

SPILLWAY CHANNEL

$D = 1.7'$
 LENGTH = 60'
 FLOWLINE ELEV. = 6538.9'

OUTFLOW CHANNEL

$D = 1'$

**SPILLWAY AND
 OUTFLOW CHANNEL
 CROSS SECTION
 J7-CD**

APPENDIX A
INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			
a. Adequate grass cover?		X	10%
b. Any erosion?	X		fills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?		X	
g. Any stone deterioration?		X	NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?		X	10%
b. Any erosion?	X		fills
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?		X	NA
i. Are the relief wells flowing?		X	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		fills
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM Rock near surface

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		5m. Hills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:		X	
Condition?			
7. SPILLWAY/EMERGENCY			
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. IMPOUNDMENT

b. Water present?	<input checked="" type="checkbox"/>	(Elev.)	feet
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d. Watershed matches soil map?	<input checked="" type="checkbox"/>	Reclaimed 40	Natural 60
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Canopy Cover	40
Ground Cover	75%

Sagebrush/grass 60 Juniper 40

APPENDIX B
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6657 - 6537 = 120 ft.

WATER COURSE LENGTH = $5.6 \text{ in } (400 \text{ ft}) = 2240 \text{ ft} = 0.424 \text{ mi.}$

$T_c = \left(\frac{11.9 (0.424)^3}{120} \right)^{0.385} = 0.153 \text{ hr.} = 9.2 \text{ min.}$

LAG TIME = $0.6 T_c = 0.092 \text{ hr.} = 5.5 \text{ min.} \checkmark$
 1091 hr. 5.5 min

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
28%	Post-Low Reclaimed	fair	—	81 (0.28) = 22.7
67%	I-P	fair	C	73 (0.67) = 48.9
5%	Haul Road	—	C E.H. 322	89 (0.05) = 4.5
				76.1
				USE <u>77</u> \checkmark

DRAINAGE AREA

39.25 AC 0.061 sq. mi. \checkmark

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UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 20% RECLAIMED
~~TEXTURE~~ 70% FH #22

0.3 (0.42) = 0.126

0.7 (0.22) = 0.154

0.280

K = 0.28

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
700	65	9	3.12 ✓
550	35	6	1.57 ✓
400	30	8	1.98 ✓

Use 2.5

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
35%	reclaimed	—	—	0.3 (.15)
65%	P-J	60	25	0.65 (.085)
5%	hwy road.	—	—	0.05 (.10)

C = .151 -

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$$A = 40 (0.28) (2.5) (0.151) (1.0) = 4.228 \text{ ton/acre/year}$$

$$A = 4.228 \left(\frac{1}{2047} \right) (39.25) (0.95) = .077 \text{ acre-feet/year}$$

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INSPECTION REPORT
Sedimentation Structure
J7-CD
Black Mesa Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J7-CD 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 J7-CD is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J7-CD. 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 J7-CD was inspected on September 2, 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 J7-CD 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 J7-CD has a 39.3-acre tributary drainage area and is located near Sagebrush Wash at the Black Mesa Mine. The watershed is classified as 67% Pinion/Juniper, 28% reclaimed, and 5% disturbed.

EMBANKMENT

Structure J7-CD is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure J7-CD

Embankment	Residual Shale Soils
Foundation	Residual Sandstone Soils/Sandstone
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	11.7 ft
Crest Width	15 ft
Upstream Slope	1.8 H : 1 V
Downstream Slope	2.5 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J7-CD, A-A'.

ANALYSES

STABILITY

Structure J7-CD is a category B-2 embankment. A standard category B-2 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 J7-CD 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.

HYDROLOGY

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

The following parameters were used in the hydrologic analysis:

1. Water Course length, L	0.424	mi
2. Elevation Difference, H	120	ft
3. Time of Concentration, T	0.152	h
4. Lag time, $0.6T_c$	0.091	h
5. SCS Curve Number	77	
6. Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
25-year, 6-hour storm. .	1.9	in.
7. Drainage Area	39.3	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.

J7-CD HYDRAULICS

	Units	10-year 24-hour Storm	25-year 6-hour Storm
<hr/>			
Initial Reservoir Volume			
Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	30	35
Volume	acre-ft	1.75	1.44
Storage			
Peak Stage	ft	6532.70	6537.58
Spillway Elevation . .	ft	6536.90	—
Peak Storage	acre-ft	1.75	—
Storage Capacity . . .	acre-ft	5.73	—
Outflow			
Peak Flow	cfs	0	3
Embankment Crest			
Elevation	ft	—	6540.09
Peak Stage	ft	—	6537.53
Freeboard	ft	—	2.56
Spillway Channel			
Flow Depth	ft	—	0.63
Critical Velocity. . .	fps	—	1.7
Manning's "n"		—	0.035
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	—	3.5 16
Normal Velocity. . . .	fps	—	1.6 2.6
Normal Depth	ft	—	0.09 0.06
Manning's "n"		—	0.035 0.035

Spillway Channel

The existing spillway for J7-CD has a trapezoidal channel with the following dimensions:

Channel depth	3 ft
Channel width	21 ft
Channel length	60 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 structure presently has no outflow channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J7-CD.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.28
3. Slope Factor, LS 2.5
4. Cover Factor, C 0.151
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 J7-CD and the results of the sediment inflow analysis are summarized in the following table.

J7-CD STORAGE

Total Storage Capacity	5.73	acre-ft
10-year, 24-hour Storm Inflow	1.75	acre-ft
Available Sediment Storage Capacity . .	3.98	acre-ft
Sediment Inflow Rate	0.077	acre-ft/yr
Sediment Storage Life	52	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J7-CD indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes, the side slopes of the spillway channel and the right abutment; and the steep 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.

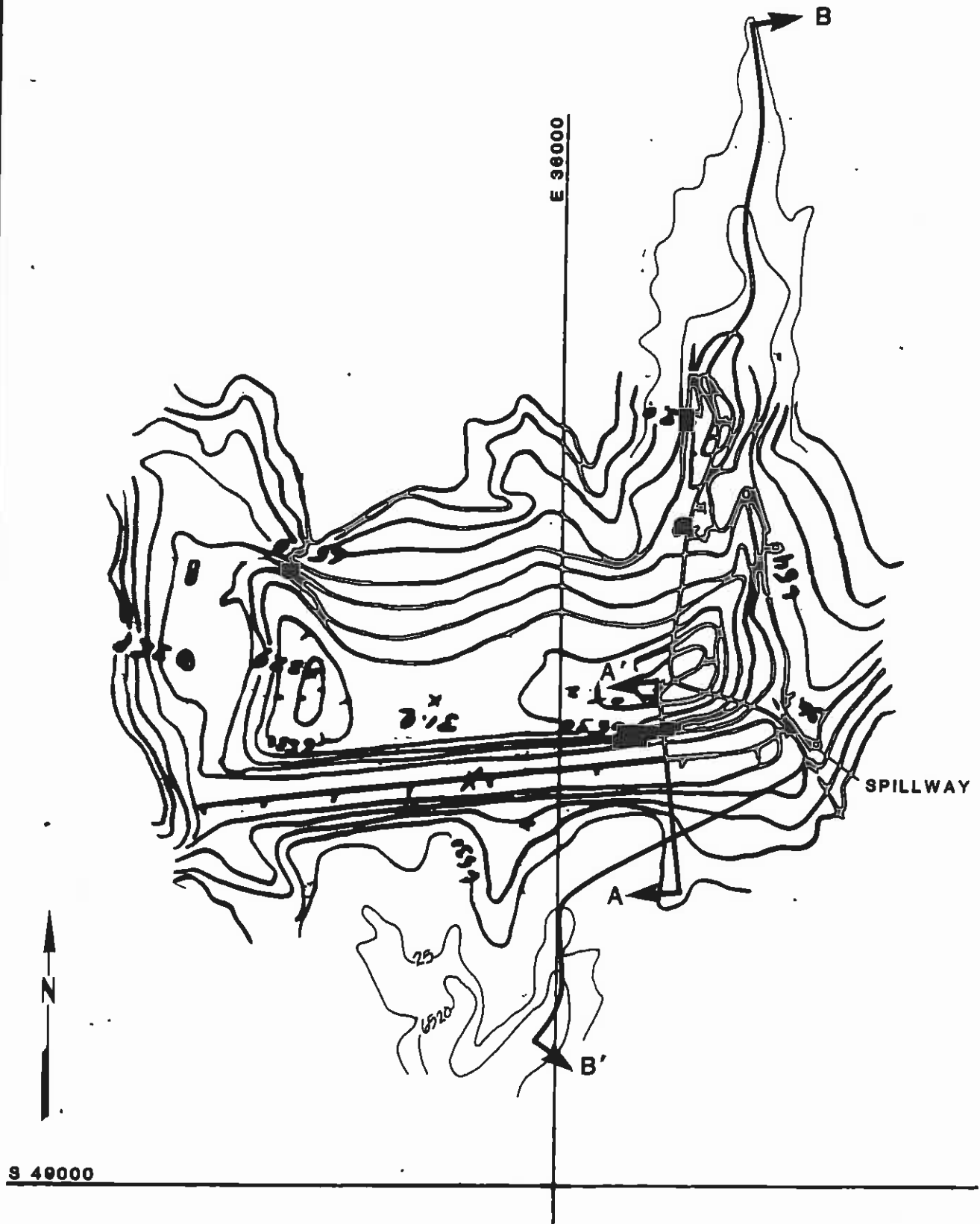
HYDRAULICS

The storage capacity and spillway capacity of Structure J7-CD 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 J7-CD
- Plate 2 - Existing Maximum Cross Section J7-CD, A-A'
- Plate 3 - Volume-Elevation Curve J7-CD
- Plate 4 - Channel Profile J7-CD, B-B'
- Plate 5 - Spillway and Outflow Channel Cross Section J7-CD
- Appendix A - Inspection Check List
- Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN J7-CD

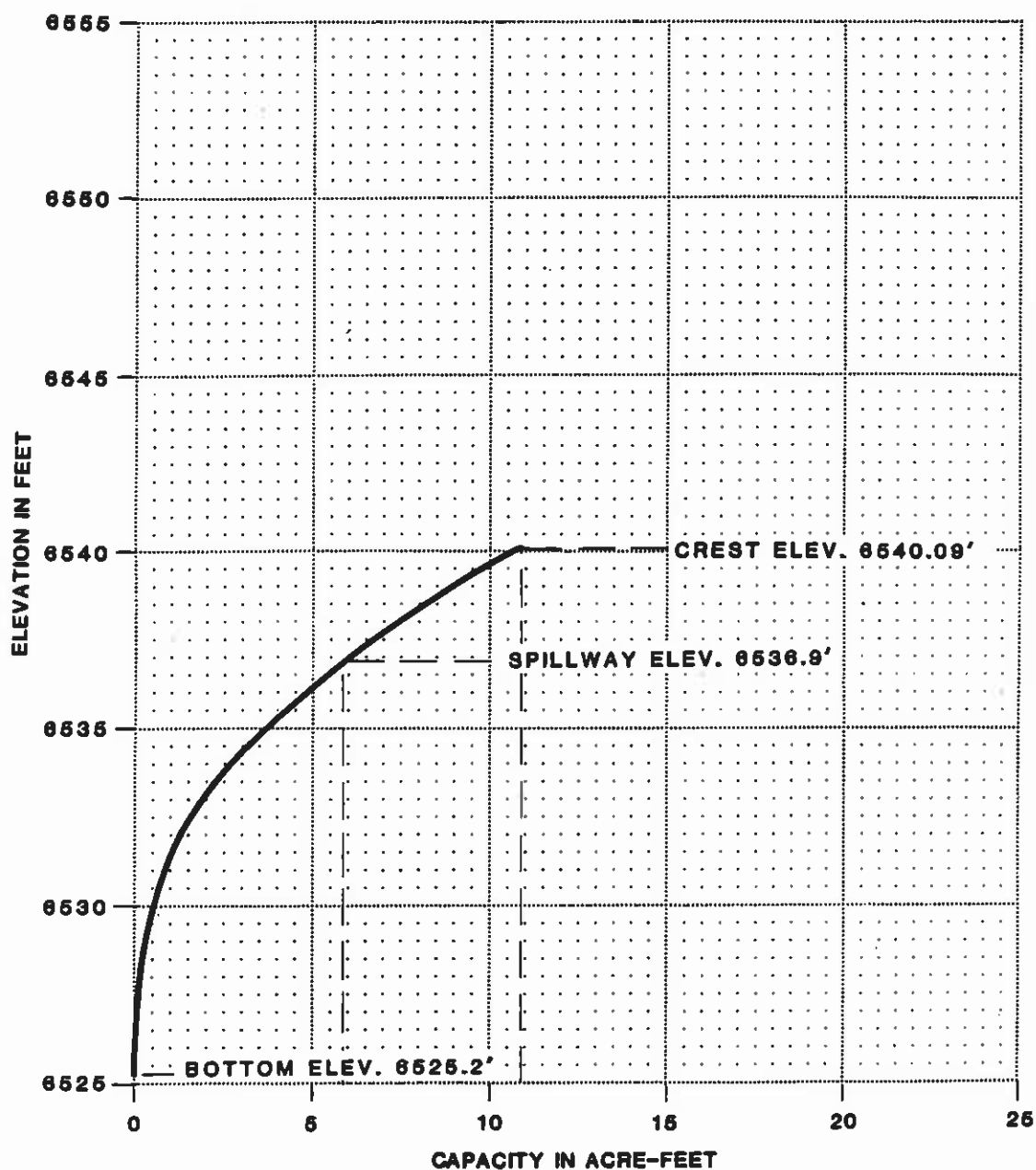


EXISTING
MAXIMUM CROSS-SECTION
A-A'
J7-CD

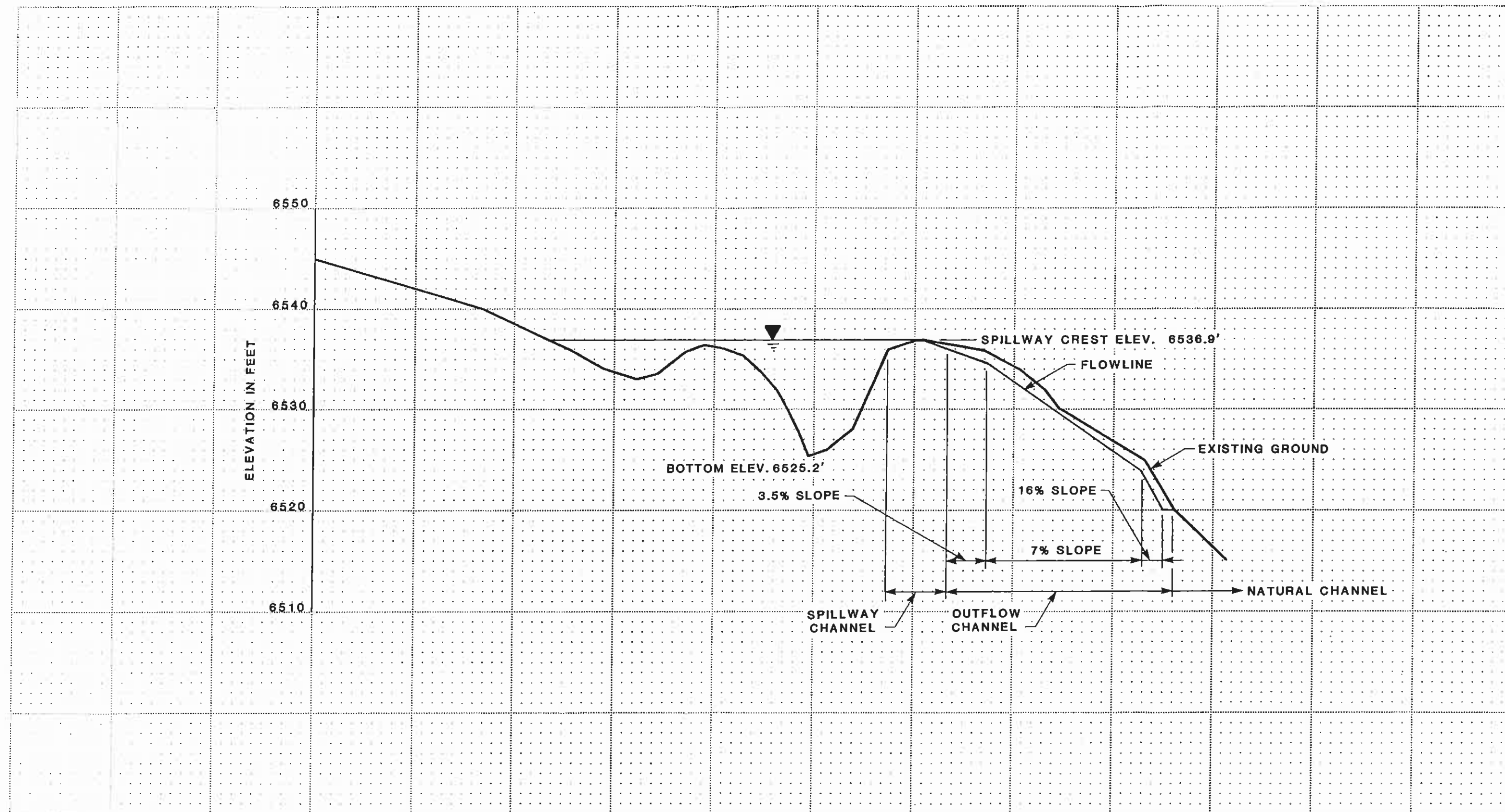
FOR LOCATION SEE PLATE 1

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Plate 2



**VOLUME-ELEVATION
CURVE
J7-CD**



SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J7-CD

FOR LOCATION SEE PLATE 1

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Plate 4