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NATIONAL DAM SAFETY PROGRAM. BOONTON RESERVOIR DAM (NJ-00255), --ETC(U)
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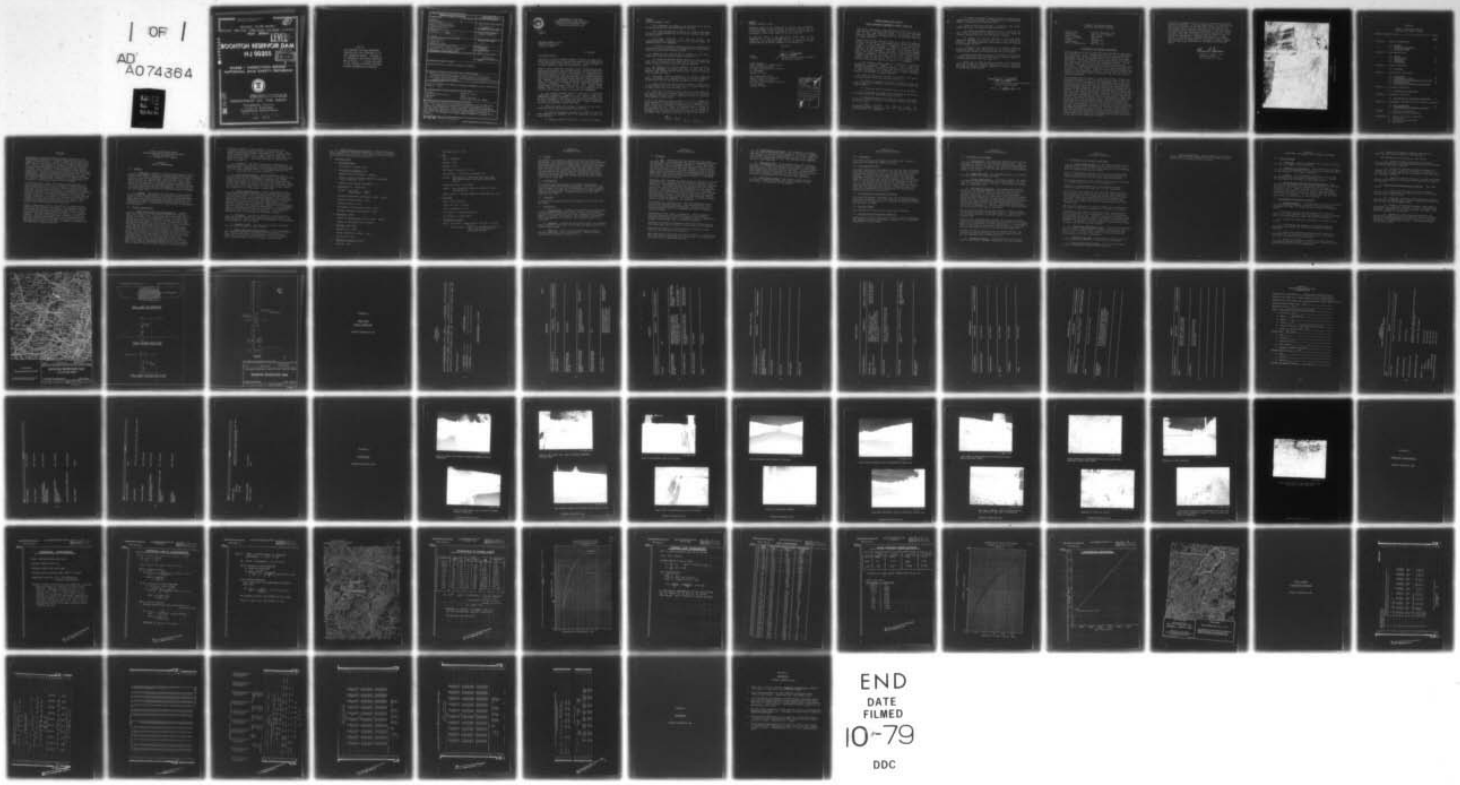

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PASSAIC RIVER BASIN
STONY BROOK TRIBUTARY, MORRIS COUNTY
NEW JERSEY

LEVEL II

BOONTON RESERVOIR DAM
NJ 00255

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

July, 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NJ00255
2. GOVT ACCESSION NO.:
3. RECIPIENT'S CATALOG NUMBER:
4. TITLE (and Subtitle): Phase I Inspection Report
National Dam Safety Program
Boonton Reservoir Dam
Morris County, N.J.
5. TYPE OF REPORT & PERIOD COVERED: (9) FINAL rept.,
6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): (10) Guinan, Warren A., P.E. /Guinan
8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-79-C-0011
9. PERFORMING ORGANIZATION NAME AND ADDRESS:
Anderson-Nichols & Co.
6 Louden Rd.
Concord, NJ 03301
10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 76p.
11. CONTROLLING OFFICE NAME AND ADDRESS:
U.S. Army Engineer District, Philadelphia
Custom House, 2d & Chestnut Streets
Philadelphia, Pennsylvania 19106
12. REPORT DATE: (11) July 1979
13. NUMBER OF PAGES: 45
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):
15. SECURITY CLASS. (of this report): Unclassified
15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(6) National Dam Safety Program. Boonton Reservoir Dam (NJ-00255), Passaic River Basin, Stony Brook Tributary, Morris County, New Jersey. Phase 1 Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Spillways
Boonton Reservoir Dam, N.J.
Embankment
Réprap
Structural analysis
Safety
Visual inspection
National Dam Safety Act Report

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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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) 108

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

IN REPLY REFER TO

NAPEN-D

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

16 SEP 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Boonton Reservoir Dam in Morris 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, Boonton Reservoir Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 41 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise procedures for removal of trees and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and reestablishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not, design and install an adequate reservoir drain for emergency drawdown.

(2) Identify the size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient. Any remedial measures found necessary should be initiated within calendar year 1980.

d. A program to check the condition of the dam once a month and monitor the seepage until remedial measures are effected should be initiated within 30 days from the date of approval of this report.

e. Within three months from the date of approval of this report the owner should clear trees and brush from the discharge channel and its banks and see that this area is kept clear.

f. Within one year from the date of approval of this report the owner should engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the 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.

NAPEN-D
Honorable Brendan T. Byrne

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

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

Sincerely,

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting 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 CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
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BOONTON RESERVOIR DAM (NJ00255)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 15 May 1979 by Anderson-Nichols & Co., Inc. under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Boonton Reservoir Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 41 percent of the Spillway Design Flood--SDF - would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the dam's reduced hazard classification and expectation that failure of the structure would probably result in no loss of life. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and supervise procedures for removal of trees and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and reestablishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway. Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within one year from the date of approval of this report, engineering studies and analyses should be performed to:

(1) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not, design and install an adequate reservoir drain for emergency drawdown.

(2) Identify the size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient. Any remedial measures found necessary should be initiated within calendar year 1980.

d. A program to check the condition of the dam once a month and monitor the seepage until remedial measures are effected should be initiated within 30 days from the date of approval of this report.

e. Within three months from the date of approval of this report the owner should clear trees and brush from the discharge channel and its banks and see that this area is kept clear.

f. Within one year from the date of approval of this report the owner should engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years.

APPROVED: Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 13 September 1977

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Boonton Reservoir Dam
ID Number:	Fed. ID No. NJ00255
State Located:	New Jersey
County Located:	Morris
Stream:	Stony Brook
River Basin	Passaic
Date of Inspection:	May 15, 1979

ASSESSMENT OF GENERAL CONDITIONS

Boonton Reservoir Dam is about 80 years old and in poor overall condition. It is intermediate in size and is classified as Significant Hazard. Trees and brush are growing on the embankment and the downstream slope. The riprap is in poor condition. Extensive seepage was noted along the toe of the dam between the spillway and the northwest abutment. There are tree stumps on the crest and downstream face of the spillway. Trespassing and erosion are evident along the crest of the dam. Spalling and erosion of the visible portion of the core wall was noted. Trees and brush are overhanging and growing in the downstream channel. The spillway can pass less than 20% of the PMF without overtopping the dam and is considered inadequate.

We recommend that the owner, in the near future, design and supervise procedures for the removal of the trees, their root systems, and brush growing on the embankment and in the downstream toe area, and backfilling; investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures; design and supervise procedures for removal of the stumps on the crest and downstream face of the spillway, and repair holes after removal; clear the downstream area of brush, trees, and debris, and keep it cleared; design and supervise procedures for repair of the riprap; design procedures for repairing erosion and re-establishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment; design and implement remedial measures for repairing the concrete crest of the spillway; and determine the size and condition of water supply and other pipes passing through the embankment and design a reservoir drain system for emergency drawdown if none is found. Further evaluation of the hydrology and hydraulics of the dam and reservoir and design of additional spillway discharge capacity should be accomplished in the future by a professional engineer qualified in the design and inspection of dams.

We further recommend that as a part of operating and maintenance procedures: starting immediately, the owner should check the condition of the dam once a month and monitor the seepage until remedial measures are effected; a surveillance program should be established in the near future for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure; in the future, a professional engineer qualified in the design and inspection of dams should be engaged to make a comprehensive technical inspection of the dam once every two years.

Warren A. Guinan

Warren A. Guinan, P.E.
Project Manager
New Jersey No. 16848

15 MAY 1979

OVERVIEW

BOONTON RESERVOIR DAM

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

BOONTON RESERVOIR DAM N.J. NO. 22-25 and FED ID NO. NJ00255

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 aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
BOONTON RESERVOIR DAM
U.S. #NJ00255 N.J. #22-25

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety Inspection of Boonton Reservoir Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 4 April 1979 under contract No. FPM-39 dated 28 June 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the U.S. Army Engineers District, Philadelphia. The inspection discussed herein was performed by Anderson-Nichols & Company, Inc. on 15 May 1979.

b. Purpose. The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to the safety of Boonton Reservoir Dam and appurtenances based upon available data and visual inspection, and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Boonton Reservoir Dam is a 15-foot high, 600-foot long earthfill dam, built about 1900. A cut stone core wall runs the full length of the dam. The downstream face is covered with riprap up to one foot in diameter and has a 1.5H:1V slope. Riprap has been placed at the toe of the embankment from the easterly abutment to the spillway to act as a toe drain. The slope of the upstream face is unknown. There is a stone masonry gate building located on the crest approximately 80 feet west of the east abutment. A pump house is located at the toe of the dam immediately below the gatehouse. The spillway is a free overflow, 90 feet long and constructed of dry stone masonry, capped with 8-inch thick concrete slabs. The concrete slabs are 5 feet wide. Immediately upstream is a 4.5-foot wide concrete apron. The crest width of the dam embankment varies from 9 to 12 feet. The easterly embankment abutment is at the westerly edge of Boonton Avenue (County Route 511) which parallels

the entire length of the reservoir. The slope rises gradually from the easterly side of Boonton Avenue. The westerly embankment abutment intersects with a steep natural slope (approximately 2H:1V). Approximately 4000 feet upstream of the dam a low causeway, with a 4-foot pipe arch, spans the reservoir. Essential features of the dam are given in Figure 2.

b. Location. The dam is located in Morris County, New Jersey on a tributary to Stony Brook, a tributary to the Rockaway River, approximately 1 mile northeast of Taylortown. It is at north latitude 40° 57.2' and west longitude 74° 23.0'. A location map is given in Figure 1.

c. Size Classification. Boonton Reservoir Dam is classified as being "intermediate" in size in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams, on the basis of storage (which governs rather than height) at the dam crest of 1265 acre-feet, which is less than 50,000 acre-feet, but more than 1,000 acre-feet. Its height of 14.9 feet, which is less than 40 feet, would have classified it otherwise as a small dam.

d. Hazard Classification. Visual inspection of the downstream area shows that failure of Boonton Reservoir Dam could possibly lead to the overtopping and failure of Deer Pond Dam downstream, and subsequent damage to the clubhouse downstream of Deer Pond Dam and approximately 8 houses, which are at least 10 feet above the discharge channel, in the Rockaway Valley section of Boonton. Substantial valley storage to reduce and attenuate the flood peak exists between Deer Pond Dam and the potential damage area. It is estimated that the affected structures could sustain only appreciable damage and that loss of life is unlikely. Thus Boonton Reservoir Dam is classified as Significant Hazard.

e. Ownership. The dam is owned by the Boonton Water Department, Town of Boonton, Morris County, New Jersey. Mr. Frank Costabile, Sewer and Water Superintendent, was contacted for information (201-334-3450).

f. Purpose of Dam. The lake was originally designed and is currently used for water supply.

g. Design and Construction History. Little information was disclosed regarding the design and construction of the dam. The original plans were prepared around 1900 and construction followed soon thereafter. No major modifications have been made since the original construction.

h. Normal Operational Procedures. Boonton Reservoir Dam is operated as the water supply for the Town of Boonton. Three quarters of a million to one million gallons per day are currently drawn from the reservoir.

1.3 Pertinent Data

a. Drainage Areas

Watershed 2.0 square miles

b. Discharge at Damsite (cfs)

Maximum flood at damsite - unknown

Ungated (total) spillway capacity at maximum pool elevation - 613

Maximum water supply withdrawal - 1.5

c. Elevation (ft. above MSL)

Top Dam Low Point - 639.4
High Point - 640.7

Maximum pool-design surcharge (½ PMF) - 640.8

Normal recreation pool - 637.5

Spillway crest - 637.5

Streambed at centerline of dam - 624.5

Maximum tailwater (estimated) - 627.2

d. Reservoir (feet)

Length of maximum pool (top of dam) - 8640'±

Length of recreation pool - 8440'±

e. Storage (acre-feet)

Normal pool - 1066

Design surcharge (½ PMF) - 1435

Top of dam - 1270

f. Reservoir Surface (acres)

Top dam - 133

Spillway crest - 88.8

g. Dam

Type - Earthfill

Length - 600'

Height - 14.9'

Top Width - Varies 9' to 12'

Side Slopes - 1.5H:1V d/s, unknown u/s

Zoning - Earthfill d/s face with cut stone core and "puddle bank" upstream (from design plans)

Impervious Core - Cut stone

Cutoff - Cut stone core keyed into bedrock (from design plans)

Grout curtain - Partial added in 1960s (see Sec. 2.2)

h. Spillway

Type - Free overflow

Length of weir - 90 feet

Crest elevation - 637.5

U/S Channel - Boonton Reservoir

D/S Channel - Stony Brook

i. Regulating Outlets

Type - Low level - None visible (see Sec. 2.1 and 5.1 a.)

Water Supply - Access in gatehouse on top of dam. Type of regulating mechanism unknown.

SECTION 2
ENGINEERING DATA

2.1 Design

No hydraulic or hydrologic design engineering data were disclosed. The original design plans, on file at the Boonton Water Department show a 627-foot long earthfill dam with a cut-stone core wall and a "puddle bank" upstream. The plans also show an 18-inch, 24-foot long low level outlet pipe with an intake just upstream of the southeasterly end of the spillway and an outlet near the bottom of the southeasterly end of the spillway face. The design top of dam elevation is 640.5 feet MSL and the design spillway elevation is 637.5 feet MSL.

2.2 Construction

No recorded data concerning the original construction of Boonton Reservoir Dam were disclosed. The current water superintendent for the Town of Boonton stated that a partial grout curtain was added in the mid 1960s to reduce seepage through the embankment. Riprap along the toe was also added at that time.

2.3 Operation

No engineering data pertaining to operation of the dam were disclosed.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files, contact with community officials and contact with the owner revealed only a limited amount of recorded information. All disclosed information, with the exception of a copy of the original plans, was retrieved.

b. Adequacy. Because of the limited amount of recorded data available, evaluation of this dam was based primarily on visual observations.

c. Validity. Parts of the recorded data reviewed did not agree with visual observations. Specific discrepancies are discussed in Section 5.1 a.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. Trees and brush are growing on the crest, upstream face, and downstream face of the embankment between the spillway and the northwest abutment. Trees and brush are growing on the embankment from the southeast end of the spillway part way to the southeast abutment (ending about 2/3 of the distance from the left abutment to the spillway). Small brush is growing through the riprapped section of the downstream slope which extends from the southeast abutment part way to the spillway as shown on Figure 2. The riprap is in poor condition locally.

Extensive clear seepage was noted along the entire toe of the dam between the spillway and the northwest abutment. The seepage at the downstream toe near the spillway was estimated at 12 gpm. Some clear seepage was observed from the lower part of the contact between the embankment and the southeast abutment. This seepage is being channeled in a man-made ditch around a small wooden building near the toe of the dam. The area near the toe of the dam is generally soft and wet and covered with dense brush between the discharge channel and the southeast abutment. No evidence of bulging or other signs of slope instability were observed.

Tree stumps are located on the crest and downstream face of the stone masonry spillway. The concrete crest of the spillway is deteriorated and spalled. Several sections of the concrete crest have separated and brush is growing from the cracks.

Trespassing on the crest is extensive. Wheel tracks on the crest are bare of vegetation between the southeast abutment and the spillway. A footpath is bare of vegetation between the spillway and the northwest abutment.

Evidence of extensive trespassing and erosion were noted on the downstream slope adjacent to both sides of the spillway.

Extensive erosion of the upstream slope adjacent to both sides of the gatehouse has occurred.

Some spalling of the mortar as well as erosion of the top of the stone masonry core wall was noted where it is exposed on the crest of the embankment section.

b. Appurtenant Structures. The gatehouse was locked; thus the type of operating facilities it contains is unknown. The exterior of the gatehouse appears to be in fair condition. The concrete steps that descend from the top of the embankment to the downstream toe near the gatehouse were observed to be in good condition.

c. Reservoir Area. The watershed above the reservoir is gently to steeply sloping and heavily wooded. The slopes adjacent to the reservoir appear to be stable. No structures were observed on the shore of the reservoir. Sediment has accumulated behind the spillway to the elevation of the crest for a short distance upstream, but no other evidence of extensive sedimentation in the reservoir was observed.

d. Downstream Channel. The channel bottom appears to be soil. There is a moderately dense growth of trees and brush in and adjacent to the channel.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed. Water is drawn off as needed for supply purposes.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed. From the condition of the dam it is apparent that a regular maintenance program has not been followed for the dam as a whole. An effort has been made to keep the crest and embankment slopes on the southeast side of the spillway clear of trees and brush and the seepage at the toe on that side of the dam has been channeled as described in Section 3.1 a. Maintenance of the dam to the northwest of the spillway has been neglected and Mr. Frank Costabile stated that this was because union workers refused to cross the spillway to accomplish such maintenance as has been performed southeast of the spillway.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities were disclosed. From the condition of the appurtenant structures it is apparent that a regular maintenance program has not been followed.

4.4 Warning System

No description of any warning system was disclosed.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures, the remedial measures described in Section 7.2 b. should be implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. Design Data. Two hydraulic features of the structure did not agree with the original design plans. The spillway is shown to be 100 feet in length on the plans and is actually 90 feet in length. The low level outlet pipe, shown in the plans to exit through the face of the spillway, could not be found.

b. Experience Data. No recorded hydraulic or hydrologic experience data were disclosed.

c. Visual Observations. No visual evidence was found of damage to the structure caused by overtopping. At the time of inspection, water less than 1-inch deep was passing over the spillway crest.

d. Overtopping Potential. The hydraulic/hydrologic evaluation for Boonton Reservoir Dam is based on a spillway design flood (SDF) equal to one-half the probable maximum flood (PMF) on the basis of the limited hazard observed downstream and in accordance with evaluation guidelines for dams classified as Significant Hazard and intermediate in size. The PMF has been determined by application of the SCS dimensionless unit hydrograph procedure to a 24-hour PMP storm of 22.5 inches. Hydrologic computations are given in Appendix 3. The routed half-PMF peak discharge for the subject watershed is 3597 cfs.

The minimum elevation of the dam allows 1.9 feet of depth in the spillway before overtopping occurs. Under this head the spillway capacity is 613 cfs which is less than the required SDF.

Flood routing calculations indicate that Boonton Reservoir Dam will be overtopped for more than 4 1/2 hours to a maximum depth of 1.4 feet under half PMF conditions. It is estimated that the spillway can pass less than 20 percent of the PMF without overtopping, and thus is considered inadequate.

Because the dam is classified as Significant Hazard, the increase in downstream hazard due to overtopping failure was not assessed with a breach analysis.

e. Drawdown Capacity. Because the low level outlet could not be found, drawdown capability was not assessed.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. If the trees growing on the embankment and in the downstream toe area blow over and pull out their roots, or if a tree dies and its roots decay, serious seepage problems may result.

If the brush growing through the riprap on the downstream slope is allowed to grow into trees, problems similar to those associated with the existing trees may develop.

The riprap which is in poor condition may result in erosion or sloughing problems if it is not repaired.

Seepage at the downstream toe of the dam may result in long-term stability problems if it is not corrected.

The roots of tree stumps on the crest and downstream face of the masonry spillway may rot and leave open channels through spillway or the stumps may sprout new growth which will cause additional deterioration of the masonry and concrete. Continued deterioration of the concrete crest may result in erosion and loss of stone masonry under the concrete cap.

The lack of vegetation in vehicle tracks and a footpath on the crest of the dam is conducive to erosion of the crest.

Trespassing and erosion, particularly near the gatehouse and the spillway, if not controlled, could lead ultimately to breaching of the dam. Based on the visual inspection and limited data available it was not possible to determine the character of the dam foundation, the interior of the cross section. Therefore it is not possible to evaluate the factor of safety of the dam against sliding.

b. Design and Construction Data. Plans for the original dam show that it was designed to have a masonry wall core with a 10-foot "puddle bank" upstream of the masonry wall. An 18" x 24" low level outlet shown on the plans was not found during the visual inspection.

c. Operating Records. No operating records pertinent to the structural stability of the dam were disclosed.

d. Post-Construction Changes. No records pertinent to post-construction changes were disclosed.

e. Seismic Stability. Boonton Reservoir Dam is in Seismic Zone 1 and in accordance with the Phase I guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Boonton Reservoir Dam is about 80 years old and is in poor overall condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 a. and the operating and maintenance procedures in 7.2 b. should be implemented by the owner as prescribed below.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems that are listed in Sections 5 and 6. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to instability of the structure.

7.2 Recommendations/Remedial Measures

a. Recommendations. The owner should retain the services of a professional engineer, qualified in the design and inspection of dams, to accomplish the following in the near future:

(1) Design and supervise procedures for removal of trees, their root systems, and brush growing on the embankment and in the downstream toe area, and properly backfill.

(2) Design and supervise procedures for repair of the riprap.

(3) Investigate the seepage at the downstream toe of the dam and design and supervise appropriate remedial measures.

(4) Design and supervise procedures for removal of the stumps on the crest and downstream face of the masonry spillway, and repair the holes created.

(5) Design procedures for repairing erosion and re-establishing grassy vegetation on the crest, upstream slope, and downstream slope of the embankment.

(6) Design and implement remedial measures for repairing the concrete crest of the spillway.

and accomplish the following in the future:

(1) Conduct further hydrologic and hydraulic analyses and design and oversee modification of the spillway to provide additional capacity.

(2) Design and implement remedial measures to restore the low level outlet to operation if it exists; if it does not: design and install an adequate reservoir drain for emergency drawdown.

(3) Identify size and condition of pipes and valves within the embankment, and repair such pipes as are found to be deficient.

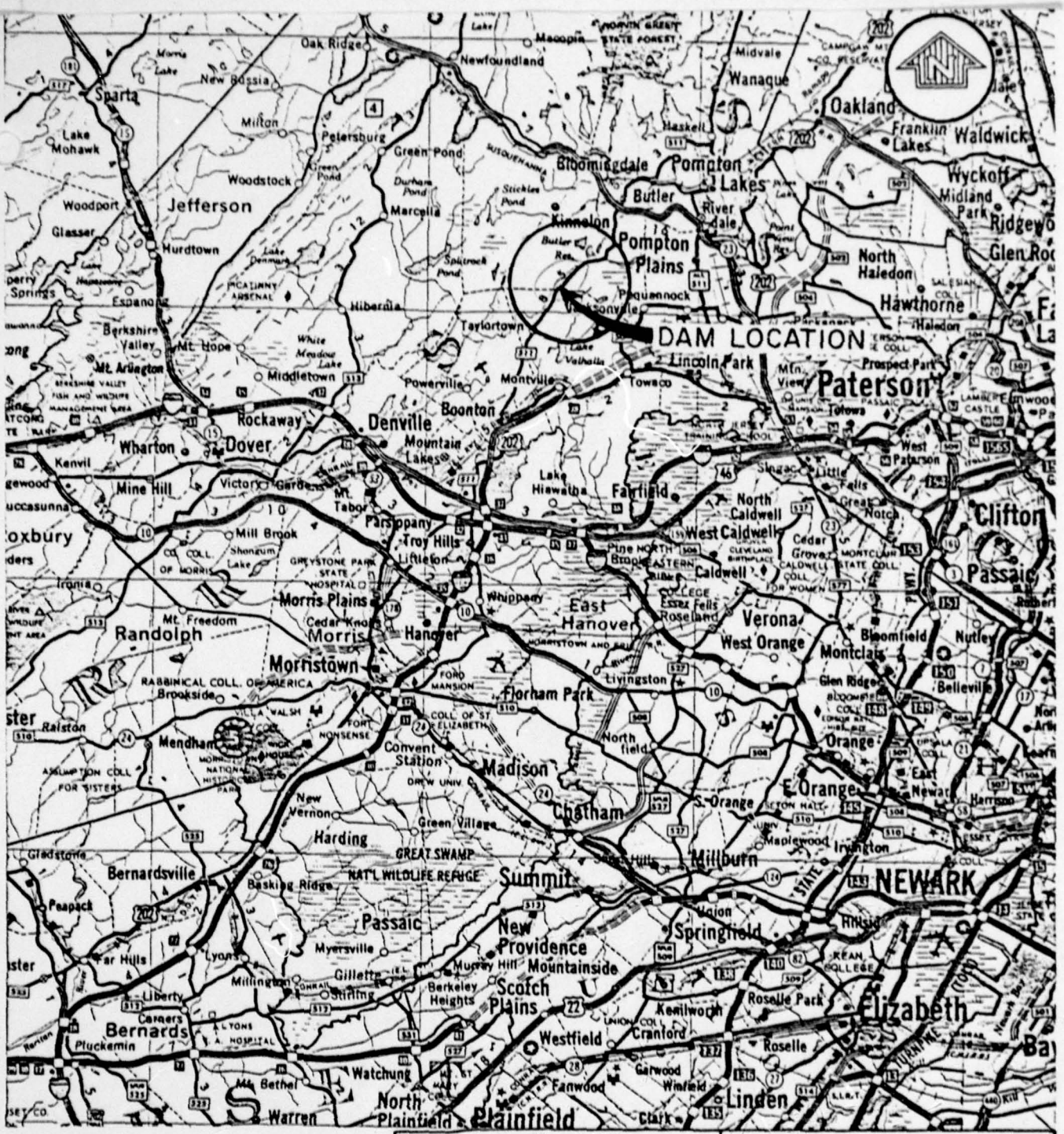
b. Operating and Maintenance Procedures. The owner should:

(1) Clear trees and brush from the discharge channel and its banks and see that this area is kept clear. This should be started soon.

(2) Check the condition of the dam once a month and monitor the seepage until remedial measures are effected. This should be started immediately.

(3) Engage a professional engineer, qualified in the design and inspection of dams, to make a comprehensive technical inspection of the dam once every two years. This should be started in the future.

(4) Establish a surveillance program for use during and immediately following periods of heavy rainfall, and also a warning program to follow in case of floodflow conditions or imminent dam failure. This should be done in the near future.



Anderson-Nichols & Co., Inc.
BOSTON MASSACHUSETTS

U.S. ARMY ENGINEER DIST. PHILADELPHIA
CORPS OF ENGINEERS
PHILADELPHIA, PA.

SCALE IN MILES

0 5 10

MAP BASED ON STATE OF NEW JERSEY
OFFICIAL HIGHWAY MAP AND GUIDE.

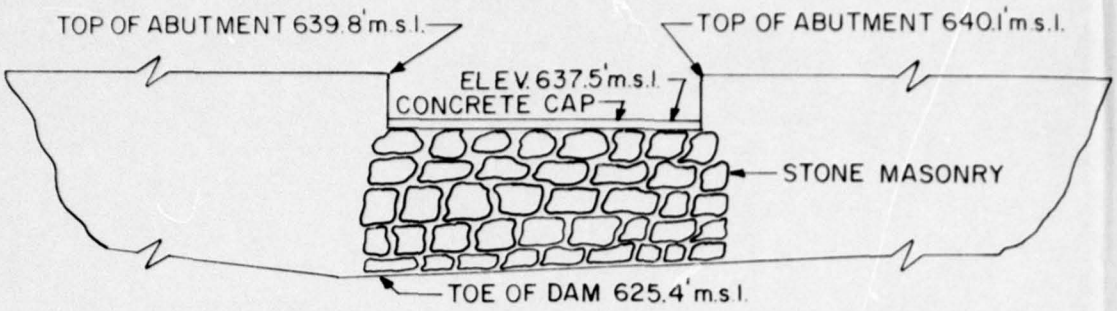
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BOONTON RESERVOIR DAM
LOCATION MAP

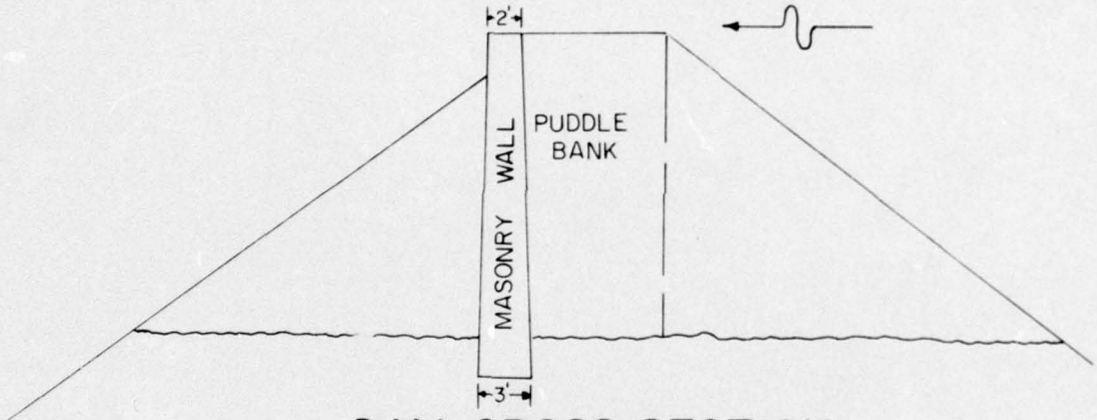
TRIBUTARY TO STONY BROOK NEW JERSEY

			SCALE: SEE BAR SCALE
			DATE:

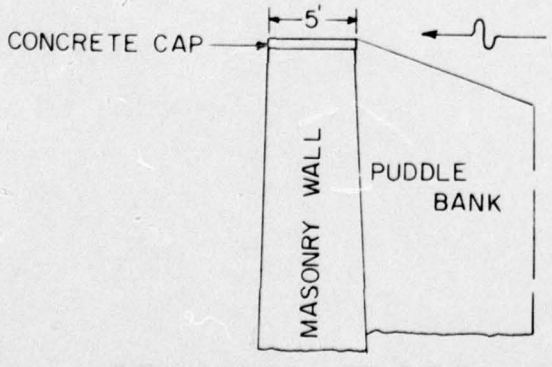
Figure 1



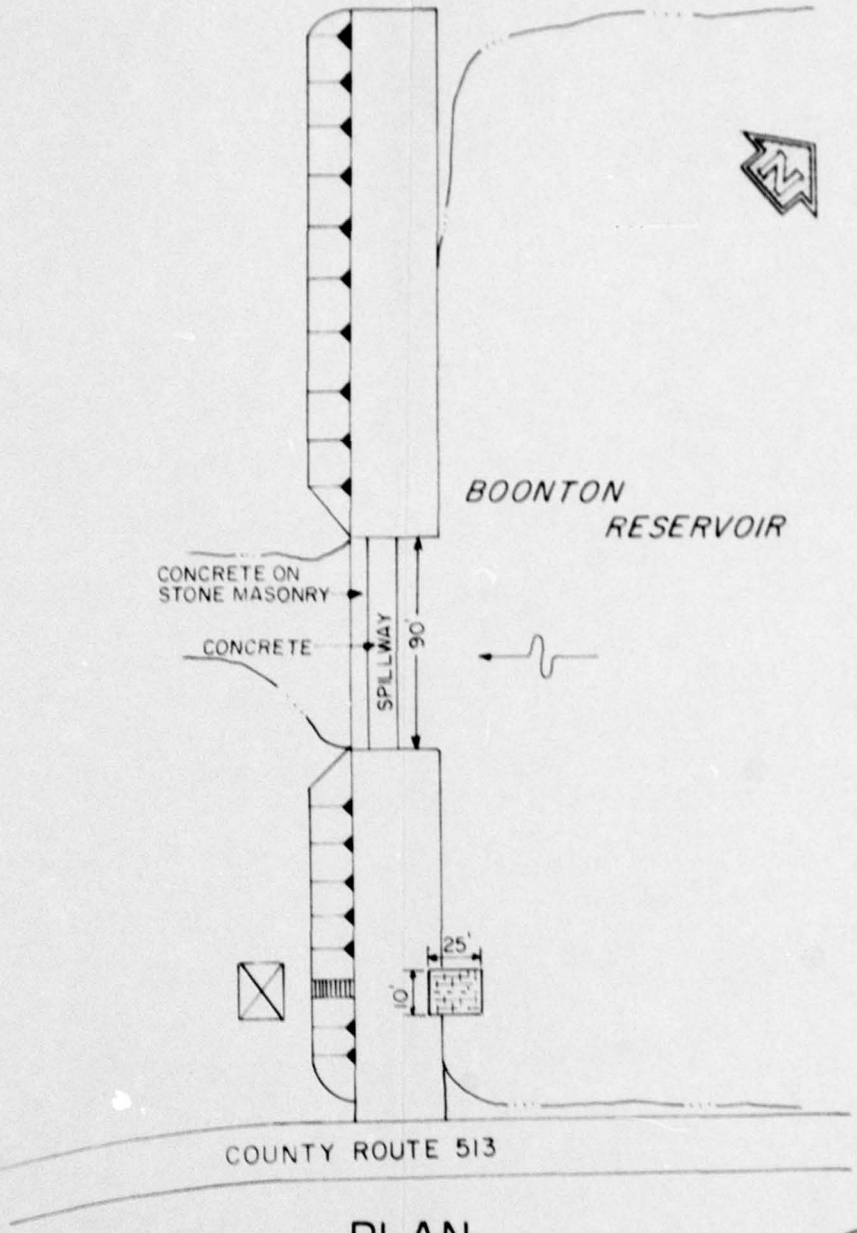
SPILLWAY ELEVATION



DAM CROSS SECTION



SPILLWAY CROSS SECTION



PLAN

2

DATA FROM FIELD INSPECTION MAY 15, 1979

Anderson-Nichols & Co., Inc. BOSTON MASSACHUSETTS	U.S. ARMY ENGINEER DIST. PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BOONTON RESERVOIR DAM

BOONTON RESERVOIR NEW JERSEY

SCALE: NOT TO SCALE	
DATE JULY, 1979	

FIGURE 2

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

BOONTON RESERVOIR DAM

Check List
Visual Inspection
Phase 1

Name Dam Boonton Reservoir Dam County Morris State New Jersey Coordinators N.J. D.E.P.

Date(s) Inspection 5/15/79 Weather Sunny, hot Temperature 75°

Pool Elevation at Time of Inspection 637.5 MSL Tailwater at Time of Inspection 624.7 MSL

Inspection Personnel:

Warren Guinan	Ronald Hirschfeld
Stephen Gilman	
David Deane	

Gilman and Hirschfeld Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None apparent.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None apparent.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some erosion of upstream slope on left side and right side of gatehouse.	Repair erosion.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	Riprap, which covers downstream slope from left abutment to a point about 30 feet west of gatehouse is quite uneven. Brush beginning to grow through riprap.	Clear brush growing through riprap.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
RAILINGS	None	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Trespassing and erosion of downstream slope of embankment near training wall on right side downstream of spillway. Stone masonry core on left side of dam has numerous small cracks and spalling of small stones on surface.	Repair erosion and prevent trespassing. Riprap should be repaired. Only the top surface of the core wall was visible.
ANY NOTICEABLE SEEPAGE	Major seepage occurring at downstream toe along practically the entire length of the dam.	Investigate seepage and design remedial measures.
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	

OUTLET WORKS - None Visible

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE		
OUTLET PIPE		
OUTLET CHANNEL		
EMERGENCY GATE		

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR Concrete capped stone masonry	Concrete cap poured in two sections. Numerous cracks and evidence of movement between sections. Small brush growing in cracks. At least 2 small areas (2 sq. ft.) of concrete cap broken and spalled away.	Brush should be removed. Concrete cap should be repaired or replaced.
APPROACH CHANNEL	Wide and unobstructed sediment fills channel to elevation of upstream edge of spillway crest.	
DISCHARGE CHANNEL	Soil bottom. Covered with brush and trees.	Clear trees and brush from channel and channel banks.
BRIDGE AND PIERS OVER SPILLWAY	None	

INSTRUMENTATION

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

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Soil bottom. Brush and trees in and adjacent to channel.	Clear trees and brush from channel and channel banks.
SLOPES	Gentle slopes, heavily wooded.	
APPROXIMATE NO. OF HOMES AND POPULATION	Eight homes with an estimated population of 30 people in Rockaway Valley Section of Boonton approximately 1 mile downstream of Deer Pond Dam which is approximately 2 miles downstream of the subject dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle slopes. Heavily wooded, except that a highway is close to the left bank near the dam.	
SEDIMENTATION	Not visible beneath reservoir surface, except near spillway as noted above.	

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 2 square miles, wooded and hilly

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 637.5' (1066 acre-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 639.4' (1265 acre-ft.)

ELEVATION MAXIMUM DESIGN POOL: 640.7'

ELEVATION TOP DAM: 639.4'

CREST: Free overflow concrete-capped spillway

a. Elevation 637.5'

b. Type concrete weir

c. Width 5'

d. Length 90'

e. Location Spillover approximate center of dam

f. Number and Type of Gates none

OUTLET WORKS: none visible

a. Type

b. Location

c. Entrance Inverts

d. Exit Inverts

e. Emergency Draindown Facilities

HYDROMETEORLOGICAL GAGES: none

a. Type

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 613 cfs

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Original on file at Town of Boonton Water Department
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	None disclosed
TYPICAL SECTIONS OF DAM	Prepared for this report from sketches taken from original plans and visual observations.
HYDROLOGIC/HYDRAULIC DATA	No original data disclosed
OUTLETS - PLAN	None disclosed
- DETAILS	None disclosed
- CONSTRAINTS	None disclosed
- DISCHARGE RATINGS	None disclosed
RAINFALL/RESERVOIR RECORDS	None disclosed

ITEM	REMARKS
DESIGN REPORTS	None disclosed.
GEOLOGY REPORTS	None disclosed.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None disclosed.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None disclosed.
POST-CONSTRUCTION SURVEYS OF DAM	None disclosed.
BORROW SOURCES	Unknown

ITEM	REMARKS
MONITORING SERVICES	None.
MODIFICATIONS	Partial grout curtain and toe drain added in 1960's
HIGH POOL RECORDS	None disclosed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None disclosed.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	None disclosed.

ITEM	REMARKS
SPILLWAY PLAN	Prepared for this report from sketches taken from original plans and visual observations.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT	Not visible.
PLANS & DETAILS	None.

APPENDIX 2

PHOTOGRAPHS

BOONTON RESERVOIR DAM

15 MAY 1979

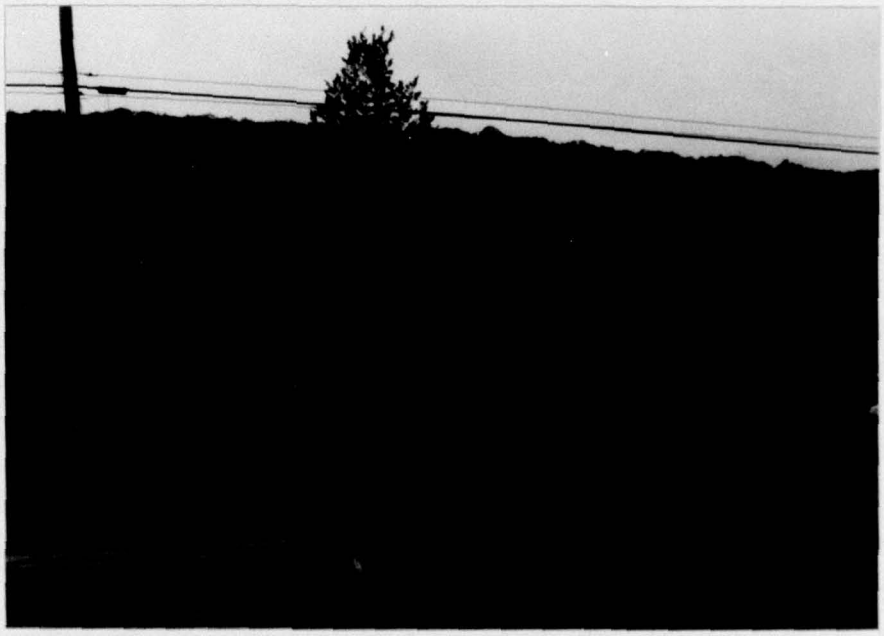
VIEW OF CREST FROM RIGHT SPILLWAY ABUTMENT LOOKING SOUTHEAST

15 MAY 1979

VIEW OF CREST FROM LEFT SPILLWAY ABUTMENT LOOKING NORTHWEST

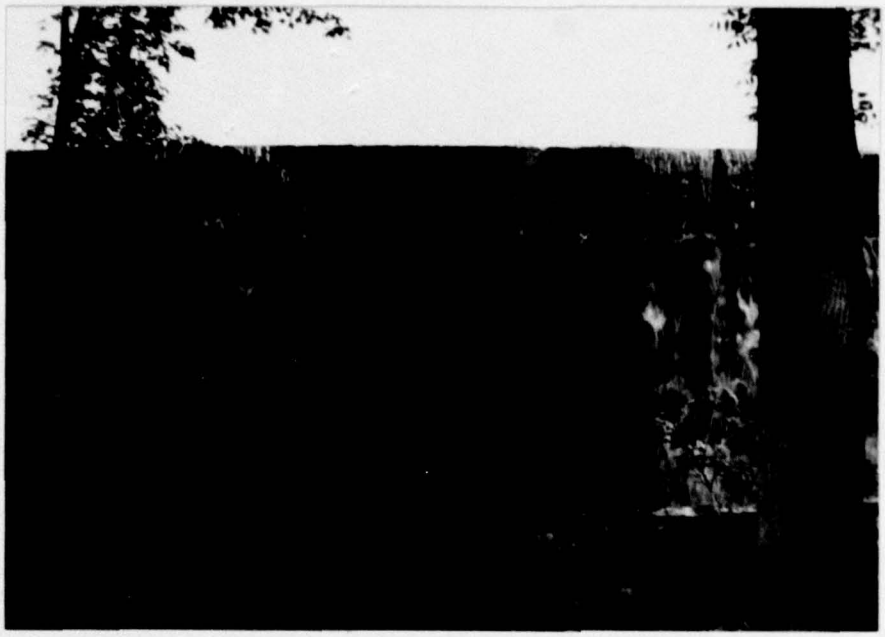
15 MAY 1979

VIEW OF DAM CREST FROM LEFT SPILLWAY ABUTMENT TOWARDS ROAD



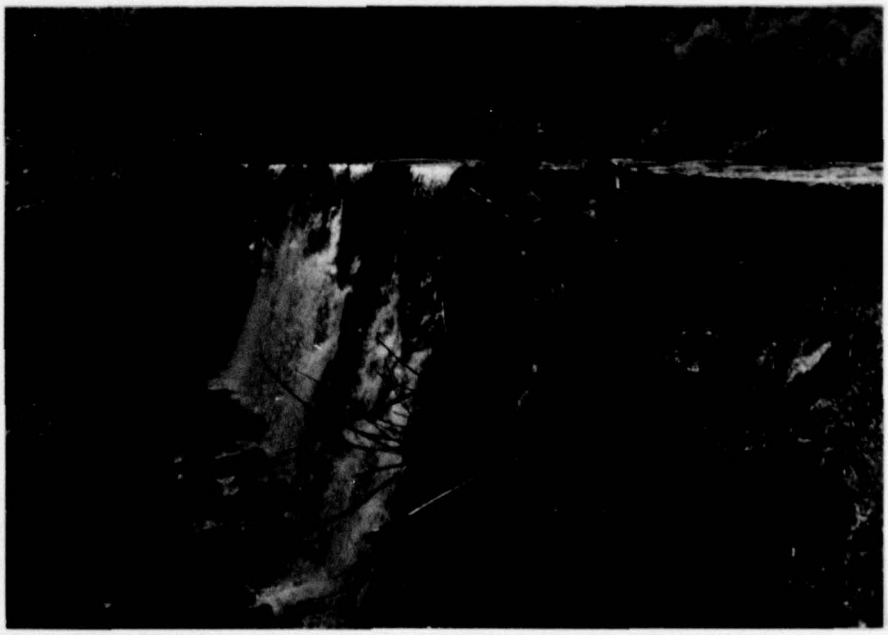
15 MAY 1979

VIEW SHOWING CREST OF DAM FROM RIGHT SIDE OF ROAD



15 MAY 1979

VIEW OF DOWNSTREAM FACE OF SPILLWAY

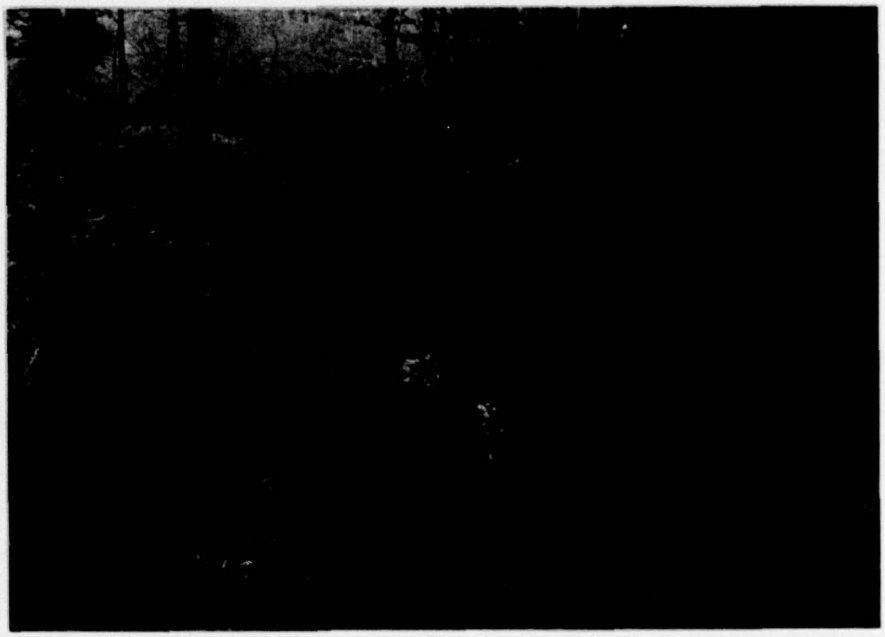


15 MAY 1979

TREE STUMP IN DOWNSTREAM FACE OF SPILLWAY

15 MAY 1979

VIEW UPSTREAM FROM CENTER OF SPILLWAY



15 MAY 1979

VIEW OF DOWNSTREAM CHANNEL

15 MAY 1979

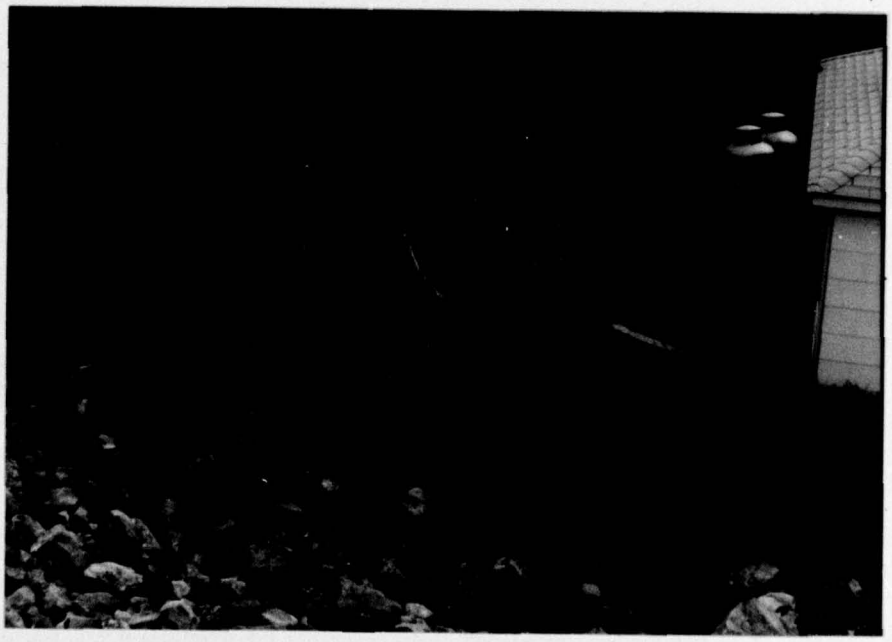
VIEW FROM SOUTHEAST SIDE OF RESERVOIR TOWARD DAM

15 MAY 1979

VIEW FROM NORTHWEST SIDE OF RESERVOIR TOWARD DAM

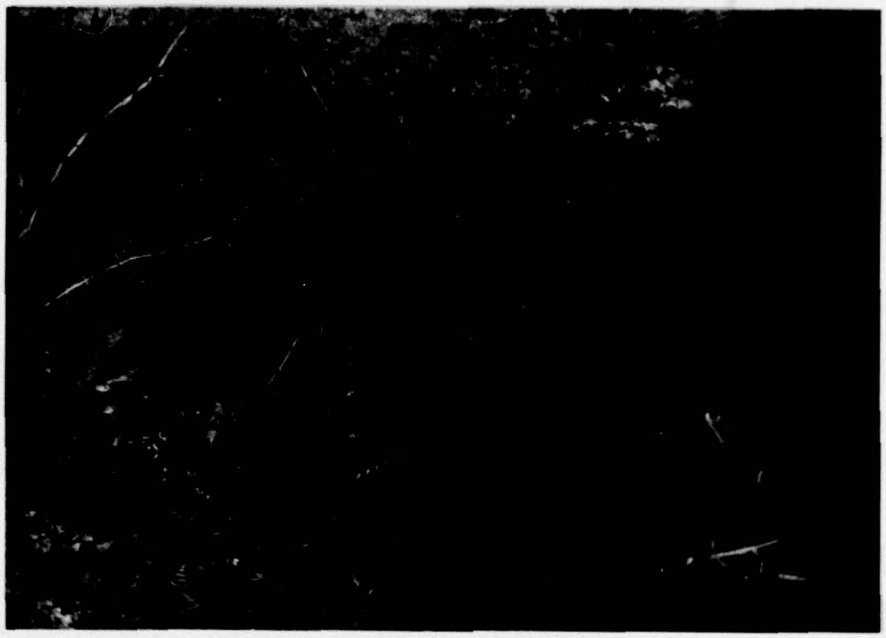
15 MAY 1979

VIEW SHOWING DOWNSTREAM FACE OF DAM WITH GATE-HOUSE AND PUMP HOUSE



15 MAY 1979

WET AREA, SEEPAGE, AND COLLECTION DITCH AT D/S TOE OF DAM LEFT OF GATEHOUSE



15 MAY 1979

LARGE SEEPAGE AT DOWNSTREAM TOE OF DAM NEAR RIGHT ABUTMENT VIEWED FROM CREST

15 MAY 1979

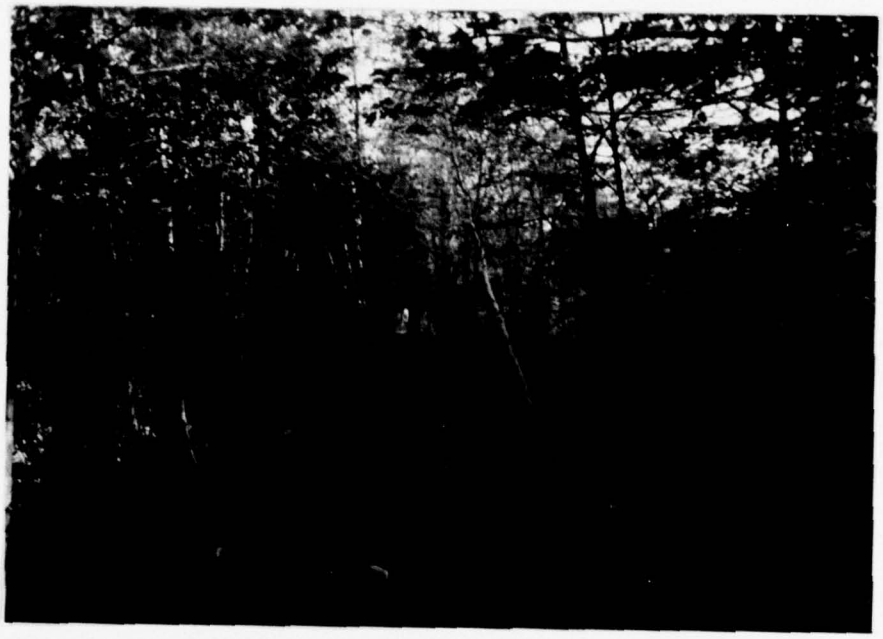
SEEPAGE AT LEFT TOE OF DAM

15 MAY 1979

CONTACT AT LEFT ABUTMENT

15 MAY 1979

VIEW SHOWING RIPRAP ON DOWNSTREAM FACE AND CORE WALL ALONG DOWNSTREAM EDGE OF CREST IMMEDIATELY WEST OF GATEHOUSE



15 MAY 1979

VIEW ALONG CREST OF DAM FROM RIGHT DAM
ABUTMENT SHOWING FOOTPATH

APPENDIX 3

HYDROLOGIC COMPUTATIONS

BOONTON RESERVOIR DAM

Anderson-Nichols & Company, Inc.

Subject BOONTON RESERVOIR Sheet No. 1 of 11

JOB NO. 3290-0 Date Computed KATE Checked EHD

SQUARES 1/4 IN. SCALE 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 3

HYDROLOGIC COMPUTATIONS

NAME: BOONTON RESERVOIR DAM

LOCATION: MORRIS COUNTY, NJ

DRAINAGE AREA: 2.0 SQ. MILES

SURFACE AREA AT NORMAL POOL: 88.8 ACRES

EVALUATION CRITERIA: SIZE - INTERMEDIATE
HAZARD - SIGNIFICANT

SPILLWAY DESIGN FLOOD: BASED ON SIZE AND HAZARD CLASSIFICATION, THE SPILLWAY DESIGN FLOOD WILL BE 1/2 PMF (PROBABLE MAXIMUM FLOOD). THE PMF IS EQUIVALENT TO 22.5 INCHES OF RAINFALL, AND HAS A PEAK INFLOW OF 10409 CFS. AN INFLOW HYDROGRAPH WILL BE DEVELOPED USING THE SCS TRIANGULAR UNIT HYDROGRAPH WITH CURVILINEAR TRANSFORMATION UTILIZING THE SPECIFIED K-VALUE OF 256.

Anderson-Nichols & Company, Inc.

Subject TAYLORTOWN-BOONTON RESERVOIR

Sheet No. 2 of 11

Date 6/14/79

Computed AJE

Checked

JOB NO. 3290-10

SQUARES 1/4 IN. SCALE

DETERMINE TIME OF CONCENTRATION

① TAKE OVERLAND FLOW FROM FARTHEST POINT TO UNNAMED ROAD

$L = 650'$ $H = 100'$

② BY KIRPICH NOMOGRAPH $T_c = 2.4$ mins

③ BY IZZARDS FORMULA

$$T_c = \frac{L^{1.115}}{7700(H^{.38})} = \frac{650^{1.115}}{(7700)(100^{.38})} = .03 \text{ hrs} = 1.9 \text{ mins}$$

where L = length (ft)
H = head (ft)

④ BY CALIFORNIA CULVERT EQUATION
p. 71 DESIGN OF SMALL DAMS

$$T_c = \left[\frac{11.9L^3}{H}\right]^{.385} = \left[\frac{(11.9)(.123)^3}{100}\right]^{.385} = .040 \text{ hrs} = 2.4 \text{ mins}$$

where L = length (mi.)
H = head (ft)

⑤ BY WESTON FORMULA
velocity derived from TEXAS HIGHWAY TABLE p. 70 DESIGN OF SM. DAMS

$$T_c = \frac{L}{3600V} = \frac{650}{(3600)(3.5)} = 0.05 \text{ hrs} = 3 \text{ mins}$$

where L = length (ft)
V = velocity (cfs)

AVERAGE T_c REACH 1 = 2.4 mins

Anderson-Nichols & Company, Inc.

Subject BOONTON RESERVOIR

Sheet No. 3 of 11

Date 6/5/79

Computed ELIE

Checked EDB

JOB NO. 3290-10

SQUARES 1/4 IN. SCALE

REACH 2 FROM UNNAMED ROAD TO BOONTON RESERVOIR. L = 4550' H = 130'

(A) KIRPICH NOMOGRAPH T_c = 20.5 mins

(B) BY CALIFORNIA CULVERT EQUATION
P. 71 DESIGN OF SMALL DAMS

$$T_c = \left[\frac{(11.9)(L\,mi.^3)}{Hft}\right]^{.385} = \left[\frac{(11.9)(.862)^3}{130}\right] = .34 \text{ hrs} = 20.4 \text{ mins}$$

(C) BY WESTON FORMULA
VELOCITY DERIVED FROM TEXAS HIGHWAY TABLE, p. 70, DESIGN OF SMALL DAMS

$$T_c = \frac{L}{3600\,V} = \frac{4550'}{(3600)(3.0)} = .42 \text{ hrs} = 25.2 \text{ mins}$$

AVG T_c REACH 2 = (20.5 + 20.4 + 25.2) ÷ 3 = 22.0 mins

TOTAL T_c = 22.0 + 2.4 = 24.4 mins = .41 hrs.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UN
DEPAR
COR

DEVELOPMENT OF RATING CURVE

ELEVATION	SPILLWAY HEAD FT	SPILLWAY Q CFS	DAM HEAD FT	DAM LENGTH FT	DAM Q CFS	COMBINED Q CFS
637.5	0	0			0	0
639.4	1.9	613	0	510	0	613
639.6	2.1	712	.2	510	114	826
640	2.5	925	.6	510	593	1518
640.5	3.0	1216	1.1	510	1471	2687
641	3.5	1532	1.6	535	2707	4239
641.5	4.0	1872	2.1	560	4260	6132
642	4.5	2234	2.6	580	6079	8313
644	6.5	3878	4.6	585	14429	18307
646	8.5	5799	6.6	590	25010	30809
648	10.5	7962	8.6	595	37515	45477
650	12.5	10341	10.6	600	51767	62108

$Q = CLH^{3/2}$ where C = COEFFICIENT = 2.6 FOR SPILLWAY
= 2.5 FOR DAM

L = LENGTH (FT) = 90 FOR SPILLWAY
VARIES FOR DAM

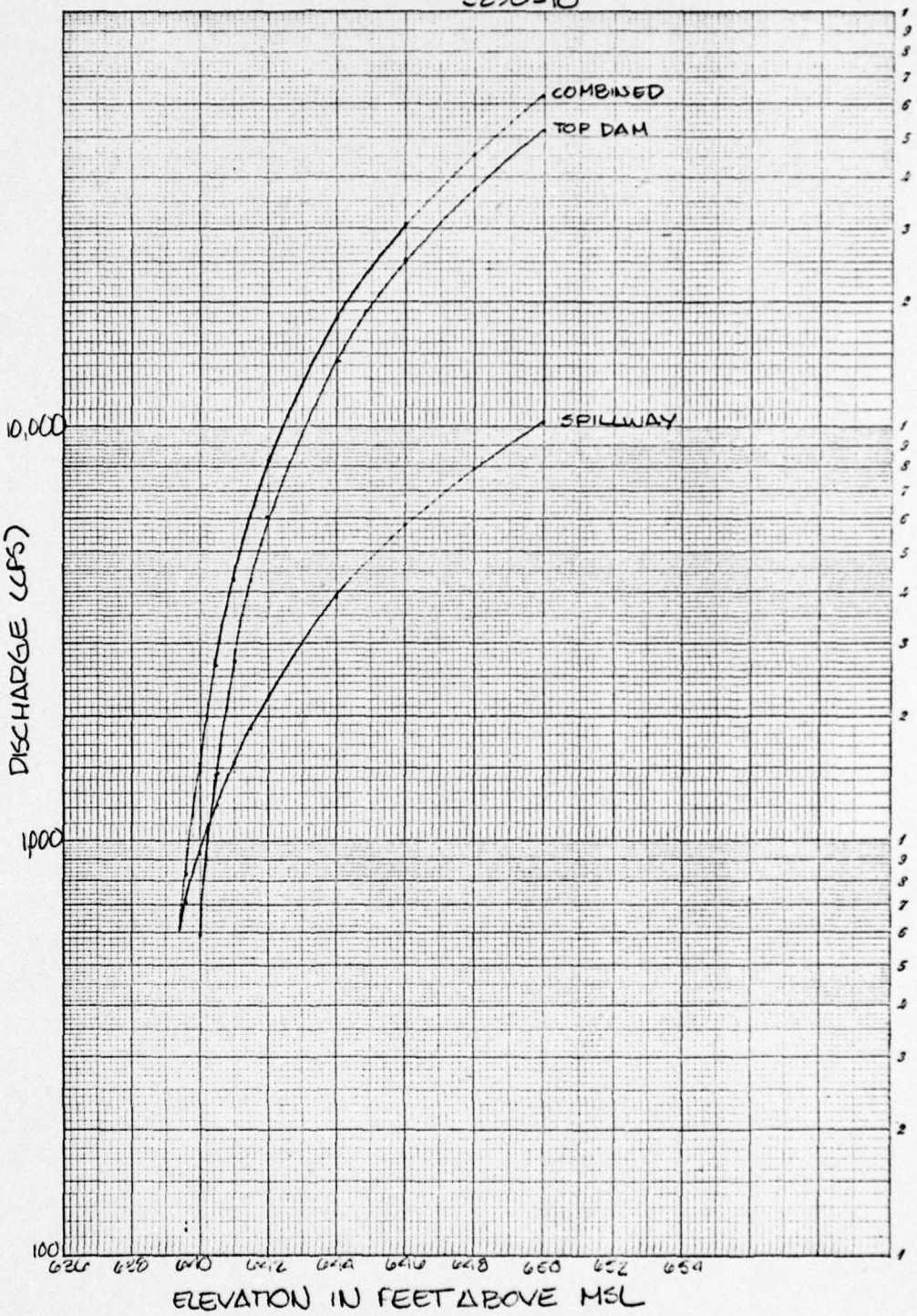
H = HEAD (FT)

"HANDBOOK OF HYDRAULICS" KING & BRATER TABLE 5.46
USED FOR DETERMINING SPILLWAY COEFFICIENT

FDD ESTIMATED DAM COEFFICIENT

21.3-70
<D
6 CF.1

BOONTON RESERVOIR DAM
COMBINED RATING CURVE
3290-10



Anderson-Nichols & Company, Inc.

JOB NO. 3200-10

Subject TAYLORTOWN-BOONTON RESERVOIR

Sheet No. 7 of 11
Date 6/21/78
Computed DATE
Checked EL

SQUARES 1/4 IN. SCALE

DEVELOP UNIT HYDROGRAPH

TIME OF CONCENTRATION = 24.4 mins = .41 hrs

LAG = $.6T_c$ = .25 hrs

DETERMINATION OF TIME OF PEAK:

$T_p = \frac{D}{2} + .6T_c$ where D = 5 mins = 0.08 hours

$T_p = \frac{.08}{2} + .25 = .29$

UNIT HYDROGRAPH

TAKE $T_p = .33$

TAKE Q_p FROM SCS FORMULA

TAKE A = AREA IN SQ MI. = 2.0

$$Q_p = \frac{256A}{T_p} = \frac{(256)(2)}{.33} = 1552 \text{ CFS}$$

A CURVILINEAR HYDROGRAPH MAY BE CONSTRUCTED FOR THE VALUES OF Q_p AND T_p BY USING SCS RATIOS (P.74 DESIGN OF SMALL DAMS)

Anderson-Nichols & Company, Inc.

Subject ECONION RESERVOIR

Sheet No. 8 of 11

Date 6/24/?

Computed

Checked

JOB NO. 3290-10

UNIT HYDROGRAPH

TIME (HRS)	TIME RATIO T/TP	DISCH. RATIO Q/Qp	DISCHARGE CFS
.08	.24	.13	202
.17	.52	.51	792
.25	.76	.88	1366
.33	1.0	1.0	1552
.42	1.27	.986	1530
.49	1.48	.930	1443
.58	1.76	.848	1316
.67	2.03	.750	1164
.75	2.27	.652	1012
.83	2.52	.530	823
.92	2.79	.428	664
1.0	3.03	.360	559
1.08	3.27	.312	484
1.17	3.55	.255	396
1.25	3.79	.217	337
1.33	4.03	.182	282
1.42	4.30	.153	237
1.50	4.55	.132	205
1.58	4.79	.111	172
1.67	5.06	.092	143
1.75	5.30	.078	121
1.83	5.55	.065	101
1.92	5.81	.054	84
2.0	6.06	.047	73
2.08	6.30	.040	62
2.17	6.58	.033	51
2.25	6.82	.029	45
2.33	7.06	.026	40
2.42	7.33	.020	31
2.50	7.58	.017	26
2.58	7.82	.015	23
2.67	8.09	.013	20
2.75	8.33	.011	17
2.83	8.58	.010	16
2.92	8.85	.009	14
3.00	9.09	.007	11
3.08	9.33	.006	9
3.17	9.61	.004	6
3.25	9.85	.002	3
3.33	10.09	.001	2
3.50	10.61	.000	0

Anderson-Nichols & Company, Inc.

JOB NO. 5290-10

Subject TAYLORTOWN DETENTION RESERVOIR

Sheet No. 9 of 11

Date

Computed

Checked

SQUARES 1/4 IN. SCALE

STAGE-STORAGE DETERMINATIONS

ELEVATION FT	SURFACE AREA ACRES	AVG. SURFACE AREA ACRES	INCREM. STORAGE ACRE-FT	CUMULATIVE STOR. ACRE-FEET
637.5	88.8	88.8	1066 *	1066
640	121	104.9	262	1328
660	369	245	4900	6228

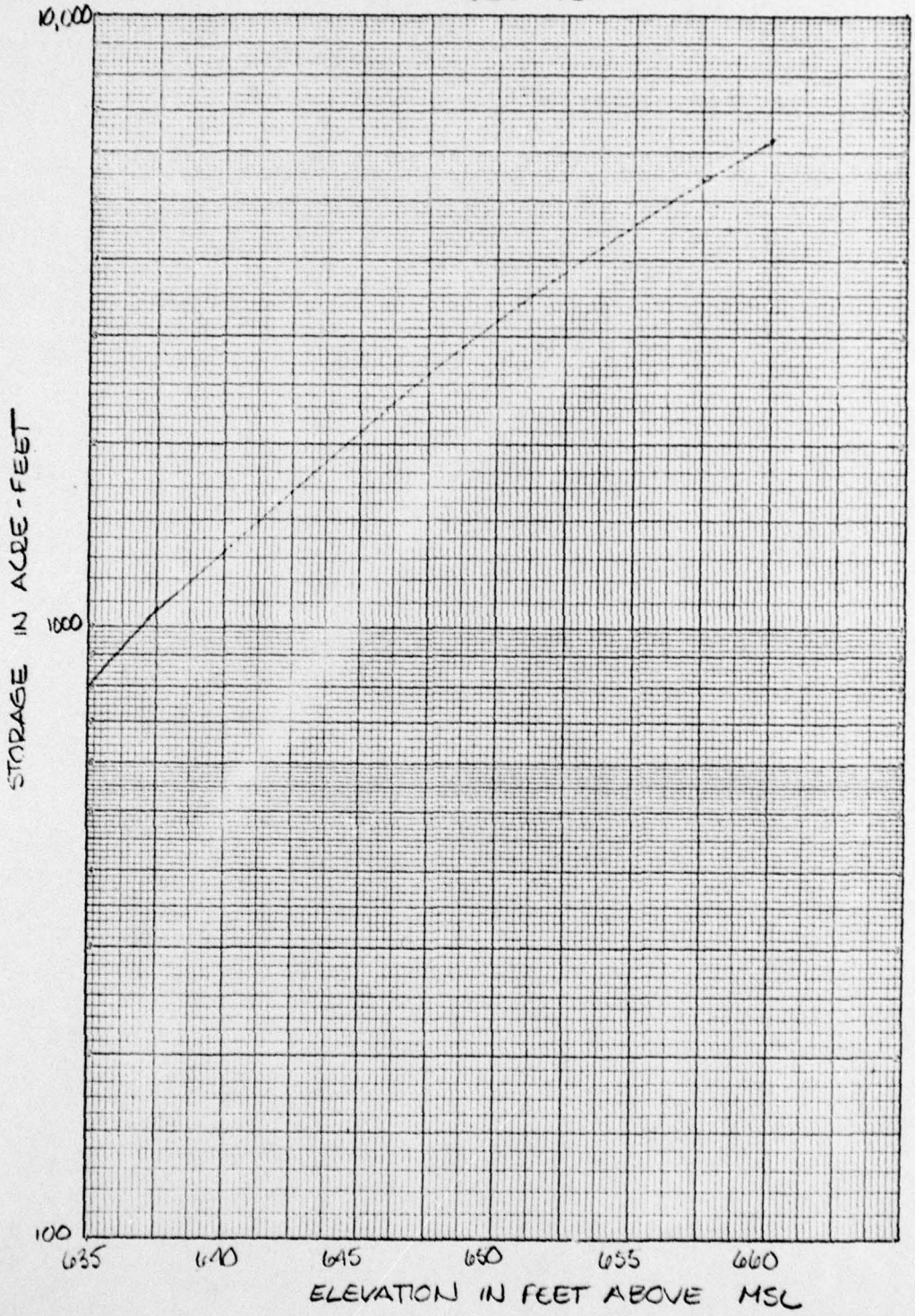
* assume average depth T-B Reservoir to be 12'

INPUT FOR HEC 1:

ELEVATION	STORAGE
625.5	0
637.5	1066
640	1828
640.5	1895
642	1600
644	1920
646	2280
648	2720
650	3190
655	4550
660	6228

10/11

TAYLORTOWN-BOONTON RESERVOIR
STORAGE ELEVATION CURVE
3290-10



Anderson-Nichols & Company, Inc.

Subject: BOONTON RESERVOIR

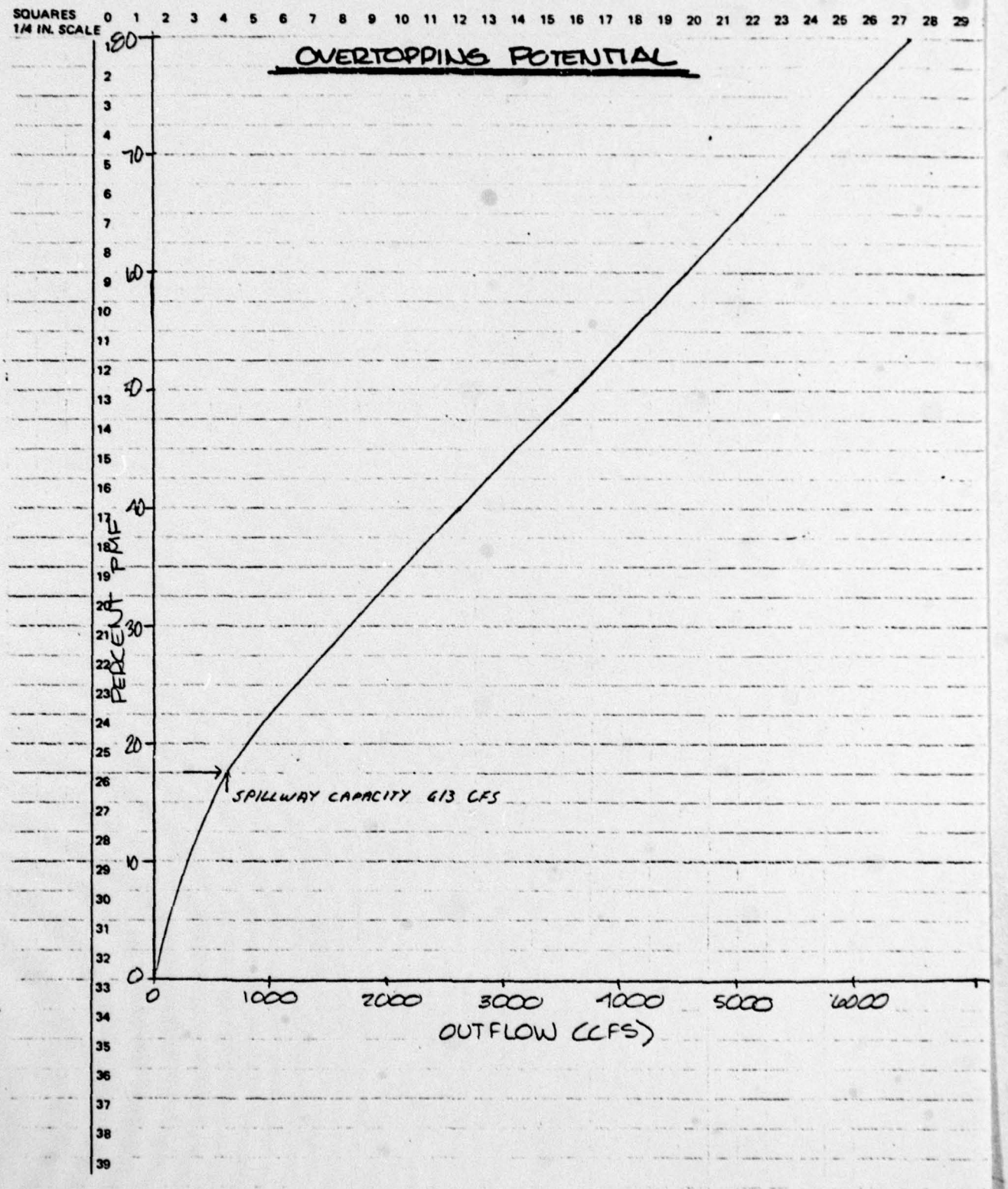
Sheet No. 11 of 11

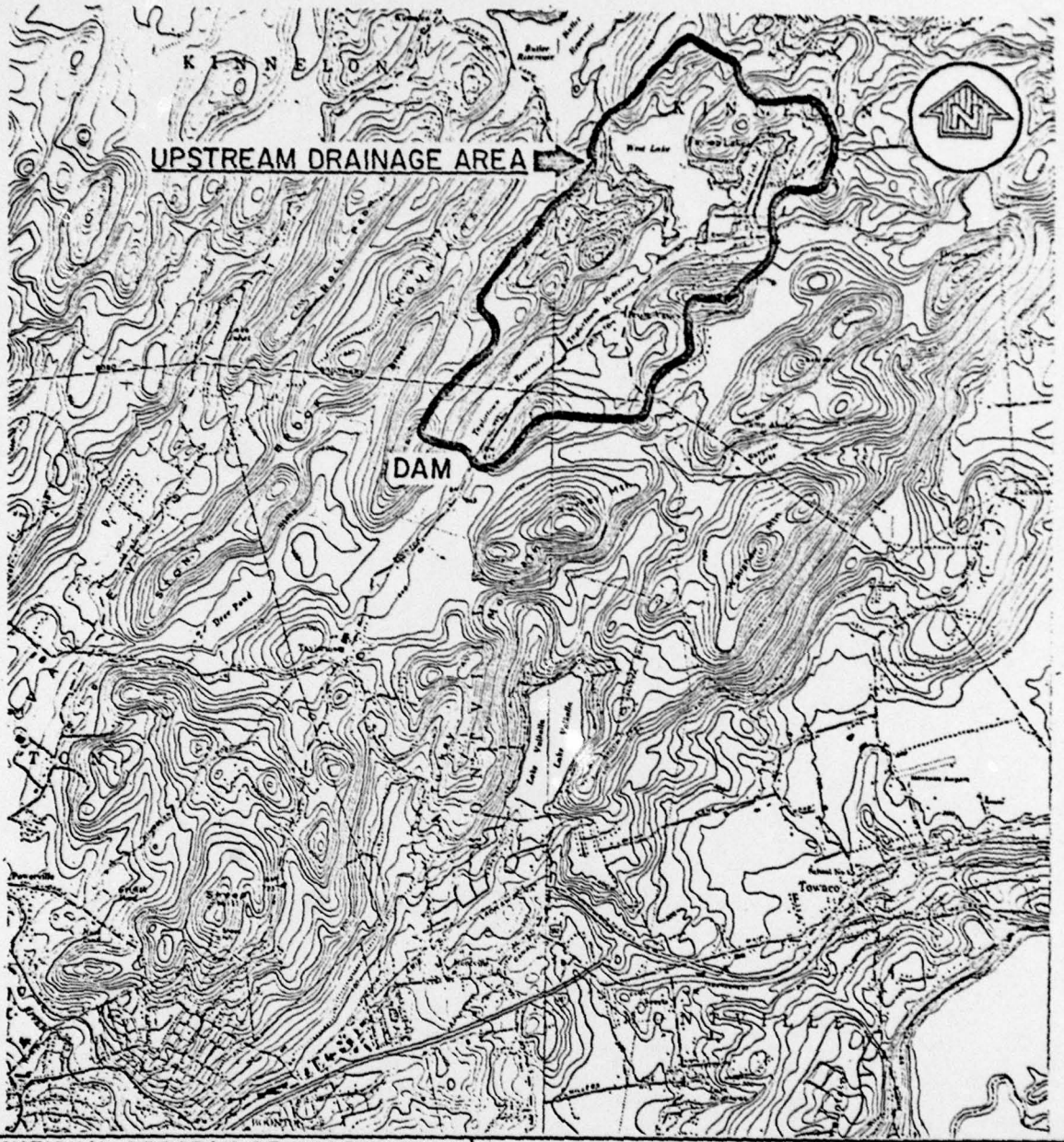
Date 6/6/79

Computed [illegible]

Checked

JOB NO. 3290-10





NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BOONTON RESERVOIR
MONTVILLE TOWNSHIP, NEW JERSEY

REGIONAL VICINITY MAP

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

ANDERSON-NICHOLS & CO., INC. BOSTON, MA.

SCALE IN MILES

0 1/2 1 2

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEETS. BOONTON, N.J., 1954, UPDATED 1970. POMPTON PLAINS, N.J., 1955, UPDATED 1970.

HEC-1 OUTPUT

OVERTOPPING ANALYSIS

BOONTON RESERVOIR DAM

BOONTON

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***********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
***********************************
A1 TAYLORTOWN-BOONTON RESERVOIR DAM-OVERTOPPING ANALYSIS-KD+ANDERSON-NICHOLS*
A2 NEW JERSEY DAM NUMBER 22-25
A3 0.2,0.4,0.5,0.8,AND 1.0 MULTIPLES OF PMF FROM 24-HR 25.5-INCH PMP
B      120       0       5       0       0       0       0       0       0       0
B1       5
J        1       5       1
J1     0.2     0.4     0.5     0.8     1.0
K               A1                                       1
K1 DEVELOP INFLOW HYDROGRAPH
M               -1     2.0                      .8                       1
O       72
O1    .213    .213    .213    .213    .213    .213    .213    .213    .213    .213
O1    .213    .213    .255    .255    .255    .255    .255    .255    .255    .255
O1    .255    .255    .255    .255    .319    .319    .319    .319    .319    .319
O1    .319    .319    .319    .319    .319    .319    .194    .308    .308    .581
O1    .678   1.687   2.713   1.066    .678    .581    .388    .388    .298    .298
O1    .298    .298    .298    .298    .298    .298    .298    .298    .298    .298
O1    .234    .234    .234    .234    .234    .234    .234    .234    .234    .234
O1    .234    .234
T                                                        1      .1
U       41
U1    202.    792.   1366.   1552.   1530.   1443.   1316.   1164.   1012.    823.
U1    664.    559.    484.    396.    337.    282.    237.    205.    172.    143.
U1    121.    101.     84.     73.     62.     51.     45.     40.     31.     26.
U1     23.     20.     17.     16.     14.     11.      9.      6.      3.      2.
U1      0.
X      -3.
K        1      A2                               0       1
K1 ROUTE HYDROGRAPH THROUGH IMPOUNDMENT
Y                                1       1
Y1       1                                           1066.      -1
Y4   637.5   639.4   639.6    640.   640.5    641.   641.5    642.    644.    646.
Y4    648.    650.
Y5       0    613.    826.   1518.   2687.   4239.   6132.   8313.  18307.  30809.
Y545477.    62108.
$S       0   1066.   1270.   1328.   1395.   1600.   1920.   2280.   2720.   3190.
$S   4550.
$E   625.5   637.5   639.4    640.   640.5    642.    644.    646.    648.    650.
$E    655.
$$   637.5
$D   639.4
K       99
```

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

        RUNOFF HYDROGRAPH AT          A1
        ROUTE HYDROGRAPH TO           A2
        END OF NETWORK
```

[illegible]
NEW JERSEY DAM NUMBER 22-25
0.2,0.4,0.5,0.8,AND 1.0 MULTIPLES OF PMF FROM 24-HR 25.5-INCH PMP

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
120	0	5	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1
RTIOS= .20 .40 .50 .80 1.00

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

SUB-AREA RUNOFF COMPUTATION

DEVELOP INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
01	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	2.00	0.00	2.00	.80	0.000	0	1	0

PRECIP DATA

NP	STORM	DAJ	DAK
72	0.00	0.00	0.00

PRECIP PATTERN

.21	.21	.21	.21	.21	.21	.21	.21	.21	.21
.21	.21	.26	.26	.26	.26	.26	.26	.26	.26
.26	.26	.26	.26	.32	.32	.32	.32	.32	.32
.32	.32	.32	.32	.32	.32	.39	.39	.39	.58
.68	1.65	2.71	1.07	.68	.58	.39	.39	.38	.38
.38	.38	.38	.38	.38	.38	.38	.38	.38	.38
.23	.23	.23	.23	.23	.23	.23	.23	.23	.23
.23	.23								

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 41

207.	772.	1366.	1552.	1530.	1443.	1316.	1164.	1012.	823.
664.	559.	474.	396.	337.	282.	227.	205.	172.	143.
121.	101.	86.	73.	62.	51.	45.	40.	31.	26.
23.	20.	17.	16.	14.	11.	9.	6.	3.	2.
0.									

UNIT GRAPH TOTALS 15434. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA
STRTQ= -3.00 QRCSN= 0.05 RTIOR= 1.00

O PC.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	PC.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.17	0.00	.17	6.	1.01	5.05	61	.19	.18	.01	4419.
1.01	.10	2	.17	0.00	.17	6.	1.01	5.10	62	.19	.18	.01	4239.
1.01	.15	3	.17	0.00	.17	6.	1.01	5.15	63	.19	.18	.01	4053.
1.01	.20	4	.17	0.00	.17	6.	1.01	5.20	64	.19	.18	.01	3874.
1.01	.25	5	.17	0.00	.17	6.	1.01	5.25	65	.19	.18	.01	3714.
1.01	.30	6	.17	.02	.15	10.	1.01	5.30	66	.19	.18	.01	3575.
1.01	.35	7	.17	.16	.01	56.	1.01	5.35	67	.19	.18	.01	3451.
1.01	.40	8	.17	.16	.01	196.	1.01	5.40	68	.19	.18	.01	3342.
1.01	.45	9	.17	.16	.01	422.	1.01	5.45	69	.19	.18	.01	3254.
1.01	.50	10	.17	.16	.01	673.	1.01	5.50	70	.19	.18	.01	3178.
1.01	.55	11	.17	.16	.01	919.	1.01	5.55	71	.19	.18	.01	3110.
1.01	1.00	12	.17	.16	.01	1150.	1.01	6.00	72	.19	.18	.01	3057.
1.01	1.05	13	.20	.20	.01	1367.	1.01	6.05	73	0.00	0.00	0.00	2977.
1.01	1.10	14	.20	.20	.01	1579.	1.01	6.10	74	0.00	0.00	0.00	2799.
1.01	1.15	15	.20	.20	.01	1785.	1.01	6.15	75	0.00	0.00	0.00	2524.
1.01	1.20	16	.20	.20	.01	1967.	1.01	6.20	76	0.00	0.00	0.00	2222.
1.01	1.25	17	.20	.20	.01	2124.	1.01	6.25	77	0.00	0.00	0.00	1925.
1.01	1.30	18	.20	.20	.01	2261.	1.01	6.30	78	0.00	0.00	0.00	1644.
1.01	1.35	19	.20	.20	.01	2382.	1.01	6.35	79	0.00	0.00	0.00	1388.
1.01	1.40	20	.20	.20	.01	2488.	1.01	6.40	80	0.00	0.00	0.00	1160.
1.01	1.45	21	.20	.20	.01	2579.	1.01	6.45	81	0.00	0.00	0.00	962.
1.01	1.50	22	.20	.20	.01	2644.	1.01	6.50	82	0.00	0.00	0.00	802.
1.01	1.55	23	.20	.20	.01	2704.	1.01	6.55	83	0.00	0.00	0.00	672.
1.01	2.00	24	.20	.20	.01	2755.	1.01	7.00	84	0.00	0.00	0.00	566.
1.01	2.05	25	.26	.25	.01	2809.	1.01	7.05	85	0.00	0.00	0.00	475.
1.01	2.10	26	.26	.25	.01	2885.	1.01	7.10	86	0.00	0.00	0.00	401.
1.01	2.15	27	.26	.25	.01	2986.	1.01	7.15	87	0.00	0.00	0.00	338.
1.01	2.20	28	.26	.25	.01	3091.	1.01	7.20	88	0.00	0.00	0.00	286.
1.01	2.25	29	.26	.25	.01	3190.	1.01	7.25	89	0.00	0.00	0.00	242.
1.01	2.30	30	.26	.25	.01	3283.	1.01	7.30	90	0.00	0.00	0.00	204.
1.01	2.35	31	.26	.25	.01	3366.	1.01	7.35	91	0.00	0.00	0.00	172.
1.01	2.40	32	.26	.25	.01	3438.	1.01	7.40	92	0.00	0.00	0.00	145.
1.01	2.45	33	.26	.25	.01	3501.	1.01	7.45	93	0.00	0.00	0.00	123.
1.01	2.50	34	.26	.25	.01	3553.	1.01	7.50	94	0.00	0.00	0.00	104.
1.01	2.55	35	.26	.25	.01	3598.	1.01	7.55	95	0.00	0.00	0.00	88.
1.01	3.00	36	.20	.20	.01	3630.	1.01	8.00	96	0.00	0.00	0.00	74.
1.01	3.05	37	.16	.15	.01	3643.	1.01	8.05	97	0.00	0.00	0.00	63.
1.01	3.10	38	.31	.30	.01	3618.	1.01	8.10	98	0.00	0.00	0.00	53.
1.01	3.15	39	.31	.30	.01	3626.	1.01	8.15	99	0.00	0.00	0.00	45.
1.01	3.20	40	.46	.46	.01	3732.	1.01	8.20	100	0.00	0.00	0.00	38.
1.01	3.25	41	.54	.53	.01	3973.	1.01	8.25	101	0.00	0.00	0.00	32.
1.01	3.30	42	1.32	1.31	.01	4508.	1.01	8.30	102	0.00	0.00	0.00	28.
1.01	3.35	43	2.17	2.16	.01	5744.	1.01	8.35	103	0.00	0.00	0.00	24.
1.01	3.40	44	.85	.84	.01	7665.	1.01	8.40	104	0.00	0.00	0.00	20.
1.01	3.45	45	.54	.53	.01	9355.	1.01	8.45	105	0.00	0.00	0.00	17.
1.01	3.50	46	.46	.46	.01	10155.	1.01	8.50	106	0.00	0.00	0.00	14.
1.01	3.55	47	.31	.30	.01	10405.	1.01	8.55	107	0.00	0.00	0.00	12.
1.01	4.00	48	.31	.30	.01	10330.	1.01	9.00	108	0.00	0.00	0.00	10.
1.01	4.05	49	.24	.23	.01	9782.	1.01	9.05	109	0.00	0.00	0.00	8.
1.01	4.10	50	.24	.23	.01	9166.	1.01	9.10	110	0.00	0.00	0.00	7.
1.01	4.15	51	.24	.23	.01	8447.	1.01	9.15	111	0.00	0.00	0.00	6.
1.01	4.20	52	.24	.23	.01	7674.	1.01	9.20	112	0.00	0.00	0.00	6.
1.01	4.25	53	.24	.23	.01	6954.	1.01	9.25	113	0.00	0.00	0.00	6.
1.01	4.30	54	.24	.23	.01	6454.	1.01	9.30	114	0.00	0.00	0.00	6.
1.01	4.35	55	.24	.23	.01	6081.	1.01	9.35	115	0.00	0.00	0.00	6.
1.01	4.40	56	.24	.23	.01	5890.	1.01	9.40	116	0.00	0.00	0.00	6.
1.01	4.45	57	.24	.23	.01	5275.	1.01	9.45	117	0.00	0.00	0.00	6.
1.01	4.50	58	.24	.23	.01	5081.	1.01	9.50	118	0.00	0.00	0.00	6.
1.01	4.55	59	.24	.23	.01	4776.	1.01	9.55	119	0.00	0.00	0.00	6.
1.01	5.00	60	.24	.23	.01	4503.	1.01	10.00	120	0.00	0.00	0.00	6.
									SUM	20.41	18.86	1.55	291760.
										(519.3	479.3	39.3	7364.5

HYDROGRAPH AT STA A1 FOR PLAN 1, RTIO 3

3.	3.	3.	3.	3.	5.	28.	98.	211.	336.
458.	575.	683.	789.	892.	983.	1062.	1131.	1191.	1242.
1286.	1322.	1352.	1378.	1404.	1443.	1493.	1545.	1595.	1641.
1683.	1719.	1751.	1777.	1797.	1815.	1820.	1809.	1813.	1866.
1987.	2254.	2872.	3833.	4678.	5100.	5205.	5116.	4891.	4583.
4223.	3838.	3457.	3227.	3001.	2799.	2637.	2501.	2388.	2296.
2209.	2119.	2026.	1937.	1857.	1788.	1725.	1671.	1627.	1589.
1555.	1528.	1489.	1400.	1262.	1111.	962.	822.	694.	580.
481.	401.	336.	283.	238.	200.	169.	143.	121.	102.
86.	73.	61.	52.	44.	37.	31.	27.	23.	19.
16.	14.	12.	10.	8.	7.	6.	5.	4.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5205.	1987.	1216.	1216.	145925.
CMS	147.	56.	34.	34.	4132.
INCHES		9.24	9.43	9.43	9.43
MM		234.71	239.44	239.44	239.44
AC-FT		985.	1005.	1005.	1005.
THOUS CU M		1215.	1240.	1240.	1240.

```
**********        **********        **********        **********        **********

                               HYDROGRAPH ROUTING

          ROUTE HYDROGRAPH THROUGH IMPOUNDMENT

                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      A2       1       0       0       0       0       1       0       0
                                          ROUTING DATA
           QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
             0.0   0.000    0.00       1       1       0       0               0

                   NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                       1       0       0   0.000   0.000   0.000   1066.      -1

 STAGE      637.50    639.40    639.60    640.00    640.50    641.00    641.50    642.00    644.00    646.00
            648.00    650.00

 FLOW         0.00    613.00    826.00   1518.00   2687.00   4239.00   6132.00   8313.00  18307.00  30809.00
          45477.00  52108.00

 CAPACITY=      0.     1066.     1270.     1328.     1295.     1600.     1920.     2280.     2720.     3180.
             4550.

 ELEVATION=   626.      638.      639.      640.      641.      642.      644.      646.      648.      650.
              655.

                   CREL    SPWID    COQW    EXPW    ELEVL    COQL    CAREA    EXPL
                  637.5      0.0     0.0     0.0      0.0     0.0      0.0     0.0

                                     DAM DATA
                               TOPEL    COQD    EXPD   DAMWID
                               639.4     0.0     0.0       0.
```

STATION A2. PLAN 1. RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	1.	2.	5.	11.
19.	29.	41.	55.	71.	89.	108.	128.	150.	171.
194.	217.	240.	263.	286.	309.	333.	357.	382.	407.
433.	459.	485.	511.	537.	563.	589.	616.	703.	786.
895.	1038.	1215.	1463.	1781.	2133.	2475.	2805.	3124.	3358.
3509.	3585.	3597.	3563.	3498.	3411.	3311.	3203.	3093.	2984.
2878.	2774.	2670.	2567.	2518.	2439.	2342.	2287.	2215.	2146.
2081.	2020.	1962.	1903.	1838.	1765.	1682.	1593.	1506.	1399.
1299.	1199.	1103.	1011.	923.	842.	768.	742.	697.	654.
613.	602.	591.	580.	570.	559.	548.	537.	527.	516.
506.	496.	486.	477.	467.	458.	448.	439.	430.	422.
413.	405.	396.	388.	381.	373.	365.	358.	351.	343.

STORAGE

1066.	1066.	1066.	1066.	1066.	1066.	1066.	1067.	1068.	1070.
1072.	1076.	1080.	1084.	1090.	1096.	1102.	1109.	1116.	1123.
1131.	1138.	1146.	1153.	1161.	1169.	1177.	1185.	1193.	1202.
1210.	1219.	1227.	1236.	1245.	1253.	1262.	1270.	1279.	1286.
1293.	1301.	1311.	1320.	1343.	1363.	1383.	1400.	1414.	1425.
1431.	1435.	1435.	1434.	1431.	1427.	1422.	1418.	1413.	1408.
1403.	1399.	1394.	1390.	1385.	1381.	1376.	1372.	1368.	1364.
1360.	1357.	1353.	1350.	1346.	1342.	1337.	1332.	1327.	1321.
1316.	1310.	1305.	1300.	1295.	1290.	1286.	1282.	1278.	1274.
1270.	1266.	1263.	1259.	1256.	1252.	1249.	1245.	1241.	1238.
1234.	1231.	1228.	1225.	1221.	1218.	1215.	1212.	1209.	1206.
1203.	1201.	1198.	1195.	1193.	1190.	1188.	1185.	1183.	1180.

STAGE

637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5
637.6	637.6	637.6	637.7	637.7	637.8	637.8	637.9	638.0	638.0
638.1	638.2	638.2	638.3	638.4	638.5	638.5	638.6	638.7	638.8
638.8	638.9	639.0	639.1	639.2	639.2	639.3	639.4	639.5	639.6
639.6	639.7	639.8	640.0	640.1	640.3	640.4	640.5	640.6	640.7
640.8	640.8	640.8	640.8	640.8	640.7	640.7	640.7	640.6	640.6
640.6	640.5	640.5	640.5	640.4	640.4	640.4	640.3	640.3	640.3
640.2	640.2	640.2	640.2	640.1	640.1	640.1	640.0	640.0	639.9
639.9	639.8	639.8	639.7	639.7	639.6	639.6	639.5	639.5	639.4
639.4	639.4	639.3	639.3	639.3	639.2	639.2	639.2	639.1	639.1
639.1	639.0	639.0	639.0	638.9	638.9	638.9	638.9	638.8	638.8
638.8	638.8	638.7	638.7	638.7	638.7	638.6	638.6	638.6	638.6

PEAK OUTFLOW IS 3597. AT TIME 4.42 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3597.	1643.	1079.	1079.	129355.
CMS	102.	47.	31.	31.	3663.
INCHES		7.64	8.36	8.36	8.36
MM		194.14	212.27	212.27	212.27
AC-FT		815.	891.	891.	891.
THOUS CU M		1005.	1099.	1099.	1099.

OUTFLOW RATIO 5 TO BE USED AS INFLOW TO DEER POND

STATION A2, PLAN 1, RATIO 5

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	1.	1.	1.	4.	10.	21.
37.	57.	82.	111.	143.	178.	216.	257.	299.	343.
388.	433.	479.	525.	571.	631.	799.	1043.	1287.	1513.
1718.	1909.	2086.	2245.	2389.	2536.	2661.	2794.	2914.	3025.
3145.	3304.	3568.	4023.	4761.	5635.	6492.	7250.	7796.	8128.
8260.	8221.	8049.	7787.	7478.	7146.	6807.	6477.	6162.	5901.
5660.	5429.	5206.	4990.	4782.	4584.	4358.	4226.	4051.	3964.
3845.	3735.	3631.	3523.	3398.	3250.	3079.	2891.	2692.	2530.
2368.	2196.	2031.	1871.	1718.	1573.	1435.	1304.	1184.	1072.
969.	875.	803.	752.	704.	659.	616.	602.	591.	580.
569.	558.	547.	536.	526.	515.	505.	495.	485.	475.
465.	456.	447.	438.	429.	420.	412.	403.	395.	387.

STORAGE

1056.	1066.	1066.	1066.	1066.	1066.	1066.	1067.	1069.	1073.
1078.	1085.	1093.	1103.	1114.	1125.	1138.	1152.	1166.	1180.
1195.	1210.	1225.	1241.	1256.	1272.	1287.	1301.	1315.	1328.
1339.	1350.	1361.	1370.	1379.	1386.	1394.	1400.	1405.	1410.
1415.	1422.	1434.	1454.	1482.	1514.	1543.	1567.	1584.	1594.
1598.	1597.	1592.	1584.	1574.	1563.	1553.	1542.	1533.	1523.
1515.	1506.	1498.	1490.	1483.	1476.	1469.	1463.	1457.	1451.
1446.	1441.	1437.	1432.	1426.	1420.	1412.	1404.	1395.	1386.
1376.	1367.	1357.	1348.	1339.	1331.	1323.	1316.	1309.	1303.
1297.	1292.	1287.	1283.	1278.	1274.	1270.	1266.	1263.	1259.
1255.	1252.	1248.	1244.	1241.	1237.	1234.	1231.	1227.	1224.
1221.	1218.	1215.	1212.	1209.	1206.	1203.	1200.	1198.	1195.

STAGE

637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.6
637.6	637.7	637.8	637.8	637.9	638.1	638.2	638.3	638.4	638.6
638.7	638.8	639.0	639.1	639.3	639.4	639.6	639.7	639.9	640.0
640.1	640.2	640.2	640.3	640.4	640.4	640.5	640.5	640.6	640.6
640.6	640.7	640.8	640.8	641.1	641.4	641.6	641.8	641.9	642.0
642.0	642.0	641.9	641.9	641.8	641.7	641.7	641.6	641.5	641.4
641.4	641.3	641.3	641.2	641.1	641.1	641.0	641.0	641.0	640.9
640.9	640.8	640.8	640.8	640.7	640.7	640.6	640.6	640.5	640.4
640.4	640.3	640.2	640.2	640.1	640.0	640.0	639.9	639.8	639.7
639.7	639.6	639.6	639.5	639.5	639.4	639.4	639.4	639.3	639.3
639.3	639.2	639.2	639.2	639.1	639.1	639.1	639.0	639.0	639.0
638.9	638.9	638.9	638.9	638.9	638.8	638.8	638.8	638.7	638.7

PEAK OUTFLOW IS 8260. AT TIME 4.25 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8260.	3583.	2277.	2277.	273187.
CMS	234.	101.	64.	64.	7736.
INCHES		16.66	17.65	17.65	17.65
MM		423.29	448.25	448.25	448.25
AC-FT		1777.	1881.	1881.	1881.
THOUS CU M		2191.	2321.	2321.	2321.

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .40	RATIO 3 .50	RATIO 4 .80	RATIO 5 1.00
HYDROGRAPH AT	A1	2.00	1	208.	416.	520.	832.	1040.
		(5.18)	(	5.95)(	11.90)(	14.73)(	23.80)(	29.75)(
ROUTED TO	A2	2.00	1	75.	261.	359.	639.	826.
		(5.18)	(	2.08)(	7.43)(	10.25)(	18.25)(	23.90)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	637.50	637.50	639.40
STORAGE	1066.	1066.	1270.
OUTFLOW	0.	0.	613.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	639.54	.14	1283.	759.	1.92	5.42	0.00
.40	640.47	1.07	1391.	2618.	3.75	4.50	0.00
.50	640.79	1.39	1435.	3597.	4.50	4.42	0.00
.80	641.56	2.16	1540.	6387.	5.50	4.33	0.00
1.00	641.99	2.59	1598.	8260.	6.00	4.25	0.00

APPENDIX 4

REFERENCES

BOONTON RESERVOIR DAM

APPENDIX 4

REFERENCES

BOONTON RESERVOIR DAM

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