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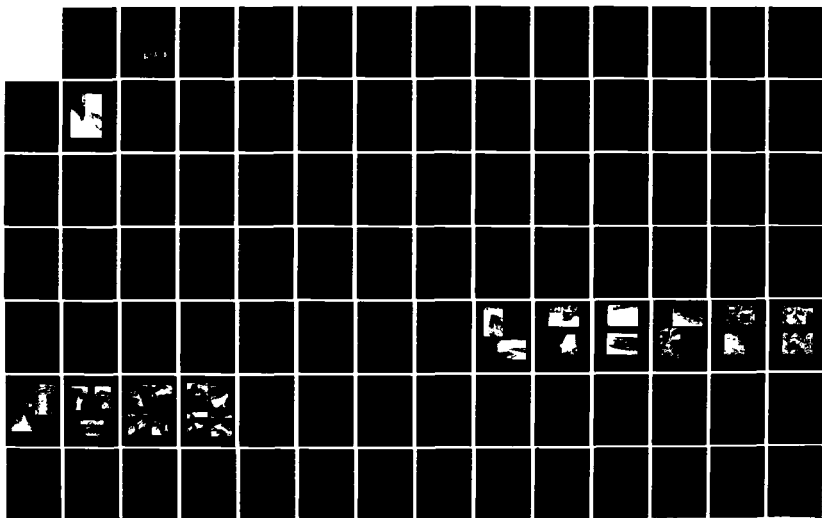
NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
WESTCONNAUG RESERVOIR (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 81

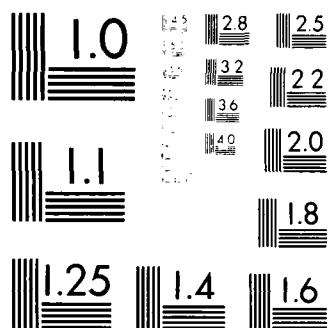
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MICROCOPY RESOLUTION TEST CHART
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**PAWTUXET RIVER BASIN
(NORTH BRANCH)
FOSTER, RHODE ISLAND**

**WESTCONNAUG RESERVOIR DAM
RI 01201**

**PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

AD-A156 838

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

MARCH 1981

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Pawtuxet River Basin (North Branch) Foster, Rhode Island Providence Water Supply Board		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam is an earth embankment dam with a downstream stone masonry wall. The dam is about 320 ft. long and 17 ft. high. The dam is considered to be in generally good condition. The overall rating must be fair, however, due to the spillway inadequacy. It is intermediate in size with a high hazard potential. The test flood for the dam is the PMF.		

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

REPLY TO
ATTENTION OF:

JUN 15 1921

NEDED-E

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

Inclosed is a copy of the Westconnaug Reservoir Dam (RI-01201) Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Westconnaug Reservoir Dam would likely be exceeded by floods greater than 4 percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

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

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

NEDED-E

Honorable J. Joseph Garrahy

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to the Department of Environmental Management, the cooperating agency for the State of Rhode Island. This report has also been furnished to the owner of the project, Providence Water Supply Board, Providence, RI.

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

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

Sincerely,



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

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**PAWTUXET RIVER BASIN
(NORTH BRANCH)
FOSTER, RHODE ISLAND**

**WESTCONNAUG RESERVOIR DAM
RI 01201**

**PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**



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

MARCH 1981

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.: RI 01201
Name of Dam: Westconnaug Reservoir Dam
Town: Foster
County & State: Providence, Rhode Island
Stream: Westconnaug Brook
Owner: Providence Water Supply Board
Date of Inspection: 1 December 1980

BRIEF ASSESSMENT

Westconnaug Reservoir Dam is an earth embankment dam with a downstream stone masonry wall. The dam is approximately 320 feet long, 17 feet high above the stream bed, and 16 feet wide at the crest. A portion of the upstream slope is protected by a concrete apron poured over riprap, approximately 100 feet to the left and 75 feet to the right of the spillway. The downstream stone masonry wall was originally constructed of dry masonry; joints were later concreted. The spillway is approximately 16 feet wide and has 3 foot high masonry training walls on both sides. A 16" diameter outlet conduit passes through the base of the dam on the right side of the spillway. The outlet control structure consists of a gate chamber with a grated inlet. A gate valve located within the structure is manually operated through a gate box on top of the dam.

The facility is a part of the Scituate Reservoir System. Its reservoir has a maximum storage capacity of 1,950 acre-feet at the top of the dam, and its drainage area is approximately 4 square miles. The dam was designed and constructed in 1845 for power generation purposes. Later it was used for water supply purposes by a private company until it was purchased by the Providence Water Supply Board during the 1920's. In 1964 there was a general upgrading program and later, during 1974, a repair was instituted on the dam.

As a result of the visual inspection, hydrologic and hydraulic computations, and the review of available data regarding this facility, the dam is considered to be in generally good condition structurally. The overall rating must

be FAIR, however, due to the spillway inadequacy. To assure the long-term performance of the structure, there are a number of items which require attention. Adequate spillway capacity should be provided or the dam should be designed to structurally withstand overtopping. It is important to monitor the flow from the drainpipe at the base of the dam to determine the saturation levels within the dam and to monitor seepage on a regular basis. Trees growing downstream of the dam should be cut, and saplings and brush growing on the upstream embankment should also be cleared. The alignment of the downstream masonry wall should be checked periodically in order to determine any horizontal movement.

The dam is classified as INTERMEDIATE in size and as having a HIGH hazard potential, in accordance with the recommended guidelines established by the Corps of Engineers.

The test flood for this dam is the Probable Maximum Flood. This test flood has an inflow of 7,450 cfs and an outflow discharge of 6,390 cfs, which will overtop the dam by 3.7 feet. The maximum outflow capacity of the spillway and low level discharge pipe, when water level is at the top of the dam, is 260 cfs. This represents 4% of the test flood outflow.

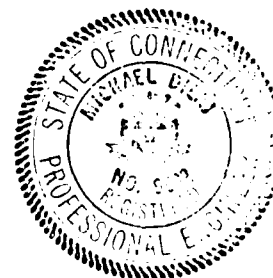
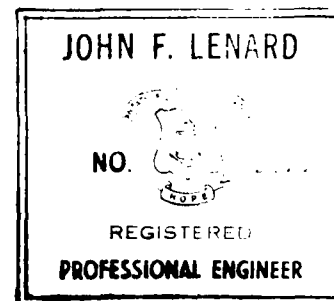
It is recommended that the Owner retain the services of a registered professional engineer to perform the tasks outlined in Section 7 of this report. These recommendations and any further remedial measures should be instituted within one year of the Owner's receipt of this report.

LENARD & DILAJ ENGINEERING, INC.

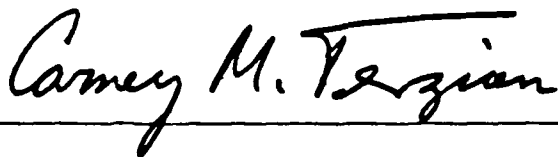
By:

John F. Lenard
John F. Lenard, P.E.
President

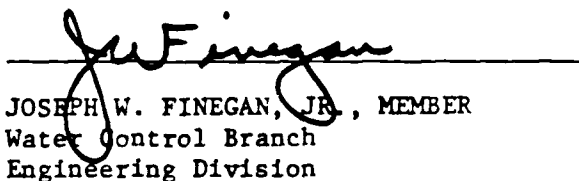
Michael Dilaj
Michael Dilaj, P.E., Vice President
Project Manager



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



CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

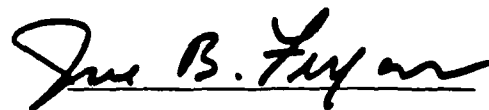


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division



ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and 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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A horizontal drain was placed 13.6 feet to the right of the spillway and its discharge at the time of inspection was minor (Photo 10). At the upstream end of the horizontal drain there is a vertical standpipe extending to the crest of the dam. The standpipe has been monitored in the past (See Appendix B), indicating that the water level is at the bottom of the pipe, i.e., that the horizontal drain has remained open. Two observation wells located in a line about 7 feet from the spillway wall have also been monitored in the past (See Appendix B). One of the wells, however, dropped about 6 inches since its installation. The horizontal drain is about 5 feet further from the spillway than the line of the two observation wells. Observation Well 2, about 5.5 feet from the drain, indicates a water level about 5 feet higher than the drain elevation. Thus the efflorescence and seepage observed through the downstream wall between the drain and the spillway are consistent with the observation well readings. The water level behind the concrete and stone walls is probably at an elevation of about 4 to 5 feet above the base of the wall immediately to the right of the spillway.

At about 15 to 20 feet downstream of the dam there is seepage and standing water along most of the length of the dam left of the spillway and also immediately to the right of the spillway (Photos 11, 12, and aerial photo). Flowing water can be observed in some locations after removal of leaves and twigs covering the area. No silt transportation was observed. Because of the wetland characteristics of this area, however, the amount of seepage directly attributable to the dam could not be estimated.

The left downstream stone wall is bulging somewhat about half-way between the spillway and the end of the dam. It is uncertain whether it was constructed in this manner or whether frost and other physical actions may have moved it out of alignment.

- c. Appurtenant Structures: The spillway training walls are in good condition (Photo 6). The downstream wall of the spillway is also in good condition with evidence of only minor seepage.

The intake and gate structure, rebuilt in 1964, appear to be in good condition. To prevent damage by vandalism there is a permanent concrete cover with a 4-inch pipe sleeve for inserting a key to operate the gate valve. Thus, the gate valve mechanism cannot be inspected on a regular basis. The corner of the concrete is chipped (Photo 4).

SECTION 3
VISUAL INSPECTION

3.1 Findings:

- a. General: An inspection of the Westconnaug Reservoir Dam was performed on December 1, 1980 by Lenard & Dilaj Engineering, Inc., with the assistance of Geotechnical Engineers, Inc. The weather was clear and sunny with temperatures in the 30°F range. At the time of inspection the water level in the reservoir was practically at the spillway crest.
- b. Dam: The dam is an earth embankment type with a downstream ashlar masonry wall. The joints of the downstream wall have been covered with mortar over most of the dam. Immediately to the right of the spillway a concrete wall was built in 1964, adjacent to the upstream side of the stone wall, in order to decrease seepage. During 1970 more extensive seepage occurred and it was found that this new wall had been undermined, with large cavities eroded beneath it. Additional walls were installed parallel to the spillway and the downstream wall to a greater depth than the previous walls. Observation wells were also installed at this time to monitor groundwater levels (see discussion later). There was no extensive seepage observed since this repair.

The upstream slope has riprap covered by a concrete facing (constructed in 1974) from the crest to about one foot below the spillway crest level. The concrete facing is in good condition with a few minor cracks (Photo 3). The crest of the dam is partially covered with grass, with vehicle tracks to the right of the spillway and footpaths to the left of the spillway. There is minor erosion at the left abutment at the end of the downstream wall.

The downstream wall is of cut masonry, apparently dry when originally constructed. The joints were later patched with mortar. The wall is in generally good condition (Photo 7). Because of the normally irregular wall surface it is not possible to ascertain if minor bulging of the wall may have occurred. The wall surface shows evidence of seepage or efflorescence on both sides of the spillway. There are a few locations where the mortar has fallen leaving open joints as shown in Photos 8 and 9.

2.4 Evaluation:

- a. Availability: Data was not readily available by the dam safety engineer. The project was not on the State Land Resources and Planning Board's list of projects. There was no project file maintained by the water-material make-good project.
- b. Adequacy: The project was not on the engineering data available for the project. The project was not an in-depth study of the project. Therefore, the structural integrity of the dam could not be assessed. The project was not a design and construction project. The project was not a visual inspection. The project was not a field inspection. Information from the project was not available. The project was not a sound engineering project.
- c. Validity: A comparison of the data, photographs, and other construction information and visual observation reveals no observable significant discrepancies in the record data.

SECTION 2

ENGINEERING DATA

- 2.1 Design: According to information from the Providence Water Supply Board, the dam was probably designed and constructed during the end of the past century for power generation. Later it was used for water supply purposes by a private company, until the reservoir was purchased by the Providence Water Supply Board during the 1920's. During 1964 there was a general upgrading program of the entire water supply system, and within this system, Westconnaug Reservoir was also improved. Plans for this upgrading are attached in the Appendix. Subsequently, a serious leak developed on the east side of the spillway and further improvements were made. Plans for these improvements along with photographs are enclosed in this report.
- 2.2 Construction: Very little is known about the original construction, other than the plans shown in this report. The material make-up of the dam is unknown. As indicated above, reconstruction of the dam took place during 1964 and it was again repaired during 1974. Photographs and plans for these two phases of construction are available and shown in this report. Indications are that at some time prior to the 1964 construction the dam was raised approximately 18" along its entire length. This is based on the layer of stone slightly offset from the face of the downstream ashlar masonry wall.
- 2.3 Operation: The dam and appurtenant works are operated by the Providence Water Supply Board. The general area is patrolled and maintained by the watershed management personnel, and the facilities are regularly inspected by the engineering department. The sluiceway is opened only during times when water from the reservoir is utilized. The reservoir is usually kept full for the basic purpose of storing water for the system. In case water is needed, the sluiceway is opened and the water runs down into the other reservoirs of the system. A flow chart of the system, showing the contribution of this reservoir, is attached in the appendix of this report. According to information from the Water Supply Board, the dam has never been overtopped.

- | | |
|---------------------|---------|
| 6. Zoning: | Unknown |
| 7. Impervious core: | Unknown |
| 8. Cutoff | Unknown |
| 9. Grout curtain: | Unknown |
- h. Diversion and Regulating Tunnel: N/A
- i. Spillway:
- | | |
|--|-----------------------|
| 1. Type: | Concrete, broad crest |
| 2. Length of weir: | 16 feet |
| 3. Crest elevation
(without flashboards): | 454.2 |
| 4. Gates: | None |
| 5. U/S channel: | Reservoir bottom |
| 6. D/S channel: | Natural bed |
- j. Regulating outlets:
- | | |
|-----------------------|---|
| 1. Invert: | 440.3 |
| 2. Size: | 16" diameter |
| 3. Description: | Cast iron pipe |
| 4. Control mechanism: | Gate valve |
| 5. Other: | The gate valve is located in a chamber at the upstream end of the outlet conduit and must be operated manually. |

- | | | |
|----|------------------------------------|---|
| 8. | Top of dam: | 457.2 |
| 9. | Test flood surcharge: | 460.9 |
| d. | <u>Reservoir (Length in Feet):</u> | |
| 1. | Normal pool: | 8,100 |
| 2. | Flood control pool: | N/A |
| 3. | Spillway crest pool | 8,100 |
| 4. | Top of dam: | 8,400 |
| 5. | Test flood pool: | 10,600 |
| e. | <u>Storage (acre-feet):</u> | |
| 1. | Normal pool: | 1,390 |
| 2. | Flood control pool: | N/A |
| 3. | Spillway crest pool: | 1,390 |
| 4. | Top of dam: | 1,950 |
| 5. | Test flood pool: | 2,750 |
| f. | <u>Reservoir Surface (acres):</u> | |
| 1. | Normal pool | 170 |
| 2. | Flood control pool: | N/A |
| 3. | Spillway crest: | 170 |
| 4. | Test flood pool: | 240 |
| 5. | Top of dam: | 200 |
| g. | <u>Dam:</u> | |
| 1. | Type | Earth embankment |
| 2. | Length: | 320 feet |
| 3. | Height: | 17 feet |
| 4. | Top width: | 16 feet |
| 5. | Side slopes: | Upstream: 3H:1V
Downstream: Vertical |

b. Discharge at Dam Site: No discharge records are maintained at this facility. The gates are opened when additional water is needed for the water supply system. Listed below are calculated discharge data for the spillway and outlet works:

1. Outlet works:
 Size: 16" diameter cast iron pipe
 Invert Elev.: 440.3 feet
 Discharge capacity: 33 cfs (at spillway Elev.)
2. Maximum known flood at dam site: Discharge unknown
3. Ungated spillway capacity at top of dam: 220 cfs at Elev. 457.2
4. Ungated spillway capacity at test flood elevation: 740 cfs at Elev. 460.9
5. Outlet works capacity at normal pool elevation: 36 cfs at Elev. 454.2
6. Outlet works capacity at test flood elevation: 40 cfs at Elev. 460.9
7. Total discharge capacity at test flood elevation: 790 cfs at Elev. 460.9
8. Total project discharge at top of dam: 256 cfs at Elev. 457.2
9. Total project discharge at test flood elevation: 6,390 cfs at Elev. 460.9

c. Elevation (Feet Above National Geodetic Vertical Datum):

1. Streambed at toe of dam: 440.3
2. Bottom of cutoff: Unknown
3. Maximum tailwater: Unknown
4. Normal pool: 454.2
5. Full flood control pool: N/A
6. Spillway crest: 454.2
7. Design surcharge: Unknown

- g. Purpose of Dam: The dam at Westconnaug Reservoir impounds water from Westconnaug Brook. It is used as the water supply for the Providence Water Supply System.
- h. Design and Construction History: The dam was constructed in 1845 for power generation purposes. It was later purchased by a private water company for water supply purposes. During the 1920's it was purchased by the present owner, the Providence Water Supply Board. In 1964 there was a general upgrading program and the dam was considerably improved. Later, a serious leak developed on the right side of the spillway and further improvements were implemented. Design plans, construction records, and photographs showing the upgrading and repairs are presented in this report. They were made available by the Providence Water Supply Board. A brief history of the original construction is also presented under the engineering data.
- i. Normal Operating Procedure: Normally the water level is maintained at spillway elevation, unless there is a projected hurricane or extensive precipitation. In this case, the outlet conduit is reportedly opened and the water level is lowered in anticipation of the storm event. In case there is need for the water in the system, it is discharged through the outlet conduit and into Scituate Reservoir, from which it passes into the Providence system.

Excess water in the reservoir passes over the spillway crest and into the brook downstream of the dam. Normal operating procedures do not provide low flow releases to the stream below the dam.

1.3 Pertinent Data:

- a. Drainage Area: Westconnaug Reservoir Dam is located in the Town of Foster in western Rhode Island. The drainage basin is generally irregular in shape with a length of approximately 2.3 miles along its long (north-south) axis and a width of 2 miles. The total drainage area is 3.87 square miles. The topography consists of rolling terrain with elevations ranging from 454 feet at the spillway crest to a high of 690 feet at the western divide. Basin slopes are moderate to steep with grades of 5% to 25%. The average time of concentration for the entire drainage basin is estimated to be about 5.1 hours.

16" diameter outlet conduit on the right side of the spillway passing beneath the main body of the dam. The outlet control structure consists of a gate chamber with a grated inlet and a reinforced concrete structure with a cover cast permanently into place. There is a small hole (gate box) through the top of the structure to insert a key to operate a gate valve on the pipe. There is no access to the valve chamber for maintenance purposes. Water level is normally maintained at spillway elevation. The gate valve is reportedly opened when there is need downstream for water or an extraordinary storm is anticipated. Water passing over the spillway or through the outlet conduit discharges into Westconnaug Brook.

- c. Size Classification: With the pool level at the top of the dam, the impoundment capacity of the reservoir is 1,950 acre-feet. The height of the dam above the stream bed is 17 feet. The dam is therefore classified as an INTERMEDIATE structure, based on impoundment, in accordance with the recommended guidelines of the Corps of Engineers.
- d. Hazard Classification: The dam is classified as having a HIGH hazard potential, because the failure discharge can cause damage due to high velocity, impact from debris, and flooding to 6 or 7 homes, 3 roads (State Road #94, Field Road and Tunk Hill Road) and public utilities. The failure could also cause the potential loss of more than a few lives, since the anticipated water depth at the homes may be 2 to 3 feet. Loss of the surface water supply will also cause an impact on the Providence Water Supply System. The estimated increase in water depths due to the dam failure discharge of 11,300 cfs may range from 17 feet at the dam to 9 feet at a distance of 1,300 feet downstream.
- e. Ownership: Westconnaug Reservoir Dam is owned by the Providence Water Supply Board, 552 Academy Avenue, Providence, RI 02908
- f. Operator: Operating personnel for the dam are under the direction of Wiley Archer, Chief Engineer, Providence Water Supply Board, 552 Academy Avenue, Providence, RI 02908, telephone (401) 521-6300.

The watershed is controlled by the Watershed Division under Hans T. Bergey, Watershed Manager, telephone (401) 821-8050.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.
4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report does not pass judgment on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 Description of the Project:

- a. Location: The project is located on Westconnaug Brook, a tributary to Scituate Reservoir located approximately 1.5 miles downstream of Westconnaug Reservoir. The reservoir and dam are located in the Town of Foster, County of Providence and State of Rhode Island. The dam is located just south of Route 94 (Plainfield Pike) and Field Road, and is shown on the Clayville, Rhode Island USGS quadrangle map, having coordinates $41^{\circ} 46' 21''$ (north latitude) and $71^{\circ} 40' 40''$ (west longitude).
- b. Description of Dam and Appurtenances: The dam at Westconnaug Reservoir is approximately 320 feet in length; it is an earth embankment dam with a vertical downstream stone masonry wall. The dam is 17 feet high at the discharge pipe near the spillway. The average height is approximately 11 feet, with a crest width of about 16 feet. The typical upstream slope is about 1 vertical to 3 horizontal. It is protected by a concrete apron extending approximately 100 feet to the left and 75 feet to the right of the spillway. A reinforced concrete spillway is located to the right of the center of the dam. It is 16 feet wide and the two vertical masonry training walls are approximately 3 feet high. The spillway is located approximately at the original stream known as Westconnaug Brook. This brook flows into the Scituate Reservoir system approximately 1.5 miles downstream from this facility. There is a

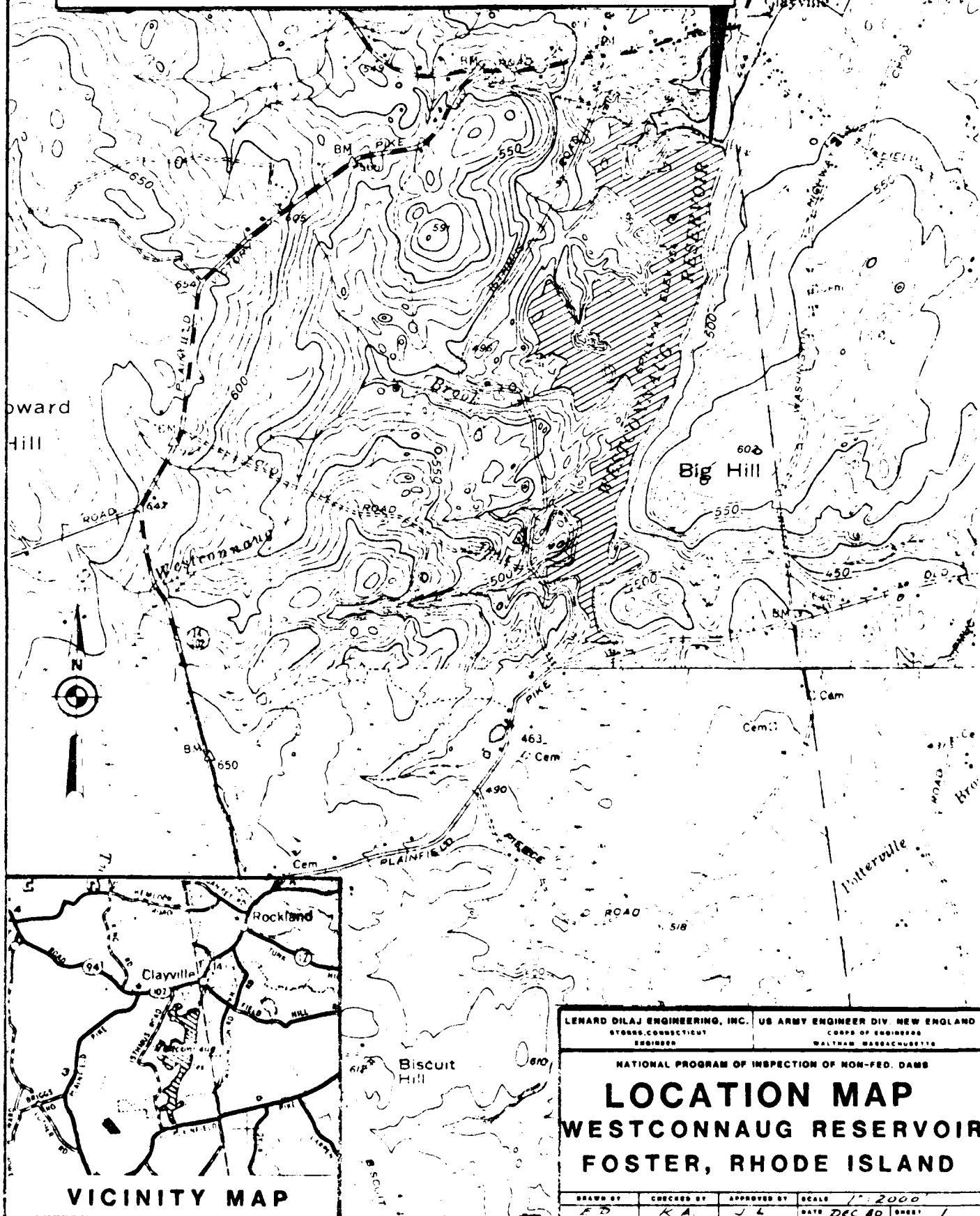
PHASE I INSPECTION REPORT

SECTION I - 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. Lenard & Dilaj Engineering, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of Connecticut and Rhode Island. Authorization and notice to proceed were issued to Lenard & Dilaj Engineering, Inc. under a letter of 6 November, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-81-C-0014 has been assigned by the Corps of Engineers for this work.
- b. Purpose of Inspection Program: The purposes of the program are to:
 1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interest.
 2. Encourage and prepare the states to quickly initiate effective dam inspection programs for non-federal dams.
 3. To update, verify and complete the National Inventory of Dams.
- c. Scope of Inspection Program: The scope of this Phase I inspection report includes:
 1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.
 2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

WESTCONNAUG RESERVOIR DAM



VICINITY MAP

LENARD DILAJ ENGINEERING, INC. US ARMY ENGINEER DIV. NEW ENGLAND
STORRS, CONNECTICUT CORPS OF ENGINEERS
ENGINEER WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION MAP WESTCONNAUG RESERVOIR FOSTER, RHODE ISLAND

DRAWN BY	CHECKED BY	APPROVED BY	SCALE
FD	KA	JL	1" = 2000'
			DATE DEC 10 SHEET 1



OVERVIEW PHOTO

TAKEN 15 DEC. 1980

US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM MASSACHUSETTS

LENARD-DILAJ ENGINEERING, INC
STORRS CONNECTICUT
ENGINEER

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED DAMS

WESTCONNAUG RESERVOIR
FOSTER, RHODE ISLAND

RI 01201

JAN. 1981

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APPENDICES

APPENDIX A - INSPECTION CHECKLIST

APPENDIX B - ENGINEERING DATA

APPENDIX C - PHOTOGRAPHS

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

d. Reservoir: There is no visual evidence of instability along the edge of the reservoir in the vicinity of the dam.

e. Downstream Channel: The downstream channel is the natural stream bed and does not have significant obstructions to the flow.

3.2 Evaluation: On the basis of the visual inspection, the dam is judged to be in good condition. The proper operation of the single drainage pipe immediately to the right of the spillway is an important feature for the integrity of this section of the downstream concrete and stone walls. If the drainage pipe were to become clogged, water pressures could increase behind these walls. The seepage observed downstream of the dam presents no immediate threat to the dam but merits periodic observation.

The trees growing downstream of the dam could, after they die out, cause foundation seepage to concentrate along decaying roots. Saplings and brush have started to grow on the upstream side of the dam and could eventually cause the same type of seepage problems.

The permanent concrete cap on the valve vault does not allow maintenance or repair of the gate structure.

There is some bulging on the left downstream wall, which must be monitored to determine whether or not a problem exists.

SECTION 4

OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures:

- a. General: The Providence Water Supply Board watershed management is responsible for patrolling and maintaining the watershed, including the dam. The physical maintenance of the dam and the operation of the valves is supervised by the engineering staff of the Providence Water Supply Board. Water is generally maintained at spillway level unless there is a need for the water stored in the reservoir, in which case the gate valve is opened and water is discharged into the channel.
- b. Description of Any Warning System in Effect: Emergency action and/or warning would be coordinated through the Providence Water Supply Board through their offices in Providence, Rhode Island. No formal emergency or contingency plan is in effect to reduce or minimize the downstream impact of flood flows in emergency situations. Monitoring of the approach of intense storm activity is normally through the U.S. Weather Service or local weather forecast.

4.2 Maintenance Procedures:

- a. General: The phreatic surface near the spillway is monitored on an intermittent basis by the three observation wells on the dam. Maintenance is generally carried out as required. There are a few small trees growing on the dam not exceeding three inches in diameter. There is considerable tree growth on the downstream side, but away from the ashlar masonry wall. There is more maintenance needed on the downstream side.
- b. Operating Facilities: To protect the gate valve from vandalism, a concrete cap was cast for the valve chamber. Consequently, there is no access to the chamber itself. The concrete cap would have to be removed with a jack hammer before the gate valve were to become accessible. There is a trash rack in front of the intake which is cleaned intermittently. All the joints in the masonry wall on the downstream side appear to have been filled with grout. Many of these joints are now cracked and the grout has been removed by water seepage.

- 4.3 Evaluation: Operational and maintenance procedures are generally satisfactory. Nevertheless, it should be systemized, and emergency warning procedures should be developed.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

- 5.1 General: Westconnaug Reservoir Dam is an earth embankment dam with a vertical stone masonry face on the downstream side. The dam is approximately 320 feet long and an average of 11 feet high. The highest point is at the spillway, where the dam reaches a height of 17 feet. The spillway is 16 feet wide and the crest is 3 feet below the top of the dam. For purposes of hydraulic calculations, the spillway weir was considered as a broad crest. A 16-inch discharge pipe passes beneath the right abutment of the dam adjacent to the spillway and is controlled by a gate valve.

The downstream channel is approximately 16 feet wide at the base of the dam and spreads out into a ponded swampy area about 100 feet further downstream. The channel is in fairly good condition, but the banks are overgrown with trees and brush.

The watershed encompasses an area of 3.87 square miles and is basically undeveloped. A few houses can be found along the major roads passing through the watershed area.

At spillway elevation, Westconnaug Reservoir has a storage capacity of 1,390 acre-feet; this increases to 1,952 acre-feet at the top of the dam.

- 5.2 Design Data: No design data was found to be available for the original construction of this dam. Some records of the repairs were found to be available and have been included in the Appendix.
- 5.3 Experience Data: No records, other than the observations of the well points since the 1964 installation, were found to be available. Although no specific records could be found, the dam reportedly has never been overtopped since the reservoir has been under the observation of the Providence Water Supply Board.
- 5.4 Test Flood Analysis: Based on the "Recommended Guidelines for Safety Inspection of Dams", the dam is classified as INTERMEDIATE in size with a HIGH hazard potential. The test flood for these conditions is the Probable Maximum Flood (PMF).

Using the HEC-1 Flood Hydrograph Computer Program developed by the Army Corps of Engineers for dam safety investigations, the inflow and outflow for the test flood were found to be 7,450 cfs and 6,390 cfs, respectively. As a basis of comparison, the PMF resulted in an inflow of 3,730 cfs and an

outflow of 2,630 cfs. The outflow capacity of the spillway and low level outlet at Westconnaug Reservoir Dam is 256 cfs with the water level at the top of the dam. This represents 4% of the test flood outflow. The maximum overtopping associated with the test flood outflow is 3.7 feet over the top of the dam. The duration of the overtopping would be approximately 35 hours.

In development of the inflow hydrograph, it was assumed that the wetland areas just to the south of the reservoir would have no effect on the peak inflow. Although there is some storage available, the effect would be negligible during the occurrence of the PMF. Consequently, this simplified view of the inflow hydrograph gives a more conservative estimate of the effects at Westconnaug Reservoir Dam.

- 5.5 Dam Failure Analysis: A dam failure analysis was performed using the "Rule of Thumb" method for estimating downstream dam failure hydrographs, as developed by the Corps of Engineers. Failure was assumed to occur when the water level in the reservoir was at the level of the top of the dam. The calculated dam failure discharge is 11,300 cfs and will produce an increase in the depth of flow of approximately 9 feet at a point 1,300 feet downstream of the dam. The failure analysis covered a distance of 7,000 feet downstream, as shown by the calculations in Appendix D. The increase in the depth of flow at that point (a short distance before entering Scituate Reservoir) was calculated to be 6 feet for the dam failure. The depth of flow resulting from the pre-failure discharge of 256 cfs would be about 0.5 feet and 1 foot, respectively, for the sections mentioned above.

The dam breach would cause appreciable damage downstream of the dam and might result in the loss of more than a few lives. Several houses immediately downstream, in the vicinity of Field Road and Plainfield Pike, could be flooded to depths of 2 to 3 feet due to these flows, which could result in the loss of lives if adequate forewarning were not provided. Serious damage to the bridge on Field Road and three additional road crossings further downstream could also result.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

- 6.1 Visual Observations: The visual inspection did not disclose any indication of present structural instability. Future stability in the section of the dam immediately to the right of the spillway depends on the proper operation of the horizontal drain.

The slight misalignment at the center of the left downstream stone wall may be caused by physical forces rather than construction irregularity. Future monitoring of this wall may reveal whether inadequate drainage behind the wall causes this problem.

- 6.2 Design and Construction Data: There is no available design and construction data on the original construction of the dam.

- 6.3 Post-Construction Changes: In 1964 a new inlet and gate structure were built as shown in drawings made available by the owner. Drawings and photographs of repairs made in 1974 were also reviewed. The 1974 repairs consisted principally of:

1. Reconstruction of the spillway slab that had been undermined by piping of soil through the downstream wall.
2. Construction of a concrete wall along the downstream stone wall and spillway-dam contact, immediately to the right of the spillway.
3. Installation of two observation wells and a horizontal drain in the same section of the dam.
4. Placement of a concrete facing over the riprap.
5. Grouting of joints in the downstream masonry wall, which should not have taken place because it could raise the phreatic surface within the dam.

- 6.4 Seismic Stability: The dam is located near the boundary between seismic zones 1 and 2 and, in accordance with the Phase I inspection guidelines, does not warrant seismic stability analysis.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL PROCEDURES

7.1 Dam Assessment:

- a. Condition: On the basis of the visual inspection and a review of available information the dam is judged to be in good condition structurally, but must be rated FAIR overall because of the spillway inadequacy. Recommendations are presented in Section 7.3 to monitor the continuing operation of a drain and the seepage downstream of the dam which could affect its future integrity.
- b. Adequacy of Information: The evaluation presented in this report is based on the visual inspection and on a review of the available information concerning the 1964 and 1974 repairs of the dam.
- c. Urgency: The recommendations presented below should be carried out within one year after receipt of this report by the Owner.

7.2 Recommendations: The following should be carried out under the direction of a qualified registered engineer:

- a. The alignment of the left downstream stone masonry wall should be monitored to determine if the bulging is caused by horizontal movement or if it was built in its present form.
- b. As shown in the hydrologic and hydraulic calculations, the spillway is only capable of handling 4% of the test flood outflow. A qualified engineer should therefore perform a detailed hydrologic-hydraulic investigation to assess further the potential of overtopping the dam and the need for and the means to increase the project discharge capacity.
- c. Any future grouting operations or repairs on the downstream masonry wall should be done under the supervision of an engineer.
- d. Remove all trees, brush and debris from the dam and within 20 feet of the toe. Any resulting voids from root removal should be backfilled with a suitable compacted material, and a protective vegetative cover should be established over all bare areas.

7.3 Remedial Measures:

- a. Operation and Maintenance Procedures: A formal operation and maintenance program should be established. The program should include:
1. Monitoring of flow out of the downstream drain right of the spillway every two months.
 2. Observation of seepage areas for indications of concentrated flow and soil transport every two months.
 3. Continue the present technical inspections on an annual basis, or more frequently if necessary.
 4. 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.

7.4 Alternatives: There are no practical alternatives to the above listed recommendations in Sections 7.2 and 7.3.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT WEST VIRGINIA REVERDINE DAM

DATE DECEMBER 1, 1949

TIME 9:30

WEATHER Cloudy

At drill-
W.S. ELEV. 100 U.S. 100 DN.S.

PARTY:

1. John Doe - D.F.B.

6. *Edmund Bendurevskis* - Providence

2. Walter Dill - D.D.S.

7. Water Supply Board

3. Michael Barmannski - L.R.E.T.

8. *Hans T. Berger - Providence Water*

4. Gonzalo Guevara - GFI

9. _____

5. _____

10. _____

PROJECT FEATURE

INSPECTED BY

REMARKS

1.

_____.

PERIODIC INSPECTION CHECKLIST

PROJECT WESTHOONANG RESERVOIR DAM DATE DECEMBER 1, 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>DAM EMBANKMENT</u>	
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	<i>Reportedly never overtopped.</i>
Surface Cracks	<i>None observed.</i>
Pavement Condition	<i>Not applicable.</i>
Movement or Settlement of Crest	<i>None observed.</i>
Lateral Movement	<i>Possibly some bulging of downstream wall. (See Site Plan)</i>
Vertical Alignment	<i>Too impervious to judge</i>
Horizontal Alignment	<i>See lateral movement.</i>
Condition at Abutment and at Concrete Structures	<i>Good. Some erosion at left end of downstream wall.</i>
Indications of Movement of Structural Items on Slopes	<i>Not applicable.</i>
Trespassing on Slopes	<i>Footpaths on crest and at left abutment. Vehicle tracks at right abutment.</i>
Sloughing or Erosion of Slopes or Abutments	<i>None observed.</i>
Rock Slope Protection - Riprap Failures	<i>Slough observed with concrete. 1st condition, some erosion.</i>
Unusual Movement or Cracking at or Near Toe	<i>None observed.</i>
Unusual Embankment or Downstream Seepage	<i>Seepage 11 to 12 ft. downstream of dam along crest. 200' length of left portion of dam.</i>
Piping or Boils	<i>None observed.</i>
Foundation Drainage Features	<i>None known or observed.</i>
Toe Drains	<i>None known. One drain hole through downstream wall.</i>
Instrumentation System	<i>Information walls, no instrumentation wall apparently installed at 1st condition, some erosion.</i>
Vegetation	<i>Vegetation on crest and at left abutment. 1st condition, some erosion.</i>

PERIODIC INSPECTION CHECKLIST

PROJECT WETLANDS/RESERVOIR DAM DATE DECEMBER 1, 1980
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT Crest Elevation Current Pool Elevation Maximum Impoundment to Date Surface Cracks Pavement Condition Movement or Settlement of Crest Lateral Movement Vertical Alignment Horizontal Alignment Condition at Abutment and at Concrete Structures Indications of Movement of Structural Items on Slopes Trespassing on Slopes Sloughing or Erosion of Slopes or Abutments Rock Slope Protection - Riprap Failures Thermal Movement or Cracking at or Near Joints General Encroachment or Downstream Encroachment Piling or Logs Foundation Drainage Features Toe Drains Instrumentation System Vegetation	<i>There is no dike at this location.</i>

PERIODIC INSPECTION CHECKLIST

PROJECT WESTCONNAUG RESERVOIR DAM

DATE DECEMBER 1, 1980

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u> a. Approach Channel Slope Conditions Bottom Conditions Rock Slides or Falls Log Boom Debris Condition of Concrete Lining Drains or Weep Holes b. Intake Structure Condition of Concrete Stop Logs and Slots	<i>None observed. Under water.</i> <i>Good. Crack at bottom on right corner.</i> <i>None.</i> <i>See drawing for gate valve. Gate not observed to. Should be routinely maintained.</i>

PERIODIC INSPECTION CHECKLIST

PROJECT WESTCONNAUG RESERVOIR DAM

DATE DECEMBER 1, 1980

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - CONTROL TOWER

a. Concrete and Structural

General Condition

Condition of Joints

Spalling

Visible Reinforcing

Rusting or Staining of Concrete

Any Seepage or Efflorescence

Joint Alignment

Unusual Seepage or Leaks in Gate Chamber

Cracks

Rusting or Corrosion of Steel

b. Mechanical and Electrical

Air Vents

Float Wells

Crane Hoist

Elevator

Hydraulic System

Service Gates

Emergency Gates

Lightning Protection System

Emergency Power System

Wiring and Lighting System

See intake structure. There is no control tower at this location.

PERIODIC INSPECTION CHECKLIST

PROJECT WENTONNANG RESERVOIR DAM DATE DECEMBER 1, 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u> General Condition of Concrete Rust or Staining on Concrete Spalling Erosion or Cavitation Cracking Alignment of Monoliths Alignment of Joints Numbering of Monoliths	<i>See outlet structure and outlet channel.</i>

July 17, 1974

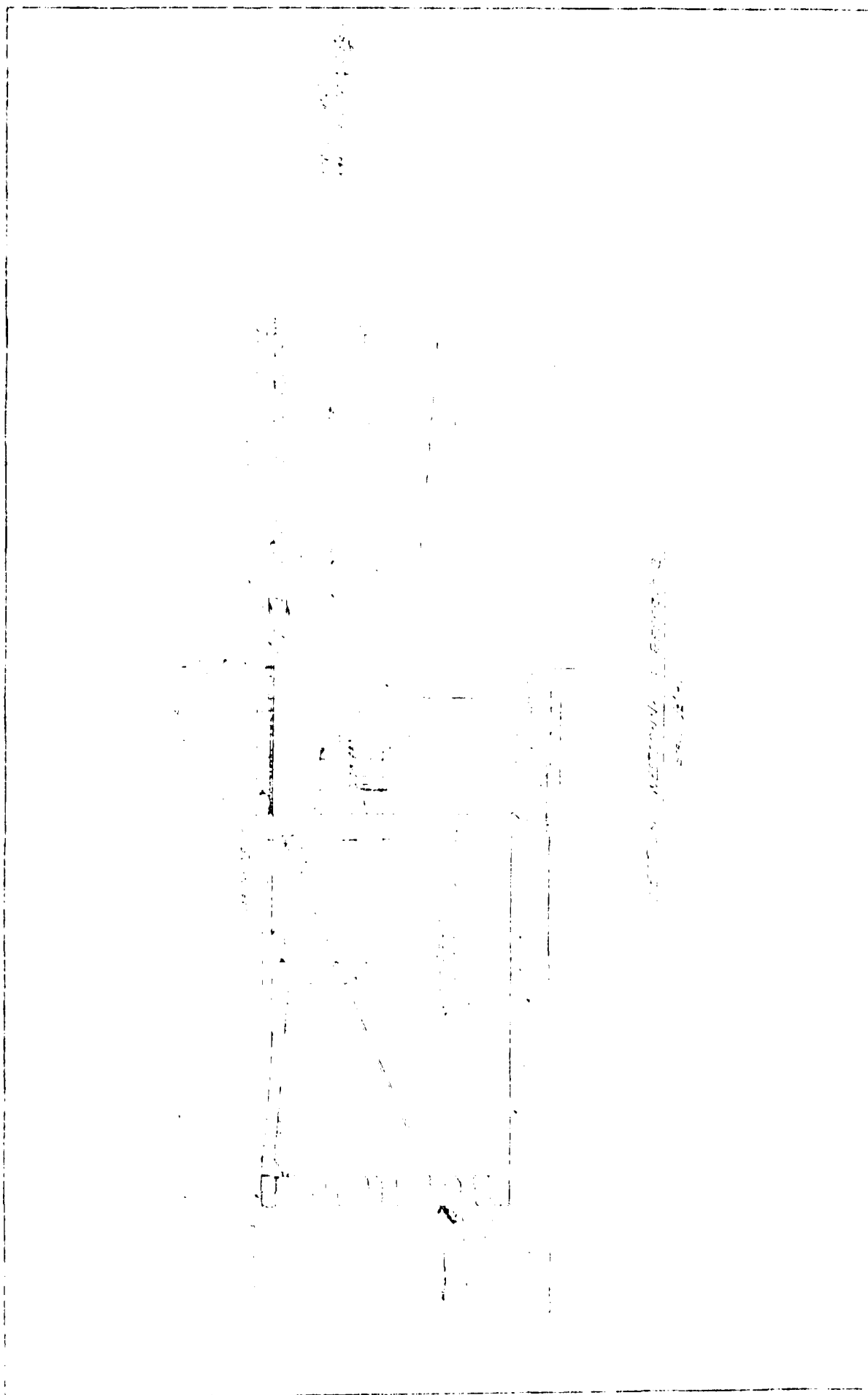
During routine inspection of the dams of the reservoirs above the main Scituate Reservoir made in March 24, 1974, the Westconnaug Reservoir in Foster showed depression on top of the dam about 6 feet east from the east wall of the spillway and 24 feet north of draw off chamber. Closer examination of the downstream wall revealed a leak about 13 feet east of the east wall of the spillway. All evidence showed that the east portion of the dam had developed serious leakage and dam fill material washout.

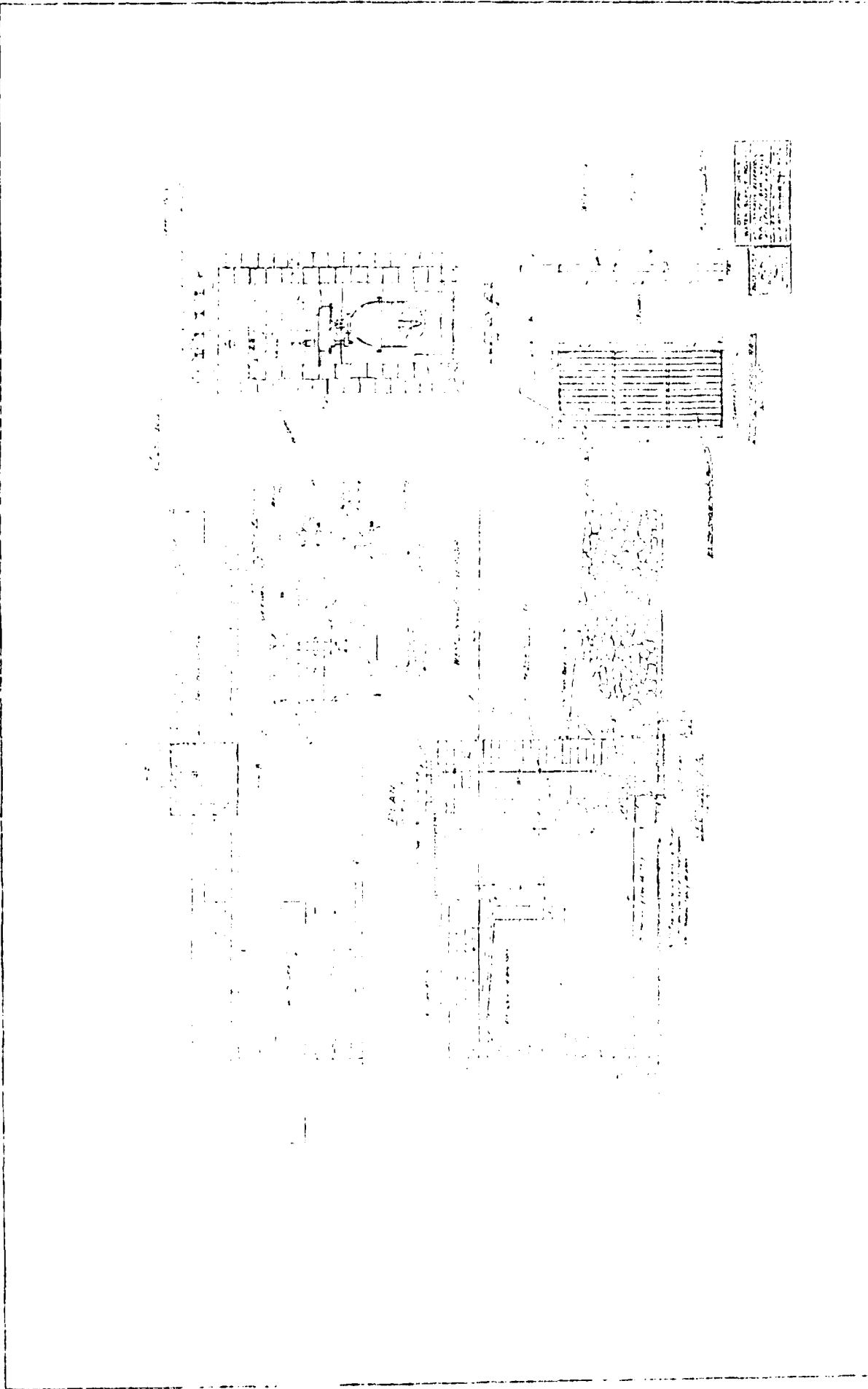
Further investigation showed that the leakage originated in draw off chamber, and on May 6, 1974, the Westconnaug Reservoir draw off 16-inch gate was opened to drain the reservoir. To properly determine the extent of damage and the required repair work, authority was obtained from the Board of Contract and Supply to employ outside contractual assistance in conducting exploratory investigations and to make the necessary repairs. The services of the Fanning and Doorley Construction Company of Central Falls, Rhode Island were obtained on a cost plus basis. Consulting Engineers from CE Maguire, Inc. were engaged to provide assistance for the best solution to stop and control the leakage.

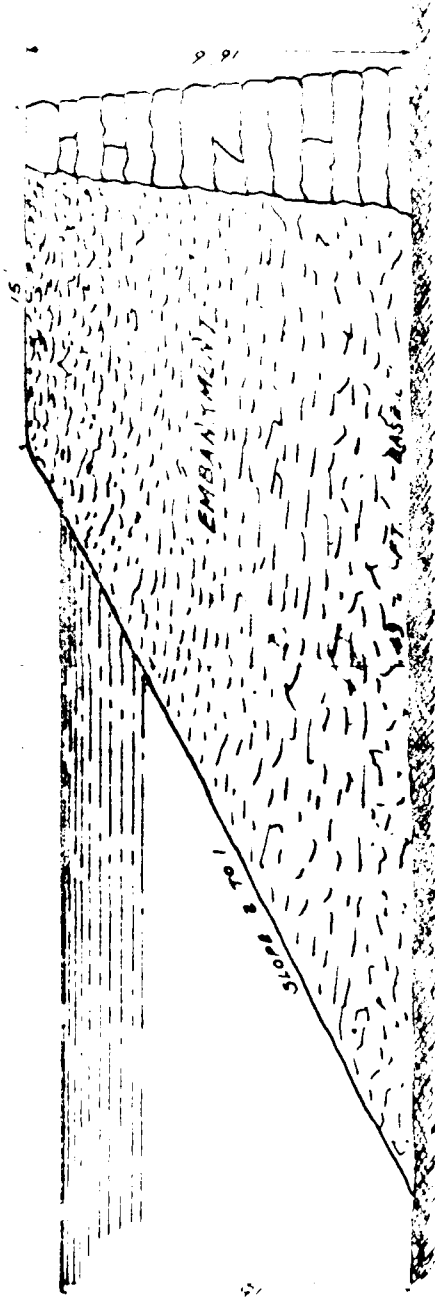
The work included extensive excavation along inside face of the spillway east wall and inner face of the east downstream rubble masonry wall, removal of approach slab at the spillway channel and cleaning of boulders from inlet approach to the draw off structure. Repairs included cement concrete sealing of the inner face of the east spillway wall and downstream rubble masonry wall, installation of three (3) 1 1/4 inch well points and 1 1/4 inch pipe outlet through rubble wall where leak was discovered, sealing all joints inside the draw off structure, securing all rip-rap along upstream with concrete cement and installation of trash racks to protect draw off structure inlet from future obstructions.

The work was completed on June 27, 1974 at a total cost of \$; and refilling of the reservoir began on June 25, 1974.

Handwritten notes:
10,000.00
7,710.00
750.00 1974.
TOTAL: \$ 18,008.91







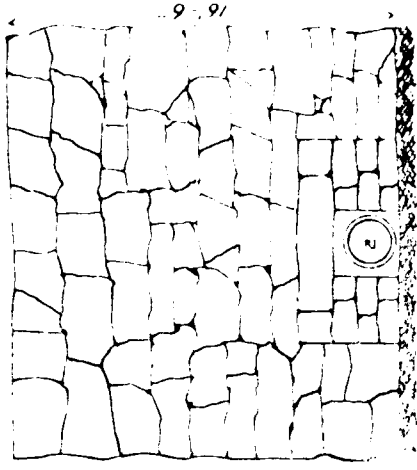
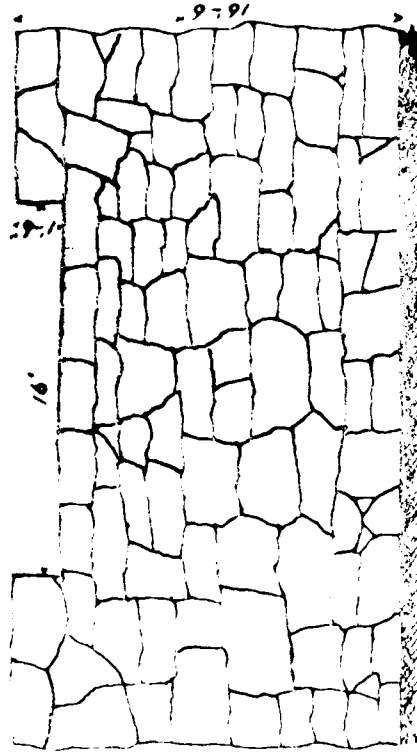
*CROSS SECTION IN WESTCOMING RESERVOIR
DAM IN FOSTER.*

FROM DAM INSPECTION FILES OF STATE OF RHODE ISLAND

E-1-46

DATE: 1906

SCALE: 1"=8'



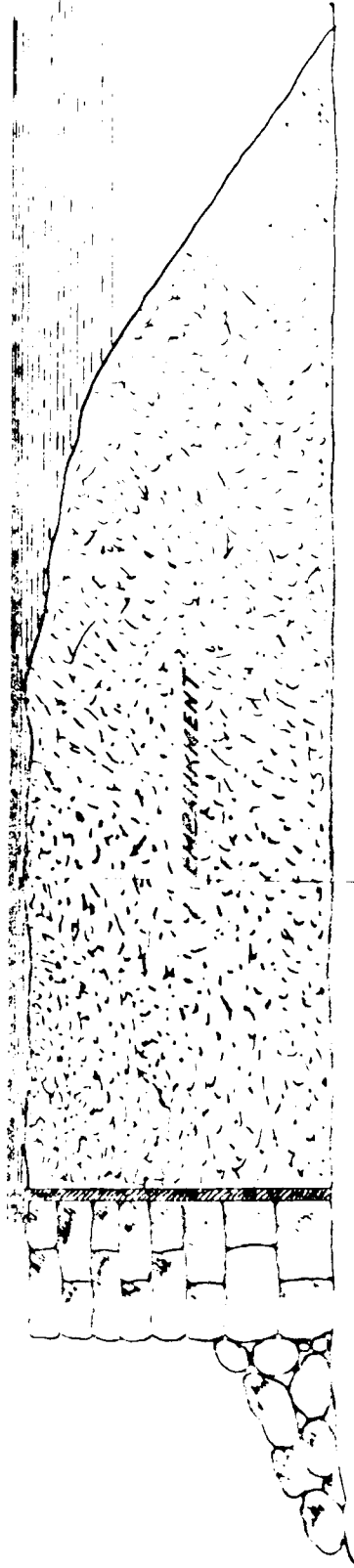
LONGITUDINAL SECTIONS IN WESTCONNAUG RESERVOIR DAM,
IN FOSTER, SHOWING ROLLWAY AND DRAW-OFF PIPE.
SCALE 8 FT. TO ONE INCH.

FROM DAM INSPECTION FILES OF STATE OF RHODE ISLAND

E-1-45

DATE: 1906

SCALE: 1"=8'



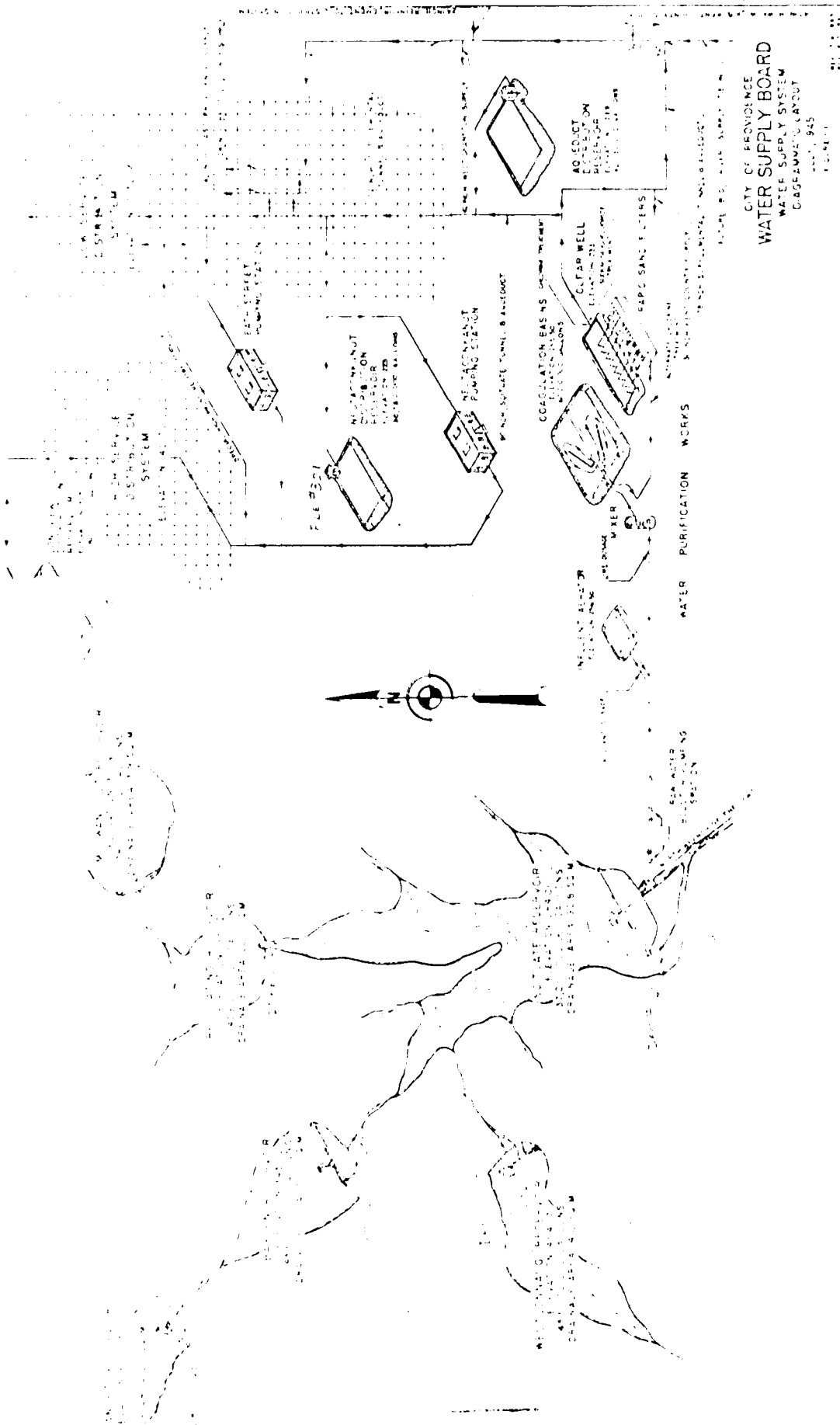
CROSS SECTION IN ROLLWAY OF DAM AT
WESTCONNAUG RESERVOIR IN
FOSTER.

FROM DAM INSPECTION FILES OF STATE OF RHODE ISLAND

E-1-44

DATE: 1906

SCALE: 1"=8'



CITY OF PROVIDENCE
 WATER SUPPLY BOARD
 WATER SUPPLY SYSTEM
 DIAGRAM LAYOUT
 1945

HISTORY OF WESTCONNAUG RESERVOIR DAM

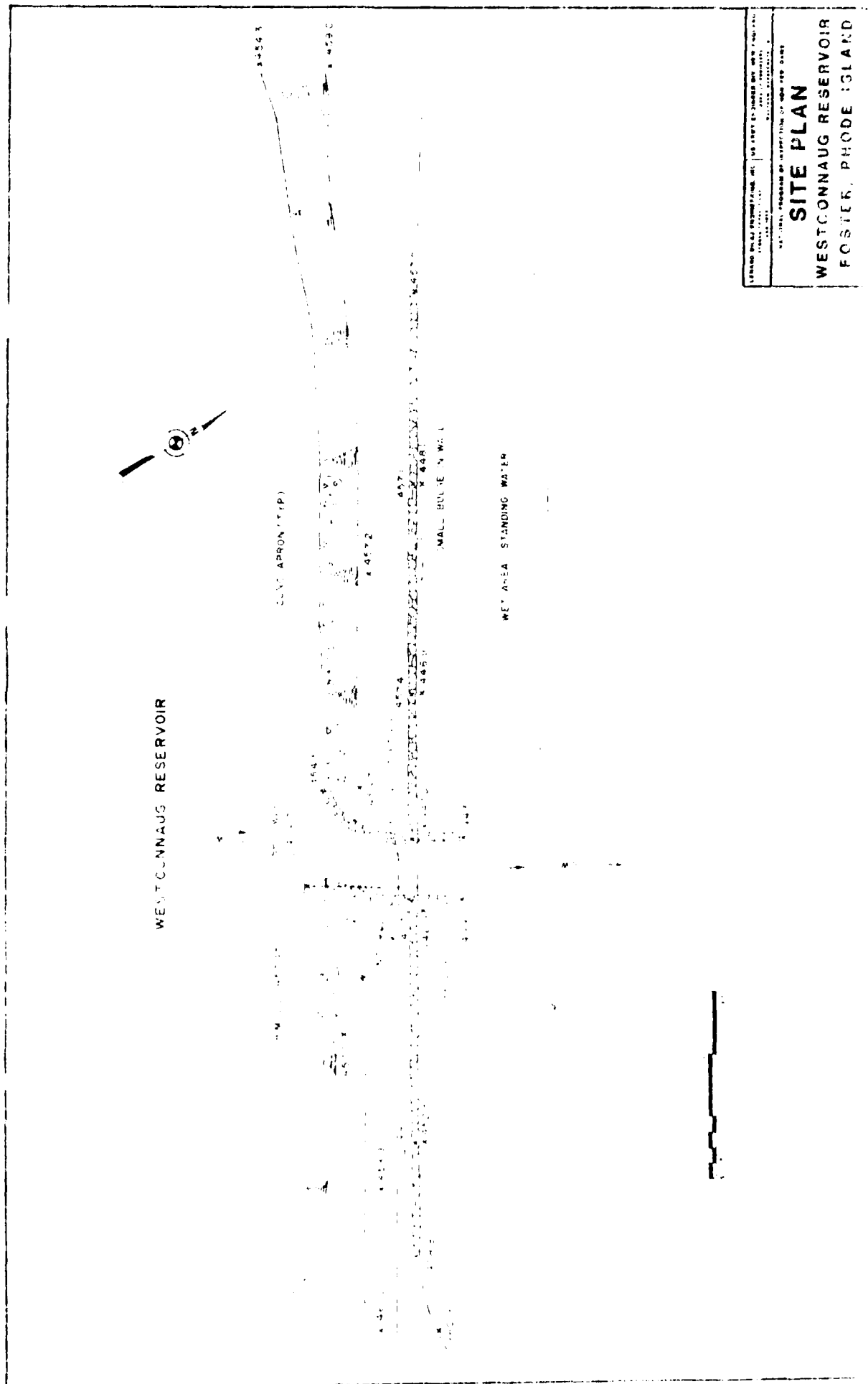
Around 1843 the Westconnaug Reservoir Company was incorporated in Rhode Island. Land was purchased in and around Granbury Brook¹ by the Company. When the local residents were told to leave their land for the new reservoir, one man killed himself as he felt intensely attached to the land of his forebears.

The earliest reference to the Westconnaug Reservoir is found in a warrantee deed from Josiah Whitaker to the trustees of the Westconnaug Reservoir Company in November 1845. The dam was built sometime between 1846 and 1847. A report of the State Dam Commission in 1885 described the body of water formed by the dam as covering 175 acres with a 15 foot depth at the dam.

The original Westconnaug Dam was constructed for more reliable water power at the nearby, downstream Clayville Mills. Whitaker had expanded his Clayville Mill and thus needed the increased water flow in the drier months between June and October.

It is difficult to research the historical background of the dam as records are divided between the towns of Scituate and Foster. Mary Matthews, the President of the Foster Historical Society, has tried to trace back several of the Clayville Mills with limited success.

¹Foster Historical Society Map, 1799.



APPENDIX B

ENGINEERING DATA

PERIODIC INSPECTION CHECKLIST

PROJECT WETZELMAN RESERVOIR DAM DATE DECEMBER 1, 1980

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SERVICE BRIDGE</u> a. Super Structure - Bearings - Anchor Bolts - Bridge Seat - Longitudinal Members - Underside of Deck - Secondary Bracing - Deck - Drainage System - Railings - Expansion Joints - Paint b. Abutment & Piers - General Condition of Concrete - Alignment of Abutment - Approach to Bridge - Condition of Seat & Backwall	<i>There is no service bridge at this location.</i>

PERIODIC INSPECTION CHECKLIST

PROJECT WESTERNHART RESERVOIR DAM

DATE DECEMBER 1, 1980

PROJECT FEATURE _____

NAME _____

DISCIPLINE _____

NAME _____

AREA EVALUATED

CONDITION

OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS

a. Approach Channel

Not observed.

General Condition

Loose Rock Overhanging Channel

Trees Overhanging Channel

Floor of Approach Channel

b. Weir and Training Walls

General Condition

Cut stone masonry walls. Good condition.

Rust or Staining

None observed.

Spalling

None observed.

Any Visible Reinforcing

Not applicable.

Any Seepage or Efflorescence

None observed.

Drain Holes

None observed.

c. Discharge Channel

Natural stream bed.

General Condition

Good.

Loose Rock Overhanging Channel

None observed.

Trees Overhanging Channel

General trees.

Floor of Channel

Bed level.

Other Obstructions

None observed.

Other Comments

Downstream face of spillway is of cut stone masonry. Good condition. No seepage observed. Joints are patched.

PERIODIC INSPECTION CHECKLIST

PROJECT WELTCONNAULT REPAIRS TO LAM DATE SEPTEMBER 1, 1999
 PROJECT FEATURE _____ NAME _____
 DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	
General Condition of Concrete	<i>Good.</i>
Rust or Staining	<i>None observed.</i>
Spalling	<i>None observed.</i>
Erosion or Cavitation	<i>None observed.</i>
Visible Reinforcing	<i>None observed.</i>
Any Seepage or Efflorescence	<i>None observed.</i>
Condition at Joints	<i>Not observable.</i>
Drain holes	<i>Not applicable</i>
Channel	<i>Natural stream bed.</i>
Loose Rock or Trees Overhanging Channel	<i>Some trees.</i>
Condition of Discharge Channel	<i>Good.</i>
	<i>Discharge conduit is an old cast iron pipe. See drawing. Stone box outlet for conduit. New pipe installed at pipe, grouted inside old pipe.</i>

DATE 1 MAY 79

GROUND WATER ELEVATIONS
AT WESTCONNAUG RESERVOIR DAM
FOR MONTH

OF APR

OSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
# 1	456.84	4.60	452.24	5.70 ft.
#2	456.96	—	—	6.70 ft.
#3	457.06	10.07	446.99	10.40 ft.

TAKEN BY J. H. G. H. G.
RECORDED BY E. Bruckner

RESERVOIR SPILLWAY ELEVATION - 454.17

RESERVOIR ELEVATION - TODAY 454.81

DATE 1 JUNE 79

GROUND WATER ELEVATIONS
AT WESTCONNAUG RESERVOIR DAM
FOR MONTH

OF May

OSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
# 1	456.84	4.18	452.66	5.70 ft.
#2	456.96	—		6.70 ft.
#3	457.06	10.07	446.99	10.40 ft.

TAKEN BY HARRIS & MATHEWSON
RECORDED BY Ed. Bruland

RESERVOIR SPILLWAY ELEVATION - 454.17
RESERVOIR ELEVATION - TODAY 454.91

DATE 1400 7 1977

GROUND WATER ELEVATIONS
AT WESTCONHAUG RESERVOIR DAM
FOR MONTH

OF 1977

OSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
# 1	456.84	5.40	451.44	5.70 ft.
#2	456.96	2.00		6.70 ft.
#3	457.06	13.01	447.05	10.40 ft.

TAKEN BY W. A. 10-07

RECORDED BY E. H. H. H.

RESERVOIR SPILLWAY ELEVATION - 454.17

RESERVOIR ELEVATION - TODAY 454.17

DATE 1 OCTOBER 79

GROUND WATER ELEVATIONS
AT WESTCONNAUG RESERVOIR DAM
FOR MONTH

OF SEPTEMBER

OSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
# 1	456.84	—	—	5.70 ft.
#2	456.96	—	—	6.70 ft.
#3	457.06	10.04	447.02	10.40 ft.

TAKEN BY HARRISAN - McCARREN
RECORDED BY Ed. Bruland

RESERVOIR SPILLWAY ELEVATION - 454.17

RESERVOIR ELEVATION - TODAY 452.39

#1 UNABLE TO REMOVE CAP
#2 PIPE FENCED WITH STONES

DATA: E. & C. ...

DATE 1 Nov. 7

GROUND WATER ELEVATIONS
AT WESTCONNAUG RESERVOIR DAM
FOR MONTH

OF OCTOBER

CSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
# 1	456.84	UNABLE TO REMOVE CAP		5.70 ft.
#2	456.96	STUCK IN PIPE		6.70 ft.
#3	457.06	10.03	447.03	10.40 ft.

TAKEN BY P. HARRIS
RECORDED BY E. B. ...

RESERVOIR SPILLWAY ELEVATION - 454.27

RESERVOIR ELEVATION - TODAY 453.74

Ed. Lunny

DATE 1 April 80

GROUND WATER ELEVATIONS
AT WESTCONNAUG RESERVOIR DAM
FOR MONTH

OF March

OSB WELL NO.	WELL ELEVATION	MEASUREMENT	GR. WATER ELEV.	DEPTH OF WELL
* # 1	456.84	4.36	452.48	5.70 ft.
#2	456.96			6.70 ft.
#3	457.06	10.06	447.00	10.40 ft.

TAKEN BY

T. HARRIS

RECORDED BY

E. Brubaker

RESERVOIR SPILLWAY ELEVATION - 454.27

RESERVOIR ELEVATION - TODAY 454.74

* PIPE HAS DROPPED ABOUT 6 INCHES BELOW
GROUND LEVEL.

* - Pipe full of small stones - unable to take reading. Possibility
that WSB may want to replace this pipe with a functional one.

CFM

FLB

APPENDIX C

PHOTOGRAPHS

RECEIVED
JAN 10 1964
U.S. DEPARTMENT OF COMMERCE
BUREAU OF ECONOMIC ANALYSIS
WASHINGTON, D.C. 20540

WESTCONNAUG RESERVOIR

FOSTER, RHODE ISLAND

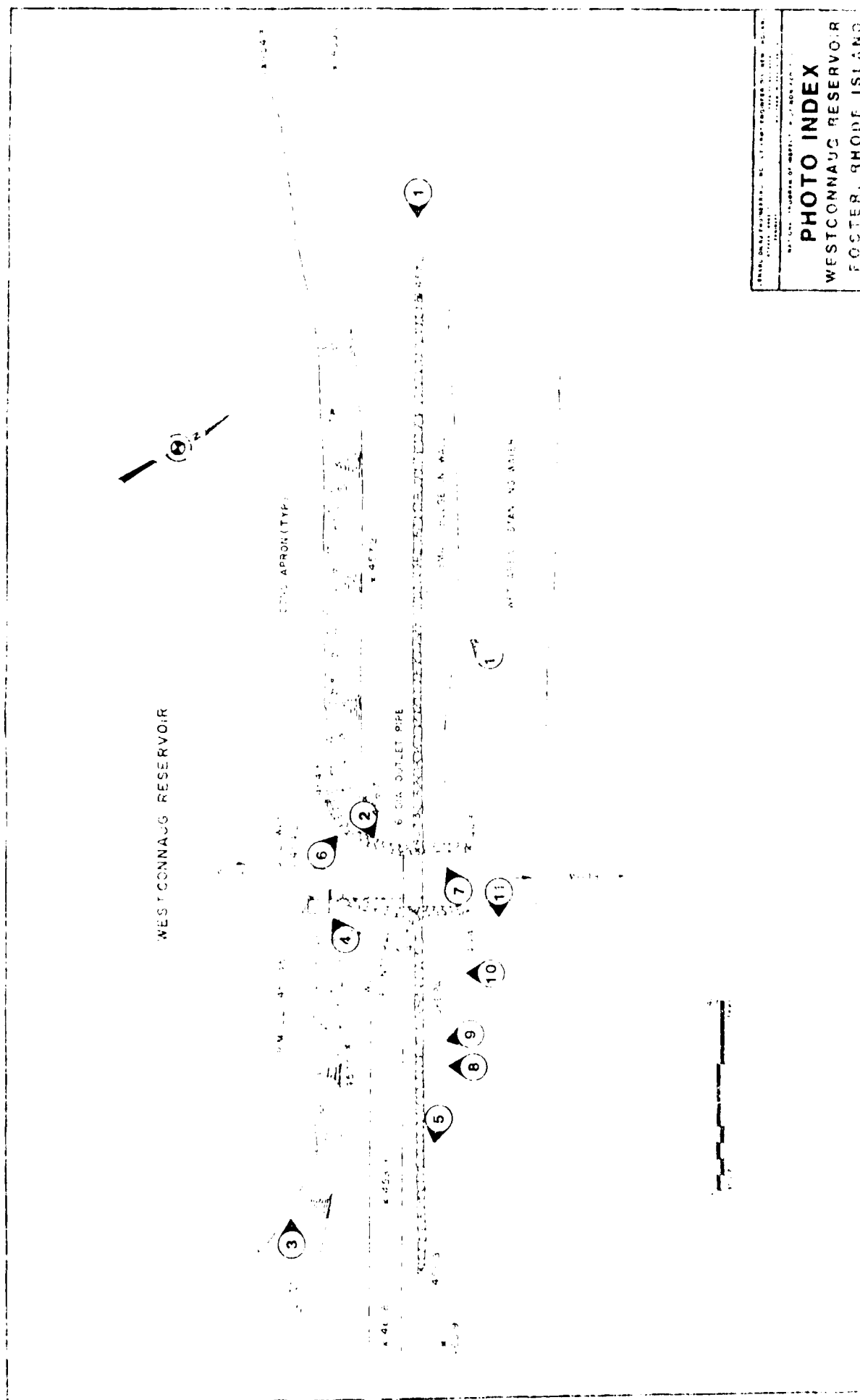




Photo 1

General view of dam from left abutment. Photo taken about downstream stone masonry wall.

Photo 2

Spillway looking downstream. View of right training wall. Photos of dam and training wall are also presented in this report.



US ARMY ENGINEER DIV. NEW ENGLAND
P. O. BOX 1000
WATSON, MASSACHUSETTS

LENARD DEAC ENGINEERING, INC.
87 ANN STREET
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

WESTONNAUG, MASSACHUSETTS
P. O. BOX 1000

REPORT NO. 1000

JAN. 1981

C-2



Photo 3 - General upstream view of dam from right abutment. Note concrete covered slope. Also note intake structure with concrete top.



Photo 4 - Sharp corner of intake structure shown. Same corner can be seen in Photo 3.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
400 TOWN SQUARE
WALTHAM, MASSACHUSETTS

LEONARD DILLI ENGINEERING, INC.
500 RIVER STREET
NEW BEDFORD, MASSACHUSETTS

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

WHITTON DAM, BECKETT, MA
1970

POSTED BY: [illegible]



Photo 5 - Downstream stone masonry wall looking toward right abutment. Note indentation on upper 18" of dam. It may be assumed that this was an addition to the original height of the dam.



Photo 6 - Left training wall of spillway. Note concrete paving on upstream slope and saplings growing on slope.

US ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

LENARD DILLI ENGINEERING, INC.
97 PARK STREET
BOSTON, MASSACHUSETTS

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED. DAMS

WESTCONNAUG RECEIVED
PI 01201

FOSTER, PHOT. 1, 2, 3, 4, 5
JAN. 1961



Left window of spillway near
spillway channel. Note the
concrete filling and joints.



Photo 2

Close-up of concrete spillway channel
showing concrete filling and joints.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
1000 BOSTON HEARE
400 NEW MARKET STREET

TENARD DILLI ENGINEERING, INC.
1000 BOSTON HEARE
400 NEW MARKET STREET

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED DAMS

WATER RESOURCES DIVISION
U.S. ARMY ENGINEER DIV.
1000 BOSTON HEARE
400 NEW MARKET STREET



Photo 9 - Downstream wall of dam between discharge pipe of Observation Well No.3 and still-way. Note efflorescence and seepage. Ruler is inserted into 2½' deep crack.



Photo 10 - Discharge drain connected to observation pipe of Well No. 3. Discharge is approximately 1/2" and low flow condition.

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS. 01981

LENARD DILL ENGINEERING, INC.
1000 N. 10TH ST.
DENVER, CO. 80202

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED DAMS

WATERSHED DISTRICT NO. 1
P.O. BOX 1000
DENVER, CO. 80202



Figure 14 - Seepage about 20 feet downstream of dam, right of stillway. Note rusted pipe of seepage.

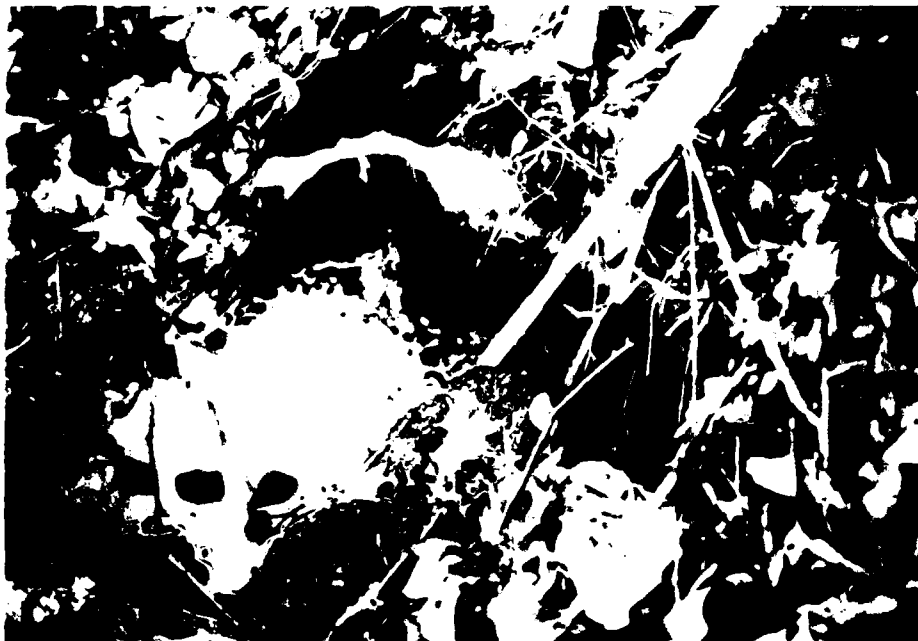


Figure 15 - Seepage about 12 feet downstream of dam, right of stillway. Note rusted pipe of seepage.

ARMY ENGINEERING NEW ENGLAND
DISTRICT
WATERWAYS DIVISION

CONSTRUCTION ENGINEERING INC.
WASHINGTON, D.C.

NATIONAL PROGRAM OF
INSPECTION OF
NON-FED DAMS

NO. 100-100000

NO. 100-100000

NO. 100-100000

UNITED STATES GOVERNMENT
 OFFICE OF THE SECRETARY OF DEFENSE
 WASHINGTON, D. C. 20301
 REPORT OF THE SECRETARY OF DEFENSE
 ON THE RESULTS OF THE DEFENSE RESEARCH AND ENGINEERING
 PROGRAMS FOR THE FISCAL YEAR 1964

		RATIOS APPLIED TO FIGURES			
FISCAL YEAR	RATIO	RATIO 1	RATIO 2	RATIO 3	RATIO 4
		.10	.20	.30	.40
1964	1	1.00	1.00	1.00	1.00
1965	1	1.00	1.00	1.00	1.00
1966	1	1.00	1.00	1.00	1.00
1967	1	1.00	1.00	1.00	1.00
1968	1	1.00	1.00	1.00	1.00
1969	1	1.00	1.00	1.00	1.00
1970	1	1.00	1.00	1.00	1.00
1971	1	1.00	1.00	1.00	1.00
1972	1	1.00	1.00	1.00	1.00
1973	1	1.00	1.00	1.00	1.00
1974	1	1.00	1.00	1.00	1.00
1975	1	1.00	1.00	1.00	1.00
1976	1	1.00	1.00	1.00	1.00
1977	1	1.00	1.00	1.00	1.00
1978	1	1.00	1.00	1.00	1.00
1979	1	1.00	1.00	1.00	1.00
1980	1	1.00	1.00	1.00	1.00
1981	1	1.00	1.00	1.00	1.00
1982	1	1.00	1.00	1.00	1.00
1983	1	1.00	1.00	1.00	1.00
1984	1	1.00	1.00	1.00	1.00
1985	1	1.00	1.00	1.00	1.00
1986	1	1.00	1.00	1.00	1.00
1987	1	1.00	1.00	1.00	1.00
1988	1	1.00	1.00	1.00	1.00
1989	1	1.00	1.00	1.00	1.00
1990	1	1.00	1.00	1.00	1.00
1991	1	1.00	1.00	1.00	1.00
1992	1	1.00	1.00	1.00	1.00
1993	1	1.00	1.00	1.00	1.00
1994	1	1.00	1.00	1.00	1.00
1995	1	1.00	1.00	1.00	1.00
1996	1	1.00	1.00	1.00	1.00
1997	1	1.00	1.00	1.00	1.00
1998	1	1.00	1.00	1.00	1.00
1999	1	1.00	1.00	1.00	1.00
2000	1	1.00	1.00	1.00	1.00
2001	1	1.00	1.00	1.00	1.00
2002	1	1.00	1.00	1.00	1.00
2003	1	1.00	1.00	1.00	1.00
2004	1	1.00	1.00	1.00	1.00
2005	1	1.00	1.00	1.00	1.00
2006	1	1.00	1.00	1.00	1.00
2007	1	1.00	1.00	1.00	1.00
2008	1	1.00	1.00	1.00	1.00
2009	1	1.00	1.00	1.00	1.00
2010	1	1.00	1.00	1.00	1.00
2011	1	1.00	1.00	1.00	1.00
2012	1	1.00	1.00	1.00	1.00
2013	1	1.00	1.00	1.00	1.00
2014	1	1.00	1.00	1.00	1.00
2015	1	1.00	1.00	1.00	1.00
2016	1	1.00	1.00	1.00	1.00
2017	1	1.00	1.00	1.00	1.00
2018	1	1.00	1.00	1.00	1.00
2019	1	1.00	1.00	1.00	1.00
2020	1	1.00	1.00	1.00	1.00
2021	1	1.00	1.00	1.00	1.00
2022	1	1.00	1.00	1.00	1.00
2023	1	1.00	1.00	1.00	1.00
2024	1	1.00	1.00	1.00	1.00
2025	1	1.00	1.00	1.00	1.00
2026	1	1.00	1.00	1.00	1.00
2027	1	1.00	1.00	1.00	1.00
2028	1	1.00	1.00	1.00	1.00
2029	1	1.00	1.00	1.00	1.00
2030	1	1.00	1.00	1.00	1.00
2031	1	1.00	1.00	1.00	1.00
2032	1	1.00	1.00	1.00	1.00
2033	1	1.00	1.00	1.00	1.00
2034	1	1.00	1.00	1.00	1.00
2035	1	1.00	1.00	1.00	1.00
2036	1	1.00	1.00	1.00	1.00
2037	1	1.00	1.00	1.00	1.00
2038	1	1.00	1.00	1.00	1.00
2039	1	1.00	1.00	1.00	1.00
2040	1	1.00	1.00	1.00	1.00
2041	1	1.00	1.00	1.00	1.00
2042	1	1.00	1.00	1.00	1.00
2043	1	1.00	1.00	1.00	1.00
2044	1	1.00	1.00	1.00	1.00
2045	1	1.00	1.00	1.00	1.00
2046	1	1.00	1.00	1.00	1.00
2047	1	1.00	1.00	1.00	1.00
2048	1	1.00	1.00	1.00	1.00
2049	1	1.00	1.00	1.00	1.00
2050	1	1.00	1.00	1.00	1.00
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2053	1	1.00	1.00	1.00	1.00
2054	1	1.00	1.00	1.00	1.00
2055	1	1.00	1.00	1.00	1.00
2056	1	1.00	1.00	1.00	1.00
2057	1	1.00	1.00	1.00	1.00
2058	1	1.00	1.00	1.00	1.00
2059	1	1.00	1.00	1.00	1.00
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2062	1	1.00	1.00	1.00	1.00
2063	1	1.00	1.00	1.00	1.00
2064	1	1.00	1.00	1.00	1.00
2065	1	1.00	1.00	1.00	1.00
2066	1	1.00	1.00	1.00	1.00
2067	1	1.00	1.00	1.00	1.00
2068	1	1.00	1.00	1.00	1.00
2069	1	1.00	1.00	1.00	1.00
2070	1	1.00	1.00	1.00	1.00
2071	1	1.00	1.00	1.00	1.00
2072	1	1.00	1.00	1.00	1.00
2073	1	1.00	1.00	1.00	1.00
2074	1	1.00	1.00	1.00	1.00
2075	1	1.00	1.00	1.00	1.00
2076	1	1.00	1.00	1.00	1.00
2077	1	1.00	1.00	1.00	1.00
2078	1	1.00	1.00	1.00	1.00
2079	1	1.00	1.00	1.00	1.00
2080	1	1.00	1.00	1.00	1.00
2081	1	1.00	1.00	1.00	1.00
2082	1	1.00	1.00	1.00	1.00
2083	1	1.00	1.00	1.00	1.00
2084	1	1.00	1.00	1.00	1.00
2085	1	1.00	1.00	1.00	1.00
2086	1	1.00	1.00	1.00	1.00
2087	1	1.00	1.00	1.00	1.00
2088	1	1.00	1.00	1.00	1.00
2089	1	1.00	1.00	1.00	1.00
2090	1	1.00	1.00	1.00	1.00
2091	1	1.00	1.00	1.00	1.00
2092	1	1.00	1.00	1.00	1.00
2093	1	1.00	1.00	1.00	1.00
2094	1	1.00	1.00	1.00	1.00
2095	1	1.00	1.00	1.00	1.00
2096	1	1.00	1.00	1.00	1.00
2097	1	1.00	1.00	1.00	1.00
2098	1	1.00	1.00	1.00	1.00
2099	1	1.00	1.00	1.00	1.00
2100	1	1.00	1.00	1.00	1.00

• • • • •

(continued)

[illegible]

10-10

PEAK OUTFLOW IS 6346. AT TIME 44.00 HOURS

INFLOW/OUTFLOW HYDROGRAPH

UNITED STATES OF AMERICA
 DEPARTMENT OF THE ARMY
 WASHINGTON, D.C. 20315

1. TITLE
 2. DATE

FOSTER RHODE ISLAND

DESIGN STAGE--PMF

JOB SPECIFICATION

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

MULTI-PLAN ANALYSES TO BE PERFORMED

PLAN=1 RATIO=6 LATIO=1
 RATIO=1.20 .30 .50 .70 1.00

SUB-AREA R.O.F. COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO WESTCONAGG RESERVOIR DAM

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

HYDROGRAPH DATA

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

PRECIP DATA

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

LOSS DATA

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

UNIT HYDROGRAPH DATA

TP= 3.06 CP= .63 NTAE= 0

RECESSION DATA

RTIO= -1.80 RRSSE= -.05 RTIO= 1.00

END-OF-PERIOD ORIGINATES LAG= 3.03 HOURS CP= .62 VOL= 1.00

ITEM	UNIT	VALUE	ITEM	UNIT	VALUE
1.1	1.00	1.00	1.1	1.00	1.00
1.2	1.00	1.00	1.2	1.00	1.00
1.3	1.00	1.00	1.3	1.00	1.00
1.4	1.00	1.00	1.4	1.00	1.00
1.5	1.00	1.00	1.5	1.00	1.00

END-OF-PERIOD FLOW

COMP= 0 M.O.DA HR.MY PERIOD DATA FVCS

UNITED-COMPUTING SYSTEMS INC

PREFACE OF SEQUENCE OF STREAM NETWORK CALCULATIONS

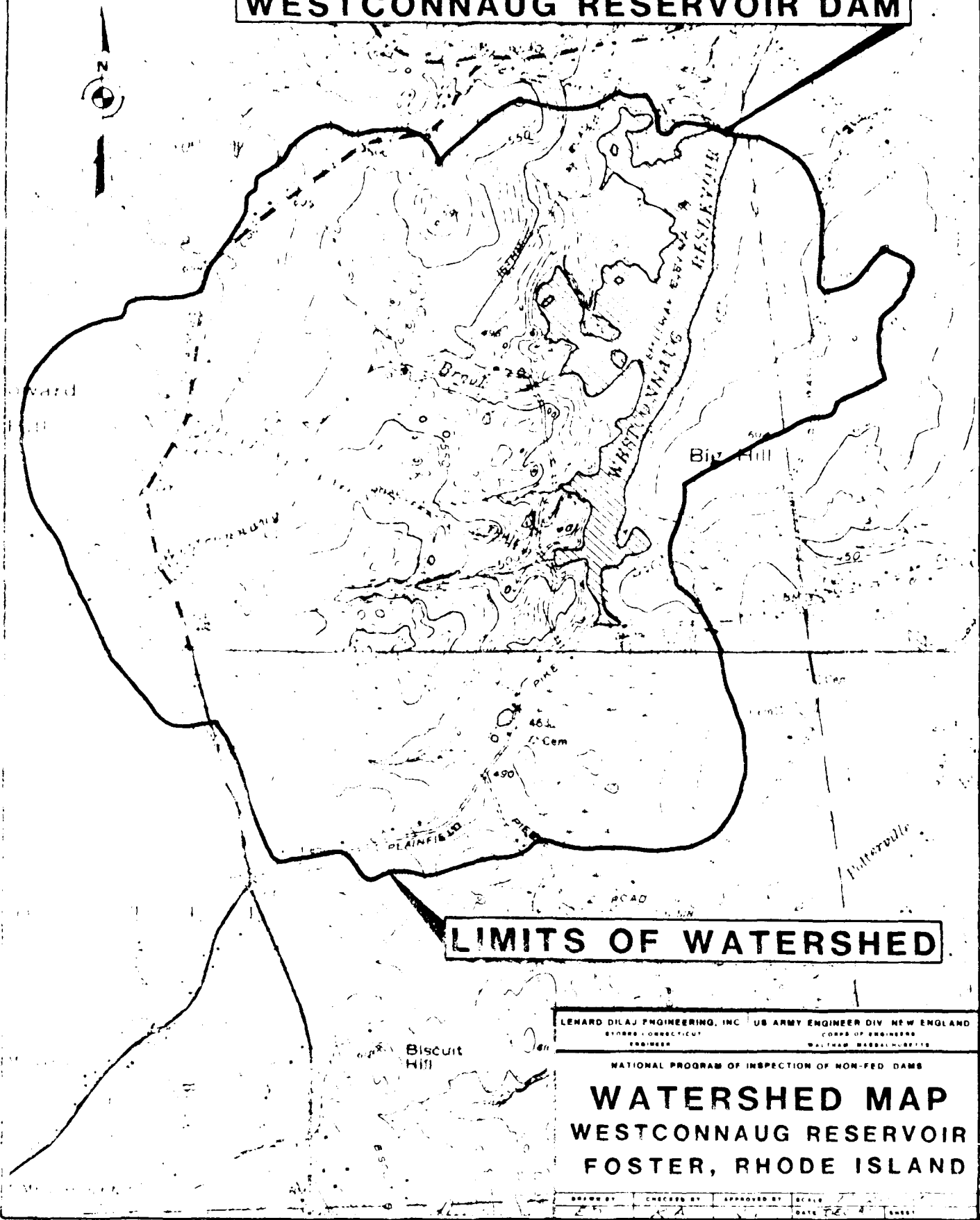
- | |
|---|
| 1 |
| 2 |

ROUTE HYDROGRAPH AT
ROUTE HYDROGRAPH TO
END OF NETWORK

WATERSHED ANALYSIS

WESTCONNAUG RESERVOIR DAM

WESTCONNAUG RESERVOIR DAM



LIMITS OF WATERSHED

LENARD DILAJ ENGINEERING, INC. US ARMY ENGINEER DIV. NEW ENGLAND
 STORRS, CONNECTICUT
 ENGINEERS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

WATERSHED MAP WESTCONNAUG RESERVOIR FOSTER, RHODE ISLAND

DRAWN BY: CHECKED BY: APPROVED BY: SCALE: DATE: 7-2-81 SHEET: 1

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM
SHEET NO. _____ OF _____
CALCULATED BY K.A. DATE _____
CHECKED BY _____ DATE _____
SCALE _____

DETERMINATION OF SPILLWAY TEST FLOOD*

A. SIZE CLASSIFICATION

THIS DAM:

Based on either storage or height

Small	Storage 50-999 Ac.-Ft. Height 25-39 Ft.	_____
<u>Intermediate</u>	Storage 1,000-50,000 Ac.Ft. Height 40-100 Ft.	<u>1950 Ac.Ft.</u> <u>17 Ft.</u>
Large	Storage More than 50,000 Ac.-Ft. Height Greater than 100 Ft.	_____

B. HAZARD POTENTIAL CLASSIFICATION

<u>Category</u>	<u>Loss of Life</u>	<u>Economic Loss</u>
Low	None expected	Minimal
Significant	Few	<u>Appreciable</u>
<u>High</u>	<u>More than few</u>	Excessive

Hazard Classification HIGH

C. HYDROLOGIC EVALUATION GUIDELINES

<u>Hazard</u>	<u>Size</u>	<u>Spillway Test Flood</u>
Low	Small Intermediate Large	50 to 100-Year Frequency 100-Year Frequency to $\frac{1}{2}$ PMF $\frac{1}{2}$ PMF to PMF
Significant	Small Intermediate Large	100-Year Frequency to $\frac{1}{2}$ PMF $\frac{1}{2}$ PMF to PMF PMF
<u>High</u>	Small <u>Intermediate</u> Large	$\frac{1}{2}$ PMF to PMF <u>PMF</u> PMF

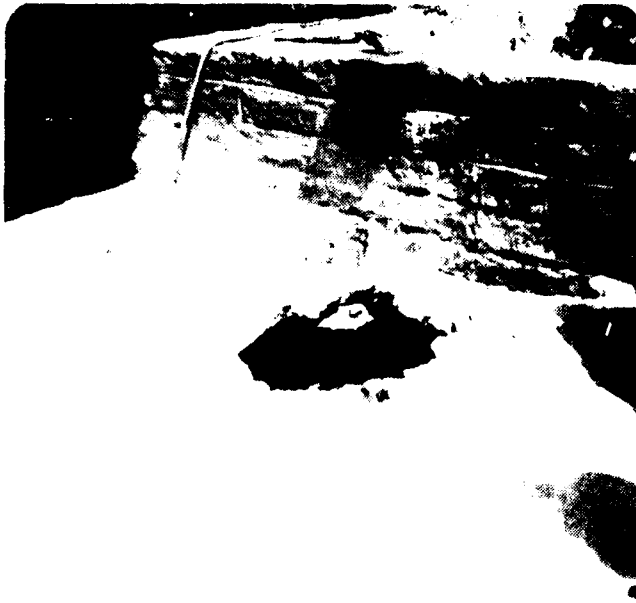
Spillway Test Flood PMF

* Based upon "Recommended Guidelines for Safety Inspection of Dams" Department of the Army, Office of the Chief of Engineers, November 1976.

APPENDIX D

WIND TUNNEL AND HYDRAULIC
EXPERIMENTATIONS

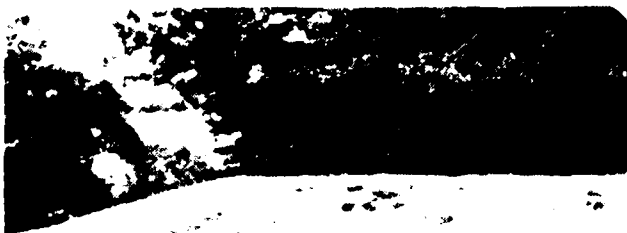
1970 REPAIR OF LEAK NEAR SPILLWAY



LEAK NEAR SPILLWAY, WESTERN
CANAL, 1970. (1)

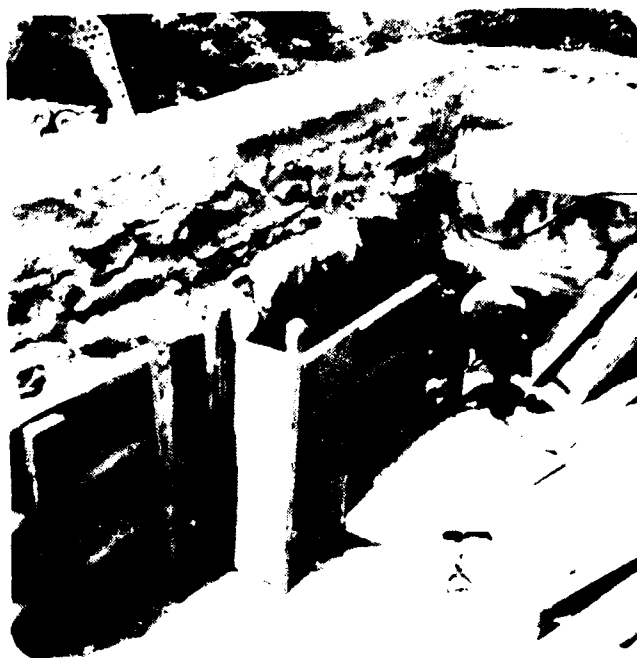


LEAK NEAR SPILLWAY, WESTERN
CANAL, 1970. (2)

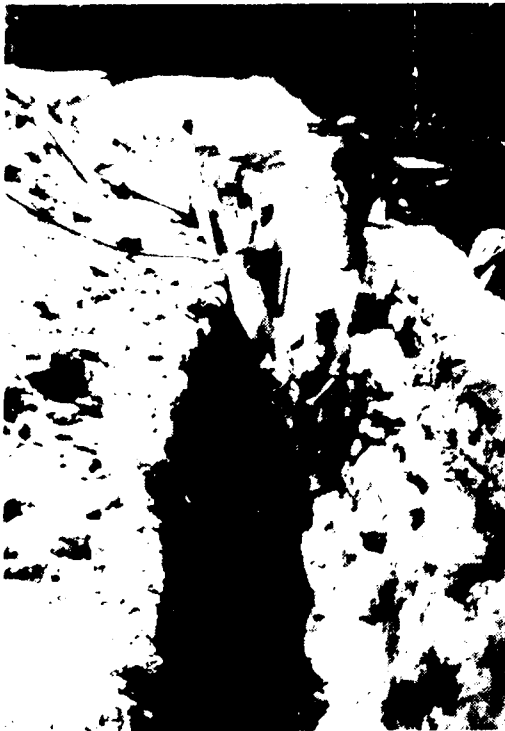


LEAK NEAR SPILLWAY, WESTERN
CANAL, 1970. (3)

1970 REPAIR OF LEAK NEAR SPILLWAY



REPAIRS OF DAM DURING 1964



REPAIRS OF DAM DURING 1964

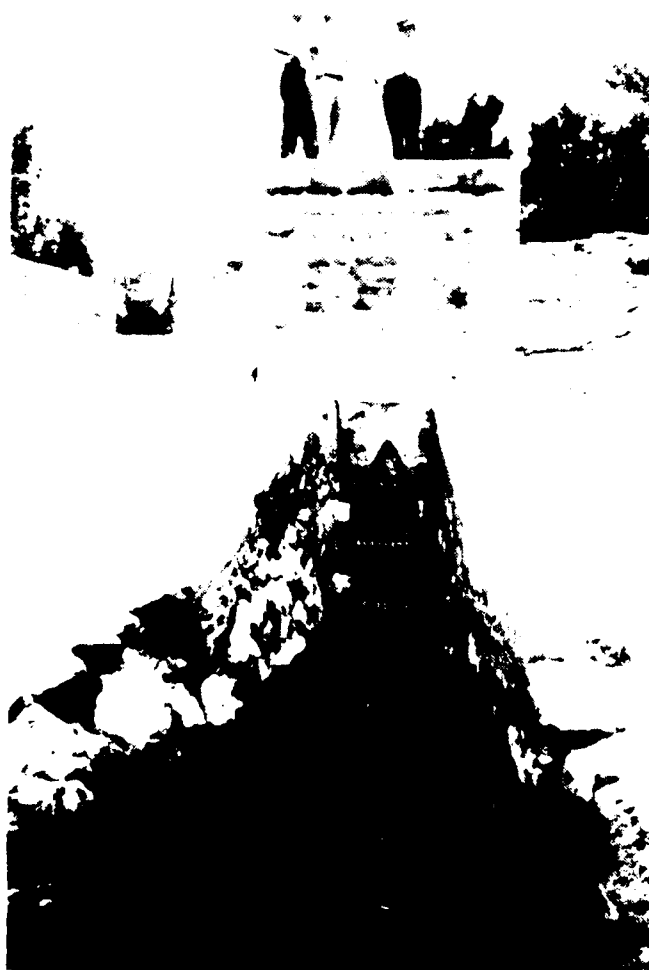


REPAIRS OF DAM DURING 1964



REPAIRS OF DAM DURING 1964

1964 UPGRADING PROGRAM



1. MILLER INTAKE STRUCTURE SHOWING
MAJOR AND MINOR DAMS IN PLACE
ON THE MILLER DAM. (1964)



2. MILLER INTAKE STRUCTURE SHOWING
MAJOR AND MINOR DAMS IN PLACE
ON THE MILLER DAM. (1964)

[illegible]UNITED COMPUTING SYSTEMS, INC.

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNANG RESERVOIR DAM

SHEET NO.

CALCULATED BY K. A.

CHECKED BY M.E.

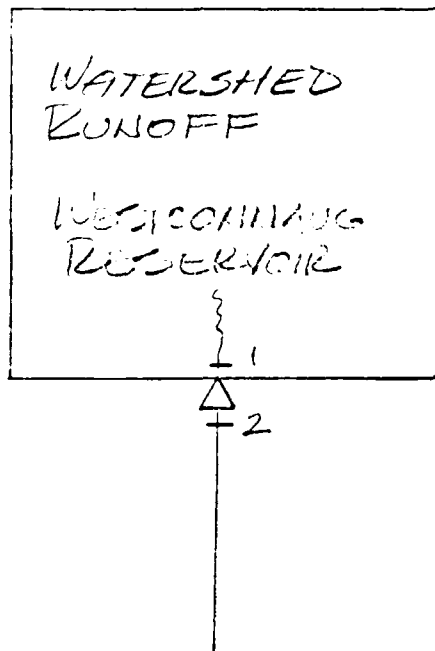
SCALE

OF

DATE

DATE

SCHEMATIC



1- WESTCONNANG RESERVOIR INFLOW

2- " " " ROUTED THROUGH DAM

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNANG RESERVOIR DAM
SHEET NO. 2
OF 9
DATE 12/4/80
CHECKED BY K.A.
DATE 1/1/81
SCALE

WATERSHED AREA

CLAYVILLE ROAD:

$$\begin{array}{r} 10482 \\ 3184 \\ \hline 1228 \text{ grads} \Rightarrow 2.96 \text{ S.M.} \end{array}$$

$$\begin{array}{r} 5212 \\ 6510 \\ \hline 1298 \text{ grads} \Rightarrow 2.96 \text{ S.M.} \end{array}$$

$$\begin{array}{r} 9098 \\ 7801 \\ \hline 1297 \text{ grads} \Rightarrow 2.96 \text{ S.M.} \end{array}$$

2.96 S.M.

COLENTREY CENTER ROAD:

$$\begin{array}{r} 1558 \\ 1161 \\ \hline 397 \text{ grads} \Rightarrow 0.91 \text{ S.M.} \end{array}$$

$$\begin{array}{r} 1055 \\ 1028 \\ \hline 397 \text{ grads} \Rightarrow 0.91 \text{ S.M.} \end{array}$$

$$\begin{array}{r} 3265 \\ 8265 \\ \hline 400 \text{ grads} \Rightarrow 0.91 \text{ S.M.} \end{array}$$

0.91 S.M.

TOTAL 2.87 S.M.

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM

SHEET NO

3

OF

9

CALCULATED BY

K. A.

DATE

12/4/80

CHECKED BY

M. R.

DATE

1/5/81

SCALE

RESERVOIR SURFACE AREAS

Elev. 454 (Spillway):

0248

0129

119 grads $\Rightarrow$ 174 Ac.

0365

0246

117 grads $\Rightarrow$ 171 Ac.

173 Ac.

Elev. 460:

0901

0746

155 grads $\Rightarrow$ 227 Ac.

1056

0905

156 grads $\Rightarrow$ 228 Ac.

227 Ac.

Elev. 470:

1328

1058

270 grads $\Rightarrow$ 395 Ac.

159

1328

266 grads $\Rightarrow$ 384 Ac.

1564

1371

273 grads $\Rightarrow$ 399 Ac.

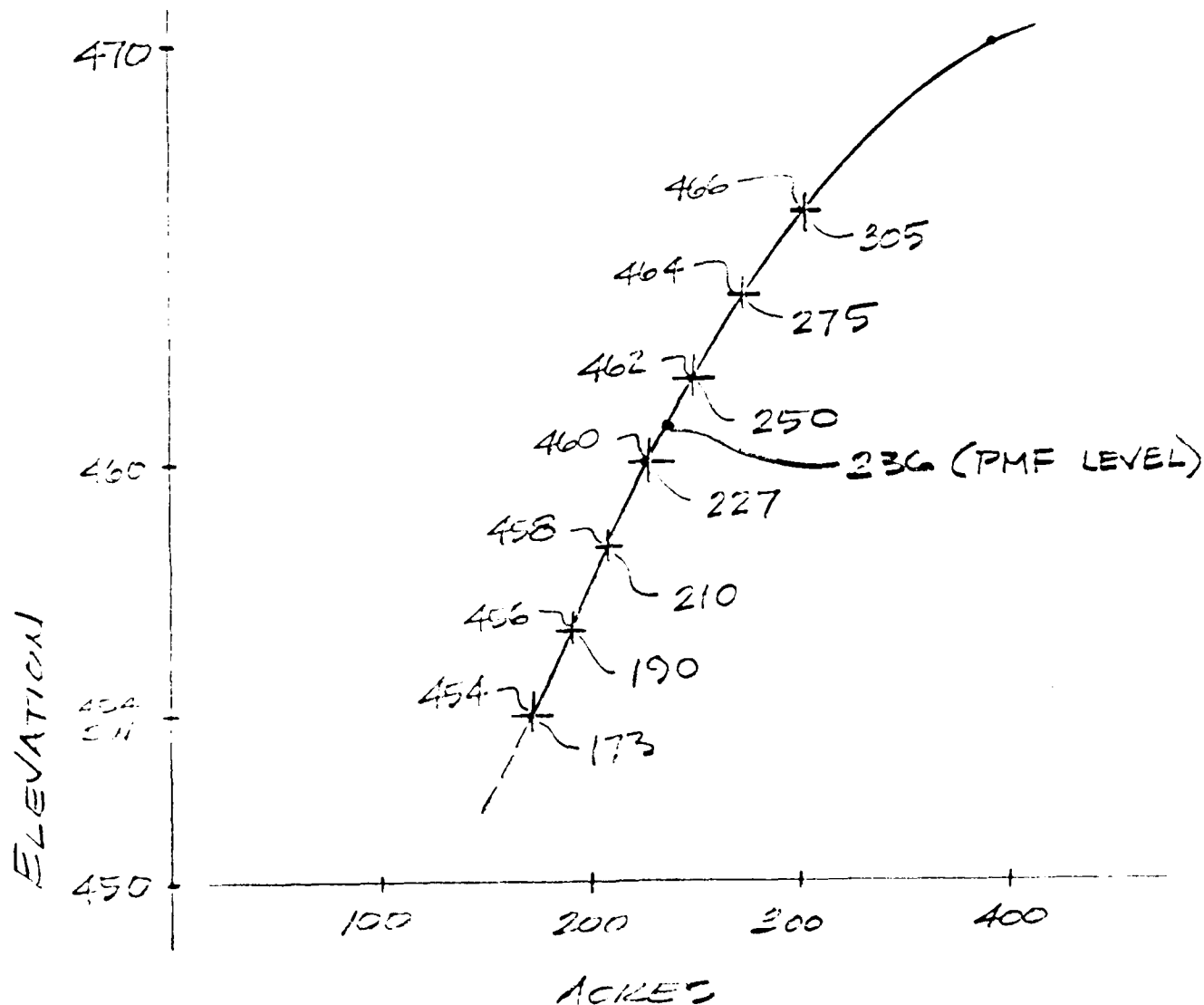
395 Ac.

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(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM
SHEET NO. 4
CALCULATED BY K. A.
CHECKED BY M. Z.
SCALE
DATE 12/4/80
DATE 1/6/91

SURFACE AREAS (CONT.)



Notes: Storage below spillway = 1290 ac. - 173 ac. = 1117 ac.
Storage at top of dam = 1952 ac. - 173 ac. = 1779 ac.

LENARD & DILAJ ENGINEERING, INC.

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(203) 429-7308

JOB WESTCONNIAUG RESERVOIR DAM
SHEET NO 5
CALCULATED BY K. A.
CHECKED BY M. Z.
SCALE

OF 9
DATE 12/4/80
DATE 1/2/81

PRECIPITATION

U.S. Weather Bureau
Tech. Paper No. 40

PI-F - 6 Hour
10 Sq. Mi.

25 inches

LAG TIME (SNYDER'S)

$$t_p = C_t (L L_{CA})^{0.3}$$

$$C_t = 2.0$$

$$L = 17,100' / 5280' = 3.25 \text{ mi.}$$

$$L_{CA} = 6500' / 5280' = 1.23 \text{ mi.}$$

$$t_p = 2.0 [(3.25)(1.23)]^{0.3}$$

$$\underline{t_p = 2.06 \text{ hrs.}}$$

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(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM

SHEET NO.

CALCULATED BY K. A.

CHECKED BY M. E.

SCALE

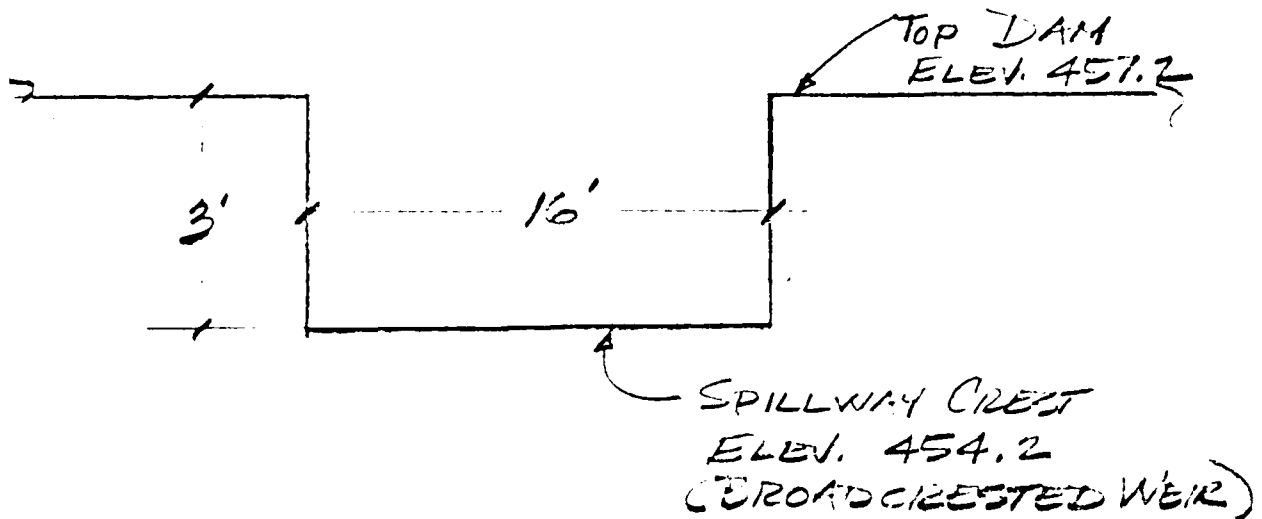
OF

DATE

DATE

6
12/4/80
9
1/6/31

SPILLWAY



DISCHARGE: $Q = CLH^{1.5}$

ELEV	C	L	H	Q (cfs)
454.2	2.5	16'	0	0
455.2	2.7	↑	1'	43.2
456.2	2.64	↑	2'	119.5
457.2	2.64	↑	3'	219.5
458.0	2.64	↑	3.8'	312.9
459.0	2.64	↑	4.8'	444.2
460.0	2.64	↑	5.8'	550.0
462.0	2.7	↑	7.8	941.1
464.0	2.7	↑	9.8	1325.3
466.0	2.7	16'	11.8	1751.1
460.0	2.65	16'	6.7	735.3

PMF LEVEL

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM

SHEET NO. 7

CALCULATED BY K.A.

CHECKED BY M.E.

SCALE

OF 9

DATE 12/4/80

DATE 1/6/81

LOW LEVEL OUTLET

CONTROL: 16" DIA. PIPE OPENING

$$Q = A \sqrt{\frac{2gH}{K}}$$

$$A = \pi r^2 = \pi \left(\frac{8}{12}\right)^2 = 1.40 \text{ ft.}^2$$

$$g = 32.2 \text{ ft/s}^2$$

$$K = 1.6$$

DISCHARGE:

<u>Elev.</u>	<u>A</u>	<u>g</u>	<u>K</u>	<u>H</u>	<u>Q (cfs)</u>
454.2	1.40	32.2	1.6	13.9	33.1
455.2	↑	↑	↑	14.9	34.3
456.2	↑	↑	↑	15.9	35.4
457.2	↑	↑	↑	16.9	36.5
458.0	↑	↑	↑	17.7	37.4
459.0	↑	↑	↑	18.7	38.4
460.0	↑	↑	↑	19.7	39.4
462.0	↑	↑	↑	21.7	41.4
464.0	↑	↑	↑	23.7	43.2
466.0	1.40	32.2	1.6	25.7	45.0

NOTE: INVERT ELEV. = 440.3'

→ 460.0 1.40 32.2 1.6 20.6 40.3

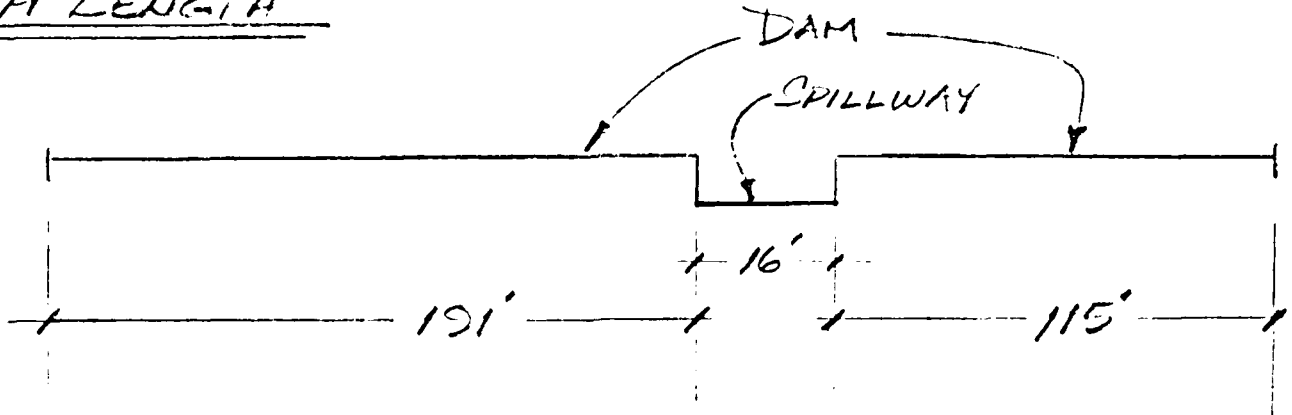
— PMF LEVEL

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB: WEST CONNAUG RESERVOIR DAM
SHEET NO: 8
CALCULATED BY: K. A.
CHECKED BY: P. C.
DATE: 12/4/80
SCALE: 1/50' = 1"

DAM LENGTH



DAM LENGTH = TOTAL LENGTH - SPILLWAY WIDTH

$$\text{DAM LENGTH} = 191' + 115' = L$$

$$\underline{L = 306'}$$

DISCHARGE COEFFICIENT OVER DAM

$$\underline{C = 2.6}$$

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS CONN 06268
(203) 429-7308

JOB WESTCONNAUG RESERVOIR DAM

SHEET NO

CALCULATED BY

CHECKED BY

SCALE

9
K. A.
M. Z.

OF

DATE

DATE

9
12/4/30
1/6/31

DISCHARGE SUMMARY

<u>ELEV.</u>	<u>Q_{SPILLWAY}</u>	<u>Q_{PIPE}</u>	<u>Q_{TOTAL} (cfs)</u>
454.2	0	33.1	33.1
455.2	43.2	34.3	77.5
456.2	119.5	35.4	154.9
457.2	219.5	36.5	256.0
458.2	312.9	37.4	350.3
459.2	444.2	38.4	482.6
460.0	590.0	39.4	629.4
462.0	941.1	41.4	982.5
464.0	1325.3	43.2	1368.5
466.0	1751.1	45.0	1796.1
468.0	735.3	40.3	775.6
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PIPE LEVEL

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WEST CONNING RESERVOIR

SHEET NO. 1

CALCULATED BY E. A.

CHECKED BY M. R.

OF 3

DATE 12/24/50

DATE 1/6/51

SCALE

DAM FAILURE ANALYSIS

STORAGE (AT TOP OF DAM): $L = 1952$ K.-FT.

PEAK FAILURE OUTFLOW:

$$Q_{D1} = \frac{8}{27} W_1 \sqrt{g} Y_1^{3/2}$$

WHILE: $W_1 = 0.4 \times 240 = 96$ ft.
 $C = 12.2$ ft/s²
 $Y_1 = 17.5$ ft.

$$Q_{D1} = \frac{8}{27} (96) \sqrt{32.2} (17)^{3/2}$$

$Q_{D1} = 11,214$ CFS

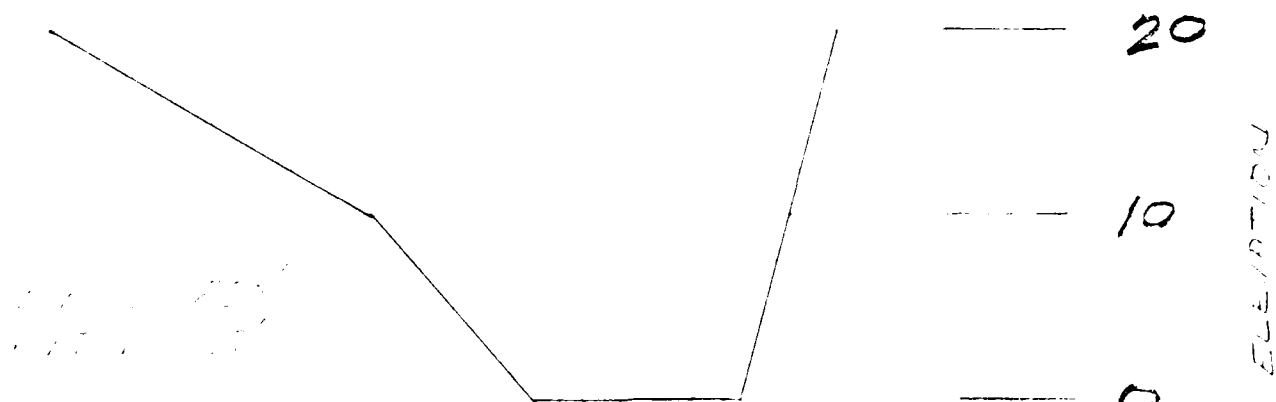
LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB *WEEP CORNERS*
SHEET NO. *2*
CALCULATED BY *M.H.*
CHECKED BY *K.A.*
SCALE

DATE *12/1/81*
DATE *1/2/81*

WEEP CORNERS



	<i>A</i>	<i>HP</i>	<i>K</i>	<i>V</i>	<i>S</i>
				1.4	688
				2.1	2299
				2.7	4752
				3.2	5085
				3.6	12344
				3.7	16322
				3.8	21309
				3.9	27372
				4.1	34585
				4.3	43083

1050

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB

SHEET NO

CALCULATED BY

CHECKED BY

SCALE

3

OF

DATE

DATE

13

12/1/81

1/2/81

K.A.

WATER MAIN 12" DIA. 40' - 50' DEPTH

DISCHARGE 1000 CFS

10' 20' 30' 40' 50'

DISCHARGE

AREA

10' 20' 30' 40' 50'

LENARD & DILAJ ENGINEERING, INC.

1000 St. James Road
ST. GARY, INDIANAPOLIS 06268
(203) 429-7308

JOB: 2000 TOWER ROAD
SHEET NO: 4
CALCULATED BY: J.R.
CHECKED BY: K.A.
SCALE:

REVISION
OF: 13
DATE: 12/31/80
DATE: 1/2/81

2000 TOWER ROAD SECTION 1

1. DESIGN LOAD COEFFICIENT = 0.050

2. STRESS AT TIME OF FAILURE = 1952 KSI

3. LENGTH OF REBAR = 13.00 FT

4. DESIGN LOAD WITH REBAR = 11,314 KSI

5. DEPTH OF TOWER = 9.7 FT

6. CROSS SECTIONAL AREA = 3,550 KSI

7. STRESS IN REBAR = 100.0 KSI

8. TOTAL REBAR AREA = 19,734

9. TOTAL STRESS IN REBAR = 9.42

10. TOTAL STRESS IN REBAR = 2250

11. TOTAL STRESS IN REBAR = 27.0

12. TOTAL STRESS IN REBAR = 7,742

13. TOTAL STRESS IN REBAR = 4

AD-A156 838

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
WESTCONNAUG RESERVOIR. (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 81

2/2

UNCLASSIFIED

F/G 13/13

NL



END	END
FILMED	FILMED
1981	1981



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

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONN AUG RESERVOIR

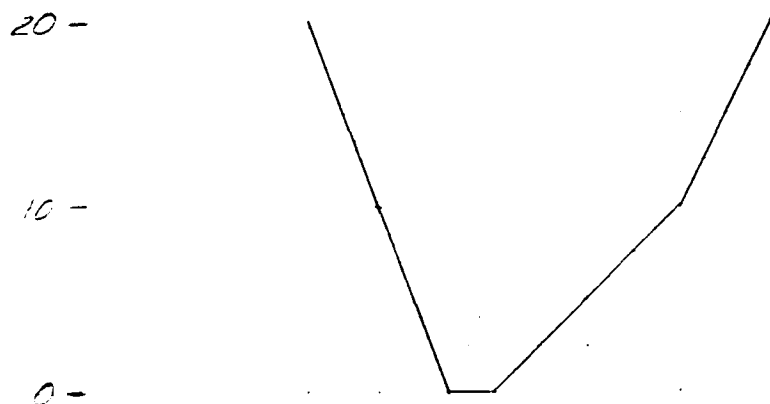
SHEET NO. 5 OF 13

CALCULATED BY M.H. DATE 12/21/90

CHECKED BY K.A. DATE 1/2/81

SCALE _____

WESTCONN AUG RESERVOIR DAM SECTION 2



HOR 1" = 200'
VERT 1" = 10'

<u>H</u>	<u>A</u>	<u>WP</u>	<u>R</u>	<u>V</u>	<u>Q</u>
2	155	105	1.5	7.1	1104
4	420	160	2.6	10.5	4402
6	795	216	3.7	13.1	10451
8	1280	271	4.7	15.5	19388
10	1875	326	5.8	17.7	33243
12	2560	381	7.1	20.4	52224
14	3315	436	8.1	22.3	75577
16	4140	492	9.6	25.0	103337
18	5085	547	11.5	28.2	142186
20	6000	602	11.7	28.9	173653

$n = 0.045$
 $S = 0.0275$
 $L = 1500$

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WEST CONNAUG RESERVOIR

SHEET NO. 6 OF 13

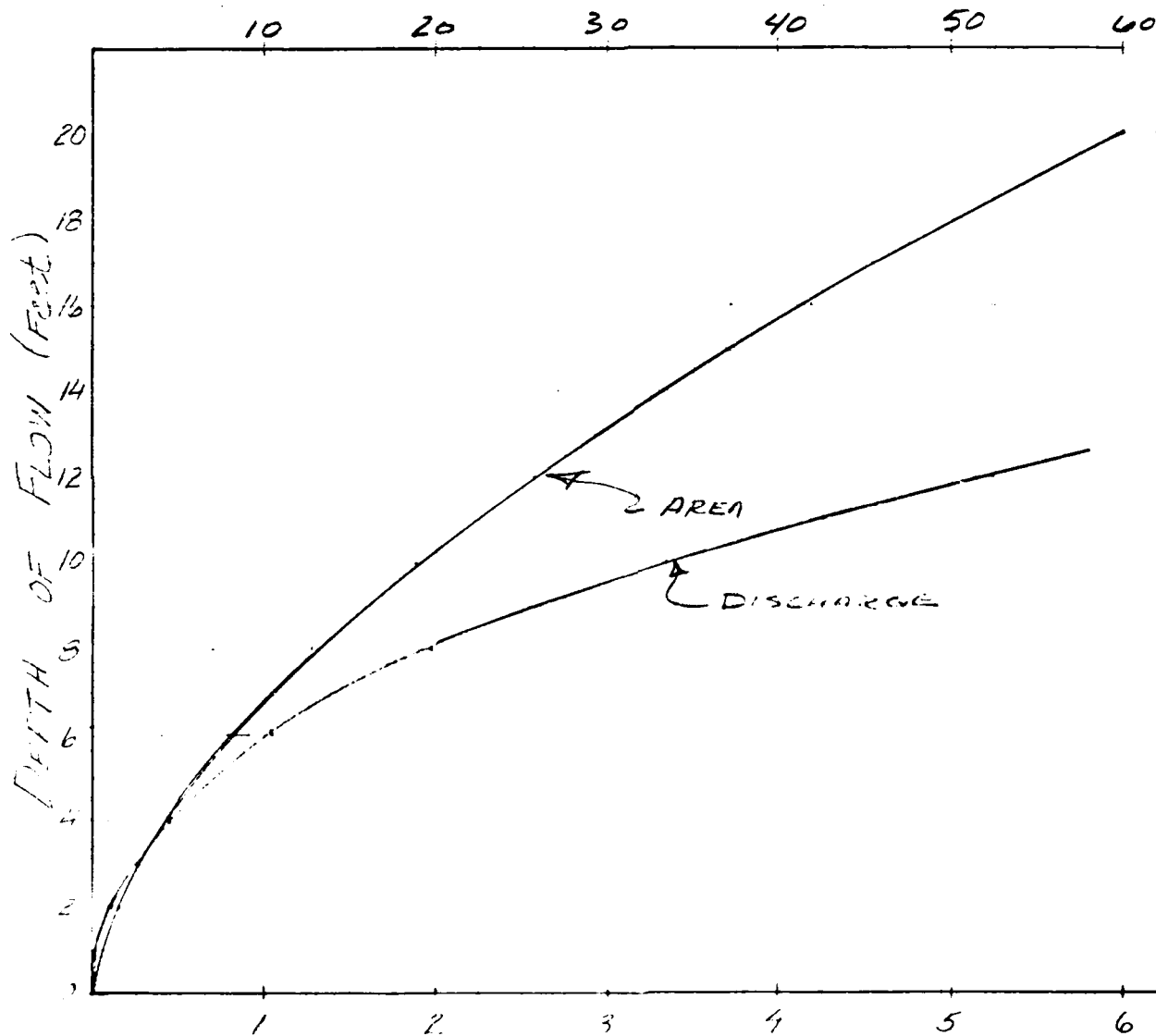
CALCULATED BY MH DATE 12/24/80

CHECKED BY K.A. DATE 1/2/81

SCALE _____

WEST CONNAUG RESERVOIR - SECTION 2

DISCHARGE (1000 cfs)



AREA (1000 sq. ft.)

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WEST CONNAUG RESERVOIR
SHEET NO. 7 OF 13
CALCULATED BY MR DATE 12/31/80
CHECKED BY _____ DATE _____
SCALE _____

FLOOD ROUTING SECTION 2

$$A = \text{MAINTENANCE COEFFICIENT} = 0.045$$

$$S = \text{STORAGE AT TIME OF FAILURE} = 1952 \text{ ACH}$$

$$L = \text{LENGTH OF REACH} = 1600 \text{ ft}$$

$$Q_{P2} = \text{INFLOW INTO REACH} = 10,743 \text{ cfs}$$

$$H_2 = \text{DEPTH OF FLOW} = 6.2 \text{ ft}$$

$$A_2 = \text{CROSS SECTIONAL AREA} = 850 \text{ sq ft}$$

$$V_2 = \text{STORAGE IN REACH} = 31.2 \text{ ACH}$$

$$Q_{P3} (\text{TRIAL}) = \text{TRIAL REACH OUTFLOW} = 10,571 \text{ cfs}$$

$$H (\text{TRIAL}) = \text{TRIAL DEPTH OF FLOW} = 6.0 \text{ ft}$$

$$A (\text{TRIAL}) = \text{TRIAL CROSS SECTIONAL AREA} = 800 \text{ sq ft}$$

$$V (\text{TRIAL}) = \text{TRIAL STORAGE IN REACH} = 29.4 \text{ ACH}$$

$$Q_{L2} = \text{REACH OUTFLOW} = Q_{P2} \left(1 - \frac{V_{L2}}{S}\right) = 10,576 \text{ cfs}$$

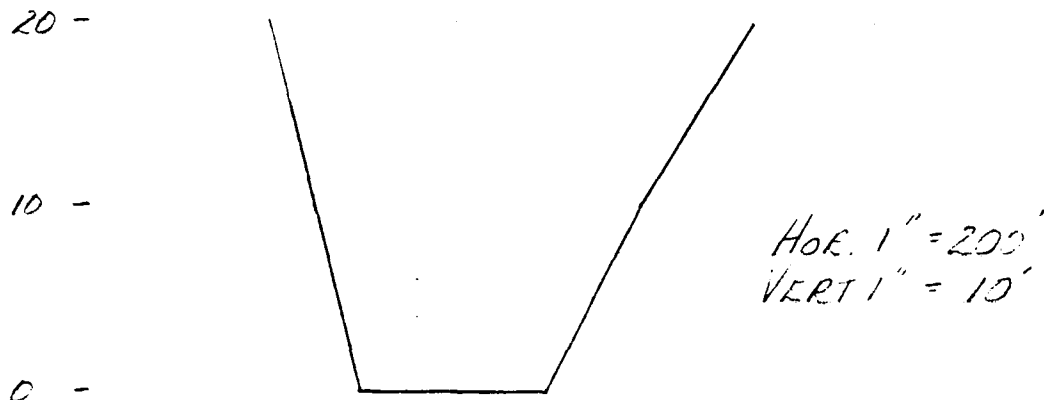
$$H_2 = \text{DEPTH OF FLOW} = 6.0 \text{ ft}$$

LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNHAUG RESERVOIR
SHEET NO. 5 OF 13
CALCULATED BY M.H. DATE 12/24/86
CHECKED BY C.A. DATE 1/2/81
SCALE _____

WESTCONNHAUG RESERVOIR - SECTION 3 -



<u>T</u>	<u>A</u>	<u>WP</u>	<u>R</u>	<u>V</u>	<u>Q</u>
2	430	230	1.9	5.4	2,306
4	920	260	3.5	8.2	7,564
6	1470	291	5.0	10.4	15,342
8	2050	321	6.5	12.3	25,650
10	2750	351	7.8	14.0	33,513
12	3435	387	9.0	15.3	53,579
14	4190	422	10.2	16.6	71,536
16	5065	457	11.3	17.9	92,462
18	6110	493	12.4	19.0	116,349
20	7125	528	13.5	20.2	143,637

$\Sigma A = 0.553$
 $\Sigma S = 0.114$
 $\Sigma L = 2.500$

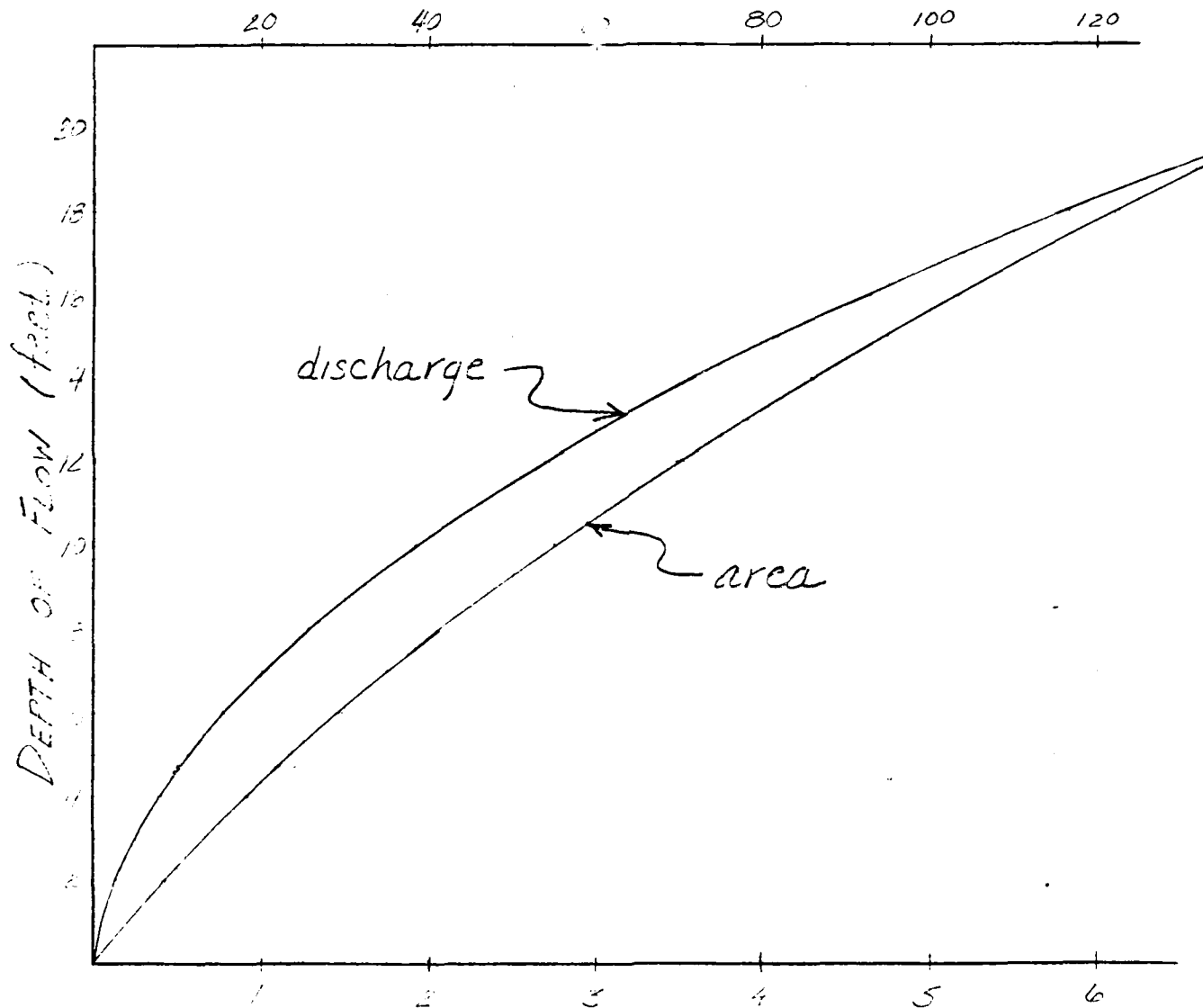
LENARD & DILAJ ENGINEERING, INC.

1066 Storrs Road
STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WESTCONNAUG RESERVOIR
SHEET NO. 9 OF 13
CALCULATED BY M.H. DATE 12/24/80
CHECKED BY K.A. DATE 1/2/81
SCALE _____

WESTCONNAUG RESERVOIR - SECTION 3

DISCHARGE (1000 cfs)



AREA (acres)

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(203) 429-7308

JOB WESTCONNAUG RESERVOIR

SHEET NO. 10 OF 13

CALCULATED BY MR DATE 12/31/80

CHECKED BY K.A. DATE 1/2/81

SCALE _____

FLOOD ROUTING SECTION 3

n = MANNING COEFFICIENT = 0.050

S = STORAGE AT TIME OF FAILURE = 1952 ACH

L = LENGTH OF REACH = 2500 ft

Q_{P2} = INFLOW INTO REACH = 10,576 cfs

H_3 = DEPTH OF FLOW = 4.7 ft

A_3 = CROSS SECTIONAL AREA = 1,100 sq ft

V_3 = STORAGE IN REACH = 63.1 ACH

$Q_{TH}(\text{TRIAL})$ = TRIAL REACH OUTFLOW = 10,234 cfs

$H(\text{TRIAL})$ = TRIAL DEPTH OF FLOW = 4.6 ft

$A(\text{TRIAL})$ = TRIAL CROSS SECTIONAL AREA = 1,050 sq ft

$V(\text{TRIAL})$ = TRIAL STORAGE IN REACH = 60.3 ACH

Q_{out} = REACH OUTFLOW = $(1 - \frac{V_{out}}{V})$ = 10,242 cfs

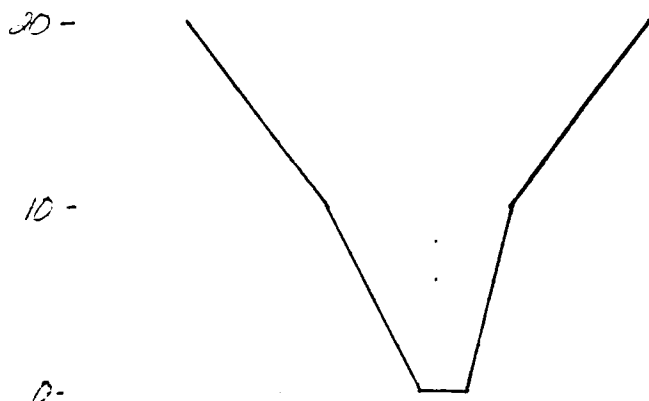
H_{out} = DEPTH OF FLOW = 4.6 ft

LENARD & DILAJ ENGINEERING, INC.

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JOB WEST CONNAUG RESERVOIR
SHEET NO 11 OF 12
CALCULATED BY M.H. DATE 12/21/90
CHECKED BY K.A. DATE 1/2/81
SCALE _____

WESTCONNAUG RESERVOIR DAM SECTION 4 -



HOR 1" = 200'
VERT 1" = 10'

<u>H</u>	<u>A</u>	<u>WP</u>	<u>R</u>	<u>V</u>	<u>Q</u>
1	38	65	0.9	5.1	295
2	130	80	1.6	7.6	989
3	218	95	2.3	9.6	2090
4	320	110	2.9	11.2	3596
5	438	126	3.5	12.7	5546
6	570	141	4.0	14.0	7735
8	580	171	5.1	16.5	14,492
10	1250	201	6.2	18.7	23,370
15	3625	352	7.4	21.1	55,426
20	4750	508	9.5	24.8	117,642

$$K = 0.050$$

$$C = 0.034$$

$$L = 1600$$

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JOB WEST CONNAUG RESERVOIR

SHEET NO. 12 OF 13

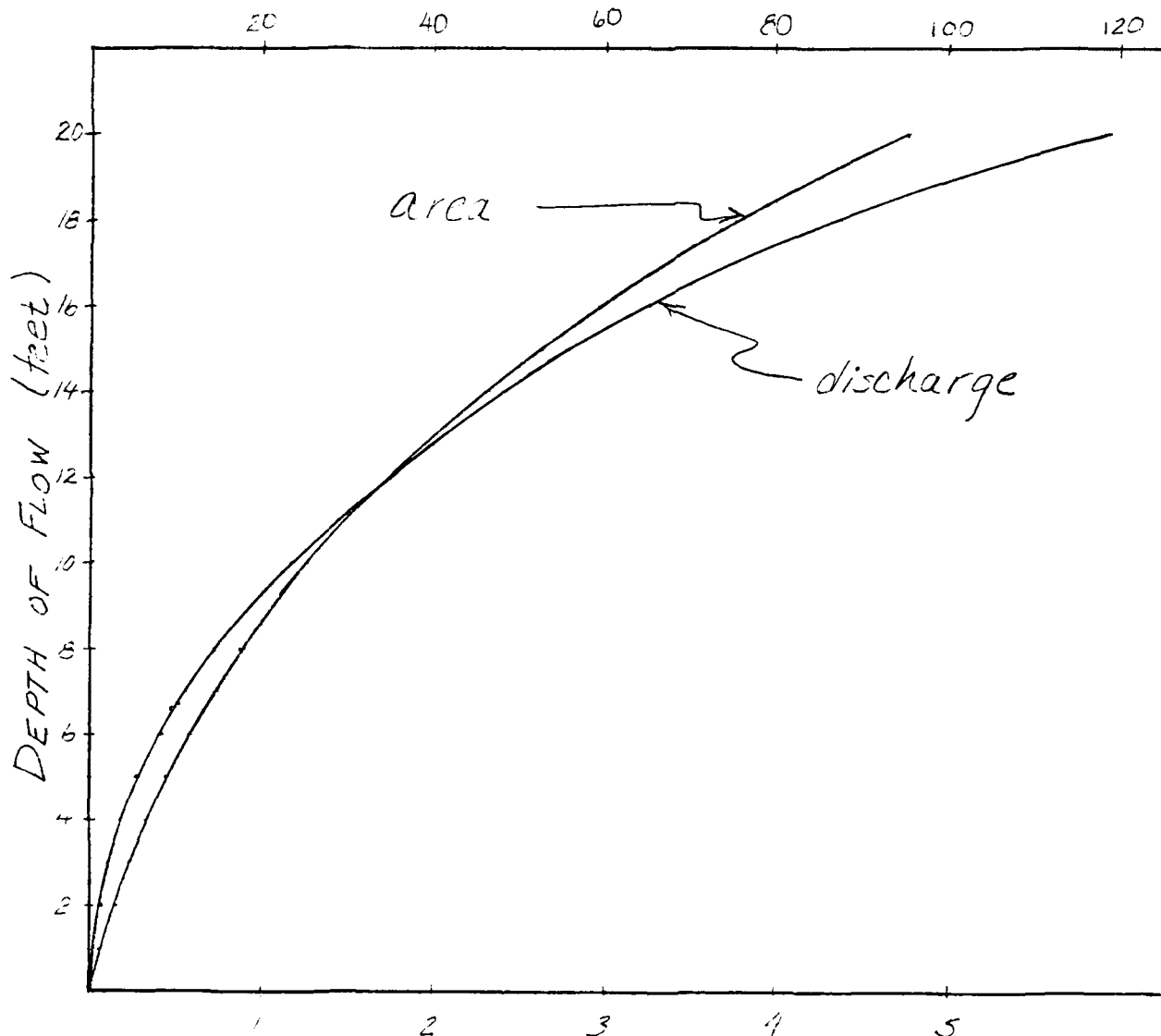
CALCULATED BY MH DATE 12/24/80

CHECKED BY K. A. DATE 1/2/81

SCALE _____

WEST CONNAUG RESERVOIR DAM - SECTION 4 -

DISCHARGE (1000 cfs)



AREA (thousand sq. ft)

LENARD & DILAJ ENGINEERING, INC.

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STORRS, CONNECTICUT 06268
(203) 429-7308

JOB WEST CONNAUGHT RESERVOIR
SHEET NO 13 OF 100
CALCULATED BY MR DATE 12/31/93
CHECKED BY K. A. DATE 1/2/81
SCALE _____

FLOOD ROUTING - SECTION 4

n = MANNING COEFFICIENT = 0.050

S = STORAGE AT TIME OF FAILURE = 1952 ACH

L = LENGTH OF REACH = 1600 FT

Q_{in} = INFLOW INTO REACH = 10,242 CFS

H_f = DEPTH OF FLOW = 6.7 FT

A_c = CROSS SECTIONAL AREA = 690 SQ FT

V_r = STORAGE IN REACH = 25.3 ACH

$Q_{out}(trial)$ = TRIAL REACH OUTFLOW = 10,109 CFS

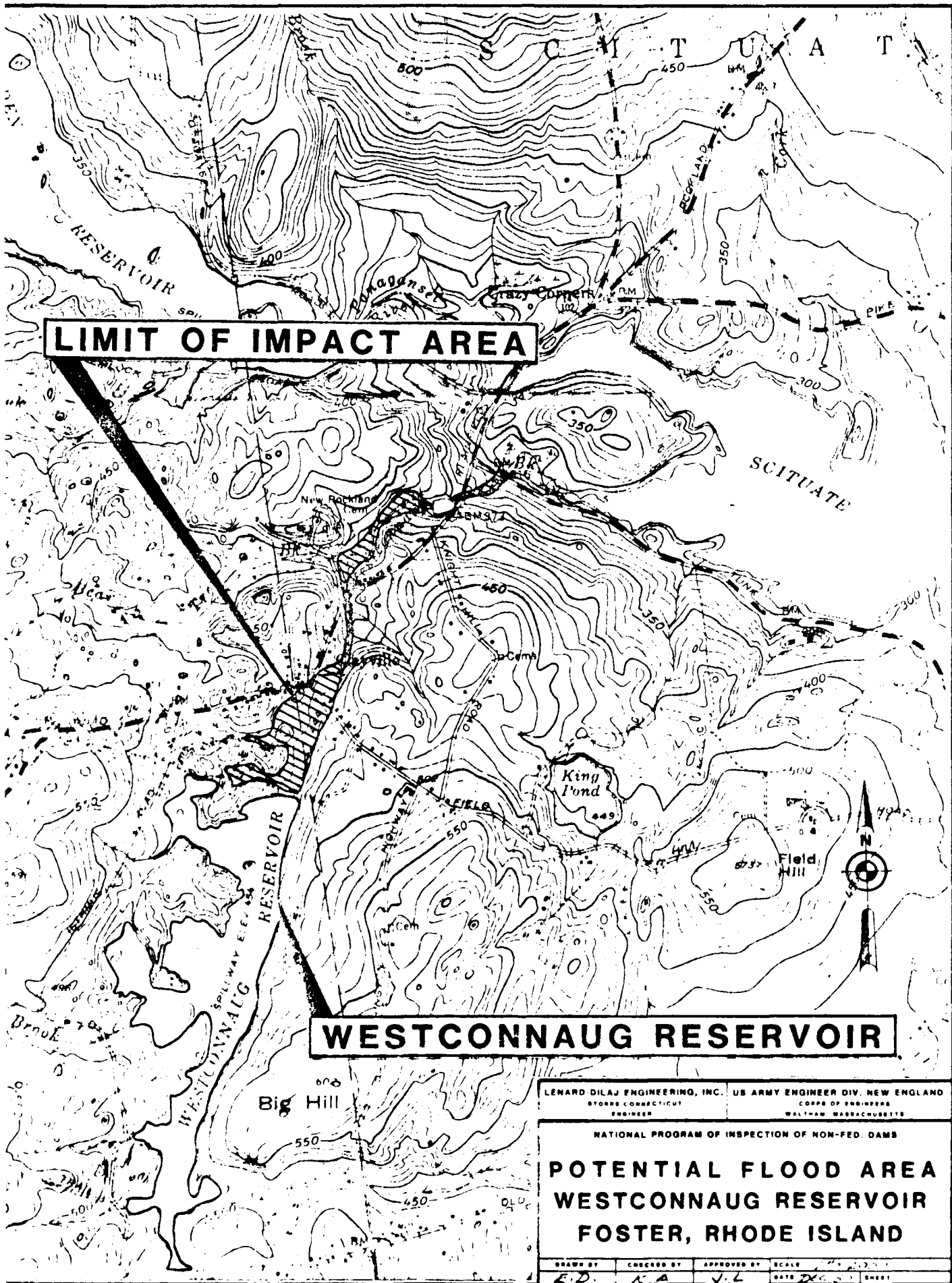
$H_f(trial)$ = TRIAL DEPTH OF FLOW = 6.7 FT

$A_c(trial)$ = TRIAL CROSS SECTIONAL AREA = 690 SQ FT

$V_r(trial)$ = TRIAL STORAGE IN REACH = 25.3 ACH

Q_{out} = REACH OUTFLOW = 10,109 CFS

H_f = DEPTH OF FLOW = 6.7 FT



LIMIT OF IMPACT AREA

WESTCONNAUG RESERVOIR

LENARD DILAJ ENGINEERING, INC. STORRS, CONNECTICUT ENGINEER		US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASSACHUSETTS	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
POTENTIAL FLOOD AREA WESTCONNAUG RESERVOIR FOSTER, RHODE ISLAND			
DRAWN BY E.D.	CHECKED BY K.A.	APPROVED BY J.L.	SCALE DATE DEC 2 1961 SHEET

APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

FILMED

8-85

DTIC

END

FILMED

8-85

DTIC