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NATIONAL DAM INSPECTION PROGRAM. PIKES CREEK DAM (NDS PA-00576/--ETC(U)
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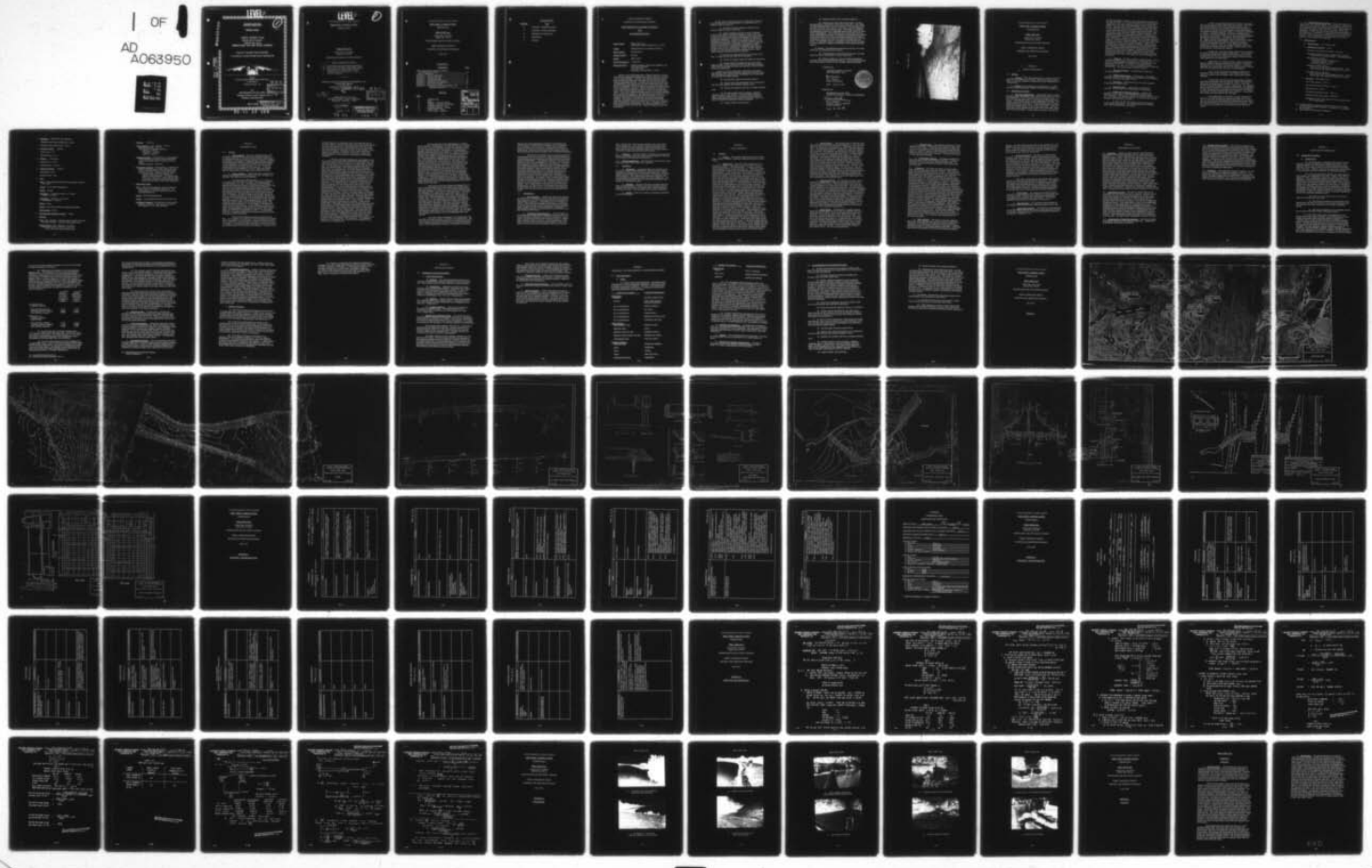

LEVEL II

AD A063950

SUSQUEHANNA RIVER BASIN
PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID NO. PA-00576

DER ID NO. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.

Consulting Engineers

Harrisburg, Pennsylvania 17105

For

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

JULY 1978

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LEVEL II

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

(6) NATIONAL DAM INSPECTION PROGRAM,
Pikes Creek Dam (NDS PA-00576, DER 40-18)
Susquehanna River Basin, Pikes Creek,
Luzerne County, Pennsylvania. Phase I
Inspection Report.

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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P.O. Box 1963
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Contract No. (15) DACW31-78-C-0046

For

(10) 97 p.

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

(11) JULY 1978

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SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Pikes Creek Dam NDS ID No. PA-00576/DER ID No. 40-18
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Luzerne
Stream:	Pikes Creek
Date of Inspection:	8 June 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. Consulting Engineers P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance, Pikes Creek Dam is judged to be in good condition. However, the existing spillway will not pass the Probable Maximum Flood (PMF) or one-half of the PMF without overtopping the dam. If Pikes Creek Dam should fail due to overtopping, the hazard to loss of life downstream from the dam would be significantly increased from that which would exist just prior to overtopping. Based on criteria established for these studies by the Department of the Army, Office of the Chief of Engineers (OCE), the existing spillway capacity is rated as seriously inadequate. If the top of embankment were raised to the design elevation that is shown on the plans, if the flashboards are removed or it can be shown that the flashboards will fail as intended, and if the channels downstream of the spillways are made hydraulically adequate, the spillway capacity and surcharge storage effect would be sufficient to pass 57 percent of the PMF, or 12,620 cfs, peak inflow without overtopping of the dam. At present, assuming that the flashboards remain intact, the existing spillways can accommodate a flood of 5,640 cfs. This is 25 percent of the PMF peak inflow.

In view of the concern for safety of Pikes Creek Dam, the following measures are recommended to be undertaken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Pikes Creek Dam.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Pikes Creek Dam, as well as the nature and extent of mitigation measures required to make the spillways and channels downstream of spillways hydraulically adequate. Filling in the existing low area of the embankment would help increase the spillway capacity and this should be accomplished. The cause of the surface cracking observed on the top of the embankment, especially the crack normal to axis of dam, should be investigated before filling in the low areas at top of embankment. Should the core wall be cracked, or other structural problems become evident, appropriate remedial measures should be instituted.

(3) Remove the flashboards from the auxiliary spillway, or ascertain that they will fail as designed.

(4) Clear the auxiliary spillway channel of vegetation.

(5) Provide closure facilities for the outlet works pipes upstream of the concrete core wall for periodic inspection and for use in the event the pipes leak severely, thereby endangering the embankment.

In order to correct operational, maintenance and repair deficiencies, and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Fill the holes made by burrowing animals.

(2) Remove trees near downstream toe of embankment and near main spillway and auxiliary spillway walls.

(3) Replace dry masonry wall with a suitably designed wall.

(4) Visually monitor surface cracking, spalling, shrinkage cracks, and pitting in the main spillway walls and apron, auxiliary spillway walls, and outlet works headwall. Areas where reinforcing bars are exposed and areas where concrete is severely disintegrated should be repaired.

(5) Repair leaking valve packings.

(6) Replace missing valve position indicator.

(7) Install ten or more observation wells, or other instrumentation, downstream of the axis of the dam. Two wells, or other instrumentation, should be located in the vicinity of the wet areas near the valve house. Two others should be located near the wet area at the left abutment. The other six should be at appropriate locations to determine general water level in downstream embankment. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the embankment and assessing piping potential in the future. Continue to observe wet areas and seepage downstream from dam. Periodically measure and record quantity of seepage from all areas. If conditions worsen, appropriate action should be taken to control apparent seepage and turbidity with properly designed drains.

In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) During periods of unusually heavy rains, provide round-the-clock surveillance of Pikes Creek Dam.

(2) 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.

A. C. HOOKE
Head, Dam Section

Date: July 31, 1978

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
ALBERT CHARLES HOOKE
ENGINEER
No. 2201-E

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 31 Jul 78

PIKES CREEK DAM

View of Embankment from
Main Spillway at Right Abutment

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

ABSTRACT

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.

ABSTRACT

1.2 Description of Project.

a. Dam and Appurtenances. Pikes Creek Dam is a homogeneous earthen embankment with a reinforced-concrete core wall. The embankment is 2,155 feet long and it is curved in plan. It has a 10-foot top width and 1V on 2H slopes upstream and downstream. The maximum height of the embankment is 65 feet. The upstream slope has 18 inches of riprap protection and the downstream slope has a grass cover. A 10-foot wide berm is provided along the upstream slope, 31 feet below top of dam. A 10-foot wide berm is also provided along a part of the downstream slope near the right abutment, 36 feet below top of dam. The dam has

a main and auxiliary spillway. The main spillway is located at the right abutment. It is 72 feet long with a low concrete ogee-shaped weir. The main spillway discharges into a flume that extends to Pikes Creek Canal headworks, about 0.25 mile downstream. The auxiliary spillway is located at the left abutment. It is 133 feet long with a low concrete ogee-shaped weir. Two 2-foot wide piers divide the auxiliary spillway into three equal length bays. Each bay has a different height flashboard. The channel downstream of the auxiliary spillway is narrow and it leads into the borrow pit that was used for the original embankment construction. Should discharge over the auxiliary spillway occur, flow from the borrow pit would travel for a short distance overland, not within a defined channel, into Harveys Creek Canal that extends to Pikes Creek Canal headworks. Three 30-inch diameter cast-iron pipes, encased in concrete, extend through the embankment with valves provided at the downstream toe of dam. The pipes extend under Pennsylvania Route No. 29, which generally parallels the embankment. The pipes continue and terminate at Pikes Creek. Pikes Creek flows into the Pikes Creek Canal headworks. 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 Pikes Creek, 2 miles northwest of Ceasetown, Pennsylvania. Pikes Creek Dam is shown on USGS Quadrangle, Harveys Lake, Pennsylvania, with coordinates N41°15'55" - W76°02'40" in Luzerne County, Pennsylvania. The dam is 3.4 miles northwest of West Nanticoke, Pennsylvania. The location map is shown on Plate 1.

c. Size Classification. Intermediate (65 feet high, 10,556 acre-feet).

d. Hazard Classification. High hazard. Downstream conditions indicate that a high hazard classification is warranted for Pikes Creek Dam (Paragraph 5.1e.).

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

f. Purpose of Dam. Water supply for Nanticoke, Plymouth, Wilkes-Barre, and Edwardsville, Pennsylvania.

g. Design and Construction History. The dam was designed by John Lance, Chief Engineer of the Spring Brook Water Company. The dam was constructed between 1908 and 1911. Mr. Lance supervised the construction. No plans of the original structure were available for review.

In 1914, the dam was studied by the Pennsylvania Water Supply Commission. No recommendations for remedial work were forthcoming from that study.

In 1917, a supplementary study of the dam was undertaken by the Pennsylvania Water Supply Commission. The resulting recommendations were that the spillway channel (flume) capacity be increased or an auxiliary spillway be provided and that the top of dam be raised and widened. These recommendations were essentially concurred within a 1918 report by Frederick P. Stearns, Consulting Engineer, of Boston, Massachusetts. Mr. Lance, the designer of the dam but not a consulting engineer, prepared a report in 1919. This report, although differing with Mr. Stearns' methodology, agreed with the conclusions. Mr. Stearns issued a supplementary report in 1919 that attempted to clarify the recommended methods of modifying the dam. During 1920 both Arthur Morgan, of the Morgan Engineering Companies of Dayton, Ohio, and Leonard Metcalf, of the consulting firm of Metcalf and Eddy, Boston, Massachusetts, were both consulted on the spillway capacity.

During 1921, the Spring Brook Water Company modified the spillway channel and raised the embankment. An inspection by the Pennsylvania Water Supply Commission during that year revealed that the work was progressing without the plans having been approved by the Commission.

Meanwhile, Mr. Morgan issued a report recommending that the spillway capacity be increased by building an auxiliary spillway and then modifying the existing spillway. It was recommended that the auxiliary spillway be a broad-crested concrete weir with an erodable earth plug in lieu of flashboards.

Also, during 1920 the Water Company undertook an infiltration study of the watershed. The results of the study appear of limited value and appear never to have been utilized in design.

During 1921, the Pennsylvania Water Supply Commission formally requested that the spillway capacity be increased. Plans were submitted to the Commission in 1926. Work commenced on the modifications in 1926. During 1929, an inspection by the Commission indicated that the modifications, now complete, had not been constructed in accordance with the plans submitted to them. Although not in accordance with the plans, the Commission agreed that the modifications were beneficial. No modifications since have been made to the spillways.

The embankment was surveyed in 1928, probably because of the Commonwealth's proposed modifications to Route No. 29. The road was actually constructed about 1933, at which time the outlet works were modified by extending the pipes under the roadway embankment and construction a new headwall. About this time, French drains were also constructed near the valve house.

h. Normal Operating Procedure. The primary purpose of Pikes Creek Dam is water supply. It is possible to collect water discharging over either the spillway or the auxiliary spillway, as well as water passing through the outlet works. These flows can be diverted into Pikes Creek Canal by the Pikes Creek Canal headworks. Excess flow passes into Pikes Creek downstream of the headworks. The reservoir is maintained below spillway crest during the winter season and at spillway crest during the other seasons. Flow is regulated by valves located in the valve house at the downstream toe of the dam.

1.3 Pertinent Data.

a. Drainage Area. 11.7 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - unknown.

Emergency drawdown line at maximum pool elevation (Three 30-inch diameter pipes) - 380 (approximate).

Main spillway capacity -
Pool at top of lowest flashboard on auxiliary spillway - 1,215.
Pool at top of dam - 2,375.

Auxiliary spillway capacity -
Pool at top of dam with flashboards intact - 715.
Pool at top of dam without flashboards - 4,255 (1).

Combined spillway capacity -
Pool at top of dam with flashboards intact - 3,090.
Poll at top of dam without flashboards - 6,630(1).

c. Elevation. (Feet above msl.)

Top of dam (design) - 1057.1

Top of dam (lowest elevation) - 1055.9.

Maximum pool - 1055.9.

Normal pool (spillway crest) - 1051.6.

Upstream invert outlet works - 1000.6(2).

Downstream invert outlet works (30-inch diameter pipe) - 992.0 (approximate).

(1) Auxiliary spillway channel discharge capacity may be limited by downstream channel conditions - see Section 5, Hydrology and Hydraulics.
(2) Center pipe has telescoping extension.

c. Elevation. (Feet above msl.)(Cont'd.)

Upstream invert water supply line - none.

Streambed near outlet works - 991.0.

d. Reservoir Length. (Miles.)

Normal pool - 2.1

Maximum pool - 2.2.

e. Storage. (acre-feet.)

Normal pool - 8,823.

Maximum pool - 10,556.

f. Reservoir Surface. (Acres.)

Normal pool - 400.

Maximum pool - 406.

g. Dam.

Type - Homogeneous earthfill with reinforced-concrete core wall.

Length - 2,155 feet (embankment).

Height - 65 feet.

Top Width - Concrete core wall - 0.75 feet.
Earthfill - 10 feet.

Side Slopes - Upstream - 1V on 2H.
Downstream - 1V on 2H.

Zoning - None.

Cutoff - Core wall founded on impervious material.

Grout Curtain - None.

h. Diversion and Regulating Tunnel. None.

i. Spillway.

Type - Main spillway - concrete weir (10-inch level top).
Auxiliary spillway - concrete ogee-shaped weir.

Length of Weir - Main spillway - 72.0 feet.
Auxiliary spillway - three 43.0-foot bays with 2-foot wide piers between bays.

i. Spillway. (Cont'd.)

Crest Elevation - Main spillway - 1051.6.
Auxiliary spillway - 1051.6.
Flashboards on auxiliary spillway -
Right bay - 1054.6.
Center bay - 1054.35.
Left bay - 1054.85.

Upstream Channel - Main spillway - short approach from reservoir with vertical concrete approach walls and concrete slab on adverse 1V on 2H slope.
Auxiliary spillway - reservoir.

Downstream Channel - Main spillway - supercritical flume of varying cross section leading to Pikes Creek Canal headworks 0.25 mile downstream.
Auxiliary spillway - vertical walls and narrow channel which leads into channel cut through natural materials. The channel then leads into a borrow pit. Flow from the borrow pit travels overland to Harveys Creek Canal, which flows to Pikes Creek Canal headworks.

j. Regulating Outlets.

Type - Three 30-inch diameter cast-iron pipes for water supply and emergency drawdown. The center pipe has a 20-inch diameter reducer on the downstream end.

Length - 600 feet (approximate).

Access - To downstream end and valve house only.

Regulating Facilities - For each pipe, two manually operated, nonrising, dual-stem, gate valves with exposed 2.6 to 1 gear reducers.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. Very little engineering data was available for review for the structure as originally designed. 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. A summary of the results of the analyses is on file. Some engineering data for modifications to the dam was available for review.

b. Design Features. Pikes Creek Dam consists of an earthfill embankment with a concrete core wall, concrete main spillway, and concrete auxiliary spillway.

The embankment (Photographs A, B, C, and D) is 2,155 feet long and is curved in plan. The maximum height of the embankment is 65 feet. The centerline of dam extends straight from the main spillway at the right abutment for 880 feet, then curves downstream along a 360-foot radius curve for 150 feet. The embankment then extends straight for 240 feet, curves upstream along a 360-foot radius curve for 275 feet, and then extends straight for 610 feet to the natural high ground at the left abutment. The embankment is constructed of a sandy clay. A 16-foot wide berm, 36 feet below the top, extends for 450 feet along the downstream side of embankment near the right abutment. A 10-foot wide berm, 31 feet below the top, extends along the upstream side. The embankment has a 10-foot top width and a grass-covered 1V on 2H downstream slope. The riprapped upstream slope is 1V on 2H except for the uppermost 2 feet, which is near vertical. In this uppermost section, the riprap has been placed so that it acts as a dry masonry retaining wall. The embankment is founded on a firm clay. The lowest elevation of the top of embankment is 1055.9. Pennsylvania Route No. 29 generally parallels the embankment about 300 feet downstream of the top of dam.

The core wall extends along the centerline of the dam. It is founded on a 3-foot thick concrete footing that extends across the bottom of a cutoff trench. About one-half of the footing is founded on a dense shale and the other one-half is founded on hardpan. The portion founded on hardpan is near the left abutment starting about 800 feet left of the spillway. The core wall is

9 inches thick and is reinforced with 1-inch diameter bars on 64-inch centers. The bars are anchored into the concrete footing. The top of the core wall is 2 feet below the design top of dam. The core wall extends well into the hillsides of the abutments. The cutoff trench was excavated 20 feet, on the average, either onto rock or hardpan. The trench is 3 to 5 feet wide on the bottom and 9 feet wide at the top. The trench is filled with select material up to the surface of the adjacent embankment foundation.

The main spillway (Photograph E and Plates 3 and 4) is a concrete weir at the right abutment of the embankment. The crest is 10 inches wide at the top and is 72 feet long. The elevation of the crest is 1051.6 and it is 4.3 feet below the top of dam. The main spillway has concrete approach walls and a 24-foot long concrete apron. The upstream end of the concrete apron has a 3.5-foot deep key. A 25-foot deep cutoff wall extends under the spillway weir and is tied into the core wall of the dam. The spillway channel conveys water to the Pikes Creek Canal headworks and consequently will be referred to as a flume. The flume has a supercritical slope with a level bottom section and 7-foot high vertical walls at each side (Photograph F). The invert of flume at the upstream end is 1.6 feet below the spillway crest. The flume narrows as it extends downstream of the spillway on a 2.7-percent grade. The flume is about 18 feet wide at a section 315 feet downstream of the spillway crest. Pennsylvania Route No. 29 crosses the flume at this point on a concrete bridge. Low chord of the bridge is 7.7 feet above the invert of the flume. The 18-foot wide flume then continues downstream for another 170 feet at the same slope. At the downstream end of this reach, there is a concrete cutoff wall extending 5 feet into the fill on each side of the flume and also extending below the flume to a depth of 20 feet. The flume then continues through a 90-foot long transition to a concrete trapezoidal-shaped section with rounded invert. At this section, 5-inch diameter tile drains discharge into the flume. These drains extend from the spillway to this point by running behind the walls of the flume. The trapezoidal flume then extends downstream at varying grade for about 700 feet to the reservoir of Pikes Creek Canal headworks. Pikes Creek also flows into this headworks reservoir, as does Harveys Creek Canal. The headworks have facilities to divert water from Harveys Creek Canal into either the reservoir above the headworks or directly into Pikes Creek below the headworks. Facilities are also provided to divert water from the headworks reservoir into either Pikes Creek Canal or Pikes Creek downstream of the headworks. The headworks reservoir is at Elevation 981. Pikes Creek downstream of the headworks is at Elevation 971.

The left abutment of the embankment is a natural earthen hillside. Approximately 180 feet upstream of the centerline of dam at the left abutment, an auxiliary spillway channel has been excavated through the hillside. The centerline of the auxiliary spillway channel at the reservoir is approximately parallel to the centerline of dam (Plate 5). About 60 feet downstream of the auxiliary spillway crest, the auxiliary spillway channel curves right on a 150-foot radius along a 180-foot arc until the channel is approximately normal to centerline of dam. The channel then extends straight for 340 feet until it runs out at a borrow pit. This borrow pit was used in the original construction of the embankment. The auxiliary spillway crest is a 133-foot long concrete ogee-shaped weir with steel flashboards along the crest. Two 2-foot wide piers divide the auxiliary spillway into three equal length bays. The auxiliary spillway crest (Photograph G and Plate 6) is at Elevation 1051.6, which is the same elevation as the main spillway crest. The flashboards in each bay have different heights. The flashboards in the right bay are 3.0 feet high. Those in the center and left bays are 2.75 and 3.25 feet high, respectively. All the flashboards are secured by hollow steel pipes which extend into sockets along the crest. These sockets extend through the weir and drain through openings in the downstream face of the weir.

The auxiliary spillway channel (Photograph H) consists of vertical walls which curve inward and a paved apron. The upstream end of the apron is 4.4 feet below spillway crest. The most upstream 3.5 feet of the apron is paved with concrete. The remaining 49.5 feet of apron is mortared stone. The walls are of concrete construction and they curve inward in such a manner that 58 feet downstream of the crest, the channel is 30 feet wide. The top elevation of the walls at the spillway crest is 1056.6. Just downstream of the crest, the wall elevation drops so that the walls maintain an elevation of 1050.0 over the length of the apron. The walls, which are provided with weep holes, terminate at the end of the apron. Earthen slopes above and behind the walls are riprapped. Downstream of the apron, the auxiliary spillway channel continues with vertical cuts in rock and 1V on 1.5H cuts in soil. In this reach, the channel narrows from 30 feet at the upstream end to 20 feet just upstream of the borrow pit at the downstream end of the channel.

The valve house (Photograph I) is located about 600 feet left of the main spillway at the toe of the embankment. The valve house and the area downstream lie in a depression formed by the natural higher ground to the left and right of the embankment, and the Pennsylvania Route No. 29 roadway embankment.

The toe of the dam embankment terminates 3 feet behind the valve house at a 3-foot high dry masonry wall which extends for the length of the valve house. French drains extending along the sides of the valve house discharge into 4-inch diameter drains, which also collect water from surface inlets near the valve house and near the upstream toe of roadway embankment.

Three 30-inch diameter cast-iron pipes pass through the embankment to the valve house. These pipes run parallel on 5-foot centers and are encased in concrete of unknown thickness under the embankment. The upstream inverts of the pipes are at Elevation 1000.6 but, as reported by the Owner, the center pipe draws water from a higher elevation in the reservoir. An elbow and telescoping extension extending along the upstream embankment slope are provided on the center pipe to supply water from the higher elevation. After passing through the valve house, these pipes parallel the two 4-inch diameter drains and run under the roadway embankment to a concrete headwall at the downstream toe of the roadway embankment (Photograph J). Except for the center 30-inch diameter pipe, the pipes terminate at the headwall. The center 30-inch diameter pipe extends through the headwall and deflects upward at a 45-degree angle through a 20-inch diameter reducer. Discharge from this pipe free falls to the stream below. This is used to aerate the discharge. Valves downstream are provided on the left 30-inch diameter pipe. A force main joins this pipe at a manhole just downstream of the valve house. This provides the capability to pump water into Pikes Creek Reservoir from Harveys Creek Canal.

2.2 Construction.

a. Data Available. Construction data for the original structure that is available for review, consists of the information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. Information in the 1914 report is limited. Some data for subsequent modifications is available for review from the files of the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania, and from the files of the Owner.

b. Construction Considerations. The 1914 report by the Pennsylvania Water Supply Commission raised several concerns about the construction of the original structure. In particular, the slender concrete core wall and the lack of embankment compaction were of concern. Other observations in this report, such as placing select material backfill in the cutoff trench and placing the best stone-free material near the core

wall, indicate that some care was utilized in the construction of the embankment. From review of the available data, there are no special concerns regarding subsequent modifications other than the excessive monolith lengths used during construction of the various concrete features of the dam.

2.3 Operation. No formal records of operation were reviewed. Based on information from the Owner and the caretaker of the dam, all structures have performed satisfactorily.

2.4 Other Investigations. The Owner does not have any plans to further modify Pikes Creek Dam at present.

2.5 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments, Bureau of Water Quality Management, Department of Environmental Resources, Commonwealth of Pennsylvania and by the Owner, Pennsylvania Gas and Water Company. The Owner made available an engineer, and two caretakers for information during the visual inspection. The Owner also researched his files for additional information upon request of the inspection team.

b. Adequacy. The type and amount of design data and other engineering data is limited, and the assessment must be based on the combination of available data, visual inspection, performance history, and hydrologic 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 general appearance of Pikes Creek Dam is good. However, there are some deficiencies as noted below.

b. Embankment. The sod on the embankment is in excellent condition. There are a number of holes, made by burrowing animals, in the embankment. A number of turtles were observed making holes to lay eggs in. Some other holes were observed to be of a size suitable only for small rodent-sized animals. A few larger holes were observed. None of the larger holes appeared to be active. The vertical alignment of the dam is uneven, with the lowest elevation being 1055.9. These low spots are not localized but extend over most of the dam, except at the abutments. One 10-foot long section of rip-rap on the upstream slope of the embankment is bulged toward the reservoir (Photograph C). The dry masonry wall at the downstream toe of embankment near the valve house is bulged. The center of the wall protrudes about 6 inches further downstream than the ends. Along lengths of the downstream toe, the tree line is at the toe. Some surface cracking was observed on the top of dam. One crack extended normal to the centerline of dam across the entire top. Another crack extended longitudinally for about 100 feet. This crack appeared intermittent. These cracks were very fine and their depth could not be measured. No relative movement was observed at the cracks. Seepage was observed at three separate areas along the downstream toe. One area (Photograph D) was near the left abutment. This area measured approximately 225 feet along the toe and extended about 300 feet downstream of the toe. The area was irregular in shape and had a swampy surface. Water was observed over most of the area. A low artificial pond was also observed in the middle of the wet area. Clear seepage of about 15 gpm was observed flowing from the wet area. The Owner reports that the water in this area is coming from the left abutment hillside. He reports that the pond was originally used to store bait. A second seepage area, about 1 square foot, exists 150 feet left of the valve house. Clear water was seeping from this area at the rate of about 1 gpm. A dry erosion gully extends from the embankment berm to this area. A third seepage area was observed at the valve house. The source of the seepage was not evident. Water was clear and flowing at a rate of about 10 gpm. The Owner reported that the source of the seepage was leakage from the defective packing on the valves in the valve house.

c. Main Spillway. The concrete weir of the main spillway is in generally good condition (Photograph E). The weir was placed in two 36-foot long monoliths. Shrinkage cracks are evident. The aggregate is exposed on the weir. The right approach wall is cracked (Photograph E). Evidence of relative movement was observed. The approach channel slab has a crack, parallel to the weir, extending across the entire slab. The flume downstream of the weir is in generally good condition. Two of the monoliths in the bottom of the flume are pitted over most of their area. The concrete walls were constructed as 30-foot long monoliths and numerous shrinkage cracks were observed. At the cracks there was evidence of slight leaching, as white deposits or "efflorescence" was observed. The toe of the wall stem is slightly scoured along the entire length. The top of the walls are slightly spalled in spots. At a few joints, the concrete has spalled to a depth of about 2 inches over an average length of 5 inches. The reinforcing bars, which appear to extend continuously between monoliths, are exposed in these areas. Trees are very close to the left wall. The branches hang over part of the flume. The inspection of the flume ceased about 500 feet downstream of the spillway crest.

d. Auxiliary Spillway. The auxiliary spillway crest is pitted in localized areas. Spalling, typically 0.5-inch deep, was observed at the joints. One of the piers on the crest was slightly spalled at its junction with the crest. The steel flashboards appeared to be in excellent condition. The concrete apron has a minor amount of vegetation growing at the joints. Vegetation was also observed in localized areas of the mortared stone apron. The left auxiliary spillway wall has a surface crack and leaching approximately at the crest of the auxiliary spillway. The top of the walls on both sides is slightly spalled. Trees are close to both walls. Shrinkage cracks were observed at identical locations in the curved section of each wall. Downstream of the apron, the auxiliary spillway channel (Photograph H) is heavily overgrown and swampy. It was not possible to inspect it. It was not possible to measure the inside diameter of the hollow-pipe pins which support the flashboards.

e. Outlet Works. The headwall is slightly spalled along the exposed edges and more heavily spalled at the downstream end of the walls. One 4-inch square pitted area was observed. The valve packings in the valve house leak. The position indicator on the right valve was missing. The operation of the valves was observed. It required four men turning a 30-inch diameter handwheel to operate the valve. It is estimated that it would require about 1 hour to fully open a valve manually. The Owner supplied an air compressor and attachments to operate the valves. It took two men 20 minutes to fully open a valve. All valves are operational.

f. Reservoir Area. The reservoir slopes are wooded and relatively mild. No evidence was visible of creep, rock slides, or land slides. The Owner indicated that sedimentation is not a problem from the standpoint of reduced reservoir capacity. About 70 percent of the watershed is owned by the Pennsylvania Gas and Water Company. The remaining portion is only sparsely developed.

g. Downstream Channel. The channel immediately below the dam is rocky with wooded overbanks. A brief inspection of Pikes Creek Canal headworks was made. No conditions that would present a hazard to Pikes Creek Dam were observed.

3.2 Evaluation. The turtle egg holes and small rodent holes are of no concern as they are shallow. The Owner reports that larger burrowing animals are shot. The number of larger holes is not sufficient to be of more than slight concern. The bulged riprap was probably caused by ice action the previous winter. The Owner stated happenings of this type occur most winters. This condition is of no special concern. The embankment, at its lowest point, is about 1.2 feet below the design elevation. It has apparently settled. The periodic inspections by the Commonwealth noted apparent settlement. As was noted in Section 2, Engineering Data, the compaction of the embankment was not reported as being thorough. Settlement is probably the cause of the surface cracking parallel to the dam axis, as the core wall is below the crack. The cause of the crack normal to the axis is unknown. It is of some concern as it could indicate cracking of the core wall. The dry masonry wall behind the valve house apparently cannot resist the earth loads behind it. The trees at toe of slope are undesirable. The seepage observed along the toe is of some concern. All these seepage areas have been previously noted in the periodic inspections by the Commonwealth. The areas are apparently stabilized. From review of the inspection reports by the Commonwealth, the dam was apparently built adjacent to some springs. The seepage area 150 feet left of the valve house is identified in some inspection reports as coming from a drain. No drain was observed. The valve house was reportedly built very near to an old well. French drains were added near the valve house to control seepage from this well. It is uncertain that these drains are functioning properly.

b. Main Spillway. The crack in the right approach wall of the main spillway was probably caused by settlement. The crack in the approach channel apron may be related to settlement or may have been caused by ice pressure. Neither condition presents an immediate hazard to the dam. The shrinkage cracks were probably caused by the excessive monolith

lengths. The other deficiencies noted in the concrete are to be expected after long term exposure to the weather and to flowing water. Long term neglect will lead to further deterioration of the concrete and deterioration of the exposed reinforcing bars. Trees close to the walls are undesirable.

c. Auxiliary Spillway. The pitting of the auxiliary spillway crest may have been caused by honeycombing of the concrete when it was placed. The shrinkage cracks in the walls and surface crack in the wall near the crest are probably caused by the location of the joints. The other deficiencies in the concrete are probably caused by exposure to the weather. Long term neglect can lead to worsening conditions. The vegetation in the apron and the trees adjacent to the walls are undesirable. The overgrown channel below the apron can significantly affect the hydraulics. This situation is further evaluated in Section 5, Hydrology and Hydraulics. Except for the downstream channel, the conditions observed at the auxiliary spillway present no special concern.

The Owner stated that the flashboards were used to prevent flow from passing through the borrow pit. Flow through the borrow pit would probably result in reduced water quality and overtax the discharge capacity of Harveys Creek Canal. The Owner stated that he did not have calculations on design of the flashboards, however, flashboard design computations are in the files of the Division of Dams and Encroachments.

d. Outlet Works. The spalling and pitted concrete observed is usual after long-term exposure to the weather and to flowing water. Leaking valve packings are undesirable. The operation of the valves was satisfactory. It would be desirable to have position indicators on all valves.

e. Reservoir Area. No conditions were observed in the reservoir that might present significant hazard to the dam.

f. Downstream Channel. No conditions were observed in the downstream channel that might present significant hazard to the dam. Additional discussion on downstream conditions is presented in Paragraph 5.1e.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. During the winter season, the reservoir is maintained 2.3 feet below spillway crest to protect the flashboards from ice. During other seasons, the reservoir is maintained at spillway crest. Water is normally drawn from the reservoir from either two low intakes or one high intake. Through one of the low intake pipes, water can be pumped into the reservoir from Harveys Creek Canal via a pipeline which originates at a small intake structure on Harveys Creek Canal. This intake structure is just upstream of the Pikes Creek Canal headworks. This system is used when there is excess flow in Harveys Creek Canal and Pikes Creek Reservoir is below normal pool. Excess inflow passes over the main spillway into the flume which leads to Pikes Creek Canal headworks. Any discharge over the auxiliary spillway would pass through an old borrow pit, which is now a swamp, and travel overland to Harveys Creek Canal. Harveys Creek Canal discharges into Pikes Creek Canal headworks. Facilities are provided at this headworks to supply Pikes Creek Canal with sufficient water. Excess water at the Pikes Creek Canal headworks would pass into Pikes Creek. Pikes Creek Canal feeds a complex distribution system, which in turn supplies the communities of Plymouth, Wilkes-Barre, Nanticoke, and Edwardsville. The demand on the system is usually between 15 and 20 mgd.

4.2 Maintenance of Dam. The dam is visited daily by two caretakers who check the level of the reservoir, regulate valves in the valve house, check the canal headworks, flumes, and chlorination equipment, regulate headworks' gates and perform general maintenance on the system. The reservoir level is recorded daily and reports are mailed to the Owner's Engineering Department weekly. This information is used by the Engineering Department for regulating flows in the distribution system. The caretakers are also responsible for reporting any changes or deficiencies to the Owner's Engineering Department via two-way radio provided in the Owner's trucks. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and reports are utilized when determining priority of repairs. Informal inspections are also made when an engineer is on the site. The grass on the embankment is mowed annually.

4.3 Maintenance of Operating Facilities. There is no regular maintenance program for the operating facilities. Maintenance is performed when deemed necessary.

4.4 Warning System in Effect. The Owner furnished the inspection team with a chain of command diagram for Pikes Creek Dam and a generalized emergency notification list that is applicable for all 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 Pikes Creek Dam but are as directed by the Owner's Engineering Department.

4.5 Evaluation. The operational measures appear to be adequate. The maintenance generally appears to be good. The procedures used by the Owner for inspecting the dam are adequate, but needed repairs have not been made. In general, the warning system is adequate, but it is not in sufficient detail for Pikes Creek Dam when its overall importance is considered.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic or hydraulic analyses for the original Pikes Creek Dam design were available for review. The spillway capacity and the spillway channel capacity have been estimated in past years when the various construction modifications were made. Spillway capacity as used in this Section refers to the combined capacity of the main and auxiliary spillways.

(2) 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 for the size (intermediate) and hazard potential (high) classification of Pikes Creek Dam is the Probable Maximum Flood (PMF). If the dam and spillway are not capable of passing the PMF 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, 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.

(3) The 1926 "Report upon the Application of the Spring Brook Water Supply Company" by the Pennsylvania Water Supply Commission shows the main spillway capacity at 1,600 cfs with 2.2 feet of freeboard and the auxiliary spillway capacity without flashboards at 2,900 cfs with 2.2 feet of freeboard. Calculations were performed for this study to determine the capacity of the spillways without freeboard. For the design condition, the main spillway capacity without freeboard is 3,435 cfs, and the auxiliary spillway capacity without flashboards and without freeboard is 6,155 cfs. However, low spots exist on the top of embankment that reduce the capacity of the main spillway

to 2,375 cfs and the auxiliary spillway to 4,255 cfs at the point of initial overtopping of the dam.

(4) Flashboards are located on top of the auxiliary spillway crest. The elevation of the top of the flashboards is different for each of the three bays of the auxiliary spillway. According to computations of the Pennsylvania Water Supply Commission dated 14 October 1929, all of the flashboards were designed to fail at or below a depth of 2.4 feet on the auxiliary spillway crest. If the flashboards do not fail, the existing capacity of the auxiliary spillway is 715 cfs. If the embankment were raised to the design elevation that is shown on the plans, the auxiliary spillway capacity with flashboards would be 1,890 cfs. The table below summarizes the spillway capacities for the various conditions:

	Present[1] condition - low point on top of embankment (cfs)	Design[2] condition - embankment at design elevation (cfs)
No flashboards on auxiliary spillway:		
Main spillway capacity	2,375	3,435
Auxiliary spillway capacity	4,255	6,155
Total spillway capacity	6,630	9,590
Flashboards on auxiliary spillway remain intact:		
Main spillway capacity	2,375	3,435
Auxiliary spillway capacity	715	1,890
Total spillway capacity	3,090	5,325

(5) Pennsylvania Gas and Water Company owns 5,500 acres of Pikes Creek Dam watershed. Most of the watershed remains undeveloped. Hydrologic analysis for this study was based on existing conditions, and the effects of future development of the watershed were not considered.

(6) The flume downstream of the main spillway has a supercritical slope. Analyses of flumes require detailed water surface profile computations. This kind of analysis was beyond the scope of this report. Calculations were performed for this study to ascertain the energy required to pass water under the Pennsylvania Route No. 29 Bridge (Appendix C).

(1) Low Point Elevation 1055.9.
(2) Design Top of Dam Elevation 1057.1.

The results indicate that the flume is hydraulically inadequate to pass either the spillway discharge if the embankment is raised to design level or the spillway discharge with the embankment at its existing level.

(7) The auxiliary spillway channel immediately downstream of the crest narrows rapidly. Calculations were performed for this report to ascertain the effects of this narrow channel (Appendix C). The results indicate that the narrow channel constricts the flow and produces a backwater effect on the auxiliary spillway weir if the flashboards are not present. This will reduce the capacity of the auxiliary spillway if the flashboards are not present. The calculations required to quantitatively ascertain these effects were beyond the scope of this study. No reduction was made in the auxiliary spillway capacity because of this backwater effect.

(8) Because the Owner did not have calculations to demonstrate that the flashboards will fail and because it was not possible to check the size of the flashboard supports to determine if they have sections identical to those analyzed in the computations on file in the Division of Dams and Encroachments, the hydraulic rating for Pikes Creek Dam was determined with the assumption that the flashboards remain intact with the pool level at top of embankment. The table in Paragraph 5.1a.(4) shows the effect of various conditions on spillway capacity. However, none of the effects of the channels downstream of the spillways have been included in the figures presented.

b. Experience Data. For this study, the PMF was obtained from the curve of PMF peak flow versus drainage area for Region 2 of the Susquehanna River Basin.(1) The PMF peak flow was estimated to be 22,230 cfs. The volume of the inflow hydrograph was adjusted so that it represented 26 inches of runoff from the entire watershed.

c. Visual Observations. During the inspection of Pikes Creek Dam, it was observed that the channel downstream of the auxiliary spillway was heavily overgrown. This vegetation could cause backwater to reduce the auxiliary spillway discharge capacity. It was also estimated that Harveys Creek Canal was hydraulically unable to pass large flows from the auxiliary spillway. As Harveys Creek Canal does not present a hazard to the dam, this condition was only of slight concern. No habitations were observed near Harveys Creek Canal.

d. Overtopping Potential. For an occurrence of the PMF, the peak inflow of 22,230 cfs is greater than the spillway capacity of Pikes Creek Dam. A check of the surcharge storage effect of Pikes Creek Reservoir shows that the surcharge available is insufficient to contain an inflow with a peak flow of 22,230 cfs

(1) Obtained from the Baltimore District, Corps of Engineers.

without overtopping the dam (Appendix C). If Pikes Creek Dam should fail because of overtopping, the Pikes Creek Canal headworks would be overtopped.

e. Downstream Conditions. A plan of the area downstream of the dam is shown on Plate 1. Pikes Creek Canal headworks is located 0.25 mile downstream of Pikes Creek Dam. It would be overtopped by the discharge resulting from the failure of Pikes Creek Dam. Pikes Creek Canal headworks is low and has a small storage volume in the reservoir. The failure of the headworks would not add a significant amount of water to the downstream channel. However, it would provide almost no mitigating effects to floods originating upstream. Pikes Creek then proceeds about 0.6 stream mile through uninhabited and relatively flat country to its confluence with Harveys Creek, just upstream of an old breached dam. Harveys Creek then proceeds 1.1 stream miles to Ceasetown, Pennsylvania. There are at least four houses in this reach which would be affected by floodflows. Ceasetown also has a number of houses which would be affected by floodflows. Harveys Creek then proceeds 4.1 stream miles through a narrow valley to its confluence with the Susquehanna River. At the confluence, the heavily populated community of West Nanticoke exists on both sides of Harveys Creek. The downstream conditions indicate that a high hazard classification is warranted for Pikes Creek Dam.

f. Spillway Adequacy.

(1) The existing spillway will not pass the PMF without overtopping the dam. One-half of the PMF inflow is 11,115 cfs and is greater than the spillway capacity. A check of the surcharge storage effect of Pikes Creek Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak flow of 11,115 cfs without overtopping the dam (Appendix C).

(2) If the top of embankment were raised to the design elevation that is shown on the plans, if the flashboards are removed or it can be shown that the flashboards will fail as intended, and if the channels downstream of the spillways are made hydraulically adequate, the spillway capacity and surcharge storage effect would be sufficient to pass 57 percent of the PMF, or 12,620 cfs, peak inflow without overtopping.

(3) The maximum tailwater is estimated to be Elevation 1008 at the spillway capacity of 6,630 cfs (without flashboards). At maximum pool elevation, there is a difference of about 50 feet between headwater and tailwater. If Pikes Creek Dam should fail due to overtopping, the hazard to loss of life downstream from the dam will be significantly increased from that which would exist just prior to overtopping.

(4) Based on established OCE criteria as outlined in Paragraph 5.1a.(2), the existing spillway capacity of Pikes Creek Dam is rated as seriously inadequate. Considering the effects of the surcharge storage of 1,733 acre-feet, the spillway capacity of 3,090 cfs (with flashboards) can accommodate a flood with a peak flow of 5,460 cfs for a storm of the same duration as the PMF. This is 25 percent of the PMF peak inflow.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of the dam resulted in a number of observations relevant to structural stability. These observations are listed herein for various features.

(2) Embankment. Seepage was observed at three locations along the toe of embankment. Settlement and surface cracking of the embankment was also observed. A short, dry masonry wall at the toe of embankment was observed to be bulged. A detailed description and evaluation of these conditions are in Paragraphs 3.1b. and 3.2a., respectively.

(3) Spillway. Cracks were observed on the spillway weir, approach apron, and spillway walls. A detailed description and evaluation of these conditions are in Paragraphs 3.1c. and 3.2b., respectively.

(4) Auxiliary Spillway. Cracks were observed on the auxiliary spillway walls. A detailed description and evaluation of these conditions are in Paragraphs 3.1d. and 3.2c., respectively.

b. Design and Construction Data. No record of design data or stability analysis for the original structures or subsequent modifications was available for review. The structure was studied in 1914 by the Pennsylvania Water Supply Commission. No stability analysis for the structures, as they then existed, was performed.

The existing main spillway weir crest is 1.6 feet above the upstream and downstream channel. During a review of the spillway section (Plate 3), it was estimated that the structure would be stable for the expected loads. Stability analyses on structures this small are usually not performed.

A stability analysis for the auxiliary spillway was performed in this study. Only the bottom section was considered. The loading assumptions were as follows: reservoir level at top of highest flashboard, full hydrostatic pressure on upstream face and uplift varying uniformly from full tailwater at the toe to full tailwater at the heel plus two-thirds of the difference between the headwater and tailwater also at the heel.

The results of the stability analysis for the auxiliary spillway showed that the toe pressure and sliding factor are within acceptable limits and that the resultant is within the middle third, about 3.6 feet from the toe. OCE guidelines on overturning recommend that the resultant be within the middle third. The structure is apparently stable for this maximum loading condition.

c. Operating Records. Based on the operating records, there is no evidence that the main spillway, auxiliary spillway, or embankment have experienced stability problems, except for the settlement of the embankment.

d. Post-Construction Changes. As noted herein, there is adequate information concerning modifications made to Pikes Creek Dam.

e. Seismic Stability. Pikes Creek Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected loading. However, since there are no formal static stability analyses, and since there is the potential of earthquake forces moving or cracking the concrete core wall, the theoretical seismic stability of this dam cannot be assessed.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on the visual inspection, available records, calculations and past operational performance, Pikes Creek Dam is judged to be in good condition. However, some maintenance and repair deficiencies were noted. A summary of features and observed deficiencies are listed below:

Feature and Location	Observed Deficiencies
Embankment:	
Earthfill	Burrowing animal holes.
Earthfill	Pipes under pressure through embankment.
Top of embankment	Surface cracking.
Top of embankment	Low areas.
Toe of embankment	Seepage areas.
Toe of embankment	Bulged dry masonry wall.
Toe of embankment	Contiguous tree line.
Main Spillway:	
Right approach wall	Structural crack.
Approach apron	Crack.
Spillway walls and weir	Shrinkage cracks.
Spillway channel walls and slab	Spalling and pitting.
Left spillway wall	Trees too close.
Auxiliary Spillway:	
Weir and piers	Pitting and spalling.
Apron	Vegetation.
Walls	Cracks.
Walls	Trees too close.
Downstream channel	Vegetation.

Feature and Location	Observed Deficiencies
Outlet Works:	
Valves	Leaks in packing.
Right valve	Missing position indicator.
Headwall	Spalling and pitting.

(2) The overtopping potential analysis shows that Pikes Creek Dam, as existing, will be overtopped by the PMF and one-half the PMF. Therefore, based on OCE criteria, as outlined in Paragraph 5.1a.(2), the existing spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 25 percent of the PMF peak inflow. Additional analyses were performed to evaluate the effects of the channels downstream of the spillways. The channels are hydraulically inadequate for the design discharges. These channels might affect the discharge capacity of the spillways. If the top of embankment were raised to the design elevation that is shown on the plans, if the flashboards are removed or it can be shown that the flashboards will fail as intended and if the channels downstream of the spillways are made hydraulically adequate, the spillway capacity and surcharge storage effect would be sufficient to pass 57 percent of the PMF, or 12,620 cfs, peak inflow without overtopping of the dam.

(3) Stability computations performed for this study indicate that the auxiliary spillway weir is apparently structurally adequate for the maximum pool condition. For the maximum pool condition, computations show that the resultant is inside the middle third and that the sliding factor and toe pressure are within acceptable limits. The main spillway weir was judged to be stable.

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, computations performed prior to and as a part of this study, and other information.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as soon as practical or in a timely manner as noted.

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

7.2 Recommendations and Remedial Measures.

a. In view of the concern for the safety of Pikes Creek Dam, the following measures are recommended to be taken by the Owner as soon as practical:

(1) Develop a detailed emergency operation and warning system for Pikes Creek Dam.

(2) Perform additional studies to more accurately ascertain the spillway capacity required for Pikes Creek Dam, as well as the nature and extent of mitigation measures required to make the spillways and spillway channels hydraulically adequate. Filling in the existing low area of the embankment would help increase the spillway capacity and this should be accomplished. The cause of the surface cracking observed on the top of the embankment, especially the crack normal to axis of dam, should be investigated before filling in the low areas at top of embankment. Should the core wall be cracked, or other structural problems become evident, appropriate remedial measures should be instituted.

(3) Remove the flashboards from the auxiliary spillway or ascertain that they will fail as designed.

(4) Clear the auxiliary spillway channel of vegetation.

(5) Provide closure facilities for the outlet works pipes upstream of the concrete core wall for periodic inspection and for use in the event the pipes should leak severely, thereby endangering the embankment.

b. In order to correct operational, maintenance and repair deficiencies, and to more accurately assess the condition of the dam, the following measures are recommended to be undertaken by the Owner in a timely manner:

(1) Fill the larger burrowing animal holes.

(2) Remove trees near downstream toe of embankment and near main spillway and auxiliary spillway walls.

(3) Replace dry masonry wall with a suitably designed wall.

(4) Visually monitor surface cracking, spalling, shrinkage cracks, and pitting in the main spillway walls and apron, auxiliary spillway walls, and outlet works headwall. Areas where reinforcing bars are exposed and areas where concrete is severely disintegrated should be repaired.

(5) Repair leaking valve packings.

(6) Replace missing valve position indicator.

(7) Install ten or more observation wells, or other instrumentation, downstream of the axis of the dam. Two wells, or other instrumentation, should be located in the vicinity of the wet areas near the valve house. Two others should be located near the wet area at the left abutment. The other six should be at appropriate locations to determine general water level in downstream embankment. Data collected from observation wells or other instrumentation should be utilized in evaluating the stability of the embankment and assessing piping potential in the future. Continue to observe wet areas and seepage downstream from dam. Periodically measure and record quantity of seepage from all areas. If conditions worsen, appropriate action should be taken to control apparent seepage and turbidity with properly designed drains.

c. In addition, the following operational measures are recommended to be undertaken by the Owner:

(1) Provide round-the-clock surveillance of Pikes Creek Dam during periods of unusually heavy rains.

(2) 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

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

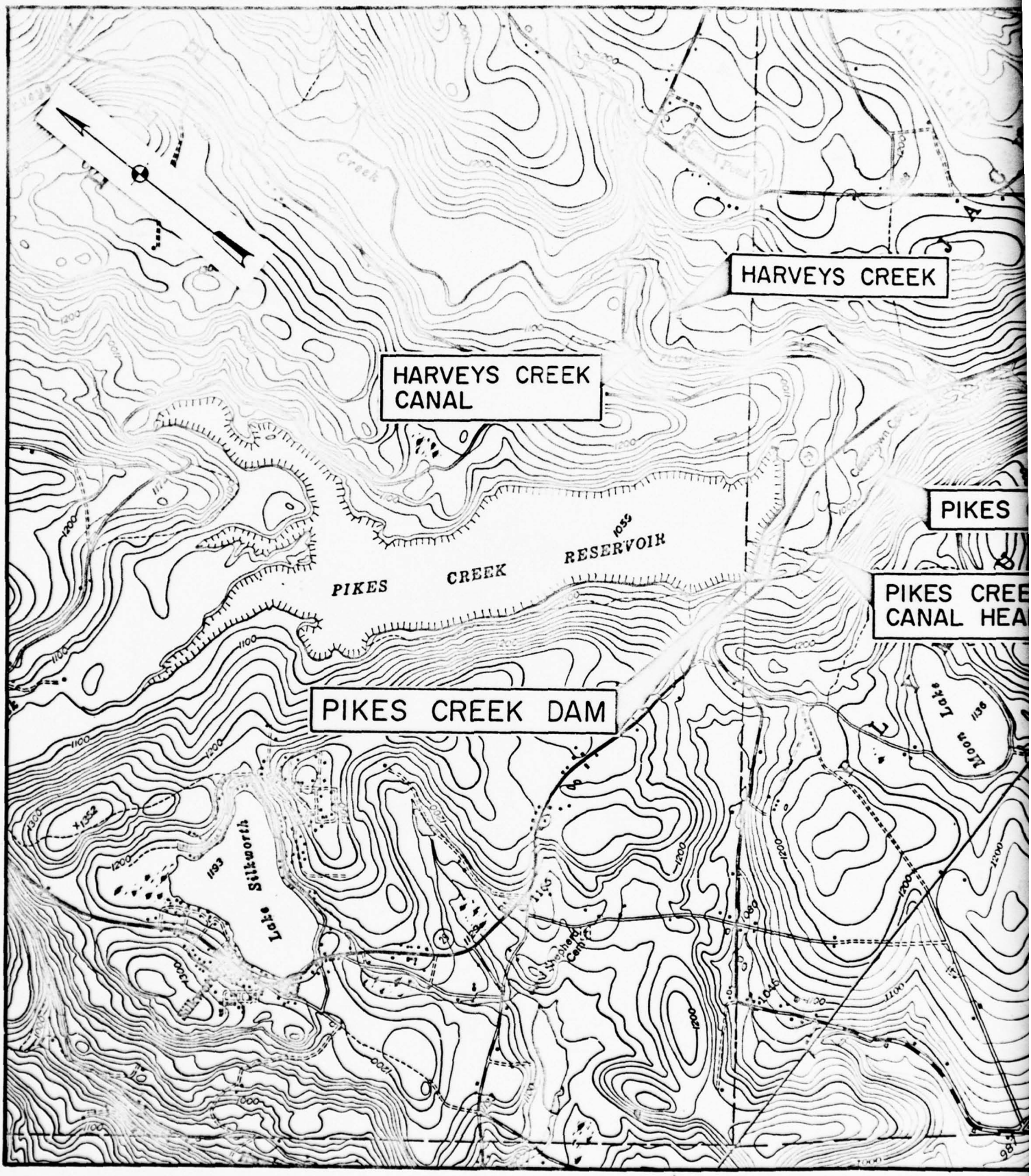
PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

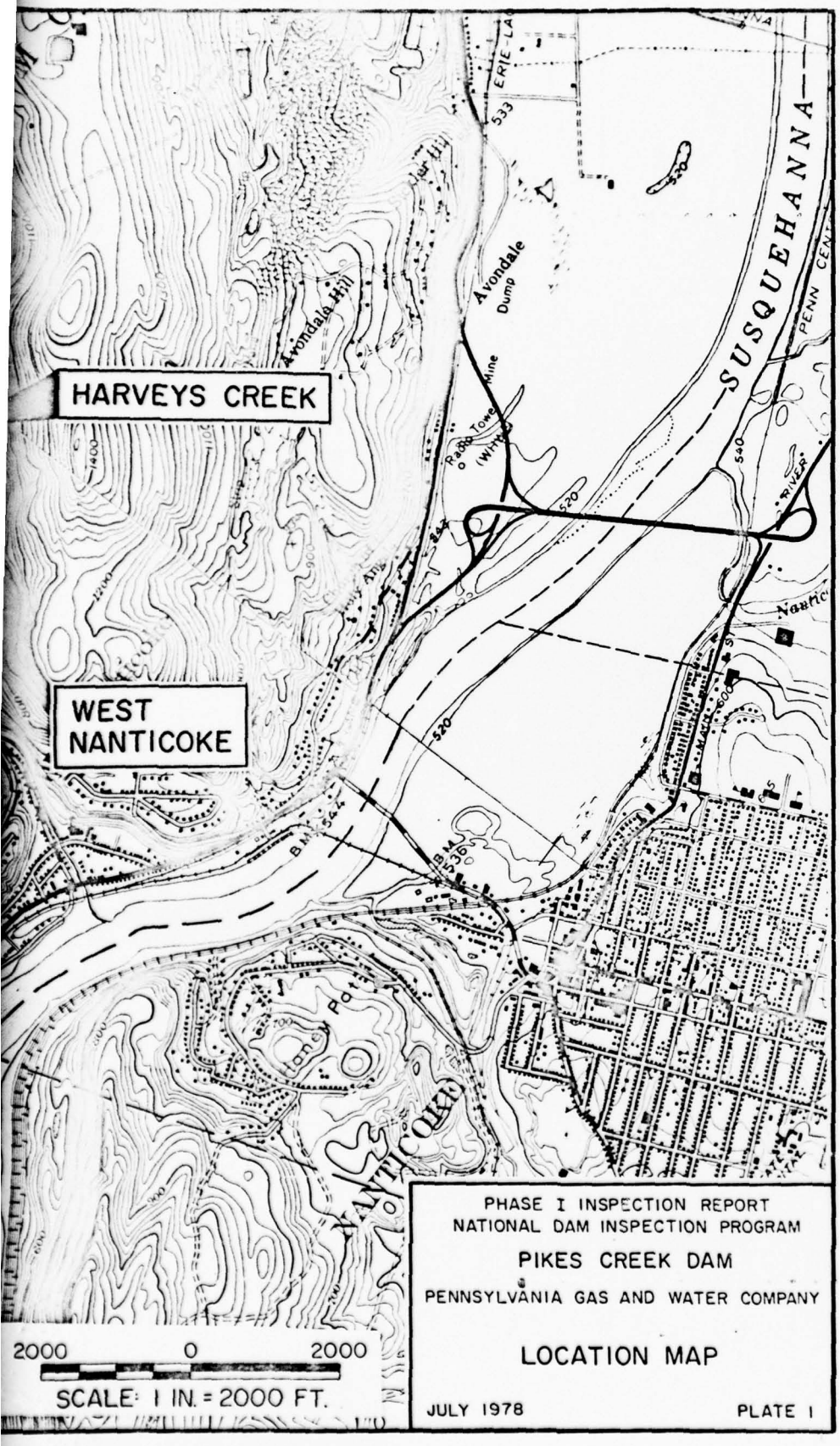
NATIONAL DAM INSPECTION PROGRAM

JULY 1978

PLATES


HARVEYS CREEK
HARVEYS CREEK CANAL
PIKES
PIKES CREEK RESERVOIR
PIKES CREE
CANAL HEA
PIKES CREEK DAM
Lake Silkworth
Stephenson Cemetery
Bloom Lake


YS CREEK
PIKES CREEK CANAL
PIKES CREEK
PIKES CREEK CANAL HEADWORKS
HARVEY
WEST NANTICO
Bloom Lake
CEMETERY
ERIE-LACKAWANNA
2000
SCALE: 1



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PIKES CREEK DAM

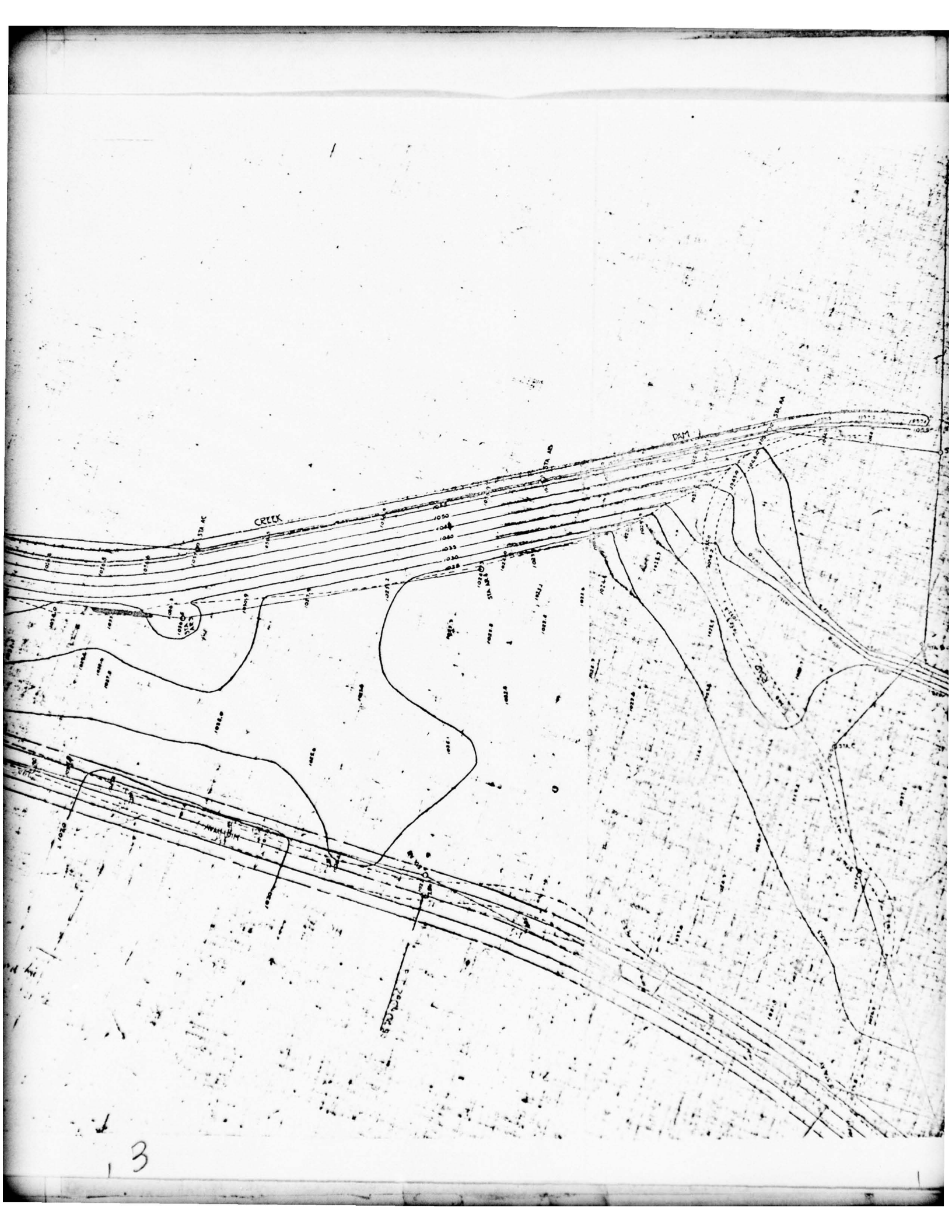
PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

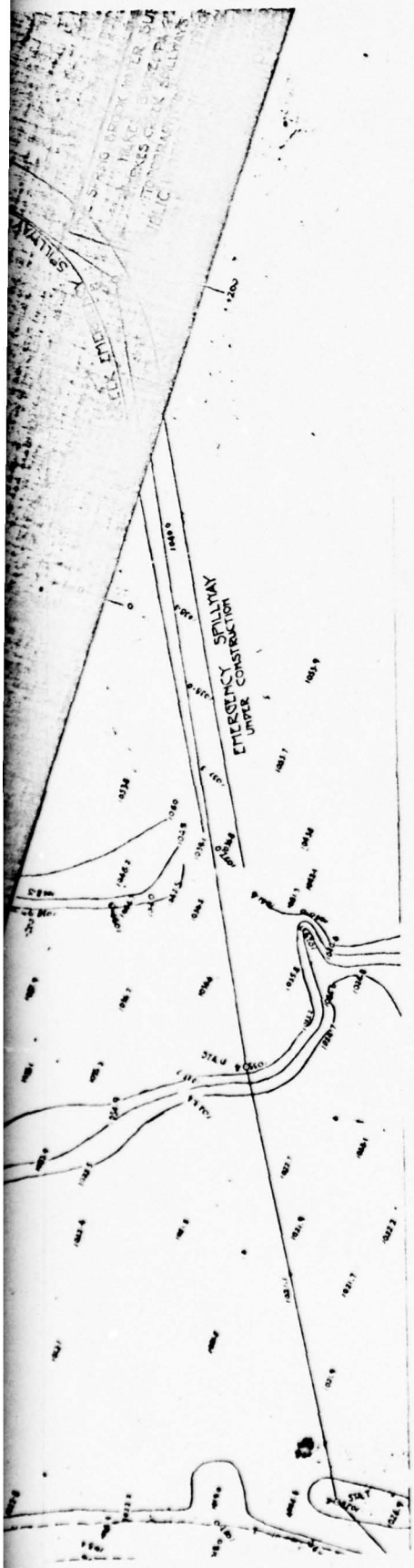
JULY 1978 PLATE 1


STATE
CHANNEL
STREAM
HIGHWAY
SKILLMAY
CREEK


STA AE
STA AE 1
STA AE 2
STA AP
PIKES
ROUTE
B2


DAM
CREEK
STA AE
STA AD
STA AA
STA AC
1050
1045
1040
1035
1030
1025

13



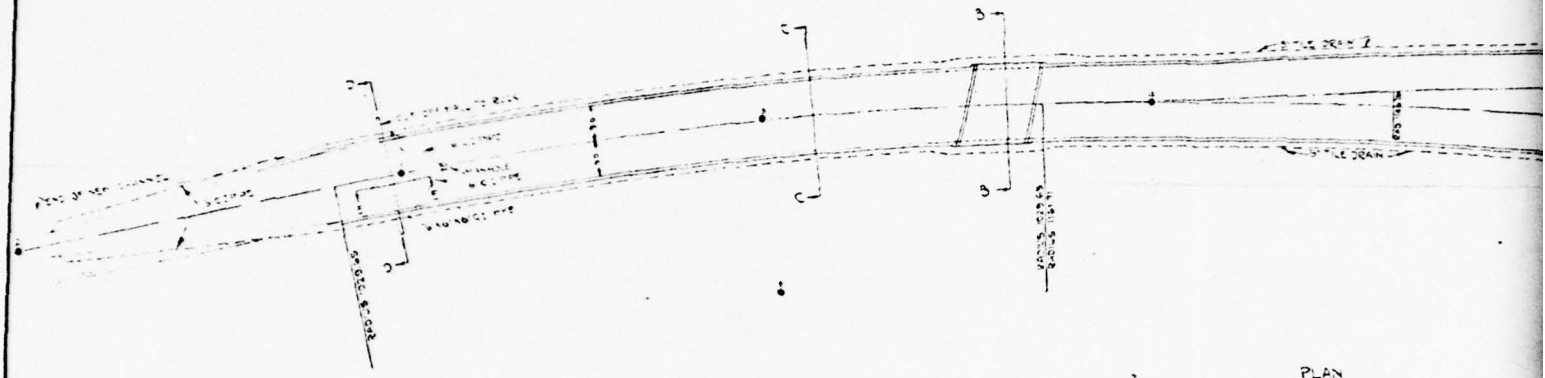
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PIKES CREEK DAM

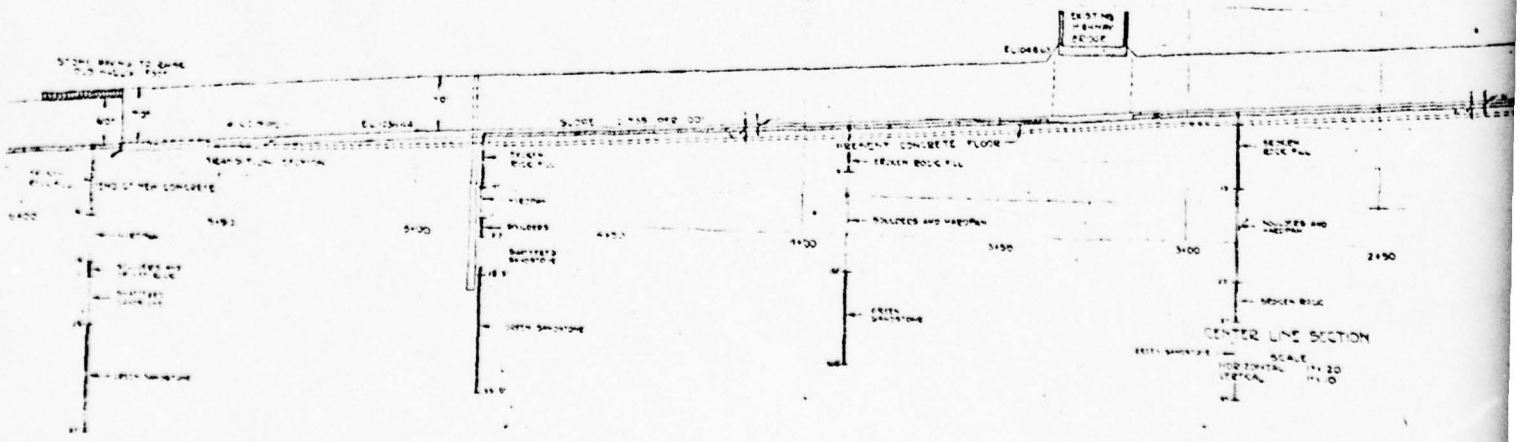
PENNSYLVANIA GAS AND WATER COMPANY

PLAN

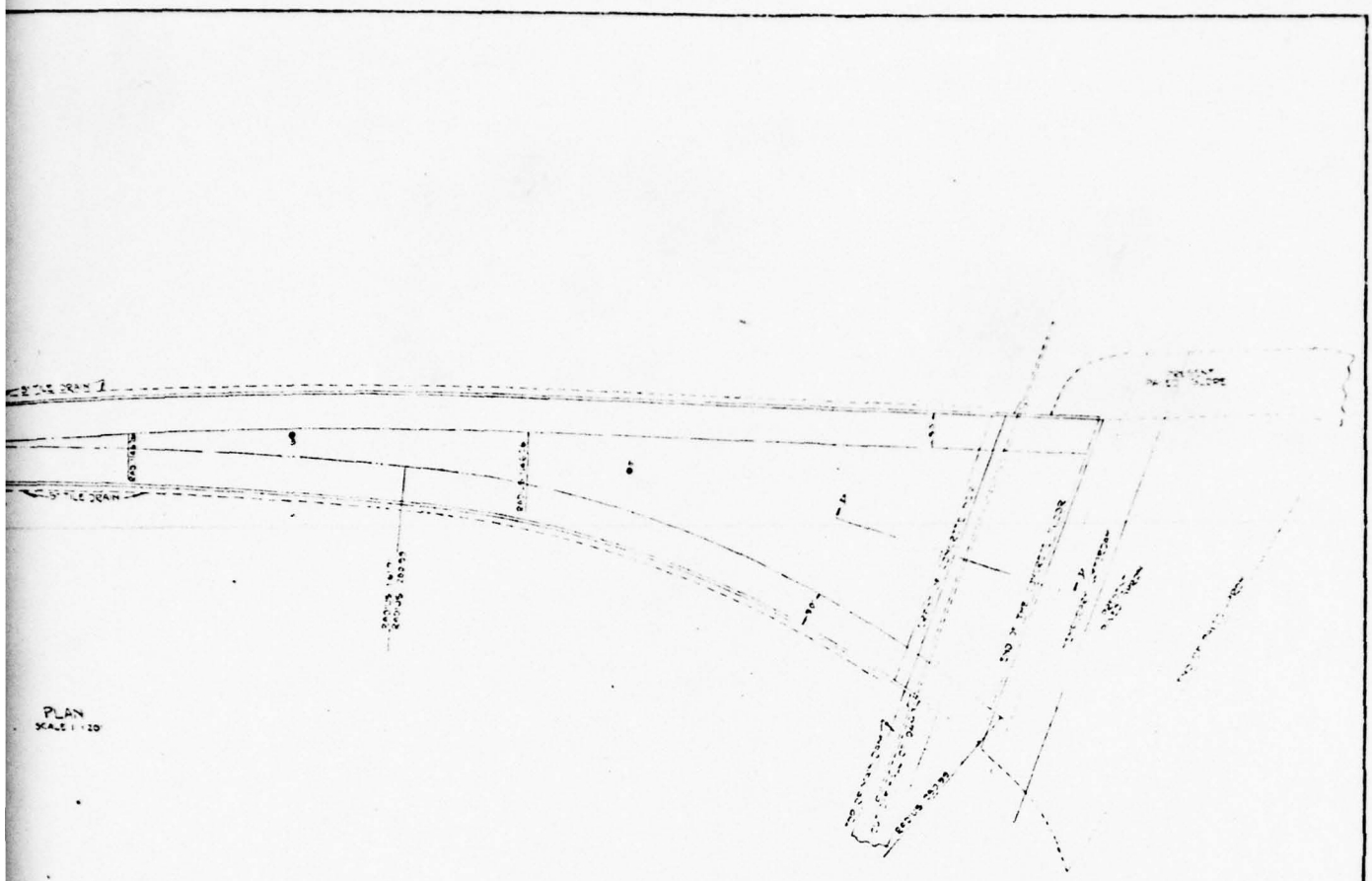
JULY 1978 PLATE 2

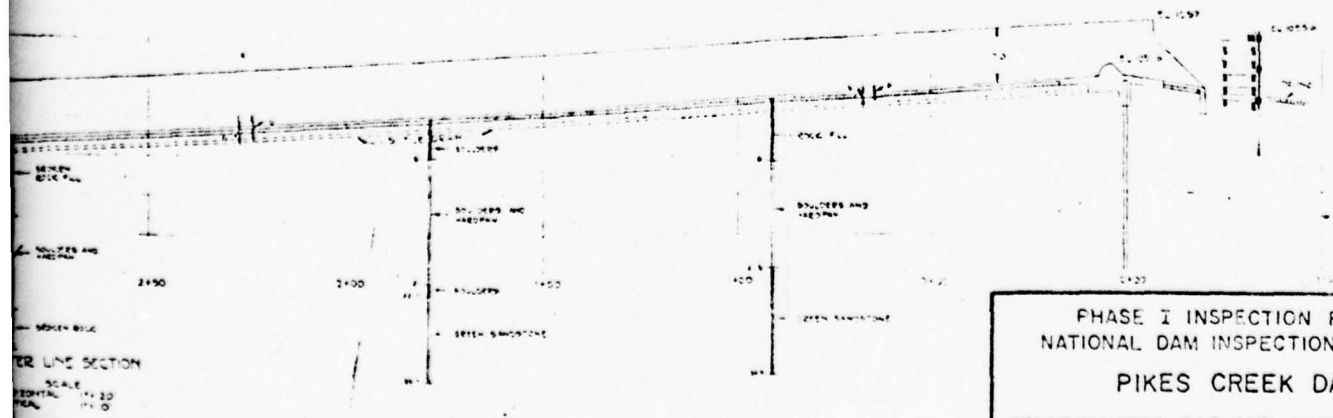


PLAN
SCALE 1:20



CENTER LINE SECTION
SCALE
HORIZONTAL 1:20
VERTICAL 1:10





PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

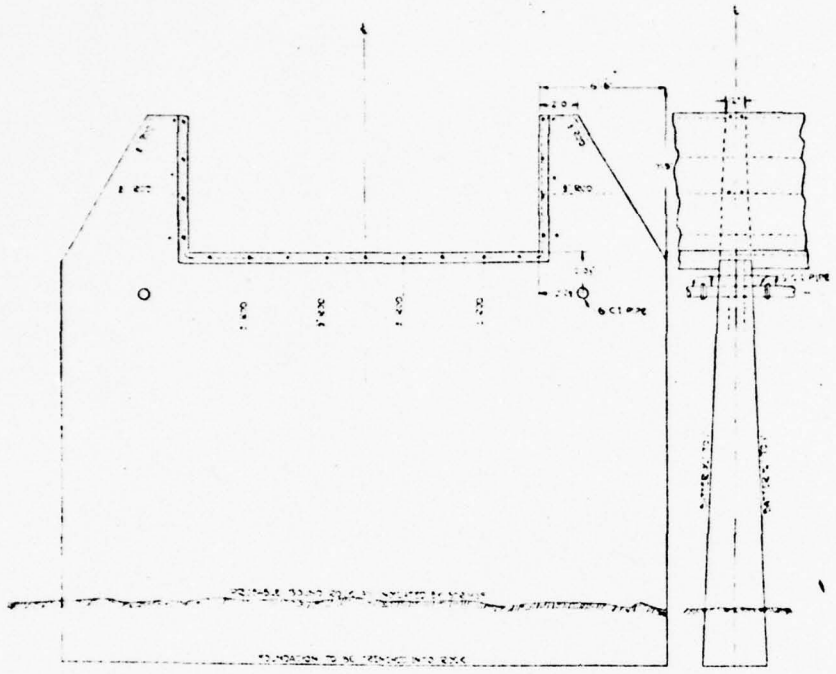
PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

SPILLWAY-PLAN AND PROFILE

JULY 1978 PLATE 3

2

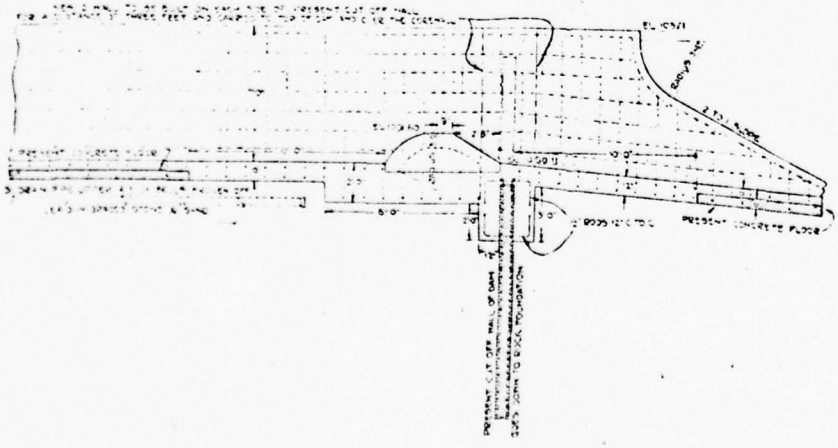


DD

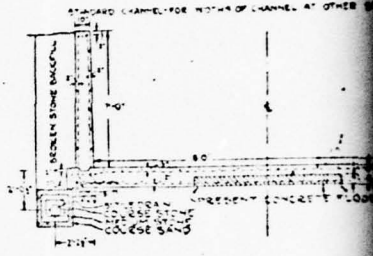
CROSS SECTION AT LOWER CUT OFF WALL

EE

LONGITUDINAL SECTION AT LOWER CUT OFF WALL

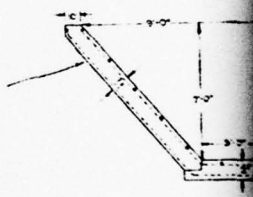


LONGITUDINAL SECTION OF CHANNEL AT CUT OFF WALL

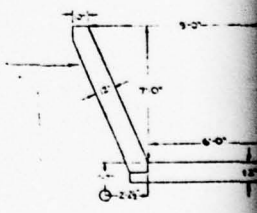


CC

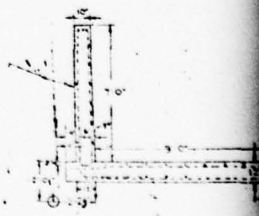
CHANNEL SECTION



CROSS SECTION HH

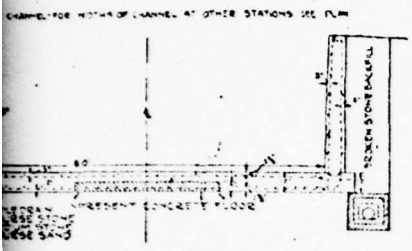


CROSS SECTION GG



CROSS SECTION EE

STONE PACKING LAID AS A PAVED SURFACE AND SUNKEN TO FORM BACK FORM FOR 12" POURED WALLS FOR ALL OF TRANSITION SECTION



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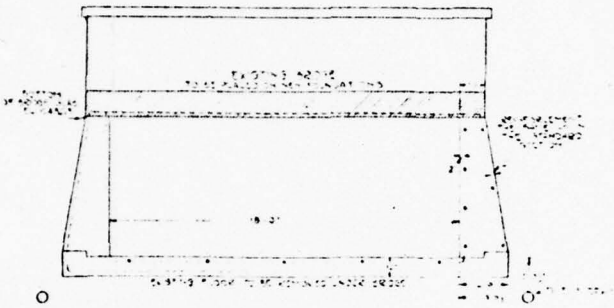
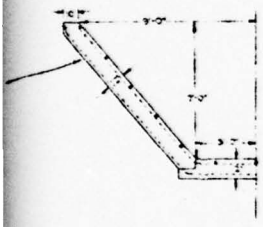
CHANNEL SECTION



BB

BRIDGE SECTION



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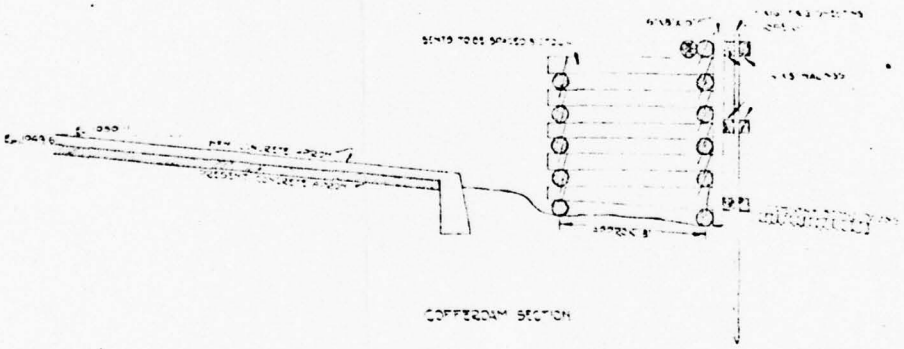
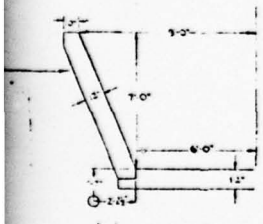
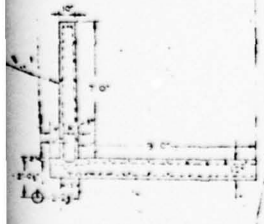


COFFERDAM SECTION



CROSS SECTION GG

—NOTE—



CROSS SECTION EE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

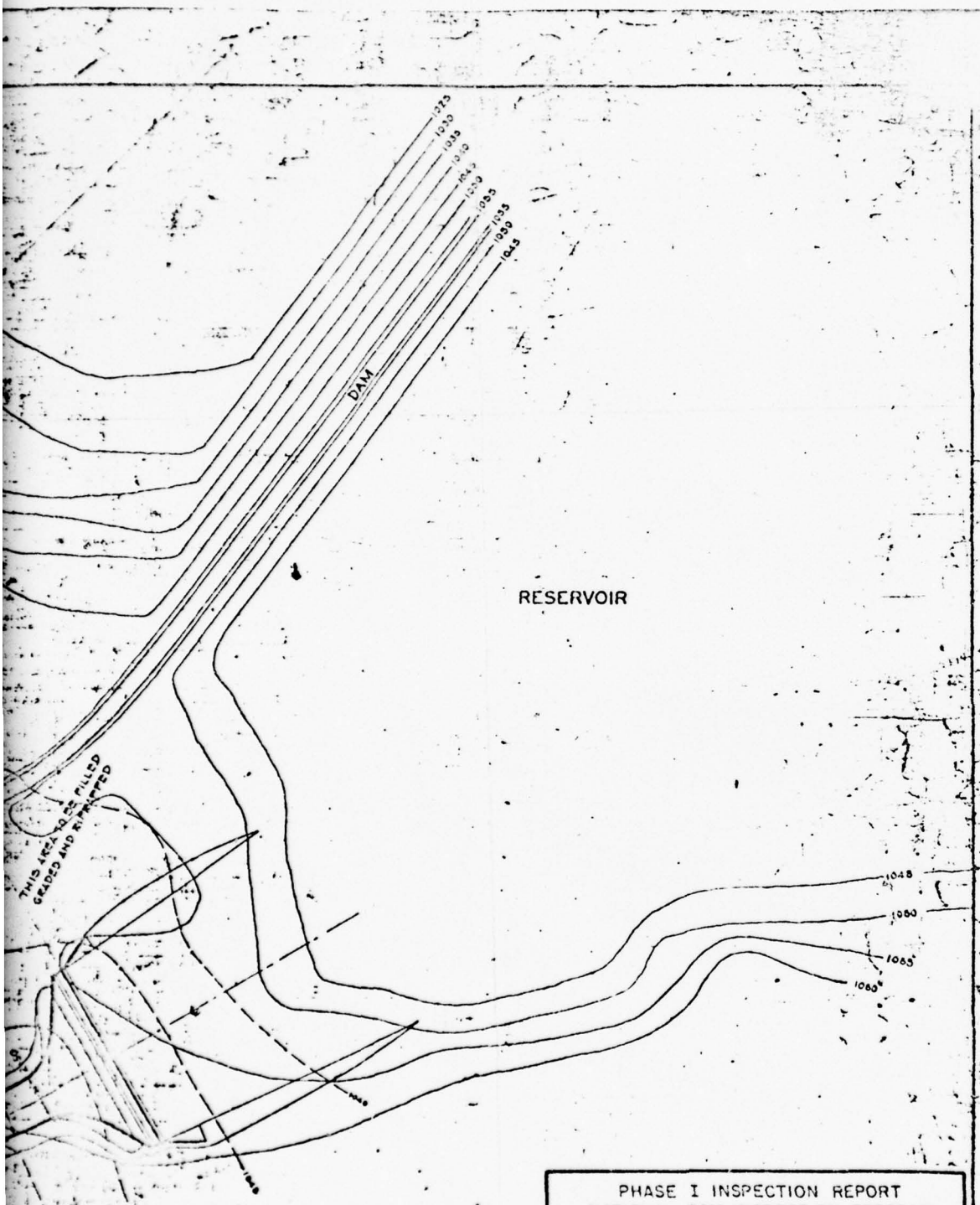
SPILLWAY
SECTIONS AND DETAILS

JULY 1978 PLATE 4

SHEET 2

2


1025
1040
1045
1050
1055
1060
1065
6+50
5+50
THIS AREA TO BE FILLED
GRADED AND RIPRAPPED
EARTH CONTOURS
ROCK CONTOURS



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

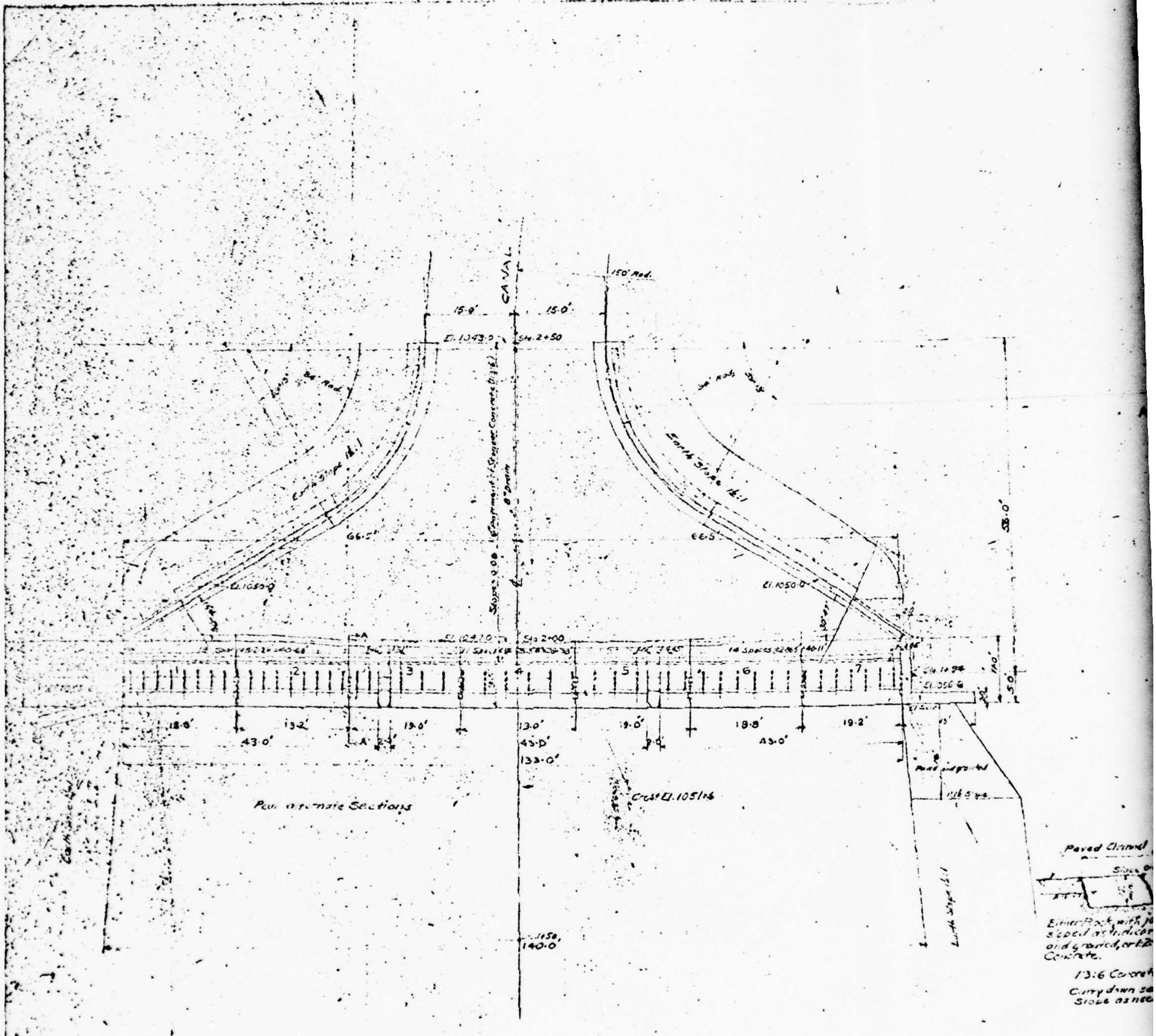
PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

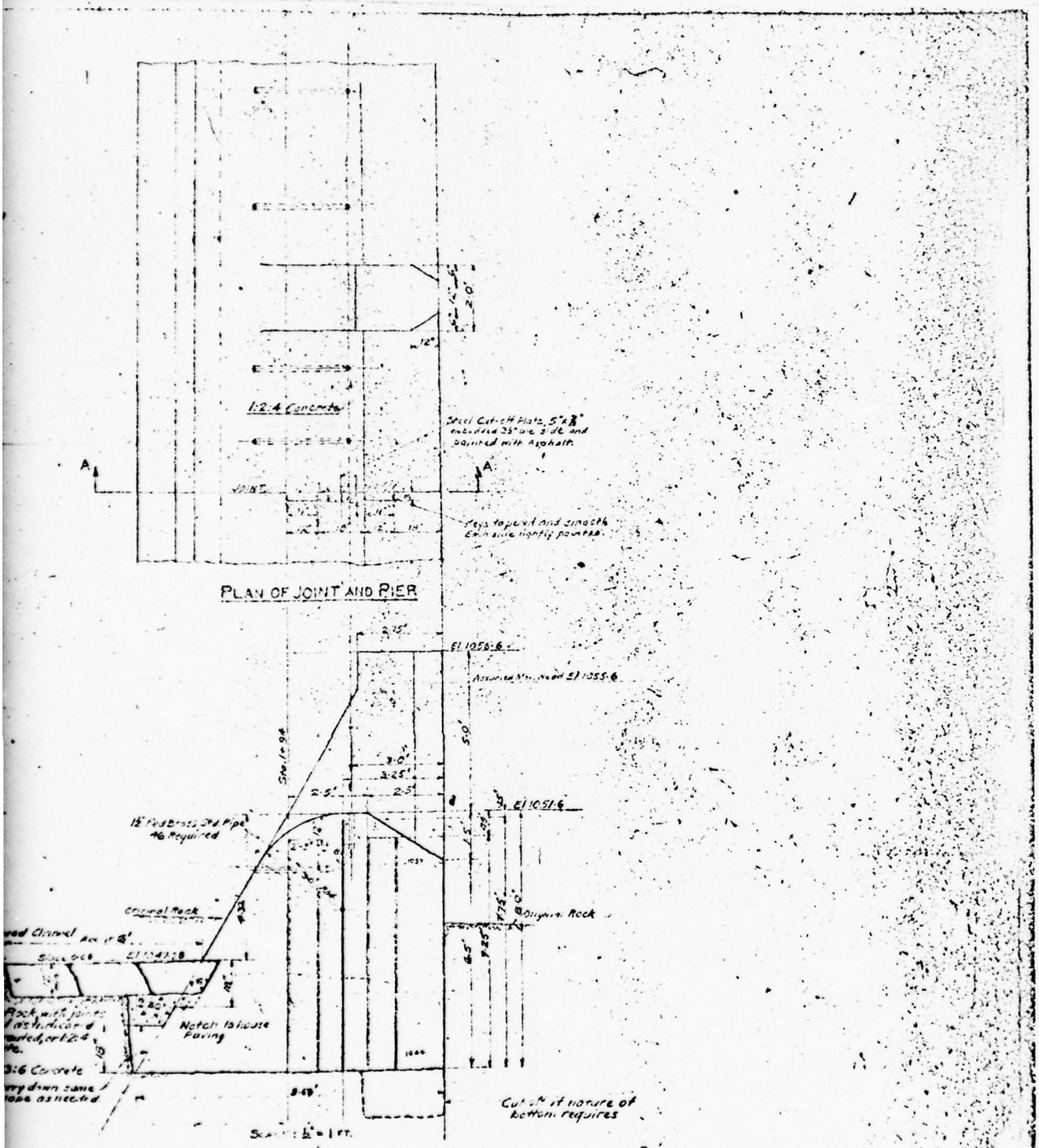
AUXILIARY SPILLWAY - PLAN

JULY 1978 PLATE 5

2



PLAN OF D... ... CANAL
SCALE 1"=10 FT.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

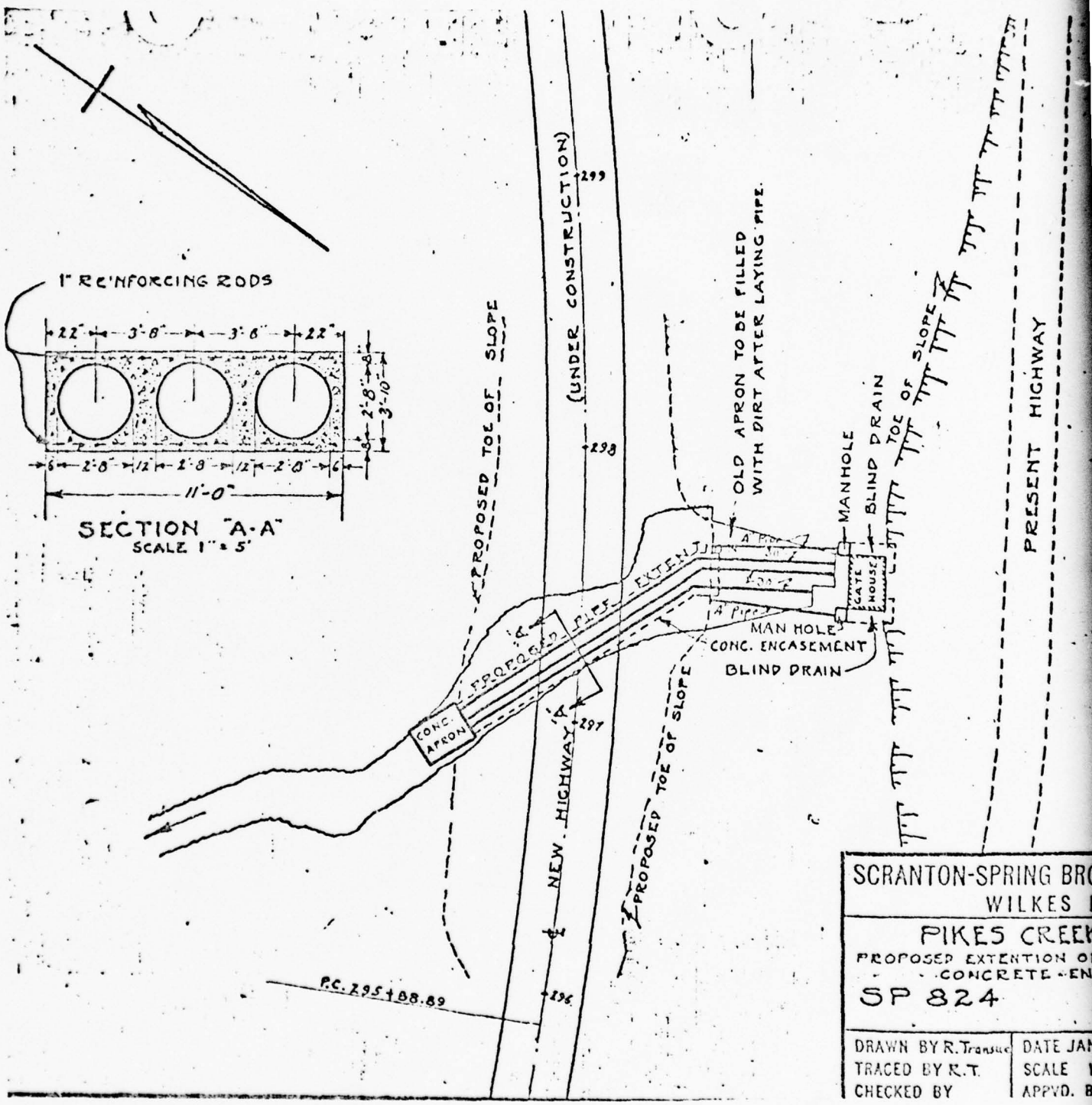
PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

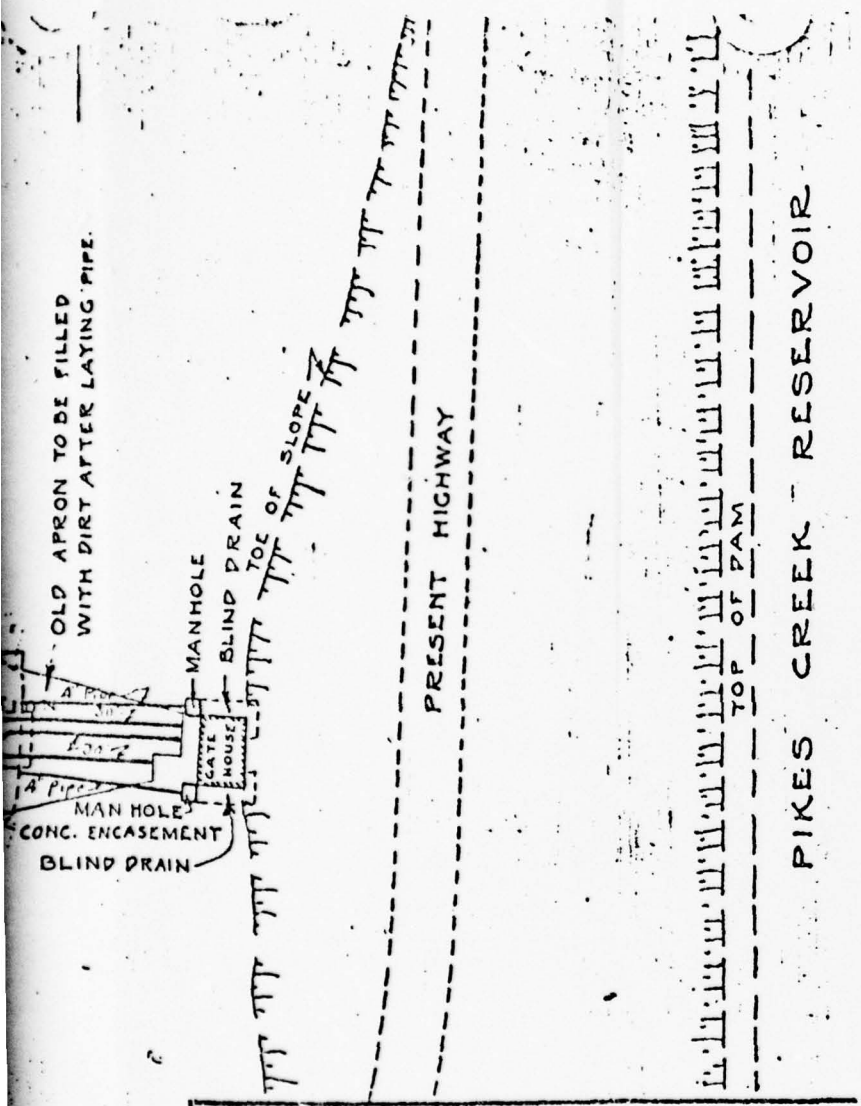
AUXILIARY SPILLWAY - DETAILS

JULY 1978 PLATE 6

2


1" REINFORCING RODS
22"
3'-8"
3'-8"
22"
2'-8"
3'-10"
6
2'-8"
12
2'-8"
12
2'-0"
6
11'-0"
SECTION "A-A"
SCALE 1" = 5'
PROPOSED TOE OF SLOPE
(UNDER CONSTRUCTION)
299
298
OLD APRON TO BE FILLED WITH DIRT AFTER LAYING PIPE.
MANHOLE
BLIND DRAIN
TOE OF SLOPE
PRESENT HIGHWAY
GATE HOUSE
PROPOSED 14" PIPE EXTENSION
MAN HOLE
CONC. ENCASEMENT
BLIND DRAIN
CONC. APRON
NEW HIGHWAY
297
PROPOSED TOE OF SLOPE
P.C. 295+88.89
296
SCRANTON-SPRING BRO
WILKES B
PIKES CREEK
PROPOSED EXTENTION OF
CONCRETE END
SP 824
DRAWN BY R. Transue
TRACED BY R.T.
CHECKED BY
DATE JAN
SCALE 1"
APPVD. B

1



SCRANTON-SPRING BROOK WATER SERVICE CO.
WILKES BARRE, PA.

PIKES CREEK RESERVOIR
PROPOSED EXTENTION OF 30" OUTLET PIPES AND CONCRETE ENDWALL AND APRON.

SP 824 F.W.(

DRAWN BY R. Transue	DATE JAN. 20, 1933.
TRACED BY R.T.	SCALE 1" = 50'
CHECKED BY	APPVD. BY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

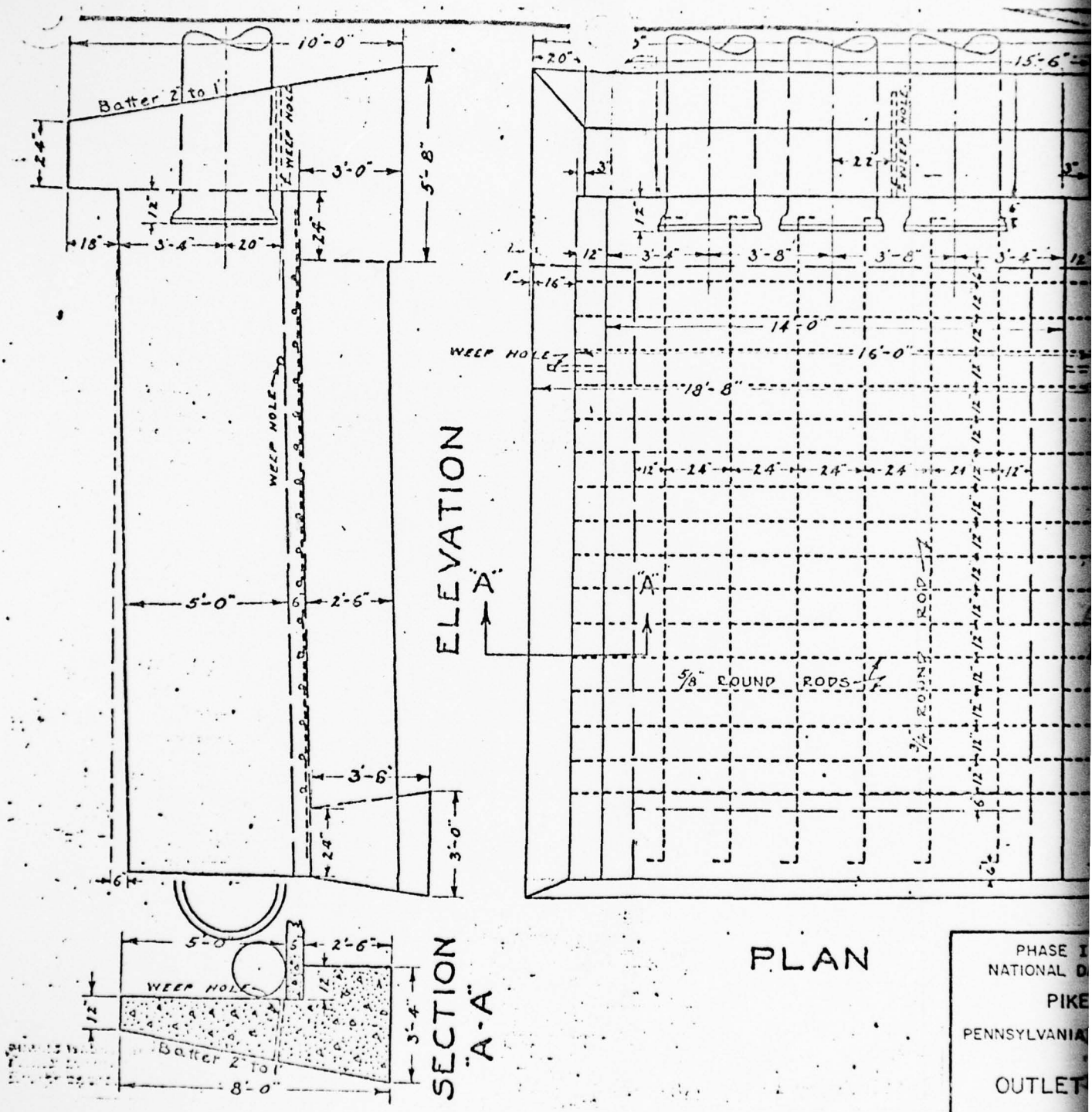
PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

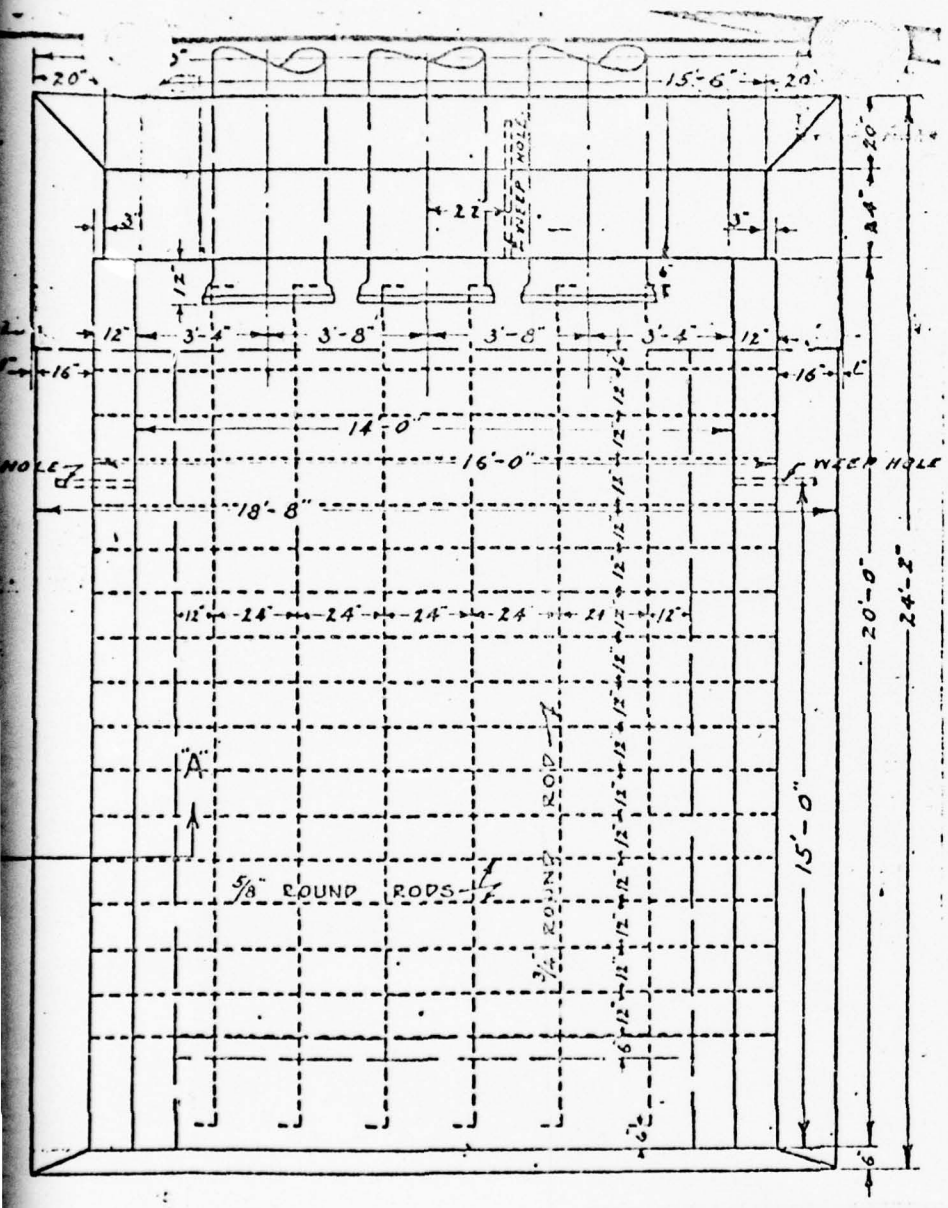
OUTLET WORKS - PLAN

JULY 1978 PLATE 7

2



PHASE I
NATIONAL D
PIKE
PENNSYLVANIA
OUTLET
JULY 1978



PLAN

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PIKES CREEK DAM

PENNSYLVANIA GAS AND WATER COMPANY

OUTLET WORKS - DETAILS

JULY 1978 PLATE 8

2

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Pikes Creek

NDS ID NO.: PA-00576 DER ID NO.: 40-18

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	As-built drawings for spillway and auxiliary spillway available. No other as-built drawings available.
REGIONAL VICINITY MAP	Project is shown on USGS Quadrangle - Harvey's Lake, Pennsylvania N 4115 - W 7600/7.5 1946, photo revised 1969.
CONSTRUCTION HISTORY	Built by Spring Brook Water Company in 1908-1911. Designed by John Lance, Chief Engineer of the Water Company. Constructed under his supervision.
TYPICAL SECTIONS OF DAM	None.
OUTLETS: Plan Details Constraints Discharge Ratings	Plan of 1933 modification available. No other data available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	None.
GEOLOGY REPORTS	Foundation reported as "firm" clay.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	None.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	Some boring data along spillway channel available.
POSTCONSTRUCTION SURVEYS OF DAM	Drawing dated 1928 has plan of dam.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Hillside north of left abutment and from reservoir area. Material reported to be "fairly good sandy clay".
MONITORING SYSTEMS	None.
MODIFICATIONS	1919: Increased capacity of spillway channel and raised dam. 1926: Modified spillway and constructed auxiliary spillway. Circa 1933: Outlet pipes extended to new headwall.
HIGH POOL RECORDS	No continual records available.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1914: Pennsylvania Water Supply Commission Report - required weir to measure flow. 1917: Pennsylvania Water Supply Commission Report - inadequate spillway channel. 1918: Frederic P. Stearns Report - inadequate spillway channel (Continued on Page A-5)
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	None available.
SPILLWAY: Plan Sections Details	All available.
OPERATING EQUIPMENT: Plans Details	None available.
PREVIOUS INSPECTIONS Dates Deficiencies	1921: Small amount of seepage at toe of each hill. Noted unauthorized modifications - spillway channel and raised crest. Brush on upper part of embankment. 1922: Noted unauthorized modifications. Concrete in channel walls is disintegrating in a number of places. Small amount of leakage to left of gatehouse. 1923: Small amount of leakage near right end to left of gatehouse. Concrete in spillway channel disintegrating in places. 1925: Disintegrating concrete abutments in spillway. Small flow of water at side and left of gatehouse. Disintegrating concrete at spillway crest and in spillway channel. (Continued on Page A-5)

ITEM	REMARKS
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS (Cont'd. from Page A-3)	1919: Lance Report - concurred with conclusions of Stearns Report. 1919: Stearns Report - recommended re-construction of upper spillway channel. 1919: Lance Report on spillway channel. 1920: Owner's report on hydrologic loss rates. 1921: Pennsylvania Water Supply Commission Report on spillway capacity.
PREVIOUS INSPECTIONS (Cont'd. from Page A-4)	1926: Swampy conditions at toe near right end and at toe near left end. Water noted in bank behind the gatehouse. Disintegrating concrete in spillway as noted previously. 1927: Embankment appeared a little low on upstream side along highest portion. Seepage from right hill and water behind gatehouse. Concrete disintegrating as noted previously. Excavation complete for auxiliary spillway. 1928: Concrete condition as noted previously. Auxiliary spillway complete. Seepage as noted previously. 1929: Notes concrete repairs. Seepage back and right of gatehouse. 1930: Pool at toe near left end. 1932: Small stream flowing from a drain near the center of the embankment. 1933: Slight amount of settlement. Swampy area near toe at left end. Flow from drain 500 feet left of gatehouse. Water around gatehouse. French drain constructed around gatehouse (previous to inspection). Considerable flow from drain. Ground above appeared reasonably dry. Owner tested water in dam and from seep. Conclusion: chemical differences indicate water from different sources. (Continued on Page A-6)

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (Cont'd. from Page A-5)	1936: 200 feet right of left end abutment is a swampy area with cloudy water. 100 feet left of valve house is seepage from drain. 100 feet below valve house are 2 pipes with small flow. 1941: Animal holes. Riprap bulged from ice. Brush on embankment. Swampy area 250 feet right of left end. Some flow in two manholes below gatehouse. Concrete badly disintegrated in walls of spillway channel 300 feet below highway bridge. 1943: Leakage from area 250 feet right of left end. Concrete disintegrated per 1941 report. 1948: Settling of upstream riprap face. Starting 500 feet right of left end, there is a 200-foot long wet area at toe of dam. Conclusion: water from ground water in hill to left. 1964: No deficiencies.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Pikes Creek NDS ID NO.: PA-00576 DER ID NO.: 40-18

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1051.6

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1055.9

ELEVATION MAXIMUM DESIGN POOL: 1055.9

ELEVATION TOP DAM: 1055.9

SPILLWAY CREST:
- a. Elevation 1051.6
- b. Type Ogee weir
- c. Width 0.83 foot
- d. Length 82.0 feet
- e. Location Spillover Right abutment
- f. Number and Type of Gates

OUTLET WORKS:
- a. Type 3 - 30
- b. Location 600 feet left of main spillway
- c. Entrance Inverts Unknown
- d. Exit Inverts 992.0 (approximate)
- e. Emergency Draindown Facilities Outlet works

HYDROMETEOROLOGICAL GAGES:
- a. Type None
- b. Location None
- c. Records None

MAXIMUM NONDAMAGING DISCHARGE: 6,630 cfs*

AUXILIARY SPILLWAY CREST:
- a. Elevation 1051.6
- b. Type Ogee weir
- c. Width 0.83 foot
- d. Length 3 - 43-foot bays with 2-foot piers between
- e. Location Spillover Left abutment
- f. Number and Type of Gates Flashboards in each bay, lowest is 2.75 feet above crest

* Without flashboards on auxiliary spillway.

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Pikes Creek County: Luzerne State: Pennsylvania

NDS ID No.: PA-00576 DER ID No.: 40-18

Type of Dam: Earthfill with Core Wall Hazard Category: High

Date(s) Inspection: 8 June 1978
9 June 1978 Weather: Sunny - Humid
Hazy - Humid Temperature: 75° F.
70° F.

Soil Conditions: Moist

Pool Elevation at Time of Inspection: 1051.7 msl/Tailwater at Time of Inspection: 992± msl

Inspection Personnel:

J. Crouse (GFCC)	D. Kauffman (PG&W)	W. Reakes (PG&W)
W. Seip (GFCC)	J. Skoritowski (PG&W)	R. Stepanski (PennDER)
D. Ebersole (GFCC)	W. Trusko (PG&W)	J. Labuz (PennDER)

A. Whitman (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	On top: Narrow cracks with no relative movement noted. Normal to centerline, one crack extending across top. One crack parallels centerline for 100 feet±.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	None. Animal holes present.	Many animal holes are turtle holes for eggs. Some are burrowing mammals; none active.
CREST ALIGNMENT: Vertical Horizontal	Horizontal: appears to follow plan. Vertical: surveyed; low spots.	
RIPRAP FAILURES	One 10-foot long section of riprap is bulged.	Probably ice action from last winter.

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	Junction embankment and dry masonry wall behind valve house: wall is bulged about 6 inches at center.	
ANY NOTICEABLE SEEPAGE	See Sheet B-10.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	
VEGETATION	Sod - excellent. Trees close to toe.	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Not applicable.	
INTAKE STRUCTURE	Not visible.	
OUTLET STRUCTURE	Ends of walls spalled. Exposed edges slightly spalled. A 4-inch square area is pitted.	
OUTLET CHANNEL	Rocky with wooded banks.	
EMERGENCY GATE	Valves for three outlet pipes operational. Required four men on 30-inch diameter wheel to operate. Packings leak.	Operation with air compressor and air-powered operator observed; it required two men. Some trouble with compressor was observed.

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Slightly pitted. Shrinkage cracks in 36-foot monoliths. Aggregate exposed.	
APPROACH CHANNEL	Right approach wall cracked through. Crack parallel to crest in approach apron.	Crack in approach apron - probably ice action.
DISCHARGE CHANNEL	Some leaching at shrinkage cracks (30'± monoliths). At joints - spalling for about 5 inches along 6± joints, rebar exposed. Rebar appears continuous.	Drains at downstream end have no flow. Trees too close to left wall. (See below)
BRIDGE AND PIERS	Single span high over spillway channel.	
DISCHARGE CHANNEL	Slab quite pitted over two monoliths.	

GATED SPILLWAY
AUXILIARY SPILLWAY WITH FLASHBOARDS
Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Pitted at localized areas. Spalling along joints (0.5 inch deep, typical). Aggregate exposed.	
APPROACH CHANNEL	Reservoir.	
DISCHARGE CHANNEL	Concrete: vegetation at joints. Mortared stone: slight amount of mortar missing & vegetation. Earth: wet and heavily vegetated.	Walls: left wall at crest - surface crack and leaching. Both walls: slightly spalled at edges, shrinkage cracks at bends. Trees close to walls.
PIERS	Two 2-foot piers. One slightly spalled at junction with crest.	
GATES AND OPERATION EQUIPMENT	Flashboard (steel) in good condition.	Owner does not have failure calculations.

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	No detrimental conditions - relatively mild.	
SEDIMENTATION	No problems observed or reported by Owner.	
WATERSHED DESCRIPTION	Mostly wooded near reservoir. Owner reports he owns 5,500 acres (73%) of watershed.	

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Outlet works discharges into creek which runs to canal head-works. No deficiencies.	
SLOPES	Relatively mild.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	One house is observable.	

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE (Cont'd. from Sheet B-3)	Around valve house: water is flowing clear at 10 g.p.m. Source not evident, but probably includes water leaking from valve packings.	Owner reports this water is from leaking valves.
	150 feet left of valve house: clear seepage of 1 g.p.m. forming stream to drain.	Owner reports this water is from seepage area below.
	Near left abutment at toe: seepage area 225 feet along toe by 300 feet normal to centerline. Area is irregularly shaped and has pools of water, including one pool with built-up sides. Clear seepage from area is about 15 g.p.m.	Owner reports built-up pool used to be bait pond. Owner reports seepage is from hill to left of dam and not from dam.

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

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

SUBJECT PIKES CREEK DAM (40-19) FILE NO. 7613.10
HYDROLOGY AND HYDRAULICS ANALYSIS SHEET NO. 1 OF 8 SHEET
FOR USCE - BALTIMORE DISTRICT
COMPUTED BY JMC DATE 6/15/78 CHECKED BY P.V.C. DATE 6/20/78

CLASSIFICATION

HIGH HAZARD, SINCE DOWNSTREAM POPULATION IS 133, AND FAILURE OF THE DAM COULD RESULT IN MORE THAN A FEW LIVES LOST AND EXCESSIVE ECONOMIC LOSS

INTERMEDIATE SIZE, SINCE HEIGHT = 58 FEET AND CAPACITY = 10,556 AC-FT
REFERENCE: "RECOMMENDED GUIDELINES FOR SAFETY INSPECTION OF DAMS," p. D-8

SPILLWAY DESIGN FLOOD (SDF)

THE SDF SHOULD BE THE PMF (FROM p. D-12 OF "REC. GUIDELINES ...")

HYDROLOGY AND HYDRAULICS ANALYSIS

REFERENCE: PHASE I PROCEDURE PACKAGE

II. A. 2. PMF INFLOW HYDROGRAPH NOT AVAILABLE

a. BALTIMORE CONTACT, MIKE KANOWITZ, RECOMMENDS OBTAINING PMF PEAK FLOW CURVE

b. FROM CURVE FOR SUSQUEHANNA RIVER BASIN, REGION 2, AND DRAINAGE AREA = 11.7 SQ. MI., PMF = 1,900 CFS/SQ. MI. × 11.7 SQ. MI. = 22,230 CFS

EFFECT OF UPSTREAM RESERVOIRS

NO UPSTREAM RESERVOIRS EXIST

B. ABILITY OF SPILLWAY TO PASS PMF

1. CAPACITY OF SPILLWAYS - ANALYZE WITH TWO APPROACHES - CASE 1, FLASHBOARDS ON AUXILIARY SPILLWAY FAIL, AND CASE 2, FLASHBOARDS ON AUXILIARY SPILLWAY DO NOT FAIL. FOR BOTH CASES, THE CAPACITY OF THE MAIN SPILLWAY IS CONSTANT.

MAIN SPILLWAY CAPACITY - REFERENCE: "REPORT UPON THE APPLICATION OF THE SPRING BROOK WATER SUPPLY COMPANY," WATER SUPPLY COMMISSION OF PENNSYLVANIA, 4 FEBRUARY 1926.

LENGTH = 72'
HEAD = 3.3'
FREEBOARD = 2.2'
TOTAL HEAD AVAILABLE = 5.5' (DESIGN)
Q AT HEAD OF 3.3' = 1600 CFS
FROM WEIR EQUATION ($Q = CLH^{3/2}$), $C = 3.7$

SP 1180A

FROM THE FIELD SURVEY CONDUCTED DURING THE VISUAL INSPECTION OF THE DAM, A LOW

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

SUBJECT PIKES CREEK DAM (40-18) FILE NO. 7613.1Q
HYDROLOGY AND HYDRAULICS ANALYSIS SHEET NO. 2 OF 8 SHEETS
FOR USCE - BALTIMORE DISTRICT
COMPUTED BY JMC DATE 6/15/78 CHECKED BY PvdL DATE 6/22/78

AREA EXISTS IN THE EMBANKMENT CREST AT ELEVATION 1,055.9'. SINCE THE SPILLWAY CREST ELEVATION IS 1,051.6' THE MAXIMUM HEAD ON THE SPILLWAY BEFORE OVERTOPPING OF THE EMBANKMENT IS 1,055.9' - 1,051.6' = 4.3'. THEREFORE, THE SPILLWAY CAPACITY WITHOUT FREEBOARD IS:

$$Q = C L H^{3/2}$$
$$Q = (3.7)(72)(4.3)^{3/2}$$
$$Q = 2,375 \text{ CFS}$$

CASE 1

FLASHBOARDS ON AUXILIARY SPILLWAY FAIL

AUXILIARY SPILLWAY CAPACITY - REFERENCE : SAME AS ABOVE

LENGTH = 130' (AS BUILT CONDITION IS 3 x 43' = 129')
HEAD = 3.3'
FREEBOARD = 2.2'
TOTAL HEAD AVAILABLE = 5.5' (DESIGN)
Q AT HEAD = 3.3' = 2900 CFS
FROM WEIR EQUATION ($Q = CLH^{3/2}$), C = 3.72, SAY 3.7

THE AUXILIARY SPILLWAY CAPACITY WITHOUT FREEBOARD IS:

$$Q = C L H^{3/2}$$
$$Q = (3.7)(129)(4.3)^{3/2}$$
$$Q = 4,256 \text{ CFS}$$

TOTAL SPILLWAY CAPACITY FOR CASE 1 (FLASHBOARDS FAIL) = 2,375 + 4,256 = 6,631 CFS
SAY 6,630 CFS

CASE 2

FLASHBOARDS ON AUXILIARY SPILLWAY DO NOT FAIL

AUXILIARY SPILLWAY CAPACITY - 3 SECTIONS AT 3 ELEVATIONS

	LEFT BAY	CENTER BAY	RIGHT BAY
LENGTH (FT)	43	43	43
TOP OF FLASHBOARD ELEV. (FT)	1054.6	1054.35	1054.85
SPILLWAY CREST ELEV. (FT)	1051.6	1051.6	1051.6
LOW ELEV. OF EMBANKMENT (FT)	1055.9	1055.9	1055.9
MAX HEAD ON CREST (FT)	1.3	1.55	1.05
Q (CFS)	236	307	171

SP 11660A

Q_{TOTAL} AUXILIARY = 236 + 307 + 171 = 714 CFS

TOTAL SPILLWAY CAPACITY FOR CASE 2 (FLASHBOARDS DO NOT FAIL) = 2,375 + 714 = 3,089 CFS
SAY 3,090 CFS

TEST SPILLWAY CAPACITY FOR BEST CASE, CASE 1 - FLASHBOARDS FAIL

3. THE PMF PEAK FLOW IS GREATER THAN THE SPILLWAY CAPACITY (22,230 > 6,630)

b. ROUTING OF THE PMF IS NOT AVAILABLE

(1.) THE SPILLWAY WILL PASS (6,630 / 22,230) = 0.298 = p = 29.8% OF THE PMF PEAK

(2.) INCLUDE 3 METHOD TO ESTIMATE THE STORAGE EFFECT OF THE RESERVOIR

(a) TRIANGULAR SHAPE FOR PMF HYDROGRAPH

(b) FROM THE GRAPH OF TOTAL TIME VS. D.A. FOR THE SUSQUEHANNA RIVER BASIN, TOTAL TIME = 29.3 HOURS.

— CHECK INCHES OF RUNOFF PRODUCED BY THE PMF PEAK AND THE TOTAL TIME —

RUNOFF VOLUME = $\frac{1}{2} bh = \frac{1}{2}(29.3 \text{ HRS})(22,230 \text{ CFS}) = 325,670$ CFS-HOURS

$325,670 \text{ CFS-HOURS} \times \frac{3,600 \text{ AC-SECS}}{43,560 \text{ FT}^2\text{-HOURS}} \times \frac{12 \text{ IN}}{1 \text{ FT}} = 322,978$ AC-IN

DRAINAGE AREA = 11.7 SQ. MI. × (640 ACRES / 1 SQ. MI.) = 7,488 ACRES

RUNOFF AMOUNT = $\frac{322,978 \text{ AC-IN}}{7,488 \text{ ACRES}} = 43.1$ INCHES

SINCE 43.1 INCHES OF RUNOFF IS A HIGH VALUE FOR THE PMF, REDUCE THE INCHES OF RUNOFF TO 26, AS PER THE INSTRUCTIONS OF THE BALTIMORE CONTACT, MIKE KANDNITZ. FROM THE PMF PEAK AND THE VOLUME OF RUNOFF PRODUCED BY 26 INCHES OF RUNOFF OVER THE DRAINAGE AREA, CALCULATE THE EQUIVALENT TOTAL TIME OF PMF HYDROGRAPH.

$VOL = \frac{1}{2} bh$; $b = \frac{2\,VOL}{h}$

VOL = 26" RUNOFF × 7,488 ACRES = 194,688 AC-INCHES

$194,688 \text{ AC-IN} \times \frac{1 \text{ FT}}{12 \text{ IN}} \times \frac{43,560 \text{ FT}^2\text{-HOURS}}{3,600 \text{ AC-SECS}} = 196,310$ CFS-HRS

$b = \frac{2\,VOL}{h} = \frac{2 \times 196,310 \text{ CFS-HRS}}{22,230 \text{ CFS}} = 17.7$ HOURS

$1-p = 1 - 0.298 = 0.702 = \frac{\Delta AOC}{\Delta AOB}$

$\Delta AOB = \frac{1}{2} bh = VOL = 194,688 \text{ AC-IN} \times (1 \text{ FT}/12 \text{ IN}) = 16,224$ AC-FT

SUBSTITUTING, $\Delta AOC = (1-p)\,\Delta AOB = (0.702)(16,224) = 11,389$ AC-FT

REQUIRED STORAGE = ΔAOC = 11,389 AC-FT

(c) INCREMENTAL STORAGE AVAILABLE BETWEEN NORMAL POOL ELEVATION AND MAXIMUM POOL ELEVATION

NORMAL POOL ELEVATION = SPILLWAY CREST ELEVATION = 1051.6'
MAXIMUM POOL ELEVATION = TOP OF DAM ELEVATION = 1,055.9'
AREA OF RESERVOIR WITH W.S. @ SPILLWAY CREST = 400 ACRES
AREA OF RESERVOIR WITH W.S. @ TOP OF DAM = ?

ASSUME RESERVOIR SIDE SLOPES OF 4H ON 1V AND ASSUME CIRCULAR SHAPE

$400 \text{ ACRES} \times \frac{43,560 \text{ FT}^2}{1 \text{ ACRE}} = 17,424,000 \text{ FT}^2 = \pi r_1^2$

$r_1^2 = 5,545,232 \text{ FT}^2$

$r_1 = 2,355.0 \text{ FT}$

$r_2 = r_1 + \Delta H = r_1 + 4(\Delta V)$

$r_2 = 2,355.0 + 4(4.3')$

$r_2 = 2,372.2'$

$A_2 = \pi r_2^2 = \pi (2,372.2')^2$

$A_2 = 17,679,400 \text{ FT}^2$

$A_2 = 405.9 \text{ ACRES}$

$\text{INCREMENTAL STORAGE} = \left(\frac{A_1 + A_2}{2}\right) \Delta V$

$= \left(\frac{400 + 405.9}{2}\right) 4.3'$

INCREMENTAL STORAGE = 1,733 AC-FT

STORAGE REQUIRED = 11,389 AC-FT > STORAGE AVAILABLE = 1,733 AC-FT

C. PROCEDURES FOR DETERMINATION OF ADEQUATE / INADEQUATE SPILLWAY CAPACITY

2. STORAGE REQUIRED FOR THE PMF IS GREATER THAN THE STORAGE AVAILABLE

a. ETL 1110-2- STATES THREE CONDITIONS THAT MUST EXIST BEFORE THE SPILLWAY CAPACITY IS CONSIDERED TO BE SERIOUSLY INADEQUATE. CHECK CONDITION "C." (IS THE SPILLWAY ABLE TO PASS ½ PMF W/O OVERTOPPING FAILURE?)

b. REPEAT CALCULATIONS FOR ½ PMF PEAK

½ PMF PEAK = ½ (22,230) = 11,115 CFS

II. B. ABILITY OF SPILLWAY TO PASS ½ PMF

1. CAPACITY OF SPILLWAY = 6,630 CFS (CASE 1, FLASHBOARDS FAIL)

3. ½ PMF PEAK FLOW IS GREATER THAN THE SPILLWAY CAPACITY (11,115 > 6,630)

b. ROUTING OF ½ PMF IS NOT AVAILABLE

(1.) THE SPILLWAY WILL PASS (6,630/11,115) = 0.596 = p < 59.6% OF ½ PMF PEAK

SP 1166GA

(2.) INCLOSURE 3 METHOD TO ESTIMATE THE STORAGE EFFECT OF THE RESERVOIR

(a) TRIANGULAR SHAPE FOR ½ PMF HYDROGRAPH

(b) SAME AS BEFORE, EXCEPT THAT THE PEAK IS NOW 11,115 CFS

$1-\rho = 1 - 0.596 = 0.404 = \frac{\Delta AOC}{\Delta AOB}$

$\Delta AOB = \frac{1}{2} bh = \frac{1}{2}(17.7 \text{ HOURS})(11,115 \text{ CFS}) = 98,368 \text{ CFS-HOURS}$

SUBSTITUTING, $\Delta AOC = (0.404)(\Delta AOB) = 0.404(98,368) = 39,741 \text{ CFS-HRS}$

$\therefore$ 39,741 CFS-HRS IS REQUIRED TO PASS ½ PMF W/O OVERTOPPING

$$39,741 \frac{FT^3}{SEC} \times \text{HOURS} \times \frac{3,600 \text{ AC-SECS}}{43,563 FT^2\text{-HRS}} = 3,284 \text{ AC-FT}$$

(c) INCREMENTAL STORAGE AVAILABLE BETWEEN NORMAL POOL ELEVATION AND MAXIMUM POOL ELEVATION - SEE SHEET 4 - = 1,733 AC-FT

STORAGE REQUIRED = 3,284 AC-FT > STORAGE AVAILABLE = 1,733 AC-FT

C. PROCEDURES FOR DETERMINATION OF ADEQUATE / INADEQUATE SPILLWAY CAPACITY

2. STORAGE REQUIRED IS GREATER THAN STORAGE AVAILABLE

a. ETL 1110-2-

① THERE IS A HIGH HAZARD OF LOSS OF LIFE FROM LARGE FLOWS DOWNSTREAM OF DAM

② CHECK TAILWATER AT INSTANT BEFORE OVERTOPPING OCCURS

③ THE DAM AND SPILLWAYS ARE NOT CAPABLE OF PASSING ½ PMF WITHOUT OVERTOPPING FAILURE

b. TAILWATER AT INSTANT BEFORE OVERTOPPING OCCURS

SPILLWAY CAPACITY DISCHARGE = 6,630 CFS (CASE 1). FROM HEC-2 COMPUTER RUN USING A USGS TOPO SHEET CROSS-SECTION DOWNSTREAM OF DAM,

TAILWATER DEPTH @ Q = 6,630 CFS IS 8.4 FEET		
TOP OF DAM ELEVATION	=	1057.1'
HEIGHT OF DAM	=	58
BOTTOM OF DAM ELEVATION	=	999.1'
TAILWATER DEPTH	=	8.4'
TAILWATER ELEVATION	=	1,007.5'
TOP OF DAM ELEV. - TAILWATER ELEV.	=	1057.1' - 1,007.5' = 49.6'

PERCENT OF PMF THAT SPILLWAY CAN PASS
GENERAL FORMULA

$$\% \text{ OF PMF THAT SPILLWAY CAN PASS} = \frac{Q_T}{Q_{PMF}} \times 100\%,$$

WHERE $Q_T = Q_{SPILLWAY} + 2S/\Delta t$,

$S = \sum_{i=1}^{n} S_i$ FOR UPSTREAM RESERVOIR CASES,

AND T = EQUIVALENT TOTAL TIME OF PMF HYDROGRAPH

$$\% \text{ OF PMF} = \frac{6,630 + \left(\frac{2 \times (1,733)\ \text{AC-FT}}{17.7\ \text{HOURS}} \times \frac{43,560\ \text{FT}^2\text{-HRS}}{3,600\ \text{AC-SECS}} \right)}{22,230} \times 100\%$$

$$= \frac{6,630 + 2,369}{22,230} \times 100\%$$

% OF PMF = 40% FOR CASE 1, FLASHBOARDS FAIL

$$\% \text{ OF PMF} = \frac{3,090 + 2,369}{22,230} \times 100\%$$

% OF PMF = 25% FOR CASE 2, FLASHBOARDS DO NOT FAIL

SPILLWAY CAPACITY THAT COULD BE REALIZED IF THE EMBANKMENT ELEVATION WAS BROUGHT UP TO THE DESIGN ELEVATION

DESIGN ELEVATION OF EMBANKMENT	=	1,057.1'
SPILLWAY CREST ELEVATION	=	1,051.6'
POTENTIAL AVAILABLE HEAD	=	5.5'

MAIN SPILLWAY CAPACITY INCREASE

$Q = C\ L\ H^{3/2}$

$Q = (3.7)\ 72\ (5.5)^{3/2}$

$Q = 3436$

CASE 1

FLASHBOARDS ON AUXILIARY SPILLWAY FAIL

AUXILIARY SPILLWAY CAPACITY INCREASE

$Q = C L H^{3/2}$

$Q = (3.7)\ 129\ (5.5)^{3/2}$

$Q = 6,157$

TOTAL SPILLWAY CAPACITY FOR CASE 1 WITH INCREASED CAPACITY = 3,436 + 6,157 = 9,593, SAY 9,590 CFS

CASE 2

FLASHBOARDS ON AUXILIARY SPILLWAY DO NOT FAIL

AUXILIARY SPILLWAY CAPACITY INCREASE

	LEFT BAY	CENTER BAY	RIGHT BAY
DESIGN ELEVATION OF EMBANKMENT	1,057.1'	1,057.1'	1,057.1'
TOP OF FLASHBOARDS ELEVATION	1,054.6'	1,054.35'	1,054.85'
POTENTIAL AVAILABLE HEAD	2.5'	2.75'	2.25'
Q (CFS)	629	726	537

$Q_{TOTAL\ AUXILIARY\ WITH\ INCREASE} = 629 + 726 + 537 = 1,892$ CFS

TOTAL SPILLWAY CAPACITY FOR CASE 2 WITH INCREASED CAPACITY = 3,436 + 1,892 = 5,328, SAY 5,330 CFS

% OF PMF THAT SPILLWAY CAN PASS WITH INCREASED CAPACITY FOR CASE 1

$$= \frac{9,590 + \left(\frac{2 \times (5.5 \times 402.35)\ AC\text{-}FT}{17.7\ HOURS} \times \frac{43,560\ FT^2\text{-}HRS}{3,600\ AC\text{-}SECS} \right)}{22,230} \times 100\%$$

$$= \frac{9,590 + 3,030}{22,230} \times 100\%$$

% OF PMF THAT SPILLWAY CAN PASS WITH INCREASED CAPACITY FOR CASE 1 = 57%

% OF PMF THAT SPILLWAY CAN PASS WITH INCREASED CAPACITY FOR CASE 2

$$= \frac{5,330 + 3,030}{22230} \times 100\%$$

% OF PMF THAT SPILLWAY CAN PASS WITH INCREASED CAPACITY FOR CASE 2 = 38%

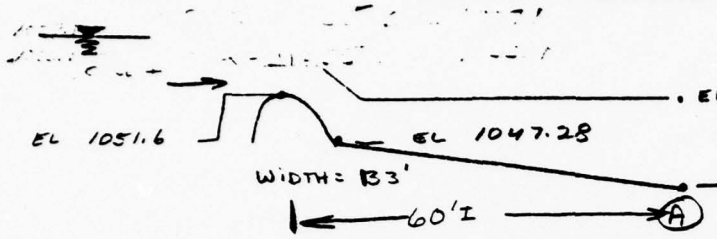
SUMMARY TABLE
% PMF PASSING WITHOUT OVERTOPPING DAM

FLASHBOARD CONDITION	PRESENT CONDITION LOW POINTS IN EMBANKMENT	DESIGN CONDITION EMBANKMENT AT DESIGN ELEVATION
CASE 1, FLASHBOARDS ON AUXILIARY SPILLWAY FAIL	40	57
CASE 2, FLASHBOARDS ON AUXILIARY SPILLWAY DO NOT FAIL	25	38

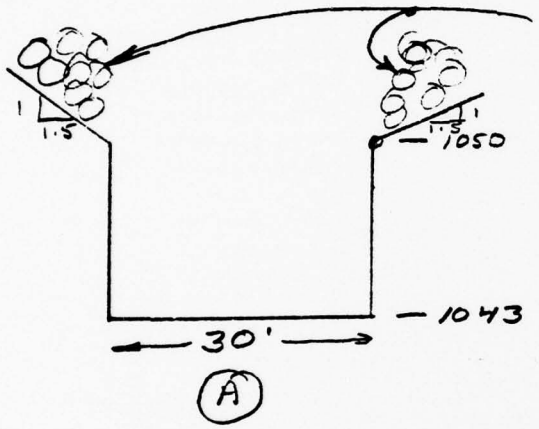
GANNETT FLEMING CORDDRY AND CARPENTER, INC.
HARRISBURG, PA.

SUBJECT Pikes Creek Auxiliary Spillway FILE NO.
SHEET NO. 1 OF 1 SHEETS
FOR
COMPUTED BY AHW DATE 6/24/78 CHECKED BY JMC DATE 6/25/78

NO FLASHBOARDS



WITH NO LOSSES



$$dc = \sqrt[3]{\frac{q^2}{g}}$$

ENERGY = 1.5 dc

ENERGY GRADE LINE = ENERGY + INVERT

	NO FLASHBOARDS CASE 1	NO FLASHBOARDS CASE 2	FLASHBOARDS CASE-1A	FLASHBOARDS CASE-2A
Q (CFS)	4255	6155	715	1890
CRITICAL DEPTH (FT)	8.55	10.94	2.60	4.98
CRITICAL ENERGY (FT)	12.83	16.40	3.91	7.47
E.G.L (ELEV.)	1055.83	1059.4	1046.9	1050.47
ENERGY AVAILABLE (ELEV.)	1055.9	1057.1	1055.9	1057.1

NO LOSSES WERE ASSUMED

∴ IF FLASHBOARDS NOT ON SPILLWAY, THERE IS A BACKWATER EFFECT FROM SECTION (A)

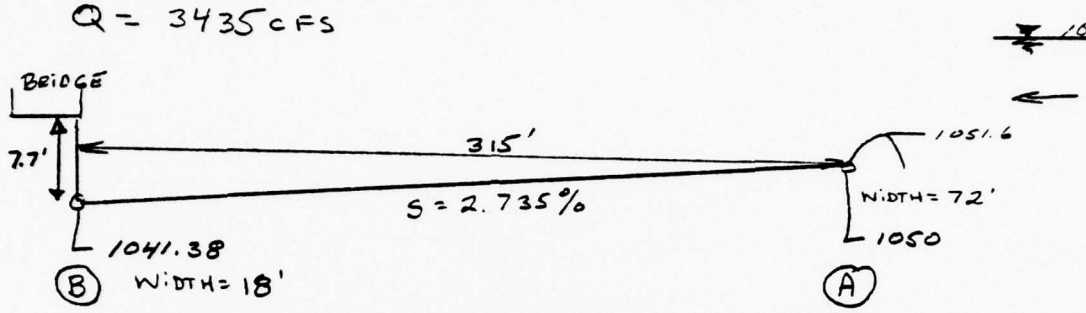
SP 11860A

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

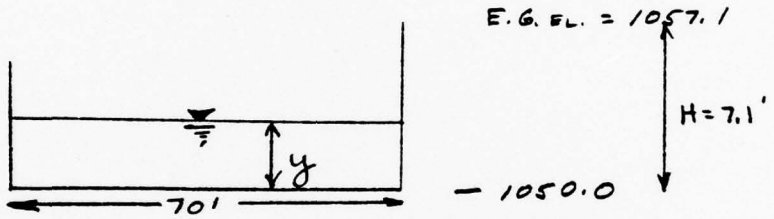
SUBJECT PIKES CREEK FILE NO.
MAIN SPILLWAY FLUME SHEET NO. 1 OF 2 SHEETS
FOR DAM INSPECTION PROGRAM
COMPUTED BY AMS DATE 6/24/78 CHECKED BY JMC DATE 7/25/78

USE POOL WITH EMBANKMENT AT DESIGN LEVEL

$Q = 3435$ CFS



AT (A) DETERMINE WATER SURFACE USING WIDTH OF 70 FT.

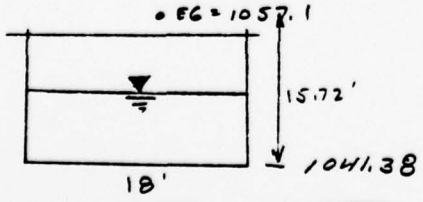


$$E = y + V^2/2g \quad 7.1 = y + \frac{Q^2}{y^2 \cdot 2g \cdot 70^2} = y + \frac{37.415}{y^2}$$

$y = 3.03'$ $A = 212.1$ SF $V = 16.20$ FPS $P = 76.06$ FT
$V^2/2g = 4.08'$ $E = 7.11$ FT $R = 2.789$ FT
$EGL = 1057.1$

$$\text{SLOPE}_{EG} = \frac{16.20^2 \times .015^2}{1.486^2 \times (2.789)^{4/3}} = .00681 \text{ FT/FT}$$

AT (B) DETERMINE WATER SURFACE WITH ENERGY GRADE LINE AT 1057.1 $\therefore$ $H_{AVAILABLE} = 1057.1 - 1041.38 = 15.72$



$$y + \frac{Q^2}{A^2 \cdot 2g\, y^2} = E = 15.72'$$

$$d_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(3435/18)^2}{32.18}} = 10.42 \text{ FT} \quad E_{CRIT} = 1.5 d_c = 15.63$$

$$V d_c = \frac{3435}{10.42 \times 18} = 18.31 \qquad \text{SLOPE} = \frac{18.31^2 \times .015^2}{1.486^2 \times \left(\frac{10.42 \times 18}{10.42 \times 2 + 18}\right)^{4/3}} = .0042$$

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

SUBJECT Pikes Creek FILE NO.
Main Spillway Flume SHEET NO. 2 OF 2 SHEETS
FOR
COMPUTED BY AHW DATE 6/24/78 CHECKED BY JAC DATE 6/26/78

AVERAGE HEAD LOSS = $\frac{\text{SLOPE AT (A)} + \text{SLOPE AT (B)}}{2} \times \text{DISTANCE}$

$= \frac{.00681 + .0042}{2} \times 315 = 1.73$ FT

∴ HEAD AVAILABLE AT BRIDGE = 1057.1 − 1.73 ≈ 1055.4

1055.4 − 1041.38 = 14 FT

HOWEVER MINIMUM ENERGY REQUIRED AT BRIDGE IS 15.63 FT. DEPTH AT THIS ENERGY WOULD BE 10.4 FT

∴ SPILLWAY CHANNEL CANNOT PASS MAXIMUM DISCHARGE.

CHECK SECTION (B) AT EXISTING EMBANKMENT ELEVATION

Q = 2375 CFS

$d_c = \sqrt[3]{\frac{(2375/18)^2}{g}} = 8.148'$ $E = 1.5\, d_c = 12.22$

$V_{dc} = 2375/(8.15 \times 18) = 16.19$ FPS $V^2/2g = 4.07$ FT

EGL AT POINT (B) = 12.22 + 1041.38 = 1053.6

$\text{SLOPE}_{EG} = \frac{(16.19)^2 \times (.015)^2}{1.486^2 \times \left(\frac{8.15 \times 18}{8.15 \times 2 + 18}\right)^{4/3}} = .00385$

AT SECTION (A) WATER SURFACE IS:

ENERGY = 1055.9 − 1050 = 5.9 = $y + \frac{Q^2}{2g\,b^2 y^2}$

$y = 2.2$ FT $V = 15.42$ FPS

$S = \frac{15.42^2 \times .015^2}{1.486^2 \times \left(\frac{2.2 \times 70}{4.4 + 70}\right)^{4/3}} = .0092$

AVERAGE HEAD LOSS = $\frac{.0092 + .0039}{2} \times 315 = 2.06$ FT

∴ HEAD AVAILABLE = (1055.9 − 2.1 − 1041.4) = 12.4 FT

AT THIS DISCHARGE THE CHANNEL WILL BE FLOWING ABOUT 8 FEET DEEP AT SECTION B

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX D

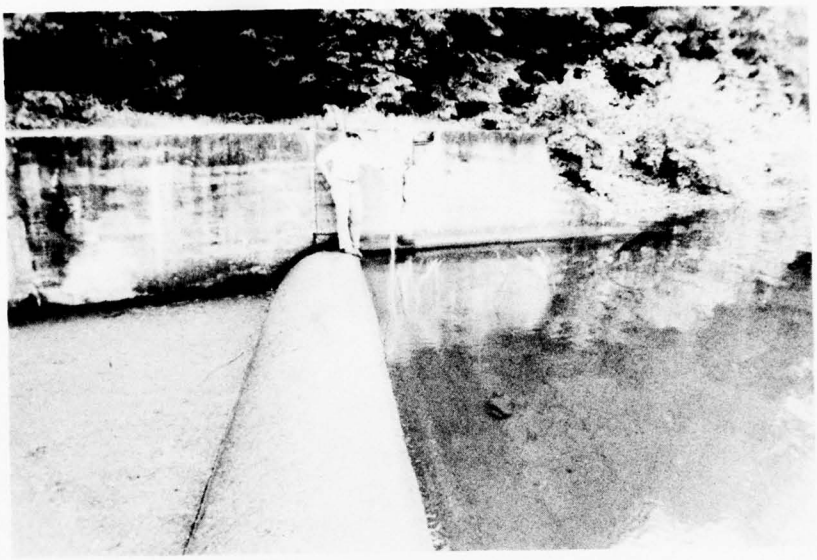
PHOTOGRAPHS

A. Embankment and Main Spillway
View from Right Abutment

B. Embankment — View from
Auxiliary Spillway at Left Abutment

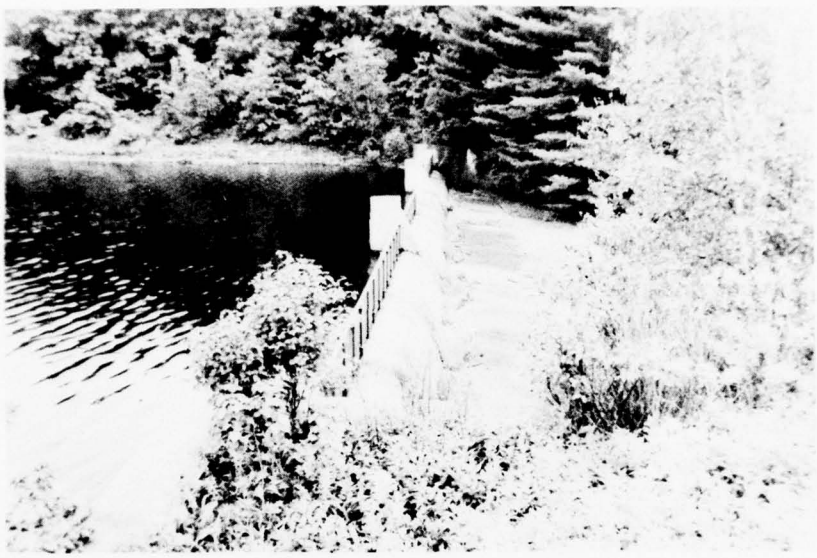
C. Riprap on Upstream Slope

D. Embankment and Wet Area
Near Left Abutment



E. Main Spillway Crest and
Main Spillway Right Training Wall

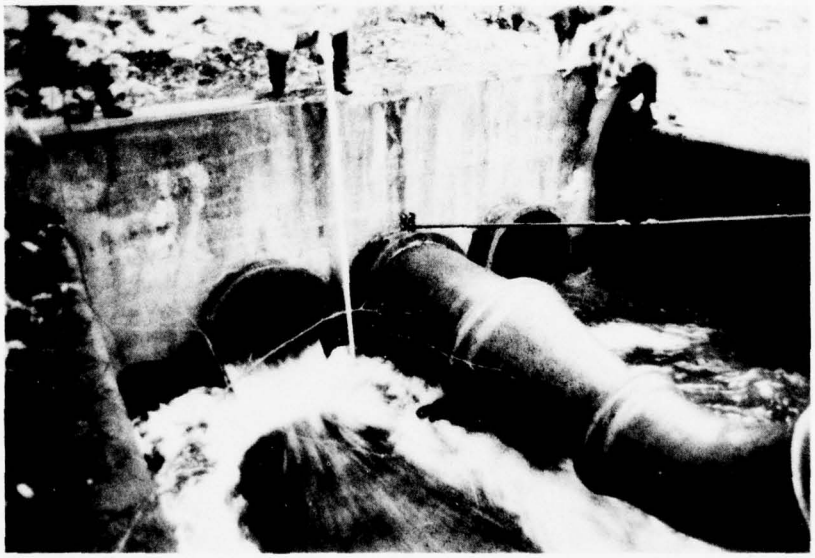
F. Main Spillway Channel



G. Auxiliary Spillway and Flashboards

H. Auxiliary Spillway Channel

I. Valve House — Embankment in Background



J. Outlet Works Headwall

SUSQUEHANNA RIVER BASIN

PIKES CREEK, LUZERNE COUNTY

PENNSYLVANIA

PIKES CREEK DAM

NDS ID No. PA-00576
DER ID No. 40-18

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JULY 1978

APPENDIX E

GEOLOGY

PIKES CREEK DAM

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Luzerne County. The rock formations exposed in Luzerne County range from the post-Pottsville formations, of Pennsylvanian Age, down to the Onondaga formation, of Middle Devonian Age. The Wisconsin terminal moraine crosses the southern part of the County, and the greater part of the County is covered by glacial drift. Extensive deposits of glacial outwash occur along the Susquehanna River and less extensive deposits along the smaller streams.

Nearly all of Luzerne County lies in the Valley and Ridge Province in which nearly all the rocks have been strongly folded. In going from north to south across the County, five major folds are encountered, all of which trend northeast. The first of these is a shallow syncline on the crest of North Mountain, forming the Mehoopany coal basin. The second is the Milton Anticline, which exposes the Portage group in the northwestern part of the County and gradually flattens out toward the northeast. The third and most pronounced is the Lackawanna Syncline, which originates in Lackawanna County to the north, and has preserved the post-Pottsville formations throughout the Wyoming Valley. The maximum depth of this syncline is reached in the vicinity of Wilkes-Barre and Plymouth. The double rim of this syncline is formed by the resistant Pottsville formations and Pocono sandstone, separated by the less resistant Mauch Chunk shale. The fourth fold is the Berwick (Montour) Anticline, which exposes a few feet of the Onondaga formation in the vicinity of Beach Haven. This fold reaches its maximum development farther west and only the eastern portion reaches Luzerne County. The fifth major fold comprises a series of anticlines and synclines forming the Eastern Middle Anthracite Field in the vicinity of Hazleton. The synclinal basins in this region are relatively shallow and there are large areas from which all coalbeds have been eroded.

The general dips of the region vary from 0° to 40°, and the maximum dips are found on the rims and within the synclinal coal basins. The relatively soft post-Pottsville beds in their cores are severely folded and contorted with numerous minor faults. The northern and easternmost parts of the County border the Appalachian Plateau Province and are characterized by horizontal, or nearly horizontal strata. The Catskill continental group of rocks underlies those parts of Luzerne County that are outside of the five major folds.

2. Site Geology. The dam and reservoir are sited in nearly horizontal Catskill continental formations, northwest of the Lackawanna Syncline and the Susquehanna River. At the damsite, the valley is quite broad and the sidehills have a fairly gentle slope. For that reason the dam with an overall length of 2,125 feet is quite long. The dam is irregular in alignment because of the designers tried to take advantage of the higher knobs in the valley. From information gathered by the Pennsylvania Water Supply Commission engineers during the initial inspection of the dam in 1914, it is learned that the spillway, at the southwest end of the dam is founded on hard green sandstone rock. The embankment to the right, or northeast, of the spillway rests upon a firm clay from which the topsoil has been removed. For the first 800 feet of embankment, the concrete core wall in the center of the embankment is founded upon rock. As the core wall continues down the right abutment, and away from the spillway, the bedrock changes from green sandstone to a hard, gray sandy shale to a red sandy clay shale and, at the end of the 800 feet section, to a hardpan that is either decomposed shale or glacial till, probably the latter. The core wall of the next 1,070 feet of embankment rests on a 3-foot thick concrete mattress that is founded on hardpan. The hardpan is located an average of 12 to 20 feet below the natural ground surface of the valley bottom. The core wall of the final 255 feet of embankment, which forms the left or northeast abutment of the dam, is again founded upon a hard, gray sandy shale.

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