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RARITAN RIVER BASIN  
AMBROSE BROOK, MIDDLESEX COUNTY  
NEW JERSEY



**LEVEL II**

**LAKE NELSON DAM**

**NJ 00376**

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

Lake Nelson Dam (NJ 00376). Raritan River Basin, Ambrose Brook, Middlesex County, New Jersey. Phase 1 Inspection Report.

DOC FILE COPY

- 9 Final report.,
- 10 Robert J. / Jenny
- 15 DACW61-78-C-0124



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DEPARTMENT OF THE ARMY D C

Philadelphia District  
Corps of Engineers  
Philadelphia, Pennsylvania

JUN 1 1979

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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.		

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IN REPLY REFER TO

NAPEN-D

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

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7 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Nelson Dam in Middlesex 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, Lake Nelson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the spillway is considered inadequate, as 17 percent of the 100 year design flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, in order to maintain the structural integrity of the dam, the following remedial actions could be undertaken by the owner:

- a. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed.
- b. The downstream edge of the spillway sill should be repaired at areas showing erosion.
- c. The base of the two buttresses at the northern end of the downstream face of the spillway should be repaired.
- d. The eroded portion of the spillway beneath the concrete cap should be repaired, and the concrete cap should be reconstructed.
- e. Any erosion of the apron at the toe of the spillway should be

**NAPEN-D**

**Honorable Brendan T. Byrne**

**repaired and undermined areas filled with concrete and stone.**

- f. The cracks and spalls in the concrete wing walls should be repaired.**
- g. The gully on the downstream face of the south embankment should be filled with suitable material and compacted.**
- h. Riprap should be placed at sections on the upstream face of the embankment where the original riprap has been removed or dislodged.**
- i. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.**
- j. A program of annual inspection of the dam should be initiated.**

**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 Edward Patton of the Fifteenth District. Under the provision 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.**

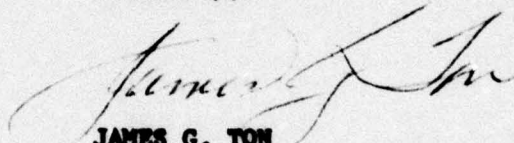
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**Honorable Brendan T. Byrne**

**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 actions 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**

LAKE NELSON DAM (NJ00376)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 and 21 December 1978 by Jenny-Leedshill Engineers 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.

Lake Nelson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in poor overall condition. Also, the spillway is considered inadequate, as 17 percent of the 100 year design flood would overtop the dam. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. For the same reasons no further studies or increase of spillway capacity are recommended. However, in order to maintain the structural integrity of the dam, the following remedial actions could be undertaken by the owner:

a. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed.

b. The downstream edge of the spillway sill should be repaired at areas showing erosion.

c. The base of the two buttresses at the northern end of the downstream face of the spillway should be repaired.

d. The eroded portion of the spillway beneath the concrete cap should be repaired, and the concrete cap should be reconstructed.

e. Any erosion of the apron at the toe of the spillway should be repaired and undermined areas filled with concrete and stone.

f. The cracks and spalls in the concrete wing walls should be repaired.

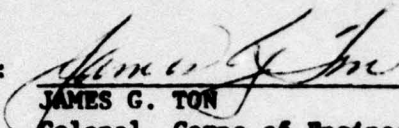
g. The gully on the downstream face of the south embankment should be filled with suitable material and compacted.

h. Riprap should be placed at sections on the upstream face of the embankment where the original riprap has been removed or dislodged.

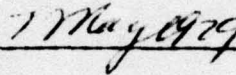
i. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

j. A program of annual inspection of the dam should be initiated.

APPROVED:

  
\_\_\_\_\_  
JAMES G. TON  
Colonel, Corps of Engineers  
District Engineer

DATE:

  
\_\_\_\_\_  
17 May 1929

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Nelson Dam  
Federal I.D. No. NJ 00376  
New Jersey I.D. No. 97  
State Located: New Jersey  
County Located: Middlesex  
Stream: Ambrose Brook, Branch of the  
Raritan River  
Dates of  
Inspection: December 6 and 21, 1978

Brief Assessment of General Condition of Dam

Based on visual observations, the dam and spillway are in poor overall condition and their structural integrity is questionable. However, the potential downstream hazards are low, so that it has been assessed as a low hazard dam.

The hydrologic and hydraulic analysis indicates that the spillway is inadequate and can only pass approximately 16% of the 100-year frequency flood.

Failure of the Lake Nelson Dam would not result in a significant downstream hazard to loss of life or property damage. However, in order to maintain the integrity of the structure, it is suggested that the owners initiate the following remedial measures in the near future:

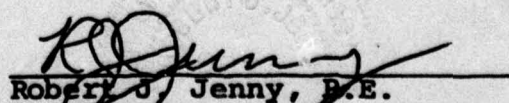
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5. Any erosion of the apron at the toe of the spillway should be repaired and undermined areas filled with concrete and stone.
6. The cracks and spalls in the concrete wing walls should be repaired.
7. The gully on the downstream face of the south embankment should be filled with suitable earth and compacted.
8. Riprap should be placed at sections at the upstream face of the embankment where the original riprap has been removed or dislodged.
9. A permanent extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

A long term solution would be to remove and replace the spillway with a new structure and to restore the embankment sections.

A program of annual inspection of the dam should be initiated in the near future.

  
Frank L. Panuzio, P.E.  
Project Engineer

  
Robert J. Jenny, P.E.  
Project Director  
New Jersey License No. 9878

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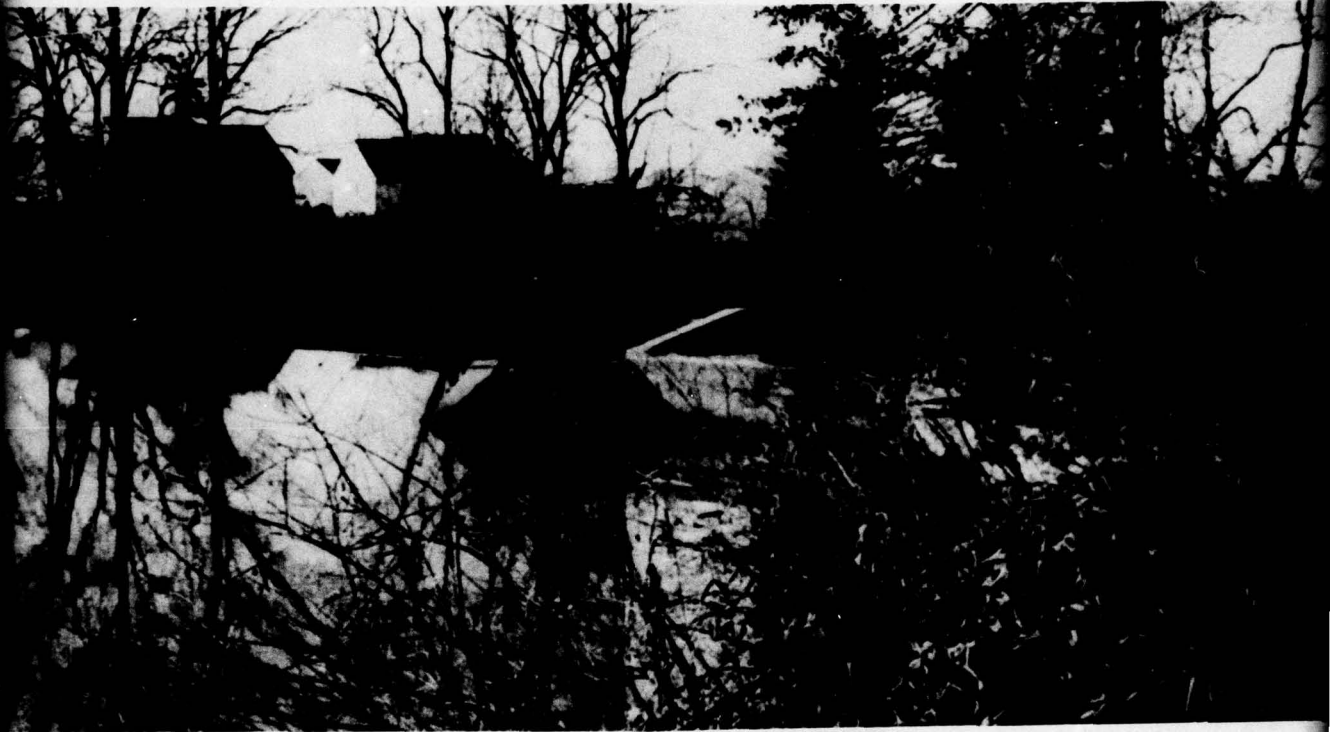
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8. Crack in left (south) wing wall
9. Right (north) spillway abutment
10. Outlet conduit
11. Downstream channel

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APPENDIX D - Hydrologic and Hydraulic Computations



LAK  
View of dam looking c  
(D



2

ELSON DAM

stream from north bank of reservoir.  
(, 1978)

## 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.

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

LAKE NELSON DAM  
Federal I.D. No. NJ 00376  
New Jersey I.D. No. 97

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act, Public Law 92-367, 1972, provides for the National Inventory and Inspection Program by the U. S. Army Corps of Engineers. This report has been prepared in accordance with this authority through contract between the State of New Jersey and Leachhill Engineers. The State of New Jersey has also entered into an agreement with the U. S. Army Engineering District, Philadelphia, to have this work performed.

b. Purpose of Inspection

The purpose of this inspection was to evaluate the structural integrity and hydraulic adequacy of the dam, and to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Description of Dam and Appurtenances

Lake Nelson Dam is an earthfill dam with a concrete core wall and clay puddle backfill adjacent to the core wall. The dam is 487 feet long and has a maximum height of approximately 10.5 feet. The slope of both the upstream and downstream face is 2 horizontal on 1 vertical.

A masonry spillway is located in the northern third of the dam. The length of the spillway weir is 83 feet and the crest is approximately 3 feet wide.

The emergency outlet consists of an 8-inch diameter outlet pipe, which has been installed to supplement a sluice gate to drain the reservoir. The outlet is controlled by a gate valve on the right side of the spillway. The presently unused wooden sluice gate is located at the upstream end of a rectangular outlet conduit, approximately 5 feet high and 2 feet wide, discharging at the lower right side of the spillway. The sluice gate control is located on the upstream end of the right (north) wing wall.

b. Location

Lake Nelson Dam is located across the Ambrose Brook, a branch of the Raritan River, in north central New Jersey, in the borough of Piscataway, in Middlesex County. The regional vicinity map is presented on Plate 1.

c. Size Classification

The maximum storage capacity of Lake Nelson Dam is 85 acre-feet at the top of dam, and the dam is 10.5 feet high; therefore, the size classification of the dam is small, based on the Corps of Engineers Guidelines.

The criteria for size classification of dams are set forth in the Corps' Guidelines. A small size dam is one in which the reservoir capacity is greater than or equal to 50 acre-feet and less than 1,000 acre-feet, and/or the maximum height is greater than or equal to 25 feet and less than 40 feet.

d. Hazard Classification

Several houses on both sides of the downstream channel were visible from the dam. The closest residence downstream is located on the north bank of the channel approximately 100 yards downstream from the dam. However, these dwellings appear to be at an elevation greater than the spillway crest.

Investigation of the downstream channel and study of the U. S. Geological Survey 7.5-minute topographic maps indicate that there are no buildings or major roads which would be significantly influenced by a flood resulting from failure of the dam. Therefore, the dam is classified as low hazard.

e. Ownership

The dam is owned by the Lake Nelson Improvement Association, Inc., 29 North Lakeside Drive, Piscataway, New Jersey, 08854.

f. Purpose of Dam

The reservoir is used only for recreation and its aesthetic value to neighboring residents.

g. Design and Construction History

A small dam of unknown size and construction was reportedly built on the John Nelson Farm about 100 years ago to make a 200-foot long pond. In 1913, an earthfill dam was constructed in the location of the present Lake Nelson dam. This dam was breached in 1926 and reconstructed with a concrete core wall and raised 2 feet in 1927, as shown in Plate 2.

An eight-inch diameter outlet pipe was placed beneath the wooden sluice gate in about the late 1960's. This outlet pipe was installed to be used to drain the reservoir in lieu of the sluice gate.

The remains of an emergency spillway located adjacent to the left (south) abutment of the main spillway was observed; however there is no available information regarding its design and construction history.

h. Normal Operational Procedures

There is no normal regulation, nor is the reservoir

drawn down in anticipation of heavy runoff. The reservoir has been drained on occasions in order to repair the dam and inspect the bottom of the reservoir.

1.3 Pertinent Data

- a. Drainage Areas 5 sq. miles
- b. Discharge at Damsite
  - Ungated spillway capacity at maximum pool elevation 610 cfs
- c. Elevation (ft. above MSL)\*
  - Top dam 58.5 ft. (Approx.)
  - Top spillway wing walls 60.0 ft. (Approx.)
  - Spillway crest 56.5 ft. (Approx.)
  - Streambed at centerline of dam 48.0 ft. (Approx.)
- d. Reservoir
  - Length of maximum pool 4000 ft.
  - Length of recreation pool (Spillway crest) 2600 ft.
- e. Storage (acre-feet)
  - Top of dam 85
  - Recreation pool (Spillway crest) 40
- f. Reservoir Surface (acres)
  - Top dam 30
  - Spillway crest 14
- g. Dam
  - Type Earth fill

\*Elevations on design plans (Plate 2) are based on a local datum. MSL elevation has been estimated from U.S.G.S. maps.

•Length	487 ft.
•Height	10.5 ft. (Approx.)
•Top width	3 to 6 ft. (Approx.)
•Side slopes - upstream	2H:1V
- downstream	2H:1V
•Impervious core	Concrete core wall with clay puddle backfill
h. Spillway	
•Type	Masonry, free overfall
•Length of weir	83 ft.
•Crest elevation	56.5 ft.
•U/S channel	None (reservoir)
•D/S channel	Narrow masonry apron at toe of spillway. Stilling basin with revetted embankments immediately downstream discharging to natural channel.
i. Regulating Outlets	
	Wooden sluice gate and 8-inch diameter pipe; both discharge into a 5 ft. high by 2 ft. wide conduit which exits at the toe of the spillway.

## SECTION 2: ENGINEERING DATA

### 2.1 Design

#### a. Geologic Conditions

Lake Nelson Dam is located in the Piedmont Lowlands physiographic province south of the Wisconsin age glacier terminal moraine. The regional geology of this province is discussed in Appendix C to this report.

The dam is situated on a broad, flat, dissected plain composed primarily of stratified material deposited by glacial melt-waters during the most recent glacial period. This glacial outwash is typically silt, sandy silt, silty sand and gravelly sand with some cobbles, deposited in well defined beds. Permeability of this material is fair to good depending on the percent of fines.

Within the stream banks, and in the flat lowlands adjacent to them, are soils and recent alluvial stream deposits. This soil typically takes on the characteristics of the soil or alluvium from which they originated. At this project the alluvium appears to be mainly silt and sand with some clay and a significant amount of organic matter near the surface.

Report Number 10, Middlesex County, of the Engineering Soil Survey of New Jersey series indicates that relatively shallow bedrock could be expected on both abutments of the dam. The classification presented by the report assumes that shale bedrock could be expected at depths from 2 to 6 feet below the surface. However, due to extensive development adjacent to the dam and the lakes, no bedrock exposures were observed during the inspection. Bedrock in the area is known to be the Brunswick formation, a Triassic age red-brown soft shale with

minor sandstone beds which dips gently to the northwest. Construction reports indicate that the core wall is founded on the Brunswick formation, which is described as "red shale". From surface observations, it would appear that the embankment of this dam is constructed of soils and rock derived primarily from this formation.

Since the dam lies within Seismic Zone 1, only minor damage from distant earthquakes should be expected. No active faults are known to exist in the immediate vicinity nor surrounding area of the dam.

b. Design Data

There are no available data regarding the design of the original dam. Details regarding construction of the existing dam, repairing breaches through the embankment and the construction of the concrete and clay core wall are shown on a drawing dated October, 1926 (Plate 2). The design called for a concrete core wall to be constructed to an elevation 2 feet below the top of the dam. The designer of these modifications is not known. This drawing indicates that the spillway wing walls were to be raised to 3.5 feet above the spillway crest and the embankment was to be raised to the top of the wing walls and have upstream and downstream slopes of 2 horizontal to 1 vertical. Plate 2 has very limited details of the main spillway and there is no information regarding the emergency spillway nor the outlet works. The design drawing indicates that earth fill was to be placed adjacent to the upstream side of the spillway to within 6 inches of the crest.

An engineering report titled "Lake Nelson Environmental Protection and Improvement" dated August 1971 was prepared by Robert J. Haefeli, P.E., Consulting Engineers.

This report discusses the physical condition of the reservoir at that time and alternative methods of improvement. This report also contains contours and cross sections of the lake depth and sediment thickness, and storage curves for the original lake and surface of sediments in 1959 and 1971. Selected illustrations are included in Appendix D.

## 2.2 Construction

No information regarding the construction of the original dam is available.

Inspection reports of the construction of the core wall indicate that the section of the wall from approximately 150 feet from the left (south) abutment to the spillway was extended approximately 4 feet deeper than shown on the plans due to the presence of unsuitable foundation material. These reports also indicate that the wall was founded on red shale and clay.

## 2.3 Operation

The reservoir is essentially unregulated and the only operation consists of occasional draining of the reservoir for repair of the dam or inspection of the reservoir. No engineering data regarding the operation or design of the outlet works are available.

## 2.4 Evaluation

### a. Availability

Available design data for the dam are limited to the plans and sections shown in Plate 2. Engineering reports related to more recent reservoir siltation problems prepared by R. Haefeli, P.E., are available.

### b. Adequacy

The available design and construction data are

inadequate to evaluate the structural stability of the dam. Calculations relating to the structural design of the dam or the stability of the as-built structure are not available. Nothing is known of construction methods or as-built material properties. Design plans are old and do not reflect present conditions regarding details of embankment configuration and locations of appurtenant structures.

c. Validity

Visual inspection indicates that the existing dam differs somewhat from that shown in Plate 2. This drawing indicates that the top of the embankment was to be raised to the top of the spillway wing walls; however, the top of the dam is presently approximately 1.5 feet below the top of the wing walls, possibly due to subsequent erosion. The present configuration of the spillway discharge channel is not as shown on Plate 2, and a concrete wall has been added at the upstream side of the north embankment. In addition, the spillway buttresses and apron and the emergency spillway are not shown on Plate 2. A sketch of the present configuration of the general spillway area based on visual inspection is shown on Plate 3.

## SECTION 3: VISUAL INSPECTION

### 3.1 Findings

#### a. General

Visual inspections of Lake Nelson Dam were made on December 6 and 21, 1978. The water surface at the time of both inspections was less than one inch above the spillway crest.

The visual inspection revealed that the masonry spillway is severely eroded and there is significant cracking and spalling of the concrete wing walls. Severe erosion of the embankment and local riprap failures were also noted.

Detailed inspection was made of the dam, appurtenant structures, reservoir area and the downstream channel. Descriptions of the findings of these inspections are summarized in the paragraphs which follow. The checklist of visual inspection items is included in Appendix A. Geologic and foundation conditions observed at the time of inspection are noted in greater detail in Section 2.1-a.

#### b. Dam

The dam was inspected for signs of settlement, seepage, erosion, cracking, and other evidence of undesirable behavior which might affect the stability of the structure.

The dam crest is, on the average, about 1- $\frac{1}{2}$  feet below its design elevation apparently due to erosion and/or settlement.

The embankment is covered with a relatively dense growth of mature trees (Photos 1, 2 and 3). A gully, approximately 20 feet long by 3 to 5 feet wide and 1 to 2 feet deep, was noted on the downstream face of the dam

about 125 feet south of the spillway (Photo 1). Contours shown on Plate 2 indicate that this gully is upstream of a natural depression in the ground surface below the embankment.

The visible portion of the upstream face of the dam is covered with riprap, consisting of 6- to 9-inch stones. The face is covered with grass and disrupted by tree roots. Two sections of riprap about 20 feet wide have been dislodged from the upstream face of the dam; one 30 feet and another 175 feet south of the spillway (Photos 2 and 3). The upstream face of the dam was submerged below the spillway crest elevation and could not be inspected.

A concrete retaining wall protects the upstream side of the embankment north of the spillway (Plate 3 and Overview Photo). This section of the embankment is covered with trees and grass and appears to be in satisfactory condition. The embankment in this area is in the backyard of a house, the owner of which (Mr. Komanski) reported several instances of dam overtopping which flooded his basement and endangered the foundation of his house.

The remains of the emergency spillway consisting of a broken concrete slab approximately 20 feet long is located on the crest of the dam just south of the left spillway abutment (Photo 3). The top of this broken concrete slab is several inches higher than the average elevation of the embankment crest which is approximately 1.5 feet below the top of the concrete wing walls. The emergency spillway thus serves no function.

#### c. Appurtenant Structures

##### Spillway

The spillway is a mortared stone masonry structure located in the northern third of the dam. The downstream

edge of the spillway crest is badly eroded and has a very irregular outline as shown in Photo 4 and Photos A and B, Plate 4. The width of the crest has been reduced up to about one foot due to the erosion and plucking of stones in this area.

A breach in the spillway crest adjacent to the left (south) wing wall, about 10 feet long and 2 to 3 feet deep, has been filled with concrete; the surface of which is now approximately 3 inches higher than the rest of the spillway crest. Rubble masonry beneath this concrete cap has been partially undermined, and water was observed leaking through this section of the spillway (Photo 5).

Water flowing over the spillway generally obscured the downstream face of the spillway, thus restricting inspection of the spillway (Photo 6). Three concrete and stone buttresses are located along the downstream face of the dam, one in the center and the others approximately 30 feet on either side. The face of the spillway, buttresses and stone apron at the toe of the spillway appear to be significantly eroded and the bases of the two northernmost buttresses have been removed. In addition, water appeared to be flowing through the face of the spillway between the masonry stones in an area approximately 30 feet north of the left (south) abutment and 2 to 3 feet below the crest of the spillway.

Cracking and spalling of the concrete wing walls at each abutment of the spillway was noted. A vertical crack 1/8 to 1/4 inch wide, plus spalling of the concrete on the surface adjacent to the crack were noted in the center of the left (south) wing wall (Photo 7). Cracking and displacement of about 1/2 inch were also noted in the left wing wall just downstream of the downstream edge of the spillway crest (Photo 8). Nearly vertical cracks were

observed in the upstream section of the right wing wall; however, there did not appear to be any significant displacement along the cracks. Spalling of the upstream section of the right wing wall near the spillway crest elevation was also observed. Severe spalling along what appear to be horizontal construction joints is present on the downstream section of the right wing wall. A concrete sill is present at the downstream base of the right wing wall and part of the wooden form is still in place (Photo 9). It was not possible to inspect the apron because of the flow of water, but erosion is suspected, a condition which could imperil the structural stability of the spillway. Photographs taken in 1973 showing the spillway when the reservoir was empty are shown on Plate 4.

#### Outlet Works

The sluice gate and intake of the 8 inch diameter outlet pipe, described in Section 1.2-a were submerged during the visual inspection and therefore could not be observed. The outlet of the 5 feet by 2 feet rectangular conduit on the downstream face of the spillway was partly obscured by water flowing over the spillway (Photo 10). An automobile tire, cobble size stones and minor wood debris were observed in the outlet conduit. Water was flowing through the outlet conduit at a rate of about 15 gallons per minute. A photograph of the intake to the outlet works taken in 1973 when the reservoir was empty, is shown on Plate 5.

#### Reservoir Area

Single family residences surround the perimeter of the reservoir. The adjacent slopes are gentle and covered with lawns and a few trees. Ambrose Creek enters at the

east end of the reservoir and passes under a bridge at Metlars Lane.

The water in the reservoir is extremely turbid and brown in color. Considerable bottom sediment is visible from the water surface. The lake is obviously very shallow due to the heavy silt deposits. No noticeable debris was seen on the reservoir surface.

#### Downstream Channel

The discharge over the spillway falls into a pool at the base of the weir. The water depth in the pool was 0.5 to 1 foot during the inspection. A few of the cut stones which line the south embankment of the pool have been dislodged, but the sandbag lining of the southern edge appears to be in good condition. The rubble masonry wall which lines the north embankment of the pool appears to be in satisfactory condition. A soil deposit is present at the toe of this wall (Plate 3 and Photo 9).

Water flows from the pool into a natural channel generally along the north side of a 250-foot wide flood plain. The flood plain is heavily wooded and has thick undergrowth. A steel foot bridge, parallel to the spillway, is located 35 feet downstream from the spillway. This bridge crosses the downstream channel and appears to be in good condition (Photo 11).

## SECTION 4: OPERATIONAL PROCEDURES

### 4.1 Procedures

The reservoir level is generally unregulated. The sluice gates have not been operated in many years and the 8 inch diameter outlet pipe installed beneath the gates is now used in lieu of the gates to drain the reservoir. The reservoir has been lowered occasionally to repair the dam and inspect the lake bottom. The outlet pipe valve control does not have a permanent extension, and is operated by a key. The outlet pipe was reportedly last operated in 1973.

An engineering report to evaluate the problem of siltation of Lake Nelson was prepared by Robert S. Haefeli, P.E., dated August, 1971. This report concluded that the accumulation of sediments threatens the existence of the lake and recommended that the sediments should be removed.

### 4.2 Maintenance of the Dam

There has been very little maintenance work over the years. The dam is maintained by the Lake Nelson Improvement Association, Inc. Maintenance and dam repairs, including the repair of the dam crest and right (north) wing wall of the spillway described in Section 3, have been performed by volunteer members of the Association. The inspection report, prepared by Frank and Haefeli Associates, P.A., dated November 16, 1973, notes that the foot bridge and discharge channel immediately downstream from the spillway are maintained by the Township.

A breach of the spillway crest approximately 10 feet long and 2 to 3 feet deep was replaced with concrete and

embankment repairs of unknown location and extent were performed following overtopping of the dam in 1968. In 1973 concrete was placed at the base of the right (north) wing wall, just downstream of the outlet conduit, where undercutting had been observed.

4.3 Maintenance of Operating Facilities

The owner has installed an alternative reservoir drain in recent years, but there has apparently been little other work done.

4.4 Description of Warning Systems

There are no warning systems or contingency procedures at Lake Nelson Dam.

4.5 Evaluation of Operational Adequacy

The poor condition of the dam indicates that maintenance of the structure has been inadequate. The present arrangement of the outlet pipe valve control is inadequate. A permanent extension should be attached to the valve and extend up to the adjacent wing wall.

## SECTION 5: HYDRAULIC/HYDROLOGIC

### 5.1 Evaluation of features

#### a. Design Data

The capacity of Lake Nelson Dam Reservoir is 40 acre-feet at the spillway crest and 85 acre-feet at the dam crest. The embankment height is 10.5 feet. In accordance with Corps' guidelines, the dam is classified as small in size. The small capacity of the reservoir and absence of buildings or major roads within the potential flood area downstream of the dam indicates that failure of the dam should not result in a significant downstream hazard to loss of life or property damage. Thus, the dam is classified as low hazard and the Spillway Design Flood (SDF) is the 100-year frequency flood.

Data obtained from State files indicate the drainage basin area of the Dam is 5.0 square miles. Elevations range from a maximum of about 100 feet mean sea level along the perimeter of the drainage basin to a minimum of about 60 feet mean sea level in the valley floor. Over 50 percent of the land within the watershed is occupied by commercial, industrial, and residential developments. About 0.5 percent of the watershed area is the reservoir of the dam. The drainage basin is delineated on a U.S.G.S. topographic map and is presented on Plate D-1, Appendix D.

The hydraulic and hydrologic features of the dam were evaluated using criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance and criteria

provided by the Philadelphia District, Corps of Engineers. The 100-year frequency precipitation was calculated using NOAA Technical Memorandum NWS HYDRO-35 for precipitation durations less than 60 minutes and U.S. Weather Bureau Technical Paper No. 40 for precipitation duration greater than 60 minutes.

The SDF was calculated using the Corps' computer program HEC-1, Dam Break Version. In computing the SDF the Corps requested that the Soil Conservation Service triangular unit hydrograph with curvilinear transformation be used. The computer program was used to calculate this unit hydrograph from the basin lag. A lag time of 2.0 hours was calculated for the basin and used in the program.

An initial infiltration loss of 0.5 inch and a constant infiltration loss rate of 0.05 inches per hour were used in the HEC-1 program to give the rainfall excess. These values were selected because a large percentage of the basin area is developed. Using the excess rainfall and the unit hydrograph, the program computed the peak discharges of the 10 percent, 25 percent, 50 percent and 100 percent SDF. These discharges are approximately 435 cfs, 1090 cfs, 2180 cfs, and 4350 cfs, respectively.

The various percentages of the SDF inflow hydrograph were routed through the reservoir using the Modified Puls Method by the HEC-1 program. The peak outflow discharges of the 10 percent, 25 percent, 50 percent and 100 percent SDF were calculated to be approximately 370 cfs, 1070 cfs, 2140 cfs and 4270 cfs, respectively. The flood routings indicate that all floods greater than about 16 percent of the SDF will overtop the dam.

A plot of percent SDF versus peak outflow is presented as Plate D-2 in Appendix D.

The spillway and overtop stage-discharge rating curve used in the flood routings was calculated using the weir equation and assuming free overflow across the entire length of the dam and spillway. The spillway is a 3-foot wide weir with a reported discharge coefficient of 2.6. The dam crest is a round-crested weir with an estimated discharge coefficient of 2.6. The reservoir stage-storage curve was determined from U.S. Geological Survey 7.5-minute topographic maps and data obtained from State files. This stage-storage curve, adjusted for sediments, was extended above the dam crest to include surcharge storage during peak flood discharges. In the reservoir routing computations possible discharges through the outlet works were excluded because their capacity is small compared to the SDF and because of the possibility that the outlet valves may be inoperable. The stage-storage and the spillway and overtop stage-discharge curves are presented in Appendix D as Plates D-3 and D-4, respectively.

The various percentages of the SDF were routed 2.8 miles downstream through three successive reaches to the township of Possumtown, which has a population of approximately 36,000. These routings were made to determine downstream flooding characteristics without dam failure. These flooding characteristics were compared to those that would result assuming the dam fails because of the inadequate capacity of its spillway. From this comparison the seriousness of the spillway's inadequacy was assessed.

The hydraulic parameters used in the HEC-1 program

for the downstream routing calculations were estimated based on observations made in the field and information obtained from U.S.G.S. topographic maps. The locations of the channel cross-sections used in these routings are shown on page D-8, Appendix D.

The breach parameters used in the HEC-1 analysis are: the breach is trapezoidal in shape with 45-degree side slopes, 410 feet wide at the base, will extend to the approximate original reservoir floor elevation (50.5'), will begin breaching when the dam is first overtopped, and will develop to its maximum size in 2.0 hours.

The flooding characteristic at the township of Possumtown, (Pop. 36,000 approximately), for the various percentages SDF are summarized in the following tabulation:

<u>No Breaching</u>	<u>10% SDF</u>	<u>25% SDF</u>	<u>50% SDF</u>	<u>100% SDF</u>
Peak Discharge, cfs	275	725	1580	3370
Peak Flow Depth, ft.	3.9	5.1	6.6	8.1
Peak Flow Width, ft.	125	255	420	560
Peak Flow Velocity, fps	1.9	2.0	1.8	2.1
 <u>Breaching</u>				
Peak Discharge, cfs	275	1080	1930	3570
Peak Flow Depth, ft.	3.9	5.9	6.9	8.3
Peak Flow Width, ft.	125	345	455	610
Peak Flow Velocity, fps	1.9	1.8	1.9	2.0

As shown in the above tabulation, there would be little increase in downstream flooding should the dam fail, during any of the specified flood events.

Information obtained from the dam owners indicates that the only operable drain for the reservoir is an 8-inch diameter pipe through the dam that discharges into the downstream spillway channel. Using the orifice flow equation, and assuming no inflow into the reservoir or tailwater, the time required to drain the reservoir

from the spillway crest elevation was calculated to be a little over 6 days.

b. Experience Data

Records of lake levels are not maintained for this site. The reservoir is unregulated, used for recreation and therefore is generally at or near its spillway level. The dam owners report that the dam has been overtopped several times.

c. Visual Observations

There is a well defined spillway channel downstream of the embankment. Dwellings were observed on both sides of the immediate downstream channel. However, those dwellings appeared to be at an elevation equal to or greater than the spillway crest. The flood plain below the dam contains a fairly dense stand of medium and small trees with significant undergrowth (Photo 11).

d. Overtopping Potential

As indicated in Section 5.1-a, Lake Nelson Dam spillway can pass only 16 percent of the SDF. During the SDF the embankment would be overtopped for about 7.0 hours and would have a maximum overtopping stage about 1.8 feet above the dam crest. These overtopping heights assume the dam remains in its current condition. It is highly probable that the embankment would be breached during overtopping at this duration and the core wall is not expected to provide adequate protection against breaching. However, failure is not expected to increase the potential hazard to loss of life or property damage nor is the dam classified as high hazard. Therefore, in accordance with the Corps' Guidelines, the spillway for Lake Nelson Dam should be classified as Inadequate.

## SECTION 6: STRUCTURAL STABILITY

### 6.1 Evaluation of Structural Stability

#### a. Visual Observations

Visual inspection indicates that the dam, and the spillway in particular, shows signs of distress. The seepage and the severe erosion of the spillway crest, downstream face and possible undercutting at the toe, plus the cracking of the concrete wing walls jeopardize the structural stability of the spillway. Local erosion noted on the southern slope does not appear to presently be severe enough to affect the structural strength or stability but could cause problems if left unchecked. There has apparently been general erosion and possibly settlement of this embankment which has lowered the crest elevation approximately 1.5 feet.

The intake to the outlet works was submerged during inspection and could not be observed; however, flow through the outlet conduit indicates that there is leakage around or through the outlet pipe.

#### b. Design and Construction Data

The available design and construction data are inadequate to evaluate the structural stability of the dam since little is known of design criteria, construction methods or as-built material properties.

#### c. Operating Records

The reservoir is essentially uncontrolled except for occasional draining of the reservoir for repairs to the dam and inspection of the reservoir bottom.

Records of reservoir levels and water withdrawals are not available, and there are few records of operation and maintenance. There is no instrumentation of the dam.

d. Post-Construction Changes

The elevation of the crest of the embankment is presently approximately 1.5 feet lower than shown on the plan for dam modifications (Plate 2). Therefore, it appears that the embankment crest has been significantly eroded and possibly settled since its reconstruction in 1927.

The breach through the spillway crest adjacent to the left (south) abutment was repaired by placing a concrete cap in the eroded section. Water was observed seeping through the face of the spillway beneath the concrete cap and erosion causing partial undermining of the concrete cap has occurred. Therefore, the structural stability of this section of the spillway is questionable.

The concrete placed to repair the erosion at the base of the right (north) wing wall appears to be in satisfactory condition.

An 8-inch diameter pipe has been installed to be used in place of the wooden sluice gates. The outlet pipe and sluice gates were submerged during the inspection; therefore, their structural integrity cannot be evaluated.

e. Seismic Stability

Since the area lies within Seismic Zone 1, only minor damage may be expected from distant earthquakes. In general, projects located within Seismic Zone 1 may be assumed to present no hazard from earthquakes, provided static stability conditions are satisfactory and conventional safety margins exist. However, static stability analyses are not presently available.

SECTION 7: ASSESSMENT, RECOMMENDATIONS,  
PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The safety of Lake Nelson Dam cannot be quantitatively analyzed due to lack of available data. However, visual inspection indicates that the dam is in very poor condition. The seepage and the severe erosion of the spillway crest, downstream face and possible undercutting at the toe, plus the cracking of the concrete wing walls jeopardize the structural stability of the spillway. Local erosion noted on the southern slope is not presently severe enough to affect the structural strength or stability but could cause problems if left unchecked.

Observation of the downstream channel from the dam and U.S.G.S. maps indicate that there are no buildings or major roads which would be significantly influenced by a flood resulting from failure of the dam. Therefore, the dam is classified as low hazard.

The hydrologic and hydraulic analyses discussed in Section 5 indicates that the present spillway is inadequate and can pass only approximately 16% of the 100-year frequency flood.

b. Adequacy of Information

The information and data obtained are not adequate to perform a comprehensive, definitive evaluation of the dam's structural stability.

c. Urgency

The visual inspection revealed critical deficiencies that imperil the integrity of the structure. It is recommended that the owners perform the remedial measures discussed below in the near future.

d. Necessity fo Additional Data/Evaluation

At the present time there is insufficient information available to fully evaluate the structural stability of the dam. However, due to the low hazard potential classification, no additional data or evaluations are considered necessary at this time.

7.2 Remedial Measures

Failure of Lake Nelson Dam would not result in a significant downstream hazard to loss of life or property damage. However, in order to maintain the integrity of the structure, it is suggested that the owners perform the following remedial measures in the near future:

1. The reservoir should be lowered below the spillway crest so that a thorough inspection of the spillway can be performed to determine deficiencies.
2. The downstream edge of the spillway sill should be repaired at areas showing erosion.
3. The base of the two buttresses at the northern end of the downstream face of the spillway should be reconstructed.
4. The eroded portion of the spillway beneath the concrete cap should be repaired and the concrete cap reconstructed.
5. The erosion of the apron at the toe of the spillway should be repaired and any possible undermining filled with concrete and stone.

5. The cracks and spalls in the concrete wing walls should be repaired.
6. The gully on the downstream face of the south embankment should be filled with suitable earth and compacted.
7. Riprap should be placed at sections at the upstream face of the embankment where the original riprap has been removed or dislodged.
8. A practical extension should be added to the outlet pipe valve so that it can be operated from the top of the adjacent wing wall.

A long term solution would be to remove the spillway and replace it with a new structure or enclose the existing structure in a new one and restore the embankment sections.

b. Operation and Maintenance Procedures

A program of annual inspections of the dam should be initiated, utilizing the standard visual checklist in this report. Inspection of the outlet works should be performed when the reservoir is sufficiently low to observe these facilities. In addition, the dam should be carefully inspected should it be overtopped, in order to detect additional erosion or other detrimental effects on the structure.

A permanent record should be kept of all maintenance and operating events of the dam and reservoir.

PLATES

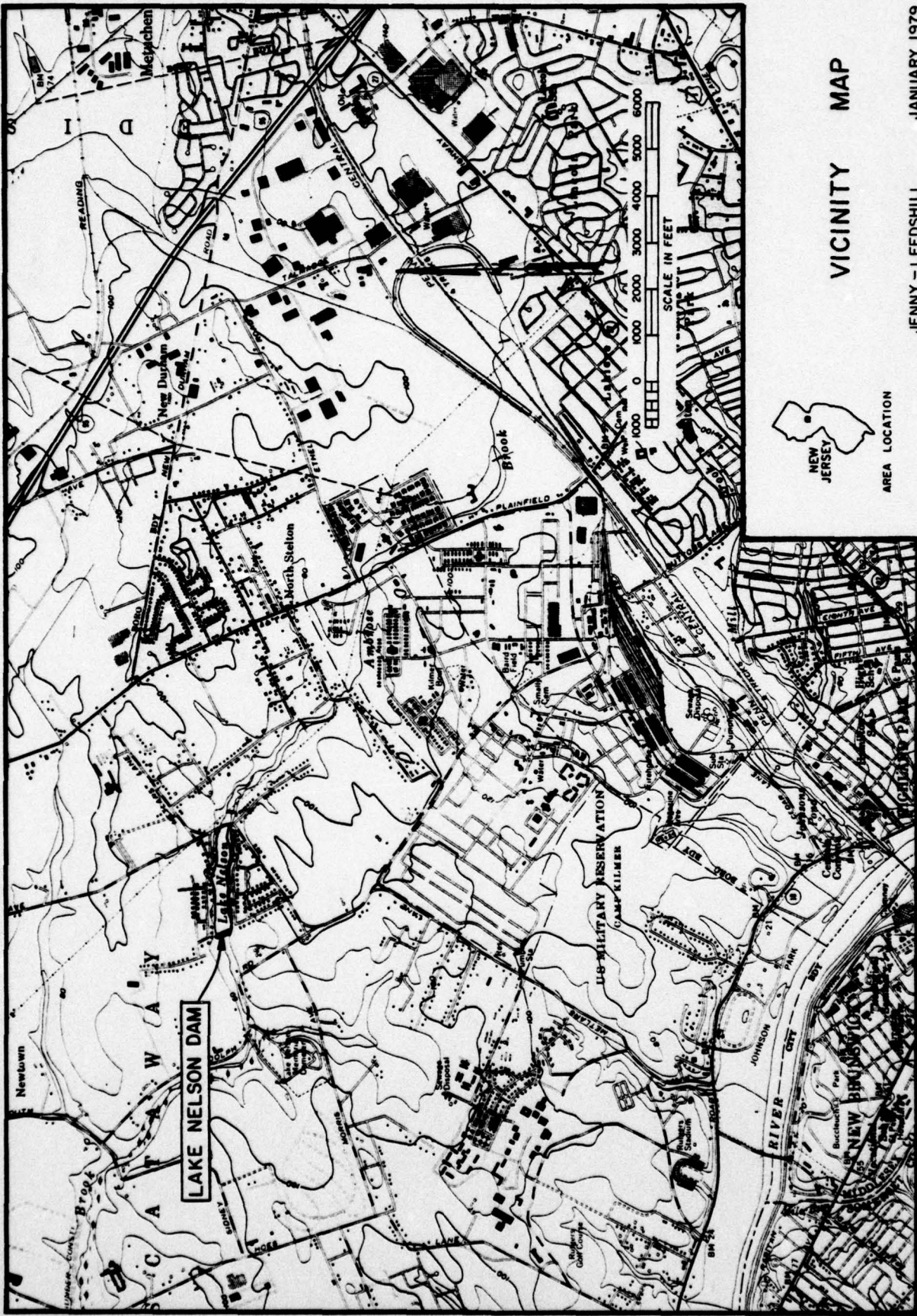
JANUARY 1979

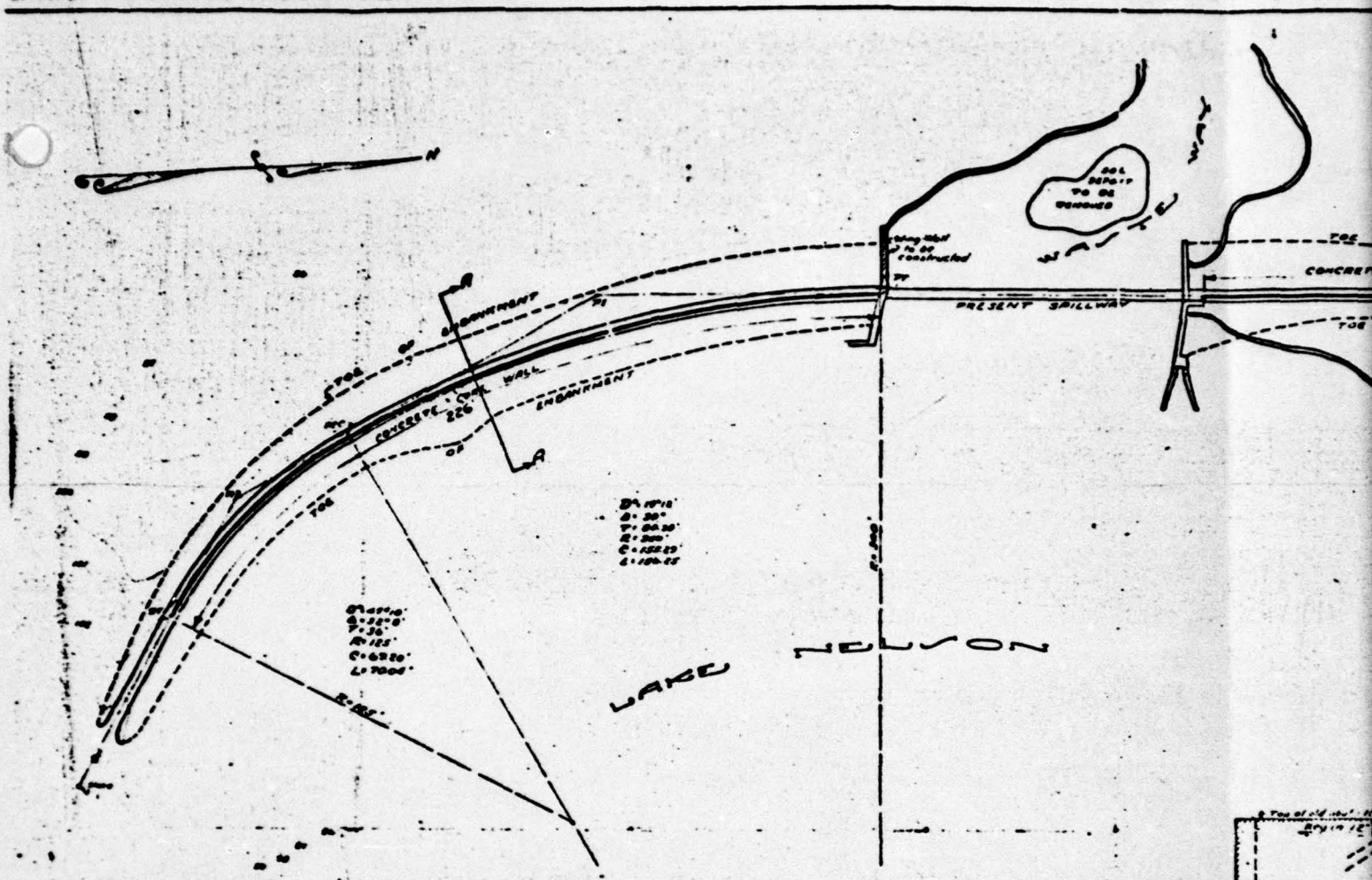
JENNY - LEEDSHILL

VICINITY MAP



AREA LOCATION



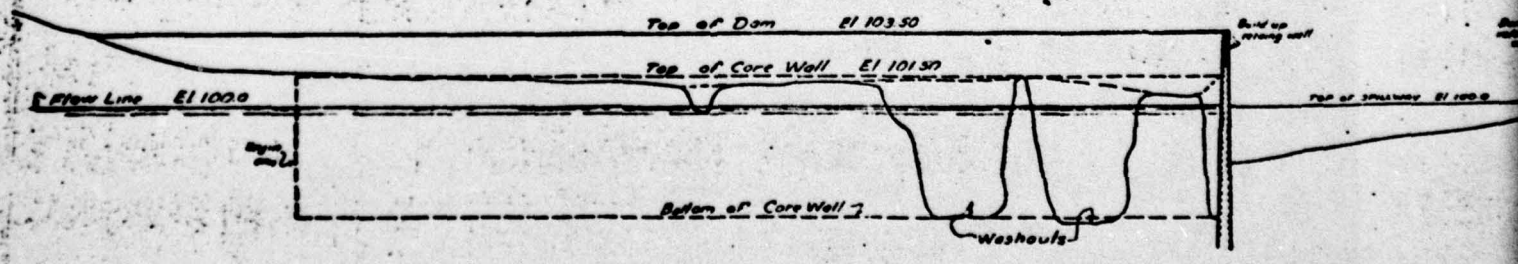


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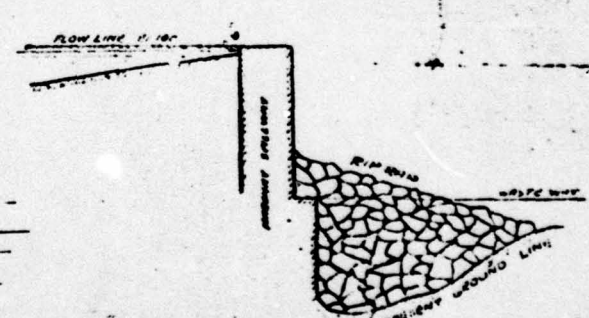
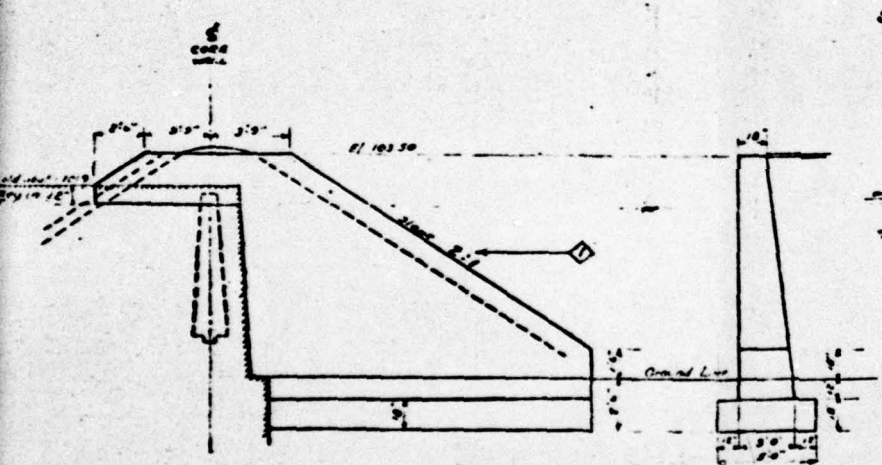
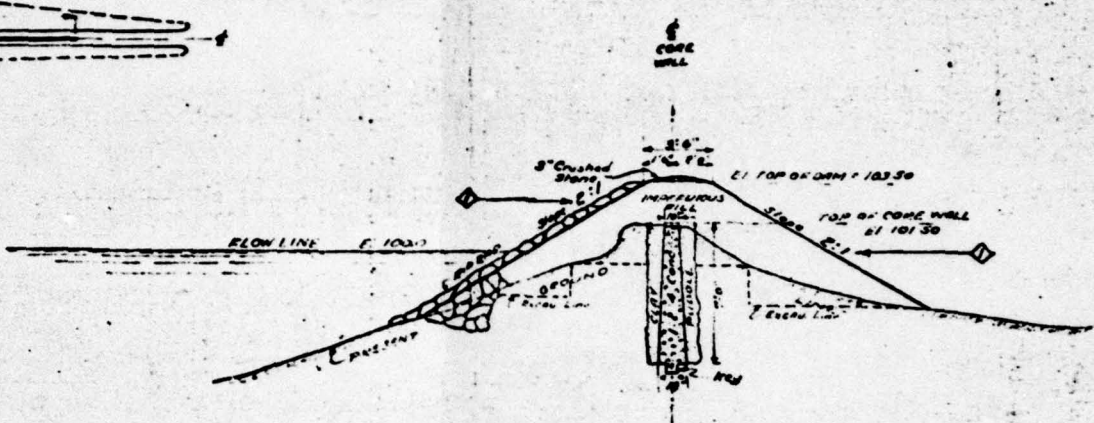
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LAKE NELSON

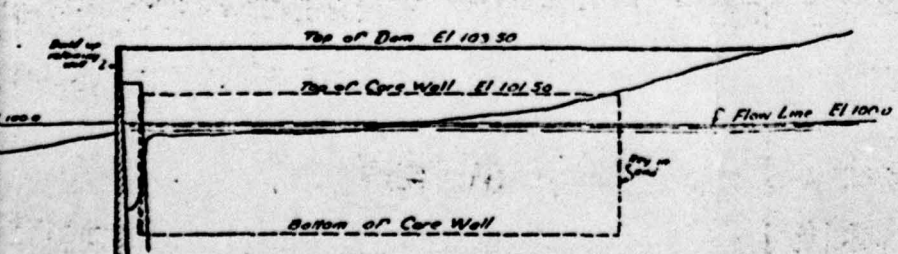
PLAN VIEW  
 SCALE 1"=20'



PROFILE  
 SCALE - VERT. - 1"=10'  
 HOR. - 1"=20'

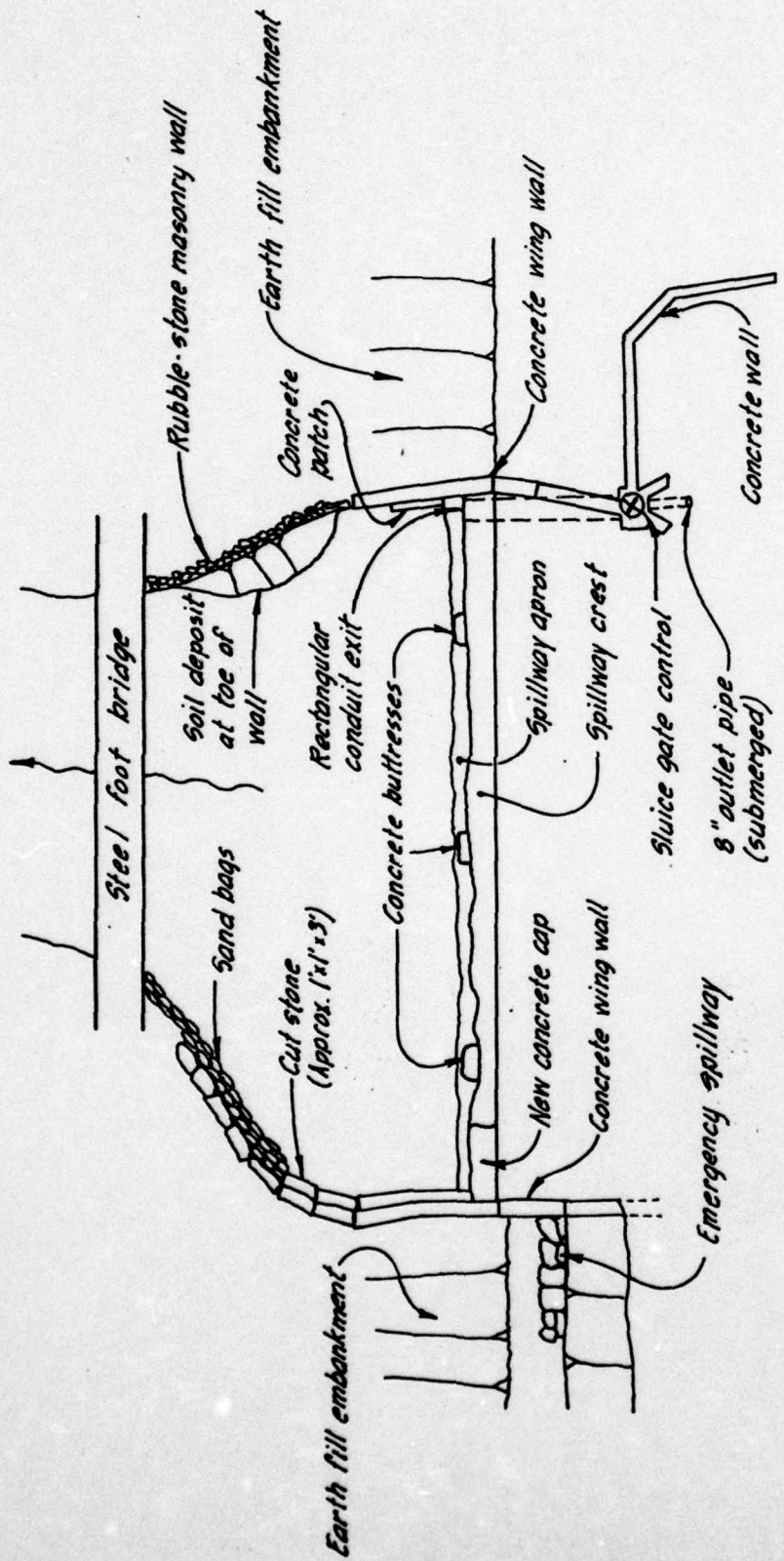


2



NO.	REVISIONS	DATE
1	Bank Slopes Modified	10/1/56

PROPOSED RECONSTRUCTION  
OF  
**LAKE NELSON DAM**  
AT  
NEW MARKET, N.J.  
OCT 1, 1956 SCALE 1/4" = 1'-0"



RESERVOIR



LAKE NELSON DAM  
 SPILLWAY PLAN

GENERALIZED SKETCH BASED ON DEC. 6, 1978  
 VISUAL FIELD INSPECTION

JENNY - LEEDSHILL  
 JANUARY 1979

Not to scale



Photo A View of southern half of spillway (Oct. 28, 1973)  
(Photo courtesy of Haefeli Engineering, P.A.)



Photo B View of northern half of spillway (Oct. 28, 1973)  
(Photo courtesy of Haefeli Engineering, P.A.)

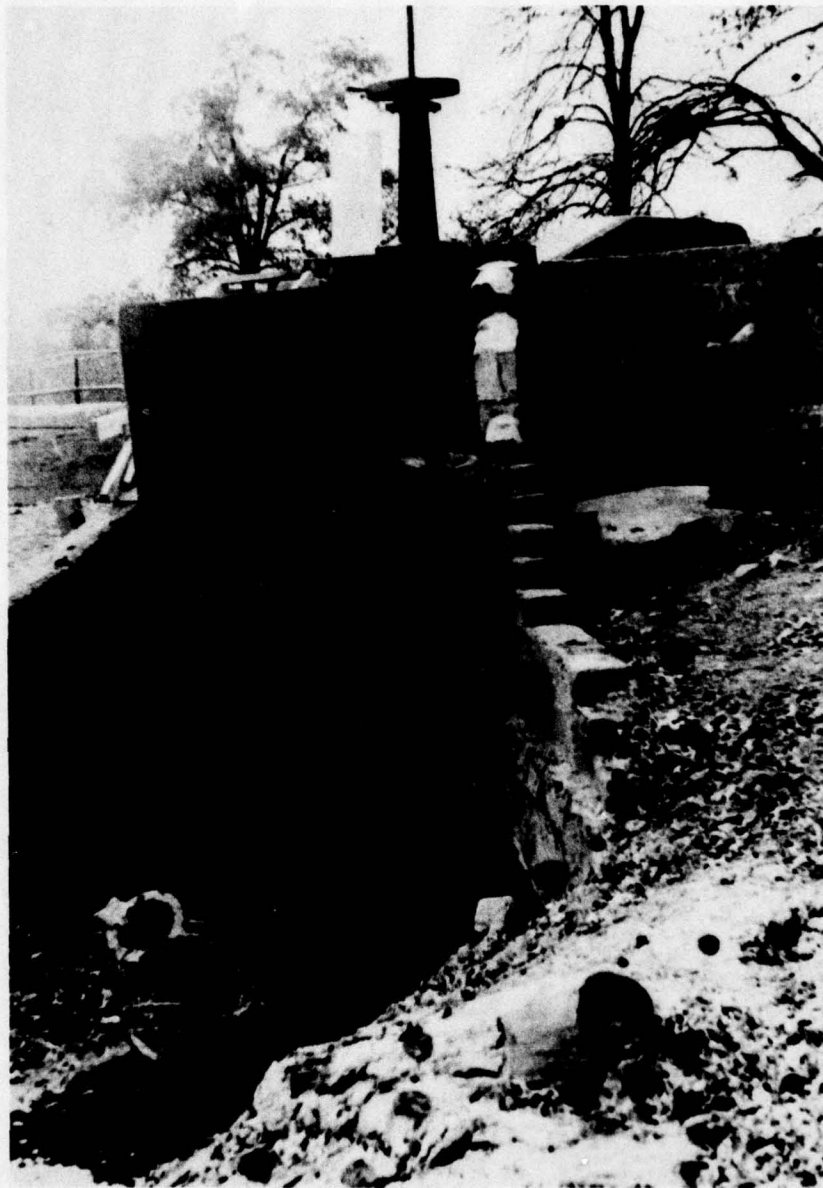


Photo C View of intake to outlet works looking  
downstream (Oct. 28, 1973)  
(Photo courtesy of Haefeli Engineering, P.A.)

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS  
CHECK LIST - ENGINEERING, CONSTRUCTION  
MAINTENANCE DATA

Check List  
Visual Inspection  
Phase 1

Name Dam Lake Nelson County Middlesex State New Jersey Coordinator NJDEP  
Dec. 6 and  
Date(s) Inspection 21, 1978 Weather clear Temperature 43°F  
Coordinates: Lat. 40° 32' 28" N  
Long. 74° 26' 40" W

Pool Elevation at Time of Inspection 56.5 ft M.S.L. Tailwater at Time of Inspection 49 ft. M.S.L.  
(Spillway crest) (Approx.)

Inspection Personnel:  
December 6, 1978

R. C. Gaffin

P. L. Wagner

December 21, 1978

R. J. Jenny

D. J. Lachel

F. L. Panuzio

R. C. Gaffin

December 21, 1978

A. R. Slaughter

Recorder

Owner Representative: (December 6, 1978)

Mrs. L. Loveland - President, Lake Nelson Improvement Assoc.

CONCRETE/MASONRY DAMS  
(None)

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Not Applicable	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not Applicable	
DRAINS	Not Applicable	
WATER PASSAGES	Not Applicable	
FOUNDATION	Not Applicable	

CONCRETE/MASONRY DAMS  
(None)

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not Applicable	
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Not Applicable	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Moderate and locally severe erosion of downstream face of embankment. Erosional gully approximately 20 feet long and 1 to 2 feet deep noted on the downstream face approximately 125 feet south of left spillway abutment. Present dam crest is approximately 1.5 feet lower than shown on design plan (Plate 2) Telephone pole located in center of right abutment.	Gully should be filled with suitable earth and compacted.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Arched shaped embankment, concave upstream. Remains of emergency spillway immediately left of the left abutment of main spillway, is higher than average embankment crest.	
RIPRAP FAILURES	Riprap approximately 6" x 6" eroded from + 20' long sections approximately 30 and 175 feet south of spillway. Riprap is overgrown with grass and disrupted by tree roots.	Riprap should be replaced.

EMBANKMENT

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy growth of trees and partially covered with grass.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Some erosion of embankment noted adjacent to left (south) spillway wing wall.	Erosion is probably aggravated by pedestrian traffic.
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Wood debris and loose stones were observed in the outlet conduit. Limited visibility into outlet conduit due to water spilling over spillway.	
INTAKE STRUCTURE	Submerged during the inspection and therefore could not be observed.	Sluice gates were reportedly not operated in numerous years.
OUTLET STRUCTURE	Rectangular conduit 2 ft. x 5 ft. exits at lower right side of spillway. Approximate flow through conduit of about 15 gpm was observed during inspection.	
OUTLET CHANNEL	Same as spillway.	
EMERGENCY GATE	8-in. diameter pipe and sluice gate. See above.	

UNGATED SPILLWAY

Lake Nelson

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Sill is heavily eroded. The left (south) end of the spillway has been repaired with a concrete cap which is approximately 3" higher than the rest of the spillway crest. The base of the two right buttresses have been seriously eroded. Possible leakage through left face of spillway.	Eroded sections of spillway sill, face and buttresses should be repaired.
APPROACH CHANNEL	Considerable sedimentation reported. Water depth + 1.5' immediately upstream of spillway crest.	
DISCHARGE CHANNEL	Natural channel of embankment walls reverted with stone and sand bags immediately downstream from spillway. Masonry apron at toe of spillway.	
BRIDGE AND PIERS	Not Applicable	
WING WALLS	Cracking and spalling of both concrete wing walls noted. Crack displacement up to 1" at left wing wall.	Cracks and spalls should be repaired or wing walls reconstructed.

**INSTRUMENTATION**

(None)

Lake Nelson

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

**RESERVOIR**

Lake Nelson

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<b>SLOPES</b>	Gentle slopes with single family residents. Grass lawns with few trees.	
<b>SEDIMENTATION</b>	Brown extremely turbid water. Reservoir is reportedly heavily silted.	

DOWNSTREAM CHANNEL

Lake Nelson

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<b>CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)</b>	Steel foot bridge located approximately 35 feet downstream from spillway. Flood plain has numerous trees and dense brush.	
<b>SLOPES</b>	Broad flood plain with low, gently sloping adjacent slopes.	
<b>APPROXIMATE NO. OF HOMES AND POPULATION</b>	Approximately 10 single family residents located adjacent to flood plain, at an elevation greater than the spillway crest, visible from dam.	

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
PLAN OF DAM	Plan and sections of dam shown on drawing titled, 'Proposed Reconstruction of Lake Nelson Dam,' dated October 1, 1926.
REGIONAL VICINITY MAP	Reservoir is shown on U. S. Geological Survey, Plainfield Quadrangle (Scale 1:24,000).
CONSTRUCTION HISTORY	History of dam is described in "Engineering Report: Lake Nelson Environmental Protection and Improvement, August 1971; prepared by Robert J. Haefeli, P.E., Consulting Engineers, Edison, N.J.
TYPICAL SECTIONS OF DAM	See 'Plan of Dam'
HYDROLOGIC/HYDRAULIC DATA	Lake area-depth curve and reservoir storage curve for various sediment levels are included in 'Engineering Report: Lake Nelson Environmental Protection and Improvement, August 1971; prepared by Robert J. Haefeli, P. E.
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	See 'Plan of Dam' Sketches included with letter regarding Lake Nelson Dam Inspection dated Nov. 16, 1973, prepared by Frank and Haefeli Associates, P.A.
RAINFALL/RESERVOIR RECORDS	None Available

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
DESIGN REPORTS	None
GEOLOGY REPORTS	None
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Spillway capacity calculations prepared by the State for increase in freeboard, 3/2/27. None None
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Not Known

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM	REMARKS
SPILLWAY-PLAN -SECTIONS -DETAILS	Plan and section of main spillway shown on drawing titled, 'Proposed Reconstruction of Lake Nelson Dam,' dated Oct. 1, 1926. No information regarding emergency spillway. No details available.
OPERATING EQUIPMENT PLANS & DETAILS	Not available
MONITORING SYSTEMS	None
MODIFICATIONS	See 'Plan of Dam'
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	'Engineering Report: Lake Nelson Environmental Protection and Improvement, August, 1971. Report prepared by Robert J. Haefeli, P. E.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Dam has reportedly been overtopped several times and was severely breached in 1926.

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

Lake Nelson

ITEM

REMARKS

MAINTENANCE  
OPERATION  
RECORDS

None Available

APPENDIX B

PHOTOGRAPHS

(Note: All photographs were taken on Dec. 6, 1978)



Photo 1 View of downstream face of south embankment  
looking north



Photo 2 View of upstream face of dam from south  
abutment looking north



Photo 3 View of embankment crest looking south from spillway



Photo 4 View of spillway crest looking north



Photo 5 View of downstream face of spillway at left  
(south) abutment



Photo 6 View of downstream face of spillway looking  
north

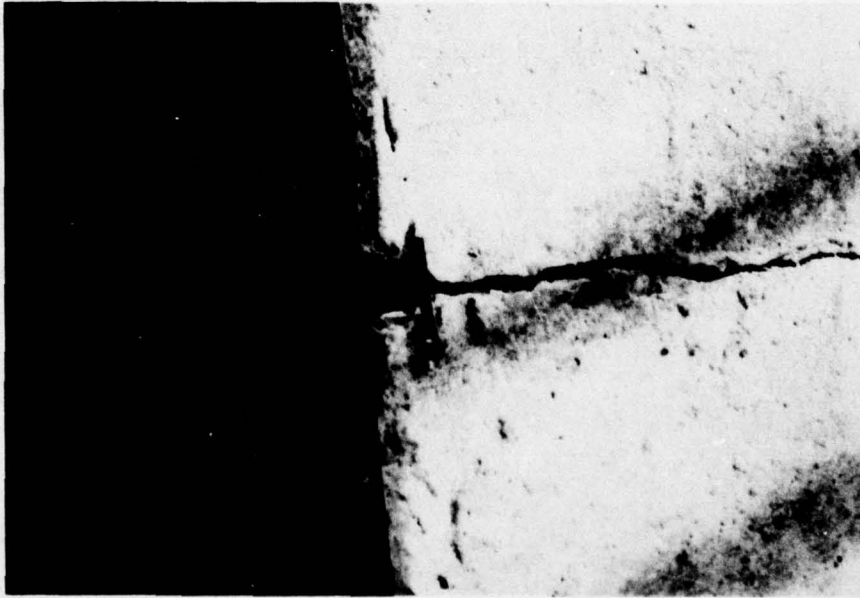


Photo 7 Vertical view of crack  
at center of left (south)  
wing wall



Photo 8 View of crack  
in left (south) wing wall  
just downstream of spillway  
crest



Photo 9 Overview of right (north  
spillway abutment

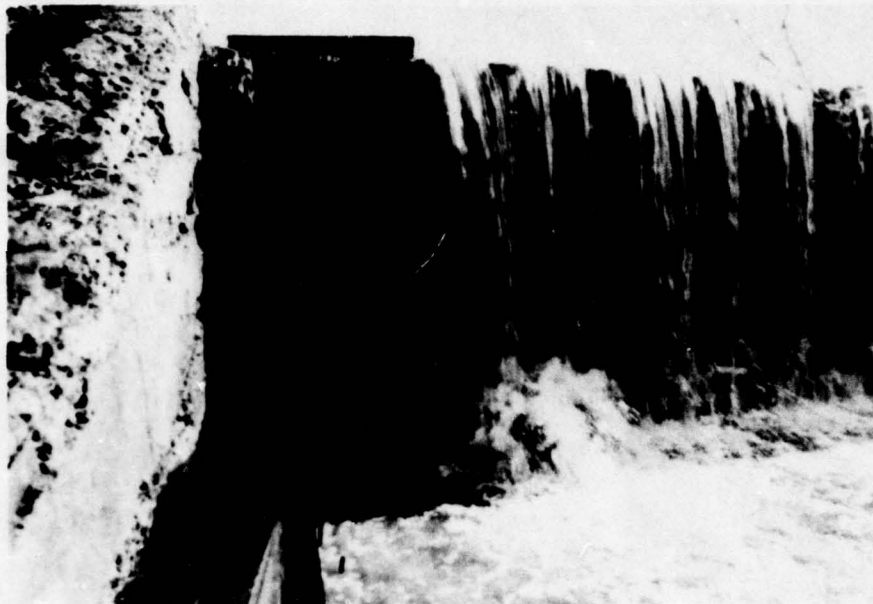


Photo 10 View of downstream face of spillway showing outlet conduit  
(Board placed on spillway crest is not part of the structure)



Photo 11 View looking downstream from spillway crest

APPENDIX C

REGIONAL GEOLOGY - PIEDMONT LOWLANDS

## REGIONAL GEOLOGY - PIEDMONT LOWLANDS

### Physiography

The Piedmont Lowlands Province of New Jersey lies northwest of a line approximately between Trenton and Perth Amboy and southeast of an approximate line between Milford on the Delaware River and Mahwah near the New York State border. Physiographically, the province is situated between the predominantly Precambrian age New Jersey Highlands Province to the northwest and the typically unconsolidated Cretaceous age and younger sediments of the Coastal Plain Province to the southeast. (See Figure C-1).

### Bedrock

The Piedmont Lowlands, encompassing about one-fifth of the state, is characterized by northwestward dipping bedrock composed of interbedded red shales, siltstones and sandstones of Triassic and Jurassic age and igneous basalt extrusions (lava flows) and diabase intrusions of Jurassic age. The sedimentary rocks have been eroded to a broad southeastward sloping piedmont plain. The northwest border of the province is a north-east-southwest trending fault zone (Ramapo Fault) which truncates the sedimentary beds. Total vertical displacement on the fault may reach 10,000 feet.

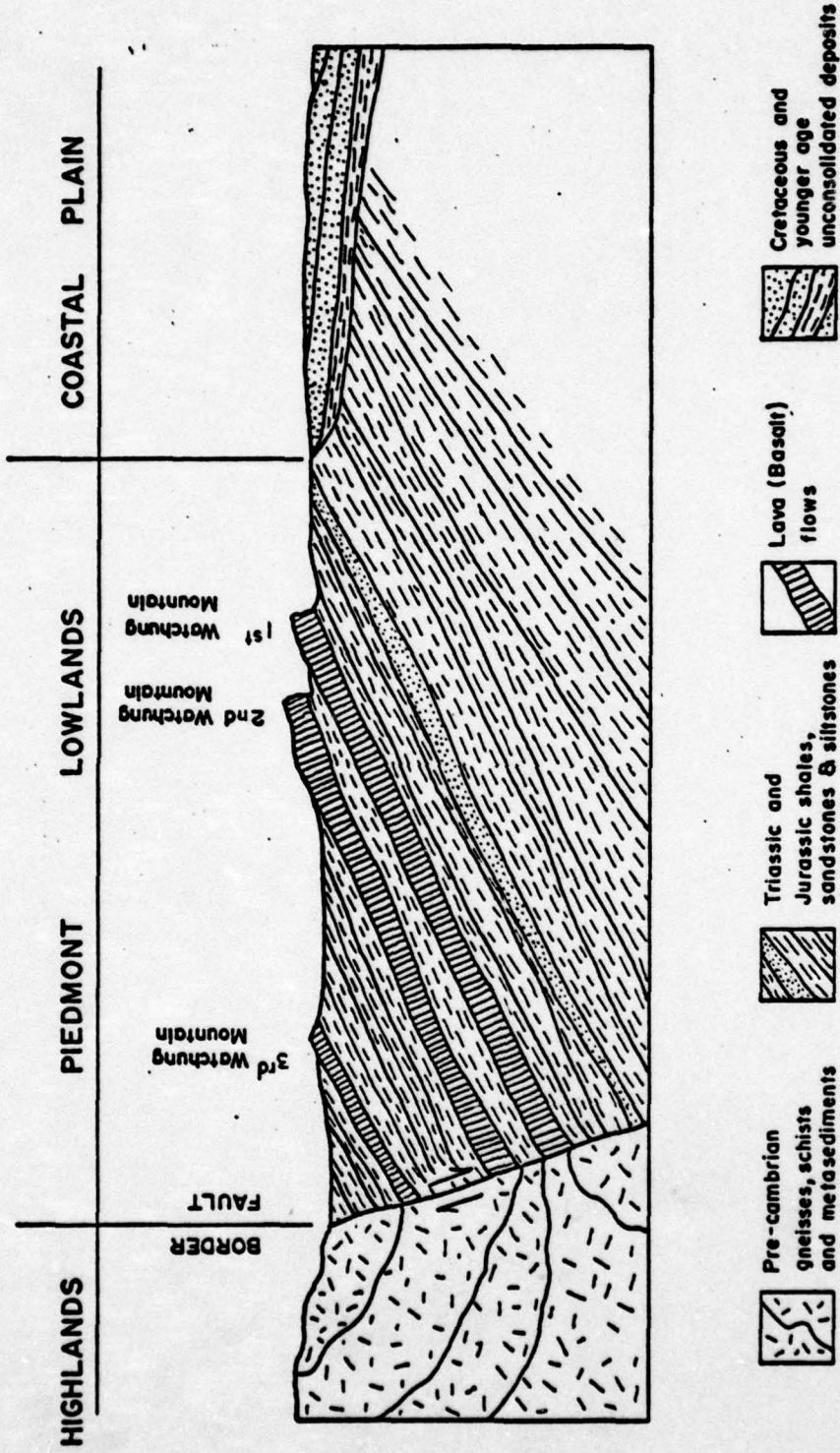
The gently rolling lowland topography of the piedmont lowlands is pierced by long asymmetric ridges of hard

and resistant igneous rocks which were intruded into or on top of the sedimentary sequences. With the subsequent erosion of the softer sedimentary rocks, these igneous formations have been left standing, often in bold relief, up to 400 ft. above the surrounding plains. The igneous bodies composed of diabase and basalt form the Palisades along the Hudson River and the three Watchung Mountain ridges of the central Piedmont. The ridges are all steeper on the southeast with gentle dip slopes to the northwest.

#### Overburden

The Pleistocene Age Wisconsin continental glacier has smoothed and filled approximately the northern half of the province. The terminal moraine of the glacier extends from Perth Amboy to Summit then northward to Morris Plains. North of the morainal line the soils characteristically consist of glacial tills overlying the bedrock with scattered overlying stratified outwash deposits. At least three large glacial lakes occupied portions of the area north of the moraine at different periods, resulting in a relatively flat topography composed predominantly of silts and clays.

South of the terminal moraine, most of the overburden consists of alluvial deposits overlying a more highly developed weathered transition zone on top of the bedrock. Some highly weathered tills of pre-Wisconsin glaciation can be found on the top of intervalley ridges. Much of the alluvium is glacial outwash.



SCHEMATIC CROSS-SECTION OF  
NEW JERSEY PIEDMONT LOWLANDS  
PHYSIOGRAPHIC PROVINCE

JENNY / LEEDSHILL  
JANUARY 1979

FIGURE C-1

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.0 SQ. MI.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 56.5 FT (40 AF)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 60.3 FT.

ELEVATION TOP DAM: 58.5 FT

CREST: SPILLWAY

- a. Elevation 56.5 FT
- b. Type MASONRY WALL
- c. Width 3'
- d. Length 83'
- e. Location Spillover Northern Third
- f. Number and Type of Gates NONE

OUTLET WORKS: \_\_\_\_\_

- a. Type 1-8" PIPE (Wooden check gate removable)
- b. Location Right side of spillway
- c. Entrance inverts 50.5 FT
- d. Exit inverts 48.3 FT
- e. Emergency draindown facilities Same as (a)

HYDROMETEOROLOGICAL GAGES: NONE

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE: 610 CFS

LEEDS, HILL AND JEWETT, INC.

BY RRE DATE 7/10/11 CLIENT N.J. SHEET NO. OF  
CHKD. DATE JOB LAKE NELSON JOB NO. 302-03

### RAINFALL DURATION CURVE

REF. <sup>1</sup>DURATION < 1 hr HYDRO-35" FIVE TO 60 MINUTE PRECIPITATION  
FREQUENCY FOR THE EASTERN AND CENTRAL  
UNITED STATES" JUNE 1977 NOAA

<sup>2</sup>DURATION > 1 hr TECH PAPER No. 40  
"RAINFALL FREQUENCY ATLAS OF THE UNITED  
STATES" U.S. DEPT OF COMMERCE MAY 1961

CENTROID LOCATION LAT. 40° 32'  
LONG. 74° 25'

100 YEAR

DURATION (HRS)	RAINFALL (IN)
1/4	1.64 <sup>1</sup>
1/2	2.33 <sup>1</sup>
1	3.11 <sup>2</sup> 3.05 <sup>1</sup> <u>USE 3.1</u>
2	3.81 <sup>2</sup>
3	4.25 <sup>2</sup>
6	5.21 <sup>2</sup>
12	6.21 <sup>2</sup>
24	7.21 <sup>2</sup>

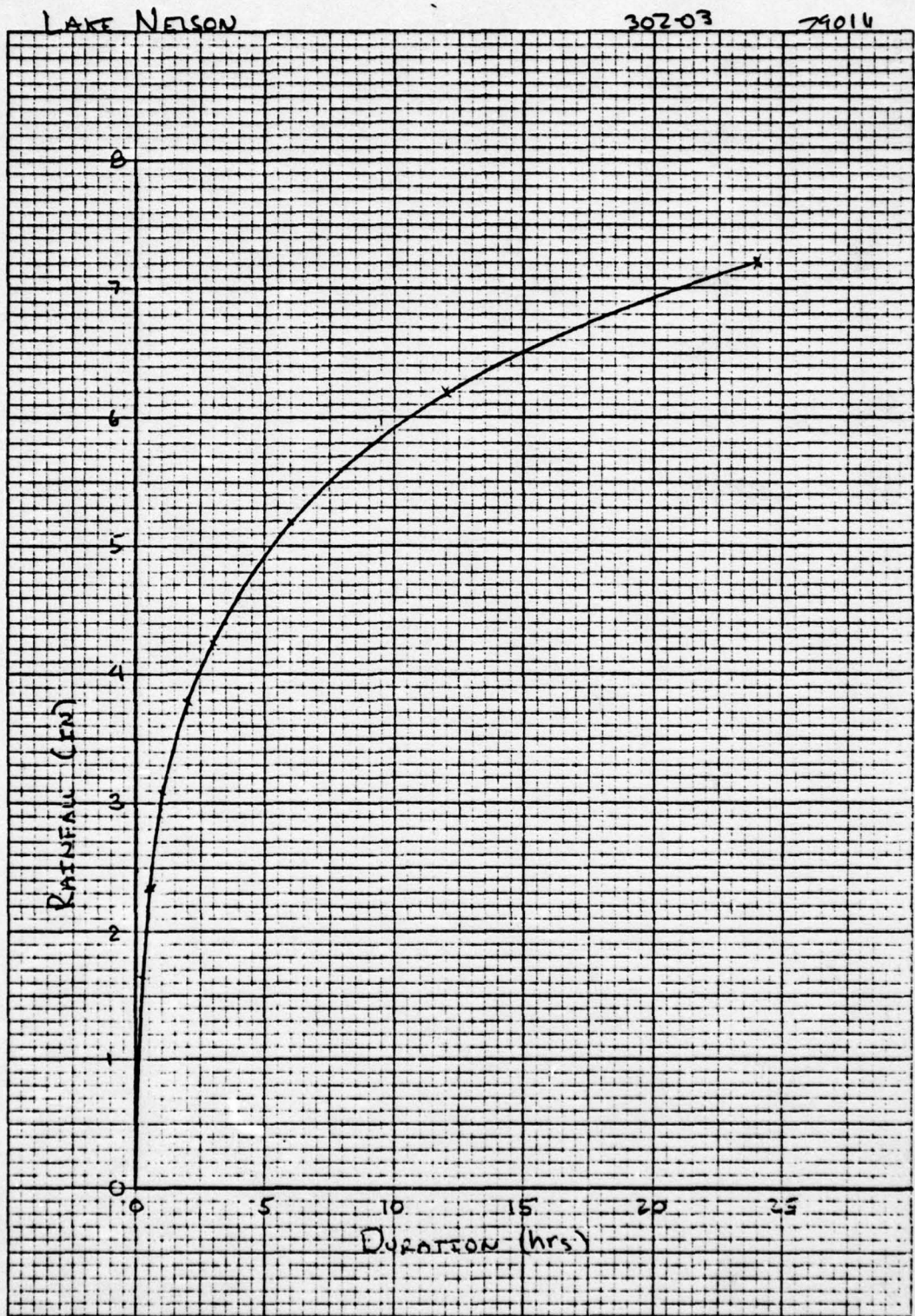
$$t_{30 \text{ MIN}} = 0.49 t_{60 \text{ MIN}} + 0.51 t_{15 \text{ MIN}} \quad \text{21}$$

$$t_{30 \text{ MIN}} = 2.33''$$

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CLEARPRINT PAPER CO. C38 10 X 10 DIVISIONS PER INCH. 70 X 100 DIVISIONS.



D-3

CHAMPION LINE NO. C36-P LEEDS, HILL AND JEWETT, INC.

BY RRE DATE 7/10/11 CLIENT N.T

SHEET NO. OF

CHKD DATE JOB LAKE NELSON

JOB NO. 302-03

1	2			4	7			9
	DURATION (hrs)	RAINFALL (IN) Δ	Σ		DURATION hrs	RAINFALL (IN) Σ	Δ	
3	0	0	0		12 1/4		.02	0.42
4	1/4	1.64	1.64	↑	12 1/2			0.2
5	1/2	2.33	0.69		12 3/4			0.15
6	3/4	2.75	0.42		13			0.1
7	1	3.1	0.35		13 1/4			0.15
8	1 1/4	3.3	0.2		13 1/2			0.1
9	1 1/2	3.5	0.2		13 3/4			0.05
10	1 3/4	3.65	0.15		14			0.1
11	2	3.8	0.15		14 1/4			0.05
12	2 1/4	3.9	0.1		14 1/2			0.1
13	2 1/2	4.0	0.1		14 3/4			0.05
14	2 3/4	4.15	0.15		15			0.04
15	3	4.25	0.10		15 1/4			
16	3 1/4	4.35	0.10		15 1/2			
17	3 1/2	4.45	0.10		15 3/4			
18	3 3/4	4.5	0.05		16			
19	4	4.6	0.1		16 1/4			
20	4 1/4	4.7	0.1		16 1/2			
21	4 1/2	4.8	0.1		16 3/4			
22	4 3/4	4.85	0.05		17			
23	5	4.9	0.05		17 1/4			
24	5 1/4	5.0	0.1		17 1/2			
25	5 1/2	5.05	0.05		17 3/4			
26	5 3/4	5.1	0.05	0.02	18			0.02
27	6	5.2	0.1		18 1/4			
28	6 1/4	5.25	0.04		18 1/2			
29	6 1/2	5.3			18 3/4			
30	6 3/4	5.35			19			
31	7	5.4			19 1/4			
32	7 1/4	5.45			19 1/2			
33	7 1/2	5.5			19 3/4			
34	7 3/4	5.55			20			
35	8	5.6			20 1/4			
36	8 1/4	5.65			20 1/2			
37	8 1/2	5.7			20 3/4			
38	8 3/4	5.75		.04	21			
39	9	5.75		0.1	21 1/4			
40	9 1/4	5.8		0.05	21 1/2			
41	9 1/2	5.85		0.05	21 3/4			
42	9 3/4	5.9		0.1	22			
43	10	5.9		0.1	22 1/4			
44	10 1/4	5.95		0.1	22 1/2			
45	10 1/2	6.0		0.1	22 3/4			
46	10 3/4	6.0		0.1	23			
47	11	6.05		0.15	23 1/4			
48	11 1/4	6.1		0.2	23 1/2			
49	11 1/2	6.1		0.35	23 3/4			
50	11 3/4	6.15		0.69	24	7.2	↓	↓
	12	6.2	↓	1.64				

D-4

BY PBE DATE 7/31/20 CLIENT N.J.

SHEET NO. 1 OF 2

CHKD. DATE \_\_\_\_\_ JOB TIME OF CONCENTRATION

JOB NO. 302

1	2	3	4	5	6	7	8	9
1	<b>DATA</b>							
2		L = STREAM LENGTH FROM WATERSHED		= <u>4.55</u>		mi		
3		OUTLET TO THE MOST DISTANT RIDGE						
4		LCA = STREAM LENGTH FROM BASIN CENTROID		= <u>1.93</u>		mi		
5		H = DIFF BETWEEN ELEV AT OUTLET AND						
6		ELEV AT MOST DISTANT POINT		=		<u>85'</u>		
7		T <sub>C</sub> = TIME OF CONCENTRATION OR TIME FOR						
8		WATER TO FLOW FROM THE MOST DISTANT						
9		POINT IN THE WATERSHED TO THE WATERSHED						
10		OUTLET						
11		T <sub>L</sub> = LAG TIME FROM CENTER OF EXCESS						
12		RAINFALL TO TIME OF PEAK. = <u>0.6 T<sub>C</sub></u>						
13		<b>METHOD 1</b>						
14		T <sub>C</sub> = $\frac{L^{1.15}}{7700 H^{0.38}}$		L IN FT		H IN FT		
15		T <sub>L</sub> = $\frac{0.6 L^{1.15}}{7700 H^{0.38}}$						
16		<b>METHOD 2</b>						
17		T <sub>C</sub> = $\left(\frac{11.913}{H}\right)^{0.385}$		L IN MILES		H IN FT.		
18		T <sub>L</sub> = $0.6 \left(\frac{11.913}{H}\right)^{0.385}$						
19		<b>METHOD 3</b>						
20		T <sub>L</sub> = C <sub>T</sub> $\left(\frac{L L_c}{S^{1/2}}\right)^{0.38}$		S IN FT/MI		S = H/L = <u>0.35%</u>		
21		T <sub>L</sub> = C <sub>T</sub> $\left(\frac{L L_c}{(H/L)^{1/2}}\right)^{0.38}$		C <sub>T</sub> = 1.2 MOUNTAIN		FOOTHILL		
22				= 0.72		VALLEY DRAINAGE		
23				= <u>0.35</u>		AREA.		
24		<b>METHOD 4</b>						
25		T <sub>C</sub> = L/V		V = AVG VELOCITY FROM		CURVE OF V VS. AVG SLOPE		
26		T <sub>L</sub> = 0.6 L/V		V = <u>0.8</u>		fps		

DAM  
LAKE  
NELSON

LAG IN HOURS				
METHODS				
1	2	3	4	USE
1.6	1.6	2.3	5.0	2.0

D-5

LEEDS, HILL AND JEWETT, INC.

BY DSE DATE CLIENT N.J. DAM SAFETY SHEET NO OF

CHKD DATE JOB JOB NO. 302-03

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EMERSON LINE NO. 635-P

RBE

74023

LAKE NELSON

302-03

### ASSUMED BREACH PARAMETERS <sup>U</sup>

WIDTH OF BREACH BOTTOM: 410'

SIDE SLOPES: 45° (1:1)

BOTTOM ELEVATION: 50.5 FT

TIME TO FAIL: 2.0 HRS

ELEVATION AT WHICH FAILURE OCCURS: 58.5 FT

INITIAL WATER SURFACE ELEVATION: 56.5 FT

<sup>U</sup> BASED ON PREVIOUS STUDIES OF ACTUAL  
DAM FAILURES.



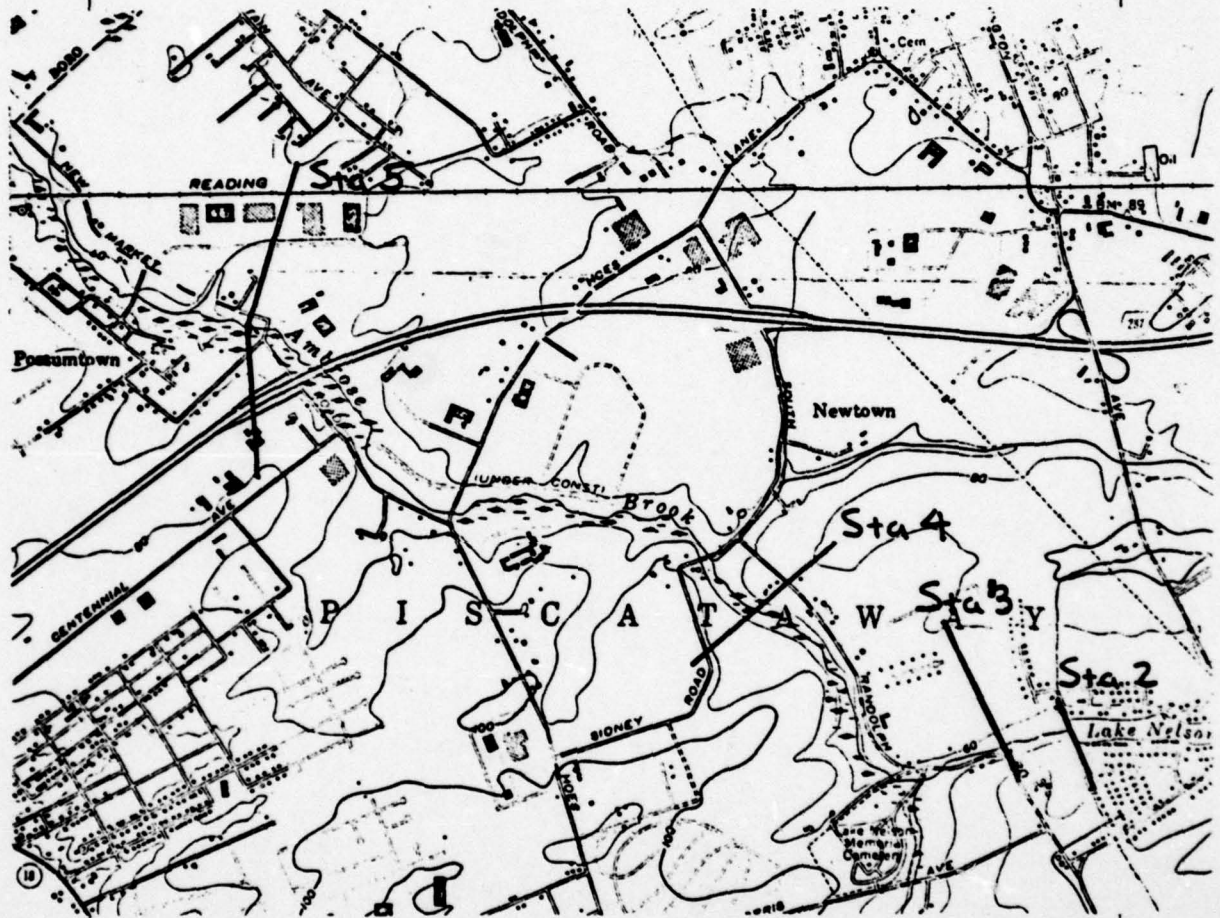
RBE

790207

LAKE NELSON

302-03

LOCATION MAP OF CROSS-SECTIONS USED IN  
ROUTING CALCULATIONS



59B  
153  
87

LEONA HILL AND JEWETT, INC.  
ST. PETERSBURG, FLORIDA

DATE	DESCRIPTION	AMOUNT	DATE	DESCRIPTION	AMOUNT	DATE	DESCRIPTION	AMOUNT
1	LAKE NELSON		1	LAKE NELSON		1	LAKE NELSON	
2	LAKE NELSON		2	LAKE NELSON		2	LAKE NELSON	
3	LAKE NELSON		3	LAKE NELSON		3	LAKE NELSON	
4	LAKE NELSON		4	LAKE NELSON		4	LAKE NELSON	
5	LAKE NELSON		5	LAKE NELSON		5	LAKE NELSON	
6	LAKE NELSON		6	LAKE NELSON		6	LAKE NELSON	
7	LAKE NELSON		7	LAKE NELSON		7	LAKE NELSON	
8	LAKE NELSON		8	LAKE NELSON		8	LAKE NELSON	
9	LAKE NELSON		9	LAKE NELSON		9	LAKE NELSON	
10	LAKE NELSON		10	LAKE NELSON		10	LAKE NELSON	
11	LAKE NELSON		11	LAKE NELSON		11	LAKE NELSON	
12	LAKE NELSON		12	LAKE NELSON		12	LAKE NELSON	
13	LAKE NELSON		13	LAKE NELSON		13	LAKE NELSON	
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16	LAKE NELSON		16	LAKE NELSON		16	LAKE NELSON	
17	LAKE NELSON		17	LAKE NELSON		17	LAKE NELSON	
18	LAKE NELSON		18	LAKE NELSON		18	LAKE NELSON	
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31	LAKE NELSON		31	LAKE NELSON		31	LAKE NELSON	
32	LAKE NELSON		32	LAKE NELSON		32	LAKE NELSON	

LAKE NELSON

LAKE NELSON

LAKE NELSON

PRECEDENCE AND NO. 828

LAKE NELSON

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT  $n$  (continued)

Type of channel and description	Minimum	Normal	Maximum
<b>b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages</b>	0.020	0.040	0.050
<b>1. Bottom: gravel, cobbles, and few boulders</b>	0.040	0.060	0.070
<b>2. Bottom: cobbles with large boulders</b>			
<b>D-2. Flood plains</b>			
<b>a. Pasture, no brush</b>	0.025	0.030	0.035
<b>1. Short grass</b>	0.030	0.035	0.050
<b>2. High grass</b>			
<b>b. Cultivated areas</b>	0.020	0.030	0.040
<b>1. No crop</b>	0.025	0.035	0.045
<b>2. Mature row crops</b>	0.030	0.040	0.050
<b>3. Mature field crops</b>			
<b>c. Brush</b>	0.035	0.050	0.070
<b>1. Scattered brush, heavy weeds</b>	0.035	0.050	0.060
<b>2. Light brush and trees, in winter</b>	0.040	0.060	0.080
<b>3. Light brush and trees, in summer</b>	0.045	0.070	0.110
<b>4. Medium to dense brush, in winter</b>	0.070	0.100	0.160
<b>5. Medium to dense brush, in summer</b>			
<b>d. Trees</b>	0.110	0.150	0.200
<b>1. Dense willows, summer, straight</b>	0.030	0.040	0.050
<b>2. Cleared land with tree stumps, no sprouts</b>	0.050	0.060	0.080
<b>3. Same as above, but with heavy growth of sprouts</b>	0.060	0.100	0.130
<b>4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches</b>	0.100	0.120	0.100
<b>5. Same as above, but with flood stage reaching branches</b>			
<b>D-3. Major streams (top width at flood stage &gt; 100 ft). The <math>n</math> value is less than that for minor streams of similar description, because banks offer less effective resistance.</b>	0.025	0.035	0.100
<b>a. Irregular section with no boulders or brush</b>			
<b>b. Irregular and rough section</b>			

OPEN-CHANNEL HYDRAULICS

SECTION 2, 3, 4

VEN TE CHOW, Ph.D.  
Professor of Hydraulic Engineering  
University of Illinois

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT  $n$  (continued)

Type of channel and description	Minimum	Normal	Maximum
<b>C. EXCAVATED OR DUGPODS</b>			
<b>a. Earth, straight and uniform</b>	0.016	0.018	0.020
<b>1. Clean, recently completed</b>	0.018	0.023	0.025
<b>2. Clean, after weathering</b>	0.022	0.025	0.030
<b>3. Gravel, uniform section, clean</b>	0.022	0.027	0.033
<b>4. With short grass, few weeds</b>			
<b>b. Earth, winding and sluggish</b>	0.023	0.025	0.030
<b>1. No vegetation</b>	0.025	0.030	0.033
<b>2. Grass, some weeds</b>	0.030	0.035	0.040
<b>3. Dense weeds or aquatic plants in deep channels</b>	0.028	0.030	0.035
<b>4. Earth bottom and rubble sides</b>	0.025	0.035	0.040
<b>5. Stony bottom and weedy banks</b>	0.030	0.040	0.050
<b>6. Cobble bottom and clean sides</b>			
<b>c. Dragline-excavated or dredged</b>	0.025	0.028	0.033
<b>1. No vegetation</b>	0.035	0.050	0.060
<b>2. Light brush on banks</b>			
<b>d. Rock cuts</b>	0.025	0.035	0.040
<b>1. Smooth and uniform</b>	0.035	0.040	0.050
<b>2. Jagged and irregular</b>			
<b>e. Channels not maintained, weeds and brush uncut</b>	0.050	0.080	0.120
<b>1. Dense weeds, high as flow depth</b>	0.040	0.050	0.060
<b>2. Clean bottom, brush on sides</b>	0.045	0.070	0.110
<b>3. Same, highest stage of flow</b>	0.060	0.100	0.140
<b>4. Dense brush, high stage</b>			
<b>D. NATURAL STREAMS</b>			
<b>D-1. Minor streams (top width at flood stage &lt; 100 ft)</b>			
<b>a. Streams on plain</b>	0.025	0.030	0.033
<b>1. Clean, straight, full stage, no rills or deep pools</b>	0.030	0.035	0.040
<b>2. Same as above, but more stones and weeds</b>	0.033	0.040	0.045
<b>3. Clean, winding, some pools and shoals</b>	0.035	0.045	0.060
<b>4. Same as above, but some weeds and stones</b>	0.040	0.048	0.055
<b>5. Same as above, lower stages, more ineffective slopes and sections</b>	0.045	0.050	0.060
<b>6. Same as 4, but more stones</b>	0.050	0.070	0.080
<b>7. Sluggish reaches, weedy, deep pools</b>	0.075	0.100	0.150
<b>8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush</b>			

SECTION 2, 3, 4

Plan

790118

Lake Nelson

302-03

DRAW DOWN CALCULATION

	<u>ELEV #</u>	<u>Sto AF</u>	<u>ΔSto AF</u>	<u>Mean Head ft</u>	<u>Incr. Time, HR</u>	<u>Cum Time Hrs</u>
Spillway →	56.5	40				
	55.5	26	14	5.5	43.0	43.0
	54.5	14	12	4.5	40.7	83.7
	53.5	5	9	3.5	34.6	118.3
	50.5	0	5	1.5	29.4	147.7

USE orific equation

$$Q = CA \sqrt{2gH}$$

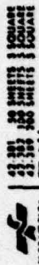
Assume C = 0.6

$$Q = 0.6 \left[ \frac{\pi}{4} \left( \frac{8}{12} \right)^2 \right] \sqrt{2g} \sqrt{H}$$

$$Q = 1.68 H^{1/2}$$

Total time to drain = 147.7 HRS / 24 = 6.2 days

THIS CALCULATION ASSUMES OUTLET OPERATIONAL WITH NO TAILWATER OR INFLOWS INTO RESERVOIR



No Breach  
Calc.

.....  
FLOOD HYDROGRAPH PACKAGE (PFC-1)  
DAM SAFETY VERSION JULY 1978  
LAST MODIFICATION 24 SEP 78  
.....

NEW JERSEY DAM SAFETY - LAKE NELSON DAM I.O.D. NO 08176  
HYDRAULIC-HYDROLOGIC ANALYSIS 382-03  
PROBABLE MAXIMUM FLOOD

STATION	TIME	FLOW (CFS)	WATER SURFACE (ELEVATION)	CHANNEL ROUTING - MODIFIED PULS - STATION 2 TO 3	ROUTED FLOWS THROUGH RESERVOIR	WATER SURFACE (ELEVATION)	CHANNEL ROUTING - MODIFIED PULS - STATION 3 TO 4	CHANNEL ROUTING - MODIFIED PULS - STATION 4 TO 5	PROBABLE MAXIMUM FLOOD
1	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0
3	2	0	0	0	0	0	0	0	0
4	3	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0
6	5	0	0	0	0	0	0	0	0
7	6	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
8	7	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
9	8	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
10	9	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
11	10	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
12	11	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
13	12	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
14	13	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
15	14	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
16	15	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
17	16	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
18	17	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
19	18	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
20	19	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
21	20	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
22	21	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
23	22	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
24	23	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
25	24	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
26	25	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
27	26	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
28	27	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
29	28	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
30	29	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
31	30	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
32	31	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
33	32	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
34	33	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
35	34	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
36	35	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
37	36	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
38	37	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
39	38	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
40	39	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
41	40	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
42	41	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
43	42	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
44	43	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
45	44	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
46	45	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
47	46	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
48	47	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
49	48	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
50	49	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
51	50	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
52	51	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
53	52	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
54	53	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
55	54	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
56	55	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
57	56	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
58	57	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
59	58	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
60	59	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
61	60	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
62	61	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
63	62	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
64	63	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
65	64	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
66	65	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
67	66	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
68	67	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
69	68	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
70	69	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
71	70	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
72	71	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
73	72	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
74	73	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
75	74	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
76	75	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
77	76	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
78	77	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
79	78	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
80	79	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
81	80	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
82	81	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
83	82	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
84	83	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
85	84	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
86	85	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
87	86	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
88	87	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
89	88	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
90	89	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
91	90	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
92	91	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
93	92	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
94	93	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
95	94	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
96	95	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
97	96	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
98	97	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
99	98	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00
100	99	0.1	0.25	0.50	1.00	0.25	0.50	0.75	1.00



MO,DA	MP,MM	PERIOD	PAIN	ENCS	LOSS	END-OF-PERIOD FLOW COMP Q	NO,DA	MR,MM	PARLOD	RAIN	EMCS	LUSS	LOP Q
1.01	1.15	1	.02	0.00	.02	5.	1.01	12.15	59	1.64	1.63	.01	1.64
1.01	1.30	2	.02	0.00	.02	4.	1.01	12.30	59	.62	.61	.01	1.59
1.01	1.45	3	.02	0.20	.02	4.	1.01	12.45	51	.68	.19	.01	2.31
1.01	1.00	4	.02	0.10	.02	4.	1.01	13.00	52	.19	.14	.01	2.05
1.01	1.15	5	.02	0.30	.02	4.	1.01	13.15	53	.09	.09	.01	3.07
1.01	1.30	6	.02	0.30	.02	3.	1.01	13.30	54	.19	.14	.01	3.34
1.01	1.45	7	.02	0.30	.02	3.	1.01	13.45	55	.09	.09	.01	4.05
1.01	1.00	8	.02	0.10	.02	1.	1.01	14.00	59	.09	.09	.01	4.31
1.01	1.15	9	.02	0.10	.02	1.	1.01	14.15	59	.09	.09	.01	4.37
1.01	1.30	10	.02	0.10	.02	2.	1.01	14.30	59	.09	.09	.01	4.74
1.01	1.45	11	.02	0.10	.02	2.	1.01	14.45	59	.09	.09	.01	5.05
1.01	1.00	12	.02	0.10	.02	2.	1.01	15.00	61	.16	.16	.01	5.14
1.01	1.15	13	.02	0.10	.02	2.	1.01	15.15	62	.09	.09	.01	5.55
1.01	1.30	14	.02	0.30	.02	2.	1.01	15.30	62	.09	.09	.01	5.73
1.01	1.45	15	.02	0.30	.02	2.	1.01	15.45	62	.09	.09	.01	6.04
1.01	1.00	16	.02	0.30	.02	2.	1.01	16.00	64	.09	.09	.01	6.04
1.01	1.15	17	.02	0.30	.02	2.	1.01	16.15	65	.09	.09	.01	6.31
1.01	1.30	18	.02	0.30	.02	1.	1.01	16.30	66	.09	.09	.01	6.31
1.01	1.45	19	.02	0.30	.02	1.	1.01	16.45	67	.09	.09	.01	6.31
1.01	1.00	20	.02	0.30	.02	1.	1.01	17.00	69	.09	.09	.01	6.31
1.01	1.15	21	.02	0.30	.02	1.	1.01	17.15	69	.09	.09	.01	6.31
1.01	1.30	22	.02	0.30	.02	1.	1.01	17.30	70	.09	.09	.01	6.31
1.01	1.45	23	.02	0.30	.02	1.	1.01	17.45	71	.09	.09	.01	6.31
1.01	1.00	24	.02	0.30	.02	1.	1.01	18.00	72	.09	.09	.01	6.31
1.01	1.15	25	.04	.01	.01	2.	1.01	18.15	73	.02	.01	.01	6.31
1.01	1.30	26	.04	.03	.01	4.	1.01	18.30	74	.02	.01	.01	6.31
1.01	1.45	27	.04	.03	.01	4.	1.01	18.45	75	.02	.01	.01	6.31
1.01	1.00	28	.04	.03	.01	21.	1.01	19.00	76	.02	.01	.01	6.31
1.01	1.15	29	.04	.03	.01	17.	1.01	19.15	77	.02	.01	.01	6.31
1.01	1.30	30	.04	.03	.01	6.	1.01	19.30	78	.02	.01	.01	6.31
1.01	1.45	31	.04	.03	.01	6.	1.01	19.45	79	.02	.01	.01	6.31
1.01	1.00	32	.04	.03	.01	11.	1.01	20.00	81	.02	.01	.01	6.31
1.01	1.15	33	.04	.03	.01	17.	1.01	20.15	81	.02	.01	.01	6.31
1.01	1.30	34	.04	.03	.01	20.	1.01	20.30	82	.02	.01	.01	6.31
1.01	1.45	35	.04	.03	.01	23.	1.01	20.45	82	.02	.01	.01	6.31
1.01	1.00	36	.04	.03	.01	25.	1.01	21.00	85	.02	.01	.01	6.31
1.01	1.15	37	.04	.03	.01	26.	1.01	21.15	86	.02	.01	.01	6.31
1.01	1.30	38	.04	.03	.01	37.	1.01	21.30	87	.02	.01	.01	6.31
1.01	1.45	39	.04	.03	.01	37.	1.01	21.45	87	.02	.01	.01	6.31
1.01	1.00	40	.04	.03	.01	37.	1.01	22.00	88	.02	.01	.01	6.31
1.01	1.15	41	.04	.03	.01	37.	1.01	22.15	89	.02	.01	.01	6.31
1.01	1.30	42	.04	.03	.01	41.	1.01	22.30	90	.02	.01	.01	6.31
1.01	1.45	43	.04	.03	.01	46.	1.01	22.45	91	.02	.01	.01	6.31
1.01	1.00	44	.04	.03	.01	51.	1.01	23.00	92	.02	.01	.01	6.31
1.01	1.15	45	.04	.03	.01	58.	1.01	23.15	93	.02	.01	.01	6.31
1.01	1.30	46	.04	.03	.01	65.	1.01	23.30	94	.02	.01	.01	6.31
1.01	1.45	47	.04	.03	.01	75.	1.01	23.45	95	.02	.01	.01	6.31
1.01	1.00	48	.04	.03	.01	82.	1.01	24.00	96	.02	.01	.01	6.31

SUN 7.12 9.73 1.03 7367.  
( 101.11 145.11 35.11 208.40)

PEAK	9-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
4351.	2497.	780.	780.	7292.
123.	459.	866.	866.	866.
	116.60	141.73	141.73	141.73
	1224.	1506.	1520.	1550.
	1559.	1666.	1668.	1680.

THOUS CU W



STATION E, PLAN 1, RATIO 4  
 END-CY-PERIOD HYDROGRAPH ORDINATES

OUTFLOW		STORAGE		STAGE	
0.	1.	0.	1.	0.	1.
49.	49.	49.	49.	56.5	56.5
51.	51.	51.	51.	56.5	56.5
51.	51.	51.	51.	56.5	56.5
54.	54.	54.	54.	56.5	56.5
54.	54.	54.	54.	56.5	56.5
57.	57.	57.	57.	56.5	56.5
57.	57.	57.	57.	56.5	56.5
58.	58.	58.	58.	56.5	56.5
58.	58.	58.	58.	56.5	56.5
59.	59.	59.	59.	56.5	56.5
59.	59.	59.	59.	56.5	56.5
61.	61.	61.	61.	56.5	56.5
61.	61.	61.	61.	56.5	56.5
62.	62.	62.	62.	56.5	56.5
62.	62.	62.	62.	56.5	56.5
63.	63.	63.	63.	56.5	56.5
63.	63.	63.	63.	56.5	56.5
64.	64.	64.	64.	56.5	56.5
64.	64.	64.	64.	56.5	56.5
65.	65.	65.	65.	56.5	56.5
65.	65.	65.	65.	56.5	56.5
66.	66.	66.	66.	56.5	56.5
66.	66.	66.	66.	56.5	56.5
67.	67.	67.	67.	56.5	56.5
67.	67.	67.	67.	56.5	56.5
68.	68.	68.	68.	56.5	56.5
68.	68.	68.	68.	56.5	56.5
69.	69.	69.	69.	56.5	56.5
69.	69.	69.	69.	56.5	56.5
70.	70.	70.	70.	56.5	56.5
70.	70.	70.	70.	56.5	56.5
71.	71.	71.	71.	56.5	56.5
71.	71.	71.	71.	56.5	56.5
72.	72.	72.	72.	56.5	56.5
72.	72.	72.	72.	56.5	56.5
73.	73.	73.	73.	56.5	56.5
73.	73.	73.	73.	56.5	56.5
74.	74.	74.	74.	56.5	56.5
74.	74.	74.	74.	56.5	56.5
75.	75.	75.	75.	56.5	56.5
75.	75.	75.	75.	56.5	56.5
76.	76.	76.	76.	56.5	56.5
76.	76.	76.	76.	56.5	56.5
77.	77.	77.	77.	56.5	56.5
77.	77.	77.	77.	56.5	56.5
78.	78.	78.	78.	56.5	56.5
78.	78.	78.	78.	56.5	56.5
79.	79.	79.	79.	56.5	56.5
79.	79.	79.	79.	56.5	56.5
80.	80.	80.	80.	56.5	56.5
80.	80.	80.	80.	56.5	56.5
81.	81.	81.	81.	56.5	56.5
81.	81.	81.	81.	56.5	56.5
82.	82.	82.	82.	56.5	56.5
82.	82.	82.	82.	56.5	56.5
83.	83.	83.	83.	56.5	56.5
83.	83.	83.	83.	56.5	56.5
84.	84.	84.	84.	56.5	56.5
84.	84.	84.	84.	56.5	56.5
85.	85.	85.	85.	56.5	56.5
85.	85.	85.	85.	56.5	56.5
86.	86.	86.	86.	56.5	56.5
86.	86.	86.	86.	56.5	56.5
87.	87.	87.	87.	56.5	56.5
87.	87.	87.	87.	56.5	56.5
88.	88.	88.	88.	56.5	56.5
88.	88.	88.	88.	56.5	56.5
89.	89.	89.	89.	56.5	56.5
89.	89.	89.	89.	56.5	56.5
90.	90.	90.	90.	56.5	56.5
90.	90.	90.	90.	56.5	56.5
91.	91.	91.	91.	56.5	56.5
91.	91.	91.	91.	56.5	56.5
92.	92.	92.	92.	56.5	56.5
92.	92.	92.	92.	56.5	56.5
93.	93.	93.	93.	56.5	56.5
93.	93.	93.	93.	56.5	56.5
94.	94.	94.	94.	56.5	56.5
94.	94.	94.	94.	56.5	56.5
95.	95.	95.	95.	56.5	56.5
95.	95.	95.	95.	56.5	56.5
96.	96.	96.	96.	56.5	56.5
96.	96.	96.	96.	56.5	56.5
97.	97.	97.	97.	56.5	56.5
97.	97.	97.	97.	56.5	56.5
98.	98.	98.	98.	56.5	56.5
98.	98.	98.	98.	56.5	56.5
99.	99.	99.	99.	56.5	56.5
99.	99.	99.	99.	56.5	56.5
100.	100.	100.	100.	56.5	56.5
100.	100.	100.	100.	56.5	56.5

PEAK OUTFLOW IS 4273. AT TIME 14.25 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
4273	2466	752	752	72155
121.	78.	21.	21.	2843.
	4.59	5.59	5.59	3.59
	116.25	142.37	142.37	142.07
	1288.	1491.	1491.	1491.
	1595.	1835.	1835.	1835.

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

ISTAT 3 ICCHP 1 IECON 6 ITAPE 6 JPLI 0 JPRF 0 INAME I STAGE 3 IAUFL 0  
 ROUTING DATA  
 LOSS LOSS AVG IPES ISAME IOPT IPHP LSTR  
 0.0 0.000 0.00 1 1 0 0 0  
 MSPE MSIBL LAG ANSK X TSK STORA ISPRAT  
 0.000000 0 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

NORMAL DEPTH CHANNEL ROUTING

QM(1) QM(2) QM(3) ELNVT ELMAX RLMTM SEL  
 .0500 .0450 .0500 49.0 80.0 1000. .00100

CROSS SECTION COORDINATES--STA,ELEV,S,M,ELEV--ZIG  
 0.00 49.00 150.00 64.30 160.00 54.00 1000.00  
 1025.00 54.00 200.00 60.90 240.00 80.00

STORAGE	0.00	1.00	145.70	146.95	1.07	2.01	5.42	11.04	22.07	30.19	39.34	49.99
OUTFLOW	0.00	56.54	161.03	206.34	207.99.25	307.09.33	534.01	1019.57	2145.70	3016.90	4016.73	5111.13
STAGE	49.00	50.03	54.26	53.04	55.53	57.16	59.79	64.42	70.11	74.74	78.37	81.04
FLW	14431.55	21170.33	20069.25	30769.33	50352.05	63051.23	70635.10	8010.33	97025.23	110000.52	140000.52	170000.52



HYDROGRAPH ROUTING

CHANNEL ROUTING - MODIFIED PULS- STATION 3 TO 4

ISTAQ 4  
 IECOM 1  
 ICAPE 0  
 JPLI 0  
 JPT 0  
 INAML 1  
 ISTAGE 0  
 IAUTO 0  
 IRES 1  
 ISARE 1  
 IOPT 0  
 IPMP 0  
 LAG 0  
 AMSKK X  
 STORA 0  
 ISPRAT 0  
 MSIPS 0.000000  
 LAG 0.000  
 AMSKK 0.000  
 STORA 0.000  
 ISPRAT 0

NORMAL DEPTH CHANNEL ROUTING

GM11 GM12 GM13  
 .0500 .0450 .0400  
 ELNVT 46.0  
 ELMAX 80.0  
 RLNTH 4300.0  
 SEL 0.0100

CROSS SECTION COORDINATES--STA, ELEV, STA, ELEV--ETC

0+00 98.00 100+00 81.00 100+00 49.00 110+00 60.00 1125+00 46.00  
 1125+00 49.00 1250+00 61.00 1500+00 80.00

STORAGE

0.00 5.01 19.42 24.42 44.86 83.94 129.67 186.33 253.41 342.00  
 499.96 665.00 776.16 979.17 1226.89 1464.92 1746.00 2062.33 2406.94 2771.00

OUTFLOW

0.00 63.15 191.95 460.55 596.34 1031.16 1425.31 1803.42 2162.07 2502.00  
 2826.00 3136.00 3436.00 3726.00 4006.00 4276.00 4526.00 4756.00 4956.00 5126.00

STAGE

46.07 47.79 49.58 51.37 53.16 54.95 56.74 58.53 60.32 62.11  
 63.89 65.68 67.47 69.26 71.05 72.84 74.63 76.42 78.21 80.00

FLOW

0.00 63.15 191.95 460.55 596.34 1031.16 1425.31 1803.42 2162.07 2502.00  
 2826.00 3136.00 3436.00 3726.00 4006.00 4276.00 4526.00 4756.00 4956.00 5126.00

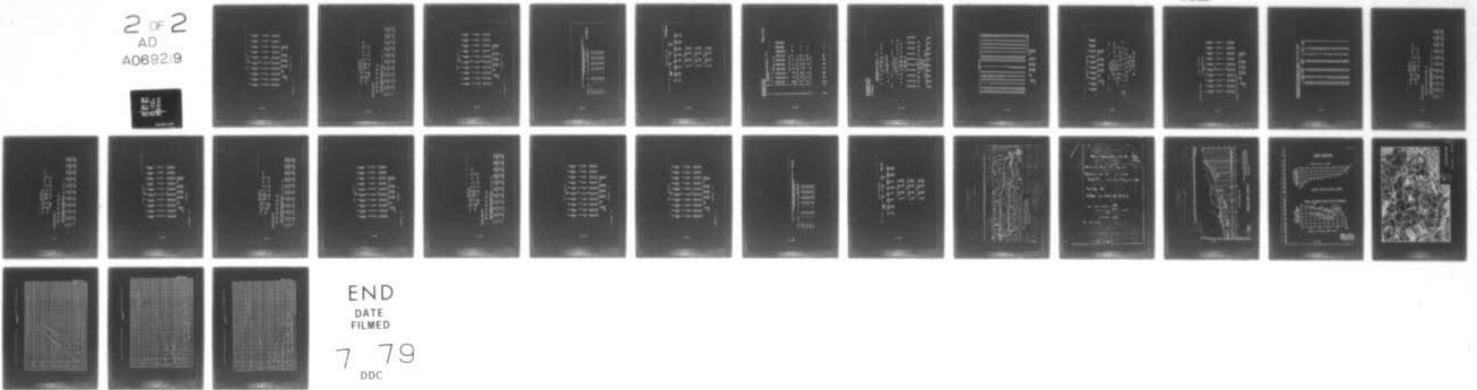
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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. LAKE NELSON DAM (NJ 00376). RARITA--ETC(U)  
MAY 79 R J JENNY DACW61-78-C-0124

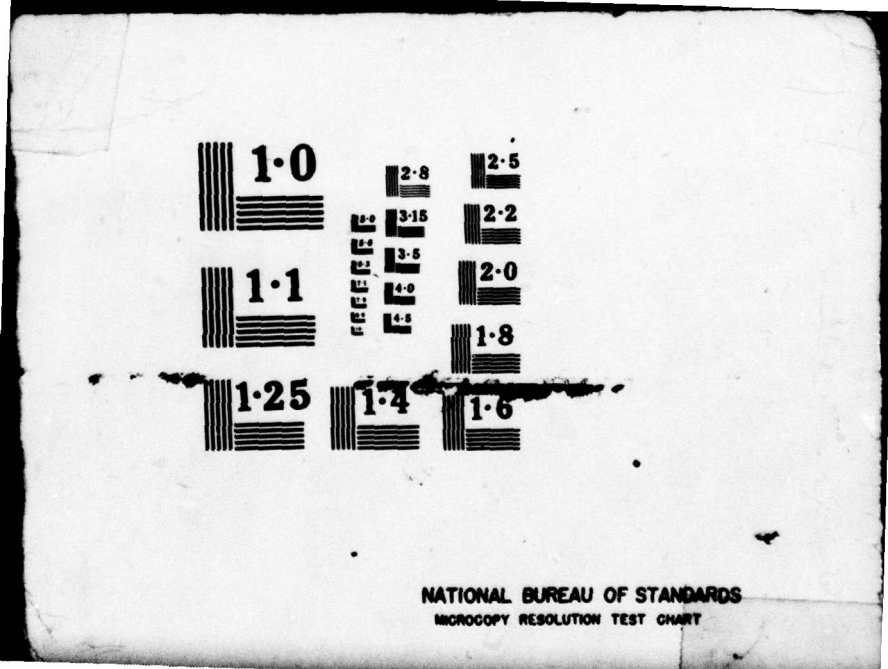
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NATIONAL BUREAU OF STANDARDS  
MICROCOPY RESOLUTION TEST CHART







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)

No Breach

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS		
				RATIO 1	RATIO 2	RATIO 3
HYDROGRAPH AT	1	5.00		.15	.25	1.00
	2	12.591	1	435.	1300.	2175.
ROUTED TO	1	5.00		12.321	30.001	61.001
	2	12.591	1	372.	1300.	2137.
ROUTED TO	1	5.00		10.531	30.241	65.511
	2	12.591	1	372.	1300.	2135.
ROUTED TO	1	5.00		10.541	30.161	65.511
	2	12.591	1	366.	951.	2309.
ROUTED TO	1	5.00		9.751	26.791	56.991
	2	12.591	1	275.	725.	1570.
ROUTED TO	1	5.00		7.771	20.561	44.651
	2	12.591	1	275.	725.	1570.

4351.  
123.201  
4273.  
4273.  
4997.  
116.331  
95.341

No Breach

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	RATIO OF PWP	ELEVATION STORAGE	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
			56.50	56.20	56.50
			0.	0.	0.
			0.	0.	0.

RATIO OF PWP	MAXIMUM RESERVOIR STORAGE M.S.SLEV	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	57.94	0.00	79.	372.	3.06	15.26	1.03
.75	56.30	0.0	90.	1000.	2.59	16.25	3.00
.50	50.4	0.0	119.	2137.	1.50	16.25	3.00
1.00	60.36	1.06	150.	4273.	7.00	16.25	3.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	372.	54.4	15.00
.75	1045.	57.1	16.25
.50	2137.	59.8	16.25
1.00	4273.	60.7	16.25

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	340.	50.0	15.50
.75	952.	53.0	15.25
.50	2000.	55.1	15.03
1.00	4037.	57.6	14.75

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	275.	43.0	15.75
.75	745.	45.1	15.25
.50	1572.	46.6	15.00
1.00	3167.	48.1	14.75





NO.00	NO.00	PERIOD	RAIN	SICS	LOSS	COMP 0	PERIOD	RAIN	SICS	LOSS	COMP 0
1.01	1.01	15	.02	.00	.02	5	1.01	12.15	1.04	.01	1140.
1.01	1.01	20	.02	.00	.02	6	1.01	12.20	.42	.01	1334.
1.01	1.01	25	.02	.00	.02	7	1.01	12.25	.19	.01	1334.
1.01	1.01	30	.02	.00	.02	8	1.01	12.30	.20	.01	2031.
1.01	1.01	35	.02	.00	.02	9	1.01	13.00	.14	.01	2031.
1.01	1.01	40	.02	.00	.02	10	1.01	13.05	.09	.01	3207.
1.01	1.01	45	.02	.00	.02	11	1.01	13.10	.10	.01	3207.
1.01	1.01	50	.02	.00	.02	12	1.01	13.15	.15	.01	3207.
1.01	1.01	55	.02	.00	.02	13	1.01	13.20	.09	.01	4105.
1.01	1.01	60	.02	.00	.02	14	1.01	13.25	.04	.01	4105.
1.01	1.01	65	.02	.00	.02	15	1.01	13.30	.04	.01	4174.
1.01	1.01	70	.02	.00	.02	16	1.01	13.35	.04	.01	4174.
1.01	1.01	75	.02	.00	.02	17	1.01	13.40	.04	.01	4174.
1.01	1.01	80	.02	.00	.02	18	1.01	13.45	.04	.01	3904.
1.01	1.01	85	.02	.00	.02	19	1.01	13.50	.04	.01	3904.
1.01	1.01	90	.02	.00	.02	20	1.01	13.55	.04	.01	3559.
1.01	1.01	95	.02	.00	.02	21	1.01	13.55	.04	.01	3167.
1.01	1.01	100	.02	.00	.02	22	1.01	14.00	.04	.01	2733.
1.01	1.01	105	.02	.00	.02	23	1.01	14.05	.04	.01	2301.
1.01	1.01	110	.02	.00	.02	24	1.01	14.10	.04	.01	2005.
1.01	1.01	115	.02	.00	.02	25	1.01	14.15	.04	.01	1831.
1.01	1.01	120	.02	.00	.02	26	1.01	14.20	.04	.01	1831.
1.01	1.01	125	.02	.00	.02	27	1.01	14.25	.04	.01	1831.
1.01	1.01	130	.02	.00	.02	28	1.01	14.30	.04	.01	1831.
1.01	1.01	135	.02	.00	.02	29	1.01	14.35	.04	.01	1831.
1.01	1.01	140	.02	.00	.02	30	1.01	14.40	.04	.01	1831.
1.01	1.01	145	.02	.00	.02	31	1.01	14.45	.04	.01	1831.
1.01	1.01	150	.02	.00	.02	32	1.01	14.50	.04	.01	1831.
1.01	1.01	155	.02	.00	.02	33	1.01	14.55	.04	.01	1831.
1.01	1.01	160	.02	.00	.02	34	1.01	14.55	.04	.01	1831.
1.01	1.01	165	.02	.00	.02	35	1.01	14.55	.04	.01	1831.
1.01	1.01	170	.02	.00	.02	36	1.01	14.55	.04	.01	1831.
1.01	1.01	175	.02	.00	.02	37	1.01	14.55	.04	.01	1831.
1.01	1.01	180	.02	.00	.02	38	1.01	14.55	.04	.01	1831.
1.01	1.01	185	.02	.00	.02	39	1.01	14.55	.04	.01	1831.
1.01	1.01	190	.02	.00	.02	40	1.01	14.55	.04	.01	1831.
1.01	1.01	195	.02	.00	.02	41	1.01	14.55	.04	.01	1831.
1.01	1.01	200	.02	.00	.02	42	1.01	14.55	.04	.01	1831.
1.01	1.01	205	.02	.00	.02	43	1.01	14.55	.04	.01	1831.
1.01	1.01	210	.02	.00	.02	44	1.01	14.55	.04	.01	1831.
1.01	1.01	215	.02	.00	.02	45	1.01	14.55	.04	.01	1831.
1.01	1.01	220	.02	.00	.02	46	1.01	14.55	.04	.01	1831.
1.01	1.01	225	.02	.00	.02	47	1.01	14.55	.04	.01	1831.
1.01	1.01	230	.02	.00	.02	48	1.01	14.55	.04	.01	1831.
1.01	1.01	235	.02	.00	.02	49	1.01	14.55	.04	.01	1831.
1.01	1.01	240	.02	.00	.02	50	1.01	14.55	.04	.01	1831.
1.01	1.01	245	.02	.00	.02	51	1.01	14.55	.04	.01	1831.
1.01	1.01	250	.02	.00	.02	52	1.01	14.55	.04	.01	1831.
1.01	1.01	255	.02	.00	.02	53	1.01	14.55	.04	.01	1831.
1.01	1.01	260	.02	.00	.02	54	1.01	14.55	.04	.01	1831.
1.01	1.01	265	.02	.00	.02	55	1.01	14.55	.04	.01	1831.
1.01	1.01	270	.02	.00	.02	56	1.01	14.55	.04	.01	1831.
1.01	1.01	275	.02	.00	.02	57	1.01	14.55	.04	.01	1831.
1.01	1.01	280	.02	.00	.02	58	1.01	14.55	.04	.01	1831.
1.01	1.01	285	.02	.00	.02	59	1.01	14.55	.04	.01	1831.
1.01	1.01	290	.02	.00	.02	60	1.01	14.55	.04	.01	1831.
1.01	1.01	295	.02	.00	.02	61	1.01	14.55	.04	.01	1831.
1.01	1.01	300	.02	.00	.02	62	1.01	14.55	.04	.01	1831.
1.01	1.01	305	.02	.00	.02	63	1.01	14.55	.04	.01	1831.
1.01	1.01	310	.02	.00	.02	64	1.01	14.55	.04	.01	1831.
1.01	1.01	315	.02	.00	.02	65	1.01	14.55	.04	.01	1831.
1.01	1.01	320	.02	.00	.02	66	1.01	14.55	.04	.01	1831.
1.01	1.01	325	.02	.00	.02	67	1.01	14.55	.04	.01	1831.
1.01	1.01	330	.02	.00	.02	68	1.01	14.55	.04	.01	1831.
1.01	1.01	335	.02	.00	.02	69	1.01	14.55	.04	.01	1831.
1.01	1.01	340	.02	.00	.02	70	1.01	14.55	.04	.01	1831.
1.01	1.01	345	.02	.00	.02	71	1.01	14.55	.04	.01	1831.
1.01	1.01	350	.02	.00	.02	72	1.01	14.55	.04	.01	1831.
1.01	1.01	355	.02	.00	.02	73	1.01	14.55	.04	.01	1831.
1.01	1.01	360	.02	.00	.02	74	1.01	14.55	.04	.01	1831.
1.01	1.01	365	.02	.00	.02	75	1.01	14.55	.04	.01	1831.
1.01	1.01	370	.02	.00	.02	76	1.01	14.55	.04	.01	1831.
1.01	1.01	375	.02	.00	.02	77	1.01	14.55	.04	.01	1831.
1.01	1.01	380	.02	.00	.02	78	1.01	14.55	.04	.01	1831.
1.01	1.01	385	.02	.00	.02	79	1.01	14.55	.04	.01	1831.
1.01	1.01	390	.02	.00	.02	80	1.01	14.55	.04	.01	1831.
1.01	1.01	395	.02	.00	.02	81	1.01	14.55	.04	.01	1831.
1.01	1.01	400	.02	.00	.02	82	1.01	14.55	.04	.01	1831.
1.01	1.01	405	.02	.00	.02	83	1.01	14.55	.04	.01	1831.
1.01	1.01	410	.02	.00	.02	84	1.01	14.55	.04	.01	1831.
1.01	1.01	415	.02	.00	.02	85	1.01	14.55	.04	.01	1831.
1.01	1.01	420	.02	.00	.02	86	1.01	14.55	.04	.01	1831.
1.01	1.01	425	.02	.00	.02	87	1.01	14.55	.04	.01	1831.
1.01	1.01	430	.02	.00	.02	88	1.01	14.55	.04	.01	1831.
1.01	1.01	435	.02	.00	.02	89	1.01	14.55	.04	.01	1831.
1.01	1.01	440	.02	.00	.02	90	1.01	14.55	.04	.01	1831.
1.01	1.01	445	.02	.00	.02	91	1.01	14.55	.04	.01	1831.
1.01	1.01	450	.02	.00	.02	92	1.01	14.55	.04	.01	1831.
1.01	1.01	455	.02	.00	.02	93	1.01	14.55	.04	.01	1831.
1.01	1.01	460	.02	.00	.02	94	1.01	14.55	.04	.01	1831.
1.01	1.01	465	.02	.00	.02	95	1.01	14.55	.04	.01	1831.
1.01	1.01	470	.02	.00	.02	96	1.01	14.55	.04	.01	1831.
1.01	1.01	475	.02	.00	.02	97	1.01	14.55	.04	.01	1831.
1.01	1.01	480	.02	.00	.02	98	1.01	14.55	.04	.01	1831.
1.01	1.01	485	.02	.00	.02	99	1.01	14.55	.04	.01	1831.
1.01	1.01	490	.02	.00	.02	100	1.01	14.55	.04	.01	1831.

SUM 7.12 5.73 1.89 786.47  
 ( 101.14 105.14 55.14 2006.40)

PEAR	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
4251.	2487.	760.	760.	72005.
123.	70.	22.	22.	547.
	4.50	5.66	5.66	5.66
	110.00	143.73	143.73	143.73
	122.	1500.	1500.	1500.
	1500.	1000.	1000.	1000.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
68.	149.	170.	207.	233.	258.	282.	307.	331.	355.
322.	414.	462.	510.	558.	606.	654.	702.	750.	798.
2031.	2319.	2381.	2408.	2418.	2418.	2418.	2418.	2418.	2418.
3149.	2733.	2381.	2086.	1831.	1618.	1418.	1244.	1097.	970.
663.	774.	698.	586.	506.	422.	338.	254.	170.	86.
310.	276.	240.	205.	171.	137.	103.	69.	35.	1.
135.	126.	110.	107.	107.	107.	107.	107.	107.	107.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS 4351. 760. 760. 72005.

CMS 123. 70. 22. 2007.

INC-FEET 4.59 5.66 5.66 3.66

MG 116.00 142.73 142.73 142.73

AC-F 1224. 1806. 1806. 1806.

THOUS CU 4 1889. 1886. 1886. 1886.

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

ISSTA	ICOMP	IECON	ITAPE	JPLY	JPST	INAME	ESTAGE	IAUTO	
2	1	0	0	0	0	1	1	0	
ROUTING DATA									
GLSS	AVG	INES	ISANE	IUPT	IPMP	LSTR			
0.0	0.000	1	1	0	0	0			
MSTPS									
MSTOL	L46	ANSKK	Z	ISK	STDA	ISPRAT			
1	0	0.000	0.000	0.000	40.	0			
CAPACITY=	0.	5.	14.	26.	40.	100.	140.	250.	320.
ELEVATION=	51.	56.	57.	57.	59.	60.	62.	62.	65.
BAR DATA									
COEL	SPVID	COOD	SRPM	ELEVL	COOL	CAREA	ESPL		
56.5	83.0	2.6	1.5	0.6	0.0	0.0	0.0		
TOPEL									
COOD	ESPD	BARVID							
80.5	2.6	1.5	410.						
BAR BREACH DATA									
BRVID	Z	EL04	TFALL	WSEL	FAILEL				
410.	1.00	50.50	2.00	50.50	50.50				



THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION. DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .256 HOURS. THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH. INTERMEDIATE PLUGS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	COMPUTED BREACH HYDROGRAPH (CFS)	ERROR (CFS)	ACCUMULATED ERROR FROM (CFS)	ACCUMULATED ERROR (CFS-HR)
12.000	0.000	671	671	0	0	0
12.042	0.042	636	627	11	11	0
12.084	0.084	1063	1017	112	112	0
12.126	0.126	1173	1206	-36	-36	0
12.167	0.167	1340	1372	-69	-69	0
12.208	0.208	1507	1532	-25	-25	0
12.250	0.250	1676	1676	0	0	0
12.292	0.292	1776	1906	-22	-22	0
12.333	0.333	1982	1913	193	193	0
12.375	0.375	1986	2021	-34	-34	0
12.417	0.417	2059	2117	-28	-28	0
12.458	0.458	2153	2209	-16	-16	0
12.500	0.500	2272	2297	-27	-27	0
12.542	0.542	2387	2486	-40	-40	0
12.583	0.583	2476	2573	-9	-9	0
12.624	0.624	2569	2654	-9	-9	0
12.667	0.667	2660	2693	-7	-7	0
12.708	0.708	2750	2748	2	2	0
12.750	0.750	2841	2811	0	0	0
12.792	0.792	2932	2881	0	0	0
12.833	0.833	3023	2946	0	0	0
12.874	0.874	3114	3016	0	0	0
12.917	0.917	3205	3086	0	0	0
12.958	0.958	3296	3157	0	0	0
13.000	1.000	3387	3227	0	0	0
13.042	1.042	3478	3298	0	0	0
13.083	1.083	3569	3369	0	0	0
13.124	1.124	3660	3440	0	0	0
13.167	1.167	3751	3511	0	0	0
13.208	1.208	3842	3582	0	0	0
13.250	1.250	3933	3653	0	0	0
13.292	1.292	4024	3724	0	0	0
13.333	1.333	4115	3795	0	0	0
13.375	1.375	4206	3866	0	0	0
13.417	1.417	4297	3937	0	0	0
13.458	1.458	4388	4008	0	0	0
13.500	1.500	4479	4079	0	0	0
13.542	1.542	4570	4150	0	0	0
13.583	1.583	4661	4221	0	0	0
13.624	1.624	4752	4292	0	0	0
13.667	1.667	4843	4363	0	0	0
13.708	1.708	4934	4434	0	0	0
13.750	1.750	5025	4505	0	0	0
13.792	1.792	5116	4576	0	0	0
13.833	1.833	5207	4647	0	0	0
13.874	1.874	5298	4718	0	0	0
13.917	1.917	5389	4789	0	0	0
13.958	1.958	5480	4860	0	0	0
14.000	2.000	5571	4931	0	0	0

HYDROGRAPH ROUTING

CHANNEL ROUTING - MODIFIED PULS- STATION 2 TO 3

ESTAG 3 ICOMP 1 ISECON 0 ITAPE 0 JPLY 0 JPR1 0 IMAINE 1 IMAUTO 0  
 ROUTING DATA  
 IRES 1 ISANE 1 IOPT 0 IPMP 0 LSTR 0  
 CLOSS 0.00  
 MSTPS 0.00000000  
 LAG ANSCK 0.000  
 I 154 STORA ISPRAT 0

NORMAL DEPTH CHANNEL ROUTING

0M11 0M21 0M31 0M41 0M51 0M61 0M71 0M81 0M91 0M01  
 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000

CROSS SECTION COORDINATES--STA-ELEV, STA-ELEV--ETC  
 0.00 40.00 1000.00 40.00 1000.00 54.00 1000.00 54.00 1000.00 49.00 1025.00 49.00  
 1825.00 54.00 2000.00 60.00 2200.00 80.00

STORAGE	0.00	110.14	145.80	187.94	233.40	285.75	343.91	406.56	475.21	549.10	627.02	709.98	797.98	890.98	989.98	1094.98	1194.98	1289.98	1379.98	1464.98	1544.98	1619.98	1689.98	1754.98	1814.98	1869.98	1919.98	1964.98	2004.98	2039.98	2069.98	2094.98	2114.98	2129.98	2144.98	2154.98	2159.98	2164.98	2169.98	2174.98	2179.98	2184.98	2189.98	2194.98	2199.98	2204.98	2209.98	2214.98	2219.98	2224.98	2229.98	2234.98	2239.98	2244.98	2249.98	2254.98	2259.98	2264.98	2269.98	2274.98	2279.98	2284.98	2289.98	2294.98	2299.98	2304.98	2309.98	2314.98	2319.98	2324.98	2329.98	2334.98	2339.98	2344.98	2349.98	2354.98	2359.98	2364.98	2369.98	2374.98	2379.98	2384.98	2389.98	2394.98	2399.98	2404.98	2409.98	2414.98	2419.98	2424.98	2429.98	2434.98	2439.98	2444.98	2449.98	2454.98	2459.98	2464.98	2469.98	2474.98	2479.98	2484.98	2489.98	2494.98	2499.98	2504.98	2509.98	2514.98	2519.98	2524.98	2529.98	2534.98	2539.98	2544.98	2549.98	2554.98	2559.98	2564.98	2569.98	2574.98	2579.98	2584.98	2589.98	2594.98	2599.98	2604.98	2609.98	2614.98	2619.98	2624.98	2629.98	2634.98	2639.98	2644.98	2649.98	2654.98	2659.98	2664.98	2669.98	2674.98	2679.98	2684.98	2689.98	2694.98	2699.98	2704.98	2709.98	2714.98	2719.98	2724.98	2729.98	2734.98	2739.98	2744.98	2749.98	2754.98	2759.98	2764.98	2769.98	2774.98	2779.98	2784.98	2789.98	2794.98	2799.98	2804.98	2809.98	2814.98	2819.98	2824.98	2829.98	2834.98	2839.98	2844.98	2849.98	2854.98	2859.98	2864.98	2869.98	2874.98	2879.98	2884.98	2889.98	2894.98	2899.98	2904.98	2909.98	2914.98	2919.98	2924.98	2929.98	2934.98	2939.98	2944.98	2949.98	2954.98	2959.98	2964.98	2969.98	2974.98	2979.98	2984.98	2989.98	2994.98	2999.98	3004.98	3009.98	3014.98	3019.98	3024.98	3029.98	3034.98	3039.98	3044.98	3049.98	3054.98	3059.98	3064.98	3069.98	3074.98	3079.98	3084.98	3089.98	3094.98	3099.98	3104.98	3109.98	3114.98	3119.98	3124.98	3129.98	3134.98	3139.98	3144.98	3149.98	3154.98	3159.98	3164.98	3169.98	3174.98	3179.98	3184.98	3189.98	3194.98	3199.98	3204.98	3209.98	3214.98	3219.98	3224.98	3229.98	3234.98	3239.98	3244.98	3249.98	3254.98	3259.98	3264.98	3269.98	3274.98	3279.98	3284.98	3289.98	3294.98	3299.98	3304.98	3309.98	3314.98	3319.98	3324.98	3329.98	3334.98	3339.98	3344.98	3349.98	3354.98	3359.98	3364.98	3369.98	3374.98	3379.98	3384.98	3389.98	3394.98	3399.98	3404.98	3409.98	3414.98	3419.98	3424.98	3429.98	3434.98	3439.98	3444.98	3449.98	3454.98	3459.98	3464.98	3469.98	3474.98	3479.98	3484.98	3489.98	3494.98	3499.98	3504.98	3509.98	3514.98	3519.98	3524.98	3529.98	3534.98	3539.98	3544.98	3549.98	3554.98	3559.98	3564.98	3569.98	3574.98	3579.98	3584.98	3589.98	3594.98	3599.98	3604.98	3609.98	3614.98	3619.98	3624.98	3629.98	3634.98	3639.98	3644.98	3649.98	3654.98	3659.98	3664.98	3669.98	3674.98	3679.98	3684.98	3689.98	3694.98	3699.98	3704.98	3709.98	3714.98	3719.98	3724.98	3729.98	3734.98	3739.98	3744.98	3749.98	3754.98	3759.98	3764.98	3769.98	3774.98	3779.98	3784.98	3789.98	3794.98	3799.98	3804.98	3809.98	3814.98	3819.98	3824.98	3829.98	3834.98	3839.98	3844.98	3849.98	3854.98	3859.98	3864.98	3869.98	3874.98	3879.98	3884.98	3889.98	3894.98	3899.98	3904.98	3909.98	3914.98	3919.98	3924.98	3929.98	3934.98	3939.98	3944.98	3949.98	3954.98	3959.98	3964.98	3969.98	3974.98	3979.98	3984.98	3989.98	3994.98	3999.98	4004.98	4009.98	4014.98	4019.98	4024.98	4029.98	4034.98	4039.98	4044.98	4049.98	4054.98	4059.98	4064.98	4069.98	4074.98	4079.98	4084.98	4089.98	4094.98	4099.98	4104.98	4109.98	4114.98	4119.98	4124.98	4129.98	4134.98	4139.98	4144.98	4149.98	4154.98	4159.98	4164.98	4169.98	4174.98	4179.98	4184.98	4189.98	4194.98	4199.98	4204.98	4209.98	4214.98	4219.98	4224.98	4229.98	4234.98	4239.98	4244.98	4249.98	4254.98	4259.98	4264.98	4269.98	4274.98	4279.98	4284.98	4289.98	4294.98	4299.98	4304.98	4309.98	4314.98	4319.98	4324.98	4329.98	4334.98	4339.98	4344.98	4349.98	4354.98	4359.98	4364.98	4369.98	4374.98	4379.98	4384.98	4389.98	4394.98	4399.98	4404.98	4409.98	4414.98	4419.98	4424.98	4429.98	4434.98	4439.98	4444.98	4449.98	4454.98	4459.98	4464.98	4469.98	4474.98	4479.98	4484.98	4489.98	4494.98	4499.98	4504.98	4509.98	4514.98	4519.98	4524.98	4529.98	4534.98	4539.98	4544.98	4549.98	4554.98	4559.98	4564.98	4569.98	4574.98	4579.98	4584.98	4589.98	4594.98	4599.98	4604.98	4609.98	4614.98	4619.98	4624.98	4629.98	4634.98	4639.98	4644.98	4649.98	4654.98	4659.98	4664.98	4669.98	4674.98	4679.98	4684.98	4689.98	4694.98	4699.98	4704.98	4709.98	4714.98	4719.98	4724.98	4729.98	4734.98	4739.98	4744.98	4749.98	4754.98	4759.98	4764.98	4769.98	4774.98	4779.98	4784.98	4789.98	4794.98	4799.98	4804.98	4809.98	4814.98	4819.98	4824.98	4829.98	4834.98	4839.98	4844.98	4849.98	4854.98	4859.98	4864.98	4869.98	4874.98	4879.98	4884.98	4889.98	4894.98	4899.98	4904.98	4909.98	4914.98	4919.98	4924.98	4929.98	4934.98	4939.98	4944.98	4949.98	4954.98	4959.98	4964.98	4969.98	4974.98	4979.98	4984.98	4989.98	4994.98	4999.98	5004.98	5009.98	5014.98	5019.98	5024.98	5029.98	5034.98	5039.98	5044.98	5049.98	5054.98	5059.98	5064.98	5069.98	5074.98	5079.98	5084.98	5089.98	5094.98	5099.98	5104.98	5109.98	5114.98	5119.98	5124.98	5129.98	5134.98	5139.98	5144.98	5149.98	5154.98	5159.98	5164.98	5169.98	5174.98	5179.98	5184.98	5189.98	5194.98	5199.98	5204.98	5209.98	5214.98	5219.98	5224.98	5229.98	5234.98	5239.98	5244.98	5249.98	5254.98	5259.98	5264.98	5269.98	5274.98	5279.98	5284.98	5289.98	5294.98	5299.98	5304.98	5309.98	5314.98	5319.98	5324.98	5329.98	5334.98	5339.98	5344.98	5349.98	5354.98	5359.98	5364.98	5369.98	5374.98	5379.98	5384.98	5389.98	5394.98	5399.98	5404.98	5409.98	5414.98	5419.98	5424.98	5429.98	5434.98	5439.98	5444.98	5449.98	5454.98	5459.98	5464.98	5469.98	5474.98	5479.98	5484.98	5489.98	5494.98	5499.98	5504.98	5509.98	5514.98	5519.98	5524.98	5529.98	5534.98	5539.98	5544.98	5549.98	5554.98	5559.98	5564.98	5569.98	5574.98	5579.98	5584.98	5589.98	5594.98	5599.98	5604.98	5609.98	5614.98	5619.98	5624.98	5629.98	5634.98	5639.98	5644.98	5649.98	5654.98	5659.98	5664.98	5669.98	5674.98	5679.98	5684.98	5689.98	5694.98	5699.98	5704.98	5709.98	5714.98	5719.98	5724.98	5729.98	5734.98	5739.98	5744.98	5749.98	5754.98	5759.98	5764.98	5769.98	5774.98	5779.98	5784.98	5789.98	5794.98	5799.98	5804.98	5809.98	5814.98	5819.98	5824.98	5829.98	5834.98	5839.98	5844.98	5849.98	5854.98	5859.98	5864.98	5869.98	5874.98	5879.98	5884.98	5889.98	5894.98	5899.98	5904.98	5909.98	5914.98	5919.98	5924.98	5929.98	5934.98	5939.98	5944.98	5949.98	5954.98	5959.98	5964.98	5969.98	5974.98	5979.98	5984.98	5989.98	5994.98	5999.98	6004.98	6009.98	6014.98	6019.98	6024.98	6029.98	6034.98	6039.98	6044.98	6049.98	6054.98	6059.98	6064.98	6069.98	6074.98	6079.98	6084.98	6089.98	6094.98	6099.98	6104.98	6109.98	6114.98	6119.98	6124.98	6129.98	6134.98	6139.98	6144.98	6149.98	6154.98	6159.98	6164.98	6169.98	6174.98	6179.98	6184.98	6189.98	6194.98	6199.98	6204.98	6209.98	6214.98	6219.98	6224.98	6229.98	6234.98	6239.98	6244.98	6249.98	6254.98	6259.98	6264.98	6269.98	6274.98	6279.98	6284.98	6289.98	6294.98	6299.98	6304.98	6309.98	6314.98
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STATION D. PLAN 1. RATIO 4

0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.	66.	67.	68.	69.	70.	71.	72.	73.	74.	75.	76.	77.	78.	79.	80.	81.	82.	83.	84.	85.	86.	87.	88.	89.	90.	91.	92.	93.	94.	95.	96.	97.	98.	99.	100.
0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.	38.	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.	66.	67.	68.	69.	70.	71.	72.	73.	74.	75.	76.	77.	78.	79.	80.	81.	82.	83.	84.	85.	86.	87.	88.	89.	90.	91.	92.	93.	94.	95.	96.	97.	98.	99.	100.

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MAXIMUM STAGE IS 60.0

MAXIMUM STORAGE 41.









STATION 9. PLAN 1. RTIS 4

INLET		OUTFLOW		STAGE		STAGE		STAGE	
0.	1.	0.	1.	0.	1.	0.	1.	0.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
5.	5.	5.	5.	5.	5.	5.	5.	5.	5.
6.	6.	6.	6.	6.	6.	6.	6.	6.	6.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
8.	8.	8.	8.	8.	8.	8.	8.	8.	8.
9.	9.	9.	9.	9.	9.	9.	9.	9.	9.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
11.	11.	11.	11.	11.	11.	11.	11.	11.	11.
12.	12.	12.	12.	12.	12.	12.	12.	12.	12.
13.	13.	13.	13.	13.	13.	13.	13.	13.	13.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
15.	15.	15.	15.	15.	15.	15.	15.	15.	15.
16.	16.	16.	16.	16.	16.	16.	16.	16.	16.
17.	17.	17.	17.	17.	17.	17.	17.	17.	17.
18.	18.	18.	18.	18.	18.	18.	18.	18.	18.
19.	19.	19.	19.	19.	19.	19.	19.	19.	19.
20.	20.	20.	20.	20.	20.	20.	20.	20.	20.
21.	21.	21.	21.	21.	21.	21.	21.	21.	21.
22.	22.	22.	22.	22.	22.	22.	22.	22.	22.
23.	23.	23.	23.	23.	23.	23.	23.	23.	23.
24.	24.	24.	24.	24.	24.	24.	24.	24.	24.
25.	25.	25.	25.	25.	25.	25.	25.	25.	25.
26.	26.	26.	26.	26.	26.	26.	26.	26.	26.
27.	27.	27.	27.	27.	27.	27.	27.	27.	27.
28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
29.	29.	29.	29.	29.	29.	29.	29.	29.	29.
30.	30.	30.	30.	30.	30.	30.	30.	30.	30.
31.	31.	31.	31.	31.	31.	31.	31.	31.	31.
32.	32.	32.	32.	32.	32.	32.	32.	32.	32.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
34.	34.	34.	34.	34.	34.	34.	34.	34.	34.
35.	35.	35.	35.	35.	35.	35.	35.	35.	35.
36.	36.	36.	36.	36.	36.	36.	36.	36.	36.
37.	37.	37.	37.	37.	37.	37.	37.	37.	37.
38.	38.	38.	38.	38.	38.	38.	38.	38.	38.
39.	39.	39.	39.	39.	39.	39.	39.	39.	39.
40.	40.	40.	40.	40.	40.	40.	40.	40.	40.
41.	41.	41.	41.	41.	41.	41.	41.	41.	41.
42.	42.	42.	42.	42.	42.	42.	42.	42.	42.
43.	43.	43.	43.	43.	43.	43.	43.	43.	43.
44.	44.	44.	44.	44.	44.	44.	44.	44.	44.
45.	45.	45.	45.	45.	45.	45.	45.	45.	45.
46.	46.	46.	46.	46.	46.	46.	46.	46.	46.
47.	47.	47.	47.	47.	47.	47.	47.	47.	47.
48.	48.	48.	48.	48.	48.	48.	48.	48.	48.
49.	49.	49.	49.	49.	49.	49.	49.	49.	49.
50.	50.	50.	50.	50.	50.	50.	50.	50.	50.

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
357%	24.5	73.	73.	325.0
131.	69.	22.	22.	207.
	4.55	5.68	5.68	5.68
	119.54	144.24	144.24	144.24
	1212.	1516.	1516.	1516.
	1495.	1667.	1667.	1667.

MAXIMUM STORAGE = 350.

MAXIMUM STAGE IS 40.3

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D-3300

Breach

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 FEET (SQUARE METERS)

OPERATION	STATION	AREA	PLAN RATIO	RATIOS APPLIED TO FLOWS			
				RATIO 1	RATIO 2	RATIO 3	RATIO 4
			.10	.25	.50	1.00	
HYDROGRAPH AT	1	5.00	1	439.	1000.	2175.	4351.
	1	12.051	1	12.3214	30.0001	61.6011	123.2011
ROUTED TO	2	5.00	1	375.	2007.	3040.	4370.
	1	12.051	1	10.5511	50.1111	06.0211	120.0311
ROUTED TO	3	5.00	1	372.	2050.	3052.	4509.
	1	12.051	1	10.5411	50.2711	06.0011	127.9011
ROUTED TO	4	5.00	1	345.	1602.	2717.	4301.
	1	12.051	1	0.7411	47.0211	76.9311	121.4011
ROUTED TO	5	5.00	1	275.	1001.	1932.	2974.
	1	12.051	1	7.7011	30.0311	56.7111	101.1011

SUMMARY OF DAM SAFETY ANALYSIS

Breach

PLAN 1 .....

INITIAL VALUE SPILLWAY CREST TOP OF DAM  
 54.50 54.50 56.00  
 40. 40. 60.  
 0. 0. 01.

ELEVATION STORAGE OUTFLOW

RATIO OF PWS	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM REPTM OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	57.94	0.00	75.	370.	0.00	19.00	0.00
.25	56.70	.20	91.	2100.	.44	14.20	22.75
.50	56.70	.20	91.	3207.	.34	13.00	13.00
1.00	56.30	.00	90.	4057.	.42	13.00	12.00

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PLAN 1 STATION 3

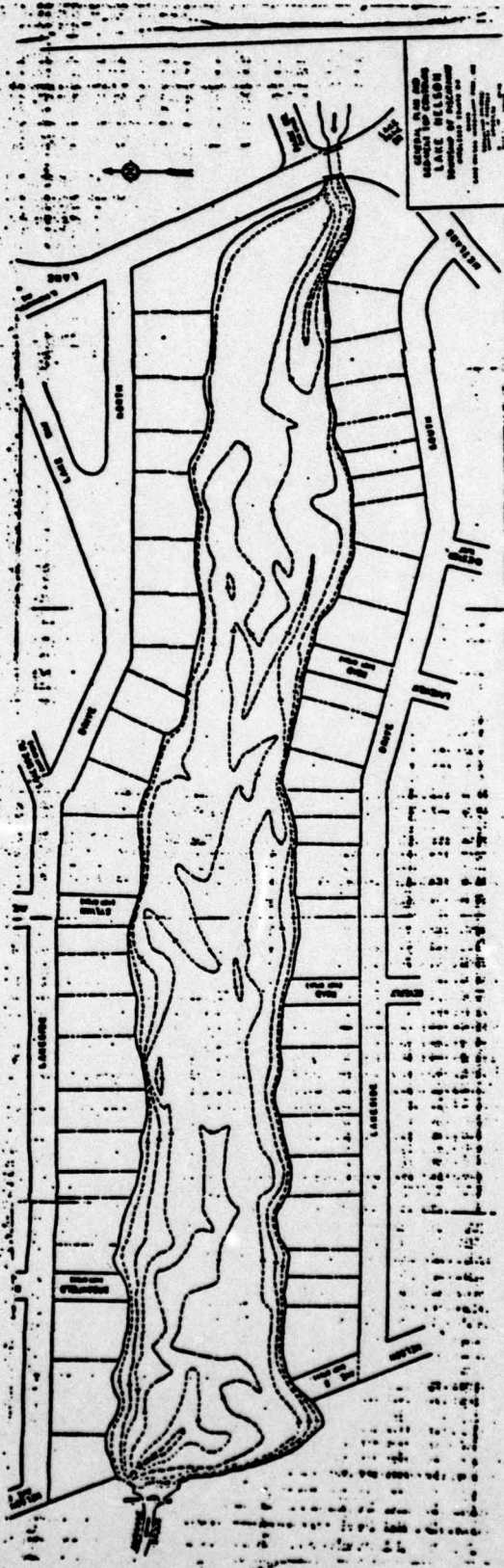
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	370.	56.4	19.00
.25	2050.	56.7	14.20
.50	3003.	56.7	13.00
1.00	4003.	56.0	13.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	344.	50.6	15.50
.25	1672.	54.0	15.00
.50	2717.	56.3	14.56
1.00	4301.	57.0	14.50

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.10	279.	43.0	16.75
.25	1001.	52.0	16.00
.50	1572.	56.3	15.50
1.00	2374.	56.3	15.50



REF. LAKE NELSON ENVIRONMENTAL  
 PROTECTION AND IMPROVEMENT  
 AUG. 1971 HAEFELI, CONSULTING  
 ENGINEERS

Dam Application No 97

One  
3/2/27

Drainage Area 5.0 sq mi

Spillway 81' x 3"  $C = 2.64$

$$\frac{13.7 \times 81}{5} = 222 \text{ sec } 17 \text{ sq mi OK.}$$

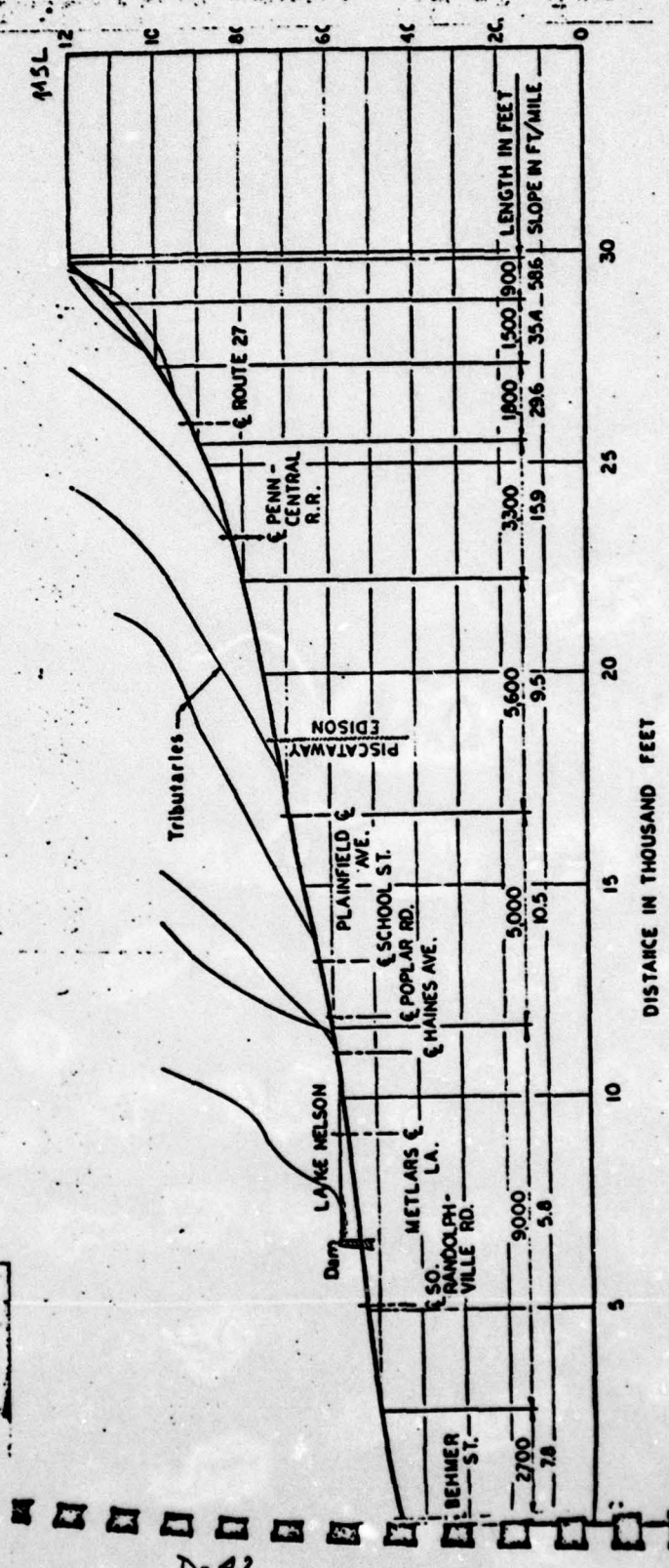
Cut off. OK

Slopes see letter of 3/2/27

$$Q = \frac{81 \times 2.64 \times 3^{3/2}}{5.2} = 222$$
$$= 1111.14 \text{ C.F.S.}$$

REF. STATE FILES

FIGURE 3

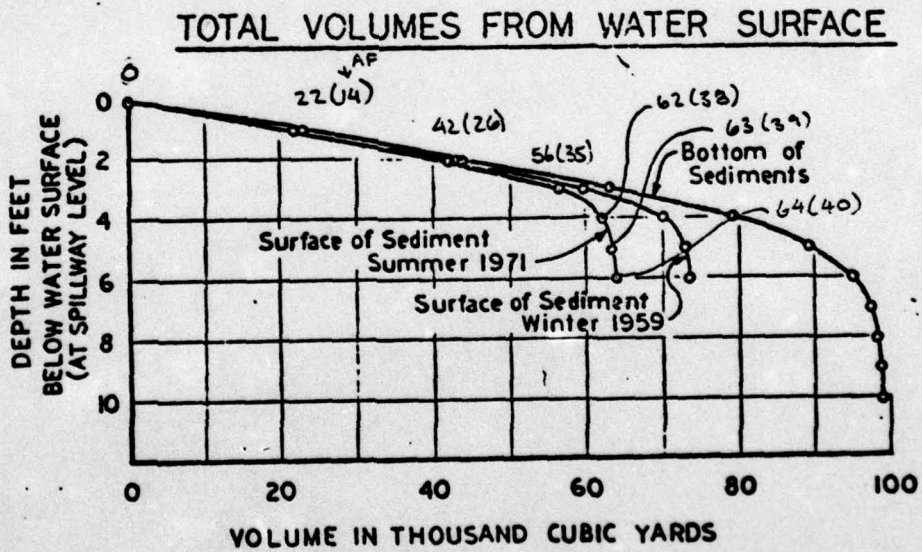
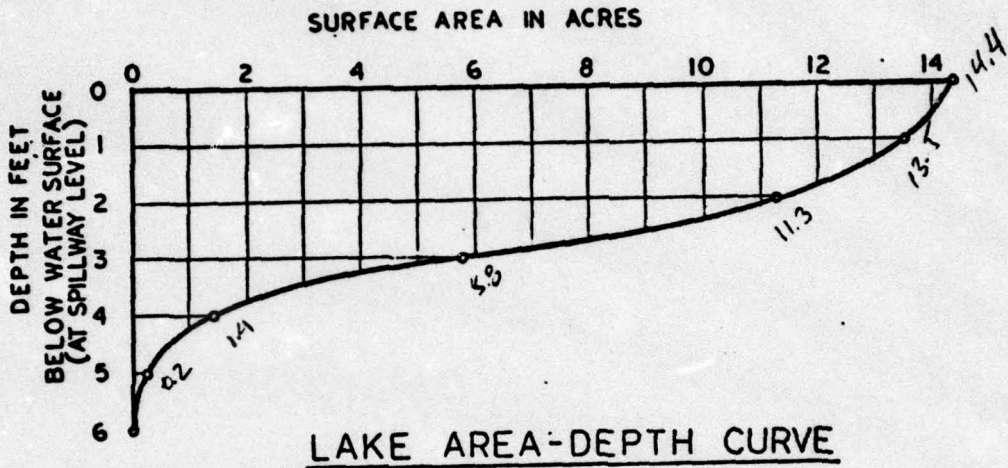


REF. LAKE NELSON ENVIRONMENTAL PROTECTION AND IMPROVEMENT AUG. 1971 HAEFELT, CONSULTING ENGINEERS

AMBROSE BROOK PROFILE

J. HAEFELT, P.E.  
 1100 W. 10th Ave.  
 Denver, CO 80202

# LAKE NELSON



ROBERT J. HAEFELI, P  
 CONSULTING ENGINEER  
 1996 STATE HIGHWAY  
 EDISON, N. J. 08817

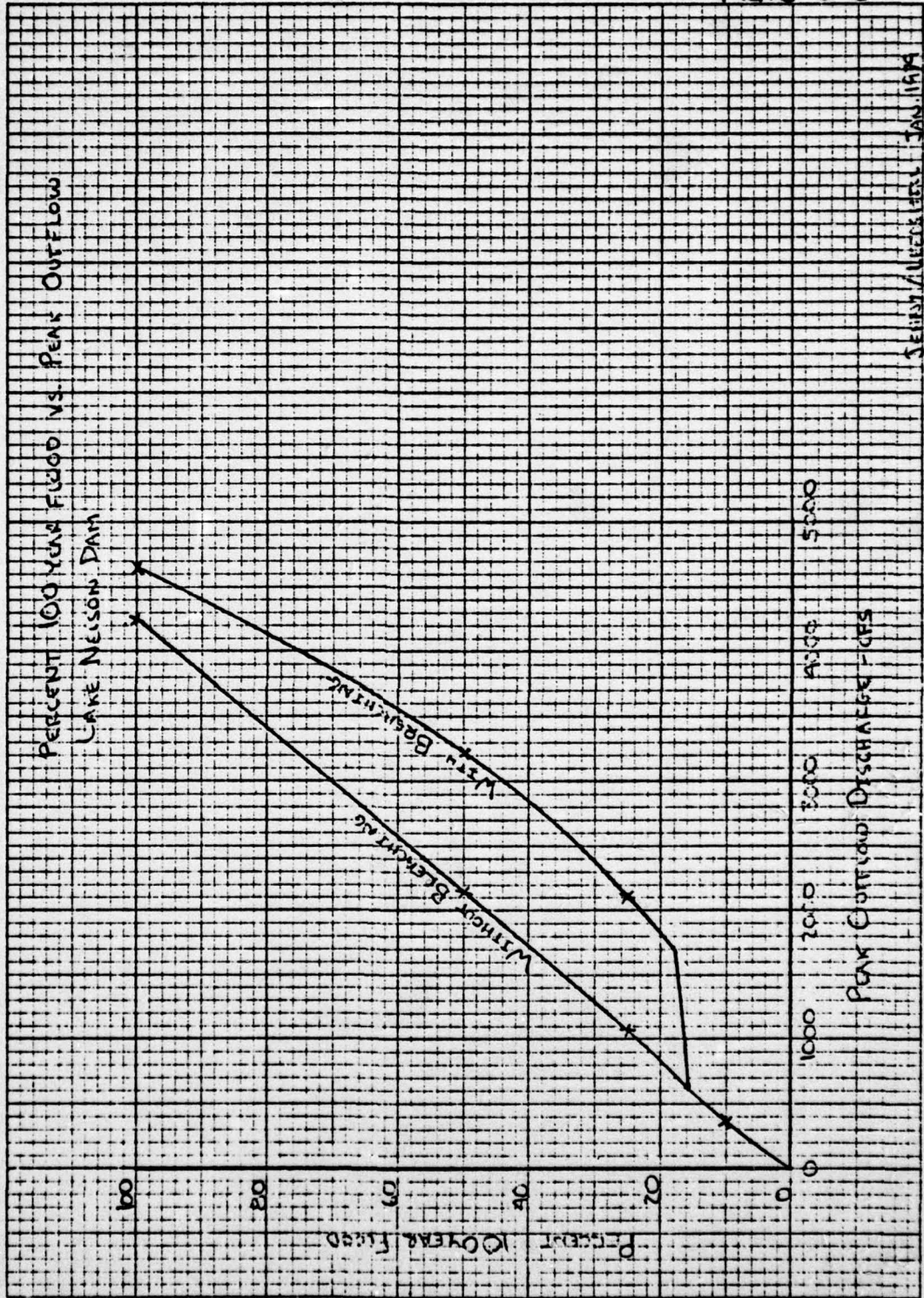
# LAKE NELSON DAM



AREA LOCATION

DRAINAGE BASIN  
BOUNDARY

SCALE IN FEET  
0 1000 2000 3000 4000 5000 6000



SEBEST / WICKS / ESSL JAN. 1979

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Plate D-3

