:

	Emergency Spillway
r Diameter (in)	----
Riser Height (ft)	----
Barrel 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	6472.5
t Length (ft)	40.0
(Left and Right)	3 3
Bottom Width (ft)	20.0

POND RESULTS:

Permanent

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Pool (ac-ft)
7.3

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	13.17	188.24
OUT	13.17	145.63

Peak Elevation	Hydrograph Detention Time (hrs)
6474.4	0.18

****

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Company Name: ACZ, INC.
Filename: J:\861\0500\J-27-2II User: D. GLEASON
Date: 07-16-1998 Time: 11:32:59
J-27 AREA
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
J27-RA

Drainage Area from J1, B1, S1, SWS(s)1: 45.8 acres
Total Contributing Drainage Area: 45.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6532.00	0.00	0.01	0.00	0.00	
6533.00	1.00	0.07	0.04	0.00	
6534.00	2.00	0.17	0.16	0.00	
6535.00	3.00	0.22	0.36	0.00	
6536.00	4.00	0.27	0.61	0.00	
6537.00	5.00	0.32	0.91	0.00	
6538.00	6.00	0.37	1.25	0.00	
6539.00	7.00	0.43	1.66	0.00	
6540.00	8.00	0.48	2.11	0.00	
6541.00	9.00	0.55	2.63	0.00	Stage of SW#1
6541.70	9.70	0.60	3.04	10.90	
6541.80	9.80	0.61	3.10	14.42	
6541.90	9.90	0.62	3.16	18.33	
6542.00	10.00	0.62	3.22	22.63	
6542.50	10.50	0.66	3.54	52.82	
6542.59	10.59	0.67	3.60	59.70	Peak Stage
6543.00	11.00	0.70	3.88	92.64	
6543.50	11.50	0.74	4.25	141.13	
6544.00	12.00	0.78	4.63	207.48	

****

J1, B2, S1
J27-RB

Drainage Area from J1, B2, S1, SWS(s)1: 10.8 acres
Total Contributing Drainage Area: 10.8 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
6554.50	0.00	0.00	0.00	0.00
6555.50	1.00	0.04	0.01	0.00
6556.50	2.00	0.10	0.08	0.00

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6557.50	3.00	0.15	0.21	0.00	
6558.50	4.00	0.20	0.39	0.00	
6559.50	5.00	0.25	0.61	0.00	
[illegible]0.50	6.00	0.30	0.89	0.00	
[illegible].50	7.00	0.34	1.21	0.00	
6562.00	7.50	0.37	1.39	0.00	Stage of SW#1
6562.50	8.00	0.41	1.58	7.79	
6562.66	8.16	0.43	1.65	10.35	Peak Stage
6562.70	8.20	0.43	1.67	10.90	
6562.80	8.30	0.44	1.71	14.42	
6562.90	8.40	0.45	1.76	18.33	
6563.00	8.50	0.46	1.80	22.63	
6563.50	9.00	0.51	2.05	52.82	
6564.00	9.50	0.58	2.32	92.64	
6564.50	10.00	0.64	2.62	141.13	
6565.00	10.50	0.71	2.96	207.48	

****

J2, B1, S1
J27-RC

Drainage Area from J2, B1, S1, SWS(s)1: 14.8 acres
Total Contributing Drainage Area: 143.4 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
[illegible].80	0.00	0.00	0.00	0.00	
6461.80	1.00	0.17	0.06	0.00	
6462.80	2.00	0.27	0.28	0.00	
6463.80	3.00	0.34	0.58	0.00	
6464.80	4.00	0.43	0.97	0.00	
6465.80	5.00	0.52	1.44	0.00	
6466.80	6.00	0.63	2.02	0.00	
6467.80	7.00	0.75	2.71	0.00	
6468.80	8.00	0.85	3.51	0.00	
6469.80	9.00	0.94	4.40	0.00	
6470.80	10.00	1.03	5.39	0.00	
6471.80	11.00	1.13	6.47	0.00	
6472.50	11.70	1.19	7.28	0.00	Stage of SW#1
6472.80	12.00	1.22	7.64	8.93	
6473.20	12.40	1.25	8.14	20.85	
6473.30	12.50	1.26	8.26	27.35	
6473.40	12.60	1.27	8.39	34.50	
6473.50	12.70	1.28	8.52	42.27	
6473.80	13.00	1.31	8.91	71.77	
6474.00	13.20	1.33	9.17	94.82	
6474.39	13.59	1.37	9.69	145.63	Peak Stage
6474.50	13.70	1.38	9.85	160.74	
6474.80	14.00	1.40	10.27	205.34	
6475.00	14.20	1.42	10.55	237.78	
6475.50	14.70	1.47	11.27	339.41	
[illegible].80	15.00	1.50	11.72	408.58	
[illegible].00	15.20	1.52	12.02	458.15	

****

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APPENDIX C

Water Persistence Calculations

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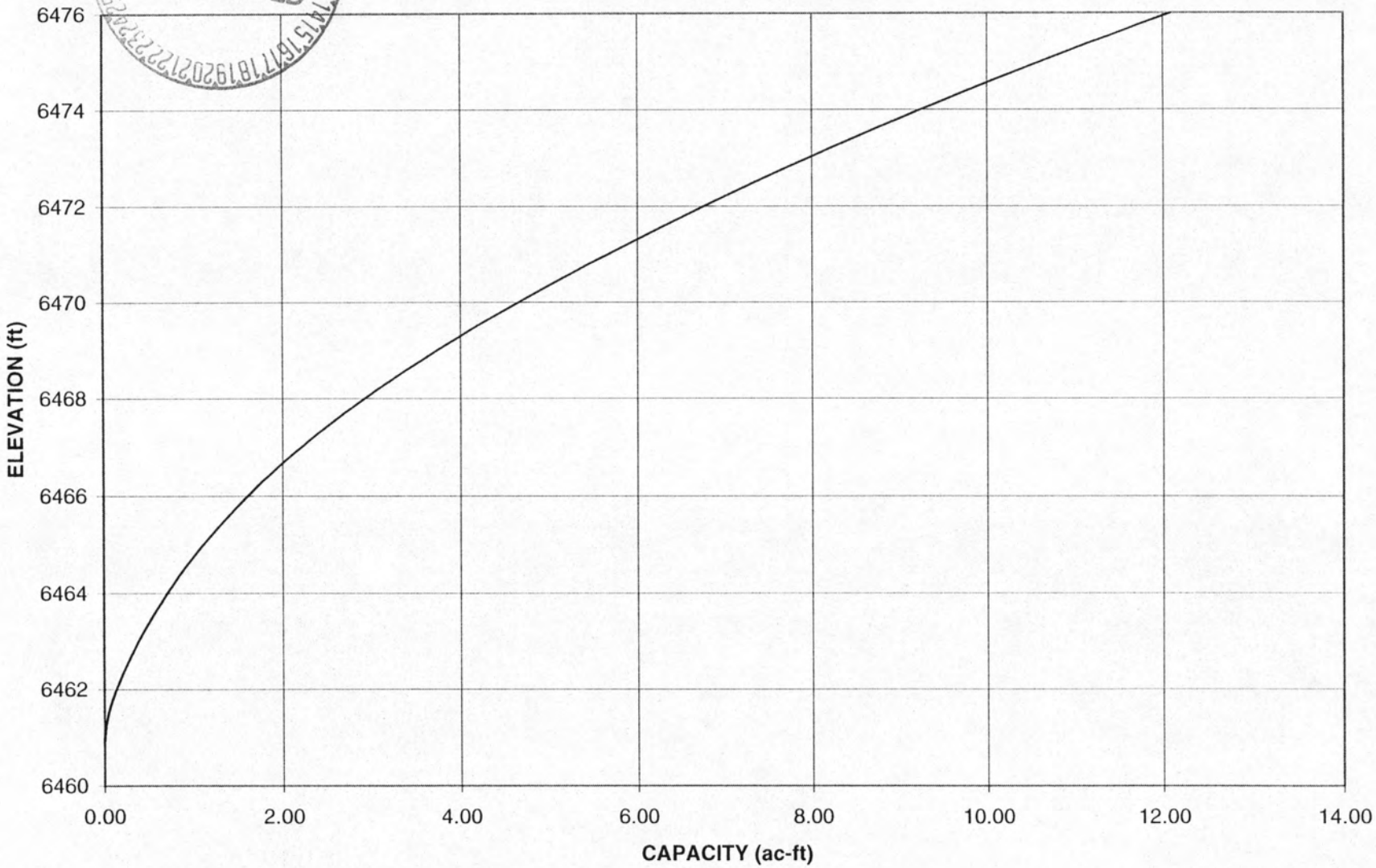
PERMANENT IMPOUNDMENTJ27-RC
ELEVATION /CAPACITY CURVE



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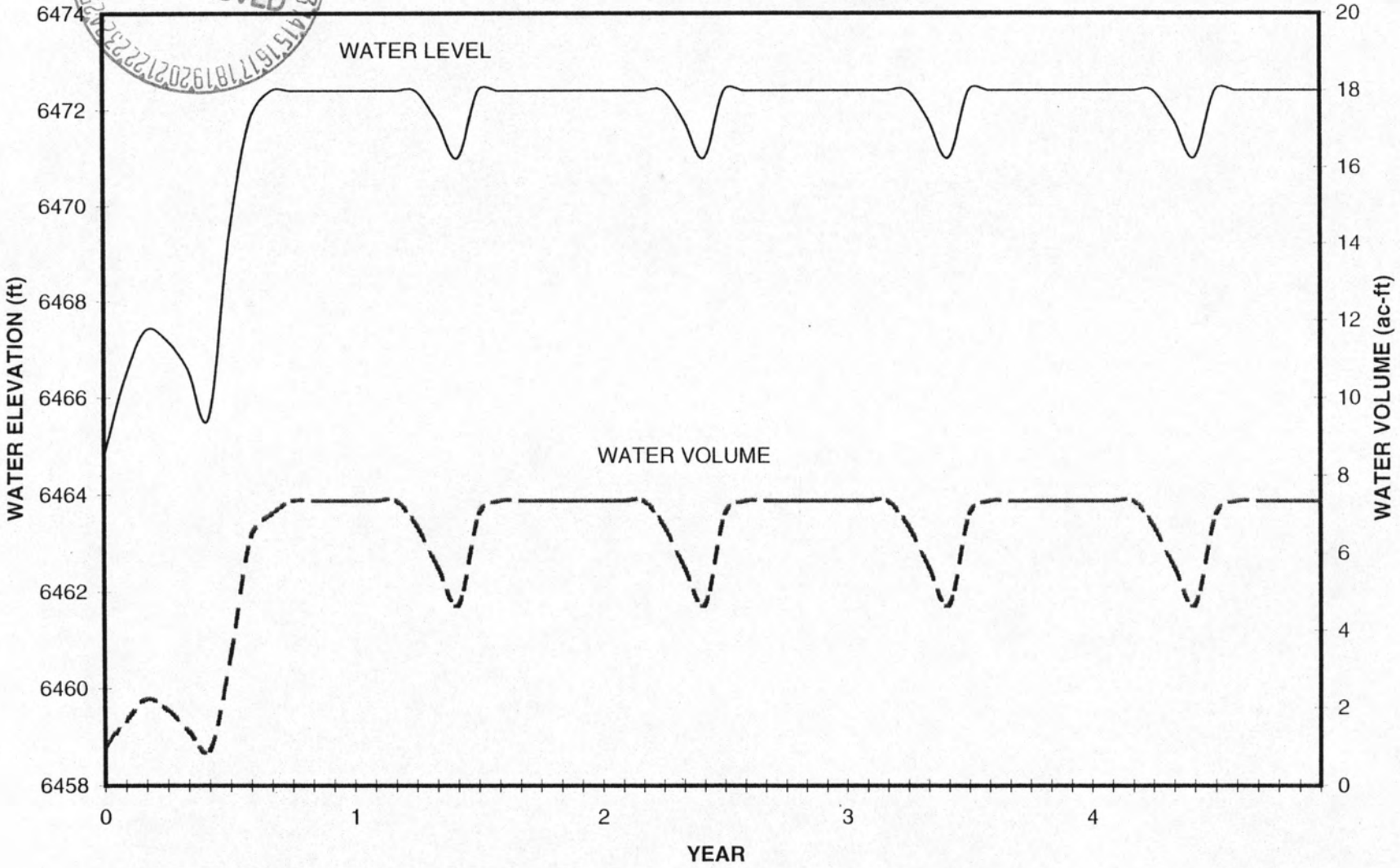
J27-RC PERMANENT IMPOUNDMENT
WATER PERSISTENCE EVALUATION



PEABODY WESTERN COAL COMPANY
PERMANENT IMPOUNDMENT POND WATER PERSISTENCE EVALUATION

	January	February	March	April	May	June	July	August	September	October	November	December	End of Year2	End Of Year 3	End Of Year 4	End Of Year 5
Average Precipitation (inch)	0.95	0.86	0.89	0.58	0.45	0.46	1.49	1.49	0.95	1.09	0.98	1.08	1.08	1.08	1.08	1.08
Area (acres)	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8	86.8
Curve Number	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
S	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
Run-Off (inches)	0.15	0.11	0.13	0.03	0.01	0.01	0.45	0.45	0.15	0.22	0.16	0.21	0.21	0.21	0.21	0.21
Run-Off (ac-ft)	1.09	0.82	0.91	0.19	0.04	0.04	3.22	3.22	1.09	1.57	1.19	1.53	1.53	1.53	1.53	1.53
Starting Pond Volume (ac-ft)	0	1.02	1.66	2.23	1.94	1.39	0.93	3.32	6.44	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Pond Volume + Runoff (ac-ft)	1.09	1.84	2.57	2.42	1.98	1.43	4.15	6.55	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35
Water Elevation (ft)	6464.8	6466.4	6467.4	6467.2	6466.6	6465.6	6469.4	6471.8	6472.5	6472.5	6472.5	6472.5	6472.5	6472.5	6472.5	6472.5
Water Surface Area (acres)	0.43	0.59	0.70	0.68	0.62	0.51	0.90	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Evaporation Rate (inches/month)	0.87	2.63	4.68	7.38	10.54	10.77	9.95	8.49	7.08	4.68	2.82	1.46	1.46	1.46	1.46	1.46
Evaporation (ac-ft)	0.03	0.13	0.27	0.42	0.54	0.46	0.75	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Infiltration Rate (inches/month)	1.054	0.952	1.054	1.02	1.054	1.02	1.054	1.054	1.02	1.054	1.02	1.054	1.054	1.054	1.054	1.054
Infiltration (ac-ft)	0.04	0.05	0.06	0.06	0.05	0.04	0.08	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Water Loss (ac-ft)	0.07	0.18	0.34	0.48	0.60	0.50	0.83	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Water Change (ac-ft)	1.02	0.64	0.57	-0.29	-0.56	-0.46	2.39	2.32	1.09	1.57	1.19	1.53	1.53	1.53	1.53	1.53
Run-off From J27-RC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.29	0.67	0.54	0.80	0.80	0.80	0.80	0.80
Ending Pond Volume	1.02	1.66	2.23	1.94	1.39	0.93	3.32	6.44	7.35	7.35	7.35	7.35	7.35	7.35	7.35	7.35

Notes:

1) Run-off volumes based on SCS Runoff Curve Number method: Q = (P-0.2S)^2/(P+0.8S)

P= Accumulative Precipitation
S= (1000/CN)-10

2) Evaporation and infiltration rates based on data presented in the report entitled " Hydrologic and Engineering Studies at the Peabody Coal Company Mines" in Permit AZ-0001, Volume 27.

3) Maximum Pond Volume 7.35 ac-ft

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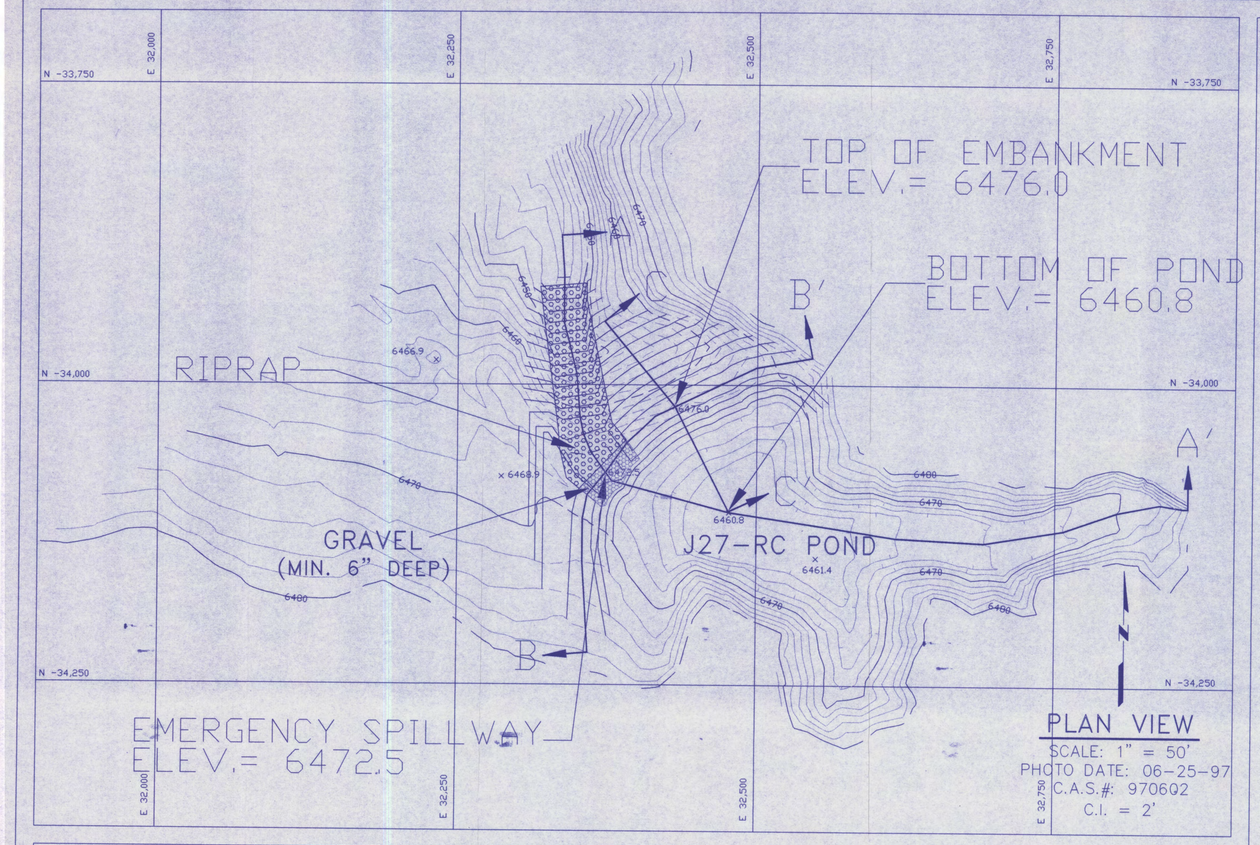
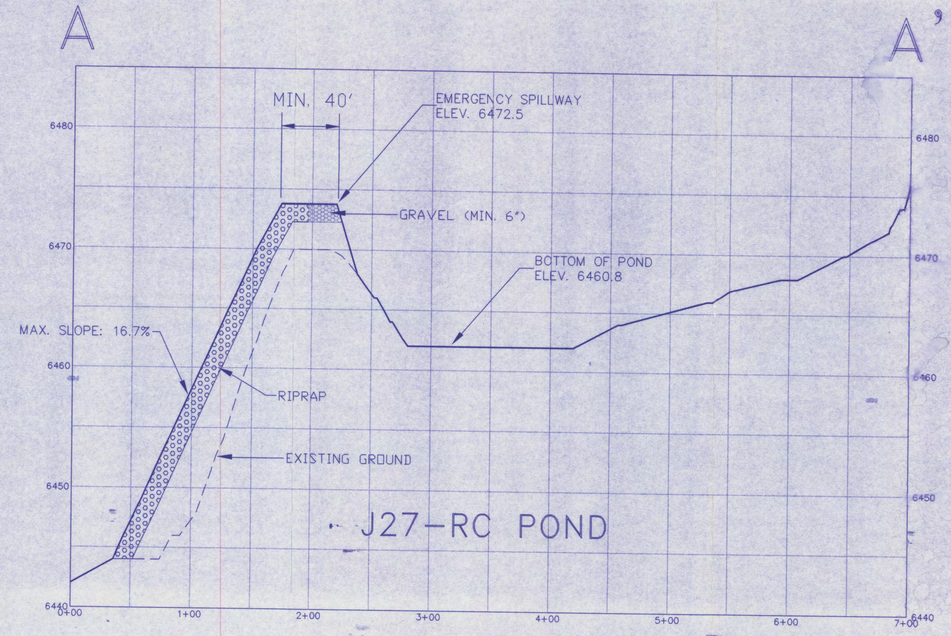


PLAN VIEW

SCALE: 1" = 50'
PHOTO DATE: 06-25-97
C.A.S.#: 970602
C.I. = 2'

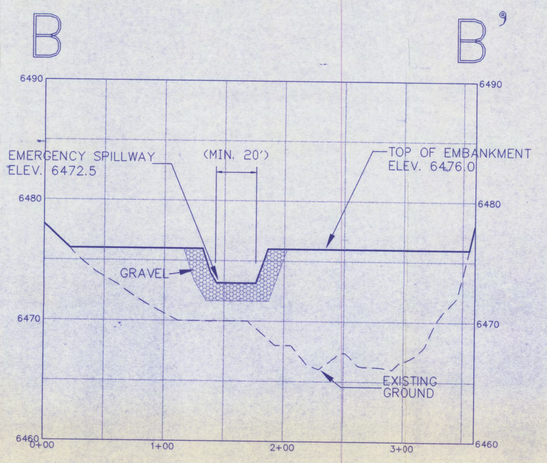


SECTION A – A'

VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 50'

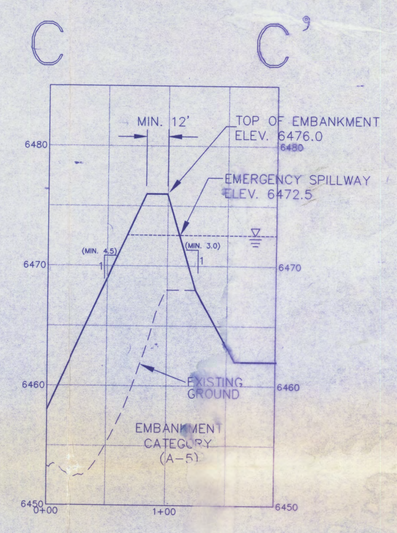
J27-RC POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6460.8	0.0	0.00	0.00	0.00	BOTTOM OF POND
6462.0	1.2	0.22	0.13	0.13	
6464.0	3.2	0.35	0.57	0.70	
6466.0	5.2	0.55	0.90	1.60	
6468.0	7.2	0.77	1.32	2.92	
6470.0	9.2	0.96	1.73	4.65	
6472.0	11.2	1.15	2.11	6.76	
6472.5	11.7	1.19	0.59	7.35	EMERGENCY SPILLWAY
6474.0	13.2	1.33	1.89	9.24	
6476.0	15.2	1.52	2.85	12.09	TOP OF EMBANKMENT



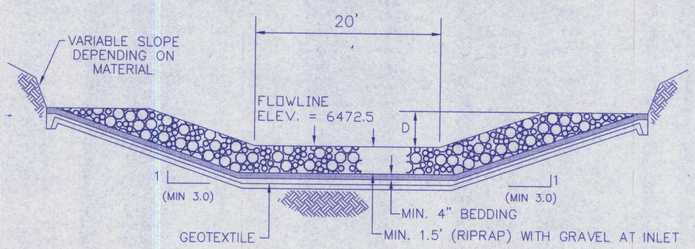
SECTION B – B'

VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 50'



SECTION C – C'

VERTICAL SCALE: 1" = 5'
HORIZONTAL SCALE: 1" = 50'



SPILLWAY D=3.0'
OUTFLOW CHANNEL D=2.0'

J27-RC POND
TYPICAL CROSS-SECTION OF EMERGENCY SPILLWAY

NOT TO SCALE

NOTES:
1) General location, see Drawing No. 85400, Sheet L-10 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the disturbed area above the high waterline shall be in accordance with the approved reclamation plan.
6) Ponding area side slopes, typical 3:1 slope or flatter and blend into natural topography.

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ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil) CERTIFICATE NO. 18782 JAMES GARY SCHLENVOGT Date Signed 7-29-98 State of Arizona

JAMES G. SCHLENVOGT
COMPLIANCE ENGINEERING MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: JUL 29 1998

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J27-RC PERMANENT IMPOUNDMENT DESIGN

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
1300 SOUTH YALE ST. FLAGSTAFF, ARIZONA 86001

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: SMM	DRAWING DATE: 07-29-98
CHECKED BY: JGS	PHOTO DATE: 06-25-97
CONTOUR INT.: 2'	DWG FILE: J27-RC-1.DWG

INSPECTION REPORT

Sedimentation Structure

J28-B

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure J28-B is an earthen embankment, designed and constructed in 1983 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J28-B is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J28-B. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J28-B was inspected on September 12, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J28-B project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure J28-B has a 14.0-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 55% disturbed and 45% Pinion/Juniper.

EMBANKMENT

Structure J28-B is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J28-B

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	19.4 ft
Crest Width	13 ft
Upstream Slope	2.1 H : 1 V
Downstream Slope . . .	3.1 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J28-B, A-A'. Grass provides erosion protection on the downstream slope of the embankment.

ANALYSES

STABILITY

Structure J28-B is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 30 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J28-B embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J28-B is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J28-B was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.152	mi
2.	Elevation Difference, H	47	ft
3.	Time of Concentration, T_c	0.067	h
4.	Lag time, $0.6T_c$	0.040	h
5.	SCS Curve Number	89	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	14.0	acres

HYDRAULICS

The HEC-1 program was 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.

J28-B HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	35	44	
Volume	acre-ft	1.45	1.21	
Storage				
Peak Stage	ft	6842.51	6858.31	
Spillway Elevation . .	ft	6857.90	--	
Peak Storage	acre-ft	1.45	--	
Storage Capacity . . .	acre-ft	19.8	--	
Outflow				
Peak Flow	cfs	0	2	
Embankment Crest Elevation	ft	--	6860.50	
Peak Stage	ft	--	6858.30	
Freeboard	ft	--	2.20	
Spillway Channel				
Flow Depth	ft	--	0.40	
Critical Velocity. . .	fps	--	1.6	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	18	5
Normal Velocity. . . .	fps	--	2.4	1.5
Normal Depth	ft	--	0.05	0.08
Manning's "n"		--	0.035	0.035

Approach Channel

The existing approach channel for J28-B has the following dimensions:

Channel width	15 to 35 ft
Channel length	40 ft
Average slope	8 percent

Spillway Channel

The existing spillway for J28-B has a trapezoidal channel with the following dimensions:

Channel depth	2.6 ft
Channel width	15 ft
Channel length	35 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	0 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J28-B has a trapezoidal shape with the following dimensions:

Channel width	15 ft
Channel length	50 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	5 percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J28-B.

The calculations for the sediment load entering Structure J28-B were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.32
3. Slope Factor, LS 1.54
4. Cover Factor, C 0.730
5. Erosion Control Factor, P 1.0

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. The existing storage capacity of J28-B is shown on Plate 3, Volume-Elevation Curve, J28-B, and the results of the analysis are summarized in the following table.

J28-B STORAGE

Total Storage Capacity	19.8	acre-ft
10-year, 24-hour Storm Inflow	1.45	acre-ft
Available Sediment Storage Capacity . .	18.35	acre-ft
Sediment Inflow Rate	0.094	acre-ft/yr
Sediment Storage Life	195	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J28-B indicated that the only geotechnical problem is rill erosion on the upstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure J28-B are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown in Plate 5.

* * *

The following plates and appendix are attached and complete this inspection report.

Plate 1 - Site Plan J28-B

Plate 2 - Existing Maximum Cross Section J28-B, A-A'

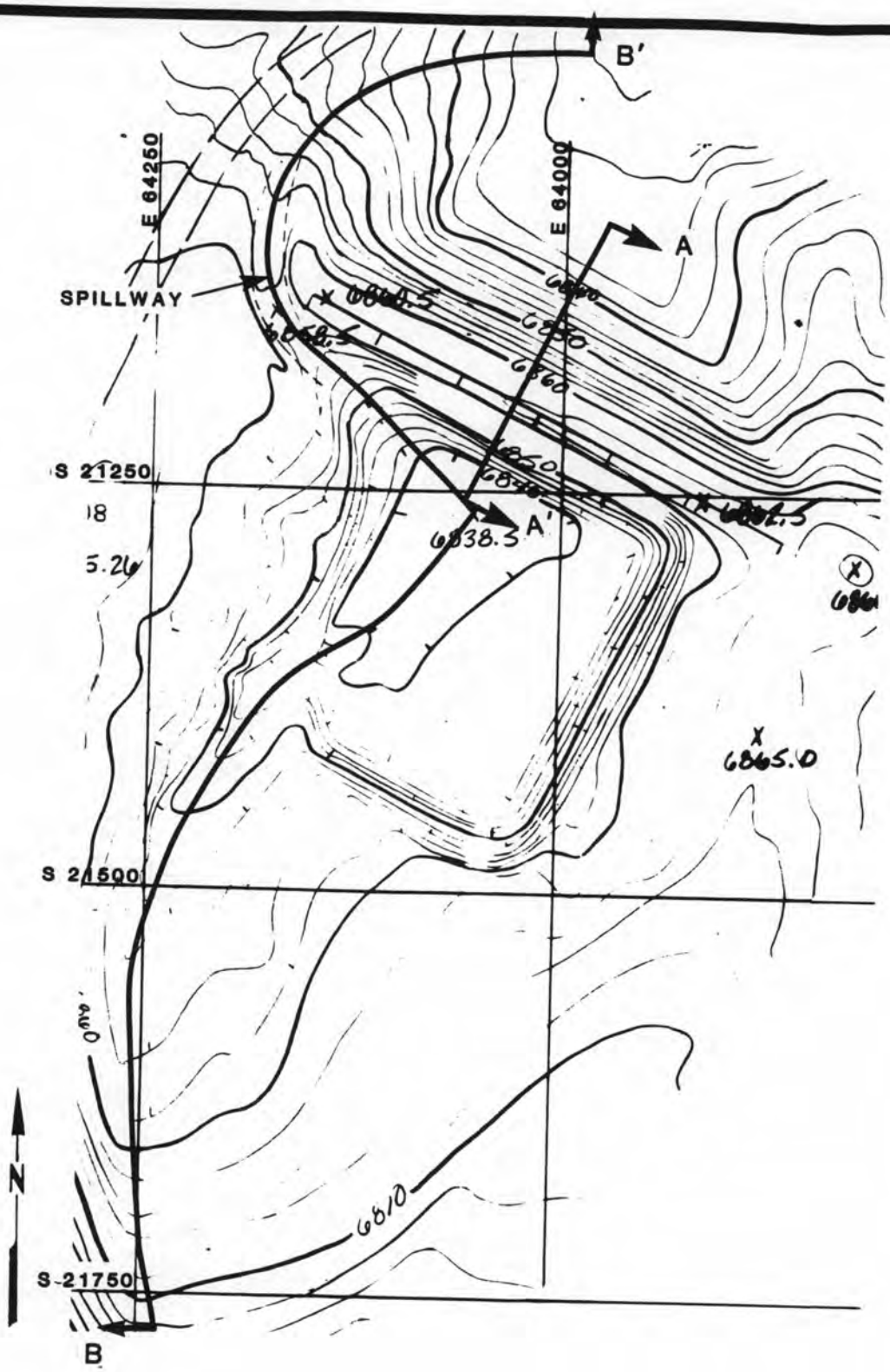
Plate 3 - Volume-Elevation Curve J28-B

Plate 4 - Channel Profile J28-B, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J28-B

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



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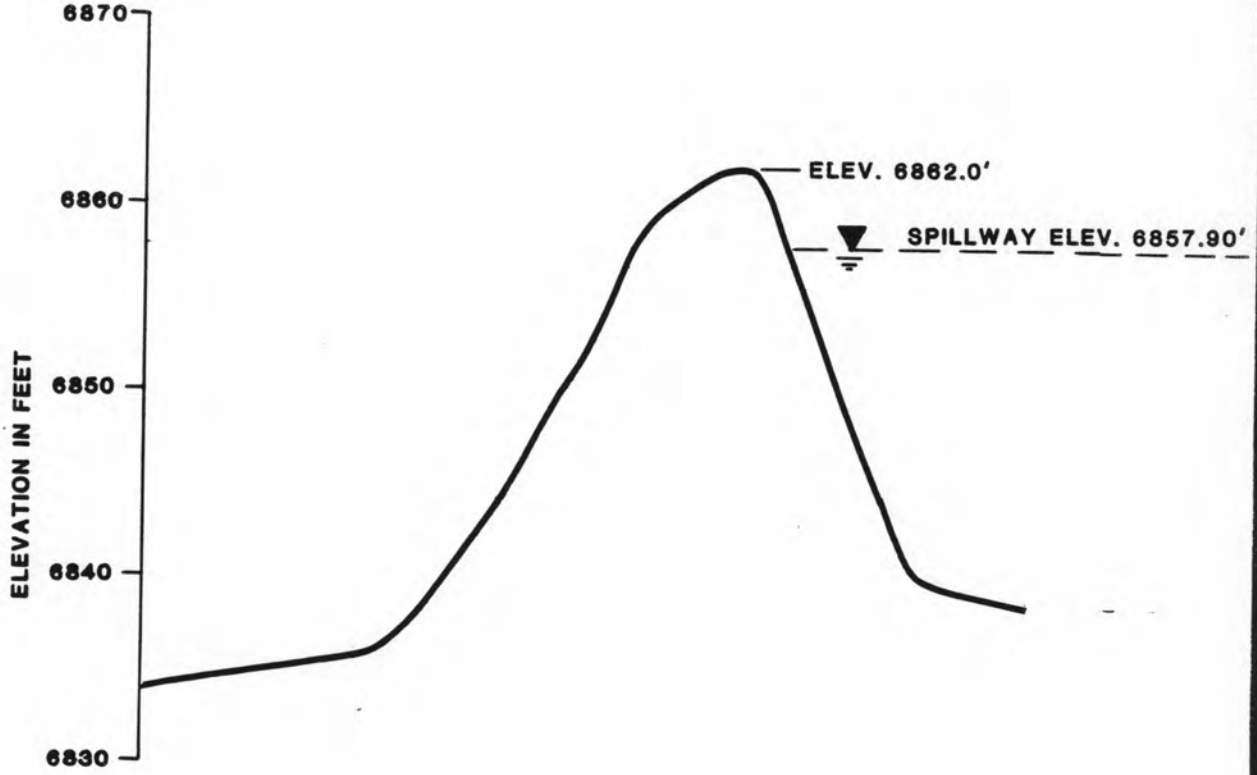
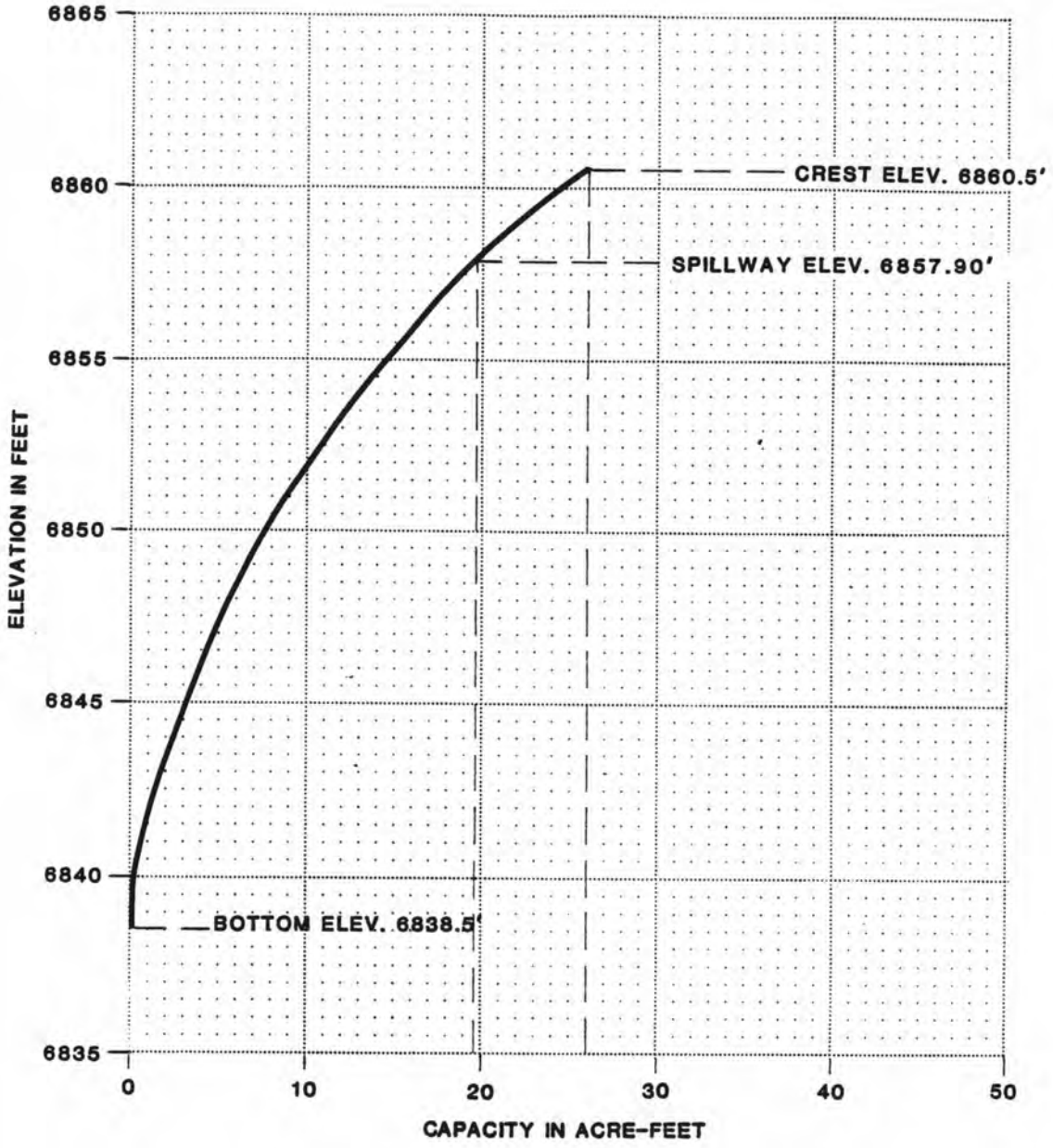
SITE PLAN
J28-B

BY **Dames & Moore** Plate 1



EXISTING
MAXIMUM CROSS-SECTION
A-A'
J28-B

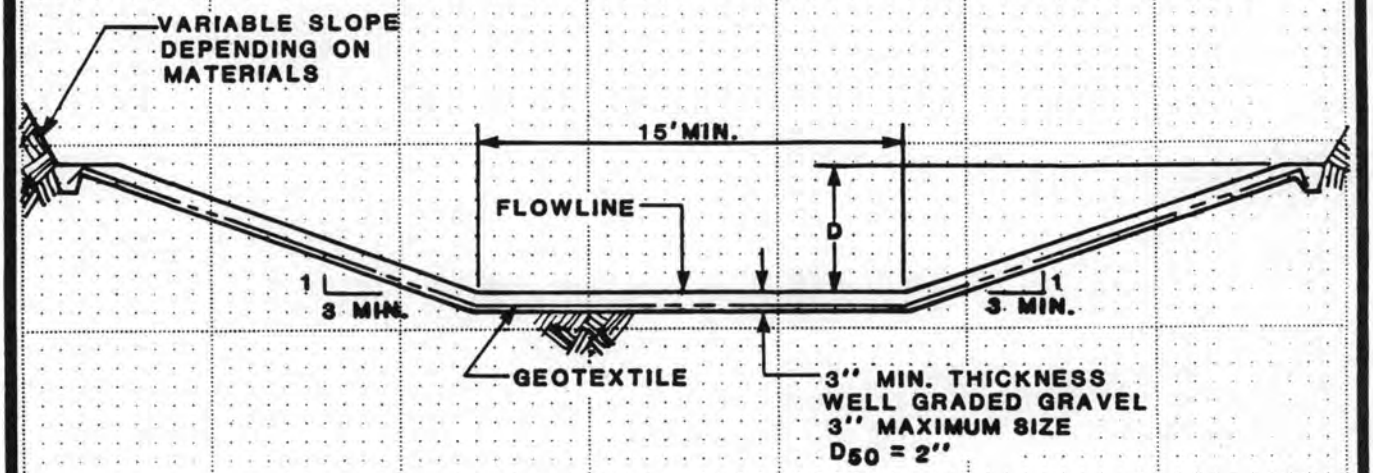
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J28-B

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.4'

LENGTH = 40'

FLOWLINE ELEV.= 6857.90'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J28-B

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J-28-B
Page: 4

Sidehill

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			13' w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			26½°
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?		X	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			18°
a. Adequate grass cover?	X		
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			Some erosion into pond away from dam
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM brown
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

Sediment Impoundment Name: J28-B
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:	X		15' W at spillway 35' L at entrance
Are side slopes eroding?		X	8% slope
Are side slopes sloughing?		X	3.1' below crest
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		15'W 35'L 0% slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		15'W 50'L 5% Sl.
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

Sediment Impoundment Name: J28-B
Page: 6

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Canopy Cover 0

Ground Cover 25

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J28-B SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6905 − 6858 = 47 ft.

WATER COURSE LENGTH = 2.0 (400) = 800 ft. = 0.152 mi.

$$T_c = \left(\frac{11.9\ (0.152)^3}{47}\right)^{0.385} = 0.067 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.040 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
6.3	P-J	poor	C	85 (.45)
7.7	disturbed	—	C	91 (.55)
				88.3

100% EH # 26

use 89

DRAINAGE BASIN AREA

14.0 ACRE 0.022 SQ MILE

BY S. DOLAN DATE 10-2-85
CHECKED BY ___
COPY TO EO ___

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
J28-B SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___ BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #26 = .32

K = .32

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
250	20	8	1.57 (.5)
500	30	6	1.51 (.5)
			= 1.54

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
45%	P-J	10	25	.45 (.40)
55%	disturbed	—	—	.55 (1.0)
				C = .73

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

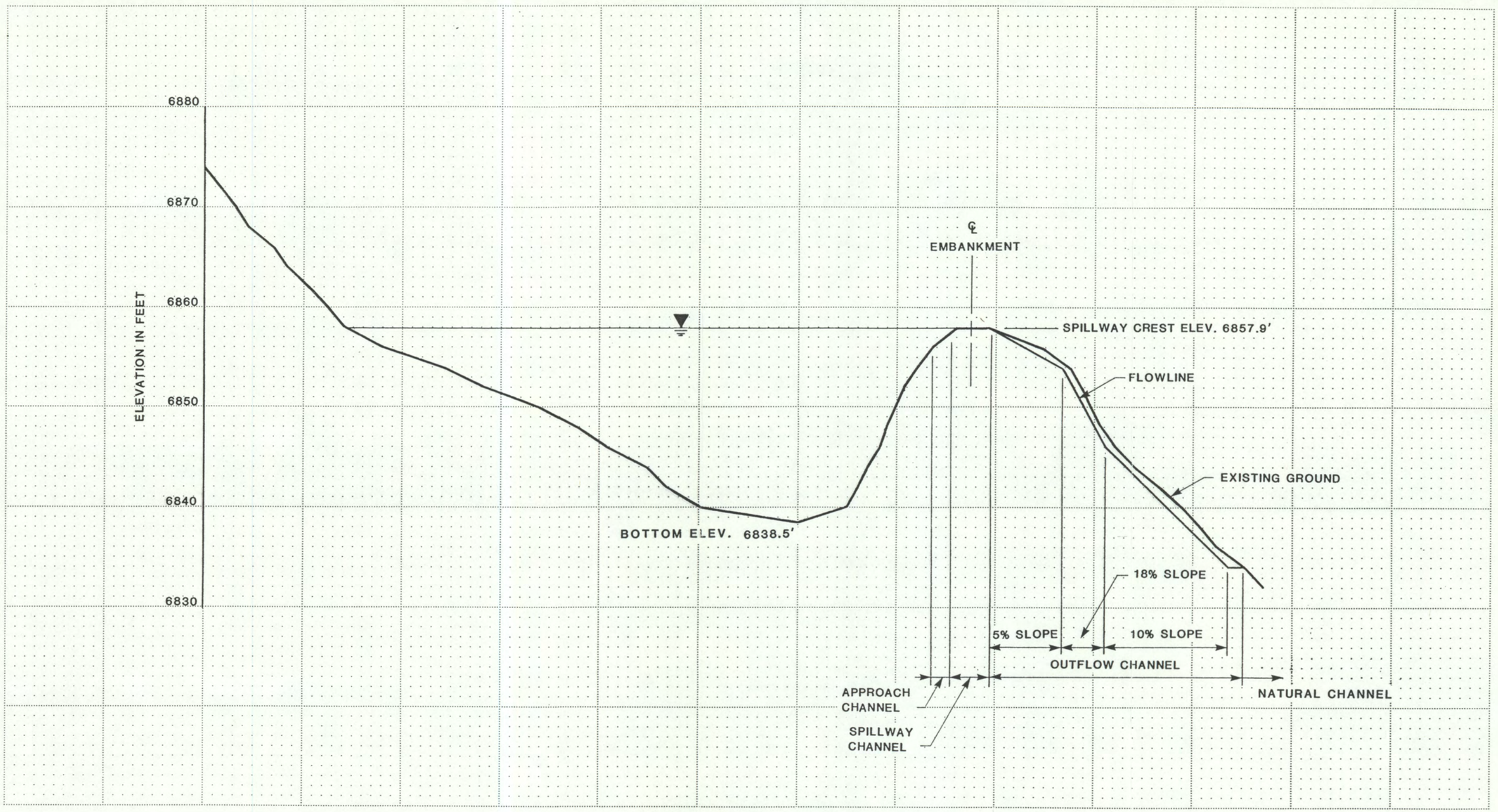
P = 1.0

SEDIMENT INFLOW

$A = 40(.32)(1.54)(.73)(1.0) = 14.39$ ton/acre/year

$A = (14.39)\left(\frac{1}{2047}\right)(14.0)(.95) = 0.094$ acre-feet/year

Dames & Moore



SCALE
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CHANNEL PROFILE B–B′
J28–B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

J28-C

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

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Spillway Channel	6
Outflow Channel	6
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HYDRAULICS	8

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure J28-C is an earthen embankment, designed and constructed in 1983 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J28-C is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J28-C. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J28-C was inspected on September 12, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J28-C project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure J28-C has a 31.6-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 71% disturbed and 29% Pinion/Juniper.

EMBANKMENT

Structure J28-C is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J28-C

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	9.9 ft
Crest Width	15 ft
Upstream Slope	2.2 H : 1 V
Downstream Slope . . .	3.3 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J28-C, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J28-C is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J28-C embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J28-C is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J28-C was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.242	mi
2.	Elevation Difference, H	68	ft
3.	Time of Concentration, T_c	0.099	h
4.	Lag time, $0.6T_c$	0.060	h
5.	SCS Curve Number	88	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	31.6	acres

HYDRAULICS

The HEC-1 program was 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.

J28-C HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	62	80	
Volume	acre-ft	2.90	2.40	
Storage				
Peak Stage	ft	6805.83	—	
Spillway Elevation . .	ft	6812.41	—	
Peak Storage	acre-ft	2.89	—	
Storage Capacity . . .	acre-ft	13.4	--	
Outflow				
Peak Flow	cfs	0	4	
Embankment Crest Elevation	ft	--	6815.64	
Peak Stage	ft	--	6813.17	
Freeboard	ft	--	2.47	
Spillway Channel				
Flow Depth	ft	--	0.76	
Critical Velocity. . .	fps	--	1.8	
Manning's "n"		—	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	2	16
Normal Velocity. . . .	fps	--	1.4	2.7
Normal Depth	ft	--	0.14	0.08
Manning's "n"		--	0.035	0.035

Approach Channel

The existing approach channel for J28-C has a U-shaped channel with the following dimensions:

Channel width	21 ft
Channel length	30 ft
Average exit slope	0 percent

Spillway Channel

The existing spillway for J28-C has a trapezoidal channel with the following dimensions:

Channel depth	3.9 ft
Channel width	21 ft
Channel length	45 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	0 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J28-C has a U-shaped channel with the following dimensions:

Channel width	21 ft
Channel length	90 ft
Average exit slope	2 percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J28-C.

The calculations for the sediment load entering Structure J28-C were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.32
3. Slope Factor, LS 4.42
4. Cover Factor, C 0.751
5. Erosion Control Factor, P 1.0

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. The existing storage capacity of J28-C is shown on Plate 3, Volume-Elevation Curve, J28-C, and the results of the analysis are summarized in the following table.

J28-C STORAGE

Total Storage Capacity	13.4	acre-ft
10-year, 24-hour Storm Inflow	2.89	acre-ft
Available Sediment Storage Capacity . .	10.51	acre-ft
Sediment Inflow Rate	0.623	acre-ft/yr
Sediment Storage Life	17	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J28-C indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes, the side slopes of the approach, spillway, and outlet channel and the right abutment and cracks in the embankment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. Longitudinal cracks were noted on the crest and at the top of the upstream slopes. The sections of embankment exhibiting the cracks should be repaired by excavating the material to the depths of the cracks and replacement with compacted fill.

HYDRAULICS

The storage capacity and spillway capacity of Structure J28-C are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown in Plate 5.

* * *

The following plates and appendix are attached and complete this inspection report.

Plate 1 - Site Plan J28-C

Plate 2 - Existing Maximum Cross Section J28-C, A-A'

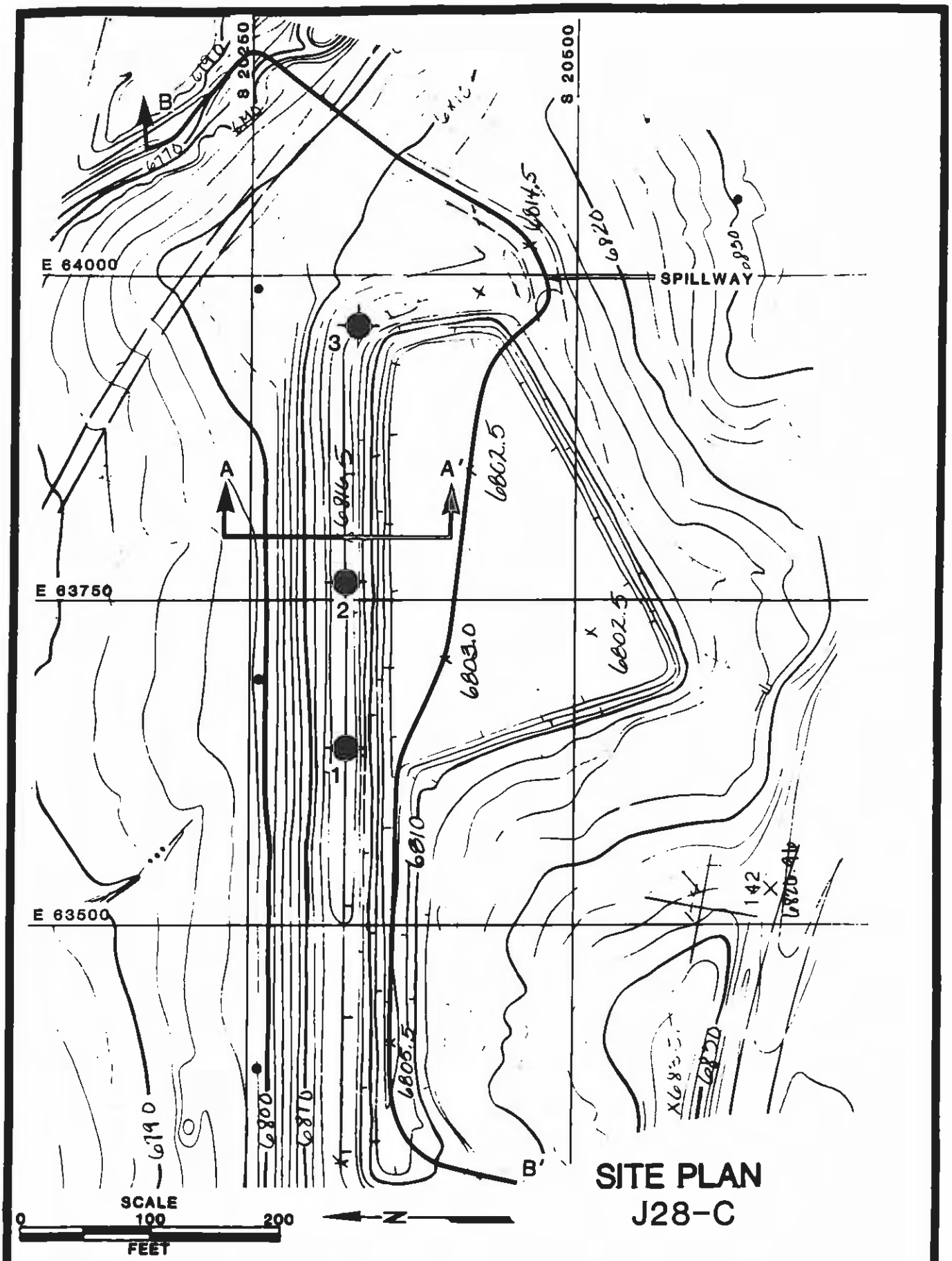
Plate 3 - Volume-Elevation Curve J28-C

Plate 4 - Channel Profile J28-C, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J28-C

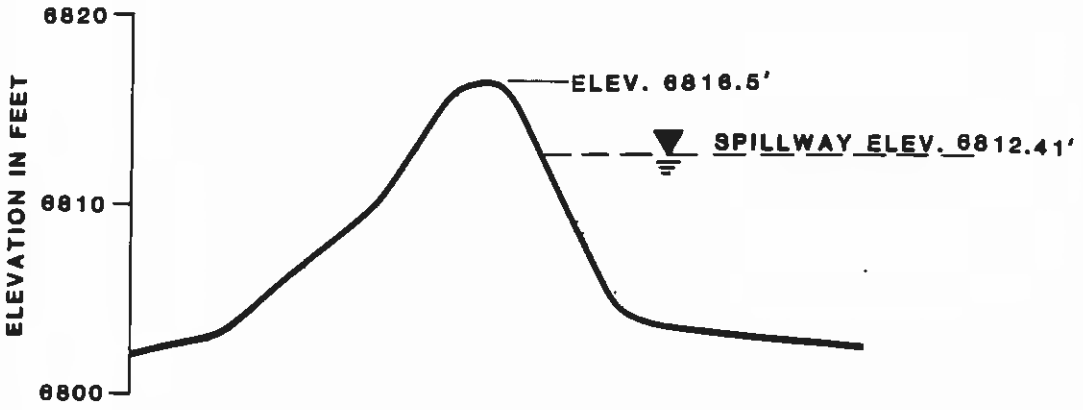
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J28-C

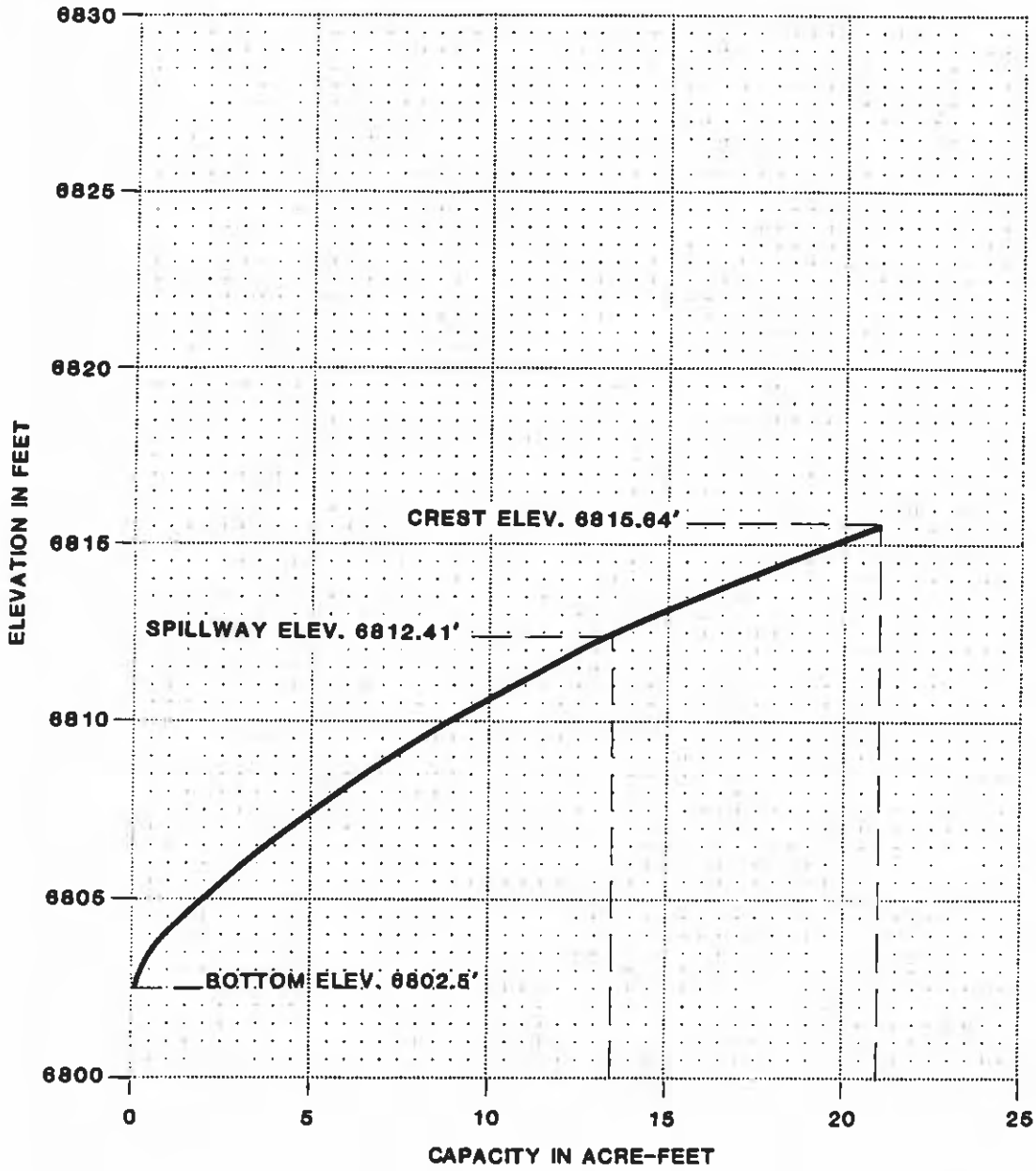
BY **Dames & Moore** Plate 1



EXISTING MAXIMUM CROSS-SECTION A-A' J28-C

FOR LOCATION SEE PLATE 1

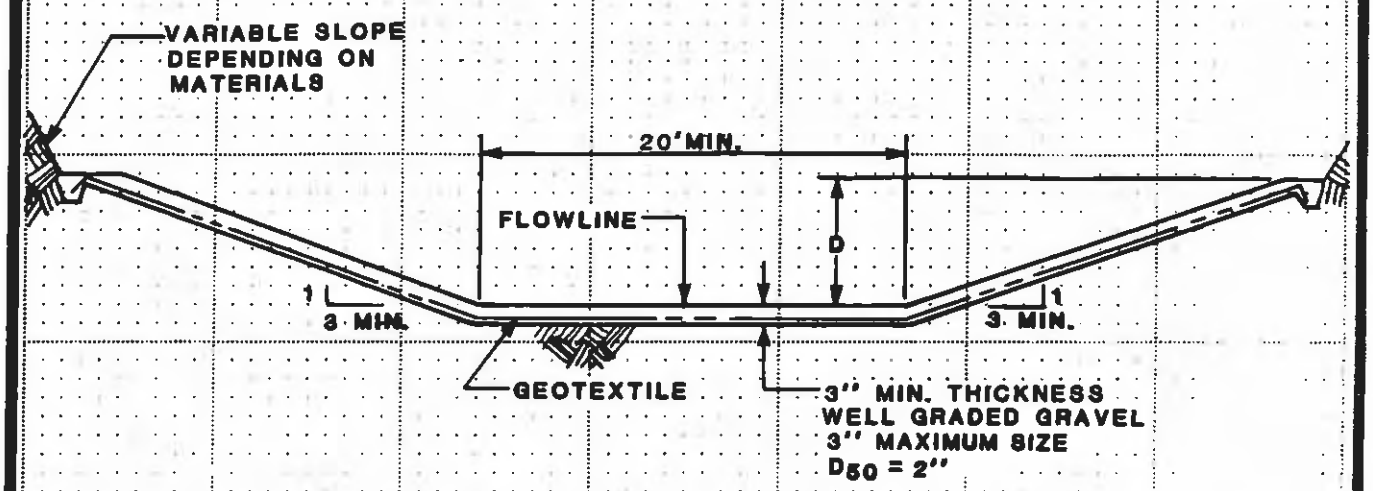
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J28-C

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.8'

LENGTH = 50'

FLOWLINE ELEV.= 6812.41'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

J28-C

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sidehill

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			15' w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?	X		1 crack (longitudinal) near u.s slope at center of 30'L. dam 25°
2. UPSTREAM SLOPE			
a. Adequate grass cover?	X		60%
b. Any erosion?	X		Rills another 2 cracks towards LA near u.s. slp
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			Some unevenness near RA not trimmed 17°
a. Adequate grass cover?	X		65%
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?	X		near turn due to poor trimming.
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		Rills into spillway
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			Fence in spillway and across outlet channel, could catch brush & reduce flow.
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:	X		
Are side slopes eroding?	X		Rills 21'W Gulley at entrance
Are side slopes sloughing?		X	30' L into pond
Bottom of channel eroding?		X	39' below crest 6% slope
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		Rills 45'L 21'W 0' slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		21'W x 90'L 2% Slope
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Some gulleying where runoff enters pond from road culvert partially blocked.

Cracks at u.s. edge of crest noted.

Canopy 0
Ground 35%

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE [illegible]
SUBJECT SEDIMENT POND HYDROLOGY
J28-C SHEET ___ OF ___

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6380 − 6312 = 68 ft.

WATER COURSE LENGTH = 3.2(400) = 1280 = 0.242 mi.

$$T_c = \left(\frac{11.9\,(0.242)^3}{68}\right)^{0.385} = 0.099 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.060 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
9.3	P-J	average	C	78 (.29)
22.3	disturbed	—	C	91 (.71)
				87.2

100% EH # 26

use 88

DRAINAGE BASIN AREA

31.6 ACRE 0.049 SQ MILE

BY S. Dolan DATE 10-2-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE [illegible]
SUBJECT SEDIMENT INFLOW
J28-C SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #26 = .32

K = .32

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
600	40	6.7	1.89 (.4)
400	110	27.5	13.79 (.2)
400	35	8.8	2.25 (.4)
			= 4.42

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
29 %	P-J	40	25	.29 (.14)
71 %	disturbed	—	—	.71 (1.0)
				C = .751

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

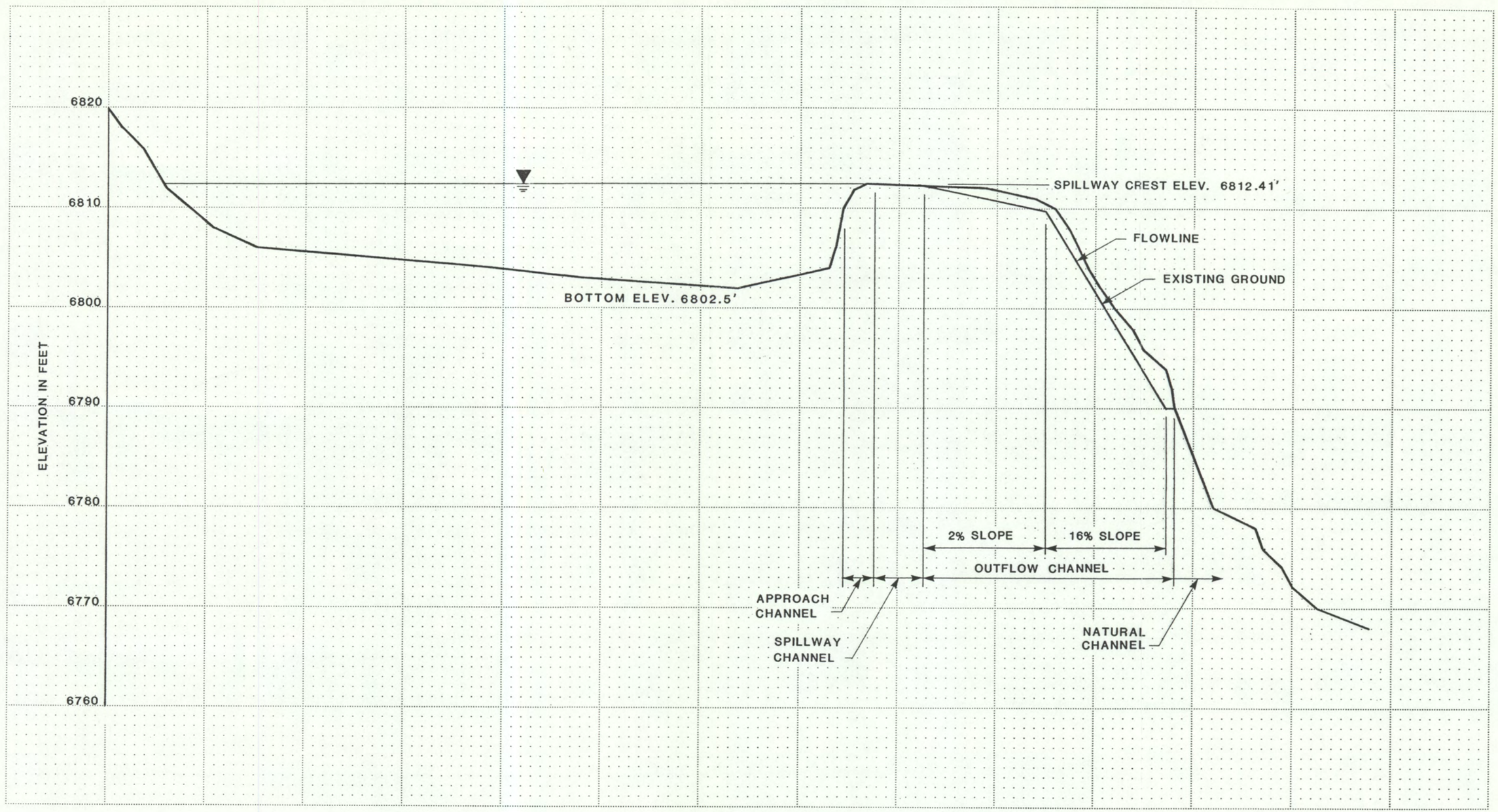
P = 1.0

SEDIMENT INFLOW

$$A = 40(.32)(4.42)(.751)(1.0) = 42.49 \text{ ton/acre/year}$$

$$A = (42.49)\left(\frac{1}{2047}\right)(31.6)(.95) = .623 \text{ acre-feet/year}$$

Dames & Moore



SCALE
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FEET

CHANNEL PROFILE B–B'
J28–C

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

J28-D

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J28-D is an earthen embankment, designed and constructed in 1983 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J28-D is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J28-D. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J28-D was inspected on September 12, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J28-D project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

Peabody Coal Company. The survey data developed in August 1984 was used in the analyses of the structure. Results of the field inspection are included in this report as Appendix A.

SITE DESCRIPTION

LAND USE

Structure J28-D has a 30.4-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 76% disturbed and 24% Pinion/Juniper.

EMBANKMENT

Structure J28-D is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J28-D

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	14.5 ft
Crest Width	15 ft
Upstream Slope	2.6 H : 1 V
Downstream Slope . . .	2.4 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J28-D, A-A'. Grass provides erosion protection on the downstream slope of the embankment.

ANALYSES

STABILITY

Structure J28-D is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 20 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J28-D embankment is lower in height; however, the downstream slope is steeper than the category standard; therefore, the embankment has factors of safety less than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J28-D is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J28-D was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.227	mi
2.	Elevation Difference, H	106	ft
3.	Time of Concentration, T_c	0.078	h
4.	Lag time, $0.6T_c$	0.047	h
5.	SCS Curve Number	88	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	30.4	acres

HYDRAULICS

The HEC-1 program was 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.

J28-D HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	67	82
Volume	acre-ft	2.79	2.31
Storage			
Peak Stage	ft	6779.10	6789.70
Spillway Elevation . .	ft	6788.96	—
Peak Storage	acre-ft	2.83	—
Storage Capacity . . .	acre-ft	17.6	--
Outflow			
Peak Flow	cfs	0	6
Embankment Crest Elevation	ft	—	6791.10
Peak Stage	ft	--	6789.72
Freeboard	ft	—	1.38
Spillway Channel			
Flow Depth	ft	—	0.76
Critical Velocity. . .	fps	—	2.1
Manning's "n"		—	0.035
Outflow Channel			
Slope	%	--	6
Normal Velocity. . . .	fps	--	2.5
Normal Depth	ft	--	0.12
Manning's "n"		—	0.035

Spillway Channel

The existing spillway for J28-D has a trapezoidal channel with the following dimensions:

Channel depth	3.0	ft
Channel width	17	ft
Channel length	25	ft
Side slopes (horizontal to vertical). .	2:1	
Average exit slope	0	percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J28-D has a U-shaped channel with the following dimensions:

Channel width	17	ft
Channel length	120	ft
Average exit slope	2	percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J28-D.

The calculations for the sediment load entering Structure J28-D were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.32
3. Slope Factor, LS 8.53
4. Cover Factor, C 0.794
5. Erosion Control Factor, P 1.0

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. The existing storage capacity of J28-D is shown on Plate 3, Volume-Elevation Curve, J28-D, and the results of the analysis are summarized in the following table.

J28-D STORAGE

Total Storage Capacity	17.6	acre-ft
10-year, 24-hour Storm Inflow	2.79	acre-ft
Available Sediment Storage Capacity . .	14.77	acre-ft
Sediment Inflow Rate	1.22	acre-ft/yr
Sediment Storage Life	12	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J28-D indicated that the only geotechnical problem is rill and gulley erosion on the upstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope should be flattened to 2.5 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The storage capacity and spillway capacity of Structure J28-D are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown in Plate 5.

* * *

The following plates and appendix are attached and complete this inspection report.

Plate 1 - Site Plan J28-D

Plate 2 - Existing Maximum Cross Section J28-D, A-A'

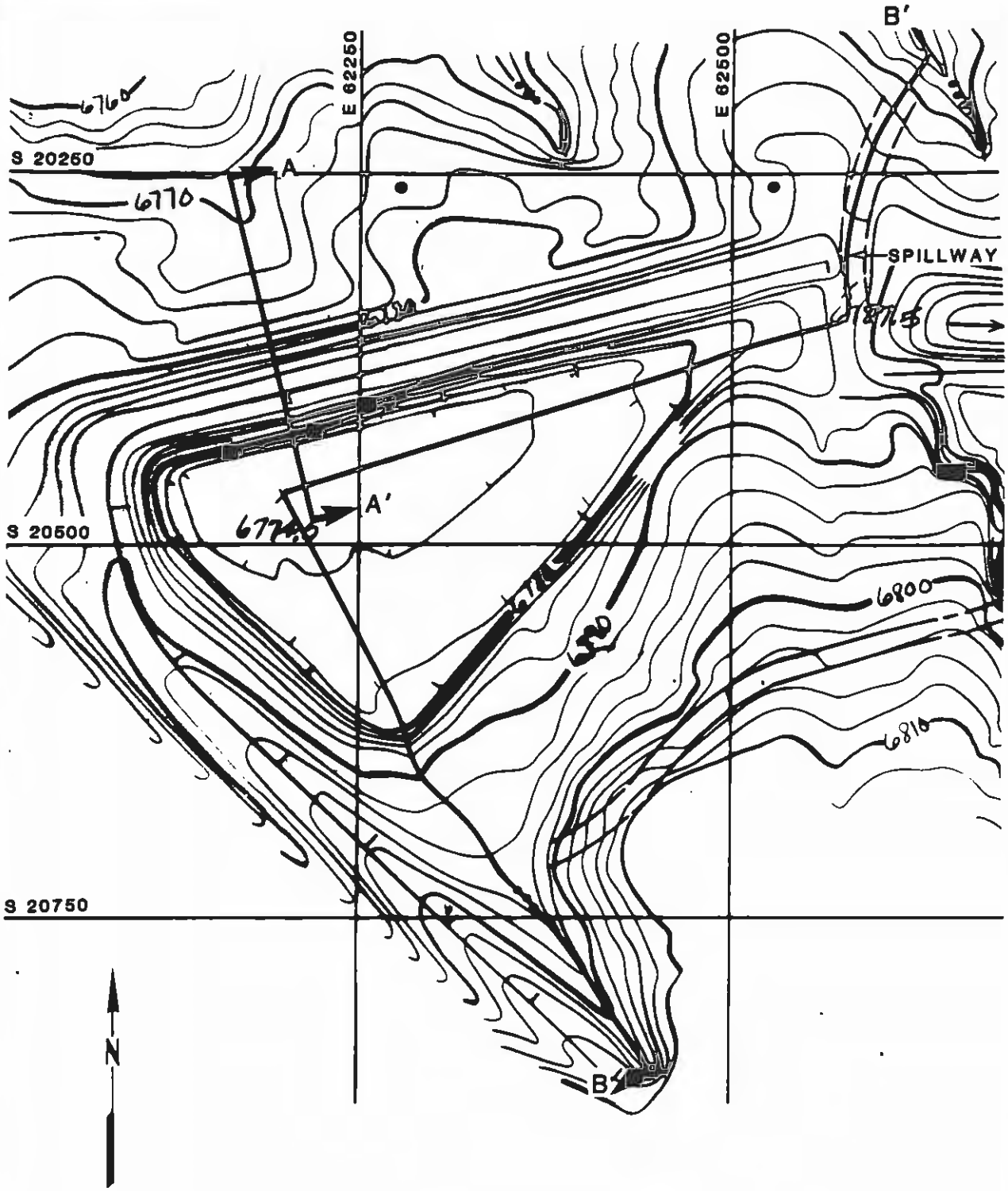
Plate 3 - Volume-Elevation Curve J28-D

Plate 4 - Channel Profile J28-D, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J28-D

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



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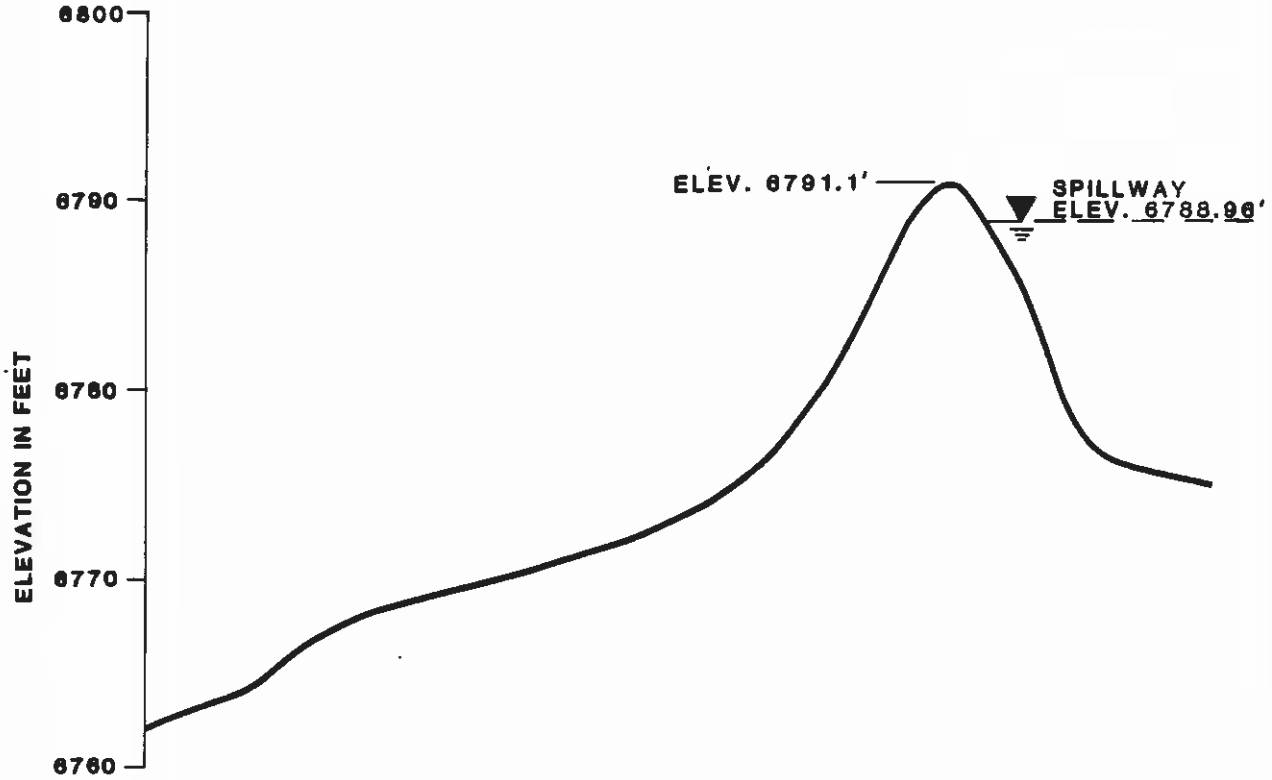
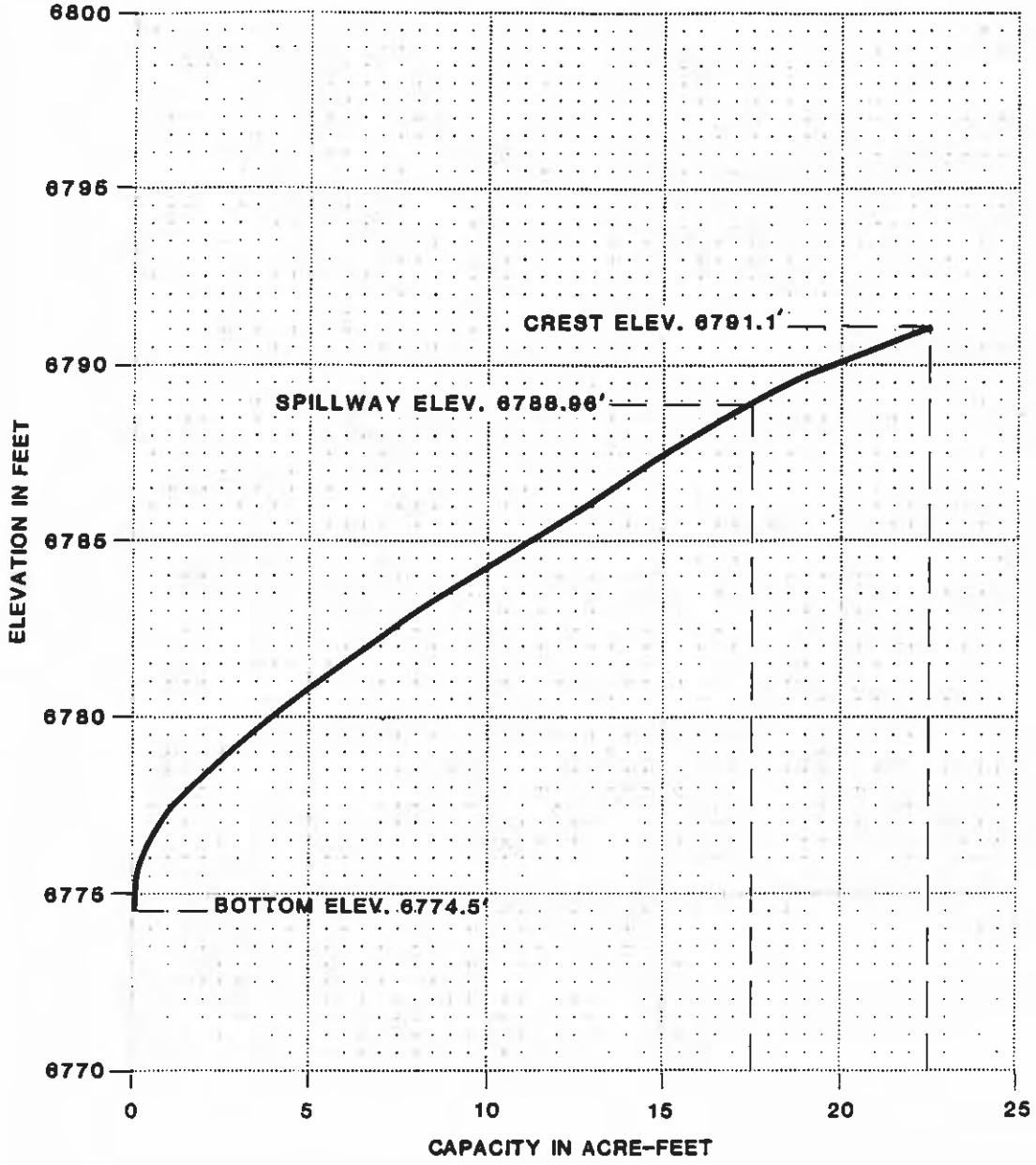
SITE PLAN
J28-D

BY **Dames & Moore** Plate 1



EXISTING
MAXIMUM CROSS-SECTION
A-A'
J28-D

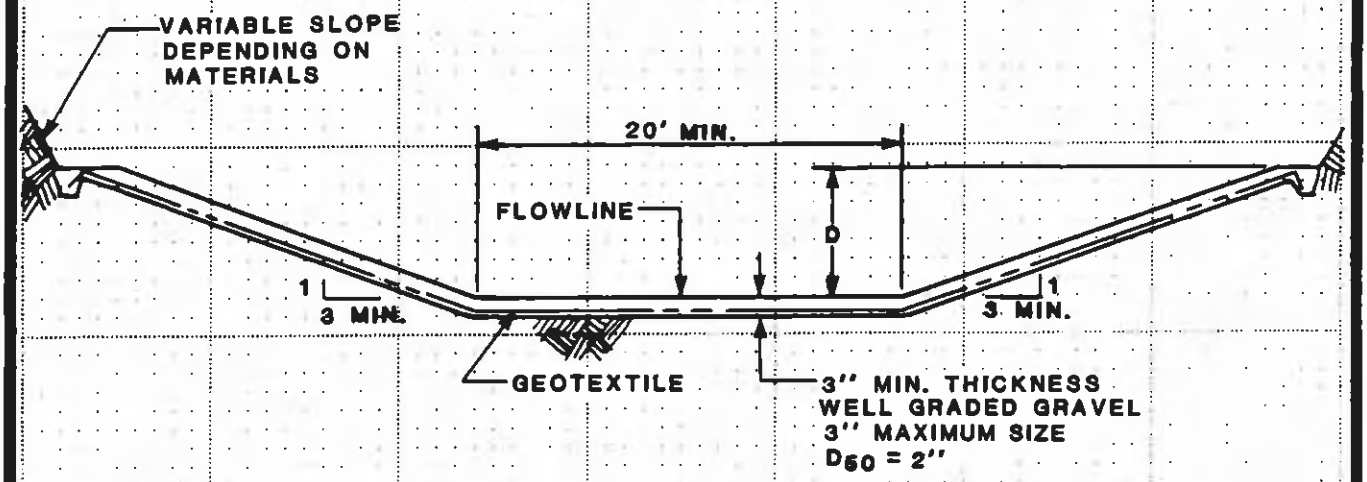
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J28-D

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.8'

LENGTH = 30'

FLOWLINE ELEV.= 6788.96'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J28-D

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J 28 - D
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			15'w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			32° on long leg of crest 21° on short leg.
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills & one or two gullies
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?		X	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			23°
a. Adequate grass cover?	X		
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		17'W 25'L 0% Slope 3.0' below crest
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		17'W ±120' 2% Slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?	X		Fence across channel, may catch brush & slow flow
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Canopy 0 %
Ground 35 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10137-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J28-D SHEET ___ OF ___

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6895 − 6789 = 106 ft.

WATER COURSE LENGTH = 3.0(400) = 1200 ft. = 0.227 mi.

$$T_c = \left(\frac{11.9\ (0.227)^3}{106}\right)^{0.385} = 0.078 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.047 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
7.3	P-J	average	C	78 (.24)
23.1	disturbed	—	C	91 (.76)
				87.9

100% EH #26

use 88

DRAINAGE BASIN AREA

30.4 ACRE 0.048 SQ MILE

BY S. DOLAN DATE 10-2-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE HEABDY COAL CO 10139-01-22
SUBJECT SEDIMENT INFLOW
J28-D SHEET ___ OF ___

REVISIONS BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #26 = .32

K = .32

SLOPE FACTOR

LENGTH (ft)	Δ ELEV (ft)	SLOPE (%)	LS
600	130	21.7	11.4 (.7)
500	35	7.0	1.84 (.3)
			= 8.53

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
24 %	P-J	40	25	.24(.14)
76 %	disturbed	—	—	.76(1.0)
				C = .794

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

EROSION CONTROL FACTOR

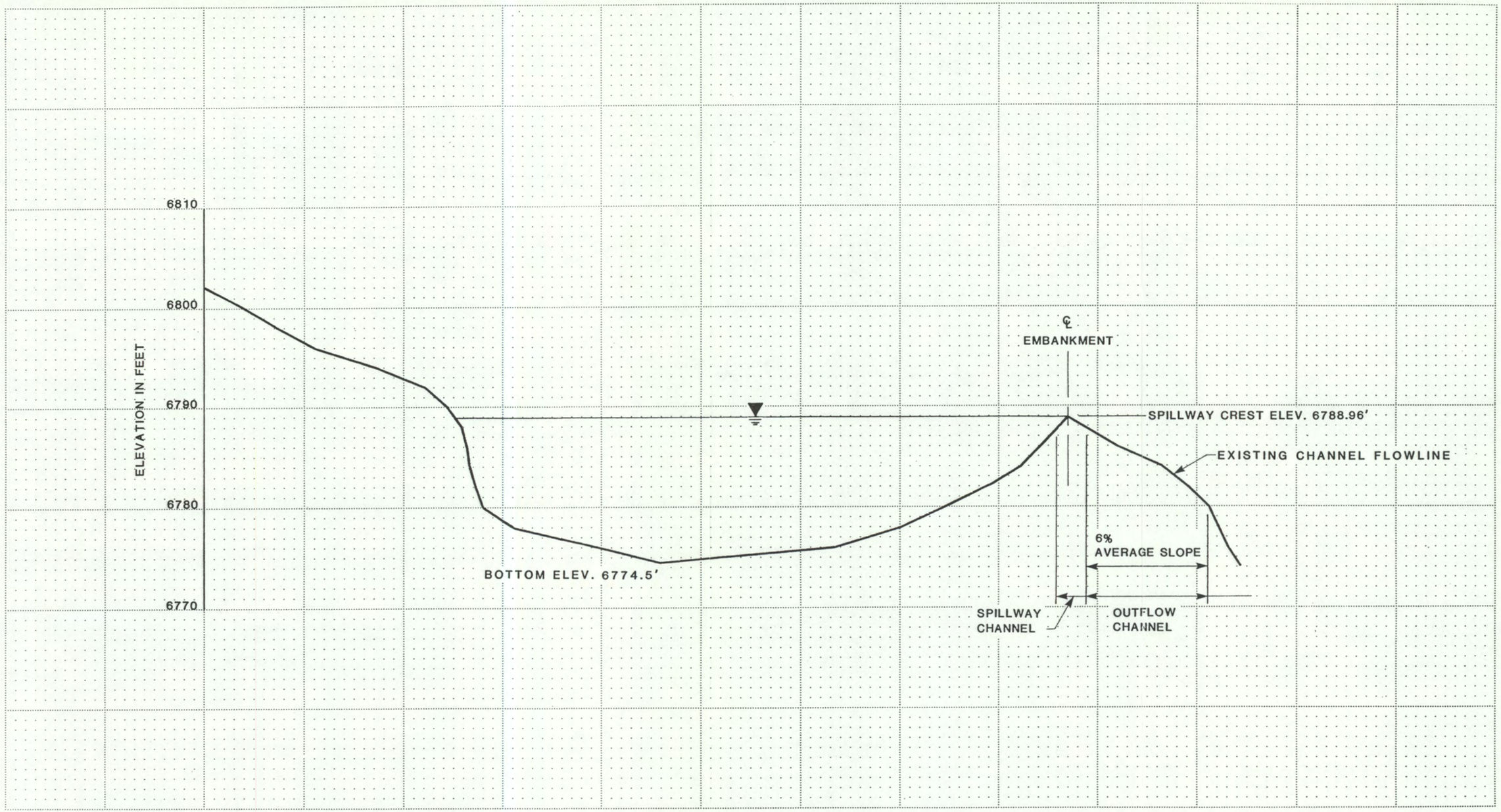
P = 1.0

SEDIMENT INFLOW

$$A = 40(.32)(8.53)(.794)(1.0) = 86.69 \text{ ton/acre/year}$$

$$A = (86.69)\left(\frac{1}{2047}\right)(30.4)(.95) = 1.22 \text{ acre-feet/year}$$

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE B–B'
J28–D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4