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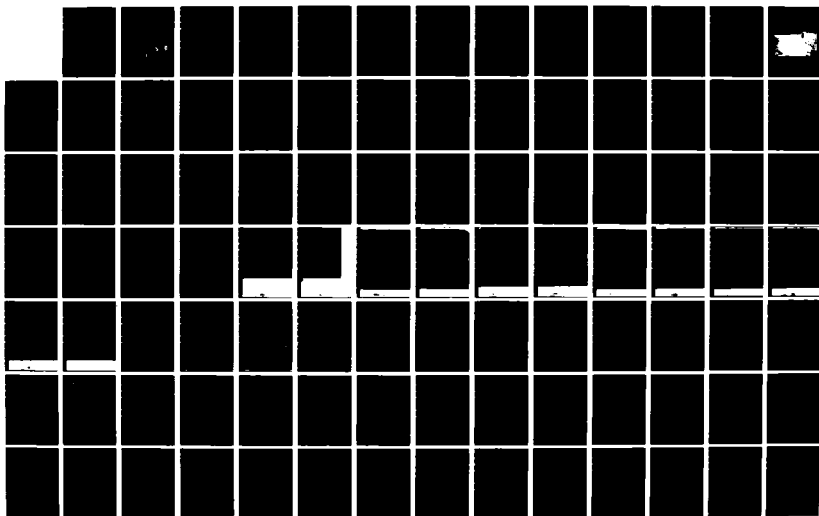
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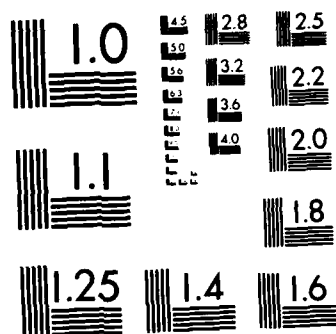
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BLACKSTONE RIVER BASIN
AUBURN, MASSACHUSETTS

DARK BROOK RESERVOIR DAM

MA. 00198

DIKE A

MA. 01293

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Dark Brook Reservoir Dam (and Dike A) NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Blackstone River Basin Dark Brook Auburn, Massachusetts		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Dark Brook Reservoir Dam consists of three earth embankments: the Main Dam which is about 760 ft. long and 17 ft. high; Dike A which is about 375 ft. long and 11 ft. high; and, Dike B which is about 120 ft. long and 6 ft. high. The Main Dam, Dike A and Dike B are judged to be in fair condition. Dike B is overgrown with brush and mature trees. The owner should implement a regular periodic maintenance program.		



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

REPLY TO
ATTENTION OF:

NEDED

DEC 9 1980

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

Dear Governor King:

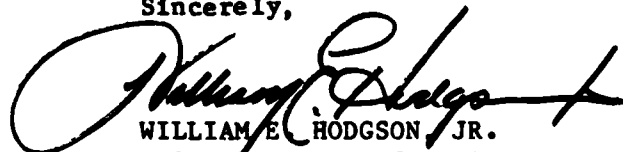
Inclosed is a copy of the Dark Brook Reservoir Dam and Dike A (MA-00198 & MA-01293) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

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

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

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

Sincerely,


WILLIAM E. HODGSON, JR.
Colonel, Corps of Engineers
Acting Division Engineer

Incl
As stated

DARK BROOK RESERVOIR DAM

MA 00198

DIKE A

MA 01293

BLACKSTONE RIVER BASIN
AUBURN, MASSACHUSETTS

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.: MA 00198
Name of Dam: Dark Brook Reservoir Dam
Town: Auburn
County and State: Worcester County, Massachusetts
Stream: Dark Brook
Date of Inspection: 15 April and 20 May 1980

BRIEF ASSESSMENT

(Dark Brook Reservoir Dam consists of three earth embankments: the Main Dam which is about 760 ft. long and 17 ft. high; Dike A which is about 375 ft. long and 11 ft. high; and, Dike B which is about 120 ft. long and 6 ft. high.) The spillway for the facility is located near the right abutment of the Main Dam. It is a concrete channel spillway with a 13 ft. long ogee crest and a 3 ft. wide sluice gate opening controlled by a 7.5 ft. high bulkhead type sluice gate. The spillway crest has provisions for the installation of 3 ft. high flashboards. There is a low level outlet facility located at about midlength of the Main Dam. The low level outlet conduit is a 20 in. dia. pipe which transitions to a 21 in. dia. pipe. The Dam was originally constructed to store cooling water for a power plant located downstream, but the reservoir is now used for recreational purposes.

The reservoir is about 8,500 ft. long and the surface area of the reservoir at spillway crest level is about 288 acres. The drainage area above the dam is about 2.62 sq. mi. (1,677 acres), the maximum storage to top of dam is about 4,940 acre-ft. Based on storage criteria, the size classification is intermediate. Because a breach of the dam could affect several homes and four local roadways with the possibility of some loss of life, the dam has been classified as having a high hazard potential. Based upon the Guidelines, the recommended test flood is a full PMF. The test flood inflow was calculated to be 7,470 cfs.

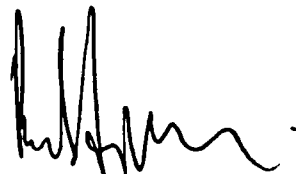
The spillway is adequate to pass the routed test flood outflow of about 825 cfs without overtopping the dam or dikes. When the routed test flood peaks there will be about 2 ft. of freeboard to the crest of the dam. The total spillway capacity at top of dam is about 155 percent of the routed test flood outflow.

(The Main Dam, Dike A and Dike B are judged to be in fair condition. Dike B is overgrown with brush and mature trees.) The use of flash boards reduces the spillway capacity and results in the test flood overtopping the dam. There is also a wet area at the toe of the Main Dam.

Within one year of receipt of this Phase I Inspection Report, the owner, Massachusetts Electric Company should utilize the services of a registered professional engineer experienced in the design of

dams and implement the results of his evaluations of the following: (1) review the present reservoir procedure concerning the installation of flashboards on the spillway crest and ascertain if their use can be abandoned in future operations; (2) investigate the stability of the downstream spillway channel walls; and, (3) removal of trees and heavy brush growth from the crest and slopes to within at least 10 ft. of toe of Dike B and the backfilling with a suitable material.

The owner should also implement the following operating and maintenance measures: (1) repair minor erosion of the upstream slope of the Main Dam near the left training wall of the spillway and repair three small potholes on the downstream slope near the left abutment; (2) cut and trim brush and wild rhubarb growth on the downstream slope of the Main Dam to the left of the low level outlet; (3) trim brush and growth on the upstream slope of the Main Dam and mow grass on the crest and downstream slope; (4) repair the low level outlet downstream headwall and repair the void in the low level outlet pipe at a point about 3 ft. upstream of the low level outlet downstream headwall; (5) as part of an annual technical inspection monitor the wet area along the downstream toe of the Main Dam to the left of the low level outlet structure to observe any changes in quantity or clarity of the water, monitor the wet area on the north side of the road at the downstream toe of Dike A, and monitor any changes in the minor cracks and efflorescence in the spillway channel walls downstream of the ogee crest; (6) remove minor brush growth and small tree growth on the upstream slope of Dike A and trim brush growth on the downstream slope of the dike; (7) develop a formal surveillance and downstream emergency warning plan including round-the-clock monitoring during periods of heavy precipitation; (8) institute procedures for an annual technical inspection of the dam and appurtenant structures; and (9) implement a regular periodic maintenance program.



Peter B. Dyson
Project Manager



This Phase I Inspection Report on Dark Brook Reservoir Dam and Dike A 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.

Aramast Mahtesian

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar
JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

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

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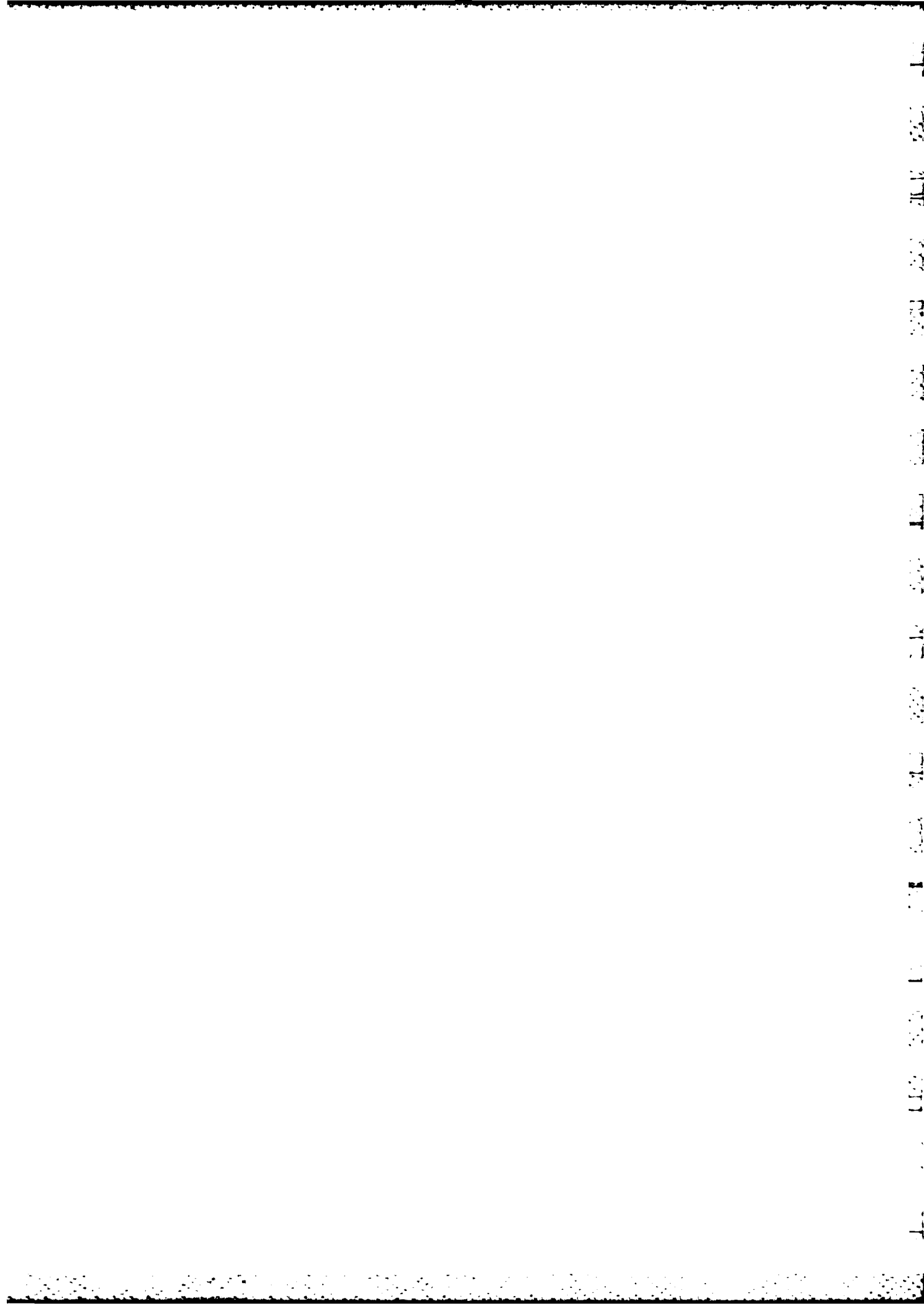
APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

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INVENTORY OF DAMS

DARK BROOK RESERVOIR DAM



OVERVIEW FROM RIGHT ABUTMENT



SECTION 4 - OPERATIONAL AND MAINTAINANCE PROCEDURES

4.1 Operation Procedures

a. General. The dam is owned and operated by Massachusetts Electric Company. It was originally operated as a facility for storing cooling water for a power plant located downstream. The facility is no longer used for that purpose and water levels now appear to be maintained for the benefit of property owners located along the rim of the reservoir.

b. Description of any Warning System in Effect. No warning system is in effect at Dark Brook Reservoir Dam.

4.2 Maintenance Procedures

a. General. There is no documented regular periodic maintenance program in effect at Dark Brook Reservoir Dam. There are, however, several items which require periodic maintenance, such as: the removal of brush growth and trees from the crest and slopes of the dam and dikes; the upkeep of the grass on the crest and downstream slopes; the repair and the upkeep of the riprap on the upstream slope of the Main Dam and Dike A.; the repairing of pot holes and voids on the slopes; the surveillance of the embankments regarding seeps; and maintenance of the spillway and low level outlet facilities.

b. Operating Facilities. All outlet facilities appear to be well maintained and reported to be in operating condition.

4.3 Evaluation

Overall maintenance of the Main Dam and Dike A is good. It appears that Dike B has not been maintained in a number of years. Specific maintenance items are evaluated as follows: a light growth of brush is taking a firm stand on the Main Dam and Dike A embankment slopes; trees and brush are well established on Dike B; the grass on the Main Dam and Dike A embankments needs to be cut on a regular basis; there are a few pot holes on the downstream slope of the Main Dam; the riprap on the upstream slopes of the Main Dam and Dike A is in good condition; there was a wet area at the downstream toe of the Main Dam; the headwall of the low level outlet should be repaired; the spillway was free of debris and the operating facilities were reported to be in good condition. The owner should establish a formal downstream warning system for the dam in the event of an emergency. There is no regular periodic maintenance program.

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The training walls of the spillway outlet channel are in good condition with no evidence of movement although there is minor pitting at the intersection of the wall of the spillway outlet channel. Photo No. 11 shows repairs that have been made to the same wall just below the ogee crest, however, the wall appears to be in good condition with only minor efflorescence observed. Horizontal struts between the training walls and weep holes were added to the spillway discharge channel in 1961 to improve lateral stability as can be seen in Photo No. 10. The walls are presently in good condition with the exception of minor cracking and minor efflorescence.

2. Gatehouse. Photo No. 12 shows the gate house for the facility. It is an 8 ft. square wooden structure in fair condition located over a concrete gate well and contains the control mechanism for the low level discharges from the facility. The low level conduit is believed to be a 20 in. dia. cast iron pipe at the inlet end which transitions to a 21 in. dia. concrete pipe at the outlet end. The control mechanism for the outlet is a 20 in. gate valve which was not operated during the inspection but was reported to be in good operative condition.

d. Reservoir Area. The shoreline around the reservoir rims both right and left of the dam and dikes appears to be in good condition, with no evidence of any instability or movement of the reservoir slopes.

e. Downstream Channel. The spillway discharges into a 100 ft. long concrete lined channel which passes under Leicester Street, then into a manmade unlined channel for a distance of about 180 ft. which connects back to the original Dark Brook channel. The Dark Brook channel below the dam to Stoneville Pond and Kettle Brook is quite steep and confined. Below Stoneville Pond, Kettle Brook passes through residential, industrial, and commercial developments as it flows from Auburn to Worcester. The brook flows through two more impoundments before joining another stream to form the Middle River, a tributary of the Blackstone River.

3.2 Evaluation

The visual inspection has adequately revealed key characteristics of the dam as they may relate to its stability and integrity. The dam, dikes and appurtenant works are judged to be in fair condition. At the Main Dam the items of concern are the wet area at the downstream toe of the embankment to the left of the low level outlet channel, the minor erosion on the upstream slope, the three potholes on the downstream slope, the brush growth on the downstream and upstream slopes, the movement of the low level outlet headwall and 21 in. dia. concrete pipe and the stability of the downstream spillway channel walls. Dike A appears to be in fair condition except for the brush growth on the upstream slope, the tall grass on the crest, and some light tree growth on the upstream slope particularly on the right abutment. Dike B is extensively overgrown with brush and mature trees and has not been maintained for a number of years. The operating facilities appeared to be well maintained. There is no regular periodic maintenance program.

slope was cleared and trimmed about a year ago. However, some minor small brush has grown back in the interim. There is some minor erosion of the upstream slope adjacent to the left side of the spillway structure which should be corrected.

2. Dike A. Dike A is located about 350 ft. left of the Main Dam. It is an earth embankment about 375 ft. long and 11 ft. high. The dike has a crest width of 15 ft., a $1\frac{1}{2}$ horizontal to 1 vertical downstream slope and a 2 horizontal to 1 vertical upstream slope. The dike is slightly curved. The horizontal and vertical alignment is good. Photo No. 5 is a view from the left abutment of the dike looking to the right. While there is some minor brush growth on the downstream slope, it appears to be in good condition with no evidence of seepage along the toe. Leicester Road parallels the dike on the downstream side and serves as a berm between the downstream toe of the embankment and a low swampy area downstream of the road. The wet area downstream of the roadway is apparently caused by surface drainage. The upstream slope is covered with riprap to a point about 6 ft. below the crest of the dike. The riprap appears to be in good condition. However, there is minor growth through the riprap as shown on Photo No. 6. Photo No. 7 shows some light tree growth on the right abutment of the dike.

3. Dike B. Dike B is located about 1,600 ft. left of Dike A. It is an earth embankment about 120 ft. long and 6 ft. high. The dike has a crest width of 15 ft., a $1\frac{1}{2}$ horizontal to 1 vertical downstream slope and a 2 horizontal to 1 vertical upstream slope. The alignment of the dike appears to be good with no evidence of lateral or vertical movement. There is however, extensive brush and tree growth on the crest of the dike and both slopes. Many of the trees are 6 in. to 8 in. dia. as shown in Photo No. 8. There was no seepage evident along the downstream toe of the dike. It appears that the dike has not been maintained for a number of years.

c. Appurtenant Structures.

1. Spillway. The spillway is located at the right abutment of the Main Dam. It is a channel spillway with a 13 ft. long ogee crest and a 3 ft. wide sluice gate opening which is controlled by a 3 ft. by 7.5 ft. bulkhead type sluice gate. The spillway has provisions for the installation of 3 ft. high flashboards on top of the ogee crest against collapsible pins. There is a small gate house in good condition located just left of the ogee crest and above the sluice way which houses electrical and manual controls for the sluice gate, which are reported to be operative and appear in good condition. The training walls above the ogee crest are 8.5 ft. high. The upstream approach channel is about 40 ft. long and has a concrete floor 4.5 ft. below the ogee crest. The concrete exit channel below the ogee crest is about 100 ft. long. Its width tapers from 17.5 ft. at the upstream end to 14.5 ft. on the downstream end. The concrete channel passes under Leicester Street near the outlet end. Photo No. 9 is a view of the spillway taken from the downstream side. The downstream face of the concrete ogee spillway appears to be in good condition. The concrete walls retaining the spillway appear to be in good condition with only minor pitting of the face of the wall at the waterline upstream of the ogee crest. The concrete apron slab downstream of the ogee appears to be in good condition with only minor pitting of the surface.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Dark Brook Reservoir took place on 15 April and 20 May 1980. On 15 April the water level was about 6 in. above the ogee crest of the spillway and the discharge was estimated to be about 15 cfs. On 20 May, flashboards had been installed on the ogee crest and no flow was passing over the spillway. Wet areas were discovered at the downstream toe of the Main Dam and downstream of Dike A. A few other maintenance items require attention (see Section 7.3). In general the dam dikes and appurtenant works were judged to be in fair condition.

b. Dam.

1. Main Dam. The Main Dam is an earth embankment about 760 ft. long and 17 ft. high. The dam has a crest width of 15 ft. with a $2\frac{1}{2}$ horizontal to 1 vertical downstream slope and a 3 horizontal to 1 vertical upstream slope. The alignment of the crest of the dam is good with no evidence of lateral or vertical movement, as shown in Photo No. 1 taken from the left abutment. Photo No. 2 is a view of the downstream slope of the embankment taken near the right abutment. The slope appears to be in good condition. However, there is some vegetation on the slope particularly in the area left of the low level outlet. The growth consists mostly of wild rhubarb, generally not over 4 ft. high, with minor amounts of brush. This material should be cleared from the slope. Near midlength of the dam there is an approximately 6 in. by 12 in. void in the embankment toe about 3 ft. upstream of the low level outlet pipe headwall. This void is probably due to the outward movement of the low level outlet pipe headwall which is tilted outward at the top by about 3 to 4 inches. In any event this void shown in Photo No. 3 should be corrected. There are three small potholes on the downstream slope about 5 ft. below the crest of the dam and about 150 ft. from the left abutment. These potholes are approximately 1 ft. wide, 3 ft. long, and 1 ft. deep. They should be backfilled with compacted fill. There is a low lying wet area at the downstream toe on the left side of the dam. It is not known whether this is just a topographical low area which collects runoff from Leicester Street or whether it may be seepage from the dam. In any event, there is a rather sizeable wet area which should be observed and monitored in the future. The total wet area encompasses an area along the downstream toe starting at about 50 ft. left of the low level outlet and extends for a distance of about 100 ft. along the toe. The area is 50 ft. wide at its right end and about 20 ft. wide on its left end (see Photo Nos. 2 and 4).

Photo No. 4 is a view of the upstream slope taken from the right abutment. The upstream slope has some minor growth generally not over 3 ft. high intermingled with the riprap on the slope. The upper 3 ft. of the slope is not riprapped but is grass covered. The riprap appears to be in good condition. It varies in size from 1 in. stones up to 4 ft. slabs. It appears that the brush on the upstream

SECTION 2 - ENGINEERING DATA

2.1 Design Data

The dam was designed in 1948 by New England Power Service Company. Specifications dated May 9, 1950 for Dam and Control Works on Dark Brook were retrieved during the inspection period and are included in Appendix B. Also included in Appendix B are concrete specifications and proposed plans for the dam, as well as a limited amount of hydraulic data.

2.2 Construction Data

The dam was constructed in 1950 by New England Power Service Company. With the exception of the proposed construction plans and specifications mentioned above, no records or correspondence regarding the construction have been found.

2.3 Operation Data

No engineering operational data were disclosed.

2.4 Evaluation of Data

a. Availability. There was limited engineering data available. The basis of the evaluation presented in this report is principally the visual observations of the inspection team.

b. Adequacy. The lack of in-depth engineering data did not allow for a definite review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The documents recovered appear to be valid and are not challenged.

- | | | |
|---|---------|---------|
| (7) Impervious Core - None | None | None |
| (8) Cutoff - 8 ft. wide, 5 ft. below
Original Ground | None | None |
| (9) Grout curtain - Unknown | Unknown | Unknown |

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway

- (1) Type - Flashboarded ogee crest
- (2) Length of weir - 13 ft.
- (3) Crest elevation - 608.5 without flashboards
611.5 with flashboards
- (4) Gates (Flashboards) - 3 ft. high
- (5) Upstream channel - 17.5' wide with approach floor at
elevation 604.
- (6) Downstream channel - Approximately 100 ft. long concrete
lined channel, 14.5 ft. wide leading to Dark Brook.
- (7) General - 3' wide by 7.5' high bulkhead type sluicgate
placed adjacent to ogee crest at left side of spillway
channel. Top of gate at elevation 611.5. Roadway bridge
crosses at lower end of spillway channel. Average clearance
from bottom of bridge to floor of channel is about 4.5 ft.

j. Regulating Outlets

- (1) Invert - 598.0
- (2) Size - 20 in. dia. transitions to 21 in dia.
- (3) Description - Cast iron pipe transitions to concrete pipe.
- (4) Control Mechanism - Hand operated gate valve.
- (5) Other - Gate house on crest of dam.

(8) Top of dam - 617

(9) Test Flood surcharge - 615.0

d. Reservoir (Length in feet)

(1) Normal pool - 8,450

(2) Flood control pool - Not applicable

(3) Spillway crest pool - 8,450

(4) Top of dam - 8,450

(5) Test flood pool - 8,450

e. Storage (acre-ft)

(1) Recreation pool (El. 608.5) - 1793

(2) Flood control pool (El. 611.5) - Not applicable

(3) Spillway crest pool (El. 608.5) - 1793

(4) Test flood pool (El. 615.0) - 4110

(5) Top of dam (El. 617.0) - 4940

f. Reservoir Surface (acres)

(1) Recreation pool (El. 608.5) - 288

(2) Flood control pool (El. 611.5) - Not Applicable

(3) Spillway crest (El. 608.5) - 288

(4) Test flood pool (El. 615.0) - 403

(5) Top of dam (El. 617.0) - 417

g. Dam

Dike A

Dike B

(1) Type - Earthfill

Earthfill

Earthfill

(2) Length - 760 ft.

375 ft.

120 ft.

(3) Height - 17 ft.

11 ft.

6 ft.

(4) Top Width - 15 ft.

15 ft.

15 ft.

(5) Side Slopes - U/S 3H to 1V
D/S 2½H to 1V

U/S 2H to 1V
D/S 1½H to 1V

U/S 2½H to 1V
D/S 1½H to 1V

(6) Zoning - Unknown

Unknown

Unknown

b. Discharge at Damsite

(1) Outlet Works Conduit. Low level discharge from Dark Brook Reservoir is provided for by means of a 190 ft. long conduit located near midpoint of the dam. The conduit is a 20 in. dia. cast iron pipe which transitions to a 21 in. dia. concrete pipe. The inlet of the outlet pipe has an invert elevation of about 598.0 ft. The conduit would be capable of discharging about 40 cfs when the control gate is wide open and the reservoir water surface level is at the top of dam, elevation 617.

(2) According to past inspection reports found in Appendix B "high water occurring in 1955 reached an elevation of 612.5 or one foot above normal pond".

(3) Ungated Spillway capacity at Top of Dam. (Sluicgate in place, flashboards removed) - 1280 cfs at elevation 617.0.

(4) Ungated Spillway capacity at Test Flood Elevation. (Sluicgate in place, flashboards removed) - 825 cfs at elevation 615.0

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

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

(7) Total Spillway Capacity at Test Flood Elevation. (Sluicgate in place, flashboards removed) 825 cfs at 615.0.

(8) Total Project Discharge at Top of Dam. (Sluicgate in place, flashboards removed, low level outlet open) 1,320 cfs at elevation 617.0.

(9) Total Project Discharge at Test Flood Elevation. (Sluicgate in place, flashboards removed, low level outlet open), 865 cfs at elevation 615.0.

c. Elevations (Ft. N.G.V.D.)

(1) Streambed at Toe of dam - 600 ($\pm$)

(2) Bottom of Cutoff - Varies (5 ft. below original ground)

(3) Maximum tailwater - unknown

(4) Normal pool - (crest of ogee spillway) - 608.5

(5) Full flood control pool (Not applicable)

(6) Spillway crest - 608.5

(7) Design surcharge (original design) - Unknown

In this area it is estimated that about four houses would be flooded by about 8 ft. of water and that five houses would be flooded by 2 to 3 ft. of water. It appears that none of these houses would be flooded under maximum spillway discharge conditions. In addition to flooding of homes in this area, three roadways would also be flooded. Since there is the potential for loss of more than a few lives and major economic damage, in accordance with the Recommended Guidelines for Safety Inspection of Dams, the project has been classified as having a high hazard potential.

e. Ownership. Dark Brook Reservoir is owned by Massachusetts Electric Company, 939 Southbridge Street, Worcester, Massachusetts 01610. Telephone - 617-791-8511.

f. Operator. Mr. Barry Houston, District Superintendent
Massachusetts Electric Company
939 Southbridge Street
Worcester, Massachusetts 01610
Tele: 617-791-8511

g. Purpose of Dam. The dam was originally constructed to store cooling water for a power plant located downstream. The dam no longer serves its original purpose. However, the reservoir is used for recreational purposes at present.

h. Design and Construction History. The dam was designed and constructed by an affiliate company of the owner, the New England Power Service Company. The dam was built in 1950.

i. Normal Operating Procedures. No written operating procedures for the dam were disclosed. Operating facilities for the dam consist of the hand operated low level outlet facility, an electrically/manually operated sluice gate in the spillway channel, and a flashboard installation on the ogee crest section in the spillway channel. These facilities are operated as required, but not on a regular basis.

1.3 Pertinent Data

a. Drainage Area. The drainage area contributing to Dark Brook Reservoir is mainly from Prospect Hill, Tinker Hill and Crawl Hill, situated along Dark Brook, southwest of Auburn, Mass. The drainage area measures about 2.62 sq. mi., being about 2.4 mi. in length and about 2 miles in width.

The basin is traversed in an east-west direction by the Mass. Turnpike and by secondary roads, which trisect Dark Brook Reservoir into three separate ponds, and drainage areas. These drainage areas are designated as follows:

<u>Drainage Area</u>	<u>Description of Area</u>	<u>Drainage Area</u>
A	North of Mass Pike	0.80
B	South of Mass Pike and East of West Street	0.93
C	West of West Street, north and south of Mass. Pike	<u>0.89</u>
Total		2.62

(2) Dike A. Dike A is located about 350 ft. left of the Main Dam. It is an earth embankment about 375 ft. long and 11 ft. high. The dike has a crest width of 15 ft., a $1\frac{1}{2}$ horizontal to 1 vertical downstream slope and a 2 horizontal to 1 vertical upstream slope. The crest of the dike is at elevation 617. The upstream slope of this dike is riprapped below elevation 614. The crest and the downstream slope is grass covered.

(3) Dike B. Dike B is located about 1,600 ft. left of Dike A. It is an earth embankment about 120 ft. long and 6 ft. high. The dike has a crest width of 15 ft. a $1\frac{1}{2}$ horizontal to 1 vertical downstream slope and a 2 horizontal to 1 vertical upstream slope. The crest of the dike is at elevation 617. There is no riprap on the slopes of this dike, which are covered with trees and bush.

(4) Spillway. The spillway for Dark Brook Reservoir Dam is located at the right abutment of the Main Dam. It is a concrete channel spillway with a 13 ft. long ogee crest and a 3 ft. wide sluice opening controlled by a 3 ft. by 7.5 ft. bulkhead type sluice gate. Provision is made for the installation of 3 ft. high flashboards on top of the ogee crest which is 8.5 ft. below top of dam.

(5) Gate House. The gate house for the facility is located just upstream from the crest at about midlength of the Main Dam. It is about 8 ft. square and is located over a concrete gate well. A 20 in. dia. cast iron low level outlet pipe extends 43 ft. from an inlet headwall at the upstream toe of the dam to a gate valve in the gate house. Downstream of the gate house the 20 in. dia. cast iron pipe is shown on the plans in Appendix B to extend for about 67 ft. before its transition into an approximately 100 ft. long 21 in. dia. concrete pipe. The type of connection between the 20 in. dia. cast iron pipe and the 21 in. dia. concrete pipe is unknown. It is estimated that the 21 in. dia. concrete pipe is only about 40 ft. long. However, the downstream end of the outlet pipe is not located on the downstream side of Leicester Street as indicated on the proposed construction plans shown in Appendix B but at the downstream toe of the dam.

c. Size Classification. Dark Brook Reservoir Dam has a hydraulic height of about 17 ft. above downstream level, and impounds a normal storage of about 1,800 acre-ft. to spillway crest level and a maximum of about 4,940 acre-ft. to top of dam. In accordance with the size and capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, the project falls into the intermediate category on the basis of capacity and is therefore classified accordingly.

d. Hazard Classification. A breach failure of Dark Brook Reservoir Dam would release water down Dark Brook, into Stoneville Pond on Kettle Brook, into Middle River and thence into the Blackstone River. The streams traverse near and along populated areas of Auburn and Worcester, past residential areas, industrial sites, roadways and railroads. In the initial impact area between Dark Brook Reservoir Dam and Stoneville Pond the breach discharge of about 26,000 cfs would only be slightly reduced along that course of the stream.

PHASE I INSPECTION REPORT

DARK BROOK RESERVOIR DAM MA 00198

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. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 28 March 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-80-C-0043, has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

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

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

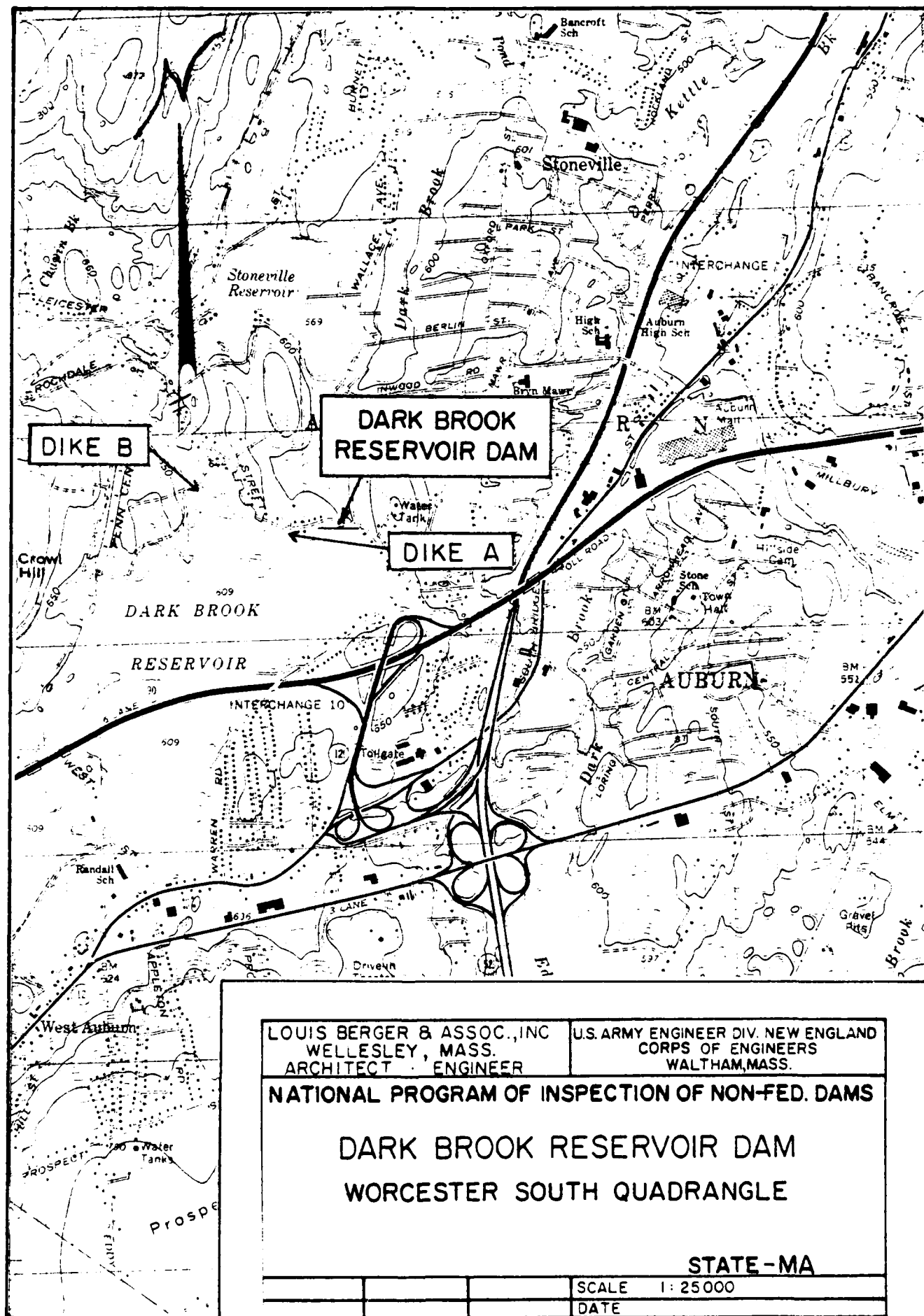
(3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. Dark Brook Reservoir Dam is located in Worcester County in the City of Auburn in south-central Massachusetts. The reservoir is situated on Dark Brook approximately 1.7 miles upstream from the confluence of Dark Brook and Kettle Brook and 5.3 miles upstream from the confluence of Kettle Brook and Middle River. The dam is located just south of and parallel to Leicester Street, and is shown on U.S.G.S. Quadrangle, Worcester South, Massachusetts with coordinates approximately at N 42° 11' 53", W 71° 51' 32".

b. Description of Dam and Appurtenances.

(1) Main Dam. The main dam is a compacted earth embankment about 760 ft. long and 17 ft. high. There is an 8 ft. wide cut-off trench along the center line of the embankment, approximately 5 ft. below original ground surface. The dam has a crest width of 15 ft., a 2½ horizontal to 1 vertical downstream slope and a 3 horizontal to 1 vertical upstream slope. The crest is at elevation 617 NGVD. There is 18 inc. thick riprap slope protection on the upstream slope between elevation 605 and 615. The crest and downstream slope is grass covered.



SECTION 5: EVALUATION OF HYDRAULIC AND HYDROLOGIC FEATURES

5.1 General.

Dark Brook Reservoir Dam consists of three earth embankments impounding a normal storage of about 1,800 acre-ft. with provision for an additional 3,140 acre-ft. of capacity in its surcharge space to the top of dam. It is basically a high storage-low spillage facility once used to supply cooling water to a power plant downstream. Dark Brook Reservoir was developed prior to construction of the Massachusetts Turnpike. When the Massachusetts Turnpike and West Street were subsequently built they trisected the reservoir into three separate ponds, each with its separate contributing drainage area. Because the culverts and waterways connecting these separate ponds have limiting capacities, inflows and outflows to and from each upper pond should be routed consecutively to determine the reservoir level and outflows at the main pond and dam. The general topographic characteristics of the 2.62 sq. mi. drainage area is best described as rolling terrain, which rises from about elevation 609 at spillway crest level to elevation 882. The area contains both open fields and forested areas and is densely populated in its southern sector. Provision is made for the installation of 3 ft. high flashboards against collapsible pins on top of the ogee crest spillway of the dam.

5.2 Design Data.

A limited amount of hydrologic and hydraulic data has been retrieved for the dam, which shows the original reservoir to have a surface area at elevation 611.5 of 334 acres and a capacity of 3,020 acre-ft. Construction of the Massachusetts Turnpike and the West Street causeway across the reservoir has reduced these values. A letter of December 3, 1958 notes a reduction of capacity to 2,777 acre-ft. at elevation 611.5, but measurements from the U.S.G.S. quadrangle sheets indicate a somewhat higher reservoir area. Shown on Sheet D-3, Appendix D are area and capacity curves for the surcharge heads above the spillway crest level, elevation 608.5 for each of the three reservoir impoundments created by the turnpike and crossings.

A listing of critical data for the dam has been retrieved and is shown in Appendix B. The listing contains basin, reservoir, spillway and design storm data. It should be noted that this data indicates the flashboards were designed to fail when the reservoir reached about elevation 612.8; however for the flood routing performed with flashboards in place it was assumed that the flashboards did not fail and were in place during the entire flood routing period.

5.3 Experience Data.

An inspection report found in Appendix B states that "High water occurring in 1955 reached an elevation of 612.5 or one foot above normal pond".

5.4 Test Flood Analysis

The test flood used to evaluate the hydrologic and hydraulic capacity of Dark Brook Reservoir Dam was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as intermediate in size with a high hazard potential, the recommended test flood is of a magnitude corresponding to the Probable Maximum Flood (PMF).

Precipitation data were obtained from Hydrometeorological Report No. 33, which for the Southern Massachusetts area approximates 23.5 inches of 6 hour maximum rainfall over a 10 square mile area. This value was then reduced by 20 percent to allow for basin size, shape and fit factors. The 6 hour rainfall was distributed into one hour incremental periods as suggested in COE Publication EC 1110-2-1411. A 0.5 inch loss for the first hour and 0.1 inch loss per hour thereafter was deducted from the precipitation values to give the excess rainfall used to prepare the inflow hydrographs (See Appendix D, Page D-8).

For the overland runoffs, a triangular incremental unitgraph was assumed for the inflow hydrograph; for direct precipitation on the reservoir areas, a rectangular incremental unitgraph was assumed.

The hydrologic characteristics of Dark Brook Reservoir drainage area are dictated by the arrangement of the separate storage ponds created by the imposition of the highway and street crossings. The reservoir to the west of the West Street Causeway controls the drainage from the western side of the basin; the middle reservoir south of the Mass. Pike controls the drainage from the southern side of the basin; and the lower reservoir north of the Pike controls the direct precipitation on the lake area plus the drainage from adjacent Crowl Hill.

The following criteria were developed for deriving the inflow hydrographs for each of the three separate drainage areas:

Drainage area designation	Drainage area (sq.mil)	Water Course length (mi)	Slope of Water Course (Ft/mi)	Lag Time (hrs)	Time to Peak for triangular hydrograph (Hrs)	Time of Concentration (Hrs)	Channel Velocity (ft/sec)
A(over-land)	0.55	0.57	282	0.81	1.0	0.95	0.88
A(Direct precip)	0.25	-	-	-	-	-	-
B	0.93	1.3	170	1.52	1.65	1.92	1.0
C	0.89	1.3	139	1.57	1.70	2.0	0.95

Developed inflow design floods for the three separate drainage areas are shown on Sheets D-12 thru D-14, Appendix D. Computations are shown on Sheets D-8 thru D-11, Appendix D.

The separate inflow hydrographs have characteristics as follows:

PMF INFLOW HYDROGRAPHS

Drainage Area	Peak inflow (cfs)	Peak Time (hrs)	Inflow volume (4-F)
A	2170	4.5	784
B	2800	4.7	879
C	2670	4.7	852
Combined Areas	7470	4.7	2515

The combined hydrograph represents a CSM value of about 2850.

Release of inflows upstream from the West Street causeway will be controlled by the waterway under that roadway. This culvert is below water level and its exact size could not be ascertained. For the routing studies its size has been assumed as 3 ft. diameter. Inflows into this upper reservoir in excess of the capacity of the culvert will be accumulated in the reservoir surcharge space, until the roadway is overtopped. About a 700 ft. length of this causeway road at elevation 615 is expected to form the control for this overtopping.

The waterway through the Mass. Pike connecting the middle and lower reservoirs is a 14 ft. wide culvert with invert at elevation 598. A differential head between the two ponds will exist to release discharges through the waterway. Sheet D-7, Appendix D shows differential pond levels for various flows through the culvert.

Discharge curves for the main spillway, flow over the West Street causeway, and head-discharges over the main dam and dikes are shown on Sheet D-6, Appendix D. Spillway discharges are shown for conditions with and without the flashboard installation.

For the test flood condition it was assumed that the flashboards were not in place. However, additional flood routings of the test flood inflows were made assuming a different reservoir level and spillway flashboards installed. The routing computations are shown on sheets D-15 and D-16 and graphically on Sheets D-17 and D-18. Results of these routings are tabulated below:

Alternate	Spillway Flashboards on ogee crest	Reservoir level at start of routing	Maximum Reservoir level at Dam	Maximum Reservoir level above West Street Causeway	Maximum depth of flow over Dam and Dikes
I (Test Flood)	Removed	El. 609.0	El. 615.0	El. 616.2	0
II	Installed to El. 611.5	El. 611.5	El. 617.2	El. 617.90	0.20 ft.

From the above table, it can be seen that the project will pass the routed test flood with a freeboard of about 2 ft. if the spillway flashboards are not installed; however, the dam will be overtopped by about 0.2 ft. if the flashboards are installed and the reservoir is at the top of the flashboards (Elev. 611.5) at the start of the routings. It will also be noted that the West Street Causeway will be overtopped by 1.2 ft. if the flashboards are not installed and by 2.9 ft. if the flashboards are installed and the reservoir level is at the top of the flashboards when the routing is started.

5.5 Dam Failure Analysis.

A breach owing to structural failure of any one of the three embankments is a possibility. However, it is estimated that a breach of Dike B would not pose a significant hazard because of its size and the downstream conditions. A breach analysis was performed for both the Main Dam and Dike A using the "rule of thumb" method suggested in the March 1978 Guidance Report. Because of the relatively small spillway discharge, the downstream valley storage filled by the prefailure flow was not subtracted from available storage for attenuation of the dam failure flow when routing the dam failure flood.

Main Dam. With a breach width of 40 percent of the dam length at midheight equal to 216 ft. and the reservoir level at top of dam, an outflow of 26,200 cfs, which includes about 800 cfs from spillway would be realized.

A breach failure at this location would release water down Dark Brook. In this initial impact area between Dark Brook Reservoir and Stoneville Pond, the breach discharge would be only slightly reduced as the brook is rather steep and confined. There are a number of residences in the area between the reservoir and Stoneville Pond and it is estimated that four houses would be flooded to a depth of about 8 ft. and that about five houses would

be flooded by 2 to 3 ft. of water. It is estimated that none of these houses would be flooded by the maximum spillway discharge alone. Where Dark Brook enters Stoneville Pond it is estimated the discharge would be about 24,000 cfs and that the flood surge would start to subside as the breach outflow enters the pond.

Dike A. With a breach width of 40 percent of the dam length at midheight equal to 100 ft., an outflow of about 6,100 cfs would be realized if Dike A breached. Water flowing from this breach would travel about 1,400 ft. overland before reaching Dark Brook and then follow the same path as described above. There are three additional houses located below Dike A which would be flooded by this breach discharge. The foundations of these homes all rise about 8 to 10 ft. above the toe of the dike. It is estimated that a breach of the dike would only cause flooding in the basement of these homes and that the magnitude of flooding would be between 3 and 6 ft.

In addition to the homes described above it is estimated that four local roadways in the initial impact area would also be flooded.

In summary, more than a small number of homes and four local roadways in the initial impact area are within the area of potential flooding. There is also the potential for the loss of more than a few lives. Therefore, in accordance with the Recommended Guidelines for Safety Inspection of Dams, the project has been classified as having a high hazard potential. Sheet D-25, Appendix D shows the area of potential flooding described above.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The Dark Brook Reservoir Dam and dikes are in good condition at the present time as revealed by the field inspections of 15 April and 20 May 1980. However, there are several items of a remedial nature which were observed during the field inspection and which will require treatment as outlined in Section 7.

6.2 Design and Construction Data

Five design drawings prepared by New England Power Service Company dated September 1948, are available and are included in the appendix to this report. These drawings show the general layout of the dam and sufficient details of the spillway structure and outlet structure to permit a reasonable interpretation of the field conditions observed. However, data on the construction of the embankment, the methods of compaction and detailed laboratory soil test results are not available. Calculations pertaining to the stability of the embankment are unavailable.

6.3 Post-Construction Changes

Cracks and horizontal movement of portions of the spillway channel walls downstream of the ogee section were repaired in 1961. Horizontal steel struts were added between the spillway discharge channel training walls and weepholes were installed in the walls. These measures improved the lateral stability of the concrete training walls downstream of the spillway and the walls are presently in good condition with the exception of minor cracking and efflorescence noted during the inspection.

6.4 Seismic Stability

The dam is located in Seismic Zone #2 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Dark Brook Reservoir Dam is judged to be in fair condition. The deficiencies revealed indicate that some remedial work is needed. The major concerns with the overall integrity of the facility are as follows:

- (1) The use of flashboards on the spillway crest.
- (2) The stability of the downstream spillway channel walls.
- (3) The extensive brush and tree growth on Dike B.
- (4) The wet area at toe of Main Dam.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definite review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner with one year after receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the owner, The Massachusetts Electric Company, should utilize the services of a competent registered professional engineer to make investigations and studies of the following, and, if proved necessary, to design appropriate remedial works:

- (1) Review the use of flashboards on the spillway crest and determine the feasibility of either eliminating their use altogether, or modifying them to facilitate quick removal in anticipation of a storm.
- (2) Investigate the stability of the downstream spillway channel walls.
- (3) Removal of extensive trees and brush growth on Dike B to within at least 10 ft. of toe and backfilling with a suitable material.

The owner should implement all recommendations by the Engineer.

7.3 Remedial Measures

a. Operation and Maintenance Procedures:

(1) Repair minor erosion of upstream slope of the Main Dam near the left training wall of the spillway and repair three small potholes on the downstream slope near the left abutment.

(2) Cut and trim brush and wild rhubarb growth on the downstream slope of the Main Dam to the left of the low level outlet.

(3) Trim brush and growth on the upstream slope of the Main Dam and mow grass on the crest and downstream slope.

(4) Repair void in the 21 in. dia. low level outlet pipe approximately 3 ft. upstream of the headwall at the downstream end and repair or reconstruct the concrete downstream headwall at its discharge end.

(5) As part of an annual technical inspection monitor the wet area along the downstream toe of the Main Dam to the left of the low level outlet structure to observe changes in quantity or clarity of the water, monitor the wet area on the north side of the road at the toe of Dike A, and monitor any changes in the minor cracks and efflorescence in the spillway channel walls downstream of the ogee section.

(6) Remove minor brush growth and small tree growth on the upstream slope of Dike A and trim brush growth on the downstream slope of the dike.

(7) Develop an "Emergency Action Plan" that will include an effective preplanned downstream warning system, locations of emergency equipment, materials and manpower, authorities to contact and potential areas that require evacuation. The plan will also include round-the-clock monitoring of the project during periods of heavy precipitation.

(8) Institute procedures for an annual technical inspection of the dam and appurtenant structures.

(9) Implement a regular periodic maintenance program.

7.4 Alternatives

There appear to be no practical alternatives to the above recommendations.

Appendix A
Inspection Checklist

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980
OWNER Massachusetts Electric Co. TIME 15 April - 1:30 PM
20 May - 1:00 PM
WEATHER 15 April - Clear/Cool
20 May - Clear/Warm
W.S. ELEV. 609 U.S. DN.S.

INSPECTION PARTY

A/E REPRESENTATIVES

1. Peter B. Dyson
2. Pasquale E. Corsetti
3. Roger F. Berry
4. Carl J. Hoffman
5. William S. Zoino

OWNER'S REPRESENTATIVES

1. Mr. Stanley Maleski
2.
3.
4.
5.

PROJECT FEATURE

INSPECTED BY

REMARKS

- | | | |
|---|---|---|
| 1. <u>Hydrologic</u> | <u>Roger F. Berry</u> | <u>LBA</u> |
| 2. <u>Hydraulics/Structures</u> | <u>Carl J. Hoffman</u> | <u>LBA</u> |
| 3. <u>Soils Geology</u> | <u>William S. Zoino</u> | <u>GZA</u> |
| 4. <u>General Features</u> | <u>Peter B. Dyson</u> | <u>LBA</u> |
| 5. <u>General Features</u> | <u>Pasquale E. Corsetti</u> | <u>LBA</u> |
| 6. <u> </u> | <u> </u> | <u> </u> |
| 7. <u> </u> | <u> </u> | <u> </u> |
| 8. <u> </u> | <u> </u> | <u> </u> |
| 9. <u> </u> | <u> </u> | <u> </u> |
| 10. <u> </u> | <u> </u> | <u> </u> |

LBA - Louis Berger & Associates, Inc.
GZA - Goldberg-Zoino & Associates, Inc.

PERIODIC INSPECTION CHECKLIST

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980
 PROJECT FEATURE Main Dam NAME _____
 DISCIPLINE Soils/Geology NAME William S. Zoino

AREA EVALUATED	CONDITIONS
----------------	------------

DAM EMBANKMENT

Crest Elevation	617
Current Pool Elevation	609
Maximum Impoundment to Date	unknown
Surface Cracks	None
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	3 small potholes downstream slope 5 ft. below crest, 150 ft. from left abutment.
Rock Slope Protection - Riprap Failures	Riprap - Good Condition
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	Wet area along downstream toe of embankment to left of low level outlet
Piping or Boils	None Observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

Note: Brush growth on downstream slope

PERIODIC INSPECTION CHECKLIST

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980
 PROJECT FEATURE Dike A NAME _____
 DISCIPLINE Soils/Geology NAME William S. Zoino

AREA EVALUATED	CONDITIONS
<u>DIKE EMBANKMENT</u>	Dike A
Crest Elevation	617
Current Pool Elevation	609
Maximum Impoundment to Date	unknown
Surface Cracks	None
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	None
Rock Slop Protection - Riprap Failures	Good Condition - Contains brush and growth*
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	None observed, but wet area occurs north of road along downstream toe.
Piping or Boils	None Observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

Note: Brush growth on upstream slope heaviest at east abutment.

PERIODIC INSPECTION CHECKLIST

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980

PROJECT FEATURE Dike B NAME

DISCIPLINE Soils/Geology NAME William S. Zoino

AREA EVALUATED	CONDITIONS
----------------	------------

DAM EMBANKMENT

Crest Elevation	617
Current Pool Elevation	609
Maximum Impoundment to Date	unknown
Surface Cracks	None
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alginment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	**
Sloughing or Erosion of Slopes or Abutments	None
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None evident
Toe Drains	None evident
Instrumentation System	None evident

** Extensive brush and tree growth on crest and slopes.

PERIODIC INSPECTION CHECKLIST

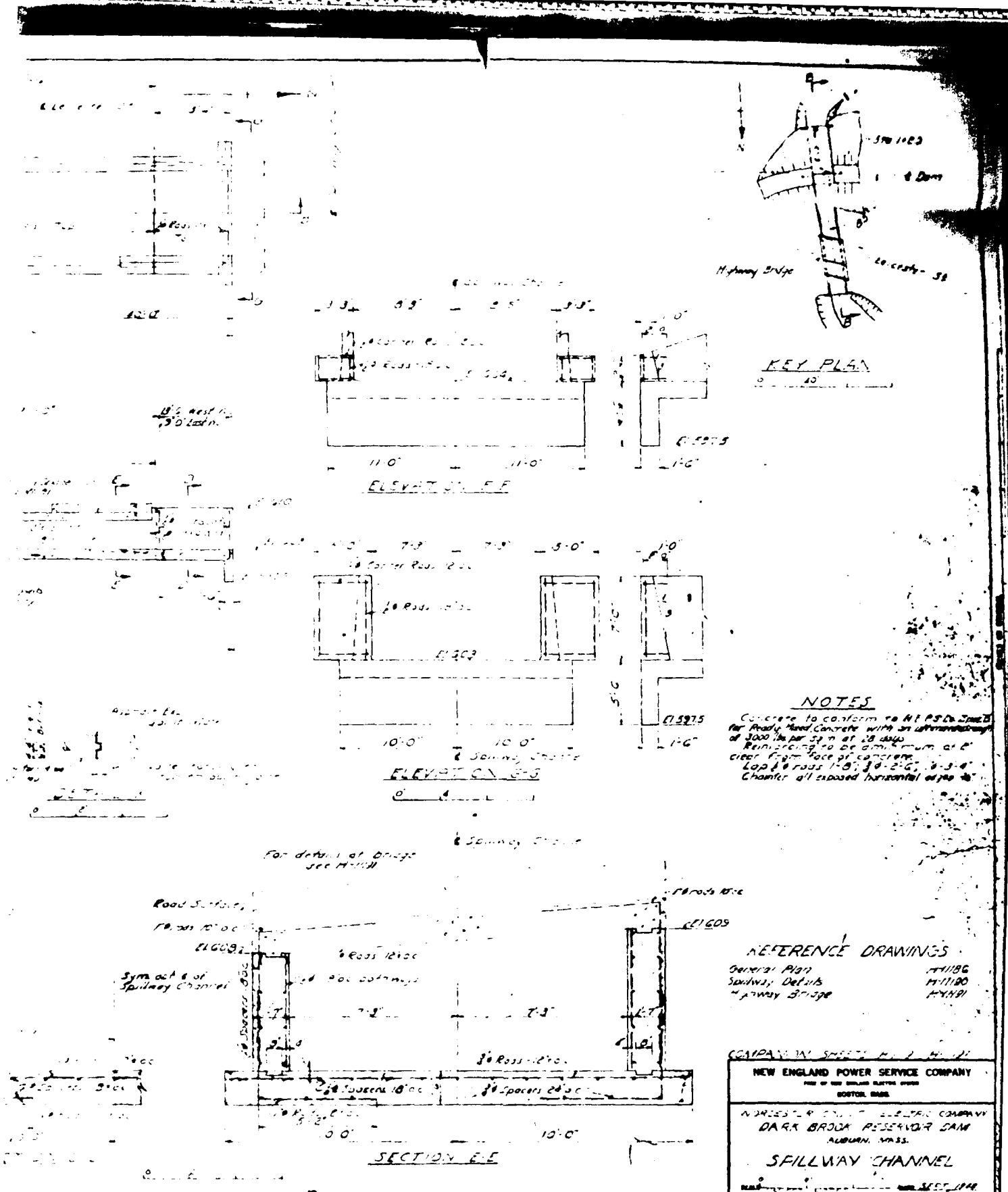
PROJECT Dark Brook Reservoir DATE 15 April and 20 May 1980
 PROJECT FEATURE Gate House NAME _____
 DISCIPLINE Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
<u>CUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural	
General Condition	Reported Good
Condition of Joints	Not observed
Spalling	Not observed
Visible Reinforcing	Not observed
Rusting or Staining of Concrete	Not observed
Any Seepage or Efflorescence	Not observed
Joint Alignment	Not observed
Unusual Seepage or Leaks in Gate Chamber	Not observed
Cracks	Not observed
Rusting or Corrosion of Steel	Not observed

b. Mechanical and Electrical

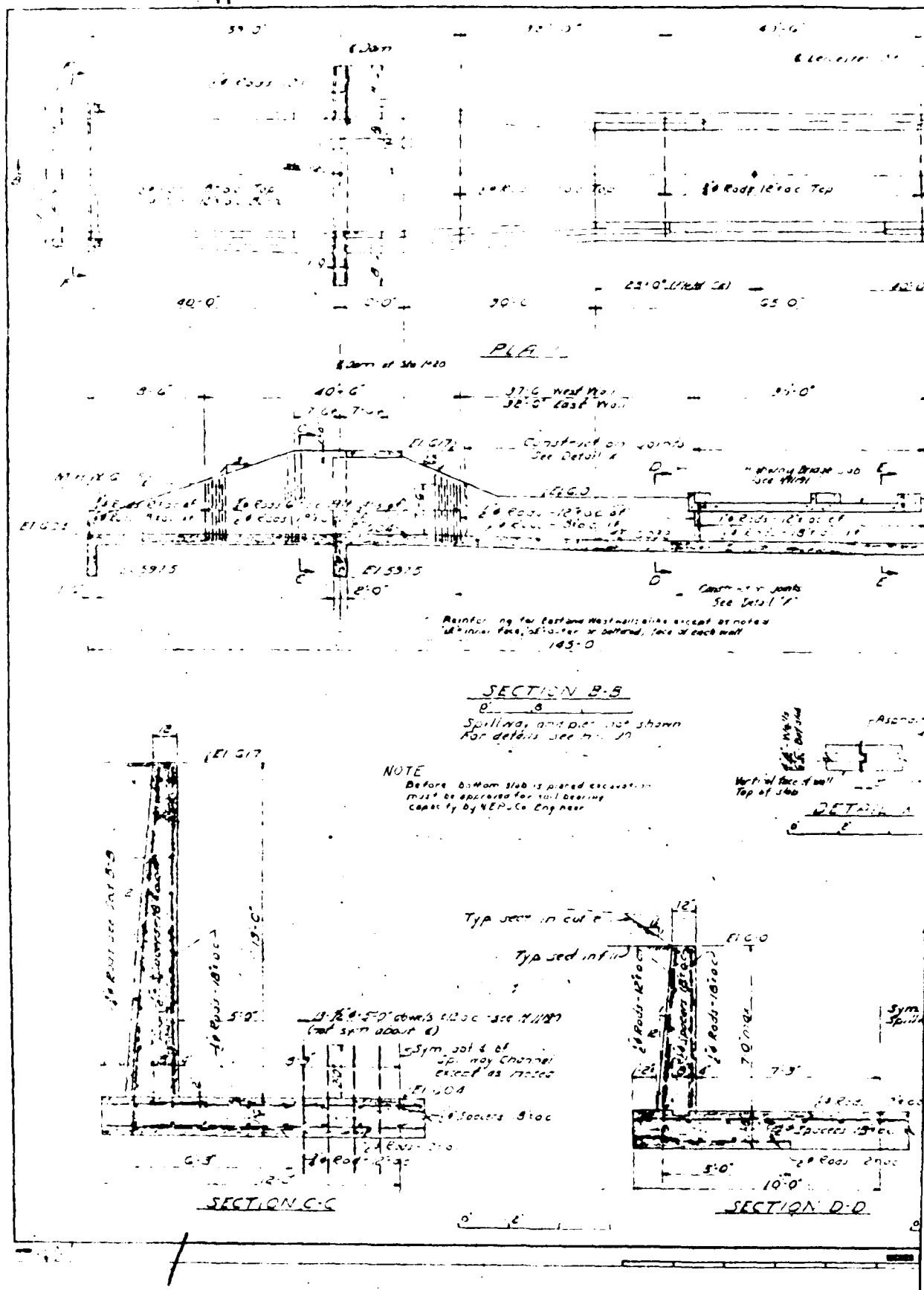
N/A

Air Vents
 Float Wells
 Crane Hoist
 Elevator
 Hydraulic System
 Service Gates
 Emergency Gates
 Lighting Protection System
 Emergency Power System
 Wiring and Lighting System in Gate Chamber



2

B-5

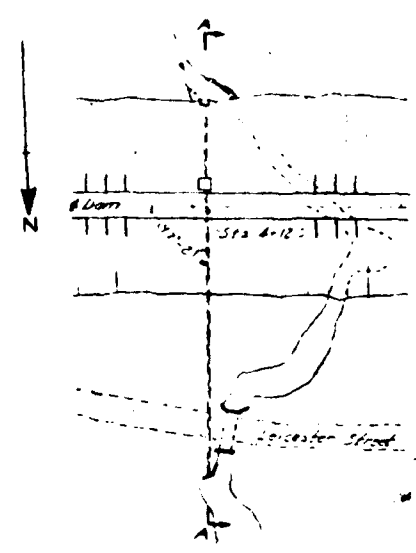
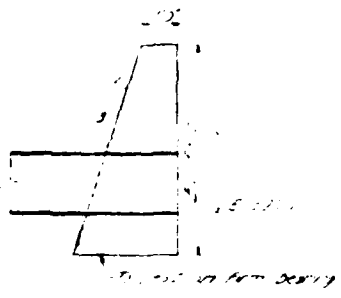


10' 0" 21" 4" Concrete Pipe

See Sect. A

21" 4" Concrete Pipe
Invert El. 596

3-A

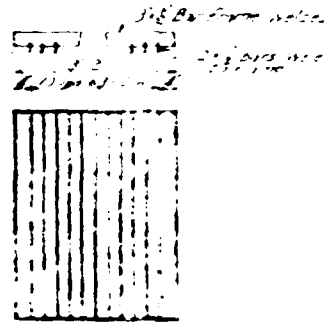


NOTES

Concrete to conform to N.E.P.S. Co. Spec.
for ready-mixed concrete (Rev. 7-1-62)
All reinforcement to be a minimum of #2
from top of concrete
Structural steel to conform to A.S.T.M.
Spec. A7-16

REFERENCE DRAWINGS

General Plan H-11186
Gate Well Details H-11188



CONTRACT NO. 11186-1

NEW ENGLAND POWER SERVICE COMPANY
ONE OF THE BOSTON TRADING COMPANIES
BOSTON, MASS.

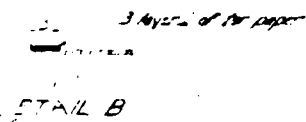
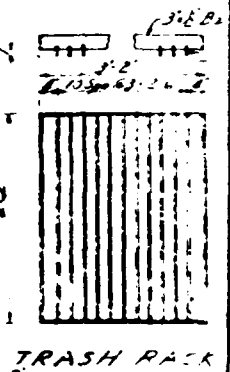
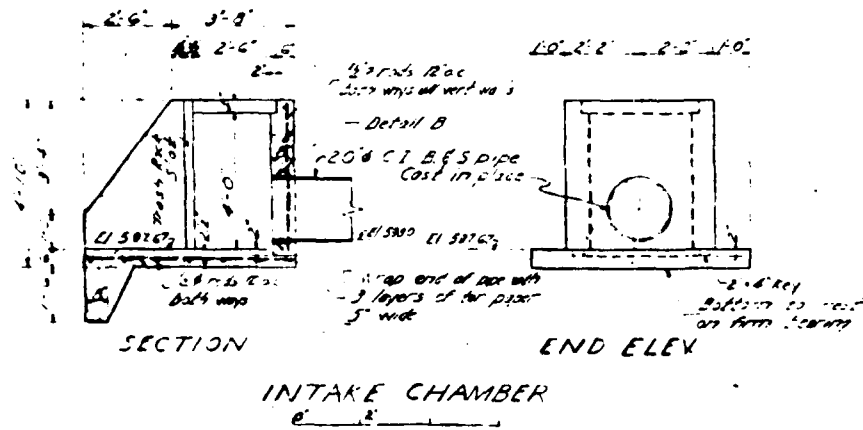
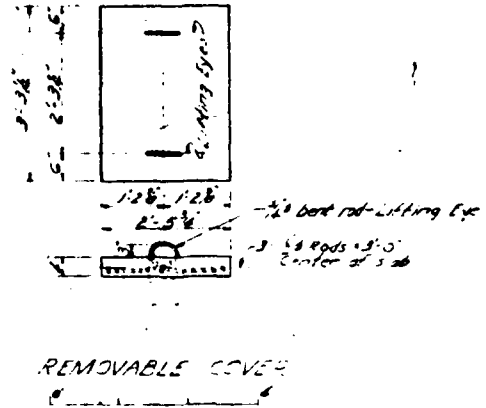
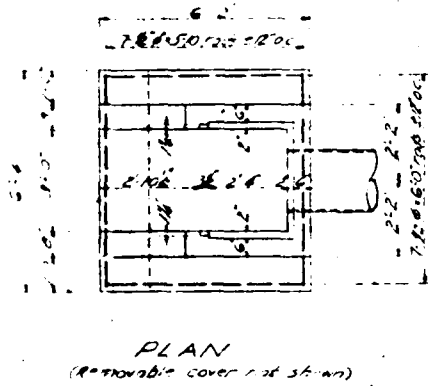
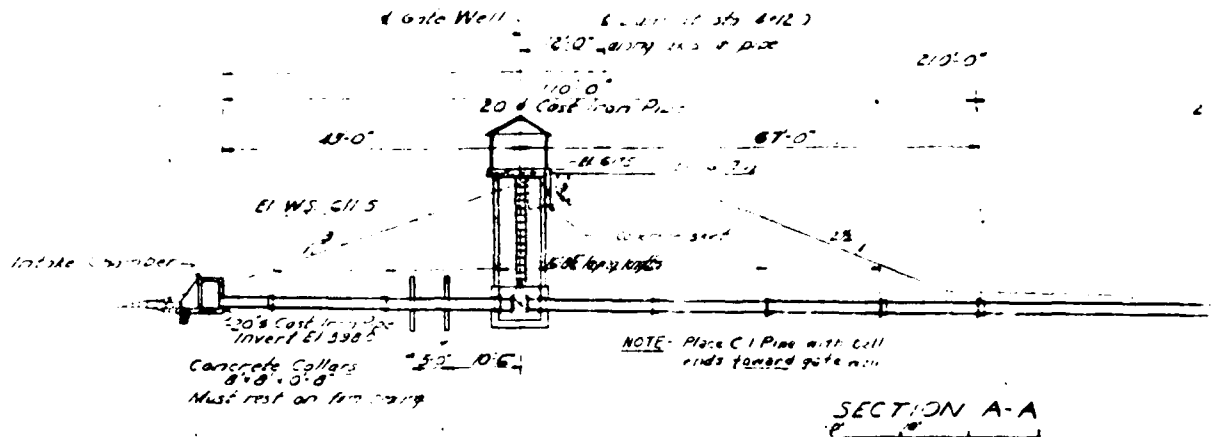
WORCESTER COUNTY ELECTRIC COMPANY
DARK BROOK RESERVOIR DAM
ALBANY, MASS.

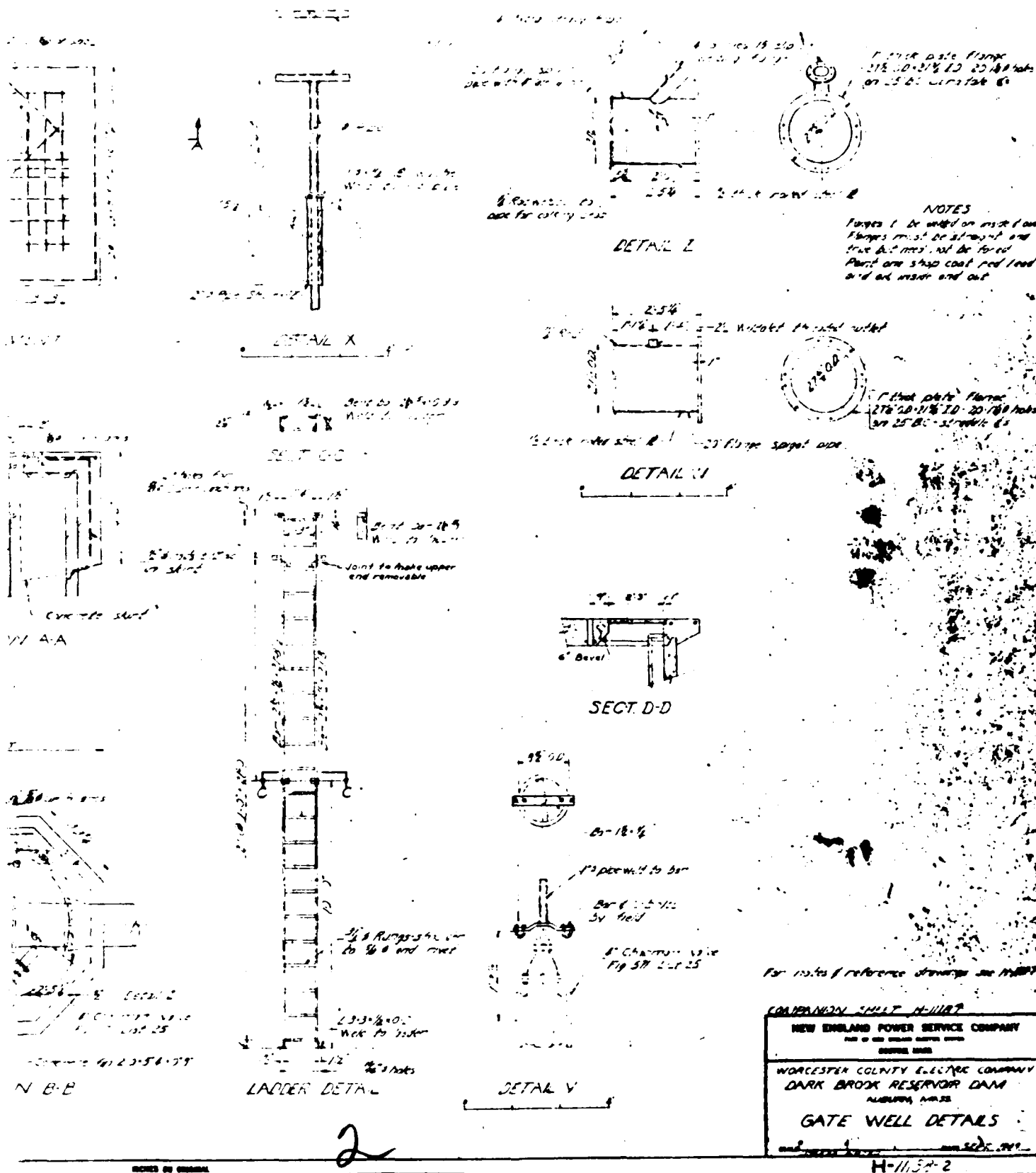
DISCHARGE CONDUIT

DATE AS NOTED

H-11187-2

B-4





For notes & reference drawings see 12007

CONNECTION SHEET H-11187
NEW ENGLAND POWER SERVICE COMPANY
PART OF NEW ENGLAND ELECTRIC SYSTEM
BOSTON, MASS.

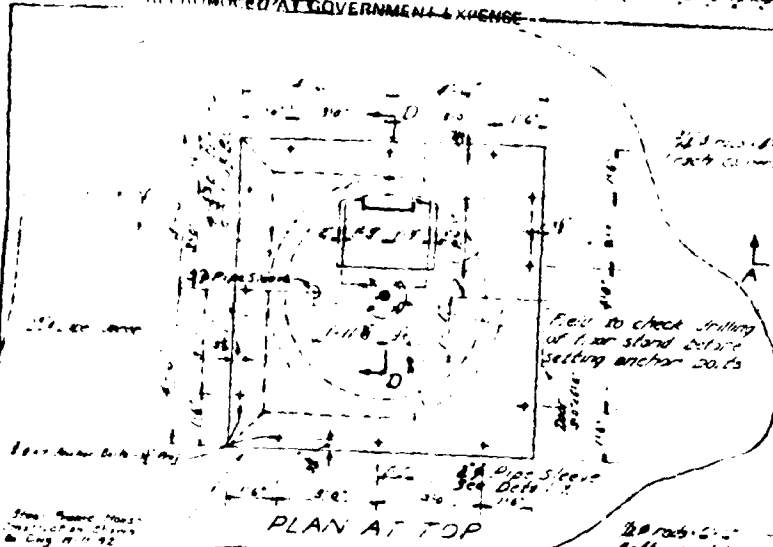
WORCESTER COUNTY ELECTRIC COMPANY
DARK BROOK RESERVOIR DAM
ALBANY, MASS.

GATE WELL DETAILS

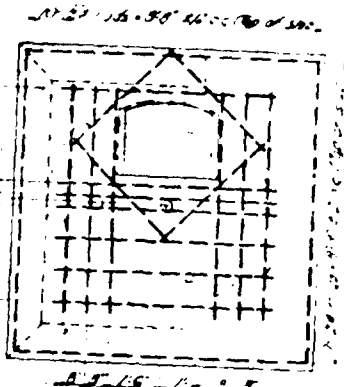
and the other side of the road

H-1154-2

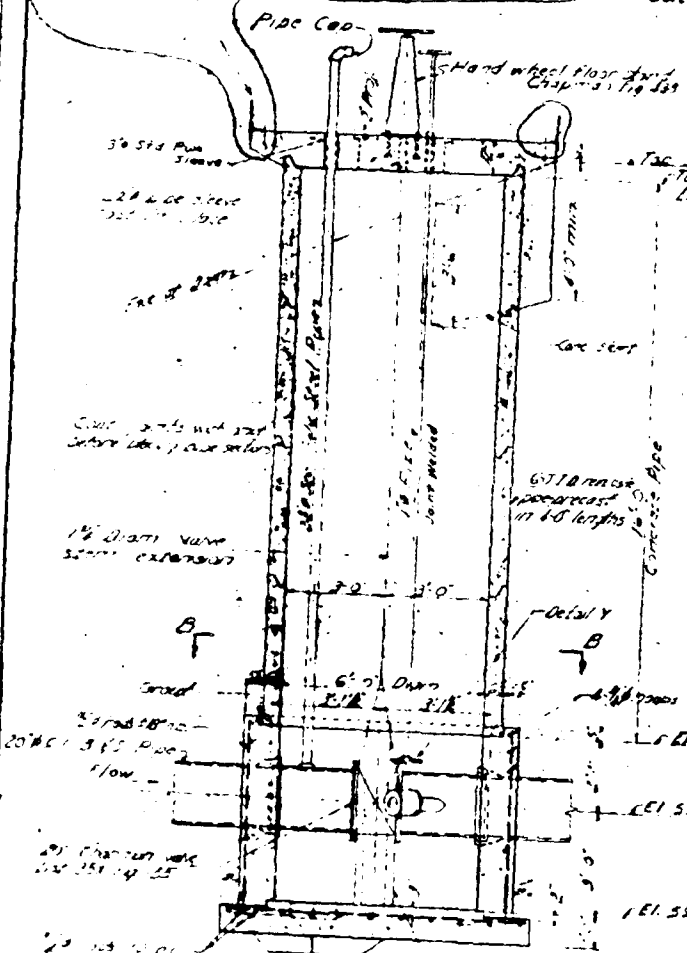
B-3



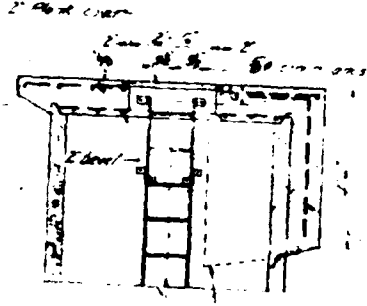
PLAN AT TOP



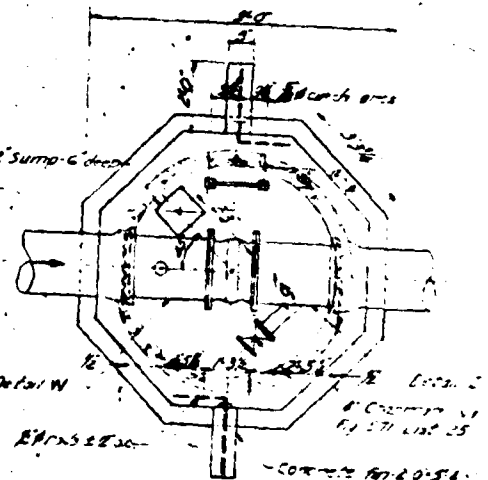
REINFORCEMENT



SECTION



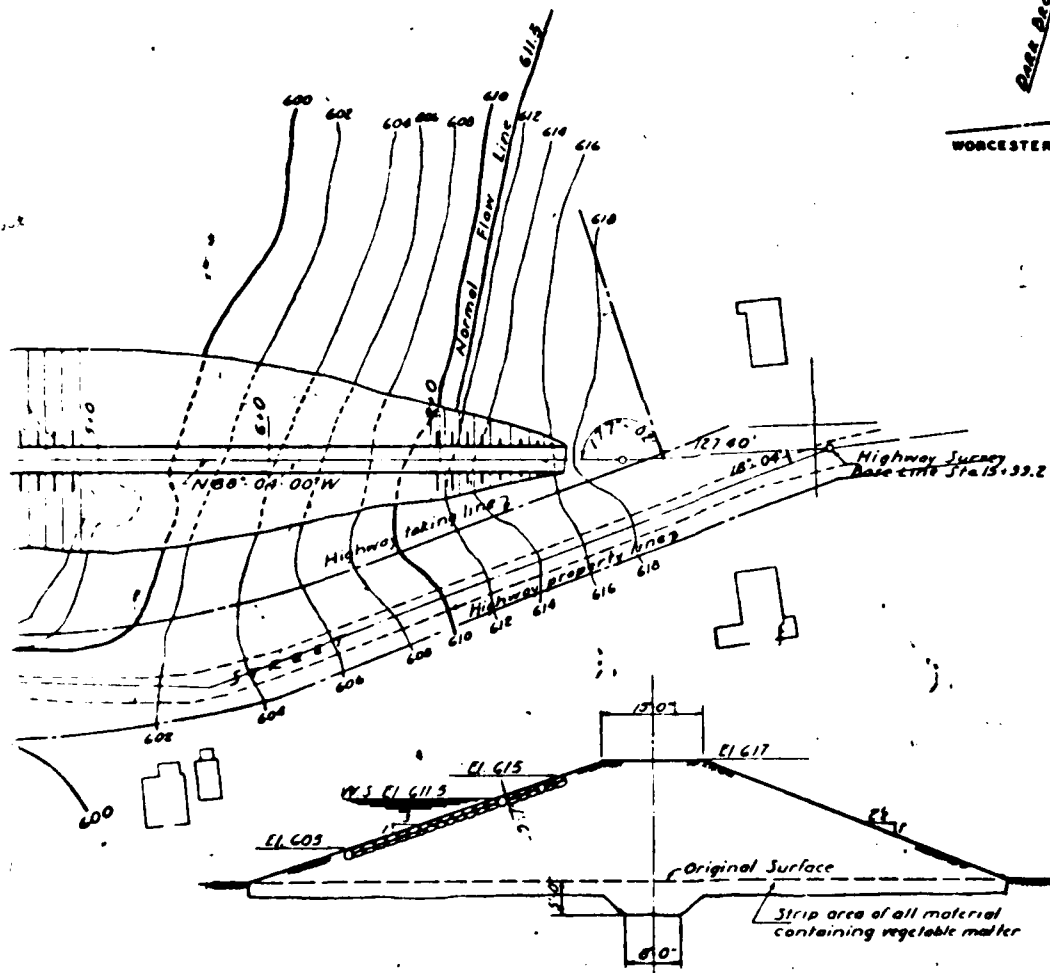
SECTION A-A



SECTION B-B

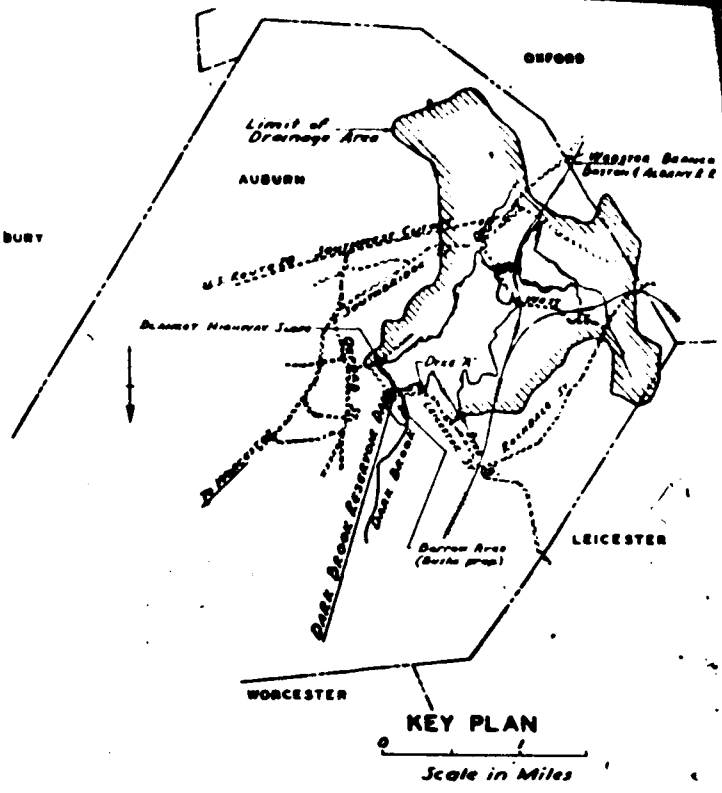
NOTE
Before bottom slab is placed
excavation must be approved for soil
bearing capacity by AC PCE Engineer

REVISIONS	DESCRIPTION
1	As shown
2	As shown
3	As shown
4	As shown
5	As shown
6	As shown
7	As shown
8	As shown
9	As shown
10	As shown
11	As shown
12	As shown
13	As shown
14	As shown
15	As shown
16	As shown
17	As shown
18	As shown
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90	As shown
91	As shown
92	As shown
93	As shown
94	As shown
95	As shown
96	As shown
97	As shown
98	As shown
99	As shown
100	As shown



TYPICAL CROSS SECTION
THRU DAM

Scale in Feet



KEY PLAN

Scale in Miles

REFERENCE DRAWINGS.
Discharge Conduit H-11107
Spillway Channel H-11109
Barnet A & B (Title Letter) H-11327

NEW ENGLAND POWER SERVICE COMPANY
MADE BY THE NEW ENGLAND POWER SERVICE COMPANY
DESIGNED BY

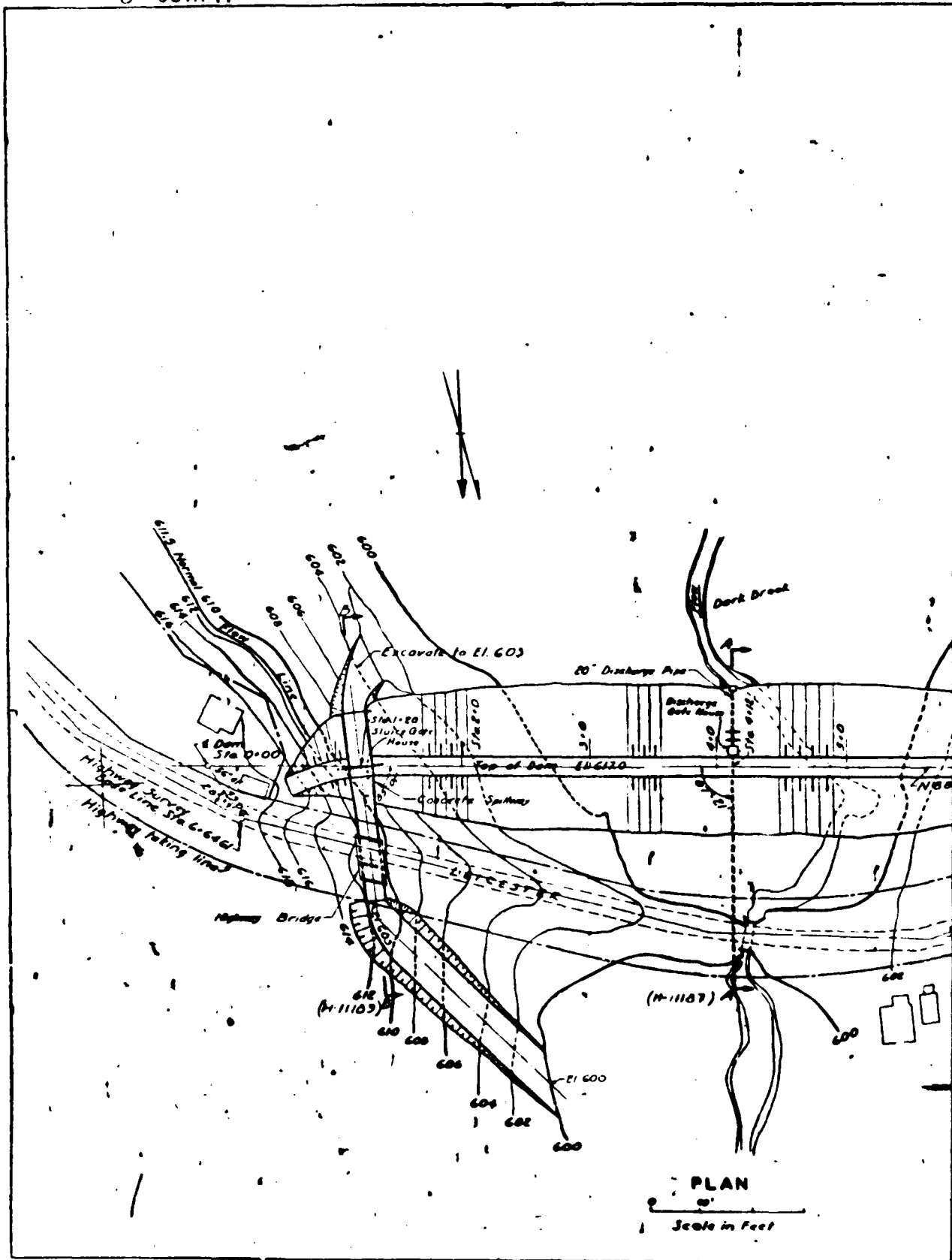
WORCESTER COUNTY ELECTRIC COMPANY
BARK BROOK RESERVOIR DAM
AUBURN, MASS
MAIN DAM

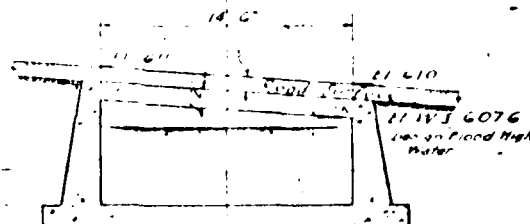
GENERAL PLAN

MADE AS NOTED AND SCALE 1" = 100'

H-11186-0

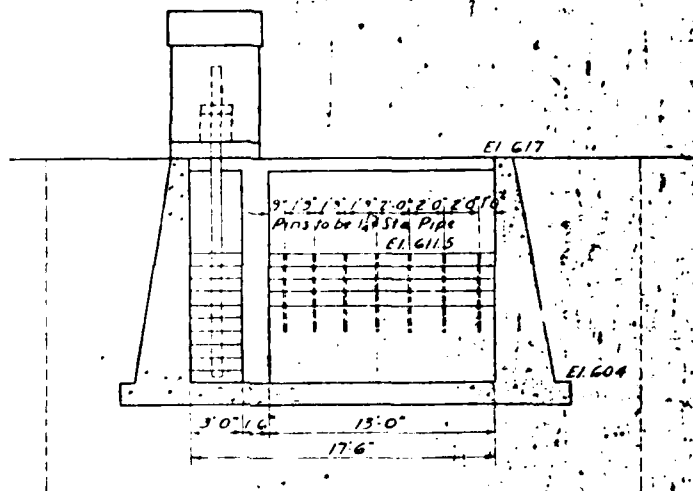
B-2





21" Rein. concrete
pipe invert El 596

Scale in Feet



SPILLWAY CROSS SECTION

Scale in Feet

WORCESTER COUNTY COMMISSIONERS
WORCESTER COUNTY ENGINEERING DEPARTMENT
PLAN OF
DAM AND CONTROL WORKS ON DARK BROOK
IN THE TOWN OF AUBURN
WORCESTER COUNTY ELECTRIC COMPANY
AS FILED AND APPROVED BY THE
COUNTY COMMISSIONERS

SCALES AS NOTED

May 12, 1950

James B. Gandy
CLERK OF THE HOUSE OF REPRESENTATIVES

Abstract

COPIES DESTROYED

FOR APPROVAL... May '21 1950

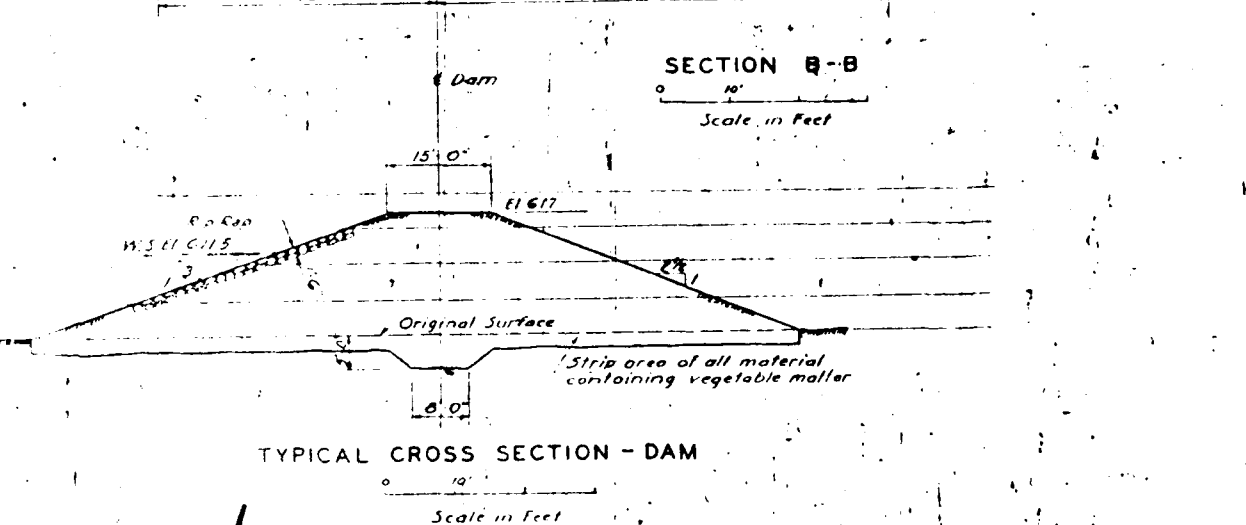
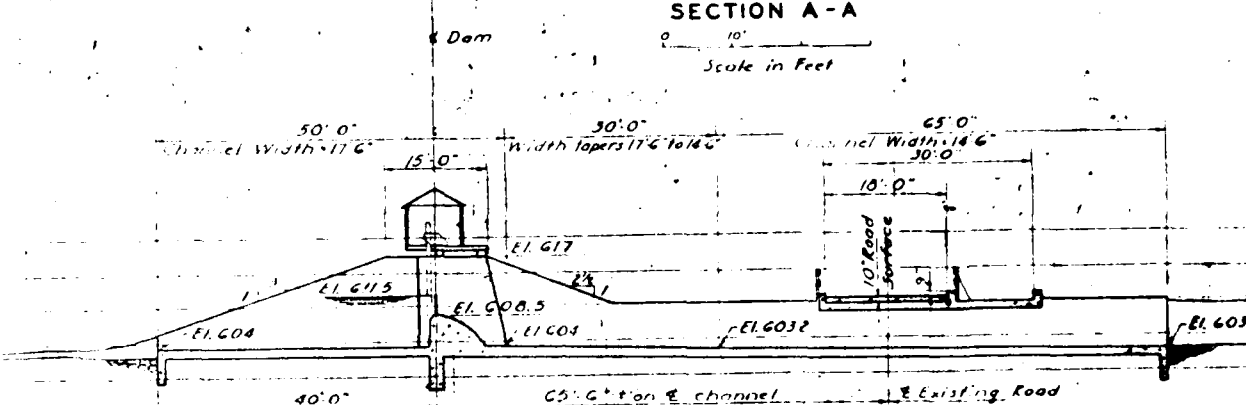
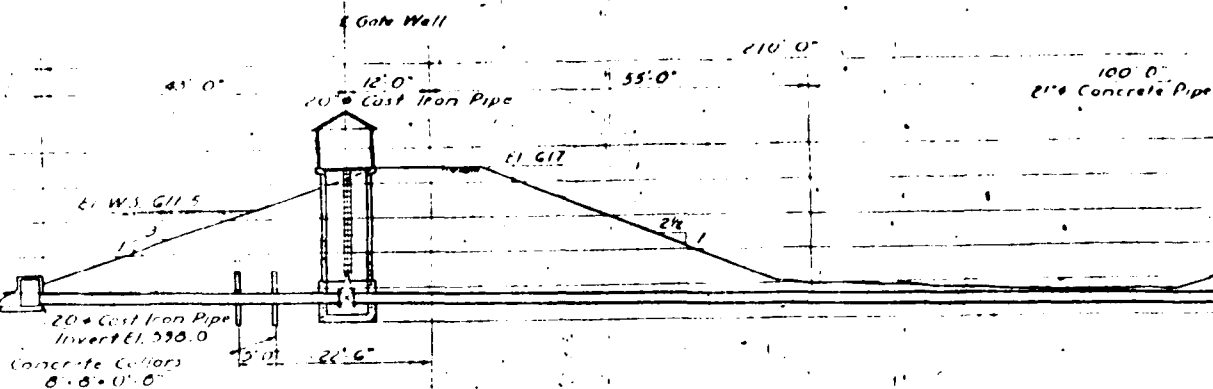
L. O. Menden
CIVIL ENGINEER

ENCLOSURE NEW ENGLAND POWER

SMITH & COMPANY

DAM NO 65400

72-1



Appendix B
Engineering Data

PERIODIC INSPECTION CHECKLIST

PROJECT: DARK BROOK RESERVOIR DAM

DATE: 15 April and 20 May 1980

AREA EVALUATED

CONDITIONS

Outlet Works - Intake Channel and Intake Structure	N/A
Outlet Works - Transition and Conduit	N/A
Outlet Works - Service Bridge	N/A

PERIODIC INSPECTION CHECKLIST

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980
 PROJECT FEATURE Spillway NAME _____
 DISCIPLINE Hydraulics/Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	Not visible
General Condition	unknown
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Not visible
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	Minor
Spalling	Minor
Any Visible Reinforcing	None
Any Seepage or Efflorescence	Minor
Drain Holes	Yes
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Channel	Good
Other Obstructions	Bridge Crossing at lower end of channel

PERIODIC INSPECTION CHECKLIST

PROJECT Dark Brook Reservoir Dam DATE 15 April and 20 May 1980
 PROJECT FEATURE Low Level Outlet NAME _____
 DISCIPLINE Hydraulics/Structures NAME Carl J. Hoffman

AREA EVALUATED	CONDITIONS
----------------	------------

OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL

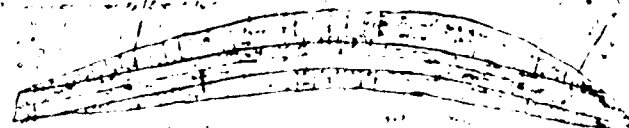
General Condition of Concrete	Good
Rust or Staining	None
Spalling	None
Erosion or Cavitation	Outlet headwall has shifted, and there is a void in outlet pipe about 3 ft. upstream of header
Visible Reinforcing	None
Any Seepage or Efflorescence	None
Condition at Joints	Not Visible
Drain Holes	Not Visible
Channel	No defined channel
Loose Rock or Trees Overhanging Channel	None
Condition of Discharge Channel	Good

REVISIONS

DESCRIPTION

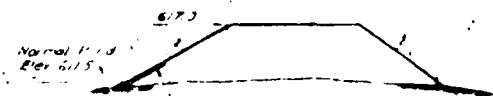
REVISIONS

DESCRIPTION



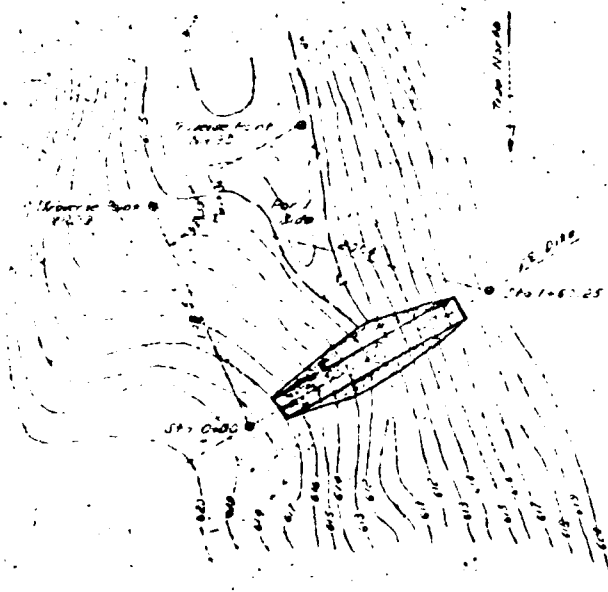
PLAN OF DYKE "A"

0 20



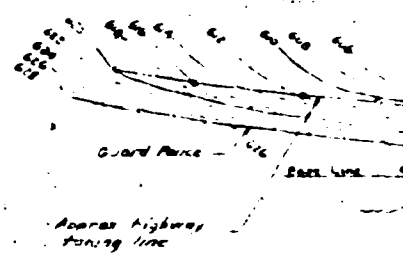
TYPICAL SECTION OF DYKE "B"

0 20



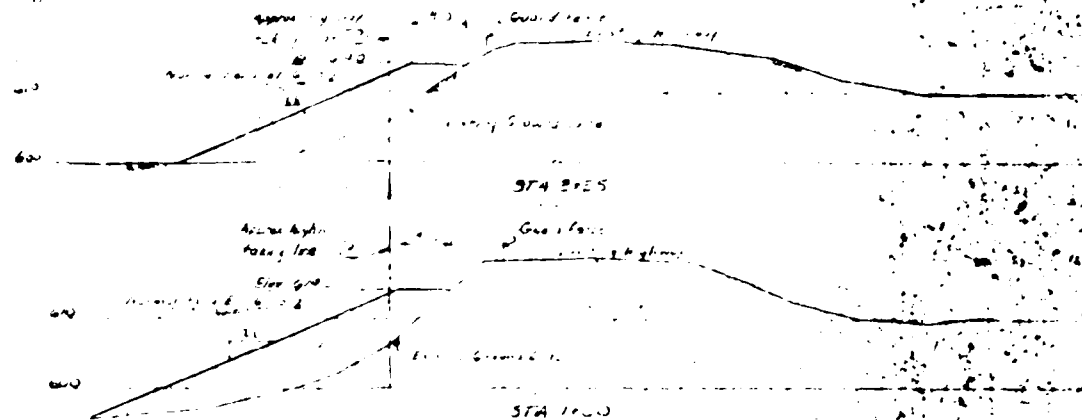
PLAN OF DYKE "B"

0 40

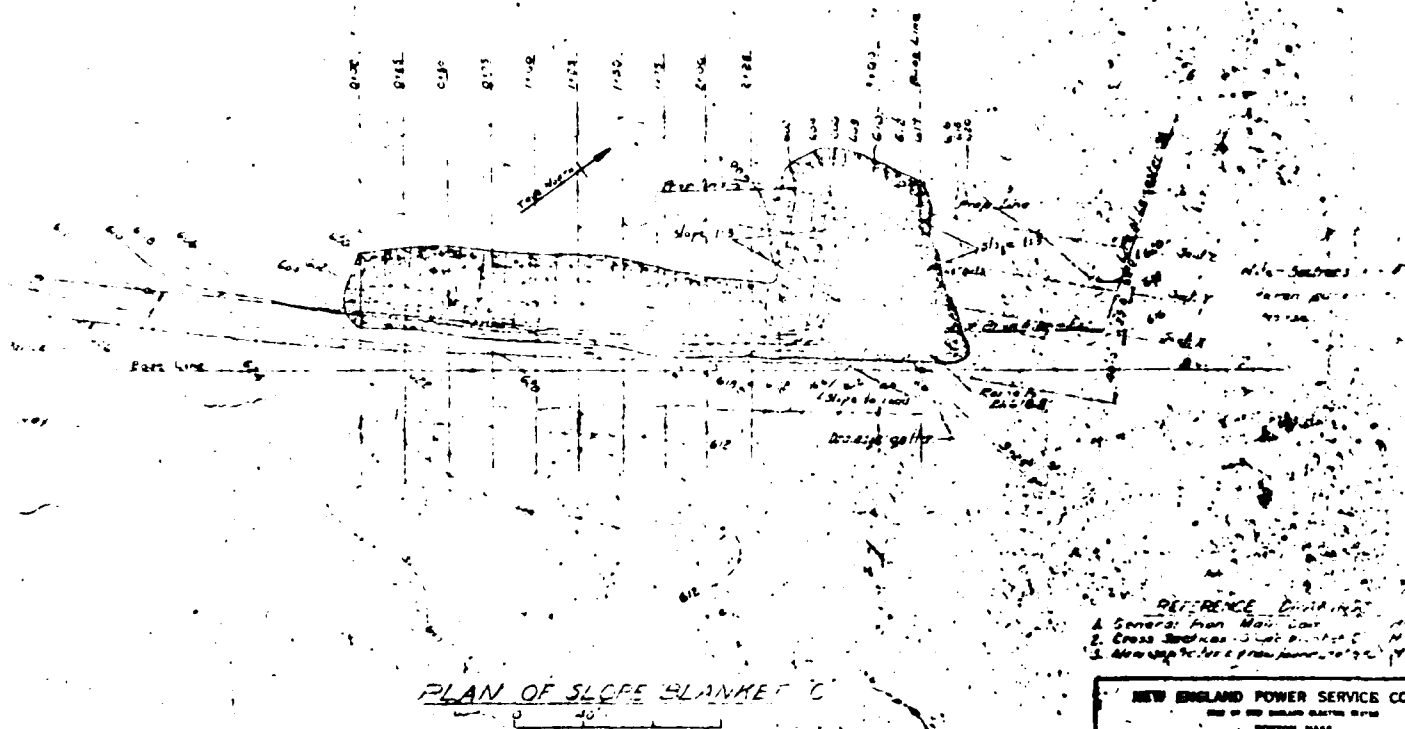


Guard Rail

Across Highway
turning line



TYPICAL SECTIONS OF SPEC. 9, 1VH7C



REFERENCE DIVISION

1. General: from Main List
2. Cross Sections - 3rd & 4th
3. New York & Co. & from June 1952

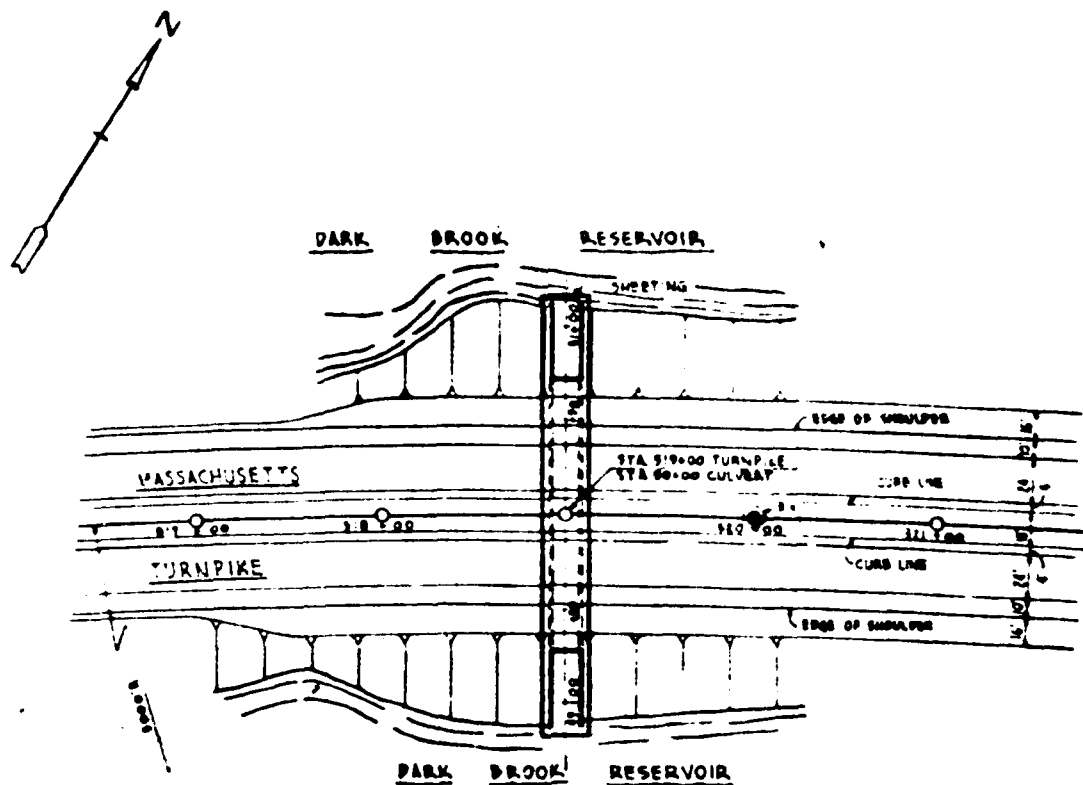
NEW ENGLAND POWER SERVICE COMPANY
 ONE OF NEW ENGLAND ELECTRIC SYSTEMS
 BOSTON, MASS.

WORCESTER COUNTY ELECTRIC CO
DARK BROOK RESERVOIR
BIKES A & B and
SLOPE BEAUFORT C

END AS NOTED

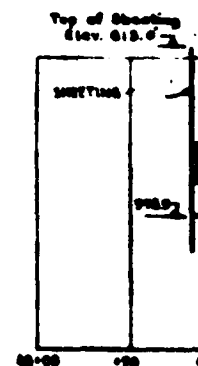
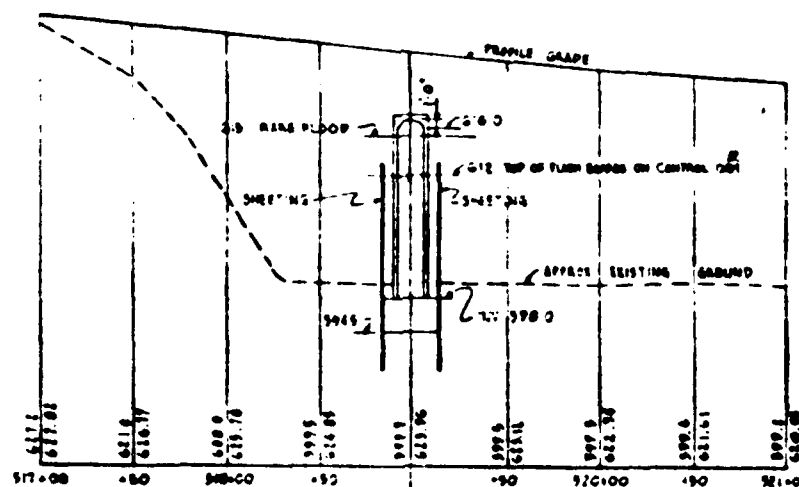
H-

B-6



KEY PLAN
SCALE: 1" = 30'

1400' VC



PROFILE ALONG TURNPIKE
VERT. SCALE: 1" = 10'
HORIZ. SCALE: 1" = 30'

BY	DATE				
DESIGNED	7/1/55				
CHECKED	10/8 7/1/55				
IN CHARGE OF	R. P.	NO	REVISION	BY	DATE

GENERAL NOTES

BORINGS

BORINGS ARE TAKEN FOR THE PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY. THEY DO NOT NECESSARILY SHOW MATERIALS TO BE ENCOUNTERED DURING CONSTRUCTION.

FOUNDATIONS

FOUNDATIONS MAY BE ALTERED IF NECESSARY TO SUIT CONDITIONS ENCOUNTERED IN CONSTRUCTION.

DESIGN LOADING

A A S H O LOADING DESIGNATION H20 S16

CONCRETE CLASS

CONCRETE SHALL BE CLASSIFIED AND PLACED AS PERMITTED IN THE STANDARD SPECIFICATIONS FOR MASSACHUSETTS TURNPIKE AND SHALL BE USED AS NOTED IN PLANS AND SPECIFICATIONS.

BENCH MARK

HIGHEST POINT ON SHOULDER (PAINTED YELLOW), 140 FT SOUTH OF TURNPIKE E AT STA. 914+75. BENCH MARK ELEV. 650.45.

STANDARD NOTES

FOR OTHER STANDARD NOTES RELATING TO BRIDGES SEE SHEET NOS. 179 TO 178.

TURNPIKE CURVE DATA	
VERTICAL CURVE	
SLOPE	-2.90%
PVC STA	918+29 ELEV. 651.00
PVI STA	922+25 ELEV. 614.50
PVT STA	929+15 ELEV. 617.10
SLOPE	+0.40%
L	1000'
HORIZONTAL CURVE	
LOC. STA	912+15.75
P.T. STA	924+06.68
R	9000'

ITEM NO.

AS-1 BRIDGE EXCAVATION

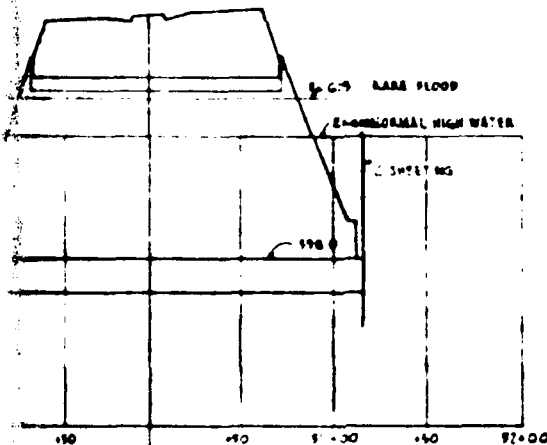
BS-222 CRUSHED ROCK BORROW

CS-1 STEEL SHEET PILING

CS-10 CLASS B CEMENT CONCRETE MASONRY IN CULVERT

CS-7 STEEL REINFORCEMENT FOR STRUCTURES

ITEM



ON 8000 CULVERT
ON 8000 MASSACHUSETTS TURNPIKE

PROFILE ALONG CULVERT

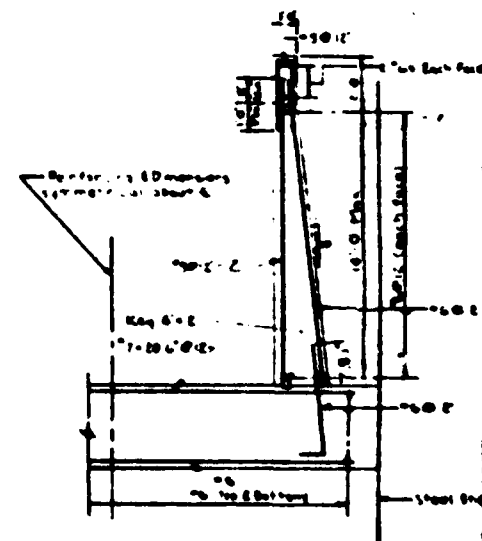
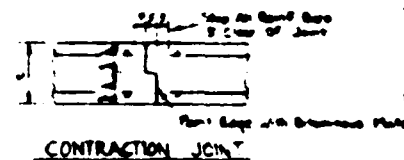
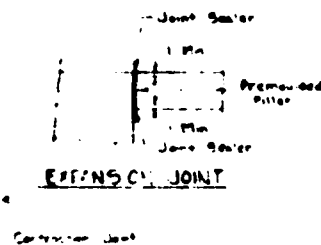
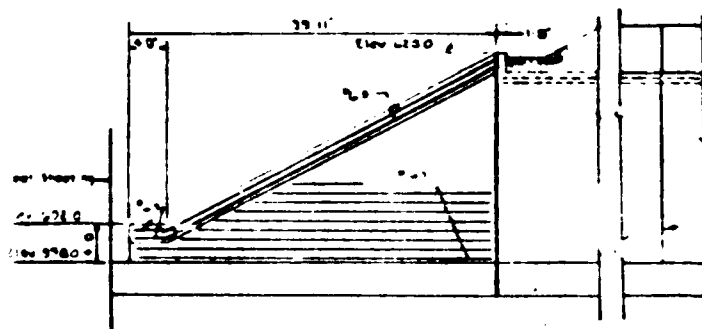
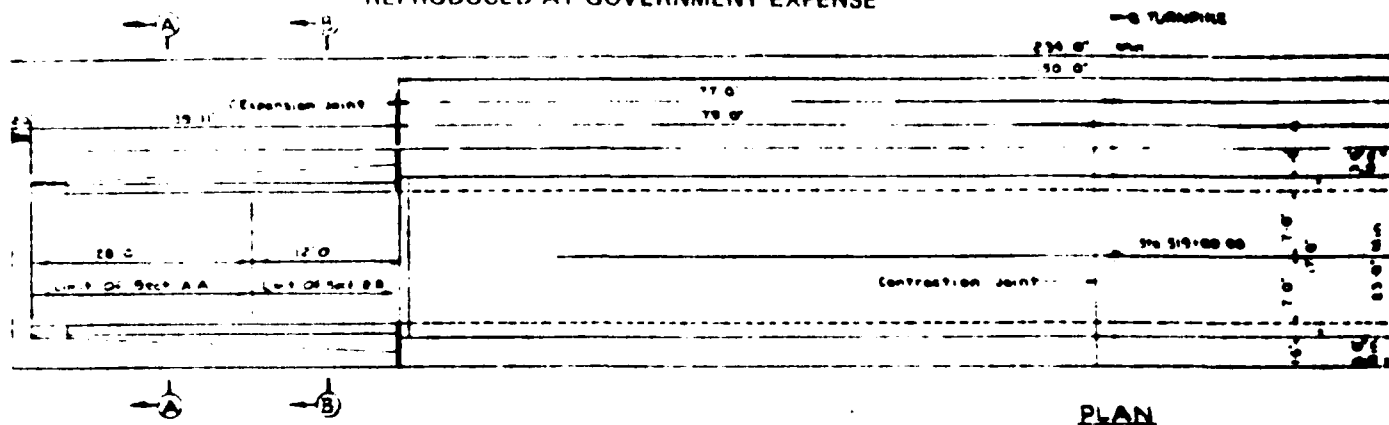
SCALE: VERT. 1" = 10'
HORIZ. 1" = 50'

AS BUILT DRAWING

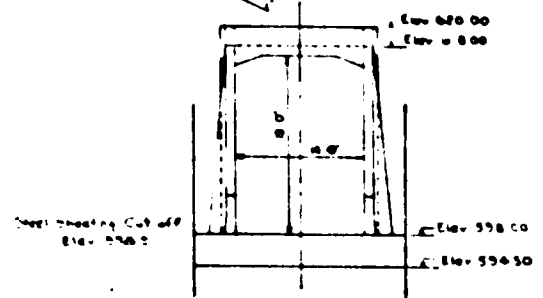
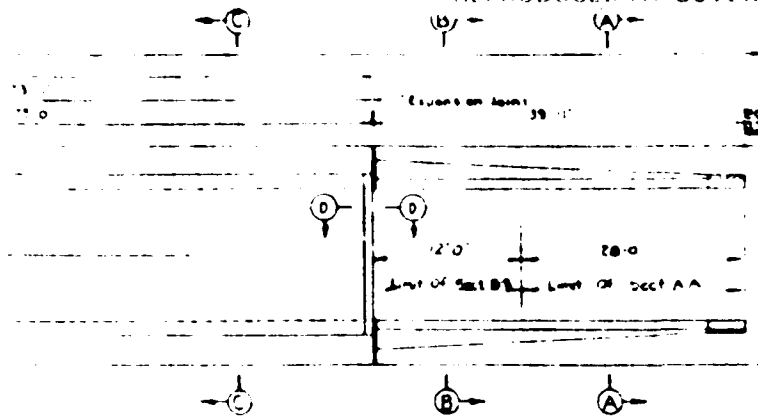
MASSACHUSETTS TURNPIKE AUTHORITY	
MASSACHUSETTS TURNPIKE	
SECTION 2	
BRIDGE No. 1	
DARK BROOK RESERVOIR CULVERT-AUBURN MASS.	
PLANE PROFILES	
SHEET 1 OF 2	
MASTEN, HARRING & BUCHANAN	SCALE - 1" = 10'
CONSULTING ENGINEERS	CONTRACT NO. P-1-61
SECTION	MASSACHUSETTS
	SHEET NO. 67 OF 10

2

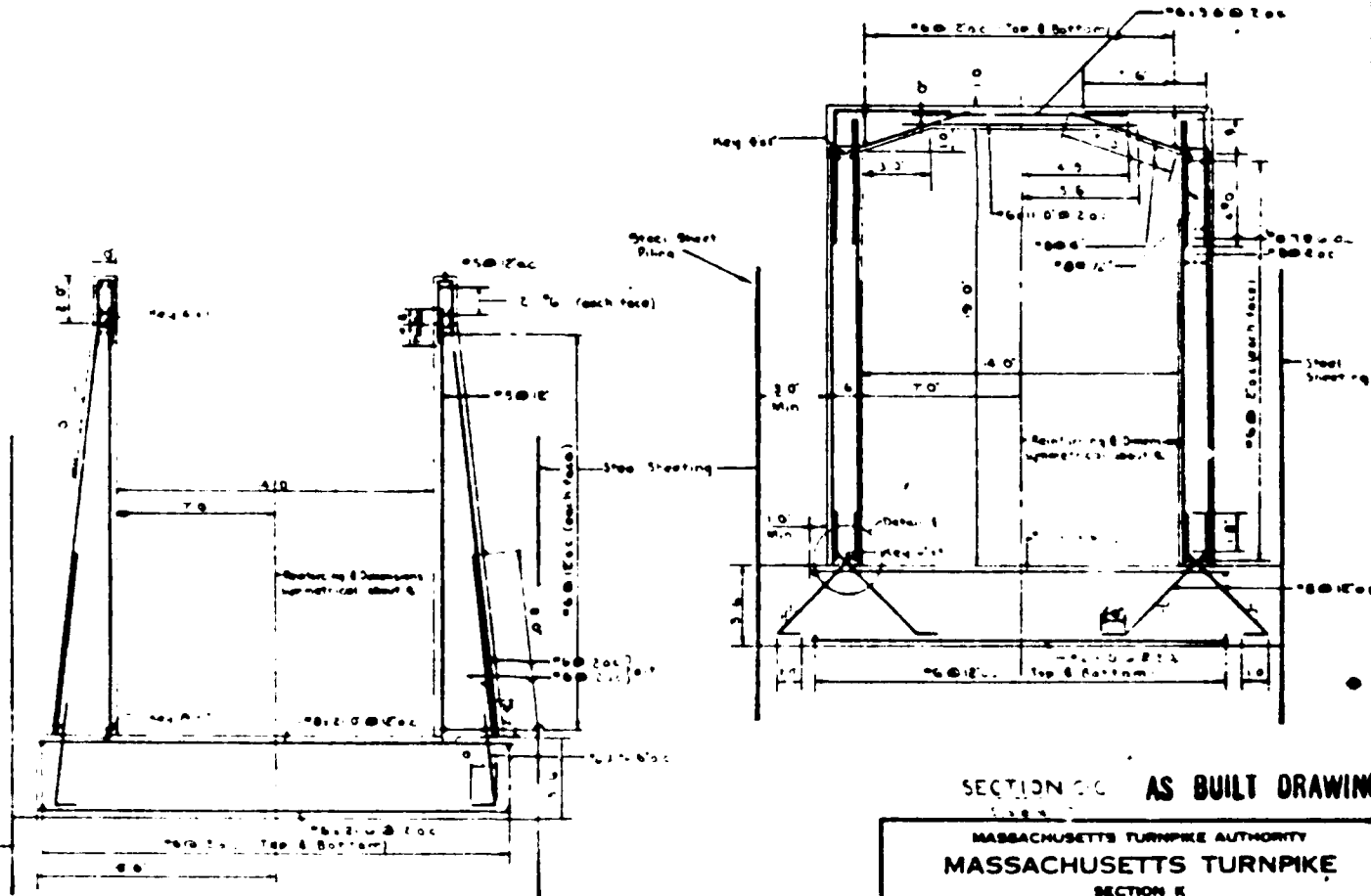
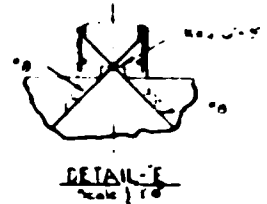
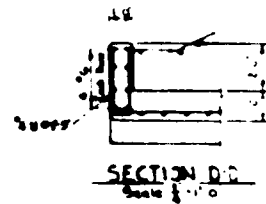
B-7



BY	DATE				
MADE	TERM				
TRACED					
CHECKED	BY	DATE			
CHARGE OF	P.P.	NO	REVISION	BY	DATE



END ELEVATION



SECTION B-B

2

Note: In case of any discrepancy between the Minimum Concrete Cover On Reinforcing Steel, Wall Thickness

MASSACHUSETTS TURNPIKE AUTHORITY	
MASSACHUSETTS TURNPIKE	
SECTION K	
DARK BROOK RESERVOIR OVERLY-AUBURN MASS.	
PLANS & SECTIONS	
SHEET 2 OF 2	
HAYDEN HARDING & BUCHANAN	SCALE - 1/4" = 1'-0"
CONSULTING ENGINEERS	AS SHOWN
BOSTON	CONTRACT NO. 91-1
MASSACHUSETTS	SHEET NO. 60 OF 1

B-8

INSPECTION REPORT & DATA FOR DAMS

Owner: _____
 His Address: _____
 Function of Dam: _____

Location & Access: _____

TSS Quad: _____ Lat: _____ Long: _____
 Drain. Ar.: _____ Sq. Mi.; Ponds: _____ ac.; Res. Cap.: _____
 Character of D.A.: _____

Estimated
 Discharge: _____
 Capacity: _____

General Description of Dam and Discharge Channel: _____

1. _____
 2. _____
 3. _____

Sketch (Not to Scale):

Dam No. _____
 Name: _____
 Stream: _____
 Pond: _____
 Date: _____
 By: _____
 Construction Rating
 Structural: _____
 Hydraulic: _____
 General: _____
 Priority: _____

Remarks and Recommendations: _____

Date: _____ By: _____ Comment: _____

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 permit fully legible reproduction

Dam No. _____

INSPECTION OF SMALL HYDRAULIC PROPERTIES

Massachusetts Electric Company
New England Power Company
Granite State Electric Company

- 1964 -

A policy of inspection of all small hydraulic properties at five year intervals was established in 1959, when the first such inspection was made. Pursuant to this policy, these properties were again inspected in November, 1964. This report contains the results of that inspection and the recommendations of the inspecting party for future maintenance and repair.

The following are the hydraulic properties involved.

Massachusetts Electric Company

Curtis Pond Dam	Ramshorn Pond Dam
Lower Stoneville Dam	Ramshorn Meadow Dam
Upper Stoneville Dam	Shaker Mill Dam
Dark Brook Dam	Lake Gardner Dam
Leesville Dam	Amesbury No. 5 Plant

New England Power Company

Worcester Consolidated Railroad Dam at Millbury
Mumford River Dam at Uxbridge

Granite State Electric Company

Goose Pond Dam	Mascoma Lake Dam
Grafton Pond Dam	Mascoma River Dam
Crystal Lake Dam	(Nos. 1, 2 and 3)

All of these properties were visited except the Shaker Mill Dam in West Stockbridge, Massachusetts, which the Town has voted to acquire and the Mumford River Dam in Uxbridge which has been abandoned and the boards removed, permitting free passage of stream flow with no restriction of the original channel.

MASSACHUSETTS ELECTRIC COMPANY

Worcester Area

An inspection of the storage ponds and dams in the Worcester area, under the jurisdiction of the Massachusetts Electric Company, was made on November 17, 1964, by H. E. Stockwell, G. D. Bacon and D. R. Campbell of Boston and F. T. Daft and J. R. Pitman of Worcester. All properties visited were found to be in excellent operating condition, well maintained and capable of performing their functions without danger of failure.

Recommendations

General

Continue to cut growth on earth embankments and in spillway channels so as to prevent development of high brush and scrub trees.

Curtis Pond

Make periodic check of erosion of steel posts supporting walkway across spillway.

Lower Stoneville

None.

Upper Stoneville

Remove tree stumps in the easterly spillway channel at the downstream end of the pool formed by a back eddy.

Place riprap on bare spot just east of the auxiliary spillway.

Dark Brook

Consider erecting chain link fence on both sides of spillway to prevent children from walking on struts over channel.

Ramshorn Pond

Repair break at top of dry masonry wall at outlet of control pipe.

MASSACHUSETTS ELECTRIC COMPANY
Worcester Area

5.

Upper Stoneville - Continued

An excellent job of brush and tree removal, on the earth dam and downstream of it, has recently been completed. The small leak about 50 feet east of the control pipe outlet appears to have diminished greatly. The area is still wet but no flow was discernible. The riprap has been displaced on an area about 10 feet long and 5 feet high just east of the auxiliary spillway. It is recommended that riprap be replaced in this area.

Dark Brook

This dam consists of an earth dike about 700 feet long and 18 feet high, with a concrete spillway consisting of a 13 foot pin board section, 3 feet high, and a sluice gate 3 feet wide with its sill 7.5 feet below normal pond. There is a 20 inch control pipe at about the center of the dam. Dark Brook was constructed in 1950. The project also included two small dikes across low passes to the west. High water occurring in 1955 reached an elevation of 612.5 or one foot above normal pond.

The dam and dikes were found to be in satisfactory condition with no wet spots observed below the fill. The spillway concrete is in good condition. Cracks and offsets due to movement of portions of the spillway channel walls were repaired in 1961 by the addition of steel struts between the spillway channel walls, and the installation of weep holes in the walls. The cracks were patched except for an offset and crack at the joint adjacent to the south side of the highway bridge slab in the west wall. The offset at this point was measured in April, 1961, and noted as 5/8 inch. It is still 5/8 inch indicating that the movement of the walls has been arrested. The question was raised as to whether

Dark Brook - Continued

a chain link fence should be installed on either side of the spillway channel to keep children off the steel struts, and this should be considered. See Pictures Nos. 56458 and 56459, Page 6A, for detail of this area. Picture No. 56460, Page 6A, shows a general view of the upstream face of the dam.

Cracks were noted on both spillway channel walls downstream of the highway bridge, where the walls meet the bridge abutments. These are minor and require no repair at this time.

Leesville Dam

Leesville Dam is owned by the Worcester Rendering Company. It has a stone masonry stepped spillway with a concrete crest about 70 feet long. There are two sluice gates in a concrete structure at the north end of the dam. Extensive repairs were made to the dam following flood damage suffered in 1955. These consisted of lengthening the structure at both ends and adding riprap to some of the slopes. The dam is in good condition at present.

It has been the policy of the Rendering Company to keep the pond full, and they have been uncooperative in the matter of drawing the pond to provide us with quick water during dry periods.

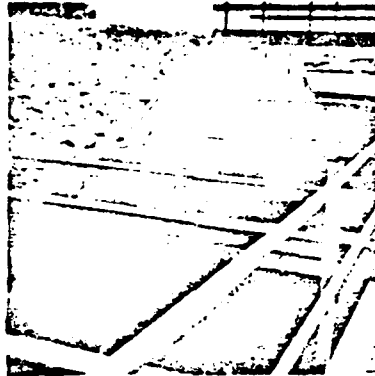
Ramshorn Pond

This dam was built over 120 years ago to supply water for the Blackstone Canal. It was rebuilt and raised in 1872. The dam consisted of sheeting along its center and a sluiced core fill. About 55 years ago the spillway was rebuilt with a substantial cutoff near the center line of the dam. In 1937 the highway bridge over the spillway channel was rebuilt and raised 2 feet. In 1939, following the 1938

MASSACHUSETTS ELECTRIC COMPANY
Worcester Area

- 6A -

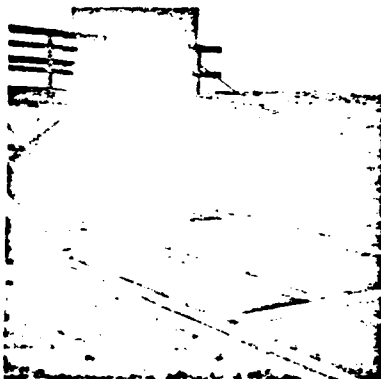
Dark Brook Reservoir



#56458 11-17-64
Dark Brook

Picture No. 56458

Spillway Looking Upstream



#56459 11-17-64
Dark Brook

Picture No. 56459

Spillway Channel Wall



#56460 11-17-64
Dark Brook

Picture No. 56460

Upstream Face of
Dam and Spillway

-SRC-

MEMORANDUM

R. L. Noble

Hopedale

23 April 1976

D. R. Campbell

Westborough

FILE

ECT MASSACHUSETTS ELECTRIC COMPANY -- INSPECTION OF STORAGE DAMS

An inspection of the storage dams in the Worcester area, under the jurisdiction of the Massachusetts Electric Company, was made on 10 March 1976 by D. R. Campbell and D. E. Nichols of NEPSCO and Paul Marshall of Massachusetts Electric. A separate inspection report for Ramshorn Pond Dam was issued on 31 March 1976. Inspection notes and recommendations for the remaining dams are as follows:

Curtis Pond

This dam consists of a granite masonry spillway section, 75 feet long and 7 feet high, with concrete abutments and a non-overflow dike to the north, about 180 feet long with a concrete wall along its upstream face. The spillway formerly carried 14 inches of flashboards which were supported by vertical steel posts which also support a walkway across the spillway. The crest elevation is 470.5 and the pond elevation is limited to 474.0 before overflowing the former coal yard. Maximum high water occurred in 1936 to elevation 478.0 and in 1955 to elevation 478.25.

The masonry appeared sound with no loose blocks and there was no indication of leakage through the dam. The vertical members supporting the walkway are badly eroded and are no longer able to support flashboards. In two or three bays flashboards are jammed up against these posts. These should be removed and in the future no flashboards should be carried on the dam. Trash and debris collected against the crest and against these boards should be removed. There is no need to repair the vertical members since flashboards are no longer needed, and the walkway can be abandoned when failure is imminent since access to both sides of it is available by other means. The condition of the non-overflow dike and concrete upstream wall was satisfactory.

Picture No. #62215 shows this dam looking downstream and picture No. #66216 gives a view looking upstream.

Lower Stoneville

The original dam at this site was supposed to have been a timber crib. The present dam is a concrete gravity structure. The apron below the dam is a concrete slab about 12 inches thick poured over a double layer of stone slabs. The spillway is about 100 feet long with two 2'-6" x 3'-0" sluices located about 45 feet from the south end. The gate stems extend through a block of concrete the top of which is about two feet above the crest, which divides the spillway into two sections. Immediately downstream of the dam are the old abutments of the original highway bridge, which have a clear opening of about 35 feet. No flashboards are carried. The highway fill acts as a dike on both sides of the

The trees and brush should be removed from the upstream side of the embankment. The leak about 50 feet east of the control pipe outlet appears unchanged since 1964, but another wet area to the east of it was noted. This may be due to snow melt or flow from the leak noted above but it should be checked again under drier conditions when there is no snow cover.

Picture No. #66220 was taken looking into the gate house area and Picture No. #66221 shows the damp spots downstream of the dam.

Dark Brook

This dam consists of an earth dike about 700 feet long and 18 feet high, with a concrete spillway consisting of a 13 foot pin board section, 3 feet high, and a sluice gate, 3 feet wide, with its sill 7.5 feet below normal pond level. There is a 20 inch control pipe at about the center of the dam. Dark Brook Dam was constructed in 1950. The project also includes two small dikes across low passes to the west. High water occurring in 1955 reached an elevation of 612.5 or one foot above normal pond level.

The earth dam appeared in satisfactory condition. Some dampness was noted below the fill but this was probably due to snow melt. The repairs to the spillway channel walls made in 1961, and the steel struts installed at that time were in good condition and have arrested the movement of the walls. A large amount of debris has collected in and below the spillway channel and should be removed. The bottom board and the vertical members of the 3 foot wide timber sluice gate are badly eroded and the gate should be repaired.

Picture No. #66222 shows the spillway and sluice area looking downstream.

Ramshorn Meadow

Ramshorn Meadow Dam is a very low concrete structure, built about 1920, containing a single sluice and gate. This dam is usually filled in the fall or early winter and drained out in the spring. Water is not stored behind this dam in the summer.

The concrete was in satisfactory condition and the gate was rebuilt in 1960. Water was finding its way around the dam but no use is being made of it and no damage would occur even if the dam failed.

Picture No. #66223 shows this structure.

WORCESTER COUNTY ELECTRIC COMPANY

Worcester, Massachusetts

SPECIFICATIONS

for

DAM AND CONTROL WORKS ON DARK BROOK

Auburn, Massachusetts

May 9, 1950

New England Power Service Company

Engineers

Boston, Massachusetts

TOWN Andover DAM NO. 07-09

LOCATION Danvers River STREAM

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by _____ Place _____ Use _____

Inspected by Reynolds Date _____

Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place 30" board Recent Repairs _____

Condition Level 18" above crest

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs 11. Gate closed. Gate will be open

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: 28 March 1969

County Engineer

OWN Auburn DAM NO. 03-09.1
LOCATION West St STREAM Dark Brook

"Partridge Pond"
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mass Electric Co Place Worcester Use Storage Reservoir
Inspected by WOL Date Nov. 4, 1963
Type of Dam Natural Pond Condition No damage

P I L L W A Y

Dashboards in Place _____ Recent Repairs _____
Condition Flowage is now part of Flowage from dam 03-09
Repairs Needed - A channel has been excavated through old RR embankment for back flowage and drainage of this old pond.

B A N K M E N T

Recent Repairs _____
Condition _____
Repairs Needed _____

F E S

Recent Repairs _____
Condition _____
Repairs Needed _____

W A K E

Is Serious _____

By: _____ County Engineer

TOWN Auburn DAM NO. 0309
LOCATION Leicester St. STREAM Dark Brook

"Dark Brook Reservoir."

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mass. Electric Co Place Worcester Use Storage Reservoir
Inspected by WOL Date Nov. 4, 1963
Type of Dam Earth - Concrete Condition Good condition

SPILLWAY

Flashboards in Place 506" height boards Recent Repairs 1961
Condition Good condition. Repairs in 1961 to downstream concrete
Repairs Needed abutment walls. Back of walls were excavated and backfilled
with gravel. Weep holes installed. Steel braces installed between walls.

EMBANKMENT

Recent Repairs Brush recently cut
Condition Good condition
Repairs Needed (Repairs above were done by NEP Service Co.)
(Dikes at 09A & 09B are in good condition)

GATES

Recent Repairs _____
Condition Good condition. Gate in spillway section is open - small flow
Repairs Needed at present time. - Water level is at crest of gate.

LEAKS

How Serious Slight leak ^{near} at outlet pipe from gate near center of dam.

DATE: _____ County Engineer

TOWN Auburn DAM NO. 03-09
LOCATION Leicester St STREAM Dark Brook

"Dark Brook Reservoir."
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mass Electric Co. Place Worcester Use Storage Pond
Inspected by WOL - GJC Date Sept 24, 1963
Type of Dam Earth and Concrete Condition Good condition

SPILLWAY

Flashboards in Place 3' of boards Recent Repairs _____
Condition Water level is 3' below crest or 6' below top of boards -
Repairs Needed water level can be drawn down at spillway gate only
1' more - then water will have to be drawn by use of gate in center of dam.

EMBANKMENT

Recent Repairs _____
Condition Good condition
Repairs Needed _____

GATES

Recent Repairs _____
Condition Good condition
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Auburn DAM NO. 03-09
LOCATION Leicester St STREAM Dark Brook

"Dark Brook Reservoir"
WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Mass. Electric Co Place Worcester Use Storage Pond
Inspected by WOL, JOT, GIC Date June 17, 1963
Type of Dam Earth - Concrete Condition Good condition

SPILLWAY

Flashboards in Place 3' of boards Recent Repairs _____
Condition Good condition - present water level is 15" below top of boards
Repairs Needed that brace constructed between downstream abutment
walls in 1962.

EMBANKMENT

Recent Repairs _____
Condition Good condition
Repairs Needed Some small brush on embankment

GATES

Recent Repairs _____
Condition Good condition
Repairs Needed _____

LEAKS

How Serious No leaks are visible

DATE: _____ County Engineer

TOWN Auburn DAM NO. 03-09
LOCATION Laicester St STREAM Dark Brook

"Dark Brook Reservoir"

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by Worce. County Electric Co Place Worcester Use Storage Reservoir

Inspected by WOL Date June 15, 1961

Type of Dam Earth - Concrete Condition Repairs to spillway

SPILLWAY

Flashboards in Place Yes Recent Repairs _____

Condition Downstream retaining walls to be repaired by Marcis Bros Inc,

Repairs Needed - back of walls to be excavated and replaced with gravel.

- weep holes to be installed - steel I Beam braces to be installed between walls.

EMBANKMENT

Recent Repairs (Mr. Lencioni - Maintenance Supt for New England

Condition Power Service Co is on job.)

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Asbury DAM NO. 03-09
LOCATION Dark Brook Rd STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by N. E. Elec. Co. Boston Place Boston Use _____
Inspected by _____ Date March 30, 1959
Type of Dam _____ Condition _____

SPILLWAY

Flashboards in Place _____ Recent Repairs _____
Condition _____
Repairs Needed _____

EMBANKMENT

Recent Repairs _____
Condition _____
Repairs Needed call Doug Hayle Green Eng. Associates
abt clay fill be used on Embankment

GATES

Recent Repairs _____
Condition _____
Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ County Engineer

TOWN Auburn DAM NO: 03-29

LOCATION Dark Brook Res STREAM Dark Brook

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

D A M I N S P E C T I O N R E P O R T

Owned by N.E. Elec Co. Place Boston Use _____

Inspected by L.O. M. Date 3-30-59

Type of Dam _____ Condition Placing clay fill

Call Green Eng Associates on embankment.
Talked with Doug Hyle re clay fill " " " "

SPILLWAY

Flashboards in Place _____ Recent Repairs _____

Condition _____

Repairs Needed _____

EMBANKMENT

Recent Repairs _____

Condition _____

Repairs Needed _____

GATES

Recent Repairs _____

Condition _____

Repairs Needed _____

LEAKS

How Serious _____

DATE: _____ L.O. Marden County Engineer

TOWN Auburn

DAM NO. 03-07⁰⁹

LOCATION Dark Brook Rd

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Worce. Co. PCCC Co PLACE Worcester USE Storage

INSPECTED BY Lom DATE 1-30-57

TYPE OF DAM Earthemb- clay core CONDITION _____

SPILLWAY

FLASHBOARDS IN PLACE yes RECENT REPAIRS None

CONDITION OK

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS None

CONDITION OK

REPAIRS NEEDED None

GATES

RECENT REPAIRS None

CONDITION OK

REPAIRS NEEDED None

LEAKS

HOW SERIOUS _____

DATE 1-30-57

Leo Marden

COUNTY ENGINEER

TOWN Andover

DAM NO. 03-09

LOCATION Dark Brook Reservoir

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Worc. Co. Elec. Co. PLACE Worcester USE Storage

INSPECTED BY LOM. Ed. Higgins DATE 1956

TYPE OF DAM Earth embankment CONDITION Good

SPILLWAY

FLASHBOARDS IN PLACE Yes RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

EMBANKMENT

RECENT REPAIRS None

CONDITION Good

REPAIRS NEEDED None

GATES

RECENT REPAIRS None

CONDITION good

REPAIRS NEEDED None

LEAKS

HOW SERIOUS None visible

DATE _____

P. O. Marden
COUNTY ENGINEER

TOWN AndoverDAM NO. 0309LOCATION Dark Brook Dam

STREAM _____

WORCESTER COUNTY ENGINEERING DEPARTMENT
WORCESTER, MASSACHUSETTS

DAM INSPECTION REPORT

OWNED BY Worce. County Elec Co PLACE Worcester USE _____INSPECTED BY L.S.M. Norberg - Esley DATE July 12, 1951TYPE OF DAM Earth - H. Nelson - Morley - Norberg CONDITION Under constructionSPILLWAY

FLASHBOARDS IN PLACE _____

CONDITION _____

REPAIRS NEEDED _____

RECENT REPAIRS

LOM - Morley - " July 21, 1950
Aug 9, 1950
LOM - Norberg - Baker Sept. 12, 1950 - dikeEMBANKMENT

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

GATES

RECENT REPAIRS _____

CONDITION _____

REPAIRS NEEDED _____

LEAKS

HOW SERIOUS _____

DATE _____

COUNTY ENGINEER

TOWN OR CITY		AUBURN		DEGREE NO.		PLAN NO.		DAM NO. 02-09	
LOCATION		Lexington St. - Dark Brook Reservoir		C. C. DOCKET NO.		DESCRIPTION OF RESERVOIR & WATERSHED			
Type <i>Earth embankment</i>				Name of Main Stream <i>Dark Brook</i>					
Length <i>229 ft</i>				" " any other Streams					
Height <i>17'</i>				Length of Watershed					
Thickness top <i>15'</i>				Width "					
" bottom <i>117'</i>				Is Watershed Cultivated					
Downstream Slope <i>2 1/2 : 1</i>				Percent in Forest					
Upstream " <i>3 : 1</i>				Steepness of Slope					
Length of Spillway <i>14' 6"</i>				Kind of Soil					
Size of Gates <i>20" x 12" Cast Iron Rye</i>				No. of Acres in Watershed <i>249 5/8 M</i>					
Location of Gates <i>Sta. 4+12 on dam</i>				" " " Reservoir					
Flashboards used				Length of Reservoir					
Width Flashboards or Gates				Width "					
Dam designed by <i>New England Power</i>				Max Flow Cu. Ft. per Sec.					
" constructed by <i>Morris Bros.</i>				Head or Flashboards-Low Water					
Year constructed <i>1961</i>				" " " High "					
GENERAL REMARKS				GENERAL REMARKS					
Owned by <i>The Worcester Co. Elec. Co.</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
Inspected: <i>July 18, 1950 - LAN - Norbury</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
" <i>" 21 " " Norbury</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
" <i>Aug 9 " " Norbury</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
" <i>" 29 " " Norbury</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
" <i>Sept. 12 " " Norbury</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					
" <i>June 15, 1961 - W.O.L.</i>				Inspected: <i>Sept. 15, 1954 - LAN</i>					

116
MEMORANDUM

TO H. P. LeCount
FROM D.R. Campbell, L.D. Pierce
SUBJECT MASSACHUSETTS ELECTRIC COMPANY

April 28, 1961

FILE

Inspection of Dark Brook Spillway
Channel walls

On April 21, 1961, the undersigned inspected the Dark Brook spillway channel at the request of S.F. Perkins, Superintendent of Production. We were accompanied by Mr. V.A. Lucander, Ass't. to the Superintendent, and Mr. Cariani.

Offsets and cracking due to movement of portions of the walls were noted in four locations adjacent to vertical keyed construction joints, where the concrete on one side of the joint is supported by strut action across the channel, but the concrete on the other side of the joint cantilevers up from the base slab.

These cracks and offsets occur near the top of both sidewalls at the first vertical joint downstream of the spillway bridge slab, and at the joint adjacent to the south side of the highway bridge slab. Offsets were as follows, as compared to when first observed on August 20, 1959.

	<u>Aug. 20, 1959</u>	<u>April 21, 1961</u>
West Channel Wall	1/4"	1/2"
East Channel Wall	1/8"	1/4"
West Wall at Bridge	not noted	5/8"
East Wall at Bridge	3/4"	2"

An examination should be made during a period when there is no flow through the channel to check the condition of the floor slab and the bottom of the walls, after which we recommend that a study and estimate be made of the best method of strengthening the walls against further deflection.

DRC:mj

Cc: S.F. Perkins - Worc. (2)
O.E. Sawyer
E.F. Walsh

D.R. Campbell
L.D. Pierce

These Specifications govern the construction of a rolled earth fill dam and appurtenant structures on the stream known as DARK BROOK in the Town of Auburn, Worcester County, Massachusetts, at a location on the south side of Leicester Street, west of Oxford Street.

The owner is the WORCESTER COUNTY ELECTRIC COMPANY,
11 Foster Street, Worcester, Massachusetts.

The Engineers are the NEW ENGLAND POWER SERVICE COMPANY,
441 Stuart Street, Boston, Massachusetts.

Before work is commenced, the Contractor shall give notification to the Worcester Commissioners as to when construction will start.

All work to be done on this project shall be subject to inspection and approval by the Worcester County Engineer.

SCOPE OF WORK

This project consists essentially of an earth embankment dam for the storage of water. The dam has an approximate total length of 800 feet and a maximum height of about 18 feet, and is provided with a concrete spillway channel extending under Leicester Street. For regulating the flow of water, there is a 20 inch pipe through the dam and extending under Leicester Street, with appurtenant intake, gate house, and downstream head wall structures. At low points on the basin periphery, there are two small earth dikes designated on the plans as Dike A and Dike B.

The plan and construction details of this dam are shown on the following drawings of the New England Power Service Company

H-11186 - General Plan
H-11187 - Discharge Conduit
H-11188 - Gate Well Details
H-11189 - Spillway Channel
H-11190 - Spillway Details
H-11191 - Highway Bridge
H-11192 - Gate Hoist Details
H-11327 - Dikes "A" and "B"

SPECIFICATIONS

Materials

Concrete

All concrete in the structures included in this project shall be in accordance with the New England Power Service Company's Specification "B" for Ready-Mixed Concrete, Revised to December 1, 1948. The proportioning of the concrete shall be the same as given for concrete in "Floor and Roof Slabs" on page 2 of the above specifications, which calls for a minimum strength of 3,000 lbs. per sq. in. in 28 days. A copy of Specification "B" is included elsewhere in these specifications.

Reinforcing

Reinforcing shall be new billet intermediate grade steel deformed reinforcing rods. Rods must be free from rust, mill scale or any other coating that would reduce the bond of the concrete to the steel surface.

Reinforced Concrete Pipe

21" reinforced concrete pipe as supplied by the owner shall be made of portland cement, sand and stone aggregate, reinforced with steel wire mesh or rods, conforming to A.S.T.M. Specifications C76-41 for reinforced concrete culvert pipe.

The ends of the pipe sections shall be of the bell and spigot type, of such design that the pipe when laid shall have a smooth and uniform interior surface.

Cast Iron Pipe

20" Cast Iron Pipe as supplied by the owner shall be bell and spigot type, and shall conform to the American Water Works Association Specifications for Class A Cast Iron Water Pipe.

Timber

Timber for the spillway gate, sills and railings shall be

select structural grade Southern Yellow Pine creosoted with A.W.P.A. grade one creosote oil by the empty cell pressure process with a retention of 8 lbs. of oil per cubic foot.

Methods of Construction

The work shall be done in accordance with the drawings listed under scope of work which show the details of all structures.

Further conditions not covered on the drawings, but which also govern the work, are given below.

CLEARING

The Contractor shall clear all trees, brush, buildings, fences and rubbish within the limits of the dam site, spillway channel, discharge pipe, dikes A and B, borrow areas and access roads. All trees, brush and rubbish not otherwise satisfactorily disposed of shall be burned.

GRUBBING

The Contractor shall remove all stumps and roots completely to a depth of two feet and shall remove other vegetable matter to a depth of six inches below the original ground surface in the areas within the limits of the main dam, dikes A and B, and borrow areas. All stumps, roots and rubbish obtained by grubbing operations shall be burned completely or otherwise satisfactorily disposed of.

STRIPPING

Before the general excavation of the core trench is begun the contractor shall remove to the extent ordered and shall satisfactorily dispose of all peat, moss, muck, stones in the pockets and top soil to the depths directed from the areas to be covered by the embankments of the dam.

The contractor may store and use selected top soils of

satisfactory quality from the areas required to be stripped as soil dressing for the embankments of the main dam and dikes. Holes left by grubbing or stripping operations in the dam and dike areas shall be filled with suitable, compacted material.

EXCAVATION

The contractor shall excavate all areas for the spillway channel, regulating pipe including appurtenant structures, and also the main cutoff trench true to the lines and grades as shown on the plans of these structures.

DISCHARGE CONDUIT AND GATE WELL

The trench for the discharge conduit under the dam shall be excavated as closely as possible to the grade of the bottom of the pipe, in order to have the pipe rest on firm material.

The discharge pipe and its gate well, must be in place before the dam fill is placed, and the pipe must be set true to the grades shown on the drawings, and so supported that those grades will not be altered by the compacting of the earth above. Any blocking under the pipe shall be temporary wood blocks, so placed that the dam material may be thoroughly compacted around the entire surface of the pipe.

The two 8 foot square concrete cut-off walls upstream from the gate well are to prevent passage of water along the pipe, so they shall be poured with the pipe in place. The backfill on all sides of the cutoff walls shall be placed to approximately the same elevation at all times to prevent unequal earth pressures on the walls.

Backfill around the conduit and the gate well shall be of the same material as the dam and placed in the manner described under Dam Construction.

The pipe joints shall be completely caulked with oakum

and poured lead for the cast iron pipe, and with oakum and asphalt caulking compound for the twenty one inch diameter concrete pipe. The 6 foot concrete well pipe shall be laid with cement mortar joints.

SPILLWAY CHANNEL

Due to the length of this structure, it is necessary to have expansion joints in the bottom slab and walls; these are shown on the drawing without dimensions, the exact location is to be determined in the field. The section in the dam must be in place before the compacted earth fill is placed and all backfill around it shall be the same as the dam material and placed in the same way.

The cut-off walls under the slab and back of the walls shall be made monolithic with the slab and walls.

The construction of the section forming the highway bridge shall be planned to cause as little inconvenience to traffic as possible. During this construction, traffic will be temporarily detoured over the open ground at the side of the site. The bridge slab shall not be subjected to external loads in less than ten days after the concrete is placed. If a shorter time interval is necessary, then fresh high-early-strength cement may be used, in which case the slab may be loaded not less than four days after the concrete is placed. The concrete forms and bracing under the floor slab shall not be removed before 28 days after completion of the slab pour. The road material on the bridge slab shall be as specified by Worcester County Commissioners.

GATE HOUSES

The Sluice Gate House is of wood frame construction as shown and described on drawing H-11192, with a high roof to allow for movement of the gate stem.

The Discharge Gate House is of similar construction with 7' headroom inside.

CONCRETE CONSTRUCTION - GENERAL

Concrete shall be deposited as nearly as practicable in its final position using no chutes longer than 8 feet to avoid segregation due to handling. It shall be thoroughly compacted and worked around reinforcement during the operation of placing. All concrete shall be protected to prevent the surface temperature from going below 50°F., and maintained in a moist condition, for at least the first seven days after placing.

Forms shall be properly braced or tied together so as to maintain the position and shape called for on the plans, and shall be sufficiently tight to prevent leakage of mortar. They shall be removed in such a manner as to insure the complete safety of the structure, but removal shall not be made in less than seven days after the concrete is placed, except by special permission of the Engineer.

Reinforcement shall be accurately placed and adequately secured in position.

Before placing new concrete at a construction joint, laitance shall be removed, the surface cleaned of dirt and loose particles, and immediately before the concrete is placed the surface shall be moistened and painted with cement grout.

EMBANKMENT

The contractor shall furnish and transport from approved borrow areas acceptable impervious materials and place, grade and consolidate these materials within the limits shown on the plans in the cut-off trench, the main dam and A and B dikes.

After the cut-off trench shall have been excavated to the line and grade shown on the plan, it shall be refilled to the general level of the surrounding area with material spread in horizontal layers before the main dam embankment is begun. While this refill is in progress standing or running water shall be excluded from the trench by pumping or draining.

The main dam and dike embankments shall be started on a base which shall have been cleared, grubbed as specified and stripped to the extent ordered. If ordered to do so, the contractor shall roll or otherwise compact the natural material within limits of the embankment area of the main dam before any new embankment material is placed.

All material in the cut-off trench, the main dam embankment and in the dikes, shall be deposited and spread in horizontal layers 6 inches thick after compaction. All embankment material in these structures shall be rolled as directed with an approved sheepfoot roller weighted as required, or with a self-propelled, banded three-wheel type of roller weighing not less than 12 tons, the resulting pressure under the rear wheels of which shall not be less than 500 pounds per inch width of wheel. The roller shall pass over every part of each layer that can be traversed by it, and the number of trips required for satisfactory consolidation will be specified by the Engineer as the work progresses. The number of trips will probably be more than six and less than ten.

Materials placed in the embankment unless sufficiently moist for proper compaction as spread shall be wetted to the extent directed. It is expected that the materials in the borrow areas will be sufficiently moist so that no wetting will be required. If, however, the material as it comes from the borrow pit is too moist in the opinion of the Engineer the contractor shall drain or otherwise dry out the

material in the borrow pit or shift his operations to a location where the moisture content is satisfactory.

All stones having a maximum dimension in excess of six inches shall be excluded from the finished embankment of the main dam, and the dikes. If stones with a maximum dimension in excess of six inches are dumped on the embankment during the progress of the work, they shall be removed before the layer in which they are dumped is rolled or compacted. No nests of stones or gravel of any size shall be permitted in the embankments.

Material placed around the spillway channel walls and the cast iron control pipe with its appurtenant structures which cannot be reached with the roller shall be placed in three-inch layers and tamped with compressed air plunger type or manually-operated tampers. This hand tamping shall continue until material is compacted to the satisfaction of the Engineer.

No work shall be done on the placing of rolled earth fill or embankment between November 15 and April 15, or at other times or periods when in the opinion of the Engineer the weather is such as to interfere with proper construction. No frozen material shall be used in the construction of rolled earth fills nor shall materials be dumped upon foundations or fills which contain frost.

Stones culled from the earth embankment fill, which are not in excess of eighteen inches thick, may be used in the riprap specified for the upstream side of the embankment.

STONE RIP RAP

The contractor shall furnish all materials, equipment and labor required to construct the stone riprap protection eighteen inches thick on the upstream side of the main dam and dikes A and B as shown on the plans. The riprap shall be composed of durable stones

of acceptable sizes. No stones shall be in excess of eighteen inches thick. For any volume of 10 cubic yards at least 20 percent shall be larger than one-half a cubic foot, 50 percent shall be larger than one-quarter cubic foot, and 90 percent larger than a one-inch ring size.

SOIL DRESSING

The contractor shall dress the portion of the upstream slope above the riprap, all of the top and all of the downstream slope of the main dam and dikes A and B with suitable top soil 5 inches thick.

Acceptable materials from the stripping operations may be used for soil dressing or the contractor may borrow suitable materials from approved areas upstream from the dam site. The contractor will not be required to procure top soil from beyond the limits of land furnished by the Worcester County Electric Company.

Soil dressing shall not be deposited until the embankment on which it is to be placed has been properly compacted and trimmed true to line and grade. The surface upon which soil dressing is to be placed shall be raked or otherwise satisfactorily treated to insure a proper bond between the two types of material. After placing, the soil dressing shall be trimmed true to line and grade and then lightly rolled or tamped.

FERTILIZING AND SEEDING

The entire soil-dressed area shall be treated with an approved commercial fertilizer containing 4 parts nitrogen, 8 parts phosphoric acid and 4 parts potash applied at the rate of 1,000 pounds to the acre. The fertilizer shall be uniformly applied and raked into the top-soil.

This entire area shall next be seeded with first quality grass seed of an approved mixture at the rate of 60 pounds of grass seed per acre. If the seed planting is done between the first of June

and the middle of September about 15 pounds of oats per acre seeded shall be added to the mixture.

The seed shall be carefully raked in and the whole surface then lightly rolled. The contractor shall take advantage of favorable weather and shall employ a method of sowing satisfactory to the Engineer.

If before the work is finally accepted, any top soil is washed away or any of the seeded areas are not covered with grass, the contractor shall replace the top soil, refertilize and reseed without additional compensation.

New England Power Service Company
Office of Engineer of Structures

May 9, 1950

NEW ENGLAND POWER SERVICE COMPANY - ENGINEERS

SPECIFICATION "B"

READY-MIXED CONCRETE

CEMENT

Only a standard brand of Portland Cement approved by the Engineer shall be used. It shall conform to the requirements of the standard specifications for Portland Cement as adopted by the American Society for Testing Materials.

WATERPROOFING

Since the mix and slumps specified below have produced for us waterproof structures without the use of any special cements or other admixtures, their use for the purpose of waterproofing is not required.

ACCELERATION

In case it may be necessary to strip forms or place the concrete under load at an earlier date than the use of standard cements permits, then Incor or an equivalent cement may be used in the concrete mix. No other admixture than the above or its equivalent shall be used for this or any other purpose without the approval of the Engineer. If Incor or its equivalent is used, stripping of forms or loading the structure may take place not before but any time after 48-hours. for the period between May 1st. and October 1st. Without the use of such materials, forms may not be stripped or concrete loaded in less than 96-hours.

COARSE AGGREGATE

The coarse aggregate shall all pass a $1\frac{1}{2}$ ", 1", $\frac{3}{4}$ ", or $\frac{1}{2}$ " screen (as noted under Proportioning) and all shall be retained on $\frac{1}{4}$ " screen. The gradation shall be uniform between these limits. Coarse aggregates shall pass the sodium sulphate soundness test and shall not contain more than 2% of soft or otherwise deleterious material.

Specifications for Ready-Mixed Concrete (Continued)

SAND

Sand shall all pass a #4 sieve and not less than 92% shall be retained on a 100-mesh sieve, and as to gradation shall be the best available on the market. It shall satisfactorily pass the sodium sulphate soundness test, and shall not contain more than 2% of soft or deleterious material. The sand shall show a mortar strength ratio of at least 90%. In the standard colorimetric test for organic matter, the sand shall show a color not greater than plate 1½.

WATER

In case water other than that supplied by a municipal water supply is used in mixing concrete, it shall be subject to the test and approval of the Engineer.

MIXING

Concrete shall be proportioned at the plant and mixed in transit, and thoroughly.

PROPORTIONING

The following tabulation gives the general criteria for determining the proportioning of concrete according to its use or location. In general, where actual designed mixes indicate a disparity between the water/cement ratio, and slump, slump shall prevail. In any event, proportions shall be such as to provide a workable concrete.

Location of Use of Concrete	Bags of Cement per Cubic Yard of Concrete to be	Total Water per Bag of Cement	Slump Inches	Maximum Size of Aggregate	Minimum Strength in 28 days Pounds per sq.in.	Approximate Mix Volumes
	Not less than	Not more than	Not more than	Not more than		
Pile Caps and Floor Fill	4½	6 gallons	4"	1½"	2,000	1 - 3 - 5
Duct Line Outdoors	4½	6 "	2"	½"	2,500	1 - 3 - 5
Column Footings and Outdoor Foundation Slabs	5	6 "	4"	1½"	2,500	1 - 2½ - 4½
Foundation walls - and Manholes (Floors & walls)	5½	5 "	4"	1½"	2,600	1 - 2½ - 4
Cell walls - Conduit Casing or Envelopes	5½	6 "	6"	½"	2,600	1 - 2½ - 4
Floor & Roof Slabs & Manhole Roof Slabs	6	5 "	4"	1"	3,000	1 - 2 - 3½

Specifications for Ready-Mixed Concrete (Continued)

TESTS

Records of all tests that the vendor may have or may make regarding any or all ingredients and concrete shall not only be available to our Field Engineer but copies shall be furnished upon request

GENERAL

The Vendor's plant equipment and procedure shall be subject to the approval of the Engineer.

COLD WEATHER

In case the air temperature falls below 40° F. during the period of delivery, concrete shall be delivered at a temperature in excess of 70°.

INSPECTION

All concrete shall be proportioned and mixed subject to the inspection of our Field Engineer.

JOINTS

Special care shall be taken so that walls are poured only upon thoroughly cleaned surfaces. Without such care, leaky joints at floor level are probable.

ORDERING CONCRETE

When ordering from the concrete plant, the "location of use of concrete" shall be carefully specified so that the correct mix will be shipped.

SHIPMENT

Delivery of concrete in unit amount in excess of the rated capacity of the mixer shall be cause of rejection of that shipment.

MAY 12, 1939
REVISED FEBRUARY 20, 1940
REVISED MAY 15, 1941
REVISED JULY 11, 1946
REVISED OCT. 11, 1948

B-43

New England Power Service Co.
Boston, Mass.

Analysis of Soils
Cedar Swamp Dam
Worcester, Mass.

Test Number	H 873 A-I
Date Received	4-16-48
Source	Delivered by E.P. Moseley
Samples	Nine samples of soil, each approximately 10 lbs. in size from specific locations described below.
Test Procedure	Mechanical analysis for gradation and soil constants in conformity with Standard ASTM and USBPR procedures.
Results	The following data have been obtained:

AD-R154 491

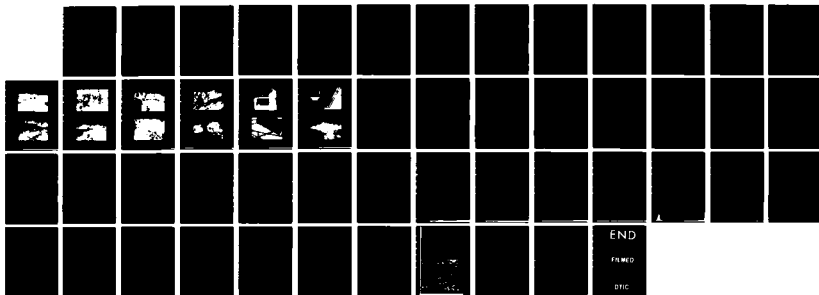
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
DARK BROOK RESERVOIR. (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV JUL 88

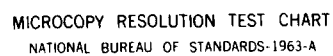
2/2

UNCLASSIFIED

F/G 13/13

NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

N.E. Power Service

-2-

May 6, 1948

Identification of Samples

<u>Test Number</u>	<u>Mark</u>	
H873-A	#1	East 6' deep
B	2	East 2' deep
C	3	West 5' deep
D	6	-
E	7	-
F	10	6' down. 30' W of stone wall of E. prop. line of Busha. 60' N of Leicester St. Drove rod to 11' below surface, seepage about 2' below surface, about one foot of top soil at holes 10, 11, 12.
G	11	70' W of Busha, E. Wall 6' below surface, 60' S of tel. pole 1707 Trickle of water boiled up in bottom while hole was being dug. Ground water at 7' Drove rod to -8' when stopped by stone More honey than #10 or #12.
H	12	70' SW Tel. pole 1706 5' down, 80' SE Tower 530 Considerable seepage begins 2.5' below surface. Drove rod to 11' below surface; still driving easy at 11 ft.
I	13	Hole #10 Sample taken at 5' 6" Water seeping in from 1' to bottom of hole

N.E. Power Service Co. -3-

May 6, 1948

Gradation

Sieve Size	Percent Passing By Weight								Y
	A	B	C	D	E	F	G	H	I
2"	100	100	100	100	100	100	100	100	100
1 1/2"	100	100	93	100	100	100	100	100	98
1-1/4"	95	100	89	100	100	92	100	100	98
1"	95	100	89	100	100	92	96	100	96
3/4"	90	97	83	94	97	92	93	97	93
1/2"	86	93	82	92	91	89	88	96	89
3/8"	83	91	78	89	85	87	86	94	86
1/4"	79	84	75	85	81	84	83	92	81
# 4	77	81	73	82	78	82	81	89	79
10	69	74	65	74	69	76	78	84	73
20	63	70	58	66	62	69	72	76	68
40	59	67	50	59	55	62	66	69	66
60	53	60	42	53	48	53	59	63	60
80	48	56	35	48	43	48	53	57	54
100	43	52	30	45	39	42	49	53	49
140	37	48	24	40	34	36	43	48	44
200	30	42	20	34	28	28	36	40	32
	✓	✓	✓	✓	✓	✓		✓	✓

Analysis By Weight

Gravel	21	16	25	15	19	16	17	8	19
Sand	49	42	55	51	53	56	47	52	49
Silt	24	38	17	28	24	26	28	31	28
Clay	6	4	3	6	4	2	8	9	4

N.E. Power Service

-4-

May 6, 1948

Sample IHydrometer Analysis

<u>Grain Size (Microns)</u>	<u>Percent Smaller Than Size Shown</u>
38	19
28	13
18	9
11	6
7	5
5	4
3	3
1	1

Permeability Test (Sub 1/4" Material)

<u>Permeability Coefficient</u>	<u>Void Ratio</u>
3.40×10^{-4} cm/sec	0.90
1.56×10^{-4} "	0.54

Compaction Test (On Sub 1/4" Material)

<u>Moisture Content</u>	<u>Moist Density</u>	<u>Dry Density</u>
0%	-	114.0 lbs/c.f.
4%	122.1	117.4 " *
6%	122.1	115.2 " "

*Optimum density

Certified Correct,

THE THOMPSON & LIGHTNER CO., INC.

cc 3

Benjamin Lekesky

B-47

WORCESTER ELECTRIC LIGHT CO.
CEDAR SWAMP RESERVOIR
DARK BROOK - BLACKSTONE RIVER

Basin-Data

1. D. A. above site, sq. mi.	2.75
2. Storage above site	None

Reservoir Data

1. Elevation, top of dike	617.
2. " , full pond (top of boards)	611.5 ✓
3. Area, full pond, acres	334
4. Capacity above elevation 598, full pond at elev. 611.5, acre-feet	3020
5. " " " " " " " " " " , in. on 2.75sq.mi.	20.6
6. " " " " , at elev. 608.5, inches on 2.75 sq. mi.	14.2
7. " " " " , full pond (for one inch rise)	2.28

Spillway Data

1. 1-20" Gate valve and pipe, intake invert elevation	597±
Discharge capacity, c.f.s., W.S. at 604.0	20
" " " " " 611.5	30
2. 1-3' horiz. by 7.5' vert. gate, sill elev.	604
Discharge capacity, c.f.s., W.S. at 603.5	80
" " " " " 611.5	150
" " " " " 612.5	195
3. 13' Ogee Spillway, crest elev.	608.5
with 8' boards to elev.	611.5
4 1 1/4 Std. pipe pins, 2.0' ctrs., failure W.S. elev.	612.5
5 1 1/4 " " " 1.75 " " "	612.8
Discharge capacity of 13.5' spillway, c.f.s.	
W.S. elev. 612.5 just before failure	35
" " 612.5 " after "	220
" " 612.8 " before "	255
" " 612.8 " after "	420

Design Storm

	A Harriman '38x1.5	B Priest Brook '38x2
1. Inches precipitation, actual	8.77	9.19
2. " " , used in design	14.45 (1)	18.38
3. " run-off under hydrograph	12.80	17.6
4. " " to max. discharge	9.83	11.3
5. (a) Max. inflow c.f.s.	3575	1373
(b) " " c.s.m.	1300	500
6. (a) Max. discharge c.f.s.	740	807
(b) " " c.s.m.	269	294
7. Max. Pond elev.	613.35	613.7
8. " Tail-water elev.	?	?
9. Total hours precip.	60.0	120
10. " " run-off	97	82
11. Hours run-off to peak of discharge	62.6	39.5

H. W. Nelson

G. N. Bailey

March 23, 1948

CEDAR SWAMP DAM FLOOD HYDROGRAPH

The discharge of Priest Brook at the U.S.G.S. gaging station near Winchendon, Mass., Sept. 20-23, 1938, was taken as a basis of a design inflow hydrograph.

The drainage area is 19.4 sq. mi., whereas that above the Cedar Swamp dam site is only 2.75 sq. mi. For the same volume of run-off from a given area, i.e. for the same inches depth of run-off, the hydrograph of the smaller would be more concentrated; i.e. of shorter duration and more peaked. To adjust for this factor recourse was had to certain principles of hydraulic similitude set forth in the paper "The Unit Hydrograph and Flood Routing" by Gerald T. McCarthy of the U.S. Engineer Office at Providence, R.I. for presentation at the Conference of the North Atlantic Div., U.S. Engr. Dept. at New London, Conn., June 24, 1938. The principles applying to the specific case of Cedar Swamp Dam design inflow hydrograph may be stated as follows:

Let A = the larger drainage area in square miles

a = " smaller " " " " "

Q = " discharge of the larger drainage area, in c.f.s.

q = " " " smaller " " " "

T = time from beginning of any point of the larger hydrograph

t = time from " " " homologous point of the smaller

Then $Q/q = (A/a)$ to the $3/4$ power

$(Q/A) + (q/a) = (A/a)$ to the minus $1/4$ power

$T/t = (A/a)$ to the $1/4$ power.

As presented by Mr. McCarthy the above principles are valid as applied to a unit hydrograph - which implies a constant rate of precipitation; their application to an inflow hydrograph made up of several successive hydrographs, each from a precipitation of different rate, contains a distortion of that validity. It may (and in the case of the whole Priest Brook hydrograph does) exaggerate the increase of concentration with decrease of drainage area, which fact may be demonstrated by the argumentum ad absurdum as follows:

Consider a long series of equal short periods each of equal excess precipitation available for run-off. Application of a given unit hydrograph to this series would produce a combined run-off hydrograph, say with c.f.s. per sq. mi. (c.s.m.) as ordinate and time as abscissa, that would gradually build up to a maximum and stay practically constant until the end of the last precip period. Application to the same series of an homologous unit hydrograph of a smaller drainage area would produce a hydrograph similar to the former, coming to maximum sooner, but equal in maximum ordinate (c.s.m.). This to all practical intent is true to fact. Consider, however, what kind of a hydrograph for the smaller area would result from literal application of McCarthy's ratios: it would be of shorter duration, practically by the one fourth power of the drainage area ratio, and of higher ordinate practically by the one fourth power of the inverse ratio of drainage areas. In other words literal application would exaggerate the concentration.

Theoretically the proper method of adjustment of the larger hydrograph to that of the smaller would develop the unit hydrograph of Priest Brook from the precip and discharge records (the precip observations at Fitzwilliam, N.H., about 7 miles northwest has been considered more or less representative), adjust it to the smaller drainage area by the McCarthy ratios,

and apply the new unit hydrograph to the same precip record: but this was dismissed as too laborious and the following compromise adopted:

The first 21 hours up to 9 P.M., Sept. 20, of the Priest Brook discharge hydrograph (c.s.m.) was not changed either as to time or as to ordinate; but beginning at that point (where the slope of the hydrograph steepened quickly) increment abscissae were multiplied by the one fourth power of the drainage area while the ordinates were divided by the same ratio. Finally the ordinates were all doubled to allow for still greater flood.

The multiplying factors combining in the above to derive Cedar Swamp run-off in c.f.s. from Priest Brook c.s.m. are developed as follows:

1. Drainage area ratio = $2.75 \div 19.4 = 0.142$
2. One fourth power = 0.614
- (3) Time factor = 0.614
- (4) C.f.s. factor (after hour 21) = $2.0 \times 2.75 \div 0.614 = 8.97$

^{1938 Sept. flood}

The run-off of the 154 sq. mi. drainage below Somerset and above Harriman Dam was also used as basis of a design inflow hydrograph of a much more peaked pattern. All ordinates were multiplied by the factor 1.645, which in turn is composed of two factors: a factor of 1.5 to allow for greater storms than experienced, and another factor of 1.097 to reflect the greater precip concentration, which was derived by a method admittedly approximate, but giving values more or less consistent with those already accepted for Mascoma and Goose design hydrographs, as follows:

The design values of inches run-off of Mascoma Lake and of Goose Pond for this ²⁷1938 pattern storm had already been accepted

Mascoma,	153 sq. mi.,	10.44 inches
Goose	15.7 " "	12.02 " "

Plotting the 1927 inches run-off as arithmetic ordinate vs. log abscissa of drainage area for these two points and prolonging the straight line of the two gave 13.2 inches for 2.75 sq. mi. The Goose Pond design run-off hydrograph in c.s.m., was just 1.5x Harriman, 1938. It was taken as roughly consistent to raise the Cedar Swamp factor by the ratio of 13.2 over 12.02 (from above) or 1.097.

Following the same method as with Priest Brook the first 58 hours of Harriman run-off was unchanged in time and the run-off upped only by the factor of 1.645 above. After hour 58 (4 P.M., Sept. 21) when the hydrograph steepened abruptly, the increment time was shortened in the ratio of the one-fourth power of the drainage area, while the c.s.m. ordinate was divided by the one fourth power of the drainage area ratio - besides multiplying by the 1.645 factor.

The multiplying factors combining in the above to derive Cedar Swamp run-off c.f.s. from Harriman inflow in c.s.m. were developed as follows:

1. Drainage area ratio = $2.75 \div 154 = .01785$
2. One fourth power = $.3655$
3. Inches run-off factor = 1.645
4. C.f.s. to hour 58 = $\times 1.645$
5. Time after hour 58 = $\times .3655$ or $+ 2.736$
6. C.f.s. after hour 58 = $2.736 \cdot 2.75 \cdot 1.645 = 12.4$

December 3, 1958

Mr. Edward M. Keith, Supt. of Production
Worcester County Electric Co.
939 Southbridge St.
Worcester 10, Mass.

Dear Ed:

The enclosed memorandum from E.P. Moseley to A.V. Colman dated January 12, 1956, contains the information regarding storage loss in Dark Brook Reservoir due to the Mass. Turnpike, which was requested by Mr. Lutka by telephone, December 2, 1958.

We have estimated the loss to be 233 acre feet, reducing the total from 3010 to 2777 acre feet.

Very truly yours,

NEW ENGLAND POWER SERVICE COMPANY

D. R. Campbell
Engineer

DRC:mj
Enc.

Appendix C
Photographs

OVERVIEW PHOTO

APPENDIX 'C' PHOTOS



LOUIS BERGER & ASSOC., INC. U.S. ARMY ENGINEER DIV. NEW ENGLAND
WELLESLEY, MASS. CORPS OF ENGINEERS
ARCHITECT ENGINEER WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

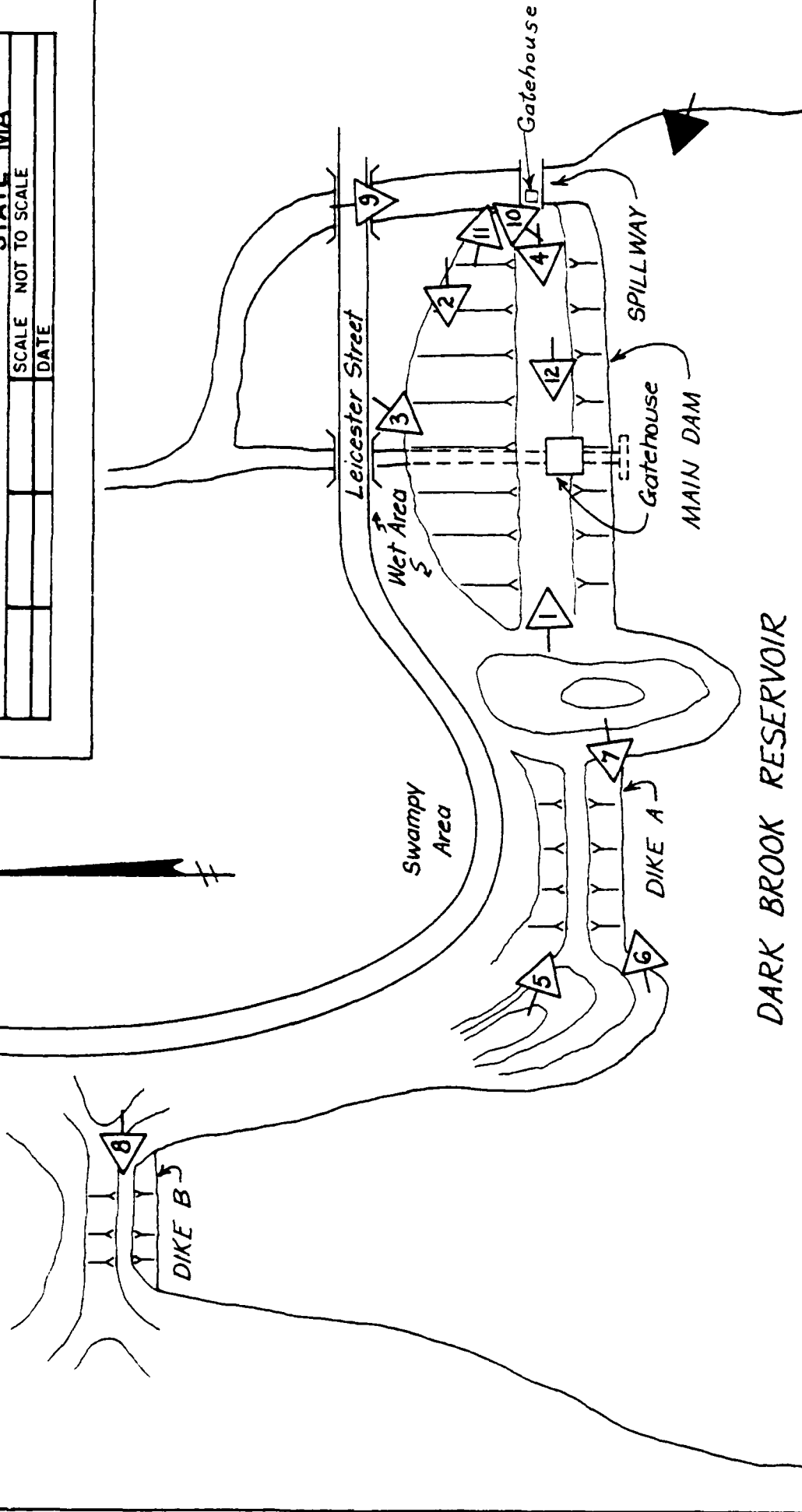
DARK BROOK RESERVOIR DAM

SKETCH PLAN SHOWING LOCATION &
ORIENTATION OF PHOTOS

STATE - MA

SCALE NOT TO SCALE

DATE



DARK BROOK RESERVOIR

CHKD. BY _____ DATE _____

PROJECT N-28

SUBJECT DR. BERNARD L. HARRIS - 100-405622

104756 - 4-114-5 - 8075 (in R117, 1932) - 1913

2011-2012-12-12

[Handwritten notes at bottom of page]

	15.5-16.5 Aw=12.5	15.5-16.5 Aw=13.1	16.5-17.5 Aw=13.5	17.5-18.5 Aw=14.1	18.5-19.5 Aw=14.7	19.5-20.5 Aw=15.3	20.5-21.5 Aw=15.9	21.5-22.5 Aw=16.5	22.5-23.5 Aw=17.1	23.5-24.5 Aw=17.7	24.5-25.5 Aw=18.3	25.5-26.5 Aw=18.9	26.5-27.5 Aw=19.5	27.5-28.5 Aw=20.1	28.5-29.5 Aw=20.7	29.5-30.5 Aw=21.3	30.5-31.5 Aw=21.9	31.5-32.5 Aw=22.5	32.5-33.5 Aw=23.1	33.5-34.5 Aw=23.7	34.5-35.5 Aw=24.3	35.5-36.5 Aw=24.9	36.5-37.5 Aw=25.5	37.5-38.5 Aw=26.1	38.5-39.5 Aw=26.7	39.5-40.5 Aw=27.3	40.5-41.5 Aw=27.9	41.5-42.5 Aw=28.5	42.5-43.5 Aw=29.1	43.5-44.5 Aw=29.7	44.5-45.5 Aw=30.3	45.5-46.5 Aw=30.9	46.5-47.5 Aw=31.5	47.5-48.5 Aw=32.1	48.5-49.5 Aw=32.7	49.5-50.5 Aw=33.3	50.5-51.5 Aw=33.9	51.5-52.5 Aw=34.5	52.5-53.5 Aw=35.1	53.5-54.5 Aw=35.7	54.5-55.5 Aw=36.3	55.5-56.5 Aw=36.9	56.5-57.5 Aw=37.5	57.5-58.5 Aw=38.1	58.5-59.5 Aw=38.7	59.5-60.5 Aw=39.3	60.5-61.5 Aw=39.9	61.5-62.5 Aw=40.5	62.5-63.5 Aw=41.1	63.5-64.5 Aw=41.7	64.5-65.5 Aw=42.3	65.5-66.5 Aw=42.9	66.5-67.5 Aw=43.5	67.5-68.5 Aw=44.1	68.5-69.5 Aw=44.7	69.5-70.5 Aw=45.3	70.5-71.5 Aw=45.9	71.5-72.5 Aw=46.5	72.5-73.5 Aw=47.1	73.5-74.5 Aw=47.7	74.5-75.5 Aw=48.3	75.5-76.5 Aw=48.9	76.5-77.5 Aw=49.5	77.5-78.5 Aw=50.1	78.5-79.5 Aw=50.7	79.5-80.5 Aw=51.3	80.5-81.5 Aw=51.9	81.5-82.5 Aw=52.5	82.5-83.5 Aw=53.1	83.5-84.5 Aw=53.7	84.5-85.5 Aw=54.3	85.5-86.5 Aw=54.9	86.5-87.5 Aw=55.5	87.5-88.5 Aw=56.1	88.5-89.5 Aw=56.7	89.5-90.5 Aw=57.3	90.5-91.5 Aw=57.9	91.5-92.5 Aw=58.5	92.5-93.5 Aw=59.1	93.5-94.5 Aw=59.7	94.5-95.5 Aw=60.3	95.5-96.5 Aw=60.9	96.5-97.5 Aw=61.5	97.5-98.5 Aw=62.1	98.5-99.5 Aw=62.7	99.5-100.5 Aw=63.3	100.5-101.5 Aw=63.9	101.5-102.5 Aw=64.5	102.5-103.5 Aw=65.1	103.5-104.5 Aw=65.7	104.5-105.5 Aw=66.3	105.5-106.5 Aw=66.9	106.5-107.5 Aw=67.5	107.5-108.5 Aw=68.1	108.5-109.5 Aw=68.7	109.5-110.5 Aw=69.3	110.5-111.5 Aw=69.9	111.5-112.5 Aw=70.5	112.5-113.5 Aw=71.1	113.5-114.5 Aw=71.7	114.5-115.5 Aw=72.3	115.5-116.5 Aw=72.9	116.5-117.5 Aw=73.5	117.5-118.5 Aw=74.1	118.5-119.5 Aw=74.7	119.5-120.5 Aw=75.3	120.5-121.5 Aw=75.9	121.5-122.5 Aw=76.5	122.5-123.5 Aw=77.1	123.5-124.5 Aw=77.7	124.5-125.5 Aw=78.3	125.5-126.5 Aw=78.9	126.5-127.5 Aw=79.5	127.5-128.5 Aw=80.1	128.5-129.5 Aw=80.7	129.5-130.5 Aw=81.3	130.5-131.5 Aw=81.9	131.5-132.5 Aw=82.5	132.5-133.5 Aw=83.1	133.5-134.5 Aw=83.7	134.5-135.5 Aw=84.3	135.5-136.5 Aw=84.9	136.5-137.5 Aw=85.5	137.5-138.5 Aw=86.1	138.5-139.5 Aw=86.7	139.5-140.5 Aw=87.3	140.5-141.5 Aw=87.9	141.5-142.5 Aw=88.5	142.5-143.5 Aw=89.1	143.5-144.5 Aw=89.7	144.5-145.5 Aw=90.3	145.5-146.5 Aw=90.9	146.5-147.5 Aw=91.5	147.5-148.5 Aw=92.1	148.5-149.5 Aw=92.7	149.5-150.5 Aw=93.3	150.5-151.5 Aw=93.9	151.5-152.5 Aw=94.5	152.5-153.5 Aw=95.1	153.5-154.5 Aw=95.7	154.5-155.5 Aw=96.3	155.5-156.5 Aw=96.9	156.5-157.5 Aw=97.5	157.5-158.5 Aw=98.1	158.5-159.5 Aw=98.7	159.5-160.5 Aw=99.3	160.5-161.5 Aw=99.9	161.5-162.5 Aw=100.5	162.5-163.5 Aw=101.1	163.5-164.5 Aw=101.7	164.5-165.5 Aw=102.3	165.5-166.5 Aw=102.9	166.5-167.5 Aw=103.5	167.5-168.5 Aw=104.1	168.5-169.5 Aw=104.7	169.5-170.5 Aw=105.3	170.5-171.5 Aw=105.9	171.5-172.5 Aw=106.5	172.5-173.5 Aw=107.1	173.5-174.5 Aw=107.7	174.5-175.5 Aw=108.3	175.5-176.5 Aw=108.9	176.5-177.5 Aw=109.5	177.5-178.5 Aw=110.1	178.5-179.5 Aw=110.7	179.5-180.5 Aw=111.3	180.5-181.5 Aw=111.9	181.5-182.5 Aw=112.5	182.5-183.5 Aw=113.1	1
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$D_{\text{USE}} = 1.56$ $D_{\text{USE}} = 1.56$ $D_{\text{USE}} = 1.56$
 $A = 2.05$ $A = 2.57$ $A = 2.73$
 1.56 1.56 1.56

100	0.40	0	0.39	1	0.37	0
200	0.52	0.02	0.77	0.01	0.73	0.01
400	1.63	0.00	1.54	0.06	1.47	0.05
500	3.27	0.25	3.04	0.22	2.73	0.20
1000	4.70	0.50	4.03	0.50	4.40	0.45
1500	5.53	0.80	5.15	0.50	5.80	0.80
2000	8.00	1.55	7.72	1.27	7.33	1.25
2500	7.50	2.24	7.27	2.00	6.79	1.80

Note: These data plotted on Page 3

WEST STREET CAUSEWAY BETWEEN RES B and C

$$\pm 700' \approx \pm 615'$$

Q-Assumed 3' dia culvert

FLA - R. COVER -

2000 FLOW OVER CREST OF ROADWAY

S	-	LSH	Σ(E)	W	C	Q
10	1.22	0.05	615.0	0	-	0
20	2.30	0.11	615.2	0.2	2.04	163
30	4.29	0.43	615.4	0.4	2.58	400
40	5.70	0.70	615.6	0.6	2.70	870
50	7.10	1.19	615.8	0.8	2.70	1370
60	8.50	1.71	616.0	1.0	2.70	1900
70	10.2	2.58				

BY LM DATE 5-28-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF 1
 CHKD. BY DATE INSPECTION OF DAM PROJECT 11-94
 SUBJECT PARKBURN RESERVOIR DAM - DISCHARGE CURVES

SPILLWAY AND BULKHEAD GATE

12' x 15' x 15' - 12' x 15' x 15'

3 x 7.5 ft. 12' x 15' x 15' 2-15-80 EL. 608.5

12' x 15' x 15' - Provision for 3' high collapsible stoplogs
- EL. 604.5 (stoplogs presently not installed, 2-15-80)

FLOW THRU SPILLWAY - BULKHEAD GATES IN PLACE

ELEV	SPILLWAY - L=15'			FLOW OVER BULKHEAD GATE L=30' x 3.11'		TOTAL SPILLWAY CAPACITY
	H	C	Q	H	Q	
608.5	0	-	0			0
609	0.5	3.1	14			14
610	1.5	3.2	76			76
611	3.0	3.28	222	0	0	222
612	3.5	3.3	291	0.5	3	294
613	4.5	3.4	422	1.5	17	439
614	5.5	3.5	537	2.5	37	624
615	6.5	3.6	776	3.5	61	837
616	7.5	3.6	991	4.5	89	1050
617	8.5	3.6	1160	5.5	120	1280

FLOW THRU SPILLWAY AND OVER DAM - STOPLOGS IN PLACE

ELEV	FLOW OVER GATE AND STOPLOGS L=16' C=2.3			OVER DAM - L=1150'			Σ Q
	H	C	Q	H	C	Q	
611.5	0	-	0				0
612	0.5	-	19				19
613	1.5	-	97				97
614	2.5	-	209				209
615	3.5	-	346				346
616	4.5	-	504				504
617	5.5	-	681	0	0	0	681
617.5	5.5	-	692	0.5	2.4	32	722
618	5.5	-	692	1.0	2.5	43	732
618.5	5.5	-	702	1.5	2.6	178	887
619	5.5	-	714	2.0	2.7	285	1004
619.5	5.5	-	729	2.5	2.75	436	1130
620	5.5	-	738	3.0	2.8	543	1281

LONG-GRASS PRAIRIE
 1850-1851 HUNTER'S COUNTRY

RESERVED AREA

100

200

300

400

500

600

700

800

BY 112 DATE 5/2/74 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF 2
 CHKD. BY DATE INSPECTION OF DAM PROJECT W-174
 SUBJECT D-25 B-201 - RESERVOIR DAM - RESERVOIR AREA - CAPACITY

PLAN VIEW OF RESERVOIR

ELEV.	RESERVOIR A		RESERVOIR B		RESERVOIR C		TOTAL
	EAST OF HAND DKE	EAST OF HAND DKE	EAST OF HAND DKE	EAST OF HAND DKE	WEST OF WEST DKE	WEST OF WEST DKE	
	Platometer Area	AREA - AC	Platometer Area	AREA - AC	Platometer Area	AREA - AC	AREA - AC
504	1.22	182	0.72	66	0.57	54	302
500	2.0	198	0.51	70	0.73	67	335
492	2.03	223	1.0	102	1.10	101	426

RESERVOIR 102, 1965 (450' E. EL. 400.5)

ELEV.	RESERVOIR A				RESERVOIR B				RESERVOIR C				SUM
	Area	400	400	400	Area	400	400	400	Area	400	400	400	
495	170	-	-	0	0	-	-	0	0	-	-	0	0
507	182	179	90	30	30	60	64	32	54	52	26	20	100
510	191	185	130	270	70	70	70	100	50	50	50	80	200
511	193	190	124	470	70	70	70	170	70	70	60	155	200
512	204	200	200	670	85	80	80	240	70	70	70	230	200
513	209	205	200	577	89	80	80	300	80	80	80	300	200
514	213	200	200	1000	90	80	80	400	80	80	80	400	200
515	216	205	200	1300	95	80	80	500	90	80	80	400	200
516	218	207	200	1520	97	80	80	600	90	80	80	500	200
517	220	210	200	1730	97	80	80	700	90	80	80	600	200
518	222	220	220	1900	101	100	100	800	100	90	80	700	200

NOTE - THESE DATA PLATE 1 OF 2 PLATE 1

LOUIS BERGER & ASSOCIATES INC.

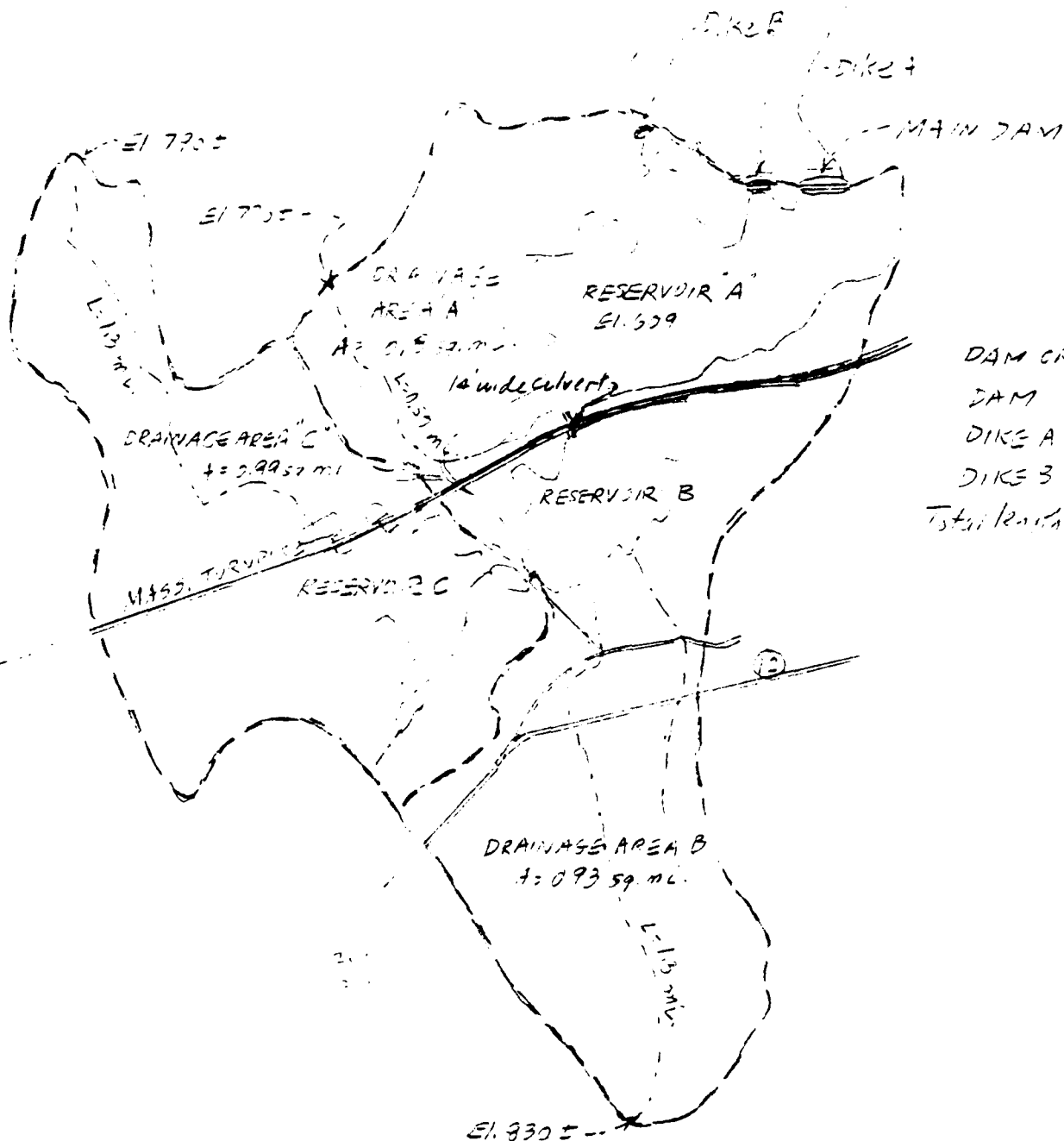
BY SLH DATE 5-1-61

SHEET NO. 1 OF 1

CHKD. BY DATE

PROJECT VI-124

SUBJECT DRAINAGE RESERVOIR DAM - DRAINAGE AND RESERVOIR AREAS



DAM CREST LENGTH - 4
DAM 7.5 ft.
DIKE A 360
DIKE B 120
Total length - 1175 ft.

DRAINAGE AREAS

	AREA SQ. MI.	WATER COURSE LENGTH - L MI.	HEIGHT DIFFERENTIAL - H FT.	SLOPE FT. MI.
AREA A	0.57	2.57	161	262
AREA B	0.93	1.3	221	170
AREA C	0.99	2.62 TSM	181	139

RESERVOIR AREAS

RESERVOIR A	132 AC.
" B	66
" C	54

Total

302 AC.

(10% of drainage area)

D-1

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS

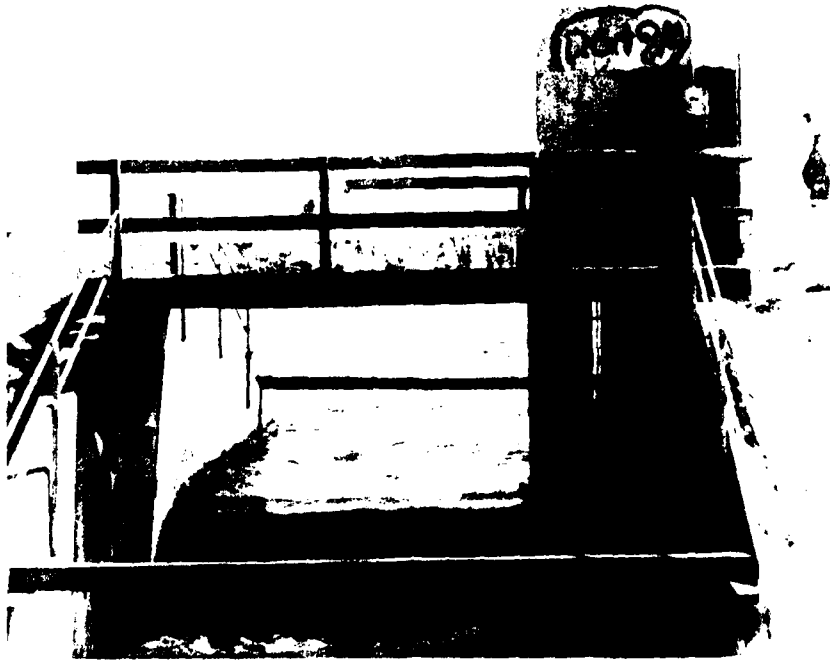


11. Repaired right spillway training wall.

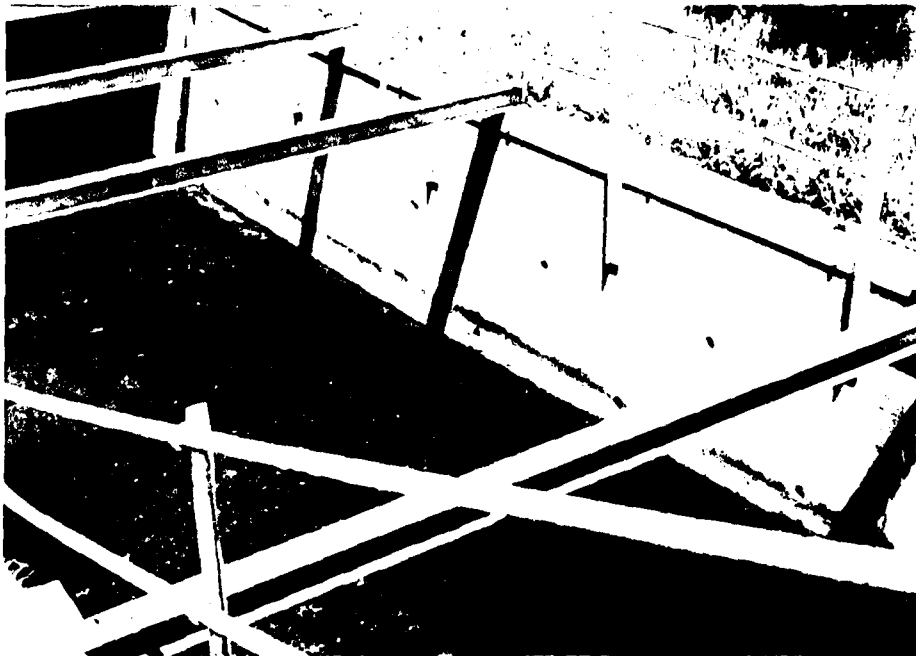


12. Gate house for low level outlet conduit.

REPRODUCED AT GOVERNMENT EXPENSE
DARK BROOK RESERVOIR DAM



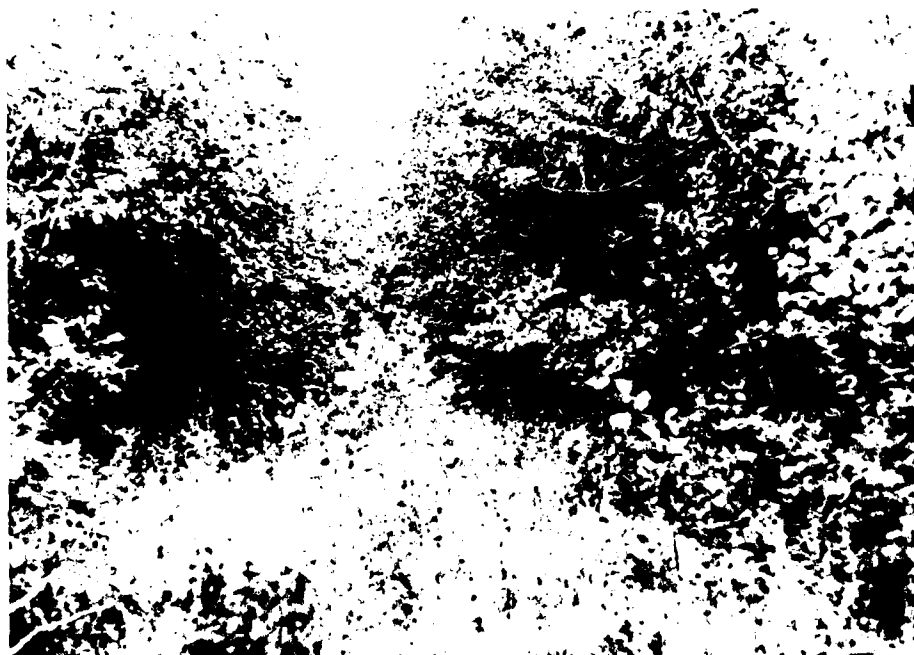
9. Spillway crest and sluice gate.



10. Right spillway training wall.



7. Brush and tree growth on upstream slope of Dike A.



8. View of Dike B from right abutment (note-inspection team member standing at left abutment).

REPRODUCED AT GOVERNMENT EXPENSE
DARK BROOK RESERVOIR DAM



5. Crest and downstream slope of Dike A from left abutment.



6. Riprap along upstream toe of Dike A.

REPRODUCED AT GOVERNMENT EXPENSE
DARK BROOK RESERVOIR DAM



3. Void above 21 in. dia. outlet conduit.



4. Upstream slope of main dam from right abutment.

DARK BROOK RESERVOIR DAM



1. Crest of main dam from left abutment.



2. Brush growth along downstream slope of main dam.

BY LH DATE 6-12-90

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 5 OF CHKD. BY DATE INSPECTION OF PAVE MANTPROJECT W-174SUBJECT PAVE BRIDGE RESERVATION JAIL - UNCONTROLLED2MP RAINFALL DISTRIBUTION

6 hour point rainfall for Southern Mass. - per Hydromet #33

For 10 sq. mi. area = 23.5 inches

Reduction for imperfect fit for 41.00 mi. B.A. = .20

PMP rainfall = $23.5 \times 0.8 = 18.8$ inches

Rainfall distribution

Time in hours	Rainfall in inches	Rainfall in inches	Hydromet 1055 inches	Rainfall 34055 inches
0		0		
1.0	10	1.88	0.5	1.38
2.0	12	2.26	0.1	2.16
3.0	15	2.82	0.1	2.72
4.0	33	7.14	0.1	7.04
5.0	14	2.63	0.1	2.73
6.0	11	2.07	0.1	1.97
Total	100	18.80	1.0	17.80

(420r EM 1110-2-1411)

BY: LDH DATE: 5-12-50

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 6 OF 6CHKD. BY: DATEINSPECTION: 2-2-50PROJECT: W-132SUBJECT: DAVE BRICK RESERVOIR DATA HYDROLOGY

INFLUX HYDROGRAPH - DRAINAGE AREA 4"

Area in sq mi = 0.80 L = 5.57 mi H = 101' S = 282' mi

Total Res. Area = 152.4 = $\frac{132}{512}$ or 0.35 of DA.For $\frac{2}{3}$ of DA. L = 5.7 L H = 101' S = $\frac{161}{57} = 2.82$ mi

$$Lag = K \left(\frac{L L_c}{15} \right)^{.33}$$

$$\text{Say } K = 3.75 \quad Lag = 3.75 \left(\frac{5.57 \times 0.57}{15} \right)^{.33} = 0.81 \text{ hrs}$$

$$D = 1 \text{ hr} \quad T_p = 0.41 + 0.32 Lag = 0.41 + 0.32 \times 0.81 = 1.07 \text{ hrs}$$

$$T_c = T_p + D = 0.95 \text{ hrs}$$

$$C = \frac{5.57 \times 5.23}{0.95 \times 300} = 0.98 \text{ (sec = reasonable overland flow)}$$

$$\text{Overland runoff - Say } A = 0.55 \text{ sq. mi} \quad Q_p = \frac{484 \times 0.55 Q}{T_p} = 266.2 Q$$

$$\text{Direct precip. res. Say } A = 0.25 \text{ sq. mi}$$

$$Q = 0.25 \times 645.3 = 161.3 \text{ cfs/mch. prec.}$$

Time - hrs	HOURLY OVERLAND TRIANGULAR HYDROGRAPHS					DIRECT PRECIP. RECTANGULAR HYDROGRAPHS		TOTAL HYDROGRAPH DISCHARGE - cfs
	Initial Excess Inches	Qp cfs	Base hrs	Peak hrs	End hrs	Excess Inches	Runoff cfs	
0	0	0				0		280
0.5								450
1.0	1.38	367	0	1.0	2.07	1.88	3.03	690
1.5								900
2.0	2.16	575	1.0	2.0	3.67	2.26	365	1100
2.5								1310
3.0	2.72	724	2.0	3.0	4.67	2.32	455	1500
3.5								3300
4.0	7.04	1874	3.0	4.0	5.67	7.14	1152	2660
4.5								2170
5.0	2.53	673	4.0	5.0	6.67	2.63	424	1750
5.5								1300
6.0	1.97	524	5.0	6.0	7.67	2.07	334	900
6.5								470
7.0								210
7.5								60
8.0								

These data are plotted on Plate 4

Total

7844 cfs

BY DATE 5-25-57

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 7 OF CHKD. BY DATE INSPECTOR M 455PROJECT 111-125SUBJECT 2-2K 3200K RESERVOIR DAM - HYDROLOGYINFLOW HYDROGRAPH - 1000 CFS - AREA "B"(South of Main, fire & 1st - 1st - 34th St. Causeway)Area in sq. mi. = 0.93 L = 1.3 mi. $\Delta H = 170'$ Slope = 170 ft/mi.

$$Lag = K \left(\frac{L + L_0}{1.483} \right) = K \left(\frac{1.3 + 0.35}{1.483} \right) = .405K$$

$$Slope K = 3.75 \quad Lag = .405 \times 3.75 = 1.52 \text{ hrs}$$

$$T_p = 0.410 + .52Lag \quad P = 1.1 \text{ hr} \quad T_p = 0.41 + .52 \times 1.52 = 1.25 \text{ hrs}$$

$$T_c = \frac{T_p - 0.410}{0.5} = 1.22 \text{ hrs} \quad U = \frac{1.3 \times 5280}{1.22 \times 3600} = 1.0' / \text{sec} \quad \text{OK}$$

$$Q_p = \frac{464 \times 0.93 Q}{1.65} = 272.85$$

UNIT GRAPH CONSTRUCTION:

Time hrs	Area sq. mi.	Triangular hydrograph - Time hrs	Peak CFS	End CFS	TOTAL HYDROGRAPH CFS
0	0	0	-	-	0
0.5					110
1.0	1.38	376	0	1.65	440
1.5					480
2.0	2.16	589	1.0	2.65	740
2.5					1900
3.0	2.72	742	2.0	3.65	1260
3.5					1700
4.0	7.34	1920	3.0	4.65	2570
4.5					2660
5.0	2.53	690	4.0	5.65	2600
5.5					2340
6.0	1.77	537	5.0	6.65	2030
6.5					1640
7.0					1150
7.5					630
8.0					380
8.5					180
9.0					80
9.5					0
Total					37745

Notes: These data are plotted on Plate 5

Sum of hydrographs for Areas A, B, & C gives a peak value of 7470 cfs
at 4.7 hrs. This corresponds to a CSM of $\frac{7470}{2.65} = 2819 \text{ cfs}$

D-10

BY 2-15 DATE 5-2-69

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 8 OF 8CHKD. BY DATE INSPECTION OF DAMS - MASSPROJECT W-175SUBJECT DANK BROOK RESERVOIR - HYDROLOGY

LINE-20, F400, 52404 - D2 - MASS AREA "C"
(NOT AT NOT 54204)

$$\text{Area in sq. mi} = 0.89 \quad L = 1.3 \text{ mi} \quad \Delta H = 1.81' \quad S = \frac{81}{1.3} = 134' / \text{mi.}$$

$$\text{Lag} = K \left(\frac{LLC}{15} \right)^{.33} = K \left(\frac{1.3 \times 65}{15} \right)^{.33} = 0.42 K$$

$$\text{Say } K = 3.75 \quad \text{Lag} = 0.42 \times 3.75 = 1.57 \text{ hrs}$$

$$T_p = 0.47 + 0.82 \text{ Lag} = 1.0 \text{ hrs} \quad T_p = 2.41 - 1.29 = 1.70 \text{ hrs}$$

$$T_c = \frac{T_p - 0.5}{0.5} = 2 \text{ hrs} \quad U = \frac{1.3 \times 5250}{2 \times 3650} = 0.95 \text{ hrs} - 910$$

$$Q_p = \frac{484 \times 0.39}{1.7} Q = 253.4 Q$$

Time	Rainfall inches	Qp cfs	INCR. TRIANGULAR HYDROGRAPHS			Total HYDROGRAPH cfs
			Begin	Peak	End	
0	0	0	0			0
0.5						100
1.0	1.55	350	0	1.7	4.54	210
1.5						450
2.0	2.16	547	1.0	2.7	5.54	690
2.5						940
3.0	2.72	689	2.0	3.7	6.54	1200
3.5						1630
4.0	7.04	1784	3.0	4.7	7.54	2050
4.5						2480
5.0	2.53	641	4.0	5.7	8.54	2520
5.5						2250
6.0	1.97	499	5.0	6.7	9.54	1980
6.5						1580
7.0						1150
7.5						680
8.0						400
8.5						200
9.0						100
9.5						0
Total						352 A.F

Note: These data
plotted on Plate 6

Total of all hydrographs

Check for runoff

Area A 734 A.F

$$2.3709 \text{ mi} @ 17.8' = \frac{2.37 \times 0.40 \times 17.8}{12} = 225' A.F$$

Area B 879

$$0.25' @ 18.3' = \frac{0.25 \times 600 \times 18.3}{12} = 251' A.F$$

Area C 852

Total 2515 A.F

D-11

3500

3000

2500

2000

1500

1000

500

10/10/49 1945

PMF HYDROGRAPH FOR DRAINAGE AREA "A"

Incremental hourly hydrographs

Direct precipitation

DARK AREA: RESERVOIR
INFLOW HYDROGRAPH FOR DRAINAGE
AREA NORTH OF MASS TUNNEL
TO PMF

TIME - HRS

KEUFFEL & ESSER CO.
MADE IN U.S.A.

3000

2500

2000

1500

1000

500

DISCHARGE - CFS

4-PMF INFLOW HYDROGRAPH FOR AREA G

1-PMF INFLOW HYDROGRAPH FOR AREA G

DARK BRINK RESERVOIR
INFLOW HYDROGRAPH FOR DRAINAGE
AREA SOUTH OF MASS TURNPIKE
AND EAST OF WEST STREET

1-PMF

0 2 4 6 8 10 12

TIME - HOURS

KEUFFEL & ESSER CO.
MADE IN U.S.A.

2000

1500

1000

500

DISCHARGE - CFS

← PMF INFLOW HYDROGRAPH FOR AREA C

INTERPOLATED FLOOD HYDROGRAPHS

DARK BRINK RESERVOIR
INFLOW HYDROGRAPH FOR BRINK
AREA WEST OF WEST ST. LAURENCE
1.0 PMF

0 2 4 6 8 10
TIME - HOURS

KEUFFEL & ESSER CO.
MADE IN U.S.A.

[illegible]

compute ③ and ④

ASSUME VALUE FOR (33) and COMPUTE (34) (35) and (36)

4 READ VALUE OF (37) FOR RES. EL. OF (30) FROM DISCH. CURVE - PLATE 2

5. COMPUTE (39) AND (39)

1. COMPUTE (42) BY SUBTRACTING (39) FROM (36)

7. ADD (42) TO (41) AND READ VALUE OF (42) FROM PLATE 1. RECORD IN (21)

RECORD (33) in (23) AND SEND (23) FROM PLATE 3.

2 400. (2) + 10 (2) AND RECORD IN (2)

10. COMPUTE (24) (25) AND (26).

Assume (16) and compute (17) (18) and (19)

12. COMPUTE (25) by SUBTRACTING 25 FROM (14) AND ADDING (27) READ (30) FROM PLATE

13 RECORDED (1) IN (2) AND COMPUTED (3) AND (4)

14. SAMPLE 111b, SUBTRACTING 10 FROM 14 AND ADD TO 12. RESULT 6 FROM PLATE 111b

CHKD BY _____ DATE _____

SHEET NO. 15 OF

PROJECT W. 198

SUBJECT: 44-110-32 245-246-247-248-249-250-251-252-253-254-255-256-257-258-259-260-261-262-263-264-265-266-267-268-269-270-271-272-273-274-275-276-277-278-279-280-281-282-283-284-285-286-287-288-289-290-291-292-293-294-295-296-297-298-299-300-301-302-303-304-305-306-307-308-309-310-311-312-313-314-315-316-317-318-319-320-321-322-323-324-325-326-327-328-329-330-331-332-333-334-335-336-337-338-339-340-341-342-343-344-345-346-347-348-349-350-351-352-353-354-355-356-357-358-359-360-361-362-363-364-365-366-367-368-369-370-371-372-373-374-375-376-377-378-379-380-381-382-383-384-385-386-387-388-389-390-391-392-393-394-395-396-397-398-399-400-401-402-403-404-405-406-407-408-409-410-411-412-413-414-415-416-417-418-419-420-421-422-423-424-425-426-427-428-429-430-431-432-433-434-435-436-437-438-439-440-441-442-443-444-445-446-447-448-449-450-451-452-453-454-455-456-457-458-459-460-461-462-463-464-465-466-467-468-469-470-471-472-473-474-475-476-477-478-479-480-481-482-483-484-485-486-487-488-489-490-491-492-493-494-495-496-497-498-499-500-501-502-503-504-505-506-507-508-509-510-511-512-513-514-515-516-517-518-519-520-521-522-523-524-525-526-527-528-529-530-531-532-533-534-535-536-537-538-539-540-541-542-543-544-545-546-547-548-549-550-551-552-553-554-555-556-557-558-559-560-561-562-563-564-565-566-567-568-569-570-571-572-573-574-575-576-577-578-579-580-581-582-583-584-585-586-587-588-589-590-591-592-593-594-595-596-597-598-599-600-601-602-603-604-605-606-607-608-609-610-611-612-613-614-615-616-617-618-619-620-621-622-623-624-625-626-627-628-629-630-631-632-633-634-635-636-637-638-639-640-641-642-643-644-645-646-647-648-649-650-651-652-653-654-655-656-657-658-659-660-661-662-663-664-665-666-667-668-669-670-671-672-673-674-675-676-677-678-679-680-681-682-683-684-685-686-687-688-689-690-691-692-693-694-695-696-697-698-699-700-701-702-703-704-705-706-707-708-709-710-711-712-713-714-715-716-717-718-719-720-721-722-723-724-725-726-727-728-729-730-731-732-733-734-735-736-737-738-739-740-741-742-743-744-745-746-747-748-749-750-751-752-753-754-755-756-757-758-759-760-761-762-763-764-765-766-767-768-769-770-771-772-773-774-775-776-777-778-779-780-781-782-783-784-785-786-787-788-789-790-791-792-793-794-795-796-797-798-799-800-801-802-803-804-805-806-807-808-809-810-811-812-813-814-815-816-817-818-819-820-821-822-823-824-825-826-827-828-829-830-831-832-833-834-835-836-837-838-839-840-841-842-843-844-845-846-847-848-849-850-851-852-853-854-855-856-857-858-859-860-861-862-863-864-865-866-867-868-869-870-871-872-873-874-875-876-877-878-879-880-881-882-883-884-885-886-887-888-889-890-891-892-893-894-895-896-897-898-899-900-901-902-903-904-905-906-907-908-909-910-911-912-913-914-915-916-917-918-919-920-921-922-923-924-925-926-927-928-929-930-931-932-933-934-935-936-937-938-939-940-941-942-943-944-945-946-947-948-949-950-951-952-953-954-955-956-957-958-959-960-961-962-963-964-965-966-967-968-969-970-971-972-973-974-975-976-977-978-979-980-981-982-983-984-985-986-987-988-989-990-991-992-993-994-995-996-997-998-999-1000-1001-1002-1003-1004-1005-1006-1007-1008-1009-1010-1011-1012-1013-1014-1015-1016-1017-1018-1019-1020-1021-1022-1023-1024-1025-1026-1027-1028-1029-1030-1031-1032-1033-1034-1035-1036-1037-1038-1039-1040-1041-1042-1043-1044-1045-1046-1047-1048-1049-1050-1051-1052-1053-1054-1055-1056-1057-1058-1059-1060-1061-1062-1063-1064-1065-1066-1067-1068-1069-1070-1071-1072-1073-1074-1075-1076-1077-1078-1079-1080-1081-1082-1083-1084-1085-1086-1087-1088-1089-1090-1091-1092-1093-1094-1095-1096-1097-1098-1099-1100-1101-1102-1103-1104-1105-1106-1107-1108-1109-1110-1111-1112-1113-1114-1115-1116-1117-1118-1119-1120-1121-1122-1123-1124-1125-1126-1127-1128-1129-1130-1131-1132-1133-1134-1135-1136-1137-1138-1139-1140-1141-1142-1143-1144-1145-1146-1147-1148-1149-1150-1151-1152-1153-1154-1155-1156-1157-1158-1159-1160-1161-1162-1163-1164-1165-1166-1167-1168-1169-1170-1171-1172-1173-1174-1175-1176-1177-1178-1179-1180-1181-1182-1183-1184-1185-1186-1187-1188-1189-1190-1191-1192-1193-1194-1195-1196-1197-1198-1199-1200-1201-1202-1203-1204-1205-1206-1207-1208-1209-121

444K RESERVOIR A

RAILWAY STOPLOPS REMOVED - GATE IN PLACE - START ROUTING AT EL 600.0

[illegible]

15. Repeat procedure with other trial values (23, 33 and 48) to RECONCILING DIFFERENCES IN COMPARATIVE VALUES OF POND LEVELS.

SUB

NOTE. ELEVATION-TIME CURVES FROM COLUMNS (13), (58) and 42 PLOTTED IN PLATE 8

SUBJECT Jack

PROJECT 41-146

MIDDLE REFERENCE B

TIME HRS	INFLW CFS	TRIAL INFLW CFS	TRIAL OUTFLW CFS	AVERAGE INFLW CFS	AVERAGE OUTFLW CFS	TRIAL WS POND B	TRIAL WS POND 4	DIFF. HEAD FT	TRIAL INFLW CFS	TRIAL OUTFLW CFS	AVERAGE INFLW CFS	AVERAGE OUTFLW CFS	INCR. STORAGE AC	TOTAL STOR. A.E.	25. MIN ELEV.
1.0	0	0	0	0	0	611.5	611.5	0	0	0	0	0	0	220	611.5
1.5	0	0	110	55	2	611.5	611.5	0	0	0	0	0	2	222	611.53
1.2	30	0	230	70	7	611.54	611.4	0	0	0	0	0	7	229	611.53
1.5	40	0	410	200	15	611.55	611.65	0	0	0	0	0	15	244	611.63
2.0	750	0	750	325	26	612.27	612.06	0.005	100	75	2	2	24	268	612.04
2.5	1000	0	1000	445	37	612.42	612.25	1.07	350	225	7	28	28	296	612.43
3.0	1000	0	1000	440	44	612.22	612.00	0.04	400	275	15	33	323	323	612.23
3.5	1000	0	1000	440	52	612.31	612.20	0.04	400	400	15	48	371	371	612.23
4.0	1000	0	1000	440	91	612.35	612.00	0.12	500	450	14	62	433	433	612.40
4.5	2600	535	3135	2700	112	614.85	614.05	0.40	950	725	23	31	513	513	614.85
5.0	2120	1505	4625	3720	153	615.45	615.00	0.43	1500	1225	51	82	625	625	615.73
5.5	2300	715	3085	3630	150	616.76	615.54	1.22	1700	1350	68	82	707	707	616.70
6.0	2040	905	2935	3000	124	617.26	616.00	1.26	1850	1510	75	49	757	757	617.26
6.5	1430	845	2575	2735	113	617.63	616.39	1.24	1950	1850	76	37	788	788	617.63
7.0	150	775	1425	2225	92	617.78	616.68	1.10	1870	1825	75	17	805	805	617.72
7.5	430	125	1255	1640	76	617.82	616.78	0.90	1650	1725	71	5	810	810	617.82
8.0	400	365	765	1260	52	617.72	619.08	0.64	1400	1525	53	-11	799	799	617.72
8.5	200	775	975	370	36	617.53	617.6	0.17	1125	1253	52	-16	783	783	617.53
9.0	85	345	425	700	29	617.44	617.8	0.26	700	713	42	-13	770	770	617.44
9.5	0	335	335	365	15	617.28	617.4	0.14	150	775	32	-17	753	753	617.28
10.0	0	0	0	145	6	617.13	617.07	0.06	400	525	22	-16	737	737	617.13

SHEET NO. 100 OF _____

DRAWN BY: _____ DATE: _____ SUSPENSION OF DAVIS - MASS. PROJECT: 10-183
 SUBJECT: _____ RESERVOIR DAM FLOOD ROUTING - PMC INFLOW

— 250 —

[illegible]

3

NOTE: FUTURE REVISIONS TO THIS DRAWING
SHOULD BE MADE BY THE DESIGNER
(15 OCT 60) (15 OCT 60)

100' 0" 0" 0"

REVISION: 100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

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100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

100' 0" 0" 0"

NOTE: FLOODING ALTERNATE WITH SPILLWAY STAGES AND
SPRY. S. INCREASING IN PLACE TO ELEV. 611.5. RESERVOIR
AT ELEV. 611.5 AT START OF FLOODING

MAX. ELEV. 611.5 - RES. 611.5

Top of dam and dike El. 612.0

RES. "A" MAX. ELEV. 611.5

RES. "A" MAX. ELEV. 611.5

Top of spillway crest El. 615.0

MAX. BRICK RESERVOIR DAM
FLOOD ROUTING - 1.000 F. INFLOW

Top of spillway crest El. 615.0

Top of spillway crest El. 615.0

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

TIME - 4 HOURS

BY: RFE DATE: 7-2-57

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 2

CHKD. BY: DATE:

PROJECT: No. 5

SUBJECT: DASH FLOOD CONTROL FACILITY

MAIN DAM

STEP 1: Reservoir Elevation & Flooded 6"
Water & T₂ - DAM
Storage = 4110

Height = 17 ft

Length = Minimum = 340 ft

$W = 40\% \text{ of } 340 = 216 \text{ ft}$

STEP 2: Peak Flood Capacity

$$Q_{p1} = 8/27 W \sqrt{g} Y_0^{3/2}$$

$$Q_{p1} = 1.03 (216) (17)^{3/2}$$

$$Q_{p1} = 25,400 \text{ cfs}$$

Add Spilling Flow & $Q_{\text{Spilling}} = 325 \text{ cfs}$

$$Q_{p1} (\text{TOTAL}) = 25,400 + 325 = 26,200 \text{ cfs}$$

STA 0+00 TO STA 35+00 (11000 ft)

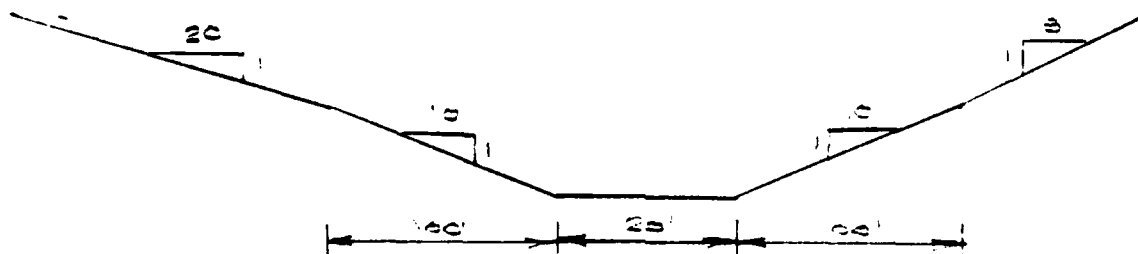
$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$S = \frac{590 - 570}{3200} = 0.0188$$

$$n = 0.045$$

$$S^{1/2} = 0.137$$

$$Q = 4.53 A R^{2/3}$$



BY NEB DATE 7.2.55

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 2 OF 4

CHKD. BY DATE

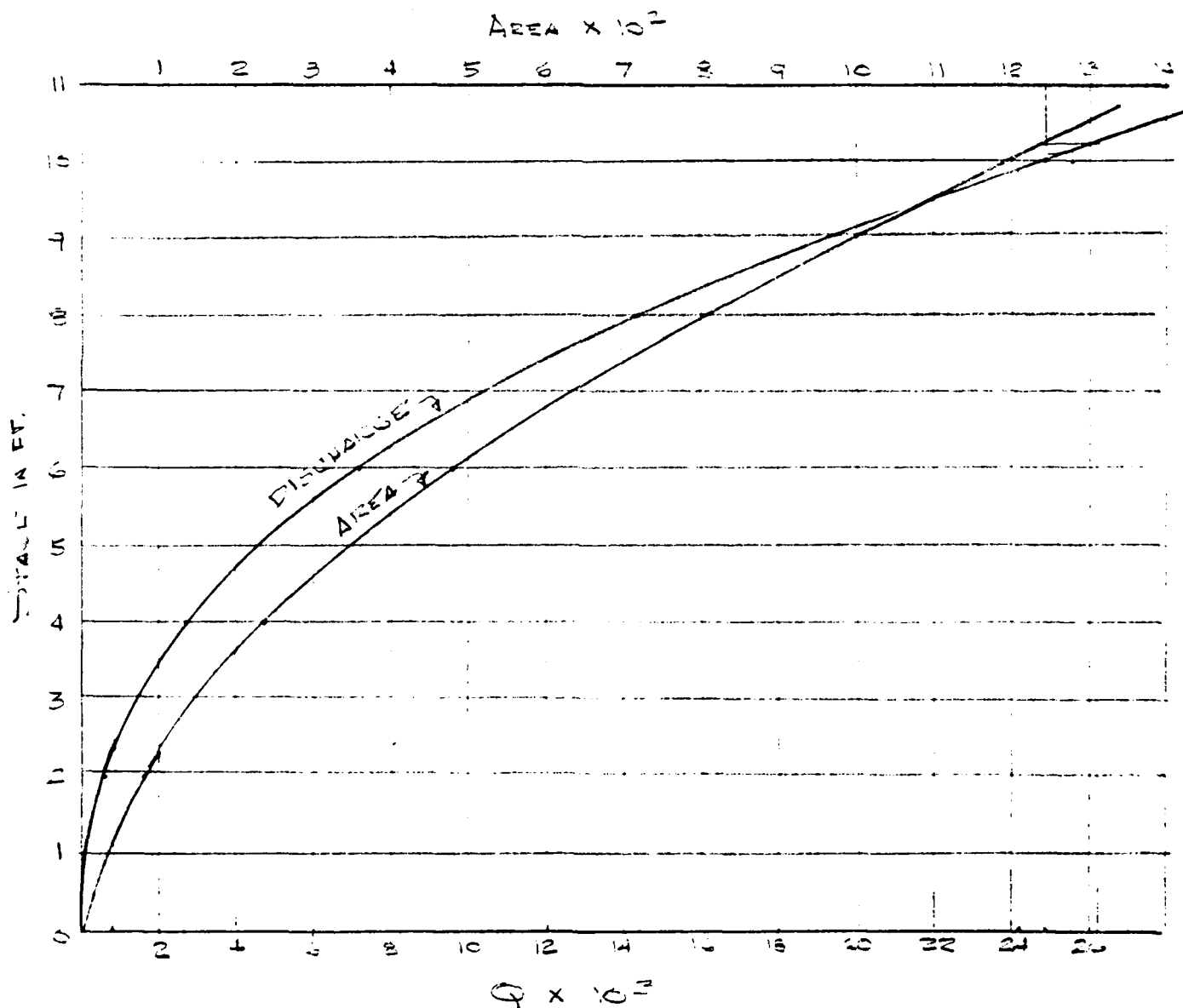
INSPECTOR DATE

PROJECT 10-15

SUBJECT Canal

San Antonio, Texas

Stage	Area	P	$R^{3/2}$	Q
2	80	40.6	1.55	570
4	240	60.8	2.50	2710
6	480	81.2	3.27	7190
8	800	101.6	3.96	14330
10	1200	122.0	4.59	24400
12	1600	150.0	5.04	35640



BY RFB DATE 7.2.50 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 3 OF 6
 CHKD. BY DATE INSPECTION OF DAMS PROJECT W-148
 SUBJECT DAMS Flood Risk FA-158 AL-1-1-1

For $Q = 26,200$, STAGE = 10.4, AREA = 1245 ft^2

$$V_1 = \frac{1245 \times 3500}{43,560} = 100 \text{ A.F.}$$

$$Q_{p2} (\text{TRIAL}) = 26,200 \left(1 - \frac{100}{4116}\right)$$

$$= 25,600$$

For $Q = 25,600$, STAGE = 10.3, ≈ 10.4

Say $Q_{p2} = 25,600$, STAGE = 10.3 $\Delta H = 7.8 \text{ ft}$

ADDITIONAL FLOODING NEAR INWASH STREET

3	HOUSES	:	7-8	FT	OF	FLOODING
2	"	:	3	FT	"	"

STA 35+00 TO 70+00

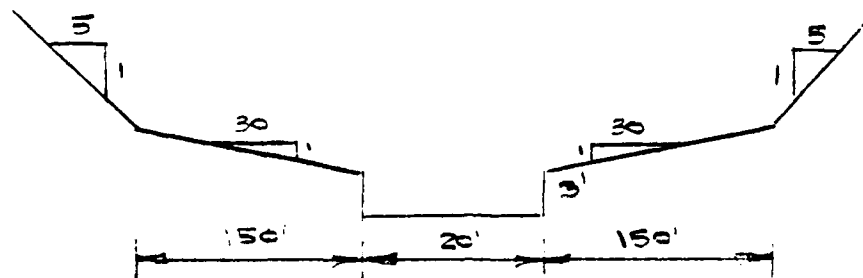
$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$Q = 2.72 A R^{2/3}$$

$$S = \frac{10}{2400}$$

$$S^{1/2} = 0.064$$

$$n = 0.033$$



BY: RFB DATE: 7-1-50

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. 1 OF 2

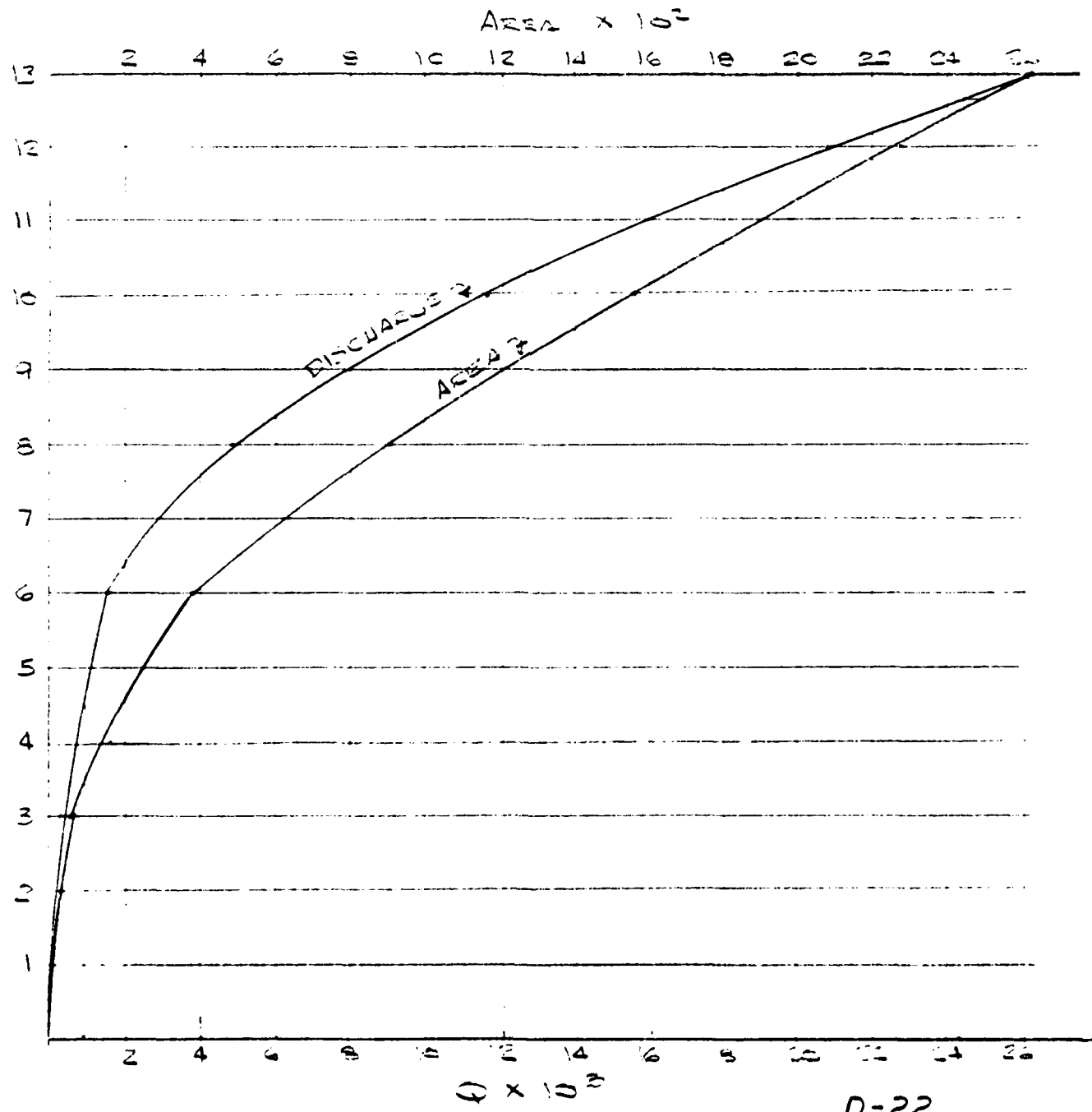
CHKD. BY: _____ DATE: _____

INSPECTION OF DAM

PROJECT N-13

SUBJECT: D-22 Reservoir, FA-22

STAGE	AREA	P	Q	Q
8	60	26	1.75	286
6	340	206.1	1.53	1622
8	910	306.2	1.43	4000
10	1570	346.6	3.74	11700
12	2570	366.4	3.38	20870
13	2835	376.5	3.66	26300



BY REF DATE 7-2-80 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 5 OF 5
 CHKD. BY DATE 10-10-80 PROJECT W-126
 SUBJECT CLARK POND - 2500 - 1000 - 1000 - 1000 - 1000 - 1000

For $Q = 25,000$, Stage = 13 ft, Area = 2500

$$V_1 = \frac{2675 \times 2500}{48,000} = 27.4 \text{ ft}$$

$$Q_{P2}(\text{ft}^2) = 25,000 \left(1 - \frac{212}{410}\right)$$

$$= 24,300$$

For 24,300, Stage = 12.7 ft, Area = 2500

SAV $Q_{P2} = 24,300$, Stage = 12.7 ft, Area = 2500

ADDITIONAL FLOODING @ BELLING S-

1 HOUSE - 8 FT DEPTH

ENTRANCE TO STONEVILLE POND

3 HOUSES MINOR FLOODING 1-2 FT

FIND BEACH DISCHARGE FROM DIKE A

LENGTH @ MIDDLE = 250

$W = 40\% \text{ OF } 250 = 100 \text{ FT}$

$H = 11 \text{ FT}$

$$Q_{P1} = 3.07 W \sqrt{g} Y_0^{3/2}$$

$$Q_{P1} = 1.63 (100) (11)^{3/2}$$

$$Q_{P1} \approx 6100 \text{ CFS}$$

BY LT DATE 7-2-50 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 9 OF 9
 CHKD. BY DATE INSPECTION OF DATE PROJECT DATE
 SUBJECT DRAINAGE CANAL

REACH FROM DRAIN CANAL DATE

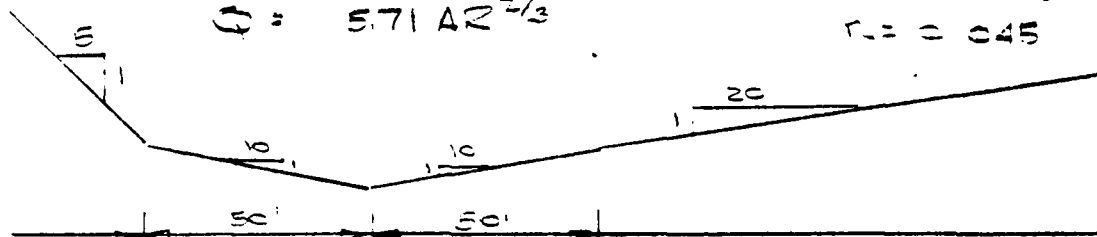
$$Q = \frac{1483}{1000} A R^{2/3} S^{1/2}$$

$$S = \frac{30}{1000} = 0.03$$

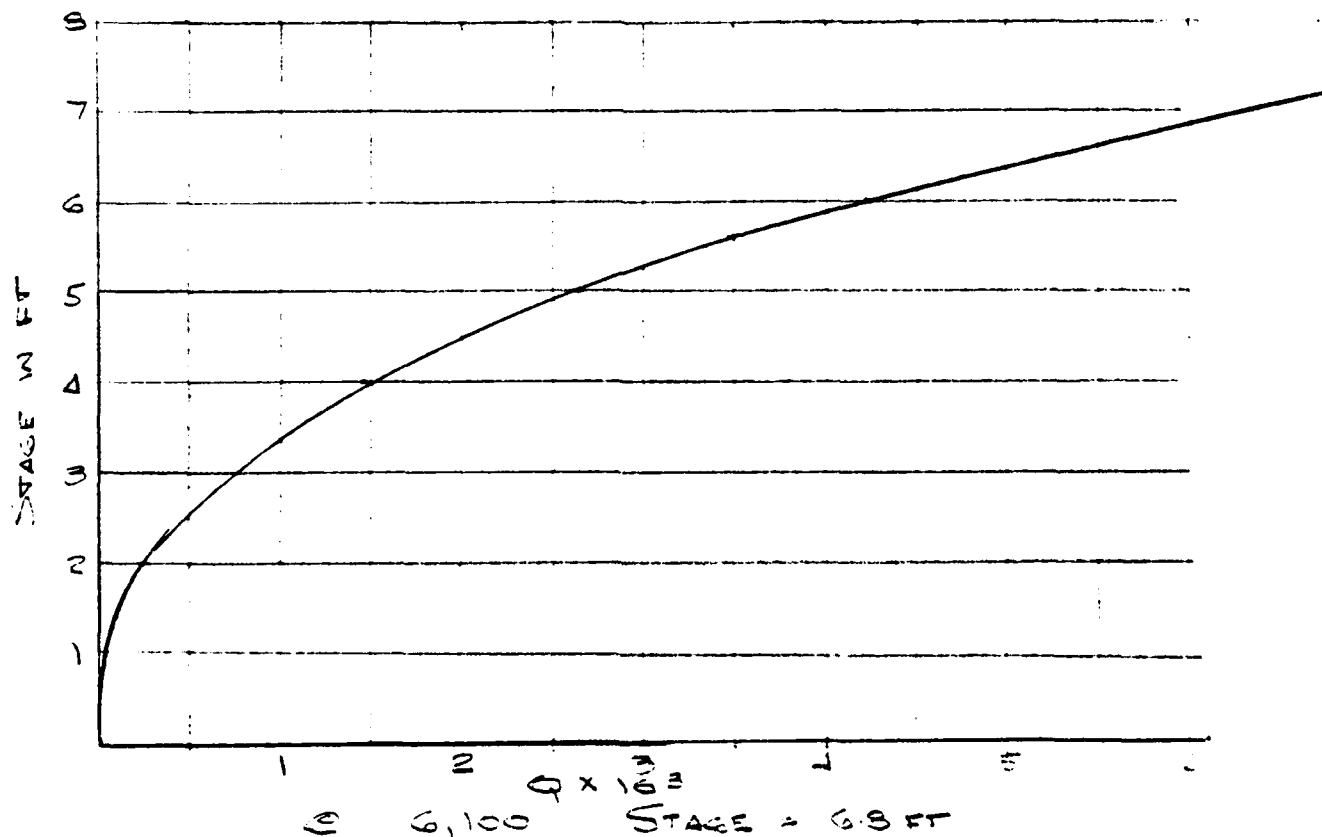
$$Q = 571 A R^{2/3}$$

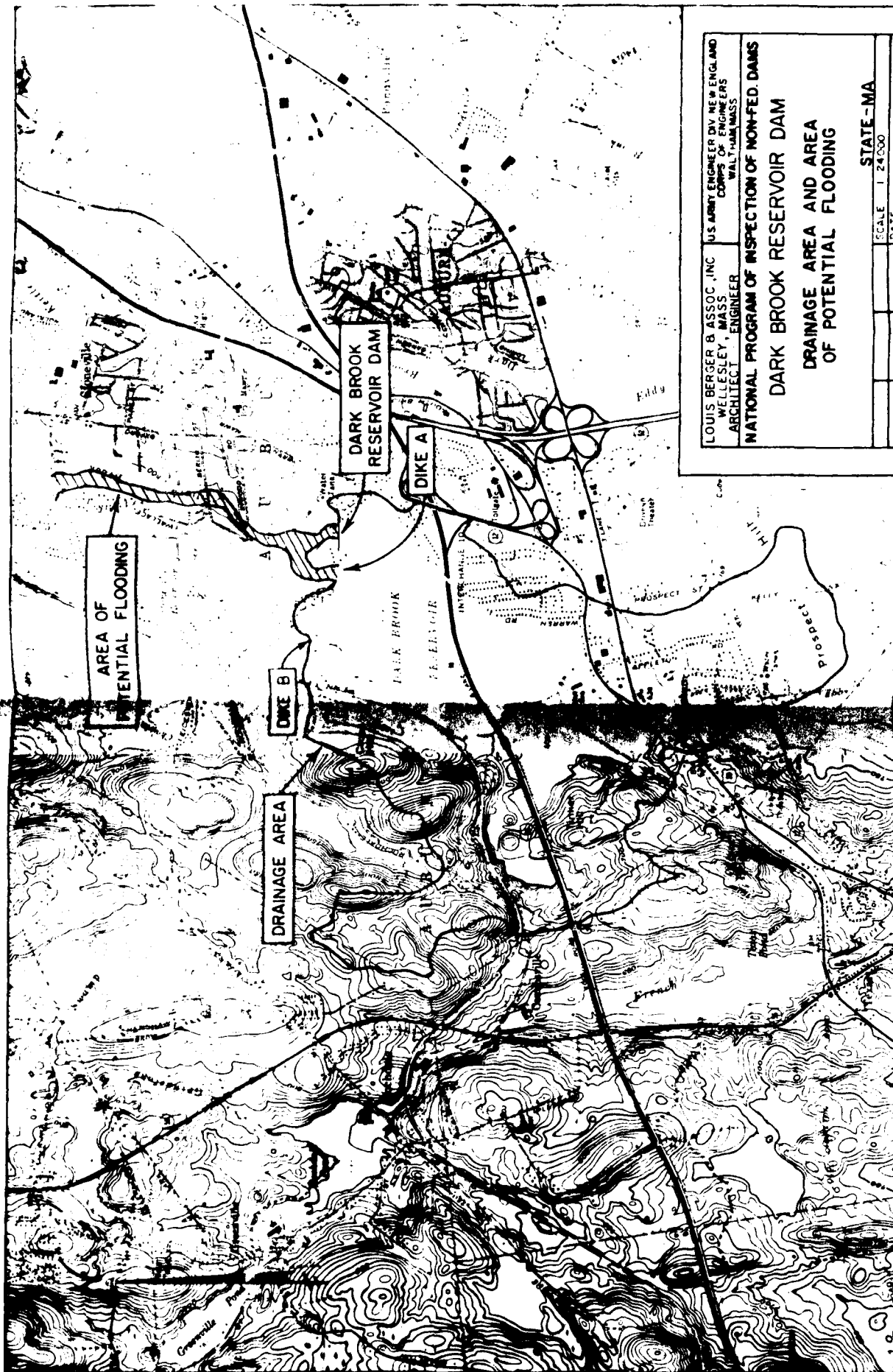
$$S^{1/2} = 0.173$$

$$R = 0.045$$



STAGE	AREA	P	$R^{2/3}$	Q
2	40	40.2	1.0	230
4	160	30.2	1.58	1460
5	250	100.5	1.84	2630
6	363	125.6	2.03	4210
7	500	150.7	2.23	6370





LOUIS BERGER & ASSOC., INC.
WELLESLEY, MASS.
ARCHITECT-ENGINEER

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

DARK BROOK RESERVOIR DAM

DRAINAGE AREA AND AREA
OF POTENTIAL FLOODING

STATE-MA
SCALE 1" = 24,000'
DATE

APPENDIX E

INFORMATION AS CONTAINED
IN THE
NATIONAL INVENTORY OF DAMS

10-77
1-77

INVENTORY OF DAMS IN THE UNITED STATES

FEDERAL DIVISION NUMBER	STATE	COUNTY	DIST.	CONGR. DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
194	MA	27	05		DARK BROOK RESERVOIR DAM	4211.9	7151.5	15APR80

POPULAR NAME		NAME OF IMPOUNDMENT	
		DARK BROOK RESERVOIR	
RE-ION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY - TOWN - VILLAGE	DIST FROM DAM (MI.)
0113	DARK BROOK	AUBURN	0
			15300

TYPE OF DAM	YEAR COMPLETED	PURPOSES	SURFACE HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES	
					MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)
WFO	1950	R	22	17	4000	1800

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

REMARKS	
AS-POWER POWER PLANT COOLING WATER	

D/S HAS	SPILLWAY TYPE	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (KW)	POWER CAPACITY PROPOSED (KW)	NAVIGATION LOCKS			
						NO.	LENGTH (FT.)	WIDTH (FT.)	DEPTH (FT.)
1	740	13	20000						

OWNER	ENGINEERING BY	CONSTRUCTION BY
MASSACHUSETTS ELECT CO.	NEW ENGLAND POWER SER CO	NEW ENGLAND POWER SER CO

REGULATORY AGENCY		
DESIGN	CONSTRUCTION	OPERATION
	NONE	NONE

INSPECTION BY	INSPECTION DATE		AUTHORITY FOR INSPECTION
	DAY	MO YR	
LOUIS BERGER & ASSOC INC	15	APR 80	PL 92-363

REMARKS	

END

FILMED

7-85

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