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HILL RESERVOIR DAM (M..(U) CORPS OF ENGINEERS WALTHAM
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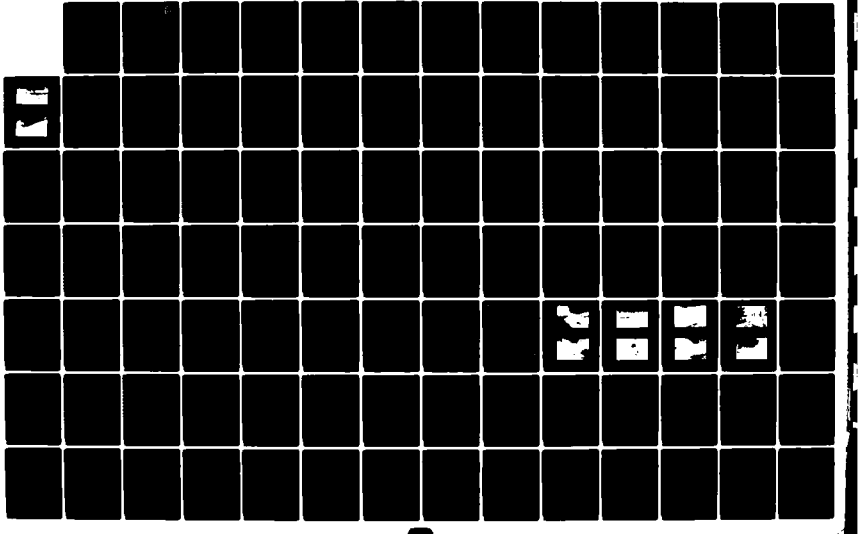

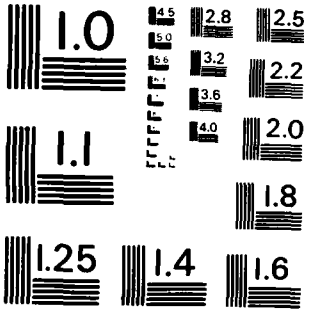

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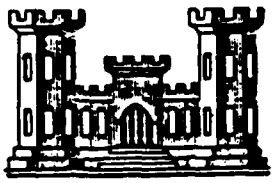
CONNECTICUT RIVER BASIN
PELHAM, MASSACHUSETTS

HILL RESERVOIR DAM
MA 00064

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

APRIL 1981

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Hill Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Connecticut River Basin
Pelham, Massachusetts

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

Hill Reservoir Dam is a 47-year old earth embankment dam with a concrete core wall. Its crest is approximately 14 feet wide and 410 feet long. The dam appears to be in fair overall condition. Hill Reservoir Dam has a maximum storage capacity of approximately 67 acre-feet and a maximum height of about 41 feet. It is classified as "Intermediate" size with a "Significant" hazard classification. The selected test flood for the site is ½ the PMF.

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

REPLY TO
ATTENTION OF

AUG 0 6 1981

NEDED

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

Dear Governor King:

Inclosed is a copy of the Hill Reservoir Dam (MA-00064) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve 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 vitally important.

Copies of this report have been forwarded to the Department of Environmental Quality Engineering, and to the owner, Town of Amherst, Board of Public Works - Water Division, Town Offices, Amherst, MA 01002. 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

Incl
As stated

HILL RESERVOIR DAM
MA 00064

CONNECTICUT RIVER BASIN
PELHAM, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	MA 00064
Name of Dam:	Hill Reservoir Dam
Town:	Pelham
County and State:	Hampshire County, MA
Stream:	Amethyst Brook
Date of Inspection:	December 5, 1980

BRIEF ASSESSMENT

Hill Reservoir Dam is a 47-year old earth embankment dam with a concrete core wall which impounds water for the Town of Amherst. Its crest is approximately 14 feet wide and 410 feet long. Both the upstream and downstream faces of the dam are sloped at 2H:1V. The entire dam is grass-covered, except for the upstream face, which is protected with random size loose riprap.

The dam appears to be in fair overall condition. No signs of settlement, structural movement, or seepage through the dam or at any of the abutment areas were apparent at the time of the inspection. The most serious deficiencies concern the condition of the intake tower, the questionable operability of the presumed low level outlet, and the inaccessibility of the intake tower. The spillway appears to be in good condition.

Hill Reservoir Dam has a maximum storage capacity of approximately 67 acre-feet and a maximum height of about 41 feet. According to guidelines established by the Corps of Engineers, Hill Reservoir Dam is classified as an "Intermediate" size dam. Failure of the dam would result in an increase in flow along Amethyst Brook and over a small dam located at the Boiler Equipment Trust Corporation approximately 2 miles downstream of the dam. Because of the increased potential for appreciable property damage and the chance for possible loss of life due to the breach discharge, the hazard classification for the dam is "Significant". The recommended range for the test flood for an "Intermediate" size, "Significant" hazard dam is from one-half of the probable maximum flood (PMF) to the full PMF. The selected test flood for the site is one-half of the PMF.

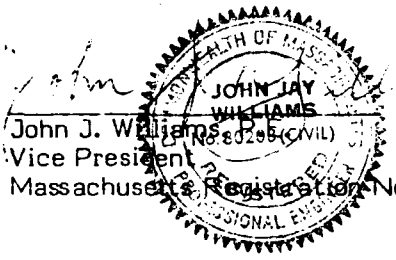
The test flood peak inflow to Hill Reservoir was computed to be 3,350 cfs. The test flood peak outflow was also computed to be 3,350 cfs and would result in a depth of flow over the dam of approximately 1.4 feet. The spillway, with the flashboards in place, has a discharge capacity of 810 cfs (24 percent of the routed test flood outflow) with the reservoir pool at the top of the dam. Assuming the flashboards are removed or fail prior to overtopping of the dam, the spillway capacity is approximately 1,200 cfs, or 36 percent of the routed test flood outflow.

Within one year after receipt of this Phase I Inspection Report, the Owner, the Town of Amherst, Board of Public Works, should retain the services of a qualified, registered professional engineer, experienced in the design and construction of dams, to: 1) investigate the structural condition of the intake tower and recommend remedial action; 2) recommend appropriate measures to provide access to the intake

tower; 3) perform detailed hydrologic and hydraulic analyses to assess the need to increase the spillway discharge capacity; 4) determine the locations and operations of all outlet works; 5) investigate the need to remove trees along the spillway discharge channel; and 6) evaluate the ability of the structure to withstand overtopping.

In addition, the Owner should implement the following operation and maintenance procedures: 1) immediately remove the flashboards; 2) inspect and repair, if needed, the gatewell under the gatehouse; 3) establish a detailed operation and maintenance program to include periodic removal of brush from the dam, exercising of all valves, etc.; 4) repair the spalled concrete on the gatehouse; 5) institute a program of annual technical inspection; and 6) develop a formal surveillance and downstream warning system.

O'BRIEN & GERE ENGINEERS, INC.



Date: 26 May 81

John J. Williams, P.E.
Vice President
Massachusetts Registration No. 30208

This Phase I Inspection Report on Hill Reservoir Dam (MA-00064) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

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

ARAMAST MAHTESIAN, MEMBER
Geotechmical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

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Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation: however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an 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.

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 trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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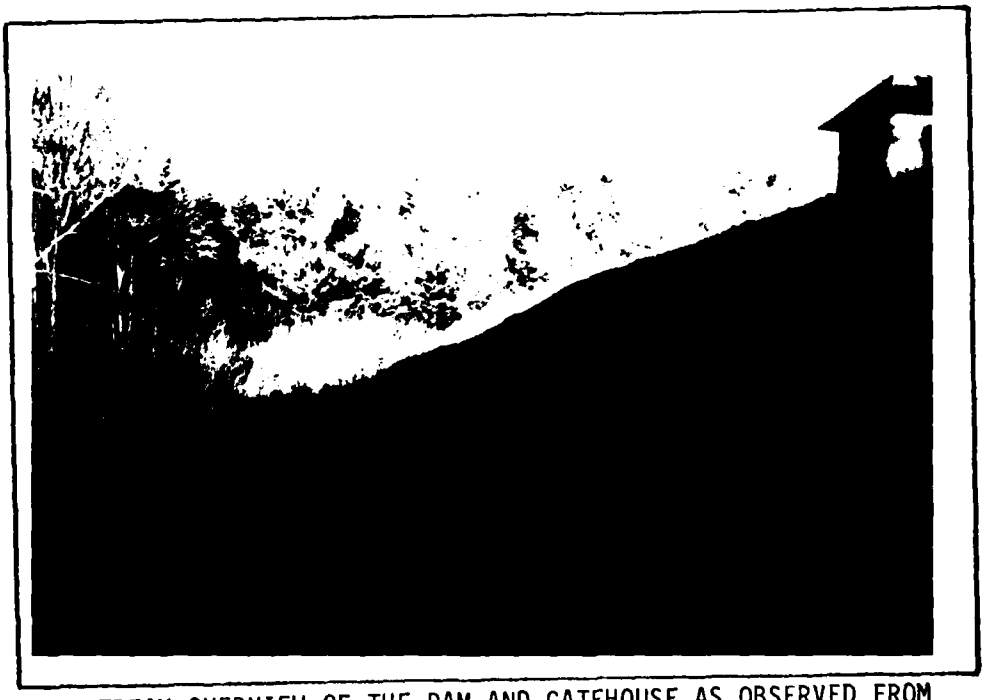
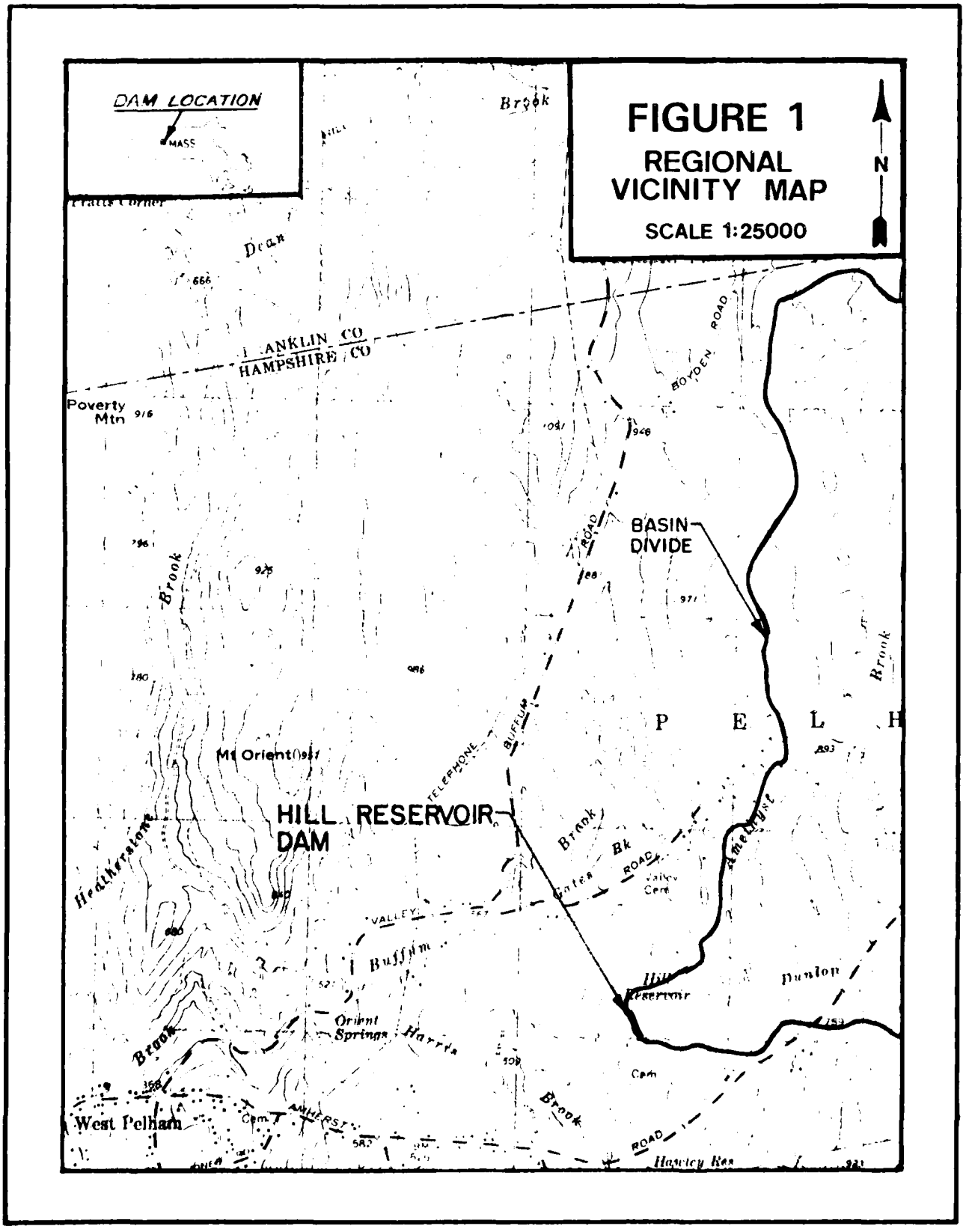
UPSTREAM OVERVIEW OF THE DAM AND GATEHOUSE AS OBSERVED FROM THE SOUTH ABUTMENT. (12/5/80)



DOWNSTREAM OVERVIEW OF THE DAM AND GATEHOUSE AS OBSERVED FROM THE SOUTH ABUTMENT. (12/5/80)


DAM LOCATION
MASS
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:25000
N
FRANKLIN CO
HAMPSHIRE CO
Poverty
Mtn
BOYDEN ROAD
BASIN
DIVIDE
HILL RESERVOIR
DAM
Mt Orient
TELEPHONE
BUFFUM
Brook
ROAD
VALLEY
Buffum
Orient
Springs
Harris
Brook
West Pelham
AMHERST
ROAD
Hawley Res
Dunton
Reservoir
Cem
P E L H

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act (Public Law 92-367) was passed by Congress on August 8, 1972. Under this Act, the Secretary of the Army was authorized to initiate, through the Corps of Engineers, the National Program for Inspection of Dams throughout the United States. Responsibility for supervising inspection of dams in the New England Region has been assigned to the New England Division of the Army Corps of Engineers.

O'Brien & Gere Engineers, Inc. has been retained by the New England Division to inspect and report on selected non-federal dams in Massachusetts. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 12, 1980 and signed by Col. William E. Hodgson, Jr. Contract No. DACW33-81-C-0016 has been assigned by the Corps for this work.

b. Purpose. The purpose of inspecting and evaluating non-federal dams is to:

1. Identity conditions which threaten public safety and make the Owner aware of any deficiencies so that he may correct them in a timely manner;

2. Encourage and prepare the Commonwealth to initiate an effective dam safety program for non-federal dams as soon as possible; and

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

1.2 Description. (Information for the dam was obtained from the Town of Amherst, Department of Public Works - Water Division and from the Commonwealth of Massachusetts, Department of Environmental Quality Engineering (DEQE)).

a. Location. Hill Reservoir Dam is located on Amethyst Brook in the Town of Pelham, Massachusetts. Amethyst Brook originates approximately 3.7 miles northeast of the dam and merges with Dunlop Brook prior to draining to Hill Reservoir. Water passing over the spillway at Hill Reservoir flows via Amethyst Brook to an intake reservoir located approximately 0.6 miles west of the dam. From the intake reservoir, Amethyst Brook continues to flow westerly for approximately two miles where it merges with Adams Brook to form the Fort River. The Fort River flows southwesterly for another six miles until it drains to the Connecticut River in South Hadley. To illustrate the location, portions of the USGS Quadrangle maps entitled "Shutesbury, Mass." and "Belchertown, Mass." have been used to develop Figure 1 on page vi of this report. USGS reference coordinates for this dam are N 42° 22.9' and W 72° 26.5'.

b. Description of Dam and Appurtenances. Hill Reservoir Dam is a 41-foot high earth embankment approximately 410 feet long, with a crest width of 14 feet. The upstream face of the dam which is on a slope of 2H:1V is protected with random size riprap from the normal water surface elevation to within about a foot of the dam crest. According to a section drawing of the dam, a concrete core wall extends from the dam's foundation to within a few feet of the top of the dam. The downstream face of the dam is also on a slope of 2H:1V. A 5-foot high stone masonry headwall for the outlet of the 24-inch diameter reservoir drain pipe is located at the downstream toe of the embankment.

A rectangular broad-crested, stepped spillway with 12-inch high permanent wooden flashboards is located at the north abutment. It is 48 feet long with an invert approximately 3.4 feet below the crest of the dam. Three concrete steps at the spillway inlet, each one foot high, descend to a spillway chute. The chute is approximately 48 feet wide at its upstream end and tapers to approximately 30 feet in width where it outlets into Amethyst Brook. Six more steps, each two feet high, are located at the chute outlet approximately 150 feet downstream of the spillway inlet. Stone masonry and concrete retaining walls of varying heights line the spillway chute.

Little information is available with respect to the outlet works. It is believed that the handwheel operator at the intake tower (see Photo No. 3, Appendix C) operates a gate valve on the low level outlet. Similarly, the operator at the gatehouse on the dam is believed to operate a gate valve on a mid-level intake. Both of these intakes drain to a single 24-inch diameter cast iron pipe which discharges to Amethyst Brook, just downstream of the dam, at El. 574±.

Drawings of the dam and other pertinent engineering data are included in Appendix B.

c. Size Classification. Hill Reservoir Dam has a maximum storage capacity of approximately 67 acre-feet and a maximum height of about 41 feet. The storage capacity for Hill Reservoir Dam falls within the 50 to 1000 acre-foot range specified by the U.S. Army Corps of Engineers for "Small" size dams; however, because the height of the dam lies within the 40 to 100 foot range specified for "Intermediate" size dams, Hill Reservoir Dam is classified as an "Intermediate" size structure.

d. Hazard Classification. Failure of Hill Reservoir Dam would result in an increase in flow along Amethyst Brook. The primary hazard area is located approximately 1.8 miles downstream of the dam, where a small overflow dam is located just upstream of the Boiler Equipment Trust (B.E.T.) Corporation.

To evaluate the effect that a breach of Hill Reservoir Dam would have at the hazard area, a storm event was simulated to coincide with a full-depth dam breach. The runoff from this storm would result in a rise of the water surface in Hill Reservoir to the top of the dam; at which time, the dam was assumed to fail. Based upon computer analysis of this hypothetical breach, the dam at the B.E.T. Corporation would be overtopped by approximately 4 feet. If Hill Reservoir Dam were not to breach during this storm, the B.E.T. Corporation dam could be expected to overflow at a depth of approximately 2.5 feet. Extensive damage would most

likely result in either case, but because of the potential for loss of a few lives at the B.E.T. Corporation Building following a breach of the dam, Hill Reservoir Dam is classified as a "Significant" hazard structure.

e. Ownership. The dam is owned by the Town of Amherst, Board of Public Works - Water Division, Town Offices, Amherst, Massachusetts, 01002. Telephone: 413-253-3355. Correspondence with the Owner should be directed to Mr. James Smith, Town Engineer, at the same address.

f. Operator. Several Water Division employees operate facilities at the dam; however, Mr. Charles Mosakewicz is primarily responsible for operating and maintaining the dam.

g. Purpose of the Dam. The dam was constructed to impound water for water supply purposes. Along with the Atkins and Hawley Reservoirs, Hill Reservoir supplies water for the Town of Amherst.

h. Design and Construction History. Hill Reservoir Dam was constructed in 1934, as indicated by the record drawings dated 1935. From discussions with Mr. Mosakewicz and from the field investigation of the site, it does not appear that the dam has been modified since its original construction.

i. Normal Operating Procedures. Under normal operating conditions, enough water overflows the spillways at the Hill and Hawley Reservoirs to maintain an adequate supply of water at a downstream intake reservoir. If the level at the intake reservoir should fall below a critical depth, valves may be operated at either of the dams to permit water to flow by open channel to the intake reservoir. According to Water Division foreman Carl Field, these valves are opened primarily during periods of dry weather between July and October.

1.3 Pertinent Data

a. Drainage Area. The watershed for Hill Reservoir consists of approximately 4.1 square miles of primarily steep and forested terrain, ranging from El. 1240 at its northern boundary to El. 611.6 at normal water surface elevation. Approximately 55 houses are scattered throughout the watershed.

b. Discharge at Damsite

1. Outlet Works. A single 24-inch diameter pipe outlet exists for Hill Reservoir Dam. Water may enter the outlet pipe at one of two intake valves; the intake tower located in the reservoir or in the gatewell under the gatehouse on the dam crest. Though no information exists to confirm it, the valve in the intake tower is believed to be the low level outlet intake. This drain is capable of passing approximately 130 cfs, assuming the pool surface is at the top of the dam. The inlet invert elevations are not known, but the outlet invert is estimated to be at Elev. 574.

2. Maxmum Known Flood at Damsite. Unknown.

3. Ungated Spillway Capacity at Top of Dam. The capacity of the spillway is approximately 1,200 cfs, assuming the flashboards are removed and the

reservoir pool is at the top of dam Elevation 615. Under the same conditions, except with the flashboards in place, the spillway discharge capacity is approximately 810 cfs.

4. Ungated Spillway Capacity at Test Flood Elevation. Assuming the flashboards are removed, the spillway capacity at test flood Elevation 616.4 is about 1,800 cfs. With the flashboards in place, the spillway capacity at test flood Elevation 616.4 is approximately 1360 cfs.

5. Gated Spillway Capacity at Normal Pool. N/A

6. Gated Spillway Capacity at Test Flood Elevation. N/A

7. Total Spillway Capacity at Test Flood Elevation. Assuming the flashboards are removed, the spillway capacity at test flood Elevation 616.4 is about 1,800 cfs. With the flashboards in place, the spillway capacity at test flood Elevation 616.4 is approximately 1360 cfs.

8. Total Project Discharge at Top of Dam. The total project discharge at top of dam Elevation 615, including flow through the 24-inch diameter low level outlet, is approximately 940 cfs with the flashboards in place and approximately 1330 cfs with the flashboards removed.

9. Total Project Discharge at Test Flood Elevation. The total project discharge at test flood Elevation 616.4, including discharge over the spillway, through the low level outlet and over the dam, is approximately 3,480 cfs. with the flashboards in place and approximately 3920 cfs with the flashboards removed.

c. Elevation. (NGVD)

1.	Streambed at Toe of Dam	±574.0
2.	Bottom of Cutoff	±570.0
3.	Maximum Tailwater	Unknown
4.	Normal Pool (Flashboards in Place)	611.6
5.	Full Flood Control Pool	NA
6.	Spillway Crest (Flashboards in Place)	611.6
7.	Spillway Crest (Flashboards Removed)	610.6
8.	Design Surcharge (Original Design)	Unknown
9.	Top of Dam	615.0
10.	Test Flood Surcharge	616.4

d. Reservoir Length. (Feet)

1.	Normal Pool	1,200
2.	Flood Control Pool	NA
3.	Spillway Crest Pool (Flashboards in Place)	1,200
4.	Spillway Crest (Flashboards Removed)	1,100
5.	Top of Dam Pool	1,320
6.	Test Flood Pool	1,380

e. Storage. (Acre-Feet)

1.	Normal Pool	48
2.	Flood Control Pool	NA
3.	Spillway Crest Pool (Flashboards in Place)	48
4.	Spillway Crest (Flashboards Removed)	42
5.	Top of Dam Pool	67
6.	Test Flood Pool	76

f. Reservoir Surface Area. (Acres)

1.	Normal Pool	4.6
2.	Flood Control Pool	NA
3.	Spillway Crest Pool (Flashboards in Place)	4.6
4.	Spillway Crest (Flashboards Removed)	4.2
5.	Top of Dam Pool	6.1
6.	Test Flood Pool	6.9

g. Dam Data.

1.	Type	Earth Embankment
2.	Length	±410.0 feet
3.	Height	41 feet
4.	Top Width	14 feet
5.	Side Slopes (Upstream)	2H:1V
	(Downstream)	2H:1V
6.	Zoning	Unknown
7.	Impervious Core	Concrete Core Wall
8.	Cutoff	Concrete Core Wall
9.	Grout Curtain	NA

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway.

1.	Type	Broad crested weir with stepped outlet channel
2.	Length of Weir	48 feet
3.	Crest Elevation (Flashboards Removed)	610.6
4.	Crest Elevation (Flashboards in Place)	611.6
5.	Upstream Channel	Reservoir
6.	Downstream Channel	Amethyst Brook

j. Regulating Outlet.

1.	Invert Elevation at Outlet	±574.0
2.	Size	24-inch diameter
3.	Description	Cast Iron Pipe
4.	Control Mechanisms	Gate Valve at Intake Tower Gate Valve at Gatehouse Inlet Inverts Not Known

SECTION 2

ENGINEERING DATA

2.1 Design

The original design information for Hill Reservoir Dam is not available.

2.2 Construction

Record drawings of the dam which consist of a location plan, a plan of the dam and a typical dam section, are available at the Town of Amherst, Department of Public Works office. No information is available regarding the outlet works. Refer to Appendix B for prints of the record drawings.

2.3 Operation

No operating information is available; however, according to operating personnel, only one outlet exists through the dam. Discharge through the 24-inch diameter cast iron pipe outlet is controlled at two intake valves. One is located in the intake tower (believed to be the low level valve) and the other one is located in the gatewell under the gatehouse on the dam crest (believed to be mid-level valve). The gate valve in the intake tower may be operable, but it has not been operated for many years. The valve located in the gatewell under the gatehouse is exercised several times each year, particularly during the dry weather months when the water level at a downstream intake reservoir falls below a desired level.

2.4 Evaluation

a. Availability. Record drawings of the dam (pages B-1 and B-2 of Appendix B) are available at the Department of Public Works office in Amherst. In addition, a topographical plan of the site (page B-18) is available at the Town Engineer's office.

b. Adequacy. The information obtained from the Owner's representative and the files at the Massachusetts DEQE, along with information obtained during the visual inspection of the site proved adequate for a Phase I dam evaluation.

c. Validity. The information obtained from the Town of Amherst and the Massachusetts DEQE files appears to be in general compliance with the field measurements, except that the riprap is not of uniform size, as indicated on page B-2 of Appendix B.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Hill Reservoir Dam was inspected on December 5, 1980. At the time of inspection, the reservoir pool was less than an inch above the flashboard crest elevation of 611.6. Underwater areas were not inspected.

A copy of the field inspection checklist is included as Appendix A.

b. Dam. The dam appears to be in fair overall condition. The crest of the dam is covered with grass and no signs of settlement or misalignment were observed. The upstream face of the dam, which is on a 2H:1V slope, is protected with random size riprap to within about a foot of the dam crest. It does not appear, however, that the riprap extends very far below the normal water surface. The downstream face of the dam which is also on a 2H:1V slope has a good cover of grass. Some slight brush growth was observed on the toe of the dam and at the abutment areas. No evidence of seepage was observed.

c. Appurtenant Structures. Hill Reservoir has an intake tower located approximately 75 feet from the dam in the reservoir and a gatehouse located on the crest of the dam. The intake tower houses a handwheel operator for what is believed to be a 24-inch diameter gate valve on the low level outlet. The valve may be operable, but has not been operated for many years. As illustrated in photo No. 3 of Appendix C, the intake tower has badly spalled concrete and safe access to the structure is not available. Consequently, the intake tower was not inspected.

The gatehouse on the dam crest houses an operator for what is believed to be a 24-inch diameter gate valve on a mid-level intake. This concrete structure appears to be in fair overall condition, with only hairline cracking and minor spalling observed on its exterior walls. Access was not available to observe the interior walls of the gatewell under the gatehouse.

A 48-foot wide spillway is located at the northern abutment. It consists of a broad crested weir with one-foot high wooden flashboards, three one-foot high concrete steps, a stone masonry channel which tapers in width as it directs the discharge westerly from the spillway inlet and seven two-foot high concrete steps at the downstream end of the channel which descend to Amethyst Brook. The masonry construction appears to be in good overall condition; however, signs of efflorescence, staining and minor spalling were observed at the concrete training walls along the spillway channel. As illustrated on photo No. 2 of Appendix C, both deciduous and coniferous trees line the spillway training walls and overhang the channel.

d. Reservoir Area. The watershed consists of approximately 4.1 square miles of primarily steep and forested terrain. The periphery of the reservoir is lined with both deciduous and coniferous trees. Little erosion of the banks is evident.

e. Downstream Channel. The spillway outlet channel discharges into Amethyst Brook approximately 150 feet downstream of the dam. The brook is well defined with a rock-lined bottom and tree-lined banks. (See Photo 6, Appendix C).

3.2 Evaluation

The dam is considered to be in fair overall condition. The dam embankment and spillway appear to be well maintained, but safer and more reliable means of draining the reservoir should be provided. The structural condition of the intake tower should be investigated.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operation Procedures

a. General. During most of the year, enough water is discharged from the Hawley and Hill Reservoirs to maintain an adequate supply of water at an intake reservoir located approximately 0.6 miles west of Hill Reservoir. Operation of a 24-inch diameter gate valve on what is believed to be a mid-level outlet (located in a gatewell under the gatehouse on the crest of the dam) is often necessary during dry weather months to provide enough water to the intake reservoir. A handwheel operator for this valve is located in the gatehouse. The valve operator in the intake tower has not been operated for many years, but operating personnel believe it may still be operable. Stage readings are kept only when the reservoir pool falls below the spillway crest elevation.

b. Description of Any Warning Systems in Effect. According to the Owner's Representative, Mr. Carl Field, the dam would be monitored in the event overtopping was imminent. However, formal downstream warning procedures have not been established.

4.2 Maintenance Procedures

a. General. Other than the periodic cutting of the grass on the dam embankment, no routine maintenance is performed. It appears, however, that maintenance of the dam and spillway is adequate. The dam faces are relatively smooth and clear of trees and brush, and the spillway is clear of debris and has no serious deficiencies.

The intake tower located in the reservoir appears to have badly spalled concrete. The gatehouse on the crest of the dam appears to be in good condition except for some minor spalling and hairline cracks of the concrete.

b. Operating Facilities. The valve in the gatehouse which is believed to be the mid-level intake appears to be operated often enough to keep it in good condition. The valve in the intake tower has not been exercised for many years; consequently, its operation is questionable.

4.3 Evaluation

Existing operating and maintenance procedures appear to be adequate, except for operation of the presumed low level outlet valve at the intake tower. This valve should be exercised at periodic intervals to ensure its reliable operation in emergency situations. In addition, access should be made available to the intake tower, the structural condition of the intake tower should be investigated, formal downstream warning procedures should be established and annual technical inspection by qualified, registered engineers should be performed.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Hill Reservoir Dam has a steep and forested watershed of 4.1 square miles, ranging from El. 1240 at its northern boundary to El. 611.6 at normal pool elevation. Amethyst Brook, the main tributary to Hill Reservoir originates approximately 3.7 miles northeast of the reservoir and merges with Dunlop Brook prior to discharging into Hill Reservoir. The normal storage in Hill Reservoir is approximately 48 acre-feet.

5.2 Design Data

No hydraulic/hydrologic information is available, according to current operating personnel.

5.3 Experience Data

Personnel from the Town of Amherst, Department of Public Works visit the site daily and record the stage elevation when it falls below the spillway crest elevation. With this information, they are able to determine which reservoir in the system should be drawn down during dry weather periods. Current operating personnel are not aware of any past storm event which resulted in overtopping of the dam.

5.4 Test Flood Analysis

The recommended test flood range for an "Intermediate" size, "Significant" hazard dam is from one-half of the probable maximum flood (PMF) to the full PMF. Because the height of the dam is near to the lower limit established for and "Intermediate" size dam, the selected test flood is one-half of the PMF.

Hydraulic and hydrologic calculations were performed with the assistance of the HEC-1-DB computer program. Flood hydrographs were developed from Snyder unit hydrographs using average coefficients, an initial infiltration value of zero, and a constant loss rate of 0.05 inches per hour. The test flood runoff was reduced according to the "Hop Brook" reduction factor,[1] a hypothetical value which takes into consideration the size of the drainage area and the probability of the storm area coinciding with the drainage area. The routing analyses consisted of constructing inflow hydrographs for various percentages of the PMF and routing them over the dam. Stage vs. discharge and stage vs. storage relationships were developed to obtain the outflow hydrographs. In each case, the reservoir pool was assumed to be at the crest of the flashboards at the beginning of the storm event.

The peak test flood inflow to Hill Reservoir was computed to be approximately 3,350 cfs (817 CSM). The peak outflow was also 3,350 cfs and resulted in a 1.4-foot depth of flow over the dam, assuming the outlet works are not opened. The spillway (with the flashboards in place) has a discharge capacity of about 810 cfs, or about 24

[1]Corps of Engineers Circular No. 1110-2-27, Aug. '66.

percent of the routed test flood outflow, assuming the reservoir pool is at the top of the dam. With the flashboards removed, the spillway will pass approximately 1,200 cfs, or about 36 percent of the routed test flood outflow.

5.5 Dam Failure Analysis

Failure of the dam was simulated through the use of the HEC-1-DB computer program. The breach of the dam was assumed to be 100 feet wide by 32 feet deep and it was initiated when the reservoir pool elevation reached the top of the dam during a 0.13 PMF storm event. The quantity of breach discharge for this size dam is very sensitive to the duration over which the breach is assumed to develop. Therefore, two durations were evaluated: 1) a 15-minute breach and 2) a 1.5-hour breach. For the purposes of this Phase I Report, breach discharges corresponding to the 15-minute breach are discussed. (See Breach Summary, Appendix D).

The resulting outflow was routed along Amethyst Brook, past the intake reservoir, through the culverts under Valley Road and ultimately, over a small dam located at the Boiler Equipment Trust (B.E.T.) Corporation. Just prior to failure of Hill Reservoir Dam, a discharge of approximately 870 cfs would be flowing over the B.E.T Corporation dam, approximately 1.8 miles downstream of Hill Reservoir. The resulting pool elevation was computed to be 292.5 NGVD, or about 2.5 feet over the B.E.T. Corporation dam. As a result of the simulated dam failure, a peak discharge of approximately 7,840 cfs would be experienced at Hill Reservoir Dam. A discharge approximately 3,530 cfs would be experienced at the B.E.T. Corporation Dam, where the depth of flow over the dam would approach four feet. Because of the potential for appreciable property damage and the possible loss of a few lives due to a breach of Hill Reservoir Dam, the hazard classification for the dam is "Significant".

SECTION 6

STRUCTURAL STABILITY

6.1 Visual Observations

The dam was observed to be in fair overall condition. No signs of settlement, structural movement or seepage from the dam were observed. Minor spalling and hairline cracking of concrete were observed at the gatehouse located on the dam crest and also at the spillway abutment walls, but no major structural deficiencies were observed. The gate well under the gatehouse was not examined because it was not accessible.

The major problem at this site is the condition of the intake tower. As shown on photo No. 3, the intake tower is not accessible from the dam and it appears to be in poor condition.

6.2 Design and Construction Data

Record drawings of the dam are included in Appendix B. According to the Water Division foreman, no further information is available.

6.3 Post Construction Changes

No known modifications have been made to the dam since it was originally constructed in 1934.

6.4 Seismic Stability

Hill Reservoir Dam is located in seismic zone 2 on the "Seismic Zone Map of Contiguous States". Therefore, according to the "Recommended Guidelines for Phase I Dam Inspections", the dam need not be evaluated for seismic stability.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. From visual inspection, the dam appears to be in fair overall condition. No signs of settlement, seepage or structural movement were observed and, with the exception of the intake tower, the facilities appear to be well maintained. The intake tower located in the reservoir has badly spalled concrete and safe access to the structure is not available. The assumed mid-level intake valve in the gatewell of the gatehouse is in good operating condition, but the condition of the assumed low level intake valve located in the intake tower in the reservoir is questionable.

b. Adequacy of Information. The visual inspection, along with information furnished by the Town of Amherst and obtained from the files of the Massachusetts DEQE, proved adequated for a Phase I evaluation of Hill Reservoir Dam.

c. Urgency. The recommendations and remedial measures described in this section should be implemented within one year of the receipt of this Phase I Inspection Report.

7.2 Recommendations

The Owner, the town of Amherst, Board of Public Works, should retain the services of a qualified, registered professional engineer, experienced in the design and construction of dams, to:

1. Investigate the structural condition of the intake tower and recommend remedial action;

2. Recommend appropriate measures to provide access to the intake tower;

3. Perform detailed hydrologic and hydraulic analyses to assess the need to increase the spillway discharge capacity;

4. Determine the locations and operation of all outlet works;

5. Investigate the need to remove trees along the spillway discharge channel; and

6. Evaluate the ability of the structure to withstand overtopping.

7.3 Remedial Measures

The following operation and maintenance procedures should be implemented by the Owner:

1. Immediately remove the flashboards.

2. Inspect and repair, if needed, the gatewell under the gatehouse.

3. Establish a detailed operation and maintenance program to include periodic removal of brush from the dam, exercising of all valves, etc.

4. Repair the spalled concrete on the gatehouse.

5. Institute a program of annual technical inspection.

6. Develop a formal surveillance and downstream warning system.

7.4 Alternatives

No valid alternatives to the recommendations and remedial measures described above are considered feasible for this site.

APPENDIX A

CHECKLIST
VISUAL INSPECTION

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: Hill Reservoir Dam

National I.D.#: MA 00064

Location: Pelham, Massachusetts

Type of Dam: Earth Embankment

Inspection Date(s): December 5, 1980

Weather: Clear, low 40°'s

Pool Elevation: 611.6± NGVD

Inspection Team

Lee DeHeer	O'Brien & Gere	Managing Engineer
Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Denis Mehu	Bryant & Associates	Hydrology/Hydraulics

Owner's Representative

Mr. Charles Mosakewicz, Water Division Foreman; Board of Public Works - Water Division; 586 South Pleasant Street; Amherst, Massachusetts; 01002

(Mr. Carl Fields, Water Division Foreman, accompanied the field inspection team during the investigation.)

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	615.±
Current Pool Elevation	611.6
Maximum Impoundment to Date	Unknown
Surface Cracks	None Observed
Pavement Condition	NA
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	Appears to be good
Horizontal Alignment	Appears to be good
Condition at Abutment and at Concrete Structures	Slight settlement on south side of spillway inlet
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	No indications
Vegetation on Slopes	Miscellaneous brush and trees at abutments and toe of dam
Sloughing or Erosion of Slopes or Abutments	Slight erosion channel at south abutment
Rock Slope Protection - Riprap Failures	Slight settlement along upstream dam face

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	None Observed
Piping or Boils	None Observed
Foundation Drainage Features	Unknown
Toe Drains	Unknown
Instrumentation System	Not Applicable

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	Reservoir overflows broad-crested weir. There is no approach channel.
General Condition	
Loose Rock Overhanging Channel	
Trees Overhanging Channel	
Floor of Approach Channel	
b. Weir and Training Walls	
General Condition of Concrete	Fair
Rust or Staining	Rust and evidence of efflorescence
Spalling	Minor spalling at edges
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	No seepage, evidence of efflorescence (see Photo 1)
Drain Holes	None Observed
c. Discharge Channel	
General Condition	Good

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	None Observed
Trees Overhanging Channel	Several, primarily coniferous
Floor of Channel	Very stable, few rocks
Other Obstructions	None observed

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel (None)	24-inch intake pipe
Slope Conditions	
Bottom Conditions	
Rock Slides or Falls	
Log Boom	
Debris	
Condition of Concrete Lining	
Drains or Weep Holes	
b. Intake Structure (see Photo No. 3)	
Condition of Concrete	Severe spalling
Stop Logs and Slots	NA, hand-wheel operated low level gate

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	Minor
Visible Reinforcing	None Observed
Rusting or Staining of Concrete	None Observed
Any Seepage or Efflorescense	None Observed
Joint Alignment	Good
Unusual Seepage or Leaks in Gate Chamber	Gate Chamber not readily accessible, not observed
Cracks	Superficial
Rusting or Corrosion of Steel	None observed
b. Mechanical and Electrical	
Air Vents	NA
Float Wells	NA
Crane Hoist	NA

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER (Con't)	
Elevator	NA
Hydraulic System	NA
Service Gates	24-inch gate-operable
Emergency Gates	None
Lighting Protection System	NA
Emergency Power System	NA
Wiring and Lighting System in Gate Chamber	NA

VISUAL INSPECTION CHECK LIST

Project: Hill Reservoir Dam

National I.D. #: MA 00064

Date(s): December 5, 1980

AREA EVALUATED	CONDITIONS
OUTLET WORKS - TRANSITION AND CONDUIT	(Stone Masonry Headwall)
General Condition of Concrete	Fair (see Photo No. 5)
Rust or Staining on Concrete	Slight efflorescence
Spalling	Few stones missing
Erosion or Cavitation	NA
Cracking	Few loose stones
Alignment of Monoliths	Random alignment
Alignment of Joints	Random alignment
Numbering of Monoliths	Various stone sizes

Note:

Discharge is to a natural brook, which feeds an intake reservoir for subsequent pumping to the Town of Amherst water distribution system.

APPENDIX B

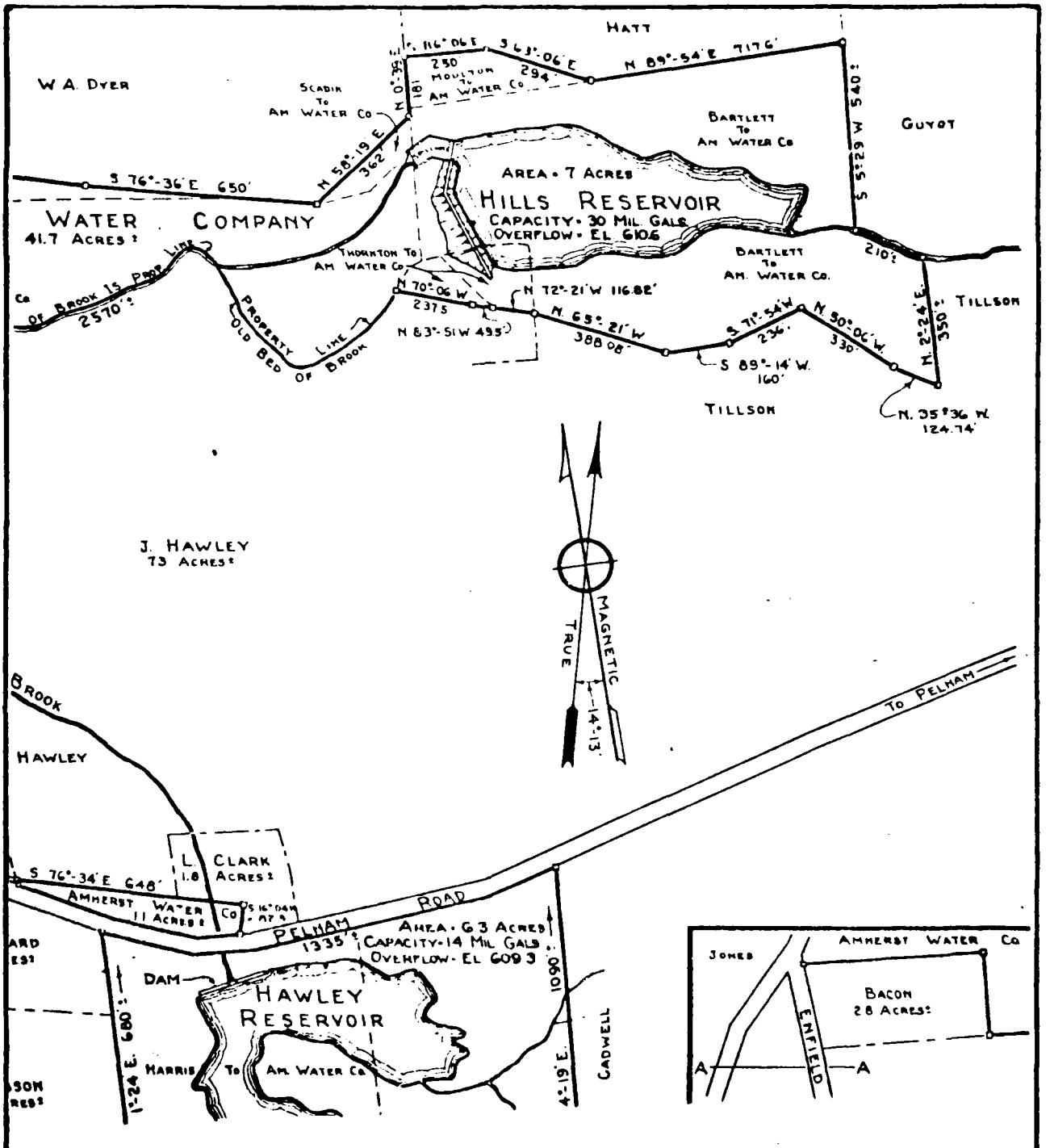
CHECKLIST
ENGINEERING DATA

APPENDIX B

ENGINEERING DATA*

TABLE OF CONTENTS

*NOTE: The information included on pages B-1, B-2, and B-18 was obtained from the Town of Amherst Department of Public Works. The remaining information was obtained from the files of the Massachusetts DEQE.



NOTE:
This plan was reproduced from the set of record drawings kept at the Amherst DPW office.

U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION

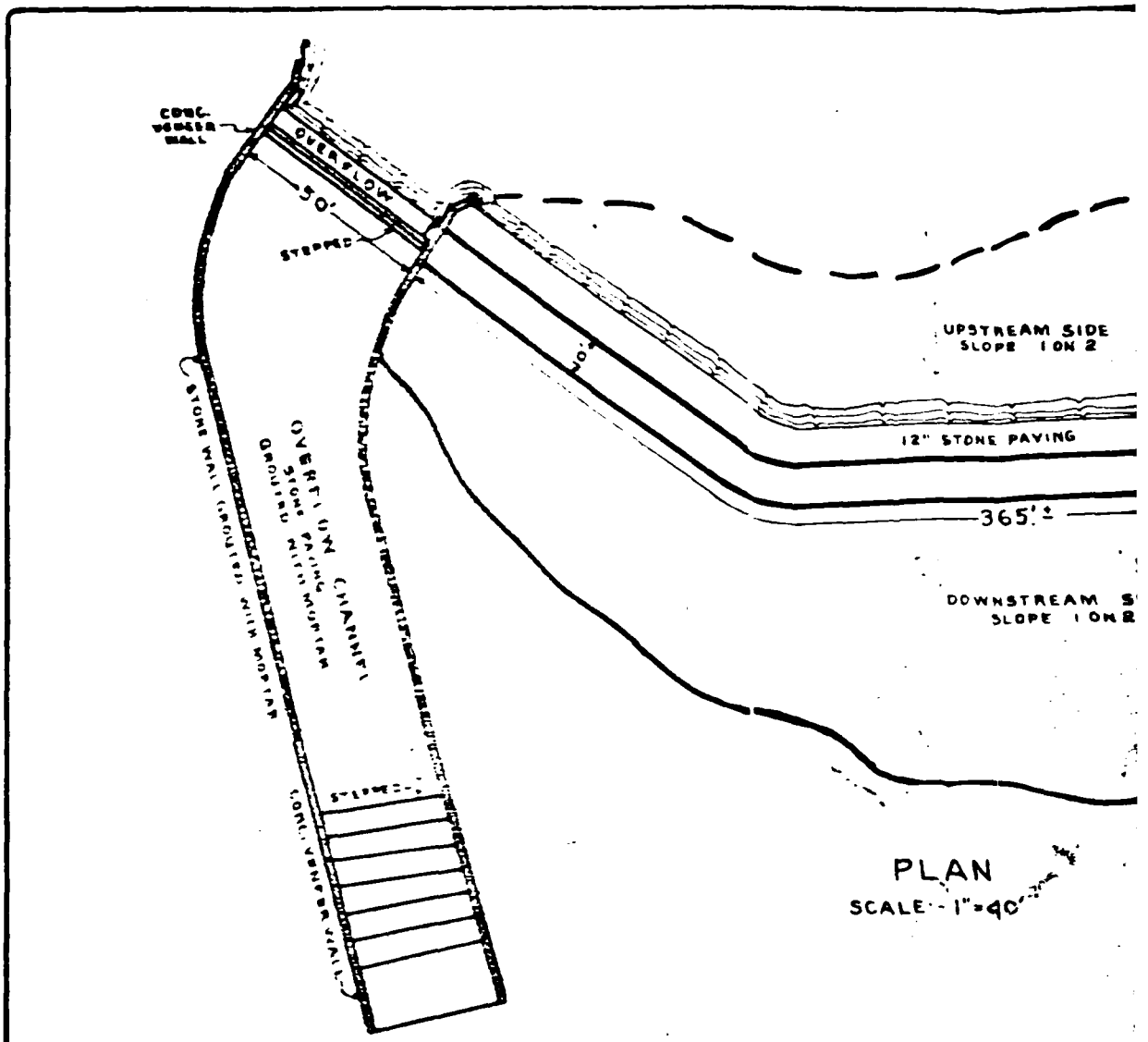
CONTRACT NO. DACW 33-81-C-0016
HILL RESERVOIR DAM

SITE PLAN

O'BRIEN & GERE

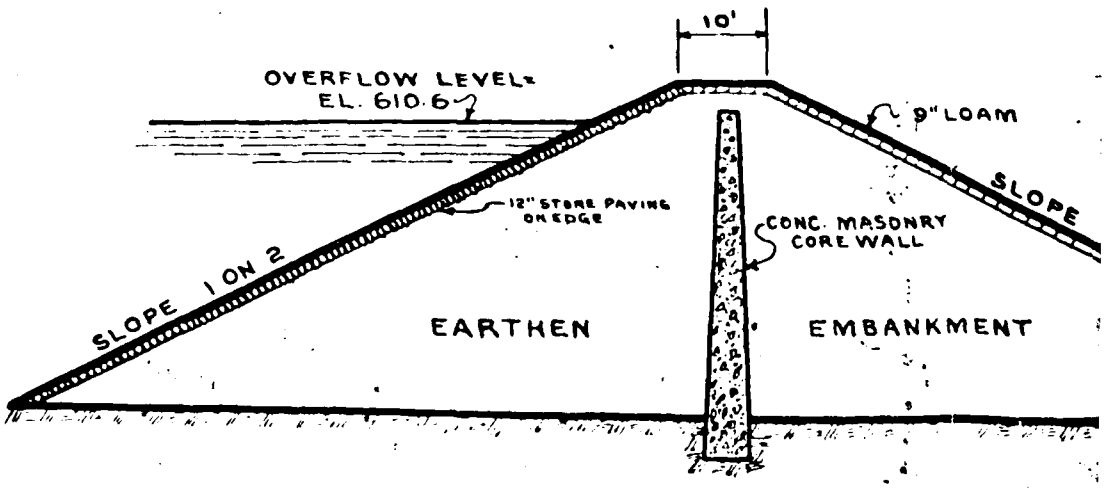
Date: March, 1981
Scale: None

B-1



PLAN

SCALE:- 1"=40'



TYPICAL SECTION

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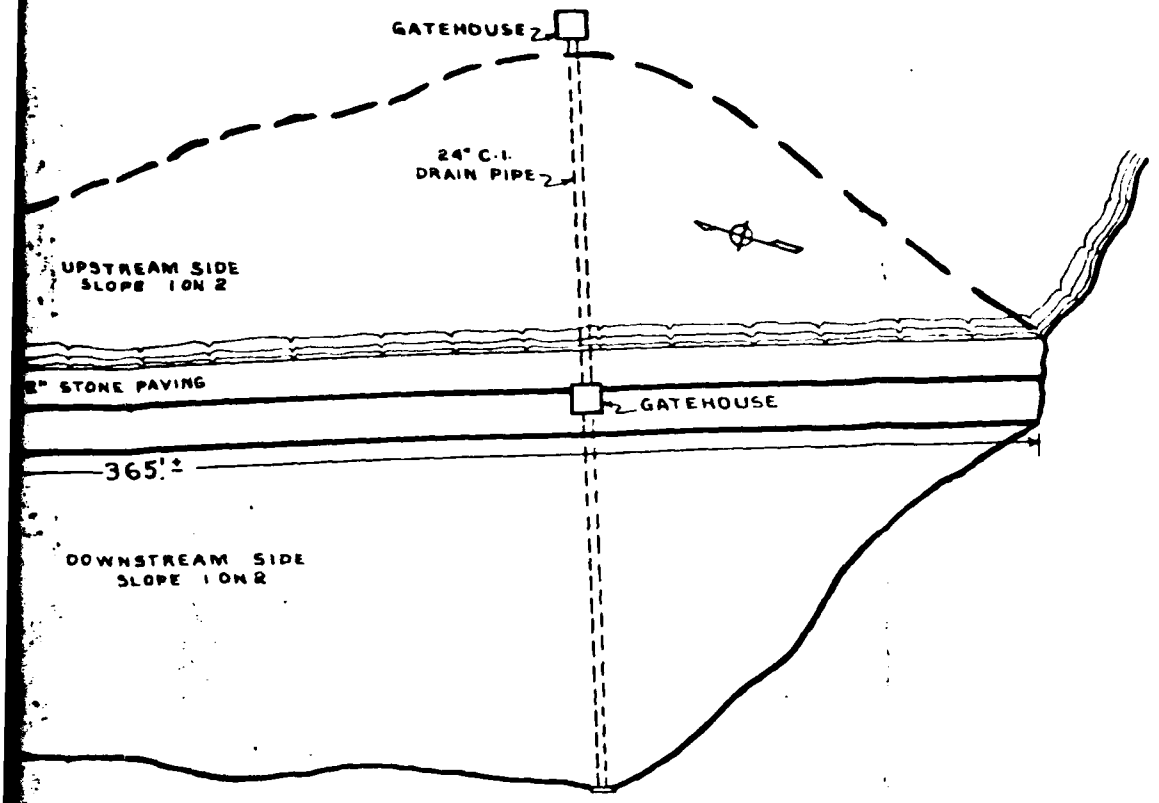
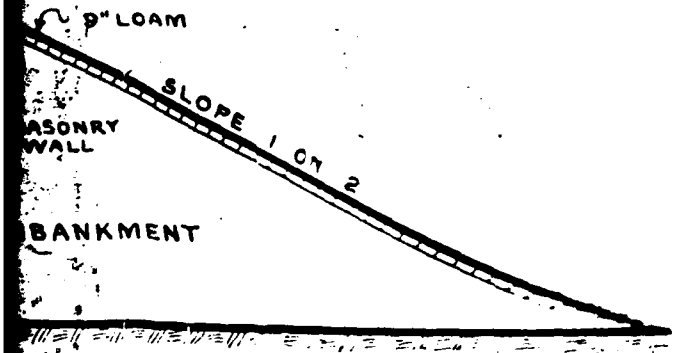


LAN
E - 1"=40'



TION

HILLS RESERVOIR DAM

U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		
CONTRACT NO. DACW 33-81-C-0016 HILL RESERVOIR DAM		
PLAN AND TYPICAL SECTION		
O'BRIEN & GERE	Date: March, 1981 Scale: As Shown	B-2

Hill Reservoir Dam

The embankment of this dam is in good condition. In fact, it is in better condition than has been observed in many years. All of the trees growing from the embankment have been cut down. Both the shape and the surfaces of the embankment were observed to be o. k. No brush growth or tall weed growth was observed on the embankment proper.

At the toe area there was some tall brush growth and weed growth. This is not extensive as yet but if it exists at the time of the next inspection, the Amherst Water Department should be advised to cut this growth.

The end wall at the drawdown pipe has been repaired with cemented stone masonry. It looks quite stable and serviceable.

The spillway crest was o. k. Normal flashboards were on the crest and water level in storage was flowing over the top of the flashboards.

The spillway channel was in satisfactory condition. The unraveled end of the spillway chute has not progressed back towards the spillway proper. The unraveled edge is still about 90 feet more or less from the toe of the spillway structure.

Sidewalls of the spillway were observed to be o. k. Some of the vertical faces of the masonry steps will be in need of repair in the near future. Voids are becoming numerous and it will be necessary in the not too distant future to patch these voids.

In the opinion of the undersigned the dam has been well maintained and is safe.

NOTE: The above assessment was reproduced from a report prepared by the engineering firm of Tighe & Bond in 1970. A copy of the report may be obtained from the Massachusetts DEQE.

The Commonwealth of Massachusetts

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR.
DIVISION OF WATERWAYS

100 Nashua Street, Boston 02114

February 25, 1977

Town of Amherst
Board of Public Works
Water Division
Town Offices
Amherst, Massachusetts

Attention: Charles Mosakewicz, Water Division Foreman

Re: Insp. Dam #2-8-230-3
Hill Reservoir
Pelham

Dear Sir:

On 5-28-76, an Engineer from the Massachusetts Department of Public Works made a visual inspection of the above dam. Our records indicate the owner to be Town of Amherst. 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 706 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:

See "REMARKS AND RECOMMENDATIONS" on reverse side.

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

Very truly yours,

John J. Hannon, P.E.
Chief Engineer

Attn:

cc: Francis J. Hoey
Russell Salls

This is an earthen embankment dam with a concrete core wall and a side chute overflow spillway of concrete and stone masonry. The grade and alignment of dam appeared good. Slopes were well turfed and only a minor brush growth was noted, see items #7 and #8. Two woodchuck holes were noted at toe of downstream slope but these do not pose any hazard to safety of dam. Minor seepage was noted at toe of slope and a leak of some G.P.M. was evident at headwall of 24" C.I. pipe outlet. This area was quite rust stained from the leak. The condition of the chute spillway channel is only fair and immediate repairs seem indicated. At toe of third step below crest of spillway and on the southerly side of channel an area 10'± wide by 20'± long has broken up. The layer of concrete veneer has entirely peeled off and lays in chunks farther downstream in the chute channel. The exposed stone paving in this area shows signs of erosion. Approx. 130' downstream from this area is a small hole, 1½'± in diameter, broken through the concrete veneer of the channel bed. The stone paving here has become misplaced and a hole 8" to 12" deep exists. It would appear that water action from a heavy overflowing of spillway would easily cause further erosion of these exposed areas and possibly cause extensive damage to rest of channel bed, if not a total collapse of chute structure. Further deterioration of the 10' X 20' area could weaken the spillway crest structure, thereby creating a definite hazard to safety of the dam. Mr. Charles Mosakewicz, Water Division foreman, was present at this inspection and this problem was discussed with him. The channel floor at toe of channel or end of chute has broken away more since last inspection and the erosion hole in bed channel has enlarged greatly. While this is a considerable distance away from crest of spillway (300'±) and does not pose any immediate threat to safety of dam, correction of the existing condition would prevent further deterioration. The Division rates this dam as condition 2-minor repairs needed, but notes that this rating could rapidly deteriorate to an unsafe condition if proper repairs are not made where needed. Failure of this dam could cause the failure of 2 more dams downstream, Nos. 2-8-230-2 and 2-8-230-1, with resulting flood damage to a business and residential area downstream.

INSPECTION REPORT - DAMS AND RESERVOIRS

(1.) LOCATION:

City/Town PELHAM. County HAMPSHIRE. Dam No. 2-8-230-3

Name of Dam Hill Reservoir.

Topo Sheet No. 14A. Mass. Rect. Coordinates: N 504,900, E 345,300.

Inspected by: Harold T. Shumway, On May 28, 1976. Date Last Inspection 10/29/73

(2.) OWNER/S: As of May 28, 1976

per: Assessors_____, Reg. of Deeds_____, Prev. Insp. X, Per. Contact X

1. Town of Amherst Board of Public Works, Water Division, Town Offices, Amherst, Mass.
Name | St. & No. | City/Town | State | Tel. No.

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

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

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

Mr. Charles Mosakewicz Water Division Foreman, Town Offices Amherst, Mass. 253-3355
Name | St. & No. | City/Town | State | Tel. No.

(4.) DATA:

No. of Pictures Taken None. Sketches See description of Dam.

Plans, Where Record plans in office of Amherst D. P.W.

(5.) DEGREE OF HAZARD: (if dam should fail completely)*

1. Minor_____.
2. Moderate X.
3. Severe_____.
4. Disastrous_____.

Comments: Approx. 21 million gallons impoundment, could over top two dams downstream

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

(6.) OUTLETS: OUTLET CONTROLS AND DRAWDOWN

No. 1 Location and Type: Northerly end of dam - 48' w x 4 3/4' h. conc.and stone masonry side chute spillway with conc. veneered floor on run-off channel floor.

Controls Yes, TYPE: Wood stoplog - 48' long x 1.0 high x 2" thick.

Automatic ____. Manual X. Operative Yes X, No ____.

Comments: Stoplog in place at inspection-channel floor deteriorating-see remarks

No. 2 Location and Type: Southerly portion of dam - gate house on top of dike.

Controls Yes, Type: 24" C.I. pipe drawdown with screw lift gate valve.

Automatic ____. Manual X, Operative Yes X, No ____.

Comments: Leakage flow of some G.P.M. on northerly side of 24" drain pipe at outlet end - flow rust colored.

No. 3 Location and Type: 75'+out into pond from dike-old conc. gate house over end of 24" C.I. Pipe.

Controls Yes, Type: Screw lift gate valve.

Automatic ____. Manual X. Operative Yes ____. No X.

Comments: Controls are no longer used per water civision personnel. Gate is in open position.

Drawdown present Yes X, No ____. Operative Yes X, No ____.
Comments: See No. 2 above.

(7.) DAM UPSTREAM FACE: Slope 2:1, Depth Water at Dam 39' ±

Material: Turf ____. Brush & Trees ____. Rock Fill X. Masonry ____. Wood ____.

Other Earth embankment with 12" stone payed upstream slope

Condition: 1. Good ____. 3. Major Repairs ____.

2. Minor Repairs X. 4. Urgent Repairs ____.

Comments: Minor brush growth along water line on upstream slope. Minor spalling of face of southerly abutment of side chute spillway.

(8.) DAM DOWNSTREAM FACE: Slope 2:1.

Material: Turf X. Brush & Trees ____. Rock Fill ____. Masonry X Conc. & Stone Chute spillway. Wood ____.

Other ____.

Condition: 1. Good ____. 3. Major Repairs ____.

2. Minor Repairs X. 4. Urgent Repairs ____.

Comments: Minor brush growth on lower portion of southerly end of slope and along toe of slope. Brush growth was dense. Minor seepage noted. See remarks for condition of spillway and runoff channel.

(9.) EMERGENCY SPILLWAY: Available No. Needed No.

Height Above Normal Water_____Ft.

Width_____Ft. Height_____Ft. Material_____.

Condition: 1. Good_____. 3. Major Repairs_____.

2. Minor Repairs_____. 4. Urgent Repairs_____.

Comments: Present overflow side chute spillway appears to have been adequate for many years.

(10.) WATER LEVEL AT TIME OF INSPECTION: 1/6 Ft. Above X. Below_____.

Top Dam_____ F.L. Principal Spillway_____.

Other Top of stop log on crest of spillway.

Normal Freeboard 4 Ft.

(11.) SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Minor brush growth-see items #7 and #8.

Animal Burrows and Washouts 2 animal burrows noted at toe of slope.

Damage to Slopes or Top of Dam None found.

Cracked or Damaged Masonry Yes-severe spalling and peeling of concrete veneer on floor of spillway channel outlet.

Evidence of Seepage Minor seepage at toe of slope around drawdown pipe.

Evidence of Piping None found.

Leaks See item #6 - sub 2 comments.

Erosion Bed of stream at toe of spillway chute badly eroded.

Trash and/or Debris Impeding Flow None found.

Clogged or Blocked Spillway None found.

Other Spillway floor breaking up at toe of slope.

12. OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed X .
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list_____.

---

13. REMARKS AND RECOMMENDATIONS: (Fully Explain)

This is an earthen embankment dam with a concrete core wall and a side chute overflow spillway of concrete and stone masonry. The grade and alignment of dam appeared good. Slopes were well turfed and only a minor brush growth was noted, see items #7 and #8. Two woodchuck holes were noted at toe of downstream slope but these do not pose any hazard to safety of dam. Minor seepage was noted at toe of slope and a leak of some G.P.M. was evident at headwall of 24" C.I. pipe outlet. This area was quite rust stained from the leak. The condition of the chute spillway channel is only fair and immediate repairs seem indicated. At toe of third step below crest of spillway and on the southerly side of channel an area 10'± wide by 20'± long has broken up. The layer of concrete veneer has entirely peeled off and lays in chunks farther downstream in the chute channel. The exposed stone paving in this area shows signs of erosion. Approx. 130' downstream from this area is a small hole, 1½'± in diameter, broken through the concrete veneer of the channel bed. The stone paving here has become misplaced and a hole 8" to 12" deep exists. It would appear that water action from a heavy overflowing of spillway would easily cause further erosion of these exposed areas and possibly cause extensive damage to rest of channel bed, if not a total collapse of chute structure. Further deterioration of the 10' x 20' area could weaken the spillway crest structure, thereby creating a definite hazard to safety of the dam. Mr. Charles Mosakewicz, Water Division foreman, was present at this inspection and this problem was discussed with him. The channel floor at toe of channel or end of chute has broken away more since last inspection and the erosion hole in bed channel has enlarged greatly. While this is a considerable distance away from crest of spillway (300'±) and does not pose any immediate threat to safety of dam, correction of the existing condition would prevent further deterioration. The District rates this dam as condition 2-minor repairs needed, but notes that this rating could rapidly deteriorate to an unsafe condition if proper repairs are not made where needed. Failure of this dam could cause the failure of 2 more dams downstream, Nos. 2-8-230-2 and 2-8-230-1, with resulting flood damage to a business and residential area downstream.

(9.) EMERGENCY SPILLWAY: Available No. Needed No.

Height Above Normal Water _____ Ft.

Width _____ Ft. Height _____ Ft. Material _____.

Condition: 1. Good _____. 3. Major Repairs _____.

2. Minor Repairs _____. 4. Urgent Repairs _____.

Comments: Present overflow chute spillway has carried high water levels for many years.

(10.) WATER LEVEL AT TIME OF INSPECTION: 11½ Ft. Above _____. Below X.

Top Dam X F.L. Principal Spillway _____.

Other _____.

Normal Freeboard 4 Ft. to top dam.

(11.) SUMMARY OF DEFICIENCIES NOTED:

Growth (Trees and Brush) on Embankment Minor brush growth on upstream face.

Animal Burrows and Washouts None found.

Damage to Slopes or Top of Dam None found.

Cracked or Damaged Masonry Stone and concrete paved floor of chute spillway broken off at lower end. Severe spalling of concrete at water line on concrete gate house set out in pond.

Evidence of Seepage None found.

Evidence of Piping None found.

Leaks None found.

Erosion Erosion of channel bed at end of spillway.

Trash and/or Debris Impeding Flow None found.

Clogged or Blocked Spillway None found.

Other 1' high flashboard in place on spillway.

(12.) OVERALL CONDITION:

1. Safe_____.
2. Minor repairs needed X.
3. Conditionally safe - major repairs needed_____.
4. Unsafe_____.
5. Reservoir impoundment no longer exists (explain)

   Recommend removal from inspection list_____.

(13.) REMARKS AND RECOMMENDATIONS: (Fully Explain)

The grade and alignment of dam appear good. Top of earth dike is well turfed and mowed. Minor brush growth was noted on upstream face near top of dike. The water level was $7\frac{1}{2}$ feet, $\pm$, below normal at time of inspection. Severe spalling of concrete surface of gate house structure at end of drawdown pipe at normal water level line was noted. Stone paving of upstream slope appeared stable and concrete spillway structure appeared sound. There was noted a break-off of stone and concrete paved floor of spillway chute at very end of 3' to 4' in width and an erosion hole of $1\frac{1}{2}$' to 2' in depth of channel bed in this spot.

Dam appears safe at this time.

RCS/js/vk

DESCRIPTION OF DAM

DISTRICT 2.

Submitted by H. T. Shumway Dam No. 2-8-230-3

Date October 29, 1973 ~~City~~/Town Pelham

Name of Dam Hill Reservoir Dam

1. Location: Topo Sheet No. 14A Mass. Rect. Coordinates N 504,900 E 345,300

Provide 8½" x 11" in clear copy of topo map with location of Dam clearly indicated.

On Dunlop Brook, access via a private road about 2000 ft. from Gates Road.

Private road is 2200 ft. north of Amherst Rd.

2. Year built Unknown Year/s of subsequent repairs Unknown

3. Purpose of Dam: Water Supply Amherst Water Supply / Recreational _____

Flood Control _____ Irrigation _____ Other _____

4. Drainage Area: 3.8 sq. mi. _____ acres.

Type: City, Bus. & Ind. _____ Dense Res. _____ Suburban _____ Rural, Farm 30%

Wood & Scrub Land 70% Slope: Steep 50% Med. 50% Slight _____.

5. Normal Ponding Area: 5½ Acres; Ave. Depth 12'

Impoundment: 21. million gals.; 66 acre ft.

Silted in: Yes X No _____ Approx. Amount Storage Area 20%

6. No. and type of dwellings located adjacent to pond or reservoir _____

i.e. summer homes etc. None

7. Dimensions of Dam: Length 419'± Max. Height 42½'

Freeboard 4' to top dike - normal water level

Slopes: Upstream Face 2:1 - stone paved

Downstream Face 2:1 - turfed

Width across top 10'

Dam No. 2-8-230-2

8.

Classification of Dam by Material:

Earth X Conc. Masonry X Stone Masonry X

Timber _____ Rockfill _____ Other _____

8A.

Dam Type: Gravity X Straight _____ Curved, ~~Arched~~ X Other _____

Overflow _____ Non-overflow _____

Concrete spillway is straight - earth dike curved.

9.

A. Description of present land usage downstream of dam:

90 % rural; 10 % ~~urban~~ developed

B. Is there a storage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure? Yes _____ No X

C. Character Downstream Valley: Narrow X Wide _____ Developed 10%

Rural 90% Urban _____

10.

Risk to life and property in event of complete failure.

No. of people 2

No. of homes 2

No. of businesses 1 - Boiler Equip. Trust.

No. of industries None Type _____

No. of utilities 3 Type Amherst feeder water mains - Electric and telephone distribution lines

Railroads 1 - Vermont Central

Other dams Intake Reservoir Dam, No. 2-8-230-2, - Bartlett Fish Rod Co. Dam, No. 2-8-230-1 in West Pelham.

Other Amherst Sewage Disposal Plant - increasing development in Amherst.

11.

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

RCS/vk

Attachments

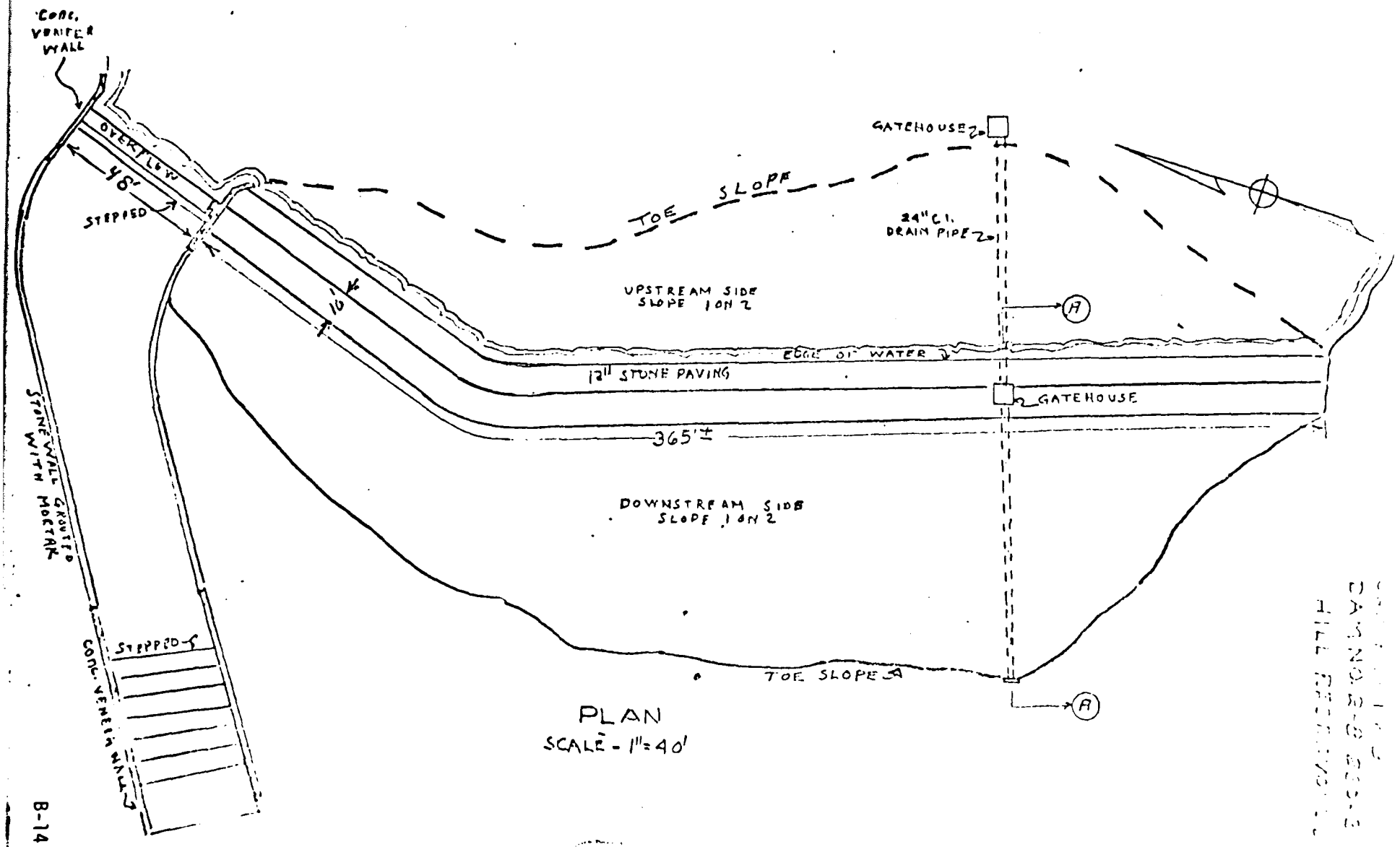
Locus Plan

Sketches

STOCKS

HILL RESERVOIR DAM

TAKEN FROM RECORD PLAN IN AMHERST DPW OFFICE
1935 PLAN PLATE F & CHECKED IN FIELD OCT 29, 1973 By M.T.S

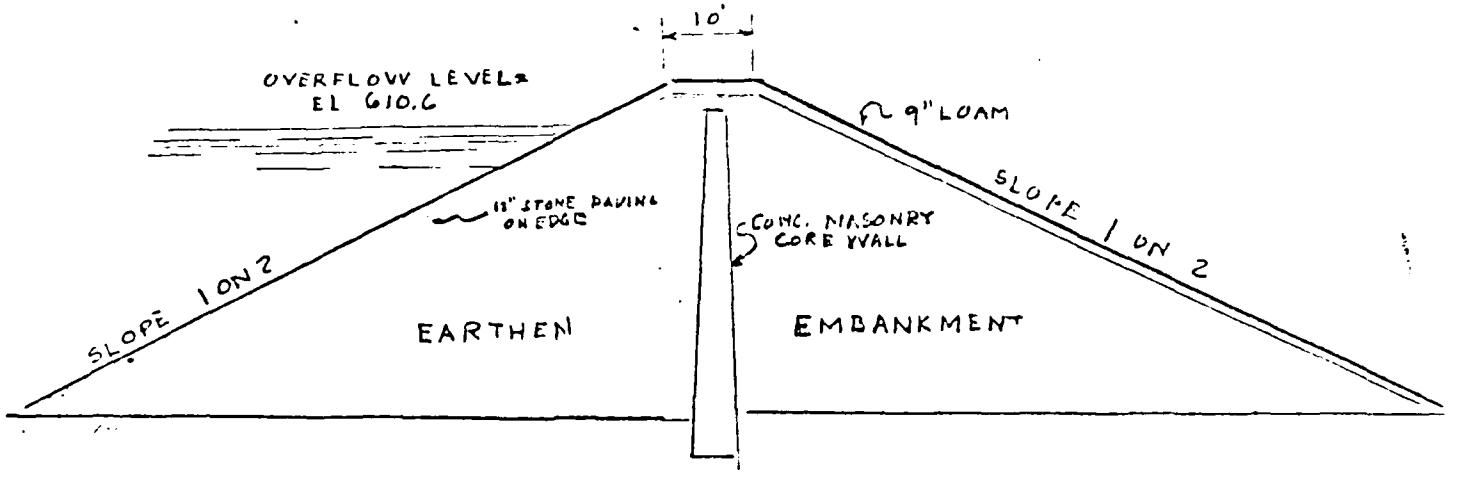


PLAN
SCALE - 1" = 40'

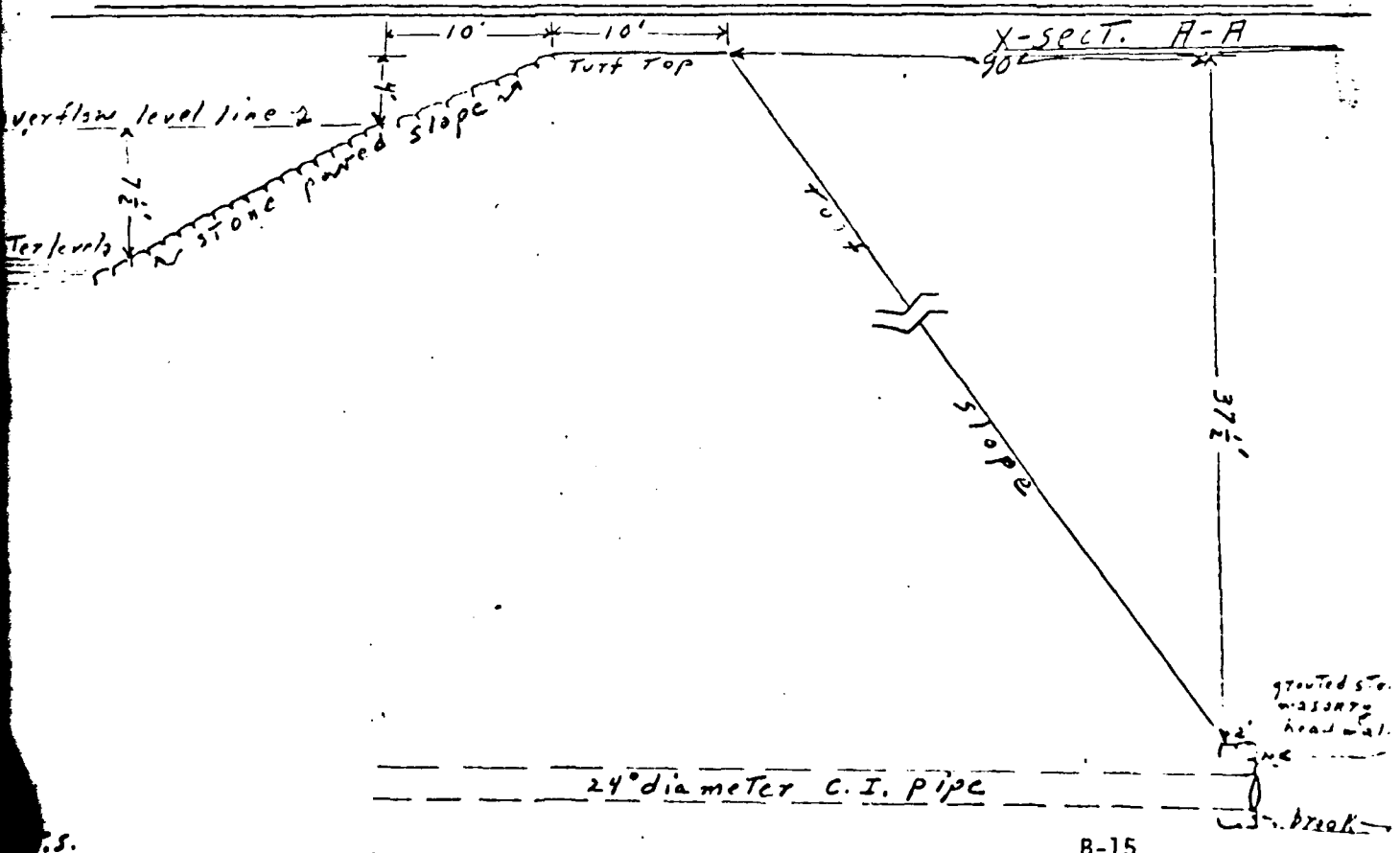
DAM NO. [illegible]

TYPICAL X SECTION FROM PLANS IN AMHERST D.P.W. OFFICE 1935 PLAN PLATE - CHECKED IN FIELD OCT 29, 1973 by H.T.S.

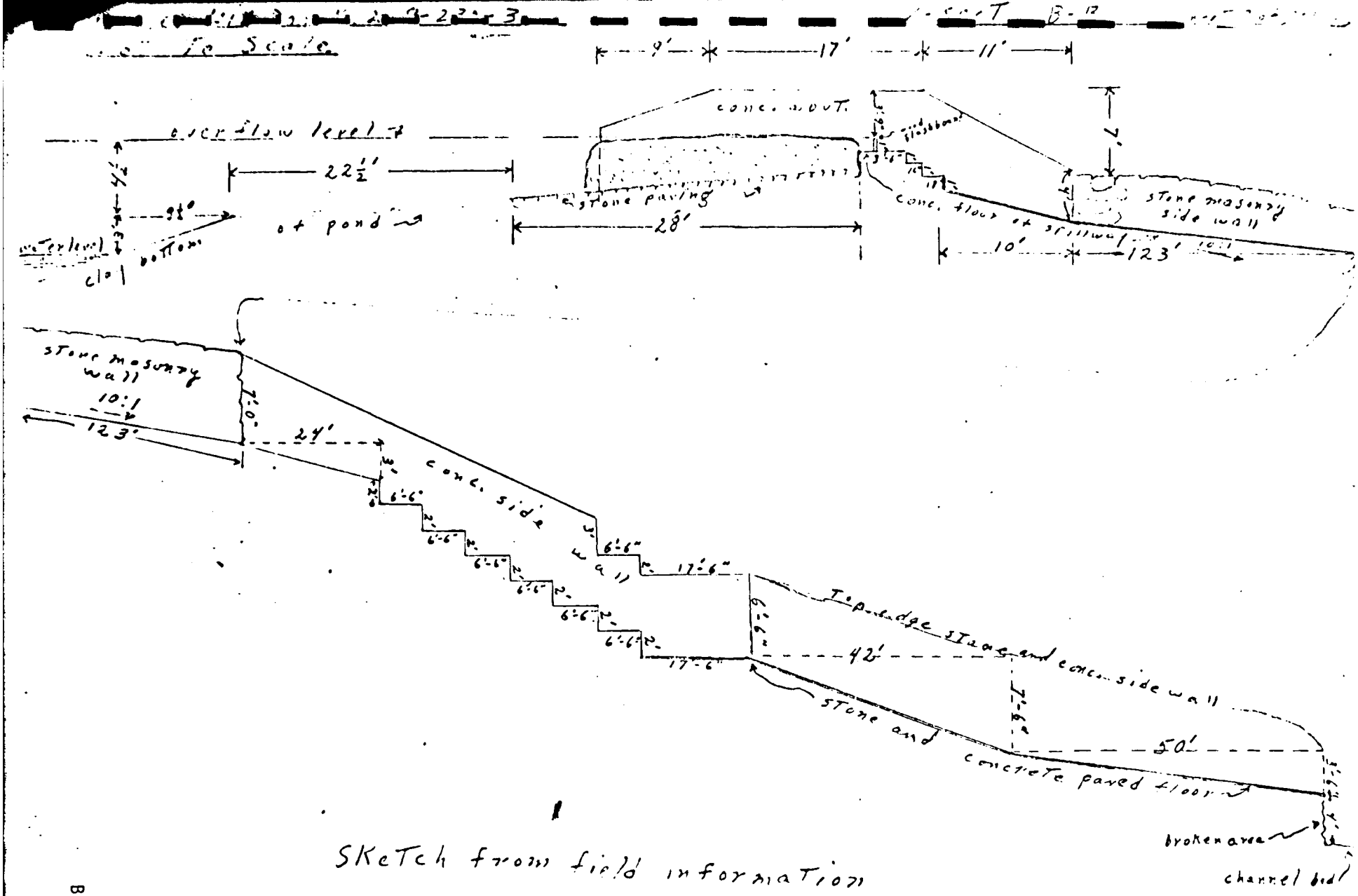
HILL RESERVOIR DAM



TYPICAL SECTION
SCALE 1" = 20



H.T.S.
10-29-73

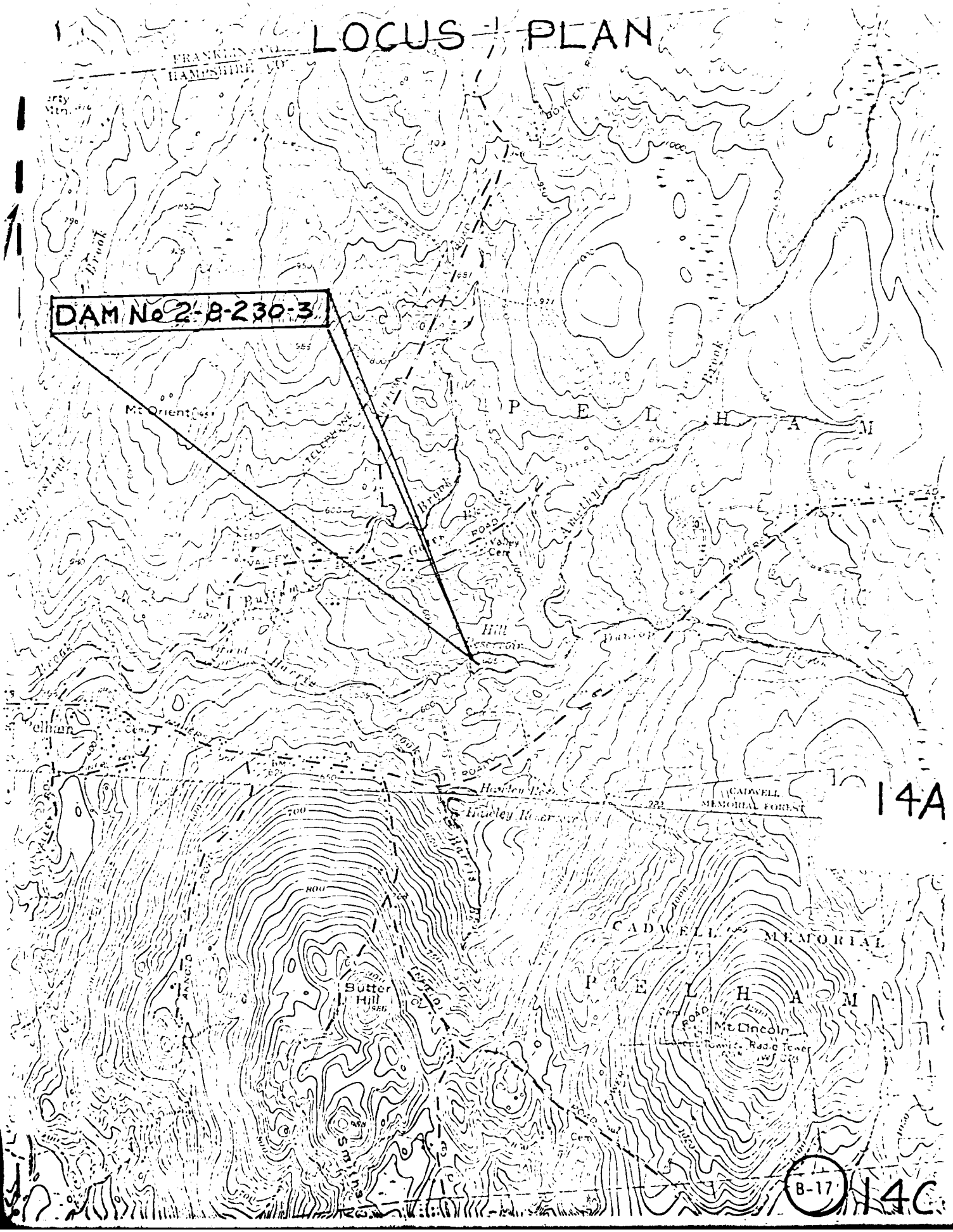


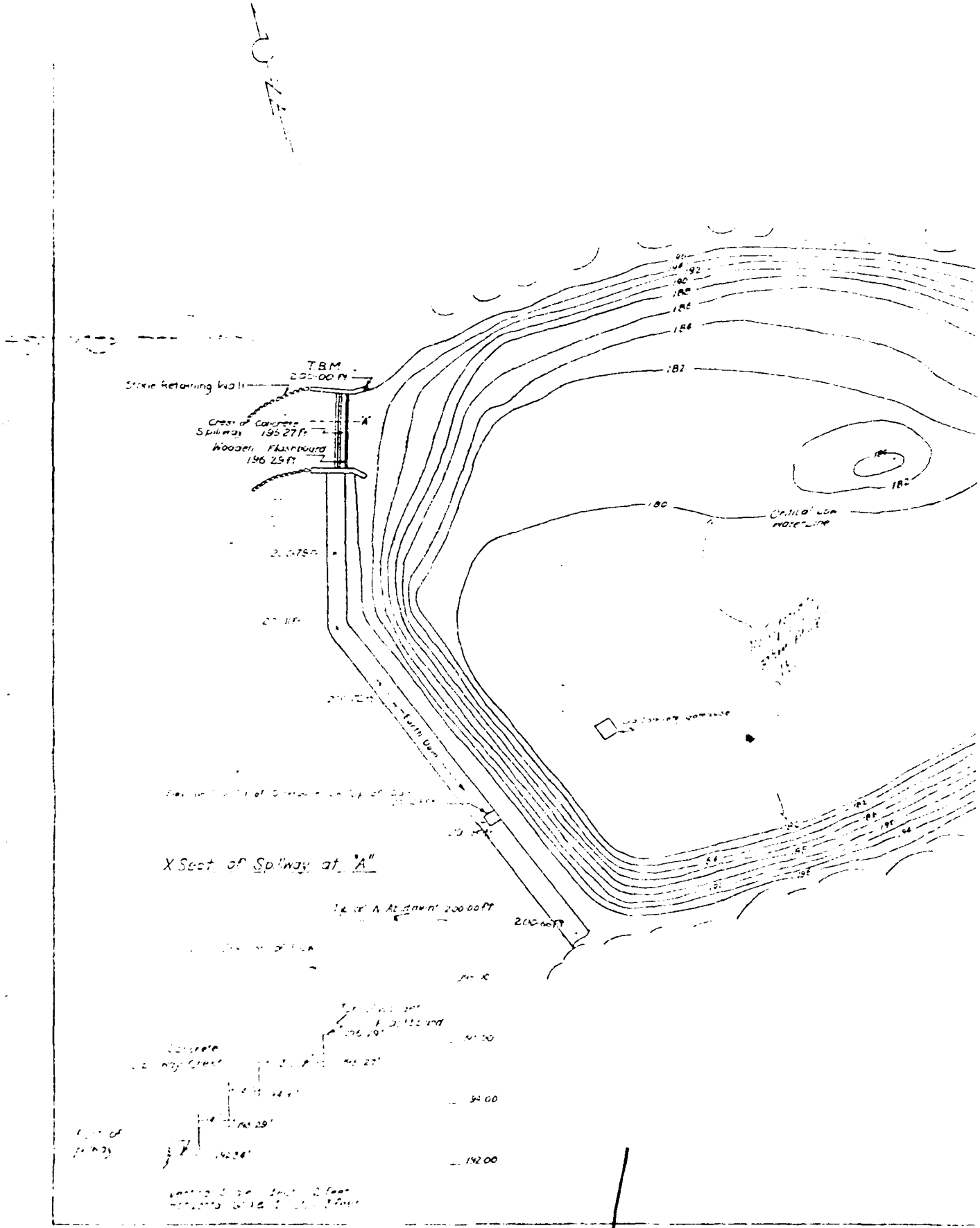
SKetch from field information

B-16

H.T.S.
12-24-73

LOCUS PLAN


DAM No 2-8-230-3
Mt Orient
Hill
Sutter Hill
Mt Lincoln
Radio Tower
CADWELL MEMORIAL FOREST
PELHAM
14A
14C
B-17


T.B.M.
200.00 ft
Stone retaining wall
Crest of concrete Spillway 195.27 ft
Wooden Flashboard 196.29 ft
"A"
182
180
Contour line
X Sect of Spillway at "A"
200.00ft

NOTES

Elevations are assumed datum
Elevations Taken below 180ft.
Est. * Surface Acres at HWL.

HILLS RESERVOIR

TOPOGRAPHIC PLAN

Situated in Town of Dalton, Mass.
Made for Town of Pittsfield, Mass.
Scale 1in = 40ft
Date Oct 8 1982

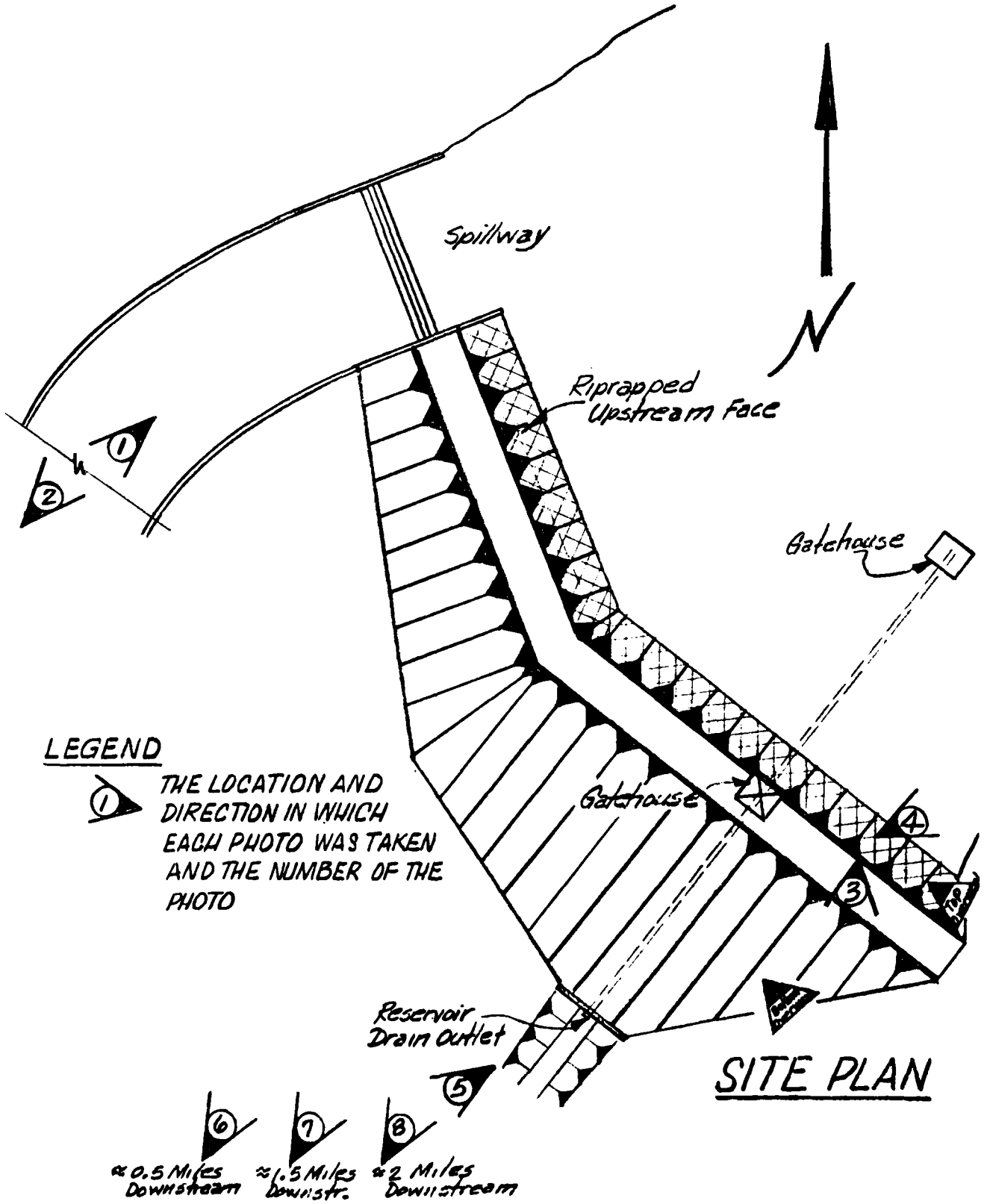
APPENDIX C

PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	A			



SITE PLAN

1. SPILLWAY OUTLET CHANNEL AND SPILLWAY LOOKING UPSTREAM. (12/5/80)

2. SPILLWAY OUTLET CHANNEL AND NATURAL CHANNEL DOWNSTREAM. (12/5/80)

3. IMPOUNDMENT AND LOW LEVEL OUTLET GATEHOUSE. (12/5/80)

4. TYPICAL RIP RAP ON UPSTREAM FACE OF DAM. (12/5/80)

5. LOW LEVEL OUTLET, (12/5/80)

6. FIRST BRIDGE CROSSING CHANNEL ABOUT 0.5 MILES DOWNSTREAM FROM THE DAM. (12/5/80)

7. POTENTIAL DAMAGE AREA APPROXIMATELY 1.5 MILES DOWNSTREAM FROM THE DAM. (12/5/80)

8. POTENTIAL DAMAGE AREA ABOUT 2.0 MILES DOWNSTREAM FROM THE DAM. (12/5/80)

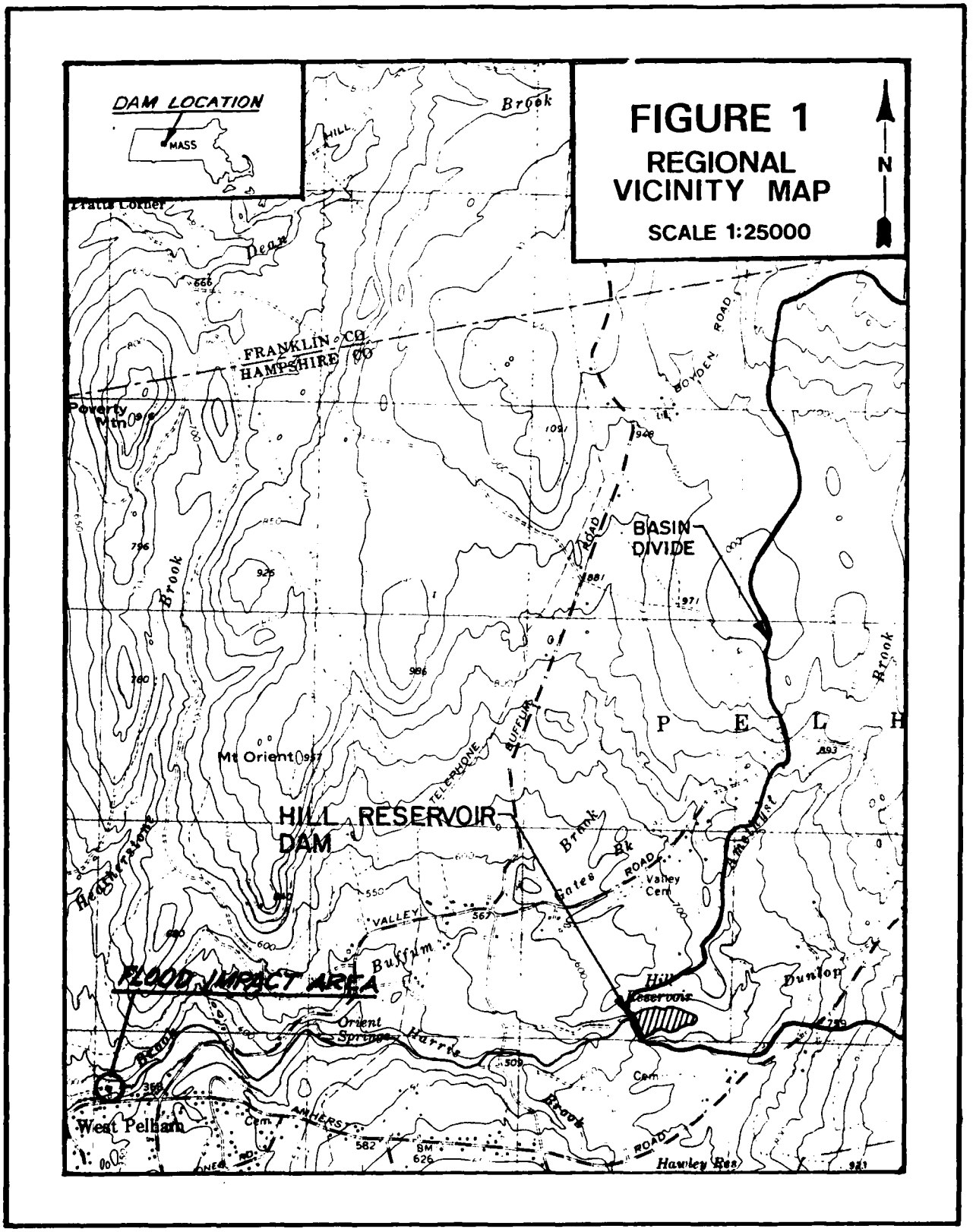
APPENDIX D

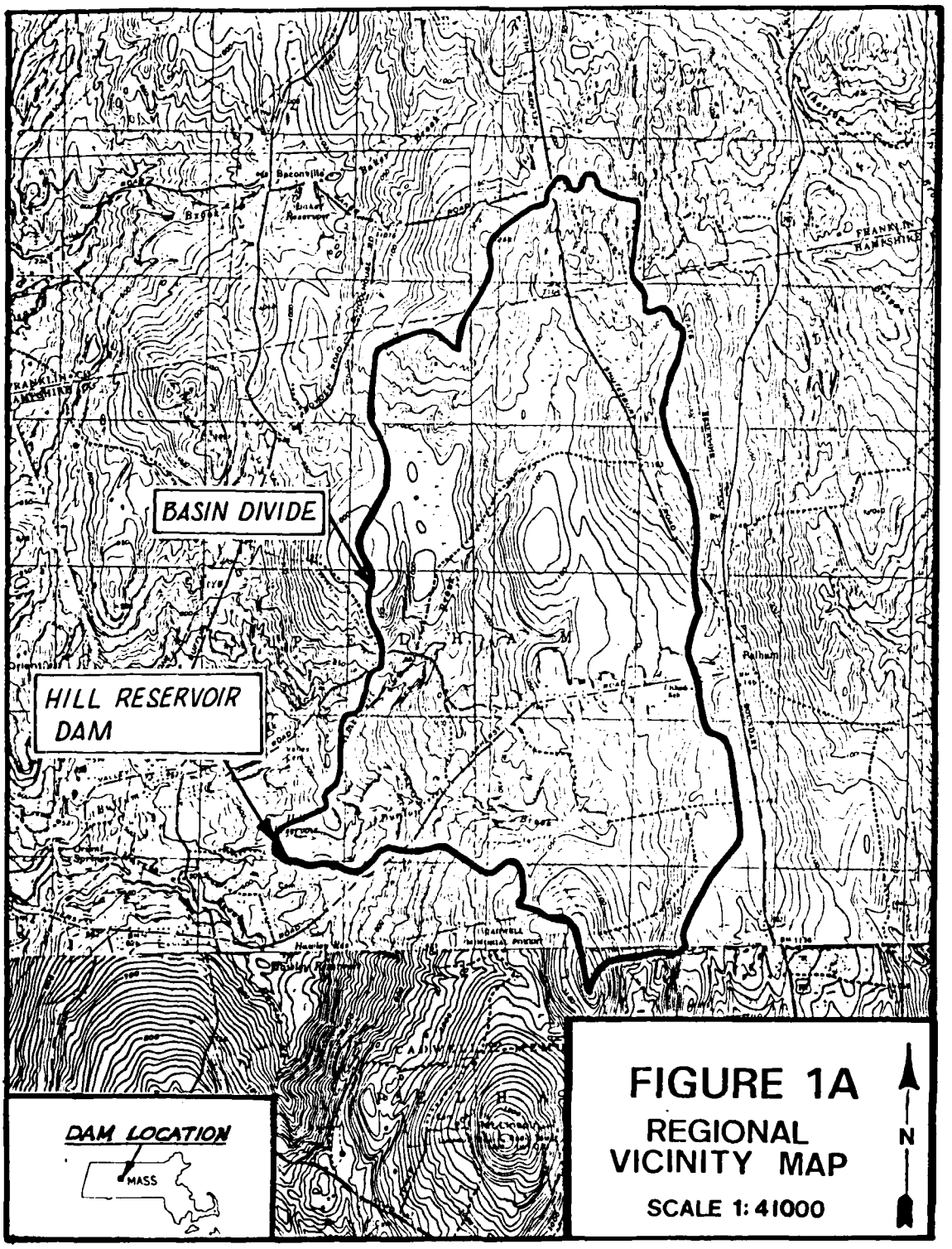
HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS


DAM LOCATION
MASS
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:25000
N
Brook
Patts Corner
Dean
FRANKLIN CO
HAMPSHIRE CO
BOWDEN ROAD
Poverty Mtn
BASIN
DIVIDE
Brook
ROAD
P E L H
Brook
Mt Orient
TELEPHONE
BLUFFLIN
HILL RESERVOIR
DAM
Brook
Rk
Gates
ROAD
Valley
Cem
VALLEY
Buffum
FLOOD IMPACT AREA
Hill
Reservoir
Dunton
Orient
Springs
Hurrle
Brook
Cem
West Pelham
Cem
ROAD
Hawley Res


BASIN DIVIDE
HILL RESERVOIR DAM
DAM LOCATION
MASS
FIGURE 1A
REGIONAL VICINITY MAP
SCALE 1: 41000
N

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	D-2	ADH ✓	2/20/81 3/4/81	2060.002

(I.) Drainage Area ... 4.1 sq. mi.

(II.) Snyder Hydrograph Coefficients

$C_t = 2.0$ & $C_p = 0.6$

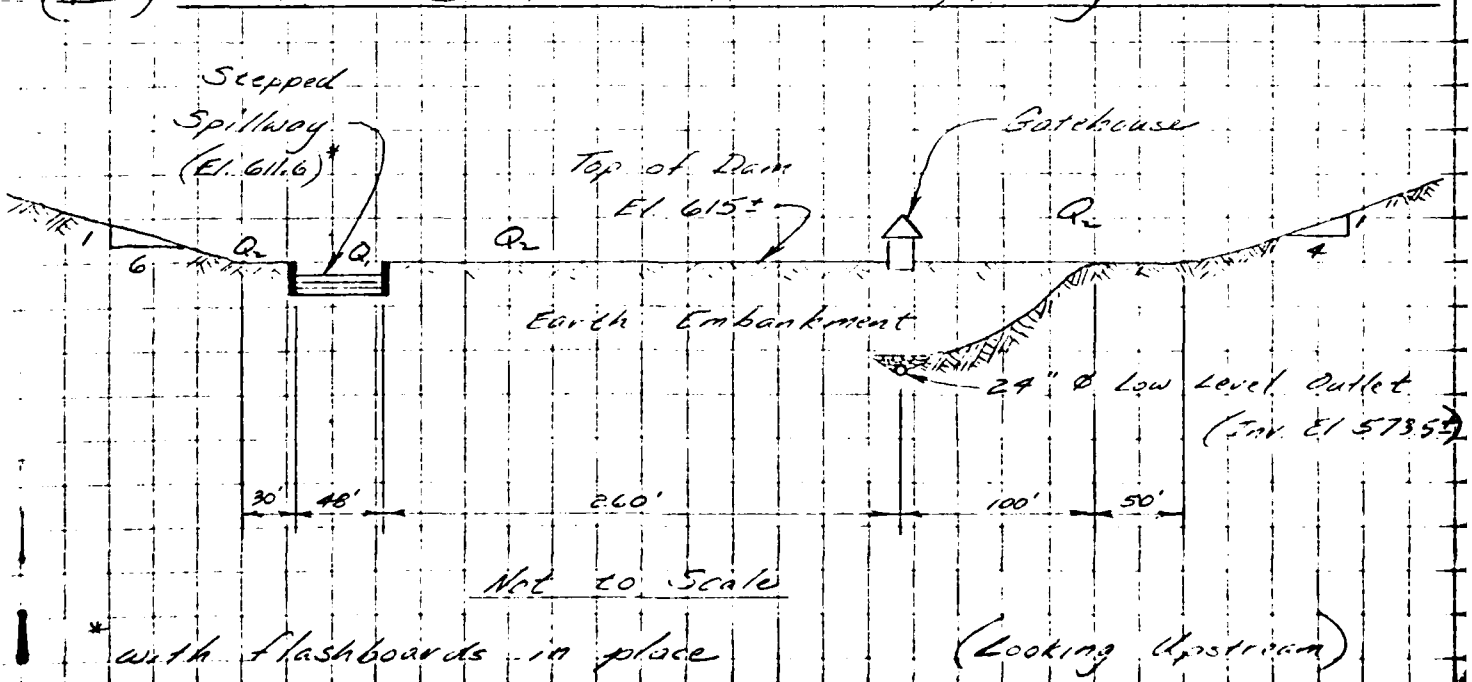
(III.) T_p Calculation

$$T_p = C_t (L \times L_{ca})^{0.3} = (2.0)(3.7 \times 1.9)^{0.3} = 3.59 \approx 3.5 \text{ Hrs}$$

where L = main channel length from the outflow point to the upstream watershed boundary (river miles), and

L_{ca} = main channel length from the outflow point to a point opposite the centroid of the river basin (in river miles).

(IV.) Sketch: Dam Elevation & Spillway Dimensions



Not to Scale

* with flashboards in place

(Looking Upstream)

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
Hill Reservoir Dam	D-3	ADH	2/20/81	2060.002
			3/4/81	

(V.) Stage - Discharge Relationship

Elevation (NGVD)	H_1 (ft)	Q_1 (cfs)	H_2 (ft)	Q_2 (cfs)	ΣQ cfs
611.6	0	0	—	—	0
612	0.4	33	—	—	33
613	1.4	215	—	—	215
614	2.4	482	—	—	482
615	3.4	812	0	0	812
616	4.4	1,196	1.0	1,136	2,332
617	5.4	1,626	2.0	3,214	4,840
618	6.4	2,098	3.0	5,904	8,002

Formula for weir discharge: $Q = CLH^{3/2}$

- where $C_1 = 2.7$ for flow over the broad-crested spillway
  $C_2 = 3.0$ for flow over the dam
- also, Q_1 = flow over spillway
  Q_2 = flow over dam
  $L = 48'$ (measured)

Note: Discharge through the 24-inch diameter low level outlet is not included in the above stage-discharge table. It is normally closed and its operation during a high runoff storm event is not ensured.

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
H. H. Reservoir Dam	D-4	ADH	2/23/81	2060.002

✓ 3/4/81

(VI) Stage - Storage Table *

Description	Elevation (NGVD)	Area (acres)	Storage (acre-feet)
Toe of Dam	574. ±	0	0
Spillway Crest	611.6	4.6	48
Top of Dam	615	6.1	67
Test Flood El.	616.4	6.9	76

* Areas have been approximated from USGS maps. Storage values were computed according to the conical method by the HEC-1DB computer program.

(VII) PMP Data (Total D.A. = 4.1 mi.²)

24-hr. 200 mi.² probable maximum precipitation

≈ 20.2 inches (Ref. HMS #33)

Distribution:

6-Hr. % of index for this basin ≈ 111

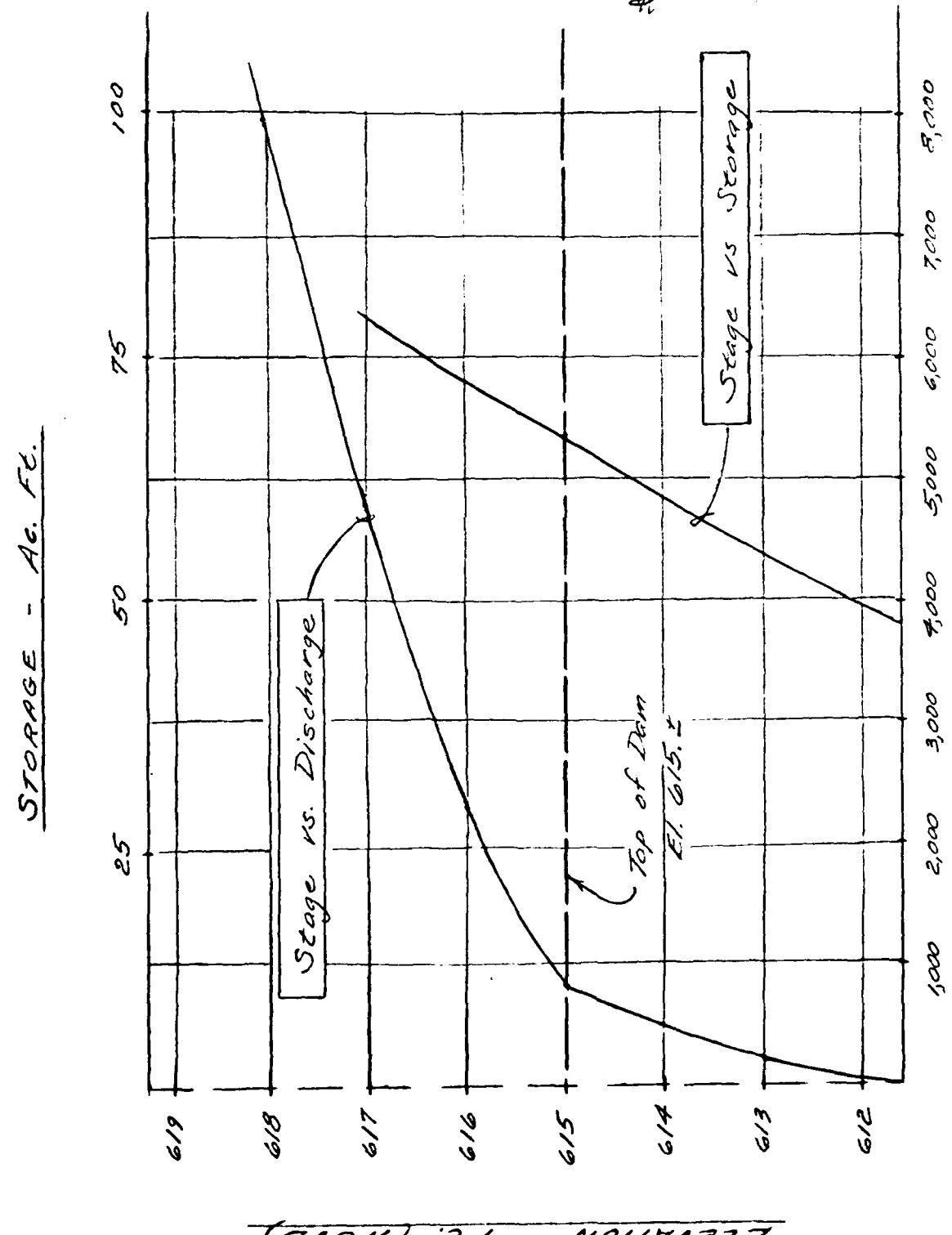
12-Hr. " " " " " " ≈ 123

24-Hr. " " " " " " ≈ 132

O'BRIEN & GERE
ENGINEERS, INC

SUBJECT	SHEET	BY	DATE	JOB NO.
Hill Reservoir Dam	D-5	ADH	3/23/81	2060.002

3/4/81



O'BRIEN & GERE

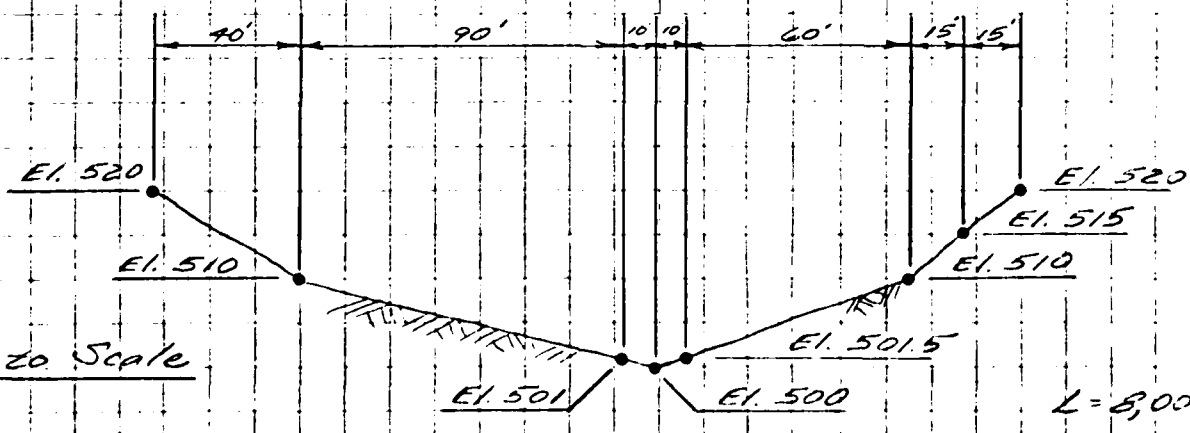
SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	D-6	ADH	2/23/81	2060.002

VT 3/4/81

(VIII.) Downstream Routing Information:

To assess the impact of dam failure upon downstream hazard areas, it is necessary to route both the maximum spillway discharge and the breach outflow along Amethyst Brook. Pertinent routing information is presented in this Section.

a.) The following section is taken approximately 2,000 feet downstream of the dam and is assumed to be typical for the first 8,000 feet of the discharge channel.



Not to Scale

Station ID: (DS-1)

Channel Cross Section

L = 8,000'
SF. 030

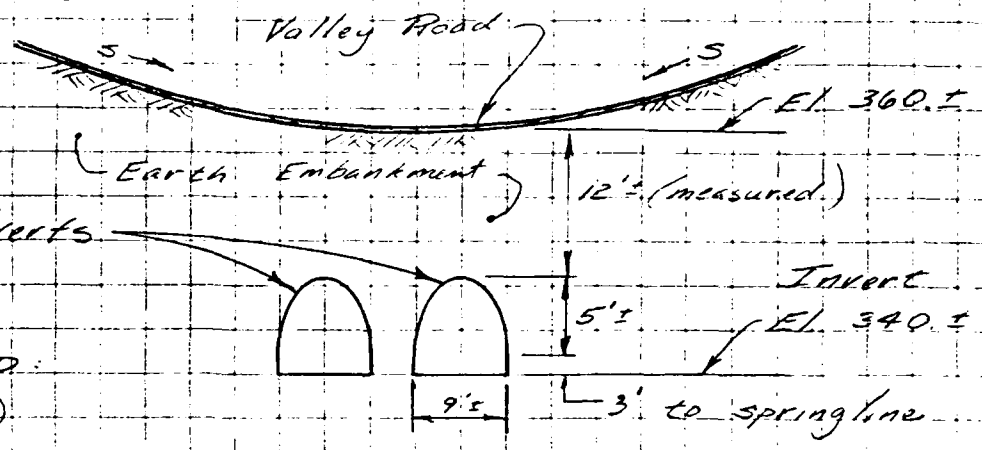
O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	D-7	ADH	3/25/81	3060.002

1 of 3/4/81

(VIII.) Downstream Routing Information: (Cont.)

b.) Valley Road Culverts: (Not to Scale)

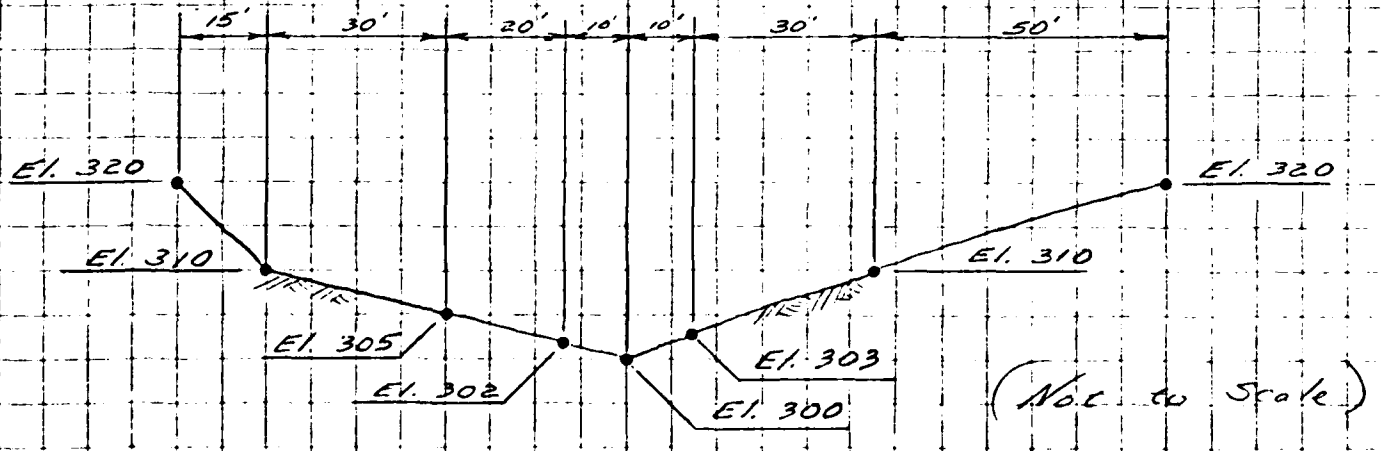


Station ID: (VALLRD)

Elevation (Looking Downstream)

(see p. D-8 for stage-discharge table)

c.) Channel Cross Section (DS-2)



(Not to Scale)

Elevation (Looking Downstream)

Station ID: (DS-2)

ℓ = 1800'

S = 0.025

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	D-8	ADH ✓	2/25/81	2060.002

(VIII.) Downstream Routing Information: (Cont.)

Stage - Discharge Table: (Valley Road Culverts)

Elevation (NGVD)	H* (ft.)	Q (cfs)
340	0	0
341.4	1.4	66
342.8	2.8	188
344.2	4.2	337
345.4	5.4	477
346.5	6.5	587
347.5	7.5	677
Transitional Flow		
350.3	10.3	1,126
352.4	12.4	1,301
356.6	15.6	1,594
359.0	19.0	1,900

NOTE: The above table indicates the discharge per culvert.

*Includes ½ velocity head loss at entrance

Formulas

Due to site conditions and flow characteristics, open channel flow was assumed until the upstream head reached the crown of the culverts and inlet control was assumed for greater heads.

Open channel flow: (Mannings Equation)

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

Flow computed for upstream elevations greater than El. 348 were also based upon Manning's Equation, with the slope of the EGL taken from the assumed u/s water surface elev. to the E of discharge

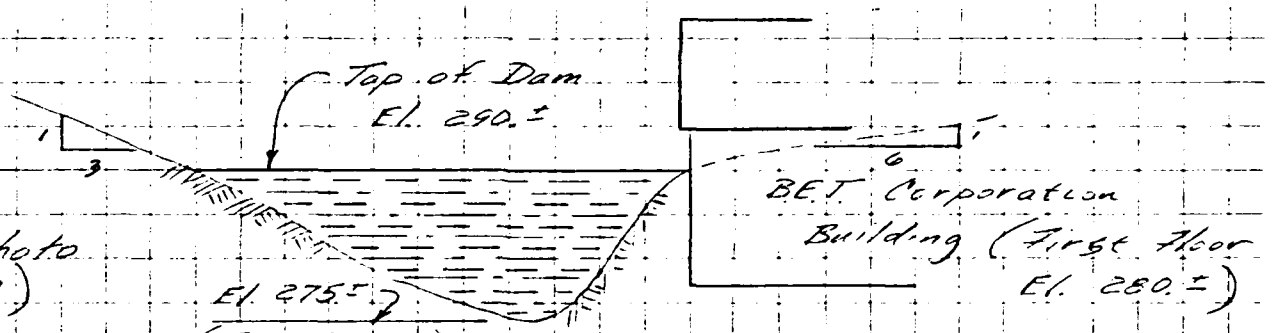
O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Hill Reservoir Dam	D-9	ADH ✓	2/25/81	2060.002

(VIII) Downstream Routing Information: (Cont.)

d.) Dam at B.E.T. Corporation Bldg.

For routing purposes, we will neglect the upstream drainage area. In effect, the peak runoff will already have been routed over the dam and the effect of the local inflow hydrograph would be minimal by the time the breach outflow reached this location.



Not to Scale

Sketch of Dam

(Elevation - Looking Upstream)

$Q = CLH^{3/2}$

Stage vs. Discharge Table: (L & H in feet)

Elevation	C	L	H	Q (cfs)	Elevation	C	L	H	Q (cfs)
290	3.0	60	0	0	294	3.0	78	4	1,872
291	3.0	65	1	195	295	3.0	83	5	2,784
292	3.0	69	2	585	296	3.0	87	6	3,834
293	3.0	74	3	1,154	297	3.0	92	7	5,112

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION  JULY 1978
   LAST MODIFICATION  01 APR 80
 **********
     1     A1       HYDROLOGIC ANALYSIS OF HILL RESERVOIR DAM
     2     A2             NATIONAL DAM INSPECTION PROGRAM
     3     A3          NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4     R    300    0    10    0    0    0    0    0    -4    0
     5     R1     5
     6     J      1     9     1
     7     J1    .1    .13   .15   .2   .25   .3   .4   .5    1
     8     K      0   INFHR                                  1
     9     K1                INFLOW TO HILL RESERVOIR
    10     M      1     1    4.1          0                        1
    11     P      0    20.2  111   123   132
    12     T                                                 0   0.05
    13     W    3.5    0.6
    14     X   -1.7   -0.1    2
    15     K      1   OUTHR                                  1
    16     K1              ROUTED OUTFLOW FROM HILL RESERVOIR
    17     Y                                1    1
    18     Y1     1                                       -611.6   -1
    19     Y4  611.6   612   613   614   615   616   617   618
    20     Y5     0     33   215   482   812  2332  4840  8002
    21     $A     0    4.6   6.1
    22     $E   580   611.6  615
    23     $$  611.6
    24     $D   615
    25     N     99

1                  PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                   RUNOFF HYDROGRAPH AT      INFHR
                   ROUTE HYDROGRAPH TO       OUTHR
                   END OF NETWORK

                HYDROLOGIC ANALYSIS OF HILL RESERVOIR DAM
                      NATIONAL DAM INSPECTION PROGRAM
                   NEW ENGLAND DIVISION - CORPS OF ENGINEERS

                                JOB SPECIFICATION
          NO    NHR    NMIN   IDAY   IHR   IMIN   METRIC   IPLT   IPRT   NSTAN
         300      0      10      0     0      0        0      0     -4       0
                      JOPER     NWT   LROPT   TRACE
                          5       0      0       0

                   MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1  NRTIO= 2  LRTIO= 1
          RTIOS=    .10   .13   .15   .20   .25   .30   .40   .50   1.00
```

SUB-AREA RUNOFF COMPUTATION

INFLOW TO HILL RESERVOIR

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFHR		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.10	0.00	4.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.20	111.00	123.00	132.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 3.50 CP= .60 NTA= 0

RECESSION DATA

STRTQ= -1.70 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES. LAG= 3.50 HOURS. CP= .60 VOL= .99

5.	18.	38.	61.	87.	116.	145.	178.	210.	244.
277.	314.	346.	376.	401.	422.	440.	455.	465.	471.
473.	469.	458.	440.	419.	400.	381.	363.	346.	330.
314.	300.	286.	272.	260.	247.	236.	225.	214.	204.
195.	186.	177.	169.	161.	153.	146.	139.	133.	126.
121.	115.	110.	104.	99.	95.	90.	86.	82.	78.
75.	71.	68.	65.	62.	59.	56.	53.	51.	48.
46.	44.	42.	40.	38.	36.	35.	33.	31.	30.
29.	27.	26.	25.	24.	23.	21.	20.	19.	19.
18.	17.	16.	15.	15.	14.	13.	13.	12.	12.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
						0							
									SUM	21.33	20.13	1.20	316143.
										(542.)	(511.)	(30.)	(8952.17)

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HILL RESERVOIR

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTHR		1	0	0	0	0	1	0	0

ROUTING DATA

	QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	LSTR	ITYP
	0.0	0.000	0.00	1	1	1	1	0

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-412.	-1

STAGE	411.60	412.00	413.00	414.00	415.00	416.00	417.00	418.00
FLOW	0.00	33.00	215.00	482.00	812.00	2332.00	4040.00	7002.00

D-11

SURFACE AREA= 0. 5. 6.

CAPACITY= 0. 48. 67.

ELEVATION= 580. 612. 615.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
611.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
615.0	0.0	0.0	0.

PEAK OUTFLOW IS 666. AT TIME 19.17 HOURS

PEAK OUTFLOW IS 870. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 1004. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 1338. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 1673. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 2007. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 2676. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 3347. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 6694. AT TIME 19.00 HOURS

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1

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .13	RATIO 3 .15	RATIO 4 .20	RATIO 5 .25	RATIO 6 .30	RATIO 7 .40	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	INFHR	4.10	1	670.	870.	1004.	1339.	1674.	2009.	2678.	3348.	6695.
		(10.62)		(18.96)(	24.65)(	28.44)(	37.92)(	47.40)(	56.88)(	75.81)(	94.80)(	189.59)
ROUTED TO	OUTHR	4.10	1	666.	870.	1004.	1338.	1673.	2007.	2678.	3347.	6694.
		(10.62)		(18.87)(	24.64)(	28.43)(	37.90)(	47.36)(	56.84)(	75.82)(	94.78)(	189.57)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	611.60	611.60	615.00
STORAGE	48.	48.	67.
OUTFLOW	0.	0.	812.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	614.56	0.00	64.	666.	0.00	19.17	0.00
.13	615.04	.04	67.	870.	1.50	19.00	0.00
.15	615.13	.13	67.	1004.	2.83	19.00	0.00
.20	615.35	.35	69.	1338.	4.83	19.00	0.00
.25	615.57	.57	70.	1673.	6.17	19.00	0.00
.30	615.79	.79	72.	2007.	7.33	19.00	0.00
.40	616.14	1.14	74.	2678.	9.00	19.00	0.00
.50	616.40	1.40	76.	3347.	10.33	19.00	0.00
1.00	617.59	2.59	84.	6694.	14.17	19.00	0.00

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1*********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
   DAM SAFETY VERSION      JULY 1978
     LAST MODIFICATION  01 APR 80
 *********************************
     1                A1          HYDROLOGIC ANALYSIS OF HILL RESERVOIR DAM BREACH
     2                A2                  NATIONAL DAM INSPECTION PROGRAM
     3                A3          NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4                B    300       0      10       0       0       0       0       0      -4       0
     5                B1     5
     6                J      2       1       1
     7                J1   .13
     8                K      0   INFHR                                                   1
     9                K1                        INFLOW TO HILL RESERVOIR
     1                M      1       1     4.1               0                                       1
     1                P      0    20.2     111     123     132
     1                T                                                                 0    0.05
     1                W    3.5     0.6
                      X   -1.7    -0.1       2
                      K      1   OUTHR                                                   1
                      K1                ROUTED OUTFLOW FROM HILL RESERVOIR
    17                Y                                 1       1
    18                Y1     1                                                   -611.6      -1
    19                Y4 611.6     612     613     614     615     616     617     618
                      Y5     0      33     215     482     812    2332    4840    8002
    21                $A     0     4.6     6.1
                      $E   580   611.6     615
    23                $$ 611.6
    24                $D   615
    25                $B   100    0.01     583     1.5   611.6     615
    26                $B   100    0.01     583     1.5   611.6     620
    27                K      1   DS-1                                                    1
    28                K1                CHANNEL ROUTING TO VALLEY ROAD CULVERTS
    29                Y                                 1       1
    30                Y1     1                                                      -1
    31                Y6  0.08    0.04    0.08     340     360    8000    0.03
    32                Y7     0     360      40     350     130     341     140     340     150   341.5
    33                Y7   210     350     225     355     240     360
    34                K      1   VALLRD                                                  1
    35                K1                ROUTED OUTFLOW THROUGH VALLEY ROAD CULVERTS
    36                Y                                 1       1
    37                Y1     1                                                      -1      -1
    38                Y4   340   341.4   342.8   344.2   345.4   346.5   347.5   350.3   352.4   356.6
    39                Y5     0     132     326     624     954    1174    1354    2052    2602    3188
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    40              $A     0      0.1      0.6
    41              $E   340      348      360
    42              $$ 340.1
    43              $D   360
    44              K      1    DS-2                                          1
    45              K1           CHANNEL ROUTING TO HAZARD AREA
    46              Y                                    1        1
    47              Y1     1                                                -1
    48              Y6  0.06     0.04     0.06      300      320     1800  0.025
    49              Y7     0      320       15      310       45      305     65      303      75      300
    50              Y7    85      303      115      310      165      320
 1  51              K      1    BETCO                                         1
    52              K1           ROUTED OUTFLOW OVER B.E.T. CORP. DAM
    53              Y                                    1        1
    54              Y1     1                                                -1       -1
    55              Y4   290      291      292      293      294      295     296      297
    56              Y5     0      195      585     1154     1872     2784    3834     5112
    57              $A   1.3      2.8
    58              $E   290      295
    59              $$   290
    60              $D   290
    61              K     99
 1                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                 RUNOFF HYDROGRAPH AT        INFHR
                                 ROUTE HYDROGRAPH TO         OUTHR
                                 ROUTE HYDROGRAPH TO         DS-1
                                 ROUTE HYDROGRAPH TO         VALLEY
                                 ROUTE HYDROGRAPH TO         DS-2
                                 ROUTE HYDROGRAPH TO         BETCO
                                 END OF NETWORK

                        HYDROLOGIC ANALYSIS OF HILL RESERVOIR DAM BREACH
                                 NATIONAL DAM INSPECTION PROGRAM
                              NEW ENGLAND DIVISION - CORPS OF ENGINEERS

                                        JOB SPECIFICATION
                        JO      NHR      NMIN      IDAY      IHR      IMIN     METRC     IPLT     IPRT    NSTAN
                       300        0        10         0        0         0         0        0       -4        0
                                        JDER      NWT     IPROPT     IRACE
                                           1        0          0         0

                                 MULTI PLAN ANALYSES TO BE PERFORMED
                                      NPLAN= 2 NRTIO= 1 LRTIO= 1
                              RTIOS=     .13
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SUB-AREA RUNOFF COMPUTATION

INFLOW TO HILL RESERVOIR

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFHR		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.10	0.00	4.10	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	20.20	111.00	123.00	132.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .900

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	SIRIL	CNSIL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 3.50 CP= .60 NTA= 0

RECESSION DATA

STRTQ= -1.70 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 3.50 HOURS, CP= .60 VOL= .99

5.	18.	38.	61.	87.	116.	146.	178.	210.	244.
279.	314.	346.	376.	401.	422.	440.	455.	465.	471.
473.	469.	458.	440.	417.	400.	381.	363.	346.	330.
314.	300.	286.	272.	260.	247.	236.	225.	214.	204.
195.	186.	177.	169.	161.	153.	146.	139.	133.	126.
121.	115.	110.	104.	99.	95.	90.	86.	82.	78.
75.	71.	68.	65.	62.	59.	56.	53.	51.	48.
46.	44.	42.	40.	38.	36.	35.	33.	31.	30.
29.	27.	26.	25.	24.	23.	21.	20.	19.	19.
18.	17.	16.	15.	15.	14.	13.	13.	12.	12.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 21.33 20.13 1.20 316143.
(542.)(511.)(30.)(8952.17)

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HILL RESERVOIR

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTHR	1	0	0	0	0	1	0	0	

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	ISTR
0.0	0.000	0.00	1	1	0	0	0

ISTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ITEMAT
1	0	0	0.000	0.000	0.000	612.	1

D-16

STAGE	611.60	612.00	613.00	614.00	615.00	616.00	617.00	618.00
FLOW	0.00	33.00	215.00	482.00	812.00	2332.00	4940.00	8002.00
SURFACE AREA=	0.	5.	6.					
CAPACITY=	0.	48.	67.					
ELEVATION=	580.	612.	615.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
611.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
615.0	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	.01	583.00	1.50	611.60	615.00

BEGIN DAM FAILURE AT 19.50 HOURS

PEAK OUTFLOW IS 2225. AT TIME 19.11 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
100.	.01	583.00	1.50	611.60	620.00

PEAK OUTFLOW IS 870. AT TIME 19.00 HOURS

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HYDROGRAPH ROUTING

CHANNEL ROUTING TO VALLEY ROAD CULVERTS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS-1	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IEPR	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELVUL	ELMAX	FLOTH	SEL
.0800	.0400	.0800	540.0	560.0	3000.	.03000

D-17

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 350.00 40.00 350.00 130.00 341.00 140.00 340.00 150.00 341.50
210.00 350.00 225.00 355.00 240.00 360.00

STORAGE	0.00	1.70	6.80	15.36	27.40	42.90	61.89	84.33	110.26	139.45
	172.26	206.55	242.26	279.40	317.96	357.95	399.36	442.19	486.45	532.14
OUTFLOW	0.00	39.34	246.07	673.49	1379.16	2415.66	3831.86	5673.73	7984.92	10807.12
	14534.47	19173.73	24358.93	30083.04	36341.32	43130.89	50450.30	58299.23	66678.26	75588.68
STAGE	340.00	341.05	342.11	343.16	344.21	345.26	346.32	347.37	348.42	349.47
	350.53	351.58	352.63	353.68	354.74	355.79	356.84	357.89	358.95	360.00
FLOW	0.00	39.34	246.07	673.49	1379.16	2415.66	3831.86	5673.73	7984.92	10807.12
	14534.47	19173.73	24358.93	30083.04	36341.32	43130.89	50450.30	58299.23	66678.26	75588.68

MAXIMUM STAGE IS 344.7

MAXIMUM STAGE IS 343.4

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HYDROGRAPH ROUTING

ROUTED OUTFLOW THROUGH VALLEY ROAD CULVERTS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
VALLRD	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IETHP	ISTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	-1

STAGE	340.00	341.40	342.80	344.20	345.40	346.50	347.50	350.30	352.40	356.60
FLOW	0.00	132.00	376.00	674.00	954.00	1174.00	1354.00	2552.00	2602.00	3188.00
SURFACE AREA=	0.	0.	1.							
CAPACITY=	0.	0.	4.							
ELEVATION=	340.	340.	360.							

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
340.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
360.0	0.0	0.0	0.

PEAK OUTFLOW IS 1875. AT TIME 12.33 HOURS

PEAK OUTFLOW IS 866. AT TIME 12.33 HOURS

HYDROGRAPH ROUTING

CHANNEL ROUTING TO HAZARD AREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS-2	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IEMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0400	.0600	300.0	320.0	1800.	.02400

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 320.00 15.00 310.00 45.00 305.00 65.00 303.00 75.00 300.00
85.00 303.00 115.00 310.00 165.00 320.00

STORAGE	0.00	.15	.61	1.38	2.67	4.62	7.08	10.02	13.43	17.31
	21.63	26.28	31.23	36.47	42.01	47.85	53.98	60.41	67.15	74.17
OUTFLOW	0.00	13.78	87.49	254.77	557.26	1123.09	2071.92	3308.02	4848.39	6710.16
	8928.66	11507.90	14428.51	17693.10	21305.95	25272.35	29598.27	34290.15	39354.26	44799.07
STAGE	300.00	301.05	302.11	303.16	304.21	305.26	306.32	307.37	308.42	309.47
	310.53	311.58	312.63	313.68	314.74	315.79	316.84	317.89	318.95	320.00
FLOW	0.00	13.78	87.49	254.77	557.26	1123.09	2071.92	3308.02	4848.39	6710.16
	8928.66	11507.90	14428.51	17693.10	21305.95	25272.35	29598.27	34290.15	39354.26	44799.07

MAXIMUM STAGE IS 306.1

MAXIMUM STAGE IS 304.8

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HYDROGRAPH ROUTING

ROUTED OUTFLOW OVER D.E.I. CORP. DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ROUT	1	2	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IEMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	-1

D-19

STAGE	290.00	291.00	292.00	293.00	294.00	295.00	296.00	297.00
FLOW	0.00	195.00	585.00	1151.00	1872.00	2784.00	3834.00	5112.00

SURFACE AREA= 1. 3.

CAPACITY= 0. 10.

ELEVATION= 290. 295.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
290.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
290.0	0.0	0.0	0.

AK OUTFLOW IS 1906. AT TIME 19.33 HOURS

AK OUTFLOW IS 866. AT TIME 19.33 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1
				.13
HYDROGRAPH AT	INFHR	4.10	1	370.
		(10.62)		(24.65)(
			2	370.
				(24.65)(
ROUTED TO	OUTHR	4.10	1	2154.
		(10.62)		(61.00)(
			2	370.
				(24.64)(
ROUTED TO	RS-1	4.10	1	1922.
		(10.62)		(53.57)(
			2	365.
				(24.59)(
ROUTED TO	OUTLET	4.10	1	1922.
		(10.62)		(53.57)(
			2	364.
				(24.57)(
ROUTED TO	RS 2	4.10	1	1914.
		(10.62)		(54.20)(
			2	366.
				(24.61)(
ROUTED TO	RETRO	4.10	1	1906.
		(10.62)		(53.95)(
			2	366.
				(24.61)(

SUMMARY OF DAM SAFETY ANALYSIS

1

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	611.60	611.60	615.00
STORAGE	48.	48.	67.
OUTFLOW	0.	0.	812.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	615.02	.02	67.	2225.	.28	19.11	18.50

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	611.60	611.60	615.00
STORAGE	48.	48.	67.
OUTFLOW	0.	0.	812.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	615.04	.04	67.	820.	1.50	19.00	0.00

PLAN 1 STATION DS-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	1892.	344.7	19.33

PLAN 2 STATION DS-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	865.	343.4	19.17

SUMMARY OF DAM SAFETY ANALYSIS

1

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	340.00	340.10	350.00
STORAGE	0.	0.	4.
OUTFLOW	0.	2.	3662.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	347.12	0.00	0.	1075.	0.00	19.33	0.00

PLAN 2

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	340.00	340.10	360.00
STORAGE	0.	0.	4.
OUTFLOW	0.	9.	3662.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	345.02	0.00	0.	866.	0.00	19.33	0.00

PLAN 1 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	1914.	306.1	19.33

PLAN 2 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	866.	304.8	19.33

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	290.00	290.00	290.00
STORAGE	0.	0.	0.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	294.04	4.04	3.	1906.	50.00	19.33	0.00

PLAN 2

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	290.00	290.00	290.00
STORAGE	0.	0.	0.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	293.42	3.42	1.	866.	50.00	19.33	0.00

SUMMARY OF DAM SAFETY ANALYSIS - 15-Min. Breach
(Hill Reservoir Dam)

PLAN 1 ..15min. Breach..

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	611.60	611.60	615.00
STORAGE	48.	48.	67.
OUTFLOW	0.	0.	812.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	615.02	.02	67.	7838.	.19	18.66	18.50

PLAN 2 ..4th. Breach..

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	611.60	611.60	615.00
STORAGE	48.	48.	67.
OUTFLOW	0.	0.	812.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	615.04	.04	67.	870.	1.50	19.00	0.00

PLAN 1 STATION DS-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	3876.	346.3	18.83

PLAN 2 STATION DS-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	865.	343.4	19.17

SUMMARY OF DAM SAFETY ANALYSIS
(Top Valley Dam)

PLAN 1 ..Top Valley..

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	340.00	340.10	360.00
STORAGE	0.	0.	4.
OUTFLOW	0.	9.	4055.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	358.86	0.00	3.	3763.	0.00	18.83	0.00

PLAN 2 ..Top Valley..

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	340.00	340.10	360.00
STORAGE	0.	0.	4.
OUTFLOW	0.	9.	4055.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	345.02	0.00	0.	866.	0.00	19.33	0.00

PLAN 1 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	3801.	307.7	18.83

PLAN 2 STATION DS-2

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.13	866.	304.8	19.33

SUMMARY OF DAM SAFETY ANALYSIS

(@ BET Corporation Dam)

PLAN 1 w/breach

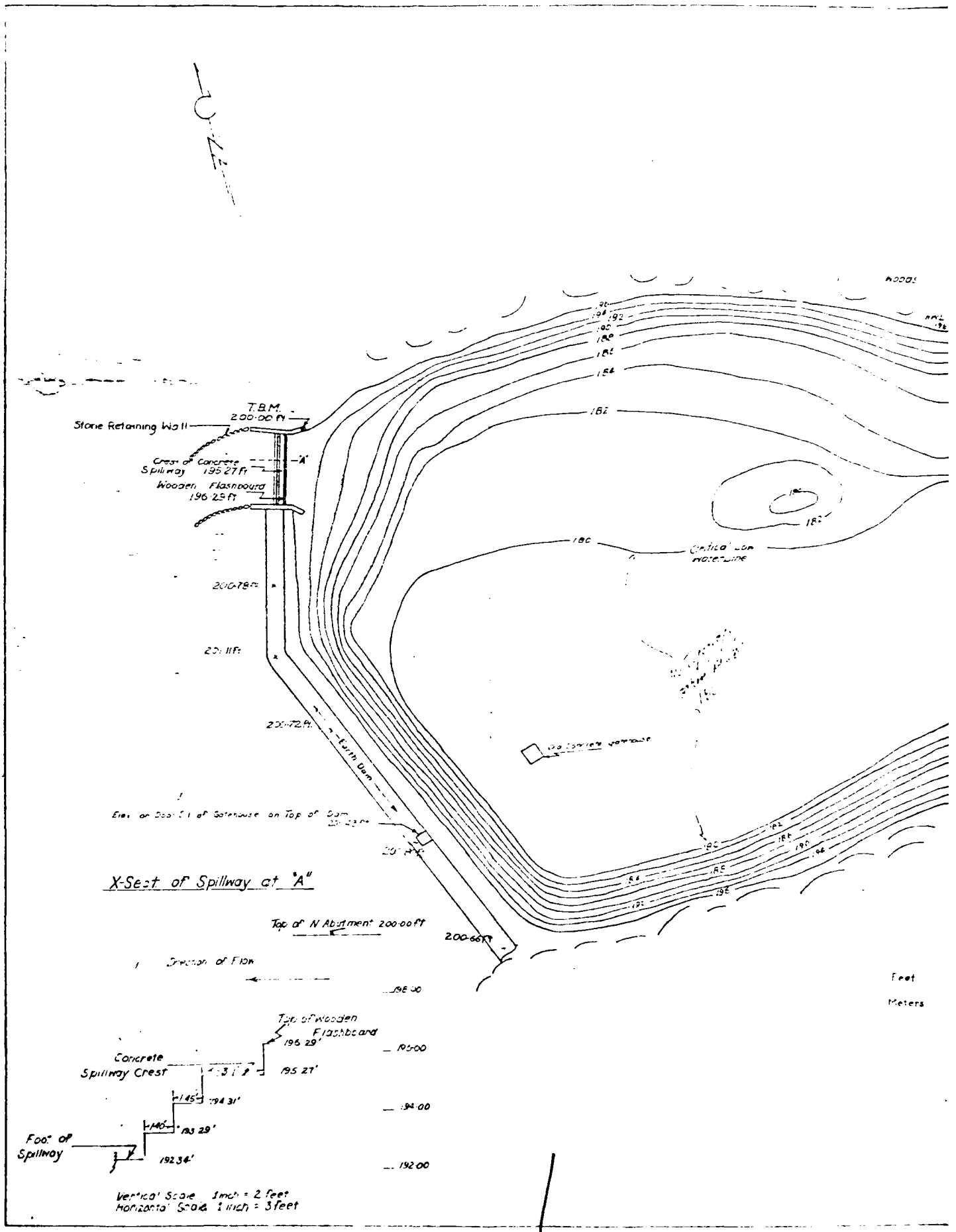
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	290.00	290.00	290.00
STORAGE	0.	0.	0.
OUTFLOW	0.	0.	0.

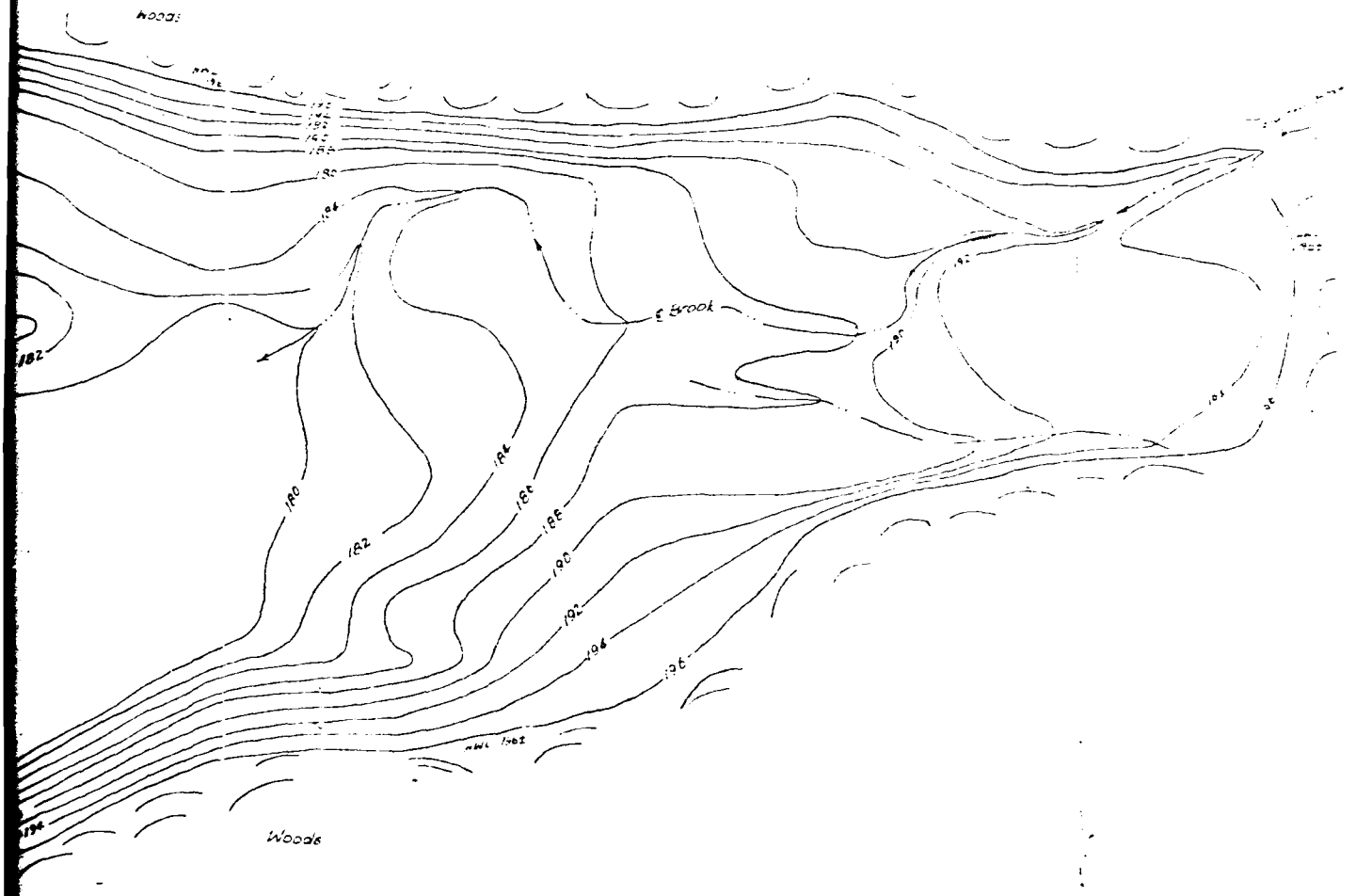
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	295.71	5.71	12.	3528.	50.00	18.83	0.00

PLAN 2 w/o breach

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	290.00	290.00	290.00
STORAGE	0.	0.	0.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.13	292.49	2.49	4.	866.	50.00	19.33	0.00


T.B.M.
200·00 Ft
Stone Retaining Wall
Crest of Concrete Spillway 195·27 Ft
Wooden Flashboard 196·29 Ft
'A'
200·78 Ft
201·11 Ft
202·72 Ft
Earth Dam
Elev. of Sill of Gatehouse on Top of Dam
X-Sect of Spillway at 'A"
Top of N Abutment 200·00 Ft
200·66 Ft
Direction of Flow
196·00
195·00
194·00
192·00
Top of Wooden Flashboard
196·29'
Concrete Spillway Crest
195·27'
194·31'
193·29'
Foot of Spillway
192·34'
Vertical Scale 1 inch = 2 feet
Horizontal Scale 1 inch = 3 feet
Critical Low Water Line
Feet
Meters



Feet 0 40 80 120 160 200

Meters 0 12 24 36 48 60

NOTES
Elevations are assumed datum for elevations Taken below 180ft.
6.4 ± Surface Acres at HWL.

HILLS RESERVOIR
TOPOGRAPHIC PLAN
Situate in Town of Pelham, Mass.
Middle of Town of Amherst, Mass.
Scale 1in = 40ft
Date Oct 9 1985 Drawn by JCZ