ATTACHMENT H

Sedimentation and Impoundment Structures

Inspection and Design Reports

INSPECTION REPORT

Sedimentation Structure

BM-A1

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure BM-A1 is an earthen embankment, designed and constructed in 1980 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 BM-A1 is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure BM-A1. 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 BM-A1 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 BM-A1 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 BM-A1 has a 80.8-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 57% Sagebrush/grass and 43% disturbed.

EMBANKMENT

Structure BM-A1 is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure BM-A1

Embankment	Residual Sandstone Soils
Foundation	Sandstone
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	17.6 ft
Crest Width	16 ft
Upstream Slope	2.2 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 BM-A1, A-A'. Grass provides erosion protection on the upstream slope of the embankment.

ANALYSES

STABILITY

Structure BM-A1 is a category A-5 embankment. A standard category A-5 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 = 4.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The BM-A1 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 BM-A1 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 BM-A1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.515	mi
2.	Elevation Difference, H	92	ft
3.	Time of Concentration, T_c	0.212	h
4.	Lag time, $0.6T_c$	0.127	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	80.8	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.

BM-A1 HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	103	123
Volume	acre-ft	5.98	5.11
Storage			
Peak Stage	ft	6408.23	6417.77
Spillway Elevation . .	ft	6416.38	--
Peak Storage	acre-ft	5.98	--
Storage Capacity . . .	acre-ft	18.6	--
Outflow			
Peak Flow	cfs	0	26
Embankment Crest Elevation	ft	--	6419.28
Peak Stage	ft	--	6417.77
Freeboard	ft	--	1.51
Spillway Channel			
Flow Depth	ft	--	1.39
Critical Velocity. . .	fps	--	3.0
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	10
Normal Velocity. . . .	fps	--	4.1
Normal Depth	ft	--	0.21
Manning's "n"		--	0.040

Spillway Channel

The existing spillway for BM-A1 has a trapezoidal channel with the following dimensions:

Channel depth	2.6	ft
Channel width	36	ft
Channel length	50	ft
Side slopes (horizontal to vertical). .	2:1	
Average exit slope	1	percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for BM-A1 has a trapezoidal channel with the following dimensions:

Channel width	35	ft
Channel length	35	ft
Side slopes (horizontal to vertical). .	2:1	
Average exit slope	5	percent

There is presently no erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, BM-A1.

The calculations for the sediment load entering Structure BM-A1 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.30
3. Slope Factor, LS 2.71
4. Cover Factor, C 0.640
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 BM-A1 and the results of the sediment inflow analysis are summarized in the following table.

BM-A1 STORAGE

Total Storage Capacity	18.6	acre-ft
10-year, 24-hour Storm Inflow	5.98	acre-ft
Available Sediment Storage Capacity . .	12.6	acre-ft
Sediment Inflow Rate	0.780	acre-ft/yr
Sediment Storage Life	16	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure BM-A1 indicated that the only geotechnical problem is rill and gulley erosion on the upstream and downstream slopes, the side slopes of the spillway, the bottom of the outlet channel and the right abutment. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure BM-A1 are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and riprap as shown in Plate 5.

* * *

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

Plate 1 - Site Plan BM-A1

Plate 2 - Existing Maximum Cross Section BM-A1, A-A'

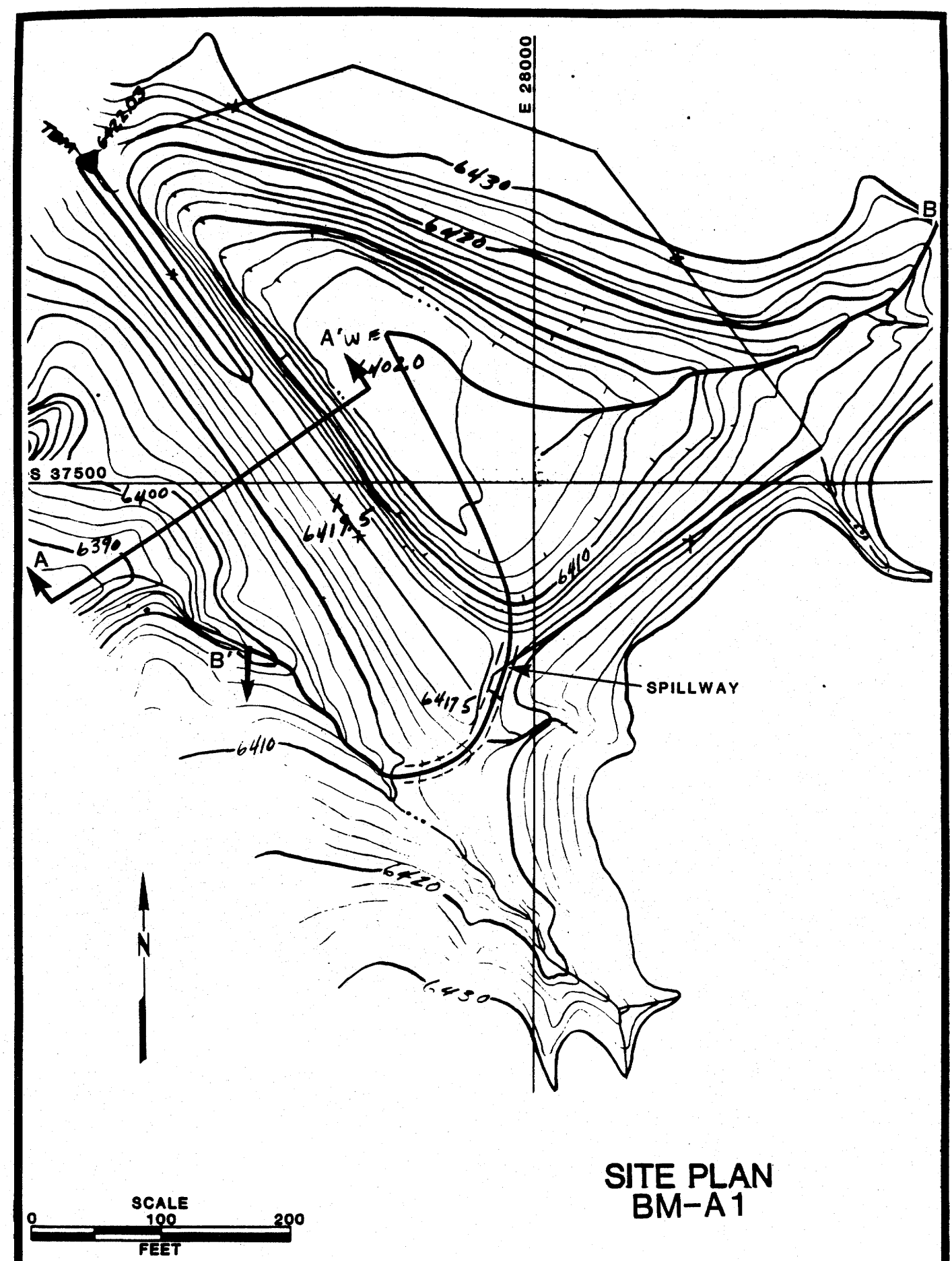
Plate 3 - Volume-Elevation Curve BM-A1

Plate 4 - Channel Profile BM-A1, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section BM-A1

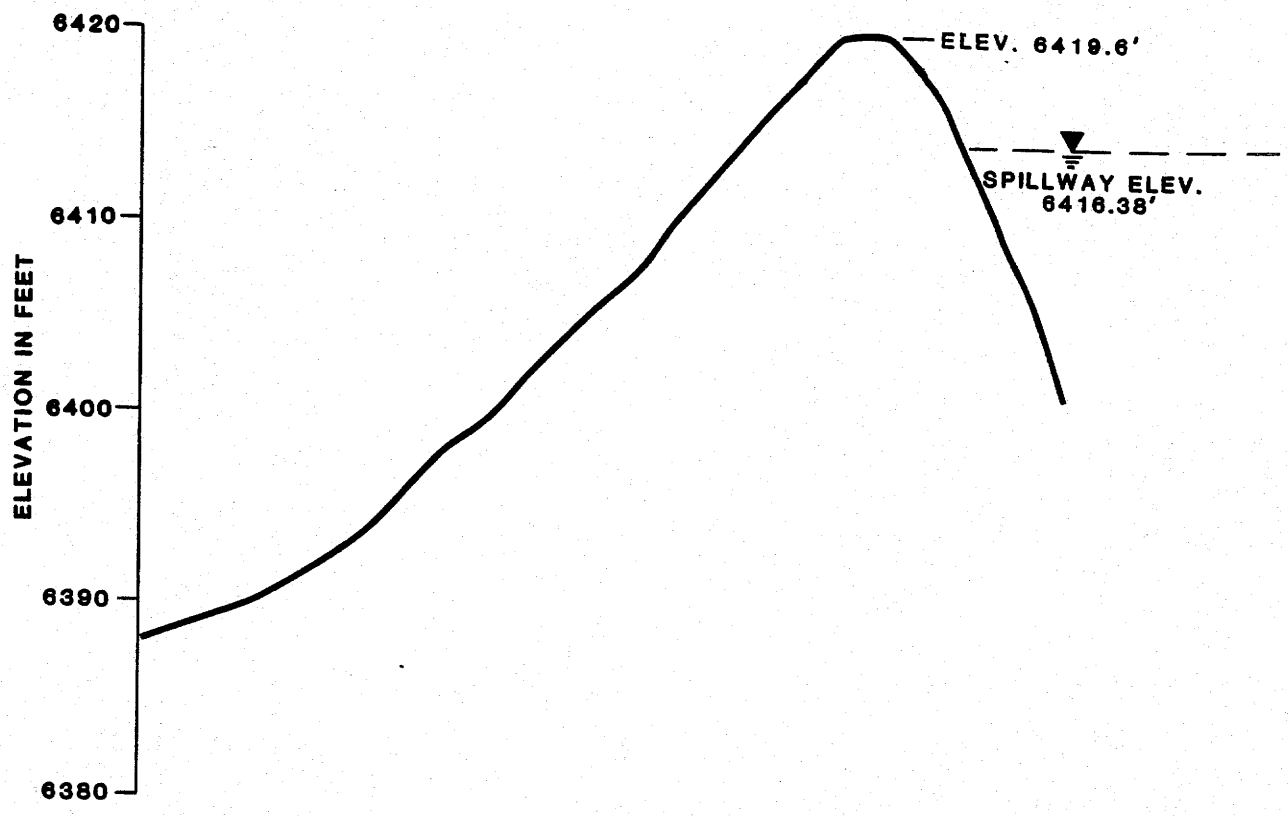
Appendix A - Inspection Check List

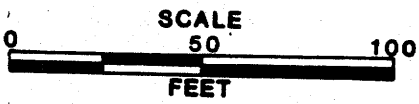
Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
BM-A1

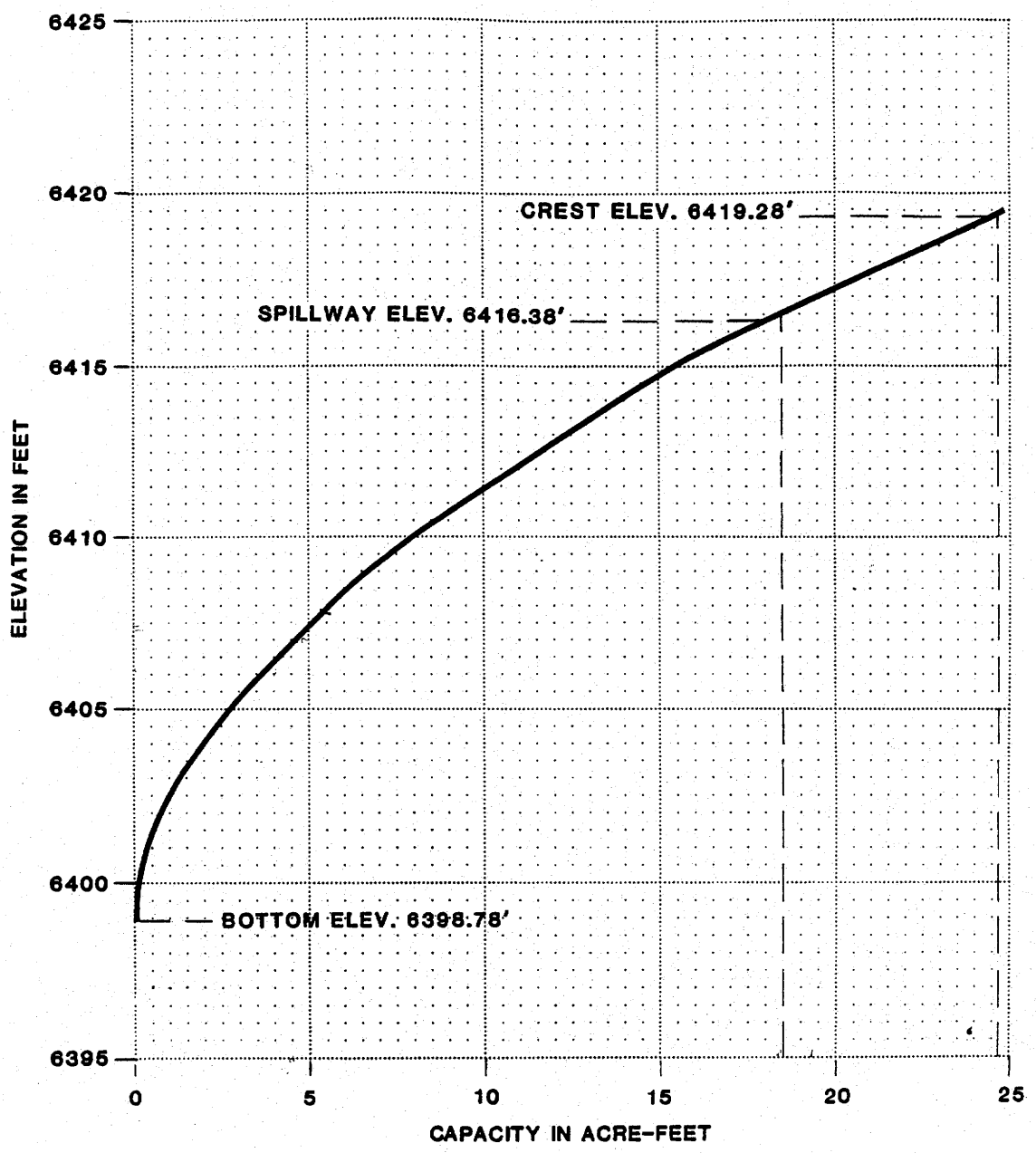
BY Dames & Moore Plate 1





EXISTING MAXIMUM CROSS-SECTION A-A' BM-A1

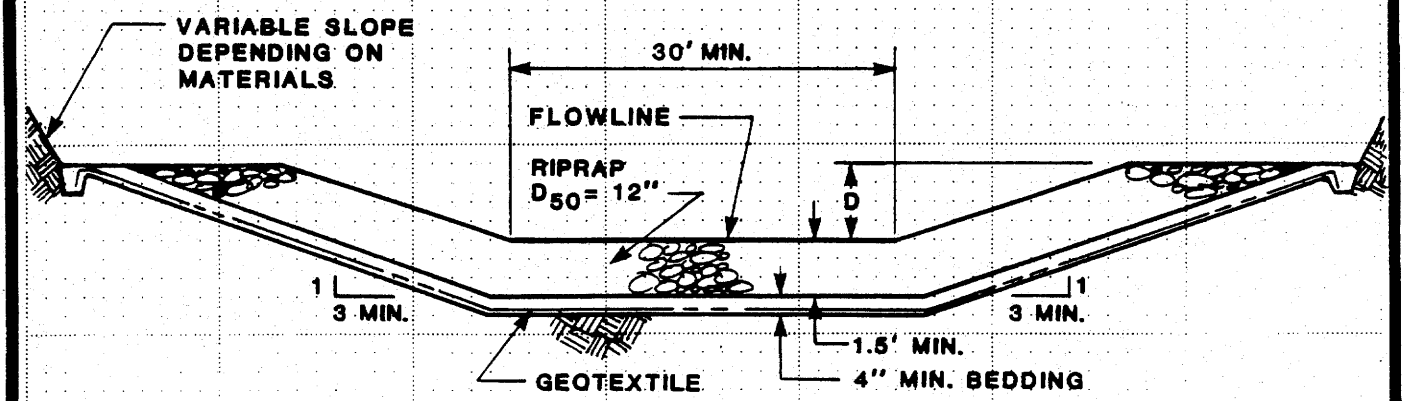
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

BM-A1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.4'

LENGTH = 50'

FLOWLINE ELEV. = 6416.38'

OUTFLOW CHANNEL

D = ~~1~~ 1.3'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION BM-A1

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: BM-A1
Page: 4

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		60%
b. Any erosion?	X		rills & gulleys
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			
a. Adequate grass cover?		X	20%
b. Any erosion?	X		Minor
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		Rills
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			lt brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			light brown SM

Sediment Impoundment Name: CM-A1
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?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		
Are side slopes eroding?	X		From Alant. 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	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		Rills
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

Sediment Impoundment Name: BIVI-A1
Page: 6

ITEM	YES	NO	REMARKS
8. IMPOUNDMENT			
a. Sinkholes?		X	(Elev.) feet
b. Water present?	X		(Elev.) feet
c. Siltation?	X		~30%
d. Watershed matches soil map?		X	Recium / Fave

9. GENERAL COMMENTS

Canopy cover ≤10%
ground cover 30%

Culvert at roadway

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10137-011-22
SUBJECT SEDIMENT POND HYDROLOGY
3M-A1 SHEET ___ OF ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6508 − 6416 = 92 ft.

WATER COURSE LENGTH = 6.8 in. (40 ft/in.) = 2720 ft. = 0.515 mi.

$T_c = \left(\frac{11.9\,(0.515)^3}{92}\right)^{0.385} = 0.212$ hr. .211

LAG TIME = $0.6\,T_c$ = 0.127 hr.

.127

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
46.5	57%	S-G	Good	C	0.57 (80) = 46.6
31.3	43%	DIST GRAVEL	—	D	0.43 (91) = 39.1
					84.7

Distribution Ponds
S-G EH #32

USE 85

DRAINAGE BASIN AREA

80.3 ACRE 0.1[illegible] SQ MILE

BY S. DOLAN DATE 10/29/85
CHECKED BY BHM 10/29/85
COPY TO EO

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

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 43%, EH #35 .43 (.42)
57%, EH # 32 .57 (.21)
.30

K = .30

SLOPE FACTOR

LENGTH (ft.)	ΔELEV (ft.)	SLOPE (%)	LS
1000	60	6	2.13 (.4)
600	60	10	3.36 (.4)
600	50	8.3	2.57 (.2)
			use 2.20

2.71

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
57%	S-G	10%	25%	.36 (.57)
43%	disturbed	—	—	.43 (1.0)
				C = .64

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

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.3)(\cancel{3.2}\ 2.71)(.64)(1.0) = \cancel{16.90}\ 20.81$ ton/acre/year

$A = \frac{\cancel{16.90}\ 20.81}{}\left(\frac{1}{2047}\right)(80.8)(.95) = \cancel{.634}\ .780$ acre-feet/year

Dames & Moore

INSPECTION REPORT

Sedimentation Structure

BM-B

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Approach Channel	6
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
REMEDIAL COMPLIANCE PLAN	8
GEOTECHNICS	8
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

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

This inspection report contains information specific to Structure BM-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 BM-B was inspected on August 29, 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 BM-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

ANALYSES

STABILITY

Structure BM-B is a category A-5 embankment. A standard category A-5 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions: not accurate 1.4

1. Maximum height = 10 ft
2. Maximum upstream slope = 1.5 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The BM-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 BM-B is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure BM-B was analyzed using the 10-year, 24-hour storm.

BM-B HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	61	78
Volume	acre-ft	3.3	2.60
Storage			
Peak Stage	ft	6366.42	6374.66
Spillway Elevation . .	ft	6373.80	--
Peak Storage	acre-ft	3.3	--
Storage Capacity . . .	acre-ft	13.2	--
Outflow			
Peak Flow	cfs	0	5
Embankment Crest Elevation	ft	--	6375.40
Peak Stage	ft	--	6374.66
Freeboard	ft	--	0.74
Mannings "n"		--	0.040

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, BM-B.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.21
3. Slope Factor, LS 4.15
4. Cover Factor, C 0.443
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 BM-B and the results of the sediment inflow analysis are summarized in the following table.

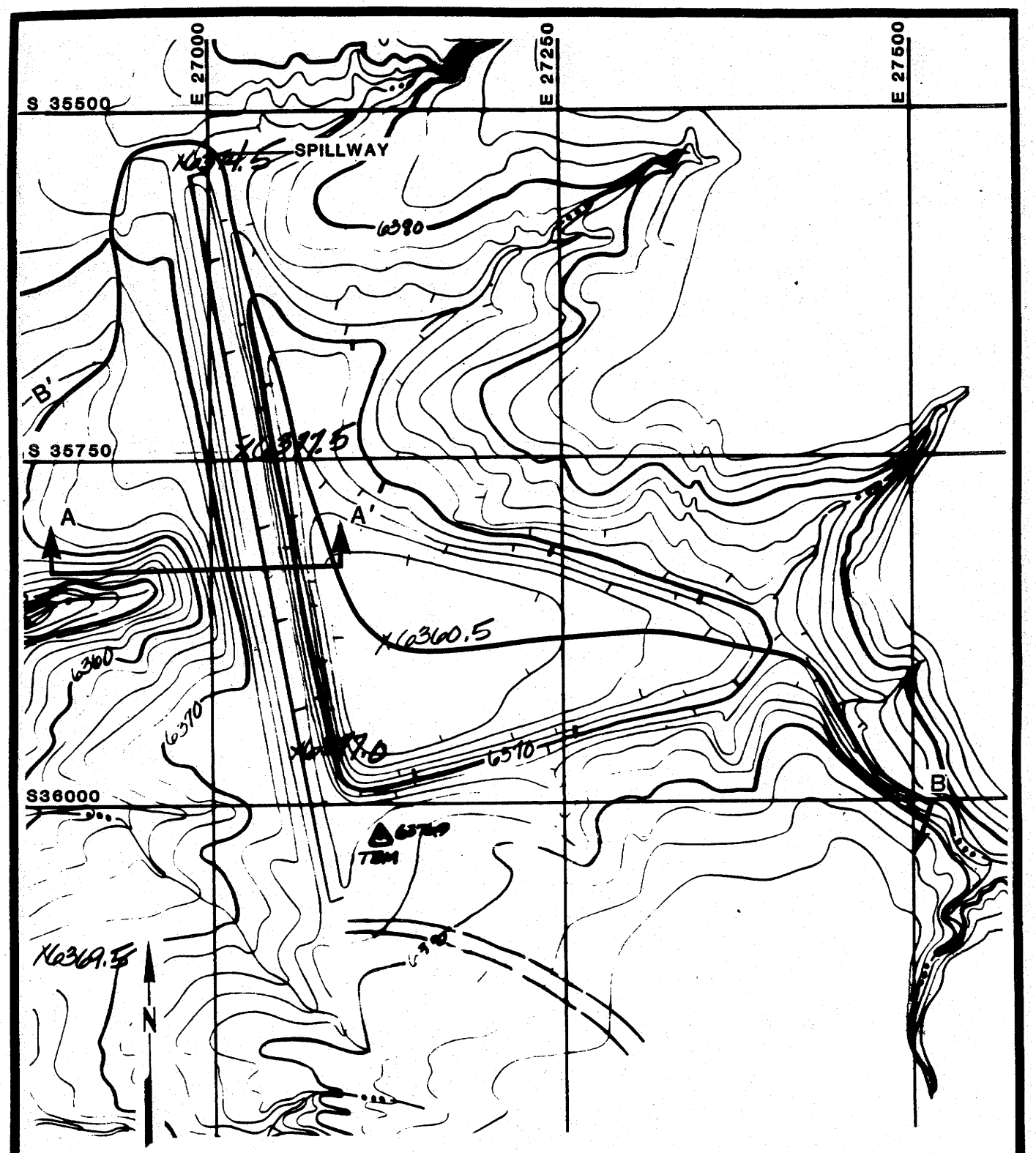
BM-B STORAGE

Total Storage Capacity	12.76	acre-ft
10-year, 24-hour Storm Inflow	3.3	acre-ft
Available Sediment Storage Capacity . .	9.46	acre-ft
Sediment Inflow Rate	0.372	acre-ft/yr
Sediment Storage Life	25	yrs

BM-B HYDRAULICS FOR REDESIGNED SPILLWAY

	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	61	78
Volume	acre-ft	3.30	2.60
Storage			
Peak Stage	ft	6366.42	--
Spillway Elevation . .	ft	6373.55	--
Peak Storage	acre-ft	3.30	--
Storage Capacity . . .	acre-ft	12.76	--
Available Sediment Storage Capacity . .	acre-ft	9.46	--
Sediment Inflow Rate .	acre-ft/yr	0.372	--
Sediment Storage Life.	yrs	25	--
Outflow			
Peak Flow	cfs	--	6
Embankment Crest Elevation	ft	--	6375.40
Peak Stage	ft	--	6374.41
Freeboard	ft	--	0.99
Spillway Channel			
Flow Depth	ft	--	0.86
Critical Velocity. . .	fps	--	2.1
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	8
Normal Velocity. . . .	fps	--	2.7
Normal Depth	ft	--	0.11
Manning's "n"		--	0.035

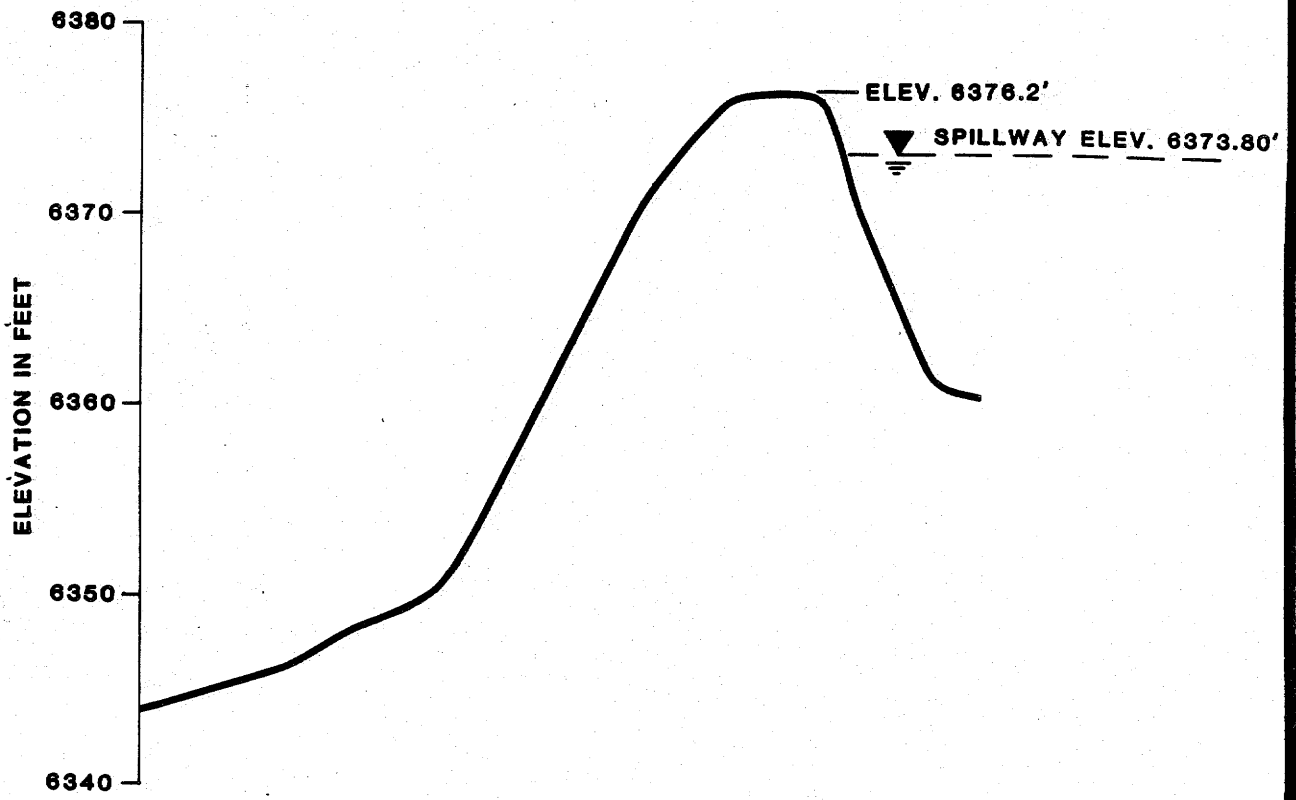
still high for
$D_{50} = 2''$
$D_{100} = 3''$
$\Rightarrow n = .03$
see pg 5



SITE PLAN
BM-B

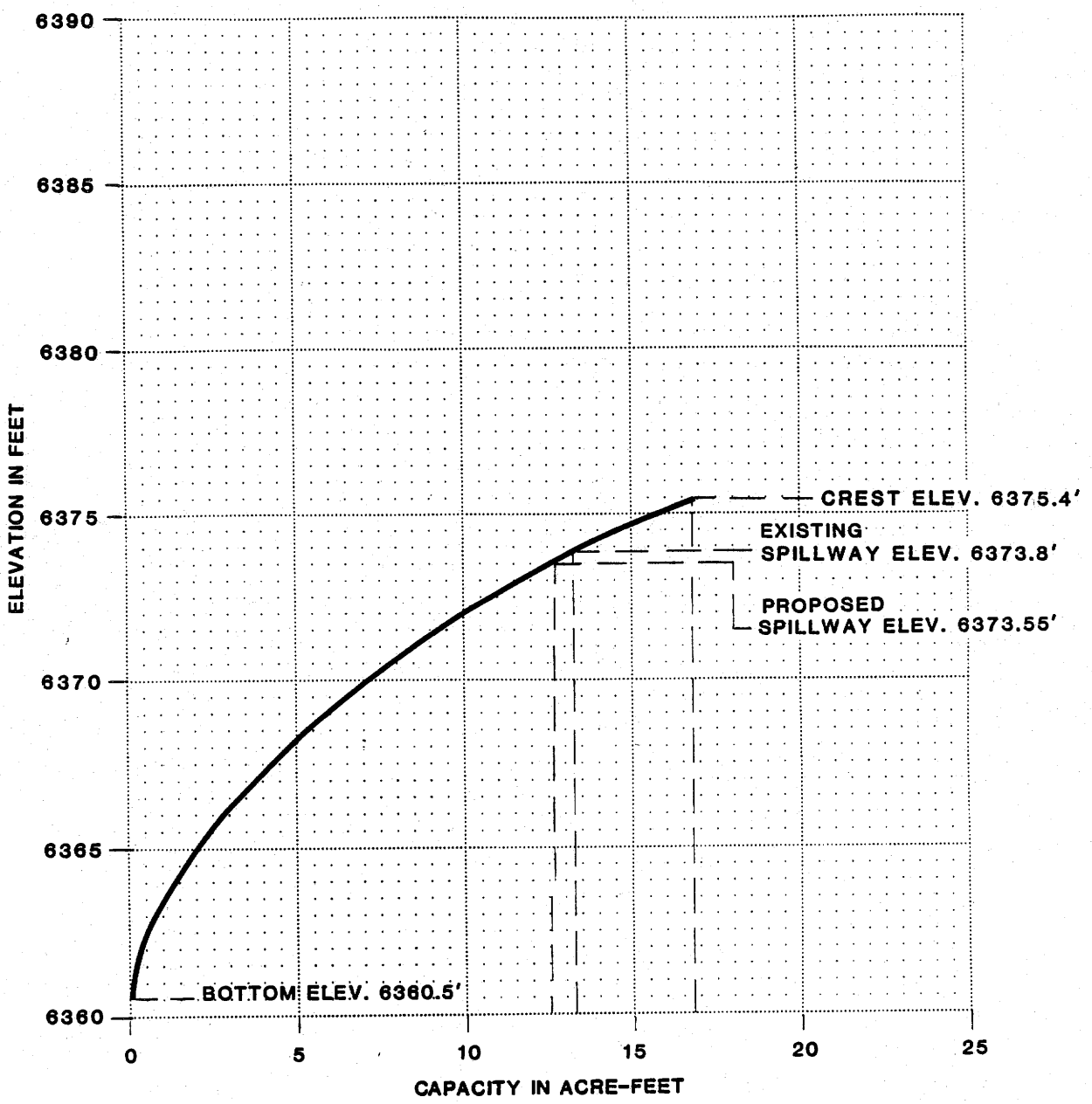
SCALE
0 100 200
FEET

BY Dames & Moore Plate 1



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

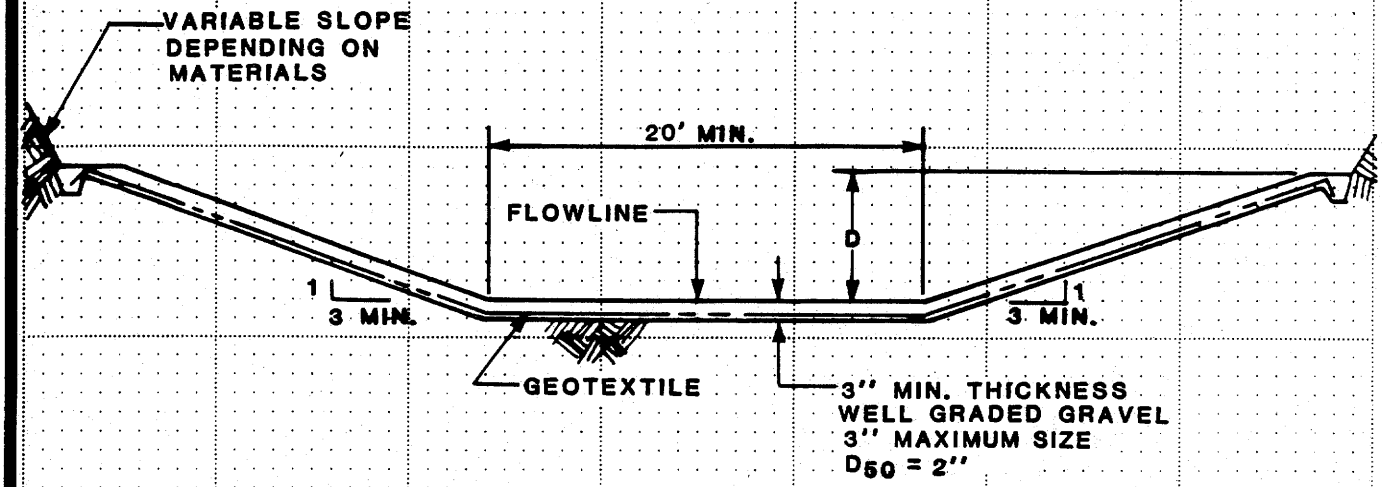
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

BM-B

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.9'

LENGTH = 30'

FLOWLINE ELEV.= 6373.55'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION BM-B

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: F11-B
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?			
b. Misalignment?		X	
c. Cracking?			
2. UPSTREAM SLOPE			25°
a. Adequate grass cover?			Ask
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?			NONE
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			20°
a. Adequate grass cover?			Ask
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?			NA
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		Slight
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		gulley u.s. 3.5' DEEP x 4' WIDE
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

Sediment Impoundment Name: EM-B
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:			Parallel to Crest
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		gulley
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:			
Are side slopes eroding?	X		minor
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:			Parallel to Crest
Are side slopes eroding?		X	Natural swale
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			N/A
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: BM-B
Page: 6

8. GENERAL COMMENTS
left abutment gulley 3' deep 4' wide
dump rock to prevent further erosion

IMPOUNDMENT

WATERSHED 100% SAGE-GRASS
≈ 80% UNDISTURBED

NO WATER PRESENT

NO SINK HOLES

Some sediment in impoundment

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE Peabody Coal Co 10139-011-22
SUBJECT Sediment Pond Hydrology
3M-A1 SHEET ___ OF ___

Time of Concentration

Elevation Difference = 6508 − 6416 = 92 ft.

Water Course Length = 6.8 in. (40 ft/in) = 2720 ft. = 0.515 mi. ✓

$T_c = \left(\frac{11.9\,(0.515)^3}{92}\right)^{0.385} = 0.212$ hr. .211

Lag Time = $0.6\,T_c$ = 0.127 hr. ✓

.127

SCS Curve Number

Drainage Area (ac)		Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
46.5	57%	S-G	good	C	0.57 (80) = 45.6
34.3	43%	Dist Grass	—	D	0.43 (91) = 39.1
					84.7 ✓

Distributed Earthen
S-G EH #32

Use 85

Drainage Basin Area

80.3 acre 0.1[illegible] sq mile ✓

BY S. Dolan DATE [illegible]
CHECKED BY BHM 10/29/85
COPY TO EO

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

Dames & Moore

DESIGN REPORT

Temporary Impoundment Structure

BM-FWP

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED FEB 1999

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

MAY 07 1998

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

INLET AND OUTLET STRUCTURES 5

APPENDIX A Hydrology Calculations
APPENDIX B SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 BM-FWP Temporary Impoundment Design

APPROVED
FEB 1999

INTRODUCTION

Impoundment Structure BM-FWP is an incised impoundment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to contain clean water for use by the Black Mesa plant. BM-FWP was constructed to store clean water pumped from the upstream pipeline and wells WW-5 and 6. Clean water is gravity fed from the impoundment to the Black Mesa plant via a 14-inch underground waterline. The location of Structure BM-FWP is shown on Drawing No. 85400 (Sheet L-9) 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 BM-FWP. 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 Structure BM-FWP was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for incised slope design.

FEB 1999
APPROV

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A and B). Structure BM-FWP is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in depth. The impoundment does not contain a spillway. Adequate storage will be maintained in the impoundment above the normal operating level to contain the storm run-off from the 25-year storm event. To assure that adequate storm water storage volume is available, the operating water level in the impoundment will be maintained at or below elevation 6611.0. Water level management and stormwater de-watering will be accomplished through control of process water feed rates to the plant with discharge through the existing outlet structure (two 8-inch steel pipes). This design methodology and compliance with applicable regulatory requirements were verified through discussions with OSM personnel.

The following parameters were used in the hydrologic analysis:

		25yr-6hr Storm	
1.	Water Course length, L	0.015	mi.
2.	Elevation Difference, H	2	ft
3.	Time of Concentration, T_c	0.016	hr
4.	SCS Curve Number	96	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	2.3	acres

FEB 1999 APPROVED

The SEDCAD+ computer program was used to evaluate inflow to the impoundment structure. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A and B).

INLET AND OUTLET STRUCTURES

The inlet structures consist of two, 8-inch steel pipes at elevations 6612.4 and 6612.8, which are fed from the upstream pipeline and wells WW-5 and 6. The outlet structure consists of two, 8-inch steel pipe at elevation 6602.5 and are connected to a 14-inch underground steel pipe that transfers discharge to the Black Mesa plant. The alignment and dimensions are shown on Exhibit 1.

* * *

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

APPENDIX A	Hydrology Calculations
APPENDIX B	SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
Exhibit # 1	BM-FWP Temporary Impoundment Design

FEB 1999 APPROVED

APPENDIX A

Hydrology Calculations

FEB 1999
APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: FWP

TIME OF CONCENTRATION:

Start Elevation (ft) =	6613
End Elevation (ft) =	6611
Elevation Difference, E (ft) =	2
Watercourse Length (ft) =	80
Watercourse Length, L (mi) =	0.015
Tc = (11.9L^3/E)^0.385 =	0.016 hours

ROUTING PARAMETERS:

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed	C	91	0.98	89.18
Pond	C	100	1.32	132
TOTAL:			2.3	221.18

Weighted CN = Total CN*Area/ Total Area = 96

DRAINAGE BASIN AREA:

2.3 Acres

FEB 1999 APPROVED

APPENDIX B

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

FEB 1999
APPROVED

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY :BM-FWP TEMPORARY IMPOUNDMENT

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\FWP

Date: 04-09-1998

FEB 1999 APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\FWP User: D. GLEASON
Date: 04-09-1998 Time: 15:34:04
PEABODY WESTERN COAL COMPANY :BM-FWP TEMPORARY IMPOUNDMENT
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

BS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
.11	1	2.30	96	F	0.016	0.000	0.000	0.0	0.28	4.42
			Type: Null		Label: BM-FWP					
.11	Structure	2.30							0.28	
.11	Total IN/OUT	2.30							0.28	4.42

APPROVED FEB 1999

INSPECTION REPORT

Sedimentation Structure

BM-SS

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure BM-SS is a partially incised structure with an earthen embankment, designed and constructed in 1980 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 BM-SS is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure BM-SS. 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 BM-SS 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 BM-SS 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 BM-SS has a 76.5-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 58% Sagebrush/grass, 26% Pinion/Juniper, and 16% disturbed.

EMBANKMENT

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

Structure BM-SS

Embankment	Residual Sandstone Soils
Foundation	Sandstone
Right Abutment	Sandstone/Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	9.2 ft
Crest Width	15 ft
Upstream Slope	2.9 H : 1 V
Downstream Slope . . .	3.5 H : 1 V

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

ANALYSES

STABILITY

Structure BM-SS is a category A-5 embankment. A standard category A-5 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

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

The BM-SS 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 BM-SS 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 BM-SS was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.318	mi
2.	Elevation Difference, H	125	ft
3.	Time of Concentration, T_c	0.108	h
4.	Lag time, $0.6T_c$	0.065	h
5.	SCS Curve Number	71	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	76.5	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.

BM-SS HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	32	36	
Volume	acre-ft	2.10	1.53	
Storage				
Peak Stage	ft	6404.15	6410.34	
Spillway Elevation . .	ft	6409.67	--	
Peak Storage	acre-ft	2.14	--	
Storage Capacity . . .	acre-ft	7.25	--	
Outflow				
Peak Flow	cfs	0	4	
Embankment Crest Elevation	ft	--	6413.17	
Peak Stage	ft	--	6410.30	
Freeboard	ft	--	2.87	
Spillway Channel				
Flow Depth	ft	--	0.63	
Critical Velocity. . .	fps	--	2.0	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	2	18
Normal Velocity. . . .	fps	--	1.7	3.3
Normal Depth	ft	--	0.15	0.08
Manning's "n"		--	0.035	0.035

Spillway Channel

The existing spillway for BM-SS has a trapezoidal channel with the following dimensions:

Channel depth	3 ft
Channel width	13 ft
Channel length	35 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 BM-SS has a U-shaped channel with the following dimensions:

Channel width	13 ft
Channel length	85 ft
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, BM-SS.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.207
3. Slope Factor, LS 7.05
4. Cover Factor, C 0.230
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 BM-SS and the results of the sediment inflow analysis are summarized in the following table.

BM-SS STORAGE

Total Storage Capacity	7.25	acre-ft
10-year, 24-hour Storm Inflow	2.10	acre-ft
Available Sediment Storage Capacity . .	5.11	acre-ft
Sediment Inflow Rate	0.477	acre-ft/yr
Sediment Storage Life	11	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure BM-SS indicated that the geotechnical problems consist of rill and gulley erosion on the downstream 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 and spillway capacity of Structure BM-SS are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. A trapezoidal outflow channel should be constructed along the alignment B-B' shown in Plate 1. The channel profile is shown in Plate 4 and the required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown in Plate 5.

* * *

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

Plate 1 - Site Plan BM-SS

Plate 2 - Existing Maximum Cross Section BM-SS, A-A'

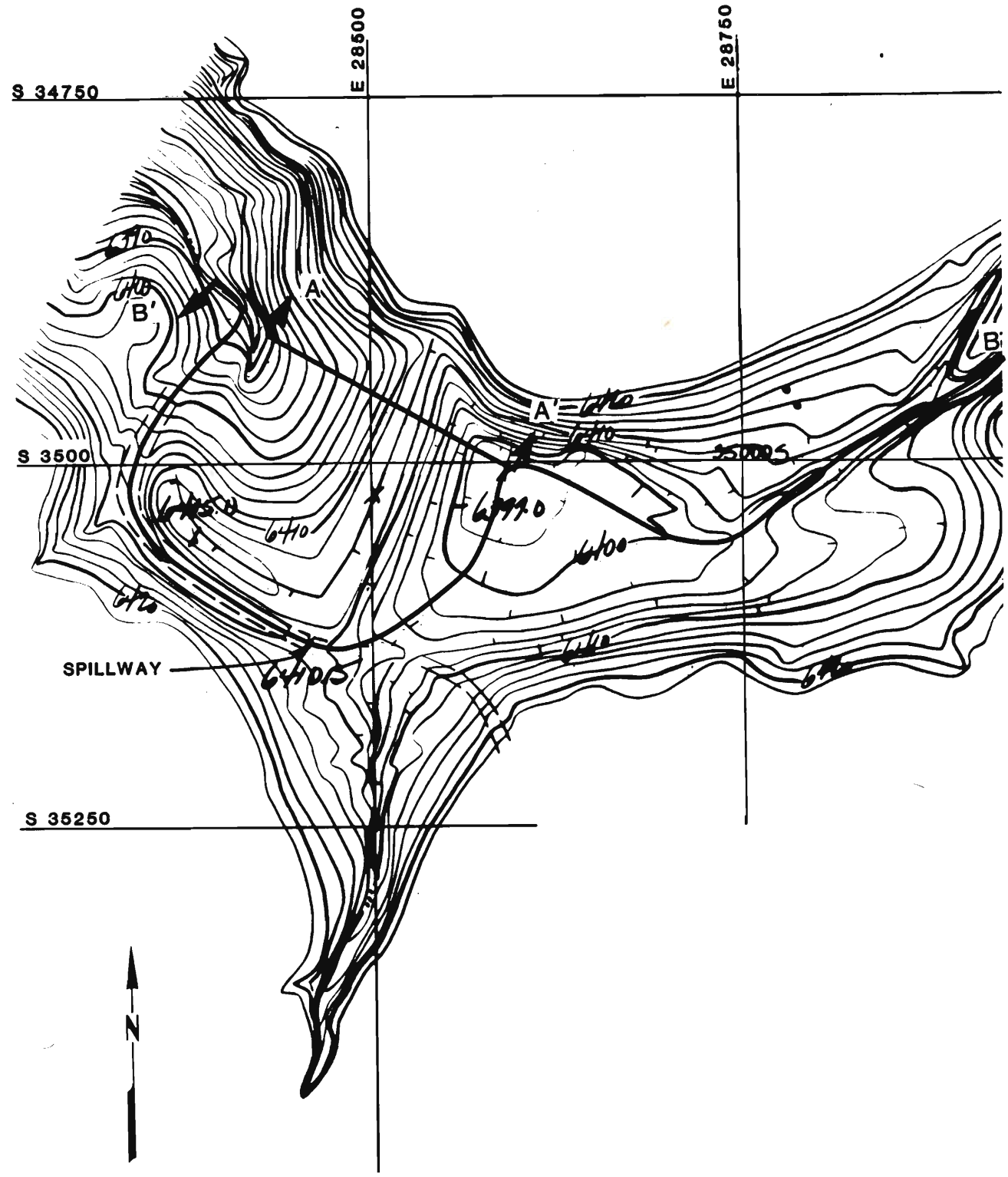
Plate 3 - Volume-Elevation Curve BM-SS

Plate 4 - Channel Profile BM-SS, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section BM-SS

Appendix A - Inspection Check List

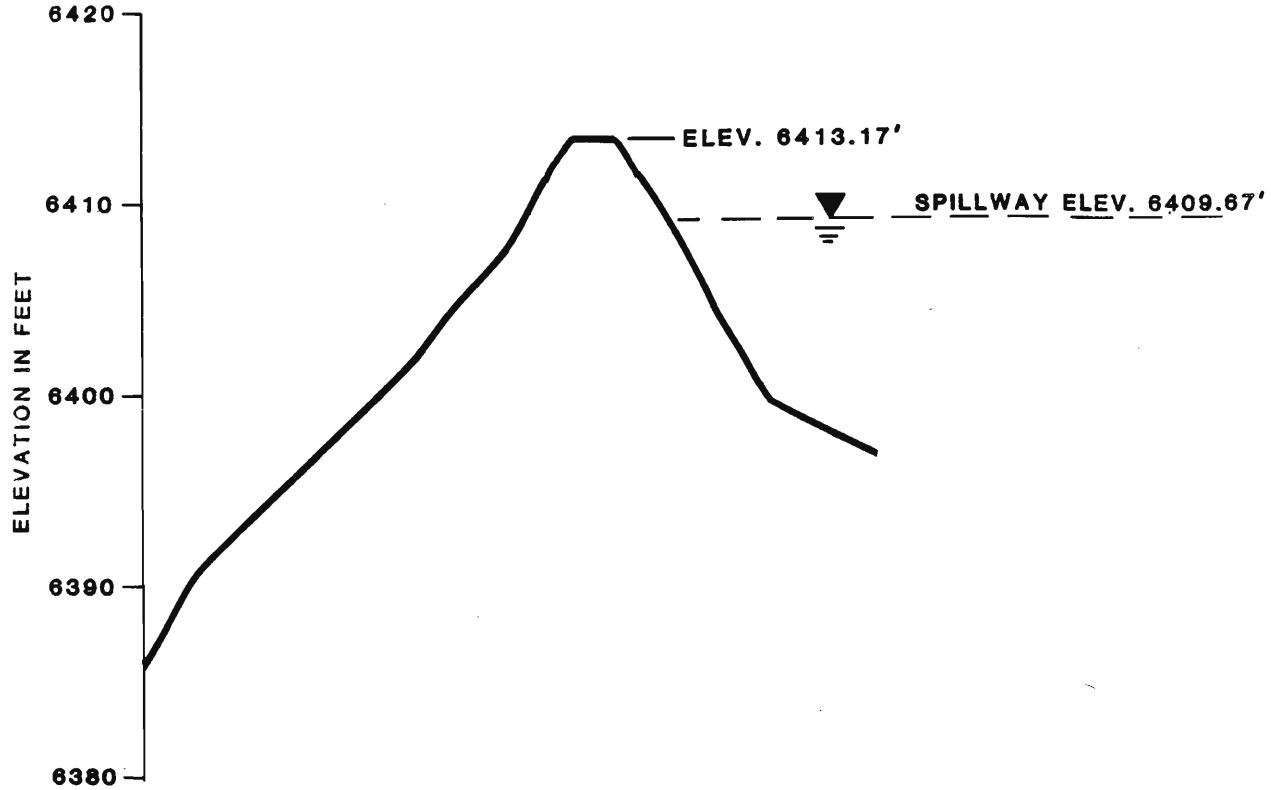
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

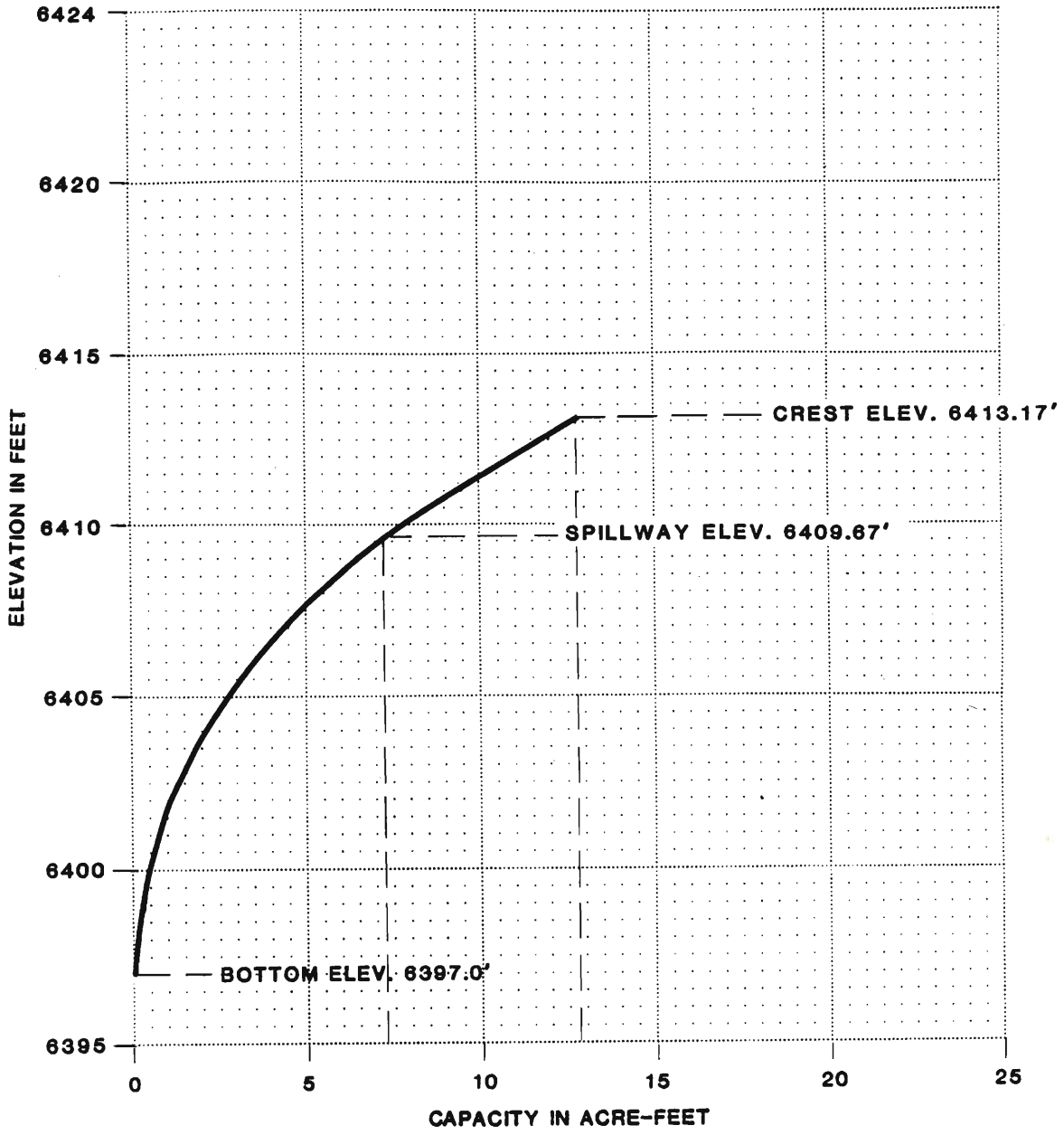
SITE PLAN
BM-SS

BY **Dames & Moore** Plate 1



EXISTING
MAXIMUM CROSS-SECTION
A-A'
BM-SS

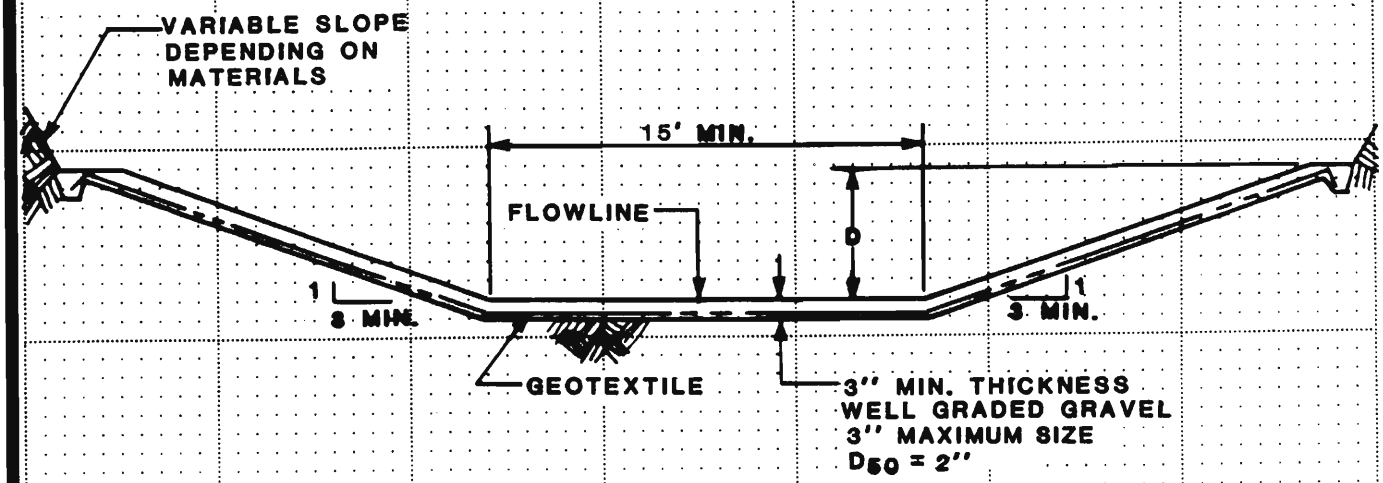
BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE

BM-SS

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.7'

LENGTH = 30'

FLOWLINE ELEV.= 6409.67'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION BM-SS

BY Dames & Moore Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: BM-SS
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			19°
a. Adequate grass cover?		X	40%
b. Any erosion?		X	
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			16°
a. Adequate grass cover?		X	30%
b. Any erosion?	X		Some gulley at toe
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?			Rock
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills sm gullays
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray SM

Sediment Impoundment Name: BM-SS
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		
Are side slopes eroding?	X		Rills from abutment
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		
Are side slopes eroding?	X		from abutment Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			
a. Location:			NA
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

OK - Riprap spillway & outlet.

Ground Cover 75

Canopy cover 30

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10137-011-2
SUBJECT SEDIMENT POND HYDROLOGY
BM-SS SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6535 − 6410 = 125 ft.

WATER COURSE LENGTH = 4.2(400) = 1680 ft. = 0.318 mi.

$$T_c = \left(\frac{11.9\,(0.318)^3}{125\text{ ft.}}\right)^{0.385} = 0.108 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.065 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
44.2 (53%)	S-G	fair	C	0.53(63) = 33.5
12.4 (16%)	DIST. GRAVEL	–	D	0.16(91) = 14.6
19.9 (26%)	P-J	fair	C	0.26(73) = 19.0
				70.1

10% EH #23
90% EH #32

USE 71

DRAINAGE BASIN AREA

76.5 ACRE 0.120 SQ MILE

BY S. DOLAN DATE 9-9-85
CHECKED BY BHM 10/24/85
COPY TO EO ___

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 10% EH #23 .1 (.18)
90% EH #32 .9 (.21)
.207

K = .207

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
500	150	30.0	17.8 (.10)
600	50	8.3	2.58 (.40)
400	90	22.5	9.90 (.30)
500	80	16.0	6.35 (.20)

use 7.05

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
58%	S-G	60	25	.58 (.082)
16%	disturbed	—	—	.16 (1.0)
26%	P-J	60	25	.26 (.085)

C = .230

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.207)(7.05)(.23)(1.0) = 13.43$ ton/acre/year

$A = 13.43\left(\frac{1}{2047}\right)(76.5)(.95) = .477$ acre-feet/year

BY ___ DATE ___
CHECKED BY ___ DATE ___
COPY TO EO ___

DESIGN REPORT

Temporary Impoundment Structure

BM-T

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
FEB 1999

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

MAY 01 1998

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 3

EMERGENCY SPILLWAY AND OUTLET CHANNEL 5

APPENDIX A Hydrology and Hydraulic Calculations
APPENDIX B SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 BM-T Temporary Impoundment Design

FEB 1999 APPROVED

INTRODUCTION

Impoundment Structure BM-T is an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to collect runoff from portions of facilities area at the Black Mesa Mine. The pond was constructed to minimize coal fines from washing down the undisturbed portions of the wash above sediment structure BM-A1. BM-T is not designed as a sediment control structure. The sediment control for the BM-T watershed is incorporated into the designs for downstream structure BM-A1 assuming BM-T is non-existent. The location of Structure BM-T and its watershed boundary are shown on Drawing No. 85400 (Sheet K-10) 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 BM-T. 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 Structure BM-T was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design.

FEB 1999
APPROVED

SITE DESCRIPTION

LAND USE

Structure BM-T has a 3.2-acre tributary area and is located upstream of Pond BM-A1. The watershed is classified as 100% disturbed.

DESIGN ANALYSES

GENERAL

Structure BM-T 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 1990 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure BM-T is a Category B-4 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and minimum 12 feet wide on top was constructed. A minimum upstream slope of 1.5:1 (horizontal to vertical) and a downstream slope of 2.5:1 were utilized. Based on the total embankment height of approximately 9 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.

FEB 1999
APPROVED

HYDROLOGY

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

The following parameters were used in the hydrologic analysis:

		25yr-6hr Storm	
1.	Water Course length, L	0.082	mi.
2.	Elevation Difference, H	29	ft
3.	Time of Concentration, T_c	0.040	hr
4.	SCS Curve Number	91	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	3.2	acres

HYDRAULICS

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

APPROVED
FEB 1999

BM-T POND HYDRAULICS TABLE

	Units	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	5.1
Volume	ac-ft	0.3
Storage		
Storage Capacity	ac-ft	0.75
Outflow		
Peak Flow	cfs	4.35
Spillway Elevation	msl	6486
Embankment Crest Elev.	msl	6487.4
Peak Stage	msl	6486.2
Freeboard	ft	1.2
Emergency Spillway Channel		
Flow Depth	ft	0.2
Critical Velocity	fps	2.0
Mannings "n"	--	.031
Width	ft	18
Outflow Channel		
Slope	%	27
Normal Velocity	fps	3.9
Normal Depth	ft	0.1
Mannings "n"	--	0.031
Riprap D_{50}	in	coarse gravel

FEB 1999 APPROVED

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for BM-T is a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	1.4	
	(Outflow)	1.0	ft
Channel Width		18	ft
Channel Length	(Spillway)	27	ft
	(Outflow)	50	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	27	%
Spillway Elevation		6486	ft

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

* * *

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

Appendix A - Hydrology and Hydraulic Calculations

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

Exhibit # 1 - BM-T Temporary Impoundment Design

4 FEB 1999 APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: BM-T

TIME OF CONCENTRATION:

Start Elevation (ft) =	6511
End Elevation (ft) =	6482
Elevation Difference, E (ft) =	29
Watercourse Length (ft) =	435
Watercourse Length, L (mi) =	0.082
Tc = (11.9L^3/E)^0.385 =	0.040 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed	C	91	3.2	291.2
TOTAL:			3.2	291.2

Weighted CN = Total CN*Area/ Total Area = 91

DRAINAGE BASIN AREA:

3.2 Acres

FEB 1999 APPROVED

BM-T temporary impoundment
Worksheet for Trapezoidal Channel

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

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.028562	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	18.00	ft
Discharge	4.35	cfs

Results		
Depth	0.12	ft
Flow Area	2.22	ft²
Wetted Perimeter	18.77	ft
Top Width	18.73	ft
Critical Depth	0.12	ft
Critical Slope	0.028566	ft/ft
Velocity	1.96	ft/s
Velocity Head	0.06	ft
Specific Energy	0.18	ft
Froude Number	1.00	
Flow is subcritical.		

FEB 1999
APPROVED

SEDCAD+ NONERODIBLE CHANNEL DESIGN

BM-T SPILLWAY

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	4.35 cfs	
Slope	27.00 %	
Sideslopes	3.00:1 (L)	3.00:1 (R)
Bottom Width	18.00 ft	
Manning's n	0.031	
Material	COARSE GRAVEL	
Freeboard	1 ft	

RESULTS:

Depth	0.06 ft
with Freeboard	1.06 ft
Top Width	18.37 ft
with Freeboard	24.37 ft
Velocity	3.87 fps
Cross Sectional Area	1.12 sq ft
Hydraulic Radius	0.06 ft
Froude Number	2.76

FEB 1999 APPROVED

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\BM-T

Date: 03-23-1998

FEB 1999
APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

BS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
11	1	3.20	91	F	0.040	0.000	0.000	0.0	0.29	5.09
		Type: Pond			Label: POND BM-T					
11	Structure	3.20							0.29	
11	Total IN	3.20							0.29	5.09
11	Total OUT								0.29	4.35

FEB 1999 APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
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 BM-T

Drainage Area from J1, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 3.2 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	6486.0
Crest Length (ft)	27.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	18.0

POND RESULTS:

Permanent Pool (ac-ft)
0.7

FEB 1999 APPROVED

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.29	5.09
OUT	0.29	4.35

Peak Elevation	Hydrograph Detention Time (hrs)
6486.1	0.00

****

FEB 1999
APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-T User: D. GLEASON
Date: 03-23-1998 Time: 08:35:25
PEABODY WESTERN COAL COMPANY : BM-T TEMPORARY IMPOUNDMENT
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 BM-T

Drainage Area from J1, B1, S1, SWS(s)1: 3.2 acres
Total Contributing Drainage Area: 3.2 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6483.10	0.00	0.00	0.00	0.00	
6484.10	1.00	0.28	0.09	0.00	
6485.10	2.00	0.32	0.39	0.00	
6486.00	2.90	0.35	0.70	0.00	Stage of SW#1
6486.10	3.00	0.35	0.73	3.05	
6486.14	3.04	0.36	0.75	4.35	Peak Stage
6486.70	3.60	0.38	0.95	21.34	
6486.80	3.70	0.39	0.99	27.72	
6486.90	3.80	0.39	1.03	34.49	
6487.00	3.90	0.40	1.07	42.09	
6487.10	4.00	0.40	1.11	50.80	
6487.40	4.30	0.42	1.23	80.81	

APPROVED FEB 1999

DESIGN REPORT

Temporary Impoundment Structure

CW-A

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
FEB 1999

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

MAY 01 1998

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 3

EMERGENCY SPILLWAY AND OUTLET CHANNEL 5

APPENDIX A Hydrology and Hydraulic Calculations
APPENDIX B SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 CW-A Temporary Impoundment Design

FEB 1999 APPROVED

INTRODUCTION

Impoundment Structure CW-A is an existing earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to impound water for the N-6 Water Tank for the Black Mesa Mine. The N-6 Water Tank's water is utilized to water the roads and control dust. The pond receives runoff from the N-6 watershed, pumped water from the J2-A Dam or water from the WW #2 to WW #5 pipeline. The impoundments provides surge storage capacity to allow a submersible pump installed in the ponding area to pump water, as required, to the N-6 Water Tank. CW-A is not designed as a siltation control structure. The sediment control for the entire CW-A watershed is incorporated into the design for the downstream sediment structure J2-A assuming CW-A is non-existent. The location of structure CW-A and its watershed boundary are shown on Drawing No. 85400 (Sheet K-8) 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 CW-A. 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, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the Structure CW-A was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed; rather, the information in Chapter 6, Attachment D was utilized for embankment design.

APPROVED
FEB 1999

SITE DESCRIPTION

LAND USE

Structure CW-A has a 1230-acre drainage area and is located upstream of sediment structure J2-A on the Wild Ram Valley Wash and a tributary to Coal Mine Wash. The watershed is classified as 70% reclaimed, 16% undisturbed 14% disturbed.

DESIGN ANALYSES

GENERAL

Structure CW-A 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 including 816.49 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 1990 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure CW-A is a Category A-5 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 12 feet wide on top was constructed. A minimum upstream slope of 2.0:1 (horizontal to vertical) and a downstream slope of 4.0:1 were utilized. Based on the total embankment height of approximately 20 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 21-foot wide riprap-lined trapezoidal channel.

FEB 1999 APPROVED

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A and B). Structure CW-A is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the emergency spillway invert elevation. The spillway for the CW-A pond was analyzed using the 25-year, 6-hour storm. Structure CW-A was conservatively assumed to be full to the emergency spillway prior to the time of the 25-year storm event. CW-A Pond currently stores approximately 9.34 ac.-ft. The storage capacity is adequate to provide surge storage capacity, allowing a submersible pump installed in the ponding area to pump water, as required, to the N-6 Water Tank. The water is utilized for dust control for the mining operation.

The following parameters were used in the hydrologic analysis:

		25yr-6hr Storm	
1.	Water Course length, L	3.341	mi.
2.	Elevation Difference, H	450	ft
3.	Time of Concentration, T_c	0.995	hr
4.	SCS Curve Number	81	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	1230	acres

HYDRAULICS

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

FEB 1999 APPROV

CW-A POND HYDRAULICS TABLE

	Units	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	402.1
Volume	ac-ft	55.6
Storage		
Storage Capacity	ac-ft	9.34
Outflow		
Peak Flow	cfs	332.8
Spillway Elevation	msl	6471.9
Embankment Crest Elev.	msl	6476.0
Peak Stage	msl	6474.8
Freeboard	ft	1.2
Emergency Spillway Channel		
Flow Depth	ft	2.9
Critical Velocity	fps	7.0
Mannings "n"	--	.031
Width	ft	21
Outflow Channel		
Slope	%	9.2
Normal Velocity	fps	9.4
Normal Depth	ft	1.4
Mannings "n"	--	0.054
Riprap D_{50}	in	9

FEB 1999
APPROVED

EMERGENCY SPILLWAY AND OUTLET CHANNEL

The emergency spillway and outlet channel for CW-A is a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Minimum Channel Depth	(Spillway)	3.9	ft
	(Outflow)	2.4	ft
Channel Width		21	ft
Channel Length	(Spillway)	35	ft
	(Outflow)	200	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0	%
Maximum Slope	(Outflow)	9.2	%
Spillway Elevation		6471.9	ft

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

* * *

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

Appendix A - Hydrology and Hydraulic Calculations

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

Exhibit # 1 - CW-A Temporary Impoundment Design

FEB 1999 APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: CW-A

TIME OF CONCENTRATION:

Start Elevation (ft) =	6920
End Elevation (ft) =	6470
Elevation Difference, E (ft) =	450
Watercourse Length (ft) =	17640
Watercourse Length, L (mi) =	3.341
Tc = (11.9L^3/E)^0.385 =	0.995 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Topsoil	C	81	15.1	1223.1
Reclaimed	C	81	846.8	68590.8
Disturbed	C	91	171.3	15588.3
Pinyon-Juniper	C	78	91.6	7144.8
Sagebrush	C	73	105.2	7679.6
TOTAL:			1230	100226.6

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

DRAINAGE BASIN AREA:

1230.0 Acres

FEB 1999 APPROVED

CW-A temporary impoundment
Worksheet for Trapezoidal Channel

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

Input Data		
Mannings Coefficient	0.031	
Channel Slope	0.012529	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	21.00	ft
Discharge	332.80	cfs

Results		
Depth	1.81	ft
Flow Area	47.87	ft²
Wetted Perimeter	32.45	ft
Top Width	31.87	ft
Critical Depth	1.81	ft
Critical Slope	0.012529	ft/ft
Velocity	6.95	ft/s
Velocity Head	0.75	ft
Specific Energy	2.56	ft
Froude Number	1.00	
Flow is supercritical.		

FEB 1999
APPROVED

SEDCAD+ RIPRAP CHANNEL DESIGN

CW-A SPILLWAY

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	332.80 cfs	
Slope	9.20 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	21.00 feet	
Freeboard	1 ft	

RESULTS:

Steep Slope Design - PADER Method

Depth	1.41 ft
with Freeboard	2.41 ft
Top Width	29.44 ft
with Freeboard	35.44 ft
Velocity	9.38 fps
Cross Sectional Area	35.48 sq ft
Hydraulic Radius	1.19 ft
Manning's n	0.054
Froude Number	1.51
Dmax	0.938 ft (11.25 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

FEB 1999 APPROVED

APPENDIX B

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

APPROVED
FEB 1999

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\CW-A

Date: 03-12-1998

FEB 1998
APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

BS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
11	1	1230.00	81	F	0.995	0.000	0.000	0.0	55.57	402.11
		Type: Pond			Label: CW-A POND					
11	Structure	1230.00							55.57	
11	Total IN	1230.00							55.57	402.11
11	Total OUT								55.57	332.83

APPROVED FEB 1999

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
Storm: 1.90 inches, 25 year- 6 hour, SCS Type II
Hydrograph Convolution Interval: 0.1 hr

POND INPUT/OUTPUT TABLE

J1, B1, S1
CW-A POND

Drainage Area from J1, B1, S1, SWS(s)1: 1230.0 acres
Total Contributing Drainage Area: 1230.0 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	6471.9
Crest Length (ft)	35.0
Z:1 (Left and Right)	3 3
Bottom Width (ft)	21.0

FEB 1999 APPROVED

POND RESULTS:

	Permanent Pool (ac-ft)
	9.2

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	55.57	402.11
OUT	55.57	332.83

Peak Elevation	Hydrograph Detention Time (hrs)
6474.8	0.45

:**********

FEB 1999
APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\CW-A User: D. GLEASON
Date: 03-12-1998 Time: 12:03:08
PEABODY WESTERN COAL COMPANY : TEMPORARY IMPOUNDMENT CW-A
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
CW-A POND

Drainage Area from J1, B1, S1, SWS(s)1: 1230.0 acres
Total Contributing Drainage Area: 1230.0 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
6466.40	0.00	0.00	0.00	0.00	
6467.40	1.00	0.85	0.28	0.00	
6468.40	2.00	1.53	1.46	0.00	
6469.40	3.00	1.94	3.19	0.00	
6470.40	4.00	2.34	5.33	0.00	
6471.40	5.00	2.68	7.83	0.00	
6471.90	5.50	2.88	9.22	0.00	Stage of SW#1
6472.40	6.00	3.08	10.71	16.38	
6472.60	6.20	3.18	11.34	22.93	
6472.70	6.30	3.23	11.66	29.84	
6472.80	6.40	3.28	11.98	37.43	
6472.90	6.50	3.32	12.31	45.65	
6473.40	7.00	3.57	14.03	101.63	
6473.90	7.50	3.84	15.89	169.19	
6474.40	8.00	4.10	17.87	252.33	
6474.78	8.38	4.32	19.48	332.83	Peak Stage
6474.90	8.50	4.38	19.99	358.37	
6475.00	8.60	4.44	20.43	381.66	

FEB 1999 APPROVED

DESIGN and AS-BUILT CONSTRUCTION REPORT

Temporary Sedimentation Structure

J1-A

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
26858
RANDOLPH S.
LEHN
Date Signed
ARIZONA, U.S.A.

MAY 1 3 2004

AUG 2004
APPROVED

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 3

EMERGENCY SPILLWAY AND OUTLET CHANNEL 5

STORAGE CAPACITY 5

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD4 (Input and Output) 10-Year, 25-Hour Storm Event
APPENDIX C SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 Proposed J1-A Sedimentation Pond Design

AUG 2004
APPROVED

INTRODUCTION

Sedimentation Structure J1-A 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 J-1 and N-6 disturbed surface mining area and facilities at the Black Mesa Mine. The location of Structure J1-A and its watershed boundary are shown on Drawing No. 85400 (Sheet K-8 and L-8) and Drawing No. 85405.

This design report contains information specific to Structure J1-A. 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 49, "Sediment and Water Control Facility Plan".

INSPECTION

The construction site of the proposed structure J1-A was inspected in August, 2003 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.

AUG 2004
APPROVED

SITE DESCRIPTION

LAND USE

Structure J1-A has a 128.5-acre watershed and is located on a tributary of Wild Ram Valley Wash at the Black Mesa Mine. The watershed is classified as 76% reclaimed, 16% disturbed and 8% undisturbed.

DESIGN ANALYSES

GENERAL

Structure J1-A 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 ground surveys performed in 2003 by Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure J1-A is assumed to be category B-4 embankment. The embankment was constructed using Table 3-6, Attachment D, Chapter 6, as the guidance to construct stable embankment slopes. A homogenous earthen embankment, compacted in lifts to design specifications, and approximately 10-16 feet wide on top was constructed. A minimum upstream slope of a minimum 1.75:1 (horizontal to vertical) or flatter slope and a downstream slope of 2.5:1 or flatter slope was required. All embankment slopes were contructed at 2.5:1 or flatter. Based on the total embankment height of approximately 12.3 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 is an 18 to 19-foot wide riprap-lined trapezoidal channel.

APPROVED
AUG 2004

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD4 (see Appendices A, B, and C). Structure J1-A is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The earthen embankment 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 J1-A was analyzed using the 25-year, 6-hour storm. Structure J1-A 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 J1-A was analyzed using the 10-year, 24-hour storm. The pond was verified to completely contain the 10-year, 24-hour storm event, and provide adequate sediment storage volume, without discharging downstream to Wild Ram Valley Wash.

The following parameters were used in the hydrologic analysis:

		J1-A
1.	Water Course length, L	0.5483 mi.
2.	Elevation Difference, H	129 ft
3.	Time of Concentration, T_c	0.1994 hr
4.	SCS Curve Number	87
5.	Rainfall Depth, 10-year, 24-hour storm 25-year. 6-hour	2.1 in 1.9 in
6.	Drainage Area	128.5 acres

HYDRAULICS

The SEDCAD 4 and Dodson computer programs were used to evaluate inflow to the sedimentation structure, outflow from the structure and resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendix A, B, and C).

AUG 2004
APPROVED

J1-A 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	112.47	135.1
Volume	ac-ft	10.54	8.87
Storage			
Peak Stage	msl	N/A	6571.1
Emergency Spillway Elevation	msl	6570.1	6570.1
Peak Storage	ac-ft	N/A	21.5
Storage Capacity	ac-ft	18.4	18.4
Outflow			
Peak Flow	msl	N/A	47.7
Spillway Elevation	msl	6570.1	6570.1
Embankment Crest Elevation	msl	6572.3	6572.3
Peak Stage	msl	--	6571.1
Freeboard	ft	--	1.2
Emergency Spillway Channel			
Flow Depth	ft	--	0.9
Critical Velocity	fps	--	4.1
Mannings "n"	--	--	0.030
Width	ft	--	18.0
Outflow Channel			
Slope	%	--	25
Normal Velocity	fps	--	6.6
Normal Depth	ft	--	0.38
Mannings "n"	--	--	.057
Riprap D_{50}	in	--	6

APPROVED
AUG 2004

EMERGENCY SPILLWAY AND OUTFLOW CHANNEL

The emergency spillway and outlet channel for J1-A will be a trapezoidal channel with dimensions listed below. The alignment and dimensions are shown on Exhibit 1.

Channel Depth	(Spillway)	2.2	ft
	(Outflow)	3.0	ft
Channel Width		18	ft
Channel Length	(Spillway)	34	ft
	(Outflow)	27	ft
Sideslopes (Horizontal to Vertical)		3:1	or flatter
Average Slope	(Spillway)	0.4	%
Maximum Slope	(Outflow)	25	%
Spillway Elevation		6570.1	ft

A 18' X 3' riprap-lined energy-dissipating basin was constructed beyond the toe of embankment as a transition into the downstream channel.

STORAGE CAPACITY

The impoundment stage-capacity table (see Exhibit 1) is based on the 2003 topographic mapping conducted for Peabody Western Coal Company. Structure J1-A is designed and constructed to contain approximately 18.4 acre-feet.

The calculations for the sediment load entering structure J1-A were made utilizing the Revised Universal Soil Loss Equation with the following parameters:

APPROVED AUG 2004

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.34
3.	Slope Factor, LS	4.16
4.	Cover Factor, C	0.29
5.	Erosion Control Factor, P	0.85

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 of J1-A is shown on Exhibit 1, J1-A Stage Capacity Table, and the results of the sediment inflow analysis are summarized in the following table.

J1-A STORAGE

Total Storage Capacity	18.4 acre-ft
10-Year, 24-Hour Storm Inflow	10.54 acre-ft
Available Sediment Storage Capacity	7.86 acre-ft
Sediment Inflow Rate	0.779 acre-ft /yr
Sediment Storage Life	10.1 yrs

* * *

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

Appendix A	- Hydrology, Hydraulic, and Sedimentation Calculations
Appendix B	- SEDCAD4 (Input and Output) 10-Year, 24-Hour Storm Event
Appendix C	- SEDCAD4 (Input and Output) 25-Year, 6-Hour Storm Event
Exhibit 1	- Proposed J1-A Sedimentation Pond Design

APPROVED
4 AUG 2004

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

AUG 2004
APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: J-1 AREA

STRUCTURE: J1-A POND

TIME OF CONCENTRATION

	H (HI)	H (LO)	H
ELEV. DIFFERENCE (H):	6687.5	6558.2	**129.3**

	L (FT.)	L (MI.)
WATERCOURSE LENGTH (L):	2895	**0.5483**

TC = [(11.9 x (**L**^3)) / **H**]^ 0.385

TC = **0.1994**

SCS CURVE NUMBER

	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	CN	AREA (Ac.)	CN*AREA
AREA1	RECLAIMED	AVG	B	86	98	8428
AREA2	DISTURBED	AVG	D	91	20.6	1874.6
AREA3	PJ	AVG	D	83	9.9	821.7
					TOTAL AREA 128.5	TOTAL CN*AREA 11124.3

CN = 87

DRAINAGE BASIN AREA

ACRES = **128.5** **SQ. MILES=** **0.200781**

APPROVED AUG 2004

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J1-A

SOIL ERODIBILITY FACTOR:

Soil Type	Erodibility Factor, K	Area (Acres)	K*Area
Reclaimed	0.38	98	37.24
Disturbed	0.22	20.6	4.532
PJ	0.18	9.9	1.782
	TOTAL:	128.5	43.55

Weighted K = Total K*Area/Total Area = 0.339

LENGTH SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
878	124	14.1%	0.6	8.0	8.25
509	37.5	7.4%	0.5	4.2	2.18
367	30	8.2%	0.5	4.7	2.05

Average LS = 4.16

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*

COVER AND PRACTICE FACTORS:

Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Reclaimed	40	0	98	0.15	14.70	0.8	78.4
Disturbed	0	0	20.6	1	20.60	1	20.6
PJ	30	25	9.9	0.18	1.78	1	9.9
		TOTAL	128.5		37.08		108.9

Weighted C = Total C*Area/ Total Area = 0.289

Weighted P = Total P*Area/ Total Area = 0.85

RAINFALL FACTOR:

R = 40

APPROVED AUG 2004

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J1-A

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	
Soil Erodibility Factor	0.339	
Length Slope Factor	4.16	
Cover Factor	0.3	
Practice Factor	0.8	
Annual Rainfall Factor	40	
Gross Annual Sediment Yield	13.79	*tons/acre/year*
Sediment Density	94	pcf
Gross Annual Sediment Yield	0.00674	acre-feet/acre/year
Sediment Delivery Ratio (SDR)*	90%	
Estimated Annual Sediment Yield	0.0061	acre-feet/acre/year
Watershed Area	128.5	acres
Watershed Annual Sediment Yield	0.7790	acre-feet/year
Number of years	1	years
Required Pond Sediment Storage	0.779	acre-feet

*SDR = 0.95 for drainage basins less than 100 acres
SDR=0.90 for drainage basins greater than 100 acres

APPROVED
AUG 2004

TRAPEZOIDAL CHANNEL ANALYSIS
NORMAL DEPTH COMPUTATION

May 13, 2004

PROGRAM INPUT DATA

DESCRIPTION	VALUE
Flow Rate (cfs)	47.7
Channel Bottom Slope (ft/ft)	0.004
Manning's Roughness Coefficient (n-value)	0.03
Channel Left Side Slope (horizontal/vertical)	4.0
Channel Right Side Slope (horizontal/vertical)	4.0
Channel Bottom Width (ft)	18.0

COMPUTATION RESULTS

DESCRIPTION	VALUE
Normal Depth (ft)	0.87
Flow Velocity (fps)	2.56
Froude Number	0.523
Velocity Head (ft)	0.1
Energy Head (ft)	0.97
Cross-Sectional Area of Flow (sq ft)	18.61
Top Width of Flow (ft)	24.93

HYDROCALC Hydraulics for Windows, Version 1.0 Copyright (c) 1996
Dodson & Associates, Inc., 5629 FM 1960 West, Suite 314, Houston, TX 77069
Phone:(281)440-3787, Fax:(281)440-4742, Email:software@dodson-hydro.com
All Rights Reserved.

APPROVED
AUG 2004

J1-A OUTFLOW CHANNEL

Material: Riprap

Trapezoidal Channel

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
18.00	3.0:1	3.0:1	25.0			

PADER Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	47.70 cfs	
Depth:	0.38 ft	
Top Width:	20.28 ft	
Velocity:	6.57 fps	
X-Section Area:	7.26 sq ft	
Hydraulic Radius:	0.356	
Froude Number:	1.93	
Manning's n:	0.0570	
Dmin:	3.00 in	
D50:	6.00 in	
Dmax:	9.00 in	

AUG 2004
APPROVED

APPENDIX B

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

AUG 2004
APPROVED

Copyright 1998 Pamela L. Schwab

Temporary Sedimentation Structure
J1-A
Black Mesa Mine

APPROVED
AUG 2004

Randy S. Lehn

Peabody Western Coal Company
P.O. Box 650
Kayenta, AZ 86033

Copyright 1998 Pamela J. Schwab

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	2.100 inches

APPROVED
AUG 2004

Copyright 1998 Pamela L Schwab

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	128.500	128.500	112.47	10.54

APPROVED
AUG 2004

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	128.500	0.199	0.000	0.000	87.000	F	112.47	10.542
	$\sum$	**128.500**						**112.47**	**10.542**

APPROVED
AUG 2004

APPENDIX C

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

APPROVED
AUG 2004

Copyright 1998 Pamela J. Schwab

Temporary Sedimentation Structure
J1-A
25 YR-6 HR
Black Mesa Mine

APPROVED
AUG 2004

Randy S. Lehn

Peabody Western Coal Company
P.O. Box 650
Kayenta, AZ 86033

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.900 inches

APPROVED
AUG 2004

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	J1-A

#1
Pond

APPROVED
AUG 2004

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	128.500	128.500	135.08	8.87
	Out			47.65	8.87

APPROVED
AUG 2004

Structure Detail:

Structure #1 (Pond)

J1-A

Pond Inputs:

Initial Pool Elev:	6,570.10
Initial Pool:	18.02 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
6,570.10	34.00	4.00:1	4.00:1	18.00

Pond Results:

Peak Elevation:	6,571.15
Dewater Time:	0.47 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
6,560.00	0.000	0.000	0.000	
6,560.50	0.062	0.010	0.000	
6,561.00	0.248	0.083	0.000	
6,561.50	0.557	0.278	0.000	
6,562.00	0.990	0.660	0.000	
6,562.50	1.143	1.193	0.000	
6,563.00	1.308	1.805	0.000	
6,563.50	1.483	2.503	0.000	
6,564.00	1.670	3.291	0.000	
6,564.50	1.784	4.154	0.000	
6,565.00	1.902	5.075	0.000	
6,565.50	2.024	6.057	0.000	
6,566.00	2.150	7.100	0.000	
6,566.50	2.268	8.205	0.000	
6,567.00	2.389	9.369	0.000	
6,567.50	2.513	10.594	0.000	
6,568.00	2.640	11.882	0.000	
6,568.50	2.771	13.235	0.000	

APPROVED AUG 2004

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
6,569.00	2.905	14.653	0.000		
6,569.50	3.042	16.140	0.000		
6,570.00	3.182	17.695	0.000		
6,570.10	3.210	18.015	0.000		Spillway #1
6,570.50	3.327	19.322	14.844	8.80	
6,571.00	3.476	21.023	33.403	1.90	
6,571.15	3.523	21.554	47.646	0.50	Peak Stage
6,571.50	3.629	22.799	81.074		
6,572.00	3.785	24.653	143.043		
6,572.30	3.880	25.802	187.850		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,560.00	0.000	0.000
6,560.50	0.000	0.000
6,561.00	0.000	0.000
6,561.50	0.000	0.000
6,562.00	0.000	0.000
6,562.50	0.000	0.000
6,563.00	0.000	0.000
6,563.50	0.000	0.000
6,564.00	0.000	0.000
6,564.50	0.000	0.000
6,565.00	0.000	0.000
6,565.50	0.000	0.000
6,566.00	0.000	0.000
6,566.50	0.000	0.000
6,567.00	0.000	0.000
6,567.50	0.000	0.000
6,568.00	0.000	0.000
6,568.50	0.000	0.000
6,569.00	0.000	0.000
6,569.50	0.000	0.000
6,570.00	0.000	0.000
6,570.10	0.000	0.000
6,570.50	14.844	14.844
6,571.00	33.403	33.403
6,571.50	81.074	81.074

APPROVED
AUG 2004

Elevation	Emergency Spillway (cfs)	Combined Total Discharge (cfs)
6,572.00	143.043	143.043
6,572.30	187.850	187.850

APPROVED
APR 2004

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	128.500	0.199	0.000	0.000	87.000	F	135.08	8.869
	$\sum$	**128.500**						**135.08**	**8.869**

APPROVED
AUG 2004

INSPECTION REPORT

Sedimentation Structure

J3-A

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Approach Channel	6
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
REMEDIAL COMPLIANCE PLAN	8
GEOTECHNICS	8
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J3-A is 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-A is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-A. 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-A was inspected on September 4, 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-A 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-A has a 62.9-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 84% reclaimed and 16% Sagebrush/grass.

EMBANKMENT

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

Structure J3-A

Embankment	Residual Sandstone Soils
Foundation	Sandstone
Right Abutment	Sandstone
Left Abutment	Sandstone
Height	11.7 ft
Crest Width	13 ft
Upstream Slope	3.3 H : 1 V
Downstream Slope . . .	3.7 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J3-A, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J3-A is a category A-5 embankment. A standard category A-5 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

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

The J3-A 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-A 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 J3-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.386	mi
2.	Elevation Difference, H	71	ft
3.	Time of Concentration, T_c	0.168	h
4.	Lag time, $0.6T_c$	0.101	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	62.9	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.

J3-A HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	86	103
Volume	acre-ft	4.59	3.93
Storage			
Peak Stage	ft	6529.74	6532.68
Spillway Elevation . .	ft	6531.42	6531.42
Peak Storage	acre-ft	4.59	--
Storage Capacity . . .	acre-ft	6.30	--
Outflow			
Peak Flow	cfs	0	35
Embankment Crest Elevation	ft	--	6533.84
Peak Stage	ft	--	6532.98
Freeboard	ft	--	0.86

Approach Channel

The existing approach channel for J3-A has a U-shaped channel with following dimensions:

Channel width	13 ft
Channel length	50 ft
Slope	8 percent

Spillway Channel

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

Channel depth	2 ft
Channel width	13 ft
Channel length	40 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	1 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for J3-A has a U-shaped channel with the following dimensions:

Channel width	13 ft
Channel length	210 ft
Side slopes (horizontal to vertical). .	2:1
Exit slope	15 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-A.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.39
3. Slope Factor, LS 0.83
4. Cover Factor, C 0.147
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-A and the results of the sediment inflow analysis are summarized in the following table.

J3-A STORAGE

Total Storage Capacity	6.30	acre-ft
10-year, 24-hour Storm Inflow	4.59	acre-ft
Available Sediment Storage Capacity . .	1.71	acre-ft
Sediment Inflow Rate	0.0555	acre-ft/yr
Sediment Storage Life	31	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-A indicated that the geotechnical problems consist of rill and gully erosion on the upstream and downstream slopes, the side slopes of the spillway channel and the bottom of the outlet channel; and a steep downstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. There is evidence of seepage through the foundation bedrock below the downstream toe of the embankment. Remedial action for this condition is not required at the present time, however, future inspections should check the condition for changes.

HYDRAULICS

The storage capacity of Structure J-3A is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The bottom elevation of the existing spillway channel should be lowered to elevation 6531.27 while maintaining the bottom width of 15 feet as shown on Plate 5. A trapezoidal outflow channel with the same bottom width as the spillway 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 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.

Lowering the spillway elevation to 6531.27 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

J-3A HYDRAULICS FOR REDESIGNED SPILLWAY

	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	86	103
Volume	acre-ft	4.59	3.93
Storage			
Peak Stage	ft	6529.74	6532.68
Spillway Elevation . .	ft	6531.27	6531.27
Peak Storage	acre-ft	4.59	--
Storage Capacity . . .	acre-ft	6.14	--
Available Sediment Storage Capacity . .	acre-ft	1.55	--
Sediment Inflow Rate .	acre-ft/yr	0.0555	--
Sediment Storage Life.	yrs	28	--
Outflow			
Peak Flow	cfs	--	44
Embankment Crest Elevation	ft	--	6533.84
Peak Stage	ft	--	6532.68
Freeboard	ft	--	1.16
Spillway Channel			
Flow Depth	ft	--	1.41
Critical Velocity. . .	fps	--	4.2
Manning's "n"		--	0.040
Outflow Channel			Section I / Section II
Slope	%	--	6 / 16
Normal Velocity. . . .	fps	--	5.4 / 7.3
Normal Depth	ft	--	0.50 / 0.37
Manning's "n"		--	0.040 / 0.040

* * *

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

Plate 1 - Site Plan J3-A

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

Plate 3 - Volume-Elevation Curve J3-A

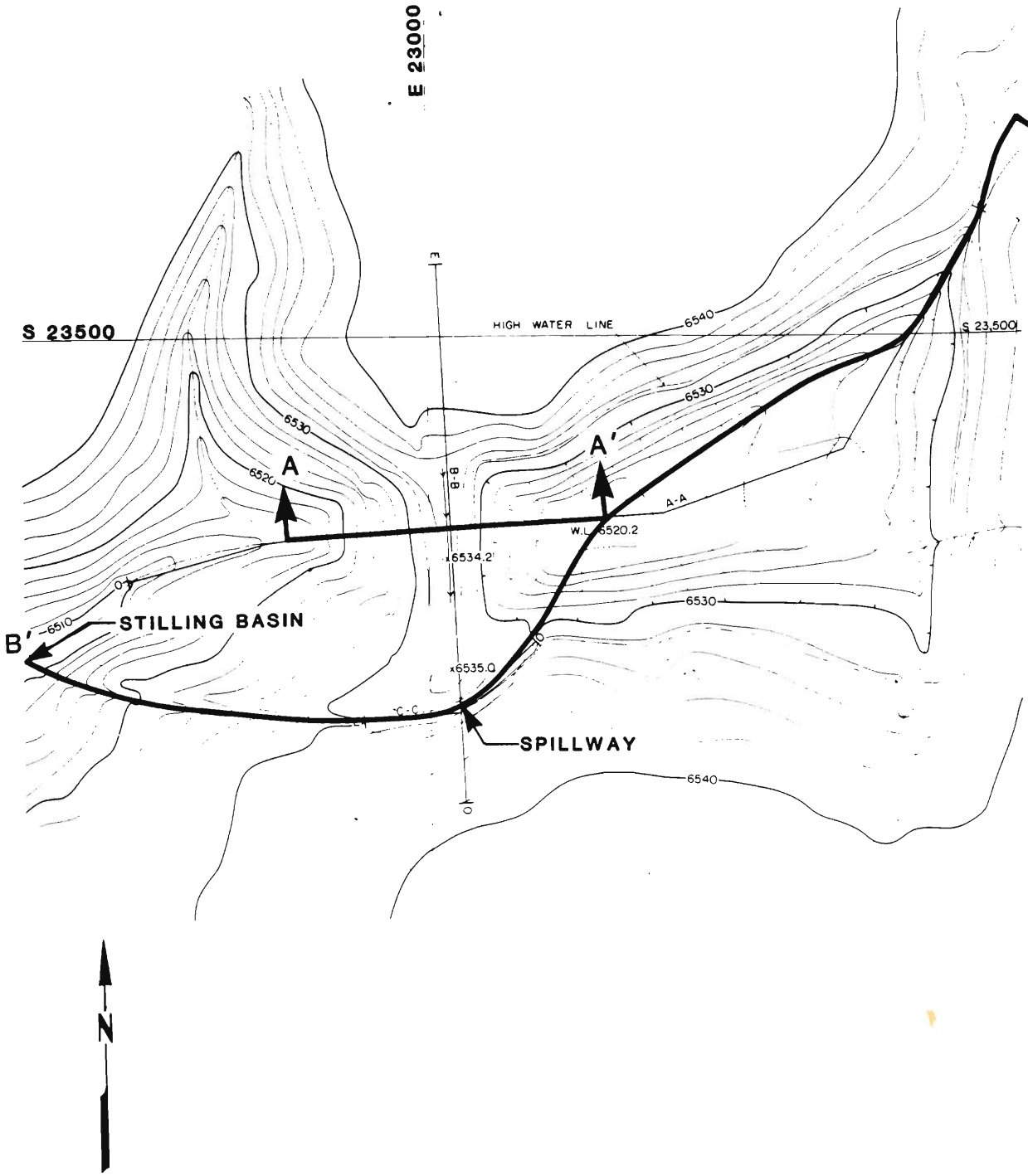
Plate 4 - Channel Profile J3-A, B-B'

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

Plate 6 - Spillway Stilling Basin Plan J3-A

Appendix A - Inspection Check List

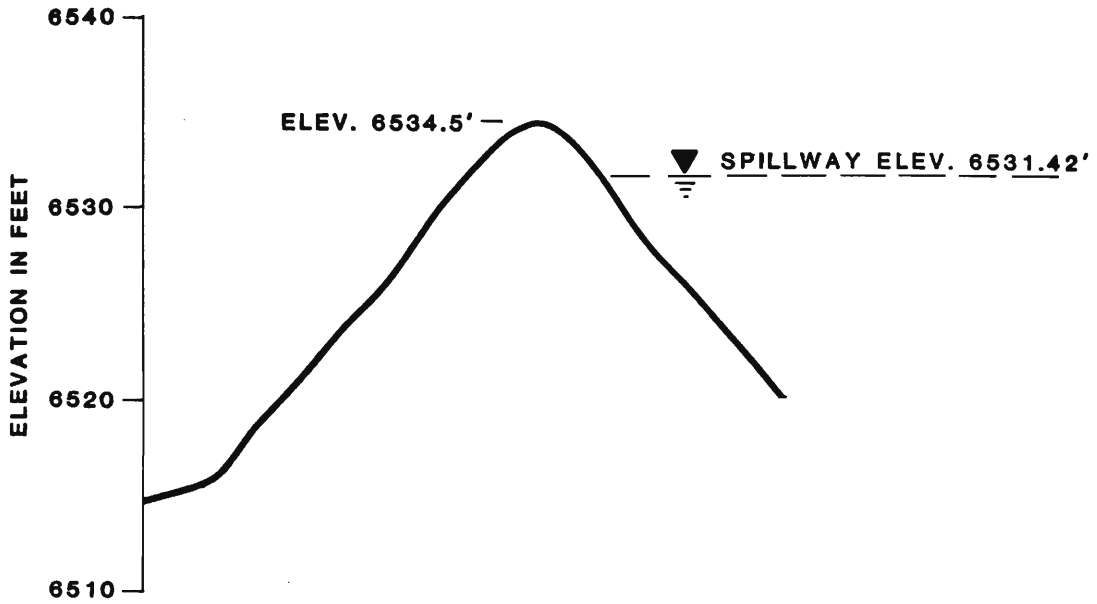
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
J3-A

BY **Dames & Moore** Plate 1

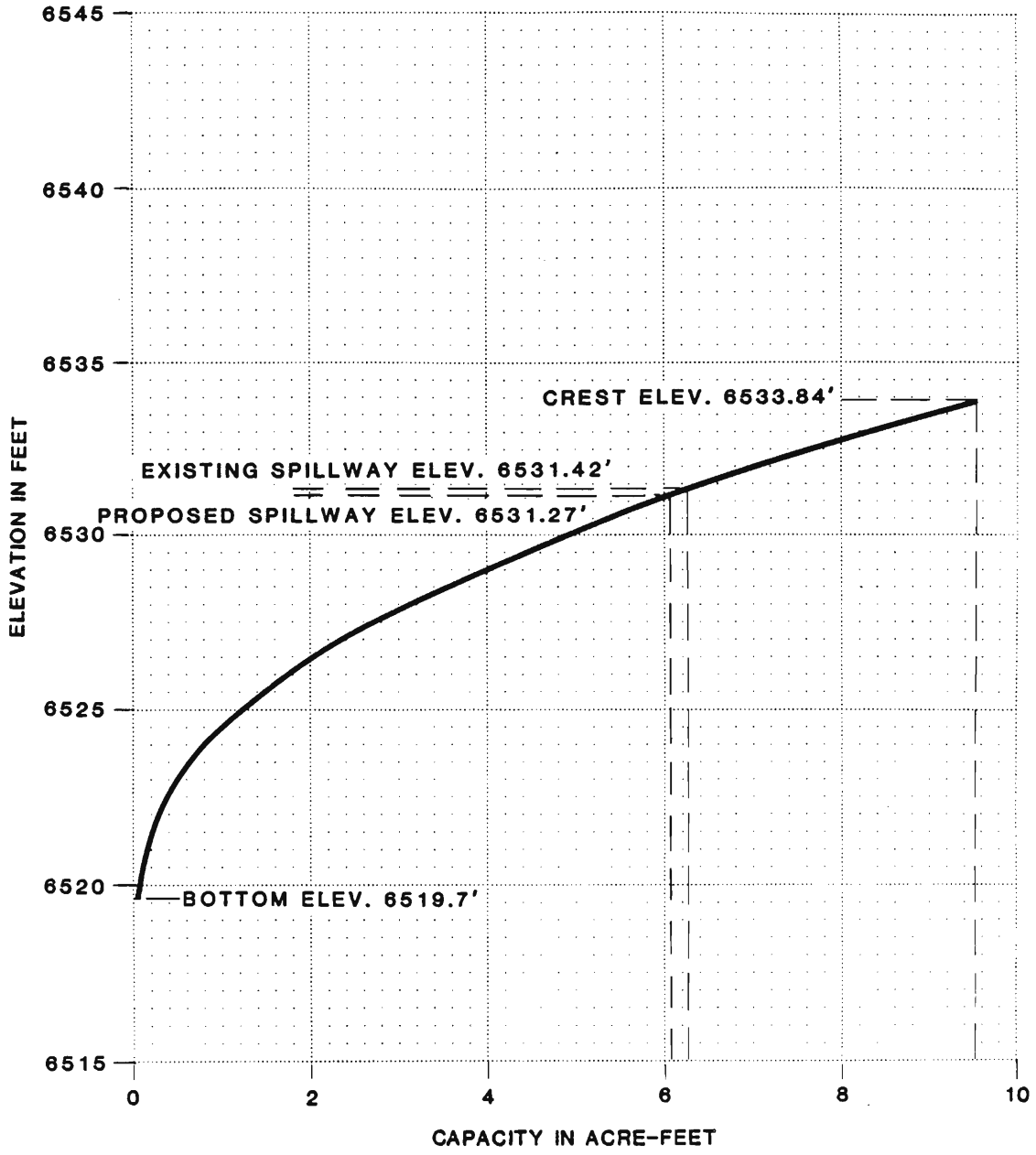


EXISTING MAXIMUM CROSS-SECTION A-A' J3-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

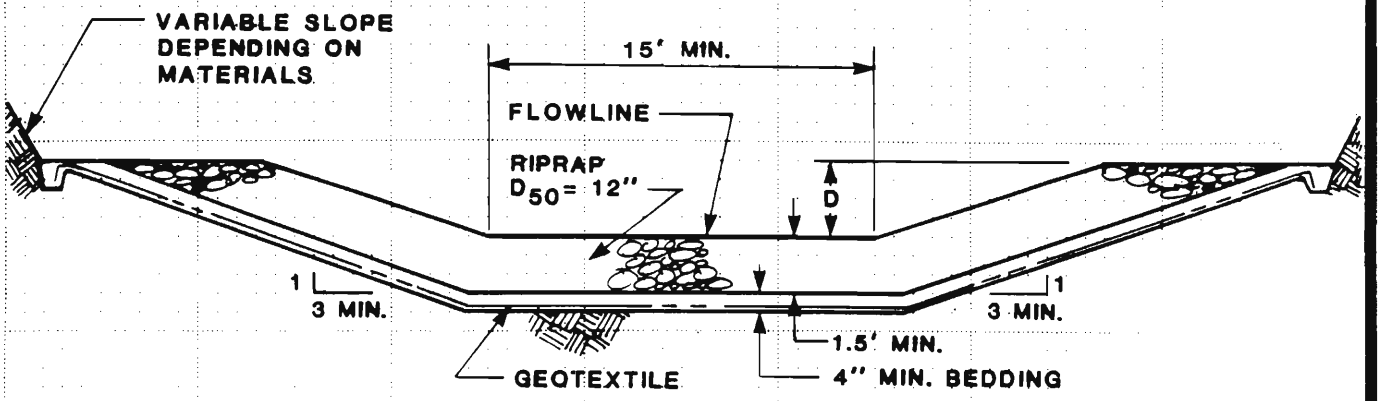
Plate 2



VOLUME-ELEVATION CURVE

J3-A

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.5'

LENGTH = 40'

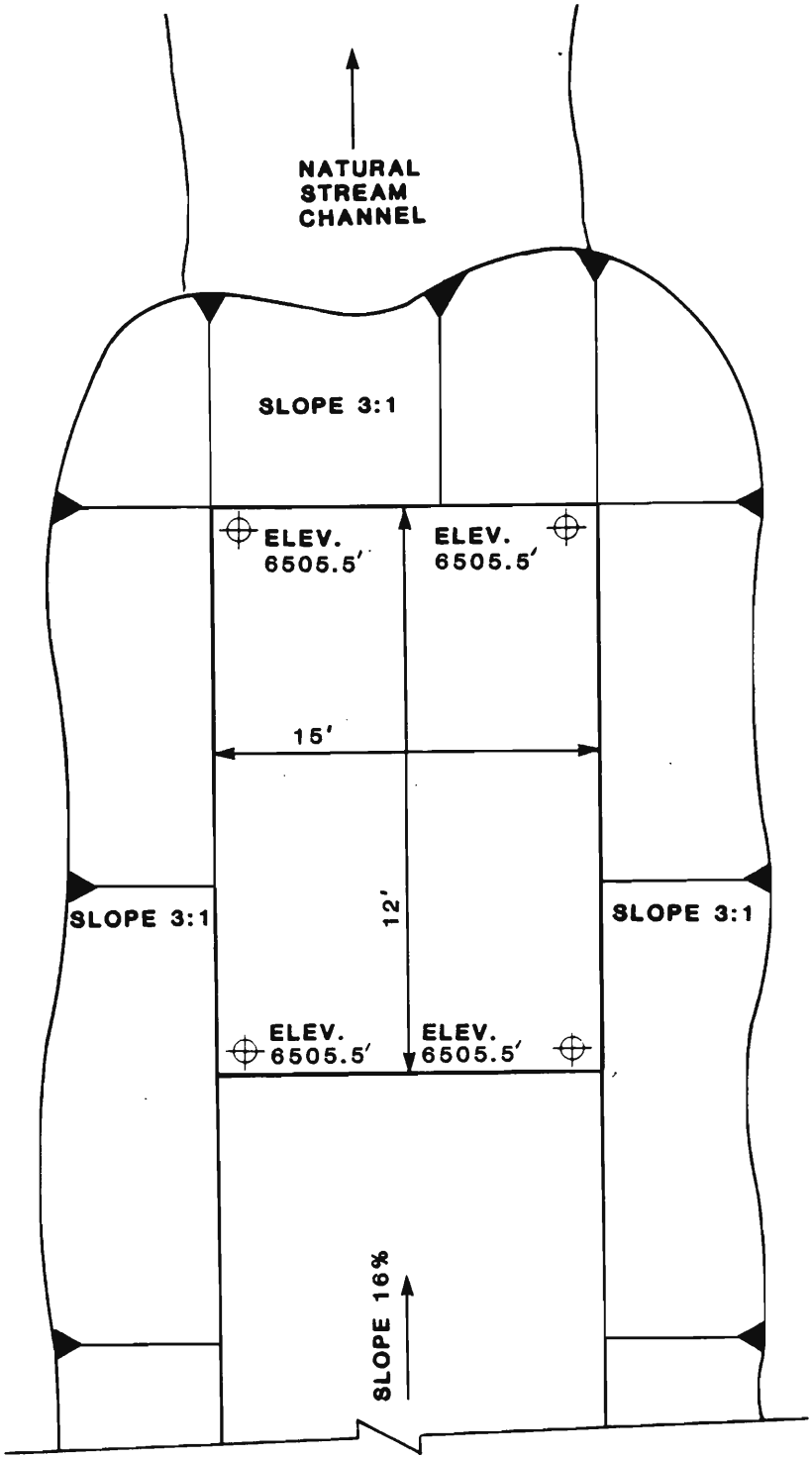
FLOWLINE ELEV. = 6531.27'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-A

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 3.4'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAM BED = 1.8'

SPILLWAY STILLING BASIN PLAN

J3-A

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J3-A
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST VALLEY EMB.			13'
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			17°
a. Adequate grass cover?	X		50%
b. Any erosion?		X	
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			15°
a. Adequate grass cover?	X		50 %
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	Evidence of past seepage thru rock
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?			Rock
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

Sediment Impoundment Name: J3-A
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			50'L 13'w
b. Approach Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
2' below crest c. Spillway Channel:	X		13'w 40'L
Are side slopes eroding?	X		Gulleys on LA.
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		210'L 15'w
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		Gulley towards bottom
Obstructed?		X	
Erosion protection?		X	
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

Sediment Impoundment Name: J3-A
Page: 6

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

9. GENERAL COMMENTS

OK

CANOPY COVER 5
GROUND COVER 100

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10134 011-22
SUBJECT SEDIMENT POND HYDROLOGY
J3-A SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6602 − 6531 = 71 ft.

WATER COURSE LENGTH = 5.1 (400) = 2040 ft. = 0.386 mi.

$$T_c = \left(\frac{11.9\,(0.386)^3}{71}\right)^{0.385} = 0.168 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.101 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
53.1 (84%)	RECLAIMED	(Pre law)	C	0.84 (87) = 73.1
9.8 (16%)	S-G	ave	C	0.16 (73) = 11.7
			EH #32	84.8

USE 85

DRAINAGE BASIN AREA

62.9 ACRE 0.098 SQ MILE

BY S. DOLAN DATE 9-9-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE FEABDY CALC'S 10.34-011-22
SUBJECT SEDIMENT INFLOW
J3A SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 84% reclaimed .84(.42)
16% EH #32 .16(.21)
.386

K = .39

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1800	65	3.6	.83

use .83

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
84%	reclaimed	—	—	.84 (.15)
16%	S-G	40	25	.16 (.13)

C = .147

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.39)(.83)(.147)(1.0) = 1.9\phi$ ton/acre/year

$A = 1.9\left(\frac{1}{2047}\right)(62.9)(.95) = .0555$ acre-feet/year

Dames & Moore

INSPECTION REPORT

Sedimentation Structure

J3-B

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8
APPENDIX A - INSPECTION CHECK LIST	
APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS	

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.

J3-B HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	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

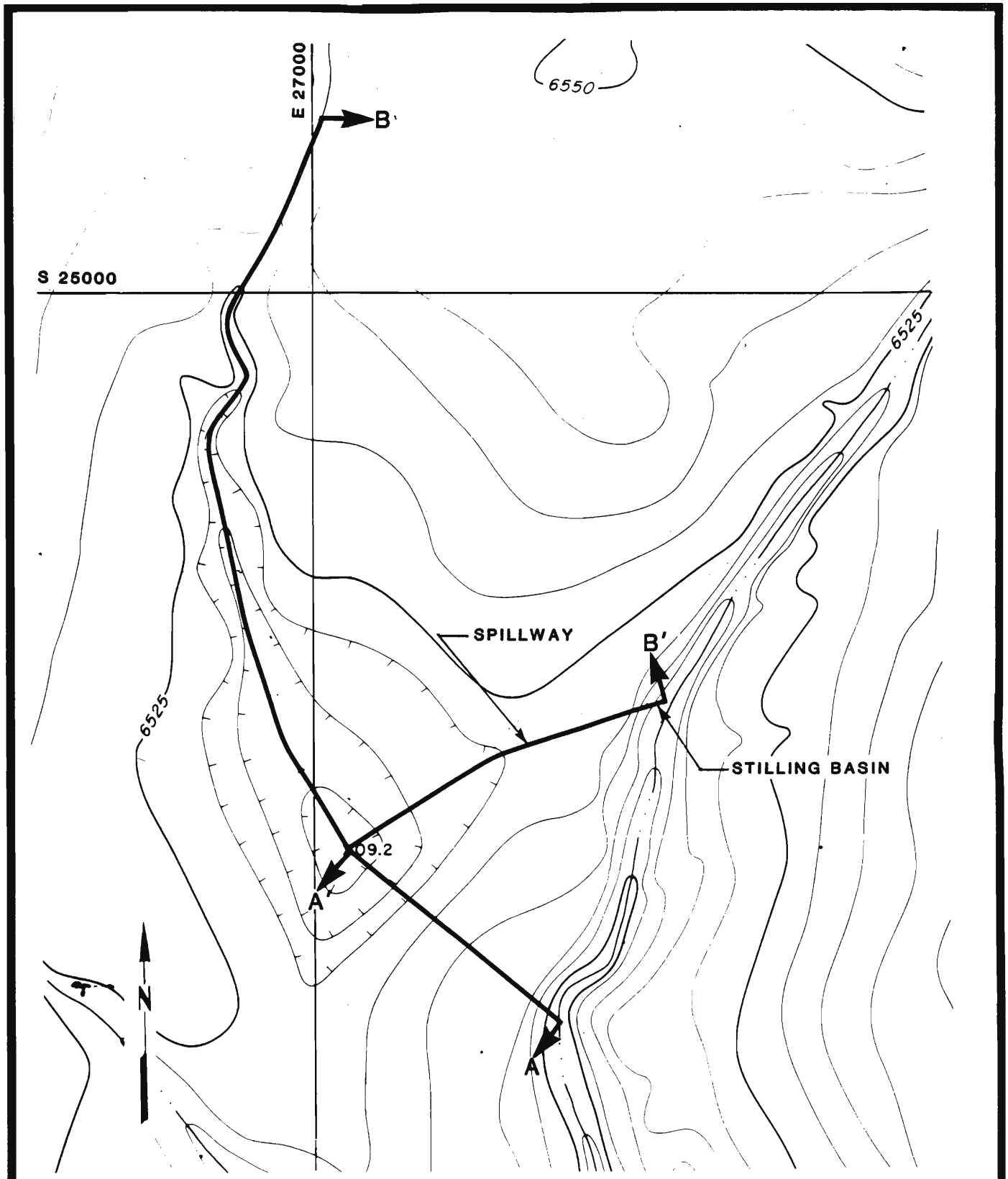
Plate 4 - Channel Profile J3-B, B-B'

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

Plate 6 - Spillway Stilling Basin Plan J3-B

Appendix A - Inspection Check List

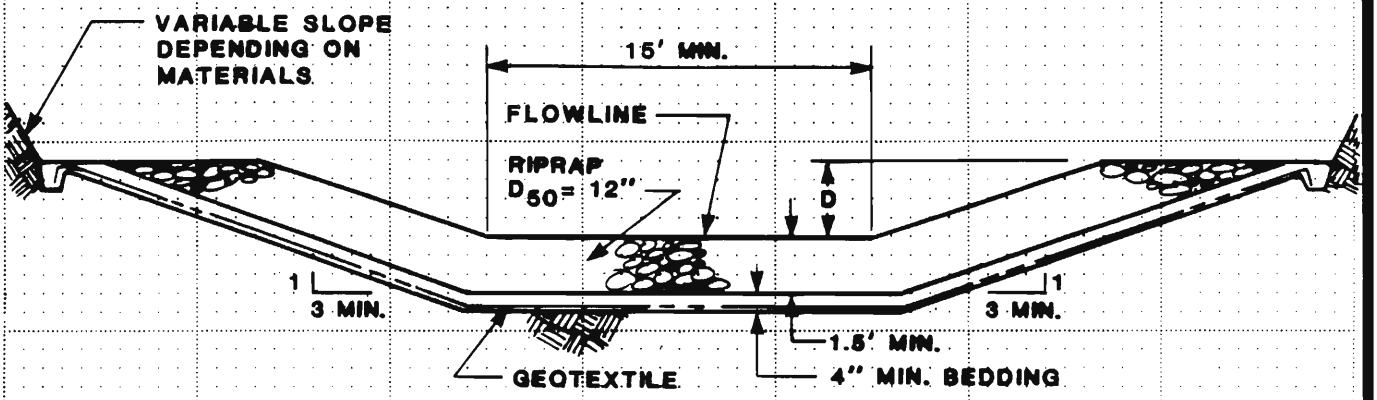
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
J3-B

BY **Dames & Moore** Plate 1



SPILLWAY CHANNEL

D = 2.9'

LENGTH = 50'

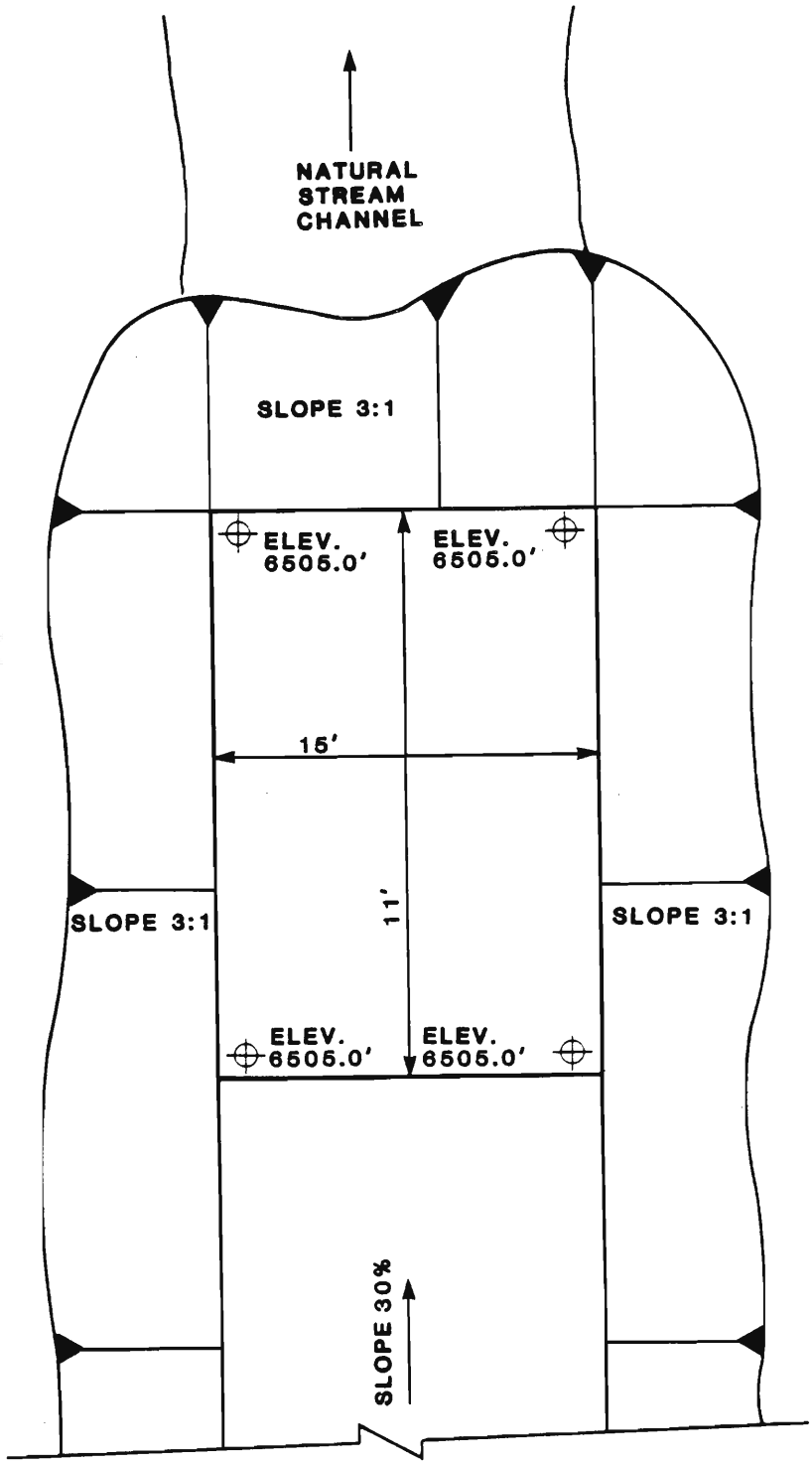
FLOWLINE ELEV. = 6523.20'

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

Sediment Impoundment Name: J3-B
Page: 4

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

Sediment Impoundment Name: J3-B
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?			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

FILE Peabody Coal Co
SUBJECT Sediment Inflow
J3 - B SHEET ___ OF ___

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ 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-J			.04 (.14)
19	S-G			.19 (.15)
6	Haul Road			.06 (1.0)
71	Reclaim			.71 (.15)
				C = .197

Erosion Control Factor

P = 1.0

SEDIMENT INFLOW

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

BY ___ DATE 10-25-86
CHECKED BY ___
COPY TO EO ___

Dames & Moore

INSPECTION REPORT

Sedimentation Structure

J3-D

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
REMEDIAL COMPLIANCE PLAN	8
GEOTECHNICS	8
HYDRAULICS	8

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure J3-D is an earthen embankment, designed and constructed in 1980 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-D is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-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 J3-D was inspected on September 4, 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-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 J3-D has a 236.2-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 32.4% Sagebrush/grass, 25.3% reclaimed, 24.9% Pinion/Juniper, and 17.4% disturbed.

EMBANKMENT

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

Structure J3-D

Embankment	Residual Shale Soils
Foundation	Sandstone
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	11.6 ft
Crest Width	15 ft
Upstream Slope	1.8 H : 1 V
Downstream Slope . . .	N/A*

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

*Sediment removed from the structure has been placed against the downstream slope of the embankment and acts as a buttress fill against the dam.

ANALYSES

STABILITY

Structure J3-D is a category B-5 embankment. A standard category B-5 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 J3-D embankment is lower in height; however, the upstream slope is steeper than the category standard; therefore, the embankment has factors of safety less than the design minimum. The downstream slope is buttressed with material excavated from the impoundment. Although a stability analysis was not performed for this specific condition the fill acts as an added resisting force and, therefore, the downstream slope is considered stable.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J3-D is located downstream from Structure J3-B. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J3-D was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J3-D 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	1.36	1.36	mi
2.	Elevation Difference, H	167	167	ft
3.	Time of Concentration, T_c . . .	0.516	0.516	h
4.	Lag time, $0.6T_c$	0.311	0.311	h
5.	SCS Curve Number	82	82	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	236.2	318.0	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table.

J3-D HYDRAULICS

	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	151	385
Volume	acre-ft	13.44*	24.38
Storage			
Peak Stage	ft	6466.42	6471.62
Spillway Elevation . .	ft	6469.08	--
Peak Storage	acre-ft	13.44	--
Storage Capacity . . .	acre-ft	19.8	--
Outflow			
Peak Flow	cfs	0	288
Embankment Crest Elevation	ft	--	6473.10
Peak Stage	ft	--	6471.62
Freeboard	ft	--	1.48
Spillway Channel			
Flow Depth	ft	--	2.54
Critical Velocity. . .	fps	--	6.2
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	33
Normal Velocity. . . .	fps	--	14.8
Normal Depth	ft	--	0.61
Manning's "n"		--	0.040

*Inflow volume for tributary drainage are between Structures J3-D and J3-B.

Spillway Channel

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

Channel depth	4 ft
Channel width	27 ft
Channel length	15 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	3 percent

Half the channel has rock providing some erosion protection within the channel, however the protection is inadequate based on the calculated velocities in the channel.

Outflow Channel

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

Channel width	27 ft
Channel length	90 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	20 percent

Rock provides some erosion protection within the channel, however the protection is inadequate based on the calculated velocities in 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-D.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.258
3. Slope Factor, LS 2.22
4. Cover Factor, C 0.289
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-D and the results of the sediment inflow analysis are summarized in the following table.

J3-D STORAGE

Total Storage Capacity	19.8	acre-ft
10-year, 24-hour Storm Inflow	13.44	acre-ft
Available Sediment Storage Capacity . .	6.36	acre-ft
Sediment Inflow Rate	0.687	acre-ft/yr
Sediment Storage Life	9	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-D indicated that the only geotechnical problem is rill and gully erosion on the upstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The upstream slope should be flattened to 2.0 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The storage capacity and spillway capacity of Structure J3-D are adequate; however, the spillway does not have an adequate outflow channel or adequate erosion protection. 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, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

* * *

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

Plate 1 - Site Plan J3-D

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

Plate 3 - Volume-Elevation Curve J3-D

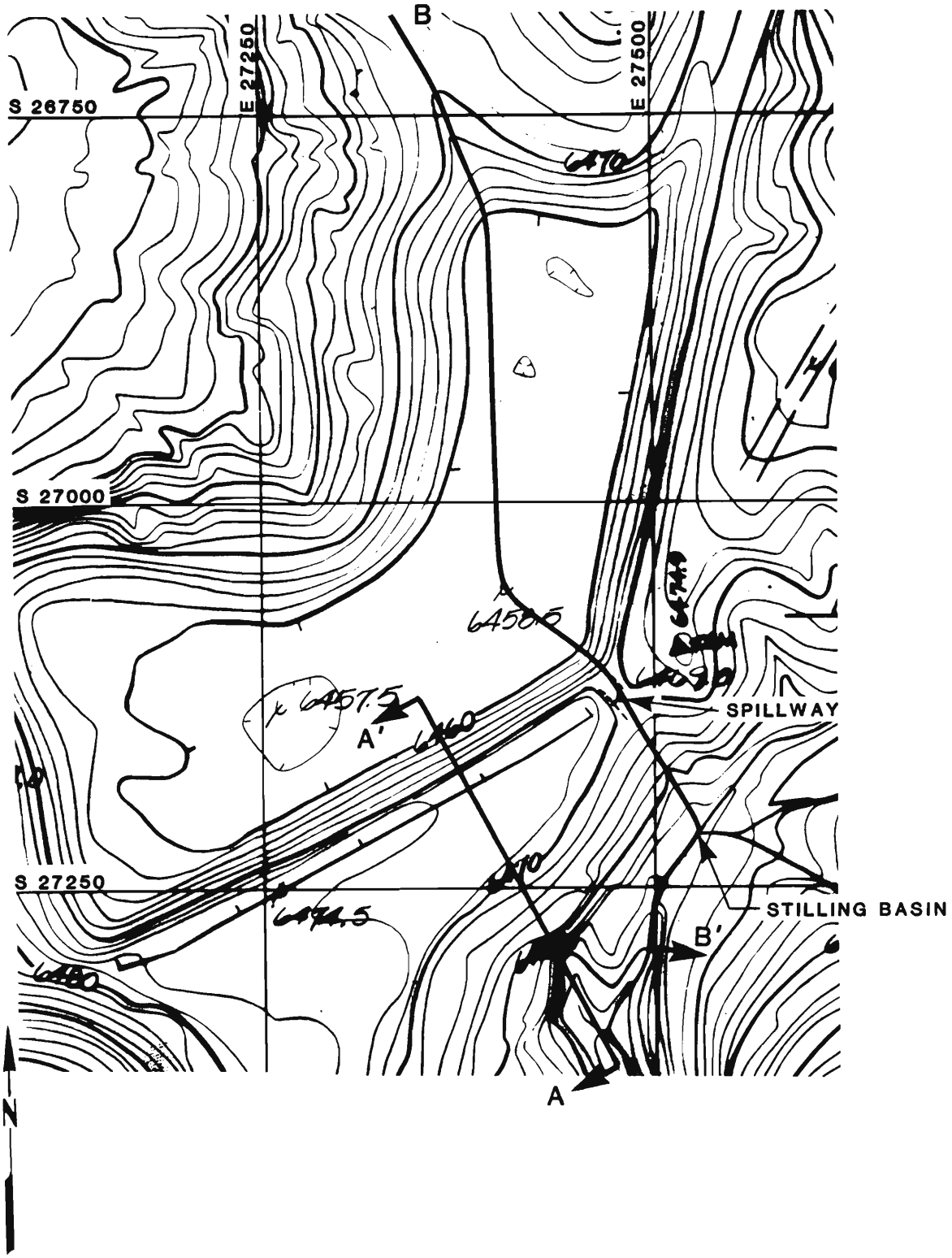
Plate 4 - Channel Profile J3-D, B-B'

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

Plate 6 - Spillway Stilling Basin Plan J3-D

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J3-D

SCALE
0 100 200
FEET

BY **Dames & Moore** Plate 1

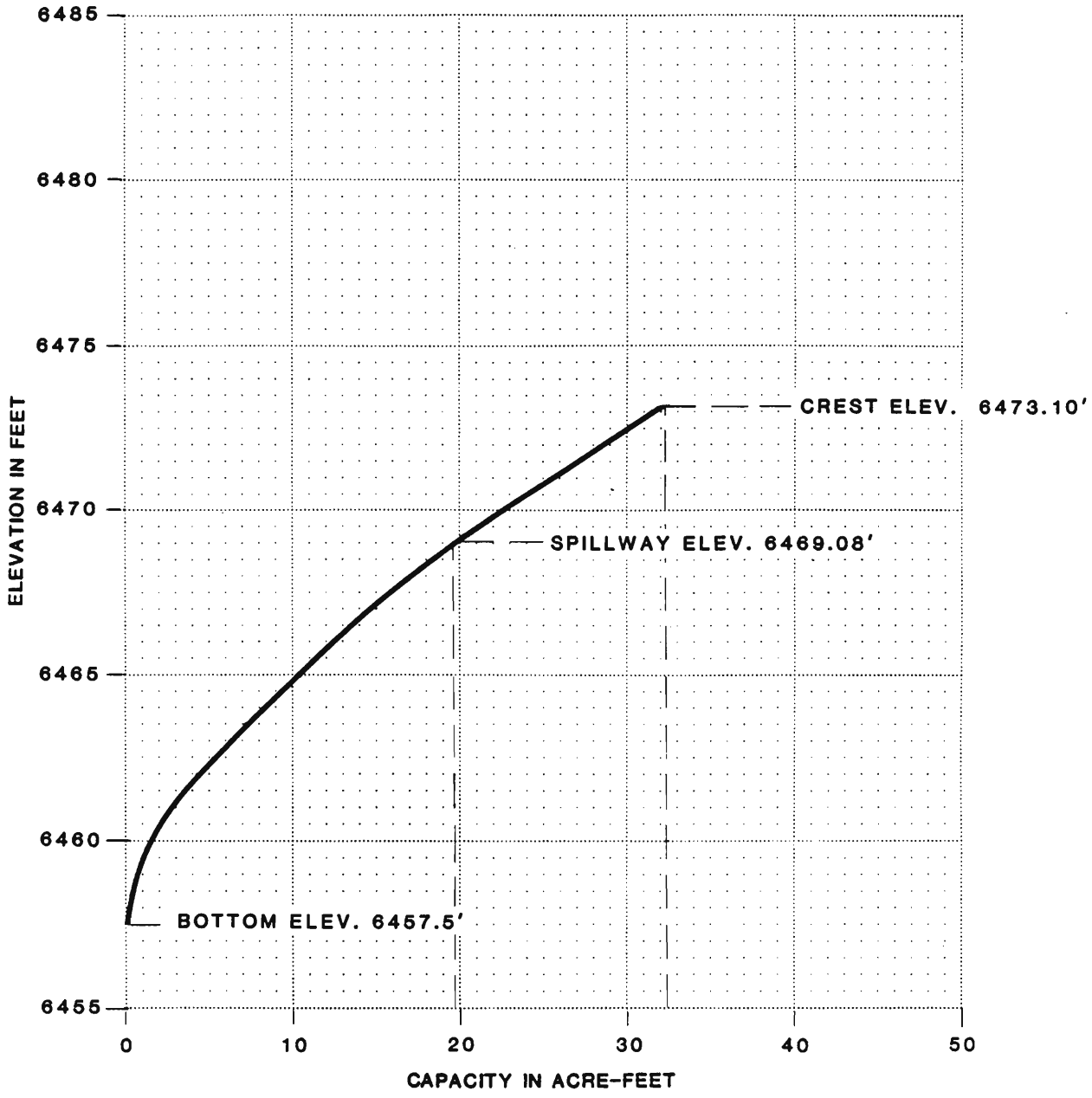
SCALE
0 50 100
FEET

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

FOR LOCATION SEE PLATE 1

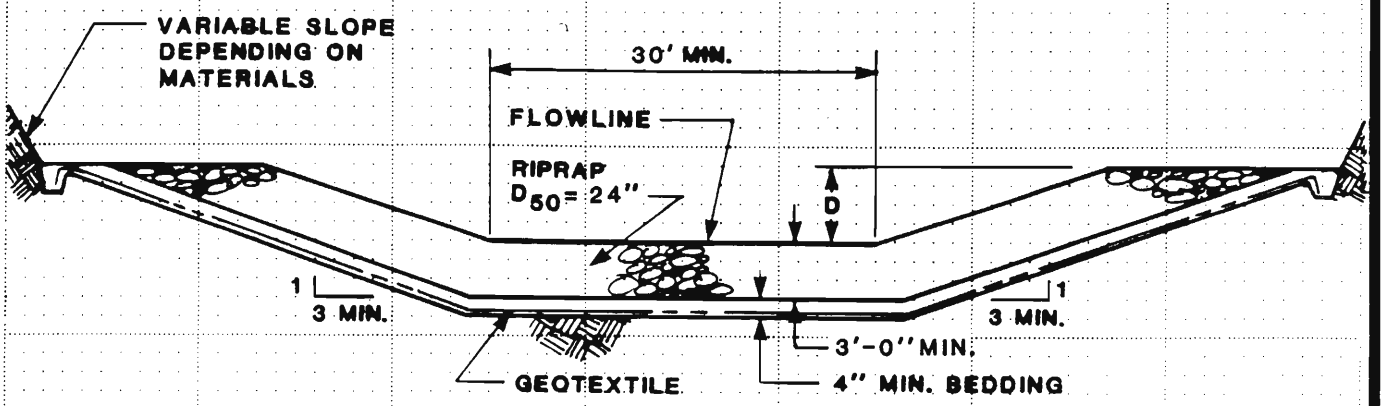
BY **Dames & Moore**

Plate 2



VOLUME-ELEVATION CURVE J3-D

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 3.6'

LENGTH = 30'

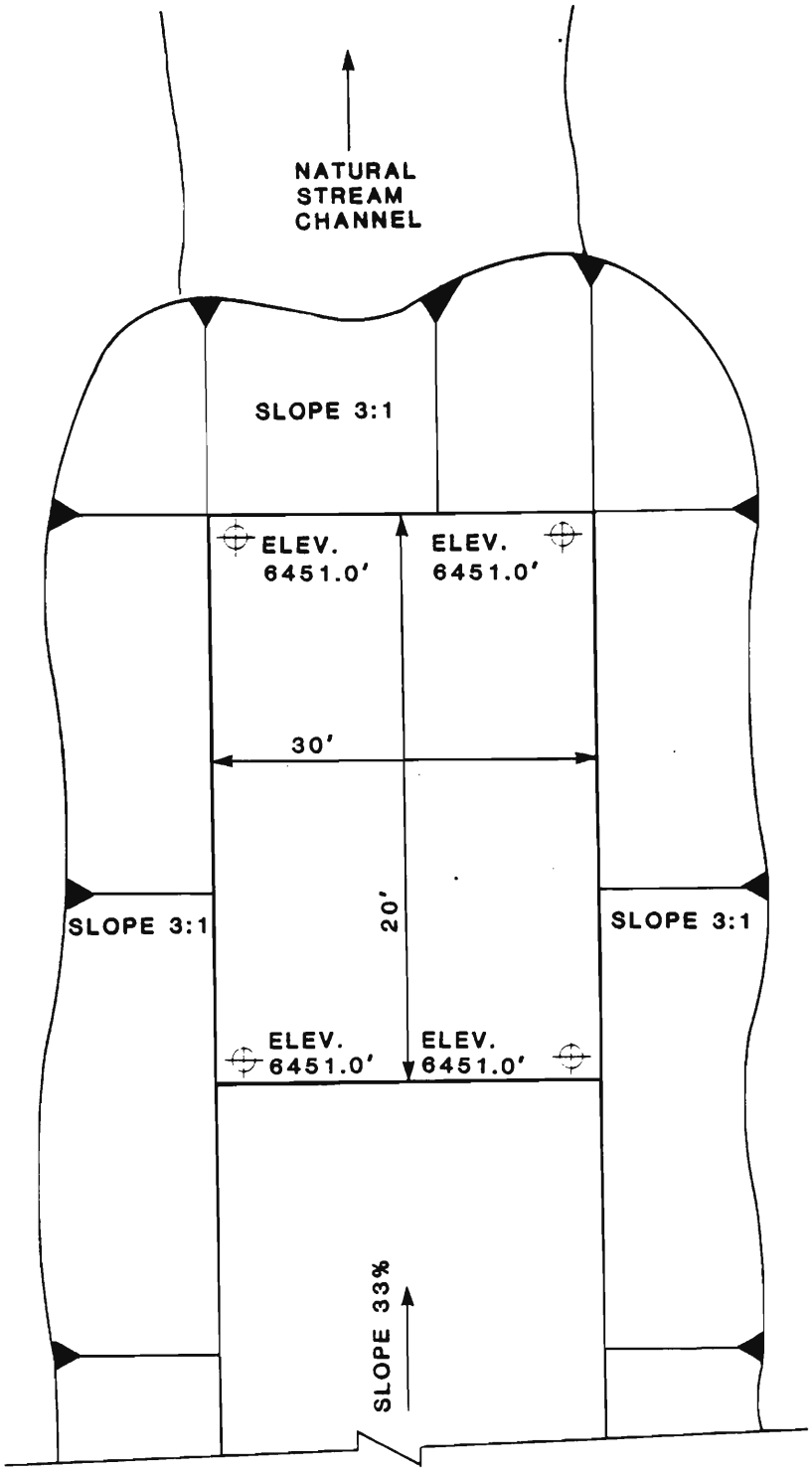
FLOWLINE ELEV. = 6469.08'

OUTFLOW CHANNEL

D = 2.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-D

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 6.1'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 2.7'

SPILLWAY STILLING BASIN PLAN J3-D

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J3-D
Page: 4

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			NA
a. Adequate grass cover?			Material from pond placed
b. Any erosion?			downstream of crest.
c. Are trees growing on slope?			
d. Longitudinal cracks?			
e. Transverse cracks?			
f. Visual depressions or bulges?			
g. Visual settlements?			NA
h. Is the toe drain dry?			
i. Are the relief wells flowing?			
j. Are boils present at the toe?			
k. Is seepage present?			
l. Animal burrows?			
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?			reddish brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

Sediment Impoundment Name: J3-D
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?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		½ Rock
d. Outflow Channel:	X		
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Fully Rock
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			NA
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

Sediment Impoundment Name: J3 - D
Page: 6

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

9. GENERAL COMMENTS

Evidence of past seepage (water loving plants & wet looking channel) downstream of outflow channel,

Sandstone outcropping d.s. of of dam

Canopy cover - 20%
ground cover - 90%

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE [illegible]
SUBJECT Sediment Pond Hydrology
J3-D SHEET ___ OF ___

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

Time of Concentration

Elev. Difference = 6635 − 6468 = 167'

Water Course Length = 18 (400) = 7200' = 1.36 mi

$$T_c = \left[\frac{11.9\,(1.36)^3}{167}\right]^{.385} = 0.516$$

Lag = .6 T_c = .310 hr

SCS Curve Number

Drainage Area (Ac)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
59.7 (25.2%)	Reclaim	Poor	D	87 (.253)
41.2 (17.4%)	Disturbed		D	94 (.174)
76.5 (32.4%)	S-G	Average	C	73 (.324)
58.8 (24.9%)	P-J	Average	C	78 (.249)
236.2				81.4

CN = 82

Drainage Basin Area

236.2 Ac = 0.369 sq. Miles

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE Peacody Coal Co
SUBJECT Sediment Inflow
J3-D SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

Rainfall Factor

K = 40

Soil Erodibility Factor

Soil Type = .253 (.42)
.573 (.21)
.174 (.18)

K = .258

Slope Factor

Length (FT)	ΔElev (FT)	Slope (%)	LS
500	55	11	.25
1000	40	4	.20
1400	40	2.9	.20
1200	85	7.1	.35
			2.22

Cover Factor

Area (Ac)	Cover Type	% Cover	Canopy (%)	Weighted C
25.3%	Reclaimed	—	—	.253 (.15)
17.4%	Disturbed	—	—	.174 (1.0)
32.4%	S-G	40	25	.324 (.13)
24.9%	P-S	40	25	.249 (.14)

C = .289

Erosion Control Factor

P = 1.0

Sediment Inflow

A = 40 (.258) (2.22) (.289) (1.0) = 6.62 Ton/Acre/Year

A = 6.62 $\left(\frac{1}{2047}\right)$ (236.2) (.9) = 0.687 A-F/Year

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE
SUBJECT Lag Time J3-B To J3-D
SHEET ___ OF ___

Pond J3-B Flows into Pond J3-D

Watercourse Length Between Ponds = 1440' = 0.273 miles

Elev. Diff. = 6510 - 6468 = 42'

Slope = 42/1440 = 3%

$$T_c = \left[\frac{11.9\,(.273)^3}{42}\right]^{.385} = .137\ hr = 8.2\ min$$

$$\text{Velocity} = \frac{1440}{8.2(60)} = 2.9\ FPS$$ Reasonable For 3% Slope

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

BY ____ DATE ____
CHECKED BY ____
COPY TO EO ____

Dames & Moore

J3-D COMBINED WITH J3-B

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J3-D SHEET ___ OF ___

SPILLWAY DESIGN FOR 100-YR · 6HR

TIME OF CONCENTRATION

ELEVATION DIFFERENCE =

WATER COURSE LENGTH =

T_c =

LAG TIME = $0.6 T_c$ = Use J3-D LAG TIME 0.311 hr

SCS CURVE NUMBER

	DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
J3-B	3.4	P-J	ave.	C	78 (0.01) = 0.78
	15.9	S-G	ave.	C	73 (0.05) = 3.65
	4.5	Haul Road	—	C	91 (0.01) = 0.91
J3-D	117.7	Reclaim (pre law)	poor	D	87 (0.37) = 32.19
	41.2	Disturbed	—	D	94 (0.13) = 12.22
	76.5	S-G	ave.	C	73 (0.24) = 17.52
	58.8	P-J	ave.	C	78 (0.18) = 14.04
					81.3

Use 82

DRAINAGE BASIN AREA

318.0 ACRES 0.497 SQ. MILE

J3-B 81.8
J3-D 236.2
318.0

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

BY G Smith DATE 10/4/85 CHECKED BY ___ COPY TO EO ___

Dames & Moore

INSPECTION REPORT

Sedimentation Structure

J3-E

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
ANALYSES	3
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	6
REMEDIAL COMPLIANCE PLAN	7
GEOTECHNICS	7
HYDRAULICS	8

APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure J3-E is an earthen embankment, designed and constructed in 1981 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-E is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J3-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 J3-E was inspected on August 29, 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-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 J3-E has a 239.2-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 41% Pinion/Juniper, 29% Sagebrush/grass, 16% reclaimed, and 14% disturbed.

EMBANKMENT

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

Structure J3-E

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	18.4 ft
Crest Width	15 ft
Upstream Slope	2.6 H : 1 V
Downstream Slope . . .	3.3 H : 1 V

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

ANALYSES

STABILITY

Structure J3-E 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 = 30 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 4.25 H : 1 V
4. Normal pool with steady seepage saturation conditions

The upstream slope is lower in height, and flatter than the design criteria. 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 J3-E is located downstream from Structure WW-5. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J3-E was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J3-E 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	0.97	0.97	mi
2.	Elevation Difference, H	160	160	ft
3.	Time of Concentration, T_c . . .	0.355	0.355	h
4.	Lag time, $0.6T_c$	0.213	0.213	h
5.	SCS Curve Number	84	84	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	239.2	251.3	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.

J3-E HYDRAULICS

	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	217	382
Volume	acre-ft	15.9*	20.7
Storage			
Peak Stage	ft	6530.84	--
Spillway Elevation . .	ft	6530.30	--
Peak Storage	acre-ft	--	--
Storage Capacity . . .	acre-ft	13.0	--
Outflow			
Peak Flow	cfs	3	276
Embankment Crest Elevation	ft	--	6534.66
Peak Stage	ft	--	6533.27
Freeboard	ft	--	1.39

*Inflow volume for tributary drainage area between Structures J3-E and WW-5.

Spillway Channel

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

Channel depth	5.5 ft
Channel width	28 ft
Channel length	32 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 J3-E has a trapezoidal channel with the following dimensions:

Channel width	20 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	31 percent

Rock with a D50 of 10 inches provides some, but inadequate 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-E.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.249
3. Slope Factor, LS 2.735
4. Cover Factor, C 0.259
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-E and the results of the sediment inflow analysis are summarized in the following table.

J3-E STORAGE

Total Storage Capacity	13.0	acre-ft
10-year, 24-hour Storm Inflow	15.9	acre-ft
Available Sediment Storage Capacity . .	0	acre-ft
Sediment Inflow Rate	0.742	acre-ft/yr
Sediment Storage Life	0	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J3-E indicated that the geotechnical problems consist of rill erosion on the downstream slope and the right and left abutments; and a steep downstream slope. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The downstream slope should be flattened to 4.25 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The spillway capacity of Structure J3-E is adequate but the storage capacity is inadequate. The structure does not have an adequate outflow channel. The storage capacity should be increased to 18.8 acre-feet by excavating the pond as shown on Plates 1 and 5. 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.

Enlarging the storage capacity to 18.8 acre-feet gives additional sediment storage. The analysis of these conditions is summarized in the following table.

J3-E HYDRAULICS FOR EXCAVATED IMPOUNDMENT

	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	217	382	
Volume	acre-ft	15.9	20.7*	
Storage				
Peak Stage	ft	6528.63	--	
Spillway Elevation . .	ft	6530.3	--	
Peak Storage	acre-ft	15.9	--	
Storage Capacity . . .	acre-ft	18.8	--	
Available Sediment Storage Capacity . .	acre-ft	2.90	--	
Sediment Inflow Rate .	acre-ft/yr	0.742	--	
Sediment Storage Life.	yrs	4	--	
Outflow				
Peak Flow	cfs	0	276	
Embankment Crest Elevation	ft	--	6534.66	
Peak Stage	ft	--	6533.27	
Freeboard	ft	--	1.39	
Spillway Channel				
Flow Depth	ft	--	2.97	
Critical Velocity. . .	fps	--	6.7	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	4	26
Normal Velocity. . . .	fps	--	8.3	15.3
Normal Depth	ft	--	1.39	0.81
Manning's "n"		--	0.040	0.040

*Inflow volume for both tributary drainage areas of WW-5 and J3-E.

* * *

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

Plate 1 - Site Plan J3-E

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

Plate 3 - Volume-Elevation Curve J3-E

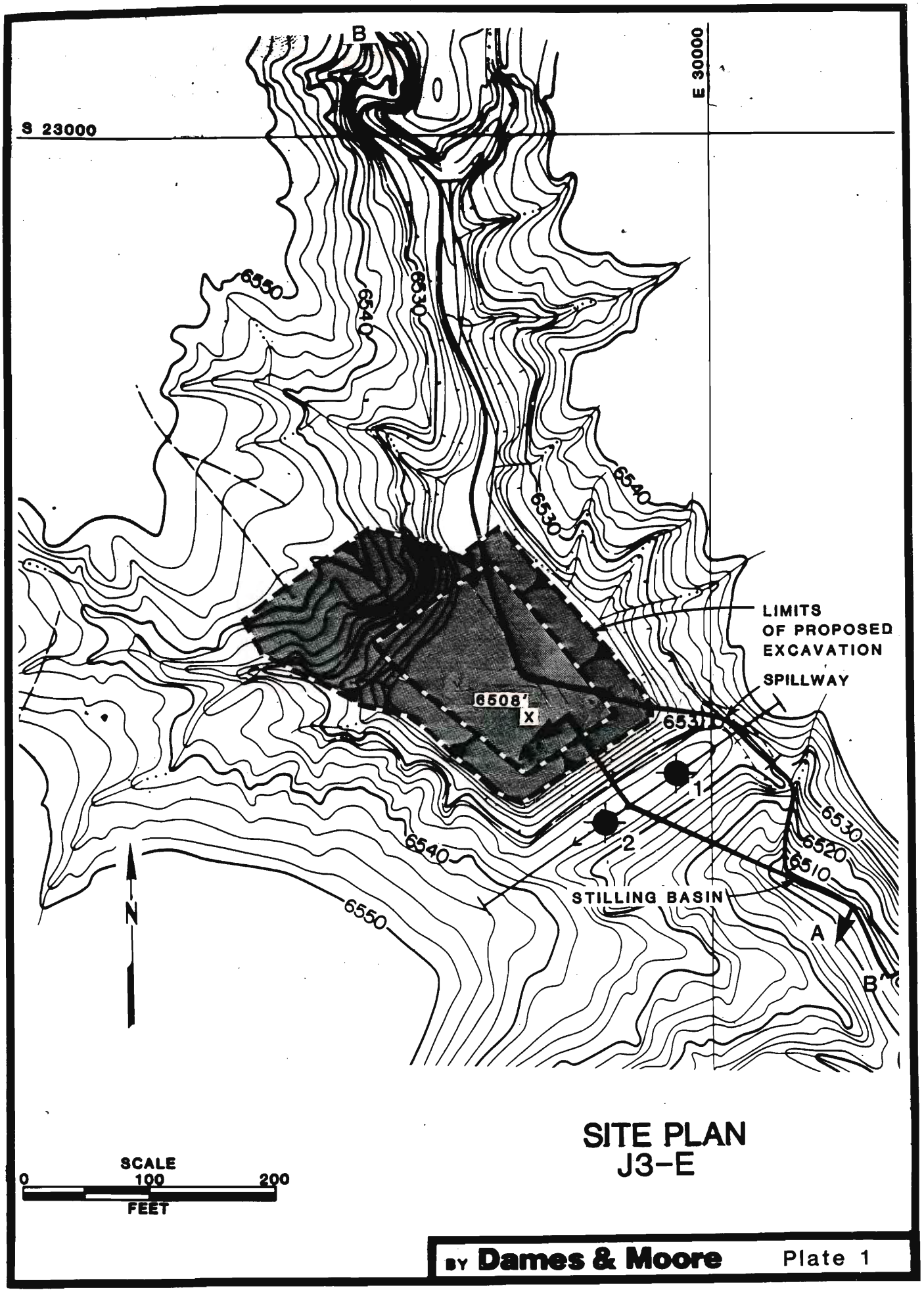
Plate 4 - Channel Profile J3-E, B-B'

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

Plate 6 - Spillway Stilling Basin Plan J3-E

Appendix A - Inspection Check List

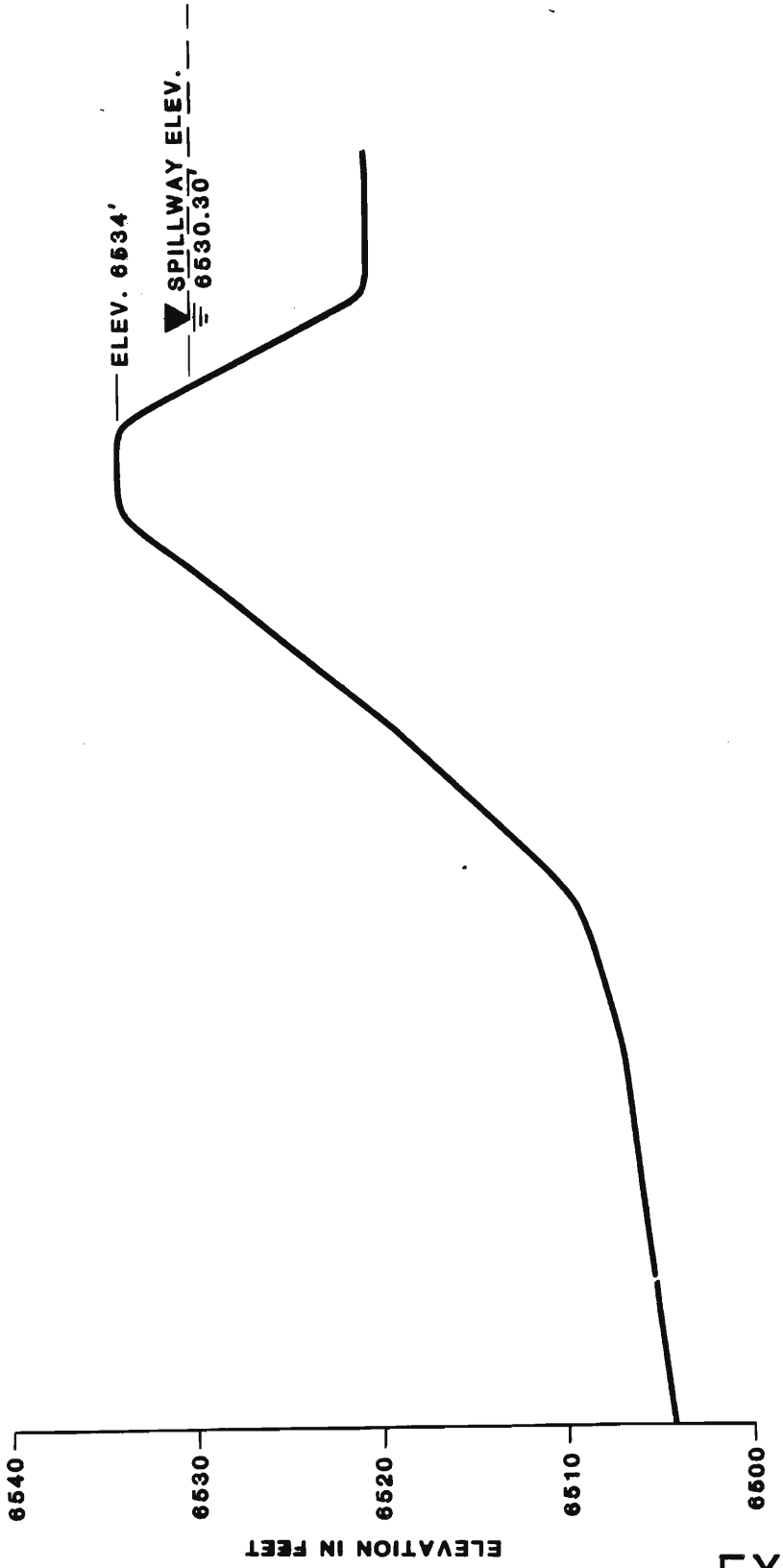
Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J3-E

BY Dames & Moore

Plate 1

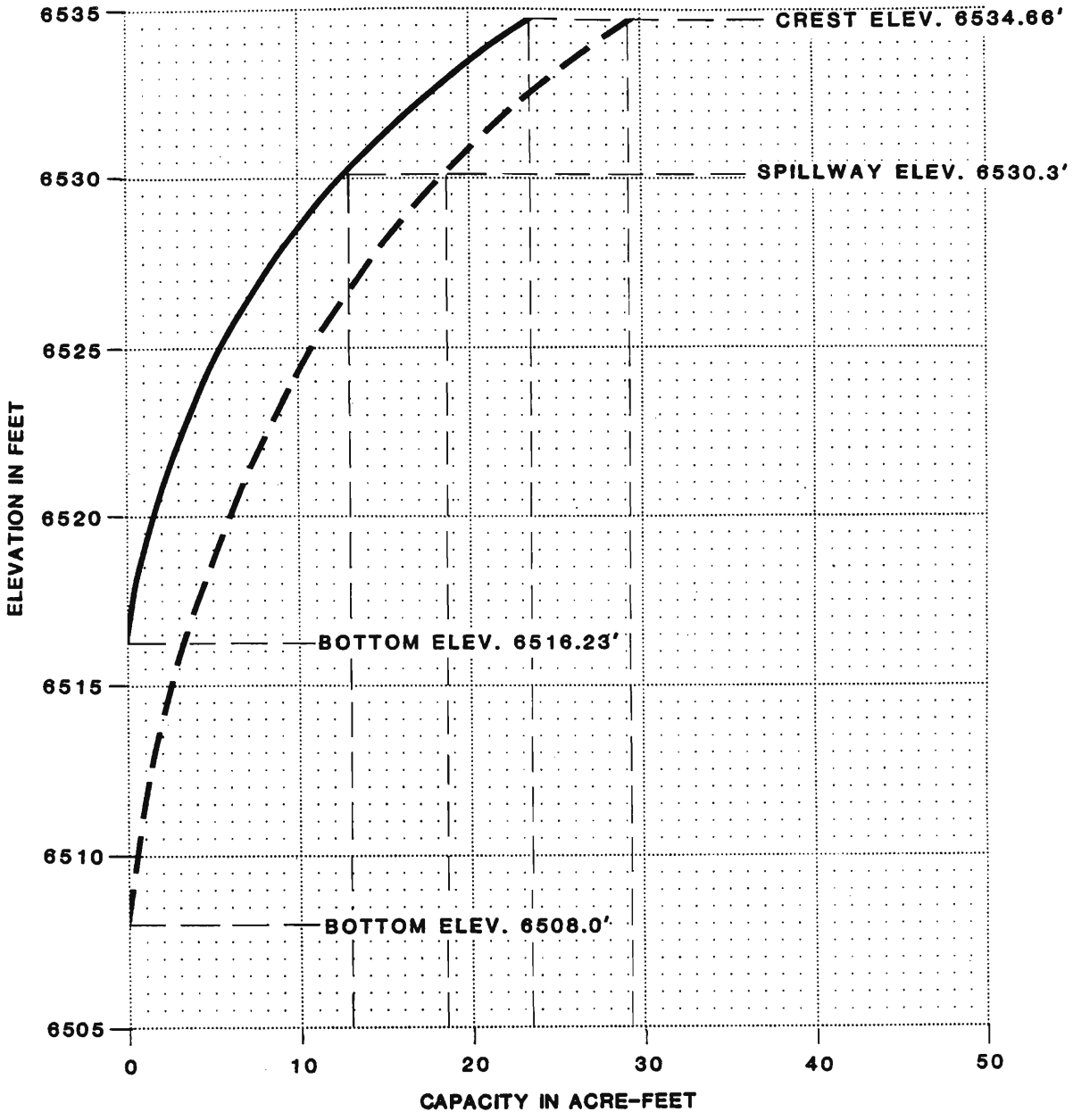


SCALE
0 50 100
FEET

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

FOR LOCATION SEE PLATE 1

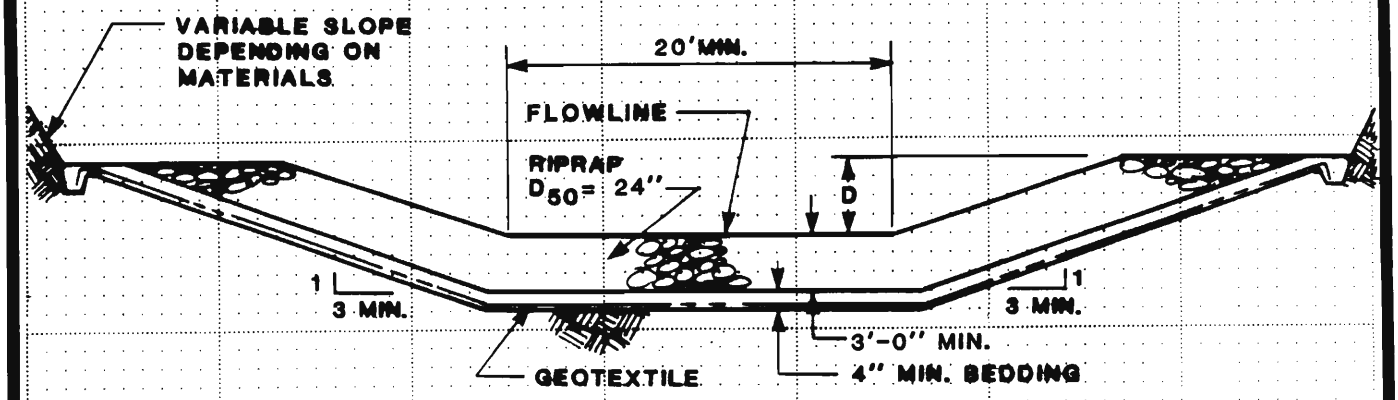
BY **Dames & Moore** Plate 2



EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE J3-E

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 4.0'

LENGTH = 30'

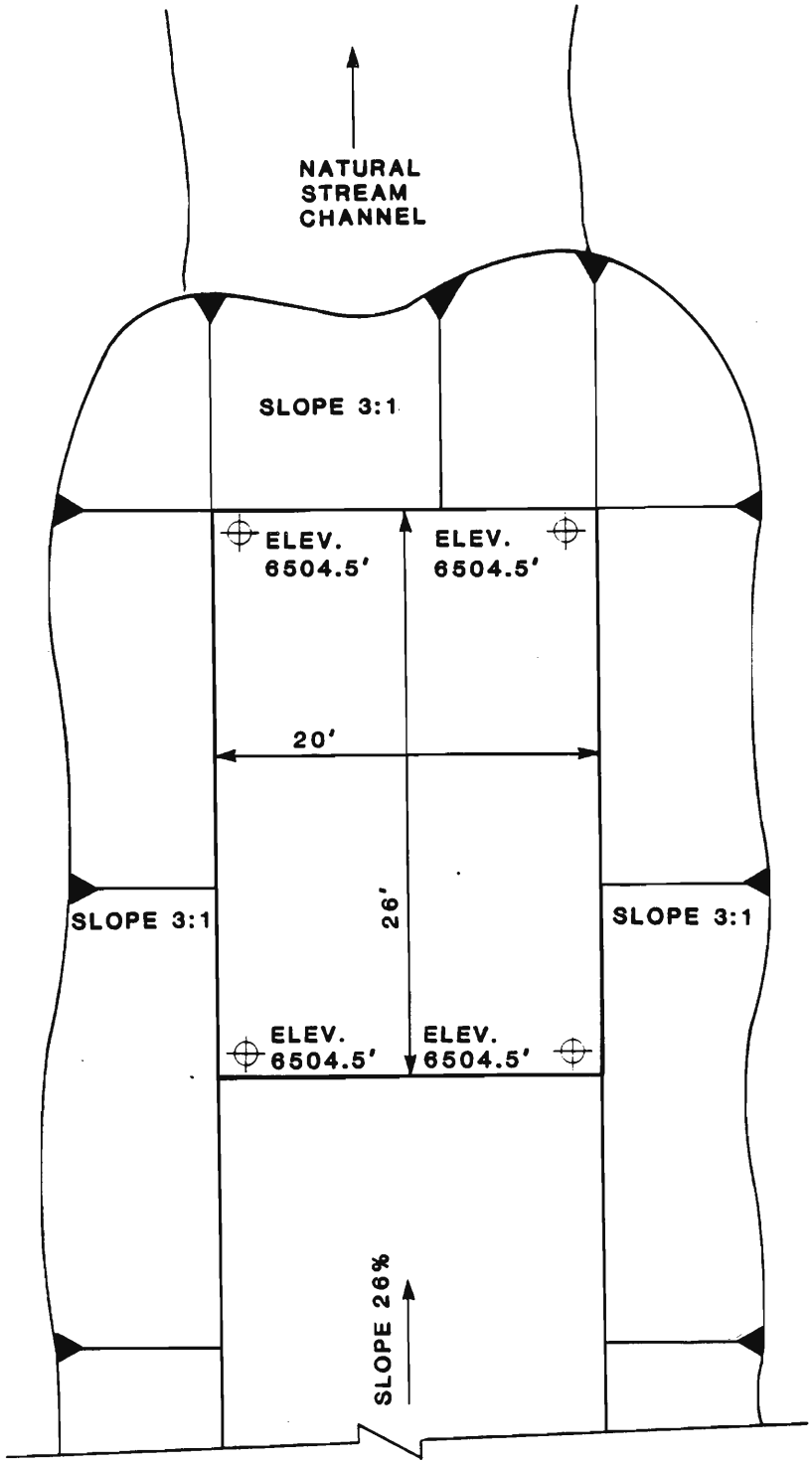
FLOWLINE ELEV. = 6530.30'

OUTFLOW CHANNEL

D = 2.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J3-E

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 7.3'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 3.5'

SPILLWAY STILLING BASIN PLAN J3-E

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: J3 -E
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			21° 2.6 to 1
a. Adequate grass cover?			NA
b. Any erosion?		X	
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?			NA
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			17° 3.25 to 1
a. Adequate grass cover?			NA
b. Any erosion?	X		Rills 40%
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?			IRREGULAR SLOPE SURFACE
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		Minor AT CONTACT
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM over shallow bedrock Reddish brown
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills Perpendicular (in line with crest
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray sm with rock

Sediment Impoundment Name: J3-E
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankment?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:			
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Rock 10"
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?			

8. GENERAL COMMENTS

Impoundment

No Sink holes

Water present 8.1' below spillway

Juniper/Pinion Bush 25% density

Watershed disturbance 25% dis.

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6690 - 6530 = 160'

WATER COURSE LENGTH = 5100' = 0.97 mi

$$T_c = \left(\frac{11.9\,(0.97)^3}{160}\right)^{0.385} = 0.355 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.213 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
(16%)	RECLAIM (pre law)		D	87 (.16)
(14%)	DIST. GRAV.		C	89 (.14)
(41%)	P-J	average	D	83 (.41)
(29%)	S-G	average	D	79 (.29)
				83.32

(Note: disturbed area is EH #32)

35% EH #32 - C
35% EH #33 - D
20% EH #35 - D
10% EH #34 - D

use 84

DRAINAGE BASIN AREA

239.2 AC. 0.374 SQ. MI.

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

FILE PEABODY COAL CO 10139-01-22
SUBJECT SEDIMENT INFLOW
J3-E SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

K = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	16 %	reclaimed	.16 (.42)
	35%	EH 32	.35 (.21)
	35%	EH 33	.35 (.22)
	14 %	EH 34	.14 (.22)
			.249

K = .249

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
900	70	7.8	2.9 (.20)
500	80	16.0	6.4 (.10)
1300	90	6.9	3.0 (.20)
500	60	12.0	4.0 (.10)
900	30	3.3	.62 (.10)
500	30	6.0	1.51 (.3)

use 2.~~8~~735

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
16%	reclaimed	—	—	.16 (.15)
14%	disturbed	—	—	.14 (1.0)
41%	P-J	40	25	.41 (.14)
29%	S-G	40	25	.29 (.13)

C = .259

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.249)(2.\cancel{8}\,735)(.259)(1.0) = 7.\cancel{22}\,055$ ton/acre/year

$A = 7.\cancel{22}\,055\left(\frac{1}{2047}\right)(239.2)(.9) = .7\cancel{50}\,42$ acre-feet/year

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

Dames & Moore

DESIGN REPORT

Sedimentation Structure

J3-G

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
DESIGN ANALYSES	2
GENERAL	2
STABILITY	3
HYDROLOGY	3
HYDRAULICS	3
Spillway and Outflow Channel	5
STORAGE CAPACITY	5
APPENDIX A - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J3-G will be an internal impoundment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the proposed mine airport at the Black Mesa Mine. The location of Structure J3-G is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J3-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

The proposed site of Structure J3-G was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure J3-G has a 241.8-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 86% reclaimed and 14% disturbed.

EMBANKMENT

The structure will not have an embankment.

DESIGN ANALYSES

GENERAL

Structure J3-G was designed by an interdisciplinary team of engineers from Dames & Moore. 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 Coal Company files includes topographic maps developed from aerial photography flown in 1985 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

A stability analysis does not need to be performed for this structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J3-G does not have a spillway. Therefore, it was designed to contain the runoff from the Probable Maximum Precipitation (PMP).

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.28	mi
2.	Elevation Difference, H	83	ft
3.	Time of Concentration, T_c	0.630	h
4.	Lag time, $0.6T_c$	0.378	h
5.	SCS Curve Number	88	
6.	Rainfall Depth,		
	Probable Maximum Precipitation		
	Local Storm (6 hour)	8.8	in.
	General Storm (72 hour - August) . . .	11.1	in.
	General Storm (6 hour - Augsut) . . .	4.7	in.
7.	Drainage Area	241.8	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned sedimentation structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table.

J3-G HYDRAULICS

	Units	General Storm PMP	Local Storm PMP
Initial Reservoir Volume Condition		Empty	Empty
Inflow			
Peak Flow	cfs	179	2052
Volume	acre-ft	193.8	144.3
Storage			
Maximum Allowable Water Surface Elevation	ft	6510.00	6510.00
Peak Stage	ft	6504.42	6501.90
Peak Storage	acre-ft	193.8	144.3
Storage Capacity . . .	acre-ft	308.9	308.9

Spillway and Outflow Channel

Structure J3-G will not have a spillway or outflow channel because it is designed to contain all runoff from the PMP.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, J3-G is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.42
3. Slope Factor, LS 3.37
4. Cover Factor, C 0.269
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 storage capacity of J3-G is shown on Plate 2, Volume-Elevation Curve, J3-G, and the results of the sediment inflow analysis are summarized in the following table.

J3-G STORAGE

	General PMP	Local PMP	
Total Storage Capacity	308.9	308.9	acre-ft
Storm Inflow	193.8	144.3	acre-ft
Available Sediment Storage Capacity . .	115.1	164.6	acre-ft
Sediment Inflow Rate	1.71	1.71	acre-ft/yr
Sediment Storage Life	67	96	yrs

* * *

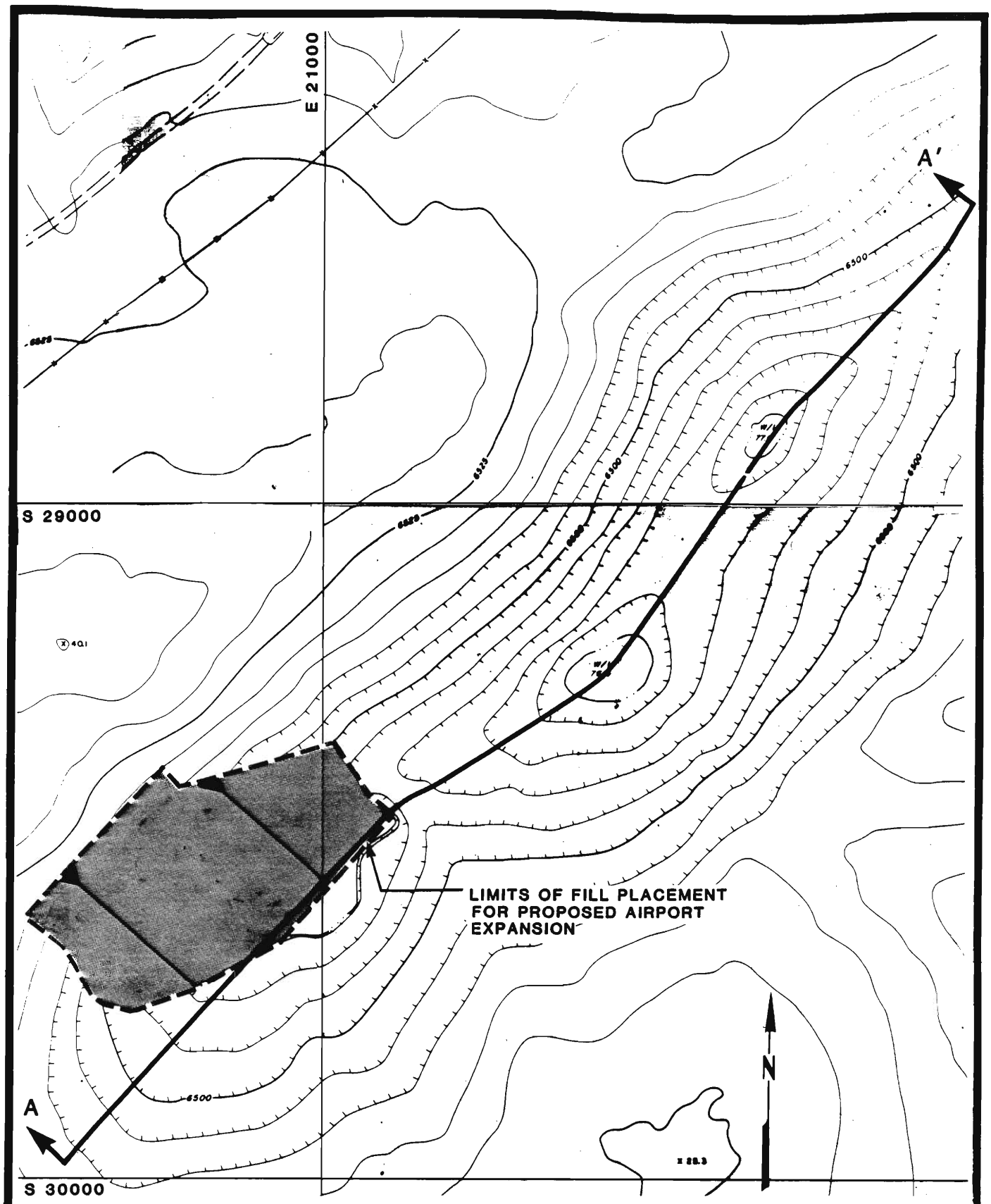
The following plates and appendix are attached and complete this design report.

Plate 1 - Site Plan J3-G

Plate 2 - Volume-Elevation Curve J3-G

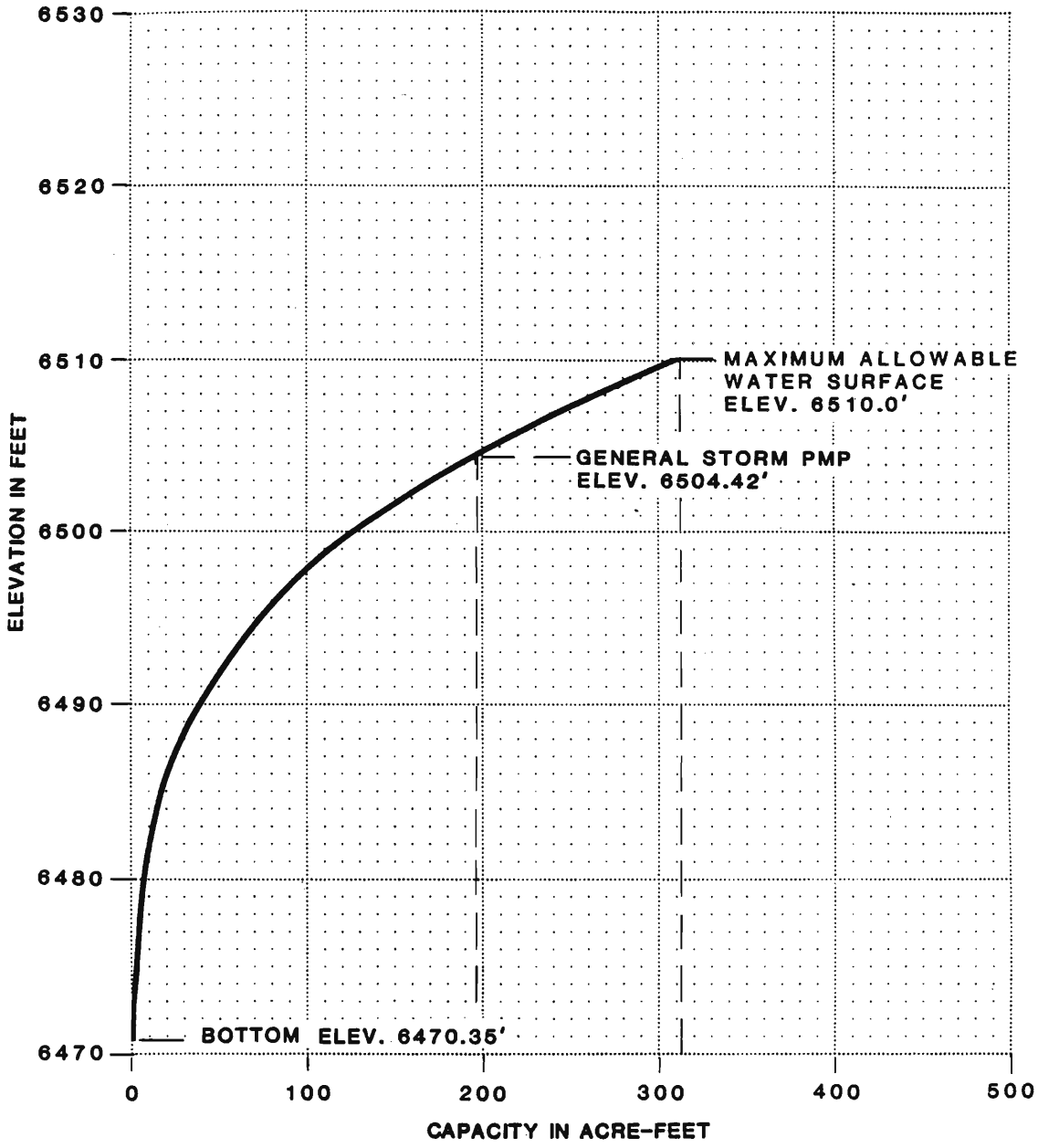
Plate 3 - Channel Profile J3-G, A-A'

Appendix A - Hydrology and Hydraulic Calculations



SITE PLAN
J3-G

BY **Dames & Moore** Plate 1



VOLUME-ELEVATION CURVE

J3-G

BY **Dames & Moore** Plate 2

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
V3-6 SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 83

WATER COURSE LENGTH = 6770' = 1.28 mi

T_c = 0.630 hr

LAG TIME = $0.6 T_c$ = ~~0.63~~ .378 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
207.4	reclaimed (pre-law)	—	—	87 (.86)
34.4	disturbed (runway)	—	C	92 (.14)
				87.7

use 88

DRAINAGE BASIN AREA

241.8 ACRE 0.378 SQ MILE

BY ___ DATE ___
CHECKED BY BHM 11/5/85
COPY TO EO ___

Dames & Moore

FILE Peabody Coal Co 10139-011-22
SUBJECT Sediment Inflow
J3-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 = 100% EA #35

K = 0.42

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
800	105	13.1	5.92 ~~4.68~~ (.4)
600	40	6.7	1.91 ~~1.53~~ (.3)
700	35	5.	1.42 ~~1.15~~ (.3)
			~~2.67~~ 3.37

Cover Factor

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
86%	reclaimed	—	—	(.15)(.86)
14%	disturbed	—	—	(1.0)(.14)
				0.269

Erosion Control Factor

P = 1.0

Sediment Inflow

$A = 40(.42)(3.37)(.269)(1.0) = 15.23$ ton/acre/year

$A = 15.23\left(\frac{1}{2047}\right)(241.8)(\cancel{A}) = \cancel{1.02}$ acre-feet/year
0.95 1.71

Se in d

BY ___ DATE ___
CHECKED BY BHM 11/5/85
COPY TO EO ___

Dames & Moore

FILE PEABODY COAL 10139-011
SUBJECT J3-G COMBINED
STORAGE CAPACITY SHEET ___ OF.

Elev.	Vol.
6472.02	0
6480	5.07
6485	14.84
6490	36.6
6495	71.0
6500	126.1
6505	202.6
6510	308.9
~~6515~~	~~443.8~~

from survey data bottom = 6470.35

BOTTOM 6472.02'
NO SPILLWAY
NO CREST

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

BY [illegible] DATE 11/5/85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

INSPECTION REPORT

Temporary Impoundment

J3-H

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

Registered Professional Engineer (Civil)
CERTIFICATE NO.
26858
RANDOLPH S.
LEHN
Date Signed
ARIZONA, U.S.A.

3/3/00

APPROVED
OCT 2000

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 4

STORAGE CAPACITY 6

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD4 100-Year, 6-Hour Storm Event
EXHIBIT #1 J3-H Temporary Impoundment Design

OCT 2000 APPROVED

INTRODUCTION

Temporary impoundment J3-H is an earthen embankment at Black Mesa Mine. The location, site-specific plans and watershed boundary of temporary impoundment J3-H are shown in Appendix A.

This design report contains information specific to temporary impoundment J3-H . 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 existing temporary impoundment J3-H was inspected by a Registered Professional Engineer from Peabody Western Coal Company in June 1999 to assure that the existing structure is stable and no adverse conditions exist. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design to assure that the design embankment configuration would be stable.

OCT 2000
APPROVED

SITE DESCRIPTION

LAND USE

The J3-H structure has a watershed of 20.2 acres. The 20.2 acre watershed that contributes directly to structure J3-H is classified as 100% reclaimed.

DESIGN ANALYSES

GENERAL

Structure J3-H was inspected under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design analysis was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM). The most current information contained in the Peabody Western Coal Company files includes topographic maps developed by Cooper Aerial aerial surveys in 1999 and was used in the analyses of the structure.

STABILITY

Structure J3-H is a category B-1 embankment. A homogenous earthen embankment with an approximately 26 feet wide embankment width. An upstream slope of 2:1 (horizontal to vertical) and a downstream slope of 3.2:1 was utilized. Based on the total embankment height of approximately 10 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6. Therefore, the embankment is stable.

OCT 2000
APPROVED

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD 4 (see Appendix B). Structure J3-H is classified as a low hazard structure. In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the top of embankment elevation.

Adequate storage capacity will be maintained in the impoundment above the normal operating level and below the top of the embankment to contain the storm runoff from the 100-year, 6-hour storm event with no discharge over the top of the embankment. To assure that adequate storm water storage capacity is available, the operating water level in the impoundment will be maintained at or below elevation 6605.8. Impoundment dewatering will be conducted in accordance with Chapter 6, Sedimentation Ponds and Impoundment, Maintenance and Reclamation.

The storage capacity of structure J3-H was analyzed using the 100-year, 6-hour storm event. The impoundment was verified to completely contain the 100-year, 6-hour storm event, and provide adequate sediment storage volume, without discharging.

OCT 2000
APPROVED

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.2889	mi.
2.	Elevation Difference, H	58.2	ft
3.	Time of Concentration, T_c	0.129 hr	
4.	SCS Curve Number	87	
5.	Rainfall Depth, 100-year, 6-hour storm	2.4 in	
6.	Drainage Area	20.2 acres	

HYDRAULICS

The SEDCAD 4 computer program was used to evaluate inflow to the sedimentation structure. J3-H does not incorporate an emergency spillway, instead the peak runoff from the 100-yr, 6-hr event will be contained with a minimum of one foot of freeboard. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendix B).

OCT 2000
APPROVED

J3-H TEMPORARY IMPOUNDMENT HYDRAULICS TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		6605.8
Inflow		
Peak Flow	Cfs	32.47
Volume	Ac-ft	2.07
Storage		
Peak Stage	Msl	6606.5
Max. Operating Elev.	Msl	6605.8
Peak Storage	Ac-ft	8.81
Storage Capacity	Ac-ft	6.74
Embankment Crest Elev.	Msl	6607.5
Freeboard	Ft	1.0

Notes: The Storage Capacity figure reflects available pond storage up to the defined Operating Elevation. The Peak Storage figures reflects available pond storage up to the Peak Storage elevation and includes Storage Capacity plus stormwater inflow volume (6.74 + 2.07).

OCT 2000
APPROVED

STORAGE CAPACITY

The impoundment stage-capacity table (see Appendix A) is based on the 1999 topographic mapping conducted by Cooper Aerial surveys. Structure J3-H is designed to contain approximately 11.63 acre-feet at the top of embankment elevation.

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

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.42
3.	Slope Factor, LS	2.21
4.	Cover Factor, C	0.2
5.	Erosion Control Factor, P	1.0

The sediment inflow calculations are included in Appendix A. The hydrologic analysis gives the storage volume required to contain the 100-year, 6-hour storm and the remaining storage volume available for storing sediment. The existing storage capacity of J3-H and the results of the sediment inflow analysis are summarized in the following table.

APPROVED
OCT 2000

Storage for Structure J3-H

	J3-H
Total Storage Capacity	11.63 acre-ft
100-Year, 6-Hour Storm Inflow plus 1 ft Freeboard	2.82 acre-ft
Available Sediment Storage Capacity	8.81 acre-ft
Sediment Inflow Rate/Year	0.052 acre-ft /yr
Sediment Storage Life	169 yrs

* * *

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

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

-Watershed Map

-Stage Storage Table

Appendix B - SEDCAD4 100-Year, 6-Hour Storm Event

Exhibit #1 - J3-H Temporary Impoundment

OCT 2000 APPROVED

APPENDIX A

Hydrology, Hydraulic and Sedimentation Calculations

Watershed Map

Stage Storage Table

OCT 2000
APPROVED

J3-H **01-Mar-00**

TIME OF CONCENTRATION

	H (HI)	H (LO)	H
ELEV. DIFFERENCE (H):	6656	6597.8	**58.2**

	L (FT.)	L (MI.)
WATERCOURSE LENGTH (L):	1525	**0.288826**

TC = [(11.9 x (**L**^3)) / **H**] ^ 0.385

TC = 0.129308

SCS CURVE NUMBER

COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	CN	AREA (Ac.)	CN*AREA
RECLAIMED	FAIR	C	87	20.2	1757.4

CN = 87

DRAINAGE BASIN AREA

ACRES = 20.2 **SQ. MILES= 0.031563**

APPROVED
OCT 2000

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J3-H

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	
Soil Erodibility Factor	0.420	
Length Slope Factor	2.21	
Cover Factor	0.2	
Practice Factor	1.0	
Annual Rainfall Factor	40	
Gross Annual Sediment Yield	5.58	*tons/acre/year*
Sediment Density	94	pcf
Gross Annual Sediment Yield	0.00273	acre-feet/acre/year
Sediment Delivery Ratio (SDR)*	95%	
Estimated Annual Sediment Yield	0.0026	acre-feet/acre/year
Watershed Area	20.2	acres
Watershed Annual Sediment Yield	0.0523	acre-feet/year
Number of years	1	years
Required Pond Sediment Storage	0.052	acre-feet

*SDR = 0.95 for drainage basins less than 100 acres
SDR=0.90 for drainage basins greater than 100 acres

OCT 2000
APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J3-H

SOIL ERODIBILITY FACTOR:

Soil Type	Soil Group	Erodibility Factor, K	Area (Acres)	K*Area
Reclaimed	C	0.42	20.2	8.484
	TOTAL :		20.2	8.48

Weighted K = Total K*Area/Total Area = 0.420

LENGTH SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
250	30	12.0%	0.6	6.8	3.15
262	20	7.6%	0.5	4.4	1.62
305	25	8.2%	0.5	4.7	1.87

Average LS = 2.21

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*

APPROVED OCT 2000

COVER AND PRACTICE FACTORS:

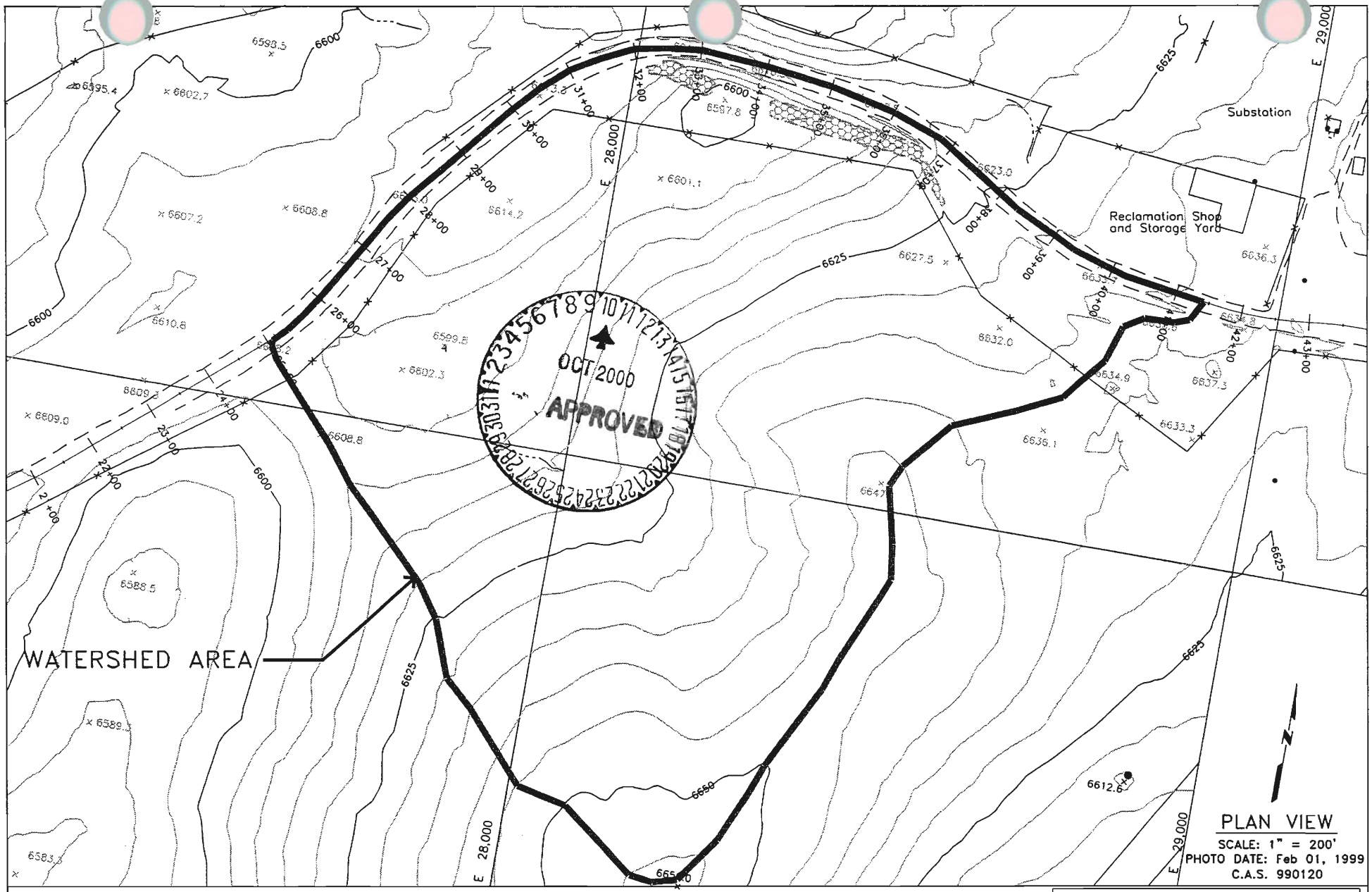
Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Reclaimed	40	0	20.2	0.15	3.03	1	20.2
		TOTAL	20.2		3.03		20.2

Weighted C = Total C*Area/ Total Area = 0.15

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

RAINFALL FACTOR:

R = 40



J3-H

Temporary Impoundment

BLACK MESA MINE

PO BOX 605 KAYENTA, ARIZONA 86033

DESIGNED BY: PWCC	SCALE: 1"=200'
DRAWN BY: CI	DRAWING DATE: 2/24/00
CHECKED BY: RL	PHOTO DATE: 2/1/99
CONTOUR INTERVAL: 5'	DWG FILE: J3-H_Imp.DWG

LAST REVISION: 3/1/00

J3-H

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6597.8	0.0	0.00	0.00	0.00	BOTTOM OF POND
6599.8	2.0	0.14	0.14	0.14	
6601.8	4.0	0.62	0.76	0.90	
6603.8	6.0	1.44	2.06	2.96	
6605.8	8.0	2.43	3.87	6.83	
6607.5	9.7	3.22	4.80	11.63	TOP OF EMBANKMENT

OCT 2000
APPROVED

APPENDIX B

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

OCT 2000
APPROVED

J3-H

Temporary Impoudment

100 yr - 6 hr Design Storm

OCT 2000
APPROVED

Christopher Irwin

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

APPROVED
OCT 2000

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	20.200	20.200	32.47	2.07

APPROVED
OCT 2000

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	20.200	0.129	0.000	0.000	87.000	F	32.47	2.07
	Σ	**20.200**						**32.47**	**2.07**

OCT 2000
APPROVED

INSPECTION REPORT

Temporary Impoundment

J3-SL

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

APPROVED
OCT 2000

Registered Professional Engineer (Civil)
CERTIFICATE NO.
26858
RANDOLPH S.
LEHN
Date Signed
ARIZONA, U.S.A.

MAR 1 2000

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 4

STORAGE CAPACITY 6

APPENDIX A Hydrology, Hydraulic and Sedimentation Calculations
APPENDIX B SEDCAD4 100-Year, 6-Hour Storm Event
EXHIBIT #1 J3-SL Temporary Impoundment Design

OCT 2000
APPROVED

INTRODUCTION

Temporary impoundment J3-SL is an earthen embankment designed and constructed as a temporary impoundment structure to collect effluent from the Contractor's Trailer Park at Black Mesa Mine. The location of temporary impoundment J3-SL and its watershed boundary are shown in Appendix A. The 1999 site-specific plans are shown on the attached Exhibit 1.

This design report contains information specific to temporary impoundment J3-SL . 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 existing temporary impoundment J3-SL was inspected by a Registered Professional Engineer from Peabody Western Coal Company in October 1999 to assure that the existing structure is stable and no adverse conditions exist. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design to assure that the design embankment configuration would be stable.

OCT 2000
APPROVED

SITE DESCRIPTION

LAND USE

The J3-SL structure has a watershed of 4.18 acres. The 4.18 acre watershed that contributes directly to structure J3-SL is classified as 100% disturbed area.

DESIGN ANALYSES

GENERAL

Structure J3-SL was inspected under the supervision of a Registered Professional Engineer from Peabody Western Coal Company. The design analysis was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM). The most current information contained in the Peabody Western Coal Company files includes topographic maps developed by Cooper Aerial aerial surveys in 1999 and was used in the analyses of the structure.

STABILITY

Structure J3-SL is a category A-3 embankment. A homogenous earthen embankment with an approximately 13 feet wide embankment width. An upstream slope of a minimum 3:1 (horizontal to vertical) and a downstream slope of 3.5:1 was utilized. Based on the total embankment height of approximately 13 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6: therefore, the embankment is stable.

4 OCT 2000 APPROVED

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD 4 (see Appendix B). Structure J3-SL is classified as a low hazard structure. In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the top of embankment elevation.

Adequate storage capacity will be maintained in the impoundment above the normal operating level and below the top of the embankment to contain the storm runoff from the 100-year, 6-hour storm event with no discharge over the top of the embankment. To assure that adequate storm water storage capacity is available, the operating water level in the impoundment will be maintained at or below elevation 6581.9. Dewatering will be accomplished through pumping to trucks and hauling to the J28 Sewage Lagoons. Additionally, disposal of portable toilet waste in J3-SL is prohibited.

The storage capacity of structure J3-SL was analyzed using the 100-year, 6-hour storm event. The impoundment was verified to completely contain the 100-year, 6-hour storm event, and provide adequate sediment storage volume, without discharging.

APPROVED
OCT 2000

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.0065	mi.
2.	Elevation Difference, H	26.5	ft
3.	Time of Concentration, T_c	0.020 hr	
4.	SCS Curve Number	91	
5.	Rainfall Depth, 100-year, 6-hour storm	2.4 in	
6.	Drainage Area	4.18 acres	

HYDRAULICS

The SEDCAD 4 computer program was used to evaluate inflow to the sedimentation structure. J3-SL does not incorporate an emergency spillway, instead the peak runoff from the 100-yr, 6-hr event will be contained with a minimum of one foot of freeboard. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendix B).

APPROVED
OCT 2000

J3-SL TEMPORARY IMPOUNDMENT HYDRAULICS TABLE

	Units	100-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		6581.9
Inflow		
Peak Flow	Cfs	9.14
Volume	Ac-ft	0.53
Storage		
Peak Stage	Msl	6582.2
Max. Operating Elev.	Msl	6581.9
Peak Storage	Ac-ft	13.40
Storage Capacity	Ac-ft	12.87
Embankment Crest Elev.	Msl	6583.2
Freeboard	Ft	1.0

Notes: The Storage Capacity figure reflects available pond storage up to the defined Operating Elevation. The Peak Storage figures reflects available pond storage up to the Peak Storage elevation and includes Storage Capacity plus stormwater inflow volume (12.87 + 0.53

APPROVED
OCT 2000

STORAGE CAPACITY

The impoundment stage-capacity table (see Appendix A) is based on the 1999 topographic mapping conducted by Peabody Western Coal Company. Structure J3-SL is designed to contain approximately 15.34 acre-feet at the top of embankment elevation.

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

1.	Rainfall Factor, R	40
2.	Soil Erodibility Factor, K	0.22
3.	Slope Factor, LS	1.78
4.	Cover Factor, C	1.0
5.	Erosion Control Factor, P	1.0

The sediment inflow calculations are included in Appendix A. The hydrologic analysis gives the storage volume required to contain the 100-year, 6-hour storm and the remaining storage volume available for storing sediment. The existing storage capacity of J3-SL and the results of the sediment inflow analysis are summarized in the following table.

OCT 2000
APPROVED

Storage for Structure J3-SL

	J3-SL
Total Storage Capacity	15.34 acre-ft
100-Year, 6-Hour Storm Inflow plus 1 ft Freeboard	2.47 acre-ft
Available Sediment Storage Capacity	12.87 acre-ft
Sediment Inflow Rate/Year	0.029 acre-ft /yr
Sediment Storage Life	443 yrs

* * *

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

Appendix A - Hydrology, Hydraulic, and Sedimentation Calculations

-Watershed Map

-Stage Storage Table

Appendix B - SEDCAD4 100-Year, 6-Hour Storm Event

Exhibit #1 - J3-SL Temporary Impoundment

APPROVED
OCT 2000

APPENDIX A

Hydrology, Hydraulic, and Sedimentation Calculations

Watershed Map

Stage Storage Table

OCT 2000
APPROVED

Temporary Impoundment J3-SL 02/23/2000

TIME OF CONCENTRATION

	H (HI)	H (LO)	H
ELEV. DIFFERENCE (H):	6598	6571.5	**26.5**

	L (FT.)	L (MI.)
WATERCOURSE LENGTH (L):	229	**0.043371**

TC = [(11.9 x (**L**^3)) / **H**] ^ 0.385

TC = **0.019593**

SCS CURVE NUMBER

COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	CN	AREA (Ac.)	CN*AREA
Newly graded or bare area	----	C	91	4.18	380.38

CN = **91**

DRAINAGE BASIN AREA

ACRES = **4.18** **SQ. MILES=** **0.006531**

APPROVED
OCT 2000

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J3-SL

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	
Soil Erodibility Factor	0.220	
Length Slope Factor	1.78	
Cover Factor	1.0	
Practice Factor	1.0	
Annual Rainfall Factor	40	
Gross Annual Sediment Yield	15.62	*tons/acre/year*
Sediment Density	94	pcf
Gross Annual Sediment Yield	0.00763	acre-feet/acre/year
Sediment Delivery Ratio	90%	
Estimated Annual Sediment Yield	0.0069	acre-feet/acre/year
Watershed Area	4.2	acres
Watershed Annual Sediment Yield	0.0288	acre-feet/year
Number of years	1	years
Required Pond Sediment Storage	0.029	acre-feet

APPROVED
OCT 2000

PEABODY WESTERN COAL COMPANY
CALCULATED SEDIMENTOLOGY DATA

PROJECT: J3-SL

SOIL ERODIBILITY FACTOR:

Soil Type	Soil Group	Erodibility Factor, K	Area (Acres)	K*Area
Disturbed	D	0.22	4.2	0.924
	TOTAL :		4.2	0.92

Weighted K = Total K*Area/Total Area = 0.220

LENGTH SLOPE FACTOR:

Length (ft)	Elevation Change (ft)	Slope (%)	m	Slope Angle (deg)	LS Factor
25	6	24.0%	0.6	13.5	1.80
24	6	25.0%	0.6	14.0	1.84
52	8	15.4%	0.6	8.7	1.68

Average LS = 1.78

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 > 10%*

Where:

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

APPROVED OCT 2000

COVER AND PRACTICE FACTORS:

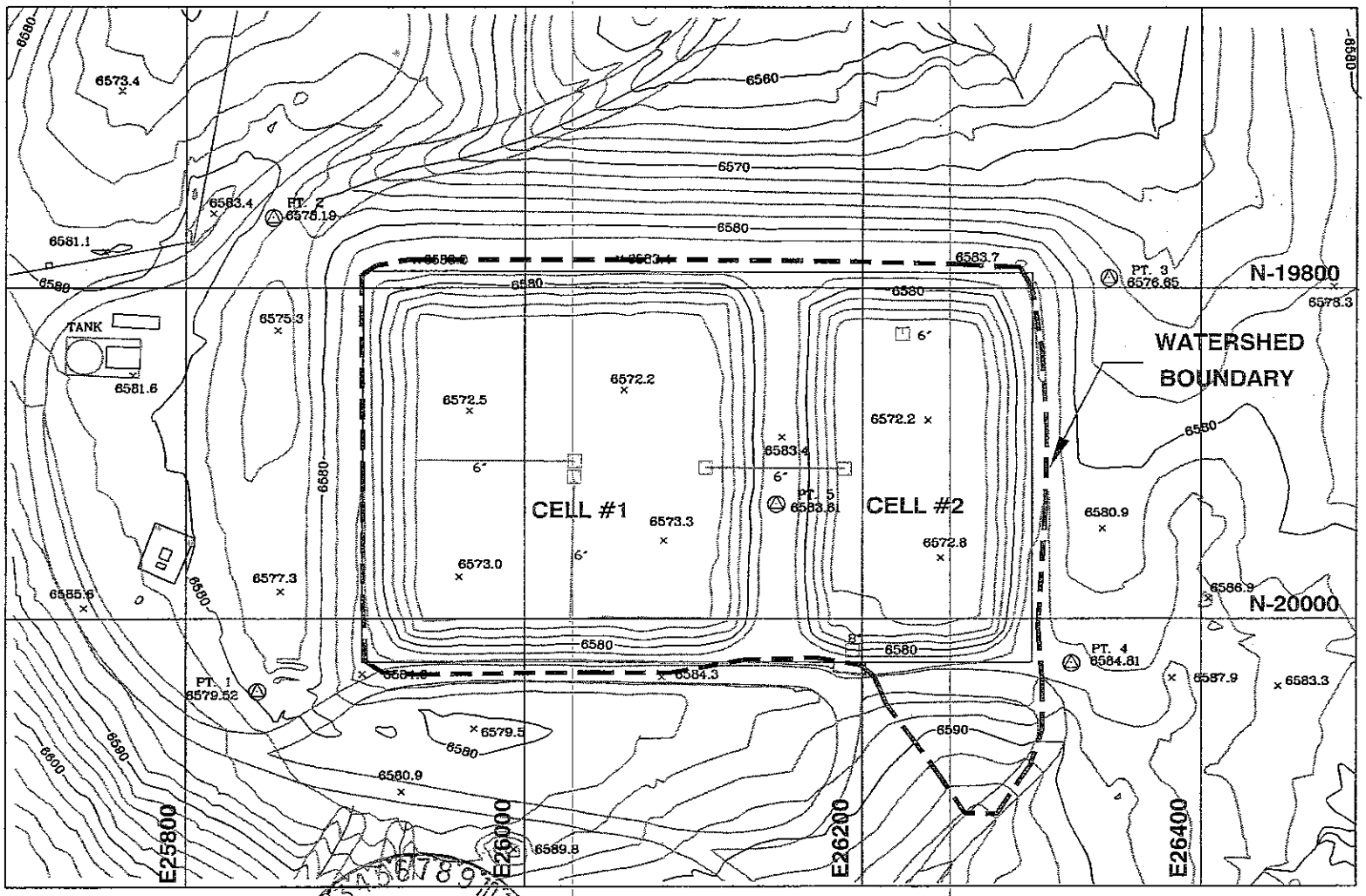
Cover Type	Cover (%)	Canopy (%)	Area (acres)	Cover Factor, C	C*Area	Practice Factor, P	P*Area
Disturbed	0	0	4.2	1	4.2	1	4.2
		TOTAL	4.2		4.2		4.2

Weighted C = Total C*Area/ Total Area = 1

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

RAINFALL FACTOR:

R = 40



N

PLAN VIEW

SCALE: 1" = 100'
SURVEY DATE: 09-25-99

C.I. = 2'

OCT 2000
APPROVED

REVISIONS		
DATE	CHK'D	DESCRIPTION

J3-SL
WATERSHED MAP

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
PO BOX 605 KAYENTA, ARIZONA 86033

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: CI	DRAWING DATE: 2-23-00
CHECKED BY: RL	SURVEY DATE: 09-25-99
CONTOUR INT.: 2'	DWG FILE: SL_WATER.DWG

LAST REVISION: 10/6/99

SEWAGE CELL #1 POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6572.2	0.0	0.00	0.00	0.00	BOTTOM OF POND
6574.0	1.8	0.75	0.68	0.68	
6576.0	3.8	0.87	1.62	2.30	
6578.0	5.8	0.98	1.85	4.15	
6580.0	7.8	1.09	2.07	6.22	
6582.0	9.8	1.20	2.29	8.51	
6583.2	11.0	1.27	1.48	9.99	TOP OF EMBANKMENT

OCT 2000
APPROVED

LAST REVISION: 10/6/99

SEWAGE CELL #2 POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6572.2	0.0	0.00	0.00	0.00	BOTTOM OF POND
6574.0	1.8	0.36	0.32	0.32	
6576.0	3.8	0.45	0.81	1.13	
6578.0	5.8	0.52	0.97	2.10	
6580.0	7.8	0.60	1.12	3.22	
6582.0	9.8	0.68	1.28	4.50	
6583.2	11.0	0.74	0.85	5.35	TOP OF EMBANKMENT

OCT 2000
APPROVED

APPENDIX B

SEDCAD4 (Input and Output) 100-Year, 6-Hour Storm Event

OCT 2000
APPROVED

Temporary Impoundment
J3-SL

OCT 2000
APPROVED

Christopher Irwin

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	100 yr - 6 hr
Rainfall Depth:	2.400 inches

APPROVED
OCT 2000

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	SL

#1 *Null*

APPROVED
OCT 2000

Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	4.180	4.180	9.14	0.53

APPROVED
OCT 2000

Structure Detail:

Structure #1 (Null)

SL

APPROVED
OCT 2000

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	4.180	0.020	0.000	0.000	91.000	F	9.14	0.53
	Σ	**4.180**						**9.14**	**0.53**

APPROVED
OCT 2000

DESIGN REPORT

Sedimentation Structure

J7-A

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
DESIGN ANALYSES	2
GENERAL	2
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
APPENDIX A - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J7-A will be a partially incised structure with an earthen embankment, designed and constructed 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 J7-A is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J7-A. 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

The proposed site of Structure J7-A was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure J7-A has a 27.3-acre tributary drainage area and is located near Red Peak Valley at the Black Mesa Mine. The watershed is classified as 90% reclaimed and 10% disturbed.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined.

DESIGN ANALYSES

GENERAL

Structure J7-A was designed by an interdisciplinary team of engineers from Dames & Moore. 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 Coal

Company files includes topographic maps developed from aerial photography flown in 1985 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure J7-A will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J7-A 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 J7-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.303	mi
2.	Elevation Difference, H	48	ft
3.	Time of Concentration, T_c	0.147	h
4.	Lag time, $0.6T_c$	0.088	h
5.	SCS Curve Number	87	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	27.3	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned 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.

J7-A HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	43	55
Volume	acre-ft	2.21	1.80
Storage			
Peak Stage	ft	6366.86	--
Spillway Elevation . .	ft	6367.00	--
Peak Storage	acre-ft	2.22	--
Storage Capacity . . .	acre-ft	2.39	--
Outflow			
Peak Flow	cfs	0	4
Embankment Crest Elevation	ft	--	6369.00
Peak Stage	ft	--	6367.86
Freeboard	ft	--	1.14
Spillway Channel			
Flow Depth	ft	--	0.86
Critical Velocity. . .	fps	--	2.0
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	24
Normal Velocity. . . .	fps	--	3.6
Normal Depth	ft	--	0.07
Manning's "n"		--	0.035

Spillway Channel

The spillway for J7-A will be a trapezoidal channel with the following dimensions:

Channel depth	1.9	ft
Channel width	15	ft
Channel length	30	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	0	percent

Outflow Channel

The outflow channel for Structure J7-A will be a trapezoidal channel with the following dimensions:

Channel width	15	ft
Channel length	20	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	24	percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plate 4. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, J7-A is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.42
3. Slope Factor, LS 0.54
4. Cover Factor, C 0.150
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 storage capacity of J7-A is shown on Plate 2, Volume-Elevation Curve, J7-A, and the results of the sediment inflow analysis are summarized in the following table.

J7-A STORAGE

Total Storage Capacity	2.39	acre-ft
10-year, 24-hour Storm Inflow	2.21	acre-ft
Available Sediment Storage Capacity . .	0.17	acre-ft
Sediment Inflow Rate	0.0270	acre-ft/yr
Sediment Storage Life	6	yrs

* * *

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

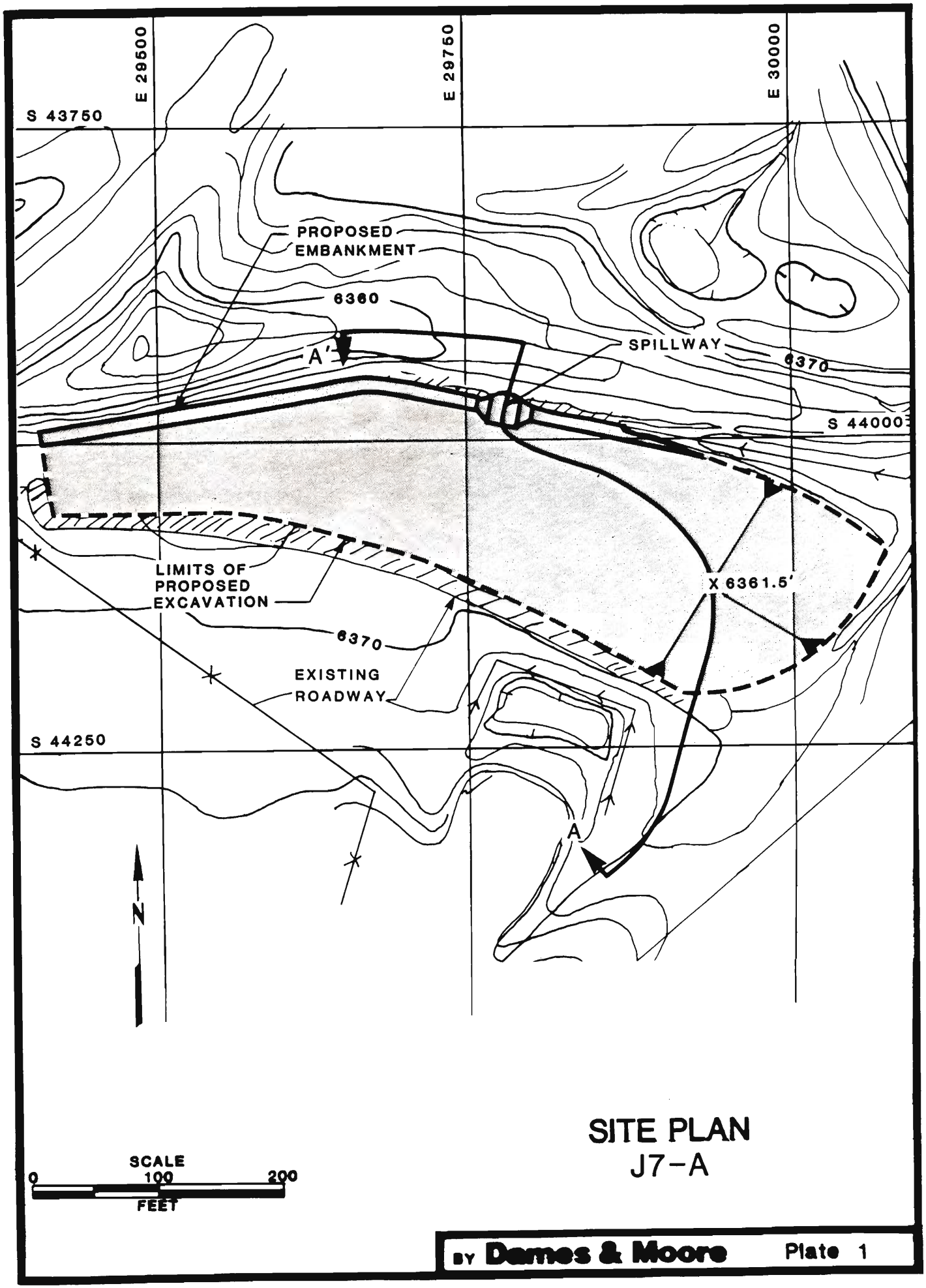
Plate 1 - Site Plan J7-A

Plate 2 - Volume-Elevation Curve J7-A

Plate 3 - Channel Profile J7-A, A-A'

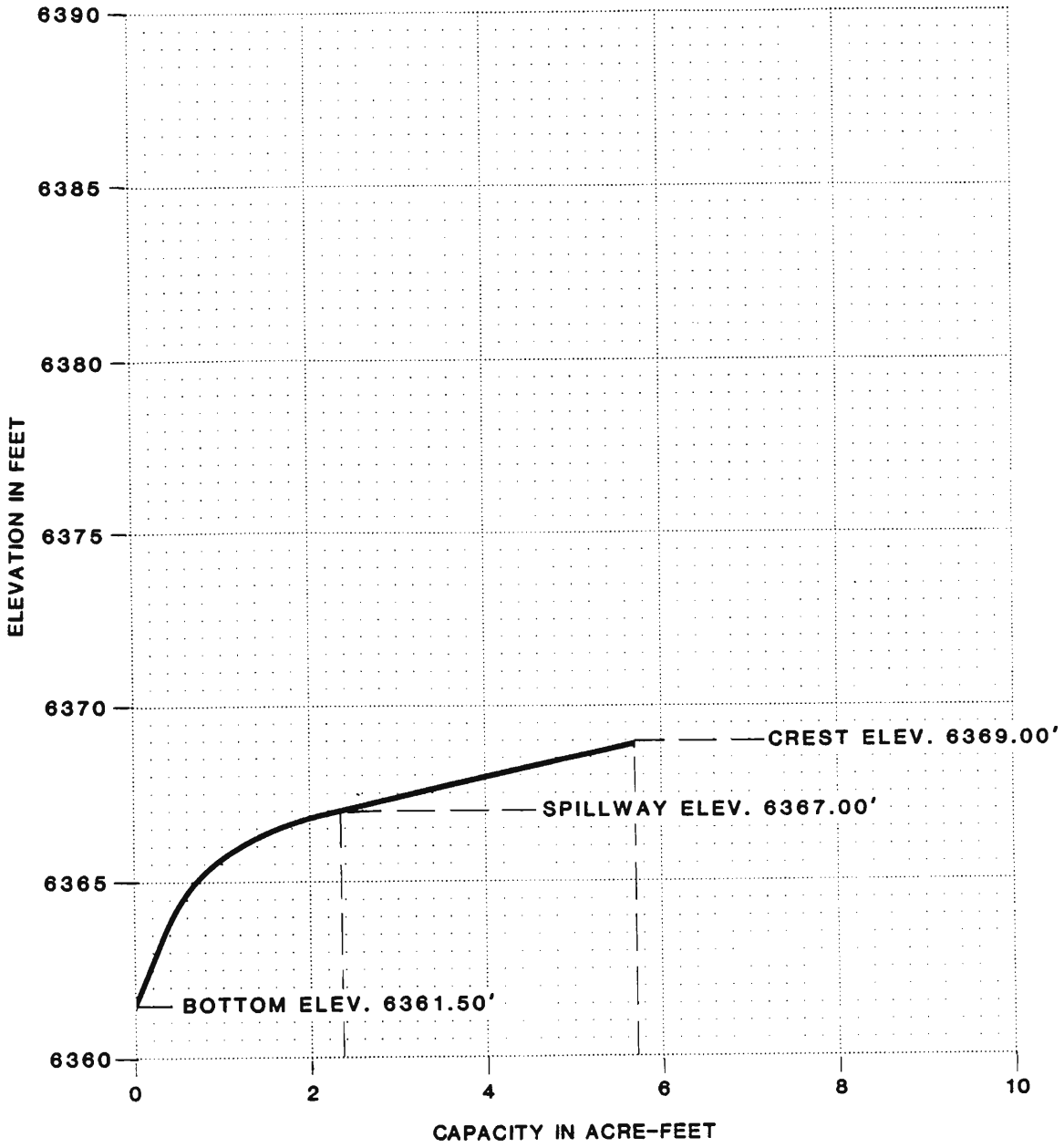
Plate 4 - Spillway and Outflow Channel Cross Section J7-A

Appendix A - Hydrology and Hydraulic Calculations



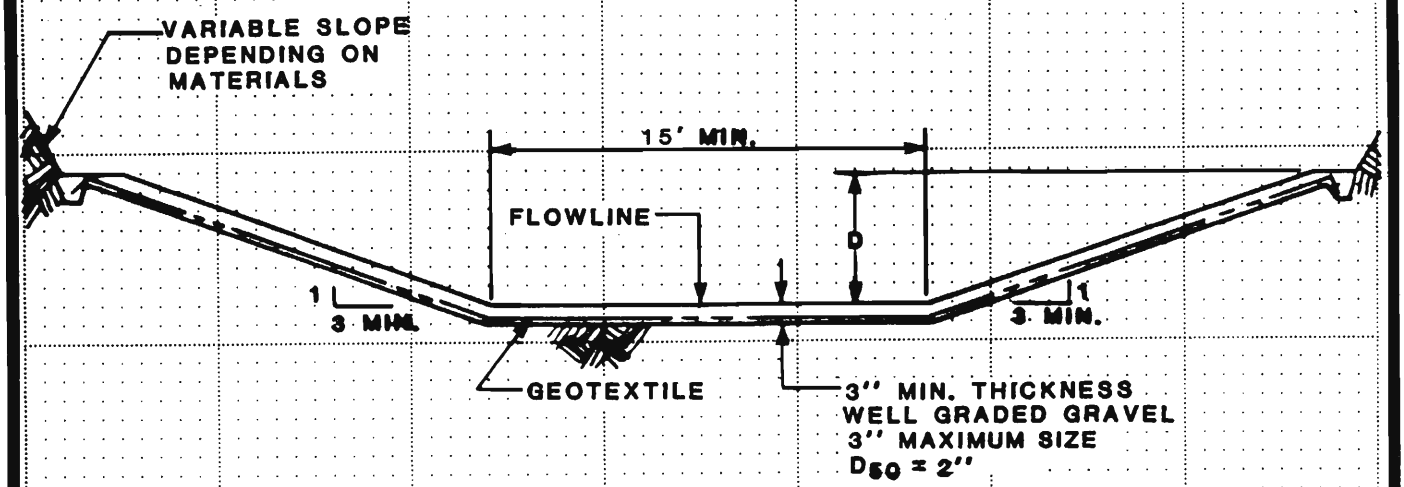
SITE PLAN
J7-A

BY Dames & Moore Plate 1



VOLUME-ELEVATION CURVE
J7-A

BY **Dames & Moore** Plate 2



SPILLWAY CHANNEL

D = 1.9'

LENGTH = 50'

FLOWLINE ELEV.= 6367.00'

OUTFLOW CHANNEL

D = 1.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

J7-A

BY **Dames & Moore** Plate 4

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6418 − 6370 = 48' ✓

WATER COURSE LENGTH = 1600' = .303 mi ✓

T_c = .147 hr ✓

LAG TIME = $0.6T_c$ = .088 hr ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
24.57	reclaimed (pre-law)	—	—	87 (0.9)
2.73	disturbed	—	C	91 (0.1)
				87.4

USE 87

BY ___ DATE ___
CHECKED BY BHM 11/11/85
COPY TO EO ___

DRAINAGE BASIN AREA

27.3 ACRE 0.043 SQ MILE ✓

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
J7-A
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 #35 (.42)(1.0)

.42

K = .42

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1400	35	2.5	.54 ✓

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
90%	reclaimed	—	—	.15 (0.9)
10%	disturbed	—	—	1.0 (0.1)
				0.235

BY ___ DATE ___
CHECKED BY BHM DATE 11/11/85
COPY TO EO ___

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

A = 40(.42)(.54)(.235)(1.0) = 2.13 ton/acre/year ✓

A = 2.13 (1/2000)(27.3)(.25) = 0.0270 acre-feet/year ✓

Dames & Moore

DESIGN REPORT

Sedimentation Structure

J3-F

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
DESIGN ANALYSES	2
GENERAL	2
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
APPENDIX A - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J3-F will be an earthen embankment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the proposed mine airport at the Black Mesa Mine. The location of Structure J3-F is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J3-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

The proposed site of Structure J3-F was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure J3-F has a 62.0-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 34% reclaimed, 28% disturbed, 25% Pinion/Juniper, and 13% Sagebrush/grass.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined.

DESIGN ANALYSES

GENERAL

Structure J3-F was designed by an interdisciplinary team of engineers from Dames & Moore. 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 Coal

Company files includes topographic maps developed from aerial photography flown in 1985 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure J3-F will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J3-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 J3-F was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.88	mi
2.	Elevation Difference, H	75	ft
3.	Time of Concentration, T_c	0.425	h
4.	Lag time, $0.6T_c$	0.255	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	62.0	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned 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.

J3-F HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm	
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation	
Inflow				
Peak Flow	cfs	57	65	
Volume	acre-ft	4.39	3.51	
Storage				
Peak Stage	ft	6502.09	--	
Spillway Elevation . .	ft	6505.00	--	
Peak Storage	acre-ft	4.41	--	
Storage Capacity . . .	acre-ft	7.64	--	
Outflow				
Peak Flow	cfs	0	4	
Embankment Crest Elevation	ft	--	6507.00	
Peak Stage	ft	--	6505.93	
Freeboard	ft	--	1.07	
Spillway Channel				
Flow Depth	ft	--	0.93	
Critical Velocity. . .	fps	--	2.0	
Manning's "n"		--	0.035	
Outflow Channel			Section I	Section II
Slope	%	--	5	14
Normal Velocity. . . .	fps	--	2.3	3.1
Normal Depth	ft	--	0.012	0.09
Manning's "n"		--	0.035	0.035

Spillway Channel

The spillway for J3-F will be a trapezoidal channel with the following dimensions:

Channel depth	2 ft
Channel width	15 ft
Channel length	40 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope	0 percent

Outflow Channel

The outflow channel for Structure J3-F will be a trapezoidal channel with the following dimensions:

Channel width	15 ft
Channel length	250 ft
Side slopes (horizontal to vertical). .	3:1
Slope	5-14 percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plate 4. Both the spillway and outflow channel should be protected against erosion using geotextile and gravel as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, J3-F is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.34
3. Slope Factor, LS 1.07
4. Cover Factor, C 0.383
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 storage capacity of J3-F is shown on Plate 2, Volume-Elevation Curve, J3-F, and the results of the sediment inflow analysis are summarized in the following table.

J3-F STORAGE

Total Storage Capacity	7.64	acre-ft
10-year, 24-hour Storm Inflow	4.39	acre-ft
Available Sediment Storage Capacity . .	3.23	acre-ft
Sediment Inflow Rate	0.152	acre-ft/yr
Sediment Storage Life	21	yrs

* * *

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

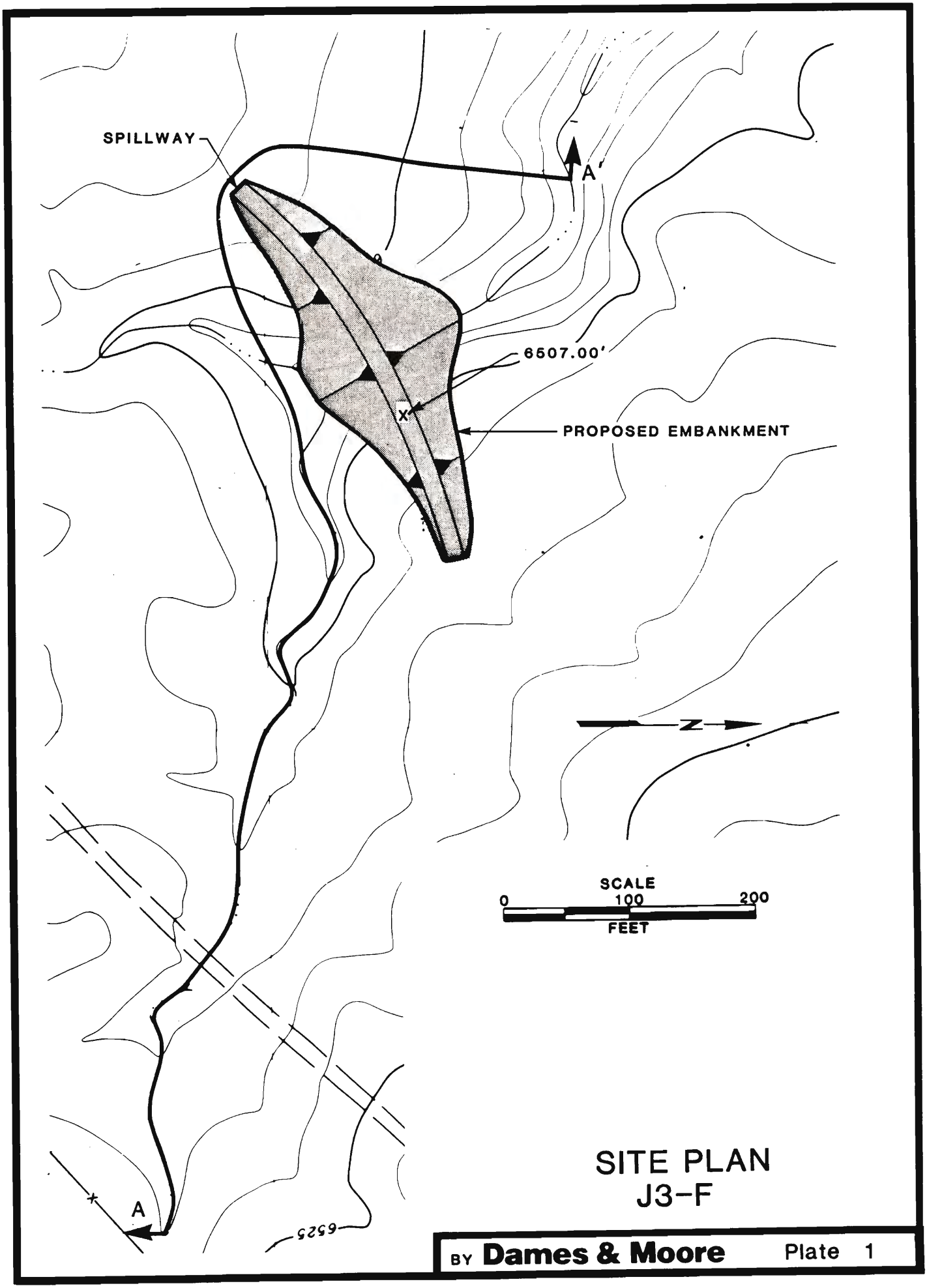
Plate 1 - Site Plan J3-F

Plate 2 - Volume-Elevation Curve J3-F

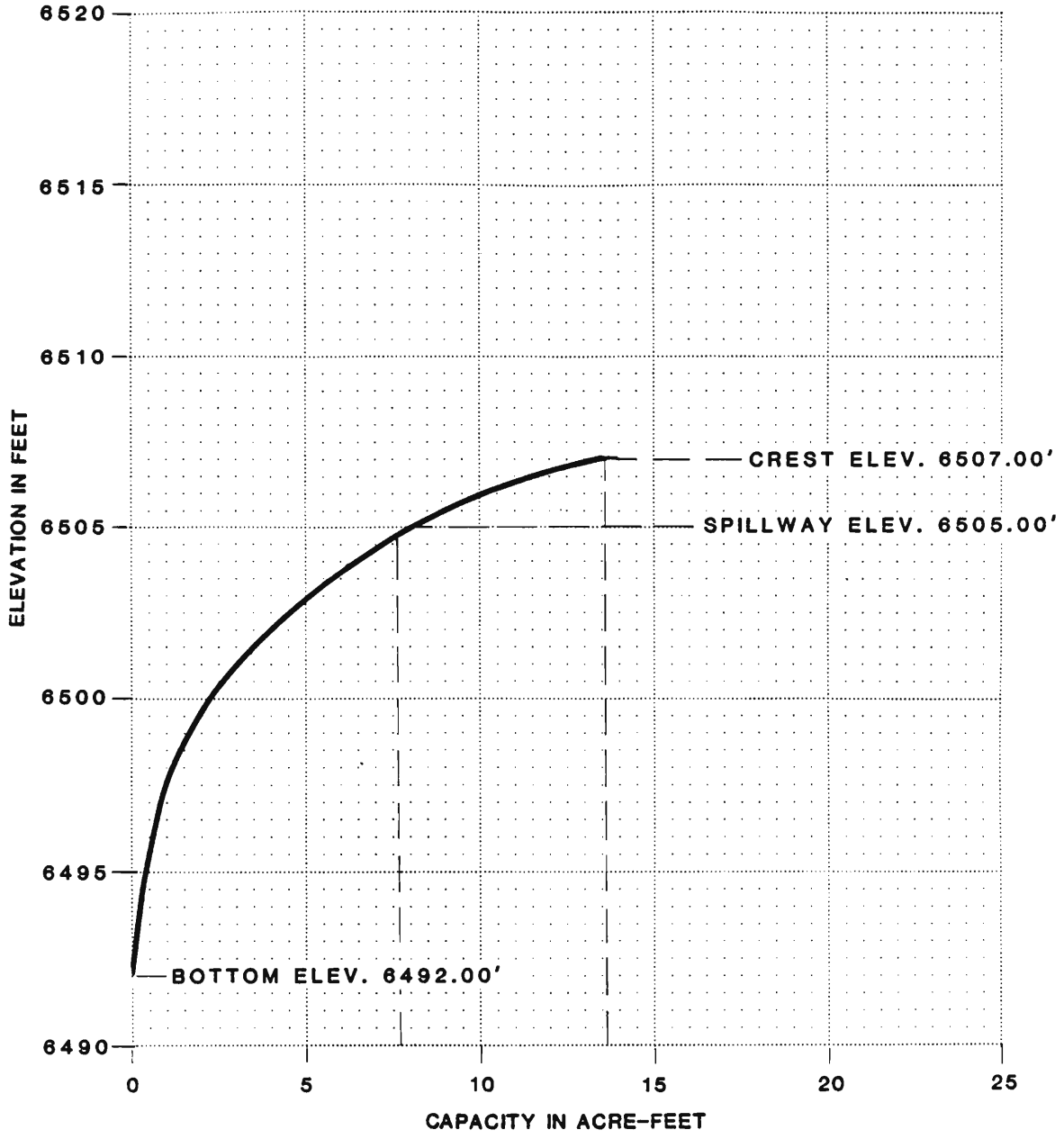
Plate 3 - Channel Profile J3-F, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section J3-F

Appendix A - Hydrology and Hydraulic Calculations

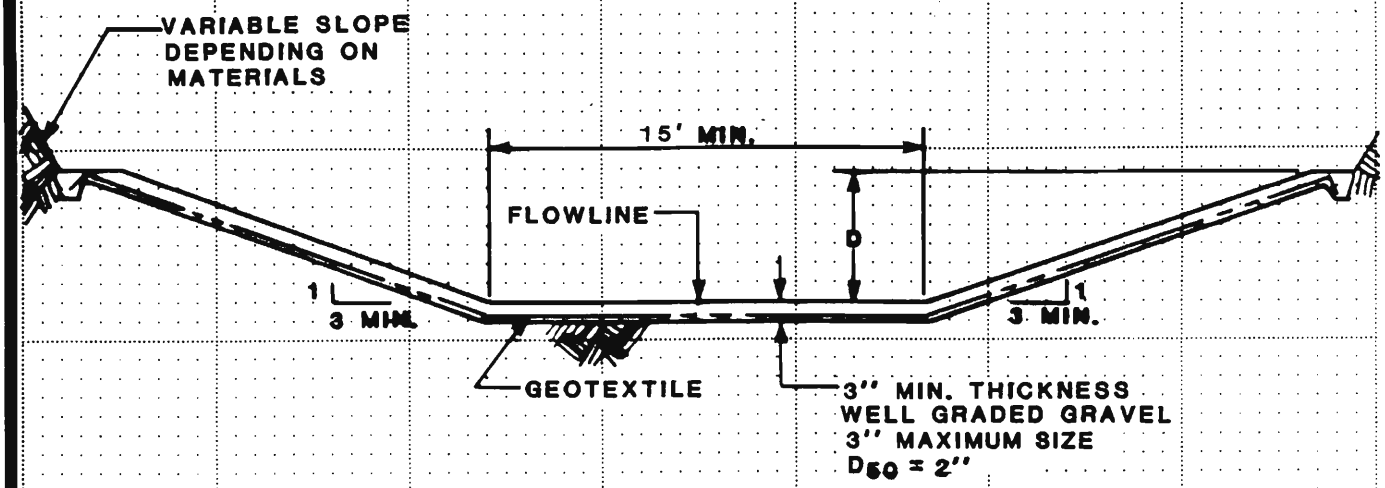


SITE PLAN
J3-F



VOLUME-ELEVATION CURVE
J3-F

BY **Dames & Moore** Plate 2



SPILLWAY CHANNEL

D = 2.0'

LENGTH = 40'

FLOWLINE ELEV.= 6505.00'

OUTFLOW CHANNEL

D = 1.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION

J3-F

BY **Dames & Moore** Plate 4

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

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

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 75'

WATER COURSE LENGTH = 4635 = .88 mi

T_c = .425 .423 hr

LAG TIME = $0.6T_c$ = .255 .254 hr

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
17.4	disturbed (runway)	—	C	92 (.28)
21.2	reclaimed (pre law)	—	—	87 (.34)
8.0	S-G	ave	C	73 (.13)
15.4	P-J	ave	C	78 (.25)
				84.33

use 85

DRAINAGE BASIN AREA

62.0 ACRE 0.097 SQ MILE

CHECKED BY BHM DATE 11/5/85
COPY TO EO ___

FILE Peabody Coal Co 10134-011-22
SUBJECT Sediment Inflow
J3-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 =	62 %	EH #35	.62 (.42)
	38 %	EH #32	.38 (.21)
			0.34

K = .34

Slope Factor

Length (ft.)	Δ Elev (ft.)	Slope (%)	LS
400	20	5.0	~~.904~~ 1.07

Cover Factor

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
28%	disturbed	—	—	.28 (1.0)
34%	reclaimed	—	—	.34 (.15)
13%	S-G	40	25	.13 (.13)
25%	P-J	40	25	.25 (.14)
				0.383

Erosion Control Factor

P = 1.0

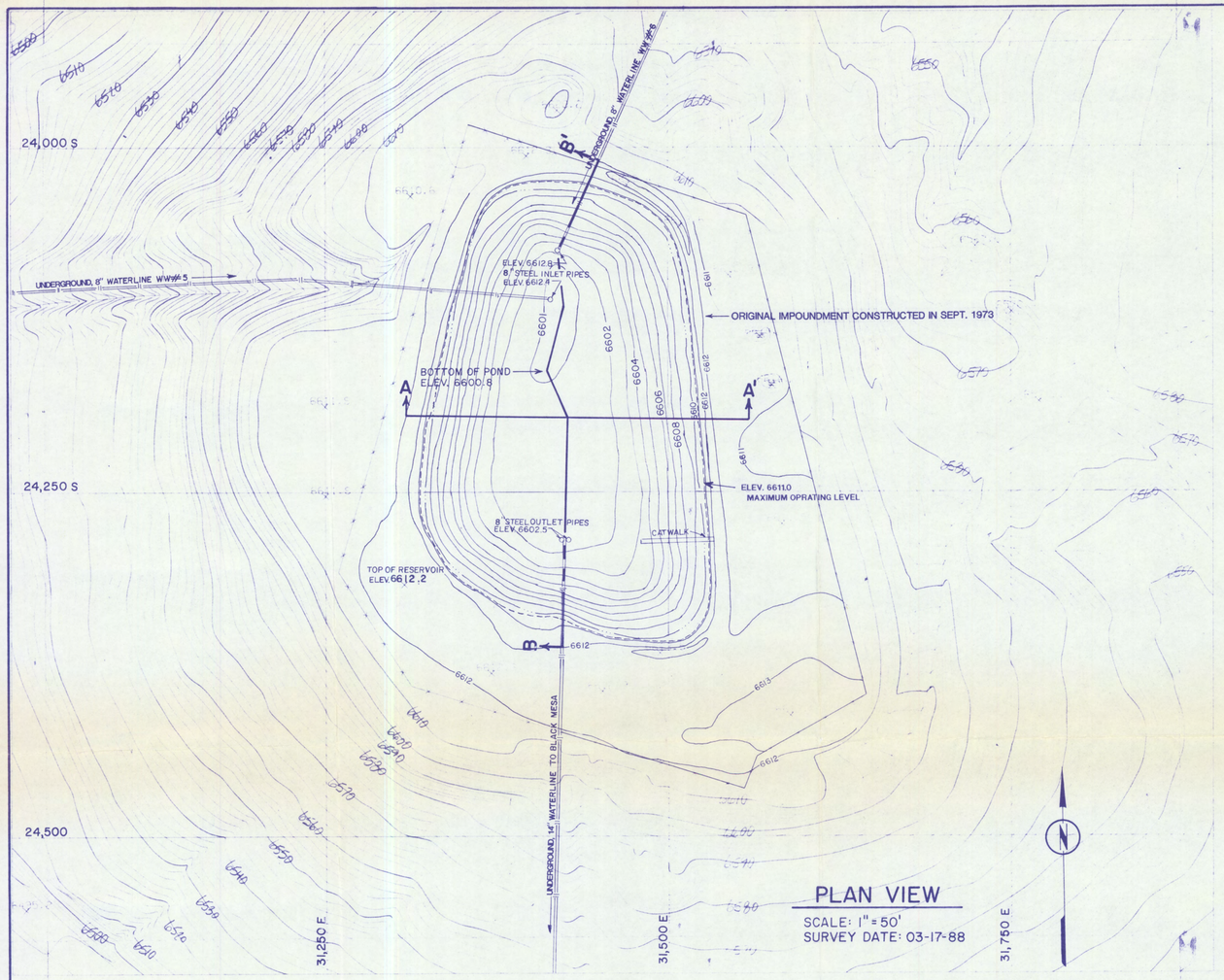
Sediment Inflow

$A = 40(.34)(\cancel{.904}\ 1.07)(.383)(1.0) = \cancel{4.71}\ 5.57$ ton/acre/year

$A = \cancel{4.71}\ 5.57\left(\frac{1}{2047}\right)(62.0)(.9) = \cancel{0.128}\ .152$ acre-feet/year

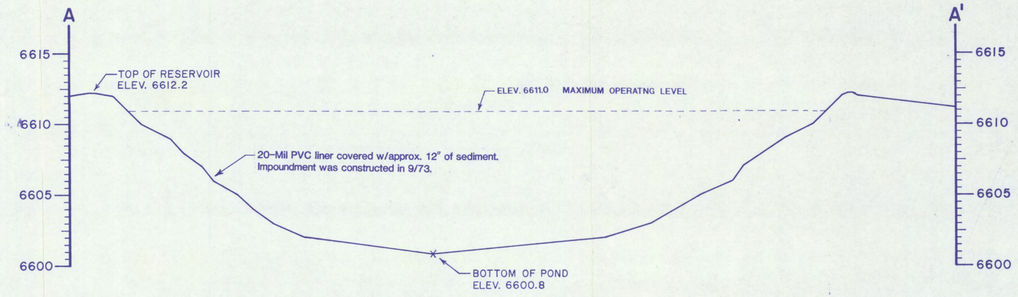
BY ___ DATE ___ CHECKED BY BHM 11/5/85 COPY TO EO ___

Dames & Moore



PLAN VIEW

SCALE: 1" = 50'
SURVEY DATE: 03-17-88

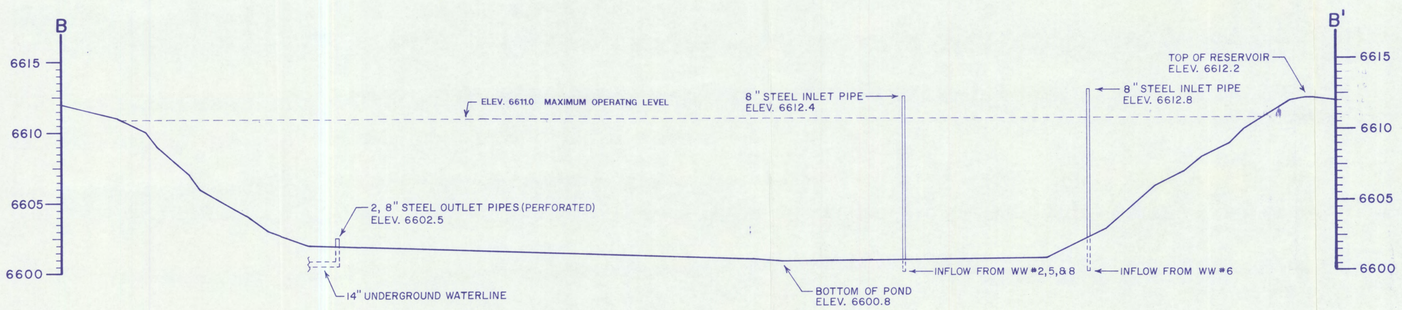


SECTION A-A'

VERT. SCALE: 1" = 5'
HORIZ. SCALE: 1" = 20'

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6600.8	0.0	0.00	0.00	0.00	BOTTOM OF POND
6601.0	0.2	0.04	0.00	0.00	
6602.0	1.2	0.37	0.21	0.21	
6602.5	1.7	0.45	0.21	0.41	OUTFLOW ELEVATION
6603.0	2.2	0.52	0.24	0.66	
6604.0	3.2	0.63	0.58	1.23	
6605.0	4.2	0.72	0.68	1.91	
6606.0	5.2	0.81	0.77	2.67	
6607.0	6.2	0.90	0.86	3.53	
6608.0	7.2	1.00	0.95	4.48	
6609.0	8.2	1.10	1.05	5.53	
6610.0	9.2	1.20	1.15	6.68	
6610.9	10.1	1.31	1.13	7.81	
6611.0	10.2	1.32	0.13	7.94	MAX. OPERATING POOL EL.
6612.0	11.2	1.44	1.38	9.32	
6612.2	11.4	1.60	0.30	9.62	TOP OF RESERVOIR

FEB 1999
APPROVED



SECTION B-B'

VERT. SCALE: 1" = 5'
HORIZ. SCALE: 1" = 20'

ENGINEER'S CERTIFICATION

Registered Professional Engineer (CIVIL) CERTIFICATE NO. 18782 STATE OF ARIZONA
JAMES GARY SCHLENVOGT

JAMES G. SCHLENVOGT
Company Engineering Manager
Peabody Coal Company

ARIZONA P.E. 18782
Date: APR 23 1998

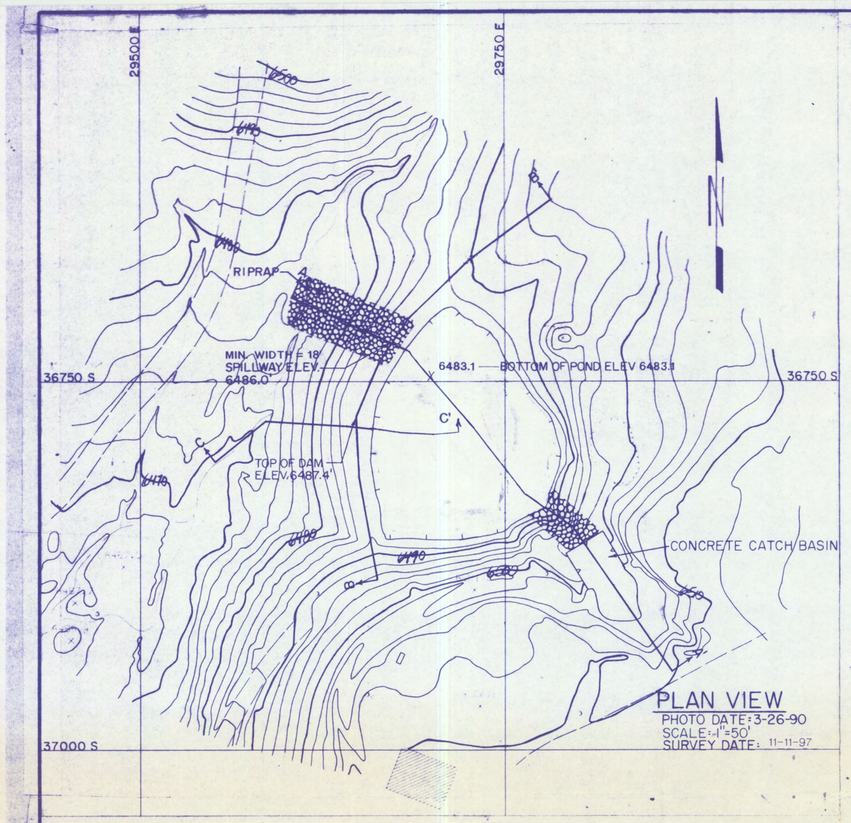
NOTES:
1) General location, see Drawing No. 85400, Sheet L-9 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation, (Incised Pond)
4) Salvage topsoil in accordance with approved topsoil salvage plan.
5) Reclamation of the distrubed area above the high waterline shall be in accordance with the approved reclamation plan.

PEABODY COAL COMPANY
BLACK MESA — KAYENTA MINE

BLACK MESA FRESH WATER POND (BM-FWP)

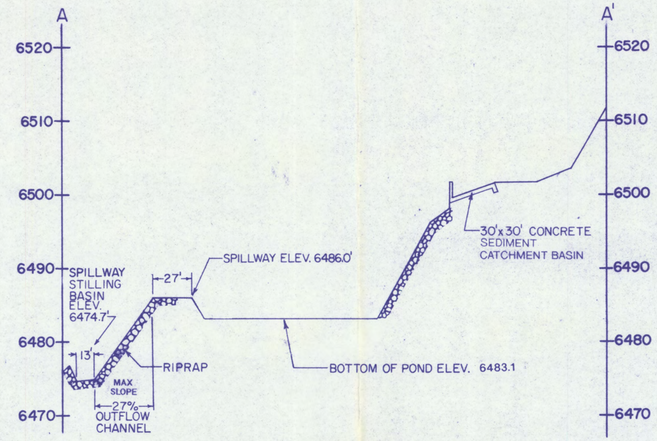
TEMPORARY IMPOUNDMENT DESIGN

SCALE: AS SHOWN	DRAWN BY: P.C.C.
DATE: 06-25-90	DRAWING NO:
REVISION: 3-25-98	APPROVED BY: J.G.S.



PLAN VIEW

PHOTO DATE: 3-26-90
SCALE: 1"=50'
SURVEY DATE: 11-11-97

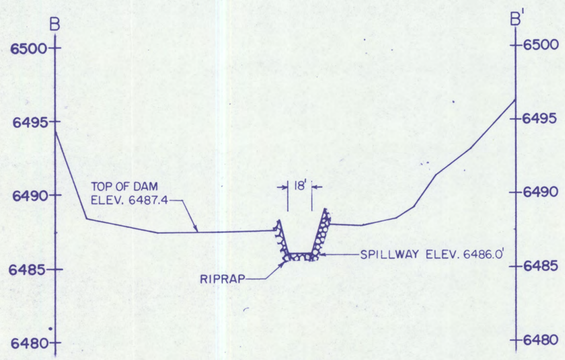


SECTION A-A'

SCALE: VERT. 1"=10'
HORIZ. 1"=50'

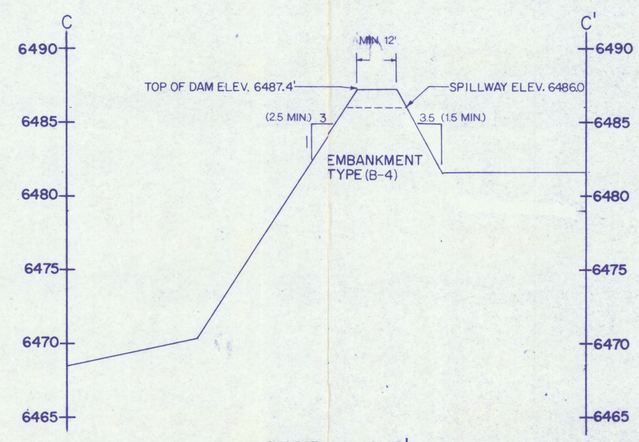
BM TIPPLE IMPOUNDMENT

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6483.1	0.0	0.00	0.00	0.00	BOTTOM OF POND
6484.0	0.9	0.28	0.13	0.13	
6486.0	2.9	0.35	0.63	0.76	EMERGENCY SPILLWAY
6487.4	4.3	0.42	0.54	1.29	TOP OF DAM



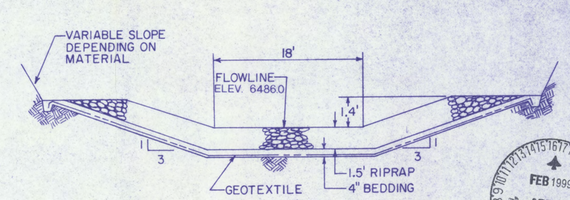
SECTION B-B'

SCALE: VERT. 1"=5'
HORIZ. 1"=50'



SECTION C-C'

SCALE: VERT. 1"=5'
HORIZ. 1"=25'



SECTION OF EMERGENCY SPILLWAY

NOT DRAWN TO SCALE

FEB 1999
APPROVED

ENGINEER'S CERTIFICATION

JAMES G. SCHLEYDGT
Construction Engineering Manager
Peabody Coal Company

ARIZONA P.E. 18782

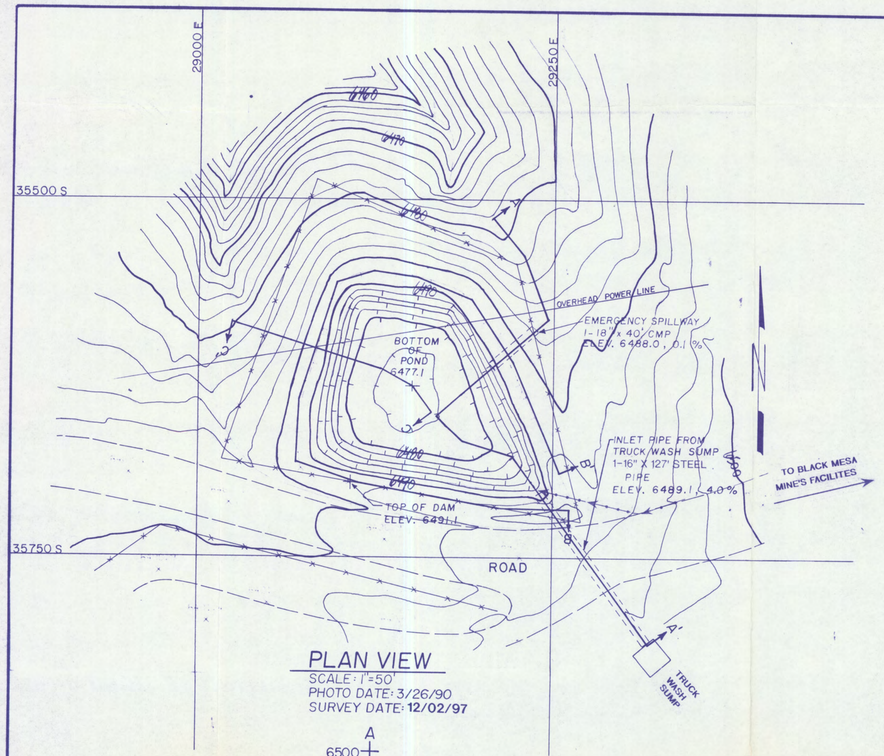
Date: APR 23 1998

NOTES:
1) General location, see Drawing No. 85400, Sheet K-10 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1-3 for description of Geotechnical Evaluation, (Incised Pond)
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.

PEABODY COAL COMPANY
BLACK MESA — KAYENTA MINE

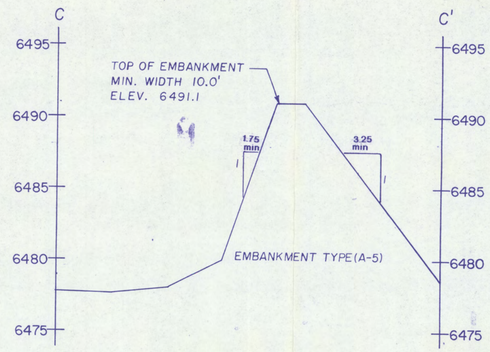
BM TIPPLE (BM-T)
TEMPORARY IMPOUNDMENT
DESIGN

SCALE: AS SHOWN	DRAWN BY: G.A.
DATE: 6/7/90	DRAWING NO:
REVISION: 3-25-98	APPROVED BY: J.G.S.



PLAN VIEW

SCALE: 1"=50'
PHOTO DATE: 3/26/90
SURVEY DATE: 12/02/97

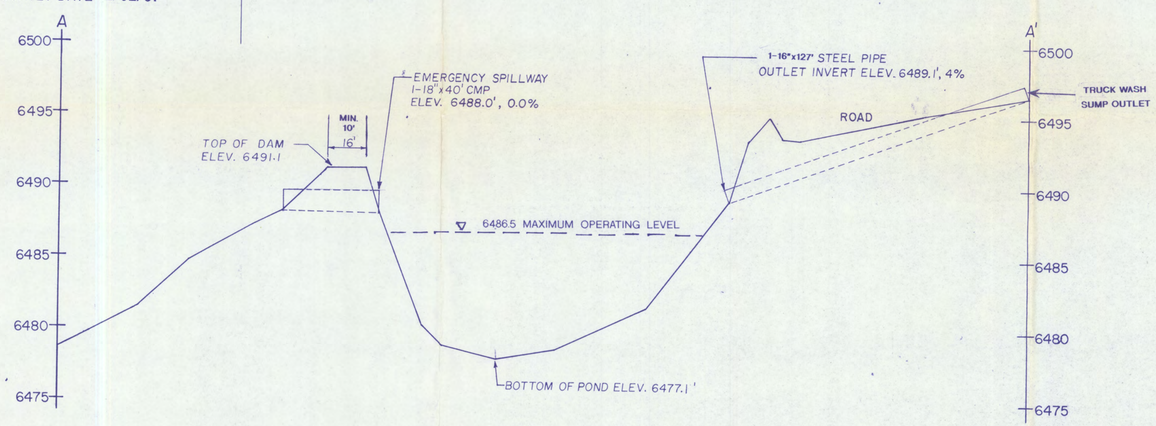


SECTION C-C'

SCALE: HORIZ. 1"=30'
VERT. 1"=5'

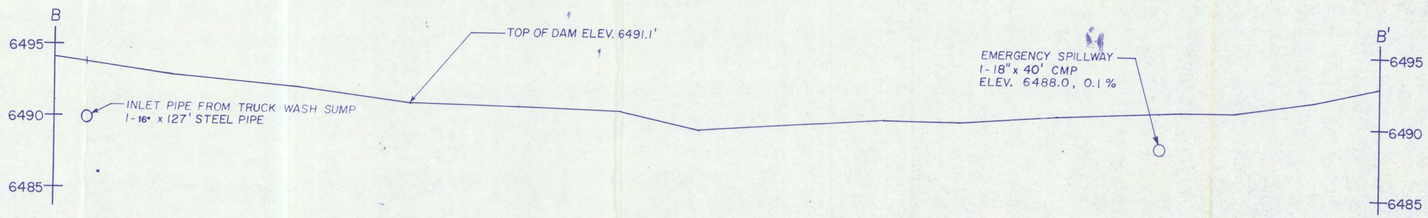
BM-TW STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6477.1	0.0	0.00	0.00	0.00	BOTTOM OF POND
6478.0	0.9	0.06	0.03	0.03	
6479.0	1.9	0.10	0.08	0.11	
6480.0	2.9	0.16	0.13	0.24	
6481.0	3.9	0.20	0.18	0.42	
6482.0	4.9	0.23	0.22	0.63	
6483.0	5.9	0.25	0.24	0.87	
6484.0	6.9	0.27	0.26	1.13	
6485.0	7.9	0.29	0.28	1.41	
6486.0	8.9	0.31	0.30	1.71	
6486.5	9.4	0.33	0.16	1.87	MAX. OPERATING LEVEL
6487.0	9.9	0.34	0.17	2.04	
6488.0	10.9	0.37	0.36	2.39	EMERGENCY SPILLWAY
6489.0	11.9	0.40	0.39	2.78	
6490.0	12.9	0.43	0.42	3.19	
6491.0	13.9	0.48	0.46	3.65	
6491.1	14.0	0.49	0.05	3.70	TOP OF EMBANKMENT



SECTION A-A'

SCALE: HORIZ. 1"=30'
VERT. 1"=5'



SECTION B-B'

SCALE: HORIZ. 1"=30'
VERT. 1"=5'

FEB 1999
APPROVED

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil)
CERTIFICATE NO. 18782
JAMES G. SCHLENVOGT
ARIZONA

JAMES G. SCHLENVOGT
COMPANY CIVIL ENGINEERING MANANGER
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 18782
DATE: APR 23 1998

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

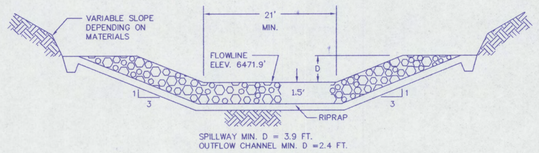
PEABODY COAL COMPANY
BLACK MESA – KAYENTA MINE

BM TRUCKWASH (BM-TW)
TEMPORARY IMPOUNDMENT
DESIGN

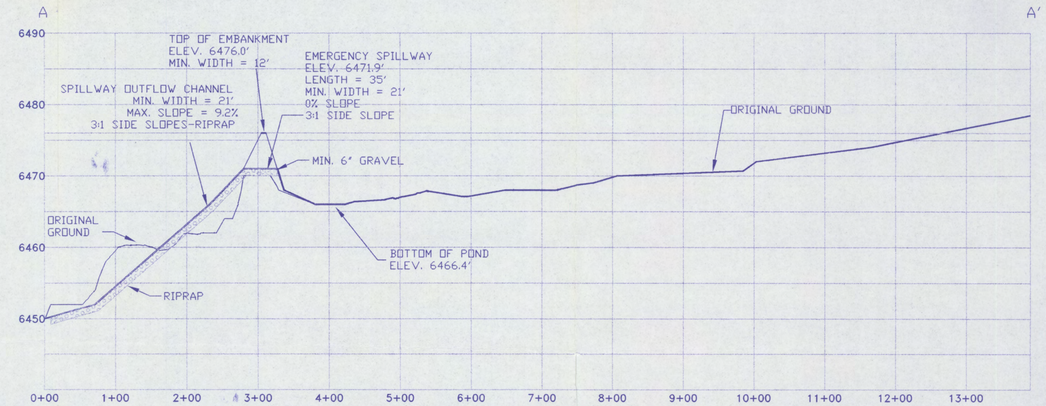
SCALE: AS SHOWN	DRAWN BY: G.A.
DATE: 6/22/90	DRAWING NO:
REVISION: 3/25/98	APPROVED BY: JGS

CW–A POND STAGE–CAPACITY TABLE

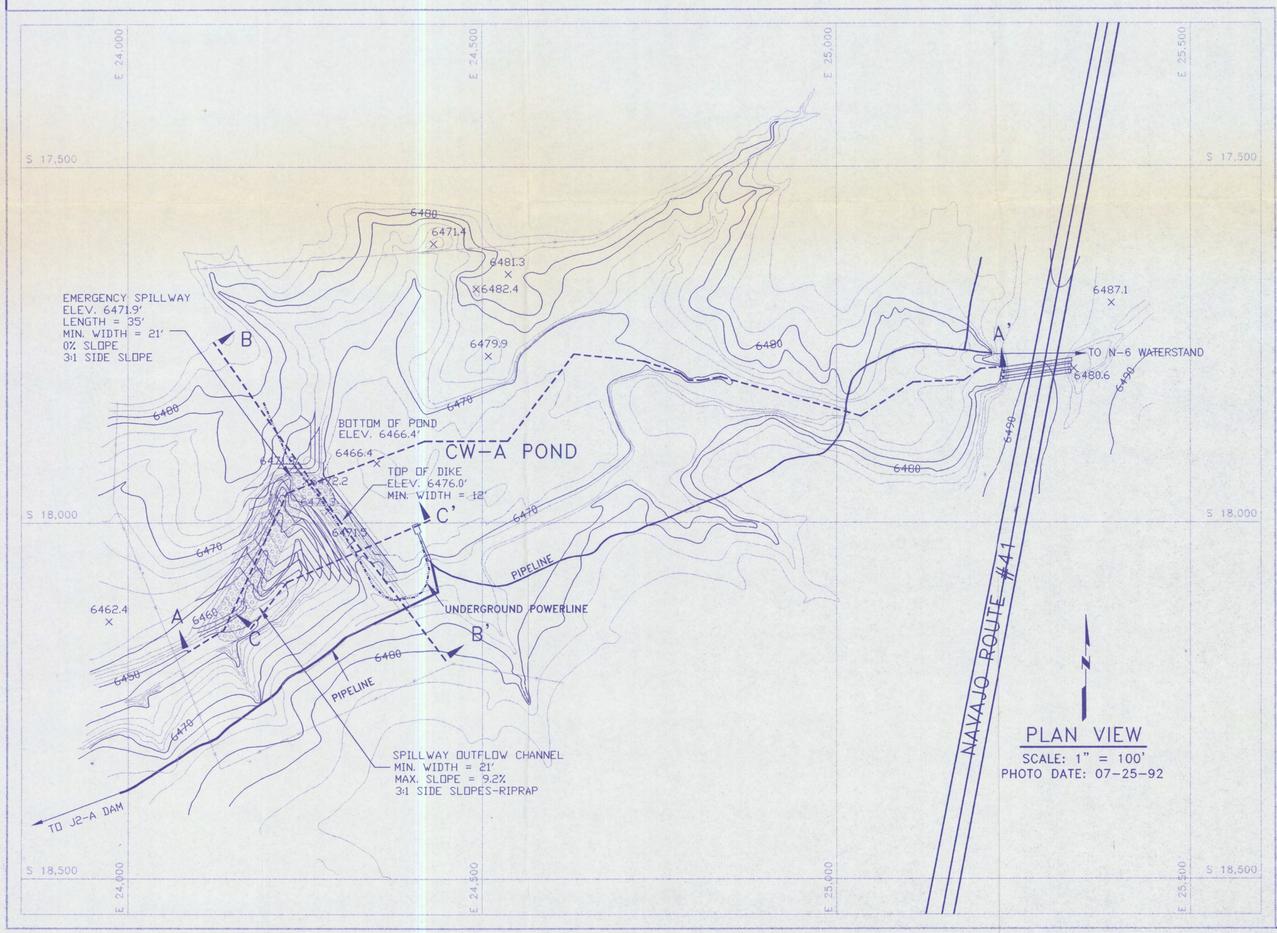
Elevation (ft–msl)	Stage (ft)	Area (Acres)	Capacity (ac–ft)	Total Capacity (ac–ft)	Description
6466.4	0.0	0.00	0.00	0.00	BOTTOM OF POND
6467.0	0.6	0.51	0.15	0.15	
6468.0	1.6	1.26	0.89	1.04	
6469.0	2.6	1.78	1.52	2.56	
6470.0	3.6	2.18	1.98	4.54	
6471.0	4.6	2.54	2.36	6.90	
6471.9	5.5	2.88	2.44	9.34	EMERGENCY SPILLWAY
6472.0	5.6	2.92	0.29	9.63	
6473.0	6.6	3.37	3.15	12.77	
6474.0	7.6	3.89	3.63	16.40	
6476.0	9.6	5.22	9.11	25.51	TOP OF EMBANKMENT



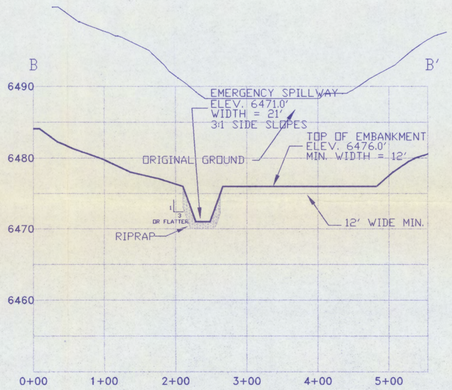
PROPOSED CW–A POND
TYPICAL SECTION OF EMERGENCY SPILLWAY
(NOT DRAWN TO SCALE)



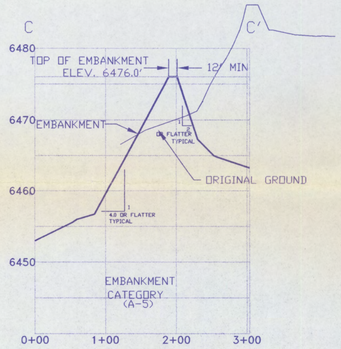
SECTION A – A'
SCALE: HORIZ. 1"=100'
VERT. 1"=10'



PLAN VIEW
SCALE: 1" = 100'
PHOTO DATE: 07–25–92



SECTION B – B'
SCALE: HORIZ. 1"=100'
VERT. 1"=10'



SECTION C – C'
SCALE: HORIZ. 1"=100'
VERT. 1"=10'

FEB 1989 APPROVED

ENGINEER'S CERTIFICATION

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

JAMES G. SCHLENDORF
Consulting Engineer, Engineering Manager
Peabody Western Coal Company

ARIZONA P.E. 18782
Date: MAY 01 1998

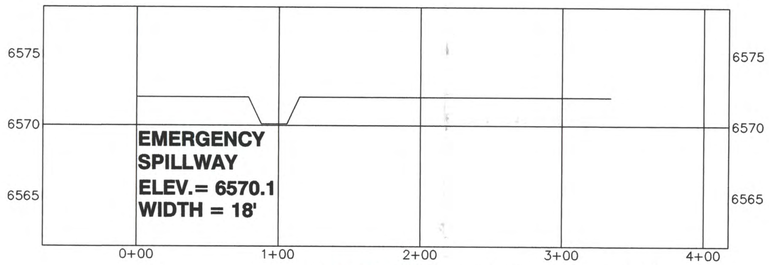
NOTES:
1) General location, see Drawing No. 85400, Sheet K–8 and Drawing No. 85405.
2) See Chapter 6, Black Mesa PAP for Construction Specifications.
3) See Vol. 2, Chapter 6, Attachment D, Sections 1–3 for description of Geotechnical Evaluation.
4) Salvage topsoil in accordance with approved topsoil 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
CW–A TEMPORARY
IMPOUNDMENT DESIGN

BLACK MESA MINE
PEABODY WESTERN 1300 S. YALE FLAGSTAFF, AZ 86001

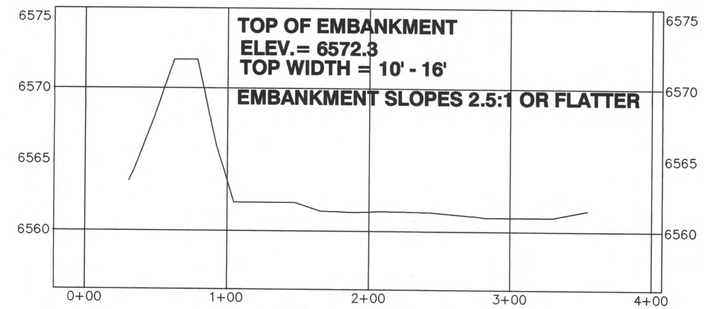
DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: PWCC	DRAWING DATE: 4–18–98
CHECKED BY: JGS	PHOTO DATE: 07–25–92
DWG FILE: CW–A DESIGN 4–98.DWG	CONTOUR INTERVAL: 2 FT.

SECTION B – B'

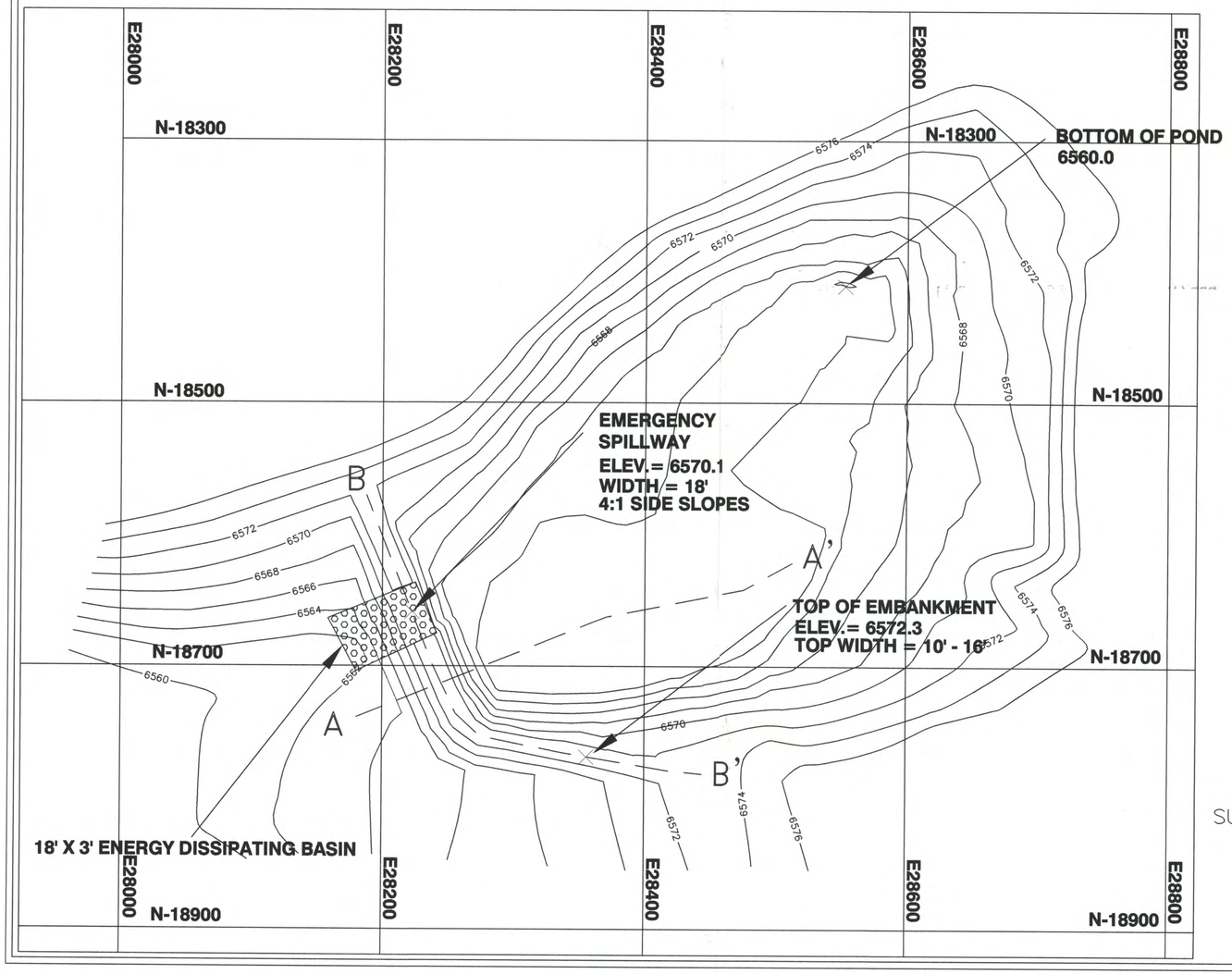


HORIZONTAL SCALE: 1" = 50'
VERTICAL SCALE: 1" = 5'

SECTION A – A'



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



J1-A POND STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6560.0	0	0	0	0	BOTTOM OF POND
6562.0	2.0	0.99	0.99	0.99	
6564.0	4.0	1.67	2.66	3.65	
6566.0	6.0	2.15	3.82	7.47	
6568.0	8.0	2.64	4.79	12.26	
6570.1	10.1	3.21	6.14	18.40	EMERGENCY SPILLWAY
6572.3	12.3	3.88	7.80	26.20	TOP OF EMBANKMENT

N

PLAN VIEW

SCALE: 1" = 50'
SURVEY DATE: 11-17-03

C.I. = 2'

I CERTIFY THAT THIS SILTATION STRUCTURE WAS CONSTRUCTED IN ACCORDANCE WITH THE APPROVED MINING PERMIT AND THAT THE INFORMATION CONTAINED HEREIN ACCURATELY DESCRIBES THE CONSTRUCTED STRUCTURE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

ENGINEER'S CERTIFICATION

Registered Professional Engineer (Civil) CERTIFICATE NO. 26858 RANDOLPH S. LEHN ARIZONA U.S.A.

RANDOLPH S. LEHN
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 26858
DATE: JUL 2 9 2004

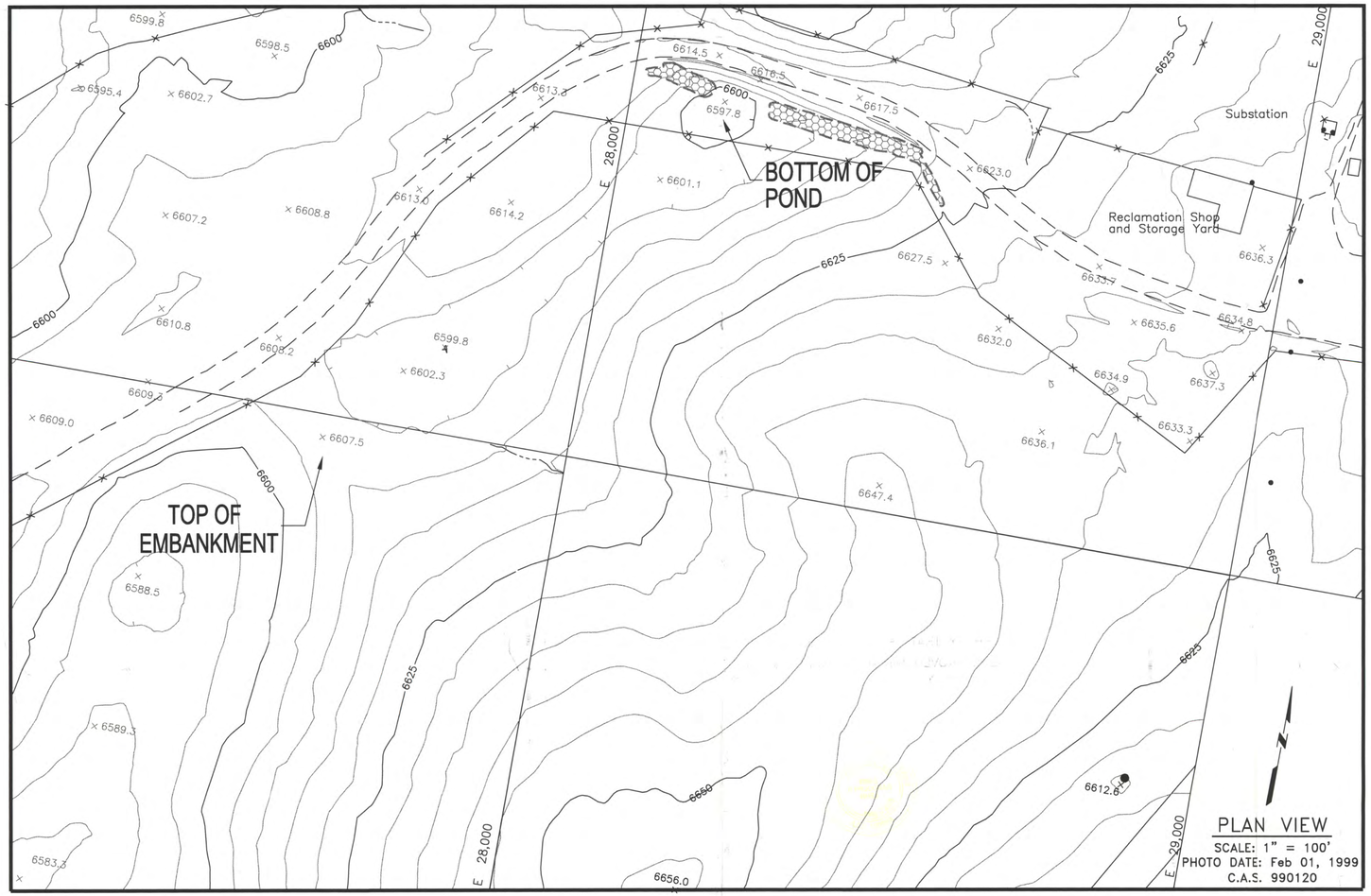
APPROVED AUG 2004

REVISIONS		
DATE	CHK'D	DESCRIPTION

J1-A POND
AS-BUILT

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
PO BOX 650 KAYENTA, ARIZONA 86033

DESIGNED BY: PWCC	SCALE: 1" = 50'
DRAWN BY: RL	DRAWING DATE: 07-29-04
CONTOUR INT.: 2'	
DWG FILE: J1-A AS-Built 07-04.dwg	



PLAN VIEW

SCALE: 1" = 100'
SURVEY DATE: 09-25-99

C.I. = 5'

I CERTIFY THAT THIS SILTATION STRUCTURE WAS CONSTRUCTED IN ACCORDANCE WITH THE APPROVED MINING PERMIT AND THAT THE INFORMATION CONTAINED HEREIN ACCURATELY DESCRIBES THE CONSTRUCTED STRUCTURE TO THE BEST OF MY KNOWLEDGE AND BELIEF

ENGINEER'S CERTIFICATION

RANDOLPH L. LEHN
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 26858
DATE: 3/3/00

OCT 2000 APPROVED

J3-H STAGE CAPACITY TABLE

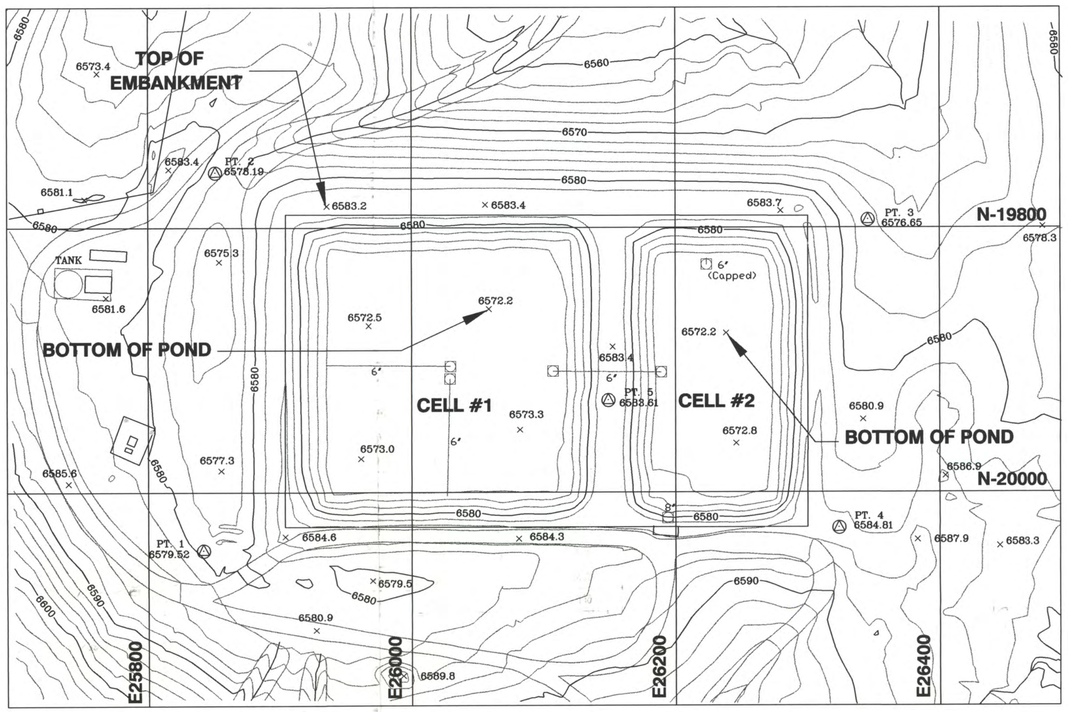
ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6597.8	0.0	0.00	0.00	0.00	BOTTOM OF POND
6599.8	2.0	0.14	0.14	0.14	
6601.8	4.0	0.62	0.76	0.90	
6603.8	6.0	1.44	2.06	2.96	
6605.8	8.0	2.43	3.87	6.83	
6607.5	9.7	3.22	4.80	11.63	TOP OF EMBANKMENT

REVISIONS		
DATE	CHK'D	DESCRIPTION

J3-H
AS-BUILT

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
PO BOX 650 KAYENTA, ARIZONA 86033

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: CI	DRAWING DATE: 03-02-00
CHECKED BY: RL	SURVEY DATE: 09-25-99
CONTOUR INT.: 5'	DWG FILE: J3-H AS..0.DWG



PLAN VIEW

SCALE: 1" = 60'
SURVEY DATE: 09-25-99

C.I. = 2'

SEWAGE CELL #1 STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6572.2	0.0	0.00	0.00	0.00	BOTTOM OF POND
6574.0	1.8	0.75	0.68	0.68	
6576.0	3.8	0.87	1.62	2.30	
6578.0	5.8	0.98	1.85	4.15	
6580.0	7.8	1.09	2.07	6.22	
6582.0	9.8	1.20	2.29	8.51	
6583.2	11.0	1.27	1.48	9.99	TOP OF EMBANKMENT

SEWAGE CELL #2 STAGE CAPACITY TABLE

ELEVATION (ft-msl)	STAGE (ft)	AREA (acres)	CAPACITY (ac-ft)	TOTAL CAPACITY (ac-ft)	DESCRIPTION
6572.2	0.0	0.00	0.00	0.00	BOTTOM OF POND
6574.0	1.8	0.36	0.32	0.32	
6576.0	3.8	0.45	0.81	1.13	
6578.0	5.8	0.52	0.97	2.10	
6580.0	7.8	0.60	1.12	3.22	
6582.0	9.8	0.68	1.28	4.50	
6583.2	11.0	0.73	0.85	5.35	TOP OF EMBANKMENT

I CERTIFY THAT THIS SILTATION STRUCTURE WAS CONSTRUCTED IN ACCORDANCE WITH THE APPROVED MINING PERMIT AND THAT THE INFORMATION CONTAINED HEREIN ACCURATELY DESCRIBES THE CONSTRUCTED STRUCTURE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

ENGINEER'S CERTIFICATION

RANDOLPH S. LEHN
PEABODY WESTERN COAL COMPANY

ARIZONA P.E. 26858
DATE: FEB 29 2000

Registered Professional Engineer (Civil) CERTIFICATE NO. 26858 RANDOLPH S. LEHN Date Signed ... Arizona, U.S.A.

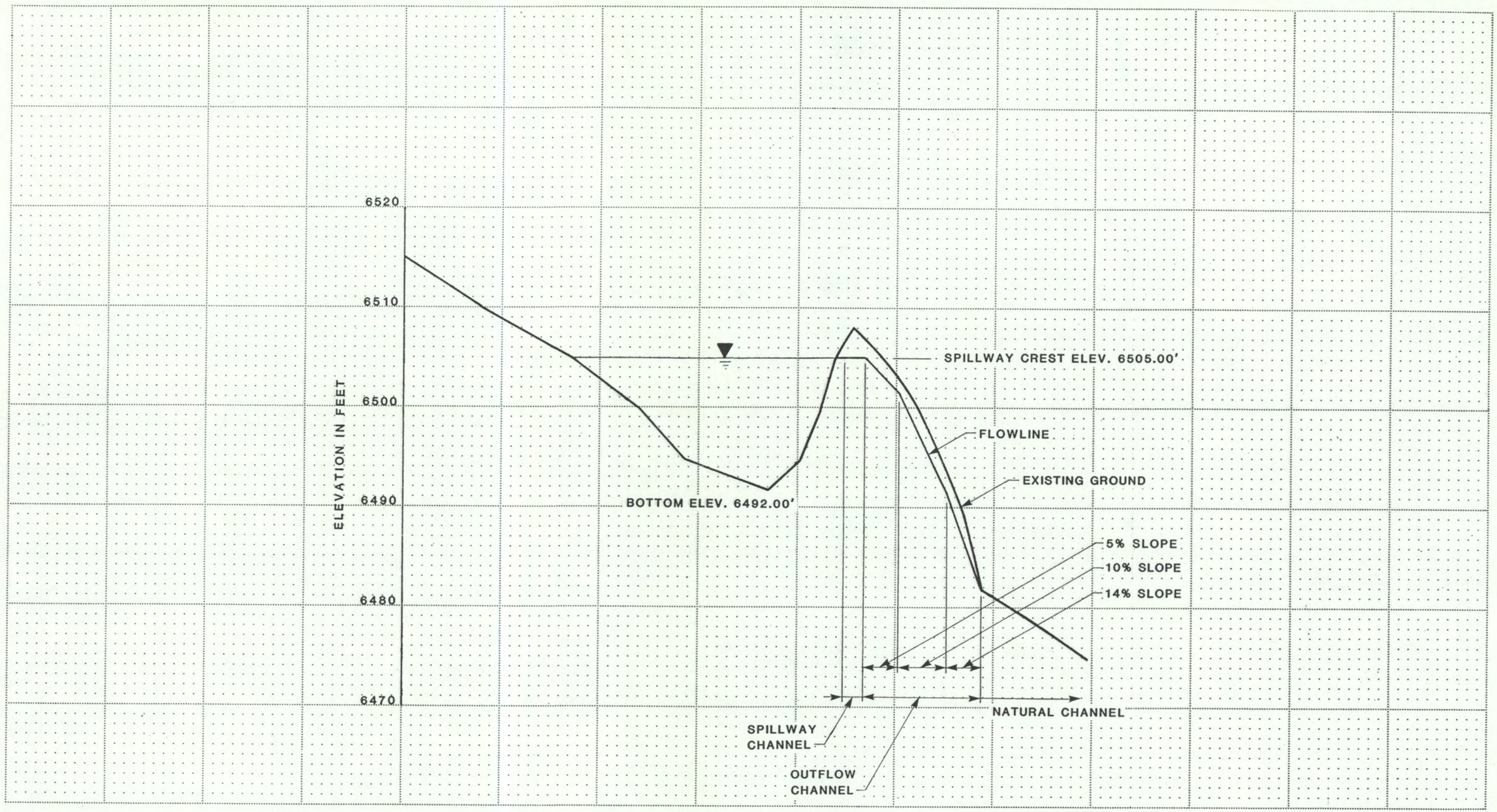
OCT 2000 APPROVED

REVISIONS		
DATE	CHK'D	DESCRIPTION

J3-SL
AS-BUILT

BLACK MESA MINE
PEABODY WESTERN COAL COMPANY
PO BOX 605 KAYENTA, ARIZONA 86033

DESIGNED BY: PWCC	SCALE: AS SHOWN
DRAWN BY: CI	DRAWING DATE: 02-25-00
CHECKED BY: RL	SURVEY DATE: 09-25-99
CONTOUR INT.: 2'	DWG FILE: J3-SL AS..9.DWG

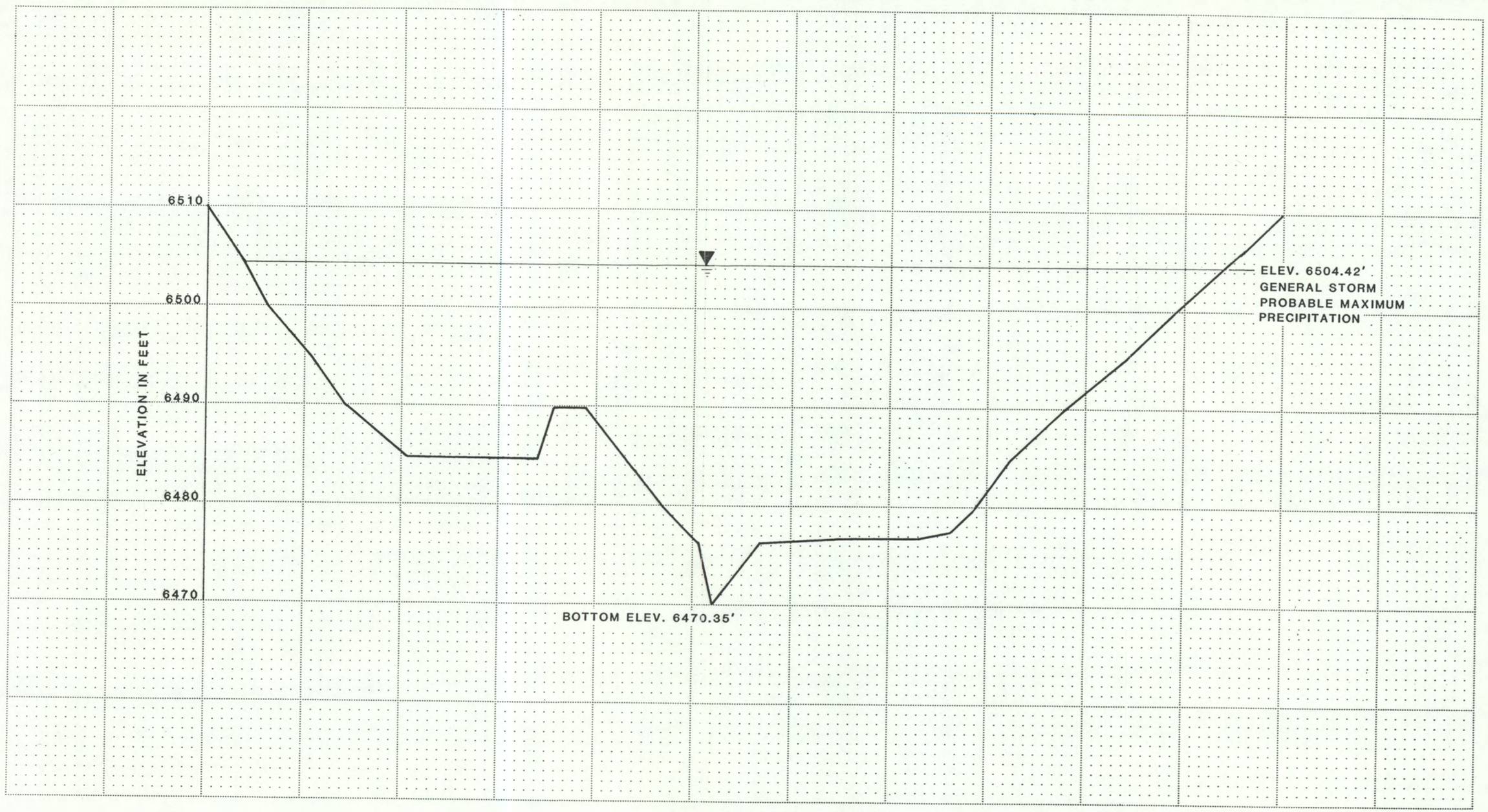


SCALE
0 200 400
FEET

CHANNEL PROFILE A-A'
J3-F

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3

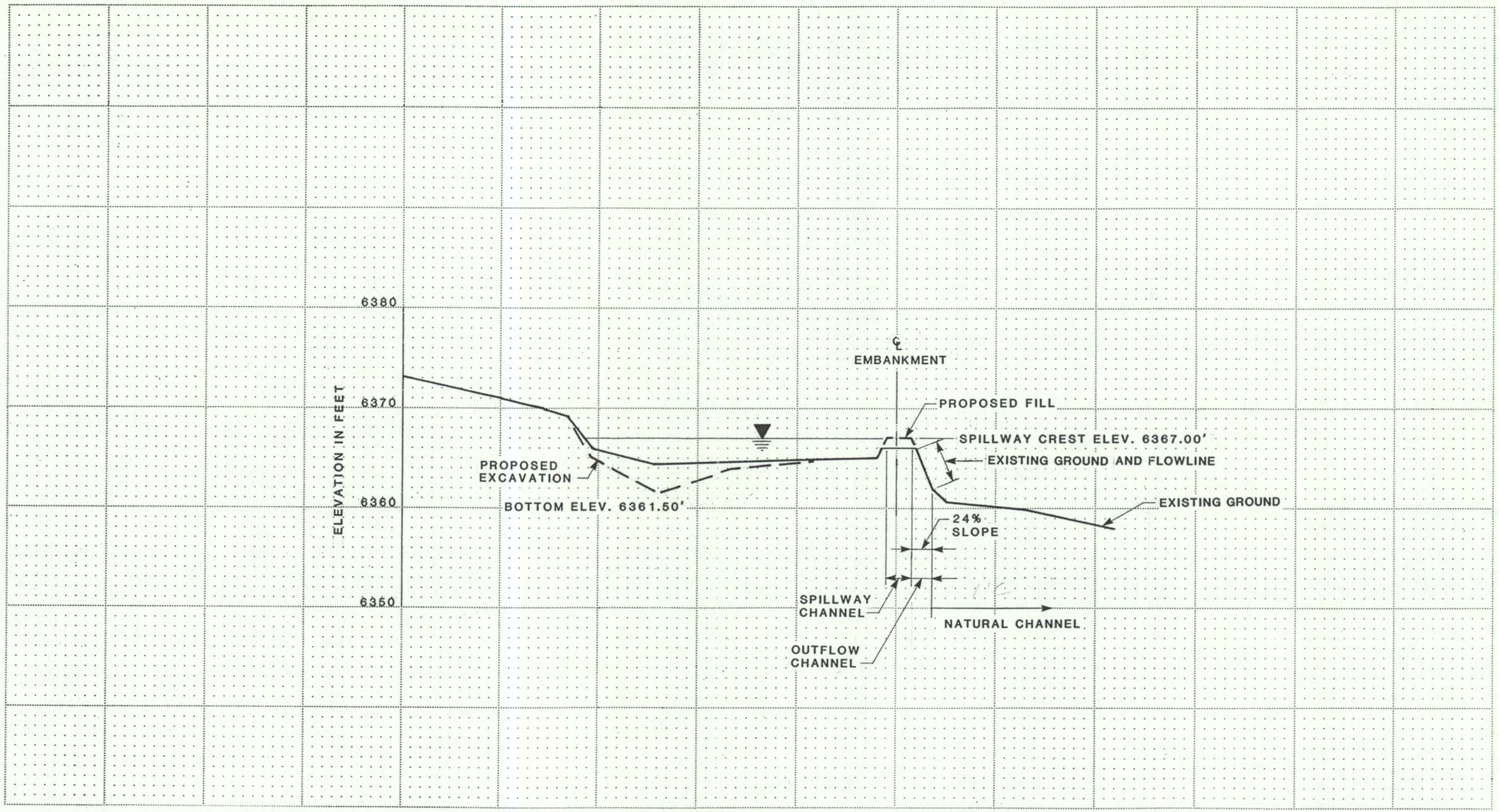


SCALE
0 200 400
FEET

CHANNEL PROFILE A-A'
J3-G

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3



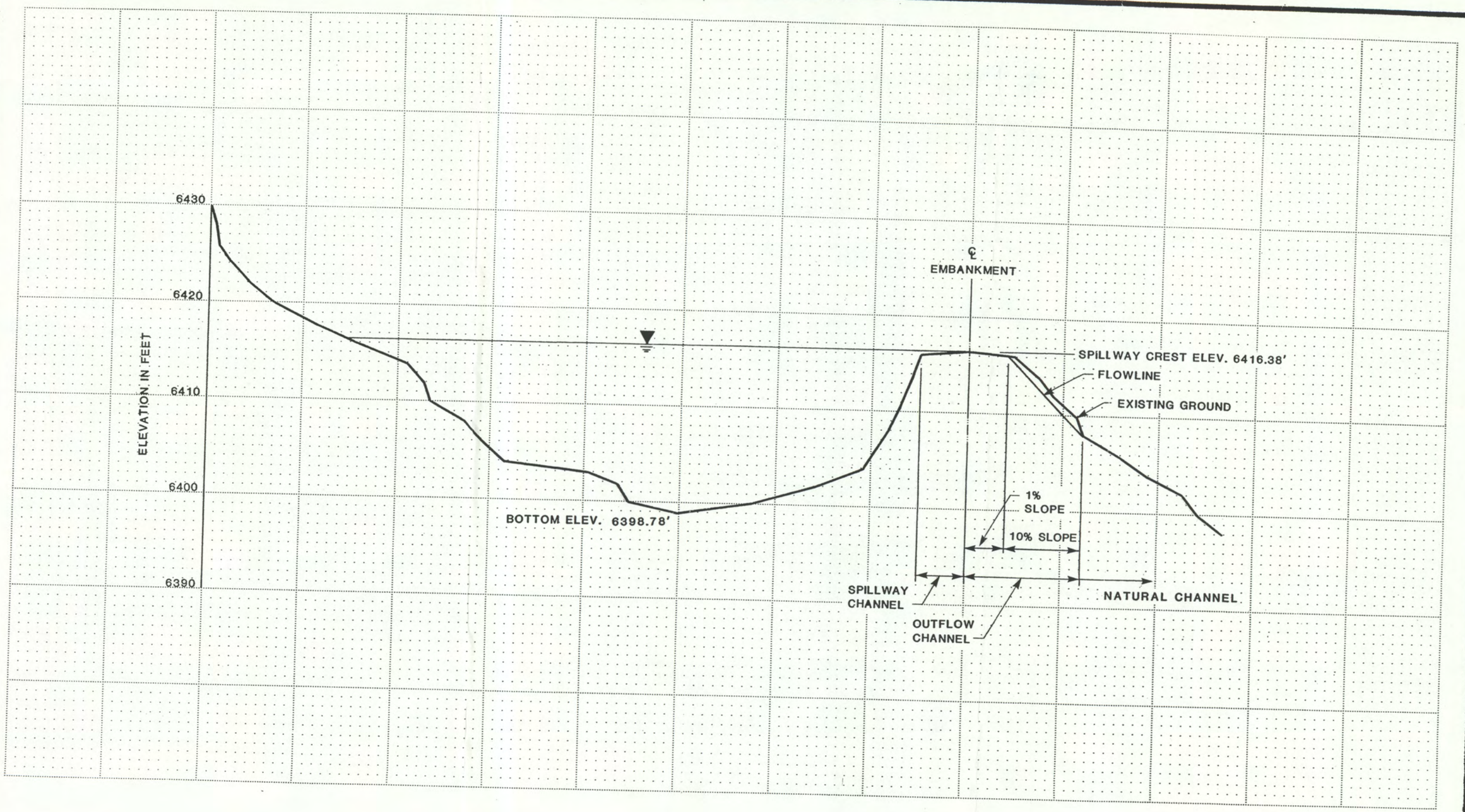
SCALE
0 100 200
FEET

CHANNEL PROFILE A-A'
J7-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 3

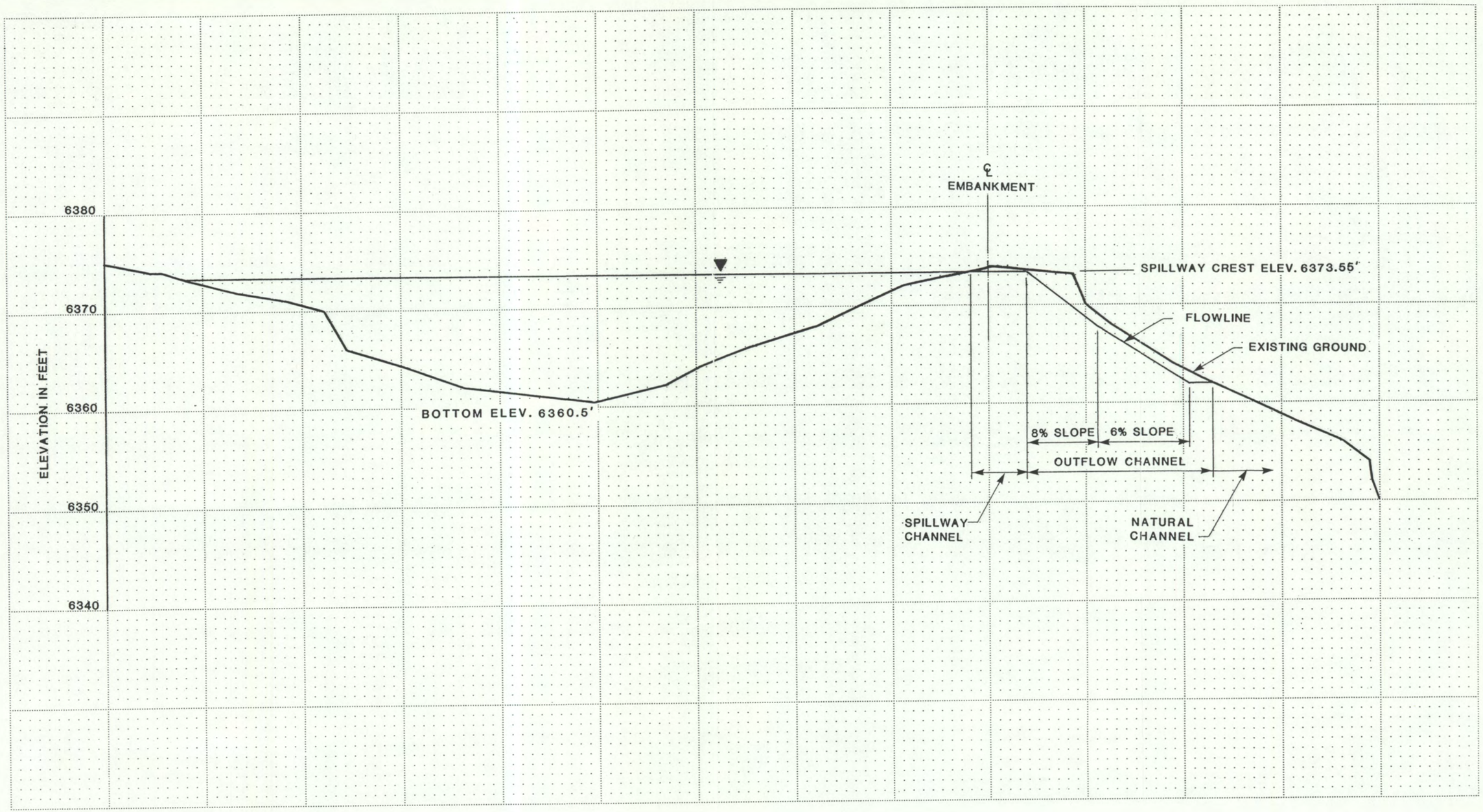


SCALE
0 100 200
FEET

CHANNEL PROFILE B–B'
BM–A1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

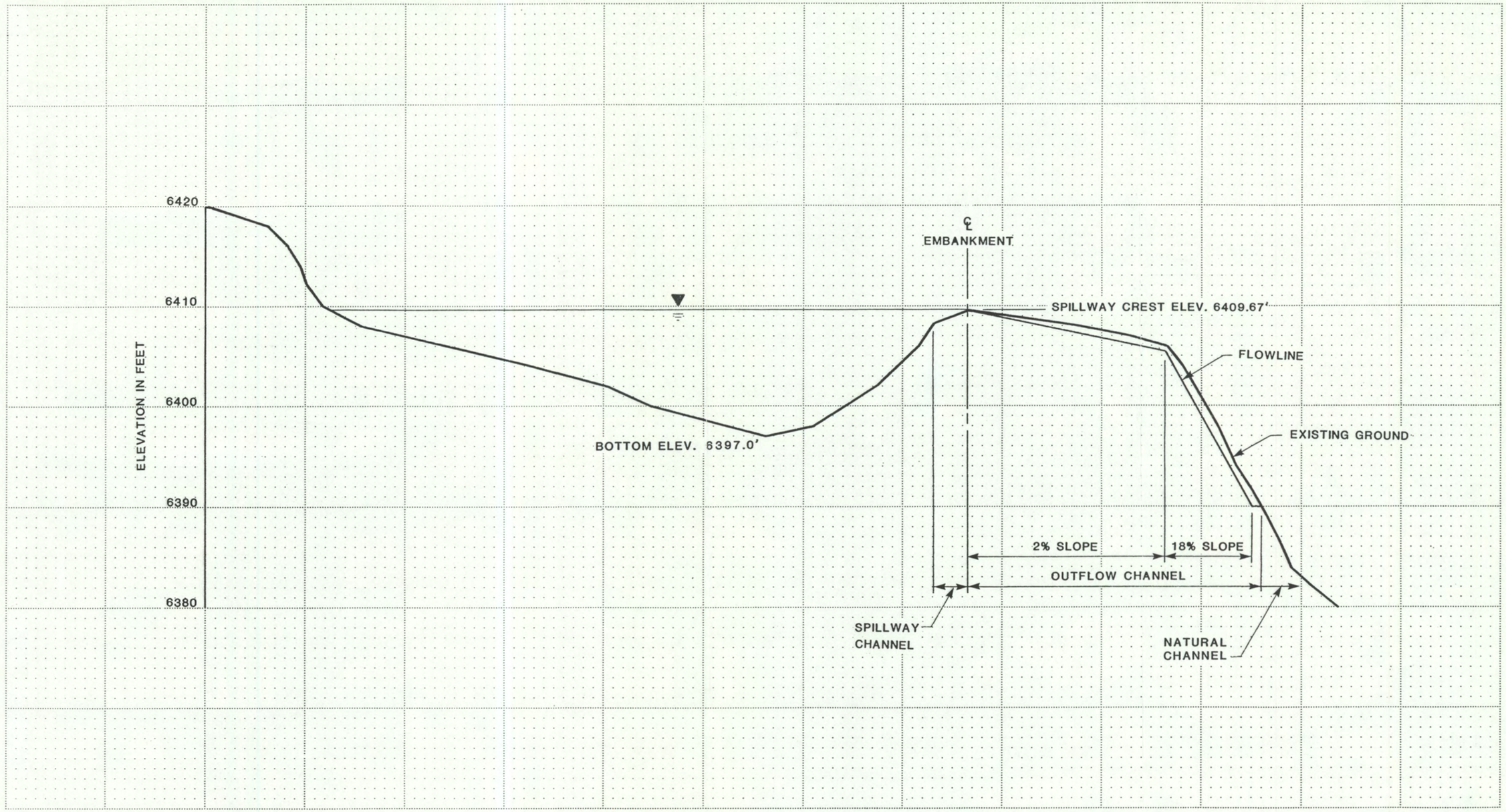


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
BM-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

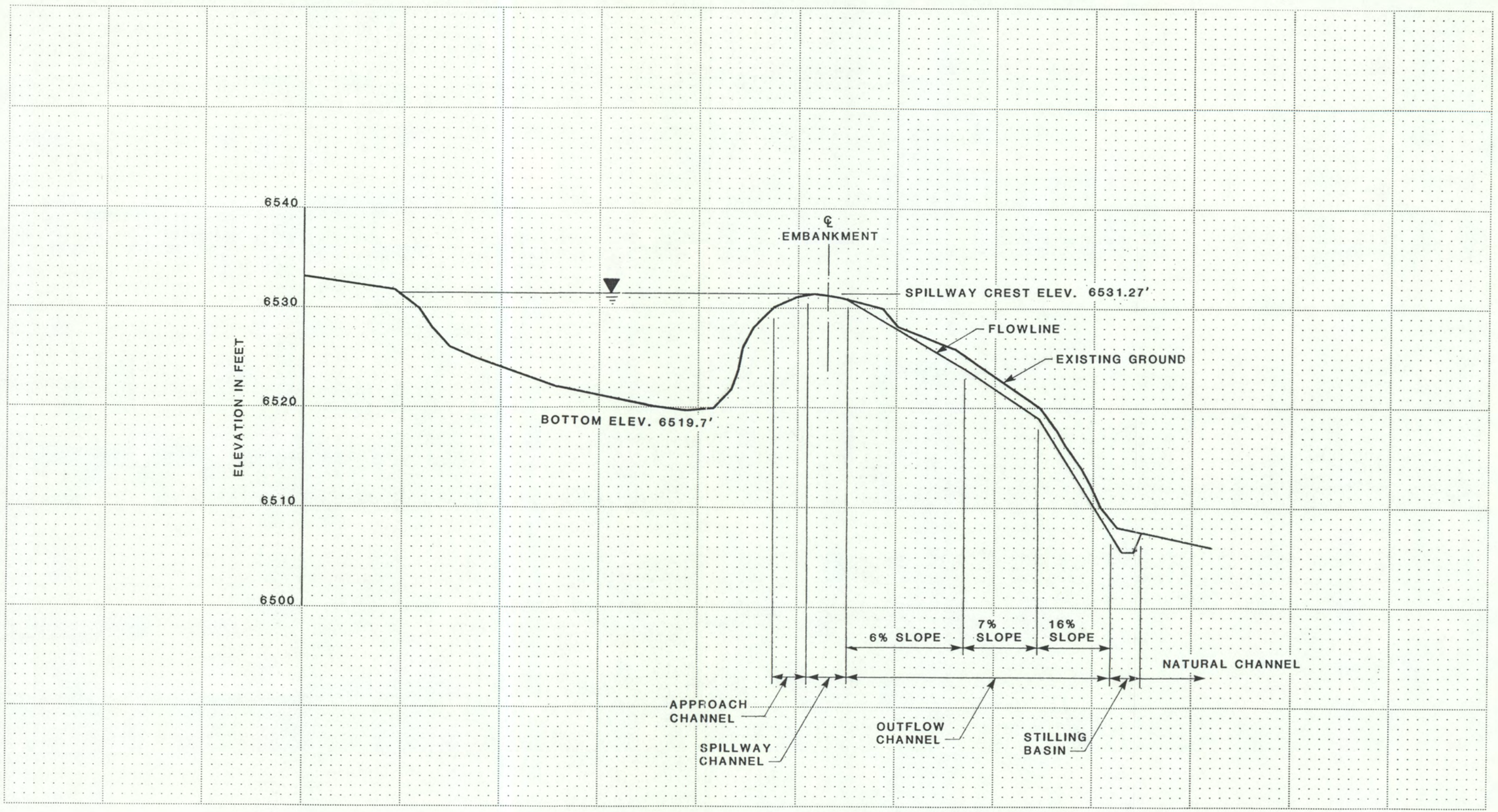


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
BM-SS

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

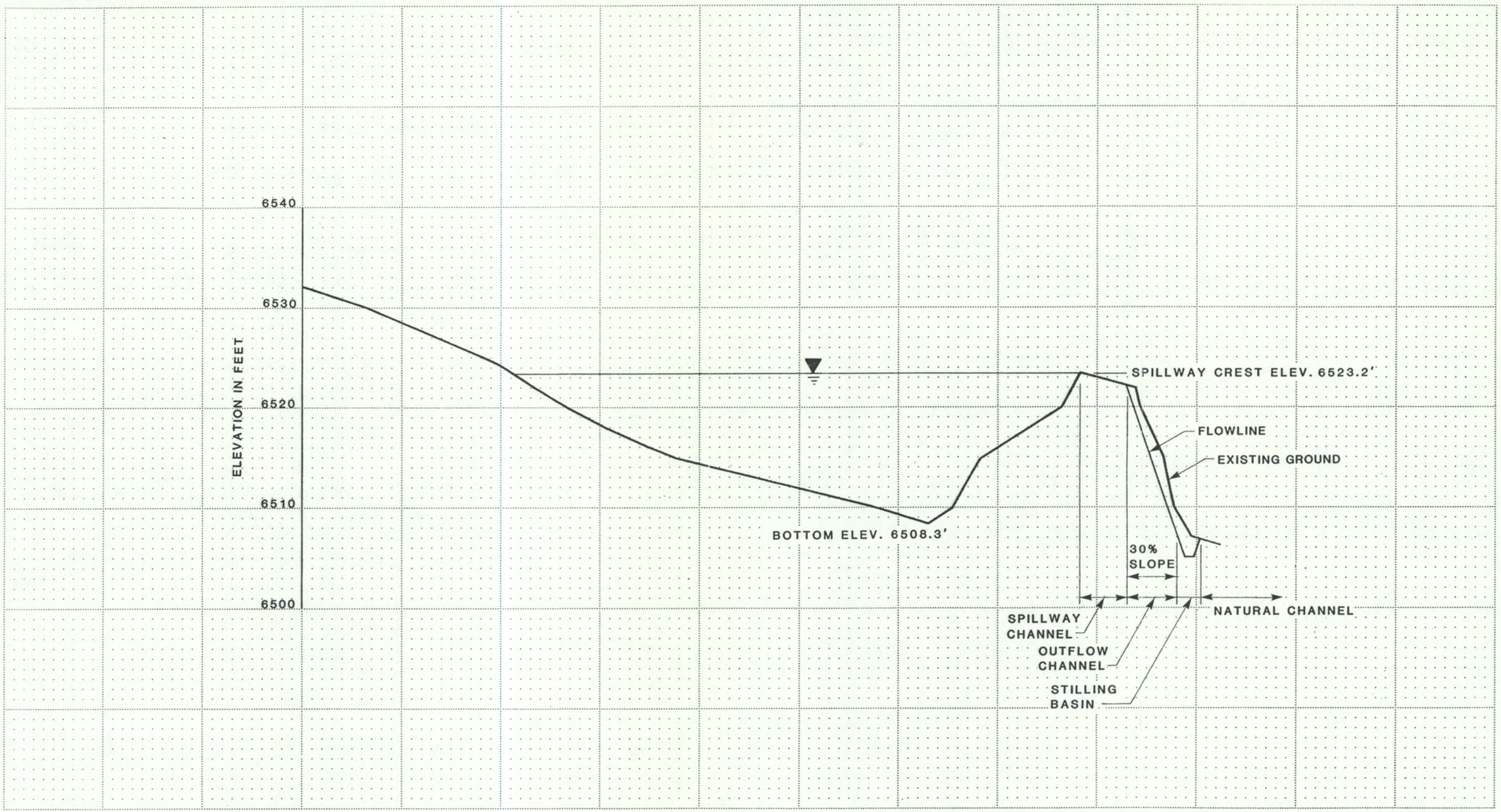


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J3-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

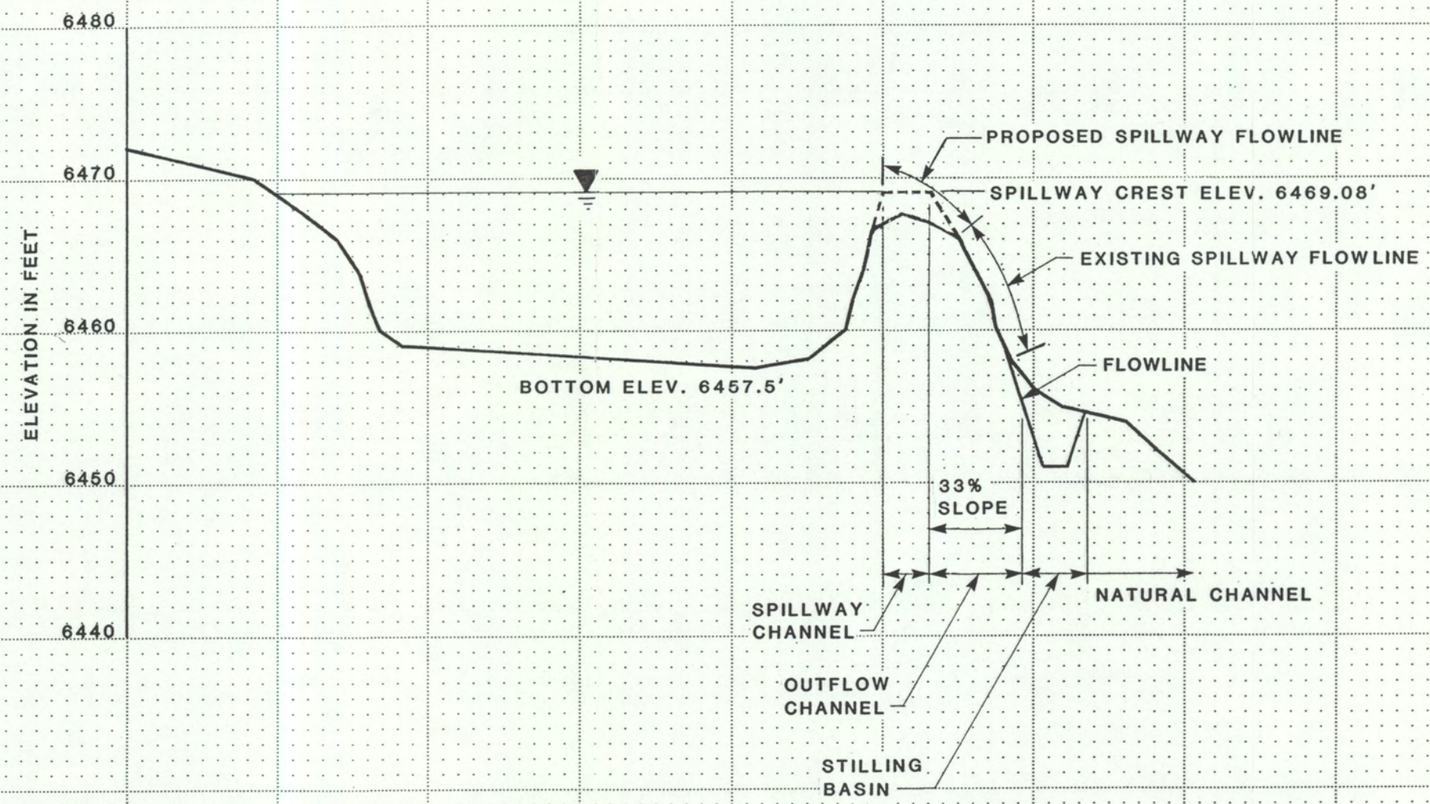


SCALE
0 100 200
FEET

CHANNEL PROFILE B–B′
J3–B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

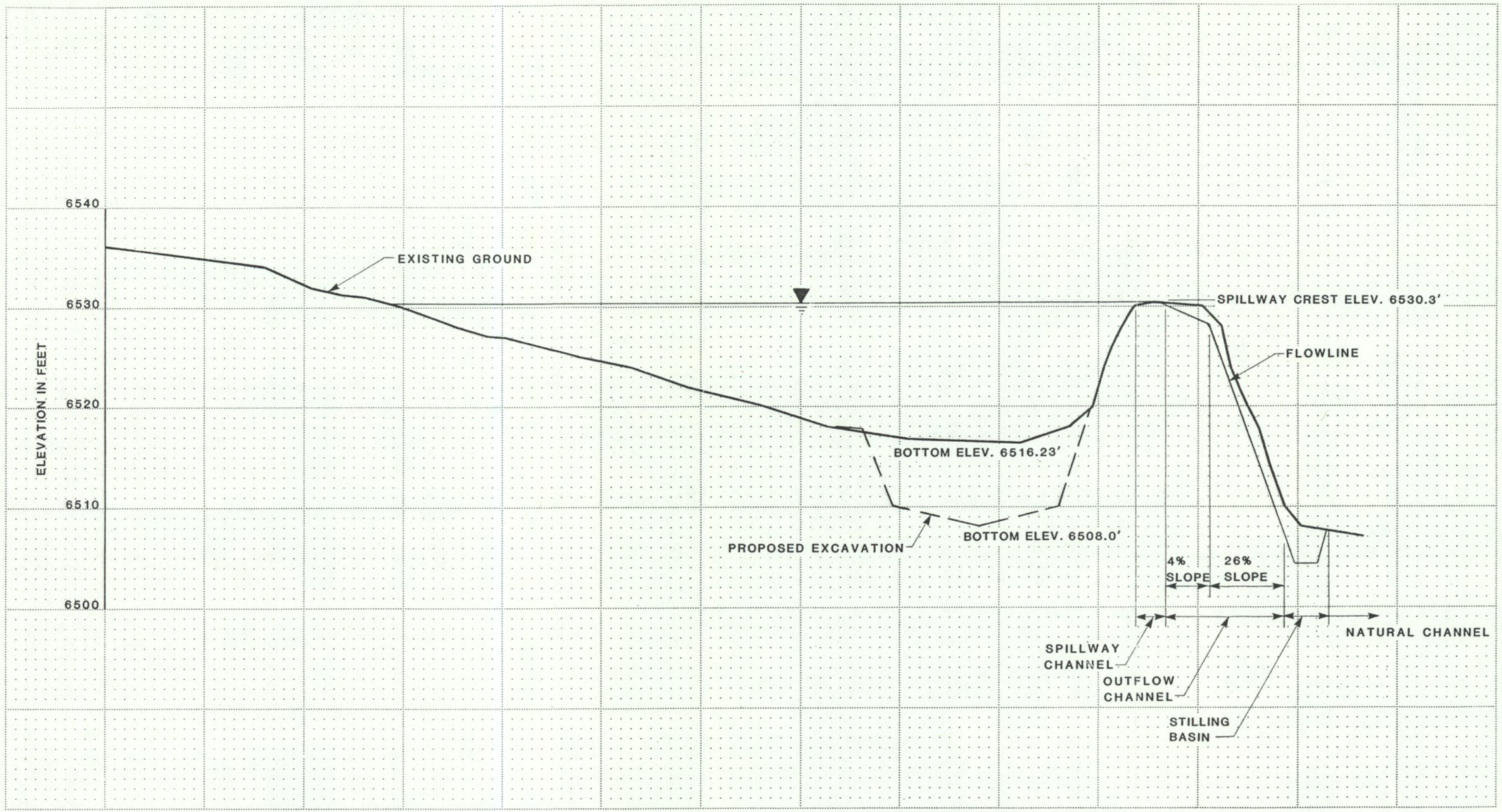


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J3-D

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SCALE
0 100 200
FEET

CHANNEL PROFILE B–B′
J3–E

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

DESIGN REPORT

Temporary Impoundment Structure

BM-TW

Black Mesa Mine

Navajo County, Arizona

For

PEABODY WESTERN COAL COMPANY

FEB 1999 APPROVED

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

MAY 01 1998

TABLE OF CONTENTS

Page

INTRODUCTION 1

INSPECTION 1

SITE DESCRIPTION 2

LAND USE 2

DESIGN ANALYSES 2

GENERAL 2

STABILITY 2

HYDROLOGY 3

HYDRAULICS 3

EMERGENCY SPILLWAY 5

APPENDIX A Hydrology Calculations
APPENDIX B SEDCAD+ (Input and Output) 25-Year, 6-Hour Storm Event
EXHIBIT #1 BM-TW Temporary Impoundment Design

APPROVED
FEB 1999

INTRODUCTION

Impoundment Structure BM-TW is an earthen embankment, designed and constructed by Peabody Western Coal Company as a temporary impoundment structure to collect runoff from portions of the facilities area at the Black Mesa Mine. BM-TW was constructed to collect runoff and wash water from the truck wash area as secondary control after the truck wash sump. BM-TW is not designed as a sediment control structure. The sediment control for the BM-TW watershed is incorporated into the designs for downstream sediment structure BM-SS assuming BM-TW is non-existent. The location of Structure BM-TW and its watershed boundary are shown on Drawing No. 85400 (Sheet K-10) 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 BM-TW. 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 Structure BM-TW was inspected in February, 1998 by a Registered Professional Engineer from Peabody Western Coal Company, to assure that the site is suitable and no adverse conditions exist for this structure. A detailed geotechnical investigation was not performed, rather, the information in Chapter 6, Attachment D was utilized for embankment design.

APPROVED
FEB 1999

SITE DESCRIPTION

LAND USE

Structure BM-TW has a 5.5-acre tributary area and is located upstream of sediment structure BM-SS. The watershed is classified as 100% disturbed.

DESIGN ANALYSES

GENERAL

Structure BM-TW 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 1990 for Peabody Western Coal Company and was used in the analyses of the structure.

STABILITY

Structure BM-TW is a Category A-5 embankment. A homogeneous earthen embankment, compacted in lifts to design specifications, and approximately 10 feet wide on top was constructed. An upstream slope of a minimum 1.75:1 (horizontal to vertical) and a downstream slope of 3.25:1 was utilized. Based on the total embankment height of approximately 13 feet, these slopes are equal to or flatter than the recommended "worst case" embankment/foundation condition slopes in Table 3-6, Attachment D, Chapter 6; therefore, the embankment will be stable.

APPROVED
FEB 1999

HYDROLOGY

The hydrologic analysis was completed using the computer program SEDCAD+ (see Appendices A and B). Structure BM-TW is classified as a low hazard structure (see Drawing No. 85408). In addition, the mine area is sparsely populated with no one living in the downstream floodplain. The structure will impound less than 20 acre-feet and be less than 20 vertical feet in height from the upstream toe of the embankment of the natural stream elevation to the spillway invert elevation.

BM-TW has an 18-inch diameter culvert spillway. Adequate storage capacity, however, will be maintained in the impoundment above the normal operating level and below the spillway invert to contain the storm runoff from the 25-year, 6-hour storm event with no discharge through the spillway. To assure that adequate storm water storage capacity is available, the operating water level in the impoundment will be maintained at or below elevation 6486.5. Water level will be controlled and excess stormwater runoff accumulations will be removed by pumping (see Chapter 6 dewatering discussion), as required. This design methodology and compliance with applicable regulatory requirements were verified through discussions with OSM personnel.

The following parameters were used in the hydrologic analysis:

		25-yr,6-hr Storm	
1.	Water Course length, L	0.171	mi.
2.	Elevation Difference, H	37	ft
3.	Time of Concentration, T_c	0.084	hr
4.	SCS Curve Number	91	
5.	Rainfall Depth, 25-year, 6-hour storm	1.9	in
6.	Drainage Area	5.5	acres

APPROVED FEB 1999

HYDRAULICS

The SEDCAD+ computer program was used to evaluate inflow to the impoundment structure. The initial conditions and results of the analysis are summarized in the following table (supporting calculations are presented in Appendices A and B).

BM-TW POND HYDRAULICS TABLE

	Units	25-Yr, 6-Hr Storm
Initial Reservoir Volume Condition		Full to emergency spillway
Inflow		
Peak Flow	cfs	8.75
Volume	ac-ft	0.49
Storage		
Spillway Invert	msl	6488.0
Peak Stage	msl	6488.0
Operational Elev.	msl	6486.5
Peak Storage	ac-ft	2.38
Storage Capacity	ac-ft	1.89
Top of Impoundment	msl	6491.1
Freeboard	ft	3.1

Notes: The Storage Capacity figure reflects available pond storage up to the defined Operational Elevation. The Peak Storage figure reflects available pond storage up to the Peak Stage elevation and includes Storage Capacity plus stormwater inflow volume (1.89 + 0.49).

APPROVED
FEB 1999

SPILLWAY

The existing spillway for BM-TW is a corrugated metal pipe with dimensions listed below. The alignment and dimensions are shown on Exhibit 1. As designed, operating water levels will be maintained at or below 6486.5 elevation such that peak stage for the 25-year, 6-hour storm is at or below the spillway invert.

Pipe Diameter	(Spillway)	1.5	ft
Pipe Length	(Spillway)	40	ft
Average Slope	(Spillway)	0.1	%
Spillway Elevation		6488	ft

* * *

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

Appendix A	- Hydrology Calculations
Appendix B	- SEDCAD+ (Input and Output) 100-Year, 6-Hour Storm Event
Exhibit # 1	- BM-TW Temporary Impoundment Design

APPROVED
FEB 1999

APPENDIX A

Hydrology Calculations

FEB 1999
APPROVED

PEABODY WESTERN COAL COMPANY
CALCULATED HYDROLOGIC DATA

PROJECT: TEMPORARY IMPOUNDMENT

STRUCTURE: BM-TW

TIME OF CONCENTRATION:

Start Elevation (ft) =	6515
End Elevation (ft) =	6478
Elevation Difference, E (ft) =	37
Watercourse Length (ft) =	905
Watercourse Length, L (mi) =	0.171
Tc = (11.9L^3/E)^0.385 =	0.084 hours

SCS CURVE NUMBER:

Cover Type	Soil Group	Curve Number	Area (acres)	CN*Area
Disturbed	C	91	5.54	504.14
TOTAL:			5.54	504.14

Weighted CN = Total CN*Area/ Total Area = 91

DRAINAGE BASIN AREA:

5.5 Acres

FEB 1989
APPROVED

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

PEABODY WESTERN COAL COMPANY : BM-TW TEMPORARY IMPOUNDMENT

by

Name: D. GLEASON

Company Name: ACZ, INC.
File Name: J:\861\1000\SEDCAD\BM-TW

Date: 04-14-1998

FEB 1999 APPROVED

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

Company Name: ACZ, INC.
Filename: J:\861\1000\SEDCAD\BM-TW User: D. GLEASON
Date: 04-14-1998 Time: 10:16:53
PEABODY WESTERN COAL COMPANY : BM-TW TEMPORARY IMPOUNDMENT
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	5.50	91	F	0.084	0.000	0.000	0.0	0.49	8.75
		Type: Null			Label: POND BM-TW					
111	Structure	5.50							0.49	
111	Total IN/OUT	5.50							0.49	8.75

APPROVED
FEB 1999

DESIGN REPORT

Sedimentation Structure

J7-B1

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

	Page
INTRODUCTION	1
INSPECTION	1
SITE DESCRIPTION	2
LAND USE	2
EMBANKMENT	2
DESIGN ANALYSES	2
GENERAL	2
STABILITY	3
HYDROLOGY	3
HYDRAULICS	4
Spillway Channel	6
Outflow Channel	6
STORAGE CAPACITY	7
APPENDIX A - HYDROLOGY AND HYDRAULIC CALCULATIONS	

INTRODUCTION

Sedimentation Structure J7-B1 will be a partially incised structure with an earthen embankment, designed and constructed 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 J7-B1 is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J7-B1. 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

The proposed site of Structure J7-B1 was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure J7-B1 has a 270.7-acre tributary drainage area and is located near Red Peak Valley at the Black Mesa Mine. The watershed is classified as 57% reclaimed and 43% disturbed.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined. The incised portion of the structure will be excavated with 3:1 (horizontal to vertical) slopes.

DESIGN ANALYSES

GENERAL

Structure J7-B1 was designed by an interdisciplinary team of engineers from Dames & Moore. 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 Coal

Company files includes topographic maps developed from aerial photography flown in 1985 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure J7-B1 will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J7-B1 is located upstream from Structure J7-B. The two structures have a combined storage capacity that is greater than 20 acre-feet. However, the spillway for J7-B1 was analyzed using the 25-year, 6-hour storm because J7-B is the upstream structure. The storage capacity of Structure J7-B1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.30	mi
2.	Elevation Difference, H	85	ft
3.	Time of Concentration, T_c	0.637	h
4.	Lag time, $0.6T_c$	0.382	h
5.	SCS Curve Number	87	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	270.7	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned 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.

J7-B1 HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	227	257
Volume	acre-ft	21.88	17.82
Storage			
Peak Stage	ft	6386.14	--
Spillway Elevation . .	ft	6387.00	--
Peak Storage	acre-ft	21.88	--
Active Storage Capacity	acre-ft	11.41	--
Incised Storage Capacity	acre-ft	13.75	--
Total Storage Capacity	acre-ft	25.16	--
Outflow			
Peak Flow	cfs	0	107
Embankment Crest Elevation	ft	--	6390.50
Peak Stage	ft	--	6389.25
Freeboard	ft	--	1.25
Spillway Channel			
Flow Depth	ft	--	2.25
Critical Velocity. . .	fps	--	5.4
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	5
Normal Velocity. . . .	fps	--	6.9
Normal Depth	ft	--	0.88
Manning's "n"		--	0.040

Spillway Channel

The spillway for J7-B1 will be a trapezoidal channel with the following dimensions:

Channel depth	3.3	ft
Channel width	15	ft
Channel length	40	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	0	percent

Outflow Channel

The outflow channel for Structure J7-B1 will be a trapezoidal channel with the following dimensions:

Channel width	15	ft
Channel length	140	ft
Side slopes (horizontal to vertical). .	3:1	
Average exit slope	5	percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plate 4. Both the spillway and outflow channel should be protected against erosion using geotextile and riprap as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, J7-B1 is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

The calculations for the sediment load entering Structure J7-B1 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.317
3. Slope Factor, LS 1.61
4. Cover Factor, C 0.52
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 storage capacity of J7-B1 is shown on Plate 2, Volume-Elevation Curve, J7-B1, and the results of the sediment inflow analysis are summarized in the following table.

J7-B1 STORAGE

Total Storage Capacity	25.16	acre-ft
10-year, 24-hour Storm Inflow	21.88	acre-ft
Available Sediment Storage Capacity . .	3.28	acre-ft
Sediment Inflow Rate	1.264	acre-ft/yr
Sediment Storage Life	3	yrs

* * *

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

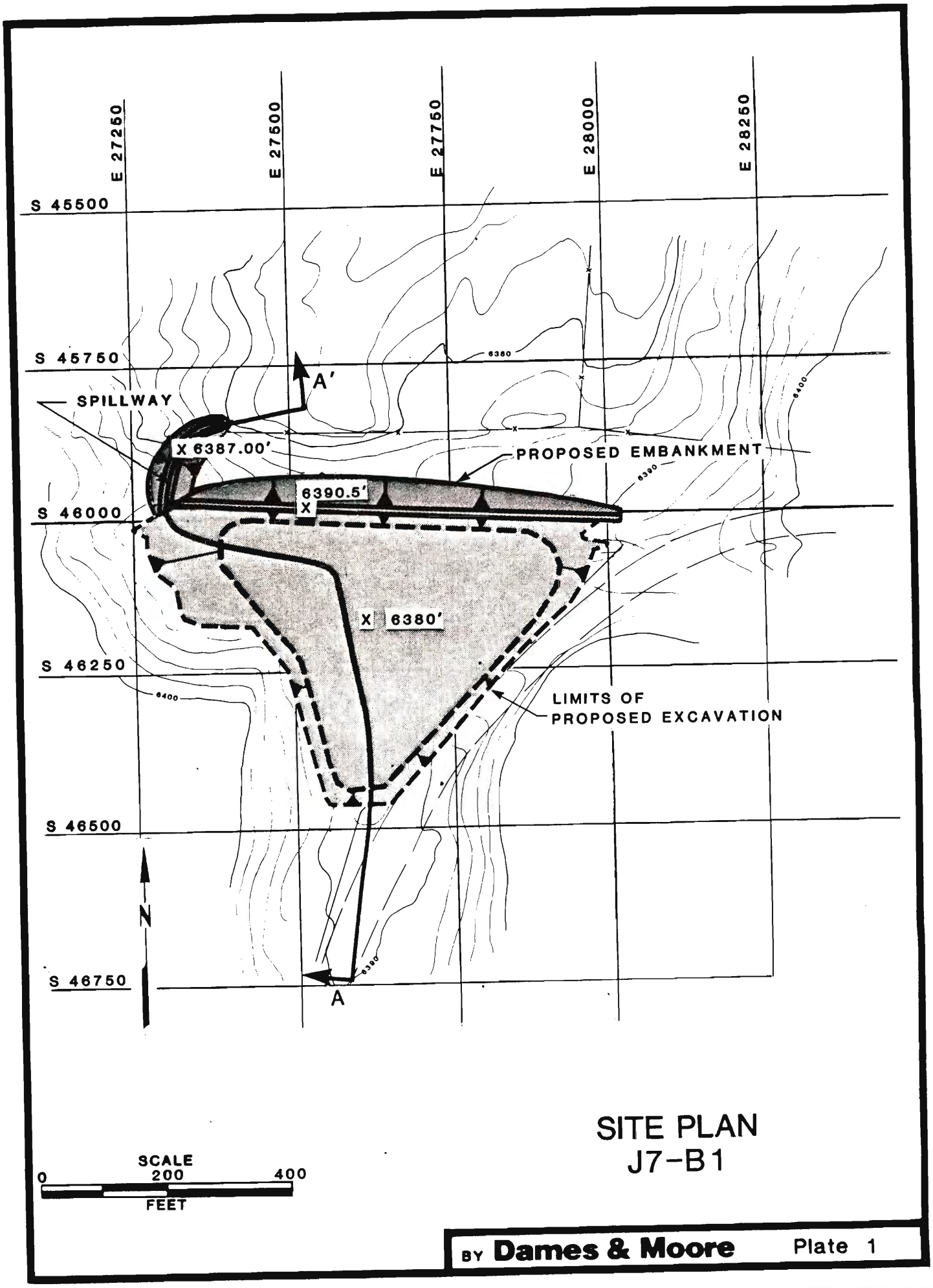
Plate 1 - Site Plan J7-B1

Plate 2 - Volume-Elevation Curve J7-B1

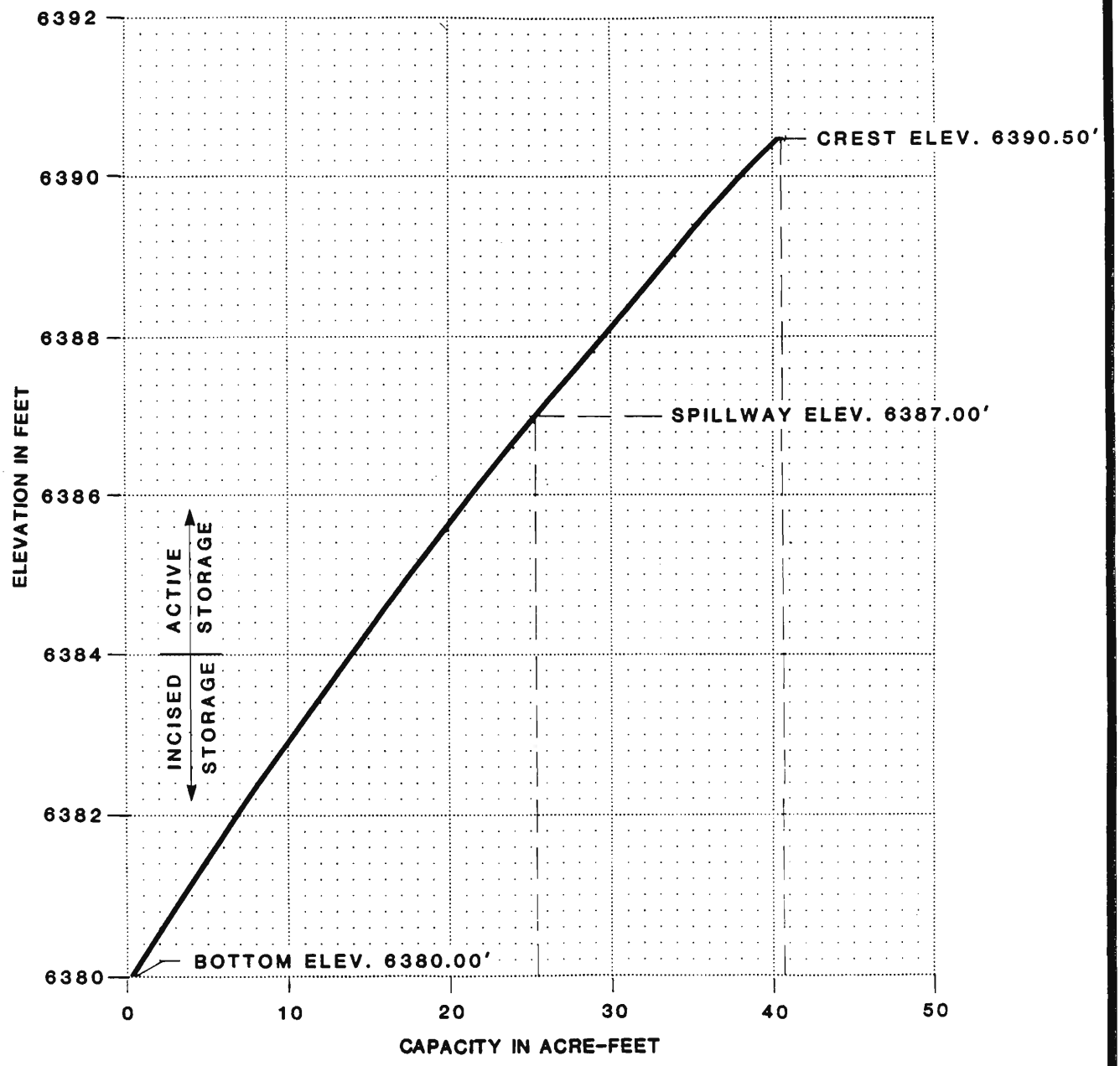
Plate 3 - Channel Profile J7-B1, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section J7-B1

Appendix A - Hydrology and Hydraulic Calculations



SITE PLAN
J7-B1



VOLUME-ELEVATION CURVE
J7-B1

BY **Dames & Moore** Plate 2

SEDCAD+ RIPRAP CHANNEL DESIGN

SEP 15 1993

J7-B1

INPUT VALUES:

Shape	TRAPEZOIDAL	
Discharge	257.00 cfs	
Slope	33.30 %	
Sideslopes (L and R)	3.00:1	3.00:1
Bottom Width	40.00 feet	
Freeboard	1 ft	

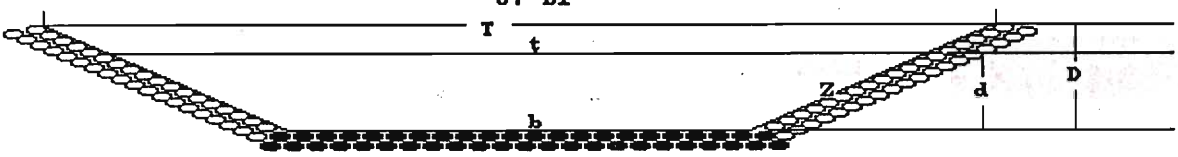
RESULTS:

Steep Slope Design - PADER Method

Depth	0.68 ft
with Freeboard	1.68 ft
Top Width	44.07 ft
with Freeboard	50.07 ft
Velocity	9.02 fps
Cross Sectional Area	28.48 sq ft
Hydraulic Radius	0.64 ft
Manning's n	0.071
Froude Number	1.98
Dmax	0.938 ft (11.25 in)
D50	0.750 ft (9.00 in)
D10	0.250 ft (3.00 in)

SEP 15 1993

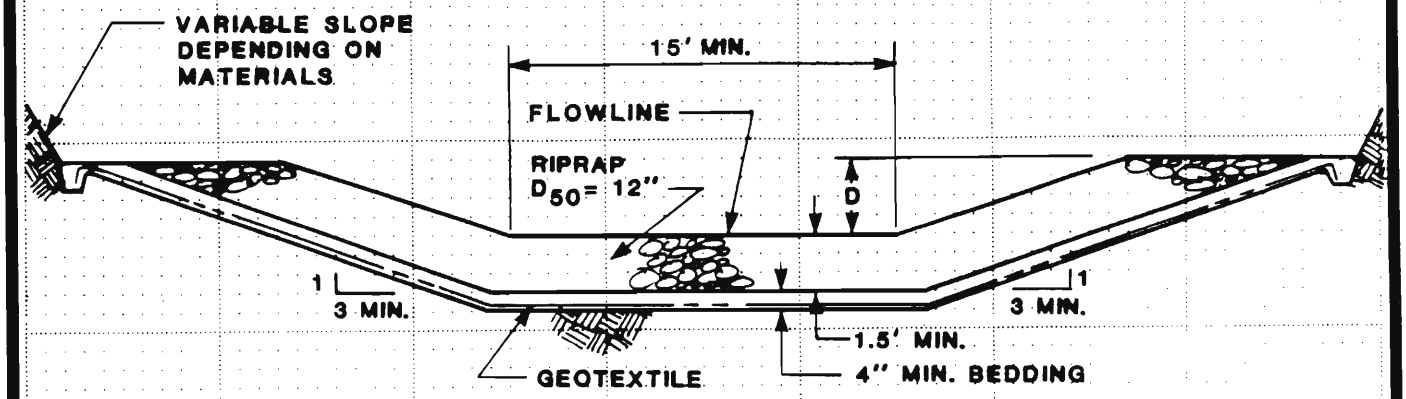
SEDCAD+ CHANNEL DESIGN
J7-B1



Riprap - Steep Slope Design - PADER Method

				w/ Freeboard:	
Discharge	= 257.00 cfs	Depth (d)	= 0.68	(D = 1.68)	ft
Bottom (b)	= 40.00 ft	Top width (t)	= 44.07	(T = 50.07)	ft
Side slopes (Z)	= 3.0:1(L) 3.0:1(R)	Velocity	= 9.02 fps		
Bed Slope	= 33.30 %	Hydraulic Radius	= 0.64 ft		
Manning's n	= 0.071	Froude number	= 1.98		

Dmax = 0.94 ft (11.25 in)
D50 = 0.75 ft (9.00 in)
D10 = 0.25 ft (3.00 in)



SPILLWAY CHANNEL

D = 3.3'

LENGTH = 40'

FLOWLINE ELEV. = 6387.00'

OUTFLOW CHANNEL

D = 2'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J7-B1

BY **Dames & Moore** Plate 4

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J.7B1 SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = ~~350'~~ 6470 - 6385 = 85 ft.

WATER COURSE LENGTH = 6974. = ~~1.32~~ 7.2(400) = 6880 ft. = 1.30 mi

T_c = ~~.376 hr~~ $\left(\frac{11.9\,(1.30)^3}{85}\right)^{0.385}$ = 0.637 hr

LAG TIME = $0.6T_c$ = ~~.225 hr.~~ = 0.382 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
116.8	disturbed	—	D	94 (.43)
153.9	reclaimed (post law)	—	D	81 (.57)
				86.6

use 87

57% EH # 35
43% EH # 23

DRAINAGE BASIN AREA

270.7 ACRE 0.423 SQ MILE

BY S. DOLAN DATE 11-5-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT INFLOW
J7B1 SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 57% EH #35 .57 (0.42)
43% EH #23 .43 (.18)
.317 ✓

K = .317

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
600	30	5.0	1.31 (.7) ✓
900	60	6.7	2.32 (.3) ✓
			1.61 ✓

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
43%	disturbed	—	—	1.0 (.43)
57%	reclaimed	60	25	.15 (.57)
				C = .52 ✓

BY ___ DATE ___
CHECKED BY BHM 11/6/85
COPY TO EO ___

EROSION CONTROL FACTOR

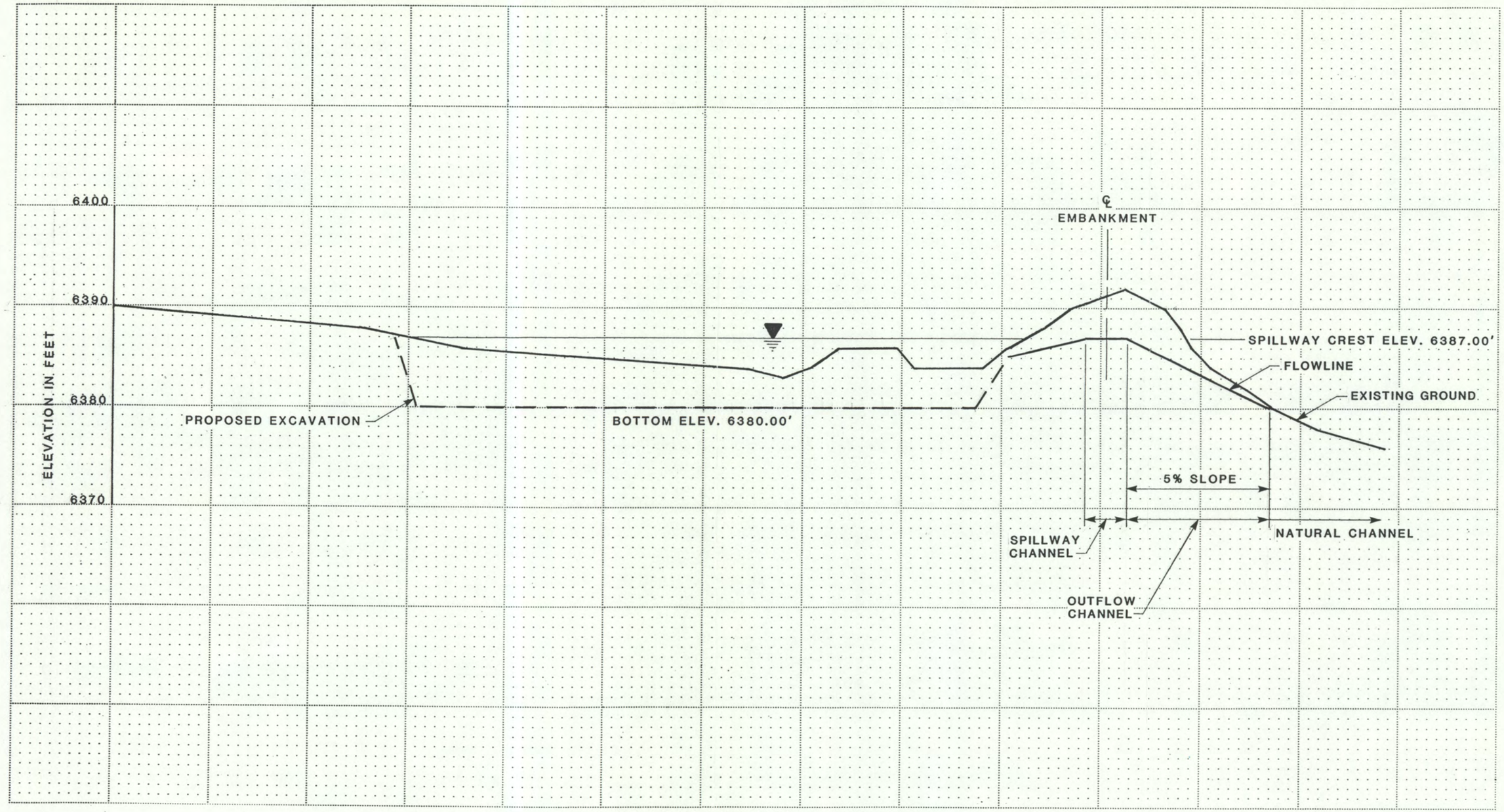
P = 1.0

SEDIMENT INFLOW

$A = 40(.317)(1.61)(.52)(1.0) = 10.62$ ton/acre/year ✓

$A = 10.62\left(\frac{1}{2047}\right)(270.7)(.9) = 1.264$ acre-feet/year ✓

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE A–A'
J7–B1

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3