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NATIONAL DAM INSPECTION PROGRAM. PA-467 DAM (NDI I.D. NUMBER PA--ETC(U)
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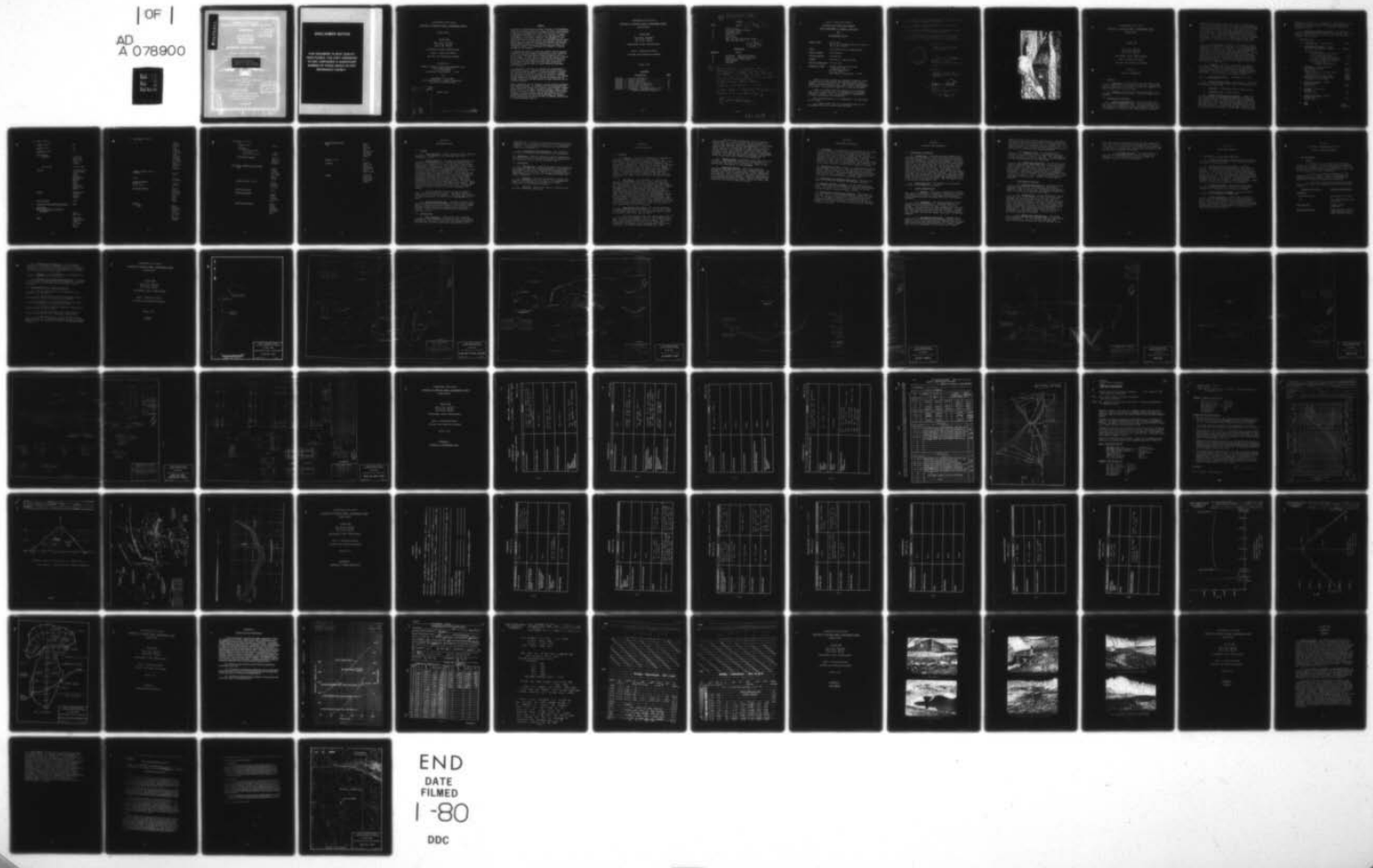

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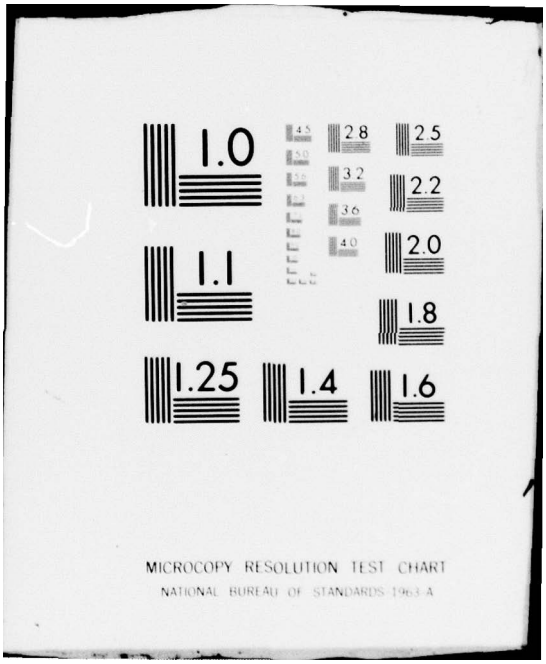
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SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

AUGUST 1979

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SUSQUEHANNA RIVER BASIN

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1979

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PLATES

(11) Aug 79

Plate	Title
1	Location Map.
2	Plan and Typical Section.
3	Alignment Plan.
4	Cutoff Trench.
5	Profiles.
6	Drain Plan.
7	Main Spillway and Outlet Works.
8	Main Spillway Riser.

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APPENDICES

Appendix	Title
A	Checklist - Engineering Data.
B	Checklist - Visual Inspection.
C	Hydrology and Hydraulics.
D	Photographs.
E	Geology.

(6) National Dam Inspection Program. PA-467 Dam (NDI I.D. Number PA-00054, DER I.D. Number 58-131, SCS I.D. Number PA-467) Susquehanna County Commissioners, Susquehanna River Basin, Tributary to Martins Creek, Susquehanna County, Pennsylvania, Phase I Inspection Report,

(10) Frederick/Futchko

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	PA-467 Dam NDI ID No. PA-00054/DER ID No. 58-131/ SCS ID No. PA-467
Owner:	Susquehanna County Commissioners
State Located:	Pennsylvania
County Located:	Susquehanna
Stream:	Tributary to Martins Creek
Date of Inspection:	17 July 1979
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

[cont'd from pp. 1&2]

Based on visual inspection, available records, calculations and past operational performance, PA-467 Dam is judged to be in good condition. The existing spillway can pass the Probable Maximum Flood (PMF) without overtopping of the dam. The spillway capacity is rated as adequate.

There is a slope stability analysis for the embankment, and it indicates that the embankment has adequate factors of safety. There is no evidence of significant problems threatening the embankment.

The following measure is recommended to be undertaken by the Owner:

(1) Remove brush from the downstream slope of the embankment and from the auxiliary spillway.

In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for PA-467 Dam.

(2) Provide round-the-clock surveillance of PA-467 Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

FREDERICK FUTCHKO
Project Manager, Dam Section

Date:

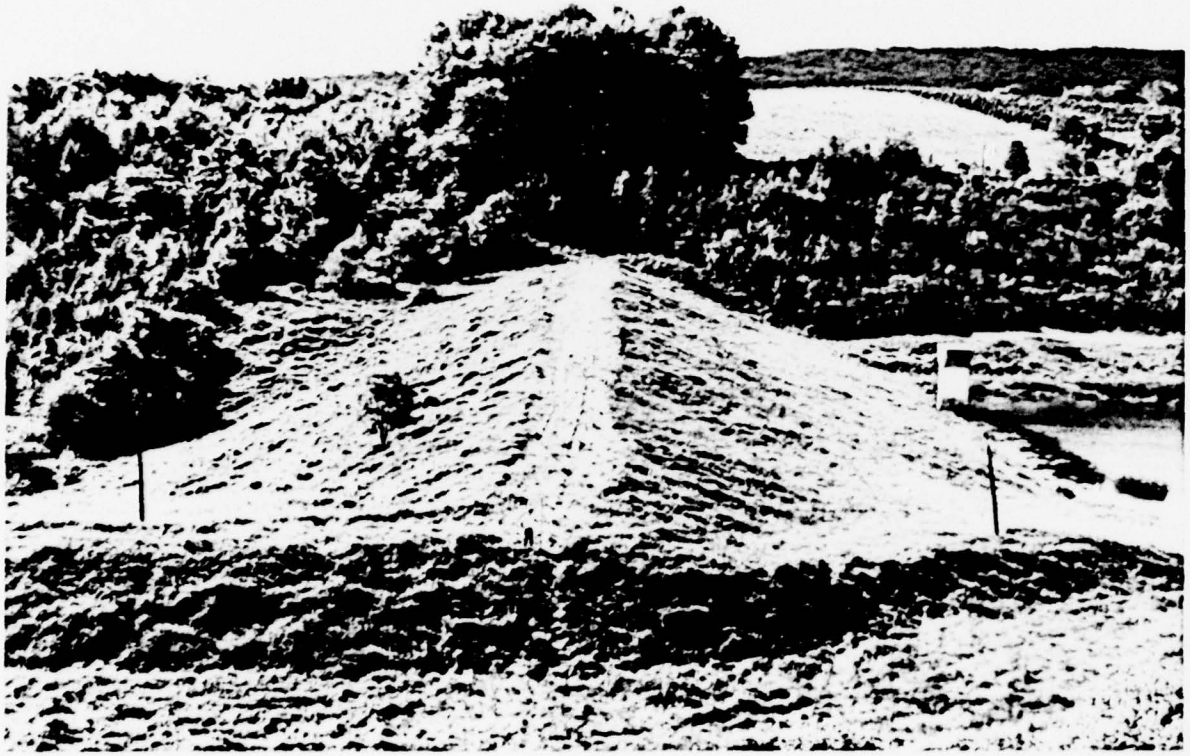
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF
ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 25 Sep 79

PA-467 DAM



Overview

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION I

PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. The dam consists of a zoned, earthfill embankment that is 590 feet long and 52 feet high at its maximum section. The main spillway is a drop spillway located near the right abutment of the dam. It consists of a concrete riser connected to a 30-inch

diameter reinforced concrete pipe under the embankment. One 12-inch by 18-inch orifice is located on the upstream face of the concrete riser. Its crest is 38.7 feet below the design elevation of the top of the dam. The top of the riser is 17.7 feet below the design elevation of the top of the dam. A platform and trashrack are located above the riser. The outlet works is located at the main spillway. It consists of an intake and a 15-inch diameter steel pipe, which outlets into the bottom of the riser. The outlet is closed off by a steel plate bolted into place.

The auxiliary spillway is an excavated channel along the left abutment of the dam. It is a grass-lined excavation in earth. An extension of the dam embankment, referred to by the SCS as a dike, is located along the right side of the auxiliary spillway exit channel. At the control section, the auxiliary spillway has an earthen crest that is 60 feet long and 9.1 feet below the design elevation of the top of the dam and 8.6 feet above the main spillway crest. The various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

b. Location. The dam is located on an unnamed tributary to Martins Creek, about 0.4 mile northeast of the Village of Kingsley, Pennsylvania. Because it was recently constructed, this dam does not appear on current USGS maps. The coordinates of the dam are N41°45'50" - W75°44'20". The location map is shown on Plate 1.

c. Size Classification. Intermediate (52 feet high, 180 acre-feet.)

d. Hazard Classification. High Hazard. Downstream conditions indicate that a high hazard classification is warranted for PA-467 Dam.

e. Ownership. Susquehanna County Commissioners.

f. Purpose of Dam. Flood Control.

g. Design and Construction History. PA-467 Dam was planned under an agreement between the Susquehanna County Commissioners (SCC-Owners) and the Soil Conservation Service of the U.S. Department of Agriculture (SCS). Land acquisition and operation and maintenance were to be provided by the SCC. The dam was designed by the SCS in 1964. The permit to construct the dam was issued in 1965, and construction was started in May, 1966. The Contractor

was Wright Griffin, Inc., LeRaysville, Pennsylvania. Construction was under the supervision of Mr. Jesse Evans, Contracting Officer for SCC. The dam was completed in September, 1967.

h. Normal Operational Procedure. The reservoir is normally maintained at the crest of the main spillway orifice. The bolted-plate closure on the outlet works is normally left in place.

1.3 Pertinent Data.

a.	Drainage Area. (square miles)	0.80
b.	Discharge at Damsite. (cfs)	
	Maximum known flood at damsite	Unknown
	Spillway capacity:	
	Orifice with pool at crest of main spillway riser.	40
	Main spillway with pool at crest of auxiliary spillway.	108
	Auxiliary spillway with pool at top of dam (design computations)	5,340
c.	Elevation. (feet above msl)	
	Top of dam (design)	1237.0
	Maximum pool	1237.0
	Normal pool (crest of main spillway orifice	1198.3
	Upstream invert outlet works	1188.3
	Downstream invert outlet works	1185.4
	Streambed at toe of dam	1185.4
d.	Reservoir Length. (miles)	
	Normal pool	0.06
	Maximum pool	0.19
e.	Storage. (acre-feet)	
	Normal pool	4
	Maximum pool	180
f.	Reservoir Surface. (acres)	
	Normal pool	0.8
	Maximum pool	9
g.	Dam.	
	Type	Zoned earthfill

g.	Dam. (Cont'd.)	
	Length (feet)	590
	Height (feet)	52
	Topwidth (feet)	18
	Side Slopes Upstream	1V on 3H. with 10-foot berm at El. 1198.3.
	Downstream	1V on 2.5H.
	Zoning	Clayey soils in upstream zone. Silty sands and gravels in middle zone. Silty gravel in downstream zone.
	Cutoff	Impervious fill in cutoff trench.
	Grout Curtain	None
h.	Diversion and Regulating Tunnel.	None
i.	Spillways. Main (Principal or Service) Spillway.	
		Drop spillway.
	Type	Vertical rectangular riser 2.5 feet by 7.5 feet,

i. Spillways.(Cont'd.)

	with rounded crest; one 1-foot high by 1.5-foot long orifice located in face of riser. Riser connects to a conduit.
Length of Weir (feet)	
Orifice	One at 1.5
Riser	Two at 7.5 each.
Crest Elevation	
Orifice	1198.3
Riser crest	1219.3
Upstream Channel	Reservoir; a platform is 1.92 feet above the riser.
Conduit	
Type	Reinforced concrete pipe; 2.5 feet in dia. on concrete cradle.

i. Spillway. (Cont'd.)

Length (feet)	286.0
Elevation	
Upstream invert at riser	1188.3
Downstream invert	1185.4
Downstream Channel	Impact basin at natural stream.
Auxiliary (Emergency) Spillway	
Type	Grass-lined earthen cut with 1V on 2H side slopes.
Length of Weir (feet)	60 at earthen control section.
Crest Elevation	1227.9
Upstream Channel	Grass-lined channel to reservoir.
Downstream Channel	Grass-lined channel extending to overbank

j.	Regulating Outlets.	
	Type	Steel pipe, 15-inch dia. extending to main spillway riser.
	Length (feet).	56
	Closure	Bolted-plate in riser at downstream end of steel pipe.
	Access	Hatch in platform above main spillway riser.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Almost complete design data are available. A summary of the available data is in Appendices A and C.

b. Design Features. The dam and appurtenances are described in Paragraph 1.2a. The design features are shown on the Plates at the end of the report and on the Photographs in Appendix D. Modifications to the original design that were performed during construction are included in Appendix A. The embankment is shown on Plates 2, 3, 4, and 5, and on Photograph A. A plan of the foundation drain is shown on Plate 6. The centerline of the cutoff trench is parallel to the axis of the dam and is 55 feet upstream from the axis. The cutoff trench extends from Station 1+63 to Station 6+14, where the embankment fill intersects natural ground. The cutoff trench has 1V on 1H side slopes except for a 50-foot reach in the vicinity of the main spillway outlet conduit, where the cutoff trench side slopes are 1V on 4H. The bottom width of the cutoff trench is 12 feet throughout its length.

The main spillway riser is shown on Plates 7 and 8 and on Photographs A and B. The impact basin is shown on Plate 7 and Photograph C. The auxiliary spillway is shown on Plates 2, 3, and 5 and on Photographs D, E, and F.

c. Design Considerations. Although the main spillway design has been used successfully by the SCS for many years, it appears that the entrance to the conduit could possibly develop cavitation during certain flow conditions. Other design considerations are discussed in Sections 5 and 6.

2.2 Construction.

a. Data Available. Construction data available consists of the construction specifications, construction photographs, and reports from both the resident inspector and from the periodic construction inspections by the

Commonwealth. A review of these data revealed no adverse comments from the resident inspector or the Commonwealth inspector. Data showing modifications to the original design are in Appendix A.

b. Construction Considerations. The available information indicates that the dam is well constructed.

2.3 Operation. Based on reports of annual inspections made by SCS since the dam was completed, it appears that all structures have performed satisfactorily.

2.4 Evaluation.

a. Availability. Engineering data were provided by the Bureau of Dams and Waterway Management, Department of Environmental Resources, Commonwealth of Pennsylvania (PennDER), and by the SCS. One of the Susquehanna County Commissioners was available for information during the visual inspection.

b. Adequacy. The type and amount of design data and other engineering data are good. The assessment is based on the combination of design data, visual inspection, and performance history.

c. Validity. There is no reason to question the validity of the available data.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The overall appearance of the dam is good with a few deficiencies as noted herein. The locations of deficiencies are shown in Appendix B on Plate B-1. Survey data acquired during this inspection are presented in Appendix B. Datum for the survey was assumed at the design elevation of the end sill of the impact basin, El. 1185.39. Since the impact basin is founded on soil, some settlement might have occurred, which would result in surveyed elevations being higher than the actual. On the day of the inspection, the pool was 0.1 foot above the crest of the orifice in the main spillway riser.

b. Embankment. The embankment is in good condition. The upstream slope has a grass cover and the downstream slope is covered with crownvetch (Photograph A). The vegetal cover is in excellent condition. Surveys performed for this inspection indicated that while both the measured top of dam elevation and the auxiliary spillway crest elevation differ from design values, the relative difference between them is approximately the same. The surveys also showed that the embankment slopes have only minor deviations from the design values. One 4-inch diameter tree was growing on the downstream slope (Photograph A). A communications line, apparently used in connection with a radio system, crosses the top of the dam near the spillway (Photograph A). The line was about 6 feet higher than the top of the dam.

c. Appurtenant Structures. The outlet works was submerged and could not be inspected. The bolted closure at the downstream end of the outlet works conduit, which is located in the riser, was in place.

The main spillway riser and impact basin were in good condition (Photographs B and C). An inspection was made of the 30-inch diameter outlet conduit. The conduit was in good condition, but some of the joints were separated. The largest joint openings were located near the axis of the dam and were approximately 1 inch.

The auxiliary spillway was in good condition (Photographs A, D, and E) except for minor amounts of brush. The previously mentioned communications line spans the spillway approach channel (Photograph D). At its lowest point, the line was at the same elevation as the top of the dam. The embankment extension (dike) downstream from the dam along the right side of the auxiliary spillway outlet channel was in good condition (Photographs E and F). The dike was partially riprapped, and the remaining portions were covered with crownvetch.

d. Reservoir Area. Watershed slopes vary from mild to steep. Approximately one-half of the watershed is wooded, and the other half is grassland. There is only minor rural development in the watershed.

e. Downstream Channel. The reach immediately downstream from the dam is a steep, V-shaped valley. The Village of Kingsley is located about 0.4 mile downstream from the dam. The tributary that the dam is located on joins Martins Creek in Kingsley. There are approximately 15 low-lying dwellings located in Kingsley upstream from the confluence with Martins Creek. There are also a few commercial structures along this reach.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at the crest of the orifice in the main spillway riser Elevation 1198.3, with excess inflow discharging over the main spillway and into the natural stream channel, which joins Martins Creek about 0.4 mile downstream. A 30-inch diameter concrete conduit discharges water from the reservoir. Since the 15-inch diameter, steel outlet works pipe is intended only for drawing down the reservoir, the bolted plate closure on that line is usually in place.

4.2 Maintenance of Dam. There is no designated caretaker for the dam. The SCC, with the assistance of the SCS, makes a formal inspection of the dam each year, and the records are filed. Maintenance deficiencies are corrected shortly after the inspection. Informal inspections are also made by the SCC several times each year.

4.3 Maintenance of Operating Facilities. There are no gates for the outlet works or for the main spillway.

4.4 Warning Systems in Effect. The SCC Representative stated that there were no emergency operation and warning plan. The condition of the dam is checked by the SCC during periods of unusually heavy rainfall.

4.5 Evaluation of Operational Adequacy. Maintenance of the dam is good. The procedures used to inspect the dam are good, as is the correction of maintenance deficiencies. An emergency operation and warning system is a necessary safeguard to improve the safety of the dam and prevent loss of life downstream, should evidence of stress develop at the dam.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The hydrology and hydraulics of the design of the dam was based on standard SCS criteria. The crest elevation of the orifice in the main spillway riser was determined by sediment requirements. The crest elevation of the drop spillway riser and the crest elevation of the auxiliary crest were set by routing 100-year storms based on SCS procedures. The design high water level was determined by routing a storm equal to 1.25 times the 100-year, 6-hour storm. The design flood was used to set the top of riprap elevation at the dike along the right side of the auxiliary spillway. The top of dam elevation was determined by routing the "Freeboard" storm, which is equal to twice the design high water storm (2.5 times the 100-year, 6-hour storm). The "Freeboard" storm is discussed in Paragraph 5.1d.

b. Experience Data. The maximum flood that has occurred at the damsite is unknown.

c. Visual Observations.

(1) General. The visual inspection of PA-467 Dam, which is described in Section 3, resulted in a number of observations relevant to hydrology and hydraulics. These observations are evaluated herein for the various features.

(2) Embankment. The slope protection on the upstream slope is dense grass. Although there is no riprap, the erosion potential due to wave action is minimal. The combination of small maximum pool (9 acres) and dense vegetal cover makes erosion unlikely. In addition, the good maintenance record for the dam indicates that any minor erosion that might occur would be repaired promptly.

(3) Appurtenant Structures. Although joint separations in the 30-inch main spillway conduit are as large as 1-inch, the Specifications indicate that the pipe joints have a minimum extensibility of 2 inches. Therefore, the joint openings are less than the allowable

amount, and the joints should be watertight. The amount of brush in the auxiliary spillway is not significant at the present time, but control of it is necessary to insure that no reduction of spillway capacity occurs. The communications line spanning the spillway approach channel would have no effects on spillway performance.

(4) Reservoir Area. No conditions were observed in the reservoir area or watershed that might present significant hazard to the dam. The assessment of the dam is based on existing conditions, and the effects of future development are not considered.

(5) Downstream Conditions. No conditions were observed immediately downstream from the dam that would create significant hazard to the dam. If the dam should fail, a hazard to dwellings in the Village of Kingsley would exist. Because of the possibility of flooding dwellings, a high hazard classification is warranted for PA-467 Dam. The SCS designed the dam assuming that it was a Class C structure. This is essentially equivalent to a high hazard classification. Access to PA-467 Dam is adequate.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE) for the size (Intermediate) and hazard potential (High) of PA-467 Dam, the Spillway Design Flood (SDF) is the Probable Maximum Flood (PMF).

(2) Design Storm. The SCS "Freeboard" storm, which was used to determine the size of the auxiliary spillway and the top elevation of the dam, was not developed from PMF methods. However, the total rainfall of 24.0 inches is equivalent to a PMF rainfall for this area. The assumed losses of 3.6 inches are higher than those established by criteria for the Susquehanna River Basin, but the unit hydrograph used by the SCS is conservative. The computed peak inflow of 5,583 cfs is equivalent to a PMF peak inflow. The storm is an acceptable estimate of the PMF.

(3) Design Storm Computations. The design storm computations and the spillway capacity computations are in Appendix C. It is noted that the main and auxiliary spillway combined can pass 98 percent of the

peak flow from the "Freeboard" storm without routing the flow. No routing computations were available, but since the reservoir can store about 20 percent of the runoff, it is reasonable to assume that the spillway can pass the PMF without any overtopping of the dam.

(4) Spillway Adequacy. The criteria used to rate the spillway adequacy of a dam are described in Appendix C. Since PA-467 Dam can pass the PMF, the spillway capacity is rated as adequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Nothing was noted during the visual inspection of the dam that adversely affects the safety of the structure.

b. Design and Construction Data. Stability analyses were performed by the SCS during the design of the dam. The results of the analyses are included in Appendix A. The minimum factors of safety were computed to be 1.41 for the upstream slope under sudden drawdown conditions and 1.56 for the downstream slope under steady seepage conditions. The factors of safety were computed using the Swedish Circle Method. The design shear strength was the consolidated - undrained strength. These factors of safety are considered to be adequate.

c. Operating Records. The reports of previous inspections indicate that no stability problems have occurred over the operational history of the dam.

d. Postconstruction Changes. There have been no postconstruction changes to PA-467 Dam.

e. Seismic Stability. PA-467 Dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. Since the factors of safety are adequate, the dam is assumed to be stable for any expected earthquake loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on visual inspection, available records, calculations, and past operational performance, PA-467 Dam is judged to be in good condition. The spillway can pass the PMF without overtopping of the dam. The spillway capacity is rated as adequate.

(2) There is a stability analysis for the embankment, and it indicates that the embankment has adequate factors of safety. There is no evidence of significant problems threatening the embankment.

(3) The visual inspection revealed some minor deficiencies, which are summarized below for the various features.

Feature and Location	Observed Deficiencies
Embankment:	
Downstream Slope	Minor amount of brush.
Top	Low communications line spans top.
Main Spillway:	Conduit joints separated.
Auxiliary Spillway:	Minor amounts of brush; communications line spans approach channel.

b. Adequacy of Information. The information available is such that an assessment of the condition of the dam can be inferred from the combination of visual inspection, past performance, and computations performed prior to and as part of this study.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented without delay.

d. Necessity for Further Investigations. In order to accomplish the remedial measures outlined in Paragraph 7.2, no further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measure is recommended to be undertaken by the Owner:

(1) Remove brush from the downstream slope of the embankment and from the auxiliary spillway.

b. In addition, it is recommended that the Owner modify his operational procedures as follows:

(1) Develop a detailed emergency operation and warning system for PA-467 Dam.

(2) Provide round-the-clock surveillance of PA-467 Dam during periods of unusually heavy rains.

(3) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

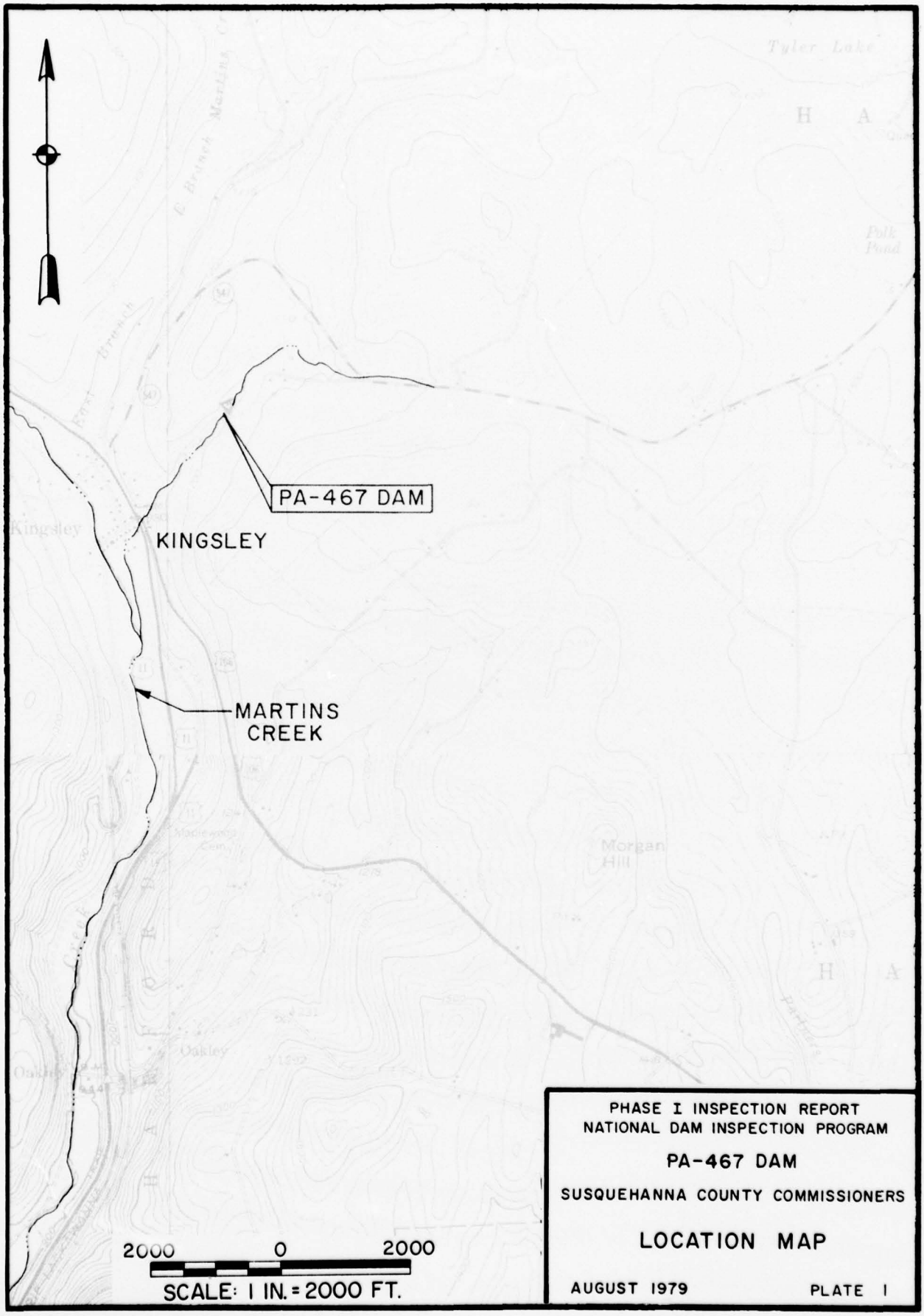
SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1979

PLATES



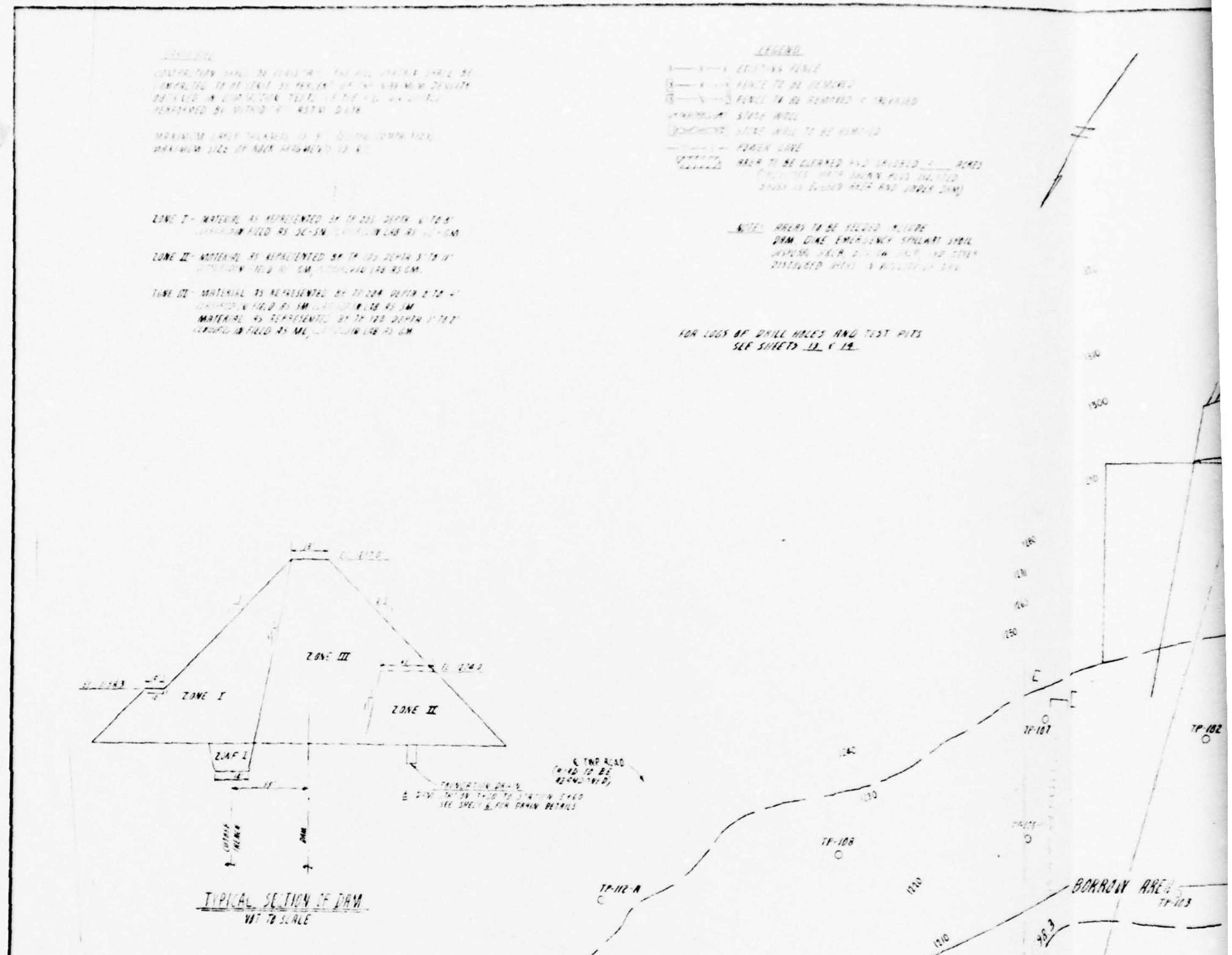
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

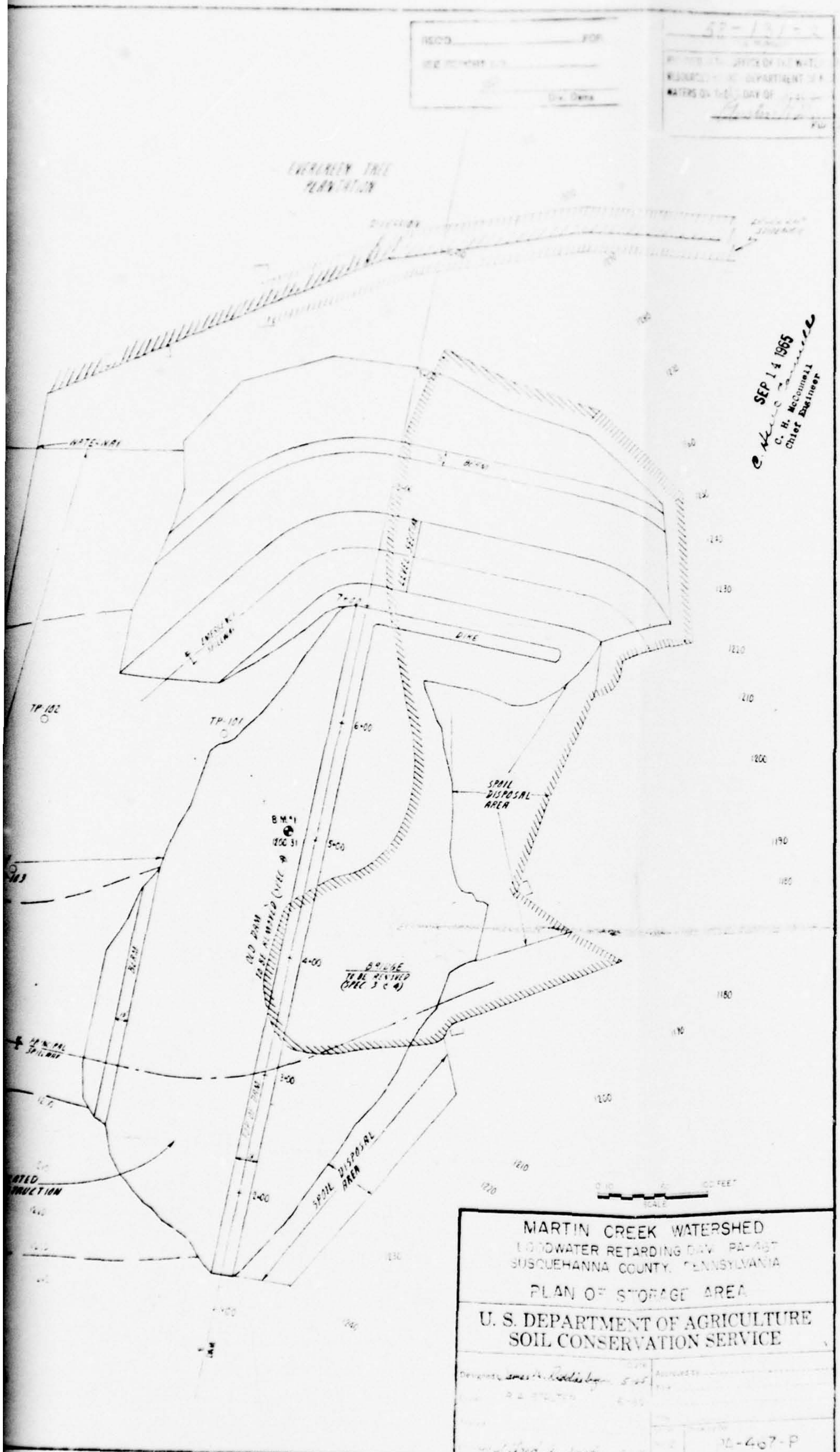
PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

LOCATION MAP

AUGUST 1979 PLATE 1


LEGEND
EXISTING FENCE
FENCE TO BE REMOVED
FENCE TO BE REMOVED & REPLACED
STONE WALL
STONE WALL TO BE REMOVED
POWER LINE
AREA TO BE CLEARED AND GRUBBED
ZONE I - MATERIAL AS REPRESENTED BY TP
ZONE II - MATERIAL AS REPRESENTED BY TP
ZONE III - MATERIAL AS REPRESENTED BY TP 204
NOTE: AREAS TO BE SEEDED INCLUDE DAM, DIKE, EMERGENCY SPILLWAY
FOR LOGS OF DRILL HOLES AND TEST PITS
SEE SHEETS 13 & 14
ZONE I
ZONE II
ZONE III
TYPICAL SECTION OF DAM
NOT TO SCALE
BORROW AREA
NORMAL POOL EL
DESIGN HIGH WATER EL 1233.5
POWER LINE TO BE RELOCATED
OTHERS BEFORE CONSTRUCTI
TP-102
TP-103
TP-104
TP-105
TP-107
TP-108
TP-109
TP-110
TP-111
TP-112
TP-112-A
TP-113
TP-114
TP-115
TP-116
TP-117



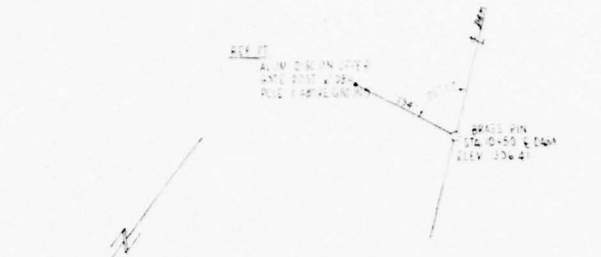
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

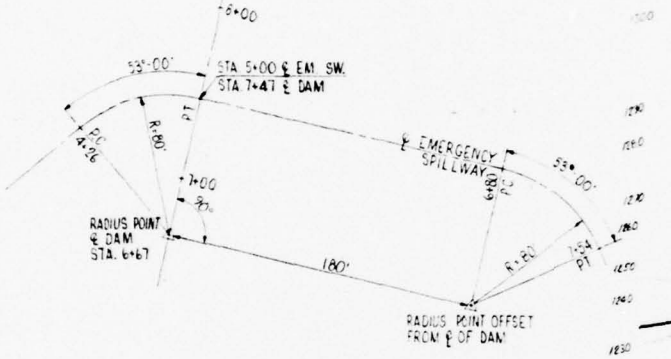
SUSQUEHANNA COUNTY COMMISSIONERS

PLAN AND TYPICAL SECTION

AUGUST 1979 PLATE 2

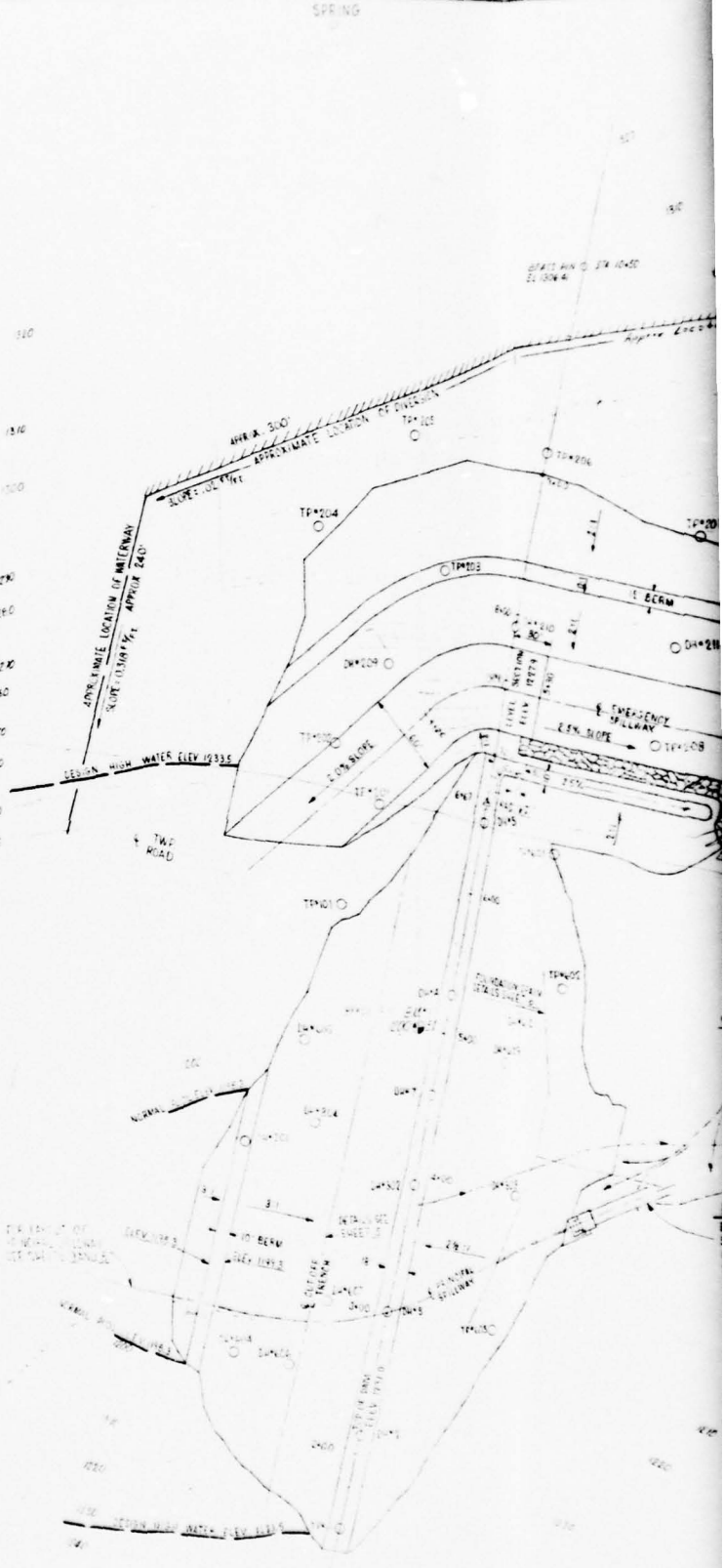


REFERENCE POINT LAYOUT
NOT TO SCALE



LAYOUT OF ℄ OF EMERGENCY SPILLWAY

0 10 50 100 FEET
SCALE



CENTERLINE CURVE DATA

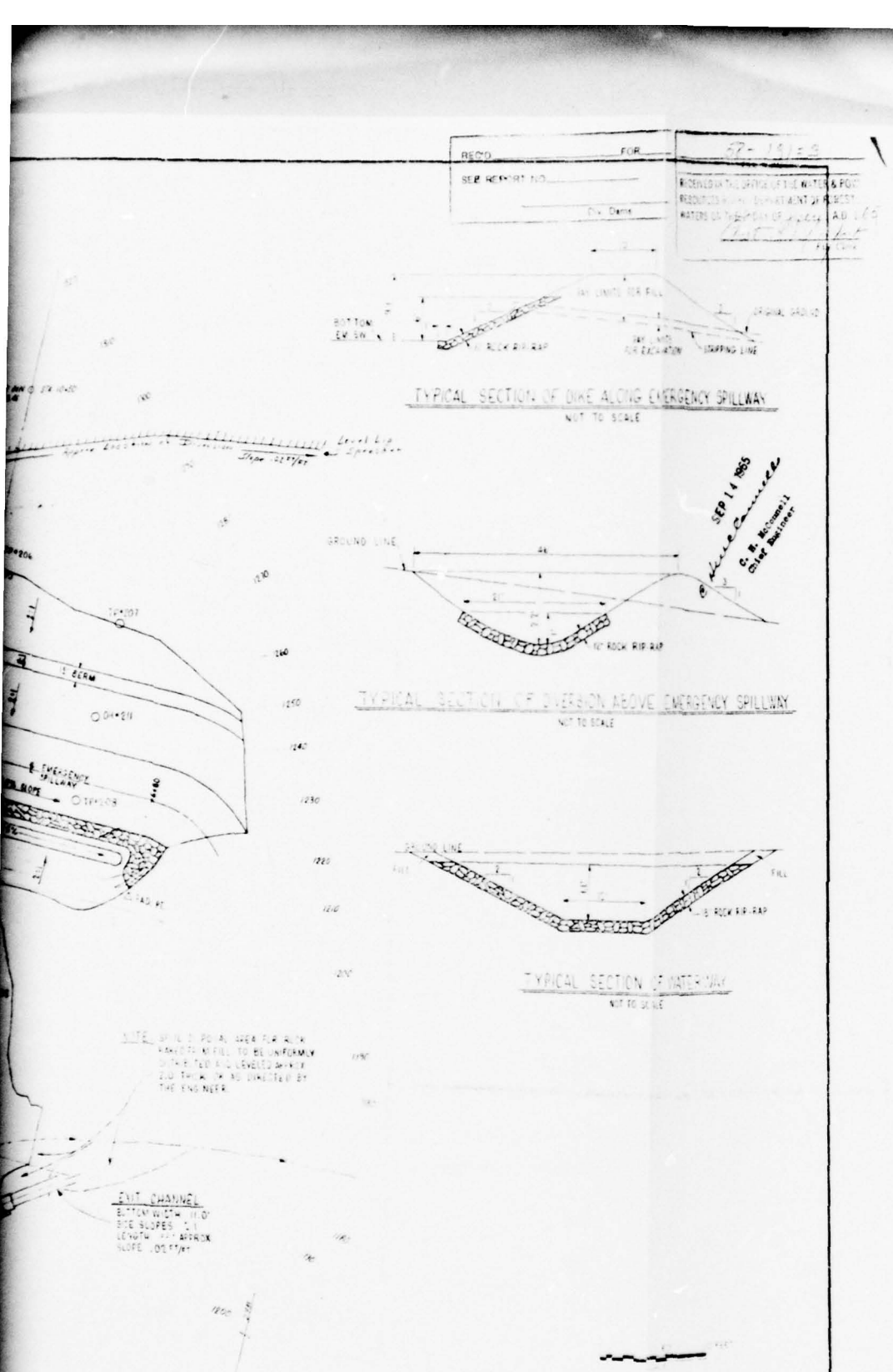
UPSTREAM CURVE

STATION	DEFLECTION ∠	CHORD
PC 4+26	0°-00'	
5+36.57	3°-47'	10.56'
5+47.13	7°-34'	10.56'
5+57.71	11°-21'	10.56'
5+68.26	15°-09'	10.56'
5+78.83	18°-56'	10.56'
5+89.40	22°-43'	10.56'
PT 5+93	24°-30'	10.56'

T = 39.88'
D = 71.39°
Lc = 74.00'
M = 8.91'
E = 9.38'
I = 53°-00'
R = 80'

DOWNSTREAM CURVE

STATION	DEFLECTION ∠	CHORD
PC 6+80	0°-00'	
6+90.57	3°-47'	10.56'
7+01.14	7°-34'	10.56'
7+11.71	11°-21'	10.56'
7+22.26	15°-09'	10.56'
7+32.85	18°-56'	10.56'
7+43.42	22°-43'	10.56'
PT 7+54	26°-30'	10.56'



MARTIN CREEK WATERSHED
FLOODWATER RETARDING DAM PA-467
SUSQUEHANNA COUNTY, PENNSYLVANIA

DAMSITE

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PA-467-P

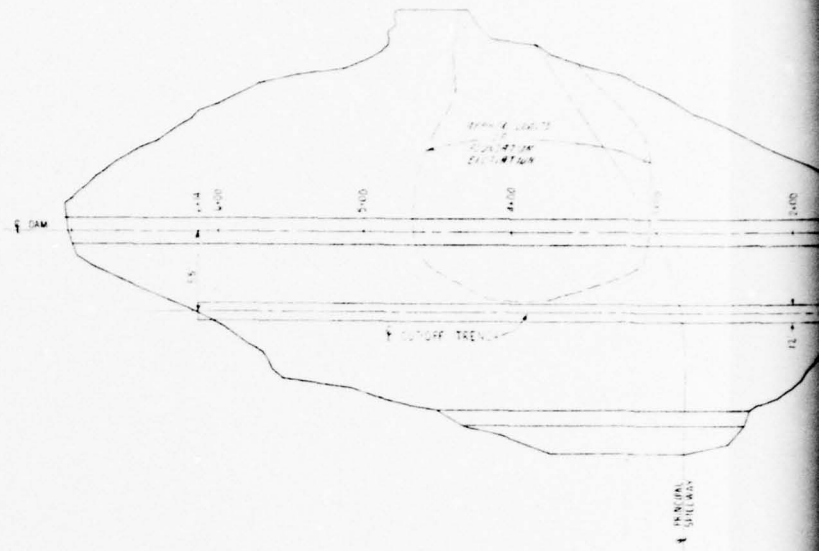
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

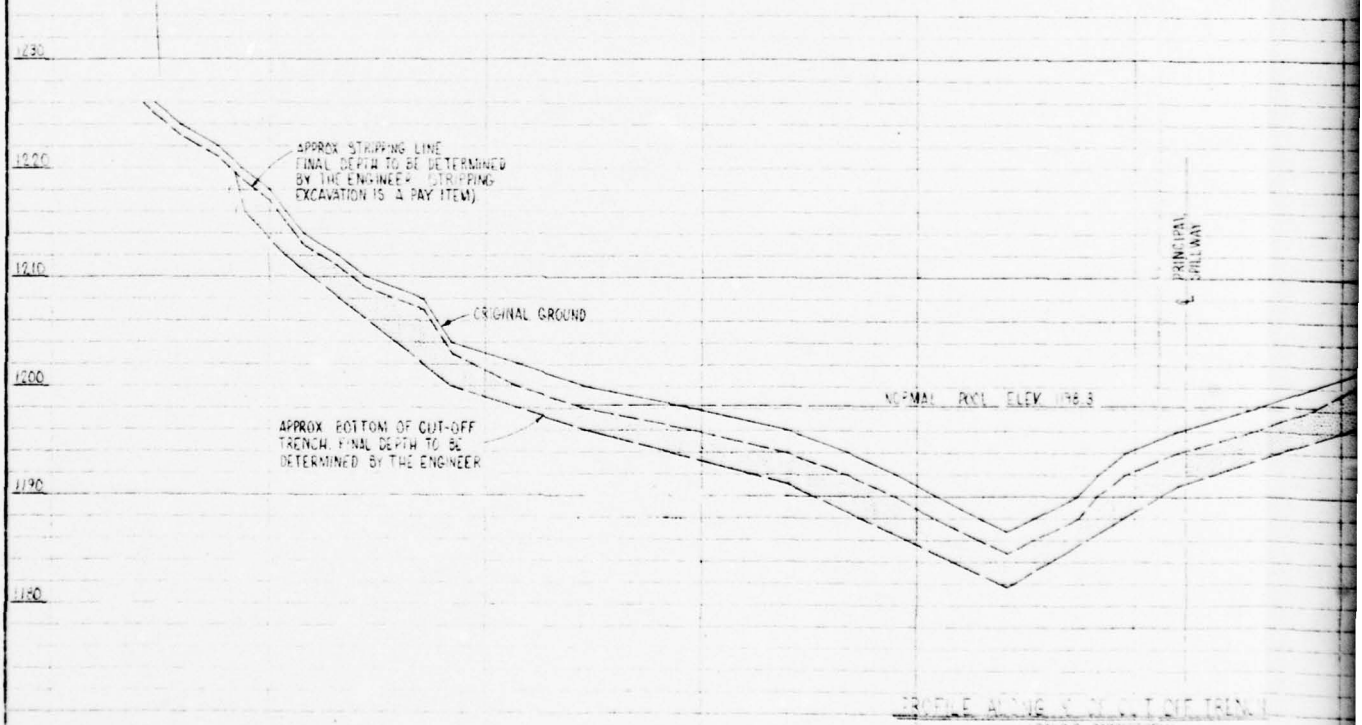
ALIGNMENT PLAN

AUGUST 1979 PLATE 3

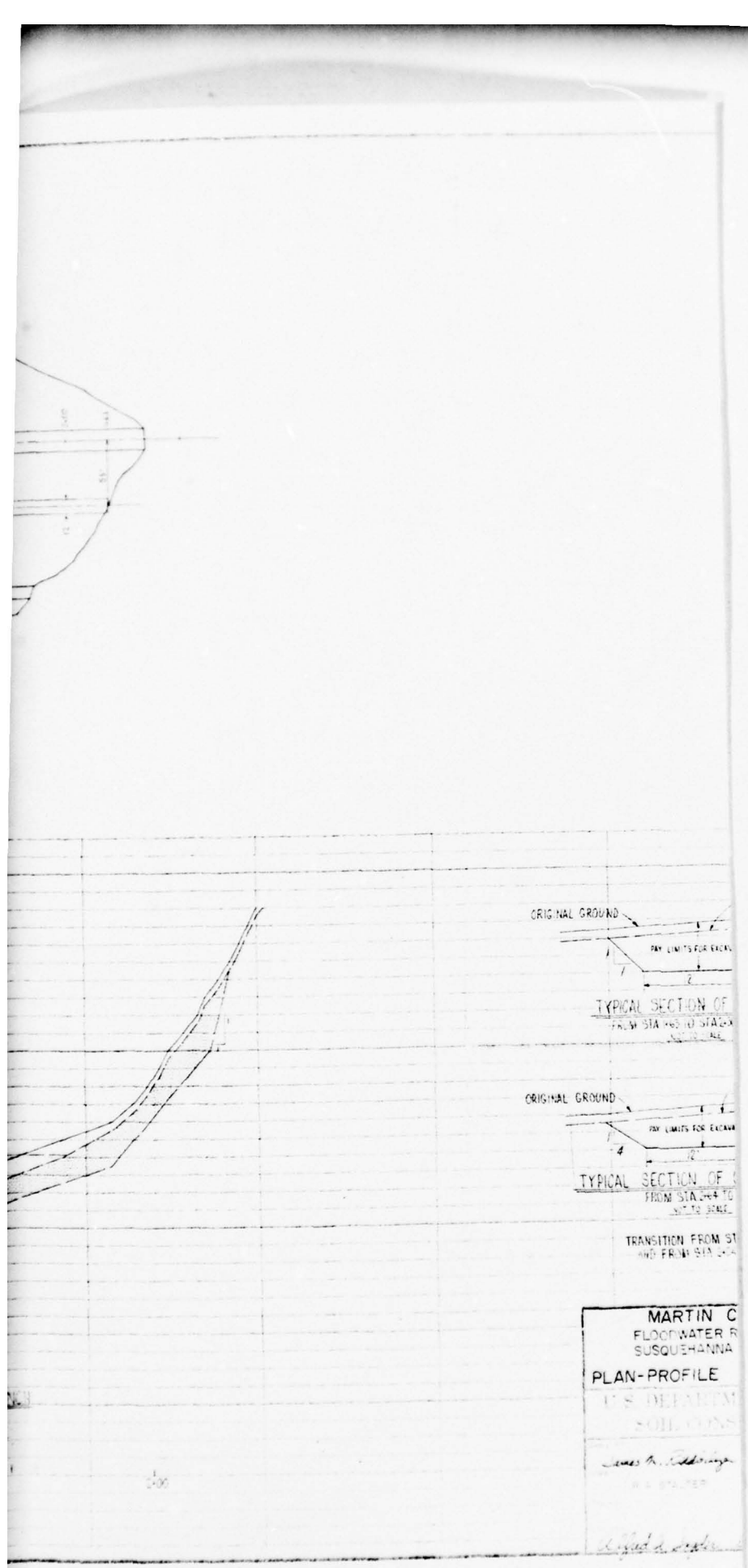


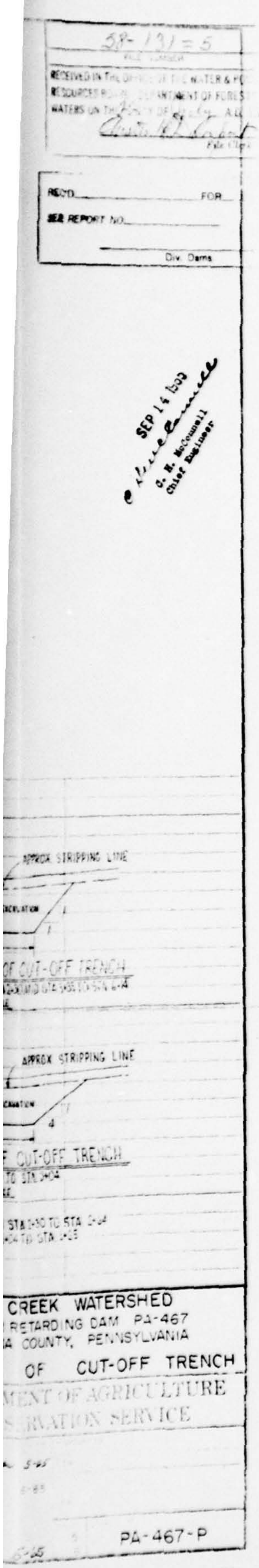
PLAN VIEW OF CUT-OFF TRENCH

SCALE



PROFILE ALONG ℄ OF CUT-OFF TRENCH


ORIGINAL GROUND
PAY LIMITS FOR EXCAV
TYPICAL SECTION OF
ORIGINAL GROUND
PAY LIMITS FOR EXCAV
TYPICAL SECTION OF
TRANSITION FROM ST
MARTIN C
FLOODWATER R
SUSQUEHANNA
PLAN-PROFILE



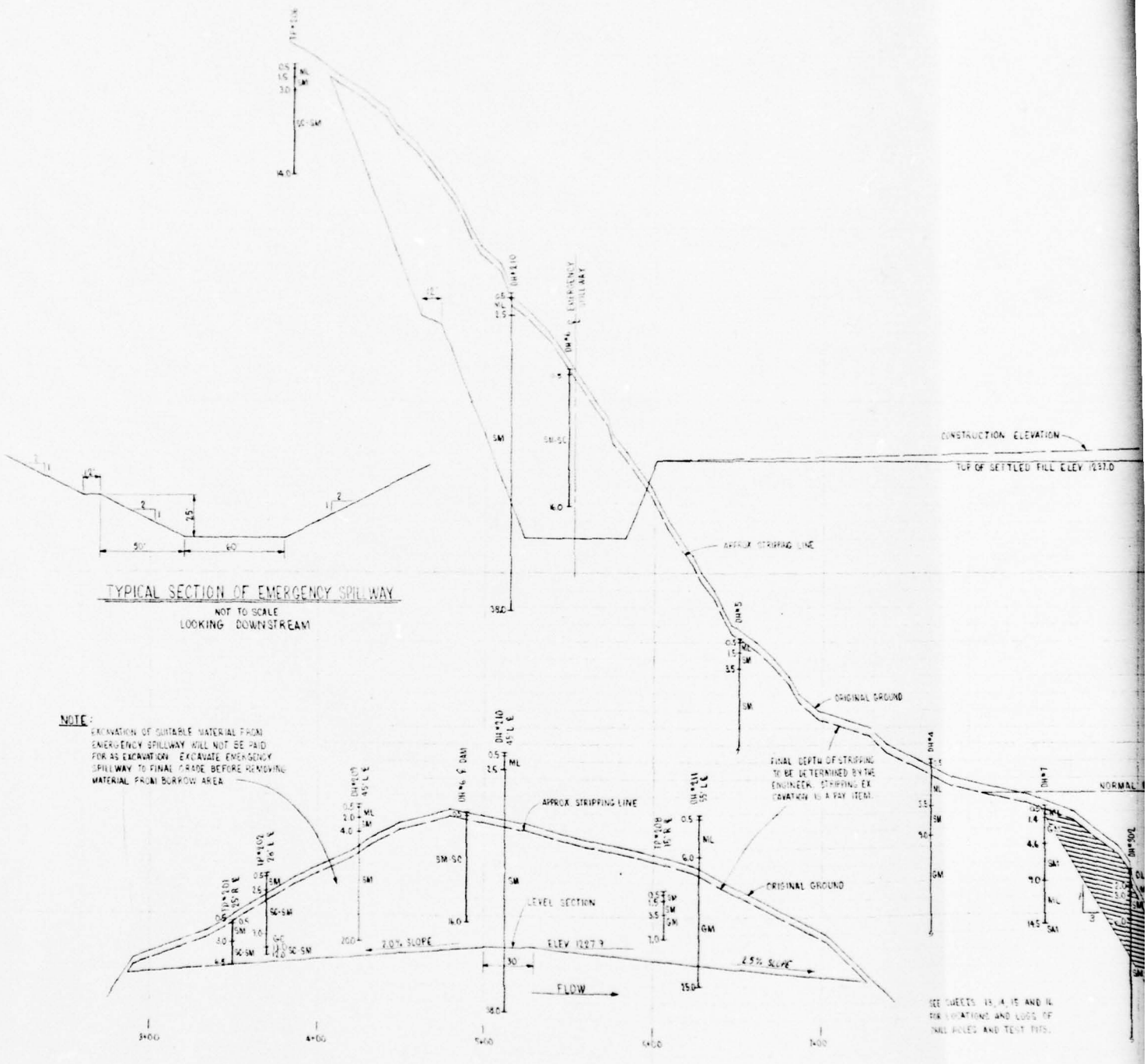
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

CUTOFF TRENCH

AUGUST 1979 PLATE 4



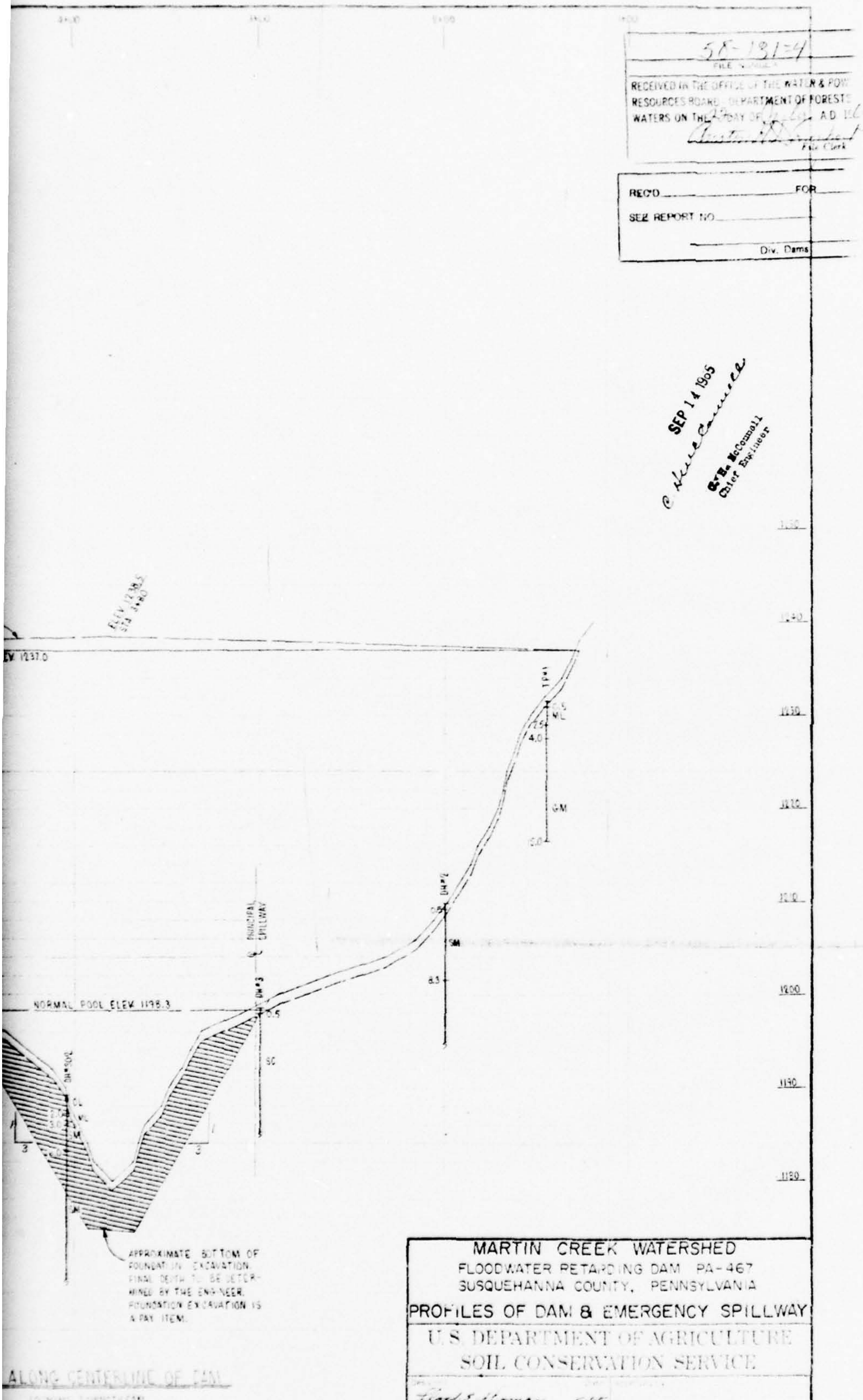
TYPICAL SECTION OF EMERGENCY SPILLWAY

NOT TO SCALE
LOOKING DOWNSTREAM

NOTE:
EXCAVATION OF SUITABLE MATERIAL FROM EMERGENCY SPILLWAY WILL NOT BE PAID FOR AS EXCAVATION. EXCAVATE EMERGENCY SPILLWAY TO FINAL GRADE BEFORE REMOVING MATERIAL FROM BORROW AREA

PROFILE ALONG ℄ OF EMERGENCY SPILLWAY

PROFILE ALONG ℄



MARTIN CREEK WATERSHED
FLOODWATER RETARDING DAM PA-467
SUSQUEHANNA COUNTY, PENNSYLVANIA
PROFILES OF DAM & EMERGENCY SPILLWAY
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Floyd S. Thomas 5-65
W.S. STAUFFER 5-65
5-65
PA-467-P

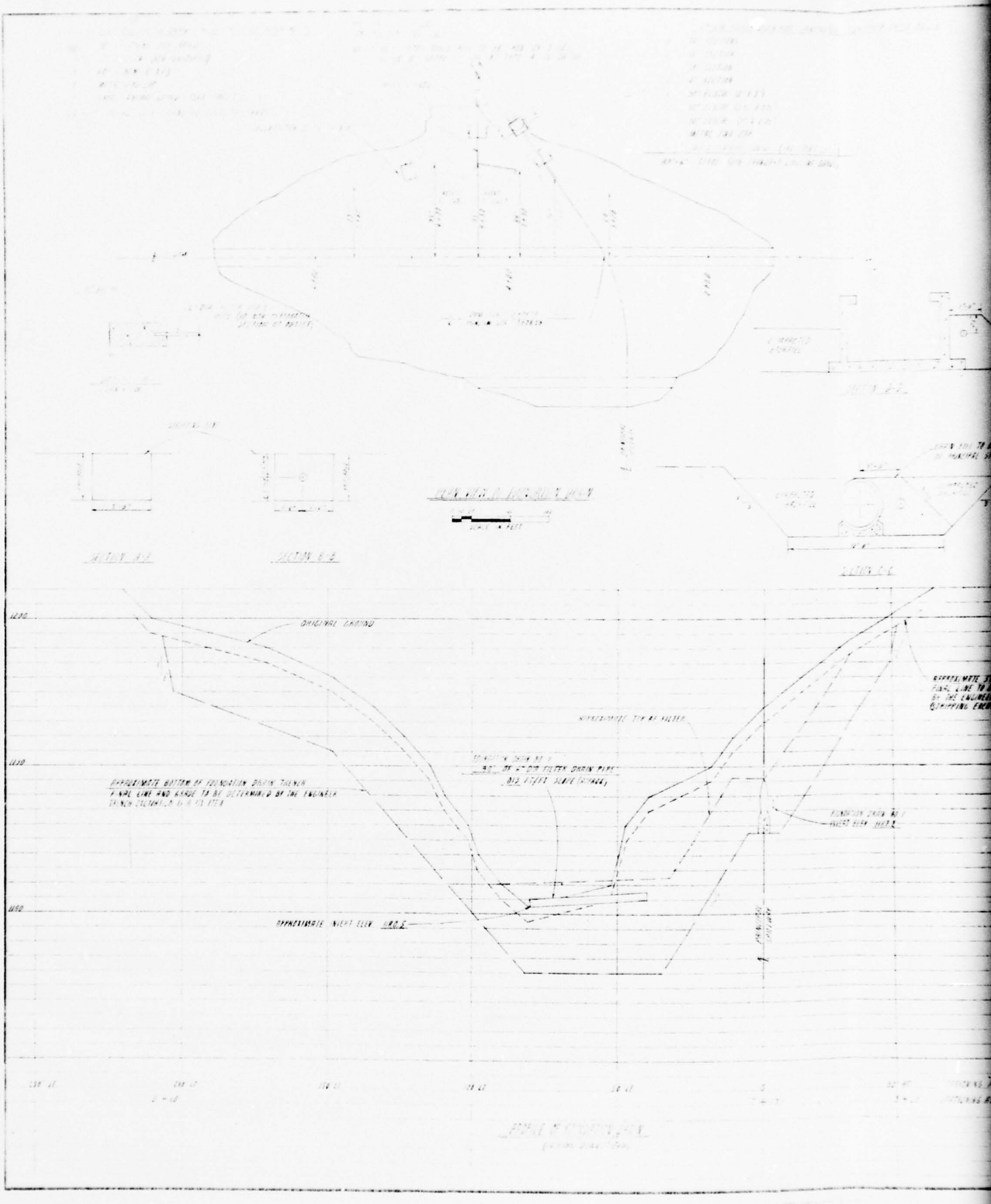
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

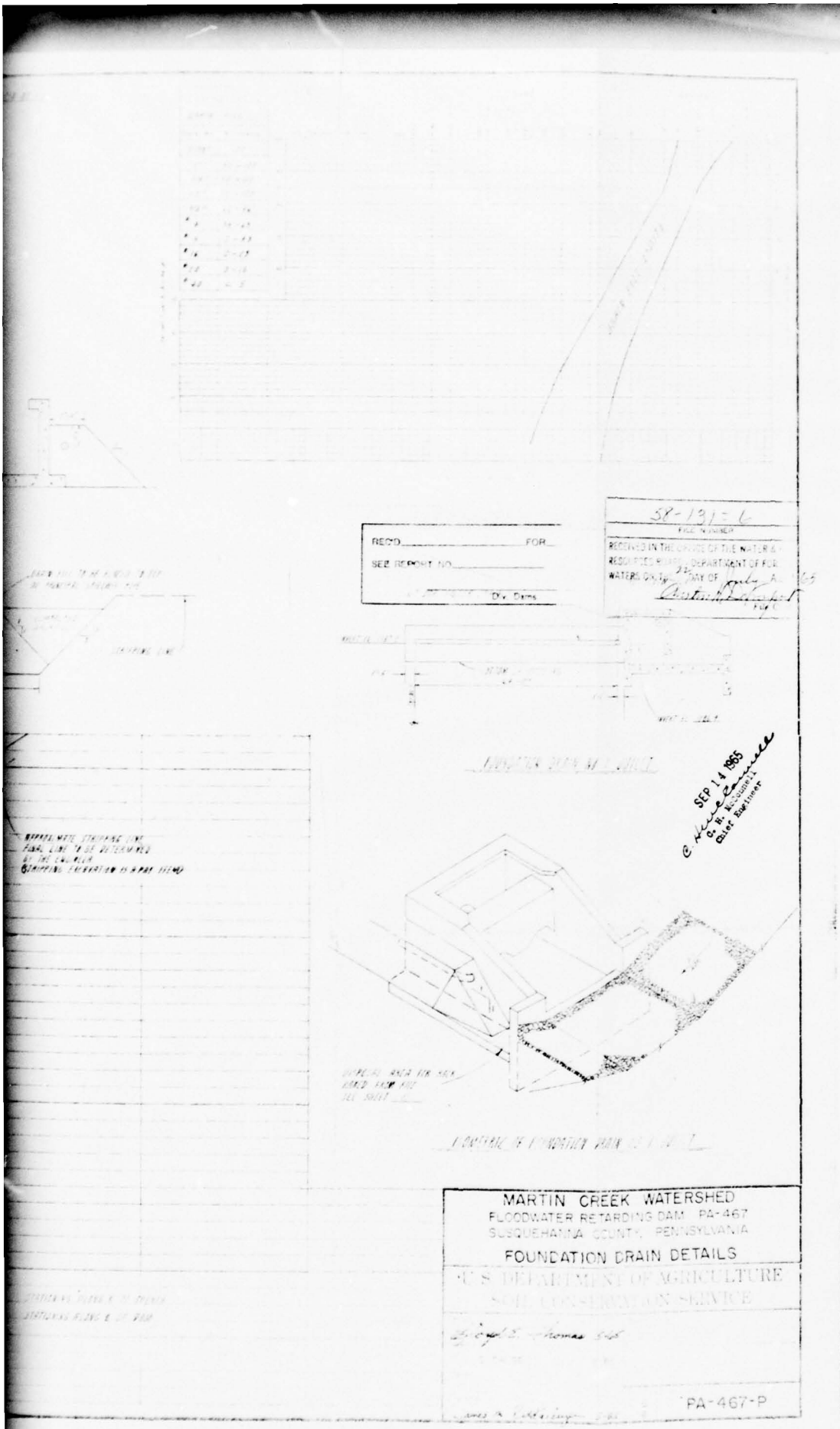
PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

PROFILES

AUGUST 1979 PLATE 5


ORIGINAL GROUND
APPROXIMATE BOTTOM OF FOUNDATION DRAIN TRENCH
FINAL LINE AND GRADE TO BE DETERMINED BY THE ENGINEER
APPROXIMATE INVERT ELEV



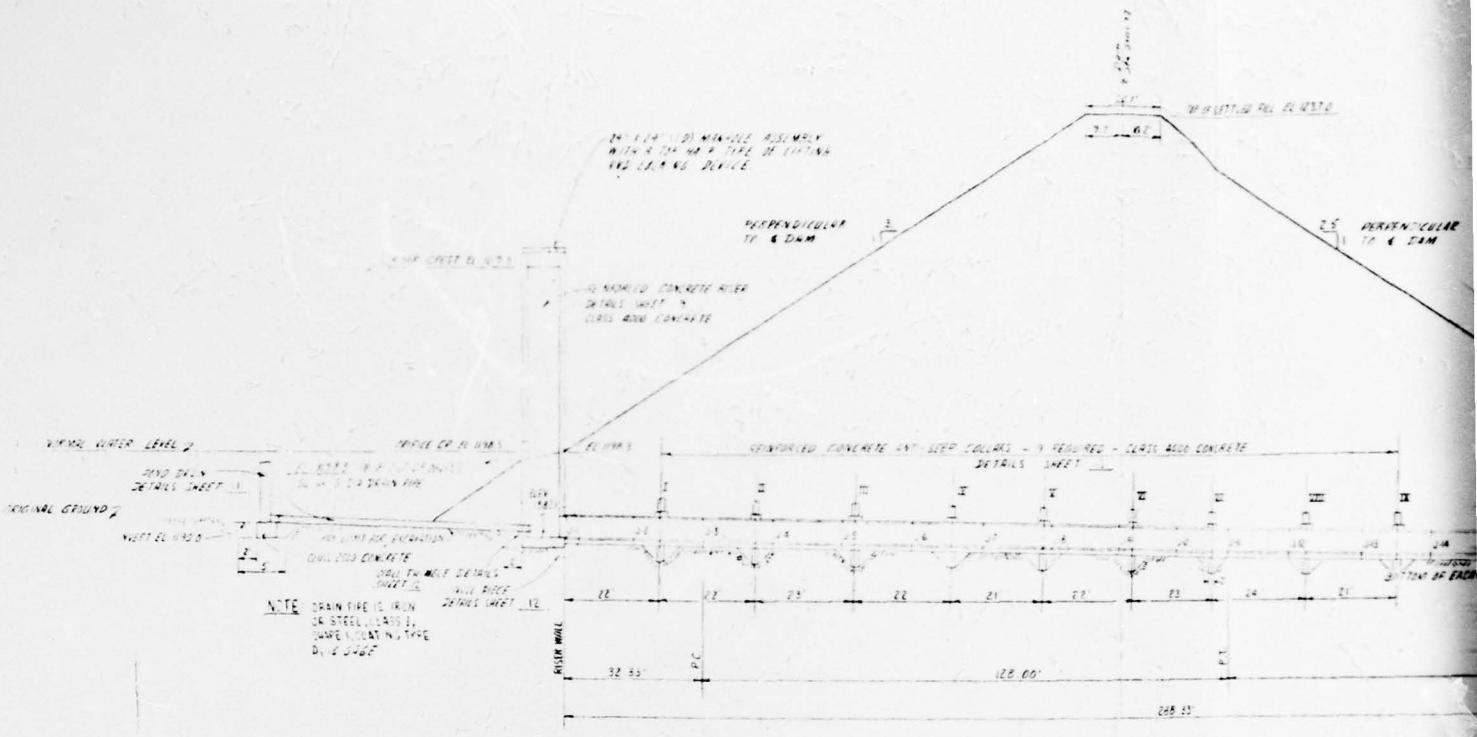
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

DRAIN PLAN

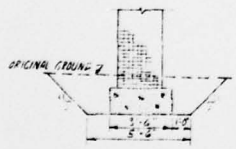
AUGUST 1979 PLATE 6



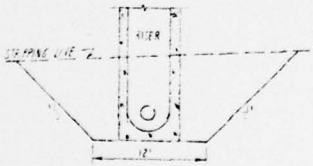
PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY PIPE

HORIZONTAL SCALE 0 50 FEET

VERTICAL SCALE

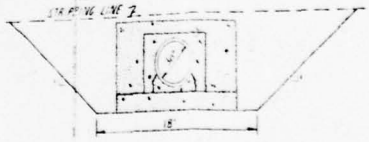


POND DRAIN INLET



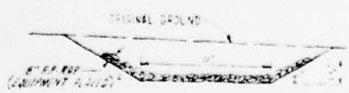
RISER

BEDDING



ANTI-SEEP COLLAR

POND DRAIN



EXIT CHANNEL

TYPICAL SECTIONS

PAY LIMITS FOR EXCAVATION BETWEEN NEAT LINES

PIPE JOINT DATA

JOINT	DISTANCE FROM RISER WALL	INVERT EL OF 30" ID PIPE
[illegible]	[illegible]	[illegible]
J-2	16.33	1188.22
J-3	32.33	1188.11
J-4	48.33	1188.01
J-5	64.33	1187.90
J-6	80.33	1187.79
J-7	96.33	1187.68
J-8	112.33	1187.58
J-9	128.33	1187.47
J-10	144.33	1187.26
J-11	160.33	1187.05
J-12	176.33	1186.85
J-13	192.33	1186.64
J-14	208.33	1186.43
J-15	224.33	1186.22
J-16	240.33	1186.01
J-17	256.33	1185.81
J-18	272.33	1185.60
OUTLET	288.33	1185.34

NOTE: DIMENSIONS OF PIPE ARE BASED ON NOMINAL SIZE AND DO NOT INCLUDE CREEP

DISTANCE FROM RISER WALL IS MEASURED ALONG ℄ OF PRINCIPAL SPILLWAY PIPE

ANTI-SEEP COLLAR DATA

COLLAR	DISTANCE FROM RISER WALL	INVERT EL OF PIPE
I	22.0	1188.16
II	44.0	1188.03
III	67.0	1187.86
IV	89.0	1187.73
V	110.0	1187.59
VI	132.0	1187.42
VII	155.0	1187.12
VIII	179.0	1186.82
IX	200.0	1186.54

58-131=7

FILE NUMBER

RECEIVED IN THE ... WATER & ... RESOURCES ... DEPARTMENT OF ... WATERS ON THE 22 DAY OF July A 65

Austin H. Davenport

File ()

REC'D ________ FOR ____

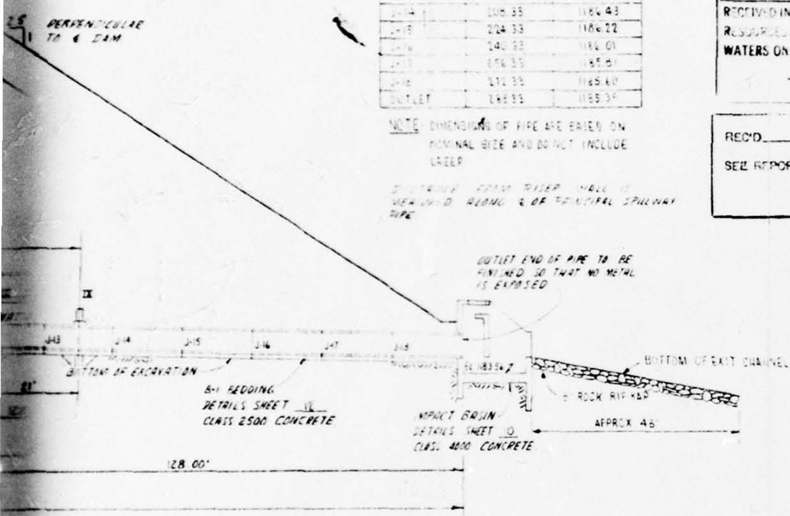
SEE REPORT NO. ________

Div. Dams

SEP 14 1965

C. H. McConnell

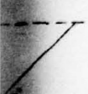
C. H. McConnell Chief Engineer

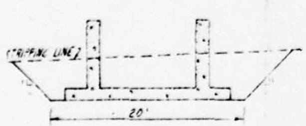


PRESSURE HEAD 30'
LOAD = 45,300 LBS PER LIN FT BASED ON O.D. OF 38"
MIN 3 EDGE BEARING STRENGTH FOR:
0.01" CRACK NON-PRESTRESSED PIPE = 23,200 LBS PER LIN. FT.
0.001" CRACK PRESTRESSED PIPE = 17,420 LBS PER LIN. FT.

30" INSIDE DIA REINFORCED CONCRETE WATER PIPE
9 - 16' STRAIGHT SECTIONS
2 - 16' HALF BEVEL SECTIONS
7 - 16' FULL BEVEL SECTIONS
1 - WALL PIECE FOR 12' WALL
289.33' TOTAL

20 FEET





IMPACT BASIN

MARTIN CREEK WATERSHED
FLOODWATER RETARDING DAM PA-467
SUSQUEHANNA COUNTY, PENNSYLVANIA

PROFILE ALONG ℄ OF PRIN/SW PIPE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	[signature]	5-65	Approved by
Drawn	R. MAYS	5-65	
Traced			
Checked	[signature]	5-65	PA-467-P

SCS-313B (APRIL 1960)

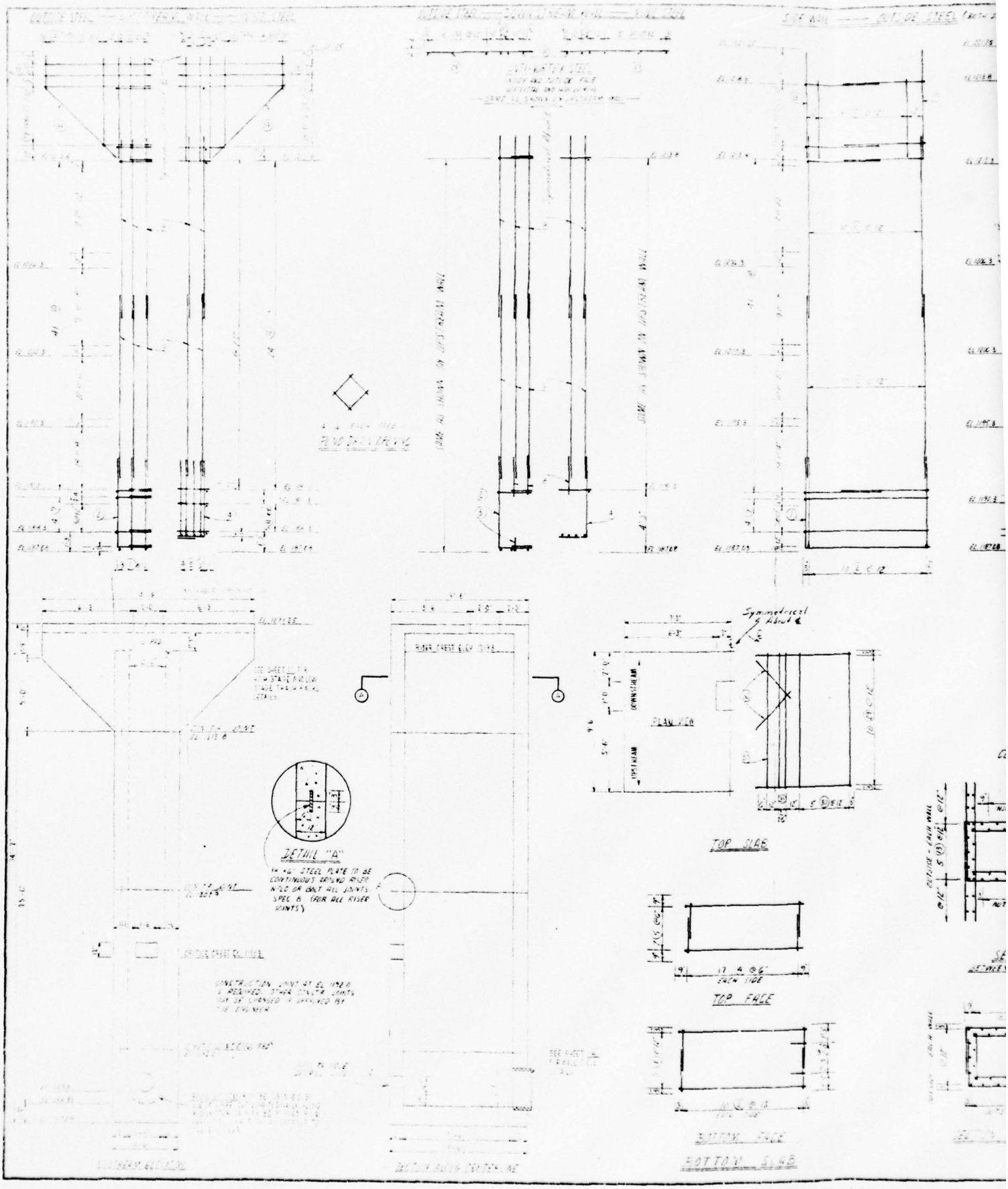
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

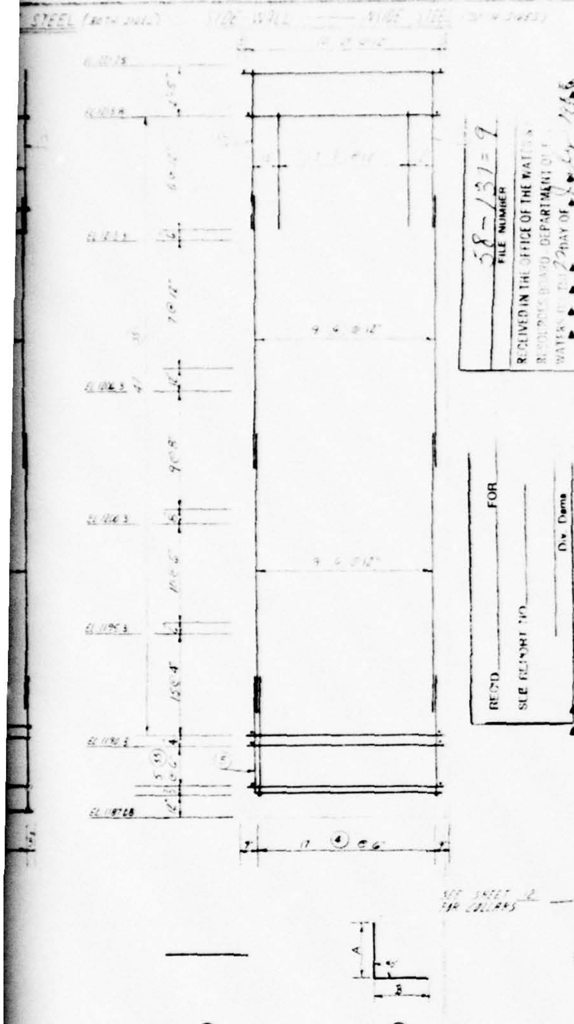
PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

MAIN SPILLWAY AND OUTLET WORKS

AUGUST 1979 PLATE 7


DETAIL "A"
TOP SLAB
TOP FACE
BOTTOM FACE
BOTTOM SLAB
PLAN VIEW
Symmetrical about ℄



STEEL SCHEDULE

MARK	LOCATION	NO.	SIZE	LENGTH	TYPE	A	B	TOTAL FT.
1		3	4	4-10	2	9-0	5-11	[illegible]
2		20	5	9-1	2	2-10	6-3	181.67
3		2	4	2-6	2	1-3	0-9	4.00
4		[illegible]	5	7-4	2	[illegible]	5-0	[illegible] 33
5		7	4	13-2	2	8-0	5-2	92 [illegible]
6		[illegible]	5	12-6	1			[illegible]
7		30	5	5-3	1			157.50
8		5	5	2-6	1			12.50
9		8	5	11-10	2	9-0	2-10	94.67
10		164	5	8-2	2	5-4	2-10	1339.33
11		5	9	3-3	1			16.25
12		48	5	3-3	1			156.00
13		22	5	3-3	1			[illegible] 50
14		8	5	2-0	1			16.00
15		8	5	3-0	1			24.00
16		8	5	4-0	1			32.00
17		8	5	5-0	1			40.00
18		8	5	6-0	1			48.00
19		4	5	10-4	2	5-0	5-4	41.33
20		4	5	11-4	2	6-0	5-4	45.33
21		4	5	12-4	2	7-0	5-4	49.33
22		4	5	13-4	2	8-0	5-4	53.33
23		4	5	14-4	2	9-0	5-4	57.33
24		10	5	14-2	1			141.67
25		2	5	12-0	1			24.00
26		2	5	10-0	1			20.00
27		2	5	8-0	1			16.00
28		2	5	6-0	1			12.00
29		10	4	14-2	1			141.67
30		12	5	9-2	1			110.00
31		4	8	9-2	1			36.67
32		4	5	3-6	1			14.00
33		10	9	8-3	1			82.50
34		8	5	7-3	1			58.00
35		94	5	8-3	1			775.50
36	ANTI-SEEP COLL	90	4	7-0	1			630.00
37		45	4	1-2	1			52.50
38		45	4	1-6	1			67.50
39		45	4	11-6	1			517.50
40		72	4	3-6	1			252.00

SEE SHEET 12 FOR COLLARS

CUT THESE BARS TO PROVIDE 2" CLEAR COVER AT OPENINGS.

PIPE DRAIN OPENING

ORIFICE OPENING

MANHOLE OPENING

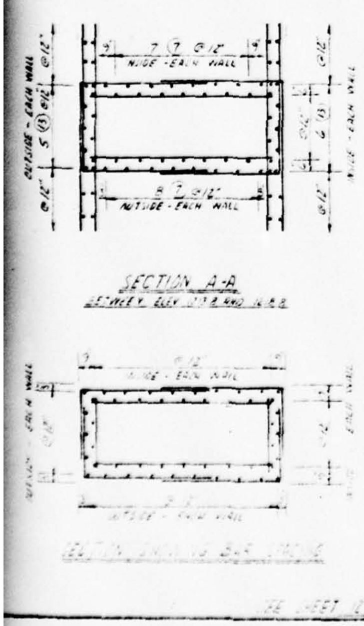
BAR TYPE

CONCRETE QUANTITY

CLASS 4000 CONCRETE 36.4 CU.YDS. (RISER ONLY)

STEEL QUANTITY (RISER AND COLLARS)

No. 4 BARS	[illegible] FT.	[illegible] LBS.
No. 5 BARS	4875.[illegible] FT.	5088.8 LBS.
No. 8 BARS	36.67 FT.	97.9 LBS.
No. 9 BARS	98.75 FT.	335.8 LBS.
TOTAL		6913 LBS.



SECTION A-A

SECTION SHOWING BAR SPACING

SEE SHEET 12 FOR GENERAL NOTES

RECEIVED IN THE OFFICE OF THE WATER AND POWER RESOURCES BOARD, DEPARTMENT OF FOREST AND WATERS THIS 2 DAY OF

38-131-9 FILE NUMBER

REC'D FOR

SEP 14 1965

C. H. McConnell Chief Engineer

MARTIN CREEK WATERSHED
FLOODWATER RETARDING DAM PA-467
SUSQUEHANNA COUNTY, PENNSYLVANIA

STRUCTURAL DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PA-467-P

SCS-313C (9-61)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

MAIN SPILLWAY RISER

AUGUST 1979 — PLATE 8

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: PA-467 Dam

NDI ID NO.: PA-00054 DER ID NO.: 58-131

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	Complete set of design drawings available. As-built conditions shown in SCS files (Attached at end of this Appendix).
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	Constructed 1966 by Susquehanna County Commissioners.
TYPICAL SECTIONS OF DAM	See Plate 2.
OUTLETS: Plan Details Constraints Discharge Ratings	See Plates 3, 7, and 8. See Appendix C for discharge ratings.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	Complete design folder in Penn DER files. Designed by SCS.
GEOLOGY REPORTS	Full geologic report in design folder.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	Complete H & H computations. Stability analysis for embankment. No seepage studies available.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	Complete investigation - summary presented in Appendix E.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	As shown on Plate 2.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	Annual operation and maintenance inspection reports by SCS.
SPILLWAY: Plan Sections Details	See Plates 3 and 5.
OPERATING EQUIPMENT: Plans Details	Available.
PREVIOUS INSPECTIONS Dates Deficiencies	1970: No deficiencies. 1971: No deficiencies. 1972: Brush piles in reservoir area. 1973: No deficiencies. 1974: Trees and brush in reservoir area. 1975: No deficiencies. 1976: No deficiencies.

10-58

SOIL MECHANICS LABORATORY Maximum Section

SUMMARY - SLOPE STABILITY ANALYSIS

State PENNSYLVANIA Project MARTIN CREEK SITE PA-467

Date 4-8-65 Analysis Made By [illegible] Checked By T.C.H

Method of Analysis SWEDISH CIRCLE

Location of Material	Found		Found. ML				Emb 95% Std SC-SM-GC-GM		Emb 95% Std. GM	
Sample No.	65W2209		65W2205		65W2304		65W2303		[illegible]	
γ_d	107.0		122.5		122.0		120.5		131.0	
γ_m							135.0		145.0	
γ_s	130.5		139.0		139.0		140.0		148.0	
γ_b	68.0		76.5		76.5		77.5		85.5	
Condition	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.
ϕ		24.0°		35.0°				25.0°		32°
Tan ϕ		0.445		0.700				0.466		0.625
K										0.309
C		1100		950				325		0

UPSTREAM SLOPE

Trial	Slope	Conditions	Fs
4	3:1	Full drawdown - 10' berm @ elev 1198 - Arc cut from opp sh'l'd'r thru Emb (25.0°-32.5) only	1.41
5	3:1	Full drawdown - 10' berm @ elev. 1198 - Arc cut from opp sh'l'd'r thru Emb. (25.0°-32.5) only	1.44
6	3:1	Full drawdown - 10' berm @ elev 1198 - Arc cut from opp sh'l'd'r thru Emb. (25.0°-32.5) only	1.42

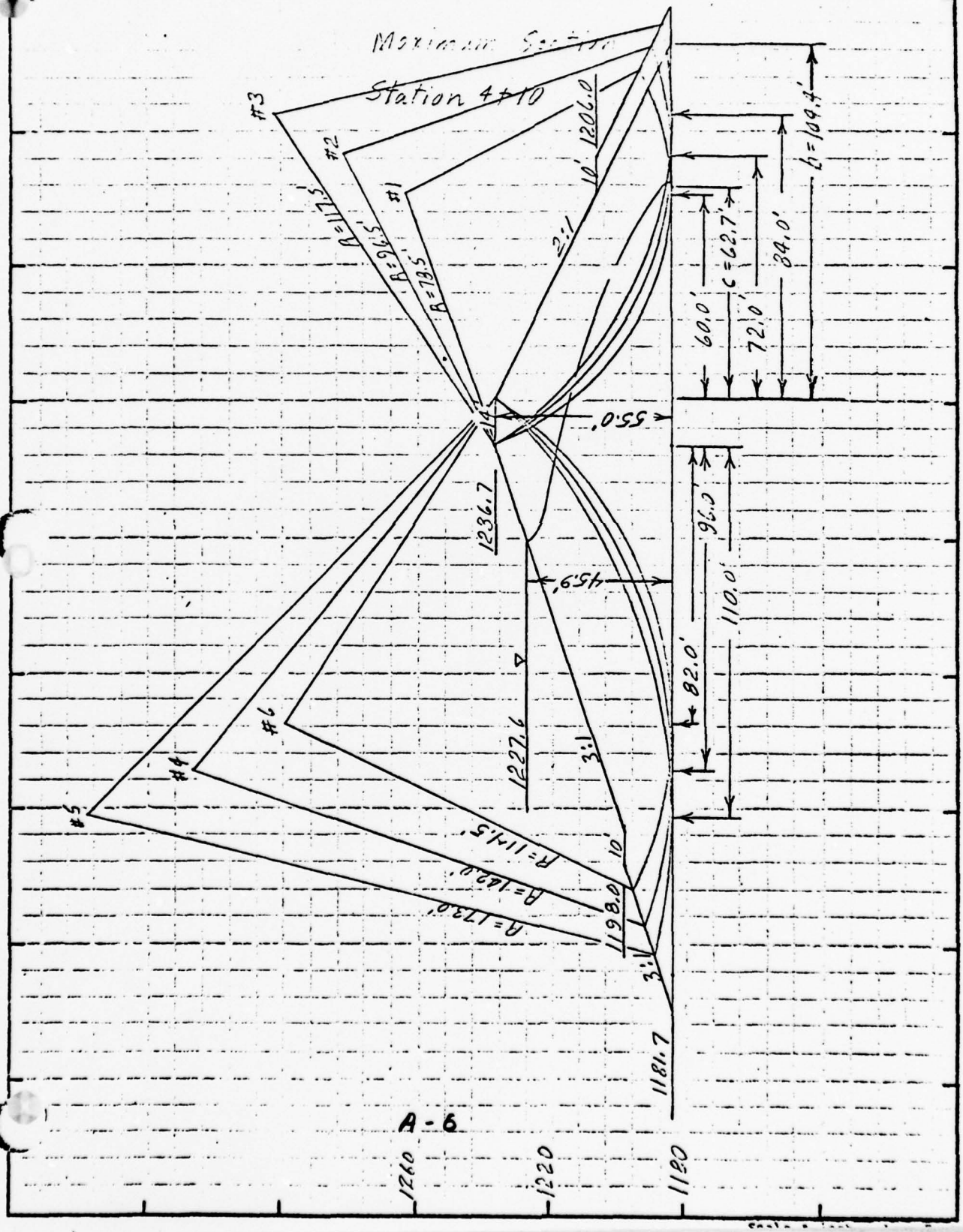
DOWNSTREAM SLOPE

Trial	Slope	Conditions	Fs
1	2:1	Drain @ c/b = 0.6 - No berm - Arc cut from opp sh'l'd'r thru Emb (25.0°-32.5) only	1.43
1A	2:1	Same as #1 except 10' berm @ elev 1206	1.57
2	2:1	Drain @ c/b = 0.6 - 10' berm @ elev 1206 - Arc cut from opp. sh'l'd'r thru Emb (25.0°-32.5) only	1.53
3	2:1	Drain @ c/b = 0.6 - 10' berm @ elev 1206 - Arc cut from opp sh'l'd'r thru Emb (25.0°-32.5) only	1.56
		Sat. shear values used on all trials	

A-5

To be used to report to field offices data used for slope stability analyses and the results of the analyses. The right side of the form will be used for a sketch of the embankment on which the analyses have been made.

Continuation of Sheet 1 of 2
Martin Creek Site PA-467
Pennsylvania



A-6

MAY 1962 EDITION
GSA GEN. REG. NO. 27

UNITED STATES GOVERNMENT

Memorandum

TO : Craig M. Right, State Conservation Engineer, SCS, Harrisburg, Pennsylvania

DATE: August 24, 1966

FROM : Rey S. Decker, Head, Soil Mechanics Laboratory, SCS, Lincoln, Nebraska

SUBJECT: ENG - Pennsylvania WP-08, Martin Creek PA-467 - Construction modification in embankment zoning

Reference is made to your phone call of August 12 and Mr. Wall's call of August 22, 1966 concerning changes in embankment design that might be required by using more material like Sample 65W2305 from TP 109 than originally planned.

Gradation of material represented by TP 109 and placed in a test fill, as called to Soil Mechanics Laboratory by Mr. Wall, is shown on Form SCS-353 attached. According to Wall, the test fill has in place dry density of 126.6 p.c.f. (mass) with mass moisture content of 7.4%.

Assuming bulk dry density of the rock at 2.4 g/cc (150 p.c.f.) - the same as rock from TP 108 in the same borrow area as TP 109 - the minus No. 4 density of the test fill would be about 109 p.c.f. with 55% rock. On the basis of other samples from this site, 109 p.c.f. on the minus No. 4 would be at least 90% of maximum standard -4 density.

Samples from PA-467 have been discarded. However, the following test data from sites with similar materials are considered applicable to this site:

Penn. - Kaercher Cr. PA-477

Test Fill, mass - γ_d	= 125-128 p.c.f.
Test Fill, minus #4 (computed) - γ_d	= 90 p.c.f. approx.
Max. Lab. Standard minus #4 - γ_d	= 120 p.c.f.
Bulk density rock	= 2.41-2.47 g/cc
Larger than No. 4	= 65-70%
Test fill specimen $\overline{\phi}$	= 36°
Test fill specimen $\overline{c}$	= 300 p.s.f.

Virginia - Dry Run Site 102

Lab test - mass γ_d	= 125 p.c.f.
Lab test - minus 4 γ_d	= 94 p.c.f.
Max std. minus 4 γ_d	= 113.5 p.c.f.
Bulk density rock	= 2.56 g/cc
Lab. test > No. 4	= 60%
Lab specimen $\overline{\phi}$	= 43°
Lab specimen c	= 0

2 -- Craig M. Right -- 8/24/66
Rey S. Decker
Subj: ENG - Pa. WP-08, Martin Cr. PA-467 - Construction modification in embankment zoning

Virginia - Lower No. River No. 78

Lab test - mass γ_d	= 126 p.c.f.
Lab test < No. 4 γ_d	= 94 p.c.f.
Max. standard < No. 4 γ_d	= 112 p.c.f.
Bulk density rock	= 2.55 g/cc
Lab test > No. 4	= 60%
Lab specimen $\overline{\phi}$	= 40°
Lab specimen c	= 0

Conclusions and Recommendations:

1. Material represented by Lab. sample 65W2305 from TP 109 and as placed in the test fill should have shear parameters equal to or greater than $\overline{\phi}$ = 35°, $\overline{c}$ = 0 when compacted to mass densities of 125 p.c.f. or greater.

   It is likely that shear parameters for this material will be about the same as for that tested on Kaercher Creek PA-477 or $\overline{\phi}$ = 36°, $\overline{c}$ = 300 p.s.f.

2. Shear parameters of $\overline{\phi}$ = 35° and $\overline{c}$ = 0 were substituted in slope stability analyses shown in the original report for this site dated April 22, 1965. These parameters produced a minimum safety factor of 1.56 for a 2:1 downstream slope. The safety factor for the designed 2-1/2:1 downstream slope will be considerably higher than 1.56.

3. Material with the gradation reported by Mr. Wall and shown on Form SCS-353 (gradation run by private laboratory in Harrisburg, Pa.) should provide an almost perfect filter and drain for adjacent embankment Zone 3 represented by samples 65W2302 (TP 204) and 2304 (TP 108). No transition filter zone will be necessary between Zones 3 and 2.

4. All available material represented by TP 109 (Zone 2) can be used anywhere in the downstream section of the dam. It is suggested, however, that the slope of the junction between the central Zone 3 (TP 204 and TP 108) and downstream Zone 2 (TP 109) be not steeper than 0.5 horizontal to 1.0 vertical starting from the downstream shoulder of the crest and sloping upstream as shown in attached figure. (This recommendation assumes that cutoff was placed upstream from ℄ of the dam.)

Attachments

Rey S. Decker

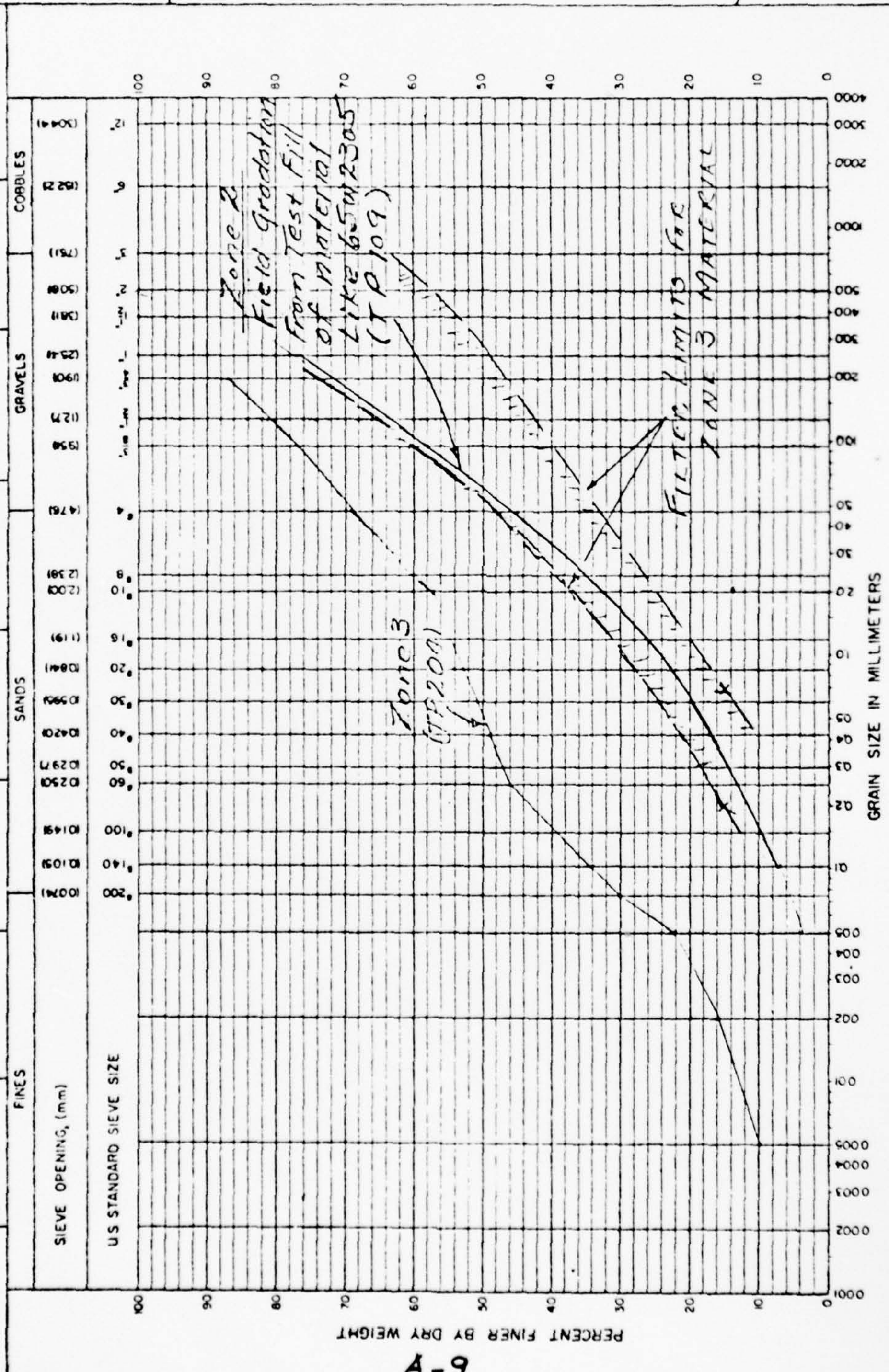
cc: H. M. Kautz - Upper Darby, Pa.

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL CLASSIFICATION

PROJECT and STATE: Penn - PA 467 - Martin Cr.	SAMPLE LOCATION: Embankment Fill
FIELD SAMPLE NO.: TP 109(f)	DEPTH:	GEOLOGIC ORIGIN:
TYPE OF SAMPLE:	TESTED AT:	APPROVED BY:	DATE:
SYMBOL:	DESCRIPTION: Field Gradation - ZONE 2 Material From Test Fill. Zone 3 Original Lab. Sample

GRAIN SIZE DISTRIBUTION

D10	D15	D30	D50	D60	D85	DMAX	Cu	Cc



UNDISTURBED CONDITION	
MOISTURE %	DRY UNIT WEIGHT g/cc pcf

SHRINKAGE LIMIT	SOLUBLE SALTS
%	%

ATTERBERG LIMITS

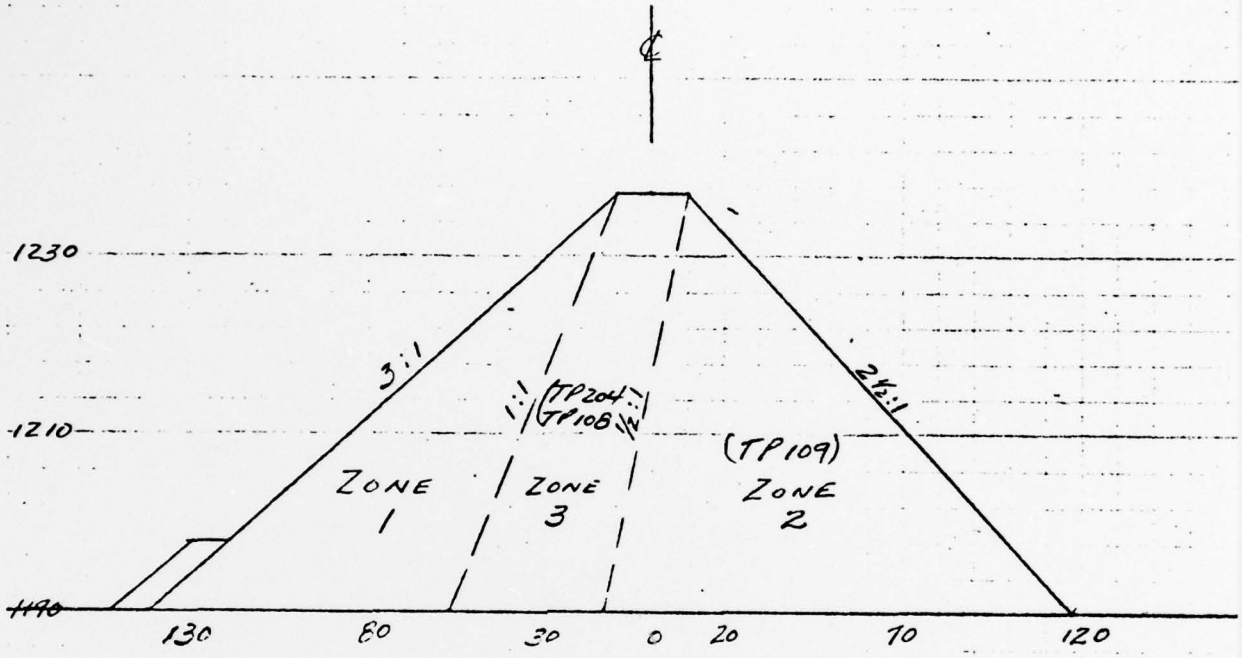
NATURAL MOISTURE LL	NATURAL MOISTURE PI	AIR DRY LL	AIR DRY PI	OVEN DRY LL	OVEN DRY PI

SPECIFIC GRAVITY (G_S)

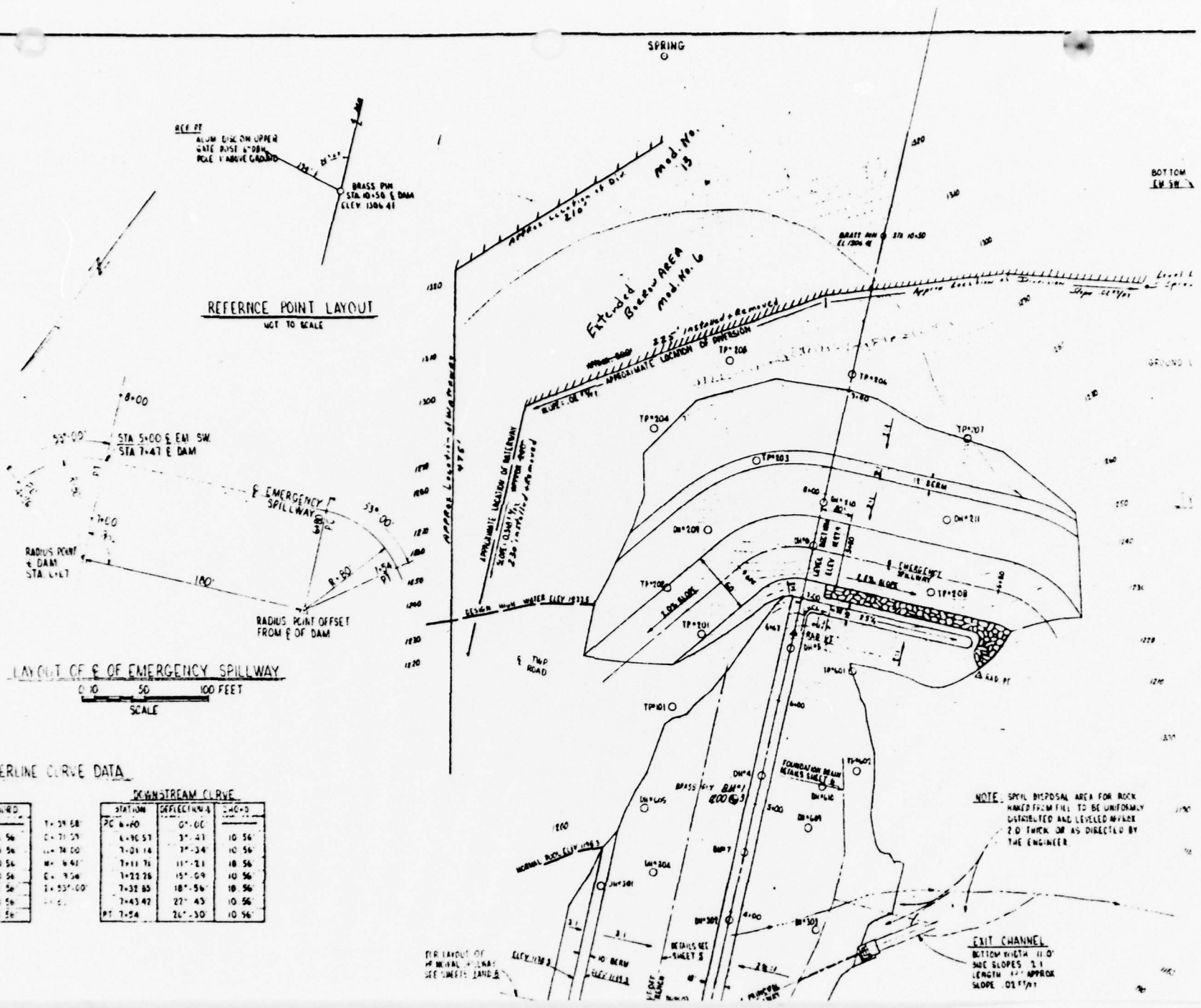
(-) #4	(+) #4

REMARKS:

STATE PENNSYLVANIA		PROJECT PA 467		
BY RSD	DATE 1/23/66	CHECKED BY	DATE	JOB NO.
SUBJECT Project Modification - Embankment Zoning				SHEET ___ OF ___



CARRY ZONE 2 MATERIAL AS HIGH AS AVAILABLE - FINISH WITH ZONE 3 MATERIAL



A-11

CENTERLINE CURVE DATA

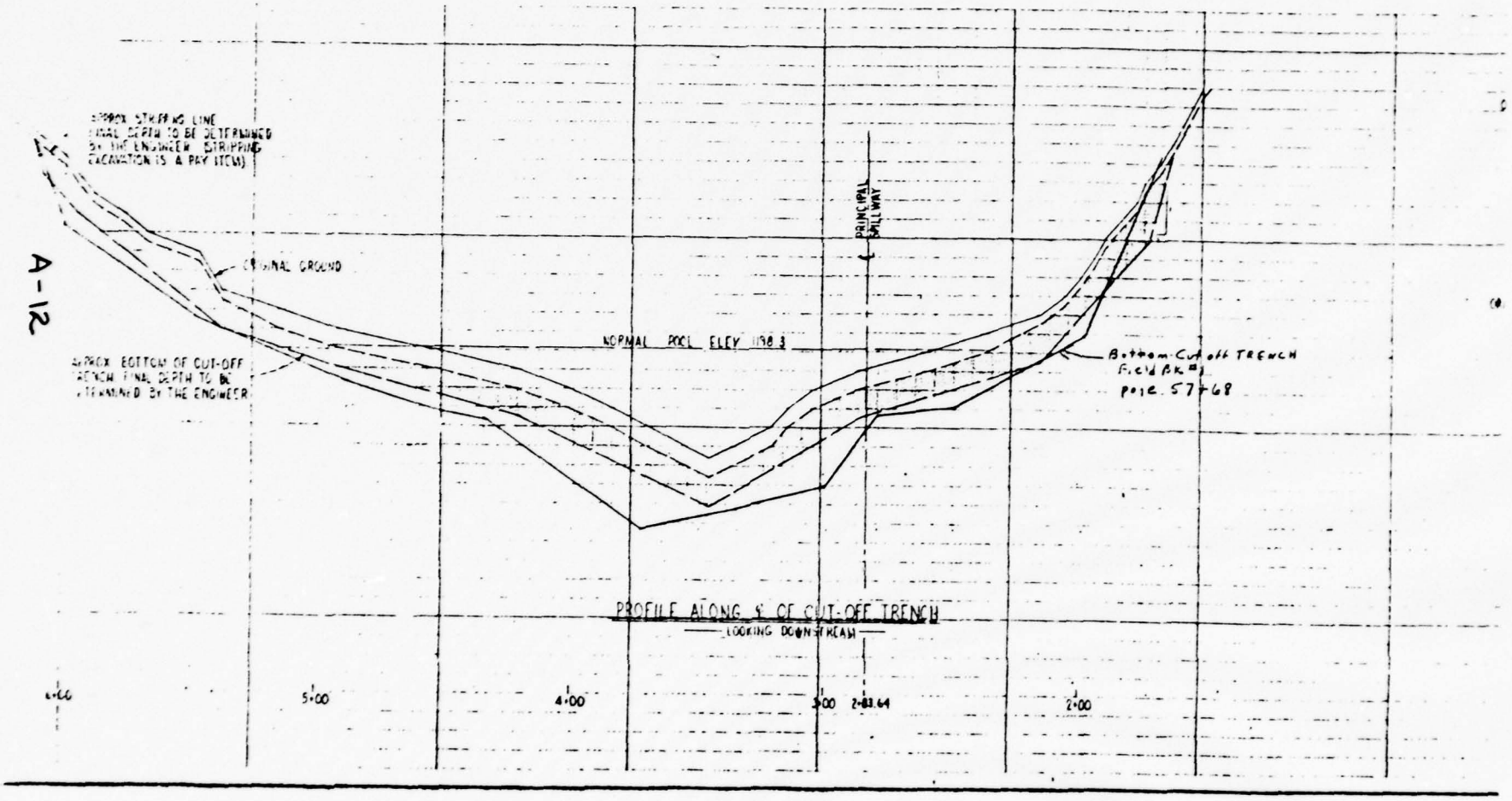
UPSTREAM CURVE

DEFLECTION ∆	CHORD
0°-00'	—
3°-43'	10.56'
7°-26'	10.56'
11°-21'	10.56'
15°-09'	10.56'
18°-56'	10.56'
22°-43'	10.56'
26°-30'	10.56'

T = 39.68'
C = 71.29'
L = 74.00'
M = 6.62'
E = 9.56'
∆ = 55°-00'

DOWNSTREAM CURVE

STATION	DEFLECTION ∆	CHORD
PC 6+60	0°-00'	—
6+90.57	3°-43'	10.56'
7+01.14	7°-34'	10.56'
7+11.71	11°-21'	10.56'
7+22.28	15°-09'	10.56'
7+32.85	18°-56'	10.56'
7+43.42	22°-43'	10.56'
PT 7+54	26°-30'	10.56'


APPROX STRIPPING LINE
FINAL DEPTH TO BE DETERMINED BY THE ENGINEER. STRIPPING EXCAVATION IS A PAY ITEM.)
ORIGINAL GROUND
PRINCIPAL SPILLWAY
NORMAL POOL ELEV 1198.3
APPROX BOTTOM OF CUT-OFF TRENCH FINAL DEPTH TO BE DETERMINED BY THE ENGINEER
Bottom Cut-off TRENCH
Field Book
pole 57+68
PROFILE ALONG ℄ OF CUT-OFF TRENCH
LOOKING DOWNSTREAM
6+00
5+00
4+00
3+00
2+83.64
2+00

A-12

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: PA-467 Dam County: Susquehanna State: Pennsylvania

NDI ID No.: PA-00054 DER ID No.: 58-131

Type of Dam: Zoned Earthfill Hazard Category: High

Date(s) Inspection: 17 July 1979 Weather: Clear Temperature: 90°

Pool Elevation at Time of Inspection: 1198.4 msl/Tailwater at Time of Inspection: 1185.4 msl

Inspection Personnel:

D.A. Wolf (GFCC)

D.R. Ebersole (GFCC)

D.B. Wilson (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	Upstream slope has heavy grass cover; downstream slope has crownvetch cover.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	None.	
CREST ALIGNMENT: Vertical Horizontal	See survey data at end of Appendix B.	
RIPRAP FAILURES	No riprap.	Thick grass cover on upstream slope.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	No deficiencies.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAGE AND RECORDER	None.	
DRAINS	One drain outlet in stilling basin; no discharge.	Drain outlet is 6-inch dia. BCCMP.
MISCELLANEOUS	One shrub (4" ϕ) on downstream slope. Communications line crosses top of dam near spillway (6 feet higher than top of dam).	Communications line has one pole on each side of top of dam. Also spans spillway approach channel.

OUTLET WORKS (MAIN SPILLWAY AND OUTLET WORKS)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit in good condition. Joint separation increases progressively toward maximum section.	30-inch diameter concrete. Maximum joint opening was approx. 1" and located near ¢ of dam.
INTAKE STRUCTURE (Riser)	Concrete and metals in good condition.	
OUTLET STRUCTURE (Impact Basin)	No deficiencies.	Impact type basin.
OUTLET CHANNEL	No deficiencies.	Steep natural channel. Some large dumped rock for lining.
EMERGENCY GATE	No gates.	Could not inspect bolted closure at end of 15" ϕ steel pipe.

UNGATED SPILLWAY (AUXILIARY SPILLWAY)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None.	Grass-lined excavated spillway.
APPROACH CHANNEL	Minor amount of brush; Communications line crosses approach channel.	Communications line is at elevation of top of dam where it spans spillway approach.
DISCHARGE CHANNEL	Minor amounts of brush.	
BRIDGE AND PIERS	None.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Mild to steep.	
SEDIMENTATION	No known problems.	
WATERSHED DESCRIPTION	Approx. 50% wooded and 50% grassland.	Undeveloped.

B-1

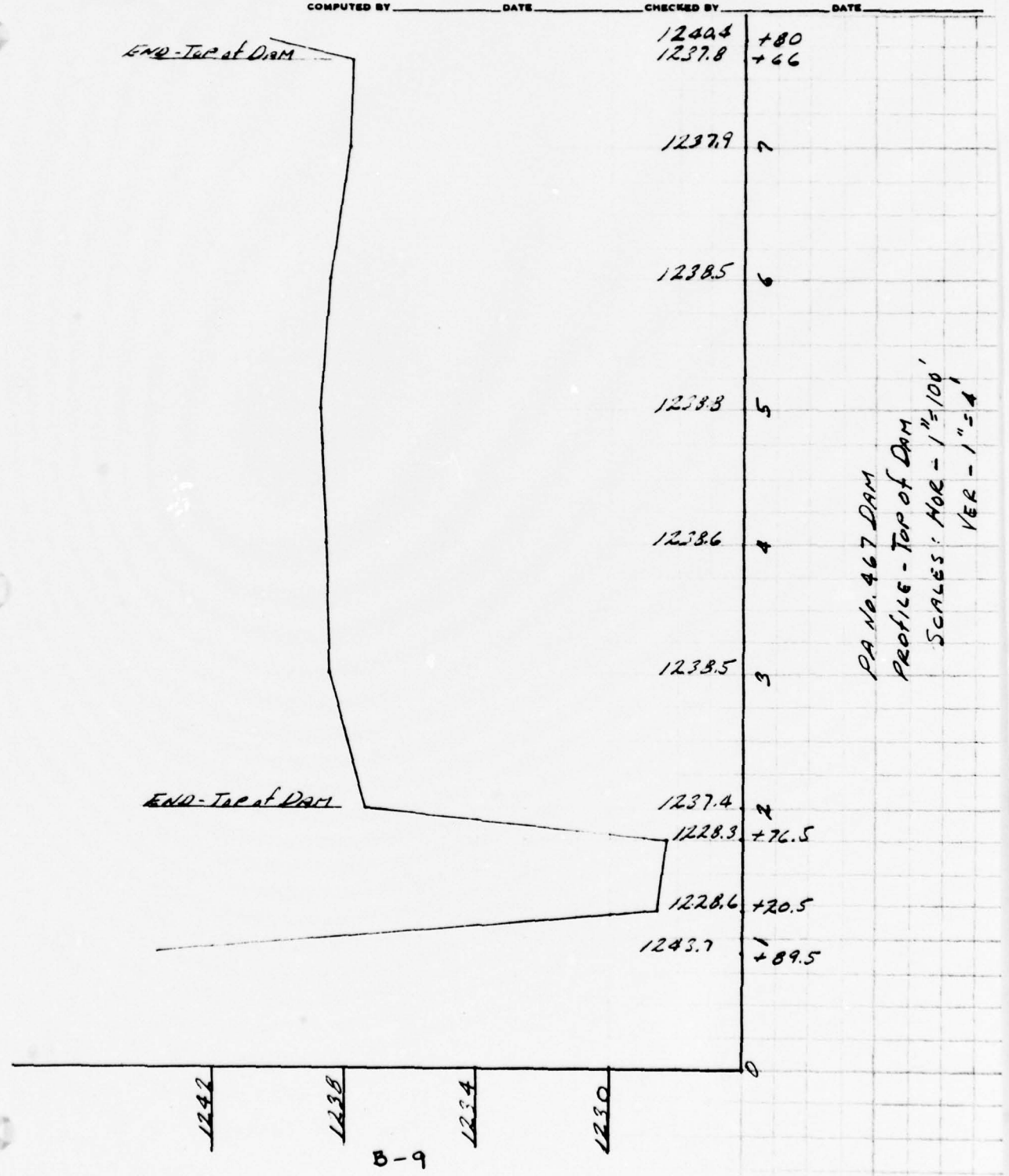
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	No obstructions; V-shaped valley.	
SLOPES	Steep.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Community of Kingsley located 0.4 mile downstream.	Approx. 15 dwellings are low-lying.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT PA No 467 DAM — FILE NO.
PROFILE - Top of DAM — SHEET NO. ___ OF ___ SHEETS
FOR
COMPUTED BY ___ DATE ___ CHECKED BY ___ DATE ___



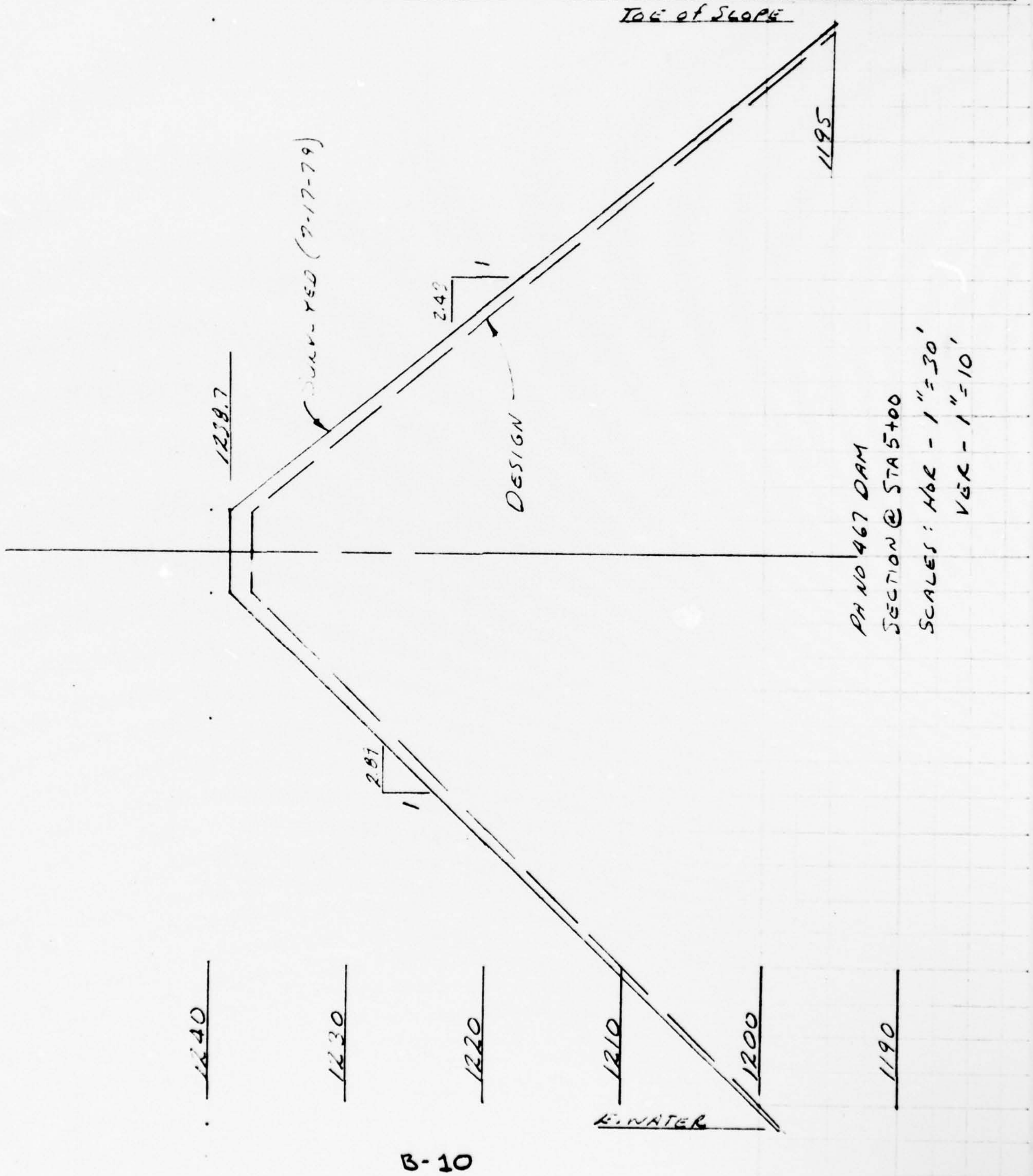
PA No. 467 DAM
PROFILE - Top of DAM
SCALES: HOR - 1" = 100'
VER - 1" = 4'

B-9

8513

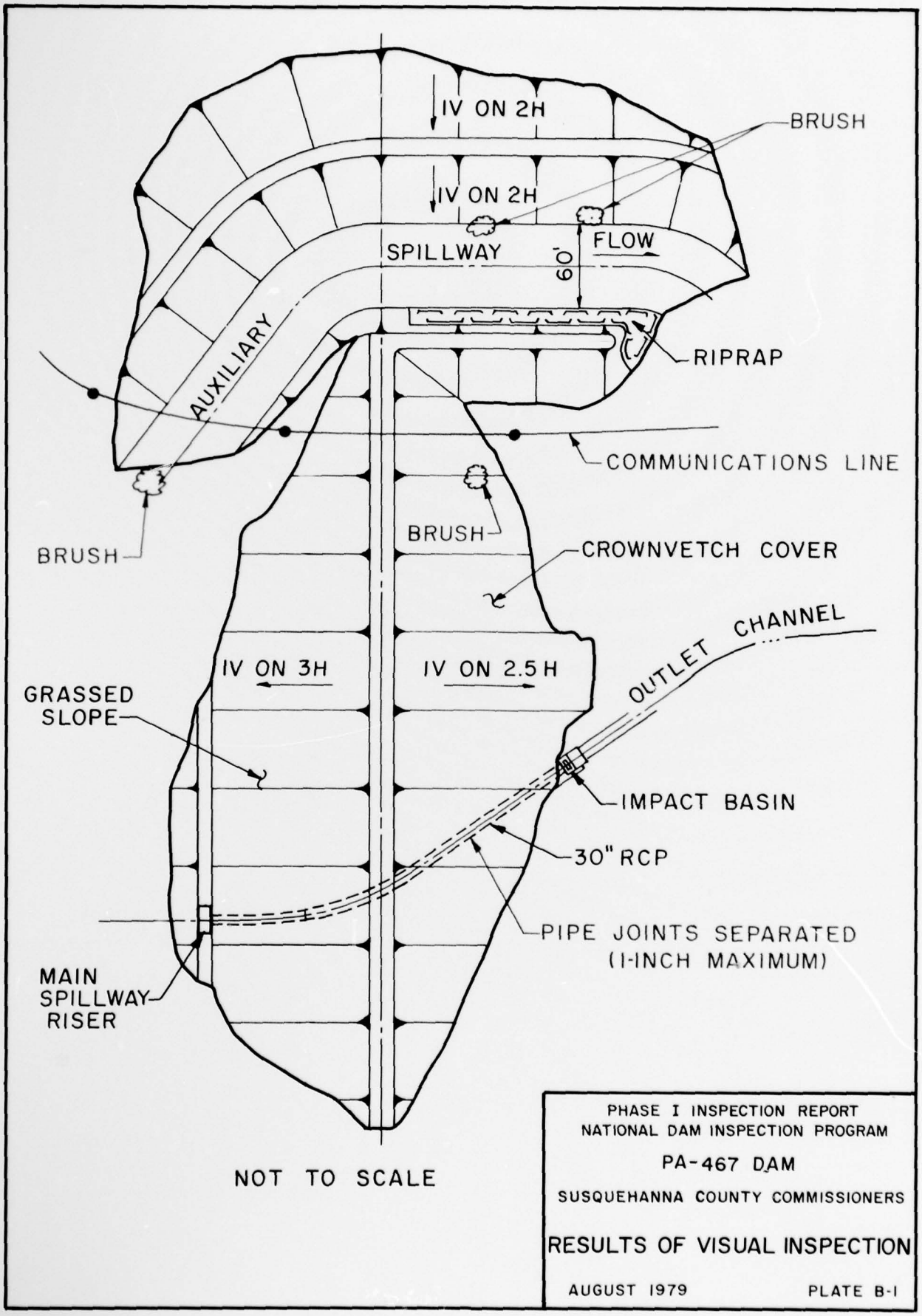
GANNETT FLEMING CORDDRY
AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT PA. No 467 DAM FILE NO. ______
EMB. SECTION @ STA 5+00 SHEET NO. ____ OF ____ SHEETS
FOR ______
COMPUTED BY ______ DATE ______ CHECKED BY ______ DATE ______



B-10

6313



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

RESULTS OF VISUAL INSPECTION

AUGUST 1979 PLATE B-1

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

AUGUST 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

In the recommended Guidelines for Safety Inspection of Dams, the Department of the Army, Office of the Chief of Engineers (OCE), established criteria for rating the capacity of spillways. The recommended Spillway Design Flood (SDF) for the size (small, intermediate, or large) and hazard potential (low, significant, or high) classification of a dam is selected in accordance with the criteria. The SDF for those dams in the high hazard category varies between one-half of the Probable Maximum Flood (PMF) and the PMF. If the dam and spillway are not capable of passing the SDF without overtopping failure, the spillway capacity is rated as inadequate. If the dam and spillway are capable of passing one-half of the PMF without overtopping failure, or if the dam is not in the high hazard category, the spillway capacity is not rated as seriously inadequate. A spillway capacity is rated as seriously inadequate if all of the following conditions exist:

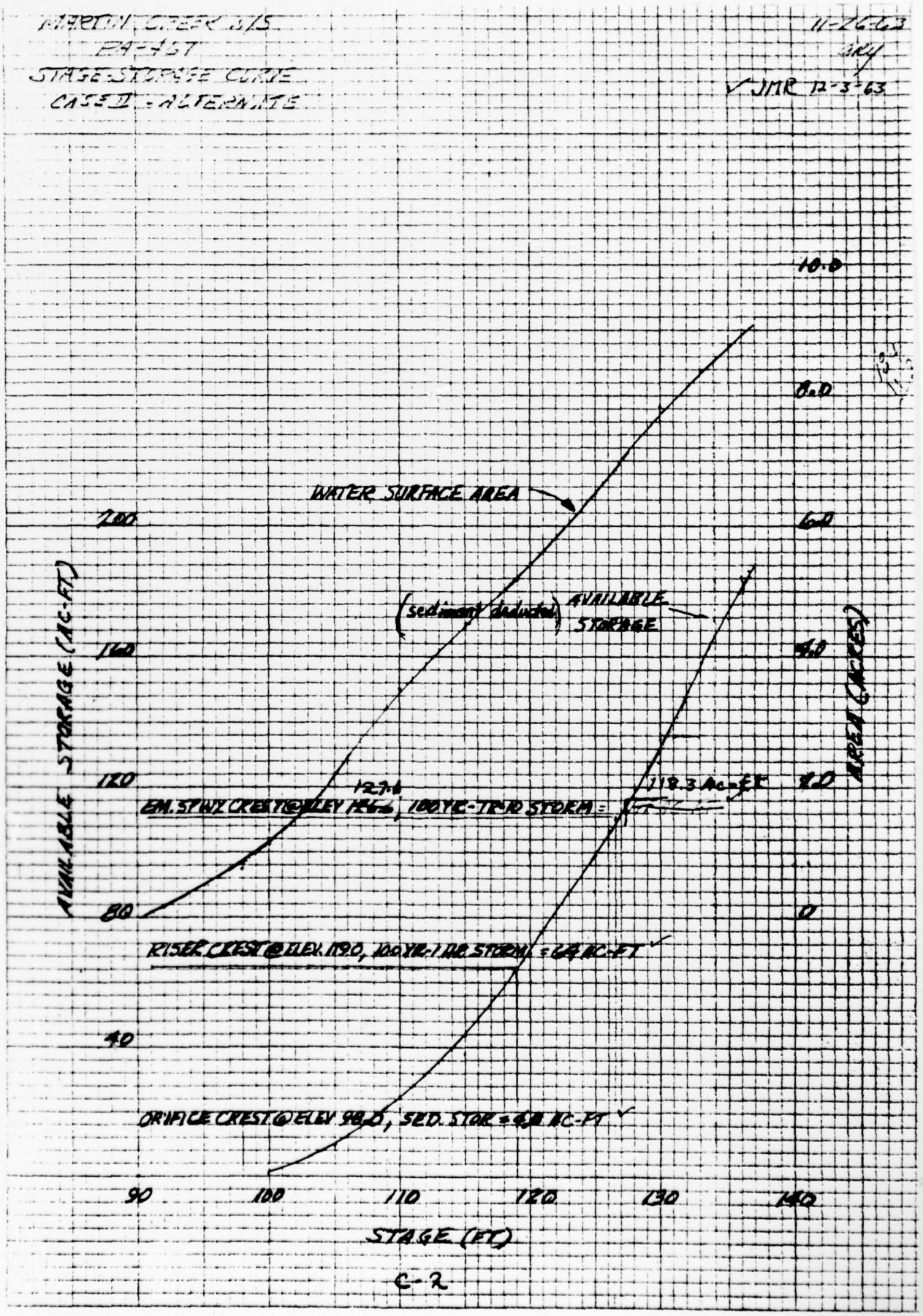
(a) There is a high hazard to loss of life from large flows downstream of the dam.

(b) Dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

(c) The dam and spillway are not capable of passing one-half of the PMF without overtopping failure.

MARION CREEK J/S
PA-757
STAGE STORAGE CURVE
CASE II - ALTERNATE

11-26-63
JRH
✓ JMR 12-3-63



C-2

1/13/59

FREEBOARD STORM

HYDROGRAPH COMPUTATION FORM

Watershed MARTIN CREEK ✓ State PENNA ✓ Susquehanna Co.

Structure Site or Sub-area PA-467 ✓

Storm Distribution Curve B ✓ Hydrograph Family 1 ✓

D. A. 0.803 ✓ sq. mi., Pt. Rainfall 25.0 ✓ inches, Aerial Rainfall 24.0 ✓ inches

R. O. Condition II ✓, R. O. Curve No. 75 ✓, Storm Duration or Freq. 6 hr ✓

T_c = 0.86 ✓ hrs., Q = 20.42 ✓ inches, $T_p = 0.686\ T_c$ = 0.59 ✓, T_o = 5.61 ✓

$\frac{T_o}{T_p}$ Computed = 9.51 ✓ $\frac{T_o}{T_p}$ used: 10 ✓ Revised T_p = 0.56 ✓ hr.

$q_p = \frac{484\,A}{\text{Rev. } T_p}$ = 694 ✓ c.f.s. $q_p \times Q$ = 14171 ✓ c.f.s.

T (column) = $\frac{t}{T_p} \times$ Rev. T_p q (column) = $\frac{q_c}{q_p}$ (q_p Q)

ΣT = 0.3136

Check: $Q = \frac{(\Sigma t)(\Sigma q)}{695\,A}$

Table 3.21-7 (sheet ___ of ___)

Line No.	$\frac{t}{t_p}$	$\frac{q_c}{q_p}$	T hours	q c.f.s.	Line No.	$\frac{t}{t_p}$	$\frac{q_c}{q_p}$	T hours	q c.f.s.
1	0	0.000	0	0	21	11.20	0.027	6.27	383
2	0.56	0.002	0.31	28	22	11.76	0.012	6.59	170
3	1.12	0.013	0.63	184	23	12.32	0.006	6.90	85
4	1.68	0.027	0.94	383	24	12.88	0.003	7.21	43
5	2.24	0.047	1.25	666	25	13.44	0.002	7.53	28
6	2.80	0.071	1.57	1006	26	14.00	0.001	7.84	14
7	3.36	0.115	1.88	1630	27	14.56	0.000	8.15	0
8	3.92	0.278	2.20	3940	28				
9	4.48	0.394	2.51	5583	29				
10	5.04	0.322	2.82	4563	30				
11	5.60	0.235	3.14	3330	31				
12	6.16	0.174	3.45	2466	32				
13	6.72	0.136	3.76	1927	33				
14	7.28	0.110	4.08	1559	34				
15	7.84	0.092	4.39	1304	35				
16	8.40	0.079	4.70	1120	36				
17	8.96	0.073	5.02	1034	37				
18	9.52	0.069	5.33	964	38				
19	10.08	0.065	5.64	921	39				
20	10.64	0.053	5.96	751	40				

763-PA-S.

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Comparison of SCS Freeboard Storm with PMF — FILE NO. ____ — SHEET NO. ____ OF ____ SHEETS
FOR PA-467
COMPUTED BY RJW — DATE ____ — CHECKED BY ____ — DATE ____

SCS Freeboard Storm Data: (6 hr. storm)
Rainfall = 24.0 inches
Runoff = 20.42 inches
Peak Inflow = 5583 cfs

PMF Data for PA-467 Site: (Hydromet. 40)
Index Rainfall = 22.15 inches
Geographic Adjustment Factor = 95%
Distribution:

6 hr	118%
12 hr	127%
24 hr	136%
48 hr	142%
72 hr	145%

Hop Brook Reduction Factor = 0.80

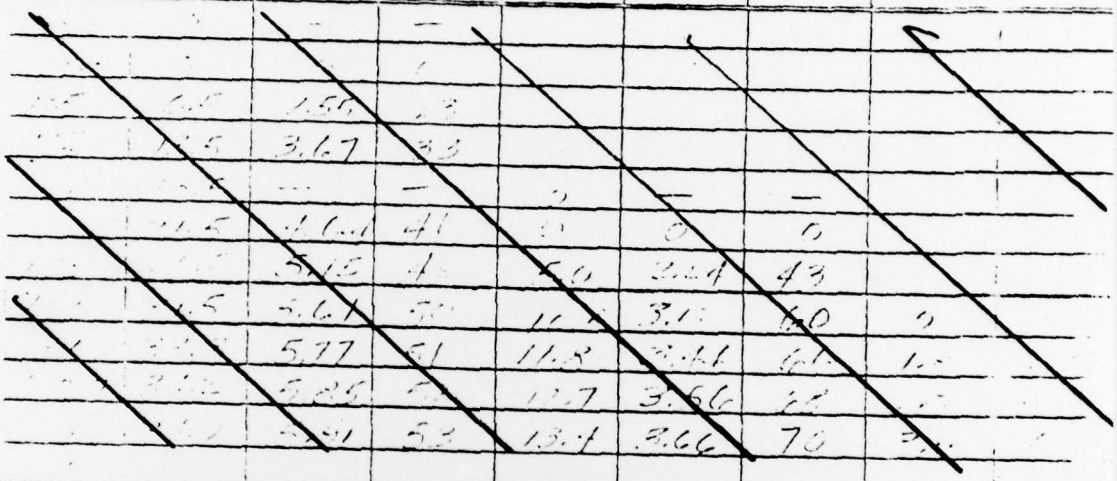
Revised PMF index rainfall = 22.15 x 0.95 x 0.80
= 16.83 inches

Total 6 hr. rainfall = 1.18 x 16.83 = 19.86 inches
Runoff from 6hr. rainfall = 19.86 - 6(.05) = 19.56 inches
(Initial abstraction of 1" occurred early in PMF)

Since small watersheds (i.e. 0.8 mi^2) are only sensitive to peak rainfall periods, it is reasonable to compare the Freeboard storm and the PMF based on the maximum 6 hr. runoff. Since the Freeboard storm runoff (20.42") is greater than the 6hr runoff from the PMF (19.56") and because the SCS unit hydrograph is conservative, the Freeboard storm is an acceptable substitute for the PMF.

8313

SOIL CONSE



STAGE - DISCHARGE Sht. 1 of 2

Elev	H_o (1.0×1.5)	$H_o^{1/2}$	$Q_o = 8.91 H_o^{3/2}$	H_w (2.5×7.5)	$H_w^{3/2}$	$Q_w = 51.0 H^{3/2}$	Q_T	H_p (30" RCP)
98.5	0	0	0					
105.0	6.5	2.55	23					
112.0	13.5	3.67	33					
119.0	20.5	4.53	40	0	0	0	40	34.2
120.0	21.5	4.64	41	1.0	1.00	51	92	35.2
121.5	23.0	4.79	43	2.5	3.95	201	244	36.7
126.6								41.8
128.4								43.6
130.0								45.2
131.7								46.9
132.7								47.9
134.5								49.7
135.3								50.5
135.7								50.9

Notes:

1. To convert to dam elevation datum, add 1100.3 to table elevations
2. Auxiliary spillway crest elev. was changed to elev. 127.6 in final plans
3. Top of dam elev. was changed to elev. 136.7 in final plans.

SOIL CONSERVATION SERVICE

... pipe outlet ...

			$H_p^{1/2}$	Q_p = 1040 $H^{1/2}$	q	H_p	d_c		
			7.2[illegible]	[illegible]	7[illegible]	8.15	[illegible]	[illegible]	[illegible]
		44.0	6.63	6.90	0	0	0	[illegible]	[illegible]
		[illegible]	6.77	7[illegible]	5	1.7[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]7	6.8[illegible]	7[illegible]	1[illegible]	[illegible]	1.[illegible]	[illegible]	[illegible]
		[illegible]	6.[illegible]	7[illegible]	[illegible]	3.[illegible]	1.[illegible]	[illegible]	[illegible]
		[illegible]	6.93	7[illegible]	[illegible]	4.04	[illegible]	[illegible]	[illegible]
		[illegible]	7.00	[illegible]	[illegible]	5.14	3.[illegible]	[illegible]	[illegible]
		51.1	7.15	7[illegible]	50	7.[illegible]	4.[illegible]	[illegible]	[illegible]
		51.9	7.20	7[illegible]	60	7.90	4.82	[illegible]	[illegible]

STAGE - DISCHARGE Sht. 2 of 2

H_p (30" RCP)	$H_p^{1/2}$ (30" RCP)	Q_p = 16.70 $H^{1/2}$	q	H_p	d_c	W = 60+2d_c	QE	Q_T	Qnet = Q - Qbase
			← Auxiliary Spillway				→		
									17
					Base flow = 5.5 cfs				27
	5.84	98			@ elev 95.9 ft				34
	5.93	99							86
	6.06	101							95
	6.46	108	0	0	0	60.00	0	108	102
	6.60	110	5	1.76	0.92	61.84	309	419	
	6.72	112	15	3.39	1.91	63.82	957	1069	
	6.84	114	30	5.14	3.04	66.08	1982	2096	
	6.92	116	40	6.14	3.70	67.40	2696	2812	
	7.05	118	60	7.90	4.82	69.64	4178	4296	
	7.10	119	70	8.65	5.36	70.72	4950	5065	
	7.13	119	75	9.05	5.60	71.20	5340	5459	

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

NDI ID No. PA-00054
DER ID No. 58-131
SCS ID No. PA-467

SUSQUEHANNA COUNTY COMMISSIONERS

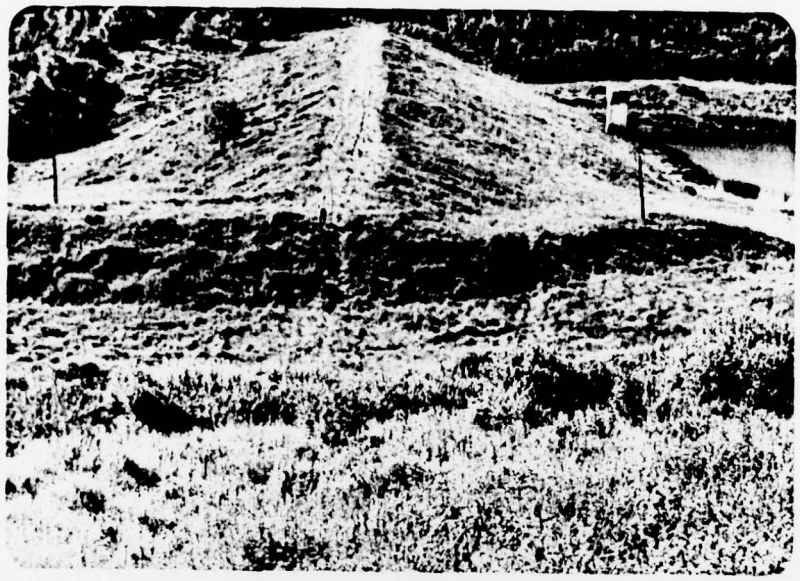
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

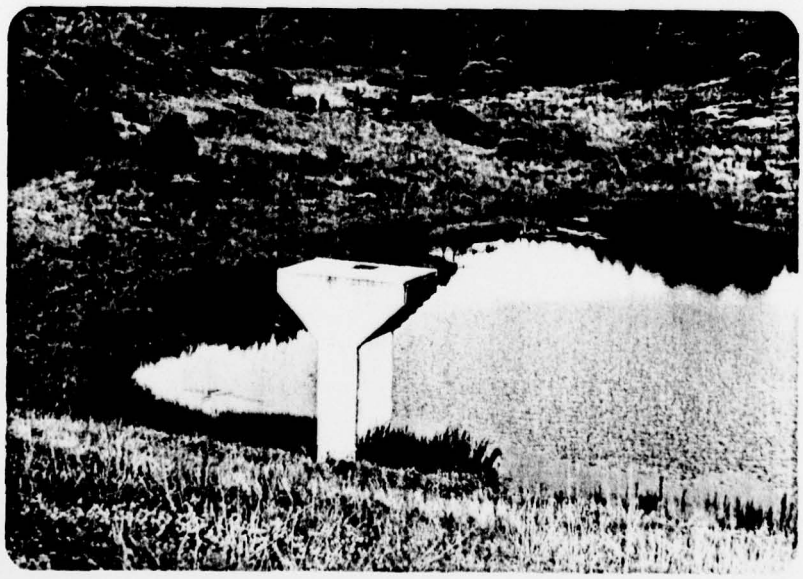
AUGUST 1979

APPENDIX D

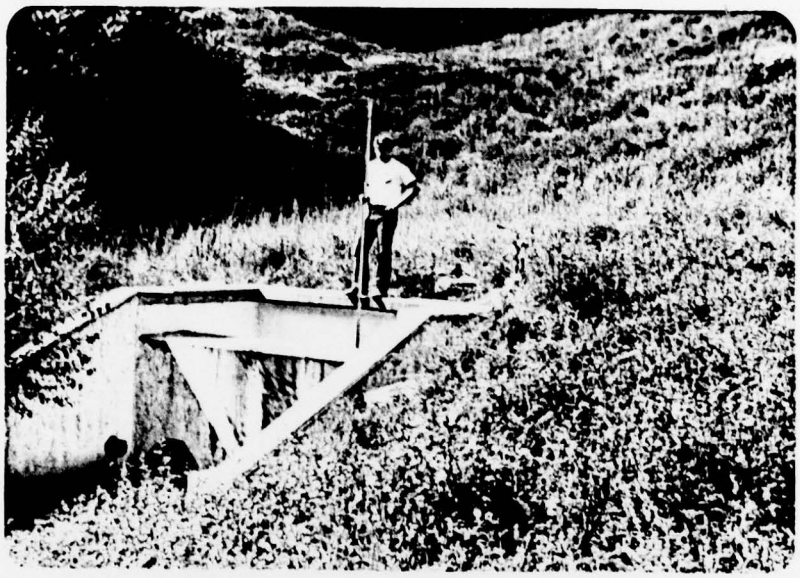
PHOTOGRAPHS



A. Embankment



B. Main Spillway Riser



C. Main Spillway Impact Basin

D. Auxiliary Spillway Approach Channel

E. Auxiliary Spillway Exit Channel

F. Embankment Extension Along Right Side of Auxiliary Spillway Exit Channel

SUSQUEHANNA RIVER BASIN

TRIBUTARY TO MARTINS CREEK, SUSQUEHANNA COUNTY

PENNSYLVANIA

PA-467 DAM

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APPENDIX E

GEOLOGY

PA-467 Dam

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Susquehanna County. Susquehanna County lies north of the Wisconsin Terminal Moraine and, with the exception of the summit of Elk Hills, was entirely covered by ice. Deposits of glacial drift of variable thickness cover the county except where they have been removed by erosion. The county is drained entirely by the north branch of the Susquehanna River and its tributaries. The Susquehanna River enters Susquehanna County from New York near the northeast corner of the County and reenters New York just north of the town of Great Bend, Pa. The river does not again re-enter the county but comes within four miles of the southwest border. As the county lies entirely north of the glacial border, there are abundant undrained areas occupied by swamps and lakes. A geologic map is presented on Plate E-1.

The rock formations exposed in Susquehanna County range in age from the Post-Pottsville of Pennsylvanian age to the Chemung of Devonian age. The youngest formations, the Post-Pottsville and Mauch Chunk, are exposed only in the southeast corner of the County. The older rocks are exposed along the western and northern boundaries.

The major structural feature of the region is the Lackawanna Syncline, which terminates in the southeast corner but whose axis turns and runs due north along the Wayne County Line. Along the west side of this synclinal axis, the strata dip steeply to the southeast. Over the next four to five miles westward, the strata flatten out to nearly horizontal. Toward Tunkhannock Creek to the northwest, the strata reverse dip on the axis of an anticline that continues southwestward as far as Union and Clinton counties. The rocks in the remainder of the county lie nearly horizontal but are folded locally into minor anticlines. The Wilmont anticline enters at the southwest corner of the county and extends across Auburn Township. Its southward dip rarely exceeds 1°, so that the strata in the southern part of the county are nearly horizontal.

2. Site Geology. PA-467 Dam is underlain by glacial drift and rocks of the Devonian Susquehanna group. The Susquehanna group is a complex unit of conglomerates, sandstones, siltstones, and shales. From the base to the top of this group the following changes occur in Northeastern Pennsylvania: (1) Grain size increases from bottom to top; (2) average thickness of beds increases upwards; (3) percent red color in shales increases upwards, and (4) in general, percent silica in rocks increases upwards. Bedding is usually well-developed with thicknesses up to sixteen feet in the coarser beds. Joints are generally open and dip steeply or vertical. The shales disintegrate rapidly when exposed to the atmosphere. The siltstones, sandstones, and conglomerates are moderately resistant to weathering. There are abundant swamps and lakes in the area which is characteristic of the glaciated low plateau section in which the dam is located.

Form SCS-376C
Sheet 1 of 2
For SCS Service Use Only

USDA-SCS

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Penna. County Susquehanna Watershed Martin Creek Subwatershed _____

Site number PA-467 Site group I Structure class C Investigated by Ronald C. Page Geologist (signature and title) Date 1/65

INTERPRETATIONS AND CONCLUSIONS

Foundation

Foundation from the centerline downstream is basically glacial till (SM) [illegible] with some areas being a GM. No problems are anticipated with the till. The 2.0 feet of ML which caps the centerline in most places may be somewhat weak; however, there is very little of this material and some will be eliminated through the use of a positive cutoff. Hardpan which lies between the ML layer and the till is sufficiently impervious to act as a base for the positive cutoff since the permeability is .08 feet per day.

Two weak areas of alluvial material cross the centerline, one at station [illegible] and one station 4+55. Both will apparently be too soft to support the proposed height of fill at their respective locations. Consideration should be given to their removal. Undisturbed sample 7A is representative of the buried stream channel. Recovery of a sample of the present channel alluvium from DH 303 was not successful because of the extreme softness and wetness of terial.

Careful analysis also should be made of the upstream toe foundation. [illegible] soft material comprises over 13,000 cubic yards plus an additional 3[illegible],000 cubic yards SM overburden on each side of the existing pond. It is recommended that the recent sediment immediately below the existing pond be removed regardless of all other considerations. Laboratory analysis of undisturbed sample 604A should give indications as to how much of the recent sediment to the right of station 3+00 needs to be removed. Remaining alluvial material under the toe can be dealt with in either of two suggested manners: (1) total removal of the soft material and backfilling with till; (2) flattening the side slopes of the proposed structure. (See also this discussion in the section on the principal spillway which follows.)

Borrow

More than enough borrow is available with 66,000 cubic yards coming from the emergency spillway and 15-20,000 cubic yards from the right side of the pool area. No special problems are expected; all material is good. Till dry density of 131 pounds per cubic foot indicates that swelling will probably occur when removed and recompacted. This extra yardage will be offset by the approximately 20 percent of boulders and cobbles which are present in the borrow area (not the spillway). It is suggested that the top 0.5 feet of soil be removed to the spoil area. This leaves 1.0 to 1.5 feet of ML material which can be mixed with the underlying Hardpan layer. Many road cuts in the area show shear failures due to over-steepening of slopes. Not less than 3:1 si[illegible] opes in the borrow area are advisable without the use of berms.

Interpretations and conclusions Cont'd

Emergency Spillway

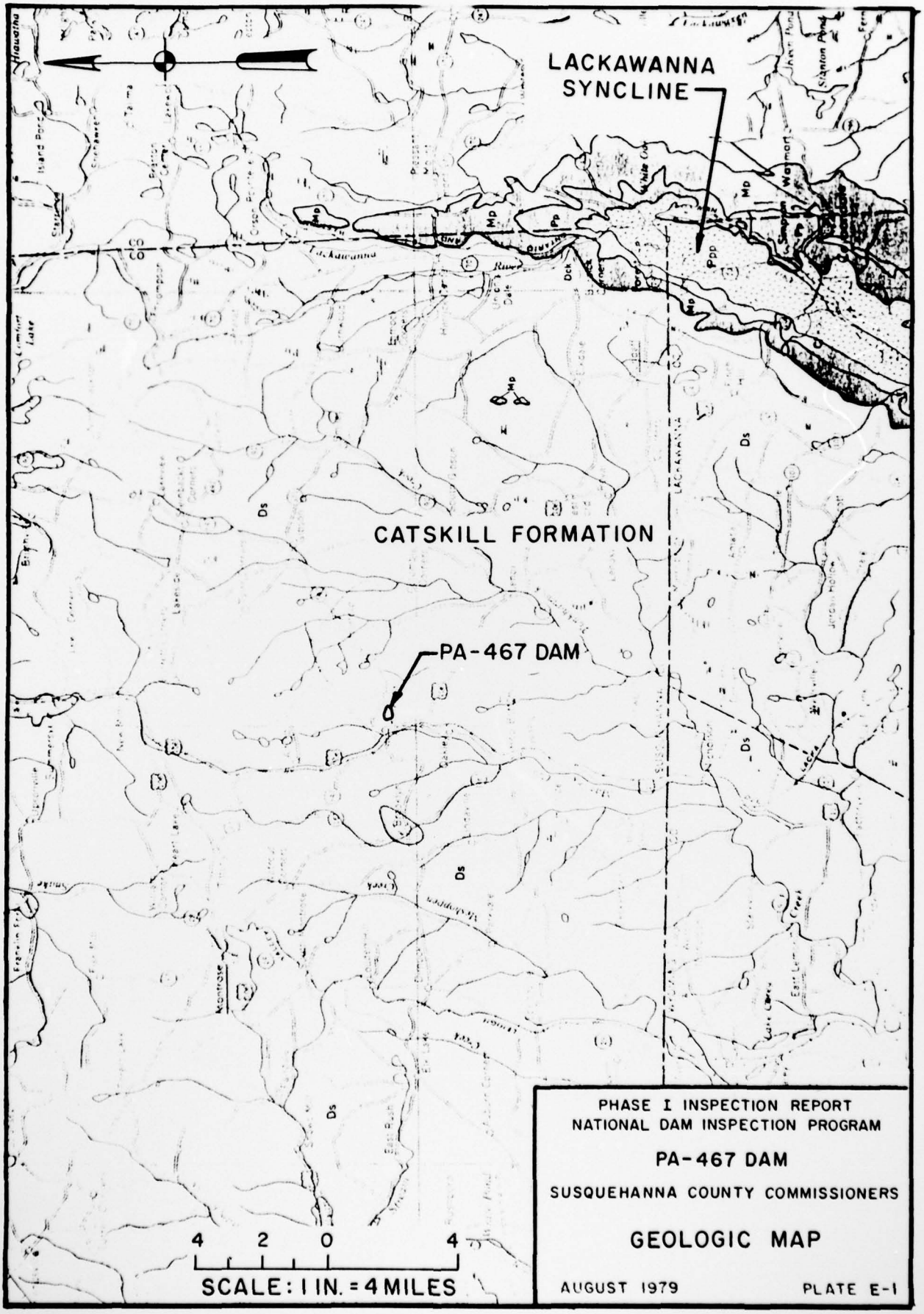
Three to one slopes suggested by the design engineers appear to be adequate. No special problems in obtaining the borrow are expected. Consideration should be given to diverting the stream running down the left abutment. Since no definite channel was observed at the site itself, some of the water is percolating into the ground and emerging on the centerline in the vicinity of station 6+00 where seeps are present. Allowed to continue, this condition would eventually cause slumping in the spillway cut. Flow was not studied, but may occur most of the year since the stream source is partially from springs.

Principal Spillway

The 12.0 feet of unusually soft material lying directly on the glacial till at DH 303 will not support any weight and should be removed. Since this material extends upstream, consideration should be given to its removal throughout the proposed location of the conduit. This will leave a hump of till sticking up in the vicinity of DH 302, thus the possibility of differential settlement between DH 301 and 302. A possible suggestion would be the removal of all material down to elevation 76.0* and backfilling with more dense till. Undisturbed samples of the alluvial material (DH 305B) and the soft underlying glacial lacustrine (DH 301A) have been forwarded to the soil mechanics laboratory for analysis.

An alternate suggestion for the principal spillway location is at station . Here the underlying till has a more even surface and the overlying material could be used for backfilling once the alluvial material is removed.

*Relative elevation (MSL = 1176.3)



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PA-467 DAM

SUSQUEHANNA COUNTY COMMISSIONERS

GEOLOGIC MAP

AUGUST 1979 PLATE E-1