MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A
BLACKSTONE RIVER BASIN
MILLBURY, MASSACHUSETTS

DOROTHY POND DAM
MA 00146

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

JULY 1978
Dorothy Pond Dam is an earthfill dam with an upstream mortared masonry headwall. The dam has a maximum height of 13 feet and is approximately 200 feet long. The dam is considered to be in fair condition. There are several signs of distress which indicated potential hazard at this site. An inflow test flood of 2,850 cfs (½ the PMF) will overtop the main dam by about 2.0 feet.
Honorable Michael S. Dukakis  
Governor of the Commonwealth of  
Massachusetts  
State House  
Boston, Massachusetts  02133

Dear Governor Dukakis:

I am forwarding to you a copy of the Dorothy 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. In addition, a copy of the report has also been furnished the owner, Buck Brothers, Inc., Box 192, Millbury, Massachusetts 01527.

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 yours,

Incl  
As stated  

JOHN P. CHANDLER  
Colonel, Corps of Engineers  
Division Engineer
DOROTHY POND DAM
MA 00146

BLACKSTONE RIVER BASIN
MILLBURY, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
Identification No.: MA00146
Name of Dam: Dorothy Pond
Town: Millbury
County and State: Worcester County, Massachusetts
Stream: Tributary of Blackstone River
Date of Inspection: June 5, 1978

Dorothy Pond Dam which was constructed around 1825 is an earthfill dam with an upstream mortared masonry headwall. The dam has a maximum height of 13 feet and is approximately 200 feet long. The outlet conduit is a 24-inch diameter cast-iron pipe controlled by a rack and pinion operated wooden slide gate. The spillway, which is located 180 feet west from the dam, consists of a mortared stone paved channel that discharges into an earth channel.

A railroad embankment which is situated 500 feet upstream from the dam divides Dorothy Pond into two sections. A 4.5-foot by 5-foot box culvert transmits flow between the two sections.

There are no plans, specifications, or computations available from the Owner, County, State, or Town offices regarding the design, construction, or repairs of this dam except for a drawing showing proposed changes in the outlet mechanism and core wall, dated August 28, 1900.

Due to its age, Dorothy Pond Dam was neither designed nor constructed by current approved state-of-art methods. Based upon the visual inspection at the site, the lack of engineering data available, and limited operational or maintenance evidence, there are areas of concern which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in fair condition. However, there are several visible signs of distress which indicate a
potential hazard at this site: slight-to-moderate seepage at the downstream toe of the dam, erosion on the upstream headwall and face of the dam, large trees on the dam crest, and accumulation of debris in the spillway channel. Between the Town and the dam there are two smaller dams, two factories, about 24 residences, and a power transmission line. However, in the event of dam failure few lives would be lost since the flood wave would be attenuated by the upstream railroad embankment and dissipated by the lower ponds, causing appreciable property damage but minimal loss of life.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 264 cubic feet per second (cfs) at Elevation (E1) 396 which is the top of the dam. An inflow test flood of 2,850 cfs (one-half of the probable maximum flood) will overtop the main dam by about 2.0 feet.

It is recommended that the Owner employ a qualified consultant to investigate the seepage at the downstream toe and to conduct a more detailed hydraulic and hydrologic study. It is further recommended that the Owner remove the trees on the dam crest and all debris from the spillway. Also, erosion of the headwall and upstream face should be repaired and riprap added to prevent continued deterioration of the dam.

The above recommendations should be implemented within 1-2 years after receipt of the Phase I Inspection Report. An alternative to these recommendations would be draining the reservoir and breaching or removing the dam. However, it was reported that residents with frontage along the east edge of Dorothy Pond have shallow water supply wells which "dry out" at low pond levels. Therefore, draining the reservoir and breaching the dam could have a serious impact on these local residents.

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

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

Approved by:
This Phase I Inspection Report on Dorothy 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 judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch
CHARLES G. TIERSC, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens, Jr.
FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper
SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar
JOE B. FRYAR
Chief, Engineering Division
This report is prepared under guidance contained in the 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 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 aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.
# TABLE OF CONTENTS

**BRIEF ASSESSMENT**

**PREFACE**

**OVERVIEW PHOTO**  iii

**LOCATION MAP** iv

**REPORT**

**SECTION 1 - PROJECT INFORMATION**

1.1 General 1
1.2 Description of Project 2
1.3 Pertinent Data 5

**SECTION 2 - ENGINEERING DATA**

2.1 General 9
2.2 Construction Records 9
2.3 Operation Records 10
2.4 Evaluation of Data 10

**SECTION 3 - VISUAL INSPECTION**

3.1 Findings 11
3.2 Evaluation 13

**SECTION 4 - OPERATING PROCEDURES**

4.1 Procedures 14
4.2 Maintenance of Dam 14
4.3 Maintenance of Operating Facilities 14
4.4 Description of Any Warning System in Effect 14
4.5 Evaluation 14

**SECTION 5 - HYDRAULIC/HYDROLOGIC**

5.1 Evaluation of Features 15
# TABLE OF CONTENTS
(Continued)

<table>
<thead>
<tr>
<th>SECTION 6 - STRUCTURAL STABILITY</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Evaluation of Structural Stability</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION 7 - ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1 Dam Assessment</td>
<td>20</td>
</tr>
<tr>
<td>7.2 Recommendations</td>
<td>21</td>
</tr>
<tr>
<td>7.3 Remedial Measures</td>
<td>21</td>
</tr>
</tbody>
</table>

**APPENDIXES**

<table>
<thead>
<tr>
<th>APPENDIX A - PERIODIC INSPECTION CHECKLIST</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPENDIX B - DAM PLAN AND PAST INSPECTION REPORTS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPENDIX C - PHOTOGRAPHS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-1</td>
<td></td>
</tr>
</tbody>
</table>
OVERVIEW
DOROTHY POND DAM
MILLBURY, MASSACHUSETTS

VIEW OF UPSTREAM EMBANKMENT AND HEADWALL

LOCATION AND DIRECTION OF PHOTOGRAPHS SHOWN ON FIGURES IN APPENDIX B
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. Authorization and notice to proceed was issued to Metcalf & Eddy, Inc. under a letter of May 3, 1978, from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0306 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 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. The dam is located in the Town of Millbury, Worcester County, Massachusetts, on Dorothy Brook, a tributary of the Blackstone River. See Location Map.

b. Description of Dam and Appurtenances. Dorothy Pond Dam is a 13-foot high earthfill dam with mortared masonry walls at the intake and outlet (see Figures B-1 and B-2 in Appendix B). A 22-foot long by 14-foot high by 2.5-foot thick stone core wall, as shown in Figure B-3 in Appendix B, is about 13 feet from the outlet conduit headwall.

The dam embankment based on field measurements is approximately 200 feet long and is situated about 65 feet west of Riverlin Street. The dam crest is approximately 10 to 15 feet wide and upstream and downstream slopes are generally 2:1 (horizontal to vertical). The slopes are partially covered with grass, brush, and a few trees. Side slopes in the vicinity of the outlet conduit are flatter, nearly level with the headwall on the upstream slope and 3:1 on the downstream slope.

The outlet conduit is a 24-inch diameter pipe, apparently cast-iron, with invert El 383.8 at the outlet. The conduit flow is controlled by a wooden slide gate* operated by a rack and pinion mechanism which is mounted on a 7.5-foot square, 8-inch thick concrete slab at the upstream headwall. The mechanism which is operable had been recently used. The upstream headwall around the intake is constructed of mortared masonry. It is 50 to 65 feet long, 2.5-feet thick at the top, and is 15-feet in height. The inlet to the conduit is 4.7 feet wide, 2.2 feet deep, and extends approximately 13 feet down to the invert of the conduit. The outlet headwall is constructed of mortared masonry and is

*Information supplied by Mr. Joseph C. Cort.
20-feet long, 7-feet high, and 2-feet thick. Discharge flow passes into a small shallow stilling pool. At 34 feet downstream, flow passes through a 54-inch diameter corrugated metal culvert beneath Riverlin Street. The culvert invert is at El 384.7. Downstream of the culvert, water flows into a swampy area east of Riverlin Street.

The spillway is located about 180-feet southwest of the dam. The stone paved spillway channel is about 21-feet wide and 40-feet long. From the spillway, water flows into a natural stream bed about 360-feet long (see Figure B-1). The upper spillway crest is a 1-foot wide concrete weir at El 394.0. An 8.6-foot wide portion of this concrete has been breached to El 393.0 (see Figure B-2).

The spillway channel has mortared masonry sidewalls which are 2.1 to 2.4-feet high. The channel is covered with rock blocks, fallen wood, and miscellaneous debris. The downstream natural channel section is about 18-feet wide and 5-feet deep with steep side banks of sand and gravel. The water subsequently discharges into a 8.3 by 4.4-foot concrete box culvert beneath Riverlin Street. Invert elevation of the culvert is 386.3. Downstream of the culvert, the water enters a wide swampy area combining with the water from the outlet conduit.

Other features possibly regulating flow in Dorothy Pond are a series of three box culverts upstream of the dam. These are located where roads and a railroad cross the pond. The first is a 10-foot wide by 14-foot high concrete box culvert (invert El 393) beneath the Massachusetts Turnpike 5,000 feet northwest of the dam. The next is a 6-foot wide by 9.6-foot high concrete culvert (invert El 390.9) beneath MacArthur Road, 4,200 feet northwest of the dam. The closest restriction is an apparently abandoned railroad embankment located 500 feet northwest of the dam. It is a 4.5-foot wide by 5.2-foot high stone box culvert with an invert elevation of 387.8.
c. Size Classification. Dorothy Pond Dam is classified in the "small" category since it has a maximum height of 13 feet and maximum storage capacity of about 800 acre-feet.

d. Hazard Classification. The Town of Millbury is located approximately 1.3 miles downstream from the dam. Between the Town and the dam there are two smaller dams, two factories, about 24 residences, and a power transmission line. However, in the event of dam failure, few lives would be lost since the flood wave would be lessened because of the railroad embankment 500 feet upstream from the dam. Flooding of downstream areas would cause appreciable property damage and possibly endanger the downstream dams, causing further damage. Accordingly, the dam has been placed in the "significant" hazard category.

e. Ownership. The dam is presently owned by Buck Brothers, Inc.; Box 192, Millbury, Massachusetts 01527. Mr. Cort (617-865-4482) granted permission to enter the property and inspect the dam.

f. Operator. There are no known operators of the dam. Mr. Cort occasionally visits the dam since his office at Buck Brothers is located nearby.

g. Purpose of Dam. The dam was originally constructed as a storage dam for the Blackstone Canal Corp. Subsequently, Buck Brothers, Inc. obtained ownership of the dam and used it as a storage dam for the generation of power elsewhere. Presently, water from the dam is used for cooling by Buck Brothers (located 3,500 feet downstream) in their manufacturing process. Also, the pond is used for recreation by local residents. Further, it was reported that residents with frontage along the east edge of Dorothy Pond have shallow water supply wells which "dry out" at low pond levels.

h. Design and Construction History. The dam was originally constructed by the Blackstone
Canal Corp. in 1825.* As mentioned, there are no plans, specifications, or computations available from the Owner, County, or State offices relative to the design, construction, or repairs of the original dam. Modifications to the original dam were proposed in 1900 by Buck Brothers (see Appendix B, Figure B-3). It was reported by Mr. Cort that the spillway elevation was raised approximately 18 inches. The date of this work is unknown. In 1955, Mr. Cort partially removed this raised spillway section because of upstream flooding. The slide gate for the outlet conduit was repaired in 1960 and subsequently replaced in 1970.

During the inspection of the dam, it was noted that some trees on the dam embankment had been cut down in the past.

1. Normal Operating Procedures. There are no normal operating procedures at the dam. The only apparent outlet control for the dam is the 24-inch diameter outlet conduit. A 24-inch square wooden sluice gate operated by a rack and pinion mechanism controls flow into the outlet conduit. There is no lock on this mechanism. However, a long steel bar is necessary to operate the device. The outlet pipe is normally closed and is not periodically opened by Buck Bros., Inc.

The spillway for Dorothy Pond is ungated and flows are unrestricted though slight blockage is caused by existing debris.

1.3 Pertinent Data

a. Drainage Area. The approximately 2,500-acre (3.91 square miles) drainage area above the dam consists of moderately developed, locally wooded, and gently rolling land. Discharge is to three unnamed small ponds located at 1,000, 3,500 and 5,000 feet downstream. Subsequent flow is to the Blackstone River which is about 1.4 miles from Dorothy Pond.

*Information supplied by Messrs. Wallace Lindquist and Joseph C. Cort.
b. **Discharge at Dam Site.** Normal discharge above El 393 from the pond is through the spillway. It is approximately 2-feet high by 21-feet wide. It has a crest elevation of 394.0. There is a breached section in the center which has an elevation of 393 (See Figure B-2).

The spillway is about 40-feet long with mortared masonry sidewalls and loosely placed stones in the bottom. The channel slopes gently for about 40 feet and then discharges into a stream bed.

The stream bed is about 18-feet wide by 5-feet deep. It slopes gradually for about 360 feet, and then the discharge enters a concrete box culvert beneath Riverlin Street. The culvert is 4.4-feet by 8.3-feet in size with an invert elevation of 386.2. Downstream of the culvert is a wide swampy area.

The spillway can discharge an estimated 264 cfs at El 396 which is the top of the dam. An inflow test flood of 2,850 cfs (half of the probable maximum flood) will overtop the main dam by about 2.4 feet.

The maximum flood at the dam site is unknown; however, Mr. Cort at Buck Brothers, Inc. stated that neither the dam nor the railroad embankment were overtopped during the 1955 floods.

c. **Elevation (feet above MSL (Mean Sea Level)).**
   A benchmark elevation of 394 at the upper section of the spillway crest was estimated from a U.S.G.S. topographic map.

   (1) Top dam - Main dam: 395.7 to 396.8. Railroad embankment (500 feet upstream) 396.1

   (2) Maximum pool-design surcharge: 396

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

   (4) Recreation pool: 393.0
(5) Spillway crest - Breached section (ungated): 393.0

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

(7) Stream bed at centerline of dam: 383

(8) Tailwater (outlet pipe closed): 386.6

d. Reservoir

(1) Length of maximum pool: 6,000 feet

(2) Length of recreation pool: 6,000 feet

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

e. Storage (acre feet)

(1) Recreation pool: 800 (approximate)

(2) Flood control pool: N/A

(3) Design surcharge: 300 at El 395.0 (approximate)

(4) Top of dam: 1,200 (approximate)

f. Reservoir Surface (acres) (It is assumed that an increase in elevation from 393 to 396 will not significantly increase the surface area of the pond.)

(1) Top dam: 145

(2) Maximum pool: 145

(3) Flood-control pool: N/A

(4) Recreation pool: 145

(5) Spillway crest: 145

g. Dam

(1) Type - earthfill dam with dry-stone masonry headwall
(2) Length - 200 feet
(3) Height - 13 feet
(4) Top width: 10 feet
(5) Side slopes - Upstream 2:1; downstream 2:1.
(6) Zoning: Unknown
(7) Impervious core: masonry core wall 20-feet long by 13-feet high by 2.5-feet thick centered at outlet conduit.
(8) Cutoff: Unknown
(9) Grout curtain: Unknown

i. Spillway
(1) Type: Broad crest
(2) Crest Length: 21 feet
(3) Crest elevation: 393 MSL (breached) section) 394 MSL (unbreached)
(4) Gates: None
(5) Upstream Channel: None
(6) Downstream Channel: 21-foot wide by 2.3-foot high spillway to stream channel 18-feet wide by 5-feet deep

j. Regulating Outlets. The only apparent regulating outlet is a 24-inch diameter outlet conduit passing under the dam embankment. The flow is controlled by a wooden slide gate operated by a rack and pinion mechanism. Flow is discharged into a stilling pond. At 35 feet downstream of the outlet, flow enters a 54-inch diameter metal corrugated culvert beneath Riverlii. Street. Downstream of the culvert, flow passes into a wide swampy area. The outlet conduit is not operated on a regular basis.
SECTION 2
ENGINEERING DATA

2.1 General. There are no plans, specifications, or computations available from the Owner, State, or County offices relative to the original dam built in 1825. However, one drawing dated August 28, 1900 is available from the Worcester County Commissioners Office showing a proposed core wall and proposed changes to the outlet works at Dorothy Pond (see Appendix, Figure B-3). The only other data used for this evaluation were visual observations during inspection, review of previous inspection reports, and conversations with the Owner and personnel from Town, State and County agencies.

The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection and past operational performance of the structure.

We acknowledge the assistance and cooperation of personnel of the Massachusetts Department of Public Works: Messrs. Willis Regan and Raymond Rochford, and of the Massachusetts Department of Environmental Quality Engineering, Division of Waterways: Messrs. John J. Hannon and Joseph Tagallo.

We acknowledge the cooperation and assistance of personnel from the Worcester County Engineer's Office: Messrs. John O'Toole, Joseph Brazauskas, and Mr. Wallace Lindquist — recently retired from county service. Also, we thank Mr. Christopher D. Baker, Millbury Town Engineer, for his assistance.

In addition, we thank Mr. Joseph C. Cort, Buck Bros., Inc. owner of the dam, who allowed the inspection of the dam and provided information on its history and operating characteristics.

2.2 Construction Records. There are no detailed construction records available except as included in Appendix B.
2.3 Operation Records. No operation records are available and there is no daily record kept of pool elevation or rainfall at the dam site.

2.4 Evaluation of Data. The data acquired are considered adequate for this Phase I Inspection and Evaluation.
SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Phase I inspection of the dam at Dorothy Pond was performed on June 5, 1978. A copy of the inspection report is included in Appendix A. Periodic inspections of this dam by others have been made since 1932. A listing of these inspections is in Appendix B. Two inspections were made in February 1972 and March 1976 by personnel from the Massachusetts Department of Public Works. Copies of their reports are included in Appendix B.

b. Dam. The main dam is an earthfill dam with a mortared masonry headwall. Photographs in Appendix C show the dam and spillway. Slight seepage was noted at the downstream toe of the dam approximately 50 feet south and 90 feet north of the outlet. The seepage forms swampy areas adjoining the stilling pond. Flow is estimated to be less than 1 gpm, and the water is clear. "Moderate to heavy leakage at the downstream toe" was noted by the State during their March 5, 1976 inspection. No estimate of the quantity of flow or the location of the leakage was reported.

Erosion of the upstream face was observed at two locations along the headwall of the dam. These are washouts about 5-feet long and 2-feet deep located at the southern end and 10-feet south of the northern end of the headwall. The erosion at the northern end caused partial failure of the headwall. Also, it should be noted that there is no protecting riprap along the entire upstream face of the dam embankment.

Two oak trees about 30-inches in diameter, and smaller trees and brush are growing on both upstream and downstream embankment slopes. Older stumps are also visible which indicate previous efforts at clearing.
c. **Appurtenant Structures.** The outlet structure is a 24-inch diameter cast-iron pipe surrounded by a mortared masonry headwall 7-feet high. The rim of the pipe is rusted, and the mortar in the headwall is deteriorated and missing in places. Downstream beneath Riverlin Street is a 54-inch diameter corrugated metal culvert with upstream and downstream headwalls. The headwalls of mortared masonry have deteriorated. The southern end of the upstream headwall has several missing stones apparently caused by surface runoff from Riverlin Street.

In the March 5, 1976 State inspection report it was noted that "the sluice gate doesn't seat properly and the timber portion of the gate stem will have to be replaced in a year or so." This condition was not apparent as the gate was not operated during the inspection.

The spillway channel is constructed of mortared masonry sidewalls. The bottom is partially lined with mortared riprap and partially covered with loose, randomly placed riprap. A few masonry blocks are missing out of place from the sidewalls and the mortar is deteriorated. The spillway channel is strewn with various debris such as fallen wood, tires, and dislocated rock blocks.

d. **Reservoir Area.** The reservoir and drainage area is moderately populated: there are over 600 residences in the drainage area. The land is locally wooded and slopes range from about 5 to 30 percent.

As noted previously, there is a series of three box culverts upstream from the dam that may regulate flow at Dorothy Pond.

e. **Downstream Channel.** The discharge from the spillway flows down a stream channel, through a concrete box culvert beneath Riverlin Street, and into a swampy area situated about 400 feet from the crest. The slope of the spillway channel is about 6 percent, and the slope of the stream channel is about 1
percent. The stream channel contains occasional fallen trees and has numerous overhanging trees. This debris would impede flow in the channel causing greater depths, but is sufficiently below the spillway level so that its discharge would not be affected. The box culvert is clear of obstructions and is in good condition.

From the culvert, the water flows to three small unnamed ponds and on to the Blackstone River.

3.2 Evaluation. The above findings indicate that the dam has several signs of distress that require attention. It is evident that the dam is not maintained and that deterioration will continue unless action is taken. Recommended measures to improve these conditions are stated in Section 7.
SECTION 4

OPERATING PROCEDURES

4.1 Procedures. There are no operating procedures at this dam. It was reported by the Owner that the outlet conduit is normally closed. It is not opened for releasing of water since there is sufficient storage in the lower ponds for their manufacturing needs. The outlet is apparently operated by persons other than the Owner, since the outlet was open during a site visit on May 19, 1978 but was closed during our inspection of June 5, 1978.

4.2 Maintenance of Dam. The dam is not regularly maintained, although some repairs as discussed previously have been done in the past.

4.3 Maintenance of Operating Facilities. The outlet conduit appears to be functional although it was reported by the State in their March 5, 1976 report that the "sluice gate doesn't seat properly and the timber portion of the gate stem will have to be replaced in a year or so." There is no locking mechanism on the rack and pinion controls for the slide gate. All that is needed is a long steel bar to operate the device.

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

4.5 Evaluation. There are no operating, maintenance, or warning systems in effect at Dorothy Pond Dam. This is undesirable considering the fact that it is in the "significant" hazard category. A program of periodic maintenance for this dam should be implemented. Further, a lock should be added to the outlet control.
5.1 Evaluation of Features

a. Design Data. The Probable Maximum Flood (PMF) maximum peak-flow rate was determined to be 1,460 cfs per square mile. This calculation is based on the average drainage area slope of 1.3 percent, the pond-plus-swamp-area to drainage-area ratio of 12 percent, as well as the U.S. Army Corps of Engineers' guide curves for Maximum Probable Flood Peak Flow Rates (dated December 1977). Applying one-half the PMF to the 3.91 square miles of drainage area results in a calculated peak flood flow of 2,850 cfs as the inflow test flood. By adjusting the inflow test flood for surcharge storage, the maximum discharge rate was established as 1,795 cfs, with a water surface at El 398.

Flow over the dam crest is predicted to be 1,172 cfs, while flow through the spillway section would be 623 cfs. The maximum head on the dam would be 2.0 feet at a discharge rate of approximately 5.9 cfs per foot of width. A flow having a 1.02-foot depth and a velocity of 5.8 feet per second would occur where flow becomes critical over the dam crest. A velocity of 5.8 feet per second could cause erosion of the dam and result in complete dam failure.

A 100-year frequency storm inflow was estimated to be 961 cfs. Adjusting this for storage would result in discharge of 440 cfs and a pond elevation of 396.6 and also produce flow over the dam.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 264 cfs at El 396 which is the top of the dam.

b. Experience Data. Experience records are not generally available for this dam. However,
Mr. Cort of Buck Brothers, Inc. stated that neither the dam nor the railroad embankment were overtopped during the 1955 floods.

c. Visual Observations. The spillway consists of a 21-foot wide by 2.3 to 3.3-foot high, mortared stone masonry spillway which discharges into a 18-foot wide by 5-foot deep earth channel. The length of the spillway from the earth channel to the channel is about 40 feet. The orientation and location of the spillway is shown in Figure B-1.

The spillway crest had been partially lowered 12 inches in 1955 (See Figure B-2) because of upstream flooding. This indicates that small changes in pond elevation could cause localized flooding to residences near the shoreline.

d. Overtopping Potential. Overtopping of the dam is expected under the inflow test flood of 2,850 cfs; as noted previously, however, the only available records on overtopping indicate that the dam was not overtopped during the 1955 floods.

In the event of overtopping, complete failure of the dam could occur. A flood wave due to dam failure would be attenuated by the upstream railroad embankment and dissipated by the lower ponds, causing appreciable property damage but minimal loss of life.

The Dorothy Pond Dam is part of a complex hydraulic system. The rectangular drainage area is crossed by several features which may constrict flow.

Drainage from the upper third of the area flows across a swamp with a man-made discharge channel which runs out between two natural highlands. Route 20 roughly divides the drainage area. The Massachusetts Turnpike separates the upper 70 percent of the area from the northern end of Dorothy Pond. Its culvert system would act to retard major flows to Dorothy Pond. About 800 feet south of the Turnpike, a 6-foot high by
9.6-foot wide culvert under MacArthur Road crosses the flow line in the pond. Finally, a railroad embankment crosses the pond about 500 feet northwest of the dam. The railroad embankment contains a stone box culvert 4.5-feet wide by 5-feet high.

Immediately downstream of the dam is the Riverlin Street embankment. The street which is about 2-feet lower than the dam crest would act as a secondary dam in case of failure of Dorothy Pond Dam. During high flows which could overtop the dam, the street embankment would cause high tailwater at the dam, in the order of 1.5 feet below the dam crest.

Downstream of Riverlin Street, discharge from Dorothy Pond passes through three impoundments before reaching the Blackstone River.

Based on the U.S.G.S. topographic maps, pond levels between El 390 and 400 may cause discharge at three locations. Two places are just upstream of the railroad, to the northeast and the southwest. The third is at the southerly most extension of the pond.
SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of Dorothy Pond Dam is based on the visual inspection on June 5, 1978. As discussed in Section 3, Visual Inspection, there were several visible signs of distress.

Based on these observations, Dorothy Pond Dam is a potential hazard. Static stability conditions are unsatisfactory and conventional factors of safety do not exist.

It is recommended that a more detailed investigation be initiated to evaluate the seepage at the downstream toe of the dam.

b. Design and Construction Data. Discussions with the Owner, Town, County, and State personnel indicate that there are no plans, specifications, or computations relative to the design, construction, or repairs of this dam other than the one drawing dated August 28, 1900 which shows proposed changes to the outlet works and a proposed core wall (see Figure B-3). Information on the type, shear strength, and permeability of the soil and/or rock materials of the dam embankment does not appear to exist.

It was learned that this dam was built in 1825, probably of local soil or rock materials. As noted above, Figure B-3, shows a proposed stone masonry core wall. This core wall is shown to be 22-feet long by 14-feet high by 2.5-feet thick and is located 13 feet from the outlet conduit headwall. Since the dam is about 200 feet long, the core wall only extends for about 10 percent of the total length.
c. **Operating Records.** There is no evidence of instrumentation of any type in Dorothy Pond Dam, and there is nothing to indicate that any instrumentation was ever installed in this dam. The performance of this dam under prior loading can only be inferred by previous records and physical evidence at the site.

d. **Post-Construction Changes.** There are no as-built drawings for Dorothy Pond Dam. Modifications to the original dam were proposed by Buck Brothers, Inc. in 1900. (See Figure B-3.) There is no as-built information relative to these changes. It was reported by Mr. Cort that the spillway elevation was raised about 18 inches at some unknown time. In 1955, Mr. Cort partially removed this raised spillway section. The slide gate for the outlet conduit was repaired in 1960 and subsequently replaced in 1970.

e. **Seismic Stability.** This dam is located in Seismic Zone 2. Since static stability conditions are unsatisfactory, the dam is particularly vulnerable in the event of an earthquake.
SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Due to its age, Dorothy Pond Dam was neither designed nor constructed according to current approved state-of-art methods. Based upon the visual inspection at the site, the limited engineering data available, and little operational or maintenance evidence, there are areas of concern which must be corrected to assure the continued performance of this dam. Generally, the dam is considered to be in fair condition. However, there were several signs of distress observed at the site: slight to moderate seepage at the downstream toe of the dam, erosion on the upstream headwall and face of the dam, large trees on the dam crest and an accumulation of debris in the spillway channel.

Hydraulic analyses indicate that the existing spillway can discharge a flow of 264 cfs at EL 396, which is the top of the dam. An inflow test flood of 1,795 cfs will overtop the main dam by about 2.0 feet. Since previous records at this site indicate the dam was not overtopped in the 1955 floods because of the upstream attenuating effect of the railroad embankment, it is unlikely that this is a serious potential hazard. Pond elevations above EL 390 may cause flow at three locations as noted in Section 5.1.d.

b. Adequacy of Information. The information available is such that the assessment of the condition of the dam must be based primarily on the visual inspection and the past operational performance of the structure.

c. Urgency. The recommendations outlined below should be implemented within 1 to 2 years after receipt of the Phase I Inspection Report.
d. Need for Additional Information. Additional investigations to further assess the adequacy of the dam and appurtenant structures are outlined below in 7.2 Recommendations.

7.2 Recommendations. In view of the concerns on the continued performance of this dam, it is recommended that the Owner employ a qualified consultant to:

a. evaluate the dam stability and the seepage at the downstream toe;

b. conduct a more detailed hydraulic and hydrologic investigation at the site and determine the need to increase spillway capacity.

The recommendations on repairs and maintenance procedures are stated below under 7.3 Remedial Measures.

7.3 Remedial Measures

a. Alternatives. An alternative to the recommendations above and the maintenance procedures itemized below would be to drain the reservoir and breach or remove the dam. However, it was reported that residents with frontage along the east edge of Dorothy Pond have shallow water supply wells which "dry out" at low pond levels. Therefore, draining the reservoir and breaching the dam could have a serious impact on those residents.

b. Operations and Maintenance Procedures. The dam and appurtenant structures are not adequately maintained. It is recommended that the Owner accomplish the following items:

(1) remove the trees on the dam and clear all debris from the spillway;

(2) repair erosion of the upstream headwall and dam face, and install riprap to prevent continued deterioration of the dam;

(3) institute a definite plan for surveillance and a warning system during periods of unusually heavy rains and/or runoff.
(4) implement a systematic program of inspection and maintenance. As a minimum the inspection program should consist of a monthly inspection of the dam and appurtenances and be supplemented by additional inspections during severe storms. All repairs and maintenance should be undertaken in accordance with all applicable State regulations.
APPENDIX A

<table>
<thead>
<tr>
<th>Periodic Inspection Checklist</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A-1</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION
PARTY ORGANIZATION

PROJECT: Dorothy Pond

DATE: 6/5/78

TIME: 8:00 am - 6:00 pm

WEATHER: partly cloudy, showers, 70º

W.S. ELEV. 393.3 U.S. 386.6 D.N.S.
Assumed benchmark elevation 394
upper section of spillway

PARTY:
1. Ed Greco
2. Carol Sweet
3. Susan Pierce
4. Lyle Branagan
5. __________________________
6. __________________________
7. __________________________
8. __________________________
9. __________________________
10. __________________________

PROJECT FEATURE: Dam

INSPECTED BY: Ed Greco

REMARKS: Spillway

LYLE BRANAGAN

Ed Greco

LYLE BRANAGAN

__________________________

9.

__________________________

10.

__________________________

page 4 of 7
PERIODIC INSPECTION CHECK LIST

PROJECT: Dorothy Pond  DATE: 6/5/78
PROJECT FEATURE: Dam site  NAME: Ed Greco
DISCIPLINE: Geotechnical

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DAM EMBANKMENT</strong></td>
<td></td>
</tr>
<tr>
<td>Crest Elevation</td>
<td>varies from 395.7 to 396.8</td>
</tr>
<tr>
<td>Current Pool Elevation</td>
<td>393.3</td>
</tr>
<tr>
<td>Maximum Impoundment to Date</td>
<td>Unknown</td>
</tr>
<tr>
<td>Surface Cracks</td>
<td>none visible</td>
</tr>
<tr>
<td>Pavement Condition</td>
<td>n/a</td>
</tr>
<tr>
<td>Movement or Settlement of Crest</td>
<td>irregular crest</td>
</tr>
<tr>
<td>Lateral Movement</td>
<td>none visible</td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td>headwall vertical</td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td>relatively straight</td>
</tr>
<tr>
<td>Condition at Abutment and at Concrete Structures</td>
<td>dam crest lowest at abutments</td>
</tr>
<tr>
<td>Indications of Movement of Structural Items on Slopes</td>
<td>none</td>
</tr>
<tr>
<td>Trespassing on Slopes</td>
<td>2 large trees growing on crest, one on left abutment, dead stumps on 1/3 face.*</td>
</tr>
<tr>
<td>Sloughing or Erosion of Slopes or Abutments</td>
<td>Erosion of 1/3 slope adjacent to inlet headwall (possible 5 feet)</td>
</tr>
<tr>
<td>Rock Slope Protection - Riprap Failures</td>
<td>see above. Also, few stones missing from headwall. No other riprap on 1/3 face.</td>
</tr>
<tr>
<td>Unusual Movement or Cracking at or near Toes</td>
<td>none visible</td>
</tr>
<tr>
<td>Unusual Embankment or Downstream Seepage</td>
<td>45 ft SW of outlet centerline, less than 1 gpm (very slight); slight seepage in left abutment area</td>
</tr>
<tr>
<td>Piping or Boils</td>
<td>none visible</td>
</tr>
<tr>
<td>Foundation Drainage Features</td>
<td>no known underdrains</td>
</tr>
<tr>
<td>Toe Drains</td>
<td>unknown</td>
</tr>
<tr>
<td>Instrumentation System</td>
<td>none visible</td>
</tr>
</tbody>
</table>

* Footpath, animal burrows
**PERIODIC INSPECTION CHECK LIST**

**PROJECT**  | **Dorothy Pond**  | **DATE**  | **6/5/78**
---|---|---|---
**PROJECT FEATURE**  | **Railroad Embankment**  | **NAME**  | **Ed Greco**
**DISCIPLINE**  | **Geotechnical**  | **NAME**  |

<table>
<thead>
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<th>AREA EVALUATED</th>
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</tr>
</thead>
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<tr>
<td><strong>DIKE EMBANKMENT</strong></td>
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</tr>
<tr>
<td>Crest Elevation</td>
<td></td>
</tr>
<tr>
<td>Current Pool Elevation</td>
<td></td>
</tr>
<tr>
<td>Maximum Impoundment to Date</td>
<td></td>
</tr>
<tr>
<td>Surface Cracks</td>
<td></td>
</tr>
<tr>
<td>Pavement Condition</td>
<td></td>
</tr>
<tr>
<td>Movement or Settlement of Crest</td>
<td></td>
</tr>
<tr>
<td>Lateral Movement</td>
<td></td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td></td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td></td>
</tr>
<tr>
<td>Condition at Abutment and at Concrete Structures</td>
<td></td>
</tr>
<tr>
<td>Indications of Movement of Structural Items on Slopes</td>
<td></td>
</tr>
<tr>
<td>Trespassing on Slopes</td>
<td></td>
</tr>
<tr>
<td>Sloughing or Erosion of Slopes or Abutments</td>
<td></td>
</tr>
<tr>
<td>Rock Slope Protection - Riprap Failures</td>
<td></td>
</tr>
<tr>
<td>Unusual Movement or Cracking at or near Toes</td>
<td></td>
</tr>
<tr>
<td>Unusual Embankment or Downstream Seepage</td>
<td></td>
</tr>
<tr>
<td>Piping or Boils</td>
<td></td>
</tr>
<tr>
<td>Foundation Drainage Features</td>
<td></td>
</tr>
<tr>
<td>Toe Drains</td>
<td></td>
</tr>
<tr>
<td>Instrumentation System</td>
<td></td>
</tr>
</tbody>
</table>

RR embankment separates upper and lower Dorothy Pond 396.1

boat launch; recreational path

U/s slope shows some erosion

riprap irregular; sloughing

none visible
PERIODIC INSPECTION CHECK LIST

PROJECT: Dorothy Pond
PROJECT FEATURE: Outlet Works
DISCIPLINE: Geotechnical

DATE: 6/5/78
NAME: Ed Greco

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet Works - Intake Channel and Intake Structure</td>
<td></td>
</tr>
<tr>
<td>a. Approach Channel</td>
<td></td>
</tr>
<tr>
<td>Slope Conditions</td>
<td>None</td>
</tr>
<tr>
<td>Bottom Conditions</td>
<td>n/a</td>
</tr>
<tr>
<td>Rock Slides or Falls</td>
<td></td>
</tr>
<tr>
<td>Log Boom</td>
<td></td>
</tr>
<tr>
<td>Debris</td>
<td></td>
</tr>
<tr>
<td>Condition of Concrete Lining</td>
<td></td>
</tr>
<tr>
<td>Drains or Weep Holes</td>
<td></td>
</tr>
<tr>
<td>b. Intake Structure</td>
<td></td>
</tr>
<tr>
<td>Condition of Concrete</td>
<td>Fair</td>
</tr>
<tr>
<td>Stop Logs and Slots</td>
<td></td>
</tr>
</tbody>
</table>

* Stone masonry headwall with concrete mortared joints

& Submerged intake with rack and pinion slide gate control
**PERIODIC INSPECTION CHECK LIST**

**PROJECT**  Dorothy Pond  
**DATE**  6/5/78  
**PROJECT FEATURE**  Outlet Works  
**NAME**  Ed Greco  
**DISCIPLINE**  Geotechnical  

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - TRANSITION AND CONDUIT</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>n/a</td>
</tr>
<tr>
<td>Rust or Staining on Concrete</td>
<td>&quot;</td>
</tr>
<tr>
<td>Spalling</td>
<td>&quot;</td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td>&quot;</td>
</tr>
<tr>
<td>Cracking</td>
<td>&quot;</td>
</tr>
<tr>
<td>Alignment of Monoliths</td>
<td>&quot;</td>
</tr>
<tr>
<td>Alignment of Joints</td>
<td>&quot;</td>
</tr>
<tr>
<td>Numbering of Monoliths</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

Inlet and outlet submerged; 24-inch diameter cast iron pipe, outlet end rusted
PERIODIC INSPECTION CHECK LIST

PROJECT    Dorothy Pond  DATE    6/5/78
PROJECT FEATURE  Outlet Works  NAME    Ed Greco
DISCIPLINE    Geotechnical

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - OUTLET STRUCTURE</td>
<td></td>
</tr>
<tr>
<td>AND OUTLET CHANNEL</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>Stone masonry headwall, mortared; condition fair</td>
</tr>
<tr>
<td>Rust or Staining</td>
<td>none</td>
</tr>
<tr>
<td>Spalling</td>
<td>minor spalling of mortar</td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td>none visible</td>
</tr>
<tr>
<td>Visible Reinforcing</td>
<td>none</td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td>none</td>
</tr>
<tr>
<td>Condition at Joints</td>
<td>mortar is spalled</td>
</tr>
<tr>
<td>Drain Holes</td>
<td>none</td>
</tr>
<tr>
<td>Channel</td>
<td>small stilling pool, randomly placed stones</td>
</tr>
<tr>
<td>Loose Rock or Trees Over-hanging Channel</td>
<td>loose rock sloughed in from D/I5 culvert headwall</td>
</tr>
<tr>
<td>Condition of Discharge Channel</td>
<td>outlet discharges into small stilling pool, then into 54-inch corrugated metal culvert under Riverlin Street. Headwall for culvert is stone masonry with recently mortared stones above crown of pipe. West section of wall has fallen down from surface erosion from road.</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT  | Dorothy Pond          | DATE  | 6/5/78
-----------|------------------------|-------|----------
PROJECT FEATURE  | Spillway            | NAME  | Ed Greco
DISCIPLINE  | Geotechnical       | NAME  |

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</td>
<td></td>
</tr>
<tr>
<td>a. Approach Channel</td>
<td>None</td>
</tr>
<tr>
<td>General Condition</td>
<td>n/a</td>
</tr>
<tr>
<td>Loose Rock Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Trees Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Floor of Approach Channel</td>
<td></td>
</tr>
<tr>
<td>b. Weir and Training Walls</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>concrete breached on weir; remnants in poor condition</td>
</tr>
<tr>
<td>Rust or Staining</td>
<td>none</td>
</tr>
<tr>
<td>Spalling</td>
<td>mortar joints deteriorating - washed out in places</td>
</tr>
<tr>
<td>Any Visible Reinforcing</td>
<td>none</td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td>none</td>
</tr>
<tr>
<td>Drain Holes</td>
<td>none</td>
</tr>
<tr>
<td>c. Discharge Channel</td>
<td></td>
</tr>
<tr>
<td>General Condition</td>
<td>cluttered with dislodged rock blocks, trees, and debris</td>
</tr>
<tr>
<td>Loose Rock Overhanging Channel</td>
<td>none</td>
</tr>
<tr>
<td>Trees Overhanging Channel</td>
<td>50'-78' downstream along earth channel -  brush and small trees (6&quot; - 1' dia)</td>
</tr>
<tr>
<td>Floor of Channel</td>
<td>rock blocks near spillway - downstream bed is gravel and cobbles</td>
</tr>
<tr>
<td>Other Obstructions</td>
<td>branches, litter</td>
</tr>
<tr>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Dam Plan – Figure B-1</td>
<td>B-1</td>
</tr>
<tr>
<td>Dam and Spillway Sections – Figure B-2</td>
<td>B-2</td>
</tr>
<tr>
<td>Plan of Dam dated August 28, 1900 – Figure B-3</td>
<td>In Pocket</td>
</tr>
<tr>
<td>Previous Inspections (Partial Listing)</td>
<td>B-4</td>
</tr>
<tr>
<td>Inspection Report by Massachusetts Department of Public Works (February 1, 1972)</td>
<td>B-6</td>
</tr>
<tr>
<td>Inspection Report by Massachusetts Department of Public Works (March 5, 1976)</td>
<td>B-7</td>
</tr>
</tbody>
</table>
DOROTHY POND
WS Elev. 393.3'

Notes:
1. Elevations shown are referenced to assumed benchmark elevation 304 (MSL) at upper spillway crest.
2. Information shown based on field survey of June 5, 1978.
3. A denotes seepage point.
4. → shows direction of view of photographs.
5. See figure B-2 for sections.

Figure B-1 DAM PLAN
DAM SECTION 1-1

SPILLWAY SECTION 2-2

Scale in Feet
0 5 10

Note: For locations of sections, see Figure B-1.

Metcalf+Eddy, Inc.

Figure B-2. DAM AND SPILLWAY SECTIONS
B-2
Plan
Scale 1 : 40

Plan of Proposed Changes in Outlet
Gate B
New Wall Crosshatched
Plan
Scale 1: 4-0
Plans of Proposed Changes in Outlet
Dorothy Pond Dam
Buck Bros' Millbury Mass
Engineer Aug 27 1960

Elevation of Present Outlet 93.65
Water 97.20

Section A B
Elevation of Water 100

Foundation to go at least as Low as Present Ones

Outlet of Present Gate 93-18

Foundation A B

27/1800

Dam at Mass
**TOWN OR CITY** | Millbury
---|---
**DEGREE NO.** | 320
**PLAN NO.** | (H F M)
**NATURAL POND** | Near center

**DESCRIPTION OF DAM**

<table>
<thead>
<tr>
<th>Type</th>
<th>Earthen - Rubble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td></td>
</tr>
<tr>
<td>Thickness top</td>
<td></td>
</tr>
<tr>
<td>Downstream Slope</td>
<td></td>
</tr>
<tr>
<td>Upstream</td>
<td></td>
</tr>
<tr>
<td>Length of Spillway</td>
<td></td>
</tr>
<tr>
<td>Size of Gates</td>
<td></td>
</tr>
<tr>
<td>Location of Gates</td>
<td></td>
</tr>
<tr>
<td>Flashboards used</td>
<td></td>
</tr>
<tr>
<td>Width Flashboards or Gates</td>
<td>24&quot;</td>
</tr>
<tr>
<td>Dam designed by</td>
<td>Outlet by Chas. A. Allen &amp; C. E</td>
</tr>
<tr>
<td>&quot; constructed by</td>
<td></td>
</tr>
<tr>
<td>Year constructed</td>
<td></td>
</tr>
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**GENERAL REMARKS**

*Buck Bros. Specifications*
*C. C. Records Vol. 29 P. 100*
*Aug. 28, 1900*
*Inspected: Sept. 29, 1932 - L. O. M."
*May 20, 1937 - K. H. F."
*Oct. 19, 1938 - "*
*Dec. 12, 1940 - C. H. S."
*Dec. 18, 1942 - W. H. I.*

**PREVIOUS INSPECTIONS (PARTIAL LISTING)**

COPY OF INSPECTION CARD ON FILE AT THE MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS, DISTRICT OFFICE, WORCESTER.
Vol.15, Pg 470 - Dec 1825 accepted and recorded for Blackstone Canal Corp.
at outlet of Greaty Pond - on land of Jacob Dodge & Daniel Rice.

Inspected Aug. 15, 1931, by W.O.E. C.R.C.

30-09
INSTRUCTION REPORT & DATA FOR DAMS

Owner: BUCK BRICKLIN, INC.
Hico Address: BRECKLIN ST MILLICENT
Function of Dam: Natural Flow Storage

Location & Access:
USGS Quad: Grafton
Drain, Acres:
Character of U.A.:

Estimated
Discharge
Capacity:

General Description of Dam and Discharge Control:
24" Draw off Pipe
24" of Timber, 20' of Canvas, 20' of Stone, 12' of Trees

Sketch (Not to Scale):

Remarks and Recommendations:
LARGE OLD TREES SHOULD BE CUT DOWN.

Date: 3/1/72
By: E. McLean
Comment: P. Nicholson

B-6
October 19, 1976

Buck Brothers, Inc.
Riverlin Street
Hillbury, Massachusetts

RE: Inspection Dam #3-14-186-38

Gentlemen:

On March 5, 1976, an Engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate the owner to be Buck Brothers, Inc. If this information is incorrect will you please notify this office.

The inspection was made in accordance with the provisions of Chapter 253 of the Massachusetts General Laws as amended (Dams-Safety Act). Chapter 736 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. By acquiring title to the dam, the Town assumes responsibility for upkeep and/or restoration.

2. The Town would be liable for damage to life and property downstream in the unlikely event of dam failure.

(Over)

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.

Sincerely yours,

JOHN H. LANNON, P.E.
CHIEF ENGINEER

A. RE:
Chairman of Selectmen, Hillbury
3. Repairs now required would be expensive. Rip rap is needed on 125+ linear feet of the upstream face. Heavy growth of trees and brusa on the downstream face should be removed. The sluice gate doesn't sit properly and the timber portion of the gate stem will have to be replaced in a year or so. There is heavy leakage flowing through the downstream toe—the only cutoff shown by County records is a 22' horizontal x 12' vertical stone concrete wall at the sluice within the dam, and 35' of grouted, cut fieldstone wall at the upstream face (at the gate).

4. A review of County records on this dam leads me to conclude that the leakage occurs whenever the pool elevation reaches spillway invert elevation and becomes insignificant when pool elevation drops a few feet below invert elevation. Since there are residences with gravity wells adjacent to the pond, the lower pond elevation may be unsatisfactory.

5. The deficiencies noted are significant. A consultant should be retained to prepare plans, specifications and an estimate for restoration.
March 11, 1976

John T. Hannon, P.E.
Chief Engineer
Division of Waterways
Department of Environmental Quality Engineering
100 Nashua St.
Boston, Mass.

SUBJECT: MILLFURY
Dam No. 3-M-186-08
INSPECTION REPORT

Dear Sir:

Enclosed for your consideration is a dam description and
an inspection report for the above dam.

Very truly yours,

John T. Lyons, P.E.
District Highway Engineer

WAR/je
C - ROR
WAR

B-9
**DESCRIPTION OF DAM**

**DISTRICT 3**

**Submitted by:** W. Regan  
**Dam No.:** 3-14-186-08  
**Date:** 3/10/76  
**Town:** Millbury  
**Name of Dam:** Dorothy Pond

1. **Location:** Topo Sheet No. 24 A (GRAFTON QUAD)  
   Provide 8½" x 11" in clear copy of topo map with location of dam clearly indicated.

2. **Year built:** 1853  
   **Year/s of subsequent repairs:** 1959, 1970

3. **Purpose of Dam:** Water Supply  
   - Recreational (Present Use)  
   - Irrigation  
   - Other (Originally Mill Storage)

4. **Drainage Area:** 4.45 sq. mi.  
   **Normal Ponding Area:** 145 ± acres; Ave. depth NA
   **Impoundment:** N/A  
   **gals.;** N/A  
   **acre ft.**

5. **No. and type of dwellings located adjacent to pond or reservoir:** 1.85 summer homes, etc. >100 Perm. Res.

6. **Dimensions of Dam:**  
   - Length: 260′ ±  
   - Max. Height: 13′ ±  
   - Slopes: Upstream Face Verit. Shwe Wall 1:1 earth emb. (1:1 Slope)  
   - Downstream Face 2:1 T. 2:1  
   - Width across top: 18′ ±

7. **Classification of Dam by Material:**  
   - Earth  
   - Conc. Masonry  
   - Stone Masonry  
   - Rockfill  

8. **Description of present land usage downstream of dam:**  
   - Residential  
   - Light Industry  
   - 80% rural; 20% __________

9. **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 __________
DAM NO. 3-14-186-08

10. Risk to life and property in event of complete failure.

No. of people: Loss of life is a Remote Possibility
No. of homes: 10
No. of Businesses: 4
No. of industries: 
Type: 
No. of utilities: 
Type: 
Railroads: 
Other dams: 186-6, 7, 71
Other: At least 2 Road Crossings, 1 Country Hi-Ton Line

See Note Below

11. Attach Sketch of dam to this form showing section and plan on 8½" x 11" sheet.

12. How to Locate: S. E. Bound on Rte. 122 (Grafton),
Turn R. onto Deerholm St. Deerholm St
becomes Riverlin St. after crossing Millbury T.L.
DAM is R. of Riverlin St. 1.3+ mi. beyond T.L.

Note (10): Impact of Failure discharge would be
Attenuated by the following Circumstances:

1) Discharge would, after some time, become
limited by the hydraulic capacity of the R.R. Culvert
(5½ x 4½ Stone box) 500' upstream of the dam.

2) The Elevation of the Riverlin Rd. Pavement
is only 6"+ below present Pond Elevation.
This present Pond Elev. appears to be
unusually high. Therefore under most conditions
the Riverlin Rd. Embankment would function
as a Supplementary Dam.
# Inspection Report - Dams and Reservoirs

1. **Location:** City/Town: Millbury  
   Dam No.: 3-14-1BC-08  
   Name of Dam: DOROTHY POND  
   Inspected by: Rizkalla  
   Date of Inspection: 3/5/76

2. **Owner/assessors:**  
   Prev. Inspection: ✓  
   Reg. of Deeds: Pers. Contact:

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>St. &amp; No.</th>
<th>City/Town</th>
<th>State</th>
<th>Tel. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Buck Brothers Inc., Riverlin St. Millbury, MASS.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Name</td>
<td>St. &amp; No.</td>
<td>City/Town</td>
<td>State</td>
<td>Tel. No.</td>
</tr>
<tr>
<td>3</td>
<td>Name</td>
<td>St. &amp; No.</td>
<td>City/Town</td>
<td>State</td>
<td>Tel. No.</td>
</tr>
</tbody>
</table>

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:**  
   (Blank)

5. **Degree of Hazards:**  
   (if dam should fail completely)  
   1. Minor  
   2. Moderate ✓  
   3. Severe  
   4. Disastrous  
   *This rating may change as land use changes (future development)*

6. **Outlet Controls:**  
   Automatic  
   Manual ✓  
   Operative ✓  
   Yes:  
   No.:  

7. **Comments:** wooden gate stem with steel rack & steel strip attached may have to be repaired or replaced in a year or so. Steel salvageable. Timber in fair to poor condition.

8. **Upstream Face of Dam Conditions:**  
   1. Good  
   2. Minor Repairs  
   3. Major Repairs ✓  
   4. Presents Repairs  

   **Comments:** R.I.P. R.A.P. has to be placed on approx. 140 ft of the upstream face. 2 washouts (slope failures) to be backfilled with suitable material (loc. @ Ends of vertical upstream walls). Both washouts approx. 5' x 4' x 3' depth.

B-12
8. Downstream Face of Dam:


Comments: Moderate to heavy leakage noted at downstream toe (no bulks noted). Heavy growth of trees & brush on downstream face.

9. Emergency Spillway:


Comments: Stone voids could be keyed with smaller stones and/or grouted. Some channel side slope erosion noted at the downstream end of the spillway.

10. Water Level at time of inspection:

Water level: 3.8 ft. above principal spillway (top of dam).

11. Summary of Deficiencies Noted:

Growth (trees and brush) on embankment (See Sketch)

Animal burrows and washouts (See Sketch)

Damage to slopes or top of dam

Cracked or damaged masonry (upstream wall collapsed at extremities)

Evidence of seepage

Evidence of piping

No bulks yet noted, but if leakage continues at present rate, bulks will very probably appear.

Erosion

Leaks

Moderate to heavy through d.s. toe

Trash and/or debris impeding flow

Clogged or blocked spillway

Other: Gate can't be seated properly - some water flowing through sluice.
12. Remarks & Recommendations (Fully Explain)

This inspection was requested by the Millbury board of selectmen. The town is considering acquisition of the dam so that it can control the water level. The owner should receive the standard letter summarizing deficiencies noted and the town should be advised of the following:

1. By acquiring title to the dam, the town assumes responsibility for upkeep and/or restoration.
2. The town would be liable for damage to life and property downstream in the unlikely event of a dam failure.
3. Repairs now required would be expensive. Rip rap is needed on 125 line feet of the upstream face. Heavy growth of trees & brush on the d.s. face should be removed. The sluice gate doesn't seat properly and the timber portion of the gate stem will have to be replaced in a year or so. There is heavy leakage flowing through the d.s. gate. The only cutoff shown by County records is a 22' x 12' x 12' vert. Stone core wall at the sluice and 35' of grouted cut/fieldstone wall at the upstream face (at the gate).

13. Overall Condition: (Cont. on Sheet 3A)

1. Safe
2. Minor repairs needed
3. Conditionally safe - major repairs needed
4. Unsafe
5. Reservoir impoundment no longer exists (explain)

Recommend removal from inspection list
4. A review of County records on this dam leads me to conclude that leakage occurs whenever Pool elev. reaches Spillway Invert Elevation and becomes insignificant when Pool elev. drops a few feet below Invert Elev.

Since there are residences with gravity wells adjacent to the pond, the lower Pool Elev. may be unsatisfactory.

5. The deficiencies noted are significant; a consultant should be retained to prepare a P.S. E.E. for restoration.
APPENDIX C

PHOTOGRAPHS
NO. 1 - SOUTHWEST VIEW OF TOP OF DAM

NO. 2 - VIEW OF OUTLET AND STILLING POOL

C-1
NO. 3 - VIEW OF SPILLWAY

NO. 4 - VIEW OF RAILROAD EMBANKMENT, LOOKING UPSTREAM
APPENDIX D

HYDROLOGIC AND
HYDRAULIC COMPUTATIONS
Est of Peak Flow Rates

Trib Area is 3.91 mi² to Dorothy Pond of 0.23 mi² in area
Trib Area is ± 2000 ft long by a little over 5000 wide
for most of the length. A natural topographic construction
12000 ft north west of the dam, culverts under I-290,
culverts under Interstate 90 and a railroad
tramway here ±500 ft north east of the dam appear to
influence the hydraulics of area runoff.

Generally, runoff is toward the central streams, until
a slope of 4% to 6%. The central stream is about
1900 ft some where winding above the pond, with a drop of
460 - 393 = 67 ft. The average slope is ± 0.5%
and the swamp + pond area is estimated @ 0.46 mi² or 12% of D.A

Total "Ave" Drop = 150 + 67 + 217 = L = 14000 + 2500 = 16500
Say Ave 5.0' = ± 1.37, "7% pond + swamp"
Using The C of E: Maximum Probable Flood - Peak Flow Rate
(M.P.F. - P.F.R.) Curve, as expanded by data on the Leamington Dam and
adjacent slope 6% pond + swamp comparisons with S.C.S. sources, a P.F.R.
for this "dam site" is taken as:

Ave. P.F.R. = 1460 cfs/mi²

Total P.F.R. = 1460 x 3.91 = 5700 cfs

½ Total P.F.R. = 2850 cfs = Inflow Test Flood

Est Pond Storage (Above Elev. 393)

Above Dam Area = 0.23 mi². Assume no area increase 9" Dep." below
Above R.P. Embankment, Area = 0.22 mi²

<table>
<thead>
<tr>
<th>Elev</th>
<th>393</th>
<th>394</th>
<th>395</th>
<th>396</th>
<th>397</th>
<th>398</th>
<th>399</th>
<th>400</th>
<th>401</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage above Dam inch - mi²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>acre ft</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>2.76</td>
<td>5.52</td>
<td>8.28</td>
<td>11.04</td>
<td>13.3</td>
<td>16.6</td>
<td>19.3</td>
<td>22.1</td>
<td></td>
</tr>
</tbody>
</table>

Storage above R.P. Embank. inch - mi² | 0.24| 5.28| 7.92| 10.56| 13.2| 15.8| 18.5| 21.1|
| acre ft | 140.4| 281.6| 422.4| 563.2| 704.0| 844.8| 985.6| 112.6|

Storage R.P. Embank. - Area = 5.65 acre = 0.0088 mi²

Storage / ft² - 0.106 mi²/fo. D-1
III. Dam Disch. - Storage vs Elev.

The dam is 200' long with a slightly off center 24" sluice pipe. The sluice is controlled by wooden slide gate and gear positioning device. About 30' below the sluice pipe discharge is carried by a 5" ACC culvert under River St. The sluice flow is about 3 to 4 feet below the dam crest. The (cent. controlled) sluice flow is 65 c.f.s. Under a head of 15', higher heads produce spillway discharge. The sluice flow is too small to be considered

The dam is protected by a spillway separate from the dam structure. It consists of a 21 foot wide, concrete lined "well". Originally it held a lower 2' below the side wall. Later a central section was broken through for 10' to create a 3' lower side wall. Approximate flow would have no influence and spillage is generally 1 to the apparent flow.

\[
Q = \frac{3.12}{(L)} H^{3/2} \]

\[
Q = \frac{3.12}{(L)} H^{3/2} + \frac{3.12}{(10)} (H+1)^{3/2} \]

\[
Q = 34.3 \ H^{3/2} + 31.2 \ (H+1)^{3/2} \]

<table>
<thead>
<tr>
<th>(H)</th>
<th>2.5</th>
<th>3</th>
<th>3.5</th>
<th>4.0</th>
<th>4.5</th>
<th>5.0</th>
<th>5.5</th>
<th>6.0</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spillway (Q)</td>
<td>340</td>
<td>428</td>
<td>521</td>
<td>623</td>
<td>736</td>
<td>842</td>
<td>960</td>
<td>1082</td>
<td>1224</td>
<td>1366</td>
<td>1592</td>
</tr>
<tr>
<td>W.S. Elev.</td>
<td>390</td>
<td>397</td>
<td>397.5</td>
<td>398</td>
<td>398.5</td>
<td>399</td>
<td>399.5</td>
<td>400</td>
<td>395.0</td>
<td>395.5</td>
<td>396.0</td>
</tr>
</tbody>
</table>

D-2
**B** Dam Crest Discharge

\[ g = 2.55 \left( \frac{H}{2} \right) \]

\[ Q_1 = 61.2 \left( \frac{H_1}{2} \right)^{3/2} - H_1 = 0 \] \[ WS = 395.8 \]

\[ Q_2 = 102 \left( \frac{H_2}{3} \right)^{3/2} - H_2 = H_1 - 0.3 \]

\[ Q_3 = 255 \left( \frac{H_3}{3} \right)^{3/2} - H_3 = H_1 - 0.6 \]

\[ Q_4 = 102 \left( \frac{H_4}{6} \right)^{3/2} - H_4 = H_1 - 0.9 \]

<table>
<thead>
<tr>
<th>Elev.</th>
<th>396.0</th>
<th>396.5</th>
<th>397.0</th>
<th>397.5</th>
<th>398.0</th>
<th>398.5</th>
<th>399.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H_1' )</td>
<td>0.2</td>
<td>0.7</td>
<td>1.2</td>
<td>1.7</td>
<td>2.2</td>
<td>2.7</td>
<td>3.2</td>
</tr>
<tr>
<td>( Q_{ch} )</td>
<td>5</td>
<td>70</td>
<td>30</td>
<td>672</td>
<td>1134</td>
<td>1673</td>
<td>2240</td>
</tr>
</tbody>
</table>

**C** Storage (Above Elev. 393.0)

Area = 0.23 mi\(^2\) = 187 Acres

<table>
<thead>
<tr>
<th>Elev.</th>
<th>Storage in mile(^2) in. m.t.</th>
<th>Elev.</th>
<th>Storage in mile(^2) in. m.t.</th>
<th>Stor. Function ( F_k )</th>
<th>( F_100 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>393.0</td>
<td>0</td>
<td>396.0</td>
<td>8.3</td>
<td>2.1</td>
<td>451</td>
</tr>
<tr>
<td>393.5</td>
<td>1.4</td>
<td>396.5</td>
<td>9.7</td>
<td>2.5</td>
<td>1980</td>
</tr>
<tr>
<td>394.0</td>
<td>2.8</td>
<td>397.0</td>
<td>11.0</td>
<td>2.9</td>
<td>1800</td>
</tr>
<tr>
<td>394.5</td>
<td>4.1</td>
<td>397.5</td>
<td>12.4</td>
<td>3.2</td>
<td>1684</td>
</tr>
<tr>
<td>395.0</td>
<td>5.5</td>
<td>398.0</td>
<td>13.8</td>
<td>3.5</td>
<td>1574</td>
</tr>
<tr>
<td>395.5</td>
<td>6.9</td>
<td>398.5</td>
<td>D-3</td>
<td>15.2</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Project: Nat. Review of Non-F. Dams  
Acct. No.: 5864  
Page: 50 of 11  
Worcester, Mass. Area  
Compd. By: LEB  
Date: 6/8/79  
Dorothy Pond Dam  
Chk’d. By:  
Date: 5/15/77  

[Gen. Reference: "Open Channel Hydraulics" - V. T. Chow]

1. **Broad Crested Spillway** - \( Q_b = CLH^{1.5} \)  
   [Ref. pp. 360-362]
   
   \[ C = 3.27 + 0.4 \frac{H}{h} \quad \text{and} \quad L = L' - 0.1NH \]
   
   \( H \) = Physical Water Head on CREST (h, not included)
   
   \( h \) = Weir Height, \( L' \) = Measured Crest Length

   **Assumptions**
   
   For Floods or Peak Flows, \( \frac{H}{h} \leq 0.5 \implies C = 3.47 \)
   
   \[ L = 90\% L' \]
   
   \[ \therefore Q_b = 3.12 L' H^{3/2} \]

2. **Flow over Crest of Dam** - \( Q_c = 3.475 \left[ \frac{y}{y+h} \right]^{1/2} (H')^{3/2} \)  
   [Ref. pp. 523]
   
   \( Q_c \) = Disch./ft. of width
   
   \( H' \) = h' as defined above; \( y = h' + H' \)

   **Assumptions**
   
   For Floods (flow over dam crest)
   
   \[ H' = \frac{1}{6} h' \]  
   [note : \( h' = h + H \) in Item 1 above]
   
   \[ y = \frac{7}{6} h' \left[ \frac{y}{y+h} \right]^{1/2} = \left[ \frac{76 h'}{13 h'} \right]^{1/2} = 0.734 \]
   
   \[ \therefore Q_c = 2.55 (H')^{3/2} \]

   Apply to Crest in steps where levels are roughly constant.
Adjusting Peak Flow by Storage Function:

$$Q_F = 2850 \left(1 - \frac{S_E}{S_T}\right)$$

$S$ = inches on Trib. Area equivalent to storage @ eleu.
$S_E$ = Final storage inches when $Q_{out}$ is balanced
$Q_F$ = Final $Q_{out}$ - def. by plot on Disch. vs. Eleu. Curve using Storage function

Storage Function: $Q_{out} = 2850 - 300S = Q_{TE}$

see pgs D-8 & D-4

From Plot final Peak Outflow = 1795 cfs.
with Pond @ Eleu. 398.0 ft

Critical Flow over Crest

<table>
<thead>
<tr>
<th>Pond Elev.</th>
<th>398.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low @ Crest</td>
<td>395.7</td>
</tr>
<tr>
<td>Max Depth</td>
<td>2.3</td>
</tr>
</tbody>
</table>

$$g = 2.55 \left(2.3\right)^{1.5} = 8.89 \text{ cfs/ft}.$$  
$$y_{crit} = 1.35\;'; \; \; V_{crit} = 6.6 \text{ fps}$$
V. Downstream Flood Due to Dam Break

Dorothy Brook connects Dorothy Pond Dam and the Blackstone River at a junction about 3000 feet east of the center of Millbury, Mass. The brook is about 7500 feet long, passes through 3 small impoundments, and has a drop of 387 - 347 = 40 feet. A number of houses, industries, and a school lie in the floodway of Dorothy Brook. Failure of Dorothy Pond Dam may cause failure of the lower impoundments.

A typical X-Section selected for the Dam Failure analysis is as follows.

\[
A_t = \frac{40}{7500} = 0.53\%
\]

\[
5\% = 0.0731
\]

Due to trees, bldgs., etc

Use \( n = 0.10 \)

\[
V = \frac{1.41}{1.10} R^{0.5} (0.073) = 1.0877 R^{0.5}
\]

For Depth Above 5' (\( y = y_t + 5' \))

<table>
<thead>
<tr>
<th>( y )</th>
<th>0'</th>
<th>1'</th>
<th>2'</th>
<th>3'</th>
<th>4'</th>
<th>5'</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_t )</td>
<td>550</td>
<td>784</td>
<td>1046</td>
<td>1336</td>
<td>1654</td>
<td>2000</td>
</tr>
<tr>
<td>( P )</td>
<td>220</td>
<td>248</td>
<td>276</td>
<td>304</td>
<td>332</td>
<td>360</td>
</tr>
<tr>
<td>( R^{0.5} )</td>
<td>1.84</td>
<td>2.15</td>
<td>2.43</td>
<td>2.68</td>
<td>2.91</td>
<td>3.13</td>
</tr>
<tr>
<td>( V )</td>
<td>2.00</td>
<td>2.34</td>
<td>2.64</td>
<td>2.92</td>
<td>3.17</td>
<td>3.41</td>
</tr>
<tr>
<td>( Q )</td>
<td>1101</td>
<td>1837</td>
<td>2766</td>
<td>3899</td>
<td>5248</td>
<td>6824</td>
</tr>
</tbody>
</table>

For Depths Below 5' -

<table>
<thead>
<tr>
<th>( y )</th>
<th>1'</th>
<th>2'</th>
<th>3'</th>
<th>4'</th>
</tr>
</thead>
<tbody>
<tr>
<td>( A_t )</td>
<td>22</td>
<td>88</td>
<td>198</td>
<td>352</td>
</tr>
<tr>
<td>( P )</td>
<td>44</td>
<td>88</td>
<td>132</td>
<td>176</td>
</tr>
<tr>
<td>( R^{0.5} )</td>
<td>0.630</td>
<td>1.0</td>
<td>1.310</td>
<td>1.587</td>
</tr>
<tr>
<td>( V )</td>
<td>0.685</td>
<td>1.088</td>
<td>1.925</td>
<td>1.727</td>
</tr>
<tr>
<td>( Q )</td>
<td>15</td>
<td>96</td>
<td>282</td>
<td>608</td>
</tr>
</tbody>
</table>
V (Cont.)

A For Full Pond (no R.R. Embankment Effects)

W.S. @ Dam - Elev. 398.0; S = 800 + 5(123)640 = 1536 Ac. ft

\[ y_0 = 398 - 387 = 11 \quad W_0 = 0.4(149) = 59.6 \]

\[ Q_{p1} = \frac{2}{9} (59.6) \sqrt{32.2} (11)^{2} = 3655 \text{ cfs} \quad \text{Stage 1} = 7.8', A = 1275 \text{ ft}^{2} \]

B For 7.50' Reach Vol. 1 = 1275 (7500) = 220 Ac. ft < \frac{1}{2} S

Trial \[ Q_{p2} = 3655 (1 - \frac{220}{1536}) = 3132 \text{ cfs} \quad \text{Stage 2: 7.3'}, A = 1125 \text{ ft}^{2} \]

Vol. 2 = 7500 (1125) = 8424 AC ft; Ave Vol. = (194220) \frac{1}{2} = 207

\[ Q_{p2} = 3655 (1 - \frac{207}{1836}) = 3160 \text{ cfs} \quad \text{Ave Stage: 7.4'} \]

\[ T = 24 \frac{5}{Q_{p2}} = 24 \frac{1536}{3160} = 11.7 \text{ hours} \quad \text{Max } V = 3160 \frac{1}{1150} = 2.75 \text{ fps} \]

At 2.75 fps, it takes 45 min. to reach Blackstone River - 7500' down stream.

VI 100 year Storm Flow

100 yr freq. - 6 hr. rain = 4.7 in (Tech Paper No. 40)

Infiltration taken @ 0.3 in/hr = 1.8

\[ \text{2.9 in for Runoff.} \]

\[ \left( \frac{2.9}{19.0-1.8} \right)(5700) = 901 \text{ cfs as est 100 yr storm peak inflow} \]

Storage Function = \( F_{100} = 901 \left( 1 - \frac{5.6}{9.7} \right) = 901 - 204.5 \)

Based on Disch. Plot vs Storage Function Plot

Give \( Q_{100} \text{ out} = 410 \text{ cfs} @ \text{Pond Elev. 396.85} \)
VI  Misc. Considerations

A  Outlet Pipe Capacity

- Flow thru 54"Ø Culvert  
  Assume On Str. Pond Const. @ Elevation 387, for Peak Q
  Top Culv: 384.7 + 4.5 = 389.2' > 386.6'  AElev = 2.6'
  Assume Inlet Control (Fig 4-20, Hubb's Stand Drain Highway Cont. Prod)

  HW/D  0.9  1.0  1.1  1.2  1.3  1.4  1.5  1.7  1.9  2.0  2.2  2.4
  Q  81  95  110  120  130  141  151  170  180  192  195  210

- Flow thru 24"Ø Disch Pipe
  Max (Inlet Cont) Discharge @ Pond Elev. @ 396
  HW/D = \frac{396 - 387.6}{2} = 4.2; \text{ Max } Q = 42 \text{ cfs}

  Since 24"Ø Pipe Max Flow is insignificant
  & since it might be shut during storm,
  ignore this pipe in following calculations.
VI  Contd.

B  Tailwater Levels - at High Flows (Q=2200 cfs)

When flow passes over Dam Crest it will fill Middle Pond & Pass over highway just downstream.

Dam Crest Flow 1500 cfs
Highway is ±300 feet long in area affected
Assume 50' Culvert Carries 200 cfs

Flow/ft over highway -

\[ q = \frac{1500 - 200}{300} = 4.333 \text{ cfs/ft} \]
\[ H = \left( \frac{4.333}{2.55} \right) = 1.67 \]

Water in "Middle" Pond @ 393.5 + 1.4 = 394.9'
This is roughly 1.5' below dam crest.

C  Peak Flow Thru R.R. Embankment

With Entrance Control

\[ \text{E1, 3962} \]
\[ \text{H4} = \frac{7}{5} = 1.4, \quad \text{H5} = 50 \text{cfs/ft} \text{ width} \]
\[ \text{H6} = \text{R.R. Has not been known to overtop} \]

D  W.S. Elev. due to R.R. Embankment Control @ Q = 2250 cfs

Flow through outlet pipe = 42 cfs
Flow out of spillway = 185 cfs
Elev. W.S. @ Dam = 395.5'

D-11
APPENDIX E

INFORMATION AS CONTAINED IN

THE NATIONAL INVENTORY OF DAMS
## INVENTORY OF DAMS IN THE UNITED STATES

<table>
<thead>
<tr>
<th>STATE DIVISION</th>
<th>STATE COUNTY</th>
<th>NAME</th>
<th>LATITUDE</th>
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<td>NY</td>
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### POPULAR NAME

DOROTHY POND

### REGION/BASIN

DOROTHY POND DAM

### CITY-TOWN-VILLAGE

MILLBURY

### TYPE OF DAM

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<th>YEAR COMPLETED</th>
<th>PURPOSES</th>
<th>STORAGE</th>
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<th>IMPOUNDING CAPACITIES</th>
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### DIST OWN

FED A PRV/FED SCS A VER/DATE

### REMARKS

25 COOLING

### SPILLWAY

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<th>MAXIMUM DISCHARGE (CFS)</th>
<th>VOLUME OF DAM (CY)</th>
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