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NATIONAL DAM INSPECTION PROGRAM. HUNTSVILLE DAM (NDS-PA-00553),--ETC(U)
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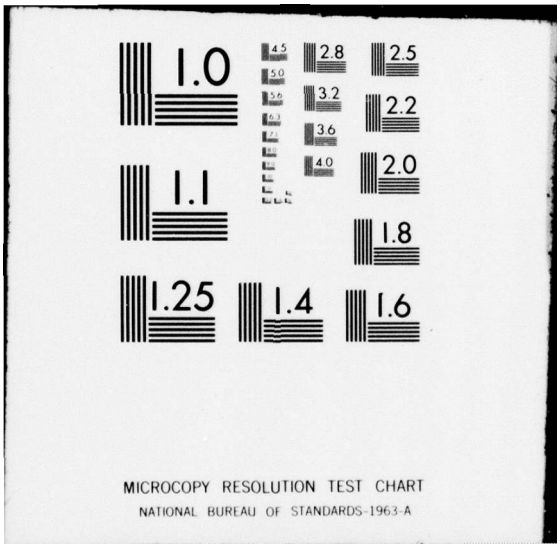
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SUSQUEHANNA RIVER BASIN
HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

LEVEL II

1

HUNTSVILLE DAM

NDS ID NO. PA-00553
DER ID NO. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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Contract No. DACW31-78-C-0046

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

JUNE 1978

411004

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(1)

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

LEVEL II

(6) National Dam Inspection Program. Huntsville Dam (NDS ID-PA-00553), (DER ID-40-5). Pennsylvania Gas and Water Company. Susquehana River Basin, Huntsville Creek, Luzerne County, Pennsylvania. Phase I Inspection Report.

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

(15) DACW31-78-C-0046

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(11) JUNE 1978 (12) 84p.

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SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

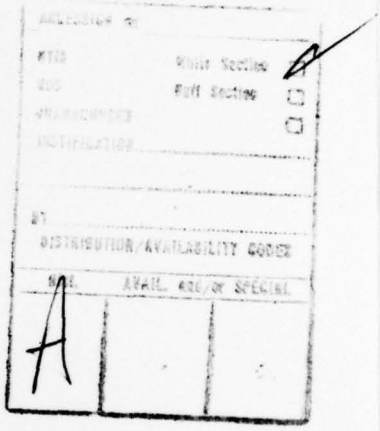
NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JUNE 1978



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PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Huntsville Dam (NDS ID No. PA-00553; DER ID No. 40-5)
Owner:	Pennsylvania Gas and Water Company
State Located:	Pennsylvania
County Located:	Luzerne
Stream:	Huntsville Creek
Date of Inspection:	25 May 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, Huntsville Dam is judged to be in good condition. However, the spillway (main and auxiliary) will not pass the Probable Maximum Flood (PMF) or one-half of the PMF without overtopping. Computations for depth of overtopping with flashboards in place indicate that the dam would be overtopped by about 8.6 feet during an occurrence of the PMF and by about 6.0 feet during an occurrence of one-half the PMF. With flashboards removed, the depths of overtopping for the PMF and one-half the PMF would be 8.1 feet and 5.4 feet, respectively. Consideration of the ability of the structure to withstand

overtopping to these depths indicates that it cannot be assumed that the structure would not fail under overtopping conditions. If Huntsville 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 spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 21 percent of the PMF peak flow without overtopping. If the flashboards were removed from the crest of the main spillway, the existing spillway would accommodate a flood with a peak inflow of 30 percent of the PMF peak inflow without overtopping.

If both gates on the outlet conduits were operable, and if access to them was possible during large floods, the existing discharge capacity for the dam would be increased by about 500 cfs. This is about 20 percent of the total existing spillway capacity, as determined for the condition of having the flashboards removed.

Due to the potential for overtopping of the dam, the following measures are recommended to be undertaken by the Owner immediately:

(1) Remove flashboards from main spillway crest.

(2) Develop a detailed emergency operation and warning system for Huntsville Dam.

(3) Repair slide gate on lower outlet conduit.

(4) Perform additional in depth studies of hydrology and hydraulics to more accurately ascertain the required spillway capacity for Huntsville Dam and the nature and extent of remedial measures required to make the spillway hydraulically and structurally adequate to pass the PMF.

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

(1) Monitor condition of mortar in joints and amount of seepage from downstream face and make repairs when necessary.

(2) Make repairs to capstones on crest of structure.

(3) Excavate high area in approach channel of left auxiliary spillway.

(4) Repair area at toe of left auxiliary spillway where riprap is displaced. Some larger stone should be provided.

(5) Fill gaps in stone protection at toe of right auxiliary spillway and extend protection downstream.

The following measures should be undertaken by the Owner as the need arises:

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

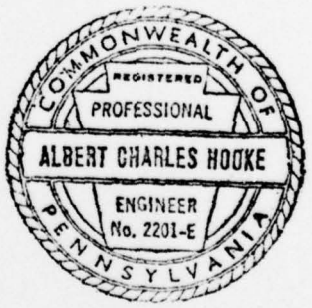
(2) When warnings of a storm of major proportions are given by the National Weather Service, the Owner should activate his emergency operation and warning system procedures.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.

A. C. HOOKE
Head, Dam Section

Date: 19 July 1978



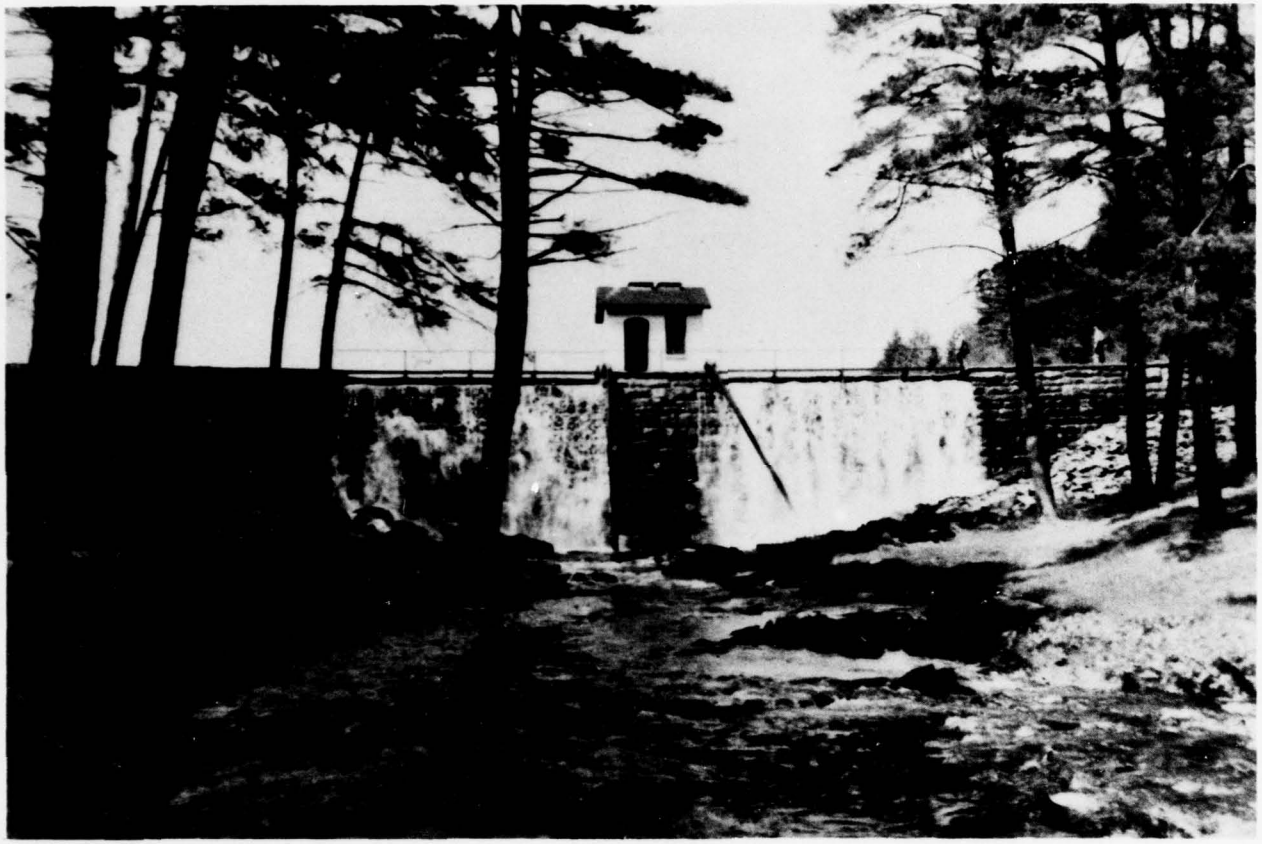
Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

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

Date: 31 Jul 78

HUNTSVILLE DAM



View of Dam Looking Upstream

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JUNE 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. Huntsville Dam is a combination masonry arch and masonry gravity structure. The total structure length is 243 feet, and its height is 27 feet.

The radius of curvature is 300 feet. The dam has a main and auxiliary spillway with nonoverflow sections located at the ends of the dam. The nonoverflow sections have a total length of 44 feet. An auxiliary spillway section is adjacent to each nonoverflow section. The total length of the auxiliary spillway is 118 feet. The crests of the auxiliary spillway sections are 2 feet lower than the top of the nonoverflow sections. Similarly, the main spillway sections are adjacent to the auxiliary spillway sections and have a total length of 65 feet. The crests of the main spillway sections are 2 feet lower than the crests of the auxiliary spillway sections. There are 1.4-foot high flashboards on the crests of the main spillway sections. The flashboards are removable, but will not fail automatically prior to overtopping of the dam. The main spillway sections are separated by a 16-foot long raised center section which is at the level of the auxiliary spillway sections and is extended upstream to provide a base for the gatehouse. The gatehouse shelters operating stands that control one slide gate for each of the two outlet conduits, which consist of 3.7-feet wide by 2.7-feet high openings in the masonry through the raised center section. An 8-inch diameter siphon is also located along each side of the gatehouse.

b. Location. The dam is located on Huntsville Creek about 3 miles upstream of the confluence of Toby Creek. Huntsville Dam is shown on USGS Quadrangle, Kingston, Pennsylvania, with coordinates N41°18'30" - W75°58'30" in Luzerne County and is 5 miles southwest of Kingston, Pennsylvania. The location map is shown on Plate 1.

c. Size Classification. Intermediate (27 feet high, 6,910 acre-feet).

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

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

f. Purpose of Dam. Water supply for the metropolitan area of the City of Wilkes-Barre, Pennsylvania.

g. Design and Construction History. Huntsville Dam was built by the West Side Water Company in 1891 to supply water to towns located on the west side of the Susquehanna River in the Wilkes-Barre area. The dam was designed and built under the supervision of W. H. Sturdevant, Chief Engineer of the West Side Water Company. No modifications have been made to the structure.

h. Normal Operational Procedure. The water level in the reservoir is normally maintained at the top of the flashboards on the main spillway crest at Elevation 1132.5 with excess inflow going over the free overfall into the natural stream channel. Outflow from the reservoir travels along the natural stream channel to treatment plant facilities located 0.8 mile downstream. During periods of low flow, water is drawn from either the upper outlet conduit or the siphons, depending on the quality of the water at the time.

1.3 Pertinent Data.

a. Drainage Area. 8.3 square miles.

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite - 900
(estimated - June 1972).

Upper outlet conduit capacity - 230 (approximate).

Lower outlet conduit capacity - 280 (approximate).

Spillway capacity (main and auxiliary) with flashboards in place - 1,870

Spillway capacity (main and auxiliary) with flashboards removed - 2,640

c. Elevation. (Feet above msl.)

Top of dam - 1135.1

Normal pool (top of flashboards) - 1132.5

Main spillway crest (flashboards removed) - 1131.1.

Auxiliary spillway crest - 1133.1.

Maximum pool - 1135.1.

Upstream invert upper outlet conduit - 1119.1.

Downstream invert upper outlet conduit - 1119.1.

Upstream invert lower outlet conduit - 1108.1.

Downstream invert lower outlet conduit - 1108.1.

Streambed at centerline of dam - 1108.0

d. Reservoir Length. (Miles.)

Normal pool - 1.57.

Maximum pool - 1.60.

e. Storage. (Acre-feet.)

Main spillway crest (flashboards removed) - 5,340.

Normal pool (top of flashboards) - 5,880.

Maximum pool (top of dam) - 6,910.

f. Reservoir Surface. (Acres.)

Main spillway crest (flashboards removed) - 380.

Normal pool (top of flashboards) - 390.

Maximum pool (top of dam) - 400.

g. Dam.

Type - Masonry arch with upstream earthfill.

Length - 243 feet.

Height - 27 feet

Top Width - 8.5 feet.

Slopes - Downstream batter - 1V on 0.25H.
Upstream batter - 1V on 0.08H.
Upstream earthfill - 1V on 1.5H.

Cutoff - Dam founded on rock foundation.

Grout Curtain - None.

h. Diversion and Regulating Tunnels. None.

i. Spillway.

Type - Main spillway - broad-crested weir (width 8.5 feet) with flashboards and free overfall.
Auxiliary spillway - broad-crested weir (width 8.5 feet) with free overfall.

Length of Weirs - Main spillway - two sections - 65 feet total.
Auxiliary spillway - two sections - 118 feet total.

Crest Elevations - Main spillway (flashboards removed) 1131.1
Top of flashboards - 1132.5.
Auxiliary spillway - 1133.1.

Upstream Channel - 1V on 1.5H rock-faced earthfill.

Downstream Channel - Natural stream channel with stone protection.

j. Regulating Outlets.

Type - Two masonry conduits (each 3.7 feet wide by 2.7 feet high) and two 8-inch siphons.

Length - Upper outlet conduit - 30 feet.
Lower outlet conduit - 44 feet.
Siphons - 50 feet each.

Access - Outlet conduits - downstream access from channel using temporary ladder.
Siphons - access from top of dam.

Regulating Facilities - Outlet conduits - one manually operated, rising stem, seating head slide gate in wet well at upstream face of dam for each conduit. Operating stand in gatehouse at center of main spillway.

Siphons - nonrising stem gate valves at top of dam and at downstream end for each siphon.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data was available for review for the original design. In a study performed in 1914 by the Pennsylvania Water Supply Commission, an account of design concepts, construction, and design features was prepared for the structure from information in the files of the Spring Brook Water Supply Company, who was then the Owner, and from visual inspection. The 1914 study also included analyses of hydrology, hydraulics, and stability. The Commission concluded that the structure was satisfactory, and no modifications were recommended.

b. Design Features. Huntsville Dam is a combination masonry arch and masonry gravity structure. A general plan is shown on Plate 2, a profile along axis of dam is shown on Plate 3 and a section through the dam is shown on Plate 4. The total length of the structure is 243 feet, and it is curved upstream with a radius of 300 feet. The maximum height is 27 feet. The structure consists of nonoverflow, auxiliary spillway, and main spillway sections. Except for height differences, all the sections have the same proportions. The downstream face has a batter of 1V on 0.25H, and the upstream face has a batter of 1V on 0.08H. The top width is about 8.5 feet. An earthfill was placed along the upstream face, and it has a rock-faced slope of 1V on 1.5H. The top of the earthfill is at the level of the main spillway crest. The entire structure is founded on sandstone. A discussion on geology is presented in Appendix E.

A 24-foot long nonoverflow section is located at the right abutment, and a 20-foot long nonoverflow section is located at the left abutment. The top elevation, which is the top of the dam, is Elevation 1135.1. At the right end the foundation is 12 feet below original ground surface and at the left end, the foundation is 24 feet, below original ground surface.

Adjacent to each nonoverflow section is a 59-foot long auxiliary spillway section with crest at Elevation 1133.1, or two feet lower than the top of the dam. The crest of the auxiliary spillway consists of large, flat capstones that are laid horizontally. In a similar manner, there is a 32.5-foot long main spillway section adjacent to each auxiliary spillway section to give a total main spillway length of 65 feet. The two sections of the main spillway are separated by an extended and raised section located at the center of the structure. The gatehouse is atop the raised center section. The crest of the main spillway is at Elevation 1131.1, which is 2 feet lower than the crests of the auxiliary spillway sections. However, the crest of the main spillway has been raised to Elevation 1132.5 by the installation of flashboards. The flashboards are 1-1/2-inch thick oak planks about 18 inches high, and they are located near the center of the main spillway crest. The flashboards on the right main spillway section are supported by four 3x3x1/4 steel angles bolted to the main spillway crest. The flashboards on the left main spillway section are supported by seven slightly smaller steel angles. Additional support for both flashboards was obtained by bolting them to the three supports for each of the plank bridges that span the main spillway sections. The flashboards were not designed to fail during high flows. The bridges consist of 2-1/2-inch thick planks having a total width of 24 inches, and they provide access from the crest of the auxiliary spillway to the raised center section where the gatehouse is located.

The raised and extended center section is 16 feet long and is at the same level as the auxiliary spillway sections. The gatehouse and outlet works are located at this section. A section through this portion of the structure is shown on Plate 4. As shown on Plate 4, both the upper and lower outlet conduits extend from the upstream limit of the earthfill to a wet well located beneath the floor of the gatehouse. Each conduit is masonry and is 3.7 feet wide and 2.7 feet high. On the downstream side of the wet well, openings through the dam having the same dimensions as the conduits form the rest of the outlet system. A seating head slide gate is located at each opening on the downstream side of the wet well, and operating stands for these

gates are in the gatehouse. A stainless steel plate was driven into the wet well at an unknown time in an attempt to separate the wet well into two chambers. Other outlet facilities for the dam consist of two 8-inch diameter steel siphons, one located on each side of the gatehouse. Each siphon has one gate valve located in the line where it crosses the top of the dam and another located near its downstream end. The siphon is primed by removing a 2-inch pipe plug and filling the siphone with water.

The outlet channel is the natural stream channel. The areas below the auxiliary spillways are covered with stone protection.

2.2 Construction.

a. Data Available. Construction data available for review for the original structures was limited to information contained in the 1914 report prepared by the Pennsylvania Water Supply Commission. That information was obtained from the files of the Spring Brook Water Supply Company, who was the Owner at that time.

b. Construction Considerations. The 1914 report by the Commission indicates that the structure was constructed from derrick size, cut sandstone laid in cement mortar. The foundation was entirely on sandstone. Near the center of the structure, the foundation is about 1.5 feet below the original surface for a reach of 40 feet. At other locations, the foundation level for the structure varies to maximum depths below original surface of 12 feet at the right abutment and 24 feet at the left abutment. The upstream earthfill was reported to be clay.

2.3 Operation. No formal records of operation were reviewed. Based on information from the Owner and the caretaker of the dam, who has been the caretaker for 28 years, all structures have performed satisfactorily except that the slide gate for the lower outlet conduit became inoperable shortly after installation of a stainless steel plate in the wet well. The plate

was installed for the purpose of separating it into two chambers. The caretaker said that water was within 0.7 foot of top of dam during the June 1972 Flood, which was caused by Tropical Storm Agnes.

2.4 Other Investigations. In 1973, the Pennsylvania Department of Environmental Resources was requested to investigate the effects on Huntsville Dam of blasting in a quarry located 1.5 miles away. On September 13, 1973, test blasts were made at the quarry, and it was concluded that there were no tremors or vibrations at the dam.

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, a caretaker, and a valve crew for information and operating demonstrations 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 are limited, and the assessment must be based on the combination of available data, visual inspection, perfromance history, hydrologic assumptions, and hydraulic assumptions.

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

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The general appearance of this project indicated that some project features have deteriorated with age and are in need of repair, while other project features have been properly maintained and are in good condition.

b. Dam and Spillways.

(1) The earthfill adjacent to the upstream face of the dam was submerged and could not be inspected. As far as could be determined, the rock slope protection was intact and continuous.

(2) The mortar in the joints on the downstream face of the structure was generally cracked and loose or missing altogether (Photograph G). Seepage was observed over most of the downstream face, and it ranged from drips to concentrated flows of up to 5 gpm. The largest single leak was located near the top of the raised center section between the two sections of the main spillway (Photograph D). This leak was estimated to be about 25 gpm. It should be noted that too much flow was going over the main spillway sections to determine the condition of the downstream face in those reaches. The amount of flow also made it impossible to inspect the toe of the main spillway for undermining. The leakage from the downstream face entered either the natural stream channel or the slope protection adjacent to it. No apparent damage to other features has resulted from the seepage. The caretaker said that the dam was routed and the joints on the downstream face were repointed in 1962. He said that the leakage at that time was considerably greater than that observed during this inspection and that the repair work stopped almost all of the leakage.

(3) It was observed that the roadway adjacent to the right abutment is about 2 feet lower than the top of the dam, and a 30-foot long ridge of ground at the same elevation as top of dam prevents overflow around the right end of the dam. If the dam were overtopped, the overflow around the right end of the dam would go onto the roadway and travel along it for some distance downstream from the dam. A view of the right abutment area is shown on Photograph B.

(4) Vertical variations of ±2 inches were noted for the capstones across the lengths of the various sections. One capstone on the crest of the right auxiliary spillway section was broken (Photograph E). It was also observed that the capstones on the crest of the right auxiliary spillway overhung the downstream face by a larger amount than those on the left auxiliary spillway. The caretaker said that the stones have been displaced laterally by ice forces. Mortar was missing from some of the joints between the capstones. Views of the top of the structure are shown on Photographs A, B, C, and E.

(5) The ground surface in a portion of the approach channel for the left auxiliary spillway section is slightly higher than the crest level of that section (Photograph J). The ground surface was covered with sod and several trees were growing there.

(6) The channel area below the overfall for the left auxiliary spillway was covered with sandstone slope protection (Photographs C and F). The stone was 1-inch to 2 inches thick and about 12 inches in diameter. Although no gaps existed, the placement was nonuniform and appeared to have undergone movement that resulted in mounding of the stone in certain areas. The caretaker said that the displacement of the stone occurred during the June 1972 Flood. The channel area below the overfall for the right auxiliary spillway was also covered with slope protection. However, the stone in this area is derrick size. Some gaps were present in the stone protection, and erosion has occurred beyond the downstream limits of the stone protection (Photograph H). No significant erosion was apparent along the structure itself. The caretaker said that the erosion occurred during the June 1972 Flood.

(7) Flashboards were installed on the crests of the main spillway sections, and plank bridges were constructed across the sections above the flashboards (Photograph I). The flashboards are 1-1/2-inch thick oak planks about 18 inches high. The bridges are 2-1/2-inch thick oak planks having a total width of 2 feet, and they are 0.6 foot above the top of the flashboards. The flashboards on the right main spillway section are supported by four

3 x 3 x 1/4 steel angles that are bolted to the main spillway crest, and additional support was obtained by bolting them to the three bridge supports, which are, in turn, bolted to the main spillway crest. The angles supporting the flashboards on the left main spillway section are slightly smaller, but seven of them were used instead of four as used on the right side. The flashboards on the left main spillway section are also bolted to three bridge supports (Photograph I). The caretaker said that the flashboards were not designed to fail and that they are kept in place throughout the year. He said that the flashboards were not removed and did not fail during the June 1972 Flood, which caused a depth of water over the flashboards of about 1.8 feet.

c. Appurtenant Structures.

(1) It was noted that the operating floor of the gatehouse is situated at the same elevation as the crest of the auxiliary spillway (Photographs A and B). Consequently, if the reservoir level were at top of dam, the operating floor would be submerged to a depth of 2 feet.

(2) The threaded stems and the exposed gears of the slide gate operating mechanisms were well lubricated, and the operating stand was maintained. The slide gate on the upper outlet conduit was operated easily by one man during the inspection (Photograph D). The gate was not opened fully because the Owner said that fish kills in the stream have occurred in the past as a result of opening the outlet conduits and because equipment for monitoring the dissolved oxygen level of the stream was not readily available at the time of operation. The Owner also said that opening the gate fully would result in flooding at the treatment plant located 0.8 mile downstream. The caretaker said that the slide gate on the lower outlet conduit was not operable, and no attempt was made to open it. There are no drawings available for the gates, and the Owner was not certain of their size.

(3) The 8-inch diameter siphon located on the left side of the gatehouse was displaced from its normal position (Photograph D). The caretaker said that it had been displaced by ice during the previous winter. Each of the siphons are held in place by wood blocking. The siphons were not operated for this inspection.

d. Reservoir Area. The watershed area is a mixture of forests, farms, and residential development. The slopes showed no signs of creep, rock slides, or land slides. The Owner indicated that sedimentation is not a problem from the standpoint of reduced reservoir capacity. Excessive turbidity, however, was a problem when the dam was constructed in 1891 and resulted in the simultaneous construction of a filtration plant, which for many years was the only plant in the entire system. Only part of the watershed in owned and controlled by Pennsylvania Gas and Water Company. The greater part is privately owned, which is unusual for reservoirs owned by the Company. Some new development in the watershed area was noted during the inspection.

e. Downstream Channel. The downstream channel is the natural stream channel. The area immediately below the structure has slope protection, but the remainder of the channel is unlined. No obstructions were noted in the channel within the reach that would have an affect on the dam. Additional discussion of downstream conditions is presented in Paragraph 5.1e.

3.2 Evaluation.

a. Dam and Spillways.

(1) The condition of the mortar in the joints on the downstream face of the structure and the leakage therefrom did not appear to have progressed to the extent that the integrity of the structure is in question. However, the condition is undesirable and will worsen in time.

(2) The extent of damage that might be caused by any overflow around the right end of the dam would probably be limited because of the existence of the paved roadway.

(3) The vertical irregularities of the capstones on the structure have little consequence. The lateral displacement apparently caused by ice forces indicates that the stones are not properly secured to the underlying structure. These capstones are primarily for appearance sake, and even if they were completely displaced it is doubtful that the underlying structure would be affected.

(4) The high ground in the approach channel area of the left auxiliary spillway has the effect of reducing spillway capacity.

(5) The displacement of the sandstone riprap below the free overfall of the left auxiliary spillway is evidence that the riprap is not of sufficient size to resist erosion. As it now exists, the reduced depth of stone in certain areas would probably be displaced and underlying material would be eroded during high flood flows. The erosion that has taken place beyond the limits of the derrick stone below the free overfall of the right auxiliary spillway is evidence that the stone size is satisfactory but that it does not extend far enough downstream.

(6) The effect of the flashboards on the main spillway crest is reduced spillway capacity. Flashboards are normally designed to fail when the pool rises to a certain level above the top of the flashboards. It is also normal operating procedure to remove the flashboards during the winter and spring months when the threat of a flood is generally the greatest.

b. Appurtenant Structures.

(1) The elevation of the operating floor of the gatehouse is such that if the gates on the conduits are not opened shortly after the reservoir level reaches the auxiliary spillway crest level, access to the operating mechanisms would be either very hazardous or not possible. Consequently, the use of the gates to augment discharge capacity depends on opening them at the proper time.

(2) The slide gate on the upper level conduit opened easily. The condition of the slide gate on the lower outlet conduit, which is inoperable, is not satisfactory. Without this gate, there is no way to fully draw down the reservoir. In addition, it should be noted that the two outlet conduits have an estimated combined discharge capacity of about 500 cfs, which is about 20 percent of the estimated spillway capacity. Consequently, if these two outlet conduits were opened during a flood, the discharge capacity of the dam would be increased and the risk of overtopping the dam would be reduced.

(3) The location and condition of the siphons have little significance in terms of hazard to the dam.

c. Reservoir Area. No conditions were observed in the reservoir area that might present significant hazard to the dam. However, the potential for future development of the watershed exists, and such development could affect the hydrologic characteristics of the reservoir area, producing faster runoff and a higher PMF peak flow.

d. Downstream Channel. Nothing was observed in the downstream channel area that would appear to have significant effect with respect to hazard to the dam. Additional discussion on downstream conditions is presented in Paragraph 5.1e.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The water level in the reservoir is normally maintained at the level of the top of the flashboards, which are at Elevation 1132.5. Excess inflow passes over the flashboards and into the natural stream channel. The water travels along the stream channel to the Owner's treatment plant located about 0.8 mile downstream. During periods of low flow, water is drawn from the upper outlet conduit and released into the stream channel. Depending on the water quality at various levels in the reservoir, water is also drawn from the two 8-inch siphons and released into the stream. The quantity and quality of water released at the dam are dictated by treatment plant requirements. The caretaker telephones the treatment plant superintendent each day and informs him of the pool elevation; the superintendent instructs the caretaker to open the gate on the upper outlet conduit a specfied amount or to operate the siphons. The flashboards remain in place throughout the year. The slide gate on the lower outlet conduit has not been operable in recent years.

4.2 Maintenance of Dam. The dam is visited daily by a caretaker who records the water level and checks with the treatment plant superintendent to determine outflow requirements from the dam. The caretaker has 28 years experience with the dam. A weekly report on the water level is sent to the Owner's Engineering Department. This information is used by the Engineering Department for regulating flows in the distribution system. The caretaker is also responsible for observing the general condition of the dam and appurtenant structures and for reporting any changes or deficiencies to the Owner's Engineering Department. A Pennsylvania Gas and Water Company engineer makes a formal inspection of the dam each year, and the records are kept on file and used for determining priority of repairs. Informal inspections are also made when the engineer is on the site for other reasons.

4.3 Maintenance of Operating Facilities. It appeared that normal maintenance of the operating facilities is adequate. Gate stems and exposed gears were lubricated, and the gate stands were painted. However, only the gate for the upper outlet conduit was operable during this inspection. The caretaker said that an attempt was made to separate the wet well into two chambers several years ago. A stainless steel plate was driven down between the slide gates, and, shortly thereafter, the slide gate for the lower outlet conduit became inoperable. Apparently, there has not been an attempt to repair it.

4.4 Warning Systems in Effect. The Owner furnished the inspection team with a chain of command diagram for Huntsville 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 Huntsville Dam but are as directed by the Owner's Engineering Department.

4.5 Evaluation. The operational procedure and normal maintenance appears satisfactory, but sufficient attention has not been given to repairs. The condition of the slide gate on the lower outlet conduit, which is inoperable, makes it impossible to fully draw the reservoir down with onsite facilities. The procedures used for inspecting the facilities are satisfactory, but, as noted above, major repairs have not been made. In general, the warning system is adequate, but it is not in sufficient detail for Huntsville Dam considering the volume of water impounded and the populated areas downstream . A description and evaluation of the access to the gatehouse are presented in Paragraph 3.1c.(1) and Paragraph 3.2b.(1), respectively. A description and evaluation of the flashboards are presented in Paragraph 3.1b.(7) and Paragraph 3.2a.(6), respectively.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features.

a. Design Data.

(1) No hydrologic or hydraulic analyses for the original Huntsville Dam were available for review. Spillway capacity as used in this Section represents the combined capacity of the main and auxiliary spillway.

(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 Huntsville 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 Huntsville Dam watershed in partially owned by the Pennsylvania Gas and Water Company. Some suburban-type development is being constructed at isolated locations within the watershed, but the overall effect of

this development on hydrologic parameters is considered negligible.. The hydrologic analysis for this study was based on existing conditions, and the effects of future development of the watershed were not considered.

b. Experience Data. For this study, a PMF peak previously calculated for the Aylesworth Creek Dam watershed was transposed to the Huntsville Dam watershed. The PMF peak flow was estimated to be 17,260 cfs. In their 1914 report, the Pennsylvania Water Supply Commission estimated the spillway capacity at 1,820 cfs with the pool 2 feet above the crest of the auxiliary spillway. With the flashboards in place and the pool at top of dam, the estimated combined capacity of the main and auxiliary spillways is 1,870 cfs (Appendix C).

c. Visual Observation. On the date of the inspection, a portion of the left auxiliary spillway approach channel was slightly higher than the crest level of the left auxiliary spillway (Photograph J). This would slightly reduce the capacity of the left auxiliary spillway. However, this reduction was not considered in this study.

d. Overtopping Potential. For an occurrence of the PMF, the peak inflow of 17,260 cfs is greater than the spillway capacity of Huntsville Dam. A check of the surcharge storage effect of Huntsville Reservoir shows that the surcharge storage available is insufficient to contain an inflow of 17,260 cfs without overtopping the dam (Appendix C).

e. Downstream Conditions. As shown on Plate 1, there are structures less than 0.1 mile downstream from the dam. These structures are inhabited. The Huntsville Creek valley is moderately developed from immediately below the dam to its confluence with Toby Creek about 3.4 miles downstream from the dam. Between the dam and Toby Creek, there are at least 16 inhabited structures that would be subject to severe inundation due to extreme flows on Huntsville Creek. Below its confluence with Huntsville Creek, Toby Creek flows down a sparsely populated valley for about 2.0 miles

until it enters the densely populated and highly industrialized Town of Kingston, Pennsylvania. The downstream conditions indicate that a high hazard classification is warranted for Huntsville Dam.

f. Spillway Adequacy.

(1) The spillway will not pass the PMF without overtopping the dam. One-half of the PMF inflow is 8,630 cfs and is greater than the spillway capacity. A check of the surcharge storage effect of Huntsville Reservoir shows that the surcharge storage available is insufficient to contain an inflow with a peak flow of 8,630 cfs without overtopping the dam (Appendix C).

(2) The maximum tailwater is estimated to be Elevation 1115.7 at the spillway capacity of 1,870 cfs. At maximum pool elevation, there is a difference of about 20 feet between headwater and tailwater. If Huntsville 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.

(3) Calculations for depth overtopping with the flashboards in place indicate that the dam would be overtopped by about 8.6 feet during an occurrence of the PMF and by about 6.0 feet during an occurrence of one-half the PMF (Appendix C). Similar calculations for the condition of having the flashboards removed indicate that the depth of overtopping would be about 8.1 feet during an occurrence of the PMF and about 5.4 feet during an occurrence of one-half the PMF. For any of the cases, overflow around the right end of the dam would occur. As discussed in Paragraph 6.1f., it cannot be assumed that the structure can withstand overtopping of the magnitude caused by the PMF or one-half the PMF.

(4) Based on established OCE criteria as outlined in Paragraph 5.1a.(2), the spillway capacity of Huntsville Dam is rated as seriously inadequate. Considering the effects of the surcharge storage of 1,034 acre-feet, the spillway discharge capacity of 1,870 cfs can accommodate a flood with a peak inflow of 3,560 cfs for a storm of the same duration as the PMF without overtopping. This is 21 percent of the PMF peak inflow.

(5) If the flashboards were removed from the crest of the main spillway, the normal reservoir surface would be lowered by about 1.4 feet. This would result in an increase in both available surcharge storage and available maximum spillway head. The total spillway capacity would be increased to 2,640 cfs. This would accommodate a flood with a peak inflow of 5,200 cfs for a storm of the same duration as the PMF without overtopping. This is 30 percent of the PMF peak inflow. If the flashboards were removed, the spillway capacity of Huntsville Dam would still be rated as seriously inadequate.

(6) If both gates on the outlet conduits were operable and if access to them was possible during large floods, the existing discharge capacity for the dam would be increased by about 500 cfs. This is about 20 percent of the total existing spillway capacity as determined for the condition of having the flashboards removed.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspections of the main dam and spillway dam resulted in some observations that are relevant to structural stability. These observations are listed herein for the various features.

(2) Downstream Face of Structure. Mortar was cracked and loose or missing on the downstream face of the structure, and seepage was observed over most of the area. The detailed description and evaluation of the condition are described in Paragraphs 3.1b.(2) and 3.2a.(1), respectively.

b. Design and Construction Data. No records of design data or stability computations for the design of the structure were available for review. However, a stability study was performed in 1914 by the Pennsylvania Water Supply Commission, and the results of the analysis are on file. The 1914 analysis considered the structure as a gravity section. Water level was assumed 3 feet above the spillway crest, and the weight of masonry was assumed to be 160 pcf. The other assumptions for the maximum loading condition were full hydrostatic pressure on the upstream face and uplift varying from two-thirds full at the heel to zero at the toe. The analysis did not include any load for the upstream earthfill, nor did it include any tailwater. The results of the analysis were that the resultant was located outside the middle third about 4.7 feet from the toe, and that toe pressures and resistance to sliding were satisfactory. Consequently, it was concluded that the structure was satisfactory.

A similar analysis was performed for this study, but the loads included 4 feet of water above the spillway crest (water at top of dam), 4 feet of tailwater,

and loads from the upstream earthfill. Considering the structure as a gravity section, the resultant is located outside the middle third and about 1.5 feet from the toe. Toe pressures and the factor of safety against sliding are within acceptable limits. Because no arch analysis was considered, which makes the results conservative, it appears that the structure is stable under the maximum loading conditions prior to overtopping.

c. Operating Records. There is no evidence that any stability problems have occurred for the structure during the operational history of the dam. During the June 1972 Flood, water was within 0.7 foot of the top of the dam, and, according to the Owner, no signs of stability problems were observed.

d. Post-Construction Changes. There have been no modifications to the structure since it was constructed.

e. Seismic Stability. Huntsville Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone is table under static loading conditions, it can be assumed safe for any expected earthquake loading.

f. Ability to Withstand Overtopping. Calculations performed for this study indicate that Huntsville Dam, with the existing flashboards in place, would be overtopped by about 8.6 feet by the PMF and by about 6.0 feet by one-half the PMF (Appendix C). This degree of overtopping would represent a 30 percent increase in loading for the maximum section height of 27 feet and more for lower section heights. There would be no point in figuring stability of the section for these loadings. Even allowance for arch action can not make the section satisfactory for these loads. For overtopping by the PMF, overflow would occur around both ends of the dam, and, for overtopping of the dam by any amount, overflow would occur around the right end of the dam. The erosive effects of this amount of overflow around the ends of the dam with respect to hazard to the dam cannot be assessed. The toe of the center portion of the structure could not be inspected for undermining because of the amount of flow over the structure at the time of the inspection. Consequently, it cannot be assumed that the structure can withstand overtopping of the magnitude caused by the PMF or one-half the PMF.

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, Huntsville Dam is judged to be in good condition. However, deficiencies of varying degree of importance were noted. A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiencies
Dam and Spillways:	
Downstream face	Seepage; mortar in joints cracked and loose or missing.
Crest	Slight vertical irregularities; some capstones displaced laterally; one capstone broken; some joints missing mortar.
Left auxiliary spillway approach channel	Ground in approach area slightly higher than crest level.
Toe of left auxiliary spillway	Stone protection displaced.
Toe of right auxiliary spillway	Erosion beyond end of stone protection.
Main spillway crest	Flashboards reduce capacity.

Feature and Location	Observed Deficiencies
Appurtenant Structures:	
Operating floor of gatehouse	Situated below maximum pool level.
Lower outlet conduit	Gate inoperable.

(2) The overtopping potential analysis shows that Huntsville Dam will be overtopped by the PMF and by one-half the PMF. Computations for depth of overtopping with flashboards in place indicate that the dam would be overtopped by about 8.6 feet during an occurrence of the PMF and by about 6.0 feet during an occurrence of one-half the PMF. With flashboards removed, the depths of overtopping for the PMF and one-half the PMF would be 8.1 feet and 5.4 feet, respectively. Consideration of the ability of the structure to withstand overtopping to these depths indicates that it cannot be assumed that the structure would not fail under overtopping conditions. Based on OCE criteria, as outlined in Paragraph 5.1a.(2), the spillway capacity is rated as seriously inadequate. The existing spillway can accommodate a flood with a peak inflow of 21 percent of the PMF peak inflow without overtopping.

(3) If the flashboards were removed from the crest of the main spillway, the existing spillway would accommodate a flood with a peak inflow of 30 percent of the PMF peak inflow without overtopping.

(4) The 1914 stability computations, computations made for this study, and performance history indicate that for the maximum loading condition before overtopping, the structure would probably be stable.

(5) If both gates on the outlet conduits were operable and if access to them was possible during large floods, the existing discharge capacity for the dam would be increased by about 500 cfs. This is about 20 percent of the total existing spillway capacity, as determined for the condition of having the flashboards removed.

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

c. Urgency. The recommendations in Paragraph 7.2 should be implemented as noted therein.

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. Due to the potential for overtopping of the dam, the following measures are recommended to be undertaken by the Owner immediately.

(1) Remove flashboards from main spillway crest.

(2) Develop a detailed emergency operation and warning system for Huntsville Dam.

(3) Repair slide gate on lower outlet conduit.

(4) Perform additional in depth studies of hydrology and hydraulics to more accurately ascertain the required spillway capacity for Huntsville Dam and the nature and extent of remedial measures required to make the spillway hydraulically and structurally adequate to pass the PMF.

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

(1) Monitor condition of mortar in joints and amount of seepage from downstream face and make repairs when necessary.

(2) Make repairs to capstones on crest of structure.

(3) Excavate high area in approach channel of left auxiliary spillway.

(4) Repair area at toe of left auxiliary spillway where riprap is displaced. Some larger stone should be provided.

(5) Fill gaps in stone protection at toe of right auxiliary spillway and extend protection downstream.

c. The following measures should be undertaken by the Owner as the need arises:

(1) Provide round-the-clock surveillance of Huntsville 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

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

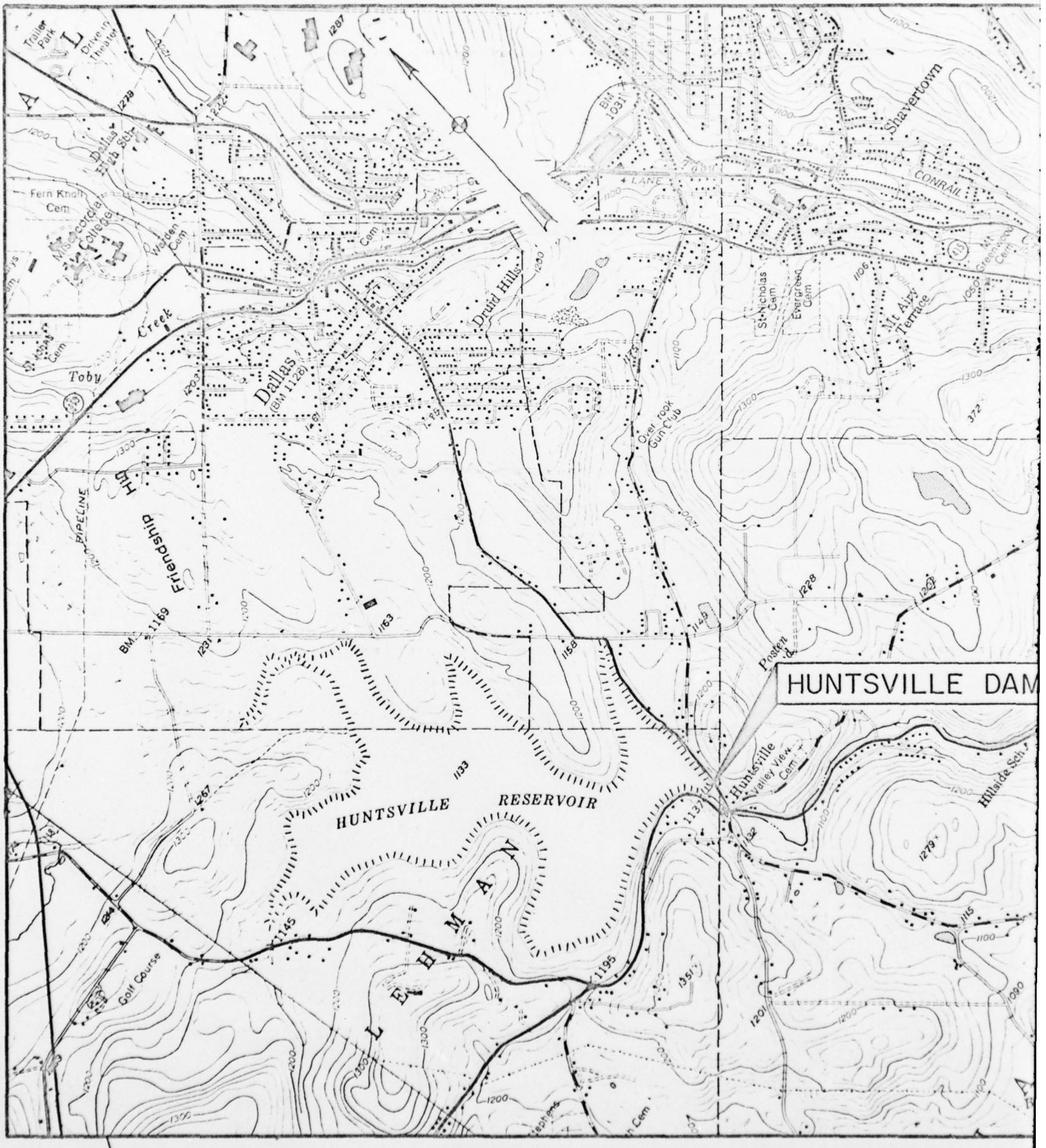
PENNSYLVANIA GAS AND WATER COMPANY

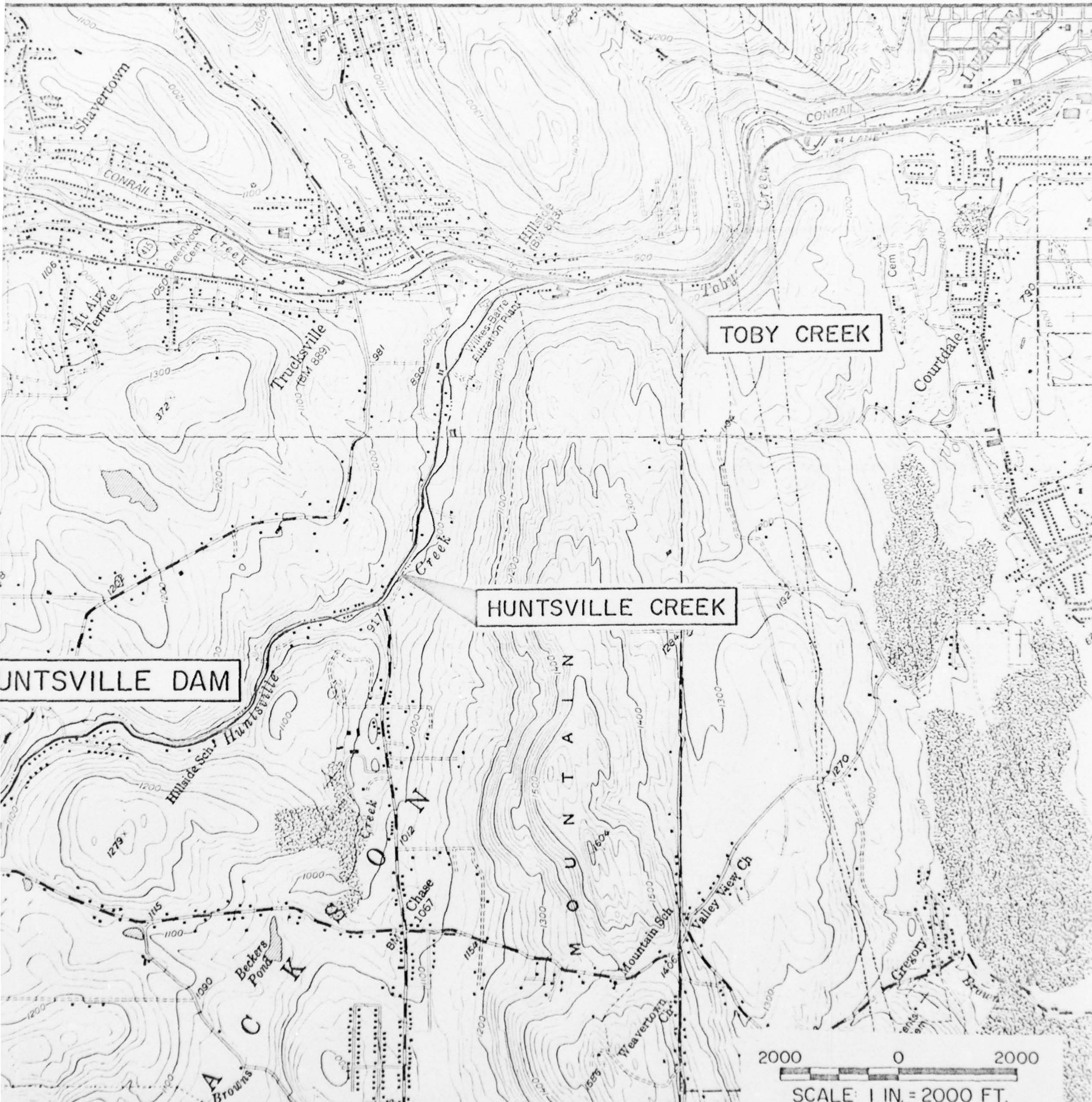
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

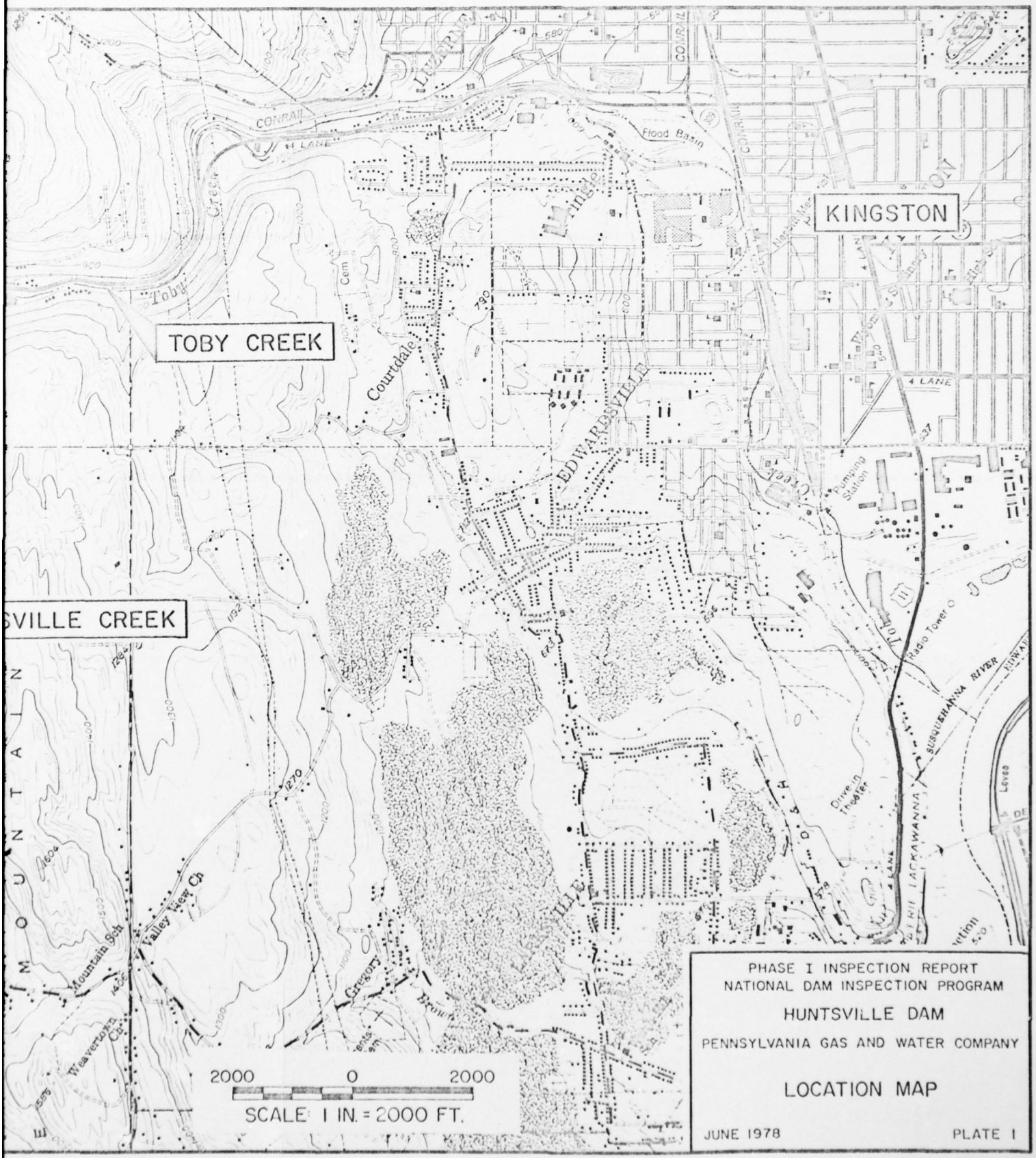
JUNE 1978

PLATES


HUNTSVILLE DAM
HUNTSVILLE RESERVOIR
LEHMAN
Dallas
(BM 1126)
Druid Hills
Shavertown
Toby Creek
Friendship
Fern Knoll Cem
Misericordia College
Dallas High Sch
Trailer Park
Drive-in Theatre
Walden Cem
Over Rock Gun Club
Mt Airy Terrace
St Nicholas Cem
Evergreen Cem
Mt Greenwood Cem
Huntsville Valley View Cem
Hillside Sch
Golf Course
CONRAIL
4 LANE
PIPELINE
BM 1169
BM 1031
Posten Rd


TOBY CREEK
HUNTSVILLE CREEK
UNTSVILLE DAM
Shavertown
CONRAIL
Mt Airy Terrace
Trucksville
Hillside
Wilkes-Barre Filtration Plant
Toby Creek
Courtdale
Cem
Huntsville Creek
Hillside Sch
Chase
Beckers Pond
Browns
Mountain Sch
Valley View Ch
Weavertown Ch
Gregory
JACKSON
MOUNTAIN
2000
0
2000
SCALE: 1 IN. = 2000 FT.

2



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

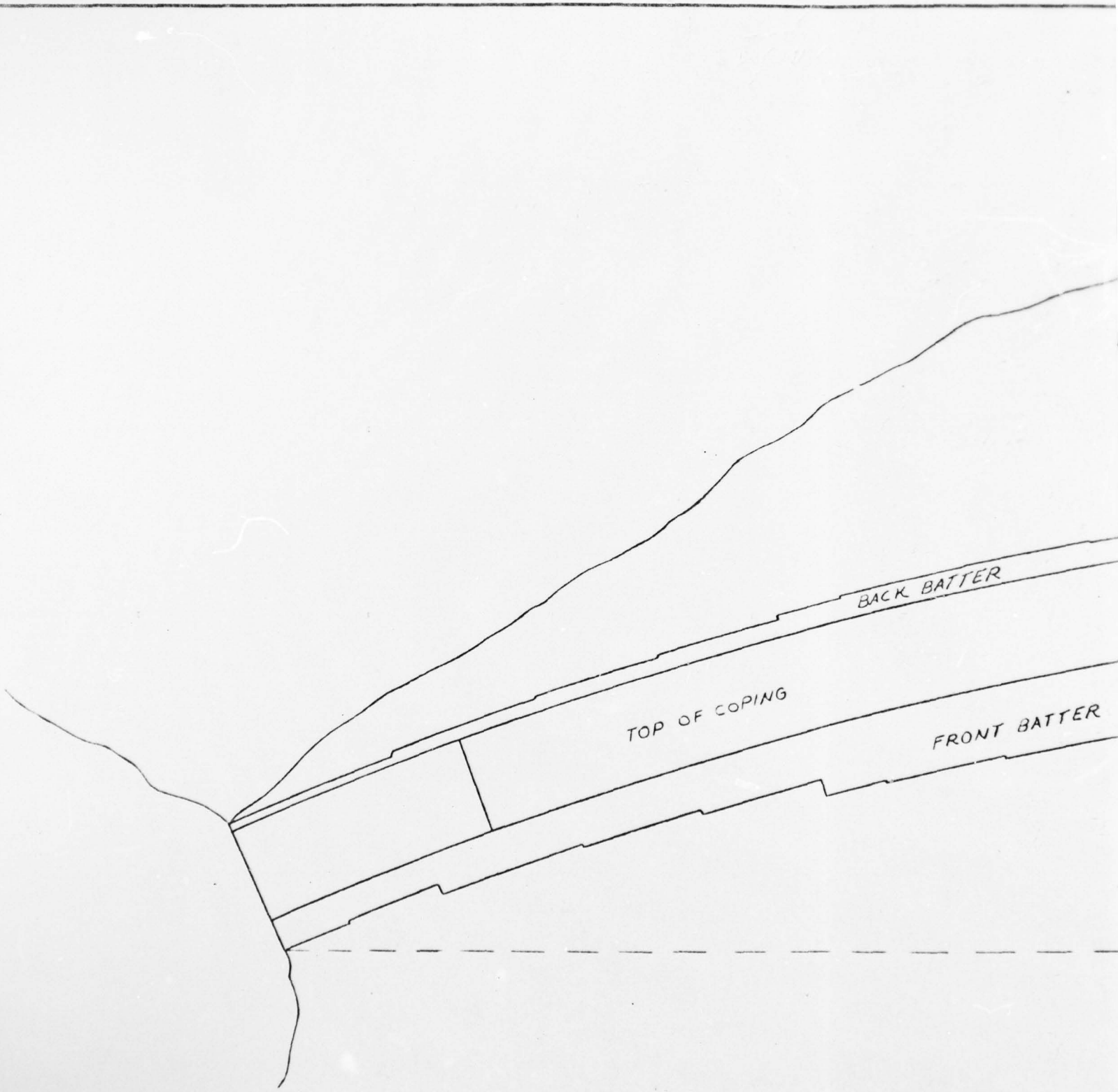
HUNTSVILLE DAM

PENNSYLVANIA GAS AND WATER COMPANY

LOCATION MAP

JUNE 1978 PLATE 1

3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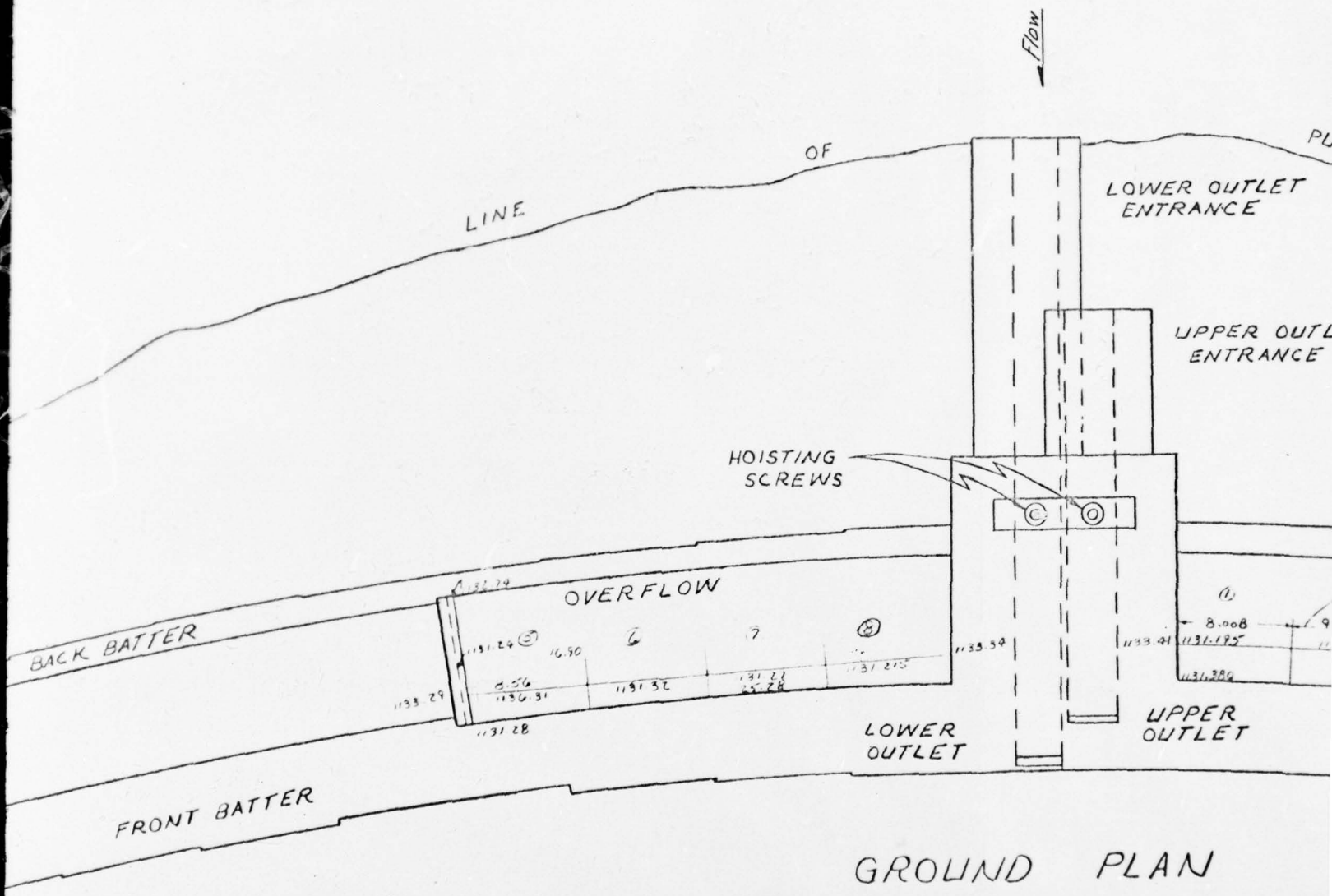

GROUND PLAN

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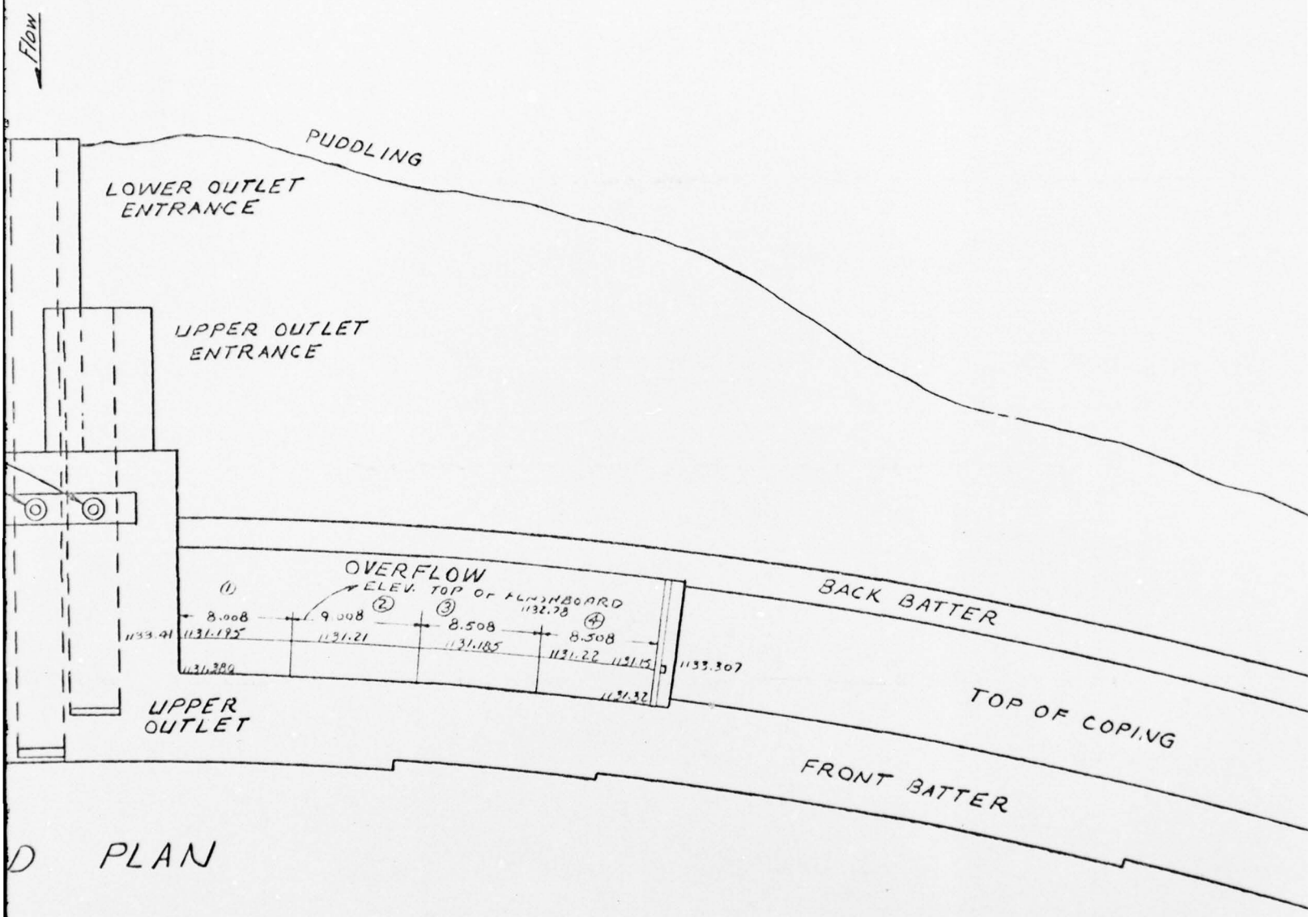

D PLAN

ORD = 240 FT.

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NATIONAL DAM INSPECTION PROGRAM

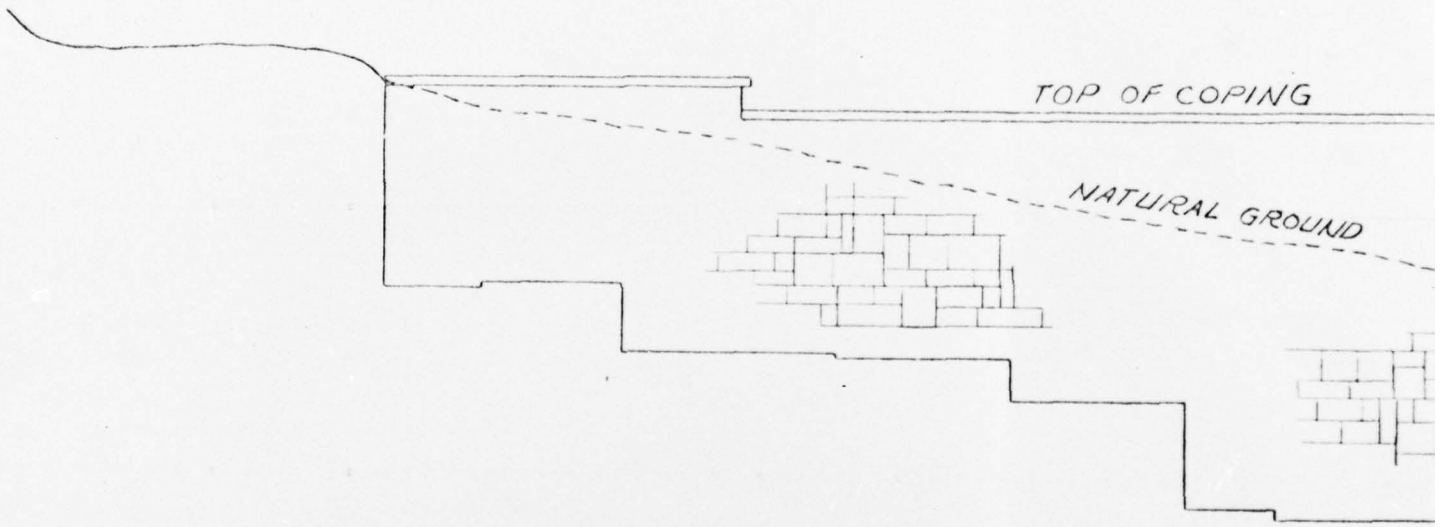
HUNTSVILLE DAM

PENNSYLVANIA GAS AND WATER COMPANY

GENERAL PLAN

JUNE 1978 PLATE 2

4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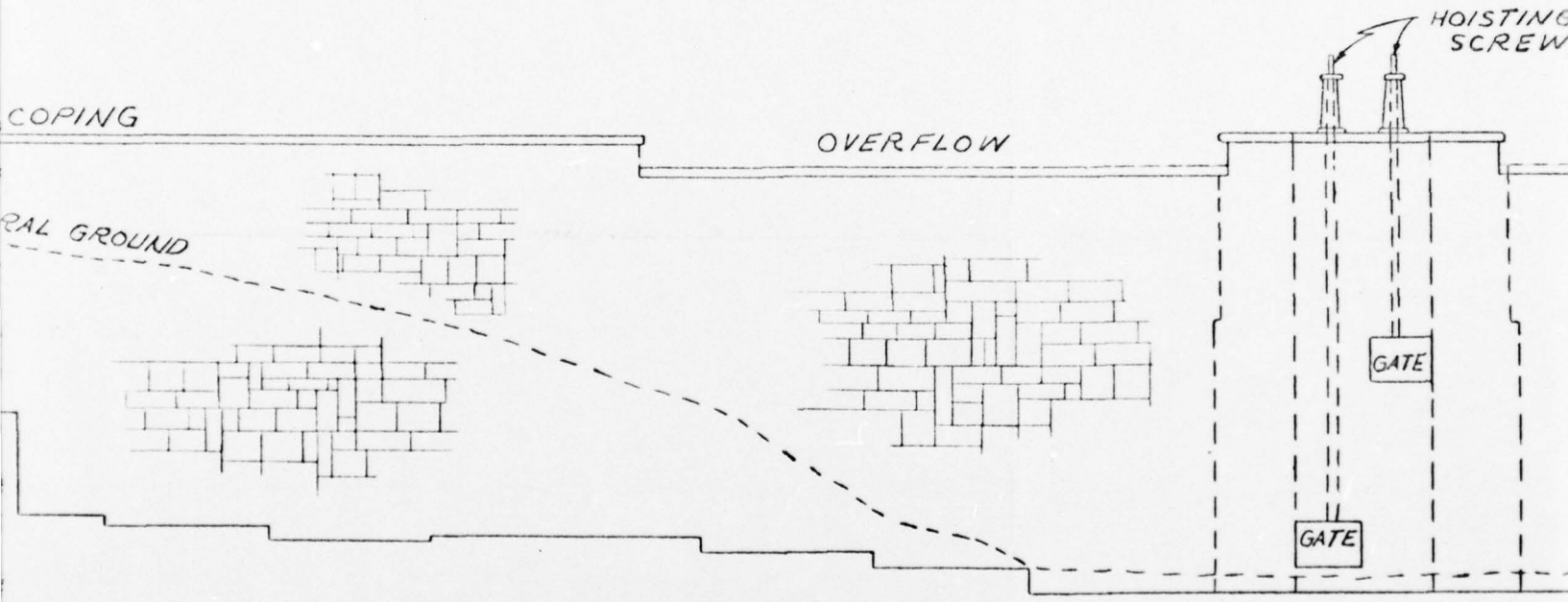
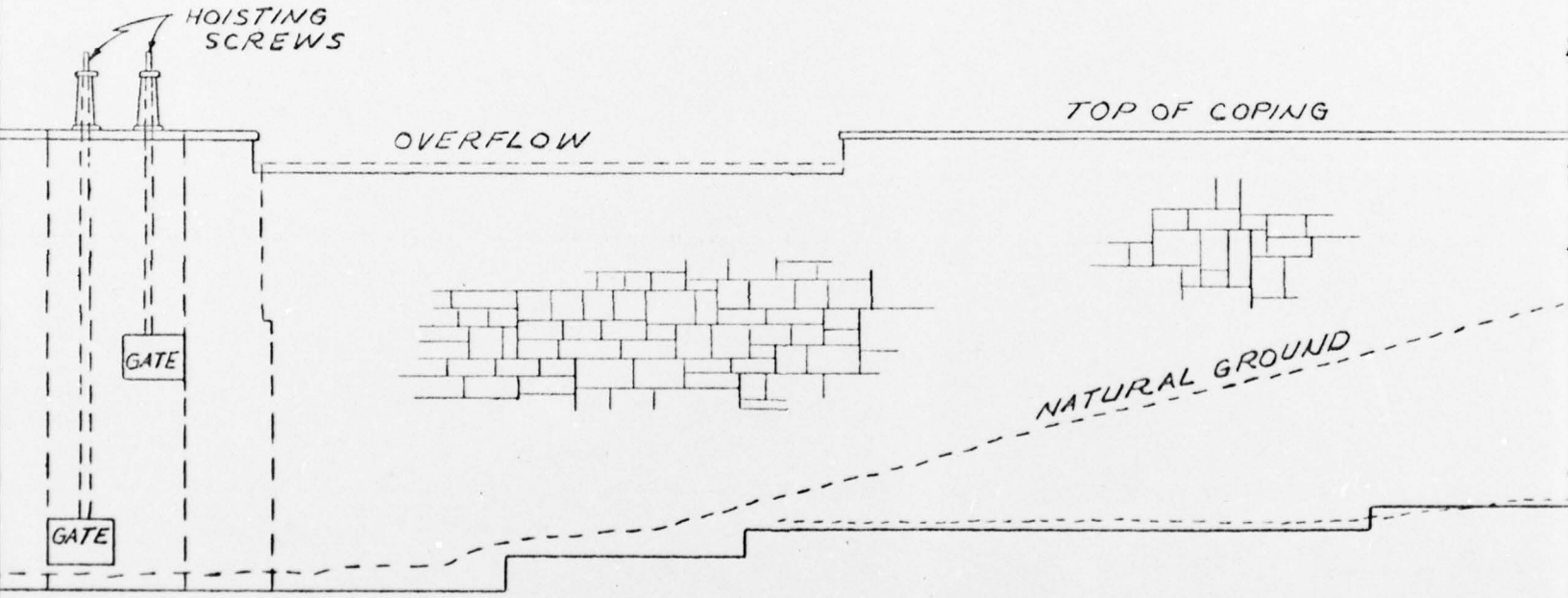
NATURAL GROUND



FRONT ELEVATION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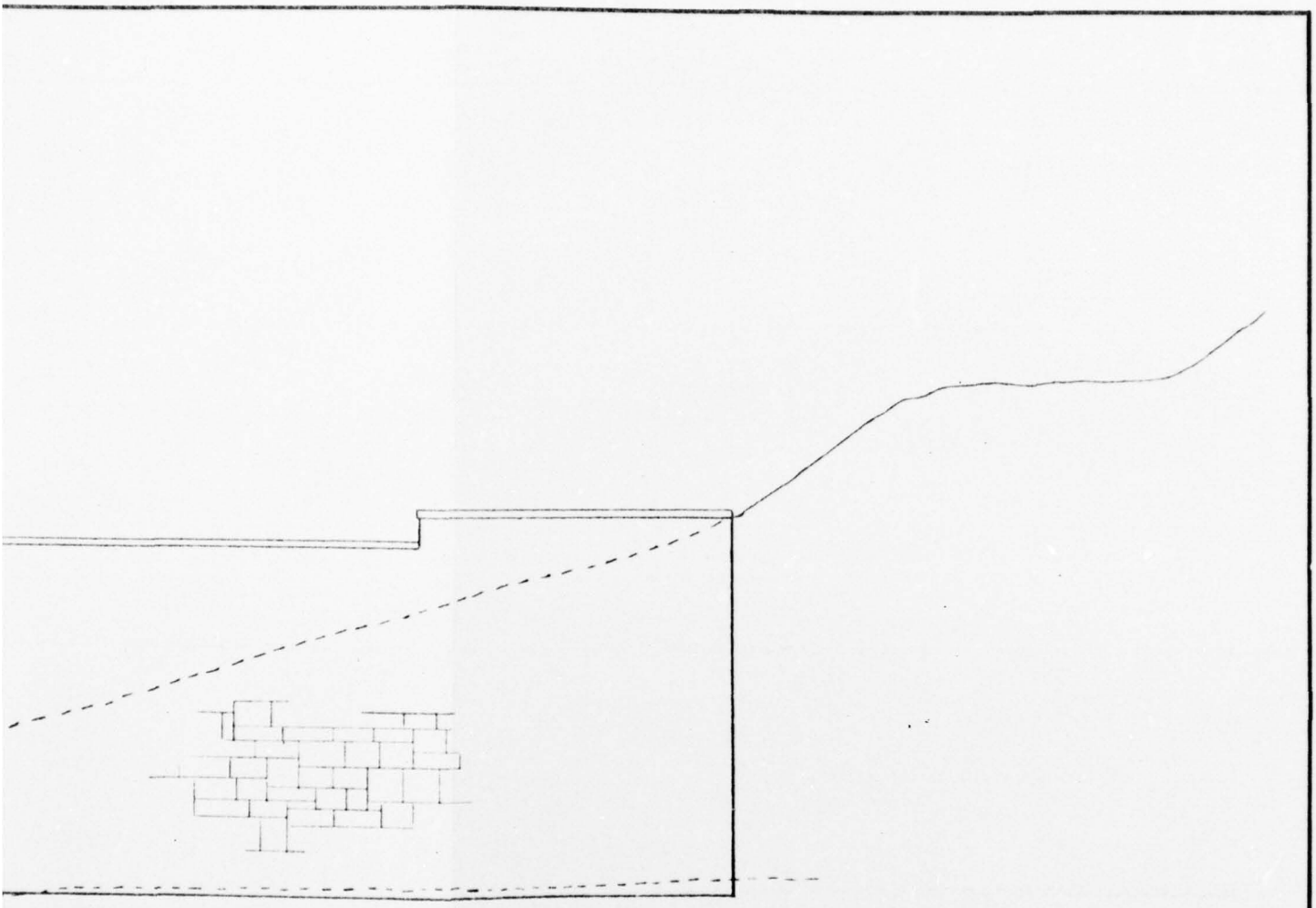
OVERFLOW
GATE
GATE
NATURAL GROUND

ELEVATION



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NATIONAL DAM INSPECTION PROGRAM

HUNTSVILLE DAM

PENNSYLVANIA GAS AND WATER COMPANY

PROFILE ALONG AXIS OF DAM

JUNE 1978 PLATE 3

Cross Section showing
and quantity of water
in Castle Reservoir
heights designated

Scale 1'=3'

Estimate of quantities as
calculated October, 1895

W. H. Sliderroot
C. E.

Dec'd

377.4 ACRES

360.7 "

344.1 "

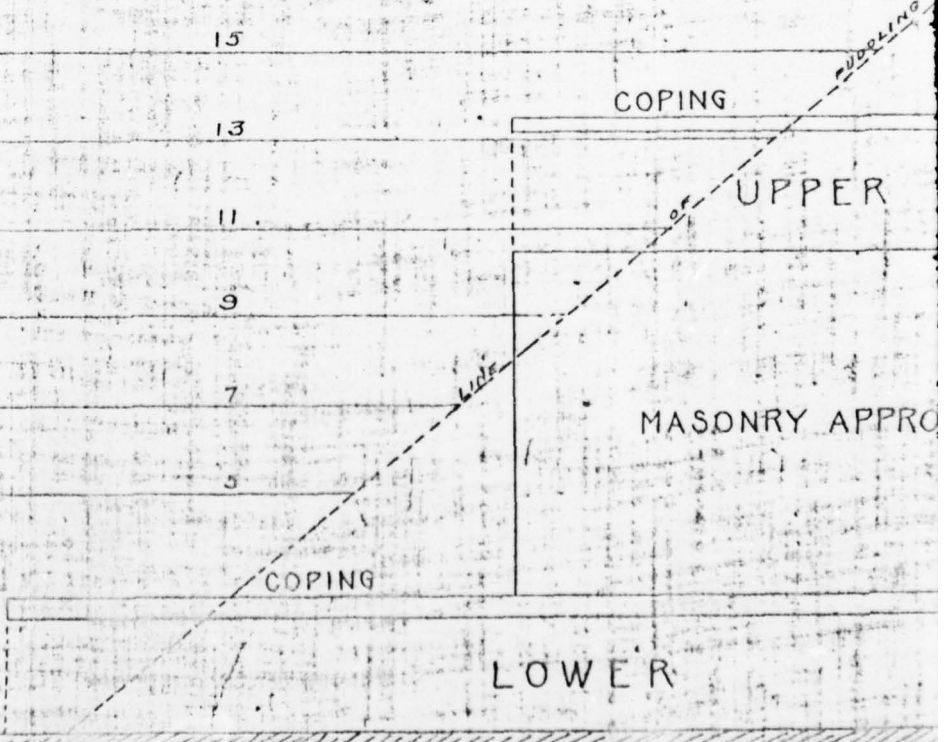
327.4 "

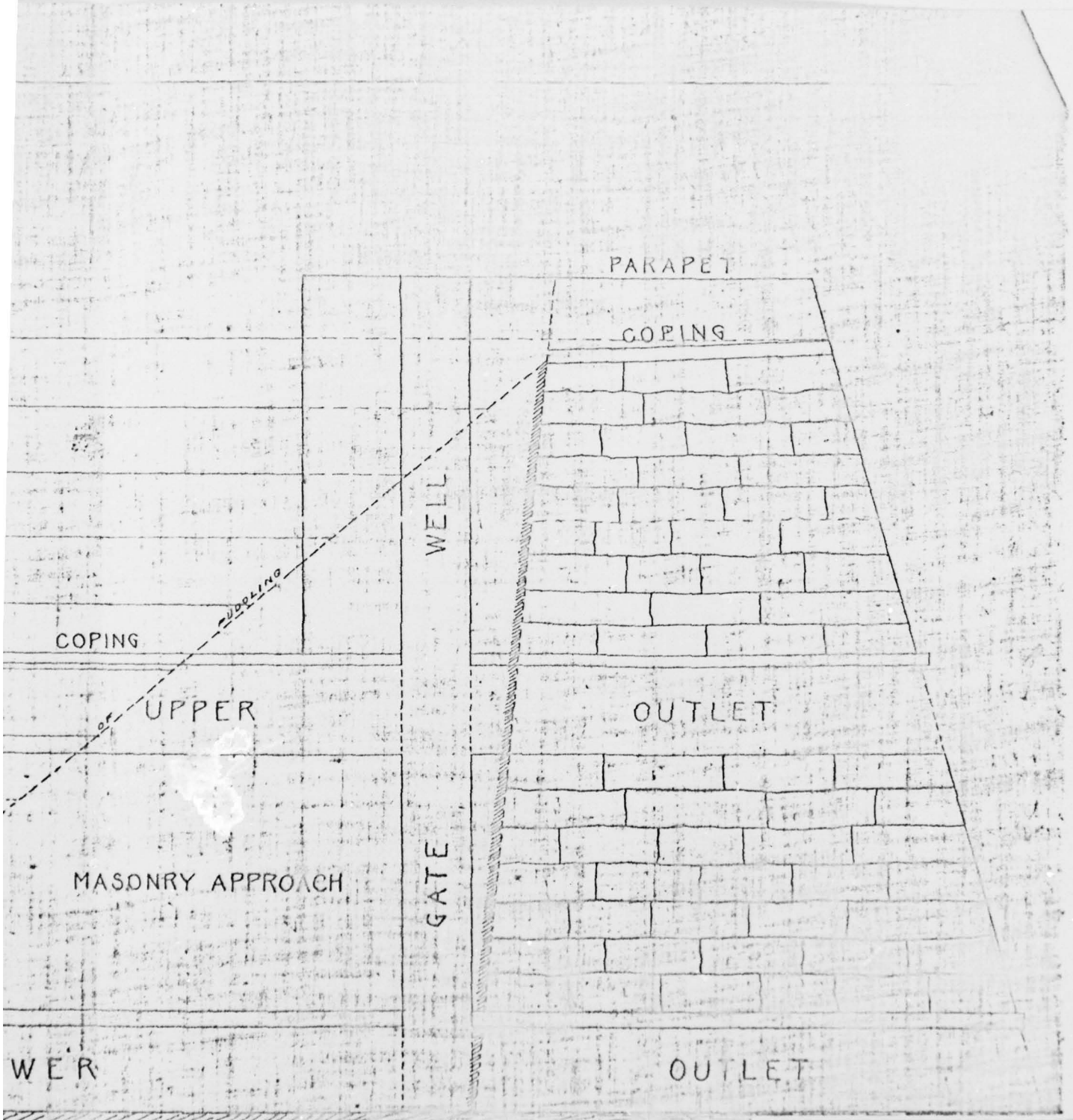
310.8 "

294.1 "

272.7 "

1,739,485,830	GALLONS	23 FT.
1498,364,475	"	21
1,268,113,840	"	19
1,048,739,925	"	17
840,236,730	"	15
642,606,255	"	13
457,416,045	"	11
300,117,904	"	9
181,552,807	"	7
92,628,985	"	5





PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

HUNTSVILLE DAM

PENNSYLVANIA GAS AND WATER COMPANY

SECTION THROUGH DAM

JUNE 1978 PLATE 4

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JUNE 1978

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: Huntsville Dam

NDS ID NO.: PA-00553 DER ID NO.: 40-5

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	Available.
REGIONAL VICINITY MAP	Project is shown on USGS Quadrangle Sheet Kingston, Pennsylvania, N4115-W7552.5/7.5, 1946, Photorevised 1969.
CONSTRUCTION HISTORY	Constructed in 1891 by the West Side Water Company.
TYPICAL SECTIONS OF DAM	One section available.
OUTLETS: Plan Details Constraints Discharge Ratings	Plan and section available. No details or discharge ratings.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	1914: Analyses of hydrology, hydraulics, and stability by Pennsylvania Water Supply Commission.
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	None.
POSTCONSTRUCTION SURVEYS OF DAM	None.

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	Unknown.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	June 1972: Elevation 1134.3 (approx.).
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1914: Evaluation of hydrology, hydraulics, and stability by Pennsylvania Water Supply Commission. 1973: Evaluation of effects of blasting at quarry 1.5 miles away by PennDER.
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	None.

ENGINEERING DATA

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	No detailed operation records. Joints repointed 1928; Joints grouted and repointed 1962.
SPILLWAY: Plan Sections Details	Available.
OPERATING EQUIPMENT: Plans Details	Plan and section only. No details.
PREVIOUS INSPECTIONS Dates Deficiencies	1914: Seepage through mortar joints. 1919: Same as 1914. 1924: Considerable seepage through mortar joints. 1928: Repair work on joints in progress. 1932: Some seepage through mortar joints. 1934: Same as 1932. 1941: Seepage through mortar joints; one capstone broken; leakage at sluice gate and at right end of dam. 1943: Same as 1941. 1964: Leakage at right end. 1975: No defects noted.

CHECKLIST

ENGINEERING DATA

HYDROLOGY AND HYDRAULICS

NAME OF DAM: Huntsville Dam NDS ID NO.: PA-00553 DER ID NO.: 40-5

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): Elevation 1132.5

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Elevation 1135.1

ELEVATION MAXIMUM DESIGN POOL: Elevation 1135.1

ELEVATION TOP DAM: Elevation 1135.1.

SPILLWAY CREST:
- a. Elevation Main - 1131.1 Auxiliary - 1133.1
- b. Type Main and Auxiliary - Broad crested with free overfall
- c. Width Main and Auxiliary - 8.5 feet
- d. Length Main - 65 feet Auxiliary - 126 feet.
- e. Location Spillover Center portion of dam.
- f. Number and Type of Gates Flashboards on Main Spillway-Elevation 1132.5

OUTLET WORKS:
- a. Type Two masonry conduits; each 3.7' wide x 2.7' high
- b. Location Center of dam
- c. Entrance Inverts Upper - 1119.1 Lower - 1108.1
- d. Exit Inverts Upper - 1119.1 Lower - 1108.1
- e. Emergency Draindown Facilities Lower Outlet Conduit.

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

MAXIMUM NONDAMAGING DISCHARGE: Unknown.

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JUNE 1978

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: Huntsville Dam County: Luzerne State: Pennsylvania

NDS ID No.: PA-00553 DER ID No.: 40-5

Type of Dam: Masonry Arch Hazard Category: High

Date(s) Inspection: 25 May 1978 Weather: Clear Temperature: 68°

Pool Elevation at Time of Inspection: 1132.7 msl/Tailwater at Time of Inspection: 1109.0 msl

Inspection Personnel:

D. Wilson (GFCC)	D. Ebersole (GFCC)	J. Chernesky (DER)
W. Seip (GFCC)	G. Rogers (PG&W)	
D. Wolf (GFCC)	D. Kaufman (PG&W)	

D. Wilson (GFCC) Recorder

CONCRETE/MASONRY DAMS (Applicable for entire structure)

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	1. General seepage from downstream face ranging from drips to 3-5 gpm. 2. Worst single leak was about 25 gpm.	1. Could not estimate total seepage. 2. Located at raised center section of structure.
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	1. Right abutment: adjacent roadway about 2 feet lower. 2. Left abutment: adjacent roadway about 6 feet higher.	1. Section of high ground prevents overflow around right end of dam. Overflow would travel along road.
DRAINS	None.	
WATER PASSAGES	Two conduits (each 3.7' high x 2.7' wide) at center of structure.	See Outlet Works.
FOUNDATION	No observed problems.	Rock outcrop across road at right abutment is thinly bedded gray sandstone; nearly horizontal beds 1" - 2" thick.

CONCRETE/MASONRY DAMS (Applicable for entire structure)

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES: Surface Cracks Spalling	1. Capstone on right auxiliary spillway broken.	
STRUCTURAL CRACKING	None.	
ALIGNMENT: Vertical Horizontal	1. ± 2-inch vertical variation in stones on crest. 2. Capstones on right side displaced horizontally.	1. Might be normal tolerances. 2. Caretaker said displaced by ice.
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Mortar in joints on downstream face generally cracked and loose or missing. Mortar missing on some crest joints.	Caretaker said last repointing was 1962.
STAFF GAGE OR RECORDER	Staff gage stored in gatehouse.	Apparently not used.

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	Some cracks in walls of brick gatehouse.	Operating floor of gatehouse would have 2 feet of water at maximum pool level.
OUTLET STRUCTURE	None.	
OUTLET CHANNEL	Natural stream channel.	
EMERGENCY GATE	1 slide gate on each 3.7' x 2.7' conduit in wet well.	Slide gate on lower outlet conduit does not work.

UNGATED SPILLWAY (Auxiliary Spillway)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Not applicable.	
APPROACH CHANNEL	1. Right section: no constraints. 2. Left section: ground in approach higher than crest over left half of section.	
DISCHARGE CHANNEL	1. Right section: protected with derrick stone; some voids. 2. Left section: protected with 1"-2" thick x 12" diameter sandstone; slabby.	1. Some erosion beyond limit of stone protection. 2. Uneven; apparently some movement; no gaps.
BRIDGE AND PIERS	Plank bridge (2-1/2" thick x 24" wide) from auxiliary spillways to raised center section.	Bridge supports bolted to main spillway crest and to flashboards.
OTHER	12" diameter pine trees located in downstream area.	

GATED SPILLWAY (Main Spillway)

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY SILL	Has 1-1/2" thick x 18" high oak flashboards. Right section: 4 - 3x3x1/4 angles plus 3 bridge supports; Left section: 7 smaller angles plus 3 bridge supports.	Not normally removed. Caretaker said they did not fail in June 1972 Flood (2 feet over boards).
APPROACH CHANNEL	Plank bridges over flashboards; 0.6 foot clearance.	
DISCHARGE CHANNEL	Natural stream channel.	
BRIDGE AND PIERS	Raised center section between main spillway sections.	Has outlet works facilities located here.
GATES AND OPERATION EQUIPMENT	Flashboards are not removed.	

INSTRUMENTATION

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	USGS benchmark on top of dam right side.	USGS B.M. - T.T. 43 K
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 instability. Slopes generally mild.	
SEDIMENTATION	No major problems reported by Owner.	
WATERSHED DESCRIPTION	Hilly; partially owned by PG&W; some wooded areas; some agricultural and residential.	Some new development in progress.

DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	Wooded slopes; generally steep, narrow valley.	No obstructions.
SLOPES	No undue erosion.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Entire valley is moderately developed below dam.	

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

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JUNE 1978

APPENDIX C

HYDROLOGY AND HYDRAULICS

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

SUBJECT Huntsville Dam — FILE NO. 7613.1M
Hydrology and Hydraulics — SHEET NO. 1 OF 8 SHEETS
FOR USCE - Baltimore
COMPUTED BY DAW DATE 5/2/78 CHECKED BY FFM DATE 6-78

Classification — (Ref. Recomended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as high since the downstream population is 86. (PD-8)
2. The size classification is intermediate since the storage is 6910 Ac.-Ft and the height of the dam is 27 feet. (PD-9)

Spillway Design Flood - (Ref. Recomended Guidelines for Safety Inspection)

The Spillway Design Flood (SDF) should be the PMF based on the above classification of the dam.

Hydrology and Hydraulics Analysis - (Ref. Phase I Procedure Package)

II.A.2. The PMF inflow hydrograph is not available.

a. Contact with Mr. Michael Konowitz, Baltimore District indicates that the PMF for Aylesworth Creek (D.A. = 6.22 Mi^2 PMF$_{peak}$ = 13700cfs) can be used for Huntsville Dam (D.A. = 8.3 Mi^2) after adjustment for drainage Area.

$$\text{Huntsville Creek} = 13{,}700\left(\frac{8.3}{6.22}\right)^{0.8} = 13700 \times 1.26 = 17{,}260 \text{ cfs}$$

There are no reservoirs upstream of Huntsville Dam

b. Spillway Capacity Determination

Max. Water Level

Aux Spillway Length 59+59 = 118'
Width 8.5'
C 3.09
H 2.0'

$Q_{AUX} = 3.09 \times 118 \times (2)^{3/2} = 1031$ cfs

SP 11860A

Main Spillway Length = 65'
Width = 8.6'
C = 3.09
H = 1135.1 − 1132.5 = 2.6' (flashboards in place)

$Q = 3.09 \cdot 65 \cdot (2.6)^{3/2} = 842 \text{ ft}^3/\text{sec}$

Total = 1031 + 842 = 1873 cfs say 1870 cfs

B.2 PMF peak flow is greater than spillway capacity
17,260 cfs > 1870 cfs

3.a. Routing of the PMF inflow hydrograph is not available

C. Procedures for determination of adequate/inadequate spillway capacity (Ref inclosure 3)

1. % of PMF which will pass spillway
(spillway capacity ÷ PMF peak) × 100 =
(1870/17,260) × 100 = 10.8% = P

2. Estimation of storage effect.
a. Triangular hydrograph assumed
b. Volume of PMF Hydrograph = 24" of runoff
∴ 2' × 8.3 mi² × 640 $\frac{Ac}{Mi^2}$ = 10,624 Acre-Ft

$$b = \left(10{,}624 \times \frac{43{,}560}{3600} \times 2\right) \div 17{,}260 = 14.9 \text{ hrs}$$

3. Incremental Storage Available

Elev	Height	Gallons	Ac-Ft.	Δ	Δ'	
	19	1,268,113,840	3892	707	32	
	21	1,498,364,475	4599	739		
Spillway 1131.1	23	1,739,485,830	5338	(771)	(32)	(assumed)
Aux. 1133.1	25	extended	(6109)	(803)	(32)	
Top of Dam 1135.1	27	extended	(6912)			

$$\Delta S = 6912 - \left[\left(\frac{1132.5 - 1131.1}{2} \times 771\right) + 5338\right] = 1034 \text{ Acre-Ft}$$

2. Storage Required > Storage Available
   10,624 > 1034

a. ETL 1110-2- states that 3 conditions must exist before the spillway capacity is considered to be seriously inadequate. Check condition "C" ability to pass ½ PMF

$\frac{1}{2}$ PMF Peak = $\frac{1}{2}(17,260) = 8630$ cfs

II B. Ability of Spillway to pass ½ PMF

1. Spillway Capacity 1870 cfs

3. ½ PMF Peak flow is greater than spillway capacity
   8630 > 1870

b. Routing of ½ PMF is not available

(1) the spillway will pass $(1870/8630) = 21.7\% = P$ of the ½ PMF

(2) inclosure 3 method of estimating storage effect

(a) triangular shape for ½ PMF inflow hydrograph

(b) same as sheet 2 except for peak

$1-P = 1-0.217 = 0.783 = \frac{\Delta AOC}{\Delta AOB}$

$\Delta AOB = 1' \times 8.3 \times 640 = 5312$ Acre-Ft.

(c) incremental storage from Sheet 2 = 1034 Ac.-Ft.

Storage required > storage available
0.783 · 5312 = 4159 > 1034

c. Procedures for determining 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 Spillway are not capable of passing ½ PMF without overtopping failure.

% PMF which will pass spillway

$$\% = \frac{\text{Spillway capacity} + (2S/T)}{\text{PMF peak}} \times 100 = \frac{1870 + \left(\frac{2 \times 1034 \times 3560}{14.9 \times 3600}\right)}{17,260}$$

$\% = 20.6\%$ $\therefore Q_{max} = 17,260 \times .206 = 3556$ cfs

SP 11860A

c. Tailwater at instant before overtopping occurs

1. Estimate Tailwater Depth

Q	Depth	
0	0	
1665	5.78	from HEC-2 computer Run
1870	6.49	Calculated

2. Estimate ΔH

a. Top of Dam Elev = 1135.1 GFCC Survey
b. Bottom of Dam Elev = 1109.2 "
c. Tailwater Depth - 6.5 above
d. tailwater Elev = 1115.7
e (a - d) = ΔH = 19.4 ft.

Spillway Capacity Determination
Flashboards Removed.

Auxiliary Spillway

Length = 59' x 2 = 118'
Width = 8.5'
C = 3.09
H = 2.0

$Q_{max} = 3.09 \times 118 \times (2)^{1.5}$ = 1030 cfs

Main Spillway

Length = 65'
Width = 8.6'
C = 3.09
H = 1135.1 - 1131.1 = 4.0

$Q_{max} = 3.09 \times 65 \times (4)^{1.5}$ = 1607 cfs

Total 2637 cfs
say 2640 cfs

Surcharge Storage

$\Delta S = 6912 - 5338 = 1574$ Acre-Ft. (see page 2)

Percent of PMF which can pass spillway if flashboards are removed

$$\% = \frac{2640 + \left(\frac{2 \cdot 1574 \cdot 43560}{14.9 \times 3600}\right)}{17260} \times 100 = 30.1\%$$

peak of inflow hydrograph with PMF base

$0.301 \times 17{,}260 = 5195$ cfs.

1. Determine Elev - Outflow

for $1132.5 < H < 1135.1$ flashboards in place

$$Q = 3.09\left[65(H-1132.5)^{3/2} + 118(H-1133.1)^{3/2}\right]$$

Assume that an extra 30' will occur along the road at the right abutment.

$$Q = 3.09\left[65(H-1132.5)^{1.5} + 118(H-1133.1)^{1.5} + 74(H-1135.1)^{1.5}\right]$$

	H	ft above spillway crest	Q	S - see p. 2
Top of Dam →	1135.1	4	1873	1034
	1136.1	5	3495	1451
	1137.1	6	5545	1869
	1138.1	7	7926	2302
	1139.1	8	10593	2736
	1140.1	9	13517	3185
	1141.1	10	16676	3635

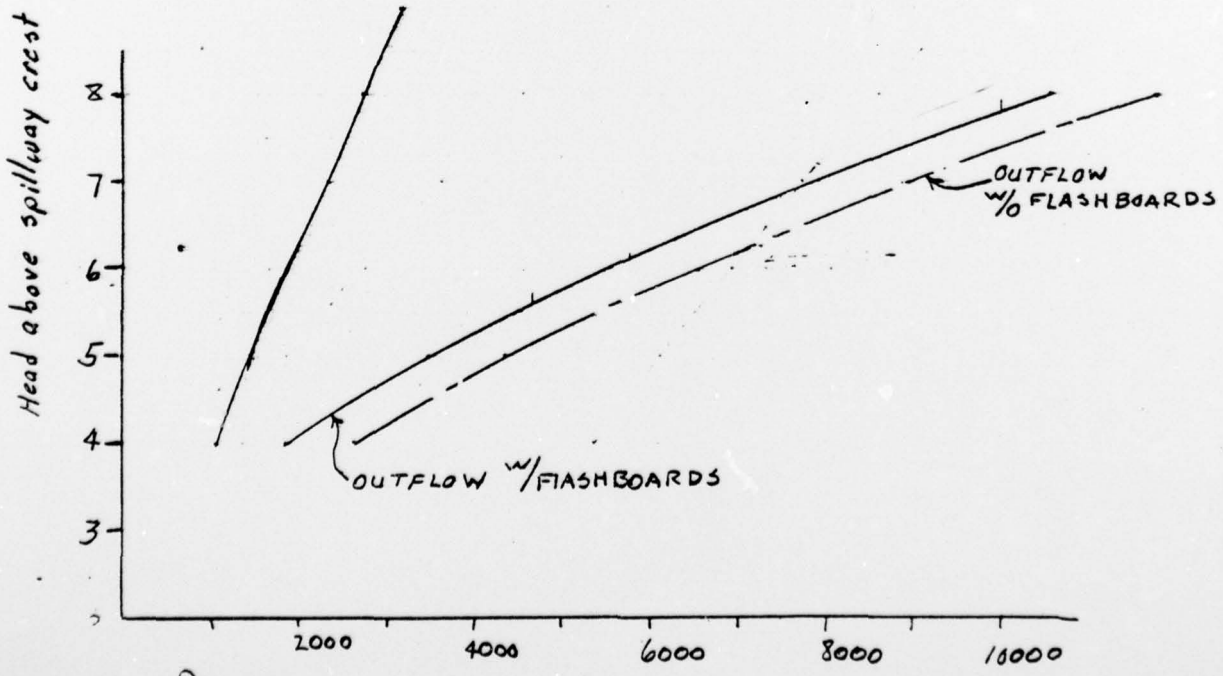

Fig. 1. OUTFLOW IN cfs OR STORAGE IN Acre-Ft

SP 11860A

Determine Overtopping at $Q = 17{,}260$ cfs with flashboards

$$Q_{in} = Q_{spillway} + \frac{2S \cdot 43560}{14.9 \times 3600}$$

$$Q_{in} = 17{,}260 = Q_s + 1.624\,S$$

@ $H = 8.0'$ $Q_s = 10{,}593$ cfs, $S = 2736$ Acre-ft - Fig 1.

$$Q_{in} = 15{,}036 \text{ cfs}$$

@ $H = 9$, $Q_s = 13{,}517$ $S = 3185$ - Fig 1

$$Q_{in} = 18{,}690 \text{ cfs}$$

interpolate $H = 8.0 + \left(\frac{17260 - 15036}{18690 - 15036}\right) = 8.0 + 0.6 = \underline{8.6'}$

Determine Overtopping at $Q = 17{,}260/2 = 8630$ with flashboards

$Q_{in} = 5545 + 1.624 \times 1869 = 8580$ @ $H = 6$

$Q_{in} = 7926 + 1.624 \times 2302 = 11{,}664$ @ $H = 7$

interpolate $H = 6.0 + \left(\frac{8630 - 8580}{11{,}664 - 8580}\right) = 6.0 + 0.02 = 6.0'$

Without flash boards, use

$$Q = 3.09\left[65(H - 1131.1)^{1.5} + 118(H - 1133.1)^{1.5} + 74(H - 1135.1)^{1.5}\right]$$

H	Q
4	2638
5	4368
6	6515
7	8984
8	11732
9	14732

plotted on fig 1.

Determine Overtopping at Q=17,260 w/o flashboards
add 540 Acre-Ft to correct S for flashboard removal

@ H = 8'

$$Q = 11,732 + 1.624(2736+540) = 17,052$$

@ H = 9'

$$Q = 14,732 + 1.624(3185+540) = 20,782$$

interpolate $H = 8 + \frac{17,260 - 17052}{20,782 - 17052} = 8.0 + 0.06 = 8.1$

Determine Overtopping at Q = 8630 w/o flashboards

@ H = 5.0

$$Q = 4368 + 1.624(1451+540) = 7602$$

@ H = 6.0

$$Q = 6515 + 1.624(1869+540) = 10428$$

$$H = 5 + \left(\frac{8630 - 7602}{10428 - 7602}\right) = 5 + 0.36 = 5.4'$$

		W/FLASHBOARDS		W/o FLASHBOARDS	
summary	Q	H	EL	H	EL
PMF	17,260	8.6	1139.7	8.1	1139.2
½ PMF	8,630	6.0	1137.0	5.4	1136.5

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
DER ID No. 40-5

PENNSYLVANIA GAS AND WATER COMPANY

PHASE I INSPECTION REPORT

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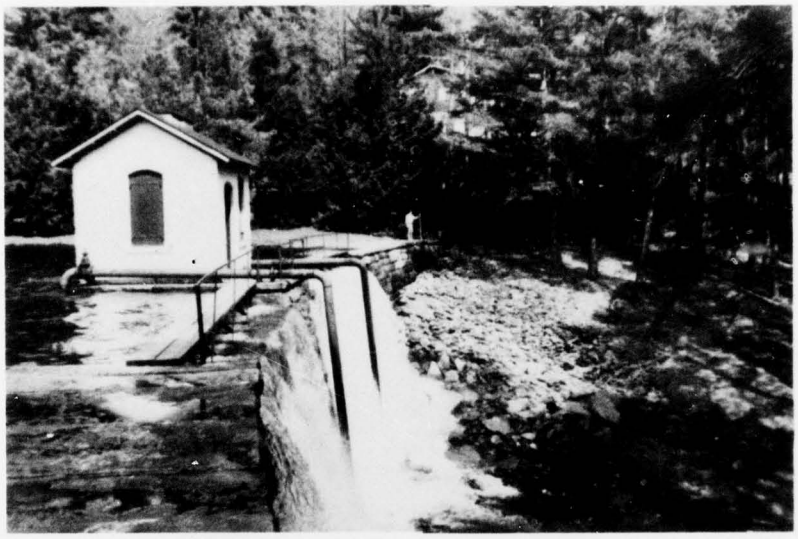
APPENDIX D

PHOTOGRAPHS

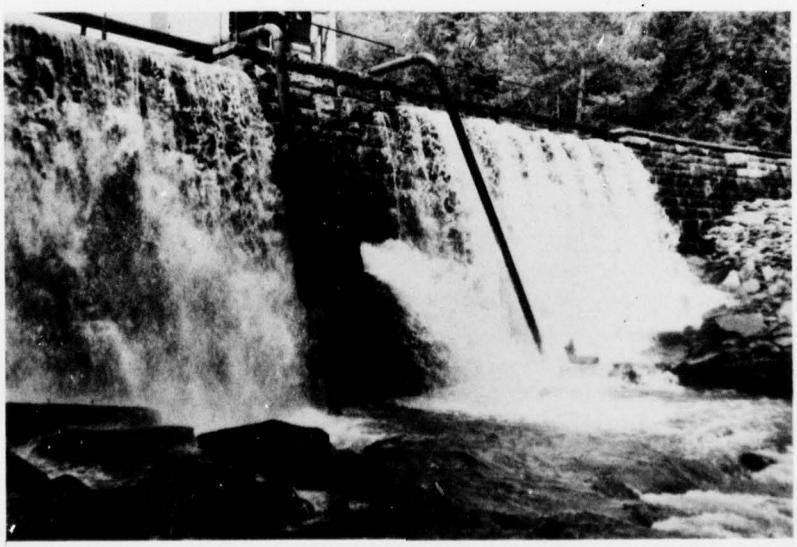
HUNTSVILLE DAM

A. Top of Dam and Auxiliary and Main Spillways. Access to Gatehouse is Plank Footbridge Over Main Spillway.

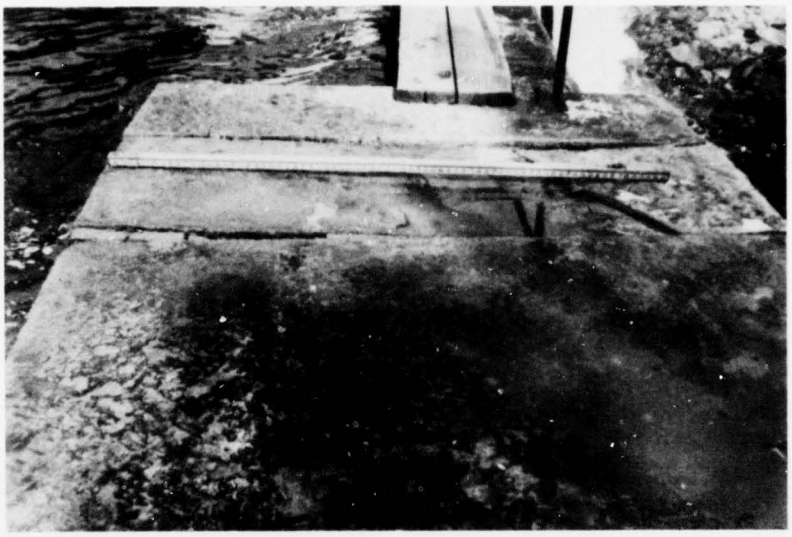
B. Downstream Face of Dam. Looking Toward Right Abutment.



C. Downstream Face of Dam,
Left Abutment and Riprap at
Downstream Toe of Left Auxiliary Spillway.

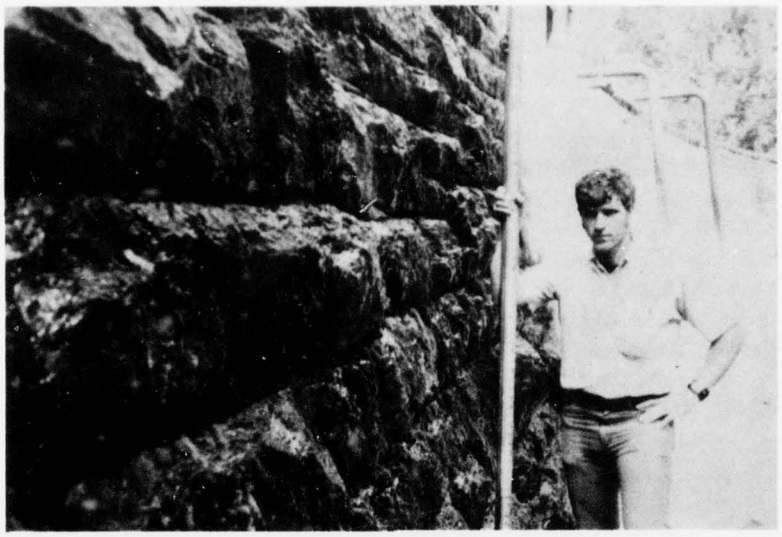


D. Upper Outlet Conduit During Operation.
Leakage from Dam Visible Above Conduit.



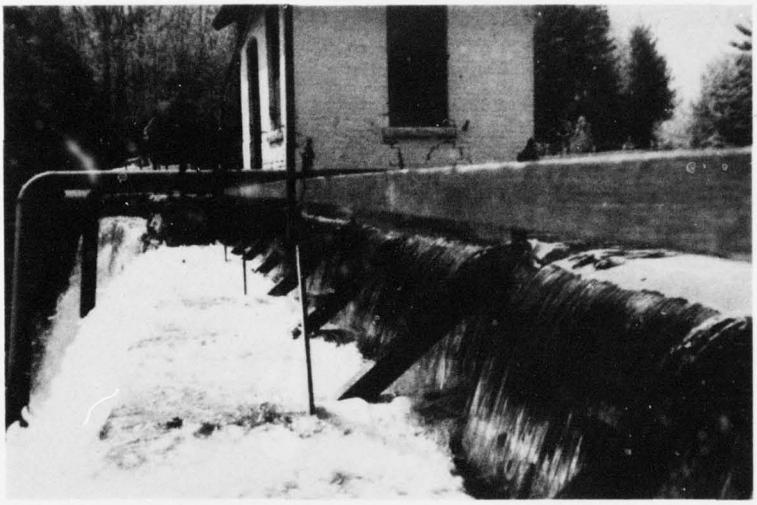
E. Broken Capstone and Missing Mortar at End of Right Auxiliary Spillway

F. Sandstone Riprap Below Left Auxiliary Spillway

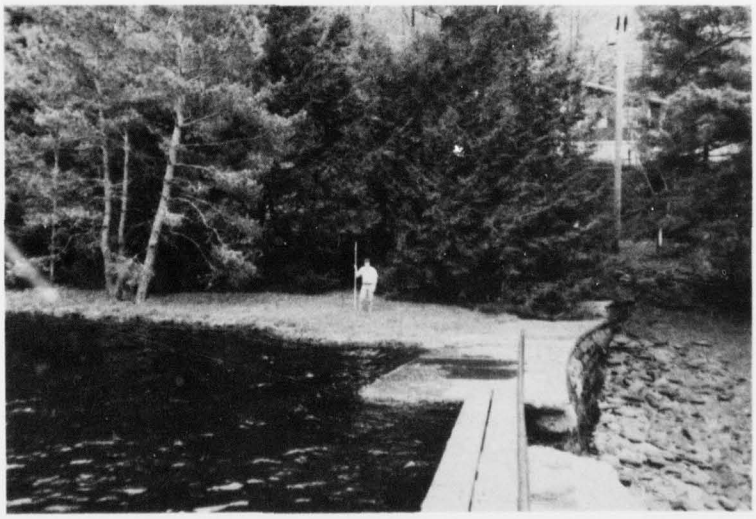


G. Loose and Missing Mortar at Masonry Joints on Downstream Face of Right Auxiliary Spillway

H. Eroded Area Downstream from Right Auxiliary Spillway



I. Flashboards on Main Spillway



J. Left Auxiliary Spillway Approach Area

SUSQUEHANNA RIVER BASIN

HUNTSVILLE CREEK, LUZERNE COUNTY

PENNSYLVANIA

HUNTSVILLE DAM

NDS ID No. PA-00553
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APPENDIX E

GEOLOGY

HUNTSVILLE 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 folds.

2. Site Geology. The dam and reservoir are sited in nearly horizontally stratified gray Catskill sandstone, northwest of the Lackawanna Syncline and the Susquehanna River. According to construction reports obtained by Pennsylvania Water Supply Commission engineers during the initial inspection of the dam in 1914, the entire length of the masonry dam is founded upon, and keyed into, sound sandstone. Both ends of the dam are said to penetrate into a dense sandstone rock that was thoroughly cleaned and roughened before placement of cement mortar. The sandstone foundation was found at a depth of about 1-1/2 feet below natural ground surface for 40 feet of its length near the middle of the structure. This depth gradually increases to 12 feet at the right end of the dam and to 24 feet at the left end. The surface was reported to be relatively free of joints or cracks. It was thoroughly roughened and coated with cement mortar before placement of stone masonry.