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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. BASS LAKE DAM (NJ00271), DELAWARE --ETC(U)  
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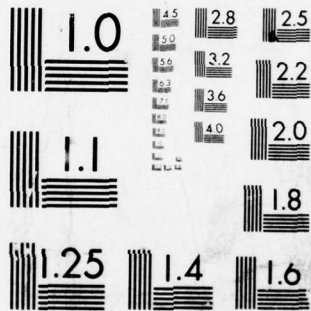
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**LEVEL**

DELAWARE RIVER BASIN  
BLAIRS CREEK  
WARREN COUNTY  
NEW JERSEY

MA 069903

**BASS LAKE DAM**

**NJ 00271**

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RECEIVED  
JUN 15 1979

**PHASE 1 INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**



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**DEPARTMENT OF THE ARMY**

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

May, 1979

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00271	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Bass Lake Dam Warren County, N.J.	5. TYPE OF REPORT & PERIOD COVERED <b>9</b> FINAL Rept.	
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7. AUTHOR(s) <b>10</b> Dennis J. Leary P.E.	8. CONTRACT OR GRANT NUMBER(s) <b>15</b> DACW61-78-C-0124	
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11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE <b>11</b> May 1979	
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) <b>6</b> National Dam Safety Program, Bass Lake Dam (NJ00271), Delaware River Basin, Blairs Creek, Warren County, New Jersey. Phase I Inspection Report.		
18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams National Dam Inspection Act Report Spillway Bass Lake Dam, N.J. Structural Analysis Visual Inspection		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. <b>440 897</b>		



DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

410 871

30 MAY 1979

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Bass Lake Dam in Warren County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Bass Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since one percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, nonemergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

NAPEN-D

Honorable Brendan T. Byrne

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam and spillway foundation condition and structural stability. This should include test borings to determine material properties relative to stability. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Make the sluice gate for the 18-inch low level outlet functional.

(2) Repair spalled and deteriorated concrete and completely plug leaks through the dam.

(3) The owner should operate the sluice gates regularly, at least two times a year, to ensure their operational condition.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

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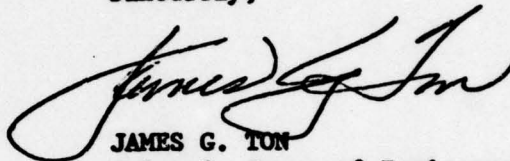
**NAPEN-D**

**Honorable Brendan T. Byrne**

**Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.**

**An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed action taken by the State to implement our recommendations.**

**Sincerely,**



**JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer**

**1 Incl  
As stated**

**Copies furnished:  
Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N. J. Dept of Environmental Protection  
P. O. Box CNO29  
Trenton, NJ 08625**

**John O'Dowd, Acting Chief  
Bureau of Flood Plain Management  
Division of Water Resources  
N. J. Dept. of Environmental Protection  
P. O. Box CNO29  
Trenton, NJ 08625**

BASS LAKE DAM (NJ00271)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 13 and 21 December 1978 and 9 January 1979 by Langan Engineering Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Bass Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since one percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard of loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam and spillway foundation condition and structural stability. This should include test borings to determine material properties relative to stability. Any remedial measures found necessary should be initiated within calendar year 1980.

c. The following remedial actions should be completed within three months from the date of approval of this report:

(1) Make the sluice gate for the 18-inch low level outlet functional.

(2) Repair spalled and deteriorated concrete and completely plug leaks through the dam.

(3) The owner should operate the sluice gates regularly, at least two times a year, to ensure their operational condition.

APPROVED: 

JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE: 30 May 1979



DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

**NAPEN**

24 MAY 1979

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Bass Lake Dam (Federal I.D. No. NJ00271), a high hazard potential structure, has recently been inspected. The dam is owned by the Princeton Education Center and is located at the Princeton Summer Camp in Hardwick Township, Warren County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate since approximately one percent of the Probable Maximum Flood would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owner take the following measures within 30 days of the date of this letter:

- a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

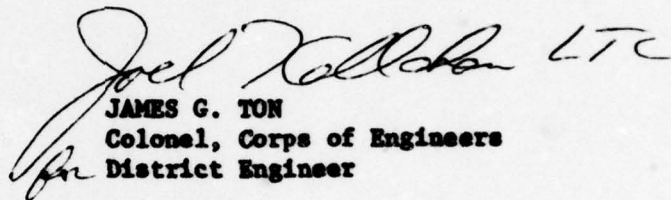
**NAPEN-D**

**Honorable Brendan T. Byrne**

b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, round-the-clock surveillance should be provided during periods of unusually heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,

  
**JAMES G. TON**  
Colonel, Corps of Engineers  
District Engineer

**Cy Furn:**

**Dirk C. Hofman, Actg Deputy Director**  
Division of Water Resources  
N. J. Dept of Environmental Protection  
P. O. Box CN029  
Trenton, NJ 08625

**John O'Dowd, Acting Chief**  
Bureau of Flood Plain Management  
Division of Water Resources  
N. J. Dept of Environmental Protection  
P. O. Box CN029  
Trenton, NJ 08625

UNSAFE DAM

NATIONAL PROGRAM OF INSPECTION OF DAMS

- a. NAME: Bass Lake Dam      b. ID NO.: NJ00271      c. LOCATION: State: New Jersey County: Warren  
d. HEIGHT: 30 feet      e. MAXIMUM IMPOUNDMENT CAPACITY: 325 ac. ft.  
River or Stream: Blairs Creek  
Nearest D/S City or Town: Blairstown
- f. TYPE: Concrete Arch      g. OWNER: Princeton Education Center
- h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 24 May 79.      i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT  
Preliminary report calculations indicate one percent of PMF would overtop the dam.
- l. URGENCY CATEGORY: UNSAFE, Non-Emergency
- m. EMERGENCY ACTIONS TAKEN:  
Governor notified of this condition by District Engineer's letter of 24 May 79.
- n. REMEDIAL ACTIONS TAKEN:  
NJDEP will notify dam's owner upon receipt of our letter.
- o. REMARKS: Final Report, to be issued within six weeks, will have WHITE cover.
- j. DESCRIPTION OF DANGER INVOLVED: Overtopping and failure of the dam significantly increases hazard potential to loss of life and property downstream of dam.
- k. RECOMMENDATIONS GIVEN TO GOVERNOR: Within 30 days of date of District Engineer letter the owner do the following:  
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analysis and to recommend any remedial measures required to prevent overtopping of the dam.  
b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around-the-clock surveillance should be provided during periods heavy precipitation.

*W. H. Zink*  
W. H. ZINK, Coordinator  
Dam Inspection Program  
U.S.A.E.D., Philadelphia

**PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**

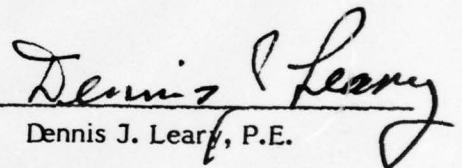
NAME OF DAM:	BASS LAKE DAM
ID NUMBER:	FED ID NO NJ00271
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	WARREN
STREAM:	BLAIRS CREEK TRIBUTARY TO PAULINS KILL
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	DECEMBER 1978 and JANUARY 1979

**ASSESSMENT OF GENERAL CONDITIONS**

Bass Lake Dam is in poor overall condition. There are leaks through the face of the dam and at the abutments. There is an old deteriorated dam within the present dam and the results of pressure grouting work done in 1970 is uncertain with respect to the extent to which zones of loose material within the dam have been grouted. The concrete has spalled and deteriorated. The closure operation of the low level 18 inch sluice gate is uncertain. The spillway capacity as determined by CE Screening criteria is seriously inadequate. We estimate the dam can adequately pass only 0.7% of the PMF.

We recommend the determination, by means of borings and tests of the engineering properties of the dam and foundation materials. This information should be used to determine the stability of the dam under different loading conditions and develop, if required, measures necessary to strengthen the dam. This should be done very soon. Make sluice gate for 18 in low level outlet functional. Repair spalled and deteriorated concrete and completely plug leaks through the dam. The above recommendations should be done soon.

The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done very soon. Operate sluice gates regularly, at least two times a year, to ensure their operational condition. This should be done regularly in the future.

  
Dennis J. Lear, P.E.



OVERVIEW  
BASS LAKE DAM

13 December 1978

**PHASE I INSPECTION REPORT**  
**NATIONAL DAM SAFETY PROGRAM**

<b>NAME OF DAM:</b>	<b>BASS LAKE DAM</b>
<b>ID NUMBER:</b>	<b>FED ID NO NJ00271</b>
<b>STATE LOCATED:</b>	<b>NEW JERSEY</b>
<b>COUNTY LOCATED:</b>	<b>WARREN</b>
<b>STREAM:</b>	<b>BLAIRS CREEK TRIBUTARY TO PAULINS KILL</b>
<b>RIVER BASIN:</b>	<b>DELAWARE</b>
<b>DATE OF INSPECTION:</b>	<b>DECEMBER 1978</b>



**LANGAN ENGINEERING ASSOCIATES, INC.**

**Consulting Civil Engineers**  
**990 CLIFTON AVENUE**  
**CLIFTON, NEW JERSEY**

**609 478 0366**

CONTENTS  
NATIONAL DAM SAFETY REPORT  
BASS LAKE DAM    FED ID NO NJ00271

	<u>PAGE</u>
PREFACE	
SECTION 1    PROJECT INFORMATION	
1.1 <u>General</u>	1
1.2 <u>Project Description</u>	1
1.3 <u>Pertinent Data</u>	4
SECTION 2    ENGINEERING DATA	
2.1 <u>Introduction</u>	6
2.2 <u>Regional Geology</u>	7
2.3 <u>Site Geology</u>	8
SECTION 3    VISUAL INSPECTION	8
SECTION 4    OPERATIONAL PROCEDURES	8
SECTION 5    HYDRAULIC/HYDROLOGIC	9
SECTION 6    STRUCTURAL STABILITY	9
SECTION 7    ASSESSMENT, RECOMMENDATIONS/ REMEDIAL MEASURES	
7.1 <u>Assessment</u>	10
7.2 <u>Recommendations/Remedial Measures</u>	10
FIGURES	
1.    Regional Vicinity Map	
2.    Essential Project Features	
3.    Regional Geologic Features	
APPENDICES	
1.    Log of Operation Bass Lake Dam Repairs	
2.    Check List, Visual Inspection	
3.    Photographs	
4.    Hydrologic Computations	
5.    References	

## PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. 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 continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide 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.

## SECTION I PROJECT INFORMATION

### 1.1 General

Authority to perform the Phase I Safety Inspection of Bass Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 20 November 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Bass Lake Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection report to imply that a dam meeting or failing to meet the screening criteria, is per se, certainly adequate or inadequate.

### 1.2 Project Description

Bass Lake Dam is a 68 year old 108-ft-long, 30-ft-high concrete arch dam. The arch has a rise from the chord of approximately ten to twelve feet. The upstream slope is vertical and the downstream slope is 1 hor to 10 vert at the top and 1 hor to 3.5 vert at the base. The dam is the result of modifications to the original dam that was constructed about 1911. The original dam is a mortared-stone faced rubble filled structure. This dam was faced and raised in the early 1930's. The depth of facing is approximately one foot and the top width of the dam is 5.2 ft.

There is a 21-ft-long overfall spillway notched at the crest of the dam about 26 feet from the left abutment. Two 3-in-thick stop logs exist on the upstream side of the spillway. They are hinged to the upstream face of the dam at the far ends and can be raised and lowered by chains at the close ends. There is a walkway along the crest with a bridge over the spillway. There are two sluice gates located at the base of the dam. The outlets are 12-in and 18-in-dia CI pipes. The operator stands are at the crest of the dam. A 4-in-dia pipe is located on the right downstream face at about mid-height of the dam. It is reported that a gate for this pipe exists on the upstream side and can be operated by lowering a rod down below the water surface.

The dam is located at the Princeton Summer Camp in Hardwick Township, Warren County, New Jersey. It is at north latitude  $41^{\circ} 1.4'$  and west longitude  $74^{\circ} 57.2'$ . A regional vicinity map is given in Fig 1 and essential features of the dam are given in Fig 2.

Bass Lake Dam is classified as being "Small" on the basis of its maximum reservoir storage volume of 325 acre feet, which is more than 50-acre feet, but less than 1000-acre feet. It is also classified as "Small" on the basis of its maximum height of 30 ft, which is less than 40 feet. Accordingly, the dam is classified as "Small" in size.

In the National Inventory of Dams, Bass Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection of the downstream area shows that breach of the dam would cause excessive damage to low-lying residences located about 2000 feet downstream and would be hazardous to the lives of the residents. Therefore, it is proposed not to change the Hazard Classification.

Bass Lake Dam is owned by Princeton Education Center at Blairstown, 5 Ivy Lane, Princeton University, Princeton, New Jersey 08540, Mr. John G. Danielson is the Executive Director of the Center.

The purpose of the dam is recreation.

There is essentially no information concerning the original dam which is reported to have been constructed about 1911. Design and construction for the modifications to the original dam in 1930 were made by the White Construction Co., Inc. 95 Madison Avenue, New York City. In July 1968, an inspection was made and seepage was observed at six locations in the downstream face.

The State requested Princeton University to make repairs at two of the locations where seepage was evident on the downstream face. Two holes were drilled adjacent to these points by the McMill Drilling Company of Netcong, New Jersey, and both holes were grouted on October 14, 1969. The locations were to the west of the spillway; the first being about six feet west of the spillway and the second being about fifteen feet further west. The first hole "took" 9.25 cubic feet of grout before refusal. The second hole took 2.00 cubic feet of grout. Both holes were filled with a grout having a mix ratio of 2 parts water to 1 part cement by volume and the pumping pressure was 25 psi.

Drilling of the first hole was easy after a penetration of approximately two inches. The depth of this hole was 22 inches. The initial grouting of the hole did seal the seepage but the seepage has started again and at a greater rate than was evident previously. The second hole was drilled thru nine inches of weak, porous concrete and that the remaining fourteen inches was quite hard indicating, perhaps, a boulder that may have been used in the construction of the dam. The initial grouting did not stop the seepage at this location and a second attempt was made on December 15. A third hole was made just below the second hole. The drilling was relatively hard and no water was struck. A

fourth hole was drilled above the second hole and a steady stream of water flowed after a depth of approximately 15 inches was reached. The first twelve inches was relatively hard concrete and the next six inches was soft (easy drilling). A grout connection was made to this fourth hole and 7.50 cubic feet of grout was taken before refusal at 25 psi. This did not seal the seepage from the second area.

The experience gained with the operation described above plus conversations of the owner's engineer with some of the older local people indicated that further investigative procedures were necessary before this seepage problem could be corrected. The conversations established that there was a dam constructed at this location about 1913 (State record indicates original dam was built in 1911) by a contractor who built many of the concrete bridges for Warren County. Due to poor quality concrete, a lack of reinforcing, and obsolescence of all, these bridges have been replaced. The last of these in the early 1950's. This dam was extended and re-faced about 1931.

On approximately 1 May 1970 authorization was given to proceed with obtaining the core sample.

The core sample obtained verified that there are two structures and that the original dam was extended by a height of 24 inches. Cooling water was lost at the juncture indicating an extensive void. It appeared that an attempt was made to obtain a seal between the original dam and the extension by a layer of asphalt and that this was ineffective. The remainder of the concrete was soft and was drilled rather easily where the concrete bond was able to be maintained. Most of the drilling, however, broke any bonding between the aggregate, and core recovery was very poor. The aggregate recovered has little evidence of cement in many areas as if the original dam was constructed in layers of wet concrete and loose aggregate. The aggregate recovered was not graded and sections were recovered as long as six inches and as small as one quarter inch. The owner's Engineer, Robert M. Cooke & Associate, believed that the loose aggregate and porous concrete seemed to lend itself to the construction techniques developed by Intrusion-Prepakt Incorporated.

A cement pressure grouting program consisting of 20 to 25 vertical grout holes at the top of the dam was developed by the Engineer, and the work was done by Intrusion-Prepakt between 6 October and 20 October 1970. A storm producing about 4 inches of rain was reported to have occurred from 21 to 22 October 1970. The 12 inch and 18 inch pipes were inadequate to carry incoming flow and the lake was filled on October 23rd before the grouted structure had a chance to cure. In a letter to the N.J. DEP dated 10 March 1971, the owner's Engineer stated that seepage through the dam had been reduced to about 25% of its former value. He also gave the following observations and opinions:

"During the period immediately after the October 21, 1970 storm there was no leakage apparent on the downstream face of the dam until after the water reached the spillway height. Therefore, it is my opinion that the water leakage that still exists is entering the dam between its original structure and the new top. This probably is coming in thru the ends of the dam adjacent to the tar layer. I do not believe this leakage will affect the structural integrity of this dam and, since the dam held when it was full of wet grout, it is my opinion that there is no danger to downstream landowners concerning this structure."

In late 1970 and early 1971, the floor stands and sluice gates for the 12-in and 18-in gates were rebuilt and new debris cages and flood control gates were installed.

Normal operating procedures consist of daily surveillance of the dam by the camp superintendent and the lowering of the stop logs in winter to prevent ice build-up and raising of the stop logs in the summer to increase the level of the lake for recreation.

### 1.3 Pertinent Data

#### a. Drainage Areas

At dam site, the drainage area is 5.9 sq mi

Area of Lake is 15 acres

#### b. Discharge at Dam Site

Maximum known flood at dam site:

Reported overflowed 6-in due to rains on about 29 May 1968.

Ungated spillway capacity at maximum pool elevation:

63 cfs (existing condition - flashboard in full top position)

Total spillway capacity at maximum pool elevation:

63 cfs (existing condition - flashboard in full top position)

#### c. Elevation \*

Top dam:

El. 101.1

Normal pool:

El. 100.1

\* All elevations are referenced to a benchmark elevation of 101.00 on the southeast corner of the dam (see Fig 2.).

Spillway crest:	El. 100.1 (top of flashboard) El. 99.1 (crest of concrete weir)
Streambed at centerline of dam:	Approx. El. 71
Maximum tailwater:	Approx. El. 73 at time of inspection
d. Reservoir	
Length of Maximum pool:	Approx. 2110 feet
Length of normal pool:	Approx. 2100 feet
e. Storage (acre-feet)	
Normal pool:	310 AF
Top of dam:	325 AF
f. Reservoir Surface (acres)	
Top dam:	15.4 Ac.
Recreation pool:	15 Ac.
Spillway crest:	15 Ac.
g. Dam	
Type:	Concrete Arch Gravity
Length:	Approx. 108 feet (arc length)
Height:	Approx. 30 feet
Top width:	5.2 feet $\pm$
Side Slopes:	D/S 1 hor 10 vert. at top 1 hor 3.5 vert at base U/S vertical
Zoning:	None observed - existing dam is reported to cover old dam
Impervious core:	None observed
Cutoff:	None observed
Grout curtain:	None observed

h. Spillway

Type: Overfall notch in crest of dam with flashboards hinged at two ends

Length of weir: 21 ft

Crest elevation: El. 100.1 (flashboard crest)

U/S channel: None observed

D/S channel:

i. Regulating Outlets

Type: Sluice gates for 12 in and 18-in-dia CI pipe

Length: Approx. 25 ft each

Closure: Gate valves with operators at crest of dam

Access: Walkway on crest of dam

## SECTION 2 ENGINEERING DATA

### 2.1 Introduction

There are no essential engineering, construction, or operation data available.

The most significant data is the "Log of Operations Bass Lake Dam Repairs". This log gives the observations of the Engineer, Mr. Robert M. Cooke, during grouting of the dam in 1970. The Log indicates loose zone within the dam, break-out of grout from the face of the dam, tar recovered from drill holes, and little or no grout take in many of the grout holes. At the conclusion of the work 3 to 5 inches of rain occurred and Mr. Cooke estimated 25% of grout work was destroyed because the areas on the downstream face of the dam which were grouted in 1969 started leaking and progressed to a rate nearly as bad as when the grouting project started. A copy of the Log is given in Appendix 1.

## 2.2 Regional Geology

Bass Lake Dam is located in the Valley and Ridge Province. This province encompasses one-twelfth of the land area of the State - chiefly in Warren and Sussex Counties. It is characterized by a series of nearly parallel ridges and valleys that trend northeast-southwest. The ridges are underlain with northwest dipping Silurian and Devonian sandstones and conglomerates. The upper Delaware Valley is underlain with weak Devonian limestones and shales while the Kittatinny Valley is underlain with folded Cambrian and Ordovician limestones and shales. Kittatinny Mountain is the most prominent topographic feature and its nearly even crest averages 1600 to 1800 feet in elevation.

The Valley and Ridge Province is divided into western, middle, and eastern sections that include the Upper Delaware Valley, Kittatinny Mountain, and Kittatinny Valley. The Upper Delaware Valley encompasses the region west of Kittatinny Mountain that has been eroded in Devonian limestones and shales. Kittatinny Mountain makes up the middle section of the Province and forms the eastern border of the Upper Delaware Valley and the northwestern border of Kittatinny Valley. The ridge is underlain with the very resistant lower Silurian Shawangunk conglomerate and High Falls sandstone. The northeastern side is bordered by the escarpments of the Shawangunk conglomerate, which rise steeply from the Kittatinny Valley floor. The Shawangunk conglomerate has been extensively broken up into large rock fragments by mechanical weathering and frost action and forms mass wasted talus slopes along the ramparts of the eastern escarpment. These talus slopes are extensively developed in the Delaware Water Gap.

The Kittatinny Valley area is a broad northeast-southwest lowland where the Harrisburg Peneplain is well developed. The valley is 10 to 13 miles wide and lies between the New Jersey Highlands on the east and Kittatinny Mountain on the west. The Wisconsin ice sheet covered all of the Valley and Ridge Province and deposited a terminal moraine south of the province near Belvidere. Much of the land surface north of the terminal moraine consists of a thin sheet of glacial till and ice-scoured bedrock surfaces. In addition, fluvial deposits of stratified drift consisting of eskers, kames, kame terraces, and deltas mantle many of the areas of the valley bottoms. Discontinuous recessional moraines were deposited during stillstands in the ice retreat. These moraines now form a discontinuous low band of hills across nearly all of Sussex County.

Glacial till covers large areas of the Valley and Ridge Province. Generally the till is extremely thin and sometimes present only in patches or as scattered boulders. It is best developed on broad summits, interstream surfaces, and in low passes or cols, and is thinnest or absent on steep slopes, on narrow ridges, and in narrow valleys. The greatest thickness of the till in the Kittatinny Valley is over 100 feet just on the edge of the valley at Ogdensburg. Estimates of the thickness range from 8 to 10 feet along the west slope of Kittatinny Mountain; 2 to 3 feet along the crest of Kittatinny Mountain; 5 to 10 feet on the limestone belts of Kittatinny Valley; 8 to 12 feet on the shale belts of Kittatinny Valley; and from 5 to 20 feet in Vernon Valley. The composition of till is largely of local origin and reflects the character of the underlying rock. It is generally compact because of the high clay content derived from the weathered shales and has many resistant boulders of Shawangunk conglomerate as well as erratics derived from more distant sources.

### 2.3 Site Geology

The Dam is located between the faces of a rock gorge at its narrowest point. The rock is reported to be Kittatinny limestone. It is fractured with leakage occurring at both abutments.

## SECTION 3 VISUAL INSPECTION

Bass Lake Dam appears to be in poor overall condition. The flashboards were raised to almost the full top position at the time of inspection. Water was flowing over the spillway with about 6 inch head. The Camp Superintendent informed us that the dam overtopped about 4 to 5 inches during the storm on the night before our January 9, 1979 visit. The downstream concrete surface has spalled and deterioration has occurred at the top and downstream face of the dam. Leakage (seepage frozen at the time of inspection) was observed at three locations on the downstream face of the dam and at the structure abutment junctions.

The gates for the 12-inch and 18-inch outlet pipes, which are located at the base of the upstream side of the dam, are operated by two control stems which extend up to the top of the dam. All gates were known to be closed at the time of our inspection. Yet, a small quantity of water was observed discharging from the 12-inch-dia pipe. The superintendent did not know whether or not the gates could be closed once they were opened, consequently, they were not operated. The concrete headwall for the two outlet pipes has deteriorated badly. Concrete support for the gate operators has cracked.

There is a 4-inch-dia pipe that locates on the right downstream face at about mid-height of the dam. No gate control was observed above the lake water. According to the Superintendent, the gate can be operated by lowering a rod down below the water where he reported there is a gate. However, the pipe is very rarely used.

The side slopes of the lake are generally flat except the area in the vicinity of the dam where the slopes are about 1 hor to 1 vert. There are no signs of unstable slopes in the lake. There are beaver dams upstream of the inlet stream to the reservoir.

A few fallen trees and leaves partially obstruct the downstream channel. The side slopes are relatively steep (1H to 1V) but appeared satisfactory.

## SECTION 4 OPERATIONAL PROCEDURES

There are no formal operating procedures for the operation and maintenance of the facilities at Bass Lake Dam. The Superintendent, Mr. H. Watters is responsible for the operation of the dam. Stop logs are lowered during the winter to prevent ice build-up and they are raised to top position during the summer to increase the level of the lake for recreation. At times of

heavy rain, Mr. Watters opens the 12 inch gate valve to release water from the Lake. The 18 inch gate valve is not used. The 4 inch valve is reported to have been used during dam construction and is no longer used.

Maintenance of the dam is performed as necessary on the basis of Mr. Watters' observations of the dam and facilities. There is no warning system in effect.

## SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a Spillway Design Flood (SDF) equal to the half Probable Maximum Flood (1/2 PMF) chosen in accordance with the evaluation guidelines for dams classified as High Hazard and Small in size. Hydrologic design data for this dam is not available. The PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 22.2 inches (200 square mile - 24 hour). Hydrologic computations are presented in Appendix 4. The 1/2 PMF peak inflow determined for the subject watershed is 5,997 cfs.

The capacity of the spillway at maximum pool elevation (El. 101.1) is 63 cfs which is significantly less than SDF.

Flood routing for the 1/2 PMF indicates the dam will overtop by approximately 6.5 ft. We estimate the dam can adequately pass only 0.7% of the PMF.

The downstream potential damage centers are two low-lying residential dwellings about 1/2 mile from the dam and a few scattered homes along the channel about a mile and further downstream. Based on our visual inspection of the immediate downstream topography and the overall condition of the dam, and our knowledge of the degree of overtopping potential, it is our opinion that dam failure resulting from overtopping would significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure.

Drawdown of the reservoir has been evaluated considering that the 12 inch and 18-inch-dia CI pipe is functioning properly and is utilized for lowering the lake. Our calculations indicate that the lake level could be lowered 25 feet from the crest of the flashboard in about 5 days.

## SECTION 6 STRUCTURAL STABILITY

Our visual observations indicate the dam is without major distortions, or misalignments that would be considered as evidence of instability. There is no essential design or construction data available that would permit evaluation of the stability of the dam. There are no available operating records.

The most revealing information concerning the stability of the dam are the records related to the 1930 modification of the original dam and to the 1970 repair of the existing dam. This information has been included in Subsection 1.2 and Appendix I.

The existence of an old deteriorated structure within the present dam and the leaks through the face of the dam and at the abutments, and loose zones within the dam that may not have been satisfactorily grouted in 1970 lead us to the conclusion that the dam is marginally stable and unlikely to withstand the stresses imposed by an extreme flood. It is our opinion the dam is likely to be unstable under earthquake loading.

## SECTION 7 ASSESSMENT RECOMMENDATIONS/REMEDIAL MEASURES

### 7.1 Assessment

Bass Lake dam is in poor overall condition. There are leaks through the face of the dam and at the abutments. There is an old deteriorated dam within the present dam and the results of pressure grouting work done in 1970 is uncertain with respect to the extent to which zones of loose material within the dam have been grouted. The concrete has spalled and deteriorated. The closure operation of the low level 18 inch sluice gate is uncertain.

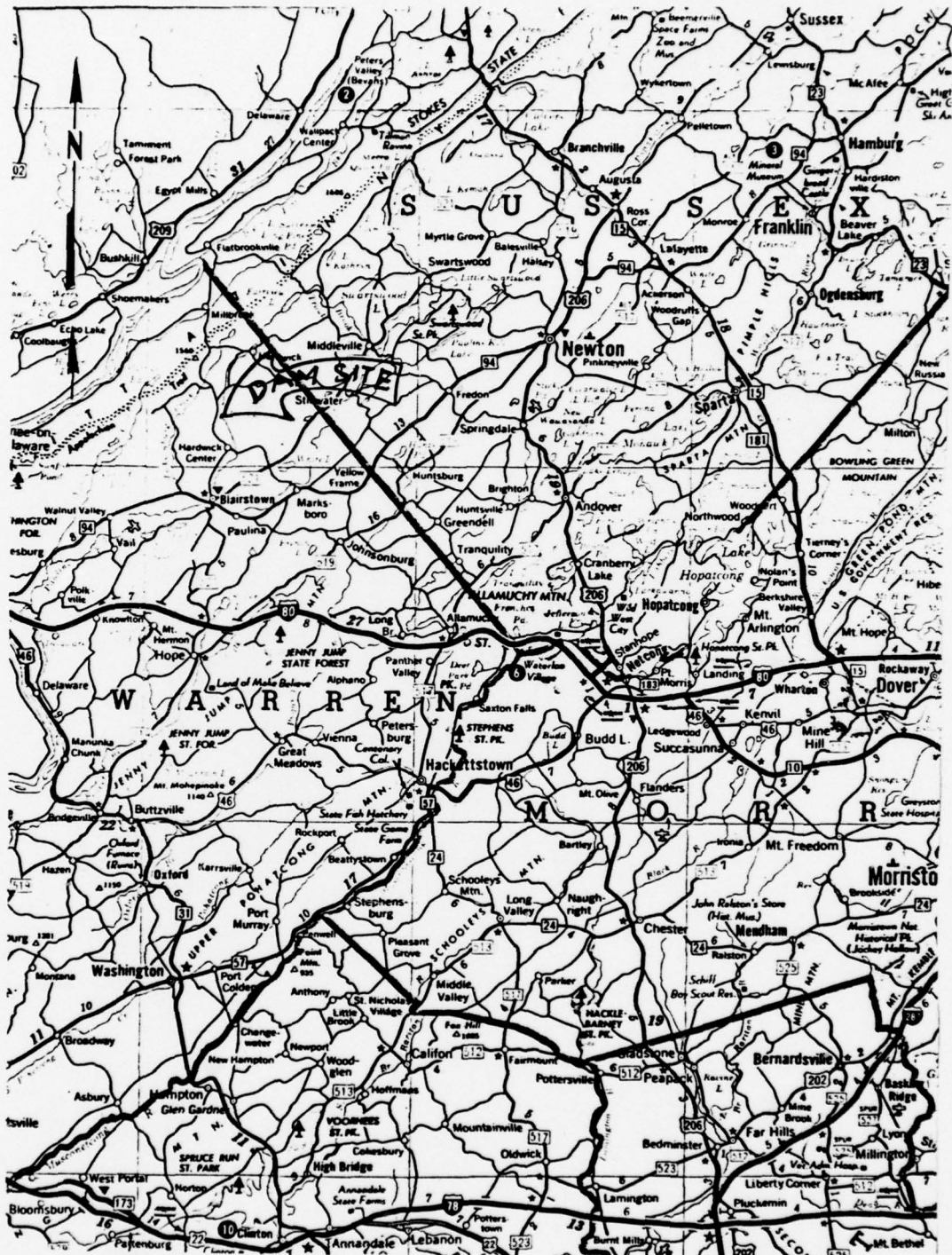
The spillway capacity as determined by CE screening criteria is seriously inadequate. We estimate the dam can adequately pass only 0.7% of the PMF.

### 7.2 Recommendations/Remedial Measures

We recommend the following remedial measures:

1. Determine by means of borings and tests the engineering properties of the dam and foundation materials. This information should be used to determine the stability of the dam under different loading conditions and develop, if required, measures necessary to strengthen the dam. This should be done very soon.
2. Make sluice gate for 18 inch low level outlet functional. This should be done soon.
3. Repair spalled and deteriorated concrete and completely plug leaks through the dam. This should be done soon.

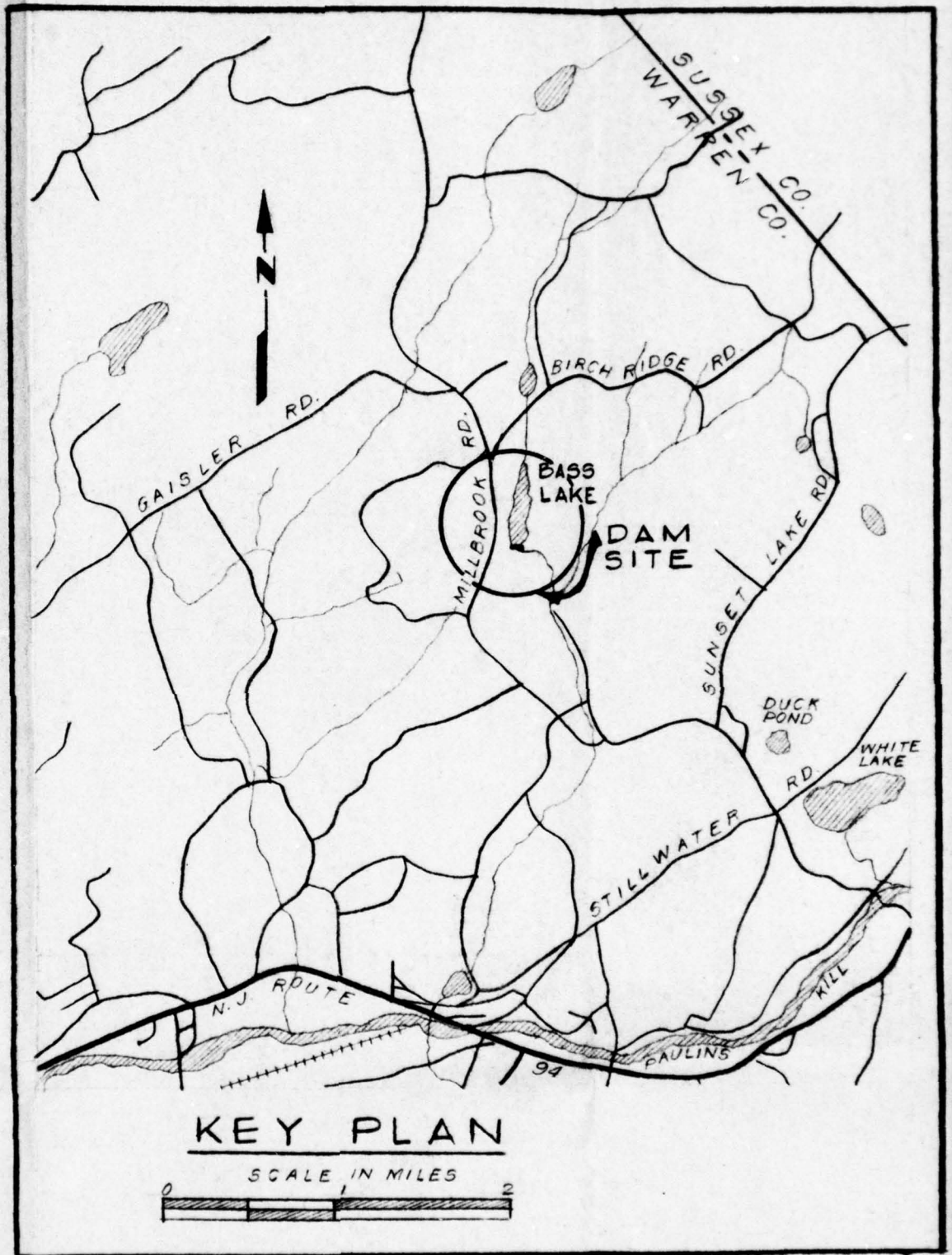
4. The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done very soon.
5. Operate sluice gates regularly, at least two times a year, to ensure their operational condition. This should be done regularly in the future.



1 in.  $\approx$  5.2 mi

REGIONAL VICINITY MAP  
BASS LAKE DAM

Fig. 1

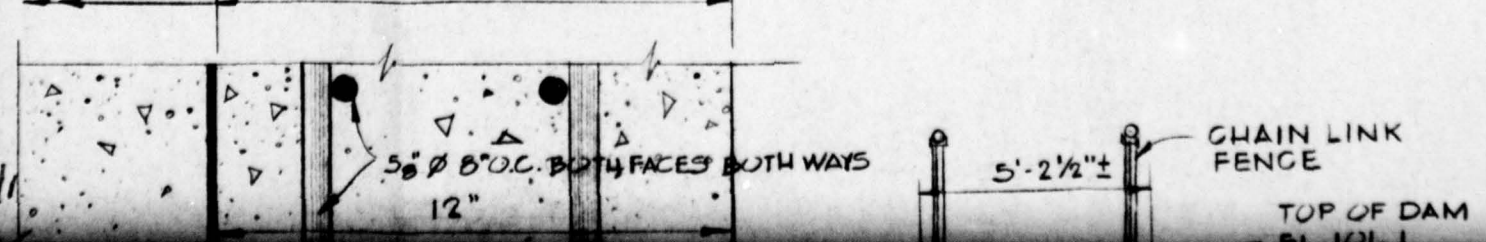


**KEY PLAN**

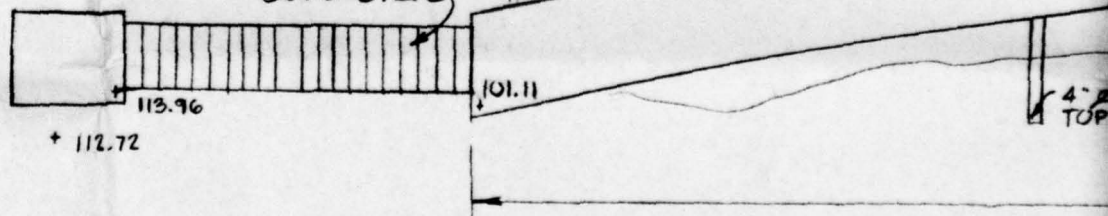
SCALE IN MILES



OLD DAM (1911)      FACING OF DAM DONE IN 1930



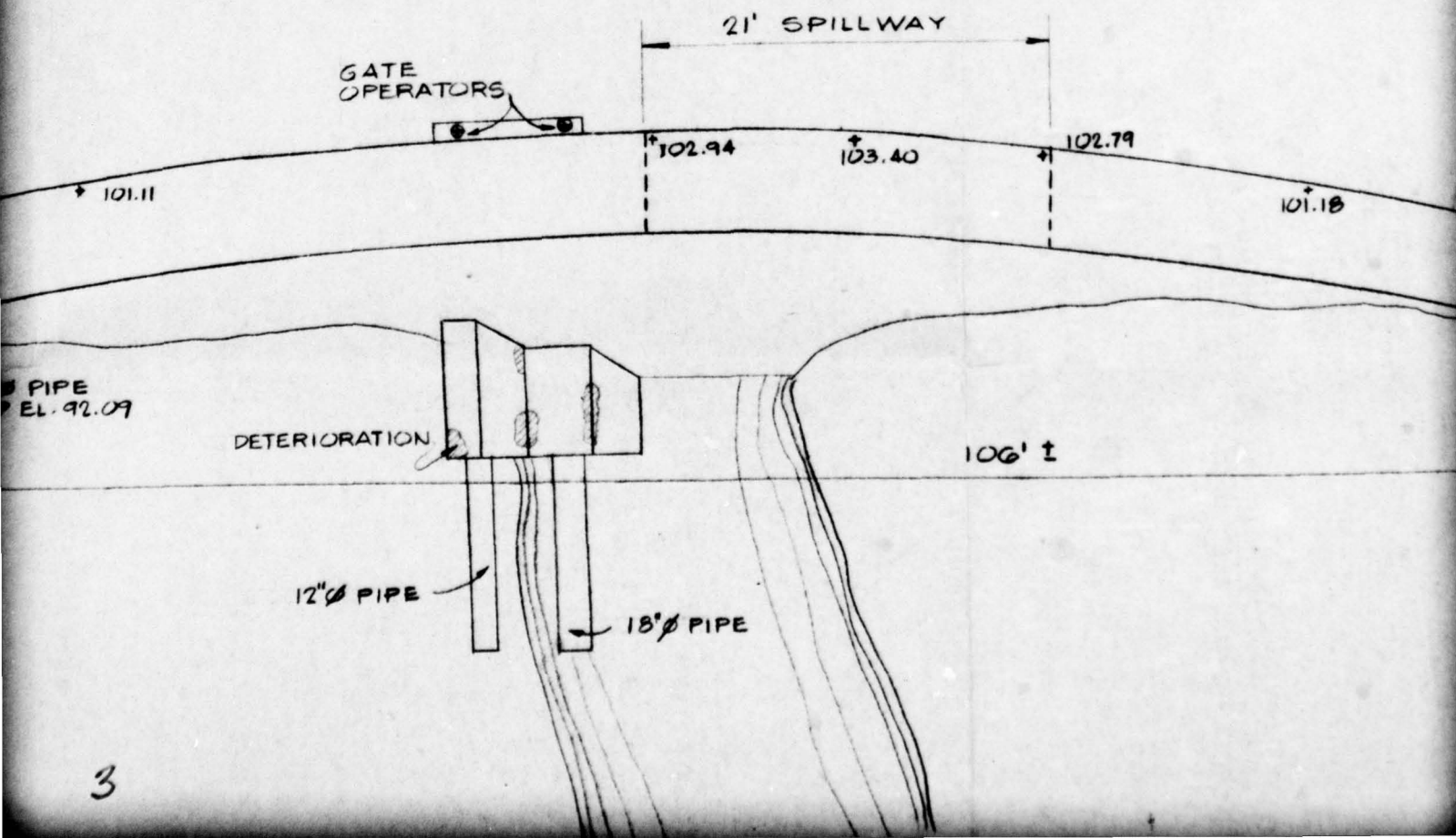
+ 117.91

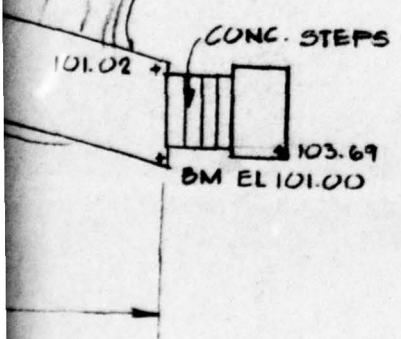
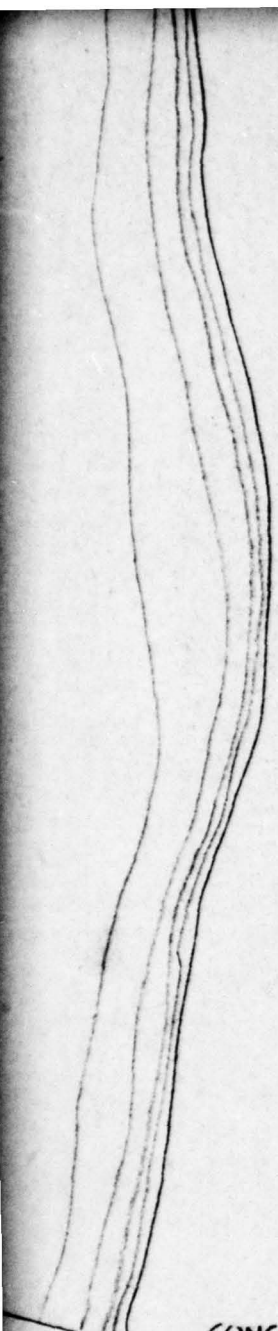


2

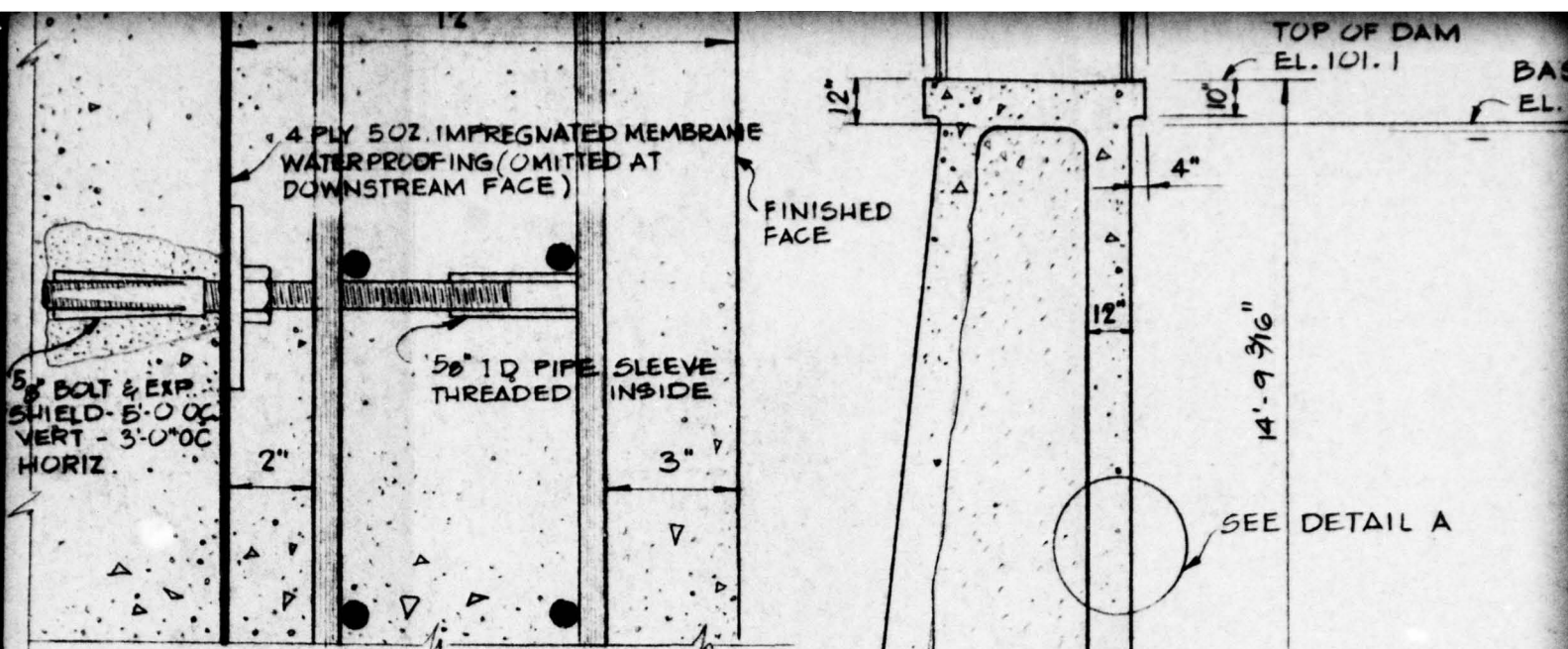
# BASS LAKE

EL. 100.20



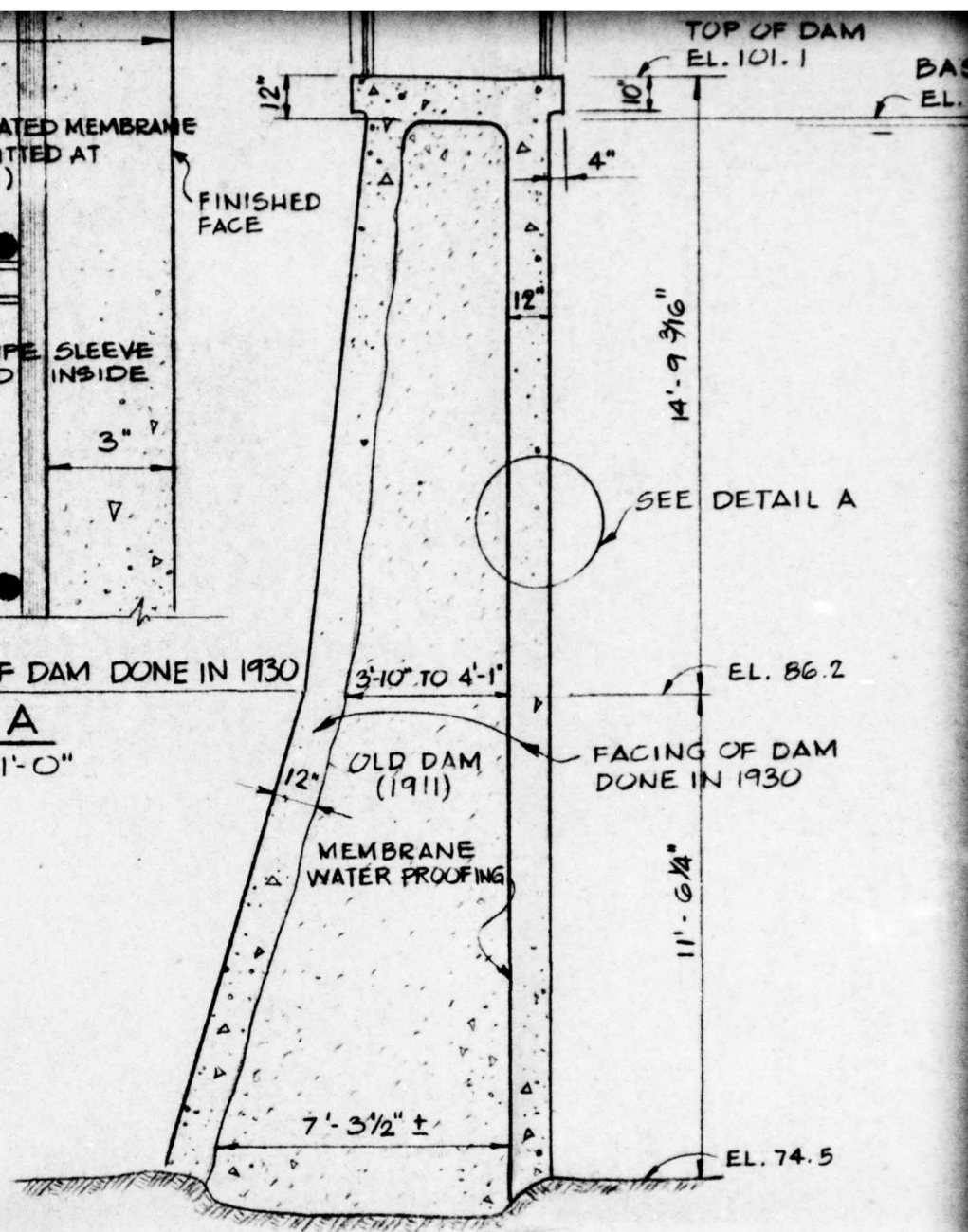


+ 109.03



TYPICAL DETAIL FOR FACING OF DAM DONE IN 1930

**DETAIL A**  
SCALE: 3" = 1'-0"

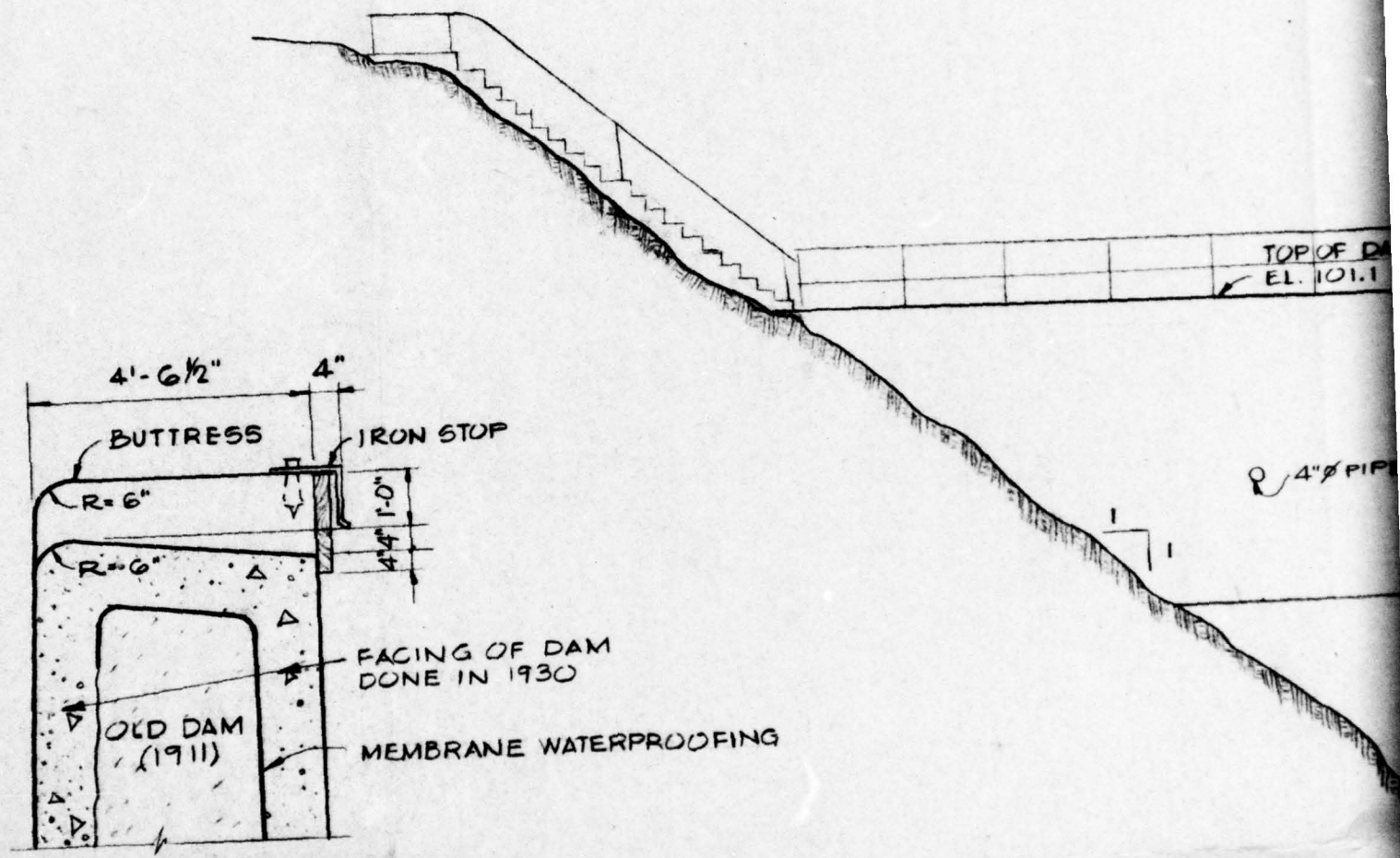


**SECTION A-A**  
SCALE: 1/4" = 1'-0"

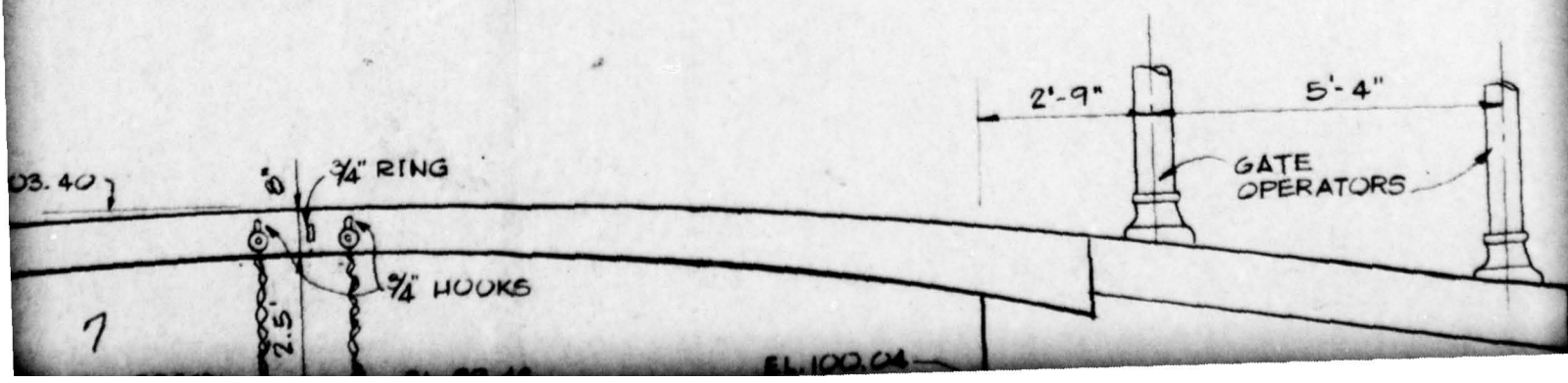
EL. 100.02

60

EL. 100.02

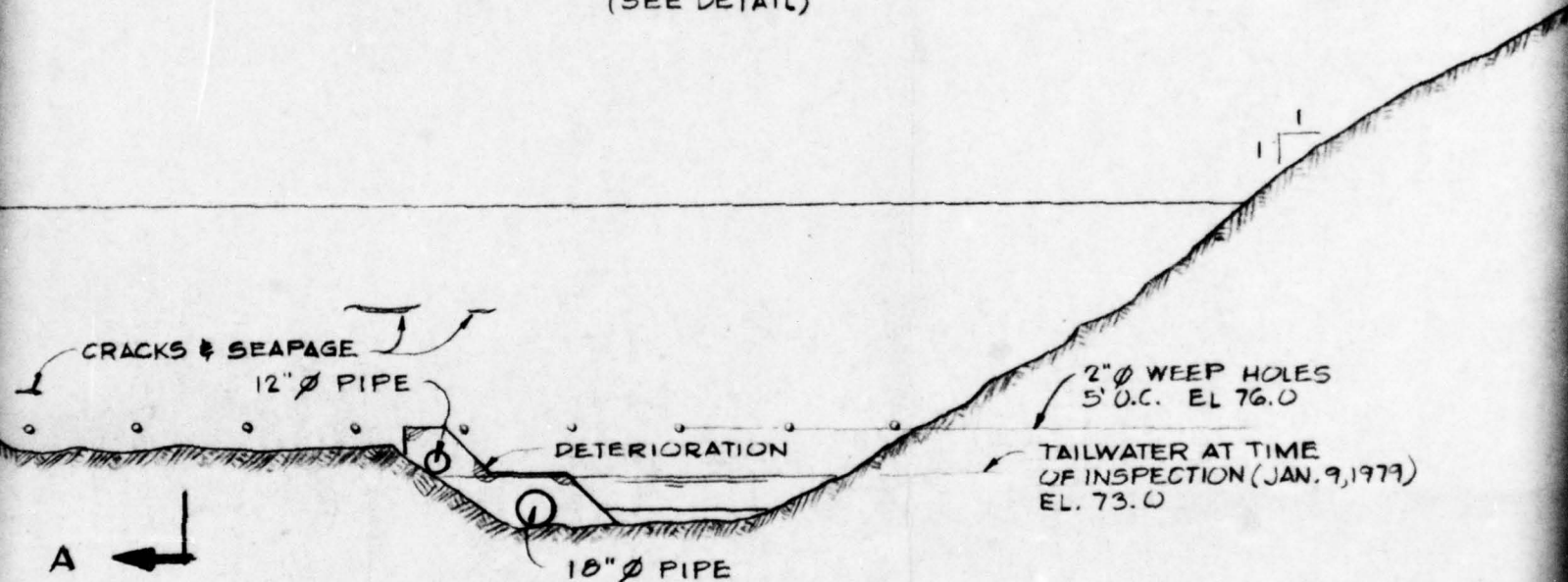
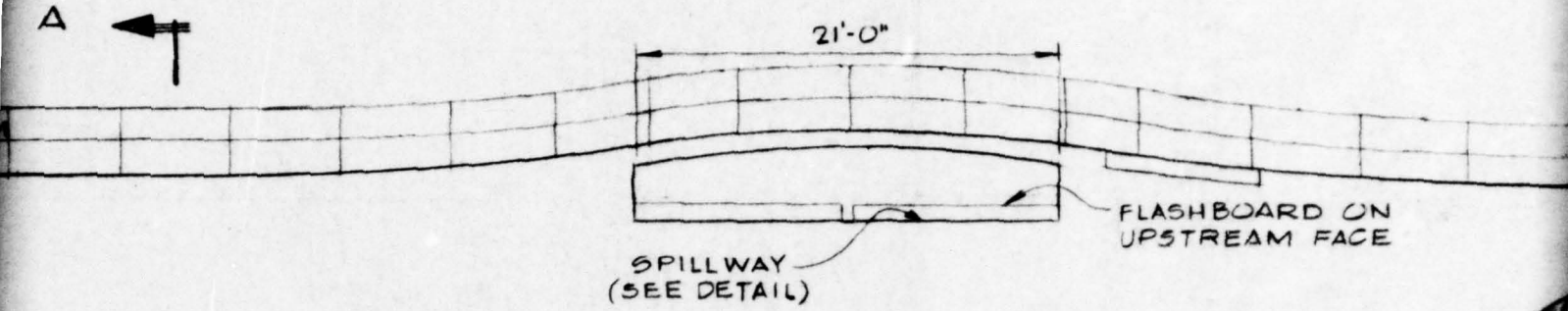


SECTION @ SPILLWAY  
SCALE : 3/8" = 1'-0"

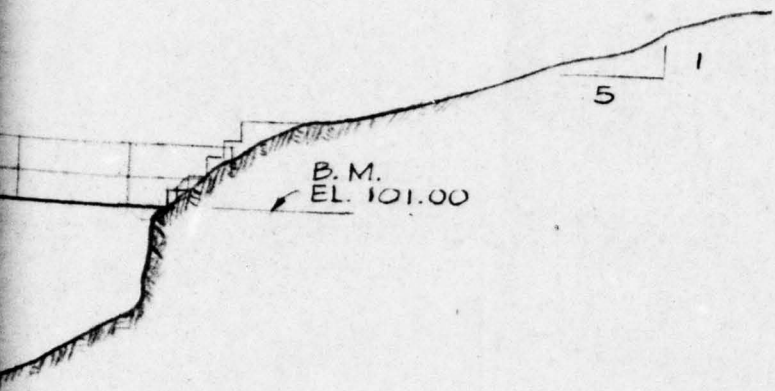


PLAN  
SCALE:  $\frac{1}{8}'' = 1'-0''$

A ←



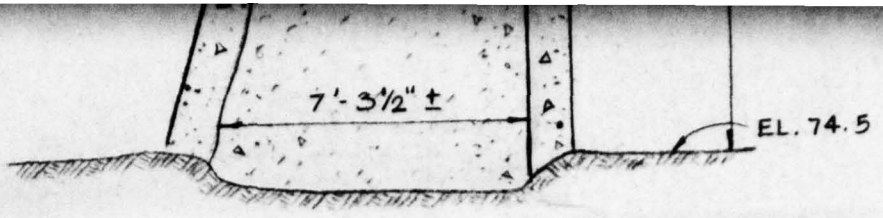
ELEVATION  
SCALE:  $\frac{1}{8}'' = 1'-0''$



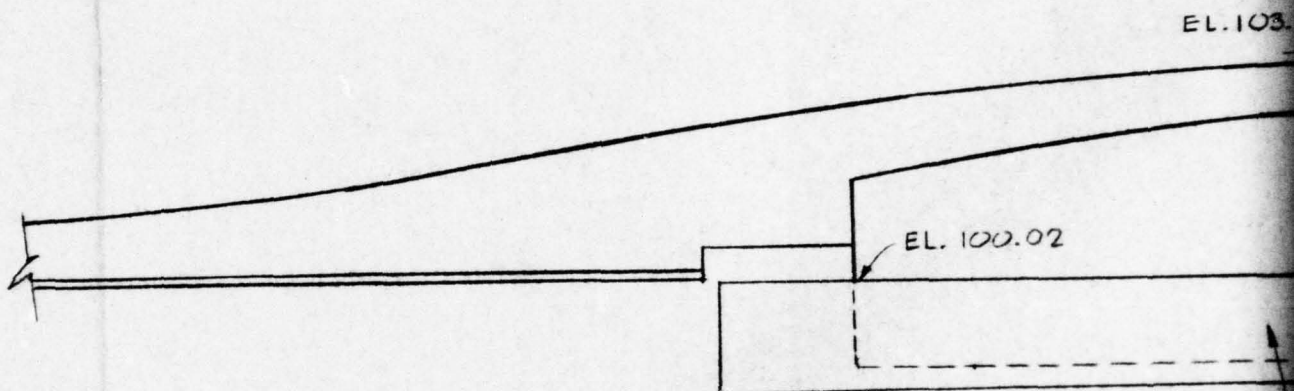
B.M.  
EL. 101.00

5

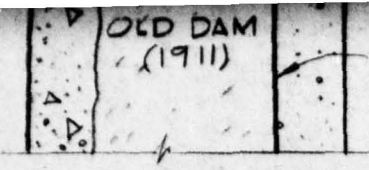
1



SECTION A-A  
SCALE:  $\frac{1}{4}'' = 1'-0''$



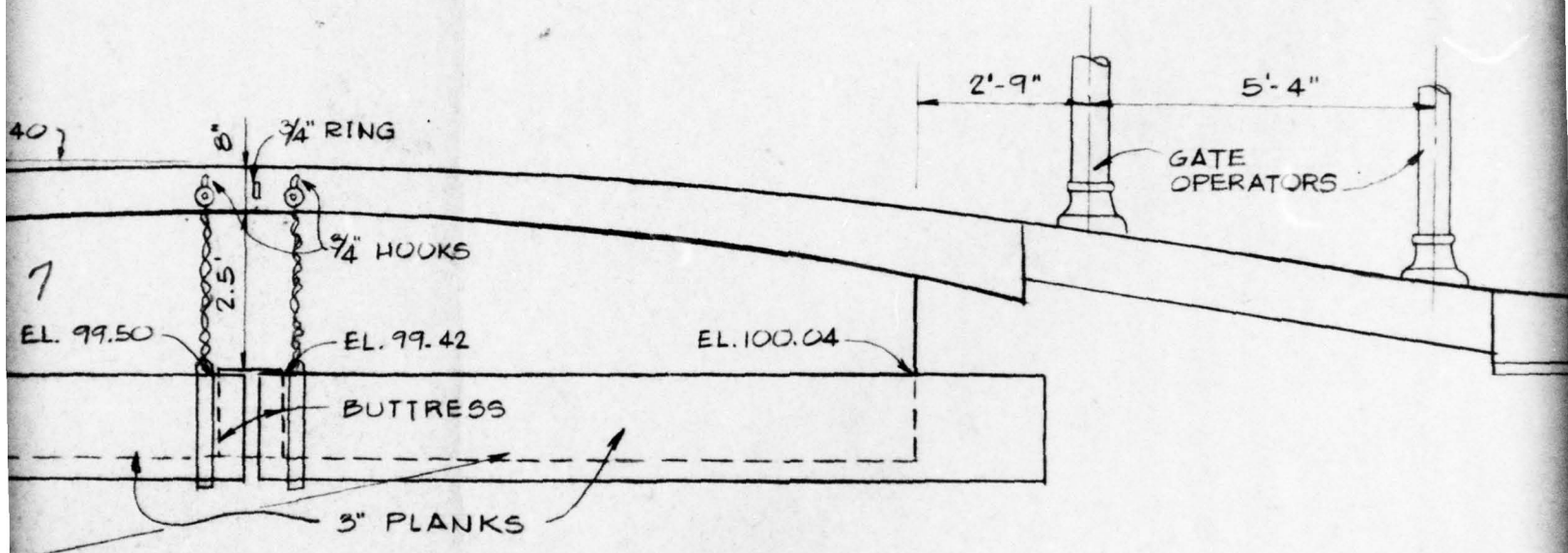
BAFFLE BOARDS RAISED AND  
LOWERED BY CHAINS OPERATED  
FROM BRIDGE



MEMBRANE WATERPROOFING

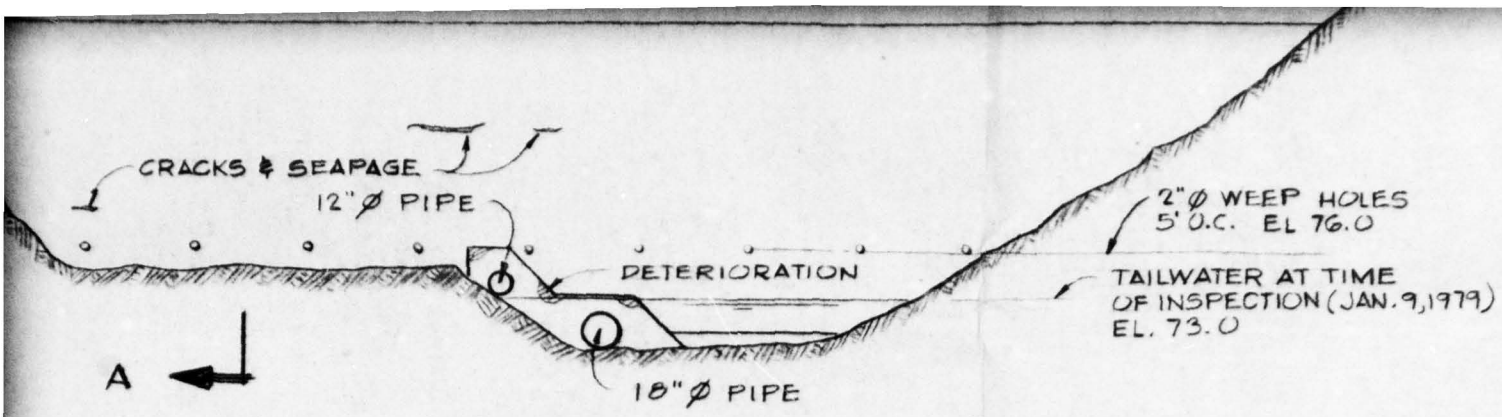
SECTION @ SPILLWAY

SCALE :  $\frac{3}{8}'' = 1'-0''$



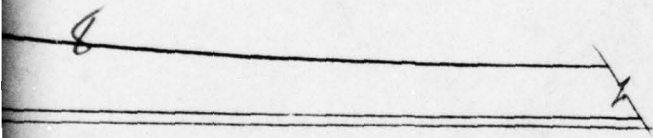
SPILLWAY DETAIL (LOOKING DOWNSTREAM)

SCALE :  $\frac{3}{8}'' = 1'-0''$



ELEVATION

SCALE:  $\frac{1}{8}$ " = 1'-0"



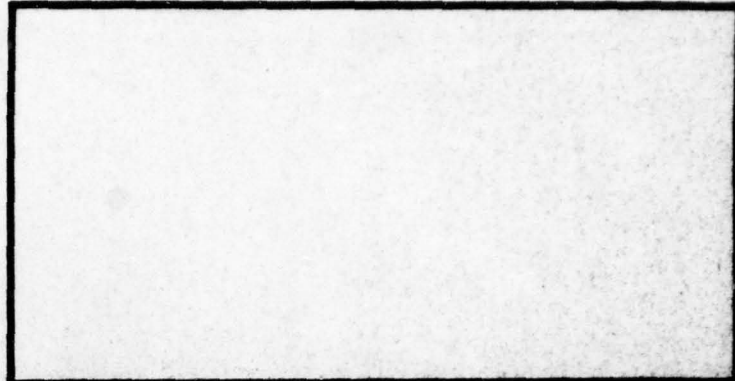
9.

10.

NOTE:

THE ELEVATIONS SHOWN WERE OBTAINED USING A SURVEYOR'S TRANSIT AND LEVEL. THE BENCHMARK ELEVATION OF 101.00 ON THE SOUTHEAST CORNER OF THE DAM WAS USED AS WAS INDICATED ON THE DRAWINGS ENTITLED "THE PHILADELPHIAN SOCIETY OF NASSAU HALL, BASS LAKE DAM, PRINCETON SUMMER CAMP BLAIRSTOWN, N. J. REVISION DATES 8-30 CONTRACT # 730. THESE ELEVATIONS ARE APPROXIMATE. INFORMATION SHOWN BELOW GROUND SURFACE AND WATER LEVEL ARE INFERRED ON THE BASIS OF THE ABOVE MENTIONED DWGS.

DATE	DESCRIPTION	NO.
REVISIONS		



LANGAN ENGINEERING ASSOCIATES, INC.

100 Clifton Avenue, Clifton, New Jersey 07011  
(201) 473-9300

WERE OBTAINED USING A SURVEYOR'S  
BENCHMARK ELEVATION OF 101.00 ON THE  
DAM WAS USED AS WAS INDICATED ON  
THE PHILADELPHIAN SOCIETY OF NASSAU  
ON SUMMER CAMP BLAIRSTOWN, N.J.  
ACT # 730. THESE ELEVATIONS ARE  
SHOWN BELOW GROUND SURFACE  
CORRECTED ON THE BASIS OF THE ABOVE

PROJECT

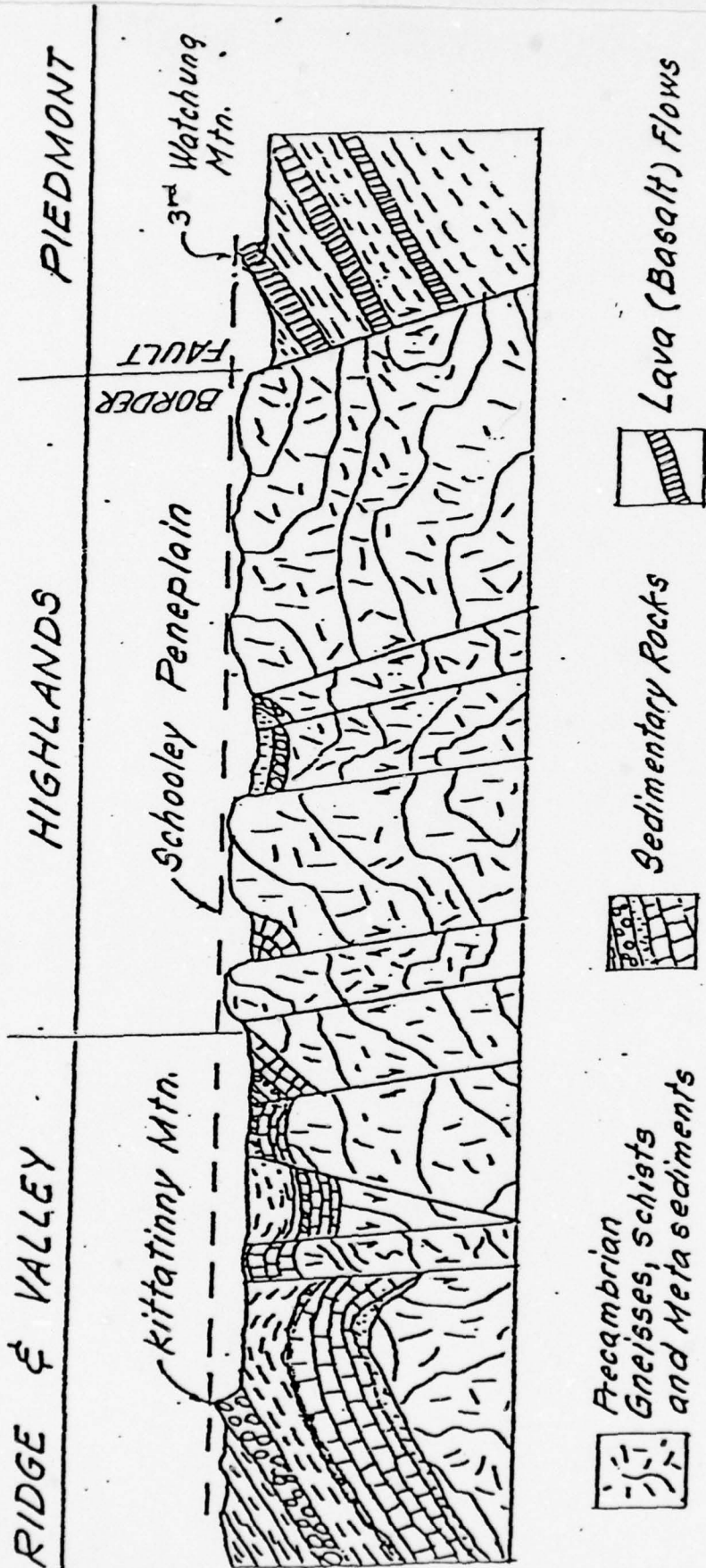
**PHASE I**  
INSPECTION & EVALUATION  
OF  
NEW JERSEY DAMS

DRAWING TITLE

**BASS LAKE DAM**  
FEBRUARY 1979  
FED. I.D. NO. NJ 00271

JOB NO. J-783 B	<b>FIG. 2</b>
DATE 20 FEB 1979	
SCALE AS NOTED	
DRN. BY J. R.	
CHKD. BY D. J. L.	

15



Schematic Cross-section of  
Ridge & Valley  
Physiographic Province  
(After Wolfe, 1977)

REGIONAL GEOLOGIC FEATURES  
Fig. 3

**APPENDIX 1**

**LOG OF OPERATION**

**BASS LAKE DAM REPAIRS**

**BASS LAKE DAM**



ROBERT M. COOKE & ASSOCIATES  
CONSULTING ENGINEERS  
202 HIGH STREET HOPE, NEW JERSEY 07844

TELEPHONE  
(201) 459-4455

## LOG OF OPERATIONS

### BASS LAKE DAM REPAIRS

- Tuesday, September 22 - Met Mr. Watters at 1:00 P.M. Walked downstream, inspected stream bed and met with Mr. George Van Tassle, a downstream property owner who was very concerned about the release of water from the dam. Mr. Van Tassle has illegally dammed the stream (Blair Creek) on Princeton Camp property to cause the water to flow into his property which contains a small lake and a swimming pool. This dam is formed of stones and debris and restricts the water from flowing down the western side of a large rock outcropping. The redirected water flows down the south side of this outcropping which is apparently the natural overflow for Blair Creek during times of high water flow. Mr. Van Tassle requested that we divert the water from his property to prevent excess silting, etc. of his lake and swimming pool. He seems to have the impression that very large quantities of water will be flowing. There seems to be little sense in arguing that the amount of water flowing from both pipes will be considerably less than that which normally runs over the stop logs since the fourteen inch valve is broken and cannot be raised. Mr. Watters and myself removed the dam and placed the stones in the southerly stream bed resulting in a major decrease in this portion of the stream. Mr. Van Tassle appeared to be satisfied with this approach and it was decided to lower the stop logs to approximate the flow of a twelve inch pipe.
- Wednesday, September 23 Went to Bass Lake in the company of Mr. Robert Burns, the Conservation Officer. Lowered the stop logs as previously agreed at approx. 1:30 P.M. Then proceeded to the Van Tassle property to determine effectiveness of water diversions. Some water flowing into Van Tassle lake. Burns, Watters and myself reinforced and raised dam but additional work with hand tools will be required. Mr. Watters indicated he would take hand tools and do this work on Thursday morning.
- Thursday, September 24 Went to the diversion dam at approximately 3:30 P.M. with my son to check the effectiveness of the work by Mr. Watters. The diversion now seems to be adequate. Went up to Bass Lake to check the water level. Very little water flowing over stop logs.

Lake has been lowered about ten inches. Lowered stop logs all the way with Mr. Watters in attendance. Water flow maintained at about the same as the previous time.

Went to Bass Lake at 10:30 A.M. to check water level. Very little water flowing. Lowered stop logs to re-establish the approximate flow of a twelve inch pipe.

Monday, September 28

The level of the lake is down about eight feet. Most of the lake bottom to the north of the swimming area is visible. Discovered two boats, one just north of swimming dock and one on a bank across from the diving board. Relatively little debris on lake bottom.

Tuesday, September 29

At noon the level of the lake is down about fifteen feet. About ten more feet to bottom. With seven foot fall in last 24 hours, this should put lake level at about three feet on Wednesday evening. Called R. Burns. Cannot get State Fisheries to be at site until Thursday A. M. Requested Harold Watters to restrict flow. Closed twelve inch valve to about half open. Operating mechanism badly corroded and bending and cannot close valve further. Doubt if we can reclose to this point after we re-open it. We must be fast if we expect to salvage fish.

Wednesday, September 30

Lake level now down to eighteen feet (approx. seven feet left and three foot loss in last 24 hours) at noon. Another attempt to close the valve further results only in more bending of the operating rod. Received call from R. Burns that Fisheries will be at site for starting fish salvage operations, Thursday A.M. at about 10:00 A.M.

Thursday, October 1

State Fisheries arrived with one large truck and three small trucks about 9:30 A.M. They have five men. A rowboat was skidded down to the water and the depth was measured at point about ten to fifteen feet upstream from the dam. The depth at this point is now about eight feet. This is too deep for the salvage operation and the twelve inch valve is re-opened. At noon the water depth is still seven feet and the State Biologist decision is to begin salvage operations on Friday morning. The twelve inch valve is again operated to close and we cannot close more than one-third. I hope this will hold enough water.

Friday, October 2

The State Fisheries begin salvage operations at 9:30 A.M. The water depth is only about two feet but the muck is about three to four feet deep. There are only four men to start. Mr. Watters and myself help unless many fish are to be lost. At about 2:00 P.M. the pickrel are gone, those left in water have

suffocated because of the silt - we have salvaged 112 large pickrel plus some small ones. At 3:00 P.M. the fish in the pool upstream of the dam are all dying and salvage operations are stopped. In addition to the pickrel, we have salvaged over three hundred bass consisting of Large Mouth, Crappie, and some Rockbass and more than five hundred Bullhead catfish. Sunfish and Golden Shiners were not salvaged due to lack of personel and trucks together with the speed with which the water dropped near the end of the salvage period. No attempt was made to salvage the suckers and these were left by the hundred to die as the remaining water receded.

It was discovered that the outlet works consisted of sluice gates and not "valves" as previously assumed. The twelve inch valve is jambed with debris and stones but some water is still flowing thru.

Monday, October 5

Prepakt Field Supertendent Cleveland Zerbe called at 3:00 P.M. The equipment will arrive Tuesday morning. He requested that I find him some laborers so I put him in contact with the Washington Local of the Laborers' Union.

Tuesday, October 6

Prepakt equipment arrived by truck at project site prior to my arrival at the site at 9:00 A.M. The laborers did not show up. In addition to Zerbe, one other man is on the site plus the truck driver. These men unloaded the truck and arranged the equipment. A skid mounted pneumatic drill was lowered to the walkway on the top of the dam, the skid causing some minor chipping of the edges of the concrete steps.

Wednesday, October 7

Still no laborers. Only two bits for drilling were included in the equipment and both are in poor condition. Started drilling to a depth of eight inches and steel was struck. Moved drill rig as close to end of walkway as possible and tilted drill to drill at 30° thru dam and into bedrock. Hole No. 2 was drilled to a depth of eight feet which was approximately one and one-half feet into bedrock. Moved drill rig ten feet northwest and drilled straight down eleven feet. Hole No. 3 is also approximately one and one-half feet into bedrock. Moved drill rig ten feet further northwest and began drilling Hold No. 4. At a depth of six inches of rough drilling this layer was passed and drilling went smoothly until a depth of seventeen feet was reached. There the bit seized and after some work it was decided to quit for the day.

While this drilling was being done Harold Watters and myself were removing the twelve inch sluice gate and frame. The gate seems to be in good condition.

Thursday, October 8

Arrived at site at 9:00 A.M. Two laborers now on site. While attempting to recover the jammed bit, a coupling broke leaving seven feet of steel and a bit in Hole No. 4. Moved rig ten feet further northwest and drilled Hole No. 5. This hole was similar to No. 4 in that the six inch of loose material was struck at approximately six feet of depth and then at seventeen and one-half feet loose material was struck. After a few seizings of the bit it was decided to stop before we lost another bit, etc.

The twelve inch sluice gate was recovered from the lake bottom and the fourteen (assumed) inch gate was removed. This fourteen (assumed) inch gate was found to be in good condition and actually is an eighteen inch gate. The reason for its jamming and breaking of the operating rod was found to be two causes: (1) only two stubs were installed to hold it in place instead of the four required and (2) the two stubs were only 1/2 inch rather than the 3/4 inch which was required. The gate was binding on the northwest side of the frame because the frame had shifted from its set position. Both sluice gates have bronze runners and corrosion should not cause problems in the future if debris can be kept from the gates themselves.

Friday, October 9

Arrived at site at 9:00 A.M. The drill rig was moved ten feet further northwest and Hole No. 6 was drilled to a depth of twelve inches. At this depth steel was struck near the center of the hole. The rig was moved about one foot south and Hole No. 7 was started. Again steel was struck but the time it was at a depth of two feet. The rig was moved about a foot west and in between the two previous holes. This was Hole No. 8 which at a depth of three feet the bit suddenly veered off toward the lake and the drilling operation stopped for the day. Due to the trouble and the two definite layers of loose material, it was decided to grout in stages in an attempt to cement these layers for easier drilling. Holes No. 2 and 3 received a total of two batches of grout consisting of two bags of cement, one bag of Fly Ash, one bag of "Aid" and twenty gallons of water (5.7 cubic feet/batch). The other holes took no measurable amount. The pumping pressure used was 100 psi.

During this time, the eighteen inch gate and frame was raised to the walk way and the operating rod for the twelve inch gate was disassembled and raised.

Saturday, October 12

Drilled Hole No. 9 to a depth of one foot where steel was encountered. Moved drill rig approximately one foot northwest and drilled Hole No. 10. This hole was drilled to a

depth of seventeen feet encountering the same loose layer at about six feet. At seventeen feet, a loose stone was turning under the bit and this hole was stopped. The drill rig was moved another ten feet further northwest and Hole No. 11 was drilled to a depth of nineteen feet before loose material caused the driller to stop. Hole No. 12 was drilled to a depth of fifteen feet and this hole is approximately one and one half feet into bedrock on the northwest side of the dam. At a depth of thirteen feet (Hole No. 12) a considerable amount of tar was brought to the surface. It appears as if a seal was attempted between bedrock and the dam structure using tar. Three more holes were drilled to bedrock, each of these encountered the same layer of tar but, in general, the drilling was relatively easy.

Mr. Watters and I dis-assembled the operating mechanism for the twelve inch valve and this was raised to the level of the walkway.

Tuesday, October 13

Lost count of number of holes drilled due to frequent moving of drill rig when steel was struck near the surface of the dam. Now moving rig in a southeast direction along walkway and drilling between the holes previously drilled.

Wednesday, October 14

Began grouting operations. Little or no "take" across the dam until the holes near the northwest cut-off were started. No. 11, 12 and 14 Holes took eight batches (total) before refusal at 100 psi. There was one breakout of grout on the downstream side of the dam. This was about halfway up the dam on the northwest cutoff wall and the amount of grout lost was minor. Drilled in afternoon on the spillway area and encountered a quantity of steel.

Tuesday, October 20

Drilled one hole on southeast side of spillway to bedrock. Struck fresh grout at twenty two feet. Grouted holes on southeast side of spillway. First hole took five batches and grout came out of core drill hole. Three other holes refused to take at 200 pse. which probably indicates grouting was successful. Decided to stop further drilling. Skidded drill rig to top and patched all holes.

Wednesday, October 21

Storm struck. Raining hard.

Thursday, October 22

Still raining hard in morning. Harold called water rising behind dam. The 12 inch and 18 inch pipes are inadequate to carry incoming flow.

Friday, October 23

Easton, Pennsylvania weather bureau announced 3.58 inches of rain in storm just passed. Some local rain gauges show close

to 5 inches. Harold called at 8:00 A.M. Water is only about three feet from cresting spillway. There is a lot of debris on the lake near the dam - mostly leaves, pieces of wood and water lilly roots. Roped a barrel to prevent its either sinking or going over dam and removed a sunken boat. Harold got canoe and netted cans, bottles, etc.

No leaks on face of dam. Some leakage around ends but not as bad as before grouting. At about 1:00 P.M. the water went over spillway. Impossible to prevent most of debris from going over and on downstream. No leakage noted on downstream face until after 2:30 P.M. when water depth over spillway was approximately eight inches. It was then both areas which were grouted in 1969 started leaking - first slowly and increasing to a rate nearly as bad as when we started this project. However, no other leakage, except end cutoff walls, was noted. Estimate 25% of work destroyed by storm but the dam held even with wet grout throughout structure.

Saturday, October 24      Went to dam at 11:00 A.M. Water no longer flowing over spillway. No leaks on face of dam. Water must be entering interior of dam at or above spillway level.

Monday, October 26      Water nearly down to stream level at noon.

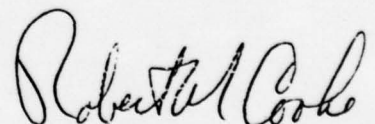
Tuesday, October 27      Harold called. Something is jamming the 18 inch pipe and he cannot remove. At 4:30 P.M. water is about eight feet deep and rising. Located grappling hook for use Wednesday morning.

Wednesday, October 28      Harold called at 8:00 A.M. water level is down and a tire is lying in stream bed below dam.

Thursday, October 29      Water flowing in at nearly capacity of both outlet pipes.

Friday, October 30      Water flow still at capacity of both outlet pipes.

\*\*\*\*\*



Robert M. Cooke, P.E.  
New Jersey License No. 13784  
November 3, 1970

**APPENDIX 2**

**CHECK LIST**

**VISUAL INSPECTION**

**BASS LAKE DAM**

CHECK LIST  
VISUAL INSPECTION

Phase I

NAME DAM Bass Lake Dam COUNTY Warren STATE New Jersey COORDINATORS N.J.D.E.P.

DATE(s) INSPECTION See Below WEATHER Cloudy TEMPERATURE 36° F

POOL ELEVATION AT TIME OF INSPECTION 100.2\* TAILWATER AT TIME OF INSPECTION 23±

\* Elevation referenced to a benchmark elevation of 101.00 on the southeast corner of the dam. (Ref. Fig. 2 of main text)

INSPECTION PERSONNEL:

<u>J. Richards</u>	<u>12/21/78</u>	<u>J. Gurkovich</u>	<u>1/9/79</u>
<u>P. Yu</u>	<u>12/21/78</u>	<u>D. Leary</u>	<u>12/13/78</u>
<u>J. Rizzo</u>	<u>1/9/79</u>		

Peter Yu RECORDER

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Leaves, a few fallen trees partially obstructed downstream channel.	Fallen trees and debris should be removed.
SLOPES	Appear satisfactory	Steep slopes - 1 Hor. to 1 Vert.
APPROXIMATE NO. OF HOMES AND POPULATION	Based on USGS Topo Map, 2 Houses 2000 ft to 2500 ft downstream. A few scattered homes located a long channel about a mile and further downstream. Population estimated to be about 30.	Warning alarm system should be installed.

CONCRETE ARCH DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	Leakage (seepage frozen) at three spots on downstream face, west of spillway.	Leakage should be completely plugged.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Small seepage through structure and rock junction on left abutment.	
DRAINS	None Observed	
WATER PASSAGES	None observed other than spillway crest.	
FOUNDATION	Not observable	

CONCRETE ARCH DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Hairline to 1/4" crack across crest near left construction joint between the raised walkway above spillway and the dam. Localized spalling and surface deterioration on downstream face.	Spalled and deteriorated concrete should be repaired.
STRUCTURAL CRACKING	None Observed	
VERTICAL AND HORIZONTAL ALIGNMENT	Appears Satisfactory	
MONOLITH JOINTS	None Observed	
CONSTRUCTION JOINTS	Hairline cracks at both ends of raised walkway above the spillway.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None Observed	
INTAKE STRUCTURE	All gates and valves are under water, unable to investigate.	All gates and valves were known to be closed at time of inspection. Superintendent expressed uncertainty in the functioning of the 18-inch gate.
OUTLET STRUCTURE	Concrete structure for the two outlet conduit deteriorated badly.	Small amount of discharge from the 12" pipe which gate was known to be closed (according to superintendent at time of inspection).
OUTLET CHANNEL	Appears satisfactory	
EMERGENCY GATE	None Observed	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARK OR RECOMMENDATIONS
SLOPES	Appear satisfactory	2 Hor. to 1 Vert. in area near dam. Relatively flat in other area.
SEDIMENTATION	Leaves deposited upstream side of dam.	Leaves should be removed.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Weir surface under water, unable to investigate.	
APPROACH CHANNEL	None observed	
DISCHARGE CHANNEL	Appears Satisfactory	About 30 ft free fall downstream
BRIDGE AND PIERS	Hairline cracks at both ends of raised walkway above spillway.	

APPENDIX 3

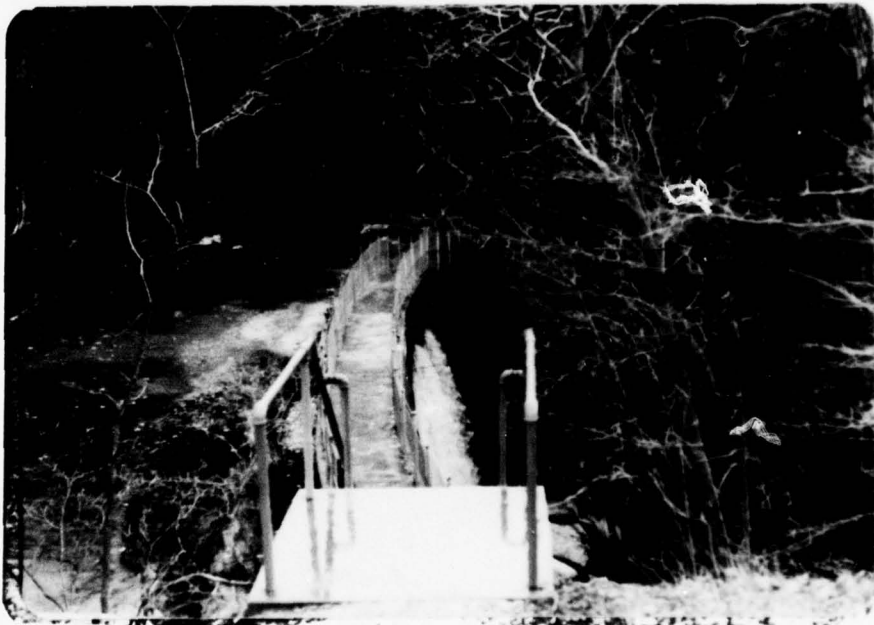
PHOTOGRAPHS

BASS LAKE DAM



Downstream right face of  
dam and spillway. Looking  
upstream.

21 December 1978



View along crest of dam.  
Looking from right abutment.

21 December 1978



Deteriorated concrete and  
approx. 4 in deep hole in  
D/S face.

21 December 1978



Leakage through dam at right  
side of spillway.

21 December 1978



Water leaking through face  
of dam at right side of  
spillway.

21 December 1978



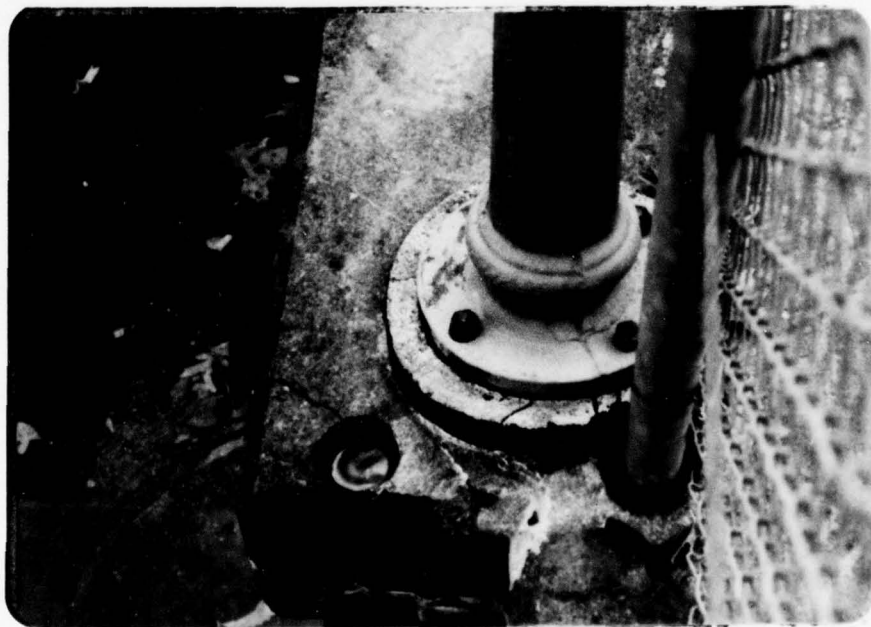
12-in-dia outlet pipe.  
Outlet pipe is below tail  
water.

21 December 1978



Spillway crest below foot  
bridge.

21 December 1978



Concrete cracked under  
gate valve operator.

21 December 1978



Crest and upstream area  
looking from left abutment  
of dam.

21 December 1978



Water leaking from rock  
at left abutment.

21 December 1978

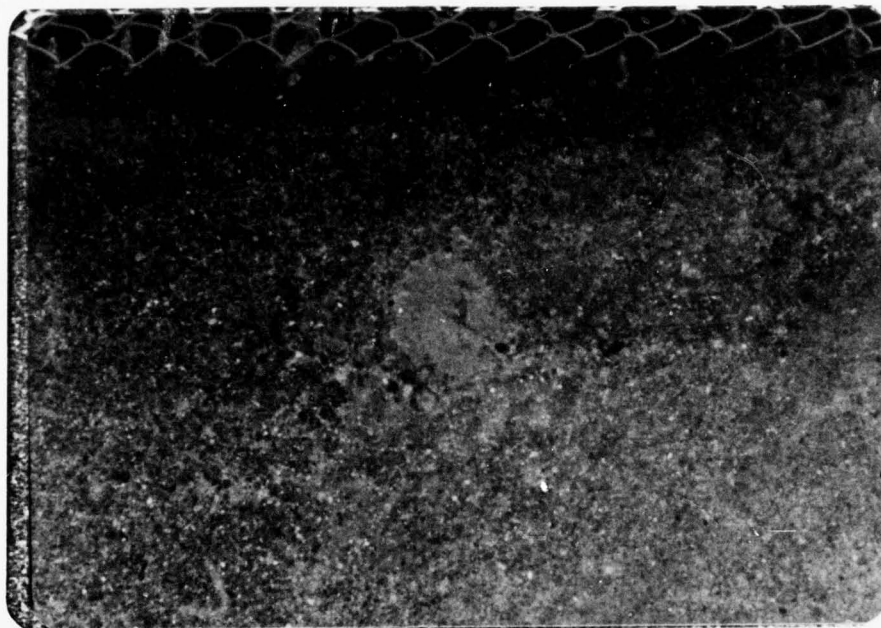
BASS LAKE DAM



View of upstream crest of dam and gate valve operators. 21 December 1978



Bass Lake looking upstream. 21 December 1978



Patched grout hole at top  
of dam.

21 December 1978



Downstream discharge  
channel.

21 December 1978



Downstream discharge  
channel viewed from foot  
bridge.

21 December 1978



Beaver dams upstream of  
inlet stream to Lake.

21 December 1978

APPENDIX 4

HYDROLOGIC COMPUTATIONS

BASS LAKE DAM

HYDROLOGIC COMPUTATIONS

BASS LAKE DAM

Location : Warren County, N.J.

Drainage Area : 5.9 sq. mi.

Lake Area : 15 Ac.

Classification : size - small  
hazard - high

Spillway Design Flood :

In accordance with the evaluation criteria,  $\frac{1}{2}$  PMF to PMF should be used.  $\frac{1}{2}$  PMF is chosen for analysis

PMP

1. Dam located in boundary area of zone 1  $\leq$  zone 6

PMP = 22.2 inches

2. PMF must be adjusted for basin size.

Duration	% Factor (for 10 sq. mi)			Reduction Factor
	Zone 1	Zone 6	Average	
0-6	111	112	112	0.80
0-12	123	123	123	
0-24	133	132	133	
0-48	142	142	142	

Unit Hydrograph :

The Corp of Engineers has indicated the SCS triangular hydrograph with the curvilinear transformation be used.

DETERMINE TIME OF CONCENTRATION

1. Majority area of watershed is hilly and woody
2. Main channel is about 3200' stream and 1200' overland flow.
3. Estimated slopes

$$\text{overland} = \frac{430}{1200} = 36\%$$

$$\text{stream} = \frac{260}{32000} = 0.8\%$$

4. Estimate  $T_c$  based on average velocity and length

	<u>slope</u>	<u>velocity</u>	<u>remark</u>
overland	36%	1.5 fps	woodland
stream	0.8%	1.8 fps	use gutter flow

$$T_c = \left( \frac{1200}{1.5} + \frac{32000}{1.8} \right) \div 3600 = 5.16 \text{ hrs.}$$

$$L = 0.6 T_c = 3.1 \text{ hrs}$$

5. Estimate  $T_c$  from curve number method SCS (Tech. Release 55 Fig. 3.3)

$$L = 33200 \text{ ft}$$

$$\text{Wt. average slope} = \frac{36 \times 1200 + 0.8 \times 32000}{33200} = 2\%$$

$$CN = 80, \quad L = 3.5 \text{ hrs.}$$

Use  $L = 3.3 \text{ hrs}$



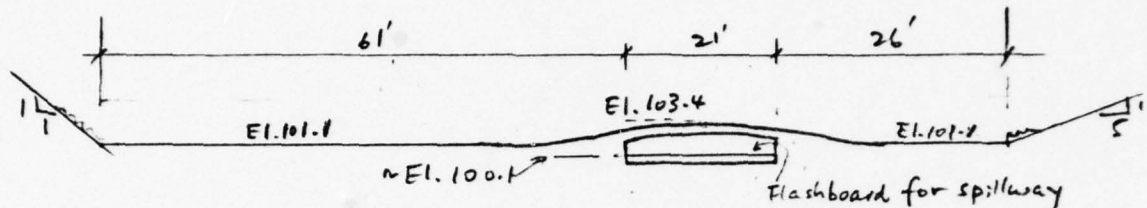
BY Pyg DATE 2.28.79 Bass Lake Dam

JOB NO. J-783B

CKD FED DATE 4.20.79

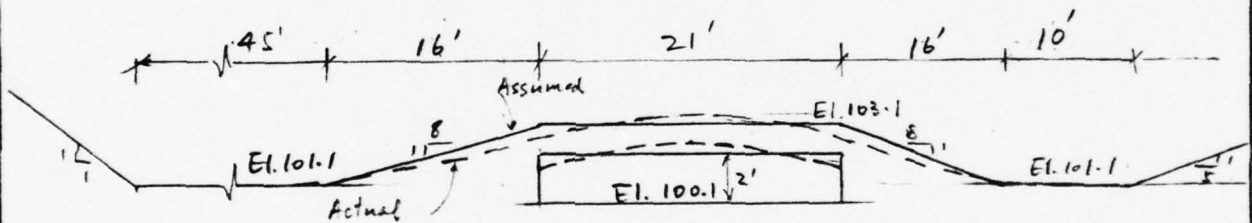
SHEET NO. 2 OF 10

SPILLWAY CAPACITY



Profile of Dam (Direction: looking U/s)

For analysis purpose, assume following configuration:

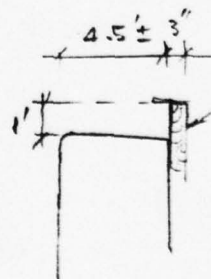


At time of inspection, the flashboards were raised to almost the full top position. Analysis is based on existing condition. Therefore top of flashboard is taken as spillway crest in calculations.



Dam Section

Direction  
←  
of flow



Spillway Section

BY Dry  
CKD ED

DATE 2-28-79  
DATE 4-20-79

Baso Lake Dam

JOB NO. J-783B

SHEET NO. 3 OF 10

Use weir equation  $Q = CLH^{3/2}$

Take  $C_{avg} = 3.0$  for spillway. Where flow is obstructed by the bridge, discharge is adjusted by the appropriate area ratio.  $L = 21$  ft  $\therefore$  for spillway  $Q = (63 H^{3/2})(\text{Area ratio})$

Take C at various head with reference to Table 5-3 of 'Handbook of Hydraulics' by King & Brater for dam section. L varies  $\therefore$  for dam  $Q = CLH^{3/2}$

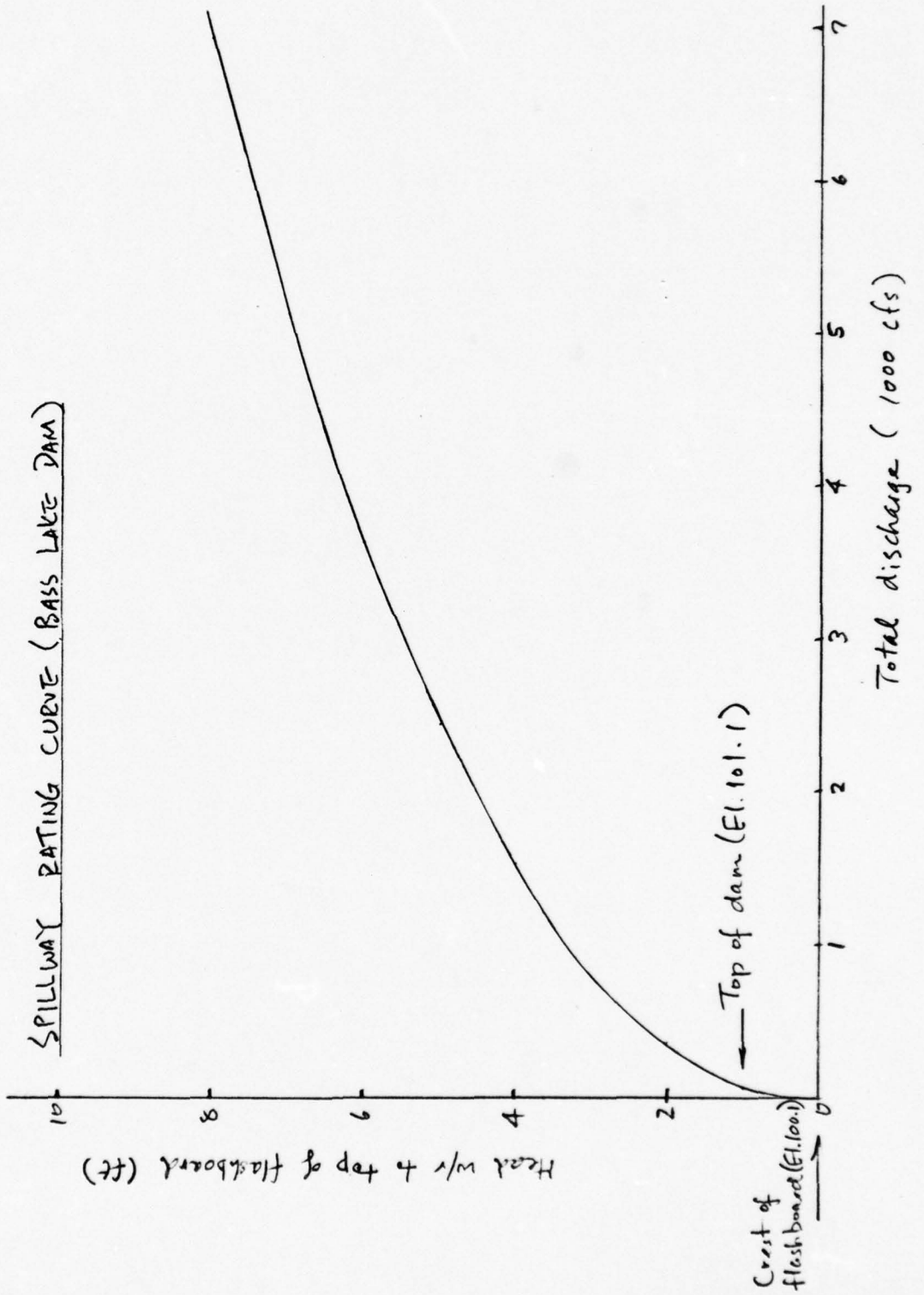
Elev. (ft)	Spillway				Dam				Total (cfs) $Q_T = Q_S + Q_D$
	H (ft)	Total flow Area (ft <sup>2</sup> )	Area <sup>2</sup> Ratio	$Q_S$ (cfs)	H (ft)	C	L (ft)	$Q_D$ (cfs)	
100.1	0	-	-	0					0
101.1	1	-	-	63	0			0	63
102.1	2	-	-	178	1	2.68	66	177	355
103.1	3	63	0.67	219	2	2.65	77	577	796
104.1	4	84	0.75	378	3	2.66	82	1133	1511
105.1	5	105	0.8	563	4	2.70	87	1879	2442
106.1	6	126	0.83	769	5	2.79	92	2870	3639
107.1	7	147	0.86	1003	6	2.90	97	4134	5137
108.1	8	168	0.88	1254	7	3.00	102	5667	6921
109.1	9	189	0.89	1514	8	3.00	107	7263	8777

Note: 1 - Total flow Area =  $21 \times H$

2 - Area ratio =  $\frac{\text{Total flow Area} - \text{Bridge Area}}{\text{Total flow Area}}$   
 $= \frac{\text{Total flow Area} - 21}{\text{Total flow Area}}$

3 - Assumed effective length.

SPILLWAY RATING CURVE (BASS LAKE DAM)



Reservoir Storage Capacity

Assume a linear distribution for the area of the lake with elevation. Start at a zero storage at the crest of the spillway. Use equivalent square method.

Area of Lake = 15 Ac.

Length of equivalent square = 808 ft

Take average side slope = 1V : 6H (From inspection)

∴ for every foot of water above the flashboard, the length of equivalent square increases by  
 $= 1 \times 6 \times 2 = 12 \text{ ft}$

Elev. (ft)	H (ft)	Length of equivalent square (ft)	Area of Lake (Acres)
100.1	0	808	15.00
101.1	1	820	15.44
109.1	9	916	19.26

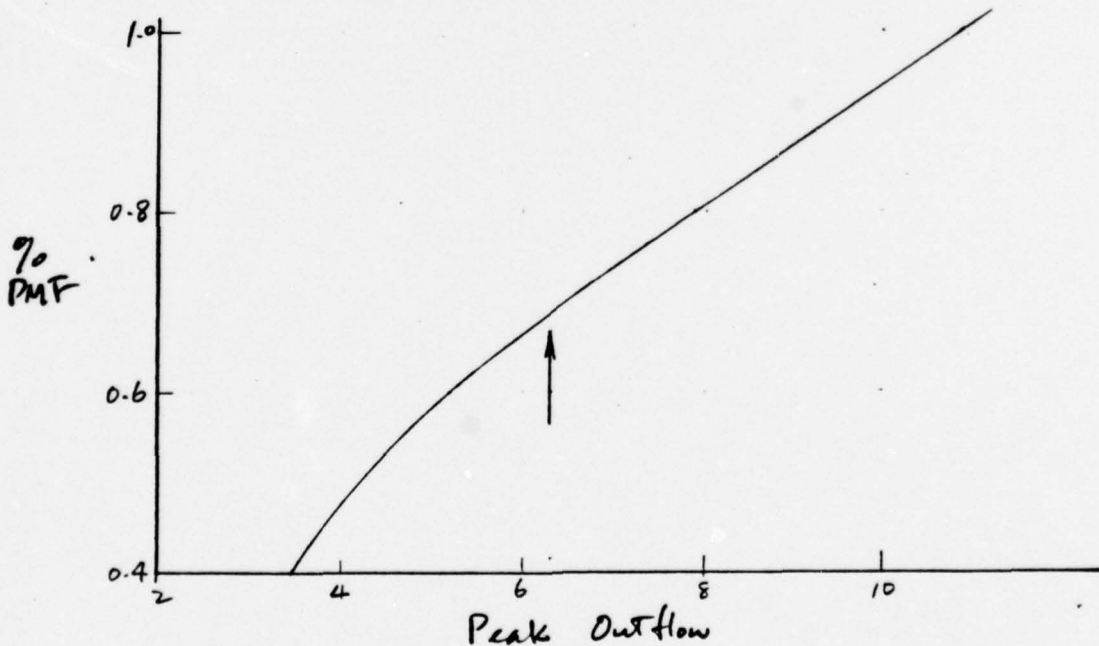
Storage capacity vs. elevation to be calculated by HEC-1.DS

SUMMARY OF HYDROGRAPH AND FLOOD ROUTING

1. Hydrograph and routing calculated using HEC-1 DB
2.  $\frac{1}{2}$  PMF peak inflow for Bass Lake is 5997 cfs  
(Routed to 5982 cfs)
3. Routing indicates that the dam will overtop by approximately 6.5 ft for  $\frac{1}{2}$  PMF

OVERTOPPING POTENTIAL

1. Various % of PMF has been routed using HEC-1 DB
2. Plot peak outflow vs % PMF



3. Dam overtops at approx. El. 101.1 with  $Q = 63$  cfs  
 $\therefore$  dam can pass approx. 0.7 % of PMF.

DRAWDOWN ANALYSIS

## 1. Outlet structures

One 12"- and one 18"-dia C.I. pipes at base of dam controlled by sluice gates.

(For analysis purpose, assume both pipes are in proper operational condition. Also assume flashboard in existing position)

## 2. Outlet capacity

Inv. of 12"- $\phi$  pipe = El. 73.5 (Estimated)

Inv. of 18"- $\phi$  pipe = El. 71 (Estimated)

Discharge of the pipes based on

$$Q = A \sqrt{\frac{2gH}{1 + K_m + K_p L}}$$

$$A = \text{area of pipe} = 0.785 \text{ ft}^2 \text{ for } 12" \phi$$

$$= 1.77 \text{ ft}^2 \text{ for } 18" \phi$$

$$L = \text{length of pipe} = 25 \text{ ft}$$

$$K_m = K_e + K_b = 0.9$$

$$\text{Use } n = 0.02$$

$$\therefore K_p = 0.0741 \text{ for } 12" \phi$$

$$= 0.0431 \text{ for } 18" \phi \quad (\text{Ref: NEH Section 5, ES-42})$$

For 12"- $\phi$  pipe

$$Q = 0.785 \sqrt{\frac{2gH}{1 + 0.9 + 0.0741 \times 25}} = 3.252 \sqrt{H}$$

For 18"- $\phi$  pipe

$$Q = 1.77 \sqrt{\frac{2gH}{1 + 0.9 + 0.0431 \times 25}} = 8.232 \sqrt{H}$$

Elev (ft)	12" - $\phi$		18" - $\phi$		Total Q (cfs)	Qoutavg (cfs)
	H (ft)	Q (cfs)	H (ft)	Q (cfs)		
100.1	26.6	16.8	29.1	44.4	61.2	58.4
95.1	21.6	15.1	24.1	40.4	55.5	52.4
90.1	16.6	13.2	19.1	36.0	49.2	45.6
85.1	11.6	11.1	14.1	30.9	42.0	37.6
80.1	6.6	8.4	9.1	24.8	33.2	27.0
75.1	1.6	4.1	4.1	16.7	20.8	

3. Storage Capacity

- Assume capacity of lake between top of flashboard (El. 100.1) and El. 75.1 is 280 Ac-ft.
- Assume area varies linearly with height  
Area of lake at El. 75.1 = 7.4 Ac.

Elev. (ft)	Area (Ac)	$\Delta$ Storage (Ac-ft)	Total (Ac-ft)
100.1	15	71.2	280
95.1	13.48	63.6	
90.1	11.96	56.0	
85.1	10.44	48.4	
80.1	8.92	40.8	
75.1	7.4		

BY PJ DATE 3-2-79 Bass Lake Dam JOB NO. J-78-B  
 CKD GED DATE 4-20-79 SHEET NO. 9 OF 10

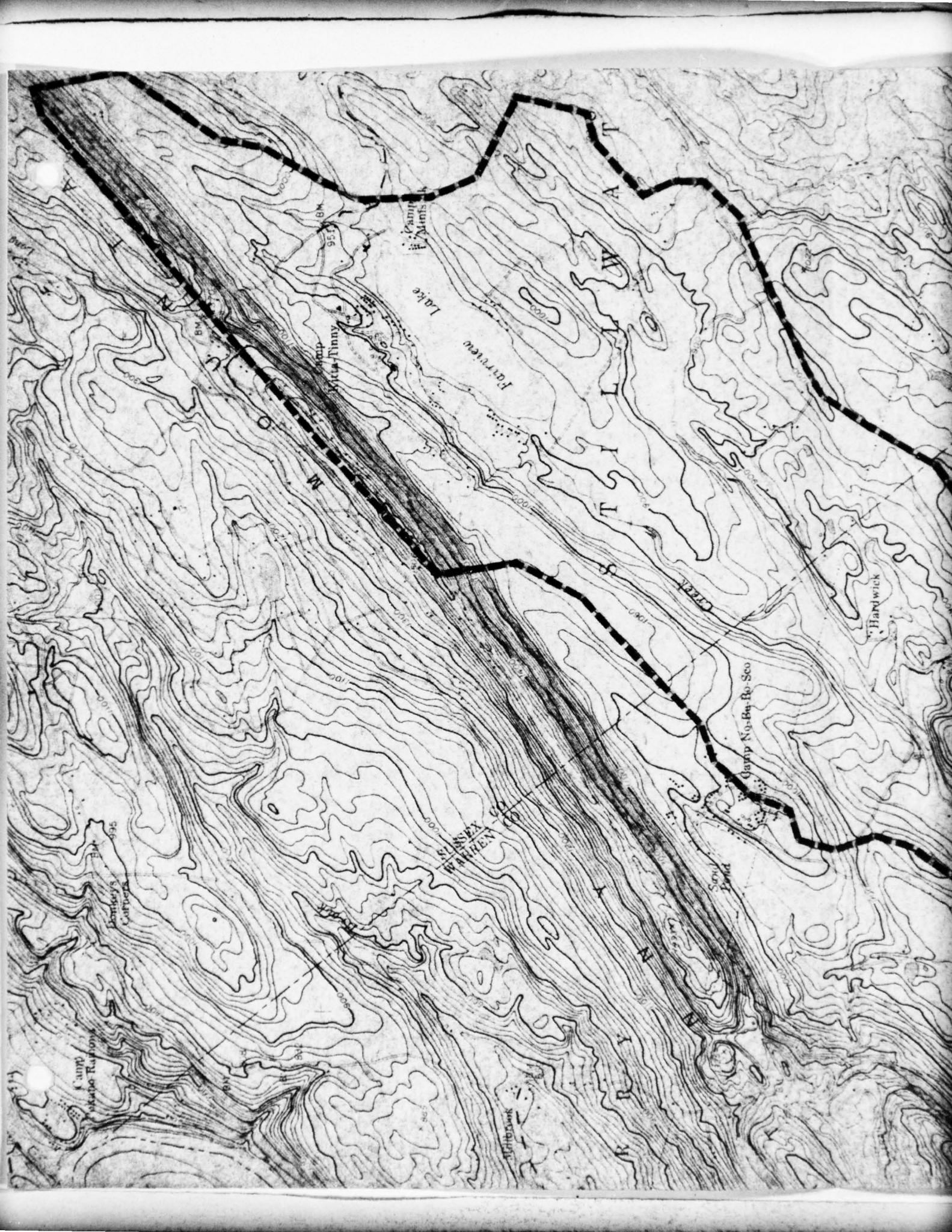
4. Assume inflow to be 2 cfs/sq. mi

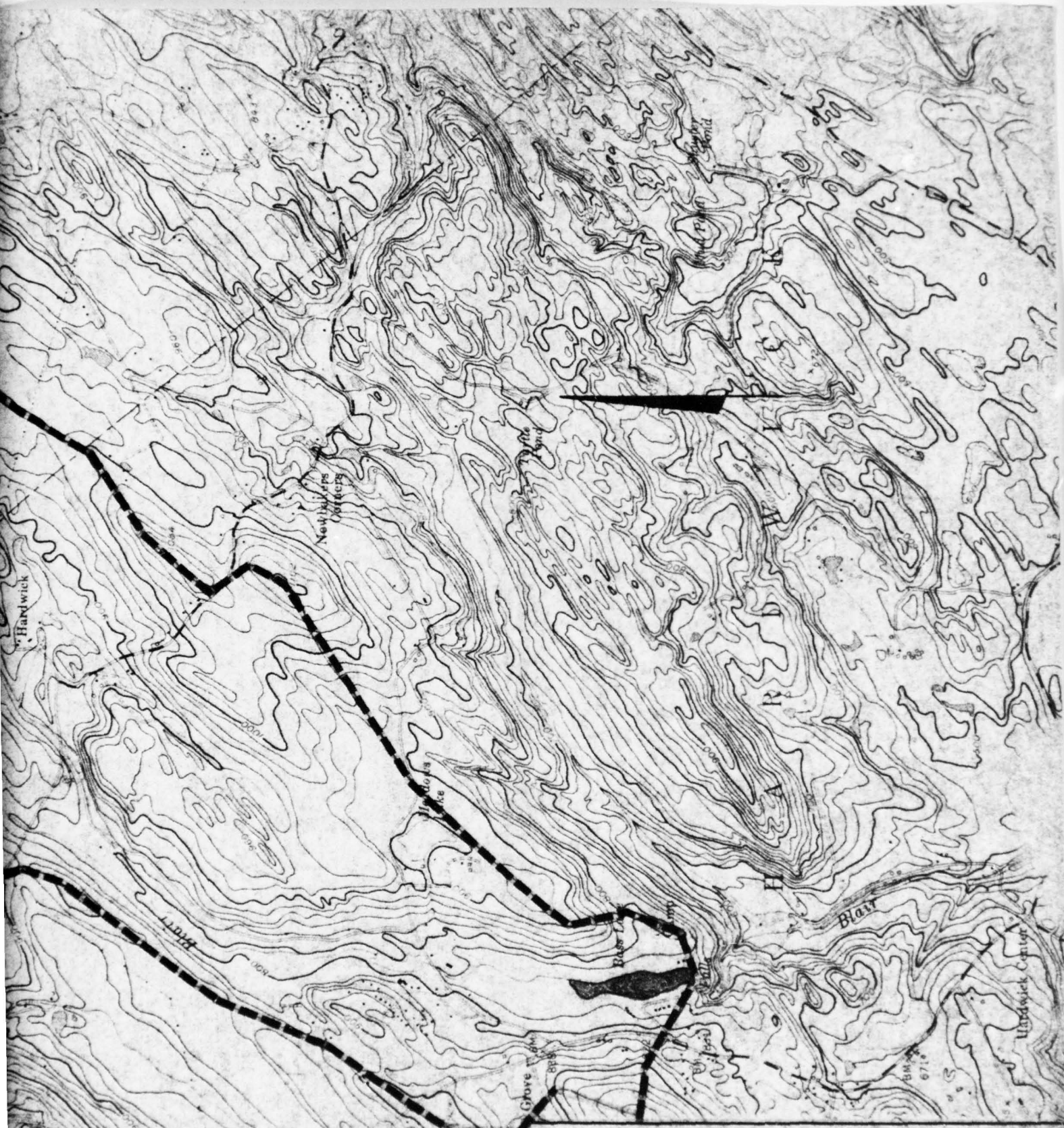
$$Q_{in} = 2 \times 5.9 = 11.8 \text{ cfs}$$

Elev. (ft)	$Q_{out avg}$ (cfs)	$Q_{net}^*$ (cfs)	$\Delta Storage$ (ac-ft)	$\Delta t$ (hrs)	$\Sigma \Delta t$ (hrs)	
100-1	58.4	46.6	71.2	18.5		
95-1	52.4	40.6	63.6	19.0		
90-1	45.6	33.8	56.0	20.0		
85-1	37.6	25.8	48.4	22.7	80.2	(3.3 days)
80-1	27.0	15.2	40.8	32.5	112.7	(4.7 days)

$$* Q_{net} = Q_{out avg} - Q_{in} = Q_{out avg} - 11.8$$

$\therefore$  lake can be lowered 25 ft in about 5 day  
(from top of flashboard)





MAP SOURCE: U.S.G.S.  
FLATBROOKVILLE  
SCALE 1" = 2000'

**DRAINAGE BASIN  
BASS LAKE DAM**

**LANGAN ENGINEERING ASSOCIATES, INC.**

CONSULTING ENGINEERS  
990 CLIFTON AVE CLIFTON, N.J. 07012 201 472-9366

HEC-I OUTPUT

BASS LAKE DAM

















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)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN RATIO	PLAN RATIO
HYDROGRAPH AT	1	5.50	1	.50
	(	15.28)	(	169.82)
ROUTE TO	2	5.90	1	.5982
	(	15.28)	(	169.39)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	DURATION OVER TOP	MAXIMUM OUTFLOW	MAXIMUM STORAGE	MAXIMUM DEPTH OVER DAM	MAXIMUM RESERVOIR W.S. ELEV	RATIO OF PMF	TIME OF MAX OUTFLOW	TIME OF FAILURE
		100.10	100.10	101.10	0.	5982.	125.	6.47	167.57	.50	43.00	0.00
		0.	0.	15.	21.50							
		0.	0.	63.								

.....  
 FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 11 JAN 79  
 .....

.....  
FLOOD HYDROGRAPH PACKAGE (HFC-1)  
DAM SAFETY VERSION: JULY 1978  
LAST MODIFICATION 11 JAN 79  
.....

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS  
1  
2  
RUNOFF HYDROGRAPH AT  
ROUTE HYDROGRAPH TO  
END OF NETWORK

.....  
 FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 11 JAN 79  
 .....

RUN DATE # 7/2/83/01  
 TIME # 12.31.43

BASS LAKE DAM  
 X PRF DAM INSPECTION  
 H.J. DAM INSPECTION

NO 200 MHR 0 NMIN 30 IDAY 0 JOPER 5  
 IHR 0 IMIN 0 METRC 0  
 NWT LROPT TRACE 0  
 IPLI 0 IPRT 4 MSTAN 0

MULTI-PLAN ANALYSES TO BE PERFORMED  
 NPLAN= 1 NPTIO= 6 LRATIO= 1  
 .01 .01 .00 .00

RTIOS= .02

\*\*\*\*\* SUR-AREA RUNOFF COMPUTATION \*\*\*\*\*

COMPUTE HYDROGRAPH

ISTAQ 1 ICOMP 0 IECON 0 ITAPE 0 JPLT 0 JPR1 0 IHAME 1 ISTAGE 0 IAUTO 0

IHYD 1 IUNG 2 TAREA 5.90 SWAP 0.00 TRSDA TRSDC RATIO ISNON ISAME LOCAL %

PRECIP DATA  
 R12 112.00 R24 133.00 R48 142.00 R72 0.00 R96 0.00

LOSS DATA  
 STRKS RTIOK SIRTU CUSLU ALCMX RIIMP  
 0.00 1.00 0.00 1.00 1.00 0.00 0.00 0.00

UNIT HYDROGRAPH DATA  
 TC= 0.01 LASE 3.30

RECESSION DATA  
 STRIO= -2.00 GRCSN= 0.00 RTION= 1.00

END-OF-PERIOD FLOW  
 MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP G

SUM ( 641.0 ) ( 511.0 ) ( 122.0 ) ( 4864.41 )

TRNSC COMPUTED BY THE PROGRAM IS .800

.....

ROUTING COMPUTATIONS

STAGE	100.10	101.10	102.10	ICOMP	1	IECON	0	ITAPE	0	JPLT	0	INAME	1	ISTAGE	0	IAUTO	0
FLOW	0.00	63.00	355.00	LOSS	0.00	ROUTING DATA	1	ISAME	0	IOFT	0	IPMP	0	LSTR	0		
SURFACE AREA=	15.	15.	19.	AVG	0.00	LAG	0	AMSKK	0.000	Y	0.000	STORA	0.	ISPRAT	-1		
CAPACITY	0.	15.	154.	NSTPL	0	103.10	104.10	1511.00				2442.00	3630.00	106.10	107.10	108.10	109.10
ELEVATION	100.	101.	109.	CREL	100.1	796.00										6921.00	8777.00

COU	0.0	EXPW	0.0	ELEVL	0.0	COOL	0.0	CAREA	0.0	FXPL	0.0
SPWID	0.0	COGD	0.0	EXPD	0.0	DAMWID	0.				
TOPEL	101.1										

PEAK OUTFLOW IS 230. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 109. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 79. AT TIME 44.50 HOURS

PEAK OUTFLOW IS 52. AT TIME 45.00 HOURS

PEAK OUTFLOW IS 35. AT TIME 45.00 HOURS

PEAK OUTFLOW IS 17. AT TIME 45.00 HOURS

.....

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 RATIO	RATIOS APPLIED TO FLOWS					
				1	2	3	4	5	6
HYDROGRAPH AT	1	5.90	.02	240	120	96	72	48	24
	( 15.28 )	( 3.40 )	( 6.79 )	( 3.40 )	( 2.72 )	( 2.04 )	( 1.36 )	( .68 )	( .34 )
ROUTED TO	2	5.90	.01	230	109	78	52	35	17
	( 15.28 )	( 3.08 )	( 6.51 )	( 3.08 )	( 2.23 )	( 1.47 )	( .98 )	( .49 )	( .24 )

SUMMARY OF DAM SAFETY ANALYSIS

FLAN 1 .....	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE
RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS	
.02	101.57	24	130	7.50	43.50	0.00	
.01	101.26	10	100	3.00	44.00	0.00	
.01	100.95	10	100	2.00	44.50	0.00	
.00	100.65	8	52	0.00	45.00	0.00	
.00	100.25	4	15	0.00	45.00	0.00	
.00	100.34	4	17	0.00	45.00	0.00	

.....  
 FLOOD HYDROGRAPH PACKAGE (HCC-1)  
 DAM SAFETY VERSION, JULY 1978  
 LAST MODIFICATION 11 JAN 79  
 .....

**APPENDIX 5**

**REFERENCES**

**BASS LAKE DAM**

APPENDIX 5

REFERENCES

BASS LAKE DAM

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