INSPECTION REPORT

Sedimentation Structure

N10-B

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N10-B is an earthen embankment, designed and constructed in 1979 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 N10-B is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N10-B. 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 N10-B 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 N10-B 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 N10-B has a 48.3-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 54% Pinion/Juniper and 46% reclaimed.

EMBANKMENT

Structure N10-B is a homogeneous earthen embankment classified as a sidehill embankment. Physical characteristics of the embankment are listed in the following table:

Structure N10-B

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	14.0 ft
Crest Width	15 ft
Upstream Slope	2.2 H : 1 V
Downstream Slope	3.1 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section N10-B, A-A'.

ANALYSES

STABILITY

Structure N10-B is a category B-1 embankment. A standard category B-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 = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N10-B 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 N10-B 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 N10-B was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.205	mi
2.	Elevation Difference, H	107	ft
3.	Time of Concentration, T_c	0.069	h
4.	Lag time, $0.6T_c$	0.041	h
5.	SCS Curve Number	83	
6.	Rainfall Depth, 10-year, 24-hour storm	2.1	in.
	25-year, 6-hour storm	1.9	in.
7.	Drainage Area	48.3	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.

N10-B 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	77	90	
Volume	acre-ft	3.16	2.54	
Storage				
Peak Stage	ft	6707.62	6715.67	
Spillway Elevation . .	ft	6714.50	—	
Peak Storage	acre-ft	3.16	—	
Storage Capacity . . .	acre-ft	9.60	—	
Outflow				
Peak Flow	cfs	0	10	
Embankment Crest Elevation	ft	—	6717.10	
Peak Stage	ft	—	6715.67	
Freeboard	ft	—	1.43	
Spillway Channel				
Flow Depth	ft	—	1.17	
Critical Velocity. . .	fps	—	2.2	
Manning's "n"		—	0.035	
Outflow Channel			Section I	Section II
Slope	%	—	20	7
Normal Velocity. . . .	fps	—	3.8	2.7
Normal Depth	ft	—	0.09	0.12
Manning's "n"		—	0.035	0.035

Spillway Channel

The existing spillway for N10-B has a trapezoidal channel with the following dimensions:

Channel depth	3.9	ft
Channel width	24	ft
Channel length	75	ft
Side slopes (horizontal to vertical)	2:1	
Average exit slope	1	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, N10-B.

The calculations for the sediment load entering Structure N10-B were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.312
3. Slope Factor, LS 5.23
4. Cover Factor, C 0.145
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 N10-B and the results of the sediment inflow analysis are summarized in the following table.

N10-B STORAGE

Total Storage Capacity	9.60	acre-ft
10-year, 24-hour Storm Inflow	3.16	acre-ft
Available Sediment Storage Capacity . .	6.44	acre-ft
Sediment Inflow Rate	0.212	acre-ft/yr
Sediment Storage Life	30	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N10-B indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes and the side slopes of the spillway channel; and cracks in the crest and downstream slope of the embankment. In addition, the slopes of the embankment are uneven. Correction of erosion is considered a periodic maintenance task and does not require remedial action. The embankment section with the

cracks should be repaired by excavating to the bottom of the cracks and reconstructing the embankment with compacted fill. The uneven slopes are due to, in our opinion, a lack of fine grading at the end of construction of the embankment and do not present a hazard to the stability of the structure. However, the slopes should be trimmed to prevent masking of potential problems in the future.

HYDRAULICS

The storage capacity and spillway capacity of Structure N10-B are adequate; however, the spillway does not have an 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 N10-B

Plate 2 - Existing Maximum Cross Section N10-B, A-A'

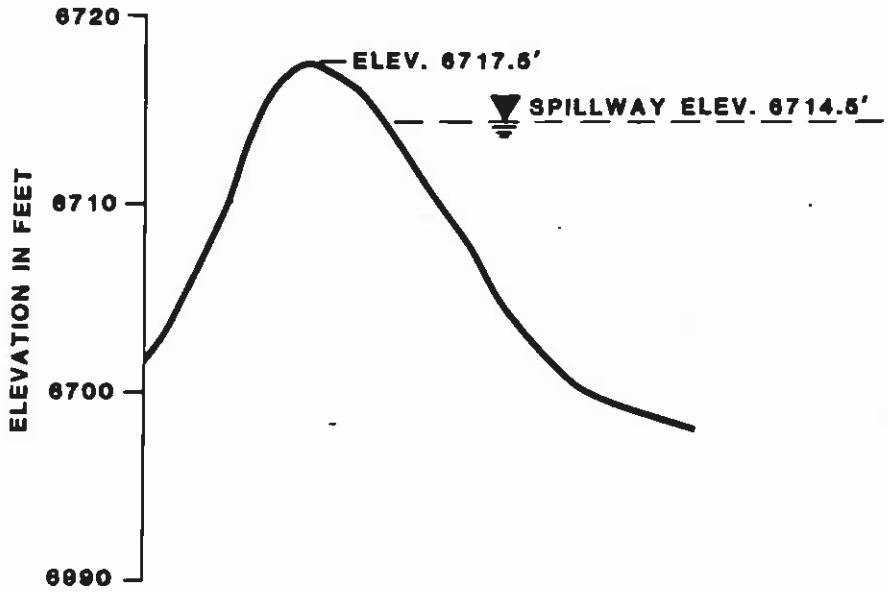
Plate 3 - Volume-Elevation Curve N10-B

Plate 4 - Channel Profile N10-B, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N10-B

Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



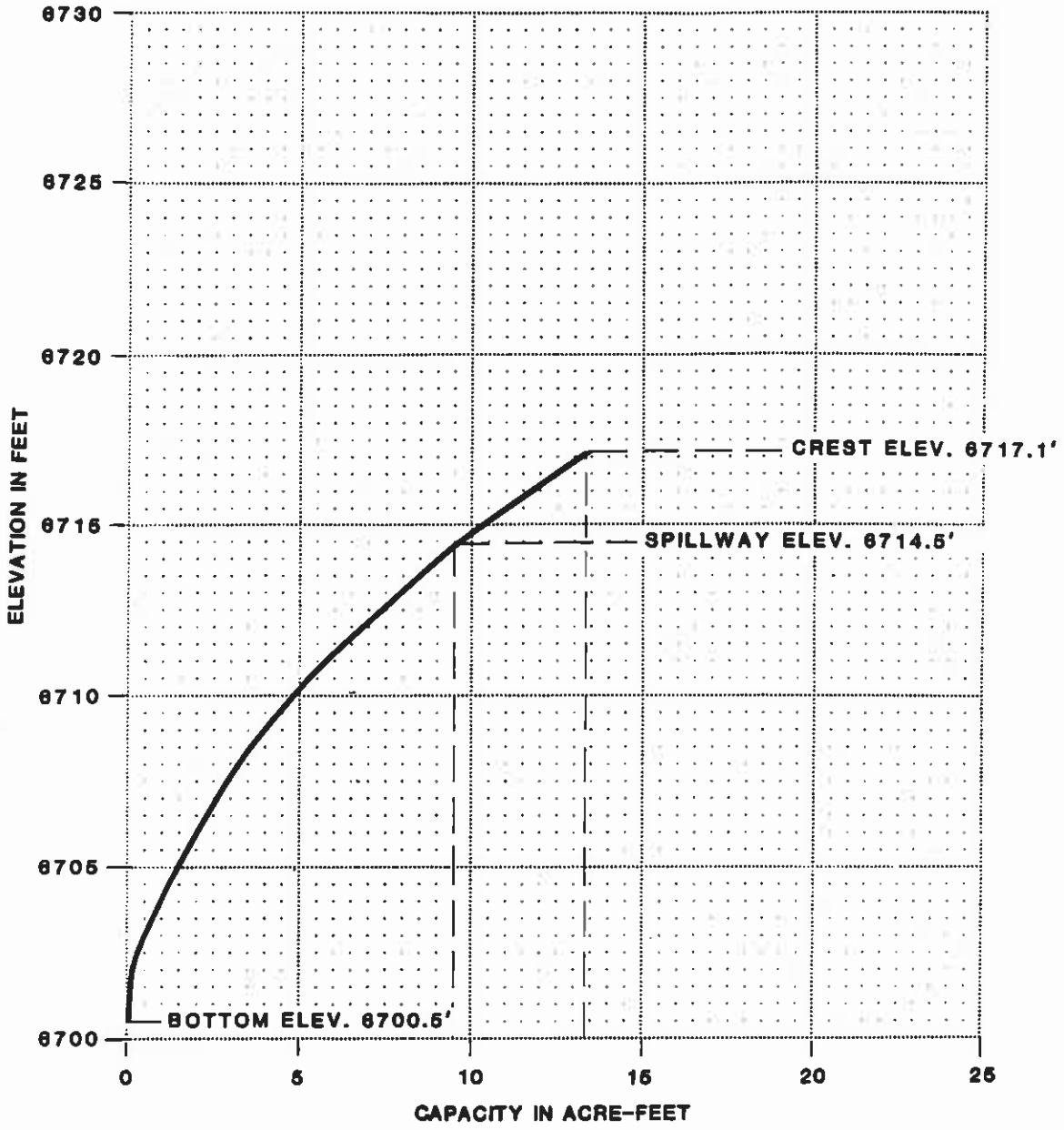
SCALE
0 50 100
FEET

EXISTING MAXIMUM CROSS-SECTION A-A' N10-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

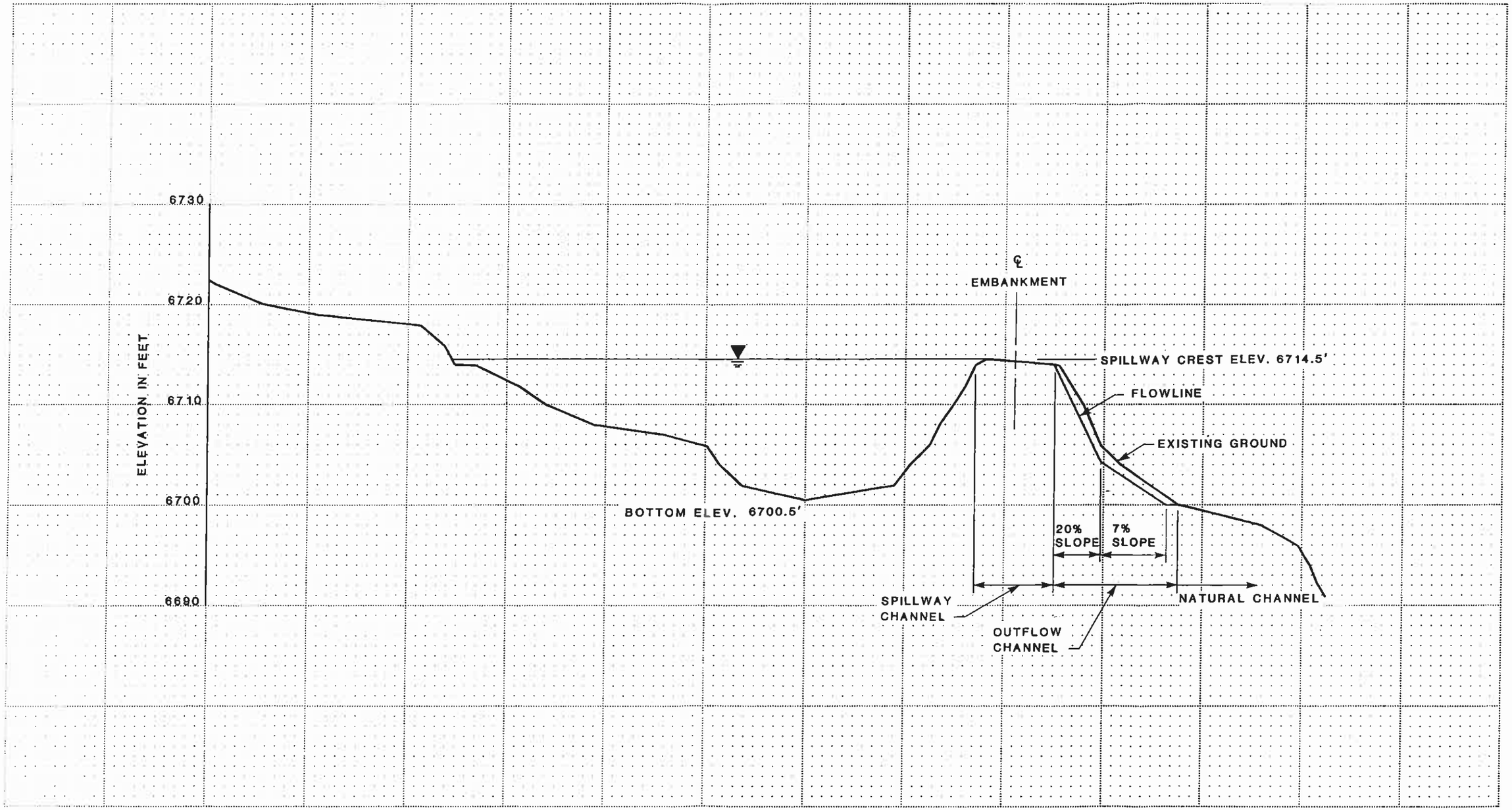
Plate 2



VOLUME-ELEVATION CURVE

N10-B

BY **Dames & Moore** Plate 3

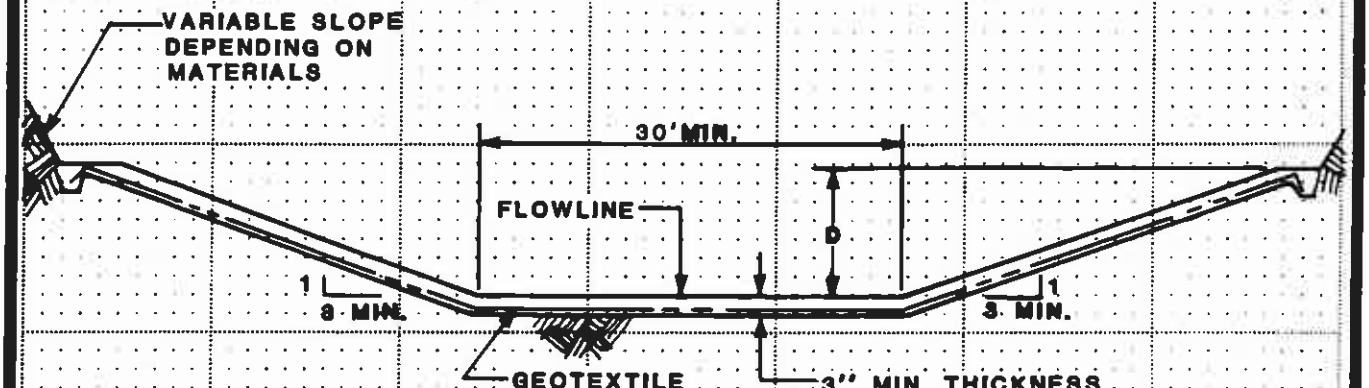


SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N10-B

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4



SPILLWAY CHANNEL

D = 2.3'

LENGTH = 75'

FLOWLINE ELEV.= 6714.50'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N10-B

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N10-B
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			15' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?	X		1 crack longitudinal near LA
2. UPSTREAM SLOPE			24° Ragged construc
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		Poor construction slope not trim
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			18° bumpy
a. Adequate grass cover?		X	
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?	X		near LA
e. Transverse cracks?	X		cracks towards LA
f. Visual depressions or bulges?	X		slope not trimmed
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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			gray/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?			gray SM + rock

Sediment Impoundment Name: N10-B
Page: 5

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?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		24'W 75'L Slope 1% 3.9' be Cre
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			0
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?			

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

Cracks in embankment near L.A both on crest and d.s. slope - not major

POND Partly incised

Canopy 15

Ground 85

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-0.1--
SUBJECT SEDIMENT POND HYDROLOGY
N10-B SHEET ___ OF

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6822 − 6715 = 107 ft.

WATER COURSE LENGTH = 2.7(400) = 1080 ft = 0.205 mi.

$$T_c = \left(\frac{11.9\ (0.205)^3}{107}\right)^{0.385} = 0.069 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.041 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
22.2	post-mine reclaimed	fair		81 (.46)
26.1	P-J	average	D	83 (.54)
				82.1
		46% #35		use 83
		54% #25		

DRAINAGE BASIN AREA

48.3 ACRE 0.075 SQ MILE

BY S. DOLAN DATE 9-22-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

945 1 (3-72) PRINTED IN U.S.A.

FILE [illegible]
SUBJECT Sediment Inflow
N10 - B SHEET ___ OF ___

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

Universal Soil Loss Equation

Rainfall Factor

K = 40

Soil Erodibility Factor

Soil Type =	46%	reclaimed	.46 (.42)
	54%	EH #25	.54 (.22)
			.312

K = .312

Slope Factor

Length (ft.)	Δ Elev (ft)	Slope (%)	LS
1300	200	15.4	9.6 (.2)
800	100	12.5	5.4 (.3)
700	90	12.9	5.3 (.3)
700	20	2.8	.5 (.2)

use 5.23

Cover Factor

Area (ac)	Cover Type	% Cover	Canopy (%)	Weighted C
46%	reclaimed	—	—	.46 (.15)
54%	P-J	40	25	.54 (.14)
				C = .145

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

Erosion Control Factor

P = 1.0

Sediment Inflow

$A = 40(.312)(5.23)(.145)(1.0) = 9.47$ ton/acre/year

$A = 9.47\left(\frac{1}{2047}\right)(48.3)(.95) = 0.212$ acre-feet/year

Dames & Moore