

DESIGN REPORT
Sedimentation Structure
N5-G
Black Mesa Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N5-G will be an incised structure with an earthen embankment, designed and constructed by Peabody Coal Company as a temporary sedimentation structure to control runoff and sediment from the disturbed mining areas of the Black Mesa Mine. The location of Structure N5-G is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N5-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

The proposed site of Structure N5-G was inspected by a senior geotechnical engineer from Dames & Moore in October, 1985 to ensure that the site is suitable and no adverse conditions exist to prevent the successful construction of the structure. A detailed geotechnical investigation was not performed.

SITE DESCRIPTION

LAND USE

Structure N5-G has a 542.02-acre tributary drainage area and is located near Coal Mine Wash at the Black Mesa Mine. The watershed is classified as 96% Pinion/Juniper and 4% Sagebrush/grass.

EMBANKMENT

A homogeneous earthen embankment was assumed for the hydraulic analysis and to develop the volume-elevation curve shown on Plate 2. Upstream and downstream slopes of 2:1 and 3:1 (horizontal to vertical), respectively, were used. The assumed slopes were not evaluated for geotechnical considerations such as slope stability since the foundation or embankment material types have not been determined. The incised portion of the structure will be excavated at 3:1 (horizontal to vertical) slopes.

DESIGN ANALYSES

GENERAL

Structure N5-G was designed by an interdisciplinary team of engineers from Dames & Moore. The design was performed in accordance with applicable 30 CFR 780 and 816 regulations of the United States Department of Interior, Office of Surface Mining (OSM) and included a review of available project files. The most current information contained in the Peabody Coal

Company files includes topographic maps developed from aerial photography flown in 1983 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure N5-G will be chosen based on the stability analyses performed for existing structures in the General Report. The embankment fill materials and the type of foundation will be identified in the field and the stable slopes chosen based on the category classification of the structure.

HYDROLOGY

The hydrologic analysis was completed using the U.S. Army Corps of Engineers generalized computer program HEC-1, Flood Hydrograph Package. Structure N5-G is located downstream from Structure N5-A1 and upstream from Structure N5-A. Structures N5-G and N5-A1 have a combined active storage capacity that is less than 20 acre-feet. Therefore, the spillway for N5-G was analyzed using the 25-year, 6-hour storm. The storage capacity of Structure N5-G was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1.	Water Course length, L	1.06	mi
2.	Elevation Difference, H	185	ft
3.	Time of Concentration, T_c	0.372	h
4.	Lag time, $0.6T_c$	0.223	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	346.7	acres

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned sedimentation structure, outflow from the structure and the resulting water surface elevations. The 10-year, 24-hour storm was routed through Structure N5-A1 located upstream and into N5-G. The 100-year, 6-hour storm was analyzed without Structure N5-A1. The initial conditions and results of the analysis are summarized in the following table.

Structure N5-A1 will be replaced by Structure N5-A2 when mining approaches N5-A1 and requires its removal.

N5-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	247	237
Volume	acre-ft	18.78*	14.74*
Storage			
Peak Stage	ft	6472.07	--
Spillway Elevation . .	ft	6471.00	--
Peak Storage	acre-ft	--	--
Storage Capacity . . .	acre-ft	9.17	--
Outflow			
Peak Flow	cfs	38	220
Embankment Crest			
Elevation	ft	--	6474.00
Peak Stage	ft	--	6472.98
Freeboard	ft	--	1.02
Spillway Channel			
Flow Depth	ft	--	1.98
Critical Velocity. . .	fps	--	5.1
Manning's "n"		--	0.030
Outflow Channel			
			<u>Section I</u> <u>Section II</u>
Slope	%	--	4 33
Normal Velocity. . . .	fps	--	6.0 12.7
Normal Depth	ft	--	1.04 0.60
Manning's "n"		--	0.040 0.040

*Inflow volume for tributary drainage area between Structures N5-G and N5-A1.

Spillway Channel

The spillway for N5-G will be a trapezoidal channel with the following dimensions:

Channel depth	4.0 ft
Channel width	20 ft
Channel length	30 ft
Side slopes (horizontal to vertical). .	15:1
Average exit slope	0 percent

Outflow Channel

The outflow channel for Structure N5-G will be a trapezoidal channel with the following dimensions:

Channel width	3.0 ft
Channel length	70 ft
Side slopes (horizontal to vertical). .	3:1
Average exit slope	4-33 percent

The alignment of the spillway and outflow channel are shown on Plate 1. The channel profile is shown on Plate 3 and the required dimensions are shown on Plate 4. Both the spillway and outflow channel should be protected against erosion using geotextile and riprap as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, N5-G is based on site specific topographic data developed for Peabody Coal Company in 1985, and 1985 site specific surveys, where available.

The calculations for the sediment load entering Structure N5-G were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.42
3. Slope Factor, LS 2.14
4. Cover Factor, C 0.15
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. Structure N5-G does not have sufficient storage capacity by itself. Therefore, the storage capacity was analyzed in combination with Structures N5-A1 located upstream and N5-A located downstream. The results of the combined sediment inflow analysis are presented in the following table.

COMBINED STORAGE FOR STRUCTURES N5-A1, N5-G, AND N5-A

	N5-A1	N5-G	N5-A	N5-G & N5-A Combined	
Total Storage Capacity	12.48	9.17	13.20	22.37	acre-ft
10-year, 24-hour Storm Inflow . .	7.32	18.78	0.54	19.32	acre-ft
Available Sediment					
Storage Capacity	5.16	--	--	3.05	acre-ft
Sediment Inflow Rate	0.53	1.07	0.025	1.09	acre-ft/yr
Sediment Storage Life	10	--	--	3	yrs

* * *

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

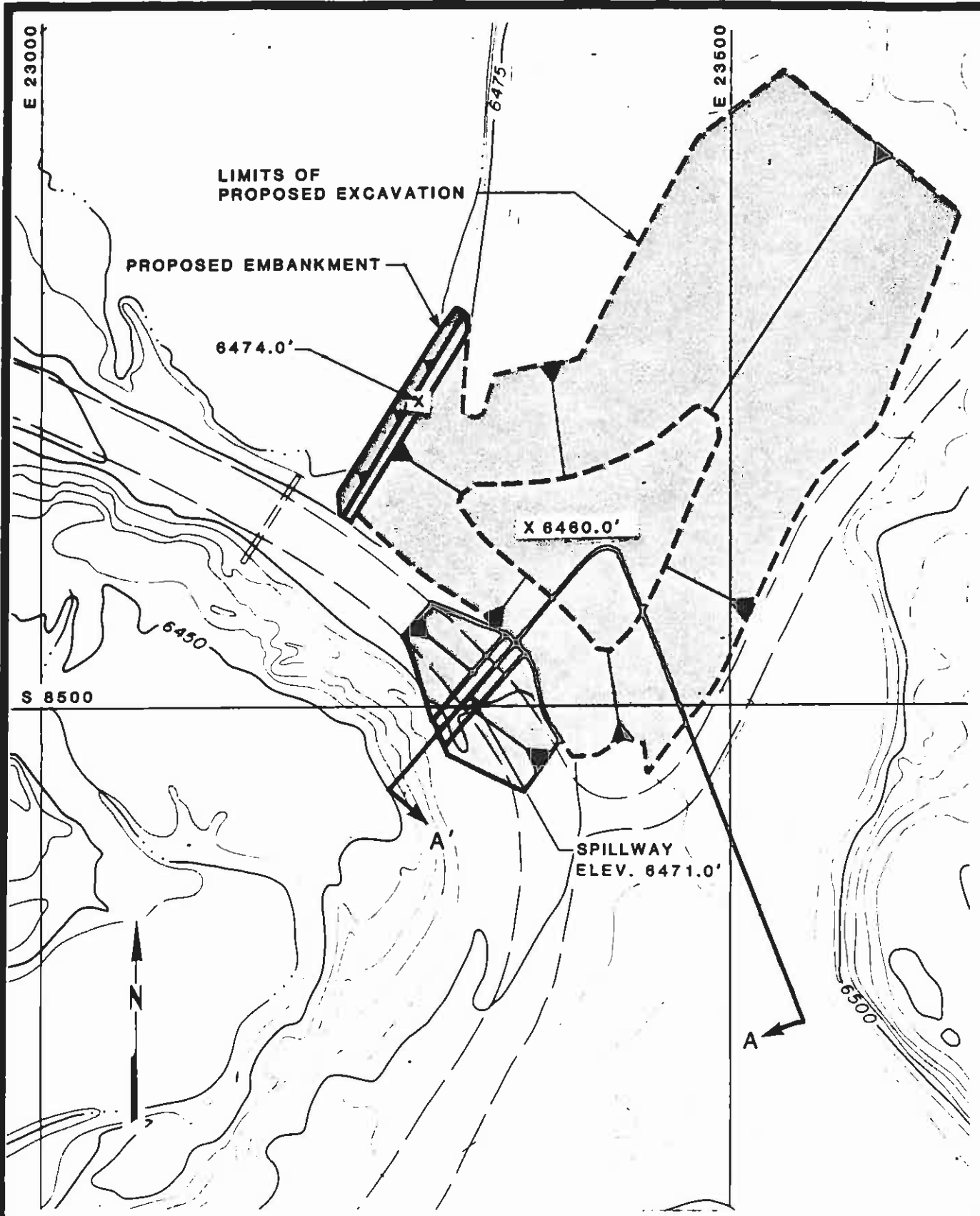
Plate 1 - Site Plan N5-G

Plate 2 - Volume-Elevation Curve N5-G

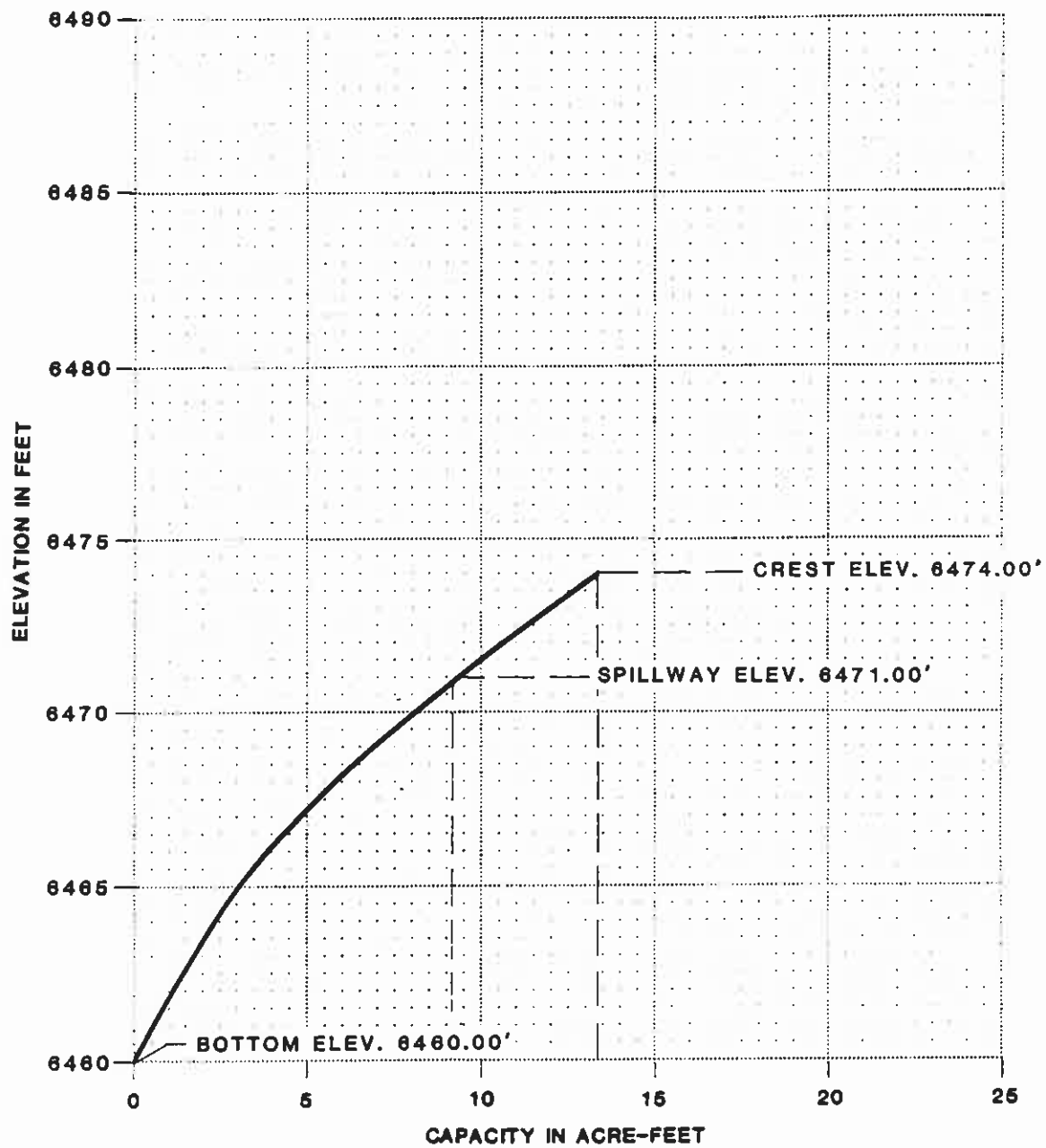
Plate 3 - Channel Profile N5-G, A-A'

Plate 4 - Spillway and Outflow Channel Cross Section N5-G

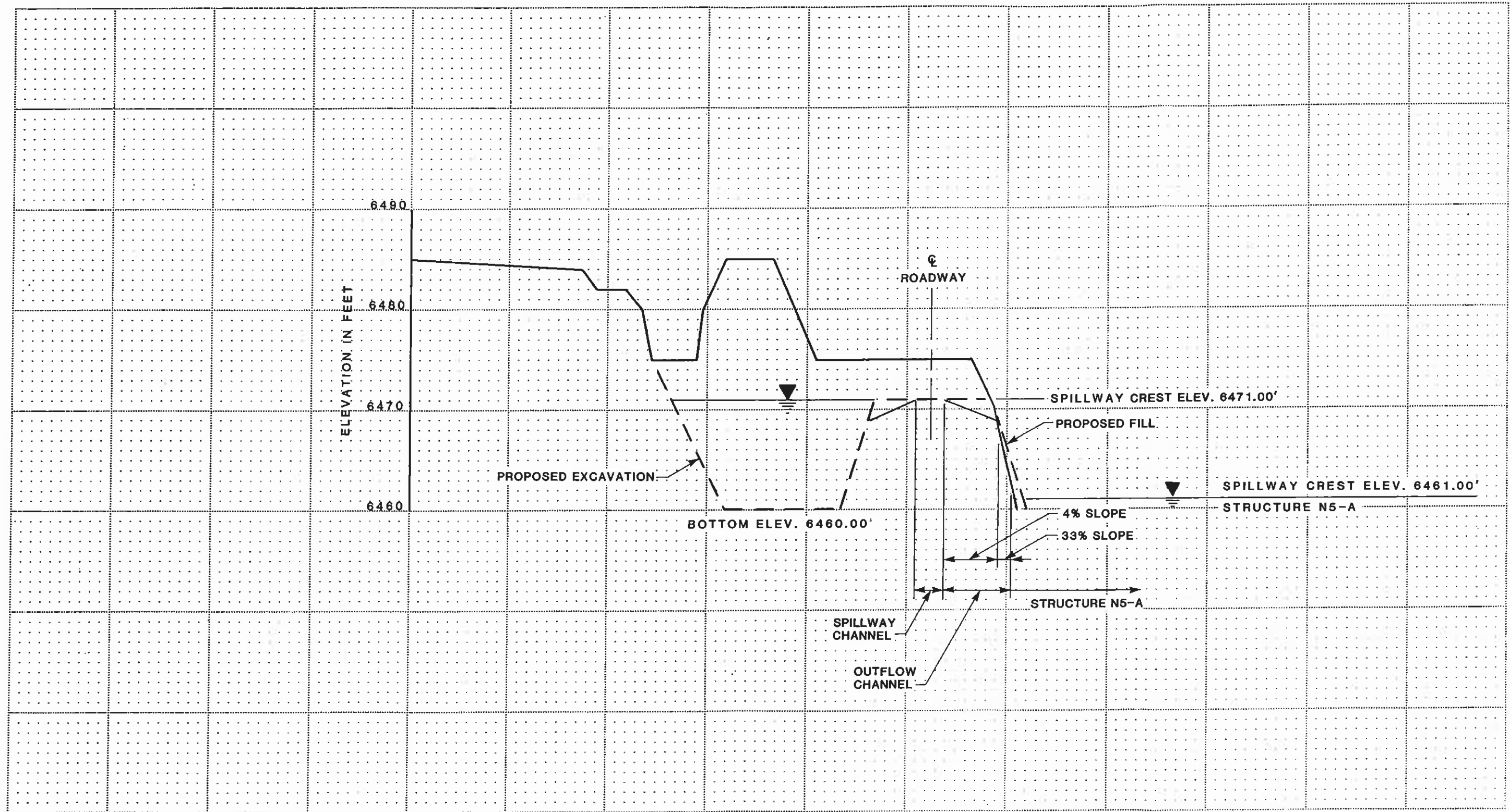
Appendix A - Hydrology and Hydraulic Calculations



**SITE PLAN
N5-G**



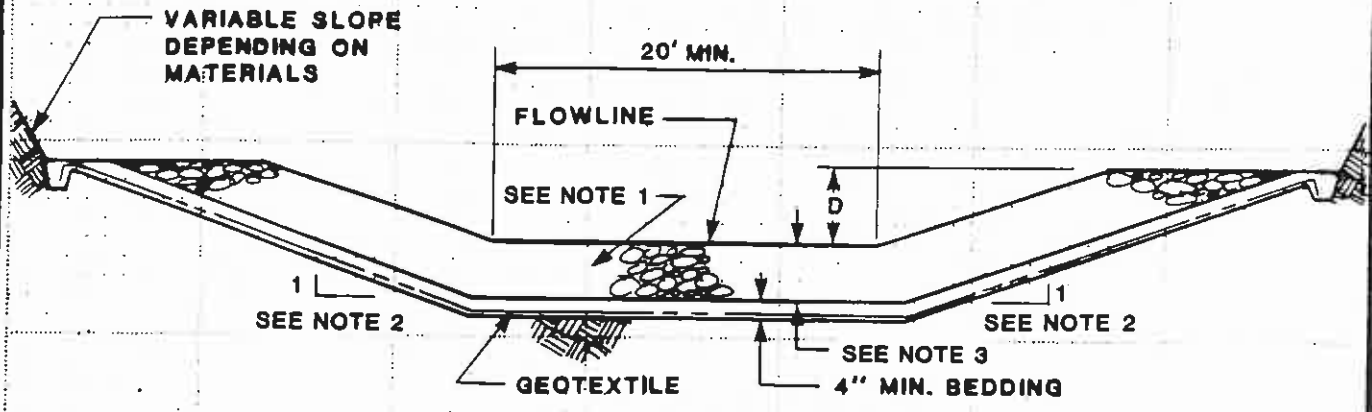
VOLUME-ELEVATION
CURVE
N5-G



CHANNEL PROFILE A-A'
N5-G



FOR LOCATION SEE PLATE 1



SPILLWAY CHANNEL

D = 3.0'

LENGTH = 30'

FLOWLINE ELEV. = 6471.00'

OUTFLOW CHANNEL

D = 2.0'

NOTES:

1. RIPRAP D 50 = 12" SPILLWAY CHANNEL
18" OUTFLOW CHANNEL
2. 3 MIN. OUTFLOW CHANNEL
15 MIN. SPILLWAY CHANNEL
3. 1.5' SPILLWAY CHANNEL
2'-3" OUTFLOW CHANNEL

**SPILLWAY AND
OUTFLOW CHANNEL
CROSS SECTION
N5-G**

APPENDIX A
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6660 - 6475 = 185 ft. ✓

WATER COURSE LENGTH = 14.0(400) = 5600 ft. = 1.061 mi. ✓

$$T_c = \left(\frac{11.9 (1.061)^3}{185} \right)^{0.355} = 0.372 \text{ hr, } \checkmark$$

LAG TIME = 0.6 T_c = 0.223 hr, ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
100 %	RECL.			use <u><u>81</u></u>

DRAINAGE BASIN AREA

346.7 ACRES 0.542 SQ MILE ✓

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

Y. S. DOLAN DATE 11-8
 CHECKED BY _____
 COPY TO EO _____

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 100% EH #35

$K = 0.42$

SLOPE FACTOR

LENGTH (ft.)	Δ ELEV (ft.)	SLOPE (%)	LS
430	55	12.8	4.14 (.04) ✓
500	10	2.0	.33 (.04) ✓
600	94	14.5	5.62 (.11) ✓
355	56	18.7	6.34 (.04) ✓
600	60	10.0	3.36 (.11) ✓
1000	55	5.5	1.69 (.29) ✓
1250	75	6.0	2.38 (.37) ✓

COVER FACTOR

2.791 ✓

AREA (ac)	COVER TYPE	% COVER	CANOPY (%)	WEIGHTED C
100%	DECLAIMED			.15

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40(0.42)(2.79)(.15)(1.0) = 7.03$ ton/acre/year ✓

$A = 7.03 \left(\frac{1}{2047} \right) (342.7)(.1) = 1.07$ acre-feet/year ✓

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S. DOLAN DATE 11-11-85
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FINAL REVISION

100 yr 6 hr EVENT
 (includes NS-A1 watershed upstream)

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6755 - 6475 = 280 ft. ✓

WATER COURSE LENGTH = 20.8(400) = 8320 ft. = 1.576 mi. ✓

$T_c = \left(\frac{11.9 (1.576)^3}{280} \right)^{0.385} = 0.501 \text{ hr. } \checkmark$

Lag Time = 0.6 T_c = 0.301 hr. ✓

SCS CURVE NUMBER

<u>DRAINAGE AREA (ac)</u>	<u>COVER TYPE</u>	<u>HYDROLOGIC CONDITION</u>	<u>SOIL TYPE</u>	<u>WEIGHTED CURVE NUMBER</u>
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- A1 195.3

- G 346.7

542.0

100% RECL.

use 81

DRAINAGE BASIN AREA

542.0 ACRES

0.947 SQ MILE ✓

REVISIONS

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

Y. S. D. DATE 11/12/85
 CHECKED BY BHM 11/12/85
 COPY TO EO _____