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NATIONAL DAM INSPECTION PROGRAM. LAKE CAREY DAM (NDI-PA-00887) --ETC(U)
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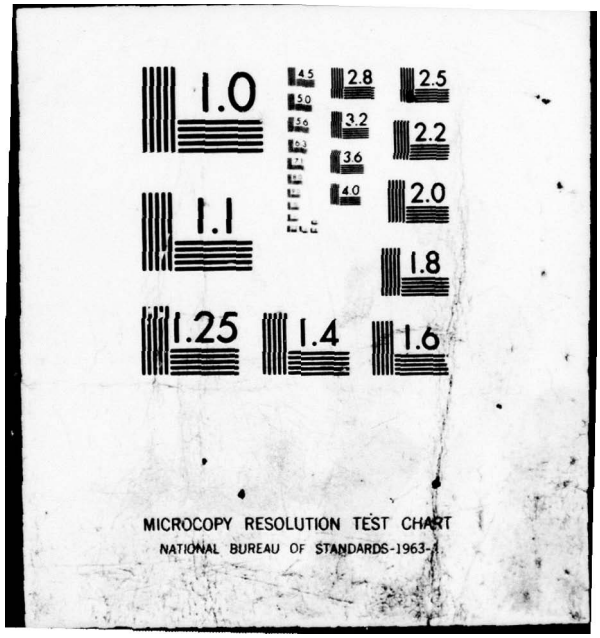
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SUSQUEHANNA RIVER BASIN
MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID NO. PA-00887
DER ID NO. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

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

JANUARY 1979

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

(6) National Dam Inspection Program. Lake Carey Dam (NDI-PA-ØØ887) (DER-66-Ø6), Susquehanna River Basin, Mill Brook, Wyoming County, Pennsylvania. Lake Carey Welfare Association, Inc.

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

(15) DACW31-79-C-ØØ15

Prepared by

GANNETT FLEMING CORDDRY AND CARPENTER, INC.
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P.O. Box 1963
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For

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Baltimore District, Corps of Engineers
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PREFACE

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

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

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

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

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

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BRIEF ASSESSMENT OF GENERAL CONDITION

AND

RECOMMENDED ACTION

Name of Dam:	Lake Carey Dam NDI ID No. PA-00887/DER ID No. 66-06
Owner:	Lake Carey Welfare Association, Inc.
State Located:	Pennsylvania
County Located:	Wyoming
Stream:	Mill Brook
Date of Inspection:	6 November 1978
Inspection Team:	Gannett Fleming Corddry and Carpenter, Inc. P.O. Box 1963 Harrisburg, Pennsylvania 17105

Based on the visual inspection, available records, calculations and past operational performance and according to criteria established for these studies, Lake Carey Dam is rated as unsafe because the spillway capacity is rated as seriously inadequate. The dam can pass only 11 percent of the probable maximum flood (PMF) without overtopping of the dam. If the dam should fail, the resulting floodflows would significantly increase tailwater and cause loss of life downstream.

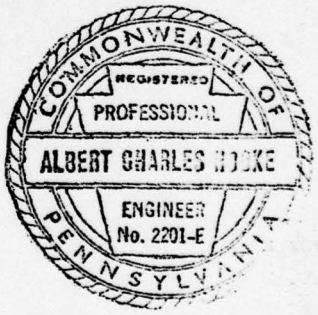
The embankment cannot be considered to have more than a marginal factor of safety for structural stability due to the age of the structure and the uncertain nature and condition of its interior composition. There are also no facilities for drawing down the reservoir in the event of an emergency.

In view of the concern for the safety of Lake Carey Dam, it is recommended that the Owner immediately undertake a study to more accurately ascertain the required spillway capacity as well as the mitigation measures required to make the spillway hydraulically adequate, and that the Owner undertake another study to ascertain remedial measures to make the embankment structurally adequate, as well as a study to include provisions for an emergency drawdown pipe. It is also recommended that the Owner modify his operational and maintenance procedures to both develop a detailed emergency operation and warning system and to institute a program of detailed annual inspections. Additionally, it is recommended that the Owner provide round-the-clock surveillance of the dam during periods of heavy rain and that the Owner activate the emergency warning and operation plan if a major storm is predicted.

Furthermore, it is recommended that the Commonwealth of Pennsylvania require the owner of the peninsula between the upper and lower ponds of Lake Carey to ensure that the earthfill and bridge present no hazard to Lake Carey Dam.

Submitted by:

GANNETT FLEMING CORDDRY
AND CARPENTER, INC.



A. C. HOOKE
Head, Dam Section

Date: 9 February 1979

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

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

Date: 4 Mar 79

LAKE CAREY DAM

Overview

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

SECTION 1

PROJECT INFORMATION

1.1 General.

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

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

1.2 Description of Project.

a. Dam and Appurtenances. Lake Carey Dam is an earthfill embankment with a vertical, mortarless, stone masonry downstream face. The dam extends 110 feet across the valley and is 13 feet high. A concrete and stone masonry spillway chute, with a crest length of 19.3 feet, is situated on the embankment near the right abutment. The spillway crest is 3.7 feet below the top of the dam. An auxiliary spillway channel, with irregular cross section and with a crest about 0.7 foot below the top of the dam, is located at the right abutment. Before the dam was constructed, Lake Carey was a natural lake. The dam raised the level of

the natural lake by 3 feet and created a second reservoir. These two impoundments are termed the upper and lower ponds. The lower pond, which was created entirely by the dam, is immediately upstream of the dam. The upper pond, which was the natural lake, is upstream of the lower pond. The ponds are partially separated from each other by a natural peninsula, which was the previous downstream limit of the natural lake. The peninsula has been extended by earthfill and a small bridge constructed to provide access across the lake. This causeway also effectively separates the ponds. Flow from the upper pond to the lower pond is controlled by the bridge opening in the causeway. The various features of the dam are shown on the Plates at the end of the report and on the Photographs in Appendix D.

The Village of Lake Carey with a normal population of over 100 persons, mostly elderly, has been established around the lake. The normal population is augmented by visitors, tourist and vacationers during the recreation season.

b. Location. The dam is located on Mill Brook approximately 3.2 miles northeast of Tunkhannock, Pennsylvania. Lake Carey Dam is shown on USGS Quadrangle, Tunkhannock, Pennsylvania, with coordinates N41° 34' 55" - W75° 55' 10" in Wyoming County, Pennsylvania. Stevens Lake, termed Mud Pond on the USGS Quadrangle, is 1.7 miles northwest of Lake Carey Dam, and it discharges into the upper pond of Lake Carey Dam. The location map is shown on Plate 1.

c. Size Classification. Intermediate (13 feet high, 4,810 acre-feet, of which about 3,130 acre-feet is contained in the natural lake).

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

e. Ownership. Lake Carey Welfare Association, Inc., R.D. 1, Tunkhannock, Pennsylvania.

f. Purpose of Dam. Recreation

g. Design and Construction History. Lake Carey Dam was built in 1876. The dam was originally used to augment flows to a mill about 0.1 mile downstream. The original dam

was apparently a stone masonry dam. The masonry was thickened and earthfill was added upstream of the masonry section at some later date. The Owner in 1919 was John Stark, whose father apparently built the dam. An inspection by the Pennsylvania Water Supply Commission in 1919 revealed that the dam had no spillway, the pool being maintained by a sluice gate and conduit. The 1919 Commission report did not mention the existence of an auxiliary spillway, however, an inspection by the Commission in 1920 noted the present auxiliary spillway.

In the 1920 inspection, the Commission recommended the construction of a main spillway. The spillway was constructed in 1921. In 1937, the deterioration of the outlet works gate was noted. In 1940, the Commission ordered the outlet works to be repaired.

The present Owner acquired the damsite in 1944. In 1945, the Owner filed an application to make the following modifications: lower the spillway crest elevation, provide stoplogs across the spillway for use during the summers, point the stone masonry downstream face, and construct a reinforced concrete conduit within the old masonry conduit near the downstream end. The spillway was re-built in 1945 by the Coon Construction Company. The Owner did not have sufficient funds to complete the remaining work, and the permit was extended to 1949. In 1951 the Owner informed The Pennsylvania Water Power Commission that funds were insufficient to complete the repairs. Meanwhile, during 1948, a Commission inspection report noted that the dam had been overtopped and washed out near its right end, over a length of 25 feet and to a depth of 7 feet. Apparently, this damage was repaired, but no information concerning the repairs could be found. In 1957 and 1966, at the urging of the Department of Forest and Waters, the Owners announced plans to repair the dam, especially the outlet works conduit, that had almost completely collapsed. Apparently, however, no work was ever accomplished. In 1967, the Owner began to search for a governmental agency to either finance repairs to the dam or to acquire the dam.

In June 1972, during Tropical Storm Agnes, sandbags were placed upon the dam as an emergency measure to prevent overtopping. The auxiliary spillway was sandbagged at the same time, although the reasons for this are unclear.

Immediately after this flood, a waterways patrolman from the Pennsylvania Fish Commission wrote to The Pennsylvania Department of Environmental Resources (PennDER) to express concern for the conditions at the spillway. He reiterated his concerns in 1974. PennDER met with the Owner in 1975 and ordered that an engineer be retained to study the problems at the dam. At this point, the Owner retained an engineer and continued looking for various agencies to finance repairs. The engineer, Albert Peters Associates of Scranton, Pennsylvania, submitted a report in 1976. The report noted a bulging downstream face, "pipings in the mass of the dam", and a small spillway capacity. No definitive conclusions concerning the stability of the dam were in the report. It did note the difficulty and expense of any remedial measures. During 1977, discussions continued between the Owner, PennDER, and other interested parties. In September 1977, PennDER formally ordered the Owner to retain an engineer, make any studies necessary, and accomplish remedial work. In October 1977, the Owner paved the spillway approach channel with 12 to 18 inches of concrete. This apparently eliminated whirlpools that had been forming in the spillway approach channel as well as the seepage that had been emerging through the downstream masonry face near the spillway. PennDER pointed out to the Owner that the work that was accomplished did not satisfy their order of September 1977, and that the order still remained in force.

Various discussions continued throughout 1978. In September 1978, PennDER informed the Owner that they would take steps necessary to enforce the order, or they would breach the dam if no action was forthcoming by October 15, 1978. This date was later extended to November 15, 1978. As of this writing, the Owner was planning to request an extension until the completion of this report. Also, as of this writing, plans are in preparation by the Coon Construction Company to provide some remedial work for the dam. Details of the plans were not available for review.

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

1.3 Pertinent Data.

a. Drainage Area. 7.0 square miles.(1)

b. Discharge at Damsite. (cfs.)

Maximum known flood at damsite(2) - 230.

Emergency drawdown line at maximum pool elevation - no drawdown line.

Spillway capacity(3) - 330.

Auxiliary spillway capacity(3) - 30.

Combined spillway capacity(3) - 360.

c. Elevation. (Feet Above msl.)

Top of dam (design) - Unknown. (Assumed as top of spillway walls elevation 950.7).

Top of dam (lowest elevation) - 950.5.

Maximum pool - 950.5

Normal pool (spillway crest) - 947.0

(1) The drainage area was reported as being 4.5 square miles by the Pennsylvania Water Supply Commission in their 1945 report. PennDER used a value of 6.33 square miles in a 1957 memorandum. Gannett Fleming Corddry and Carpenter, Inc., checked the drainage area and used 7.0 square miles. Apparently, the drainage area was never updated by the Owner after the area was re-mapped by the USGS in 1946. The drainage area that is upstream of the causeway and the upper pond, is 6.1 square miles.

(2) Tropical Storm Agnes, June 1972. Based on information from the Owner, estimated with pool 2.4 feet above spillway crest.

(3) Pool at elevation 950.7

Upstream invert outlet works - None.

Downstream invert outlet works - None.

Upstream invert water supply line - None.

Streambed near outlet works - 937.6 (Approximate).

d. Reservoir Length. (Miles.)

Normal pool - 2.0

Maximum pool - 2.1

e. Storage (acre-feet.)	Upper Pond	Lower Pond	Total
Natural Lake -	3,130	0	3,130
Normal pool -	3,634	147	3,781
Maximum pool -	4,364	446	4,810

f. Reservoir Surface Acres	Upper Pond	Lower Pond	Total
Natural Lake -	171	0	171
Normal pool -	189	73	262
Maximum pool -	206	89	295

g. Dam.
Type - Earthfill with vertical, mortarless, stone masonry downstream face.

Length - 90 feet (embankment - approximate).

Height - 13 feet.

Top Width - Varies-about 24 feet, minimum.

Side Slopes - Upstream - 1V on 4H. (Approximate).
Downstream - Vertical

Zoning - None.

Cutoff - None.

Grout Curtain - None.

h. Diversion and Regulating Tunnel - None.

i. Spillway.

Type - Spillway - Concrete ski-jump.
Auxiliary spillway - Excavated channel.

Length of Weir - Spillway - 19.3 feet
Auxiliary spillway - irregular.

Crest Elevation - Spillway - 947.0
Auxiliary spillway - 950.0
(Approximate).

Upstream Channel - Spillway - reservoir.
Auxiliary spillway - reservoir.

Downstream Channel - Natural stream with near vertical sides.

j. Regulating Outlets - None.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Data Available. No engineering data was available for review for the original structures. Plans for the 1945 re-building of the spillway and reports of periodic inspections by the Commonwealth were available for review.

b. Design Features. The features of the dam are shown on Plates 2 and 3 and on the Photographs in Appendix D. Plate 2 shows the plan and profile of the embankment (Photographs E, G, and H). Plate 3 shows the spillway as it presently exists (Photographs C, D, E and G). The outlet works shown on Plates 2 and 3 was either never built or no longer exists. These plates were drawn in 1945, and cannot be considered construction drawings for the embankment. As different datums were used, approximately 848.4 feet must be added to the elevations on the plates to match the elevations used in this report, which are based on mean sea level.

c. Design Considerations. Almost nothing is known about the design.

2.2 Construction.

a. Data Available. No construction data for the original structure was available for review. Limited details of the re-construction of the spillway in 1945 and the paving of the spillway approach channel in 1977 are available.

b. Construction Considerations. Since the available construction data is limited, construction methods cannot be assessed.

2.3 Operation. No formal records of operation were reviewed. The only operational feature is the stoplog slots on the spillway, which the Owner no longer uses.

2.4 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. The Owner made the president of the Association, as well as other Association members, available for information during the visual inspection.

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

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

SECTION 3

VISUAL INSPECTION

3.1 Findings.

a. General. The overall appearance of the dam is fair, with observations noted below:

A sketch of the dam with the location of some deficiencies is presented on Plate B-1. Survey information acquired for this inspection is summarized in Appendix B. On the day of the inspection, the pool was at spillway crest elevation.

b. Dam. The embankment appears in fair condition. Much low brush and some trees, which are about 3 inches in diameter, are growing on the earthfill (Photographs C and E). The sod appears to be in good condition except on the upstream slope of the embankment to the left of the spillway, where bare soil is visible (Photograph D). There is no riprap on the upstream slope. There are two depressed areas, each about 1 foot square, on the top of the embankment. An eroded surface drainage path leads down the left abutment. The courses of the stone masonry are uneven and tilted. To the left of the spillway, the stone masonry is bulged (Photograph H). The bulge is apparently a long standing condition and from its appearance could have been present since original construction. The bulge makes a 5.1V on 1H slope; the remainder of the stone masonry face is more vertical. Concrete, apparently wasted during previous construction, covers both an area to the right of the bulge and along the toe of the mortarless, stone masonry section (Photograph H). Clear seepage of about 10 gpm is flowing from beneath the wasted concrete. The Owner reports that this is the approximate location of the outfall of the old outlet works conduit. Although the lowest point on the top of the dam was at elevation 950.5 (Appendix B), the top elevation used in rating the dam was Elevation 950.7, which is the top of the spillway wall. No design information is available to ascertain the design elevation for the top of the dam.

c. Appurtenant Structures.

(1) Spillway. The spillway appeared to be in fair condition. The left approach wall is tilted and offset by 0.5 foot from the spillway walls (Photograph D). The mortar is missing or deteriorated in the stone masonry spillway walls. The right wall has a shrinkage crack. There is a gouge in the embankment near the left spillway wall (Photograph E). Stoplog slots were constructed in the spillway walls. The Owner reports that the stoplogs are no longer in use.

(2) Auxiliary Spillway. The auxiliary spillway is a depression in the right abutment (Photograph F). The cross section is irregular, especially at the approach area. Trees are growing in the channel, and it has not been maintained.

(3) Outlet Works. No evidence of the outlet works was observed. The original outlet works was reported to be mortarless, stone masonry conduit extending through the dam. The top of the conduit was supported by wooden planks. Previous inspections by The Pennsylvania Water Supply Commission reported the planks to be rotten and the masonry to be falling into the conduit. The Owner did not have any information on the date or method of plugging the conduit.

d. Reservoir Area. The slopes along the reservior are generally quite flat with many cottages built very close to the Lake Shore. The Peninsula separating the upper and lower ponds was visited during the inspection (Photographs A and B). Except along the Lake Shore, the watershed consists mostly of farm fields and woodland.

e. Downstream Conditions. The channel immediately downstream from the Dam has vertical sides cut into the bedrock (Photograph I). Some small debris were present in the channel. The stream flows 0.1 mile to an abandoned mill dam with a silted in reservoir and another 0.1 mile to a small bridge on a secondary road. Along this reach there are two houses situated about 15 feet above the streambed. The stream then flows for 2.2 miles through a steep and narrow valley to its confluence with Tunkhannock Creek. The latter reach is uninhabited and unobstructed except for the last 0.2 mile, where the stream passes under a small bridge. About 10 houses are located near the bridge. One house is

situated about 10 feet above streambed. The others are between 15 and 30 feet above streambed. Access to the dam is by paved road to the left of the embankment.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure. The reservoir is maintained at spillway crest Elevation 947.0 with excess inflow discharging over the spillway.

4.2 Maintenance of Dam. Most of the members of the Lake Carey Welfare Association live adjacent to Lake Carey. Maintenance is apparently performed when deemed necessary by the officers of the Association. Formal inspections of the dam are not made. Informal inspections of the dam are apparently made by the members of the Association, but not on a regular basis.

4.3 Maintenance of Operating Facilities. There are no operating facilities currently in use.

4.4 Warning Systems in Effect. The Owner gave the inspection team a verbal description of the emergency warning and operation system that is applicable for Lake Carey Dam. The Owner said that emergency warning system consists of informing the Office of Civil Defense, which, in turn, would notify local authorities.

4.5 Evaluation of Operational Adequacy. The amount of brush observed on the embankment and in the auxiliary spillway indicates that a more frequent brush-cutting schedule is warranted. The procedures used by the Owner to inspect the dam need improvement. There is no means of drawing down the lake. The emergency warning system is good, but the assessment of conditions that would require activation of the emergency warning system could be greatly improved.

SECTION 5

HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No design data was available for review. During 1919, a brief report on the dam was made by the Pennsylvania Water Supply Commission, but the hydrology and hydraulics of the dam were not addressed. In 1945, in the report upon the application of the Owner to improve the spillway, the commission estimated the combined spillway capacity of the dam at 432 cfs with stoplogs in place. This rating used an auxiliary spillway depth greater than the one currently available and did not entirely account for the existing spillway geometry.

b. Experience Data. As was noted in Paragraph 1.2g, the dam was overtopped in 1948 and there were problems during tropical storm Agnes, although it was not overtopped then.

c. Visual Observations.

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

(2) Embankment. The general arrangement of the embankment indicates that if it were overtopped by an amount sufficient to dislodge the upper part of the mortarless, stone masonry section, then the failure of the embankment will be almost instantaneous.

(3) Appurtenant Structures. No conditions were observed in the spillway that would reduce its discharge capacity during a flood. The uneven approach conditions and trees in the auxiliary spillway would reduce its discharge capacity. The auxiliary spillway is sufficiently close to the right end of the embankment

that there could be an erosion hazard to the embankment from sustained flows in the auxiliary spillway. There is no emergency drawdown capability for the reservoir, which is considered to be a serious deficiency.

(4) Reservoir Area. No conditions were observed in the reservoir that would significantly reduce the spillway capacity of Lake Carey Dam. It is apparent that many of the cottages along the Lake shore would be flooded by substantial rises in the pool. The peninsula, its earthfill extension and the bridge opening that divides the two ponds apparently will act as a dam during flood conditions. In effect, two dams must be analyzed in order to evaluate Lake Carey Dam. During the course of the inspection, a brief visit was also made to Stevens Lake, which is situated upstream from Lake Carey, to evaluate its hydraulic and hydrologic effect upon Lake Carey. Relevant data is listed in Appendix C. The assessment of Lake Carey Dam is based on existing conditions and the effects of future development were not considered.

(5) Downstream Conditions. No conditions were observed immediately downstream of the dam that would reduce the spillway discharge capacity. Access to the dam is good. The two bridges on Mill Brook would not provide significant mitigating effects to flood flows originating upstream. These bridges would increase the water surface elevation upstream from them during a flood occurence. The conditions observed downstream indicate that a high hazard classification is warranted for Lake Carey Dam.

d. Overtopping Potential.

(1) Spillway Design Flood. According to the criteria established by The Office of the Chief of Engineers (OCE) for the size (Intermediate) and Hazard potential (High) of Lake Carey Dam, the spillway design flood (SDF) is the probable maximum flood (PMF).

(2) Description of Model. The watershed was modeled with the HEC-1DB computer program. The HEC-1DB computer program computes a PMF runoff hydrograph and routes the flows through both reservoirs

and stream sections. In addition, it has the capability to simulate an overtopping dam failure. A component of the PMF was determined at Stevens Lake and then was routed through the dam. The outflow was routed down to Lake Carey Upper Pond and added to the PMF inflow component from the uncontrolled drainage area above the upper pond. The combined inflow was routed through the upper pond and added to the uncontrolled PMF component inflow to the lower pond. The combined inflow to the lower pond was routed through the lower pond and downstream to Tunkhannock Creek. It was assumed that no runoff occured downstream of Lake Carey Dam. Identical methods were used for various percentages of the PMF. It should be noted that the outflow from the upper pond is dependent upon the pool elevation of the lower pond. The HEC-1DB program is unable to model this condition. Therefore, certain simplifying assumptions were made, as noted in Appendix C.

(3) Summary of Results. The following table summarizes the results. Selected parts of the program output are in Appendix C. The total rainfall for the PMF is 24.7 inches:

	PMF	1/2 PMF
Total Runoff (inches)	22.4	11.2
Inflow to upper pond (cfs)	14,218	6,418
Outflow from upper pond (cfs)	12,592	4,976
Depth of Overtopping Peninsula between ponds (ft.)	5.7	3.8
Inflow to lower pond (cfs)	13,999	5,138
Outflow from lower pond (cfs)	11,980	4,466
Depth of overtopping at Lake Carey Dam (ft.)	9.5	4.6

As it exists, the dam can pass about 11 percent of the PMF without overtopping. If the dam were raised to its assumed design elevation, it could pass about 12 percent of the PMF without overtopping. Furthermore, many of the homes along the Lake Shore would be flooded by high pool elevations.

(4) Spillway Adequacy. The criteria used to determine the adequacy of spillways is presented in Appendix C. For the occurence of the 1/2 PMF, both the peninsula separating the ponds and Lake Carey Dam are overtopped. Lake Stevens Dam upstream of the upper pond is not overtopped by the 1/2 PMF. It was not assumed to fail. Two different methods were used to determine the spillway adequacy. In both methods it was assumed that Lake Carey Dam would develop a 25-foot wide breach 0.1 hour after being overtopped by 3 feet. For the first method, the peninsula separating the ponds was assumed not to fail. For the second method, the peninsula was assumed to develop a 50-foot wide breach 0.1 hour after being overtopped by 3.4 feet. The first method raises the water surface at the confluence of Mill Brook and Tunkhannock Creek by 0.6 foot; the second method raises the water surface by 0.9 foot. This rise in water surface does not include the effects of the narrow bridge at this point. Assuming critical depth under the bridge, the rises in water surface would be 7.4 feet and 10.4 feet for Methods 1 and 2, respectively (Appendix C). There is a significant rise in tailwater. Therefore, the spillway capacity is rated as seriously inadequate.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

(1) General. The visual inspection of Lake Carey Dam, which is described in Section 3, resulted in a number of observations relevant to structural stability. These observations are evaluated herein for the various features.

(2) Embankment. Brush and trees on the embankment are undesirable because they provide potential seepage paths along the roots. There apparently has been some minor erosion, due to waves on the unprotected upstream slope. The two small depressions on the top of the embankment could indicate that some minor internal adjustments have occurred within the embankment. The surface drainage path indicates improper control of surface drainage. Because of the age of the dam and the apparent lack of control during construction, it is impossible to determine whether the bulges and irregular stone masonry are the result of poor original construction or the result of some happening during the subsequent 102 years of service. They are obviously not of recent origin. The seepage at the toe of the dam is apparently coming from the old outlet works conduit.

(3) Appurtenant Structures. The spillway left approach wall has evidence of relative movement, probably caused by ice pressure or frost heave. The shrinkage crack in the right wall is probably caused by improper joint locations. The deteriorated mortar prevents the spillway walls from acting as a watertight structure and can only increase the seepage potential. The gouge to the left of the spillway is probably caused by a stone from the masonry wall being removed. The conditions at the outlet works are of concern. In view of the uncertain plugging procedures for the old conduit a potential for collapsing of the conduit and settlement of the embankment might be present.

b. Design and Construction Data. No records of design data or stability computations were available for review. Furthermore, except for exterior lines and grades, almost nothing is known about the design or construction of the

dam. The available information shows that the upstream earthen slope is about 1V on 4H and that the downstream masonry face is vertical. The top of embankment has a minimum width of 24 feet. Insufficient information is available to analyze the downstream masonry section. Although there is no present evidence of distress, the dam cannot be considered to have more than a marginal factor of safety for structural stability.

The data required to analyze the dam includes the dimensions and condition of the masonry structure, condition of the plugged conduit, the level of the phreatic surface within the embankment and relevant embankment and foundation physical properties.

c. Operating Records. There is no evidence that any stability problems, except for possible bulging of the masonry, have occurred to the dam during its operational history of 102 years. However, it should be recognized that conditions can change, particularly with respect to seepage, that might significantly affect the future performance of the dam.

d. Post-Construction Changes. There have been no known modifications to Lake Carey Dam that would affect the stability of the structure.

e. Seismic Stability. Lake Carey Dam is located in Seismic Zone 1. Normally, it can be considered that if a dam in this zone has adequate factors of safety under static loading conditions, it can be assumed safe for any expected earthquake loading. However, the theoretical static stability of Lake Carey Dam is not known.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety.

(1) Based on available records, visual inspection, calculations, and past operational performance, Lake Carey Dam is judged to be in poor condition. The spillway will pass only 11 percent of the PMF without overtopping of the dam. If the dam should fail, the resulting floodflows would significantly increase tailwater and cause loss of life downstream. The spillway capacity is rated as seriously inadequate. According to criteria established for these studies, the dam must be rated as unsafe because the spillway is seriously inadequate.

(2) The embankment cannot be considered to have more than a marginal factor of safety for structural stability due to the age of the structure and the uncertain nature and condition of its interior composition.

(3) There are no facilities for drawing down the reservoir.

(4) A summary of the features and observed deficiencies is listed below:

Feature and Location	Observed Deficiency
Embankment:	
slopes	brush and trees
upstream slope	erosion-no riprap
top	depressions eroded
left abutment	drainage path
downstream face	irregular and bulged
downstream toe	seepage
Spillway:	
left wall	movement
right wall	shrinkage crack
embankment at left wall	gouge

Feature and Location	Observed Deficiency (cont.)
Auxiliary Spillway:	
channel	irregular, trees in channel
Outlet Works:	
	None; probable collapse hazard from old outlet works
Reservoir	
shores	probable flooding of homes by rising pool during flood

(5) The peninsula which separates the two ponds, although not designed as a dam, acts as a dam. This presents an additional hazard to Lake Carey Dam.

b. Adequacy of Information. There is sufficient information to assess the safety of Lake Carey Dam.

c. Urgency. The recommendations in Paragraph 7.2 should be implemented immediately.

d. Necessity for Further Investigations. In order to accomplish some of the remedial measures outlined in Paragraph 7.2, further investigations will be required. There is insufficient data to analyze the stability of the embankment. No information is available concerning soil properties, zoning, foundation conditions, or structural dimensions of the mortarless stone masonry downstream face.

7.2 Recommendations and Remedial Measures.

a. In view of the concern for the safety of Lake Carey Dam, the following measures are recommended to be undertaken by the owner immediately:

(1) Perform a study to more accurately ascertain the spillway capacity required for Lake Carey Dam as well as the nature and extent of the mitigation measures required to make the spillway hydraulically adequate.

(2) Perform a study to ascertain the mitigation measures required to make the dam structurally and operationally adequate. This study should include an exploration program to ascertain the condition and the adequacy of plugging of the existing conduit, the foundation conditions, engineering soil properties, and internal structural dimension of the dam. The study should also include an analysis of the structural factors of safety for the embankment, the adequacy of seepage control measures, and whatever measures are required to make the factors of safety adequate.

(3) Perform a study to ascertain the facilities required to adequately drawdown the reservoir during an emergency condition. The recommendations resulting from each of the above studies should be implemented immediately after completion of the studies. An obvious option is that it may be more economical to replace the dam in an apparently ideal existing downstream location than to perform the above studies and remedial work. However, this decision is left to the Owner.

b. In addition, the Owner should undertake the following operational and maintenance procedures:

(1) Develop a detailed emergency operation and warning system for Lake Carey Dam. The warning system should include warnings for residents along the Lake Shore.

(2) Institute a program of detailed annual inspections for Lake Carey Dam by a professional engineer experienced in the design and construction of dams. Use the results of the inspection to determine if remedial measures are necessary.

(3) During periods of unusually heavy rains, provide round-the-clock surveillance of Lake Carey Dam.

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

c. In addition, the Commonwealth of Pennsylvania should require the owner of the peninsula between the ponds to ensure that the earthfill and bridge present no hazard to Lake Carey Dam.

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

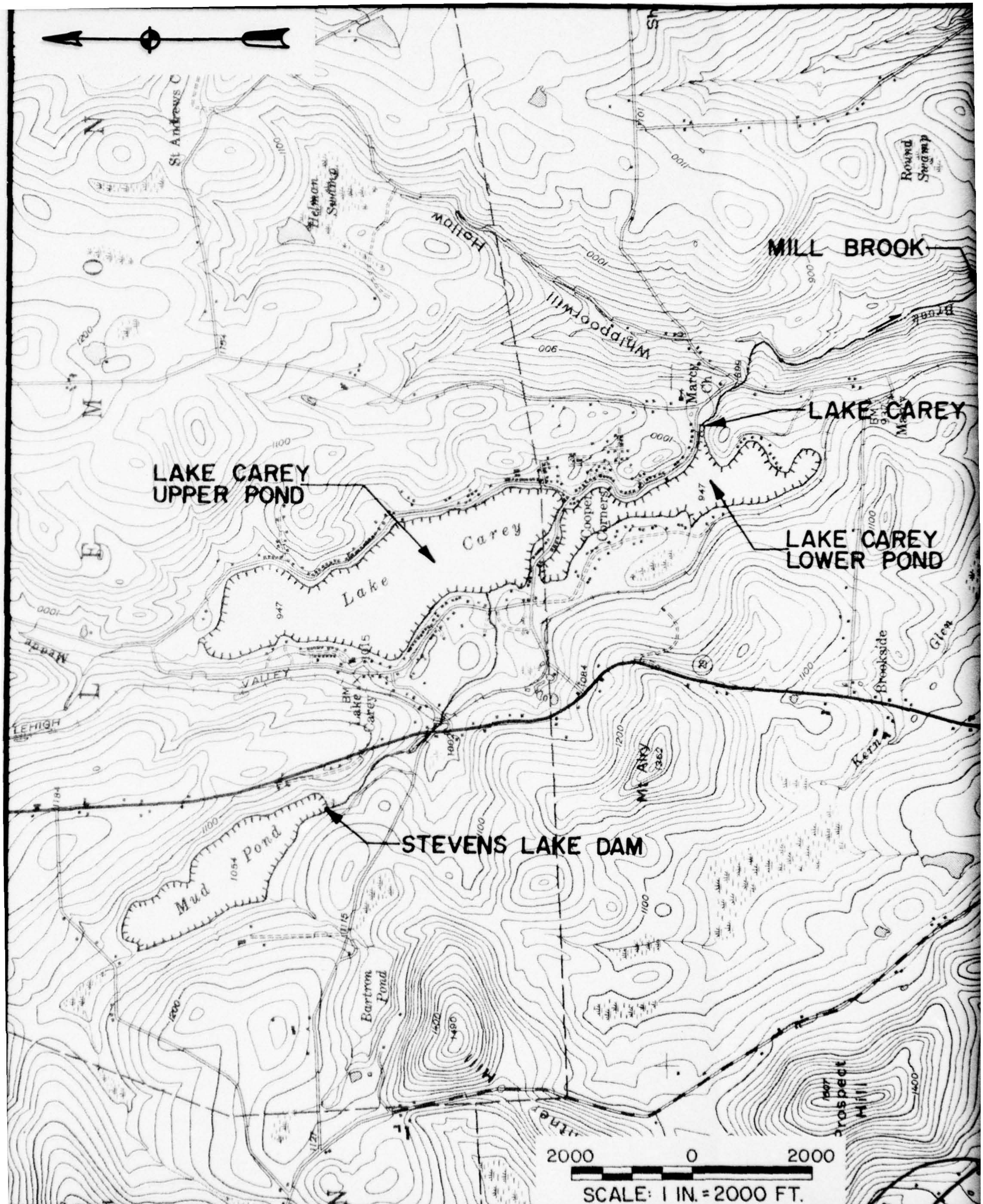
LAKE CAREY WELFARE ASSOCIATION, INC.

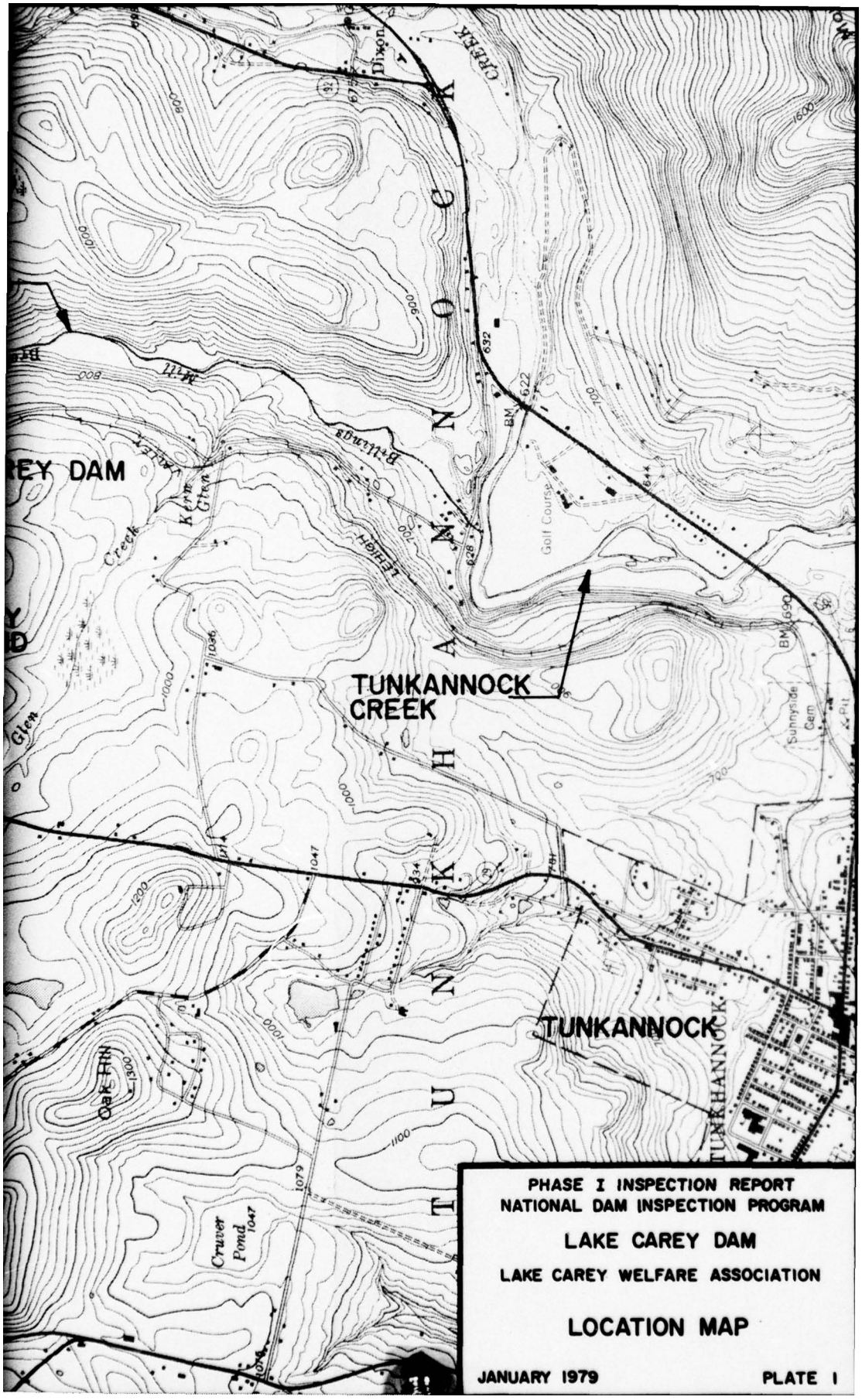
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

PLATES


MILL BROOK
LAKE CAREY
LAKE CAREY
UPPER POND
LAKE CAREY
LOWER POND
STEVENS LAKE DAM
Lake Carey
Mud Pond
Bartron Pond
Mt Airy
Round Swamp
Cooper Corners
Brookside
Glen
Prospect Hill
2000 0 2000
SCALE: 1 IN. = 2000 FT.



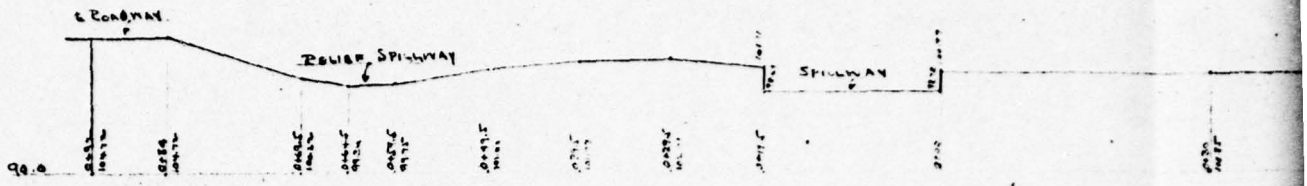
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CAREY DAM

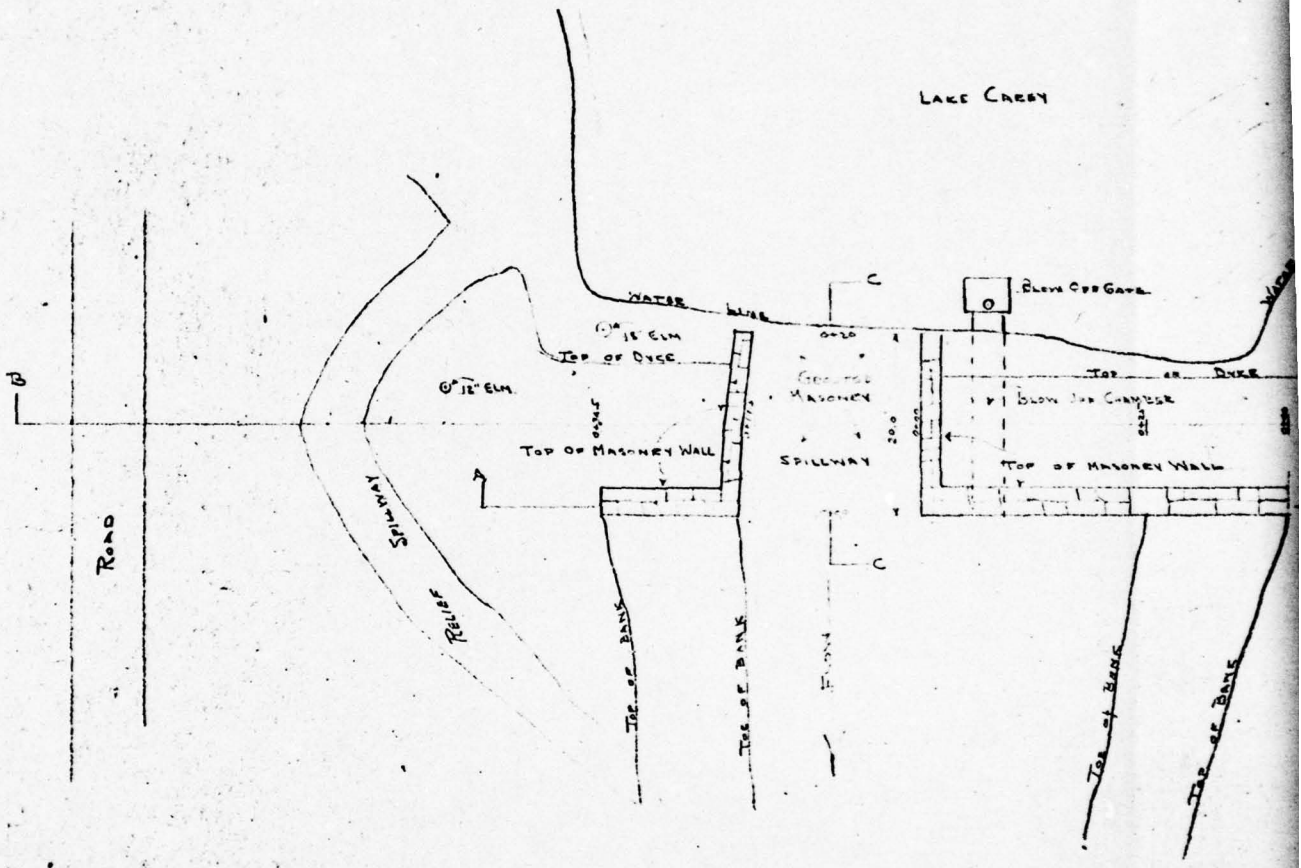
LAKE CAREY WELFARE ASSOCIATION

LOCATION MAP

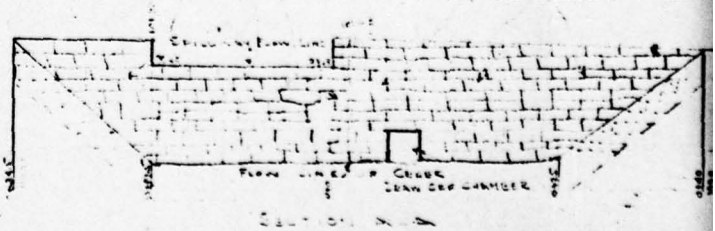
JANUARY 1979 PLATE 1



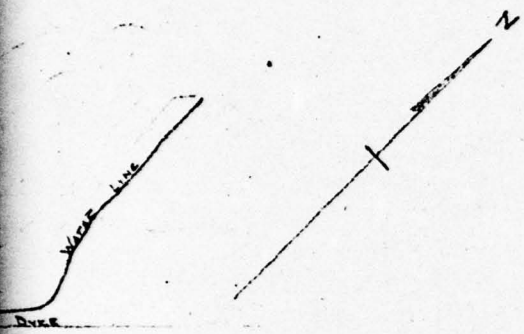
SECTION B-B

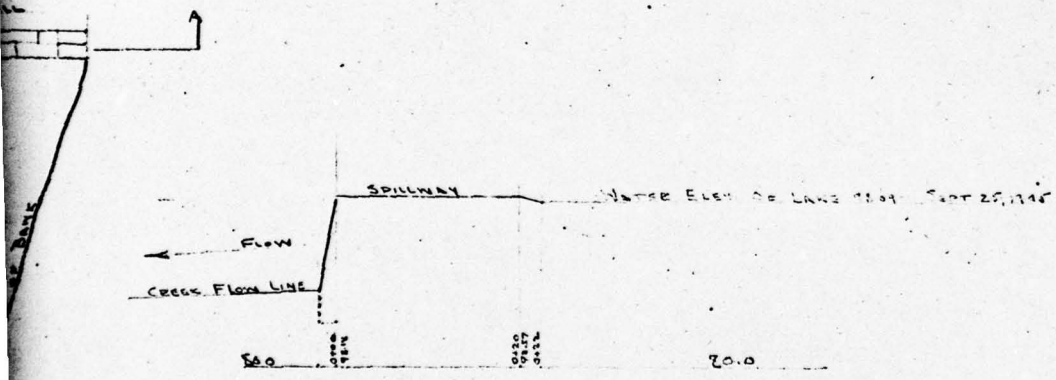


PLAN OF PRESENT SPILLWAY



90.0





SECTION C-C

WAS NOT POINTED

B. G. COON CONSTRUCTION CO.	
278 UNION ST. LUZERNE, PA.	
PRESENT BLOW OFF CHAMBER AND SPILLWAY FOR OUTLET LAKE CARBY WYOMING COUNTY PENNA	
SCALE 1" = 10'	DATE 9-27-1945
DWG. BY J.L.W.	APP. BY [illegible]
REMARKS	

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CAREY DAM

LAKE CAREY WELFARE ASSOCIATION

PLAN AND PROFILES

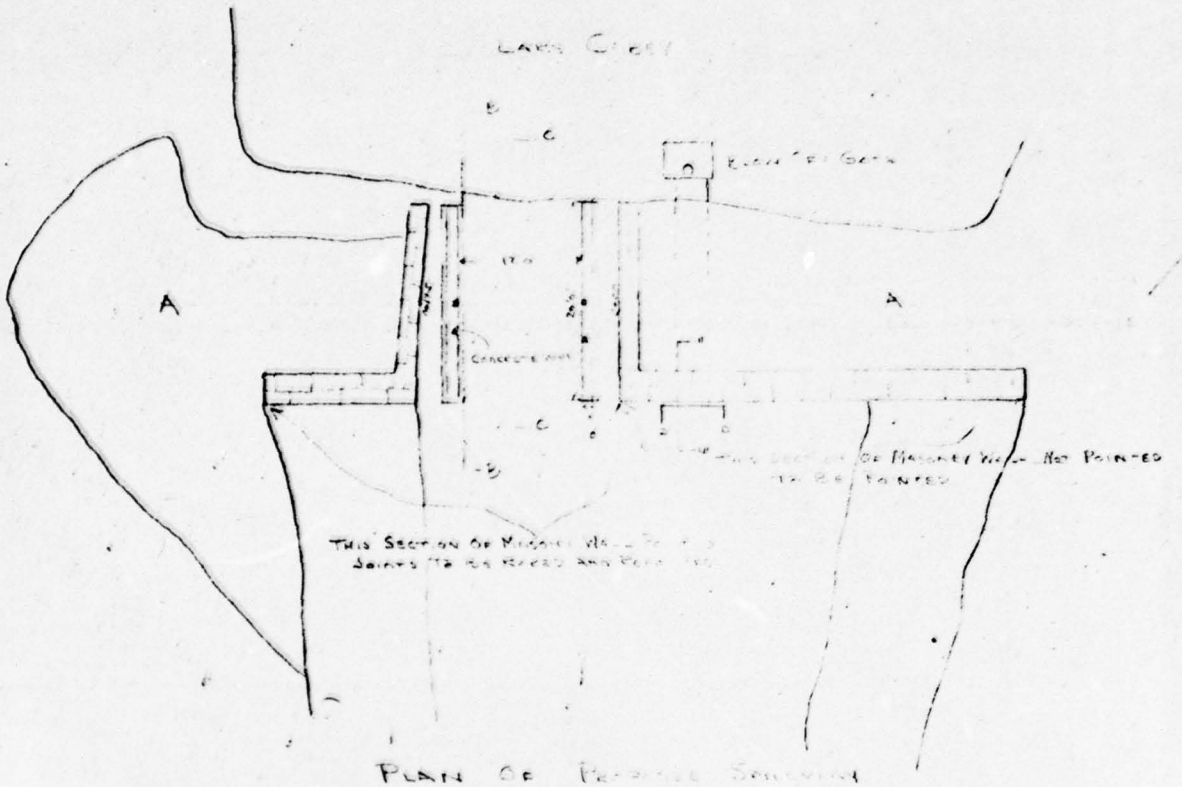
JANUARY 1979 PLATE 2

CO.
PA.

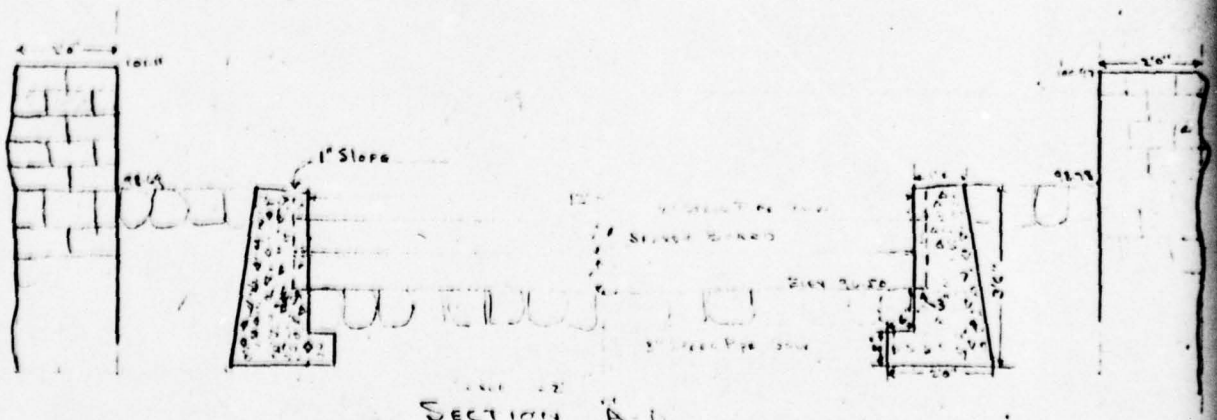
945

1

3



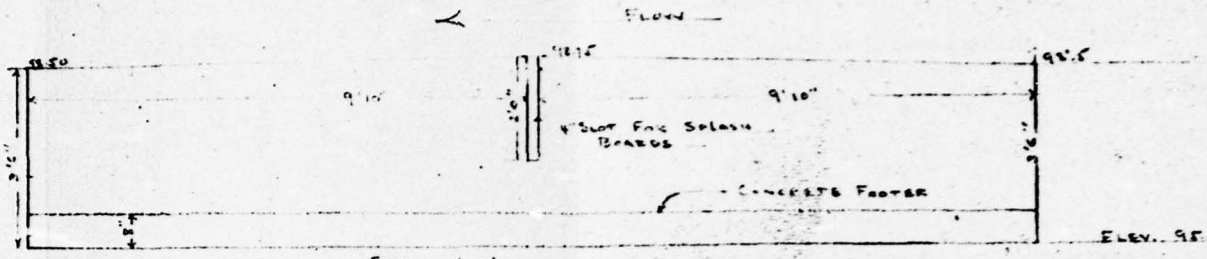
PLAN OF PROPOSED SPILLWAY
SCALE 1"=10'



SECTION A-A

NOTE

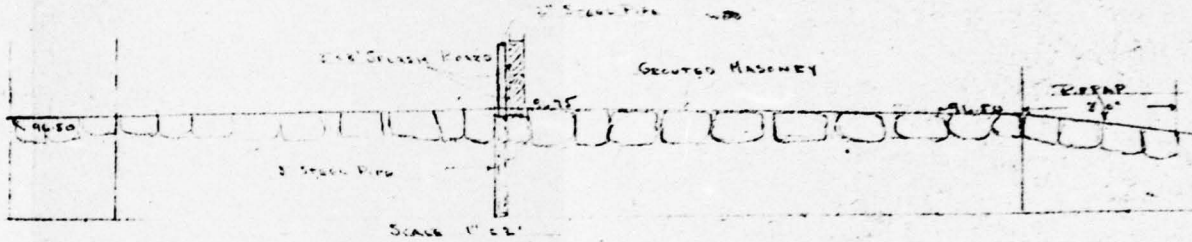
UNDER NORMAL CONDITIONS ONE 8"
SPLASH BOARD WILL BE IN PLACE
DURING WINTER SEASON NO SPLASH
BOARDS WILL BE IN PLACE



SCALE 1"=2'

SECTION B-B

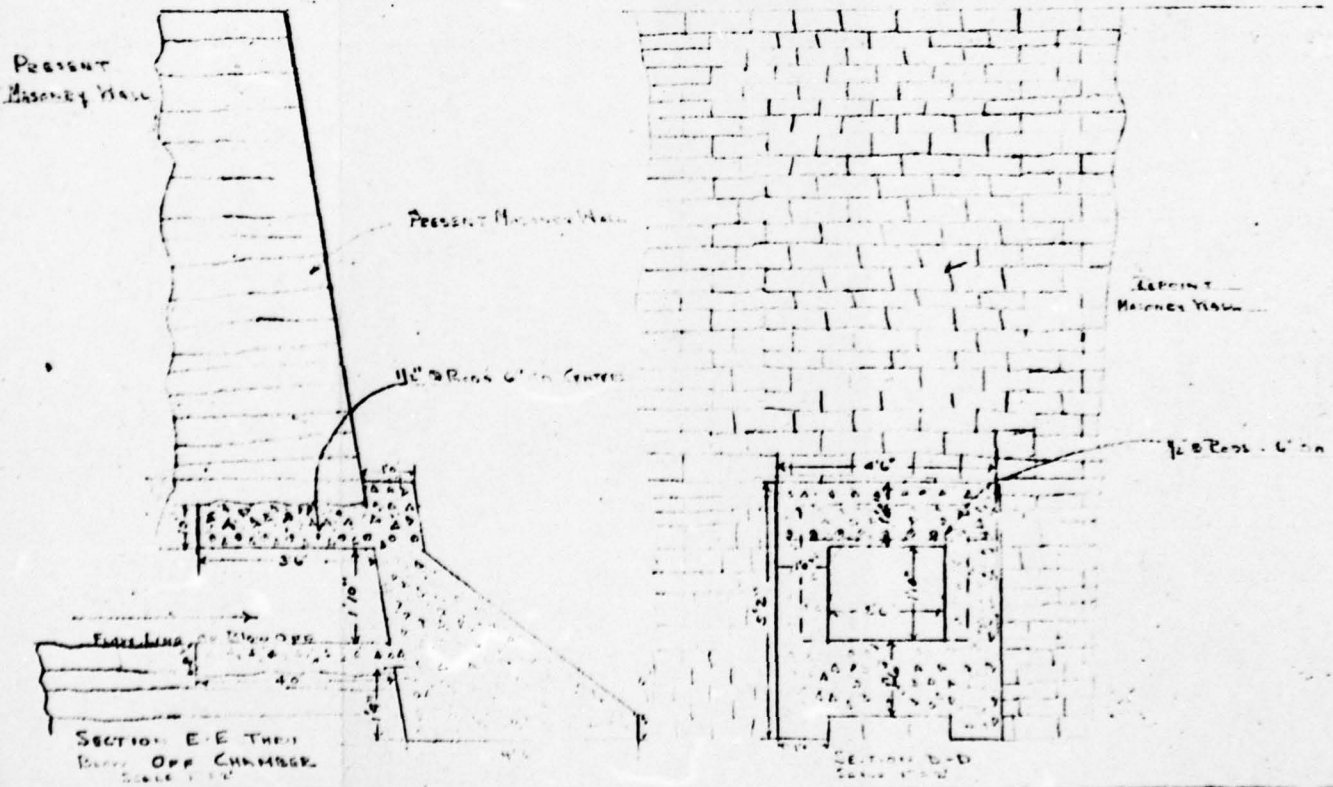
PROPOSED CONCRETE WALLS FOR SPILLWAY



SCALE 1"=2'

SECTION C-C

PROPOSED ℄ OF SPILLWAY



LAKE ELEV.
LOCATION
DAM.

B. G. C
273 UNI
PROP
BLOW
OUTL
WYOM
SCALE AS
DWG BY
REMARKS

1

95.0

94.5

WATER ELEVATIONS

LAKE ELEV 99.09		9-25-45
LOCATION	PRESENT SPILLWAY	PROPOSED SPILLWAY
Min. Clearing at Bridge	33" Below	52" Below
Canal Bank Pier	1" "	20" "
DAM.	8" "	0" "

B. G. COON CONSTRUCTION CO.
273 UNION ST. LUZERNE, PA.

PROPOSED SPILLWAY AND BLOW OFF CHAMBER OUTLET AT LAKE CAREY WYOMING COUNTY PENNA.

SCALE As SHOWN | DATE 9-27-1945

DWG BY H.L.W | APP'D BY H.L.W

REMARKS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CAREY DAM

LAKE CAREY WELFARE ASSOCIATION

SPILLWAY DETAILS

JANUARY 1979 PLATE 3

2 1

3

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

APPENDIX A

CHECKLIST - ENGINEERING DATA

CHECKLIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, AND OPERATION
PHASE I

NAME OF DAM: LAKE CAREY DAM

NDS ID NO.: PA-00887 DER ID NO.: 66-06

Sheet 1 of 4

ITEM	REMARKS
AS-BUILT DRAWINGS	NONE
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	SEE SECTION 1.2g
TYPICAL SECTIONS OF DAM	NONE IN RECORDS
OUTLETS: Plan Details Constraints Discharge Ratings	NONE

A-1

ENGINEERING DATA

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NONE
DESIGN REPORTS	NONE
GEOLOGY REPORTS	NONE
DESIGN COMPUTATIONS: Hydrology and Hydraulics Dam Stability Seepage Studies	NONE
MATERIALS INVESTIGATIONS: Boring Records Laboratory Field	NONE
POSTCONSTRUCTION SURVEYS OF DAM	FOR 1945 SPILLWAY MODIFICATIONS SEE PLATES 2 & 3

ENGINEERING DATA

ITEM	REMARKS
BORROW SOURCES	UNKNOWN
MONITORING SYSTEMS	NONE
MODIFICATIONS	Spillway ADDED 1921 Spillway MODIFIED - 1945
HIGH POOL RECORDS	8 INCHES OVER SPILLWAY LIP, DURING TROPICAL STORM AGNES.
POSTCONSTRUCTION ENGINEERING STUDIES AND REPORTS	1976 - ALBERT PETERS REPORT
PRIOR ACCIDENTS OR FAILURE OF DAM: Description Reports	1948 - OVERTOPPED AND WASHED OUT 1972 - TROPICAL STORM AGNES SANDBAGS REQUIRED

ENGINEERING DATA

Sheet 4 of 4

ITEM	REMARKS
MAINTENANCE AND OPERATION RECORDS	NONE
SPILLWAY: Plan Sections Details	SEE PLATES 2 & 3
OPERATING EQUIPMENT: Plans Details	NONE
PREVIOUS INSPECTIONS Dates Deficiencies	1919 - NOTED NO SPILLWAY 1920 - NOTED AUXILIARY SPILLWAY RECOMMENDED CONSTRUCTION OF SPILLWAY MAINTENANCE - POOR 1924 - BRUSH ON EMBANKMENT SLIGHT SEEPAGE RIGHT OF SPILLWAY. SMALL CRACK IN LEFT SPILLWAY ABUTMENT. 1928 - CONCRETE IN SPILLWAY CHANNEL DETERIORATING. SLIGHT LEAKAGE AT RIGHT END 1931 - SLIGHT SEEPAGE AT RIGHT END. 1934 - SOME FLOW AT TOE 1940 - VERY POOR CONDITION. LEAKAGE FROM TOE. UPPER END OF LEFT ABUTMENT BROKEN
CONTINUED	1941 - LEAKAGE AT LOWER TOE. SPILLWAY ABUTMENTS PARTIALLY REPAIRED. TOP OF DAM SETTLED. ROCK FALLEN FROM SLUICEWAY. POOR APPEARANCE, NEEDS REPAIRS.

A-4

ENGINEERING DATA

ITEM	REMARKS
PREVIOUS INSPECTIONS (CONTINUED)	1951 - GOOD APPEARANCE 1965 - APPEARANCE NOT GOOD, BRUSH AND TREES ON EMBANKMENT, LEAKS AT LOWER TOE

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

APPENDIX B

CHECKLIST - VISUAL INSPECTION

CHECKLIST

VISUAL INSPECTION

PHASE I

Name of Dam: LAKE CAREY DAM County: WYOMING State: PENNSYLVANIA

NDS ID No.: PA-00887 DER ID No.: 66-06

Type of Dam: EARTHFILL W/ DRY MASONRY Hazard Category: _____

Date(s) Inspection: 6 NOVEMBER 1978 Weather: CLEAR Temperature: 70°F

SOIL: MOIST

B-1

Pool Elevation at Time of Inspection: 947.0 msl/Tailwater at Time of Inspection: 937.8 msl

Inspection Personnel:

J. CROUSE (GFCC) P. YOUREN (LCWA) A.H. COON (COON CONSTRUCTION)

G. SMITH (GFCC) L. WYBELL (LCWA) R. PREGMAN (COON CONSTRUCTION)

M. BRUSSOCK (LCWA) S. JOHNSON (LEMON TOWNSHIP)

A. WHITMAN (GFCC) Recorder

EMBANKMENT

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	SEE MASONRY DAM	
SLOUGHING OR EROSION: Embankment Slopes Abutment Slopes	LEFT ABUTMENT - SURFACE RUNOFF EROSION LEFT OF SPILLWAY - UPSTREAM: BARE AREA AT SPILLWAY CREST LEVEL	
CREST ALIGNMENT: Vertical Horizontal	SEE PLATES B-2 & B-3	
RIPRAP FAILURES	NO RIPRAP	

EMBANKMENT

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT WITH: Abutment Spillway Other Features	SEE "SLOUGHING & EROSION"	
ANY NOTICEABLE SEEPAGE	SEE MASONRY DAMS	
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	
BRUSH	MUCH LOW BRUSH ON EMBANKMENT SOME TREES (ABOUT 3" DIA.) AT TOP MASONRY	

~~CONCRETE~~/MASONRY DAMS

Sheet 1 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	10 gpm FROM TOE UNDER WASTED CONCRETE NEAR BULGE.	OWNER REPORTS SEEPAGE IS FROM OLD CONDUIT
JUNCTION OF STRUCTURE WITH: Abutment Embankment Other Features	NO APPARENT DEFICIENCIES	
DRAINS	NONE	
WATER PASSAGES	NONE	
FOUNDATION	OUTCROP- THINLY LAMINATED SANDSTONE VISIBLE AT TOE	

~~CONCRETE~~/MASONRY DAMS

Sheet 2 of 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MASONRY ~~CONCRETE~~ SURFACES: Surface Cracks Spalling	MASONRY LAID IN UNEVEN (RANDOM) PATTERN.	
STRUCTURAL CRACKING	NONE	
ALIGNMENT: Vertical Horizontal	BULGE TO LEFT OF SPILLWAY 11.3 V ON 2.2 H	
MONOLITH JOINTS	NONE	
CONSTRUCTION JOINTS	NONE	
STAFF GAGE OR RECORDER	NONE	

OUTLET WORKS

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	NOT OBSERVABLE	
INTAKE STRUCTURE		
OUTLET STRUCTURE		
OUTLET CHANNEL		
EMERGENCY GATE		

UNGATED SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	CHUTE - APPARENTLY GOOD CONDITION SHRINKAGE CRACK IN RIGHT WALL	MORTAR MISSING FROM MASONRY SPILLWAY WALLS GOUGE IN LEFT EMBANKMENT BY WALL (3' x 1.5'-AREA)
APPROACH CHANNEL	PAVED IN 1977 LEFT WALL TILTED AND OFFSET TOWARD ℄ SPILLWAY BY 0.5'	
DISCHARGE CHANNEL	NATURAL STREAM	
BRIDGE AND PIERS	NONE	

AUXILIARY
~~GATED~~ SPILLWAY

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	NONE	
APPROACH CHANNEL	EARTH - UNEVEN WITH TREES GROWING	
DISCHARGE CHANNEL	SOME TREES	
BRIDGE AND PIERS	NONE	
GATES AND OPERATION EQUIPMENT	NONE	

INSTRUMENTATION

Sheet 1 of 1

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

RESERVOIR AND WATERSHED

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	GENERALLY MILD WITH MANY COTTAGES ALONG THE SHORE	
SEDIMENTATION	NO REPORTED OR VISIBLE PROBLEMS	
WATERSHED DESCRIPTION	RURAL DEVELOPMENT BUT VERY SPARSE - OTHERWISE WOODED	

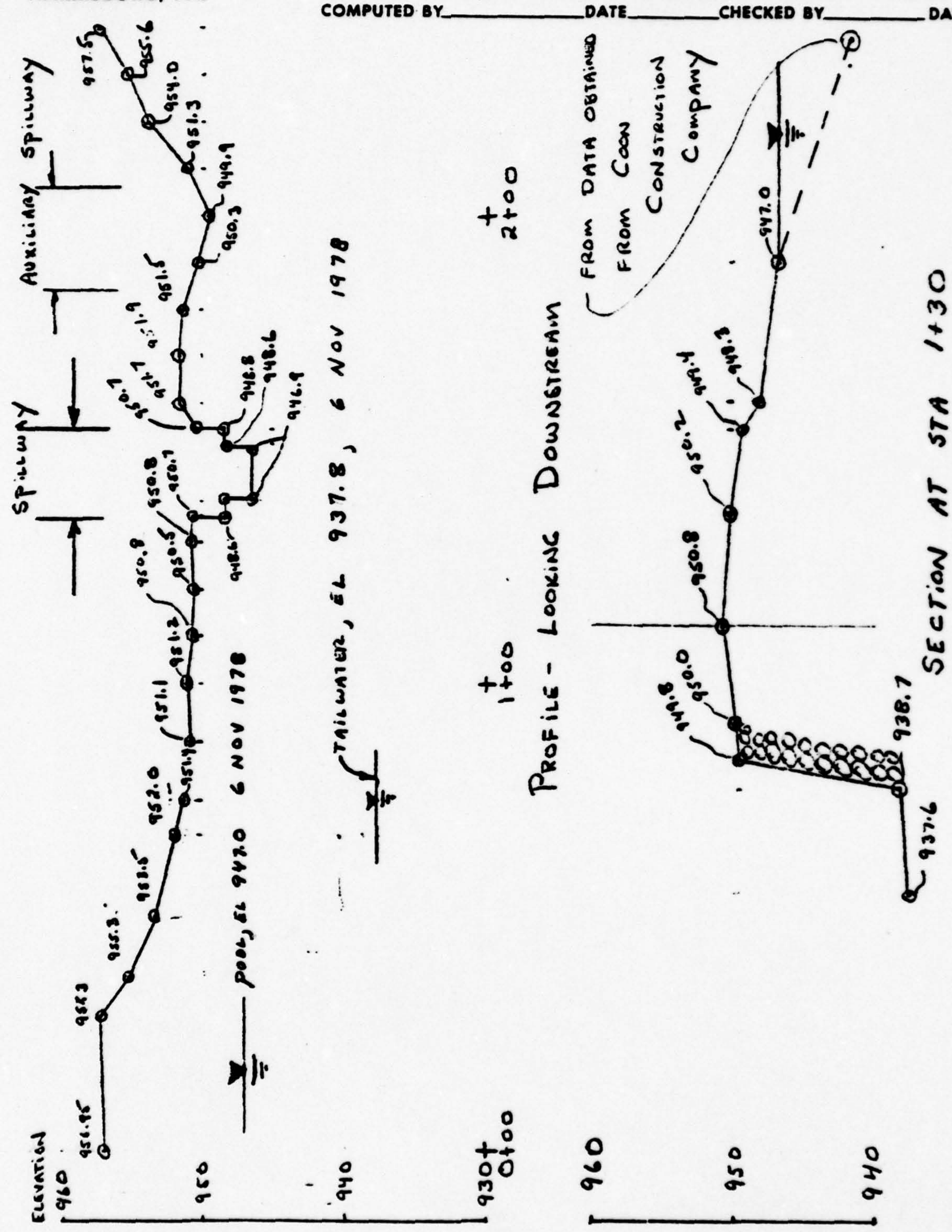
DOWNSTREAM CHANNEL

Sheet 1 of 1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION: Obstructions Debris Other	STREAM THROUGH BEDROCK	
SLOPES	STEEP	
APPROXIMATE NUMBER OF HOMES AND POPULATION	ABOUT 10 NEAR CONFLUENCE WITH TUNKHANNOCK CREEK	ELEVATIONS ABOVE STREAMBED VARY 10 FEET TO 30 FEET

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

SUBJECT: LAKE CAREY DAM FILE NO. ____
SHEET NO. ____ OF ____ SHEETS
FOR: SURVEY DATA
COMPUTED BY ____ DATE ____ CHECKED BY ____ DATE ____

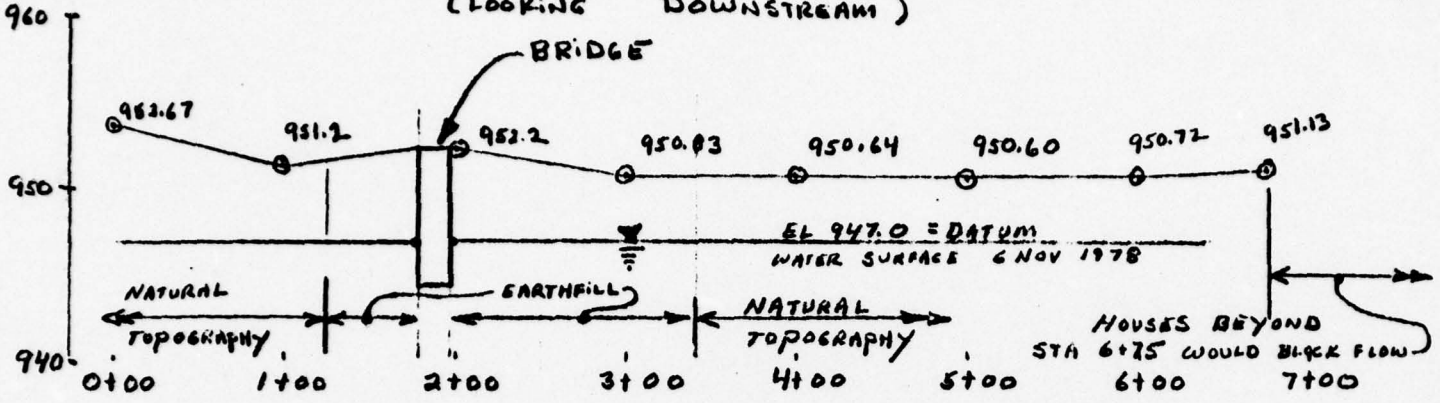


SP 11866A

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

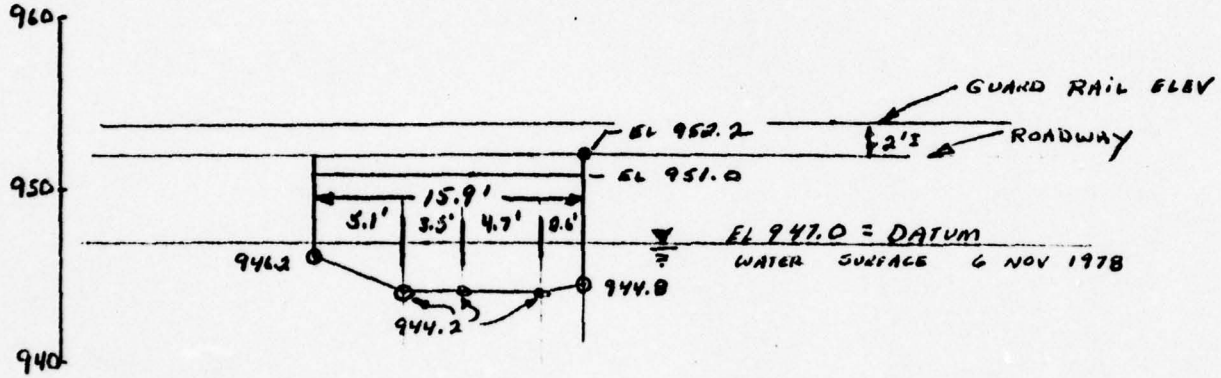
SUBJECT LAKE CAREY
UPPER ROAD SURVEY DATA
FILE NO.
SHEET NO. OF SHEETS
FOR
COMPUTED BY DATE CHECKED BY DATE

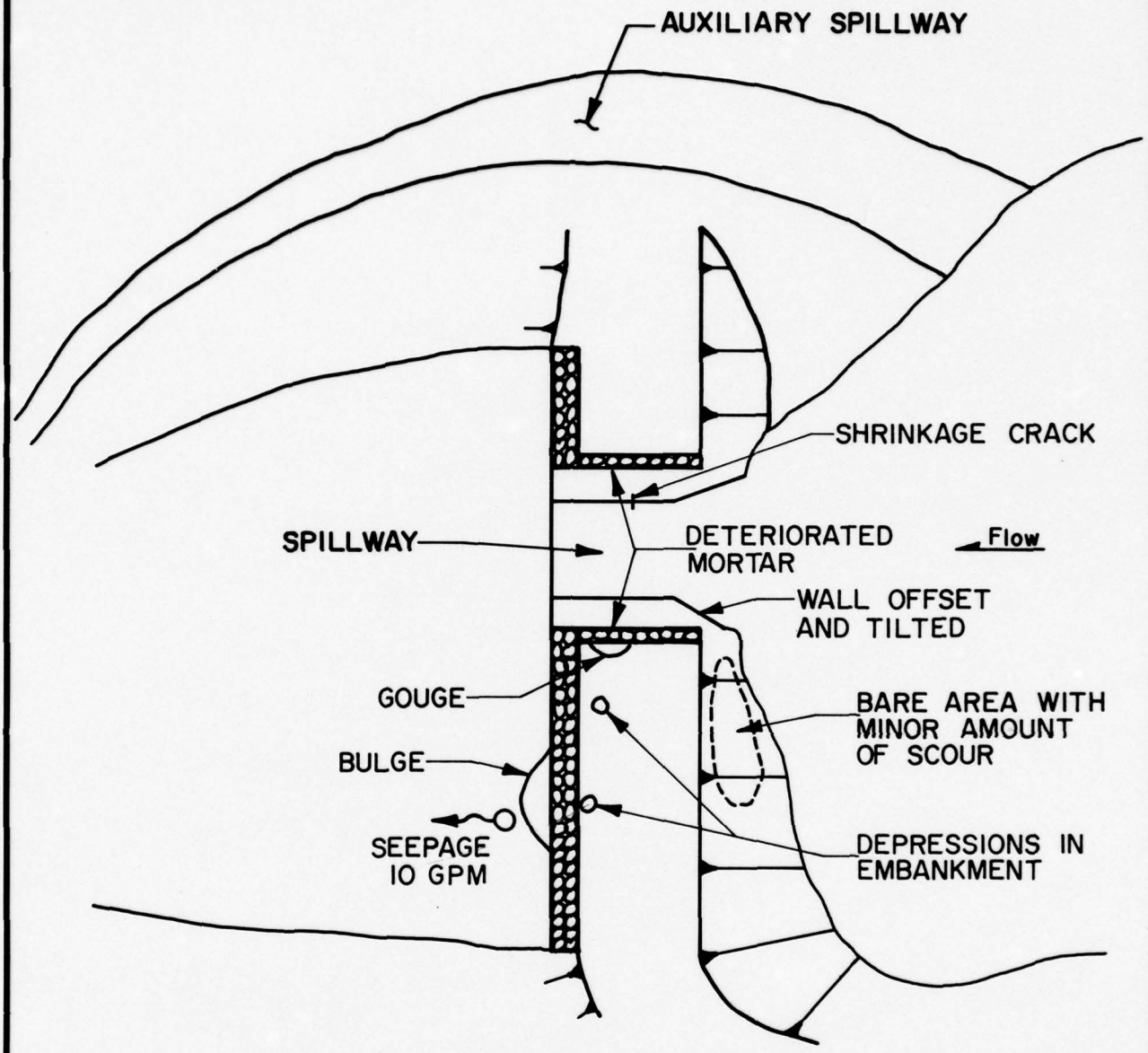
PROFILE ALONG ROAD "SEPARATING" LAKE CAREY
(LOOKING DOWNSTREAM)



B-13

PROFILE AT BRIDGE (LOOKING DOWNSTREAM)





NOT TO SCALE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CAREY DAM

LAKE CAREY WELFARE ASSOCIATION

RESULTS OF VISUAL INSPECTION

JANUARY 1979 PLATE B-1

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

APPENDIX C

HYDROLOGY AND HYDRAULICS

APPENDIX C

HYDROLOGY AND HYDRAULICS

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

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

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

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

APPENDIX C

SUSQUEHANNA River Basin

Name of Stream: MILL BROOK

Name of Dam: LAKE CAREY

NDI ID No.: PA-00887

DER ID No.: 66-06

Latitude: N 41° 34' 55" Longitude: W 75° 55' 10"

Top of Dam (low spot) Elevation: 950.5

Streambed Elevation: 937.6 Height of Dam: 13 ft

Reservoir Storage at Top of Dam Elevation: 4810* acre-ft

Size Category: INTERMEDIATE

Hazard Category: HIGH (see Section 5)

Spillway Design Flood: PMF

* SEE NEXT SHEET

UPSTREAM DAMS

Name	Distance from Dam (miles)	Height (ft)	Storage at top of Dam Elevation (acre-ft)	Remarks
STEVENS LAKE	1.7	10.3	1196	NATURAL LAKE CONTAINS ABOUT 1198 ACRE-FT. LAKE IS TERMED MUD POND ON USGS.

DOWNSTREAM DAMS

NONE				

ANNETT FLEMING CORDDRY AND CARPENTER, INC.
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SUBJECT Lake Carey FILE NO.
SHEET NO. OF SHEET
FOR
COMPUTED BY DATE CHECKED BY DATE

	Lower Pond	Upper Pond	Total
Natural Lake Volume	—	3130 AF	3130 AF
Surcharge to Spillway Crest	147 A.F.	504 AF	651 AF.
Surcharge from Spillway Crest to Top of Dam	299 A.F.	730 AF	1029 AF
TOTAL	446 AF	4364 AF	4810 AF
TOTAL LESS NATURAL LAKE			1680 AF

SP 1166BA

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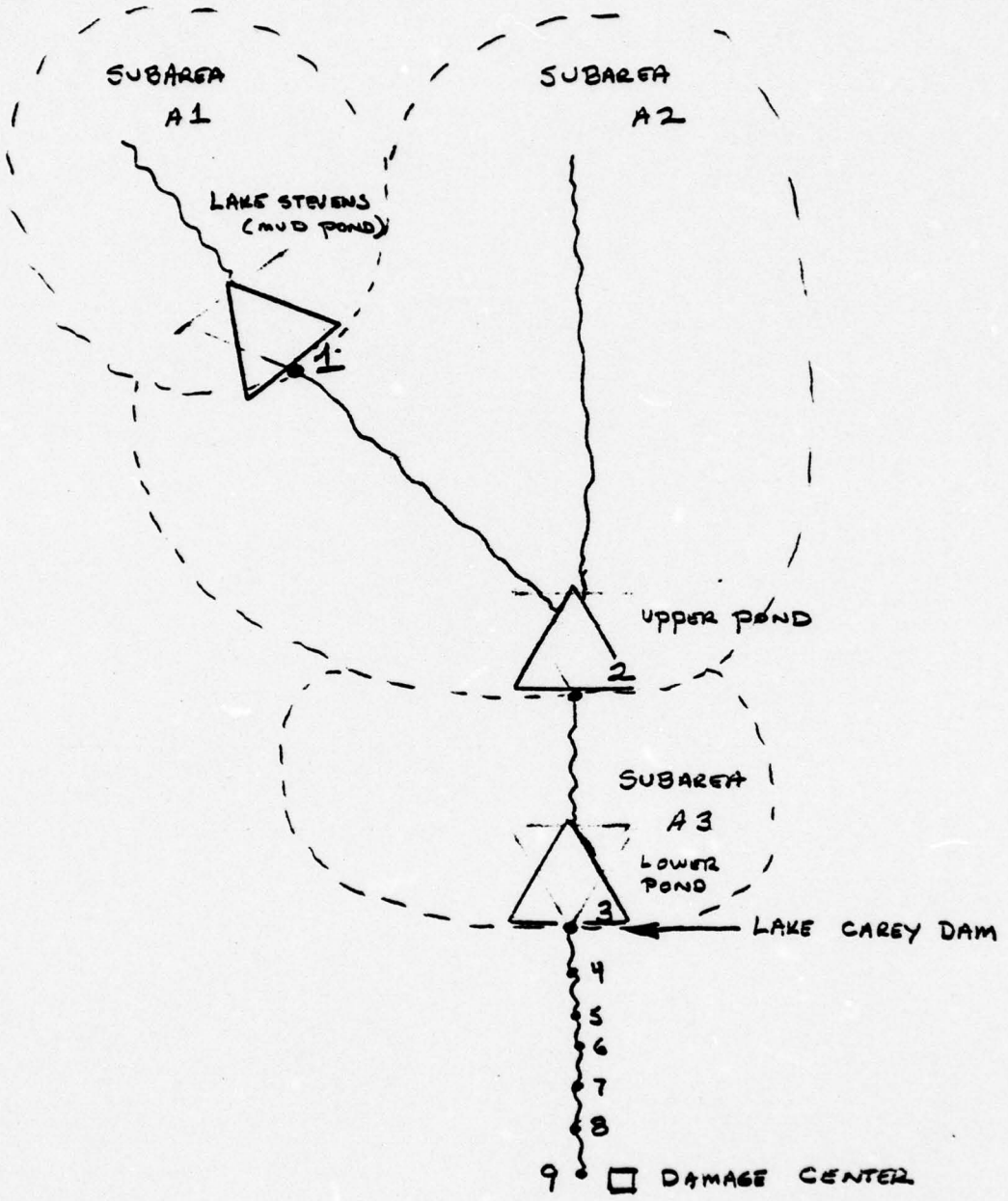
SUBJECT LAKE CAREY FILE NO.
SHEET NO. OF SHEET
FOR
COMPUTED BY DATE CHECKED BY DATE

System Sketch Area A



SUSQUEHANNA River Basin

Name of Stream: MILL BROOK

Name of Dam: LAKE CAREY AND STEVENS LAKE

NDI ID No.: PA-00887 (LAKE CAREY)

DER ID No.: 66-06 (LAKE CAREY); 66-55 STEVENS LAKE

Latitude: N 41° 35' Longitude: W 75° 55'

DETERMINATION OF PMF RAINFALL

For Area A

which consists of Subareas	A1	of 1.7 sq. mile
	A2	4.4
	A3	0.9
Total Drainage Area		7.0 sq. mile

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

	Hydromet. 40 (Susquehanna Basin)	Hydromet. 33 (Other Basins)
Zone	N/A	N/A
Geographic Adjustment Factor	96%	1.0
Revised Index Rainfall	21.3	N/A

RAINFALL DISTRIBUTION (percent)

Time	Percent
6 hours	118
12 hours	127
24 hours	136
48 hours	142
72 hours	145
96 hours	N/A

SUSQUEHANNA River Basin

Name of Stream: MILL BROOK

Name of Dam: LAKE CAREY

NDI ID No.: PA-00387

DER ID No.: 66-06

Latitude: N 41° 34' 55" Longitude: W 75° 55' 10"

Drainage Area: 7.0 sq. mile

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

Name of Dam at Outlet of Subarea: LAKE STEVENS

Drainage Area of Subarea: 1.7 sq. mile

Subarea Characteristics:

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

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

L = Length of Main Watercourse extended to the divide = 2.00 miles

L_{CA} = Length of Main Watercourse to the centroid = 0.45 mile

From NAB Data: AREA 11 PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 1.45 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 2.55 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A1
(see Sketch on Sheet C-7)

Name of Dam: LAKE STEVENS Sheet 1 of __

Height: 10.3 FT. (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	1059.0	NOT DETERMINED
Spillway Crest Elevation	1054.0	
Spillway Head Available (ft)	5.0	
Type Spillway	SHARP CRESTED WEIR	
"C" Value - Spillway	3.1	
Crest Length - Spillway (ft)	51.9	
Spillway Peak Discharge (cfs)	1799 ≈ 1800	
Auxiliary Spillway Crest Elevation	NONE	
Auxiliary Spillway Head Available (ft)	NONE	
Type Auxiliary Spillway	NONE	
"C" Value - Auxiliary Spillway	N/A	
Crest Length - Auxiliary Spillway (ft)	N/A	
Auxiliary Spillway Peak Discharge (cfs)	N/A	
Combined Spillway Discharge (cfs)	1800	

Spillway Rating Curve:

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
	NOT DETERMINED		

Data for Dam at Outlet of Subarea A1

Name of Dam: LAKE STEVENS Sheet 2 of __

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet NO OUTLET			
Invert of Inlet STOPLOGS			
Type AT RIGHT END OF			
Diameter (ft) = D SPILLWAY			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction* $= 29.1_N{}^2 L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = C\ A\ \sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

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

Data for Dam at Outlet of Subarea A1

Name of Dam: LAKE STEVENS Sheet 3 of 4

Storage Data:

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
1017	= ELEVO*	0		0	0		ESTIMATED BOTTOM OF NATURAL LAKE
1049		46.4		161	493		INVERT OF STREAM AT TOE DAM
1054	= ELEV1	62	= A1	249	764	= S1	SPILLWAY CREST KNOWN STORAGE
1059		110.6		390	1196		TOP OF DAM
1060		122					
1080	**	135.6					

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ Normal Pool is 5 percent of watershed.

Remarks: _____

Data for Dam at Outlet of Subarea A1

Name of Dam: LAKE STEVENS Sheet 4 of 4

Breach Data: PASSES 50% OF PMF - NO BREACH DATA REQUIRED.

Sketch of Dam Profile (not to scale):

Sketch of Top of Dam (not to scale):

Soil Type from Visual Inspection: _____

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) _____ fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H)

HMAX = $(4/9\ V^2/C^2)$ = _____ ft., C = _____

HMAX + Top of Dam Elev. = _____ = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = _____ ft (width of bottom of breach)

Z = _____ (side slopes of breach)

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

WSEL = _____ (normal pool elevation)

T FAIL = _____ mins

= _____ hrs (time for breach to develop)

Data for Dam at Outlet of Subarea A-2
(see Sketch on Sheet C-4)

Name of Dam: LAKE CAREY - UPPER POND Sheet 1 of 4

Height: 6.4 FT (existing)

Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	950.6	NOT designed
Spillway Crest Elevation	944.2	AS A dam
Spillway Head Available (ft)	6.4	
Type Spillway	WATERWAY UNDER BRIDGE	
"C" Value - Spillway	N/A	
Crest Length - Spillway (ft)	15.9	
Spillway Peak Discharge (cfs)	698≈700	
Auxiliary Spillway Crest Elevation	N/A	
Auxiliary Spillway Head Available (ft)	N/A	
Type Auxiliary Spillway	N/A	
"C" Value - Auxiliary Spillway	N/A	
Crest Length - Auxiliary Spillway (ft)	N/A	
Auxiliary Spillway Peak Discharge (cfs)	—	
Combined Spillway Discharge (cfs)	700	

Spillway Rating Curve:

Elevation	Q Spillway* (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
947.0	0		0
948.0	273		273
949.0	454		454
950.0	611		611
950.6	700		700
952.6	965		965

* USING $Q = 273 \cdot h^{.733}$, h ABOVE ELEVATION 9470

SEE SHEET C-12

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

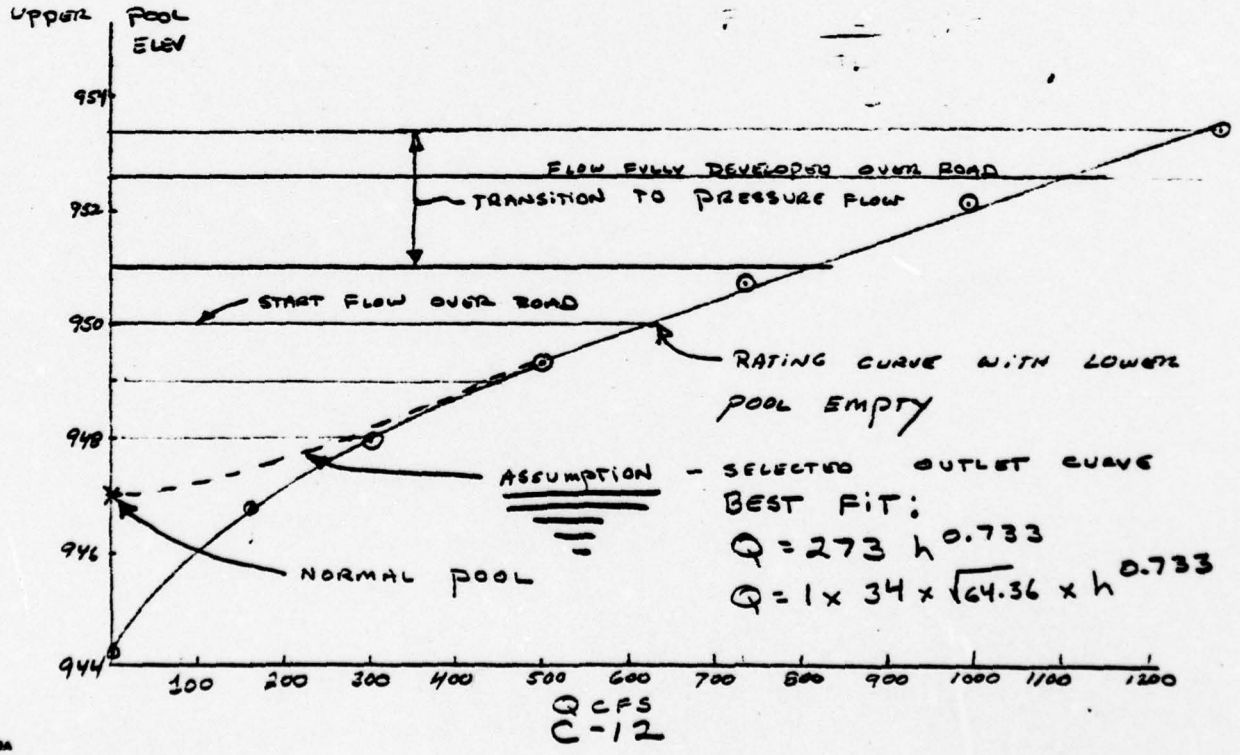
SUBJECT LAKE CAREY FILE NO.
SHEET NO. 1A OF 4 SHEETS
FOR
COMPUTED BY DATE CHECKED BY DATE

UPPER POND OUTLET WORKS

Q' = CRITICAL DEPTH

W.S. ELEV	d (FT)	T (FT)	A (FT²)	$Q'=\sqrt{\frac{A^3}{T}}$ CFS	$Q=\frac{2.7Q'}{3.1}$ CFS	hv	POOL ELEV
944.2	0	8.2	0	0	0	0	944.2
946.2	2	15.9	25.92	187.7	164	.61	946.8
947.0	2.8	15.9	38.64	341.7	298	.92	947.9
948.0	3.8	15.9	54.54	573.0	499	1.30	949.3
949.0	4.8	15.9	70.44	841.1	733	1.63	950.7
950.0	5.8	15.9	86.34	1141.3	994	2.06	952.1
951.0	6.8	15.9	102.24	1470.1	1281	2.44	953.4

(ABOVE WITH NO TAILWATER)



C-12

Data for Dam at Outlet of Subarea A-2

Name of Dam: LAKE CAREY - UPPER POND Sheet 2 of 4

Outlet Works Rating: NO	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet OUTLET WORKS			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction* = $29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = C\ A\ \sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

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

Data for Dam at Outlet of Subarea A-2

Name of Dam: LAKE CAREY - UPPER POND Sheet 3 of 4

Storage Data:

Elevation	Area (acres)	Storage million gals	Storage acre-ft	Remarks
889.3 = ELEVO*	0	0	0	
944.2 ~~= ELEV1~~	171.2 ~~= A1~~	1020	3130 = ~~S1~~	NATURAL LAKE STORAGE
947.0 = ELEV1	189 = A1	1134	3634 = S1	NORMAL POOL
950.7	206	1422	4364	
960 **	251			

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ NORMAL POOL is 6.7 percent of watershed.

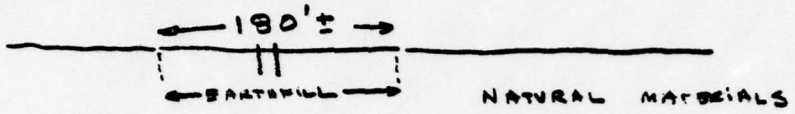
Remarks:

Data for Dam at Outlet of Subarea A1

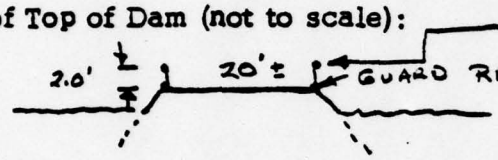
Name of Dam: LAKE CAREY - UPPER POND Sheet 4 of 4

Breach Data:

Sketch of Dam Profile (not to scale):



Sketch of Top of Dam (not to scale):



Soil Type from Visual Inspection: PAVED EXCEPT AT EDGES

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 7.5 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) $A = L \cdot d$

HMAX = $(4/9\ V^2/C^2)$ = 3.4 ft., C = 2.7

HMAX + Top of Dam Elev. = 954.0' = FAILEL
(Above is elevation at which failure would start)
USING TOP OF DAM = ROAD ELEV = 950.6

Dam Breach Data:

BRWID = 50 ft (width of bottom of breach)

Z = 1.0 (side slopes of breach)

ELBM = 944.2 (bottom of breach elevation, minimum of zero storage elevation)

WSEL = 947 (normal pool elevation)

T FAIL = 6 mins (USING 0.1 HRS PER 25' HEIGHT).

= 0.1 hrs (time for breach to develop)

SUSQUEHANNA River Basin

Name of Stream: MILL BROOK

Name of Dam: LAKE CAREY

NDI ID No.: PA-00887

DER ID No.: 66-06

Latitude: N 41° 34' 55" Longitude: W 75° 55' 10"

Drainage Area: 7.0 sq. mile

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

Name of Dam at Outlet of Subarea: LAKE CAREY - UPPER POND

Drainage Area of Subarea: 6.1, 4.4 IS UNCONTROLLED sq. mile

Subarea Characteristics:

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

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

L = Length of Main Watercourse extended to the divide = 3.71 miles

L_{CA} = Length of Main Watercourse to the centroid = 1.73 mile

From NAB Data: AREA II PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = 2.62 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 6.6 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

RTIOR = 2.0

Remarks: _____

Data for Dam at Outlet of Subarea A-3
(see Sketch on Sheet C-4)

Name of Dam: LAKE CAREY - LOWER POND Sheet 1 of 4

Height: 12.9 (existing)

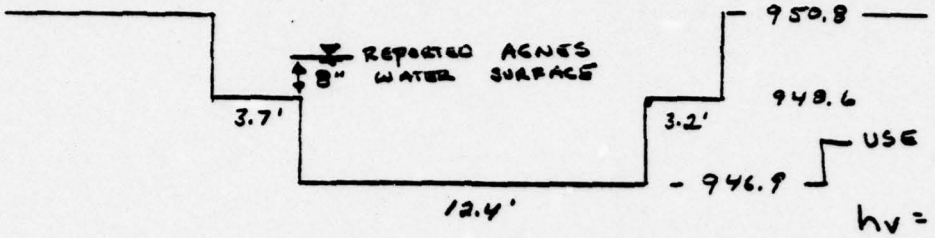
Spillway Data:	Existing Conditions	Design Conditions
Top of Dam Elevation	950.5	950.7
Spillway Crest Elevation	947.0	947.0
Spillway Head Available (ft)	3.5	3.7
Type Spillway	SEE SHEET C-17	
"C" Value - Spillway	2.7	2.7
Crest Length - Spillway (ft)	19.3	19.3
Spillway Peak Discharge (cfs)	299 ≈ 300	329 ≈ 330
Auxiliary Spillway Crest Elevation	950.0	UNKNOWN - USE EXISTING
Auxiliary Spillway Head Available (ft)	0.5	0.7
Type Auxiliary Spillway	SEE SHEET C-18	
"C" Value - Auxiliary Spillway	2.7	
Crest Length - Auxiliary Spillway (ft)	19 (APPROXIMATE)	
Auxiliary Spillway Peak Discharge (cfs)	18 ≈ 20	30
Combined Spillway Discharge (cfs)	320	360

Spillway Rating Curve:

Elevation	Q Spillway (cfs)	Q Auxiliary Spillway (cfs)	Combined (cfs)
947.0	0	0	0
948.4	71	0	71
950	228	0	228
950.5	300	20	320
950.7	330	30	360
952.0	570	145	715
957.8	1956	1118	3074

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

SUBJECT Spillway FILE NO.
SHEET NO. 1A OF 4 SHEETS
FOR LAKE CAREY DAM
COMPUTED BY DATE CHECKED BY DATE



$hv = \frac{Q^2}{2gA^2}$

pool ELEV = ELEV + hv

Q' = CRITICAL DEPTH

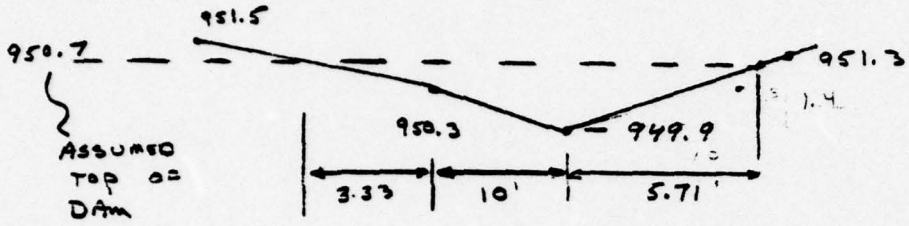
ELEV	depth	Topwidth	Area	$Q' = \sqrt{\frac{A^3 g}{T}}$	$Q = \frac{2.7 Q'}{3.1}$	hv	pool ELEV
	FT	FT	FT²	CFS	CFS	FT	
946.9	0	12.4	0	0	0	0	946.9
947.0	.1	12.4	.12	.1	.1	0	947.0
947.5	.6	12.4	7.44	32.7	28.5	.23	947.7
948.0	1.1	12.4	13.64	81.2	70.7	.42	948.4
948.6	1.7	12.4	21.08	155.9	135.8	.64	949.2
949.0	2.1	19.3	28.8	199.6	173.8	.57	949.6
949.5	2.6	19.3	38.45	307.9	268.1	.76	950.3
950.0	3.1	19.3	48.1	430.8	375.2	.95	951.0
950.5	3.6	19.3	57.75	566.7	493.6	1.13	951.6
950.8	3.9	19.3	63.54	654.0	569.6	1.2	952.0
951.0	4.1	19.3	67.4	714.5	622.3	1.3	952.3
955.0	8.1	19.3	144.6	2245	1956	2.8	957.8
960.0	13.1	19.3	241.1	4834	4210	4.7	964.7
948.6 + 8" = 949.3	2.4	19.3	34.59	262.7	229	.68	950.0

ESTIMATED ACNES DISCHARGE = 230 CFS

SP 11660A

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

SUBJECT Auxiliary Spillway FILE NO.
SHEET NO. 18 OF 4 SHEET
FOR Lake Carey Dam
COMPUTED BY DATE CHECKED BY DATE



IN VIEW OF IRREGULAR GEOMETRY
USE WEIR WITH C = 2.7, BW = 19'
AT ELEVATION 950.0

H	POOL = 950 + H	Q = CLH$^{3/2}$ (CFS)
0	950	0
.3	950.3	8.4
1.0	951.0	51.0
1.6	951.6	103.8
2.0	952.0	145.1
2.3	952.3	178.9
7.8	957.8	1117.5
14.7	964.7	2891.3

SP 1186BA

Data for Dam at Outlet of Subarea A3

Name of Dam: LAKE CAREY - LOWER POND Sheet 2 of 4

Outlet Works Rating:	Outlet 1	Outlet 2	Outlet 3
Invert of Outlet NO OUTLET WORKS			
Invert of Inlet			
Type			
Diameter (ft) = D			
Length (ft) = L			
Area (sq. ft) = A			
N			
K Entrance			
K Exit			
K Friction* = $29.1_N{}^2L/R^{4/3}$			
Sum of K			
$(1/K)^{0.5} = C$			
Maximum Head (ft) = HM			
$Q = C\ A\ \sqrt{2g(HM)}$ (cfs)			
Q Combined (cfs)			

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

Data for Dam at Outlet of Subarea A3

Name of Dam: LAKE CAREY - LOWER POND Sheet 3 of 4

Storage Data:

Elevation		Area (acres)		Storage million gals	Storage acre-ft		Remarks
941.0	= ELEVO*	0		0	0		
947.0	= ELEV1	73	= A1	48	147	= S1	
950.7		88.7		145	446		
960.0		135					
	**						

* ELEVO = ELEV1 - $(3S_1/A_1)$

** Planimetered contour at least 10 feet above top of dam

Reservoir Area at ~~Top of Dam~~ Normal Pool is 13 percent of watershed.

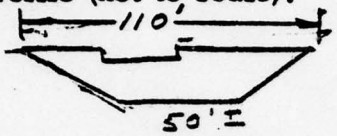
Remarks: _____

Data for Dam at Outlet of Subarea A3

Name of Dam: LAKE CAREY (LOWER POND) Sheet 4 of 4

Breach Data:

Sketch of Dam Profile (not to scale):



Sketch of Top of Dam (not to scale):

Soil Type from Visual Inspection: STONE FACING

Maximum Permissible Velocity (Plate 28, EM 1110-2-1601) 8 fps
(from $Q = CLH^{3/2} = V \cdot A$ and depth = (2/3) x H) $A = L \cdot d$

HMAX = $(4/9\ V^2/C^2)$ = 3.0 ft., C = 3.1

HMAX + Top of Dam Elev. = 953.7 = FAILEL
(Above is elevation at which failure would start)

Dam Breach Data:

BRWID = 50 ft (width of bottom of breach)

Z = 1.0 (side slopes of breach)

ELBM = 937.6 (bottom of breach elevation, minimum of zero storage elevation)

WSEL = 947.0 (normal pool elevation)

T FAIL = 6 mins

= 0.1 hrs (time for breach to develop)

SUSQUEHANNA River Basin

Name of Stream: MILL BROOK

Name of Dam: LAKE CAREY (LOWER POND)

NDS ID No.: PA-00887

DER ID No.: 66-06

Latitude: N 41° 34' 55" Longitude: W 75° 55' 10"

Drainage Area: 7.0 sq. mile

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

Name of Dam at Outlet of Subarea: LAKE CAREY DAM

Drainage Area of Subarea: 7.0 (0.9 UNCONTROLLED) sq. mile

Subarea Characteristics:

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

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

L = Length of Main Watercourse extended to the divide = .65 mile

L_{CA} = Length of Main Watercourse to the centroid = .27 mile

From NAB Data: AREA 11 PLATE E

Cp = 0.62

C_T = 1.5

$Tp = C_T \times (L \times L_{CA})^{0.3}$ = .89 (hrs)

Flow at Start of Storm = 1.5 cfs/sq. mile x Subarea D.A = 1.35 cfs

Computer Data:

QRCSN = -0.05 (5% of peak flow)

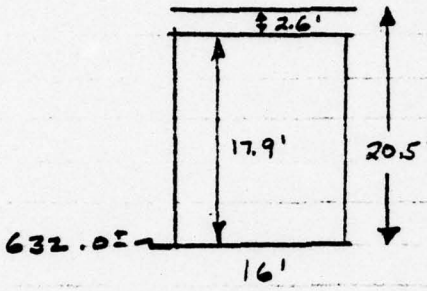
RTIOR = 2.0

Remarks: _____

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

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

BRIDGE AT CROSS SECTION 9
(DAMAGE CENTER)



ASSUME CRITICAL depth

$d_c = \sqrt[3]{\frac{q^2}{g}}$ $q = Q/b$

Q	q	d_c	
3000	187.5	10.29	
4458	278.6	13.41	← FLOW WITH NO FAILURE
8618	538.625	20.81	← FLOW WITH FAILURE OF LOWER DAM
10,568	660.5	23.84	← FLOW WITH FAILURE OF UPPER & LOWER dam

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APPENDIX C

SUMMARY

	Stevens Lake Subarea A1	Upper Pond Subarea A2	Lower Pond Subarea A3	Subarea	Total
Drainage Area (sq. mile)	1.70				
PMF:					
Peak Outflow (cfs)	4495	12,592	11,980		
Total Runoff (inches)					
Dam at Outlet?	YES	YES (Roadway and Bridge)	YES		
Is Dam Overtopped?	YES	YES	YES		
Depth of Overtopping (ft)	1.11	5.74	9.53		
One-Half PMF:					
Peak Outflow (cfs)	1578	4976	4446		
Total Runoff (inches)					
Dam at Outlet?	YES	YES	YES		
Is Dam Overtopped?	NO	YES	YES		
Depth of Overtopping (ft)	—	3.82	4.62		
Does Dam Fail?	NO	SEE TEXT	YES		
Peak Failure Outflow (cfs)	—		SEE TEXT		
At time (hrs)	—		AND COMPUTER		
Spillway (percent of PMF)	60±	20+/-	PRINTOUT.		

DOWNSTREAM SUMMARY

FOR 1/2 PMF

	Peak Water Surface Elevation Before Failure	After Failure	Remarks
Cross Section 9	639.3	639.9	WITHOUT BRIDGE
Cross Section 9	645.4	652.8	LOWER DAM FAILS WITH BRIDGE
Cross Section 9	639.3	640.2	WITHOUT BRIDGE
Cross Section 9	645.4	655.8	UPPER & LOWER FAIL WITH BRIDGE
Cross Section			

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

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

SELECTED COMPUTER PRINTOUT NOTES AND INDEX

6313

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  21 AUG 78
**********
    1          A1                                LAKE CAREY DAM
    2          A2                                    MILL BROOK
    3          A3                                      GFCC
    4          B   300      0     15      0      0      0      0      0     -4      0
    5          B1    5
    6          J     1      7      1
    7          J1  1.0     .70    .50    .35    .25    .15    .05
    8          K     0      1                                  1
    9          K1                    RUNOFF INTO STEVENS LAKE-MUD POND
   10          M     1      1    1.7             7.0
   11          P                 21.3    118    127    136    142    145
   12          T                                                 1.0    .05            .057
   13          W  1.45    .62
   14          X  2.55   -.05    2.0
   15          K     1      1                                  1
   16          K1              ROUTE THROUGH LAKE SUEVENS
   17          Y                                       1
   18          Y1    1                                                -1054      1
   19          $A  .01   46.4     62    122   135.6
   20          $E 1017   1049   1054   1060   1080
   21          $$ 1054   51.9    3.1    1.5
   22          $R    0     10      0
   23          $F    1      0      5 1048.7   51.9      0      1   1059
   24          $T1048.7 1049.0   1068
   25          $W    0      1  99999
   26          $D 1059    2.7    1.5    148
   27          K     1      1                                  1
   28          K1              ROUTE OUTFLOW LAKE STEVENS TO UPPER LAKE CAREY(SECT.1)
   29          Y                                       1
   30          Y1    1
   31          Y6  .07    .05    .07   1030   1100   2400    .02
   32          Y7    0   1100    370   1060    600   1040    700   1030    710   1030
   33          Y7  750   1040    850   1080   1050   1100
   34          K     1      1                                  1
   35          K1          ROUTE OUTFLOW TO UPPER POND (SECT. 2)
   36          Y                                       1
   37          Y1    1
   38          Y6  .07    .05    .07    968   1000   2400   .022
   39          Y7    0   1000    150    980    250    973    255    968    265    968
   40          Y7  270    973    600    980   1320   1000
   41          K     0      2                                  1
   42          K1          UNCONTROLLED RUNOFF INTO LAKE GAREY UPPER POND
   43          M     1      1    4.4             7.0                                1
   44          P                 21.3    118    127    136    142    145
   45          T                                                 1.0    .05            .067
   46          W  2.62    .62
   47          X   6.6   -.05    2.0
   48          K     2      2                                  1
   49          K1          COMBINE OUTFLOW LAKE STEVENS AND INFLOW UPPER LAKE CAREY
   50          K     1      2                                  1
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1  51          K1      ROUTE THROUGH UPPER LAKE CAREY
   52          Y                           1
   53          Y1   1                                                -947
   54          $A  .01   171.2     189     251
   55          $E 889.3  944.2     947     960
   56          $$  947    15.9    .001     1.5    947       1      34    .733
   57          $D 952.6    3.1     1.5     500
   58          K    0      3                                         1
   59          K1      UNCONTROLLED INFLOW INTO LOWER POND
   60          M    1      1      0.9              7.0                          1
   61          P           21.3     118     127     136     142     145
   62          T                                                    1.0    .05          .13
   63          U   .89    .62
   64          X  1.35   -.05     2.0
   65          K    2      3                                         1
   66          K1      COMBINE FLOWS TO LOWER POND
   67          K    1      3                                         1
   68          K1      ROUTE THROUGH LOWER POND
   69          Y                           1
   70          Y1   1                                                -947    -1
   71          Y4 946.9    947   947.7   948.4   949.2   949.6     950   950.3     951   951.6
   72          Y4  952   952.3   957.8   964.7
   73          Y5    0      .1      29      71     136     174     228     276     426     598
   74          Y5  715     801    3074    7101
   75          $A  .01     .02      73    88.7     135
   76          $E 937.6    941     947   950.7     960
   77          $$  947
   78          $D 950.7    2.7     1.5      90
   79          K    1      4                                         1
   80          K1      ROUTE THROUGH DOWNSTREAM SECTION
   81          Y                           1
   82          Y1   1
   83          Y6  .07     .05     .07     920     960     900    .066
   84          Y7    0     960     420     940     550     930     560     920     600     920
   85          Y7  610     930     700     940     800     960
   86          K    1      5
   87          Y                           1
   88          Y1   1
   89          Y6  .09     .06     .09     840     880     600    .133
   90          Y7    0     880     100     860     200     850     201     840     216     840
   91          Y7  217     850     280     860    1000     880
   92          K    1      6
   93          Y                           1
   94          Y1   1
   95          Y6  .09     .05     .09     758     840    2450    .024
   96          Y7    0     840     450     800     660     760     665     758     675     758
   97          Y7  720     760     850     800     950     840
   98          K    1      7
   99          Y                           1
  100          Y1   1
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1  101          Y6   .07    .05    .07    718    800    2250   .018
   102          Y7    0     800    280    740    420    720    430    718    450    718
   103          Y7   500    720    560    740    740    800
   104          K     1      8
   105          Y                          1
   106          Y1    1
   107          Y6   .07    .05    .07    679    800    3300   .012
   108          Y7    0     800    450    700    750    680    .755   679    765    679
   109          Y7   780    680    850    700   1380    800
   110          K     1      9                                    1
   111          K1   ROUTE TO DOWNSTREAM NO. 9 (DAMAGE CENTER)
   112          Y                          1
   113          Y1    1
   114          Y6   .05    .04    .05    632    700    3150   .013
   115          Y7    0     700    450    640-   840    637    845    632    860    632
   116          Y7   865    637   1070    640   1600    700
   117          K    99
1                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                         RUNOFF HYDROGRAPH AT          1 -
                         ROUTE HYDROGRAPH TO           1
                         ROUTE HYDROGRAPH TO           1
                         ROUTE HYDROGRAPH TO           1
                         RUNOFF HYDROGRAPH AT          2
                         COMBINE  2 HYDROGRAPHS AT     2
                         ROUTE HYDROGRAPH TO           2
                         RUNOFF HYDROGRAPH AT          3
                         COMBINE  2 HYDROGRAPHS AT     3
                         ROUTE HYDROGRAPH TO           3
                         ROUTE HYDROGRAPH TO           4
                         ROUTE HYDROGRAPH TO           5
                         ROUTE HYDROGRAPH TO           6
                         ROUTE HYDROGRAPH TO           7
                         ROUTE HYDROGRAPH TO           8
                         ROUTE HYDROGRAPH TO           9
                         END OF NETWORK
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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)

AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
				1.00	.70	.50	.35	.25	.15	.05
HYDROGRAPH AT	1	1.70	1	5113.	3579.	2557.	1790.	1278.	767.	256.
	(	4.40)	(	144.80)(	101.36)(	72.40)(	50.68)(	36.20)(	21.72)(	7.24)(
ROUTED TO	1	1.70	1	4495.	2254.	1578.	1143.	836.	514.	176.
	(	4.40)	(	127.29)(	63.82)(	44.69)(	32.36)(	23.66)(	14.56)(	4.99)(
ROUTED TO	1	1.70	1	4664.	2252.	1577.	1143.	836.	514.	176.
	(	4.40)	(	132.07)(	63.78)(	44.65)(	32.36)(	23.66)(	14.55)(	4.98)(
ROUTED TO	1	1.70	1	4564.	2248.	1577.	1141.	834.	514.	176.
	(	4.40)	(	129.25)(	63.66)(	44.65)(	32.31)(	23.63)(	14.55)(	4.98)(
HYDROGRAPH AT	2	4.40	1	9784.	6849.	4892.	3424.	2446.	1468.	489.
	(	11.40)	(	277.05)(	193.93)(	138.52)(	96.97)(	69.26)(	41.56)(	13.85)(
2 COMBINED	2	6.10	1	14218.	8982.	6418.	4536.	3258.	1972.	662.
	(	15.80)	(	402.62)(	254.34)(	181.74)(	128.44)(	92.27)(	55.83)(	18.75)(
ROUTED TO	2	6.10	1	12592.	7921.	4976.	2575.	945.	637.	265.
	(	15.80)	(	356.56)(	224.30)(	140.90)(	72.93)(	26.75)(	18.04)(	7.49)(
HYDROGRAPH AT	3	.90	1	3433.	2403.	1716.	1202.	858.	515.	172.
	(	2.33)	(	97.21)(	68.05)(	48.61)(	34.02)(	24.30)(	14.58)(	4.86)(
2 COMBINED	3	7.00	1	13999.	8380.	5138.	2631.	1204.	748.	271.
	(	18.13)	(	396.39)(	237.29)(	145.50)(	74.50)(	34.11)(	21.19)(	7.67)(
ROUTED TO	3	7.00	1	11980.	7320.	4466.	2275.	940.	587.	160.
	(	18.13)	(	339.24)(	207.27)(	126.46)(	64.43)(	26.61)(	16.62)(	4.52)(
ROUTED TO	4	7.00	1	11995.	7321.	4464.	2275.	940.	587.	160.
	(	18.13)	(	339.66)(	207.30)(	126.42)(	64.43)(	26.61)(	16.62)(	4.52)(
ROUTED TO	5	7.00	1	12001.	7322.	4466.	2275.	940.	587.	160.
	(	18.13)	(	339.84)(	207.34)(	126.47)(	64.43)(	26.61)(	16.62)(	4.52)(
ROUTED TO	6	7.00	1	11979.	7324.	4462.	2276.	940.	587.	160.
	(	18.13)	(	339.21)(	207.40)(	126.34)(	64.44)(	26.61)(	16.62)(	4.52)(
ROUTED TO	7	7.00	1	11998.	7326.	4464.	2273.	940.	587.	160.
	(	18.13)	(	339.75)(	207.44)(	126.40)(	64.35)(	26.61)(	16.62)(	4.52)(

ROUTED TO	8	7.00	1	11976.	7318.	4465.	2271.	939.	587.	160.
		(18.13)		(339.13)(	207.22)(	126.42)(	64.31)(	26.60)(	16.61)(	4.52)(
ROUTED TO	9	7.00	1	11961.	7311.	4458.	2264.	939.	587.	160.
		(18.13)		(338.70)(	207.03)(	126.23)(	64.12)(	26.60)(	16.61)(	4.52)(

1 SUMMARY OF DAM SAFETY ANALYSIS

LAKE STEVENS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1054.00	1054.00	1059.00
STORAGE	772.	772.	1198.
OUTFLOW	0.	0.	1878.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1060.11	1.11	1328.	4495.	4.25	41.75	0.00
.70	1059.56	.56	1262.	2254.	2.50	42.75	0.00
.50	1058.20	0.00	1113.	1578.	0.00	42.75	0.00
.35	1057.04	0.00	1002.	1143.	0.00	42.75	0.00
.25	1056.23	0.00	932.	836.	0.00	42.75	0.00
.15	1055.37	0.00	865.	514.	0.00	42.50	0.00
.05	1054.47	0.00	802.	176.	0.00	42.50	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

LAKE CAREY UPPER POND

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	947.00	947.00	952.60 ← TOP OF
	STORAGE	3661.	3661.	4791.
	OUTFLOW	0.	0.	964.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	956.34	3.74	5626.	12592.	13.00	42.75	0.00
.70	955.24	2.64	5373.	7921.	11.25	43.50	0.00
.50	954.42	1.82	5188.	4976.	9.25	44.00	0.00
.35	953.57	.97	5002.	2575.	7.00	45.00	0.00
.25	952.45	0.00	4757.	945.	0.00	47.00	0.00
.15	950.18	0.00	4285.	637.	0.00	46.50	0.00
.05	947.96	0.00	3845.	265.	0.00	46.00	0.00

1 SUMMARY OF DAM SAFETY ANALYSIS

LAKE CAREY LOWER POND

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	947.00	947.00	950.70
	STORAGE	149.	149.	447.
	OUTFLOW	0.	0.	362.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	960.23	9.53	1511.	11980.	36.75	43.50	0.00
.70	957.54	6.84	1165.	7320.	35.00	44.50	0.00
.50	955.32	4.62	907.	4466.	33.00	45.00	0.00
.35	953.34	2.64	697.	2275.	30.75	46.25	0.00
.25	951.80	1.10	548.	940.	27.50	48.50	0.00
.15	951.23	.53	495.	587.	15.75	50.00	0.00
.05	949.45	0.00	340.	160.	0.00	54.25	0.00

PLAN 1 STATION 9 DAMAGE CENTER

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	11961.	640.5	43.75
.70	7311.	639.7	44.75
.50	4458.	639.3	45.25
.35	2264.	637.6	46.75
.25	939.	636.0	49.00
.15	587.	635.6	50.50
.05	160.	633.1	54.50

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  21 AUG 78
**********
    1          A1                                LAKE CAREY DAM
    2          A2                                   MILL BROOK
    3          A3                                     GFCC
    4          B   300      0     15      0       0       0       0       0      -4       0
    5          B1    5
    6          J     2      1      1
    7          J1  .50
    8          K     0      1                                                    1
    9          K1                     RUNOFF INTO STEVENS LAKE-MUD POND
   10          M     1      1    1.7               7.0                                    1
   11          P           21.3    118     127     136     142     145
   12          T                                                    1.0     .05             .057
   13          W  1.45    .62
   14          X  2.55   -.05    2.0
   15          K     1      1                                                    1
   16          K1           ROUTE THROUGH LAKE SUEVENS
   17          Y                                    1       1
   18          Y1    1                                                   -1054       1
   19          $A  .01   46.4     62     122   135.6
   20          $E 1017   1049   1054    1060    1080
   21          $$ 1054   51.9    3.1     1.5
   22          $R    0     10      0
   23          $F    1      0      5  1048.7    51.9       0       1    1059
   24          $T1048.7 1049.0   1068
   25          $W    0      1  99999
   26          $D 1059    2.7    1.5     148
   27          $B   50      1 1048.7     1.0    1054    1070
   28          $B   50      1 1048.7     1.0    1054    1070
   29          K     1      1                                                    1
   30          K1           ROUTE OUTFLOW LAKE STEVENS TO UPPER LAKE CAREY(SECT.1)
   31          Y                                    1       1
   32          Y1    1
   33          Y6  .07    .05     .07    1030    1100    2400     .02
   34          Y7    0   1100     370    1060     600    1040     700    1030     710    1030
   35          Y7  750   1040     850    1080    1050    1100
   36          K     1      1                                                    1
   37          K1           ROUTE OUTFLOW TO UPPER POND (SECT. 2)
   38          Y                                    1       1
   39          Y1    1
   40          Y6  .07    .05     .07     968    1000    2400    .022
   41          Y7    0   1000     150     980     250     973     255     968     265     968
   42          Y7  270    973     600     980    1320    1000
   43          K     0      2                                                    1
   44          K1           UNCONTROLLED RUNOFF INTO LAKE CAREY UPPER POND
   45          M     1      1    4.4               7.0                                    1
   46          P           21.3    118     127     136     142     145
   47          T                                                    1.0     .05             .067
   48          W  2.62    .62
   49          X   6.6   -.05    2.0
   50          K     2      2                                                    1
```

```
1   51          K1      COMBINE OUTFLOW LAKE STEVENS AND INFLOW UPPER LAKE CAREY
    52          K       1       2                                               1
    53          K1      ROUTE THROUGH UPPER LAKE CAREY
    54          Y                                       1       1
    55          Y1      1                                                       -947
    56          $A      .01     171.2   189     251
    57          $E      889.3   944.2   947     960
    58          $$      947     15.9    .001    1.5     947     1       34      .733
    59          $D      952.6   3.1     1.5     500
    60          $B      100     1       944.2   .1      947     954.5
    61          $B      50      1       944.2   .1      947     954.5
    62          K       0       3                                               1
    63          K1      UNCONTROLLED INFLOW INTO LOWER POND
    64          M       1       1       0.9             7.0                                     1
    65          P               21.3    118     127     136     142     145
    66          T                                                       1.0     .05             .13
    67          W       .89     .62
    68          X       1.35    -.05    2.0
    69          K       2       3                                               1
    70          K1      COMBINE FLOWS TO LOWER POND
    71          K       1       3                                               1
    72          K1      ROUTE THROUGH LOWER POND
    73          Y                                       1       1
    74          Y1      1                                                       -947    -1
    75          Y4      946.9   947     947.7   948.4   949.2   949.6   950     950.3   951     951.6
    76          Y4      952     952.3   957.8   964.7
    77          Y5      0       .1      29      71      136     174     228     276     426     598
    78          Y5      715     801     3074    7101
    79          $A      .01     .02     73      88.7    135
    80          $E      937.6   941     947     950.7   960
    81          $$      947
    82          $D      950.7   2.7     1.5     90
    83          $B      50      1       937.6   .1      947     953.7
    84          $B      25      1       937.6   .1      947     953.7
    85          K       1       4                                               1
    86          K1      ROUTE THROUGH DOWNSTREAM SECTION
    87          Y                                       1       1
    88          Y1      1
    89          Y6      .07     .05     .07     920     960     900     .066
    90          Y7      0       960     420     940     550     930     560     920     600     920
    91          Y7      610     930     700     940     800     960
    92          K       1       5
    93          Y                                       1       1
    94          Y1      1
    95          Y6      .09     .06     .09     840     880     600     .133
    96          Y7      0       880     100     860     200     850     201     840     216     840
    97          Y7      217     850     280     860     1000    880
    98          K       1       6
    99          Y                                       1       1
   100          Y1      1
```

```
1  101          Y6  .09   .05   .09   758   840   2450  .024
   102          Y7   0    840   450   800   660   760   665   758   675   758
   103          Y7  720   760   850   800   950   840
   104          K    1     7
   105          Y                      1     1
   106          Y1   1
   107          Y6  .07   .05   .07   718   800   2250  .018
   108          Y7   0    800   280   740   420   720   430   718   450   718
   109          Y7  500   720   560   740   740   800
   110          K    1     8
   111          Y                      1     1
   112          Y1   1
   113          Y6  .07   .05   .07   679   800   3300  .012
   114          Y7   0    800   450   700   750   680   755   679   765   679
   115          Y7  780   680   850   700  1380   800
   116          K    1     9                                  1
   117          K1   ROUTE TO DOWNSTREAM NO. 9 (DAMAGE CENTER)
   118          Y                      1     1
   119          Y1   1
   120          Y6  .05   .04   .05   632   700   3150  .013
   121          Y7   0    700   450   640   840   637   845   632   860   632
   122          Y7  865   637  1070   640  1600   700
   123          K   99
1                    PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                     RUNOFF HYDROGRAPH AT          1
                     ROUTE HYDROGRAPH TO           1
                     ROUTE HYDROGRAPH TO           1
                     ROUTE HYDROGRAPH TO           1
                     RUNOFF HYDROGRAPH AT          2
                     COMBINE  2 HYDROGRAPHS AT     2
                     ROUTE HYDROGRAPH TO           2
                     RUNOFF HYDROGRAPH AT          3
                     COMBINE  2 HYDROGRAPHS AT     3
                     ROUTE HYDROGRAPH TO           3
                     ROUTE HYDROGRAPH TO           4
                     ROUTE HYDROGRAPH TO           5
                     ROUTE HYDROGRAPH TO           6
                     ROUTE HYDROGRAPH TO           7
                     ROUTE HYDROGRAPH TO           8
                     ROUTE HYDROGRAPH TO           9
                     END OF NETWORK
```

AD-A070 716 GANNETT FLEMING CORDDRY AND CARPENTER INC HARRISBURG PA F/G 13/2
NATIONAL DAM INSPECTION PROGRAM. LAKE CAREY DAM (NDI-PA-00887) --ETC(U)
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2 OF 2
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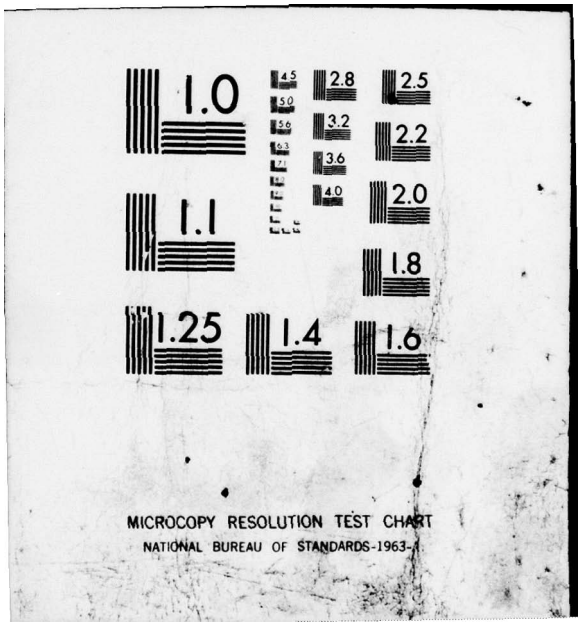
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1.1
1.25
1.4
1.6
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2.8
3.2
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4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50
HYDROGRAPH AT	1	1.70 (4.40)	1	2557. (72.40)(
			2	2557. (72.40)(
ROUTED TO	1	1.70 (4.40)	1	1578. (44.69)(
			2	1578. (44.69)(
ROUTED TO	1	1.70 (4.40)	1	1577. (44.65)(
			2	1577. (44.65)(
ROUTED TO	1	1.70 (4.40)	1	1577. (44.65)(
			2	1577. (44.65)(
HYDROGRAPH AT	2	4.40 (11.40)	1	4892. (138.52)(
			2	4892. (138.52)(
2 COMBINED	2	6.10 (15.80)	1	6418. (181.74)(
			2	6418. (181.74)(
ROUTED TO	2	6.10 (15.80)	1	4975. (140.89)(
			2	4976. (140.89)(
HYDROGRAPH AT	3	.90 (2.33)	1	1716. (48.61)(
			2	1716. (48.61)(
2 COMBINED	3	7.00 (18.13)	1	5138. (145.49)(
			2	5138. (145.49)(

ROUTED TO	3	7.00	1	12483.	
		(18.13)		(353.47)(	
			2	9244.	
				(261.76)(	
ROUTED TO	4	7.00	1	11958.	
		(18.13)		(338.62)(	
			2	8880.	
				(251.47)(	
ROUTED TO	5	7.00	1	11473.	
		(18.13)		(324.89)(	
			2	8640.	
				(244.65)(	
ROUTED TO	6	7.00	1	12322.	
		(18.13)		(348.91)(	
			2	9325.	
				(264.06)(	
ROUTED TO	7	7.00	1	12479.	
		(18.13)		(353.37)(	
			2	9343.	
				(264.57)(	
ROUTED TO	8	7.00	1	11052.	
		(18.13)		(312.96)(	
			2	8375.	
				(237.16)(	
ROUTED TO	9	7.00	1	11085.	
		(18.13)		(313.91)(	
			2	8618.	
				(244.03)(	

LAKE CAREY LOWER POND

PLAN 2	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	947.00	947.00	950.70
STORAGE	149.	149.	447.
OUTFLOW	0.	0.	362.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	953.94	3.24	758.	10347.	5.00	43.35	43.25

DAMAGE CENTER

PLAN 2 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	8618.	639.9	44.00

```
1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
 LAST MODIFICATION  21 AUG 78
**********
    1     A1                                LAKE CAREY DAM
    2     A2                                   MILL BROOK
    3     A3                                      GFCC
    4     B   300     0    15     0     0     0     0     0    -4     0
    5     B1    5
    6     J     2     1     1
    7     J1  .50
    8     K     0     1                                      1
    9     K1                RUNOFF INTO STEVENS LAKE-MUD POND
   10     M     1     1   1.7           7.0                            1
   11     P          21.3   118   127   136   142   145
   12     T                                      1.0   .05          .057
   13     W  1.45   .62
   14     X  2.55  -.05   2.0
   15     K     1     1                                      1
   16     K1          ROUTE THROUGH LAKE SUEVENS
   17     Y                             1     1
   18     Y1    1                                  -1054     1
   19     $A  .01  46.4    62   122  135.6
   20     $E 1017  1049  1054  1060  1080
   21     $$ 1054  51.9   3.1   1.5
   22     $R    0    10     0
   23     $F    1     0     5 1048.7  51.9     0     1  1059
   24     $T1048.7 1049.0  1068
   25     $W    0     1 99999
   26     $D 1059   2.7   1.5   148
   27     $B   50     1 1048.7   1.0  1054  1070
   28     $B   50     1 1048.7   1.0  1054  1070
   29     K     1     1                                      1
   30     K1          ROUTE OUTFLOW LAKE STEVENS TO UPPER LAKE CAREY(SECT.1)
   31     Y                             1     1
   32     Y1    1
   33     Y6  .07   .05   .07  1030  1100  2400   .02
   34     Y7    0  1100   370  1060   600  1040   700  1030   710  1030
   35     Y7  750  1040   850  1080  1050  1100
   36     K     1     1                                      1
   37     K1          ROUTE OUTFLOW TO UPPER POND (SECT. 2)
   38     Y                             1     1
   39     Y1    1
   40     Y6  .07   .05   .07   968  1000  2400  .022
   41     Y7    0  1000   150   980   250   973   255   968   265   968
   42     Y7  270   973   600   980  1320  1000
   43     K     0     2                                      1
   44     K1          UNCONTROLLED RUNOFF INTO LAKE CAREY UPPER POND
   45     M     1     1   4.4           7.0                            1
   46     P          21.3   118   127   136   142   145
   47     T                                      1.0   .05          .067
   48     W  2.62   .62
   49     X  6.6   -.05   2.0
   50     K     2     2                                      1
```

```
1   51          K1      COMBINE OUTFLOW LAKE STEVENS AND INFLOW UPPER LAKE CAREY
    52          K    1      2                                                  1
    53          K1      ROUTE THROUGH UPPER LAKE CAREY
    54          Y                                    1      1
    55          Y1   1                                                    -947
    56          $A  .01   171.2    189     251
    57          $E 889.3  944.2    947     960
    58          $$  947    15.9    .001    1.5     947      1      34    .733
    59          $D 952.6    3.1     1.5     500
    60          $B  100      1   944.2      .1     947  954.0
    61          $B   50      1   944.2      .1     947  954.0
    62          K    0      3                                                  1
    63          K1      UNCONTROLLED INFLOW INTO LOWER POND
    64          M    1      1     0.9             7.0                                    1
    65          P           21.3    118     127     136     142     145
    66          T                                                  1.0    .05          .13
    67          W   .89    .82
    68          X  1.35   -.05     2.0
    69          K    2      3                                                  1
    70          K1      COMBINE FLOWS TO LOWER POND
    71          K    1      3                                                  1
    72          K1      ROUTE THROUGH LOWER POND
    73          Y                                    1      1
    74          Y1   1                                                    -947     -1
    75          Y4 946.9    947   947.7   948.4   949.2   949.6     950   950.3     951   951.6
    76          Y4   952  952.3   957.8   964.7
    77          Y5     0     .1      29      71     136     174     228     276     426     598
    78          Y5   715     801    3074    7101
    79          $A  -.01    .02      73    88.7     135
    80          $E 937.6     941     947   950.7     960
    81          $$   947
    82          $D 950.7     2.7     1.5      90
    83          $B    50      1   937.6      .1     947  953.7
    84          $B    25      1   937.6      .1     947  953.7
    85          K    1      4                                                  1
    86          K1      ROUTE THROUGH DOWNSTREAM SECTION
    87          Y                                    1      1
    88          Y1   1
    89          Y6  .07     .05     .07     920     960     900    .066
    90          Y7     0     960     420     940     550     930     560     920     600     920
    91          Y7   610     930     700     940     800     960
    92          K    1      5
    93          Y                                    1      1
    94          Y1   1
    95          Y6  .09     .06     .09     840     880     600    .133
    96          Y7     0     880     100     860     200     850     201     840     216     840
    97          Y7   217     850     280     860    1000     880
    98          K    1      6
    99          Y                                    1      1
   100          Y1   1
```

```
1  101          Y6   .09    .05    .09    758    840    2450   .024
   102          Y7   0      840    450    800    660    760    665    758    675    758
   103          Y7   720    760    850    800    950    840
   104          K    1      7
   105          Y                         1      1
   106          Y1   1
   107          Y6   .07    .05    .07    718    800    2250   .018
   108          Y7   0      800    280    740    420    720    430    718    450    718
   109          Y7   500    720    360    740    740    800
   110          K    1      8
   111          Y                         1      1
   112          Y1   1
   113          Y6   .07    .05    .07    679    800    3300   .012
   114          Y7   0      800    450    700    750    680    755    679    765    679
   115          Y7   780    680    850    700    1380   800
   116          K    1      9                                   1
   117          K1   ROUTE TO DOWNSTREAM NO. 9 (DAMAGE CENTER)
   118          Y                         1      1
   119          Y1   1
   120          Y6   .05    .04    .05    632    700    3150   .013
   121          Y7   0      700    450    640    840    637    845    632    860    632
   122          Y7   865    637    1070   640    1600   700
   123          K    99
1                    PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                     RUNOFF HYDROGRAPH AT          1
                     ROUTE HYDROGRAPH TO           1
                     ROUTE HYDROGRAPH TO           1
                     ROUTE HYDROGRAPH TO           1
                     RUNOFF HYDROGRAPH AT          2
                     COMBINE  2 HYDROGRAPHS AT     2
                     ROUTE HYDROGRAPH TO           2
                     RUNOFF HYDROGRAPH AT          3
                     COMBINE  2 HYDROGRAPHS AT     3
                     ROUTE HYDROGRAPH TO           3
                     ROUTE HYDROGRAPH TO           4
                     ROUTE HYDROGRAPH TO           5
                     ROUTE HYDROGRAPH TO           6
                     ROUTE HYDROGRAPH TO           7
                     ROUTE HYDROGRAPH TO           8
                     ROUTE HYDROGRAPH TO           9
                     END OF NETWORK
```

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50
HYDROGRAPH AT	1	1.70	1	2557.
		(4.40)		(72.40)(
			2	2557.
				(72.40)(
ROUTED TO	1	1.70	1	1578.
		(4.40)		(44.69)(
			2	1578.
				(44.69)(
ROUTED TO	1	1.70	1	1577.
		(4.40)		(44.65)(
			2	1577.
				(44.65)(
ROUTED TO	1	1.70	1	1577.
		(4.40)		(44.65)(
			2	1577.
				(44.65)(
HYDROGRAPH AT	2	4.40	1	4892.
		(11.40)		(138.52)(
			2	4892.
				(138.52)(
2 COMBINED	2	6.10	1	6418.
		(15.80)		(181.74)(
			2	6418.
				(181.74)(
ROUTED TO	2	6.10	1	12097.
		(15.80)		(342.56)(
			2	8707.
				(246.56)(
HYDROGRAPH AT	3	.90	1	1716.
		(2.33)		(48.61)(
			2	1716.
				(48.61)(
2 COMBINED	3	7.00	1	12453.
		(18.13)		(352.62)(
			2	9063.
				(256.63)(

ROUTED TO	3	7.00	1	15958.
		(18.13)		(451.88)(
			2	10929.
				(309.47)(
ROUTED TO	4	7.00	1	15390.
		(18.13)		(435.79)(
			2	10543.
				(298.54)(
ROUTED TO	5	7.00	1	14865.
		(18.13)		(420.93)(
			2	10657.
				(301.76)(
ROUTED TO	6	7.00	1	16281.
		(18.13)		(461.04)(
			2	11449.
				(324.21)(
ROUTED TO	7	7.00	1	16631.
		(18.13)		(470.93)(
			2	11388.
				(322.48)(
ROUTED TO	8	7.00	1	14651.
		(18.13)		(414.87)(
			2	10361.
				(293.39)(
ROUTED TO	9	7.00	1	14835.
		(18.13)		(420.09)(
			2	10568.
				(299.25)(

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	947.00	947.00	952.60
STORAGE	3661.	3661.	4791.
OUTFLOW	0.	0.	964.

LAKE CAREY UPPER POND

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	954.08	1.48	5114.	9360.	3.00	43.10	43.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	947.00	947.00	950.70
STORAGE	149.	149.	447.
OUTFLOW	0.	0.	362.

LAKE CAREY LOWER POND

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	954.47	3.77	814.	11595.	6.00	43.35	43.25

PLAN 2 STATION 9

DAMAGE CENTER

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	10568.	640.2	44.00

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

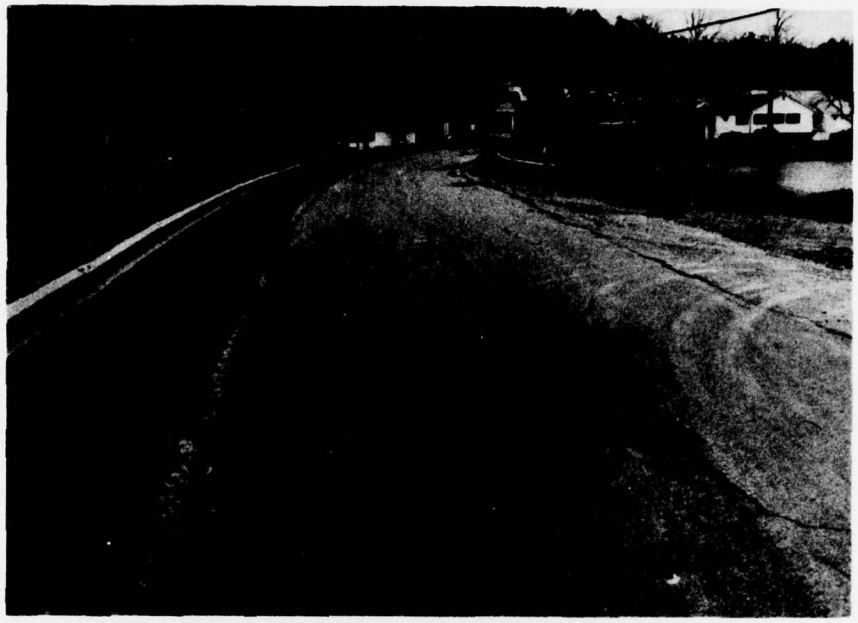
PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

APPENDIX D

PHOTOGRAPHS



A. Roadway Separating the Lake Upper Pond at Left.

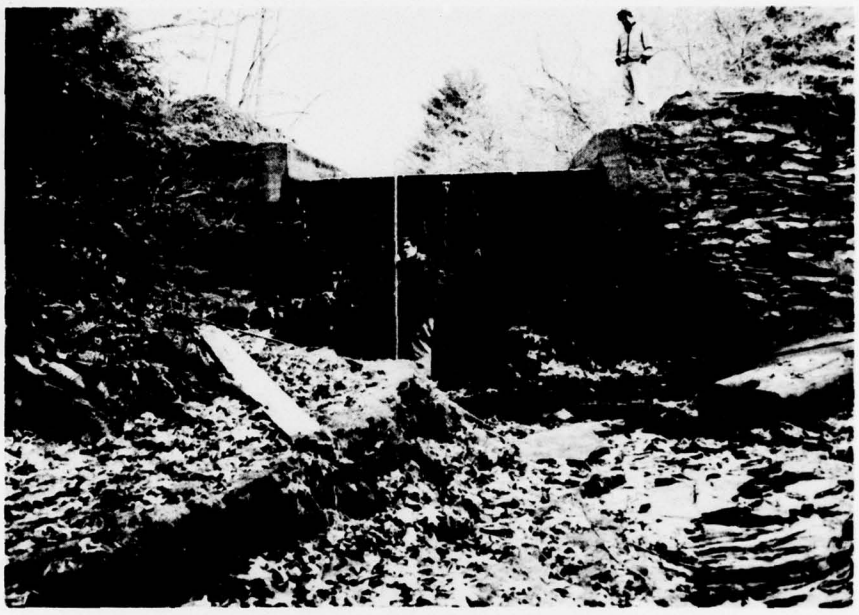
B. Bridge Between Upper and Lower Pond - Looking Upstream.

C. Upstream Slope of Embankment, Spillway Approach, and Auxiliary Spillway Approach.

D. Spillway Left Approach Wall.

E. Spillway Left Wall.

F. Auxiliary Spillway Channel.



G. Downstream Face of Dam.

H. Downstream Face of Dam to Left of Spillway.

I. Channel Downstream of Dam.

J. Stevens Lake - Upstream of Lake Carey Dam.

SUSQUEHANNA RIVER BASIN

MILL BROOK, WYOMING COUNTY

PENNSYLVANIA

LAKE CAREY DAM

NDI ID No. PA-00887
DER ID No. 66-06

LAKE CAREY WELFARE ASSOCIATION, INC.

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

JANUARY 1979

APPENDIX E

GEOLOGY

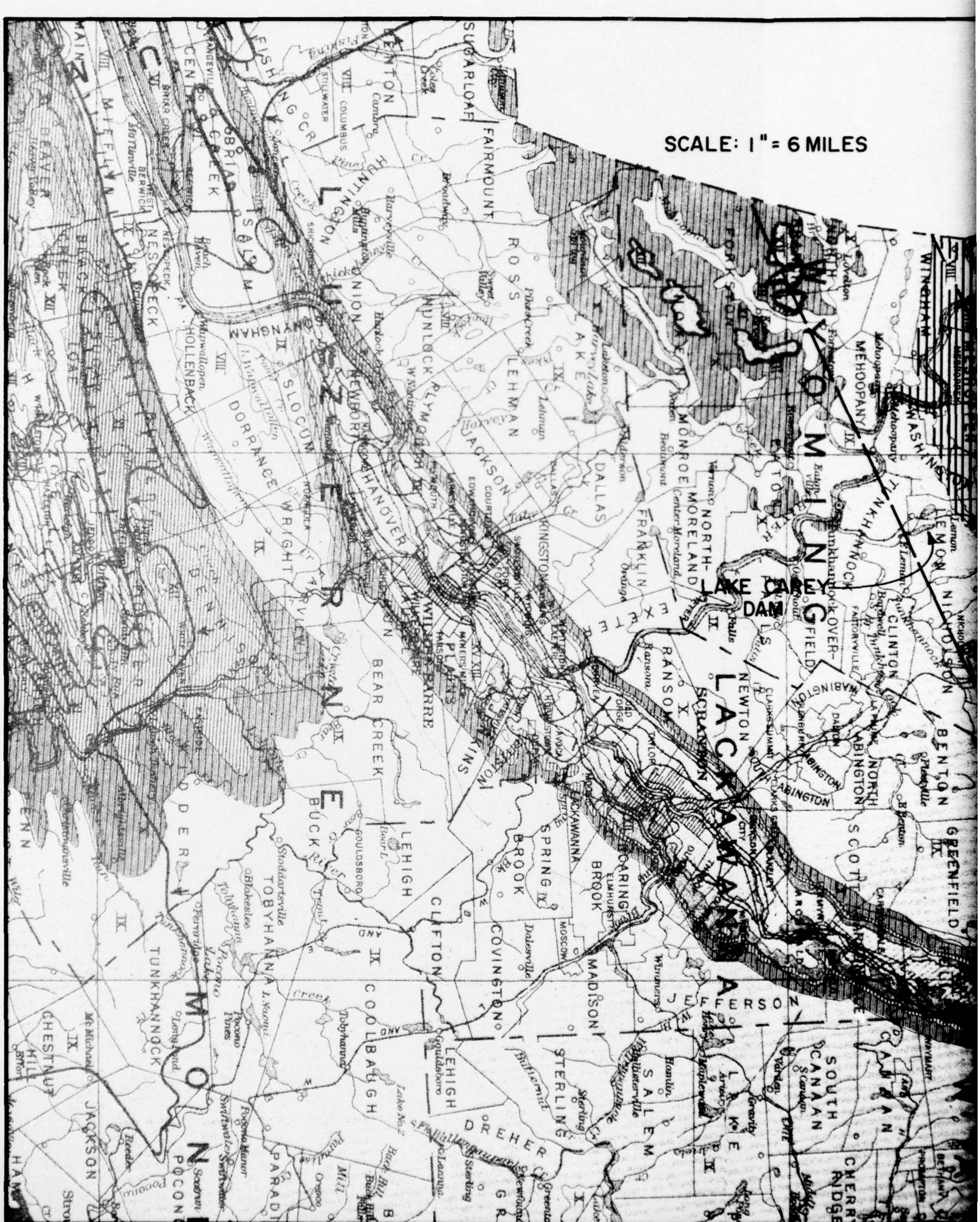
Lake Carey Dam

APPENDIX E

GEOLOGY

1. General Geology. The damsite and reservoir are located in Wyoming County. In general, the rocks of Wyoming County are practically horizontal, as there are no major folds. There are a number of minor anticlines and synclines, most of which trend in a northeasterly direction. At the northwest corner of the county, the Wilmot anticline crosses the North Branch of Susquehanna River at Skinners Eddy, bringing up the top strata of the Chemung formation. The axis trends about N 65°E and the dips on both sides are very gentle, not exceeding 5° to 6°. The adjacent axis of the Bernice syncline passes across the top of Dutch Mountain in North Branch Township, forming the Mehsopany Coal Basin, and continues as a gentle fold across the county about 8 miles southeast of, and generally parallel to the Wilmot anticline. The syncine leaves the county about 2 miles east of West Nicholson in Nicholson Township. Southeast of the Bernice Sycline, the rocks are nearly horizontal, except for minor undulations, as far as the eastwood extension of the White Deer anticline beyond the southeast corner of the county. The Pottsville formation, Mauch Chunk shale and Pocono sandstone crop out only on the summits of the high mountains in the southwest corner of Wyoming County. The Pocono extends as far east as Tunkhannock. The greater part of the county is underlain by rocks belonging to the Catskill continental group.

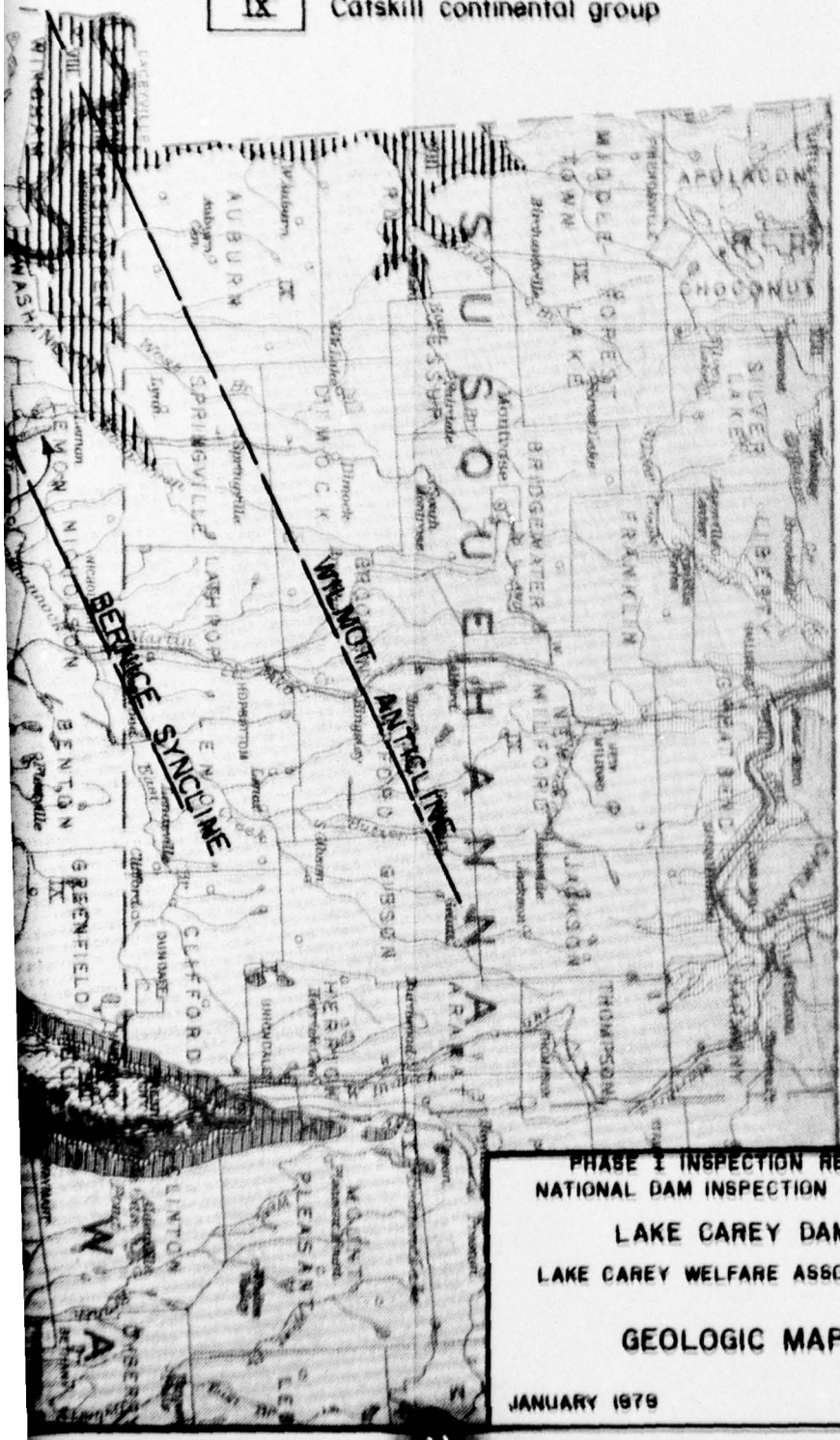
2. Site Geology. Lake Carey Dam is founded in nearly horizontal, hard, "slaty", yellow sandstone and hard sandy shales of the Catskill group in an area immediately southeast of the Bernice syncline. The natural lake portion of the reservoir was apparently formed in a natural depression in the area between the Wilmot anticline and the Bernice syncline and is largely fed by springs. Apparently flow from the natural lake cut a vee gorge channel through the sandstorm strata as an outlet to Tunkhannock Creek. The dam was constructed across this channel, downstream of the natural lake, in order to raise the water level and increase the storage capacity of the lake. Some water leakage apparently occurs from the reservoir by way of the "slaty", horizontal stratifications in the sandstone and sandy shale sidewalls of the gorge.


SCALE: 1" = 6 MILES
LAKE CAREY
DAM

DEVONIAN FORMATIONS

VIII — Chemung formation, Portage group, Hamilton formation, Marcellus shale and Onondaga formation

IX — Catskill continental group



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

LAKE CAREY DAM

LAKE CAREY WELFARE ASSOCIATION

GEOLOGIC MAP

JANUARY 1979 PLATE E-1