INSPECTION REPORT

Sedimentation Structure

N1-AC

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N1-AC is an earthen embankment, designed and constructed in 1980 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 N1-AC is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N1-AC. 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 N1-AC was inspected on September 5, 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 N1-AC 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 N1-AC has a 118.8-acre tributary drainage area and is located near Yellow Water Canyon at the Kayenta Mine. The watershed is classified as 45% Pinion/Juniper, 38% reclaimed, 17% disturbed.

EMBANKMENT

Structure N1-AC is a homogeneous earthen embankment classified as a in-wash embankment. Physical characteristics of the embankment are listed in the following table:

Structure N1-AC

Embankment	Residual Shale Soils
Foundation	Residual Shale Soils
Right Abutment	Residual Shale Soils
Left Abutment	Residual Shale Soils
Height	10.8 ft
Crest Width	17 ft
Upstream Slope	1.9 H : 1 V
Downstream Slope . . .	2.5 H : 1 V

A cross-section of the embankment is shown on Plate 2, Existing Maximum Cross Section N1-AC, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure N1-AC 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 N1-AC 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 N1-AC 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 N1-AC was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.432	mi
2.	Elevation Difference, H	154	ft
3.	Time of Concentration, T_c	0.141	h
4.	Lag time, $0.6T_c$	0.085	h
5.	SCS Curve Number	87	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	118.8	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.

N1-AC 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	189	239
Volume	acre-ft	9.80	8.42
Storage			
Peak Stage	ft	6535.84	--
Spillway Elevation . .	ft	6538.80	--
Peak Storage	acre-ft	9.82	--
Storage Capacity . . .	acre-ft	16.3	--
Outflow			
Peak Flow	cfs	0	102
Embankment Crest Elevation	ft	--	6540.80
Peak Stage	ft	--	6540.46
Freeboard	ft	--	0.34

Spillway Channel

The existing spillway for N1-AC has a trapezoidal channel with the following dimensions:

Channel depth	8 ft
Channel width	45 ft
Channel length	60 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 N1-AC has a U-shaped channel with the following dimensions:

Channel width	45 ft
Channel length	140 ft
Average exit slope	2 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, N1-AC.

The calculations for the sediment load entering Structure N1-AC were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.26
3. Slope Factor, LS 9.60
4. Cover Factor, C 0.31
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 N1-AC and the results of the sediment inflow analysis are summarized in the following table.

N1-AC STORAGE

Total Storage Capacity	16.3	acre-ft
10-year, 24-hour Storm Inflow	9.82	acre-ft
Available Sediment Storage Capacity . .	6.48	acre-ft
Sediment Inflow Rate	1.62	acre-ft/yr
Sediment Storage Life	4	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N1-AC indicated that the geotechnical problems consist of rill on the upstream and downstream slopes; the side slopes of the spillway and outlet channel; and the right abutment and cracks at the upstream edge of the crest towards the left abutment. Correction of erosion is considered a periodic maintenance task and does not require

remedial action. The cracks in the crest should be repaired by excavating to the bottom of the cracks and replacing with compacted fill.

HYDRAULICS

The storage capacity of Structure N1-AC is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The bottom elevation of the existing spillway channel should be lowered to elevation 6538.0 feet while maintaining the bottom width of 50 feet as shown on Plate 5. A trapezoidal outflow channel with the same bottom width as the spillway should be constructed along the alignment shown in Plate 1. The channel profile is shown in Plate 4 and required dimensions are shown in Plate 5 and Plate 6. The spillway, outflow channel and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

Lowering the spillway elevation to 6538.0 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

N1-AC HYDRAULICS FOR REDESIGNED SPILLWAY

	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	189	239	
Volume	acre-ft	9.80	8.42	
Storage				
Peak Stage	ft	6538.81	6539.67	
Spillway Elevation . .	ft	6538.00	--	
Peak Storage	acre-ft	9.82	--	
Storage Capacity . . .	acre-ft	14.53	--	
Available Sediment Storage Capacity . .	acre-ft	4.71	--	
Sediment Inflow Rate .	acre-ft/yr	1.62	--	
Sediment Storage Life.	yrs	3	--	
Outflow				
Peak Flow	cfs	--	107	
Embankment Crest Elevation	ft	--	6540.80	
Peak Stage	ft	--	6539.67	
Freeboard	ft	--	1.13	
Spillway Channel				
Flow Depth	ft	--	1.67	
Critical Velocity. . .	fps	--	4.0	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	48	3
Normal Velocity. . . .	fps	--	9.3	4.0
Normal Depth	ft	--	0.22	0.51
Manning's "n"		--	0.040	0.040

* * *

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

Plate 1 - Site Plan N1-AC

Plate 2 - Existing Maximum Cross Section N1-AC, A-A'

Plate 3 - Volume-Elevation Curve N1-AC

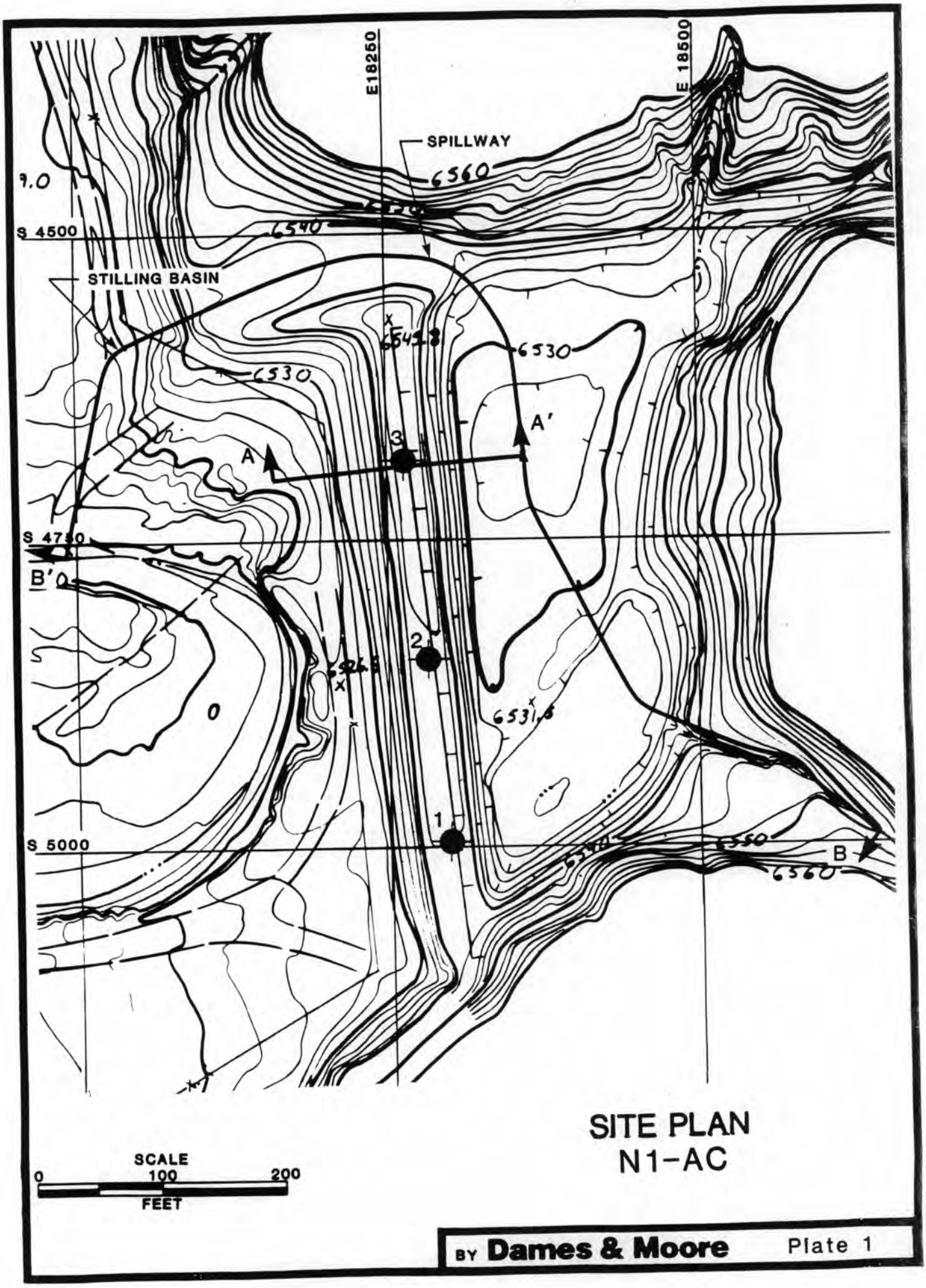
Plate 4 - Channel Profile N1-AC, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N1-AC

Plate 6 - Spillway Stilling Basin Plan N1-AC

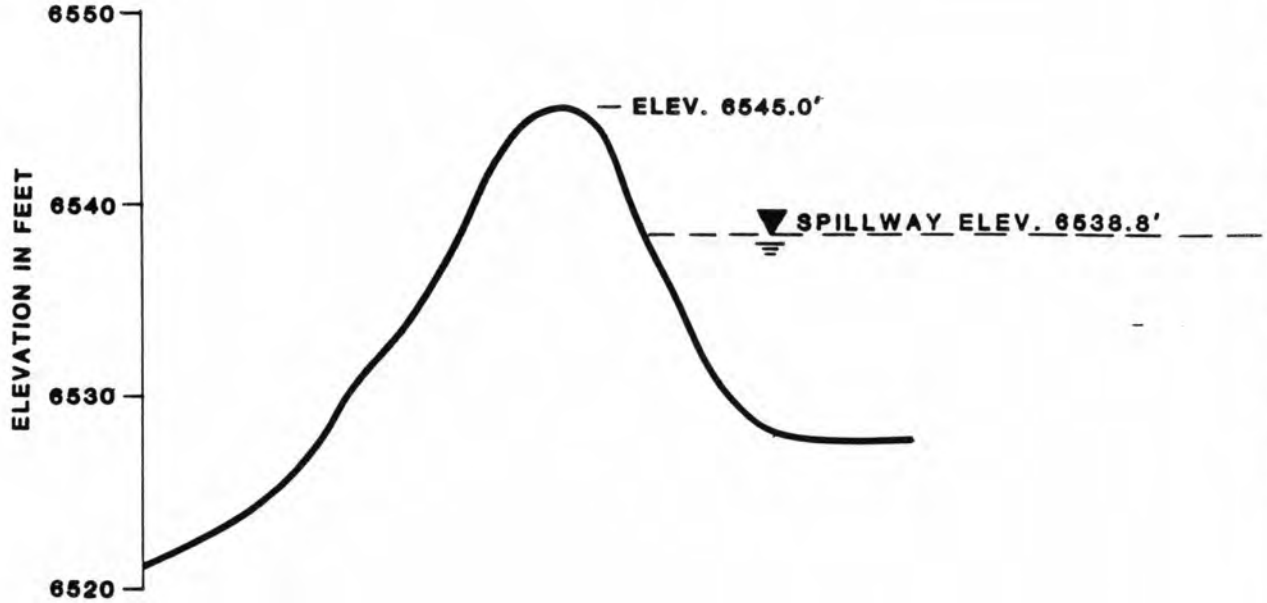
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N1-AC

BY **Dames & Moore** Plate 1

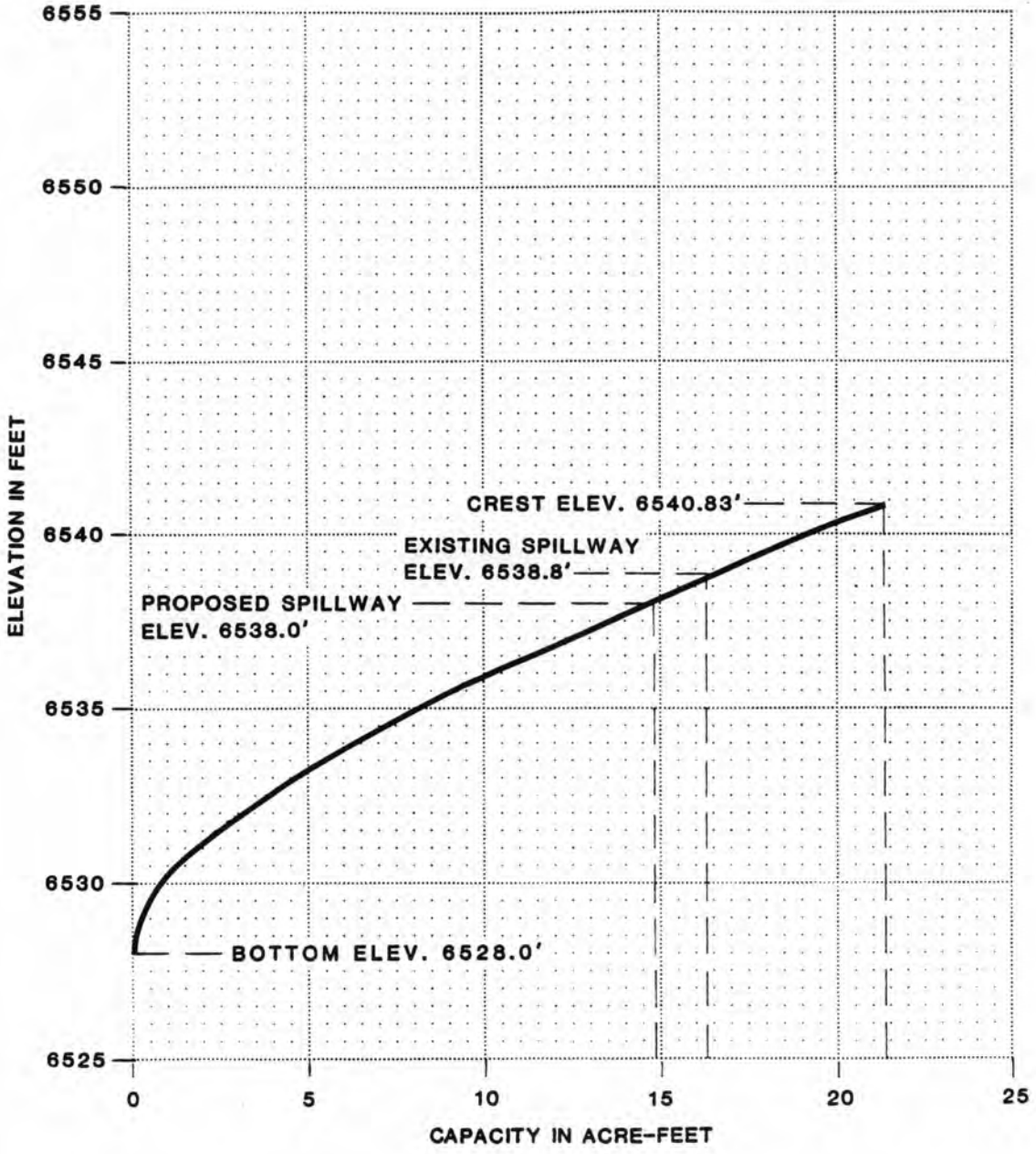


EXISTING MAXIMUM CROSS-SECTION A-A' N1-AC

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

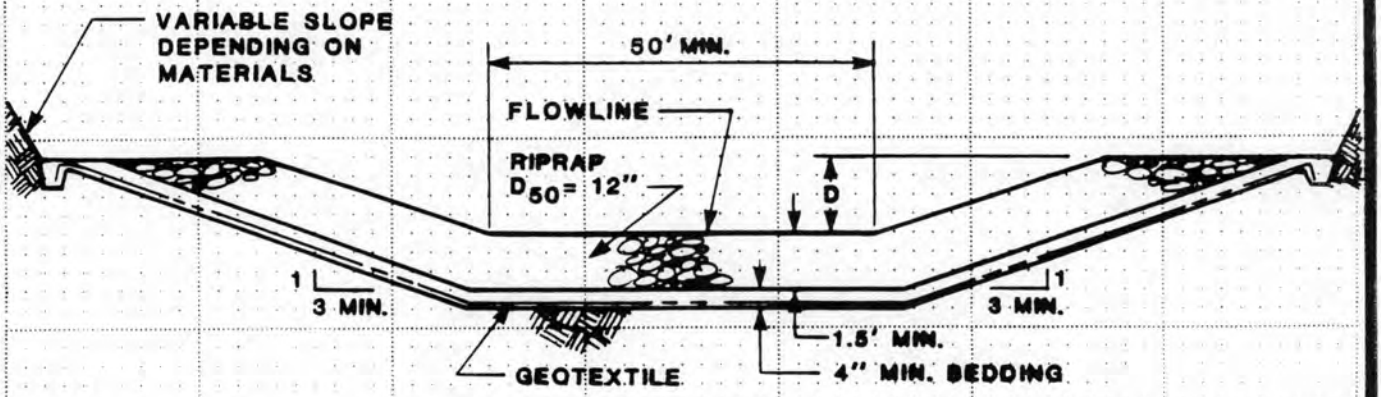
Plate 2



VOLUME-ELEVATION CURVE

N1-AC

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.7'

LENGTH = 50'

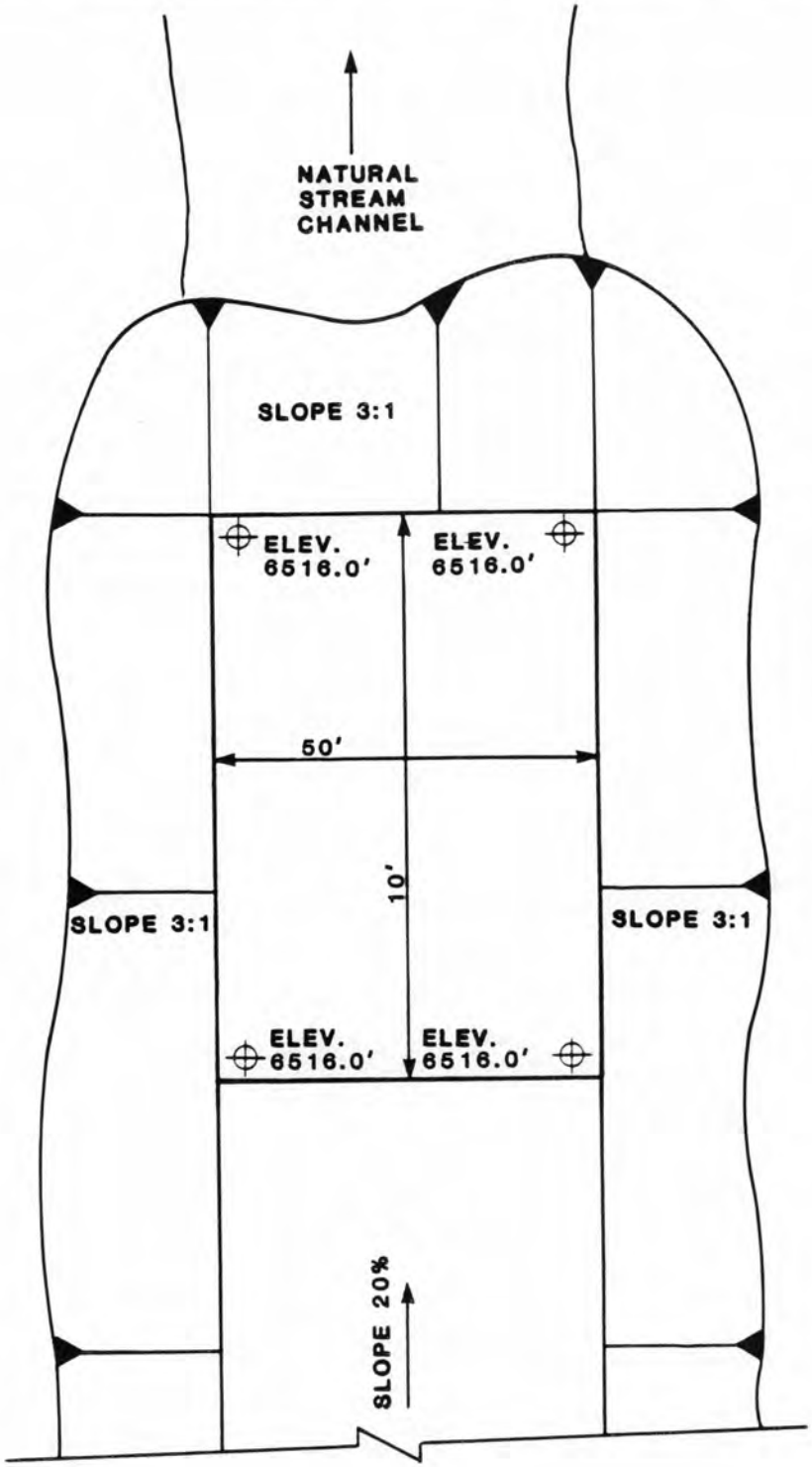
FLOWLINE ELEV. = 6538.00'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N1-AC

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 2.9'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 1.5'

SPILLWAY STILLING BASIN PLAN N1-AC

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N1-AC
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			17'
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			28° Ragged uneven
a. Adequate grass cover?	X		60%
b. Any erosion?	X		Rills
c. Are trees growing on slope?		X	
d. Longitudinal cracks?	X		At edge of crest 12" deep
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			22°
a. Adequate grass cover?	X		75%
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			Rills
a. Any erosion?	X		& INTO Spillway
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock
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?			Rock

Sediment Impoundment Name: N1-AC
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
Crest of Embankments?			
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			No
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		8' below crest 45' w.
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?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		at end
Obstructed?		X	
Erosion protection?		X	some rock at end
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?			

Sediment Impoundment Name: N1-AC
Page: 6

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

9. GENERAL COMMENTS

Found cracks at U.S. edge of crest 12" deep. May be due to poor edge compaction of crest or no trimming after building crest.

Ground cover ≈75 %
Canopy cover ≈25 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-2
SUBJECT SEDIMENT POND HYDROLOGY
NI-AC SHEET ___ OF

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6693 − 6539 = 154 ft.

WATER COURSE LENGTH = 5.7(400) = 2280 ft = 0.432 mi.

$$T_c = \left(\frac{11.9\,(0.432)^3}{154}\right)^{0.385} = 0.141 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.085 hr.

Note: SEE CALCULATIONS ON BACK.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
7.4	Disturbed		D	(.06) 94
45.2	pre-law Reclaimed			(.38) 87
52.9	P-J	average	D	(.45) 83
13.3	Gravel Road		D	(.11) 91
		38% #35		use 87
		62% #24		

DRAINAGE BASIN AREA

118.8 ACRE 0.186 SQ MILE

BY S. DOLAN DATE 9-12-85
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 = 38% reclaimed .38 (.42)
62% EH # 24 .62 (.16)
.26

K = .26

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
1100	30	3%	.59 (.3)
400	30	8%	1.98 (.2)
400	180	45%	22.00 (.4)
300	30	10%	2.37 (.1)

use 9.6

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
6%	disturbed			(.06)(1.0)
38%	reclaimed			(.38)(.15)
45%	P-J	40	25	(.45)(.14)
13%	road			(.13)(1.0)
				.31

EROSION CONTROL FACTOR

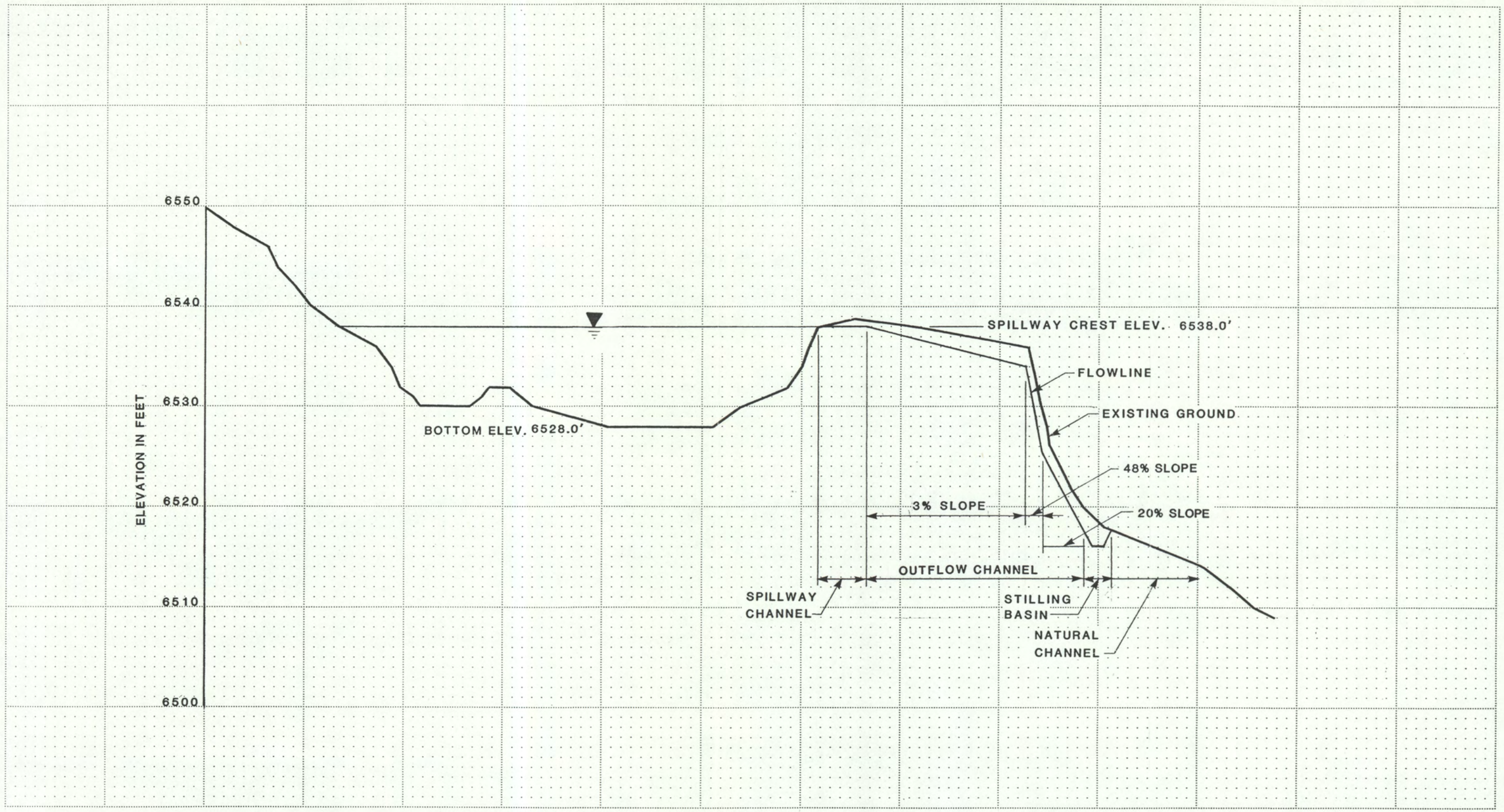
P = 1.0

SEDIMENT INFLOW

$A = 40(.26)(9.6)(.31)(1.0) = 30.95$ ton/acre/year

$A = 30.95\left(\frac{1}{2047}\right)(118.8)(.9) = 1.62$ acre-feet/year

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___



SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N1-AC

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

N1-F

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N1-F is an earthen embankment, designed and constructed in 1980 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 N1-F is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N1-F. 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 N1-F was inspected on September 6, 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 N1-F 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 N1-F has a 105.7-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 58% reclaimed, 36% Pinion/Juniper, and 6% disturbed.

EMBANKMENT

Structure N1-F is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure N1-F

Embankment	Residual Sandstone Soils
Foundation	Residual Sandstone Soils
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	16.7 ft
Crest Width	24 ft
Upstream Slope	3.5 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 N1-F, A-A'.

ANALYSES

STABILITY

Structure N1-F is a category A-1 embankment. A standard category A-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 = 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 N1-F 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 N1-F 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 N1-F was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.364	mi
2.	Elevation Difference, H	100	ft
3.	Time of Concentration, T_c	0.137	h
4.	Lag time, $0.6T_c$	0.082	h
5.	SCS Curve Number	84	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	105.7	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.

N1-F 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	136	171
Volume	acre-ft	7.05	5.64
Storage			
Peak Stage	ft	6492.54	--
Spillway Elevation . .	ft	6494.20	--
Peak Storage	acre-ft	7.05	--
Storage Capacity . . .	acre-ft	8.58	--
Outflow			
Peak Flow	cfs	0	81
Embankment Crest Elevation	ft	--	6496.20
Peak Stage	ft	--	6496.25
Freeboard	ft	--	Overtop

Spillway Channel

The existing spillway for N1-F has a trapezoidal channel with the following dimensions:

Channel depth	2 ft
Channel width	15 ft
Channel length	35 ft
Side slopes (horizontal to vertical). .	2:1
Average exit slope	2 percent

There is presently no erosion protection within the channel.

Outflow Channel

The existing outflow channel for N1-F has a U-shaped channel with the following dimensions:

	Sec. I	Sec. II	
Channel width	15	6	ft
Channel length	35	100	ft
Side slopes (horizontal to vertical). .	2:1	2:1	
Average exit slope	6	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, N1-F.

The calculations for the sediment load entering Structure N1-F were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.36
3. Slope Factor, LS 4.68
4. Cover Factor, C 0.200
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 N1-F and the results of the sediment inflow analysis are summarized in the following table.

N1-F STORAGE

Total Storage Capacity	8.58	acre-ft
10-year, 24-hour Storm Inflow	7.04	acre-ft
Available Sediment Storage Capacity . .	1.53	acre-ft
Sediment Inflow Rate	0.627	acre-ft/yr
Sediment Storage Life	2	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N1-F indicated that the only geotechnical problem is rill and gully erosion on the upstream slope and the right and left abutments. 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 of Structure N1-F is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The embankment crest should be raised to elevation 6497.30 feet. The existing outflow channel should be extended and improved and a stilling basin should be constructed along the alignment shown in Plate 1. The channel and stilling basin profile is shown in Plate 4 and required dimensions are shown in Plate 5 and Plate 6. The spillway, outflow channel, and stilling basin should be protected against erosion using geotextile and riprap as shown in Plate 5.

Raising the embankment crest increases the freeboard. The analysis of these conditions is summarized in the following table.

N1-F HYDRAULICS FOR RAISED EMBANKMENT

	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	136	171	
Volume	acre-ft	7.05	5.64	
Storage				
Peak Stage	ft	6492.54	6496.25	
Spillway Elevation . .	ft	6494.20	--	
Peak Storage	acre-ft	7.05	--	
Storage Capacity . . .	acre-ft	8.58	--	
Available Sediment Storage Capacity . .	acre-ft	1.53	--	
Sediment Inflow Rate .	acre-ft/yr	0.627	--	
Sediment Storage Life.	yrs	2	--	
Outflow				
Peak Flow	cfs	0	81	
Embankment Crest Elevation	ft	--	6497.30	
Peak Stage	ft	--	6496.25	
Freeboard	ft	--	1.05	
Spillway Channel				
Flow Depth	ft	--	2.05	
Critical Velocity. . .	fps	--	5.0	
Manning's "n"		--	0.040	
Outflow Channel			Section I	Section II
Slope	%	--	6	15
Normal Velocity. . . .	fps	--	6.7	8.9
Normal Depth	ft	--	0.71	0.54
Manning's "n"		--	0.040	0.040

* * *

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

Plate 1 - Site Plan N1-F

Plate 2 - Existing Maximum Cross Section N1-F, A-A'

Plate 3 - Volume-Elevation Curve N1-F

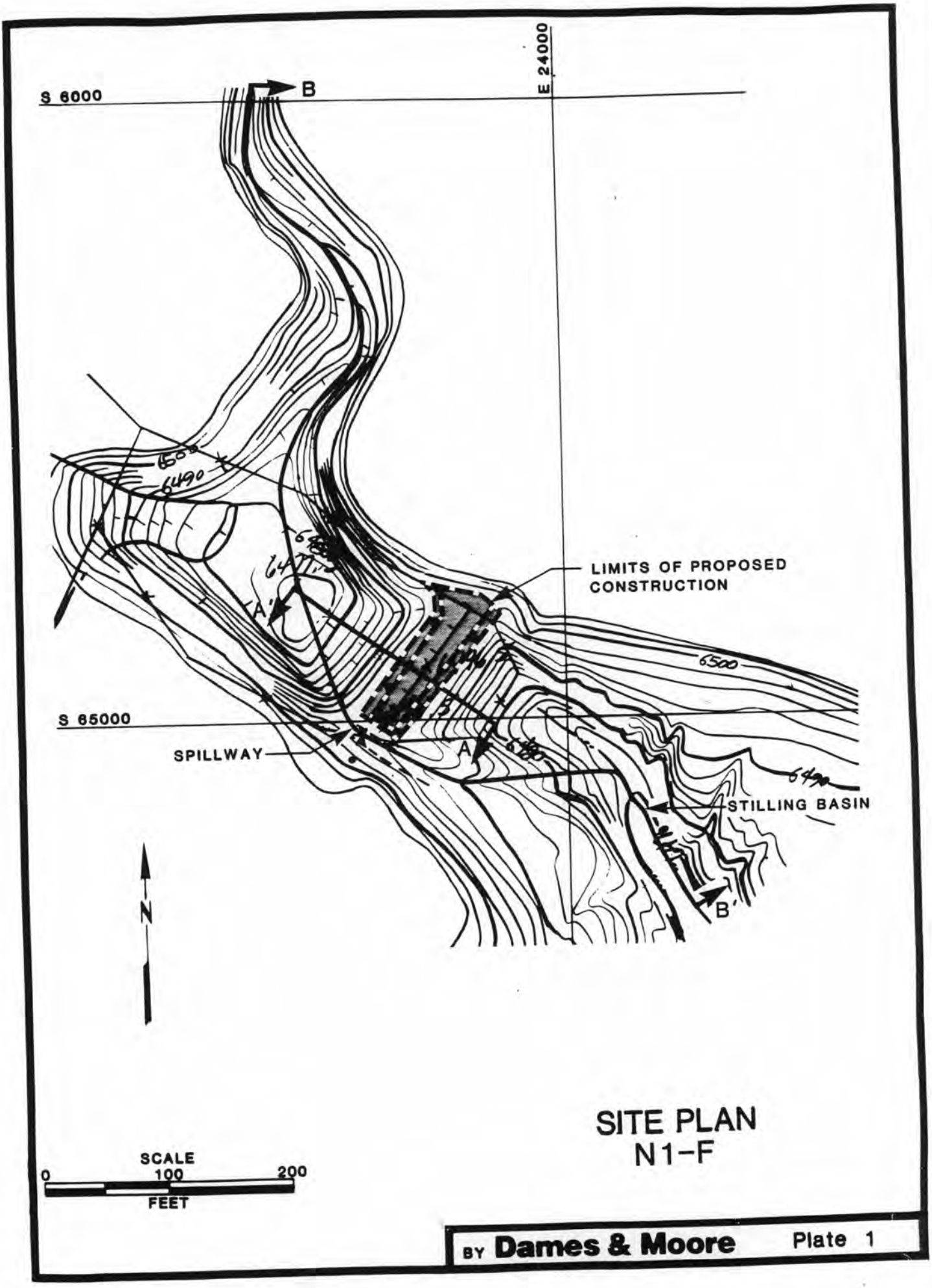
Plate 4 - Channel Profile N1-F, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N1-F

Plate 6 - Spillway Stilling Basin Plan N1-F

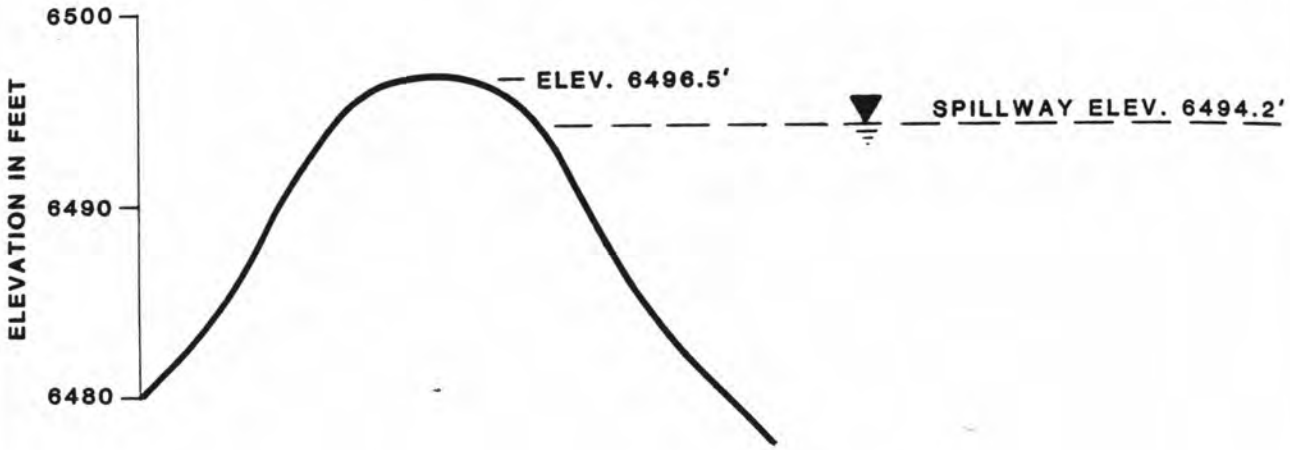
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N1-F

BY **Dames & Moore** Plate 1

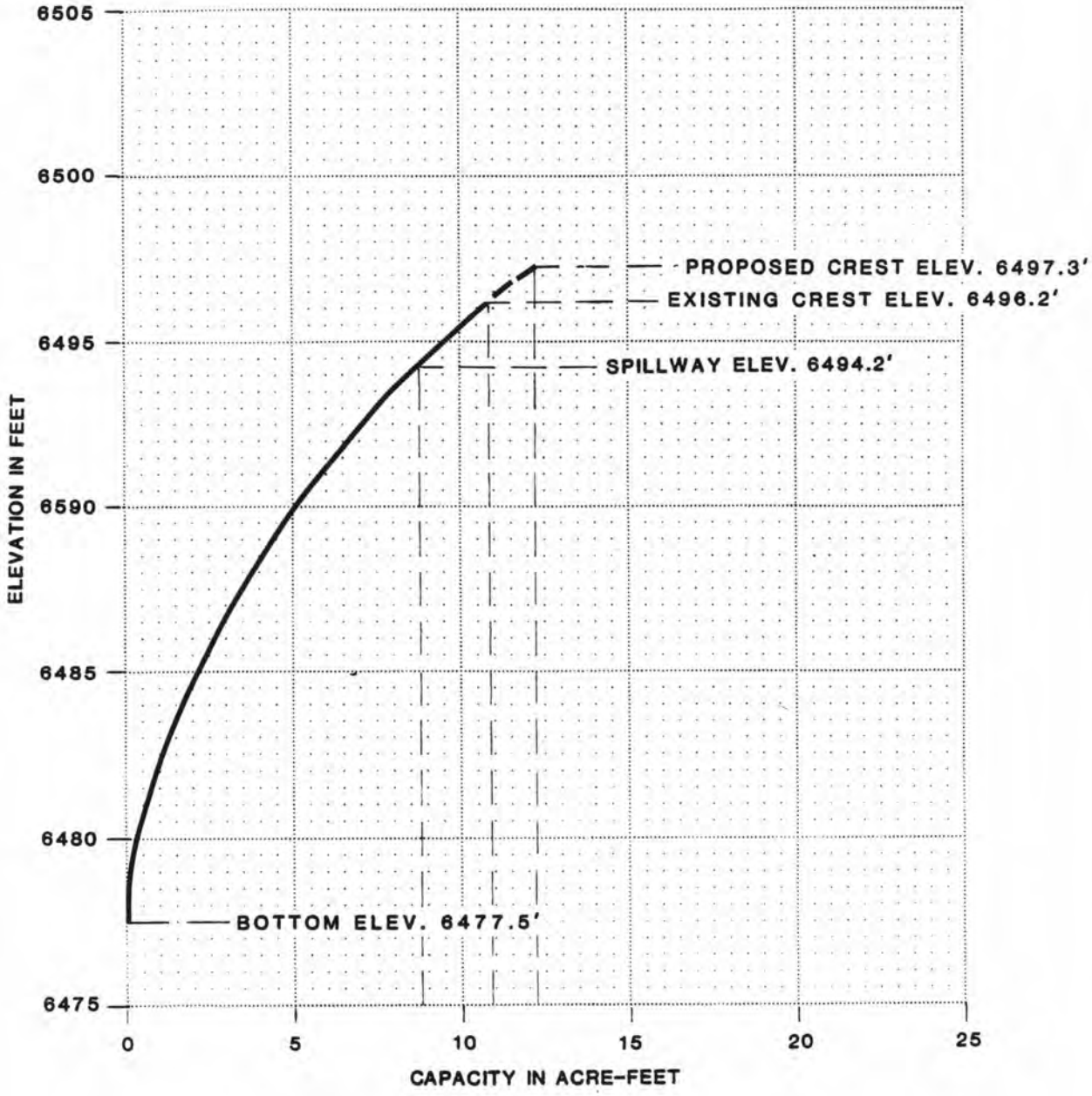


EXISTING MAXIMUM CROSS-SECTION A-A' N1-F

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

Plate 2

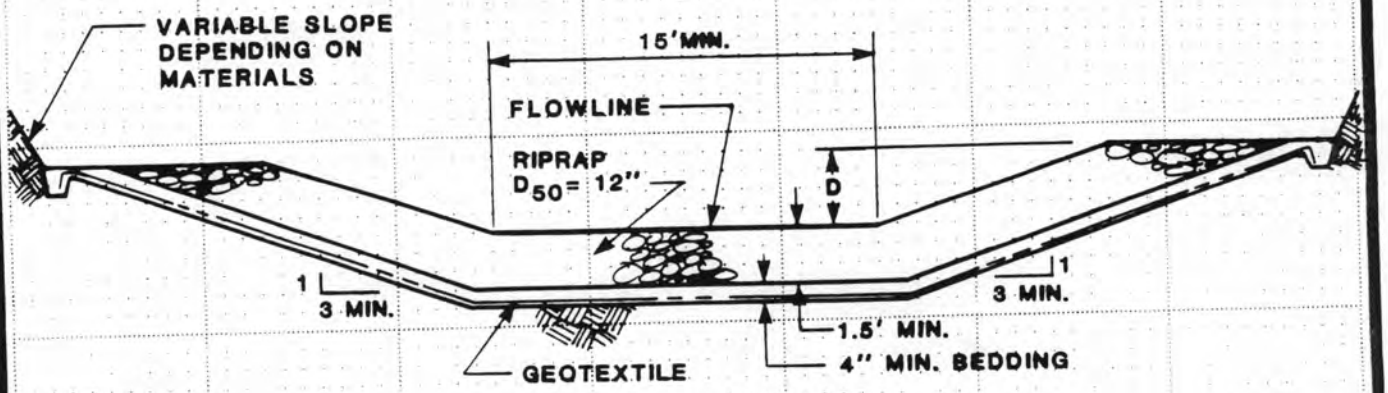


EXISTING VOLUME
PROPOSED VOLUME

VOLUME-ELEVATION CURVE

N1-F

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 3.1'

LENGTH = 40'

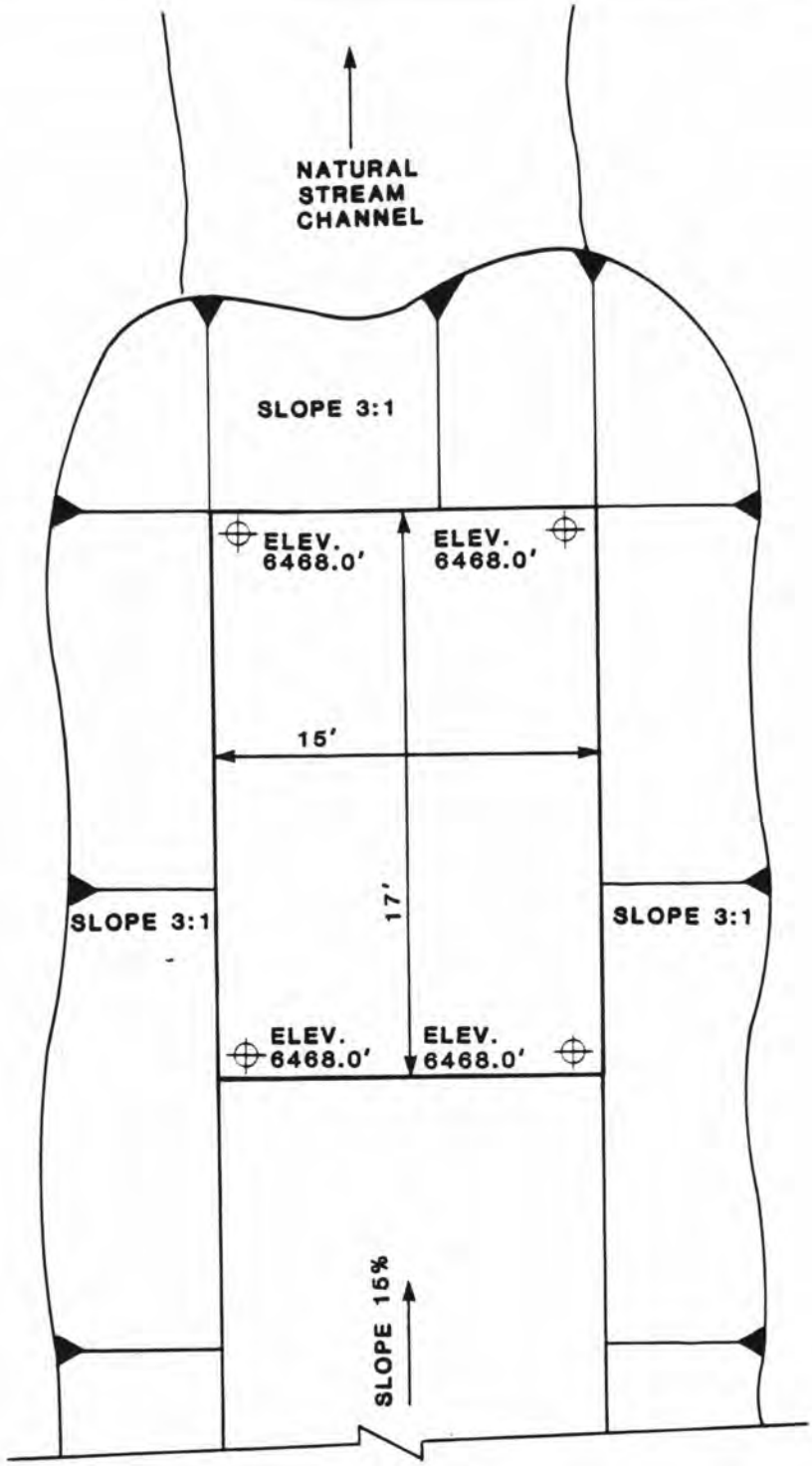
FLOWLINE ELEV. = 6494.2'

OUTFLOW CHANNEL

D = 2.0'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N1-F

BY **Dames & Moore** Plate 5



MINIMUM HEIGHT OF RIPRAP
ALONG SIDEWALLS ABOVE
THE BASIN FLOOR = 4.9'

MINIMUM DEPTH OF BASIN FLOOR
BELOW NATURAL STREAMBED = 2.2'

SPILLWAY STILLING BASIN PLAN N1-F

BY **Dames & Moore** Plate 6

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N1-F
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			24' W
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			16°
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			13° Note There is a lot of sediment at downstream toe
a. Adequate grass cover?		X	
b. Any erosion?		X	
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		gulley into pond
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Brown Silt
5. ABUTMENT CONTACT. LEFT			
a. Any erosion?	X		gulley into pond at contact
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			Rock & brown silt

Sediment Impoundment Name: N1-F
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?	X		
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		15'W/35'L+2%
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
d. Outflow Channel:	X		1st: 55'L 15'W 6% / 2nd: 100'L 6' 20%
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
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?			

Sediment Impoundment Name: N1-F
Page: 6

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

Lot of sediment in channel d.s. of toe. towards coal mine waste.

Canopy Cover 10 %
Ground Cover 80 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-01-22
SUBJECT SEDIMENT POND HYDROLOGY
N1-F SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6594 - 6494 = 100 ft.

WATER COURSE LENGTH = 4.8(400) = 1920 ft. = 0.364 mi.

$$T_c = \left(\frac{11.9\ (0.364)^3}{100}\right)^{0.385} = 0.137 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.082 hr.

Note: USED MAX. T_c ON BACK

SCS CURVE NUMBER

DRAINAGE AREA (ac)		COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
37.6	(36%)	P-J	Average	C	0.36 (78) = 28.1
61.4	(58%)	RECLAIM (prelaw)	—	—	0.58 (87) = 50.5
6.7	(6%)	Haul Road	—	C	0.06 (89) = 5.3
					83.9

P-J EH #21
reclaimed EH #35

USE 84

DRAINAGE BASIN AREA

105.7 ACRE 0.165 SQ MILE

BY S. DOLAN DATE 9-10-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	42%	EH #21	.42 (.27)
	58%	EH #35	.58 (.42)
			.36

K = .36

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
300 A	40	14	3.98 (30%)
200 A	80	40	17.90 (10%)
1700	80	5	2.21 (30%)
1700	110	7	3.43 (30%)
			ave 4.68

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
58%	reclaimed	—	—	.58 (.15)
36%	P-J	40	25	.36 (.14)
6%	disturbed	—	—	.06 (1.0)
				C = .200

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

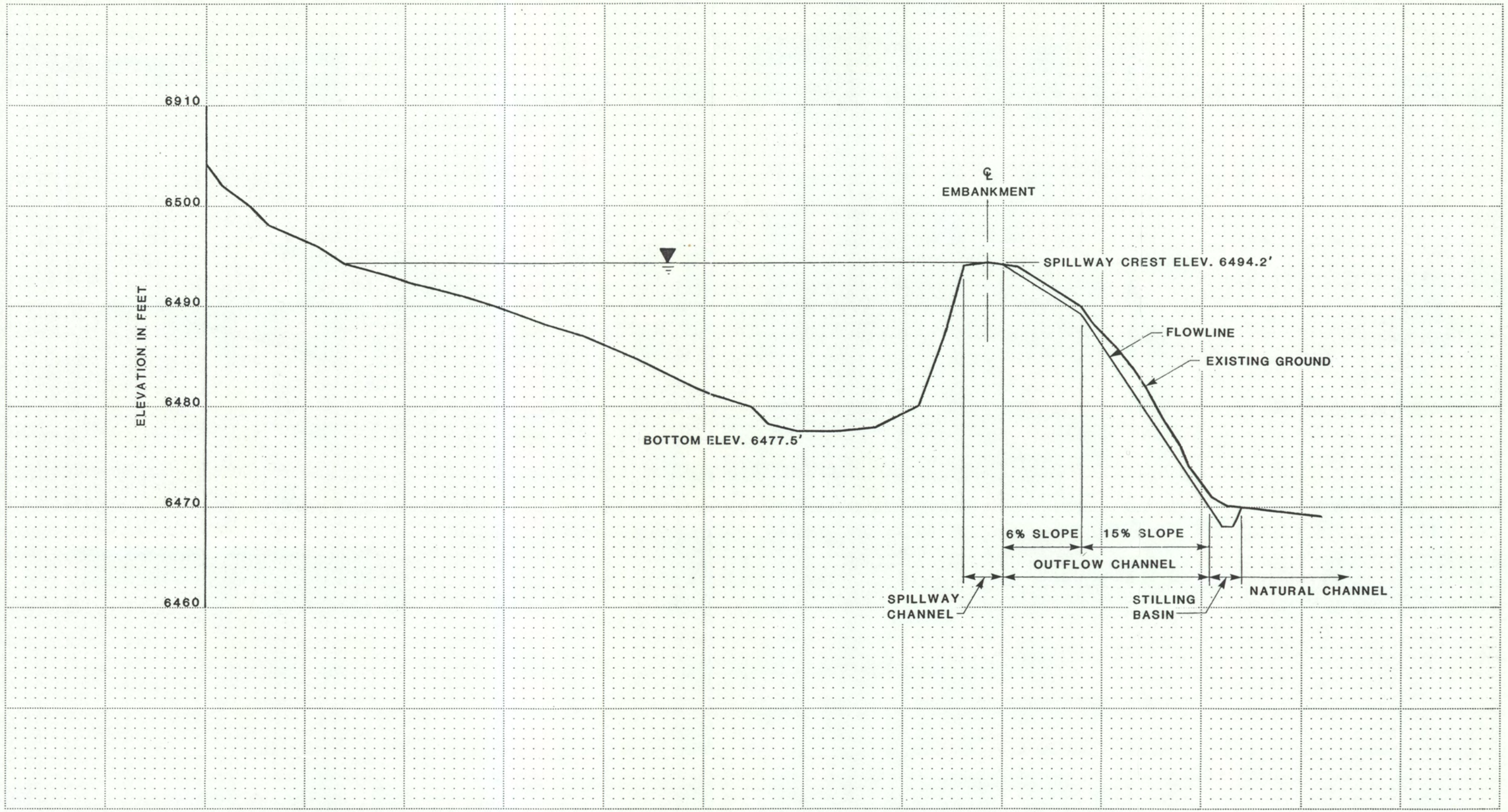
EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.36)(4.68)(.200)(1.0) = 13.48$ ton/acre/year

$A = 13.48\left(\frac{1}{2047}\right)(105.7)(.9) = .627$ acre-feet/year



SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N1-F

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

N1-L

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

TABLE OF CONTENTS

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INTRODUCTION	1
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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure N1-L is an earthen embankment, designed and constructed in 1980 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 N1-L is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N1-L. 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 N1-L was inspected on September 6, 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 N1-L 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 N1-L has a 39.2-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 55% reclaimed, 36% Pinion/Juniper, and 9% disturbed.

EMBANKMENT

Structure N1-L is a homogeneous earthen embankment classified as a in-wash embankment. Physical characteristics of the embankment are listed in the following table:

Structure N1-L

Embankment	Alluvial Soils
Foundation	Alluvium
Right Abutment	Alluvium
Left Abutment	Scoria
Height	12.6 ft
Crest Width	20 ft
Upstream Slope	3.1 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 N1-L, A-A'.

ANALYSES

STABILITY

Structure N1-L is a category C-1 embankment. A standard category C-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 N1-L 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 N1-L 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 N1-L 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	83	ft
3.	Time of Concentration, T_c	0.106	h
4.	Lag time, $0.6T_c$	0.063	h
5.	SCS Curve Number	81	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	39.2	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.

N1-L 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	44	55
Volume	acre-ft	2.22	1.76
Storage			
Peak Stage	ft	6497.36	6503.09
Spillway Elevation . .	ft	6501.82	--
Peak Storage	acre-ft	2.22	--
Storage Capacity . . .	acre-ft	5.02	--
Outflow			
Peak Flow	cfs	0	12
Embankment Crest Elevation	ft	--	6504.32
Peak Stage	ft	--	6502.95
Freeboard	ft	--	1.37
Spillway Channel			
Flow Depth	ft	--	1.13
Critical Velocity. . .	fps	--	2.9
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	1
Normal Velocity. . . .	fps	--	2.6
Normal Depth	ft	--	0.36
Manning's "n"		--	0.035

Approach Channel

The existing approach channel for N1-L has a U-shaped channel with following dimensions:

Channel width	15-25 ft
Channel length	40 ft
Slope	32 percent

Spillway Channel

The existing spillway for N1-L has a trapezoidal channel with the following dimensions:

Channel depth	2 ft
Channel width	15 ft
Channel length	35 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 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, N1-L.

The calculations for the sediment load entering Structure N1-L were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.35
3. Slope Factor, LS 3.95
4. Cover Factor, C 0.223
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 N1-L and the results of the sediment inflow analysis are summarized in the following table.

N1-L STORAGE

Total Storage Capacity	5.02	acre-ft
10-year, 24-hour Storm Inflow	2.22	acre-ft
Available Sediment Storage Capacity . .	2.80	acre-ft
Sediment Inflow Rate	0.224	acre-ft/yr
Sediment Storage Life	12	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N1-L indicated that the only geotechnical problem is rill and gully erosion on the upstream and downstream slopes, the side slopes of the approach and spillway channel; and the bottom of approach channel. The downstream slope should be flattened to 4.0 horizontal to 1 vertical to meet stability requirements. Correction of erosion is considered a periodic maintenance task and does not require remedial action.

HYDRAULICS

The storage capacity and spillway capacity of Structure N1-L 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 N1-L

Plate 2 - Existing Maximum Cross Section N1-L, A-A'

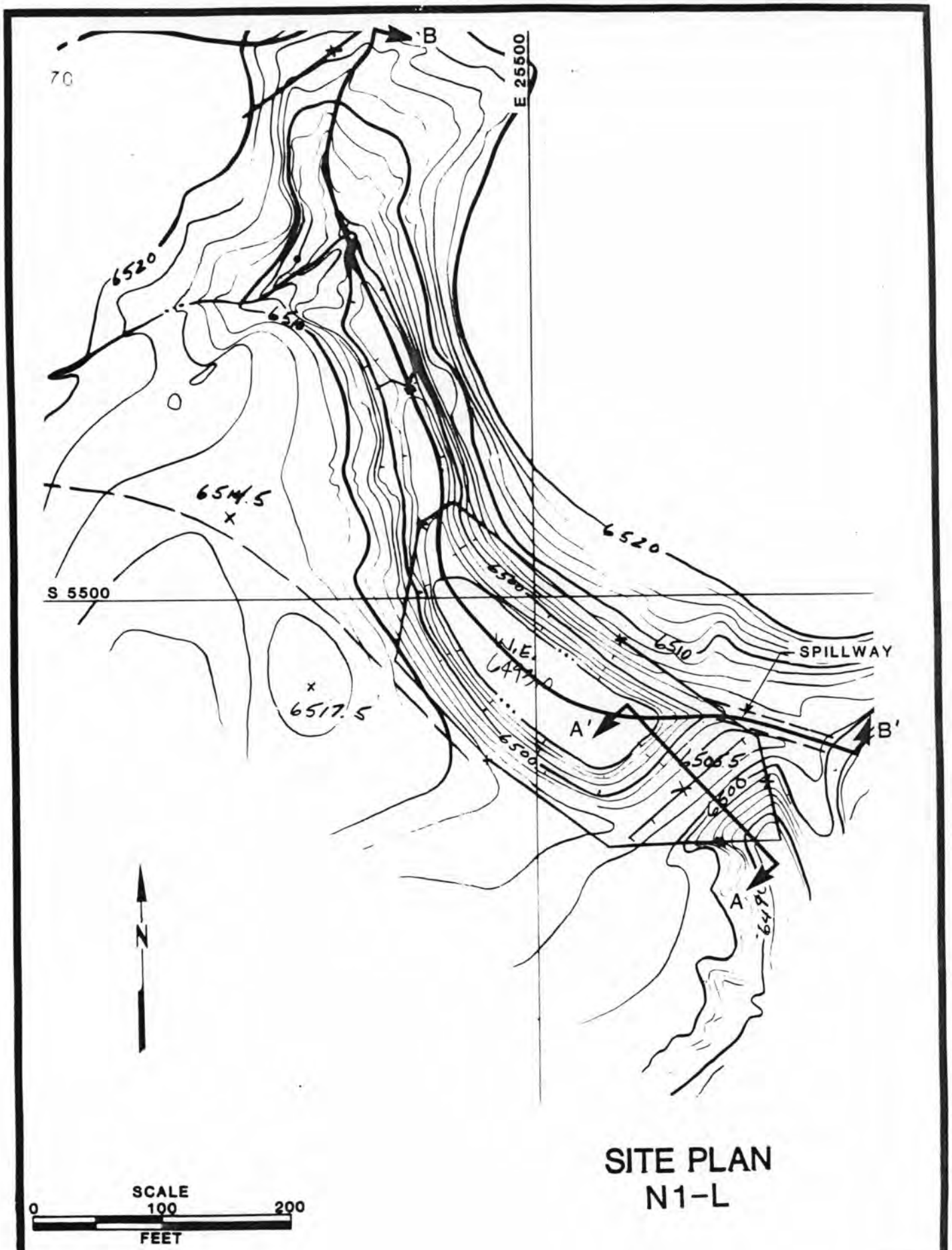
Plate 3 - Volume-Elevation Curve N1-L

Plate 4 - Channel Profile N1-L, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N1-L

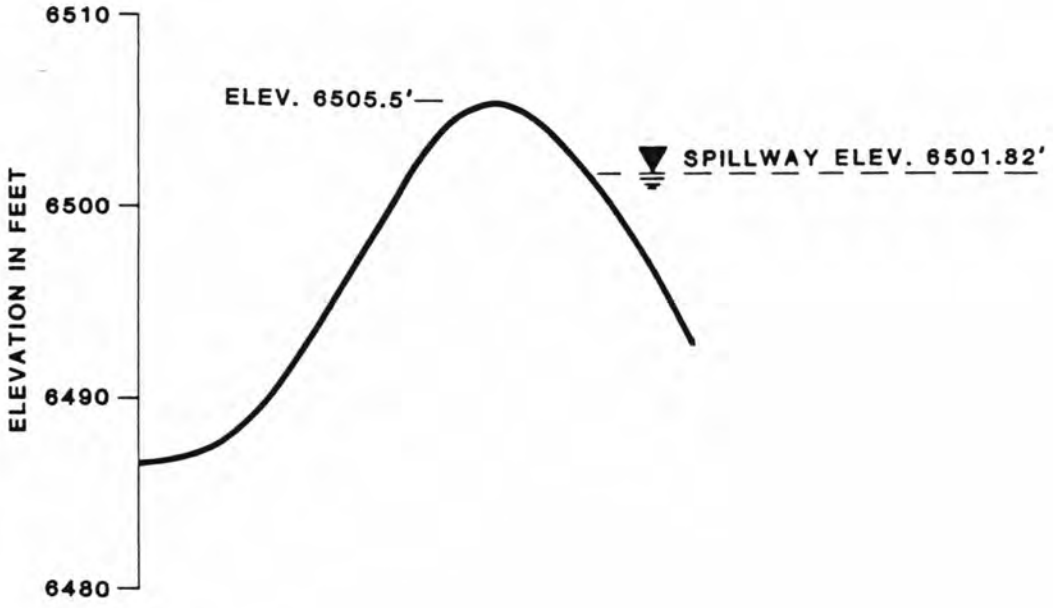
Appendix A - Inspection Check List

Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N1-L

BY **Dames & Moore** Plate 1

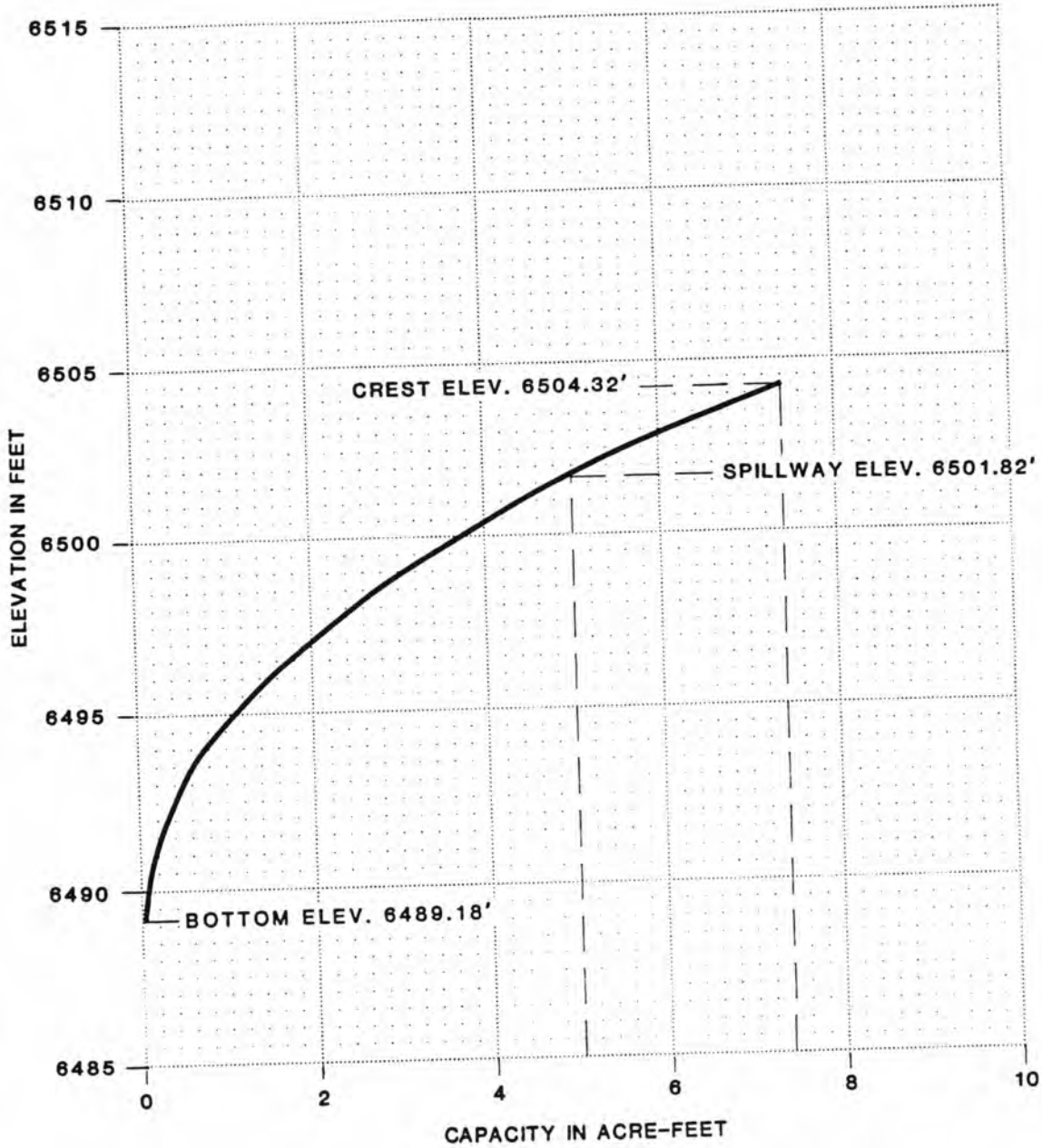


EXISTING MAXIMUM CROSS-SECTION A-A' N1-L

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

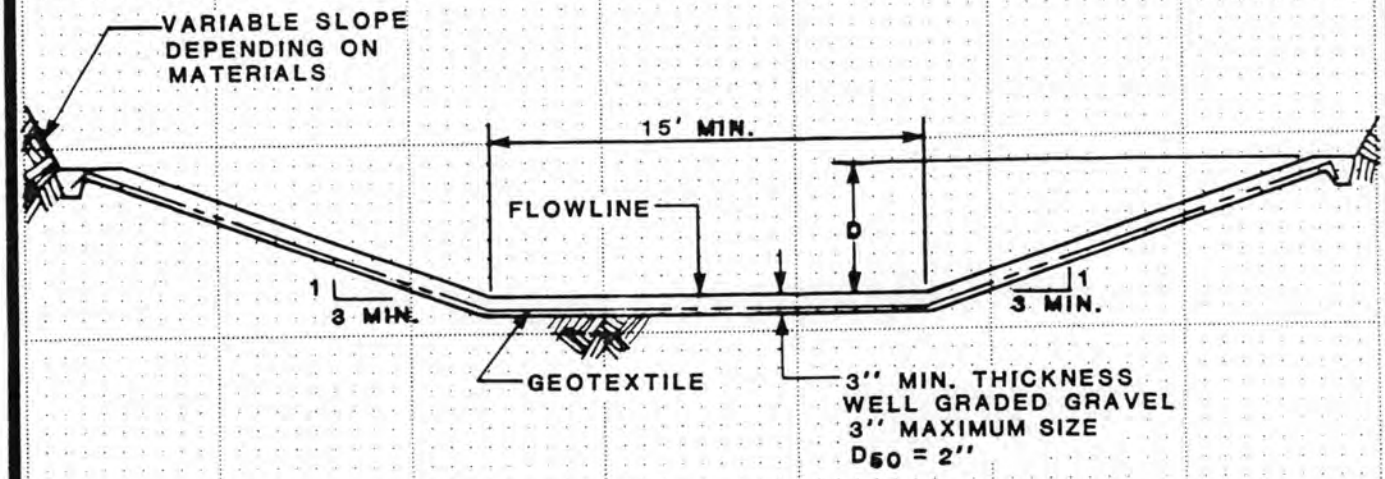
Plate 2



VOLUME-ELEVATION CURVE

N1-L

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.2'

LENGTH = 40'

FLOWLINE ELEV.= 6501.82'

OUTFLOW CHANNEL

D = 1.5'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N1-L

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N1-L
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			20' w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			18°
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?		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?		X	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?			Rock & brown SM

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?	X		
Right abutment?			
Crest of Embankments?			
b. Approach Channel:	X		UP Slope of Dam & LA width ← 10' →
Are side slopes eroding?	X		1 gulley
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		gulley
Obstructed?		X	
Erosion protection?		X	
c. Spillway Channel:	X		2' below Crest W 15 L 35
Are side slopes eroding?	X		Rills from Dam Slope 0°
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
d. Outflow Channel:			40' L 15' W Slope 2° then 40
Are side slopes eroding?		X	
Are side slopes sloughing?		X	
Bottom of channel eroding?	X		at exit gulley
Obstructed?		X	
Erosion protection?		X	
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?			(Elev.) feet
c. Siltation?			
d. Watershed matches soil map?		X	

9. GENERAL COMMENTS

Canopy Cover 5
Ground cover 95

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10137-01-[illegible]
SUBJECT SEDIMENT POND HYDROLOGY
N1-L
SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6585 − 6502 = 83 ft.

WATER COURSE LENGTH = 3.6(400) = 1440 ft. = 0.273 mi

$$T_c = \left(\frac{11.9\,(0.273)^3}{83}\right)^{0.385} = 0.106 \text{ hr.}$$

LAG TIME = $0.6T_c$ = 0.063 hr.

Note: USE MAX. T_c.
SEE BACK.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
14.0 (36%)	P-T	ave	use C	0.36(78) = 28.1
21.6 (55%)	Reclaimed (Post law)	-	C	0.55(81) = 44.6
3.6 (9%)	Haul Road	—	C	0.09(89) = 8.0
				80.7

PJ { EH #27 - B
EH #21 - C

USE 81

DRAINAGE BASIN AREA

39.2 ACRE 0.061 SQ MILE

BY S.P.A. DATE 7-10-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

FILE

SUBJECT SEDIMENT INFLOW

NIL

SHEET ___ OF ___

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 45% EH #21 .45(.27)
55% EH #35 .55(.42)
.35

K = .35

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft)	SLOPE (%)	LS
300	90	30%	13.78 (10%)
500	50	10%	3.06 (30%)
800	60	8%	2.81 (40%)
500	45	9%	2.64 (20%)

use 3.95

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
36%	P-J	40	25	(.14)(.36)
9%	disturbed	—	—	(1.0)(.09)
55%	reclaimed	—	—	(.55)(.15)

C = .223

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

EROSION CONTROL FACTOR

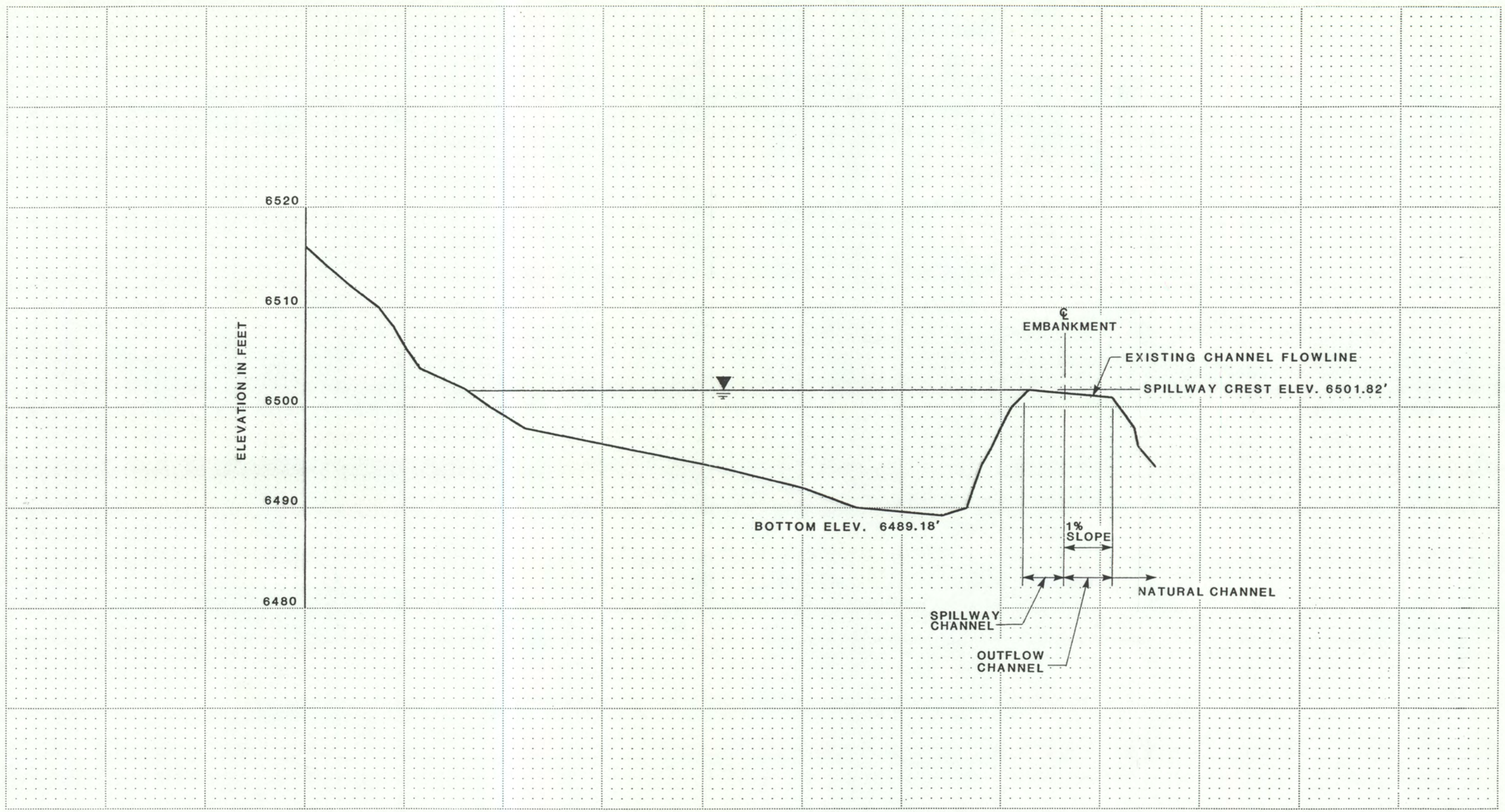
P = 1.0

SEDIMENT INFLOW

$A = 40(.35)(3.95)(.223)(1.0) = 12.33$ ton/acre/year

$A = (12.33)\left(\frac{1}{2047}\right)(39.2)(.95) = .224$ acre-feet/year

Dames & Moore



SCALE
0 100 200
FEET

CHANNEL PROFILE B-B'
N1-L

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

N1-M

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure N1-M is an earthen embankment, designed and constructed in 1980 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 N1-M is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N1-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 N1-M was inspected on September 6, 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 N1-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 N1-M has a 10.7-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 91% Pinion/Juniper and 9% disturbed.

EMBANKMENT

Structure N1-M is a homogeneous earthen embankment classified as a cross-valley embankment. Physical characteristics of the embankment are listed in the following table:

Structure N1-M

Embankment	Residual Sandstone Soils
Foundation	Alluvium
Right Abutment	Residual Sandstone Soils
Left Abutment	Residual Sandstone Soils
Height	6.9 ft
Crest Width	20 ft at right abutment 19 ft at left abutment
Upstream Slope	2.1 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 N1-M, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure N1-M is a category A-3 embankment. A standard category A-3 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 = 10 ft
2. Maximum upstream slope = 1.5 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N1-M 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 N1-M 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 N1-M was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.136	mi
2.	Elevation Difference, H	68	ft
3.	Time of Concentration, T_c	0.051	h
4.	Lag time, $0.6T_c$	0.031	h
5.	SCS Curve Number	80	
6.	Rainfall Depth, 10-year, 24-hour storm .	2.1	in.
	25-year, 6-hour storm. .	1.9	in.
7.	Drainage Area	10.7	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.

N1-M 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	14	17
Volume	acre-ft	0.59	0.46
Storage			
Peak Stage	ft	6520.78	--
Spillway Elevation . .	ft	6523.90	--
Peak Storage	acre-ft	0.59	--
Storage Capacity . . .	acre-ft	1.4	--
Outflow			
Peak Flow	cfs	0	3
Embankment Crest Elevation	ft	--	6525.10
Peak Stage	ft	--	6524.61
Freeboard	ft	--	0.50
Mannings "n"		--	0.040

Spillway Channel

The existing spillway for N1-M has a trapezoidal channel with the following dimensions:

Channel depth	1.8	ft
Channel width	5	ft
Channel length	20	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 N1-M has a trapezoidal channel with the following dimensions:

Channel width	5	ft
Channel length	75	ft
Side slopes (horizontal to vertical). .	2:1	
Average exit slope	3	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, N1-M.

The calculations for the sediment load entering Structure N1-M were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.26
3. Slope Factor, LS 3.50
4. Cover Factor, C 0.217
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 N1-M and the results of the sediment inflow analysis are summarized in the following table.

N1-M STORAGE

Total Storage Capacity	1.4	acre-ft
10-year, 24-hour Storm Inflow	0.59	acre-ft
Available Sediment Storage Capacity . .	0.81	acre-ft
Sediment Inflow Rate	0.040	acre-ft/yr
Sediment Storage Life	20	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N1-M indicated that the geotechnical problems consist of rill erosion on the upstream and downstream slopes and the side slopes of the spillway and outlet channel; and two tranverse cracks near the center of the embankment. 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 crack and replacing with compacted fill.

HYDRAULICS

The storage capacity of Structure N1-M is adequate but the spillway capacity is inadequate. The structure does not have an adequate outflow channel. The bottom elevation of the existing spillway channel should be lowered to elevation 6523.0 feet while maintaining the bottom width of 15 feet as shown on Plate 5. A trapezoidal outflow channel with the same bottom width as the spillway should be constructed along the alignment shown in Plate 1. The channel profile is shown in Plate 4 and 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.

Lowering the spillway elevation to 6523.0 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

N1-M HYDRAULICS FOR REDESIGNED SPILLWAY

	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	14	17
Volume	acre-ft	0.59	0.45
Storage			
Peak Stage	ft	6520.78	6523.79
Spillway Elevation . .	ft	6523.00	--
Peak Storage	acre-ft	0.59	--
Storage Capacity . . .	acre-ft	1.17	--
Available Sediment Storage Capacity . .	acre-ft	0.58	--
Sediment Inflow Rate .	acre-ft/yr	0.040	--
Sediment Storage Life.	yrs	14	--
Outflow			
Peak Flow	cfs	0	3
Embankment Crest Elevation	ft	--	6525.10
Peak Stage	ft	--	6523.79
Freeboard	ft	--	1.31
Spillway Channel			
Flow Depth	ft	--	0.79
Critical Velocity. . .	fps	--	1.8
Manning's "n"		--	0.035
Outflow Channel			
Slope	%	--	6
Normal Velocity. . . .	fps	--	2.11
Normal Depth	ft	--	0.09
Manning's "n"		--	0.035

* * *

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

Plate 1 - Site Plan N1-M

Plate 2 - Existing Maximum Cross Section N1-M, A-A'

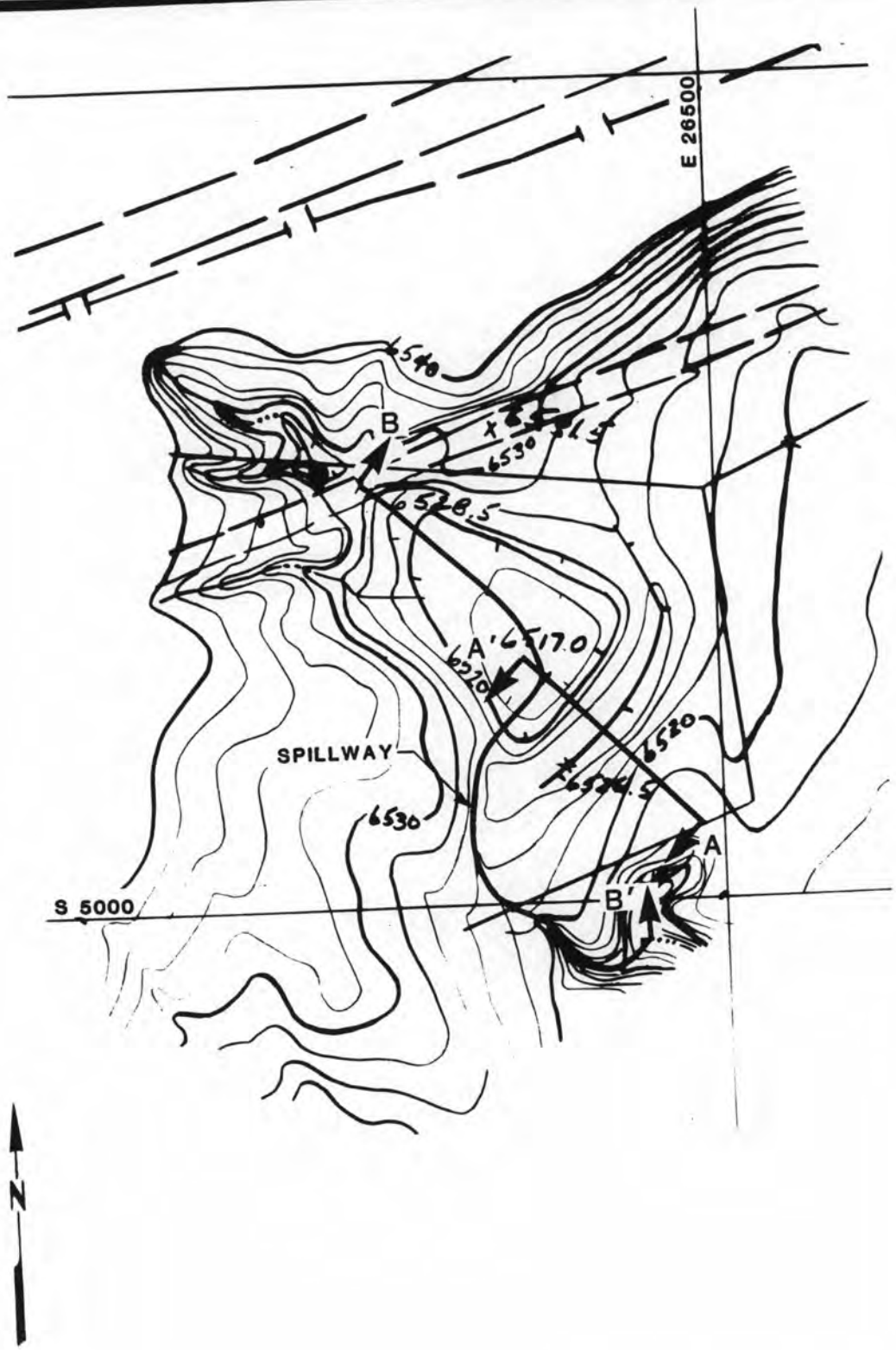
Plate 3 - Volume-Elevation Curve N1-M

Plate 4 - Channel Profile N1-M, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N1-M

Appendix A - Inspection Check List

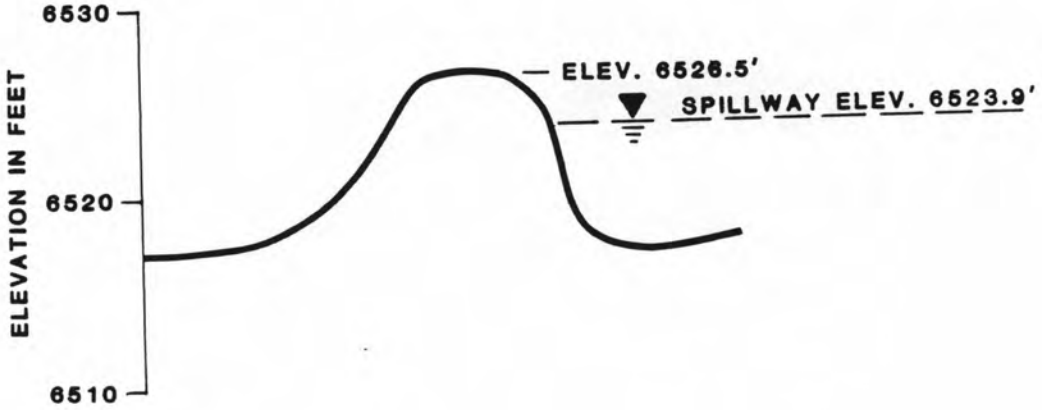
Appendix B - Hydrology and Hydraulic Calculations



SITE PLAN
N1-M

SCALE
0 100 200
FEET

BY **Dames & Moore** Plate 1

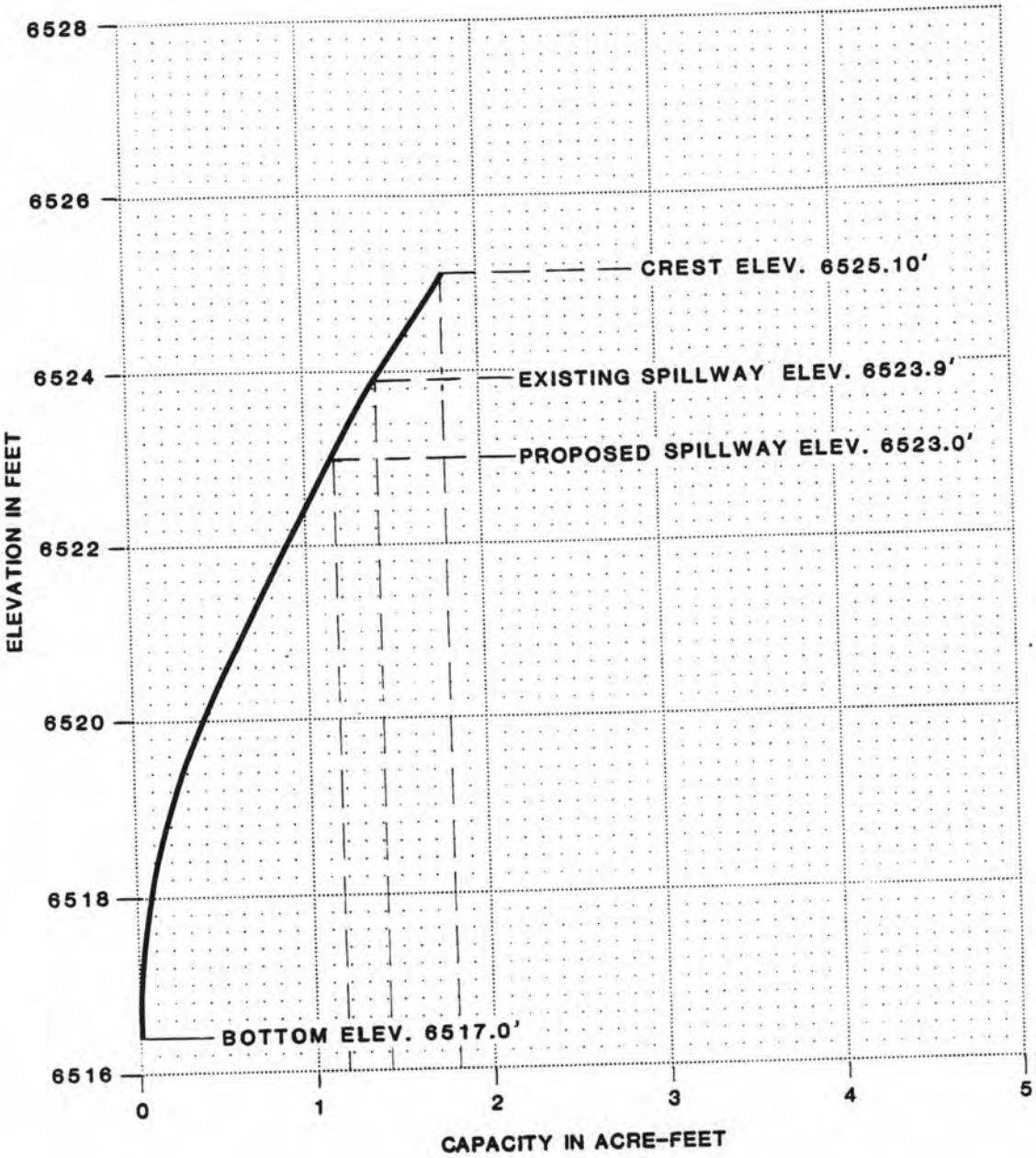


EXISTING MAXIMUM CROSS-SECTION A-A' N1-M

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

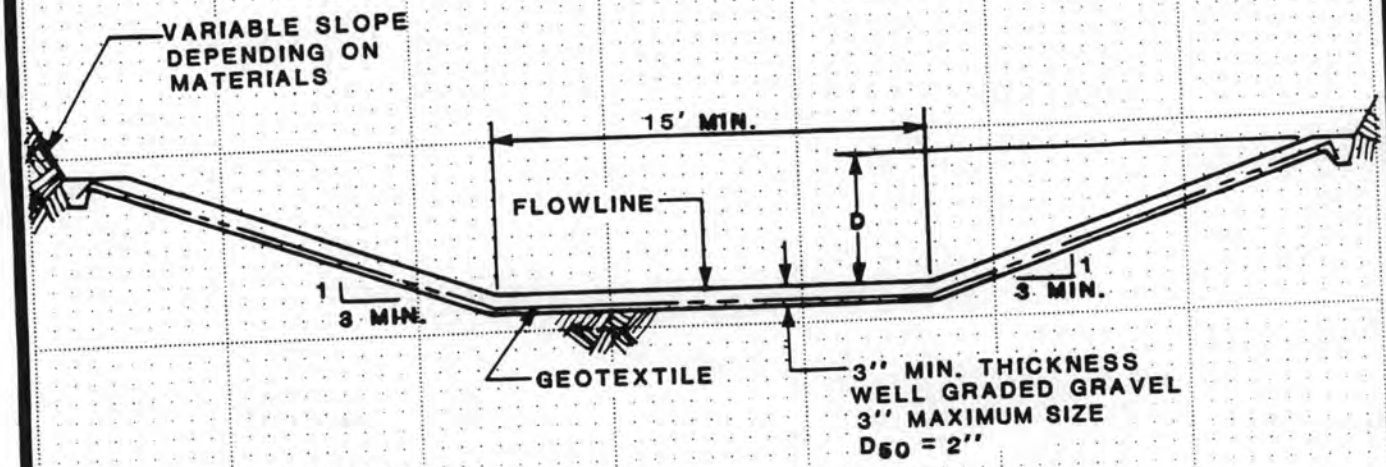
Plate 2



VOLUME-ELEVATION CURVE

N1-M

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 1.8'

LENGTH = 50'

FLOWLINE ELEV.= 6523.00'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N1-M

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

Sediment Impoundment Name: N1-M
Page: 4

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			20' towards RA 18' toward LA
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?	X		two transverse cracks ± middle of embankment 3" deep
2. UPSTREAM SLOPE			25°
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			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. 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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			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?			brown SM

Sediment Impoundment Name: N1 -M
Page: 5

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		
b. Approach Channel:		X	
Are side slopes eroding?			NA
Are side slopes sloughing?			
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		5' w. 20' L 0° Slope
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	Partial Grass
d. Outflow Channel:			5' w 75' L Slope 3%
Are side slopes eroding?	X		Rills
Are side slopes sloughing?		X	
Bottom of channel eroding?		X	
Obstructed?		X	
Erosion protection?		X	
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

Powerline road would block runoff momentarily

Two transverse cracks 1/2 way across crest starting from U.S. slope - 3" deep

Canopy 25°
Ground 85°

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO. 10139-011-22
SUBJECT SEDIMENT POND HYDROLOGY
N1-M SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6592 − 6524 = 68 ft.

WATER COURSE LENGTH = 1.8(400) = 720 ft. = 0.136 mi.

$$T_c = \left(\frac{11.9\ (0.136)^3}{68}\right)^{0.385} = 0.051 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.031 hr.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
1.0 (9%)	Haul Road	—	D	0.09(91) = 8.2
9.7 (91%)	P-J	ave.	C	0.91(78) = 71.0
			80% EH #21 20% EH #34	79.2
				USE 80

DRAINAGE BASIN AREA

10.7 ACRE 0.017 SQ MILE

BY S. DOLAN DATE 9-10-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE = 80% EH 21 .8(.27)
20% EH 34 .2(.22)
.26

K = .26

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
650 ft	70	11%	4.02 (60%)
400 ft	40	10%	2.74 (40%)

use 3.5

COVER FACTOR

AREA (ac.)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
9%	disturbed	—	—	.09 (1.0)
91%	P-J	40	25	.91 (.14)
				.218

BY ___ DATE ___ CHECKED BY ___ COPY TO EO ___

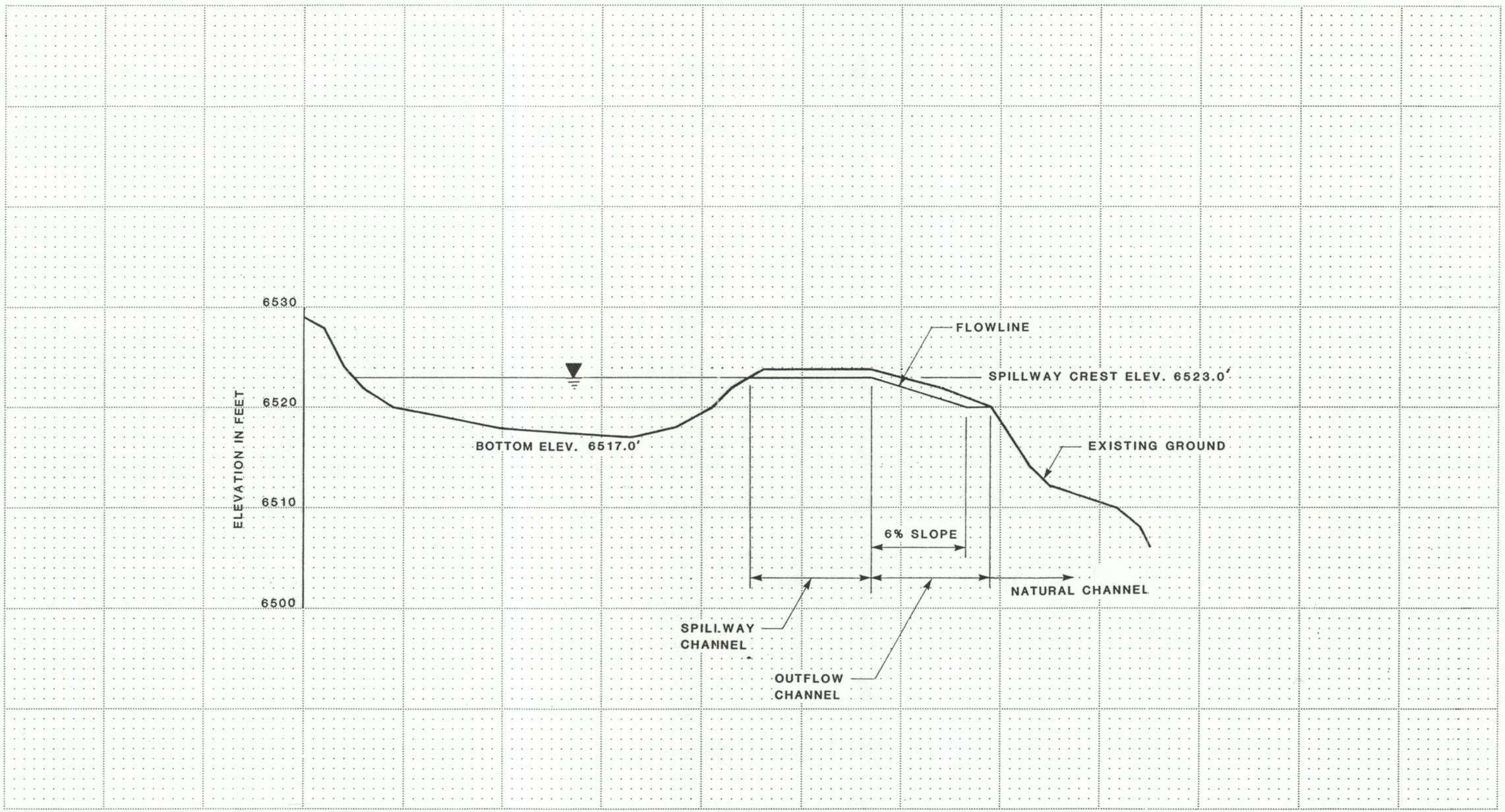
EROSION CONTROL FACTOR

P = 1.0

SEDIMENT INFLOW

$A = 40(.26)(3.5)(.218)(1.0) = 7.94$ ton/acre/year

$A = (7.94)\left(\frac{1}{2047}\right)(10.7)(.95) = 0.040$ acre-feet/year



SCALE
0 50 100
FEET

CHANNEL PROFILE B-B'
N1-M

FOR LOCATION SEE PLATE 1

BY **Dames & Moore** Plate 4

INSPECTION REPORT

Sedimentation Structure

N1-O

Kayenta Mine

Navajo County, Arizona

for

PEABODY COAL COMPANY

Dames & Moore
10139-011-22

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APPENDIX A - INSPECTION CHECK LIST

APPENDIX B - HYDROLOGY AND HYDRAULIC CALCULATIONS

INTRODUCTION

Sedimentation Structure N1-O is an earthen embankment, designed and constructed in 1982 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 N1-O is shown on Plate 1, Site Plan.

This inspection report contains information specific to Structure N1-O. 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 N1-O was inspected on September 6, 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 N1-O 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 N1-O has a 116.4-acre tributary drainage area and is located near Coal Mine Wash at the Kayenta Mine. The watershed is classified as 87% reclaimed and 13% disturbed.

EMBANKMENT

Structure N1-O is a homogeneous earthen embankment classified as a in-wash embankment. Physical characteristics of the embankment are listed in the following table:

Structure N1-O

Embankment	Alluvium
Foundation	Alluvium
Right Abutment	Residual Shale
Left Abutment	Alluvium
Height	9.1 ft
Crest Width	18 ft
Upstream Slope	3.1 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 N1-O, A-A'. Grass provides erosion protection on the upstream and downstream slopes of the embankment.

ANALYSES

STABILITY

Structure N1-O is a category C-1 embankment. A standard category C-1 embankment has static and seismic factors of safety of 1.5 and 1.2, respectively, under the following conditions:

1. Maximum height = 10 ft
2. Maximum upstream slope = 1.5 H : 1 V
3. Maximum downstream slope = 2.5 H : 1 V
4. Normal pool with steady seepage saturation conditions

The N1-O 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 N1-O 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 N1-O was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	0.318	mi
2.	Elevation Difference, H	98	ft
3.	Time of Concentration, T_c	0.118	h
4.	Lag time, $0.6T_c$	0.071	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	116.4	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.

N1-O 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	143	190
Volume	acre-ft	7.66	6.11
Storage			
Peak Stage	ft	6522.43	6524.99
Spillway Elevation . .	ft	6523.80	--
Peak Storage	acre-ft	7.66	—
Storage Capacity . . .	acre-ft	10.88	--
Outflow			
Peak Flow	cfs	0	36
Embankment Crest Elevation	ft	--	6525.80
Peak Stage	ft	--	6524.99
Freeboard	ft	--	0.81

Spillway Channel

The existing spillway for N1-O has a U-shaped channel with the following dimensions:

Channel depth	1 ft
Channel width	30 ft
Channel length	18 ft
Average exit slope	0 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, N1-O.

The calculations for the sediment load entering Structure N1-O were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.394
3. Slope Factor, LS 2.86
4. Cover Factor, C 0.261
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 N1-O and the results of the sediment inflow analysis are summarized in the following table.

N1-O STORAGE

Total Storage Capacity	10.88	acre-ft
10-year, 24-hour Storm Inflow	7.66	acre-ft
Available Sediment Storage Capacity . .	3.32	acre-ft
Sediment Inflow Rate	0.602	acre-ft/yr
Sediment Storage Life	5	yrs

REMEDIAL COMPLIANCE PLAN

GEOTECHNICS

The inspection of Structure N1-O indicated that there are no geotechnical problems.

HYDRAULICS

The storage capacity of Structure N1-O is adequate but the spillway capacity is inadequate. The structure does not have an outflow channel. The bottom elevation of the existing spillway channel should be lowered to elevation 6523.5 feet while maintaining the bottom width of 30 feet as shown on Plate 5. A trapezoidal outflow channel with the same bottom width as the spillway should be constructed along the alignment shown in Plate 1. The channel profile is shown in Plate 4 and required dimensions are shown in Plate 5. Both the spillway and outflow channel should be protected against erosion using geotextile and riprap as shown in Plate 5.

Lowering the spillway elevation to 6523.5 feet decreases the storage capacity and increases the freeboard. The analysis of these conditions is summarized in the following table.

N1-O HYDRAULICS FOR REDESIGNED SPILLWAY

	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		190
Volume	acre-ft		
Storage			
Peak Stage	ft	6522.43	6524.72
Spillway Elevation . .	ft	6523.50	--
Peak Storage	acre-ft	7.66	—
Storage Capacity . . .	acre-ft	10.21	--
Available Sediment Storage Capacity . .	acre-ft	2.55	--
Sediment Inflow Rate .	acre-ft/yr		--
Sediment Storage Life.	yrs	4	—
Outflow			
Peak Flow	cfs	--	40
Embankment Crest Elevation	ft	--	6525.80
Peak Stage	ft	--	6524.72
Freeboard	ft	--	1.08
Spillway Channel			
Flow Depth	ft	--	1.22
Critical Velocity. . .	fps	--	3.4
Manning's "n"		--	0.040
Outflow Channel			
Slope	%	--	33
Normal Velocity. . . .	fps	--	7.0
Normal Depth	ft	--	0.19
Manning's "n"		--	0.040

* * *

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

Plate 1 - Site Plan N1-O

Plate 2 - Existing Maximum Cross Section N1-O, A-A'

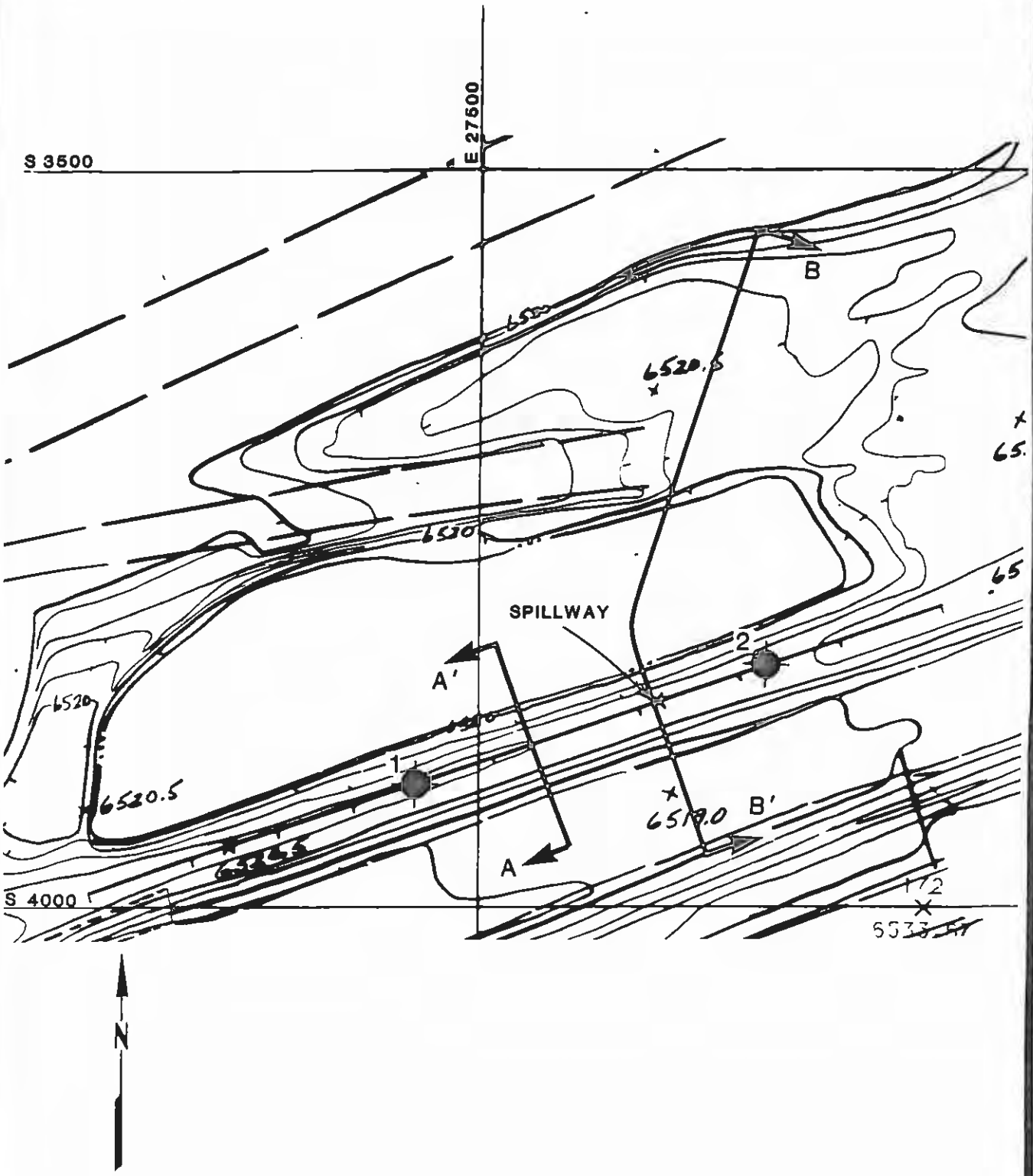
Plate 3 - Volume-Elevation Curve N1-O

Plate 4 - Channel Profile N1-O, B-B'

Plate 5 - Spillway and Outflow Channel Cross Section N1-O

Appendix A - Inspection Check List

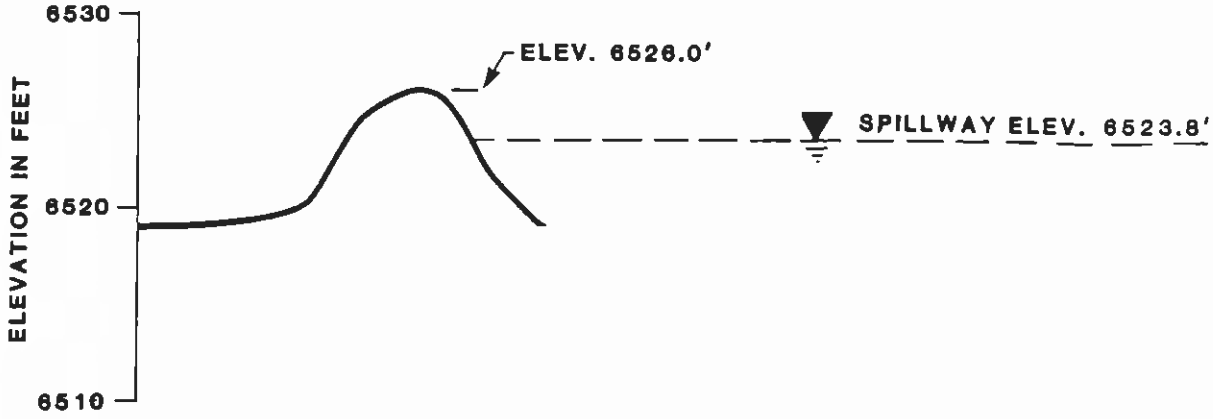
Appendix B - Hydrology and Hydraulic Calculations



SCALE
0 100 200
FEET

SITE PLAN
N1-O

BY **Dames & Moore** Plate 1

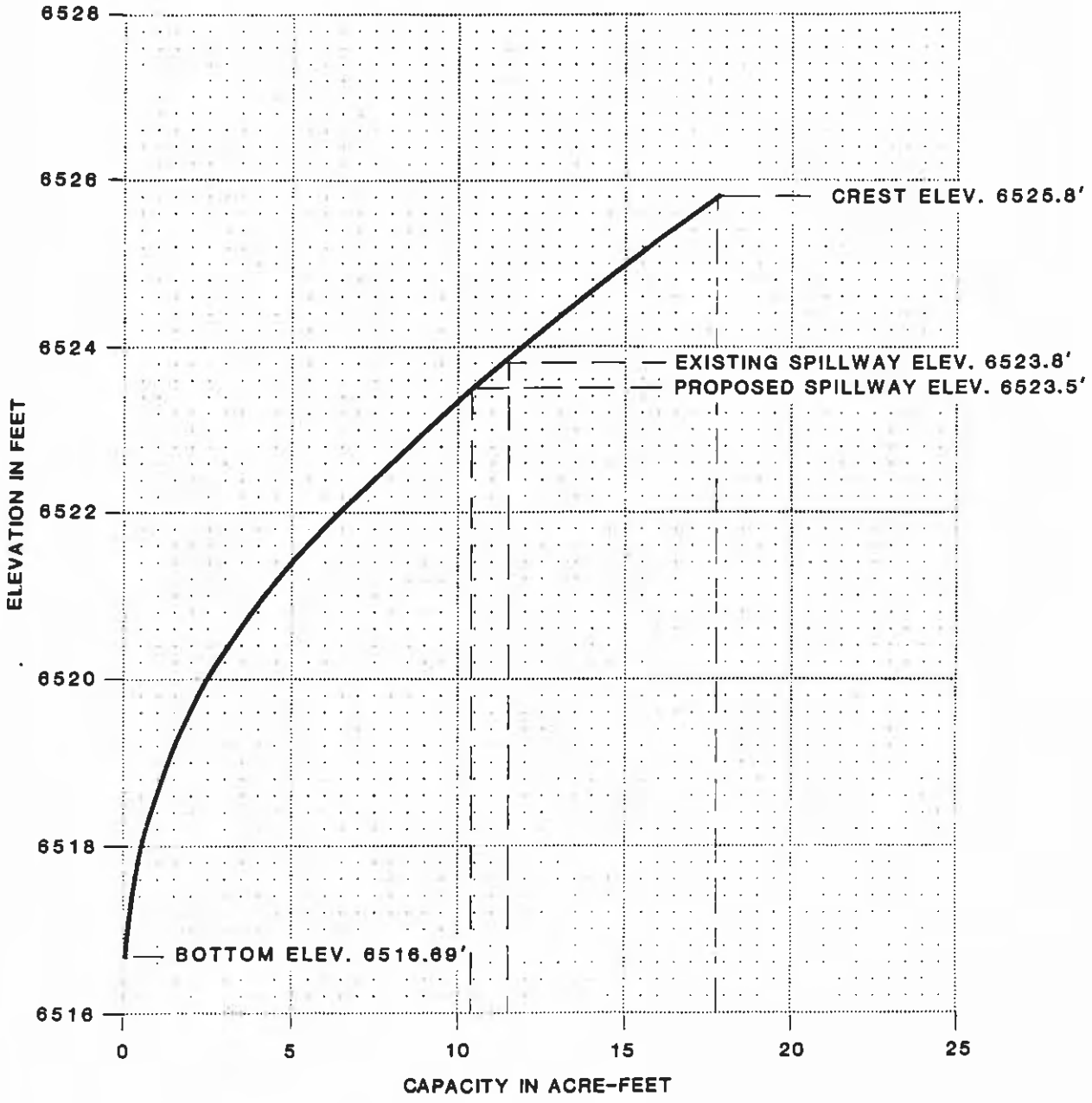


EXISTING MAXIMUM CROSS-SECTION A-A' N1-O

FOR LOCATION SEE PLATE 1

BY **Dames & Moore**

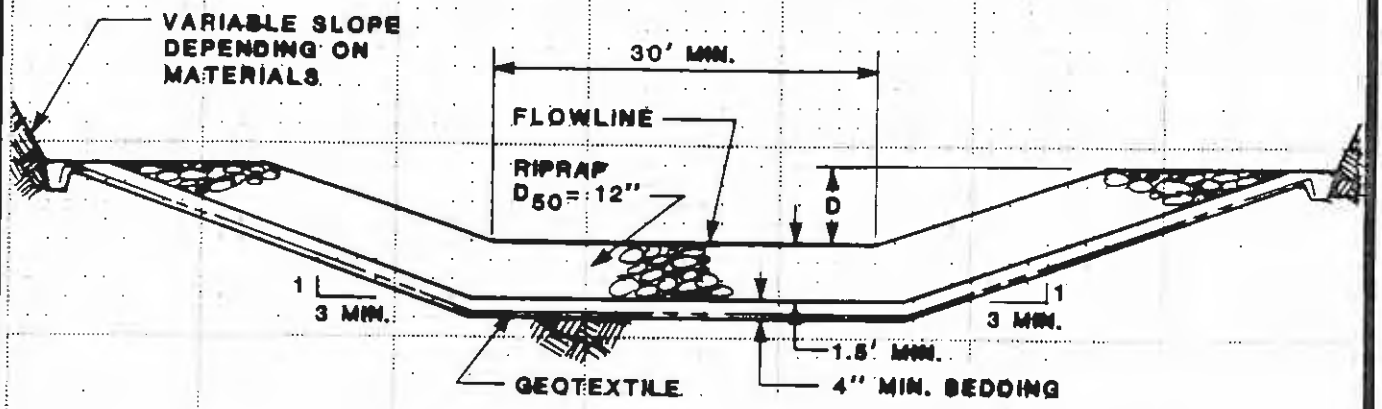
Plate 2



VOLUME-ELEVATION CURVE

N1-O

BY **Dames & Moore** Plate 3



SPILLWAY CHANNEL

D = 2.3'

LENGTH = 30'

FLOWLINE ELEV. = 6523.5'

OUTFLOW CHANNEL

D = 1'

SPILLWAY AND OUTFLOW CHANNEL CROSS SECTION N1-O

BY **Dames & Moore** Plate 5

APPENDIX A

INSPECTION CHECK LIST

INSPECTION CHECK LIST

ITEM	YES	NO	REMARKS
1. CREST			18' w
a. Any visual settlements?		X	
b. Misalignment?		X	
c. Cracking?		X	
2. UPSTREAM SLOPE			18°
a. Adequate grass cover?	X		80
b. Any erosion?		X	
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?			N/A
h. Visual depressions or bulges?		X	
i. Visual settlements?		X	
j. Animal burrows?		X	
3. DOWNSTREAM SLOPE			18°
a. Adequate grass cover?	X		80
b. Any erosion?		X	
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	
b. Visual differential movement?		X	
c. Any cracks noted?		X	
d. Is seepage present?		X	
e. Type of Material?			brown silt
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?			brown silt

ITEM	YES	NO	REMARKS
6. SPILLWAY/NORMAL			
a. Location:			
Left abutment?			
Right abutment?			
Crest of Embankments?	X		
b. Approach Channel:		X	
Are side slopes eroding?			
Are side slopes sloughing?			
Bottom of channel eroding?			NA
Obstructed?			
Erosion protection?			
c. Spillway Channel:	X		Not well defined ≈ 1' below crest ∞ slope 30' W 18' L
Are side slopes eroding?		X	
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?			NA
Bottom of channel eroding?			
Obstructed?			
Erosion protection?			
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?			

Sediment Impoundment Name: N1-O
Page: 6

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

SPILLWAY POORLY DEFINED - NEEDS WORK - GRADING

Canopy Cover 5 %
Ground Cover 80 %

APPENDIX B

HYDROLOGY AND HYDRAULIC CALCULATIONS

FILE PEABODY COAL CO 10139-011-23
SUBJECT SEDIMENT POND HYDROLOGY
N1-0 SHEET ___ OF ___

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

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6623 − 6525 = 98 ft.

WATER COURSE LENGTH = 4.2(400) = 1680 ft. = 0.318 mi.

$$T_c = \left(\frac{11.9\ (0.318)^3}{98}\right)^{0.385} = 0.118 \text{ hr.}$$

LAG TIME = $0.6 T_c$ = 0.071 hr.

Note: SEE CALCULATIONS ON BACK.

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
(87%)	post law RECLAIM	fair	D	(81)(.87)
(13%)	ROAD		D	(91)(.13)
				82.3
			90% EH #31 - D	
			10% EH #35 - D	

use 83

DRAINAGE BASIN AREA

116.4 ACRE 0.182 SQ MILE

BY S. DOLAN DATE 9-16-85
CHECKED BY ___
COPY TO EO ___

Dames & Moore

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

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

R = 40

SOIL ERODIBILITY FACTOR

SOIL TYPE =	87%	reclaimed	.87(.42)
	13%	#34	.13(.22)
			.394

K = 0.394

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS	
1440	90	6.2	2.68	35%
550	40	7.3	2.06	20%
400	80	20.0	8.16	10%
2200	90	4.1	1.33	25%
300	40	13.3	3.68	10%

use 2.86

COVER FACTOR

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
87%	reclaimed	—	—	.87(.15)
13%	disturbed	—	—	.13 (1.0)
				C = .261

EROSION CONTROL FACTOR

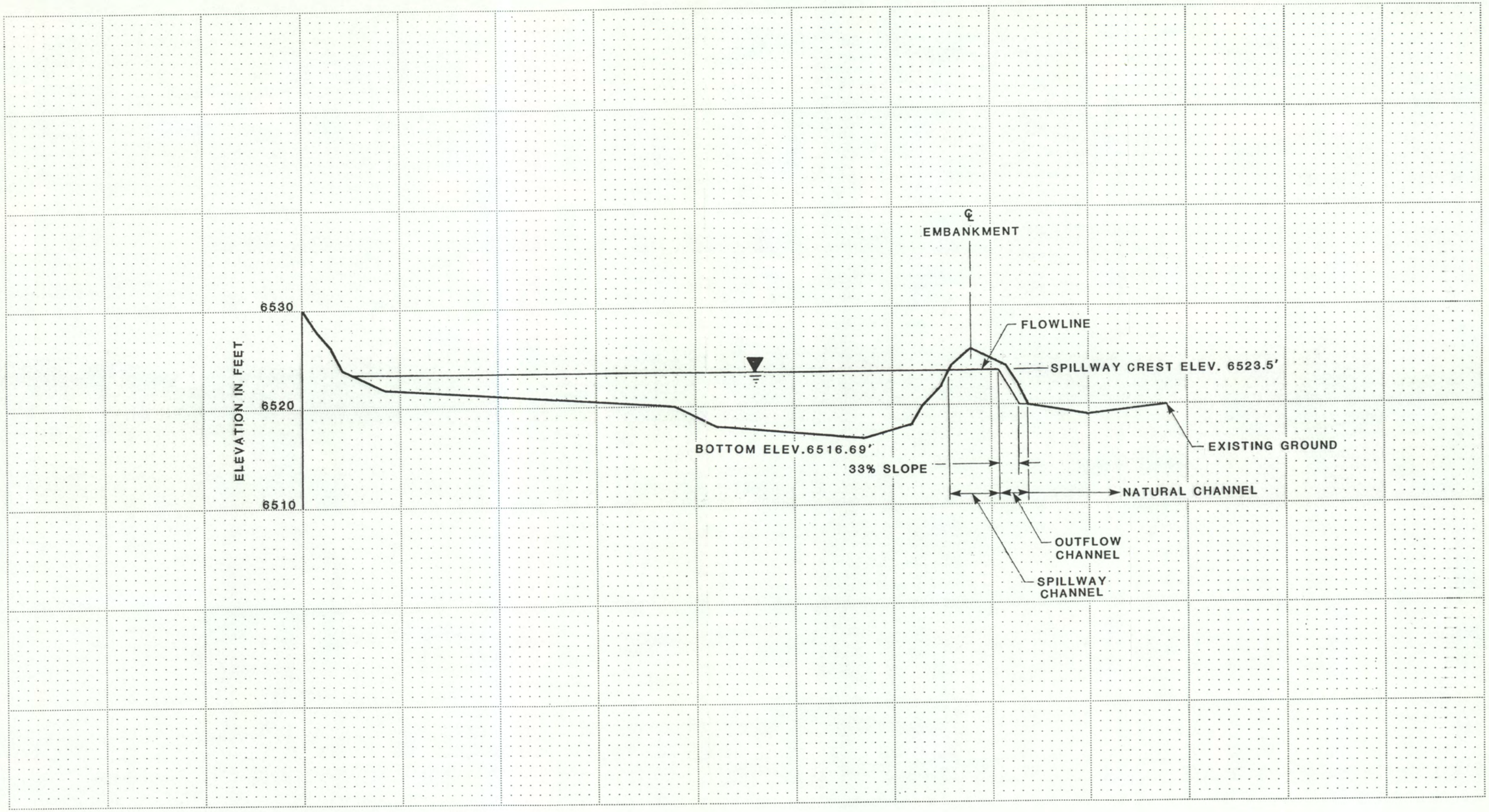
P = 1.0

SEDIMENT INFLOW

$$A = 40(.394)(2.86)(.261)(1.0) = 11.76 \quad \text{ton/acre/year}$$

$$A = 11.76(116.4)\left(\frac{1}{2047}\right)(.9) = .602 \quad \text{acre-feet/year}$$

BY ___ DATE ___
CHECKED BY ___
COPY TO EO ___

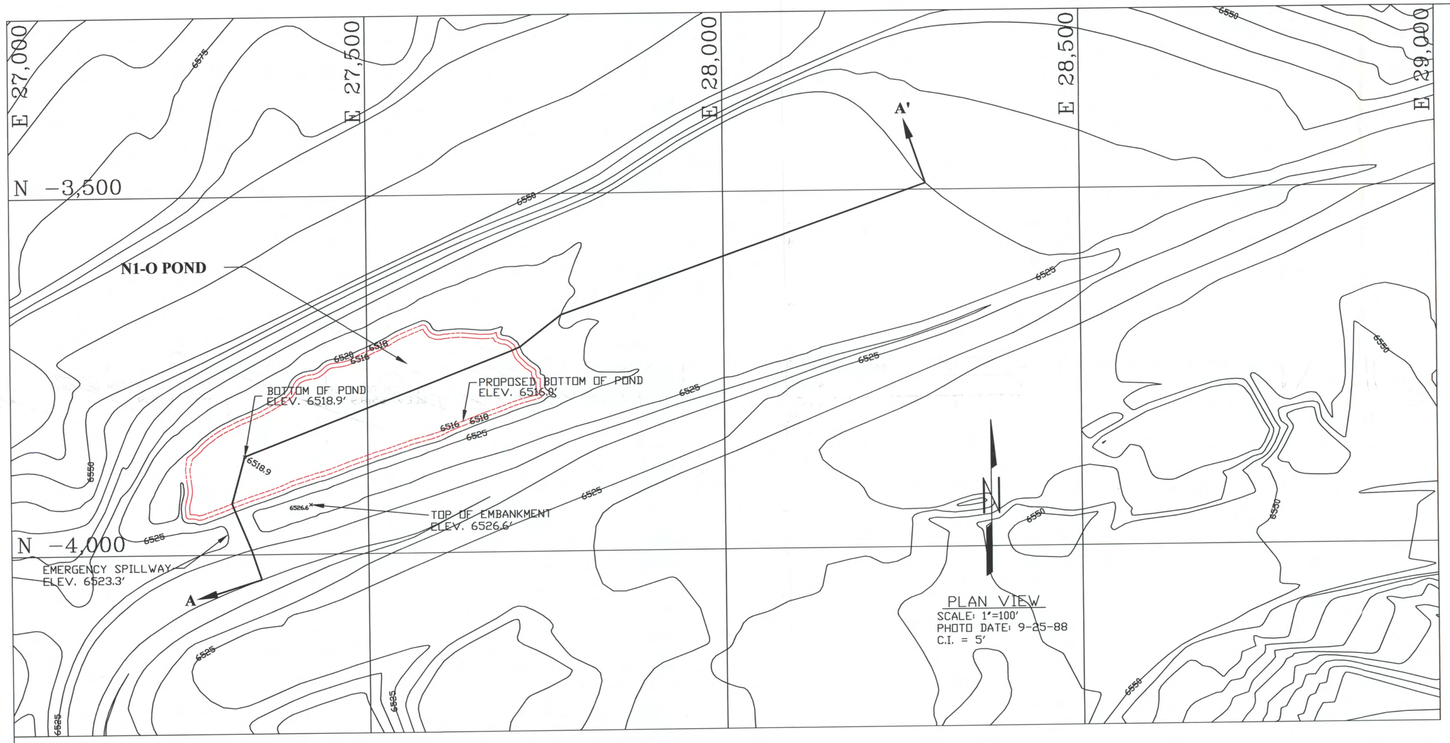


SCALE
0 50 100
FEET

CHANNEL PROFILE B–B'
N1–0

FOR LOCATION SEE PLATE 1

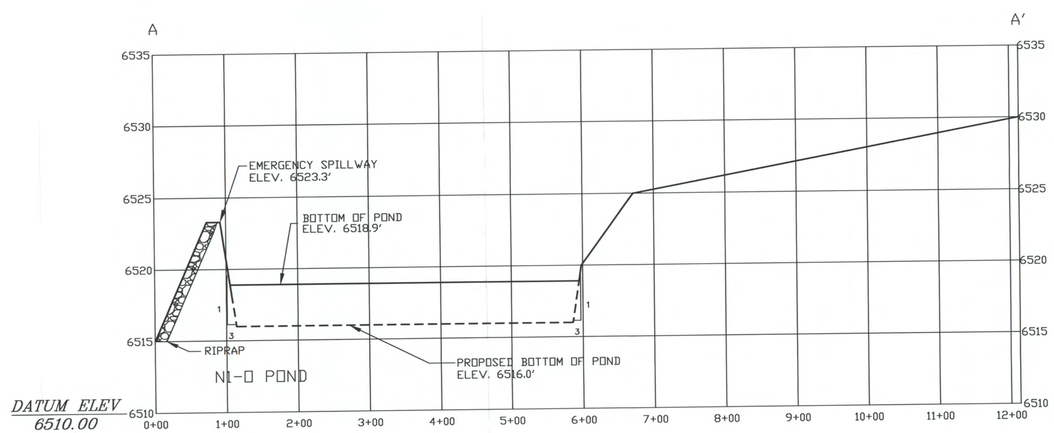
BY **Dames & Moore** Plate 4



PLAN VIEW
SCALE: 1"=100'
PHOTO DATE: 9-25-88
C.I. = 5'

N1-O POND STAGE CAPACITY

ELEV. (FT.-MSL)	STAGE (FT.)	AREA (ACRES)	CAPACITY (AC.-FT.)	TOTAL CAPACITY (AC.-FT.)	DESCRIPTION
6516.0	0.0	1.29	0.00	0.00	BOTTOM OF POND
6518.0	2.0	1.46	2.75	2.75	
6520.0	4.0	1.69	3.15	5.90	
6523.3	7.3	2.44	6.81	12.71	EMERGENCY SPILLWAY
6525.0	9.0	2.82	4.47	17.19	
6526.6	10.6	4.17	5.59	22.78	TOP OF EMBANKMENT



PROFILE SECTION A-A'
SCALE: HORIZ. 1"=100'
VERT. 1"=5'

ENGINEER'S CERTIFICATION

REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO. 37842
GARY ALTSISI
DATE SIGNED 2-15-11
ARIZONA, U.S.A.
Expires 9/30/2011

Gary Altsisi
Reclamation Supervisor
Peabody Western Coal Company

Arizona P.E. 37842

JUL 2011
APPROVED

EXHIBIT #1
N1-O POND
REMEDIAL DESIGN

KAYENTA MINE
PEABODY WESTERN P.O. BOX 650 KAYENTA, AZ 86033

DESIGNED BY: G.A.	SCALE: AS SHOWN
DRAWN BY: G.A.	DRAWING DATE: 2-10-11
CHECKED BY: G.A.	PHOTO DATE: 6-1-95
CONTOUR INTERVAL: 2'	DWG FILE: N1-O REMEDIAL FEB 2011.DWG