INSPECTION REPORT

Sedimentation Structure

J3-B

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

INTRODUCTION

Sedimentation Structure J3-B is a partially incised structure with an earthen embankment, designed and constructed in 1979 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Black Mesa Mine. The location of Structure J3-B is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-B. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J3-B was inspected on September 3, 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 J3-B project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

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

SITE DESCRIPTION

LAND USE

Structure J3-B has a 81.8-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 70.9% reclaimed, 19.4% Sagebrush/grass, 5.5% disturbed, and 4.2% Pinion/Juniper.

EMBANKMENT

Structure J3-B is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure J3-B

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	9.9 ft
Crest Width	12 ft
Upstream Slope	3.3 H : 1 V
Downstream Slope	4.3 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J3-B, A-A'.

ANALYSES

STABILITY

Structure J3-B 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 = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 3.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J3-B embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J3-B is located upstream from Structure J3-D. The two structures have a combined storage capacity that is greater than 20 acre-feet. However, the spillway for J3-B was analyzed using the 25-year, 6-hour storm because J3-B is the upstream structure. The storage capacity of Structure J3-B was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.06	mi
2.	Elevation Difference, H	113	ft
3.	Time of Concentration, T_c	0.450	h
4.	Lag time, $0.6T_c$	0.270	h
5.	SCS Curve Number	85	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	81.8	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	75	86
Volume	acre-ft	6.01	5.11
Storage			
Peak Stage	ft	6524.46	6525.01
Spillway Elevation . .	ft	6523.20	—
Peak Storage	acre-ft	6.01	—
Storage Capacity . . .	acre-ft	7.92	--
Outflow			
Peak Flow	cfs	0	43
Embankment Crest Elevation	ft	--	6524.90
Peak Stage	ft	—	6525.01
Freeboard	ft	—	Overtop

Spillway Channel

The existing spillway for J3-B has a trapezoidal channel with the following dimensions:

Channel depth	4 ft
Channel width	16 ft
Channel length	60 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	3 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J3-B has a trapezoidal channel with the following dimensions:

Channel width	16 ft
Channel length	40 ft
Side slopes (horizontal to vertical)	2:1
Average exit slope	3 percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J3-B.

The calculations for the sediment load entering Structure J3-B were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.36
3. Slope Factor, LS 2.53
4. Cover Factor, C 0.197
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 J3-B and the results of the sediment inflow analysis are summarized in the following table.

J3-B STORAGE

Total Storage Capacity	7.92	acre-ft
10-year, 24-hour Storm Inflow	6.01	acre-ft
Available Sediment Storage Capacity . .	1.91	acre-ft
Sediment Inflow Rate	0.273	acre-ft/yr
Sediment Storage Life	7	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-B indicated that the only geotechnical problem is rill and gully erosion on the upstream slope, the side slopes of the spillway and outlet channel and the left abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity of Structure J3-B is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The embankment crest should be raised to elevation 6526.10 feet. A trapezoidal outflow channel and a stilling basin should be constructed along the alignment 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, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

Raising the embankment crest elevation gives additional freeboard for passing the 25-year storm; the storage capacity and sediment storage life are unchanged. The analysis of the spillway capacity is summarized in the following table.

J3-B HYDRAULICS FOR RAISED EMBANKMENT

	Units	25-year 6-hour Storm
Initial Reservoir Volume Condition		Full to the spillway elevation
Inflow		
Peak Flow	cfs	86
Volume	acre-ft	5.11
Outflow		
Peak Flow	cfs	43
Embankment Crest Elevation	ft	6526.10
Peak Stage	ft	6525.01
Freeboard	ft	1.09
Spillway Channel		
Flow Depth	ft	1.81
Critical Velocity. . .	fps	4.2
Manning's "n"		0.040
Outflow Channel		
Slope	%	30
Normal Velocity. . . .	fps	9.0
Normal Depth	ft	0.31
Manning's "n"		0.040

* * *

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

Plate 1 - Site Plan J3-B

Plate 2 - Existing Maximum Cross Section J3-B, A-A'

Plate 3 - Volume-Elevation Curve J3-B

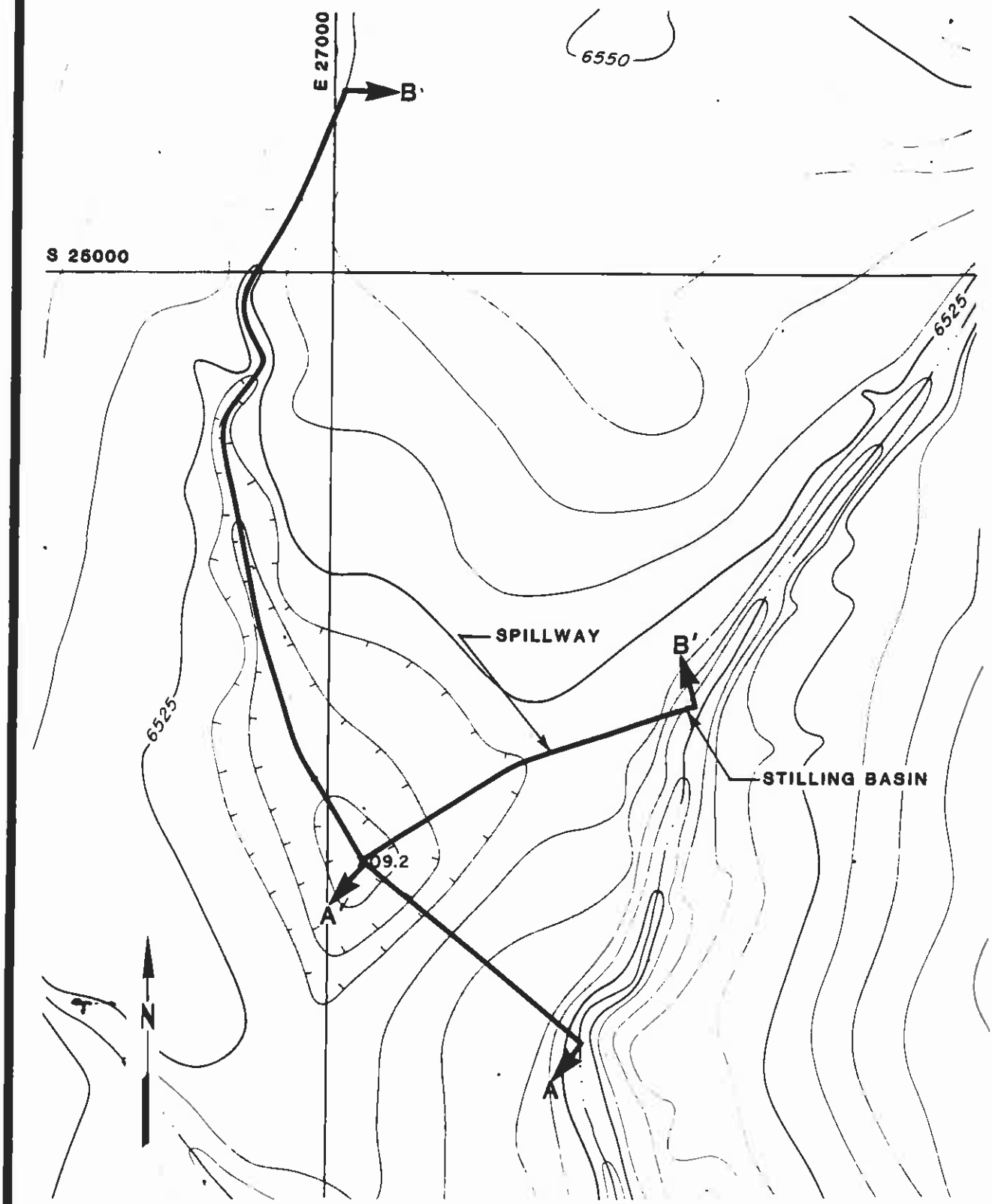
Plate 4 - Channel Profile J3-B, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section J3-B

Plate 6 - Spillway Stilling Basin Plan J3-B

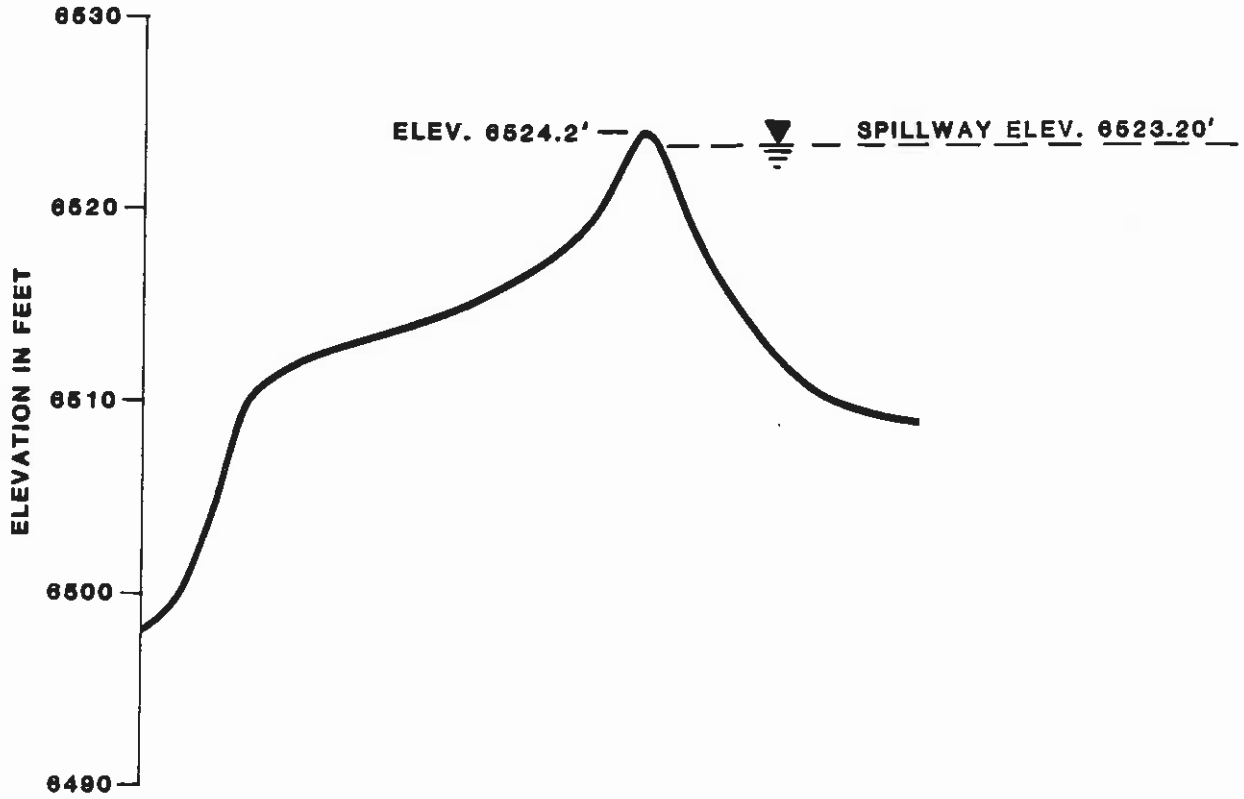
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J3-B

BY **Dames & Moore** Plate 1

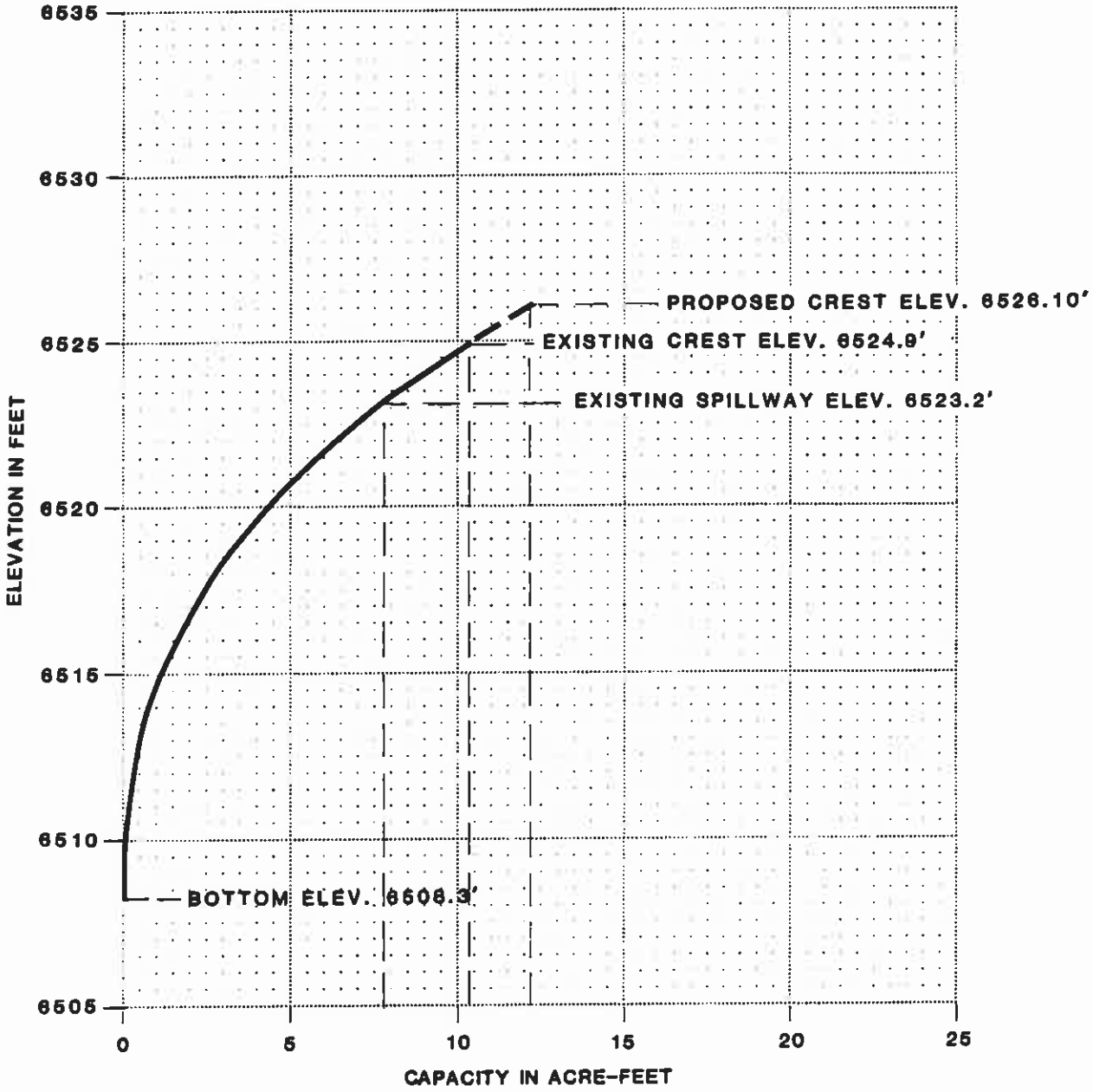


SCALE
0 50 100
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' J3-B

FOR LOCATION SEE PLATE 1

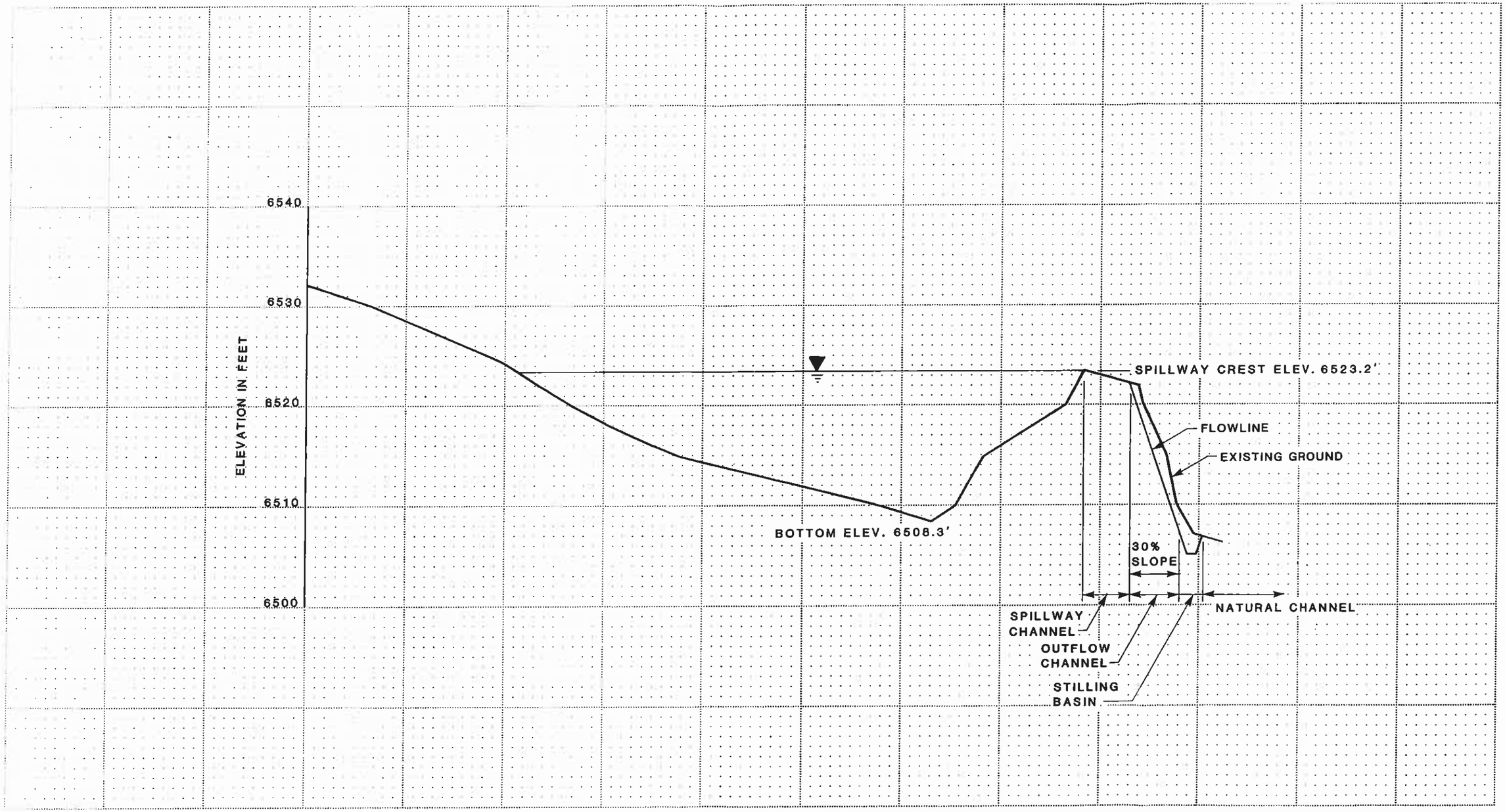
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

J3-B

BY **Dames & Moore** Plate 3



SCALE
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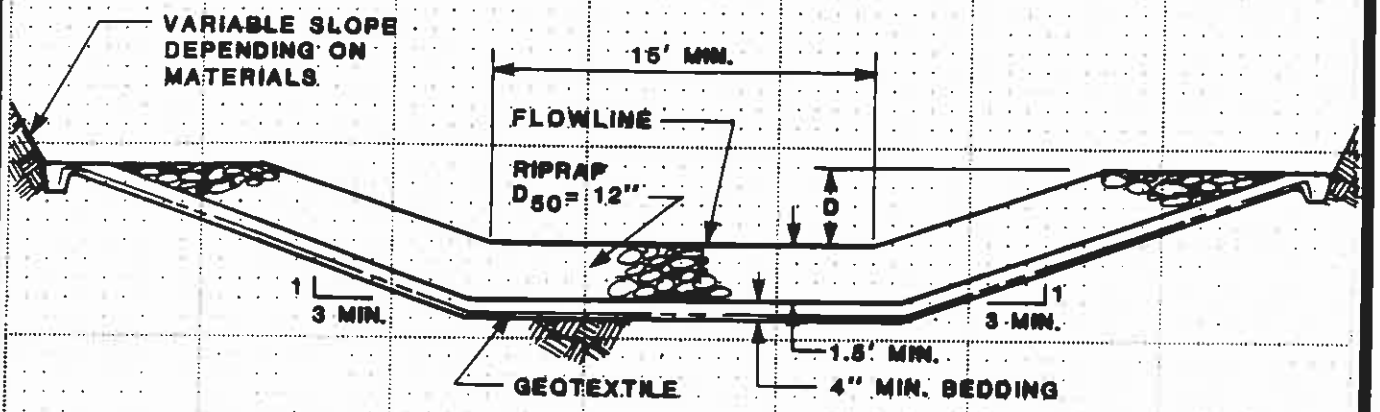
FEET

CHANNEL PROFILE B-B'
J3-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 2.9'

LENGTH = 50'

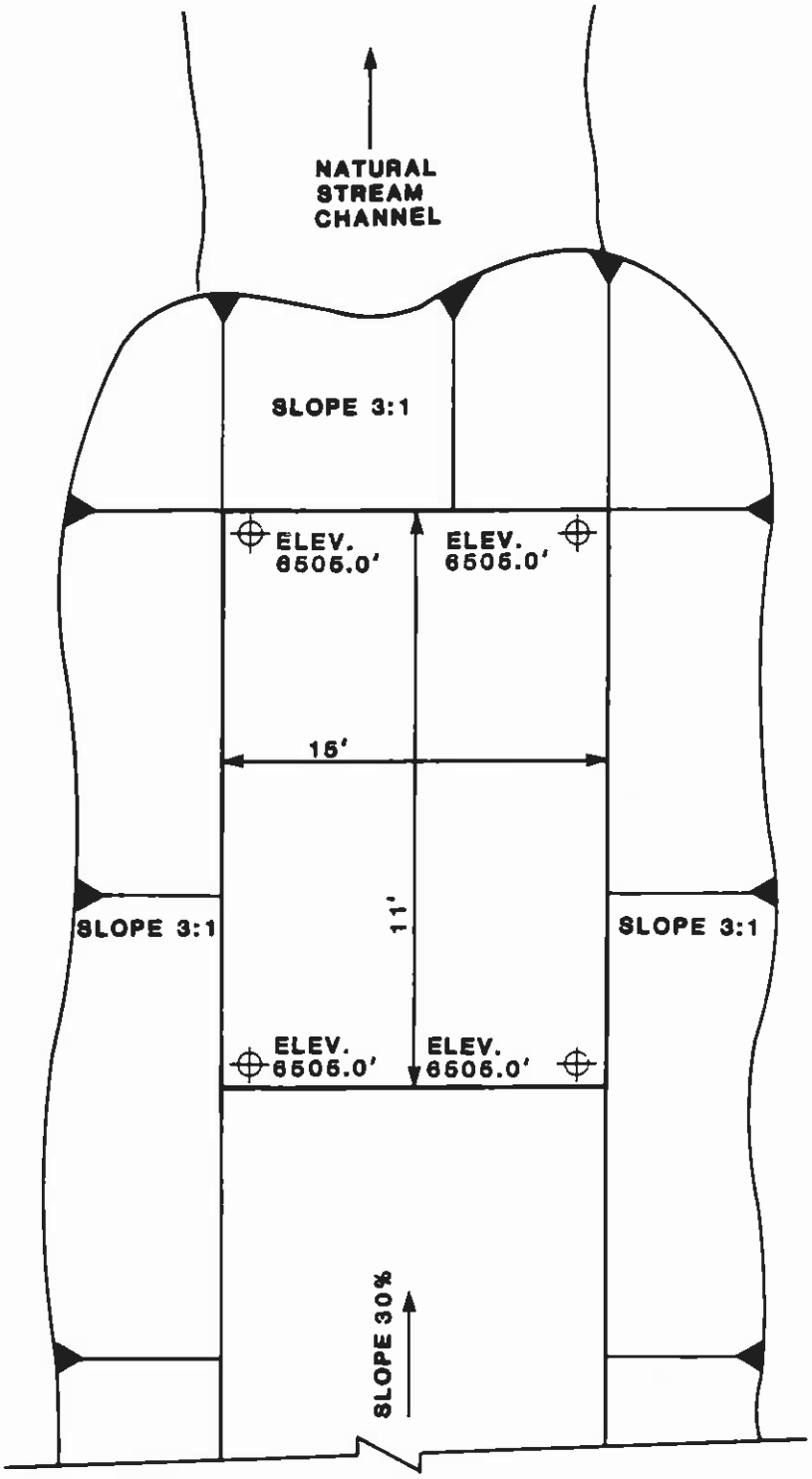
FLOWLINE ELEV. = 6523.20'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-B

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP ALONG SIDEWALLS ABOVE THE BASIN FLOOR = 3.2'

MINIMUM DEPTH OF BASIN FLOOR BELOW NATURAL STREAMBED = 1.5'

SPILLWAY STILLING BASIN PLAN

J3-B

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			
a. Adequate grass cover?		X	
b. Any erosion?	X		Minor 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			
a. Adequate grass cover?		X	
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			red brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills & gulleys
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			reddish brown SM

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?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		
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		
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

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

9. GENERAL COMMENTS

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

Revised by Peabody

FILE Peabody Coal - 20.09-01 -
SUBJECT Sediment Pond Hydrology
J3-B SHEET ___ OF ___

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

Time of Concentration

Elevation Difference = 6636 − 6523 = 113 FT

Water Course length = 5600 FT = 1.06 mi

$$T_c = \left[\frac{11.9(1.06)^3}{113}\right]^{0.385} = 0.450 \text{ hr}$$

$$\text{Lag} = .6\,T_c = .270 \text{ hr}$$

SCS Curve Number

Drainage Area (Ac)	(%)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve No
3.4	(4.2)	P-5	Average	C	78 (.042)
15.9	(19.4)	S-G	"	C	78 (.194)
4.5	(5.5)	Haul Road		C	91 (.055)
58	(70.9)	Reclaim	Poor	D	87 (.709)
81.8 Ac					85

Drainage Basin Area

81.9 Ac = 0.128 Sq. Miles

BY ___ DATE 10-25-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE Peabody Coal Co
SUBJECT Sediment Influx
T3-B SHEET ___ OF ___

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

BY ___ DATE 10-25-85
CHECKED BY ___
COPY TO EO ___

Universal Soil Loss Equation

Rainfall Factor

K = 40

Soil Erodibility Factor

Soil Type = 30% EH32: .3(.21)
70% Reclaim: .7(.42)

K = 0.36

Slope Factor

Length (FT)	ΔElev. (FT)	Slope (%)	LS
750	75	10	3.78 (.4)
450	40	8.9	2.46 (.35)
550	25	4.5	1.01 (.15)
1750			2.53

Cover Factor

Area %	Cover Type	% Cover	Canopy (%)	Weighted C
4	F-S			.04 (.14)
19	S-G			.19 (.13)
6	Dirt Road			.06 (1.0)
71	Reclam			.71 (.15)
				= .197

Erosion Control Factor

P = 1.0

Sediment Influx

A = 40(.36)(2.53)(.197) = 7.18 Ton/Acre/Year

A = 7.18 $\left(\frac{1}{2047}\right)$(81.8)(.95) = 0.273 Acre-Feet/Year

Dames & Moore