

INSPECTION REPORT
Sedimentation Structure
J16-I
Kayenta Mine
Navajo County, Arizona

for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

TABLE OF CONTENTS

	<u>Page</u>
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 J16-I is a partially incised structure with an earthen embankment, designed and constructed in 1984 by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Kayenta Mine. The location of Structure J16-I is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure J16-I. Regional site information is presented in the "General Report, Kayenta and Black Mesa Mines, Navajo County, Arizona for Peabody Coal Company," along with the methods and results of analyses used for slope stability, hydrology and hydraulics.

INSPECTION

Structure J16-I was inspected on September 10, 1985 by an interdisciplinary team of engineers from Dames & Moore. The purpose of the inspection was to assess the safety and general condition of the structure with respect to United States Department of Interior, Office of Surface Mining (OSM) regulations.

Dames & Moore's inspection was performed in accordance with applicable 30 CFR 780 and 816 regulations and included a review of the J16-I project files and a field inspection of the structure. The most current information contained in the Peabody Coal Company files includes the 1984 and current survey data and inspections performed in 1984 and 1985 by

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

SITE DESCRIPTION

LAND USE

Structure J16-I has a 36.2-acre tributary drainage area and is located near Moenkopi Wash at the Kayenta Mine. The watershed is classified as 57% disturbed and 43% Pinion/Juniper.

EMBANKMENT

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

<u>Structure J16-I</u>	
Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	7.8 ft
Crest Width	20 ft
Upstream Slope	2.2 H : 1 V
Downstream Slope	2.6 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section J16-I, A-A'.

ANALYSES

STABILITY

Structure J16-I is a category B-1 embankment. A standard category B-1 embankment has static and seismic factors of safety equal to or greater than 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 15 ft
2. Maximum upstream slope = 1.75 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The J16-I embankment is lower in height and has flatter slopes than the category standard; therefore, the embankment has factors of safety greater than the design minimum.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure J16-I is not in series with any other structure and therefore the spillway was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure J16-I was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1. Water Course length, L	0.212	mi
2. Elevation Difference, H	107	ft
3. Time of Concentration, T _c	0.072	h
4. Lag time, 0.6T _c	0.043	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	36.2	acres

HYDRAULICS

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

J16-I 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	101	126
Volume	acre-ft	4.10	3.44
Storage			
Peak Stage	ft	6615.00	6629.16
Spillway Elevation . .	ft	6627.80	—
Peak Storage	acre-ft	4.10	—
Storage Capacity . . .	acre-ft	19.95	—
Outflow			
Peak Flow	cfs	0	17
Embankment Crest			
Elevation	ft	—	6632.50
Peak Stage	ft	—	6629.07
Freeboard	ft	—	3.43
Spillway Channel			
Flow Depth	ft	—	1.27
Critical Velocity . . .	fps	—	2.9
Manning's "n"		—	0.035
Outflow Channel			
Slope	%	—	11
Normal Velocity	fps	—	2.8
Normal Depth	ft	—	0.11
Manning's "n"		—	0.040

Spillway Channel

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

Channel depth	5.7 ft
Channel width	25 ft
Channel length	75 ft
Side slopes (horizontal to vertical).	2:1
Average exit slope	0 percent

There is presently no erosion protection within the channel.

Outflow Channel

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

Channel width	25-30 ft
Channel length	150 ft
Side slopes (horizontal to vertical).	2:1
Average exit slope	9 percent

Rock provides adequate erosion protection within the channel.

STORAGE CAPACITY

The impoundment volume-elevation curve is based on site specific surveys conducted for Peabody Coal Company's August 1984 inspection, and 1985 resurveys, where available. Additionally, the most current topographic maps available were used in developing Plate 3, Volume-Elevation Curve, J16-I.

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

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.22
3. Slope Factor, LS 3.11
4. Cover Factor, C 0.742
5. Erosion Control Factor, P 1.0

The hydrologic analysis gives the storage volume required to contain the 10-year, 24-hour storm, and the remaining storage volume available for storing sediment. The existing storage capacity of J16-I and the results of the sediment inflow analysis are summarized in the following table.

J16-I STORAGE

Total Storage Capacity	20.0	acre-ft
10-year, 24-hour Storm Inflow	4.10	acre-ft
Available Sediment Storage Capacity	15.9	acre-ft
Sediment Inflow Rate	0.341	acre-ft/yr
Sediment Storage Life	47	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

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

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

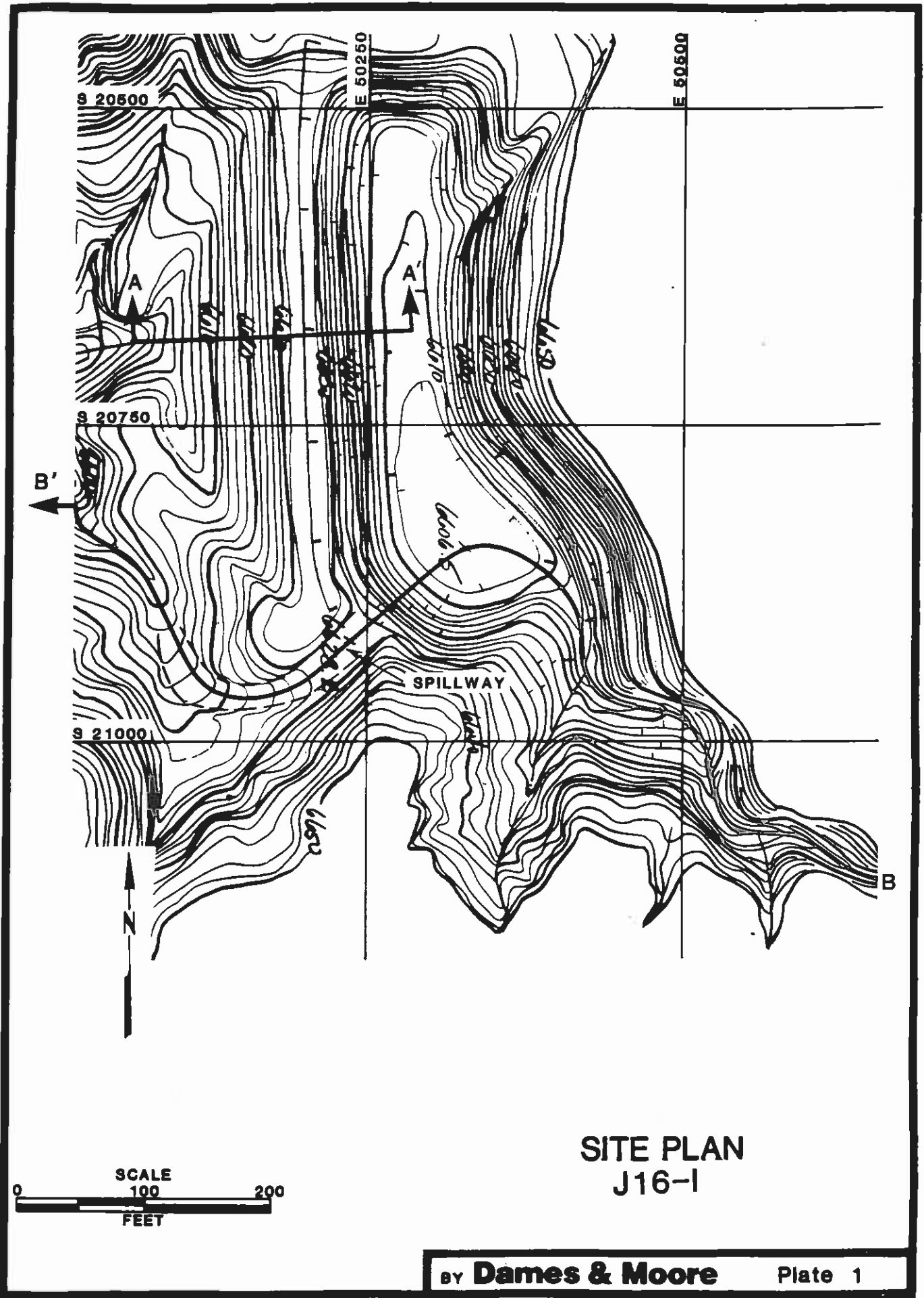
HYDRAULICS

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

* * *

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

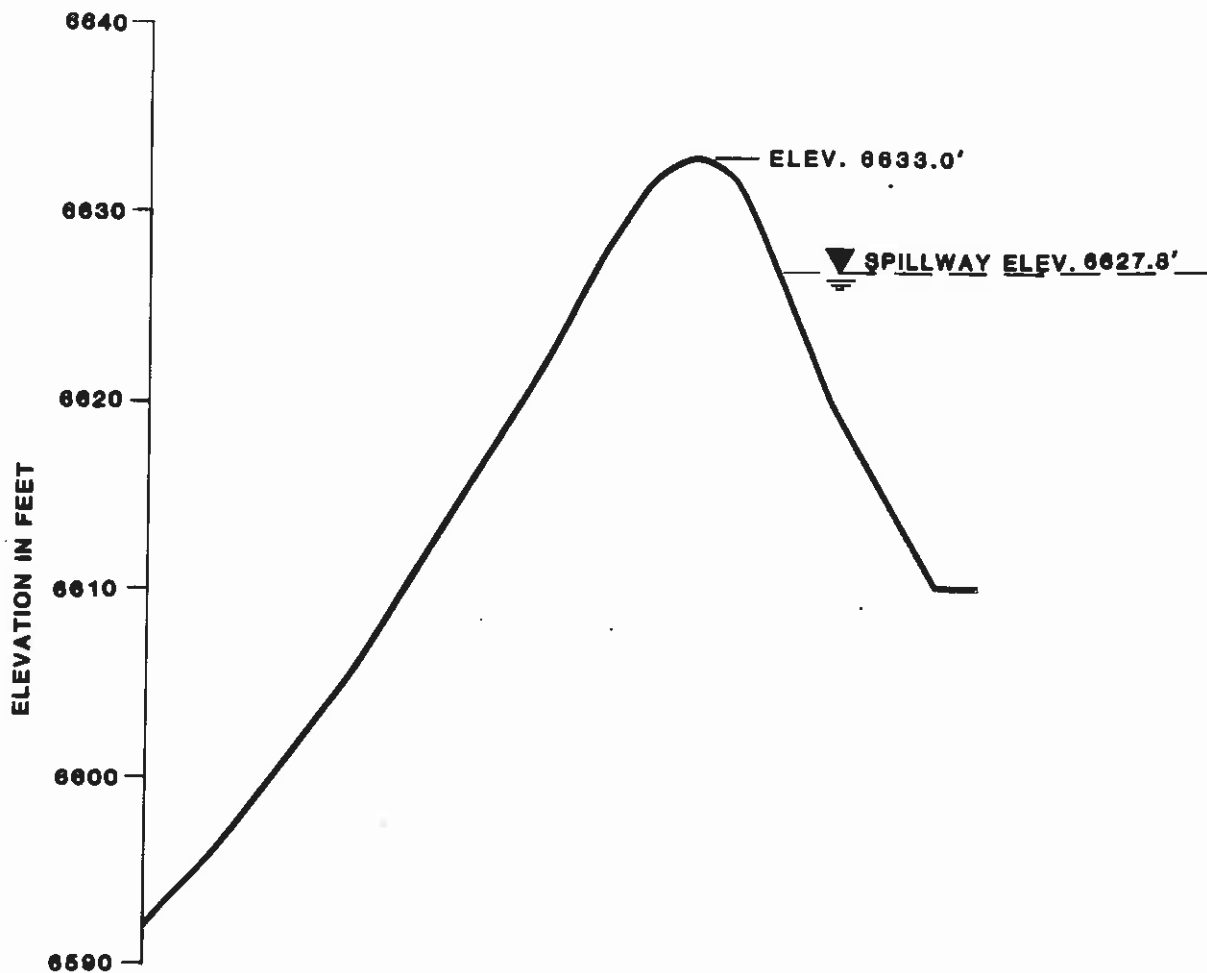
- Plate 1 - Site Plan J16-I
- Plate 2 - Existing Maximum Cross Section J16-I, A-A'
- Plate 3 - Volume-Elevation Curve J16-I
- Plate 4 - Channel Profile J16-I, B-B'
- Plate 5 - Spillway Channel Cross Section J16-I
- Appendix A - Inspection Check List
- Appendix B - Hydrology and Hydraulic Calculations



**SITE PLAN
J16-1**

BY Dames & Moore

Plate 1

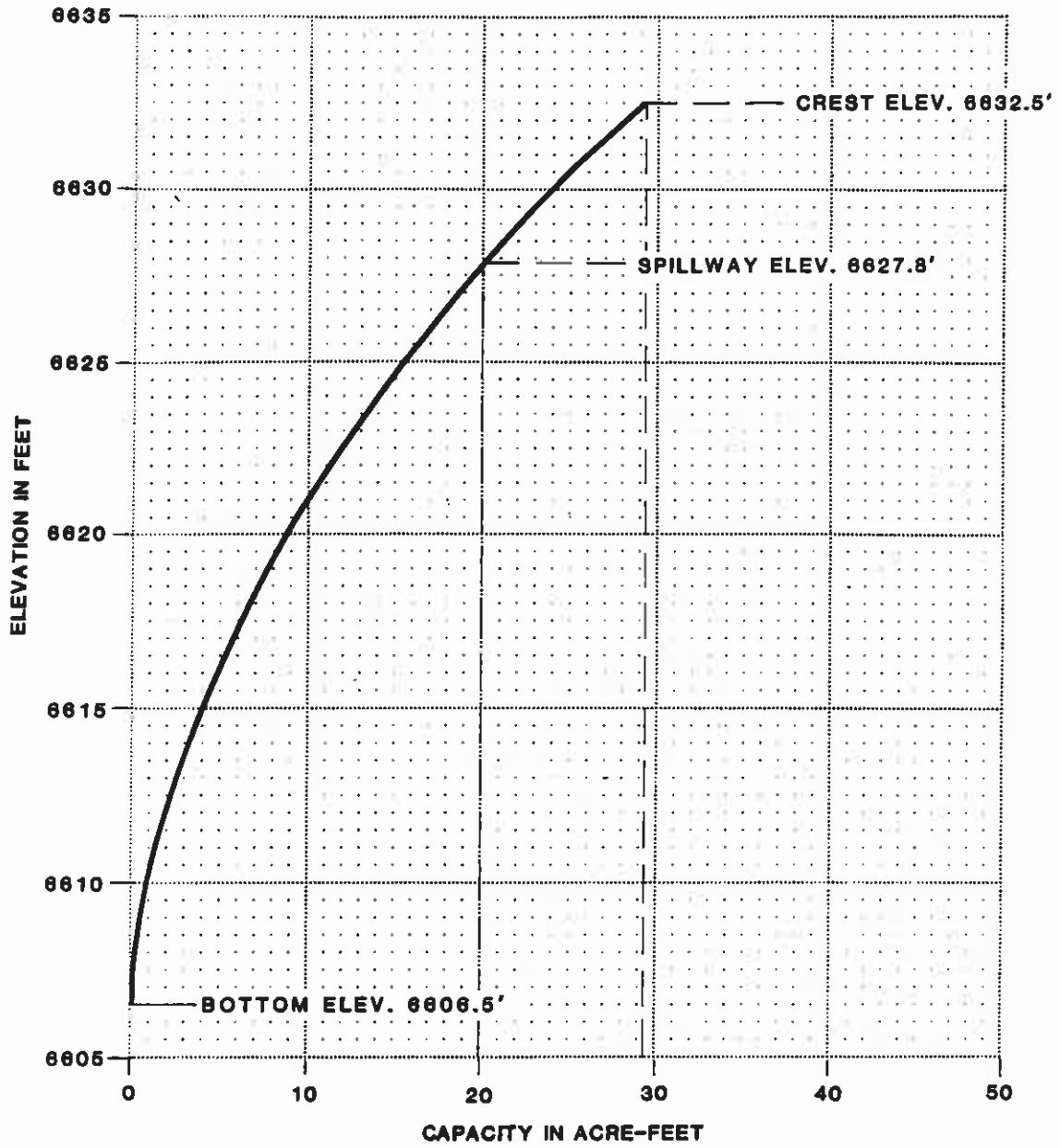


EXISTING
MAXIMUM CROSS-SECTION
A-A'
J16-1

FOR LOCATION SEE PLATE 1

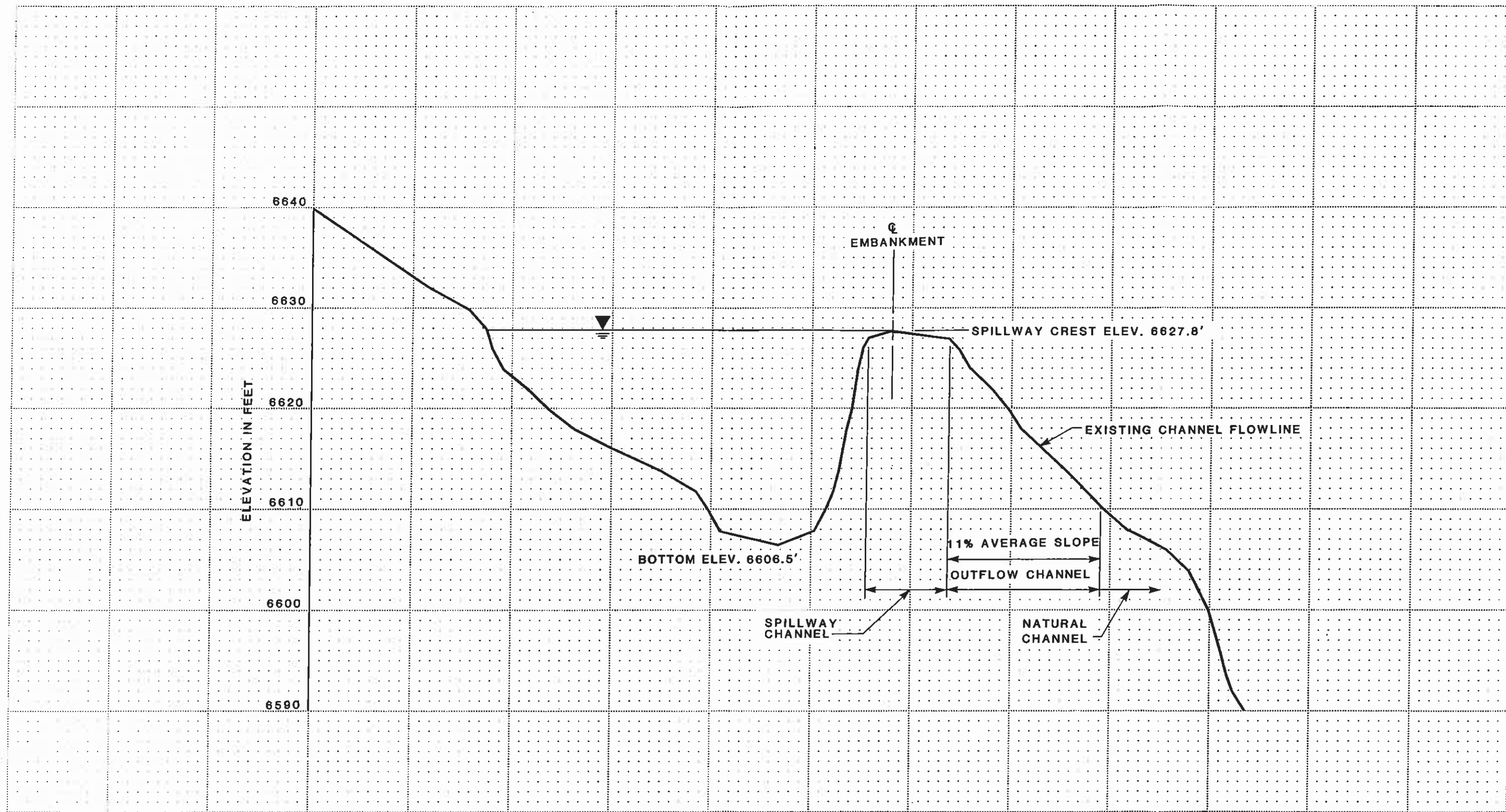
BY **Dames & Moore**

Plate 2

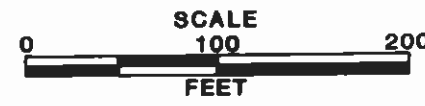


VOLUME-ELEVATION
CURVE

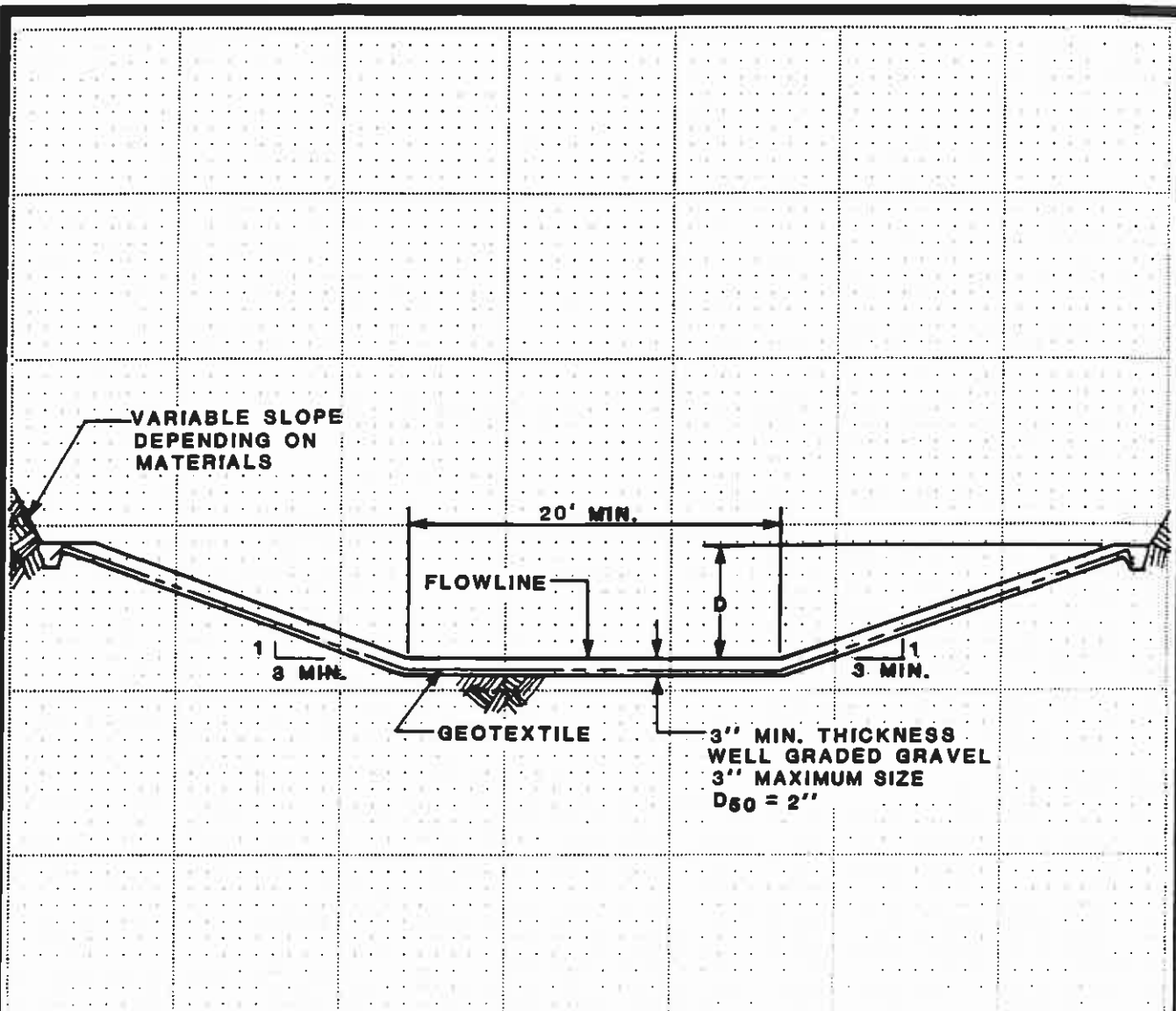
J16-1



CHANNEL PROFILE B-B'
J16-1



FOR LOCATION SEE PLATE 1



SPILLWAY CHANNEL

D = 2.3'
LENGTH = 75'
FLOWLINE ELEV. = 8827.80'

**SPILLWAY CHANNEL
 CROSS SECTION
 J16-1**

APPENDIX A
INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			Uneven top - not trimmed 20' w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			25°
a. Adequate grass cover?		X	
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	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			Uneven slope face not trimmed after construction 21°
a. Adequate grass cover?		X	
b. Any erosion?	X		gulleys & 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			Erosion gulleys into pond away from dam
a. Any erosion?		X	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray/black SM / Rock
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		into spillway - gulleys & rills
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?	X		25' W 75' L 0% slope 5.7' below crest From LA of dam sum. gully & hills
Are side slopes sloughing?	X	X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:			
Are side slopes eroding?	X	X	5° slope ^{hr bottom} 25-30' W ± 150' L
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?			Rock DSU-12"
e. Weir:			
Condition?			
7. SPILLWAY/EMERGENCY			
a. Location:			
Left abutment?			NA
Right abutment?			
Crest of Embankments?			
b. Approach Channel:			
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:			
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
e. Weir:			
Condition?			

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

9. GENERAL COMMENTS

Canopy Cover 20
 Ground Cover 30

APPENDIX B
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = $6735 - 6628 = 107$ ft.

WATER COURSE LENGTH = $2.8 \text{ in} = 1120 \text{ ft.} = 0.212 \text{ mi}$

$T_c = \left(\frac{11.9 (0.212)^3}{107} \right)^{0.385} = 0.072 \text{ hr.}$

Lag Time = $0.6 T_c = 0.043 \text{ hr.}$

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
20.5	disturbed	—	D	94 (.57)
15.7	P-J	poor	D	89 (.43)
				<u>91.85</u>

100% EA #22

use 92

DRAINAGE BASIN AREA

367.2 ACRES 0.857 SQ. MILES

REVISIONS

BY _____ DATE _____ TO EO _____
 BY _____ DATE _____ TO EO _____

DATE 10-2-85

CHECKED BY _____
 COPY TO EO _____

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #22 = .22

$K = .22$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
200	60	30	11.25 (.1)
450	50	11.1	3.40 (.4)
550	28	5	1.26 (.5)
			<u>= 3.11</u>

COVER FACTOR

<u>AREA (ac.)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (%)</u>	<u>WEIGHTED C</u>
57%	disturbed	—	—	.57 (1.0)
43%	P-J	10	25	.43 (.40)
				<u><u>C = .742</u></u>

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40 (.22) (3.11) (.742) (1.0) = 20.31 \text{ ton/acre/year}$

$A = (20.31) \left(\frac{1}{2047} \right) (36.2) (.95) = .341 \text{ acre-feet/year}$

REVISIONS
 BY _____ DATE _____ TO EO _____
 BY _____ DATE _____ TO EO _____

BY _____ DATE _____
 CHECKED BY _____
 COPY TO EO _____