

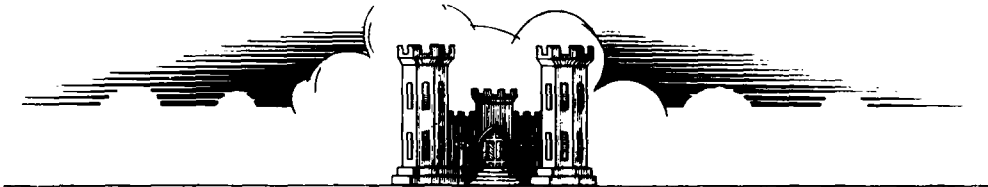
SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM
NDI ID NO. PA-00375
DER ID NO. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

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Prepared by
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
Consulting Engineers

Harrisburg, Pennsylvania 17105

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For

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

APRIL 1979

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SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY
PENNSYLVANIA

(6) National Dam Inspection Program
Number 5 DAM

Number
(NDI ID # PA-00375
DER ID # 35-22),
Number

~~PENNSYLVANIA GAS AND WATER COMPANY,~~
Susquehanna River Basin, Stafford Meadow Brook
Lackawanna County, Pennsylvania.
PHASE I INSPECTION REPORT,
NATIONAL DAM INSPECTION PROGRAM

Prepared by

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

(11) Apr 1979

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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
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY
PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

April 1979

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam: No. 5
NDI ID No. PA-00375/DER ID No. 35-22D

Owner: Pennsylvania Gas and Water Company

State Located: Pennsylvania

County Located: Lackawanna

Stream: Stafford Meadow Brook

Date of Inspection: 8 November 1978

Inspection Team: Gannett Fleming Corddry and Carpenter, Inc.
Consulting Engineers
P.O. Box 1963
Harrisburg, Pennsylvania 17105

Based on visual inspection, available records, calculations, and past operational performance, and according to criteria established for these studies, No. 5 Dam is judged to be unsafe, nonemergency, because the spillway capacity is rated as seriously inadequate. The spillway can pass 29 percent of the Probable Maximum Flood (PMF) without overtopping of the dam. Failure of the dam would cause an increase hazard to loss of life downstream. As a whole, the dam is judged to be in fair condition.

The spillway gravity weir does not have any significant deviations from the guidelines for stability, since the toe pressure is well below the allowable. There is no evidence of instability on the embankment.

The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for No. 5 Dam, as

well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take remedial measures as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Repair the concrete at the spillway weir and the core-wall.

(3) Repair the vandalized interior of the intake structure so that adequate access to the upstream closure valves is available. Ensure that the valves are operational.

(4) Repair the mortar at the spillway and at the masonry gravity training wall.

(5) Replace the dislodged capstones at the outlet works approach wall.

(6) Repair the riprap on the upstream slope of the embankment.

(7) Provide a proper surface drainage path near the right abutment.

(8) Monitor, by any suitable means, the seepage at the spillway channel. If significant changes are noted, take appropriate action.

(9) Monitor, by any suitable means, the depression behind the dry masonry wall. If changes are noted, take appropriate action.

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

(1) Develop a detailed emergency operation and warning system for No. 5 Dam. A similar system has already been recommended in other reports for Lake Scranton and Williams Bridge Dams, which are located upstream.

(2) Provide round-the-clock surveillance of No. 5 Dam during periods of unusually heavy rains.

(3) Develop impediments to trail bike use on the embankment and improve security at the damsite.

(4) 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.

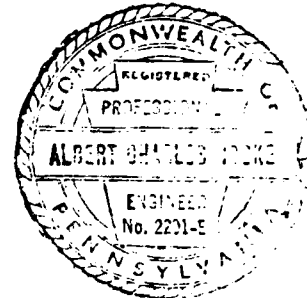
NO. 5 Dam

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. Hooke
A. C. HOOKE
Head, Dam Section

Date: 30 April 1979



Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

NO. 5 DAM



Overview

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

SECTION 1

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. No. 5 Dam is a homogeneous earthfill embankment with a masonry core-wall. A concrete cap is on top of the core-wall and the cap protrudes from 3 to 4 feet above the embankment. The dam is 248 feet long and 35 feet high at its maximum section.

The masonry gravity spillway is at the left abutment of the dam. A parabolic-shaped concrete weir is atop the masonry. The crest is 86.1 feet long and 7.3 feet below

the design top elevation of the dam. A masonry gravity wall extends along the right side of the spillway channel. It acts as the spillway training wall and also retains the embankment.

The outlet works is about in the middle of the embankment. The intake structure is located along the axis of the embankment. Masonry gravity approach walls extend along both sides of the approach channel to retain the embankment. Valves for both the 24-inch diameter cast-iron pipe (CIP) emergency drawdown line and the 18-inch diameter CIP water supply line are located in the intake structure. Other valves for these lines are located in valve pits near the downstream toe of the embankment.

b. Location. The dam is located on Stafford Meadow Brook approximately 3.4 miles south from the center of Scranton, Pennsylvania. No. 5 Dam is shown on USGS Quadrangle, Avoca, Pennsylvania, with coordinates $N41^{\circ}21'40''$ and $W75^{\circ}40'15''$ in Lackawanna County, Pennsylvania. Lake Scranton Dam is 2.3 miles upstream from No. 5 Dam. Williams Bridge Dam is about 0.8 mile upstream from Lake Scranton Dam. A location Map is shown on Plate 1.

c. Size Classification. Small (35 feet high, 206 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for No. 5 Dam (Paragraph 5.1c.).

e. Ownership. Pennsylvania Gas and Water Company, Wilkes-Barre, Pennsylvania.

f. Purpose of Dam. Previous use was water supply. At present, the dam is used as a contingency water supply intake for Lake Scranton Dam.

g. Design and Construction History. No. 5 Dam was constructed between 1887 and 1888. It was designed by E. Sherman Gould, consulting engineer of Scranton. The dam was constructed by Burke Brothers, Contractors of Wilkes-Barre, under the supervision of William Marple. The original dam was 18 feet high and was constructed with a vertical masonry downstream face and with earthfill, extending to within 1.5 feet of the top, along the upstream side on a 1V on 4.5H slope. Two buttresses were provided along the downstream face of the dam.

In 1893, the dam was raised by increasing the height of the masonry by 10 feet. The masonry was then covered by 2 feet of earthfill, which was extended both upstream and downstream. Thus the original masonry dam is the core-wall of the existing structure. Mr. Marple supervised this work also.

The dam was studied in 1914 by the Pennsylvania Water Supply Commission. The study indicated that the upper portion of the masonry gravity section had its resultant only 0.05 foot inside the base. These results were confirmed by Professor Frank McKibben of Lehigh University, as a consultant to the Water Supply Commission. Remedial measures were ordered.

In 1916, the dam was modified to its present configuration by constructing the parabolic-shaped concrete cap on the spillway weir to improve the stability. A concrete cap was added to the core-wall at the same time; the cap is about 6 feet in height and extends about 4 feet above the embankment.

h. Normal Operational Procedure. The pool is maintained at spillway crest with excess inflow discharged over the spillway.

1.3 Pertinent Data.

a. <u>Drainage Area.</u> (square miles.)	12.0
b. <u>Discharge at Damsite.</u> (cfs.)	
Maximum known flood at damsite	unknown
Outlet works at maximum pool elevation	80
Spillway capacity at maximum pool elevation	5,940
c. <u>Elevation.</u> (feet above msl.)	
Top of dam (design)	929.5
Top of dam (existing)	See Section 5.
Maximum pool	929.5
Normal pool	922.2
Upstream invert outlet works	Not available

c. <u>Elevation</u> (Cont'd)	
Downstream invert outlet works	895.1
Streambed at toe of dam	894.3
d. <u>Reservoir Length.</u> (miles.)	
Normal pool	0.2
Maximum pool	0.3
e. <u>Storage.</u> (acre-feet.)	
Normal pool	98
Maximum pool	206
f. <u>Reservoir Surface.</u> (acres.)	
Normal pool	9.8
Maximum pool	20.3
g. <u>Dam.</u>	
<u>Type</u>	Homogeneous earthfill with masonry core-wall, which is extended with concrete above the earthfill.
<u>Length</u> (feet)	248
<u>Height</u> (feet)	35
<u>Topwidth</u> (feet)	
Concrete cap	3.0
Earthfill	Varies; about 12, minimum
<u>Side Slopes</u> - Upstream -	Irregular, about 1V on 3.5H

g. Dam (Cont'd)

Downstream -

Varies-
1V on 1.9H
to
1V on 2.4H

Zoning

Homogeneous
earthfill

Cutoff

Core-wall

Grout Curtain

None

h. Diversion and Regulating Tunnel.

None

i. Spillway.

Type

Masonry-
gravity
weir with
parabolic-
shaped con-
crete crest

Length of Weir (feet)

86.1

Crest of Elevation

922.2

Upstream Channel

Reservoir

Downstream Channel

Natural
stream in
bedrock.
Masonry-
gravity
training wall
on right.

j. Regulating Outlets.

Type

24-inch
diameter
cast-iron
pipe.

Length (feet)

118

Closure

24-inch
gate valves.
One at in-
take
structure,
Another
near down-
stream toe
of dam.

j. Regulating Outlets (Cont'd)

Access

Intake
structure-
see Section 3.
Valve near
toe in valve
pit.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data were available for review for the structure as originally designed or for the 1893 modifications. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, geology, construction materials and methods, and design features was prepared for the components of the dam from interviews with the Owner, visual inspection, and other sources. The 1914 study also included analyses for hydrology and hydraulics and structural stability. A summary of the results of the analyses is on file. Some engineering data for the 1916 modification to the dam is available.

b. Design Features. The project is described in Paragraph 1.2g. The various features of the dam are shown on Plates at the end of the report and on the Photographs in Appendix D. The plan of the dam is shown on Plate 2. The profile is shown on Plate 3. Views of the embankment are shown on Photographs A, B, C, and D. Cross sections of the embankment are shown on Plate 4. The spillway is shown on Photographs E, F, and G. Spillway sections are shown on Plate 5, which also has a summary of the stability analysis for the 1916 modification. The outlet works is shown on Photograph H. A plan of the outlet works is on Plate 2.

c. Design Considerations. There are no particular concerns about the design of the dam, except for the capacity of the spillway, which is discussed in Section 5.

2.2 Construction.

a. Data Available. Construction data for the original structure that are available for review, consists of the information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. Site geology is discussed in Appendix E. The report states that the original masonry of the dam was extended about 10 feet below the original ground surface to a compact and impervious hardpan foundation. The overexcavation was then backfilled with selected material. The lower elevations of the embankment were constructed with a mixture of loam, sand, and clay. The upper elevations were constructed of sand, loam, and "small stones". The 6-inch to 12-inch lifts were not rolled, but compacted by the travel of earth moving equipment.

b. Construction Considerations. It appears that reasonable care was used in the construction of No. 5 Dam. Although the compaction of the embankment might have been better, it has existed for 92 years without any reported problems.

2.3 Operation. There are no formal records of operation. The Owner did not report any problems having occurred over the operational history of the dam.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Bureau of Dam Safety, Obstructions, and Storm Water Management; Department of Environmental Resources, Commonwealth of Pennsylvania, and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer for information. He also researched his files for additional data at the request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data are limited, and the assessment must be based on the combination of available data, visual inspection, performance history, hydrologic assumptions, and hydraulic assumptions.

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. However, some deficiencies were observed as noted below. A sketch of the dam with the location of deficiencies is presented in Appendix B on Plate B-1. Survey information acquired for this report is summarized in Appendix B. On the day of the inspection, the pool was 0.1 foot above the spillway crest.

b. Embankment. The embankment is in generally good condition. Trail bike ruts extend up the downstream slope to the left of the intake structure (Photograph H). A surface drainage swale is at the right abutment. A minor amount of erosion was observed at the swale. Left of the intake structure, the riprap on the upstream slope is washed out. It is also washed out for 20 feet to the right of the structure. The remainder of the slope is covered with riprap, which is obscured by tall grass (Photograph C). The riprap in this area appears in good condition. The core-wall extension, above the top of the embankment, is in poor condition. The concrete is spalled and peeling over 70 percent of the wall (Photograph D). The survey performed for this inspection revealed that the top of the core-wall is at elevation 929.9, which is 0.4 foot above the design elevation, except where the concrete is severely spalled. The severest spalling is at the vertical joints in the wall. The wall has spalled down a distance of 0.7 foot at one joint (Photograph D).

c. Appurtenant Structures. The spillway is in fair condition. The concrete weir, which was added to the original masonry spillway in 1916, is very deteriorated. The reinforcing bars are completely exposed along the top of the weir (Photographs E and F). The mortar in the masonry section of the spillway is slightly deteriorated. The masonry training wall to the right of the spillway is leaching along its face (Photograph G). The mortar in the upper 3 feet of the wall is deteriorated. At the left of the spillway channel there are two minor seeps from the bedrock about 4 feet above the bottom of the channel. Downstream of the masonry training wall, a low, dry masonry wall extends for a short reach. The soil immediately behind this wall is depressed. The dry masonry wall is downstream from the toe of the embankment.

The operation of the outlet works was observed. The outlet works valve near the downstream toe was opened 5 percent by two men in 15 minutes with no apparent problems. The valves in the intake structure provide upstream closure for the outlet works. Their operation was not observed on the day of the inspection. The interior of the intake structure has been vandalized. The access ladder and debris are at the bottom of the valve pit. The Owner has provided steel shutters to prevent further vandalism. The window ledges and door sill are raised by concrete lips to 0.2 foot above the design elevation of the top of the dam. The capstones on the outlet works masonry gravity approach walls are dislodged (Photograph C).

d. Reservoir Area. All of the watershed that is downstream from Lake Scranton Dam is steep and wooded. It is also undeveloped and uninhabited. It is owned and controlled by the Pennsylvania Gas and Water Company. The access road to the dam, from Lake Scranton Dam, generally parallels the stream and crosses over it a few times.

e. Downstream Conditions. From the dam, the stream flows for 0.5 mile in a fairly steep and wooded reach until it passes under a railroad bridge. The stream then turns right and flows for 1.5 miles through a relatively flat and wide valley which generally parallels Interstate 81 on the left. In this reach the stream passes under a railroad embankment on three occasions. At the end of the reach, the stream turns left and passes under the Interstate 81 bridge, which is high overhead. The stream then flows for 1.1 miles through the City of Scranton to the Lackawanna River. In this reach, which is a major urban area, the stream passes through many small culverts and is adjacent to numerous dwellings.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest, Elevation 922.2, with excess inflow discharging over the spillway and into Stafford Meadow Brook. Water supply lines at the dam are connected directly to the Owner's distribution system. The Owner stated that, although Pennsylvania Gas and Water Company is responsible for the dam, it serves no purpose at present. However, the water supply line is connected to the distribution system, and the dam could be used for water supply.

4.2 Maintenance of Dam. The dam is visited weekly by a caretaker who records the reservoir elevation. Weekly reports are mailed to the Owner's Engineering Department. This information is taken for record purposes only. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are filed and used for determining the priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. The water supply line and outlet works valves used to be operated frequently, when the dam was operational. The caretaker stated that recently the operation of the valves was infrequent since the dam is not considered operational. In response to the National Dam Inspection Program of the previous year, the Owner is in the process of modifying his maintenance procedures. Details of the procedures have not been fully formulated.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a verbal description of the chain of command diagram for No. 5 Dam and of a generalized emergency notification list that is applicable for all of the Pennsylvania Gas and Water Company dams. The Owner said that during periods of heavy rainfall, available personnel are dispatched to the dams to observe conditions. All company vehicles are equipped with radios, and the personnel can communicate with each other and with a central control facility. Evaluation

of risk is made by the Owner's Engineering Department. The Owner's Engineering Department is also responsible for notification of emergency conditions to the local authorities. Detailed emergency operational procedures have not been formally established for No. 5 Dam, but are as directed by the Owner's Engineering Department.

4.5 Evaluation of Operational Adequacy. More frequent operation of the valves on the emergency drawdown line appears to be warranted, although the downstream valve on the line operated adequately on the day of the inspection. The damsite is remote, and security appears to be a major problem. The vandalized valve pit leaves the dam with no readily available upstream closure facilities. The maintenance of the embankment is good, but the trail bike ruts indicate that security measures could be improved. The procedures used by the Owner for inspecting the dam are adequate, but some needed repairs have not been made. In general, the warning system is adequate, but it would be more effective if it were more detailed.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. The Pennsylvania Water Supply Commission prepared a report upon the application of the Owner, prior to issuing a permit for the 1916 modifications to the dam. In that report, they estimated the design spillway capacity at 3,670 cfs with 2.0 feet of freeboard. A design discharge of 5,940 cfs was used for this study, and is in agreement with the discharge noted above, except that the capacity was estimated with no freeboard. There is other data pertaining to the spillway before the 1916 modification; however, it is not relevant to the existing condition.

b. Experience Data. No hydraulic problems were reported by the Owner. He stated that no records of maximum pool levels were available.

c. Visual Observations

(1) General. The visual inspection of No. 5 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 spillway capacity is rated with the core-wall at its design elevation. Most of the core-wall is 0.4 foot above the design elevation. This additional height does not have a significant effect on the conclusions described hereafter. The spalled low area in the core-wall, 0.3 foot below the design elevation, would allow water to pass through the core-wall; this is a definite erosion hazard. The cause of the condition is assessed in Section 6.

(3) Appurtenant Structures. No deficiencies relevant to hydrology and hydraulics were observed at the spillway. The conditions at the outlet works intake structure are evaluated in Section 4.

(4) Reservoir Area. No conditions were observed in the reservoir area 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.

Phase I reports for the National Dam Inspection Program were previously prepared for Lake Scranton Dam and Williams Bridge Dam, both of which are upstream of No. 5 Dam. Both these dams are of intermediate size and categorized as high hazard. They both have seriously inadequate spillway capacities. The failure of either of the upstream dams would cause the failure of No. 5 Dam. Although the access road to the dam was in good condition on the day of the inspection, it is almost certain that it would be impassable during periods of high runoff.

(5) Downstream Conditions. No conditions that would present a hazard to the dam were observed downstream. The downstream conditions indicate that a high hazard classification is warranted for No. 5 Dam. The stream crossings under the railroad along the downstream channel were not observed on the day of the inspection. The available information indicates that the embankments are relatively low; they would not provide significant mitigating effects to floodflows.

d. Overtopping Potential

(1) Spillway Design Flood. According to the criteria established by the Office of the Chief of Engineers (OCE), the spillway design flood (SDF) for the size (Small) and hazard potential (High) of No. 5 Dam varies between the probable maximum flood (PMF) and the 1/2 PMF. Because of the very large downstream population, the PMF is selected as the SDF.

(2) Description of Model. The watershed was modelled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs and stream sections. In addition, it has the capability to simulate an overtopping dam failure.

The PMF inflow component to Williams Bridge Dam was computed and routed through the dam. The outflow was routed downstream. This flow was added to the uncontrolled PMF inflow component to Lake Scranton Dam. The combined flow was routed through Lake Scranton Dam and downstream to No. 5 Reservoir, where it was combined with the uncontrolled PMF inflow component to No. 5 Dam. The combined flow was routed through No. 5 Dam. Identical methods were used for various percentages of the PMF.

(3) Summary of Results. Pertinent results are tabularized at the end of Appendix C. The analysis reveals that Williams Bridge Dam and Lake Scranton Dam can pass 45 percent and 34 percent, respectively, of their components of the PMF. The analysis also reveals that No. 5 Dam can pass 29 percent of the PMF without overtopping.

(4) Spillway Adequacy. The criteria for rating a spillway is presented in Appendix C. Since the dam cannot pass the 1/2 PMF, a further analysis was performed. For the occurrence of the 1/2 PMF, it was assumed that Lake Scranton Dam and Williams Bridge Dam would not fail. It was also assumed that no inflow occurred downstream of No. 5 Dam. In addition, it was assumed that No. 5 Dam would develop a breach 85 feet wide and 35 feet high 0.2 hour after being overtopped by 1.0 foot. A breach of this size results in an outflow of 27,300 cfs. The resulting outflow was routed downstream to Scranton. The locations of cross sections used for routing are shown on Plate C-1. The peak discharge at Scranton would only increase by about 1,190 cfs over the 10,790 cfs that would occur if the dam did not fail. The normal depth calculations used in the model indicate that the water surface in Scranton, resulting from the failure of the dam would rise only 0.2 foot over the peak non-failure water surface. The major reason for the negligible increase in water surface is the valley storage available between the dam and Scranton. However, there are conditions that would make the dam failure worse than the results of the analysis indicate. Plate 1 shows Interstate 81 crossing the left overbank of the stream in the reach between the dam and Scranton. As the road is high in this area, the roadway embankment may encroach significantly on the stream overbank. The computed valley storage may not all be available. The normal depth calculations used in the model do not take into account the effects of culvert flow. Pressure pipe calculations indicate that the water surface would increase by 23 percent (0.9 foot) for the computed discharge. Furthermore, the model analysis indicates that the peak failure water surface in Scranton would occur 2.0 hours before the peak non-failure water surface, only 20 minutes after the dam failed. Because of the above, the failure of No. 5 Dam would probably result in an increased hazard to loss of life. The spillway capacity of No. 5 Dam is rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of No. 5 Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. The trail bike ruts damage the embankment. The swale at the right abutment indicates the improper control of surface runoff. The condition is not severe at present. The riprap missing on the upstream slope presents an erosion hazard. However, because of the core-wall protruding above the embankment, this condition is not of special concern. The condition of the core-wall is evaluated with the spillway.

(3) Appurtenant Structures. The concrete on the spillway weir was specifically added to improve its stability. Further deterioration could have significant effect on the stability. The deterioration of the concrete at the spillway and core-wall was first noted in 1921, during one of the periodic inspections by the Commonwealth, only 5 years after it was placed. Although the spillway concrete is subject to scour, the core-wall concrete is not. The deterioration of the core-wall, which is only exposed to the weather, is indicative of poor concrete mix design. The same concrete mix was probably used in the spillway. The seepage observed in the spillway channel is not excessive. It is flowing from the bedrock. The deteriorated mortar at the masonry gravity training wall prevents the wall from acting as a watertight structure. As the deterioration is in the upper part of the wall, it is not of major concern. Surface runoff may have washed some soil through the dry masonry wall near the toe of the embankment. As this wall is low and beyond the embankment, the condition is only of minor concern.

b. Design and Construction Data. No record of design data or stability analysis for the embankment was available for review. Analysis of the embankment stability is beyond the scope of this study. Also,

sufficient data on the engineering properties of the embankment material would have to be acquired before the analysis could be performed. No evidence of stability problems presently threatening the embankment were observed.

An analysis of stability for the spillway both in its present condition and in its pre-1916 condition are available for review. In the 1914 Report by the Pennsylvania Water Supply Commission, an analysis of the spillway indicated that the resultant was almost at the toe. A more complete history is given in Section 1.2g. The spillway was modified in 1916 to improve the stability. The results of the analysis of the modified section is shown on Plate 5.

For this study, a stability analysis was performed. The stability of the spillway section was analyzed. Only the highest section was considered and the stability was checked at its base. It was assumed that: headwater was at the top of the dam, tailwater was 15 feet above the toe, full hydrostatic head and at-rest earth pressure was on the upstream face, and uplift was varying from full tailwater at the toe to full tailwater plus two-thirds the difference between headwater and tailwater at the heel. For this loading condition, the resultant is about 5.4 feet inside the toe, but outside the middle third. The toe pressure and factor of safety against sliding are adequate. Although OCE guideline states that the resultant should be within the middle third, the location of the resultant is not deemed to be a significant deviation from the guideline, since the toe pressure is well below the allowable.

c. Operating Records. There are no formal records of operation. No evidence of instability on any feature of the dam has been noted.

d. Postconstruction Changes. As noted herein, there is sufficient information available on all modifications made to No. 5 Dam, such that its stability can be assessed.

e. Seismic Stability No. 5 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. However, since there are no formal static stability analyses, and since there is the potential of earthquake forces moving or cracking the masonry core-wall, the theoretical seismic stability of No. 5 Dam cannot be assessed.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND
PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety.

(1) Based on the visual inspection, available records, calculations, and past operational performance, No. 5 Dam is judged to be in fair condition. The existing spillway will pass 29 percent of the PMF without overtopping of the dam. Failure of the dam would cause an increased hazard to loss of life downstream. The spillway is rated as seriously inadequate. According to criteria established for these studies, the dam must be rated as unsafe, nonemergency, because the spillway capacity is seriously inadequate.

(2) There is no evidence of serious stability problems at the embankment. The gravity spillway has a resultant outside the middle third but within the base for the maximum loading condition. This is not considered to be a significant deviation from the OCE guidelines, since the toe pressure is well below the allowable.

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

<u>Feature and Location</u>	<u>Observed Deficiency</u>
<u>Embankment</u>	
Top	Deteriorated concrete core-wall.
Right abutment	Eroded surface drainage swale.
Upstream slope	Riprap missing.
Downstream slope	Trail bike ruts.
<u>Spillway:</u>	
Weir	Deteriorated concrete and mortar

<u>Feature and Location</u>	<u>Observed Deficiency (Cont'd)</u>
Training wall	Deteriorated mortar.
Channel	Seepage from bedrock.
Dry masonry wall	Depression behind wall.
<u>Outlet Works:</u>	
Intake approach walls	Capstones dislodged.
Intake structure	Interior vandalized.

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 immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations by the Owner will be required.

7.2 Recommendations and Remedial Measures.

a. The following measures are recommended to be undertaken by the Owner, in approximate order of priority, immediately:

(1) Perform additional studies to more accurately ascertain the spillway capacity required for No. 5 Dam, as well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate. Take remedial measures as required. The studies should be performed by a professional engineer experienced in the design and construction of dams.

(2) Repair the concrete at the spillway weir and the core-wall.

(3) Repair the vandalized interior of the intake structure so that adequate access to the upstream closure valves is available. Ensure that the valves are operational.

(4) Repair the mortar at the spillway and at the masonry gravity training wall.

(5) Replace the dislodged capstones at the outlet works approach wall.

(6) Repair the riprap on the upstream slope of the embankment.

(7) Provide a proper surface drainage path near the right abutment.

(8) Monitor, by any suitable means, the seepage at the spillway channel. If significant changes are noted, take appropriate action.

(9) Monitor, by any suitable means, the depression behind the dry masonry wall. If changes are noted, take appropriate action.

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 No. 5 Dam. A similar system has already been recommended in other reports for Lake Scranton and Williams Bridge Dams, which are located upstream.

(2) Provide round-the-clock surveillance of No. 5 Dam during periods of unusually heavy rains.

(3) Develop impediments to trail bike use on the embankment and improve security at the damsite.

(4) 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
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979


PLATES

SCRANTON


LAKE SCRANTON
DAM



STAFFORD MEADOW
BROOK



NO. 5 DAM



WILLIAMS BRIDGE DAM



2000 0 2000



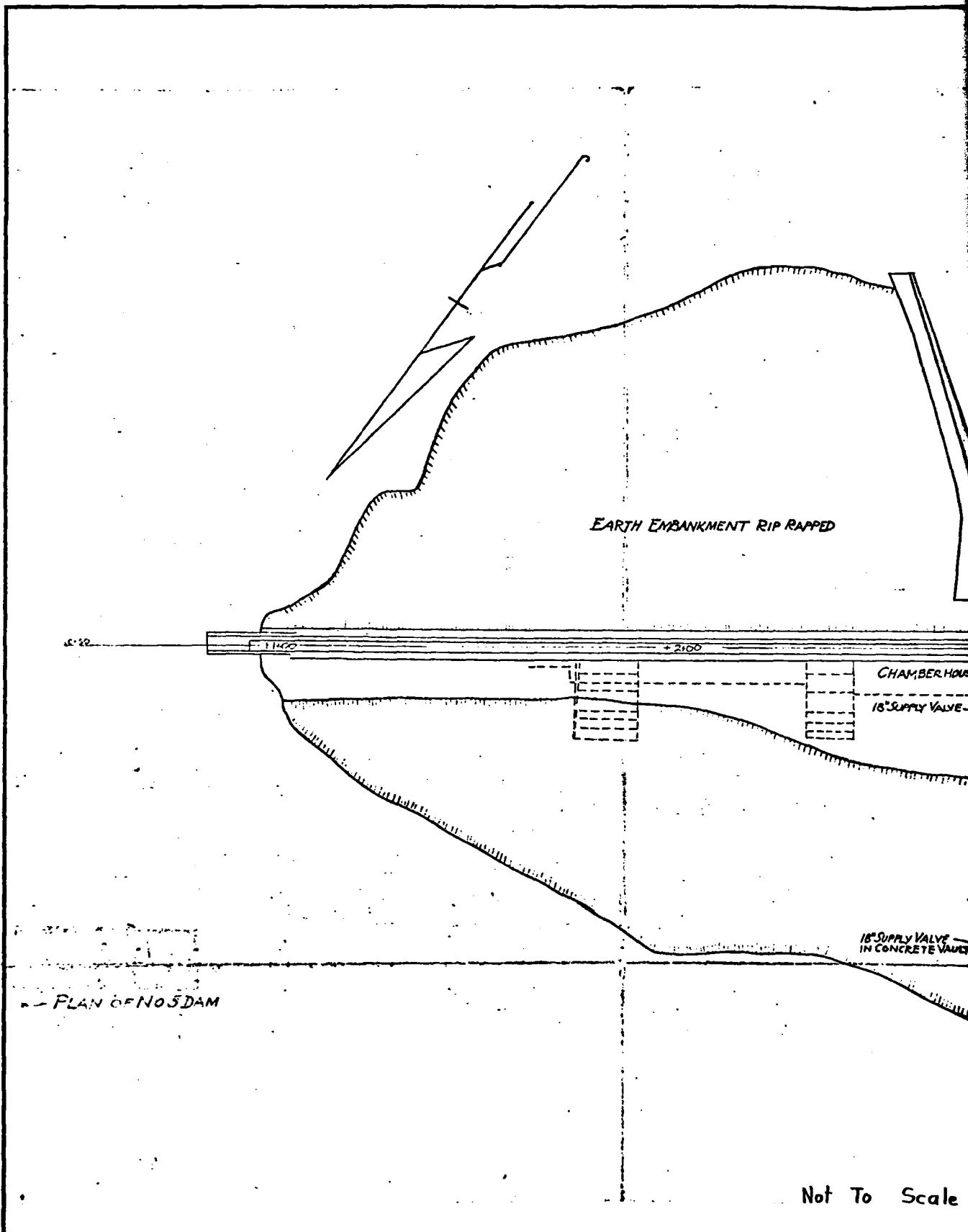
SCALE: 1 IN. = 2000 FT.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

APRIL 1979

PLATE I



EARTH EMBANKMENT RIP RAPPED

+1100

+2100

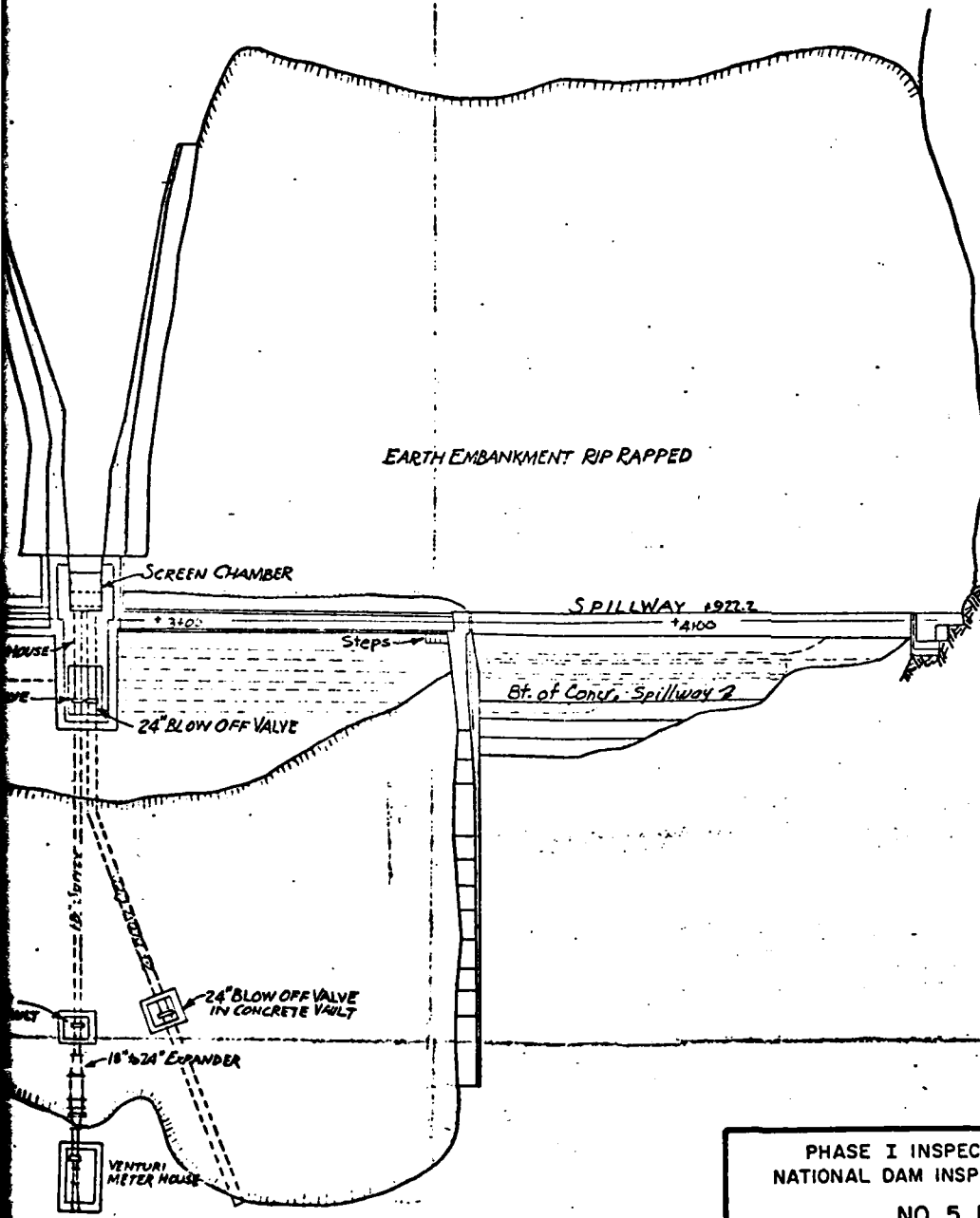
CHAMBER HOUSE
18" SUPPLY VALVE

18" SUPPLY VALVE
IN CONCRETE VAULT

PLAN OF NO 5 DAM

Not To Scale

S.G. & W. CO.
DISTRIBUTING RESERVOIR
Sheet 2-C



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY
PLAN
1979 PLATE 2

2+00

CONCRETE

MASONRY

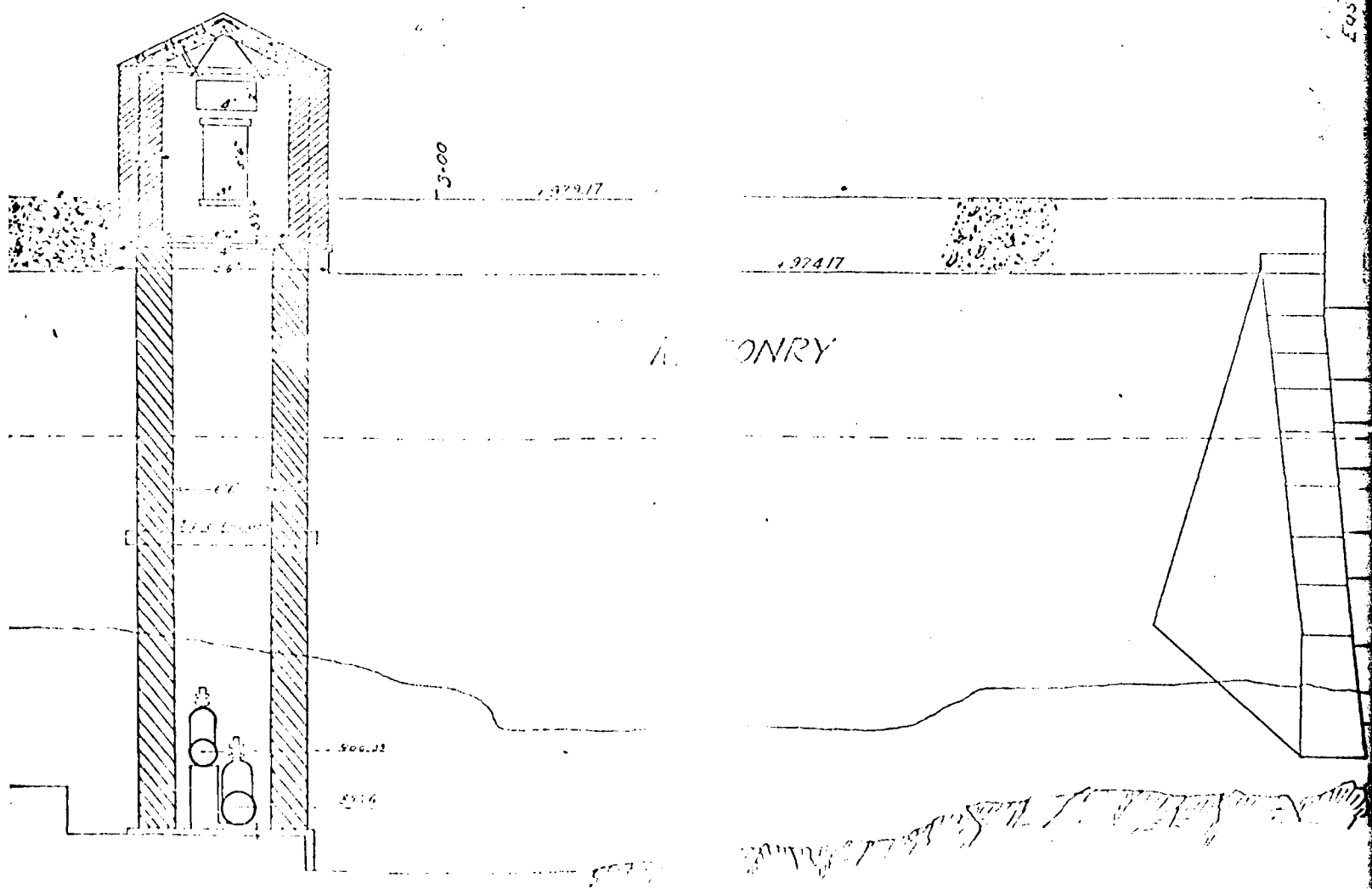
TOP OF OLD DAM

Original Surface

RESERVOIR M
LONGITUDINAL SECTION OF
... .. 1955

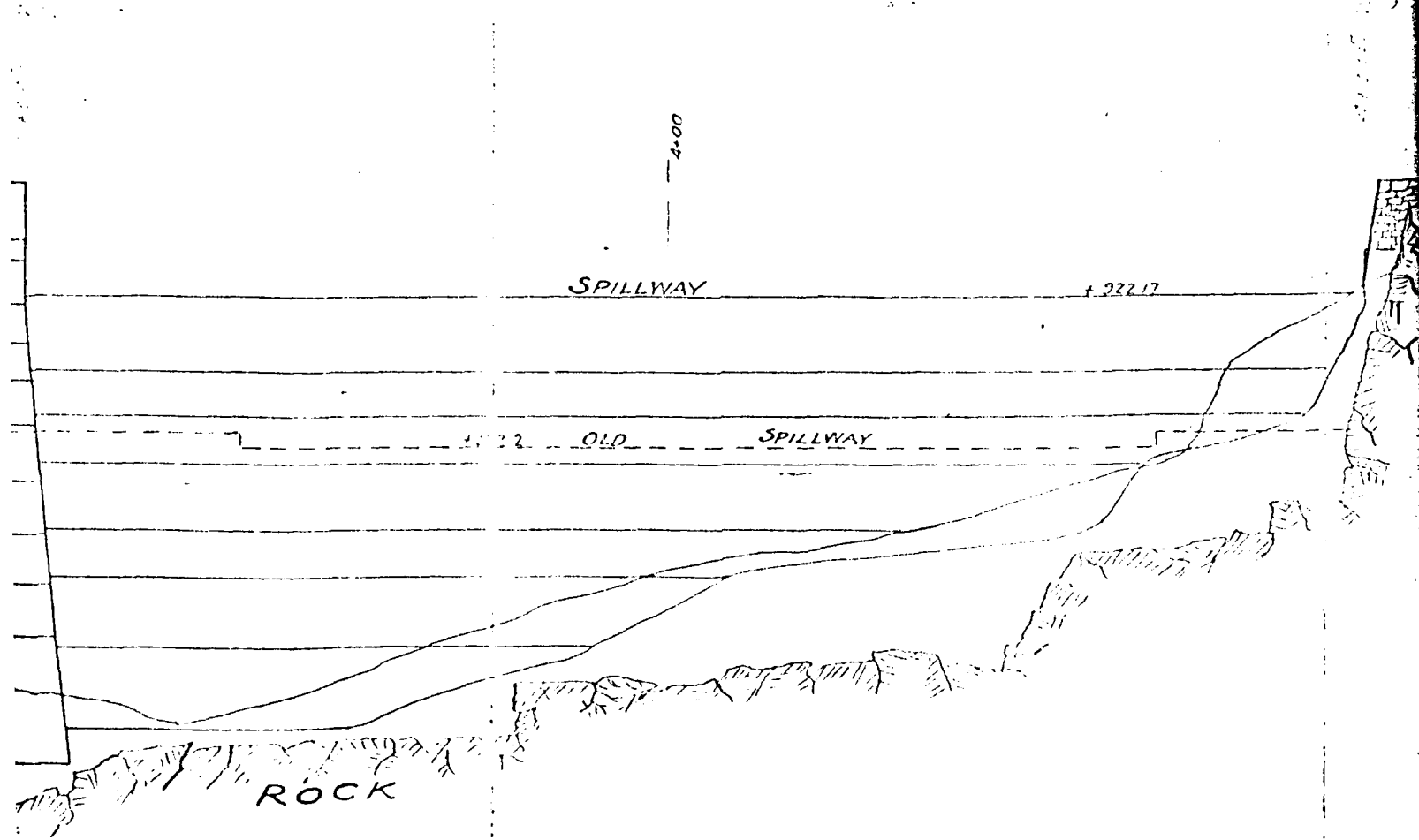
3

East End Spillway



No. 5
OF MAIN DAM

S. G. & W. CO
DISTRIBUTING RESER
Sheet # 151



PHASE I INSPECTION
NATIONAL DAM INSPECTION
NO. 5 DAM
PENNSYLVANIA GAS AND WATER
PROFILE
APRIL 1979

4

Co. 
cevoie

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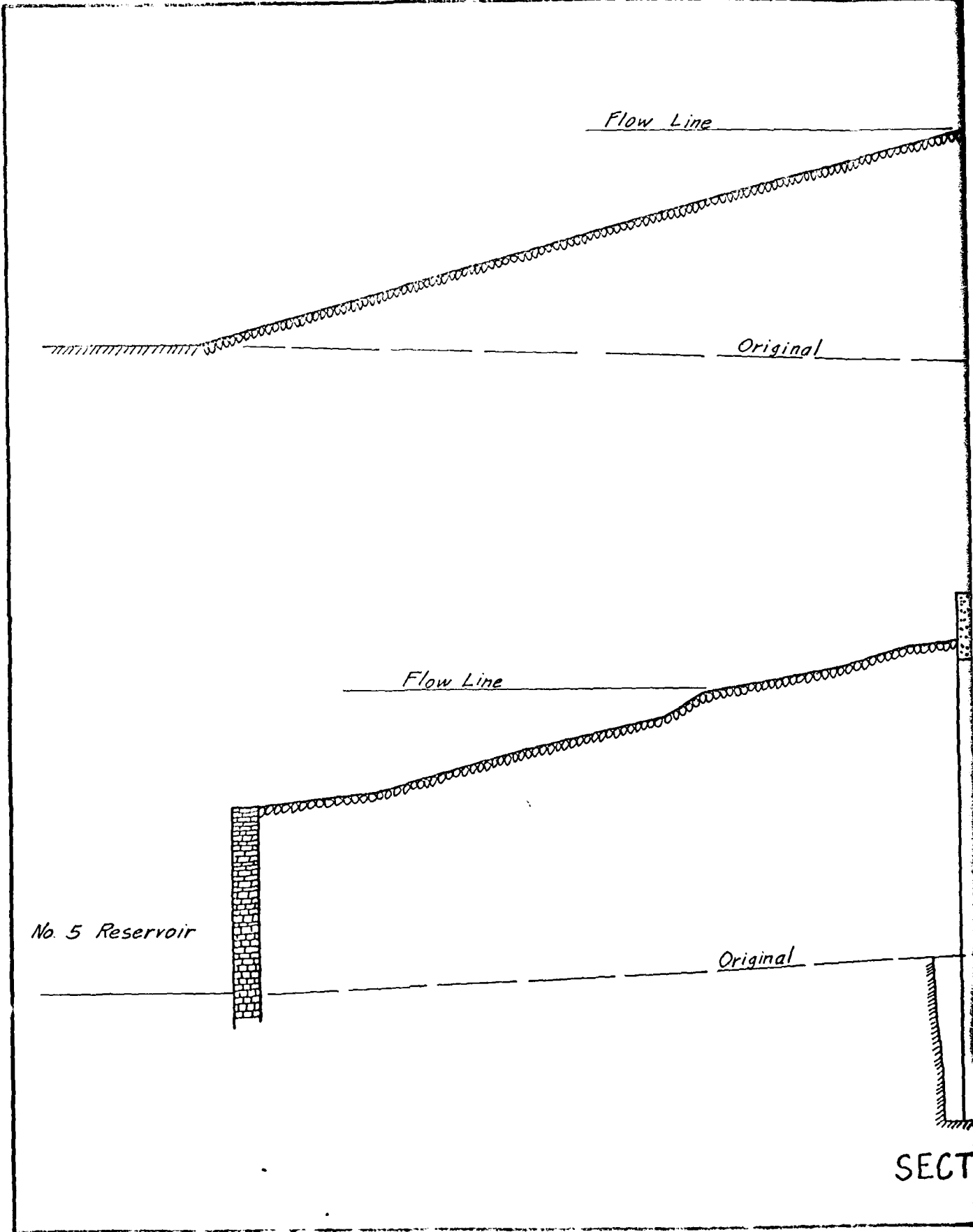


REPORT
ON PROGRAM

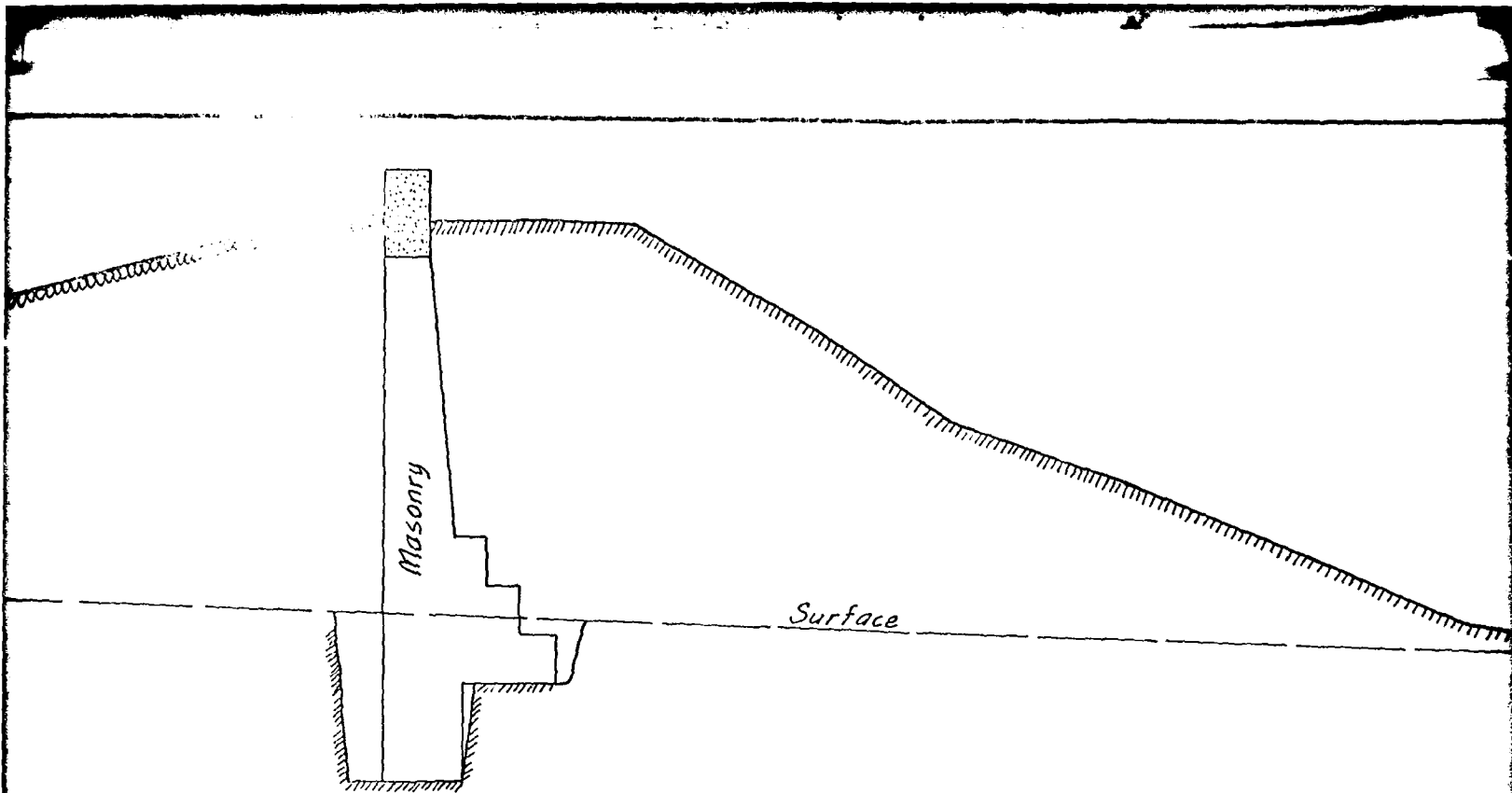
TER COMPANY

PLATE 3

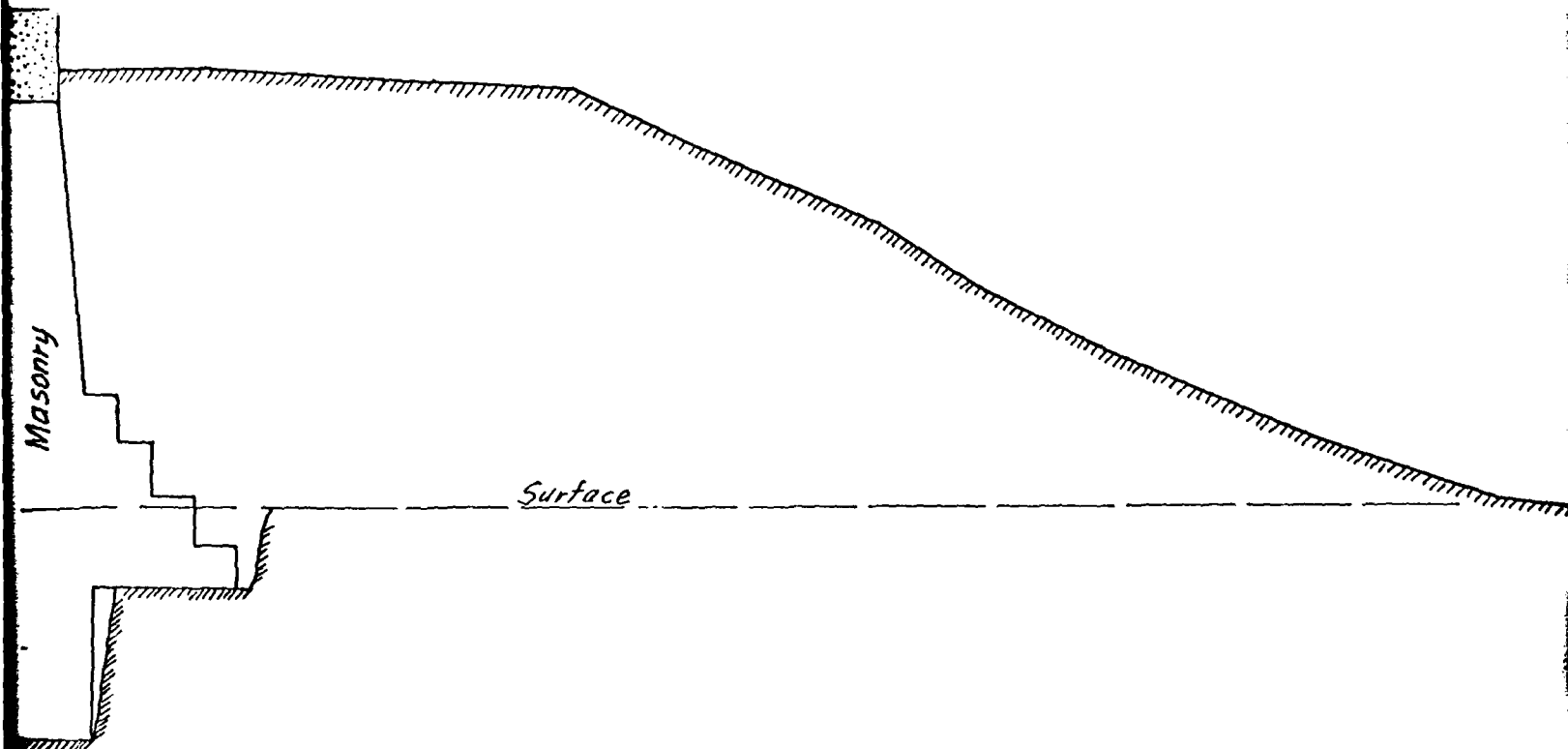
3



SECT

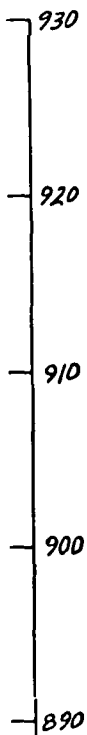
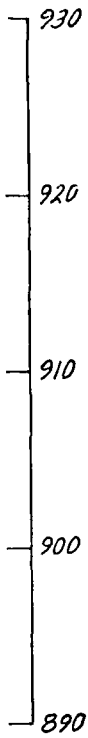


SECTION 2+00



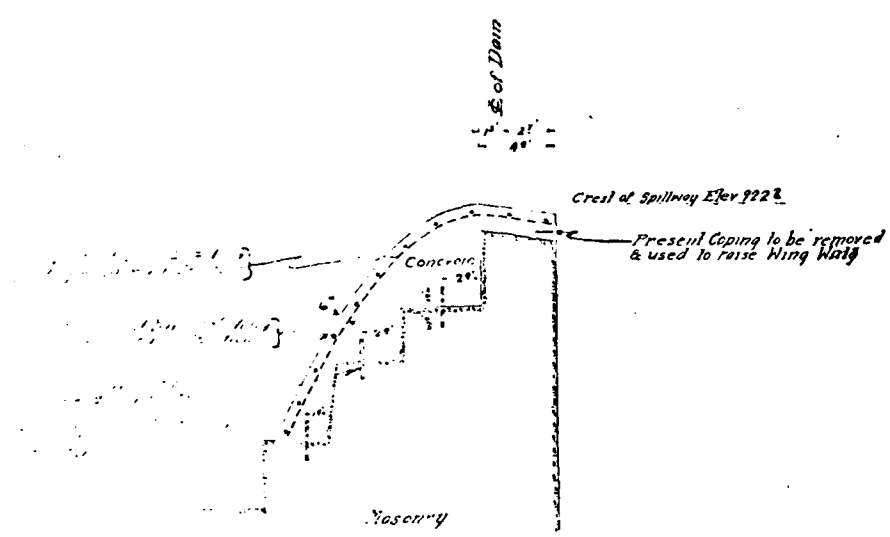
SECTION 2+72

1

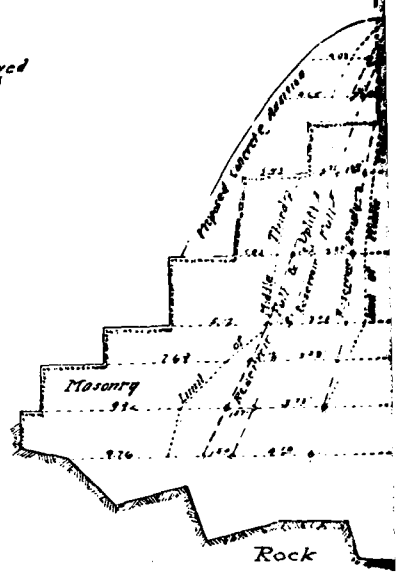


NOTE:
*This drawing was traced from
owner's original drawing.*

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY
SECTIONS
APRIL 1979 *4* PLATE 4

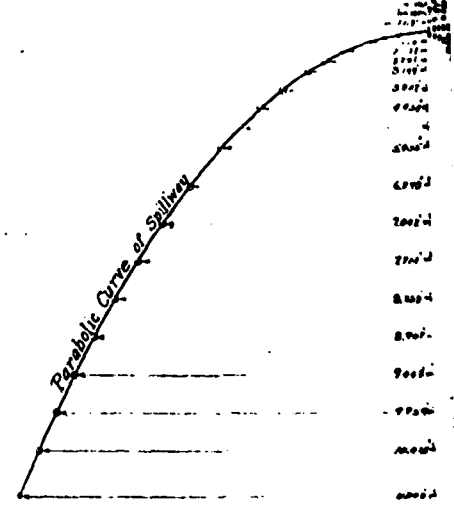


Plan Section showing Reinforcement in Proposed Addition to Spillway. Scale 1/4"



Section through Spillway Lines of Pressure, Reservoir Full. Scale 1/2"

NO. 5 DAM
ON STAFFORD MEADOW BROOK
SECTIONS
showing
PROPOSED METHOD OF STRENGTHENING SPILLWAY
S. G. & W. CO.
Scales indicated Scranton Pa. *March 27, 1916*
H. J. [Signature]
 Chief Engineer



Parabolic Spillway. Scale 1/2"

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY
PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: No. 5

I PA-00375

NDO ID NO.: 35-22

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	DRAWINGS PREPARED FOR VARIOUS MODIFICATIONS - SEE PLATES 2-5.
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT 1907-1908 ENLARGED 1993 SPILLWAY STRENGTHENED - 1916
TYPICAL SECTIONS OF DAM	SEE PLATE 4
OUTLETS: Plan Details Constraints Discharge Ratings	AVAILABLE

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	1914 PA. WATER SUPPLY COMMISSION REPORTS.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	ANALYSES FOR HYDRAULICS AND HYDROLOGY AND SPILLWAY STABILITY AVAILABLE.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	SEE "AS-BUILT DRAWINGS"

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	LOWER DOWNSTREAM EMBANKMENT FROM RESERVOIR. UPPER DOWNSTREAM EMBANKMENT FROM HILLSIDE.
MONITORING SYSTEMS	NONE
MODIFICATIONS	SEE CONSTRUCTION HISTORY
HIGH POOL RECORDS	NONE
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	SUPPLEMENTARY REPORT BY WATER SUPPLY COMMISSION NOT AVAILABLE.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	NONE

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NOT AVAILABLE
SPILLWAY: Plan Sections Details	SEE PLATE 5
OPERATING EQUIPMENT: Plans Details	SEE PLATE 2
PREVIOUS INSPECTIONS Dates Deficiencies	1921 - NEW CONCRETE ON SPILLWAY DETERIORATING. 1925 - PER 1921 AND SLIGHT SEEPAGE AT LEFT END OF SPILLWAY 1928 - PER 1921 1932 - PER 1925 1941 - PER 1925, DISINTEGRATION IS MORE SEVERE. CORE WALL SHOWS SIGNS OF DETERIORATION. 1943 - PER 1941 AND SLIGHT DETERIORATION AT RIGHT TRAINING WALL. 1945 - PER 1943. 1953 - NO DEFICIENCIES (WATER FLOWING OVER SPILLWAY). 1957 - "SLIGHT LEAKAGE" - "DOWNSTREAM FACE DETERIORATED" POOL LEVEL NOT NOTED.

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: No. 5 County: LACKAWANNA State: PENNSYLVANIA
NDS ID No.: PA - 00375 DER ID No.: 35-22
Type of Dam: EARTHEN WITH CORE WALL Hazard Category: HIGH
Date(s) Inspection: 8 November 1978 Weather: OVERCAST Temperature: 50°F

SOIL CONDITIONS: MOIST

Pool Elevation at Time of Inspection: 922.3 msl/Tailwater at Time of Inspection: 895.2 msl

Inspection Personnel:

J. CROUSE (GFCC)

G. SMITH (GFCC)

B. GIOENAR (PGW)

A. WHITMAN (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	TRAIL BIKE RUTS IN DOWNSTREAM EMBANKMENT. CAR RUTS ON TOP.	OLD WINGWALL ENTIRELY WITHIN EMBANKMENT IS DETERIORATED. THIS IS OF NO SIGNIFICANCE.
CREST ALIGNMENT: Vertical Horizontal	SEE SURVEY DATA	
RIPRAP FAILURES	RIPRAP IS WASHED OUT LEFT OF THE INTAKE STRUCTURE AND FOR 20' TO THE RIGHT.	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	SURFACE DRAINAGE SWALE AT RIGHT ABUTMENT	
ANY NOTICEABLE SEEPAGE	NONE	
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
CORE-WALL	70% SPALLED AND PEELING SEE SURVEY DATA PROFILE.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	CIP- 24" DIA.	
INTAKE STRUCTURE	INSIDE IS VANDALIZED AND HAZARDOUS. CAPSTONES ON APPROACH WALL ARE DISLODGED.	DOOR SILL AND WINDOW LEDGES HAVE BEEN RAISED.
OUTLET STRUCTURE	NO DEFICIENCIES	
OUTLET CHANNEL	NO DEFICIENCIES	
EMERGENCY GATE	OPENED 5% by 2 MEN IN 15 MINUTES	NO DEFICIENCIES

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR UPPER PART - CONCRETE LOWER PART - MASONRY	CONCRETE VERY DETERIORATED REBAR EXPOSED. MASONRY HAS MINOR MORTAR DETERIORATION.	
APPROACH CHANNEL	RESERVOIR	
DISCHARGE CHANNEL	MASONRY WINGWALL - DETERIORATED MORTAR ALONG UPPER 3'. LEACHING OBSERVED BELOW. DRY MASONRY WALL - SOIL BEHIND WALL DEPRESSED	2 MINOR STEPS 4' ABOVE BOTTOM OF CHANNEL.
BRIDGE AND PIERS	NONE	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE IN A USEABLE STATE.	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	STEEP	
SEDIMENTATION	NO PROBLEMS REPORTED OR OBSERVED.	
WATERSHED DESCRIPTION	BETWEEN LAKE SCRANTON AND NO.5 DAM - WOODED, UNINHABITED, VERY STEEP	LAKE SCRANTON AND WILLIAMS BRIDGE DAM ARE UPSTREAM. THEIR WATERSHEDS HAVE SOME RURAL DEVELOPMENT.

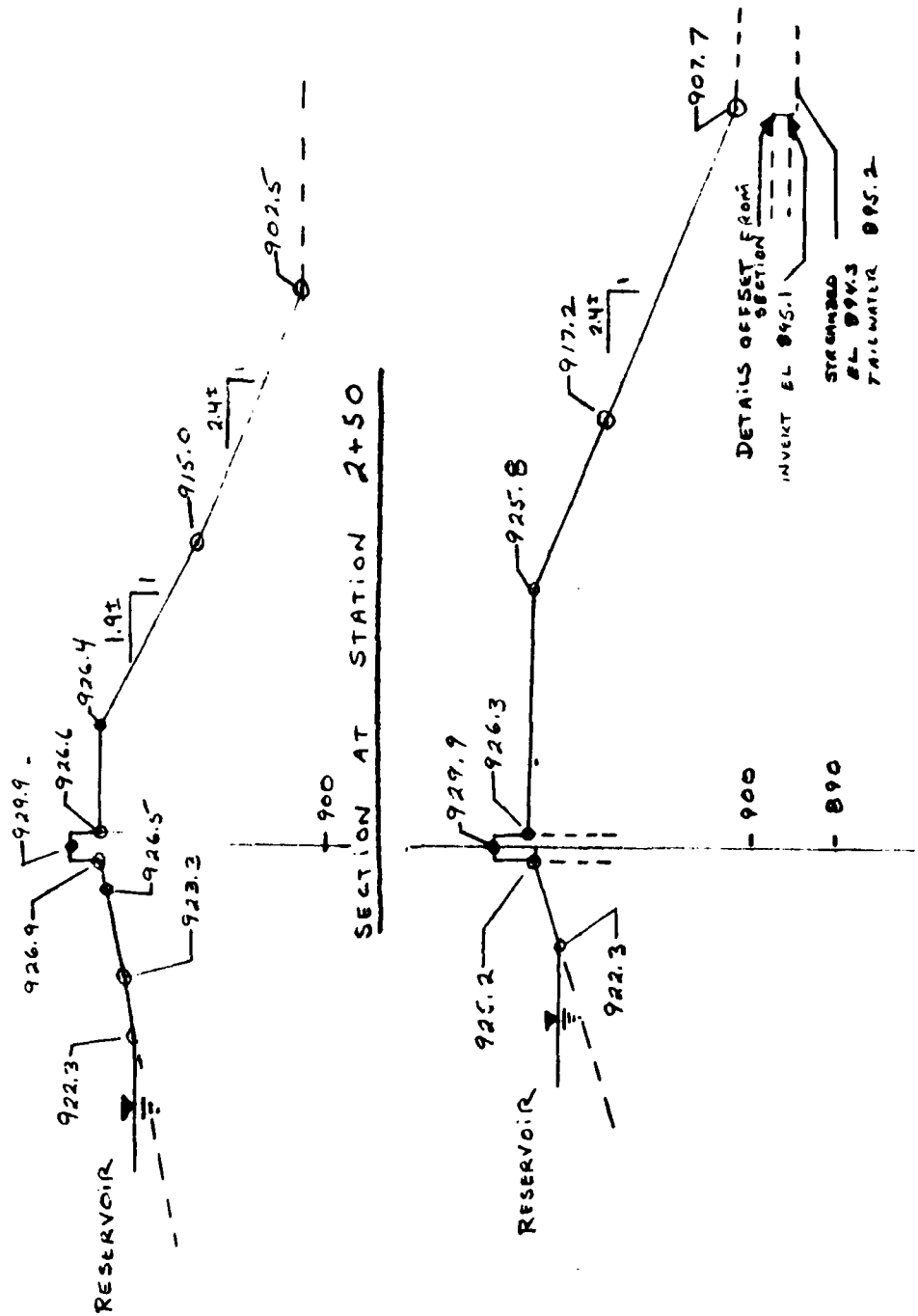
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	NO DEFICIENCIES	
SLOPES	RELATIVELY STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	SCRANTON - MAJOR URBAN - STREAM PASSES THROUGH MANY SMALL CULVERTS.	

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

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

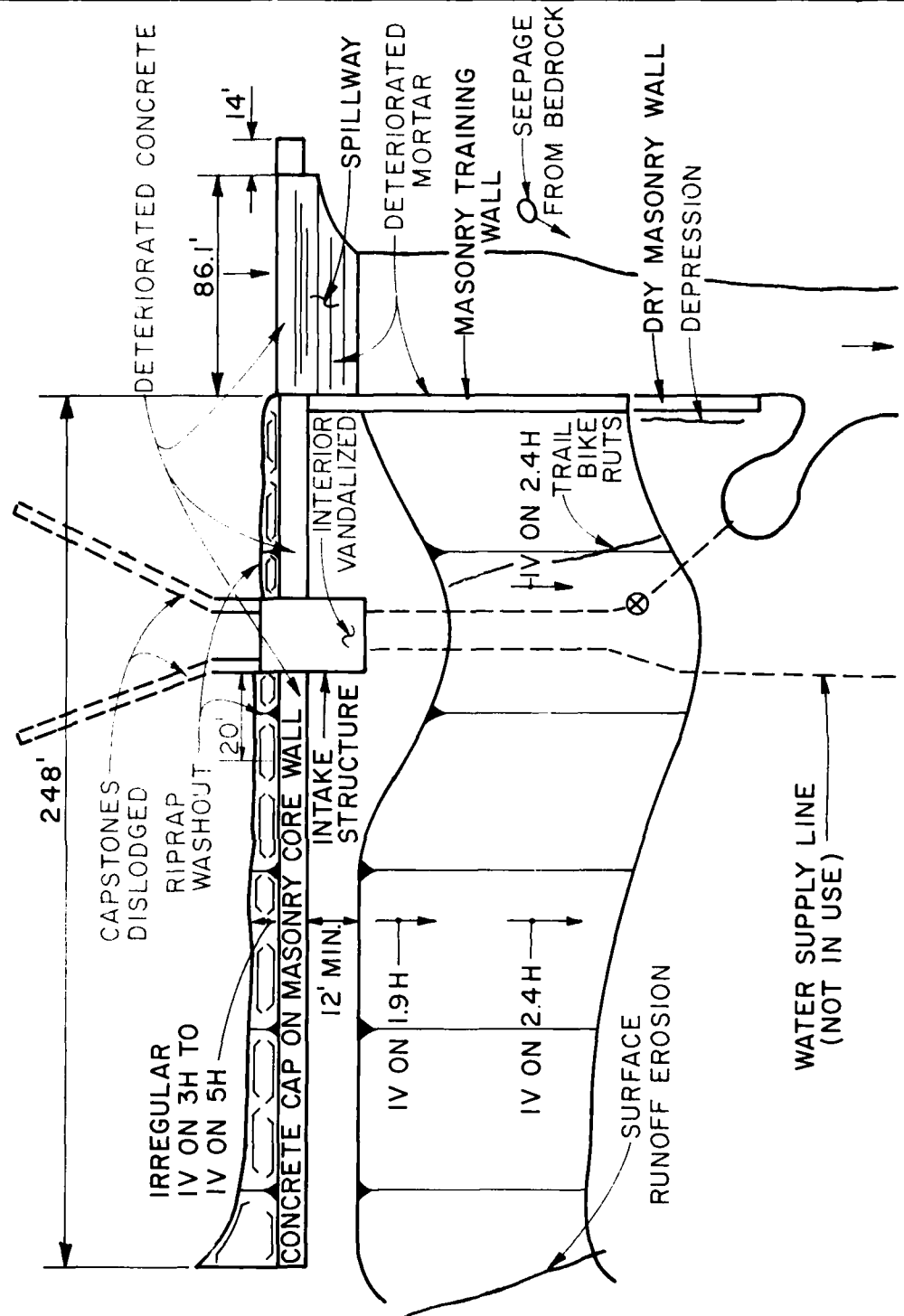


SECTION AT STATION 1+87

SCALE 1" = 20'

B-10

RESERVOIR
(0.1' ABOVE SPILLWAY CREST ON DAY OF INSPECTION)



NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY
RESULTS OF VISUAL INSPECTION

APRIL 1979

PLATE B-1

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY
PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 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.

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

NDS ID No.: PA-00375

DER ID No.: 35-22

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Top of Dam ^{design} (low-spot) Elevation: 929.5

Streambed Elevation: 894.3 Height of Dam: 35 ft

Reservoir Storage at Top of Dam Elevation: 927 acre-ft

Size Category: SMALL

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: PMF - MANY PEOPLE DOWNSTREAM

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
<u>Williams Bridge</u>	<u>UPSTREAM 2.3</u>	<u>54</u>	<u>1,276</u>	<u>SERIOUSLY INADEQUATE SPILLWAY</u>
<u>LAKE SCRANTON</u>	<u>2.3</u>	<u>60</u>	<u>8,397</u>	<u>SERIOUSLY INADEQUATE SPILLWAY</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

DOWNSTREAM DAMS

<u>NONE</u>	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

NDS ID No.: PA-00375

DER ID No.: 35-22

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas A1 of 5.7 sq. mile

A2 1.5

A3 4.8

Total Drainage Area 12.0 sq. mile

PMF Rainfall Index = 22.15 in., 24 hr., 200 sq. mile

Hydromet. 40 (Susquehanna Basin) Hydromet. 33 (Other Basins)

Zone N/A

Geographic Adjustment Factor 98% 1.0

Revised Index Rainfall 21.7 INCHES

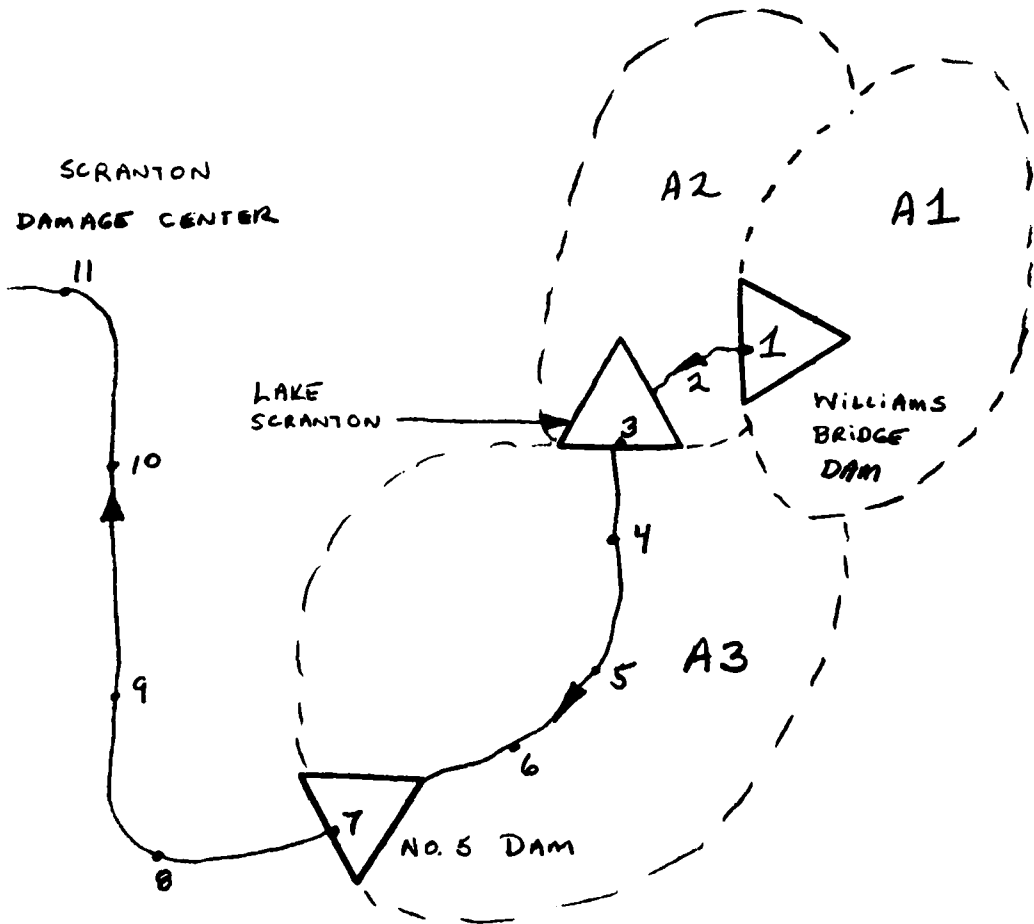
RAINFALL DISTRIBUTION (percent)

<u>Time</u>	<u>Percent</u>
6 hours	<u>116</u>
12 hours	<u>125</u>
24 hours	<u>134</u>
48 hours	<u>141</u>
72 hours	<u>143</u>
96 hours	<u>N/A</u>

C-3

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

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____



SKETCH
OF SYSTEM

SEE PLATE C-1
FOR EXACT LOCATIONS

C-4

Data for Dam at Outlet of Subarea A 1
 (see Sketch on Sheet C-4)

Name of Dam: WILLIAMS BRIDGE Sheet 1 of

Height: 54 FEET (existing) OUTLET WORKS
130 CFS MAX - NEGLECTED

Spillway Data: FROM PHASE I
 REPORT

	Existing Conditions	Design Conditions
--	------------------------	----------------------

Top of Dam Elevation	<u>1366.2</u>	<u>1366.2</u>
----------------------	---------------	---------------

Spillway Crest Elevation	<u>1360.6</u>	<u>1360.6</u>
--------------------------	---------------	---------------

Spillway Head Available (ft)	<u> </u>	<u>5.6</u>
------------------------------	-------------	------------

Type Spillway	<u>BROAD CRESTED WEIR</u>	
---------------	---------------------------	--

"C" Value - Spillway	<u> </u>	<u>3.15</u>
----------------------	-------------	-------------

Crest Length - Spillway (ft)	<u> </u>	<u>56.3</u>
------------------------------	-------------	-------------

<u>Spillway</u> Peak Discharge (cfs)	<u> </u>	<u>2350</u>
--------------------------------------	-------------	-------------

Auxiliary Spillway Crest Elevation	<u>1361.6</u>	<u>1361.6</u>
------------------------------------	---------------	---------------

Auxiliary Spillway Head Available (ft)	<u> </u>	<u>4.6</u>
--	-------------	------------

Type Auxiliary Spillway	<u>BROAD CRESTED WEIR</u>	
-------------------------	---------------------------	--

"C" Value - Auxiliary Spillway	<u> </u>	<u>3.15</u>
--------------------------------	-------------	-------------

Crest Length - Auxiliary Spillway (ft)	<u> </u>	<u>103.3</u>
--	-------------	--------------

<u>Auxiliary Spillway</u> Peak Discharge (cfs)	<u> </u>	<u>3210</u>
---	-------------	-------------

<u>Combined Spillway</u> Discharge (cfs)	<u> </u>	<u>5560</u>
--	-------------	-------------

Spillway Rating Curve: COMPUTED FROM ABOVE

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
<u>1360.6</u>	<u>0</u>	<u>0</u>	<u>0</u>
<u>1361.6</u>	<u>177</u>	<u>0</u>	<u>177</u>
<u>1362.6</u>	<u>502</u>	<u>325</u>	<u>827</u>
<u>1364.6</u>	<u>1419</u>	<u>1691</u>	<u>3110</u>
<u>1366.2</u>	<u>2350</u>	<u>3210</u>	<u>5560</u>
<u>1368.6</u>	<u>4013</u>	<u>6026</u>	<u>10,039</u>

C-5

SUSQUEHANNA River Basin

Name of Stream: STAFFORD MEADOW BROOK

Name of Dam: NO. 5

~~NDS ID No.~~: _____

~~DBR ID No.~~: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A1 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: WILLIAMS BRIDGE

Drainage Area of Subarea: 5.7 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 4.4 mile

LCA = Length of Main Watercourse to the centroid = 1.5 mile

From NAB Data: AREA 11 PLATE E

$C_p =$ 0.62

$C_T =$ 1.50

$T_p = C_T \times (L \times L_{CA})^{0.3} =$ 2.64 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 8.6 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A2
 (see Sketch on Sheet C-4)

Name of Dam: LAKE SCRANTON Sheet 1 of

Height: 60 FEET (existing) OUTLET WORKS
IGNORED FOR FLOODFLOWS

Spillway Data: FROM PHASE I
REPORT

	<u>Existing</u> <u>Conditions</u>	<u>Design</u> <u>Conditions</u>
--	--------------------------------------	------------------------------------

Top of Dam Elevation	<u>1286.1</u>	<u>1286.1</u>
----------------------	---------------	---------------

Spillway Crest Elevation	<u>1282.8</u>	<u>1282.8</u>
--------------------------	---------------	---------------

Spillway Head Available (ft)	<u>3.3</u>	<u>3.3</u>
------------------------------	------------	------------

Type Spillway ROUNDED CREST

"C" Value - Spillway SEE NEXT SHEET

Crest Length - Spillway (ft)	<u>100</u>	<u>100</u>
------------------------------	------------	------------

<u>Spillway</u> Peak Discharge (cfs)	<u>2298</u>	<u>2298</u>
--------------------------------------	-------------	-------------

Auxiliary Spillway Crest Elevation	<u>1283.3</u>	<u>1283.3</u>
------------------------------------	---------------	---------------

Auxiliary Spillway Head Available (ft)	<u>2.8</u>	<u>2.8</u>
--	------------	------------

Type Auxiliary Spillway 11 ARCHES EACH 3.5' HIGH BY 17' LONG

"C" Value - Auxiliary Spillway SEE NEXT SHEET

Crest Length - Auxiliary Spillway (ft)

<u>Auxiliary Spillway</u>	<u>Peak Discharge (cfs)</u>	<u> </u>
	<u>2215</u>	<u>2215</u>

Combined Spillway Discharge (cfs)

Spillway Rating Curve: * PHASE I REPORT NOTES DIFFICULTY
OF ESTIMATING CAPACITY

** VARIES SLIGHTLY FROM PHASE I
REPORT

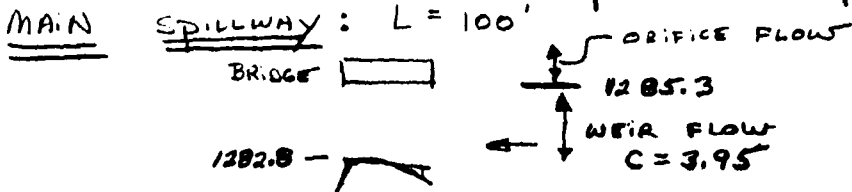
<u>Elevation</u>	<u>Q Spillway (cfs)</u>	<u>Q Auxiliary Spillway (cfs)</u>	<u>Combined (cfs)</u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>

SEE NEXT SHEETS

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

SUBJECT LIKE SECTION FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR MAIN SPILLWAY
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

DATA FROM PHASE I REPORT



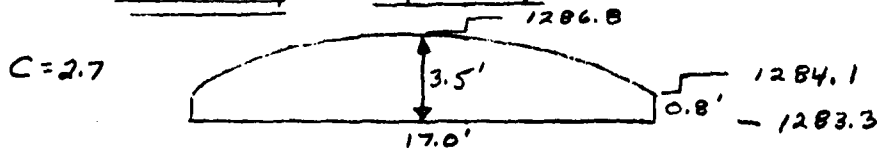
ORIFICE EQUATION USED IN PHASE I REPORT

$$Q = CA\sqrt{2gh} \quad A = 2500' \quad C = 0.8$$

$$h = \text{POOL ELEV} - \left(\frac{1285.3 + 1282.8}{2} \right) = \text{POOL} - 1284.05$$

POOL ELEV	Q (CFS)
1282.8	0
1283.0	35
1283.3	140
1284.0	519
1285.0	1289
1285.3	1561
1286.0	2240
1286.1	2298
1287.0	2756
1288.0	3189
1295.0	5309

AUXILIARY SPILLWAY 17e:



SEE NEXT SHEET

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

SUBJECT LAKE SCRANTON FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR Auxiliary Spillway - CONTINUED
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

ASSUME ADJUSTED CRITICAL DEPTH

$$Q = \frac{2.7}{3.1} \sqrt{\frac{A_3 g}{T}} \quad A \text{ AND } T \text{ ESTIMATED FROM}$$

Auxiliary
Spillway:

PAGE C-5, PHASE I REPORT

$$h_v = v^2 / 2g \quad v = Q/A$$

W.S. ELEV	INCREMENT	A	TOTAL A	T	Q	Q x H	h _v	Pool ELEV
1283.3			0	17	0	0	0	83.3
	13.6		13.6	17	60.1	661.1	.3	84.4
	15		28.6	13	209.6	2306	1.1	86.2
	10.75		39.35	8.5	418.3	4601	1.8	87.9
	3		42.35					
TOP OF ARCH						<u>FINAL Q</u>		<u>Pool ELEV.</u>

FOR FOLLOWING USE

ORIFICE EQUATION

$$Q = C A \sqrt{2gH} \quad A = 424 \times 11 \quad C = 0.8$$

$$H = \text{POOL} - \left(\frac{1286.8 + 1283.3}{2} \right)$$

Q x H
7891
Pool ELEV
92.0

ABOVE EL 1292

INCLUDE 390' LONG ROAD

TOP OF ARCHES EL 1292

C = 2.7

14,914
95.0

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

SUBJECT _____ FILE NO. _____
SHEET NO. _____ OF _____ SHEETS
FOR _____
COMPUTED BY _____ DATE _____ CHECKED BY _____ DATE _____

COMBINED RATING CURVE
INTERPOLATING BETWEEN POINTS
COMPUTED

<u>POOL ELEV</u>	<u>CFS</u> <u>Q MAIN SPILL</u>	<u>CFS</u> <u>Q AUX. SPILL</u>	<u>CFS</u> <u>TOTAL Q</u>
1282.8	0 ✓	0 ✓	0
1283.3	140 ✓	0 ✓	140
1284.0	519 ✓	421 *	940
1285.0	1289 ✓	1209 *	2498
1286.1	2298 ✓	2215 *	4513
1288.0	3189 ✓	4681 *	7870
1292.0	4400 *	7891 ✓	12291
1295.0	5309 ✓	14914 ✓	20223

* INTERPOLATED FROM TABLES
ON PREVIOUS PAGES

SUSQUEHANNA River Basin

Name of Stream: STAIRFORD MEADOW BROOK

Name of Dam: NO. 5

NDS ID No.: _____

DER ID No.: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A2 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: LAKE SCRANTON

Drainage Area of Subarea: 7.2 OF WHICH 1.5 UNCONTROLLED sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 1.3 mile

L_{CA} = Length of Main Watercourse to the centroid = 0.91 mile

From NAB Data: AREA 11 PLATE E

C_p = 0.62

C_T = 1.50

T_p = C_T × (L × L_{CA})^{0.3} = 1.58 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile × Subarea D.A = 2.3 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A3
(see Sketch on Sheet C-4)

Name of Dam: NO.5 Sheet 1 of

Height: 35 FEET (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	<u>929.2</u>	<u>929.5</u>
Spillway Crest Elevation	<u>RATING OF DAM</u>	<u>922.2</u>
Spillway Head Available (ft)	<u>BASED ON DESIGN CONDITIONS</u>	<u>7.3</u>
Type Spillway	<u>Ogee-Type</u>	<u>CREST</u>
"C" Value - Spillway	<u>3.50</u>	<u>3.50*</u>
Crest Length - Spillway (ft)	<u>86.1</u>	<u>86.1</u>
Spillway Peak Discharge (cfs)		<u>5940</u>
Auxiliary Spillway Crest Elevation	<u>NONE</u>	<u>NONE</u>
Auxiliary Spillway Head Available (ft)		
Type Auxiliary Spillway		
"C" Value - Auxiliary Spillway		
Crest Length - Auxiliary Spillway (ft)		
Auxiliary Spillway Peak Discharge (cfs)		
Combined Spillway Discharge (cfs)		<u>5940</u>

Spillway Rating Curve: * FROM WATER SUPPLY COMMISSION ESTIMATE

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Data for Dam at Outlet of Subarea A3

Name of Dam: NO.5 Sheet 2 of

Outlet Works Rating:	<u>Outlet 1</u>	<u>Outlet 2</u>	<u>Outlet 3</u>
Invert of Outlet	<u>895.1</u>	<u> </u>	<u> </u>
Invert of Inlet	<u>NOT AVAILABLE</u>	<u> </u>	<u> </u>
Type	<u>CIP</u>	<u> </u>	<u> </u>
Diameter (ft) = D	<u>2</u>	<u> </u>	<u> </u>
Length (ft) = L	<u>118</u>	<u> </u>	<u> </u>
Area (sq. ft) = A	<u>3.14</u>	<u> </u>	<u> </u>
N	<u>.014*</u>	<u> </u>	<u> </u>
K Entrance	<u>0.5</u>	<u> </u>	<u> </u>
K Exit	<u>1.0</u>	<u> </u>	<u> </u>
K Friction* = $29.1N^2L/R^{4/3}$	<u>1.70</u>	<u> </u>	<u> </u>
Sum of K	<u>3.20</u>	<u> </u>	<u> </u>
$(1/K)^{0.5} = C$	<u>0.56</u>	<u> </u>	<u> </u>
Maximum Head (ft) = HM	<u>34.4</u>	<u> </u>	<u> </u>
$Q = C A \sqrt{2g(HM)}$ (cfs)	<u>83</u>	<u> </u>	<u> </u>
Q Combined (cfs)	<u>± 80</u>	<u> </u>	<u> </u>

* CHOW

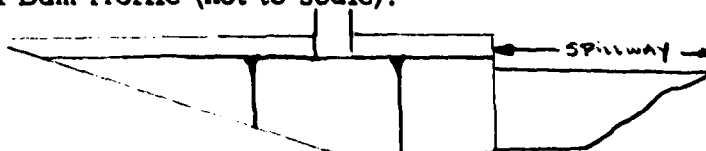
* R = Hydraulic Radius = (Area/Wetted Perimeter) =
D/4 for Circular Conduits.

Data for Dam at Outlet of Subarea A 3

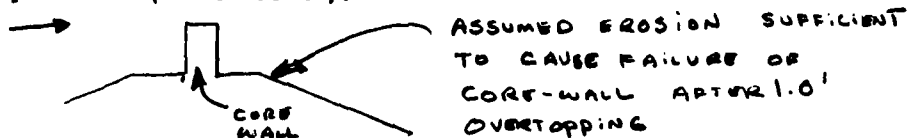
Name of Dam: NO. 5 Sheet 4 of

Breach Data:

Sketch of Dam Profile (not to scale):



Sketch of Top of Dam (not to scale):



Soil Type from Visual Inspection: SANDY SILT

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) ^{NOT} USED fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = $(2/3) \times H$)

$$H_{MAX} = (4/9 V^2 / C^2) = \text{NOT USED ft.}, C = \text{NOT USED}$$

$$1.0 \quad 929.5$$
$$H_{MAX} + \text{Top of Dam Elev.} = \underline{930.5} = \text{FAILEL}$$

(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 85 ft (width of bottom of breach)

Z = 1 (side slopes of breach)

ELBM = 894.5 (bottom of breach elevation,
minimum of zero storage elevation)

WSEL = 922.2 (normal pool elevation)

T FAIL = 12 mins

= 0.2 hrs (time for breach to develop)

SUSQUEHANNA River Basin
Name of Stream: STAFFORD MEADOW BROOK
Name of Dam: NO. 5
NDS ID No.: _____
DER ID No.: _____

Latitude: N 41° 21' 40" Longitude: W 75° 40' 15"

Drainage Area: 12.0 sq. mile

Data for Subarea: A3 (see Sketch on Sheet C-4)

Name of Dam at Outlet of Subarea: NO. 5

Drainage Area of Subarea: 4.8 sq. mile

Subarea Characteristics:

Assumed Losses: 1.0-inch initial abstraction + 0.05 in/hr

The following are measured from outlet of subarea to the point noted:

L = Length of Main Watercourse extended to the divide = 2.6 mile

LCA = Length of Main Watercourse to the centroid = 1.5 mile

From NAB Data: AREA 11 PLATE E

$C_p =$ 0.62

$C_T =$ 1.5

$T_p = C_T \times (L \times L_{CA})^{0.3} =$ 2.26 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 7.2 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

SELECTED Computer Output

<u>ITEM</u>	<u>PAGE</u>
MULTI-RATIO ANALYSIS	
INPUT	C-20 TO C-21
SYSTEM PEAK FLOWS	C-22
WILLIAMS BRIDGE DAM	C-23
LAKE SCRANTON DAM	C-24
NO. 5 DAM	C-25

BREACH ANALYSIS⁽¹⁾ ⁽²⁾ ⁽³⁾ FOR 50% PMF

INPUT	C-26 TO C-28
SYSTEM PEAK FLOWS	C-29 TO C-30
NO. 5 DAM	C-31
STREAM SECTIONS	C-32

- (1) PEAK FLOWS VARY SLIGHTLY FROM MULTI-RATIO ANALYSIS BECAUSE OF DIFFERENT ΔT FOR HYDROGRAPHS
- (2) WILLIAMS BRIDGE AND LAKE SCRANTON OUTPUT NOT INCLUDED BECAUSE IT WAS ASSUMED THAT THEY WOULD NOT FAIL.
- (3) PLAN 1 - NO FAILURES
PLAN 2 - NO. 5 DAM FAILS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS					
				RATIO 1 1.00	RATIO 2 .50	RATIO 3 .40	RATIO 4 .30	RATIO 5 .25	RATIO 6 .20
HYDROGRAPH AT	1	5.70 (14.76)	1	12714. (360.03)	6357. (180.02)	5086. (144.01)	3814. (108.01)	3179. (90.01)	2543. (72.01)
ROUTED TO	1	5.70 (14.76)	1	12506. (354.13)	6274. (177.65)	4992. (141.35)	3738. (105.85)	3087. (87.41)	2470. (69.93)
ROUTED TO	2	5.70 (14.76)	1	12486. (353.57)	6262. (177.33)	4989. (141.27)	3738. (105.86)	3087. (87.41)	2469. (69.92)
HYDROGRAPH AT	2	1.50 (3.88)	1	4380. (124.03)	2190. (62.02)	1752. (49.61)	1314. (37.21)	1095. (31.01)	876. (24.61)
2 COMBINED	2	7.20 (18.65)	1	15792. (447.18)	7917. (224.19)	6291. (178.14)	4711. (133.39)	3878. (109.81)	3101. (87.81)
ROUTED TO	3	7.20 (18.65)	1	14058. (398.07)	6704. (189.84)	5291. (149.84)	3914. (110.84)	3217. (91.10)	2494. (70.63)
ROUTED TO	4	7.20 (18.65)	1	14029. (397.26)	6681. (189.18)	5273. (149.30)	3896. (110.52)	3200. (90.61)	2482. (70.29)
ROUTED TO	5	7.20 (18.65)	1	14007. (396.64)	6671. (188.91)	5266. (149.11)	3894. (110.26)	3190. (90.34)	2476. (70.11)
ROUTED TO	6	7.20 (18.65)	1	13994. (396.27)	6666. (188.75)	5259. (148.92)	3886. (110.03)	3185. (90.18)	2474. (70.05)
HYDROGRAPH AT	6	6.80 (12.43)	1	11636. (329.48)	5818. (164.74)	4654. (131.79)	3491. (98.84)	2909. (82.37)	2327. (65.90)
2 COMBINED	6	12.00 (31.08)	1	23000. (651.28)	10949. (310.05)	8641. (244.67)	6317. (178.88)	5115. (144.85)	3967. (112.32)
ROUTED TO	7	12.00 (31.08)	1	22876. (647.77)	10915. (309.08)	8613. (243.88)	6287. (178.04)	5100. (144.62)	3955. (112.01)

C
N
P

15
No. 3

SUMMARY OF DAM SAFETY ANALYSIS

Williams Bridge Dam

INITIAL VALUE SPILLWAY CREST TOP OF DAM
 1360.60 1360.60 1366.20
 1033. 1033. 1277.
 0. 0. 5560.

ELEVATION
 STORAGE
 OUTFLOW

PLAN 1

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1369.92	3.72	1455.	12506.	5.50	42.50	0.00
.50	1366.58	.38	1294.	6274.	2.00	42.50	0.00
.40	1365.83	0.00	1261.	4992.	0.00	42.50	0.00
.30	1365.01	0.00	1225.	3738.	0.00	42.50	0.00
.25	1364.58	0.00	1206.	3087.	0.00	42.75	0.00
.20	1364.04	0.00	1182.	2470.	0.00	42.75	0.00

PLAN 1 STATION 2

RATIO	MAXIMUM FLOW/CFS	MAXIMUM STAGE/FT	TIME HOURS
1.00	12486.	1313.4	42.50
.50	6262.	1310.4	42.50
.40	4989.	1309.5	42.75
.30	3738.	1308.5	42.75
.25	3087.	1307.9	42.75
.20	2469.	1307.3	42.75

C-23

16
No. 5

SUMMARY OF DAM SAFETY ANALYSIS

LAKE SCRANTON DAM

TOP OF DAM
1286.10
8393.
4513.

SPILLWAY CREST
1282.80
7643.
0.

INITIAL VALUE
1282.80
7643.
0.

ELEVATION
STORAGE
OUTFLOW

PLAN 1

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1290.51	4.41	9436.	14058.	8.25	43.25	0.00
.50	1287.27	1.17	8664.	6704.	4.50	43.50	0.00
.40	1286.53	.43	8493.	5291.	2.75	43.50	0.00
.30	1285.77	0.00	8318.	3914.	0.00	43.75	0.00
.25	1285.39	0.00	8231.	3217.	0.00	43.75	0.00
.20	1285.00	0.00	8141.	2494.	0.00	44.00	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
1.00	14029.	1149.0	43.50
.50	6681.	1145.8	43.75
.40	5274.	1145.1	43.75
.30	3896.	1144.3	44.00
.25	3200.	1143.8	44.00
.20	2482.	1143.3	44.25

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
1.00	14007.	1065.0	43.50
.50	6671.	1063.2	43.75
.40	5266.	1062.8	44.00
.30	3894.	1062.3	44.00
.25	3190.	1062.1	44.25
.20	2476.	1061.7	44.25

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
1.00	13994.	975.1	43.75
.50	6666.	971.5	44.00
.40	5259.	970.5	44.00
.30	3886.	969.3	44.25
.25	3185.	966.7	44.25

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SUMMARY OF DAM SAFETY ANALYSIS

NO. 5 DAM

PLAN 1

RATIO OF PHF	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 922.20 98.0 0.	SPILLWAY CREST 922.20 98.0 0.	TOP OF DAM 929.50 206. 5944.	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	940.13	10.63	531.	22876.	9.50	43.25	0.00				
.50	933.15	3.65	292.	10915.	6.00	43.25	0.00				
.40	931.55	2.05	251.	8613.	4.50	43.25	0.00				
.30	929.78	.28	212.	6287.	1.75	43.50	0.00				
.25	928.79	0.00	192.	5100.	0.00	43.50	0.00				
.20	927.76	0.00	173.	3955.	0.00	43.50	0.00				

C-25

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FLOOD CONTROL PACKAGE (CFC-1)
FAY SEXTON JULY 1979
LAST MODIFICATION 25 FEB 79

NATIONAL DAM INSPECTION PROGRAM STAFFORD MEADOW BROOK NO. 5 DAM									
1	A1								
2	A2								
3	A3								
4	B1	300	0	0	0	0	0	0	0
5	B2	5							
6	J1	2	1	1					
7	J2	5							
8	K1	0							
9	K2	0							
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97	K90	0							
98	K91	0							
99	K92	0							
100	K93	0							

INLET FLOW AND STORAGE (END OF PLATON) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

RATIOS APPLIED TO FLOWS

PLAN RATIO 1
 .50

OPERATION	STATION	AREA	PLAN RATIO 1
HYDROGRAPH AT	1	5.70	1 6353.
	(	14.76)	(179.89)(
ROUTED TO	1	5.70	2 6353.
	(	14.76)	(179.89)(
ROUTED TO	1	5.70	1 6321.
	(	14.76)	(178.78)(
ROUTED TO	2	5.70	2 6321.
	(	14.76)	(178.78)(
HYDROGRAPH AT	1	5.70	1 6317.
	(	14.76)	(178.89)(
ROUTED TO	2	5.70	2 6317.
	(	14.76)	(178.89)(
HYDROGRAPH AT	2	1.50	1 2206.
	(	3.88)	(62.47)(
ROUTED TO	2	1.50	2 2206.
	(	3.88)	(62.47)(
ROUTED TO	1	7.20	1 9016.
	(	18.65)	(226.05)(
ROUTED TO	2	7.20	2 9016.
	(	18.65)	(226.05)(
ROUTED TO	1	7.20	1 6653.
	(	18.65)	(172.40)(
ROUTED TO	2	7.20	2 6653.
	(	18.65)	(172.40)(
ROUTED TO	1	7.20	1 6632.
	(	18.65)	(171.78)(
ROUTED TO	2	7.20	2 6632.
	(	18.65)	(171.78)(
ROUTED TO	1	7.20	1 6625.
	(	18.65)	(171.78)(
ROUTED TO	2	7.20	2 6625.
	(18.65)	(171.78)(
ROUTED TO	1	7.20	1 6618.
	(18.65)	(171.78)(
ROUTED TO	2	7.20	2 6618.
	(18.65)	(171.78)(

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2	5327.					
	(145.01)	(
1	10942.					
	(309.84)	(
2	10967.					
	(309.84)	(
1	10903.					
	(309.72)	(
2	23704.					
	(673.77)	(
1	10398.					
	(308.59)	(
2	23608.					
	(	651.52)	(
1	10399.					
	(	309.61)	(
2	21236.					
	(	601.27)	(
1	10796.					
	(	305.71)	(
2	12248.					
	(	366.93)	(
1	10794.					
	(305.66)	(
2	11990.					
	(339.22)	(

> COMBINED

ROUTED TO

ROUTED TO

ROUTED TO

ROUTED TO

ROUTED TO

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SUMMARY OF DAM SAFETY ANALYSIS

NO. 5 DAM

ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	922.20	922.20	929.50
	99.	98.	206.
	0.	0.	5944.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	933.16	291.	10903.	5.80	19.20	0.00

ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	922.20	922.20	929.50
	98.	98.	206.
	0.	0.	5944.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	930.69	231.	27303.	0.57	17.36	17.20

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	10898.	883.3	19.30

PLAN 2 STATION 8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	23008.	885.2	17.60

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	10829.	363.0	19.30

PLAN 2 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.50	21224.	864.5	17.60

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PLAN 1		STATION 10	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10796.	846.7	19.60

PLAN 2		STATION 10	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	12268.	847.2	17.60

PLAN 1		STATION 11	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10796.	803.7	19.70

PLAN 2		STATION 11	
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	11980.	803.9	17.70

SUMMARY OF PERTINENT RESULTS

PMF RAINFALL = 25.02"

	<u>PMF</u>	<u>1/2 PMF</u>
RUNOFF (INCHES - APPROXIMATE)	22.4	11.2

NO. 5 DAM:

INFLOW (CFS)	23,000	10,949
OUTFLOW (CFS)	22,876	10,915
DEPTH OVERTOPPING (FT)	10.63	3.65
DURATION OVERTOPPING (HRS)	9.50	6.00

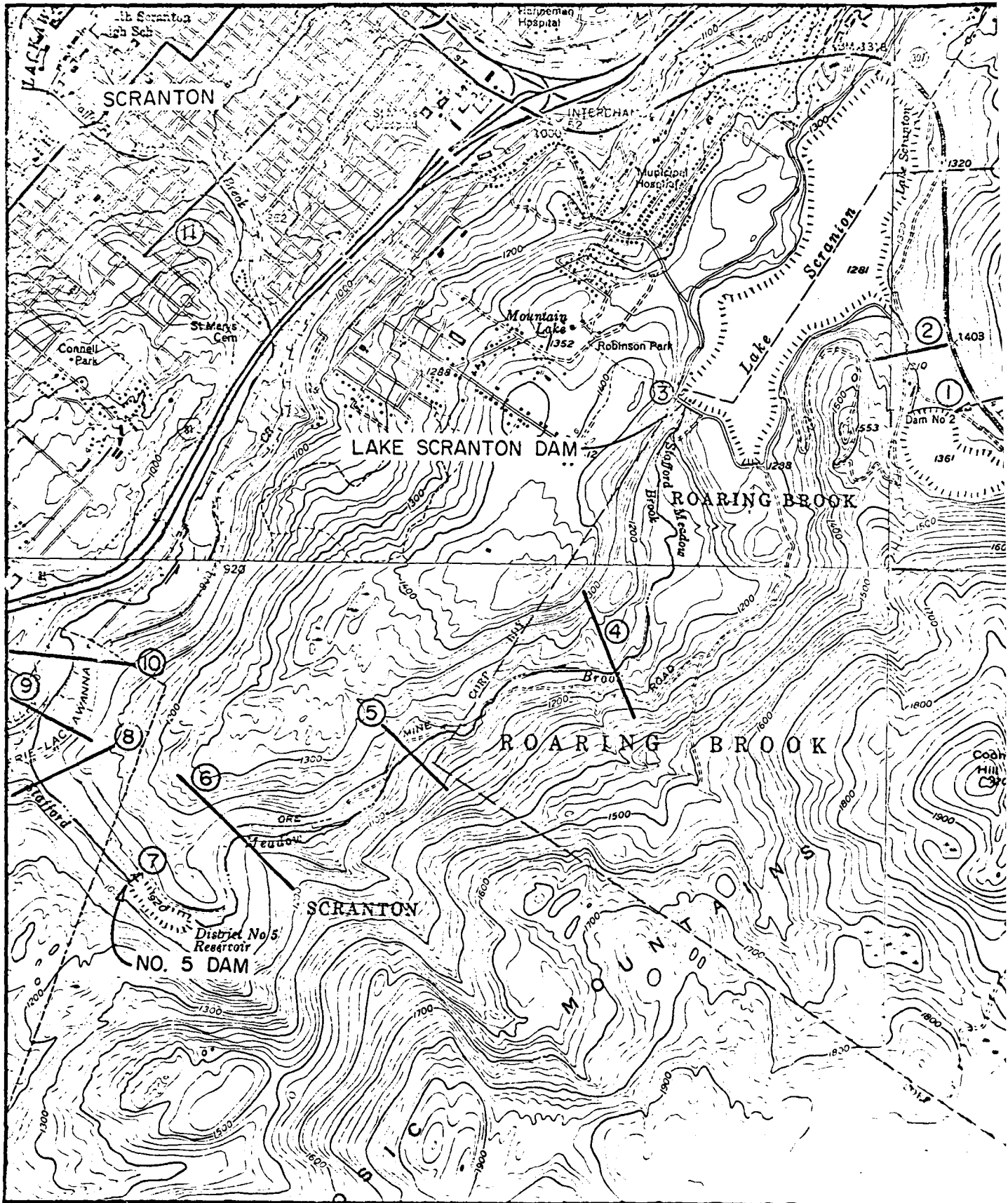
FROM BREACH ANALYSIS

CROSS SECT. <u>NO.</u>	DEPTH (NO FAILURE)	DEPTH (NO. 5 FAILS)	Δ <u>DEPTH</u>
8	3.3	5.2	1.9
9	3.0	4.5	1.5
10	6.7	7.2	0.5
11	3.7	3.9	0.2 DAMAGE CENTER

AT STATION 11 THE RATIO OF PEAK FLOWS WITH AND WITHOUT FAILURE IS $\frac{11980}{10794} = 1.109$

USING $Q = C\sqrt{H}$ PRESSURE PIPE FLOW

$$\frac{Q_1}{Q_2} = \sqrt{\frac{H_1}{H_2}} \Rightarrow \frac{Q_1^2}{Q_2^2} = \frac{H_1}{H_2} = (1.109)^2 = 1.23$$



AD-A079 025

GANNETT FLEMING CORDRY AND CARPENTER INC HARRISBURG PA F/6 13/13
NATIONAL DAM INSPECTION PROGRAM. NUMBER 5 DAM (NDI ID NUMBER PA--ETC(U)
APR 79 A C HOOKE DACW31-79-C-0015

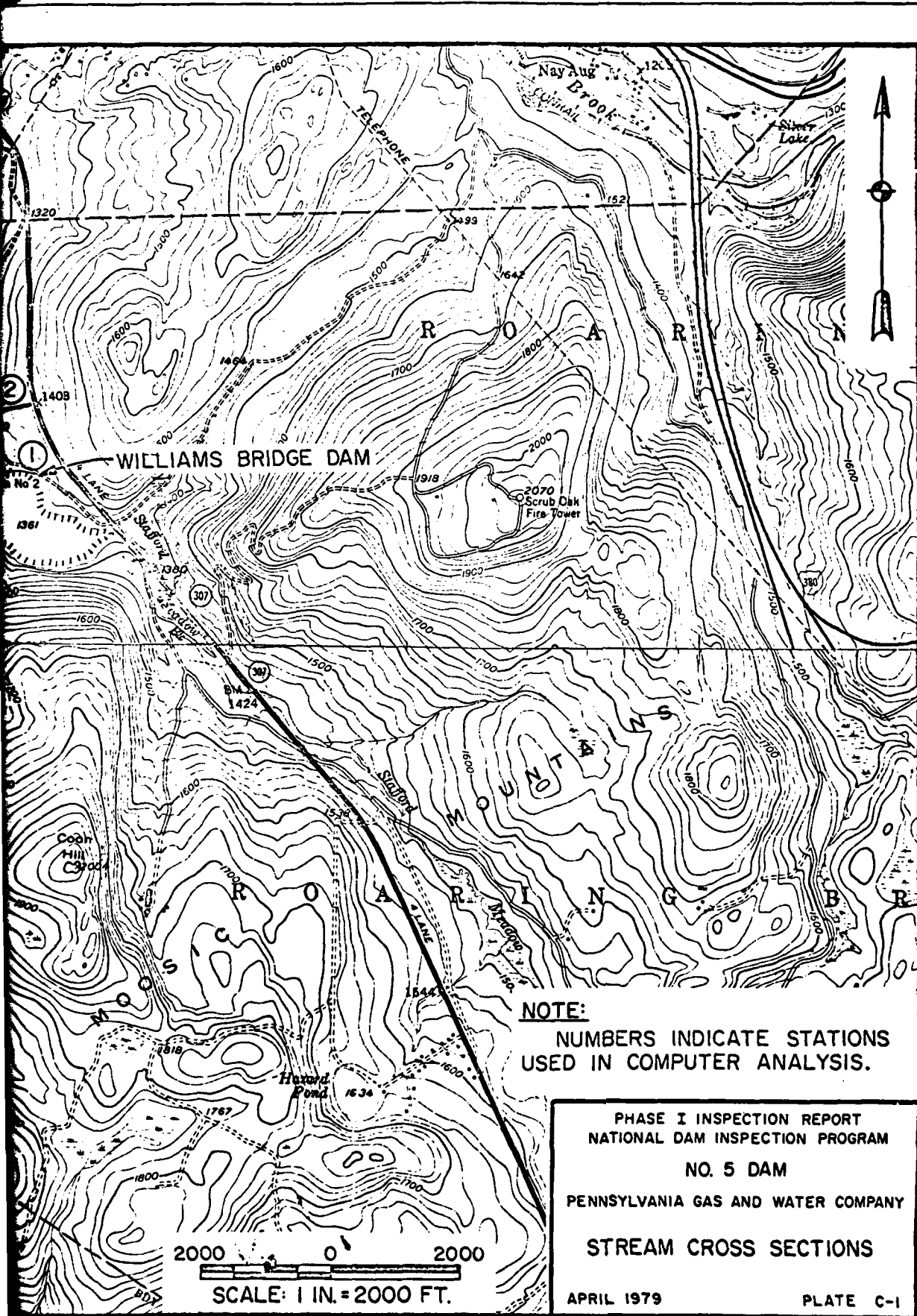
JNCLASSIFIED

2 of 2
AD
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END
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2-80
DCC



NOTE:
 NUMBERS INDICATE STATIONS
 USED IN COMPUTER ANALYSIS.

PHASE I INSPECTION REPORT
 NATIONAL DAM INSPECTION PROGRAM
 NO. 5 DAM
 PENNSYLVANIA GAS AND WATER COMPANY
 STREAM CROSS SECTIONS

APRIL 1979 PLATE C-1

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY

PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

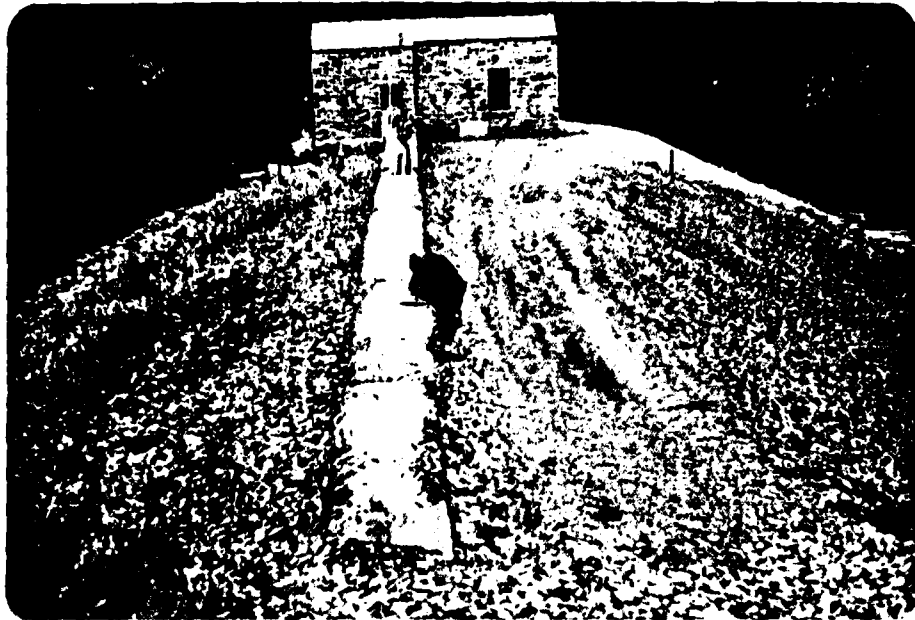
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

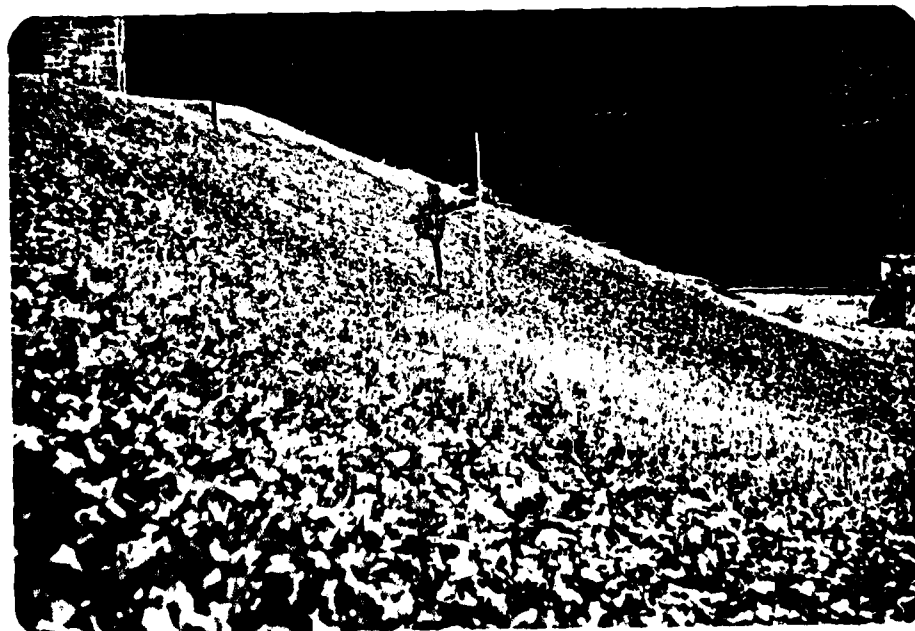
APPENDIX D

PHOTOGRAPHS

NO. 5 DAM

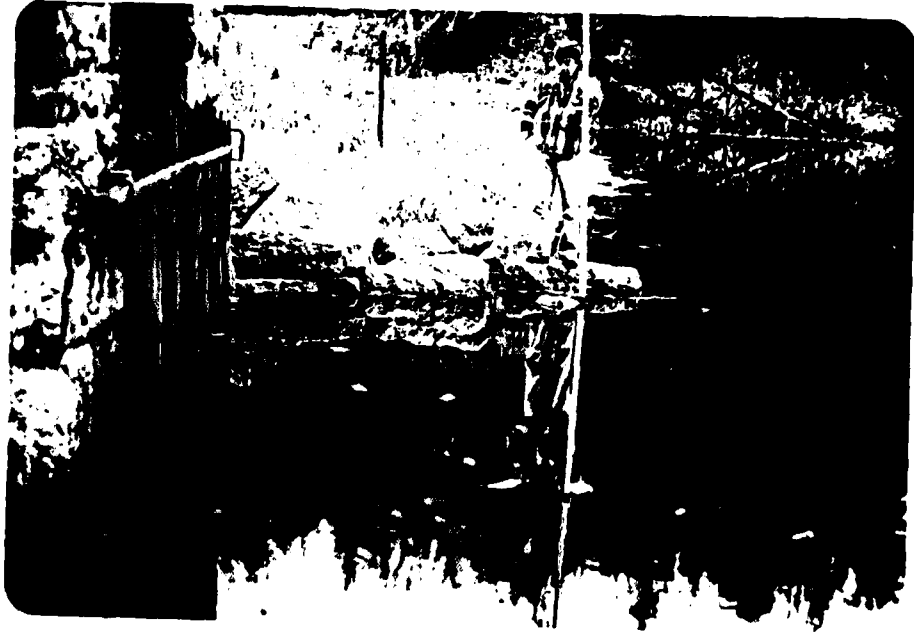


A. Top of Dam - from Right Abutment



B. Downstream Slope

NO. 5 DAM

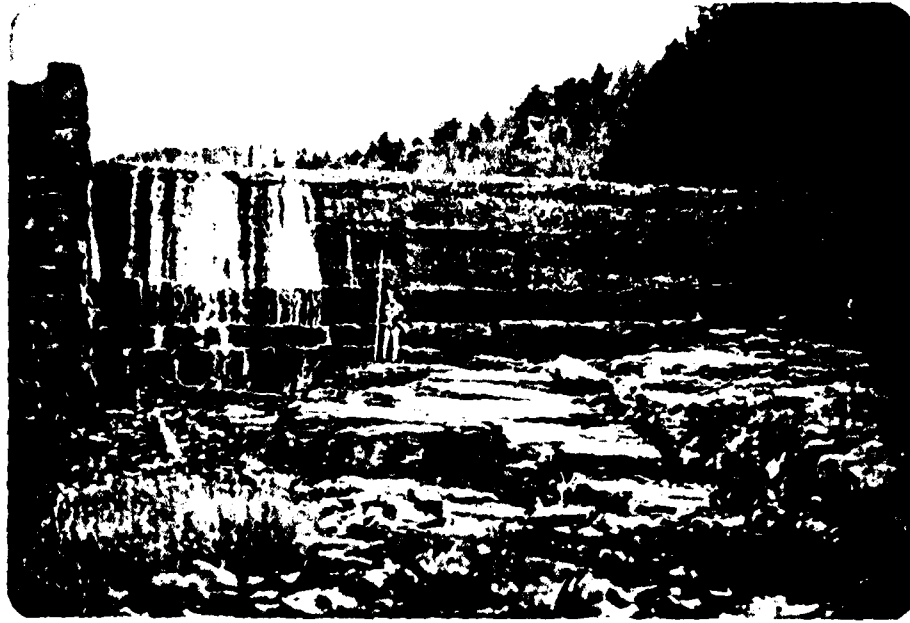


C. Upstream Slope and Intake Structure



D. Core Wall

NO. 5 DAM

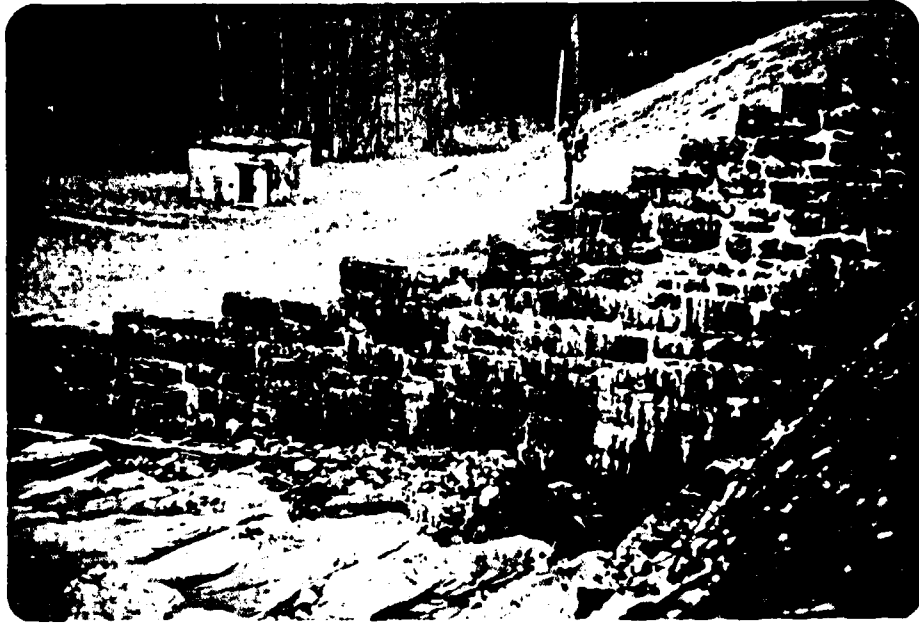


E. Spillway

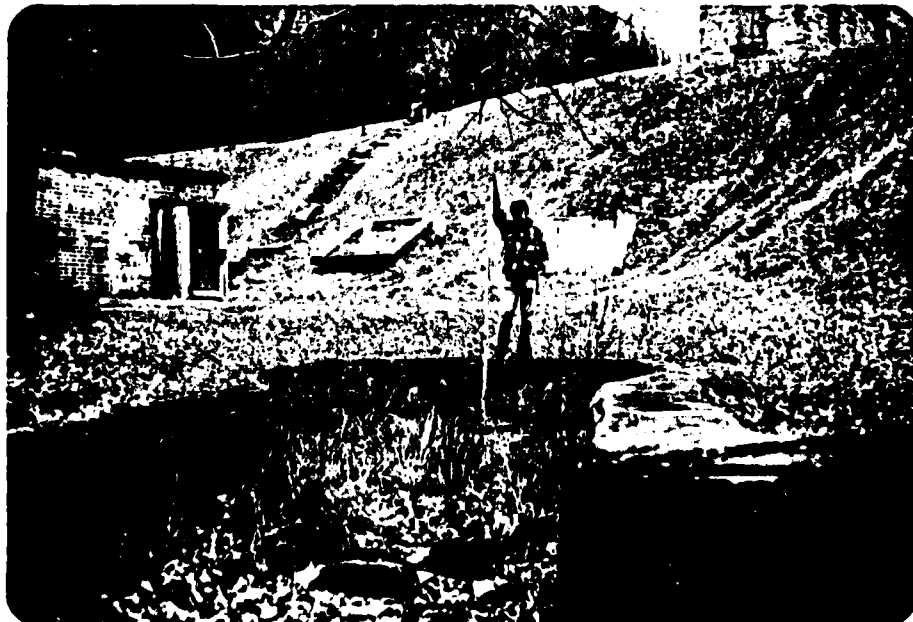


F. Spillway Crest

NO. 5 DAM



G. Spillway Training Wall



H. Outlet Works Outfall

SUSQUEHANNA RIVER BASIN
STAFFORD MEADOW BROOK, LACKAWANNA COUNTY
PENNSYLVANIA

NO. 5 DAM

NDI ID No. PA-00375
DER ID No. 35-22

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

APRIL 1979

APPENDIX E

GEOLOGY

NO. 5 DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Lackawanna County. Lackawanna County was completely covered with ice during the last continental glaciation of Pleistocene time. The general direction of ice movement was S. 35° - 40° W. Glacial drift covers the entire County, except where subsequent erosion has removed it. Thick deposits of glacial outwash occur in many places along the Lackawanna River, and are 50 to 100 feet thick near Dickson, Scranton, and Moosic.

The only important structural feature in Lackawanna County is the Lackawanna Syncline, which traverses the County in a southwesterly direction. The syncline enters the County at the northeast corner as a narrow shallow trough, gradually deepens and broadens toward the southwest, and reaches its maximum development in Luzerne County. The rock formations exposed range from the post-Pottsville, Mauch Chunk shale, Pocono sandstone to the Damascus formation of the Catskill group (oldest). The rim rocks, the Pottsville formation and Pocono sandstone, have dips that rarely exceed 10° to 20° and form a rather simple syncline. The core rocks, the post-Pottsville formations, are folded into a series of minor anticlines and synclines which trend about N 70° E. The rocks in the northwestern and southeastern parts of the County, outside of the limits of the Lackawanna Syncline, are generally horizontally stratified.

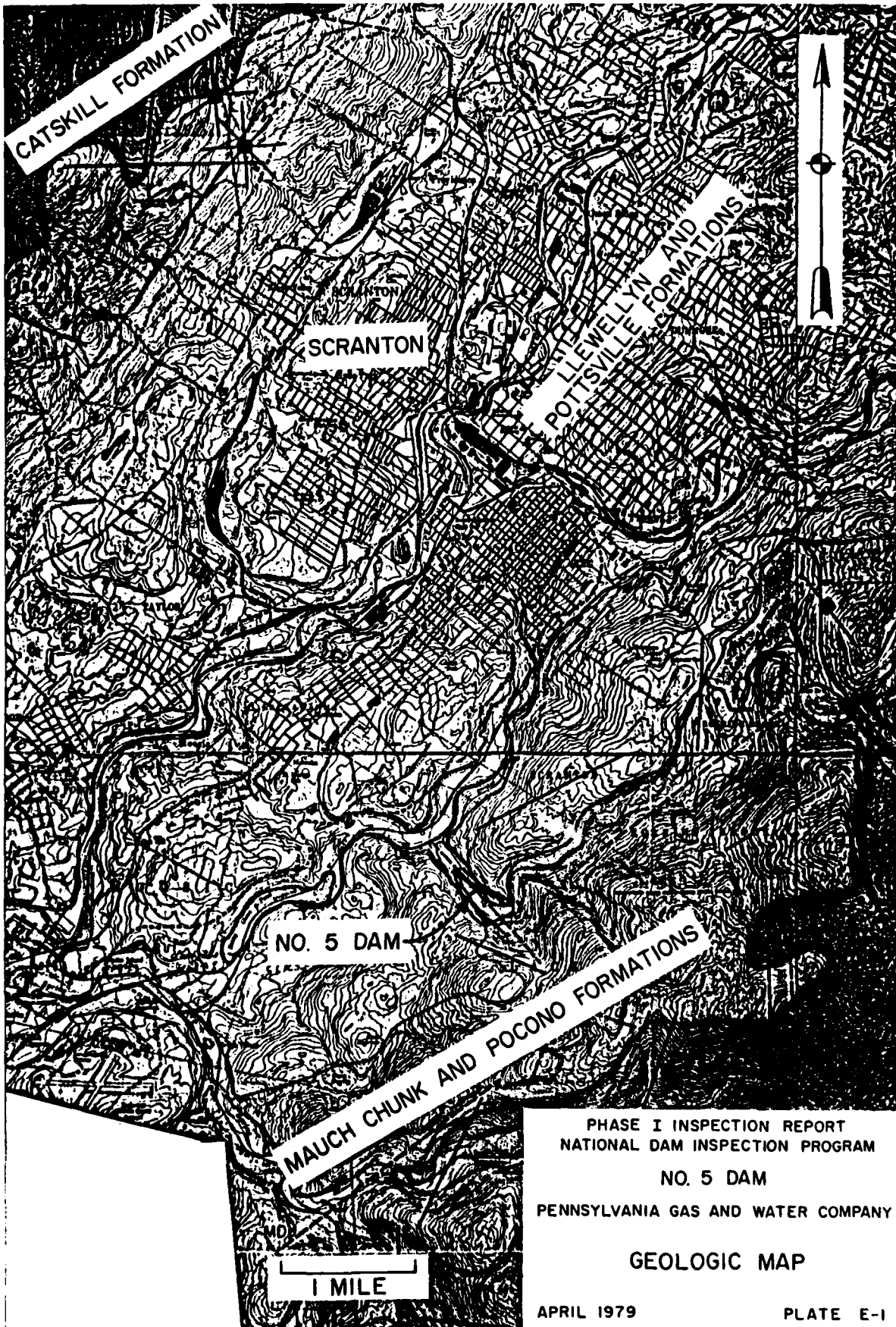
The Lackawanna River, in general, follows the axis of the Lackawanna Syncline. Southeast of the Lackawanna River, the rise in terrain is quite gradual and the crests of the high mountains are several miles from the Lackawanna River. Streams, such as Little Roaring Brook, Stafford Meadow Brook, and Spring Brook, have cut deep canyons through the mountains and follow a torturous course to their confluence with the Lackawanna River near Scranton, Pennsylvania. Northwest of Lackawanna River, the mountains rise abruptly to a sharp ridge which in most places is somewhat higher than the country to the northwest. Consequently, most of the drainage in this part of the County flows westward by way of Tunkhannock

Creek. A few small tributary streams, however, such as Leggetts Creek, flow eastward from this area into Lackawanna River. In the area of interest, the Lackawanna River streambed is founded in post-Pottsville formations. Proceeding uphill from the river, the older Pottsville formation, Mauch Chunk shale, Pocono sandstone, and Catskill continental group are encountered in turn. The tributary streams, in flowing down the mountains, have generally cut through or around the hard sandstone and conglomerate members, and have eroded their streambed into the softer shales and glacial till. The Catskill continental group of rocks underlies the greater part of Lackawanna County.

2. Site Geology. No. 5 Dam is founded on conglomerate of late Mississippian Age on the left end and a hardpan in the Pennsylvanian Pottsville Formation on the right end of the Pennsylvania Water Supply Commission Report of 1914 states that:

"The Geological formation at the dam site is similar to that at the two other dams along the stream. On the south side a bastard conglomerate outcrop follows across the valley to the original stream channel, where it drops off abruptly, and the remainder of the valley and the opposite bank is a hardpan formation."

The Pottsville Formation is composed of gray, fine grained to coarsely conglomeratic sandstone; gray shales, limestone and coal. Bedding is generally well developed ranging in thickness from thin shale laminate to several feet in the sandstones. The Mississippian Mauch Chunk Formation is primarily a calcareous red shale with some interbedded fine to medium grained sandstones. Bedding is moderately well developed with abundant sedimentary features. Shale exposures in the formation are extremely susceptible to weathering while the sandstone and siltstone beds appear to be only slightly weathered.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NO. 5 DAM
PENNSYLVANIA GAS AND WATER COMPANY
GEOLOGIC MAP
APRIL 1979
PLATE E-1