

DESIGN REPORT
Sedimentation Structure
TS-A
Kayenta Mine
Navajo County, Arizona
for
PEABODY COAL COMPANY



Dames & Moore
10139-011-22

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INTRODUCTION

Sedimentation Structure TS-A will be an 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 areas of the Kayenta Mine. The location of Structure TS-A is shown on Plate 1, Site Plan.

This design report contains information specific to Structure TS-A. 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 TS-A 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 TS-A has a 122.3-acre tributary drainage area and is located near Shonto Wash at the Kayenta Mine. The watershed is classified as 63% Sagebrush/grass, 27% Pinion/Juniper, and 10% disturbed.

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 TS-A 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 1982 for Peabody Coal Company and was used in the analyses of the structure.

STABILITY

The slopes of Structure TS-A 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 TS-A 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 TS-A was analyzed using the 10-year, 24-hour storm.

The following parameters were used in the hydrologic analysis:

1. Water Course length, L	0.777	mi
2. Elevation Difference, H	150	ft
3. Time of Concentration, T	0.282	h
4. Lag time, $0.6T_c$	0.169	h
5. SCS Curve Number	70	
6. Rainfall Depth, 10-year, 24-hour storm	2.1	in.
25-year, 6-hour storm	1.9	in.
7. Drainage Area	122.3	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.

TS-A 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	30	32
Volume	acre-ft	2.77	1.94
Storage			
Peak Stage	ft	6592.13	--
Spillway Elevation . .	ft	6598.00	--
Peak Storage	acre-ft	2.77	--
Storage Capacity . . .	acre-ft	6.26	--
Outflow			
Peak Flow	cfs	0	3
Embankment Crest			
Elevation	ft	--	6600.00
Peak Stage	ft	--	6598.81
Freeboard	ft	--	1.19
Spillway Channel			
Flow Depth	ft	--	0.81
Critical Velocity . . .	fps	--	1.9
Manning's "n"		--	0.040

Spillway and Outflow Channel

The combined spillway and outflow channel for TS-A will be a trapezoidal channel with the following dimensions:

Channel depth	1.9	ft
Channel width	15	ft
Channel length	250	ft
Side slopes (horizontal to vertical) . .	3:1	
Average exit slope	0	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. The spillway and outflow channel should be protected against erosion using geotextile and gravel as shown on Plate 4.

STORAGE CAPACITY

The impoundment volume-elevation curve shown on Plate 2, Volume-Elevation Curve, TS-A 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 TS-A were made utilizing the Universal Soil Loss Equation with the following parameters:

1. Rainfall Factor, R 40
2. Soil Erodibility Factor, K 0.25
3. Slope Factor, LS 2.58
4. Cover Factor, C 0.220
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 TS-A is shown on Plate 2, Volume-Elevation Curve, TS-A, and the results of the sediment inflow analysis are summarized in the following table.

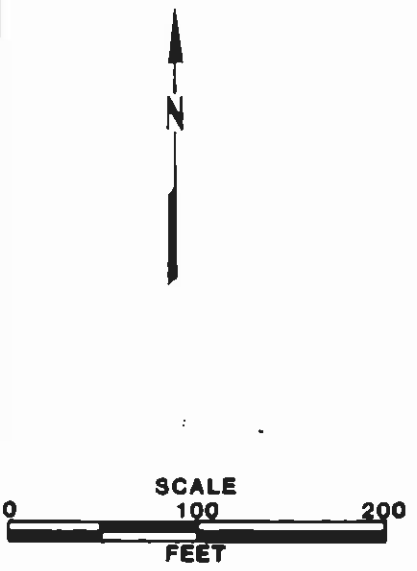
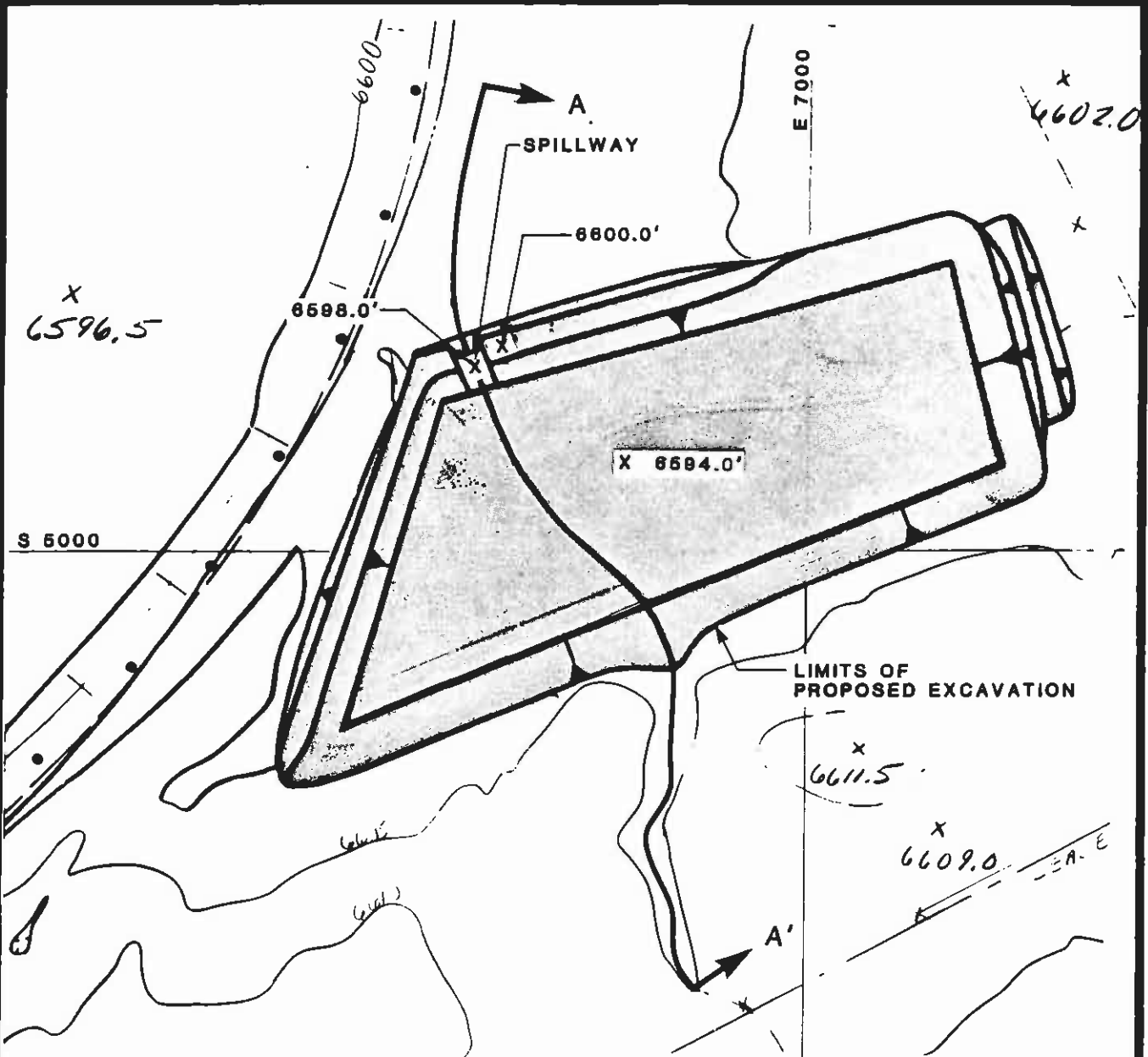
TS-A STORAGE

Total Storage Capacity	6.26	acre-ft
10-year, 24-hour Storm Inflow	2.75	acre-ft
Available Sediment Storage Capacity	3.51	acre-ft
Sediment Inflow Rate	0.322	acre-ft/yr
Sediment Storage Life	11	yrs

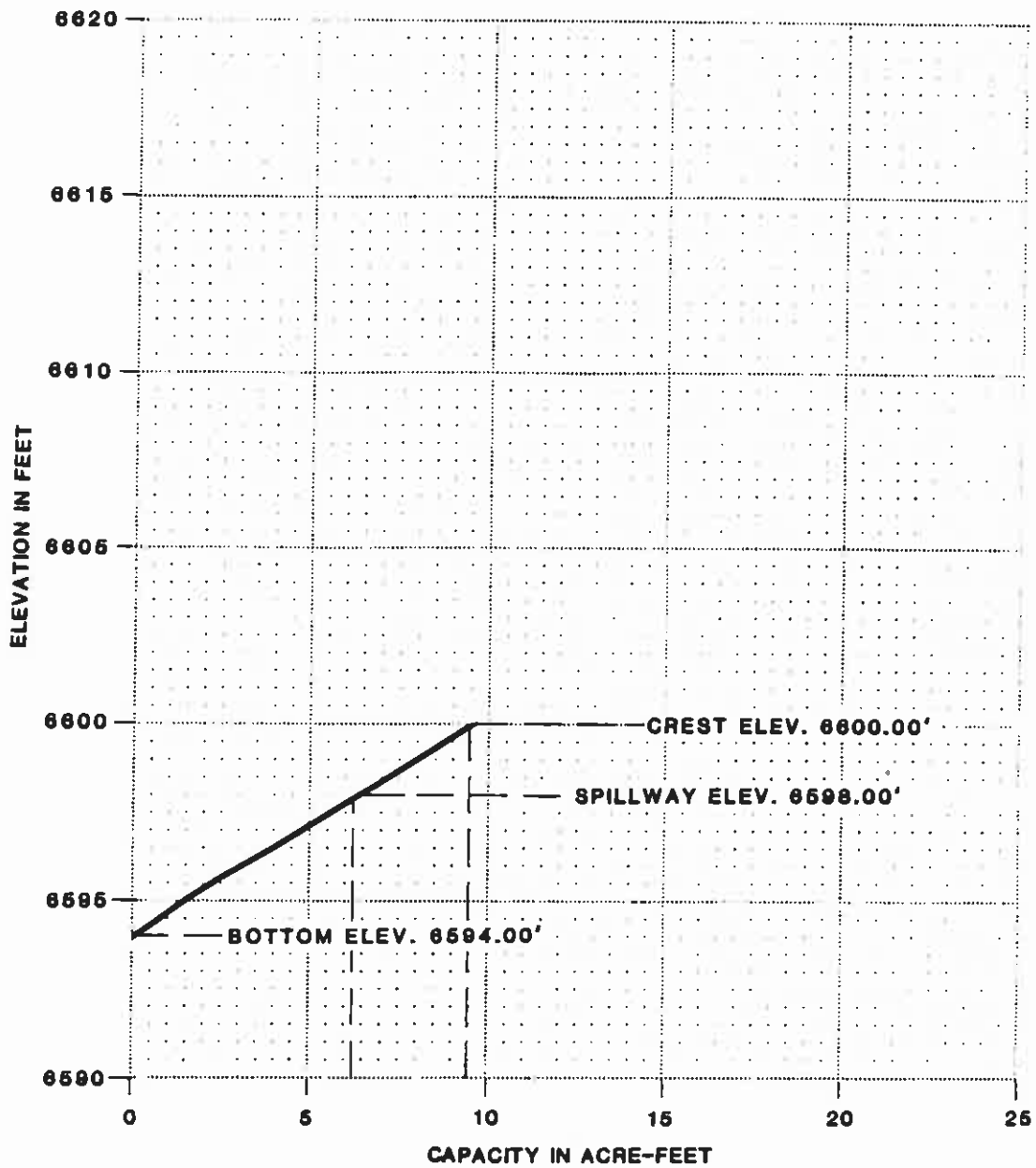
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The following plates and appendix are attached and complete this design report.

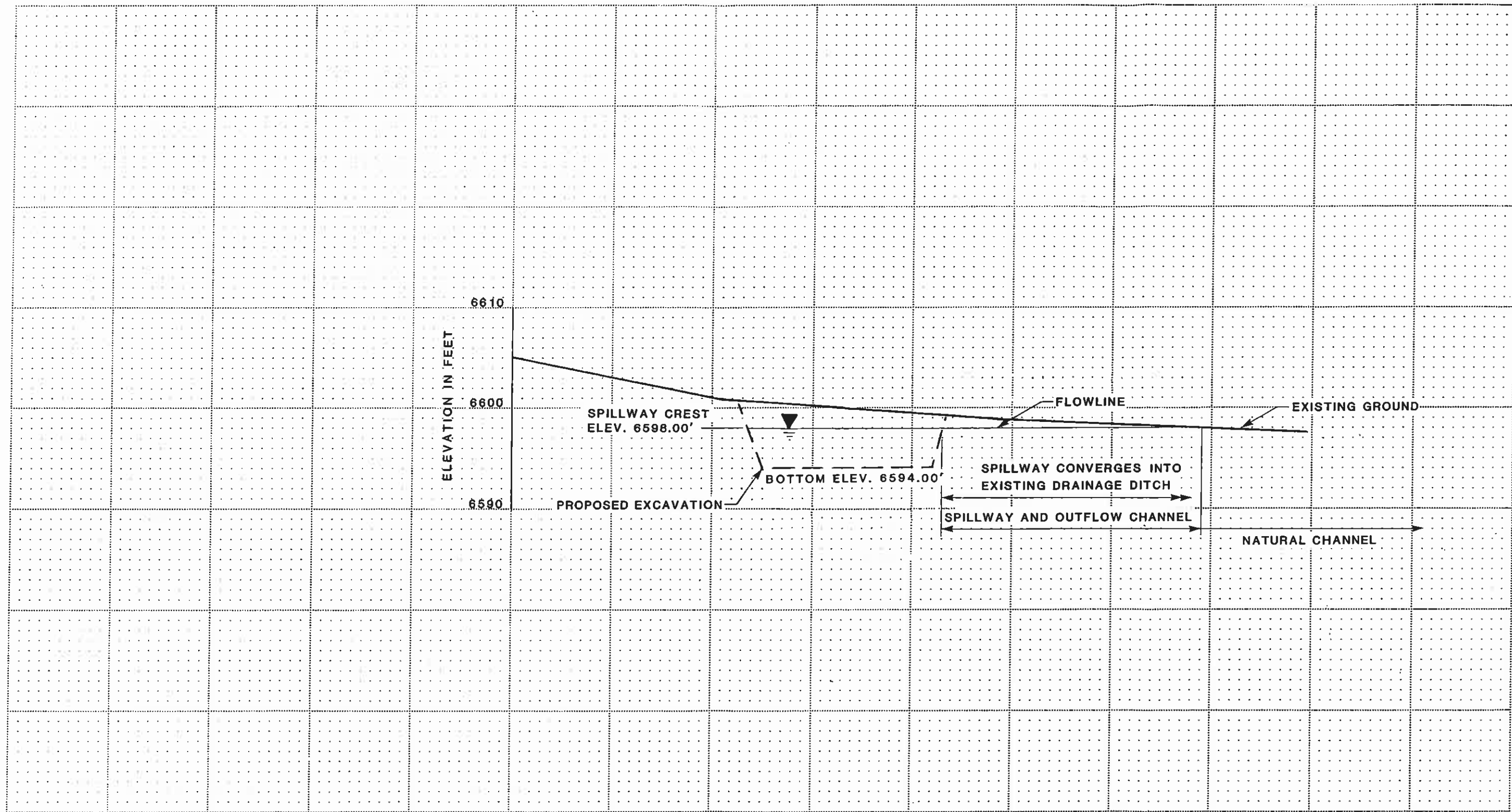
- Plate 1 - Site Plan TS-A
- Plate 2 - Volume-Elevation Curve TS-A
- Plate 3 - Channel Profile TS-A, A-A'
- Plate 4 - Spillway and Outflow Channel Cross Section TS-A
- Appendix A - Hydrology and Hydraulic Calculations



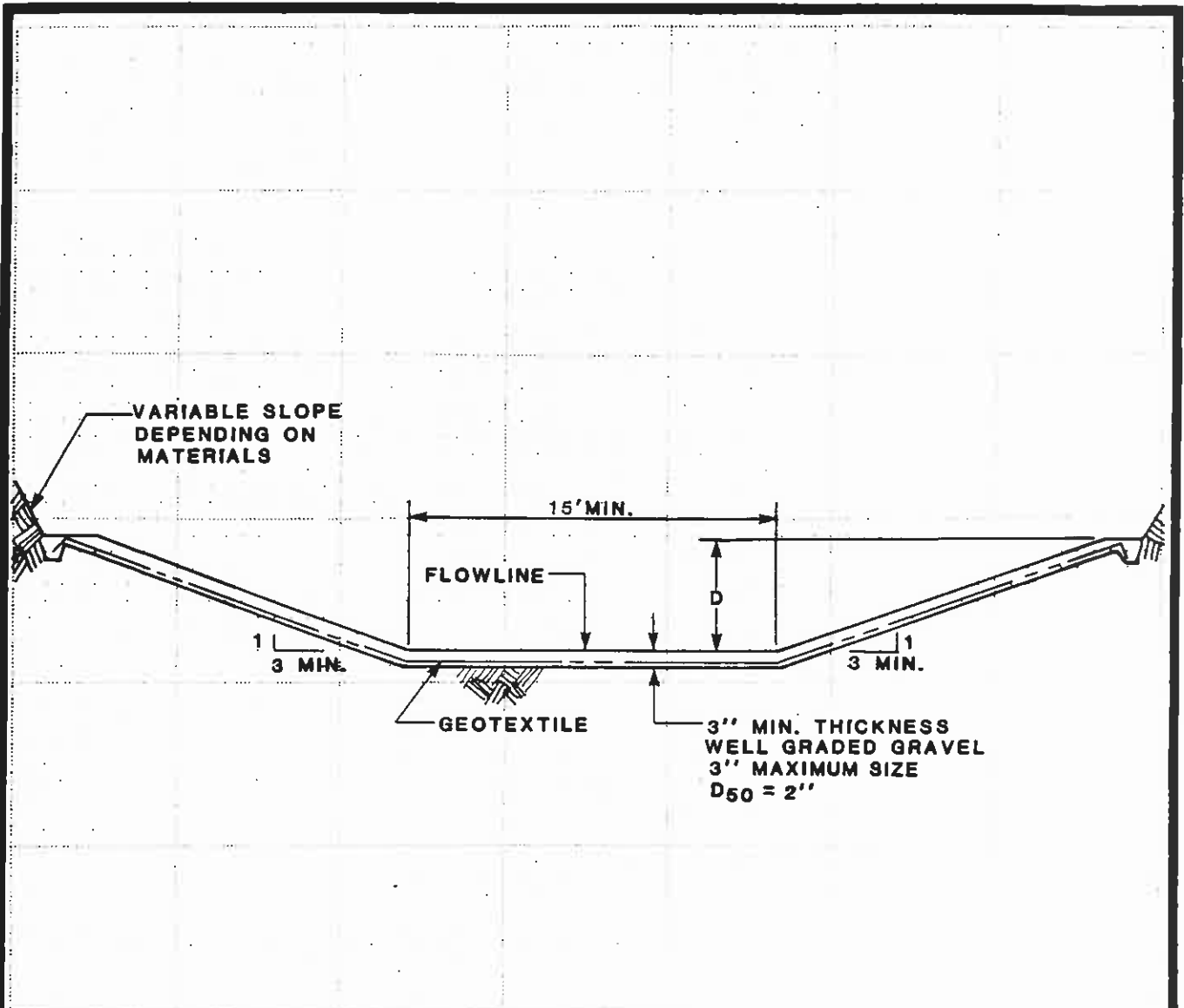
**SITE PLAN
TS-A**



VOLUME-ELEVATION
CURVE
TS-A



CHANNEL PROFILE A-A'
TS-A



SPILLWAY CHANNEL

D = 1.9'
 LENGTH = 50'
 FLOWLINE ELEV. = 8598.00'

OUTFLOW CHANNEL

D = 1.5'

**SPILLWAY AND
 OUTFLOW CHANNEL
 CROSS SECTION
 TS-A**

APPENDIX A
HYDROLOGY AND HYDRAULIC CALCULATIONS

TIME OF CONCENTRATION

ELEVATION DIFFERENCE = 6750 - 6600 = 150' ✓
 WATER COURSE LENGTH = 4102' = .777 mi ✓
 $T_c = 0.282$ ✓
 LAG TIME = $0.6 T_c = .169$ ✓

SCS CURVE NUMBER

DRAINAGE AREA (ac)	COVER TYPE	HYDROLOGIC CONDITION	SOIL TYPE	WEIGHTED CURVE NUMBER
12.3	disturbed - road	—	D	89 (.10)
77.1	S-G	average	80% B, 20% D	60 (.63)
32.9	P-J	average	D	83 (.27)
				69.11

use 70 ✓

DRAINAGE BASIN AREA

122.3 ACRES 0.191 SQ MILES ✓

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

BY _____ DATE 11/5/80
 CHECKED BY BHM
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UNIVERSAL SOIL LOSS EQUATION

RAINFALL FACTOR

$R = 40$

SOIL ERODIBILITY FACTOR

SOIL TYPE = 50% #41 (\approx ET #27) $.5(.36)$
 50% #43 (\approx ET #30) $.5(.14)$
.25

$K = 0.25$

SLOPE FACTOR

<u>LENGTH (ft.)</u>	<u>Δ ELEV (ft.)</u>	<u>SLOPE (%)</u>	<u>LS</u>
1200	60	5	1.86 (.1) ✓
300	50	16.7	5.37 (.4) ✓
1300	30	2.3	.49 (.5) ✓
			<u>2.58</u> ✓

COVER FACTOR

<u>AREA (ac)</u>	<u>COVER TYPE</u>	<u>% COVER</u>	<u>CANOPY (%)</u>	<u>WEIGHTED C</u>
10%	disturbed	—	—	1.0 (.10)
63%	S-G	40	25	.13 (.63)
27%	P-J	40	25	.14 (.27)
				<u>.220</u> ✓

EROSION CONTROL FACTOR

$P = 1.0$

SEDIMENT INFLOW

$A = 40(.25)(2.58)(.22)(1.0) = 5.68$ ton/acre/year ✓

$A = 5.68 \left(\frac{1}{2047} \right) (122.3)(.95) = 0.322$ acre-feet/year ✓

REVISIONS
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