

DESIGN REPORT
Sedimentation Structure
N6-D1
Black Mesa Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure N6-D1 will be a partially incised structure with a small 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 N6-D1 is shown on Plate 1, Site Plan.

This design report contains information specific to Structure N6-D1. 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 N6-D1 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 N6-D1 has a 343.0-acre tributary drainage area and is located near Moenkopi Wash at the Black Mesa Mine. The watershed is classified as 80% reclaimed, 15% disturbed, and 5% Pinion/Juniper.

EMBANKMENT

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

DESIGN ANALYSES

GENERAL

Structure N6-D1 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 N6-D1 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 N6-D1 is located upstream from Structure N6-D. The two structures have a combined storage capacity that is greater than 20 acre-feet. However, the spillway for N6-D1 was analyzed using the 25-year, 6-hour storm because N6-D1 is the upstream structure. The storage capacity of Structure N6-D1 was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

| | | |
|---|-------|-------|
| 1. Water Course length, L | 1.47 | mi |
| 2. Elevation Difference, H | 242 | ft |
| 3. Time of Concentration, T_c | 0.489 | h |
| 4. Lag time, $0.6T_c$ | 0.293 | 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 | 343.0 | acres |

HYDRAULICS

The HEC-1 program was used to evaluate inflow to the planned sedimentation structure, outflow from the structure and the resulting water surface elevations. The initial conditions and results of the analysis are summarized in the following table.

N6-D1 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 | 267 | 304 |
| Volume acre-ft | 22.87 | 18.29 |
| Storage | | |
| Peak Stage ft | 6676.32* | 6677.96* |
| Spillway Elevation . . ft | 6676.50 | -- |
| Peak Storage acre-ft | 22.87 | -- |
| Storage Capacity, Pond C acre-ft | 9.73 | -- |
| Storage Capacity, Pond A & B acre-ft | 23.97 | -- |
| Total Storage Capacity acre-ft | 33.70 | -- |
| Outflow | | |
| Peak Flow cfs | 0 | 93 |
| Embankment Crest Elevation ft | -- | 6679.00 |
| Peak Stage ft | -- | 6677.96* |
| Freeboard ft | -- | 1.04 |
| Spillway Channel | | |
| Flow Depth ft | -- | 1.46 |
| Critical Velocity . . . fps | -- | 3.0 |
| Manning's "n" | -- | 0.040 |
| Outflow Channel | | |
| Slope % | -- | 3 |
| Normal Velocity fps | -- | 2.9 |
| Normal Depth ft | -- | 0.31 |
| Manning's "n" | -- | 0.040 |

*Peak stage for Pond A and Pond B combined.

Spillway Channel

The spillway for N6-D1 will be a trapezoidal channel with the following dimensions:

| | |
|---|-----------|
| Channel depth | 2.5 ft |
| Channel width | 100 ft |
| Channel length | 50 ft |
| Side slopes (horizontal to vertical). . | 15:1 |
| Average exit slope | 0 percent |

Outflow Channel

The outflow channel for Structure N6-D1 will be a trapezoidal channel with the following dimensions:

| | |
|---|-----------|
| Channel width | 50 ft |
| Channel length | 125 ft |
| Side slopes (horizontal to vertical). . | 15:1 |
| Average exit slope | 3 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, N6-D1 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 N6-D1 were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.38
3. Slope Factor, LS 3.77
4. Cover Factor, C 0.277
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 storage capacity of N6-D1 is shown on Plate 2, Volume-Elevation Curve, N6-D1, and the results of the sediment inflow analysis are summarized in the following table.

N6-D1 STORAGE

| | | |
|---|-------|------------|
| Total Storage Capacity | 33.70 | acre-ft |
| 10-year, 24-hour Storm Inflow | 22.87 | acre-ft |
| Available Sediment Storage Capacity | 10.83 | acre-ft |
| Sediment Inflow Rate | 2.393 | acre-ft/yr |
| Sediment Storage Life | 5 | yrs |

* * *

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

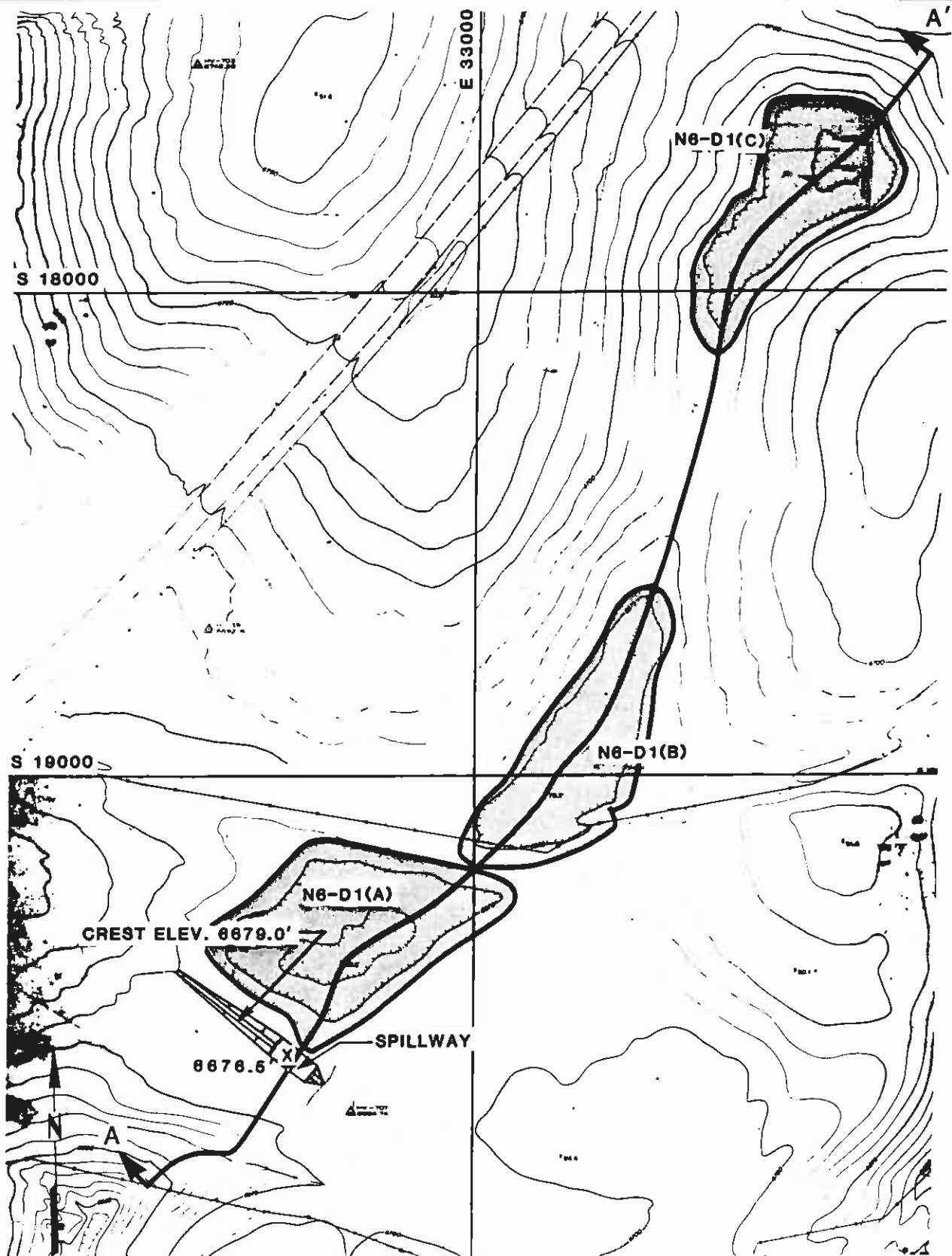
Plate 1 - Site Plan N6-D1

Plate 2 - Volume-Elevation Curve N6-D1

Plate 3 - Channel Profile N6-D1, A-A'

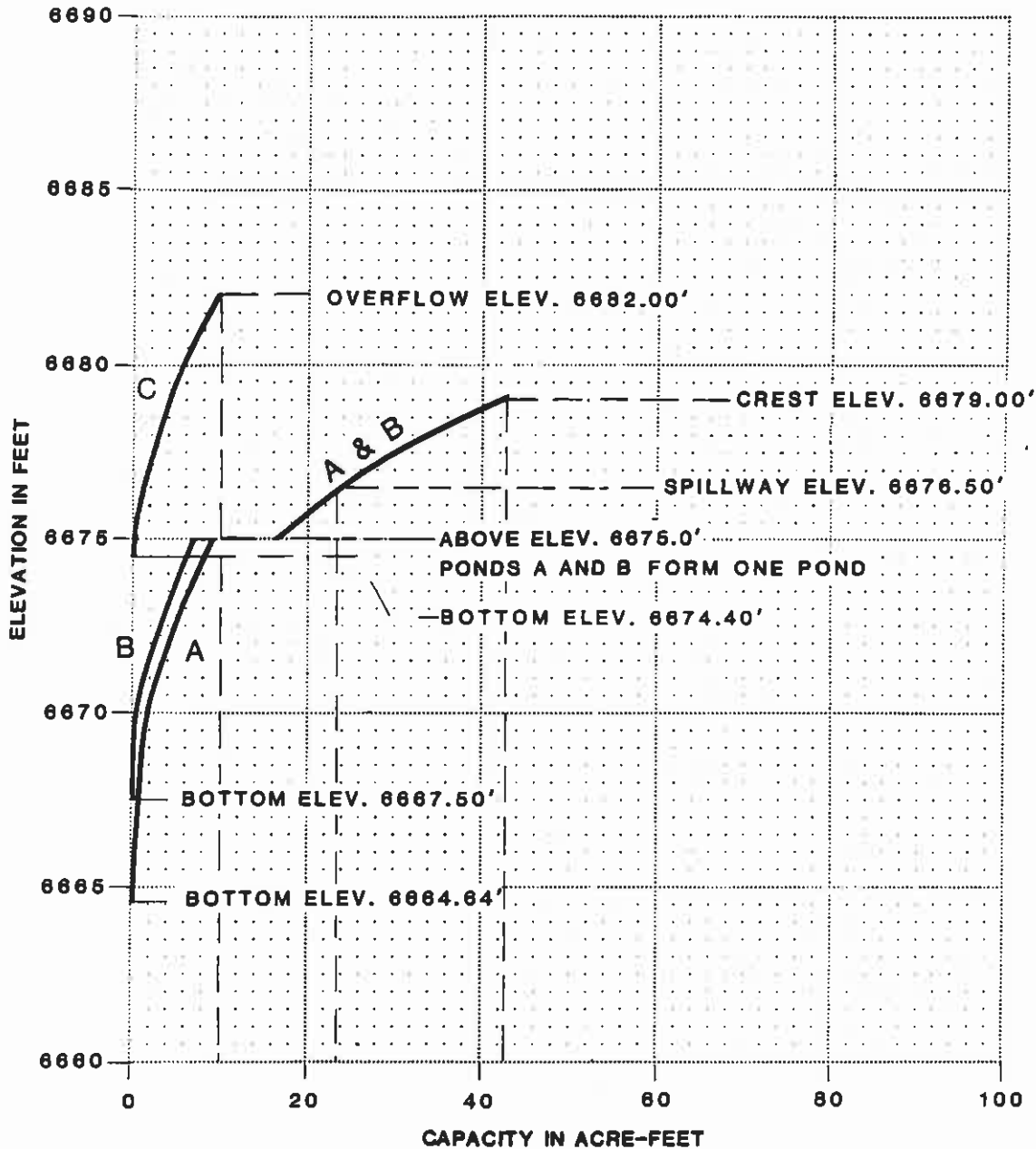
Plate 4 - Spillway and Outflow Channel Cross Section N6-D1

Appendix A - Hydrology and Hydraulic Calculations

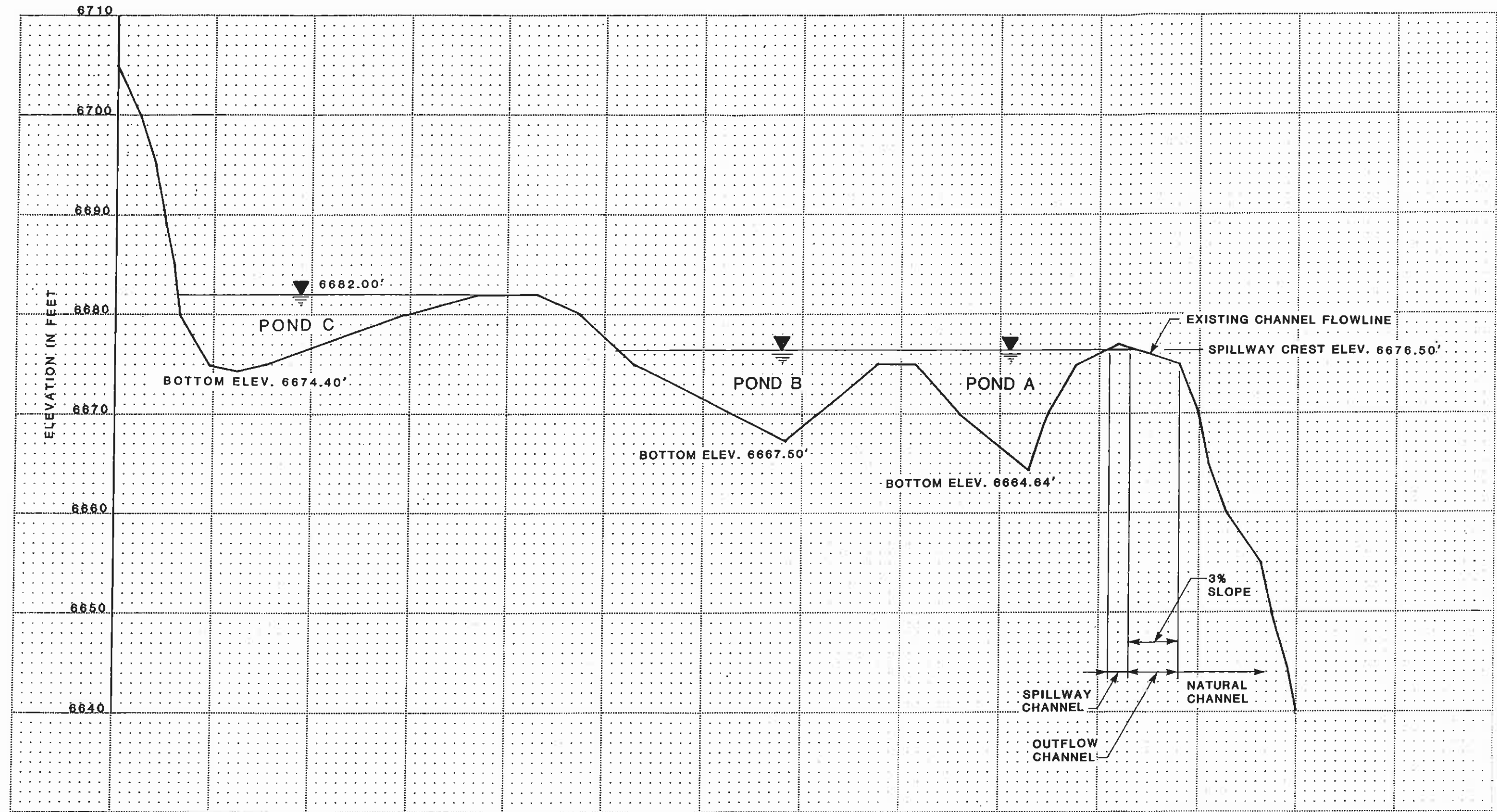


**SITE PLAN
N6-D1**





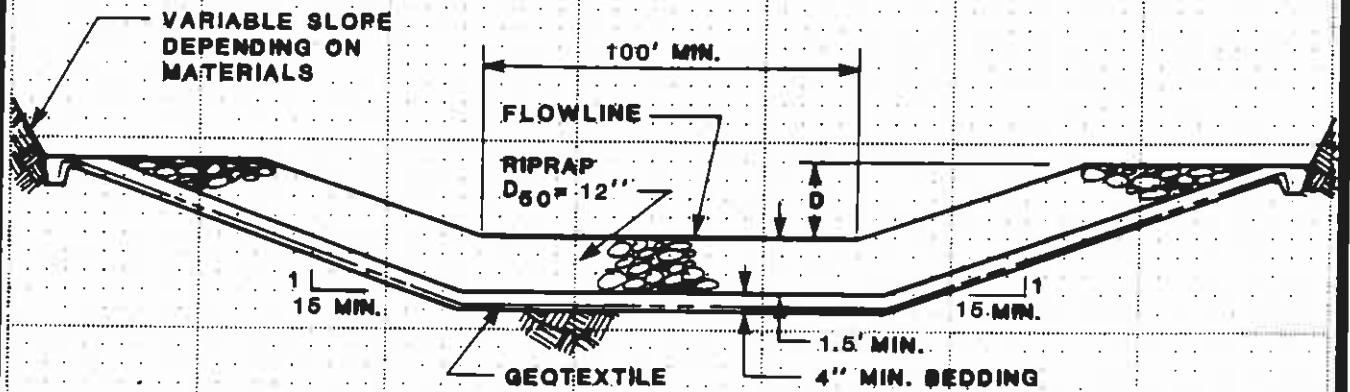
VOLUME-ELEVATION
CURVE
N6-D1



CHANNEL PROFILE A-A'
N6-D1



FOR LOCATION SEE PLATE 1



SPILLWAY CHANNEL

D = 2.5'
 LENGTH = 50'
 FLOWLINE ELEV. = 8676.50'

OUTFLOW CHANNEL

D = 1.6'

**SPILLWAY AND
 OUTFLOW CHANNEL
 CROSS SECTION
 N6-D1**

APPENDIX A
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6910. - 6668.0 = 242. ✓

WATER COURSE LENGTH = 7760.0 = 1.47 ✓

$T_c = \left(\frac{11.9 (1.47)^3}{242} \right)^{.385} = .489 \text{ hrs.} ✓$

Lag Time = 0.6 T_c = .293 hrs ✓

SCS CURVE NUMBER

| DRAINAGE AREA (ac) | COVER TYPE | HYDROLOGIC CONDITION | SOIL TYPE | WEIGHTED CURVE NUMBER |
|--------------------|------------|---------------------------------------|-----------|---|
| 272.9 | reclaimed | 90% post law 10% pre law | | [.9(81) + .1(87)] (80) 94 (.09) 83 (.05) 89 (.06) <hr/> 83.2 use <u>84</u> ✓ |
| 29.7 | disturbed | — | D | |
| 17.2 | P-J | average | D | |
| 23.2 | road | — | D | |
| | | 80% EH #35 15% EH #34 5% EH #33 | | |

DRAINAGE BASIN AREA

343.0 ACRES = 0.536 SQ. MILE ✓

UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 80% EH #35 .8 (.42)
 15% EH #34 .15 (.22)
 5% EH #33 .05 (.22)
.38 ✓
 $K = .38$

SLOPE FACTOR

| LENGTH (ft.) | Δ ELEV (ft.) | SLOPE (%) | LS |
|--------------|--------------|-----------|---------------|
| 800 | 120 | 15 | 7.24 (.05) ✓ |
| 900 | 75 | 8.3 | 3.15 (.75) ✓ |
| 600 | 80 | 13.3 | 5.21 (.20) ✓ |
| | | | <u>= 3.77</u> |

COVER FACTOR

| AREA (ac.) | COVER TYPE | % COVER | CANOPY (%) | WEIGHTED C |
|------------|------------|---------|------------|--------------------------------|
| 15% | disturbed | — | — | .15 (1.0) |
| 80% | reclaimed | — | — | .80 (.15) |
| 5% | P-J | 40 | 25 | .05 (.14) |
| | | | | <u>$C = .277$</u> ✓ |

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40 (.38) (3.77) (.277) (1.0) = 15.87 \text{ ton/acre/year}$ ✓

$A = (15.87) \left(\frac{1}{2047} \right) (343) (.9) = 2.393 \text{ acre-feet/year}$ ✓