Peabody Western
Pond J7Jr

J19 West Diversion Channel - Seg. 1

10-year, 6-hour

djk

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

Phone: 303 763-5140

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J7Jr Diversion Channel

TIME OF CONCENTRATION:

Start Elevation (ft) =	6895
End Elevation (ft) =	6730
Elevation Difference, E (ft) =	165
Watercourse Length (ft) =	3038
Watercourse Length, L (mi) =	0.575
Tc = (11.9L^3/E)^0.385 =	0.192 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	19.2	1593.6
Sagebrush	D	79	0	0
Disturbed - Mine		90	0	0
Disturbed - Spoil		86	7.3	627.8
Diturbed - TS Reclaimed	C	81	0	0
TOTAL:			26.5	2221.4

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

DRAINAGE BASIN AREA:

26.5 Acres

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.600 inches

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	26.500	26.500	16.30	1.05

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	26.500	0.192	0.000	0.000	84.000	F	16.30	1.051
	Σ	**26.500**						**16.30**	**1.051**

J7Jr Diversion Channel - Seg. 1

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.5	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	1.42 ft	2.42 ft
Top Width:	8.52 ft	14.52 ft
Velocity:	2.70 fps	
X-Section Area:	6.04 sq ft	
Hydraulic Radius:	0.673	
Froude Number:	0.56	

J7Jr Diversion Channel - Seg. 1

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.7	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	1.13 ft	2.13 ft
Top Width:	6.77 ft	12.77 ft
Velocity:	4.27 fps	
X-Section Area:	3.82 sq ft	
Hydraulic Radius:	0.535	
Froude Number:	1.00	

J7Jr Diversion Critical Slope
Worksheet for Triangular Channel

Project Description	
Project File	untitled.fm2
Worksheet	J19-E Div. Critical Slope
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.017000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	16.30	cfs

Results		
Depth	1.13	ft
Flow Area	3.83	ft^2
Wetted Perimeter	7.14	ft
Top Width	6.78	ft
Critical Depth	1.13	ft
Critical Slope	0.017022	ft/ft
Velocity	4.26	ft/s
Velocity Head	0.28	ft
Specific Energy	1.41	ft
Froude Number	1.00	
Flow is subcritical.		

J7Jr Diversion Channel - Seg. 1

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.8	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	1.12 ft	2.12 ft
Top Width:	6.70 ft	12.70 ft
Velocity:	4.36 fps	
X-Section Area:	3.74 sq ft	
Hydraulic Radius:	0.529	
Froude Number:	1.03	

J7Jr Diversion Channel - Seg. 1

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	4.2	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	0.95 ft	1.95 ft
Top Width:	5.71 ft	11.71 ft
Velocity:	5.99 fps	
X-Section Area:	2.72 sq ft	
Hydraulic Radius:	0.452	
Froude Number:	1.53	

J7Jr Diversion Channel - Seg. 1

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	4.3	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	1.04 ft	2.04 ft
Top Width:	6.21 ft	12.21 ft
Velocity:	5.06 fps	
X-Section Area:	3.22 sq ft	
Hydraulic Radius:	0.491	
Froude Number:	1.24	
Manning's n:	0.0380	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J7Jr Diversion Channel - Seg. 1

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	8.8	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	0.91 ft	1.91 ft
Top Width:	5.49 ft	11.49 ft
Velocity:	6.49 fps	
X-Section Area:	2.51 sq ft	
Hydraulic Radius:	0.434	
Froude Number:	1.69	
Manning's n:	0.0390	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J7Jr Diversion Channel - Seg. 1

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	8.9	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	0.91 ft	1.91 ft
Top Width:	5.48 ft	11.48 ft
Velocity:	6.52 fps	
X-Section Area:	2.50 sq ft	
Hydraulic Radius:	0.433	
Froude Number:	1.70	
Manning's n:	0.0390	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

J7Jr Diversion Channel - Seg. 1

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	30.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	16.30 cfs	
Depth:	0.82 ft	1.82 ft
Top Width:	4.89 ft	10.89 ft
Velocity:	8.17 fps	
X-Section Area:	1.99 sq ft	
Hydraulic Radius:	0.387	
Froude Number:	2.26	
Manning's n:	0.0530	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

Peabody Western
Pond J7Jr

J19 West Diversion Channel - Seg. 2

10-year, 6-hour

djk

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

Phone: 303 763-5140

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J19 AREA

STRUCTURE: J7Jr Diversion Channel - Seg 2

TIME OF CONCENTRATION:

Start Elevation (ft) =	6825
End Elevation (ft) =	6715
Elevation Difference, E (ft) =	110
Watercourse Length (ft) =	1442
Watercourse Length, L (mi) =	0.273
Tc = (11.9L^3/E)^0.385 =	0.095 hours

ROUTING PARAMETERS:

Between structure routing parameters were calculated using the SCS Upland Method in SEDCAD4. Input and output parameters are shown on the SEDCAD4 printouts in Appendices C.

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Pinyon Juniper	B	65	0	0
Pinyon Juniper	D	83	0	0
Sagebrush	D	79	0	0
Disturbed - Mine		90	0	0
Disturbed - Spoil		86	0	0
Diturbed - TS	C	90	13.4	1206
TOTAL:			13.4	1206

Weighted CN = Total CN*Area/ Total Area = 90

DRAINAGE BASIN AREA:

13.4 Acres

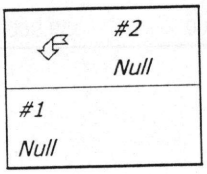
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 6 hr
Rainfall Depth:	1.600 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Design Peak Flow
Null	#2	==>	#1	0.077	0.347	



Structure Routing Details:

Stru #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	7. Paved area and small upland gullies	3.71	40.00	1,078.00	3.87	0.077
#2	**Muskingum K:**					**0.077**

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	26.500	26.500	16.30	1.05
#1	13.400	39.900	19.96	1.90

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	26.500	0.192	0.000	0.000	84.000	F	16.30	1.051
	$\sum$	**26.500**						**16.30**	**1.051**
#1	1	13.400	0.950	0.000	0.000	90.000	F	6.76	0.852
	$\sum$	**39.900**						**19.96**	**1.902**

J7Jr Diversion Channel - Seg. 2

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	0.5	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.53 ft	2.53 ft
Top Width:	9.19 ft	15.19 ft
Velocity:	2.84 fps	
X-Section Area:	7.04 sq ft	
Hydraulic Radius:	0.727	
Froude Number:	0.57	

J7Jr Diversion Channel - Seg. 2

Material: Graded Spoil

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.6	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.23 ft	2.23 ft
Top Width:	7.39 ft	13.39 ft
Velocity:	4.39 fps	
X-Section Area:	4.55 sq ft	
Hydraulic Radius:	0.584	
Froude Number:	0.99	

J7Jr Seg 2 Diversion Critical Slope
Worksheet for Triangular Channel

Project Description	
Project File	untitled.fm2
Worksheet	J7Jr Seg2 Cr Slope
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.016565	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	20.00	cfs

Results		
Depth	1.23	ft
Flow Area	4.50	ft^2
Wetted Perimeter	7.75	ft
Top Width	7.35	ft
Critical Depth	1.23	ft
Critical Slope	0.016565	ft/ft
Velocity	4.44	ft/s
Velocity Head	0.31	ft
Specific Energy	1.53	ft
Froude Number	1.00	
Flow is supercritical.		

J7Jr Diversion Channel - Seg. 2

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	1.7	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.22 ft	2.22 ft
Top Width:	7.31 ft	13.31 ft
Velocity:	4.49 fps	
X-Section Area:	4.45 sq ft	
Hydraulic Radius:	0.578	
Froude Number:	1.01	

J7Jr Diversion Channel - Seg. 2

Material: Gravel

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
3.0:1	3.0:1	3.6	0.0300	1.00			6.0

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.06 ft	2.06 ft
Top Width:	6.35 ft	12.35 ft
Velocity:	5.95 fps	
X-Section Area:	3.36 sq ft	
Hydraulic Radius:	0.502	
Froude Number:	1.44	

J7Jr Diversion Channel - Seg. 2

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	3.7	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.14 ft	2.14 ft
Top Width:	6.83 ft	12.83 ft
Velocity:	5.14 fps	
X-Section Area:	3.89 sq ft	
Hydraulic Radius:	0.540	
Froude Number:	1.20	
Manning's n:	0.0370	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J7Jr Diversion Channel - Seg. 2

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	7.3	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.01 ft	2.01 ft
Top Width:	6.08 ft	12.08 ft
Velocity:	6.50 fps	
X-Section Area:	3.08 sq ft	
Hydraulic Radius:	0.480	
Froude Number:	1.61	
Manning's n:	0.0380	
Dmin:	2.00 in	
D50:	3.00 in	
Dmax:	4.50 in	

J7Jr Diversion Channel - Seg. 2

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	7.4	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	1.01 ft	2.01 ft
Top Width:	6.06 ft	12.06 ft
Velocity:	6.53 fps	
X-Section Area:	3.06 sq ft	
Hydraulic Radius:	0.479	
Froude Number:	1.62	
Manning's n:	0.0380	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

J7Jr Diversion Channel - Seg. 2

Material: Riprap

Triangular Channel

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
3.0:1	3.0:1	30.0	1.00		

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	20.00 cfs	
Depth:	0.87 ft	1.87 ft
Top Width:	5.24 ft	11.24 ft
Velocity:	8.73 fps	
X-Section Area:	2.29 sq ft	
Hydraulic Radius:	0.415	
Froude Number:	2.33	
Manning's n:	0.0520	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

POND
J19-E

J19-E
WATERSHED

J7-JR
DIVERSION

(SEG. 2 WATERSHED)

SEG. 1 DIVERSION

SEG. 2 DIVERSION

J7-JR MSHA DAM

E 48,000

E 49,000

S 37,000

S 38,000

S 39,000

NOTES:
(1). Construct temporary diversions/berms to control runoff from mining disturbance areas in accordance with the requirements in the J-19 West Area, Temporary Diversion Channels Design Report and in Chapter 26. - Terreace Design. Field-fit location to minimize disturbance.

N

SCALE
50' 0 50' 100'
CONTOUR INTERVAL 5 FT.

ENGINEER'S CERTIFICATION

JAMES G. SCHMIDT
ENGINEERING & RECLAMATION MANAGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE DEC 07 2001

OCT 2002
APPROVED

REVISIONS		
DATE	CHK'D	DESCRIPTION

EXHIBIT #1
J19-E & J7-Jr
TEMPORARY DIVERSIONS

KAYENTA MINE
PEABODY WESTERN COAL COMPANY
P. O. BOX 650 KAYENTA, ARIZONA 86033

DESIGNED BY: MW	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 09-28-01
CHECKED BY: JGS	PHOTO DATE: XX-XX-XX
CONTOUR INT.: 5'	DWG FILE: J19EWTRSHD

DESIGN REPORT

Temporary Sedimentation Structure

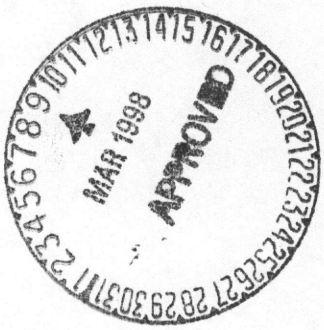
J7-V

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY



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STORAGE CAPACITY 5

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD+ (Input and Output) 10-Year, 24-Hour Storm Event
APPENDIX C SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 Proposed J7-V Sedimentation Pond Design

INTRODUCTION

Sedimentation Structure J7-V will be an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary sedimentation structure designed to control runoff and sediment from portions of J7 disturbed surface mining area at the Black Mesa Mine. The location of Structure J7-V and its watershed boundary are shown on Drawing No. 85400 (Sheet L-11) and Drawing No. 85405. The site-specific general construction plans are shown on the attached Exhibit 1.

This design report contains information specific to Structure J7-V. Mine-wide design, construction, and reclamation information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona, for Peabody Western Coal Company", December, 1985 (PAP), Chapter 6, Attachment D, Volume 2, along with the methods and results of analyses used for slope stability, hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the proposed Structure J7-V was inspected in August, 1997 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist to prevent the successful construction of this structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design and will be utilized during construction to construct a stable embankment.

SITE DESCRIPTION

LAND USE

Structure J7-V has a 140.1-acre tributary drainage area and is located on a tributary upstream of Yucca Flat Wash at the Black Mesa Mine. The watershed is classified as 39% spoil, 55% reclaimed and 6% disturbed.

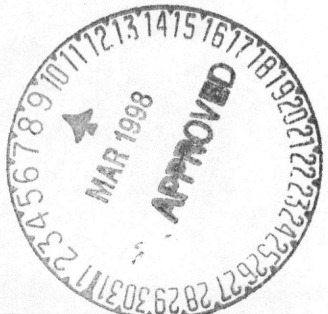
DESIGN ANALYSES

GENERAL

Structure J7-V 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 1992 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J7-V is a Category A-3 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 15 feet wide on top will be constructed. An upstream slope of 3:1 (horizontal to vertical) and a downstream slope of 4:1 were assumed. Based on the total embankment height of approximately 17 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.



HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). Structure J7-V is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream flood plain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The spillway for the J7-V pond was analyzed using the 25-year, 6-hour storm. Structure J7-V was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event. The storage capacity of structure J7-V was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

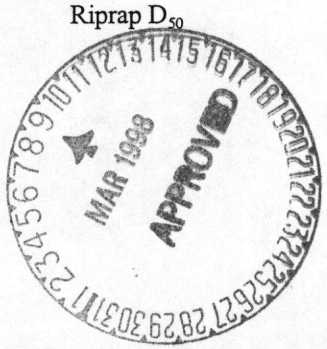
		10yr-24hr Storm	
1.	Water Course length, L	0.795	mi.
2.	Elevation Difference, H	180	ft
3.	Time of Concentration, T_c	0.27	hr
4.	SCS Curve Number	84	
5.	Rainfall Depth, 10-year, 24-hour storm	2.1	in
	25-year, 6-hour storm	1.9	in
6.	Drainage Area	140.1	acres

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, B, and C).

J7-V SEDIMENTATION POND HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	cfs	97.8	113.4
Volume	ac-ft	9.5	7.9
Storage			
Peak Stage	msl	N/A	6365.3
Emerg. Spillway Elev.	msl	6364	6364
Peak Storage	ac-ft	N/A	14.4
Storage Capacity	ac-ft	12.4	12.4
Outflow			
Peak Flow	cfs	N/A	79
Spillway Elevation	msl	6364	6364
Embankment Crest Elev.	msl	6367	6367
Peak Stage	msl	--	6365.3
Freeboard	ft	--	1.7
Emergency Spillway Channel			
Flow Depth	ft	--	1.3
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	.031
Width	ft	--	20
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	7.1
Normal Depth	ft	--	0.5
Mannings "n"	--	--	.064
Riprap D_{50}	in	--	6



EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for J7-V will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	2.5	ft
	(Outflow)	2.0	ft
Channel Width		20	ft
Channel Length	(Spillway)	30	ft
	(Outflow)	90	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6364.0	ft

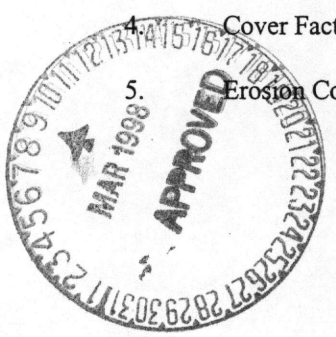
A minimum 15-foot long riprap-lined channel will be constructed beyond the toe of the embankment as a transition into the downstream channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 1992 aerial topographic mapping conducted for Peabody Western Coal Company. Structure J7-V is designed to contain approximately 12.4 acre-feet.

The calculations for the sediment load entering structure J7-V were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.27
3.	Slope Factor, LS	3.34
4.	Cover Factor, C	0.53
5.	Erosion Control Factor, P	0.59



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 storage capacity for J7-V is shown on Exhibit 1, J7-V Stage Capacity Table, and the results of the sediment inflow analysis are summarized in the following table.

J7-V STORAGE

Total Storage Capacity	12.4	acre-ft
10-year, 24-hour Storm Inflow	9.5	acre-ft
Available Sediment Storage Capacity	2.9	acre-ft
Sediment Inflow Rate	0.70	acre-ft/yr.
Sediment Storage Life	4.1	years

* * *

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

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

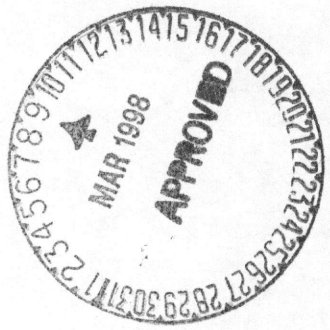
Appendix B - SEDCAD+ (Input and Output) 10-Year, 24-Hour Storm Event

Appendix C - SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event

Exhibit 1 - Proposed J7-V Sedimentation Pond Design

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations



PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J7-V

TIME OF CONCENTRATION (Haul Road):

Start Elevation (ft) =	6530
End Elevation (ft) =	6350
Elevation Difference, E (ft) =	180
Watercourse Length (ft) =	4200
Watercourse Length, L (mi) =	0.795
Tc = (11.9L^3/E)^0.385 =	0.270 hours

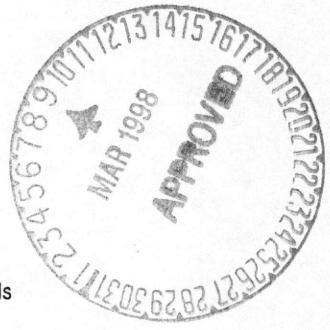
SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Spoil	B	86	54	4644
Reclaimed	C	81	77.1	6245.1
Disturbed	D	91	9	819
TOTAL:			140.1	11708.1

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

DRAINAGE BASIN AREA:

140.10 Acres



PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J7-V

SOIL ERODIBILITY FACTOR:

Soil Type	Soil Group	Erodibility Factor, K	Area (acres)	K*Area
Spoil	B	0.12	54	6.48
Reclaimed	C	0.38	77.1	29.298
Disturbed	D	0.22	9	1.98
TOTAL:			140.1	37.76

Erodibility factor average of spoil to reclaimed condition to simulate various stages of reclamation.

Weighted K = Total K*Area/ Total Area = 0.270

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
400	35	8.8%	0.5	5.0	2.28
150	60	40.0%	0.6	21.8	8.87
200	30	15.0%	0.6	8.5	3.66
900	45	5.0%	0.5	2.9	2.00
400	40	10.0%	0.5	5.7	2.75
400	30	7.5%	0.5	4.3	1.97
600	55	9.2%	0.5	5.2	2.97
550	40	7.3%	0.5	4.2	2.24

Average LS = 3.34

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 > or = 9%*

Where:

Slope < or = 3% *m = 0.3*
Slope = 4% *m = 0.4*
5% > Slope < 10% *m = 0.5*
Slope > 10% *m = 0.6*
|::

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J7-V POND

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Spoil	0%	0%	54	1	54	0.80	43.2
Reclaimed	40%	0%	77.1	0.15	11.565	0.40	30.84
Disturbed	0%	0%	9	1.00	9	1.00	9
TOTAL:			140.1		74.565		83.04

Weighted C = Total C*Area/ Total Area = 0.53

Weighted P = Total P*Area/ Total Area = 0.59

RAINFALL FACTOR:

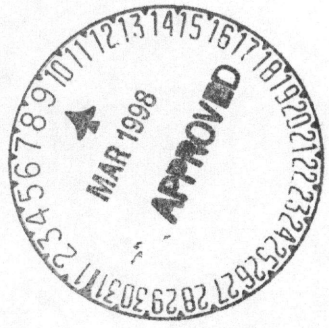
R = 40

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J7-V

The following spreadsheet calculates the predicted sediment yield for the project area. The gross sediment yield is determined according to the Revised Universal Soil Loss Equation.

PARAMETER DESCRIPTION	VALUE	
Annual Rainfall Factor	40.00	
Soil Erodibility Factor	0.27	
Length Slope Factor	3.34	
Cover Factor	0.53	
Practice Factor	0.59	
Gross Annual Sediment Yield	11.37	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0056	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0050	acre-feet/acre/year
Watershed Area	140.1	acres
Watershed Annual Sediment Yield	0.7002	acre-feet/year
Number of years	1	years
Required Pond Sediment Storage	0.700	acre-feet



SEDCAD+ RIPRAP CHANNEL DESIGN

J7-V OUTFLOW

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	79.00 cfs	
Slope	25.00 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	20.00 feet	
Freeboard	.3 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.52 ft
with Freeboard	0.82 ft
Top Width	23.09 ft
with Freeboard	24.89 ft
Velocity	7.11 fps
Cross Sectional Area	11.11 sq ft
Hydraulic Radius	0.48 ft
Manning's n	0.064
Froude Number	1.81
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)

J7-V SPILLWAY
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	J7-V SPILLWAY
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.016093	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	20.00	ft
Discharge	79.00	cfs

Results		
Depth	0.76	ft
Flow Area	16.82	ft²
Wetted Perimeter	24.78	ft
Top Width	24.53	ft
Critical Depth	0.76	ft
Critical Slope	0.016093	ft/ft
Velocity	4.70	ft/s
Velocity Head	0.34	ft
Specific Energy	1.10	ft
Froude Number	1.00	
Flow is supercritical.		

APPENDIX B

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY: POND J7-V

by

Name: T. LEIDICH

Company Name: ACZ, INC.
File Name: J:\861\0350\SEDCAD\J7-V

Date: 10-18-1997

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

Company Name: ACZ, INC.
Filename: J:\861\0350\SEDCAD\J7-V User: T. LEIDICH
Date: 10-18-1997 Time: 08:56:01
PEABODY WESTERN COAL COMPANY: POND J7-V
Storm: 2.10 inches, 10 year-24 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	140.10	84	F	0.270	0.000	0.000	0.0	9.52	97.76
		Type: Null Label: POND J7-V								
111	Structure	140.10							9.52	
111	Total IN/OUT	140.10							9.52	97.76

APPENDIX C

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

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

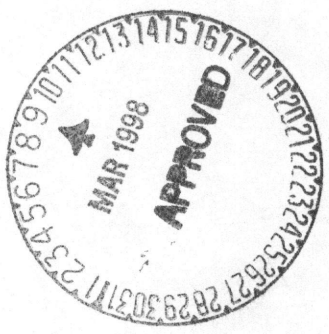
PEABODY WESTERN COAL COMPANY: POND J7-V (25-YR, 6-HR)

by

Name: T. LEIDICH

Company Name: ACZ, INC.
File Name: J:\861\0350\SEDCAD\J7-V25

Date: 10-18-1997



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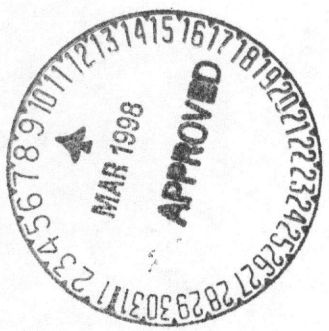
Company Name: ACZ, INC.
Filename: J:\861\0350\SEDCAD\J7-V25 User: T. LEIDICH
Date: 10-18-1997 Time: 13:04:33
PEABODY WESTERN COAL COMPANY: POND J7-V (25-YR, 6-HR)
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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	140.10	84	F	0.270	0.000	0.000	0.0	7.87	113.42
		Type: Pond Label: POND J7-V								
111	Structure	140.10							7.87	
111	Total IN	140.10							7.87	113.42
111	Total OUT								7.87	79.00



Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: J:\861\0350\SEDCAD\J7-V25 User: T. LEIDICH
Date: 10-18-1997 Time: 13:04:33
PEABODY WESTERN COAL COMPANY: POND J7-V (25-YR, 6-HR)
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

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

J1, B1, S1
POND J7-V

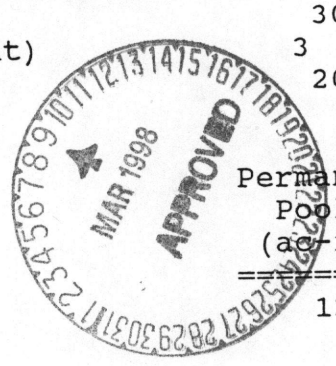
Drainage Area from J1, B1, S1, SWS(s)1: 140.1 acres
Total Contributing Drainage Area: 140.1 acres

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	6364.0
Crest Length (ft)	30.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	20.0

POND RESULTS:

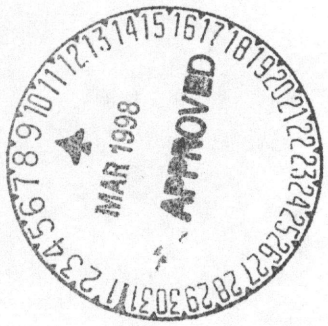
	Permanent Pool (ac-ft)
	12.4



	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	7.87	113.42
OUT	7.87	79.00

Peak Elevation	Hydrograph Detention Time (hrs)
6365.3	0.00

****



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Company Name: ACZ, INC.
Filename: J:\861\0350\SEDCAD\J7-V25 User: T. LEIDICH
Date: 10-18-1997 Time: 13:04:33
PEABODY WESTERN COAL COMPANY: POND J7-V (25-YR, 6-HR)
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

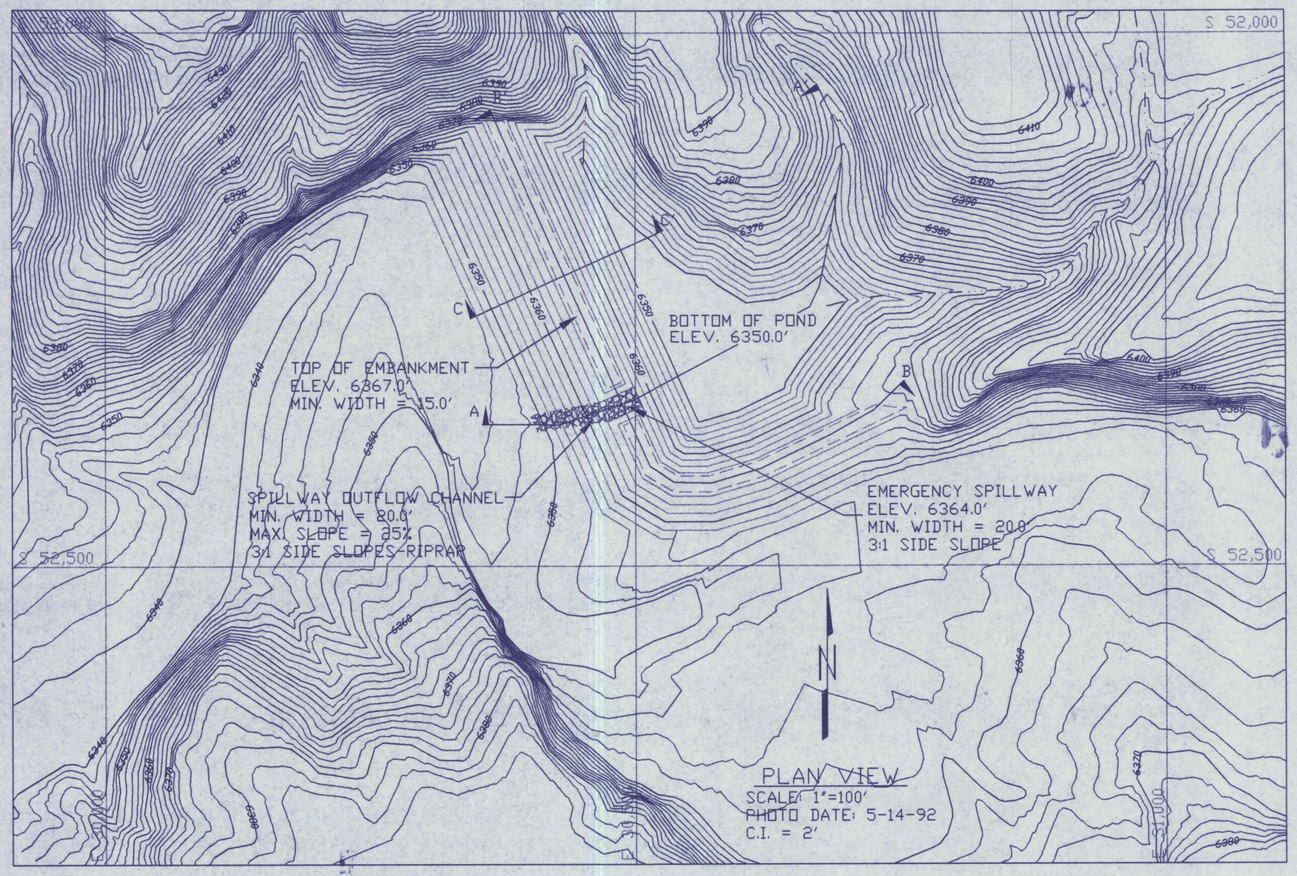
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
POND J7-V

Drainage Area from J1, B1, S1, SWS(s)1: 140.1 acres
Total Contributing Drainage Area: 140.1 acres

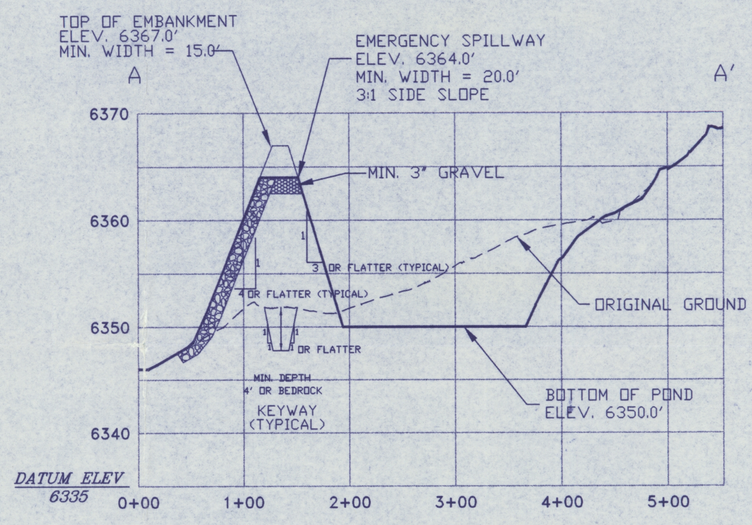
SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6350.00	0.00	0.42	0.00	0.00	
6351.00	1.00	0.48	0.45	0.00	
6352.00	2.00	0.53	0.95	0.00	
6353.00	3.00	0.59	1.52	0.00	
6354.00	4.00	0.65	2.14	0.00	
6355.00	5.00	0.72	2.83	0.00	
6356.00	6.00	0.78	3.58	0.00	
6357.00	7.00	0.85	4.40	0.00	
6358.00	8.00	0.93	5.29	0.00	
6359.00	9.00	1.00	6.25	0.00	
6360.00	10.00	1.08	7.30	0.00	
6361.00	11.00	1.17	8.43	0.00	
6362.00	12.00	1.26	9.64	0.00	
6363.00	13.00	1.36	10.95	0.00	
6364.00	14.00	1.47	12.36	0.00	Stage of SW#1
6364.70	14.70	1.54	13.41	22.94	
6364.80	14.80	1.55	13.56	29.66	
6364.90	14.90	1.56	13.72	37.02	
6365.00	15.00	1.57	13.88	44.99	
6365.31	15.31	1.61	14.37	79.00	Peak Stage
6365.50	15.50	1.63	14.68	99.85	
6366.00	16.00	1.69	15.51	163.88	
6366.50	16.50	1.73	16.36	247.18	
6367.00	17.00	1.78	17.24	350.51	



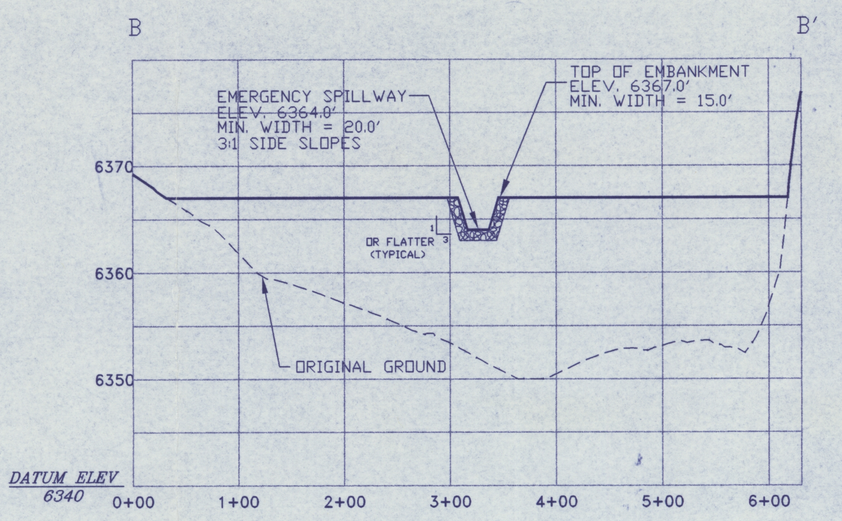
PLAN VIEW

SCALE: 1"=100'
PHOTO DATE: 5-14-92
C.I. = 2'



SECTION A - A'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

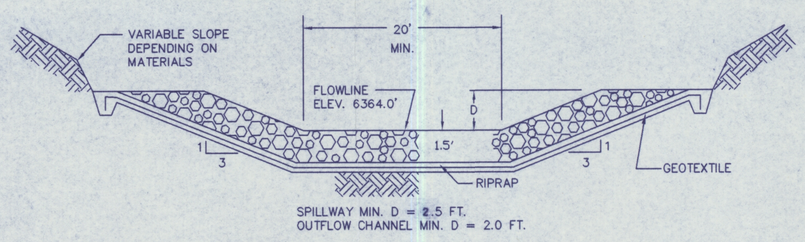


SECTION B - B"

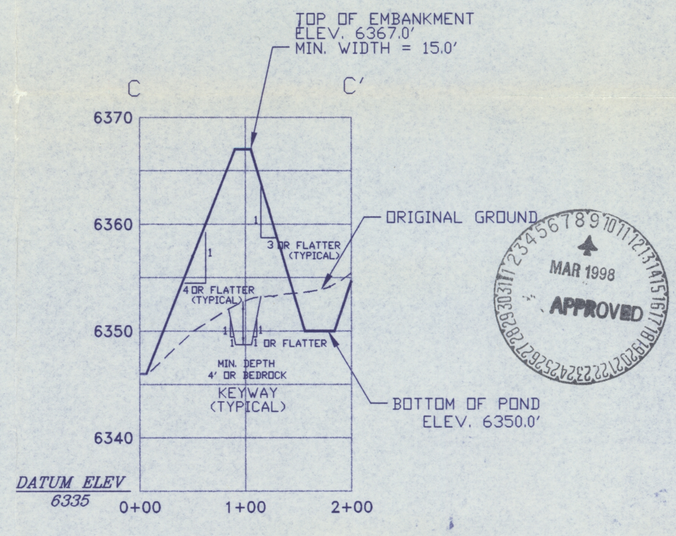
SCALE: HORIZ. 1"=100'
VERT. 1"=10'

J7-V POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAP. (AC.-FT.)	TOT. CAP. (AC.-FT.)	DESCRIPTION
6350.0	0.00	0.42	0.00	0.00	BOTTOM OF POND
6352.0	2.00	0.53	0.95	0.95	
6354.0	4.00	0.65	1.19	2.14	
6356.0	6.00	0.78	1.44	3.58	
6358.0	8.00	0.93	1.71	5.29	
6360.0	10.0	1.08	2.01	7.30	
6362.0	12.0	1.26	2.34	9.64	
6364.0	14.0	1.47	2.72	12.36	EMERGENCY SPILLWAY
6366.0	16.0	1.69	3.15	15.51	
6367.0	17.0	1.78	1.73	17.24	TOP OF EMBANKMENT



PROPOSED J7-V POND
TYPICAL SECTION OF EMERGENCY SPILLWAY
(NOT DRAWN TO SCALE)



SECTION C - C'

SCALE: HORIZ. 1"=100'
VERT. 1"=10'

MAR 1998
APPROVED

ENGINEER'S CERTIFICATION

Registered Professional Engineer CERTIFICATE NO. 18782 STATE OF ARIZONA U.S.A.

JAMES G. SCHLENGER
Compliance Eng. Mgr.
Peabody Western Coal Company

ARIZONA P.E. 18782

Date: OCT 24 1997

NOTES:
1) General location, see Drawing No. 85400, Sheet L-11 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 natural topography.

EXHIBIT 1
PROPOSED J7-V SEDIMENTATION POND DESIGN

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

DESIGNED BY: TEL	SCALE: 1"=100'
DRAWN BY: JMB	DRAWING DATE: 10-24-97
CHECKED BY: JGS	PHOTO DATE: 05-14-92
CONTOUR INTERVAL: 2 FT.	DWG FILE: J7-V DESIGN~1.DWG

DESIGN REPORT - MSHA

SEDIMENTATION STRUCTURE

J16-A DAM

Revised 08/03/98

MSHA
Sedimentation Structure
M.S.H.A. I.D.#1211-AZ-09-01195-07

J16-A Dam
Revised Hydrology and Sedimentology Design Report

Kayenta Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

AUG 0 3 1998

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STORAGE CAPACITY 5

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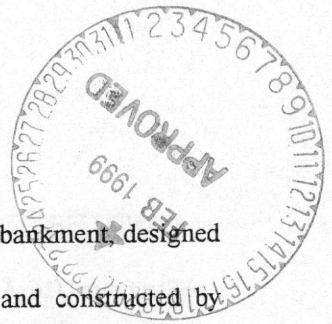
APPENDIX A Hydrology, Hydraulic, Sedimentation Calculations and Stage-Capacity Table
APPENDIX B SEDCAD+ (Input and Output) 10-Year, 24-Hour Storm Event
APPENDIX C SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event



INTRODUCTION

Sedimentation Structure J16-A, MSHA I.D. #1211-AZ-09-01195-07 is a zoned embankment, designed by Sargent, Hauskins & Beckwith (SHB) Consulting Geotechnical Engineers and constructed by Peabody Western Coal Company in the fall, 1982 to control runoff and sediment from portions of the J16 disturbed surface mining area at the Kayenta Mine. The location of Structure J16-A and its watershed boundary are shown on Drawing No. 85400 (Sheet M-8) and Drawing No. 85405 in the OSM AZ-0001D Permit. This report reviews the hydrology, sedimentology and hydraulics of the structure. It evaluates current "worst case" watershed conditions and storage requirements.

This design report contains information specific to Structure J16-A and replaces Sections 2.4, Operating Pool Restrictions, 5.1, Hydrology and Sedimentology Of The Watershed Above Damsite J-16A, Tables 3, 4, 5, 6, and 7, and Figures 2, 3, and 4 in Appendix C, and all of Appendix D, Computer Printouts, in the March 16, 1982, Geotechnical Investigation Report, Water Retention Dam J16-A, by Sargent, Hauskins & Beckwith (SHB) Consulting Geotechnical Engineers. Geotechnical aspects were assessed in the 1982, SHB Report and no geotechnical revision or modification to the existing embankment is proposed in this report. 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, OSM AZ-0001D Permit, along with the methods and results of analyses used for hydrology, and hydraulics, and in Chapter 6, Pages 11 to 42, "Sediment and Water Control Facility Plan".

INSPECTION

Structure J16-A is inspected on a regular basis by or under the supervision of a Registered Professional Engineer from Peabody Western Coal Company.

SITE DESCRIPTION

LAND USE

Structure J16-A has a 2,415-acre tributary drainage area and is located on a tributary to upper Moenkopi Wash at the Kayenta Mine. The watershed is classified as 54% pinyon-juniper, 21% sagebrush, 14% disturbed, and 11% reclaimed.

EMBANKMENT

Structure J16-A is a zoned earthen embankment classified as an MSHA Structure, (see SHB's March 16, 1982 Report).

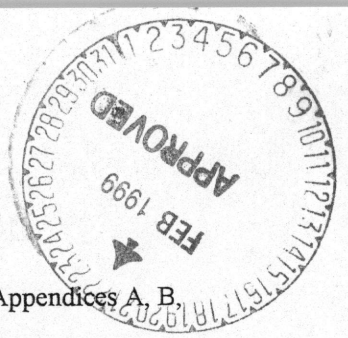
ANALYSES

GENERAL

Structure J16-A was reevaluated under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design was evaluated in accordance with applicable 30 CFR 77.216 and 816 regulations of the United States Department of Labor, Mine Safety & Health Administration (MSHA) and 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, which were used in the review of the structure.

STABILITY

No change is proposed to the embankment, which was constructed in accordance with the approved design as outlined in the 1982 SHB Report, and the embankment shows no signs of deterioration or instability.



HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A, B, and C). J16-A is a MSHA Structure and therefore the spillway was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J16-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

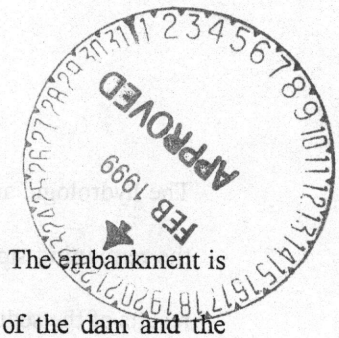
1.	Water Course length, L	4.959 mi.
2.	Elevation Difference, H	650 ft
3.	Time of Concentration, T_c	1.362 hr
4.	SCS Curve Number	81
5.	Rainfall Depth, 10-year, 24-hour storm 100-year, 6-hour storm	2.1 in 2.4 in
6.	Drainage Area	2,415 acres

HYDRAULICS

The SEDCAD+ and FlowMaster computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A, B, and C).

J16-A SEDIMENTATION POND HYDROLOGY and HYDRAULICS TABLE

	Units	10-Yr, 24-Hr Storm	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Empty	Full to emergency spillway
Inflow			
Peak Flow	cfs	591.6	1076.1
Volume	ac-ft	134.6	175.5
Storage			
Peak Stage	msl	N/A	6636.3
Emergency Spillway Elev.	msl	6635	6635
Peak Storage	ac-ft	N/A	287.5
Storage Capacity	ac-ft	261.0	261.0
Outflow			
Peak Flow	cfs	N/A	975.9
Spillway Elevation	msl	6635	6635
Embankment Crest Elev.	msl	6635	6635
Peak Stage	msl	--	6636.3
Freeboard	ft	--	NA
Emergency Spillway Channel			
Flow Depth	ft	--	1.3
Critical Velocity	fps	--	4.7
Mannings "n"	--	--	0.030
Width	ft	--	300
Outflow Channel			
Slope	%	--	50
Normal Velocity	fps	--	8.0
Normal Depth	ft	--	0.4
Mannings "n"	--	--	0.072
Riprap D_{50}	in	--	6.0



EMERGENCY SPILLWAY

The J16-A embankment is designed with the capability to overtop without failing. The embankment is protected by a 5-foot by 300-foot rock spillway built into a swale in the crest of the dam and the outslope face of the embankment is covered with a 2-foot thick layer of rock with a D_{50} of 12 inches, (see the 1982 SHB Report). To verify the capacity of the spillway and the stability of the outslope, the following channel dimensions were assumed.

Minimum Channel Depth	(Spillway)	5.0 ft
	(Outflow)	2.0 ft
Channel Width		300 ft
Channel Length	(Spillway)	30 ft
	(Outflow)	300 ft
Sideslopes (Horizontal to Vertical)		3:1or flatter
Average Slope	(Spillway)	0%
Maximum Slope	(Outflow)	50%
Spillway Elevation		6635 ft

The riprap protection on the embankment outslope extends beyond the embankment toe as an outrun transition zone for any flow which might overtop the embankment.

STORAGE CAPACITY

The impoundment stage-capacity table (see Appendix A) is based on the 1997 survey conducted by Peabody Western Coal Company. The 1997 capacity of J16-A is approximately 261.0 ac-ft.

The calculations for the sediment load entering structure J16-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.23
3.	Slope Factor, LS	4.62
4.	Cover Factor, C	0.30
5.	Erosion Control Factor, P	0.93

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 storage capacity for J16-A and the results of the sediment inflow analysis are summarized in the following table.

J16-A STORAGE

Total Storage Capacity	261.0 acre-ft
10-year, 24-hour Storm Inflow	134.6 acre-ft
Available Sediment Storage Capacity	126.4 acre-ft
Sediment Inflow Rate	11.2 acre-ft/yr.
Sediment Storage Life	11.3 years

Given the size and the long configuration of the watershed, PWCC used a Sediment Delivery Ratio of 80% which, based on good engineering practice, is considered to be conservative for large watersheds.

OPERATING POOL RESTRICTIONS

In order to maintain adequate storage to contain the 10-year, 24-hour storm event, the water level in the pond will be maintained at or below the 6,627-foot elevation. This will provide approximately 137.9 ac-ft of storage. The water level in the pond will be dewatered utilizing the existing 24-inch decant (invert elevation 6,628 feet) and pumping. The other lower existing 24-inch decant pipe at approximately elevation 6,610 feet, is covered and sealed-off with sediment in the ponding area and will no longer be utilized. Sediment should be removed when 145.6 ac-ft or approximately 6626.4 elevation (the 10-year, 24-hour storm; plus, one year of sediment inflow) of storage can no longer be maintained.

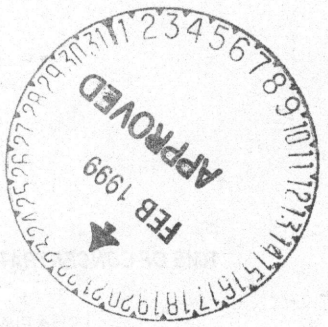
* * *

The following appendices are attached and complete this design report.

Appendix A - Hydrology, Hydraulic, Sedimentation Calculations, and Stage-Capacity Table

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

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



APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: MSHA J16-A Pond

STRUCTURE: J16-A

TIME OF CONCENTRATION:

Start Elevation (ft) =	7270
End Elevation (ft) =	6620
Elevation Difference, E (ft) =	650
Watercourse Length (ft) =	26185
Watercourse Length, L (mi) =	4.959

Tc = (11.9L^3/E)^0.385 = 1.362 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Sagebrush-Grass	B	60	236.4	14184
Sagebrush-Grass	D	79	267.1	21100.9
Pinyon Juniper	D	83	1313.5	109020.5
Reclaimed	C	81	266.7	21602.7
Disturbed	C	91	331.3	30148.3
TOTAL:			2415	196056.4

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

DRAINAGE BASIN AREA:

2415.0 Acres

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J16-A Pond

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (acres)	K*Area
Disturbed	0.22	331.3	72.89
25	0.19	1580.6	300.31
27	0.36	236.4	85.10
Reclaimed	0.38	266.7	101.35
TOTAL:		2415	559.65

Weighted K = Total K*Area/ Total Area = 0.23

SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
390	70	17.9%	0.6	10.2	6.77
105	30	28.6%	0.6	15.9	5.14
165	50	30.3%	0.6	16.9	7.16
180	50	27.8%	0.6	15.5	6.89
370	30	8.1%	0.5	4.6	2.04
255	70	27.5%	0.6	15.4	8.39
740	50	6.8%	0.5	3.9	2.42
335	30	9.0%	0.5	5.1	2.13
295	50	16.9%	0.6	9.6	5.35
410	30	7.3%	0.5	4.2	1.94
340	40	11.8%	0.6	6.7	3.69
335	80	23.9%	0.6	13.4	8.52
500	40	8.0%	0.5	4.6	2.34
490	40	8.2%	0.5	4.7	2.36
195	40	20.5%	0.6	11.6	5.20
210	30	14.3%	0.6	8.1	3.55

Average LS = 4.62

The LS Factor was calculated by:

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

LS = (Slope Length/72.6)^m(16.8*sin(slope angle) - 0.5) for Slopes > 9%*

Where:

Slope < 3%	*m = 0.3*
Slope = 4%	*m = 0.4*
5% > Slope < 10%	*m = 0.5*
Slope > 10%	*m = 0.6*

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Sagebrush-Grass	20%	25%	559.4	0.20	111.88	1.00	559.40
Pinyon Juniper	20%	25%	1313.5	0.22	288.97	1.00	1313.50
Disturbed	0%	0%	275.4	1.00	275.40	1.00	275.40
Reclaimed	40%	0%	266.7	0.15	40.01	0.40	106.68
TOTAL:			2415		716.26		2254.98

Weighted C = Total C*Area/ Total Area = 0.297

Weighted P = Total P*Area/ Total Area = 0.934

RAINFALL FACTOR:

R = 40

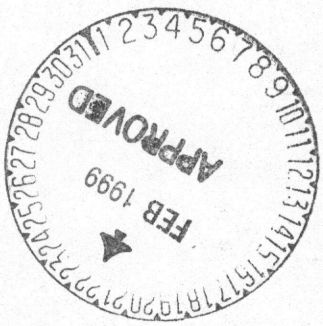
PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENT YIELD

PROJECT: J16-A 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	0.23	
Length Slope Factor	4.62	
Cover Factor	0.30	
Practice Factor	0.93	
Gross Annual Sediment Yield	11.85	tons/acre/year
Sediment Density	94.00	pcf
Gross Annual Sediment Yield	0.0058	acre-feet/acre/year
Sediment Delivery Ratio	80%	
Estimated Annual Sediment Yield	0.0046	acre-feet/acre/year
Watershed Area	2415	acres
Watershed Annual Sediment Yield	11.19	acre-feet/year
Number of years	1	years
Calculated Sediment Volume	11.19	acre-feet

J16-A Spillway
Worksheet for Trapezoidal Channel



Project Description	
Project File	untitled.fm2
Worksheet	J16-A Spillway
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.014899	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	300.00	ft
Discharge	975.90	cfs

Results		
Depth	0.69	ft
Flow Area	208.03	ft²
Wetted Perimeter	304.36	ft
Top Width	304.13	ft
Critical Depth	0.69	ft
Critical Slope	0.014899	ft/ft
Velocity	4.69	ft/s
Velocity Head	0.34	ft
Specific Energy	1.03	ft
Froude Number	1.00	
Flow is subcritical.		

SEDCAD+ RIPRAP CHANNEL DESIGN

MSHA POND SPILLWAY

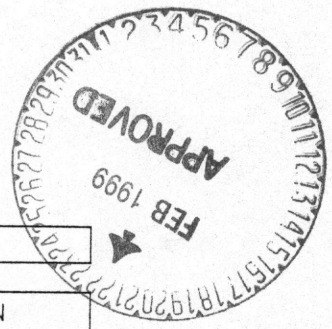
INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	975.86 cfs	
Slope	50.00 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	300.00 feet	
Freeboard	Max(1.0 ft, %)	

RESULTS:

Steep Slope Design - PADER Method

Depth	0.41 ft
with Freeboard	1.41 ft
Top Width	302.43 ft
with Freeboard	308.43 ft
Velocity	7.99 fps
Cross Sectional Area	122.11 sq ft
Hydraulic Radius	0.40 ft
Manning's n	0.072
Froude Number	2.22
Dmax	0.625 ft (7.50 in)
D50	0.500 ft (6.00 in)
D10	0.167 ft (2.00 in)



J16-A DAM STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6612.8	0.0	3.77	0.00	0.00	BOTTOM OF POND
6616.0	3.2	5.67	15.10	15.10	
6618.0	5.2	7.32	12.99	28.09	
6620.0	7.2	8.66	15.98	44.07	
6622.0	9.2	10.19	18.85	62.92	
6624.0	11.2	11.48	21.67	84.59	
6626.0	13.2	13.10	24.58	109.17	
6628.0	15.2	14.76	27.86	137.03	
6630.0	17.2	16.25	31.01	168.04	
6632.0	19.2	18.15	34.40	202.44	
6634.0	21.2	20.02	38.17	240.61	
6635.0	22.2	20.97	20.50	261.00	TOP OF EMBANKMENT
6636.0	23.2	21.58	21.28	282.28	
6637.0	24.2	22.78	22.18	304.46	
6638.0	25.2	23.92	23.35	327.81	
6639.0	26.2	24.93	24.43	352.23	
6640.0	27.2	26.39	25.66	377.89	

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : MSHA J16-A POND

by

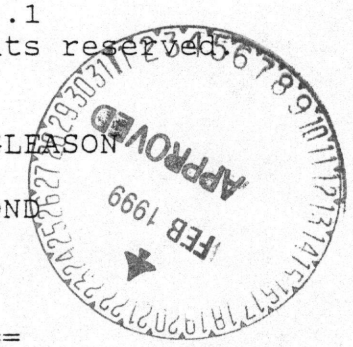
Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0900\SEDCAD\MSHA

Date: 06-01-1998

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

Company Name: ACZ, INC.
Filename: J:\861\0900\SEDCAD\MSHA User: D. GLEASON
Date: 06-01-1998 Time: 10:04:13
PEABODY WESTERN COAL COMPANY : MSHA J16-A POND
Storm: 2.10 inches, 10 year-24 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr



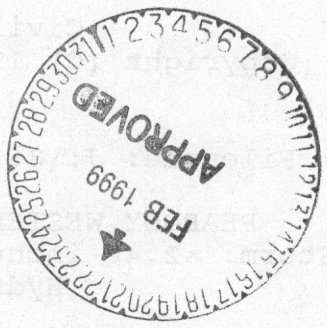
SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	2415.00	81	F	1.362	0.000	0.000	0.0	134.61	591.64
		Type: Null Label: J16-A POND								
111	Structure	2415.00							134.61	
111	Total IN/OUT	2415.00							134.61	591.64

APPENDIX C

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



CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : MSHA J16-A POND (100 YR-6 HR)

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\0900\SEDCAD\MSHA100

Date: 06-05-1998

Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: ACZ, INC.
Filename: J:\861\0900\SEDCAD\MSHA100 User: D. GLEASON
Date: 06-05-1998 Time: 11:41:21
PEABODY WESTERN COAL COMPANY : MSHA J16-A POND (100 YR-6 HR)
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	2415.00	81	F	1.362	0.000	0.000	0.0	175.45	1076.11
		Type: Pond Label: MSHA POND J16-A								
111	Structure	2415.00							175.45	
111	Total IN	2415.00							175.45	1076.11
111	Total OUT								175.45	975.86

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Company Name: ACZ, INC.
Filename: J:\861\0900\SEDCAD\MSHA100 User: D. GLEASON
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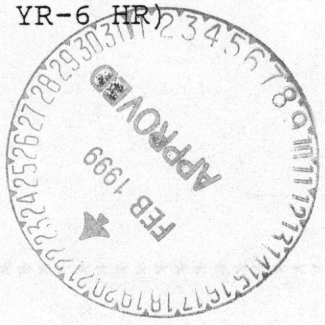
PEABODY WESTERN COAL COMPANY : MSHA J16-A POND (100 YR-6 HR)
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr



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

J1, B1, S1
MSHA POND J16-A

Drainage Area from J1, B1, S1, SWS(s)1: 2415.0 acres
Total Contributing Drainage Area: 2415.0 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	6635.0
Crest Length (ft)	30.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	300.0

POND RESULTS:

Permanent Pool (ac-ft)
260.8

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	175.45	1076.11
OUT	175.45	975.86

Peak Elevation	Hydrograph Detention Time (hrs)
6636.2	0.00

****

Civil Software Design -- SEDCAD+ Version 3.1
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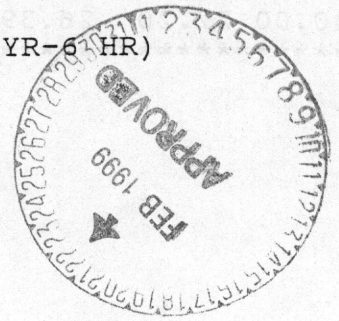
Company Name: ACZ, INC.
Filename: J:\861\0900\SEDCAD\MSHA100 User: D. GLEASON
Date: 06-05-1998 Time: 11:41:21
PEABODY WESTERN COAL COMPANY : MSHA J16-A POND (100 YR-6 HR)
Storm: 2.40 inches, 100 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr



ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
MSHA POND J16-A

Drainage Area from J1, B1, S1, SWS(s)1: 2415.0 acres
Total Contributing Drainage Area: 2415.0 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6612.80	0.00	3.77	0.00	0.00	
6613.80	1.00	4.32	4.04	0.00	
6614.80	2.00	4.92	8.66	0.00	
6[illegible].80	3.00	5.54	13.89	0.00	
[illegible].80	4.00	6.31	19.81	0.00	
[illegible].80	5.00	7.15	26.53	0.00	
6618.80	6.00	7.84	34.02	0.00	
6619.80	7.00	8.52	42.20	0.00	
6620.80	8.00	9.26	51.09	0.00	
6621.80	9.00	10.03	60.73	0.00	
6622.80	10.00	10.70	71.09	0.00	
6623.80	11.00	11.35	82.11	0.00	
6624.80	12.00	12.12	93.84	0.00	
6625.80	13.00	12.93	106.37	0.00	
6626.80	14.00	13.75	119.71	0.00	
6627.80	15.00	14.59	133.88	0.00	
6628.80	16.00	15.35	148.84	0.00	
6629.80	17.00	16.10	164.57	0.00	
6630.80	18.00	17.00	181.11	0.00	
6631.80	19.00	17.96	198.59	0.00	
6632.80	20.00	18.89	217.01	0.00	
6633.80	21.00	19.83	236.36	0.00	
6634.80	22.00	20.78	256.67	0.00	
6635.00	22.20	20.91	260.83	0.00	Stage of SW#1
6635.70	22.90	21.39	275.64	328.71	
6635.80	23.00	21.46	277.78	421.60	
6635.90	23.10	21.57	279.93	521.97	
6636.00	23.20	21.67	282.10	629.32	
6636.24	23.44	21.94	287.46	975.86	Peak Stage
6[illegible].50	23.70	22.21	293.07	1337.47	
[illegible].80	24.00	22.54	299.78	1789.11	
[illegible].00	24.20	22.77	304.31	2114.30	
6637.50	24.70	23.34	315.84	3068.21	
6637.80	25.00	23.69	322.89	3724.09	
6638.00	25.20	23.90	327.65	4185.31	

6638.50	25.70	24.42	339.73	5417.96
6638.80	26.00	24.73	347.10	6209.66
6639.00	26.20	25.00	352.07	6758.31
6639.50	26.70	25.68	364.74	8200.33
6639.80	27.00	26.09	372.51	9112.30
6640.00	27.20	26.39	377.76	9739.19

****

INSPECTION REPORT

Sedimentation Structure

J16-D

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J16-D is an earthen embankment, designed and constructed in 1982 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 J16-D is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J16-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 J16-D was inspected on September 10, 1985 by an inter-disciplinary 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 J16-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 J16-D has a 51.6-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 75% reclaimed, 21% disturbed, and 4% Sagebrush/grass.

EMBANKMENT

Structure J16-D is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J16-D

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Haul Road Fill
Left Abutment	Residual Shale Soils
Height	8.6 ft
Crest Width	16 ft
Upstream Slope	2.6 H : 1 V
Downstream Slope	2.9 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J16-D, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J16-D is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety equal to or greater than 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 J16-D 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 J16-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 J16-D was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.394	mi
2.	Elevation Difference, H	155	ft
3.	Time of Concentration, T_c	0.127	h
4.	Lag time, $0.6T_c$	0.076	h
5.	SCS Curve Number	83	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	51.6	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.

	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	79
Volume	acre-ft	3.24	2.54
Storage			
Peak Stage	ft	6595.28	6596.61
Spillway Elevation . .	ft	6595.11	--
Peak Storage	acre-ft	--	--
Storage Capacity . . .	acre-ft	2.80	--
Outflow			
Peak Flow	cfs	1	42
Embankment Crest Elevation	ft	--	6598.00
Peak Stage	ft	--	6596.61
Freeboard	ft	--	1.39

Approach Channel

The existing approach channel for J16-D is a U-shaped channel with following dimensions:

Channel width	25 ft
Channel length	30 ft
Slope	27 percent

There is presently no erosion protection within the channel.

Spillway Channel

The existing spillway for J16-D has a trapezoidal channel with the following dimensions:

Channel depth	3.6 ft
Channel width	16 ft
Channel length	21 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 J16-D has a trapezoidal channel with the following dimensions:

Channel width	16 ft
Channel length	50 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	15 percent

Rock provides adequate 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, J16-D.

The calculations for the sediment load entering Structure J16-D were made utilizing the Universal Soil Loss Equation with the following parameters:

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.37
3.	Slope Factor, LS	4.00
4.	Cover Factor, C	0.337
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 J16-D and the results of the sediment inflow analysis are summarized in the following table.

J16-D STORAGE

Total Storage Capacity	2.80	acre-ft
10-year, 24-hour Storm Inflow	3.24	acre-ft
Available Sediment Storage Capacity . .	0	acre-ft
Sediment Inflow Rate	0.478	acre-ft/yr
Sediment Storage Life	0	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J16-D indicated that the geotechnical problems consist of rill and gully erosion on the upstream and downstream slopes, the side slopes of the approach channel and the right abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. A few minor cracks were observed in the crest of the embankment near the spillway. This section of embankment should be repaired by excavating the material to the depths of the cracks and replacing with compacted fill.

HYDRAULICS

The spillway capacity of Structure J16-D is adequate but the storage capacity is inadequate. The storage capacity should be increased to 7.24 acre-feet by excavating the pond as shown on Plates 1 and 4. The trapezoidal outflow channel should be extended 20 feet along the alignment 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 extension should be protected against erosion using geotextile and riprap as shown in Plate 5.

Enlarging the storage capacity to 7.24 acre-feet gives additional sediment storage. The analysis of these conditions is summarized in the following table.

J16-D HYDRAULICS FOR EXCAVATED IMPOUNDMENT

	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	79	
Volume	acre-ft	3.24	2.54	
Storage				
Peak Stage	ft	6590.77	6596.35	
Spillway Elevation	ft	6595.11	--	
Peak Storage	acre-ft	3.24	--	
Storage Capacity	acre-ft	7.24	--	
Available Sediment Storage Capacity	acre-ft	4.00	--	
Sediment Inflow Rate	acre-ft/yr	0.478	--	
Sediment Storage Life	yrs	8	--	
Outflow				
Peak Flow	cfs	0	22	
Embankment Crest Elevation	ft	--	6598.00	
Peak Stage	ft	--	6596.35	
Freeboard	ft	--	1.65	
Spillway Channel				
Flow Depth	ft	--	1.24	
Critical Velocity	fps	--	3.5	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	6	11
Normal Velocity	fps	--	4.2	5.0
Normal Depth	ft	--	0.33	0.27
Manning's "n"		--	0.040	0.040

* * *

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

Plate 1 - Site Plan J16-D

Plate 2 - Existing Maximum Cross Section J16-D, A-A'

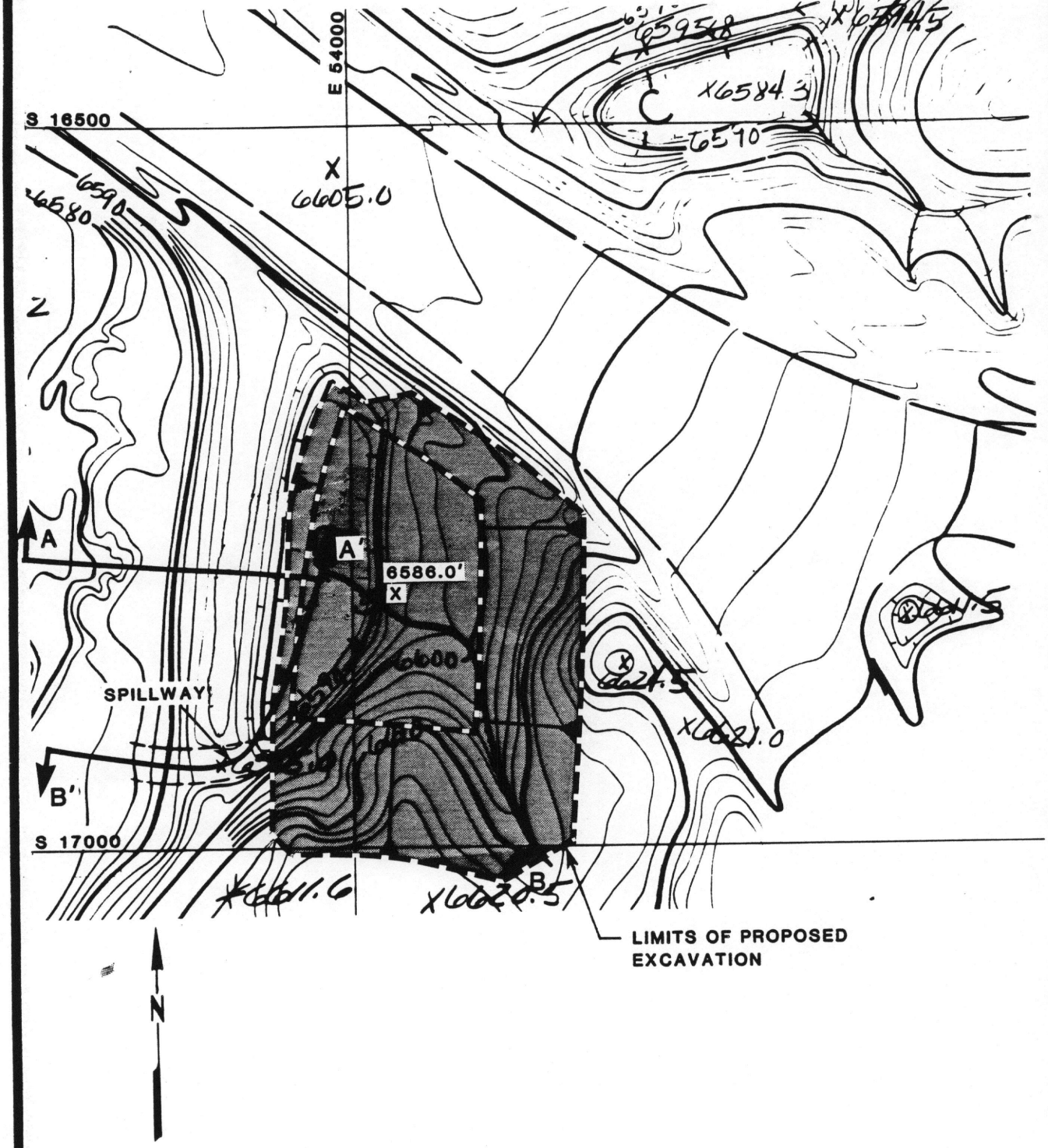
Plate 3 - Volume-Elevation Curve J16-D

Plate 4 - Channel Profile J16-D, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J16-D

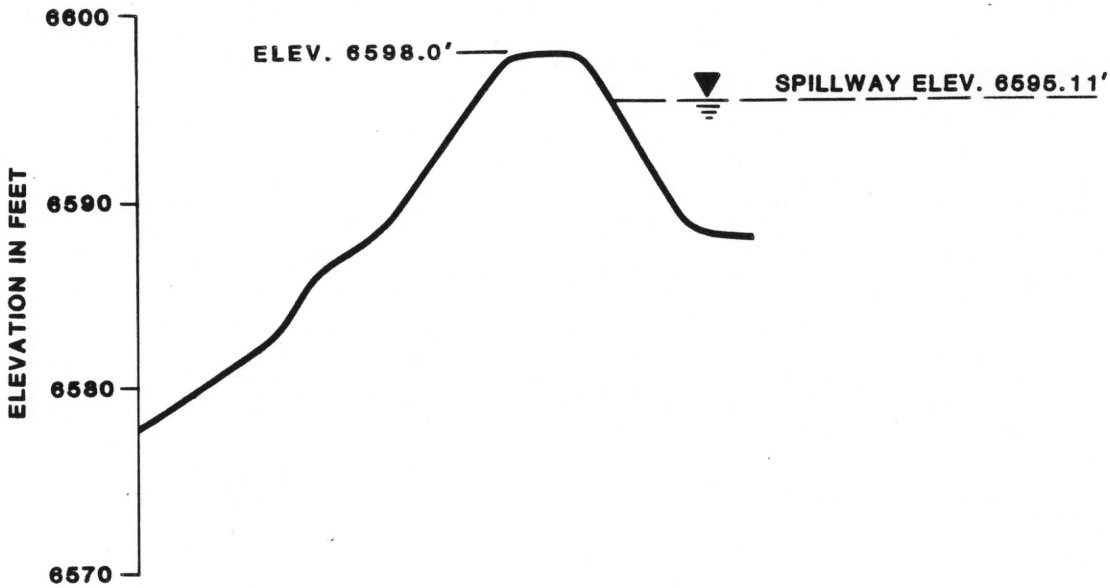
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J16-D

BY **Dames & Moore** Plate 1

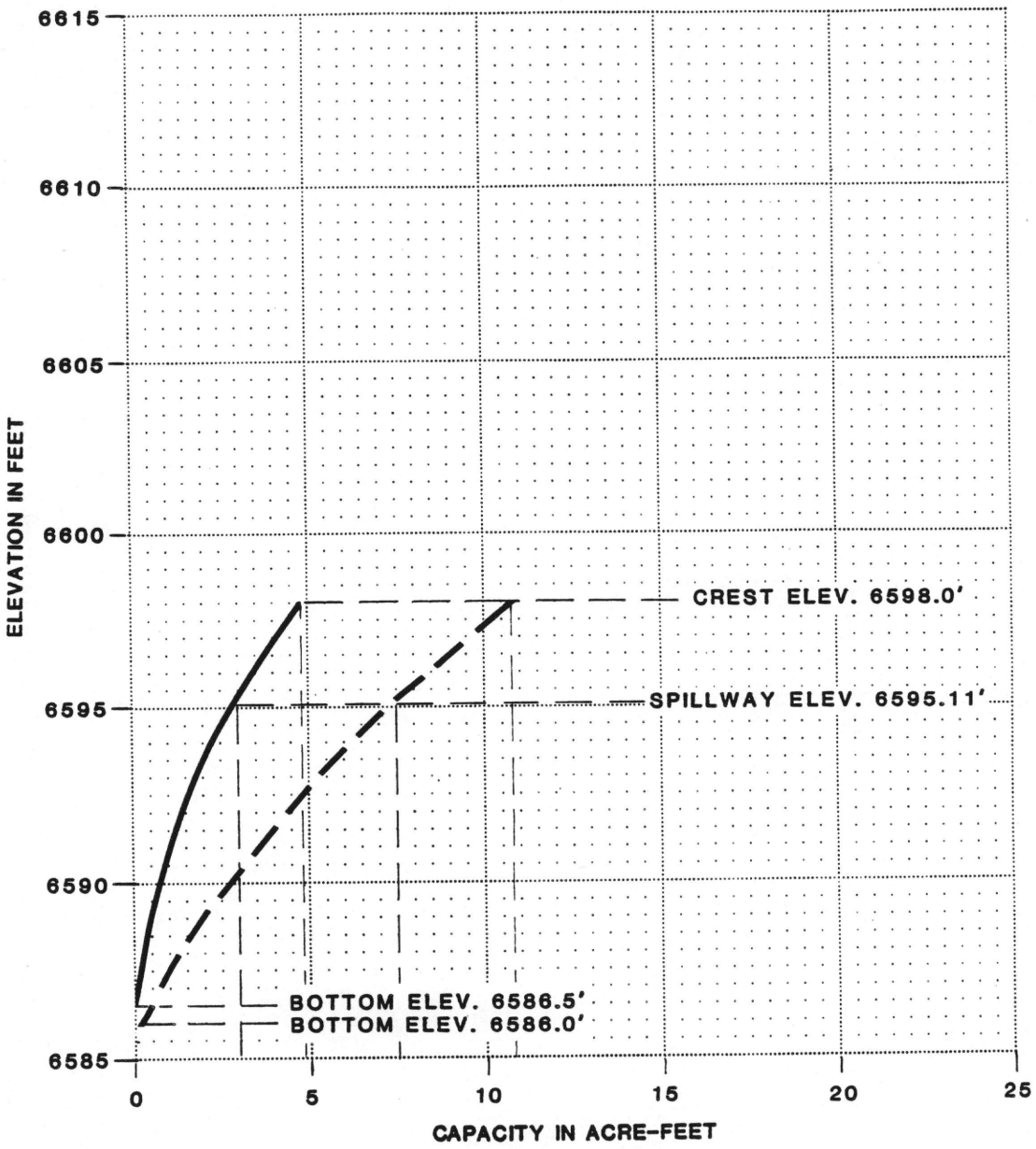


SCALE
0 50 100
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' J16-D

FOR LOCATION SEE PLATE 1

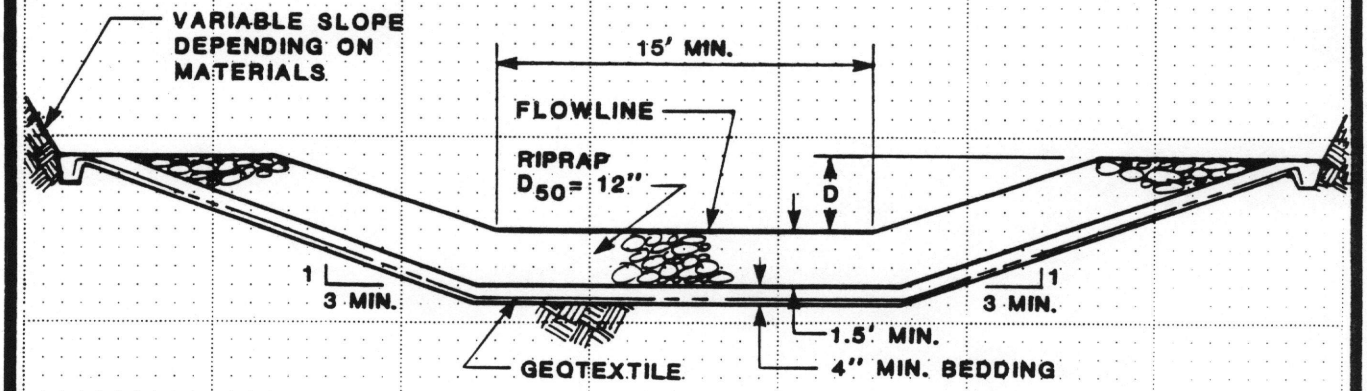
BY **Dames & Moore** Plate 2



EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE J16-D

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.3'

LENGTH = 30'

FLOWLINE ELEV. = 6595.11'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J16-D

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

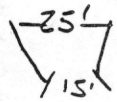
Sediment Impoundment Name: J16-D
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			16'W.
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?	X		Minor cracks towards spillway
2. UPSTREAM SLOPE			Slope uneven/not trimmed 21°
a. Adequate grass cover?	X		70%
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		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			19°
a. Adequate grass cover?	X		70%
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	
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		Gulley from Haul road
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Haul road fill
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?			Fill from J16-E

Sediment Impoundment Name: J16-D
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:	X		V shaped
Are side slopes eroding?	X		hills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		16'W. 21' L 3.6' below Crest 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° Slope 16'W 50'L
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		D50 12"
e. Weir:			
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: J16-D
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
Some cracks in crest toward spillway end. Not serious.

Canopy 0 %
Ground 30 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J16-D SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6750 - 6595 = 155 ft.

WATER COURSE LENGTH = 5.2 in. = 2080 ft. = 0.394 mi. ✓

$T_c = \left(\frac{11.9\ (0.394)^3}{155}\right)^{0.385} = 0.127$ hr. ✓

LAG TIME = $0.6 T_c$ = 0.076 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
2.3	S-G	poor	D	(85) .04
10.8	road	—	D	(89) .21
38.5	reclaimed (post-law)	fair	—	(81) .75
				82.8 ✓

25% EH #22
75% EH #35

use 83

DRAINAGE BASIN AREA

51.6 ACRES 0.081 SQ MILE ✓

BY S. DEL AN DATE 10-2-85
CHECKED BY BHM 10/24/85
COPY TO EO ___

Dames & Moore

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
J16-D SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 25% EH #22 (.22)(.25)
75% EH #35 (.42)(.75)
.37 ✓

K = .37

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
500	70	14.0	5.1 (.45)
600	70	11.7	4.2 (.15)
400	35	8.8	2.3 (.20)
300	35	11.7	3.0 (.20)
			3.98

use 4.0 ✓

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
4%	S-G	10	25	.04 (.36)
21%	disturbed	—	—	.21 (1.0)
75%	reclaimed	—	—	.75 (.15)
				C = .337 ✓

BY ___ DATE ___ CHECKED BY BHM 10/24/85 COPY TO EO ___

EROSION CONTROL FACTOR

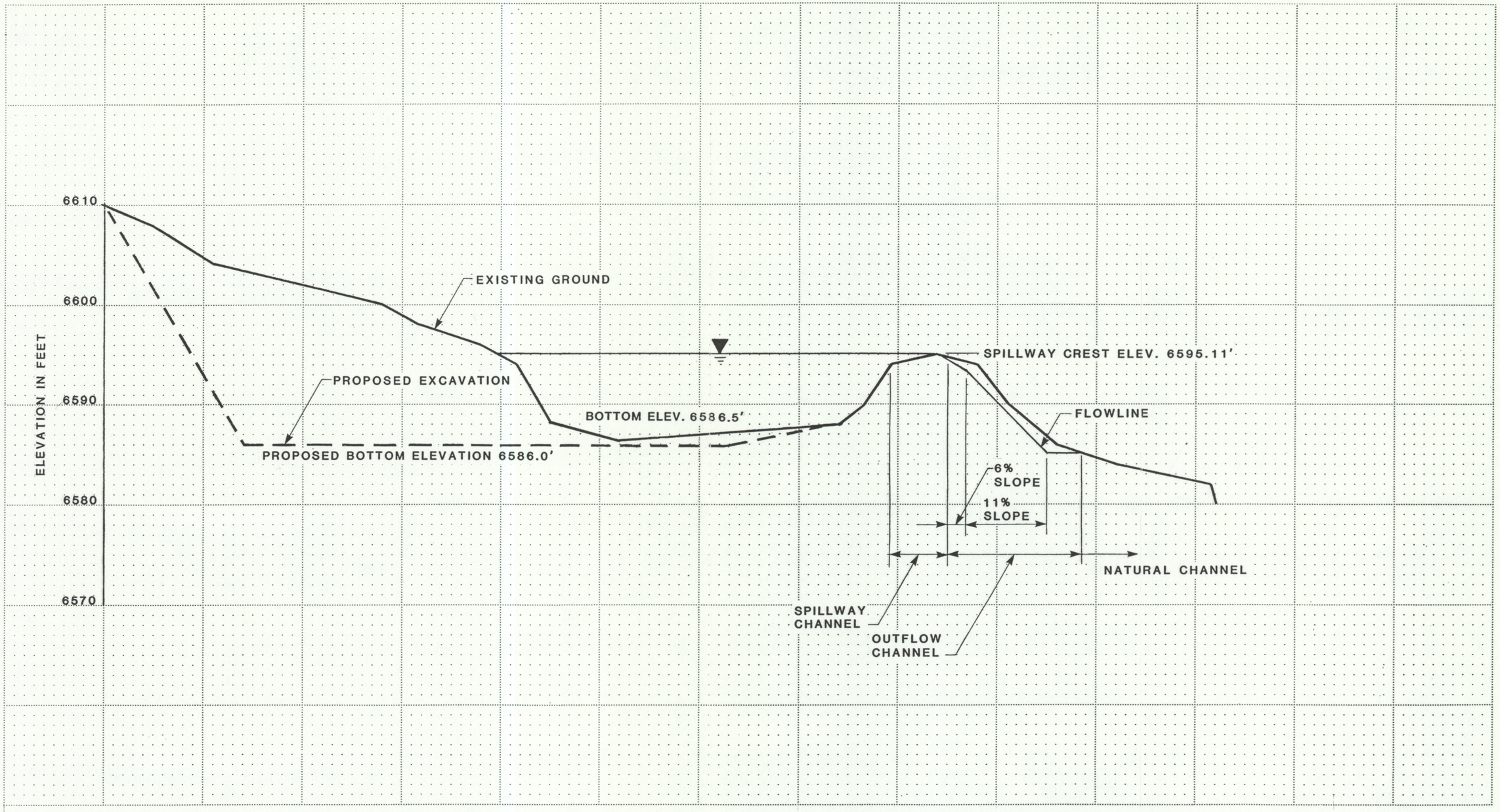
P = 1.0

SEDIMENT INFLOW

$A = 40(.37)\left(\frac{410}{}\right)(.337)(1.0) = 19.95$ ton/acre/year ✓

$A = (19.95)\left(\frac{1}{2047}\right)(51.6)(.95) = .478$ acre-feet/year ✓

Dames & Moore



SCALE
0 50 100
FEET

CHANNEL PROFILE B-B'
J16-D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

J16-E

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J16-E is an earthen embankment, designed and constructed in 1982 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 J16-E is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J16-E. 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 J16-E was inspected on September 10, 1985 by an inter-disciplinary 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 J16-E 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 J16-E has a 14.4-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 74% Sagebrush/grass and 26% disturbed.

EMBANKMENT

Structure J16-E is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J16-E

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Scoria
Height	18.6 ft
Crest Width	18 ft
Upstream Slope	2.75 H : 1 V
Downstream Slope	2.6 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J16-E, A-A'. Grass provides erosion protection on the downstream slope of the embankment.

ANALYSES

STABILITY

Structure J16-E 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 J16-E 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 J16-E 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 J16-E was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.182	mi
2.	Elevation Difference, H	82	ft
3.	Time of Concentration, T_c	0.066	h
4.	Lag time, $0.6T_c$	0.040	h
5.	SCS Curve Number	83	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	14.4	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.

	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	24	29
Volume	acre-ft	1.00	0.79
Storage			
Peak Stage	ft	6596.42	--
Spillway Elevation . .	ft	6608.30	--
Peak Storage	acre-ft	1.00	--
Storage Capacity . . .	acre-ft	6.39	--
Outflow			
Peak Flow	cfs	0	5
Embankment Crest Elevation	ft	--	6611.50
Peak Stage	ft	--	6608.97
Freeboard	ft	--	2.53
Spillway Channel			
Flow Depth	ft	--	0.67
Critical Velocity. . .	fps	--	2.0
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	31
Normal Velocity. . . .	fps	--	3.8
Normal Depth	ft	--	0.07
Manning's "n"		--	0.035

Spillway Channel

The existing spillway for J16-E has a trapezoidal channel with the following dimensions:

Channel depth	4.5	ft
Channel width	19	ft
Channel length	27	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	2	percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J16-E has a trapezoidal channel with the following dimensions:

Channel width	19	ft
Channel length	80	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	29	percent

Rock provides 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, J16-E.

The calculations for the sediment load entering Structure J16-E were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 4.25
4. Cover Factor, C 0.356
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 J16-E and the results of the sediment inflow analysis are summarized in the following table.

J16-E STORAGE

Total Storage Capacity	6.39	acre-ft
10-year, 24-hour Storm Inflow	1.00	acre-ft
Available Sediment Storage Capacity . .	5.39	acre-ft
Sediment Inflow Rate	0.089	acre-ft/yr
Sediment Storage Life	60	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J16-E indicated that the only geotechnical problem is rill erosion on the upstream and downstream slopes and the side slopes of the spillway channel. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure J16-E are adequate. The outflow channel is protected with riprap but the spillway channel is not. The spillway channel should be protected against erosion using geotextile and gravel as shown in Plate 5. Plate 4 shows the existing spillway and outflow channel profile and Plate 5 shows the channel dimensions.

* * *

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

Plate 1 - Site Plan J16-E

Plate 2 - Existing Maximum Cross Section J16-E, A-A'

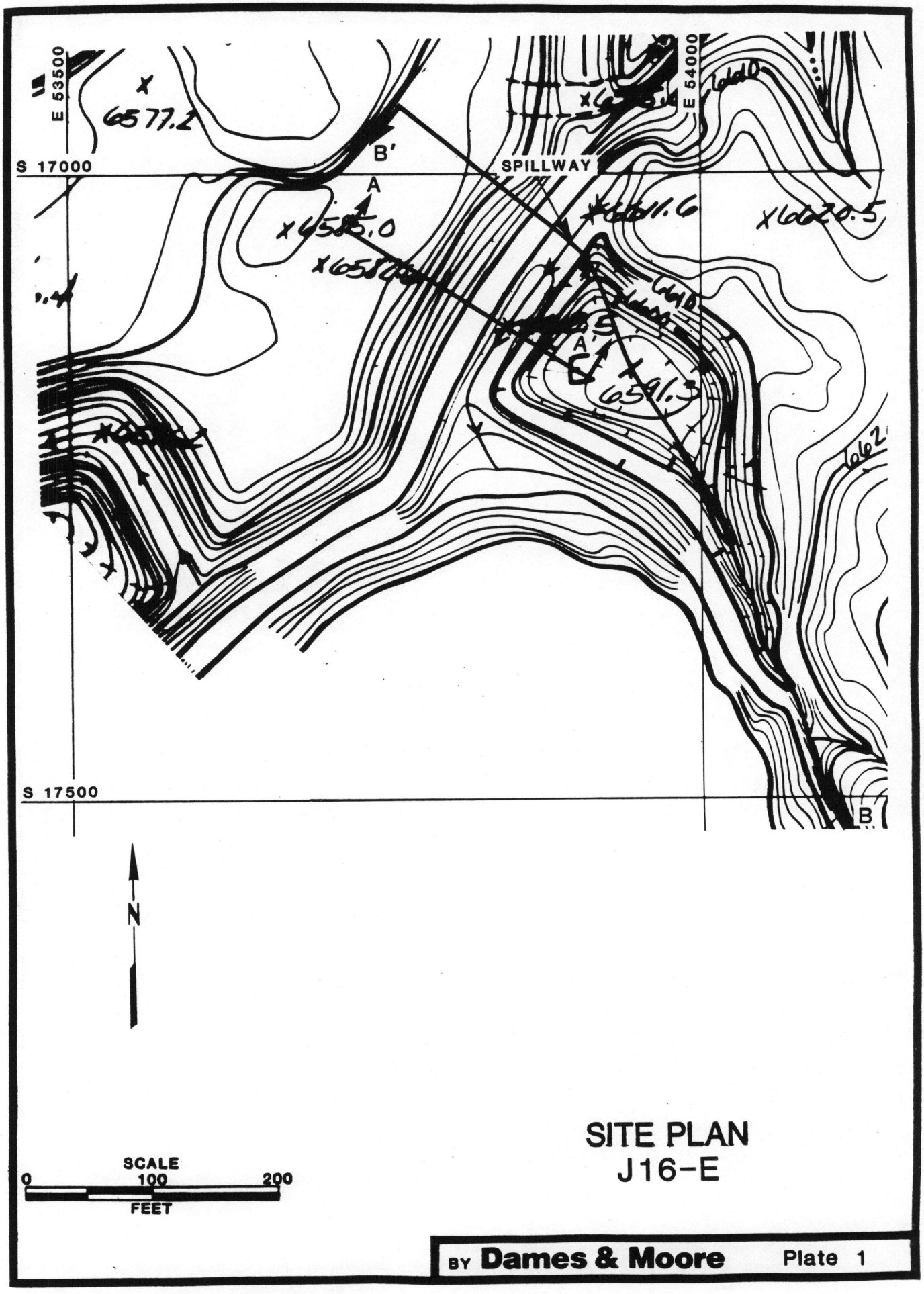
Plate 3 - Volume-Elevation Curve J16-E

Plate 4 - Channel Profile J16-E, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J16-E

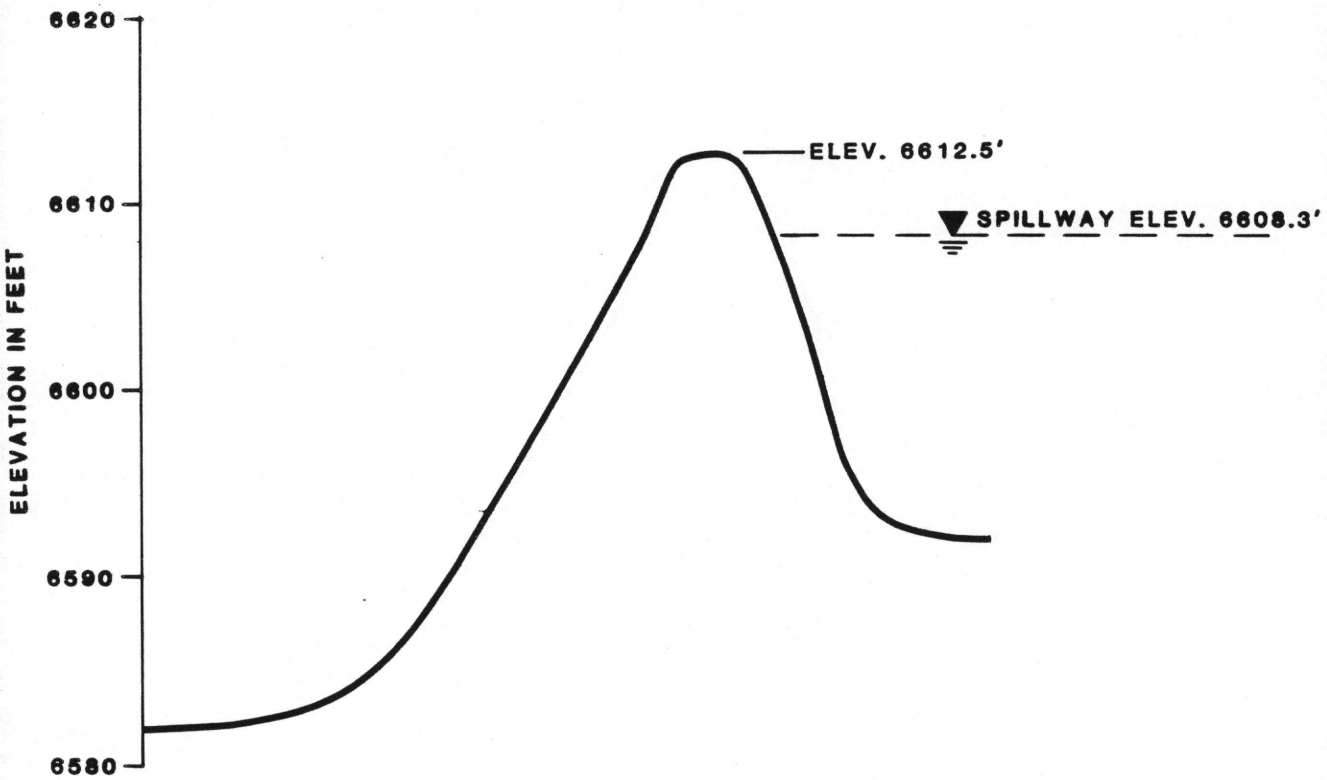
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J16-E

BY **Dames & Moore** Plate 1



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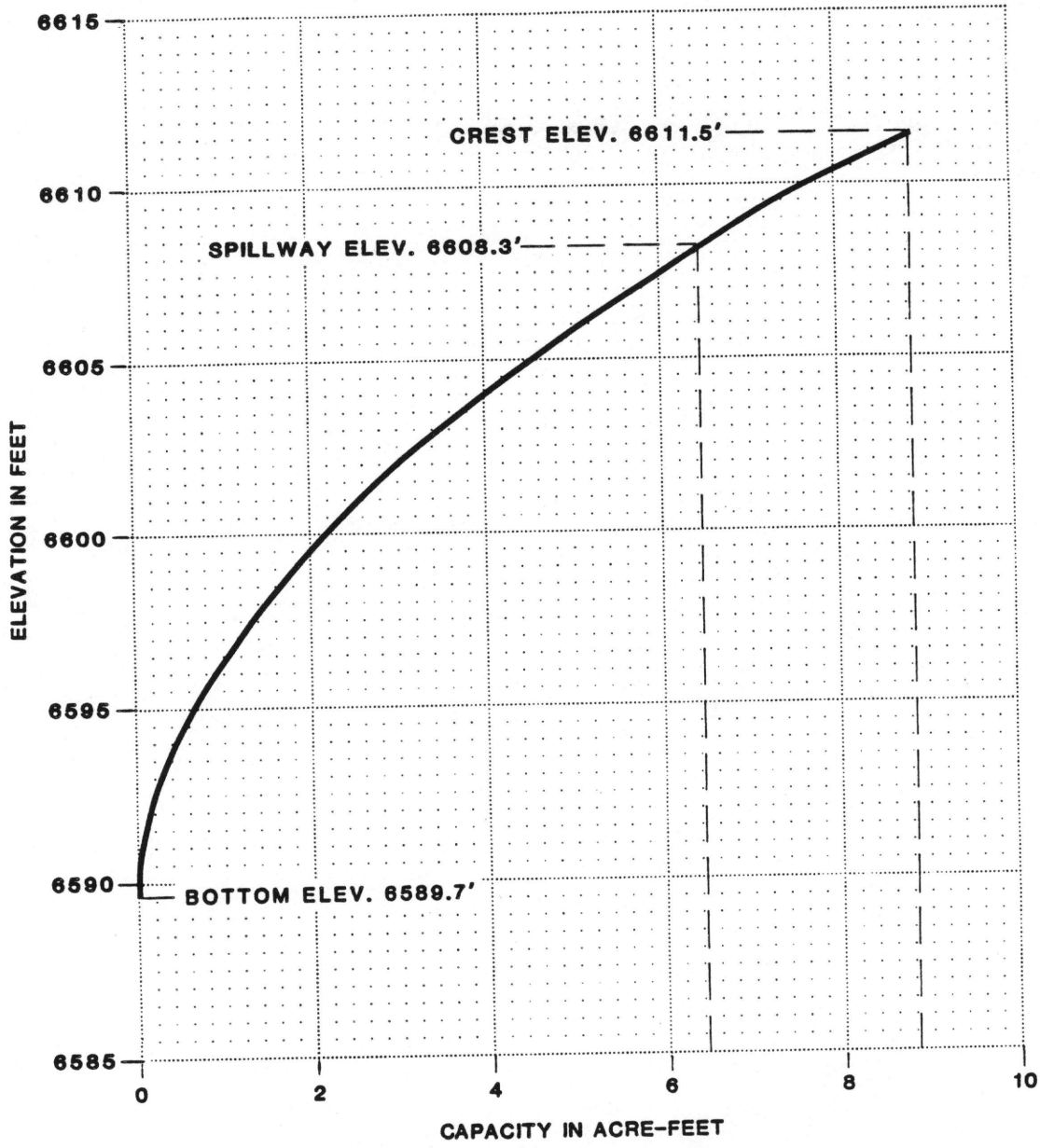
EXISTING MAXIMUM CROSS-SECTION A-A' J16-E

FOR LOCATION SEE PLATE 1

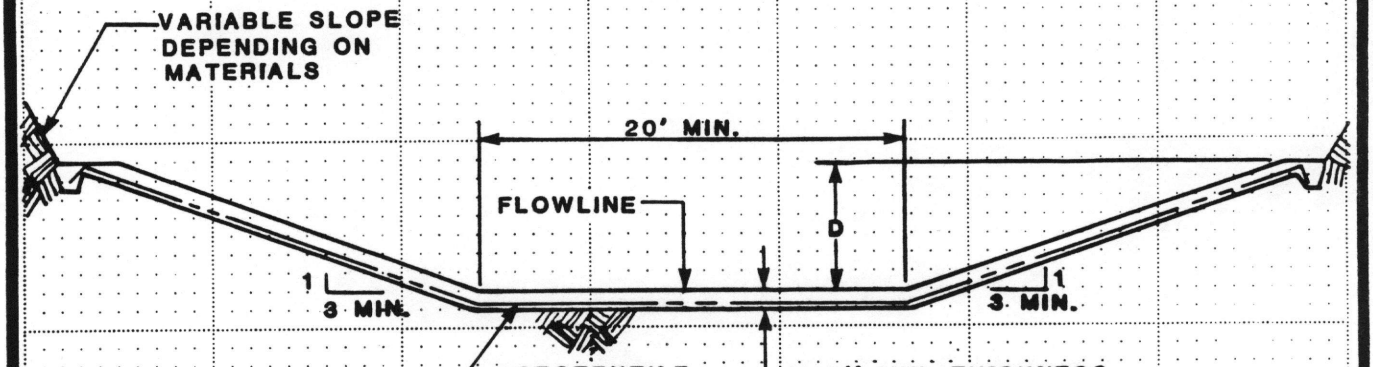
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J16-E

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.7'

LENGTH = 30'

FLOWLINE ELEV.= 6608.30'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

J16-E

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: JIG-E
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			18' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			20° Somewhat uneven
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			21°
a. Adequate grass cover?	X		80%
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	
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?			gray 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?			Rock & brown SM

Sediment Impoundment Name: J16-E
Page: 5

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?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		19'W 27'L, 2% slope 4.5' below Crest
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		16° slope 19'W ≈80'L
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		D50-18"
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

No problems

Canopy 10 %
Ground 35 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J16-E SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6690 - 6608 = 82 ft.

WATER COURSE LENGTH = 2.4 in. = 960 ft. = 0.182 mi.

$$T_c = \left(\frac{11.9\ (0.182)^3}{82}\right)^{0.385} = 0.066 \text{ hr.}$$ ✓

LAG TIME = $0.6 T_c$ = 0.040 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
10.6	S-G	average	D	(79) .74
3.8	disturbed		D	(94) .26
				82.9 ✓

100% EH #22

use 83

DRAINAGE BASIN AREA

14.4 ACRE 0.023 SQ MILE ✓

BY S.DLM DATE 10-2-85
CHECKED BY BHM 10/29/85
COPY TO EO ___

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
J16-E SHEET ___ OF ___

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

BY ___ CHECKED BY BHM 10/29/85 DATE ___ COPY TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #22 = .22

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
400	50	12.5	3.8 (.7)
300	50	16.7	5.3 (.3)
			4.25 ✓

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
74%	S-G	40	25	.74 (.13)
26%	disturbed	—	—	.26 (1.0)
				C = .356 ✓

EROSION CONTROL FACTOR

P = 1.0

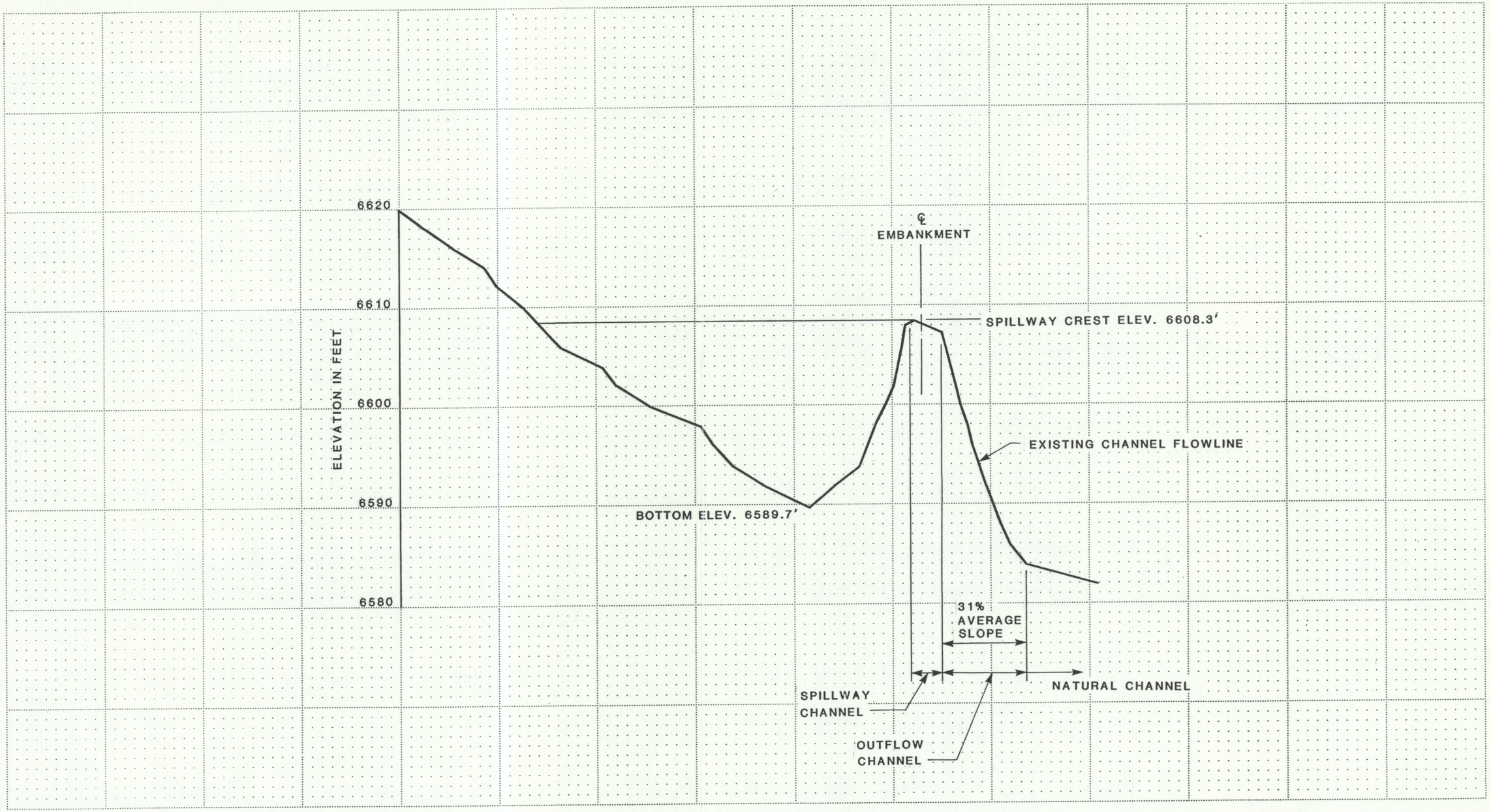
SEDIMENT INFLOW

13.31

$A = 40(.22)(4.25)(.356)(1.0) = 13.32$ ton/acre/year

$A = (13.32)\left(\frac{1}{2097}\right)(14.4)(.95) = .089$ acre-feet/year ✓

Dames & Moore



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CHANNEL PROFILE B-B'
J16-E

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

J16-F

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

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INTRODUCTION

Sedimentation Structure J16-F is an earthen embankment, designed and constructed in 1982 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 J16-F is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J16-F. 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 J16-F was inspected on September 10, 1985 by an inter-disciplinary 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 J16-F 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 J16-F has a 19.2-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 60% disturbed and 40% Sagebrush.

EMBANKMENT

Structure J16-F is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J16-F

Embankment	Residual Shale Soils/Alluvium
Foundation	Residual Shale Soils/Alluvium
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	16.9 ft
Crest Width	14 ft
Upstream Slope	2.1 H : 1 V
Downstream Slope	2.9 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J16-F, A-A'. Grass provides erosion protection on the downstream slope of the embankment.

ANALYSES

STABILITY

Structure J16-F is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety equal to or greater than 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 J16-F 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 J16-F 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 J16-F was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.189	mi
2.	Elevation Difference, H	98	ft
3.	Time of Concentration, T_c	0.065	h
4.	Lag time, $0.6T_c$	0.039	h
5.	SCS Curve Number	91	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	19.2	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.

	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	51	64
Volume	acre-ft	2.04	1.71
Storage			
Peak Stage	ft	6582.41	--
Spillway Elevation . .	ft	6591.41	--
Peak Storage	acre-ft	2.04	--
Storage Capacity . . .	acre-ft	9.34	--
Outflow			
Peak Flow	cfs	0	8
Embankment Crest Elevation	ft	--	6594.50
Peak Stage	ft	--	6592.92
Freeboard	ft	--	1.58
Spillway Channel			
Flow Depth	ft	--	1.02
Critical Velocity. . .	fps	--	2.3
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	33
Normal Velocity. . . .	fps	--	4.3
Normal Depth	ft	--	0.09
Manning's "n"		--	0.040

Spillway Channel

The existing spillway for J16-F has a trapezoidal channel with the following dimensions:

Channel depth	3.8	ft
Channel width	22	ft
Channel length	22	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 J16-F has a trapezoidal channel with the following dimensions:

Channel width	21	ft
Channel length	75	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	10.5	percent

Rock provides 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, J16-F.

The calculations for the sediment load entering Structure J16-F were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 2.87
4. Cover Factor, C 0.744
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 J16-F and the results of the sediment inflow analysis are summarized in the following table.

J16-F STORAGE

Total Storage Capacity	9.34	acre-ft
10-year, 24-hour Storm Inflow	2.04	acre-ft
Available Sediment Storage Capacity . .	7.3	acre-ft
Sediment Inflow Rate	0.167	acre-ft/yr
Sediment Storage Life	44	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J16-F indicated that the only geotechnical problem is rill and gully erosion on the upstream and downstream slopes, the side slopes of the spillway channel and the left abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The crest and upstream slope of the

embankment are uneven and should be trimmed level and smooth, respectively, to prevent masking of future potential problems.

HYDRAULICS

The storage capacity and spillway capacity of Structure J16-F are adequate. The outflow channel is protected with riprap but the spillway channel is not. The spillway channel should be protected against erosion using geotextile and riprap as shown in Plate 5. Plate 4 shows the existing spillway and outflow channel profile and Plate 5 shows the channel dimensions.

* * *

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

Plate 1 - Site Plan J16-F

Plate 2 - Existing Maximum Cross Section J16-F, A-A'

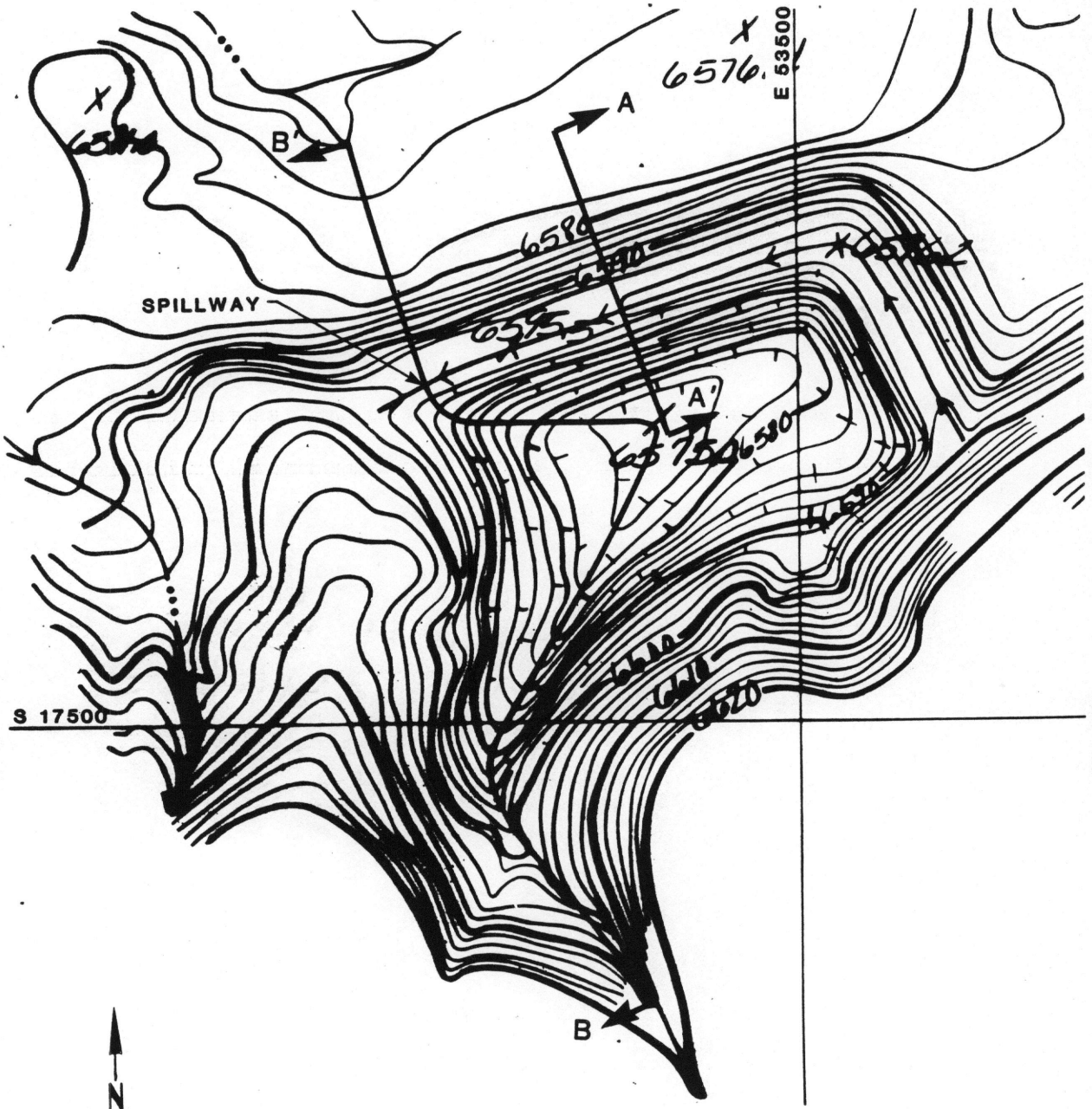
Plate 3 - Volume-Elevation Curve J16-F

Plate 4 - Channel Profile J16-F, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J16-F

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



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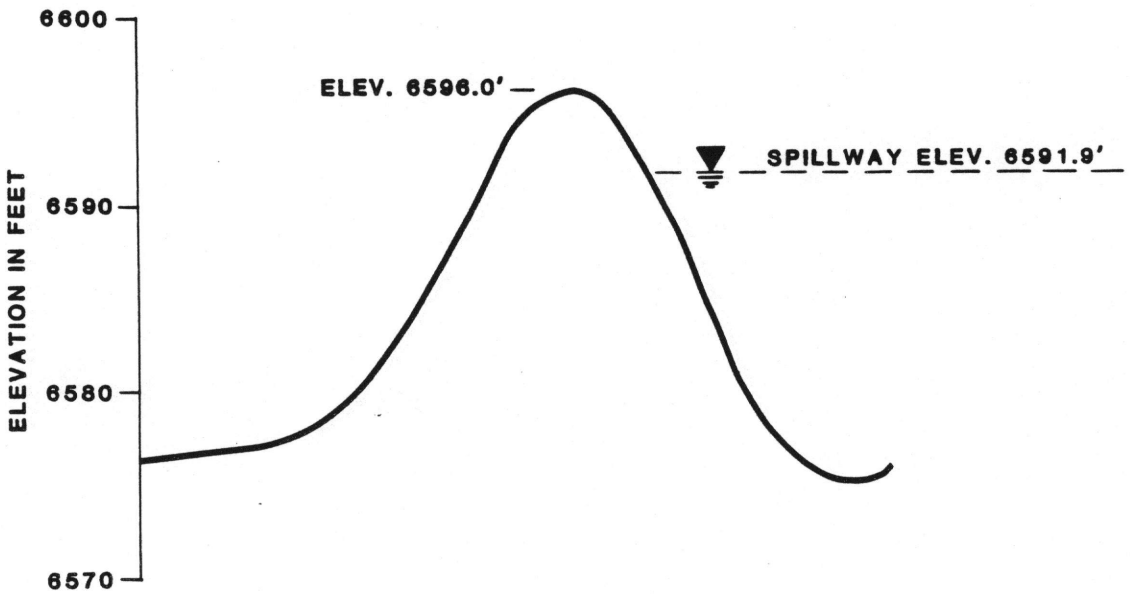
SITE PLAN
J16-F

BY **Dames & Moore** Plate 1



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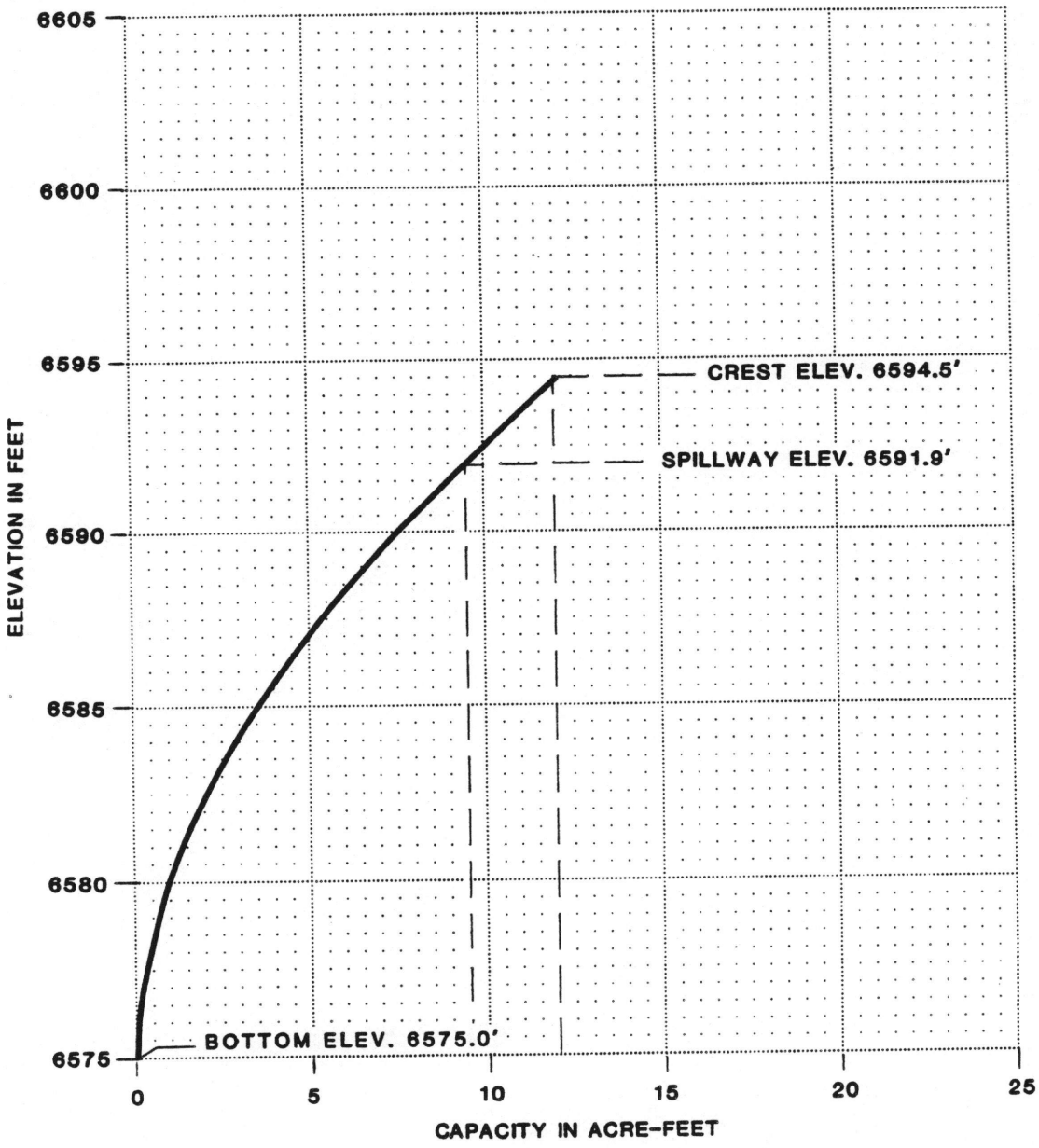
EXISTING MAXIMUM CROSS-SECTION A-A' J16-F

FOR LOCATION SEE PLATE 1

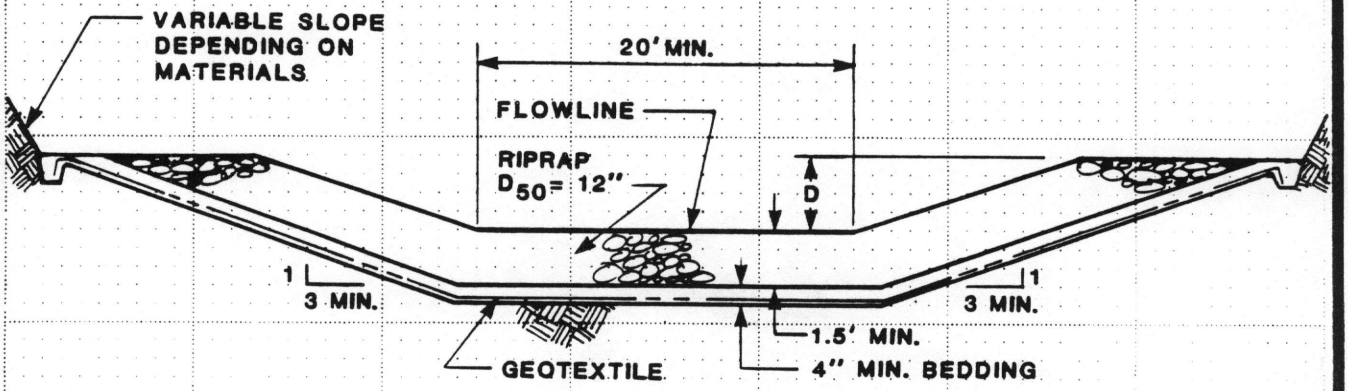
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J16-F

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.1'

LENGTH = 30'

FLOWLINE ELEV. = 6591.90'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J16-F

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J16-F
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			Uneven crest/not trimmed 14' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			uneven / not trimmed 26°
a. Adequate grass cover?		X	
b. Any erosion?	X		gullys & 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			190
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. 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?			grey/black SM /rock
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills into spill way
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

Sediment Impoundment Name: J16-F
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
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		22' W 22' L 0% slope 3.8 below crest
Are side slopes eroding?	X		Rills from LA
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		6° slope 21' W L ± 75'
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		DSD-15"
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 5%
Ground 15%

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE [illegible]
SUBJECT SEDIMENT BNA HYDROLOGY
JB-F SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6690 - 6592 = 98 ft.

WATER COURSE LENGTH = 2.5 in = 1000 ft. = 0.189 mi.

$$T_c = \left(\frac{11.9\ (0.189)^3}{98}\right)^{0.385} = 0.065 \text{ hr.}$$ ✓

LAG TIME = $0.6\ T_c$ = 0.039 hr. ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
7.6	S-G	poor	D	85 (.40)
11.6	disturbed	___	D	94 (.60)
				90.4 ✓

100% EH #22

use 91

DRAINAGE BASIN AREA

19.2 ACRES 0.030 SQ MILE ✓

BY S. DALTON DATE 10-2-85
CHECKED BY BHM 10/29/85
COPY TO EO ___

FILE HEADY COAL CO 1039-011-22
SUBJECT SEDIMENT INFLOW
J16-F 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 #22 = .22

K = .22

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
400	20	5%	1.07 (.7)
300	60	20%	7.07 (.3)
			= 2.87

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
40%	S-G	10	25	.40 (.36)
60%	disturbed	—	—	.60 (1.0)
				C = .744

EROSION CONTROL FACTOR

P = 1.0

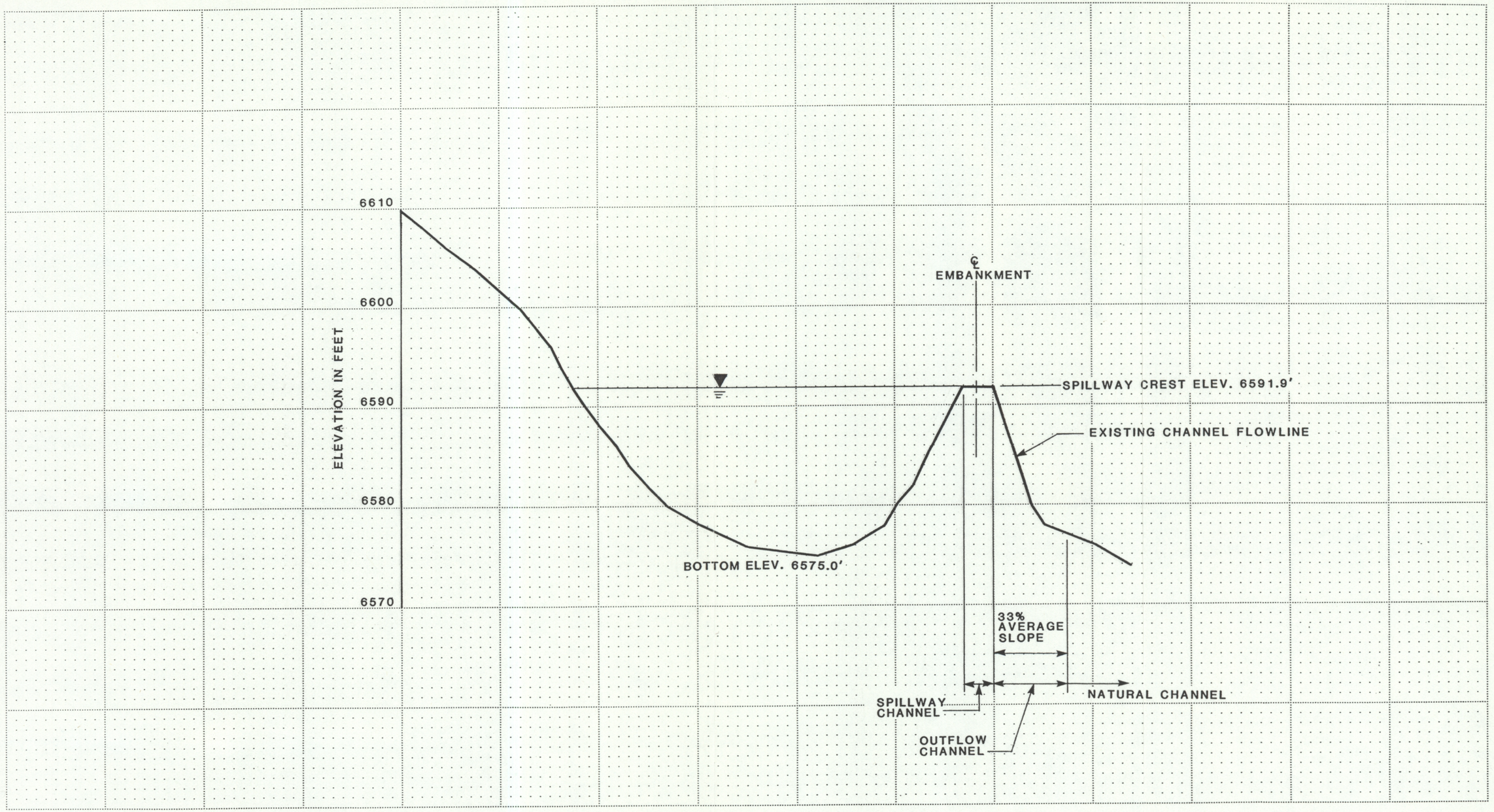
SEDIMENT INFLOW

$A = 40(.22)(2.87)(.744)(1.0) = 18.79$ ton/acre/year

$A = (18.79)\left(\frac{1}{2047}\right)(19.2)(.95) = 0.167$ acre-feet/year

BY ___ DATE ___ CHECKED BY BHM 10/29/85 COPY TO EO ___

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J16-F

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

J16-G

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J16-G is a partially incised structure with an earthen embankment, designed and constructed in 1982 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 J16-G is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J16-G. 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 J16-G was inspected on September 10, 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 J16-G 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 J16-G has a 272.0-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 80% disturbed, 16% Sagebrush/grass, and 4% reclaimed.

EMBANKMENT

Structure J16-G is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J16-G

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	12.9 ft
Crest Width	25 ft
Upstream Slope	2.9 H : 1 V
Downstream Slope	1.7 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J16-G, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J16-G is a category A-1 embankment. A standard category A-1 embankment has static and seismic factors of safety equal to or greater than 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 = 4.0 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J16-G 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 J16-G is located downstream from the proposed new Structure J16-G1. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J16-G was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J16-G was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

		10-year, 24-hour Storm	100-year, 6-hour Storm	
1.	Water Course length, L	0.106	0.477	mi
2.	Elevation Difference, H	107	144	ft
3.	Time of Concentration, T_c . . .	0.032	0.163	h
4.	Lag time, $0.6T_c$	0.019	0.098	h
5.	SCS Curve Number	91	90	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	11.2	272.0	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 10-year storm was routed through Structure J16-G1 and into Structure J16-G. The 100-year storm was analyzed without Structure J16-G1. The initial conditions and results of the analysis are summarized in the following table.

	Units	10-year 24-hour Storm	100-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	28	960	
Volume	acre-ft	1.11	31.5	
Storage				
Peak Stage	ft	6566.20	6579.57	
Spillway Elevation . .	ft	6576.40	--	
Peak Storage	acre-ft	1.11	--	
Storage Capacity . . .	acre-ft	20.7	--	
Outflow				
Peak Flow	cfs	0	674	
Embankment Crest Elevation	ft	--	6580.80	
Peak Stage	ft	--	6579.57	
Freeboard	ft	--	1.23	
Spillway Channel				
Flow Depth	ft	--	3.17	
Critical Velocity. . .	fps	--	7.1	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	2.5	17
Normal Velocity. . . .	fps	--	7.6	14.0
Normal Depth	ft	--	1.62	0.92
Manning's "n"		--	0.040	0.040

Approach Channel

The existing approach channel for J16-G has a U-shaped channel with following dimensions:

Channel width	30 ft
Slope	4 percent

There is presently no erosion protection within the channel.

Spillway Channel

The existing spillway for J16-G has a trapezoidal channel with the following dimensions:

Channel depth	8 ft
Channel width	55 ft
Channel length	40 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	2 percent

Rock provides some but inadequate erosion protection within the channel.

Outflow Channel

The structure presently has no outflow 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, J16-G.

The calculations for the sediment load entering Structure J16-G were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.246
3. Slope Factor, LS 2.87
4. Cover Factor, C 0.827
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 J16-G and the results of the sediment inflow analysis are summarized in the following table.

J16-G STORAGE

Total Storage Capacity	20.7	acre-ft
10-year, 24-hour Storm Inflow	1.11	acre-ft
Available Sediment Storage Capacity . .	19.89	acre-ft
Sediment Inflow Rate	0.642	acre-ft/yr
Sediment Storage Life	31	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J16-G indicated that the geotechnical problems consist of rill and gully erosion on the upstream and downstream slopes and the side slopes and bottom of the spillway channel. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The upstream and downstream slopes of the embankment are uneven and should be trimmed smooth to prevent masking of future potential problems. The downstream slope should be flattened to 4.0 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The storage capacity and spillway capacity of Structure J16-G are adequate; however, the spillway does not have an adequate outflow channel. A trapezoidal outflow channel and a stilling basin should be constructed along the alignment B-B' shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and the required dimensions are shown in Plate 5 and Plate 6. The spillway channel, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

The present storage capacity of Structure J16-G exceeds 20 acre-feet. The spillway should be lowered to elevation 6576.00 feet to reduce the storage capacity to 19.65 acre-feet. The analysis of these conditions is summarized in the following table.

J16-G HYDRAULICS FOR LOWERED SPILLWAY

	Units	10-year 24-hour Storm	100-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	28	960	
Volume	acre-ft	1.11*	31.51	
Storage				
Peak Stage	ft	6566.20	6579.19	
Spillway Elevation	ft	6576.00	--	
Peak Storage	acre-ft	1.31	--	
Storage Capacity	acre-ft	19.65	--	
Available Sediment Storage Capacity	acre-ft	18.34	--	
Sediment Inflow Rate	acre-ft/yr	0.642	--	
Sediment Storage Life	yrs	29	--	
Outflow				
Peak Flow	cfs	0	680	
Embankment Crest Elevation	ft	--	6580.80	
Peak Stage	ft	--	6579.19	
Freeboard	ft	--	1.61	
Spillway Channel				
Flow Depth	ft	--	3.19	
Critical Velocity	fps	--	7.1	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	2.5	17
Normal Velocity	fps	--	7.6	14.0
Normal Depth	ft	--	1.62	0.92
Manning's "n"		--	0.040	0.040

*Inflow volume for tributary drainage area between Structures J16-G and J16-G1.

The storage capacity is reduced when the spillway elevation is lowered. The capacity was reanalyzed considering the reduced storage and inflow from Structure J16-G1. Structure J16-G1 is located upstream from Structure J16-G and contributes excess flow to J16-G during the 10-year, 24-hour storm. Therefore, the structures must be combined to determine the total sediment storage capacity. The results of the combined sediment inflow analysis are summarized in the following table.

COMBINED STORAGE FOR J16-G AND J16-G1

	J16-G1	J16-G	Total	
Total Storage Capacity	19.14	19.65	38.79	acre-ft
10-year, 24-hour Storm Inflow	25.21	1.15	26.36	acre-ft
Available Sediment Storage Capacity . .	--	--	12.43	acre-ft
Sediment Inflow Rate	2.32	0.642	2.96	acre-ft/yr
Sediment Storage Life	--	--	4	yrs

* * *

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

Plate 1 - Site Plan J16-G

Plate 2 - Existing Maximum Cross Section J16-G, A-A'

Plate 3 - Volume-Elevation Curve J16-G

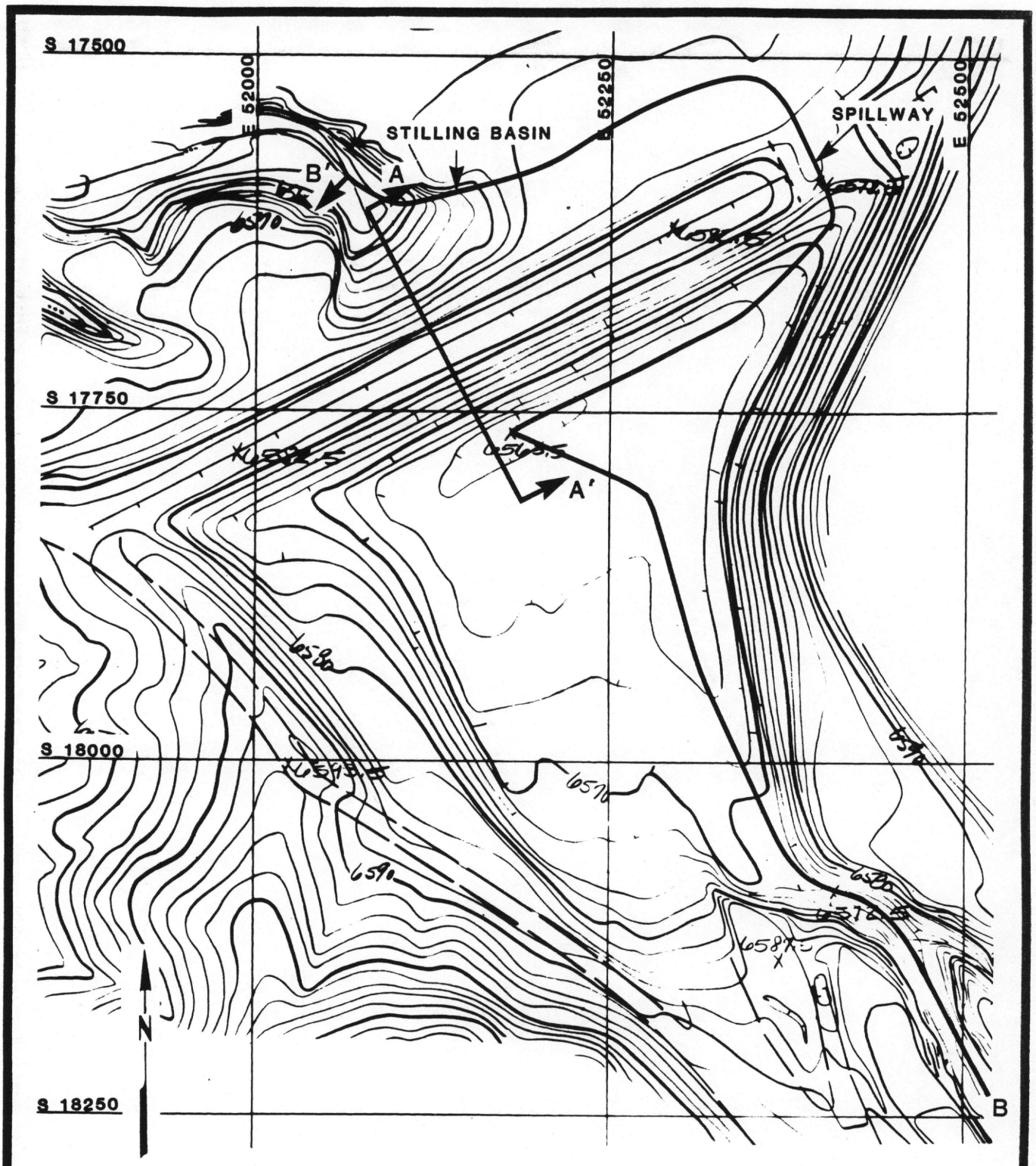
Plate 4 - Channel Profile J16-G, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J16-G

Plate 6 - Spillway Stilling Basin Plan J16-G

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SCALE
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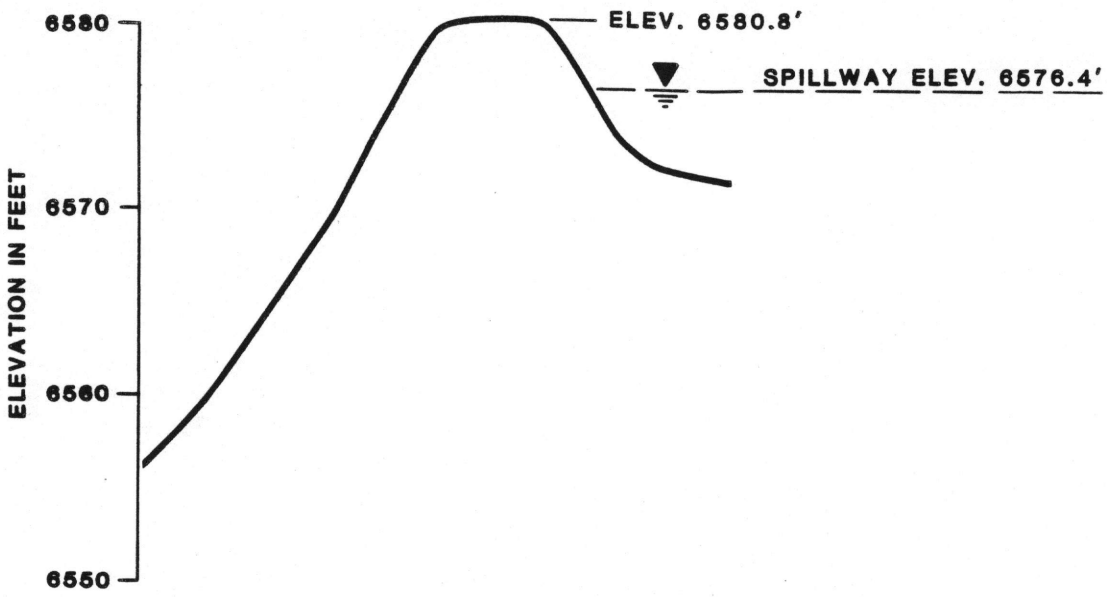
SITE PLAN
J16-G

BY **Dames & Moore** Plate 1



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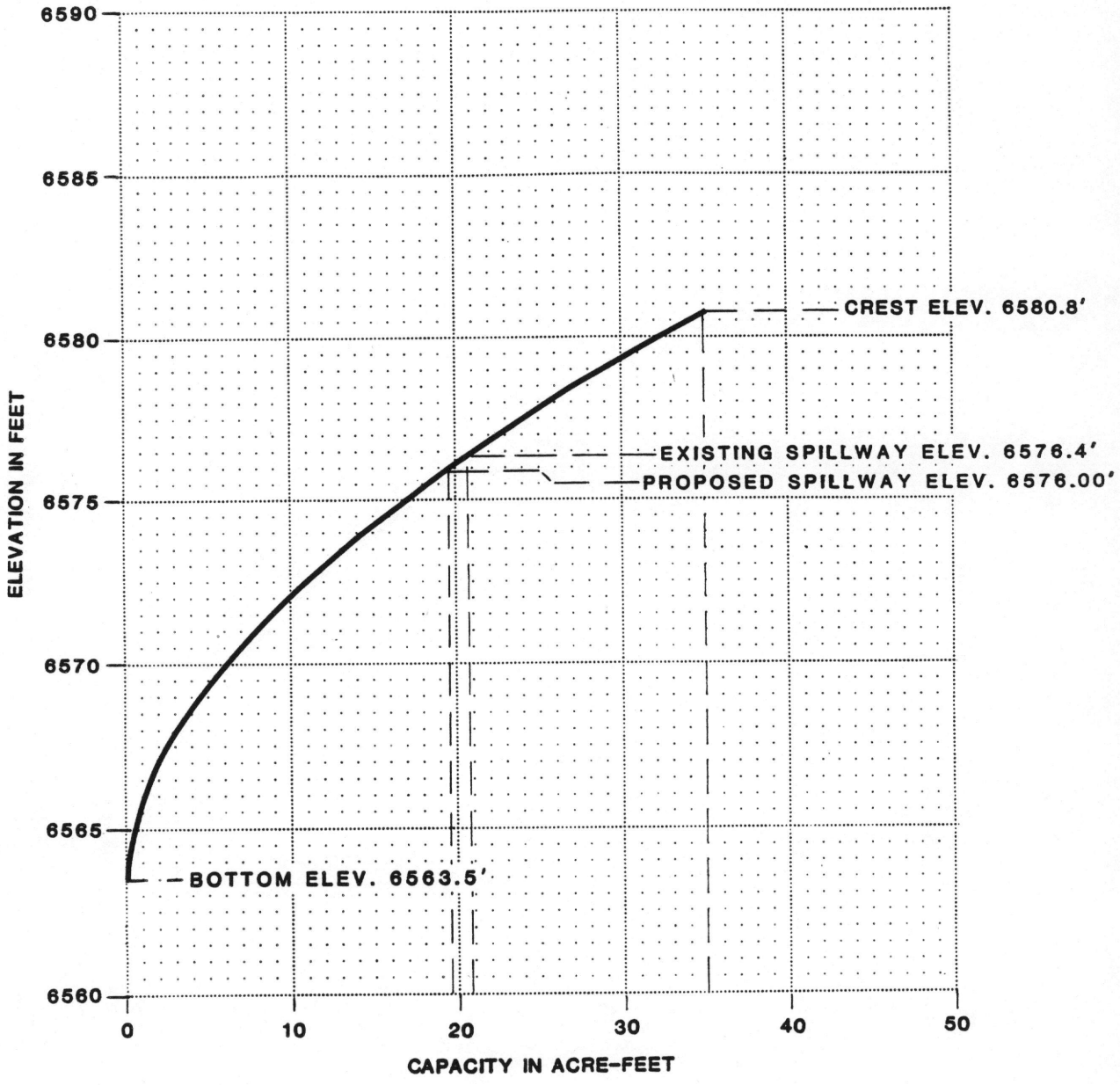
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' J16-G

FOR LOCATION SEE PLATE 1

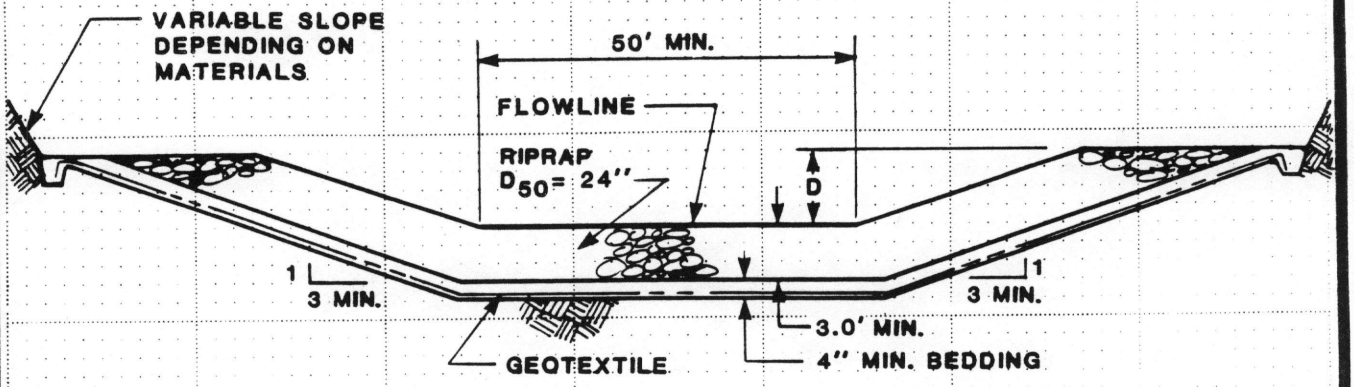
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J16-G

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 4.5'

LENGTH = 40'

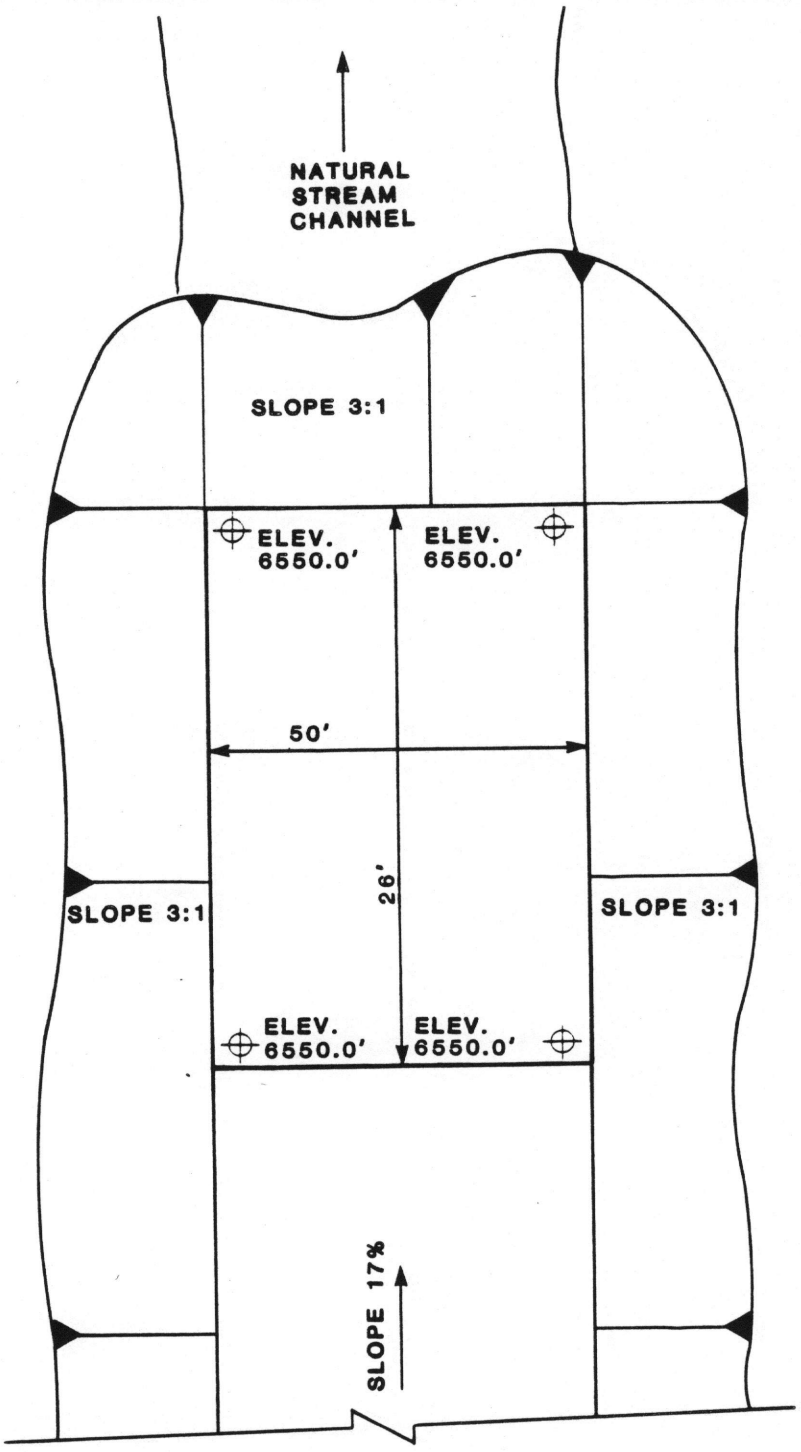
FLOWLINE ELEV. = 6576.00'

OUTFLOW CHANNEL

D = 3.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J16-G

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 7.2'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED = 3.6'

SPILLWAY STILLING BASIN PLAN J16-G

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J16-G
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			25' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			19° uneven slope surface
a. Adequate grass cover?	X		60%
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		Gravel
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			30° for top 15' uneven slope surface 14° from remainder to toe
a. Adequate grass cover?	X		60%
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	
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 snl rock shallow
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?			brow sm

Sediment Impoundment Name: JIG-G
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:	X		30'W at Spill 70'W in Pond 8' below crest
Are side slopes eroding?	X		Rills & Gullys 4% slope
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		Gullys
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		55'W 40'L Slope 2%
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?			
Erosion protection?	X		Rock D50 12"
d. Outflow Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
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

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J16-G Revised SHEET ___ OF ___
due to J16-G1

REVISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6683 − 6576 = 107 ft.

WATER COURSE LENGTH = 1.4 (400) = 560 ft. = 0.106 mi.

$$T_c = \left(\frac{11.9\,(0.106)^3}{107}\right)^{0.385} = 0.032 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.019 hr.

LAG FROM G1 TO G ≈ .009 hr 10-22-81

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
8.78	DIST	—	D	94 (.79)
2.38	S-G	mean	D	79 (.21)
				90.95
			use	91

5.82 AC #27 S-G
2.74 AC #36 DIST

DRAINAGE BASIN AREA

11.16 ACRE 0.017 SQ MILE

BY ____ DATE ____
CHECKED BY ____
COPY TO EO ____

Dames & Moore

FILE PEABODY COAL CO 1039-011-22
SUBJECT SEDIMENT INFLOW
J16-G SHEET ___ OF ___

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

BY ___ DATE ___ CHECKED BY BHH 10/24/85 COPY TO EO ___

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	80% EH #22	.8(.22)
	16% EH #36	.16(.33)
	4% EH #35	.04(.42)
		.246

K = .246

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
2200	110	5%	1.65(.7)
700	80	11.4	4.43(.1)
500	80	16.0	6.35(.2)
			= 2.87

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
16%	S-G	40	25	.16(.13)
4%	reclaimed	—	—	.04(.15)
80%	disturbed	—	—	.80(1.0)
				C = .827

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.246)(2.87)(.827)(1.0) = 23.36$ ton/acre/year

$A = (23.36)\left(\frac{1}{2000}\right)(272.0)(.95) = 2.95$ acre-feet/year

Dames & Moore

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J16G SHEET ___ OF ___

100 yr storm excluding J16G1 in watershed dam

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6720 - 6576 = 144'

WATER COURSE LENGTH = 2520 ft = .477 mi

T_c = .163 hr.

LAG TIME = $0.6 T_c$ = 0.098 hr.

REVISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER

weighted ave of J16G1 and J16G curve #'s

$$89.49\left(\frac{260.84}{272}\right) + 90.85\left(\frac{11.1}{272}\right) = 89.5$$

use 90

DRAINAGE BASIN AREA

272. ACRE .425 SQ. MILE

BY ____ DATE ____
CHECKED BY ____
COPY TO EO ____

85.8

Dames & Moore

945 1 (3-72) PRINTED IN U.S.A.

Revised Due to G-1 Upstream

FILE Peabody Coal Co 10139-011-32
SUBJECT Sediment Inflow J16-G SHEET ___ OF ___

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

Universal Soil Loss Equation

Rainfall Factor

R = 40

Soil Erodibility Factor

Soil Type =	52%	EH #22	.52 (0.22)
	48%	EH #36	.48 (0.33)
			0.273

K = 0.273

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
500	125	0.25	13.9

Cover Factor

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
79%	Disturbed	—		1.0 (.79)
21%	S-G	40	25	.13 (.21)
				C = 0.817

Erosion Control Factor

P = 1.0

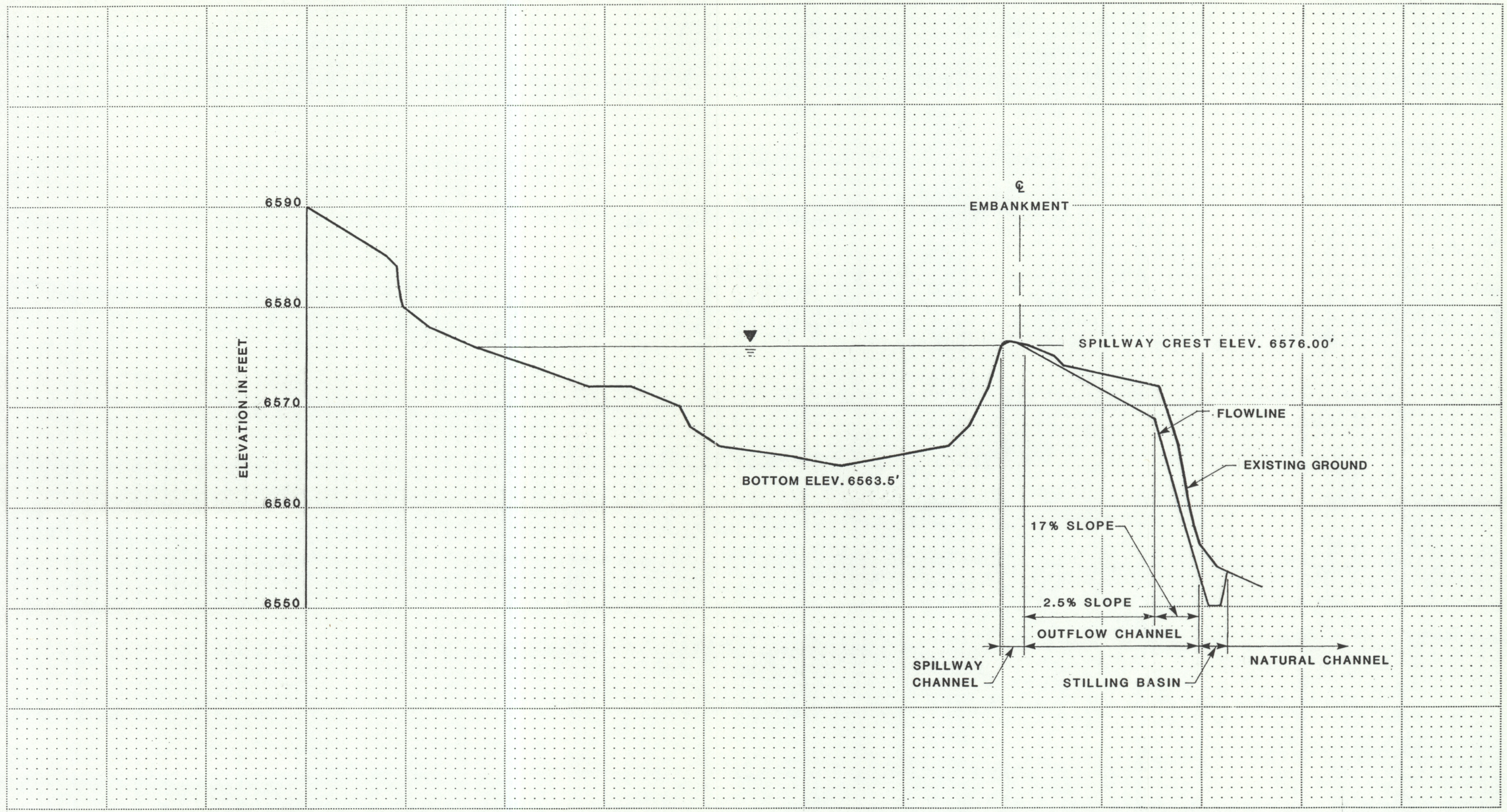
Sediment Inflow

$A = 40(0.273)(13.9)(0.517)(1.0) = 124.0$ ton/acre/year

$A = 124.0\left(\frac{1}{2047}\right)(11.16)(.95) = 0.642$ acre-feet/year

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Dames & Moore



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CHANNEL PROFILE B-B'
J16-G

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4