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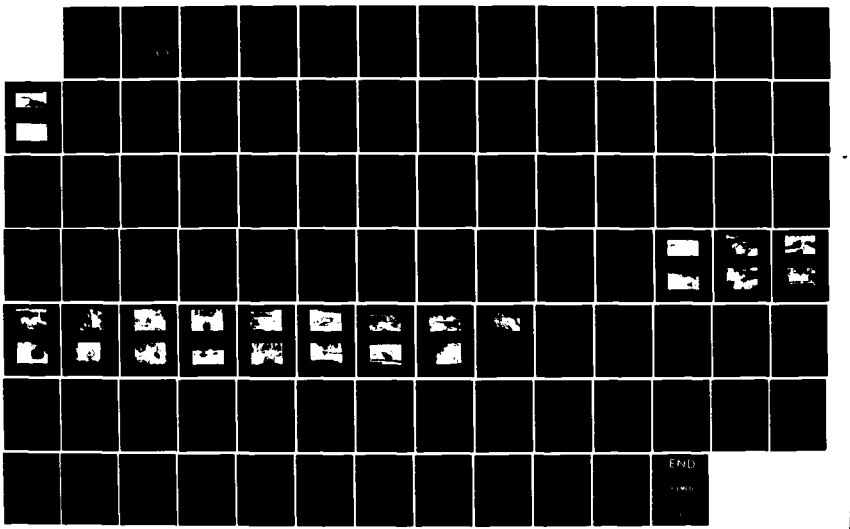

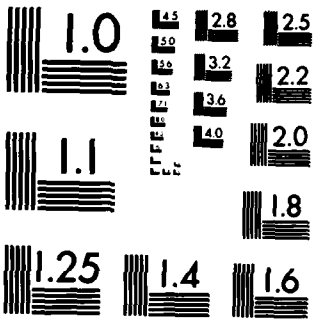

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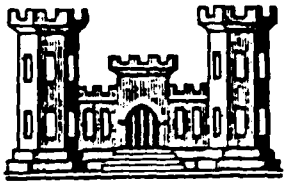
TAUNTON RIVER BASIN
AVON, MASSACHUSETTS

BROCKTON RESERVOIR DAM
MA 00786

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

JANUARY 1980

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

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

DAMS, INSPECTION, DAM SAFETY,

Taunton River Basin
Avon, Massachusetts
Beaver Brook

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

The dam is an earth embankment about 1800 ft. long with a top width of 16 ft. and a maximum height of about 10 ft. The dam appears to be in fair condition. Small trees growing from the upstream slope may displace riprap in addition to the riprap already displaced, thus exposing additional embankment to hydraulic erosion. It is small in size with a hazard potential of significant.

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

REPLY TO
ATTENTION OF:
NEDED

MAY 30 1980

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

Dear Governor King:

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

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts. In addition, a copy of the report has also been furnished the owner, the city of Brockton.

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

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

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

BROCKTON RESERVOIR DAM

MA 00786

TAUNTON RIVER BASIN

NORFOLK, MASSACHUSETTS

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.:	MA 00786
Name of Dam:	Brockton Reservoir Dam
Town:	Avon
County and State:	Norfolk, Massachusetts
Stream:	Beaver Brook
Date of Inspection:	October 17, 1979

BRIEF ASSESSMENT

Brockton Reservoir Dam is a 94 year old earth embankment approximately 1,800 feet long with a top width of 16 feet and a maximum height of about 10 feet. Both the upstream and downstream side slopes are 2H:1V. The concrete spillway with a 25-foot long broad crested weir, which has been fitted with steel flashboards, is located at the left abutment. The dam was originally constructed to provide the primary water supply for the City of Brockton. The reservoir is currently being used for emergency water supply.

The reservoir behind the dam is about 3,000 feet long and it has a surface area at the spillway crest with flashboards in place of about 85 acres. The drainage area above the dam is 2.8 sq. miles and the maximum storage at the top of the dam is about 495 acre-feet. Because the maximum storage is less than 1,000 acre-feet and the maximum height of the dam is less than 40 feet, the size classification is "Small." A breach of the dam would affect at least 35 residences about 1.8 miles downstream from the dam. The dam has been classified as having a "Significant" hazard potential. Based on the "Small" size "Significant" hazard potential the selected test flood is one-half of the Probable Maximum Flood (PMF).

The dam appears to be in fair condition. Small trees growing from the upstream slope may displace riprap in addition to the riprap already displaced, thus exposing additional embankment to hydraulic erosion. The marshy area near the right abutment immediately downstream of the dam may be an indication of seepage through the dam, foundation or abutment. The dam does not have a low level outlet which could be used to drawdown the reservoir during emergencies.

The test flood inflow for the facility is 2,330 cfs. The routed test flood outflow of 2,300 cfs overtops the dam by 0.4 feet. The spillway capacity without overtopping the dam with the flashboards in place is 495 cfs and without the flashboards in place the capacity is 978 cfs or about 22 percent and 43 percent, respectively, of the routed test flood outflow.

Within one year after receipt of this Phase I Inspection Report, the Owner, the City of Brockton, should retain the services of a qualified registered professional engineer and implement the results of his evaluation of the following: (1) further assessment of the potential for overtopping and the adequacy of the spillway; (2) study of the marshy area near the right abutment immediately downstream of the dam for possible seepage through the dam, foundation or abutment; (3) determination of the need for a low level outlet to reduce the reservoir elevation during emergencies; (4) investigation of the seismic stability of the dam; and (5) design and direct the installation of an upstream control mechanism for the 20-inch diameter water supply line.

The owner should also implement the following operation and maintenance measures: (1) cut the vegetation, especially the trees, on the embankment on more frequent intervals; (2) remove the flashboards from the spillway to increase the spillway discharge capacity and to increase the reservoir surcharge storage during periods of heavy precipitation and/or runoff; (3) replace riprap on the upstream face of the dam where necessary; (4) drain the marshy area near the right abutment to assist in determining the possible presence of seepage; (5) all rodent burrows should be backfilled to minimize seepage potential; (6) develop a formal surveillance and flood warning plan, including round-the-clock monitoring during heavy precipitation; (7) institute a program of annual technical inspection; and (8) determine the function of the three gate valves in the gatehouse and repair these valves if they are required for emergency drawdown of the reservoir.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams, P.E.
Vice President
New York Registration No. 050794

Date 27 FEB. 1980

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

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, CHAIRMAN
Design Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of theses 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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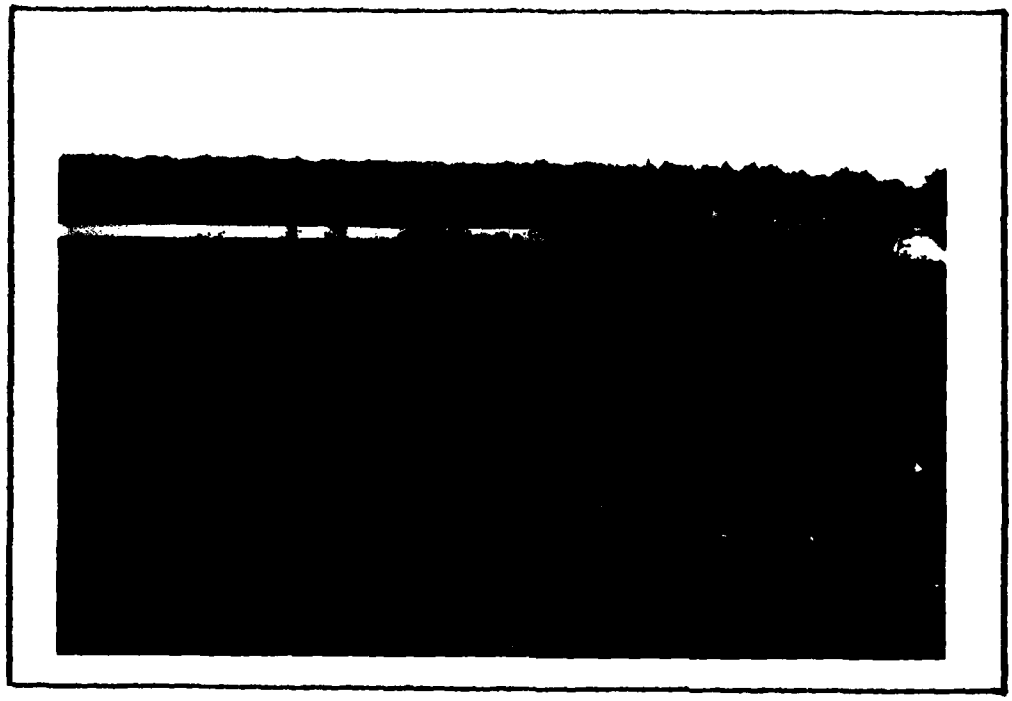
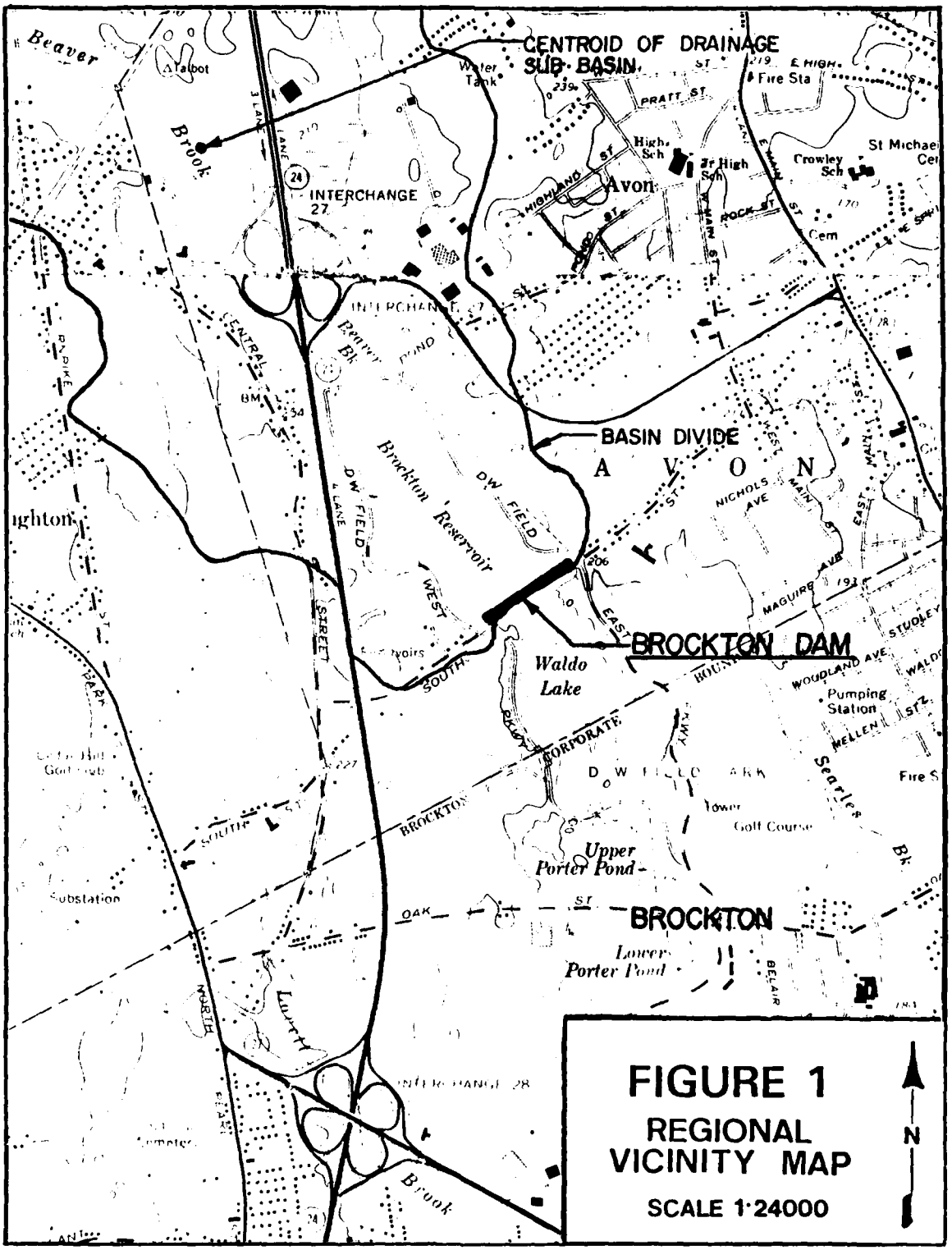
APPENDICES

UPSTREAM OVERVIEW OF BROCKTON RESERVOIR DAM. (10/17/79)



DOWNSTREAM OVERVIEW OF BROCKTON RESERVOIR DAM. (10/17/79)


CENTROID OF DRAINAGE SUB-BASIN
BASIN DIVIDE
BROCKTON DAM
Brockton Reservoir
Waldo Lake
Upper Porter Pond
Lower Porter Pond
Beaver Brook
Talbot
INTERCHANGE 27
INTERCHANGE 28
Avon
BROCKTON
Water Tank
Fire Sta
High Sch
Jr High Sch
Crowley Sch
Cem
Pumping Station
Golf Course
Substation
PRATT ST
HIGHLAND ST
ROCK ST
MAIN ST
NICHOLS AVE
WOODLAND AVE
MAGUIRE AVE
STUDLEY
MELLEN ST
OAK ST
BELAIR
CENTRAL
DW FIELD
WEST
EAST
SOUTH
NORTH
PARK
CORPORATE
BROCKTON
Brook
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1:24000
N

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
BROCKTON RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspections throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. O'Brien & Gere Engineers, Inc., has been retained by the New England Division to inspect and report on selected dams in the Commonwealth of Massachusetts. Authorization and notice to proceed were issued to O'Brien & Gere Engineers, Inc., by a letter from the Corps of Engineers dated, November 6, 1979 and signed by Col. William E. Hodgson, Jr. Contract No. DACW 33-80-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection. The purpose of performing technical inspection and evaluation of non-federal dams is to:

1) Identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

2) Encourage and prepare the states to quickly initiate effective dam safety programs for non-federal dams.

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

1.2 Description of Project (Information for this dam was obtained from the City of Brockton and the Massachusetts Department of Environmental Quality and Engineering.)

a. Location. Brockton Reservoir Dam is located on Beaver Brook within the Township of Avon, MA. The dam is shown on the USGS Quadrangle entitled "Brockton, Mass." at coordinates N 42° 06.8', W 71° 03.1'. A regional location plan of Brockton Reservoir Dam is enclosed as Figure 1, pg.v.

Approximately 1.5 miles downstream of the site in D. W. Field Park, Beaver Brook is joined by Lovett Brook to form Salisbury Brook. Salisbury Brook flows through the City of Brockton for about 1.5 miles before joining Trout Brook to form the Salisbury Plain River. The first major damage center is approximately 35 homes about 1.8 miles downstream of the site. Beyond this location the stream flows through the heavily urbanized City of Brockton.

b. Description of Dam and Appurtenances. Brockton Reservoir Dam is an earth embankment approximately 1,800 feet long with a maximum height of about 10 feet. The top width is about 16 feet and the downstream slope is 2H:1V. The

riprapped upstream slope is about 2H:1V and it is capped by a stone masonry retaining wall which extends 2 feet vertically above the riprap (pgs. B-1 and B-2).

The broad-crested, concrete spillway is located at the east abutment and is about 25 feet long with 2.5-foot high steel flashboards, supported by steel rods. The 9-foot long approach channel consists of a concrete apron and vertical stone masonry training walls. The mansory training walls extend from the approach channel entrance to the upstream face of the South Street bridge. The concrete apron located downstream of the flashboards extends for a distance of 11 feet at a slope of 11H:1V. The outlet channel downstream of the concrete apron continues at the same slope for 30 feet and is paved with hand placed stone. The spillway releases discharge under the South Street bridge located about 41 feet downstream from the spillway axis. The bridge is a double-arch stone masonry structure with two clear openings about 11 feet wide and 6 feet high. The unlined outlet channel downstream of the bridge is trapezoidal in section and has a 90 degree bend about 70 feet downstream of the bridge where discharge is directed into Waldo Lake (pgs. B-1 & B-2).

A concrete and brick masonry gatehouse is located on the upstream slope about 300 feet west of the spillway. The gatehouse is about 14 feet by 14 feet in plan and contains three gate valves of unknown dimensions. The upper level intake portal is provided with stop log slots and a wire mesh trash screen. A 20-inch diameter water supply conduit extends to the southeast and is connected to the Woodland Avenue Pumping Station. A 20-inch diameter gate valve is situated in a concrete vault about 30 feet downstream of South Street and is used as the sole controlled outlet from Brockton Reservoir. Where the 20-inch line originates from in the reservoir is not known.

c. Size Classification. Brockton Reservoir Dam's maximum storage capacity and maximum height are 1,035 acre-feet and 10 feet, respectively. The criteria for the "Intermediate" size category includes dams which have less than 50,000 acre-feet storage capacity and more than 1,000 acre-feet of storage capacity. Brockton Reservoir Dam is therefore classified as an "Intermediate" size dam.

d. Hazard Classification. Brockton Reservoir Dam is located upstream of six smaller impoundments within a municipal recreational area known as D.W. Field Park. Residential neighborhoods are located downstream of the Thirty Acre Pond, which is about 1.8 miles downstream of Brockton Reservoir Dam. In addition, the discharge from Thirty Acre Pond passes through two small ponds, a narrow man-made channel approximately one mile long and into a 1,800-foot long underground culvert. The region of potential flooding which borders the man-made channel and which is upstream of the culvert is a densely populated urban neighborhood. The dam is classified as "Significant" hazard because flood waters resulting from failure of Brockton Reservoir Dam could cause appreciable property damage and there would be little chance of loss of life. This assessment is based on a breach analysis which computed a stream depth of 2.1 feet at the initial downstream damage center.

e. Ownership. The dam is owned by the City of Brockton, Department of Public Works with offices located in City Hall, Brockton, Massachusetts, 02401, Telephone: (617) 580-1100.

f. Operator. The dam is operated by the City of Brockton, Water Department. Mr. Martin Feroli, Superintendent, is in charge of dam operations. Telephone: (617) 580-1100, Ext. 144.

g. Purpose of Dam. The dam was originally constructed to provide the primary water supply for the City of Brockton. The impoundment is currently being used for emergency water supply.

h. Design and Construction History. The dam was constructed between 1883 and 1886. Further information is unavailable.

i. Normal Operational Procedure. The reservoir stage is normally self-regulating and is maintained by steel flashboards installed prior to 1965.

1.3 Pertinent Data

a. Drainage Area. The drainage area above the dam is 2.8 square miles. The watershed is primarily forested, but it does contain some residential developments, a few low-lying marshes, and a highway interchange. The terrain is low rolling hills.

b. Discharge at Damsite.

1) Outlet Works. The low level outlets were not visible and operating personnel have no information regarding the design and construction. The discharge capacity of the 20-inch diameter conduit is unknown.

2) Maximum Known Flood at Damsite. According to Mr. Martin Feroli, Superintendent, City of Brockton, Water Department, no records of extreme reservoir pool elevations are available.

3) Ungated Spillway Capacity at Top of Dam. The capacity of the spillway with flashboards in-place and reservoir at top of dam is 495 cfs. The spillway capacity without flashboards and reservoir at top of dam is 978 cfs.

4) Ungated Spillway Capacity at Test Flood Elevation. The spillway capacity with flashboards in-place and the reservoir at test flood Elev. 204.7 is 587 cfs. The spillway capacity without flashboards and reservoir at the same Elev. 204.7 is 1,080 cfs.

5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

6) Gated Spillway Capacity at Test Flood Elevation. Not applicable.

7) Total Spillway Capacity at Test Flood Elevation. Same as 4) above.

8) Total Project Discharge at Top of Dam. Same as 3) above.

9) Total Project Discharge at Test Flood. The combined discharge capacity of the spillway and the flow over the dam at test flood Elev. 204.7 is 2,300 cfs.

c. Elevation. (Feet above NGVD)

Streambed at Toe of Dam	194.3
Bottom of Cutoff	Unknown
Maximum Tailwater	198+
Normal Pool	201.0
Full Flood Control Pool	NA
Spillway Crest (Flashboards)	201.0
(w/o flashboards)	198.5
Design Surcharge (Original Design)	NA
Top of Dam	204.3
Test Flood Design Surcharge	204.7

d. Reservoir Length. (Feet)

Normal Pool	3,200
Flood Control	NA
Spillway Crest Pool (Flashboards)	3,200
Spillway Crest Pool (w/o flashboards)	3,000
Top of Dam	3,600
Test Flood Pool	3,700

e. Storage. (acre-feet)

Normal Pool	190
Flood Control Pool	NA
Spillway Crest Pool (Flashboards)	190
Spillway Crest Pool (w/o flashboards)	85
Top of Dam	490
Test Flood Pool	530

f. Reservoir Surface. (Acres)

Normal Pool	85
Flood Control Pool	NA
Spillway Crest Pool (Flashboards)	85
Spillway Crest Pool (w/o flashboards)	35
Top of Dam	100
Test Flood Pool	105

g. Dam.

Type	Earth Embankment
Length	1,800 feet
Height	10 feet
Top Width	16 feet
Side Slopes	2H:1V
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway.

Type	Broad-crested, concrete weir
Length	25 feet
Crest Elevation (flashboards)	201.0
(w/o flashboards)	198.5
Gates	None
Upstream Channel	Concrete apron & masonry training walls.
Downstream Channel	Concrete apron, masonry training walls, double-arch bridge.

j. Regulating Outlets. A 20-inch gate valve situated in a vault downstream of the gatehouse is used to control discharge from the reservoir to the city water supply system. The valve is manually operated with a valve key.

SECTION 2

ENGINEERING DATA

2.1 Design

The following information was made available for review of Brockton Reservoir Dam:

1. Report entitled "Master Plan Study for D.W. Field Park", April, 1968, prepared by Camp Dresser & McKee (CDM) Boston, MA.

2. Dam inspection report prepared by the Commonwealth of Massachusetts, Department of Environmental Quality and Engineering, dated February 14, 1974.

No design calculations, construction drawings or record drawings are available for this site. The principal design features for the structure are shown on the sketches enclosed in Appendix B.

2.2 Construction

No information is available concerning the construction of Brockton Reservoir Dam which was built between 1883 and 1886.

2.3 Operation

No operational data is available for this site.

2.4 Evaluation

a. Availability. All information made available was obtained from the City of Brockton and the Commonwealth of Massachusetts, Department of Environmental Quality and Engineering (DEQE).

b. Adequacy. The drawings and reports, together with the data obtained during the visual inspection, are considered adequate for a Phase I investigation.

c. Validity. The data obtained from the dam inspection report by DEQE does not agree with the field measurements obtained during the visual inspection. The data in "Master Plan Study for D.W. Field Park" prepared by CDM agrees with field measurements.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Brockton Reservoir Dam was performed on October 17, 1979. At the time of inspection, the reservoir water surface was approximately one inch above the steel flashboards. No underwater areas were inspected. The dam is considered to be in fair condition.

Observations and comments made during the field inspection appear on a checklist included as Appendix A of this report.

b. Dam. There are small trees (trunk diameter less than 3 inches) and brush growing between the riprap stones on the upstream slope. The masonry stone wall at the crest of the upstream slope showed no evidence of vertical or horizontal misalignment throughout the length of the dam. Some riprap displacement was observed immediately east of the gatehouse. The embankment crest and downstream slope are covered with tall grass and brush. A small rodent hole was observed in the middle of the downstream slope near the center of the dam. The downstream slope showed evidence of pedestrian traffic and/or small erosion channels in many locations. A marshy area with standing water was observed at the downstream embankment toe adjacent to the west abutment. This area is confined by the embankment and the South Street road embankment which is located about 50 feet downstream of the dam. The marsh extends about 100 feet east of the west abutment. There was no evidence of discoloration, fines accumulation or seepage at the time of inspection. It was observed that the local topography of the toe area slopes into this low-lying zone. A 4-foot high stone masonry wall is located between the downstream embankment toe and South Street.

c. Appurtenant Structures. The broad-crested, concrete overflow spillway at the east abutment has been provided with 2.5-foot high steel flashboards. The flashboards which appeared to be in good condition are supported by 1.0-inch diameter steel rods anchored into the downstream spillway apron on 6-foot centers. The upstream concrete approach apron could not be seen, therefore, its extent and condition could not be observed. The downstream concrete spillway apron appeared to be in good condition with evidence of minor spalling and pitting of its surface. The stone masonry training walls showed no indication of vertical or horizontal misalignment. Some displacements of individual stones were observed in the stone paved outlet channel. The double-arch stone masonry bridge appeared to be in good condition.

The brick and stone masonry gatehouse appeared to be in fair condition. The three rising stem gate valves within the gatehouse are corroded and inoperable according to Mr. Martin Feroli, Superintendent, Water Department, City of Brockton. The valve operators were unavailable at the time of inspection.

The 20-inch gate valve (invert unknown) located in a stone masonry vault about 30 feet downstream of South Street appeared to be in fair condition. Although the valve key was not available at the time of inspection, Mr. Feroli stated that the valve is operable.

No low-level outlet exists at this site.

d. Reservoir Area. The reservoir shoreline has moderate to almost flat slopes. The area is primarily forested with a few parking lots and picnic areas associated with D.W. Field Park. Evidence of slope instability or reservoir siltation could not be detected.

e. Downstream Channel. The upstream reach of the Waldo Lake impoundment is located about 35 feet downstream of Brockton Reservoir Dam. Six dams are located within about 2 miles downstream of Brockton Reservoir Dam. The impoundments are connected by short open channels or roadway culverts. The potential hazard area consists of residential and light commercial development downstream of and in the vicinity of Thirty Acre Pond which is located about 1.6 miles downstream of Brockton Reservoir Dam. In addition, the discharge through this system of dams is carried by a narrow, man-made channel about one mile long into a 600-yard long underground culvert. The culvert and channel are located within a densely populated section of the City of Brockton.

3.2 Evaluation

The dam appeared to be in fair condition at the time of inspection. The marshy area immediately downstream of the dam near the right abutment should be investigated as a possible source of seepage through the embankment, foundation or abutment. Vegetation on the dam needs to be cut more frequently. Displaced riprap along the upstream face of the dam should be replaced.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

Brockton Reservoir Dam has a damage area about 3 miles long and an average width of about 0.9 miles. The drainage area which is situated in the Towns of Avon and Stoughton is wooded with some residential, commercial and industrial development and low-lying marshes in the upper reaches. The topography ranges from Elev. 250 to Elev. 201 at the dam site. Beaver Brook approaches the reservoir from the northwest. No other impoundments are located in the drainage area. Limited access highway Route 24 passes through the length of the drainage area from north to south.

5.2 Design Data

Neither hydraulic nor hydrologic design data are available for Brockton Reservoir Dam.

5.3 Experience Data

There are no records of high reservoir pools or dam overtoppings for this site.

5.4 Test Flood Analysis

The recommended test flood range for a "Small" size, "Significant" hazard dam is from the 100 year storm to one-half of the Probable Maximum Flood (PMF). Based on the hazard to the downstream flood impact area, the selected test flood for this structure is one-half of the PMF.

Hydrologic and hydraulic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from the Snyder unit hydrographs using average coefficients, an initial infiltration of zero and a constant loss rate of 0.05 inches per hour. The Hop Brook Adjustment Factor was used to reduce the Probable Maximum Precipitation based on the drainage area. The routing sequence consisted of dividing the watershed above the impact area into sub-basins for each impoundment upstream including the study dam and routing the one-half PMF inflow hydrographs through each reservoir. Stage vs. Discharge and Stage vs. Storage relationships above the spillway crest and the top of the dam were developed for Brockton and the downstream dams to obtain outflow hydrographs. All impoundments were assumed to be at their respective spillway crest elevations at the beginning of the storm event.

The peak inflow and routed outflow for the test flood at Brockton Reservoir Dam were calculated as 2,330 cfs and 2,300 cfs, respectively. The peak outflow corresponds to a reservoir stage of 3.7 feet above the spillway crest, or 0.4 feet above the top of dam elevation. The spillway capacity prior to overtopping of the

dam with the flashboards in place was calculated to be 495 cfs, which is about 22 percent of the routed test flood outflow.

5.5 Dam Failure Analysis

A failure of the embankment was simulated by the HEC-1-DB computer program assuming a 720-foot wide and 10-foot deep breach with vertical side slopes, developing within 2 hours. The failure is assumed to occur with the reservoir surface at the top of dam elevation.

The resulting outflow was routed downstream through Waldo Lake, Upper Porter Pond, Lower Porter Pond and Thirty Acre Pond to the initial impact area about 1.8 miles downstream of Brockton Reservoir Dam which contains at least 35 residences. Downstream of these homes are densely populated urban neighborhoods within the City of Brockton. The channel cross-section in this area is shown on page D-12. The stream depth at this location was computed to be 2.1 feet. This depth of water could cause appreciable property damage and there would be little chance of loss of life.

The discharge resulting from this breach analysis would overtop Waldo Lake Dam by about 0.6 feet, Upper Porter Dam by about 0.9 feet, Lower Porter Dam by about 0.6 feet and Thirty Acre Pond Dam by about 0.1 feet.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The marshy area noted at the downstream toe of the embankment near the west abutment may be an indication of seepage through the dam, foundation or abutment zone. However, local topography slopes toward this low-lying area and may be indicative of poor drainage of surface runoff. No undulations in the crest or slopes were observed which would indicate embankment instability. The rodent burrows observed on the downstream slope could increase the seepage potential through the embankment. The route systems of the trees growing on the upstream slope could displace the riprap and expose the embankment to wave action.

6.2 Design and Construction Data

No information could be located concerning stability analyses, seepage computations or embankment and foundation material properties.

6.3 Post Construction Changes

According to Mr. Feroli, the 20-inch conduit connected to Woodland Avenue Pumping Station was constructed in 1967.

6.4 Seismic Stability

The dam is located within Seismic Risk Zone 3 of the "Seismic Zone Map of Contiguous States". A dam located in Seismic Zone 3 is considered to be in the "High" seismic hazard classification. A seismic stability investigation should be conducted as recommended in Section 7.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual observations and a review of the available information indicate that Brockton Reservoir Dam is in fair condition. The marshy area near the right abutment downstream of the dam may be an indication of seepage conditions through the dam, foundation or abutment. The route systems of the trees growing from the upstream slope may displace the riprap exposing the embankment to hydraulic erosion. Vegetation on the embankment does not appear to be cut very frequently.

The peak inflow and routed outflow for the test flood at Brockton Reservoir Dam were calculated as 2,330 cfs and 2,300 cfs, respectively. The peak outflow corresponds to a reservoir stage of 3.7 feet above the spillway crest, or 0.4 feet above the top of dam elevation. The spillway capacity prior to overtopping of the dam with the flashboards in place was calculated to be 425 cfs, which is about 22 percent of the routed test flood outflow. A failure of the dam could cause appreciable property damage and there would be little chance of loss of life in the neighborhood about 1.8 miles downstream of the dam and continuing downstream through the densely populated urban neighborhoods of Brockton.

b. Adequacy of Information. The drawings and reports together with the data obtained during the visual inspection are adequate for a Phase I investigation.

c. Urgency. Further investigation and recommended remedial measures should be implemented within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

The following recommendations should be implemented by a licensed professional engineer experienced in the design and construction of dams.

1) Detailed hydrologic and hydraulic analyses should be performed to determine the need for increasing the spillway capacity.

2) Investigations should be performed to determine the existence of seepage near the west abutment. The marshy area should be monitored on a regular basis for any signs of flow and/or turbidity.

3) A study should be performed to evaluate the necessity for a low-level outlet to reduce the reservoir elevation during emergencies.

4) The seismic stability of the dam should be investigated utilizing conventional equivalent static load methods.

5) Upstream control for the 20-inch water supply line should be designed (if no such control currently exists) to ensure that the pipe is not maintained under pressure through the embankment.

7.3 Remedial Measures

a. Operation and Maintenance Procedures

1. The Owner should cut the vegetation, including the trees, on the embankment at more frequent intervals.

2. The flashboards should be removed from the spillway to increase the spillway discharge capacity and to increase reservoir surcharge storage during periods of heavy precipitation and/or runoff.

3. Riprap on the upstream face of the dam should be replaced where necessary.

4. The marshy area near the west abutment should be drained to assist in determining the possible presence of seepage.

5. All rodent burrows should be backfilled to minimize seepage potential. Rodents should be exterminated.

6. A downstream warning system should be developed. During periods of heavy rainfall and/or runoff, the dam should be monitored and downstream residents alerted in the event of an impending failure.

7. Institute a program of annual technical inspection.

8. The Owner should determine the function of the three gate valves in the gatehouse and repair these valves if they are required for emergency drawdown of the reservoir.

7.4 Alternatives

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

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Location: Avon, MA

Type of Dam: Earth Embankment

Inspection Date(s): October 17, 1979

Weather: Overcast, 47°

Pool Elevation: 201.1 MSL

Inspection Team

Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Rodney Georges	Bryant & Associates	Hydrology/Hydraulics

*Mr. John J. Williams, Vice-President, O'Brien & Gere has visited the site but not necessarily in conjunction with the inspection team.

Owner's Representative

Mr. Martin Feroli, Superintendent, Water Department, Brockton MA

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	201.0 MSL
Current Pool Elevation	201.1 MSL
Maximum Impoundment to Date	Uknown.
Surface Cracks	None.
Pavement Condition	N/A
Movement or Settlement of Crest	None.
Lateral Movement	None
Vertical Alignment	Good.
Horizontal Alignment	Good.
Condition at Abutment and at Concrete Structures	Ponded water noted d/s of dam at west abutment.
Indications of Movements of Structural Items on Slopes	None.
Trespassing on Slopes	Large number of footpaths on d/s slope.
Vegetation on Slopes	Tall grass and brush on crest and d/s slope.
Sloughing or Erosion of Slopes or Abutments	Small erosion channels in d/s slope.
Rock Slope Protection - Riprap Failures	Small local failure east of gatehouse.

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	None.
Unusual Embankment or Downstream Seepage	Ponded water at d/s toe near west abutment. No flow observed.
Piping or Boils	None.
Foundation Drainage Features	None.
Toe Drains	None.
Instrumentation System	None.

30

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Approach Channel	Submerged.
b. Weir and Training Walls	
General Condition of Concrete	Masonry walls in good condition.
Rust or Staining	Steel flashboards slightly corroded and stained.
Spalling	None.
Any Visible Reinforcing	None.
Any Seepage or Efflorescence	None.
Drain Holes	None.
c. Discharge Channel	
General Condition	Good.

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	None.
Floor of Channel	Some displacement of stone blocks.
Other Obstructions	A double arch stone masonry roadway bridge about 30 feet d/s of weir crest.

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair.
Condition of Joints	Some loss of mortar between bricks.
Spalling	None.
Visible Reinforcing	None.
Rusting or Staining of Concrete	None.
Any Seepage or Efflorescense	None.
Joint Alignment	Good.
Unusual Seepage or Leaks in Gate Chamber	None.
Cracks	None.
Rusting or Corrosion of Steel	None.
b. Mechanical and Electrical	
Air Vents	None.
Float Wells	None.
Crane Hoist	None.

VISUAL INSPECTION CHECK LIST

Project: BROCKTON RESERVOIR DAM

National I.D. #: MA 00786

Date(s): October 17, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER (Con't)	
Elevator	None.
Hydraulic System	None.
Service Gates	Three gates are inoperable & operating keys are missing.
Emergency Gates	Stoplog slots u/s of gate valves. No stoplogs on-site.
Lighting Protection System	None.
Emergency Power System	None.
Wiring and Lighting System in Gate Chamber	None.
WATER SUPPLY CONDUIT	A 20 inch diam. conduit of unknown condition can be operated by a gate valve d/s of the dam. The valve is operable but the operator was not available.

APPENDIX B

ENGINEERING DATA

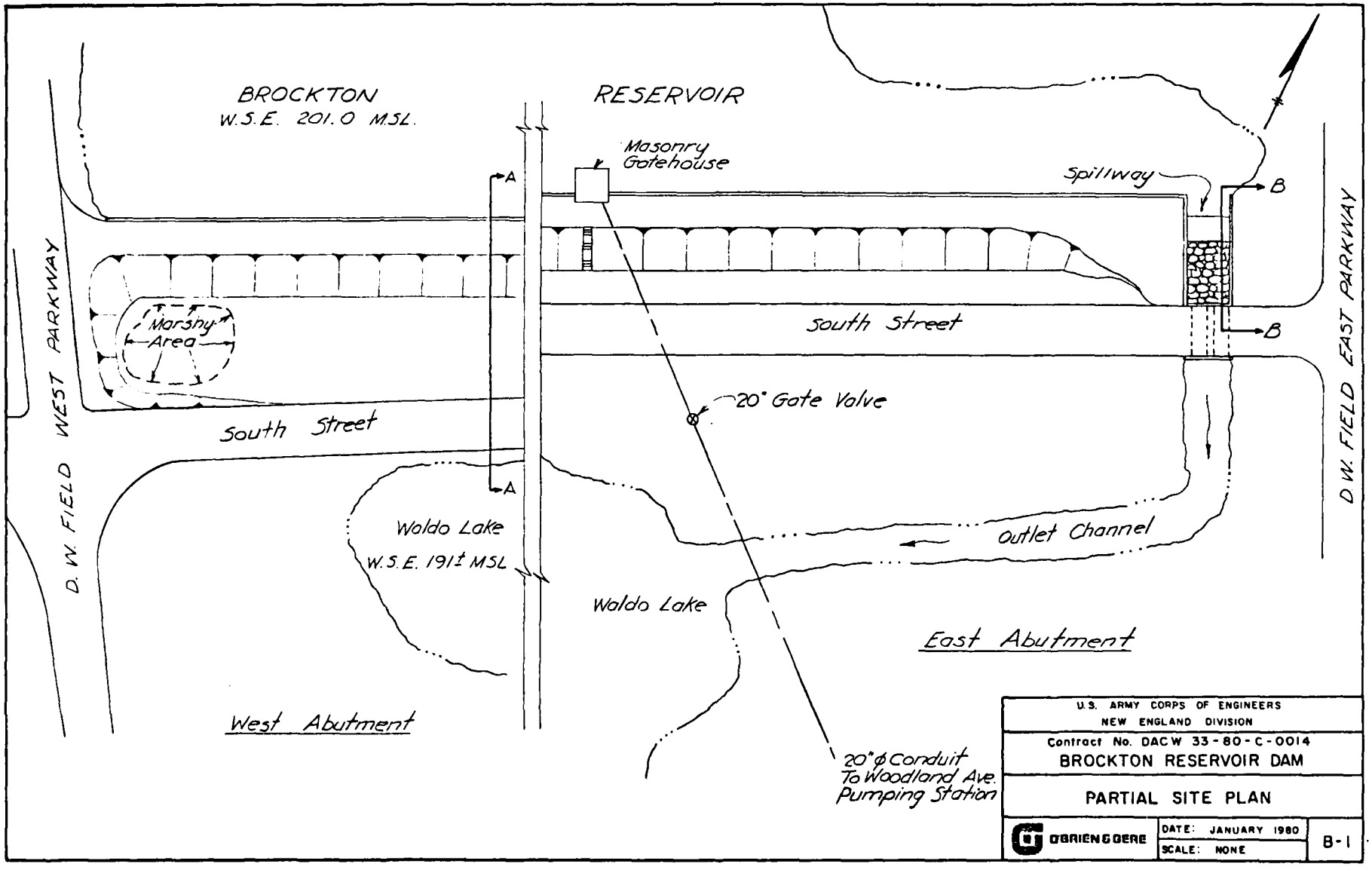
O'BRIEN & GERE
ENGINEERS, INC.

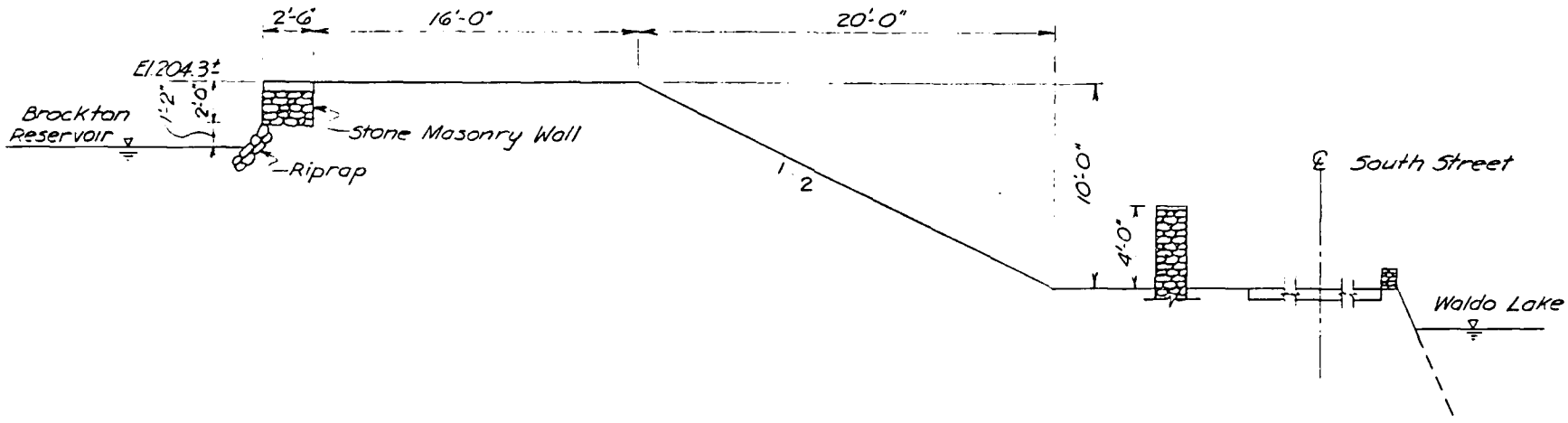
SUBJECT	SHEET	BY	DATE	JOB NO
BROCKTON RESERVOIR DAM				

APPENDIX B

ENGINEERING DATA

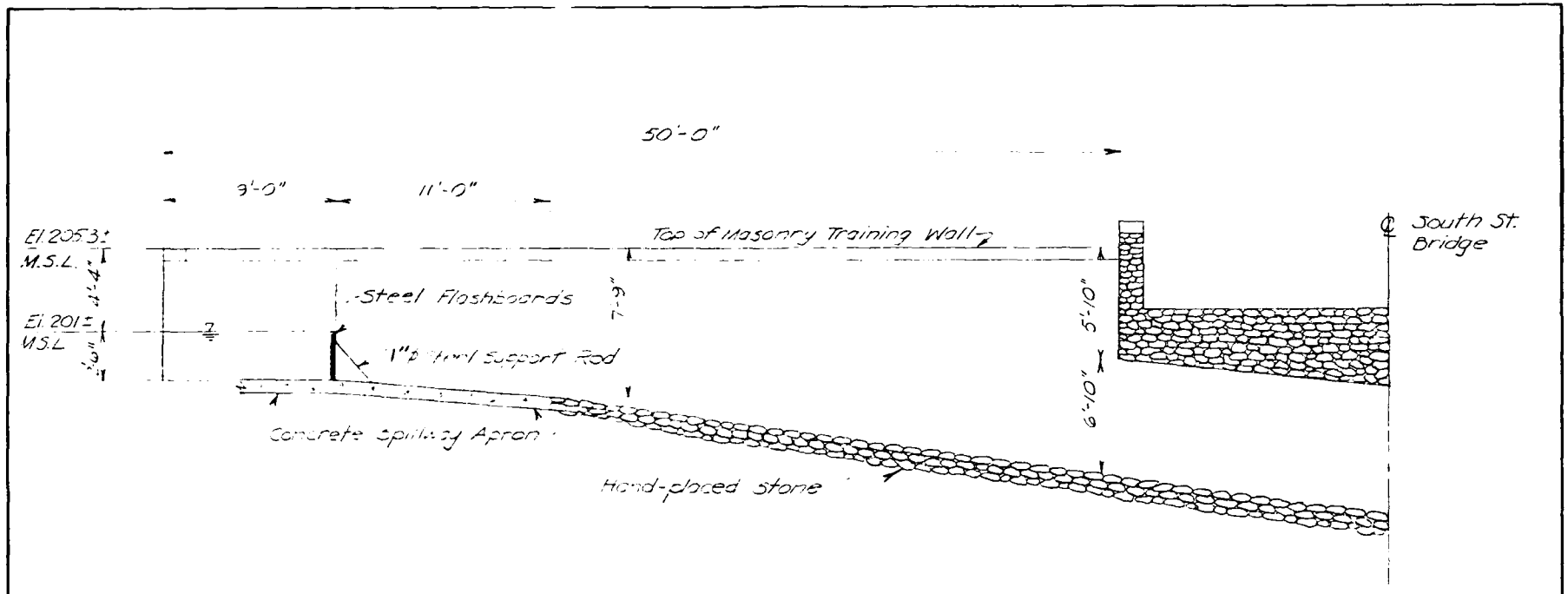
TABLE OF CONTENTS


BROCKTON
W.S.E. 201.0 M.S.L.
RESERVOIR
Masonry Gatehouse
Spillway
B
B
A
A
D. W. FIELD WEST PARKWAY
Marshy Area
South Street
South Street
20" Gate Valve
Waldo Lake
W.S.E. 191± M.S.L.
Waldo Lake
Outlet Channel
D.W. FIELD EAST PARKWAY
East Abutment
West Abutment
20"ϕ Conduit To Woodland Ave. Pumping Station
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
Contract No. DACW 33-80-C-0014
BROCKTON RESERVOIR DAM
PARTIAL SITE PLAN
O'BRIEN & GERE
DATE: JANUARY 1980
SCALE: NONE
B-1



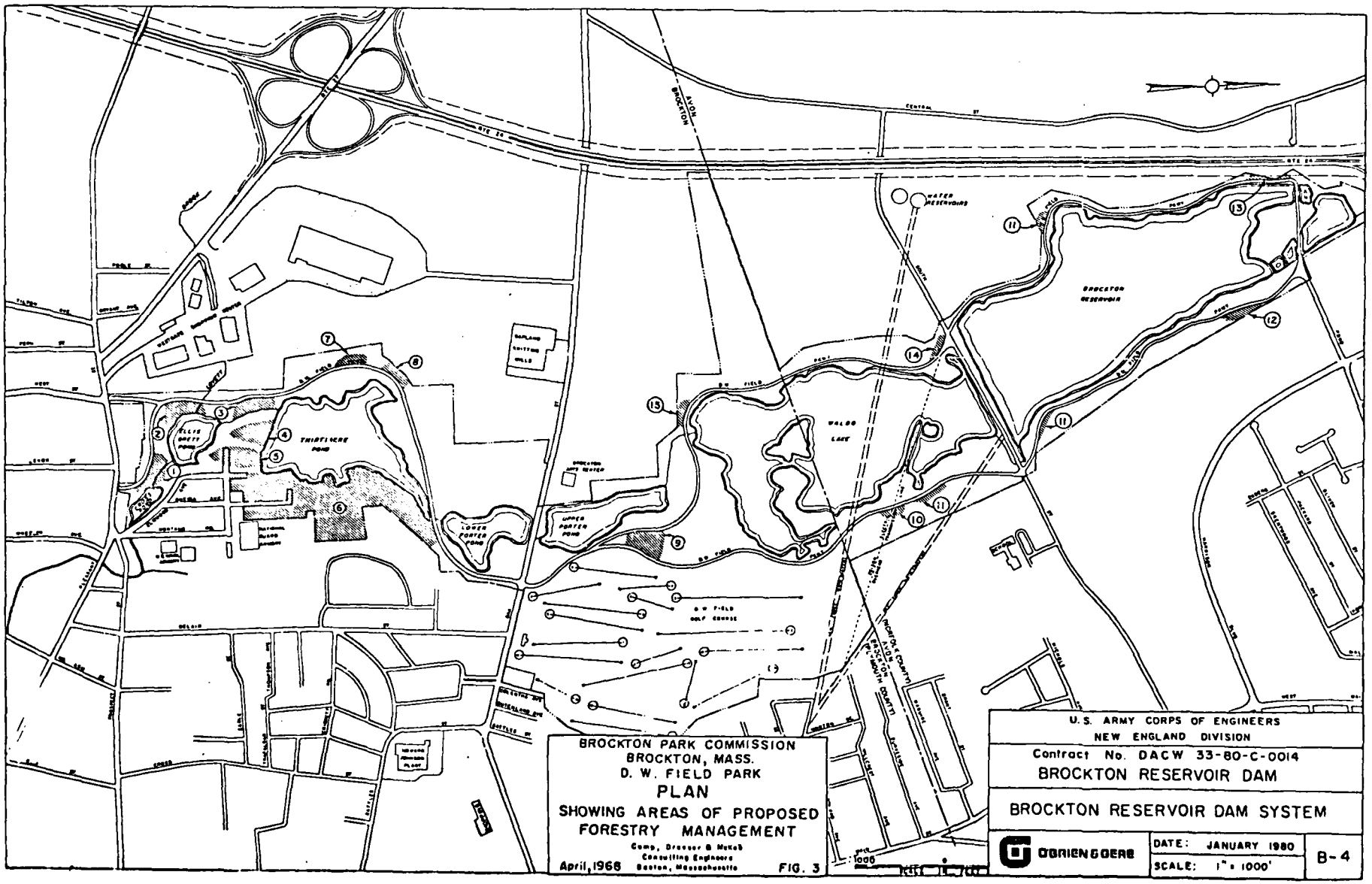
SECTION A-A

U S ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		
Contract No. DACW 33-80-C-0014 BROCKTON RESERVOIR DAM		
TYPICAL EMBANKMENT SECTION		
O'BRIEN & GERE	DATE: JANUARY 1980 SCALE: NONE	B-2

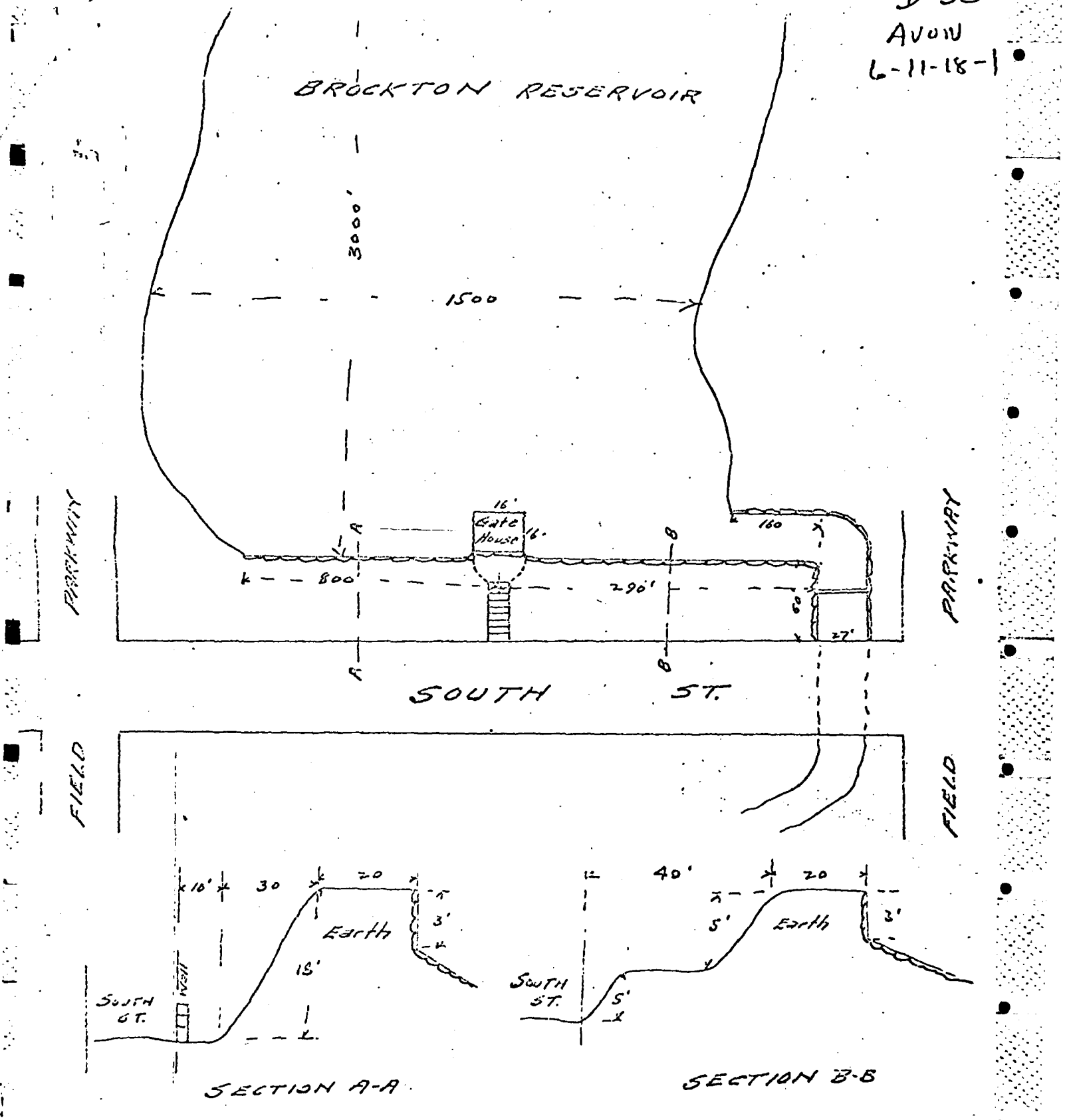


SECTION B-B

U.S ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		
Contract No DACW 33-80-C-0014 BROCKTON RESERVOIR DAM		
SPILLWAY SECTION		
O'BRIEN & GERE	DATE: JANUARY 1980 SCALE: NONE	B-3


BROCKTON PARK COMMISSION
BROCKTON, MASS.
D. W. FIELD PARK
PLAN
SHOWING AREAS OF PROPOSED
FORESTRY MANAGEMENT
Camp, Dresser & McKee
Consulting Engineers
April, 1968 Boston, Massachusetts
FIG. 3
U. S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
Contract No. DACW 33-80-C-0014
BROCKTON RESERVOIR DAM
BROCKTON RESERVOIR DAM SYSTEM
O'BRIEN & GERE
DATE: JANUARY 1980
SCALE: 1" = 1000'
B-4

D-30
AVON
L-11-18-1



From Commonwealth of Mass DEQE files

D-5

DESCRIPTION OF DAM

DISTRICT 6

Submitted by A.H. Lounsbury — Dam No. 6-11-18-1

Date Feb 14 1974 — City/Town AVON

Name of Dam BROCKTON RES.

Location; TOpo Sheet No. 32 D

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

Year built: UNK Prior to 1944 — Year/s of subsequent repairs UNK

Purpose of Dam: Water Supply ✓ Recreational ____ Irrigation ____ Other ____

Drainage Area: Total 2.76 sq.mi. 1769.6 acres.

Normal Pording Area: 5.4 Acres ; Ave Depth Est. 10'

Impoundment 1.8 million gals; 54 acre ft.

No. and type of dwellings located adjacent to pond or reservoir NONE

i.e. summer homes etc.

Dimensions of Dam: Length 1120' Max. Height 18'

Slopes: Upstream Face VERTICAL

Downstream Face 2:1

Width across top 20'

Classification of Dam by Material:

Earth ✓ Conc. Masonry ____ Stone Masonry ____

Timber ____ Rockfill ____ Other ____

A. Description of present land usage downstream of dam: 100 % rural; ____ % urban.

B. Is there a stoage area or flood plain downstream of dam which could accommodate the impoundment in the event of a complete dam failure YES ✓ NO. ____

From Commonwealth of Mass DEQE files

DAM NO. 6-11-1F-1

isk to life and property in event of complete failure.

No. of people NONE.

Np. of homes _____.

No. of Businesses _____.

No. of Industries 1 Type _____.

No. of Utilities _____. Type _____.

Railroads _____.

Other Dams NONE.

Other South St.

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

From Commonwealth of Mass. DEQE Files

Brockton Ol File #1

INSPECTION REPORT - DAMS AND RESERVOIRS

Location: ~~City~~/Town Avon . Dam No. 6-11-1 F-1

Name of Dam Brockton Res. INSPECTED BY: A-H. Lounbury.

Date of Inspection Feb 14, 1974

Owner/s: Per: Assessors V . Prev Inspection .

Reg. of Deeds . Pers. Contract .

1. City of Brockton
   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.

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

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

No. of pictures taken .

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

1. Minor V . 2. Moderate .

3. Severe . 4. Disastrous .

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

Outlet Control: Automatic . Manual V .

Operative V yes ; No.

Comments:

Upstream Face of Dam: Condition*

1. Good V . 2. Minor Repairs .

3. Major Repairs . 4. Urgent Repairs ..

Comments:

From Commonwealth of Mass. DEQE Files

B-8

DAI NO. 6-11-18-1

Upstream Face of Dam: Condition: 1. Good ✓. 2. Minor Repairs_____.
3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

Emergency Spillway: Condition: 1. Good ✓. 2. Minor Repairs_____.
3. Major Repairs_____. 4. Urgent Repairs_____.

Comments:_____

Water level @ time of inspection _____ft. above_____. below_____.
top of ~~dam~~ spillway_____. principal spillway_____.
other_____.

Summary of Deficiencies Noted:

Growth (trees and bruch) on Embankment NONE.
Animal Burrows and Washouts_____.
Damage to slopes or top of dam_____.
Cracked or Damaged Masonry_____.
Evidence of Seepage_____.
Evidence of Piping_____.
Erosion_____.
Leaks_____.
Trash and/or debris impeding flow_____.
Clogged or blocked spillway_____.
Other_____.

From Commonwealth of Mass. DEQE files

DAM NO. 6-11-18-1

Remarks & Recommendations: (Fully Explain)

3.

Overall Condition:

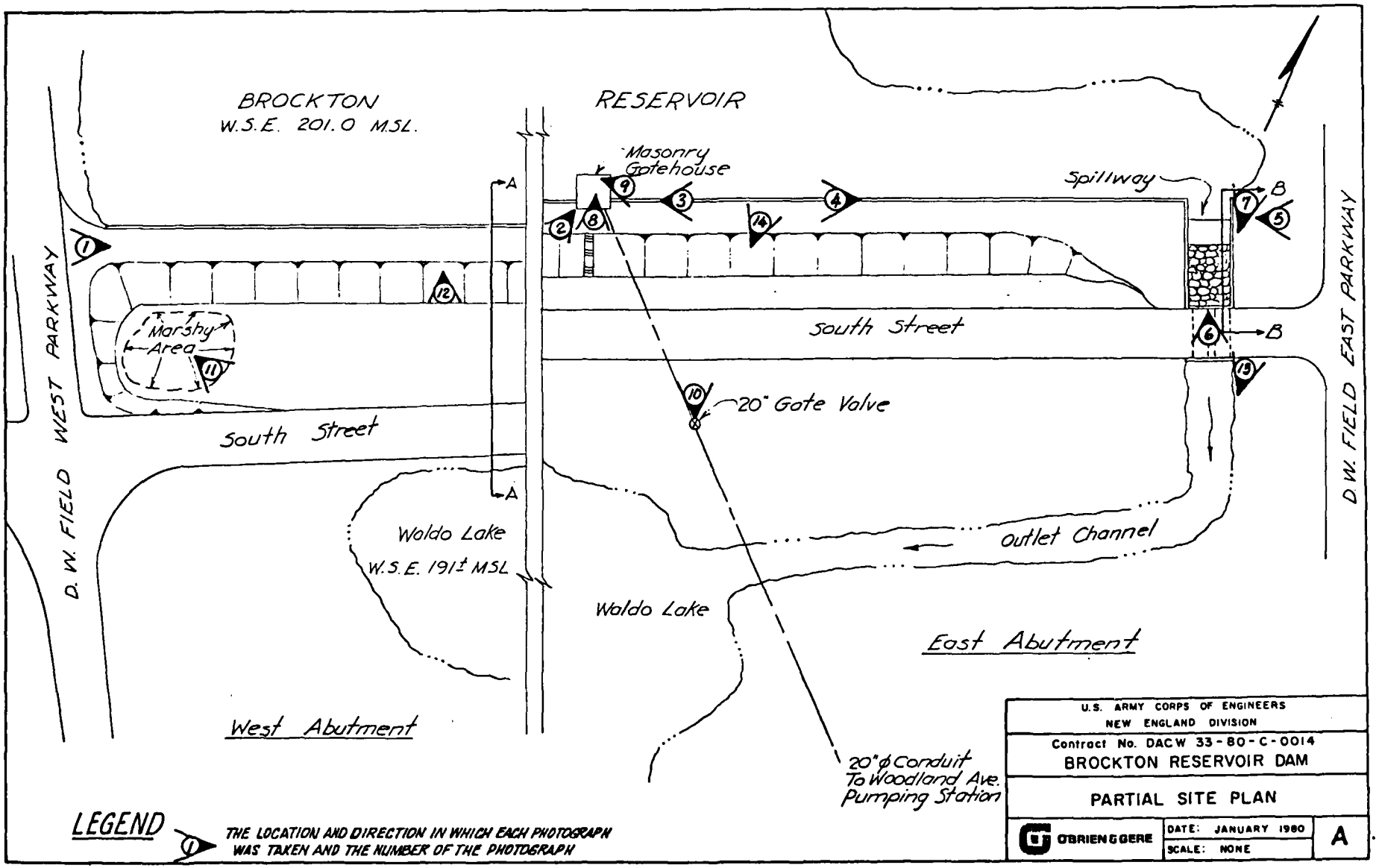
1. Safe ✓.
2. Minor repairs needed No.
3. Conditionally safe-major repairs needed_____.
4. Unsafe No.
5. Reservoir impoundment no longer exists(explain)
   Recommend removal from inspection list._____.

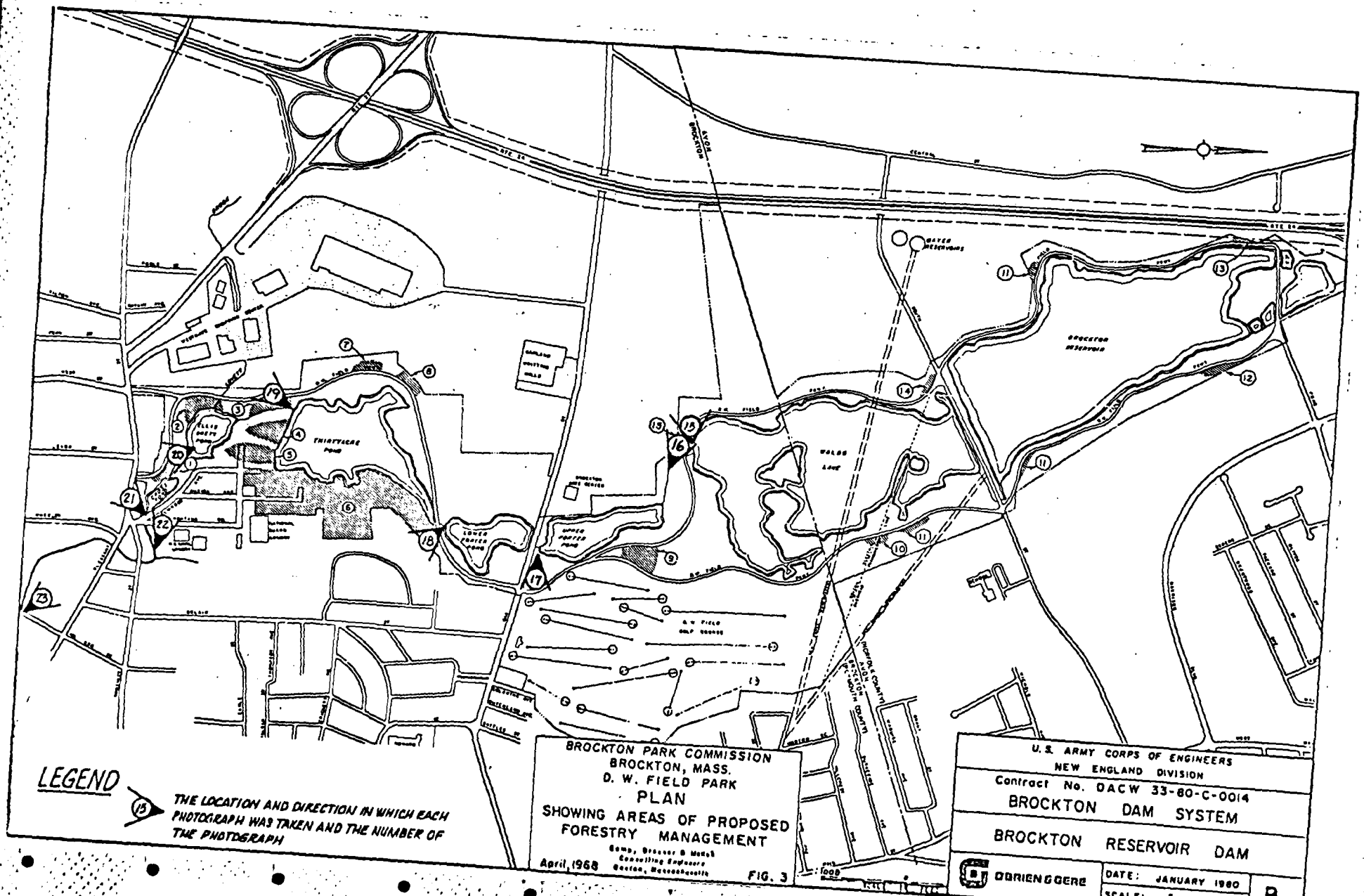
From Commonwealth of Mass DEQE Files

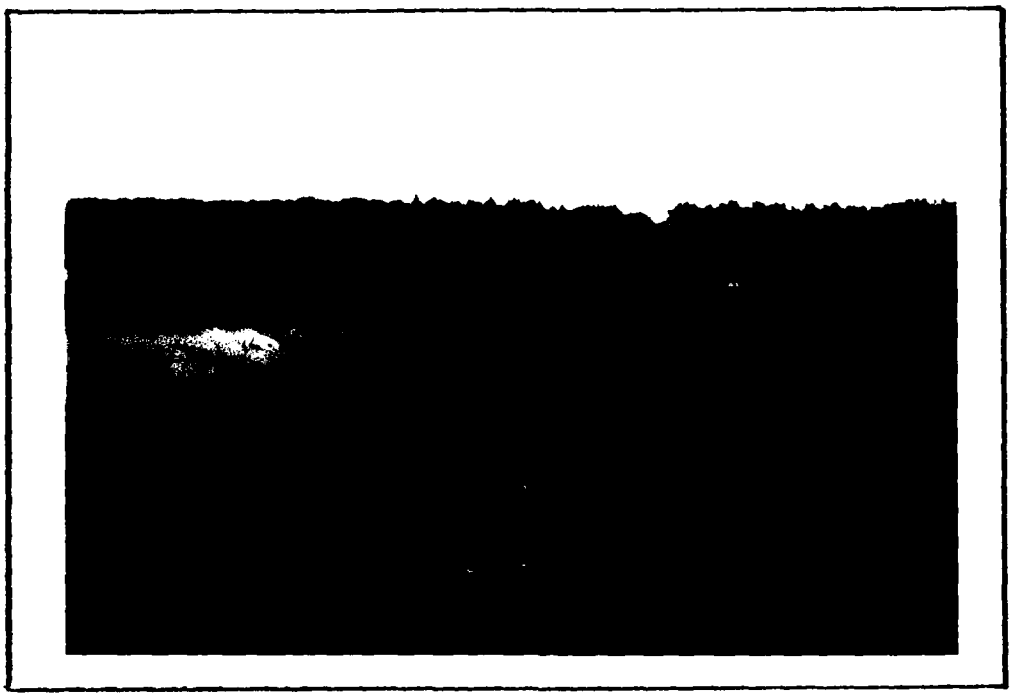
APPENDIX C

PHOTOGRAPHS

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT


BROCKTON
W.S.E. 201.0 M.S.L.
RESERVOIR
Masonry Gatehouse
Spillway
D.W. FIELD WEST PARKWAY
D.W. FIELD EAST PARKWAY
Marshy Area
South Street
South Street
20" Gate Valve
Woldo Lake
W.S.E. 191± M.S.L.
Outlet Channel
Woldo Lake
East Abutment
West Abutment
20"ϕ Conduit To Woodland Ave. Pumping Station
A
B
LEGEND
THE LOCATION AND DIRECTION IN WHICH EACH PHOTOGRAPH WAS TAKEN AND THE NUMBER OF THE PHOTOGRAPH
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
Contract No. DACW 33-80-C-0014
BROCKTON RESERVOIR DAM
PARTIAL SITE PLAN
O'BRIEN & GERE
DATE: JANUARY 1980
SCALE: NONE
A


LEGEND
THE LOCATION AND DIRECTION IN WHICH EACH PHOTOGRAPH WAS TAKEN AND THE NUMBER OF THE PHOTOGRAPH
BROCKTON PARK COMMISSION
BROCKTON, MASS.
D. W. FIELD PARK
PLAN
SHOWING AREAS OF PROPOSED
FORESTRY MANAGEMENT
Camp, Dresser & McKee
Consulting Engineers
Boston, Massachusetts
April, 1968
FIG. 3
U.S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION
Contract No. DACW 33-80-C-0014
BROCKTON DAM SYSTEM
BROCKTON RESERVOIR DAM
O'BRIEN & GERE
DATE: JANUARY 1980
SCALE: 1" = 1000'
B



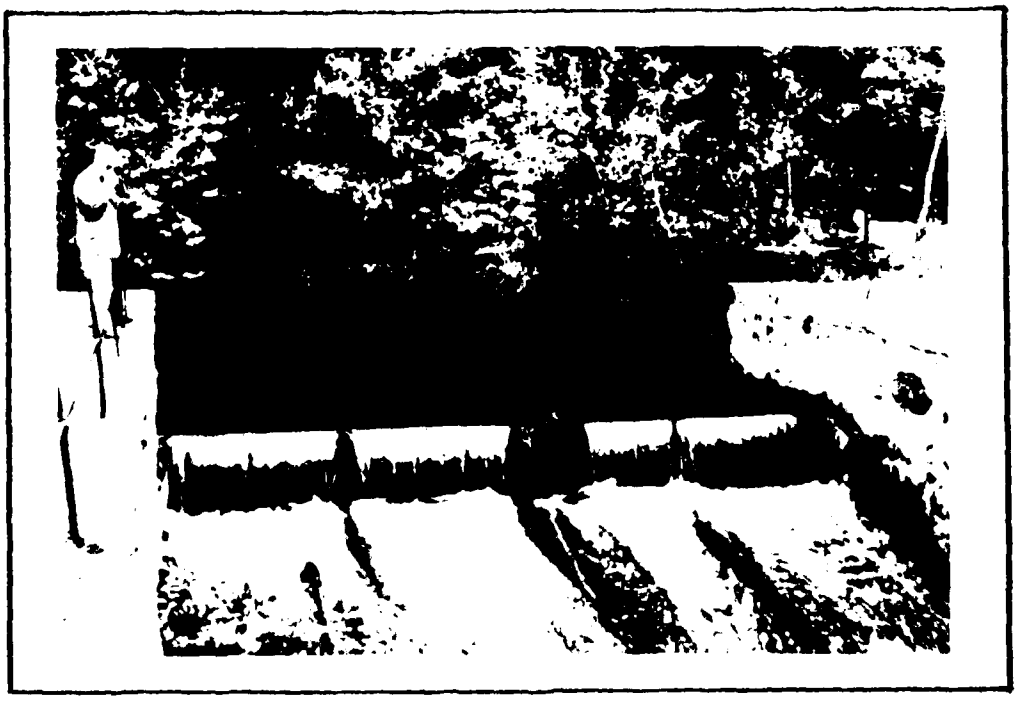
1. VIEW ALONG CREST OF DAM FROM THE RIGHT (WEST).(10/17/79)

2. GATEHOUSE AND UNMAINTAINED VEGETATIVE COVER ON THE DAM. (10/17/79)

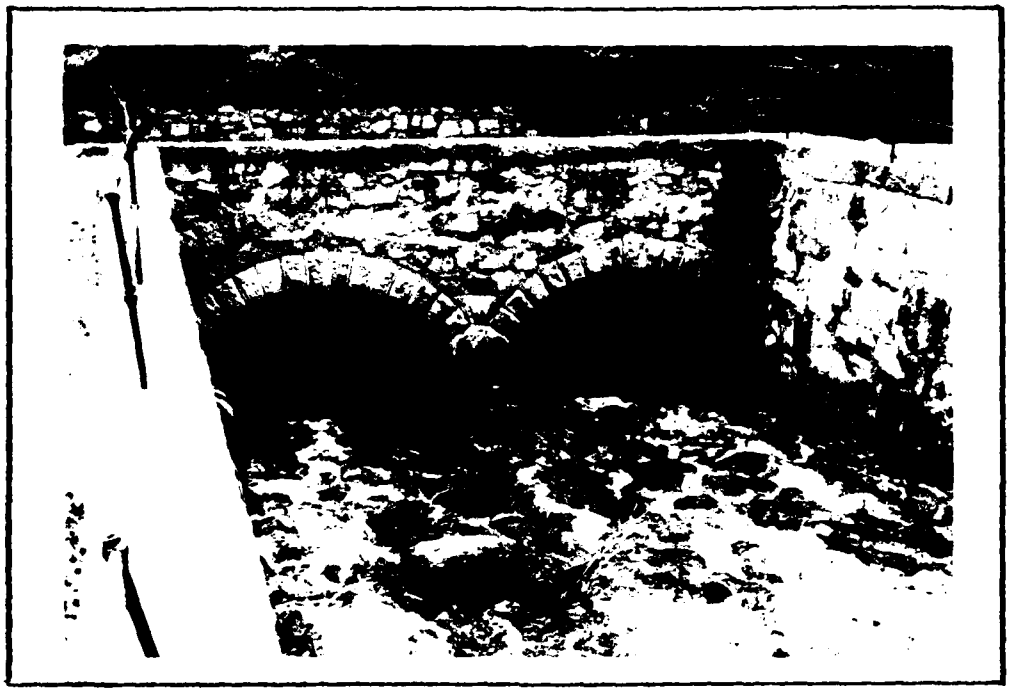
3. DISPLACED ROCK RIPRAP ON THE UPSTREAM FACE OF THE DAM NEAR THE GATEHOUSE. (10/17/79)

4. DISPLACED ROCK RIPRAP AND OVERGROWN VEGETATION ON THE UPSTREAM FACE OF THE DAM. (10/17/79).

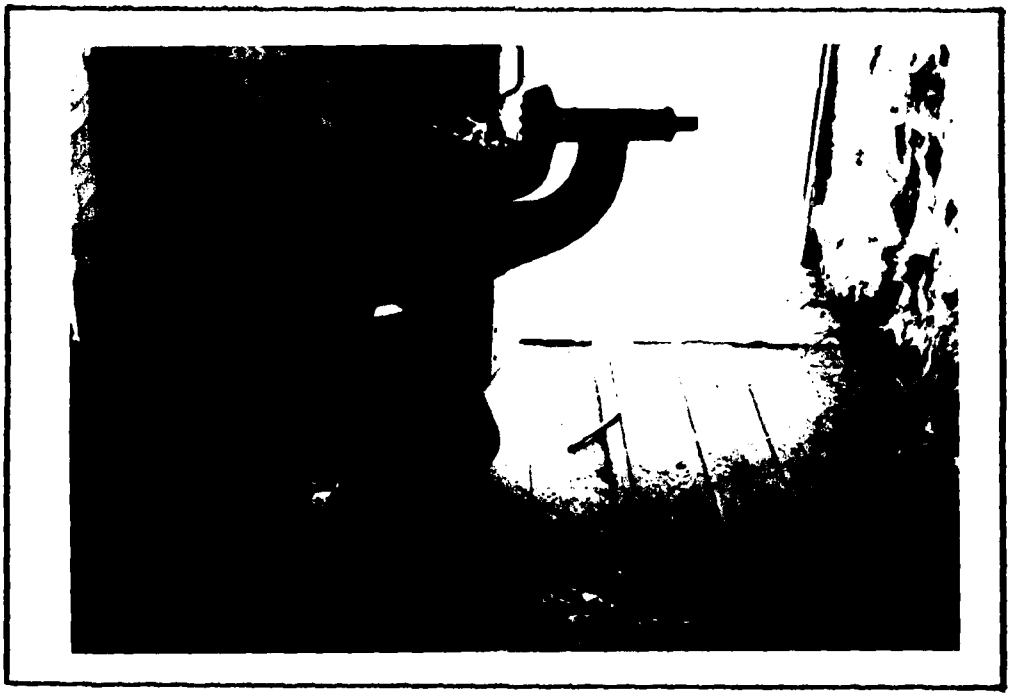
5. SPILLWAY VIEWED FROM THE LEFT ABUTMENT (EAST). (10/17/79)



6. SPILLWAY AS VIEWED FROM DOWNSTREAM. (10/17/79)

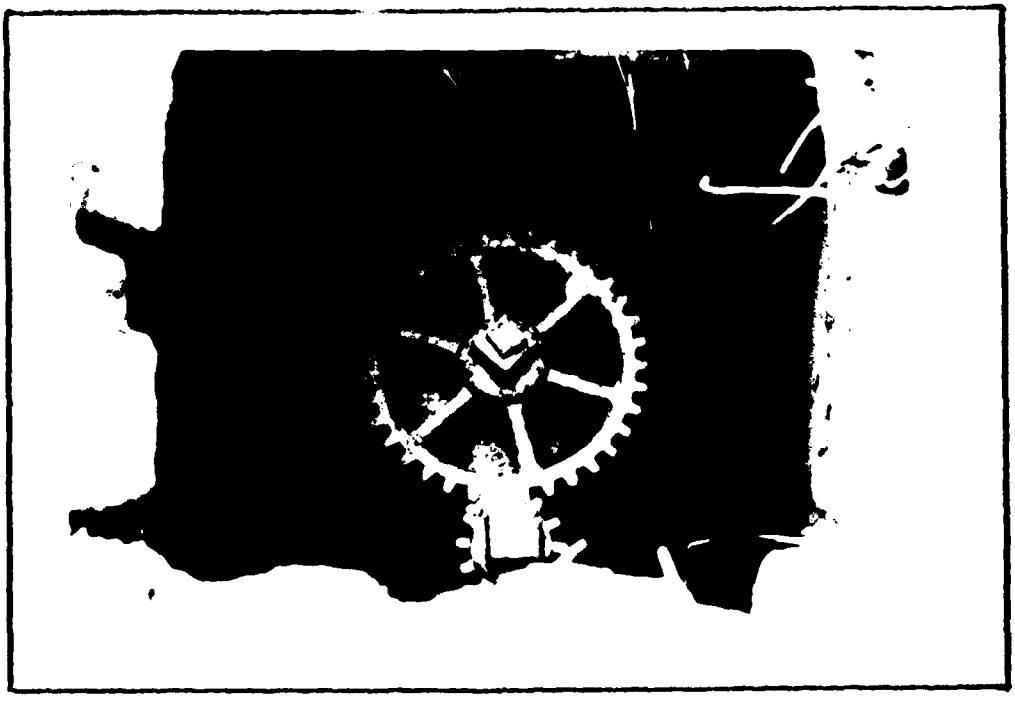


7. SPILLWAY DISCHARGE CHANNEL IMMEDIATELY DOWNSTREAM OF THE SPILLWAY (10/17/79)



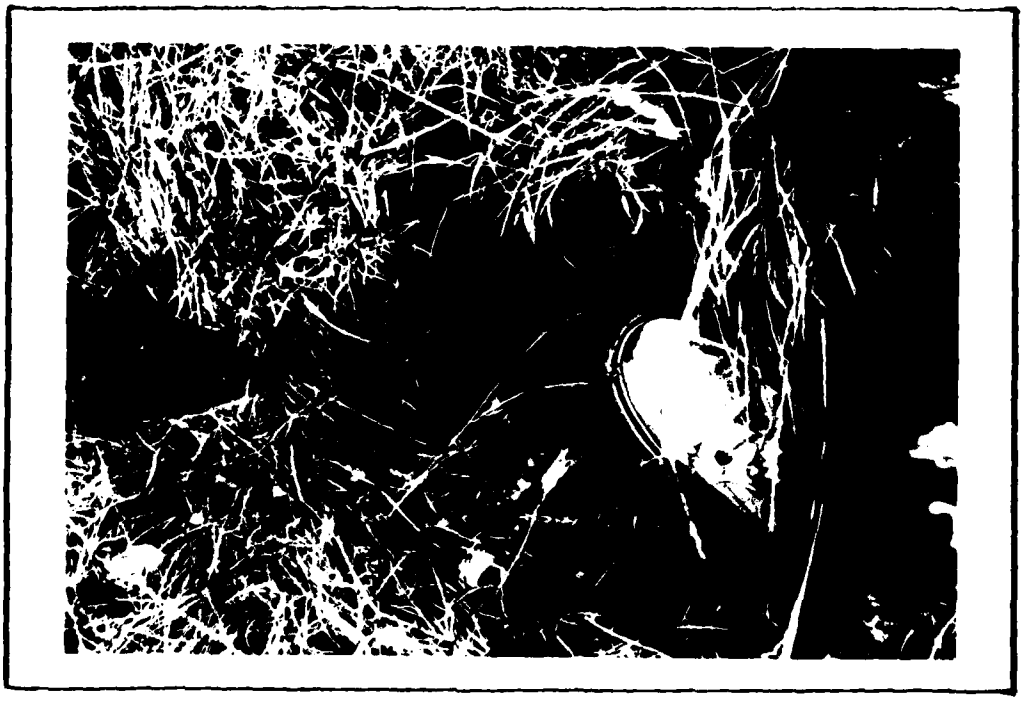
8. GATE HOIST IN GATE TOWER. (10/17/79)

9. INTAKE IN GATEHOUSE. (10/17/79)



10. VALVE CONTROL ABOUT 100 FEET DOWNSTREAM OF THE GATEHOUSE. (10/17/79)

11. STANDING WATER DOWNSTREAM OF THE DAM NEAR THE RIGHT ABUTMENT. (10/17/79).



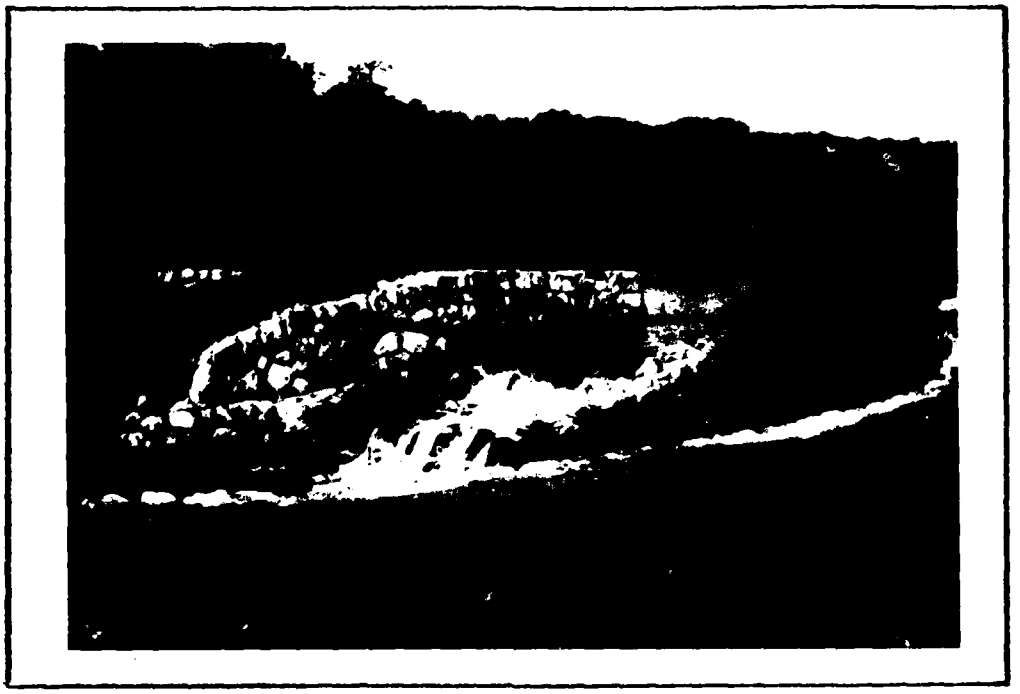
12. TYPICAL RODENT HOLE IN THE DOWNSTREAM FACE OF THE DAM. (10/17/79)

13. CHANNEL BETWEEN BROCKTON RESERVOIR SPILLWAY AND WALDO LAKE. (10/17/79)

14. WALDO LAKE IMMEDIATELY DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

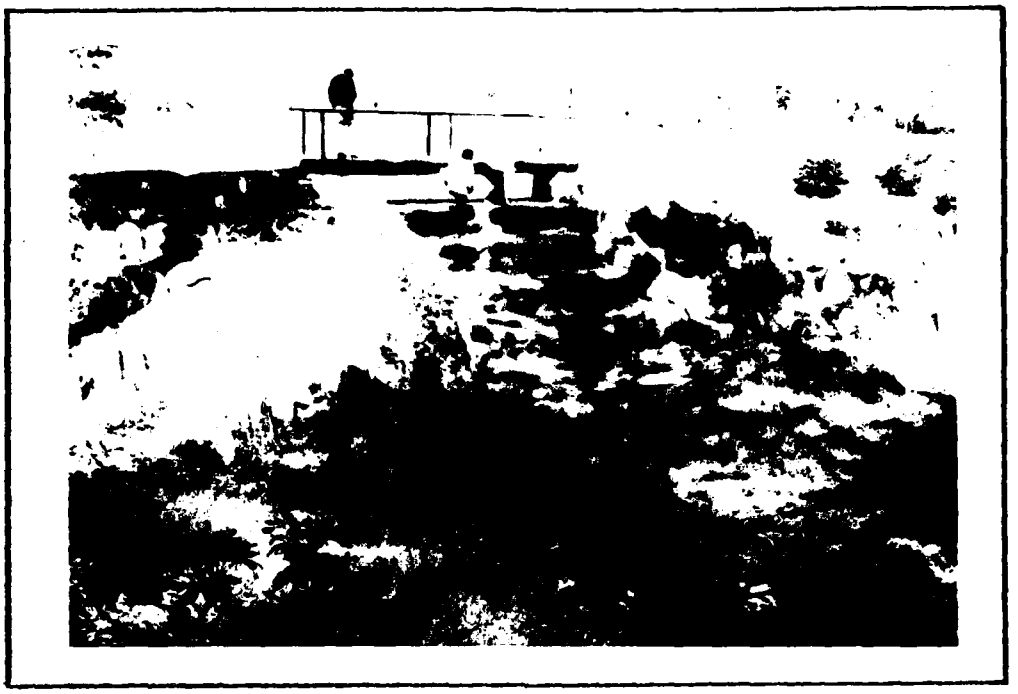
15. WALDO LAKE DAM SPILLWAY ABOUT 1,050 YARDS DOWNSTREAM OF BROCKTON RESERVOIR DAM.(10/17/79)

16. TYPICAL REACH OF CHANNEL BETWEEN WALDO LAKE DAM SPILLWAY AND UPPER PORTER LAKE.(10/17/79)



17. UPPER PORTER POND DAM SPILLWAY APPROXIMATELY 1,750 YARDS DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

18. LOWER PORTER POND DAM ABOUT 1¼ MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)



19. 30 ACRE POND DAM SPILLWAY ABOUT 1 2/3 MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

20. E. BRETT POND (DRAINED) INLET STRUCTURE A LITTLE LESS THAN 2 MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79).

21. CROSS POND SPILLWAY A LITTLE MORE THAN 2 MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

22. TYPICAL REACH OF SALISBURY BROOK ABOUT 2 3/4 MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

23. ENTRANCE TO APPROXIMATELY 600 YARD LONG BOX CULVERT FOR SALISBURY BROOK IN BROCKTON ABOUT 3 MILES DOWNSTREAM OF BROCKTON RESERVOIR DAM. (10/17/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
BROCKTON RESERVOIR DAM				

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

TABLE OF CONTENTS

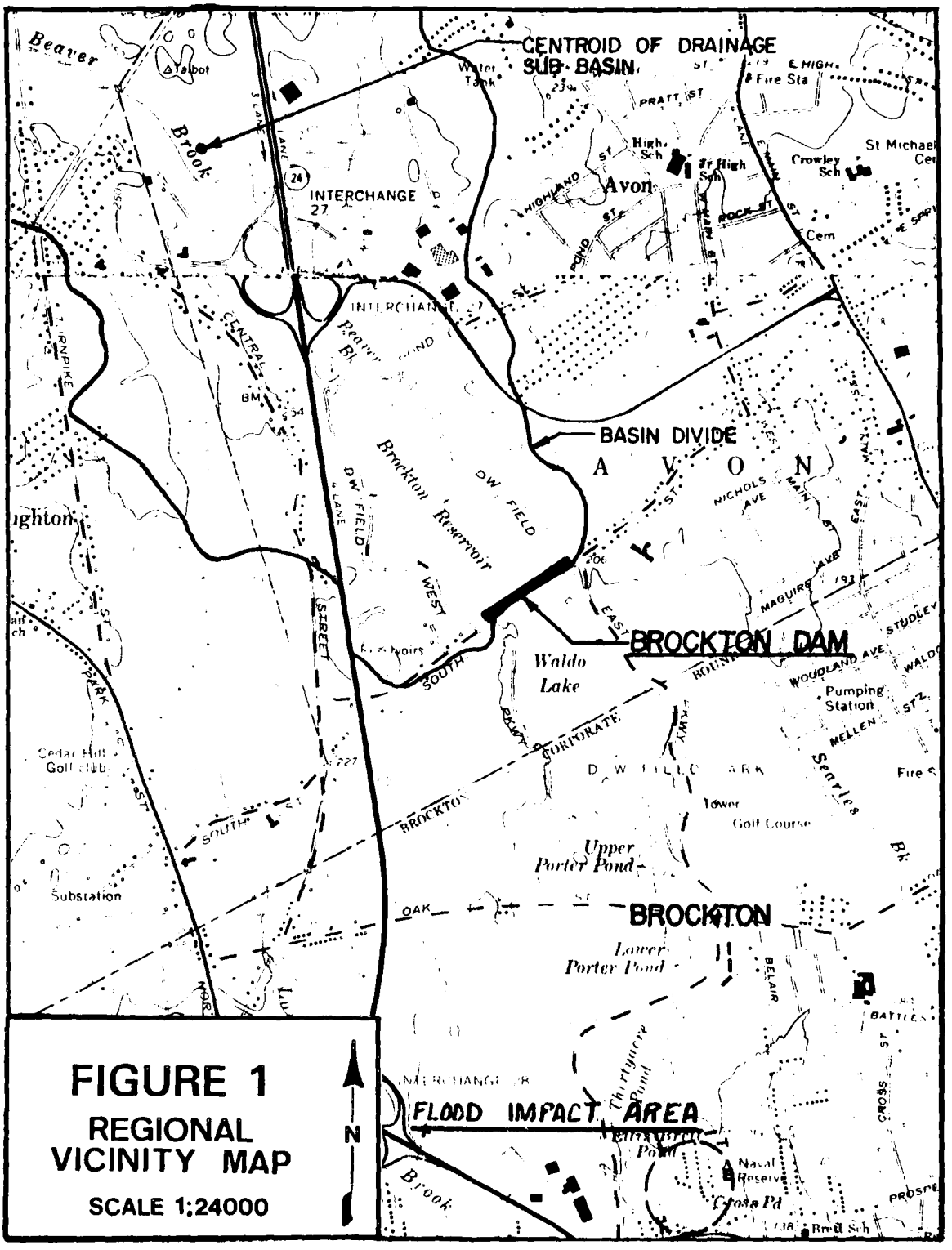


FIGURE 1

REGIONAL VICINITY MAP

SCALE 1:24000

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB NED-COE,
SHEET NO D-2 OF
CALCULATED BY RG DATE
CHECKED BY SHS DATE
SCALE

BROCKTON LAKE DAM - H & H

DRAINAGE AREA = 2.8 Sq.Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 2.70$ MILES $L_{ca} = 1.40$ MILES

$T_p = C_t \cdot (L \times L_{ca})^{.3}$

$T_p = 2.0 \times (2.7 \times 1.4)^{.3} = \underline{3.0}$ HOURS

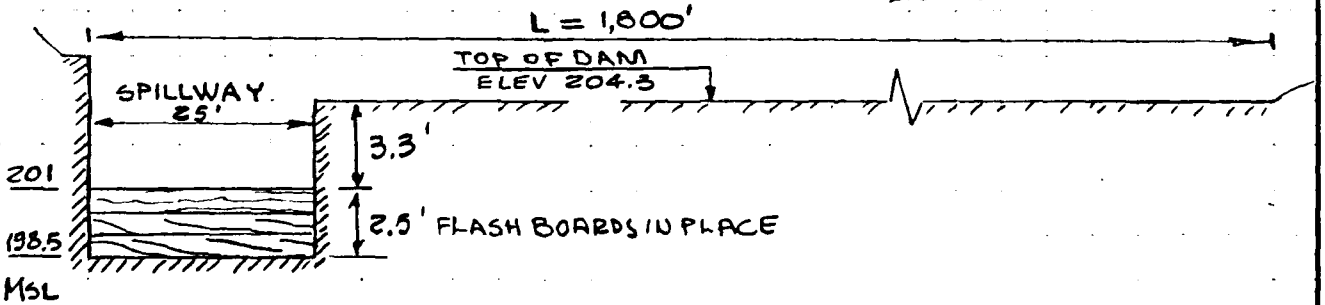
PMP DATA

FROM HMS #33 THE 24 HOUR 200 SqMi INDEX RAINFALL IS 21.5

6hr. % OF INDEX FOR THIS BASIN = 111
12hr. % " " " " " = 124
24hr. % " " " " " = 133

DAM ELEVATION & LENGTH and SPILLWAY DIMENSIONS SKETCH

LOOKING DOWNSTREAM



C = 3.3 w/BOARDS C = 2.9 TOP OF DAM
C = 2.9 w/out BOARDS

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CHECKED BY SHS DATE
SCALE

BROCKTON LAKE DAM - H&H cont'd

STAGE DISCHARGE WITH FLASHBOARDS

(H = 0 @ SPILLWAY CREST)

1) SPILLWAY : $C = 3.3$ $L = 25'$ $Q_s = CLH^{1.5}$

2) TOP OF DAM : $C = 2.9$ $L = 1800 - 25 = 1775$ $Q_{dam} = CL(H-3.3)^{1.5}$

ELEVATION MSL	H Ft.	Q_s CFS	Q_{top} CFS	ΣQ CFS
201	0	0	0	0
202	1	83	0	83
203	2	233	0	233
204	3	429	0	429
204.3	3.3	495	0	495
205	4	660	3,015	3,675
206	5	922	11,410	12,332
207	6	1,213	22,837	24,050
208	7	1,528	36,635	38,163
209	8	1,867	52,450	54,317
210	9	2,228	70,050	72,278

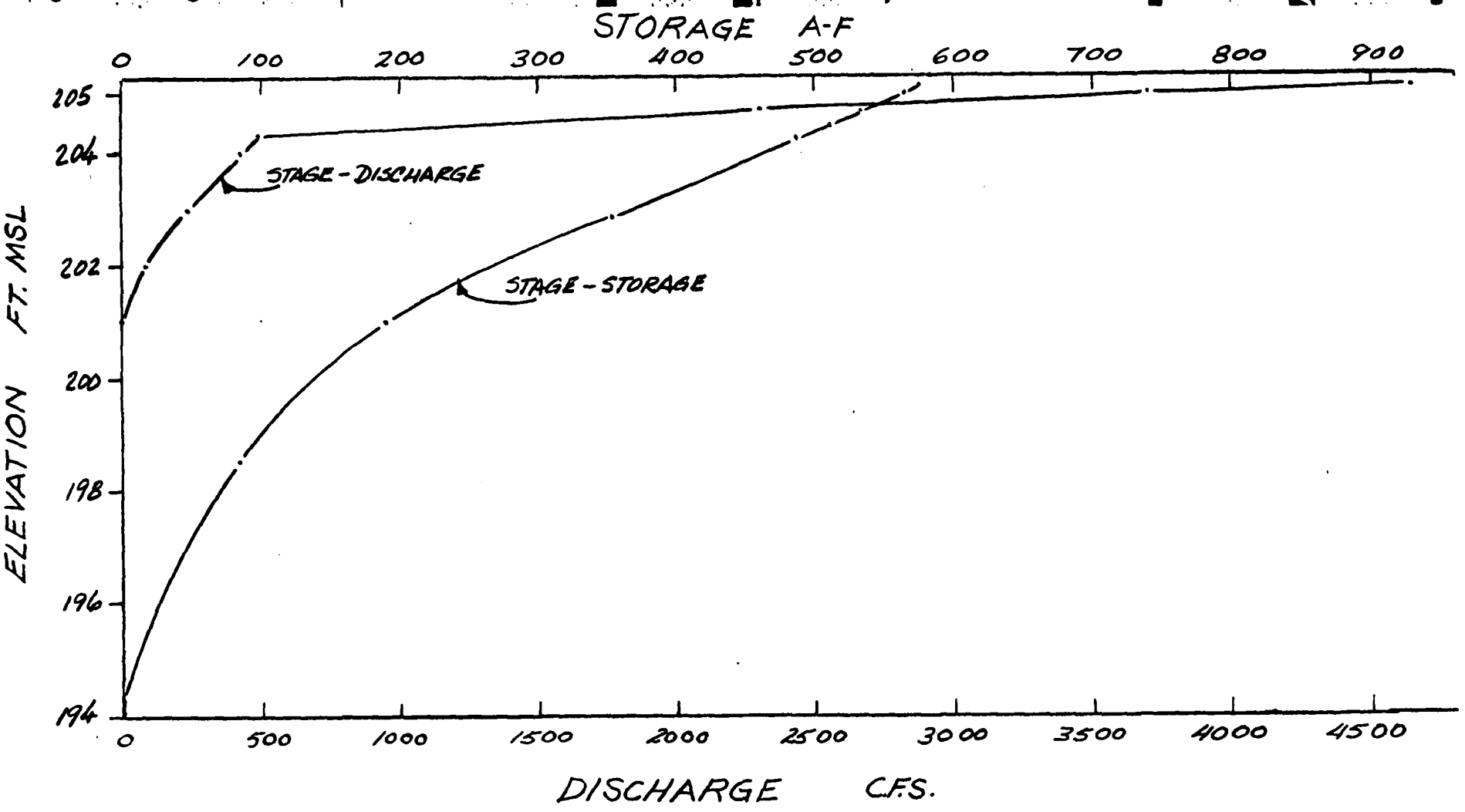
SPILLWAY DISCHARGE WITH NO FLASHBOARDS FOR TOP OF DAM EL.

$C = 2.8$ $L = 25$ $Q = CL(H + 2.5)^{1.5}$

$Q = 978$ CFS

STORAGE

	ELEV. (MSL)	AREA (Ac.) (PLANIMETERED FROM USGS)	STORAGE (ACRE FEET) (COMPUTED BY HEC-1 PROGRAM)
	194.3	0	0
NORMAL POOL	201	85	190
TOP OF DAM	204.3	—	493
	210	126	1133



BROCKTON RESERVOIR DAM

STAGE VS. STORAGE

STAGE VS. DISCHARGE

D-4

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JOB NED-COE
SHEET NO D-5 OF
CALCULATED BY RG DATE
CHECKED BY SHS DATE
SCALE

WALDO LAKE DAM - H&H

SUBDRAINAGE AREA = 0.38 Sq Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

Tp COMPUTATIONS

$L = 0.85$ MILE $L_{ca} = 0.28$

$T_p = C_t \cdot (L \times L_{ca})^{.3}$

$T_p = 2 \times (.85 \times .28)^{.3}$ $T_p \simeq$ 1.25 HOURS

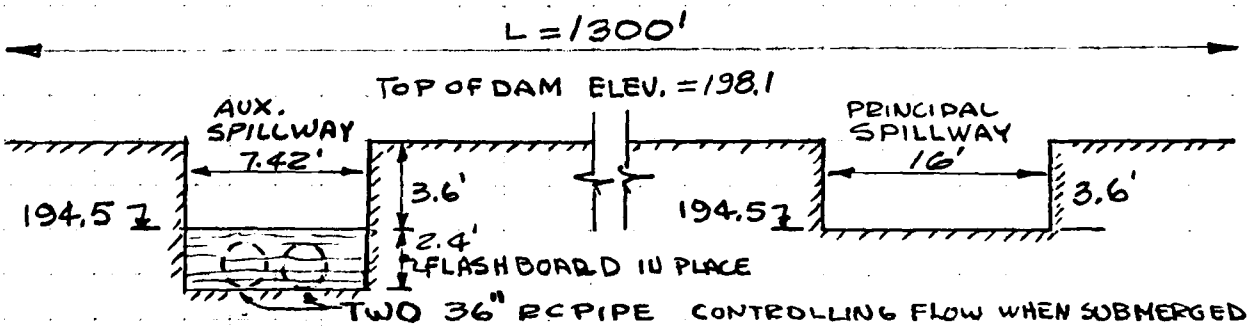
PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq Mi INDEX RAINFALL IS 21.5

6hr. % OF INDEX FOR THIS BASIN = 111
12hr " " " " " " = 124
24hr " " " " " " = 133

DAM ELEVATION & LENGTH and SPILLWAYS DIMENSIONS SKETCH

LOOKING DOWNSTREAM



$C = 3.3$ W/BOARDS $C_{Top} = 2.9$ $C = 3.1$

LOOKING DOWNSTREAM

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SHEET NO. D-6 OF
CALCULATED BY RG DATE
CHECKED BY SHS DATE
SCALE

WALDO LAKE DAM H&H cont'd

STAGE DISCHARGE

H=0 @ SPILLWAY CREST

1) SERVICE SPILLWAY : C = 3.1 L = 16' $Q_1 = CLH^{1.5}$
2) AUXILIARY SPILLWAY : C = 3.3 L = 7.42' $Q_2 = CLH^{1.5}$ FOR $H \leq 3.6$
3) H > 3.6 PIPE CONTROL $Q_3 = .65A\sqrt{2gd}$
4) TOP OF DAM : C = 2.9 L = 300' $Q_4 = CL(H-3.6)^{1.5}$

d = depth of water to centroid of pipe

ELEVATION MSL	H FT	Q_1	Q_2	Q_3	Q_4	ΣQ
		CFS				
194.5	0	0	0		0	
195.5	1	50	25		0	75
196.5	2	140	69	PIPE	0	209
197.5	3	258	127	FLOW	0	418
198.1	3.6	339	160		0	499
198.5	4	397	6	173	936	1,500
199.5	5	555	41	188	6,132	6,916
200.5	6	729	91	202	13,764	14,786
201.5	7	919	154	215	23,209	24,497
202.5	8	1,122	226	227	34,168	35,743

OVERTOPPING

SURCHARGE STORAGE

		ELEVATION (MSL)	AREA (AC) (PLANIMETERED FROM USGS)	STORAGE (AC. FEET) (COMPUTED BY HEC-1 PROGRAM)
NORMAL POOL	(FROM)	194.5	77.	0
TOP OF DAM	(TO)	198.1	-	342
		200	137	581

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CHECKED BY SHS DATE
SCALE

UPPER PORTER DAM - H & H

SUBDRAINAGE AREA = 0.11 Sq. Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 0.44$ MILES $L_{ca} = 0.22$ MILES

$T_p = C_t \cdot (L \times L_{ca})^{.3}$

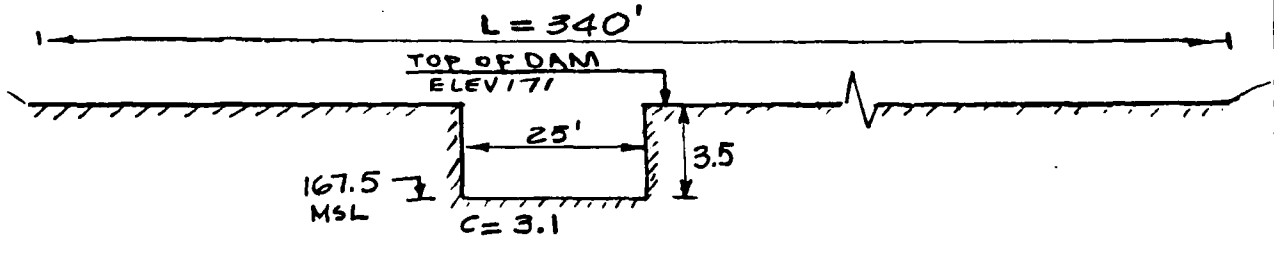
$T_p = 2 \times (.44 \times .22)^{.3} \simeq$ 1.0 Hour

PMP DATA

FROM HMS #33 THE 24 HOUR 200 SqMi INDEX RAINFALL IS 21.5

6hr. % OF INDEX FOR THIS BASIN = 111
12hr. % " " " " " = 124
24hr. % " " " " " = 133

DAM ELEVATION & LENGTH and SPILLWAY DIMENSIONS SKETCH



C = 2.8 TOP OF DAM

LOOKING DOWNSTREAM

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SHEET NO. D-8 OF
CALCULATED BY RG DATE
CHECKED BY SHS DATE
SCALE

UPPER PORTER DAM - H&H

STAGE DISCHARGE

(H=0 @ SPILLWAY CREST) ELEVATION = 167.5 MSL

1) SPILLWAY: $C = 3.1$ $L = 25'$ $Q_S = CLH^{1.5}$

2) TOP OF DAM: $C = 2.9$ $L = 340 - 25 = 315$ $Q_{TOP} = CL(H-3.5)^{1.5}$

ELEVATION MSL	H Ft.	Q_S CFS	Q_{TOP} CFS	ΣQ CFS
167.5	0	0	0	
168.5	1	78	0	78
169.5	2	219	0	219
170.5	3	403	0	403
171.0	3.5	508	0	508
172.0	4.5	740	913	1,653
173.0	5.5	1,000	2,584	3,584
174.0	6.5	1,284	4,747	6,031
175.0	7.5	1,592	7,308	8,900
176.0	8.5	1,921	10,213	12,134

STORAGE

	ELEV. (MSL)	AREA (AC) (PLANIMETERED FROM USGS)	STORAGE (AC. FEET) (COMP. BY HEC-1 PROGRAM)
	160	0	0
NORMAL POOL	167.5	11	28
TOP OF DAM	171	19	79

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SCALE

LOWER PORTER DAM - H & H

SUBDRAINAGE AREA = 0.08 Sq.Mi

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 0.64$ MILES $L_{ca} = 0.23$ MILES

$T_p = C_t \cdot (L \times L_{ca})^{.3}$

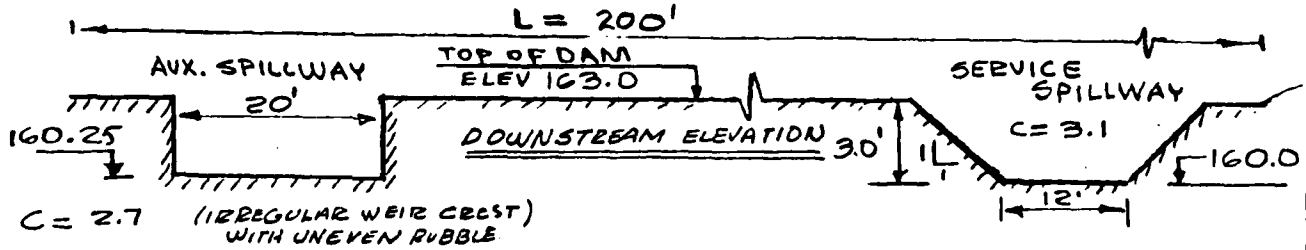
$T_p = 2 \times (.64 \times .23)^{.3} \simeq$ 1.13 HOURS

PMP DATA

FROM HMS #33 THE 24 HOUR 200 SqMi INDEX RAINFALL IS 21.5

6hr. % OF INDEX FOR THIS BASIN = 111
12hr. % " " " " " = 124
24hr. % " " " " " = 133

DAM ELEVATION & LENGTH and SPILLWAY DIMENSIONS SKETCH



C = 2.9 TOP OF DAM

LOOKING DOWNSTREAM

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JOB NED-COE
SHEET NO D-10 OF
CALCULATED BY RG DATE
CHECKED BY SHS DATE
SCALE

LOWER PORTER DAM cont'd

STAGE DISCHARGE

H = 0 @ SERVICE SPILLWAY CREST (ELEV. 160.0 MSL)

1) SERVICE SPILLWAY : $C = 3.1$ $L = 12'$ $Z = 1$
$b_o = 12'$ FOR $H \leq 3$ $Q_1 = C\left(\frac{b_o + b_H}{2}\right) H^{1.5}$
FOR $H > 3$ $Q_1 = C\left[\left(\frac{b_o + b_H}{2}\right) 3^{1.5} + 18 \times (H-3)^{1.5}\right]$

2) AUXILIARY SPILLWAY : $C = 2.7$ $L = 20'$ $Q_2 = CL(H - 0.25)^{1.5}$

3) TOP OF DAM : $C = 2.9$ $L = 200 - 38 = 162'$ $Q_3 = CL(H-3)^{1.5}$

ELEVATION MSL	H Ft	Q_1 CFS	Q_2 CFS	Q_3 CFS	ΣQ CFS
160	0	0	0	0	0
161	1	40	35	0	75
162	2	123	125	0	248
163	3	242	246	0	488
164	4	297	392	1,339	2,028
165	5	399	559	3,790	4,748
166	6	532	745	6,962	8,239
167	7	688	947	10,718	12,353
168	8	865	1,165	14,979	17,009

STORAGE

	ELEVATION (FT.)	AREA (AC.) (PLANIMETERED FROM USGS)	STORAGE (AC. FEET) (COMP. BY HEC-1 PROGRAM)
	151	0	0
NORMAL POOL	160	8	24
TOP OF DAM	163	—	54
	170	24	177

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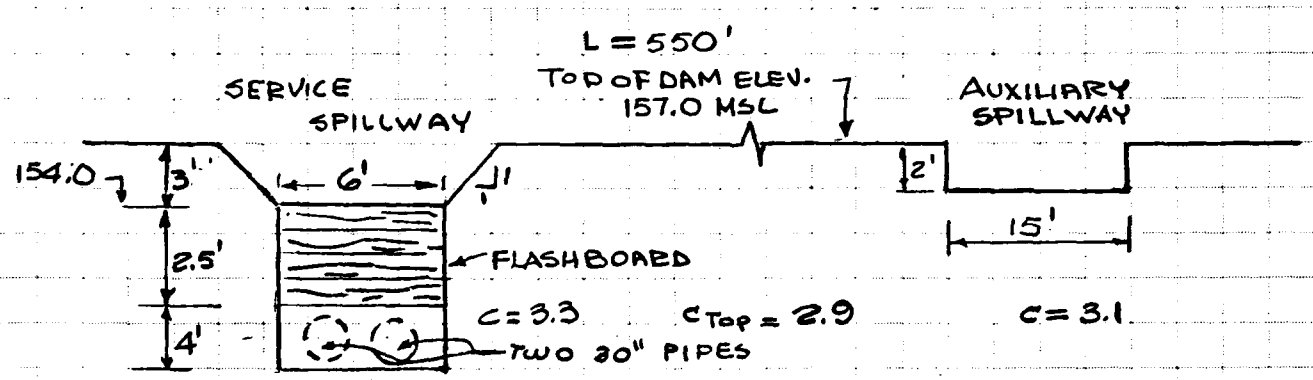
SCALE

THIRTY ACRE POND

DAM ELEVATION & LENGTH and SPILLWAYS DIMENSIONS SKETCH



STAGE DISCHARGE

H = 0 @ SERVICE SPILLWAY CREST (ELEV. = 154.0 MSL)

1) SERVICE SPILLWAY FOR $H \leq 3$ $Q_1 = C\left(\frac{b_o + b_H}{2}\right)H^{1.5}$

FOR $H > 3$ $Q_1 = C\left[\left(\frac{b_o + b_H}{2}\right)3^{1.5} + 12 \times (H-3)^{1.5}\right]$

2) AUXILIARY SPILLWAY $Q_3 = C\,L\,(H-1)^{1.5}$

3) TOP OF DAM: L = 523' $Q_4 = C\,L\,(H-3)^{1.5}$

ELEVATION MSL	H Ft.	Q_1	Q_2	Q_3	Q_4	EQ CFS
154	0	0		0	0	
155	1	23	PIPE FLOW	0	0	23
156	2	75		47	0	122
157	3	111	143	131	0	285
158	4	40	152	242	1517	1951
159	5	112	160	372	4290	4934
160	6	206	168	520	7881	8775

OVER TOPPING

SURCHARGE STORAGE

	ELEVATION	AREA (AC.) (PLANIMETERED FROM USGS)	STORAGE (AC. FEET) (COMPUTED BY HEC-1 PROGRAM)
NORMAL POOL	154	26	0
TOP OF DAM	157	—	86
	160	37	188

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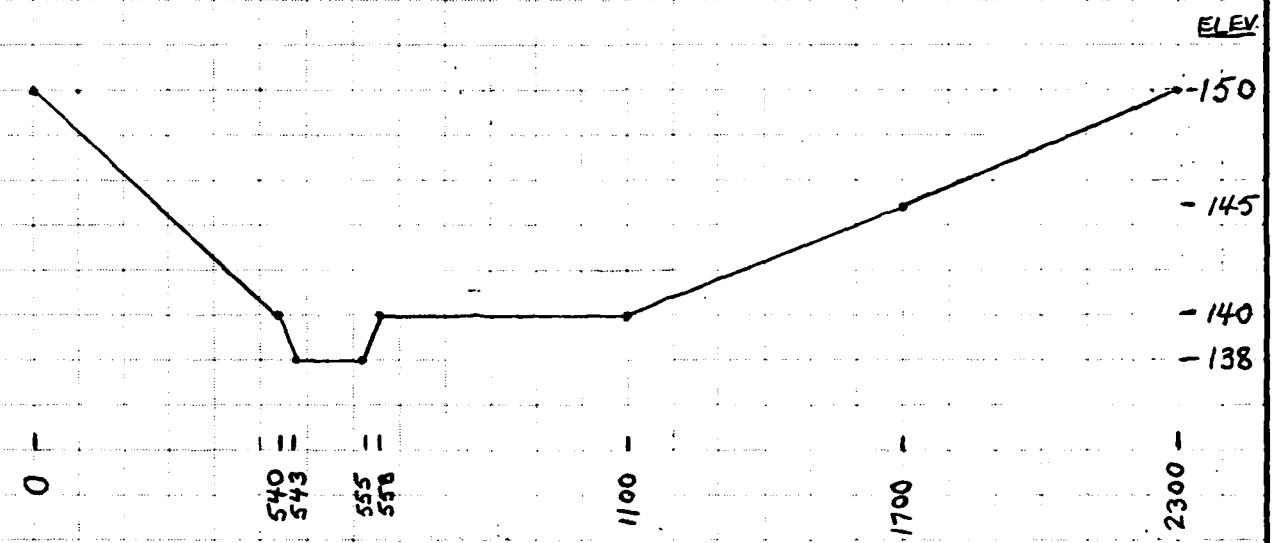
BROCKTON

DOWNSTREAM ROUTING

SECTION @ HAZARD AREA

1200 FEET DOWNSTREAM OF THIRTYACRE POND DAM



MANNING'S COEFFICIENTS : CHANNEL → 0.03
OVERBANKS → 0.08

CHANNEL SLOPE : .008 FT./FT.

ROUTING FLOODS THROUGH BROCKTON RESERVOIR DAM WITHOUT BREACHING

INPUT

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
     1      A
     2      A                    NATIONAL DAM SAFETY PROGRAM
     3      A                NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4      B    300       0      10       0       0       0       0       0      -4       0
     5      B1     5
     6      J      1       9       1
     7      J1    .1      .2      .3      .4      .5      .6      .7      .8     1.0
     8      K      0   BROCK                                                   1
     9      K1       INFLOW TO BROCKTON LAKE
    10      M      1       1     2.8       0    3.37                              1
    11      P      0    21.5     111     124     133
    12      T                                                              0    .05
    13      W    3.0     0.5
    14      X   -1.7    -0.1       2                                                1
    15      K      1   DAM 0                                                       1
    16      K1       ROUTED OUTFLOW FROM BROCKTON LAKE DAM
    17      Y                                       1       1
    18      Y1     1                                                   -201.0      -1
    19      Y4   201     202     203     204   204.3     205     206     207     208     209
    20      Y4   210
    21      Y5     0      83     233     429     495    3675   12332   24050   38163   54317
    22      Y5 70278
    23      $A     0      85     126
    24      $E 194.3     201     210
    25      $$   201
    26      $D 204.3
    27      K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	BROCK
ROUTE HYDROGRAPH TO	DAM 0
END OF NETWORK	

RUN DATE= 02/11/80.
TIME= 13.49.36.

HYDROLOGIC ANALYSIS OF BROCKTON LAKE DAM
NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	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= 9 LRTIO= 1

PERCENTAGES OF PMF USED → RTIOS= .10 .20 .30 .40 .50 .60 .70 .80 1.00

→ TEST FLOOD

INFLOW HYDROGRAPH DEVELOPMENT

SUB-AREA RUNOFF COMPUTATION

INFLOW TO BROCKTON LAKE

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

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.00	0.00	3.37	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	111.00	124.00	133.00	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= 3.00 CP= .50 NTA= 0

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

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 2.99 HOURS, CP= .50 VOL= .98

4.	14.	30.	48.	69.	91.	115.	141.	167.	194.
220.	243.	263.	279.	293.	303.	310.	313.	309.	299.
287.	276.	265.	254.	244.	234.	224.	215.	207.	198.
190.	183.	175.	168.	162.	155.	149.	143.	137.	132.
126.	121.	116.	112.	107.	103.	99.	95.	91.	87.
84.	80.	77.	74.	71.	68.	65.	63.	60.	58.
55.	53.	51.	49.	47.	45.	43.	42.	40.	38.
37.	35.	34.	32.	31.	30.	29.	28.	26.	25.
24.	23.	22.	22.	21.	20.	19.	18.	18.	17.
16.	15.	15.	14.	14.	13.	13.	12.	12.	11.

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	22.88	21.68	1.20	230485.
										(581.)	(551.)	(30.)	(6526.61)

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM BROCKTON LAKE DAM

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

ROUTING DATA

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

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-201.	-1

STAGE-DISCHARGE DATA

STAGE	201.00	202.00	203.00	204.00	204.30	205.00	206.00	207.00	208.00	209.00
	210.00									
FLOW	0.00	83.00	233.00	429.00	495.00	3675.00	12332.00	24050.00	38143.00	54317.00
	70278.00									

STAGE-STORAGE DATA

SURFACE AREA=	0.	85.	126.
CAPACITY=	0.	190.	1133.
ELEVATION=	194.	201.	210.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
201.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
204.3	0.0	0.0	0.

ROUTED OUTFLOWS

PEAK OUTFLOW IS 208. AT TIME 23.00 HOURS

PEAK OUTFLOW IS 478. AT TIME 22.33 HOURS

PEAK OUTFLOW IS 1285. AT TIME 19.67 HOURS

PEAK OUTFLOW IS 1826. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 2302. AT TIME 18.83 HOURS

PEAK OUTFLOW IS 2765. AT TIME 18.83 HOURS

PEAK OUTFLOW IS 3226. AT TIME 18.83 HOURS

PEAK OUTFLOW IS 3694. AT TIME 18.83 HOURS

PEAK OUTFLOW IS 4639. AT TIME 18.67 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	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
PEAK INFLOWS HYDROGRAPH AT	BROCK	2.80 (7.25)	1	465. (13.18)	931. (26.36)	1396. (39.54)	1862. (52.71)	2327. (65.89)	2792. (79.07)	3258. (92.25)	3723. (105.43)	4654. (131.79)
ROUTED OUTFLOWS ROUTED TO	DAM 0	2.80 (7.25)	1	208. (5.89)	478. (13.53)	1285. (36.38)	1826. (51.70)	2302. (65.18)	2765. (78.31)	3226. (91.36)	3694. (104.61)	4639. (131.37)

RESULTS OF VARIOUS FLOODS
AT BROCKTON RESERVOIR DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	201.00	201.00	204.30
STORAGE	190.	190.	493.
OUTFLOW	0.	0.	495. → SPILLWAY DISCHARGE CAPACITY

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	202.83	0.00	353.	208.	0.00	23.00	0.00
.20	204.22	0.00	486.	478.	0.00	22.33	0.00
.30	204.47	.17	511.	1285.	5.50	19.67	0.00
.40	204.59	.29	523.	1826.	7.67	19.00	0.00
.50	204.70 → TEST FLOOD ELEVATION	.40	533.	2302. → ROUTED TEST FLOOD OUTFLOW	9.33	18.83	0.00
.60	204.80	.50	543.	2765.	10.33	18.83	0.00
.70	204.90	.60	554.	3226.	11.33	18.83	0.00
.80	205.00	.70	564.	3694.	12.17	18.83	0.00
1.00	205.11	.81	575.	4639.	13.50	18.67	0.00

BROCKTON RESERVOIR DAM BREACH OUTFLOW
ROUTED THROUGH THE DOWNSTREAM RESERVOIRS
TO THE DAMAGE CENTER

INPUT

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  26 FEB 79
```

```
     1          A
     2          A
     3          A
     4          R    300       0      10       0       0       0       0      -4       0
     5          RI     5
     6          J      1       1       1
     7          J1     0
     8          K      1   DAM 0                                       1
     9          K1        ROUTED OUTFLOW FROM BROCKTON LAKE DAM
    10          Y                                  1       1
    11          Y1     1                                           -204.3      -1
    12          Y4   201     202     203     204   204.3     205     206     207     208     209
    13          Y4   210
    14          Y5     0      83     233     429     495    3675   12332   24050   38163   54317
    15          Y5 70278
    16          $A     0      85     126
    17          $E 194.3     201     210
    18          $$   201
    19          $D 204.3
    20          $R   720   0.01   194.3       2   204.3   204.3
    21          K      1   WALDO                                       1
    22          K1        BROCKTON BREACH ROUTING THROUGH WALDO LAKE
    23          Y                                  1       1
    24          Y1     1                                           -194.5      -1
    25          Y4 194.5   195.5   196.5   197.5   198.1   198.5   199.5   200.5   201.5   202.5
    26          Y5     0      75     209     418     499    1500    6916   14786   24497   35743
    27          $A    77     137
    28          $E 194.5     200
    29          $$ 194.5
    30          $D 198.1
    31          K      1   UPORT                                       1
    32          K1        BROCKTON BREACH THROUGH UPPER PORTER POND
    33          Y                                  1       1
    34          Y1     1                                           -167.5      -1
    35          Y4 167.5   168.5   169.5   170.5     171     172     173     174     175     176
    36          Y5     0      78     219     403     508    1653    3584    6031    8900   12134
    37          $A     0      11      19
    38          $E   160   167.5     171
    39          $$ 167.5
    40          $D   171
    41          K      1   LPORT                                       1
    42          K1        BROCKTON BREACH THROUGH LOWER PORTER POND
    43          Y                                  1       1
    44          Y1     1                                           -160      -1
    45          Y4   160     161     162     163     164     165     166     167     168
    46          Y5     0      75     248     488    2028    4748    8239   12353   17009
    47          $A     0       8      24
    48          $E   151     160     170
    49          $$   160
    50          $D   163
```

INPUT (CONT.)

```
K      1  TPOND                                                    1
K1       BROCKTON BREACH THROUGH THIRTYACRE POND
Y                                                  1         1
Y1     1                                                     -154      -1
Y4   154      155      156      157      158      159      160
Y5     0       23      122      285     1451     4934     8775
$A    26       37
$F   154      160
$S   154
$D   157
K      1  HAZARD                                                   1
K1       CHANNEL ROUTING TO HAZARD CENTER
Y                                                  1         1
Y1     1                                                       -1
Y6 0.008   0.03    0.08      138      150     1200    0.008
Y7     0      150      540      140      543      138      555      138      558      140
Y7  1100      140     1700      145     2300      150
K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

ROUTE HYDROGRAPH TO	DAM 0
ROUTE HYDROGRAPH TO	WALDO
ROUTE HYDROGRAPH TO	UPORT
ROUTE HYDROGRAPH TO	LPORT
ROUTE HYDROGRAPH TO	TPOND
ROUTE HYDROGRAPH TO	HAZARD

END OF NETWORK

FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

RUN DATE= 02/12/80.
TIME= 10.50.15.

HYDROLOGIC ANALYSIS OF BROCKTON LAKE DAM
NATIONAL DAM SAFETY PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	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= 1 LRTIO= 1

NO INFLOW → RTIOS= 0.00

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM BROCKTON LAKE DAM

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

ROUTING DATA

	ULOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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	-204.	-1

STAGE - DISCHARGE DATA

STAGE	201.00	202.00	203.00	204.00	204.30	205.00	206.00	207.00	208.00	209.00
	210.00									
FLOW	0.00	83.00	233.00	429.00	495.00	3675.00	12332.00	24050.00	38163.00	54317.00
	70274.00									

STAGE - STORAGE DATA

SURFACE AREA=	0.	85.	126.
CAPACITY=	0.	190.	1133.
ELEVATION=	194.	201.	210.

SPILLWAY CREST ELEVATION →

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
201.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COQD	EXPD	DAMWID
204.3	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
720.	.01	194.30	2.00	204.30	204.30

} BREACH DATA - FAILURE BEGINS IMMEDIATELY WITH RESERVOIR SURFACE AT TOP OF DAM

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 5088. AT TIME .96 HOURS

→ PEAK BREACH DISCHARGE

HYDROGRAPH ROUTING

BROCKTON BREACH ROUTING THROUGH WALDO LAKE

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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	-195.	-1

STAGE-DISCHARGE DATA FOR WALDO LAKE DAM

STAGE	194.50	195.50	196.50	197.50	198.10	198.50	199.50	200.50	201.50	202.50
FLOW	0.00	75.00	209.00	418.00	499.00	1500.00	6916.00	14786.00	24497.00	35743.00

STAGE-STORAGE DATA FOR WALDO LAKE DAM

SURFACE AREA=	77.	137.
CAPACITY=	0.	581.
ELEVATION=	195.	200.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
194.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
198.1	0.0	0.0	0.

PEAK OUTFLOW IS 2296. AT TIME 1.50 HOURS

→ PEAK DISCHARGE FROM WALDO LAKE DAM

HYDROGRAPH ROUTING

BROCKTON BREACH THROUGH UPPER PORTER POND

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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	-168.	-1

STAGE-DISCHARGE DATA FOR UPPER PORTER POND DAM

STAGE	167.50	168.50	169.50	170.50	171.00	172.00	173.00	174.00	175.00	176.00
FLOW	0.00	78.00	219.00	403.00	508.00	1653.00	3584.00	6031.00	8900.00	12134.00

STAGE-STORAGE DATA FOR UPPER PORTER POND DAM

SURFACE AREA=	0.	11.	19.
CAPACITY=	0.	28.	79.
ELEVATION=	160.	168.	171.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
167.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
171.0	0.0	0.0	0.

PEAK OUTFLOW IS 1556. AT TIME 1.83 HOURS

→ PEAK DISCHARGE FROM UPPER PORTER POND DAM

HYDROGRAPH ROUTING

BROCKTON BREACH THROUGH LOWER PORTER POND

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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	-160.	-1

STAGE-DISCHARGE DATA FOR LOWER PORTER POND DAM

STAGE	160.00	161.00	162.00	163.00	164.00	165.00	166.00	167.00	168.00
FLOW	0.00	75.00	208.00	488.00	2028.00	4745.00	8239.00	12353.00	17009.00

SURFACE AREA=	0.	8.	24.
CAPACITY=	0.	24.	177.
ELEVATION=	151.	160.	170.

STAGE-STORAGE DATA FOR LOWER PORTER POND DAM

CHEL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
160.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
163.0	0.0	0.0	0.

PEAK OUTFLOW IS 1419. AT TIME 2.00 HOURS

→ PEAK DISCHARGE FROM LOWER PORTER POND DAM

****

HYDROGRAPH ROUTING

BROCKTON BREACH THROUGH THIRTYACRE POND

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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	-154.	-1

STAGE	154.00	155.00	156.00	157.00	158.00	159.00	160.00
FLOW	0.00	23.00	122.00	285.00	1951.00	4934.00	8775.00

STAGE-DISCHARGE DATA FOR THIRTYACRE POND DAM

SURFACE AREA=	26.	37.
CAPACITY=	0.	188.
ELEVATION=	154.	160.

STAGE-STORAGE DATA FOR THIRTYACRE POND DAM

CHEL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
154.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
157.0	0.0	0.0	0.

PEAK OUTFLOW IS 485. AT TIME 3.83 HOURS

→ PEAK DISCHARGE FROM THIRTYACRE POND DAM

****

HYDROGRAPH ROUTING

CHANNEL ROUTING TO HAZARD CENTER

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	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 DEPT- CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0470	.0300	.0800	138.0	150.0	1200.	.00800

} CHANNEL CHARACTERISTICS AT DOWNSTREAM DAMAGE AREA

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

0.00 150.00 540.00 140.00 543.00 138.00 555.00 138.00 558.00 140.00
1100.00 140.00 1700.00 145.00 2300.00 150.00

} CROSS-SECTION OF DOWNSTREAM CHANNEL AT DAMAGE CENTER

STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE DOWNSTREAM CHANNEL AT THE DAMAGE AREA

STORAGE	0.00	.23	.48	.77	9.61	21.90	36.11	52.22	70.25	90.19
	112.05	135.81	161.49	189.08	218.58	249.99	283.32	318.56	355.70	394.77
OUTFLOW	0.00	25.09	80.84	161.54	1004.34	3526.43	7268.17	12147.89	18133.02	25212.25
	33385.64	42660.04	53046.66	64559.63	77215.15	91030.89	106025.57	122218.70	139630.39	158281.17
STAGE	138.00	138.63	139.26	139.89	140.53	141.16	141.79	142.42	143.05	143.68
	144.32	144.95	145.58	146.21	146.84	147.47	148.11	148.74	149.37	150.00
FLOW	0.00	25.09	80.84	161.54	1004.34	3526.43	7268.17	12147.89	18133.02	25212.25
	33385.64	42660.04	53046.66	64559.63	77215.15	91030.89	106025.57	122218.70	139630.39	158281.17

MAXIMUM STAGE IS 140.1

↳ STREAM ELEVATION AT DAMAGE AREA

BROCKTON RESERVOIR DAM
BREACH OUTFLOW

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	204.30	201.00	204.30
STORAGE	493.	190.	493.
OUTFLOW	495.	0.	495.

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
0.00	204.28	0.00	493.	5088.	0.00	.96	0.00

→ PEAK BREACH DISCHARGE

WALDO LAKE DAM
ROUTED OUTFLOW

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	194.50	194.50	198.10
STORAGE	0.	0.	342.
OUTFLOW	0.	0.	499.

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
0.00	198.65	.55	406.	2296.	1.33	1.50	0.00

→ ROUTED OUTFLOW

UPPER PORTER POND DAM
ROUTED OUTFLOW

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	167.50	167.50	171.00
STORAGE	28.	28.	79.
OUTFLOW	0.	0.	508.

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
0.00	171.92	.92	98.	1556.	1.50	1.83	0.00

→ ROUTED OUTFLOW

LOWER PORTER POND DAM
ROUTED OUTFLOW

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	160.00	160.00	163.00
STORAGE	24.	24.	54.
OUTFLOW	0.	0.	488.

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
0.00	163.60	.60	61.	1419.	1.83	2.00	0.00

→ ROUTED OUTFLOW

THIRTYACRE POND DAM
ROUTED OUTFLOW

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	154.00	154.00	157.00
STORAGE	0.	0.	86.
OUTFLOW	0.	0.	285.

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
0.00	157.12	.12	90.	485.	5.50	3.83	0.00

485. → ROUTED OUTFLOW

DAMAGE CENTER DATA → PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	484.	140.1	4.00

140.1 → STREAM ELEVATION AT DAMAGE AREA

484. → FLOW THROUGH DAMAGE AREA

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
MA	786	NED	MA	021	11				BROCKTON RESERVOIR DAM	4206.8	7103.1	04	JAN	80

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	BROCKTON RESERVOIR

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	06	BEAVER BROOK	BROCKTON	2	90000

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) NORMAL (ACRE-FT.)
HEPG	1866	S	10	10	490	190

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	

(28) REMARKS

(29) DAMS HAZ	(30) SPILLWAY CREST LENGTH	(31) TYPE	(32) WIDTH (FT.)	(33) MAXIMUM DISCHARGE (FT.)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MWE)	(36) PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT.)	(39) WIDTH (FT.)	(40) LENGTH (FT.)	(41) WIDTH (FT.)	(42) LENGTH (FT.)	(43) WIDTH (FT.)	(44) LENGTH (FT.)	(45) WIDTH (FT.)
2	1600	U	25	978	24000											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
BROCKTON WATER DEPT.	UNKNOWN	UNKNOWN

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

(50) INSPECTION BY	(51) INSPECTION DATE DAY	MO	YR	(52) AUTHORITY FOR INSPECTION
O'BRIEN + GERE ENGINEERS INC.	17	OCT	79	PL 92-367

(53) REMARKS
33-SPILLWAY DISCHARGE W/O FLASHBOARDS RESERVOIR AT TOP OF DAM

END

FILMED

8-85

DTIC