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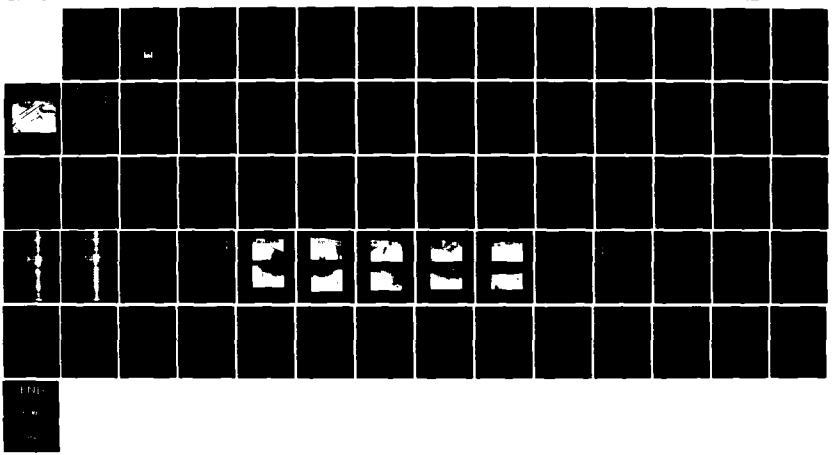
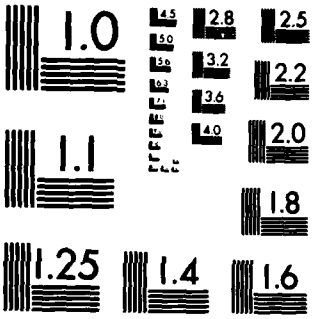
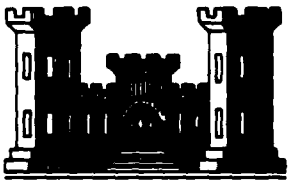




MERRIMACK RIVER BASIN
CLINTON, MASSACHUSETTS

LANCASTER MILLPOND DAM
MA 00887

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

JUNE, 1981

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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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,

Merrimack River Basin
Clinton, Massachusetts
Nashua River

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

The dam is a stone masonry structure with stone abutments. It is 490 ft. long and has an estimated hydraulic height of 24.5 ft. The dam is considered to be in fair condition. It is small in size with a hazard potential of high. A major breach of the dam would damage a parking lot, commercial and industrial establishments, mill buildings and nine houses.

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

REPLY TO
ATTENTION OF:

NEDED

SEP 1 1981

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

Dear Governor King:

Inclosed is a copy of the Lancaster Mill Pond Dam (MA-00887) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Lancaster Mill Pond Dam would likely be exceeded by floods greater than 20 percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam classified as high hazard with a spillway capacity insufficient to discharge fifty percent of the PMF be judged as having a seriously inadequate spillway. As a result this dam is assessed as unsafe, non-emergency until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as it would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

We recommend that within twelve months from the date of this report the owner of the dam engage the services of a qualified registered engineer to determine further the potential of overtopping the dam and the ability to withstand such overtopping. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed and round-the-clock surveillance should be provided during periods of heavy precipitation or high project discharge.

SEP 1 1981

NEDED
Honorable Edward J. King

I approve the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of th program.

Copies of this report have been forwarded to the Department of Environmental Quality Engineering and to the owner, Mr. Raymond L. Shea, Worcester. Copies will be available to the public in thirty days.

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

Sincerely,

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

LANCASTER MILLPOND DAM

MA 00887

MERRIMACK RIVER BASIN
CLINTON, MASSACHUSETTS

PHASE I - INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
BRIEF ASSESSMENT

Identification No.:	MA 00887
Name of Dam:	Lancaster Millpond
City:	Clinton
County and State:	Worcester County, Massachusetts
Stream:	Nashua River
Date of Inspection:	December 3, 1980

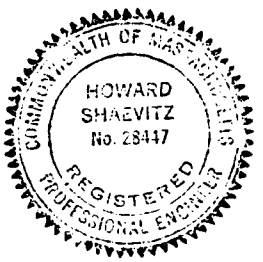
Lancaster Millpond Dam, owned and operated by Mr. Raymond L. Shea of Worcester, Massachusetts, is located in the town of Clinton, Massachusetts. The dam is a stone-masonry structure with stone abutments. It is 490 feet long and has an estimated hydraulic height of 24.5 feet. The spillway is 190 feet long and discharges to the Nashua River.

As a result of the visual inspection and a review of available data, Lancaster Millpond Dam is considered to be in fair condition. Major concerns are: erosion of the soil near the right abutment on the downstream side; trees growing on the soil of the right abutment and on the fill nearby; a tree growing out of the stone masonry at the intersection of the dam and the left training wall; seepage through the spillway; and the lack of controls on diversion and discharge structures.

The dam is classified as small in size and a high hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood range for this dam equals the 1/2 Probable Maximum Flood (PMF) to full PMF. The 1/2 PMF was utilized for the hydrologic analysis because the dam falls in the lower end of the small size range. The test flood inflow was estimated to be 14,800 cubic feet per second (cfs) and resulted in an outflow discharge estimated to be 14,800 cfs, which would overtop the dam crest by about 13 feet. This would result in the water rising to within about 1 foot of the bridge at State Routes 62 and 70 immediately upstream of the dam. A major breach to Lancaster Millpond Dam would damage a parking lot, commercial and industrial establishments, mill buildings, and nine houses.

It is recommended that the owner engage a qualified registered professional engineer to investigate the cause of the seepage through the spillway and the operation of the diversion and discharge structures. The engineer should specify repairs for the erosion on the right abutment, future erosion protection, and procedures for removal of the tree at the intersection of the dam and training wall. The engineer should assess the need for and means to provide a low-level regulating outlet that would allow draw-down of the pond. The engineer should perform a detailed hydrologic and hydraulic investigation to assess for the potential of overtopping the dam and the need for and the means to increase project discharge capacity. The owner should also remove the trees and brush in areas around the dam and maintain these areas in the future. A visual inspection should be made once a month and a comprehensive technical investigation conducted once a year. A surveillance program should be established for use during and after a heavy rainfall and during periods when spillway discharge is occurring from Wachusetts Reservoir Dam. A downstream warning program should be developed.

The recommendations and remedial measures are described in Section 7 and should be addressed by the owner within one year after receipt of this Phase I Inspection Report.



Howard Shaevitz, P.E.
Project Manager
M.P.E. No. 28447

SCHOENFELD ASSOCIATES, INC.
Boston, Massachusetts

This Phase I Inspection Report on **Lancaster Millpond Dam (MA-00887)** 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.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

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

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analysis 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 1/2 "Probable Maximum Flood" for the region (1/2 greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

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

LANCASTER MILLPOND DAM

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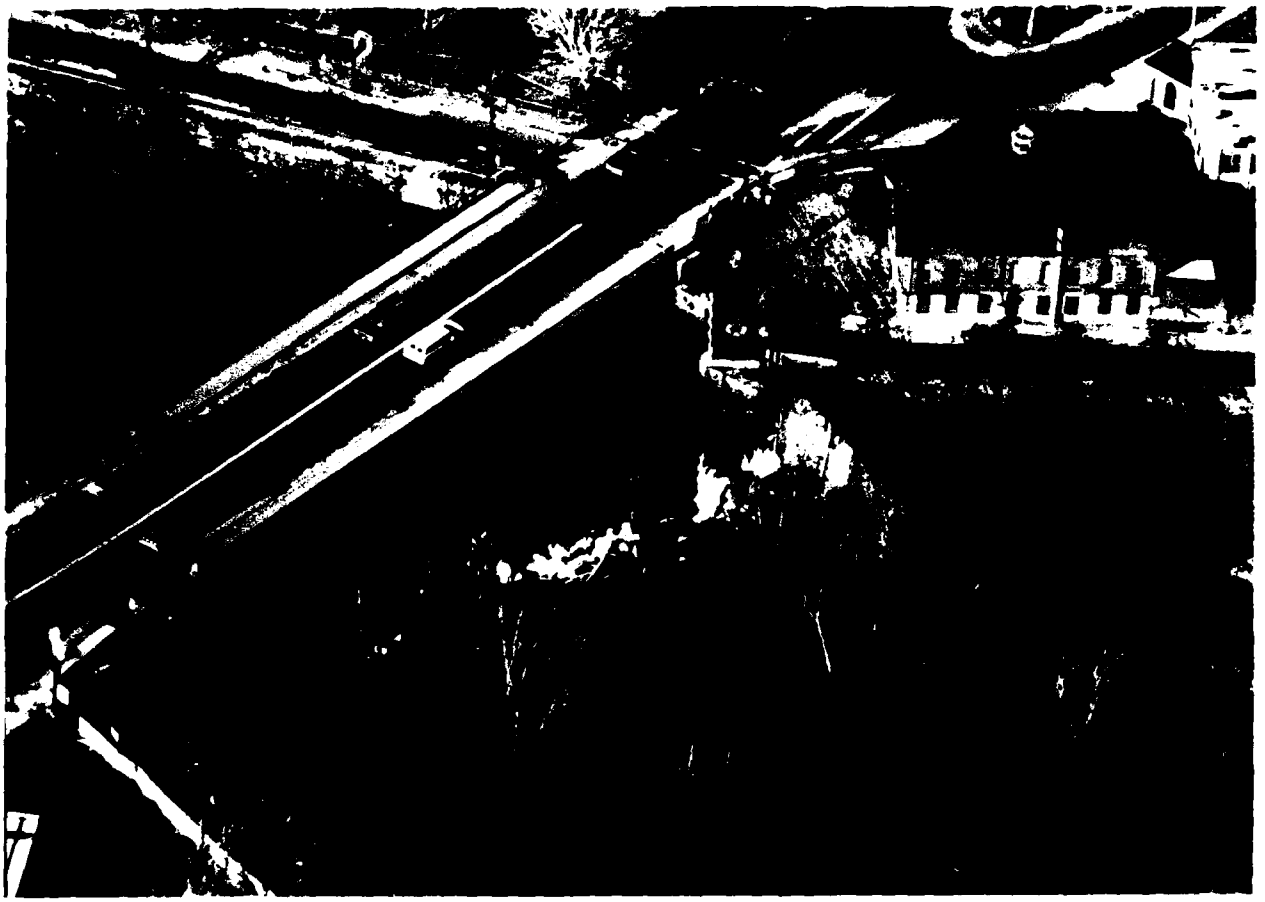
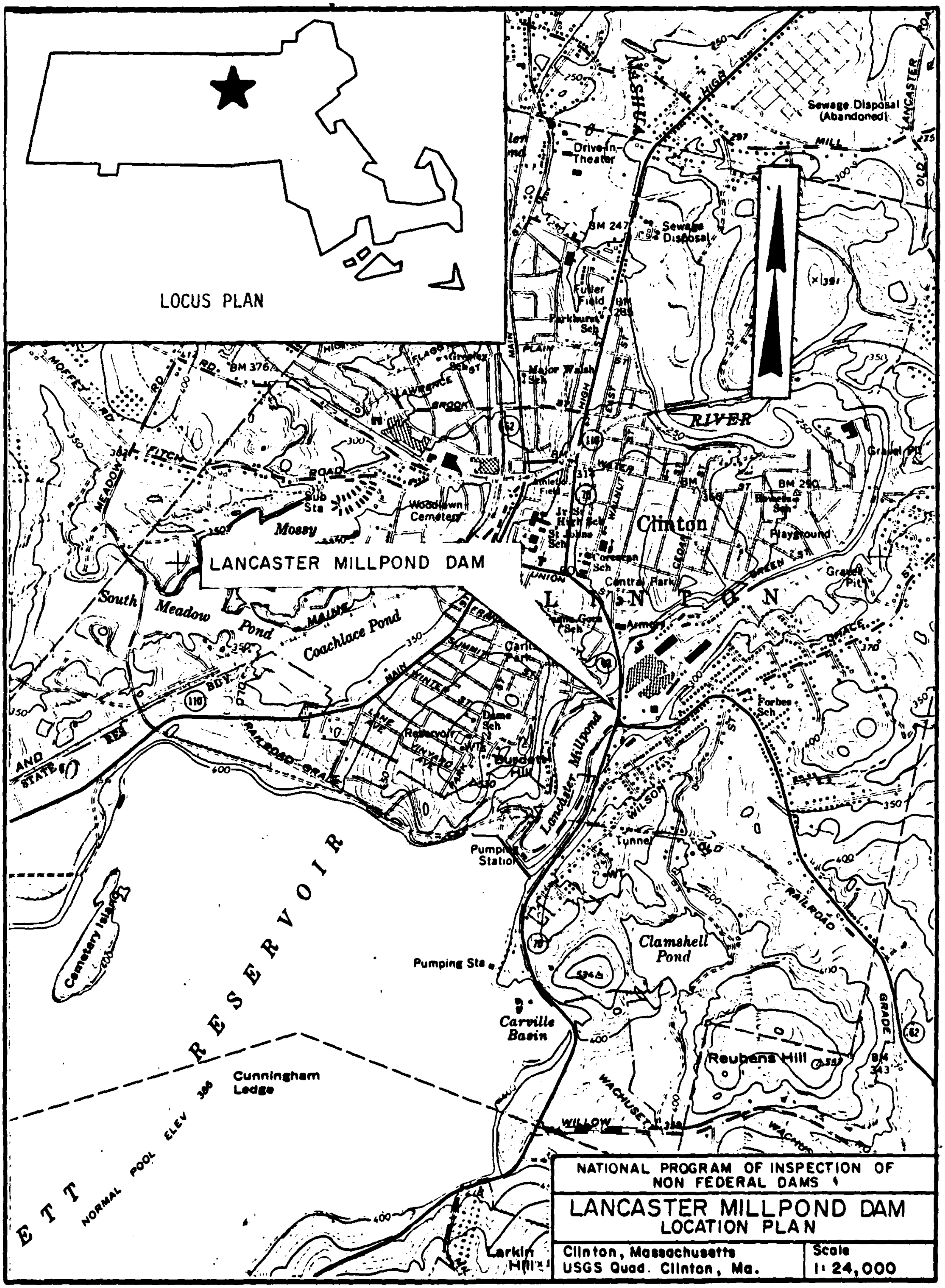


OVERVIEW PHOTOGRAPHY
LANCASTER MILLPOND DAM



NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

LANCASTER MILLPOND DAM
LOCATION PLAN

Clinton, Massachusetts USGS Quad. Clinton, Ma.	Scale 1: 24,000

NATIONAL DAM INSPECTION PROGRAM
PHASE I - INSPECTION REPORT
LANCASTER MILLPOND DAM

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. Schoenfeld Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to Schoenfeld Associates, Inc. under a letter of October 30, 1980 from Colonel William E. Hodgson, Jr., Deputy Division Engineer. Contract No. DACW33-81-C-0010 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To perform technical inspection and evaluation of nonfederal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by nonfederal interests.

(2) To encourage and prepare the states to initiate quickly effective dam safety programs for nonfederal dams.

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

1.2 Description of Project

a. Location. Lancaster Millpond Dam is located in the south central portion of the town of Clinton, Massachusetts. The dam is situated on the Nashua River east of State Routes 62 and 70 and is approximately 0.6 mile downstream of the Wachusett Reservoir Dam, also in Clinton. The dam is owned and administered by Mr. Raymond L. Shea of Worcester, Massachusetts. The spillway discharges to the Nashua River. The dam is shown on the U.S.G.S. quadrangle sheet for Clinton, Massachusetts. Its approximate coordinates are N42°-24'-36" and W71°-41'-00". The location of the dam is shown on the preceding page.

b. Description of Dam and Appurtenances. Lancaster Millpond Dam is a stone-masonry structure with stone abutments on either side. The dam is 490 feet long and has an estimated maximum structural height of 20 feet. The top of dam, as determined by the elevation of the left abutment is 4.5 feet above the spillway crest.

The spillway is 190 feet long with stone-masonry training walls. The spillway flows into the Nashua River. Although two 12-inch drain pipes are located near the right abutment and the middle of the spillway and were observed in the downstream face, neither acts as a low-level outlet. A 20-foot wide by 7.5-foot high diversion structure is located at the north end of the dam. Flow at this structure can be regulated by two sluice gates in series which allow water to flow into a small canal on the grounds of an abandoned factory.

c. Size Classification. The dam is considered to be small in size because the hydraulic height is 24.5 feet and the storage is 265 acre-feet. This is in accordance with the Recommended Guidelines for Safety Inspections for Dams, which defines a small dam as having a storage capacity of 50 to 1,000 acre-feet.

d. Hazard Classification. The potential for hazard posed by this dam is classified as high. This is in accordance with the Recommended Guidelines for Safety Inspection for Dams, which defines a high hazard structure as one which is located where failure may pose a threat to more than a few lives. A major breach to the Lancaster Millpond Dam would result in damage to a parking area, commercial and industrial buildings, and approximately nine houses.

e. Ownership. The dam is owned by Mr. Raymond L. Shea, 44 Park Avenue, Worcester, Massachusetts 01607.

f. Operator. The dam is operated and maintained by the owner. His telephone number is (617) 752-5416.

g. Purpose of Dam. The dam impounds water for Lancaster Millpond. The stored water was used for industrial purposes for the now-abandoned industrial facility located adjacent to the site. The impounded water also has an aesthetic value because of its being the tailwater of the Wachusett Reservoir.

h. Design and Construction History. The design and construction history of the dam are not known. The dam was built about 1880.

i. Normal Operation Procedures. There are no normal operation procedures.

1.3 Pertinent Data

a. Drainage Area. The area tributary to Lancaster Millpond Dam consists of 108.3 square miles of hilly terrain. Of this total, 69,120 acres (108 square miles) is controlled by Wachusett Reservoir located approximately 3,200 feet upstream. The remaining 173 acres (0.27 square miles) is uncontrolled. Maximum elevation for the uncontrolled drainage area is at about 530 feet; reservoir full elevation is at 287.5 feet.

The area around the reservoir consists of woods, abandoned factory buildings, and residential and commercial development. Union Street (State Routes 62 and 70) runs over the dam. There is substantial development in the watershed.

b. Discharge at Dam Site

(1) Outlet works for Lancaster Millpond Dam consist of a drain pipe, a diversion structure, and spillway. The drain pipe is located in the middle of the spillway and can be seen in the downstream face, but it is not known how the pipe is operated or what purpose it serves. Water flow at the diversion structure can be regulated by two sluice gates in series which allow water to flow into a small canal. The 190-foot long spillway has a crest at elevation 287.5.

(2) Daily records of maximum discharge are not maintained. However, according to bridge plan obtained by the Massachusetts Department of Public Works, the maximum elevation was recorded on March 24, 1936 when the water level reached elevation 233.6.

(3) The spillway and outlet capacity with the water surface at the top of the dam is 5,700 cfs.

(4) The spillway and outlet capacity with the water surface elevation at the test flood elevation of 300 is approximately 14,800 cfs.

(5) The total project discharge at the test flood elevation of 300 is approximately 14,800 cfs.

c. Elevation (feet above NGVD)

(1) Streambed at centerline of dam - 267.5

(2) Bottom of cutoff - unknown

(3) Maximum tailwater - unknown

(4) Normal pool - 287.5

(5) Full flood control pool - not applicable

(6) Spillway crest - 287.5

(7) Design surcharge - unknown

(8) Test flood surcharge - 300.2

(9) Top dam - 292.0

d. Reservoir (length in feet)

(1) Normal pool - 3,200

(2) Flood control pool - not applicable

(3) Spillway crest pool - 3,200

(4) Test flood pool - 3,200

(5) Top of dam - 3,200

e. Storage (gross acre-feet)

(1) Normal pool - 265

(2) Flood control pool - not applicable

(3) Spillway crest pool - 265

(4) Test flood pool - 555

(5) Top of dam - 500

f. Reservoir Surface (acres)

(1) Normal pool - 30

(2) Flood control pool - not applicable

(3) Spillway crest pool - 30

(4) Test flood pool - 35

(5) Top of dam - 30

g. Dam

(1) Type - stone-masonry with stone abutments

(2) Length - 190 feet

(3) Hydraulic height - 24.5 feet

(4) Top width - unknown

(5) Side slopes - unknown

(6) Zoning - none

(7) Impervious core - unknown

(8) Cutoff - unknown

(9) Grout curtain - unknown

(10) Other - none

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway

(1) Type - broad crested

(2) Length of weir - 190 feet

(3) Crest elevation - 287.5

(4) Gates - none

(5) U/S channel - Lancaster Millpond; State Routes 62 and 70 bridge is located just upstream of dam

(6) D/S channel - trees and brush grow in channel and branches overhang both banks

(7) General - discharges to Nashua River

j. Regulating Outlet

(1) Invert - 277.5 (approximate)

(2) Size - 20 feet wide x 7.5 feet deep

(3) Description - masonry walls, floor of unknown material

(4) Control mechanism - two sluice gates in series (sizes and detailed descriptions of gates could not be obtained from owner, community, county or Mass. D.P.W.)

(5) Other - none

SECTION 2
ENGINEERING DATA

2.1 Design

No design drawings were available for Lancaster Millpond Dam. Plans of the bridge immediately upstream are available from the Massachusetts Department of Public Works, 100 Nashua Street, Boston, Massachusetts 02114.

2.2 Construction

No construction records were available for use in evaluating the dam.

2.3 Operation

No engineering operation data on the dam were available.

2.4 Evaluation

a. Availability. No engineering data were available for use in the preparation of this report. Bridge dimensions and elevations were obtained from the Massachusetts Department of Public Works.

b. Adequacy. Engineering data and design drawings are considered inadequate for a Phase I investigation.

c. Validity. Because of the lack of information, it was not possible to determine whether the external features of the Lancaster Millpond Dam have changed from the the time of construction.

A 12-inch drain pipe is located near the middle of the spillway and was observed in the downstream face (Photo No. 2). Another 12-inch pipe is located near the right abutment and was also observed in the downstream face (Photo No. 4). However, no controls for either pipe were noted and no gatehouse exists at the site. It is unknown how these pipes are operated or what purpose they serve.

A 20-foot wide by 7.5-foot high diversion structure is located at the north end of the dam. Flow can be regulated at this structure by means of two sluice gates in series which allows water to flow into a small canal on the grounds of an abandoned factory (Photo Nos. 7 and 8). It could not be determined if these controls are operational because they were secured with chains and padlocks.

d. Reservoir. No evidence of significant sedimentation in the reservoir was observed.

e. Downstream Channel. Trees and brush are growing in the downstream channel and also overhang the channel on both banks (Photo No. 9).

3.2 Evaluation

On the basis of the visual inspection, the dam is judged to be in fair condition.

Erosion of the abutment soil on the downstream side of the right end of the dam, if not controlled, could lead to failure of the abutment.

Trees growing on the abutment soil immediately downstream of the right end of the dam, and also on the fill between the roadway and the stone-masonry dam structure near the right abutment, could lead to seepage, piping, and erosion problems when they attain large size, if one of the trees blows over and pulls out its roots or if it dies or is cut and its roots rot.

A tree growing out of the stone-masonry at the intersection of the dam and the training wall on the left side of the downstream channel could, if allowed to attain a large size, cause stability, seepage, or piping problems if it blows over and pulls out its roots or if it dies or is cut and its roots rot.

There is no low-level outlet. Although there is a 12-inch pipe visible on the downstream side of the dam, the inspection revealed no upstream control. No other low-level operational outlets were observed.

The structural condition of the dam is also judged to be fair. The visual inspection revealed items that lead to this assessment, such as seepage through the spillway and the lack of controls on diversion and discharge structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of the Lancaster Millpond Dam was conducted on December 3, 1980. The field inspection team consisted of personnel from Schoenfeld Associates, Inc., D. Baugh Associates, Inc., and Geotechnical Engineers, Inc. Inspection checklists, completed during the field site visit, are included in Appendix A.

The structural condition of the dam and its appurtenant structures is considered to be fair.

b. Dam. The dam is a stone masonry structure with stone abutments. The entire length of the dam is used as a spillway (Photo No. 1). The downstream face is in generally fair condition but seepage is prevalent through the dry-laid masonry joints of the dam.

Bedrock is exposed across the entire width of the channel next to the downstream side of the dam, and it appears that the dam itself is founded on sound bedrock (Photo Nos. 2 and 3).

The right abutment of the dam consists of soil which is not protected against erosion on the downstream side of the dam (Photo No. 4). Some erosion has occurred there. There are also some small trees and brush growing in the abutment soil next to the downstream side of the dam and in the fill between the highway and the stone-masonry dam structure near the abutment.

The left abutment appears to consist of soil and there is a stone-masonry training wall extending downstream from the dam on the left side of the downstream channel (Photo No. 5). One tree, which has been cut off several feet above its base, is growing out of the stone-masonry at the intersection between the downstream face of the stone-masonry dam and the stone-masonry training wall on the left side of the downstream channel (Photo No. 6).

There is no evidence of seepage at either the right or left abutments.

c. Appurtenant Structures. The spillway is essentially the entire length of the dam. The top cap stones of the spillway are in good alignment but seepage is particularly extensive through the longitudinal joint between the top cap stones and the underlying course of masonry. Throughout the entire length of the spillway the joints in the stone-masonry are generally in good alignment but allow extensive seepage through the spillway.

SECTION 4
OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Lancaster Millpond Dam is used to impound water that was once used for industrial purposes. At the moment, the industrial buildings located adjacent to the site are vacant and there is no requirement for this water.

b. Description of Any Warning System in Effect. No written warning system or emergency preparedness system exists for the dam.

4.2 Maintenance Procedures

a. General. The owner, Mr. Raymond L. Shea, is responsible for maintenance of the dam. There are no established procedures or manuals.

b. Operating Facilities. No formal maintenance procedures for the operating facilities were disclosed.

4.3 Evaluation

The current operational and maintenance procedures do not appear adequate to insure that normal problems can be remedied within a reasonable period of time. The dam and appurtenant structures should be visually inspected once a month and a comprehensive technical inspection made once a year.

The owner should also establish a surveillance program for use during and immediately after heavy rainfalls. A downstream warning program to follow in case of emergency should also be developed.

SECTION 5
EVALUATION OF HYDROLOGIC/HYDRAULIC FEATURES

5.1 General

Lancaster Millpond Dam is a stone-masonry structure with stone abutments. The dam is 190 feet long and has an estimated hydraulic height of 24.5 feet. The spillway has a length of 190 feet and is essentially the entire length of the dam. The crest and the side slopes are stone-masonry. The spillway discharges to the Nashua River.

5.2 Design Data

No hydrological or hydraulic design data were disclosed.

5.3 Experience Data

There are no daily readings of the water surface elevations.

5.4 Test Flood Analysis

Due to the absence of detailed design and operational information, the hydrologic evaluation was performed utilizing data gathered during the field inspection, watershed size, and an estimated test flood range equal to the 1/2 Probable Maximum Flood (PMF) to the full PMF. The 1/2 PMF test flood was selected because the dam falls on the lower end of the small size range. The drainage basin is essentially mountainous; however, the "rolling" curve from the Corps of Engineers set of guide curves was used to account for the large reservoir surface area as compared to the size of the drainage area.

Based on an estimated test flood inflow from the controlled drainage area of 108.3 square miles (Wachusett Reservoir) of 14,800 cfs and a negligible inflow from the uncontrolled drainage area of 0.3 square miles, the test flood inflow was estimated to be 14,800 cfs. The test flood was routed through the dam in accordance with the Corps of Engineers procedure for Estimating Effect of Surcharge Storage on Maximum Probable Discharge. The reservoir water surface was assumed to be at elevation 287.5 prior to the flood routing. The project discharge was estimated to be 14,800 cfs. This analysis indicated that the spillway crest would be overtopped by approximately 13 feet. This would result in the water rising to within about 1 foot of the top of the bridge at State Routes 62 and 70 located immediately upstream of the dam. The spillway would be subject to much turbulence due to pressure flow; serious damage could result.

5.5 Dam Failure Analysis

The impact of dam failure with the reservoir surface at the dam crest was assessed utilizing the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs provided by the Corps of Engineers. The analysis covered a reach extending approximately 0.5 miles downstream to a point where several structures would receive excessive damage and where loss of life would be a possibility. Based on this analysis, Lancaster Millpond Dam was classified as a high hazard.

A major breach to the dam would increase the stage along the immediate downstream channel of the Nashua River approximately 12.6 feet. Such a breach would cause extensive damage with the potential for loss of life within the study area. It is estimated that a parking lot and commercial and industrial establishments located on the south bank within 500 feet of the dam would be subject to approximately 2.6 feet of flooding; mill buildings on the north side of the channel within 1,800 feet of the dam would be subject to approximately 10.8 feet of flooding; five inhabited structures within 2,400 feet of the dam would be subject to approximately 5 feet of flooding; and four inhabited structures within 2,700 feet of the dam would all be affected would be subject to approximately 6.2 feet of flooding.

SECTION 6
EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The following conditions observed during the visual inspection are indicative of problems that could result in long-term structural instability.

(1) Erosion of the abutment soil on the downstream side of the right end of the dam, if not controlled, could lead to failure of the abutment.

(2) Trees growing on the abutment soil immediately downstream of the right end of the dam, and also on the fill between the roadway and the stone-masonry dam structure near the right abutment, could lead to seepage, piping, and erosion problems when they attain large size, if one of the trees blows over and pulls out its roots or if it dies or is cut and its roots rot.

(3) A tree growing out of the stone-masonry at the intersection of the dam and the training wall on the left side of the downstream channel could, if allowed to attain a large size, cause stability, seepage, or piping problems if it blows over and pulls out its roots or if it dies or is cut and its roots rot.

(4) Seepage through the spillway could lead to increased deterioration.

6.2 Design and Construction Data

There were no design or construction data available for this report.

6.3 Post-Construction Changes

No significant post-construction changes could be ascertained from the visual inspection.

6.4 Seismic Stability

This dam is located in Seismic Zone No. 2 and, in accordance with Corps of Engineers' guidelines, does not warrant further seismic analysis at this time.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. After consideration of the available information, the results of the inspection, and contact with the owner, the general structural condition of Lancaster Millpond Dam is judged to be fair.

Based on the results of the visual inspection of the soils and geology, the overall condition of the dam is also judged to be fair. The following conditions are indicative of potential long-term problems.

(1) Erosion of the abutment soil on the downstream side of the right end of the dam, if not controlled, could lead to failure of the abutment.

(2) Trees growing on the abutment soil immediately downstream of the right end of the dam, and also on the fill between the roadway and the stone-masonry dam structure near the right abutment, could lead to seepage, piping, and erosion problems when they attain large size, if one of the trees blows over and pulls out its roots or if it dies or is cut and its roots rot.

(3) A tree growing out of the stone-masonry at the intersection of the dam and the training wall on the left side of the downstream channel could, if allowed to attain a large size, cause stability, seepage, or piping problems if it blows over and pulls out its roots or if it dies or is cut and its roots rot.

b. Adequacy of Information. The information obtained from the the visual inspection is adequate for the purposes of this Phase I study, although there were no design or construction drawings available.

c. Urgency. The owner should implement the recommendations in 7.2 and 7.3 within one year after receipt of this Phase I report.

7.2 Recommendations

The following investigations should be carried out and needed corrections performed under the direction of a registered engineer qualified in the design and construction of dams:

(1) Specify repairs for the erosion that has occurred on the right abutment next to the downstream face of the dam and specify necessary erosion protection to prevent future erosion.

(2) Specify and oversee procedures for removal of the tree (and its root system) at the intersection of the dam and downstream training wall at the left abutment.

(3) Further investigate the seepage through the spillway to determine its cause and monitor to determine any changes.

(4) Investigate the operation of the diversion and discharge structures and their condition.

(5) Assess the need for and means to provide a low-level regulating outlet that would allow draw-down of the pool.

(6) Perform a detailed investigation to assess the dam's ability to withstand overtopping during a major flood event.

Recommendations made by the engineer should be implemented by the owner.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Cut trees and brush, and maintain free of trees and brush, the following areas: embankment fill between the highway and dam near the right abutments, and the downstream channel and a zone 25 feet wide on each bank of the downstream channel for a distance of 100 feet downstream from the dam.

(2) Visually inspect the dam and appurtenant structures once a month.

(3) Engage a registered professional engineer qualified in the design and construction of dams to make a comprehensive technical inspection of the dam once every year.

(4) Establish a surveillance program for use during and immediately after heavy rainfall and during periods when spillway discharge is occurring from Wachusett Reservoir Dam.

(5) Establish a downstream warning program to follow in case of emergency.

7.4 Alternatives

There are no practical alternatives to the remedial measures described in Section 7.3.

APPENDIX A

INSPECTION CHECK LIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Lancaster Millpond Dam

DATE Dec. 3, 1980

TIME 2:30 P.M.

WEATHER Cloudy, Windy, Cold

W.S. ELEV. 288.1 UPSTREAM
267.5 DOWNSTREAM

PARTY:

1. Peter G. Palmieri, SAI
2. Ronald Herschfeld, GEI
3. Michael Haire, DBA
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	Peter Palmieri	
2.	Structural Stability	Michael Haire	
3.	Soils and Geology	Ronald Herschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Dam NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
DAM	
Crest Elevation	287.5
Current Pool Elevation	288.1
Maximum Impoundment to Date	288.9 (March 24, 1936)
Surface Cracks	None Observed
Pavement Condition	Not applicable
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	None Observed
Horizontal Alignment	None Observed
Condition at Abutment and at Concrete Structures	Not Applicable
Indications of Movement of Structural Items on Slopes	Not Applicable
Trespassing on Slopes	Not Applicable
Sloughing or Erosion of Slopes or Abutments	Not Applicable
Rock Slope Protection - Riprap Failures	Not Applicable
Unusual Movement or Cracking at or Near Toe	None Observed
Unusual Embankment or Downstream Seepage	Seepage observed through masonry joints and joints between top cap stones and underlying course of masonry.
Piping or Boils	None Observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None
Vegetation	None

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Dike Embankment NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	No dike
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	
Pavement Condition	
Movement or Settlement of Crest	
Lateral Movement	
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	
Indications of Movement of Structural Items on Slopes	
Trespassing on Slopes	
Sloughing or Erosion of Slopes or Abutments	
Rock Slope Protection - Riprap Failures	
Unusual Movement or Cracking at or Near Toe	
Unusual Embankment or Downstream Seepage	
Piping or Boils	
Foundation Drainage Features	
Toe Drains	
Instrumentation System	
Vegetation	

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Intake Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Not visible beneath reservoir
Rock Slides or Falls	None
Log Boom	None
Debris	Some debris in channel
Condition of Concrete Lining	Not applicable
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Not applicable
Stop Logs and Slots	None

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Control Tower NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	Not applicable
a. Concrete and Structural	
General Condition	
Condition of Joints	
Spalling	
Visible Reinforcing	
Rusting or Staining of Concrete	
Any Seepage or Efflorescence	
Joint Alignment	
Unusual Seepage or Leaks in Gate Chamber	
Cracks	
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Transition & Conduit NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	Not applicable
General Condition of Concrete	
Rust or Staining on Concrete	
Spalling	
Erosion or Cavitation	
Cracking	
Alignment of Monoliths	
Alignment of Joints	
Numbering of Monoliths	

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Outlet Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	Not Applicable
Rust or Staining on Concrete	Not Applicable
Spalling	Not Applicable
Erosion or Cavitation	
Visible Reinforcing	Not Applicable
Any Seepage or Efflorescence	Seepage observed along entire length of dam.
Condition at Joints	Good alignment
Drain Holes	None observed
Channel	Trees and brush are growing in channel
Loose Rock or Trees Overhanging Channel	Trees and scrub are scattered with the channel
Condition of Discharge Channel	Good

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Spillway Weir NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Approach Channel	Not visible beneath reservoir surface
b. Weir and Training Walls	Masonry construction
General Condition of Concrete	Not applicable
Rust or Staining	Not applicable
Spalling	Not applicable
Any Visible Reinforcing	Not applicable
Any Seepage or Efflorescence	Extensive seepage through masonry dam/spillway
Drain Holes	None observed
c. Discharge Channel	
General Condition	Poor
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Many trees overhang channel
Floor of Channel	Sand, gravel
Other Obstructions	Many trees growing in channel

PERIODIC INSPECTION CHECKLIST

PROJECT Lancaster Millpond Dam DATE Dec. 3, 1980

PROJECT FEATURE Service Bridge NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	Not applicable
a. Super Structure	
Bearings	
Anchor Bolts	
Bridge Seat	
Longitudinal Members	
Underside of Deck	
Secondary Bracing	
Deck	
Drainage System	
Railings	
Expansion Joints	
Paint	
b. Abutment & Piers	
General Condition of Concrete	
Alignment of Abutment	
Approach to Bridge	
Condition of Seat & Backwall	

APPENDIX B

ENGINEERING DATA

Available Engineering Data

Engineering data, including design and construction drawings, were not available for this Phase I report. Plans of the bridge immediately upstream of the dam are available from the Massachusetts Department of Public Works, 100 Nashua Street, Boston, Massachusetts 02114.

TOWN Clinton DAM NO. 11-01

LOCATION Boylston St. (Rte 70) STREAM [illegible] River

'L[illegible] Mill Pond'

WORCESTER COUNTY [illegible]
WORCESTER, MASSACHUSETTS

DAM INSPECTION REP[illegible]

(Corp) Colonial Foods, Inc.

Owned by _____ Place Cl[illegible] Use Mill Pond

Inspected by [illegible] Date [illegible] 29, 1968

Type of Dam Highway Embankment Condition Good

SPILLWAY

Flashboards in Place _____

Condition Good

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition Good

Repairs Needed _____

GATES

Recent Repairs _____

Condition Good

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Clinton DAM 11-01

LOCATION Rt. 70 Colonial Press STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION SHEET

Owned by Place Use

Inspected by J. Palmieri Date 14 Nov 49

Type of Dam Condition

SPILLWAY

Flashboards in Place None Recommended

Condition

Repairs Needed Some leakage

EMBANKMENT

Recent Repairs

Condition

Repairs Needed

GATES

Recent Repairs Closed

Condition

Repairs Needed

LEAKS

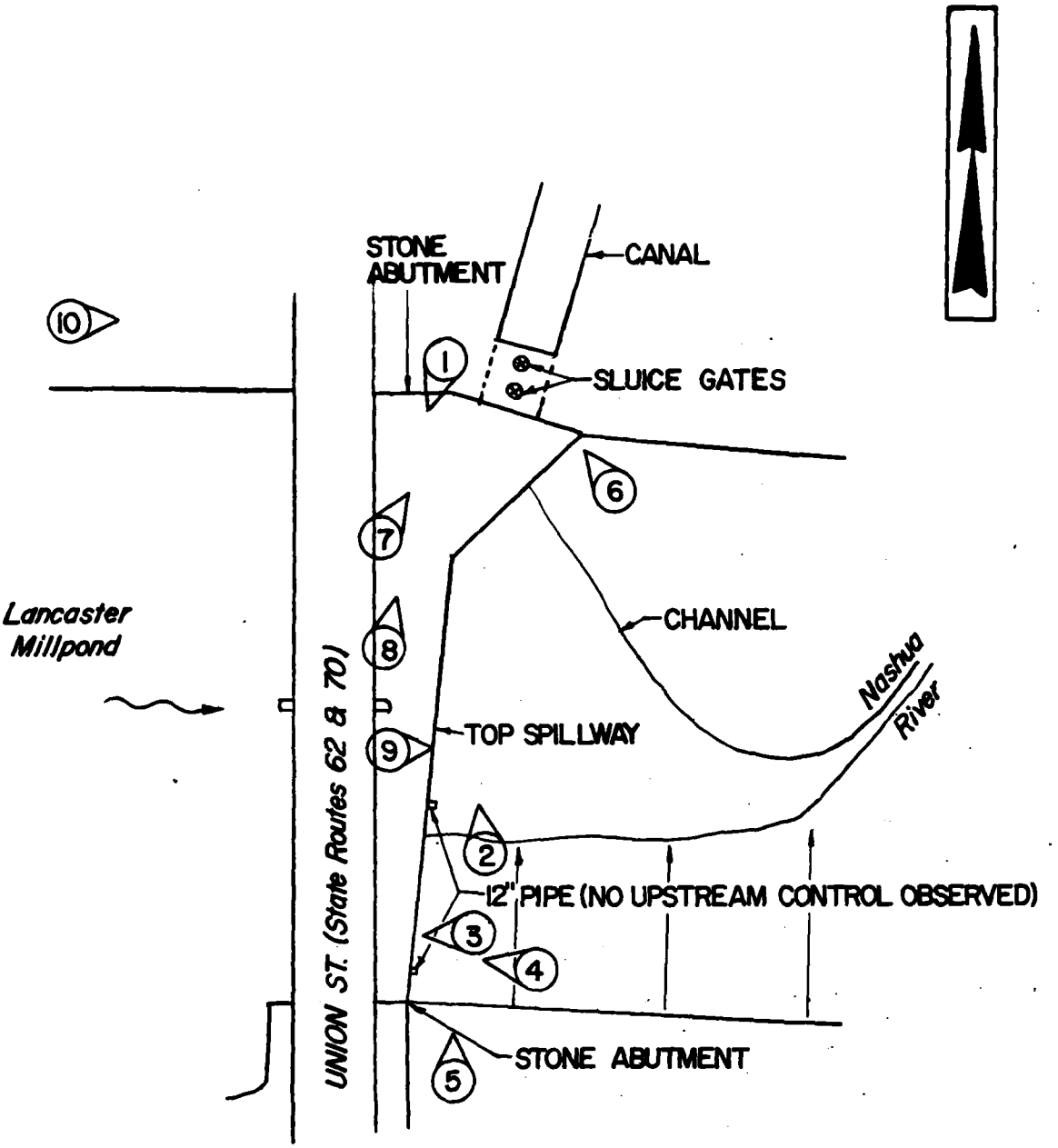
How Serious Some Leakage in front of dam

DATE:

County Engineer

APPENDIX C

SELECTED PHOTOGRAPHS



(1) ORIENTATION OF PHOTOGRAPH

NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS		
LANCASTER MILLPOND DAM PHOTO INDEX		
Clinton,	Massachusetts	Scale 1:600

Photo No. 1 - Right abutment viewed from left abutment.

Photo No. 2 - Left abutment of dam; bedrock exposed at base of dam. Dam is stone masonry; training wall at downstream side of left abutment is stone masonry; note 12-inch pipe through dam - upstream end of pipe could not be located.

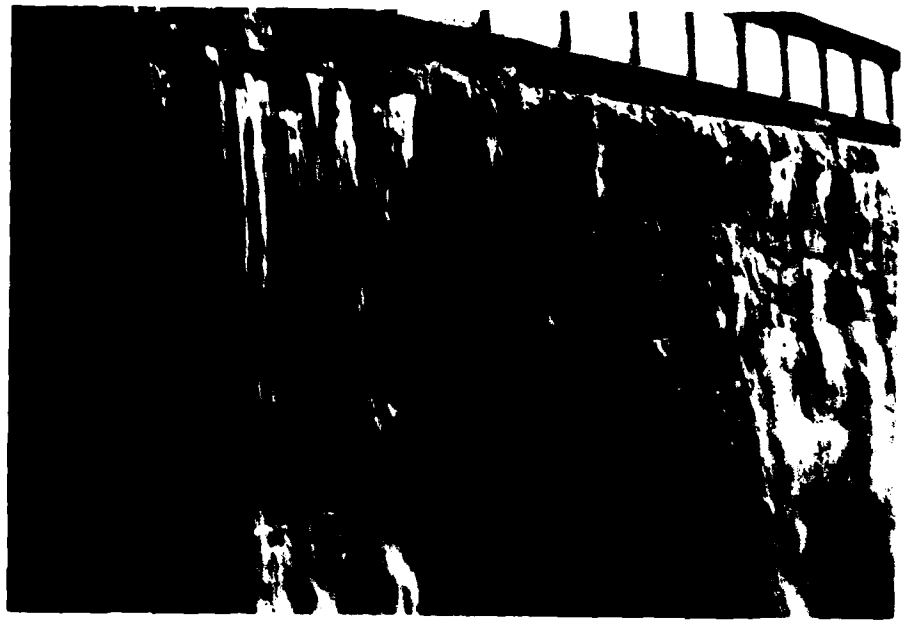


Photo No. 3 - Detail of stone masonry near right abutment.

Photo No. 4 - Right abutment contact; note 12-inch drain dam - upstream end could not be located.

Photo No. 5 - Overview of dam from right abutment.

Photo No. 6 - Tree growing out of stone masonry at joint between dam and left abutment wingwall.

Photo No. 7 - Entrance to mill channel on left side of dam.

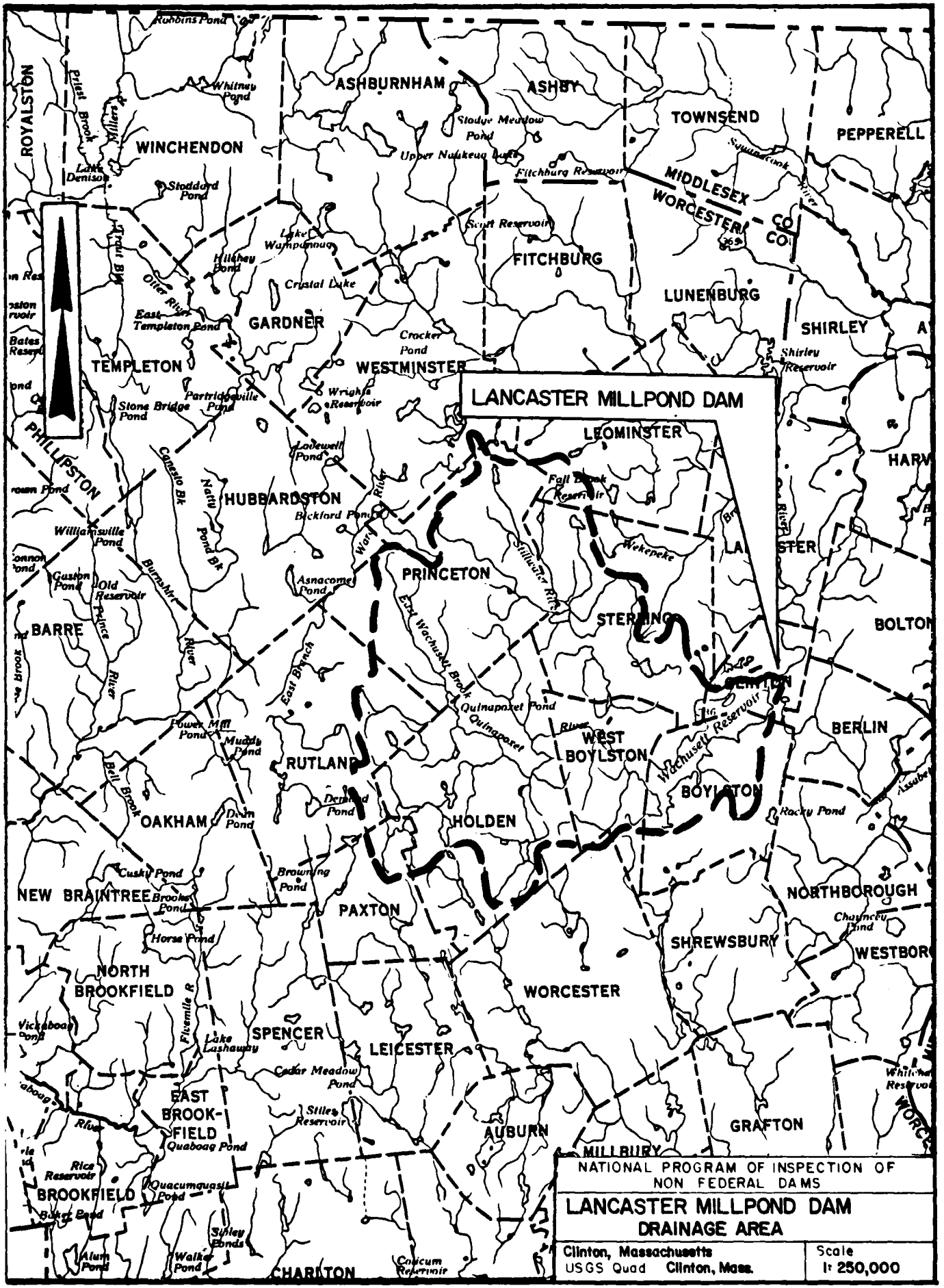
Photo No. 8 - Entrance to canal; located near left abutment.

Photo No. 9 - Downstream channel viewed from highway bridge over dam.

Photo No. 10 - View upstream of dam and Union Street looking downstream.

APPENDIX D

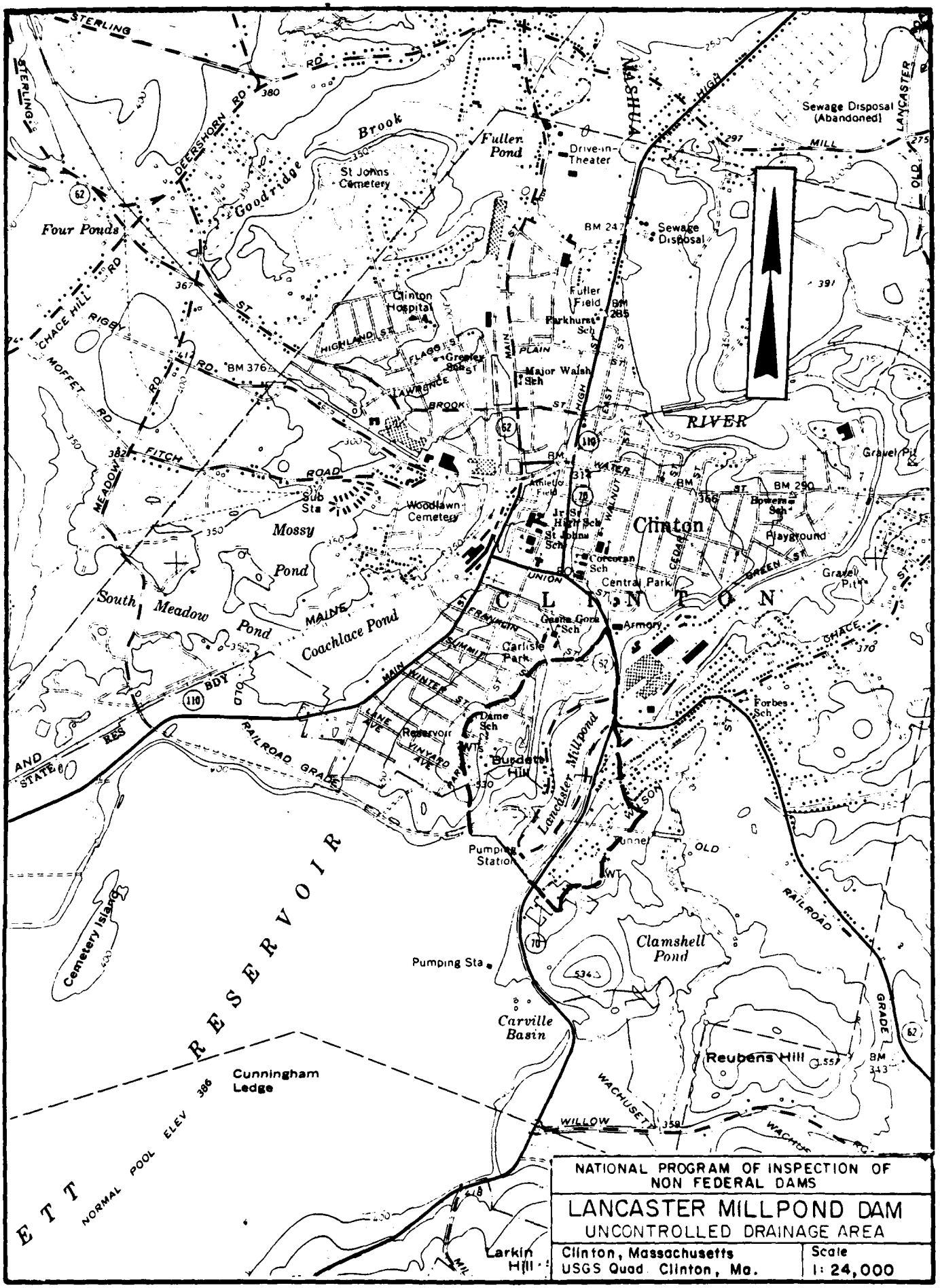
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

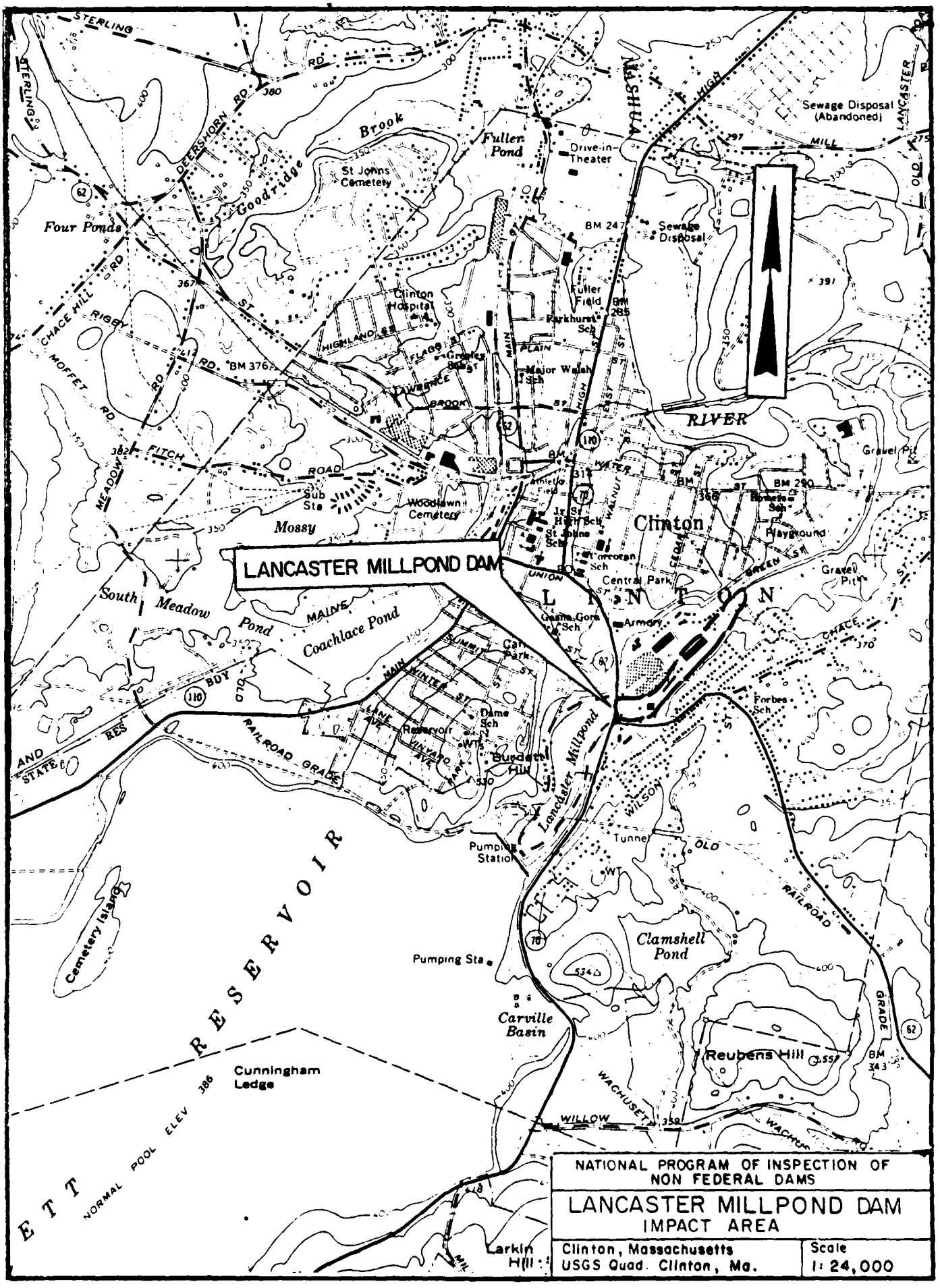


NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS

LANCASTER MILLPOND DAM
DRAINAGE AREA

Clinton, Massachusetts USGS Quad Clinton, Mass.	Scale 1: 250,000


NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS
LANCASTER MILLPOND DAM
UNCONTROLLED DRAINAGE AREA
Clinton, Massachusetts
USGS Quad Clinton, Ma.
Scale
1: 24,000
Sterling
Four Ponds
Goodridge Brook
Fuller Pond
St Johns Cemetery
Drive-in-Theater
Sewage Disposal (Abandoned)
Sewage Disposal
Clinton Hospital
Fuller Field
Parkhurst Sch
Major Walsh Sch
Greeley Sch
Woodlawn Cemetery
Sub Sta
Mossy Pond
South Meadow Pond
Coachlace Pond
Athletic Field
Jr Sr High Sch
St Johns Sch
Corcoran Sch
Central Park
Playground
Bowers Sch
Gravel Pit
Gates Gore Sch
Armory
Carlisle Park
Dame Sch
Reservoir
Bigelow Hill
Forbes Sch
Lancaster Millpond
Pumping Station
Tunnel
Clamshell Pond
Pumping Sta
Carville Basin
Reubens Hill
Cemetery Island
Cunningham Ledge
NORMAL POOL ELEV 386
RESERVOIR
Larkin Hill
RIVER
RAILROAD GRADE
OLD RAILROAD GRADE
CLINTON


LANCASTER MILLPOND DAM
Clinton
Four Ponds
Goodridge Brook
Fuller Pond
South Meadow Pond
Coachlace Pond
Mossy
Cemetery Island
RESERVOIR
Carville Basin
Clamshell Pond
Reubens Hill
Cunningham Ledge
Larkin Hill
Sewage Disposal (Abandoned)
Drive-in-Theater
St Johns Cemetery
Clinton Hospital
Fuller Field
Parkhurst Sch
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Athletic Field
Jr Sr High Sch
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Bigelow Sch
Central Park
Playground
Gravel Pit
Gasha Gora Sch
Armory
Forbes Sch
Dame Sch
Reservoir
Burdett Hill
Pumping Station
Tunnel
Pumping Sta
Lancaster Millpond
NORMAL POOL ELEV 386
RIVER
RAILROAD GRADE
STERLING RD
DEERSHORN RD
CHACE HILL RD
RIGBY RD
MOFFET RD
MEADOW RD
FITCH ROAD
MAIN ST
HIGH ST
WATER ST
UNION ST
GREEN ST
SUMMIT ST
WINTER ST
LANE AVE
VINYARD AVE
PARK ST
WILSON ST
OLD RAILROAD GRADE
WACHUSETT
WILLOW
MILL
LANCASTER
NASHUA
BM 247
BM 376
BM 382
BM 290
BM 343
NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS
LANCASTER MILLPOND DAM
IMPACT AREA
Clinton, Massachusetts
USGS Quad. Clinton, Ma.
Scale
1: 24,000

SCHOENFELD ASSOCIATES, INC.
Consulting Engineers
210 South Street
BOSTON, MASSACHUSETTS 02111
(617) 423-5541

JOB LANCASTER MILL PD. DAM
SHEET NO. 1 OF 13
CALCULATED BY G. SHARRY DATE 24 APR 81
CHECKED BY W. SHERTZ DATE April 27, 1981
SCALE

TEST FLOOD ANALYSIS

Compute spillway design flood (SDF)

Classification - Size: Small
Hazard: High

Use 1/2 probable maximum flood (1/2 PMF) as SDF

Over 99% of drainage area is controlled by the dam at Wachusett Reservoir located about 2000 ft. upstream of Lancaster Mill Pond Dam. Use routed maximum outflow from the dam at Wachusett as test flood inflow at Lancaster Mill Pond.

Routed maximum outflow (1/2 PMF) at Wachusett = 14800 * cfs.

Use 1/2 PMF inflow at Lancaster Mill Pd. = 14800 cfs.

Ignore negligible drainage area (0.27 mi^2) contributing to Lancaster Mill Pd. downstream of Wachusett.

Surcharge Storage Routing

Surcharge storage at Lancaster Mill Pond is negligible when considering size of upstream drainage area (108 mi^2) and magnitude of outflow from Wachusett Reservoir (14800 cfs). Ignore surcharge storage and assume Wachusett outflow = Lancaster outflow.

* From COE Dam Safety Report on dam at Wachusett. p. 26

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JOB LANCASTER MILL PD. DAM
SHEET NO. 2 OF 13
CALCULATED BY G. SHARRY DATE 24APR91
CHECKED BY H. SHAERTZ DATE APRIL 27, 1991
SCALE

TEST FLOOD ANALYSIS

Develop rating curve at Lancaster Mill Pd. dam...

Refer to SH 3/13, WEIR ELEVATION.

Use weir equation, $Q = CLH^{3/2}$ w/ C = 3.7 for low flow under bridge. Use orifice equation, $Q = Ca\sqrt{2g\Delta h}$ w/ C = 0.6, a = 1295 ft², Δh = stage - 7 ft. for pressure flow under bridge. Use weir equation w/ C = 2.0 for flow over bridge (Routes 62 & 70).

STAGE ABOVE SPILLWAY CREST (FT)	Q LOW FLOW (CFS)	Q PRESSURE (CFS)	Q ROAD (CFS)	Q TOTAL (CFS)
1	6857			6857
4	52476			52476
8		62357		62357
12		139433		139433
16		187066	2998	21704
18		206600	9120	29800
19		216000	13193	34793
20		224822	17930	40412

See rating curve, SH 4/13.

At Q = 14800 cfs, stage = 12.7 ft. Water would rise to within about 1.3 feet of the top of Routes 62-70. The drop spillway would be subject to much turbulence due to pressure flow occurring under Rtes. 62-70, located only about 20 feet upstream of the dam. Therefore, although the spillway itself would be overtopped by somewhat less than 12.7 feet, serious damage to the spillway could result.

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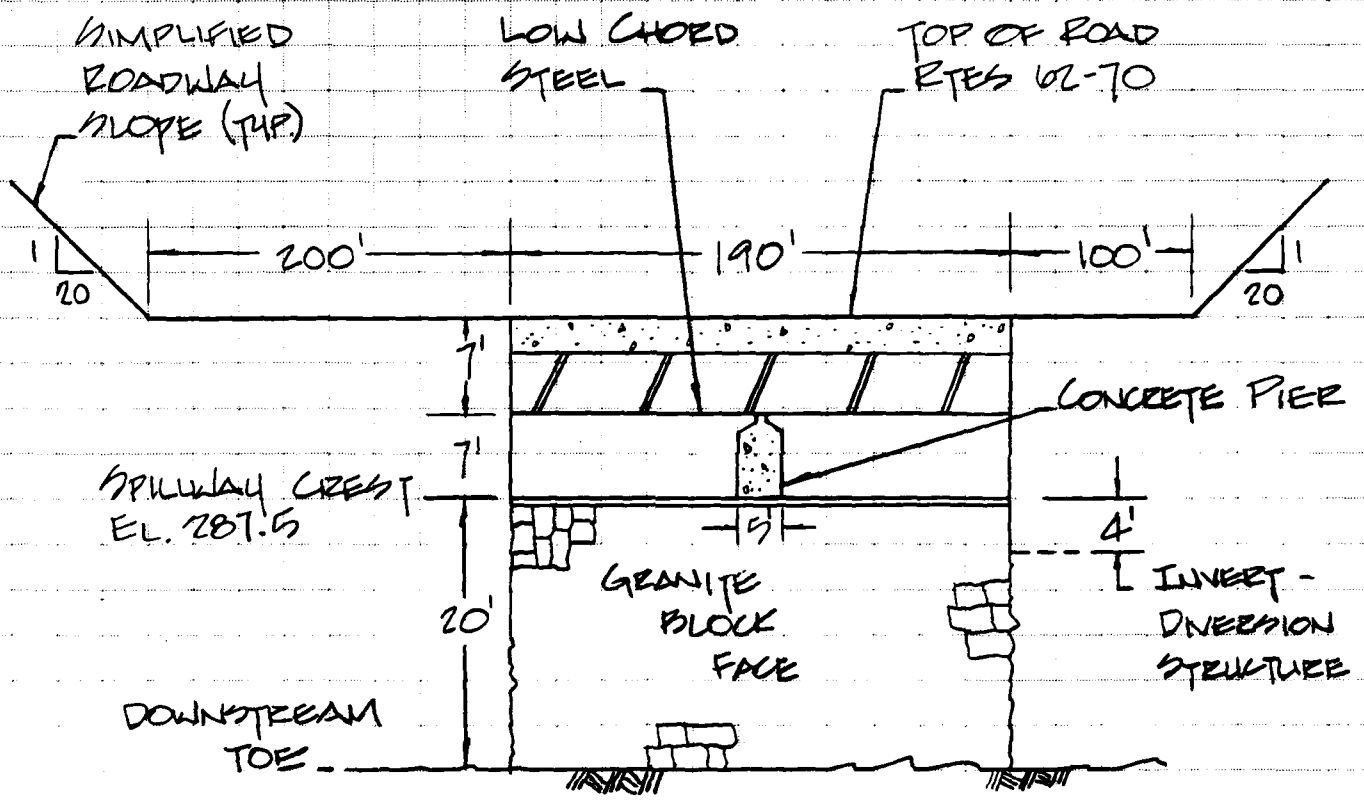
JOB LANCASTER MILL PD. DAM
SHEET NO. 3 OF 13
CALCULATED BY G. SHARRY DATE 24 APR 81
CHECKED BY H. SCHWEITZ DATE April 27, 1981
SCALE

WEIR ELEVATION



LOOKING UPSTREAM

NOTE: Diversion structure assumed closed during test flood event and breach.

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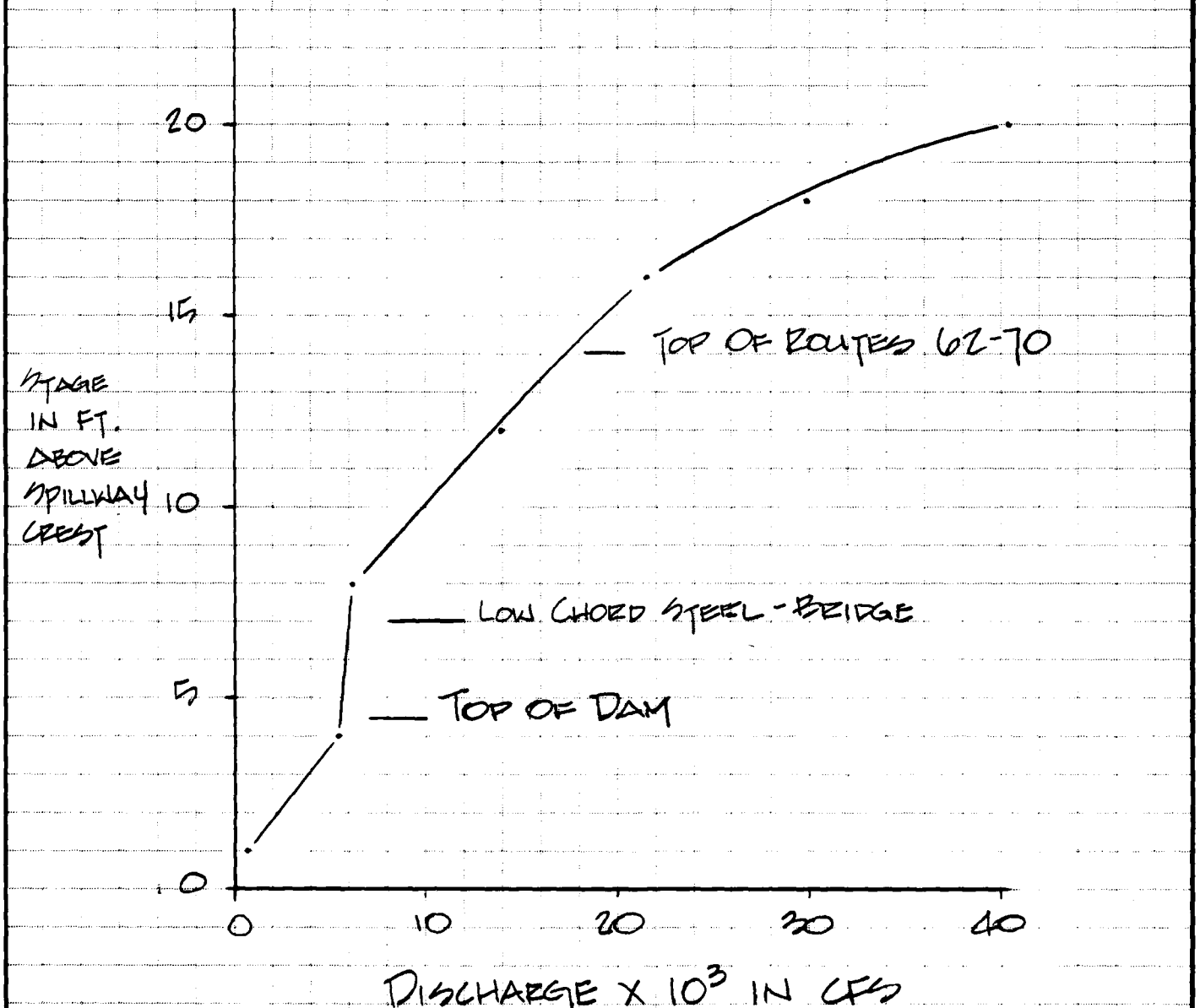
JOB LANCASTER MILL POND DAM
SHEET NO. 4 OF 13
CALCULATED BY G. SHARRY DATE 24 APR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

STAGE VS. DISCHARGE

NOTE: Curve developed assuming no flow through diversion structure.



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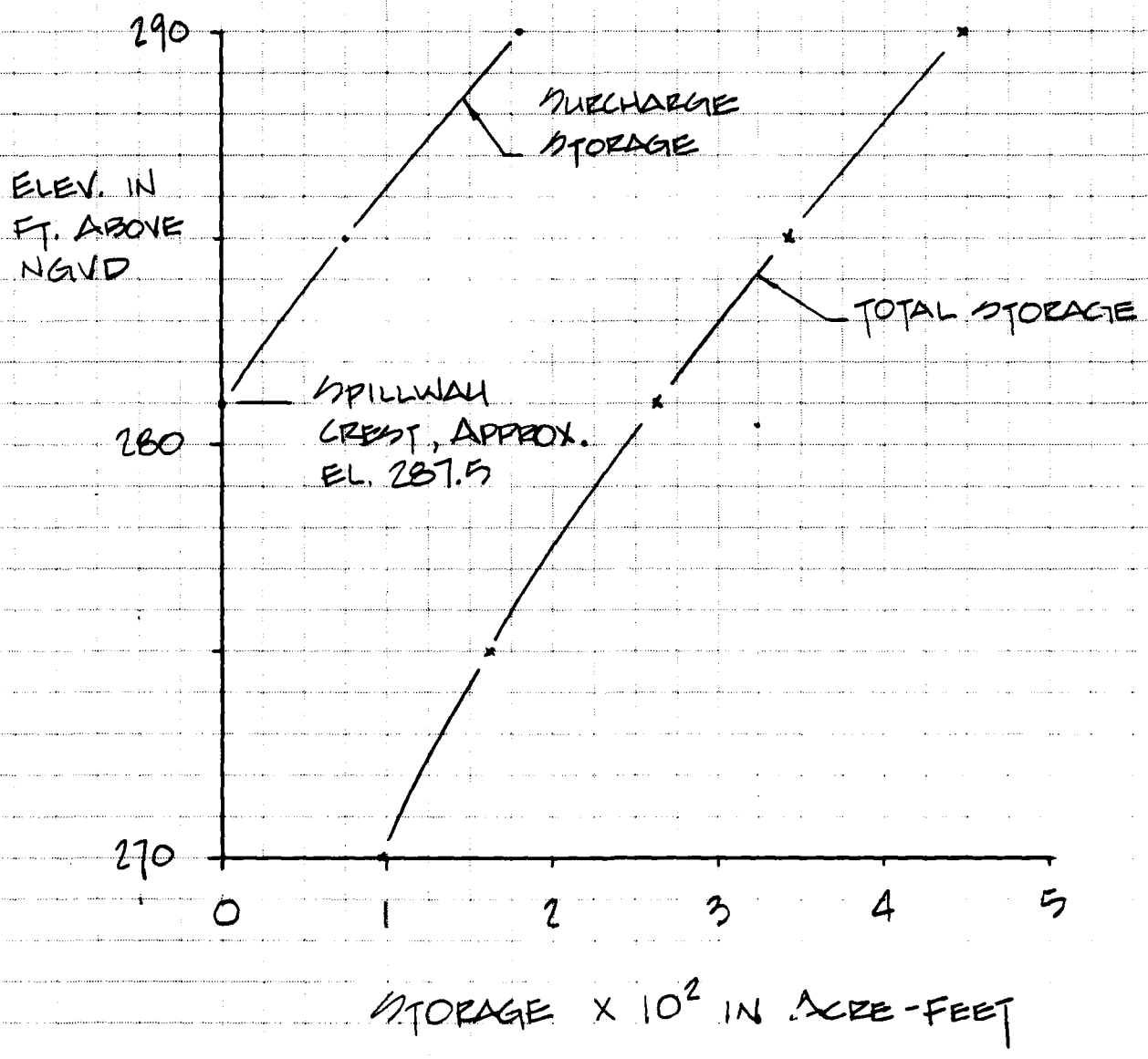
(617) 423-5541

JOB LANCASTER MILL POND DAM
SHEET NO. 5 OF 13
CALCULATED BY GUS S. DATE 27 MAR 01
CHECKED BY M SCHOENFELD DATE APRIL 27, 1981
SCALE

ELEVATION VS. STORAGE



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Consulting Engineers
210 South Street
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(617) 423-5541

JOB LANCASTER MILL POND DAM
SHEET NO. 6 OF 13
CALCULATED BY G. SHARRY DATE 31 MAR 81
CHECKED BY H. SUKEVITZ DATE March 27, 1981
SCALE

BREACH ANALYSIS

Breach outflow, $Q_{p_1} = 8/27\ W_b \sqrt{g}\ y_o^{3/2}$

Use $W_b = 90$ ft.

*Use $y_o = 20$ ft.

$Q_{p_1} = 8/27\ (90)\sqrt{32.2}\ (20)^{3/2} = 13534$ cfs

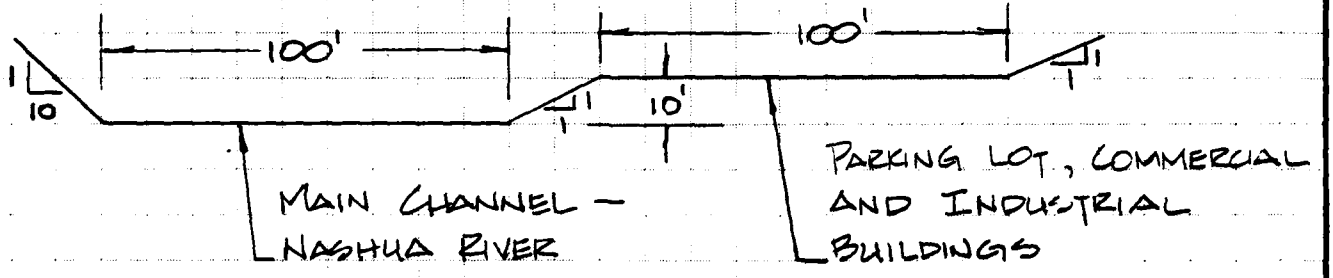
REACH 1

Length = 700 ft. $S = 0.003$

Composite "n" value = 0.06

Develop rating curve for reach using the Manning equation:

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



X-SECTION LOOKING DOWNSTREAM

*NOTE: A "dry" breach was assumed with water surface at spillway crest as this produces the greatest increases in stage and resultant damage downstream.

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BOSTON, MASSACHUSETTS 02111
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JOB LANCASTER MILL POND DAM
SHEET NO. 7 OF 13
CALCULATED BY G. SHAREK DATE 31 MAR 91
CHECKED BY H. SIMMONS DATE APRIL 2, 1991
SCALE

BREACH ANALYSIS (cont.)

REACH 1 (cont.)

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	222	123	448
4	488	146	1484
6	798	169	3054
8	1152	192	5173
10	1550	215	7866
12	2192	338	10366
14	2968	375	16029

See rating curve, SH 13/13.

Q_{P_1} = 13534 cfs stage = 13.5 ft.

$V_1 = \frac{\text{area}(\text{length})}{43560} = \frac{2702(700)}{43560} = 43.4 \text{ ac-ft} < \frac{265}{2}$ ∴ OK

$Q_{P_2(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 13534\left(1 - \frac{43.4}{265}\right) = 11317$ cfs

stage = 12.6 ft. $V_2 = \frac{2393(700)}{43560} = 38.5$ ac-ft

$V_{AVG} = 41.0$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 13534\left(1 - \frac{41.0}{265}\right) = \underline{\underline{11440}}$ cfs

stage = 12.6 ft.

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JOB LANCASTER MILL POND DAM
SHEET NO. 8 OF 13
CALCULATED BY G. SHARRY DATE 31 MAR 81
CHECKED BY H. SHKOLNIK DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 1 (cont.)

A parking lot, commercial and industrial establishments located on the south overbank would be subject to about 2.6 feet of flooding. Their proximity to the dam means that excessive damage and loss of a few lives are possible.

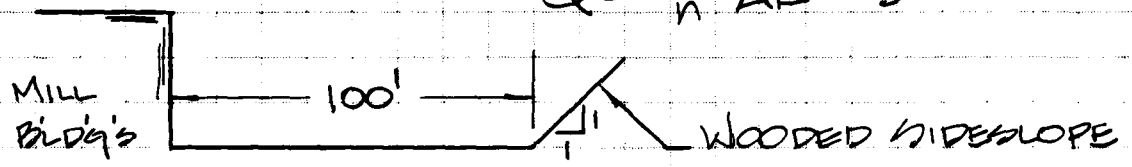
REACH 2

Length = 1150 ft. $S = 0.003$

Composite "n" value = 0.04

Develop rating curve for reach using the Manning equation:

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



TYP. X-SECT. L'KG DOWNSTREAM

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
3	305	107	1251
6	618	114	3890
8	832	119	6205
10	1050	124	8898
12	1272	129	11930

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CALCULATED BY G. SHAERF DATE 31 MAR 81
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SCALE

BREACH ANALYSIS (cont.)

REACH 2 (cont.)

See rating curve, SH 13/13.

Q_{P_1} = 11440 cfs stage = 11.7 ft.

$V_1 = \frac{\text{area (length)}}{43560} = \frac{1238(1150)}{43560} = 32.7$ ac ft $< \frac{265}{2}$ ∴ OK

$Q_{P_2(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 11440\left(1 - \frac{32.7}{265}\right) = 10028$ cfs

stage = 10.7 ft. $V_2 = \frac{1127(1150)}{43560} = 29.8$ ac ft

V_{AVG} = 31.3 ac ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 11440\left(1 - \frac{31.3}{265}\right) = 10089$ cfs

stage = 10.8 ft.

Mill buildings on north side of channel would be subject to about 10.8 feet of flooding. A high potential exists for excessive damage and loss of life.

REACH 3

Length = 550 ft. S = 0.003

Composite "n" value = 0.05

Develop rating curve for reach using the Manning equation:

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

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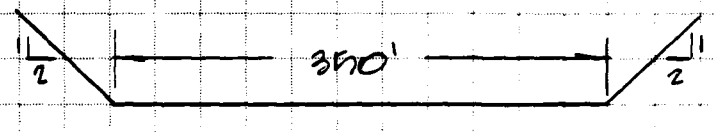
JOB LANCASTER MILL POND DAM
SHEET NO. 10 OF 13
CALCULATED BY G. SHARRY DATE 31 MAR 81
CHECKED BY H. SHAEVITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 3 (cont.)



TYP. X-SECTION

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	708	359	1817
3	1068	363	3579
4	1432	368	5781
5	1800	372	8403
6	2172	377	11390

See rating curve, SH 13/13.

$Q_{P_1} = 10089$ cfs stage = 5.6 ft.

$V_1 = \frac{\text{area(length)}}{43560} = \frac{2023(550)}{43560} = 25.5$ ac-ft $< \frac{265}{2}$ ∴ OK

$Q_{P_2(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{5}\right) = 10089\left(1 - \frac{25.5}{265}\right) = 9118$ cfs

stage = 5.2 ft. $V_2 = \frac{1874(550)}{43560} = 23.7$ ac-ft

$V_{AVG} = 24.6$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{5}\right) = 10089\left(1 - \frac{24.6}{265}\right) = \underline{9152}$ cfs

stage = 5.2 ft.

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JOB LANCASTER MILL PD. DAM
SHEET NO. 11 OF 13
CALCULATED BY G. SHARKY DATE 31 MAR 81
CHECKED BY H. SHREVE DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 3 (cont.)

Five inhabited structures would be inundated by about 5 feet of water. Excessive property damage and loss of life are possible.

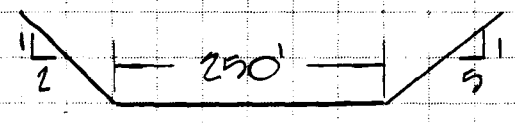
REACH 4

Length = 300 ft. $S = 0.003$

Composite "n" value = 0.05

Develop rating curve for reach using the Manning equation:

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



TYP. X-SECT. L'KG DOWNSTREAM

STAGE ABOVE CHANNEL INV (FT)	AREA (FT^2)	WETTED PERIMETER (FT)	Q (CFS)
2	514	265	1305
4	1056	279	4185
5	1338	287	6093
6	1626	294	8298
7	1922	301	10795

See rating curve, Sh 13/13.

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JOB LANCASTER MILL PD. DAM
SHEET NO. 12 OF 13
CALCULATED BY G. SHARRY DATE 31 MAR 81
CHECKED BY M. SHEVITZ DATE APRIL 27, 1981
SCALE

BREACH ANALYSIS (cont.)

REACH 4 (cont.)

$Q_{P_1} = 9152$ cfs stage = 6.3 ft.

$V_1 = \frac{\text{area (length)}}{43560} = \frac{1714(300)}{43560} = 11.8$ ac-ft $< \frac{265}{2}$ ∴ OK

$Q_{P_2\,(TRIAL)} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) = 9152\left(1 - \frac{11.8}{265}\right) = 8744$ cfs

stage = 6.2 ft. $V_2 = \frac{16855(300)}{43560} = 11.6$ ac-ft

$V_{AVG} = 11.7$ ac-ft

$Q_{P_2} = Q_{P_1}\left(1 - \frac{V_{AVG}}{S}\right) = 9152\left(1 - \frac{11.7}{265}\right) = \underline{8748}$ cfs

stage = 6.2 ft.

Four inhabited structures would be inundated by about 6.2 ft. of water. Excessive property damage and loss of 5-10 lives are possible.

Accordingly, Lancaster Mill Pond Dam is classified <u>High</u> Hazard.

<u>NOTE</u>: Antecedent stage for all reaches can be assumed to be zero ("dry" breach). Therefore, floodwater depths associated with each reach can be referred to as "increases in water surface due to breach."

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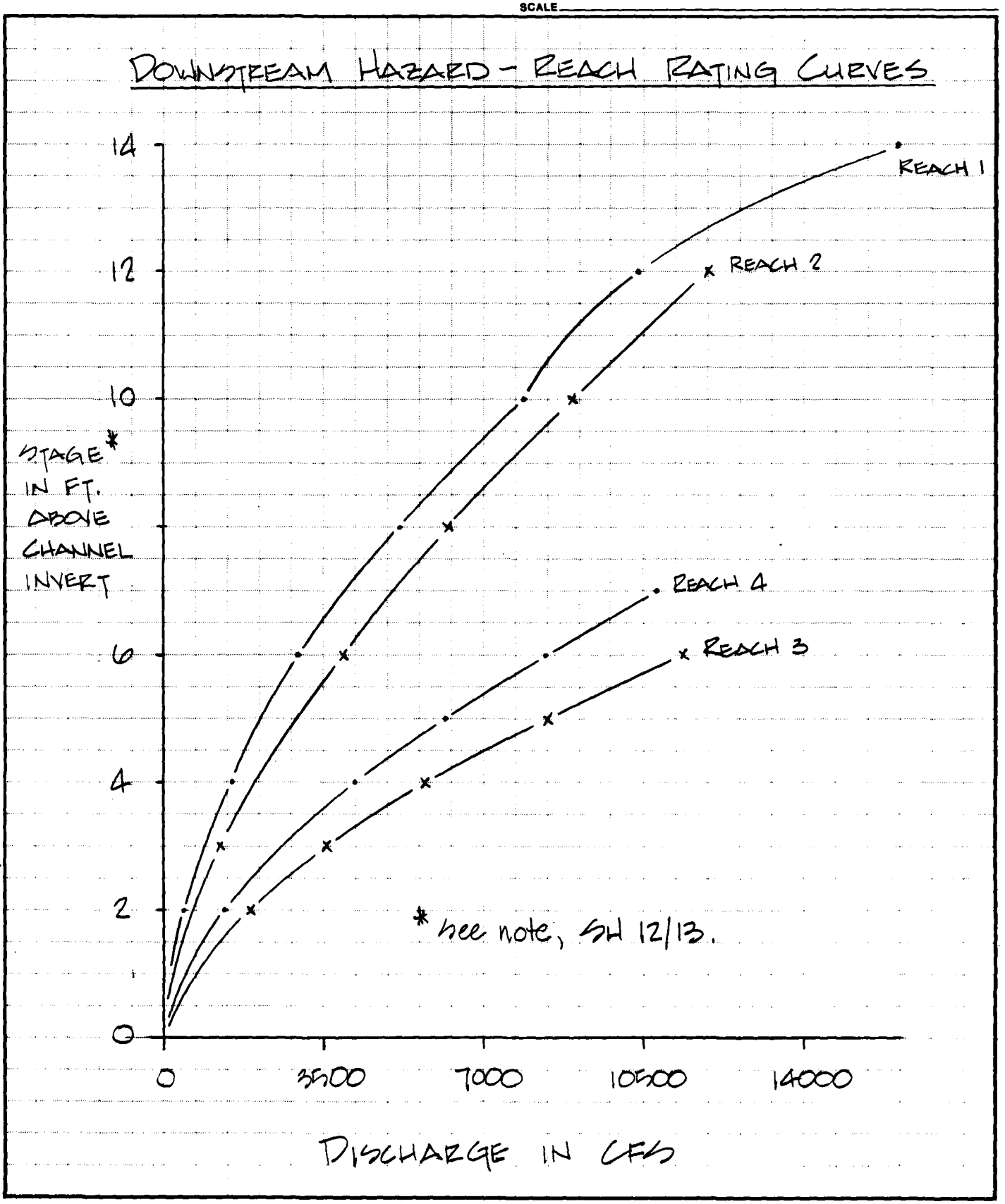
JOB LANCASTER MILL POND DAM
SHEET NO. 13 OF 13
CALCULATED BY G. SHARRY DATE 30MAR81
CHECKED BY H. SHMENTZ DATE APRIL 27, 1981
SCALE

DOWNSTREAM HAZARD - REACH RATING CURVES



APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

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