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NATIONAL DAM SAFETY PROGRAM. BIRCHWOOD LAKE DAM (NJ 00417), DEL--ETC(U)
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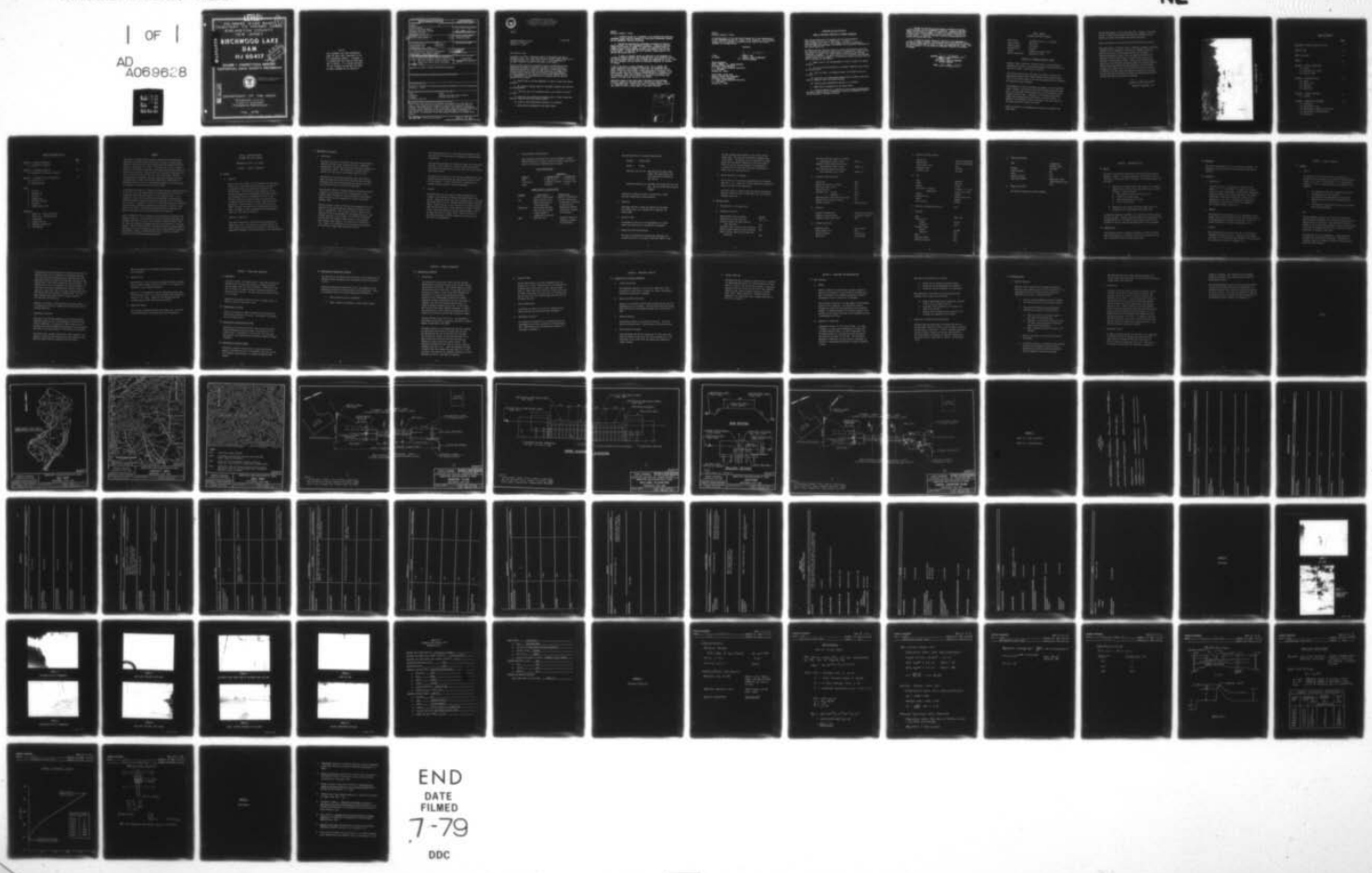

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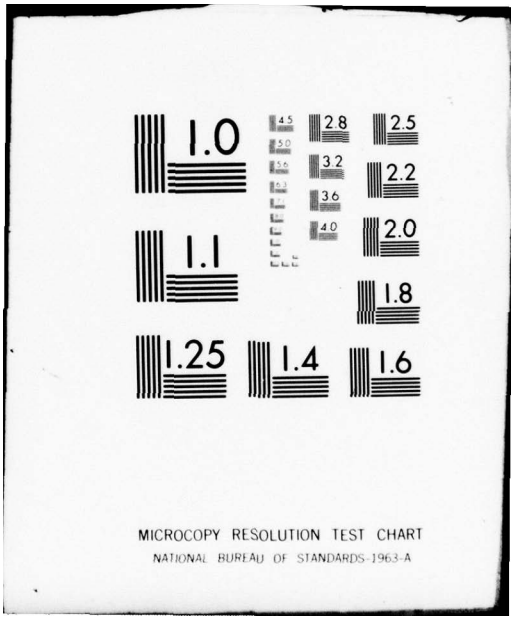
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TRIBUTARY TO HAYNES CREEK
BURLINGTON COUNTY
NEW JERSEY

BIRCHWOOD LAKE DAM
NJ 00417

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

May, 1979

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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READ INSTRUCTIONS BEFORE COMPLETING FORM

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Burlington County, N.J.

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(12) 87p.

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Safety
National Dam Inspection Act Report
Birchwood Lake Dam, N.J.

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) LB

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

IN REPLY REFER TO

NAPEN-D

24 MAY 1979

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Birchwood Lake Dam in Burlington 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, Birchwood Lake 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 good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following remedial actions are recommended to be undertaken within six months from the date of approval of this report:

a. Remove trees on the dam embankment in order to reduce the piping potential.

b. The concrete spillway should be thoroughly inspected and repaired as outlined below:

(1) Drain the lake to an elevation equal to the invert of the outlet pipe.

(2) Sand blast all concrete and pressure grout all major cracks and patch any observed spalls and eroded surfaces.

(3) Apply an epoxy preservative coating to all surfaces.

c. Remove debris accumulated in the outlet works.

d. A detailed design for a regrading of the upstream and downstream embankment slopes should be prepared by a qualified professional engineer and the embankment regraded accordingly.

e. Upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report. In addition, the dam's sprinkler system should be inspected and drained each fall.

f. In order to properly assess the condition of the embankment in relation to possible seepage, the downstream water level should be lowered (by lowering Timber Lake) in order to expose the downstream toe of dam. When the toe is exposed, the area should be thoroughly inspected for evidence of seepage.

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 Edwin B. Forsythe of the Sixth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

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.

NAPEN-D
Honorable Brendan T. Byrne

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,

1 Incl
As stated

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

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
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

BIRCHWOOD LAKE DAM (NJ00417)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 19 December 1978 by Storch 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.

Birchwood Lake 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 good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following remedial actions are recommended to be undertaken within six months from the date of approval of this report:

a. Remove trees on the dam embankment in order to reduce the piping potential.

b. The concrete spillway should be thoroughly inspected and repaired as outlined below:

(1) Drain the lake to an elevation equal to the invert of the outlet pipe.

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(3) Apply an epoxy preservative coating to all surfaces.

c. Remove debris accumulated in the outlet works.

d. A detailed design for a regrading of the upstream and downstream embankment slopes should be prepared by a qualified professional engineer and the embankment regraded accordingly.

e. Upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report. In addition, the dam's sprinkler system should be inspected and drained each fall.

f. In order to properly assess the condition of the embankment in relation to possible seepage, the downstream water level should be lowered (by lowering Timber Lake) in order to expose the downstream toe of dam. When the toe is exposed, the area should be thoroughly inspected for evidence of seepage.

APPROVED: Jed Kallchon LTC
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 24 May 1979

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Birchwood Lake Dam, I.D. NJ00417
State Located:	New Jersey
County Located:	Burlington
Drainage Basin:	Delaware
Stream:	Tributary to Haynes Creek
Date of Inspection:	December 19, 1978

Assessment of General Condition of Dam

Based on visual inspection, available records, past operational performance and Phase I engineering analyses, Birchwood Lake Dam is assessed as being in good overall condition.

The spillway and auxiliary spillways are capable of passing the designated spillway design flood (100-year storm) when the water level in the lake is equal to the dam crest elevation and, therefore, are assessed as being adequate.

The embankment is free of settlement and appears to be structurally sound. However, assessment of any possible seepage cannot be made due to the fact that the downstream toe of dam is submerged by the tailwater (Timber Lake). Inspection of the downstream toe with Timber Lake lowered should be performed in the near future. In addition, the embankment should be regraded in the near future to eliminate excessively steep side slopes.

Trees are present on the embankment and should be removed in the near future.

The spillway appears to be in good condition. However, in the near future, it should be thoroughly inspected and renovated by sand blasting, grouting where needed and coating with epoxy.

Debris accumulated in the outlet works manhole should be removed.

The owner should, in the near future, implement a program of periodic inspection and maintenance for the dam, the complete records of which to be kept on file and made available to the public. A detailed topographic survey of the dam should be performed by a qualified licensed land surveyor or professional engineer and included in the permanent records. Repairs should be made when required and the following maintenance should be performed annually: remove adverse vegetation from the embankment, fill any eroded surfaces, and inspect and drain the sprinkler system in the fall. In addition, the lake should be lowered at least every five years at which time the lake should be cleaned and submerged portions of the dam and spillway inspected and repaired.

Richard J. McDermott

Richard J. McDermott, P.E.

OVERVIEW - BIRCHWOOD LAKE DAM

19 DEC. 1978

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 30214. 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 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 the 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 PROGRAM

BIRCHWOOD LAKE DAM, I.D. NJ00417

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Insepction throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Birchwood Lake Dam was made on December 19, 1978. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

Birchwood Lake Dam is an earthfill dam with an uncontrolled concrete spillway having an ogee type crest. Additional appurtenances include two 18-inch pipe auxiliary spillways and a gated outlet works. The embankment is generally grass covered with large pine trees planted along its crest.

Birchwood Lake Dam separates Birchwood Lake (also known as Upper Birchwood Lake) from Timber Lake (also known as Lower Birchwood Lake); water discharged by the spillway and auxiliary spillways flows directly into Timber Lake.

The concrete spillway is formed between two parallel concrete wingwalls or training walls and is constructed on piles. Treated timber sheeting runs along the center of the embankment according to plans prepared by B. Harold Wills dated October, 1964.

Having an overall length of 250 feet, the embankment has a top width of 26 feet and upstream and downstream slopes of 1.5:1 and 1:1 respectively. The spillway, having an overall crest length of 45 feet, was designed for two-staged operation. The primary stage has a crest length of 24 feet and an elevation of 42.8 while the secondary stage consists of two sections each having a crest length of 10.5 feet and an elevation of 43.0. (Note: all references to the spillway crest elevation will be to the primary stage elevation of 42.8.)

The spillway crest lies 3.7 feet below the elevation of the dam crest and 5.4 feet above the elevation of the downstream lake bottom.

Two auxiliary spillways are located on either side of the main spillway. Each consists of an 18-inch reinforced concrete pipe transversely penetrating the dam with inlet invert elevation equal to 42.0.

The outlet works consists of one 36-inch corrugated metal pipe transversely penetrating the dam approximately 33 feet south of the spillway. A timber stoplog gate is contained in a concrete manhole located in the dam embankment.

b. Location

Birchwood Lake Dam, also known as Upper Birchwood Dam, is located in the Township of Medford, Burlington County, New Jersey. Separating Timber Lake from Birchwood Lake, it impounds the latter which lies in a residential area of Medford Township. (Note: Timber Lake Dam is also referred to as Lower Birchwood Lake and Birchwood Lake is also referred to as Upper Birchwood Lake.) Water outflowing from the dam passes through a series of lakes and then into Haynes Creek. Access to the dam is provided by easements through residential building lots at each end of the embankment.

c. Size and Hazard Classification

Size and Hazard Classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

	Impoundment	
Category	Storage (Ac-ft)	Height (Ft)
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and $< 50{,}000$	≥ 40 and < 100
Large	$\geq 50{,}000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (no permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

The characteristics of Birchwood Lake Dam are:

Storage = 95 acre-feet

Height = 9 feet

Potential Loss of Life: Approximately 40 homes along Timber Lake downstream of dam not significantly effected by dam failure.

Potential Economic Loss: Secondary road bridge 200 feet from dam. Failure outflow would overtop roadway.

Therefore, Birchwood Lake Dam is classified as "Small" size and "Significant" hazard potential.

d. Ownership

Birchwood Lake Dam is owned and operated by Birchwood Lake Colony Club, 55 S. Lakeside Drive, Medford, New Jersey 08055.

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility for a residential development.

f. Design and Construction History

The area now occupied by Birchwood Lake reportedly was originally used as a mill pond in the early 1800's; a dam

for that purpose being located in the vicinity of the subject dam. The usage was converted to cranberry bogs in the 1880's. The present dam was constructed to accommodate the residential development of the early 1950's. Plans for the dam and appurtenances were prepared by B. Harold Wills in 1954 and the dam was constructed in 1955 by the Hill Construction Co.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the Birchwood Lake Colony Club. There is no fixed schedule of maintenance; repairs are made as the need arises.

The outlet works is used to drain the lake for maintenance purposes and during times of high water level to attenuate flooding conditions.

1.3 Pertinent Data

a. Drainage Area - 8.5 square miles

b. Discharge at Damsite

Maximum known flood at damsite	Unknown
Outlet works at pool elevation	50 c.f.s.
Diversion tunnel low pool outlet at pool elevation	N.A.
Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at pool elevation	N.A.
Gated spillway capacity at maximum pool elevation	N.A.

Auxiliary spillway capacity at maximum pool elevation (top of dam)	30 c.f.s.
Ungated spillway capacity at maximum pool elevation (top of dam)	1078 c.f.s.
Total spillway capacity at maximum pool elevation (top of dam)	1108 c.f.s.

c. Elevation (Feet above MSL)

Top of Dam	46.5
Maximum pool-design surcharge	46.5
Full flood control pool	N.A.
Recreation pool	43
Spillway crest - Primary	42.8
- Secondary	43.0
Upstream portal invert diversion tunnel	N.A.
Stream bed at centerline of dam	36
Maximum tailwater	45 (Estimated)

d. Reservoir

Length of maximum pool	3,000 feet (Estimated)
Length of recreation pool	2,400 feet (Scaled)
Length of flood control pool	N.A.

e. Storage (Acre-feet)

Recreation pool	24 acre-feet
Flood Control pool	N.A.
Design surcharge	95 acre-feet
Top of dam	95 acre-feet

f. Reservoir Surface (Acres)

Top of dam	35 acres (Estimated)
Maximum pool	35 acres (Estimated)
Flood control pool	N.A.
Recreation pool	11 acres
Spillway crest	11 acres

g. Dam

Type	Earthfill
Length	250 feet
Height	9 feet
Side slopes - Upstream	1.5 horiz. to 1 vert.
Downstream	1 horiz. to 1 vert.
Zoning	Unknown
Impervious core	Timber sheet piles
Cutoff	Unknown
Grout curtain	Unknown

h. Diversion and Regulating Tunnel — N.A.

i. Spillway

Type	Ogee crest
Primary Crest	
Length	24 feet
Elevation	42.8
Secondary Crest	
Length	21 feet
Elevation	43.0
Gates	N.A.
Upstream channel	N.A.
Downstream channel	N.A.

j. Auxiliary Spillway

Type	2 Reinforced concrete pipes
Diameter	18 inches
Crest elevation	43
Gates	N.A.
Upstream channel	N.A.
Downstream channel	South pipe: stone lined channel 20 feet long

k. Regulating outlets

36" CMP with stoplogs in concrete manhole

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original dam could be obtained. However, information generated at the time of the construction of the present dam is available. The following plans are available:

1. Plans titled "Proposed Timber Lake Dam No. 2" (2 sheets), prepared by B. Harold Wills, dated October 1954, revised February 7, 1955; containing:
   a. Plan, profile and cross sections of dam
   b. Profile of Birchwood Lake
   c. Plan and elevations of spillway
   d. Plan of outlet works

2. Subdivision plat titled "Birchwood Lakes, Section #2" prepared by Earl Higginbotham, dated June 1955.

In addition, hydraulic calculations in connection with the subject dam are available. However, the calculations deal exclusively with a backwater effect at the Medford Lakes Sewage Treatment Plant, upstream of the dam, that was anticipated at the time of design.

2.2 Construction

Two inspection reports, written on February 23, 1955, indicated that construction was in progress at that time and that all work was in conformance with the construction plans.

2.3 Operation

No records of operation of the lake or dam are available. No inspection reports subsequent to construction of the dam are available.

2.4 Evaluation

a. Availability

Available engineering information is limited to that which is on file at the NJDEP. The NJDEP file contains copies of plans, calculations, correspondence, photographs, inspection reports and testimony relating to the Medford Lakes Sewage Corporation 1955 protest against the dam construction. The file is available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N. J.

b. Adequacy

The available information forms a fair description of the subject dam and is considered to be of significant assistance in the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

Most information that could be verified is valid within a reasonable allowance for error. Data found in the NJDEP file that is at variance with the findings of this inspection and evaluation are noted in paragraph 7.1.b.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Birchwood Lake Dam was performed on December 19, 1978 by members of the staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1. The embankment of the dam, appurtenant structures and adjacent areas were examined.
2. The embankment and appurtenant structures were measured and key elevations determined by hand level.
3. The embankment, appurtenant structures and adjacent areas were photographed.

b. Dam

The dam embankment appeared to be uniformly aligned both vertically and horizontally with a good stand of grass and low ground cover on all surfaces. Some small birch trees are present on the upstream and downstream faces and several large pine trees are planted along the crest. A buried sprinkler system was in evidence on the crest.

The downstream toe of the embankment is submerged by the tailwater which consists of Timber Lake. No evidence of cracking, settling or seepage was noted in the dam nor were any animal holes observed.

The generalized soils description of the dam site consists of shallow surface alluvial deposits of interbedded sand and silty sand with some intermixed gravel deposited during the Quaternary Period and shown as the Cape May formation on the Geologic Map of New Jersey prepared by Lewis and Kummel. The shallow surface soils are underlain by alluvial deposits of stratified silty sand interbedded with irregular layers of sandy silt, with local layers of clayey sand deposited during the Tertiary Period and known as Kirkwood sand. The lake basin contains significant surficial organic material, silt and sand with some clay.

Bedrock is in excess of 100 feet below the ground surface. It is assumed that the dam is founded on the silty sands of the Cape May formation.

c. Appurtenant Structures

The crest of the spillway appeared to be uniformly aligned, although a major part of it was submerged by overflow at the time of inspection. The concrete of those sections of the spillway that could be observed was generally in good condition. One crack in the north wingwall of the spillway was observed.

The outlet works, although fitted with a wheel mechanism for opening a slide gate, was observed to contain stoplogs in the same box manhole formerly containing the slide gate.

Debris was observed in the manhole in the section downstream of the stoplogs.

d. Reservoir Area

Birchwood Lake is long and narrow, averaging 200 feet in width with an overall length of nearly 1/2 mile. It is located in a residential area of Medford Township.

Located in a topographically flat to moderately sloping area, Birchwood Lake is part of a series of dammed lakes discharging from one to the other. Several of the lakeside homesites include docks and other lake related structures.

e. Downstream Channel

The spillway discharges directly into Timber Lake. No significant obstructions to the downstream flow were observed.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Birchwood Lake is regulated naturally by discharge over the two-stage spillway of Birchwood Lake Dam. The two-staged crest has fixed elevations. Periodically, the lake is lowered for lake maintenance by removing stoplogs in the outlet works manhole. The time required to lower the lake is 2 to 3 days.

Stoplogs are reportedly removed at times of intense storms in order to attenuate flood water level.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance of the dam and appurtenant structures. Maintenance is performed on an "as needed" basis.

4.3 Maintenance of Operating Facilities

Maintenance of operating facilities such as the outlet works and the embankment sprinkler system is performed on an "as needed" basis. Approximately six years ago, the slide gate was replaced with stoplogs when the operating mechanism became inoperable.

4.4 Description of Warning System

Reportedly, telephone communication is maintained between persons responsible for dams in the Medford Lakes area and the Civil Defense representatives in neighboring Medford Lakes Borough.

4.5 Evaluation of Operational Adequacy

The operation of the dam has been successful to the extent that the dam has not been overtopped since the present dam was constructed in 1955.

Although maintenance documentation is poor, the adequacy of the maintenance program for the dam appears to have been good. Areas of maintenance that have not been adequately performed are:

1. Trees allowed to grow on embankment.

2. Debris allowed to accumulate in outlet works manhole.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The intensity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff intensity, called the spillway design flood (SDF), is described in terms of frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers, the SDF for Birchwood Lake Dam falls in a range of 100-year frequency to 1/2 PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The peak 100-year flood is 893 c.f.s. as calculated in accordance with analytical procedures contained in Special Report 38 published by the NJDEP.

Discharge capacities for Birchwood Lake Dam were computed by considering three points of outflow from the lake: the spillway and the two 18" RCP auxiliary spillways. The spillway was assumed to have characteristics of an ogee crested weir while each auxiliary spillway was treated as a pipe culvert with outlet control. The combined discharge with water level at the dam crest was computed to be 1108 c.f.s. Since the computed discharge is greater than the computed SDF peack (893 c.f.s.), the spillway is considered to be adequate according to criteria developed by the U.S. Army Corps fo Engineers.

b. Experience Data

The dam reportedly has not been overtopped since its construction in 1955. Reportedly when a dam upstream of Birchwood lake failed about six years ago, the water level in Timber Lake rose to within 1.5 feet of the crest of Timber Lake Dam but the water level in Birchwood Lake did not rise to a level significantly near the crest of Birchwood Lake Dam.

c. Visual Observations

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a, the dam would not be overtopped during storms equivalent to the designated SDF. Detailed hydraulic and hydrologic analyses are contained in Appendix 4.

originally used as a mill pond in the early 1800's; a dam

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The embankment appeared, at the time of inspection, to be structurally stable with no evidence of cracks, displacement, differential settlement or seepage.

b. Design and Construction Data

Analysis of structural stability and construction data for the embankment are not available. The only design and construction data available are the drawings prepared by B. Harold Wills in 1954.

c. Operating Records

No operating records are available for the dam. The water level of Birchwood Lake is not monitored in the dam vicinity.

d. Post Construction Changes

Since Birchwood Lake Dam was constructed in 1955, there have been few changes to the dam or the area surrounding it. The slide gate in the outlet works was removed and replaced by timber stoplogs.

e. Seismic Stability

Birchwood Lake Dam is located in Seismic Zone 1 as defined in "Recommended Gudielines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if stable under static loading conditions. Birchwood Lake Dam appeared to be stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Birchwood Lake Dam is considered to be adequate according to criteria developed by the U.S. Army Corps of Engineers.

The structural integrity of the dam appears to be adequate based on field inspection. No reported nor written evidence was found that would contradict this assessment. However, a complete assessment of possible seepage is not possible at the present time due to the submerged condition of downstream toe of dam.

b. Adequacy of Information

Information sources for this study include: 1.) field inspecton, 2.) plans and correspondence in NJDEP files, 3.) USGS quadrangle sheet, 4.) aerial photography from Burlington County and 5.)consultation with maintenance and operation personnel for the dam. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some data not available are as follows:

1. Stream and lake elevation gauging records.
2. Description of dam embankment fill materials.
3. Inspection reports subsequent to construction.

Data contained in the NJDEP file at variance with the findings of this report are as follows:

1. Slope of downstream face of embankment, reported to be 1.5:1, was found to be 1:1
2. Top width of dam, reported to be 15 feet, was found to be 26 feet.
3. Surface area of Birchwood Lake, reported to be 25 acres, was measured to be 11 acres.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Birchwood Lake Dam are not available, additional data are not considered imperative for this Phase I evaluation. To form a complete assessment of the structural integrity of the dam, the downstream toe of dam should be inspected for possible seepage after the water level of Timber Lake is lowered. See paragraph 7.2.c.

7.2 Recommendations

a. Remedial Measures

Based on visual inspection of Birchwood Lake Dam and pertinent data obtained as part of this evaluation, it is recommended that the following remedial measures be undertaken by the owner in the near future.

1. Trees on the dam embankment should be removed. All trees should be cut at the ground surface.

2. The concrete spillway should be thoroughly inspected and repaired as outlined below:

   a. Drain the lake to an elevation equal to the invert of the outlet pipe.
   b. Sand blast all concrete and pressure grout all major cracks and patch any observed spalls and eroded surfaces.
   c. Apply an epoxy preservative coating to all surfaces.

3. Debris accumulated in the outlet works should be removed.

4. A detailed design for a regrading of the upstream and downstream embankment slopes should be prepared by a qualified professional engineer and the embankment regraded accordingly.

The implementation of the above remedial measures will require proper detailed studies and design and the obtaining of applicable NJDEP approvals.

b. Maintenance

The owner of the dam should initiate, in the near future, a program of periodic inspection and maintenance, the complete records of which to be kept on file and made available to the public. A visual inspection of the dam and appurtenances by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove adverse vegetation from the embankment, fill any eroded surfaces of the embankment and inspect and drain the sprinkler system in the fall. In addition, the lake should be lowered at least every five years at which time the lake should be cleaned and submerged portions of the dam and spillway inspected and repaired.

c. Additional Studies

In order to properly assess the condition of the embankment in relation to possible seepage, the downstream water level should be lowered (by lowering Timber Lake) in order to expose the downstream toe of dam. When the toe is exposed, the area should be thoroughly inspected for

evidence of seepage. This inspection and assessment should be performed in the near future by a qualified professional engineer.

A detailed topographic survey of the dam and area around the dam based on USGS datum should be undertaken by a qualified licensed land surveyor or professional engineer in the near future. The survey map should be related to existing construction drawings and should become part of the permanent record mentioned in paragraph 7.2.b.

PLATES

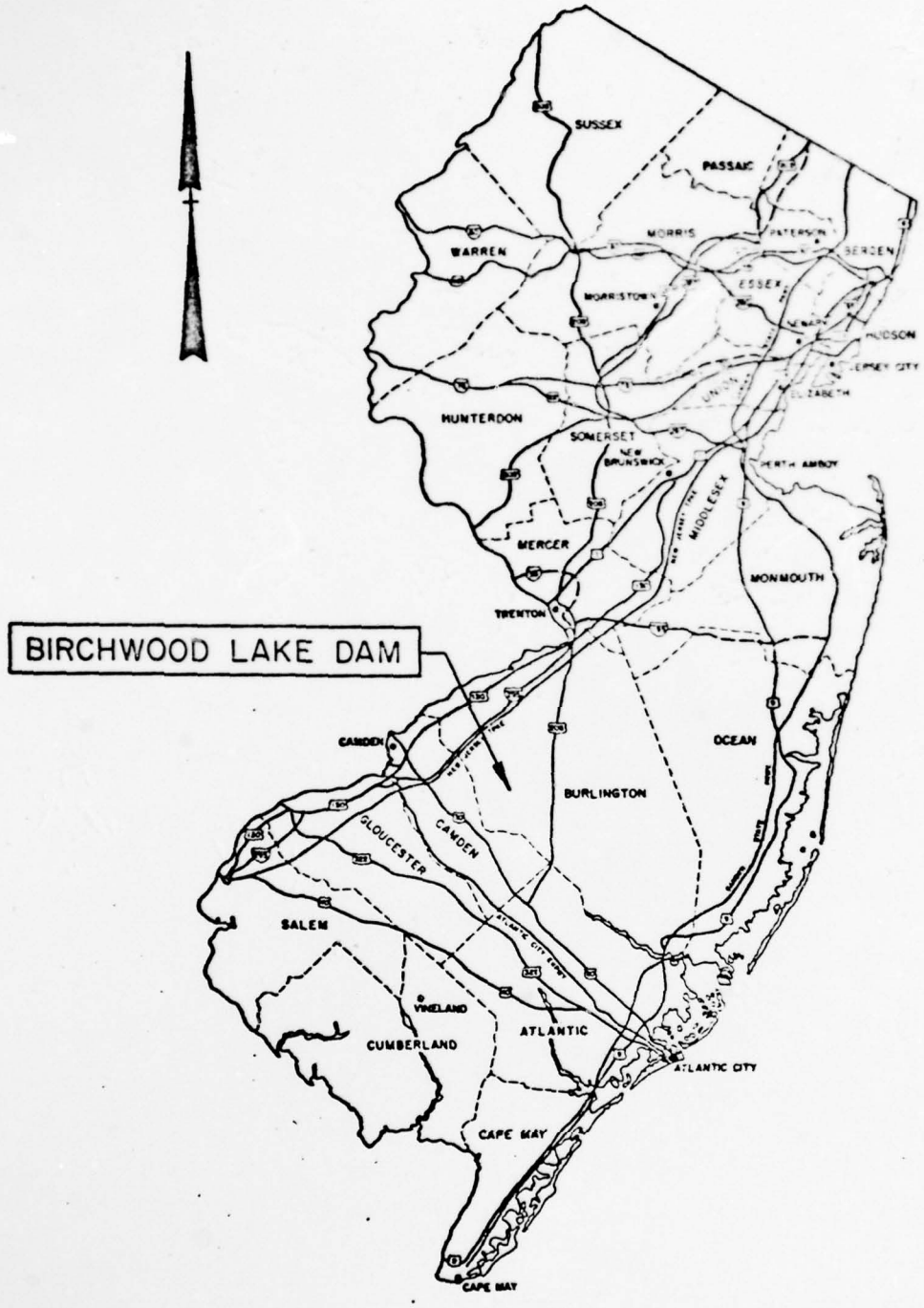


PLATE 1

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

KEY MAP

BIRCHWOOD LAKE DAM

I.D. N.J. 00417

SCALE: NONE

DATE: MARCH, 1979

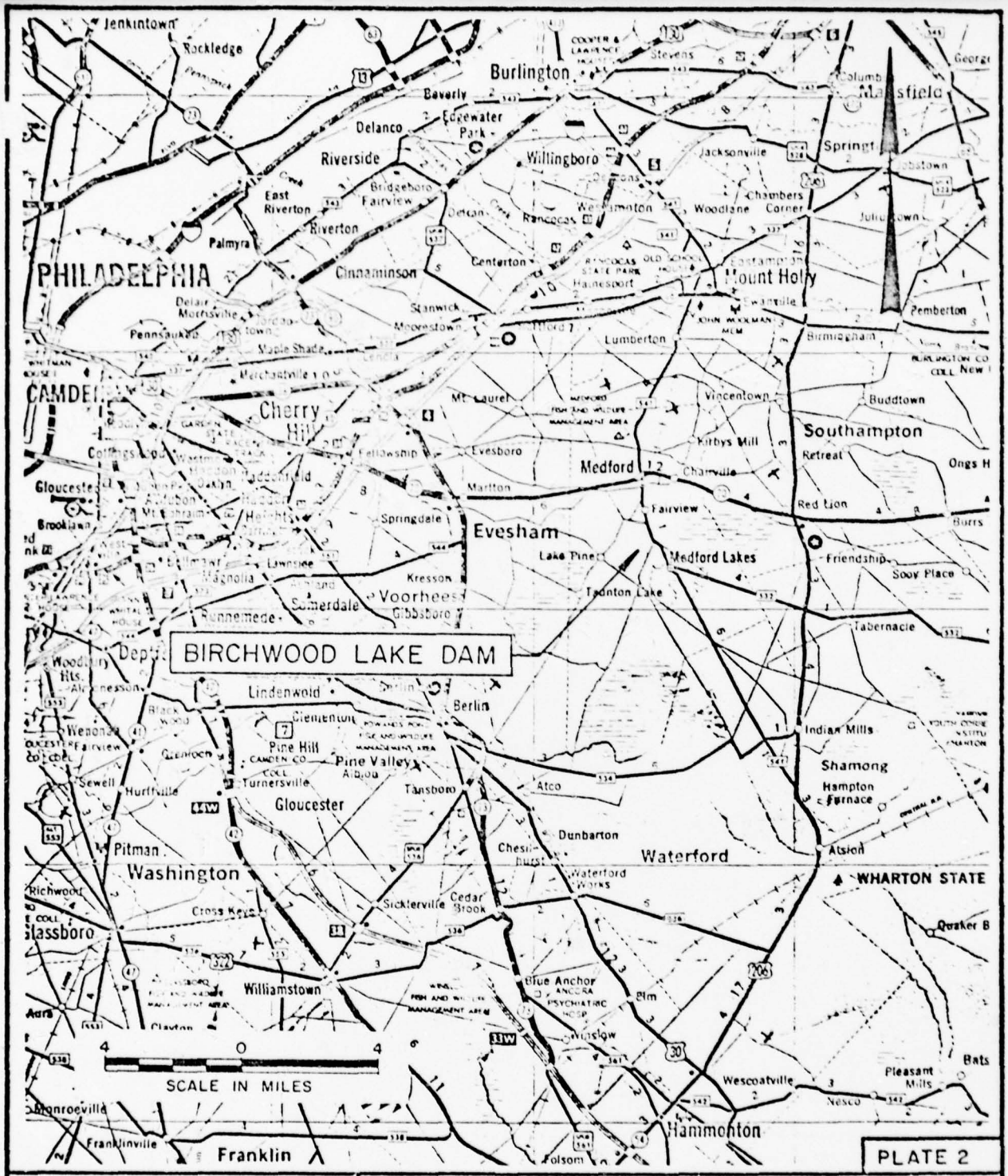


PLATE 2

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

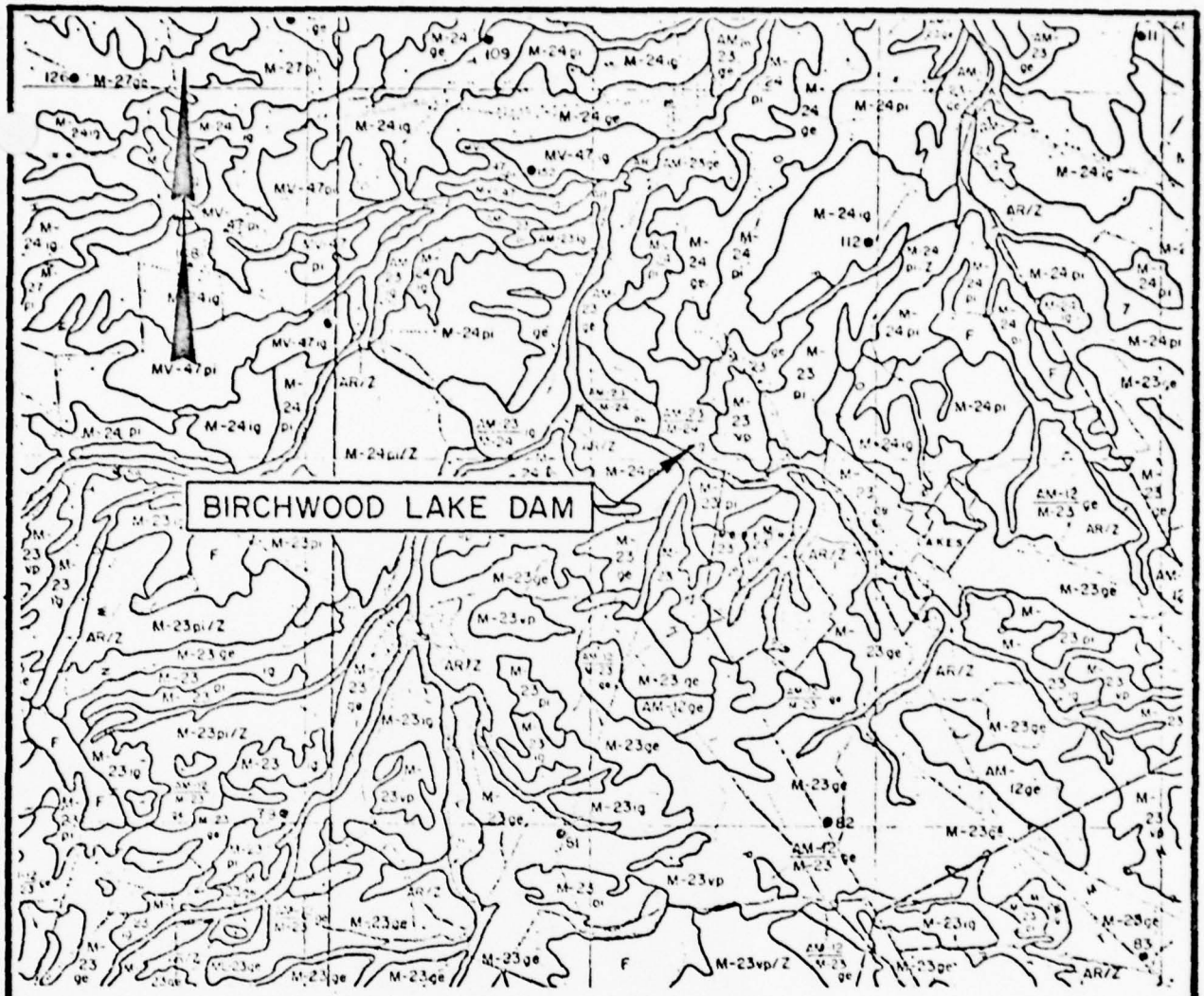
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

VICINITY MAP

BIRCHWOOD LAKE DAM

I.D. N.J. 00417	SCALE: AS SHOWN
	DATE: MARCH, 1979



Legend

AR/Z	Stratified, swampy alluvium
AM-23	Interbedded sand and silty sand with some intermixed gravel. (Cape May formation.)
M-24	Silty sand with interbedded, irregular layers of sandy silt. Local layers of clayey sand. (Kirkwood sand.)

Note: Information taken from Rutgers University Soil Survey of New Jersey, Report No. 20 and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

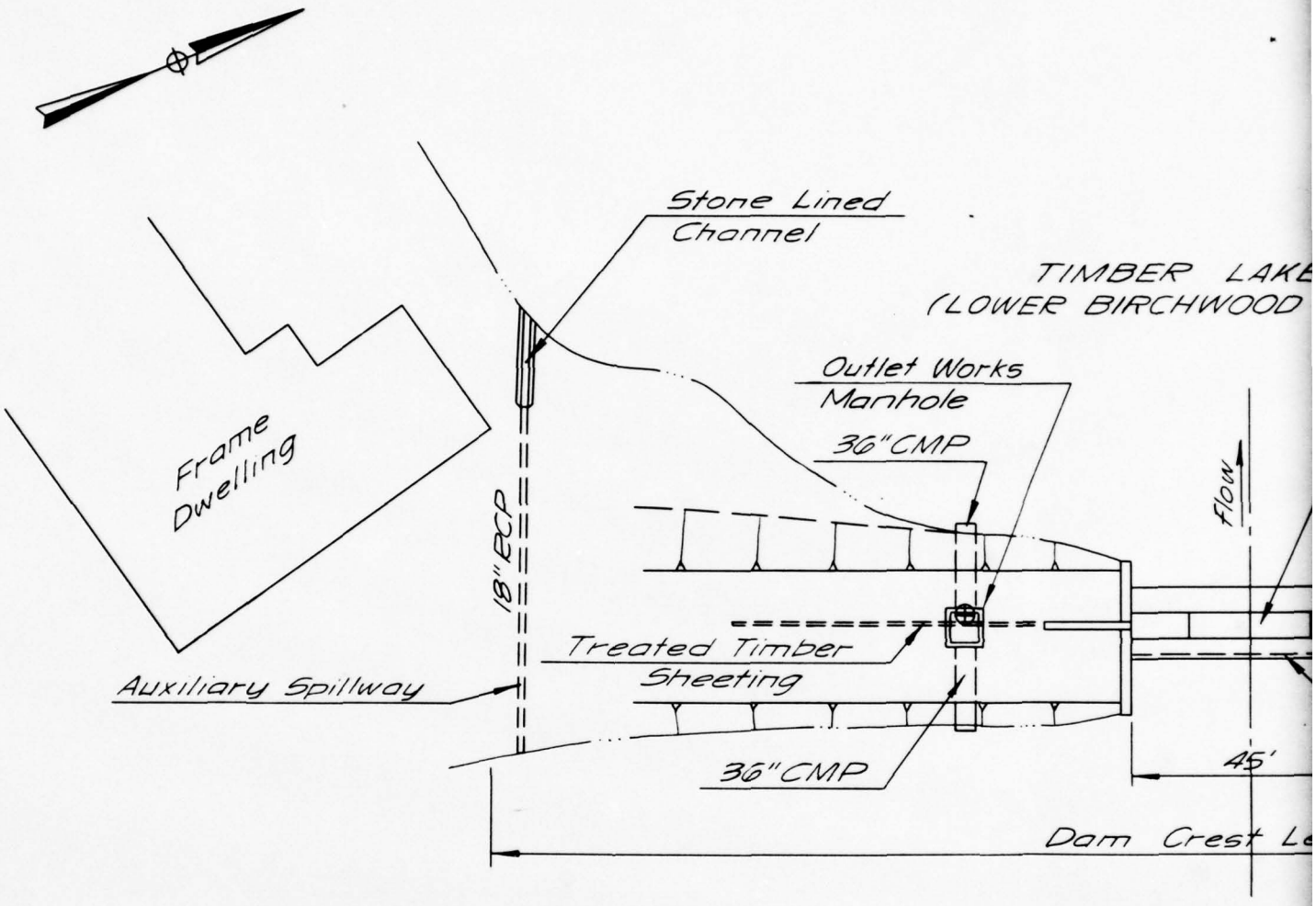
SOIL MAP

BIRCHWOOD LAKE DAM

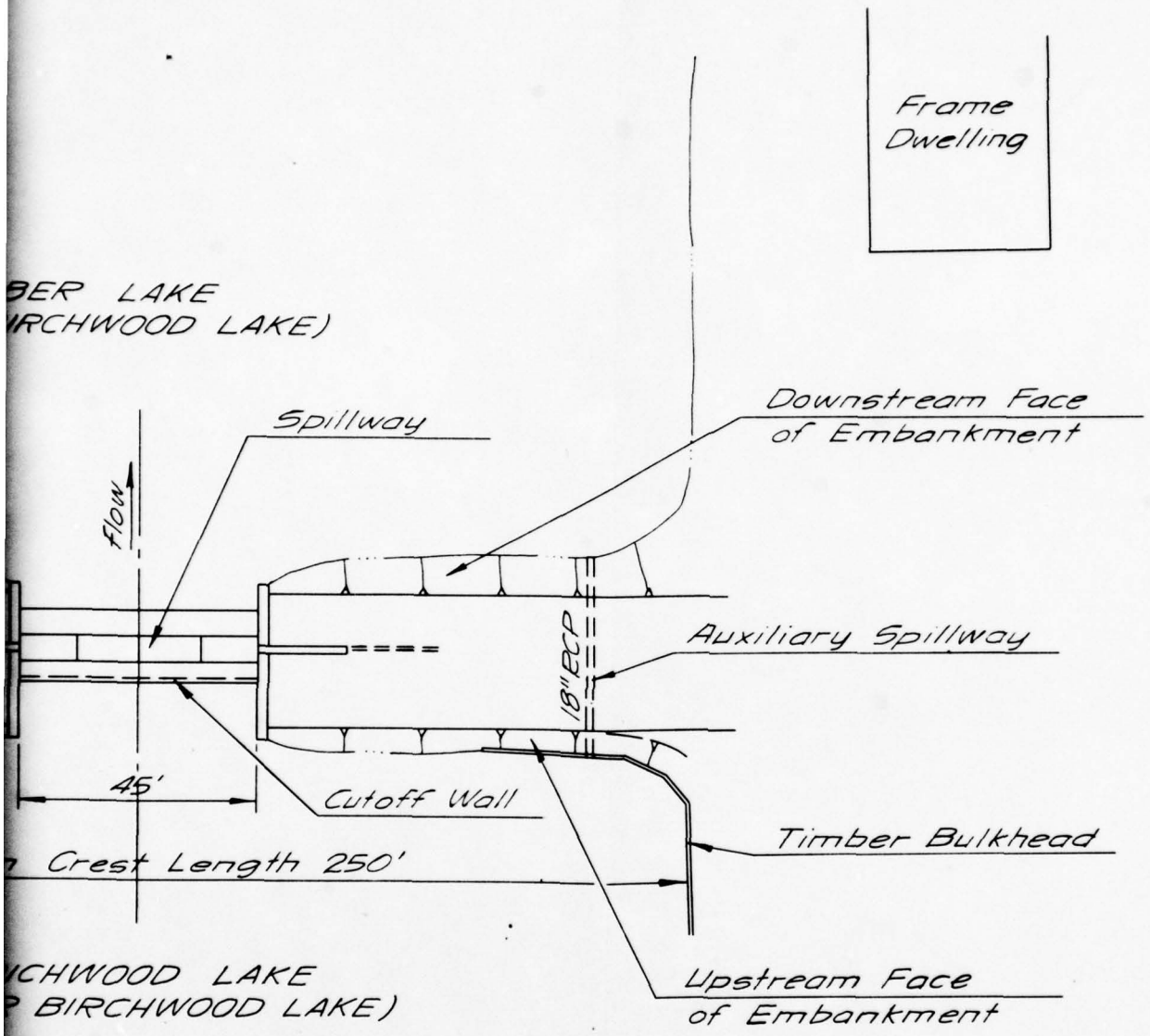
I.D. N.J. 00417

SCALE: NONE

DATE: MARCH, 1979



NOTE:
Information taken from plans prepared by B. Harold Wills dated October, 1954 and field inspection December 19, 1978.



2

PLATE 4

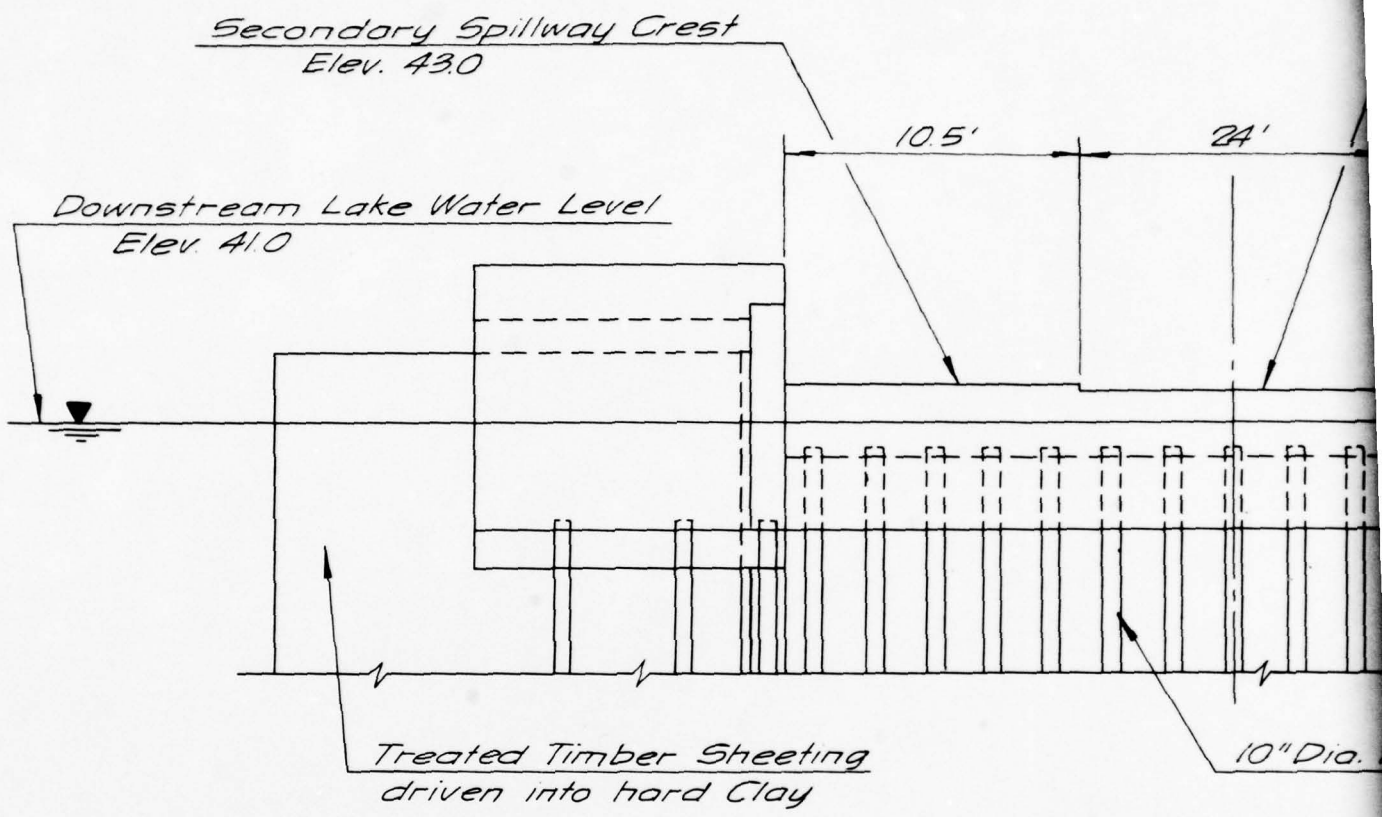
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GENERAL PLAN

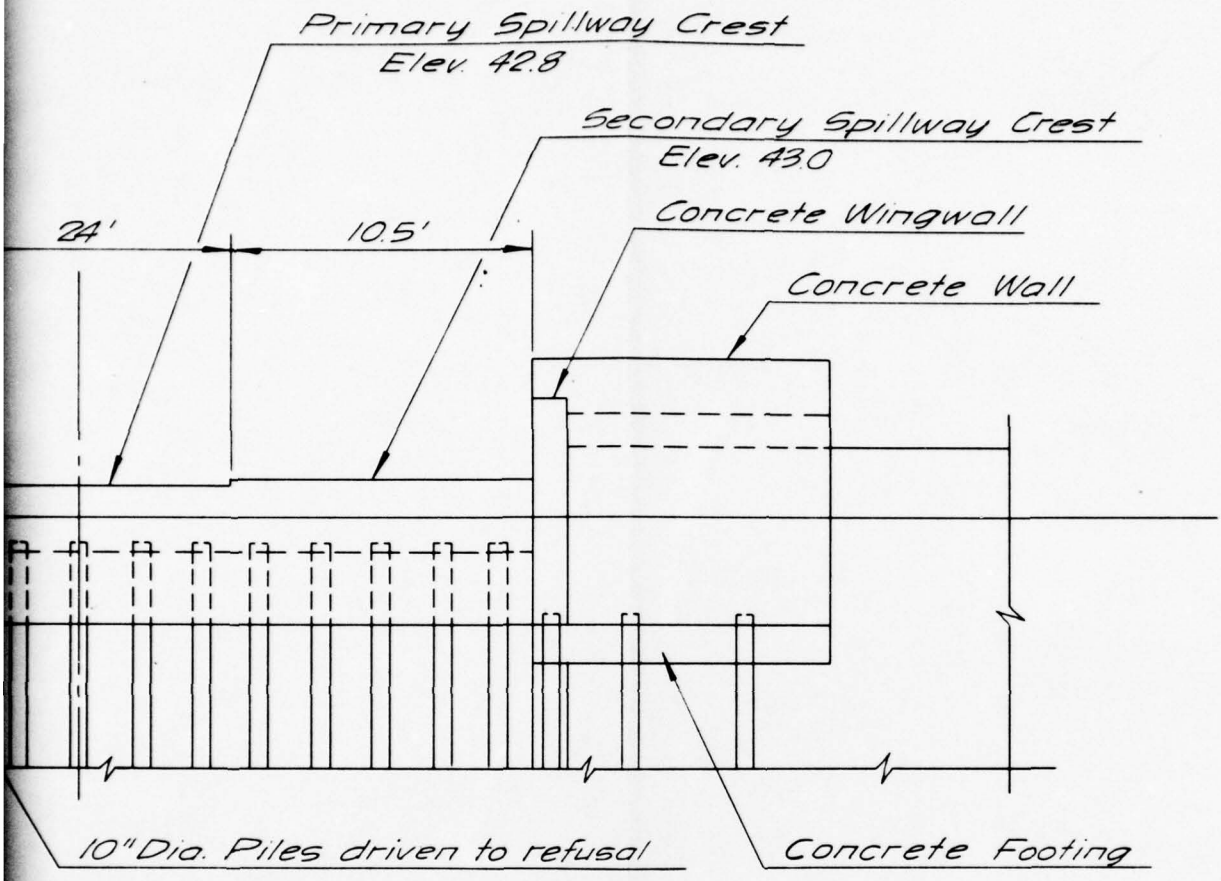
BIRCHWOOD LAKE DAM

I.D.N.J. 00417	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



FRONT ELEVATI

NOTE:
Information taken from plans prepared by B. Harold Wills dated October, 1954 and field inspection December 19, 1978.



ELEVATION

2

PLATE 5

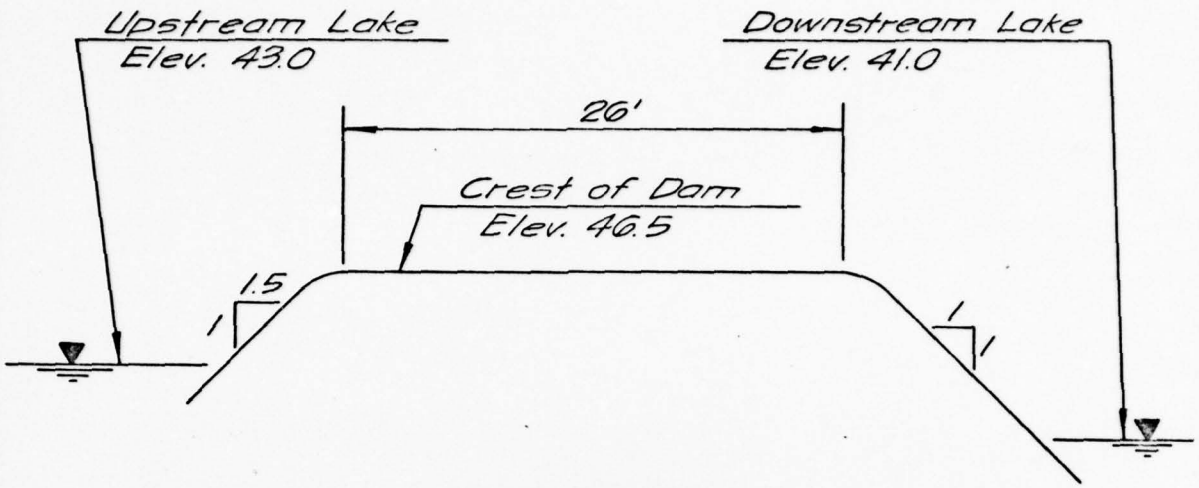
STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

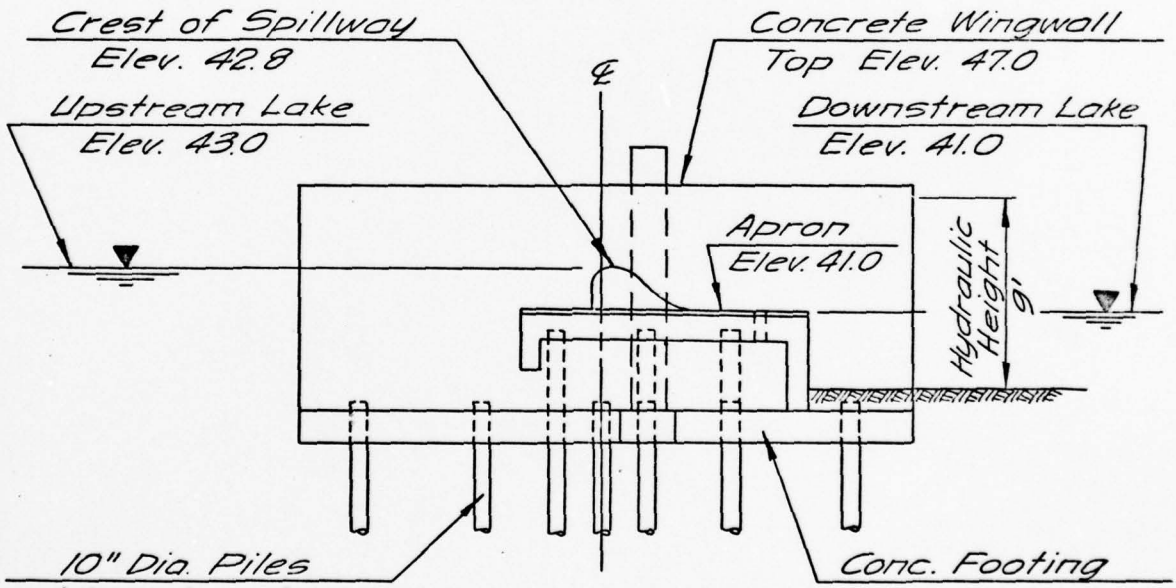
SPILLWAY ELEVATION

BIRCHWOOD LAKE DAM

I.D.N.J. 00417	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



DAM SECTION

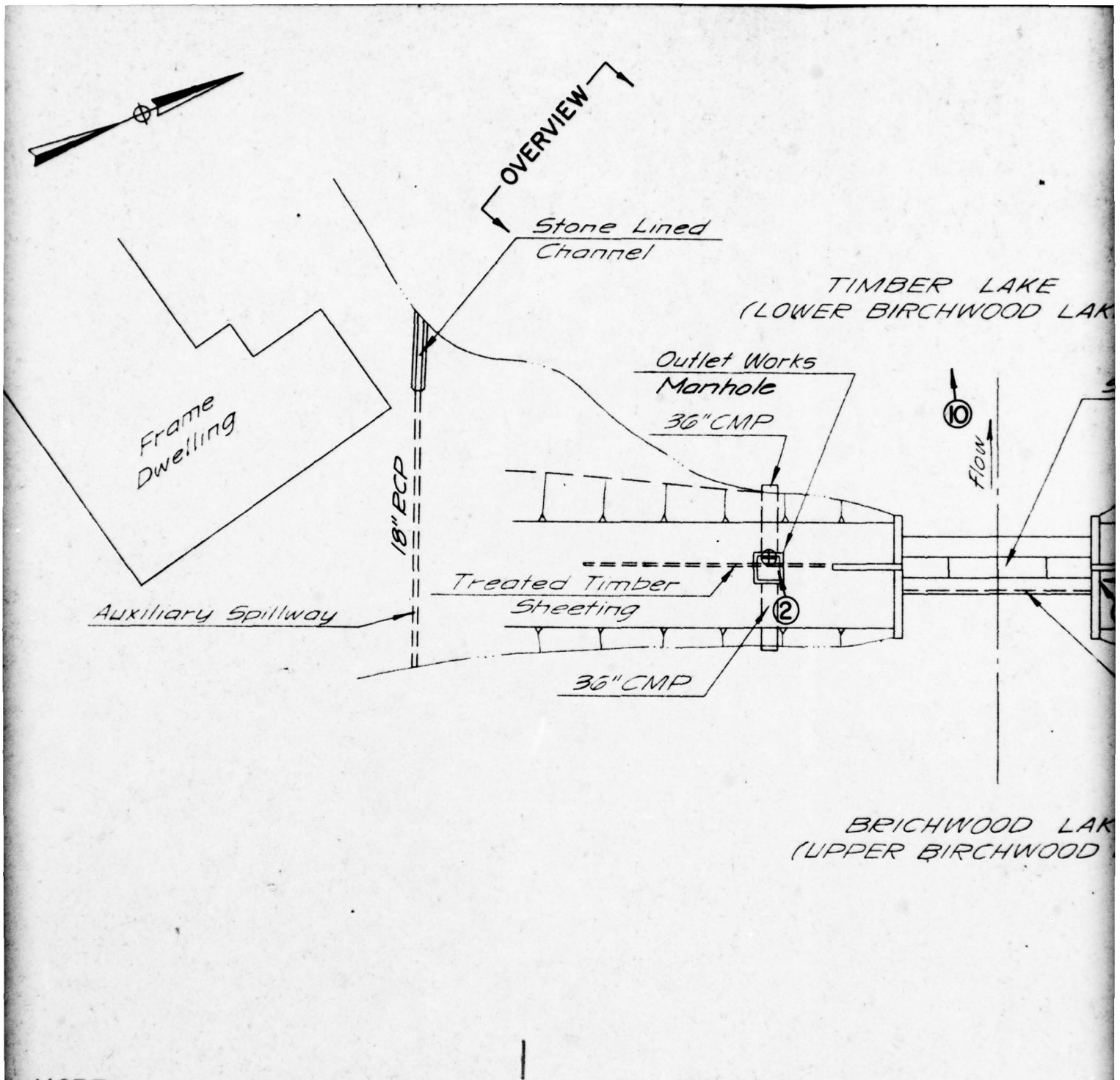


SPILLWAY SECTION

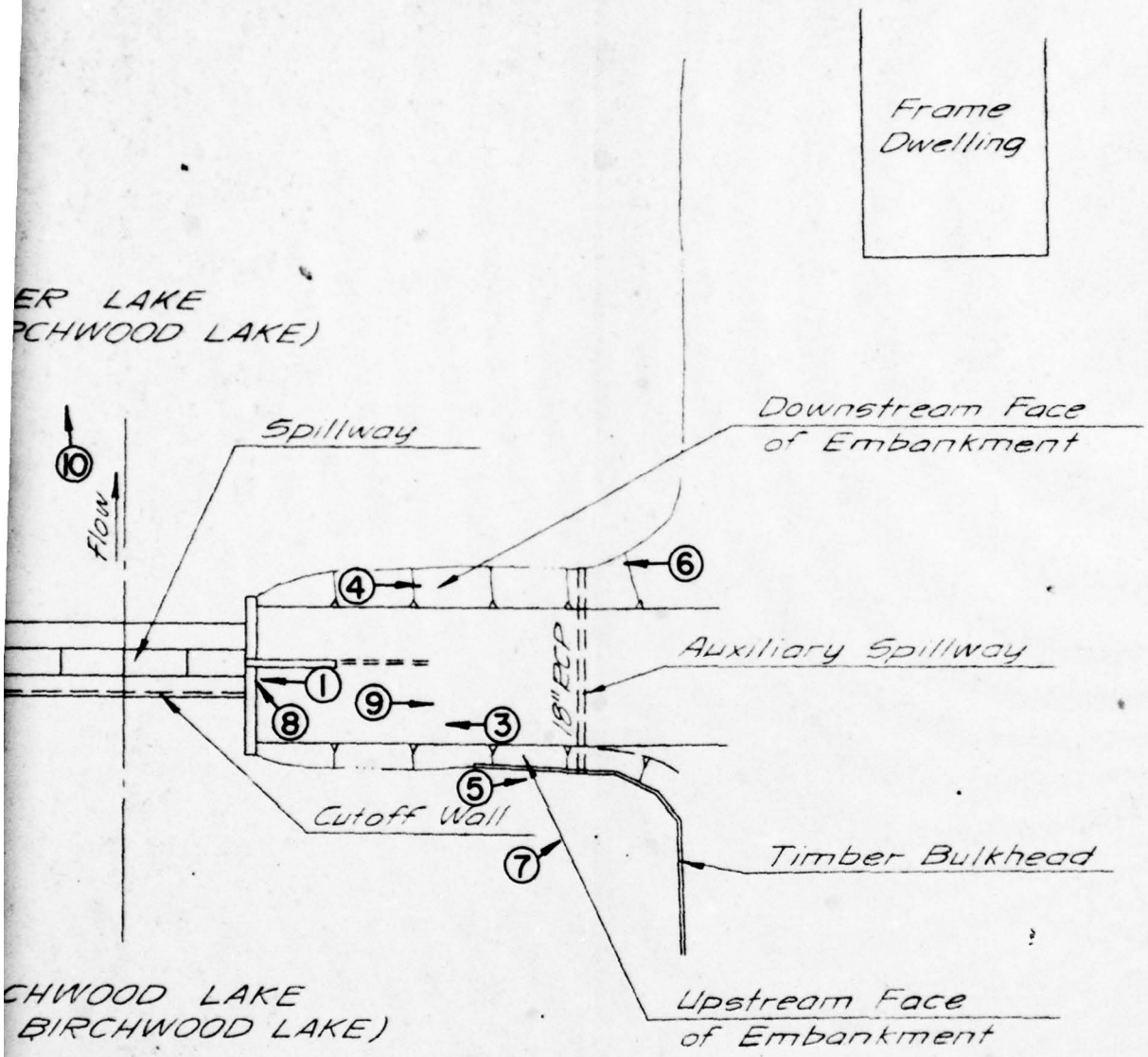
NOTE:
See Note on Plate 4.

PLATE 6

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	INSPECTION AND EVALUATION OF DAMS SECTIONS BIRCHWOOD LAKE DAM
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY	I.D. N.J. 00417
	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979



NOTE:
Information taken from plans prepared by B. Harold Wills dated October, 1954 and field inspection December 19, 1978.



2

PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

PHOTO LOCATION PLAN

BIRCHWOOD LAKE DAM

I.D N.J. 00417	SCALE: NOT TO SCALE
	DATE: FEBRUARY, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase 1

Name Dam Birchwood Lake County Burlington State N.J. Coordinators NJDEP

Date(s) Inspection 12/19/78 Weather Partly Cloudy Temperature 40°F

Pool Elevation at Time of Inspection 43 M.S.L. Tailwater at Time of Inspection 41 M.S.L.

Inspection Personnel:

J. Gribbin R. McDermott

D. Buckelew

A. Miller

J.Gribbin Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	N.A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N.A.	
DRAINS	N.A.	
WATER PASSAGES	N.A.	
FOUNDATION	N.A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N.A.	
STRUCTURAL CRACKING	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N.A.	
MONOLITH JOINTS	N.A.	
CONSTRUCTION JOINTS	N.A.	

Sheet

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	None Observed	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Satisfactory	
RIPRAP FAILURES	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Embankment is grass covered (well kept stand) Some mulch, small birch trees and ground cover on upstream and downstream faces. Large pine trees planted along top.	Sprinkling system observed
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory condition	
ANY NOTICEABLE SEEPAGE	None observed	Entire length of toe of downstream face submerged.
STAFF GAGE AND RECORDER	None	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	
INTAKE STRUCTURE	Stoplogs in center of box manhole. Debris observed in section of manhole downstream of stoplogs.	Stoplogs have replaced slide gate.
OUTLET STRUCTURE		
OUTLET CHANNEL	N.A.	
EMERGENCY GATE	Stoplogs in manhole.	Manhole (box-type) is located in center of embankment, south of spillway.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Ogee type crest with primary and secondary stages Concrete in good condition - one minor crack observed.	Auxillary spillway consists of 18" RCP through embankment 88 feet north of spillway centerline.
APPROACH CHANNEL	N.A..	
DISCHARGE CHANNEL	Spillway discharges directly into lake No. 1.	Road bridge located 200 feet downstream from spillway.
BRIDGE AND PIERS	N.A.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	N.A.	
BRIDGE AND PIERS	N.A.	
GATES AND OPERATION EQUIPMENT	N.A.	

INSTRUMENTATION

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

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slopes of lake banks approx. 5%.	Land around lake entirely developed with homes. Docks are located at some of the homesites.
SEDIMENTATION	Not known.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions observed.	Downstream condition consists of lake (Timber Lake) with residential development along its shores.
SLOPES	Banks of lake are generally flat. Homes are approx. 2 ft. to 4 ft. above water surface.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approx. 40 homes along Timber Lake.	Secondary road bridge approx. 200 feet from dam.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plans titled "Proposed Timber Lake Dam No. 2" (2 sheets) prepared by B. Harold Wills, dated October 1954, revised February 7, 1955.
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Two inspection reports made during construction.
TYPICAL SECTIONS OF DAM	Plans by Wills, 1955
HYDROLOGIC/HYDRAULIC DATA	Available (limited)
OUTLETS - PLAN	Plans by Wills, 1955
- DETAILS	
-CONSTRAINTS -DISCHARGE RATINGS	Not Available
RAINFALL/RESERVOIR RECORDS	Not Available

ITEM	REMARKS
DESIGN REPORTS	Not Available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS	
HYDROLOGY & HYDRAULICS	Available (limited)
DAM STABILITY	Not Available
SEEPAGE STUDIES	Not Available
MATERIALS INVESTIGATIONS	
BORING RECORDS	Not Available
LABORATORY	
FIELD	
POST-CONSTRUCTION SURVEYS OF DAM	Not Available
BORROW SOURCES	Not Available

ITEM	REMARKS
MONITORING SYSTEMS	Not Available
MODIFICATIONS	Stoplogs installed in outlet works No data available
HIGH POOL RECORDS	Not Available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Not Available
MAINTENANCE OPERATION RECORDS	Not Available

ITEM	REMARKS
SPILLWAY PLAN	Plans by Wills, 1955
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not Available

APPENDIX 2

Photographs

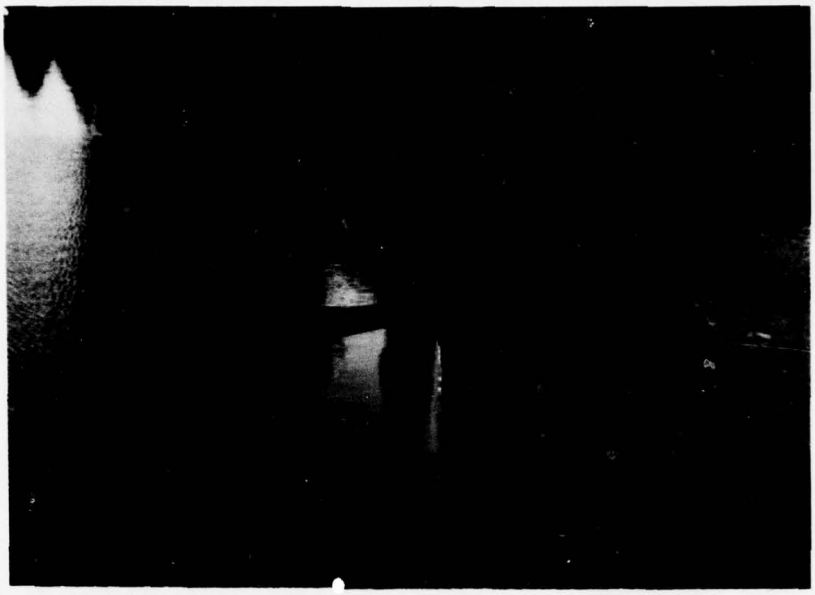


PHOTO 1

SPILLWAY

PHOTO 2

OUTLET WORKS
OPERATING
MECHANISM.

19 DEC. 1978

PHOTO 3

UPSTREAM FACE OF EMBANKMENT.

PHOTO 4

DOWNSTREAM FACE OF EMBANKMENT.

19 DEC. 1978

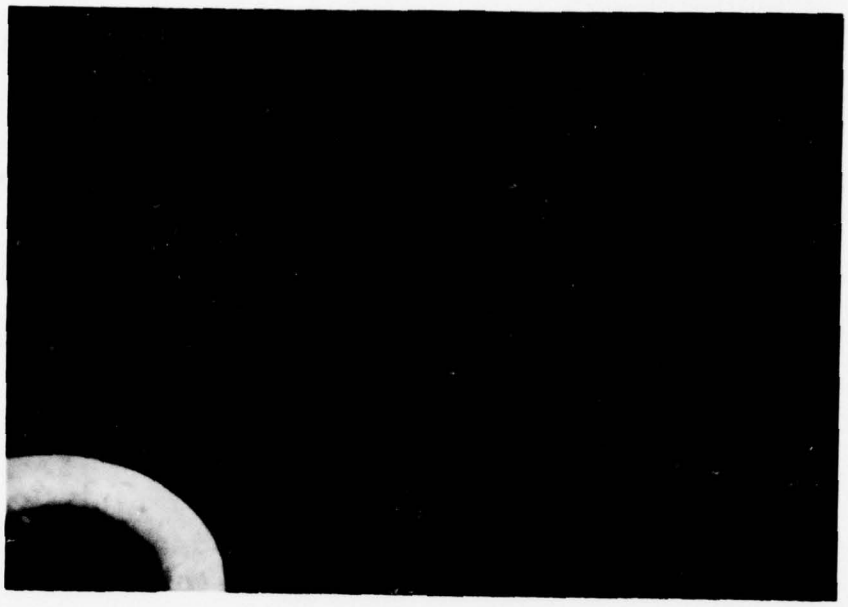


PHOTO 5

AUXILIARY SPILLWAY PIPE INLET

PHOTO 6

AUXILIARY SPILLWAY PIPE OUTLET

19 DEC. 1978

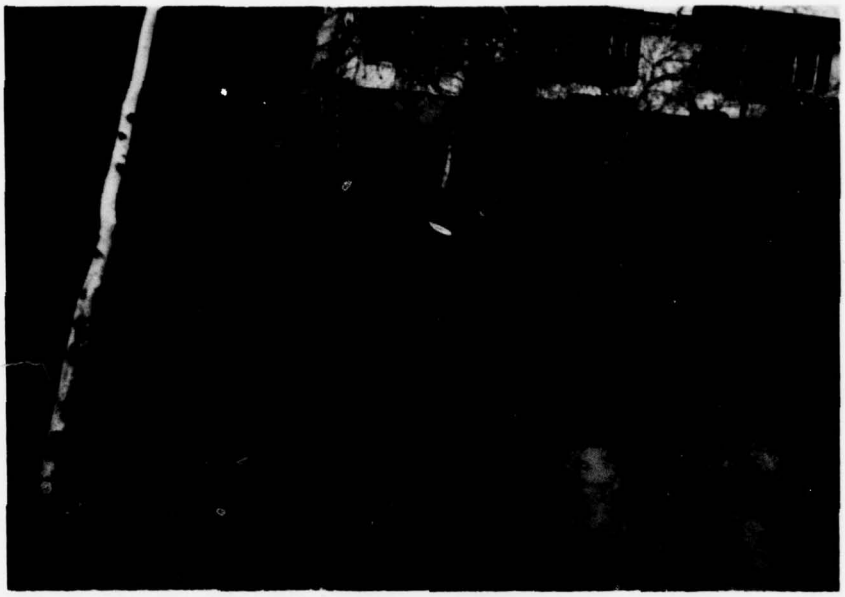


PHOTO 7

BULKHEAD ALONG NORTH EDGE OF UPSTREAM LAKE AND DAM.

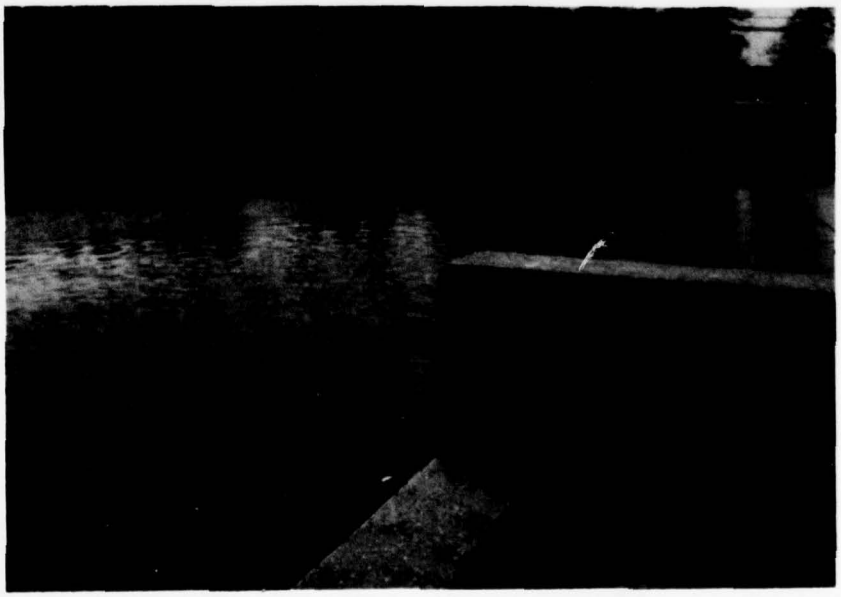


PHOTO 8

CRACK IN NORTH WINGWALL OF SPILLWAY

19 DEC. 1978

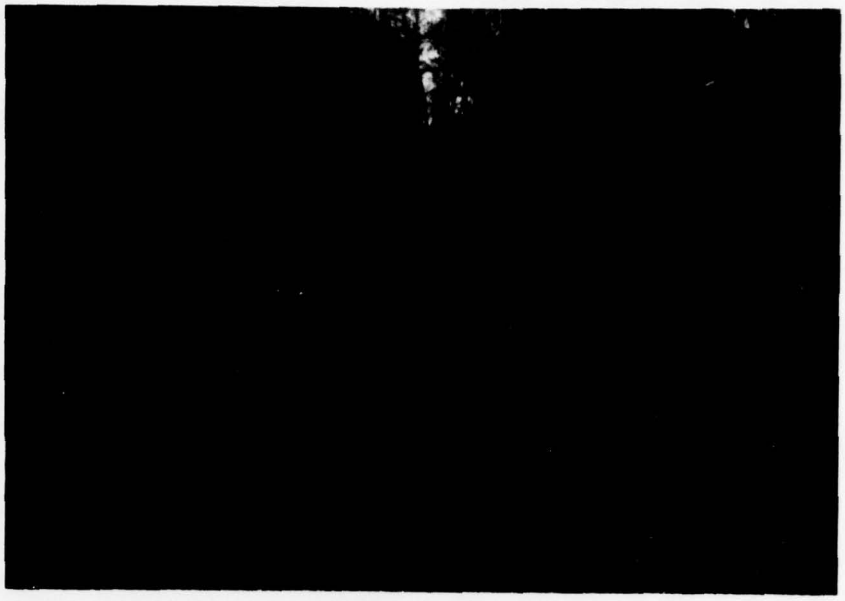


PHOTO 9

CREST OF DAM

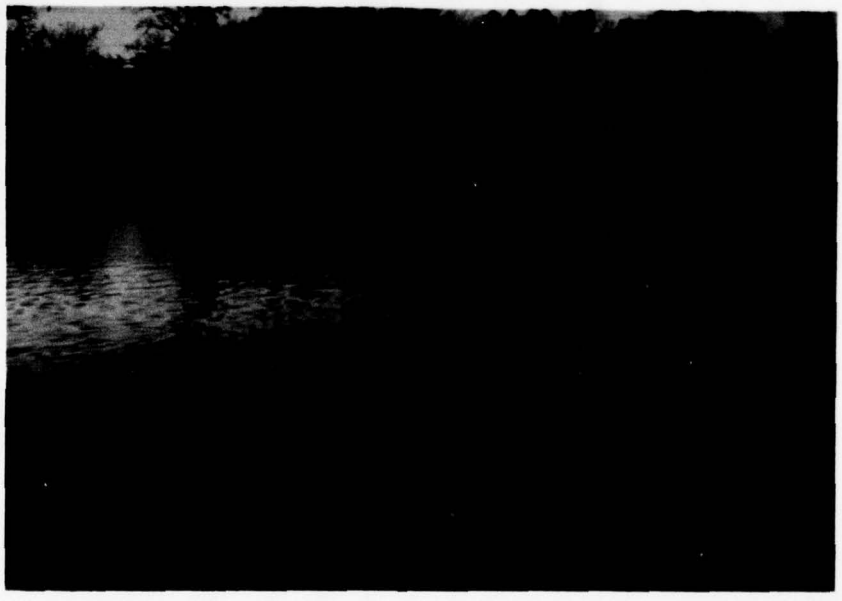


PHOTO 10

BRIDGE DOWNSTREAM FROM DAM

19 DEC. 1978

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1/8 urban, 7/8 wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 43 (24 acre-feet)

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

ELEVATION MAXIMUM DESIGN POOL: 46.5

ELEVATION TOP DAM: 46.5

PRINCIPAL SPILLWAY CREST: Uncontrolled concrete weir

a. Elevation 42.8

b. Type Ogee

c. Width 5 feet

d. Length 45 feet

e. Location Spillover Center of dam

f. Number and Type of Gates N.A.

AUXILIARY SPILLWAY CREST: 2-18" RCP

a. Elevation 43

b. Type Concrete culverts

c. Width 18-inch diameter

d. Length 40 l.f. and 65 l.f., respectively

e. Location Spillover one through each end of dam

f. Number and Type of Gates N. A.

OUTLET WORKS: 36-inch pipe

a. Type Corrugated metal

b. Location 55 feet south of spillway centerline

c. Entrance invert Unknown

d. Exit invert Unknown

e. Emergency draindown facilities: Stoplogs in conc. manhole

HYDROMETEOROLOGICAL GAGES: None

a. Type N.A.

b. Location N.A.

c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) 1108 c.f.s.

APPENDIX 4

Hydrologic Computations

STORCH ENGINEERS

Sheet 1 of 9

Project Birchwood Lake Dam

Made By RL Date 3-7-79

1132

Chkd By JRM Date 3-14-79

Size classification

Maximum Storage (Lake stage at top of dam)	95 acre-feet
Height of dam	9 ft
Size classification	Small

Hazard Potential Classification

Potential loss of life	Homes along Timber Lake not significantly affected by breach of dam
Potential economic loss	Road bridge 200 ft. from dam.
Hazard potential	Significant

Hydrology

100-yr. peak flow

The 100-yr peak flow will be calculated by the use of Report 38.

$$Q_{100} = 136\ D.A.^{0.84}\ S^{0.26}\ S_t^{-0.51}\ I^{0.14}$$

where D.A. = drainage area in sq. mi.

S = main channel slope in ft./mi.

S_t = surface storage index in %

I = manmade impervious cover index in %

D.A. = 8.5 sq. mi.
S = 12.7 ft./mi.
S_t = 6 %
I = 11.1 %

$$Q_{100} = 136\ (8.5)^{.84}(12.7)^{.26}(6)^{-.51}(11.1)^{.14}$$

$$= 136\ (6.04)(1.94)(.4)(1.4)$$

$$= \underline{\underline{893\ \text{c.f.s.}}}$$

Main Channel Slope (S):

(Information taken from USGS quadrangle)

Length of main channel = 4.0 mi

10% length = 0.4 mi. Elev. = 50

85% length = 3.4 mi Elev. = 88

$$S = \frac{88 - 50}{3.4 - .4} = 12.7 \text{ ft./mi.}$$

Surface Storage Index (S_t):

(Information taken from USGS quadrangle)

D.A. = 5440 acres

Storage area = 303 acres

$$S_t = \frac{303}{5440} \times 100 = 6\ \%$$

Manmade Impervious Cover Index (I)

(Population taken from Boro of Medford Lakes and USGS quadrangle.)

Population = 7050 persons

STORCH ENGINEERS

Sheet 4 of 9

Project 1132

Made By JG Date 2/16/79

Birchwood Lake Dam

Chkd By EAW Date Mar. 1, 1979

Population Density (D) = $\frac{7050}{8.5}$ = 829 persons/sq. mi.

$I = 0.117\, D^{(0.792 - 0.039 \log D)}$

From Special Report 38

$I = 11.1\ \%$

STORCH ENGINEERS

Sheet 5 of 9

Project Elrichwood Lake Dam 1132

Made By RL Date 3-7-79

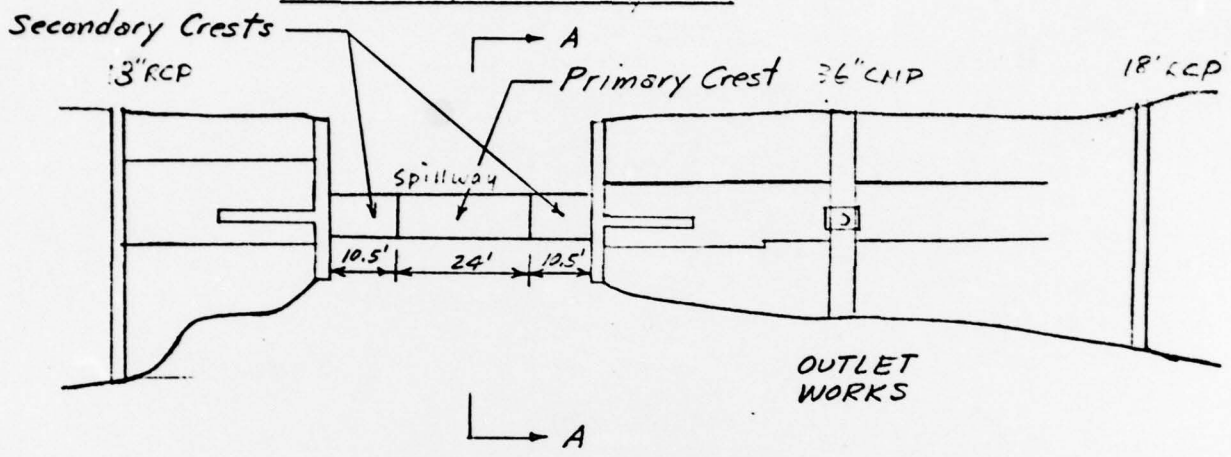
Chkd By JMP Date 3-14-79

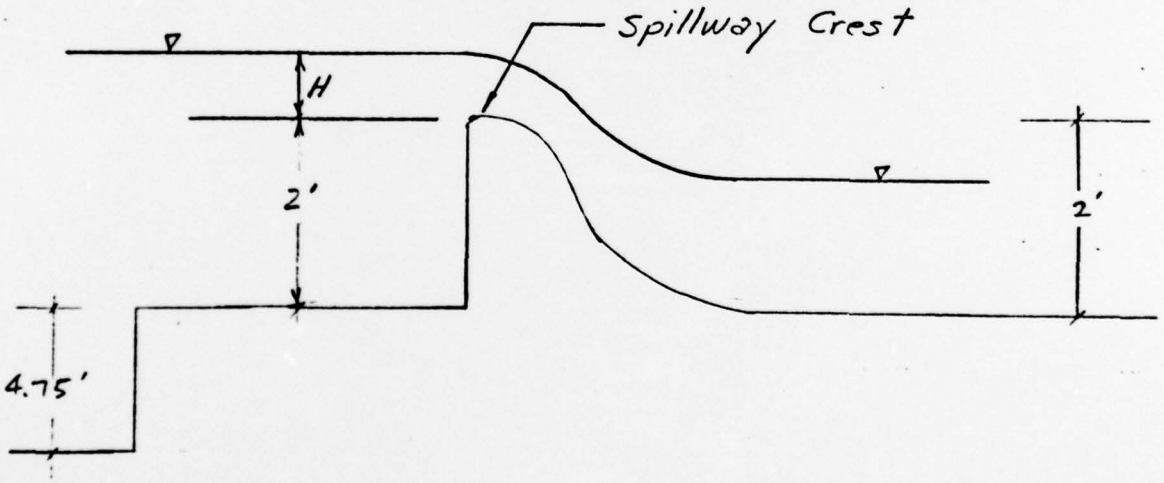
Lake Storage Volume

From USGS & Aerial photos

Stage (ft.)	Surface area (Ac)
36.0	0
43.0	11.0
50.0	58.0

Spillway Discharge





SECTION A-A

SPILLWAY DISCHARGE

Sources: Ogee crest spillway - Design of Small Dams
Auxilliary spillways - Hydraulic Charts for the Selection of Highway Culverts.

Ogee Crest Spillway -

$$Q = CLH^{3/2}$$

$L_1 = 24'$ effective length of primary crest
$L_2 = 21'$ effective length of secondary crest
C_1, C_2 coef. of discharge for L_1, L_2 respectively.

STAGE - DISCHARGE TABULATION

Stage Elev.	Spillway C_1, C_2	Spillway Q (cfs)	Auxiliary Spillway Q (cfs) (Outlet Control)	Total Q (cfs)
42.8	3.6	0	0	0
43.0	3.6	8	0	8
43.5	3.6	77	4	81
44.0	3.6	189	8	197
44.5	3.6	330	14	344
46.5	3.5	1078	30	1108
48.5	2.3	1349	30	1379

STORCH ENGINEERS

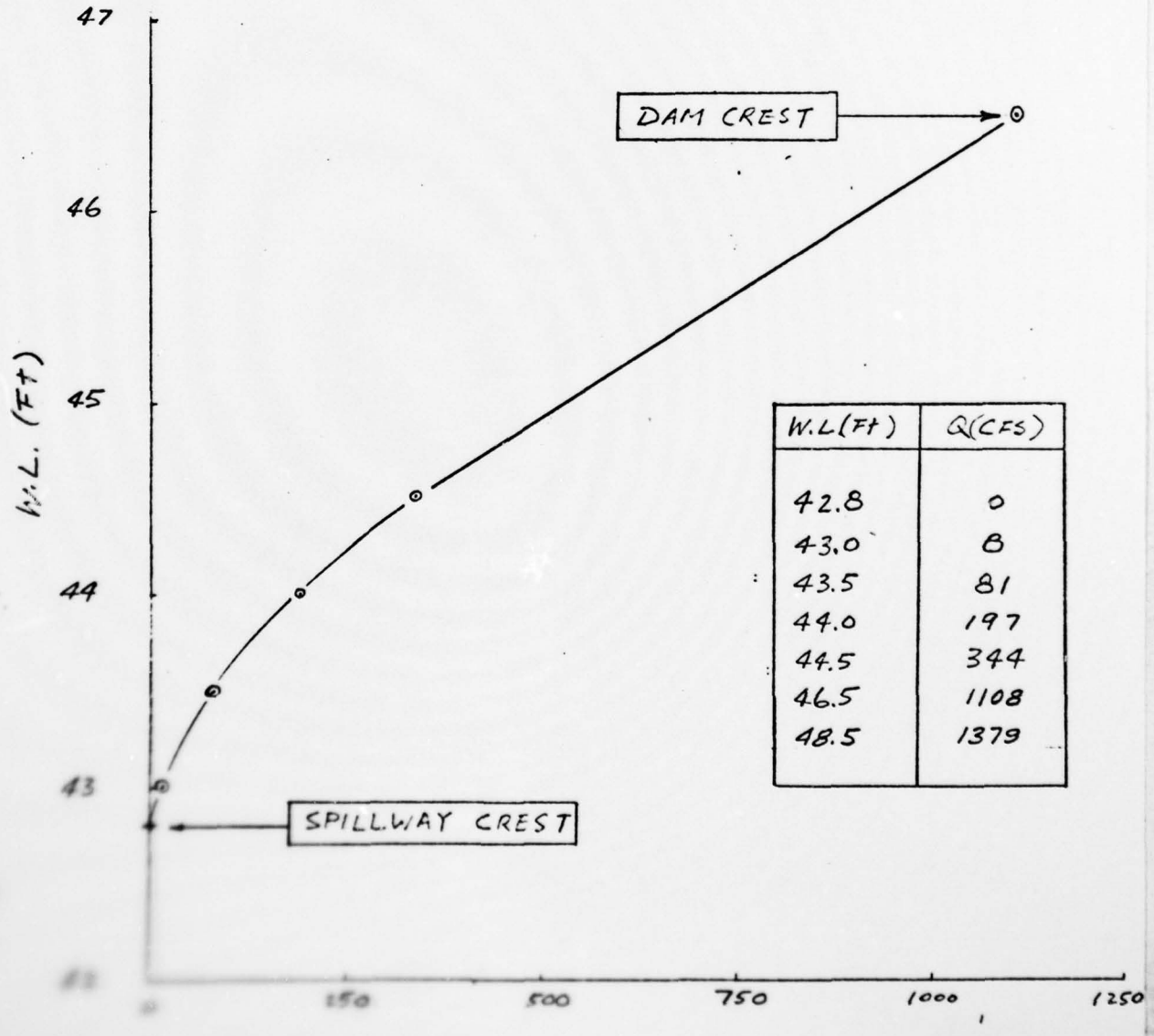
Sheet 8 of 9

Project 1132 Birchwood Lake Dam

Made By RL Date 3-8-79

Chkd By DMP Date 3-14-79

STAGE DISCHARGE CURVE



W.L(Ft)	Q(CFS)
42.8	0
43.0	8
43.5	81
44.0	197
44.5	344
46.5	1108
48.5	1379

STORCH ENGINEERS

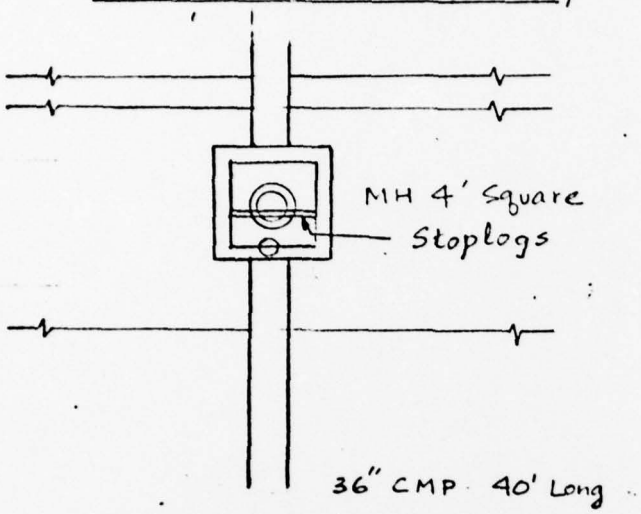
Sheet 9 of 9

Project 1132 Birchwood Lake Dam

Made By RL Date 5-8-79

Chkd By DMP Date 5-14-79

Outlet Work Capacity



HW EL. 43'
TW EL 41'
S_o = 1.8 %
L = 40'

Outlet control

H = 2
L = 40
Ke = 0.5

Q = 50 cfs

From DOT (Hydraulic charts for Highway culverts)

APPENDIX 5

Bibliography

1. "Recommended Guidelines for Safety Inspection of Dams," Department of the Army, Office of the Chief of Engineers, Washington, D. C. 20314.

2. Design of Small Dams, Second Edition, United States Department of the Interior, Bureau of Reclamation, United States Government Printing Office, Washington, 1973.

3. Holman, William W. and Jumikis, Alfreds R., Engineering Soil Survey of New Jersey, Report no. 20, Burlington County, Rutgers University, New Brunswick, N. J. 1953.

4. "Geologic Map of New Jersey" prepared by J. Volney Lewis and Henry B. Kummel, dated 1910 - 1912.

5. Stankowski, Stephen J., Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization, Special Report 38, State of New Jersey Department of Environmental Protecton, Division of Water Resources, 1974.

6. Herr, Lester A., Hydraulic Charts for the Selection of Highway Culverts, U.S. Department of Transportation, Federal Highway Administration, 1965.

7. Safety of Small Dams, Proceedings of the Engineering Foundation Conference, American Society of Civil Engineers, 1974.

8. Plans titled "Proposed Timber Lake Dam No. 2" (2 sheets) prepared by B. Harold Wills, dated October, 1954, revised February 7, 1955.