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NATIONAL DAM INSPECTION PROGRAM. KEEN LAKE DAM (NDI NUMBER PA-0--ETC(U)
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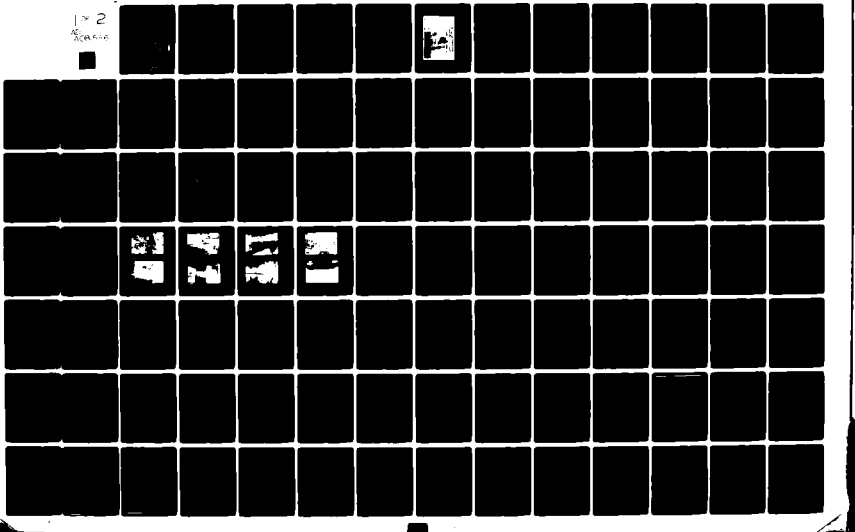

DELAWARE RIVER BASIN

KEEN LAKE DAM

NDI NO. PA-00092
DER NO. 64-13

WAYNE COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

BY

Berger Associates, Inc.
Harrisburg, Pennsylvania

JANUARY 1980

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(6) National Dam Inspection Program. Keen Lake Dam (NDI Number PA-00092, Der Number 64-12), Delaware River Basin. Phase I Inspection Report.

PREFACE

This report has been 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. (15) DACW31-80-C-0019

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.

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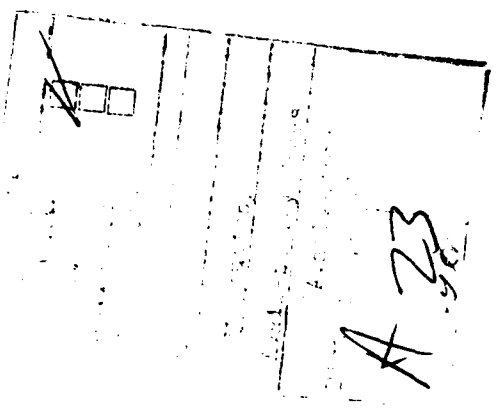
It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the 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.



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PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam: KEEN LAKE DAM

State & State No.: PENNSYLVANIA, PA-00092

County: WAYNE

Stream: VAN AUKEN CREEK

Date of Inspection: October 23, 1979

DACW31-80-C-0019

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineer's evaluation guidelines, the size classification of this dam is intermediate and the hazard classification is high. The spillway capacity is inadequate for passing the PMF (Probable Maximum Flood) peak inflow without overtopping the dam. The project is capable of passing only 14 percent of the PMF. Failure of this dam will significantly increase the hazard to loss of life downstream from the dam. The spillway capacity is seriously inadequate. The project, therefore, is considered to be unsafe, non-emergency.

The following recommendations are made for immediate action by the owner:

1. That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for improving the capacity of the spillway and reservoir system.

2. That all trees and brush be removed from the embankment and that this work be performed on a regular maintenance schedule. The embankment should be protected with an adequate vegetative cover.

3. That the walls of the spillway and sluiceway be pointed and capped to insure its structural integrity.

4. That the leakage at the downstream wall be monitored on a regular basis noting and recording approximate volume and the clarity. If increase in volume or any turbidity is observed, immediate steps shall be taken to identify and correct the condition.

5. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

6. That a program be developed for regular inspection and maintenance of the facilities.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: January 25, 1980

APPROVED BY:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE 25 Feb 1980

OVERVIEW

KEEN LAKE DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

KEEN LAKE DAM

NDI-ID NO. PA-00092
DER-ID NO. 64-13

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 inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: Project datum elevation is not available. The reservoir pool elevation shown on U.S.G.S. Quadrangle as Elevation 1272, is assumed to be normal pool elevation (top of spillway weir).

Keen Lake Dam, also known as Keen's Pond Dam is an earthfill embankment with a downstream vertical masonry stone wall. The maximum height of the dam is about 26 feet above streambed. The dam has an overall length of 200 feet. A 24 foot wide spillway is located near the center of the dam. This broadcrested weir has a crest elevation of 5.5 feet below the low point of the embankment. Adjacent to the spillway is a sluiceway opening, which is controlled with stoplogs. Removal of the stoplogs permits lowering of the pool level to about 11 feet below normal pool elevation. All structures for spillway and sluiceway are constructed with stone.

A fill was placed across the reservoir about 400 feet upstream from the dam for a railroad track. This fill was originally about twenty feet higher than the dam embankment. After the track was

abandoned, a large part of the fill was excavated and removed. A 160 foot± section of this fill is now below the crest elevation of the downstream dam. A foot wide stone arch extends through this fill and connects the large upstream reservoir with the small pond between the two embankments.

B.	Location:	Canaan Township, Wayne County U.S.G.S. Quadrangle - Honesdale, Pa. Latitude 41°-35.5', Longitude 75°-22.4' Appendix E, Plate I & II
C.	Size Classification:	Intermediate. (Height: 26 feet Storage 1449 acre-feet)
D.	Hazard Classification:	High (Refer to Section 3.1.E)
E.	Ownership:	James L. Keen R.D. #1, Box 278 Waymart, PA 18472
F.	Purpose:	Recreation

G. Design and Construction History

The dam was designed and constructed by the Delaware and Hudson Canal Company before 1851. That is the year the company received water flow rights from Jacob Keen, who owned the land covered by the water. Records of the design or construction do not exist, but it appears that the dam was constructed at the low end of a relatively wide valley in which a natural pond was located. Over the years, repairs were made consisting of replacing wooden floors in spillway and sluiceway, pointing and guniting of stone walls and the replacement of the stoplogs.

H. Normal Operating Procedures

The reservoir is used for recreational purposes including swimming, boating and fishing. Cottages are located near the water's edge. Normal pool elevation (top of spillway weir) is desirable. All inflow above that level is discharged through the spillway and sluiceway.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	15.8
Computed for this report:	14.5
Use:	14.5

B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations

Maximum known flood, May 23, 1943, based on records for the U.S.G.S. gaging station which is located near Forest City in the adjoining Lackawanna River Watershed	1153
Spillway capacity at pool Elev. 1277.5 (low point of dam)	973
Sluiceway capacity over stoplogs at Elev. 1277.5	279

C. Elevation (feet above mean sea level)

Top of dam (low point)	1277.5
Spillway crest	1272.0
Sluiceway opening top of stoplogs	1272.7
Bottom sluiceway	1261.7
Streambed at centerline of dam - estimate	1251

D. Reservoir (miles)

Length of normal pool	0.9
Length of maximum pool	1.0

E. Storage (acre-feet)

Spillway crest (Elev. 1272.0)	887
Top of dam (Elev. 1277.5)	1449

F. Reservoir Surface (acres)

Top of dam (Elev. 1277.5)	113
Spillway crest (Elev. 1272.0)	92

G. Dam

Refer to Plate IV in Appendix E for plan and Plate A-III in Appendix A for section.

Type: Earthfill embankment with a vertical downstream masonry wall.

Length: 200 feet.

Height: 26 feet.

Top Width: Varies, about 20 feet.

Side Slopes: Upstream - 2.8H to 1V (above water surface)
Downstream - Vertical (Stone wall)

Zoning: None.

Cutoff: Wall perhaps founded on rock.

Grouting: None.

H. Outlet Facilities

Stoplogs in 8' wide channel adjacent to spillway.

I. Spillway

Type: Uncontrolled broad crested weir with sloping crest.

Length of weir: 26 feet.

Crest elevation: 1272.

J. Regulating Outlets

See Section 1.3.H. above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data for Keen Lake Dam are not available in the files of the Pennsylvania Department of Environmental Resources (PennDER) nor in the files of the owner. The available drawings consist of a property survey map and two drawings indicating repairs made in 1932 and 1942. The two drawings are reproduced in Appendix E of this report (Plates III & IV).

2.2 CONSTRUCTION

Records of construction of this dam are not available.

2.3 OPERATION

Records of operation have not been maintained. Correspondence in the PennDER files indicate that the dam was overtopped during floods in May 1942 and August 1955. The records for 1942 are conflicting. One letter states an overtopping of 3 feet, another letter mentions 9 inches over the dam. Washouts occurred on the downstream side at both abutments. A photograph taken in August 1955 shows the present owner indicating an overtopping height of about three feet. During the recent inspection, the owner stated that this height was exaggerated at that time.

2.4 EVALUATION

The only engineering data available for examination were contained in the files of PennDER, Bureau of Dam Safety. The data was limited to two drawings and a letter file.

A. Adequacy

While the available information contained in the files are limited, they are considered sufficient to make a reasonable assessment of the overall condition of the dam and its appurtenances.

B. Operating Records

Formal operating records have not been maintained for this dam.

C. Post Construction Changes

The existing drawings indicate a timber floor in the spillway and sluiceway (Plate IV, Appendix E). This planking has been replaced with a concrete slab. The wooden gate in the sluiceway has been replaced by wooden stoplogs.

A concrete wall was placed at both ends of the embankment (Plate IV) to divert overtopping water away from the downstream abutment fill.

Reports and photographs indicate that the upstream side of the spillway was gunited in 1933 in an effort to reduce leakage through the downstream wall and spillway walls. Reports indicate that a 4 foot deep trench was excavated at the upstream side of the spillway and sluiceway. A concrete cut-off wall was placed in this trench and tied to the spillway slab. The original timber cut-off wall was at that time in good condition, but there was not a good junction between the sheeting and spillway floor, causing some of the leakage.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Keen Lake Dam is fair. This relatively old structure consists of an earthfill embankment and a downstream handlaid masonry stone wall. A number of trees are on top of the embankment. Seepage is occurring at the downstream side of the stone wall and the spillway is in need of some repair.

The reservoir is used for recreation, including fishing, boating and swimming. The dam and a part of the reservoir is owned by Mr. James Keen, who has developed a camping and cottage resort area immediately upstream of the dam. Mr. Keen accompanied the inspectors during their inspection.

The visual inspection check list is in Appendix A of this report. This appendix also has several sketches made from survey information obtained by the inspection team. Included are a general plan, profile, typical section and several details. Photographs taken during the inspection are reproduced in Appendix C.

B. Embankment

The actual embankment is relatively short, about 110 feet to the left of the spillway and about 50 feet at the right side of the spillway. The upstream slope is flat and is unprotected by grass or riprap. However, an upstream embankment across the reservoir prevents any wave action at the dam. The top width of the embankment varies considerably, with about a minimum width of 20 feet. The top of the embankment is covered with many trees, some of them close to spillway walls and the downstream masonry wall. The downstream face of the embankment consists of a nearly vertical handlaid masonry stone wall, which appeared to be in good condition. No displacements or bulging were noticed, indicating that the wall is stable. Some seepage water was coming out of the wall at both sides of the spillway close to the bottom of the exposed wall. The amount of seepage does not appear to be serious for this type of dam.

Concrete walls were added at both abutments. Both walls tie in with the higher sidehills and were apparently constructed to direct water from the hillside and any overtopping water of the reservoir away from the downstream joints between the dam and the hillside.

C. Appurtenant Structures

The spillway is formed from stone with a gunited surface. The gunite has cracked severely and the concrete cap of the walls is badly deteriorated. It appears that some stones could be dislodged with high discharges which could endanger the safety of the structure.

Adjacent to the 26 feet wide spillway and separated by a stone wall is an eight foot wide sluiceway. This sluiceway, also formed with stone walls, has a low flow elevation of 1261.7. Stoplogs in the sluiceway are placed to an elevation of about 8 inches above the spillway weir elevation. The stoplogs and the timbers supporting these logs were replaced in 1978 and are in good condition. No other methods of lowering the pool level are available for this dam.

D. Reservoir Area

The reservoir area has flat banks and appears to be stable. The right side of the reservoir is mostly wooded and the left side is used for cottages, homes, a campground and a swim beach. There are no reports of sedimentation.

A railroad embankment was constructed across the reservoir about 400 feet upstream of the dam. A 16 foot wide stone arch allows the water to flow from the main reservoir to the small pond between Keen Lake Dam and the railroad embankment. The arch is in excellent condition and the normal water depth at this location is about 7.3 feet (See Plate A-IV, Appendix A). A 160 foot long section of the railroad embankment is lower in elevation than the breast elevation of the Keen Lake Dam. The embankment has many trees growing on it. Several campsites are located on the embankment.

E. Downstream Channel

The discharge from the spillway and sluiceway falls over the downstream face of the stone wall and into the natural streambed which is about 100 feet wide near the dam. The banks are rocklined and steep on the right side and moderately steep on the left side. The slopes are wooded over the first 1,000 feet downstream beyond which the valley widens. There are six homes located in this widened valley which would be in the floodplain if the dam should fail due to overtopping. Therefore, the hazard category for Keen Lake Dam is "High."

3.2 EVALUATION

The visual evaluation of the facilities is fair. Trees on the embankment should be removed and some concrete repair work should be performed on the sluiceway. Although seepage is occurring, there is no serious concern as long as no fines are noticeable in the seepage water. This condition should, however, be monitored on a regular basis noting any change in volume of flow or clarity of the water.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The operational procedures for Keen Lake Dam are limited. The reservoir is used for recreation and keeping the pool level at spillway weir elevation is the major concern. All inflow above that level is discharged over the spillway.

4.2 MAINTENANCE OF DAM

The owner, Mr. James Keen, is of the opinion that tree roots on top of the embankment will hold the soil together if overtopping would occur. If the soil becomes saturated, a tree could topple over and dislodge a large area of the embankment. It is, therefore, more desirable to remove the trees and provide a good grass mat for protection of the embankment surface.

4.3 MAINTENANCE OF OPERATING FACILITIES

The sluiceway and stoplogs are in good condition. The overall condition of the spillway is good, except that some concrete capping on the top of the walls and some cementing of the vertical surfaces is required. There are no mechanical operating facilities and the lake can only be lowered by removal of stoplogs in the sluiceway. The maximum drawdown is about 11 feet below the spillway weir elevation.

4.4 WARNING SYSTEM

The owner of the property lives close to the dam and maintains a campground in the area. Although daily observations are made, there is no formal surveillance plan or downstream warning system.

4.5 EVALUATION

The operational procedures should be expanded and should include the removal of trees on the embankment. The area should then be seeded to provide a dense protective grass mat. The spillway should be inspected annually and necessary repair work should be performed.

A formal surveillance plan and downstream warning system should be developed for implementation during high or prolonged precipitation.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analyses available from PennDER for Keen Lake Dam were not very extensive. No stage-discharge curve, stage-storage curve, unit hydrograph, nor flood routings were contained in the PennDER files.

B. Experience Data

The greatest known flood at Keen Lake Dam occurred in May 1942 when the dam was overtopped. The amount of overtopping was reported at several different depths ranging from nine inches to three feet. This flood event caused a considerable amount of erosion at both the left and right abutments.

C. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped.

D. Overtopping Potential

Keen Lake Dam has a total storage capacity of 1449 acre-feet and an overall height of 26 feet, both referenced to the top of the dam. These dimensions indicate a size classification of "Intermediate", the hazard classification is "High" (See Section 3.1.E).

The recommended Spillway Design Flood (SDF) for a dam having the above classification is the Probable Maximum Flood (PMF). For this dam, the PMF peak inflow is 17,056 cfs (See Appendix D for HEC-1 inflow computations).

Comparison of the estimated PMF peak inflow of 17,056 cfs with the estimated spillway discharge capacity of 1,252 cfs indicates that a potential for overtopping of the Keen Lake Dam exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam does not have the necessary storage available to pass the PMF without overtopping. The spillway-reservoir system can pass a flood event equal to 14% of a PMF.

D. Dam Break Evaluation

The calculations to determine the behavior of the dam in the event of an overtopping and a resulting breaching of the embankment indicates that there will be a substantial increase in water levels downstream from the dam.

Several houses are located about 1,850 feet downstream from the dam. On the basis of the results of a dam break analysis, using the U.S. Army Corps of Engineers HEC-1 program, the water surface elevations in the vicinity of the houses have been compared. (Refer to Table 1, Appendix D). The facilities were overtopped in 1942 and 1955 by a maximum depth of about three feet, with no apparent structural damage. For this report, is was assumed that an overtopping of four feet depth would cause a breach of the dam. Calculations indicate that 39 percent of the PMF inflow would cause an overtopping of 4 feet. The increase due to overtopping under no failure condition as compared to no overtopping, would be 3.1 feet. While more property would be exposed to flooding, the increase to the hazard to loss of life is not considered significant. With failure, however, the breaching analysis indicates a rise of 5.7 feet above the flow level just prior to breach when considering a 15 minute time to complete the breach and a 4.3 feet rise above flow level just prior to breach when considering a 1 hour time to complete the breach. The increase in hazard to loss of life and property damage is reflected not only in the increase in depth of water of 5.7 feet in the 15 minute breach and 4.3 feet in the 1 hour breach, but more significantly in the shorter time to reach the peak. Less time would be available to respond to the flooding under the breach conditions.

Being an earth embankment, it is judged that the breach would be completed between the 15 minute and the 1 hour period. The numerical difference of water levels is 1.4 feet. The property damage would be similar with either time of failure. Again, however, the time factor is most significant regarding loss of life. Calculations indicate that the water depth will increase at a rate of 5.7 feet in 15 minutes under the 15 minute breach condition.

Three dams are located upstream of Keen Lake Dam. For this evaluation, none of those dams were considered to have failed (See Appendix D, Sheet 11).

On the basis of these calculations, it is concluded that the hazard to loss of life and property damage is significantly increased when the dam is overtopped as compared to the condition just prior to overtopping.

Refer to Table 1, Appendix D, for comparison of flood water levels.

F. Spillway Adequacy

The intermediate size category and high hazard category, in accordance with the Corps of Engineers criteria and guidelines, indicates that the spillway design flood for this dam should be the Probable Maximum Flood (PMF).

Calculations show that the spillway discharge capacity and reservoir storage capacity combine to handle 14% of the PMF (Refer to Appendix D).

Since the spillway discharge and reservoir storage capacity cannot pass one-half of the PMF and because the downstream hazard to loss of life is high and this hazard is significantly increased when the dam fails as compared to just prior to failure, the spillway is judged to be seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

The visual inspection of Keen Lake Dam did not find any major signs of distress which would signify an unstable structural condition. The upstream slope was flat. Although there is very little protective cover on the slope, the protection of the old upstream railroad embankment prevent serious wave damage. The upstream slope and the top of the embankment are covered with a considerable growth of trees, which could cause serious problems when the embankment is saturated.

The downstream side of the embankment is formed by a nearly vertical stone wall. The wall appears to be in good condition. Leakage is occurring on both sides of the spillway close to the bottom of the wall. Overtopping of the dam in 1942 and 1955 caused washouts at the abutments, but apparently did not endanger the stability of the structure.

2. Appurtenant Structures

The appurtenant structures are an integral part of the dam and consist of a stone spillway and adjacent sluiceway. The sluiceway is closed off with stoplogs from about 11 feet below spillway crest to slightly above the spillway crest. The stoplogs were replaced in 1978 and are in good condition. The walls of the spillway and sluiceway are in fair condition. The top and sides of the center wall are in need of repair to ensure structural integrity during large discharges.

B. Design and Construction

Design and Construction data are not available for review of structural stability.

C. Operating Records

Records in the files of PennDER indicate that the dam was overtopped at least twice in the last 40 years (1942 and 1955). The 1942 flood caused a washout at both abutments on the downstream side, but there is no indication that these washouts undermined the foundation of the dam. The washouts were backfilled. The flood of 1942 caused the failure of the stoplogs in the sluiceway. Other records indicate that leakage through the downstream wall has existed since at least 1930.

D. Post Construction Changes

The post construction changes have been limited to rehabilitation of the floors in the spillway and sluiceway and attempting to reduce the leakage through the walls under the spillway.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection and the review of available information indicate that the dam and its appurtenant structures are in fair condition. Repairs are required to the masonry walls of the spillway and sluiceway and the trees and brush on the embankment should be removed. Leakage exists at the downstream wall of the dam. The water is clear at the present time. Close observation and monitoring of this emerging water is recommended.

In accordance with the Corps of Engineers evaluation guidelines, the spillway is inadequate for passing the full PMF peak inflow without overtopping the dam. The combination of the storage and spillway capacity is sufficient for passing only 14 percent of the PMF. Failure of the dam due to overtopping will significantly increase the hazard to loss of life downstream of the dam. The spillway capacity is seriously inadequate. The dam, therefore, is considered to be unsafe, non-emergency.

B. Adequacy of Information

Although the available engineering data are not sufficient to make a detailed analysis of the stability of the dam and its appurtenant structures, the available drawings, reports and the observed physical conditions are judged sufficient for making a reasonable assessment of the overall condition of the dam.

C. Urgency

The recommendations presented below should be implemented without delay.

D. Necessity for Additional Studies

A detailed hydrologic and hydraulic analysis should be performed by a professional engineer experienced in the design and construction of dams to determine means for improving the capacity of this spillway and reservoir system.

7.2 RECOMMENDATIONS

In order to assure the safe operation of this dam, the following recommendations are presented for implementation by the owner:

1. That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for improving the capacity of the spillway and reservoir system.

2. That all trees and brush be removed from the embankment and that this work be performed on a regular maintenance schedule. The embankment should be protected with an adequate grass cover.

3. That the walls of the spillway and sluiceway be pointed and capped to insure its structural integrity.

4. That the leakage at the downstream wall be monitored on a regular basis noting and recording approximate volume and clarity. If increase in volume or any turbidity is observed, immediate steps shall be taken to identify and correct the condition.

5. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

6. That a program be developed for regular inspection and maintenance of the facilities.

APPENDIX A

CHECKLIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 64-13 NDI NO. PA-00 092

NAME OF DAM KEEN LAKE DAM HAZARD CATEGORY High

TYPE OF DAM Stone masonry gravity dam with upstream earthfill

LOCATION Canaan TOWNSHIP Wayne COUNTY, PENNSYLVANIA

INSPECTION DATE 10/23/79 WEATHER cloudy, windy TEMPERATURE 50-60

INSPECTORS: R.V. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

H. Jongsma James Keen

R. Shireman

A.W. Bartlett

NORMAL POOL ELEVATION: 1272.0 AT TIME OF INSPECTION:

BREAST ELEVATION: 1277.5 (as surveyed) POOL ELEVATION: 1272.1

SPILLWAY ELEVATION: 1272.0 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: (Est. 3 ft. over spillway 1942)

GENERAL COMMENTS:

Dam appears to be in a stable condition. There is no evidence of tilting, settlement or other movement. The reservoir is used for recreational purposes.

NDI NO. PA-00 092

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS	
A. SURFACE CRACKS	EMBANKMENT N/A	MASONRY WALL Loose stone.
B. UNUSUAL MOVEMENT BEYOND TOE	N/A	None.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	N/A	None.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal - Okay Vertical - See Profile Plate A-II.	Good.
E. RIPRAP FAILURES	N/A	N/A
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	N/A	Both abutments have a concrete wall diverting overflow water away from the abutment fill.
G. SEEPAGE	N/A	See sketch. Close to groundline both sides of spillway.
H. DRAINS	N/A	None.
J. GAGES & RECORDER	None.	N/A
K. COVER (GROWTH)	Trees.	None. Trees close to wall.

NDI NO. PA-00 092

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Stoplogs in sluiceway can lower reservoir to elevation 1261.7.
B. OUTLET STRUCTURE	N/A
C. OUTLET CHANNEL	Adjacent to spillway.
D. GATES	Stoplogs.
E. EMERGENCY ~~GATE~~ OUTLET	Emergency drawdown is provided by stoplogs to the left of the spillway in old sluiceway.
F. OPERATION & CONTROL	Stoplogs replaced in 1978.
G. BRIDGE (ACCESS)	None.

NDI NO. PA-00 092

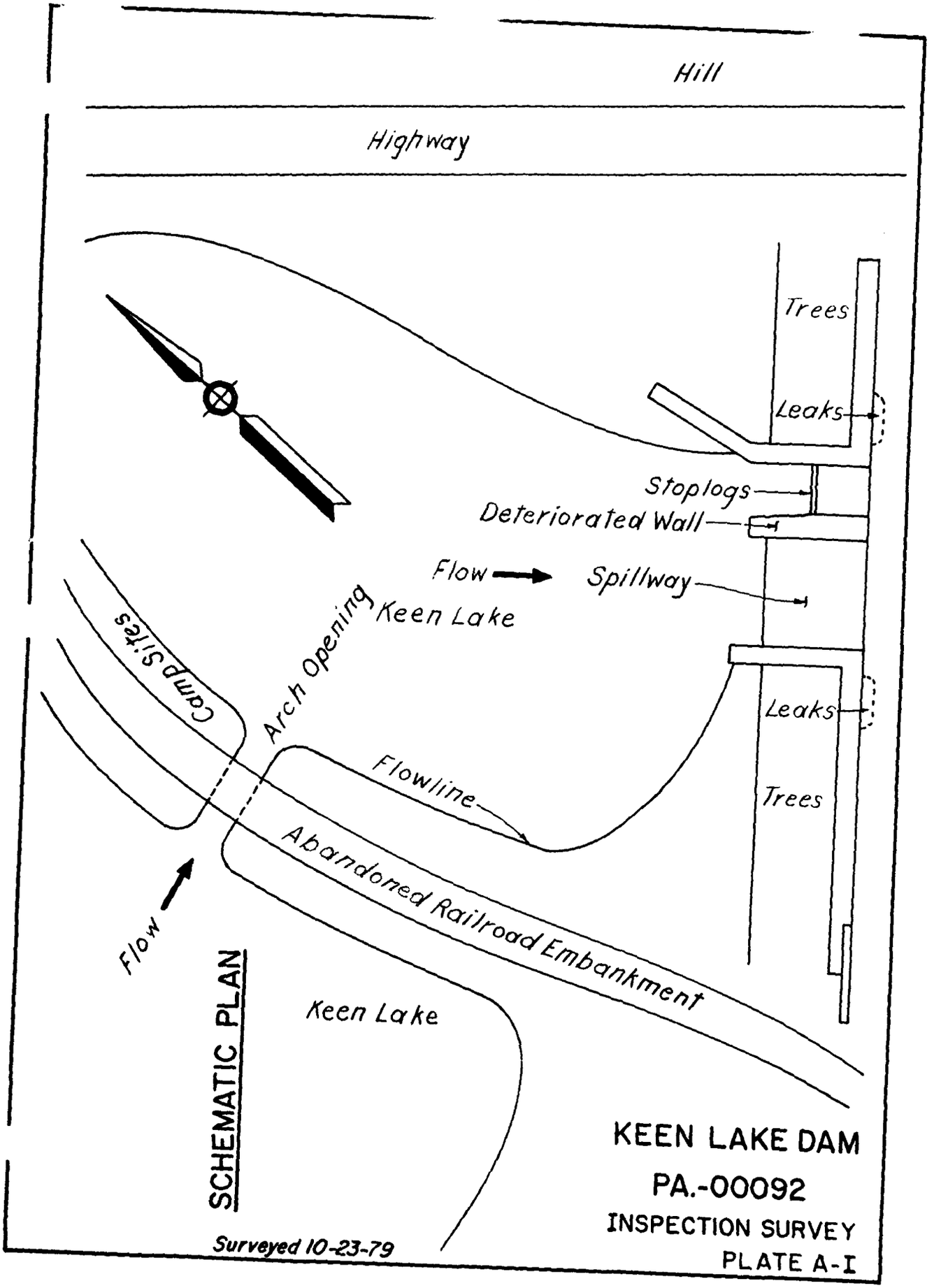
VISUAL INSPECTION
SPILLWAY

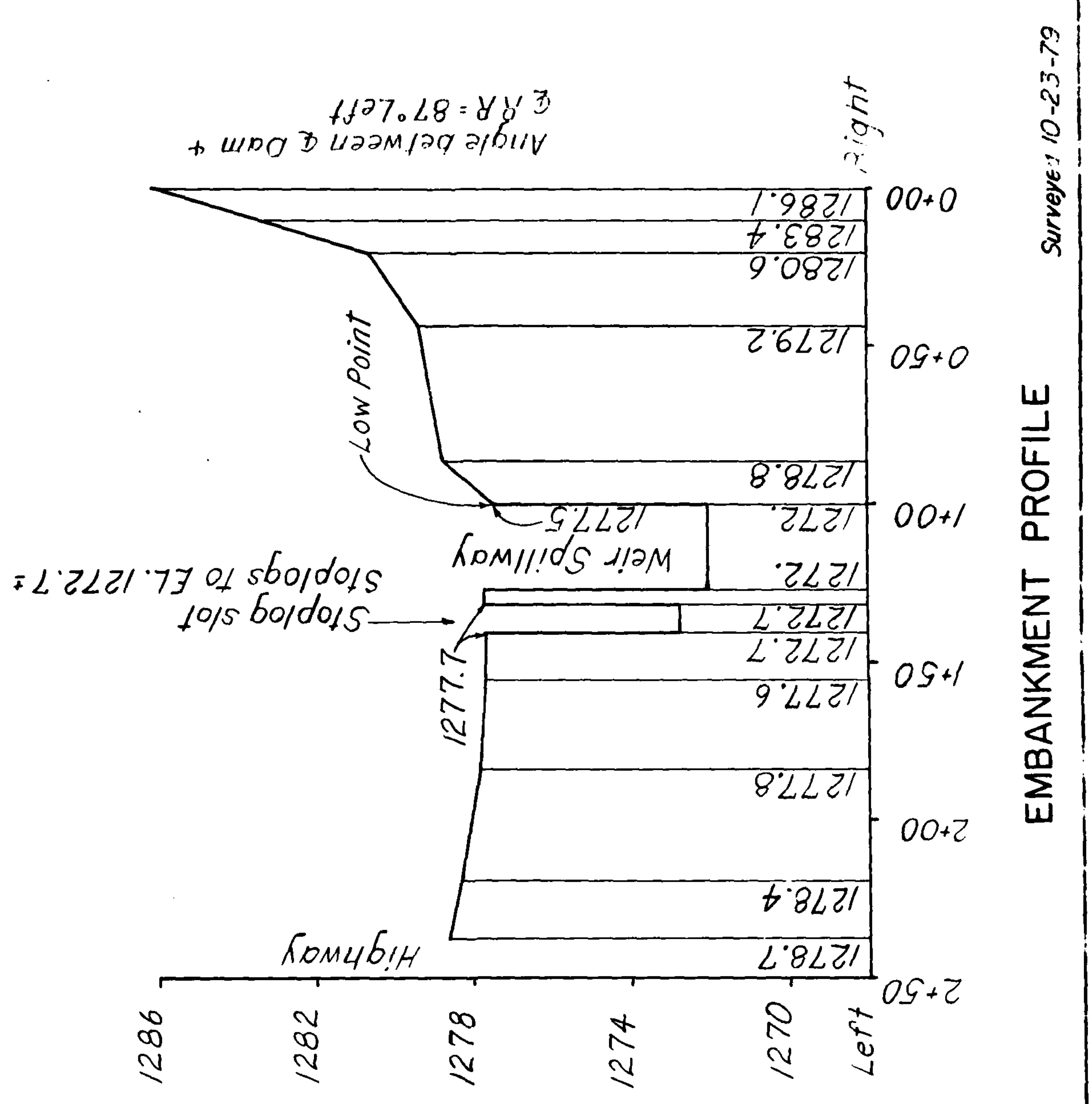
	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	The flow to the spillway must pass through a stone arch which goes through a separate embankment. A small lake is formed between this embankment and the main dam. See plan A-I.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Broadcrested weir. Walls gunited (1933) now spalled, cracked and broken. Vertical drop to plunge pool. Abutment walls need repair.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Natural mountain stream below plunge pool. Wooded overbanks - rock channel bottom.
D. BRIDGE & PIERS	None.
E. GATES & OPERATION EQUIPMENT	Stop logs in sluiceway adjacent to spillway.
F. CONTROL & HISTORY	Dam overtopped in 1942 and 1955.

NDI NO. PA-00 092

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR Slopes	Stable, flat, partially wooded.
Sedimentation	None reported.
Watershed Description	Mostly cultivated land with some marshland and woodland.
DOWNSTREAM CHANNEL Condition	Floodplain of channel 100'± wide steep side slopes on right - moderate 4:1 - 3:1 on left side near dam.
Slopes	Wooded slopes 8" - 12" trees some evergreens - downstream widens in vicinity of homes.
Approximate Population	20±
No. Homes	6 homes in flood plain within 1/2 mile of dam.


Hill
Highway
Trees
Leaks
Stoplogs
Deteriorated Wall
Flow
Spillway
Keen Lake
Arch Opening
Camp Sites
Leaks
Flowline
Trees
Abandoned Railroad Embankment
Flow
Keen Lake
SCHEMATIC PLAN
Surveyed 10-23-79
KEEN LAKE DAM
PA.-00092
INSPECTION SURVEY
PLATE A-I

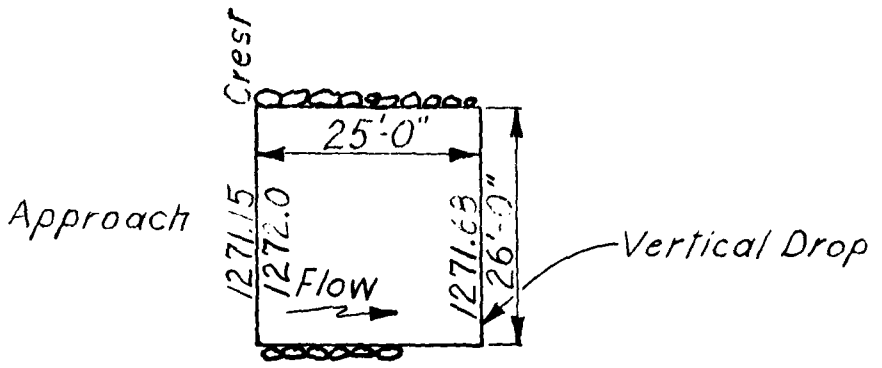


KEEN LAKE DAM

PA.-00092

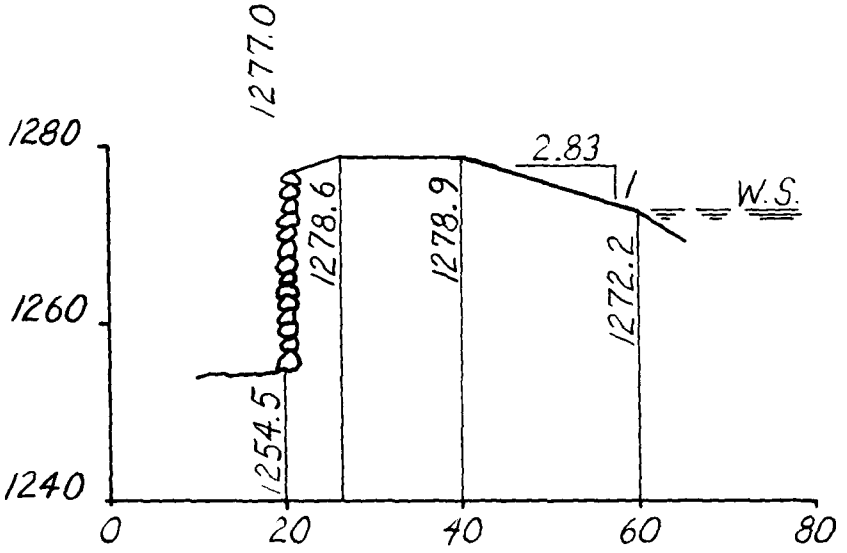
INSPECTION SURVEY

PLATE A-II



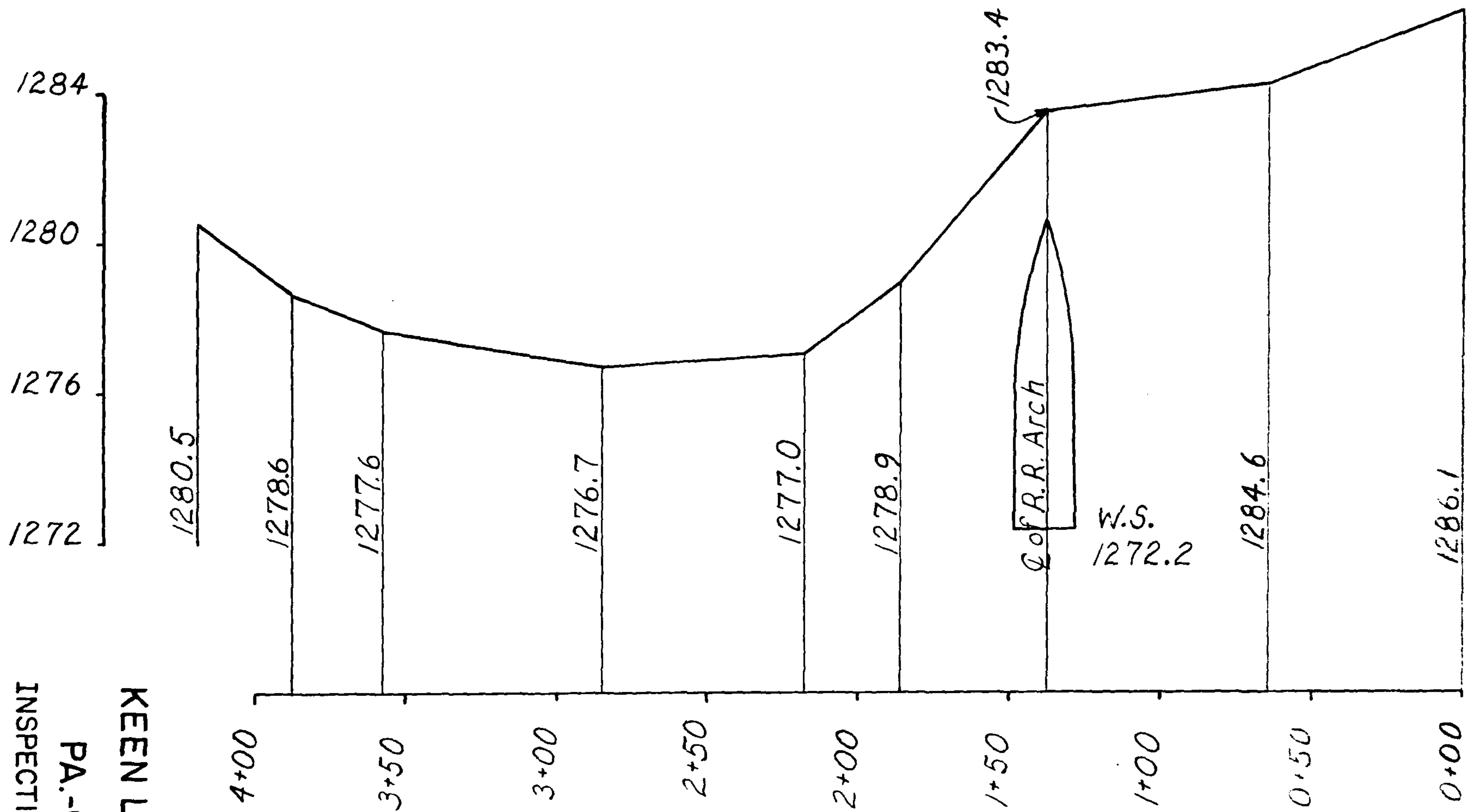
PLAN - SPILLWAY

Surveyed 10-23-79



EMBANKMENT SECTION
STA. 0+80

KEEN LAKE DAM
PA.-00092
INSPECTION SURVEY
PLATE A-III



PROFILE - R.R. FILL UPSTREAM FROM DAM

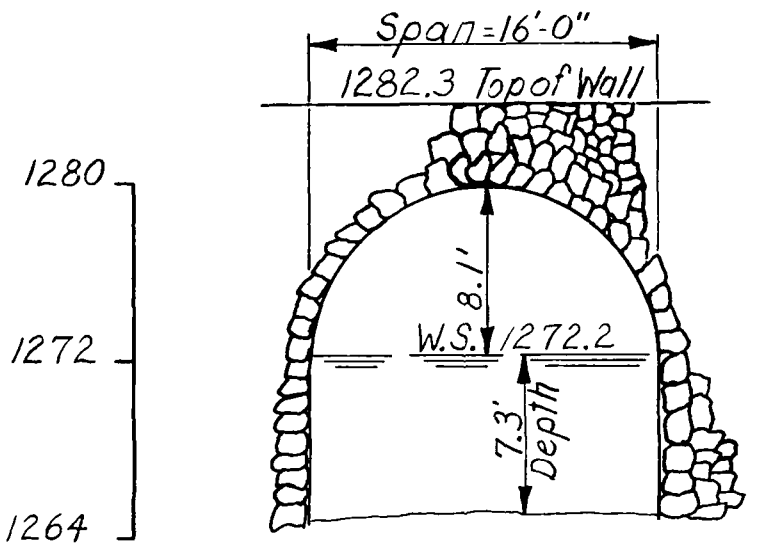
Surveyed 10-23-79

KEEN LAKE DAM

PA.-00092

INSPECTION SURVEY

PLATE A-IV



CROSS SECTION MASONRY ARCH
RAILROAD CULVERT

KEEN LAKE DAM
PA.-00092
INSPECTION SURVEY
PLATE A-V

Surveyed 10-23-79

APPENDIX B

CHECKLIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 64-13 NDI NO. PA-00092

NAME OF DAM KEEN LAKE DAM

ITEM	REMARKS
AS-BUILT DRAWINGS	Not available.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle Honesdale, Pa. See Plate II, Appendix E
CONSTRUCTION HISTORY	Built around 1850.
GENERAL PLAN OF DAM	See Plate III, Appendix E.
TYPICAL SECTIONS OF DAM	Not available.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	See Plate III, Appendix E. Not available. Not available.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	Reported at Forest City 4.4 inches, Pleasant Mount 4.03 inches on May 22, 1942.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	None available.
POST CONSTRUCTION SURVEYS OF DAM	See Plate III, Appendix E.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	2.5 feet overtopped May 1942. About 3 feet overtopped August 18, 1955, Hurricane Diane.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	No engineering reports or studies.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	Stoplogs failed on May 24, 1942. No reports.
MAINTENANCE & OPERATION RECORDS	Not maintained.
SPILLWAY PLAN, SECTIONS AND DETAILS	General Plan only. No details.

NDI NO. PA-00_____

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	None.
CONSTRUCTION RECORDS	Not available.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	PennDER Inspection Reports since 1930 indicate brush and trees on the embankment and on downstream wall. Leakage has been reported through sluiceway walls and at the bottom of the downstream wall.
MISCELLANEOUS	

NDI NO. PA-00092

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 35% woodland, 60% farmland, 5% urban

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 1272 Acre-Feet 887

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 1277.5 Acre-Feet 1449

MAXIMUM DESIGN POOL: Elev. 1277.5

TOP DAM: Elev. 1277.5

SPILLWAY:

a. Elevation 1272

b. Type Broad crested weir with sloping crest

c. Width 26'

d. Length 25'

e. Location Spillover Near center of dam

f. Number and Type of Gates None

OUTLET WORKS:

a. Type None

b. Location

c. Entrance inverts

d. Exit inverts

e. Emergency drawdown facilities

HYDROMETEOROLOGICAL GAGES:

a. Type None

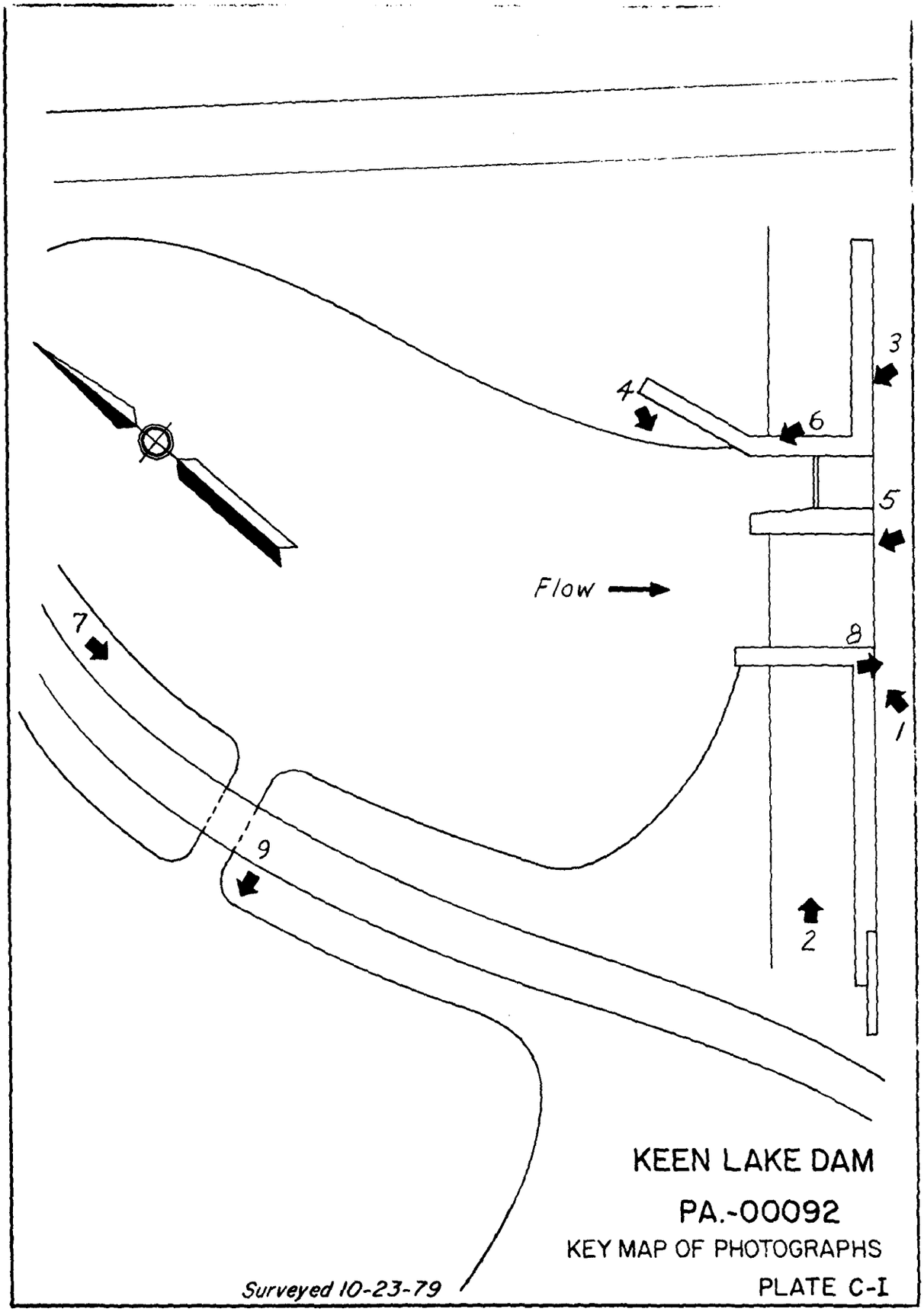
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1252 cfs

APPENDIX C

PHOTOGRAPHS



KEEN LAKE DAM

PA.-00092

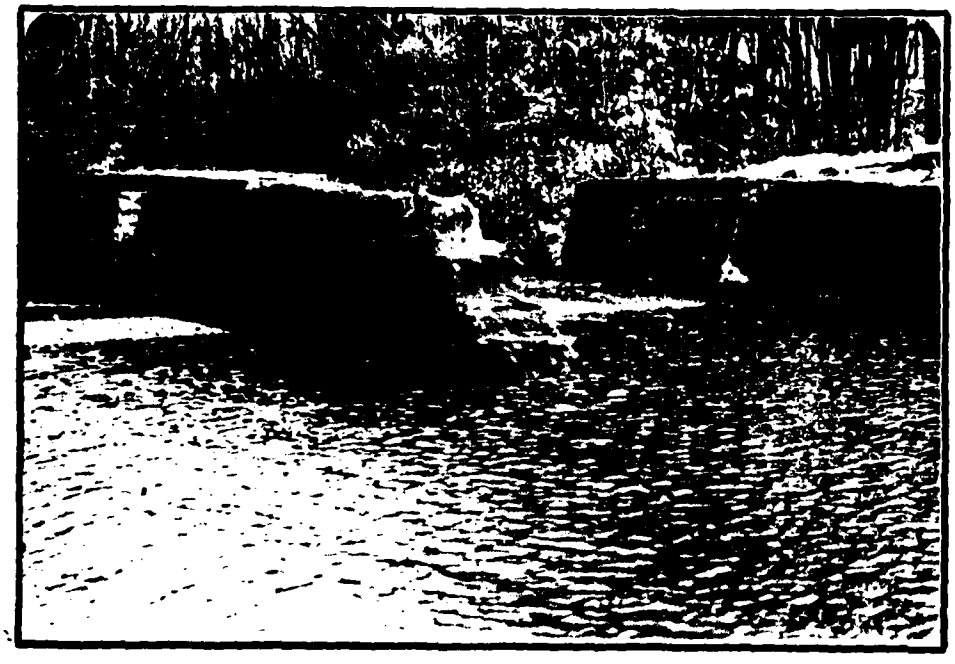
KEY MAP OF PHOTOGRAPHS

PLATE C-I

TOP OF EMBANKMENT LOOKING TO THE LEFT END - NO. 2

SEEPAGE AT DOWNSTREAM FACE - NO. 3

PA-00092
Plate C-II



UPSTREAM SLUICEWAY AND SPILLWAY - NO. 4

DOWNSTREAM ELEVATION OF SPILLWAY AND SLUICEWAY - NO. 5

THE UPSTREAM EMBANKMENT WITH ARCH - NO. 6

LOOKING TO UPSTREAM SLOPE - NO. 7

PA-00092
Plate C-IV

DOWNSTREAM CHANNEL - NO. 8

RESERVOIR - NO. 9

PA-00092
Plate C-V

APPENDIX D

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

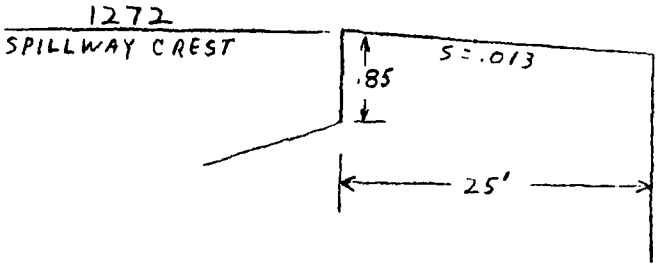
The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

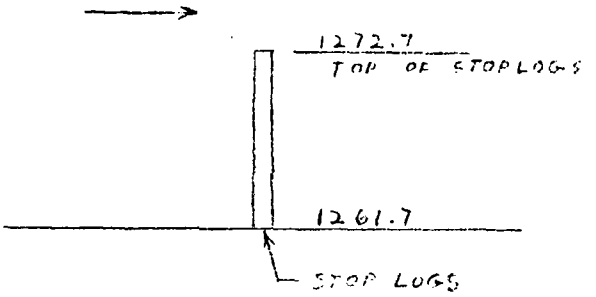
For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

BY _____ DATE 4/4/79 BERGER ASSOCIATES SHEET NO. C
CHKD. BY _____ DATE _____ PROJECT _____
SUBJECT _____ KEIL DAM

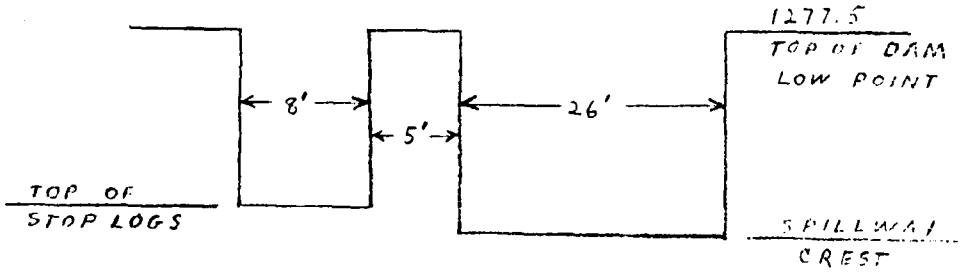
SPILLWAY RATING



C = 2.9 (ESTIMATED FROM KING'S HDBK.)



C = 3.32 (KING'S HDBK.)



BY _____ DATE 11/14/79 BERGER ASSOCIATES SHEET NO.
CHKD. BY _____ DATE _____ PROJECT
SUBJECT KEEN DAM

SPILLWAY RATING

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

$C = 2.9$
$L = 26'$
$H = 1277.5 - 1272 = 5.5'$

$Q = 2.9 \times 26 \times (5.5)^{1.5} = 973$ CFS

STOP LOG DISCHARGE

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

$C = 3.32$
$L = 8'$
$H = 1277.5 - 1272.7 = 4.8'$

$Q = 3.32 \times 8 \times (4.8)^{1.5} = 279$ CFS

ESTIMATE OF MAXIMUM DISCHARGE

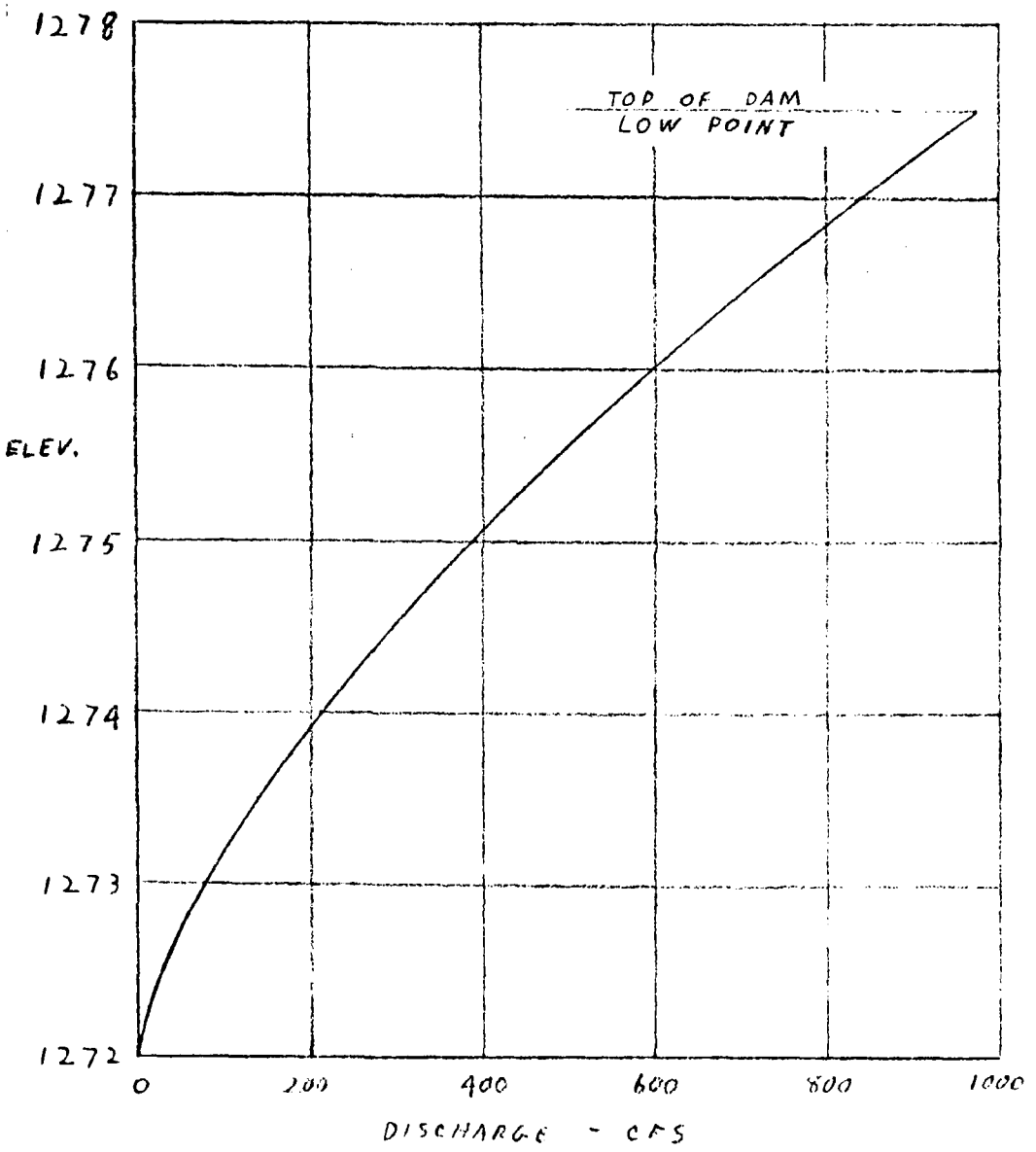
THE MAXIMUM KNOWN FLOOD AT KEEN POND OCCURRED IN MAY 1942. THIS FLOOD OVERTOPPED THE DAM. THE REPORTED AMOUNT OF OVERTOPPING RANGED FROM 4 INCHES TO 3 FEET.

AT NEARBY LACKAWANNA RIVER GAGE SITE NEAR FORREST CITY THE MAY 1942 DISCHARGE WAS 2530 CFS
D.A. LACKAWANNA RIVER = 38.8 SQ. MI.
D.A. KEEN POND = 14.53 SQ MI.

Q AT KEEN POND $= \left(14.53/38.8\right)^{.8} \times 2530 = 1153$ CFS

BY ..... DATE 11/22/29 BERGER ASSOCIATES SHEET NO.
CHKD. BY ..... DATE ..... PROJECT
SUBJECT KEEN LAKE

SPILLWAY RATING CURVE



CHKD. BY _____ DATE _____

SUBJECT _____ KLEIN LAKE _____ PROJECT _____

EMBANKMENT RATING

$Q = C L H^{1.5}$

AT ELEV 1278

$2.7 \times 5 \times (.3)^{1.5} = 2$

$2.7 \times 27 \times (.3)^{1.5} = 12$

$2.7 \times 12 \times (.1)^{1.5} = 1$

$2.7 \times 4 \times (.25)^{1.5} = 2$ $\quad \Sigma = 17$ CFS

AT ELEV 1278.3

$2.7 \times 5 \times (.6)^{1.5} = 6$

$2.7 \times 27 \times (.6)^{1.5} = 34$

$2.7 \times 29 \times (.25)^{1.5} = 10$

$2.7 \times 6 \times (.4)^{1.5} = 4$ $\quad \Sigma = 54$ CFS

AT ELEV 1278.7

$2.7 \times 5 \times (1)^{1.5} = 14$

$2.7 \times 27 \times (1)^{1.5} = 73$

$2.7 \times 35 \times (.6)^{1.5} = 44$

$2.7 \times 20 \times (.15)^{1.5} = 3$

$2.7 \times 9 \times (.6)^{1.5} = 11$ $\quad \Sigma = 145$ CFS

AT ELEV 1279.3

$2.7 \times 5 \times (1.6)^{1.5} = 27$

$2.7 \times 27 \times (1.6)^{1.5} = 148$

$2.7 \times 35 \times (1.2)^{1.5} = 124$

$2.7 \times 20 \times (.75)^{1.5} = 35$

$2.7 \times 10 \times (1.15)^{1.5} = 33$

$2.7 \times 45 \times (.3)^{1.5} = 20$ $\quad \Sigma = 387$ CFS

AT ELEV 1284

$2.7 \times 5 \times (6.3)^{1.5} = 213$

$2.7 \times 27 \times (6.3)^{1.5} = 1153$

$2.7 \times 35 \times (5.9)^{1.5} = 1354$

$2.7 \times 20 \times (5.45)^{1.5} = 687$

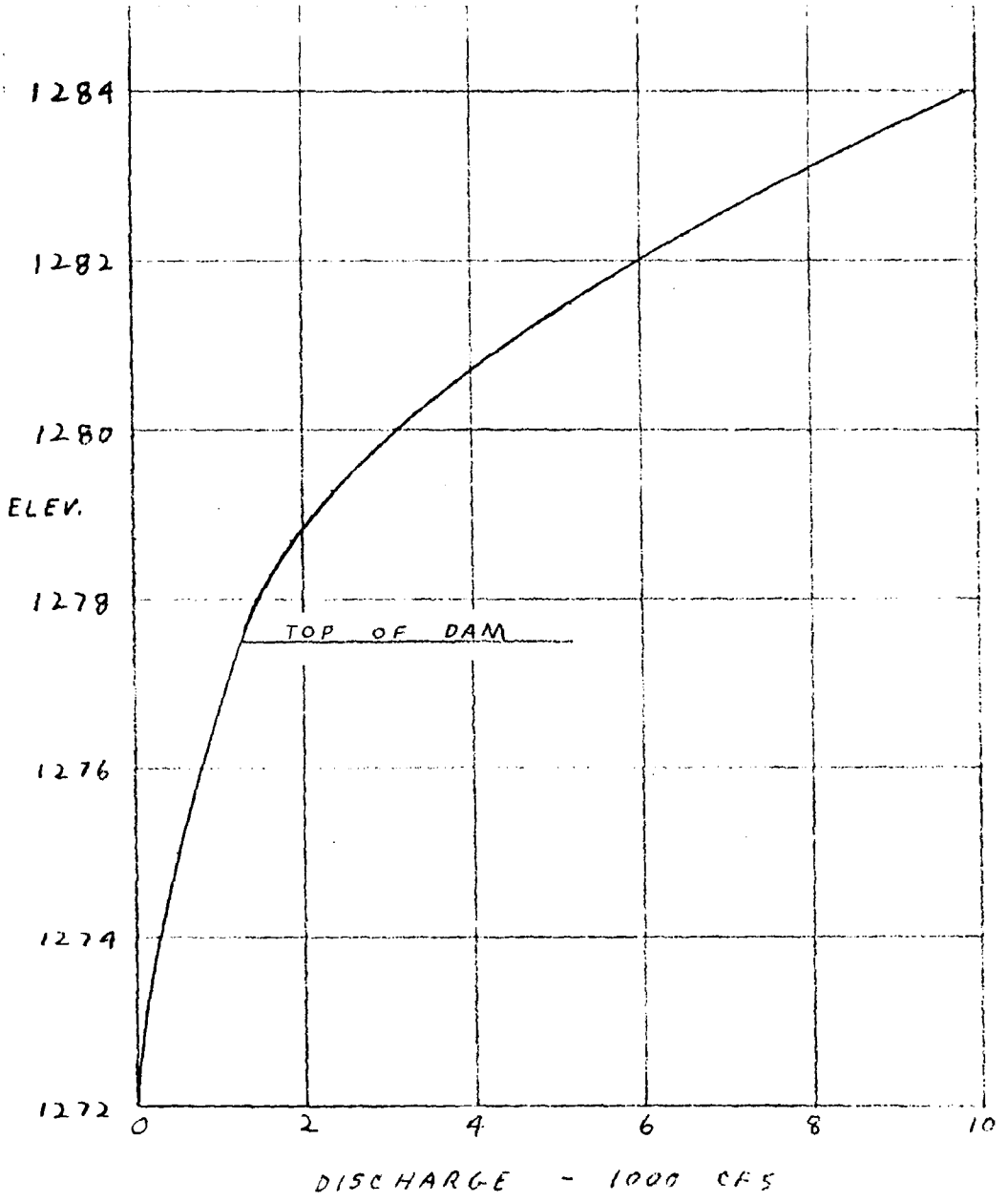
$2.7 \times 10 \times (5.85)^{1.5} = 352$

$2.7 \times 45 \times (5)^{1.5} = 1359$

$2.7 \times 25 \times (4.1)^{1.5} = 569$ $\quad \Sigma = 5717$

BY _____ DATE _____ ASSOCIATES SHEET NO.
CHKD. BY _____ DATE _____ PROJECT
SUBJECT _____ ACOM LAKE

DISCHARGE RATING CURVE



BY _____ DATE 5/4/79 BERGER ASSOCIATES SHEET NO. 6
CHKD. BY _____ DATE _____ PROJECT _____
SUBJECT KEEN LAKE

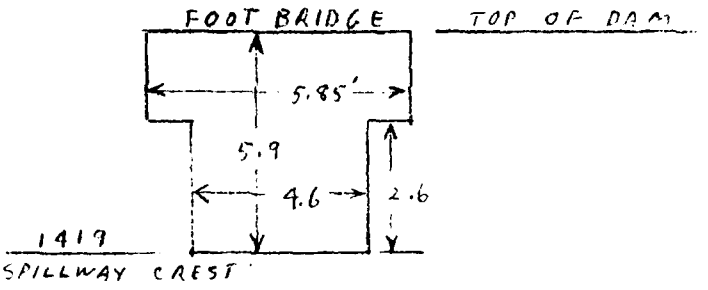
UPSTREAM RESERVOIR

ELK LAKE - ORIGINALLY NATURAL LAKE BU
NOW 12' HIGH DAM CONSTRUCTED
ACROSS OUTLET.
LENGTH OF DAM = APPROX. 200'

SPILLWAY RATING

BROADCRESTED WEIR C = 2.7 (ESTIMATED FROM KING'S HDBK.)

EMBANKMENT C = 2.7 (KING'S HDBK.)



$Q = C L_1 H_1^{3/2} + C L_2 H_2^{3/2}$

$= 2.7 \times 4.6 \times (5.9)^{3/2} + 2.7 \times 1.25 \times (3.9)^{3/2}$

$= 198$ CFS

BY _____ DATE 7/22/29 BERGER ASSOCIATES SHEET NO.
CHKD. BY _____ DATE _____ PROJECT
SUBJECT KING DAM

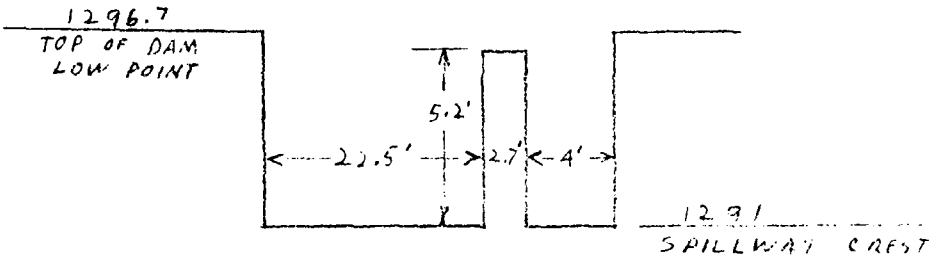
UPSTREAM RESERVOIR

LITTLE KEEN POND 12 HIGH DAM

SPILLWAY RATING

BROADCRESTED WEIR C = 2.7 (ESTIMATED FROM KING'S HDBK.)

EMBANKMENT C = 2.7 (KING'S HDBK.)



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

$= 2.7 \times (22.5 + 4) \times (5.2)^{1.5}$

$= 848$ CFS

BY JAS DATE 12/20/79 BERGER ASSOCIATES SHEET NO. 31
CHKD. BY DATE PROJECT
SUBJECT KENT DAM

UPSTREAM RESERVOIR

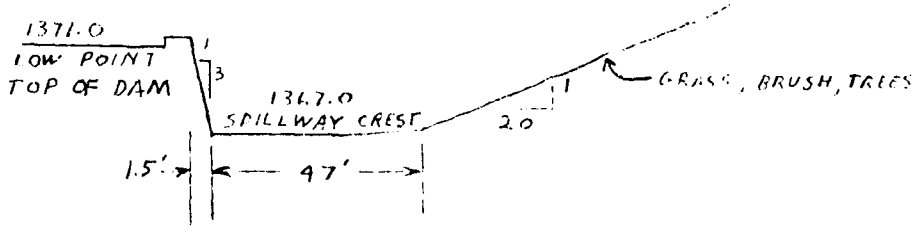
LAKE LA DORE 28 MILE DAM

SPILLWAY RATING

BROADCRESTED WEIR WITH INCLINED CREST $C = 2.9$ (ESTIMATED FROM KING'S HDBK.)

SLOPED SIDE OF WEIR WITH BRUSH USE $C = 2.6$

EMBANKMENT $C = 2.7$ (KING'S HDBK.)



$$Q = C_1 L_1 H_1^{3/2} + C_2 L_2 H_2^{3/2}$$

$C_1 = 2.9$ $C_2 = 2.6$

$H_1 = 1371 - 1367 = 4'$ $H_2 = (1371 - 1367)/2 = 2'$

$L_1 = 47 + (4/3)/2 = 47.7'$ $L_2 = 4 \times 20 = 80'$

$$Q = 2.9 \times 47.7 \times (4)^{1.5} + 2.6 \times 80 \times (2)^{1.5}$$
$$= 1106 + 588$$
$$= 1694 \text{ CFS}$$

BY RLS DATE 12/19/79 BERGER ASSOCIATES SHEET NO. OF
CHKD. BY DATE PROJECT
SUBJECT KREN DAM

SIZE CLASSIFICATION

MAXIMUM STORAGE [illegible]

MAXIMUM HEIGHT = 26 FEET

SIZE CLASSIFICATION IS "INTERMEDIATE"

HAZARD CLASSIFICATION

SEVERAL HOUSES ARE LOCATED NEAR THE DOWNSTREAM CHANNEL

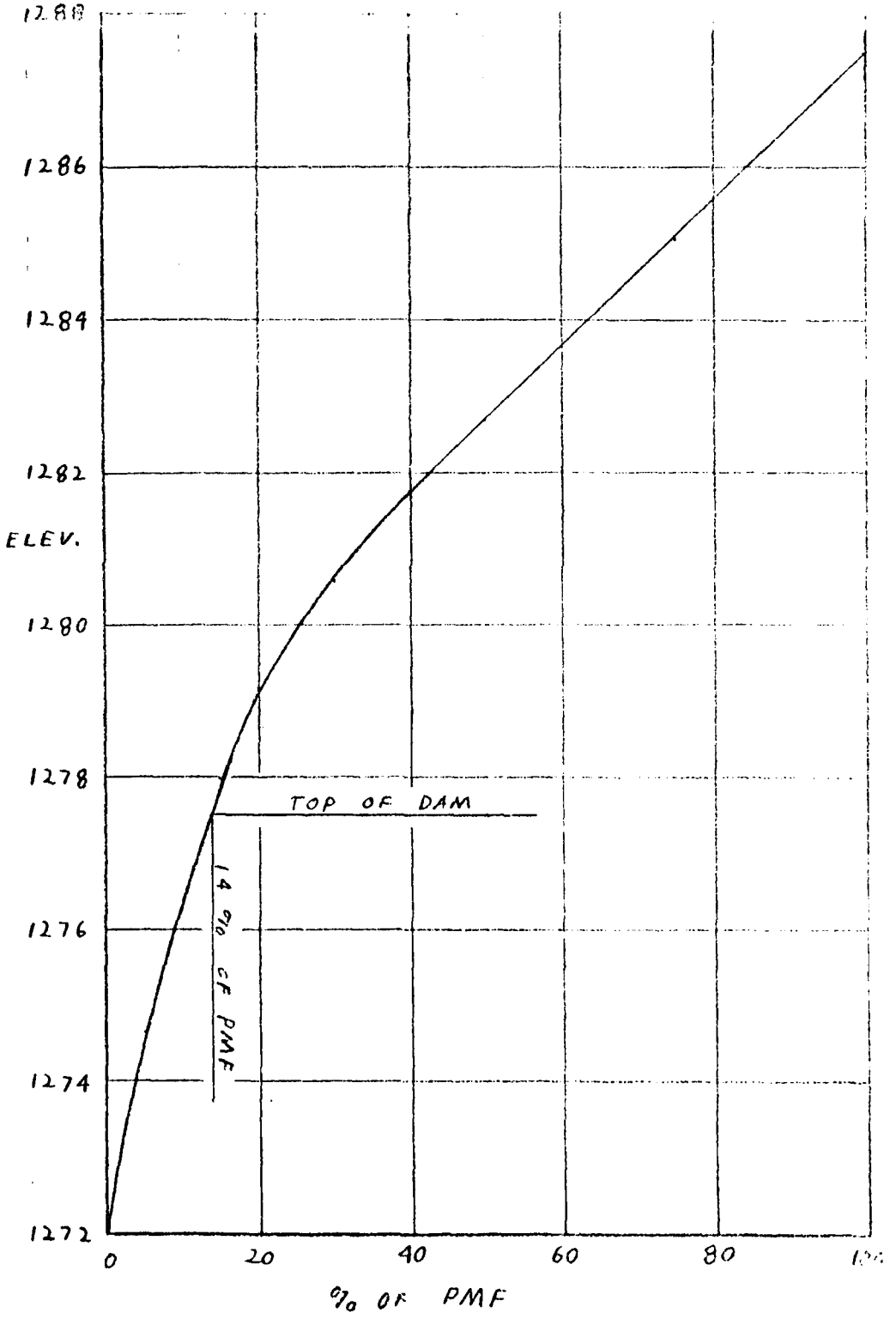
USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO THE PROBABLE MAXIMUM FLOOD.

BY BLS DATE 12/19/79 **BERGER ASSOCIATES** SHEET NO. 1 OF
CHKD. BY DATE PROJECT 1766
SUBJECT KELLY LAKE

SPILLWAY CAPACITY CURVE



BY RLS DATE 1/18/80 **BERGER ASSOCIATES** SHEET NO. 1 of
CHKD. BY DATE PROJECT
SUBJECT KEEN LAKE

BREACH ASSUMPTIONS

BREACH WIDTH = 50'

SIDE SLOPES (EARTH EMBANKMENT) = 1:1

FAILURE TIME (EARTH EMBANKMENT) =
BETWEEN 15 MIN. AND 2 HR.
USE: .25 HR., .5 HR., 1.0 HR.

POOL LEVEL AT FAILURE: EARTH EMBANKMENT PREVIOUSLY OVERTOPPED BY ABOUT THREE FEET. ESTIMATE ONE ADDITIONAL FOOT OF OVERTOPPING WILL CAUSE FAILURE.
USE 4.0 FT OVER TOP OF DAM

UPSTREAM DAMS:

ELK LAKE = NOT OVERTOPPED

LAKE LADORE = NOT OVERTOPPED BY 39% PMF

LITTLE KEEN POND = OVERTOPPED 3.25' BY 39% PMF. ESTIMATE PAST FLOODS OVERTOPPED BY ABOUT 3' WITHOUT FAILURE, ONE ADDITIONAL FOOT OF OVERTOPPING WILL CAUSE FAILURE.

∴ UPSTREAM DAMS WILL NOT FAIL DUE TO OVERTOPPING PRIOR TO BREACH OF KEEN LAKE DAM

TABLE NO. 1

COMPARISON OF WATER SURFACE ELEVATIONS

KEEN LAKE DAM

PMF = 17,056 cfs

Crest Elevation - 1277.5 Low Point - 1277.5 Spillway Elevation - 1272

STAGE	CREST OF DAM ELEVATION	CREST OF DAM DEPTH	1850' D/S OF DAM* ELEVATION
A. At Low Point in Embankment Crest	1277.5	0	1240.9
B. 39% PMF Overtopping No Breach	1281.64	4.14	1244.0
C. 39% PMF Overtopping (15 Min. Breach)	1281.51	4.01	1249.7
D. 39% PMF Overtopping (1 Hour Breach)	1281.51	4.01	1248.3

*Several houses located about 1850 feet downstream of Keen Lake Dam.

Condition C: (Time refers to elapsed time after start of storm).
Time to reach breach elevation 1281.5 at dam = 45.0 Hours. Water level 1850' downstream prior to breach = 1244.0. Duration of breach = 15 Minutes.
Time for breach to peak 1850' downstream = .25 Hours.
Peak elevation 1850' downstream due to breach = 1249.7.
Rate of increase in water level = 5.7' in 15 Minutes.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: KEEN LAKE RIVER BASIN: DELAWARE

PROBABLE MAXIMUM PRECIPITATION (PMP) = 21.3 INCHES/24 HOURS (1)

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		Elk Lake	Elk Lake Dam	Little Keen Pond	Little Keen Pond Dam
DRAINAGE AREA (SQUARE MILES)		.89		9.36	
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		.89	.89	10.25	10.25
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%) (2)	6 HOURS	111		111	
	12 HOURS	123		123	
	24 HOURS	133		133	
	48 HOURS	142		142	
	72 HOURS	-		-	
SNYDER HYDROGRAPH PARAMETERS	ZONE (3)	1		1	
	C_p / C_t (4)	.45/1.23		.45/1.23	
	L (MILES) (5)			6.01	
	L_{ca} (MILES) (5)	L'=.71 (9)		3.98	
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	1.0 (10)		3.19	
SPILLWAY DATA	CREST LENGTH (FT.)		4.6		26
	FREEBOARD (FT.)		5.9		5.7
	DISCHARGE COEFFICIENT		2.7		2.7
	EXPONENT		1.5		1.5
	ELEVATION		1419		1291
AREA (6) (ACRES)	NORMAL POOL		157		19.6
	ELEV. 1420		188.7	Elev. 1300	179.5
	ELEV. 1440		266.8	Elev. 1320	509
STORAGE (ACRE-FEET)	NORMAL POOL (7)		2922		92
	ELEV. 1363.2 (8)		0	Elev. 1276.9	0
	ELEV. ____ (8)				
	ELEV ____ (8)				

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: KEEN LAKE RIVER BASIN: DELAWARE

PROBABLE MAXIMUM PRECIPITATION (PMP) = 21.3 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		Lake Ladore	Lake Ladore Dam	Keen Lake	Keen Lake Dam
DRAINAGE AREA (SQUARE MILES)		3.37		.91	
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		3.37	3.37	14.53	14.53
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	111		111	
	12 HOURS	123		123	
	24 HOURS	133		133	
	48 HOURS	142		142	
	72 HOURS	-		-	
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	1		1	
	C_p / C_t[4]	.45/1.23		.45/1.23	
	L (MILES)[5]	4.17			
	L_{ca} (MILES)[5]	1.88		L'=.6(9)	
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (hours)	2.28		.9(10)	
SPILLWAY DATA	CREST LENGTH (FT.)		47		26
	FREEBOARD (FT.)		4		5.5
	DISCHARGE COEFFICIENT		2.9		2.9
	EXPONENT		1.5		1.5
	ELEVATION		1367		1272
AREA[6] (ACRES)	NORMAL POOL		261		91.8
	ELEV. 1380		390	Elev. 1280	123
	ELEV.			Elev. 1300	197
STORAGE (ACRE-FEET)	NORMAL POOL[7]		1605		887
	ELEV. 1348.6[8]		0	Elev. 1243	0
	ELEV.[8]				
	ELEV[8]				

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

(8) Computed by conic method.

(9) L' = Length of water course from end of reservoir to basin divide.

(10) $T_p = C_t \ (L')^{0.6}$.

```
   1          A1       KEEN POND DAM  #1A4  VAN AUKEN CREEK
   2          A2       CANAAN TWP., WAYNE COUNTY, PA.
   3          A3       NDI # PA-00092      PA DER # 64-13
   4          B   300      0     15      0      0      0      0      0     -4      0
   5          B1    5
   6          J     1      9      1
   7          J1    1    .75     .5     .4     .3     .2    .15     .1    .05
   8          K              1                                   1
   9          K1             INFLOW HYDROGRAPH - ELK LAKE SUBAREA
  10          M     1      1    .89           14.53
  11          P          21.3    111    123    133    142
  12          T                                                 1    .05
  13          W     1    .45
  14          X  -1.5   -.05      2
  15          K     1      2                                   1
  16          K1             RESERVOIR ROUTING - THRU ELK LAKE
  17          Y                            1
  18          Y1    1                                                2922     -1
  19          Y4 1419   1420  1420.5   1421   1422   1423   1424  1424.9  1425.5   1426
  20          Y5    0     12     23     35     65    105    151    198    482    884
  21          $A    0    157  188.7  266.8
  22          $E1363.2   1419   1420   1440
  23          $$ 1419
  24          $D1424.9
  25          K     1      3                                   1
  26          K1             ROUTING THRU REACH 2 - 3
  27          Y                            1
  28          Y1    1
  29          Y6   .1    .08     .1   1371   1420   2600   .016
  30          Y7    0   1400    150   1400    300   1380    670   1371    675   1371
  31          Y7 1290   1380   1540   1400   1940   1420
  32          K     1      4                                   1
  33          K1             ROUTING THRU REACH 3 - 4
  34          Y                            1
  35          Y1    1
  36          Y6   .1    .07     .1   1331   1380   6350  .0063
  37          Y7    0   1380    250   1360    850   1340   1175   1331   1180   1331
  38          Y7 1720   1340   2000   1360   2250   1380
  39          K     1      5                                   1
  40          K1             ROUTING THRU REACH 4 - 5
  41          Y                            1
  42          Y1    1
  43          Y6   .1    .05     .1   1300   1360   5750  .0054
  44          Y7    0   1360    250   1340    375   1320   1410   1300   1420   1300
  45          Y7 1650   1320   1900   1340   2050   1360
  46          K              6                                   1
  47          K1             INFLOW HYDROGRAPH - LITTLE KEEN POND SUBAREA
  48          M     1      1   9.36           14.53
  49          P          21.3    111    123    133    142
  50          T                                                 1    .05
1 51          W    3.19    .45
  52          X  -1.5   -.05      2
  53          K     2      7                                   1
  54          K1             COMBINE HYDROGRAPHS AT LITTLE KEEN POND
  55          K     1      8                                   1
  56          K1             RESERVOIR ROUTING - THRU LITTLE KEEN POND
  57          Y                            1
  58          Y1    1                                                  92     -1
  59          Y4 1291  1291.5   1292  1292.5   1293   1294  1295.5  1296.7  1297.5  1298.5
  60          Y4 1300   1302
```

```
                Y1    1                                                    92     -1
59              Y4  1291  1291.5    1292  1292.5    1293    1294  1295.5  1296.7  1298.5  1299.5
60              Y4  1300    1302
61              Y5     0      25      72     131     202     372     693     976    1396    2119
62              Y5  3903    7240
63              $A     0    19.6   179.5     509
64              $E1276.9    1291    1300    1320
65              $$  1291
66              $D1296.7
67              K      1       9                                            1
68              K1              ROUTING THRU REACH 8 - 9
69              Y                               1
70              Y1     1
71              Y6    .1     .08      .1    1280    1340     550   .0073
72              Y7     0    1340     250    1320     410    1300     700    1280     710    1280
73              Y7   900    1300    1000    1320    1120    1340
74              K               10                                           1
75              K1              INFLOW HYDROGRAPH - LAKE LADORE SUBAREA
76              M      1       1    3.37           14.53
77              P             21.3     111     123     133     142
78              T                                                    1     .05
79              W   2.28     .45
80              X   -1.5     .05       2
81              K      1      11                                            1
82              K1              RESERVOIR ROUTING - THRU LAKE LADORE
83              Y                               1
84              Y1     1                                                 1605     -1
85              Y4  1367  1367.4  1367.7    1368    1369    1370    1371  1371.5    1372  1372.5
86              Y5     0      36      81     155     491    1002    1694    2291    3311    4586
87              $A     0     261     390
88              $E1348.6    1367    1380
89              $$  1367
90              $D  1371
91              K      1      12                                            1
92              K1              ROUTING THRU REACH 11 - 12
93              Y                               1
94              Y1     1
95              Y6    .1     .08      .1    1280    1340    1050     .06
96              Y7     0    1340     100    1320     290    1320     300    1300     350    1280
97              Y7   470    1300     520    1320     650    1340
98              K               13                                           1
99              K1              INFLOW HYDROGRAPH - KEEN POND SUBAREA
100             M      1       1     .91           14.53
101           1 P             21.3     111     123     133     142
102             T                                                    1     .05
103             W    .9     .45
104             X   -1.5    -.05       2
105             K      3      14                                            1
106             K1              COMBINE HYDROGRAPHS AT KEEN POND
107             K      1      15                                            1
108             K1              RESERVOIR ROUTING - THRU KEEN POND
109             Y                               1
110             Y1     1                                                  987     -1
111             Y4  1272  1272.5    1273  1273.5    1274    1275    1276  1277.5    1278  1278.3
112             Y41278.7  1279.3  1281.5    1284
113             Y5     0      27      79     158     252     485     762    1252    1449    1598
114             Y5  1842    2325    5170    9850
115             $A     0    91.8     123     197
116             $E  1243    1272    1280    1300
117             $$  1272
118             $D1277.5
```

```
117             $$ 12/2
118             $D1277.5
119             K    79
```

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
ROUTE HYDROGRAPH TO	4
ROUTE HYDROGRAPH TO	5
RUNOFF HYDROGRAPH AT	6
COMBINE 2 HYDROGRAPHS AT	7
ROUTE HYDROGRAPH TO	8
ROUTE HYDROGRAPH TO	9
RUNOFF HYDROGRAPH AT	10
ROUTE HYDROGRAPH TO	11
ROUTE HYDROGRAPH TO	12
RUNOFF HYDROGRAPH AT	13
COMBINE 3 HYDROGRAPHS AT	14
ROUTE HYDROGRAPH TO	15
END OF NETWORK	

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 79/12/20.
TIME= 14.09.20.

KEEN POND DAM **** VAN AUKEN CREEK
CANAAN TWP., WAYNE COUNTY, PA.
NDI # PA-00092 PA DER # 64-13

JOB SPECIFICATION

NQ	NDR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 1.00 .75 .50 .40 .30 .20 .15 .10 .05

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - ELK LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - ELK LAKE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.89	0.00	14.53	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.30	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.00 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.01 HOURS, CP= .45 VOL= 1.00

26.	97.	184.	247.	253.	222.	187.	161.	137.	116.
99.	84.	72.	61.	52.	44.	38.	32.	27.	23.
20.	17.	14.	12.	10.	9.	8.	6.	5.	5.
4.	3.	3.	2.	2.	2.				

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 24.58 22.20 2.39 51685.
(624.)(564.)(61.)(1463.56)

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU ELK LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	2922.	-1

STAGE	1419.00	1420.00	1420.50	1421.00	1422.00	1423.00	1424.00	1424.90	1425.50	[illegible]
FLOW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU ELK LAKE

ISTAQ	ICONP	IECON	ITAPE	JPLT	JPRT	INAME	[illegible]	IAUTO
2	1	0	0	0	0	1	2	2

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	2922.	-1

STAGE	1419.00	1420.00	1420.50	1421.00	1422.00	1423.00	1424.00	1424.90	1425.50	1427.
FLOW	0.00	12.00	23.00	35.00	65.00	105.00	151.00	198.00	482.00	884.
SURFACE AREA=	0.	157.	189.	267.						
CAPACITY=	0.	2920.	3093.	7625.						
ELEVATION=	1363.	1419.	1420.	1440.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1419.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1424.9	0.0	0.0	0.

PEAK OUTFLOW IS 149. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 98. AT TIME 47.50 HOURS

PEAK OUTFLOW IS 54. AT TIME 48.25 HOURS

PEAK OUTFLOW IS 37. AT TIME 48.50 HOURS

PEAK OUTFLOW IS 26. AT TIME 49.00 HOURS

PEAK OUTFLOW IS 15. AT TIME 49.50 HOURS

PEAK OUTFLOW IS 10. AT TIME 49.75 HOURS

PEAK OUTFLOW IS 7. AT TIME 49.75 HOURS

PEAK OUTFLOW IS 4. AT TIME 49.50 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0800	.1000	1371.0	1420.0	2600.	.01600

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1400.00 150.00 1400.00 300.00 1380.00 670.00 1371.00 675.00 1371.00
1290.00 1380.00 1540.00 1400.00 1940.00 1420.00

AGE	0.00	22.49	86.43	197.82	346.04	506.45	674.80	851.09	1035.33	1227.[illegible]
	1427.61	1635.66	1869.09	2116.11	2371.06	2633.96	2904.60	3183.58	3470.30	3764.[illegible]
OUTFLOW	0.00	1063.85	6601.85	19314.30	44172.60	81672.86	128533.72	184371.69	248960.53	322164.[illegible]
	403917.59	494179.59	589763.65	700574.45	821303.62	951850.95	1092171.08	1242252.82	1402108.13	1571765.[illegible]
STAGE	1371.00	1373.58	1376.16	1378.74	1381.32	1383.89	1386.47	1389.05	1391.63	1394.[illegible]
	1396.79	1399.37	1401.95	1404.53	1407.11	1409.68	1412.26	1414.84	1417.42	1420.[illegible]
FLOW	0.00	1063.85	6601.85	19314.30	44172.60	81672.86	128533.72	184371.69	248960.53	322164.[illegible]
	403917.59	494179.59	589763.65	700574.45	821303.62	951850.95	1092171.08	1242252.82	1402108.13	1571765.[illegible]

MAXIMUM STAGE IS 1371.4

MAXIMUM STAGE IS 1371.2

MAXIMUM STAGE IS 1371.1

MAXIMUM STAGE IS 1371.1

MAXIMUM STAGE IS 1371.1

MAXIMUM STAGE IS 1371.0

MAXIMUM STAGE IS 1371.0

MAXIMUM STAGE IS 1371.0

MAXIMUM STAGE IS 1371.0

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HYDROGRAPH ROUTING

ROUTING THRU REACH 3 - 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0700	.1000	1331.0	1380.0	6350.	.00630

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1380.00 250.00 1360.00 850.00 1340.00 1175.00 1331.00 1180.00 1331.00
1720.00 1340.00 2000.00 1360.00 2250.00 1380.00

ORAGE	0.00	48.47	190.13	424.97	746.42	1116.59	1529.42	1984.91	2483.06	3023.
	3607.35	4233.48	4897.02	5585.35	6297.92	7034.73	7795.78	8561.07	9390.60	10234.
OUTFLOW	0.00	674.18	4170.87	12189.37	27860.56	51836.16	82337.29	119408.54	163137.92	213670.
	271093.31	335628.28	408707.38	489305.78	576941.38	671601.97	773294.71	882041.03	997873.21	1120831.
STAGE	1331.00	1333.58	1336.16	1338.74	1341.32	1343.87	1346.47	1349.05	1351.63	1354.
	1356.79	1359.37	1361.95	1364.53	1367.11	1369.68	1372.26	1374.84	1377.42	1380.
FLOW	0.00	674.18	4170.87	12189.37	27860.56	51836.16	82337.29	119408.54	163137.92	213670.
	271093.31	335628.28	408707.38	489305.78	576941.38	671601.97	773294.71	882041.03	997873.21	1120831.

MAXIMUM STAGE IS 1331.6

MAXIMUM STAGE IS 1331.4

MAXIMUM STAGE IS 1331.2

MAXIMUM STAGE IS 1331.2

MAXIMUM STAGE IS 1331.1

MAXIMUM STAGE IS 1331.1

MAXIMUM STAGE IS 1331.0

MAXIMUM STAGE IS 1331.0

MAXIMUM STAGE IS 1331.0

HYDROGRAPH ROUTING

ROUTING THRU REACH 4 - 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	1300.0	1360.0	5750.	.00540

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1360.00 250.00 1340.00 375.00 1320.00 1410.00 1300.00 1420.00 1360.00
1650.00 1320.00 1900.00 1340.00 2050.00 1360.00

AGE	0.00	45.80	174.86	387.17	692.75	1061.59	1523.69	2056.03	2616.31	3201.7
	3810.90	4445.23	5104.23	5788.01	6497.74	7233.81	7996.20	8784.92	9599.97	10441.
OUTFLOW	0.00	1062.14	6341.56	18303.81	38997.12	70247.58	113733.23	180064.13	264861.55	362979.
	473979.89	597540.01	733421.08	881417.08	1041495.18	1213626.35	1397715.69	1593710.14	1801582.55	2021324.
STAGE	1300.00	1303.16	1306.32	1309.47	1312.63	1315.79	1318.95	1322.11	1325.26	1328.
	1331.58	1334.74	1337.89	1341.05	1344.21	1347.37	1350.53	1353.68	1356.84	1360.
FLOW	0.00	1062.14	6341.56	18303.81	38997.12	70247.58	113733.23	180064.13	264861.55	362979.
	473979.89	597540.01	733421.08	881417.08	1041495.18	1213626.35	1397715.69	1593710.14	1801582.55	2021324.

MAXIMUM STAGE IS 1300.4

MAXIMUM STAGE IS 1300.3

MAXIMUM STAGE IS 1300.2

MAXIMUM STAGE IS 1300.1

MAXIMUM STAGE IS 1300.1

MAXIMUM STAGE IS 1300.0

MAXIMUM STAGE IS 1300.0

MAXIMUM STAGE IS 1300.0

MAXIMUM STAGE IS 1300.0

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LITTLE KEEN POND SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	9.36	0.00	14.53	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.30	111.00	123.00	133.00	142.00	0.00	0.00

RSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 3.19 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.19 HOURS, CP= .45 VOL= .99

17.	64.	133.	214.	306.	405.	510.	611.	699.	771.
826.	863.	878.	880.	872.	782.	744.	708.	674.	641.
610.	581.	553.	526.	501.	476.	453.	431.	410.	391.
372.	354.	337.	320.	305.	290.	276.	263.	250.	238.
226.	216.	205.	195.	186.	177.	169.	160.	152.	145.
138.	131.	125.	119.	113.	108.	102.	98.	93.	88.
84.	80.	76.	72.	69.	66.	62.	59.	57.	54.
51.	49.	46.	44.	42.	40.	38.	36.	34.	33.
31.	30.	28.	27.	26.	24.	23.	22.	21.	20.
19.	18.	17.	16.	16.	15.	14.	13.	13.	12.

0 END OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	24.58	22.20	2.39	532800.		
	(624.)	(564.)	(61.)	(15087.22)		

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT LITTLE KEEN POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LITTLE KEEN POND

ISTAO	ICOMP	ICON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	92.	-1

STAGE	1291.00	1291.50	1292.00	1292.50	1293.00	1294.00	1295.50	1296.70	1297.50	1298.50
	1300.00	1302.00								
FLOW	0.00	25.00	72.00	131.00	202.00	372.00	683.00	976.00	1386.00	2119.00
	3903.00	7240.00								
SURFACE AREA=	0.	20.	180.	509.						
CAPACITY=	0.	92.	867.	7472.						
ELEVATION=	1277.	1291.	1300.	1320.						

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1291.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1296.7	0.0	0.0	0.

EAK OUTFLOW IS 12044. AT TIME 44.50 HOURS

EAK OUTFLOW IS 9114. AT TIME 44.50 HOURS

EAK OUTFLOW IS 6069. AT TIME 44.50 HOURS

EAK OUTFLOW IS 4791. AT TIME 44.50 HOURS

EAK OUTFLOW IS 3473. AT TIME 44.75 HOURS

EAK OUTFLOW IS 2149. AT TIME 45.25 HOURS

EAK OUTFLOW IS 1539. AT TIME 45.50 HOURS

JUTFLOW IS 933. AT TIME 46.00 HOURS

EAK OUTFLOW IS 494. AT TIME 45.50 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 8 - 7

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAG	IAUTO
9	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0800	.1000	1280.0	1340.0	550.	.00730

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1340.00 250.00 1320.00 410.00 1300.00 700.00 1280.00 710.00 1280.00
900.00 1300.00 1000.00 1320.00 1120.00 1340.00

STORAGE	0.00	1.91	6.84	14.79	25.77	39.77	56.79	76.52	97.97	121.9
	145.77	172.13	200.12	229.79	261.64	295.81	332.32	371.15	412.32	455.7
OUTFLOW	0.00	350.50	1927.33	5393.39	11305.92	20163.50	32425.13	51086.56	75126.88	103320.6
	135715.57	172370.47	213353.50	258532.48	307981.26	362353.92	421815.63	486535.39	556682.04	632122.7
STAGE	1280.00	1283.16	1286.32	1289.47	1292.63	1295.79	1298.95	1302.11	1305.26	1308.4
	1311.58	1314.74	1317.89	1321.05	1324.21	1327.37	1330.53	1333.68	1336.84	1340.0
FLOW	0.00	350.50	1927.33	5393.39	11305.92	20163.50	32425.13	51086.56	75126.88	103320.6
	135715.57	172370.47	213353.50	258532.48	307981.26	362353.92	421815.63	486535.39	556682.04	632122.7

MAXIMUM STAGE IS 1292.9

MAXIMUM STAGE IS 1291.5

MAXIMUM STAGE IS 1289.8

MAXIMUM STAGE IS 1288.9

MAXIMUM STAGE IS 1287.7

MAXIMUM STAGE IS 1286.5

MAXIMUM STAGE IS 1285.5

MAXIMUM STAGE IS 1284.3

MAXIMUM STAGE IS 1283.4

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - LAKE LADORE SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.37	0.00	14.53	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.30	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 2.20 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= .05 RTIOR= 2.00

UNIT HYDROGRAPH 81 END-OF-PERIOD ORDINATES, LAG= 2.30 HOURS, CP= .45 VOL= 1.00

14.	52.	104.	170.	240.	310.	368.	410.	436.	437.
416.	388.	361.	337.	314.	293.	273.	255.	238.	221.
207.	193.	180.	167.	156.	146.	136.	127.	118.	110.
103.	96.	87.	83.	78.	72.	67.	63.	59.	55.
51.	48.	44.	41.	39.	36.	34.	31.	29.	27.
25.	24.	22.	21.	19.	18.	17.	16.	14.	14.
13.	12.	11.	10.	10.	9.	8.	8.	7.	7.
6.	6.	5.	5.	5.	4.	4.	4.	4.	3.
3.									

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	24.50	22.20	2.39	192108.
	(624.)	(564.)	(61.)	(5439.89)

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LAKE LADORE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

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HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU LAKE LADORE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1605.	-1

STAGE	1367.00	1367.40	1367.70	1368.00	1369.00	1370.00	1371.00	1371.50	1372.00	1372.
FLOW	0.00	36.00	81.00	155.00	491.00	1002.00	1694.00	2291.00	3311.00	4586.
SURFACE AREA=	0.	261.	390.							
CAPACITY=	0.	1601.	5804.							
ELEVATION=	1349.	1367.	1380.							

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1367.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1371.0	0.0	0.0	0.

PEAK OUTFLOW IS 4477. AT TIME 44.25 HOURS

PEAK OUTFLOW IS 2836. AT TIME 44.75 HOURS

PEAK OUTFLOW IS 1471. AT TIME 45.75 HOURS

PEAK OUTFLOW IS 1085. AT TIME 46.25 HOURS

PEAK OUTFLOW IS 743. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 424. AT TIME 47.25 HOURS

PEAK OUTFLOW IS 295. AT TIME 47.50 HOURS

PEAK OUTFLOW IS 161. AT TIME 48.25 HOURS

PEAK OUTFLOW IS 59. AT TIME 49.50 HOURS

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HYDROGRAPH ROUTING

ROUTING THRU REACH 11 - 12

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
12	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELINVT	ELMAX	RLNTH	SEL
.1000	.0800	.1000	1280.0	1340.0	1050.	.06000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1340.00 100.00 1320.00 290.00 1320.00 300.00 1300.00 350.00 1280.00
470.00 1300.00 520.00 1320.00 650.00 1340.00

AVERAGE	0.00	1.02	4.09	9.19	16.35	25.54	36.78	49.77	63.55	78.
	93.27	109.22	125.89	148.21	182.48	219.52	259.32	301.89	347.22	395.
OUTFLOW	0.00	256.67	1629.74	4805.01	10348.19	18762.52	30509.92	48090.59	70296.08	95908.1
	124833.77	157010.11	192396.89	232228.10	283333.70	344188.51	414248.05	493440.55	581856.98	679664.
STAGE	1280.00	1283.16	1286.32	1289.47	1292.63	1295.79	1298.95	1302.11	1305.26	1308.
	1311.58	1314.74	1317.89	1321.05	1324.21	1327.37	1330.53	1333.68	1336.84	1340.
FLOW	0.00	256.67	1629.74	4805.01	10348.19	18762.52	30509.92	48090.59	70296.08	95908.1
	124833.77	157010.11	192396.89	232228.10	283333.70	344188.51	414248.05	493440.55	581856.98	679664.

MAXIMUM STAGE IS 1289.1

MAXIMUM STAGE IS 1287.5

MAXIMUM STAGE IS 1286.0

MAXIMUM STAGE IS 1285.1

MAXIMUM STAGE IS 1284.3

MAXIMUM STAGE IS 1283.5

MAXIMUM STAGE IS 1283.2

MAXIMUM STAGE IS 1282.0

MAXIMUM STAGE IS 1280.7

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - KEEN POND SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
13	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.91	0.00	14.53	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.30	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .813

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= .90 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES, LAG= .91 HOURS, CP= .45 VOL= 1.00

37.	135.	240.	282.	258.	210.	184.	155.	131.	110.
93.	79.	66.	56.	47.	40.	34.	28.	24.	20.
17.	14.	12.	10.	9.	7.	6.	5.	4.	4.
3.	3.	2.	2.						

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.58	22.20	2.39	52816.
										(624.)	(564.)	(61.)	(1495.58)

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT KEEN POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
14	3	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU KEEN POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
15	1	0	0	0	0	1	1	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	887.	-1

STAGE	1272.00	1272.50	1273.00	1273.50	1274.00	1275.00	1276.00	1277.50	1278.00	1278.5
	1278.70	1279.30	1281.50	1284.00						
FLOW	0.00	27.00	79.00	158.00	252.00	405.00	762.00	1252.00	1449.00	1598.0
	1842.00	2325.00	5190.00	9850.00						
SURFACE AREA=	0.	92.	123.	197.						
CAPACITY=	0.	887.	1744.	4915.						
ELEVATION=	1243.	1272.	1280.	1300.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1272.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1277.5	0.0	0.0	0.

PEAK OUTFLOW IS 16352. AT TIME 45.25 HOURS

PEAK OUTFLOW IS 11828. AT TIME 45.25 HOURS

PEAK OUTFLOW IS 7400. AT TIME 45.50 HOURS

PEAK OUTFLOW IS 5642. AT TIME 45.75 HOURS

PEAK OUTFLOW IS 3950. AT TIME 46.25 HOURS

PEAK OUTFLOW IS 2204. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 1439. AT TIME 49.25 HOURS

PEAK OUTFLOW IS 886. AT TIME 50.50 HOURS

PEAK OUTFLOW IS 399. AT TIME 50.75 HOURS

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17/20

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	RATIO 8	RATIO
				1.00	.75	.50	.40	.30	.20	.15	.10	.0
HYDROGRAPH AT	1	.89	1	2531.	1898.	1266.	1012.	759.	506.	380.	253.	127
		(2.31)	(	71.69)(	53.76)(	35.84)(	28.67)(	21.50)(	14.34)(	10.75)(	7.17)(	. 3.6
ROUTED TO	2	.89	1	149.	98.	54.	39.	26.	15.	10.	7.	4
		(2.31)	(	4.23)(	2.77)(	1.53)(	1.11)(	.75)(	.42)(	.30)(	.20)(	.11
ROUTED TO	3	.89	1	149.	98.	54.	39.	26.	15.	10.	7.	4
		(2.31)	(	4.23)(	2.77)(	1.53)(	1.11)(	.75)(	.42)(	.30)(	.20)(	.11
ROUTED TO	4	.89	1	149.	97.	54.	39.	26.	15.	10.	7.	4.
		(2.31)	(	4.21)(	2.76)(	1.52)(	1.11)(	.75)(	.42)(	.30)(	.20)(	.1
ROUTED TO	5	.89	1	149.	97.	54.	39.	26.	15.	10.	7.	4
		(2.31)	(	4.21)(	2.76)(	1.52)(	1.11)(	.75)(	.42)(	.30)(	.20)(	.1
HYDROGRAPH AT	6	9.36	1	13766.	10325.	6883.	5507.	4130.	2753.	2065.	1377.	69
		(24.24)	(	389.82)(	292.37)(	194.91)(	155.93)(	116.95)(	77.96)(	58.47)(	38.98)(	19.4
2 COMBINED	7	10.25	1	13841.	10373.	6911.	5527.	4144.	2762.	2071.	1381.	69
		(26.55)	(	391.94)(	293.74)(	195.68)(	156.50)(	117.33)(	78.20)(	58.66)(	39.11)(	19.
ROUTED TO	8	10.25	1	12044.	9114.	6069.	4791.	3473.	2149.	1539.	933.	4
		(26.55)	(	341.06)(	258.08)(	171.86)(	135.67)(	98.33)(	60.85)(	43.59)(	26.43)(	14.
ROUTED TO	9	10.25	1	12044.	9115.	6070.	4791.	3473.	2150.	1540.	933.	1
		(26.55)	(	341.06)(	258.12)(	171.88)(	135.67)(	98.34)(	60.87)(	43.60)(	26.43)(	14.
HYDROGRAPH AT	10	3.37	1	6128.	4596.	3064.	2451.	1839.	1226.	919.	613.	30
		(8.73)	(	173.54)(	130.15)(	86.77)(	69.41)(	52.06)(	34.71)(	26.03)(	17.35)(	8.
ROUTED TO	11	3.37	1	4477.	2836.	1471.	1085.	743.	424.	295.	161.	
		(8.73)	(	126.77)(	80.30)(	41.66)(	30.71)(	21.03)(	11.99)(	8.34)(	4.56)(	1.
ROUTED TO	12	3.37	1	4479.	2837.	1471.	1085.	743.	424.	295.	161.	5
		(8.73)	(	126.82)(	80.34)(	41.65)(	30.72)(	21.03)(	11.99)(	8.34)(	4.56)(	1.
HYDROGRAPH AT	13	.91	1	2695.	2021.	1348.	1078.	809.	539.	404.	270.	1
		(2.36)	(	76.32)(	57.24)(	38.16)(	30.53)(	22.90)(	15.26)(	11.45)(	7.63)(	3.
3 COMBINED	14	14.53	1	17056.	12287.	7700.	5974.	4283.	2612.	1658.	1104.	5
		(37.63)	(	482.97)(	347.94)(	218.05)(	169.16)(	121.29)(	73.96)(	52.60)(	31.27)(	15.
ED TO	15	14.53	1	16352.	11828.	7400.	5642.	3950.	2204.	1439.	886.	2
		(37.63)	(	463.05)(	334.94)(	209.55)(	159.78)(	111.85)(	62.41)(	40.75)(	25.10)(	11.

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1419.01	1417.00	1424.00
STORAGE	2922.	2920.	4061.
OUTFLOW	0.	0.	139.

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	1423.96	0.00	3869.	149.	0.00	47.25	0.00
.75	1422.82	0.00	3639.	98.	0.00	47.50	0.00
.50	1421.63	0.00	3406.	54.	0.00	48.25	0.00
.40	1421.14	0.00	3311.	39.	0.00	48.50	0.00
.30	1420.64	0.00	3215.	26.	0.00	49.00	0.00
.20	1420.14	0.00	3119.	15.	0.00	49.50	0.00
.15	1419.87	0.00	3069.	10.	0.00	49.75	0.00
.10	1419.60	0.00	3020.	7.	0.00	49.75	0.00
.05	1419.31	0.00	2970.	4.	0.00	49.50	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	149.	1371.4	47.50
.75	98.	1371.2	47.75
.50	54.	1371.1	48.50
.40	39.	1371.1	48.75
.30	26.	1371.1	49.25
.20	15.	1371.0	49.75
.15	10.	1371.0	50.00
.10	7.	1371.0	50.00
.05	4.	1371.0	49.75

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	149.	1331.6	48.75
.75	97.	1331.4	49.00
.50	54.	1331.2	49.75
.40	39.	1331.2	50.00
.30	26.	1331.1	50.25
.20	15.	1331.1	50.75
.15	10.	1331.0	51.00
.10	7.	1331.0	51.00
.05	4.	1331.0	51.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	119.	1300.1	51.25
.75	87.	1300.1	51.25
.50	61.	1300.1	51.25
.40	51.	1300.1	50.50
.30	26.	1300.1	51.00
.20	15.	1300.0	51.50
.15	10.	1300.0	51.75
.10	7.	1300.0	51.50
.05	4.	1300.0	51.50

1 SUMMARY OF DAM SAFETY ANALYSIS

LITTLE KEEN POND

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1290.78	1291.00	1296.70
STORAGE	92.	92.	409.
OUTFLOW	0.	0.	976.

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	1304.88	8.18	1878.	12044.	23.25	44.50	0.00
.75	1303.12	6.42	1460.	7111.	20.75	44.50	0.00
.50	1301.30	4.60	1111.	4049.	17.75	44.50	0.00
.40	1300.53	3.83	965.	4791.	16.00	44.50	0.00
.30	1297.64	2.94	804.	3473.	13.75	44.75	0.00
.20	1296.53	1.83	631.	2149.	10.25	45.25	0.00
.15	1297.71	1.01	522.	1540.	7.75	45.50	0.00
.10	1296.53	0.00	391.	933.	0.00	46.00	0.00
.05	1294.59	0.00	235.	494.	0.00	45.50	0.00

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	12044.	1292.9	44.50
.75	9115.	1291.5	44.50
.50	6070.	1289.8	44.50
.40	4791.	1288.9	44.50
.30	3473.	1287.7	44.75
.20	2150.	1286.5	45.25
.15	1540.	1285.9	45.50
.10	933.	1285.3	46.00
.05	494.	1283.4	45.75

1 SUMMARY OF DAM SAFETY ANALYSIS

LAKE LADORA

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1367.01	1367.00	1371.00
STORAGE	1604.	1601.	2716.
OUTFLOW	1.	0.	1694.

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	1372.46	1.46	3162.	4477.	9.25	44.25	0.00
.75	1371.77	.77	2749.	2836.	6.75	44.75	0.00
.50	1370.68	0.00	2622.	1471.	0.00	45.25	0.00
.40	1370.12	0.00	2473.	1085.	0.00	[illegible]	[illegible]
.30	1367.49	0.00	2279.	743.	0.00	46.50	0.00
.20	1368.80	0.00	2085.	424.	0.00	47.25	0.00
.15	1368.42	0.00	1979.	295.	0.00	47.50	0.00
.10	1368.02	0.00	1871.	161.	0.00	48.25	0.00
.05	1367.55	0.00	1747.	59.	0.00	49.50	0.00

PLAN 1 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	4479.	1289.1	44.25
.75	2837.	1287.5	45.00
.50	1471.	1286.0	46.00
.40	1085.	1285.1	46.25
.30	743.	1284.3	46.50
.20	424.	1283.5	47.25
.15	295.	1283.2	47.50
.10	161.	1282.0	48.25
.05	59.	1280.7	49.50

1

SUMMARY OF DAM SAFETY ANALYSIS

KEEN POND

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1271.99	1272.00	1277.50
STORAGE	886.	887.	1449.
OUTFLOW	0.	0.	1252.

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	1287.49	9.99	2759.	16352.	26.75	45.25	0.00
.75	1285.06	7.56	2409.	11828.	24.50	45.25	0.00
.50	1282.69	5.19	2086.	7400.	21.25	45.50	0.00
.40	1281.74	4.24	1963.	5642.	19.25	45.75	0.00
.30	1280.55	3.05	1811.	3950.	16.25	46.25	0.00
.20	1279.15	1.65	1640.	2204.	11.75	48.00	0.00
.15	1277.97	.47	1503.	1439.	6.50	49.25	0.00
.10	1276.38	0.00	1325.	886.	0.00	50.50	0.00
.05	1274.63	0.00	1142.	399.	0.00	50.75	0.00

****

[illegible] PACKAGE (HEC-1)

[illegible] JULY 1978

[illegible] 24 FEB 79

****

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

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO 1 .39
HYDROGRAPH AT	1	.89 (2.31)	1	987. (27.95)(
ROUTED TO	2	.89 (2.31)	1	38. (1.07)(
ROUTED TO	3	.89 (2.31)	1	38. (1.07)(
ROUTED TO	4	.89 (2.31)	1	38. (1.07)(
ROUTED TO	5	.89 (2.31)	1	38. (1.07)(
HYDROGRAPH AT	6	9.36 (24.24)	1	5369. (152.03)(
2 COMBINED	7	10.25 (26.55)	1	5388. (152.58)(
ROUTED TO	8	10.25 (26.55)	1	4439. (131.92)(
ROUTED TO	9	10.25 (26.55)	1	4659. (131.92)(
HYDROGRAPH AT	10	3.37 (8.73)	1	2370. (67.68)(
ROUTED TO	11	3.37 (8.73)	1	1044. (29.57)(
ROUTED TO	12	3.37 (8.73)	1	1044. (29.57)(
HYDROGRAPH AT	13	.91 (2.36)	1	1051. (29.76)(
3 COMBINED	14	14.53 (37.63)	1	5805. (164.38)(
ROUTED TO	15	14.53 (37.63)	1	5419. (154.31)(
ROUTED TO	16	14.53 (37.63)	1	5448. (154.28)(

ROUTED TO [illegible] 14.53 [illegible]
(37.63) (151.28)(

. 1 SUMMARY OF DAM SAFETY ANALYSIS

[illegible]

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1419.01	1419.00	1423.[illegible]
STORAGE	2922.	[illegible]	4561.
OUTFLOW	0.	0.	198.

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
.39	1421.09	0.00	3301.	38.	0.00	48.75	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1371.1	49.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1331.1	50.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1300.1	50.50

1 SUMMARY OF DAM SAFETY ANALYSIS

[illegible]

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1290.98	1291.00	1296.70
STORAGE	92.	92.	409.
OUTFLOW	0.	0.	976.

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
.39	1300.45	3.75	950.	4659.	15.50	44.50	0.00

PLAN 1 STATION 9

RATIO	MAXIMUM [illegible]	MAXIMUM [illegible]	TIME [illegible]

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	4659.	1298.8	44.50

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1367.01	1367.00	1371.00
STORAGE	1604.	1601.	2718.
OUTFLOW	1.	0.	1694.

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
.39	1370.06	0.00	2442.	1044.	0.00	46.25	0.00

PLAN 1 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	1044.	1285.0	46.25

1 SUMMARY OF DAM SAFETY ANALYSIS

MEM POND

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1271.99	1272.00	1277.50
STORAGE	886.	887.	1449.
OUTFLOW	0.	0.	1252.

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
.39	1281.64	4.14	1950.	5449.	19.00	45.75	0.00

PLAN 1 STATION 16

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	5448.	1244.0	46.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****
EOI ENCOUNTERED.
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**********/**********
   1          A1       KEEN POND DAM   ****   VAN AUKEN CREEK
   2          A2       CANAAN TWP., WAYNE COUNTY, PA.
   3          A3       NDI # PA-00092      PA DER # 64-13
   4          B   300      0      15       0       0       0       0       0      -4       0
   5          B1    5
   6          J     3      1       1
   7          J1  .39
   8          K             1                                              1
   9          K1               INFLOW HYDROGRAPH - ELK LAKE SUBAREA
  10          M     1        1     .89            14.53                                    1
  11          P            21.3    111     123     133     142
  12          T                                                           1     .05
  13          W     1     .45
  14          X  -1.5    -.05       2
  15          K     1       2                                             1
  16          K1               RESERVOIR ROUTING - THRU ELK LAKE
  17          Y                                1       1
  18          Y1    1                                                  2922     -1
  19          Y4 1419    1420   1420.5    1421    1422    1423    1424  1424.9  1425.5    1426
  20          Y5    0      12      23      35      65     105     151     198     482     884
  21          $A    0     157   188.7   266.8
  22          $E1363.2    1419    1420    1440
  23          $$ 1419
  24          $01424.9
  25          K     1       3                                             1
  26          K1               ROUTING THRU REACH 2 - 3
  27          Y                                1       1
  28          Y1    1
  29          Y6   .1     .08      .1    1371    1420    2600    .016
  30          Y7    0     1400     150    1400     300    1380     670    1371     675    1371
  31          Y7 1290     1380    1540    1400    1940    1420
  32          K     1       4                                             1
  33          K1               ROUTING THRU REACH 3 - 4
  34          Y                                1       1
  35          Y1    1
  36          Y6   .1     .07      .1    1331    1380    6350   .0063
  37          Y7    0     1380     250    1360     850    1340    1175    1331    1180    1331
  38          Y7 1720     1340    2000    1360    2250    1380
  39          K     1       5                                             1
  40          K1               ROUTING THRU REACH 4 - 5
  41          Y                                1       1
  42          Y1    1
  43          Y6   .1     .05      .1    1300    1360    5750   .0054
  44          Y7    0     1360     250    1340     375    1320    1410    1300    1420    1300
  45          Y7 1650     1320    1900    1340    2050    1360
  46          K             6                                             1
  47          K1               INFLOW HYDROGRAPH - LITTLE KEEN POND SUBAREA
  48          M     1        1    9.36            14.53                                    1
  49          P            21.3    111     123     133     142
  50          T                                                           1     .05
1 51          W  3.19     .45
  52          X  -1.5    -.05       2
  53          K     2       7                                             1
  54          K1               COMBINE HYDROGRAPHS AT LITTLE KEEN POND
  55          K     1       8                                             1
  56          K1               RESERVOIR ROUTING - THRU LITTLE KEEN POND
  57          Y                                1       1
  58          Y1    1                                                    92     -1
  59          Y4 1291    1291.5    1292  1292.5    1293    1294  1295.5  1296.7  1297.5  1298.5
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58          Y1    1                                                    72      -1
59          Y4  1291  1291.5    1292  1292.5    1293    1294  1295.5  1296.7  1297.5  1298.5
60          Y4  1300    1302
61          Y5     0      25      72     131     202     372     683     976    1306    2119
62          Y5  3903    7240
63          $A     0    19.6   179.5     509
64          $E1276.9    1291    1300    1320
65          $$  1291
66          $D1296.7
67          K      1       9                                            1
68          K1              ROUTING THRU REACH 8 - 9
69          Y                                   1       1
70          Y1     1
71          Y6    .1     .08      .1    1280    1340     550   .0073
72          Y7     0    1340     250    1320     410    1300     700    1280     710    1280
73          Y7   900    1300    1000    1320    1120    1340
74          K           10                                              1
75          K1              INFLOW HYDROGRAPH - LAKE LADORE SUBAREA
76          M      1       1    3.37           14.53                                    1
77          P           21.3     111     123     133     142
78          T                                                           1     .05
79          W   2.28     .45
80          X   -1.5     .05       2
81          K      1      11                                            1
82          K1              RESERVOIR ROUTING - THRU LAKE LADORE
83          Y                                   1       1
84          Y1     1                                                 1605      -1
85          Y4  1367  1367.4  1367.7    1368    1369    1370    1371  1371.5    1372  1372.5
86          Y5     0      36      81     155     491    1002    1694    2291    3311    4586
87          $A     0     261     390
88          $E1348.6    1367    1380
89          $$  1367
90          $D  1371
91          K      1      12                                            1
92          K1              ROUTING THRU REACH 11 - 12
93          Y                                   1       1
94          Y1     1
95          Y6    .1     .08      .1    1280    1340    1050     .06
96          Y7     0    1340     100    1320     290    1320     300    1300     350    1280
97          Y7   470    1300     520    1320     650    1340
98          K           13                                              1
99          K1              INFLOW HYDROGRAPH - KEEN POND SUBAREA
100         M      1       1     .91           14.53                                    1
1 101       P           21.3     111     123     133     142
102         T                                                           1     .05
103         W    .9     .45
104         X   -1.5    -.05       2
105         K      3      14                                            1
106         K1              COMBINE HYDROGRAPHS AT KEEN POND
107         K      1      15                                            1
108         K1              RESERVOIR ROUTING - THRU KEEN POND
109         Y                                   1       1
110         Y1     1                                                  887      -1
111         Y4  1272  1272.5    1273  1273.5    1274    1275    1276  1277.5    1278  1278.3
112         Y41278.7  1279.3  1281.5    1284
113         Y5     0      27      79     158     252     485     762    1252    1449    1598
114         Y5  1842    2325    5190    9850
115         $A     0    91.8     123     197
116         $E  1243    1272    1280    1300
117         $$  1272
118         $D1277.5
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...          ...   0    ....    ...5    ...
116          $E  1243    1272    1280    1300
117          $$  1272
118          $D1277.5
119          $B    50       1    1258     .25    1272  1281.5
120          $B    50       1    1258      .5    1272  1281.5
121          $B    50       1    1258       1    1272  1281.5
122          K      1      16                                  1
123          K1                ROUTING THRU REACH 15 - 16
124          Y                                 1       1
125          Y1     1
126          Y6    .1     .06      .1    1237    1280    1850   .0097
127          Y7     0    1280     200    1260     590    1240    650    1237    655    1237
128          Y7   700    1240    1050    1260    1260    1280
129          K     99
1                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                ROUTE HYDROGRAPH TO           3
                                ROUTE HYDROGRAPH TO           4
                                ROUTE HYDROGRAPH TO           5
                                RUNOFF HYDROGRAPH AT          6
                                COMBINE  2 HYDROGRAPHS AT     7
                                ROUTE HYDROGRAPH TO           8
                                ROUTE HYDROGRAPH TO           9
                                RUNOFF HYDROGRAPH AT         10
                                ROUTE HYDROGRAPH TO          11
                                ROUTE HYDROGRAPH TO          12
                                RUNOFF HYDROGRAPH AT         13
                                COMBINE  3 HYDROGRAPHS AT    14
                                ROUTE HYDROGRAPH TO          15
                                ROUTE HYDROGRAPH TO          16
                                END OF NETWORK

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************

 RUN  DATE# 79/12/20.
      TIME# 14.10.42.

                        KEEN POND DAM   ****   VAN AUKEN CREEK
                        CANAAN TWP., WAYNE COUNTY, PA.
                        NDI # PA-00092      PA DER # 64-13

                                        JOB SPECIFICATION
                   NO     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
                  300       0      15       0       0       0       0       0      -4       0
                                        JOPER     NWT   LROPT   TRACE
                                            5       0       0       0

                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 3 NRTIO= 1 LRTIO= 1
                   RTIOS=     1.39
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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 .39
HYDROGRAPH AT	1	.89	1	987.
	(	2.31)	(	27.95)(
			2	987.
			(	27.95)(
			3	987.
			(	27.95)(
ROUTED TO	2	.89	1	38.
	(	2.31)	(	1.07)(
			2	38.
			(	1.07)(
			3	38.
			(	1.07)(
ROUTED TO	3	.89	1	38.
	(	2.31)	(	1.07)(
			2	38.
			(	1.07)(
			3	38.
			(	1.07)(
ROUTED TO	4	.89	1	38.
	(	2.31)	(	1.07)(
			2	38.
			(	1.07)(
			3	38.
			(	1.07)(
ROUTED TO	5	.89	1	38.
	(	2.31)	(	1.07)(
			2	38.
			(	1.07)(
			3	38.
			(	1.07)(
HYDROGRAPH AT	6	9.36	1	5369.
	(	24.24)	(	152.03)(
			2	5369.
			(	152.03)(
			3	5369.
			(	152.03)(
2 COMBINED	7	10.25	1	5388.
	(	26.55)	(	152.58)(
			2	5388.
			(	152.58)(
			3	5388.
			(	152.58)(
ROUTED TO	8	10.25	1	4459.

ROUTED TO	8	10.25	1	4459.
		(26.55)		(131.72)(
			2	4659.
				(131.92)(
			3	4659.
				(131.92)(
ROUTED TO	9	10.25	1	4659.
		(26.55)		(131.92)(
			2	4659.
				(131.92)(
			3	4659.
				(131.92)(
HYDROGRAPH AT	10	3.37	1	2390.
		(8.73)		(67.68)(
			2	2390.
				(67.68)(
			3	2390.
				(67.68)(
ROUTED TO	11	3.37	1	1044.
		(8.73)		(29.57)(
			2	1044.
				(29.57)(
			3	1044.
				(29.57)(
ROUTED TO	12	3.37	1	1044.
		(8.73)		(29.57)(
			2	1044.
				(29.57)(
			3	1044.
				(29.57)(
HYDROGRAPH AT	13	.91	1	1051.
		(2.36)		(29.76)(
			2	1051.
				(29.76)(
			3	1051.
				(29.76)(
3 COMBINED	14	14.53	1	5805.
		(37.63)		(164.38)(
			2	5805.
				(164.38)(
			3	5805.
				(164.38)(
ROUTED TO	15	14.53	1	24847.
		(37.63)		(703.58)(
			2	21596.
				(611.53)(
			3	17869.
				(505.98)(
ROUTED TO	16	14.53	1	22836.
		(37.63)		(646.64)(
			2	19847.

ROUTED TO 16 14.53 1 22936.
(37.63) (649.64)(
2 19947.
(564.97)(
3 17060.
(483.08)(

1 SUMMARY OF DAM SAFETY ANALYSIS

FOR LAKE

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1419.01	1419.00	1424.90
STORAGE	2922.	2920.	4061.
OUTFLOW	0.	0.	198.

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
.39	1421.09	0.00	3301.	38.	0.00	48.75	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1419.01	1419.00	1424.90
STORAGE	2922.	2920.	4061.
OUTFLOW	0.	0.	198.

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
.39	1421.09	0.00	3301.	38.	0.00	48.75	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1419.01	1419.00	1424.90
STORAGE	2922.	2920.	4061.
OUTFLOW	0.	0.	198.

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
.39	1421.09	0.00	3301.	38.	0.00	48.75	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1371.1	49.00

PLAN 2 STATION 3

RATIO	MAXIMUM	MAXIMUM	TIME

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1371.1	49.00

PLAN 3 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1371.1	49.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1331.1	50.00

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1331.1	50.00

PLAN 3 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1331.1	50.00

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1300.1	50.50

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	38.	1300.1	50.50

PLAN 3 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

PLAN 3 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	39.	1300.1	30.50

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1290.78	1291.00	1296.70
STORAGE	92.	92.	409.
OUTFLOW	0.	0.	976.

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
.39	1300.45	3.75	950.	4659.	15.50	44.50	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1290.78	1291.00	1296.70
STORAGE	92.	92.	409.
OUTFLOW	0.	0.	976.

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
.39	1300.45	3.75	950.	4659.	15.50	44.50	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1290.78	1291.00	1296.70
STORAGE	92.	92.	409.
OUTFLOW	0.	0.	976.

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
.39	1300.45	3.75	950.	4659.	15.50	44.50	0.00

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.37	4659.	1288.8	44.50

PLAN 2 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

PLAN 2 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	4659.	1288.8	44.50

PLAN 3 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	4659.	1288.8	44.50

1

SUMMARY OF DAM SAFETY ANALYSIS

LAKE LADORA

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1367.01	1367.00	1371.00
STORAGE	1604.	1601.	2718.
OUTFLOW	1.	0.	1694.

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
.39	1370.06	0.00	2442.	1044.	0.00	46.25	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1367.01	1367.00	1371.00
STORAGE	1604.	1601.	2718.
OUTFLOW	1.	0.	1694.

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
.39	1370.06	0.00	2442.	1044.	0.00	46.25	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1367.01	1367.00	1371.00
STORAGE	1604.	1601.	2718.
OUTFLOW	1.	0.	1694.

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
.39	1370.06	0.00	2442.	1044.	0.00	46.25	0.00

PLAN 1 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

PLAN 1 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	1044.	1285.0	46.25

PLAN 2 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	1044.	1285.0	46.25

PLAN 3 STATION 12

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	1044.	1285.0	46.25

1 SUMMARY OF DAM SAFETY ANALYSIS

KEEN [illegible]

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1272.00	1272.00	1277.50
STORAGE	887.	887.	1449.
OUTFLOW	0.	0.	1252.

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
.39	1281.51	4.01	1933.	24847.	3.98	45.25	45.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1272.00	1272.00	1277.50
STORAGE	887.	887.	1449.
OUTFLOW	0.	0.	1252.

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
.39	1281.51	4.01	1933.	21596.	4.13	45.50	45.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1272.00	1272.00	1277.50
STORAGE	887.	887.	1449.
OUTFLOW	0.	0.	1252.

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

AD-A081 586 BERGER ASSOCIATES INC HARRISBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. KEEN LAKE DAM (NDI NUMBER PA-0--ETC(U)
JAN 80 DACW31-80-C-0019

UNCLASSIFIED NL

2 OF 2

END
DATE FILMED
4-80
DDC

OF PMF	RESERVOIR W.S.ELEV	DEPTH OVER DAM	STORAGE AC-FT	OUTFLOW CFS	OVER TOP HOURS	MAX OUTFLOW HOURS	FAILURE HOURS
.39	1281.51	4.01	1933.	24847.	3.98	45.75	45.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1272.00	1272.00	1277.50
STORAGE	887.	887.	1449.
OUTFLOW	0.	0.	1252.

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
.39	1281.51	4.01	1933.	21596.	4.13	45.50	45.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1272.00	1272.00	1277.50
STORAGE	887.	887.	1449.
OUTFLOW	0.	0.	1252.

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
.39	1281.51	4.01	1933.	17869.	4.44	46.00	45.00

PLAN 1 STATION 16

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	22836.	1249.7	45.50

PLAN 2 STATION 16

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	19847.	1249.0	45.50

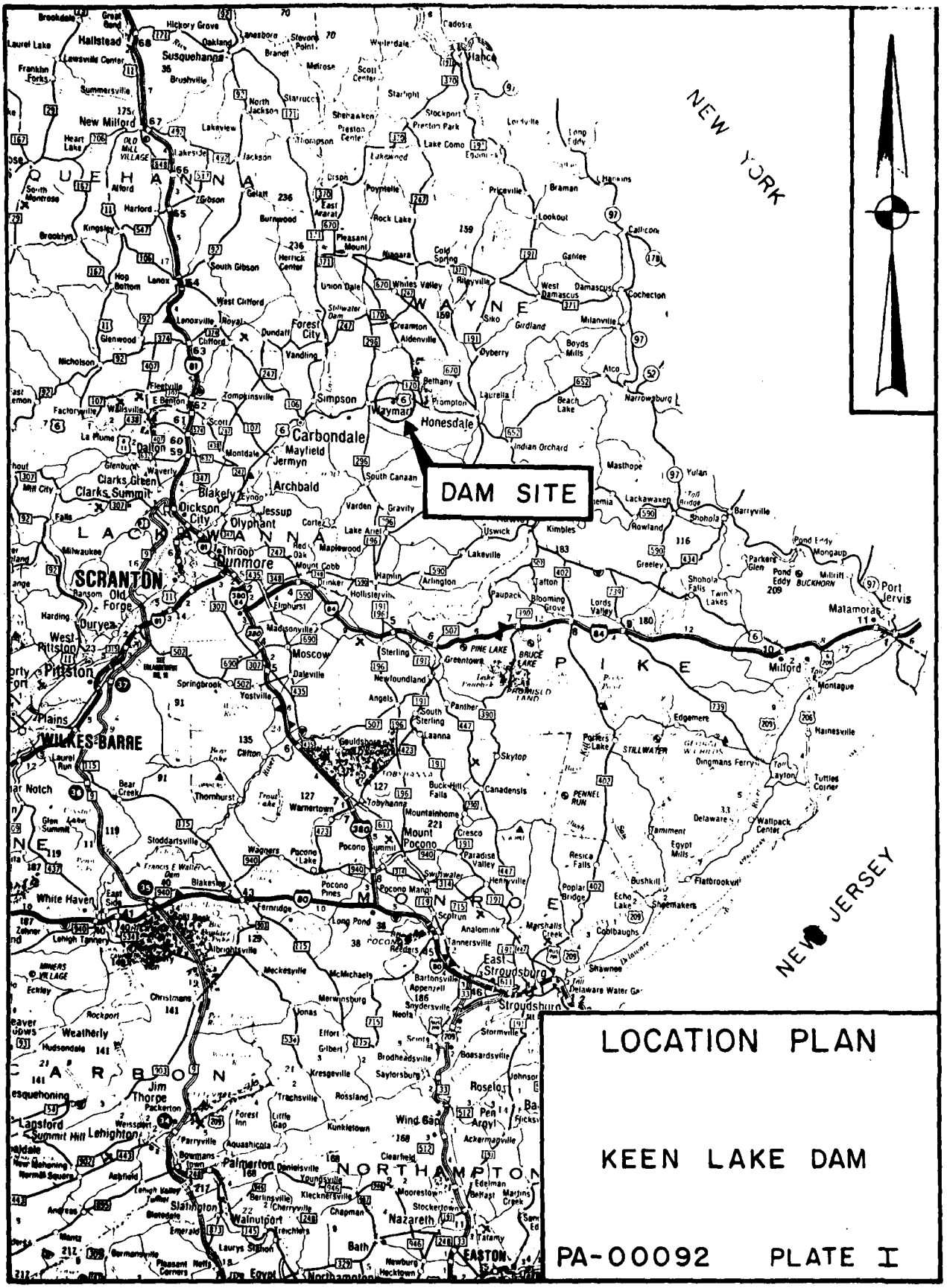
PLAN 3 STATION 16

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.39	17060.	1248.3	46.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****
EOI ENCOUNTERED.

APPENDIX E

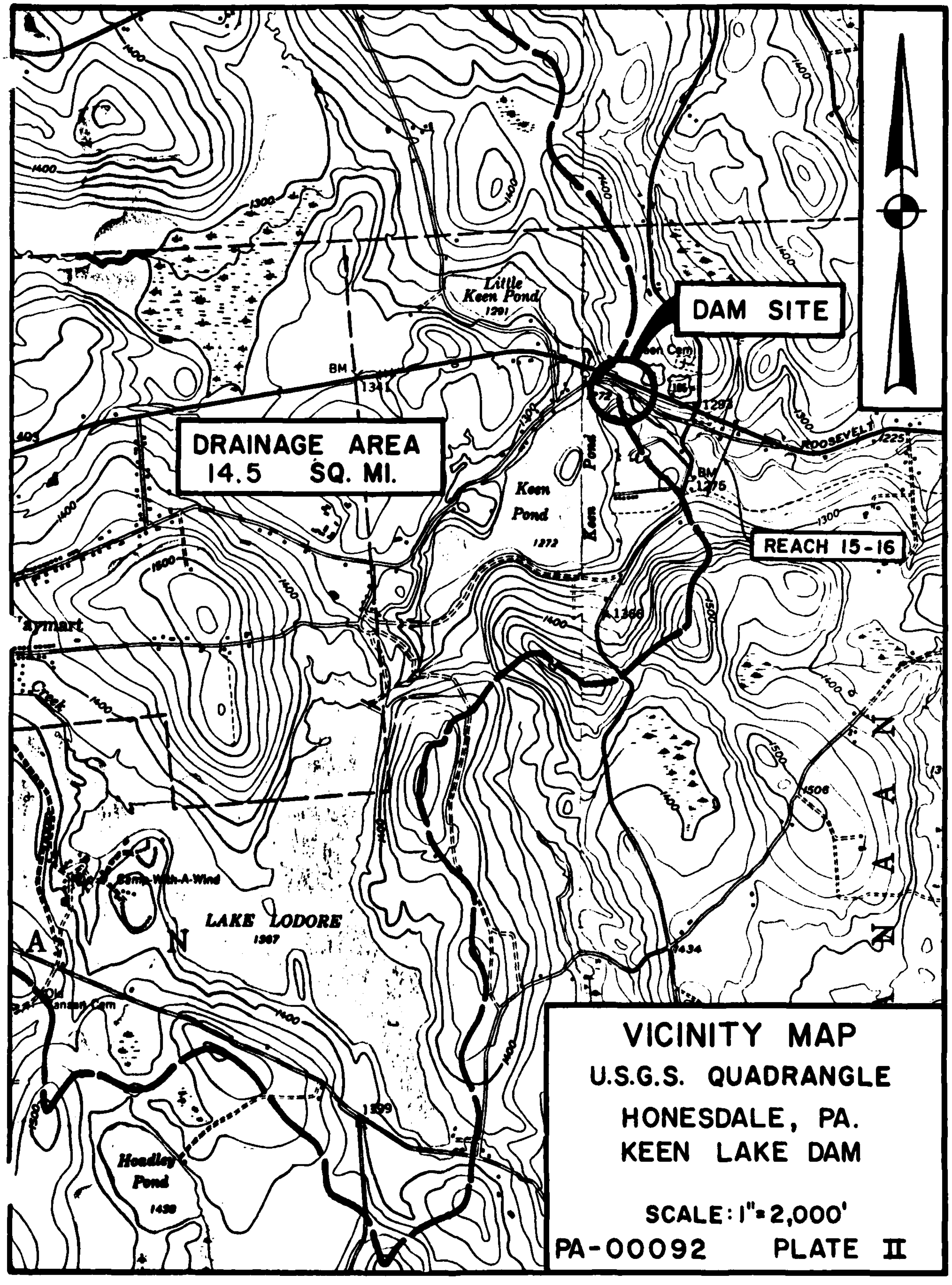
PLATES



LOCATION PLAN

KEEN LAKE DAM

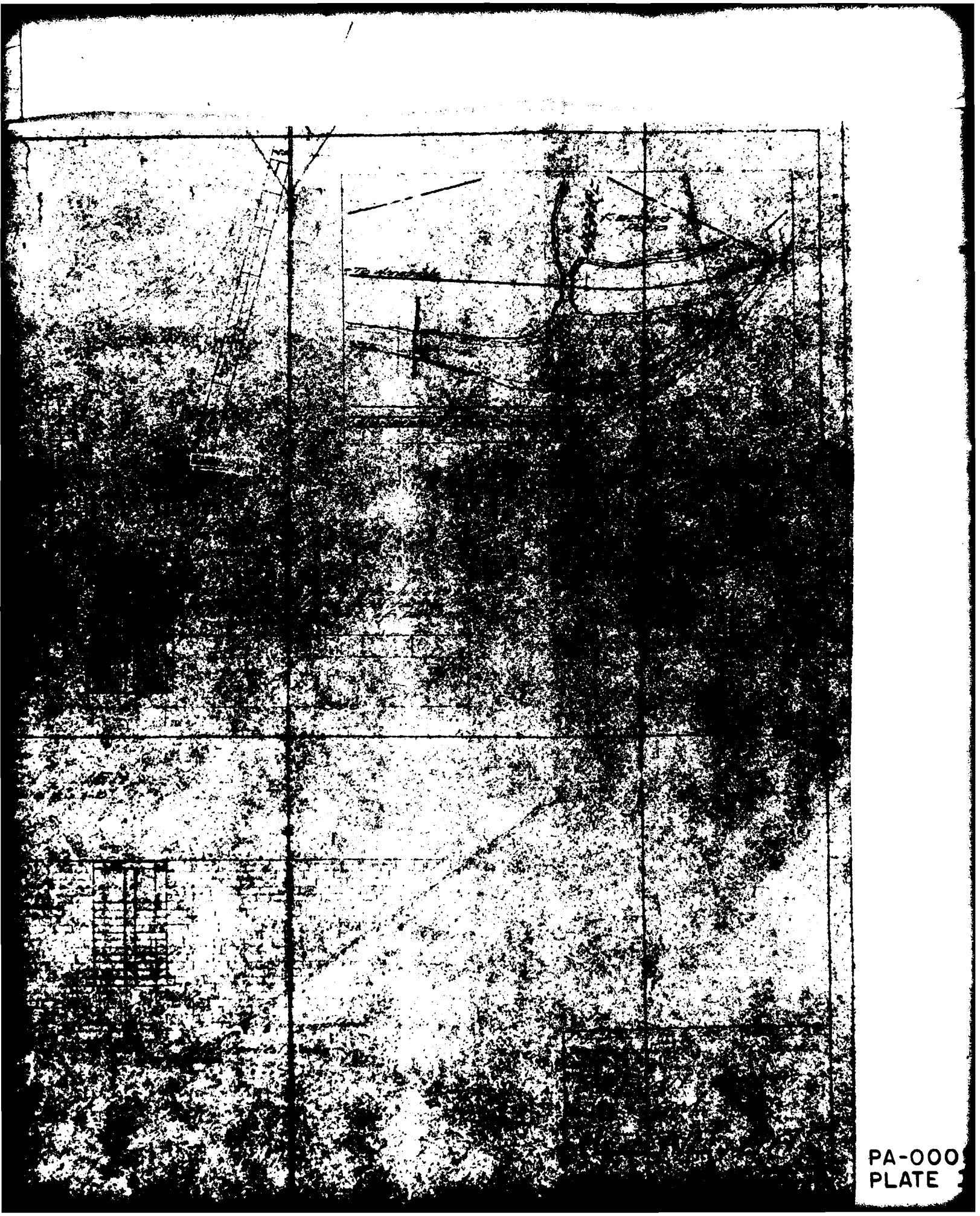
PA-00092 PLATE I



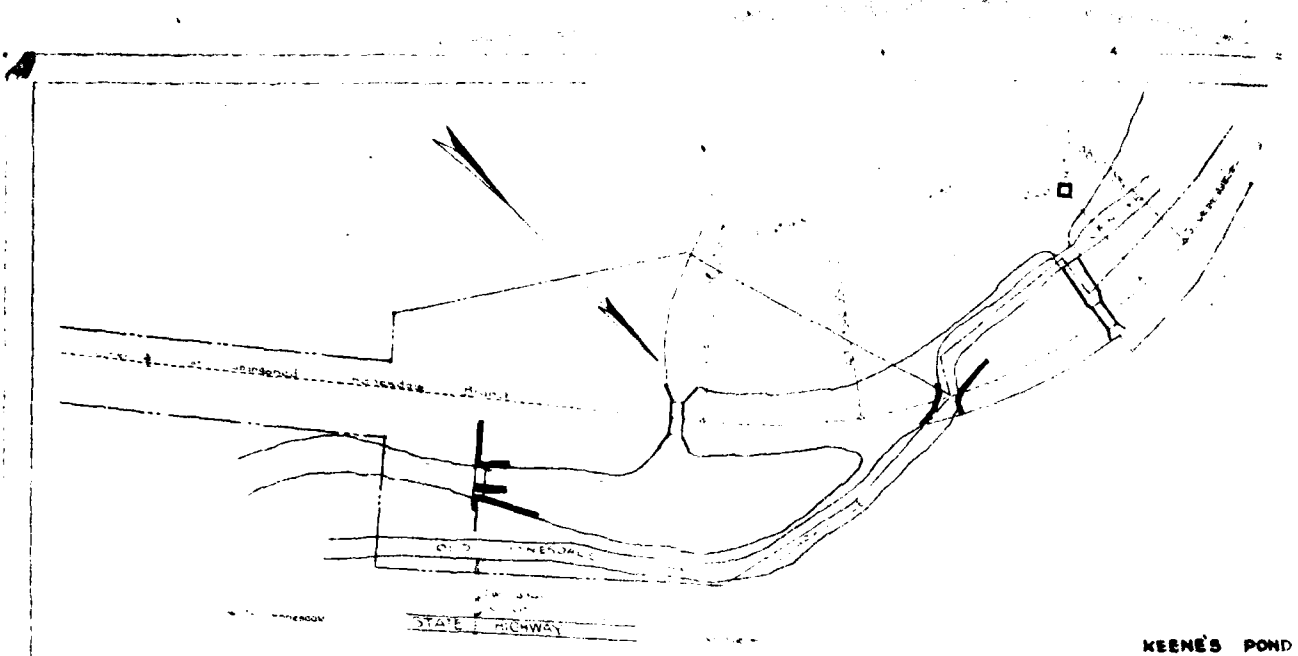
VICINITY MAP
U.S.G.S. QUADRANGLE
HONESDALE, PA.
KEEN LAKE DAM

SCALE: 1" = 2,000'

PA-00092 PLATE II



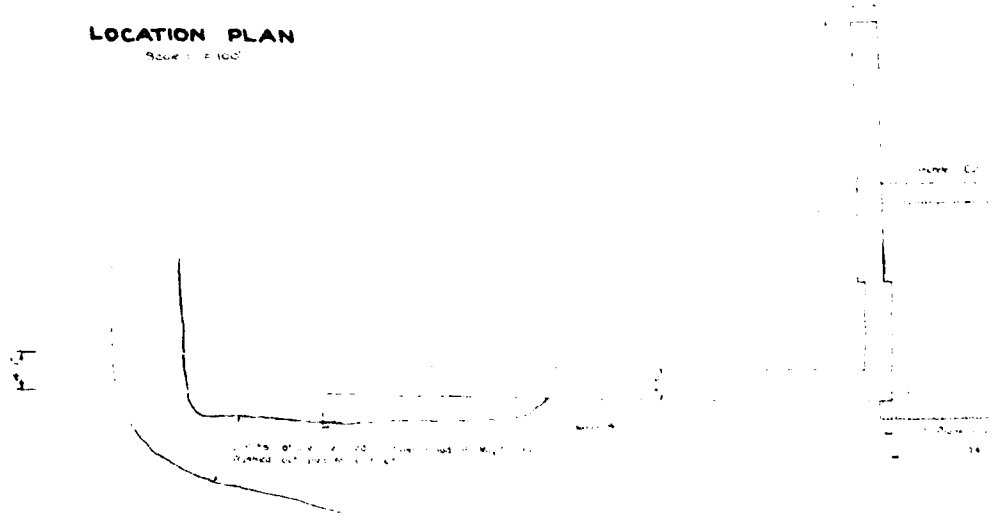
PA-000
PLATE



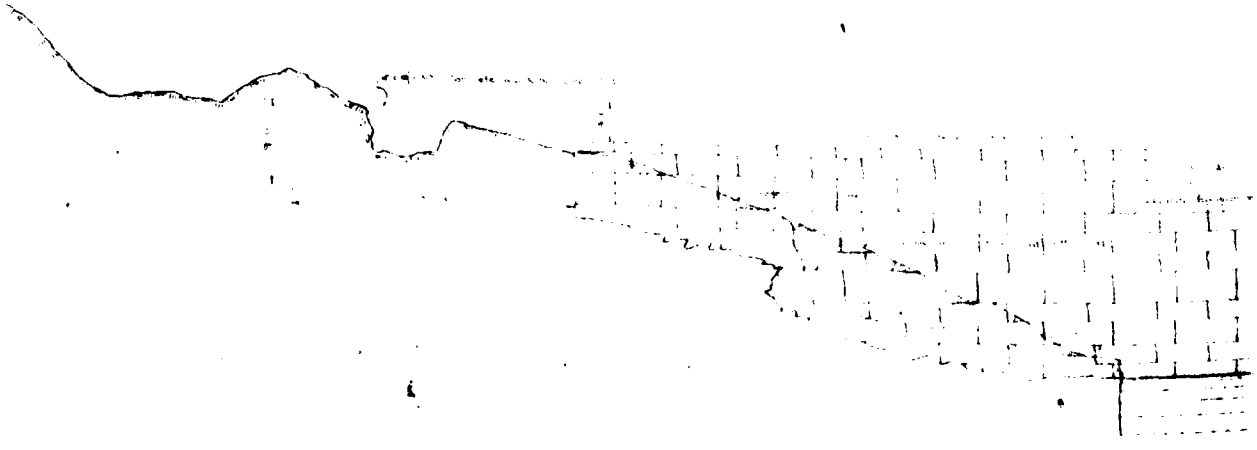
KEENE'S POND

LOCATION PLAN

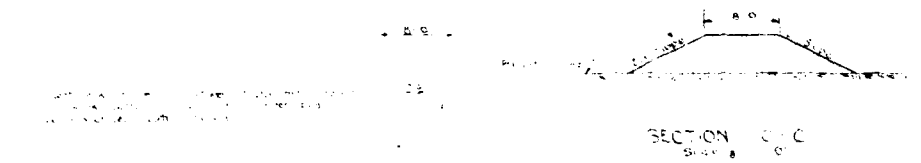
Scale 1" = 100'



PLAN



ELEVATION



SECTION C C

RECOMMENDED REPAIRS TO KEENE'S DAM AT KEENE, PA.

PA-00092
PLATE IV

APPENDIX F

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Catskill Formation - undifferentiated.

Lithology: Grayish red to greenish gray and mottled red-gray siltstone interbedded with silt-shale, and fine sandstone.

Structure

The site is within the Pocono Plateau area and the beds are essentially horizontal. There is probably a slight regional dip to the west, toward the Lackawanna Syncline. Air Photo fracture traces trend: N45°E, N20°E and N30°W.

Overburden

This dam was built in the 1830's and almost no foundation information is available. The site is within the limits of Pleistocene glaciation and variable thicknesses of ground moraine and outwash sand and gravel can be expected in the area.

In 1933, a cut-off trench was dug at the upstream edge of the spillway and was reported to be four feet deep, in clay.

Aquifer Characteristics

The rocks of the Catskill Formation are essentially impermeable, ground water moves entirely along bedding planes and fractures. The most permeable aquifers in the region are the sands and gravels of glacial origin, which are commonly present in the stream valleys.

Discussion

The overburden in the gorge is small and it is likely that the wall was founded on rock. Leakage under the dam and in the right abutment continued after the 1933 repairs. The clay reported at the spillway could be the fill placed behind the wall. The leakage is apparently not serious, and at this late date is not likely to cause deterioration of either the bedrock or the till.

Sources of Information

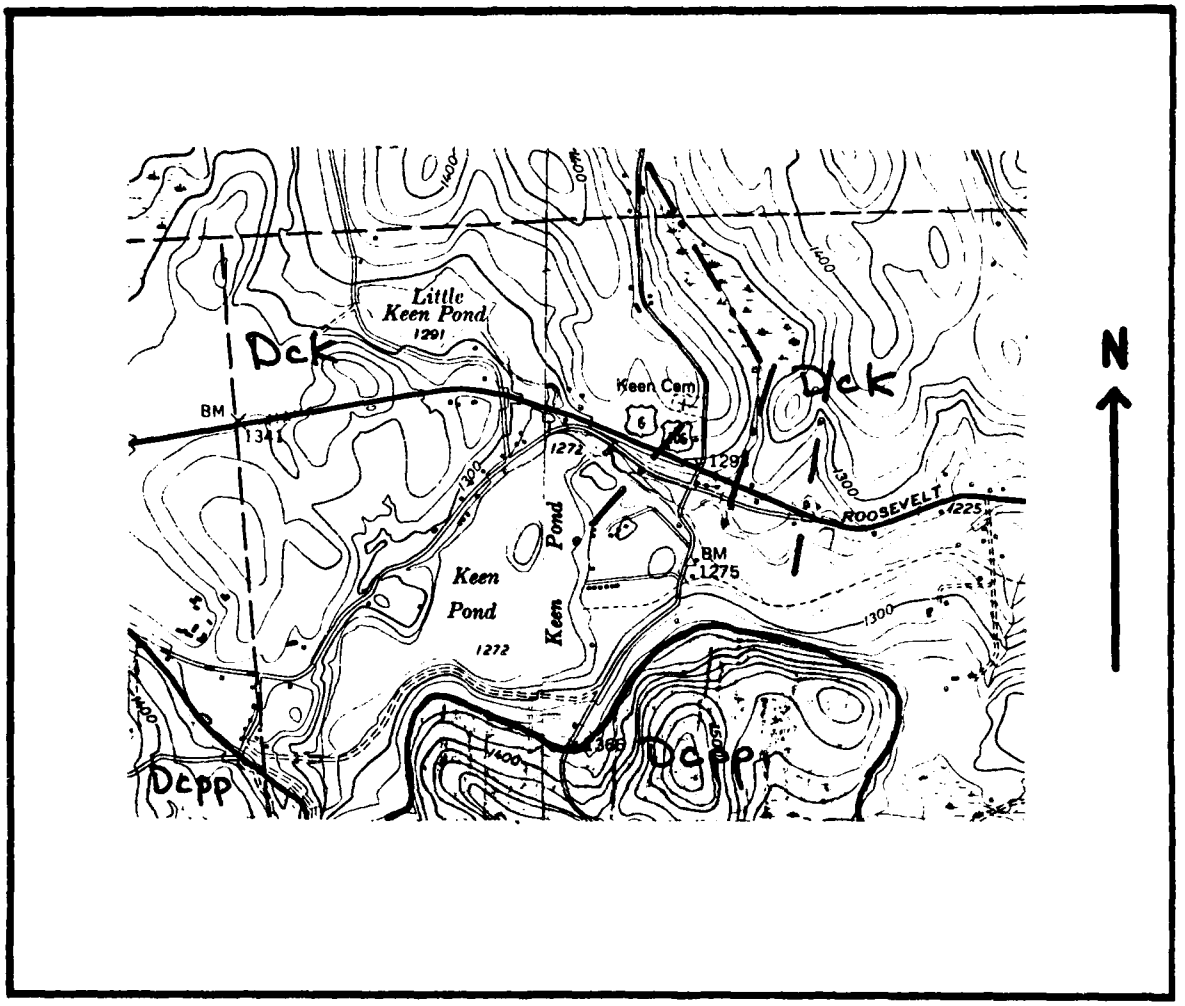
1. Manuscript Geologic Map of the Waymart Quadrangle, in open file, Pa. Geologic Survey, Harrisburg, Pa.

2. Berg, T.M. (1977) "Geology of the Pocono Pines and Mt. Pocono Quadrangles". Pa. Geologic Survey, 4th series, Atlas 204cd.

3. Air Photos. Scale 1:24,000, dated 1969.

4. Inspection reports and correspondence in file.

GEOLOGIC MAP - Keen Pond Dam



key

Dck	Catskill Fm. - undifferentiated
Depp	Catskill Fm. - Packerton member through Poplar Gap member
—.—.	air photo fracture trace

SCALE 1:24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET