INSPECTION REPORT

Sedimentation Structure

J7-M

Black Mesa Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure J7-M is an earthen embankment, designed and constructed in 1983 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Black Mesa Mine. The location of Structure J7-M is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J7-M. 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-M was inspected on August 31, 1985 by an inter-disciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J7-M 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-M has a 52.0-acre tributary drainage area and is located near Sagebrush Wash at the Black Mesa Mine. The watershed is classified as 100% disturbed.

EMBANKMENT

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

Structure J7-M

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils/Sandstone
Left Abutment	Residual Sandstone Soils/Sandstone
Height	13.9 ft
Crest Width	30 ft
Upstream Slope	3.3 H : 1 V
Downstream Slope	2.6 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J7-M, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure J7-M is a category A-1 embankment. A standard category A-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 20 ft
2. Maximum upstream slope = 2.0 H : 1 V
3. Maximum downstream slope = 4.0 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J7-M embankment is lower in height; however, the downstream slope is steeper than the category standard; therefore, the embankment has factors of safety less than the design minimum.

HYDROLOGY

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

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.540	mi
2.	Elevation Difference, H	98	ft
3.	Time of Concentration, T_c	0.218	h
4.	Lag time, $0.6T_c$	0.131	h
5.	SCS Curve Number	92	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	52.0	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. Both the 10-year and 25-year storms were routed through Structure J7-N located upstream and into Structure J7-M. The initial conditions and results of the analysis are summarized in the following table.

	Units	10-year 24-hour Storm	25-year 6-hour Storm
Initial Reservoir Volume Condition		Empty	Full to the spillway elevation
Inflow			
Peak Flow	cfs	100	127
Volume	acre-ft	5.91	5.07
Storage			
Peak Stage	ft	6373.69	—
Spillway Elevation . .	ft	6377.40	--
Peak Storage	acre-ft	5.91	--
Storage Capacity . . .	acre-ft	10.4	—
Outflow			
Peak Flow	cfs	0	49
Embankment Crest Elevation	ft	—	6382.40
Peak Stage	ft	--	6379.61
Freeboard	ft	--	2.79
Spillway			
Pipe Exit Velocity (36" CMP)	fps	—	11.8
Pipe Exit Velocity (48" CMP)	fps	--	7.2
Mannings "n"		—	0.024
Outflow Channel			
Slope	%	—	9
Normal Velocity. . . .	fps	—	6.4
Normal Depth	ft	--	0.47
Manning's "n"		--	0.040

Spillway Channel

The existing spillway for J7-M consists of two corrugated metal pipes (CMP) with the following dimensions:

Pipe diameters	36, 48 in.
Pipe lengths	60 ft
Approximate slope	1-2 percent
Upstream invert elevation	6377.40 ft

Outflow Channel

The existing outflow channel for J7-M is a U-shaped channel with the following dimensions:

Channel width	8 ft
Channel length	30 ft
Average exit slope	3 percent

Rock provides erosion protection within the channel.

STORAGE CAPACITY

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

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.203
3. Slope Factor, LS 2.6
4. Cover Factor, C 1.0
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-M and the results of the sediment inflow analysis are summarized in the following table.

J7-M STORAGE

Total Storage Capacity	10.4	acre-ft
10-year, 24-hour Storm Inflow	5.91	acre-ft
Available Sediment Storage Capacity . .	4.49	acre-ft
Sediment Inflow Rate	0.509	acre-ft/yr
Sediment Storage Life	9	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure J7-M indicated that the geotechnical problems consist of rills on the upstream and downstream slopes and gullys in 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 4.0 horizontal to 1 vertical to meet stability requirements.

HYDRAULICS

The storage capacity and spillway capacity of Structure J7-M are adequate; however, the spillway does not have an adequate outflow channel. 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. The outflow channel should be protected against erosion using geotextile and riprap as shown in Plate 5. A trash-rack should be installed on the inlet of the CMP to prevent clogging of the spillway.

* * *

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

Plate 1 - Site Plan J7-M

Plate 2 - Existing Maximum Cross Section J7-M, A-A'

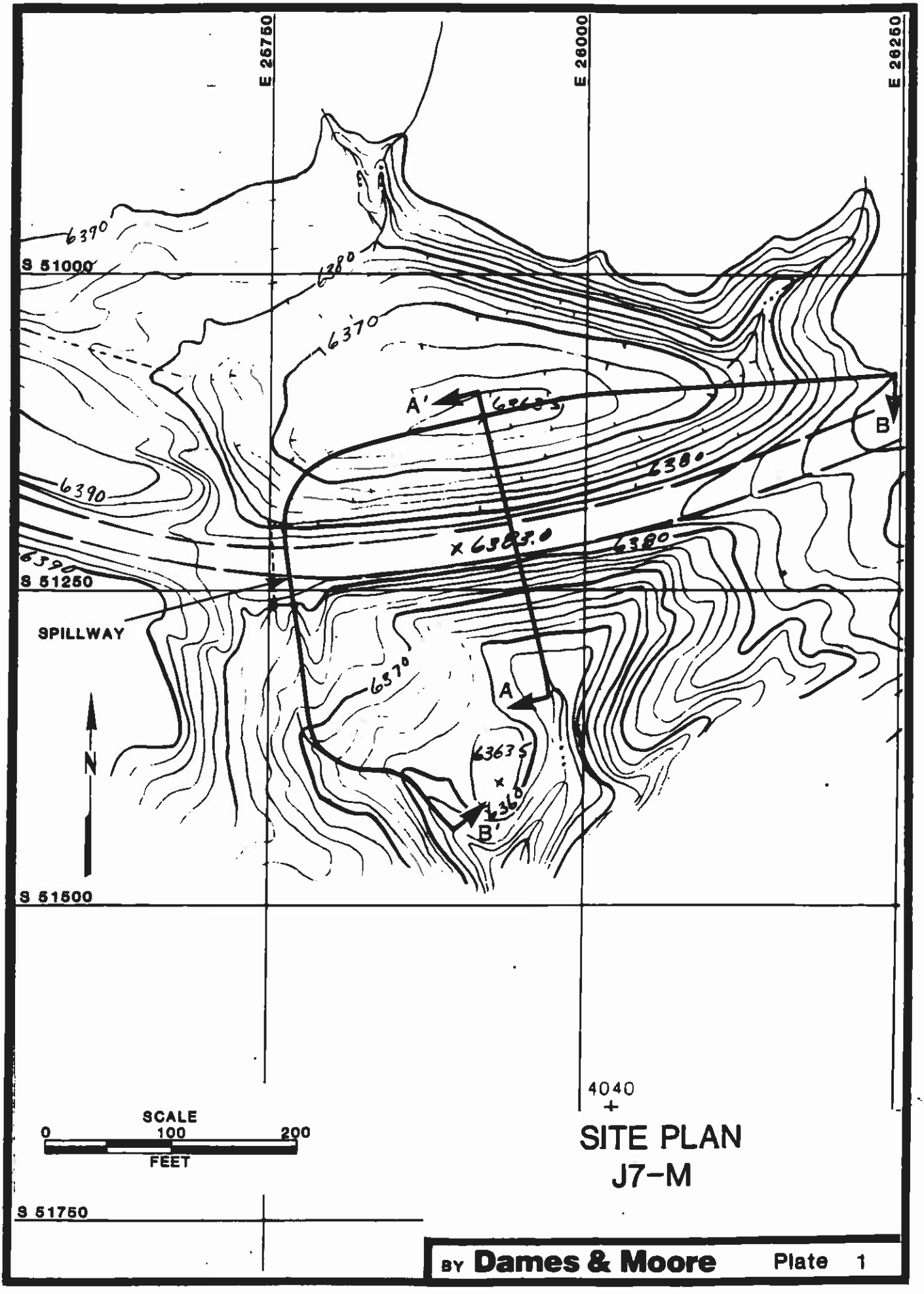
Plate 3 - Volume-Elevation Curve J7-M

Plate 4 - Channel Profile J7-M, B-B'

Plate 5 - Outflow Channel Cross Section J7-M

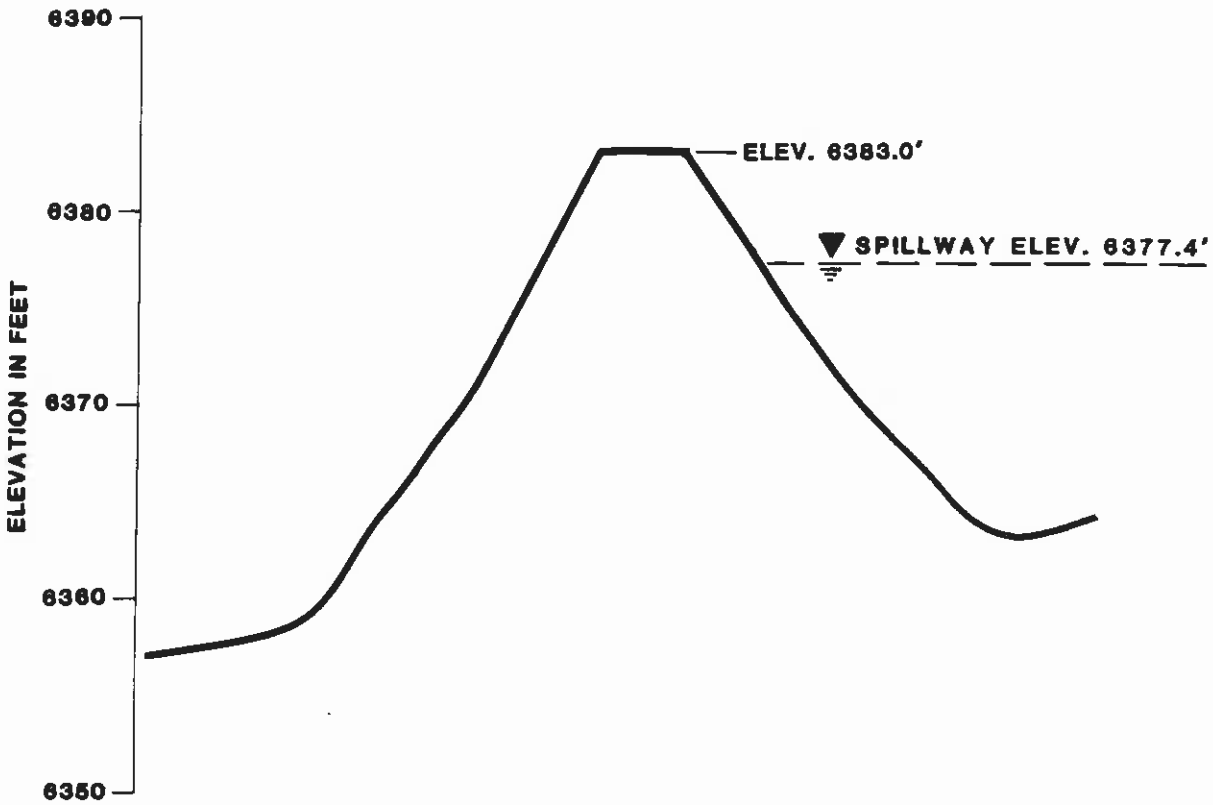
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
J7-M

BY **Dames & Moore** Plate 1

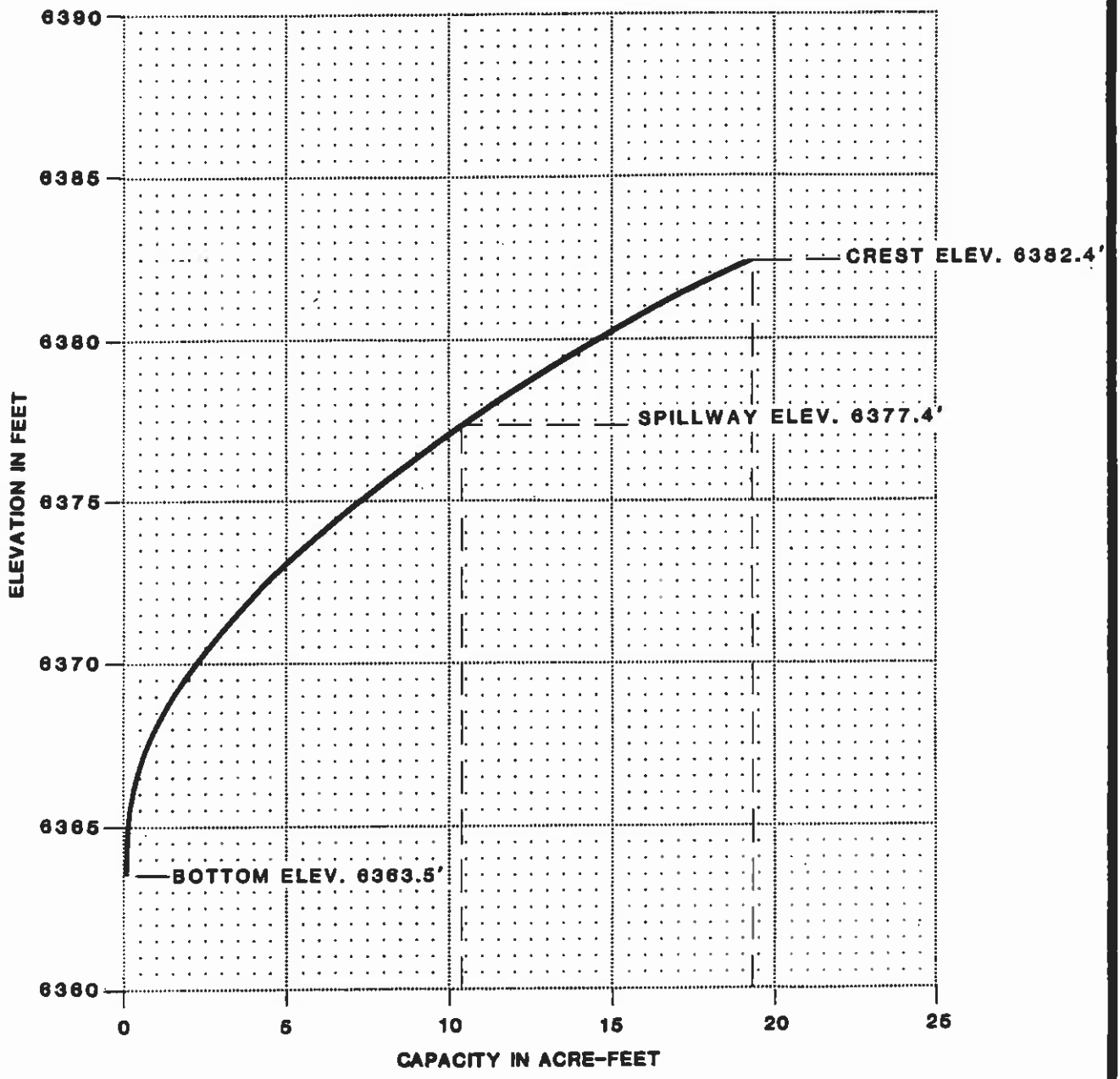


SCALE
0 50 100
FEET

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

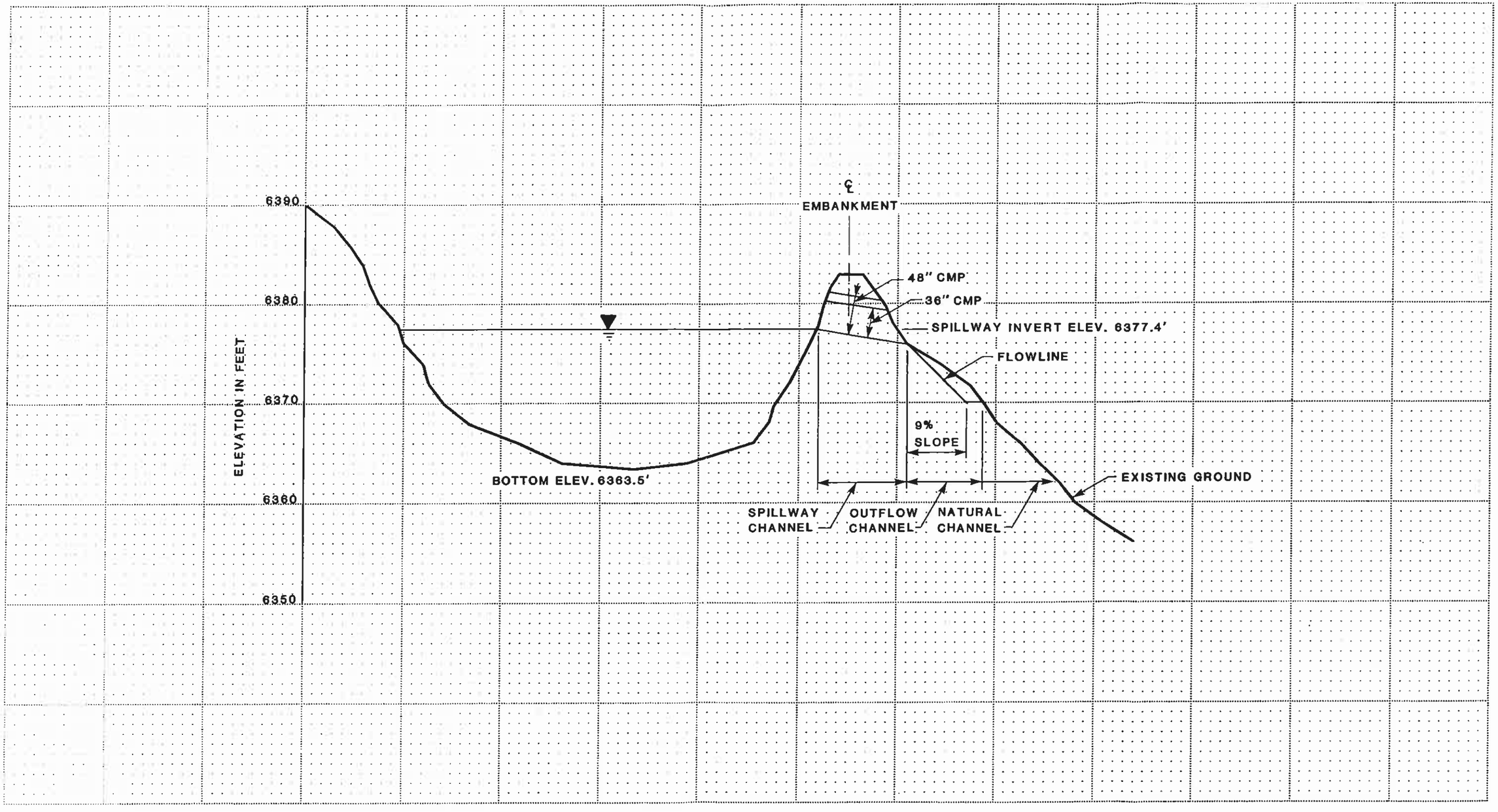
FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 2



VOLUME-ELEVATION CURVE J7-M

BY **Dames & Moore** Plate 3

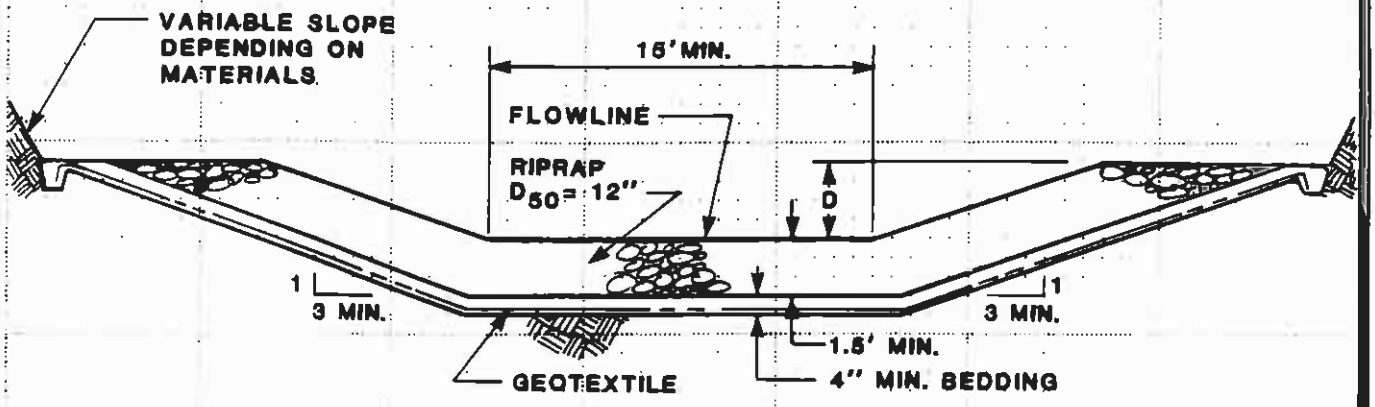


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
J7-M

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



OUTFLOW CHANNEL

D = 1.5'

OUTFLOW CHANNEL CROSS SECTION J7-M

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST ROADWAY/GRAVEL			
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			
a. Adequate grass cover?	X		85%
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Adequate riprap protection?	X		Grass
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			
a. Adequate grass cover?	X		85%
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?		X	
e. Transverse cracks?		X	
f. Visual depressions or bulges?		X	
g. Visual settlements?		X	
h. Is the toe drain dry?			NA
i. Are the relief wells flowing?			NA
j. Are boils present at the toe?		X	
k. Is seepage present?		X	
l. Animal burrows?		X	
4. ABUTMENT CONTACT. RIGHT			
a. Any erosion?	X		SM. gully || to contact
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM brown rock near surface
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Gulley adjacent to Road
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			SM rock near surface

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		towards right abutment
b. Approach Channel:		X	
Are side slopes eroding?			NA
Are side slopes sloughing?			↓
Bottom of channel eroding?			↓
Obstructed?			↓
Erosion protection?			↓
c. Spillway Channel:			CMP
Are side slopes eroding?			NA
Are side slopes sloughing?			↓
Bottom of channel eroding?			↓
Obstructed?	X		tumbleweeds in entrance
Erosion protection?			NA
d. Outflow Channel:	X		2 distinct 30'
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?	X		Rock D50 / 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

No problems

IMPOUNDMENT

Watershed - same as design

Sage brush / grass 10% disturbed

Canopy Cover ≤25

Ground Cover average

Sediment in pond - very little

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE [illegible]
SUBJECT SEDIMENT BND HYDROLOGY
JZ-M
SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6475 − 6377 = 98 ft.

WATER COURSE LENGTH = 2850' = 0.540 mi.

$$T_c = \left(\frac{11.9\ (0.540)^3}{98}\right)^{0.385} = 0.218 \text{ hr.}$$

LAG TIME = $0.6\,T_c$ = 0.131 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
52.0 (100%)	DIST	—	C-D 75% EH*32 25% EH *73	92

DRAINAGE BASIN AREA

52.0 AC. 0.081 SQ. mi.

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 75% EH # 32 — 0.75(0.21) = 0.158
25% EH # 23 — 0.25(0.18) = 0.045
0.203

K = 0.203

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
500	47	9	2.64
900	85	9	3.55
1400	45	3	0.64

USE 2.6

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
100%	DISTURBED	--	—	1.0

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(0.203)(2.6)(1.0)(1.0) = 21.1$ ton/acre/year

$A = 21.1\left(\frac{1}{2047}\right)(52.0)(0.95) = 0.509$ acre-feet/year

Dames & Moore