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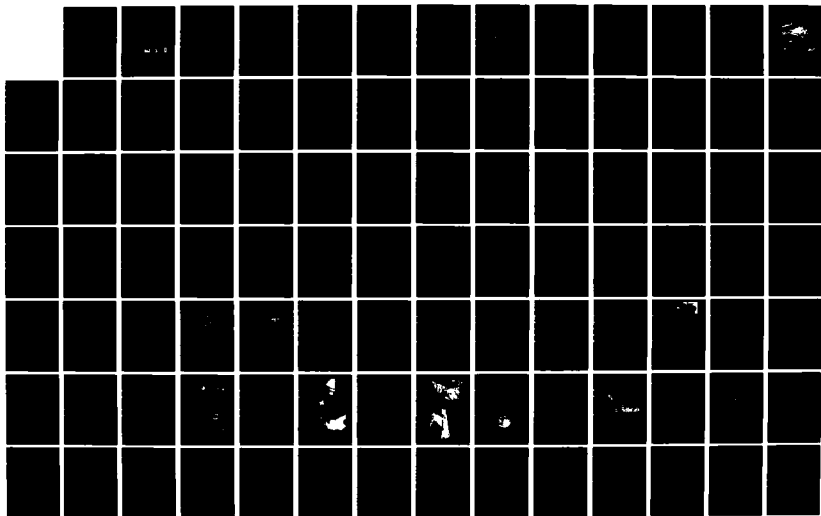
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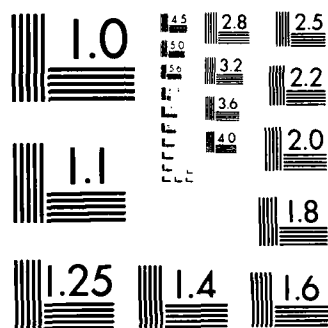
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HOUSATONIC RIVER BASIN
BECKET, MASSACHUSETTS

GREENWATER POND DAM
MA 00204

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Housatonic River Basin Greenwater Brook Becket, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Greenwater Pond Dam is an earth embankment dam, approximately 320 feet long with a maximum hydraulic height of 18 feet. The dam is considered to be in fair condition. Because the dam is classified as intermediate size with a significant hazard potential, the test flood was selected as 50% of the Probable Maximum Flood.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED

JUN 16 1981

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

Inclosed is a copy of the Greenwater Pond Dam (MA-00204) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the owner and the cooperating agency for the Commonwealth of Massachusetts.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for your cooperation in carrying out this program.

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

GREENWATER POND DAM

MA 00204

HOUSATONIC RIVER BASIN
BECKET, MASSACHUSETTS

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: MA 00204
Name of Dam: GREENWATER POND DAM
Town: BECKET
County and State: BERKSHIRE, MASSACHUSETTS
Stream: GREENWATER BROOK
Date of Inspection: 25 NOVEMBER 1980

BRIEF ASSESSMENT

Greenwater Pond Dam is an earth embankment dam, approximately 320 feet long with a maximum hydraulic height of 18 feet. The dam has a top width of approximately 14' and side slopes of approximately 2H:1V. Discharge is over a concrete spillway which has a length of 20 feet. The crest of the concrete spillway is 9' below the top of dam. The normal full pool elevation for the dam is at the top of flashboards which are 6.2 feet below the top of dam. With the flashboards in-place the dam impounds 1750 acre-feet of water. The normal pool surface area is approximately 88 acres. The impoundment is used primarily for recreation. The dam is owned by the Commonwealth of Massachusetts.

There is a 20" outlet conduit which discharges through the downstream spillway wingwall to the stilling pool. Flow through this conduit is controlled by a gate valve in an access manhole on the crest of the embankment. This system is presently inoperable because the conduit is (reportedly) clogged with roots.

Based on engineering judgment and past performance of the dam and outlet works, the project is considered to be in fair condition at the present time. The project does, however, have a number of deficiencies which if not remedied have the potential for developing into serious conditions.

Because the dam is classified as intermediate size with a significant hazard potential, the test flood was selected as 50% of the Probable Maximum Flood ($\frac{1}{2}$ PMF). The $\frac{1}{2}$ PMF inflow for Greenwater Pond Dam having a drainage area of 1.8 square miles was estimated to be 2300 cfs. With the flashboards in-place the routed test flood outflow would be approximately 850 cfs with an elevation of approximately 0.3' below the top of dam. The spillway capacity with the flashboards in place is 890 cfs at top of dam elevation. This is 105% of the routed test flood outflow.

An evaluation was made of the capability of the spillway to pass the PMF without the flashboards in place. The PMF inflow was determined to be 4600 cfs. The routed PMF outflow was determined to be 2200 cfs at an elevation of approximately 0.7' above the top of dam. The spillway capacity at top of dam elevation without flashboards in-place is approximately 1500 cfs which is 68% of the routed PMF outflow.

The discharge capacity of the 20" outlet conduit with water at top of dam is estimated to be approximately 32 cfs or less than 4% of the test flood outflow.

Greenwater Pond Dam

A major breach of the dam could potentially result in the loss of a few lives and damage to roads and bridges.

A number of recommendations are given in Section 7.2 for implementation by the owner. These recommendations should be implemented within 12 months of receipt of this Phase I Inspection Report except as otherwise noted.

These recommendations in general are as follows:

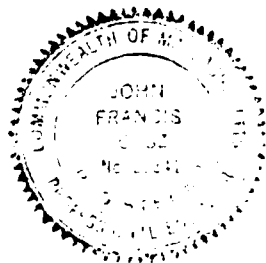
The owner should retain a qualified Registered Professional Engineer to:

- Design repairs to the concrete spillway wingwalls including the crack and seepage under the 20" outlet in the northerly spillway wall.
- Design repairs for the inoperable draw-down conduit.
- Design procedures and supervise the removal of all trees on both upstream and downstream slopes of the embankment and for a distance of at least 25' downstream of the toe of the embankments.
- Investigate the sink hole at the crest of the northerly upstream embankment in order to determine if this is associated with seepage in the access manhole or along the draw-down conduit.
- Design repairs to the spillway bridge. This should be done immediately upon receipt of this report.
- Design repairs to the areas of settlement between the embankment and the top of the spillway walls, particularly for the wingwalls at the downstream toe.

The owner should carry out all the recommendations made by the engineer.

In addition, the owner should also implement the recommended remedial program including the removal of all brush on the embankment slopes, control of the population of burrowing animals on the dam, filling of existing animal burrows, repair of the wheel marks in the crest, and augmentation of the riprap on the upstream embankment slope and on the side slopes of the stilling basin. In addition, the remains of the trash rack and timber walkway should be removed since they now constitute an obstruction to spillway flow.

Formal written programs should be established for operation and maintenance and for surveillance and downstream warning. A qualified Registered Professional Engineer should be engaged to make a comprehensive annual technical inspection of the dam.



John F. Cysz
Project Manager
P.E. MA No. 28841

A handwritten signature in cursive script that reads "John F. Cysz".

Greenwater Pond Dam

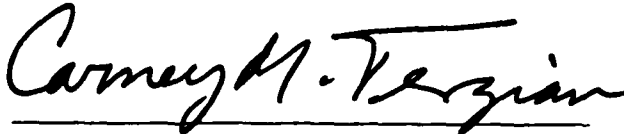
This Phase I Inspection Report on Greenwater Pond Dam (MA-00204) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.



JOSEPH W. FINEGAN, JR. MEMBER
Water Control Branch
Engineering Division

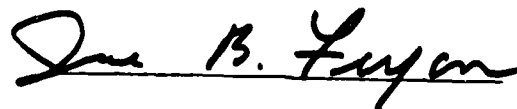


ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division



CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

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. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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INVENTORY OF DAMS



OVERVIEW OF GREENWATER POND DAM

spillway walls meet the spillway floor. The flashboard slots in the spillway walls are 3" deep. There is some recent metal work repair at the southerly flashboard slot. There is no metal on the slot on the northerly side. It appears that recent attempts were also made to patch the concrete at the southerly flashboard slot (see Photograph 10, Appendix C). There is minor leakage around the base of the first flashboard at the southerly wingwall.

c. Appurtenant Structures

There is a 20" cast iron conduit which has a submerged inlet upstream of the northerly embankment and discharges through the downstream northerly spillway wingwall into the stilling basin. The 1944 plans show the inlet structure to be in a stone filled timber crib with a trash rack. This feature was not visible during the inspection.

The downstream end of the 20" conduit is encased in a concrete yoke at the spillway wingwall (see Photograph 6, Appendix C). There is cracking around this yoke. There is a crack that goes up the upstream side and across the top of the wingwall. There is another large crack underneath the conduit. Seepage is coming from this crack on the order of 1 to 2 gallons per minute. The seepage appears clear; however, the area is characterized by a bright orange stain.

Flow through the outlet conduit is controlled by a 20" single gate valve in a mortared brick manhole located on the crest of the embankment approximately 16' north of the spillway. The manhole appears to be in good condition with no seepage noted in the sides above the water level at the bottom. The source of the water in the manhole is not known. There was water in the manhole 12.8' below the rim, approximately 1½ feet deep, at the time of the inspection. The inside diameter of the manhole at the bottom is 4'. There are no apparent cracks in the manhole. There is heavy rust scale on the ladder rungs but they appear sound. The manhole has a heavy cast iron frame and cover, which is in good condition (see Photograph 12, Appendix C). It has been reported by the owner that roots from the willow trees on the upstream face of the northerly embankment have penetrated and clogged the outlet conduit upstream of the gate valve.

d. Reservoir Area

Greenwater Pond has a normal pool surface of 88 acres. It is primarily used for recreation. There are several structures around the lake which may be affected by high water surface elevations. There are no unstable slopes upstream of the dam which would cause any adverse effects.

e. Downstream Channel

Discharge from the damsite flows into Greenwater Brook through a wetland (approximately 40 acres) immediately downstream from the damsite, and then under the Massachusetts Turnpike approximately 6,000 feet downstream from the damsite. Beyond this, Greenwater Brook flows under Route 20 approximately 8,500 feet from the dam. There is a 34-foot wide by 10½-foot high bridge at Chestnut Street approximately 13,000 feet from the dam and a 32-foot wide by 9-foot high bridge at Route 20 approximately 16,000 feet downstream of the dam. The bridge at Chestnut Street was rebuilt in 1970.

Greenwater Brook passes through the village of East Lee and enters the Housatonic River approximately 4.9 miles from the damsite.

There is no evidence of seepage at the downstream toes of the embankments. However, the embankments appear to tie into natural ground on the downstream side at a level several feet higher than the water level in the pond. There is an 8" depression at the crest of the upstream slope of the northerly embankment approximately 7' from the control manhole. This appears to line up with the manhole, the outlet conduit, and the upstream inlet (see Photograph 14, Appendix C).

The overall condition of the concrete spillway works is fair. The embankments behind the spillway walls appear to have settled up to 6". There are small saplings growing just behind the spillway walls, a large tree growing and a smaller tree (8" dbh) growing just behind the upstream wingwall on the northerly embankment.

There is a small crack across the top of the northerly downstream spillway wall. This crack continues down the face of the wall and shows efflorescence (see Photograph 8, Appendix C). There is a large crack underneath the 20" outlet conduit on the northerly spillway wingwall with a rust colored leachate seeping from the crack (see Photograph 6, Appendix C). There is a large diagonal crack at the corner of the southerly downstream spillway wingwall. The cracked wingwall is displaced vertically approximately 1". It appears that surface water flowing down the slope collects in this area. This condition plus frost action may be responsible for cracking the wingwall and pushing it out of plumb (see Photograph 9, Appendix C).

The approach channel to the spillway is in satisfactory condition with the exception of the deteriorated trash rack and walkway which presently act as an obstruction to the spillway flow (see Photographs 4 and 10, Appendix C).

A stilling basin is formed downstream of the spillway chute by a 2' high concrete baffle with an 8" x 8" hole in the center. The channel is eroded on both sides of the stilling basin and baffle. The downstream channel walls beyond the stilling basin are steep but appear stable. There are trees and brush growing from the channel walls, some of which have fallen into the stream (see Photograph 7, Appendix C). There is no loose rock overhanging the downstream channel.

There are three sections of flashboards, approximately 7' on center. The total flashboard height is 32" with each board being 8" high x 3" wide. At the time of inspection the top three boards were removed on the right side of the spillway. The flashboard supports are steel H-beams, 4" wide x 4" deep. They are 42" tall (see Photographs 2 and 10, Appendix C).

The spillway bridge is built with wood stringers, 14" deep x 4" wide. These stringers rest on concrete masonry block which in turn rest on a seat in the spillway walls. These concrete masonry blocks are 5" high and some are broken. The bridge seat is 12" wide and has accumulated soil and debris. The seven wood stringers show evidence of decay where they rest on the concrete blocks. There appear to be some old anchor bolts on the bridge seat which are not being used. There are four stringers which are cracked near mid-span and one is deflected downward about 1".

The spillway approach channel has a concrete floor which is covered with a thin layer of silt and leaves. There is some erosion of the concrete where the

SECTION 3 VISUAL INSPECTION

3.1 FINDINGS

a. General

Greenwater Pond Dam was inspected on November 25, 1980. The weather was overcast and there was slight dusting of snow on the ground.

At the time of inspection the upper three flashboards had been removed for 1/3 of the spillway length and the water surface elevation was approximately 2 feet below normal pool level.

b. Dam

The general layout of the dam with inspection notes is shown in Appendix B. Photographs showing features and conditions are included in Appendix C.

The dam consists of an earthen embankment with a concrete spillway to the north of the center. There is a wooden bridge across the top of the spillway. There are several large willow trees growing on the upstream slope of the embankment just above the normal pool elevation. There is a wave bench on the upstream face at normal pool elevation which has, in some instances, undermined the root system of the willow trees. The stone slope paving, as shown on the 1944 plans, has been displaced in some areas (see Photographs 1,3,4 & 11; Appendix C).

There are wheel ruts across the crest of the embankment (see Photograph 3, Appendix C). These appear to be somewhat deeper on the southerly side, having a maximum depth of approximately 6". There is a large tree on the crest of the southerly embankment approximately 5' from the spillway wall (see Photograph 2, Appendix C).

The downstream slope of the northerly embankment is grassed and free of brush with the exception of a few small trees, one of which is just behind the spillway wall (see Photograph 5, Appendix C). There is brush and several small maple trees on the northerly embankment of the downstream channel at the abutment with the dam embankment.

The downstream slope of the southerly embankment is overgrown with small pines and other saplings and brush. There is an erosion rill which is approximately 4" to 6" deep running down the southerly downstream embankment slope (see Photograph 13, Appendix C). There are several small saplings growing on the downstream embankment just behind the southerly spillway wall. Two animal burrows were noted at the downstream toe of the southerly embankment; one has a large depression surrounding it. Several large holes were noted between the riprap units at approximately normal pool elevation in the upstream slope of the southerly embankment.

There is a general settlement of the embankments behind the upstream and downstream spillway wingwalls. There is a large void behind the southerly downstream spillway wingwall and it appears that surface water flowing down the slope collects in this area. Surface erosion appears to be undermining the downstream end of both spillway wingwalls. Riprap has been placed behind the edges of the wingwalls to prevent this; however it needs to be augmented (see Photographs 6 and 9, Appendix C).

c. Validity

The dam as it presently exists appears to conform to the 1944 plans except for subsequent repairs to the wooden bridge.

SECTION 2 ENGINEERING DATA

2.1 DESIGN DATA

No design data for the original construction were available for Greenwater Pond Dam. Early maps of the Town of Lee filed in the state archives indicate that a dam probably existed on Greenwater Pond as early as 1795.

The dam as it now exists is the product of repairs and improvements made to an old dam over the years. An Inspection Report was prepared for the Berkshire County Commissioners in 1922 by Harry W. Heaphy, Civil Engineer of Lee, MA. Another report was prepared after the 1927 flood and recommended that a spillway be constructed. This was completed in 1928 on the orders of the County Commissioners. Plans and outline specifications for repairs and improvements were prepared by Viele, Blackwell & Buck, Engineers, 49 Wall Street, New York, NY. These plans were approved by the County Commissioners on September 10, 1929. All the above reports and plans, together with related correspondence, are on file at the offices of the Berkshire County Commissioners and Berkshire County Engineers, Berkshire County Courthouse, Pittsfield, MA.

Plans were prepared in 1944 by the Commonwealth of Massachusetts Division of Waterways. The plans include construction of a new concrete spillway with flashboards and trash rack; and raising the top of the dam about 2 feet. Copies of the plans are available at the County Engineers and also from the Division of Waterways, 100 Nashua Street, Boston, MA. No other design data is available for any of the above work.

2.2 CONSTRUCTION DATA

1929 and 1944 construction plans are available from the County Engineer. There is also some correspondence regarding repairs in the County Engineers' records. The 1944 plans call for gravel backfill behind the spillway walls.

2.3 OPERATION DATA

Maintenance of the flashboards for the dam has unofficially been assumed by the Greenwater Pond Association. The Association maintains an informal watch on the water level of the pond during heavy storms. Flashboards are removed in the fall and reinstalled in the spring. The trash rack is cleaned each spring. There is no written operation and maintenance plan for Greenwater Pond.

2.4 EVALUATION OF DATA

a. Availability

A search of files of the Berkshire County Commissioners and Massachusetts Department of Public Works revealed a 1922 report and 1929 and 1944 repair plans together with correspondence. Copies and portions are included in Appendix B. Copies of previous inspection reports and sketches prepared by the Massachusetts Department of Public Works are included in Appendix B.

b. Adequacy

The final assessments and recommendations of this investigation are based on the visual inspection and the hydrologic and hydraulic calculations.

- (6) Zoning - unknown.
 - (7) Impervious Core - earth fill only; fill materials not known.
 - (8) Cutoff - unknown.
 - (9) Grout Curtain - unknown, none shown on 1944 plans.
 - (10) Other - bridge over spillway, wood planks on wood stringers.
- h. Diversion and Regulating Tunnel - not applicable (see j).
- i. Spillway
- (1) Type - concrete with wood plank flashboards.
 - (2) Length of Weir - 20 feet.
 - (3) Crest Elevation - 1376.2 NGVD without flashboards,
1379.0 NGVD with 32" high flashboards.
 - (4) Gates - none on spillway.
 - (5) U/S Channel - Greenwater Pond.
 - (6) D/S Channel - 20 feet wide concrete spillway chute with stilling basin and end baffle, discharges to natural channel of Greenwater Brook, 4.9 miles upstream from the confluence with the Housatonic River.
- j. Regulating Outlets
- (1) Invert - 20" conduit inlet - 1372.3 NGVD, outlet 1369.3 NGVD.
 - (2) Size - 20" outlet.
 - (3) Description - 20" C.I. pipe outlet, approximately 90' long. Inlet is located beneath reservoir, approximately 40' upstream from the control manhole located on the embankment crest. Discharge is through northerly downstream spillway wingwall into stilling basin. This outlet is reportedly plugged by willow roots.
 - (4) Control Mechanism - 20" outlet is controlled by a gate valve operated by hand wheel in brick manhole on embankment crest.

- (5) Full Flood Control Pool - not applicable.
 - (6) Spillway Crest - 1376.2 (without flashboards), 1379.0 (with flashboards).
 - (7) Design Surcharge (Original Design) - not known.
 - (8) Top of Dam - 1385.2.
 - (9) $\frac{1}{2}$ PMF Test Flood Surcharge - 1384.9 (with flashboards).
- d. Reservoir (length in feet)
- (1) Normal Pool - 4800.
 - (2) Flood Control Pool - not applicable.
 - (3) Spillway Crest Pool - 4750.
 - (4) Top of Dam - 4900.
 - (5) Test Flood Pool - 4900.
- e. Storage (acre-feet)
- (1) Normal Pool - 1750 (includes volume of natural pond).
 - (2) Flood Control Pool - not applicable.
 - (3) Spillway Crest Pool - 1350.
 - (4) Top of Dam - 2350 at 1385.2 NGVD.
 - (5) Test Flood Pool - 2320 at 1384.9 NGVD.
- f. Reservoir Surface (acres)
- (1) Normal Pool - 88.
 - (2) Flood Control Pool - not applicable.
 - (3) Spillway Crest Pool - 81.
 - (4) Top of Dam - 95 at 1385.2.
 - (5) Test Flood Pool - 94 at 1384.9 NGVD.
- g. Dam (no dike)
- (1) Type - earth embankment.
 - (2) Length - 320 feet.
 - (3) Height - 18 feet from top of dam to floor of stilling pool.
 - (4) Top Width - 14 feet.
 - (5) Side Slopes - upstream 2H:1V; downstream 2H:1V

boards in-place. During the winter, three of the flashboards are removed for 1/3 of the spillway length. Additional discharge is through a 20" C.I. pipe outletting through the northerly spillway wingwall at the stilling basin. The invert elevation of the inlet to this conduit is shown as approximately 1372.3 NGVD on the 1944 plans. Flow through the 20" conduit is controlled by a 20" gate valve with a hand wheel in a 4' diameter mortared brick manhole located on the crest of the embankment.

The normal pool (flashboard) elevation is assumed to be 1379.0 NGVD from USGS Quadrangle. The spillway crest elevation is 1376.2 NGVD. The top of dam elevation is 1385.2 NGVD. There is no emergency spillway.

- (1) Outlet Works - emergency use only - one 20-inch conduit at elevation 1372.3 NGVD; discharge capacity 32 cfs at 1385 NGVD. (Reported to be inoperable at present.)
 - (2) Maximum Flood at Damsite - unknown. Water was approximately 6"-7" over the top of dam in 1938, but reportedly the dam was sandbagged and was not over washed. This was before the present spillway was constructed.
 - (3) Ungated Spillway Capacity at Top of Dam - 890 cfs at 1385.2 NGVD (with flashboards).
 - (4) Ungated Spillway Capacity at Test Flood Elevation - 825 cfs at 1384.9 NGVD.
 - (5) Gated Spillway Capacity at Normal Pool Elevation - not applicable.
 - (6) Gated Spillway Capacity at Test Flood Elevation - not applicable.
 - (7) Total Spillway Capacity at Test Flood Elevation (with 32" flashboards) - 825 cfs at 1384.9 NGVD.
 - (8) Total Project Discharge at Top of Dam - 920 cfs at 1385.2 NGVD. (Spillway with 32" flashboards and 20" outlet.)
 - (9) Total Project Discharge at $\frac{1}{2}$ PMF Test Flood Elevation - 850 cfs at 1384.9 NGVD.
- c. Elevation (Datum is feet above mean sea level NGVD.
Top of flashboards assumed to be 1379 NGVD)
- (1) Streambed at Toe of Dam - 1367.2 (at floor of stilling pool).
 - (2) Bottom of Cutoff - unknown.
 - (3) Maximum Tailwater - unknown.
 - (4) Normal Pool - 1379 according to USGS Quadrangle.

in 1976 and has not been replaced. Beginning in 1972, the Greenwater Pond Association, comprised of owners of lakefront cottages, took upon itself to maintain the flashboards at the dam.

The Association regulates the water level by removing three of the four flashboards in one bay of the spillway, drawing down the water level two feet over a period of about a month starting after Labor Day. The process is reversed in the spring after the ice comes off the pond. The Association also cleans the trash rack of accumulated debris in the early spring. They do not operate the 20-inch conduit.

The 20" gate valve controlling the low-level discharge pipe is normally closed and is reported to be inoperable at the present time. No exercising of the valve is performed.

The Association maintains an informal watch on the water level of the pond during heavy storms, primarily out of concern about lakefront flood damage. Reportedly, the water level has not risen high enough in the past eight years for the association to attempt to remove flashboards or open the gate.

There is no formal emergency preparedness or warning system in effect.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area contributing to Greenwater Pond is 1.8 square miles. The drainage area is oriented with its long axis in a northwesterly direction and has a length of approximately 1.8 miles and an average width of approximately 1 mile. The entire watershed lies in the Town of Becket. The drainage area is drained by several unnamed streams flowing southerly from October Mountain State Forest and northerly from an unnamed hill south of the Massachusetts Turnpike.

The drainage area is located on the upper fringe of the Housatonic River watershed at the divide with the Farmington River watershed. Most of the drainage area is wooded. The area immediately surrounding the northerly shore of Greenwater Pond is moderately developed with vacation homes. The remainder is undeveloped. The Massachusetts Turnpike runs along the southerly shore. Approximately 20% of the drainage area lies within October Mountain State Forest. The Appalachian Trail runs through the northwesterly end of the drainage area.

Topography within the drainage area is generally steep, mountainous terrain. Elevations vary from 1379 at the Pond to 2180 at Becket Mountain. The Greenwater Pond area appears to lie within a belt of gneiss forming a valley of the Pre-Cambrian core of the Berkshire Plateau. There is no soils data available for the actual damsite.

There are no other significant water bodies or wetlands in the drainage area. Greenwater Pond has a normal surface area of 88 acres which is about 7 percent of the total drainage area.

b. Discharge at Damsite

Discharge at the damsite is over the 20-foot long concrete spillway. The normal pool water surface elevation is maintained with four 8" high flash-

The dam as it now exists is the product of repairs and modifications of a previous dam. The present dam generally conforms to plans dated 1944. A 1922 report and 1928 plans for repairs on file at the Berkshire County Engineer's office described the previous dam as being 26' wide on top, with a dry laid stone retaining wall on the downstream face, battered 5" in 12", about 18' high at the stream, and an earth embankment on the upstream sloped about $\frac{3}{4}$ H to 1V. There was no spillway. The water level was controlled by a gate on a 20" diameter cast iron pipe through the dam.

In 1928, a 14' long spillway was constructed near the middle of the embankment, upon the orders of the Berkshire County Commissioners. In 1929, plans for additional repairs and improvements were prepared by Viele, Blackwell & Buck, Engineers, 49 Wall Street, New York, NY. Material attached to the plans indicates the concrete spillway was designed to have a capacity of 140 cfs with 2 feet of water flowing and 8" of freeboard. The 20" discharge pipe was calculated to have a capacity of 35 cfs at the same water elevation.

New earth fill was placed against the downstream face at a slope of 2H:1V. New clay fill was placed against the upstream face at a slope of $2\frac{1}{2}$ H:1V. The 20" CIP discharge pipe was extended through the new fill and a new rock-filled timber crib inlet structure with a sluice gate operated from a floor stand mounted on a wooden bridge was constructed. Willow trees on top of the dam were cut off but the roots were left in-place. This work was completed and approved by the County Commissioners in October 1929.

The September 21-22, 1938 flood raised the water level behind the dam to about 6" or 7" over the top of the dam. The dam was sandbagged, however, and negligible damage to the dam was reported. The same flood washed out the downstream dam used by the owners for electric power generation, thereby eliminating the usefulness of Greenwater Pond Dam for storage and regulating of water power supply.

In 1944, the Commonwealth of Massachusetts made a taking of the dam and an easement for access to the dam. Plans were prepared in 1944 by the Commonwealth of Massachusetts Division of Waterways for construction of a new concrete spillway with flashboards and trash rack. The plan also included raising the top of the dam by about 2 feet. The 1928 concrete spillway was filled in and stone slope paving was constructed on the upstream face at a slope of 2H:1V. A gravel driveway 10' wide was constructed on top of the dam, which included a 14 feet wide bridge at the spillway. The former sluice gate control was replaced by a 20" gate valve in a new manhole in the top of the dam. The outlet of the discharge pipe was also relocated to exit at the downstream wingwall for the spillway.

In 1957, repairs were made to the spillway consisting of a new trash rack, walkway, flashboards, planking and railing on the bridge. In 1964, repairs consisted of new bridge planking, wheel guards, and railings on the bridge. The trash rack walkway support posts were also replaced. Additional maintenance and repairs were recommended in subsequent county and state inspection reports. In 1980, the Greenwater Pond Association purchased and installed new flashboards and repaired the flashboard slots.

i. Normal Operation Procedures

There is presently no caretaker assigned and responsibility of day-to-day operation of the dam. The last caretaker employed by the owner resigned

c. Size Classification

Intermediate (hydraulic height 18 feet; storage 2350 acre-feet) based on storage (greater than 1000 acre-feet) criteria specified in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The dam is in a significant hazard category because a major breach of the dam could cause the loss of a few lives and damage to downstream roads and bridges. (See Section 5.5.)

e. Ownership

The dam was previously owned by Lake May Power Company of Lee, Mass. The dam is currently owned by:

The Commonwealth of Massachusetts
Division of Land and Water Use
100 Nashua Street
Boston, MA 02114
Tel: (617) 727-4797

The dam and an easement for access were taken by the Commonwealth in 1944. The Appalachian Trail passes along the crest of the dam.

f. Operator

There is presently no caretaker assigned the responsibility of day-to-day operation of the dam. The last caretaker, Mr. Robert Plankey, resigned in 1976. A previous caretaker, James V. Costello, had lived adjacent to the dam until his death about 1971. Beginning in 1972, the Greenwater Pond Association, comprised of owners of lakefront cottages, took upon itself the maintenance of the flashboards. This has included seasonally removing and replacing the flashboards to regulate the water level. The principal member of the Association involved in operation is:

Gerald H. Le Prevost
310 East Center Street
Lee, MA 01238
Tel: (office) (413) 243-0690
(home) (413) 243-2490
(cottage at lake) (413) 243-2577

g. Purpose of Dam

Greenwater Pond Dam impounds Greenwater Pond which is used primarily for recreation. The lakeshore is moderately developed with vacation homes and cottages. The Commonwealth of Massachusetts attributes some flood control benefit to the impoundment. Until 1938, it was used as a storage and regulating reservoir for a low-head hydro-power generating station owned by the Lake May Power Company several miles downstream.

h. Design and Construction History

The original date of construction of the dam is not definitely known. One report states the dam was built prior to 1860. Early maps of the Town of Lee filed in the state archives indicate that a dam probably existed on Greenwater Pond as early as 1795. A Massachusetts Department of Public Works survey in November 1922 determined that the natural pond would cover an area of about 60 acres. The present impoundment covers 88 acres.

The dam as it then existed was 26' wide on top and had a dry laid stone retaining wall on the downstream face. There was an earth embankment on the upstream face which had a slope of $\frac{1}{2}$ H:1V. 1929 repairs included addition of earth fill against the downstream face at the slope of 2H:1V and clay fill against the upstream face at a slope of 2.5H:1V. No evidence of the dry stone wall was noted during the visual inspection.

There are three sections of flashboards, approximately 7' on center. The total flashboard height is 32" with each board being 8" high x 3" wide. The flashboards are new oak planks. At the time of inspection the top three flashboards were removed on the right side of the spillway. The flashboard supports are embedded steel H-beams, 4" wide x 4" deep with a height of 42". The flashboards slots at the spillway walls are 3" deep. There is a deteriorated wooden trash rack with a walkway across the approach channel approximately 10' upstream from the flashboards.

The spillway and discharge chute have a reinforced concrete floor and unreinforced concrete sidewalls. The concrete spillway walls are mass concrete, gravity type with a 1:24 batter on the exposed side. The spillway walls have gravel backfill. The plans show a 12" wide x 12" deep screened gravel trench under the centerline of the spillway and stilling basin floor. The concrete spillway walls have 6.5' long wingwalls with a 40° flare at the downstream end of the spillway chute.

There is a 30' long x 20' wide stilling basin at the downstream end of the spillway chute. The stilling basin has a reinforced concrete slab floor with 3" relief holes and a 2' high reinforced concrete baffle at the end. There is a 3' deep concrete cutoff wall beneath the baffle. According to the 1944 plans the sides of the stilling basin are paved with 12" thickness riprap on a 2H:1V slope. The visual inspection revealed this riprap to be largely displaced and overgrown.

There is an 11' wide wood plank bridge across the spillway. This bridge is built on 7 wood stringers which are 14" deep x 4" wide. The stringers are resting on concrete masonry blocks on the bridge seat which is 12" wide in the spillway walls.

There is a 20" cast iron pond drain which discharges through the northerly downstream wingwall into the stilling basin. Flow through this pipe is controlled by a gate valve in a 4' diameter mortared brick access manhole located on the crest of the embankment approximately 16' north of the northerly spillway wall. The 1944 plans show the inlet to be in a stone filled timber crib box with a trash rack.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
GREENWATER POND DAM
SECTION I - 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 inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising Inspection of Dams within the New England region. Robert G. Brown & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts and State of Vermont. Authorization and notice to proceed were issued to Robert G. Brown & Associates, Inc. under a letter of 23 October 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract Number DACW33-81-C-0004 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

- (1) To perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten public safety and thus permit correction in a timely manner by non-Federal interests.
- (2) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.
- (3) To update, verify and complete the National Inventory of Dams.

1.2 DESCRIPTION OF PROJECT

a. Location

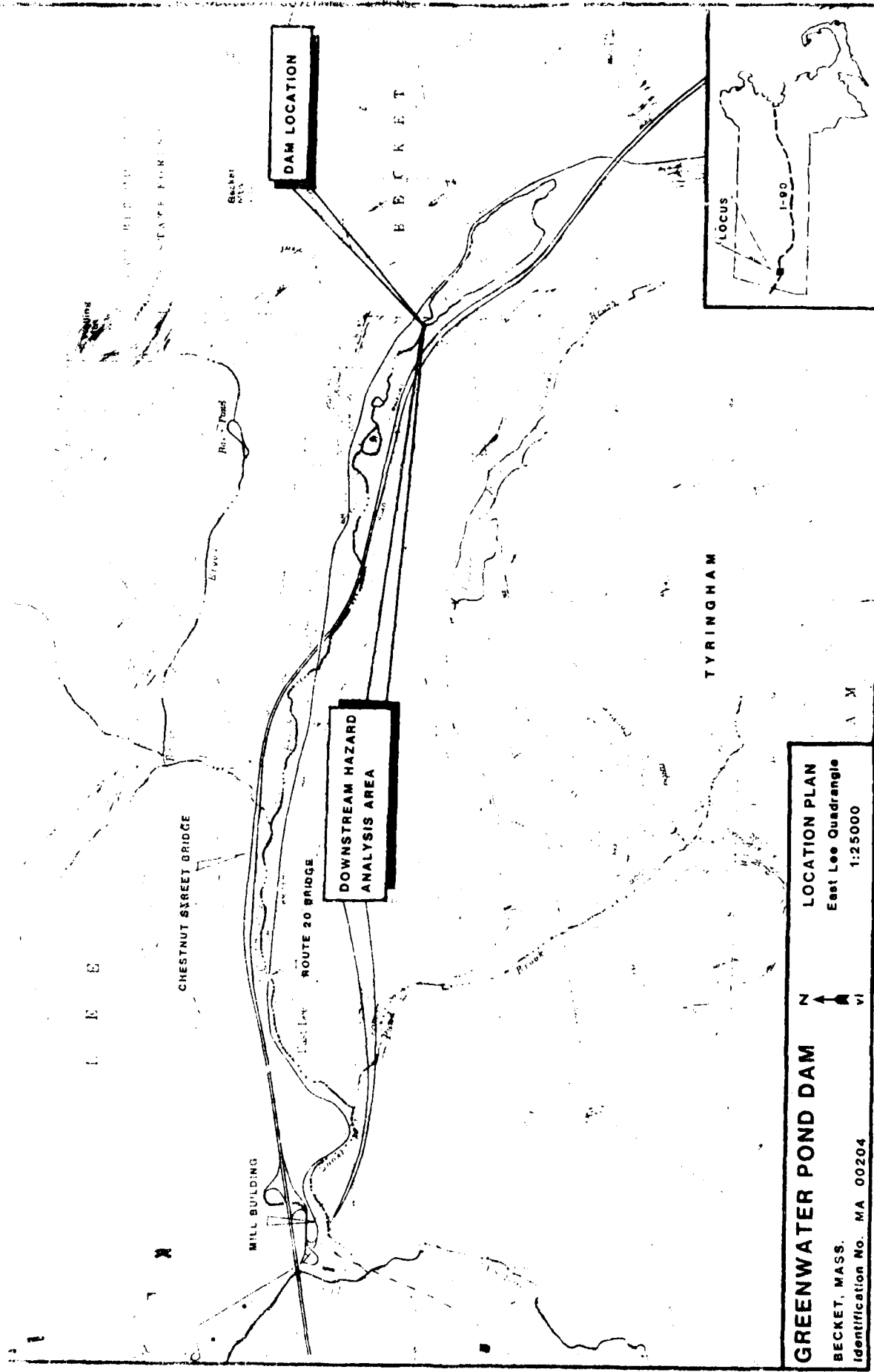
Greenwater Pond Dam is located in the Town of Becket, Massachusetts. The dam is on Greenwater Brook approximately 4.9 miles upstream from the brook's confluence with the Housatonic River. The dam impounds Greenwater Pond which is used primarily for recreation. Greenwater Pond Dam is shown on the USGS East Lee, Mass. quadrangle at latitude 42° 17.4' and longitude 73° 09.4'. Access to the damsite is from Route 20.

b. Description of Dam and Appurtenances

Greenwater Pond Dam is an earth fill dam, approximately 320 feet long, with a maximum hydraulic height of 18 feet, measured from the top of the dam to the stream channel at the outlet. The top of the dam has a width of about 14 feet and carries a gravel driveway 10' wide across the dam. This driveway is part of the Appalachian Trail (see Overview Photograph).

There is a 220' long embankment to the south of the spillway and an 80' long embankment to the north of the spillway which blends into a cut slope on the north shore.

The downstream slopes of the embankments are vegetated and have a slope of 2H:1V. The upstream slopes of the embankments are protected with stone slope paving (although this is largely overgrown and displaced) to the crest and have a slope of 2H:1V.



GREENWATER POND DAM
BECKET, MASS.
Identification No. MA 00204

LOCATION PLAN
East Lee Quadrangle
1:25000

3.2 EVALUATION

Based on the visual inspection, the Greenwater Pond Dam appears to be in fair condition overall. The investigation did reveal several deficiencies which require attention and should be corrected before further deterioration leads to a hazardous condition. Recommended measures to improve these conditions are given in Section 7. The major deficiencies noted during the investigation are, in general:

- a. Several large willow trees on the upstream face of the embankment and smaller trees and brush on the downstream face of the embankment and abutments; and in particular directly behind the spillway walls.
- b. The inoperative drawdown conduit which is reportedly clogged by roots from the large willow tree adjacent to it.
- c. The seepage through the downstream northerly spillway wingwall directly beneath the outlet conduit. This could be related to seepage behind the spillway walls and/or along the conduit.
- c. The cracks and displacement of the spillway wingwalls.
- d. The deteriorated condition of the spillway bridge.
- e. The remains of the trash rack and walkway which are creating a potential obstruction to the spillway.
- f. The erosion around both sides of the stilling basin end baffle.
- g. The general settlement of the embankment behind the spillway walls.
- h. The wheel tracks on the crest of the embankment, the erosion gully on the downstream face of the southerly embankment, and the animal burrows at the upstream and downstream toe of the southerly embankment.
- i. The need to augment the riprap on the upstream face of the embankment, at the abutments of the stilling pool weir, and at the downstream wingwalls of the spillway.
- j. The depression at the crest of the northerly upstream embankment should be investigated to determine whether this is in fact associated with seepage in the access manhole or along the outlet conduit. This depression was not noted in previous inspections.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General

Operational procedures for the project are not formally established but are based on the experience of the operating personnel. The dam is currently owned by the Commonwealth of Massachusetts, Division of Land and Water Use, 100 Nashua Street, Boston, MA.

There is presently no caretaker assigned the responsibility of day-to-day operation of the dam. The last caretaker, Mr. Robert Plankey, resigned in 1976. A previous caretaker, James V. Costello, lived adjacent to the dam until his death about 1971. Beginning in 1972, the Greenwater Pond Association, comprised of owners of lakefront cottages, took upon itself the maintenance of the flashboards. This has included seasonally removing and replacing the flashboards to regulate the water level. The Association does not operate the 20" conduit.

b. Description of any Warning System in Effect

There is no written surveillance or warning system in effect.

The Greenwater Pond Association maintains an informal watch on the water level of the pond during heavy storms, primarily out of concern about lakefront flooding damage.

4.2 MAINTENANCE PROCEDURES

a. General

There is no formal maintenance manual for the project. The Greenwater Pond Association regulates the pond level twice yearly by removing/replacing flashboards and cleans the trash racks each spring.

b. Operating Facilities

In 1957, repairs were made by the Commonwealth of Massachusetts to the spillway. The repairs consisted of a new trash rack, walkway, flashboards, planking and railing on the bridge. In 1964, repairs consisted of new bridge planking, wheel guards and railings on the bridge. The 4" x 4" trash rack walkway support posts were also replaced.

Maintenance and repairs have been recommended in previous County and State inspection reports (see copies of reports in Appendix B). In 1980, the Greenwater Pond Association purchased and installed new flashboards and repaired the flashboard slots.

4.3 EVALUATION

A formal written operational and maintenance plan including an annual comprehensive technical inspection by a qualified Registered Professional Engineer, should be developed to insure that problems that are encountered can be remedied within a reasonable period of time. A formal written surveillance and downstream warning (emergency preparedness) plan should be established for this structure.

SECTION 5 EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

Greenwater Pond Dam impounds Greenwater Brook, approximately 4.9 miles upstream of its confluence with the Housatonic River. The drainage area contributing to the pond is 1.8 square miles. Greenwater Pond has a normal surface area of 88 acres which is approximately 7% of the drainage area. The present impoundment reportedly includes a natural pond of approximately 60 acres. Topography within the drainage area is generally steep, mountainous terrain. Most of the drainage area is wooded.

5.2 DESIGN DATA

No hydraulic or hydrologic design data were available for the present dam. The 1929 plans for repairs indicates that the previous spillway was designed to have a capacity of 140 cfs with 2 feet of water flowing and 8" of freeboard. The 20" discharge pipe was calculated to have a capacity of 35 cfs at the same water elevation.

5.3 EXPERIENCE DATA

The September 21-22, 1938 flood reportedly raised the water level behind the previous dam to about 6" or 7" over the top of the dam. The dam was sandbagged, however, and negligible damage to the dam was reported. The dam was raised during 1945 construction.

5.4 TEST FLOOD ANALYSIS

Greenwater Pond Dam is classified as intermediate size having a hydraulic height of 18 feet and a top of dam storage of 1750 acre-feet (includes storage of natural pond). The dam was determined to have a significant hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood range is 50% to 100% of the Probable Maximum Flood (PMF).

Because the hydraulic height is below the lower end of the range for intermediate height, the $\frac{1}{2}$ PMF was selected as the Test Flood.

The $\frac{1}{2}$ PMF Test Flood was estimated using the methods contained in Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations, issued by the New England Division Corps of Engineers. The curve for mountainous terrain was used to determine the test flood inflow.

The $\frac{1}{2}$ PMF test flood inflow from the 1.8 square mile drainage area was estimated to be 2300 cfs.

Since the flashboard supports are of the non-yielding type, the test flood hydraulic analysis considered spillway performance with flashboards in-place.

During test flood conditions with the flashboards in-place, water would rise to elevation 1384.9 which is 0.3 feet below the design top of dam. The routed test flood outflow with flashboards would be 850 cfs. The spillway

capacity with flashboards in-place is 105% of the routed test flood outflow. The reservoir level was assumed to be at the top of flashboards at the start of the routing.

Without flashboards, the PMF would cause water to rise to elevation 1385.9 which is 0.7 feet above the design top of dam. Under these conditions the dam would be overtopped. The routed PMF outflow without flashboards would be 2200 cfs assuming the reservoir at the spillway crest at the start of the routing.

Both analyses assume that the 20" outlet is open; however, the capacity of this conduit does not significantly affect the results.

5.5 DAM FAILURE ANALYSIS

The impact of failure of the dam was assessed using Corps of Engineers "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs. The estimate assumes:

- a. the reservoir surface is at the top of the dam at the time of the breach, and
- b. a breach of 40% of the dam length at mid-height occurs (24 feet).

Downstream of Greenwater Pond Dam there is a wetland with an area of approximately 40 acres. The storage provided by this wetland would attenuate the breach flow from 4600 cfs to 4260 cfs.

The closest downstream structures are approximately 1700 feet from the dam. A valley rating at this location indicates that the breach discharge would result in an approximate 2-foot increase in water surface elevation above the elevation of the antecedent discharge. The breach flow would be approximately 6 feet below the ground level of the structures.

The brook passes under the Massachusetts Turnpike and Route 20 in areas where no structures exist. Both the bridge at Chestnut Street (1970) and the bridge at Route 20 (see Location Map) are adequate to pass the breach flow without adverse backwater effects. Structures near these bridges are 10 to 15 feet above the channel. The breach flow would result in a depth of the channel of about 6 feet. Although the structures would not be flooded by the breach flow, they, and approximately 10 homes and a mill in the Village of East Lee, could be damaged by undermining or erosion of the stream banks during high velocity flows. Flooding of structures could occur if the bridge openings were obstructed.

Because a major breach could cause extensive property damage (i.e. roads and bridges) and possible loss of a few lives in the downstream area, Greenwater Pond Dam was classified as Significant Hazard.

SECTION 6 EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

There are significant visual observations about this dam which relate to its structural stability.

The 20" outlet conduit is inoperative and the depression at the crest of the embankment could be associated with seepage into the conduit and/or the access manhole. These conditions require further investigation and repair.

The large willow trees on the upstream face of the embankment and the smaller trees and brush on the downstream face of the embankment, particularly behind the spillway walls and above the outlet conduit, are a threat to the embankment and spillway works. The growth of trees can lead to dislocations in the spillway wall. It is possible that the tree roots could damage the outlet conduit and access manhole. A breach in the embankment could result from the uprooting of a large tree.

The seepage through the crack in the spillway wingwall directly beneath the outlet conduit could indicate the development of a backward erosion path either behind the spillway walls and/or along the conduit. The backfill for the spillway walls is shown on the 1944 plans as being gravel which may be quite pervious.

The cracks and displacement of the southerly downstream wingwall should be repaired and the area behind the wall regraded.

The deteriorated spillway bridge requires repair or reconstruction. The bridge could obstruct the spillway if it collapsed.

The remains of the trash rack are creating a potential obstruction to the spillway and should be removed.

The erosion around the sides of the stilling basin end baffle should be repaired by the addition of riprap.

The settlement of the embankment behind the spillway walls could cause surface water to collect and could lead to surface erosion.

The wheel tracks on the crest, the erosion gully on the downstream face, and the animal burrows at the upstream and downstream toes of the embankment require repair to prevent further erosion.

The riprap on the upstream face of the embankment has been displaced by brush and trees and should be repaired to prevent erosion by wave action.

6.2 DESIGN AND CONSTRUCTION DATA

A 1922 report and 1928, 29, 44, and 57 plans and/or records of repairs are on file with the Berkshire County Commissioners. Copies of the 1944 plans are included in Appendix B.

6.3 POST-CONSTRUCTION CHANGES

The dam as it now exists is the product of repairs and modifications to a previous dam. The present dam generally conforms to plans dated 1944, except for subsequent repairs to the wooden bridge.

The 1944 plans called for raising the embankment and adding riprap on the upstream face. In 1929, embankment fill was added both upstream and downstream of the old embankment and stone masonry dam. These changes are described in more detail in Section 1.2(h).

6.4 SEISMIC STABILITY

The dam is located in seismic zone #2 and in accordance with recommended Phase I guidelines, does not warrant a seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition

The Phase I visual inspection of Greenwater Pond Dam indicates that the dam is in fair condition. However, a number of deficiencies were observed, which if not remedied, could develop into hazardous conditions.

b. Adequacy of Information

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the condition of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on study of available plans, visual inspection, past performance history, and sound engineering judgment.

c. Urgency

The recommendations and remedial measures described in Paragraphs 7.2 and 7.3 should be implemented by the owner within 12 months after receipt of this Phase I inspection report except as noted.

7.2 RECOMMENDATIONS

The owner should retain a qualified Registered Professional Engineer. to:

- (1) Design repairs to the concrete spillway wingwalls including the crack and seepage under the 20" outlet conduit in the northerly spillway wingwall. The engineer should evaluate if there is seepage along the spillway walls and/or along the conduit. The source of water in the access manhole should be investigated.
- (2) Design repairs for the inoperable outlet conduit. This work should include an inspection and design of any repairs to the inlet structure in the pond.
- (3) Design procedures and supervise the removal of all trees on both upstream and downstream faces of the embankment and for a distance of at least 25 feet downstream of the toe of the embankments.
- (4) Investigate the depression at the crest of the northerly upstream embankment in order to determine if this is associated with seepage in the access manhole or along the drawdown conduit.
- (5) Design repairs to the spillway bridge. This should be done immediately upon receipt of this report.
- (6) Design repairs to the areas of settlement between the embankment and the top of the spillway walls, particularly for the wingwalls at the downstream toe. The need for drainage behind the spillway walls should be evaluated.

- (7) Evaluate the feasibility of installing yielding flashboard supports.

The owner should carry out all the recommendations made by the engineer. Work should be done under the supervision of the engineer.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures

The owner should implement the following remedial measures:

- (1) Remove brush on the embankment and repair the wheel marks in the crest.
- (2) Control the population of burrowing animals on the dam and fill in all existing burrows.
- (3) Increase the riprap in areas on the upstream slope and on the sides of the stilling basin where it is insufficient.
- (4) Remove the trash rack and walkway upstream of the spillway.
- (5) Establish a formal written program for operation and maintenance including the routine exercising and servicing of the valve for the 20" outlet conduit.
- (6) Establish a formal written program for surveillance and downstream warning.
- (7) Engage a qualified Registered Professional Engineer to make a comprehensive annual technical inspection of the dam.

7.4 ALTERNATIVES

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

Greenwater Pond Dam

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: Greenwater Pond Dam MA 00204

DATE: 25 November 1980

TIME: 9:30 a.m.

WEATHER: 40°F 1½" rain previous day

W.S. ELEV. 1377.5 U.S. 1367.5 DN.S.

ELEV. DATUM: NGVD based on USGS elevation for
normal pool = 1379.

INSPECTION PARTY:

1. J.F. Cysz, P.E.
2. J.E. Walsh, P.E. (Baystate Environmental Consultants, Inc.)
3. K.N. Hendrickson, P.E.
4. _____
5. _____
6. _____

OTHERS PRESENT DURING INSPECTION:

1. _____
2. _____
3. _____
4. _____

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam HA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

DAM EMBANKMENT

Crest Elevation	9' above spillway weir, varies.
Current Pool Elevation	10" above conc. spillway
Maximum Impoundment to Date	1938 (above previous dam).
Surface Cracks	None observed.
Pavement Condition	No pavement - gravel surface
Movement or Settlement of Crest	Rutting and settlement along wheel tracks over crest.
Lateral Movement	None observed.
Vertical Alignment	Varies. Low areas at northerly abutment. Low areas near spillway walls.
Horizontal Alignment	OK
Condition at Abutment and at Concrete Structures	Low areas behind concrete spillway walls.
Indications of Movement of Structural Items on Slopes	1" horizontal disp. of cracked southerly wingwall d/s.
Trespassing on Slopes	Erosion gully, animal burrows u/s and d/s. One burrow 4' into embankment on u/s.
Vegetation on Slopes	Brush and large willows on u/s face and d/s face near normal water on u/s.
Sloughing or Erosion of Slopes or Abutments	8" depression 7' easterly of valve manhole; wave bench and undercutting of embankment at normal pool.
Rock Slope Protection - Riprap Failures	1'-2' placed riprap on u/s slope overgrown, voids & erosion between riprap units.
Unusual Movement or Cracking at or near Toes	None observed.

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

DAM EMBANKMENT (cont'd.)

Unusual Embankment or Downstream
Seepage

1-2 gpm from crack in wall at bottom
of 20" outlet (clear w/rust color)

Piping or Boils

8" depression over conduit 7' u/s of
valve manhole

Foundation Drainage Features

None

Toe Drains

None

Instrumentation System

None

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE

Submerged - not visible. Reported to be plugged in previous inspection reports.

Conduit reported plugged by roots of willow trees. (Conduit may be broken in area of 8" depression.)

a. Approach Channel

Slope Conditions

Bottom Conditions

Rock Slides or Falls

Log Boom

Debris

Condition of Concrete Lining

Drains or Weep Holes

b. Intake Structure

Condition of Concrete

Stop Logs and Slots

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204 DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER

No control tower. 4' diam. brick manhole with gate valve, manhole has frame w/ round cover

a. Concrete and Structural

General Condition	OK
Condition of Joints	Satisfactory
Spalling	Minor
Visible Reinforcing	No
Rusting or Staining of Concrete	None on brick work.
Any Seepage or Efflorescence	None above water level in manhole.
Joint Alignment	OK
Unusual Seepage or Leaks in Gate Chamber	Gate valve is submerged in manhole.
Cracks	Minor - tight cracks in brick.
Rusting or Corrosion of Steel	Yes - heavy scale on manhole ladder rungs.

b. Mechanical and Electrical

Air Vents	None
Float Wells	None
Crane Hoist	None
Elevator	None
Hydraulic System	None
Service Gates	20" gate valve with hand wheel slightly rusted. Did not attempt to operate.
Emergency Gates	None other than 20" noted.

Jan 16, 1976

Robert F. Tierney, Chief Engineer
Massachusetts Department of Public Works
100 Ashua Street
Boston, Massachusetts 02110

Re: Inspection - Dam 1-2-22-6
Becket
Green Lake Pond No.

Dear Chief Tierney:

On October 30, 1975, an engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate that your Department has responsibility for this structure. Will you please notify this office if this information is not current.

The inspection was made in accordance with the provisions of Chapter 26B of the Massachusetts General Laws as amended (Dams-Safety Act). Chapter 70C of the Acts of 1975 transferred the jurisdiction of the so-called "Dams-Safety Program" to the Commissioner of the Department of Environmental Quality Engineering.

The results of the inspection indicate that this dam is safe; however, the following conditions were noted that require attention:

1. Remove the growth of brush and trees from the embankment of the dam.
2. Seal the small crack on the southern wall of the spillway.

We call these conditions to your attention before they become serious and more expensive to correct. With any correspondence please include the number of the dam as indicated above.

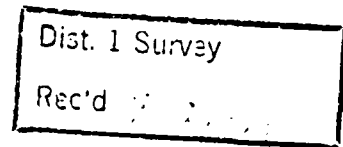
Very truly yours,

cc: D P Andon
R Jordan

DAVID STANLEY
Commissioner

July 14, 1976

To: G. Gallagher
From: R. Plankey
Subj: Resignation
cc: R. T. Tierney, Chief Engineer
Dean P. Amidon
Norman Diogoli
William A. Heaphy, County Engineer



On Sept. 18, 1968 I had E. Chase and F. Schwelm inspect the dam at Green Water Pond in Becket, Ma. At this time I asked that the fish screen be replaced and one of the Willow trees which was planted directly over the draw down pipe be cut down. Nothing was done. Now the pipe is plugged with Willow roots and the fish screen is completely rusted away.

Last year I talked with Dean Amidon about the conditions at Green Water Pond Dam and he wrote a letter to Mr. Norman Diogoli letter dated 6-3-75. As of 7-1-76 there still has been no repair made.

For the fiscal year 7-1-73 to 7-1-74 I only received \$400. dollars instead \$500.00 I am still waiting for the \$100.00 still due me.

I don't feel that I should any longer be responsible for this dam when I can not get any repair done or be properly paid for my services. So as of now I hereby submit my resignation as caretaker of Green Water Pond dam, effective 7-1-76.

Very truly yours,

Robert J. Plankey

/bwm

- 3 -

12. Remarks & Recommendations; (Fully Explain)
PREVIOUS INSPECTION DATE: OCTOBER 30, 1975

This dam is in the same condition as reported in 1975; trees and brush cover both slopes of the embankment. The embankment is stable, no sloughs or settlement was noted.

The concrete spillway is in good condition, with the exception of a crack in the southerly wall.

For location see Topo Sheet 5-C.

13. Overall Condition:

- X 1. Safe _____
 X 2. Minor repairs needed _____
_____ 3. Conditionally safe - major repairs needed _____
_____ 4. Unsafe _____
_____ 5. Reservoir impoundment no longer exists (explain)
Recommend removal from inspection list _____

DAM NO. 1-2-22-6

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs X _____
3. Major Repairs _____ 4. Urgent Repairs _____

9. Emergency Spillway

Condition: 1. Good _____ 2. Minor Repairs _____
3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

10. Water level at time of inspection 0.3' above X below _____
top of dam _____
principal spillway _____
other flashboards

11. Summary of Deficiencies Noted:

X Growth (Trees & Brush) on Embankment _____
_____ Animal Burrows and Washouts _____
_____ Damage to slopes or top of dam _____
X Cracked or damaged masonry _____
_____ Evidence of seepage _____
_____ Evidence of piping _____
_____ Erosion _____
_____ Leaks _____
_____ Trash and/or debris impeding flow _____
_____ Clogged or blocked spillway _____
_____ Other _____

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: ~~City~~/Town BECKET Dam No. 1-2-22-6Name of Dam Green Water Pond Inspected by RDJordan - RSpaniolDate of Inspection October 20, 1977Previous Inspection October 30, 19752. Owner/s per: Assessors _____
Reg. of Deeds _____ Personal Contact _____1. Massachusetts Department of Public Works 100 Nashua St Boston
Name _____ St. & No. _____ City/Town/State _____ Tel. No. _____2. _____
Name _____ St. & No. _____ City/Town/State _____ Tel. No. _____

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name _____ St. & No. _____ City/Town/State _____ Tel. No. _____

4. No. of Pictures taken 1

5. Degree of Hazard: (If dam should fail completely)*

1. Minor X 2. Moderate _____

3. Severe _____ 4. Disastrous _____

*This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual XOperative X Yes _____ No _____Comments: _____

7. Upstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs X

3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

PREVIOUS INSPECTION REPORTS

- A. Inspections of dams were performed by the Massachusetts Department of Public Works, District 1, and reports are on file at District 1 Headquarters, Pittsfield-Lenox Road, Lenox, MA - Latest Report, related correspondence, and 1973 Description of Dam are attached.
- B. Earlier inspections of dams were performed by the Berkshire County Engineer for the County Commissioners, and reports are filed at the County Engineer's office, County Court House, Pittsfield, MA - Latest Report is attached.

LIST OF AVAILABLE DESIGN,
CONSTRUCTION AND MAINTENANCE RECORDS

A. PLANS AND SPECIFICATIONS

No plans or specifications of the original work were available. Plans and description of repairs in 1929 are on file at the Berkshire County Engineers, Court House, Pittsfield, MA. Plans for repairs and improvements were prepared by the Massachusetts Division of Waterways in 1944 and are available from the owner and also from the County Engineers. No specifications for this work were available. Copies of the 1944 plans are included in Appendix B.

B. DESIGN RECORDS

No design records for the original construction or subsequent changes in 1929 and 1944 are available.

C. CONSTRUCTION RECORDS

No construction records were available, except for copies of correspondence in the County Engineer's records.

D. MAINTENANCE

No maintenance records were available, except for copies of correspondence in the County Engineer's records.

APPENDIX B

ENGINEERING DATA

	<u>Page Number</u>
LIST OF AVAILABLE DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS	B-1
PREVIOUS INSPECTION REPORTS	B-2 to B-13
PLANS, SECTIONS AND PROFILES	B-14 to B-21
BORING LOGS	B-22

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204 DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SERVICE BRIDGE

Service bridge is 14 feet wide. Wood stringer and wood deck resting on hollow core concrete blocks at bridge seats at spillway walls.

a. Super Structure

Bearings	None
Anchor Bolts	Yes, but not used.
Bridge Seat	Accumulated dirt and debris
Longitudinal Members	4" x 14" wood stringers decayed at supports, cracked and deflected near mid-span. 19½' span.
Under Side of Deck	Deck planking
Secondary Bracing	Wood bridging
Deck	2½" x 11" planking with ½" open space.
Drainage System	½" open space between timber deck planks.
Railings	Yes, wooden bolted to stringers - rails loose.
Expansion Joints	None
Paint	Unpainted

b. Abutment & Piers

General Condition of Concrete	12" recess in spillway walls. Condition satisfactory. Accumulated dirt and debris should be removed.
Alignment of Abutment	Good
Approach to Bridge	Embankment crest depressed.
Condition of Seat & Backwall	Concrete seat and backwall good. Hollow core concrete block cracked.

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204 DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (cont'd.)

Trees Overhanging Channel	Yes, growing through riprap.
Floor of Channel	OK
Other Obstructions	Fallen trees, debris

Note: There is an open joint where spillway walls meet spillway chute floor.

Settlement of embankment and saplings growing immediately behind spillway walls.

There is surface erosion where embankment toe meets ground near southerly d/s wingwall.

Southerly d/s wingwall has large open crack with 1" horizontal displacement. Settlement or voiding of fill behind wall at this location.

Fallen tree at northerly downstream wingwall.

Note: Erosion and flow around ends of concrete end baffle, especially northerly end. Minor scouring at d/s of concrete baffle at outlet hole for low flow.

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

Approach channel is pond. Concrete floor within limits of wingwalls.

a. Approach Channel

General Condition

Structurally good - obstructed by abandoned trash rack.

Loose Rock Overhanging Channel

No.

Trees Overhanging Channel

Yes - large willow trees at toe of u/s slope.

Floor of Approach Channel

Good

b. Weir and Training Walls

General Condition of Concrete

Good except at large crack with 1" horizontal displacement at d/s southerly wingwall. Recent repairs to concrete at flashboards at southerly wall.

Rust or Staining

Minor

Spalling

Weathered concrete, minor weathering and exposed aggregate below water line.

Any Visible Reinforcing

No

Any Seepage or Efflorescence

Yes, from tight cracks in spillway walls - one on south wall of spillway 2' d/s of flashboards, one crack on northerly spillway wall 8' upstream of wingwall containing 20" outlet.

Drain Holes

None

c. Discharge Channel

General Condition

Stilling basin at end of spillway chute formed by concrete end baffle.

Loose Rock Overhanging Channel

No

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL

20" CIP projects from downstream wingwall northerly side of spillway. Conduit discharges into stilling basin for spillway chute.

Pipe contained in concrete yoke, wingwall was poured around yoke.

General Condition of Concrete

Poor at conduit outlet.

Rust or Staining

Yes, from leakage under conduit.

Spalling

Yes, on face of yoke.

Erosion or Cavitation

No.

Visible Reinforcing

No.

Any Seepage or Efflorescence

Yes. 1-2 gpm under conduit, minor through pipe.

Condition at Joints

Cracks around yoke.

Drain Holes

None.

Channel

Loose Rock or Trees Overhanging
Channel

See description for spillway channel

Condition of Discharge Channel

See description for spillway channel

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204 DATE: November 25, 1980

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	20" C.I. Conduit
General Condition of Concrete	Visible at outlet northerly wingwall for spillway, visible in valve manhole.
	Conduit reported in previous inspection reports to be clogged/plugged with roots.
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

VISUAL INSPECTION CHECKLIST

DAM: Greenwater Pond Dam MA 00204

DATE: November 25, 1980

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER (cont'd.)

Lightning Protection System None

Emergency Power System No wiring

Wiring and Lighting System None
in Gate Chamber

6/4/75

June 3, 1975

SUBJECT DAMS-Becket
Greenwater Pond
Dam #1-2-22-6

ATTENTION Mr. Norman Diegoll

Mr. R. T. Tierney

Chief Engineer

Dear Sir

Mr. Robert Plankey, caretaker for the subject dam, which is owned and controlled by the Division of Waterways of the Massachusetts Department of Public Works, visited me in the District office today and verbally gave me a list of repairs that are needed for the Greenwater Pond Dam.

They are as follows:

1. Catwalk
2. Fish screen
3. Growth of Willow Trees on Dam
4. Relief Valve choked by roots of Willow Trees
5. Grate at Inlet of drawdown pipe broken and plugged
6. New flashboards needed
7. Stairs
8. Flashboard slots should be checked

The fish screen should be repaired as soon as possible as freshly stocked trout are escaping from the pond to the stream below.

If funds are available, some or most of these repairs could be completed by District personnel.

We will be pleased to cooperate with you in any way that we are able in order to bring this dam back to its original condition.

Very truly yours

Dean P. Amidon

Dean P. Amidon, P.E.
District Highway Engineer

DPA/mob
LenDams
RPlankey, Caretaker

DESCRIPTION OF DAM

DISTRICT ONE.Submitted by RD JordanDam No. 1-2-22-6Date 4-13-73City/Town BecketName of Dam Greenwater Pond

1. Location: Topo Sheet No. 5-C.

Provide 8-1/2" x 11" in clear copy of topo map with location of Dam clearly indicated.

2. Year built: _____ Year/s of subsequent repairs 1964

3. Purpose of Dam: Water Supply _____ Recreational X _____
Irrigation _____ Other Flood control _____

4. Drainage Area: _____ 1.6 sq. mi. _____ acres.

5. Normal Ponding Area: _____ 93 Acres; Avg. Depth _____
Impoundment: _____ gals; _____ acre ft.

6. No. and type of dwellings located adjacent to pond or reservoir _____
i.e. summer homes etc. _____

7. Dimensions of Dam: Length 313' Max. Height 16'
Slopes: Upstream Face earth 2:1
Downstream Face earth 2:1
Width across top 16'

8. Classification of Dam by Material:
Earth X Conc. Masonry _____ Stone Masonry _____
Timber _____ Rockfill _____ Other _____

9. A. Description of present land usage downstream of dam: _____
80 % rural; 20 % urban.
B. Is there a storage area or flood plain downstream of dam which could
accommodate the impoundment in the event of a complete dam failure
Yes _____ No X

10.

Risk to life and property in event of complete failure.

No. of people _____ Failure could cause moderate to damage

No. of homes _____ to U.S. Route 20 Mass. Turnpike and

No. of Businesses _____ East Lee.

No. of Industries _____ Type _____

No. of Utilities _____ Type _____

Railroads _____

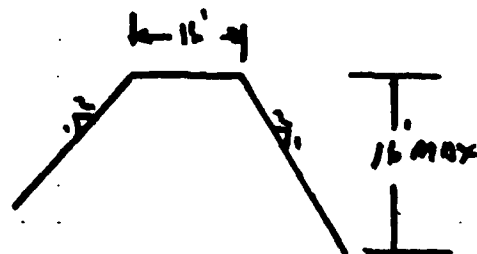
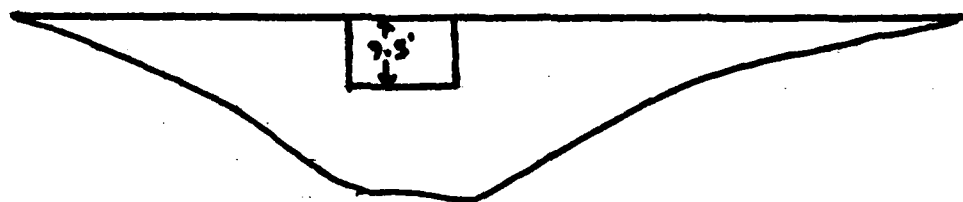
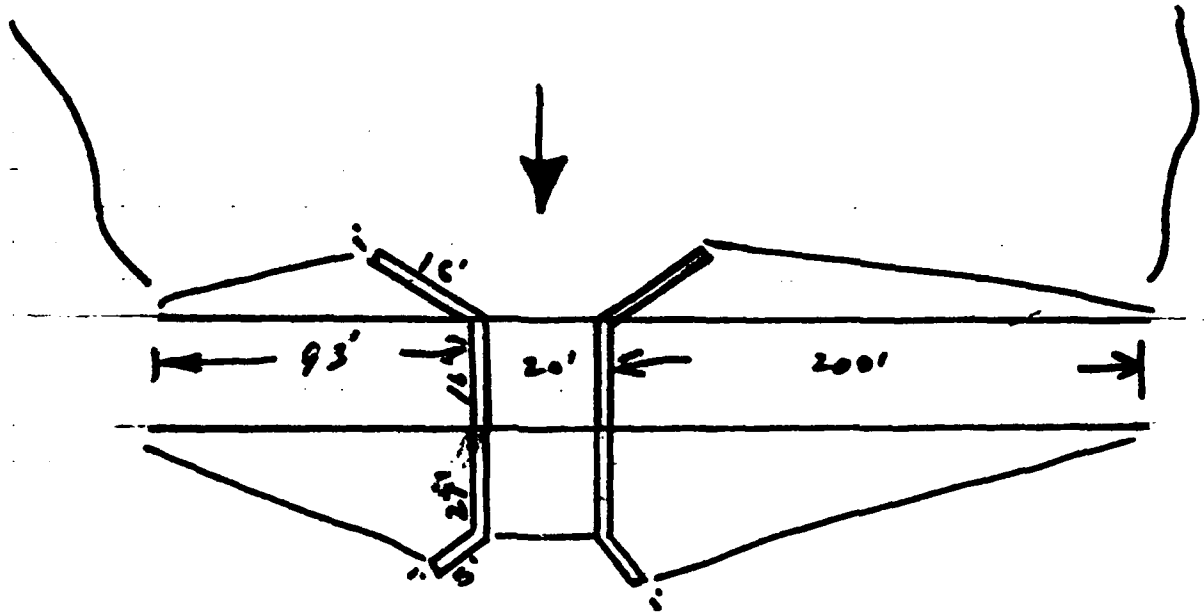
Other _____

Other _____

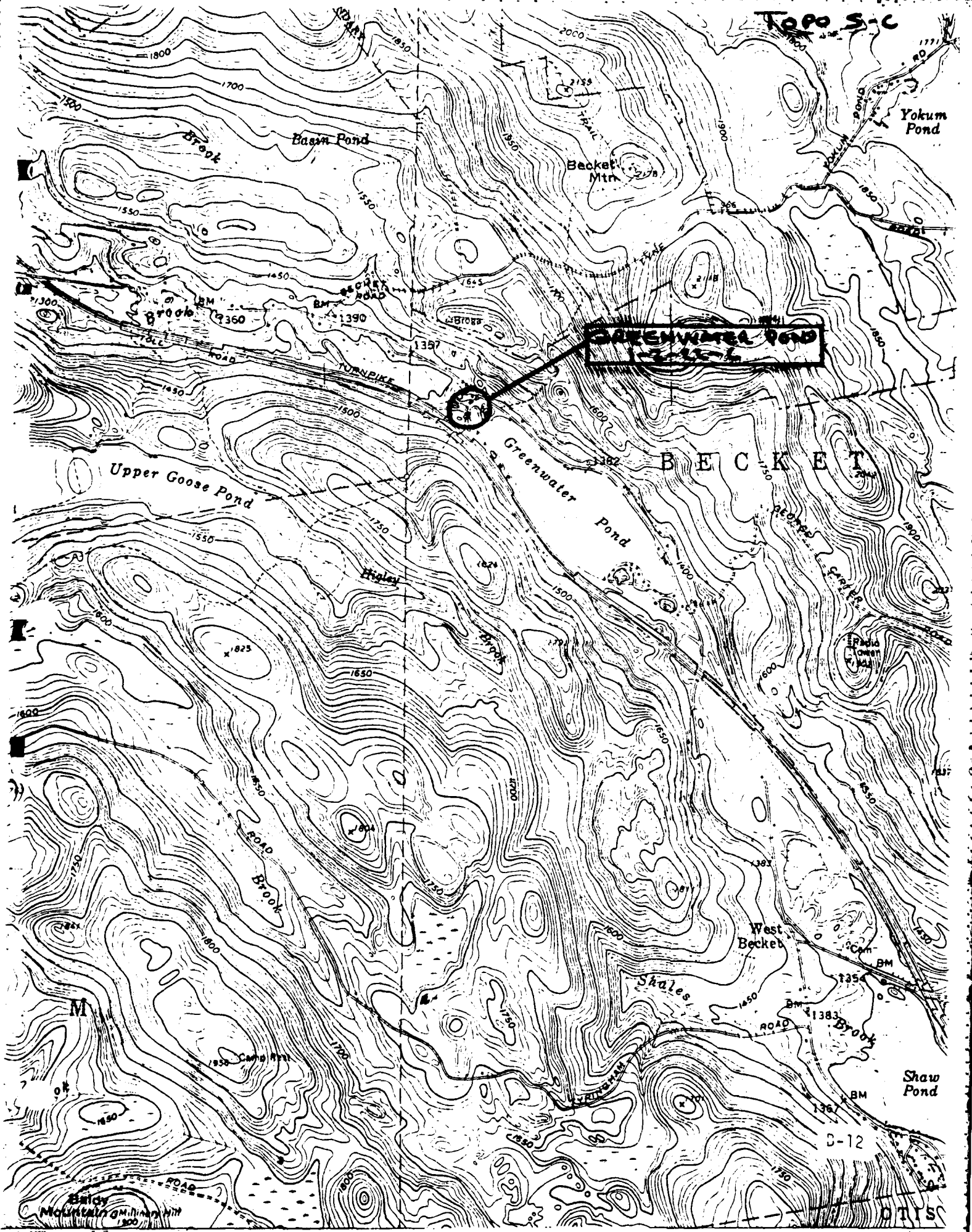
11.

Attach Sketch of dam to this form showing section and plan on 8-1/2" x 11" sheet.

GREENWATER Pond 1-2-22-6



Topo S-C



B-12

OTIS

INSPECTION OF DAMS

Dam #3-7

City or Town of Becket Date June 6, 1971

Name of Dam Greenwater Pond Inspector R. Northrup
P. Fezzie

Owner DPW - Waterways Address 100 Nashua St. - Boston

Caretaker DPW - Waterways Address 100 Nashua St. - Boston

Location Route 20 - 1/2 mile east of Lee - Becket Line

Type of Dimensions Earth embankment - 450' long - 16' high - 14" wide on top -

~~XX~~ upstream face riprapped

Spillway, type and size concrete 20' long - 7' freeboard

Outlets, type and size 20" CI pipe and gate

Flashboards, type and height wood - 28" high

Date Built _____ Condition _____

When last repaired 1964 By whose orders DPW

Nature of Repairs to bridge and cat walk

Purpose of Dam flood control and recreation

Approximate storage of water 93 acres

Approximate area of water shed 1.6 square miles

Possible damage due to failure of dam disasterous to life and property below

Remarks entire embankment overgrown with large trees - trash rack partially plugged
water running under outlet pipe in north downstream wingwall - south downstream
wing wall cracked and leaking - water 1" over XXXXXXXX flashboards

Recommendations clear embankment - clean trashrack - investigate leakage and seal

A. SKETCHES COMPILED DURING PHASE I INSPECTION SHOWING
GENERAL LAYOUT OF DAM, TYPICAL SECTIONS AND DETAILS
OF SIGNIFICANT FEATURES:

Figure 1. General Plan of Damsite

Figure 2. Profile

B. CONSTRUCTION PLANS:

"Proposed Concrete Spillway and Dike", 1944.

Plans and Sections - Sheet 1 of 3

Spillway - Sheet 2 of 3

Spillway and Details - Sheet 3 of 3

C. 1929 CONSTRUCTION:

"Proposed Additions to Dam"

Description of Work - 2 pages

NOTE: Elevation of Pond is based on Elevation of Greenwater Pond as Shown on USGS East Lee Map. Quad: angle. Normal pool at Top of flashboards 1379.0 NGVD

GENERAL PLAN

APPENDIX B FIGURE 1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

ROBERT G. BROWN & ASSOCIATES, INC.
Pittsfield, Massachusetts

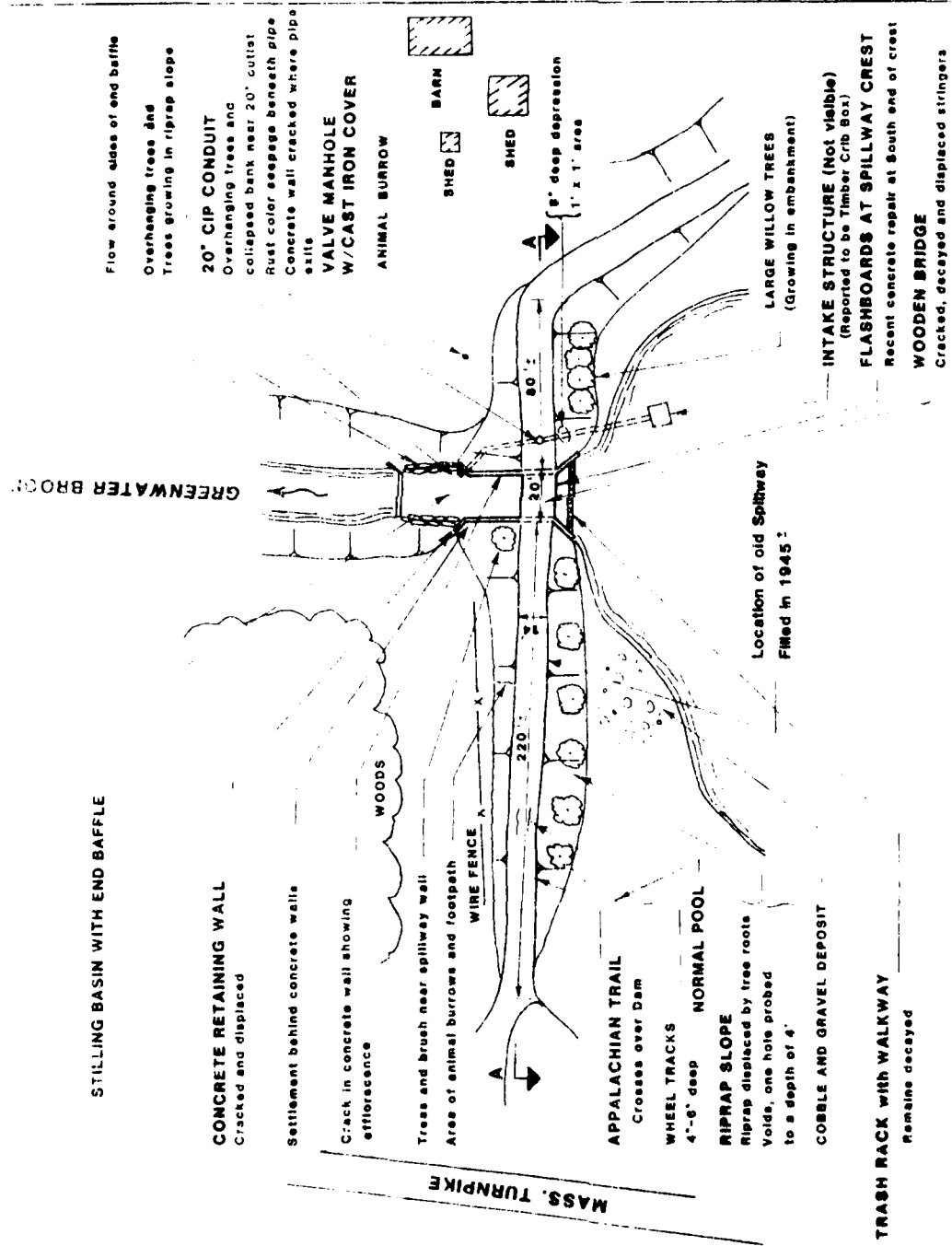
NATIONAL PROGRAM FOR
INSPECTION OF NON-FEDERAL DAMS
GREENWATER POND DAM

MA 00204

GREENWATER BROOK

MASSACHUSETTS

SCALE: NOT TO SCALE DATE: JAN 1981



GREENWATER POND

WATER LEVEL 1377.5 NOV. 1980
NORMAL POOL AT TOP OF FLASHBOARDS 1379.0 NGVD

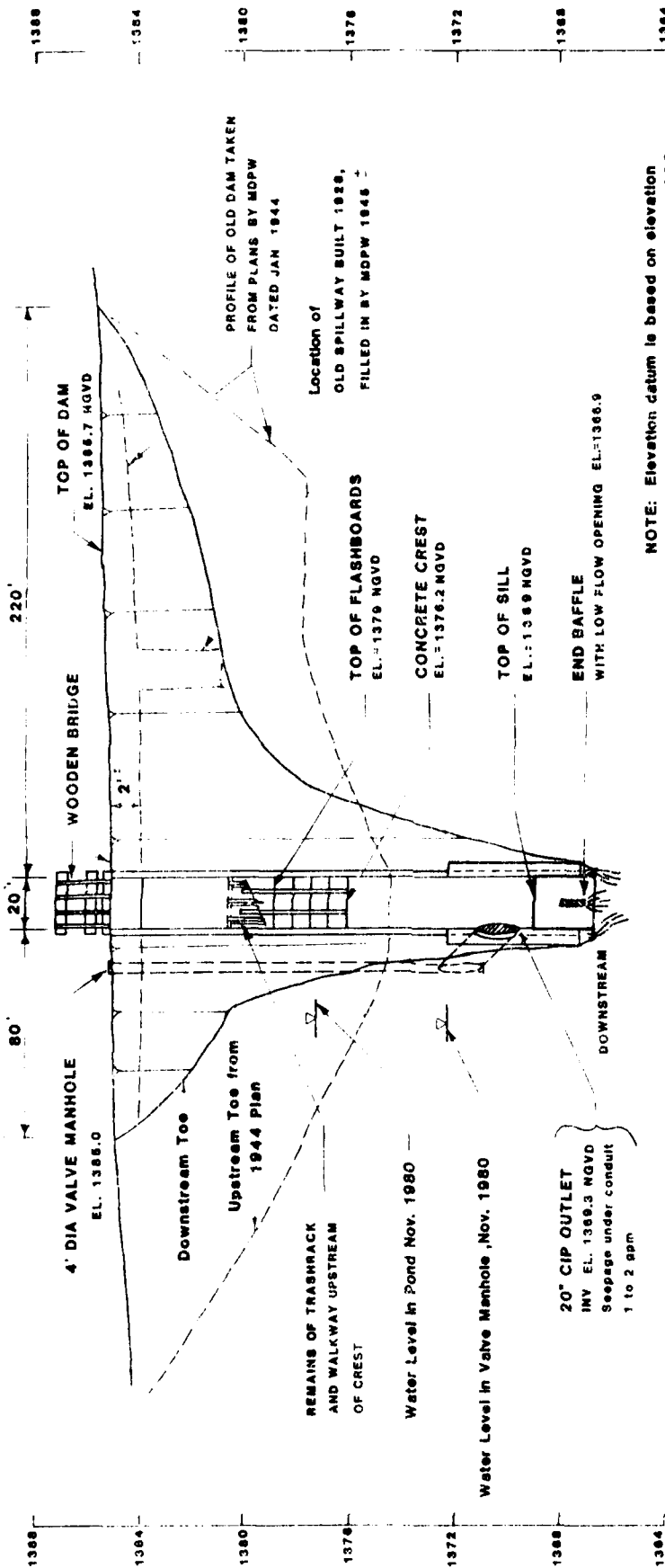
LEARN

APPROX. 30' EL. 1400' NGVD

MASS TURNPIKE

APPROX. EL. 1400' NGVD

TOP OF DAM at SPILLWAY
EL. 1388.2 NGVD



NOTE: Elevation datum is based on elevation of Greenwater Pond as shown on USGS East Lee, Mass. Quadrangle. Normal pool at top of flashboards 1379 NGVD

APPENDIX B FIGURE 2

SECTION A-A

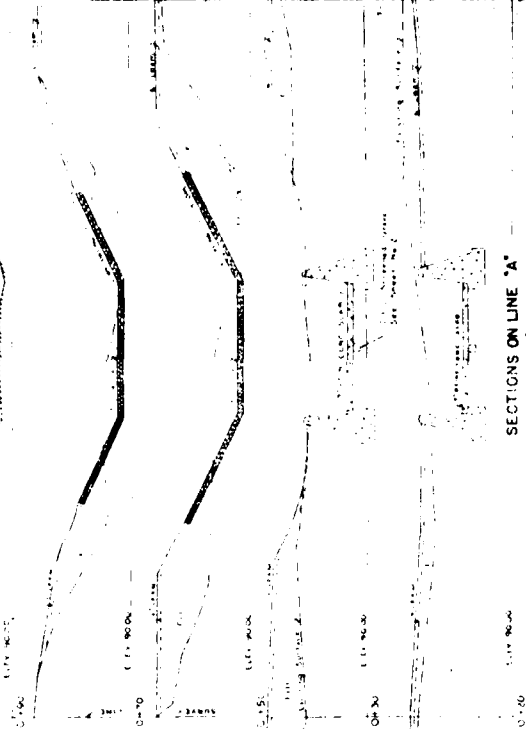
NOT TO SCALE

1-16

GREENWATER POND DAM



PLAN
SCALE 1"=40'



SECTIONS ON LINE "A"
SCALE 1"=8'

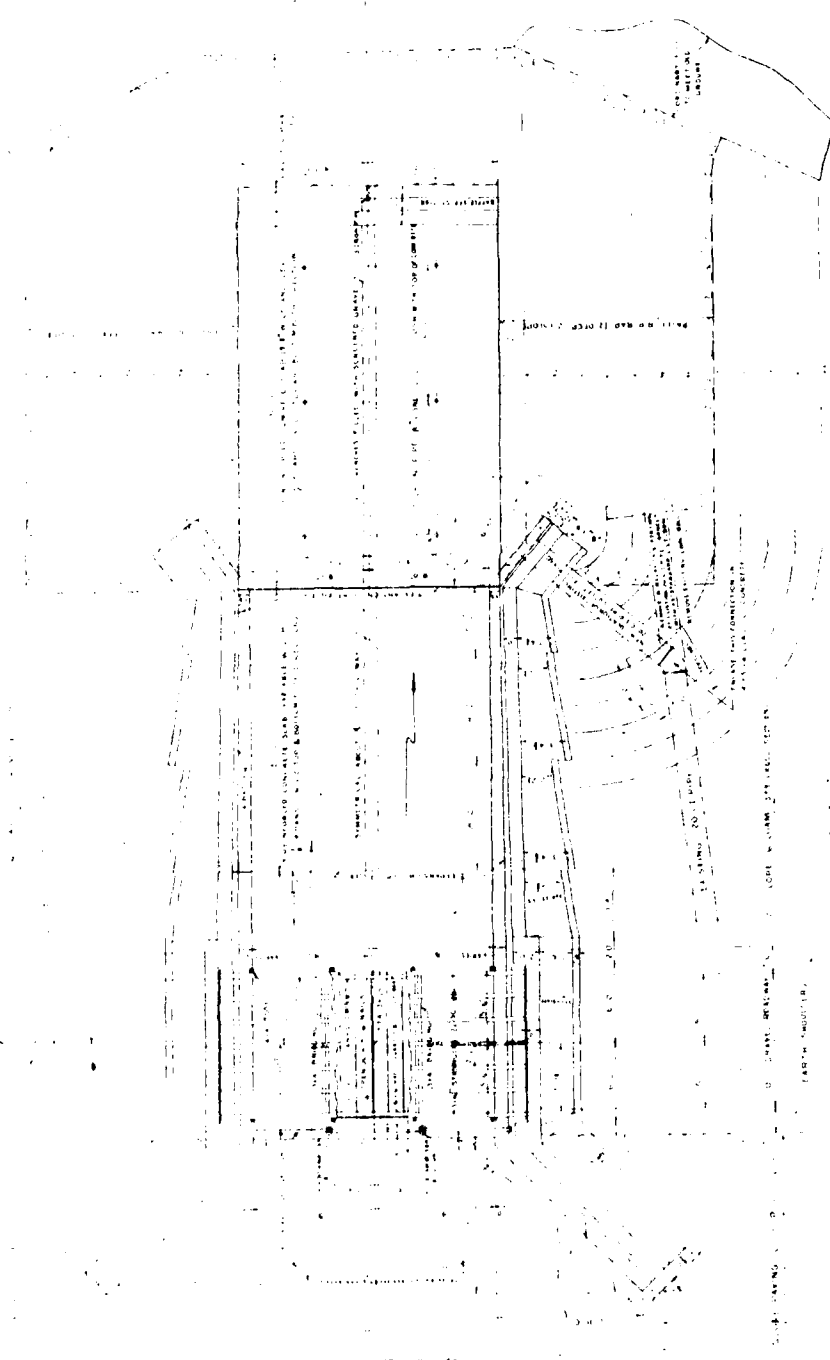
PROPOSED CONCRETE SPILLWAY AND DIKE GREENWATER POND BECKET

DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS
DIVISION OF WATERWAYS
JANUARY 1944
SCALES AS NOTED

SECTIONS ON LINE "B"
SCALE 1"=8'

BRICK MAYHOLE WITH GATE VALVE
SCALE 1/4"=10'

CONTRACT NO. 836



PROPOSED CONCRETE SPILLWAY AND DIKE
GREENWATER POND
BECKET

DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS
DIVISION OF WATERWAYS

SCALES AS NOTED

STANDARD DRAWING SYMBOLS

CONTRACT NO. 836

APPROVED

PLAN OF SPILLWAY
SCALE 1/4" = 4'-0"

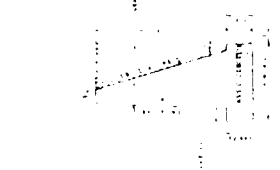
John H. Hennessey
Civil Engineer
100 State Street, Boston, Mass.

GREENWATER POND

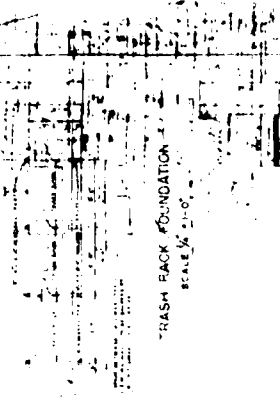
SHEET NO. 10



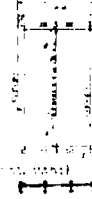
HALF UPSTREAM ELEVATION HALF SECTION ON 1/4 OF CONSTRUCTION
SCALE 1/4" = 1'-0"



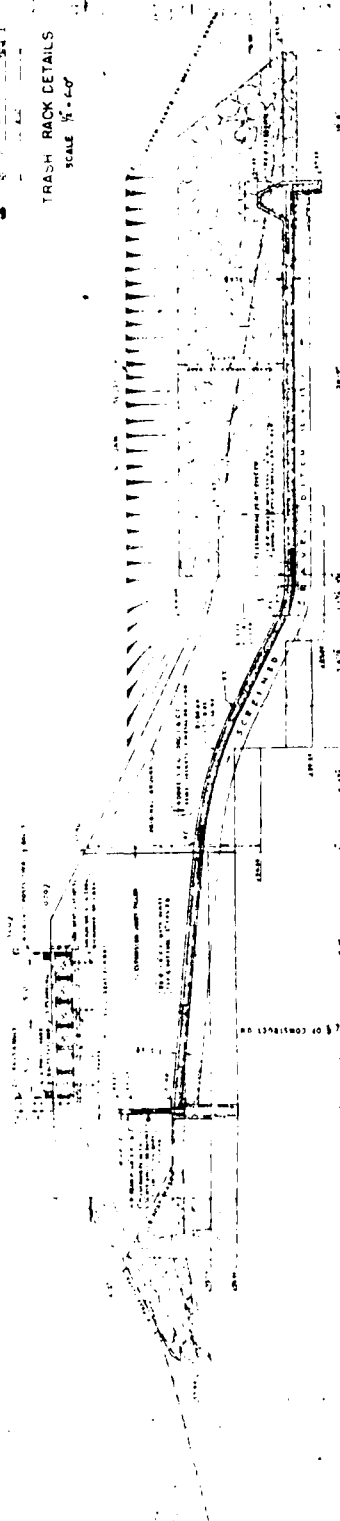
TYPICAL WING WALL SECTION
SCALE 1/4" = 1'-0"



TRASH RACK FOUNDATION
SCALE 1/4" = 1'-0"



TRASH RACK DETAILS
SCALE 1/4" = 1'-0"



SECTION ON 1/4 OF PROPOSED SPILLWAY
SCALE 1/4" = 1'-0"

PROPOSED CONCRETE SPILLWAY AND DAM

GREENWATER POND

BECKET

DEPARTMENT OF PUBLIC WORKS OF MASSACHUSETTS

DIVISION OF WATERWAYS

DESIGNED BY: [Signature]
CHECKED BY: [Signature]
SCALE AS NOTED

PROPOSED ADDITIONS TO DAM
GREENWATER POND RESERVOIR
LAKE MAY POWER COMPANY

September 3, 1929.

SPILLWAY

The concrete spillway, recently constructed, has a discharge capacity with 2 ft. of water over the apron of approx. 140. cu. ft. per second. The 20 inch discharge pipe with water at same elevation as for above, (about 8" from top of dam) will discharge about 35 c.f.s., thus making a total discharge of approx. 175. c.f.s. for the reservoir which has a discharge area of approx. 1.9 sq. miles.

The top of the dam should be practically level on top with the ends slightly lower than the center of the dam.

INTAKE SECTION MAIN DAM

To prevent seepage through the dam, it is proposed to place a clay fill on the up stream side of the dam on a slope of $2\frac{1}{2}$ to 1. from station 0. to station 1.+50., or at any other point opposite where the down stream wall shows a height greater than 3. ft.

The 20 inch intake pipe is to be lengthened, and to prevent the clay from filling in around the entrance to the intake pipe a stone filled crib will be placed on either side of the end of the pipe. The space between cribs when sheathed etc. forms a pit to house the valve and accommodate the racks.

EARTH FILL

The down stream slope of the dam, which is now retained by a heavy dry wall, is to be strengthened by having an earth fill placed against it, such earth fill to be approved by the County Commissioners' Engineers. This fill will have a slope of about two ft. horizontal to one ft. vertical and will extend from station 0. to station 1.+50. The 20" diameter iron drain pipe is to be extended through this new earth fill and should be supported by masonry or concrete piers carried down to good solid ground so that the fill as it settles will not displace the pipe. Rock should be placed under the discharge end of the 20" drain pipe so that the discharge water will not affect the earth fill. The surface of the ground should be properly cleared before fill is started. Blind drains, about 18" x 18", filled with loose stone should be constructed to carry away the seepage now coming through the old

9/3/29

dam and which will affect an earth fill if not taken care of before the fill is placed.

The County Commissioners' Engineers are to approve and designate the borrow pits from which the material for fills is to be obtained.

Application of water is to be played on the fills as and when laid, and the method is to be satisfactory to the engineers.

The proposed additions are shown on Viele, Blackwell & Buck's drawing A-7529, sheets 1 and 2., revised September 3, 1929, in accordance with an agreement reached at a conference at Pittsfield, Mass., September 3, 1929, between Berkshire County Commissioners, engineers and Mr. Louis T. Stevenson.

Robert G. Brown & Associates, Inc.
Berkshire Common - Third Floor North
PITTSFIELD, MASSACHUSETTS 01201
(413) 499-1560

JOB: Site Specific Flood Hazard Study
SHEET NO. 5 OF 5
CALCULATED BY: RLB DATE: 8/1/01
CHECKED BY: RLB DATE: 8/1/01
SCALE: AS SHOWN

DESIGN FLOOD = 100 YEAR FLOOD

DESIGN FLOOD TERRAIN

NOTE: CDR "PRELIMINARY" GUIDANCE FOR LOT 4 AT 10
YEAR FLOOD HAZARD DESIGN FLOOD FLOOD
Hazardous Intersected with 100 Year FLOOD

$$PMF = 2500 \text{ CSM} \times 100 \text{ CSM} = 4516 \text{ CFS}$$

SAY 4500 CFS

$$1/2 PMF = 2250 \text{ CFS}$$

HAZARD POTENTIAL CLASSIFICATION: SIGNIFICANT

CLASS: INTERMEDIATE ($\geq 1000 \text{ CFS} < 50,000 \text{ CFS}$)

DESIGN FLOOD OR LARGER FLOOD HAZARD

$$1/2 PMF \text{ TO } PMF$$

TEST FLOOD: USE $1/2 PMF$ BECAUSE OF LOW AVAILABLE



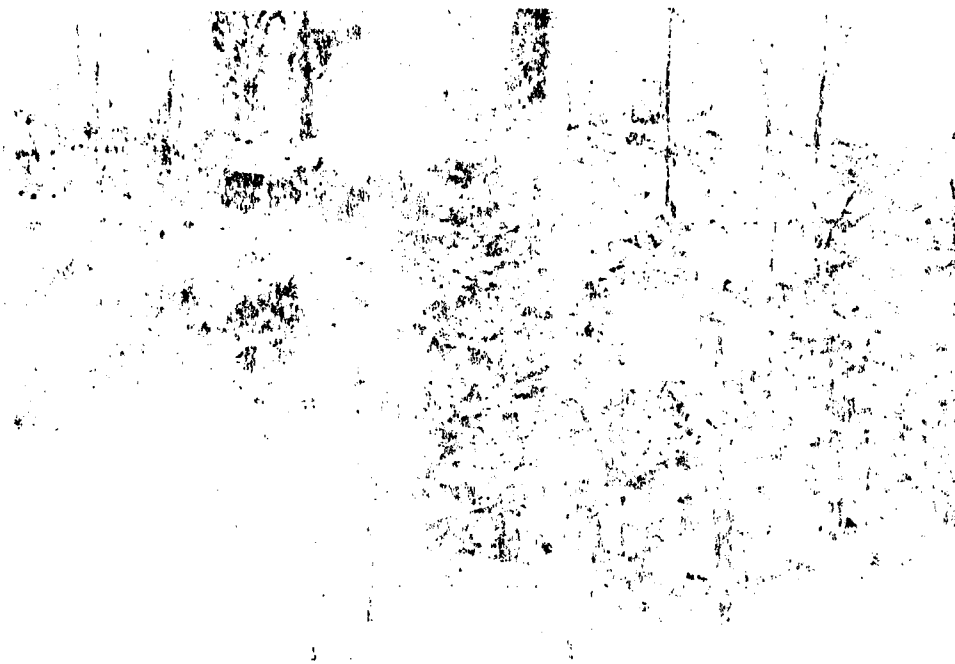
APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS

	<u>Page Number</u>
DRAINAGE AREA MAP	D-1
COMPUTATIONS	D-2 to D-18



Photograph 15 - View of Greenwater Pond looking
upstream (east) from the dam.



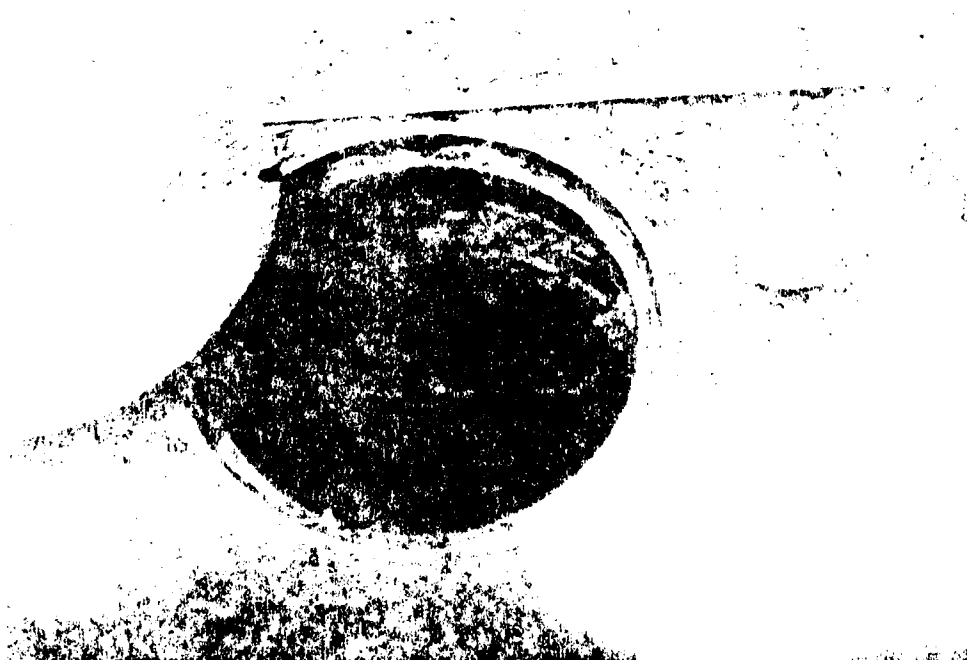
Photograph 13 - Erosion rill, brush and saplings on downstream face of southernly embankment.



Photograph 14 - Depression, 7 feet wide at top, 4 feet at bottom.



Photograph 11 - Upstream face of southerly embankment showing large trench, wave bench and generally deficient stone slope paving.



Photograph 12 - 20" Gate valve access manhole.



Photograph 9 - Southerly spillway chute wingwall. Note crack, displacement and erosion behind wall.



Photograph 10

Approach channel showing trash rack and flashboards and supports. Note recent patchwork at flashboard slot on southerly wall.

Greenwater Pond Dam



Figure 1 - Spillway stilling basin and downstream channel.
Note ineffective riprap on side channel and
erosion around ends of stilling basin end baffle.



Figure 2 - Northerly spillway chute wall. Note crack
showing afflorescence.



Photograph 5

Downstream face of
northerly embankment.
Note animal burrows in
foreground.



Photograph 6 - Outlet of 20" C.I. pipe at northerly spillway d/s
wingwall. Note cracks around yoke and seepage stain
from large crack beneath conduit.

Greenwater Pond Dam

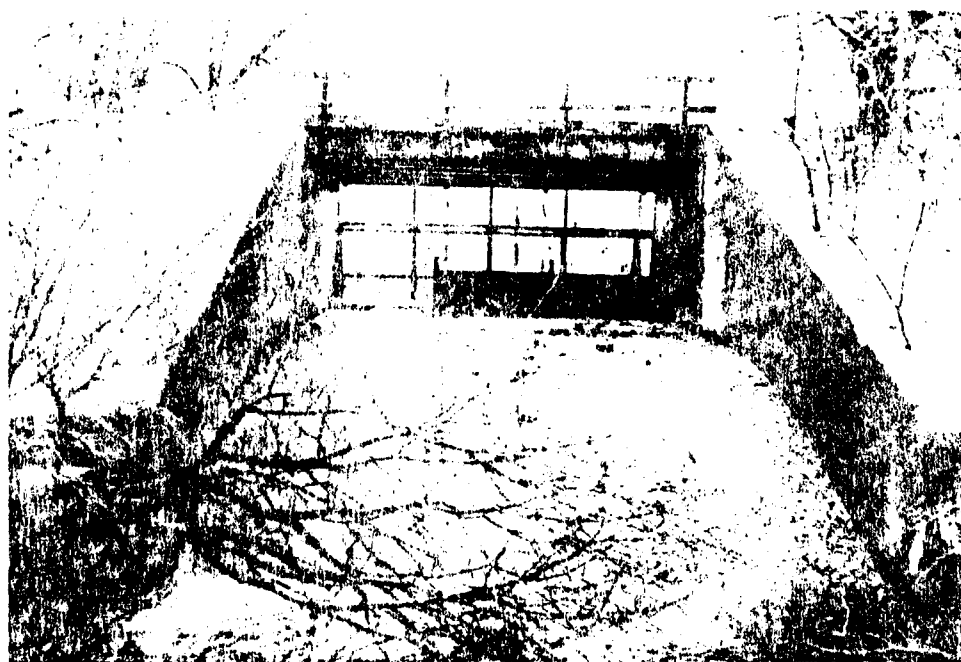
Photograph 3 - Crest of embankment looking south. Note wheel ruts and vegetation on embankment.



Photograph 4 - Spillway approach and upstream face of northernly embankment. Note decayed train track and walkway.

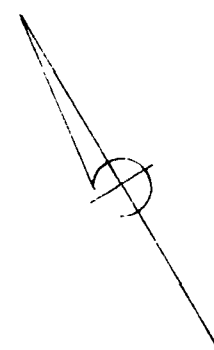
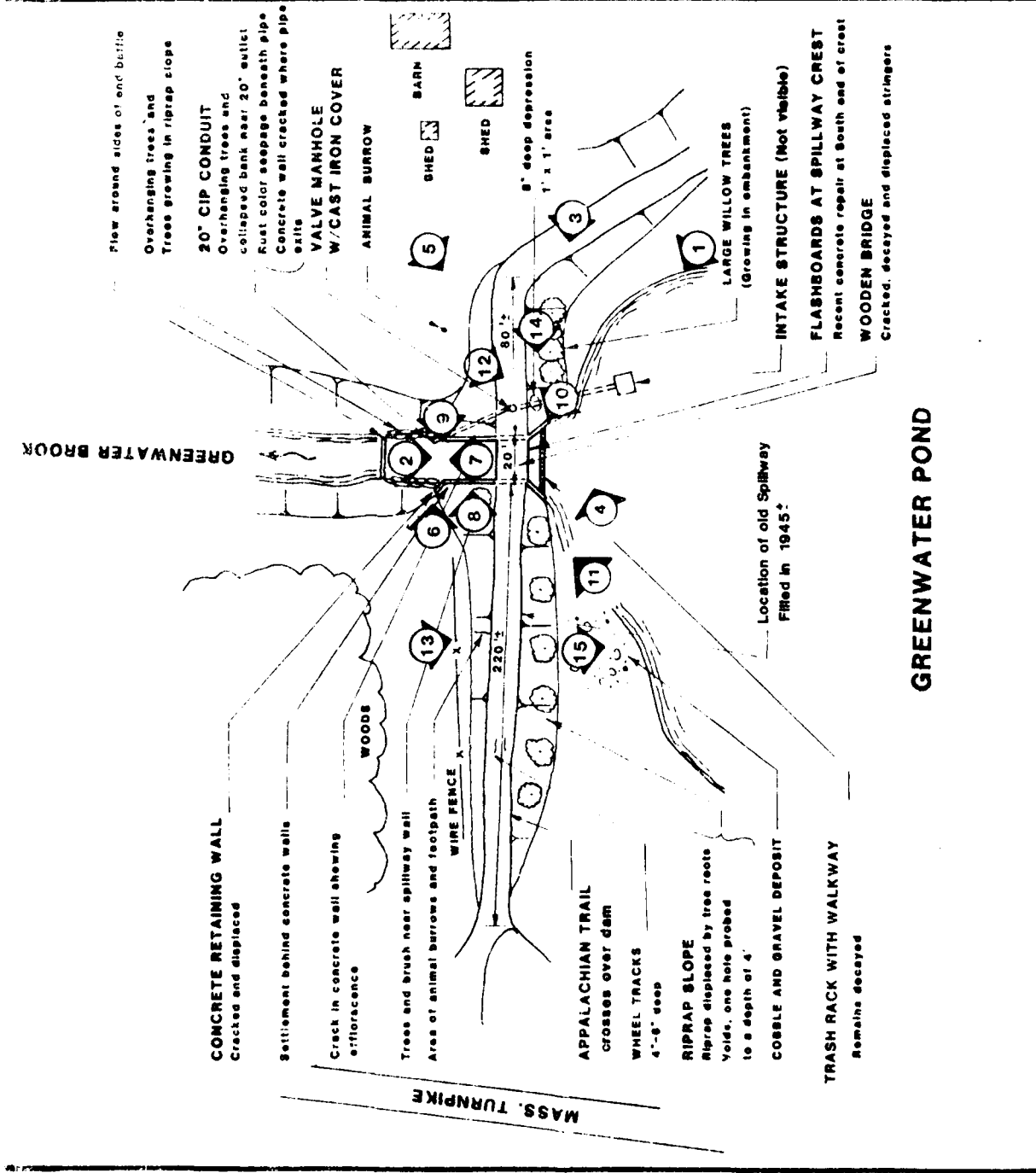


Photograph 1 - Upstream face of northerly embankment and spillway.



Photograph 2 - Spillway chute. Note condition of spillway bridge, 20" conduit discharging from northerly wingwall, and large tree on crest about 5 feet from southerly spillway wall.

NOTE: Elevation Datum is based on Elevation of Greenwater Pond as shown on USGS East Lee Mass. Quadrangle. Normal Pool is Top of Flashboards 1383.6 NGVD



INDICATES PHOTOGRAPH NUMBER AND DIRECTION IN WHICH PHOTOGRAPH WAS TAKEN

PHOTOGRAPH INDEX APPENDIX C-1

DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION CORPS OF ENGINEERS
ROBERT G. BROWN & ASSOCIATES, INC. Pittsfield, Massachusetts
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
GREENWATER POND DAM
MA 00204 GREENWATER BROOK MASSACHUSETTS
BECKET SCALE NOT TO SCALE DATE JAN 1981

GREENWATER POND

APPENDIX C

PHOTOGRAPHS

	<u>Page Number</u>
Photograph Index	C-1
Photographs	C-2 to C-9

TYPICAL BORING LOGS

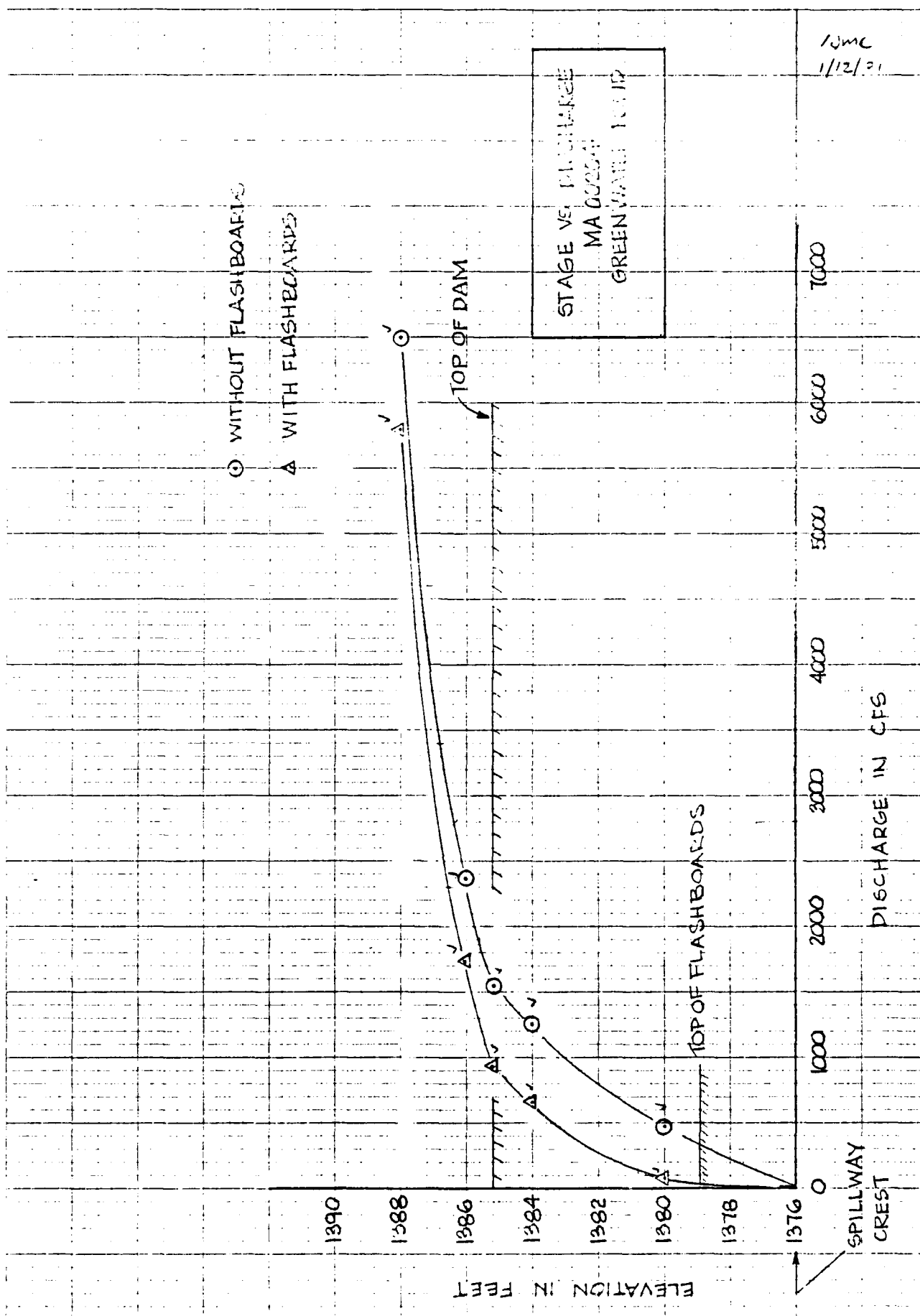
None available.

Robert G. Brown & Associates, Inc.
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 PITTSFIELD, MASSACHUSETTS 01201
 (413) 499-1560

JOB NO. 100-100-100
 SHEET NO. 10 OF 10
 CALCULATED BY DATE
 CHECKED BY DATE
 SCALE

$Q = CLH^{3/2}$		$Q = \frac{1}{2} J 2 q H$		$Q = (1 + K_1 + K_2) \frac{1}{2} J 2 q H$		$Q = CLH^{3/2}$		$Q = \frac{1}{2} J 2 q H$		$Q = (1 + K_1 + K_2) \frac{1}{2} J 2 q H$	
C	L (ft)	H	Q	Q	Q	C	L (ft)	H	Q	Q	Q
1376.2	3.1	18	0	1.75	3.18	10	31.6				
1377.0		.8	40.2				"				
1379.0		2.8	261				"				
1380		3.6	413				"				
1382		5.8	779				"				
1384		7.8	1215				"				
1385.2		9.0	1506			2.9	310	0			
1386		9.8	1712				"	.8		643	
1388		11.8	2262				31.6	2.8		4212	
1376.2	3.2	18	0								
1377.0		1	58				31.6				
1380		3	299				"				
1382		5	645				"				
1384		6.2	889			2.9	310	0			
1386		7.0	1066				"	.8		643	
1388		9	1555				"	2.8		4212	
1391.1		5.1	825								

1JMC
1/12/21



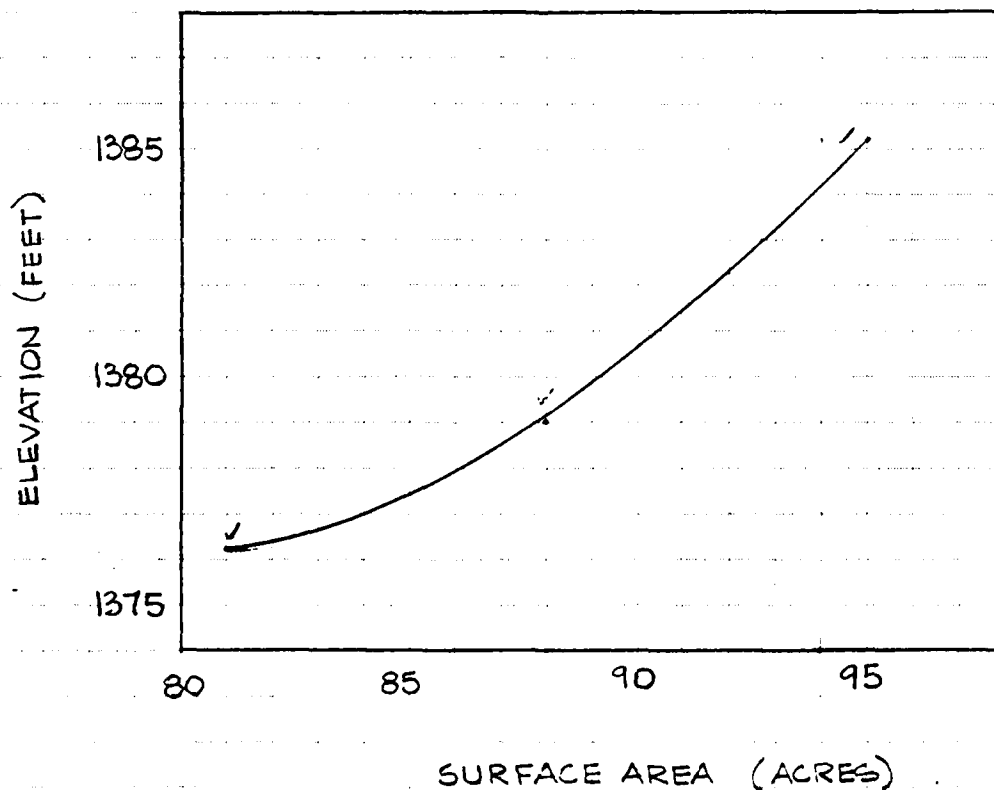
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JOB MA 00204 GREENWATER POND DAM
SHEET NO 4 OF 5
CALCULATED BY JW DATE _____
CHECKED BY Jmc DATE 1/2/81
SCALE _____

STAGE VS STORAGE

ELEV.	AREA (ACRES)	Δ STORAGE (AC-FT)	Σ STORAGE (AC-FT)
1376.2	81 ✓	1350 ✓	1350 ✓
1379.0	88 ✓	400 ✓	1750 ✓
1385.2	95 ✓	600 ✓	2350 ✓

STAGE VS SURFACE AREA



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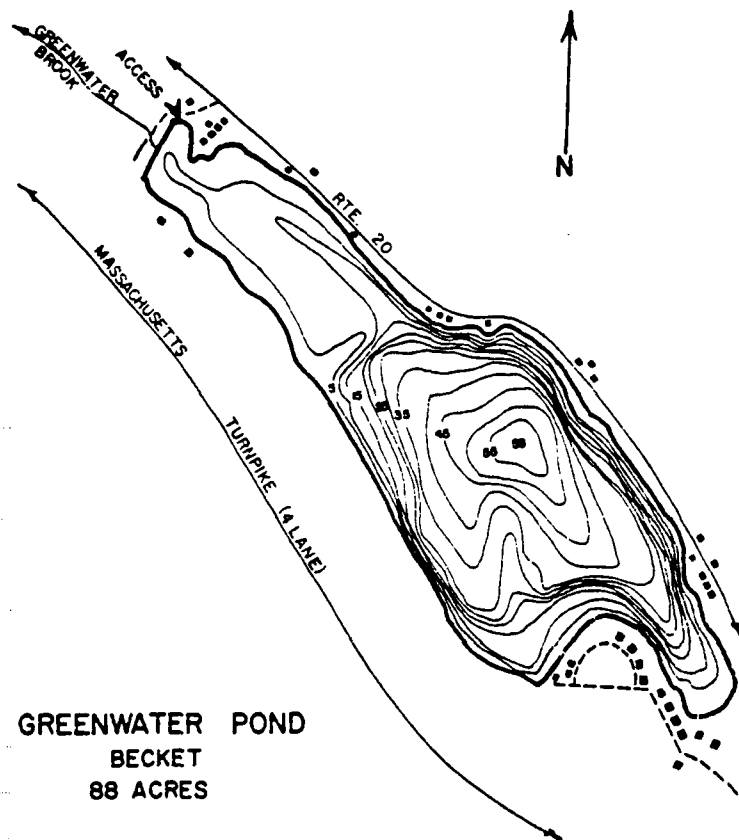
JOB MA 204 GREENWATER POND

SHEET NO 4A OF 15

CALCULATED BY RBH DATE 1/6/81

CHECKED BY _____ DATE _____

SCALE _____



GREENWATER POND
BECKET
88 ACRES

SOURCE:
AN INVENTORY OF
THE PONDS, LAKES,
AND RESERVOIRS
OF MASSACHUSETTS,
BERKSHIRE AND
FRANKLIN COUNTIES.
Water Resources
Research Center,
Publ. No. 10-2

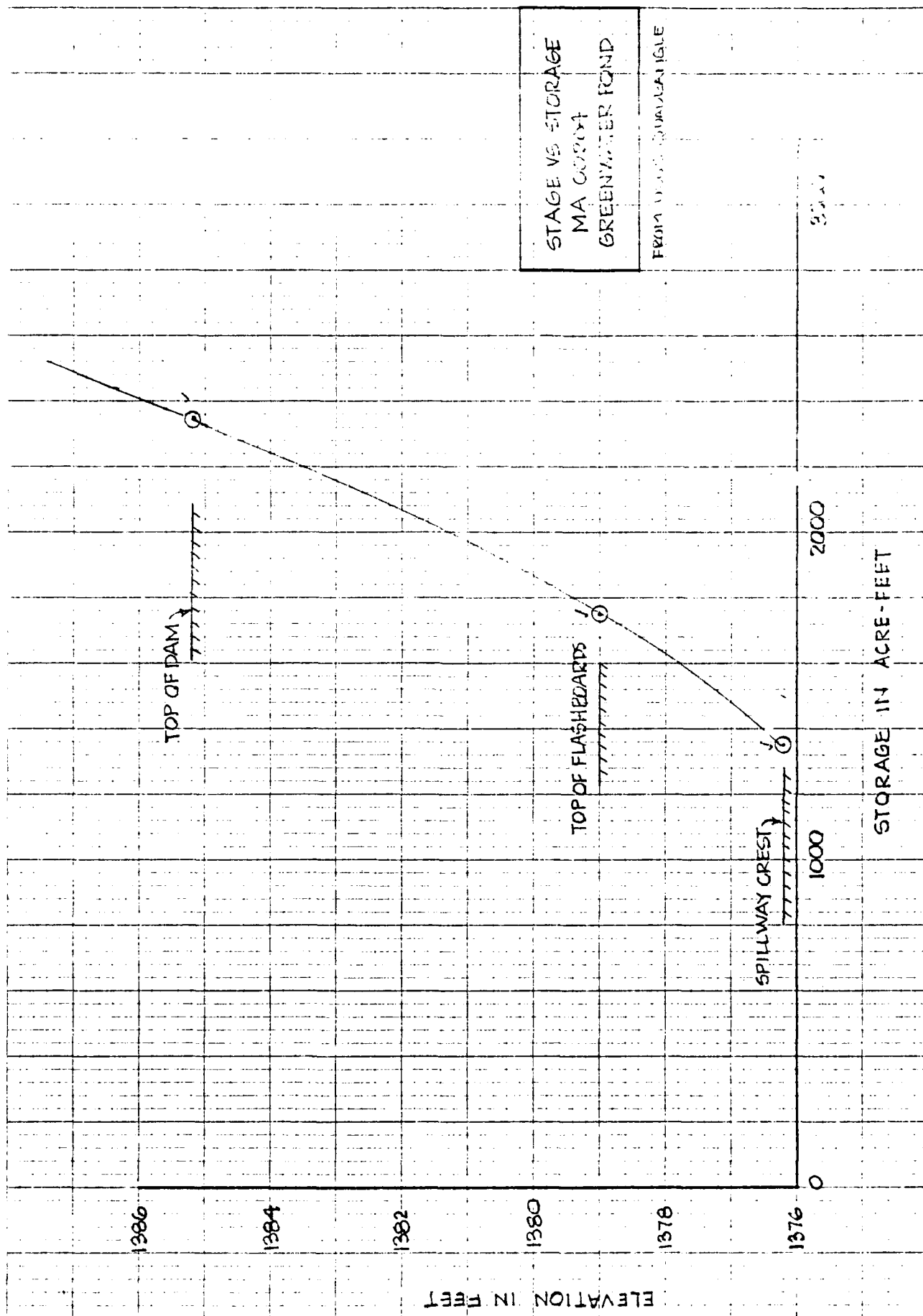
NORMAL IMPOUNDMENT:

$$\begin{array}{rcl} 16 \text{ Ac} & \times & 7' = 112 \text{ Ac-Ft} \\ \hline 72 & \times & 23' = 1656 \text{ Ac-Ft} \\ \hline 88 \text{ Ac} & & 1768 \text{ say } 1750 \text{ Ac-Ft} \end{array}$$

SURCHARGE STORAGE - TOP OF DAM

$$6.3' \times 95 \text{ Ac} \pm = 600$$

MAXIMUM STORAGE 2350 Ac-Ft



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JOB MA 00204 GREENWATER POND DAM

SHEET NO. 6 OF 15

CALCULATED BY JW DATE _____

CHECKED BY JMC DATE 1/2/20

SCALE _____

1/2 PMF TEST FLOOD ROUTING W/ FLASHSCARDS

$$Q_{P1} = 2300 \text{ CFS} \checkmark \quad R.O. = 19/2 = 9.5" \checkmark$$

$$Q_{P1} \rightarrow \text{EL. } 1386.6 \checkmark \rightarrow 2460 \text{ AC FT} \checkmark$$

$$\text{STORAGE @ } 1379.0 \rightarrow 1750 \text{ AC FT} \checkmark$$

$$\Delta \text{ STORAGE} = 710 \text{ AC FT} \checkmark$$

$$710 \text{ AC FT} \times \frac{1}{1.76 \text{ SQ MI}} \times \frac{\text{IN SQ MI}}{53.3 \text{ AC FT}} = 7.57" \checkmark$$

(STOR 1)

$$Q_{P2} = Q_{P1} \times \left(1 - \frac{\text{STOR 1}}{R.O.}\right)$$

$$Q_{P2} = 2300 \checkmark \times \left(1 - \frac{7.57}{9.5}\right) \checkmark = 467 \text{ CFS} \checkmark \rightarrow \text{EL. } 1383.2$$

$$\text{EL. } 1383.2 \checkmark \rightarrow 2180 \text{ AC FT} \checkmark$$

$$\Delta \text{ STORAGE} = 430 \text{ AC FT} \checkmark$$

$$430 \text{ AC FT} \times \frac{1}{1.76 \text{ SQ MI}} \times \frac{\text{IN SQ MI}}{53.3 \text{ AC FT}} = 4.58" \checkmark$$

(STOR 2)

$$\text{STOR AVE} = \frac{\text{STOR 1} + \text{STOR 2}}{2}$$

$$\text{STOR AVE} = \frac{7.57" + 4.58"}{2} = 6.08" \checkmark$$

$$6.08" \checkmark \times 1.76 \text{ SQ MI} \times \frac{53.3 \text{ AC FT}}{\text{IN SQ MI}} = 570 \text{ AC FT} \checkmark$$

$$570 \text{ AC FT} + 1750 \text{ AC FT} = 2320 \text{ AC FT} \checkmark$$

$$\text{EL. } 1384.9 \checkmark \rightarrow 850 \text{ CFS} \checkmark$$

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JOB MA 00204 GREENWATER POND DAM
SHEET NO. 7 OF 15
CALCULATED BY JW DATE _____
CHECKED BY WMC DATE 1/12/93
SCALE _____

1/2 PMF W/FLASHBOARDS (CONT.)

2ND ITERATION

$$Q_{p2} = 2300 \left(1 - \frac{6.08}{9.5}\right) = 828 \text{ CFS} \checkmark$$

$$\text{EL. 1384.8} \rightarrow 2330 \text{ AC FT} \checkmark$$

$$\Delta \text{ STORAGE} = 580 \text{ AC FT} \checkmark$$

$$580 \times \frac{1}{1.76} \times \frac{1}{53.3} = 6.18'' \checkmark$$

$$\text{STOR AVE} = \frac{6.08 + 6.18}{2} = 6.13'' \checkmark$$

$$6.13'' \times 1.76 \times 53.3 = 575 \text{ AC FT} \checkmark$$

$$575 \text{ AC FT} + 1750 \text{ AC FT} = 2325 \text{ AC FT} \checkmark$$

$$\text{EL. 1385.0} \rightarrow \underline{\underline{850 \text{ CFS}}} \checkmark$$

ROUTED OUTFLOW FOR 1/2 PMF TEST FLOOD WITH
FLASHBOARDS (TO EL. 1379.0) IS 850 CFS $\checkmark$

THE SPILLWAY CAPACITY AT TOP OF DAM IS
921 CFS W/ FLASHBOARDS IN PLACE TO EL. 1379.0 $\checkmark$

PMF TEST FLOOD ROUTING W/O FLASH-BOARDS

$$Q_{P1} = 4600 \text{ cfs } \checkmark \quad R.O. = 19" \checkmark$$

$$Q_{P1} \rightarrow \text{EL } 1387.4 \checkmark \rightarrow 2520 \text{ Ac FT STORAGE}$$

$$\text{STORAGE AT SPILLWAY CREST (1376.2)} = 1350 \text{ Ac FT } \checkmark$$
$$\Delta \text{STORAGE} = 1170 \text{ AC-FT } \checkmark$$

$$1170 \text{ AC FT} \times \frac{1}{1.76 \text{ SQ MI}} \times \frac{1 \text{ IN SQ MI}}{53.3 \text{ AC FT}} = 12.47" \checkmark (\text{STOR 1})$$

$$Q_{P2} = Q_{P1} \left(1 - \frac{\text{STOR 1}}{R.O.}\right)$$

$$Q_{P2} = 4600 \text{ CFS} \left(1 - \frac{12.47"}{19"}\right) = 1581 \text{ cfs } \checkmark$$

$$\text{EL } 1385.2 \checkmark \rightarrow 2350 \text{ AC FT } \checkmark$$
$$\Delta \text{STORAGE} = 1000 \text{ AC FT } \checkmark$$

$$1000 \text{ AC FT} \times \frac{1}{1.76 \text{ SQ MI}} \times \frac{1 \text{ IN SQ MI}}{53.3 \text{ AC FT}} = 10.66" \checkmark (\text{STOR 2})$$

$$\text{STOR AVE.} = \frac{12.47" + 10.66"}{2} = 11.57" \checkmark$$

$$11.57" \times 1.76 \text{ SQ MI} \times \frac{53.3 \text{ AC FT}}{1 \text{ IN SQ MI}} = 1085 \text{ AC FT } \checkmark$$

$$1085 \text{ AC FT} + 1350 \text{ AC FT} = 2435 \text{ AC FT } \checkmark \rightarrow$$

$$\text{EL } 1386.4 \rightarrow 2100 \text{ CFS}$$

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JOB GREENWATER

SHEET NO. 9 OF 15

CALCULATED BY JW DATE 1/21/00

CHECKED BY JMC DATE 1/21/00

SCALE _____

PMF W/O FLASH-BOARDING (3.7)

2ND ITERATION:

$$Q_{p2} = 4600 \left(1 - \frac{11.57}{19}\right) = 1800 \text{ CFS } \checkmark$$

$$\text{EL } 1385.6 \checkmark \rightarrow 2380 \text{ AC FT STORAGE}$$

$$\Delta \text{ STORAGE} = 1030 \text{ AC FT } \checkmark$$

$$1030 \text{ AC FT } \checkmark \times \frac{1}{1.76 \text{ SQ MI}} \times \frac{1 \text{ IN SQ MI}}{53.3 \text{ AC FT}} = 10.98'' \checkmark$$

$$\text{STOR AVE} = \frac{11.57'' + 10.98''}{2} = 11.27'' \checkmark$$

$$11.27'' \times 1.76 \times 53.3 = 1058 \text{ AC FT } \checkmark$$

$$1058 \text{ AC FT} + 1350 \text{ AC FT} = 2408 \text{ AC FT } \rightarrow$$

$$\text{EL } 1386.0 \checkmark \rightarrow 2390 \text{ CFS } \checkmark$$

3RD ITERATION

$$Q_{p2} = 4600 \left(1 - \frac{11.27}{19}\right) = 1871 \text{ CFS } \checkmark \rightarrow \text{EL } 1385.7 \checkmark \rightarrow 2390 \text{ AC FT}$$

$$\Delta \text{ STORAGE} = 1040 \text{ AC FT } \checkmark$$

$$1040 \text{ AC FT } \checkmark \times \frac{1}{1.76} \times \frac{1}{53.3} = 11.09'' \checkmark$$

$$\text{STOR AVE} = \frac{11.27'' + 11.09''}{2} = 11.18'' \checkmark$$

$$11.18'' \times 1.76 \times 53.3 = 1049 \text{ AC FT } \checkmark$$

$$1049 \text{ AC FT } \checkmark + 1350 \text{ AC FT } \checkmark = 2399 \text{ AC FT } \checkmark \rightarrow \text{EL } 1385.9 \checkmark \rightarrow$$

2200 CFS = PMF OUTFLOW W/O FLASHBOARDS. THIS
WOULD OVERTOP DAM BY APPROX. 0.7 FT $\checkmark$

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JOB GREENWATER

SHEET NO. 10 OF 15

CALCULATED BY JW DATE _____

CHECKED BY Jm DATE 11-2-83

SCALE _____

SUMMARY

	<u>1/2 PMF</u> <u>W/ FLASHBOARDS</u>	<u>PMF</u> <u>W/O FLASHBOARDS</u>
INFLOW	2300 CFS ✓	4600 CFS ✓
ROUTED OUTFLOW	850 CFS ✓	2200 CFS ✓
FLOOD ELEV	1334.9 NGVD ✓	1385.9 NGVD ✓
STORAGE AT FLOOD ELEV	2325 Ac Ft ✓	2400 Ac Ft ✓
SPILLWAY CAP AT FLOOD ELEV	850 CFS ✓	1506 CFS
TOP OF DAM ELEV	1385.2 NGVD ✓	1385.2 NGVD ✓
SPILLWAY CAP AT TOP OF DAM ELEV	921 CFS ✓	1506 CFS ✓
% ROUTED OUTFLOW	108 % ✓	68 % (DAM OVERTOPPED BY 0.7') ✓

BREACH ANALYSIS

ASSUME BREACH WIDTH, $W_b = 40\%$ CREST LENGTH
AT M.O. HEIGHT

$$W_b = 0.4 \times 60' = 24'$$

$$Q_{PI} = \frac{8}{27} W_b \sqrt{g} y_0^{3/2}$$

$$y_0 = 18' \text{ (BOTTOM OF STILLING POOL TO TOP OF DAM)}$$

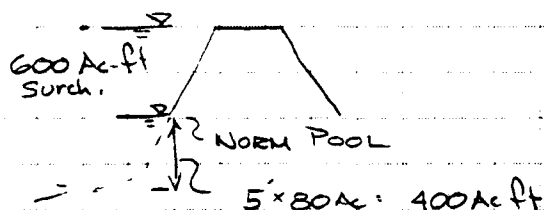
$$Q_{PI} = \frac{8}{27} \times 24' \times 32.2^{1/2} \times 18^{3/2} = 3032 \text{ CFS}$$

ANTECEDENT DISCHARGE (SPILLWAY CAPACITY AT
TOP OF DAM)

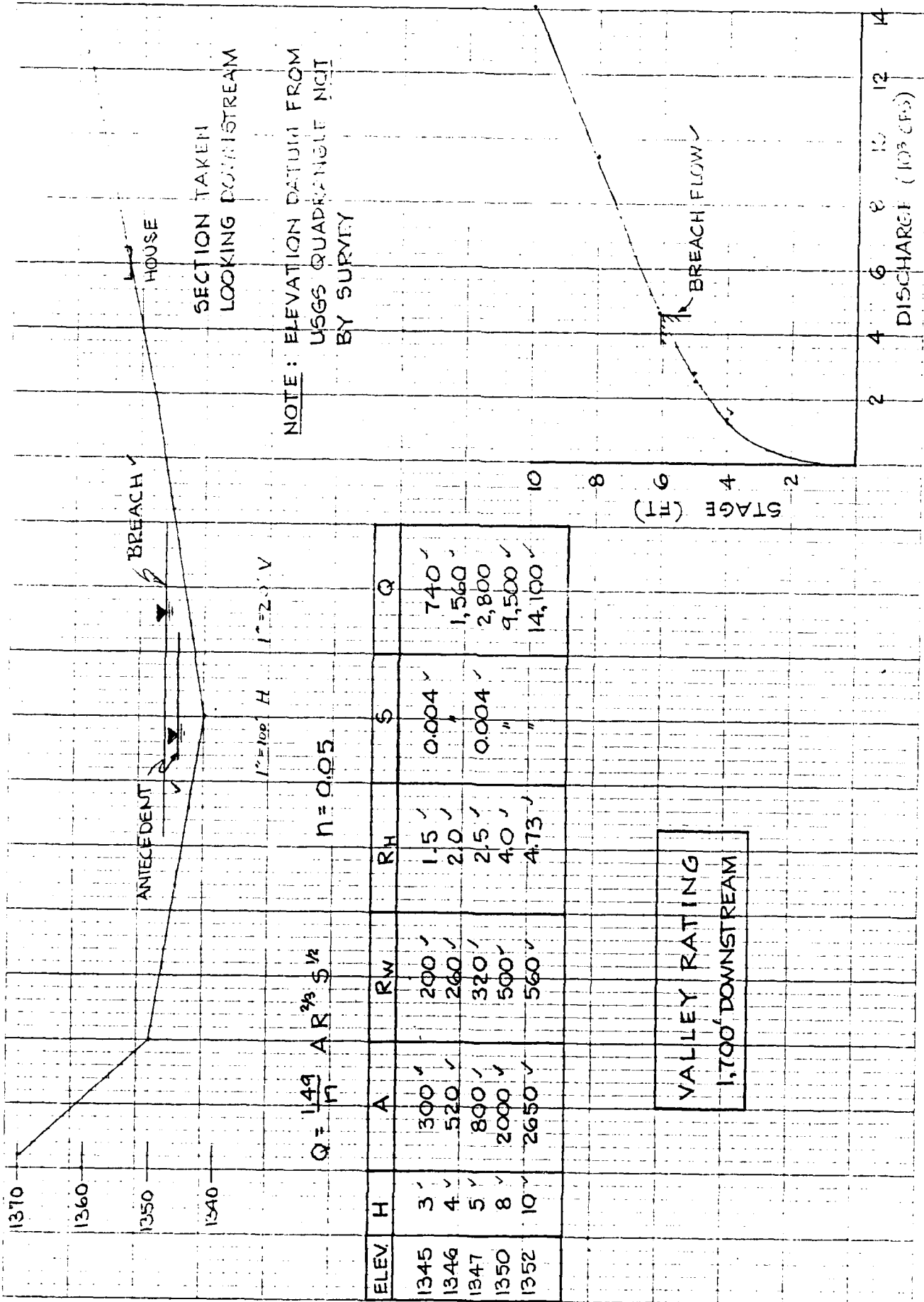
$$\text{W/ FLASHBOARDS} = 921 \text{ CFS}$$

$$\text{W/O FLASHBOARDS} = 1538 \text{ CFS}$$

$S =$ STORAGE VOL. THAT COULD
DRAIN THROUGH BREACH $\approx 1000 \text{ Ac-ft}$



$$S \approx 600 + 400 = 1000 \text{ Ac-ft}$$



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JOB GREENWATER POND

SHEET NO. 13 OF 15

CALCULATED BY JW DATE _____

CHECKED BY _____ DATE _____

SCALE _____

ATTENUATION OF BEACH FLOW BY CONVECTIONAL ALGAE CUTS

$Q_{D1} \approx 4600$ CFS, FROM STAGE/DISCHARGE CURVE (SHT 12 OF)
 $H = 2'$ & $V_1 = 80$ AC-FT

$$Q_{D2} = Q_{D1} \left(1 - \frac{V_1}{S}\right)$$

$$Q_{D2} = 4600 \left(1 - \frac{80}{1000}\right)$$

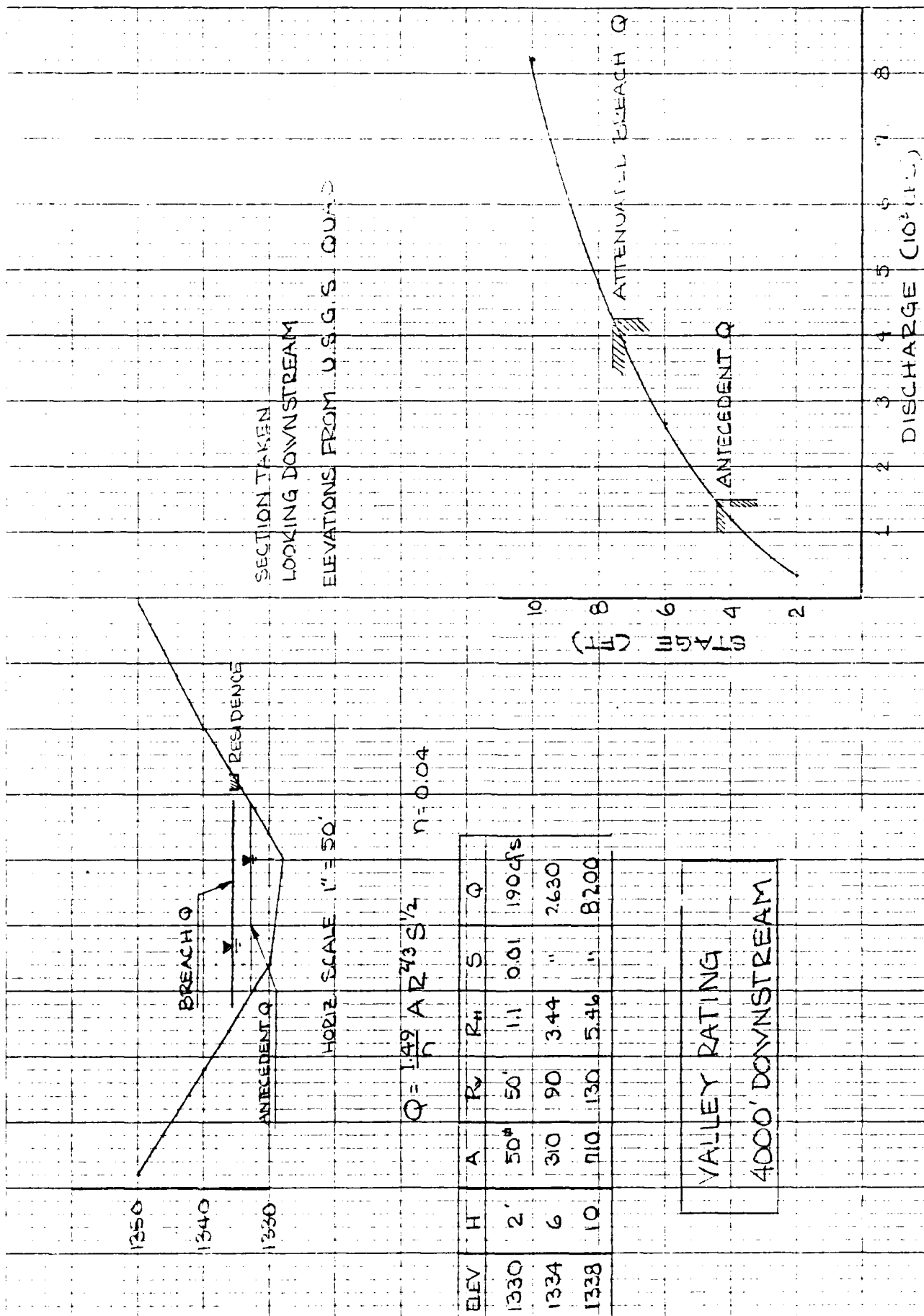
$$Q_{D2} = 4230 \text{ CFS}$$

$$V_2 = 68 \text{ AC-FT}$$

$$V_{AVE} = \frac{V_1 + V_2}{2} = \frac{80 + 68}{2} = 74 \text{ AC-FT}$$

$$Q_{D2} = 4600 \left(1 - \frac{74}{1000}\right)$$

$$Q_{D2} = 4260 \text{ CFS}$$



AD-A154 558

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HOUSATONIC RIVER BASIN (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 81

2/2

UNCLASSIFIED

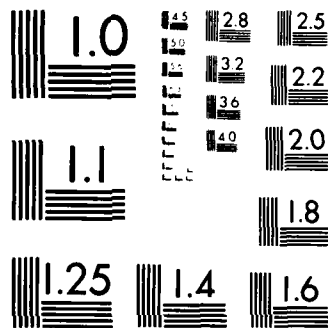
F/G 13/13

NL

END

FILED

SEP



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

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JOB GREENWATER POND MA 204
SHEET NO 15 OF 15
CALCULATED BY JIV DATE 1/17/91
CHECKED BY _____ DATE _____
SCALE _____

DOWNSTREAM BRIDGE IMPACT

1 BRIDGE AT CHESTNUT ST. - 13,000' D/S FROM DAMSITE

H = 10.5'
W = 34'
S = 0.04
n = 0.03

$$Q = \frac{1.49}{n} A R_H^{2/3} S^{1/2}$$

ELEV.	H	AREA	W/D	R _H	Q
1120±	0	0			0
1125	5'	170 [#]	44'	3.36'	4,160 cfs
1130.5	10.5	357	56	6.38	12,200

NOTE: THE ATTENUATED BREACH FLOW OF 4260 CFS WOULD HAVE A W/S ELEV. OF APPROX. 1125 (DE = 5'±) AT THIS STRUCTURE WITH A VELOCITY OF ABOUT 25 FPS. THE SILL ELEVATION OF THE LOWEST U/S RESIDENCE IS APPROX 1130.

2 BRIDGE AT ROUTE 20 - 3.2 MILES D/S FROM DAMSITE

H = 9'
W = 32'
S = 0.024
n = 0.03

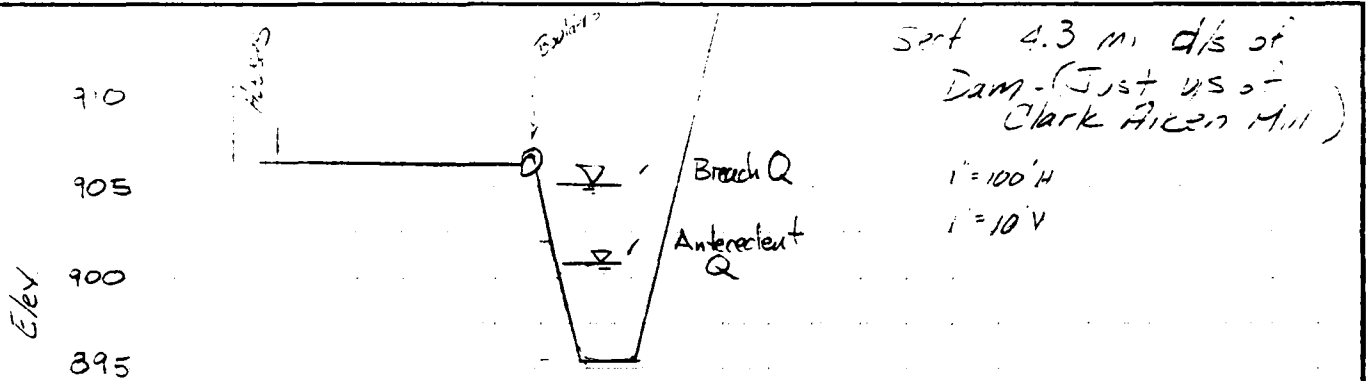
$$Q = \frac{1.49}{n} A R_H^{2/3} S^{1/2}$$

ELEV.	H	AREA	W/D	R _H	Q
	0	0			0
	6'	192 [#]	44'	4.36	3,960 cfs
	9	288	50	5.76	7,130

NOTE: THE ATTENUATED BREACH FLOW OF 4260 CFS WOULD HAVE A DEPTH OF FLOW OF APPROX 6'± AT THIS STRUCTURE WITH A VELOCITY OF ABOUT 21 FPS. THE LOWEST U/S RESIDENCE HAS A SILL ELEV. APPROX. 15' ABOVE THE CHANNEL AT THIS LOCATION. ^{Note} STRUCTURES ARE CLOSE TO CHANNEL. COULD BE MAJOR STREAM BANK EROSION - WHICH COULD ENDANGER STRUCTURES. CLARK AIKEN PLANT IN EAST LEE DAMAGED DURING FAILURE OF LAKE LEE (BASIN POND).

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JOB MA 20204
SHEET NO. 15A OF 15
CALCULATED BY JFC DATE 3/31/81
CHECKED BY REH DATE 4/7/81
SCALE _____



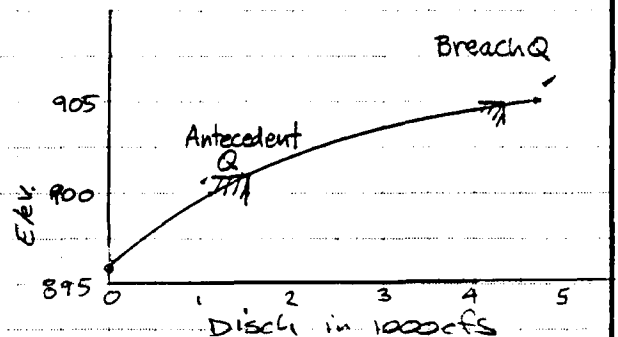
Section 2300' up of Confluence w/ Housatonic R.
Looking U.S.

$$S = 0.02'$$

$$Q = \frac{1.49}{n} A R_h^{2/3} S^{1/2}$$

use $n = 0.07$

Elev	Depth (ft)	A (ft ²)	W _P (ft)	R _h	S ^{1/2}	Q (cfs)
896	0				0.14	0
900	4	160	50	3.2	"	1027
905	9	473	78	6.1	"	4631



Note - Some large
boulders in channel
say water 1' higher due to
this factor

Note - Breach flow would not flood houses but
could cause streambank erosion - mill (Clark Aiken)
near stream - $V = 10$ fps

APPENDIX E

**INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS**

Greenwater Pond Dam

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

DTIC