DESIGN REPORT

Sedimentation Structure

J21-A

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

INTRODUCTION

Sedimentation Structure J21-A will be 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 Kayenta Mine. The location of Structure J21-A is shown on Plate 1, Site Plan.

This design report contains information specific to Structure J21-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 J21-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 J21-A has a 544.0-acre tributary drainage area and is located near Dinnebito Wash at the Kayenta Mine. The watershed is classified as 41% Sagebrush/grass, 38% Pinion/Juniper, and 21% reclaimed.

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 J21-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 1976 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure J21-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 J21-A is located downstream from Structure J21-A1. The two structures have a combined storage capacity that is greater than 20 acre-feet. Therefore, the spillway for J21-A1 was analyzed using the 100-year, 6-hour storm. The storage capacity of Structure J21-A 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	0.512	1.94	mi
2.	Elevation Difference, H	161	274	ft
3.	Time of Concentration, T_c	0.170	0.642	h
4.	Lag time, $0.6T_c$	0.102	0.385	h
5.	SCS Curve Number	74	78	
6.	Rainfall Depth	2.1	2.4	in.
7.	Drainage Area	81.3	544.0	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 10-year storm was routed through Structure J21-A1 and into Structure J21-A. The 100-year storm was analyzed without Structure J21-A1. The initial conditions and results of the analysis are summarized in the following table.

	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	40	450
Volume	acre-ft	2.64*	30.8
Storage			
Peak Stage	ft	6929.53	—
Spillway Elevation . .	ft	6934.20	—
Peak Storage	acre-ft	4.69	--
Storage Capacity . . .	acre-ft	19.60	--
Outflow			
Peak Flow	cfs	0	196
Embankment Crest Elevation	ft	—	6938.50
Peak Stage	ft	—	6937.15
Freeboard	ft	--	1.35
Spillway Channel			
Flow Depth	ft	--	2.95
Critical Velocity. . .	fps	--	6.4
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	—	5
Normal Velocity. . . .	fps	--	8.4
Normal Depth	ft	—	1.24
Manning's "n"		—	0.040

*Inflow volume for the tributary drainage are between Structures J21-A1 and J21-A.

Spillway Channel

The spillway for J21-A will be a trapezoidal channel with the following dimensions:

Channel depth	4 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 J21-A will be a trapezoidal channel with the following dimensions:

Channel width	15 ft
Channel length	215 ft
Side slopes (horizontal to vertical)	2:1
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, J21-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 J21-A were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.31
3. Slope Factor, LS 4.57
4. Cover Factor, C 0.138
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.

During the 10-year, 24-hour storm, Structure J21-A receives outflow from Structure J21-A1 located upstream. Therefore, the storage capacity analysis must consider the combined storage in the two structures. The following table summarizes the results of the sediment inflow analysis.

COMBINED STORAGE J21-A AND J21-A1

	J21-A1	J21-A	Total	
Total Storage Capacity	15.40	19.60	35.00	acre-ft
10-year, 24-hour Storm Inflow	20.44	2.64	23.08	acre-ft
Available Sediment Storage Capacity . .	--	--	11.92	acre-ft
Sediment Inflow Rate	1.12	0.295	1.42	acre-ft/yr
Sediment Storage Life	--	--	8	yrs

* * *

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

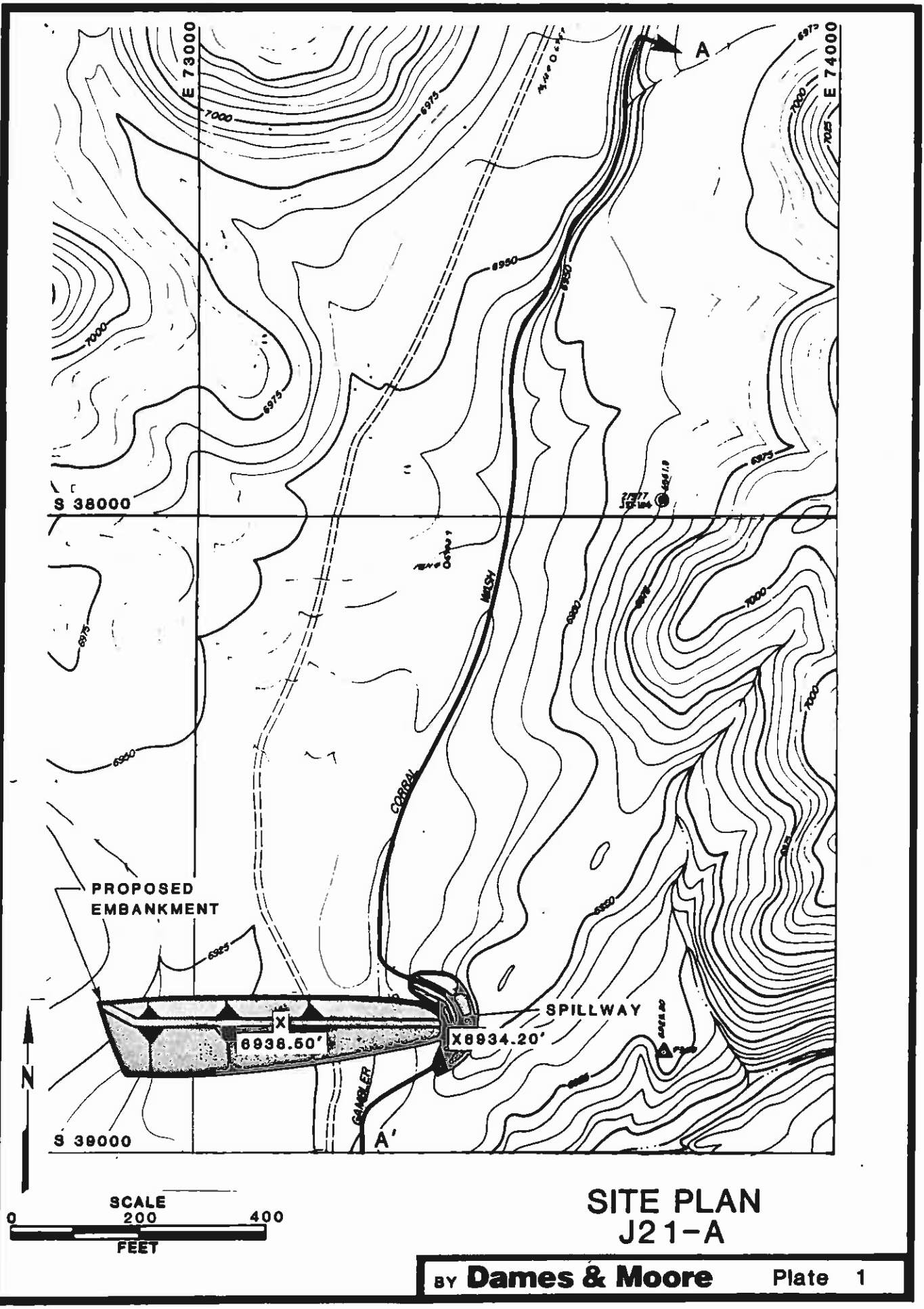
Plate 1 - Site Plan J21-A

Plate 2 - Volume-Elevation Curve J21-A

Plate 3 - Channel Profile J21-A, A-A'

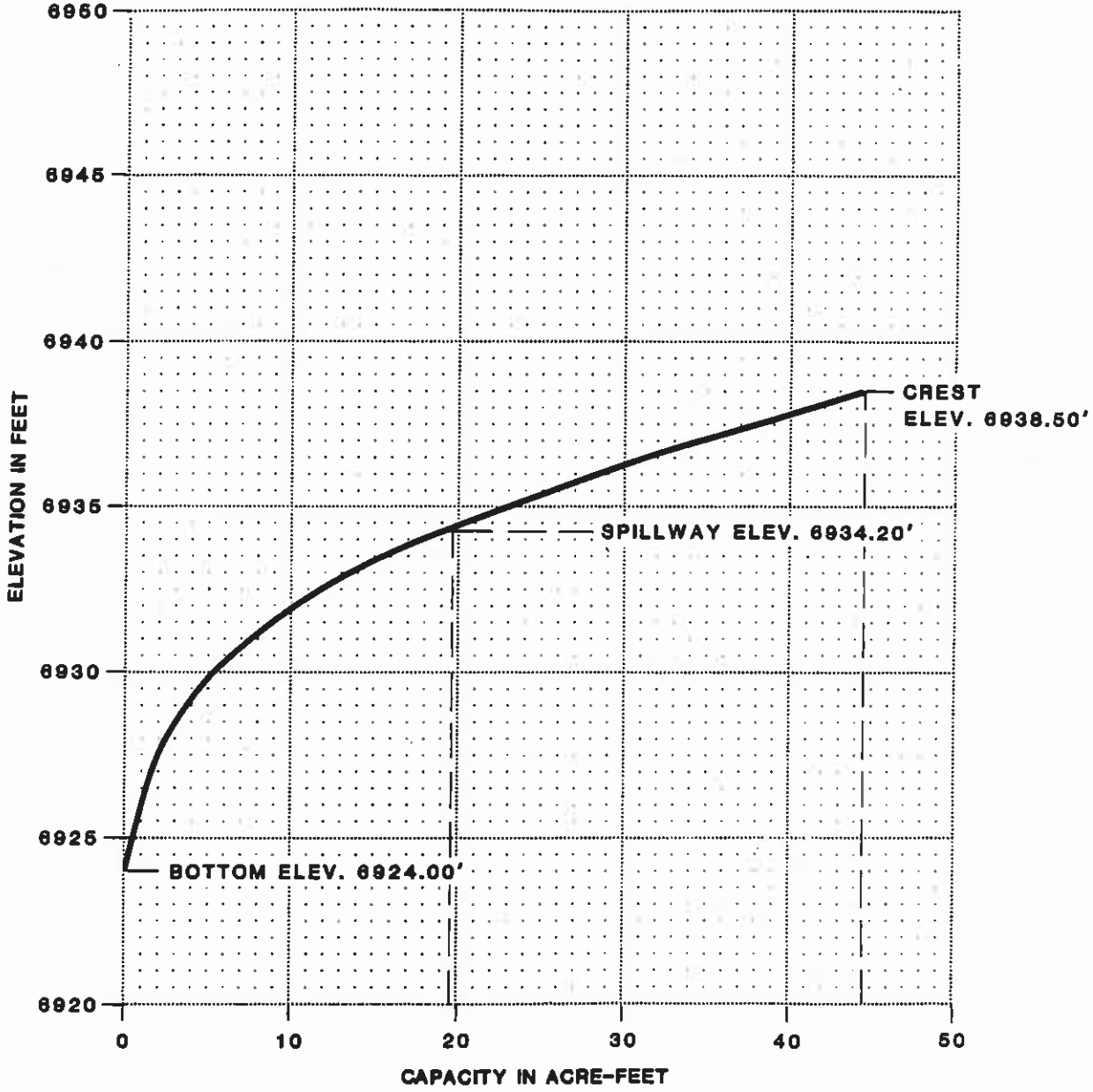
Plate 4 - Spillway and Outflow Channel Cross Section J21-A

Appendix A - Hydrology and Hydraulic Calculations



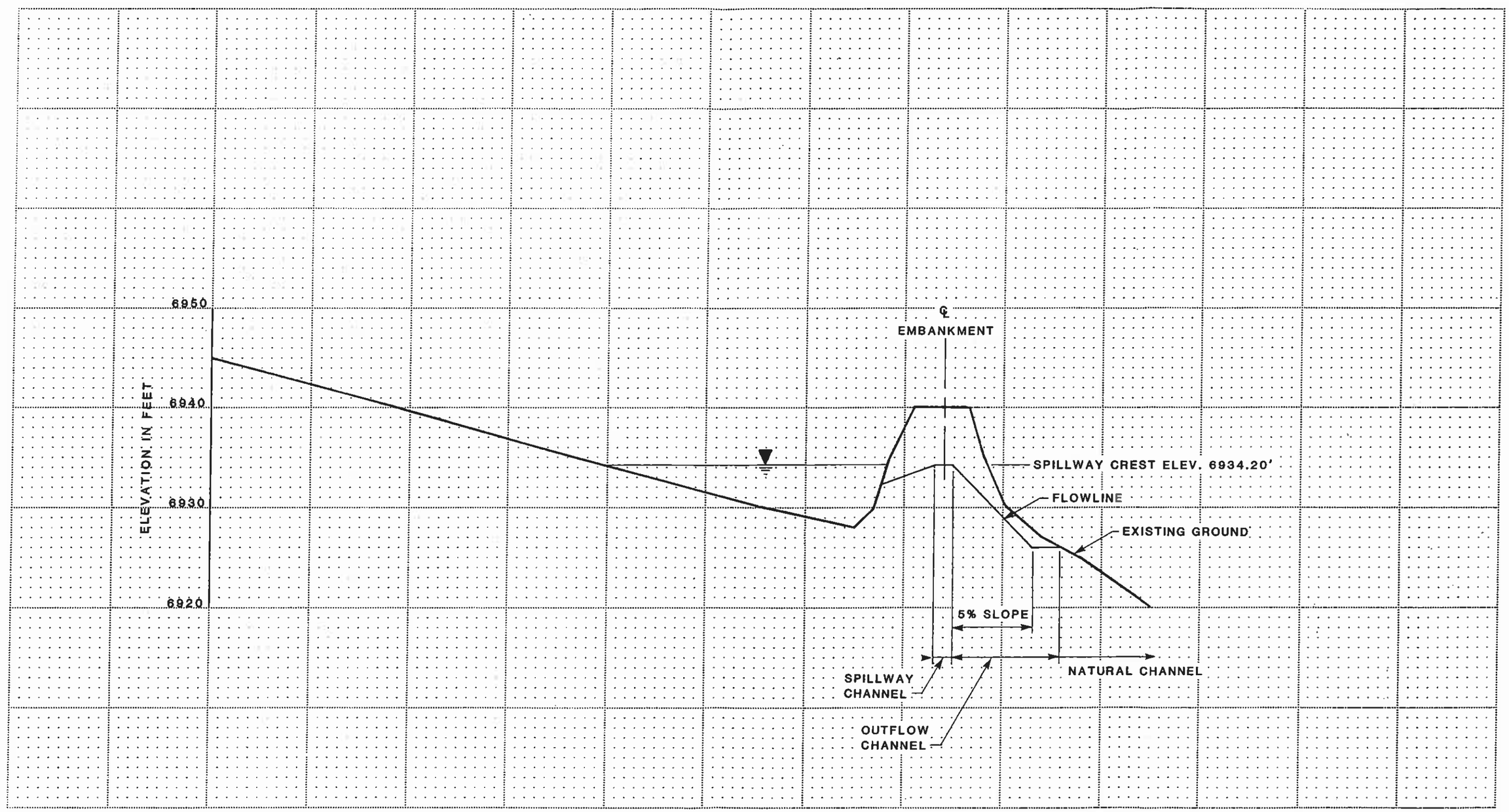
SITE PLAN
J21-A

BY **Dames & Moore** Plate 1



VOLUME-ELEVATION CURVE J21-A

BY **Dames & Moore** Plate 2

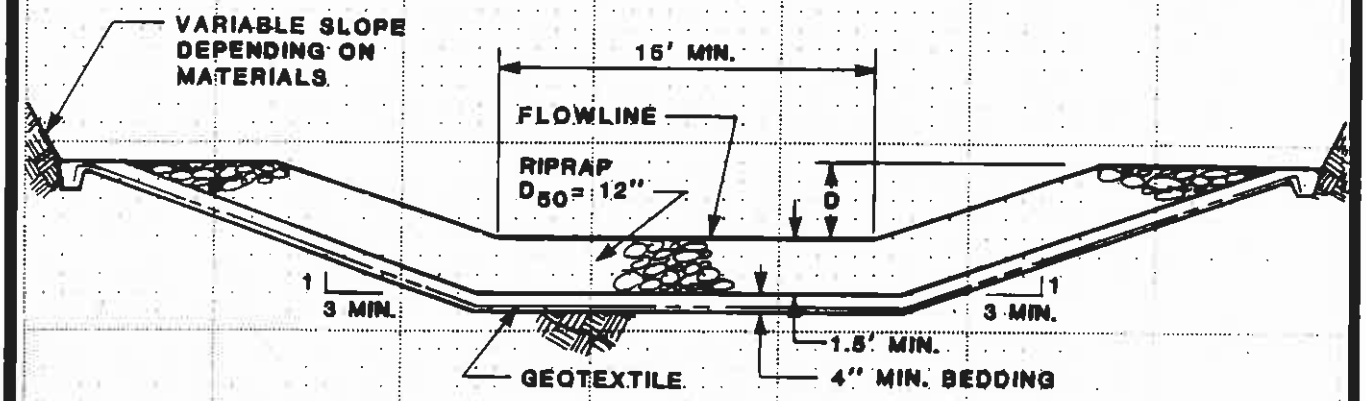


SCALE
0 200 400
FEET

CHANNEL PROFILE A-A'
J21-A

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 4.0'

LENGTH = 40'

FLOWLINE ELEV. = 6934.20'

OUTFLOW CHANNEL

D = 2.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION J21-A

BY **Dames & Moore** Plate 4

APPENDIX A

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J21-A ~~J21-A1~~ SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 7089 − 6928 = 161' ✓

WATER COURSE LENGTH = 2707.0 = .512 mi ✓

T_c = 0.170 hr. ✓

LAG TIME = $0.6 T_c$ = .102 hr ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
30.6	P-J	ave	C	78 (.38)
33.3	S-G	ave	50% C + 50% B	66.5 (.41)
17.4	reclaimed (post law)			81 (.21)
				73.9 ✓

21% EH #35
64% EH #31
15% EH #36

use 74

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

DRAINAGE BASIN AREA

81.3 ACRE 0.127 SQ MILE ✓

33
13 3
13 3
3 1

FILE PEABODY COAL CO 1039-011-22
SUBJECT SEDIMENT INFLOW
J21A J21-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 = 15% EH #36 (.33)(.15)
64% EH #31 (.26)(.64)
21% EH #35 (.21)(.42)
0,31 ✓

K = 0,31

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1200	115	9.6	4.49 (.7) ✓
600	75	12.5	4.77 (.3) ✓
			4.57 ✓

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
41%	S-G	40	25	.41 (.13)
38%	P-J	40	25	.38 (.14)
21%	reclaimed			.21 (.15)
				0,138 ✓

BY ___ DATE ___
CHECKED BY BHM 11/6/86
COPY TO EO ___

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.31)(4.57)(.138)(1.0) = 7.82$ ton/acre/year

$A = 7.82\left(\frac{1}{2047}\right)(81.3)(.95) = 0.295$ acre-feet/year

Dames & Moore

FILE PEABODY COAL CO 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
J21-A ~~J21-A1~~ SHEET ___ OF ___
100yr-Excludes ~~J21-A2~~ Upstream J21-A1 6hr

REVISIONS BY ___ DATE ___ TO ED ___ BY ___ DATE ___ TO ED ___

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 7202 − 6928 = 274 ft.

WATER COURSE LENGTH = 25.6(400) = 10240 ft. = 1.939 mi.

$$T_c = \left(\frac{11.9(1.939)^3}{274}\right)^{0.385} = 0.642 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.385 hr.

SCS CURVE NUMBER

	DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
-A1	81.3				74 (.15)
-A2	462.7				78 (.85)
					77.4
					use 78

DRAINAGE BASIN AREA

544.0 ACRE 0.850 SQ MILE

BY S. DOLAN DATE 10-29-85 CHECKED BY ___ COPY TO ED ___

7

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