INSPECTION REPORT

Sedimentation Structure

N2-G

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

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INTRODUCTION

Sedimentation Structure N2-G 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 Kayenta Mine. The location of Structure N2-G is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N2-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

Structure N2-G was inspected on September 7, 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 N2-G 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 N2-G has a 27.9-acre tributary drainage area and is located near Yellow Water Canyon at the Kayenta Mine. The watershed is classified as 65% reclaimed, 30% Pinion/Juniper, and 5% disturbed.

EMBANKMENT

Structure N2-G is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure N2-G

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	9.8 ft
Crest Width	12 ft
Upstream Slope	2.6 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 N2-G, A-A'.

ANALYSES

STABILITY

Structure N2-G 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 = 2.0 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N2-G 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 N2-G 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 N2-G was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.273	mi
2.	Elevation Difference, H	104	ft
3.	Time of Concentration, T_c	0.097	h
4.	Lag time, $0.6T_c$	0.058	h
5.	SCS Curve Number	82	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	27.9	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.

N2-G 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	37	46
Volume	acre-ft	1.78	1.40
Storage			
Peak Stage	ft	6797.48	6802.87
Spillway Elevation . .	ft	6802.19	—
Peak Storage	acre-ft	1.78	—
Storage Capacity . . .	acre-ft	5.52	--
Outflow			
Peak Flow	cfs	0	4
Embankment Crest Elevation	ft	--	6806.99
Peak Stage	ft	--	6802.87
Freeboard	ft	--	4.12
Spillway Channel			
Flow Depth	ft	--	0.68
Critical Velocity. . .	fps	--	2.0
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	7
Normal Velocity. . . .	fps	--	2.5
Normal Depth	ft	--	0.11
Manning's "n"		--	0.035

Approach Channel

The existing approach channel for N2-G has a U-shaped channel with following dimensions:

Channel width	15-20	ft
Channel length	30	ft
Slope	10	percent

Spillway Channel

The existing spillway for N2-G has a trapezoidal channel with the following dimensions:

Channel depth	4.5	ft
Channel width	14	ft
Channel length	25	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 N2-G has a U-shaped channel with the following dimensions:

Channel width	15	ft
Channel length	120	ft
Average exit slope	15-20	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, N2-G.

The calculations for the sediment load entering Structure N2-G were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.33
3. Slope Factor, LS 4.30
4. Cover Factor, C 0.19
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 N2-G and the results of the sediment inflow analysis are summarized in the following table.

N2-G STORAGE

Total Storage Capacity	5.52	acre-ft
10-year, 24-hour Storm Inflow	1.78	acre-ft
Available Sediment Storage Capacity . .	3.74	acre-ft
Sediment Inflow Rate	0.140	acre-ft/yr
Sediment Storage Life	27	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N2-G indicated that the only geotechnical problem is rill erosion on the upstream and downstream slopes, the side slopes of the spillway channel, the bottom of approach 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 N2-G 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 N2-G

Plate 2 - Existing Maximum Cross Section N2-G, A-A'

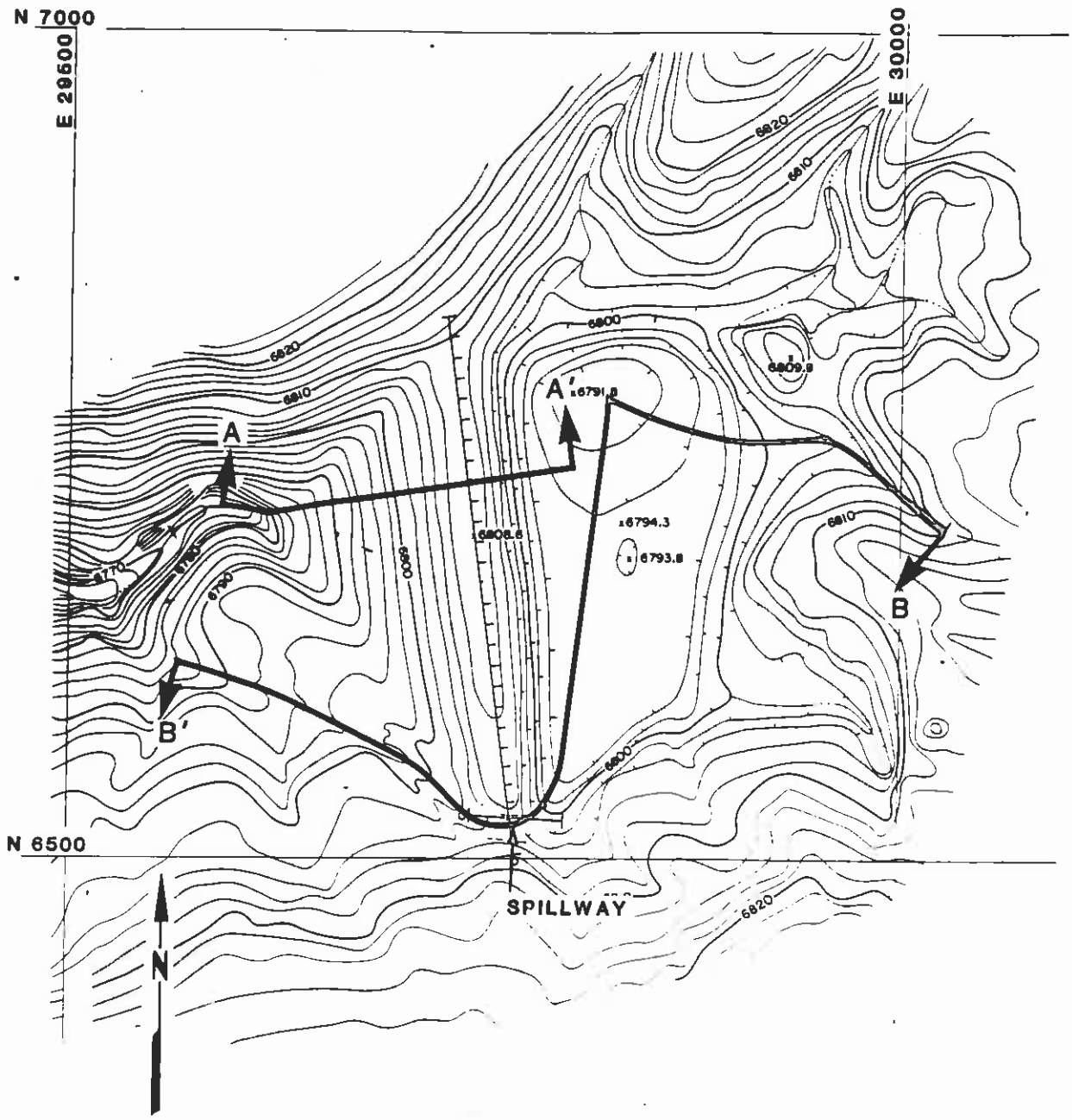
Plate 3 - Volume-Elevation Curve N2-G

Plate 4 - Channel Profile N2-G, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N2-G

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SCALE
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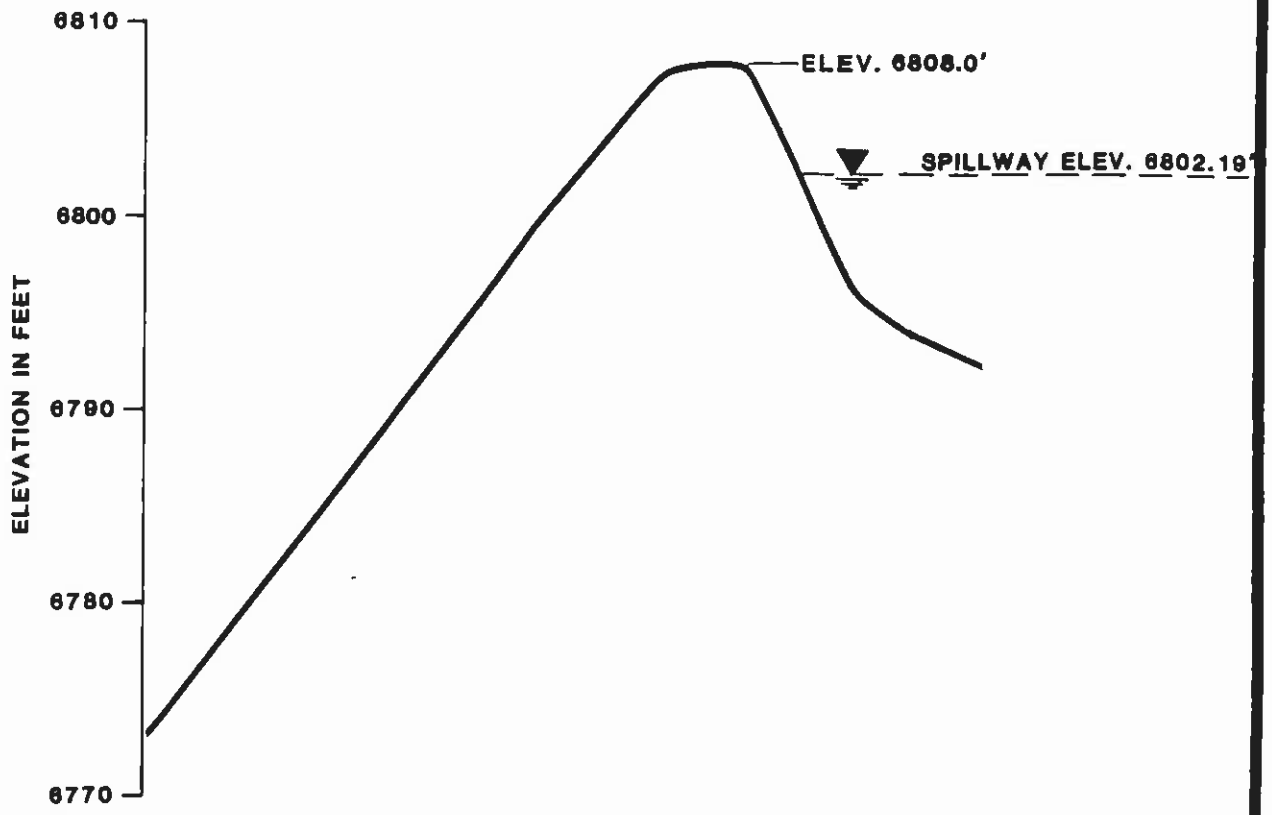
FEET

SITE PLAN
N2-G

BY **Dames & Moore** Plate 1



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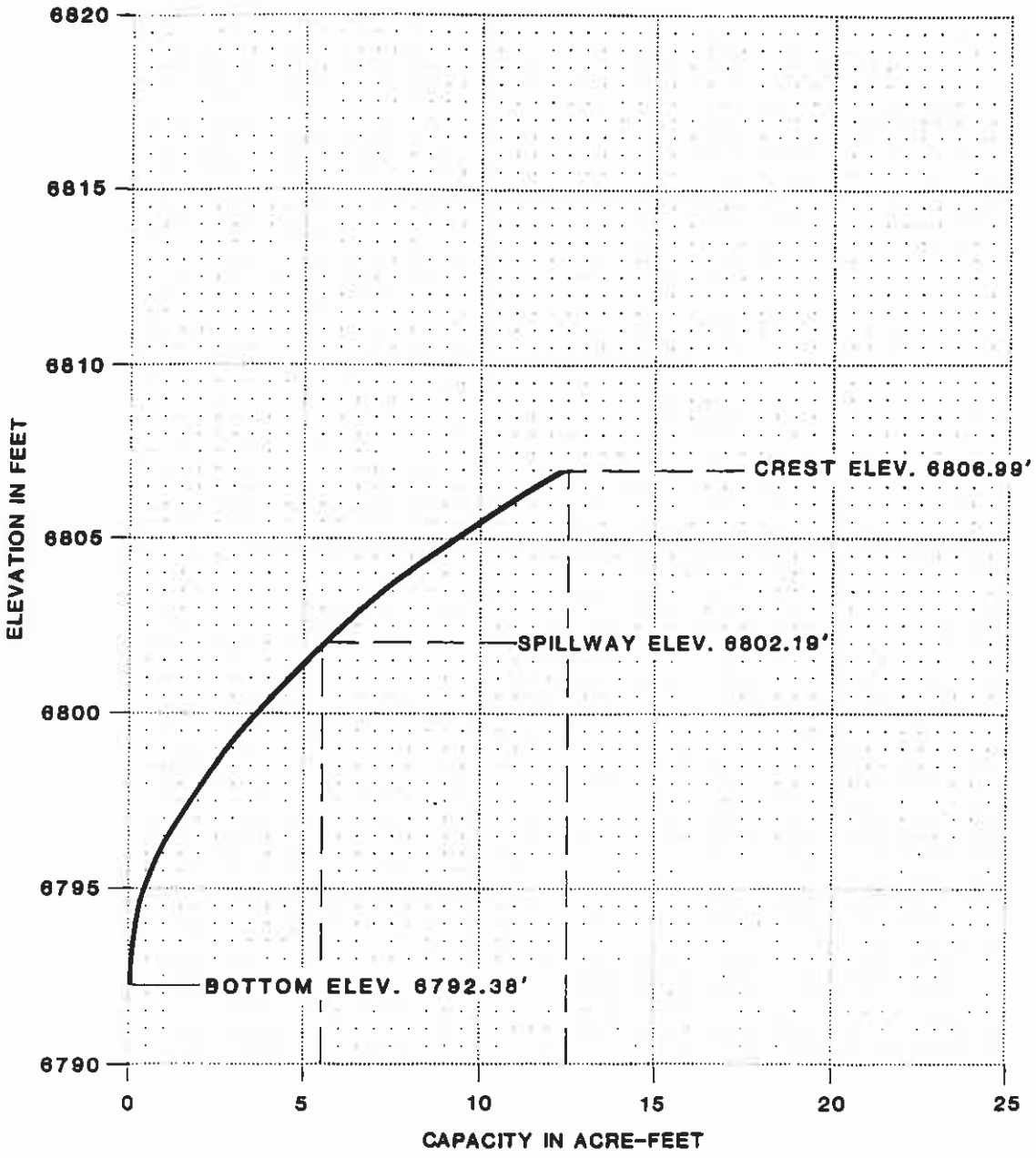
EXISTING MAXIMUM CROSS-SECTION A-A' N2-G

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

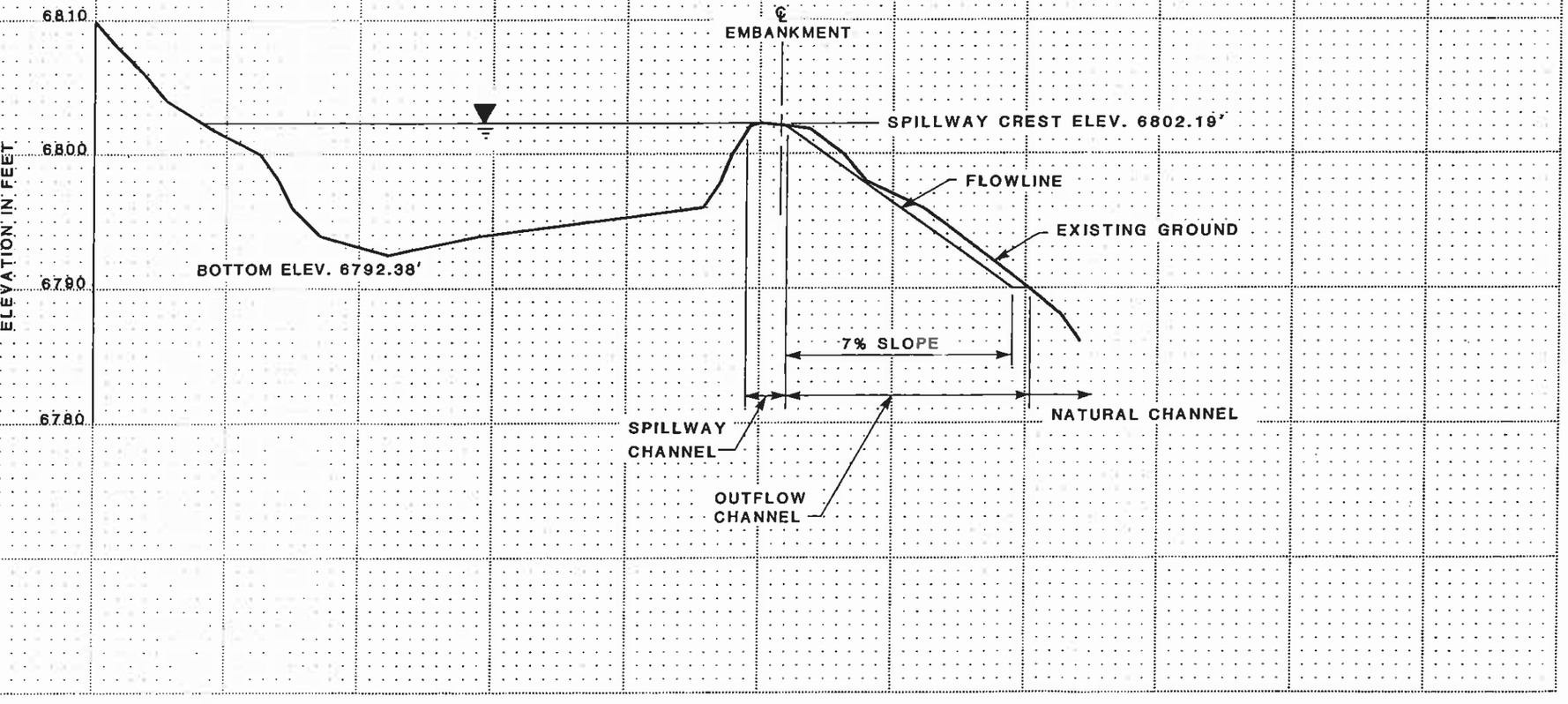
Plate 2



VOLUME-ELEVATION CURVE

N2-G

BY **Dames & Moore** Plate 3

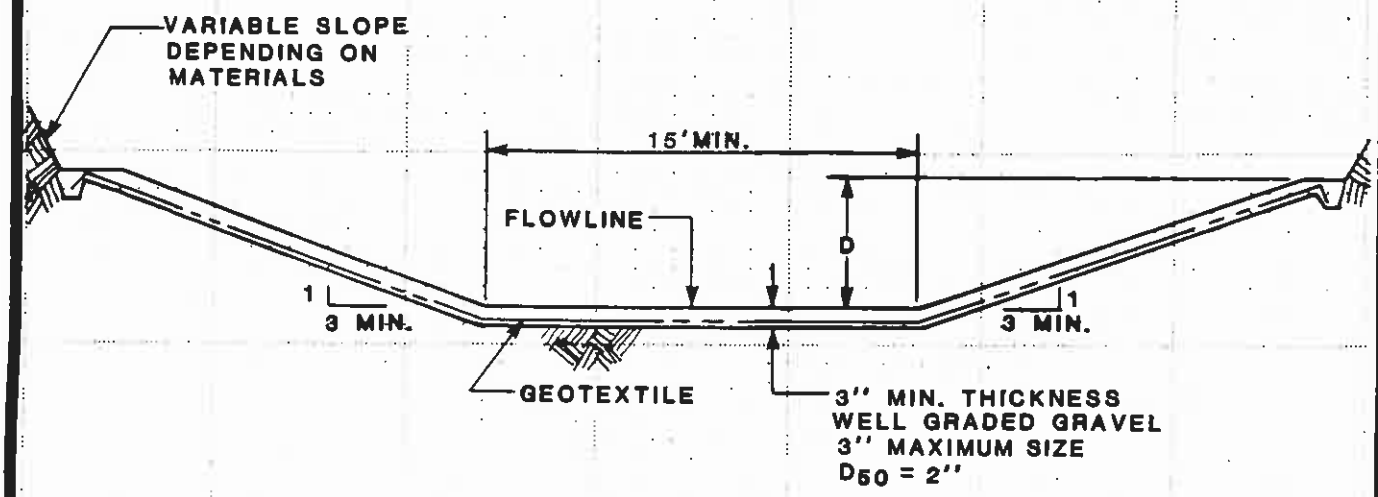


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N2-G

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 1.7'

LENGTH = 30'

FLOWLINE ELEV.= 6802.19'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N2-G

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			12' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			15°
a. Adequate grass cover?		X	
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	
g. Any stone deterioration?			NA
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			21°
a. Adequate grass cover?		X	
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?			
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 & rock shallow
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		Rills into spillway
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			grey SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			Flares to 20' W in Pond
Crest of Embankments?			
b. Approach Channel:	X		15' W 30' L Slope 10%
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		INTO POND
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		14' W 25' L 4.5' below crest
Are side slopes eroding?	X		From E.A. 0% Slope
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:			15' 120' L 20% Slope
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
e. Weir:			
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

OK.

Canopy < 5%
Ground cover 90%

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE Peabody Coal Co. 10139-011-2
SUBJECT Sediment Pond Hydrology
N2-G SHEET ___ OF

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

Time of Concentration

Elevation Difference = 6913 − 6809 = 104 ft.

Water Course Length = 3.6(400) = 1440 ft. = 0.273 mi.

$$T_c = \left(\frac{11.9\ (0.273)^3}{104}\right)^{0.385} = 0.097 \text{ hr.}$$

Lag Time = $0.6 T_c$ = 0.058 hr.

SCS Curve Number

Drainage Area (ac)	Cover Type	Hydrologic Condition	Soil Type	Weighted Curve Number
18.1	Post-law Reclaimed	fair		81 (.65)
1.5	Disturbed (Dirt road)		D	89 (.05)
8.3	Pinon-Juniper	average	D	83 (.30)
				82.0

65% # 35
35% # 24

use 82

Drainage Basin Area

27.9 acres 0.044 sq mile

BY S. DOLAN DATE 9-23-85
CHECKED BY ___
COPY TO EO ___

FILE _____

SUBJECT SEDIMENT INFLOW

N2-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 =	65%	reclaimed	.65 (.42)
	35%	EH # 24	.35 (.16)
			.33

K = .33

SLOPE FACTOR

LENGTH (ft)	Δ ELEV (ft)	SLOPE (%)	LS
1100'	100	9.1	4.0 (.9)
400	70	17.5	6.6 (.1)

use 4.3

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
65%	reclaimed	—	—	.65 (.15)
5%	disturbed	—	—	.05 (1.0)
30%	P-J	40%	25%	.30 (.14)
				C = .19

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.33)(4.3)(.19)(1.0) = 10.79$ ton/acre/year

$A = 10.79\left(\frac{1}{2047}\right)(27.9)(.95) = 0.140$ acre-feet/year

Dames & Moore