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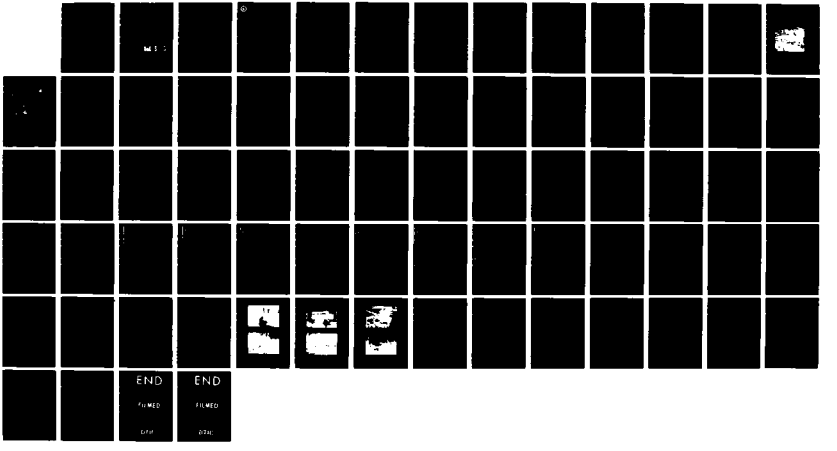

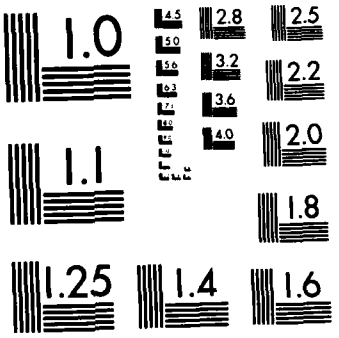

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SAUGUS RIVER BASIN
SAUGUS, MASSACHUSETTS

GRISWOLD POND DAM
MA 00292

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

OCTOBER 1979

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00292	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Griswold Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE October 1979 13. NUMBER OF PAGES 40
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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

18. SUPPLEMENTARY NOTES

Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

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

DAMS, INSPECTION, DAM SAFETY,

Saugus River Basin
Saugus, Massachusetts
Bennetts Pond Brook - Tributary of the Saugus River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

-Griswold Pond Dam is a 500 foot long, 9.5 foot high earthfill embankment. The dam is in poor condition and has been overtopped at least five times in the past. There are deficiencies which must be corrected to assure the continued performance of this dam. The size of the dam is small and it is significant in the hazard category.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

JAN 17 1980

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

Dear Governor King:

Inclosed is a copy of the Griswold Pond Dam 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 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,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

GRISWOLD POND DAM

MA 00292

SAUGUS RIVER BASIN
SAUGUS, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: MA00292

Name of Dam: Griswold Pond

Town: Saugus

County and State: Essex County, Massachusetts

Stream: Bennetts Pond Brook - Tributary of the Saugus River

Date of Inspection: April 23, 1979

Griswold Pond Dam is a 500-foot long, 9.5-foot high earthfill embankment built about 1918 to form Lake Dam Road. The top of the dam varies from elevation (El) 103.6 to 105.5. The side slopes are approximately 1.5:1 (horizontal to vertical). The spillway is a 6-foot long, ungated weir located near the north abutment of the dam. The crest of the spillway is at El 103.4. Water flows over the weir and into two 24-inch concrete pipes which extend through the embankment. The invert of the upstream end of the pipes is at El 102.0. There is no low-level outlet at the dam.

There are deficiencies which must be corrected to assure the continued performance of this dam. This conclusion is based on the visual inspection of the site, and a review of past inspection reports. There are no drawings available showing design or construction of the dam. The Owner of the dam could not be determined, and no operating or maintenance procedures appear to exist. The dam is in poor condition and has been overtopped at least five times in the past.

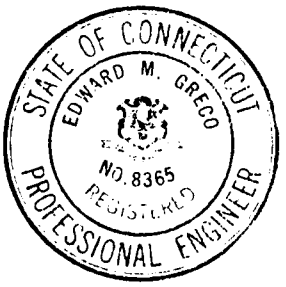
The following deficiencies were observed at the site: seepage at several locations on the downstream face of the dam, erosion of the top and slopes of the dam, inadequate freeboard due to the high level of the

spillway crest, steep slopes on the embankment, eroded riprap on the upstream slope of the dam, trees and brush growing on the slopes of the dam, and the lack of a low-level outlet.

Based on Corps of Engineers' guidelines, the dam has been classified in the "small" size and "significant" hazard categories. The drainage area is 0.22 square miles. The test flood inflow (one-half the probable maximum flood (PMF)) was estimated to be 210 cubic feet per second (cfs). A test flood outflow of 155 cfs with the pond at El 105.0 will overtop the dam by a maximum of 1.4 feet. The existing spillway can discharge 2 cfs which is only 1 percent of the test flood outflow before the dam is overtopped.

It is recommended that the Ownership of the dam immediately be established. The Owner should immediately lower the pond to a level at least 3 feet below the crest of the spillway to minimize the overtopping potential and maintain that level until the results of further studies by a qualified engineering Consultant are implemented. The Owner should employ a qualified engineering Consultant to evaluate the static and seismic stability of the dam, the seepage at the downstream toe, and the extent of repairs or reconstruction of the embankment. The Consultant should also conduct a more detailed hydraulic and hydrologic investigation to design an adequate spillway and a low-level outlet for the dam. The Owner should also implement programs of monthly maintenance and annual technical inspections, a plan for surveillance of the embankment during and after periods of unusually high runoff, and a plan for notifying nearby residents in the event of an emergency at the project.

The measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase 1 Inspection Report. An alternative to the recommendations and remedial measures would be to drain the pond and breach or remove the dam. The effect of breaching or removing the dam on the stability of Lower Pond Dam, located downstream, should be evaluated by the Consultant.



Edward M. Greco, P.E.
Project Manager
Metcalf & Eddy, Inc.

Connecticut Registration
No. 08365

Approved by:

Stephen L. Bishop, P.E.
Vice President
Metcalf & Eddy, Inc.

Massachusetts Registration
No. 19703

This Phase I Inspection Report on Griswold Pond Dam 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

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

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, CHAIRMAN
Chief, Structural Section
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in Recommended Guidelines for Safety Inspection of Dams, for a Phase I Investigation. 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 investigations, 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 will 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 aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general conditions and the downstream damage potential.

GRISWOLD POND DAM

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OVERVIEW
GRISWOLD POND DAM
SAUGUS, MASSACHUSETTS

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. The Owner of the dam could not be determined. Discussions with residents of the area indicate that there are no operating or maintenance procedures at the dam. Occasionally, the Town of Saugus will repair the surface of Lake Dam Road. Also, minor maintenance of the road is performed by a resident on Lake Dam Road who reportedly fills in potholes and oils the road in front of his house.

4.2 Maintenance of Dam. There is no maintenance program at the dam.

4.3 Maintenance of Operating Facilities. The spillway or discharge pipes at the dam are not maintained.

4.4 Description of Any Warning System in Effect. There is no warning system in effect at this dam.

4.5 Evaluation. There are no regular programs of maintenance or technical inspections at the dam. There is also no program for surveillance or a warning system in effect during periods of unusually heavy runoff. This is undesirable considering that the dam is in the "significant" hazard category. These programs should be implemented as recommended in Section 7.3.

3.2 Evaluation. The above findings indicate that the dam is in poor condition and that there are deficiencies which must be corrected to assure proper performance of this dam in the future. It is evident that the dam is not adequately maintained. Recommended measures to improve these conditions are stated in Section 7.3.

Other swampy areas were noted in back yards of downstream residents. Four residences have been constructed immediately downstream of the dam on a section of land located between Griswold Pond and Lower Pond. One resident has installed a perforated drain in his back yard with an outlet to Lower Pond. The drain was flowing.

The abutments tie into natural ground. There is a large outcrop of bedrock at the south abutment, and several outcrops occur downstream of the dam.

c. Appurtenant Structures. Near the north abutment of the dam, there is a 6-foot long, ungated weir which discharges into two 24-inch concrete pipes. This weir functions as the outlet to the dam. The crest of the weir is at El 103.4 and the invert of the discharge pipes is at El 102.0. The pond can only be maintained about 0.2 feet below the existing low area on the top of the dam. The berm along the upstream edge of the top of the dam prevents more frequent overtopping.

Masonry training walls extend outward from the headwall of the discharge pipes for a distance of about 6 feet. The training walls and headwall are in fair condition. The weir is irregular and made of bituminous concrete covering rock fill. There is no trash rack to prevent debris from clogging the discharge pipes.

d. Reservoir Area. The area around Griswold Pond is partially wooded and moderately developed with residences and paved and unpaved streets. The land slopes at about 5 to 20 percent. The full development that was apparently intended for this section of the Golden Hills District has never been completed.

e. Downstream Channel. Water from the outlet pipes flows downstream in a channel and then under Sweetwater Street in a 24-inch concrete culvert, which discharges into Lower Pond. The channel is lined with stones and the side slopes are nearly vertical. There are trees growing along both sides of the channel (see photograph No 4).

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam at Griswold Pond was performed on April 23, 1979. A copy of the inspection checklist is included in Appendix A. Previous inspections of the dam have been made by others in the past. Excerpts from these inspection reports are included in Appendix B.

b. Dam. Griswold Pond Dam, the middle in a series of three dams, is an earthfill dam. The top of the dam is Lake Dam Road. The dam was found to be in poor condition, a condition that has apparently been prevalent since the first inspection in 1928. The top of the dam is covered by an asphalt road which is in poor condition. The road is uneven and has a series of potholes. A small gravelly sand berm has been placed along the upstream edge of the top of the dam to minimize overtopping. Both the upstream and downstream slopes are steep. These slopes are estimated to be about 1.5 to 1 (horizontal to vertical). Some sloughing was noted on both slopes. The downstream slope shows evidence of erosion, either by surface drainage or past flooding over the dam. Drainage from the road flows either to Griswold Pond or along the downstream slope. Past inspection reports state that riprap formerly on the upstream slope began to slide into the pond in 1962. There is no visible portection on the downstream slope. Both slopes are covered with a thick growth of trees and brush.

Evidence of extensive seepage was noted at the downstream toe. One seepage area was observed about 130 feet downstream from the dam. Seepage flows across Sweetwater Street, situated on the upstream edge of Lower Pond (see Photograph No. 5).

SECTION 2

ENGINEERING DATA

2.1 General. The only data available on the dam are reports and notes from past inspections obtained from the Essex County Engineer's Office (copies in Appendix B). There are no known plans, specifications or computations available from the Town, County or State offices relative to the design, construction, or repair of this dam.

We acknowledge the assistance and cooperation of personnel from the Town of Saugus and from the Essex County Engineer's Office.

2.2 Construction Records. There are no construction records or as-built drawings available for this dam.

2.3 Operating Records. No operating records are available, and there is no daily record kept of the elevation of the pool or rainfall at the dam site.

2.4 Evaluation

a. Availability. There is no engineering data available. Past inspection reports and notes provide the only background data.

b. Adequacy. The lack of hydraulic, structural and construction data did not allow for a definitive review. Therefore, the evaluation of the adequacy of this dam is based on a visual inspection, a review of the past inspections reports, and engineering judgment.

c. Validity. Comparison of the available inspection reports with the field survey conducted during the Phase I inspection indicates that the available information is valid.

(5) Upstream channel: stone masonry training walls 3 feet high; natural bottom of soil and stone

(6) Downstream channel: two 24-inch diamter conduits through dam discharge into a 6-foot wide, 3-foot deep channel

j. Regulating Outlets. There is no regulating outlet at the dam.

f. Reservoir Surface (acres)

*(1) Top of dam: 12.4

*(2) Test flood pool: 12.4

(3) Flood control pool: N/A

(4) Recreation pool: 12.4

(5) Spillway crest: 12.4

g. Dam

(1) Type: earthfill

(2) Length: 500 feet

(3) Height: 9.5 feet

(4) Top width: 10 feet

(5) Side slopes: 1.5:1 upstream and downstream

(6) Zoning: Unknown

(7) Impervious core: Unknown

(8) Cutoff: Unknown

(9) Grout curtain: Unknown

i. Spillway

(1) Type: Sharp-crested weir

(2) Length of weir: 6 feet

(3) Crest elevation: 103.4

(4) Gates: None

*Based on the assumption that the surface area will not increase significantly with changes in reservoir elevation from 103.4 to 105.0.

c. Elevation (feet above Mean Sea Level (MSL)). A benchmark was established at El 102.0 at the upstream invert of the discharge pipes. This elevation was estimated from the U.S. Geological Survey topographic quadrangle.

(1) Top of dam: 103.6 to 105.5

(2) Test flood pool: 105.0

(3) Design surcharge: Unknown

(4) Full flood control pool: Not Applicable (N/A)

(5) Recreation pool: 103.4

(6) Spillway crest (ungated): 103.4

(7) Upstream portal invert diversion tunnel: N/A

(8) Stream bed at centerline of dam: 96.0

(9) Maximum tailwater: N/A

d. Reservoir

(1) Length of maximum pool: 700 feet

(2) Length of recreation pool: 700 feet

(3) Length of flood control pool: N/A

e. Storage (acre-feet)

(1) Test flood surcharge (net): 20 at El 105.0

(2) Top of dam: 54

(3) Flood control pool: N/A

(4) Recreation pool (El 103.4): 51

(5) Spillway crest (El 103.4): 51

Pond (see drainage area shown on Location Map). Spring Pond Dam is located at the northwest corner of Griswold Pond. The flow from Spring Pond is conducted directly into Griswold Pond through four 10-inch diameter, cast-iron pipes with inverts at El 107.5 upstream and El 105.7 downstream (see Section 4-4 on Figure B-2 and photograph No. 6).

The topography of the drainage area is hilly with slopes ranging from 5 to 20 percent. About one-third of the area is moderately developed with residential housing. The remaining area is wooded.

b. Discharge. Normal discharge from Griswold Pond flows over a 6-foot long, ungated spillway and into two 24-inch diameter concrete pipes that carry water through the embankment of the dam. The crest of the spillway is at El 103.4, and the invert of the 24-inch pipes is at El 102.0. Discharge from the pipes flows in a 6- foot wide, 3-foot deep channel for a distance of about 150 feet downstream. At that point, the stream enters a 24-inch diameter metal culvert beneath Sweetwater Street and then flows into Lower Pond.

Hydraulic analyses indicate that the existing spillway can discharge 2 cfs when the pond is at El 103.6, which is the low point on the crest of the dam. A test flood outflow (one-half PMF) of 155 cfs with the pond at El 105.0 will overtop the dam by a maximum of 1.4 feet. The existing spillway can discharge only 1 percent of the test flood before the dam is overtopped. If the weir was removed, the 24-inch pipes could discharge 18 cfs or 16 percent of the test flood outflow before the dam is overtopped.

The only data available on past flood levels at the dam are visual observations made in the previous inspection reports by the Essex County Engineer's Office (see pages B-3 through B-17). These state that the dam was overtopped in 1933, 1944, 1950, 1952 and 1954.

There is no record that drawings for the dam were submitted to the County for approval. In fact there were probably never any drawings for the dam since it was originally built as an access road. The inspection reports state than the dam was built about 1918, when roadways were constructed for the "Golden Hills" housing development.

Records indicate that the original spillway or outlet at the dam was a 3-foot high, 2-foot wide stone box culvert. A new 24-inch outlet pipe was installed in 1940, but had collapsed by 1942. In 1943, two new 24-inch outlet pipes were installed, and "the spillway was enlarged". Sometime in 1944-1946, the present spillway weir was constructed just upstream of the outlet pipes.

The dam has a history of being in poor condition and repeatedly overtopped (1933, 1944, 1950, 1952, 1954). Prior to construction of the new outlet pipes, the dam is described as "unsafe" and it was recommended that the spillway capacity be increased as well as the top of the dam be raised and widened. Local residents had built up the top of the dam in places to minimize overtopping. Erosion of the slopes and seepage at the downstream toe had also occurred. After the outlet pipes were installed, the dam was still overtopped. The weir was added upstream, but this only served to decrease the freeboard on the dam. Erosion of the slopes has continued, and failures of the riprap began occurring in 1962. Seepage through the dam was last mentioned in the 1950 report.

1. Normal Operating Procedures. There are no operating procedures at Griswold Pond Dam. Flow over the spillway is uncontrolled, and there is no low-level outlet.

1.3 Pertinent Data

a. Drainage Area. The 141-acre drainage area for Griswold Pond Dam includes 51 acres to Spring Pond and 90 acres direct drainage to Griswold

d. Hazard Classification. Four residences are located on the section of land between Griswold Pond Dam and Lower Pond. If Griswold Pond failed, property damage and some loss of life could occur. In addition, failure of Griswold Pond Dam could cause damage to properties below Lower Pond and possible failure of that dam. Therefore, the dam has been placed in the "significant" hazard category.

e. Ownership. Ownership of the dam could not be determined. The Owner of the dam was unknown by the Conservation Commission, Board of Selectmen, Town Manager, Board of Assessors, and the Town Engineering Department. The dam was constructed by Mr. Griswold around 1918 as an access road for a residential subdivision. Today Lake Dam Road (i.e., the dam) is an unaccepted street in the Town of Saugus. The Conservation Commission reportedly purchased the water rights to Griswold Pond several years ago. Mrs. Walter Ames (last owner of water rights and parcel of property) indicated that she sold the "property" and water rights to the Town several years ago.

It is assumed that the Town of Saugus is responsible for this dam. Therefore, copies of this report should be sent to Mr. D. Smith, Chairman, Board of Selectmen, Town Hall, Saugus, Massachusetts.

f. Operators. There are no operators of the dam.

g. Purpose of Dam. Griswold Pond serves as a small recreational pond. The dam was originally built as an access road to a residential subdivision.

h. Design and Construction History. The only records available on the design and construction of Griswold Pond Dam are the previous inspection reports from the Essex County Engineer's Office (see pages B-3 through B-17).

unnamed is referred to herein as "Lower Pond". Discharge from Griswold Pond flows into Lower Pond and then into a swamp at the headwaters of Bennets Pond Brook, a tributary of the Saugus River. Griswold Pond Dam is located in the Town of Saugus, Essex County, Massachusetts (see Location Map). The coordinates of the dam location are latitude 42 deg. 28.4 min. north and longitude 71 deg. 3.1 min west.

b. Description of Dam and Appurtenances. Griswold Pond Dam is a 500-foot long earthfill embankment with a maximum height of 9.5 feet (see Figures B-1 and B-2 and photographs in Appendix C). Lake Dam Road is a single-lane, asphalt-paved street located on the top of the dam. The embankment was built about 1918, during the development of the "Golden Hills" District of Saugus. The top of the dam is 10 feet wide and varies from El 103.6 to El 105.5. The top of the dam has been built up in places along the upstream edge to prevent overtopping. The upstream and downstream slopes are irregular and slope at approximately 1.5:1 (horizontal to vertical). The slopes are covered with trees and bushes.

The spillway consists of a 6-foot long, ungated weir located upstream of two concrete pipes which extend through the embankment (see Section 2-2 on Figure B-2). The crest of the weir is at El 103.4. The pipes are 24-inch diameter with an invert at El 102.0. Mortared stone walls 3 feet high form the sidewalls of the spillway and headwall around the discharge pipes. The pipes discharge on the downstream slope of the dam about 3 feet above the toe. The slope below the pipes is covered with rock and surfaced with concrete (see photograph No. 3). The flow continues downstream in a 6-foot wide, 3-foot deep channel lined with stone.

c. Size Classification. Griswold Pond Dam is classified in the "small" category, since it has a maximum height of 9.5 feet and a maximum storage capacity of 54 acre-feet.

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

GRISWOLD POND

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Metcalf & Eddy, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Contract No. DACW 33-79-C-0054, dated March 27, 1979, has been assigned by the Corps of Engineers for this work.

b. Purpose:

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to quickly initiate effective dam safety programs for non-Federal dams.

(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Griswold Pond is the middle pond in a series of three ponds. The upper pond is Spring Pond, while the lower pond although

LOCATION MAP – GRISWOLD POND

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Drainage to Griswold Pond originates in moderately developed, hilly areas in the Town of Saugus. The drainage area consists of 90 acres (0.14 square miles) directly tributary to Griswold Pond plus an additional 51 acres (0.08 square miles) which drain to Spring Pond which in turn discharges into Griswold Pond. The dam at Griswold Pond is a 500-foot long, 9.5-foot high earthfill dam. A 6-foot long ungated spillway discharges into two 24-inch pipes which lead to a stream channel. The crest of the spillway is at El 103.4, and the invert of the 24-inch pipes is at El 102.0. There is no low-level outlet at the dam. The maximum storage capacity in Griswold Pond is estimated to be 54 acre-feet.

b. Design Data. There are no hydraulic or hydrologic computations available for the design of this dam. The dam appears to have been built as a road embankment during development of the Golden Hills District of Saugus. According to past inspection reports, the dam was constructed without knowledge of the County Engineer's Office.

c. Experience Data. Hydraulic records are not available for this dam. Past inspection reports indicate that the dam has been overtopped at least five times (1933, 1944, 1950, 1952, 1954).

d. Visual Inspection. The crest of the spillway is very close to the elevation of the lowest point on the top of the dam. Past inspection reports indicate that a weir was placed upstream of the discharge pipes sometime between 1944 and 1946, which has further decreased freeboard on the dam. There is no low-level outlet to draw down the pond in anticipation of a storm.

A more detailed discussion of the condition of the dam and appurtenances is given in Section 3, Visual Inspection.

e. Test Flood Analysis. Griswold Pond Dam has been classified in the "small" size and "significant" hazard categories. According to the Corps of Engineers' guidelines, a test flood ranging from a 100-year storm and to a one-half probable maximum flood (PMF) should be used to evaluate the capacity of the spillway. The one-half PMF was selected for this analysis.

The test flood inflow to Griswold Pond Dam was determined after an analysis was made of the runoff into Spring Pond, located upstream. A PMF rate of 3,000 cfs per square mile was determined for the Spring Pond drainage area. Using one-half the full PMF over a drainage area of 0.08 square miles produced a test flood inflow of 120 cfs. When adjusted for storage, the peak outflow from Spring Pond into Griswold Pond was determined to be 79 cfs.

The PMF rate for the drainage area directly tributary to Griswold Pond was determined to be 2,800 cfs per square mile. This calculation is based on the average slope of the drainage area of 4.1 percent, the pond-plus-swamp area to drainage area ratio of 0 percent, and the U.S. Army Corps of Engineers' guide curves for Maximum Probable Peak Flow Rates (dated December 1977). Applying one-half the PMF to the 0.14 square miles of drainage area results in a calculated peak flood flow of 196 cfs as the inflow test flood. Using this test flood inflow plus the test flood outflow from Spring Pond, and then adjusting for the delayed occurrence of outflow from Spring Pond, the peak test flood inflow at Griswold Pond Dam was estimated to be 210 cfs. By adjusting the test flood inflow for surcharge storage, the maximum discharge rate was established as 155 cfs (705 cfs per square mile) with a water surface at El 105.0. The low area on the crest of the dam (El 103.6) would be overtopped by a maximum of 1.4 foot. The depth at critical flow would be 0.8 foot with a velocity of about 5 feet per second.

Hydraulic analyses indicate that the existing spillway can discharge 2 cfs or 1.3 percent of the test flood before the dam is overtopped.

f. Dam Failure Analysis. If failure of the dam occurred with the water surface at El 103.6, which is the low point on the crest of the dam, the peak discharge rate would be about 1,550 cfs as compared to a discharge of 2 cfs prior to failure. Failure of the dam would produce a flood wave about 50 feet wide and 3 feet deep downstream of the dam. It is possible the resulting flood wave could cause significant property damage and some loss of life in residences downstream. Failure of Griswold Pond Dam could also cause flooding of residences downstream of Lower Pond and possible failure of that dam. Accordingly, Griswold Pond Dam has been placed in the "significant" hazard category.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Griswold Pond Dam is based on a review of previous inspection reports and the visual inspection conducted on April 23, 1979. As discussed in Section 3, Visual Inspection, the dam is considered to be in poor condition.

Seepage is occurring at several locations along the downstream toe of the dam and erosion has occurred on the crest and slopes of the dam. The riprap has been eroded on the upstream slope, and trees and brush are growing on both the upstream and downstream slopes. Serious seepage has been occurring for some time, according to past inspection records.

b. Design and Construction Data. Discussions with Town personnel and review of files indicate there are no plans, specifications or computations available on the design or construction of the dam.

c. Operating Records. There is no instrumentation of any type in Griswold Pond Dam, and no instrumentation was ever reportedly installed in this dam. The performance of this dam under prior loading can only be inferred from physical evidence at the site.

d. Post-Costruction Changes. There are no as-built drawings available for Griswold Pond Dam.

e. Seismic Stability. The dam is located in Seismic Zone No. 3, indicating that there is a potential for major damage due to earthquakes in this area. This classification is based on the intensity of past earthquakes, and does not indicate the probability of such events in

the future. The highest intensity earthquakes for this area were VII and VIII on the Modified Mercalli Scale, and occurred in 1727 and 1755, respectively. There is no record of any major seismic events since 1918 when Griswold Pond Dam was completed.

Since there is no data available on the embankment or foundation materials, the seismic stability of the dam cannot be evaluated at this time. Severe seepage indicates that the dam may not be stable under static conditions. Considering that the dam is in the "significant" hazard category, an analysis of the static and seismic stability should be conducted by a qualified engineering consultant, as recommended in Section 7.3.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon a review of available data, and the visual inspection of the site, there are deficiencies which must be corrected to assure the continued performance of Griswold Pond Dam. Generally, the dam is in poor condition. Seepage was observed at several locations along the downstream toe of the dam, erosion has occurred on the top and slopes of the dam, the crest of the spillway is only 0.2 feet below the low point on the crest of the dam and no low-level outlet exists at the dam. In addition, the slopes of the embankment are steep, riprap is missing from the upstream slope of the dam, and trees and brush are growing on both slopes of the dam.

Hydraulic analyses indicate that the existing spillway can discharge a maximum flow of 2 cfs with the pond at El 103.6, which is the low point on the crest of the dam. An outflow test flood (one-half PMF) of 155 cfs will overtop the dam by a maximum of 1.4 feet. The existing spillway can discharge only 1 percent of the test flood before the dam is overtopped.

b. Adequacy. The lack of detailed design and construction data did not allow for a definitive review. Therefore, the evaluation of this dam is based primarily on visual inspection, past performance and engineering judgment.

c. Urgency. The recommendations and remedial measures should be implemented by the Owner within one year after receipt of this Phase I Inspection Report.

d. Need for Additional Investigations. Additional investigations to further assess the adequacy of the outlet are outlined below in Section 7.2, Recommendations.

7.2 Recommendations. It is recommended that legal Ownership and responsibility for the dam be established immediately. Then it is recommended that the Owner employ the services of a qualified engineering consultant to perform a detailed evaluation of the stability of the dam and a detailed hydraulic and hydrologic analysis. The evaluation should include the following items:

a. a detailed investigation of the embankment and foundation materials to evaluate the static and seismic stability of the existing dam,

b. a detailed investigation and evaluation of the wet areas and seepage downstream of the dam,

c. the feasibility and method of repairing or reconstructing the embankment including the selective clearing of brush and trees,

d. design of an adequate spillway and low-level outlet for the dam,

e. evaluation of the hydraulic interrelationship of Spring, Griswold and Lower Ponds, and the effects of failure or removal of Griswold Pond Dam on Lower Pond Dam.

The Owner should implement the recommendations of the engineering Consultant.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. It is recommended that the Owner accomplish the following:

(1) immediately lower the pond by pumping or other acceptable means to a level at least 3 feet below the crest of the spillway to minimize the overtopping potential. Lowering of the pond should be conducted under the supervision of an engineer. The pond should be maintained at that level until the recomendations of the engineering Consultant have been implemented.

(2) implement a systematic program of maintenance inspections. As a minimum, the program should include monthly inspections of the dam and appurtenances, supplemented by additional inspections

during and after severe storms. Maintenance should include repair of erosion and clearing of vegetation on the slopes of the embankment and clearing of debris from the spillway and outlet. Residents near the dam should be notified not to place additional earth on the top of the dam. All repairs and maintenance should be made in accordance with all applicable State regulations. However, further modifications to the dam and appurtenances should not be made until studies by an engineering consultant are completed.

(3) conduct technical inspections of this dam on an annual basis,

(4) implement a plan for surveillance of the embankment during and after periods of unusually heavy runoff and a plan for notifying nearby residents in the event of an emergency at the project.

7.4 Alternatives. An alternative to the recommendations and remedial measures discussed above is to drain the pond and breach or remove the dam. The impact of this action on the stability of Lower Pond Dam should be evaluated by the engineering Consultant. Also, Lake Dam Road provides access to several residences on the east side of Griswold Pond. Therefore, complete removal of this road would be unacceptable.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

GRISWOLD POND DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

PROJECT Griswold Pond Dam

DATE 4/23/79

TIME 8:00 to

WEATHER Clear, 70's

W.S. ELEV. 103.5* U.S. 96.0 D N.S.
*based on assumed benchmark at El 102.0 on invert of discharge pipes

PARTY:

1. Richard Weber
2. Henry Lord
3. Frank Sviokla
4. Bill Checchi
5. Carol Sweet
6. Ed Greco
7. Lyle Branagan
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam	Weber/Greco	
2.	Spillway	Branagan/Greco	
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECK LIST

PROJECT Griswold Pond Dam DATE April 23, 1979

PROJECT FEATURE dam NAME Richard Weber

DISCIPLINE geotechnical NAME Ed Greco

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	Pot holes - depressions
Pavement Condition	Very poor combination asphalt patches and gravel
Movement or Settlement of Crest	Yes, potholes, depression all along crest
Lateral Movement	None visible
Vertical Alignment	Graded level
Horizontal Alignment	Straight
Condition at Abutment and at Concrete Structures	Fair - ties into natural ground at each abutment
Indications of Movement of Structural Items on Slopes	No movement but sloughing and erosion evident
Trespassing on Slopes	Yes - crest in roadway - 4 residences in downstream embankment & force main.
Sloughing or Erosion of Slopes or Abutments	Yes - sloughing of upstream and downstream slopes
Rock Slope Protection - Riprap Failures	None visible
Unusual Movement or Cracking at or near Toes	None visible
Unusual Embankment or Downstream Seepage	Yes - seepage along toe, especially in one residence backyard - drains required - one seepage area cuts across lower roadway.
Piping or Boils	None visible
Foundation Drainage Features	Drain in residence backyard to permit use of the yard
Toe Drains	None visible
Instrumentation System	None

*Vandals cutting away at outlet.

PERIODIC INSPECTION CHECK LIST

PROJECT Griswold Pond Dam DATE April 23, 1979

PROJECT FEATURE spillway NAME Richard Weber

DISCIPLINE geotechnical NAME Lyle Branagan

Short

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Fair gravel bottom
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Few small trees on upstream embankment at outlet
Floor of Approach Channel	Gravel - cobbles - leaves, debris
b. Weir and Training Walls	
General Condition of Concrete	Cobbles, with asphaltic concrete Surface forms weir - poor condition
Rust or Staining	Training Walls stone masonry poor condition
Spalling	None
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	Small boulders
Trees Overhanging Channel	Small trees
Floor of Channel	Cut into rock
Other Obstructions	Small culvert under low road

PERIODIC INSPECTION CHECK LIST

PROJECT Griswold Pond Dam DATE April 23, 1979

PROJECT FEATURE discharge pipes NAME Richard Weber

DISCIPLINE geotechnical NAME Ed Greco

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Fair to poor - one pipe clogged with debris
Rust or Staining on Concrete	None visible
Spalling	None visible
Erosion or Cavitation	None visible
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

APPENDIX B

PLANS OF DAM AND PREVIOUS
INSPECTION REPORTS

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Figure B-1, Plan of Dam from April 23, 1979 Survey	B-1
Figure B-2, Additional Details and Sections from April 23, 1979 Survey	B-2
Inspection Report by Essex County Engineers, dated November 1971	B-3
Inspection Report by Essex County Engineers, dated December 8, 1953	B-5
Notes from Previous Inspections by Essex County Engineers:	
1928-1942 Notes on Spring, Griswold and Lower Ponds	B-6
1936-1968 Notes on Griswold Pond	B-14

Saugus D. 7

Before 1936 see D. 6

1936 August 4, C.C.Parker, Insp. Lower dam on Lake Dam Road, Golden Hills District is owned by the National Development and Investment Co., Reg. Land Case 8400. This dam is in the same poor condition. The outle pipe culvert is broken and nearly blocked with dirt etc. The water is low about 2.5 feet below the top of the dam or roadway.

1936 Report to Co. Comm. See D 6.

1938 October 18, C.C.Parker, Insp. The condition of this dam is the same. There has been no change. The pond is full of water. I understand this is an accepted street. Ownership of dam a question.

1938 Report to Co. Comm. See D.6.

1940 Sept. 26, C.C.Parker, Insp. This dam is in poor condition, at th south end the roadway forming the dam is badly gullied. At the northerly end there is a new 24 inch outlet pipe. The invert is about 2.5 feet below the top of the dam or roadway. This pipe is partly filled with earth. The water level is 1.5 feet below the top of the dam.

1940 Report to Co. Comm. See D.6.

1942 July 22, C.C.Parker, Insp. The condition of this dam is poor and about the same as when last inspected. At the southerly end the lower slope is gullied. The pipe outlet (made of oil drums) at the northerly end has collapsed in one place partly blocking the culvert. This is a very poor condition and sometimes the pond overflows. The water is about 1.5 feet below the top of the dam. The lower slopes are very wet indicating a great amount of seepage.

1942 Report to Co. Comm. See D.6.

1944 June 26, S. W. Woodbury, Insp. Repairs were made to this dam during the fall of 1943 according to plans which were submitted and approved. Two employees of the Power Co. were at the dam today. They say that they visit the dam once a week to check the height of the water. The water level today is 5 inches above the flow line of the 24" pipe. The water is running across the road below this culvert so that the road is not passable for pedestrians today. (See sketch in 01SOAX for change in plans due to water main.) No evidence of any bad leaks.

1944 Report to Co. Comm. Also the flow conditions at the lower dam on Lake Dam Road were improved by enlarging the culvert and spillway, giving more freeboard which is very essential. The earth embankments should be repaired and kept in shape to prevent washing.

1946 July 30, S.W.Woodbury, Insp. Went to dam alone. Further inspection is needed to see that new 9" concrete wall is removed. A concrete wall 9" wide and 1'-3" high has been built across the upper end of the culvert between the wing walls which decreases the freeboard 1'-3" (see sketch) Conditions below the dam are the same. Water level today is 0.3' above the invert of the pipes. Condition of the dam is the same.

Saugus D. 6

1940 Sept. 26, C.C.Barker, Insp. The same unsatisfactory condition exists here. There is quite some leakage. The water level is about 6 inc below the spillway.

1940 Report to Co. Comm. The three dams in the Golden Hills district, as I previously have reported, should each be provided with a proper spillw and sufficient freeboard above spillway level to care for any reasonable con dition of runoff. They are now without any adequate provision for taking care of runoff from severe storms and have at times been overtopped, so far without serious consequences, which speaks well for the material of which they were made, but I do not believe that it is reasonable to assume that they would still withstand a much greater overflow from a storm of far greater intensity which may occur, and a progressive failure of these dams, conceivably with loss of life, is a possibility.

1942 July 22, C.C.Parker, Insp. The conditions here are unsatisfactory The earth embankment at the easterly end is low and the water probably over-flows the roadway at times and might wash out the dam. There is much leaka The pond is nearly full.

1942 Report to Co. Comm. The three dams at Golden Hills were found, on inspection this year, to be in very bad condition as has been previously reported in past years. The owner, after being notified by you of the unsatisfactory condition, presented plans which were approved by you for improving the culverts and spillways of the two lower dams by increasing the capacity to take care of any reasonable runoff, and it is expected that the improvements will be made this fall.

1944 June 26, S.W.Woodbury, Insp. Repairs were made at this dam durin the summer of 1943 according to plans which were submitted and approved. I did not see the owner of this dam. The water level today is about 1/2" over the spillway. The filling at each end of the new culvert has settled some, but the culvert looks to be in good condition. There are leaks at the bottom of the wall about 20 feet and 30 feet south of the culvert and one small leak about 30 feet north of the culvert.

1944 Report to Co. Comm. The flow conditions at the dam on Pond Stree Golden Hills District, were improved by enlarging the spillway and culvert during 1943 in accordance with plans approved by the Commissioners. How-ever, the earth embankment should be repaired and kept in shape as a safe-guard against washing out.

1946 July 30, S.W.Woodbury, Insp. I did not see the owner and went to dam alone. No repairs made since last inspection. Water level today is 3.0' below floor of bridge. Seepage is about the same. Concrete blocks in wing walls have been washed away.

1946 Report to Co. Comm. At the dam on Pond Street repairs are needed around the spillway to allow the water to flow freely over the spillway.

1948 Sept. 10, S. W. Woodbury, Insp. Did not see the owner and went to dam alone. Another inspection needed to see that repairs are made around the spillway. Water level today: 2.5' below floor of bridge. Seepage about the same.

Saugus D. 6

1934, Sept. 21. C. C. Barker, Insp. The conditions in the Golden Hills District are about the same. I did not see the owners. In the lower dam, the bridge over the spillway has been repaired giving an opening 6 inches deep and 8 feet wide. Otherwise the dam is the same, not very good. The water level is about 2 feet below the spillway. The second dam is the same as before except the roadway has been filled in with stone and gravel. The 20 inch outlet pipe is partly plugged. The water level is about 1.5 feet below the top. The third dam formed by the roadway has 6-8inch iron pipes at the roadway grade for an outlet. These are somewhat plugged with earth etc. The water level is about 1.5 feet below the top. These dams are in poor shape.

1934 Report to Co. Comm. As regards the three dams at Golden Hills north of Howard Street and near the Melrose town line, I can only repeat previous recommendations that wider spillways are needed, and that either the tops of the dams should be raised or the spillways lowered to obtain proper free board for safety. Conditions are substantially the same as when the Commissioners first took the matter up with the representative of the owners.

1936 August 4, C. C. Barker, Insp. This dam on Pond St., Golden Hill District is owned by the National Development and Investment Co. Reg. Land Case #400. I did not see the owners. The dam is in poor condition, same as when last inspected. The spillway has an opening under the bridge 5' wide 8" deep. Water is low about 2.5 or 3 feet below the top.

1936 Report to Co. Comm. Of the three dams in the Golden Hills section nothing can be said further than what has been said. Conditions are bad with no adequate spillways and very little freeboard at each. Proper spillways should be provided and the dams raised or pond level lowered as has previously been recommended.

1938 October 18, C.C.Barker, Insp. The condition of this dam is the same. There has been no change. The pond is full of water. I understand this is an accepted street. Ownership of dam a question.

1938 Report to Co. Comm. The three dams in the Golden Hills section are substantially the same today as in the past. I have previously noted that there are no spillways of any considerable size in these dams, and that the dams should be raised and provided with proper spillways. Within these years since I have been reporting upon them it is known that they have on several occasions been overtopped to some extent, but no serious results have occurred, which would seem to indicate that the lower dam, an earth embankment with masonry walls, must have been made of pretty good material which withstands overtopping with some success. Whether this material extends to all parts of the dam and whether it would withstand an overtopping which might well occur under some conditions of precipitation and runoff which have in the last few years occurred in localities not far away is a matter of conjecture only. I still feel that my previous recommendations should be carried out.

Saugus D. 6

for conditions which may reasonably be expected. Much more adequate spillway capacity should be provided, the dams should be strengthened and the tops of both raised several feet, in order that the required over-flow at these spillways might take place without over-topping the structure, or if the dams are not to be raised, the spillway level should be lowered.

1932, July 28. C. C. Barker, Insp. The conditions in the Golden Hills District are the same, and the three dams are in poor shape. On the lower dam some of the stones of the dry wall on the easterly side down stream face have fallen off. The spillway is more or less blocked. The water is about 2 feet below the spillway today. The water level in the second pond is about 2 feet below the road, Some bank has charge of this property now.

1932 Report to Co. Comm. In the Golden Hills section north of Howard St. there are three dams, the upper of which is unimportant, or at least would be if those below it were put in proper condition. The two lower dams were reported to you in my report for 1930 as unsafe, and the recommendation was there made that "much more adequate spillway capacity should be provided, the dams should be strengthened and the tops of both raised several feet, in order that the required over-flow at these spillways might take place without over-topping the structure, or if the dams are not to be raised, the spillway level should be lowered". The conditions are the same today, and I renew those recommendations.

1933, March 6. C.C. Barker, Insp. Last week the easterly end of this dam overflowed and cut across Sweetwater St., forming a channel three feet wide and from 1.5 to 2 ft. deep. This has been filled with sand bags and gravel. The water washed out some of the road southeast of the dam. I do not think any damage was done to the house southeast of the dam, but today some water is coming out of the ground just in front of the house. This may come from the pond.

The dam just above this one is in poor shape, and only a few inches rise in this pond would over top it in places.

1933, March 9. C.C. Barker, Insp. The 3rd or northern most dam (D9) over-flowed the roadway, washing it somewhat, Wednesday March 8th in the fore noon. This caused the middle or 2nd dam D7 to over-flow the road in three places. At the southerly end of the dam, an opening about 7 ft. wide on the upper side and 1 ft. deep narrowing to 1.5 ft. wide on the lower side and 1 ft. deep has gulled out the road and slope on the lower side. There is not so much water running out as has been.

The over-flowing of these dams caused the lower dam #1 D6 to over-flow again at the easterly end. The water cut around the sand bags that were put in a few days ago, and is washing for a width of 30 ft. in some places 4" to 6" deep. Also, through the dry wall on the lower side at the easterly end. The dam was over-topped about 10:00 A. M. yesterday. About 3" of water is flowing through the spillway which is more or less blocked. I do not think there would be a sudden failure as the material is quite coarse and there are some large stones.

Saugus D. 6

road. Below this dam are houses and camps which would be damaged in case of failure. There might be loss of life. This dam is in very poor condition. There is some leakage. The overflow culvert, 2 feet wide and 1 foot deep, more or less, is very poor.

Above this pond is another small earth dam belonging to Griswold, 3.5 feet high and 12 feet wide and about 75 feet long. This dam forms the road. The over-flow culvert is 6 inches deep and 3.5 feet wide. This dam is in poor shape. The pond formed above this dam is quite large, but rather shallow from all appearances. These dams should have some good spillways and be put in good shape.

1930, Nov. 20. R. R. Evans, Insp. Seems to have been widened, but spillway has been made narrower by putting cement blocks. Water less than 6" below top bound to wash over but gravel is apparently very good and would cut out slowly with moderate overflow - washout rather than collapse seems probable. Worst danger is from collapse of dam above. Next dam above - No spillway of consdquence. Shows seepage, condition doubtful 6 or 8 ft. max. ht.

Griswold

1930, Dec. 22. R. R. Evans, Insp. Visited the lower dam and the middle dam in company with Mr. Mitchell, Chairman of the Commissioners, and with Mr. Howard, representing the owner of the property. Some water is running through the spillway at each of the dams today, and I showed Mr. Mitchell and Mr. Howard the wet lands below the middle dam where considerable water shows today just below the toe of the dam. I told them that in my opinion the top of each dam should be three feet or more above spillway level, that the middle dam should be widened on the top and one or both slopes increased, and that the spillway in each dam should be at least ten feet long. Mr. Howard seems to agree that this should be done, and said that he is anxious to see it done. I told him that a definite plan drawn by an engineer of experience should be submitted so that the Commissioners might approve or disapprove of the proposed alterations. He agrees to this and suggests that the firm of Morse & Dickinson is doing work for him and apparently would like to have them draw the plans. He suggests a location for the spillway at the middle dam at a point in the line of the high tension wires crossing this land on steel towers, and here the natural surface is not more than two to three feet below the top of the present dam. At the lower dam he feels that, if possible, he should like to keep the spillway at about its present location, rather than attempt to move it to the solid ground at either end.

1930 Report to Co. Comm. The three dams in Golden Hills district north of Howard Street are presumably owned by L. D Griswold, who developed this property. The upper of these three dams is probably of little consequence under any conditions, and the lower dam, considered by itself, would hardly be capable of causing serious damage through failure, but failure of the middle dam might also cause a failure in the lower dam approaching a collapse, and by reason of the presence of houses immediately below, the results might be serious. This condition was noted in my report to you in the year 1923, and no improvement in conditions has been made. Some work apparently has been done at the lower dam, but the spillway capacity has been reduced by these minor changes, rather than increased. Nothing is known of the internal construction of any of these dams, and with their almost total lack of spillway capacity, it is apparent that the two lower dams are not safe

Saugus D. 6

dams would not come within the scope of the law requiring inspections. All the dams are in poor condition and I have no information as to their internal construction, or the foundation on which they rest. They were built apparently without any regard to the law requiring the approval of the County Commissioners and had been over-looked on our previous inspections as they were not known to us to exist. While they are small affairs, they are entirely inadequate for the purpose to which they are put, and because a sudden failure of the second dam would undoubtedly wash out the dam at the lower pond, there is a possibility of loss of life in the houses below the lower dam in case of such a failure. If the water in each pond is to be maintained at its present level, these dams should be strengthened and raised several feet and adequate spillways provided. If such strengthening and raising cannot be done, deeper and wider outlets should be provided and the pond levels each maintained at least two feet lower than at present.

1929, Apr. 17. R. R. Evans, Insp. Visited these dams about 11:00 o'clock, A. M., some of the residents having requested Mr. Trefry by telephone to have someone see the conditions there. At the lower dam the water is 8 inches or more in depth over the spillway at the end next the pond and a considerable stream of water is flowing over the top of the dam west of the spillway near the end of the masonry wall, and a larger stream is flowing over the east end. The stream at the west end seems not to be cutting the embankment appreciably, but the one at the east end has made quite a gulley near the lower side of the dam. The water is between one and two feet deep at that point. There is no place on the water side of the dam where the stream flowing over it is more than two or three inches in depth, and at present no erosion is taking place there. The water finds its way behind the wall on the east end of the dam and it would seem likely to cave out. A resident of the vicinity who came along while we were making the inspection says that at 1:00 o'clock this morning the water was very much higher, as high as the bridge over the spillway which is the highest part of the dam.

The upper pond is over-flowing near the culvert in a broad stream only a few inches in depth. Mrs. Perry says that during the height of the storm yesterday afternoon, it was flowing over the dam for its full length and that the spray from the waves was going over the top of the dam.

1930, Sept. 10. C. C. Barker, Insp. Dam about one-half mile north of Howard Street near the Saugus-Melrose line, is owned by L. D. Griswold, Saugus. At present Alfred H. Howard, 15 State St., Boston, has charge. The pond is used for a pleasure pond. I did not leave a copy of the notice with anyone. There are several houses below this dam, and in case of failure it is very likely there would be loss of life and a great deal of damage done. The land below is wet and there is some leakage. The water level is about 8 inches below the spillway. The wall on the lower side of the dam is in good condition, except at the ends. The earth embankments need topping out. About two years ago the pond overflowed the dam and washed around the east end, flooding down the street flooding some houses and doing a great deal of damage. At that time an opening was cut through the east end to let the water into the brook and prevent it washing down the street. This dam needs to be repaired and a proper spillway made.

A few hundred feet upstream is another earth dam belonging to Griswold, about 6 feet high and 14 feet wide on top and about 500 feet long. The [illegible] level is about 6 inches below the

Saugus D. 6

of inspection. These three dams form a series of ponds at different elevations so that the water from all three must eventually be discharged at the lower dam. Apparently there was a small pond at the site of what is now the lower pond and this may have been true in the case of the other two, but I have no information to that effect. According to residents in the vicinity this section was opened up about ten years ago and roads were built which now form the three dams holding back these three ponds. The lower pond has an area which I estimated at four or five acres. There is a wall of field stone laid in cement, except at the ends which are dry and in poor condition, and an earth fill behind this wall forming a dam of a maximum height of seven or eight feet above the swamp below. The land below is wet, and well defined streams come from the wall. The top of the earth is highest on the side of the dam next the water but so low even here that at the time of inspection, with the pond level just below the spillway the small waves which a strong northwest wind was forming lacked not more than two or three inches at the most from washing across the top of the dam. The spillway, about eight feet wide covered by a wooden bridge which leaves only about six inches clear opening beneath it, is so near the level of the top of the earth dam that it almost entirely fails of its purpose. Immediately below this dam a street has been roughly graded, approximately along the old water course and on this street there are six small houses whose occupants would be endangered by a failure of the dam.

Just above the lower pond on the north is the second pond with an area of about fifteen acres by estimate. The roadway forms a dam about eight feet high at maximum, some eight or nine hundred feet long, crossing several low points, and there are rough stone walls in places on the side away from the water. The land below the dam is in many places wet. The roadway is higher on the side next the pond and even there is nowhere much, if any, more than a foot higher than the water surface at time of inspection. I was informed that some of the residents in this district have at times been obliged to bank up the earth on the side next the pond to prevent overtopping and appearances would indicate that this is so. The only overflow or spillway provided is at the northerly end of the dam, a rough stone culvert less than three feet in width and two feet in height at the outlet and apparently much obstructed in the portions beneath the road. The water at the time of inspection is just high enough to reach the culvert and a very small stream of water is trickling through. The capacity of the culvert is much less than that necessary to prevent the pond from overflowing the top of the dam under conditions which occur at no very great intervals of time. In the present state of the dam the first overflow would presumably be in the vicinity of the culvert and at that point the embankment is little above the natural surface of the ground, so that the pond might be only partially drained, but the highest parts of the dam are by no means safe from overtopping, and failure here would release a great volume of water suddenly.

The third pond is to the northwest of the second, about three feet higher than the second and separated from it only by the road forming the dam. This pond is smaller than the second, having an area of perhaps three or four acres, apparently is shallow and the dam is in somewhat better condition and the outlet somewhat larger than in the other cases, so that I do not believe that this third pond by itself presents any serious problem.

The total water shed of the three ponds is, according to the United States Topographic maps, only about one-quarter of a square mile and none of the dams is ten feet in height, so that except for the fact that the ponds hold much more than a million gallons of water, these

Saugus D. 6

less than three feet in width and two feet in height and apparently it is much obstructed where it passes beneath the road. The condition of this roadway or dam is poor. The land below the wall in the low points is wet, the road which is wide enough only for one vehicle is decidedly lower on the side away from the pond, and it would appear that temporary banking of the earth on that side had been done in times past to keep the pond from over flowing the road. In fact, one of the residents tells me that he himself has come out in times of heavy storms and done this to prevent the pond from over-flowing. The low side of the road is at about the level of the water at the time of inspection, and the high side is practically nowhere more than a foot above that level. A small stream of water is just beginning to flow through the culvert at the north end of the dam. Should the water rise high enough to cause any considerable over flow through the spillway, it would also over flow the road at some other points, unless it might cut its way through in the vicinity of the culvert first, which seems quite probable. In that case, there would probably be no very great rush of water, but certainly it would be more than the outlet of the lower pond can take care of. The area of this second pond we estimate at about twelve to fifteen acres or possibly a little more than that.

Above this second pond to the northwest is a third small pond estimated to contain three or four acres, the level being some three feet higher than that of the second pond. This is said to be very shallow, hardly more than a flooded swamp, and appears to be such. The road forming the dam is of similar construction to the others but the culvert is in a little better shape and somewhat more ample for the size of the pond, so that this third pond does not seem to be a serious factor. The total water shed according to the United States Topographic maps is about one-quarter of a square mile, of which the total water surface area apparently constitutes from ten to fifteen percent, so that it is reasonable to expect in very heavy storms a rise of the water surface sufficient to over flow these dams.

To put all these dams in the proper condition and raise them to the level to which they should be raised, if these ponds are to be maintained, would entail considerable expense, and I am not just certain from the information I have at hand as to the exact ownership. Apparently Mr. Griswold owned the whole tract of land and laid out these roads or dams and sold lots probably in some cases abutting on the lower sides of these roads. No approval of the County Commissioners was obtained or sought, so far as I am aware, and these dams had not been found on any previous inspection which we have made. While there does not seem to be any possibilities of wide spread damage in case of such failure as would probably occur, there is, nevertheless, great uncertainty as to what would happen in case of failure and the possibility that such a failure might occur in such manner and on such time as to cause loss of life in the region below the lower dam. The level of these ponds should be materially lowered and outlets provided to maintain them at this lowered level, pending any raising and strengthening of the dams. I have not the definite information at hand to say whether permenent lowering of the water level would cause objectionable conditions, but it seems probably that this might be the case.

1928 Report to Co. Comm. Dams in Golden Hills district: North of Howard Street in what is known as the Golden Hills district, are three dams presumably belonging to Mr. L. D. Griswold, who developed this property. I inspected these on November 9, having previously notified Mr. Griswold by registered letter, but he was not present at the ti e

Saugus D. 6 Golden Hills Dams

1928 Watershed sq. m. Max. Ht. ft. Apparent condition, Fair

1928, Oct. 9. C. C. Barker, Insp. Dam about one-half mile north of Howard St. near the Saugus-Melrose line, is owned by L. D. Griswold, Franklin Park, Saugus, and is used for a pleasure pond (possibly ice). I did not see the owner. There are several houses below the dam and in case of failure there would likely be loss of life. The roadway forms the dam with a heavy rubble wall on the lower side. There is a great deal of leakage at the ends and some through the wall. The land below is wet. More data should be obtained about this dam.

1928, Nov. 9. R. R. Evans, Insp. Dams north of Howard Street (Golden Hills District). Inspected these dams with Mr. Barker November 9, 1928, arriving at 3:00 P. M., having previously notified Mr. Griswold by registered letter and obtained return receipt. Mr. Griswold was not present, but the store keeper said that just before my arrival at the dam Mr. Griswold had called up but they were unable to get the message. From the accounts of residents in that vicinity, it appears that about ten years ago Mr. Griswold, in the development of the "Golden Hills" real estate sub-division, built three boads forming dams through what had been a swampy region, and thereby formed three ponds at different levels. Apparently there had been a small pond before that time at the lower level. This lower pond has an area which we estimated at four or five acres. The dam which holds it back is an earth fill behind a wall of field stone laid in cement for the most part of its length, but apparently a dry wall at the ends. The maximum height of this dam above the swamp below it is seven or eight feet and there are well defined streams of water flowing away from the bottom of the wall, all the land below this wall being very wet. A spillway about eight feet in width has been provided at about mid length of the dam, and the roadway is carried over the spillway by a wooden bridge, so that the clear space between the spillway and the bottom of the bridge timbers is about six inches, and the roadway is noticeably higher at the spillway than on both sides of it, so that when the water reaches the level of the spillway it comes very near to over-flowing the road. At the time of our visit there was a strong wind blowing from the northwest, raising some waves on the pond. These waves were coming up onto the surface of the road at the low points, especially at the east end, and were intermittently washing through the spillway. In other words, if the water had been high enough to over flow the spillway steadily, the waves would have been washing across the dam. Residents say that this dam was washed out a few years ago and did considerable damage to the farm below it. There are now six small houses in the territory immediately below the dam where the brook formerly flowed. The brook has been covered in for the most part and failure of the dam would cause damage to some or all of these houses, depending upon nature of such a failure which cannot be foretold because we have no knowledge of the interior construction of the dam. It evidently is of poor construction and nowhere near what it should be for such a structure. The amount of water held back by this dam alone is comparatively small and the probabilities are that the pond might be drained before any general collapse of the structure took place.

GRISWOLD

Just above this pond on the north is the second pond, held back by a dam which has a maximum height of about eight feet. The construction is somewhat similar to the dam at the lower pond. There is a rough wall on the lower side of the road crossing several low points in its total length of about eight hundred feet, and near the northwesterly end there is a stone culvert with a wooden bridge. At the outlet this culvert is

GRISWOLD POND DAM

ESSEX COUNTY ENGINEER'S OFFICE
FIELD REPORT ON DAM INSPECTION

TOWN Saugus DESIGNATION D-7

LOCATION Lake Dam Road, Golden Hills District
(Middle Dam, Griswold Lake)

19 52 REPORT TO COUNTY COMMISSIONERS #

DATE OF THIS INSPECTION December 8 19 53 INSPECTOR J.C.Harmaala & E.H.Pace

NAME OF OWNER Edgar G. Paine TEL.

ADDRESS

OWNER'S AGENT TEL.

ADDRESS

NOTICE GIVEN TO

OWNER COOPERATED

REPAIRS SINCE LAST INSPECTION The road has been gravelled and oiled, increasing the freeboard somewhat and reducing danger from overtopping.

DEVELOPMENT OF SURROUNDING COUNTRY Residential

CONDITIONS BELOW DAM Flows into lower pond.

PROBABLE LOSS OF LIFE OR DAMAGE IN CASE OF FAILURE One house might be damaged. Would undoubtedly cause failure of lower dam.

ELEV OF WATER OR DISTANCE ABOVE OR BELOW SPILLWAY 1" over spillway

LEAKS None visible

HEIGHT OF FLASH BOARDS ETC. IN PLACE None

MINIMUM FREEBOARD WITH ALL POSSIBLE STOP LOGS ETC. IN PLACE

OBSTRUCTIONS IN SPILLWAY, SLUICE, ETC. None

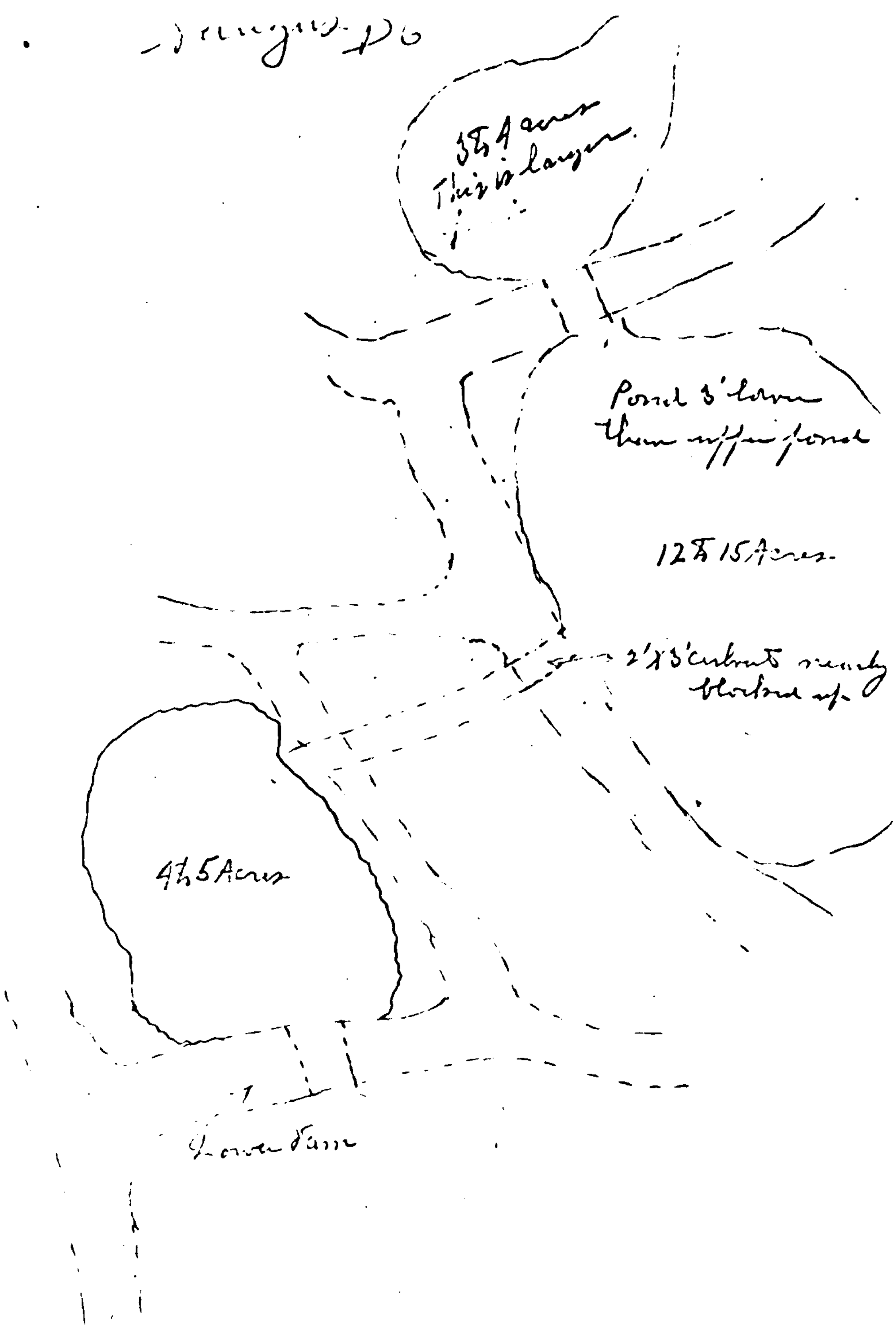
EROSION OF BANKS

CONDITION OF DAM Relatively good. Spillway is adequate. (Rebuilt a few years ago).

FURTHER INSPECTION NEEDED

REMARKS AND RECOMMENDATIONS The dam is low at Claremont Road and should be raised. The freeboard is still too low, but this dam is in much better condition than the others.

GRISWOLD POND DAM



GRISWOLD POND DAM

D.7

SAUGUS
5-5-262-7

L.E. WILKINSON 11/ /71

(GRISWOLD LAKE)
OUTLET OF MIDDLE POND - BEGIN ON HOWARD ST. AT SWEETWATER ST. - TAKE SWEETWATER ST. NORTHWESTERLY 0.65 MI. TO LAKE DAN ROAD WHICH FORMS DAM.

MRS. WALTER J. AMES

PLEASURE POND

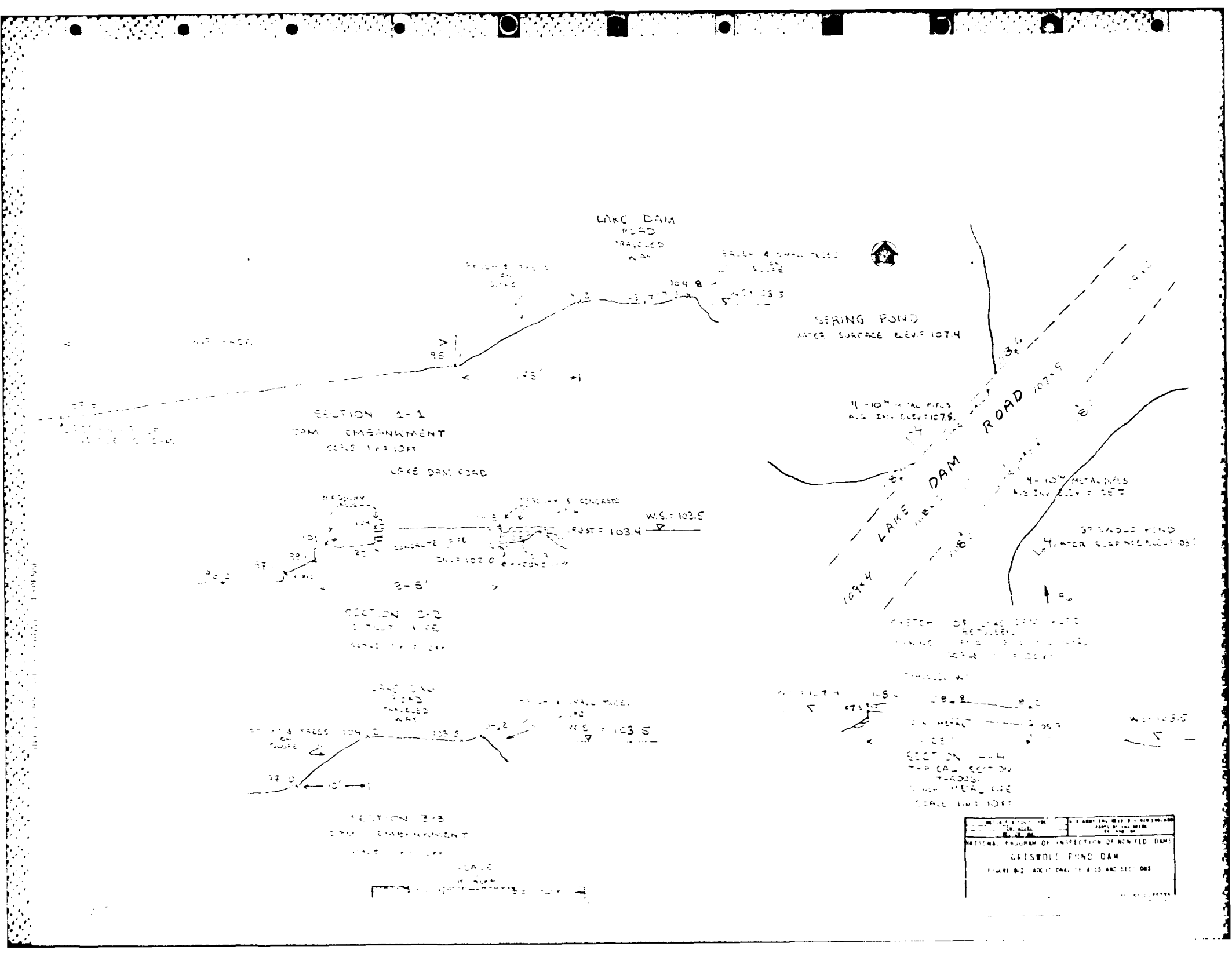
SEE PLANS

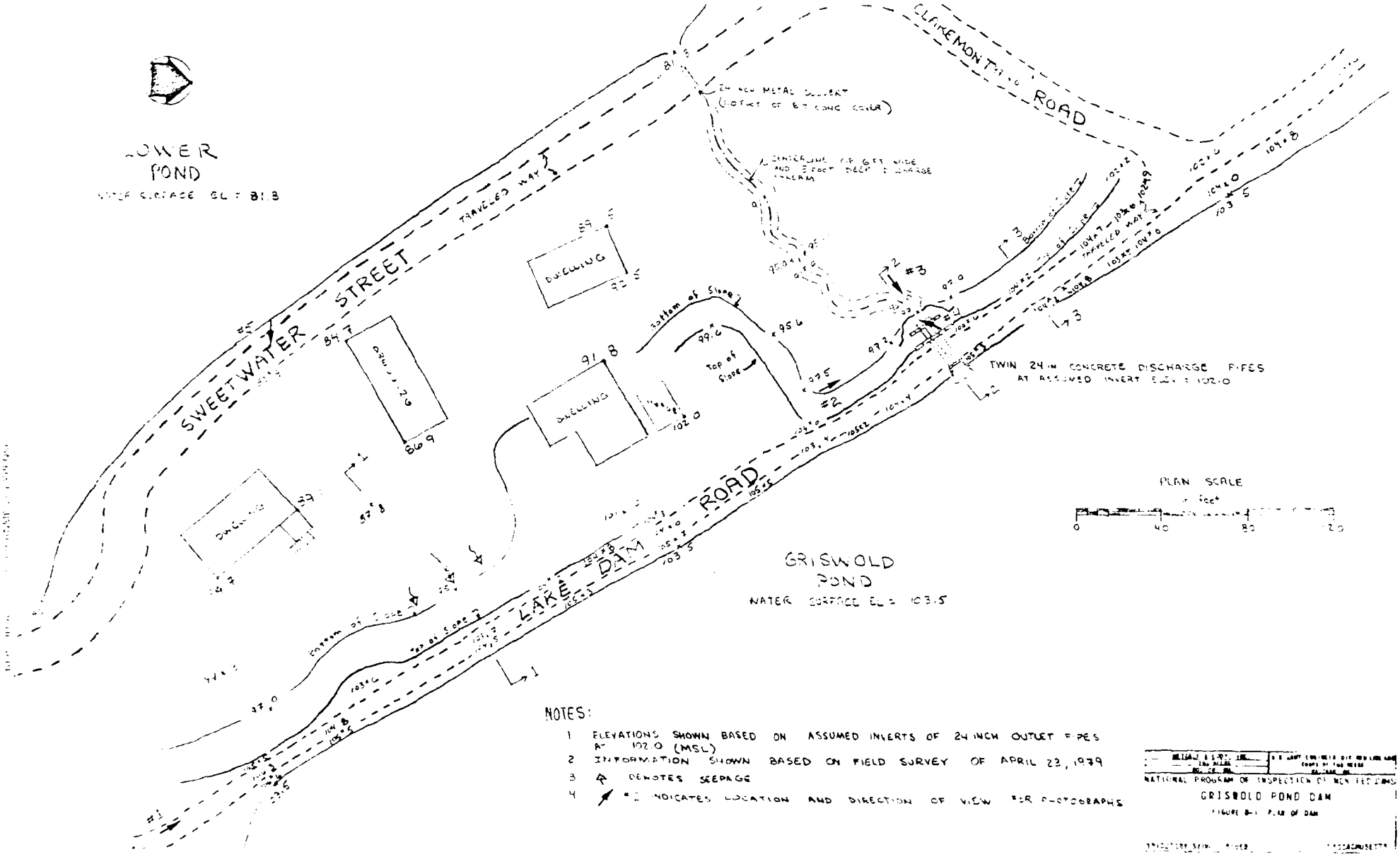
WATER LEVEL TO-DAY 6" BELOW WALL

AT CREST OF SPILLWAY ~ EROSION OF LAKE DAM ROAD, POND SIDE 10' X 6' INTO ROAD & 3FT. DEEP / THIS SPOT 90 FT. NORTH OF SPILLWAY

HOLE IN EDGE OF ROAD SHOULD BE FILLED WITH ROCK FILL (INFORMED TOWN ENGINEER HE SAYS HE WILL HAVE PUBLIC WORKS MAKE TEMPOR. REPAIR TO WASHOUT.)

(IMPORTANT ONLY AS MINOR FLOOD CONTROL)


LAKE DAM
ROAD
TRAVELED
WAY
SPRING POND
WATER SURFACE ELEV. 107.4
LAKE DAM ROAD
SECTION 1-1
DAM EMBANKMENT
SCALE 1 INCH = 10 FT
SECTION 2-2
SCALE 1 INCH = 10 FT
SECTION 3-3
SCALE 1 INCH = 10 FT
W.S. = 103.5
POOL = 103.4
11-10" METAL PIPES
4-10" METAL PIPES
SPARE POND
WATER SURFACE ELEV. 103.5
SKETCH OF DAM AND RESERVOIR
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
GRISWOLD POND DAM



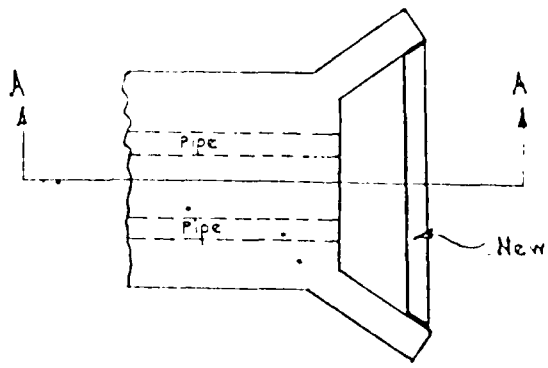
NOTES:

1. ELEVATIONS SHOWN BASED ON ASSUMED INVERTS OF 24 INCH OUTLET PIPES AT 102.0 (MSL)
2. INFORMATION SHOWN BASED ON FIELD SURVEY OF APRIL 23, 1979
3. ⚓ DENOTES SEEPAGE
4. ↗ #2 INDICATES LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS

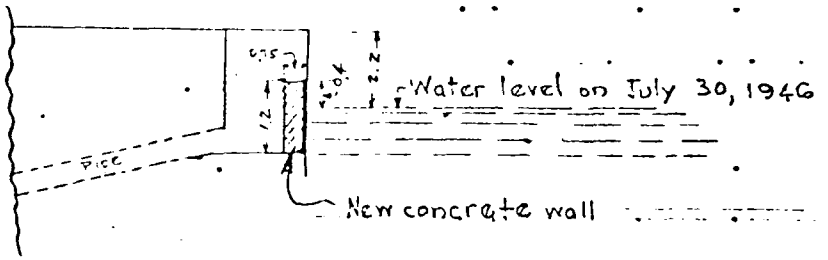
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

GRISWOLD POND DAM

FIGURE B-1 PLAN OF DAM



PLAN AT UPPER END OF CULVERT



SECTION A-A

SKETCH SHOWING NEW WALL. Wall built sometime between June 1944 and July 1946

Saugus D. 7

1946 Report to Co. Comm. In the Golden Hills section at the Lower Dam on Lake Dam Road, a concrete wall one foot high has been built across the spillway raising the water level one foot, defeating the purpose of obtaining more freeboard when the new spillway was build in 1943. This wall should be removed.

1948 Sept. 10, S. W. Woodbury, Insp. Went to dam alone. Further inspection needed to see that new 9" wall is removed. No repairs since last inspection. Water level today: 0.8' above flow line outlet pipes. Condition of the dam is the same.

1948 Report to Co. Comm. See D. 6

1950 Sept. 12, S.W.Woodbury, Insp. Want to dam alone. Further inspection needed to see that 9" wall is removed across spillway. Conditions below the dam: There is still quite a lot of seepage here. Water is running across the road below the dam. Water level today: 0.8' above flow line of outlet pipes. Condition of the dam: Same.

1950 Report to Co. Comm. See D. 6

1952 Oct. 1, E.H.Page, Insp. Went to dam alone. No repairs since inspection. Water level today: about 0.3 above flow line of pipes. Leaks: same. 9" conc. wall across the spillway is still in place but top 6½ inches has disintegrated and broken off. Water still runs across the roadway below the dam.

1952 Report to Co. Comm. See D. 6.

1954, Sunday, May E.H.Page and J.O.Harmaala, Insps. The new spillway seems to be adequate. The freeboard of the dam should be increased. It was overtopped on the easterly end.

1954, Sept. 11, E.H.Page & J.O.Harmaala, Insps. We inspected this dam in the height of hurricane "EDNA" at 4:30 P.M. The water was extremely high. Water was overtopping dam at the southeasterly end at Claremont Road. This condition was reported last spring and should be remedied right away. The spillway was replaced a few years ago and seems to have enough capacity.

1954, Report to Co. Comm. See D. 6.

1955, April 29, E.H.Page, Insp. Owner: Walter S. Ames, Pond St., Saugus. Elev. of water: 2 1/2" of water over conc. spillway. No provisi for flashboards. No obstructions.

1956, Sept. 6, E.H.Page, Insp. No repairs since last inspection. Elev. of water: 7" below spillway. No provision for flashboards. Banks eroded in many places. Condition: Poor. Freeboard on the easterly end should be increased as previously recommended.

1956 Report to Co. Comm. See D. 6

1958, Dec. 31, E.H.Page & K.M.Jackson, Insp. Elev. of water: 1/2 over spillway. No flashboards in place. No obstructions in spillway, etc. Eroded in many places.

1958 Report to Co. Comm. See D 6.

1961, January 3, S.H.Page and P.D.Killam, Insps. Elev. of Water: 1 1/2" over spillway.

1960 Report to Co. Comm. See D. 6.

1963, Jan. 2, K.M.Jackson, Insp. Owner: Walter S. Ames. No repairs. Conditions below dam: Debris and bushes. Elev. of water: Just topping spillway. Condition: Same as 1960 report. Some erosion of dam up to edge of roadway. The stone riprap has fallen in. south of junction of Claremont Avenue and Lake Dam Road. Frozen over. Skating

1962 Report to Co. Comm. At the dam on Lake Dam Road, Golden Hills District, the middle pond, there is some erosion of the dam up to the edge of the roadway, where the riprap has fallen in south of the junction of Claremont Avenue and Lake Dam Road.

1964 Jan. 12, 1965. P.D.K. & K.M.J. Insps. Condition same as 1962 report.

1964 Report to Co. Comm. The middle pond, south of the junction of Claremont Avenue and Lake Dam Road. There is some erosion of the dam up to the edge of the roadway where the riprap has fallen in.

1966 April 5, 1967. P.D.K. & K.M.J. Insps. Condition same as 1964 report.

1968 Feb. 5, 1969. P.D.Killam. There was 0.5 ft. of water going over the spillway.

APPENDIX C

PHOTOGRAPHS

(For location and direction of view of photographs, see Figures B-1 and B-2 in Appendix B).

GRISWOLD POND DAM

NO. 1 CREST OF DAM

NO. 2 DOWNSTREAM EMBANKMENT

NO. 3 DISCHARGE OUTLET CONDUITS DOWNSTREAM

NO. 4 DISCHARGE CHANNEL

NO. 5 SEEPAGE FROM DAM FLOWING FROM TOE

NO. 6 INLET TO GRISWOLD POND FROM UPPER POND

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

GRISWOLD POND DAM

Project Nat Review of Non Fed. Dams Acct No 6356 Page 1 of 6
Subject Essex County, Mass. Compld By LEB Date 5/25/79
Detail GRISWOLD POND Ck'd By RWT Date 7/19/79

SPRING POND DATA

(I) Test Flood, Storage & Storage Functions

1- Total Drainage Area - 0.08 mi²

2- Pond(s) Area: 0
Swamp(s) Area: 0
Total Area Pond(s) & Swamp(s): 0

% Ponds & Swamps = $\frac{0}{.08}$ = 0%

3- $\frac{250-106}{2200}$ = 6.5 } Say Ave Slope = 6.5%

4- Using C. of E Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be at Mountainous and taken at 3000 c.f.s./mi²
Size Class: — ; Hazard Pot.: — ; Spill. Des. Flood: —
Use: Test Flood = ½ PMF

5- Test Flood Inflow = $\frac{1}{2}(3000)0.08$ = 120 c.f.s.

6- Pond Storage
The pond area is 0.014 sq. mi. at elev. 107.5
Based on a const. area, storage increases at 9.0 ac. feet per foot of depth increase.

7- Spillway crest elev. is 107.5

8- Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$
S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12\,D\left(\frac{.014}{.08}\right)$ = 2.1 D ; R = 6hr rain of storm
D = Storage depth in feet above spillway crest in reservoir

9- Storage Functions: (Test Flood & ½ PMF - if needed)

F_{TF} = 120	- 12.6	S = 120 - 26.5 D
$F_{½PMF} = F_{TF}$	-	S = - D

METCALF & EDDY, ENGINEERS

(II) SPRING POND - Discharge Relalations

A. Outlet Pipes

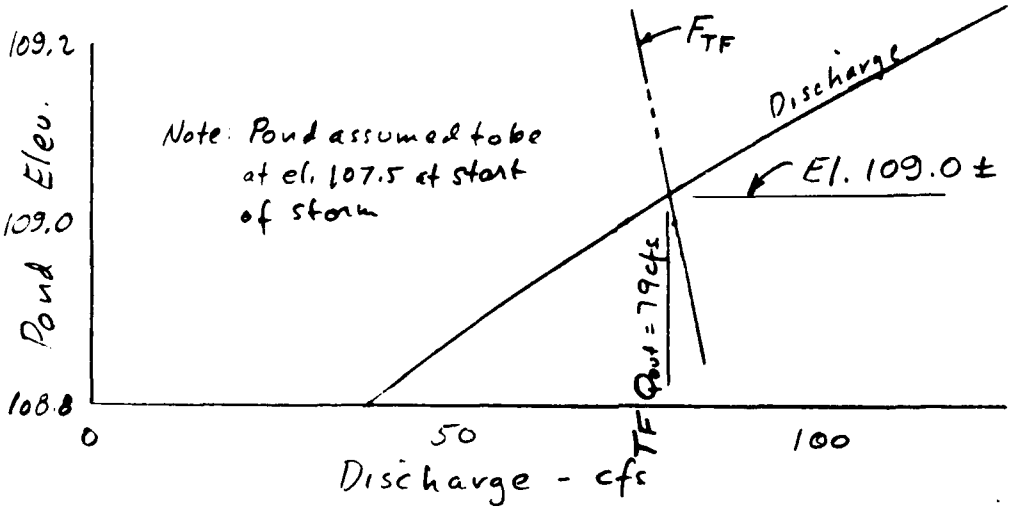
4-10" ϕ pipes. Total area = 2.18 ft². Assume $Q_A = 2.18 V_A$;
$V_A = (\text{Pond El.} - 106) = 2.0 \frac{V_A^2}{2g}$; ∴ $Q_A \cong 12 (\text{Pond El.} - 106)^{1/2}$, add to (B) below

B. Crest Flow

Assume minimum effective crest at elev. 108.6 with a length of 80 feet Use $q = 2.55 H^{1.5}$ [Ref. V.T. Chow - pg. 52-53]

Pond El.	108.8	109.0	109.2	109.5
Q_B	18	52	95	174
Q_A	20	21	21	22
ΣQ	38	73	116	196

(III) Spring Pond - Disch, Storage & Stor. Funct. vs Pond El.



Assume storage in Spring Pond delays peak discharge to Griswold by ± 0.2 hr, behind peak to Griswold from other areas. Using S.C.S. Tech. Rel. No. 55 - Table 5-3 - for Time of Conc. = 0.1 hr., local Griswold peak ∝ 991 @ 11.8 hr. but is 477 for 12.0 hr. and is 175± for 11.6 hr.

Use Max. on (IV) {
Est. Peak @ Griswold: $\frac{175}{991}(79) + 196 = 210$ @ Time of Peak Dir Flow to Gris.
or $\frac{477}{991}(196) + 79 = 173$ @ Time of Peak Outflow Spr. Pd.

Project Nat. Review of Non Fed. Dams Acct No 6356 Page 3 of 6
Subject Essex County, Mass. Compld By LEB Date 5/25/79
Detail GRISWOLD POND Ck'd By RW Date 7/19/79

GRISWOLD POND - WITHOUT SPRING POND

(IV) Test Flood, Storage & Storage Functions

1 - Total Drainage Area - 0.14 mi² (without Spring Pond)

2 - Pond(s) Area: 0
Swamp(s) Area: 0
Total Area Pond(s) & Swamp(s): 0

% Ponds & Swamps = $\frac{0}{0.14}$ = 0

3 - $\frac{240-102}{3400}$ = .041 } Say Ave Slope = 4.1%

4 - Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be just below Mountainous and taken at 2800 c.f.s./mi²
Size Class: Small ; Hazard Pot.: Signif. ; Spill. Des. Flood: 100 yr to ½ PMF
Use: Test Flood = ½ PMF

5 - Test Flood Inflow = $\frac{1}{2}$ (0.14) 2800 = 196 c.f.s.
Note: Use 210 cfs for Peak Inflow to incl. Spring Pd - See (III)

6 - Pond Storage
The pond area is 0.02 sq. mi. at elev. 103.4
Based on a const. area, storage increases at 12.8 ac. feet per foot of depth increase.

7 - Spillway crest elev. is 103.4

8 - Storage Functions are based on $Q_{out} = Q_{in}\left[1 - \frac{S_{out}}{R}\right]$

S_{out} = Storage Vol. in Reservoir related to final Q_{out} in terms of inches of rain over the drainage area.

S(in Inches) = $12\,D\left(\frac{0.02}{0.14}\right)$ = 1.71 D ; R = 6hr rain of storm

D = Storage depth in feet above spillway crest in reservoir

9 - Storage Functions: (Test Flood & ½ PMF - if needed)

F_{TF} = 210 − 20.6 S = 210 − 35.4 D	
$F_{½PMF} = F_{TF}$	− S = − D

(IV) Discharge Relations

Griswold Spillway is a rounded, asphalted hump about 6' wide, at elev. 103.4. Low points on the dam crest are also at elev. 103.4. Incluced spillway discharge with other crest flows. Use $q = 2.55 H^{1.5}$ [Ref: V.T. Chow - pg 52-53]

Spillway & crest conditions:
Q_S 6'@103.4; Q_1: 4'@103.6; Q_2: 7'@104.0; Q_3: 61'@104.4; Q_4: 126'@104.8; Q_5: 131'@105.2

Pond El.	104.0	104.5	105.0	105.2
Q_S	7	18	31	37
Q_1	3	9	17	21
Q_2	0	6	18	23
Q_3	—	5	72	111
Q_4	—	—	29	81
ΣQ_v	10	38	167	273

(VI) Modified Spillway Discharge Relations

Exist spillway consists of 2-24" ϕ pipes, inv. el. 102.0, preceeded by an asphalted hump with crest el. 103.4. If the hump is removed, discharge is probably controlled by the 2-24 in ϕ pipe inlets. Disch. rate taken from V.T. Chow - Fig 17-30

H/d	1.0	1.25	1.5	0.5	0.75
(2 pipes) Q_M	26	34	44	8	16
Pond El.	104.0	104.5	105.0	103.0	103.5
ΣQ_{VI}	26	54	180	8	16

(VII) Crest Flows

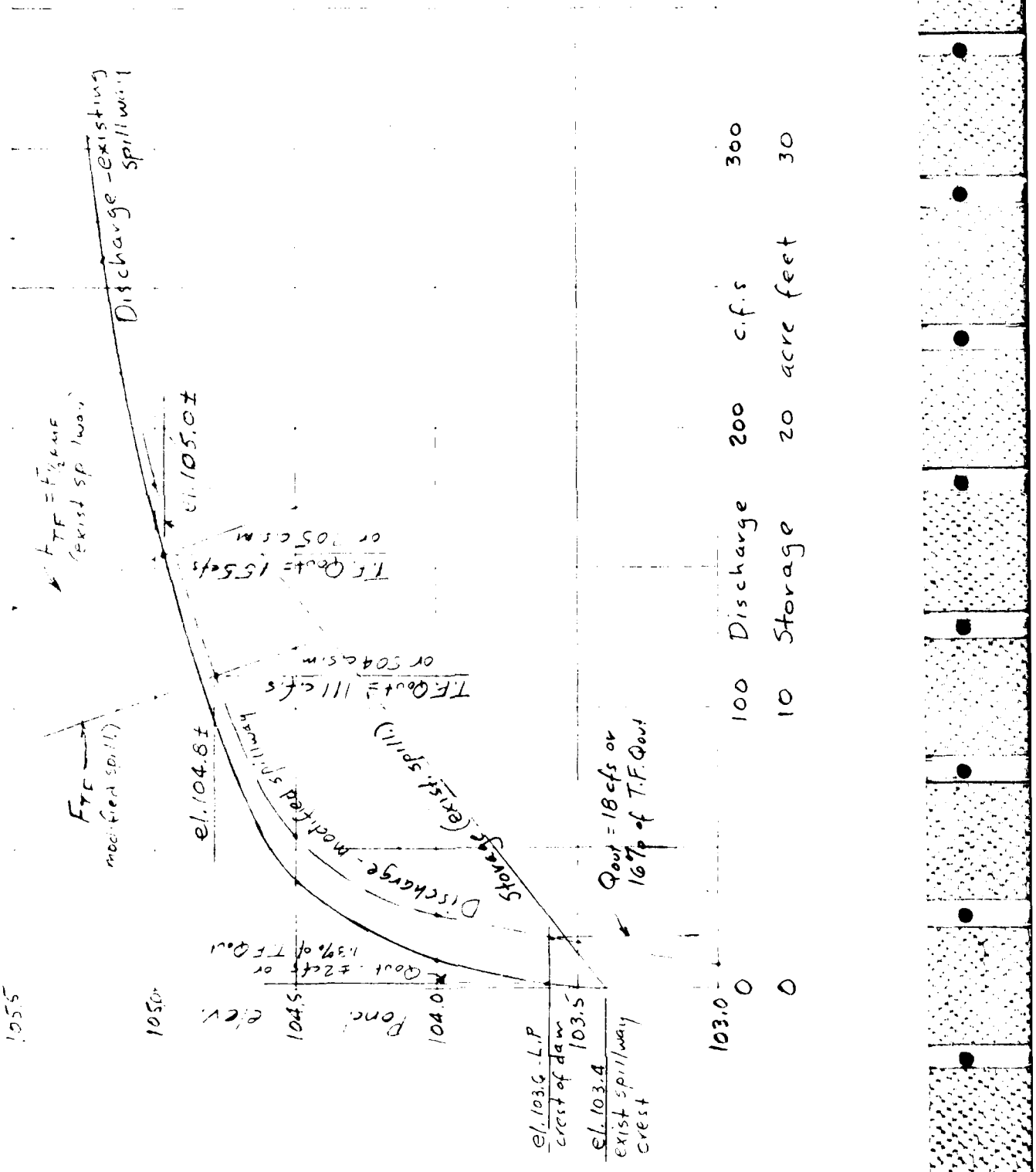
T.F. elev. 105.0
L.P. crest 103.6
Head 1.4'

$q_{max} = 2.55 (1.4)^{1.5} = 4.22$ cfs

As critical flow: $y_c = \left[\frac{(4.22)^2}{g}\right]^{1/3} = 0.82$ ft ; $V_c = 5.13$ fps

Project	Nat Review of Non Fed. Dams	Proj. No	6386	Page	5 of 6
Subject	Essex County, Mass.	Computd By	LEB	Date	7/18/79
Detail	GRISWOLD POND	Ck'd By	RW	Date	7/19/79

Discharge, Storage & Storage Function vs Pond Elev.



(IX) Failure of Dam

Peak Failure Flow:

Pond Elevation - 103.6 (L.P. Crest)
Toe Elevation — 96.0 ± (Bel. outlet pipe)
Y_o = 7.6 ft.

Dam Length Subject to Breaching = 110 ft (Northwest of spillway)
$W_o = 40\%(110) = 44$ ft

$$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68(44)(7.6)^{1.5} \cong 1550 \text{ cfs}$$

Storage Volume Released:

Storage Above Spillway	0.2 (12.8)	= 2.6 Acre ft.
Storage Below Spillway	1/3 (7.4) 12.8	= 31.6 " "
S = Total Storage =		34.2 " "

Channel Hydraulics:

Assume flow spread over ± flat area about 50' wide
$S = \frac{96.1 - 81.3}{200} = .074$, $n = .08$, $V = 5.07 R^{2/3}$,
Assume $R \simeq y$

y	A	V	Q
2	100	8.04	800
3	150	10.5	1580
2.8	140	10.1	1410

Actual failure flow channel ill defined.
Say flow at about 3 ft depth at about 10 fps

Time to Drain:

$$\frac{43560\ (34.2)}{3600(\frac{1}{2})(155)} = 0.53 \text{ Hours. or } 32 \text{ Min.}$$

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

GRISWOLD POND DAM

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
MA	292	NED	MA	009	07				GRISWOLD POND DAM	4228.4	7103.1	15	AUG	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	GRISWOLD POND

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	06	BENNETTS POND BROOK	SAUGUS	0	24700

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) NORMAL (ACRE-FT.)	DIST	OWN	FED	R	PRV/FED	SCS	A	VER/DATE
REPG	1918	R	10	10	54	51	NED	N		N		N		N

(28) REMARKS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO.	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	500	U	6	2	4000											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
UNKNOWN	UNKNOWN	UNKNOWN

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

(50) INSPECTION BY	(51) INSPECTION DATE DAY	MO	YR	(52) AUTHORITY FOR INSPECTION
METCALF AND EDDY INC	23	APR	79	PL 92-367

(53) REMARKS
46-ASSUMED RESPONSIBILITY TOWN OF SAUGUS

END

FILMED

7-85

DTIC

END

FILMED

7-85

DTIC