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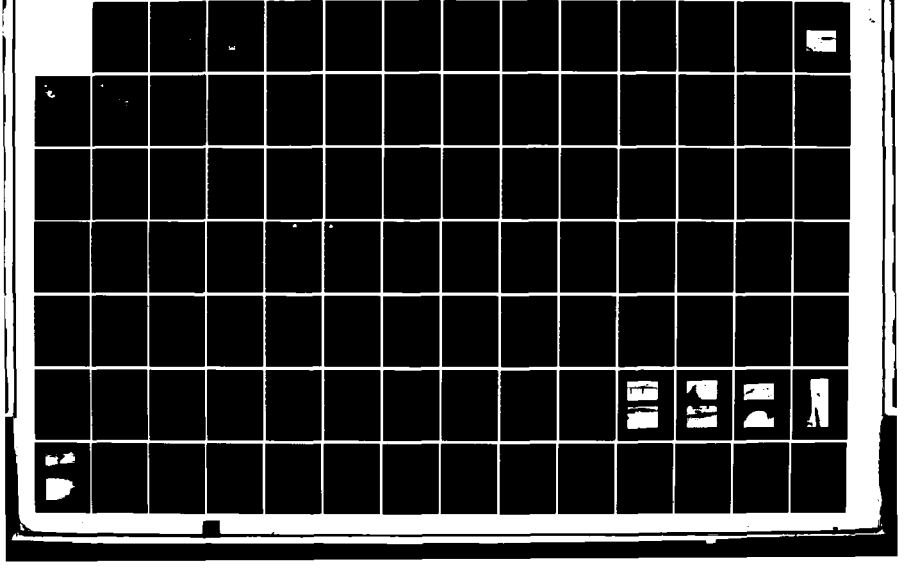

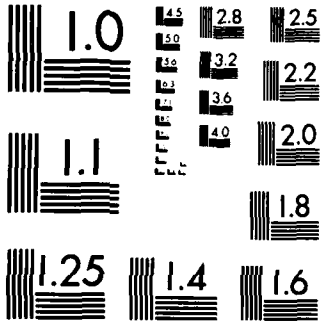

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ASSABET RIVER BASIN
WESTBOROUGH, MASSACHUSETTS

ASSABET RIVER DAM
MA 01000

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

DECEMBER 1979

UNCLASSIFIED

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

DAMS, INSPECTION, DAM SAFETY,

Assabet River Basin
Westborough, Massachusetts
Assabet River - Tributary to Merrimack River

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

The dam is an zoned earthfill dam that is about 1560 ft. long and 20 ft. high. The dam is in fair condition. Regular monitoring programs of the groundwater levels should be instituted to monitor the performance of the dam. It is intermediate in size with a hazard potential of high.

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ASSABET RIVER DAM

MA 01000

ASSABET RIVER BASIN
WESTBOROUGH, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION
PROGRAM

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

BRIEF ASSESSMENT

Identification No.: 1000

Name of Dam: Assabet River Dam

Town: Westborough

County and State: Worcester County, Massachusetts

Stream: Assabet River - Tributary to Merrimack River

Date of Inspection: September 20, 1979

The Assabet River Dam is a zoned earthfill dam and was constructed in 1969 as part of the SuAsCo (Sudbury, Assabet and Concord Rivers) flood control project. The dam is 1,560 feet long, 20 feet high and has a maximum storage capacity of 6,722 acre-ft. The top of the dam varies from elevation (El) 318.8 to 320.1. A concrete intake structure near the approximate center of the dam serves as a spillway and a low level outlet. There are four rectangular orifices with inverts at El 310.0 located on the sides of the intake structure. The top of the structure is open and forms the spillway crest at El 311.5. Trash racks are provided around the intake structure. The low level outlet consists of a 24-inch diameter corrugated metal pipe controlled by a 24-inch sluice gate located on the upstream wall of the intake structure. Discharge from the low level outlet and the spillway is carried by a 48-inch diameter reinforced concrete pipe through the dam. An emergency spillway is located at the left (west) end of the dam. This spillway extends downstream of the dam and intersects the discharge channel from the spillway outlet about 240 feet downstream of the dam.

Generally, the dam is in fair condition. Based on the visual inspection and the engineering data, certain conditions at the dam must be corrected and a regular monitoring program of the groundwater levels be

reinstitued to monitor the performance of the dam. The conditions which require attention are: the lack of riprap on the upstream slope of the dam at the left abutment, riprap dislodged around the intake structure and in the downstream channel, and brush growing on the dam.

Based on the Corps of Engineers' guidelines, the dam has been classified in the "intermediate" size and in the "high" hazard categories. The drainage area is 7.17 square miles. A test flood equal to the full probable maximum flood (PMF) was used to evaluate the spillway capacity. Due to the restriction caused by the railroad embankment along the west side of the watershed, the test flood inflow was reduced from 12,875 cubic feet per second (cfs) to 9,960 cfs. The peak test flood outflow of 5,040 cfs with the reservoir at El 318.9 would overtop a small section of the dam near the left abutment by 0.1 feet. The ungated spillway plus the emergency spillway can discharge 4,875 cfs which is 97 percent of the test flood before the dam is overtopped.

It is recommended that the Owner retain a qualified registered engineer to establish criteria by which the results of the groundwater monitoring program can be evaluated. The Owner should reinstitute monitoring of groundwater instrumentation, conduct surveillance of the dam during and after periods of heavy rainfall or flooding, and establish a plan to warn downstream residents in case of an emergency at the project. The Owner should also correct the conditions listed above, as described in Section 7.3.

The measures outlined above and in Section 7 should be implemented by the Owner within a period of one year after receipt of this Phase 1 Inspection Report.

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

Massachusetts Registration
No. 29800

Approved by:

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

Massachusetts Registration
No. 19703

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

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials
Branch
Engineering Division

FRED J. RAVENS, JR., Member
Chief, Design Branch
Engineering Division

SAUL C. COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

ASSABET RIVER DAM

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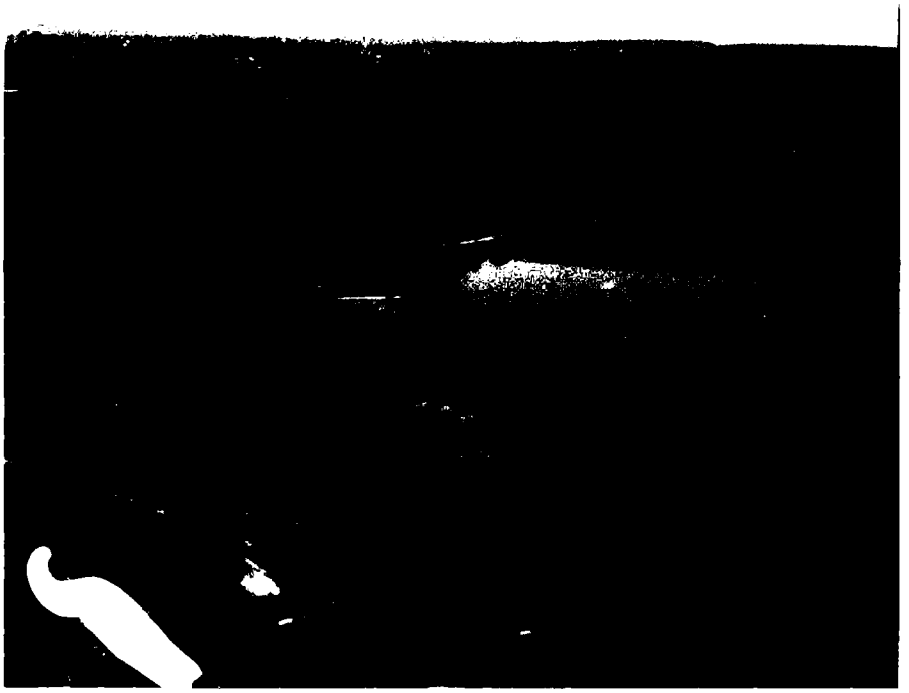
ASSABET RIVER DAM
WESTBOROUGH, MASSACHUSETTS



SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The Phase I Inspection of the dam on the Assabet River was performed on September 20, 1979. A copy of the inspection check list is in Appendix A. Copies of previous inspections done on an annual basis by the Soil Conservation Service (SCS) are included in Appendix B.

b. Dam. In general, the dam is in good condition. However, due to heavy vegetation on the embankments, close examination of the slopes and toe of the dam was not possible. At the time of the inspection, no seepage was observed in locations previously indicated in early reports as having been wet. It should be noted that the pond was at El 308.3 or about 2 feet below the normal pool. There is no riprap on the upstream slope of the dam except in the vicinity of the intake structure. The left end of the dam is also the east slope of the emergency spillway. There is no riprap protection in this area. Brush is growing on both the upstream and downstream slopes of the dam. The downstream toe is separated from the emergency spillway by an earth slope covered with vegetation. There are bike paths on the downstream slope of the dam. In these areas, minor erosion of the slope has occurred. The top of the dam is a compact gravel pathway with no vegetation.

c. Appurtenant Structures. The spillway at the Assabet River Dam consists of a concrete intake structure at the center of the dam, a low level outlet pipe 24 inches in diameter extending 24 feet out into the pond, a 48-inch conduit through the dam and a concrete outlet structure with a baffle.

The low level outlet at the intake structure was submerged and not visible. The sluice

2.2 Construction Records. As-built drawings are available from the Amherst, Massachusetts office of the SCS. A review of these drawings indicates the dam generally was built in accordance with the design plans. During construction of the dam change orders were issued to install relief wells, observation tubes and piezometers. Daily water level readings were obtained and plotted by the SCS from 1970 to 1974. Additional periodic monitoring of the instrumentation was done up to 1977.

2.3 Operating Records. The pond level and groundwater levels, daily precipitation and dates of opening and closing of the sluice gate were kept on a daily basis from October 1970 to April 1974 by the SCS.

Monitoring of the groundwater instrumentation continued on a periodic basis until 1977. At that time the monitoring program was suspended by the Soil Conservation Services because the data did not indicate any consistent trends which could be correlated to the water level; the data obtained did not indicate any problems; and several of the instruments were inoperable by 1977.

2.4 Evaluation

a. Availability. There is considerable engineering data available.

b. Adequacy. A limited review was made of the hydraulic, soils, structure and construction data. Therefore, the evaluation of the adequacy of this dam is based on a brief review of this data and available drawings visual inspection, past performance history and engineering judgment.

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

SECTION 2

ENGINEERING DATA

2.1 General. The Soil Conservation Service (SCS) in Amherst, Massachusetts has complete sets of drawings for all of the contracts issued during the construction of this dam. The SCS assisted in the planning and construction of this dam. The drawings which were received and reviewed are:

a. The George H. Nichols Multiple-Purpose Dam - 27 sheets (Assabet River Dam) (1969)

b. Emergency Spillway Earth Blanket - 2 sheets (1970)

c. Structural Additions - 8 sheets (1973)

d. Stabilization of Structures - 2 sheets (1970)

e. Relief Wells and Observation Tubes - 4 sheets (1970)

f. Piezometer Installation - 2 sheets (1970)

Design calculations and specifications for the dam were also obtained from the same office. The data available at the office are:

g. hydraulic calculations

h. embankment and foundation design

i. soil testing results

j. geology report

k. structural design

l. specifications for constructing the dam

We acknowledge the assistance and cooperation of personnel from the Soil Convervation Service particularly Mr. Jack Tibbets of that office who was present during the inspection of the dam.

(i) Regulating Outlets: The regulating outlet at the dam is a 24-inch sluice gate which controls the low-level outlet. The bottom of the gate is at El 299.0. The capacity of the gate is 263 cfs when the pond is at El 312.7. Below this elevation the intake governs the rate of flow. Above El 312.7 the 48-inch diameter outlet pipe spillway governs the rate of flow. The gate is manually operated and can be raised 2 feet to a fully open position.

(5) Side slopes - downstream: 3:1
upstream: 3:1 above El 313.0
4:1 below El 313.0

(6) Zoning: silt central core 12 feet wide at top (El 313.0) with side slopes at 1:2; compacted silty sand flanks this central core with a 1-foot thick filter material covering the upstream face below El 313.0; impervious silt core around principal spillway.

(7) Impervious core: silt

(8) Cutoff: Varies from El 295 to 310

(9) Grout curtain: none

h. Spillway

(1) Type - Orifices
Ogee crested (Main)
Narrow crested (Emergency)

(2) Crest length - 24 feet (orifices)
29 feet (Main)
100 feet (Emergency)

(3) Crest elevation - 310.0 (orifices)
311.5 (Main)
313.0 (Emergency)

(4) Gates - None

(5) Upstream channel - none (Main)
trapezoidal grass-lined channel (Emergency)

(6) Downstream channel - 48-inch reinforced concrete pipe discharging into a 15 foot wide trapezoidal riprap-lined channel with 2:1 slopes (Main)

Trapezodial grass-lined channel which merges with spillway discharge channel (Emergency)

(9) Tailwater: 298.4 (water in spillway discharge channel)

d. Reservoir

(1) Length of maximum pool: 12,400 feet

(2) Length of recreation pool: 6,800 feet

(3) Length of flood control pool: 12,400 feet

e. Storage (acre-feet)

(1) Test flood surcharge: 6,720

(2) Top of dam: 6,720 (El 318.8)

(3) Flood control pool: 3,770

(4) Recreation pool: 2,150

(5) Spillway crest: 2,150

f. Reservoir Surface (acres)

*(1) Top dam: 492

*(2) Test flood pool: 492

(3) Flood control pool: 492

(4) Recreation pool: 323

(5) Spillway crest (El 310): 323
emergency (El 313): 492

g. Dam

(1) Type - zoned - earthfill embankment

(2) Length - 1,560 feet

(3) Height - 20 feet (maximum)

(4) Top width - 12 feet

*Based on the assumption that the surface area will not significantly increase with changes in pond elevation from 313.0 to 319.0

b. Discharge at the Dam Site. Normal discharge from the pond occurs through the intake structure at the dam. Flow from the reservoir becomes the Assabet River which continues through Westborough and Northborough.

The outlet works at this dam consist of a 24 inch diameter intake conduit and a 48 inch diameter outlet conduit at invert El 299.5. The emergency spillway crest is at El 313.0.

The maximum known pond crest elevation is 311.5. At this elevation hydraulic analyses indicate that the outlet works can discharge 250 cfs. At the spillway crest the maximum normal pool is El 310.0. With the sluice gate on the intake fully opened, the outlet can discharge 45 cfs. At the dam crest, El 318.8, the ungated spillway capacity is 318 cfs and the total spillway capacity is 4,875 cfs. At the test flood elevation, 318.9 the ungated spillway capacity is 318 cfs, the gated spillway (emergency spillway only) is 4,722 cfs, and the total capacity of the spillways is 5,040 cfs with the dam overtopped.

c. Elevation (feet above the National Geodetic Vertical Datum of 1929 (NGVD)). A benchmark was set at El 307.0 on top of the concrete wall of the outlet structure.

(1) Top of dam 318.8 to 320.1.

(2) Test flood pool: 318.9

(3) Design surcharge: 313.0 (100-year storm by SCS)

(4) Full flood control pool: 313.0

(5) Recreation pool: 310.0

(6) Spillway crest: 310.0
Emergency spillway crest: 313.0

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

(8) Stream bed at centerline of dam: 299.0

f. Operator. The dam is operated by personnel of the Massachusetts Water Resources Commission.

g. Purpose of the Dam. The dam was built as part of the Sudbury Assabet Concord Rivers, (SuAs-Co) flood control project. The reservoir is used as a fish and wildlife preserve.

h. Design and Construction. Dam construction started in 1969. During construction, foundation problems developed and a supplemental contract was let in December 1970 for installation of observation wells, piezometers and relief wells. This work was designed and inspected by the Soil Conservation Service (SCS). A second supplemental contract was awarded in December 1970 for seeding approximately 730 linear feet of the emergency spillway and installing a 10-inch underdrain and impervious blanket downstream of the seeded area on the emergency spillway. In July 1973 another supplemental contract was let to riprap the spillway discharge channel.

i. Normal Operating Procedures. The pool is normally maintained below elevation 310.0. Minimum releases of 6 cfs and 2.5 cfs in the summer and winter, respectively are maintained by operating the sluice gate on the 24-inch low level outlet.

1.3 Pertinent Data

a. Drainage Area. The total drainage to the pond is approximately 4,589 acres (7.17 square miles) (see Location Map). The railroad embankment at the west end of the watershed restricts direct drainage into the pond. The area to the west of the railroad embankment is about 1,114 acres, which is approximately 24 percent of the total drainage area. This area drains into a swamp which is connected to the reservoir by a 3.2 foot by 4.0 foot box culvert under the embankment near Arch Street. The Arch Street underpass also serves as a connection to the reservoir at a higher elevation (see Location Map).

The emergency spillway, located at the left abutment of the dam, extends downstream and intersects the spillway discharge channel about 240 feet downstream of the toe of the dam (see Photo No. 7 in Appendix C). The emergency spillway is 100 feet wide at the reservoir, and has 2:1 side slopes. Along the upstream side the lowest point on the bottom of the spillway channel is at El 299.0. The entrance slopes upward at 3.5 percent to El 313.0 and is then level for about 30 feet. The contract drawings indicate a concrete weir, El 313.0 at the crest of the emergency spillway. This was not found during the inspection. There is a 6-inch perforated underdrain pipe on the west side of the emergency spillway which, according to the drawings, is 1 foot below the ground surface. The 6-inch pipe changes to a 10-inch pipe at El 298.0 with a 1.0 percent slope back into the reservoir.

The emergency spillway slopes at 2.0 percent from the crest to El 309.4 and then at a 0.2 percent slope until it merges with the spillway discharge channel. The emergency spillway bottom and embankments are grass covered.

c. Size Classification. Assabet River Dam is classified in the "intermediate" category since it has a maximum height of 20 feet and a maximum storage capacity of 6,722 acre-feet.

d. Hazard Classification. Downstream of the dam there are approximately 6 or 7 residential houses that would be affected in the event of failure of the dam. In the event of overtopping and complete failure of the dam, lives could be lost and excessive property damage could occur. For this reason the dam has been placed in the "high" hazard category.

e. Ownership. The dam is owned by the Massachusetts Water Resources Commission, Room 1901, 100 Cambridge Street, Boston, Massachusetts. Mr. Tom Douchette (telephone 617-727-3267) granted permission to enter the property and inspect the dam.

and separates the silty sand material and the sandy gravel berm shell located on the upstream embankment. A 5-foot thick drainage trench with 10-inch perforated pipe extends along the entire length of the dam along the downstream toe (see Figure B-5). This underdrain pipe discharges through the concrete training walls of the outlet structure.

A concrete intake structure serves as both the spillway and low level outlet at the dam. There are four rectangular orifices, each 6 feet long and 0.8 feet high, located on the sides of the intake structure (see Section 3-3 on Figure B-3). The inverts of the orifices are at El 310.0. The top of the intake structure is open and forms the spillway crest at El 311.5. There is a trash rack located above the sides and top of the intake structure (see photograph No. 1 in Appendix C). The low-level outlet is a 24-inch diameter corrugated metal pipe that discharges into the bottom of the intake structure. The outlet pipe extends 24 feet upstream into the pond and has an invert at El 299.5. Flow through the outlet pipe is controlled by a 24-inch wide sluice gate mounted on the upstream side of the intake structure. A metal grating over the trash rack forms a walkway to the sluice gate controls.

Discharge from the low-level outlet and the spillway is carried by a 74-foot long, 48-inch diameter reinforced concrete pipe through the dam. There are three reinforced concrete seepage collars around the pipe. The invert of the discharge pipe is at El 299.0, and the pipe has a 0.68 percent slope. There is an outlet structure at the downstream end of the discharge pipe. The outlet structure is a concrete chamber with an inverted "L" baffle. The top of the baffle is at El 304.7 (see Figure B-5 in Appendix B).

The spillway discharge channel is 15 feet wide with 2:1 slopes. The slopes and bottom are lined with hand-placed 12-inch riprap. The available drawings indicate the riprap is 1.5 feet thick with 1 foot of bedding material.

County, Massachusetts (see Flood Impact Area Map; Location Map; and Overview Photo). The coordinates of this location are Latitude 42 deg. 15.0 min. north and Longitude 71 deg. 38.2 min. west.

b. Description of Dam and Appurtenances. The Assabet River Dam is an earthfill dam with a maximum height of 20 feet (see Plan of Dam and Sections, Figures B-1 through B-5). The dam and emergency spillway are a total length of 1,560 feet. The emergency spillway which is located at the left abutment is about 100 feet wide. The top of the dam is about 12 feet wide. The design height of the dam was originally El 318.5. Additional fill was added during construction. The present height varies from El 318.8 to 320.1. A gravel covered roadway is located on the top of the dam. The slope of the upstream face of the dam is divided by a berm at El 313. Above this elevation the slope is 3:1 (horizontal to vertical) while below it is 4:1. The upstream slope is covered with vegetation and a few small bushes. There is no riprap except at the intake structure. The downstream slope is 3:1 and is covered with vegetation.

Available drawings indicate that the dam is founded on soil with a cutoff trench key varying from 12 to 15 feet deep. The trench key extends to bedrock at both the left and right abutments of the dam. The zoned embankment consists entirely of earthfill with a central core of low permeability which is 12 feet wide at the top (El 313.0) with 1:2 (horizontal to vertical) slopes down to the foundation of the dam. The bottom of the core trench varies in depth from 12 to 15 feet below the dam foundation. It extends from bedrock upward at a 2 to 1 slope to the dam foundation. In the vicinity of the spillway, this slope changes to 3 to 1 and is carried for 50 feet on each side of the spillway centerline (sta 58+00). A silty sand material flanks the central core zone. A one foot thick filter material extends from El 313.0 to the bottom of the dam foundation excavation

NATIONAL DAM INSPECTION
PROGRAM

PHASE I INSPECTION REPORT

ASSABET RIVER DAM,

SECTION 1

PROJECT INFORMATION

1.1 General

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

b. Purpose

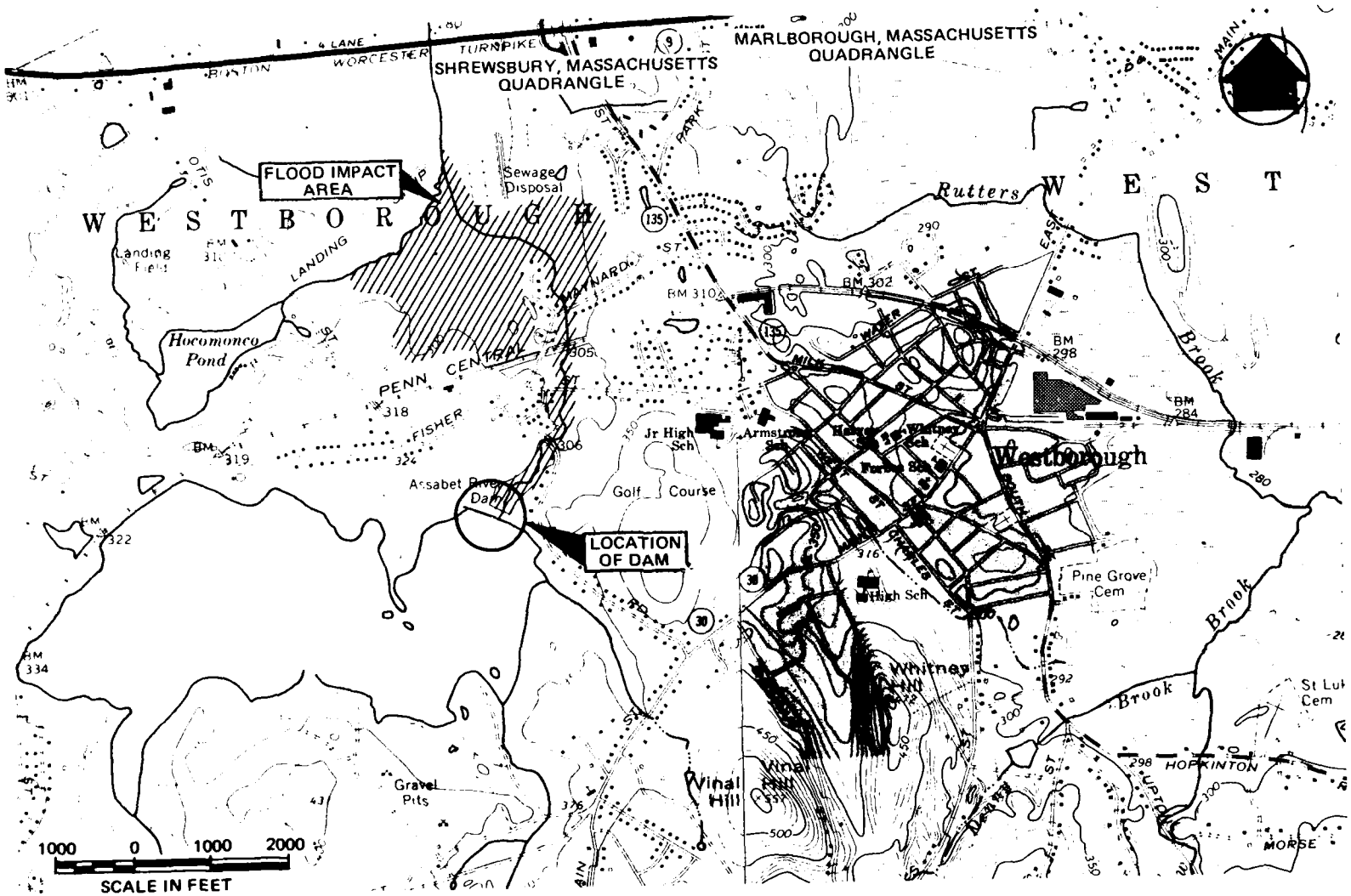
(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

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

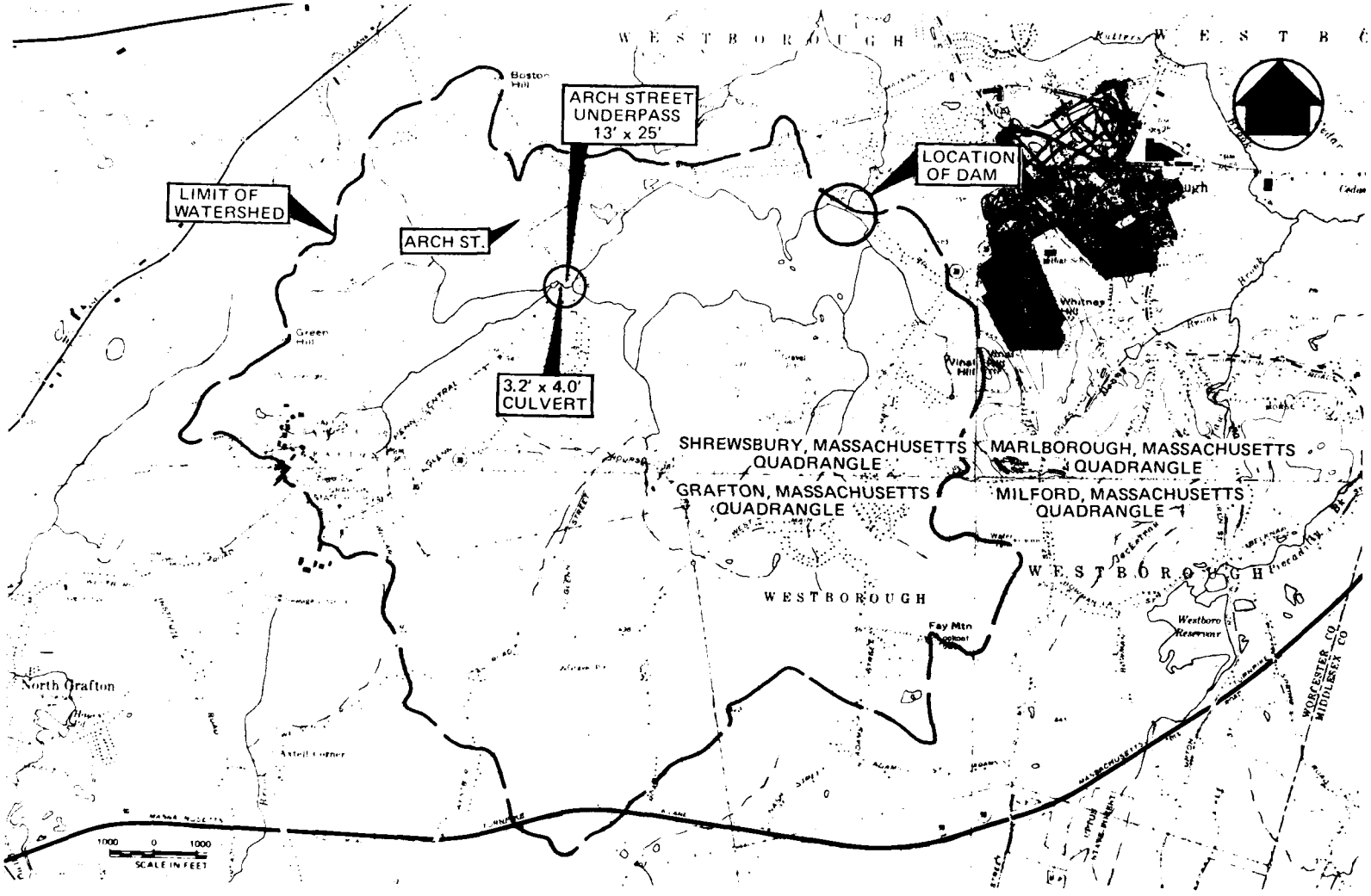
(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located on the Assabet River in the Town of Westborough, Worcester



FLOOD IMPACT AREA MAP – ASSABET RIVER DAM



LOCATION MAP – ASSABET RIVER DAM

gate is operable and at the time of the inspection was partially open to maintain flow in the Assabet River. It was not operated at the time of the inspection. The concrete on the intake structure was in good condition, although there was some minor pitting and staining on the walls. The trash rack around the intake structure is in fair condition. Some of the bar racks below the waterline show signs of heavy corrosion and several of the bolts are corroded. The riprap protection around the structure is in poor condition and in several areas the riprap is missing.

The outlet structure has a baffle wall with an aluminum grating cover. The concrete at the center I-beam connection on the upstream side has minor cracks on both sides of the support, and is in fair condition. The remaining concrete is in good condition with only minimal spalling and staining. Underdrain pipes were not observed during the dam inspection, nor was there any evidence of seepage discharge in the area where they were reported to be located.

The downstream channel which is lined with riprap is in good condition although there are localized areas where riprap is missing.

d. Reservoir Area. There are a few residential homes on the shoreline of the pond. The area around the pond is heavily wooded and is slight to very hilly. A large swamp is located on the west side of the Penn Central Railroad embankment and extends in a southwest direction from the westerly edge of the pond.

e. Downstream Channel. The discharge from the spillway flows in a riprapped channel and then into the natural Assabet River channel. The channel is generally free of debris. Immediately downstream, the river flows under three town roads and the Penn Central Railroad. The Assabet River flows north to the junction of the Sudbury River in Concord, where they form the Concord River.

3.2 Evaluation. Although the dam appears to be in good condition, there are deficiencies which require attention. Recommended measures to improve these conditions are included in Section 7.

SECTION 4

OPERATING PROCEDURES

4.1 Procedures. According to the SCS, the sluice gate is normally regulated to maintain a flow of 6.0 cfs during the summer and 2.5 cfs discharge during the winter.

4.2 Maintenance of Dam. The dam is generally well maintained. There is an annual inspection by the Soil Conservation Service and the Massachusetts Water Resources Commission. Repair work is done and the vegetation cut yearly by the Water Resources Commission.

4.3 Maintenance of Operating Facility. The operating mechanism at the dam is the sluice gate on the low-level outlet. This gate is operated by the SCS personnel during their annual inspection. The condition of the trash racks around the outlet structure (see Photo No. 1 in Appendix C) is also reported and maintenance performed as required.

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

4.5 Evaluation. An operating program has been developed for maintaining a constant flow in the Assabet River. Some additional maintenance should be implemented, and surveillance and warning programs should be put into effect, considering that the dam is in the "significant" hazard category. These recommendations are included in Section 7.3.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Data

a. General. The Assabet River Dam is a 20 foot high earthfill dam approximately 1,560 feet long. The dam is a zoned embankment with an impervious core. The intake structure located near the center of the dam is a concrete structure with a spillway crest at El 311.5 and four six-foot wide orifices at El 310.0. A 24-inch low-level outlet pipe at El 299.5 discharges into the intake structure. The low-level outlet is controlled by a manually operated sluice gate.

An emergency spillway is located at the left end of the dam. This spillway is 100 feet wide with a crest at El 313.0.

The total drainage area to the reservoir is 4,589 acres (7.17 square miles). The railroad embankment at the west end of the reservoir forms a restriction to 24 percent of the drainage area into the pond. Drainage from this area flows directly to a swamp which drains to the reservoir via a 3.2 foot by 4.0 foot box culvert through the railroad embankment. The invert of the culvert is at El 308.8. The Arch Street underpass, 25 feet wide and 13 feet high, adjacent to the culvert also would act as a connection to the reservoir during flood flows. This underpass is at El 315.2 (see Location Map).

b. Design Data. Hydraulic computations are available at the Soil Conservation Service office in Amherst, Massachusetts. A review of these calculations and plans indicate that the dam was designed to impound a 100-year frequency storm without discharge occurring in the emergency spillway. The inflow used for this

storm was 7,667 cfs. The design top of the dam was El 318.5. During construction the top of the dam was raised an additional foot to El 319.5. Measurements taken during this Phase I investigation shows a variation in the crest elevation from El 318.8 to El 320.1.

c. Experience Data. Daily readings of pond level and precipitation were recorded from October 1970 to April 26, 1974. During that period the maximum pond elevation was 310.5. Subsequently the maximum recorded water level was El 311.5 on January 26, 1979. There has been no overtopping of the dam nor has the emergency spillway ever been used.

d. Visual Observations. Minimum flow to the Assabet River is controlled by regulating the sluice gate to maintain a flow of 2.5 cfs in the winter and 6.0 cfs in the summer. Flow is into the discharge channel which is lined with riprap. All of the structures are in good condition.

e. Test Food Analysis. Assabet River Dam is classified in the "intermediate" size and "high" hazard categories. According to the Corps of Engineers' guidelines, a test flood of the full Probable Maximum Flood (PMF) should be used to evaluate the capacity of the spillway. The PMF inflow, which was determined to be 9,960 cfs, is based on a rate of 2,250 cfs per square mile for the 1.74 square miles of drainage area west of the railroad embankment and a rate of 1,650 cfs per square mile for the 5.43 square miles of drainage area east of the railroad embankment. The peak flow rate was estimated from the design curves based on the "rolling" category. The calculations assume average drainage slopes of 2.9 percent west of the railroad embankment and 2.2 percent on the east side. The maximum discharge of 1,000 cfs, with the water at El 320.0 through the culvert and underpass is added to the estimated peak runoff from the east side of the embankment. No adjustment was made for non-coincident peak flows. By adjusting the inflow test flood for

surcharge storage the maximum discharge rate was established as 5,040 cfs with the pond at El 318.9.

Hydraulic analyses indicate that the full PMF will cause overtopping of the dam for a length of up to 160 feet at the west end of the embankment. The spillways can pass 4,875 cfs or 97 percent of the test flood outflow before the dam is overtopped. With the pond at El 310.0, the low-level outlet can lower the pond 1 foot in about 9 days, assuming no inflow.

f. Dam Failure Analysis. Dam failure was calculated with the pond elevation at El 318.8, the low point on the top of the dam. In this event, if the dam fails, the initial outflow would be approximately 35,600 cfs, including 4,900 cfs through the spillways. Failure of the dam would produce a flood wave 15.5 feet high approximately 1,300 feet downstream. This distance corresponds to the location of a bridge on Mill Road. Mill Road would be overtopped by the flood wave. There are six or seven homes in this area that would be impacted by the flood wave. The depth of water in the stream channel would be 7.0 feet prior to failure of the dam.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The evaluation of the structural stability of the dam is based on the visual inspection conducted on September 20, 1979 and review of the plans and data as referenced in Section 2 Engineering Data. It should be pointed out that the groundwater and piezometer information was only obtained for a four year period when the pond elevation did not exceed El 310.5, which is only about 50 percent of the height of the embankment. As discussed in Section 3, the embankment of the dam is generally in good condition.

Based on the limited groundwater and piezometer data, the seepage under the dam can not be evaluated unless more detailed information is obtained. Monitoring of the groundwater instrumentation should be reinstituted on a regular basis. The data should be reviewed and evaluated.

b. Design and Construction Data. The information listed in Section 2, Engineering Data, represents the available design and construction data. The initial seepage calculations for the design of this dam indicated that no relief wells would be required. However, during the filling of the reservoir "boils" were observed near the downstream toe of the dam. The water level was immediately lowered and relief wells, observation tubes and piezometers were installed. The piezometers and observation tubes were monitored daily from October 1, 1970 to April 26, 1974. Subsequently periodic monitoring of these instruments continued to 1977.

c. Operating Records. Elevations of the pond and water levels in the piezometers and observation tubes were plotted by the SCS along with notes of the operating position of the sluice gate. At the present time this instrumentation is not being monitored.

d. Post-Construction Changes. Subsequent to the installation of the relief wells and piezometers, additional contracts were awarded for seeding the emergency spillway and placing an impermeable blanket on the upstream end of the emergency spillway. These contracts were awarded in 1970. In 1973, an additional contract was awarded to place riprap in the spillway channel and install an underdrain pipe in the emergency spillway.

e. Seismic Stability. The dam is located in Seismic Zone No. 2 and in accordance with Phase I "Recommended Guidelines" does not warrant seismic analyses at this time.

SECTION 7

ASSESSMENT, RECOMMENDATIONS
AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon the review of available drawings, design calculations, laboratory soil tests, visual inspection of the site, and limited operational and groundwater monitoring data, there are maintenance and monitoring measures that must be performed to assure the continued performance of this dam. There is a lack of riprap protection on the upstream face of the dam at the west abutment adjacent to the emergency spillway. At the outlet structure and in the downstream channel the riprap is in poor condition. Brush is growing on the upstream and downstream slopes of the dam.

A test flood equal to the full PMF was used to evaluate the capacity of the two spillways. The test flood inflow was estimated to be 9,960 cfs, after adjusting for the attenuating effect of the railroad embankment upstream. The test flood outflow is estimated to be 5,040 cfs. The outflow would result in a reservoir level of El 318.9 which would overtop the dam by 0.1 feet at the left end adjacent to the emergency spillway. The two spillways can discharge a combined flow of 4,875 cfs which is 97 percent of the test flood outflow without overtopping the low area of the dam.

b. Adequacy of Information. The detailed design and construction data allowed a limited review. The evaluation of the adequacy of this dam is based on review of available drawings, design computations, soil laboratory test results, visual inspection, past performance history and engineering judgment.

c. Urgency. The recommendations and remedial measures outlined below should be implemented

by the Owner within one year after receipt of this Phase I Inspection Report. The monitoring of the piezometers should be initiated immediately and should continue on at least a monthly basis.

d. Need for Additional Investigation. No additional field investigations to further assess the dam are recommended at this time. However, the piezometers and observation tubes should be monitored and the data evaluated.

7.2 Recommendations. It is recommended that the Owner retain a qualified registered engineer to review the piezometer and observation tube data and establish criteria for evaluating the data.

7.3 Remedial Measures. It is recommended that the Owner accomplish the following:

a. Institute a definite plan for surveillance of the dam during periods of heavy rain and/or runoff and a plan for notifying downstream residents in the event of an emergency at the project.

b. Monitor the water level instrumentation on a regular monthly basis plus during times of heavy rain and/or runoff.

c. Establish a plan based on the piezometer and observation tube readings, for lowering the pond and warning downstream residents if a hazardous condition develops at the dam.

d. Place riprap on the upstream slope of the dam at the west abutment adjacent to the emergency spillway.

e. Repair the riprap at the outlet structure and in the downstream channel.

f. Remove brush from the upstream and downstream slopes of the dam.

7.4 Alternatives. There are no recommended alternatives.

APPENDIX A

PERIODIC INSPECTION CHECKLIST

ASSABET RIVER DAM

PERIODIC INSPECTION

PARTY ORGANIZATION

OJECT ASSABET DAM

DATE 9-20-79

TIME 8:00 AM-3:00 PM

WEATHER Clear

W.S. ELEV. 308.3 U.S. 300.0 DN.S.

RTY:

Michael Larson		6.	Lyle Branagan
Michael Gilbert		7.	
William Checchi		8.	
Frank Sviokla		9.	
Paul Reilly		10.	

PROJECT FEATURE	INSPECTED BY	REMARKS
Dam	Gilbert & Larson	
Hydraulics	Branagan	

PERIODIC INSPECTION CHECK LIST

PROJECT Assabet River Dam DATE 9/20/79

PROJECT FEATURE Dam NAME M. Gilbert

DISCIPLINE Geotechnical NAME M. Larson

u/s = upstream
d/s = downstream

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	319.8
Current Pool Elevation	308.3
Maximum Impoundment to Date	
Surface Cracks	None
Pavement Condition	None
Movement or Settlement of Crest	None visible
Lateral Movement	None visible
Vertical Alignment	Level
Horizontal Alignment	Curved - OK
Condition at Abutment and at Concrete Structures	Outlet structure riprap in pour condition. Rt. abatement - OK
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes Needs cutting - small brush on u/s face	Vegetation - Crownvetch - thick - some paths up and down d/s fence
Sloughing or Erosion of Slopes or Abutments	Slight @ tee of slope @ high water mark - slight erosion on down stream on foot paths
Rock Slope Protection - Riprap Failures	Riprap only around outlet structure - some has moved - u/s very small riprap - very little
Unusual Movement or Cracking at or near Toes	None visible due to heavy vegetation
Unusual Embankment or Downstream Seepage	No water or seepage visible
Piping or Boils	None visible
Foundation Drainage Features	Toe drain pipes outlet @ training walls d/s outlet
Toe Drains	2 outlet pipes with trash bars - bars heavily eroded
Instrumentation System	Obs. and piezometer and relief wells (drains)

PERIODIC INSPECTION CHECK LIST

ROJECT Assabet River Dam DATE 9/20/79

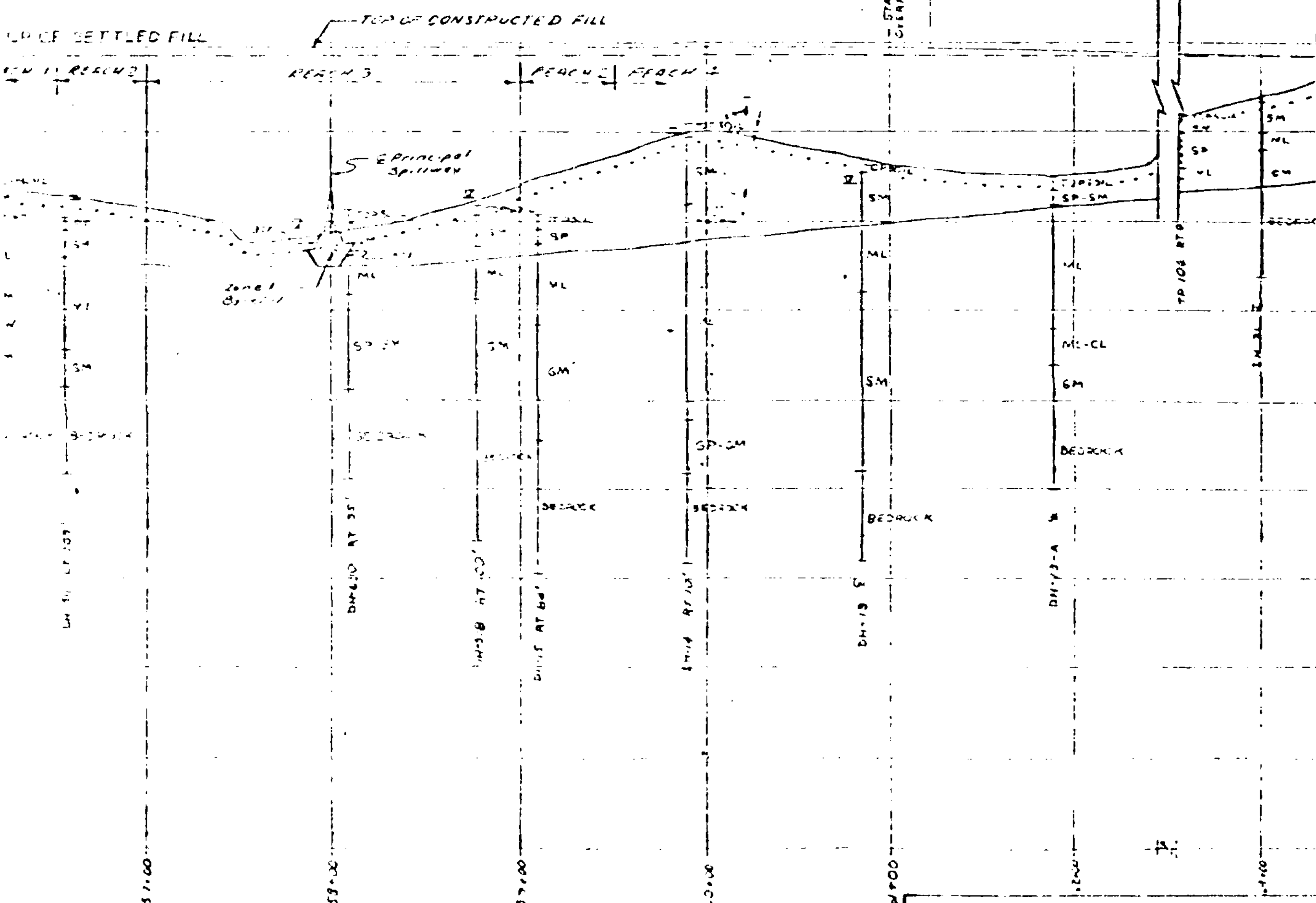
ROJECT FEATURE Outlet Structure NAME M. Gilbert

ISCIPLINE Geotechnical NAME M. Larson

AREA EVALUATED	CONDITION
UTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	No
Floor of Approach Channel	Riprap is in poor condition, trash-rack has collected some logs and branch
. Weir and Training Walls	
General Condition of Concrete	Very good
Rust or Staining	Some minor staining
Spalling	Very minor, more like pitting
Any Visible Reinforcing	Trash Rack - Bolts have heavy rusting Bolts on slide gate at a skew
Any Seepage or Efflorescence	No
Drain Holes	No
. Discharge Channel	
General Condition	Very good
Loose Rock Overhanging Channel	No
Trees Overhanging Channel	No
Floor of Channel	Concrete - good condition
Other Obstructions	No

EARTH FILL REQUIREMENTS							
ZONE	MATERIAL	SOURCE	[illegible]	[illegible]	[illegible]	[illegible]	COMPACTION
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] OF OPTIMUM	A	ASTM D [illegible] 95% STANDARD DENSITY
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] OF OPTIMUM	A	ASTM D [illegible] 95% STANDARD DENSITY
3	SANDY GRAVEL (GP) TP 15 3	[illegible]	24'	36'	NATURAL	X	SEE CONSTRUCTION SPEC. 5

REACH	LOCATION	CUTOFF TRENCH BOTTOM WIDTH
1	LEFT ABUTMENT TO STA. [illegible]	13'
2	STA. [illegible] TO STA. [illegible]	12' TO 15'
3	STA. [illegible] TO STA. [illegible]	15'
4	STA. [illegible] TO RIGHT ABUT.	12'



Note

1. See logs of drill holes & test pits for additional soils data and for dates water levels were observed.
2. Information on subsurface [illegible] is available at the Soil Conservation Service State Office, 29 College Street, Amherst, Massachusetts

SUASCO WATERSHED PROJE[CT]

GEORGE H NICHOLS MULTIPLE PURPOSE DAM

WESTBORO, MASSACHUSETTS

SECTION & PROFILE

U S DEPARTMENT OF AGRICUL[TURE]

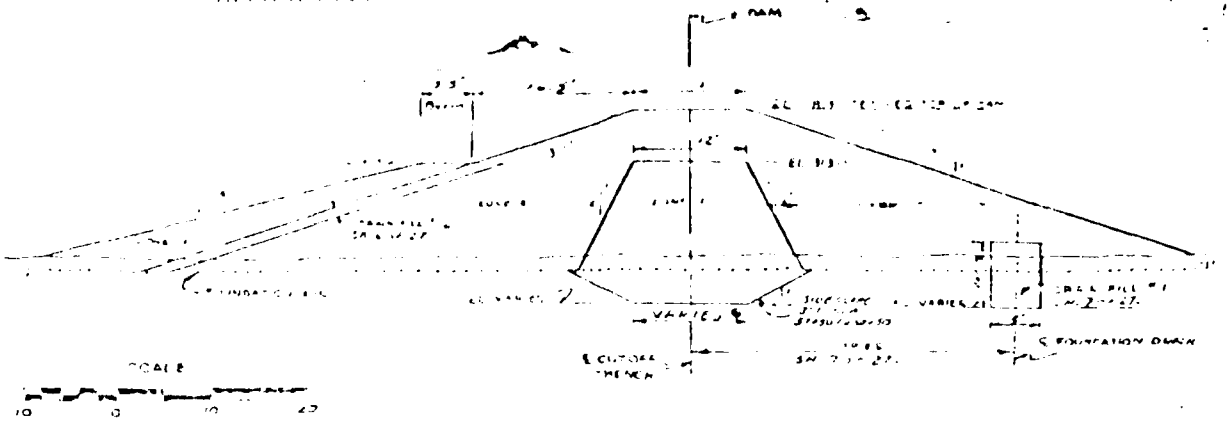
SOIL CONSERVATION SERVIC[E]

R. CAPELO 12/57

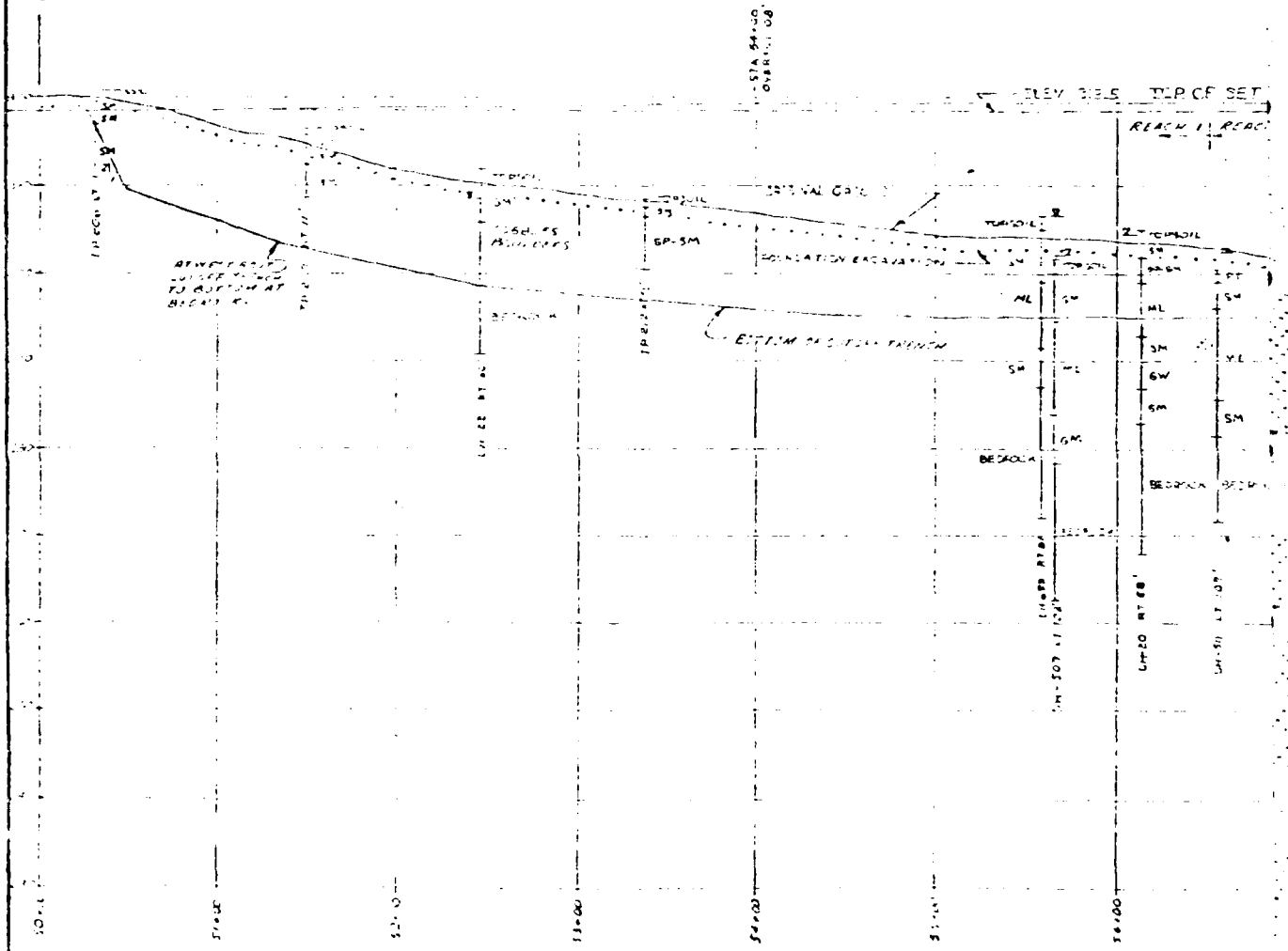
J. SMEAD 12/57

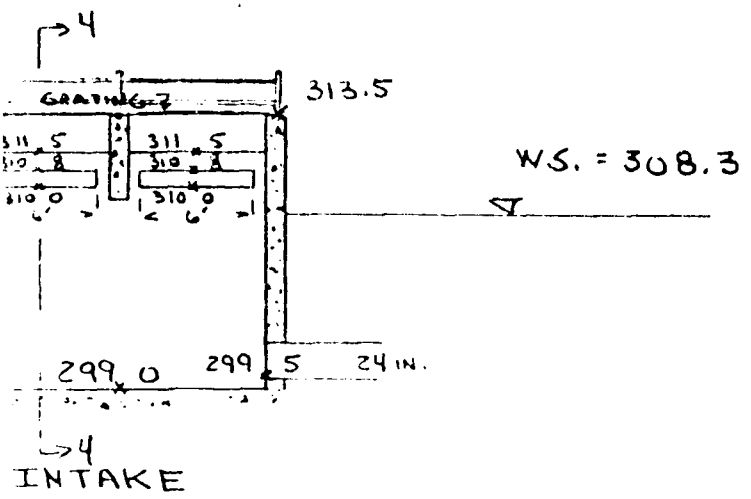
MA-30

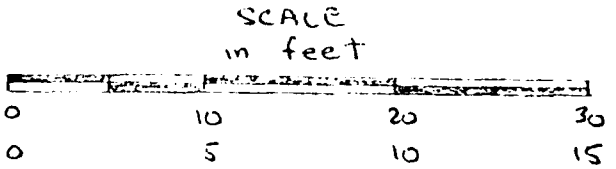
FIGURE B-4.



TYPICAL SECTION







MESCALE & CODY, INC. CONSULTANTS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

NATIONAL PROGRAM OF INSPECTION OF NON FED. DAMS

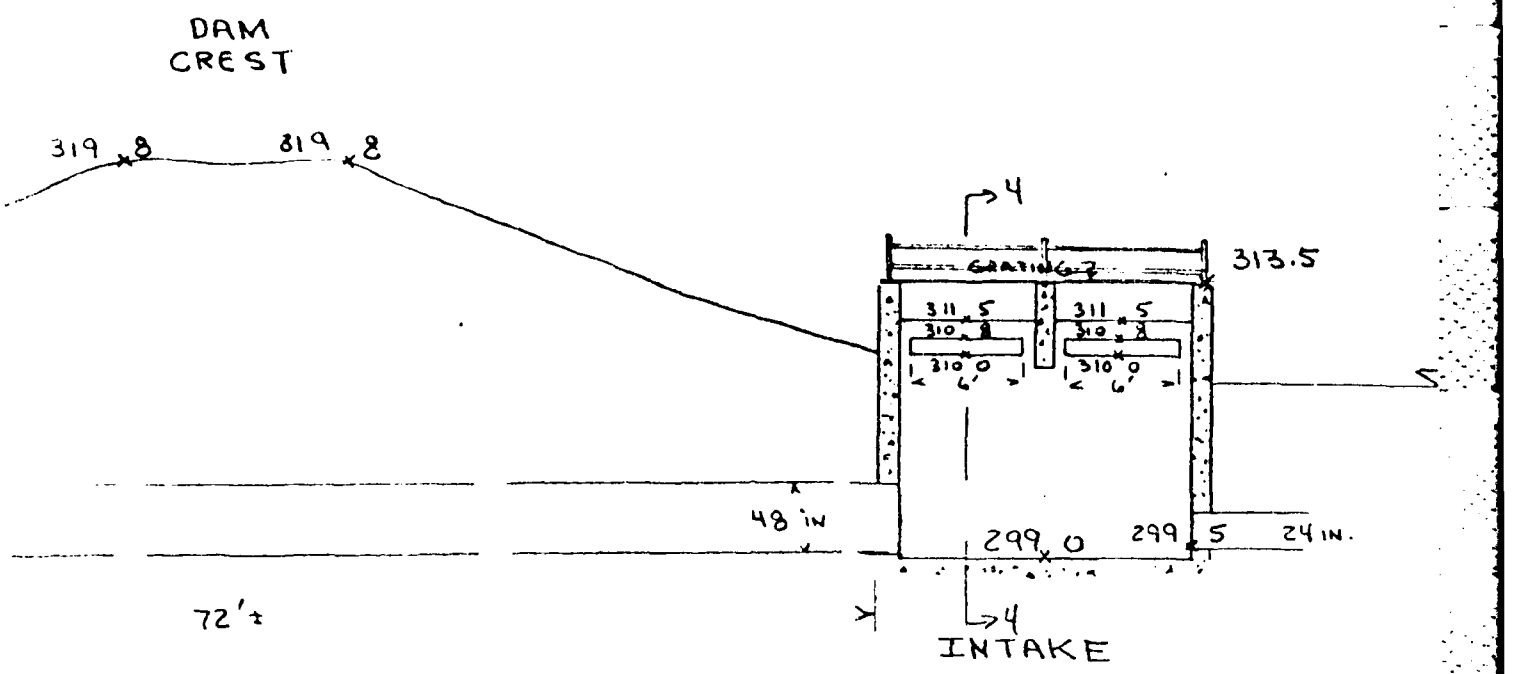
ASSABET RIVER DAM

FIGURE B-3 MAIN OUTLET SECTIONS

TRIBUTARY ASSABET RIVER — MASSACHUSETTS

SCALE: AS SHOWN — DATE: SEPTEMBER, 1979

3



SECTION 3-3

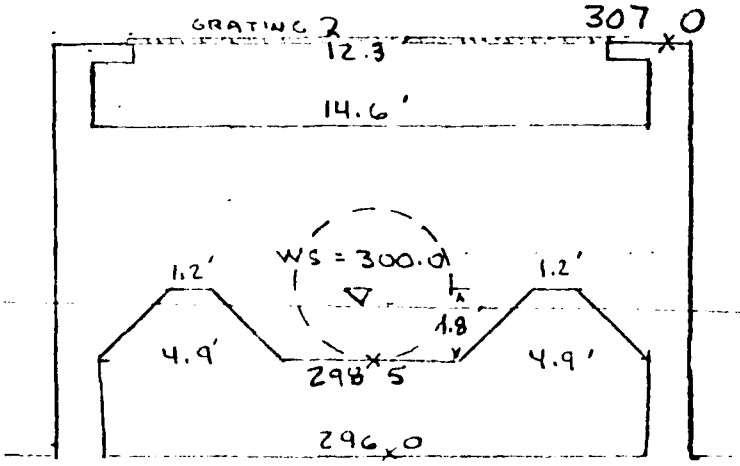
OUTLET

SCALE 1 IN. = 10 FT.

SCAL
in fe

0 10

0 5



SECTION 5-5

DISCHARGE

BAFFLE

AT OUTLET

SCALE 1 IN. = 5 FT.

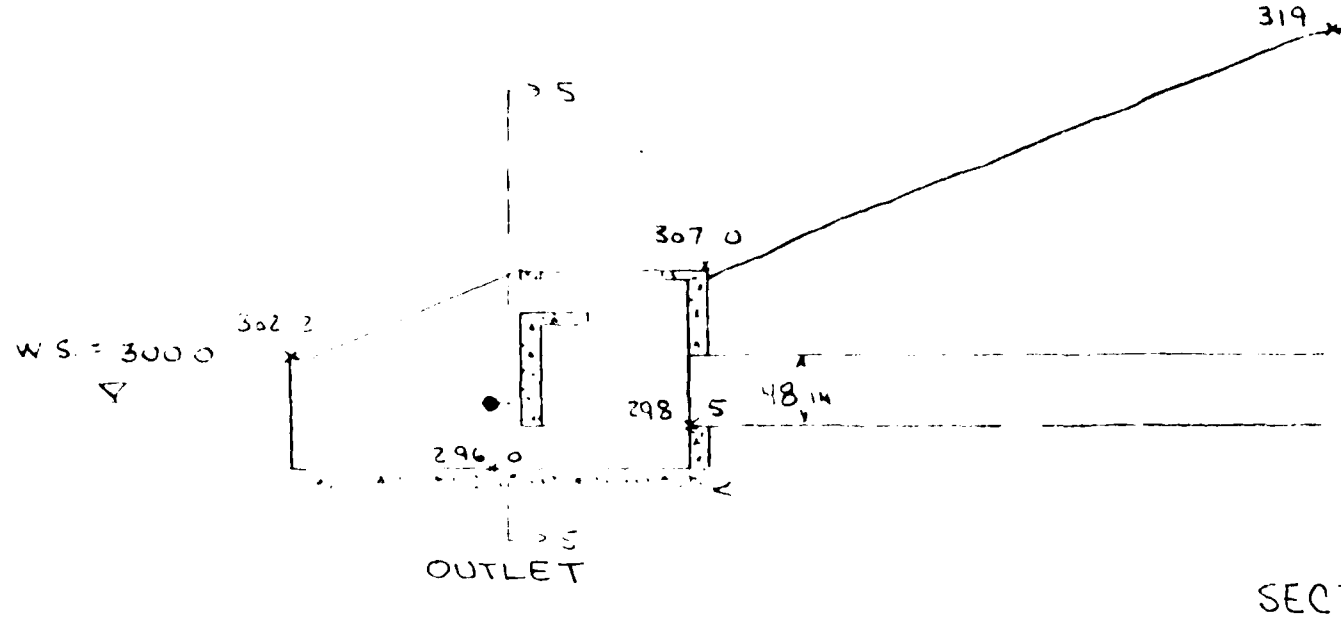
NATIONAL PROGRA-

ASSA

FIGURE

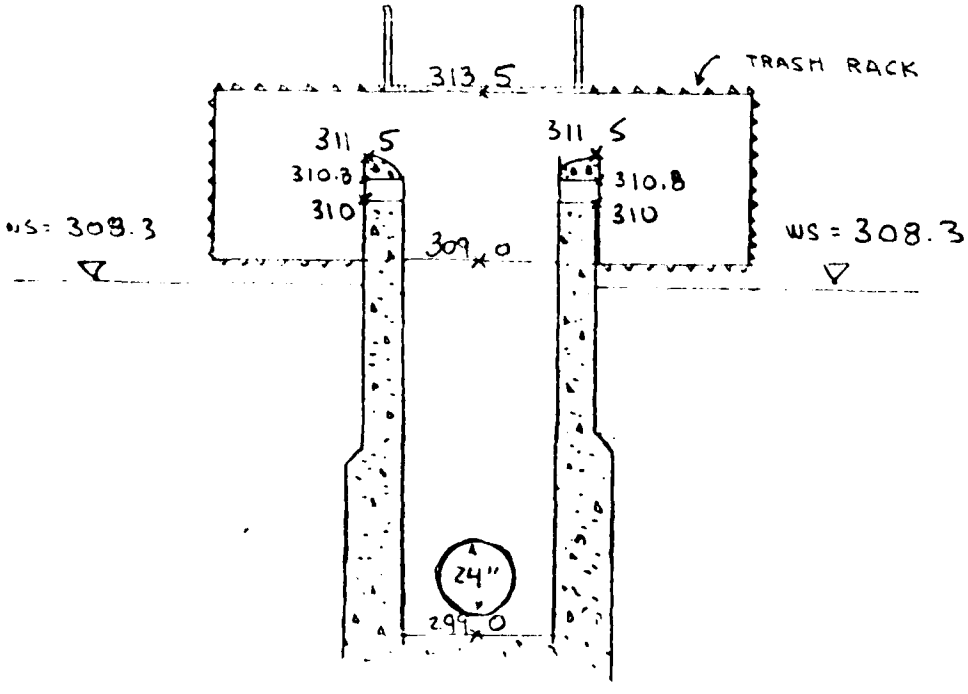
TRIBUTARY ASSABET

SCALE: AS SHOWN



SEC

SCA



SECTION 4-4

INTAKE

SCALE 1"= 5 FT

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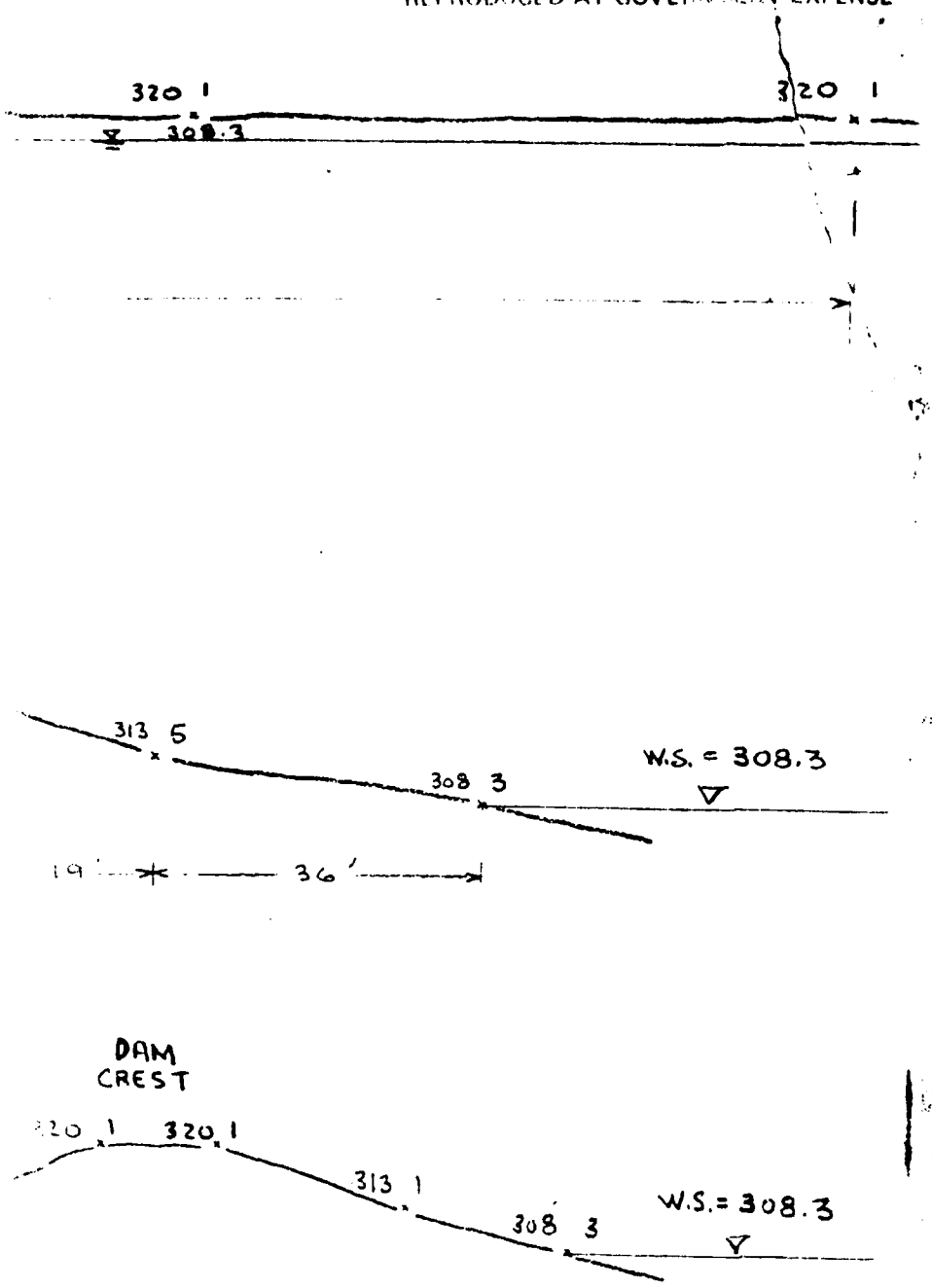
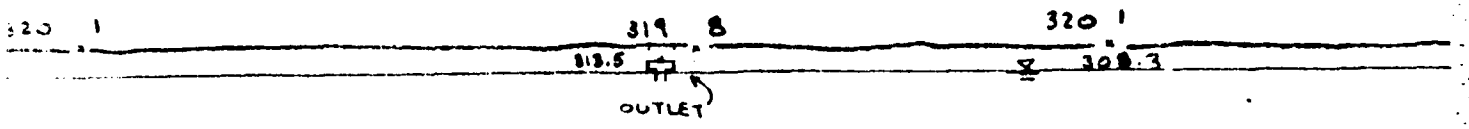


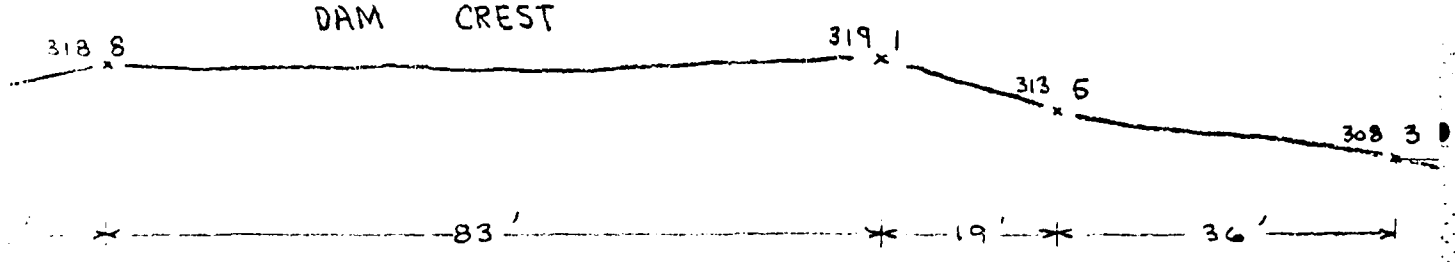
METCALF & EDDY, INC. ENGINEERS BOSTON, MA.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	
ASSABET RIVER DAM	
FIGURE B-2 DAM CREST PROFILE AND EMERGENCY SPILLWAY SECTIONS	
TRIBUTARY ASSABET RIVER	MASSACHUSETTS
SCALE: AS SHOWN	DATE. SEPTEMBER, 1978



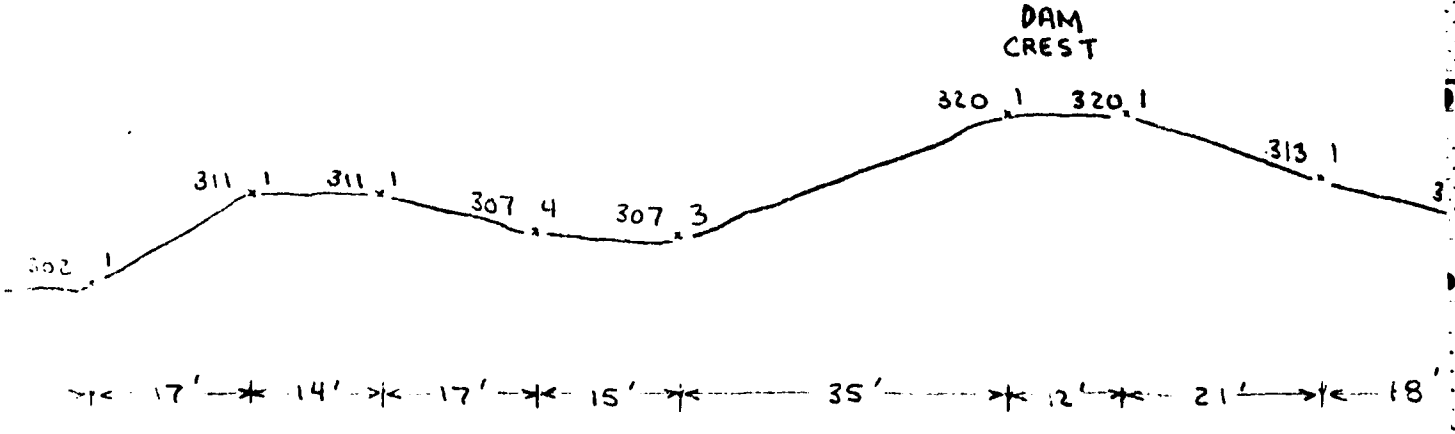
1560'±

PROFILE A-A
DAM CREST

SCALE 1IN. = 100FT.



SECTION 1-1
SCALE 1IN.= 20FT.



SECTION 2-2
SCALE 1IN = 20FT

SCALE in feet

100	200	300
20	40	60

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ENGINEERS
BOSTON, MA.

NATIONAL PROGRAM C

ASSAB

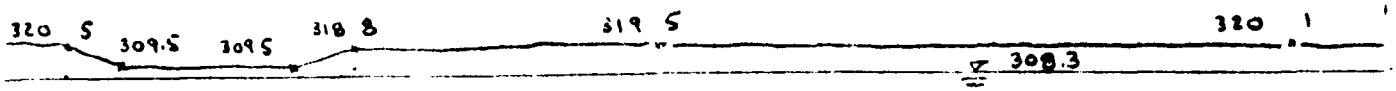
FIGURE B-2
EMERGENC

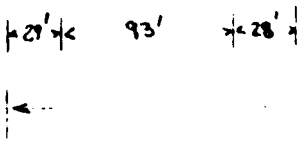
TRIBUTARY ASSABET RI

SCALE: AS SHOWN

(2)

EMERGENCY SPILLWAY





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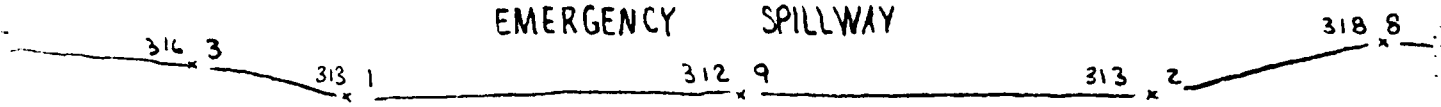
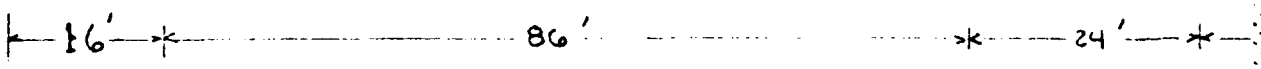
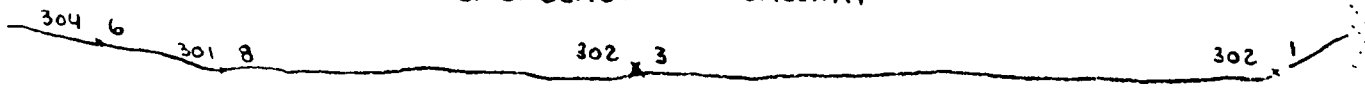
EMERGENCY SPILLWAY

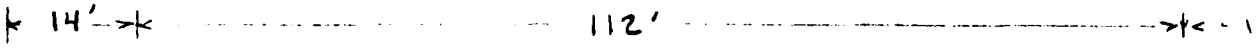




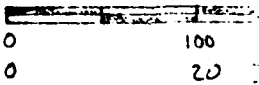
SECT
SCAL

EMERGENCY SPILLWAY





SECT
SCAL
S



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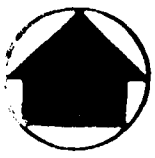

297.5

299.6

W.S.= 298.4

Piezo 308.7

309.3

308.6

MILL ROAD

OUTLET STRUCTURE
SEPT. 1979 AND
NICHOLS MULTIPLE
STRUCTURE, SOIL

FOR PHOTOGRAPHS
OBSERVATION WELL

3

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U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MA.

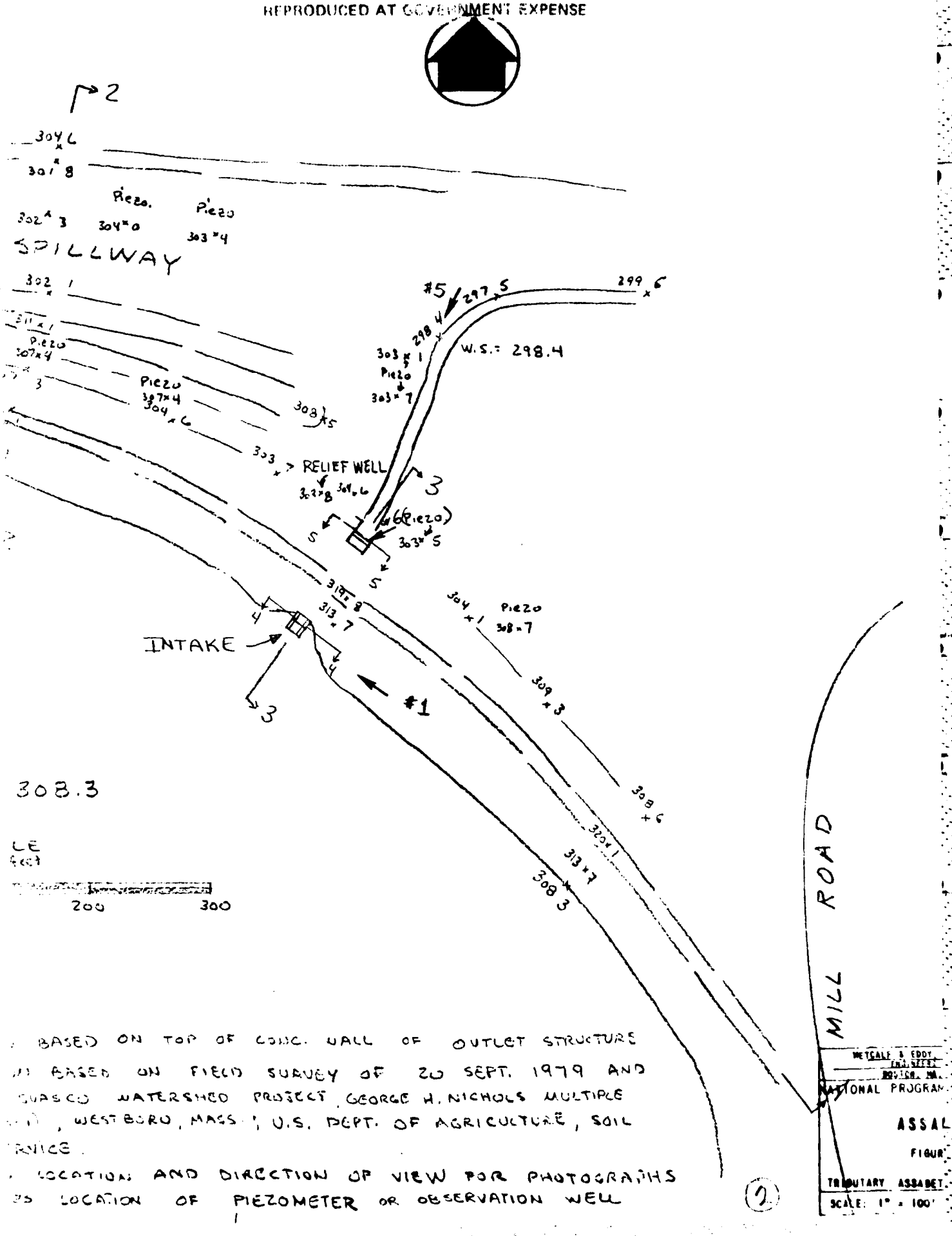
NATIONAL PROGRAM OF INSPECTION OF NON FED DAMS

ASSABET RIVER DAM

FIGURE B-1 PLAN OF DAM

TRIBUTARY ASSABET RIVER MASSACHUSETTS

SCALE 1" = 100' DATE SEPTEMBER, 1979



BASED ON TOP OF CONC. WALL OF OUTLET STRUCTURE

BASED ON FIELD SURVEY OF 20 SEPT. 1979 AND ... WATERSHED PROJECT, GEORGE H. NICHOLS MULTIPLE ..., WESTBORO, MASS.; U.S. DEPT. OF AGRICULTURE, SOIL ... SERVICE.

LOCATION AND DIRECTION OF VIEW FOR PHOTOGRAPHS

LOCATION OF PIEZOMETER OR OBSERVATION WELL

METCALF & EDDY ENGINEERS BOSTON, MA.

NATIONAL PROGRAM

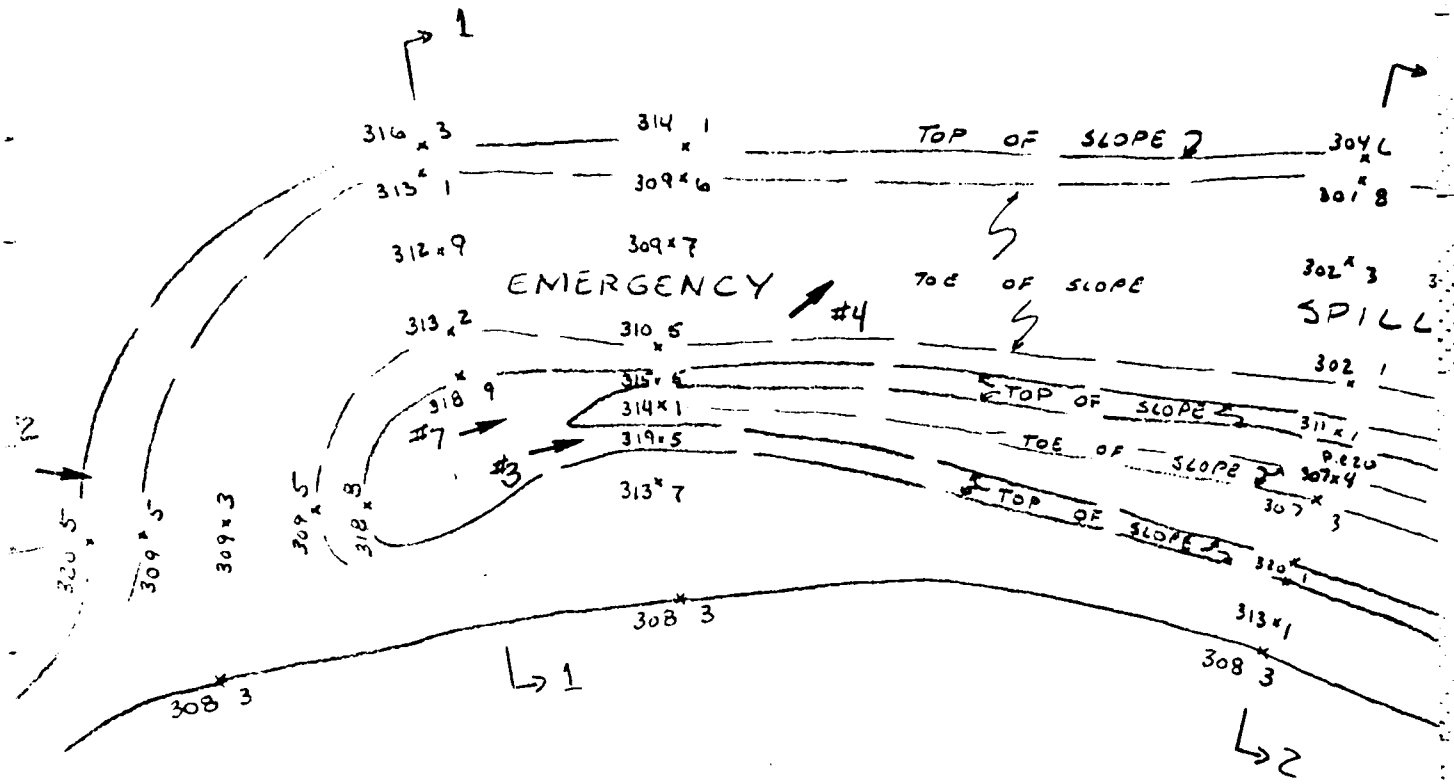
ASSAL

FIGUR

TRIBUTARY ASSABET

SCALE: 1" = 100'

(1)



WATER SURFACE ELEV. = 308.3

SCALE in feet

0 100 200

NOTES:

1. ELEVATIONS SHOWN BASED
2. INFORMATION SHOWN BASED PLANS TITLED: " SUASCO PURPOSE DAM (A-1), WES CONSERVATION SERVICE.
3. ↗ #2 INDICATES LOCATI
4. "PIEZO" INDICATES LOCA

METCALF & EDDY, INC.

APPENDIX B

PLANS OF DAM AND PREVIOUS INSPECTION REPORTS

PERIODIC INSPECTION CHECK LIST

PROJECT Assabet River Dam DATE 9/20/79

PROJECT FEATURE Emergency Spillway NAME M. Gilbert

DISCIPLINE Geotechnical NAME M. Larson

AREA EVALUATED	CONDITION
OUTLET WORKS - EMERGENCY SPILLWAY	Spillway located @ Lt. abatement of dam
a. Approach Channel	Pond - earth, bottom good condition
Slope Conditions	Earth slope no riprap. Heavy vegetation
Bottom Conditions	Earth to heavy vegetation. No erosion Good condition
Rock Slides or Falls	No
Log Boom	No
Debris	None
Condition of Concrete Lining	None - Could not locate concrete weir at spillway crest
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	
Stop Logs and Slots	

Lt. abatement of channel has rock outcrop.
Rt. abatement earth - no riprap fence on top of slope and woods behind.
Spillway goes behind dam and discharges into primary spillway channel.

PERIODIC INSPECTION CHECK LIST

PROJECT Assabet River Dam DATE 9/20/79

PROJECT FEATURE 48" Pipe & Discharging Structure NAME M. Gilbert

DISCIPLINE Geotechnical NAME M. Larson

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT	
General Condition of Concrete	Fair to good
Rust or Staining on Concrete	Some staining
Spalling	Minor
Erosion or Cavitation	None
Cracking	At I-beam support
Alignment of Monoliths	
Alignment of Joints	Concrete is cracked at I-beam support for floor grate
Numbering of Monoliths	

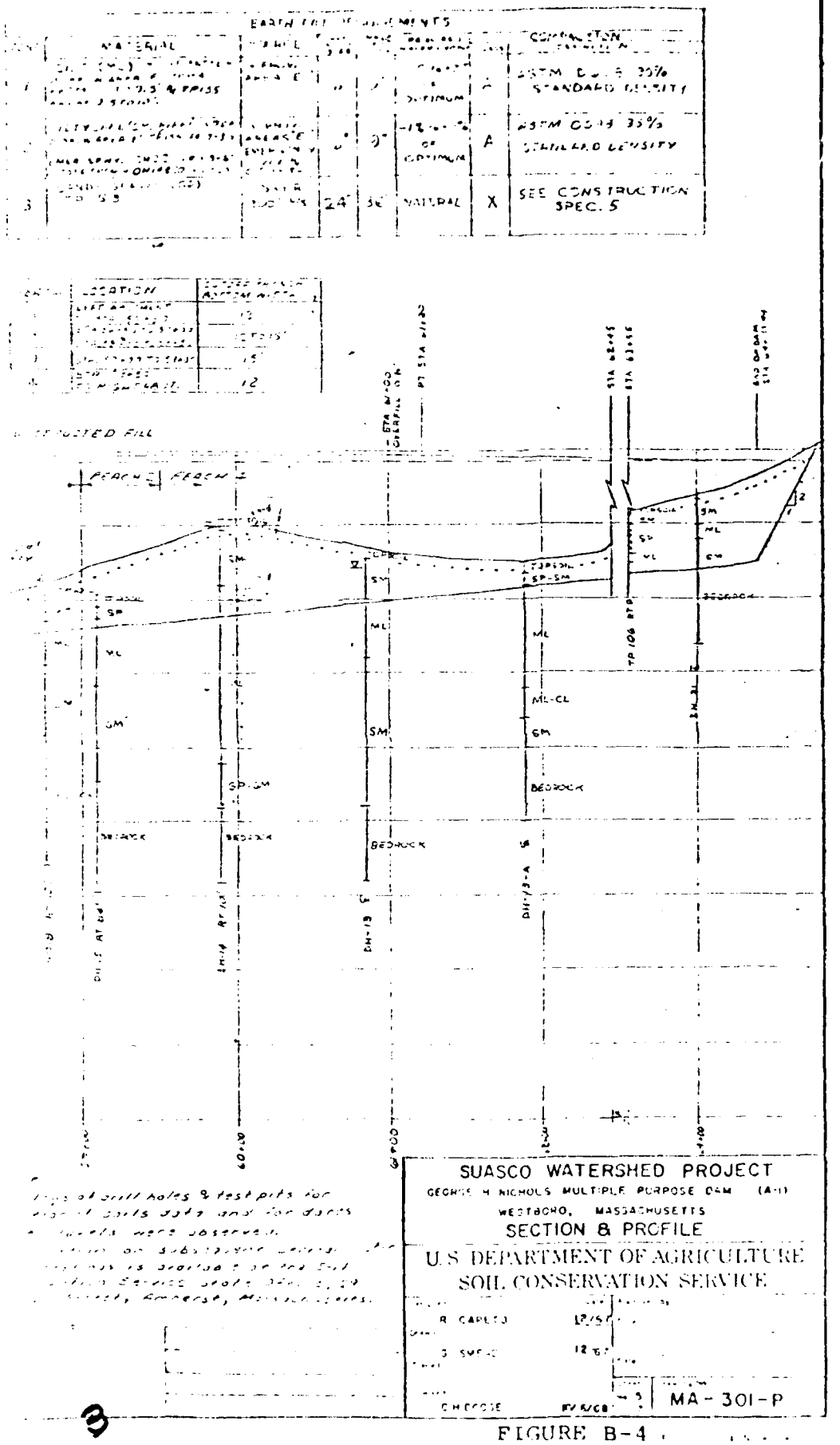
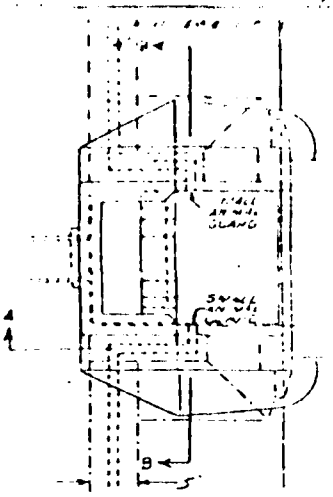
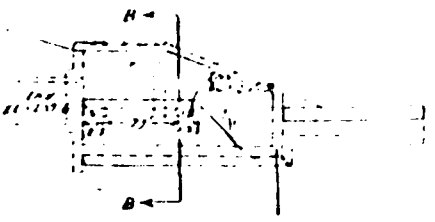


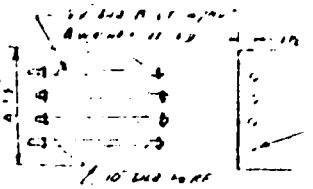
FIGURE B-4



PLAN



SECTION A-A



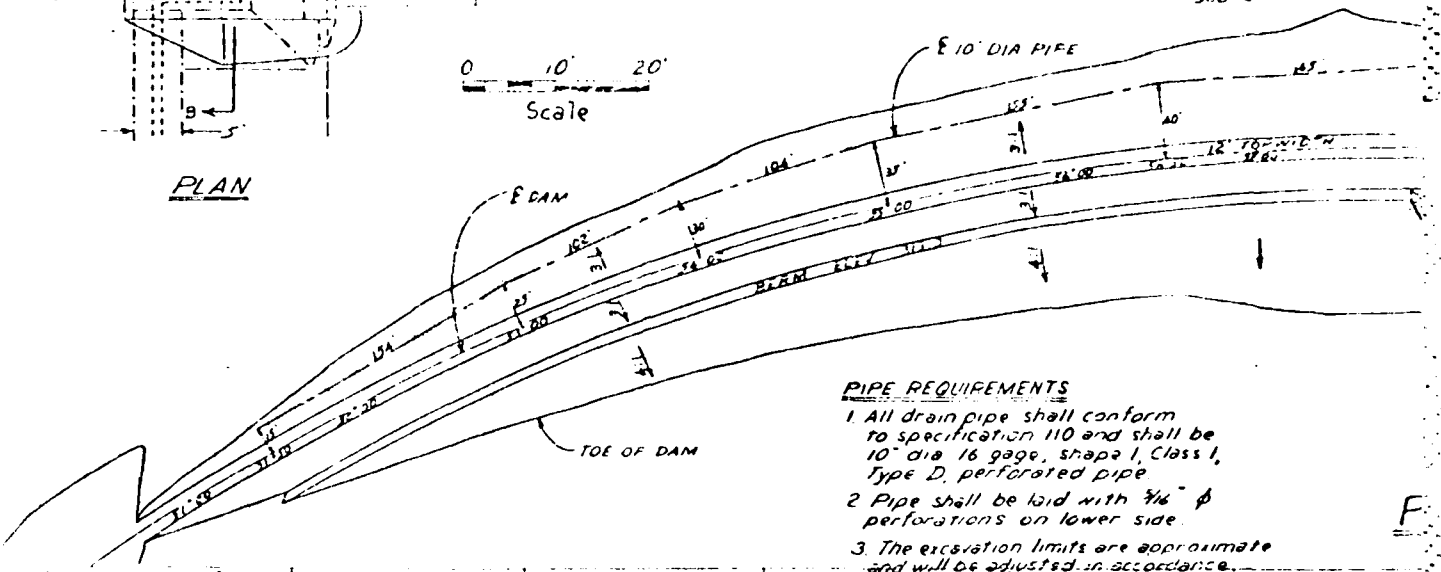
SMALL NUMBERS ARE (3 FT)

0 8' 16'

Scale

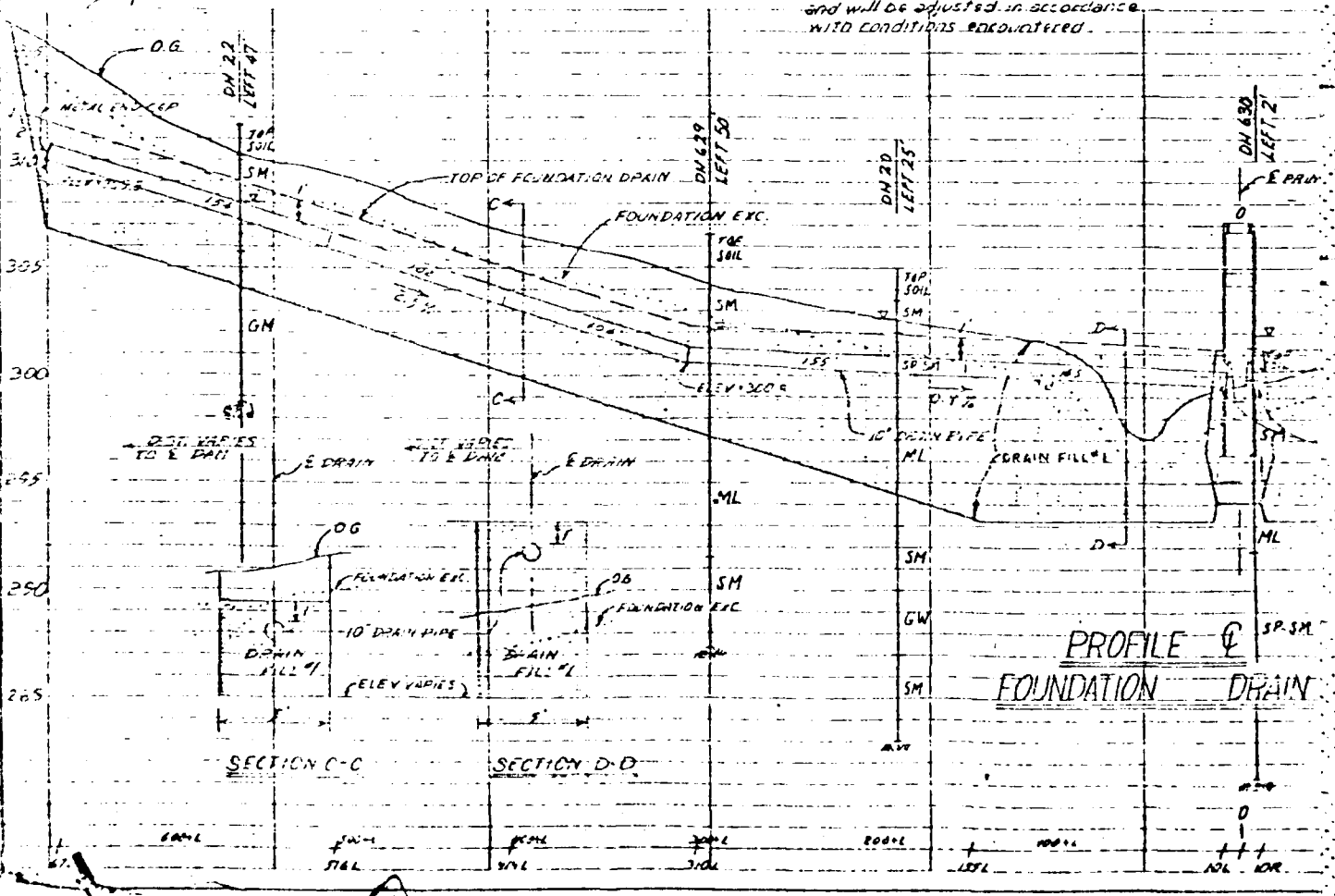
0 10' 20'

Scale



PIPE REQUIREMENTS

1. All drain pipe shall conform to specification 110 and shall be 10" dia 16 gage, shape 1, Class 1, Type D, perforated pipe
2. Pipe shall be laid with 3/16" ϕ perforations on lower side
3. The excavation limits are approximate and will be adjusted in accordance with conditions encountered.

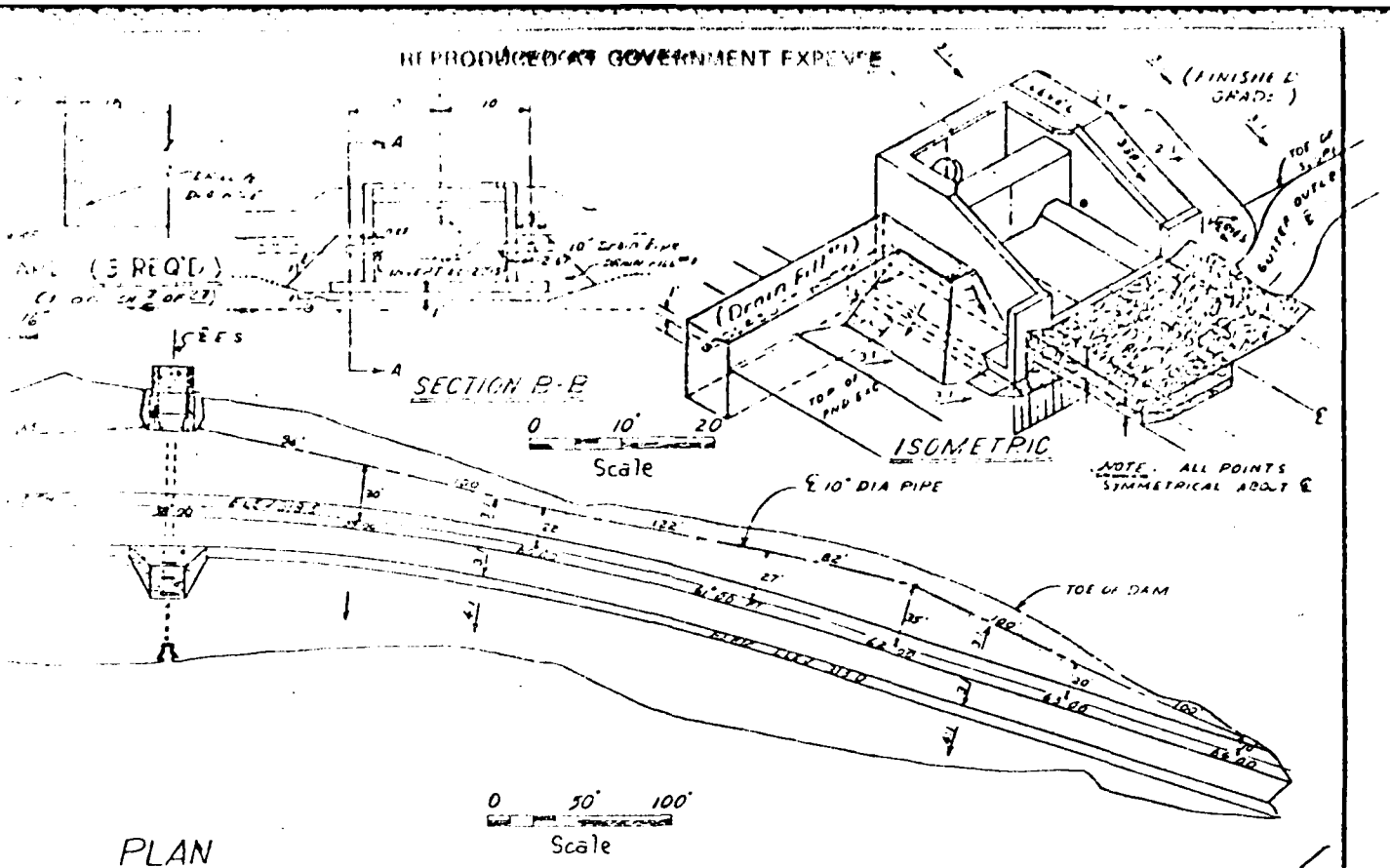


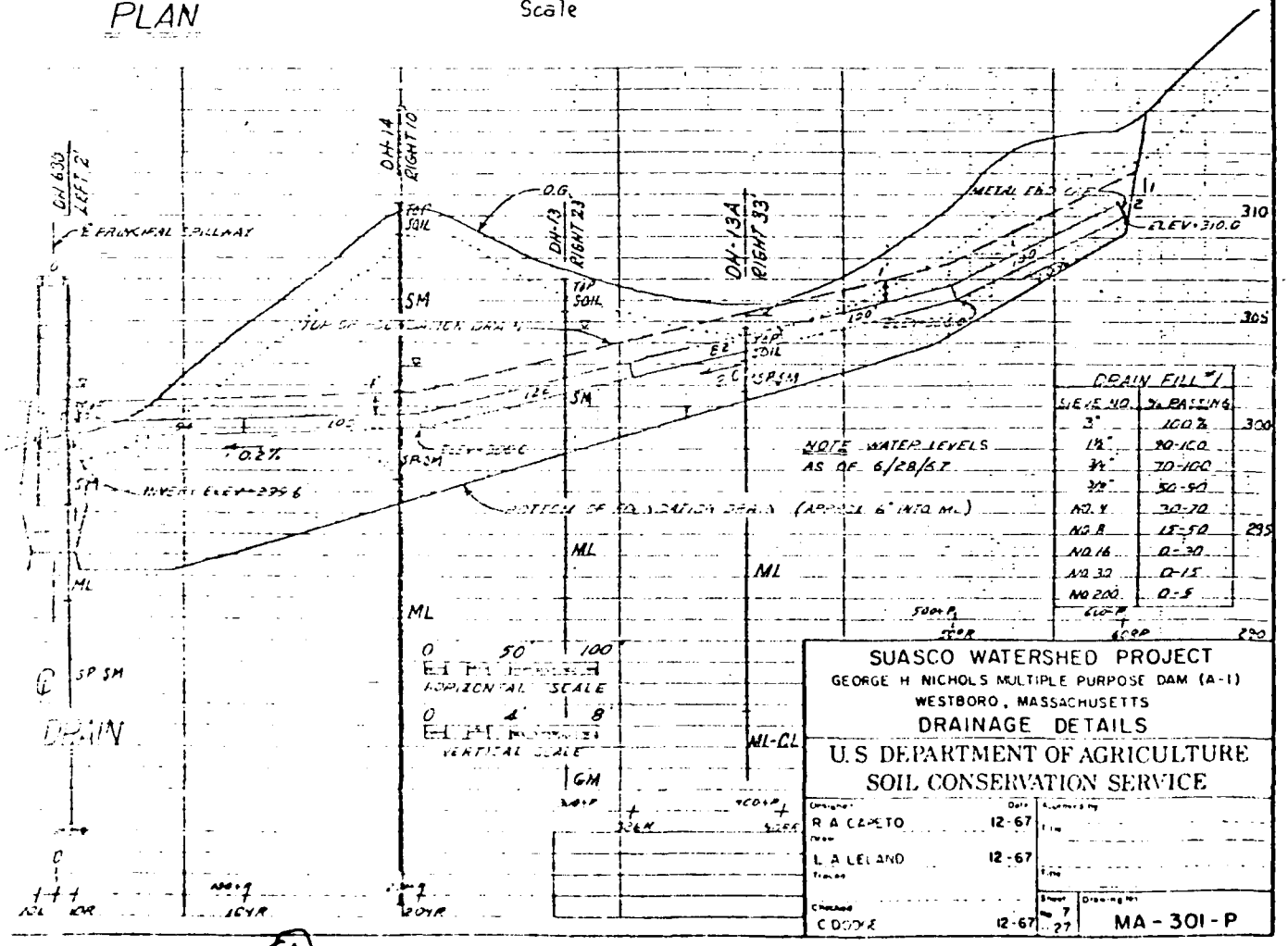
SECTION C-C

SECTION D-D

PROFILE ℄ FOUNDATION DRAIN

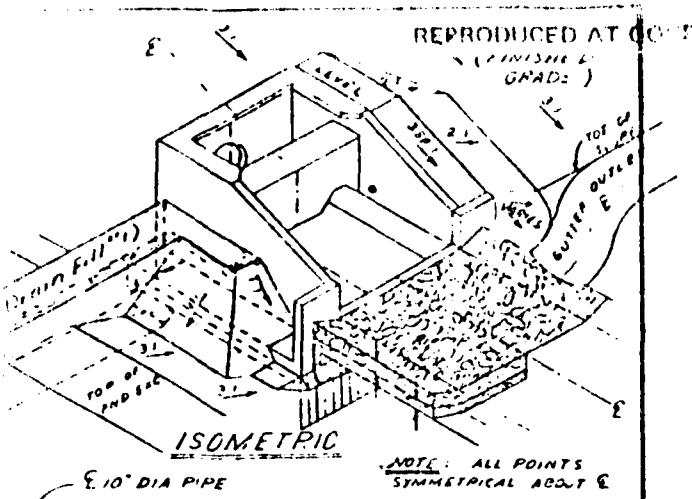
(1)

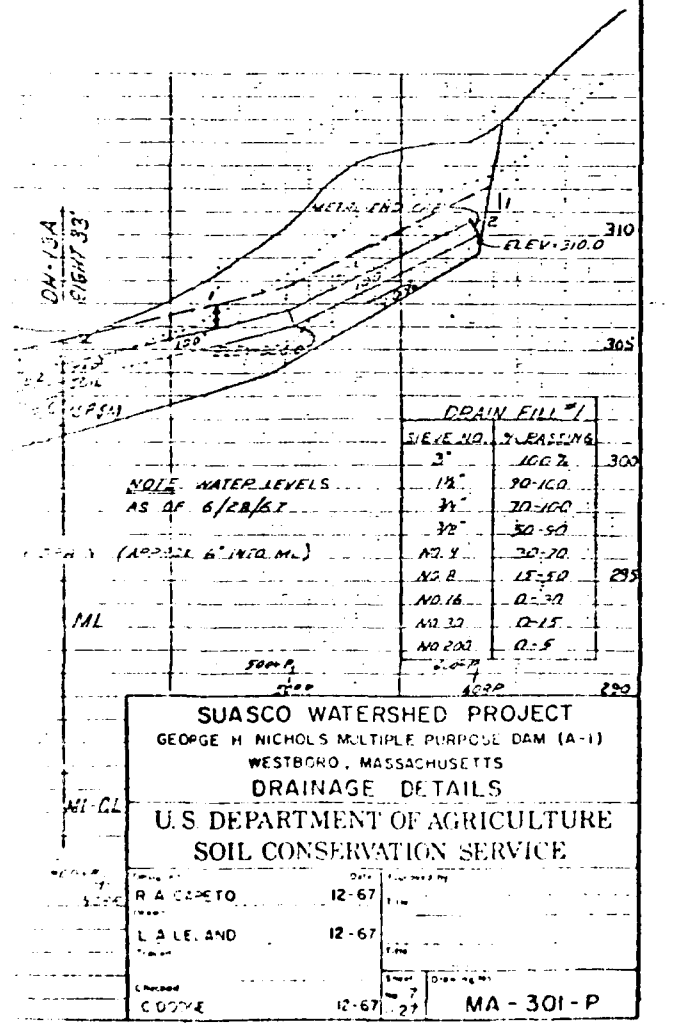




(2)

FIGURE B-5





SUASCO WATERSHED PROJECT
GEORGE H. NICHOLS MULTIPLE PURPOSE DAM (A-1)
WESTBORO, MASSACHUSETTS
DRAINAGE DETAILS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R. A. CAPETO	Date 12-67	Approved by Title
Drawn L. A. LELAND	Date 12-67	Title
Checked C. DOYLE	Date 12-67	Sheet No. 7 of 27
		Drawing No. MA-301-P

FIGURE B-5

NETSC TEMPORARY FORM
6-13-75

INFORMATION STORAGE AND RETRIEVAL - DAMS PLANNED AND CONSTRUCTED BY

MA 301
NO.

IDENTIFICATION AND LOCATION

1. GEORGE H. NICHOLS (A-1) SITE
STRUCTURE DESIGNATION (NAME OR NUMBER)
2. ASSABET
RIVER BASIN (NAME)
3. SuAsCo
WATERSHED (NAME OR UNNAMED)
4. MASSACHUSETTS
STATE (NAME)
5. WORCESTER
COUNTY (NAME)
6. WESTBOROUGH
TOWNSHIP (NAME)
7. 3
CONGRESSIONAL DISTRICT (NUMBER)
8. New England Province, Seaboard Lowland Sect.
PHYSIOGRAPHIC AREA 1/ (NAME)
9. WP
AUTHORIZATION (WP, FP, RC&D, CO-OP, PILOT)
10. 42°-15'-59"
LATITUDE (DEGREES, MINUTES, SECONDS)
11. 71°-38'-10"
LONGITUDE (DEGREES, MINUTES, SECONDS)
12. 318.5
ELEVATION OF TOP OF DAM (SETTLED FILL-FEET MSL)
13. DATE PLAN APPROVED 8-31-59
14. DATE OF MOST RECENT SUPPLEMENT 5-5-72
(LEAVE BLANK IF NOT SUPPLEMENTED)
15. DATE CONSTRUCTION COMPLETED 8-4-70
(LEAVE BLANK IF NOT COMPLETED)
16. TYPE OF DAM (CIRCLE APPLICABLE) -
(EARTH), ROCK, CONCRETE, OTHER
17. PLANNED PURPOSES (CIRCLE ALL APPLICABLE) -
(FLOOD PREVENTION), RECREATION, (FISH & WILDLIFE),
MUNICIPAL AND INDUSTRIAL WATER SUPPLY, IRRIGATION,
NAVIGATION, HYDRO-ELECTRIC, SEDIMENT CONTROL,
LOW FLOW AUGMENTATION, OTHER
18. HAZARD CLASS (A, B, OR C) C
19. EARTHQUAKE ZONE 2/ (0, 1, 2, 3, or 4) 2

SIZE AND CAPACITY

20. DRAINAGE AREA UNCONTROLLED 4589 AC.
(UPSTREAM FROM STRUCTURE)
21. DRAINAGE AREA CONTROLLED - AC.
(UPSTREAM FROM STRUCTURE)
22. MAXIMUM FILL HEIGHT 20 FT.
(FROM LOW POINT ON CENTERLINE, BEFORE EXCAVATING,
TO TOP OF SETTLED FILL.)
23. CREST LENGTH OF DAM (ALONG CENTERLINE) 1440 FT.
24. VOLUME OF FILL 53,000 CU. YD.
25. SUBMERGED SEDIMENT STORAGE 344 AC. FT.
26. AERATED SEDIMENT STORAGE - AC. FT.
27. MUNICIPAL AND INDUSTRIAL WATER STORAGE - AC. FT.
28. RECREATION WATER STORAGE - AC. FT.
29. FISH AND WILDLIFE STORAGE 1602 AC. FT.
30. IRRIGATION STORAGE - AC. FT.
31. OTHER BENEFICIAL STORAGE - AC. FT.
32. TOTAL FLOOD STORAGE 1254 AC. FT.
33. TEMPORARY EMERGENCY SPILLWAY STORAGE (BETWEEN CREST
OF LOWEST EMERGENCY SPILLWAY AND TOP OF SETTLED FILL)
3100 AC. FT.
34. SURFACE AREA OF NORMAL POOL 38C AC.
35. LENGTH OF SHORE LINE OF NORMAL POOL 6.7 MILES
36. MAXIMUM DEPTH OF NORMAL POOL 10 FT.

PRINCIPAL SPILLWAY FEATURES

37. PRINCIPAL SPILLWAY TYPE (CIRCLE APPLICABLE) -
PIPE, MONOLITHIC, OPEN CONCRETE STRUCTURE, OTHER
38. IS THERE COLD WATER RELEASE FACILITY? No
39. NUMBER OF STAGES 2 (1 or 2)
40. LOW STAGE CAPACITY 92 CFS
(AT HIGH STAGE PRINCIPAL SPILLWAY CREST)
41. PRINCIPAL SPILLWAY CAPACITY 234 CFS
(AT LOWEST EMERGENCY SPILLWAY CREST)

PRINCIPAL SPILLWAY CONDUIT FEATURES

42. MAJOR PORTION OF CONDUIT IS ON (CIRCLE APPLICABLE)
ROCK OR (EARTH)
43. TYPE OF ENERGY DISSIPATOR (CIRCLE APPLICABLE)
(IMPACT BASIN), SAF, PLUNGE POOL, NONE, OTHER
44. CONDUIT SIZE 4.0'
(LARGEST CONDUIT THROUGH DAM) (DIAM. IN FT. IF ROUND)
(HEIGHT AND WIDTH IN FT. IF MONOLITHIC) ALSO SHOW
NUMBER OF BARRELS IF MULTI-BARREL
45. INLET TYPE (CIRCLE APPLICABLE) - (CONCRETE-OPEN TOP,)
COVERED TOP, HOOD INLET, METAL-OPEN TOP, OTHER
46. HEIGHT OF RISER 14.5' FT.
(FROM TOP OF FLOOR TO TOP OF ANTI-VORTEX)

EMERGENCY SPILLWAY FEATURES

47. PRIMARY EMERGENCY SPILLWAY TYPE (CIRCLE APPLICABLE)
CLOSED CONDUIT, OPEN CONCRETE STRUCTURE, (EARTH)
(VEGETATED), SOFT ROCK, HARD ROCK 3/
48. PRIMARY EMERGENCY SPILLWAY WIDTH 100 FT.
(CREST LENGTH FOR CONCRETE)
49. 1 %
PERCENT CHANCE OF USE OF PRIMARY EMERGENCY SPILLWAY

1/ N. M. Fenneman, 1938, Physiography of Eastern United States, McGraw Hill Book Co., New York, N. Y.

2/ See TSC Technical Note - Engineering UD-22.

3/ Soft Rock - Rock that will erode when subjected to flowing water.
Hard Rock - Rock that is resistant to erosion due to flowing water.

EMERGENCY SPILLWAY FEATURES (CONT'D.)

50. 4360 CFS
CAPACITY OF PRIMARY EMERGENCY SPILLWAY (WHEN POOL IS AT TOP OF DAM)

51. 5.5 FT.
DIFFERENCE IN ELEVATION BETWEEN CREST OF PRIMARY EMERGENCY SPILLWAY AND TOP OF DAM

52. SECONDARY EMERGENCY SPILLWAY IS (CIRCLE APPLICABLE)
(NONE) EARTH, VEGETATED, SOFT ROCK, HARD ROCK 3/ -

53. WIDTH OF SECONDARY EMERGENCY SPILLWAY — FT.

54. CAPACITY OF SECONDARY EMERGENCY SPILLWAY (WHEN POOL IS AT TOP OF DAM) — CFS

55. — FT.
DIFFERENCE IN ELEVATION BETWEEN CREST OF SECONDARY EMERGENCY SPILLWAY AND TOP OF DAM

OMIT ITEMS 56-59 IF DRAINAGE AREA IS LESS THAN 10 SQUARE MILES

56. BULK LENGTH OF SOFT ROCK 3/ EARTH OR VEGETATED SPILLWAY (SEE TR-52 FOR DEFINITION) — FT.

57. —
BY OF SURFACE MATERIAL IN EARTH OR VEGETATED SPILLWAY (PREDOMINANT MATERIAL AT OR NEAR SURFACE BEFORE TOP SOILING)

—
USCS CLASSIFICATION OF ABOVE MATERIAL

59. — AC. FT.
VOLUME OF OUTFLOW THROUGH VEGETATED OR EARTH SPILLWAY (DURING PASSAGE OF FREEBOARD HYDROGRAPH)

COST DATA

WORK PLAN

60. LAND RIGHTS COST $ 490,000

61. FEDERAL SHARE OF LAND RIGHTS COST $ —

62. CONSTRUCTION COST $ 385,760
(DOES NOT INCLUDE LAND RIGHTS, ENGINEERING AND PROJECT ADMINISTRATION)

63. FEDERAL SHARE OF CONSTRUCTION COST IN PERCENT 72.8 %

COMPLETED STRUCTURE

64. FINAL CONSTRUCTION COST $ 450,913.98

ADDITIONAL DATA REQUIRED FOR U.S. REGISTER OF DAMS (LEAVE BLANK FOR DAMS LESS THAN 33 FT. IN HEIGHT)

65. George H. Nichols Dam
POPULAR NAME OF DAM

66. George H. Nichols Lake
NAME OF RESERVOIR

67. NEAREST CITY OR TOWN Westborough

68. TYPE OF DAM IF CONCRETE (CIRCLE APPLICABLE)
BUTTRESS, ARCH, MULTI-ARCH

69. IS DISCHARGE THROUGH PRINCIPAL SPILLWAY CONTROLLED BY GATES? No

70. ESTIMATED COMPLETION DATE (IF UNDER CONSTRUCTION) —

71. OWNER Commonwealth of Massachusetts

72. ENGINEERING BY Soil Conservation Service

73. CONSTRUCTION BY Northeast Construction Co.
(CONSTRUCTION CONTRACTOR)

74. ABOVE DATA FURNISHED BY Frank J. Wilda
(NAME)

75. DATE DATA FURNISHED 8-25-75

76. REMARKS "Prime Contractor. Five contracts have been awarded since prime contract was completed: (1) Stabilization (2) Piezometers (3) EARTH BLANKET IN Emergency Spillway (4) Relief Wells (5) Structure Additions.. Pool area has not yet been cleared but is scheduled for clearing in the near future.

3/ Soft Rock - Rock that will erode when subjected to flowing water.
Hard Rock - Rock that is resistant to erosion due to flowing water.

O&M INSPECTION RECORD

CHECK LIST

The items to be checked at time of inspection may include, but not be limited to, the following:

1. Vegetation (Structure & Channels)
   a. Need for cutting and/or spraying
   b. Need for reseeding
   c. Need for fertilizing
   d. Evidence of winter injury

2. Fences
   a. Loose or damaged posts
   b. Loose or broken wires
   c. Accumulated debris on fence
   d. Condition of gates and gaps

3. Principal Spillway
   a. Obstructions in spillway
   b. Condition of outlet and riser
      (1) Signs of seepage
      (2) Separation of joints
      (3) Cracks, breaks, or deterioration of concrete
      (4) Differential settlement
   c. Sediment level in relation to the top of riser
   d. Scour at outlet
   e. Condition of trash racks

4. Emergency Spillway
   a. Erosion
   b. Sedimentation
   c. Weeds, logs, or other obstructions, reducing channel capacity
   d. Deposition of sloughing

5. Embankment
   a. Settlement or cracking
   b. Erosion
   c. Leakage
   d. Rodent, wildlife, or livestock damage
   e. Wave damage

6. Reservoir Area
   a. Undesirable vegetative growth
   b. Cut or fallen trees
   c. Slash and other debris
   d. Erosion of banks

7. Gates and Valves
   a. Damage by debris, ice or freezing

8. Channels
   a. Sedimentation
   b. Bank cutting
   c. Debris accumulation
   d. Condition of riprap or other works of improvement
      (1) Undermining
      (2) Damage or deterioration
      (3) Adjacent channel scouring
   e. Adjacent property damage

9. Structure Drainage Outlets
   a. Drainage outlet pipes
      (1) Clean or dirty water?
      (2) Rodent guard attached and functioning?
      (3) Pipes free-flowing, no obstructions?
      (4) Evidence of seepage
      (5) Adjacent to pipes
      (6) Lower 1/3 downstream slope & flood plain
   b. Rock toe drains
      (1) Free draining into settling basin or collection channels?
      (2) Clean or dirty water?

10. Safety Hazards
11. Signs
12. Vandalism

REMARKS (continued)

Distribution: Mass.Div. of Water Resources
FmHA (if loan involved)
SCS

...SI... SOI... CONSERVAT... SERVICE
...ST., MASSACHUSETTS

MA-AS-10
8-78
File Code 12-13-

OPERATION AND MAINTENANCE RECORD

Project and Site A-1 Geo Nichols Date Oct 10, 1978

Sponsoring Local Organization Div. of Water Resources

...operation and maintenance Inspection Record dated JUNE 13, 1978 ...ed a need for certain maintenance and repair work. This and other maintenance ... been completed as follows:

Agreed to Item No.	Maintenance Performed by: (Contributed Labor, Force Account, Contract, Etc.)	Actual Costs	Date Completed
	Mow E.S., dam and disposal AREA		
	Pick-up debris along Toe & Cut small brush from Side Slopes		
	Clean-out TRASH Rack-replace rocks along Slopes		
	Paint all exposed vents in E.S. with Flat rust Paint		
	Remove rocks in Channel and place as Rip-Rap along Channel		
	Paint ENTRANCE GATE with Metal Paint		
		Volc -	8/1/78

REMARKS:

SCS Representative

SLO Representative

Distribution:
Mass.DWR; FmHA (if loan involved)
SCS
Sponsor

Report due: Annually

MA-AS-TRIAL (2)
3/22/76

C RATION AND MAINTENANCE INSPECTION RECORD

U.S. Dept. of Agriculture
Soil Conservation Service

Project SuAsCo W.S. Inspection Date 8/29/78

Site Name/No. A-1 GEORGE H. NICHOLS Type MULTIPLE PURPOSE

Type of Inspection: Special ☐ Annual ☒

Structure Operation: Satisfactory ☒ Unsatisfactory ☐

Sponsoring Local Organization: DIV. OF WATER RESOURCES

Present for Inspection: DAN COLBURN D.E.M., LEE MCLAUGHLIN MDFW, GAY FOLLEY & LARRY ROUTIETTE, SCS, HOWARD BORGGAARD S.W. CONS. DISTRICT ERNIE STRUZZIERO, MDWR.

ITEM	Condition * S or U	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Complet
1. Vegetation	U	MOW E S	500 -	JUNE 1979
2. Fences	S			
3. Principal Spillway	S			
4. Emergency Spillway	S			
5. Embankment & Riprap	S			
6. Reservoir Area	U	PICK-UP AND REMOVE TRASH FROM SHORE LINE	200 -	JUNE 1979
7. Gates or Valves	U	GATE HAS MOVED AWI WALL (SLEEVE) CHECK	300 -	JUNE 1979
8. Outlet Channels	U	REMOVE GROWTH FRO SIDES.	300 -	JUNE 1979
9. Structure Drainage Outlets	S			
10. Access Rd.	S			
11. ENTRANCE GATE	U	REPAIR LOCK	50 -	JUNE 1979

REMARKS: (over)

* S = Satisfactory; U = Unsatisfactory

Howland E Folley / Laurence Routhette / Everett Stumpf
(District Conservationist) (Project Engineer) (SLO Representative)

(Report due annually: July 1)

MA-AS- TRIAL
5/20/76

U.S. Department of Agriculture
Soil Conservation Service

OPERATION AND MAINTENANCE RECORD

Project MASS C. A-1 (C.H. Nichols) Date Nov. 28, 1977

Sponsoring Local Organization Water Resources

The Operation and Maintenance Inspection Record dated April 22, 1977 showed a need for certain maintenance and repair jobs. These jobs have been completed as follows:

Agreed to Item No.	Maintenance Performed by: (Contributed Labor, Force Account, Contract, Etc.)	Actual Costs	Date Completed
	New emergency spillway, dam and		
	disposal Area		
	Pick-up debris along toe + cut small		
	brush from side slopes		
	Pick-up debris along toe and cut		
	small brush from side slopes		
	Clean out trash rack - replace		
	rock along slopes		
		685.-	11/28/77

REMARKS:

SCS Representative

Ernest Pettengill
SLO Representative

Distribution:
Mass.DWR;FmHA (if loan involved)
SCS

Report due:

SDA, SOIL CONSERVATION SERVICE
MHERST, MASSACHUSETTS

MA-AS-10
8-18
File Code 12-13-1

OPERATION AND MAINTENANCE RECORD

Project and Site A-1 (Geo H. Nichols) Date Oct 17, 1977

Sponsoring Local Organization Dir. of water

The Operation and Maintenance Inspection Record dated May 1977 showed a need for certain maintenance and repair work. This and other maintenance has been completed as follows:

Related to Item No.	Maintenance Performed by: (Contributed Labor, Force Account, Contract, Etc.)	Actual Costs	Date Completed
	Liming	303.-	Oct 26, 19
	Fertilizing	167.-	Oct 26, 197

REMARKS:

Ernest Struzzieri
SCS Representative SLO Representative

Distribution:
Mass.Iwr;FmHA if loan involved
C.C.
Sponsor

Report due: Annually

-TRIAL
/6

OF ATION AND MAINTENANCE
INSPECTION RECORD

S. Dept. of Agriculture
Soil Conservation Service

: QUASCO W/S Inspection Date APRIL 22, 1977

Dam No. A-1 (CECIL E NICHOLS) Type MULTIPLE-PURPOSE

of Inspection: Special ☐ Structure Operation: Satisfactory ☒

Annual ☒ Unsatisfactory ☐

ding Local Organization: DIV. OF WATER RESOURCES

t for Inspection: ERNIE STRUZZIERO, WRC., LARRY BOUTIETTE AND OLD PITMAN, SCS.

ITEM	Condition S or U	Maintenance & Needed Repairs	Estimated Cost	Agreed Date Repairs to be Complete
vegetation	U	MOW E.S. DAM, & DISPOSAL AREA	800	JULY 1977
fence	3 U	PAINT ENTRANCE GATE	50	JULY 1977
principal spillway		CHECK GATE FOR PROPER FUNCTIONING		
auxiliary spillway	U	PICK-UP DEBRIS ALONG TOE & CUT SMALL BRUSH FROM SIDE SLOPES	300	JULY 1977
embankment & riprap	U	PICK-UP DEBRIS ALONG TOE OF DAM & CUT SMALL BRUSH FROM SIDE SLOPES	200	JULY 1977
reservoir area	S			
gates or valves	S			
outlet channels	U	CLEAN-OUT, TRASH & ROCK REPLACE ROCK ALONG SLOPES	300	JULY 1977
structure mainten. drives	S			
access Rd.	S			

KS: (over) S = Satisfactory; U = Unsatisfactory

NEW GATE HAS ELIMINATED VEHICLE TRAFFIC. GRAVEL TOP OF DAM LOOKS GOOD

Clifford Peterson Lawrence M Boutiette Jr. Ernest Thompson

(SCS Conservationist) (Project Engineer) (SLO Representative)

rt due annually: July 1)

TRIAL — RATION AND MAINTENANCE INSPECTION RECORD — U.S. Dept. of Agriculture, Soil Conservation Service

[illegible] UNTERSHED — Inspection Date 4-29-76

ame/No. [illegible] Type MULTIPLE PURPOSE

f Inspection: Special ☐ Annual ☒ — Structure Operation: Satisfactory ☒ Unsatisfactory ☐

cing Local Organization: DIVISION OF WATER RESOURCES

t for Inspection: [illegible] STATE SCS & ENGINEERS

CE SCS

EM	Condition * S or U	Maintenance & Needed Repairs	Estimated Costs	Agreed Date Repairs to be Complet
getation	S	MOW E.S. FERTILIZE E.S. LIME ACCORDING TO SOIL TEST	400	
nces	U	REPAIR FENCE NORTH LEFT SIDE OF DAM & REPLACE ENTRANCE GATE	700	
incipal illway	U	SCRAPE & RE-POINT TRAPEZOIDAL ROCK & JOINTS	200	
ergency illway	U	CLEAN OUT AROUND CATCH BASIN	50	
bankment Riprap	U	REPAIR RUTS IN TOP OF DAM GRAVEL FILL ± 200 C.Y.	1000	
servoir ea	S			
tes or lves	U	REPAIR GATE VALVE (GUIDE SLEEVE, CHECK STEM ETC)	500	
tlet annels	U	REMOVE ROCK BANKS & REPAIR & REPLACE MISSING ROCK. CLEAN OUT DEBRIS	200	
ructure ainage tlets	S			
cess Rd.	S			
AN-UP		TRASH, BRUSH, DEBRIS	400	
		[illegible] GATE VALVE		

S:(over) * S = Satisfactory; U = Unsatisfactory

[illegible] (District Conservationist) [illegible] (Project Engineer) Ernest Sturgis (SLO Representative)

t due, annually: July 1)

O&M INSPECTION RECORD

CHECK LIST

to be checked at time of inspection may include, but not be limited to,
ving:

tion (Structure & Channels)
ed for cutting and/or spraying
ed for reseeding
ed for fertilizing
idence of winter injury

ose or damaged posts
ose or broken wires
cumulated debris at fence
ndition of gates and caps

al Spillway
structions in spillway
ndition of outlet and riser
) Signs of seepage
) Separation of joints
) Cracks, breaks, or deterioration of concrete
) Differential settlement
ment level in relation
the top of riser
ow at outlet
ndition of trash racks

n Spillway
sion
mentation
ds, logs, or other obstructions, reducing channel capacity
position of sloughing

ment
ttlement or cracking
osion
akage
dent, wildlife, or
vestock damage
ve damage

6. Reservoir Area
   a. Undesirable vegetative growth
   b. Cut or fallen trees
   c. Slash and other debris
   d. Erosion of banks
7. Gates and Valves
   a. Damage by debris, ice or freezing
8. Channels
   a. Sedimentation
   b. Bank cutting
   c. Debris accumulation
   d. Condition of riprap or other works of improvement
      (1) Undermining
      (2) Damage or deterioration
      (3) Adjacent channel scouring
   e. Adjacent property damage
9. Structure Drainage Outlets
   a. Drainage outlet pipes
      (1) Clean or dirty water?
      (2) Rodent guard attached and functioning?
      (3) Pipes free-flowing, no obstructions?
      (4) Evidence of seepage?
      (5) Adjacent to pipes
      (6) Lower 1/3 downstream slope & flood plain.
   b. Rock toe drains
      (1) Free draining into settling basin or collection channels?
      (2) Clean or dirty water?
10. Safety Hazards
11. Signs
12. Vandalism

ontinued)

on: Mass.Div. of Water Resources
FmHA (if loan involved)
SCS

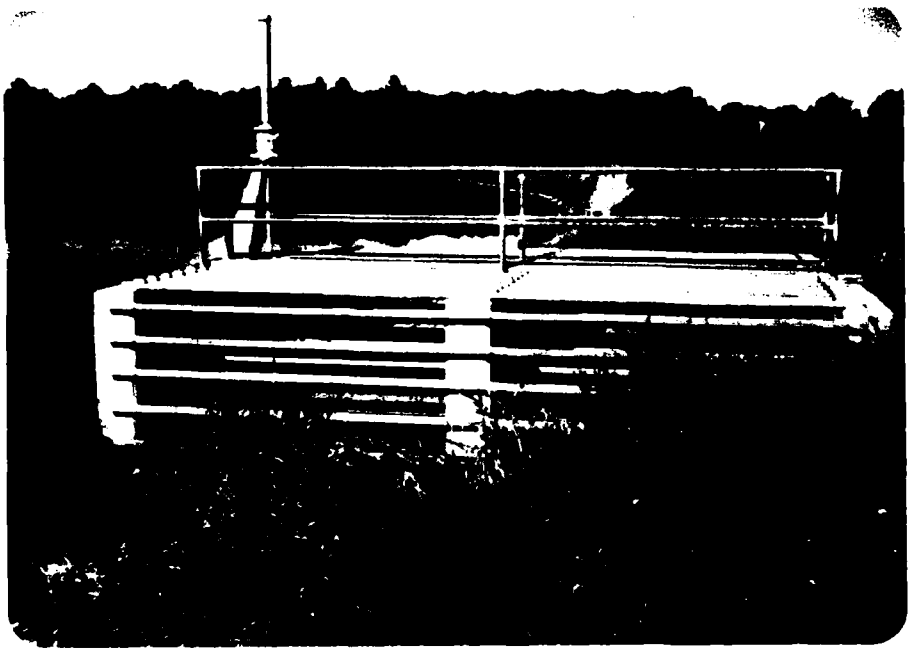
NO. 7 DOWNSTREAM TOE OF DAM AND EMERGENCY SPILLWAY

NO. 5 SPILLWAY DISCHARGE STRUCTURE AND DOWNSTREAM CHANNEL

NO. 6 48-INCH DIAMETER R.C. PIPE SPILLWAY

NO. 3 TOP OF DAM

NO. 4 EMERGENCY SPILLWAY



NO. 1 OUTLET WITH TRASH RACKS AT SPILLWAY

NO. 2 EMERGENCY SPILLWAY ENTRANCE AND WEST ABUTMENT OF DAM

APPENDIX C

PHOTOGRAPHS

(For location and direction of view of photographs, see Figure B-1)

ASSABET RIVER DAM

under the repair contracts. Those areas reseeded under the repair contracts are just beginning to show signs of germination. The need for lime, fertilizer and mowing will have to be determined at a later date.

Rocks have been thrown in the impact basin and should be removed. The control gate has a broken guide stem and the WATER RESOURCES COMMISSION is in the process of repairing it. Some trash is evident along the upstream slope and should be removed. The pool looks good, and the plaque and fences are in good shape.

Two bolts are missing from one of the trash racks on the riser and should be replaced.

A-3c Site

The vegetation visible on this site looks good. It was too early in the season to establish success of crownvetch coverage. Recommendations for lime, fertilizer and mowing should be made after inspection in June. The top of the dam shows vehicle wear.

Trash and rocks need to be removed at riser. Brush should be removed on either side of inlet stream. The low stage trash racks in the riser are badly bent and should be replaced. Dike on Tompkin Hill Road functioning.

The barricade at entrance on Route 20 needs both posts reset, restrung cable, and new eyebolts. The barricade at the right end of dam needs new eyebolt and lock. Junk vehicles still located in floodpool. Trash and rubbish on Route 20 side of both dikes need to be disposed of. Cycle traffic obvious on dam and dikes.

A-4c Site

Crownvetch just starting to show this years growth all over dam. Recommendations for lime, fertilizer and mowing will have to be decided in June. Cycle traffic obvious on top of dam and in the emergency spillway. There are a few trees growing on the upstream slope of dam which should be removed (roots and all). Trash and an old rusty barrel should be removed from riser area. Weeds and brush should be cut along inlet channel to at least 25' upstream of riser.

Access, barricades and plaque are all OK.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
29 Cottage Street
Amherst, Massachusetts 01002

REPORT OF THE ANNUAL INSPECTION
SUASCO WATERSHED

On May 3, 1971, the following people met at the A-1 Site for the purpose of conducting the annual inspection of PL-566 Sites, A-1, A-3c, A-4c, A-4a, A-6f, A-6h and Delaney Complex in the SuAsCo Watershed:

Kevin McGuire.....Water Resources Commission
Thomas Lewicke.....Water Resources Commission
Dann Colburn.....Division of Forests & Parks
Gayland Folley.....Soil Conservation Service
David Faerber.....Soil Conservation Service

GENERAL

All of the people present walked over the sites, which in general, appeared to be in good condition. Vandalism, which has been evident in previous inspections, was noticeably absent during the visit.

In general, the vegetative cover on all sites is good. The inspection was conducted too early in the growing season to evaluate the coverage or for the needs of lime, fertilizer, reseeding or mowing. These determinations should be made by the District Conservationist during the first week of June. Most of the sites show evidence of vehicular traffic, mostly cycles of one variety or another.

As noted last year, at A-4a, animals have caused potentially serious erosion adjacent to the riser. During the inspection, it was recommended that the MASS. DEPT. OF FISHERIES AND GAME be contacted to trap the animals causing the problem.

The inspection was made during rainy weather so it was difficult to detect any seepage problems.

George H. Nichols (A-1) Site

The vegetative cover on this site is good in those areas not disturbed

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
29 Cottage Street
Amherst, Massachusetts 01002

July 25, 1972

Report of Annual Inspection
SuAsCo Watershed

On May 10, 1972, the following people met at the A-1 Site for the purpose of conducting the annual inspection of PL-566 Sites in the SuAsCo Watershed:

Tom Lewicki, Water Resources Commission
Dann Colburn, Mass. Dept. of Natural Resources (Clinton)
Gay Folley, Soil Conservation Service
Phil Simmons, Soil Conservation Service
Dave Faerber, Soil Conservation Service

GENERAL

All of the people present walked over the sites, which in general, appeared to be in good condition. Vandalism, which has been evident in previous inspections, was noticeably absent except at A-4C.

In general, the vegetative cover on all sites is good. However, the Delaney Site is in immediate need of attention. It was too early in the growing season to determine the lime, fertilizer and mowing needs of the sites. After inspection of these sites in June, the District Conservationist can make appropriate recommendations as to the needs of the individual site.

GEORGE H. NICHOLS (A-1) SITE

The vegetative cover on this site is generally good. However, the top of the dam is bare and many areas in the repaired section of the emergency spillway outlet slope has bare spots. Crownvetch and Birdsfoot trefoil cover on site is sparse. There is a wet spot at the junction of the slope changes in the bottom of the emergency spillway outlet slope. A soil pile just below the control section in the emergency spillway should be removed. The depressions at the outlet end of the emergency spillway should be filled in, smoothed and seeded.

The riser and impact basin are functioning. The water control gate in the riser is broken and scheduled for repair in the next few months. Rocks should be removed from impact basin. Trash rack has wooden debris and should be removed from the upstream face of dam; also beer cans should be removed from bottom of emergency spillway. The pool looks excellent and the plaque and fences are in good shape.

In lieu of tests, agricultural limestone should be applied at the rate of three tons per acre on sites not limed within the last three years.

Eroded areas or areas denuded by animal, vehicular or cycle traffic are to be seeded to the same seeding mixture that was originally seeded on the areas in question. Seed at the rate of at least 1½ pounds of the seeding mixture per 1,000 square feet.

A-1 SITE

The vegetative cover on this site is good. Crownvetch and birdsfoot trefoil have taken hold well in previously noted sparse areas. Entire site should be mowed, particularly undesirable growth in emergency spillway. Top of dam is bare and regrading and seeding should be considered.

Foundation drain pipes are working well as observed from outlets in impact basin. Concrete for impact basin and riser seem in good shape. The gate for the pond drain was repaired last winter.

Rocks should be removed from impact basin. Grading of outlet end of emergency spillway should be considered. Pervious material placed in outlet channel below impact basin has washed downstream and replacement is recommended. These items will be included in a contract being prepared by SCS.

Cycle traffic was evident on upstream berm and on emergency spillway dike. Consideration should be given to improving the entrance gate, so that it moves more freely, by adding a 1-inch diameter pipe at hinge end.

Wet spots were observed in area between outlet edge of dike and downstream toe at dam as well as on right side of emergency spillway, above where blanket had been previously installed. These items are included in a contract being prepared by SCS.

A-3c SITE

Vegetative cover on site looks good, with the exception of top of dam which is bare. Top of dam appears to receive heavy animal and vehicular traffic. Barricade on left abutment of dam needs a cable and the barricade located on left side of Dike "B" is missing a lock. A new access has been made off Route 20 to the site on the right side of Dike "B." This could possibly be remedied by placing a mound of fill, consequently obstructing further use.

Undesirable growth on both slopes of dam and woody growth on both slopes of Dike "B" should be removed. Also, trees approximately 20 feet upstream from centerline of dam should be removed. Entire site should be mowed and such mowed material removed.

Low stage trash rack bars are bent. Riser shows several chipped holes which appear to have been caused by being used for target practice. Last section of principal spillway pipe shows small area where wire mesh is exposed. Manhole cover was retrieved from stream and placed on riser. A locking device for manhole should be considered. Plaque is still missing.

Town dump abuts very close to diversion ditch. Culvert under Tomblin Hill Road is partially obstructed by small slide of soil.

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
29 Cottage Street
Amherst, Massachusetts 01002

REPORT OF THE ANNUAL INSPECTION
SuAsCo WATERSHED

June 14, 1973

On May 2, 1973, the following people met at the A-1 Site for the purpose of conducting the annual inspection of PL-566 in the SuAsCo Watershed:

Kevin McGuire, Water Resources Commission
Tony Troiano, Mass. D.P.W. - District #3
Adam Pizan, Mass. D.P.W. -District #4 (May 2 only)
Gregory Buteau, Soil Conservation Service
Arnold Pitman, Soil Conservation Service

Because of the time limitation on the date above, the inspection of the Delaney Site occurred on May 11, 1973.

GENERAL

An inspection of the sites indicated they are generally in good condition. Vandalism was noticeably absent except at A-4c Site. However, most sites had received heavy animal and vehicular traffic as evidenced by the relatively bare tops of all dams except A-6h.

Generally, the vegetative cover on all sites is good with the exception of Delaney. Certainly, as in the past, the Delaney Site needs immediate attention in terms of seeding and fertilizing. On most sites the dense matting of the previous year's growth is slowing down new growth and could be a fire hazard. Anticipating that the maintenance contract will occur in July, mowing and removal of such material is recommended for all sites except Delaney. Fertilizing is recommended for all sites, except Delaney which will receive special consideration.

Fertilize the sites at the following rates of fertilizer per acre:

PREVAILING[1/] VEGETATION CONDITIONS	FERTILIZER	GRADE OR ANALYSIS	AMOUNT PER ACRE PER YEAR
Where grasses are dominant and legumes are at a minimum	Complete with 25 to 40% of the nitrogen from an organic source	15-10-10 or equivalent (e.g. 10-10-10)	400 pounds Approximately 480 pounds
Where the legumes crownvetch or birdsfoot trefoil are dominant	No nitrogen fertilizer	0-20-20 or equivalent	400 pounds
Where grasses and legumes are somewhat equal in occupying the site	Low to medium nitrogen fertilizer with 25 to 40% of the nitrogen from an organic source	5-10-10 or 8-16-16 or equivalent of the above	400 pounds 400 pounds

1/ Should isolated areas be eroded and devoid of vegetation, the above rates of application should be increased substantially and possibly doubled per acre.

PREVAILING 1/ VEGETATIVE [illegible]	FERTILIZER	GRADE OR ANALYSIS	AMOUNT PER ACRE PER [illegible]
[illegible] grasses and legumes are somewhat equal in occupying the site	Low to medium nitrogen fertilizer with 25 to 40% of the nitrogen from an organic source	5-10-10 or 8-16-16 or equivalent of the above	400 pounds 400 pounds

In lieu of tests, agricultural limestone should be applied at the rate of three tons per acre on sites not limed within the last three years.

Eroded areas or areas denuded by animal, vehicular or cycle traffic are to be seeded to the same seeding mixture that was originally seeded on the areas in question. Seed at the rate of at least 1½ pounds of the seeding mixture per 1,000 square feet.

[illegible] H. NICHOLS SITE, WESTBOROUGH

The entrance gate to this site is to be replaced and it will hopefully prevent access to the dam by motor vehicles.

The site is to be limed and fertilized with no mowing planned this year. The vegetative cover under the last contract has caught and is progressing nicely. The crownvetch that was mowed last year has grown back quite well.

The cover that was installed over the breather pipe at the outlet end of the emergency spillway under the last contract has been removed and the pipe filled with rock. This rock should be removed and a new cover with a [illegible] lock should be installed. Emergency spillway drains were flowing at the time of our visit.

A collection of rock which has formed a dam across the downstream channel should be removed and replaced on the channel side slope.

The plaque is to be recemented. All concrete is in good condition.

[illegible] SITE, NORTHBOROUGH

All entrances to this site are to be barricaded. Most entrance posts are still present but the cable needs to be installed. A gravel barricade will be constructed at the entrance to "Dike B" across from the town dump.

Small trees on upstream side of the dam to the right of the riser will be removed. Grass along the upstream side of the dam to the left of the riser will be mowed. Debris which has collected on the riser trash rack will be removed. The metal cover on the riser is frequently removed and deposited in the pool area. This situation could be remedied by spot-welding.

A liming program has been planned for this site.

7/24/74

United States Department of Agriculture
Soil Conservation Service
29 Cottage Street
Amherst, Massachusetts 01002

Report of the Annual Inspection
SuAsCo Watershed
July 22, 1974

On July 11, 1974, the following people met at the A-1 Site in Westboro for the purpose of conducting the annual inspection of PL-566 sites in the SuAsCo Watershed:

Kevin McGuire, Water Resources Commission
Adam Piman, Mass. D.P.W. - District #4
Otto Stein, Northwestern Worcester County Conservation District (July 11 only)
William Annable, Soil Conservation Service (July 11 only)
Laurence Boutiette, Soil Conservation Service
Arnold Pitmen, Soil Conservation Service

Because of the time limitation, the inspection of the Delaney Complex occurred on July 12, 1974.

General

Vandalism by means of horse and motor bike traffic appears to be on the increase in the SuAsCo area. Site A-3-c, Hopbrook Site, has had a great deal of horse traffic to an undesirable extent. Better methods of discouraging this traffic should be devised and installed to prevent long term eroding of those heavily travelled areas.

The Delaney Complex has a very noticable lack of vegetation throughout. This site should have a high priority with maintenance considerations to prevent severe erosion. The remaining sites are generally in good vegetative cover.

Fertilize the sites at the following rates of fertilizer per acre:

PREVAILING VEGETATION CONDITIONS 1/	FERTILIZER	GRADE OR ANALYSIS	AMOUNT PER ACRE PER YEAR
Where grasses are dominant and legumes are at a minimum	Complete with 25% to 40% of the nitrogen from an organic source	15-10-10 or equivalent (e.g. 10-10-10)	400 pounds Approximately 480 pounds
Where the legumes crownvetch or birdsfoot trefoil are dominant	No nitrogen fertilizer	0-20-20 or equivalent	400 pounds

1/ Should isolated areas be eroded and devoid of vegetation, the above rates of application should be increased substantially and possibly doubled per acre.

SPECIFIC MAINTENANCE ITEMS - The following are a listing of those specific maintenance items as determined during the inspection.

A. George H. Nichols Site, A-1 - Westboro, MA.
   1. Replace entrance gate to site. The old gate was destroyed by vandalism.
   2. Repair and straighten last five fence posts which extend into the pool from Mill Street.
   3. Remove debris, silt, and brush from the drainage ditch between the pool and Mill Street.
   4. Remove all brush and debris from around the edge of the pool at the dam and from around the riser.
   5. Remove small rock dams which have been constructed across the downstream channel and replace rock on channel slopes. Erosion of the channel banks has occurred in those areas where rock was removed to build the small dams.
   6. The breather pipe at the lower end of the outlet channel should be cleaned of rock and a new cover and lock installed.
   7. Clean debris and free the opening to the field catch basin. (edge of Dunn's field).

B. Hephbrook Site, A-3-C - Northborough, MA
   (Diversion)
   1. Install a fence adjacent to Tomlin Hill Road. Present fence is not adequate.
   2. Cut and remove shrubs and bushes from around the inlet end of the culvert under Tomlin Hill Road.
   3. Remove trash from the area around the outlet end of the culvert under Tomlin Hill Road.

   (Dam)
   1. The plaque at this site is missing.
   2. Remove the piles of old tires from the area between dikes "B" and "C" and from along the upstream toe of dike "A".
   3. Several barricades are required at dikes "A", "B", and "C".
   4. A main entrance gate at Route 20, similar to the one at the A-1 Site should be installed.
   5. Remove (including roots) all shrubs and brush from the upstream and downstream sides of dikes "A", "B", and "C".
   6. Remove (including roots) all shrubs and brush from the downstream side of the dam.

29 Cottage Street, Amherst, MA 01002

REPORT OF THE ANNUAL INSPECTION - SuAsCo WATERSHED

On May 15, 1975, the following people met at the George H. Nichols Site in Westboro, MA for the purpose of conducting the annual inspection of the PL-566 sites in the SuAsCo watershed.

Kevin Maguire - Division of Water Resources
Ken Wood - Division of Water Resources
Laurence Boutiette - Soil Conservation Service

Because of the time limitation, the inspection of the Delaney Complex was held on May 16, 1975.

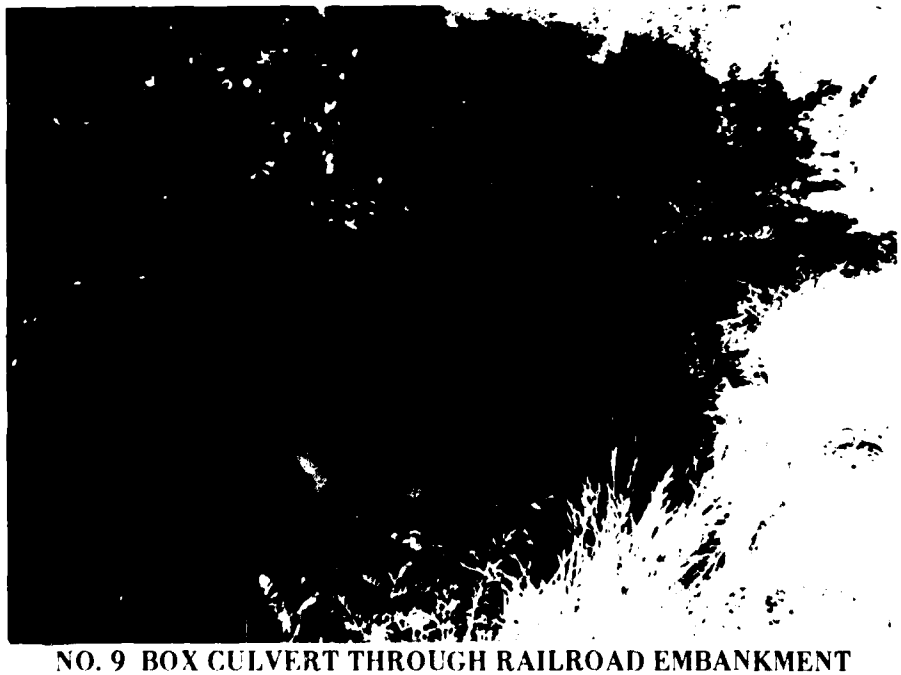
GENERAL - All of the sites inspected were in generally good condition. Once again, the SuAsCo sites have been subjected to much traffic from motorbikes and horses. It would appear that a study should be made concerning when, where, and what kind of barricades should be installed. Much vandalism has occurred throughout the SuAsCo watershed concerning unhitching and cutting of cable barricades, slipping and removal of chain-link fence, and splitting of wooden barricades. Consideration should be given to the blocking of access by placement of fill (boulders) and the installation of iron post set in concrete.

Most of the SuAsCo sites are providing excellent spots for local fishermen. Consideration should be given to the installation of impact basin gratings (similar to the one installed at the George H. Nichols site) as a protective measure and as a safety measure for small children.

The SuAsCo sites are providing homes for many varieties of wildlife as witnessed during the inspection. Consideration should be given to the installation of flashboards (particularly at the Delaney Complex) to further encourage wildlife to these areas.

Serious consideration should be given to raising the water level at the Delaney Complex. Presently, an expensive state-owned boat ramp is being used as a lunch spot and night parking area. Much glass and debris were observed. Much public benefit would be obtained if this boat ramp were made functional by creating a pool of significant depth.

NO. 8 RAILROAD EMBANKMENT AT ARCH STREET UNDERPASS



NO. 9 BOX CULVERT THROUGH RAILROAD EMBANKMENT

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Project Nat. Review of Non Fed. Dams Acct. No. 6356 Page 1 of 11
Subject Worcester County, Mass Compld. By LEB Date 11/2/79
Detail ASSABET RIVER DAM Ck'd. By MD Date 12/3/79

(I) General

A significant part (1.79 mi²) of the drainage area is separated from the remaining area by a railroad embankment. Runoff from the westerly area can reach the reservoir either via a railroad culvert or a highway underpass. A large swamp would pond the excess runoff.

The maximum discharge thru the culvert and underpass is added to the estimated peak runoff from the remainder of the drainage area (5.43 mi²) to determine the peak inflow to the reservoir. No adjustment was made for these probably non-coincident peaks.

The simplified storage routing method used in these studies was adjusted to account for the storage west of the railroad embankment

1- The value of "S" was based on the part of the drainage area east of the railroad

2- The depth of rainfall not stored west of the railroad, was added to the 19 inches of the standardized rainfall

METCALF & EDDY, ENGINEERS

(II) Test Flood, Storage & Storage Functions

1- Total Drainage Area - 1.74 mi² Note: This is for area west of railroad

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

% Ponds & Swamps = $\frac{0}{1.74}$ = 0%

3- $\frac{568 - 314}{8700} = .029$ } Say Ave Slope = 2.9%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be and taken at 2250 c.f.s./mi²
Size Class: Interm.; Hazard Pot.: High; Spill. Des. Flood: Full PMF
Use: Test Flood = Full PMF

5- Test Flood Inflow = (1.74) 2250 = 3915 c.f.s.

6- Pond Storage
The pond area is 0.18 sq. mi. at elev. .
Based on a const. area, storage increases at 115 ac. feet per foot of depth increase.

7- "Spillway crest" elev. is 308.8 (RR Culvert Invert)

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

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

S(in Inches) = $12 D \left(\frac{.18}{1.74}\right) = 1.24 D$; R = 6hr rain of storm.

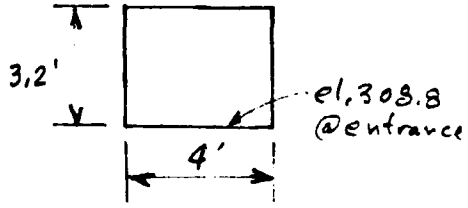
D = Storage depth in feet above spillway crest in reservoir

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

$F_{TF} = 3915 - 206 S = 3915 - 256 D$
$F_{½PMF} = 1958 - 206 S = 1958 - 256 D$

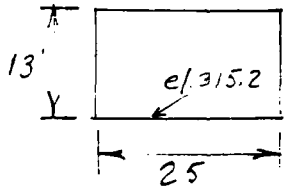
(III) Discharge Relation - Area West of Railroad

A - Railroad Culvert



H/d	0.3	0.8	1.0	1.25	1.5	2	3	4	5
Q/4'	2.3	9.5	14	17	21	25	32	40	44
Q	10	40	56	68	84	100	128	160	176
Water El	309.5	311.4	312.0	312.8	313.6	315.2	318.4	321.6	324.8

B - Highway Underpass



Assume Critical Flow at Entrance

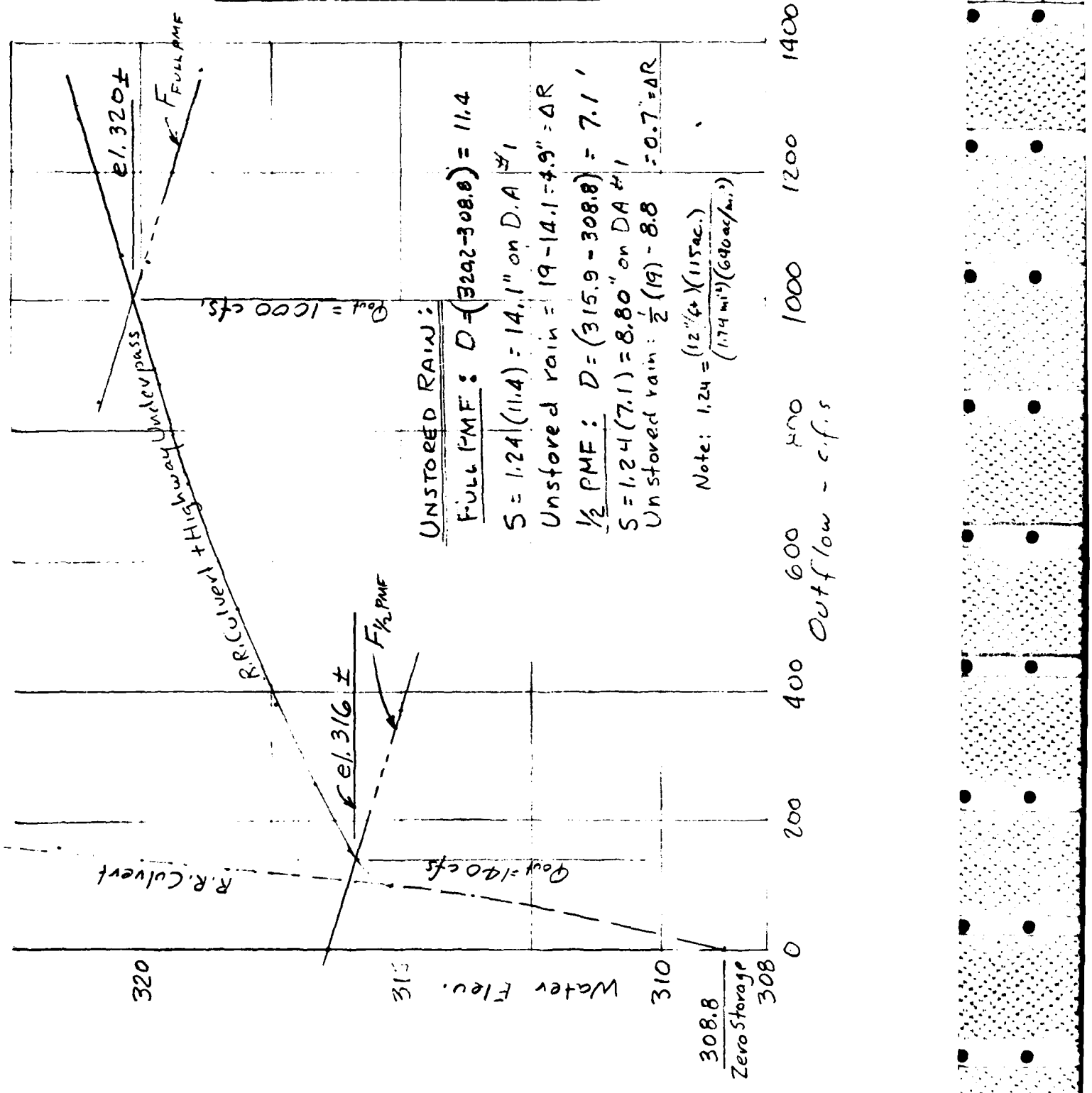
$Q = 25\, y \sqrt{g y} = 142\, y^{1.5}$

Water El. = $315.2 + 1.5y$

y	0.5	1	1.5	2.0	2.5	3.0	3.5	4.0
Q	50	142	261	402	561	738	930	1136
Water El.	316.0	316.7	317.4	318.2	319.0	319.7	320.4	321.2

Project Nat. Review of Non Fed. Dams Acct. No. 6356 Page 4 of 11
Subject Worcester County, Mass. Comptd. By LEB Date 11/1/79
Detail ASSABET RIVER DAM Ck'd. By MS Date 12/3/79

(IV) Discharge & Storage Function vs Water Elevation From Area West of Railroad (D.A. #1)



(V) Test Flood, Storage & Storage Functions

1- Total Drainage Area - 5.43 mi² | Note: This is for area east of railroad

2- Pond(s) Area: 0
Swamp(s) Area: 0.11 mi²
Total Area Pond(s) & Swamp(s): 0.11 mi²

% Ponds & Swamps = $\frac{0.11}{5.43}$ = 2.0%

3- $\frac{622 - 310}{14000}$ = 2.228 } Say Ave Slope = 2.2%

4- Using C. of E. Curves for Peak Flow Rates & above guide values the Peak Flow Rate was estimated to be a little below "Rolling" and taken at 1650 c.f.s./mi²
Size Class: Interm.; Hazard Pot.: High; Spill. Des. Flood: Full PMF
Use: Test Flood = FULL PMF

5- Test Flood Inflow = (5.43) 1650 = 8960 c.f.s. (Add local run. Will attn.)

6- Pond Storage
The pond area is 0.59 sq. mi. at elev. 310. Based on a const. area, storage increases at 380 ac. feet per foot of depth increase.

7- Spillway crest elev. is 313.0 ±

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

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

S(in Inches) = $12\,D\left(\frac{0.59}{5.43}\right)$ = 1.30 D; R = 6hr rain of storm.

D = Storage depth in feet above spillway crest in reservoir

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

F_{TF}	$= 8960 + 1000 - \frac{9960}{19 + 4.9} S = 9960 - 551\,D$
$F_{½\,PMF}$	$= 4480 + 140 - \frac{4620}{½19 + 0.7} S = 2305 - 589\,D$

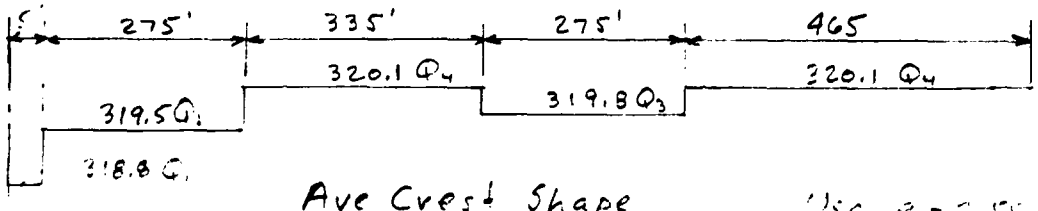
(VI) Discharge Ratings

A - Emergency Spillway

Crest El. 313.0± Width 100', y = depth at crest
Assume Critical Flow @ Crest, Pond El. = 313.0 + 1.5y
$Q_A' = 100q = 100 (gy^3)^{1/2} = 567.45 y^{1.5}$. Correct for side areas
by $K = \frac{\text{Total Area}}{100y} = 1 + \frac{2y}{100}$; Let $Q_A = Q_A' \cdot K$

y =	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Q_A'	200	570	1600	2950	4540	6340	8340	10510
Q_A	202	580	1660	3130	4900	6970	9340	11980
Pond El. =	313.75	314.5	316.0	317.5	319.0	320.5	322.0	323.5

B - Crest Flow



Ave Crest Shape Use $q = 2.55 h^{1.5}$

Pond El.	319	319.5	320	320.5	321
Q_1	10	70	170	280	420
Q_2	—	—	250	700	1290
Q_3	—	—	60	410	920
Q_4	—	—	—	520	1740
Q_B	10	70	480	1910	4370

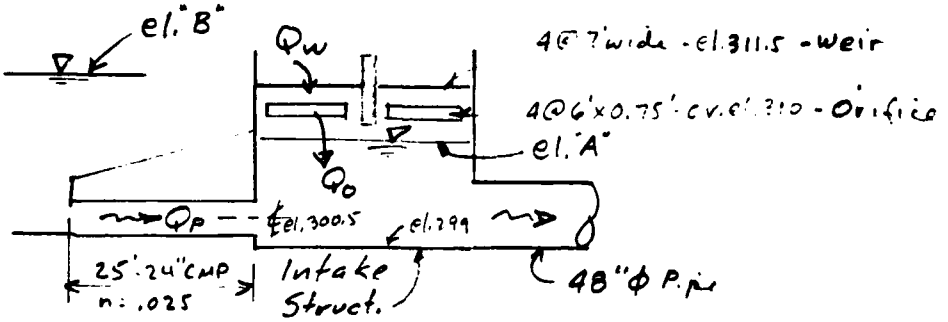
(VII) Crest Flow

Max. depth = 318.9 - 318.8 = 0.1'

$q = 2.55 (0.1)^{1.5} = 0.08$ cfs/ft.

As critical flow: $y_c = .06'$, $V_c = 1.4$ fps

VIII A: Spillway - Intake



For CMP:

$$\left[\frac{Q_p \cdot .025}{1.49\,(.5)^{2/3}}\right]^2 (25) + 1.5\left(\frac{Q_p}{\pi}\right)^2 \frac{1}{2g} = \text{el. B - el A}$$

or $\text{el. B - el. A} = Q_p^2\left[.01773 + 0.00236\right] = Q_p^2\,(.0201)$

For Orifices (ignore low levels)

$$Q_o = 0.6\sqrt{2g\,h_o}\,(.75 \times 6 \times 4) = 56.7\,h_o^{0.5}$$

For Weirs

$$Q_w = 3\,(4 \times 7)\,h_w^{1.5} = 84\,h_w^{1.5}$$

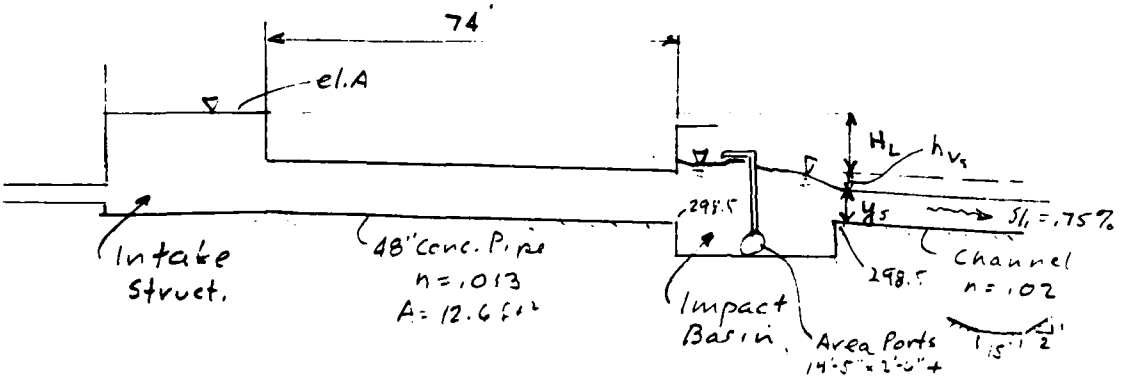
For Orifices & weirs

Pond El.	311	312	314	313	(outlet pipe, etc controls above el. 313±)
Q_o	87	123	173	150	
Q_w	—	30	332	154	
$\Sigma Q_{o/w}$	87	153	505	304	

For CMP

el. B - el. A	8.5	9.5	10.5	11.5	Ignore details & allow 23 cfs for this "pond @ 310 or higher until control taken by outlet, etc.
Q_p	21	22	23	24	
el. B	309	310	311	312	

B: Spillway - Outlet



El. A = $298.5 + y_{c_s} + h_{V_s} + H_L$

$$H_L = \left(\frac{Q}{47.3}\right)^2 \frac{1}{2g} + \left(\frac{Q}{12.6}\right)^2 \frac{1}{2g}(1.5) + 74\left[\frac{Q\,n}{1.49(1)^{1/3}/12.6}\right]^2$$

$$H_L = Q^2\left[6.94\times10^{-6} + 146.7\times10^{-6} + 35.5\times10^{-6}\right] = \left(189.1\times10^{-6}\right)Q^2$$

Channel:

$A_s = 15 y_s + 2y_s^2$, $P_s \simeq 15 + 4y_s$, $Q = A_s \frac{1.49}{.02} R_s^{2/3}(.0075)^{1/2} = 6.452\, A_s R_s^{2/3}$

y_s	2	1.5	1.0	0.5	1.7	1.8	1.9
A_s	38	27	17	8.0	31.3	33.5	35.7
$R_s^{2/3}$	1.397	1.182	.928	.605	1.272	1.315	1.357
Q	343	206	102	31	257	284	313
H_L	22.25	8.02	1.96	0.18	12.5	15.3	18.49
h_{V_s}	1.26	0.90	0.56	0.23	1.05	1.12	1.19
El. A	322.0	307.4	301.0	298.9	312.0	314.9	316.2

(IX) Reservoir Lowering

With res. @ el 310 & 24" CMP conduit fully open:

$\frac{380\,(43560)}{21.5\,(3600)}$ = 214 hours or 8.9 days to lower reservoir by one foot

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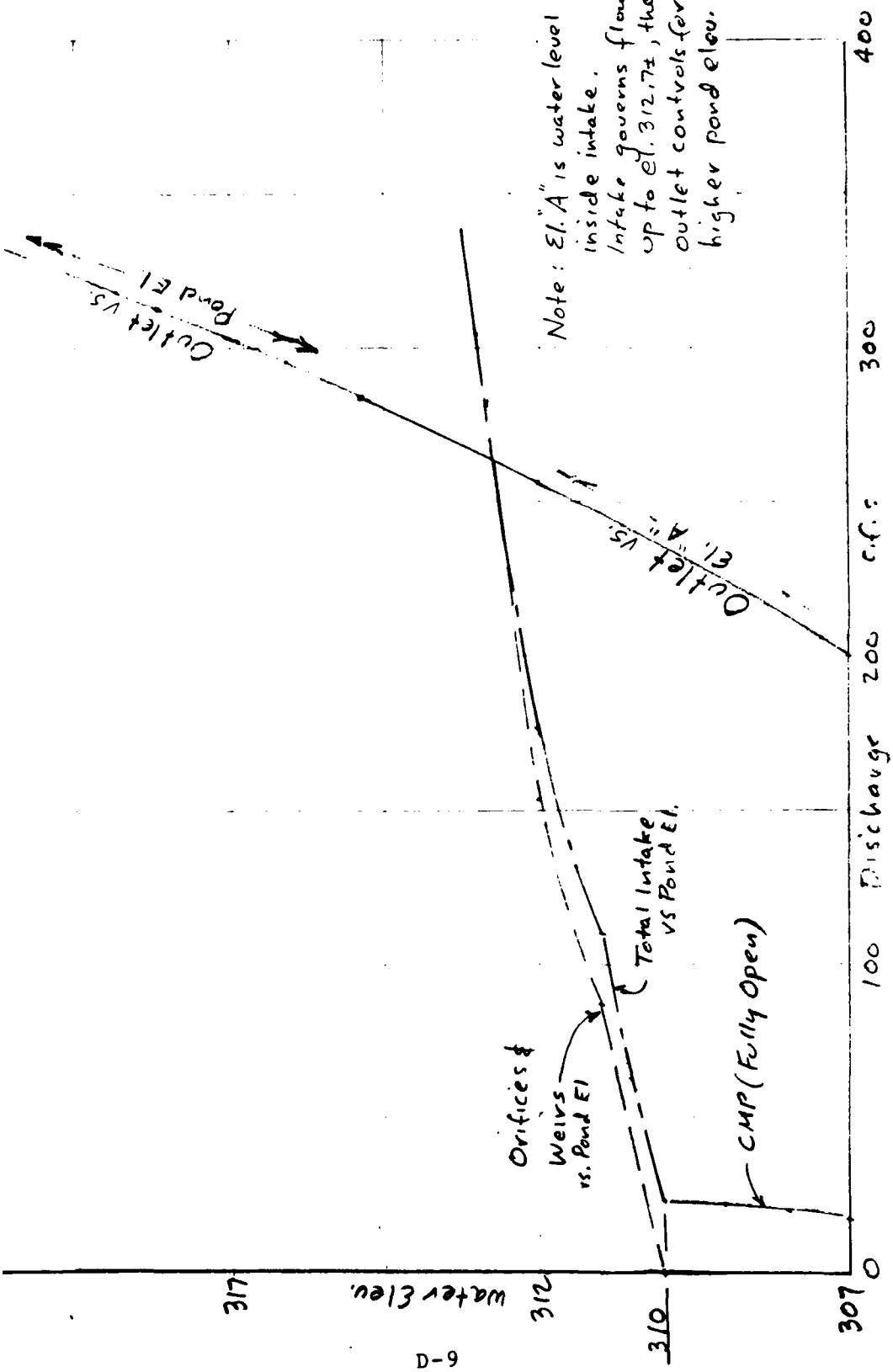
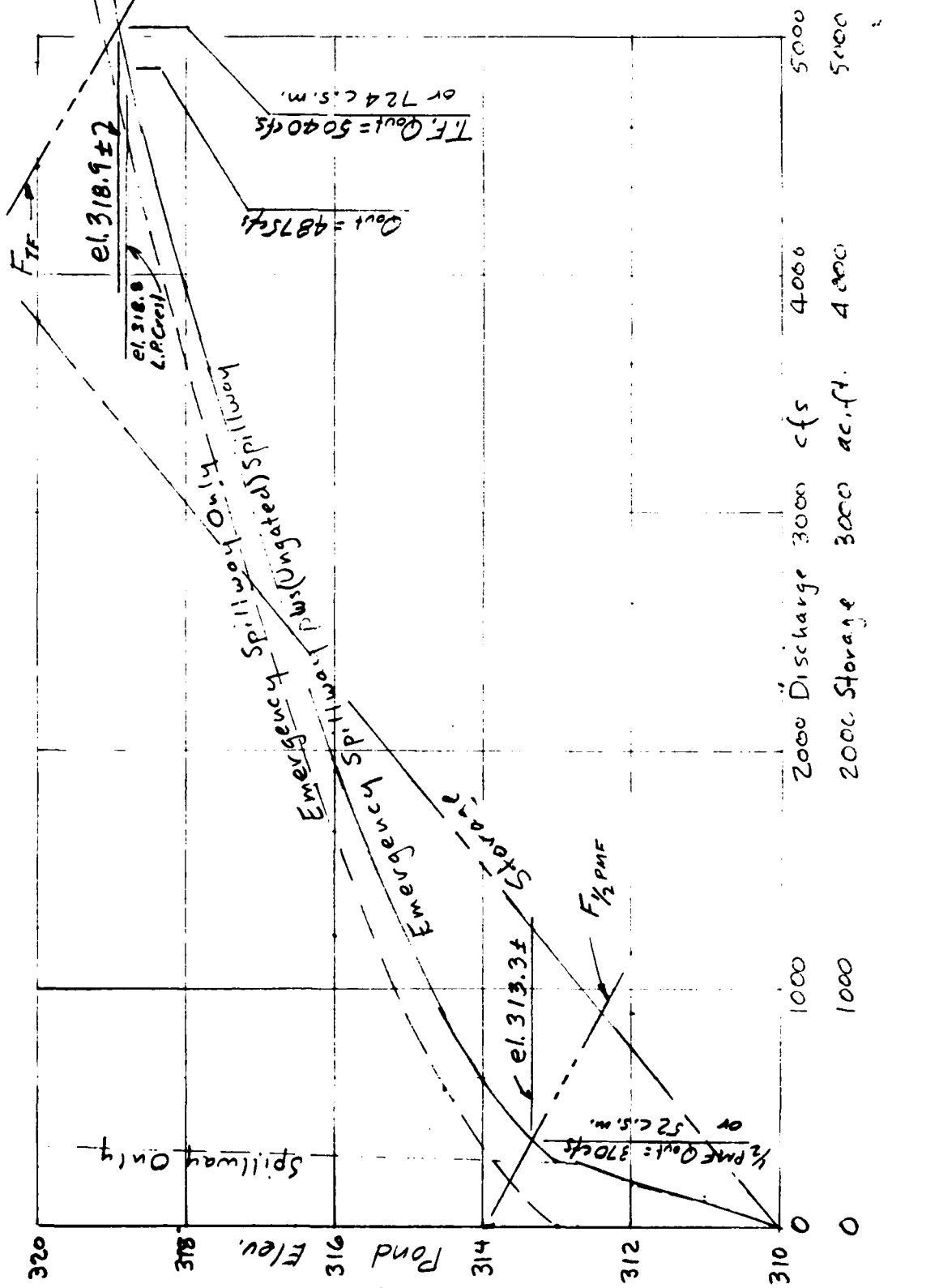
Spillway Rating



Discharge, Storage & Storage Function vs Pond Elev.



Failure of Dam

Peak Failure Flow:

Pond Elevation – 318.8 L.P. on Dam Crest
Toe Elevation — 298.5'
Y_o = 20.3

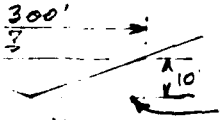
Dam Length Subject to Breaching = 500' (el. 305.6)
$W_o = 40\%(500) = 200'$

$Q_{P_1} = 1.68\, W_o (Y_o)^{1.5} = 1.68(200)(20.3)^{1.5} = 30{,}700$ cfs
On going disch. of pond @ el 318.8 is ± 4,900 cfs

Storage Volume Released:

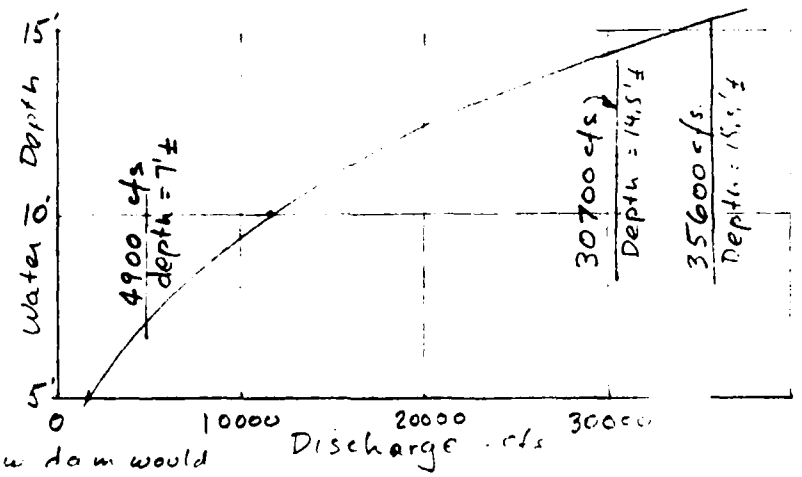
Storage Above Spillway 380(5.8) = 2204 ac. ft
Storage Below Spillway 380(14.5)⅓ = 1837 " "
S = Total Storage = 4041 " "

Channel Hydraulics: At a [illegible] section [illegible]



$S = \frac{10'}{1300'}$, $n = .05$, $V = 2.61 R^{2/3}$, $A = 15y^2$, $P = 30y$

$R^{2/3}$	Y	Q
1.84	4.51	1800
2.92	7.63	11450
3.83	10.00	33750



Max depth just below dam would be ⅔(20.3) ≃ 13.5' However ±1300' downstream where valley narrows, depth would rise from 7'± to 15.5'±

Time to Drain:

$$\frac{43560\,(4041)}{3600\,(\frac{1}{2})\,(30700)} = 3.18 \text{ Hours.}$$

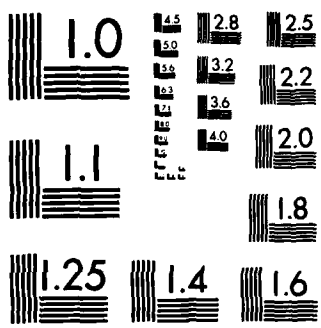
APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

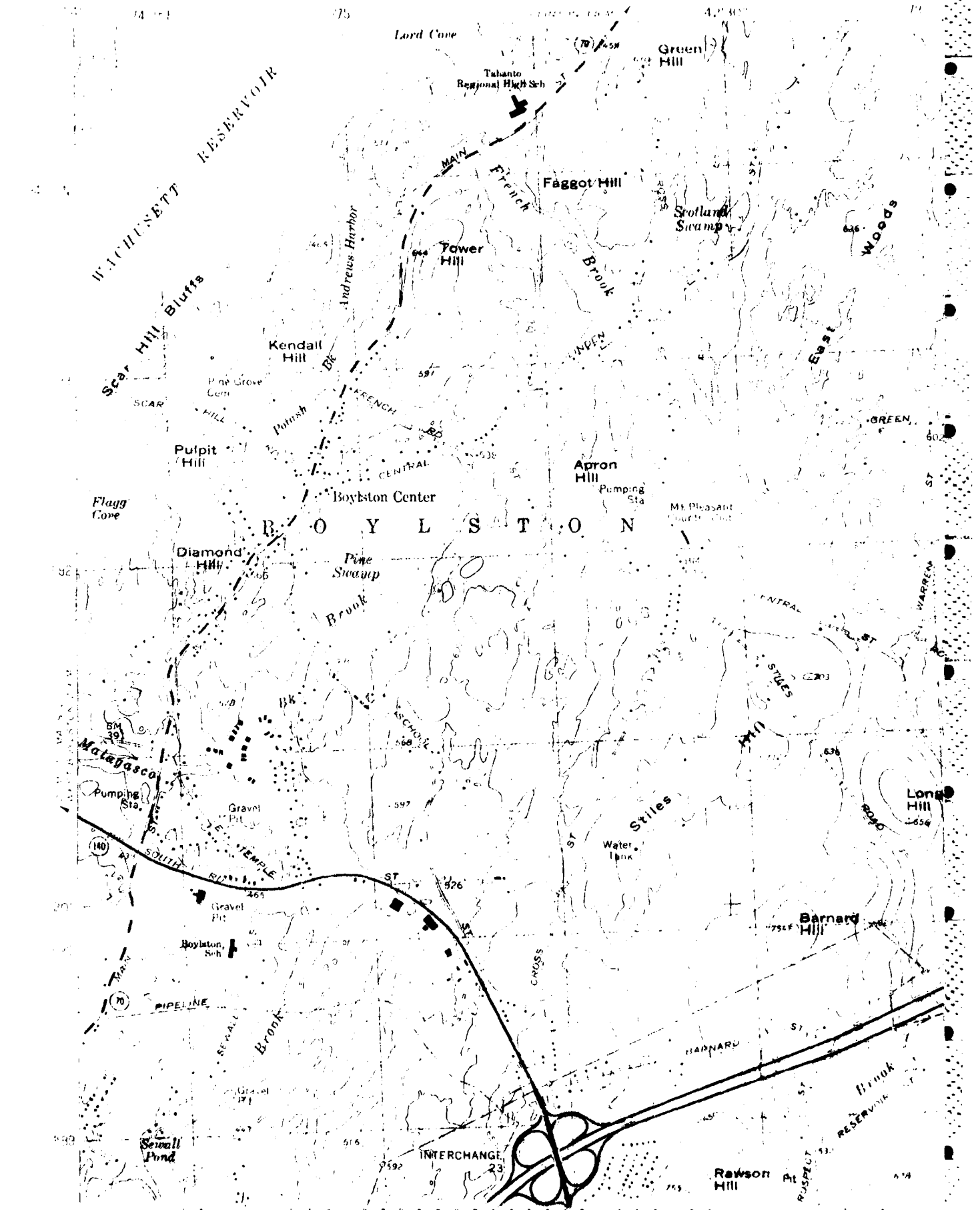
ASSABET RIVER DAM

AD-A154 689 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS ASSABET RIVER DAM (MA.. (U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV DEC 79 2/2

UNCLASSIFIED F/G 13/13 NL



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

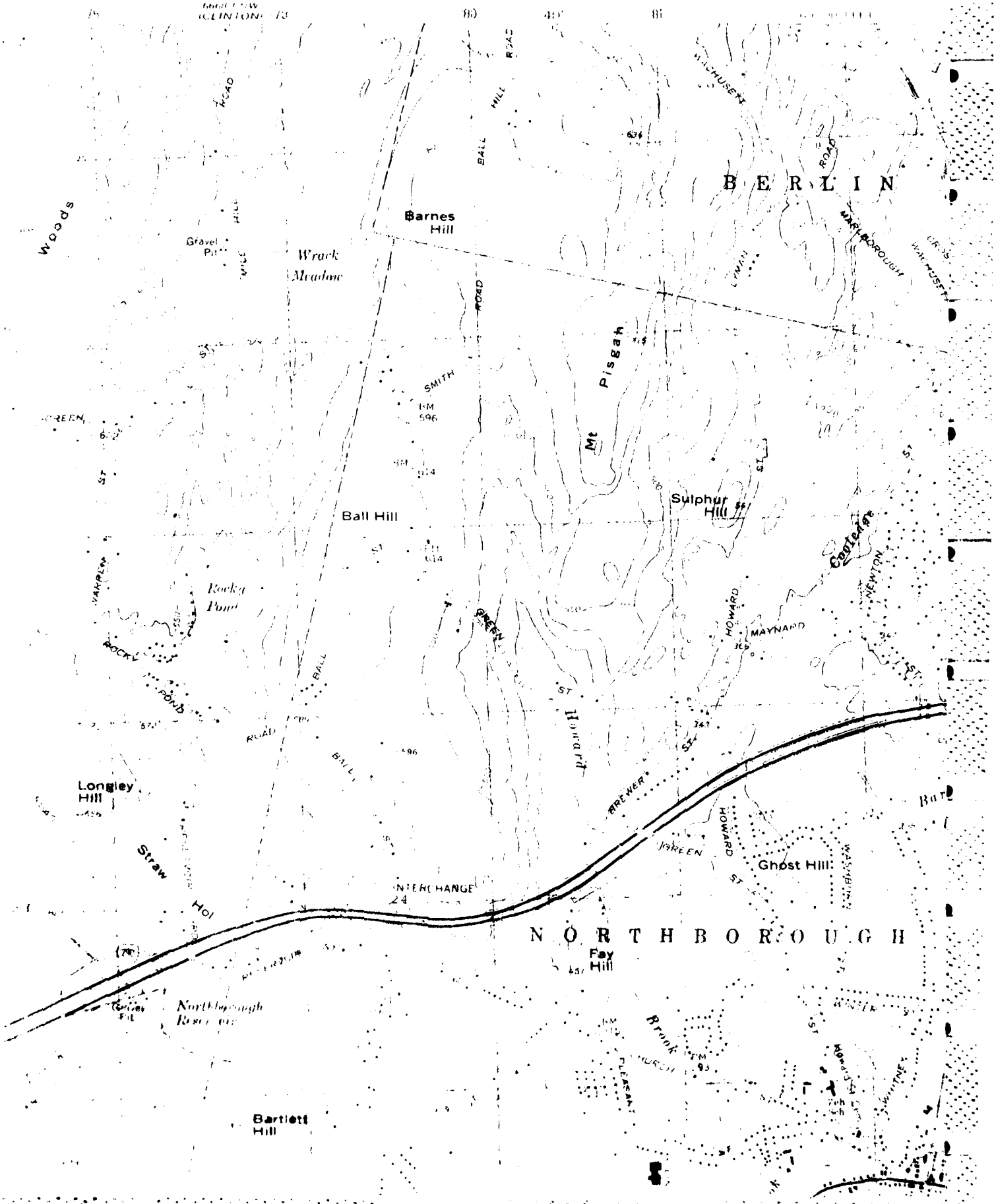


(2)

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS

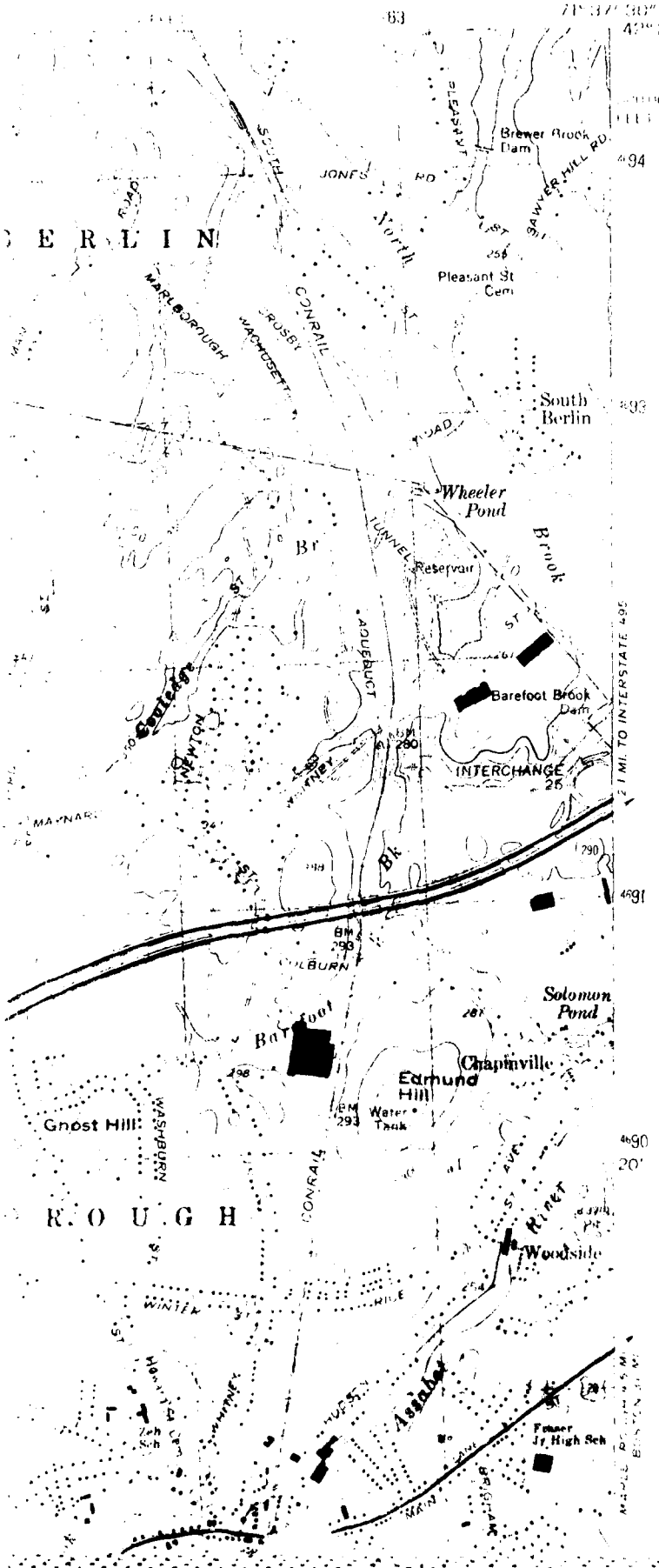
(2)

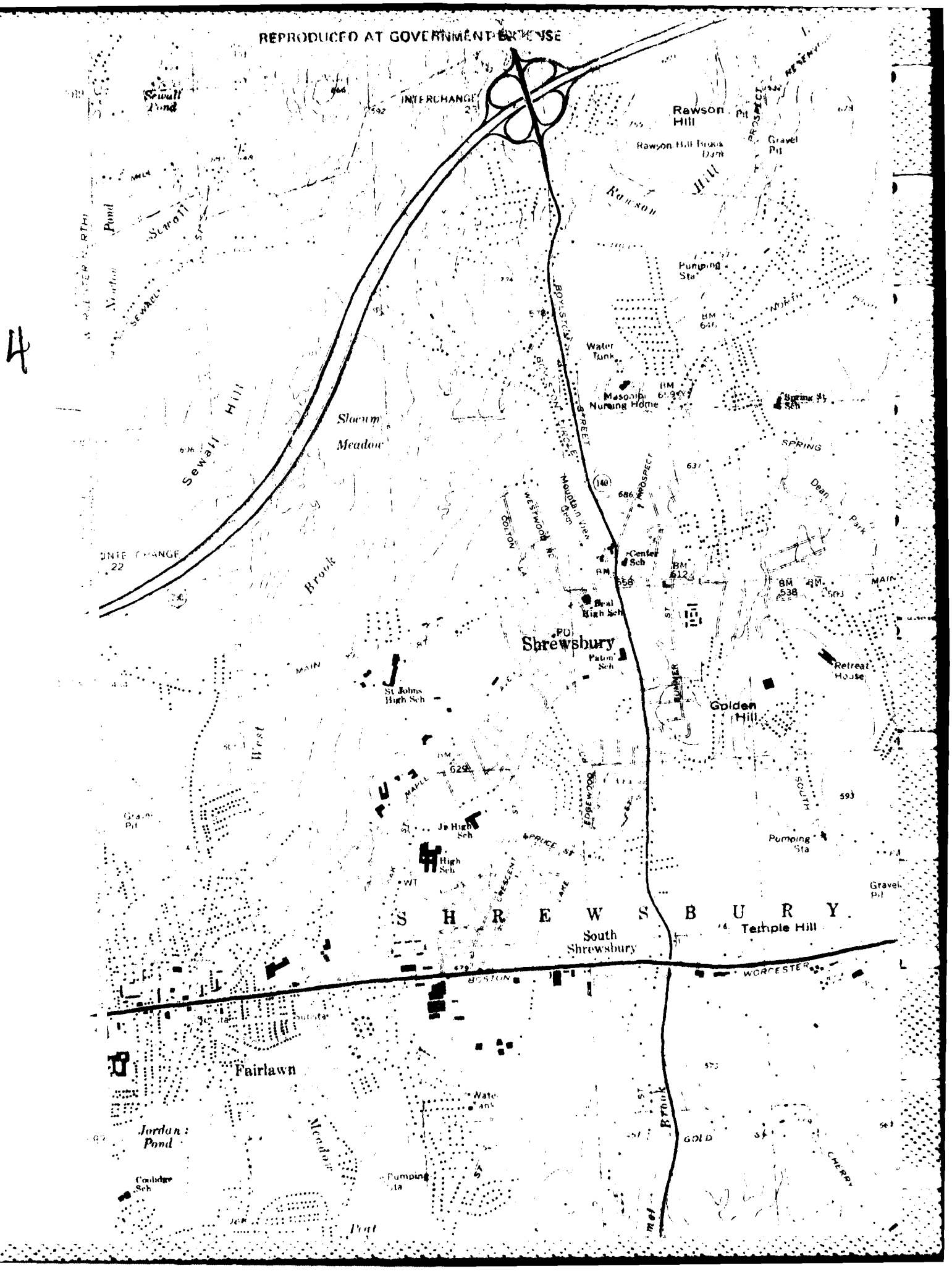
SHRE
MASSAC
7.5 MINI

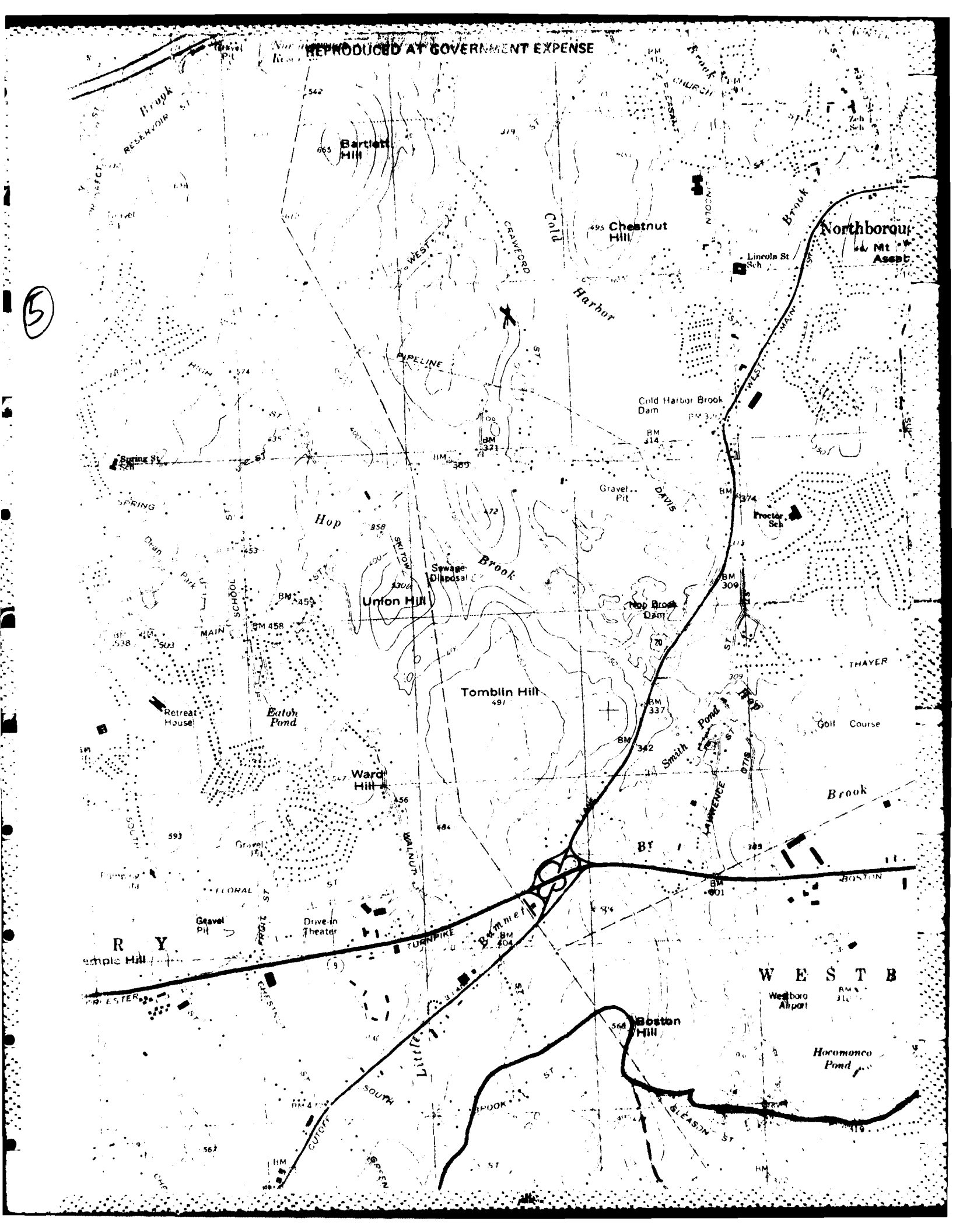


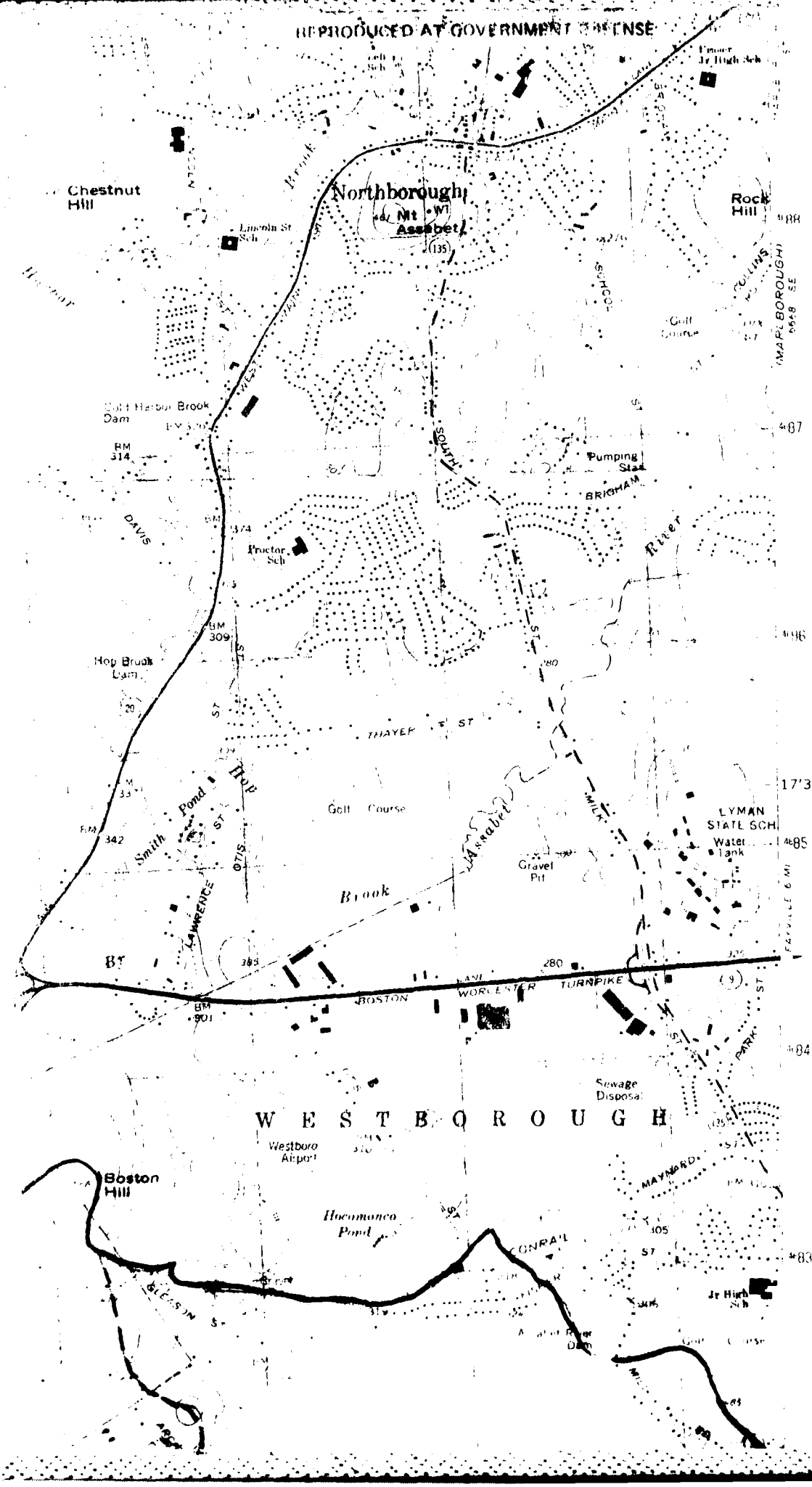
3

SHREWSBURY QUADRANGLE
MASSACHUSETTS - WORCESTER CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)





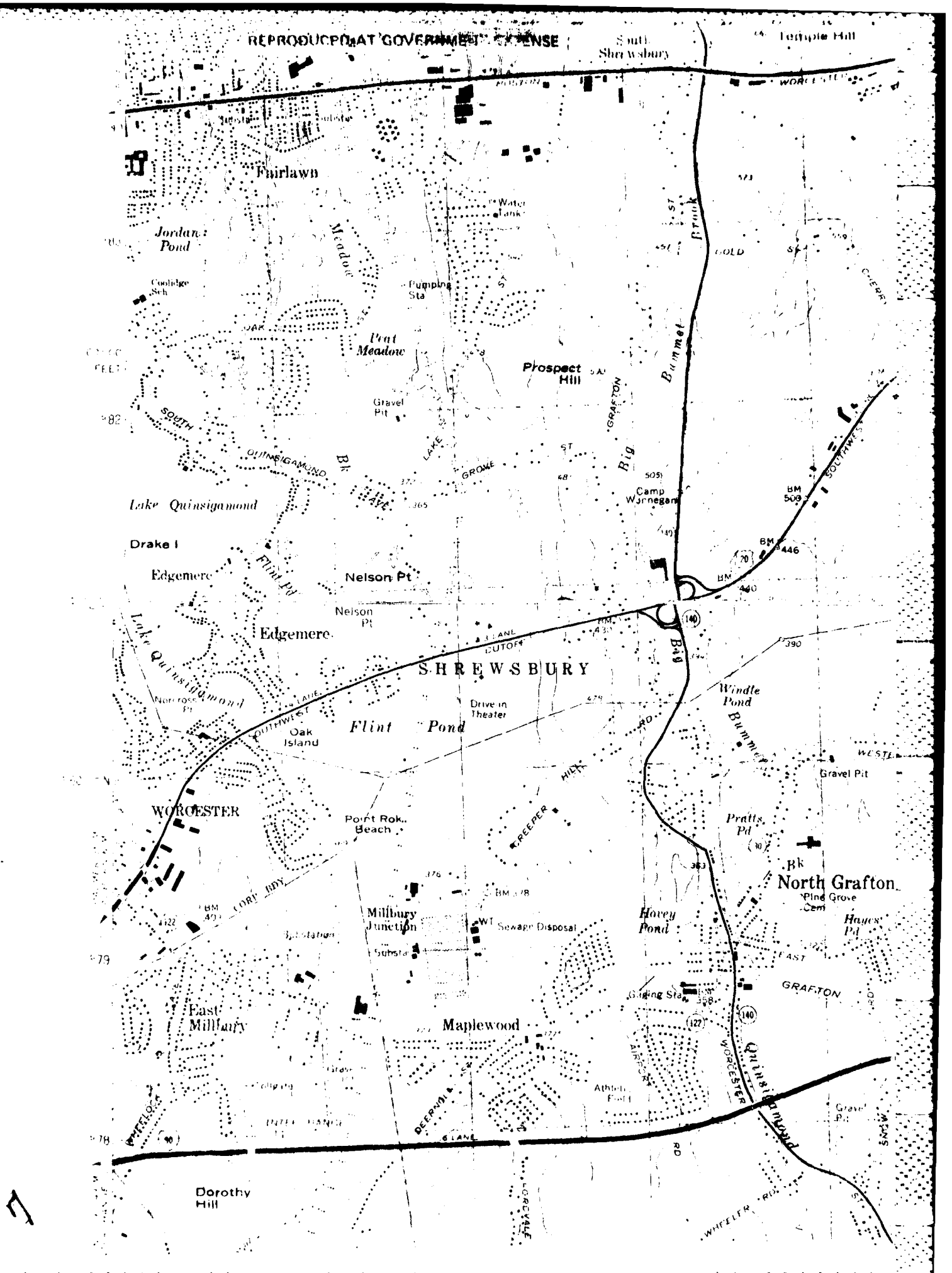


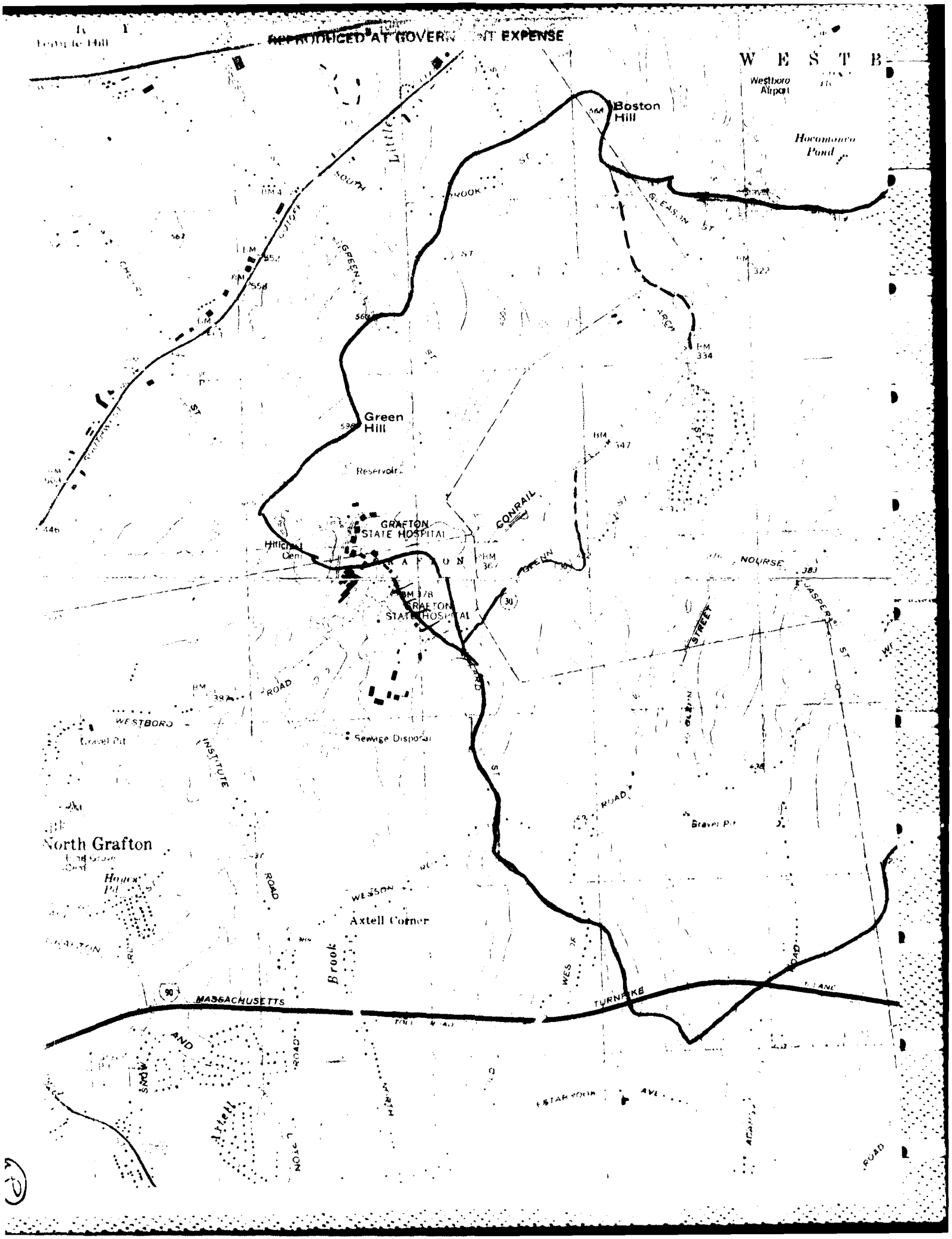


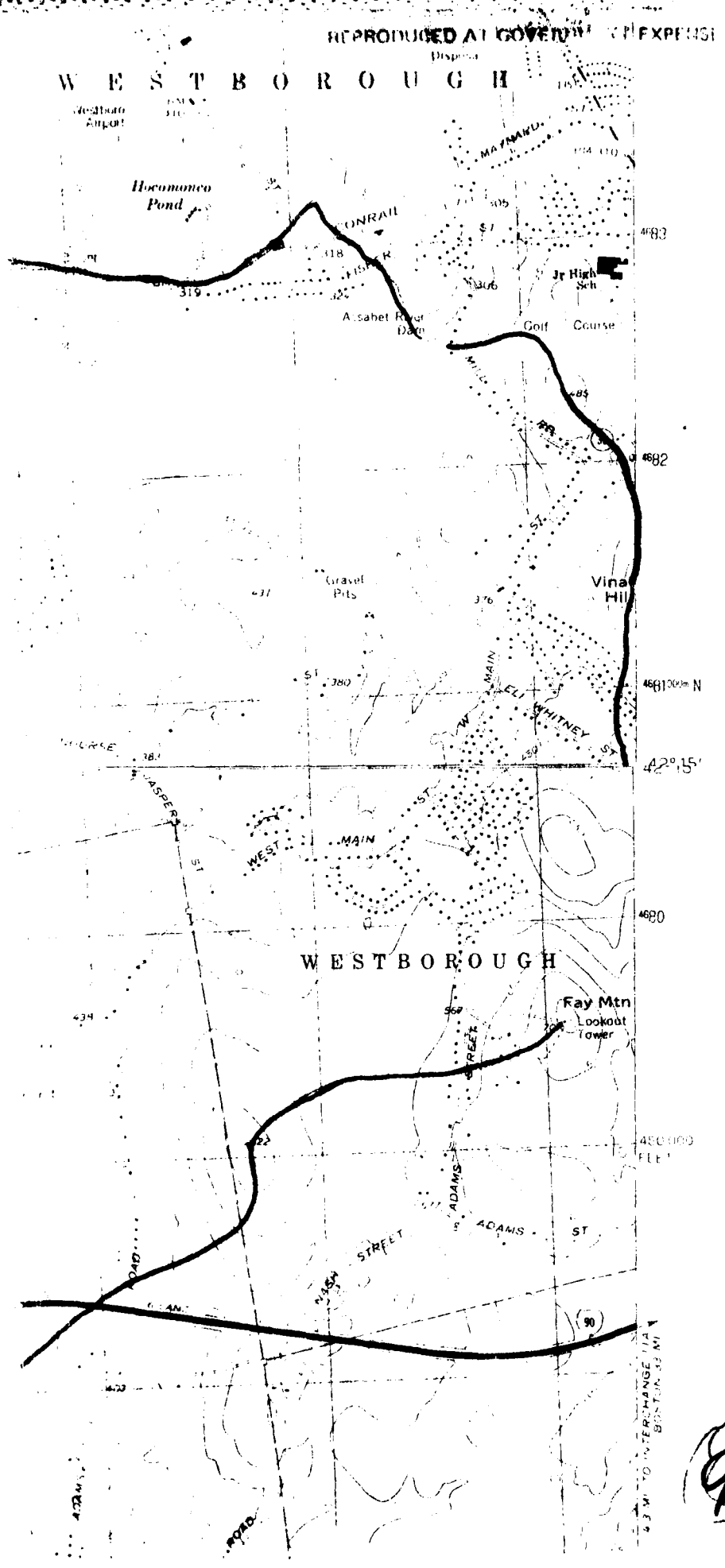
Feet	Meters
1	3048
2	6096
3	9144
4	12192
5	15240
6	18288
7	21336
8	24384
9	27432
10	30480

To convert feet to meters multiply by .3048

To convert meters to feet multiply by 3.28083







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