UPPER AND LOWER LITTLE RIVER DAMS
DAM ASSESSMENT REPORT

PREPARED FOR RANSOM CONSULTING, INC.

JULY 2018

WRIGHT-PIERCE
Engineering a Better Environment

UPPER AND LOWER LITTLE RIVER DAMS

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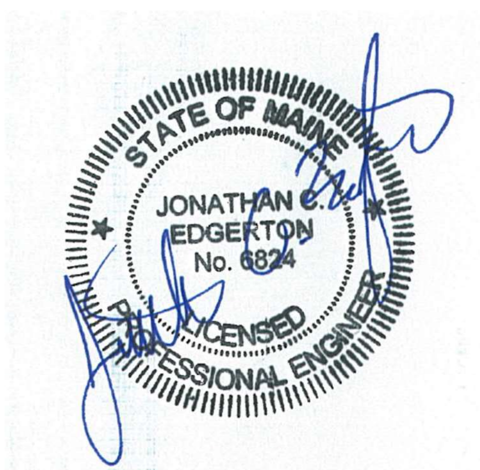

Prepared By:

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Suite 140
Topsham, Maine 04086

UPPER AND LOWER LITTLE RIVER DAMS
DAM ASSESSMENT REPORT

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APPENDICES

SECTION 1
INTRODUCTION

1.1 PREFACE

The assessment of the general condition of the dams reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

It is critical to note that the condition of the dams depends on numerous and constantly changing internal and external conditions and is evolutionary in nature. It would be incorrect to assume that the reported 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.

1.2 BACKGROUND AND PURPOSE

The purpose of this investigation was to inspect and evaluate the present condition of the dams and appurtenant structures to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation was divided into three parts: 1) obtain and review available reports, investigations, and data previously submitted to the owner pertaining to the dams and appurtenant structures; 2) perform a visual inspection of the sites; and 3) prepare and submit a report presenting the evaluation of the structures, including recommendations and remedial actions.

The discussion has been focused on the desire to understand the risks associated with failure of these two dams. As a part of this effort, we have conducted an assessment into the stability of the Lower Dam. As anticipated, this effort required development of assumptions regarding how the structure is founded (as it does not appear that design drawings for the structure are available) and dewatering the structure to allow for full observation of the structures interface with native conditions was not possible.

Our effort has included a review of past evaluations relative to the hydraulic characteristics of both dams and spillways, and development of new commentary pertinent to the goals of this assessment effort.

1.3 UPPER LITTLE RIVER DAM

The Upper Little River Dam is a 30-foot high, 216-foot long concrete gravity dam. It has historically impounded a reservoir with a surface area of approximately 48 acres and a capacity of about 850 acre-feet. The spillway section of the dam approximately 114 feet in length with a vertical upstream face and slightly battered downstream face. It has been assigned Number 5091 by the Maine Dam Safety office.

A number of inspections conducted since 1979 have identified seepage, scaling, spalling, and surface cracks on the Upper Dam face. A long horizontal crack approximately three feet below the spillway crest apparently is the result of a cold joint between the original concrete dam structure and three feet of additional concrete placed after the 1954 Hurricane Edna flood destroyed the spillway flashboards. The flashboards were not replaced. The top and downstream surfaces of the dam were repaired with sprayed on concrete (called gunite or shotcrete) in 1991. The deterioration currently visible on the face of the dam is typical for this type of application under the relatively harsh climatic conditions to which it is exposed.

Small trees exist adjacent to the dam abutments and downstream from the dam on both banks of the river. Root growth from trees can compromise the dam foundation, and vegetation can impede water flow in the river during high water events.

Discharge from the dam is controlled by three valves that allow water to enter the control tower and two valves that allow water to exit the control tower through the dam into the Little River. All three of the inlet valves and one of the outlet valves are reportedly operable. There is also an 18-inch drain located in the north abutment (approximately 14.7 feet lower than the spillway and north of the control tower). We were unable to determine the current operational state of this drain.

The top of a 24-inch diameter pipe exists at the downstream toe of the dam. We were unable to discern any gating or valving associated with it, and prior assessments include speculation that it was placed to divert water through the dam structure during the original construction.

Previous efforts included evaluations of the stability and hydraulic capacity of the Upper Dam. The Upper Dam has been inspected a number of times since issuance of the Corps of Engineers report in 1979. There have been persistent questions about its stability which remain as yet unresolved.

1.4 LOWER LITTLE RIVER DAM

The Lower Little River Dam is a 30-foot high, 126-foot long concrete and masonry dam. It has historically impounded a reservoir with a surface area of approximately 37 acres and a capacity of about 600 acre-feet. The spillway section of the dam is an ogee of approximately 91 feet in length with an apron that discharges over a vertical drystone masonry retaining wall. It has been assigned Number 5090 by the Maine Dam Safety office.

Previous inspections, made in 1979 and 1996, indicated the dam was in fair condition. Significant work was undertaken in 1988 to address erosion issues along the south bank of the channel below the dam spillway. Further work was done by the District in 1989 to address erosion issues along the north bank below the dam. Repairs to the concrete surfaces of the dam were completed in 1991.

The gating mechanism for regulating discharge and controlling water level in the reservoir is currently non-functional. This limits the District's ability to lower the level of water behind the dam should it be necessary. Public access to the dam structure is largely uncontrolled.

It was determined that the stability of the Lower Dam should be reviewed in the context of this assessment effort. Section 3 of this report includes discussion regarding the results of the stability analysis.

SECTION 2
UPPER LITTLE RIVER DAM

2.1 Visual Inspection

Upper Little River Dam was inspected on March 15, 2018 and April 10, 2018. At the time of the April inspection, the temperature was near 35^{o} F with partly sunny with a light wind. Photographs to document the current conditions of the dam were taken during both inspections and are included in Appendix C. The level of the impoundment was estimated to be approximately 1-3" inches above the top of spillway/weir crest on both dates. Underwater areas were not inspected.

2.1.1 General Findings

In general, the Upper Little River Dam was found to be in POOR condition with deteriorated concrete. See below for a discussion regarding the factors of safety against sliding and overturning.

2.1.2 Dam

- Abutments

Both abutments appear to be deteriorated and in poor condition.

- Upstream Face - Spillway

The upstream concrete face is believed to be vertical and is cast in place concrete. We were unable to observe the face of the wall as it was underwater.

- Downstream Face - Spillway

The downstream concrete face is offset from the vertical at approximately 1:12. There appear to be significant areas of spalled and cracked concrete. We were limited in our ability to see clearly this portion of the dam due to flows.

- Crest

We were limited in our ability to see clearly this portion of the dam due to flows, but anecdotal reports suggest significant concerns with the condition of the concrete.

- Instrumentation

No instruments were observed at the dam.

- Access Roads and Gates

Both ends of the dam are secured, to some extent, with chain link fencing.

- Drains

No drains were observed during the inspection.

2.1.3 Appurtenant Structures

- Dikes

Not Applicable

- Gates

We were unable to closely observe the gates, but water was discharging from several pipes on the downstream face of the dam (see photos).

2.1.4 Downstream Area

The left and right channel immediately downstream of the dam is comprised largely of rock and stone, transitioning to a bridge opening.

2.1.5 Impoundment Area

No unusual conditions were observed upstream of the dam.

2.2 Assessment Summary

In general, the overall condition of Upper Little River Dam is POOR. Our observations confirmed the presence of significant spalling and delamination of concrete face as well as diagonal and vertical cracks in the abutting gate structure.

Previous inspections and review have identified:

1. Significant concerns relative to the integrity of the concrete comprising the main spillway structure.
2. Likely structural instability, in the form of a low resistance to sliding and overturning of the dam.

2.3 Commentary from Maine Emergency Management Agency

As is customary in our assessment of dams in the State, we contacted Tony Fletcher, the State's Dam Safety Officer. He indicated that, in his opinion, "the upper dam appears to be in an unsatisfactory structural condition, and although it shows no signs of imminent failure, as a precaution I have asked the dam owners to reduce the dams head-pond". He also indicated that "if the dam owners wish to keep the dam, I suggest it be investigated for stability and current material strength before being operated at normal pond".

2.4 Recommendations

Substantial reconstruction is expected to be necessary to address current deficiencies at the dam. Prior to undertaking maintenance, repairs, or remedial measures, the applicability of environmental permits should be determined for activities that may occur within or adjacent to resource areas under the jurisdiction of the local municipal government, the Maine DEP, the Corps of Engineers or other regulatory agencies.

If it is desired to keep the dam, there will be considerable capital cost involved to address the currently identified safety concerns. Development of detailed estimates of the costs associated with such an action is not within the scope of this assessment, although we have provided some information on potential costs, in Section 4 of this report.

Given the condition of the dam, the lack of original as built drawings and the fact that the dam is reaching the end of its useful life, removing the entire dam should be strongly considered. Additional brief discussion is included in Section 4 of this report.

In the interim, the water level of the impoundment should be kept well below the spillway crest to manage the risk of dam breach.

SECTION 4
CONCLUSIONS AND RECOMMENDATIONS

4.1 FUTURE DAM MANAGEMENT

4.1.1 Operation and Maintenance Program

Regardless of any future actions undertaken with respect to the dams, a maintenance program should be put into place any structures to remain.

4.1.2 Monitoring and Surveillance Program

Both the Corps of Engineers and MEMA have recommended that the District prepare Inspection and Monitoring programs for the dams. The operations and maintenance program we have prepared includes routine inspection and monitoring as an integral part.

4.1.3 Emergency Action Plan

The purpose of an emergency action plan is to clearly state what conditions threaten each dam and the steps necessary to protect the public safety. The plan should include the steps the Dam Owner will take to prevent dam failure, for example early release of water in advance of predicted storm events, periodic checking during storm events, etc. It should also include steps the Dam Owner and the community will take to minimize loss of life and downstream damage should either dam breach. The plan, including a notification flowchart and contact information is normally prepared in conjunction with public safety officials.

4.2 UPPER LITTLE RIVER DAM

Given the condition of the Upper Dam, the lack of original as-built drawings and the fact that the dam is reaching the end of its useful life, either partial or complete removal of the dam should be strongly considered. Having said that, the three primary options available include:

4.2.1 Complete Removal of the Upper Dam

This option eliminates the risk associated with future dam breach, as well as the financial burden associated with maintaining a dam at this location. It is worth noting that residents of the community have become accustomed to the impoundment as a scenic and recreational amenity and it is to be expected that there is some contingent (possibly a vocal one) that may actively resist a decision to remove the dam and eliminate the impoundment. Assuming the lower dam is to remain in place, the ecological benefit associated with allowing upstream fish passage at this location is likely limited, and it can probably be argued that the impoundment provides desirable habitat for waterfowl and wading birds.

4.2.2 Partial Removal of the Upper Dam

This option mitigates the risk associated with future dam breach through lowering the effective height of the dam and implementing structural enhancements necessary to provide suitable factors of safety against sliding and overturning. Note that this option perpetuates the financial burden associated with maintaining a dam at this location. The precise elevation of the revised spillway crest would be determined based on a limited bathymetric study, which would support determining a reduced impoundment to remain as a scenic and recreational amenity.

4.2.3 Rehabilitation of the Upper Dam

This option addresses the currently identified deficiencies through implementing structural enhancements necessary to provide suitable factors of safety against sliding and overturning.

Any repairs undertaken at the Upper Dam should be made in accordance to standard design practices, specifications and construction methods associated with concrete gravity dams. Design or analysis of the work should be completed by a qualified professional engineer experienced in the design and rehabilitation of dams.

In the short-term, the water level of the impoundment should be kept well below the spillway crest to manage the risk of dam breach.

4.3 LOWER LITTLE RIVER DAM

Our assessment identified several potential areas for repairs or improvements:

4.3.1 Evaluate and Address Stability Concerns of Left Bank Retaining Wall

Conduct a more detailed review of the stability of the left (westerly) bank downstream retaining wall. Based on our observations, it appears that some of the precast units may have been displaced over time. As noted above, we have contacted the Corps of Engineers to determine whether As-Built drawings are available for the wall in question. In cases like this, it is not uncommon to implement a monitoring system to determine whether the retaining wall is stable in its current configuration, and to define the magnitude of any ongoing or future displacement of the concrete units.

4.3.2 Install Low Level Drain

Install a low-level drain which would facilitate dewatering for the purposes of inspection, maintenance or repairs. This should likely be included in the rehabilitation of the flow chamber/vault area and left bank retaining wall located at the right (easterly) end of the dam, as discussed below.

4.3.3 Rehabilitate / Reconstruct Vault / Flow Chamber

Conduct repairs to the existing concrete and stone masonry at the flow chamber/vault between the dam and Water District building. This effort should be coordinated with the installation of a gated low-level drain.

4.3.4 Reconstruct / Replace Left Bank Retaining Wall

Conduct repairs/replacement to the retaining wall just upstream of the Vault/Flow Chamber on the right (easterly) bank.

4.3.5 Further Evaluate Stability / Factor of Safety Against Sliding

Consider whether further efforts to refine assumptions relative to the stability analysis (sliding – depends on foundation conditions) are warranted. It is difficult to assign a cost to this element as it requires dewatering of the dam (or may be attempted with a diver). The results of such an effort are uncertain and, hence, it may make sense to further discuss the pros and cons before initiating this task.

Any repairs undertaken at the Lower Dam should be made in accordance to standard design practices, specifications and construction methods associated with concrete gravity dams. Design or analysis of the work should be completed by a qualified professional engineer experienced in the design and rehabilitation of dams.

SECTION 4
CONCLUSIONS AND RECOMMENDATIONS

4.1 FUTURE DAM MANAGEMENT

4.1.1 Operation and Maintenance Program

Regardless of any future actions undertaken with respect to the dams, a maintenance program should be put into place any structures to remain.

4.1.2 Monitoring and Surveillance Program

Both the Corps of Engineers and MEMA have recommended that the District prepare Inspection and Monitoring programs for the dams. The operations and maintenance program we have prepared includes routine inspection and monitoring as an integral part.

4.1.3 Emergency Action Plan

The purpose of an emergency action plan is to clearly state what conditions threaten each dam and the steps necessary to protect the public safety. The plan should include the steps the District will take to prevent dam failure, for example early release of water in advance of predicted storm events, periodic checking during storm events, etc. It should also include steps the Dam Owner and the community will take to minimize loss of life and downstream damage should either dam breach. The plan, including a notification flowchart and contact information is normally prepared in conjunction with public safety officials.

4.2 UPPER LITTLE RIVER DAM

Given the condition of the Upper Dam, the lack of original as built drawings and the fact that the dam is reaching the end of its useful life, either partial or complete removal of the dam should be strongly considered. Having said that, the three primary options available include:

In the short-term, the water level of the impoundment should be kept well below the spillway crest to manage the risk of dam breach.

4.2.1 Complete Removal of the Upper Dam

This option eliminates the risk associated with future dam breach, as well as the financial burden associated with maintaining a dam at this location. It is worth noting that residents of the community have become accustomed to the impoundment as a scenic and recreational amenity and it is to be expected that there is some contingent (possibly a vocal one) that may actively resist a decision to remove the dam and eliminate the impoundment. Assuming the lower dam is to remain in place, the ecological benefit associated with allowing upstream fish passage at this location is likely limited, and it can probably be argued that the impoundment provides desirable habitat for waterfowl and wading birds. We suggest an order-of-magnitude cost associated with full dam removal is likely on the order of $[redacted].

4.2.2 Partial Removal of the Upper Dam

This option mitigates the risk associated with future dam breach through lowering the effective height of the dam and implementing structural enhancements necessary to provide suitable factors of safety against sliding and overturning. Note that this option perpetuates the financial burden associated with maintaining a dam at this location. The precise elevation of the revised spillway crest would be determined based on a limited bathymetric study, which would support determining a reduced impoundment to remain as a scenic and recreational amenity. We suggest an order-of-magnitude cost associated with partial dam removal is likely on the order of $[redacted].

4.2.3 Rehabilitation of the Upper Dam

This option addresses the currently identified deficiencies through implementing structural enhancements necessary to provide suitable factors of safety against sliding and overturning. We suggest an order-of-magnitude cost associated with rehabilitation of the upper dam is likely on the order of $[redacted].

Any repairs undertaken at the Upper Dam should be made in accordance to standard design practices, specifications and construction methods associated with concrete gravity dams.

Design or analysis of the work should be completed by a qualified professional engineer experienced in the design and rehabilitation of dams.

4.3 LOWER LITTLE RIVER DAM

Our assessment identified several potential areas for repairs or improvements:

4.3.1 Evaluate and Address Stability Concerns of Left Bank Retaining Wall

Conduct a more detailed review of the stability of the left (westerly) bank downstream retaining wall. Based on our observations, it appears that some of the precast units may have been displaced over time. As noted above, we have contacted the Corps of Engineers to determine whether As-Built drawings are available for the wall in question. We suggest an order-of-magnitude cost associated with a detailed assessment into the stability of the downstream left bank retaining wall is likely on the order of $[redacted]. In the event a comprehensive rehabilitation of the wall is in order, we suggest an order-of-magnitude cost for rehabilitation of the wall may be on the order of $[redacted].

4.3.2 Install Low Level Drain

Install a low-level drain which would facilitate dewatering for the purposes of inspection, maintenance or repairs. This should likely be included in the rehabilitation of the flow chamber/vault area located at the right (easterly) end of the dam, as discussed below. We suggest an order-of-magnitude cost associated with the installation of a low-level drain is likely on the order of $[redacted]. Note that this should be undertaken in coordination with the rehabilitation of the Vault / Flow Chamber discussed below.

4.3.3 Rehabilitate / Reconstruct Vault / Flow Chamber

Conduct repairs to concrete and stone masonry at the flow chamber/vault between the dam and Water District Building. This effort should be coordinated with the installation of a gated low-level drain. We suggest an order-of-magnitude cost associated with rehabilitation of the flow chamber/vault is likely on the order of $[redacted].

4.3.4 Reconstruct / Replace Left Bank Retaining Wall

Conduct repairs/replacement to retaining wall just upstream of the Vault/Flow Chamber on the right (easterly) bank. We suggest an order-of-magnitude cost associated with replacement of the upstream left retaining wall is likely on the order of $[redacted].

4.3.5 Further Evaluate Stability / Factor of Safety Against Sliding

Consider whether further efforts to refine assumptions relative to the stability analysis (sliding – depends on foundation conditions) are warranted. It is difficult to assign a cost to this element as it requires dewatering of the dam (or may be attempted with a diver). The results of such an effort are uncertain and, hence, it may make sense to further discuss the pros and cons before initiating this task.

Any repairs undertaken at the Lower Dam should be made in accordance to standard design practices, specifications and construction methods associated with concrete gravity dams. Design or analysis of the work should be completed by a qualified professional engineer experienced in the design and rehabilitation of dams.

APPENDIX A
Location Map

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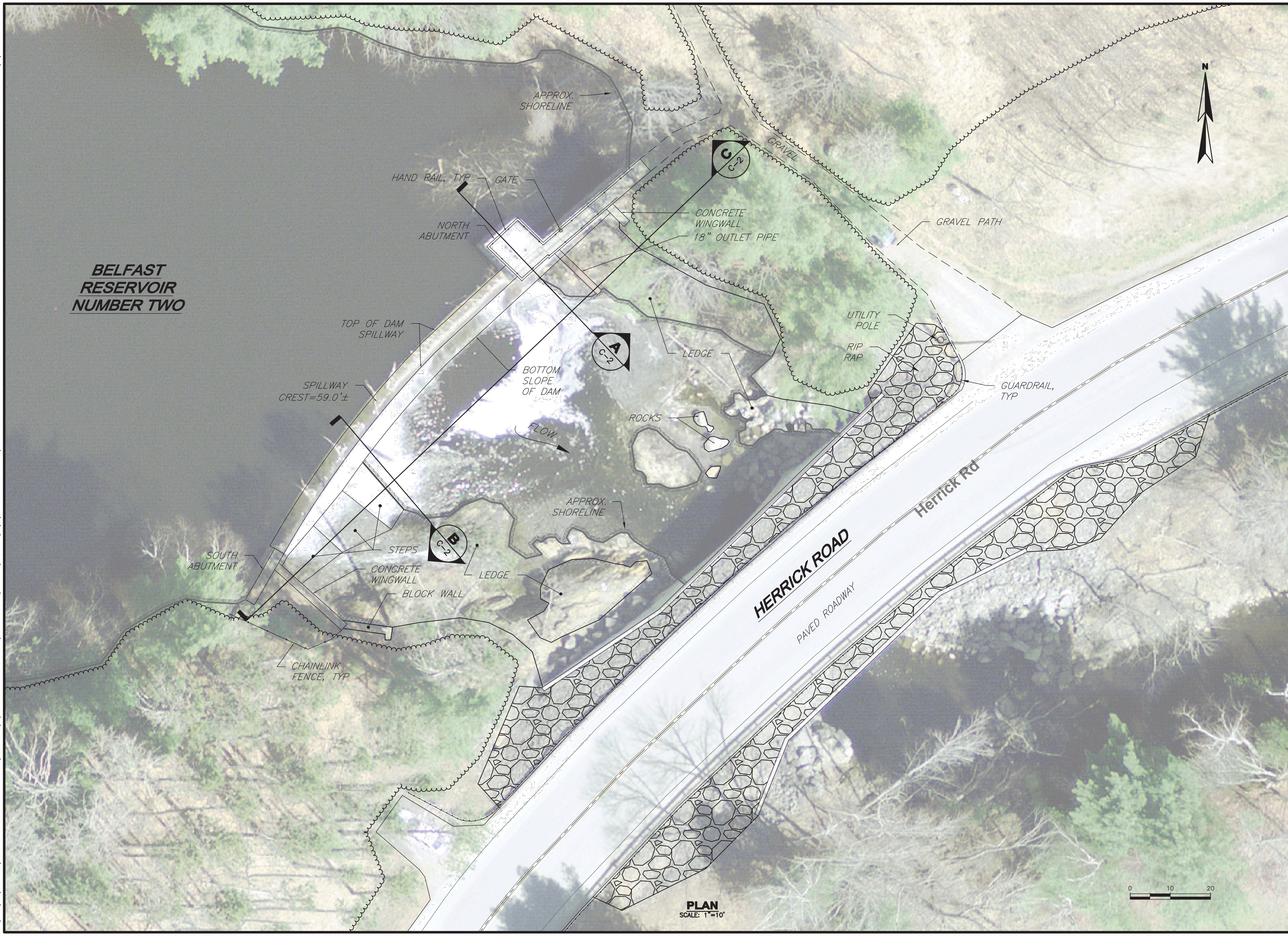
APPENDIX B

Upper Dam - Plan and Sections



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BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

UPPER DAM EXISTING CONDITIONS

DRAWING C–1

DESIGNED BY: ####
CAD COORD.: ####
CAD: ####
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO:

NO	SUBMISSIONS/REVISIONS	APP'D	DATE

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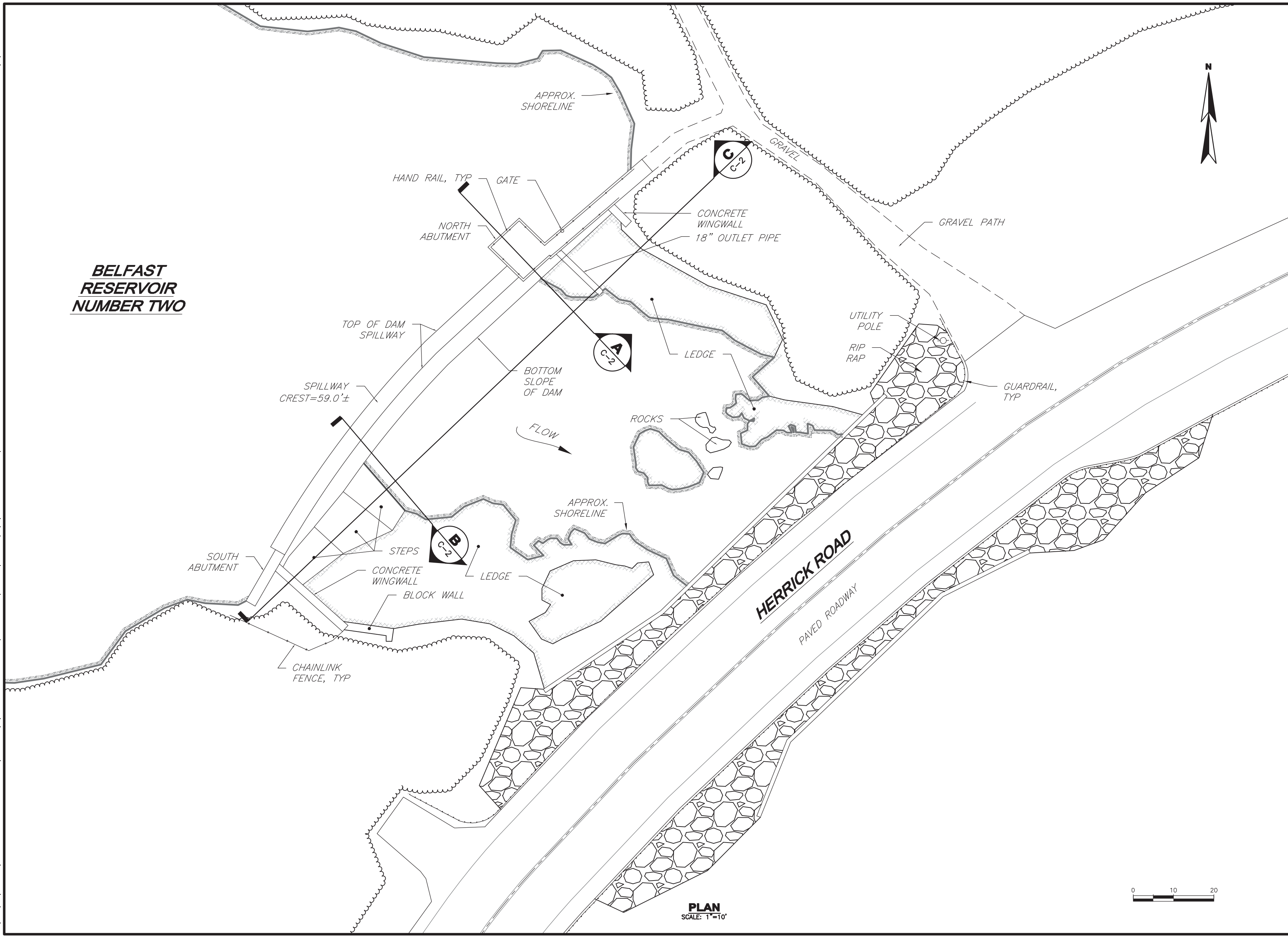

PLAN
SCALE: 1"=10'

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BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

UPPER DAM EXISTING CONDITIONS

DRAWING
C–1

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APPROVED BY:
DATE:
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NO	SUBMISSIONS/REVISIONS	APP'D	DATE

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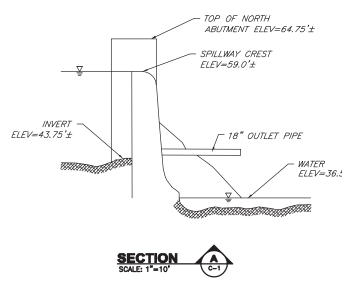

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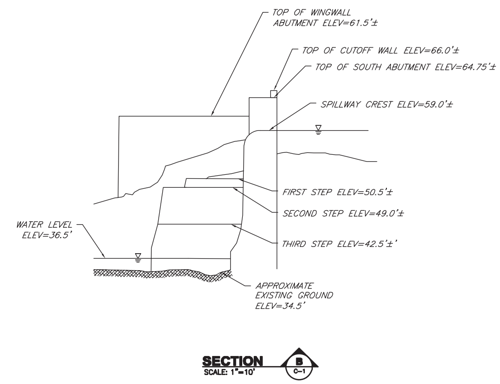

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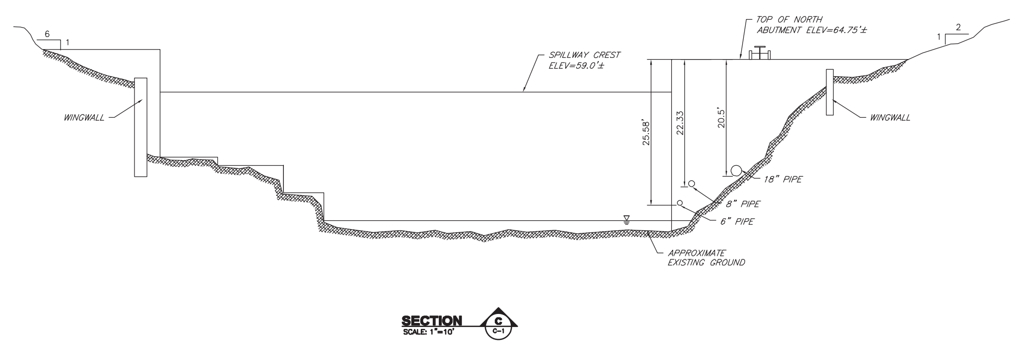

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DATE:
APPROVED BY:
DATE:
PROJECT NO:

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BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

UPPER DAM SECTIONS

DRAWING
C-2

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APPENDIX C

Upper Dam – Photographs

APPENDIX D

Upper Dam – ACOE Phase 1 Report

AD-A155 372 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 1/1
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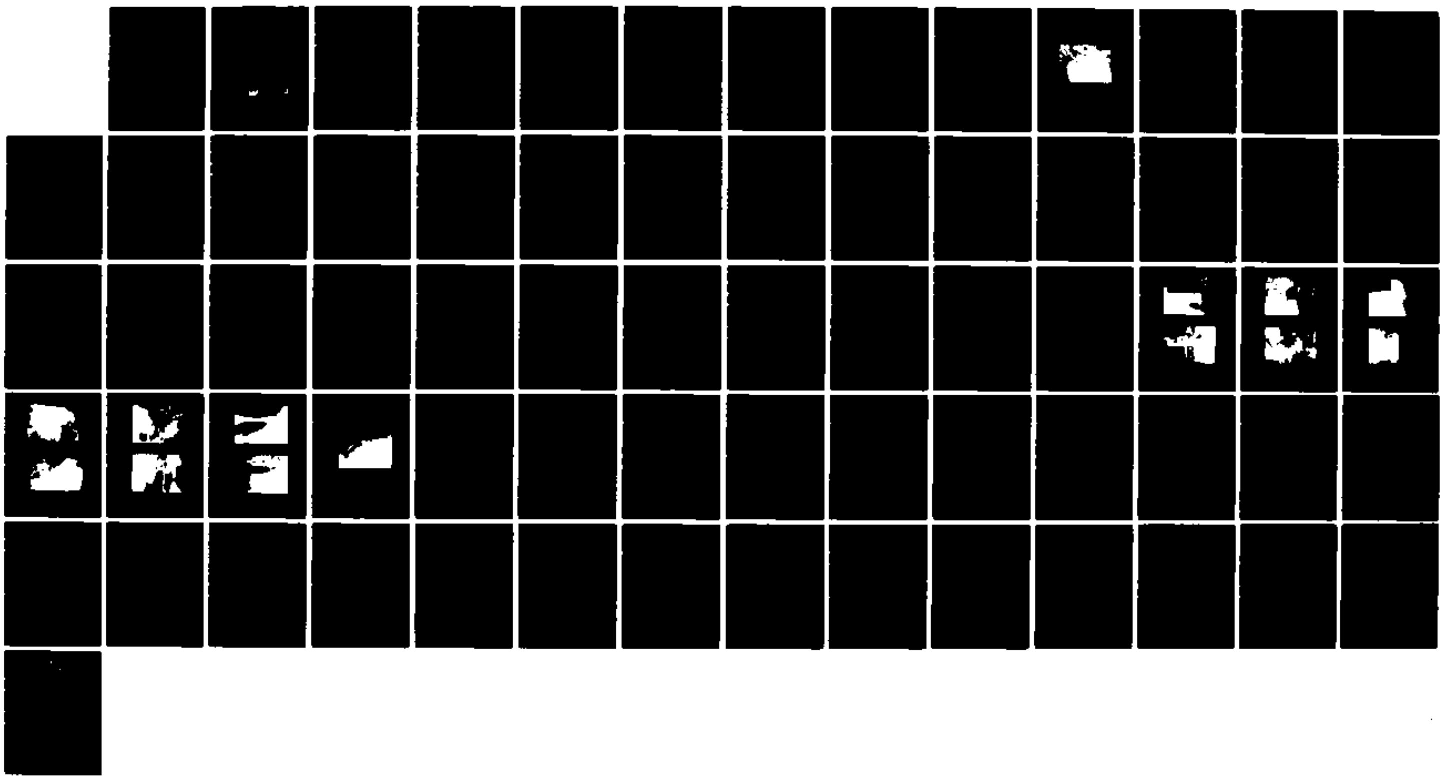
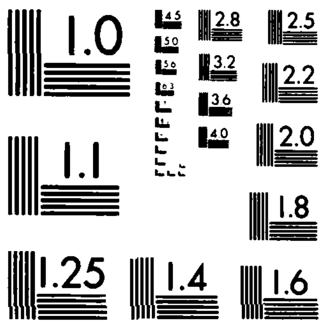
MA NEW ENGLAND DIV NOV 79

UNCLASSIFIED F/G 13/13 NL





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

ATLANTIC OCEAN
BELFAST, MAINE

LITTLE RIVER UPPER DAM
ME 00289

STATE NO. 5091

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

NOVEMBER 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER ME 00289	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Little River Upper Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE November 1979
	13. NUMBER OF PAGES 50
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Atlantic Ocean
Belfast Maine
Little River

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

The dam is a concrete gravity dam with a hydraulic height of 30 ft., and is 216 ft. long. The dam is in fair condition. It is small in size with a hazard potential of significant. A major breach at top of dam could possibly result in the loss of one life and could cause appreciable property damage.

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

REPLY TO
ATTENTION OF:
NEDED

JUL 07 1980

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan.

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

A copy of this report has been forwarded to the Department of Agriculture cooperating agency for the State of Maine. In addition, a copy of the report has also been furnished the owner, Belfast Water District, 71 Church Street, Belfast, Maine 04915.

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 Agriculture for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	ME00289
Name of Dam:	Little River Upper Dam
Town:	Belfast
County and State:	Waldo, Maine
Stream:	Little River
Date of Inspection:	September 17, 1979

BRIEF ASSESSMENT

Little River Upper Dam is a concrete gravity dam with a hydraulic height of 30 feet, 216 feet long, 3.0 feet wide at the crest, with a vertical upstream face and a downstream face battered at approximately 1H:12V. The central overflow spillway section of the dam is 114 feet long with a slight curvature. At the south abutment there is a concrete training wall. At the north end of the spillway is a concrete intake structure; beyond this, the dam extends to the north abutment. The dam impounds a reservoir with a maximum storage capacity of about 850 acre-feet. The reservoir is .83 mile long with a surface area of about 48 acres and is used as a regulating reservoir for use in water supply for the Town of Belfast.

The dam is in fair condition. Major concerns are: The large ratio of height to average width of the gravity section of the dam, trespassing and erosion on the embankment sections of the dam, trees and brush growing on the embankment sections at the ends of the dam, cracking and spalling of the exposed concrete surfaces, and flexibility and weathering of the plywood cover over the control tower.

Based on small size and significant hazard classification in accordance with Corps guidelines, the test flood ranges from ¼ to ½ Probable Maximum Flood (PMF). Because the dam's storage capacity is in the upper range of size classification, ½ PMF will be used as the test flood. The test flood inflow was determined to be 12,800 cfs. The routed test flood outflow for Little River Upper Dam, having a drainage area of 13.7 square miles was determined to be 12,200 cfs at elevation 68.2' MSL, which would overtop the dam by about 3.3 feet. Spillway capacity at top of dam is 5,390 cfs, which is 44 percent of the test flood discharge. A major breach at top of dam could possibly result in the loss of one life and could cause appreciable property damage. (See Section 5.1 f.)

The owner, Belfast Water District, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan

Warren A. Guinan
Project Manager
N.H. P.E. 2339

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

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

Accession For	
NTIS GRA&I	X
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A/1	

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 investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

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

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October, 1979

Figure 1 - Overview of Little River Upper Dam.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
LITTLE RIVER UPPER DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of August 28, 1979 from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050, as changed, has been assigned by the Corps of Engineers for this work.

b. Purpose.

(1) To 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) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location. Little River Upper Dam, commonly called Upper Dam, is located in the Town of Belfast, Maine; the dam spans Little River approximately 5,600 feet upstream from the river's confluence with the Atlantic Ocean. The dam impounds a pond called Belfast Reservoir Number 2. After discharging at the damsite, Little River flows easterly for a distance of 2,200 feet before it enters Belfast Reservoir Number 1. Little River Upper Dam is shown on the U.S.G.S. Quadrangle Belfast, Maine with coordinates approximately at N 44° 24' 00", W 69° 00' 20", Waldo County, Maine. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Little River Upper Dam is a concrete gravity dam with a hydraulic height of 30 feet, 216 feet long, 3.0 feet wide at the crest, with a vertical upstream face and a downstream face battered at approximately 1H:12V. The central overflow spillway section of the dam is 114 feet long with a slight curvature. At the south end of the overflow spillway section, there is a concrete training wall extending 22.8 feet downstream from the dam. Between this wall and the south abutment earth has been placed. At the south abutment between the training wall and downstream face of the spillway are three concrete steps. Their function is probably to protect the rocky abutment from undermining and also to act as energy dissipators.

Bedrock exposure in the valley downstream of the dam shows that the dam is at least partially founded on bedrock. At the north end of the spillway is a concrete intake structure; beyond this, the dam extends to the north abutment. Earth has been placed against the upstream and downstream faces of the concrete dam near the abutments. A gate, which is not operable and is of unknown size, exists at the north abutment. There are 3 inlet valve operators (unknown type and size)and 2 (6" & 8") outlet pipes from the intake chamber to the downstream channel. There is some evidence of another low-level outlet of an undetermined size and condition approximately 5 feet south of the intake structure under the spillway.

c. Size Classification. Small (hydraulic height - 30 feet; storage - 850 acre-feet) based on height and storage ($\geq$ 25 to $<$ 40 feet; $\geq$ 50 to $<$ 1000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant hazard. A major break would probably result in the loss of one life and could cause appreciable property damage and loss as a regulating reservoir for use in water supply. (See Section 5.1 f.)

e. Ownership. Presently Little River Upper Dam is owned by Belfast Water District. Information about past ownership was not available.

f. Operator. The current owner and operator of the dam is Belfast Water District, 71 Church Street, Belfast, Maine 04915. Telephone: (207) 338-1200.

g. Purpose of Dam. Reservoir Number 2 is used as a regulating reservoir for use in water supply. Water impounded at Little River Upper Dam can be released through valve chambers into the downstream channel to provide sufficient inflow into Reservoir Number 1 during periods of low water.

h. Design and Construction History. No information regarding the original design or construction of the dam was disclosed.

i. Normal Operating Procedures. No written operational procedures exist for Little River Upper Dam. The gate operating mechanism with 18-inch vcp outlet is rusted and is not in operable condition. Three inlet valve operators (that are reported to be operable), a valve chamber, and two outlet pipes are utilized to put discharge into the downstream channel to provide additional inflow into Reservoir Number 1 as required to meet demands.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 13.7 square miles (8,768 acres) of mountainous and partially wooded terrain. The normal pool has a surface area of 48 acres, which constitutes less than 1 percent of the watershed.

b. Discharge at Damsite.

(1) Outlet works
- (a) - unknown size gate - not operable
- (b) - 3 inlet valve operators discharge flow into valve chamber with two outlet pipes:
  6-inch diameter at outlet elevation - 38.7' MSL
  8-inch diameter at outlet elevation - 35.5' MSL
- (c) - Low-level outlet of an unknown size

(2) The maximum known discharge at damsite is unknown

(3) Ungated spillway (principal) capacity @ top of dam elevation - 5,390 cfs @ 64.9' MSL

(4) Ungated spillway capacity @ test flood elevation - 10,500 cfs @ 68.2' MSL

(5) Gated spillway capacity @ top of dam elevation - not applicable

(6) Gated spillway capacity @ test flood elevation - not applicable

(7) Total spillway capacity @ test flood elevation - 10,500 cfs @ 68.2' MSL

(8) Total project discharge @ test flood elevation - 12,200 cfs @ 68.2' MSL

c. Elevation. (feet above NGVD of 1929; formerly known as Mean Sea Level (MSL); see (6) below)

(1) Streambed at centerline of dam - 34.5 (at downstream toe)

(2) Maximum tailwater - unknown

(3) Upstream valve chamber invert - unknown

(4) Recreation Pool - not applicable

(5) Full flood control pool - not applicable

(6) Spillway crest - 59 (as shown on U.S.G.S. Quadrangle sheet)

(7) Design surcharge (original design) - unknown

(8) Top of dam - 64.9

(9) Test flood pool - 68.2

d. Reservoir (miles)

(1) Length of maximum pool - .95

(2) Length of spillway crest pool - .83

(3) Length of flood control pool - not applicable

e. Storage. (acre-feet)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest pool - 480

(4) Top of dam - 850

(5) Test flood pool - 1045

f. Reservoir Surface (acres)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest - 48

(4) Test flood pool - 75

(5) Top of dam - 70

g. Dam

(1) Type - concrete gravity

(2) Length - 216'

(3) Height - 31.5' structural height

(4) Top width - 3'

(5) Side slopes - upstream - vertical
- downstream - 1H:12V

(6) Zoning - not applicable

(7) Impervious core - not applicable

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel. - not applicable. (See j. below.)

i. Spillway

(1) Type - concrete ogee overflow

(2) Length of weir - 114'

(3) Crest elevation - 59' MSL

(4) Gates - none

(5) U/S Channel - Reservoir Number 2 completely open

(6) D/S Channel - Little River for about 2,200 feet before it enters Reservoir Number 1, rocky channel, very well defined. Herrick Road bridge spans over the river 200' below the Dam.

j. Regulating Outlets. Three inlet valve operators discharge flow into valve chamber with two outlet pipes:

6-inch diameter @ outlet elevation - 38.7' MSL
8-inch diameter @ outlet elevation - 35.5' MSL

SECTION 2
ENGINEERING DATA

2.1 Design

No design data were disclosed for Little River Upper Dam.

2.2 Construction

No construction records were disclosed.

2.3 Operation

No engineering operational data were obtained.

2.4 Evaluation

a. Availability. No engineering data were available for Little River Upper Dam. Direct contact with the Belfast Water District and a search of the files at the Maine Soil and Water Conservation Commission revealed only a limited amount of data.

b. Adequacy. The final assessments and recommendations of this investigation are based on the visual inspection and the hydrologic and hydraulic calculations.

c. Validity. No engineering data were disclosed to validate.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Little River Upper Dam is a low run-of-river dam which impounds a reservoir of small size. The watershed above the reservoir is rolling and partially wooded. The downstream area is rolling and partially wooded.

b. Dam. Little River Upper Dam is a concrete ogee shaped gravity dam 30 feet high (hydraulic), 216 feet long, and 3.0 feet wide at the crest, with a vertical upstream face and a downstream face battered at 1H:12V. (See Appendix C - Figures 2 and 3.) The central overflow spillway section of the dam is 114 feet long with a slight curved alignment. At the south end of the overflow spillway section there is a concrete training wall extending 22.8 feet downstream from the dam. Between this wall and the south abutment earth has been placed against the upstream and downstream faces of the concrete dam. At the north end of the spillway, there is a concrete intake structure, beyond which the dam extends to the north abutment. (See Appendix C - Figure 4.) Earth has been placed against the upstream and downstream faces of the concrete dam near the abutment. The ends of the dam where the concrete wall is flanked by earthfill on both the upstream and downstream sides are referred to as embankment sections in subsequent sections of this report and in the checklist. Bedrock exposures on the south side of the valley downstream of the dam show that that end of the dam is founded on bedrock. (See Appendix C - Figure 5.) Soil cover and brush growing on the north side of the valley make it impossible to determine visually whether that end of the dam is founded on bedrock.

The visible portion of the concrete spillway and training walls show some evidence of surface deterioration and cracking. A substantial portion of the spillway and training walls have been repaired with gunite in the past. Several areas of the gunite patching are cracked and spalled from the original concrete surface. (See Appendix C - Figure 6.) Numerous hairline cracks in the spillway face and training walls exhibit efflorescence. The crest and downstream face of the concrete spillway are water stained. The downstream toe of the concrete spillway has eroded exposing the coarse aggregate.

Trespassing has been considerable on the crest and downstream and upstream slopes of the embankment section at the south end of the dam, to the extent that many patches are bare of vegetation. Major erosion has occurred on the abutment side of the training wall that extends downstream from the south end of the overflow section of the dam. Brush and small trees are growing on the upstream slope. (See Appendix C - Figures 7 & 8.)

Minor trespassing has occurred on the crest and upstream and downstream slopes of the embankment section at the north end of the dam. Brush and small trees are growing on the crest and upstream and downstream slopes.

c. Appurtenant Structures. At the north end of the overflow spillway there is a 9.7-foot by 8.3-foot concrete control tower (intake structure) constructed integrally with the spillway and north end of the concrete non-overflow section of the dam. (See Appendix C - Figure 9.) The control tower contains 3 inlet valves (unknown size and type) for varied elevations. There are two discharge pipes approximately 30 feet down from the top of the tower to discharge water from the intake chamber to the downstream channel. (See Appendix C - Figure 10.) The Belfast Water Department Assistant Superintendent reported that the 3 inlet valves are in operable condition. Visual inspection revealed that there is only minor seepage into the chamber from the upstream side. There are numerous hairline cracks on the downstream face of the control tower exhibiting efflorescence. (See Appendix C - Figure 6.) Access to the interior of the chamber is through two trap doors on the top of the chamber, one steel and one plywood. (See Appendix C - Figure 4.) The steel door is surface rusted and the plywood door is weathered. The plywood door is unreinforced and is quite flexible. Continued weathering of the plywood will lead to a condition that will no longer support the weight of the operator or other persons and may fail.

Approximately 2 feet to the north of the control tower (intake structure) there is an intermediate level outlet gate operating mechanism. (See Appendix C - Figure 11.) The shaft and steel bearing attached to the upstream face of the dam are coated with gunite. The gate operating mechanism has not been maintained and does not appear operable. The Belfast Water Department Assistant Superintendent reports that the gate has not been operated in many years. An 18-inch clay tile pipe discharges from the downstream face of the dam in line with the gate operating mechanism. (See Appendix C - Figure 6.) Water is discharging from the 18-inch clay tile line at an estimated rate of 15 to 30 gpm.

d. Reservoir Area. The watershed above the reservoir is rolling and partially wooded. (See Appendix C - Figure 12.) No structures were observed on the shore of the reservoir. No evidence of significant sedimentation in the reservoir was observed.

e. Downstream Channel. The channel downstream of the dam appears to be on bedrock. The south bank of the channel is bedrock, but the left bank is soil. Trees and brush overhang the left side of the channel. Herrick Road bridge crosses the channel 200 feet downstream from the dam. (See Appendix C - Figures 13 & 14.)

3.2 Evaluation

Based on the visual inspection, Little River Upper Dam is in fair condition.

Trespassing on the embankment sections at the south and north abutments has caused major erosion on the abutment side of the downstream training wall at the south end of the overflow section of the dam and loss of vegetation elsewhere. Continued trespassing and erosion may endanger the embankment sections and the training wall. Trees and brush are growing on the embankment sections at the ends of the dam. If a tree blows over and pulls out its roots, or if a tree dies and its roots rot, seepage and erosion problems may result.

Trees and brush overhanging the downstream channel between the dam and the highway bridge could contribute to blockage of the channel and the opening under the highway bridge during floodflow.

Hairline cracks and spalled areas of the exposed concrete face could continue to deteriorate and lead to instability of the dam. Frost action in the cracks and rough areas of concrete will speed up at the deterioration process.

The plywood cover over the control tower will pose a dangerous condition to people walking on the cover if left uncorrected.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures exist for Little River Upper Dam. Three intake valve operators are kept operable to provide sufficient inflow into Reservoir Number 1 during periods of low water.

4.2 Maintenance of Dam

The owner, Belfast Water District, is responsible for the maintenance of dam.

4.3 Maintenance and Operating Facilities

No formal maintenance was disclosed. The intermediate level gate mechanism is inoperable. The three intake valve operating mechanisms are kept in operating condition.

4.4 Description of Any Warning System in Effect

No written warning system exists for the dam.

4.5 Evaluation

Formal operational and maintenance procedures should be developed to ensure that problems that are encountered can be remedied within a reasonable period of time.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Little River Upper Dam is a concrete, ogee shaped gravity dam which impounds a reservoir with a maximum storage capacity of 850 acre-feet. The dam contains runoff from a 13.7-square mile drainage area consisting of mountainous predominately wooded terrain. A gate of unknown size is located at the north abutment. The gate mechanism is rusted and not operable. The gate was designed to control discharge through an 18-inch diameter outlet pipe. There is also a valve chamber control tower at the north abutment. It has three inlet valve operators (size and type unknown) and two outlet pipes (6-inch and 8-inch respectively). The valves are in operating condition. There is evidence of another low-level outlet of an undetermined size and condition approximately 5 feet south of the intake structure, under the spillway. The reservoir level is primarily controlled by the spillway which is located at the center of the dam.

b. Design Data. No hydrologic or hydraulic design data were found.

c. Experience Data. No hydrologic or hydraulic experience data were disclosed.

d. Visual Observations. At the time of the inspection, no visual evidence was noted of damage to the structure caused by overtopping.

e. Test Flood Analysis. Little River Upper Dam is classified as being small in size having a hydraulic height of 30 feet and a maximum storage capacity of 850 acre-feet. The dam was determined to have a significant hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, test flood range is ¼ to ½ the Probable Maximum Flood (PMF).

Because the dam maximum storage capacity is in the upper range of small size classification, the test flood was determined to be ½ the Probable Maximum Flood (PMF).

Using the ½ PMF, the test flood inflow for Little River Upper Dam, having a drainage area of 13.7 square miles, was determined to be 12,800 cfs. After reservoir routing, the test flood discharge was determined to be 12,200 cfs. This value was obtained using the COE guide curves with the 'mountainous' characteristics. The test flood analysis indicates that the dam embankment would be overtopped by approximately 3.3 feet during the test flood conditions. The water depth discharging through the principal spillway would be 9.2 feet and would amount to 10,500 cfs. Spillway capacity at top of dam (64.9' MSL) is 5,390 cfs, which is 44 percent of test flood discharge. Flow through two outlet pipes (6" and 8" in diameter) from the valve chamber is insignificant. Because the gate is inoperable, the overtopping analysis was calculated assuming no discharge through the 18" outlet pipe or through the larger low-level outlet under the spillway.

f. Dam Failure Analysis. The impact of failure of the dam at the top of dam was assessed using the Guidance for Estimating Downstream Dam Failure hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to Reservoir Number 1, a distance of 2,200 feet along Little River. A major breach of Little River Upper Dam would result in a breach discharge of about 20,[illegible]60 cfs. The discharge immediately prior to a breach would be 5,3[illegible]0 cfs or maximum spillway capacity. This antecedent discharge would pass low flow through the Herrick Road bridge with a depth of about 12 feet. A breach would raise the water surface about 16.6 feet causing overtopping of the road and possible structural damage. The antecedent discharge from the Upper Dam, would cause the Lower Dam to have a depth of about 7 feet over the spillway, without considering any storage effects of the reservoir. A breach wave would cause an increase of almost 7 feet which could cause damage to the dam and the water facilities for the Town of Belfast. There could possibly be a loss of life to the dam tender at the Lower Dam. The breach could also cause loss of a regulating reservoir for use in water supply and could cause appreciable property damage. Therefore, Little River Upper Dam was classified Significant Hazard.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The most significant visual observation about the concrete section of this dam is that the ratio of its height to average width appears to be larger than the values commonly associated with gravity dams having conventional factors of safety. (Because the reservoir was filled with water, it was not practical to measure the width at various elevations during the inspection.)

Trespassing on the embankment sections at the south and north abutments has caused major erosion on the abutment side of the downstream training wall at the south end of the overflow section of the dam and loss of vegetation elsewhere. Continued trespassing and erosion may endanger the embankment sections and the training walls.

Hairline cracks and spalled areas of the exposed concrete surface could continue to deteriorate and lead to instability of the dam. Frost action in the cracks and rough areas of the concrete will speed up the process.

The plywood cover over the control tower will pose a dangerous condition to people walking on the cover if left uncorrected.

Trees and brush are growing on the embankment sections at the ends of the dam. If a tree blows over and pulls out its roots, or if a tree dies and its roots rot, seepage and erosion problems may result.

b. Design and Construction Data. No design and construction data are available for this dam.

c. Operating Records. No engineering operational records were obtained.

d. Post-Construction Changes. No information regarding post-construction changes were disclosed.

e. Seismic Stability. This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that Little River Upper Dam is in fair condition. The major concerns with respect to the integrity of the dam, if left uncorrected, are:

(1) Large ratio of height to average width of the gravity section of the dam.

(2) Trespassing and erosion on the embankment sections of the dam.

(3) Trees and brush growing on the embankment sections at the ends of the dam.

(4) Cracking and spalling of the exposed concrete surfaces.

(5) Flexibility and weathering of the plywood cover over the control tower.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection. There is not enough information about the geometry of the cross section and the foundation conditions to assess the stability of the gravity section of the dam against overturning or sliding.

c. Urgency. The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I inspection report.

d. Need for Additional Investigation. Additional investigation is needed to assess the stability of the gravity section of the dam against sliding or overturning.

7.2 Recommendations

The owner should engage a Registered Professional Engineer to:

(1) Evaluate the stability of the dam against sliding and overturning and to design remedial measures, if needed.

(2) Design procedures for and inspect the clearing of trees and brush from the embankment sections of the dam.

(3) Design repairs for the erosion that has occurred on the embankment sections of the dam.

(4) Design repairs to the cracked and spalled areas of the concrete surfaces.

(5) Repair or replace plywood cover to the control tower.

(6) Repair or replace 18" clay tile pipe.

The owner should carry out the recommendations made by the Engineer.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Prevent trespassing on the embankment section of the dam.

(2) Repair or replace plywood cover.

(3) Clear trees and brush for a distance of 25 feet on either side of the downstream channel between the dam and the highway bridge.

(4) Visually inspect the dam and appurtenant structures once a month.

(5) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once every year.

(6) Establish a surveillance program for use during and immediately after heavy rainfall, and also a downstream warning program to follow in case of emergency conditions.

7.4 Alternatives

None.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Little River Upper Dam, ME

DATE Sept. 17, 1979

TIME 1500

WEATHER Sunny, cool

W.S. ELEV U.S. 59'msl DN.S. 36.5'msl

PARTY:

1. Warren Guinan (ANCo)	6. Janusz Czyzowski (ANCo)
2. Stephen Gilman (ANCo)	7. Ronald Hirschfeld (GEI)
3. Leslie Williams (ANCo)	8.
4. John Regan (ANCo)	9.
5. Terry Sapp (ANCo)	10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	L. Williams/J. Czyzowski	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Upper Dam, ME DATE Sept. 17, 1979

PROJECT FEATURE Dam Embankment NAME ____________

DISCIPLINE ____________ NAME ____________

AREA EVALUATED	CONDITION
DAM EMBANKMENT	EMBANKMENT FROM END OF CONCRETE SECTION TO SOUTH ABUTMENT
Crest Elevation	
Current Pool Elevation	
Maximum Impoundment to Date	
Surface Cracks	None observed
Pavement Condition	No pavement
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	Good
Horizontal Alignment	Good
Condition at Abutment and at Concrete Structures	Major erosion next to downstream training wall at south end of concrete section.
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Trespassing on embankment along upstream and downstream sides of corewall.
Sloughing or Erosion of Slopes or Abutments	See "Condition at Abutment..." above.
Rock Slope Protection - Riprap Failures	No riprap
Unusual Movement or Cracking at or Near Toe	None observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed
Vegetation	Some trees and brush on embankment, some areas bare of vegetation.

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Upper Dam, ME | DATE September 17, 1979

PROJECT FEATURE Control Tower | NAME

DISCIPLINE | NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair, numerous hairline cracks in outside and inside surface. Surface of gate chamber has been faced with gunite.
Condition of Joints	Not visible.
Spalling	Numerous areas of spalling of gunite surfaces.
Visible Reinforcing	None.
Rusting or Staining of Concrete	Yes, at embedded items. Substantial staining at 8"&6" gate chamber outlets.
Any Seepage or Efflorescence	Yes, considerable efflorescence at hairline cracks.
Joint Alignment	Good. No indication of movement.
Unusual Seepage or Leaks in Gate Chamber	Minor leakage into chamber.
Cracks	Numerous hairline cracks.
Rusting or Corrosion of Steel	
b. Mechanical and Electrical	
Gate Chamber	3 inlet valve operators-reported operable. 2 outlet pipes.
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	
Service Gates	
Emergency Gates	Lower level 18" clay tile pipe (VCP) - gate operating mechanism poor condition seeping ± GPD. No lubrication, rusted, no indication of recent operation. Ass't Supt. indicated no operation that he could remember.
Lightning Protection System	
Emergency Power System	
Wiring and Lighting System	

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Upper Dam, ME DATE Sept. 17, 1979

PROJECT FEATURE Outlet Structure & Channel NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Concrete	
Rust or Staining	
Spalling	
Erosion or Cavitation	
Visible Reinforcing	
Any Seepage or Efflorescence	
Condition at Joints	
Drain holes	One drain hole (?) discharging water in concrete abutment (outlet works) section at north end of overflow spillway.
Channel	
Loose Rock or Trees Overhanging Channel	Some trees overhanging channel.
Condition of Discharge Channel	Good.

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Upper Dam, ME DATE Sept. 17, 1979

PROJECT FEATURE Spillway Weir NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Some trees overhanging channel.
Floor of Approach Channel	Not visible beneath water surface.
b. Weir and Training Walls	
General Condition of Concrete	(Training walls - fair, numerous hairline cracks in surface - surface has been gunited. (Weir - good. Minor surface erosion and spalling of gunite.
Rust or Staining	Only water stain visible
Spalling	Numerous gunited areas are surface spalling
Any Visible Reinforcing	None.
Any Seepage or Efflorescence	Majority of hairline cracks on D/S face Shows efflorescence.
Drain Holes	One drain hole (1"-3") discharging water from training wall downstream of right end of spillway section. (Only dripping seep)
c. Discharge Channel	
General Condition	Good.
Loose Rock Overhanging Channel	None.
Trees Overhanging Channel	Some trees overhanging channel.
Floor of Channel	Bedrock.
Other Obstructions	Highway bridge immediately downstream of dam.

PROJECT Little River Upper Dam, Me. DATE Sept. 17, 1979

PROJECT FEATURE Reservoir NAME J. Czyzowski

AREA EVALUATED	REMARKS
Stability of Shoreline	Good
Sedimentation	No evidence
Changes in Watershed Runoff Potential	None
Upstream Hazards	None
Downstream Hazards	Herrick Road Bridge; Reservoir Number 1
Alert Facilities	None
Hydrometeorological Gages	None
Operational & Maintenance Regulations	No written recommendations were found.

APPENDIX B

ENGINEERING DATA

APPLICATION FOR DAM REGISTRATION

Dam Registration Number 5091
Date Received DEC 15 1975
Fee Enclosed 10.00 P82
Quad Sheet Name Belfast
Quad Sheet Number 11-9-NE

ocation:

ounty: Waldo

unicipality: ~~Quasi-Municipal~~ Belfast Water District

ame of Dam: Upper Reservoir Dam

ame of Impoundment: Reservoir #2

wnership:

ame of Owner: Belfast Water District

ddress of Owner: 71 Church Street
Belfast, Maine 04915

elephone Number: 338-1200

Name of Agent:
(if different from Owner)

Address:

Telephone Number:

escription of Dam

ype: Arched Concrete

onstruction Material: Concrete
(Concrete, wood, earth)

ear Originally built: 1913

Year last major repair: 1970

eight: 25 ft.

Width: 230 ft.

pillway type: open

Spillway Width: 90 ft.

mpounding Capacity: 58½ acres 157,000,000 gallons
(~~Acre-feet~~)

Drawdown available: 20 ft.
(feet)

ish Passage available?: no

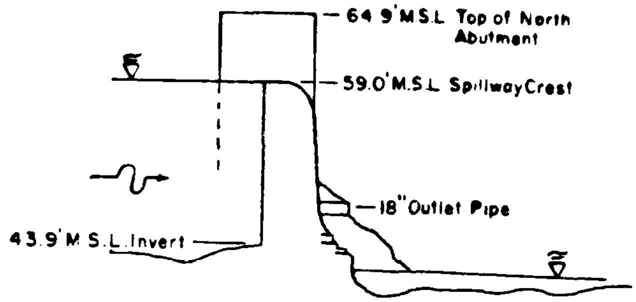
Installed Electrical Generating Cap: --

urposes for which stored water is used: Public drinking supply

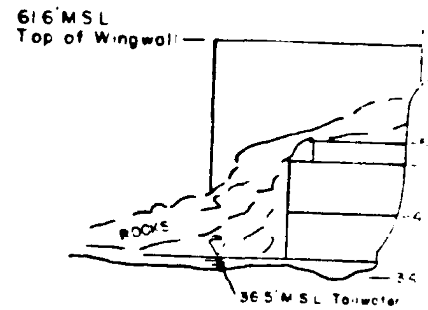
Most recent inspection by Qualified Engineer (Date): August 1972

Name and Address of Engineer: Dale E. Caruthers -(Deceased)
Masonic Building, Gorham, Maine 04038

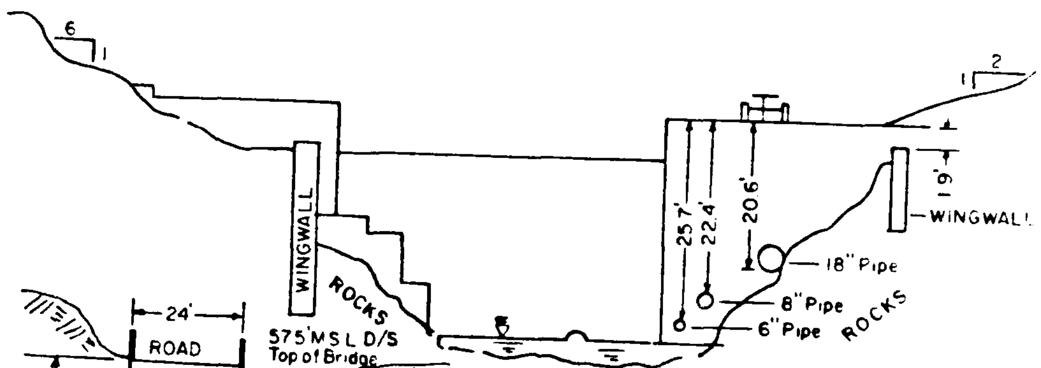
Other Permits applicable: ------



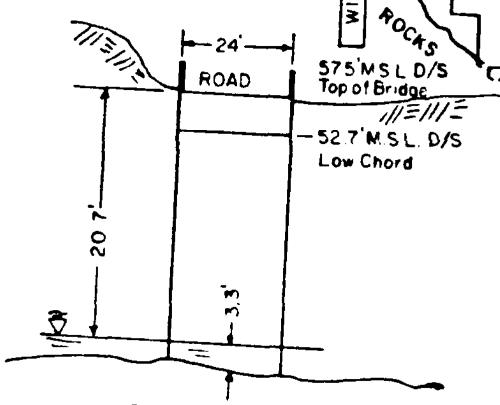
SECTION A-A



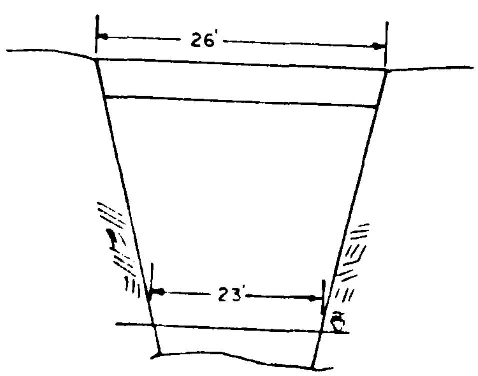
SECTION



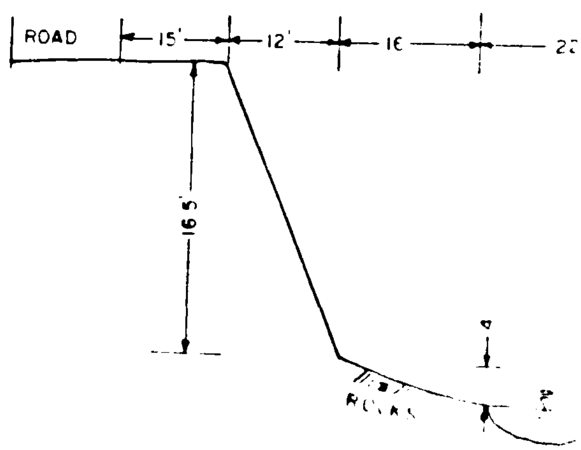
SECTION C-C

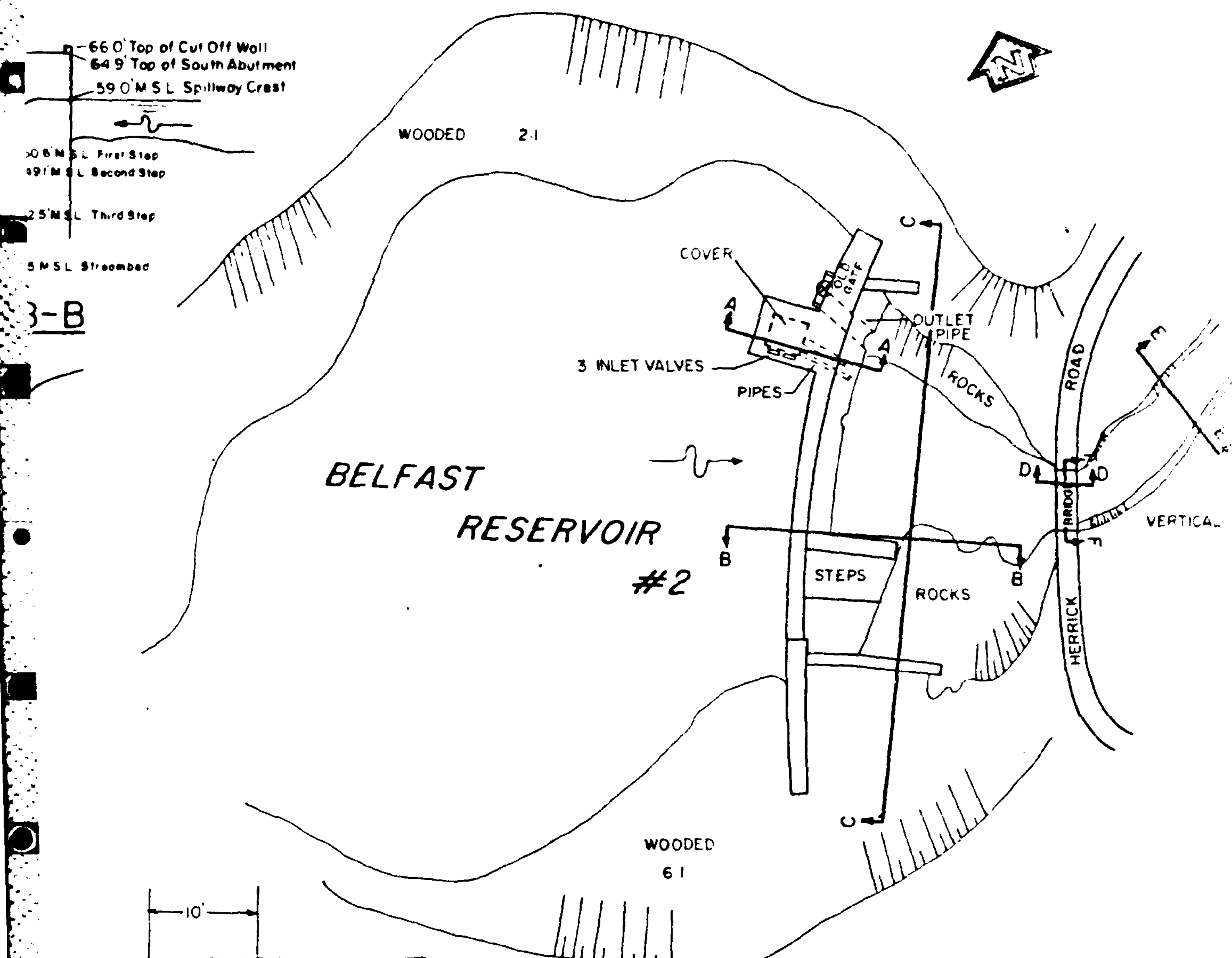


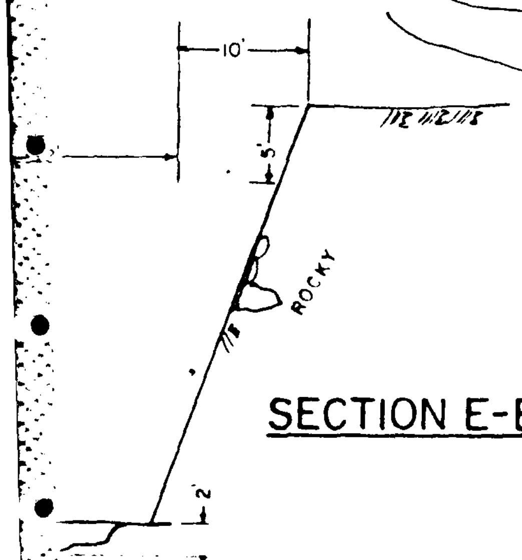
SECTION D-D



SECTION F-F







SECTION E-E

NOTE: ALL ELEVATIONS ARE BASED ON SPILLWAY CREST ASSUMED ELEVATION OF 59' MSL. DATUM (N.G.V.D.)

Anderson-Nichols & Co., Inc. CONCORD, NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LITTLE RIVER UPPER DAM

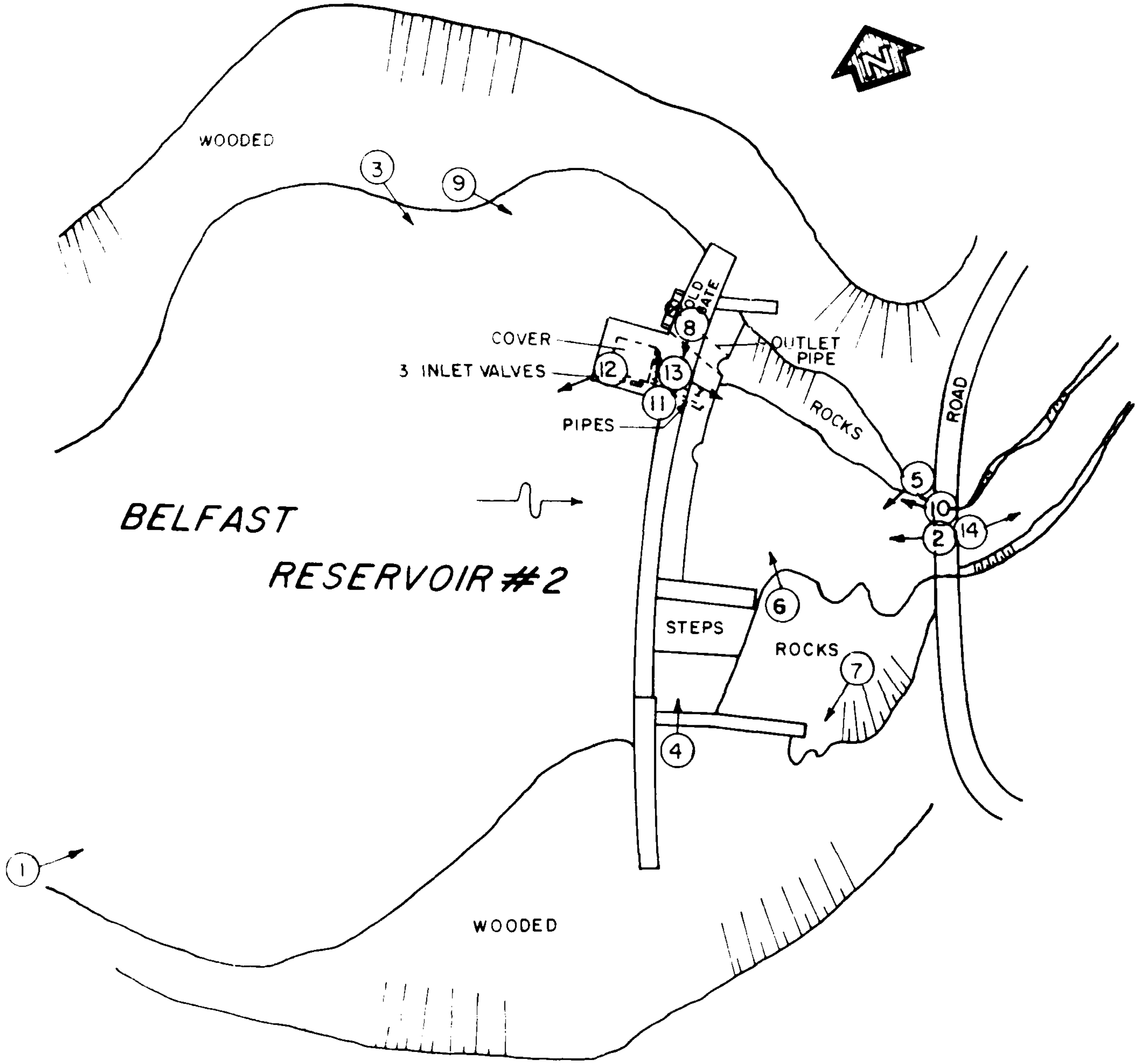
LITTLE RIVER — MAINE

SCALE: NOT TO SCALE

DATE: NOVEMBER 1979

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

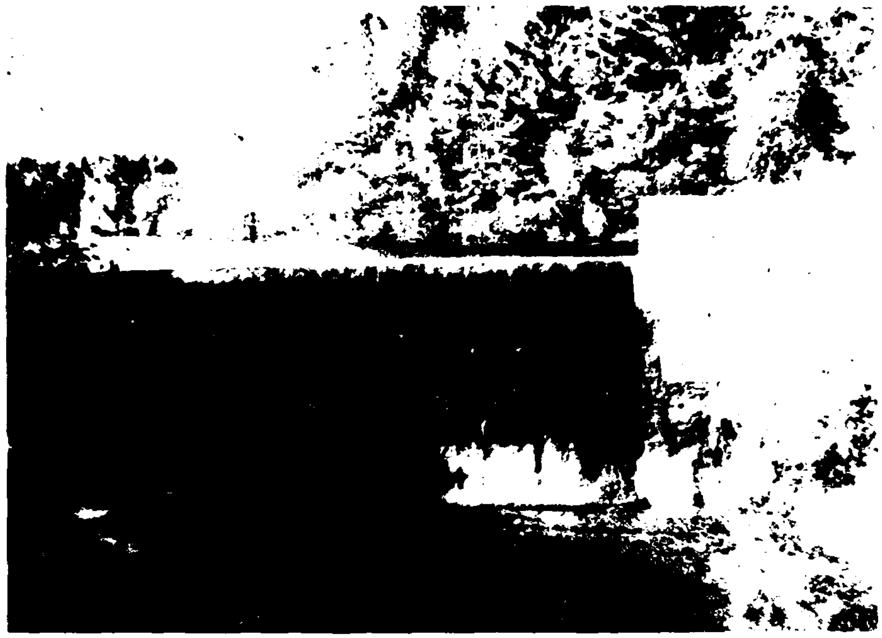
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

LITTLE RIVER MAINE

SCALE NOT TO SCALE

DATE NOVEMBER 1979



September 17, 1979
Figure 2 - Looking at downstream face of Little River Upper Dam.

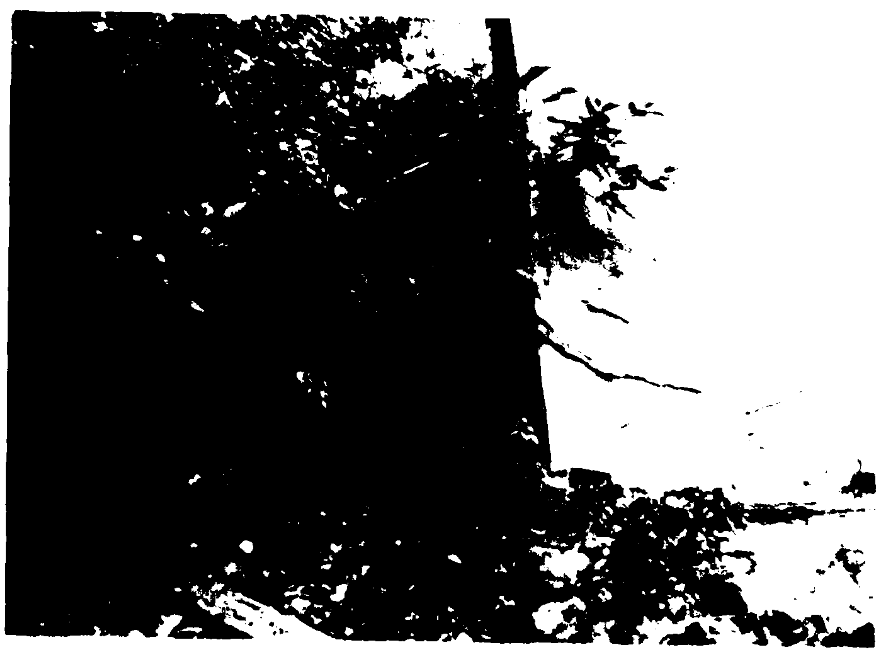
September 17, 1979
Figure 3 - View of upstream face of Little River Upper Dam.

September 17, 1979
Figure 4 - Looking at north abutment of dam.

September 17, 1979
Figure 5 - Downstream face of south abutment.

September 17, 1979

Figure 6 - Looking at 18-inch outlet pipe at north abutment of the dam.



September 17, 1979

Figure 7 - View of major erosion on south end of training wall at south abutment.

September 17, 1979

Figure 8 - Looking across crest from north abutment of the dam.

September 17, 1979

Figure 9 - Upstream face of the north abutment. View of control tower and gate mechanism.

September 17, 1979

Figure 10 - View of two discharge pipes from the intake structure.

September 17, 1979

Figure 11 - View of gate mechanism at the north abutment.

September 17, 1979

Figure 12 - Looking upstream at the reservoir from the top of the north abutment.

September 17, 1979

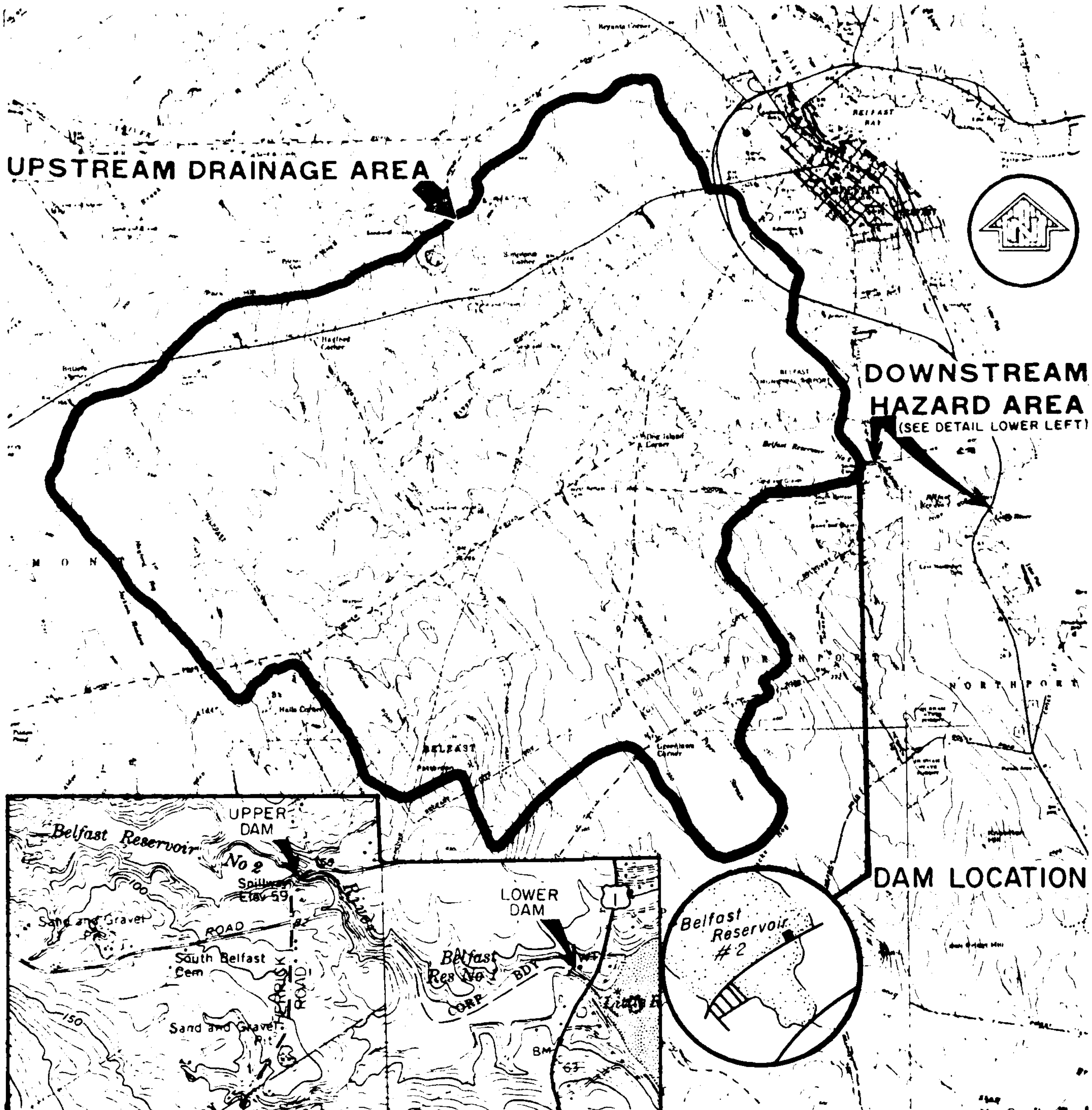
Figure 13 - Herrick Road Bridge 200' downstream of the dam.

September 17, 1979

Figure 14 - Looking at the downstream channel from the top of Herrick Road Bridge.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



NATIONAL PROGRAM OF INSPECTION
OF NON-FED. DAMS

LITTLE RIVER UPPER DAM
BELFAST, MAINE

REGIONAL VICINITY MAP

NOVEMBER 1979

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC. CONCORD, N.H.

SCALE IN MILES

0 1 2

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEETS. BELFAST, ME., 1960. REVISED 1973. SEARSPORT, ME., 1973. LINCOLNVILLE, ME., 1960, REVISED 1973. ISLESBORO, ME., 1973.

Anderson-Nichols & Company, Inc.

Subject: H/H

Sheet No. 1 of ___
Date: 09-27-79
Computed: J.G.
Checked: JW

JOB NO. 3273-16 LITTLE RIVER - UPPER DAM

BREACH ANALYSIS

DETERMINE ~~EFFECTS~~ OF BREACH AT TOP OF ~~DAM~~ TO CLASSIFY DOWNSTREAM HAZARD CONDITIONS.

$$Q_p = \frac{8}{27} W_b \sqrt{g} \, Y_o^{3/2}$$

Wb = BREACH WIDTH
g = 32.2 FT/SEC²
Yo = POOL ELEV. - U/S RIVER BED

Wb = 216 × .4 = 86 — ASSUME BREACH OCCURS AT TOP OF THE DAM — 64.9 FT MSL
Yo = 64.9 - 39.2 = 25.7
Q = 18,839 CFS

Q THROUGH SPILLWAY OTHER THAN WHERE IT IS BREACH.

L = 114 - 86 = 28 FT
H = 64.9 - 59 = 5.9
C = 3.2
$Q = C \cdot L \cdot H^{3/2}$ = 1,324 CFS

TOTAL BREACH Q = 20,160 CFS

ANTECEDENT DISCHARGE (SPILLWAY CAPACITY AT TOP OF DAM)

$Q = 3.2 \times 114 \times 5.9^{3/2}$ = 5290 CFS

LITTLE RIVER – UPPER DAM

BREACH ANALYSIS – CONT'D

REACH # 1

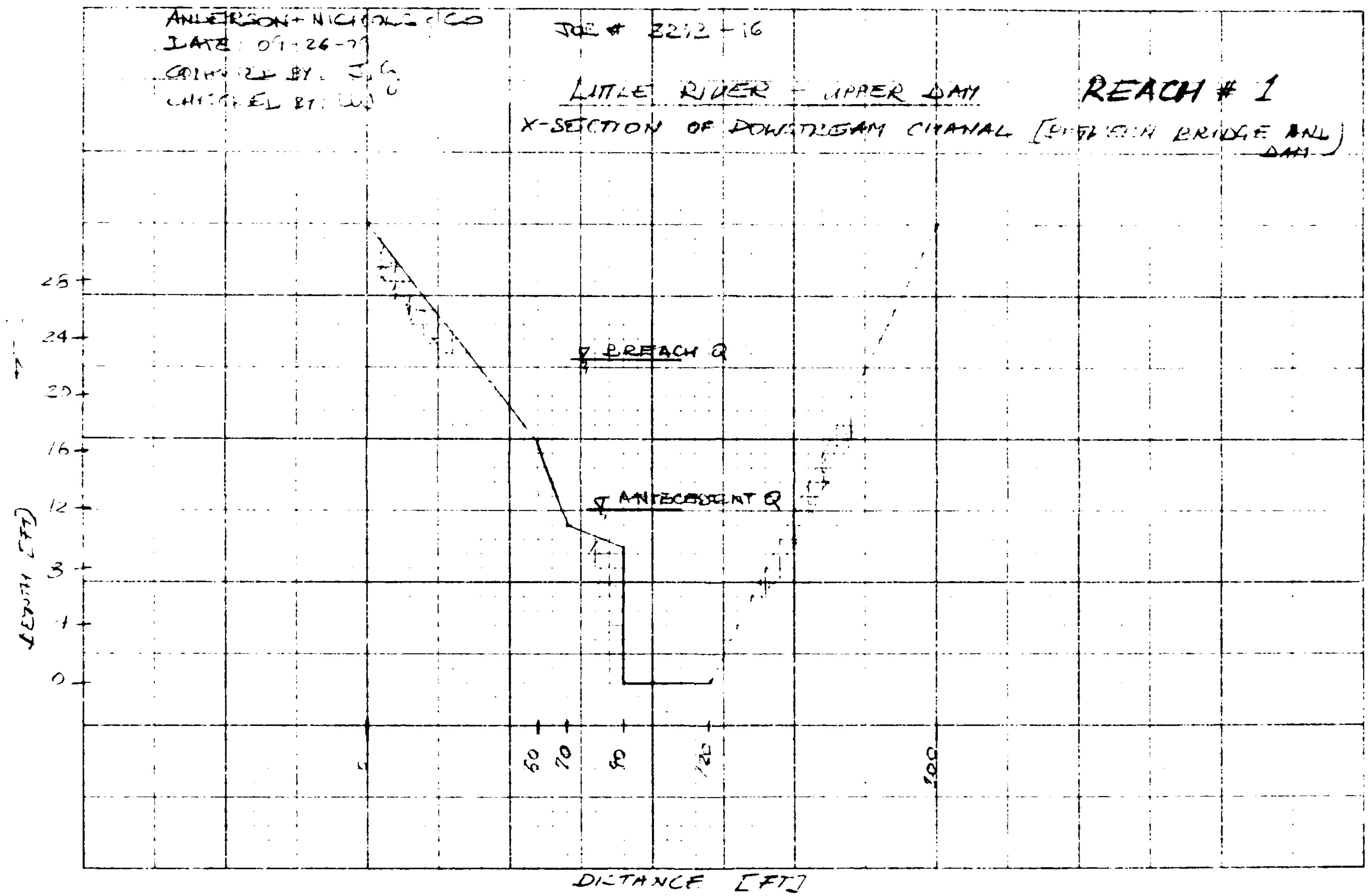
USE A TYPICAL CROSS SECTION ALONG THE DOWNSTREAM REACH FROM THE DAM TO THE HERRICK ROAD BRIDGE FOR A DISTANCE OF 200 FEET

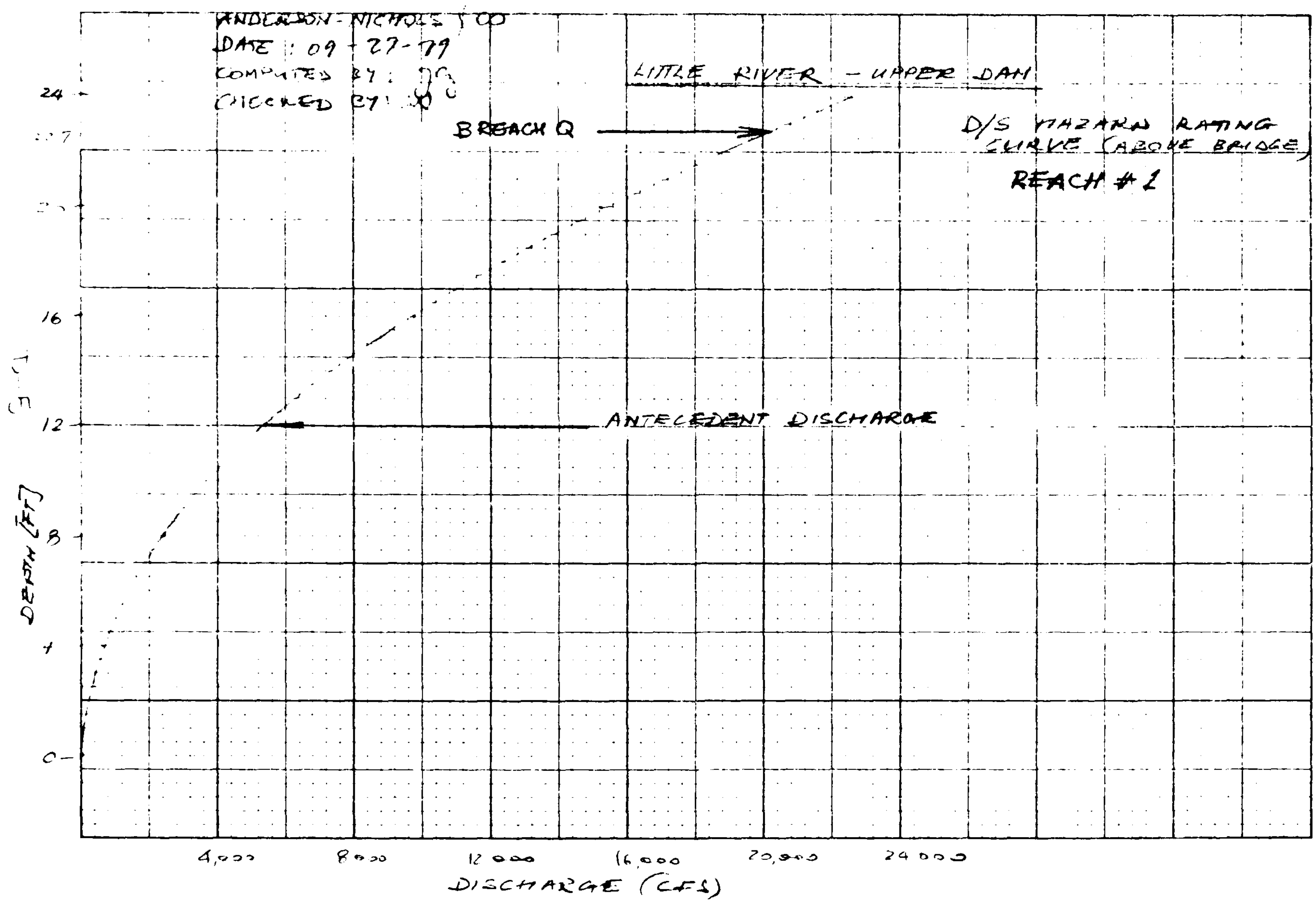
DEVELOP A RATING CURVE FOR THIS SECTION BY USE OF MANNINGS EQUATION: $Q = \frac{1.49}{n} \cdot A \cdot R^{2/3} \cdot S^{1/2}$ *

$n = .05$ $S = .005$

DEPTH [FT]	AREA	WPER	Q [CFS]
0	0	0	0
4	154.5	49.1	694
8	378.2	68.1	2469
12	670.8	87.1	5439
16	1030.8	105.6	9770
20	1468.	130.7	15265
24	2008.	158.	22658
28	2652.	185.2	32369

* 'n' – ROUGHNESS COEFFICIENT
A – AREA OF XSECTION IN SQUARE FEET
R – A/WETTED PERIMETER
S – SLOPE OF REACH


ANDERSON-NICHOLS & CO
DATE: 09-26-79
COMPUTED BY: J.G.
CHECKED BY:
JOB # 3212-16
LITTLE RIVER - UPPER DAM
REACH # 1
X-SECTION OF DOWNSTREAM CHANNEL [BETWEEN BRIDGE AND DAM]
BREACH Q
ANTECEDENT Q
DEPTH [FT]
28
24
20
16
12
8
4
0
DISTANCE [FT]
60
70
80
120
200



ANDERSON-NICHOLS & CO
DATE : 09-27-79
COMPUTED BY:
CHECKED BY:
LITTLE RIVER - UPPER DAM
D/S MAZARN RATING CURVE (ABOVE BRIDGE)
REACH # 1
BREACH Q
ANTECEDENT DISCHARGE
24
16
12
8
4
0
DEPTH [FT]
4,000
8000
12000
16,000
20,000
24000
DISCHARGE (CFS)

SQUARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

LITTLE RIVER - UPPER DAM

BREACH ANALYSIS - CONT'D

DEVELOP A RATING CURVE FOR THE X-SECTION ALONG HERRICK ROAD BRIDGE 200' DOWNSTREAM THE DAM.

LOW FLOW — CALCULATED USING MANNINGS EQUATION

	ELEV.	AREA	WPER	Q [CFS]
	33.5	0	0	0
ROUGHNESS COEFF.:	36.7	74.4	29.4	696
CONCR WALL .015	39.9	150.4	35.8	2055
BOTTOM .035	43.1	228.	42.2	3795
	46.5	307.2	48.7	5807
S = .0125	49.5	388	55.	8034
	52.7	470.4	61.5	10440

PRESSURE / WEIR FLOW

C VALUE CALCULATION FOR PRESSURE FLOW:

$$K_f = \frac{29.1 \times n^2 \times L}{R^{4/3}}$$

$$K_f = \frac{29.1 \times .03^2 \times 24}{5.27^{4/3}} = .067$$

$1.10 + .067 = 1.167$

$k = \frac{1}{C^2} = 1.167$ $C = .93$

L = LENGTH OF BRIDGE = 24'

n - for CONCRETE BRIDGE WITH EARTH BOTTOM - 0.03

R - HYDRAULIC RADIUS

INTAKE AND EXIT LOSSES = 1.10

LITTLE RIVER - UPPER DAM

BREACH ANALYSIS - CONT'D

PRESSURE FLOW - AREA - 470. SQFT   C - .93

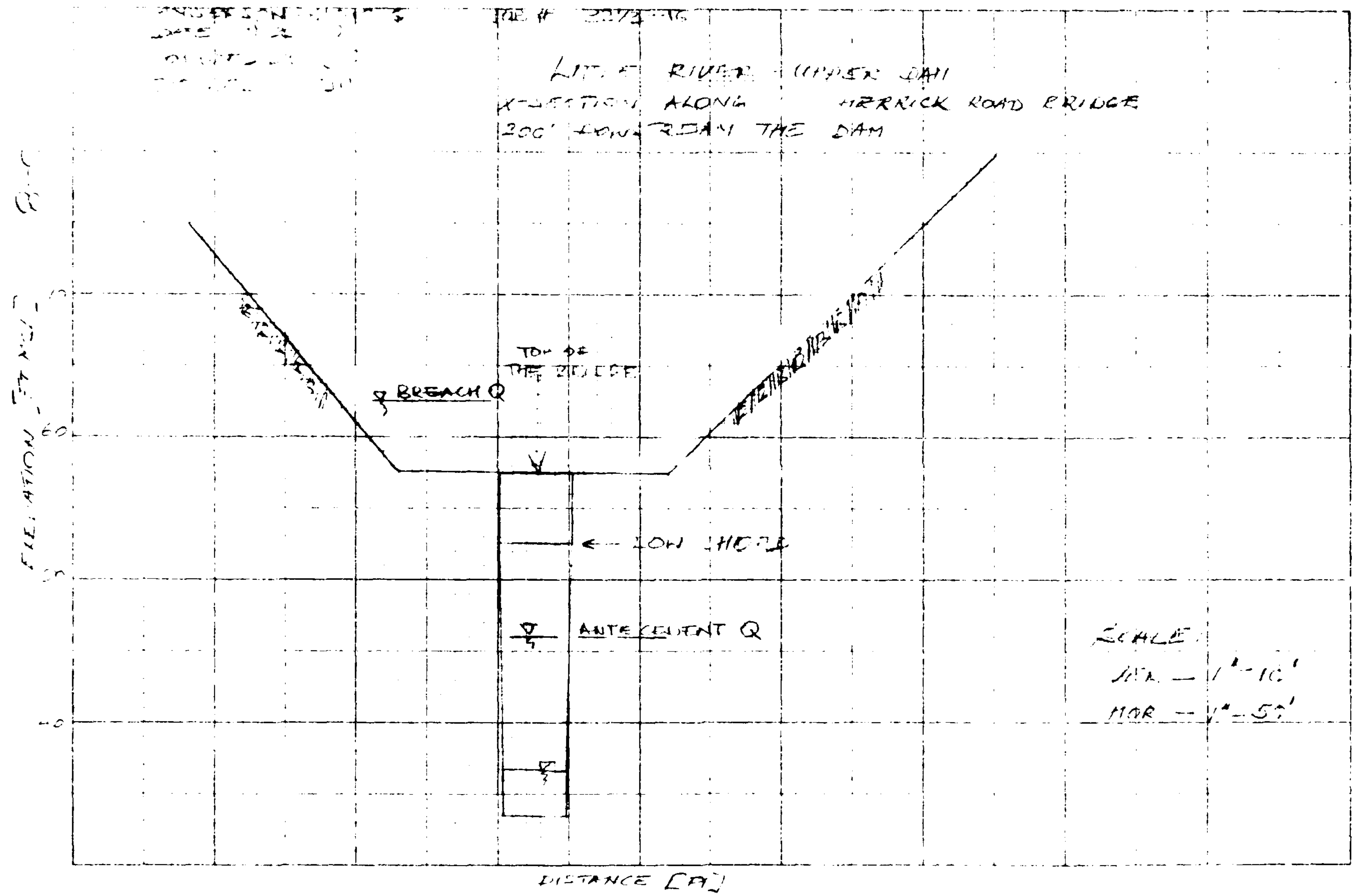
ELEV.	H.	$Q = AC\sqrt{2gH}$ [CFS]
57.5	14.4	13,331
60.0	16.9	14,424
65.0	21.9	16,435
70.0	26.9	18,183

WEIR FLOW - C = 2.8

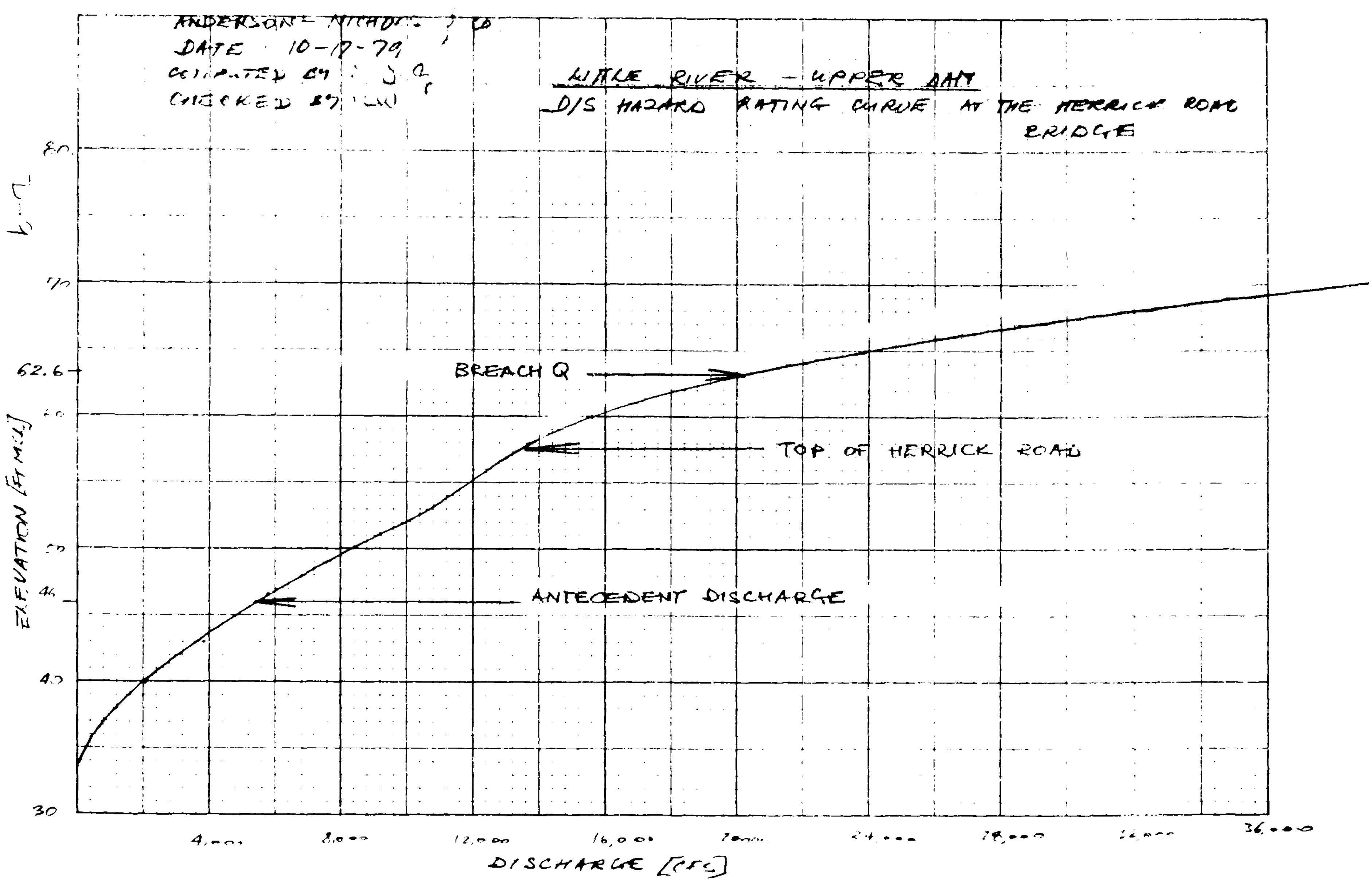
ELEV. [FT MSL]	L [FT]	H [FT]	$Q = CLH^{3/2}$ [CFS]
57.5		0	
60.0	110	2.5	1217
65.0	130	7.5	7476
70.0	170	12.5	21036

SUMMARY -

ELEV. [FT MSL]	Q [CFS]
33.5	0
36.7	696
39.9	2055
43.1	3795
46.3	5807
49.5	8034
52.7	10440
57.5	13,331
60.0	15,641
65.0	23,911
70.0	39,219



LITTLE RIVER UPPER DAM
X-SECTION ALONG HERRICK ROAD BRIDGE
200' DOWNSTREAM THE DAM
TOP OF THE BRIDGE
BREACH Q
LOW CHORD
ANTECEDENT Q
60
40
ELEVATION [FT]
DISTANCE [FT]
SCALE:
HOR. — 1" = 50'



ANDERSON-NICHOLS & CO
DATE 10-17-79
COMPUTED BY
CHECKED BY
LITTLE RIVER - UPPER DAM
D/S HAZARD RATING CURVE AT THE HERRICK ROAD BRIDGE
BREACH Q
TOP OF HERRICK ROAD
ANTECEDENT DISCHARGE
62.6
30
40
46
50
60
70
80
4,000
8,000
12,000
16,000
36,000
ELEVATION [FT MSL]
DISCHARGE [CFS]

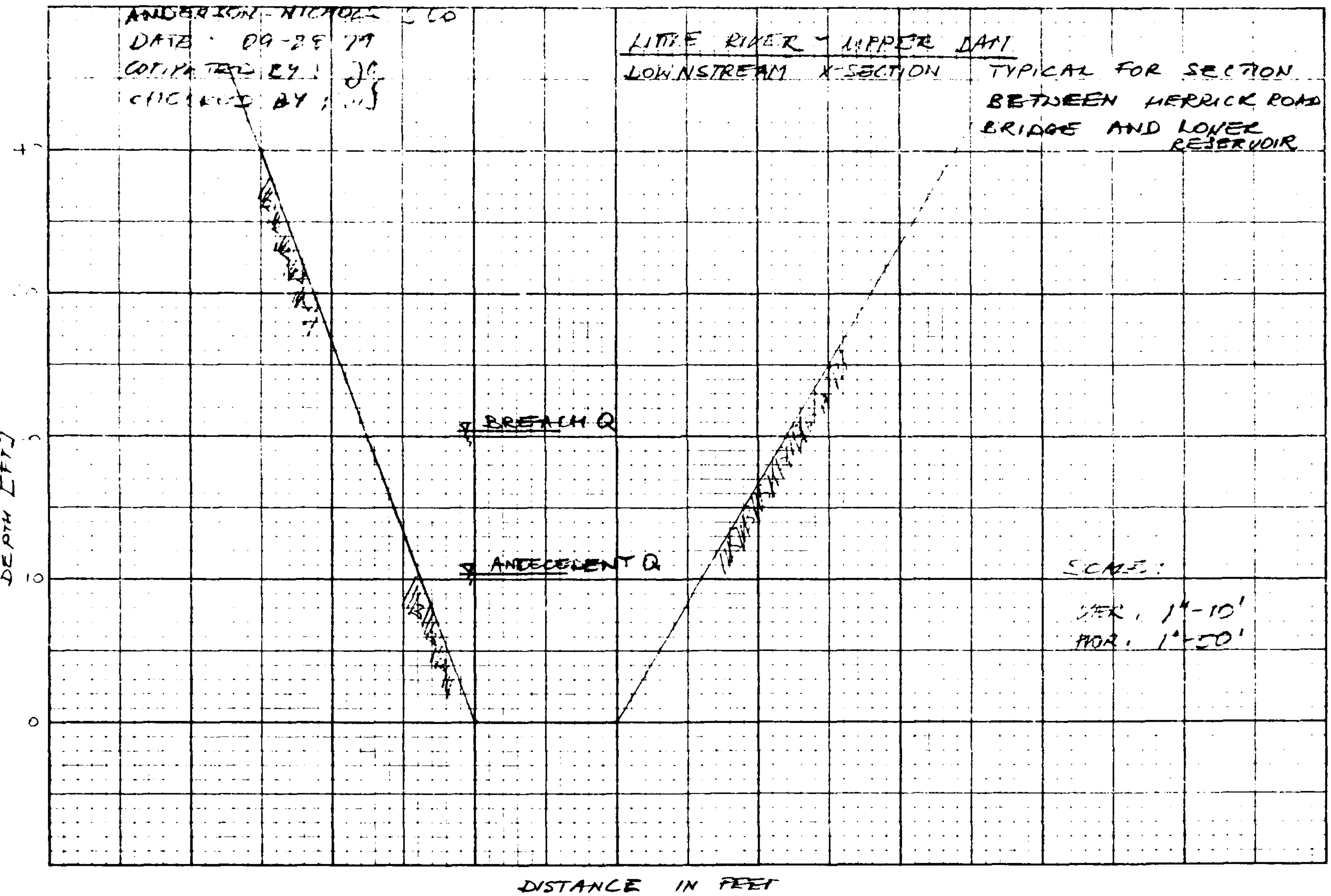
LITTLE RIVER - UPPER DAM

BREACH ANALYSIS - CONT'D

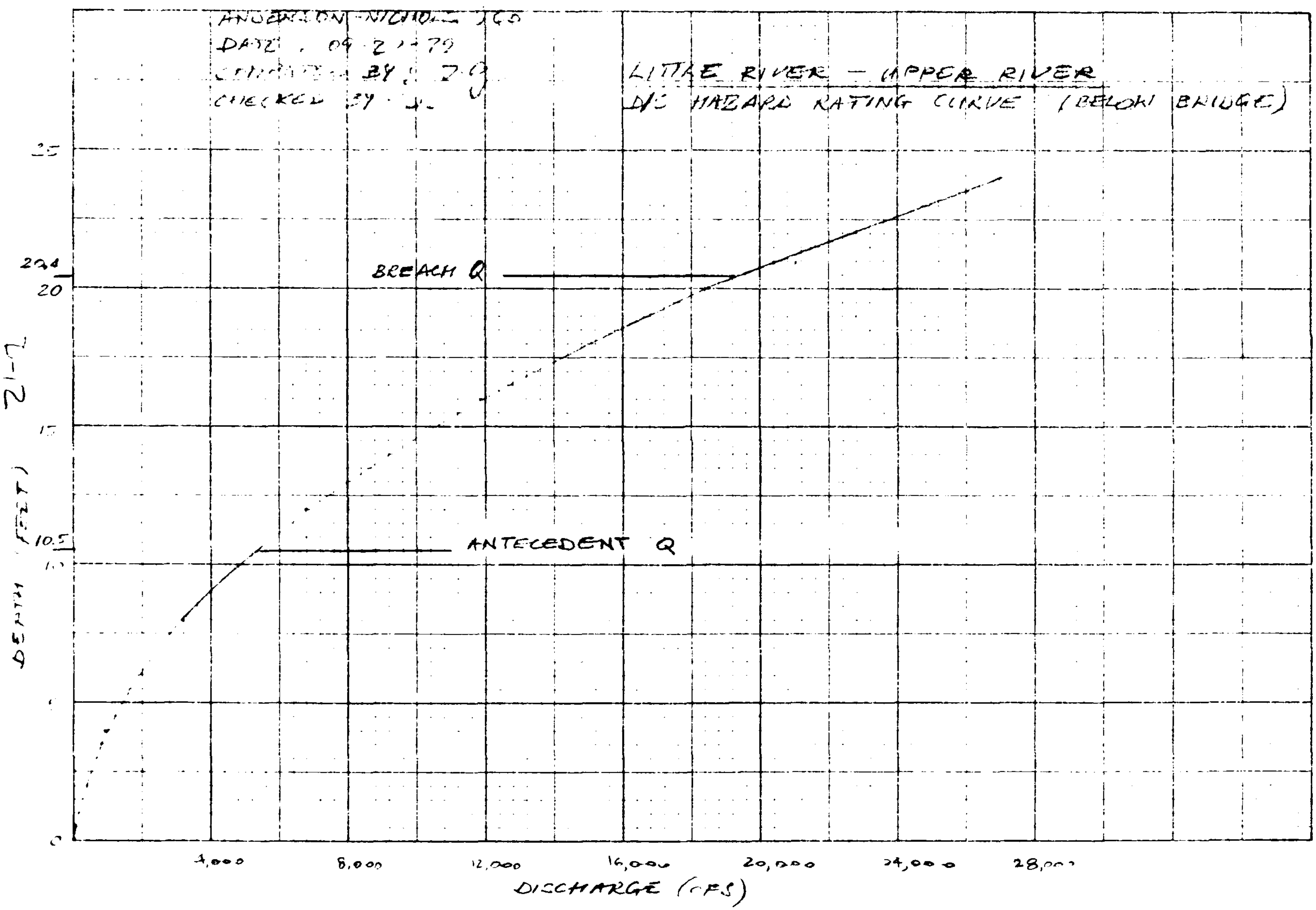
USE A TYPICAL CROSS SECTION ALONG THE DOWNSTREAM REACH FROM THE MERRICK ROAD BRIDGE (200' BELOW THE DAM) TO CONFLUENCE WITH RESERVOIR OF LOWER DAM FOR A DISTANCE OF 1700 FT. DEVELOP A RATING CURVE FOR THIS SECTION BY USE OF MANNING'S EQUATION: $Q = \frac{1.49}{n} \cdot A \cdot R^{2/3} \cdot S^{1/2}$

$n = 0.06$ $S = 0.005$

DEPTH [FT]	AREA	W. PER	Q [CFS]
0	0	0	0
4	239	71	933
8	576	92	3193
12	951	113	6794
16	1424	135	11 862
20	1975	156	18 542
24	2604	177	26 976



ANDERSON - NICHOLS & CO
DATE · 09-25-79
COMPUTED BY :
CHECKED BY :
LITTLE RIVER - UPPER DAM
DOWNSTREAM X-SECTION
TYPICAL FOR SECTION BETWEEN HERRICK ROAD BRIDGE AND LOWER RESERVOIR
BREACH Q
ANTECEDENT Q
SCALE:
VER. 1"-10'
HOR. 1"-50'
DEPTH [FT]
DISTANCE IN FEET


ANDERSON-NICHOLS & CO
DATE 09-21-79
CHECKED BY
LITTLE RIVER - UPPER RIVER
D/S HAZARD RATING CURVE (BELOW BRIDGE)
BREACH Q
ANTECEDENT Q
25
20.4
20
15
10.5
10
0
4,000
8,000
12,000
16,000
20,000
24,000
28,000
DISCHARGE (CFS)
DEPTH (FEET)

BREACH ANALYSIS CONT'D

TO DETERMINE MAXIMUM RISE OF LOWER RESERVOIR DUE TO BREACH OF UPPER RESERVOIR THE TOTAL BREACH Q WILL BE APPLIED TO THE RATING CURVE FOR THE LOWER DAM. THIS RESULTS IN AN ELEVATION OF 38.6 FT MSL

CONCLUSIONS: A BREACH OF LITTLE RIVER UPPER DAM COULD CAUSE OVERTOPPING AND POSSIBLE DAMAGE TO THE HERRICK ROAD BRIDGE AND COULD ALSO CAUSE OVERTOPPING OF LOWER RESERVOIR DAM.
THE BREACH COULD ALSO CAUSE LOSS OF A REGULATING RESERVOIR FOR USE IN WATER SUPPLY AND THEREFORE POSES A HAZARD TO A PUBLIC UTILITY. THERE WOULD PROBABLY BE NO LOSS OF LIFE BUT IT COULD CAUSE APPRECIABLE PROPERTY DAMAGE, THEREFORE, LITTLE RIVER UPPER DAM HAS BEEN CLASSIFIED AS SIGNIFICANT HAZARD

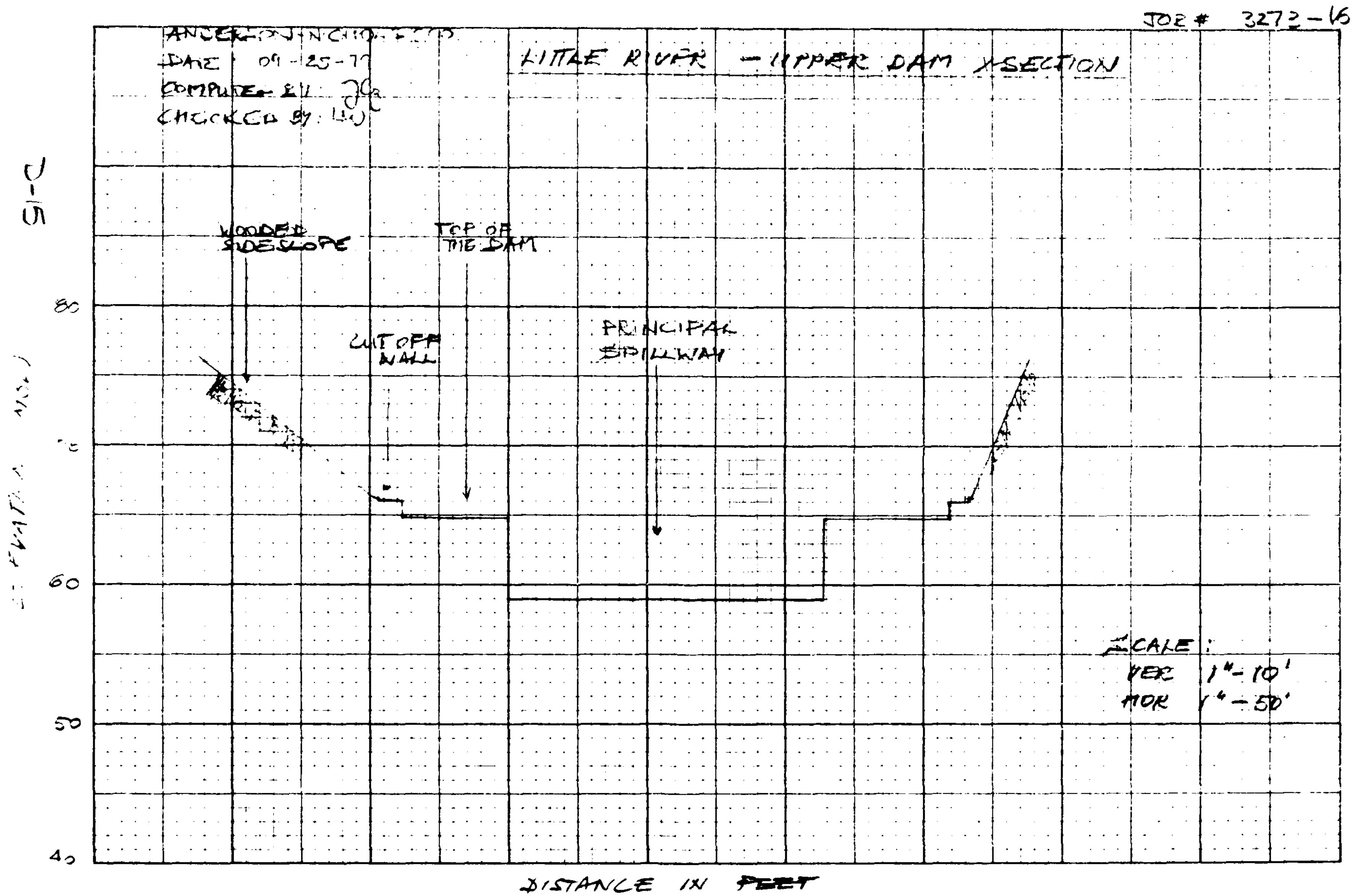
LITTLE RIVER UPPER DAM

DRAINAGE AREA — 13.7 SQ.MILE
SIZE CLASSIFICATION - SMALL
HAZARD CLASSIFICATION — SIGNIFICANT
TEST FLOOD RANGE 1/4 PMF — 1/2 PMF; CHOSEN 1/2 PMF BECAUSE THE SIZE OF DAM IS IN UPPER RANGE OF SIZE CLASSIFICATION.

STEP # 1 CALCULATE PMF USING "PRELIMINARY GUIDANCE FOR ESTIMATING MAXIMUM PROBABLE DISCHARGES IN PHASE I DAM SAFETY INVESTIGATIONS, MARCH 1978"

SLOPE OF WATERSHED IS 125 FT/MI, THEREFORE THE MOUNTAINOUS CURVE WILL BE USED.
USE A CSM VALUE OF 1870
13.7 SQ MLE × 1870 CSM = 25600 CFS
TEST FLOOD (1/2 PMF) = 12,800 CFS (Q_{P1})

STEP #2A DETERMINE SURCHARGE HEIGHT TO PASS Q_{P1} of 12,800 CFS. TO OBTAIN THIS, A DISCHARGE RATING CURVE MUST BE CALCULATED FOR UPPER RESERVOIR DAM. OUTFLOW WOULD OCCUR FIRST OVER THE PRINCIPAL SPILLWAY. HIGHER FLOOD WATERS WILL FLOW OVER THE DAM EMBANKMENTS AND SIDE SLOPES. FLOW THROUGH TWO OUTLET PIPES (6" AND 8" IN DIAMETER) FROM VALVE CHAMBER IS INSIGNIFICANT. SIZE OF EMERGENCY GATE IS UNKNOWN, GATE OPERATING MECHANISM IS RUSTED AND IN POOR CONDITION. THERE IS NO INDICATION OF RECENT OPERATION. 18" CMP OUTLET PIPE FROM THE GATE IS SEEPING ABOUT 30 GPM. BECAUSE OF ITS CONDITION POSSIBLE FLOW THROUGHT EMERGENCY GATE WILL NOT BE CALCULATED.


JOB # 3272-16
LITTLE RIVER - UPPER DAM X-SECTION
DATE 09-25-77
CHECKED BY
WOODED SIDESLOPE
TOP OF THE DAM
CUTOFF WALL
PRINCIPAL SPILLWAY
80
60
50
40
SCALE:
VER 1"-10'
HOR 1"-50'
DISTANCE IN FEET

Anderson-Nichols & Company, Inc.

JOB NO. 3272-16

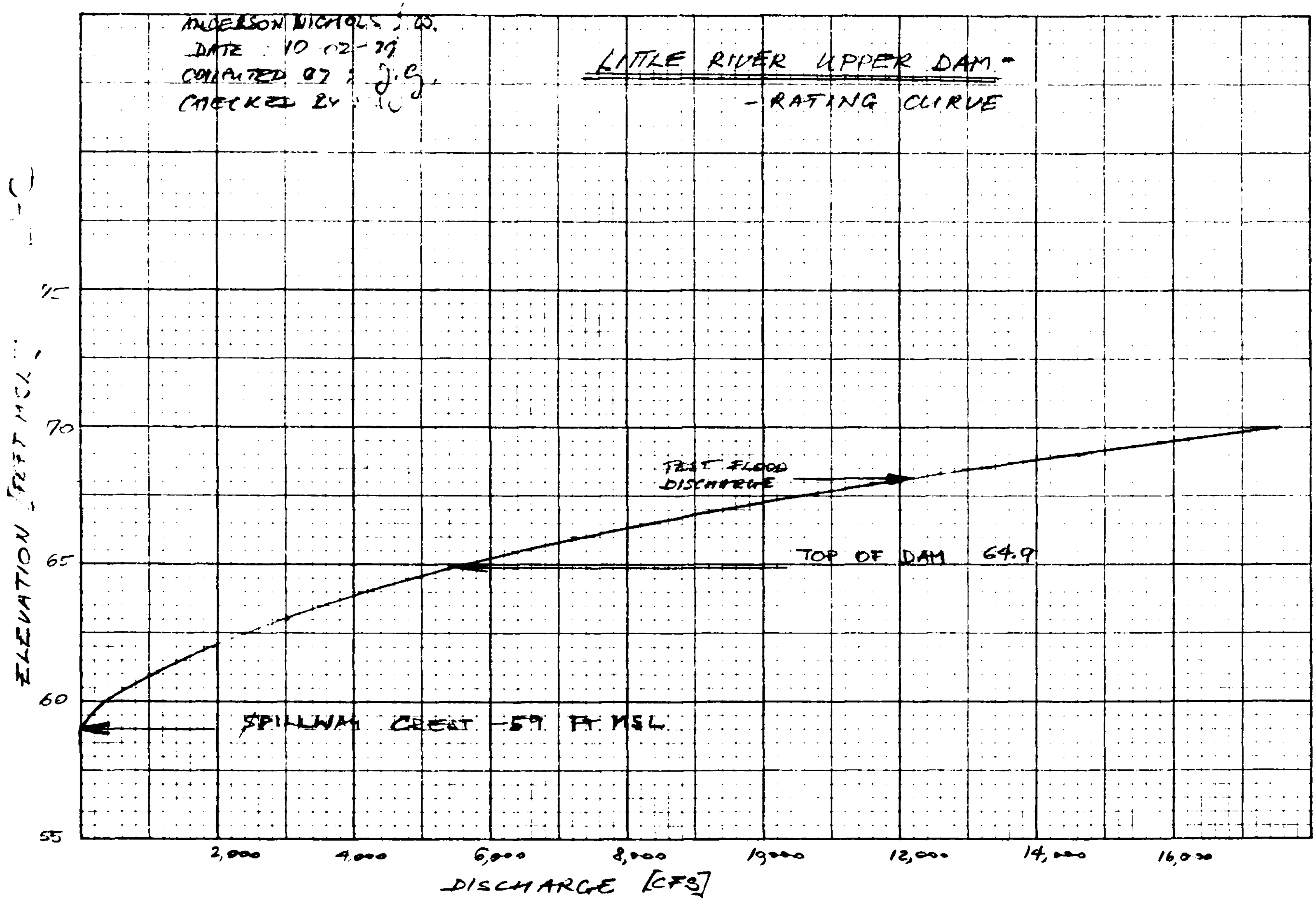
Subject H.1

Sheet No. 15 of
Date
Computed
Checked

[illegible] UPPER DAM – RATING CURVE CALCULATION

FLOW OVER THE SPILLWAY					FLOW OVER THE TOP OF DAM				FLOW OVER THE SIDE SLOPES				TOTAL
ELEV. (FEET MSL)	"C" VALUE	L (FEET)	H (FEET)	Q (CFS)	"C" VALUE	L (FEET)	H (FEET)	Q (CFS)	"C" VALUE	L (FEET)	H (FEET)	Q (CFS)	Q (CFS)
59	3.2	114	0	0									0
60			1	375									375
61			2	1065									1065
[illegible]			3	1955									1955
[illegible]			4	[illegible]									3010
[illegible]			5	[illegible]									4205
TOP DAM 64.9			5.9	5290									5290
[illegible]			6	6764	2.0	[illegible]	.85	595					7265
[illegible]			7	[illegible]		[illegible]	[illegible]	686	2.5	5	1	14	9410
[illegible]			9	[illegible]		[illegible]	1.02	1610		10	2	79	[illegible]706
[illegible]			10	[illegible]		[illegible]	1.2	[illegible]		[illegible]	[illegible]	[illegible]	14517
[illegible]			11	[illegible]		[illegible]	[illegible]	2534		[illegible]	4	[illegible]	17550
[illegible]			12	15[illegible]		[illegible]	1.05	4610		15	5	170	20518

D-16


ANDERSON NICHOLS & CO.
DATE 10-02-79
COMPUTED BY J.G.
CHECKED BY
LITTLE RIVER UPPER DAM - RATING CURVE
TEST FLOOD DISCHARGE
TOP OF DAM 64.9
SPILLWAY CREST 59 FT. MSL
ELEVATION [FEET MSL]
75
70
65
60
55
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
DISCHARGE [CFS]

Anderson-Nichols & Company, Inc.

Subject ___

Sheet No. ___ of ___
Date ___
Computed ___
Checked ___

JOB NO. 3272 – 15

SQUARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

____ RIVER – UPPER DAM

STORAGE – ELEVATION CURVE CALCULATIONS

NORMAL STORAGE (SPILLWAY CREST – 59 FT MSL) – 480 AC-FT

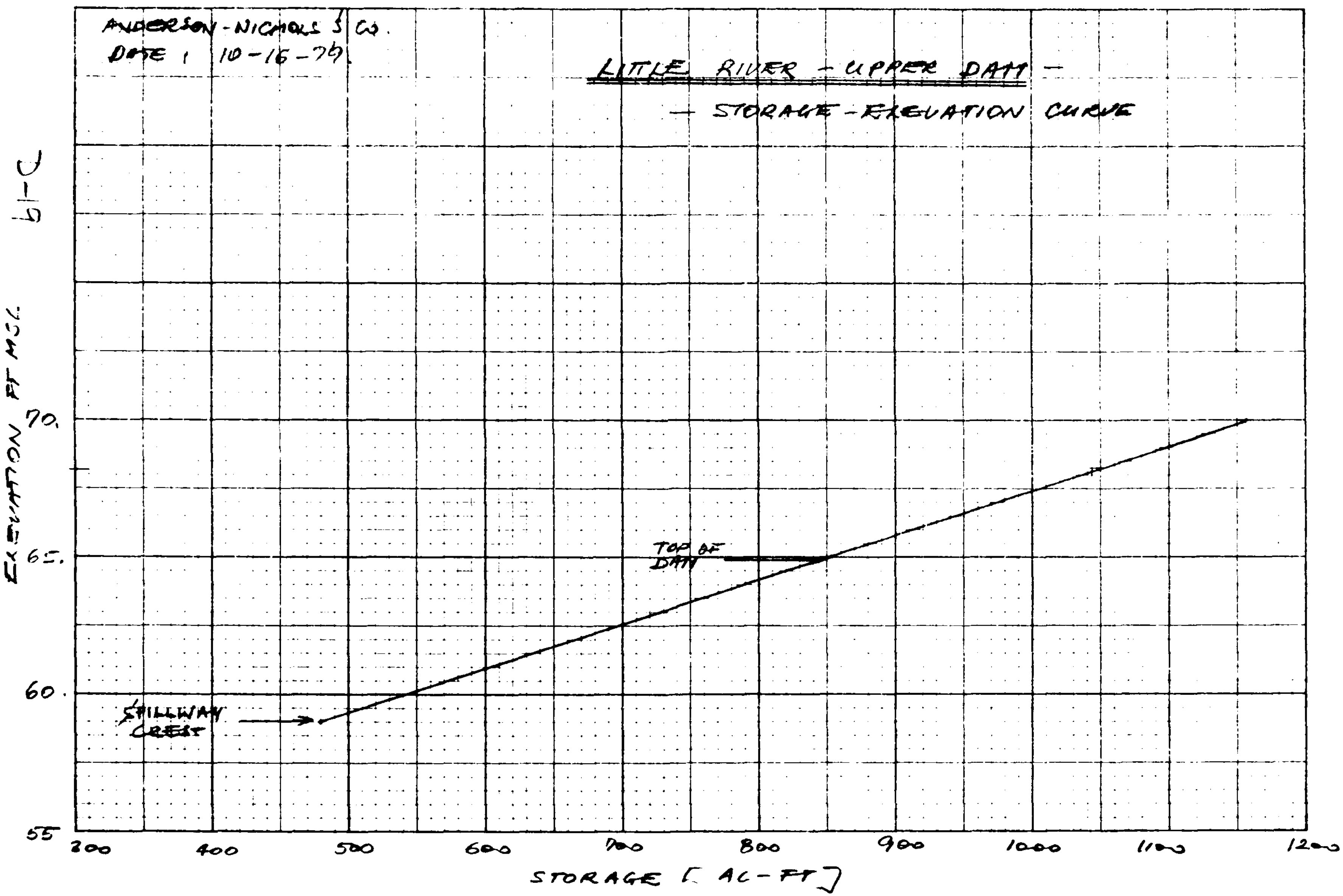
NOTE: 480 AC-FT WAS OBTAINED BY ESTIMATING AVERAGE DEPTH OF RESERVOIR – 10 FT AND PLANIMETERED SURFACE OF RESERVOIR FROM QUAD SHEET – 48 AC. 157 000 000 GAL LISTED AS IMPOUNDING CAPACITY IN APPLICATION FOR DAM REGISTRATION (SEE PAGE) AGREES WITH THIS CALCULATION.

USING 'FRUSTRUM OF PYRAMID EQUATION' AND PLANIMETERED SURFACE AREAS, DEVELOP POINTS FOR A STORAGE – ELEVATION CURVE

$$V = \frac{1}{3} h \left(L_1 + L_2 + \sqrt{L_1 L_2}\right)$$

h – ELEV. ABOVE NORMAL POOL
L_1 – NORMAL POOL SURFACE
L_2 – ENLARGE POOL SURFACE

ELEV. 70. FT MSL
SURFACE AREA – 76 AC
$V = \frac{1}{3}\, 11 \left(48 + 76 + \sqrt{48 \times 76}\right)$ = 676 AC-FT
TOTAL STORAGE – 1156 AC-FT


ANDERSON-NICHOLS & CO.
DATE: 10-16-79
LITTLE RIVER - UPPER DAM -
- STORAGE-ELEVATION CURVE
TOP OF DAM
SPILLWAY CREST
ELEVATION FT MSL
55
60.
65.
70.
200
400
500
600
700
800
900
1000
1100
1200
STORAGE [AC-FT]

LITTLE RIVER - UPPER DAM

STEP 2A (CONT)

TEST FLOOD (1/2 PMF) = 12,800 CFS

ELEV @ 12,800 CFS ⟹ 68.4 FT MSL

STEP # 2B

DETERMINE VOLUME OF SURCHARGE IN INCHES OF RUNOFF

Q_{P1} = 12,800 CFS → ELEV. 68.4 FT MSL

STORAGE AT 68.4 FT MSL ⟶ 1050 AC-FT

STORAGE AT 59.0 FT MSL (SPILLWAY CREST) ⟶ 480 AC-FT

$570 \text{ AC-FT} \times \frac{1}{13.7 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} \times 12 \frac{\text{IN}}{\text{FT}} = .78'' \text{ RUNOFF}$ (STOR 1)

STEP # 2C

$$Q_{P2} = Q_{P1} \times \left(1 - \frac{STOR1}{9.5''}\right)$$

$$Q_{P2} = 12,800 \text{ CFS} \times \left(1 - \frac{.78''}{9.5''}\right) = 11,750 \text{ CFS}$$

STEP # 2D

DETERMINE SURCHARGE HEIGHT TO PASS Q_{P2}

Q_{P2} = 11,750 CFS ⟶ 68. FT MSL ⟶ 1,035 AC-FT

$555 \text{ AC-FT} \times \frac{1}{13.7 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} \times 12 \frac{\text{IN}}{\text{FT}} = .76'' \text{ RUNOFF}$

Anderson-Nichols & Company, Inc.

Subject HSA

Sheet No. 20 of

Date 10-15-79

Computed

Checked

JOB NO. 3273 - 16

LITTLE RIVER - UPPER DAM

STEP # 36

AVERAGE STOR 1 & STOR 2

$$\frac{.78 + .76}{2} = .77" \text{ RUNOFF}$$

$$.77 \times \frac{13.7 \text{ MI}^2}{1} \times \frac{640 \text{ AC}}{\text{MI}^2} \times \frac{\text{FT}}{12 \text{ IN}} = 563 \text{ AC-FT}$$

563 AC-FT + 480 AC-FT = 1043 AC-FT ⟹ 68.2 FT-MSL

TEST FLOOD — 1/2 PMF

TEST FLOOD DISCHARGE — 12,200 CFS

TEST FLOOD ELEVATION — 68.2 FT-MSL

TOP OF DAM - 64.9 FT MSL THEREFORE DAM EMBANKMENT WOULD BE OVERTOPPED BY ABOUT 3.3 FT DURING TEST FLOOD CONDITIONS.

TOP OF DAM - 64.9 FT MSL ⟹ STORAGE 850 AC-FT

SPILLWAY CAPACITY @ TOP OF DAM IS 5390 CFS WHICH IS 44 PERCENT OF THE TEST FLOOD DISCHARGE.

APPENDIX E

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

NAME | REPORT DATE DAY MO YR

LITTLE RIVER UPPER DAM | 05NOV79

POPULAR NAME | NAME OF IMPOUNDMENT

BELFAST RESERVOIR NUMBER 2

RIVER OR STREAM | NEAREST DOWNSTREAM CITY-TOWN-VILLAGE | POPULATION

LITTLE RIVER | NORTHPORT | 2 | 1000

TYPE OF DAM | YEAR COMPLETED | PURPOSES | IMPOUNDING CAPACITIES | VER/DATE

1910 | 32 | 30 | GRD NED | N | N | N | N

REMARKS

SPILLWAY | VOLUME OF DAM | POWER CAPACITY | NAVIGATION LOCKS

2 | 216 | 114 | 5390

OWNER | ENGINEERING BY | CONSTRUCTION BY

BELFAST WATER DISTRICT

REGULATORY AGENCY

DESIGN | CONSTRUCTION | OPERATION | MAINTENANCE

INSPECTION BY | AUTHORITY FOR INSPECTION

ANDERSON-NICHOLS & COMPANY INC

END

FILMED

7-85

DTIC

APPENDIX E

Lower Dam – Plan and Sections

PLAN
SCALE: 1"=10'

LAST SAVED BY: MATT.LAPIERRE 4/3/2018 9:38 AM

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NO	SUBMISSIONS/REVISIONS	APP'D	DATE

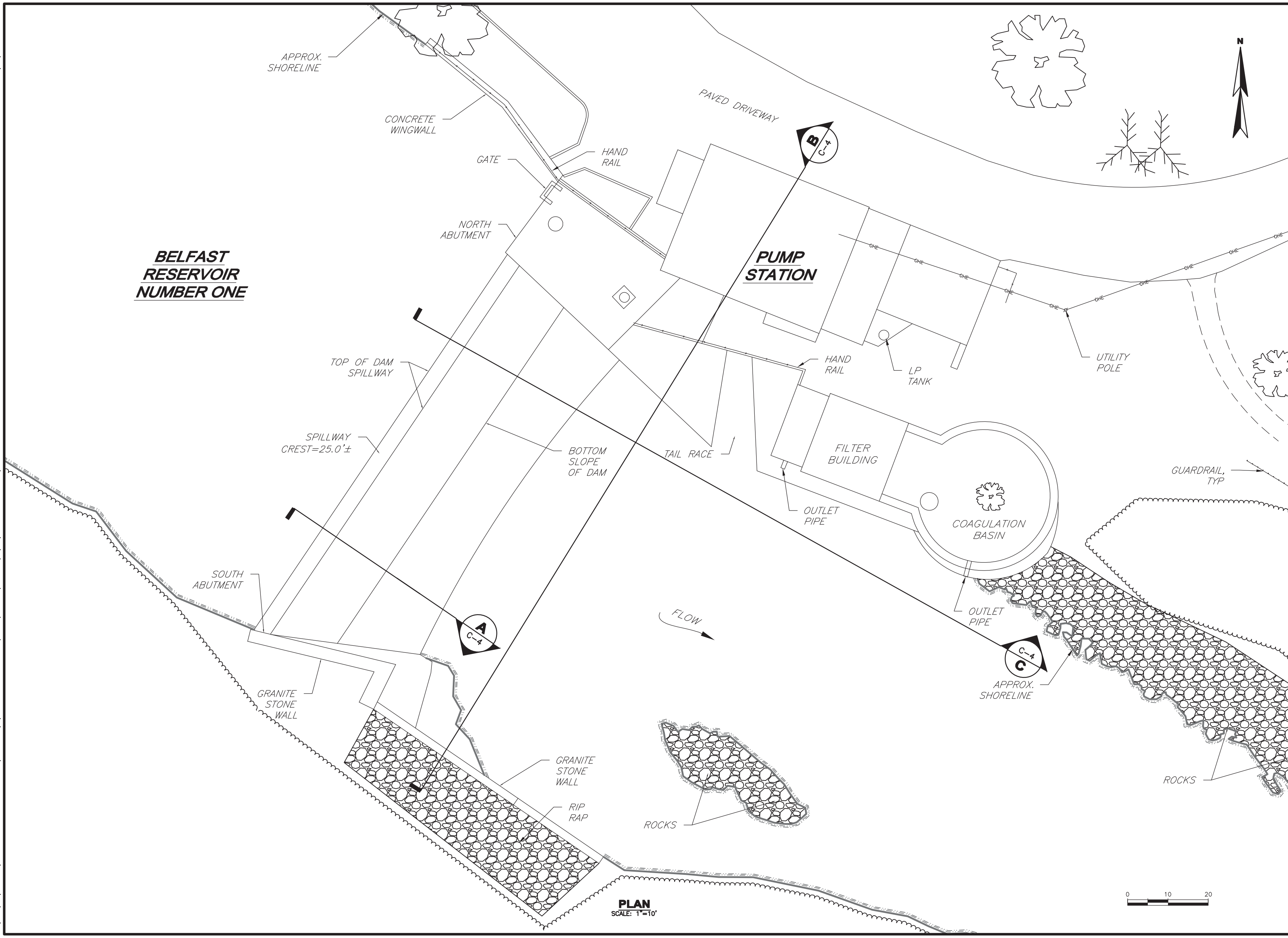
DESIGNED BY: ####
CAD COORD.: ####
CAD: ####
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO:

WRIGHT-PIERCE
Engineering a Better Environment
888.621.8156 | www.wright-pierce.com

BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

LOWER DAM EXISTING CONDITIONS

DRAWING
C-3



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BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

LOWER DAM EXISTING CONDITIONS

DRAWING
C-3

DESIGNED BY: ####
CAD COORD.: ####
CAD: ####
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO:

NO	SUBMISSIONS/REVISIONS	APP'D	DATE

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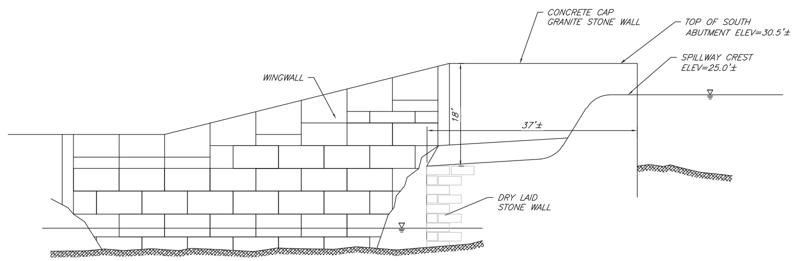
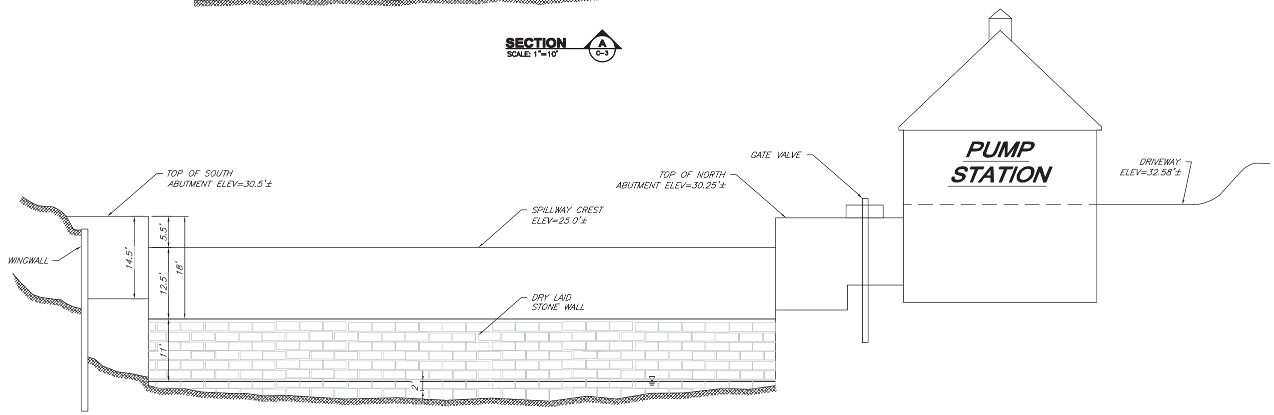


SECTION A C-3
SCALE: 1"=10'



SECTION B C-3
SCALE: 1"=10'

SECTION C C-3
SCALE: 1"=10'

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BELFAST WATER DISTRICT
UPPER AND LOWER LITTLE RIVER DAMS
BELFAST, MAINE

LOWER DAM CROSS SECTIONS

DRAWING
C-4

DESIGNED BY: ####
CAD COORD.: ####
CAD: ####
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO:

NO	SUBMISSIONS/REVISIONS	APP'D	DATE

LAST SAVED BY: MATT.LAPIERRE 4/11/2018 11:44 AM

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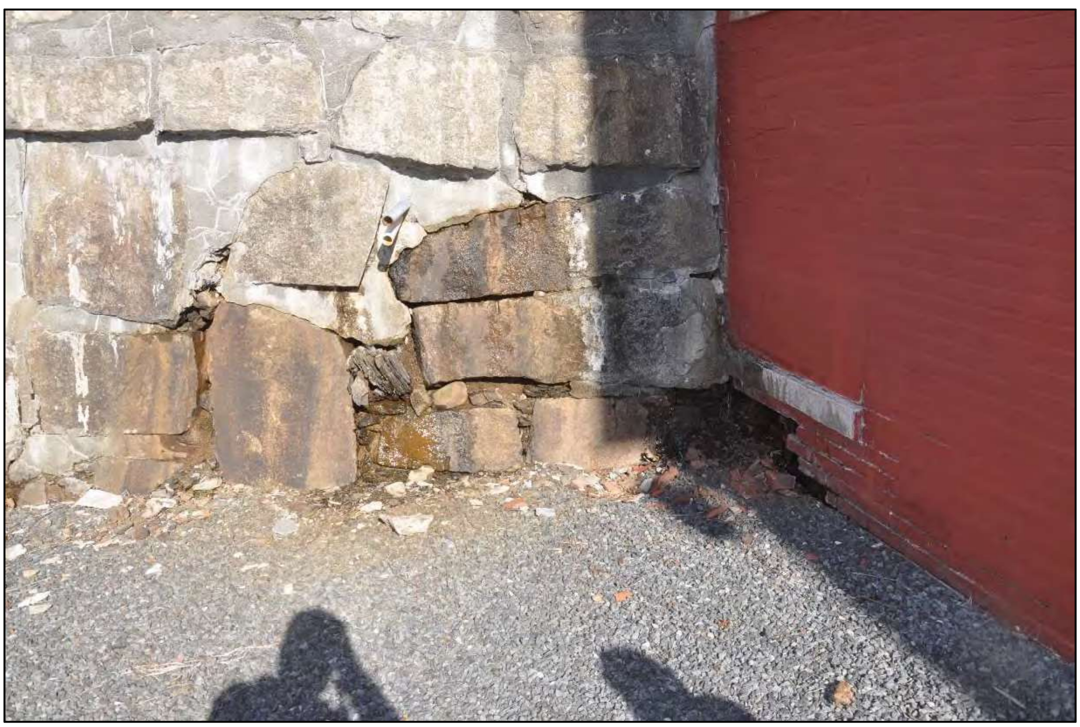
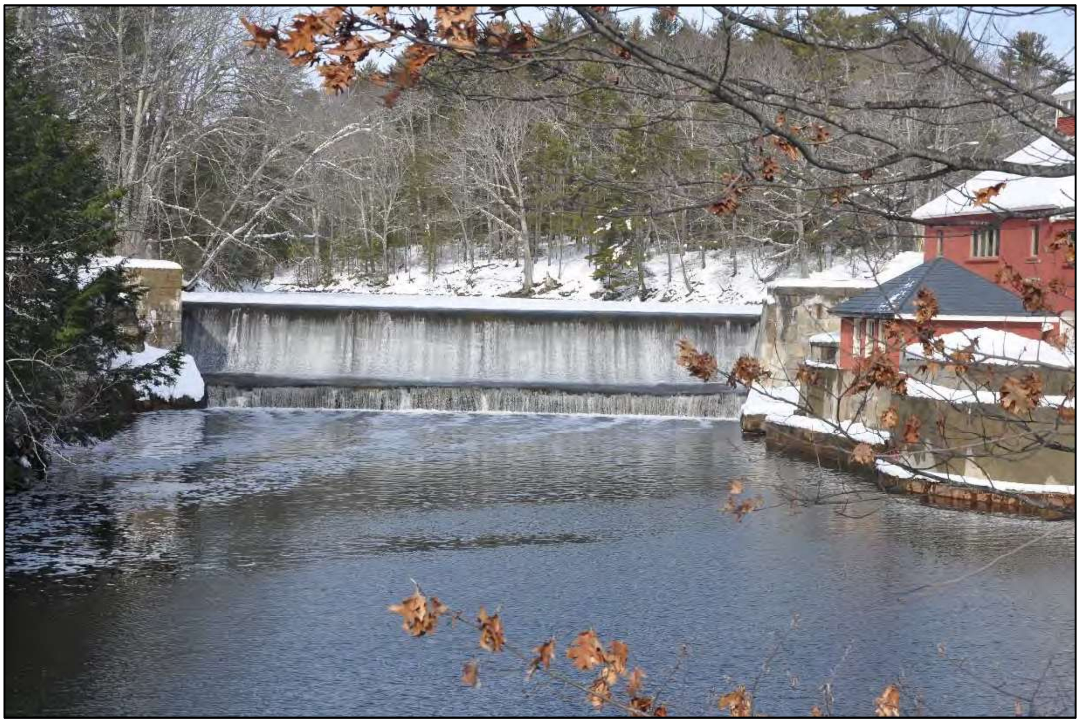
APPENDIX F

Lower Dam – Photographs



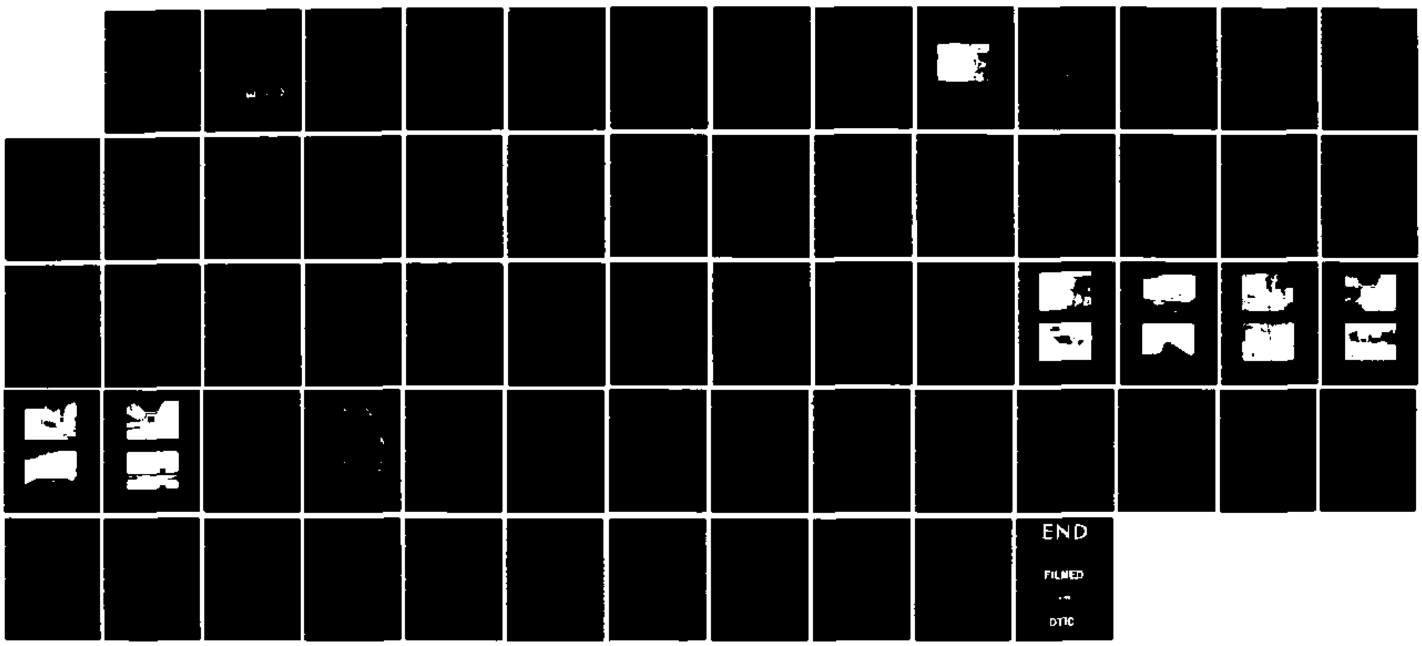


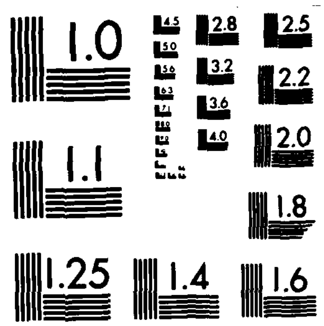
APPENDIX G

Lower Dam – ACOE Phase 1 Report

AD-A155 797 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS LITTLE RIVER LOWER DA..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV NOV 79 1/1

UNCLASSIFIED F/G 13/13 NL





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

ATLANTIC OCEAN

BELFAST, MAINE

LITTLE RIVER LOWER DAM
ME 00288

STATE NO. 5090

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

NOVEMBER 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ME 00288	2. GOVT ACCESSION NO. A155 797	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Little River Lower Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE November 1979
		13. NUMBER OF PAGES 55
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Atlantic Ocean
Belfast Maine
Little River

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

The dam is a concrete and dry stone masonry dam with a hydraulic height of 30 ft. and is 126 ft. long. The dam is in fair condition. It is small in size with a hazard potential of significant. A major breach with pool at top of dam would probably result in the loss of no lives, but could cause appreciable damage to property.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	ME00288
Name of Dam:	Little River Lower Dam
Town:	Belfast
County and State:	Waldo, Maine
Stream:	Little River
Date of Inspection:	September 17, 1979

BRIEF ASSESSMENT

Little River Lower Dam is a concrete and dry-stone-masonry dam, with a hydraulic height of 30 feet, 126 feet long, with a 91-foot long concrete ogee spillway section which makes a smooth transition into a slightly sloping spillway apron. At its downstream end the spillway apron discharges over a vertical dry-stone-masonry wall about 11 feet high. At the south end of the dam there is a concrete retaining wall. At the north end of the dam there is a massive intake structure which appears to be dry-stone-masonry encased in concrete. A pump station building and a filter house for a water supply system is located integrally with the north abutment. The gate mechanism on the north abutment is in poor condition and hasn't been operational for over 24 years. The dam impounds a reservoir with a maximum storage capacity of about 615 acre-feet. The reservoir is .51 mile long with a surface area of about 37 acres and is used for water supply for the Town of Belfast.

The dam is in fair condition. Major concerns are: Erosion on the upstream and downstream sides of the south concrete abutment, and deterioration of the dry-stone-masonry walls at the downstream edge of the spillway apron, on the north bank of the upstream channel and on the north bank of the downstream channel.

Based on small size and significant hazard classification in accordance with Corps guidelines, the test flood ranges from ¼ to ½ the Probable Maximum Flood (PMF). Because the storage capacity of this reservoir is in the upper range of the size classification, ½ PMF was selected as the test flood. Using the COE guide curves with 'mountainous' terrain, and the ½ PMF routed outflow from the Little River Upper Dam, the test flood inflow was determined to be 15,920 cfs. After routing, the test flood discharge was determined to be 15,000 cfs at elevation 36.7' NGVD. The test flood analysis indicates the dam would be overtopped by 6.4 feet. Spillway capacity at top of dam is 3,665 cfs, which is 24 percent of the routed test flood discharge. A major breach with pool at top of dam would probably result in the loss of no lives, but could cause appreciable property damage. (For details see Section 5.1 f.)

The owner, Belfast Water District, should implement the results of the recommendations and remedial measures given in Sections 7.2 and 7.3 within one year after receipt of this Phase I Inspection Report.

Warren A. Guinan
Warren A. Guinan
Project Manager
N.H. P.E. 2339

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

REPLY TO
ATTENTION OF:
NEDED

JUL 07 1980

Honorable Joseph E. Brennan
Governor of the State of Maine
State Capitol
Augusta, Maine 04330

Dear Governor Brennan:

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

A copy of this report has been forwarded to the Department of Agriculture cooperating agency for the State of Maine. In addition, a copy of the report has also been furnished the owner, Belfast Water District, 71 Church Street, Belfast, Maine 04915.

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 Agriculture for your cooperation in carrying out this program.

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, CHAIRMAN
Water Control Branch
Engineering Division

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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 investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

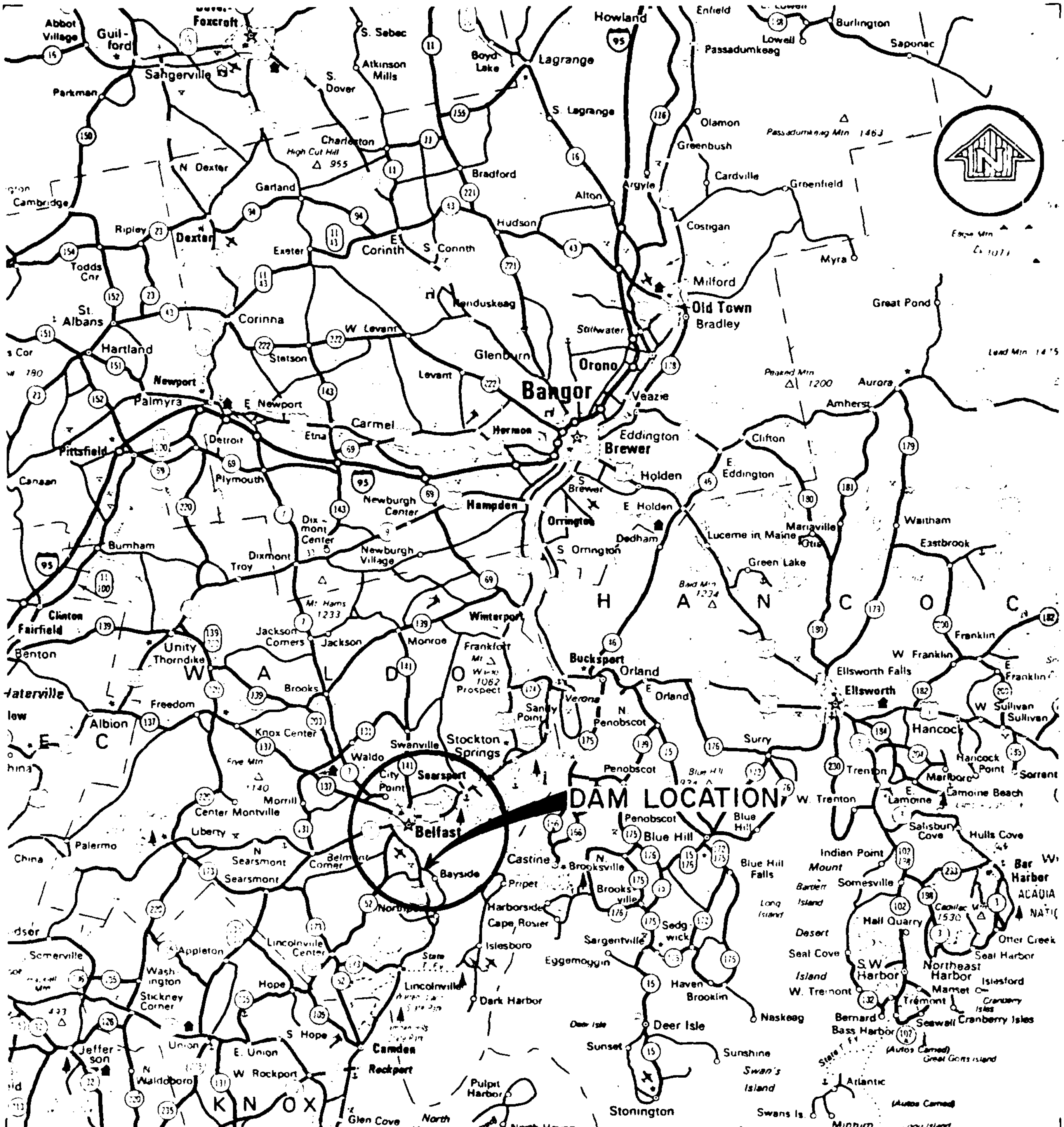
Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because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

TABLE OF CONTENTS

REPORT

APPENDICES

October, 1979
Figure 1 - Overview of Little River Lower Dam.



Permission for the reprinting of sections of the copyrighted State of Maine map has been obtained in writing from the Maine Department of Transportation. 9/15/78

SCALE IN MILES

0 10 20

MAP BASED ON 1979-1980 OFFICIAL TRANSPORTATION MAP, STATE OF MAINE

Anderson-Nichols & Co., Inc CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LITTLE RIVER LOWER DAM
LOCATION MAP

LITTLE RIVER MAINE

			SCALE SEE BAR SCALE
			DATE NOVEMBER 1979

NATIONAL DAM INSPECTION PROGRAM
PHASE 1 INSPECTION REPORT
LITTLE RIVER LOWER DAM

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Anderson-Nichols & Company, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to Anderson-Nichols under a letter of August 28, 1979 from William E. Hodgson, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0050, as changed, has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To 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) To encourage and prepare the States to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location. Little River Lower Dam, commonly called Lower Dam, is located on the boundary of the Town of Belfast and the Town of Northport, Maine; the dam spans Little River approximately 700 feet upstream from the river's confluence with the Atlantic Ocean. The dam impounds a pond called Belfast Reservoir Number 1. After discharging at the damsite, Little River flows easterly into Penobscot Bay in the Atlantic Ocean. Little River Lower Dam is shown on the U.S.G.S. Quadrangle, Searsport, Maine with coordinates approximately at N 44° 23' 42", W 68° 59' 24", Waldo County, Maine. (See Location Map page vii.)

b. Description of Dam and Appurtenances. Little River Lower Dam is a low, run-of-river dam which impounds a reservoir of small size. It is a concrete and dry-stone-masonry dam, about 30 feet high (hydraulic) and 126 feet long, with a 91-foot long ogee spillway section which makes a smooth transition into a slightly sloping spillway apron. At its downstream end, the spillway apron discharges over a vertical dry-stone-masonry wall about 11 feet high.

At the south end of the dam there is a concrete retaining wall. The wall extends downstream 36 feet (width of the spillway and apron) then bends at right angle towards south abutment for a distance of 12 feet and then again continues downstream for the next 14 feet. At the downstream side of the concrete retaining wall it can be observed that the wall is founded on bedrock. Soil lies against the upstream and landward sides of the retaining wall. At the north end of the dam there is a massive intake structure which appears to be dry-stone-masonry encased in concrete on the top, upstream face, and river side face. A stone masonry training wall, partially faced with concrete supports the north bank of the upstream approach channel. The training wall extends for 24 feet perpendicular to the spillway and then bends slightly toward the center of the upstream channel to the next 24 feet. On the north bank of the downstream channel there is a concrete-faced dry-stone-masonry wall which, in the lower section, is not faced with concrete. Located in the lower section of the downstream retaining wall is an outlet channel for the intake structure. This outlet is plugged with sand and gravel to about one-third of its height. A pump station building and a filter house for a water supply system is located immediately downstream of the north abutment. A concrete wall which exists on the river side of these buildings is an extension to the downstream retaining wall. The gate operating mechanism on the north abutment is inoperable; the gate size and type is unknown. Its outlet is a 5-foot diameter steel pipe that exits at the bottom of the training wall on the north bank of the downstream channel. The average daily intake through the water supply pump is about 275 gpm.

c. Size Classification. Small (hydraulic height - 30 feet; storage - 615 acre-feet) based on height and storage (height $\geq$ 25 to $<$ 40 feet and storage $\geq$ 50 to $<$ 1000 acre-feet) as given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Significant hazard. A major breach would probably not result in the loss of lives, but could cause appreciable property damage and loss of the reservoir and water supply of the Town of Belfast. (See Section 5.1 f.)

e. Ownership. Little River Lower Dam is owned by Belfast Water District.

f. Operator. The current owner and operator of the dam is Belfast Water District, 71 Church Street, Belfast, Maine. Telephone: (207) 338-1200.

g. Purpose of Dam. Water impounded at Little River Lower Dam is used as a water supply reservoir.

h. Design and Construction History. The original stone masonry dam was built in 1887 and was breached in 1941. In 1943 a new dam was built about 15 feet downstream of the old dam crest. Some parts of the original dam were used to build the new dam. Gunite patchwork was done on the dam face about two years ago. This historical information was obtained orally from the Belfast Water District Superintendent, Mr. Milford Rhodes, during the visual inspection. No other information regarding the original design or construction of the dam was disclosed.

i. Normal Operating Procedures. No written operational procedures exist for Little River Lower Dam. Operating procedures are restricted to water supply operation. There are two 8-inch pipes leading to a wet well which has one 10-inch supply line. The average daily supply amounts to 275 gpm.

1.3 Pertinent Data

a. Drainage Area. The drainage area consists of 16.8 square miles (10,752 acres) of rolling and partially wooded terrain. 3.1 square miles is intermediate drainage area and 13.7 square miles is drainage for Little River Upper Dam, which is located about 4,900 feet upstream. The normal pool has a surface area of 37 acres which constitutes less than 1 percent of the watershed.

b. Discharge at Damsite

(1) Outlet works (a) - unknown gate size - gate is not now operable

(b) - two 8-inch diameter intake pipes for water supply

(2) The maximum known discharge for this dam was in the 1950's when high water flowed over the abutments and filter house. No elevation for this incident was available.

(3) Ungated spillway capacity @ top of dam elevation - 3,665 cfs @ 30.3' MSL

(4) Ungated spillway capacity @ test flood elevation - 12,018 cfs @ 36.7' MSL

(5) Gated spillway capacity @ top of dam elevation - not applicable

(6) Gated spillway capacity @ test flood elevation - not applicable

(7) Total spillway capacity @ test flood elevation - 12,018 cfs @ 36.7' MSL

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT Little River Lower Dam, Me.

DATE Sept. 17, 1979

TIME 1300

WEATHER Sunny, hot

W.S. ELEV. U.S. 25' MSl DN.S. 1.3' MSL

PARTY:

1. Warren Guinan (ANCo)
2. Stephen Gilman (ANCo)
3. Leslie Williams (ANCo)
4. John Regan (ANCo)
5. Teresa Sapp (ANCo)
6. Janusz Czyzowski (ANCo)
7. Ronald Hirschfeld (GEI)
8. Milford Rhodes (Bel.Water Dist)
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrology/Hydraulics	L. Williams/J. Czyzowski	
2.	Structural Stability	S. Gilman	
3.	Soils and Geology	R. Hirschfeld	
4.			
5.			
6.			
7.			
8.			
9.			
10.			

APPENDIX A

VISUAL INSPECTION CHECKLIST

(2) Clear the sand and gravel that partially block the discharge end of the low-level outlet pipe.

(3) Inspect visually the dam and appurtenant structures once a month.

(4) Engage a Registered Professional Engineer to make a comprehensive technical inspection of the dam once a year.

(5) Establish a surveillance program for use during and immediately after heavy rainfall and also a warning program to follow in case of emergency conditions.

7.4 Alternatives

None.

SECTION 7
ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination indicates that Little River Lower Dam is in fair condition. The major concerns with respect to the integrity of the dam, if left uncorrected, are:

(1) Erosion on the upstream and downstream sides of the south concrete abutment block.

(2) Deterioration of the dry-stone-masonry walls at the downstream edge of the spillway apron, on the north bank of the upstream channel, and on the north bank of the downstream channel.

b. Adequacy of Information. The information available is such that the assessment of this dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2 and 7.3 should be implemented by the owner within one year after receipt of this Phase I report.

d. Need for Additional Investigation. No additional investigation for the purposes of this Phase I investigation is needed.

7.2 Recommendations

The owner should engage a Registered Professional Engineer to:

(1) Design and implement repairs for the dry-stone-masonry walls at the downstream edge of the spillway apron, on the north bank of the upstream channel, and on the north bank of the downstream channel.

(2) Design and implement repairs for the erosion on the upstream and downstream sides of the right concrete abutment block.

(3) Design repairs to the low-level outlet gate, operating mechanism, and outlet pipe as required.

7.3 Remedial Measures

a. Operating and Maintenance Procedures. The owner should:

(1) Remove trees and brush from the right bank of the downstream channel between the dam and the highway bridge.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. Erosion on the upstream and downstream sides of the south concrete abutment shell, if not corrected, could have an adverse effect on the stability of the abutment.

Deterioration of the dry-stone-masonry walls at the downstream edge of the spillway apron, on the north bank of the downstream channel, and on the north bank of the upstream channel, if not corrected, could result in erosion and undermining of the dam and the north abutment.

b. Design and Construction Data. No design and construction data are available.

c. Operating Records. No written operational procedures exist for Little River Lower Dam. Operating procedures are restricted to water supply operation.

d. Post-Construction Changes. See Section 1.2 h.

e. Seismic Stability. This dam is located in Seismic Zone 2 and, in accordance with the Phase I guidelines, does not warrant seismic analysis.

cfs at elevation 36.7' NGVD. The test flood analysis indicates that the dam embankment would be overtopped by approximately 6.4 feet during the test flood conditions. The spillway capacity at top of dam is 3,665 cfs which is 24 percent of the routed test flood discharge. Flow through the water supply pump which averages daily about 275 gpm is insignificant for this study. Because of the inoperable gate condition, overtopping analyses were calculated assuming gate closed.

f. Dam Failure Analysis. The impact of failure of the dam at the top of dam was assessed using the Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis covered the reach extending from the dam to the Atlantic Ocean, a distance of 700 feet along Little River. A major breach of Little River Lower Dam would discharge about 14,780 cfs. The discharge from the dam just prior to failure would be 3,665 cfs or maximum spillway capacity. A breach would cause an increase in stage of 6.3 feet in addition to the 8.2-foot antecedent stage from the dam to the U.S. Route 1 bridge. This increase could cause damage to the water treatment facilities. The U.S. Route 1 bridge would pass the breach discharge without overtopping but this discharge could possibly cause structural damage to the bridge. In the reach from the bridge to the Atlantic Ocean, a distance of 300 feet, an increase in stage of 9 feet in addition to the 10-foot antecedent stage would probably occur. An historic home which also houses a doctor's and optician's office is located on the north bank of the channel just downstream of the U.S. Route 1 bridge. The sill of this home is about 19 feet above channel bottom. Possible damage may occur to this home and the parking lot beside it. The breach could also cause loss of reservoir for use in water supply and therefore poses a hazard to a public utility. There would probably be no loss of life, but it could cause appreciable property damage. Therefore, Little River Lower Dam was classified Significant Hazard.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. General. Little River Lower Dam is a concrete and dry-stone-masonry dam with an ogee spillway section which makes a smooth transition into a slightly sloping spillway apron. Discharge is over the vertical dry-stone-masonry wall at its downstream end. The dam impounds a reservoir of small size (maximum storage capacity 615 acre-feet) which is used for water supply. The drainage area at the dam consists of 16.8 square miles of mountainous terrain. Reservoir Number 2, impounded by the Upper Dam, is located 0.42 miles upstream. A gate of unknown size is located at the north abutment. The gate mechanism is rusted and not operable. The gate was designed to control discharge through an outlet channel which is plugged with sand and gravel to about one-third of its height. Also at the north abutment, there are two 8-inch intake pipes for the water supply pump. Intake through the water supply pump averages daily about 275 gpm. The reservoir level is controlled by the spillway which is located at the center of the dam.

b. Design Data. No hydrologic or hydraulic experience data were found.

c. Experience Data. No hydrologic or hydraulic experience data were disclosed. Only oral information from the retired Superintendent of the Belfast Water District was available. He described the discharge in the 1950's when high water flowed over the abutments and filter house. No elevation of this incident was available.

d. Visual Observations. At the time of the inspection, no visual evidence was noted of damage to the structure caused by overtopping.

e. Test Flood Analysis. Little River Lower Dam is classified as being small size having a hydraulic height of 30 feet and a maximum storage capacity of 615 acre-feet. The dam was determined to have a significant hazard classification. Using the Recommended Guidelines for Safety Inspection of Dams, the test flood ranged from ¼ to ½ the Probable Maximum Flood (PMF). Because the dam's storage capacity is in the uper end of the size classification, the ½ PMF was chosen as the test flood.

Using the ½ PMF, the test flood inflow for Little River Lower Dam was determined to be 15,920 cfs. The total drainage area is 16.8 square miles, but only 3.1 square miles is intermediate drainage for Little River Lower Dam. Therefore, inflow to Little River Lower Dam is the sum of the routed outflow from Little River Upper Dam and inflow from the intermediate drainage area using the 'mountainous' COE guide curve. The routed outflow value from the Upper Dam was taken from the Little River Upper Dam Phase I inspection report. After routing, the test flood discharge was determined to be 15,000

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No written operational procedures exist for Little River Lower Dam. Operating procedures are restricted to water supply operation. There are two 8-inch pipes leading to a wet well which has one 10-inch supply line. The normal daily usage is 275 gpm.

4.2 Maintenance of Dam

The owner, Belfast Water District, is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

No formal maintenance procedure was disclosed. The Superintendent of the Belfast Water District reported that the low-level gate mechanism is inoperable and has not been operated for over 24 years. Maintenance facilities apply to the water supply station. Someone from the Belfast Water District is on duty at the dam site in the daytime during the weekdays.

4.4 Description of Any Warning System in Effect

No written warning system exists for the dam.

4.5 Evaluation

Formal operational and maintenance procedures should be developed to ensure that problems that are encountered can be remedied within a reasonable period of time.

the approximately 8-inch thick concrete cap which is severely cracked. (See Appendix C - Figure 9.)

A 5-foot-diameter steel pipe exits at the bottom of the training wall on the north bank of the downstream channel. The outlet of the pipe is plugged with sand and gravel to about one-third of its height. (See Appendix C - Figure 9.) The gate mechanism on the north abutment is inoperable; the gate size is unknown. (See Appendix C - Figure 4.) The mechanism is in poor condition with no indication of maintenance. A pump station building and a filter house for a water supply system is located integrally with the north abutment. A concrete wall which exists on the river side of these buildings is an extension to the downstream retaining wall. (See Appendix C - Figure 10.)

d. Reservoir Area. The watershed above the reservoir is rolling and partially wooded. (See Appendix C - Figure 11.) No structures were observed on the shore of the reservoir. No evidence of significant sedimentation in the reservoir was observed.

e. Downstream Channel. The downstream channel is bedrock. Trees overhang the south side of the channel. About 400 feet downstream of the dam is the U.S. Route 1 bridge that crosses the channel. (See Appendix C - Figure 12.) Little River discharges into Penobscot Bay through a channel lined with well-placed derrick stone. (See Appendix C - Figure 13.)

3.2 Evaluation

Based on the visual inspection, Little River Lower Dam is in fair condition. Erosion on the upstream and downstream sides of the south concrete abutment shell, if not corrected, could have an adverse effect on the stability of the abutment.

Deterioration of the dry-stone-masonry walls at the downstream edge of the spillway apron, on the north bank of the downstream channel, and on the north bank of the upstream channel, if not corrected, could result in erosion and undermining of the dam and the north abutment. Also, cracked concrete cap on the lower part of north abutment poses a dangerous condition to people walking on the top of the wall.

The inoperable gate and low-level outlet provides no means of draining the reservoir.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Little River Lower Dam is a low, run-of-river dam which impounds a reservoir of small size. The watershed above the reservoir is rolling and partially wooded. Little River discharges into Penobscot Bay about 700 feet downstream of the dam.

b. Dam. Little River Lower Dam is a concrete and dry-stone-masonry dam, about 30 feet high (hydraulic) and 126 feet long, with a 91-foot long ogee spillway section which makes a smooth transition into a slightly sloping spillway apron. At its downstream end, the spillway apron discharges over a vertical dry-stone-masonry wall about 11 feet high. (See Appendix C - Figure 2.) This vertical dry-stone-masonry wall has two openings, but it cannot be determined from the visual inspection whether these openings are built into the original wall or whether they are the result of blocks of rock having fallen out.

At the north end of the dam there is a massive intake structure which appears to be dry-stone-masonry encased in concrete on the top, upstream face, and river-side face. (See Appendix C - Figures 3 & 4.) The downstream face is dry-stone-masonry. (See sketch plan, Appendix B.)

At the south end of the dam there is a concrete abutment shell. (See Appendix C - Figure 5.) Bedrock is exposed at the downstream side of the concrete abutment. (See Appendix C - Figure 6.) Soil rests against both the upstream and landward sides of the concrete abutment shell. (See Appendix C - Figure 7.) Minor erosion is occurring in the soil immediately adjacent to the upstream side of the concrete abutment shell. Major erosion and sloughing of the soil cover, down to bedrock, is occurring immediately adjacent to the downstream side of the shell. (See Appendix C - Figure 6.) A weephole is located on the downstream face of this shell and it was discharging a small amount of water at the time of the inspection.

c. Appurtenant Structures. A stone masonry training wall, partially faced with concrete which is in poor condition, supports the north bank of the upstream approach channel. (See Appendix C - Figure 8.)

On the north bank of the downstream channel there is a concrete-faced dry-stone-masonry wall. The lower, dry-stone-masonry section of the wall is in poor condition and several blocks of rock are missing from the wall. This causes lack of support to

SECTION 2
ENGINEERING DATA

2.1 Design

No design data were disclosed for Little River Lower Dam.

2.2 Construction

No construction records were disclosed.

2.3 Operation

No engineering operational data were obtained.

2.4 Evaluation

a. Availability. No engineering data were available for Little River Lower Dam. Direct contact with the Belfast Water District and a search of the files at the Maine Soil and Water Conservation Commission revealed only a limited amount of information.

b. Adequacy. The final assessments and recommendations of this investigation are based on the visual inspection and the hydrologic and hydraulic calculations.

c. Validity. No engineering data were disclosed to validate.

g. Dam

(1) Type - concrete gravity

(2) Length - 126' (dam embankment)

(3) Height - 31' (structural height)

(4) Top width - 35'

(5) Side slopes - upstream - vertical

- downstream - vertical

(ogee spillway section makes transition into a slightly sloping spillway apron which drops vertically about 11 feet at downstream toe of the dam)

(6) Zoning - not applicable

(7) Impervious core - not applicable

(8) Cutoff - unknown

(9) Grout curtain - unknown

h. Diversion and Regulating Tunnel - not applicable.

i. Spillway

(1) Type - concrete ogee overflow

(2) Length of weir - 91'

(3) Crest elevation - 25' MSL

(4) Gates - none

(5) U/S Channel - Reservoir Number 1; completely open

(6) D/S Channel - Little River for about 700 feet before its confluence with the Atlantic Ocean, rock channel well defined. U.S. Route Number 1 spans the river 400' below the dam.

j. Regulating Outlets - unknown size gate (not operable) with 60-inch diameter steel pipe outlet pipe and channel which is plugged with sand and gravel to about one-third of its height. This outlet exits at the bottom of the retaining wall on the north bank of the downstream channel.

(8) Total project discharge @ test flood elevation - 15,000 cfs @ 36.7' MSL

c. Elevation (feet above MSL; see (6) below)

(1) Streambed at centerline of dam - 0.3 (at downstream toe, 1.0 foot deep pool)

(2) Maximum tailwater - unknown

(3) Upstream valve chamber invert - unknown

(4) Recreation pool - not applicable

(5) Full flood control pool - not applicable

(6) Spillway crest - 25 (estimated from U.S.G.S. Quadrangle sheet)

(7) Design surcharge (original design) - unknown

(8) Top of dam - 30.3

(9) Test flood pool - 36.7

d. Reservoir (miles)

(1) Length of maximum pool - 0.66

(2) Length of spillway crest pool - 0.51

(3) Length of flood control pool - not applicable

e. Storage (acre-feet)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest pool - 370

(4) Top of dam - 615

(5) Test flood pool - 910

f. Reservoir Surface (acres)

(1) Recreation pool - not applicable

(2) Flood control pool - not applicable

(3) Spillway crest - 37

(4) Test flood pool - 52

(5) Top of Dam - 46

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Lower Dam, Me. DATE September 17, 1979

PROJECT FEATURE Intake Channel and Structure NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	
Slope Conditions	Good
Bottom Conditions	Not visible beneath lake surface
Rock Slides or Falls	None
Log Boom	None
Debris	None
Condition of Concrete Lining	Not visible beneath lake surface
Drains or Weep Holes	None observed
b. Intake Structure	
Condition of Concrete	Not visible beneath lake surface
Stop Logs and Slots	None

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Lower Dam, ME DATE September 17, 1979

PROJECT FEATURE Control Tower NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Fair
Condition of Joints	No indication of movement
Spalling	Numerous surface spalls
Visible Reinforcing	None
Rusting or Staining of Concrete	Only at embedded items
Any Seepage or Efflorescence	None visible
Joint Alignment	Good - no indication of movement
Unusual Seepage or Leaks in Gate Chamber	None visible
Cracks	Numerous minor surface cracks
Rusting or Corrosion of Steel	Only at embedded steel items
b. Mechanical and Electrical	Gate operating mechanism is in poor condition-no indication of maintenance, lubrication or operation. Belfast Water District Superintendent indicated that gate hasn't been operated in 24 years.
Air Vents	
Float Wells	
Crane Hoist	
Elevator	
Hydraulic System	None
Service Gates	Not visible-reported to be steel
Emergency Gates	None
Lightning Protection System	None
Emergency Power System	None
Wiring and Lighting System	Not applicable

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Lower Dam, Me. DATE September 17, 1979

PROJECT FEATURE Outlet Structure and Channel NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL	
General Condition of Stone Masonry	North stone masonry wall has several large stones missing from wall.
Rust or Staining	
Spalling	Downstream wall above tailrace is badly spalled and cracked.
Erosion or Cavitation	
Visible Reinforcing	None
Any Seepage or Efflorescence	None
Condition at Joints	Considerable movement where wall is cracked.
Drain holes	One weep hole discharging water in concrete block south abutment.
Channel	
Loose Rock or Trees Overhanging Channel	Brush and a few trees overhanging channel immediately upstream.
Condition of Discharge Channel	Good

PERIODIC INSPECTION CHECKLIST

PROJECT Little River Lower Dam, Me. DATE September 17, 1979

PROJECT FEATURE Spillway Weir NAME ______

DISCIPLINE ______ NAME ______

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	A few trees
Floor of Approach Channel	Not visible beneath lake surface.
b. Weir and Training Walls	
General Condition of Concrete	Weir-good-only surface erosion of face some erosion of construction joints Training walls-poor-considerable erosion and spalling on faces, south wall cracked with ½" movement.
Rust or Staining	
Spalling	Some on face of weir and retaining walls.
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None visible
Drain Holes	One weep hole discharging water from concrete south-abutment block.
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None, but soil on top of bedrock is eroding immediately downstream of right abutment.
Trees Overhanging Channel	Some trees overhanging right side of channel.
Floor of Channel	Bedrock (phyllite) and chips of decomposed phyllite.
Other Obstructions	Bridge carrying Route 1 across downstream channel.

PROJECT Little River Lower Dam, Me. DATE September 17, 1979

PROJECT FEATURE Reservoir NAME

AREA EVALUATED	REMARKS
Stability of Shoreline	Upstream-good Downstream-phyllite and [illegible] south abutment eroded. A large flood would wash much of the lower south side away. Not much ground cover.
Sedimentation	Not visible below water surface
Changes in Watershed Runoff Potential	None
Upstream Hazards	None
Downstream Hazards	Filter house-bridge-home past bridge
Alert Facilities	None
Hydrometeorological Gages	Staff gage
Operational & Maintenance Regulations	None posted

APPENDIX B

ENGINEERING DATA

APPLICATION FOR DAM REGISTRATION

Dam Registration Number: 5090
Date Received: DEC 15 1975
Fee Enclosed: 10.00
Quad Sheet Name: Castine
Quad Sheet Number: 11 1C

Location:

County: Waldo

Municipality: Quasi-Municipal Belfast Water District

Name of Dam: Lower Reservoir Dam

Name of Impoundment: Reservoir #1

Ownership:

Name of Owner: Belfast Water District

Name of Agent: (if different from Owner) ____

Address of Owner: 71 Church Street
Belfast, Maine 04915

Address: ____

Telephone Number: 338-1200

Telephone Number: ____

Description of Dam

Type: Arched Concrete

Construction Material: Concrete
(Concrete, wood, earth)

Year Originally built: 1944

Year last major repair: 1968

Height: 25 ft.

Width: 175 ft.

Spillway type: open

Spillway Width: 70 ft.

Impounding Capacity: 57,000,000 gallons
~~(Acre-feet)~~

Drawdown available: 10 (feet)

Fish Passage available?: no

Installed Electrical Generating Cap: ---

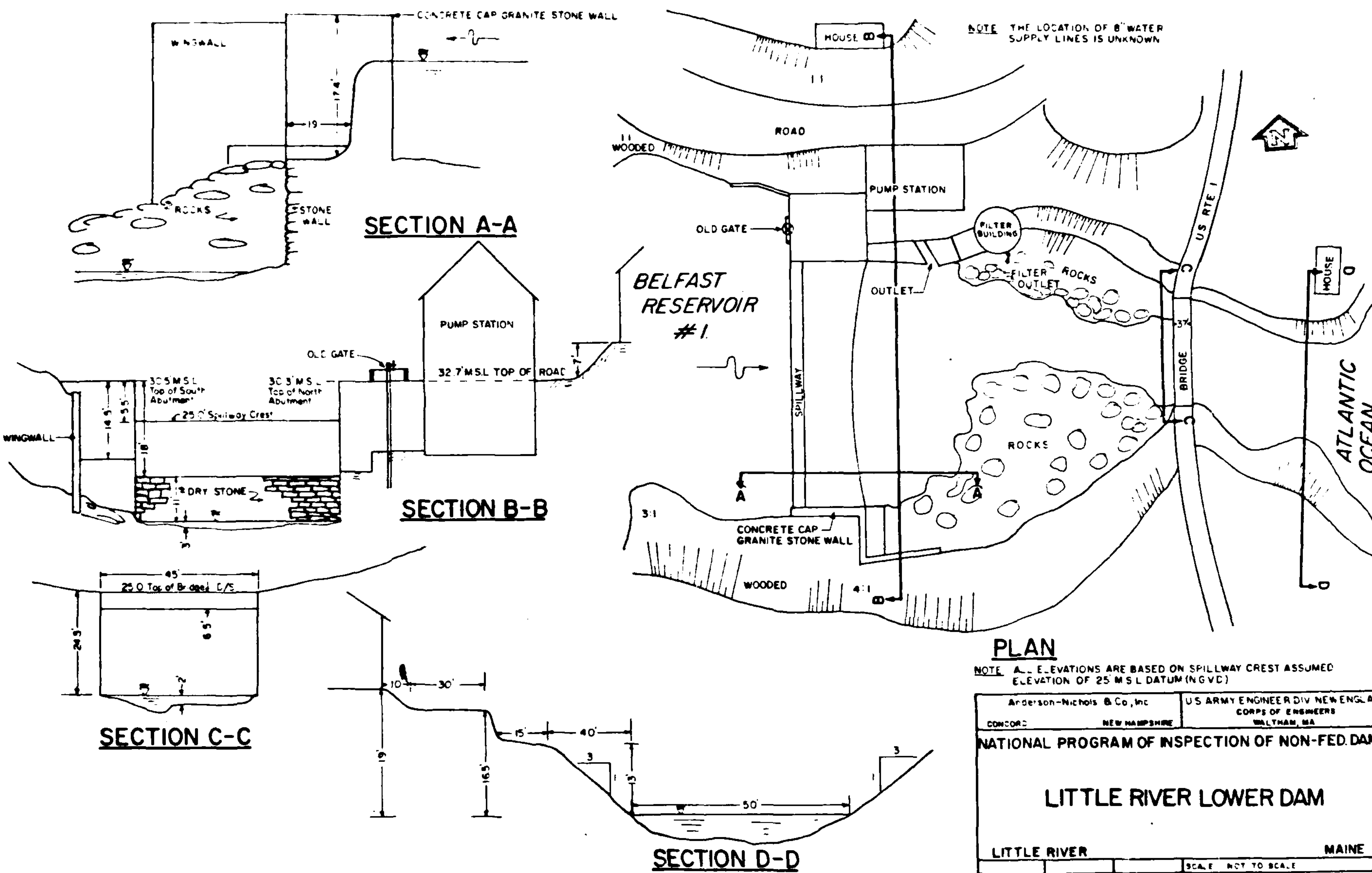
Purposes for which stored water is used: Public drinking supply

Most recent inspection by Qualified Engineer (Date): August 1972

Name and Address of Engineer: Dale E. Caruthers - (Deceased)
Masonic Building, Gorham, Maine 04038

Other Permits applicable: ----

SWCC #14



NOTE ALL ELEVATIONS ARE BASED ON SPILLWAY CREST ASSUMED ELEVATION OF 25' M.S.L. DATUM (N.G.V.D.)

Anderson-Nichols & Co., Inc. CONCORD NEW HAMPSHIRE	US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LITTLE RIVER LOWER DAM

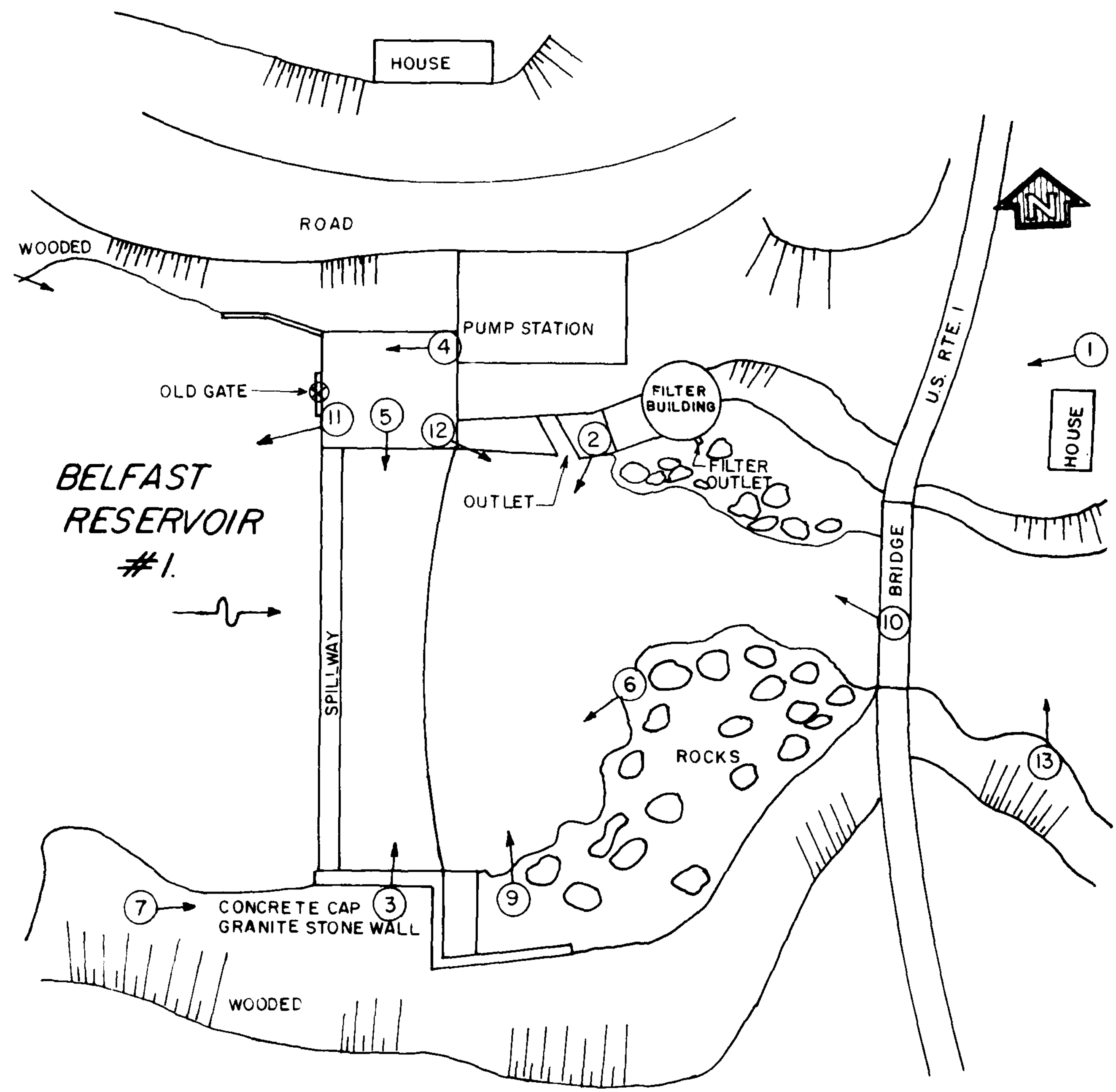
LITTLE RIVER MAINE

SCALE NOT TO SCALE
DATE NOVEMBER 1979

FIGURE B-1

APPENDIX C

PHOTOGRAPHS



Anderson-Nichols & Co., Inc CONCORD NEW HAMPSHIRE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

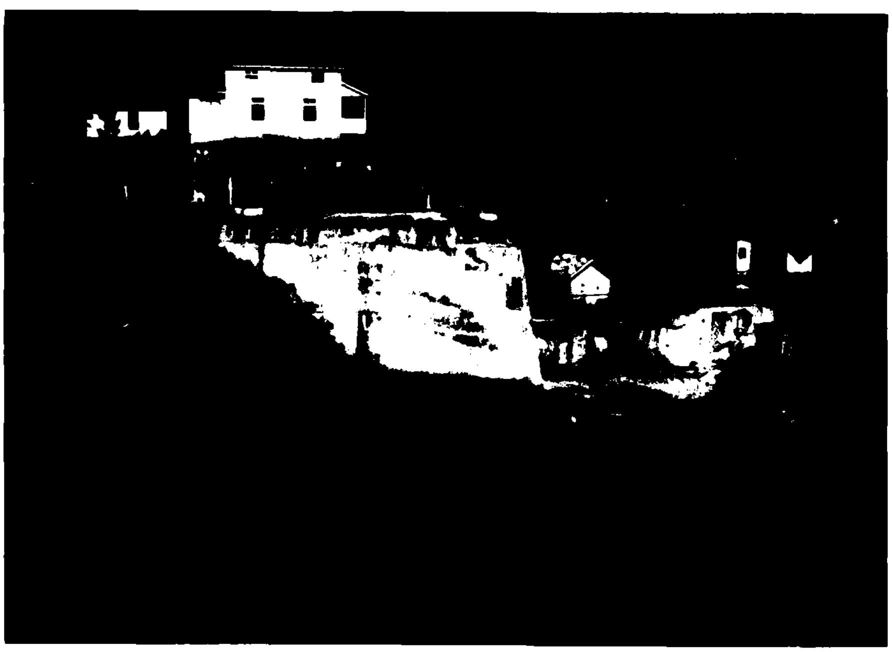
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PHOTO INDEX

LITTLE RIVER MAINE

			SCALE: NOT TO SCALE
			DATE: NOVEMBER 1979

September 17, 1979
Figure 2 - Downstream face of the dam.



September 17, 1979
Figure 3 - Looking across the crest at north abutment.

September 17, 1979
Figure 4 - Gate mechanism at the north abutment.

September 17, 1979
Figure 5 - Looking across the spillway crest at south abutment.

September 17, 1979

Figure 6 - Downstream face of south abutment of the dam. Note bedrock.

September 17, 1979

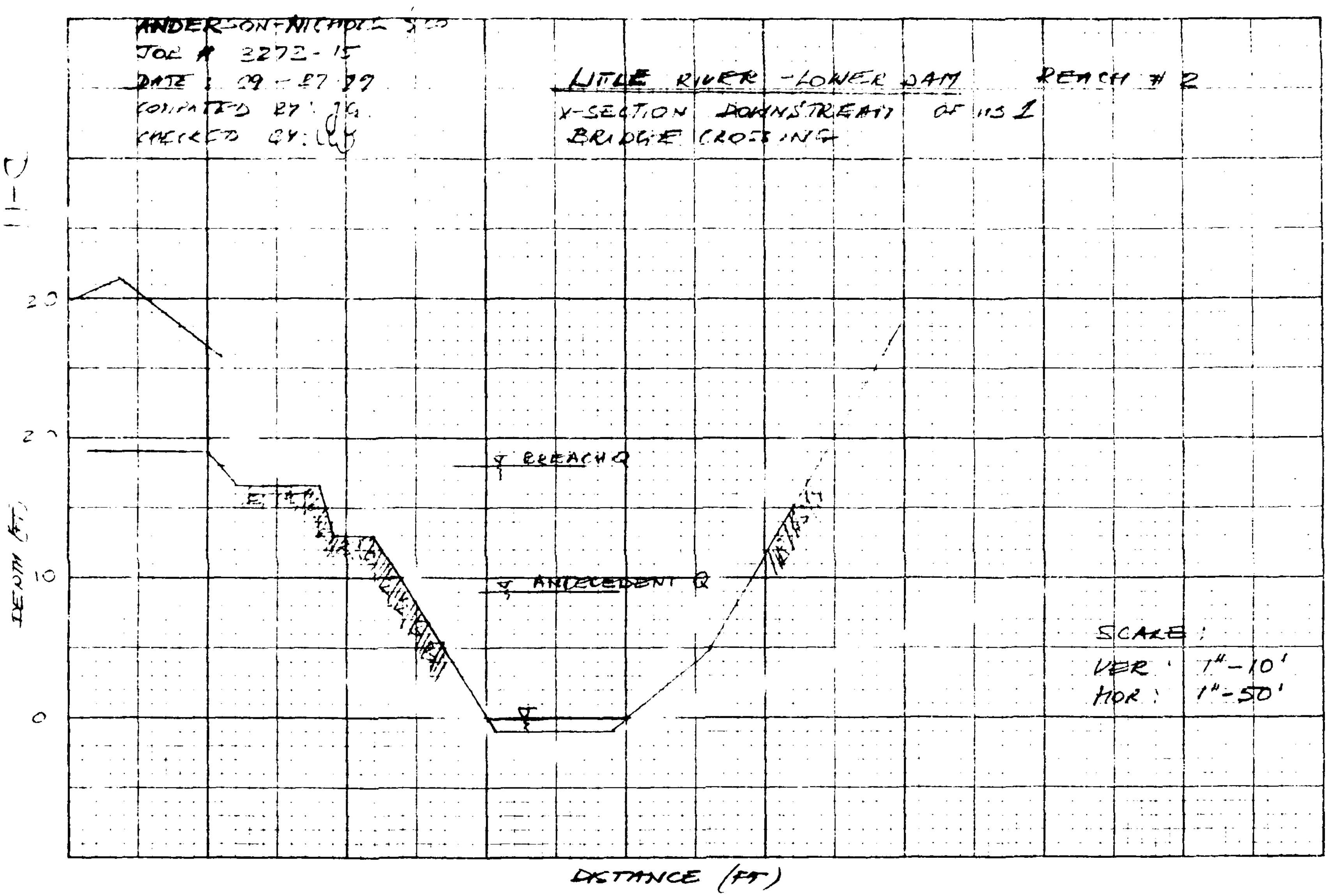
Figure 7 - View of the adjacent earth to the upstream side of south abutment.

September 17, 1979

Figure 8 - View of upstream side of the north abutment.

September 17, 1979

Figure 9 - Dry-stone-masonry wall at north bank of the downstream channel.


ANDERSON-NICHOLS & CO
JOB # 3272-15
DATE: 09-27-79
COMPUTED BY: JG
CHECKED BY:
LITTLE RIVER - LOWER DAM
REACH # 2
X-SECTION DOWNSTREAM OF US 1
BRIDGE CROSSING
BREACH Q
ANTECEDENT Q
SCALE:
VER: 1"-10'
HOR: 1"-50'
DEPTH (FT)
DISTANCE (FT)
0
10
20
30

LITTLE RIVER - LOWER DAM

BREACH ANALYSIS - CONT'D

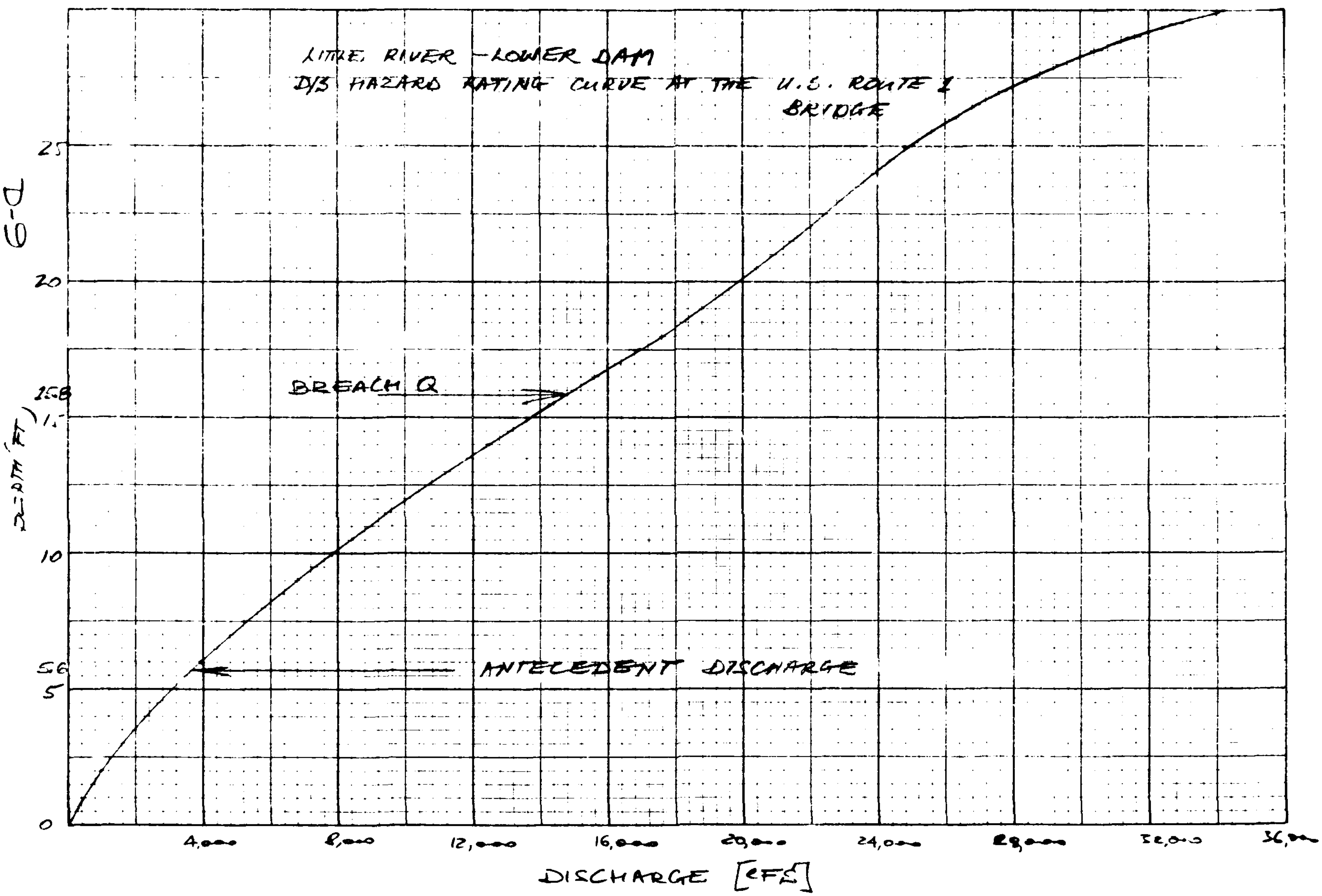
REACH # 2

USE A TYPICAL CROSS SECTION ALONG THE DOWN-STREAM REACH FROM THE BRIDGE (US 1) TO CONFLUENCE WITH ATLANTIC OCEAN FOR A DISTANCE OF 300 FEET.

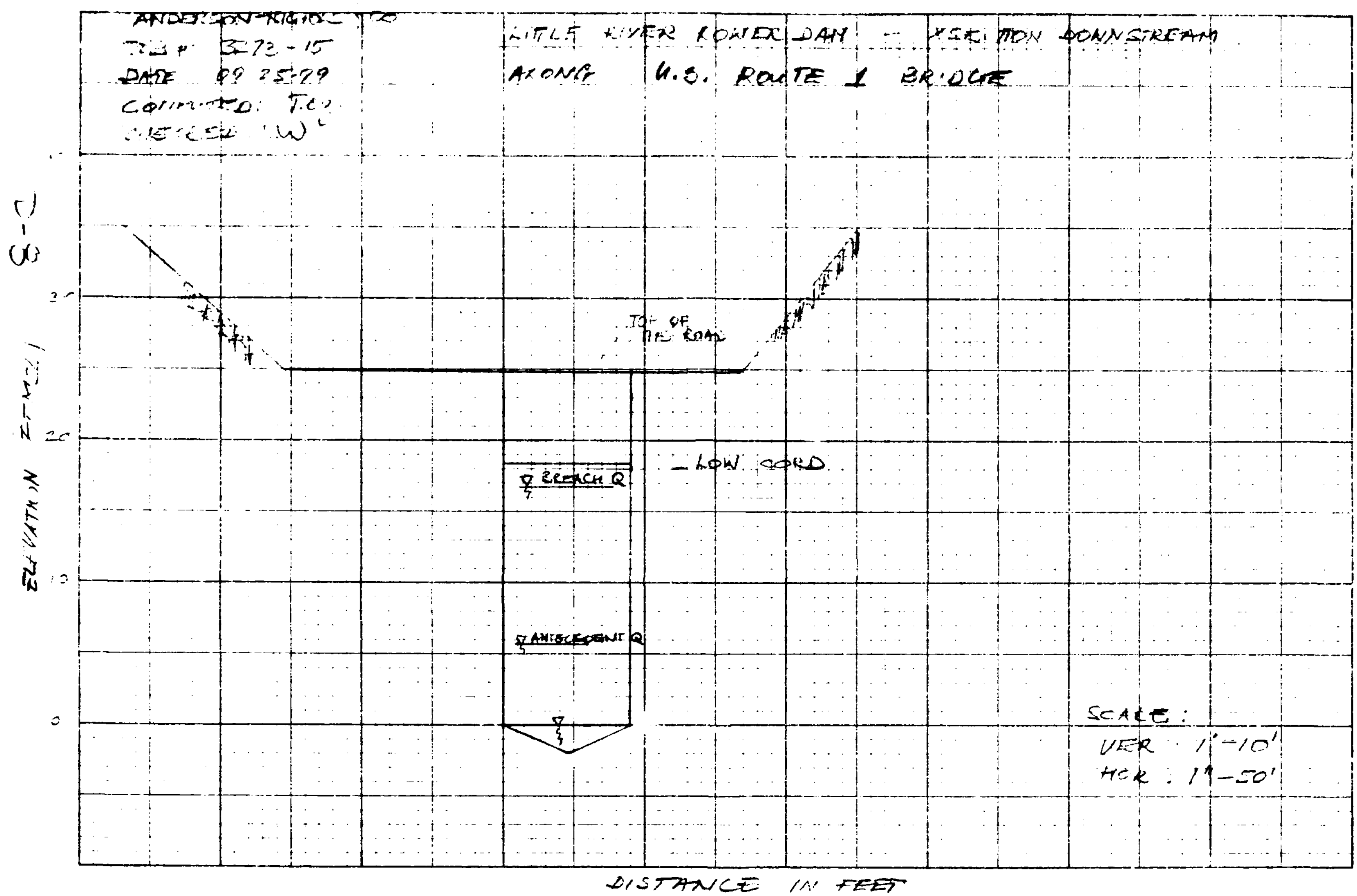
DEVELOP A RATING CURVE FOR THIS SECTION BY USE OF MANNING'S EQUATION: $Q = \frac{1.49}{n} \times A \times R^{2/3} \times S^{1/2}$

n = .05 S = .0025

DEPTH [FT]	AREA	WPER	Q [CFS]
0	0	0	0
4	242	82	736
8	626	111.	2932
12	1113	137.	6618
16	1720	174.	11648
20	2490	226.	18105


LITTLE RIVER - LOWER DAM
D/S HAZARD RATING CURVE AT THE U.S. ROUTE 1 BRIDGE
BREACH Q
ANTECEDENT DISCHARGE
DEPTH (FT)
0
5
5.6
10
15
15.8
20
25
4,000
8,000
12,000
16,000
20,000
24,000
28,000
32,000
36,000
DISCHARGE [CFS]

D-9


ANDERSON-NICHOLS
JOB # 3273-15
DATE 09-25-79
COMPUTED: T.C.
CHECKED: W
LITTLE RIVER LOWER DAM -- X-SECTION DOWNSTREAM
ALONG U.S. ROUTE 1 BRIDGE
30
20
10
0
TOP OF THE ROAD
LOW CORD
BREACH Q
ANTECEDENT Q
SCALE:
VER 1"-10'
HOR 1"-50'
DISTANCE IN FEET
ELEVATION (FT MSL)

D-8

lerson-Nichols & Company, Inc. | Subject: H & H | Sheet No. ____ of ____ | Date: 10-18-79 | Computed: LWJ | Checked:

JOB NO. 3273-16

LITTLE RIVER – LOWER DAM

BREACH ANALYSIS – CONT'D

PRESSURE FLOW – AREA – 855 SQFT   C – .92

ELEV. [FT MSL]	H. [FT]	$Q = AC\sqrt{2gH}$ [CFS]
25.	15.5	24,852
27.	17.5	26,407
30.	20.5	28,580
35.	35.5	37,610

WEIR FLOW – C = 2.8

ELEV. [FT MSL]	L [FT]	H [FT]	$Q = C \cdot L \cdot H^{3/2}$ [CFS]
25.	0	0	0
27.	170	2	1346.
30.	180	5	5635.
35.	200	10	17709.

SUMMARY –

ELEV. [FT MSL]	Q [CFS]
2	1,022
6	3,929
10	7,869
14	12,505
18	17,647
25	24,852
27	27,753
30	34,215
35	55,319

LITTLE RIVER LOWER DAM

BREACH ANALYSIS – CONT'D

DEVELOP A RATING CURVE FOR THE X-SECTION ALONG THE U.S. ROUTE 1 BRIDGE 400 FEET DOWNSTREAM THE DAM

LOW FLOW — "C" VALUES: .015 FOR CONC. WALL
.035 FOR BOTTOM
SLOPE .008

ELEV. (FT MSL)	AREA	[illegible]	Q (CFS)
2	134.9	49.1	1022
6	314.5	57.1	3929
10	494.5	65.1	7,869
14	674.6	73.1	12,505
18	854.9	81.1	17,647

PRESSURE & WEIR FLOW

C-VALUE CALCULATION FOR PRESSURE FLOW:

$K_f = \frac{29 \, n^2 \, L}{R^{4/3}}$

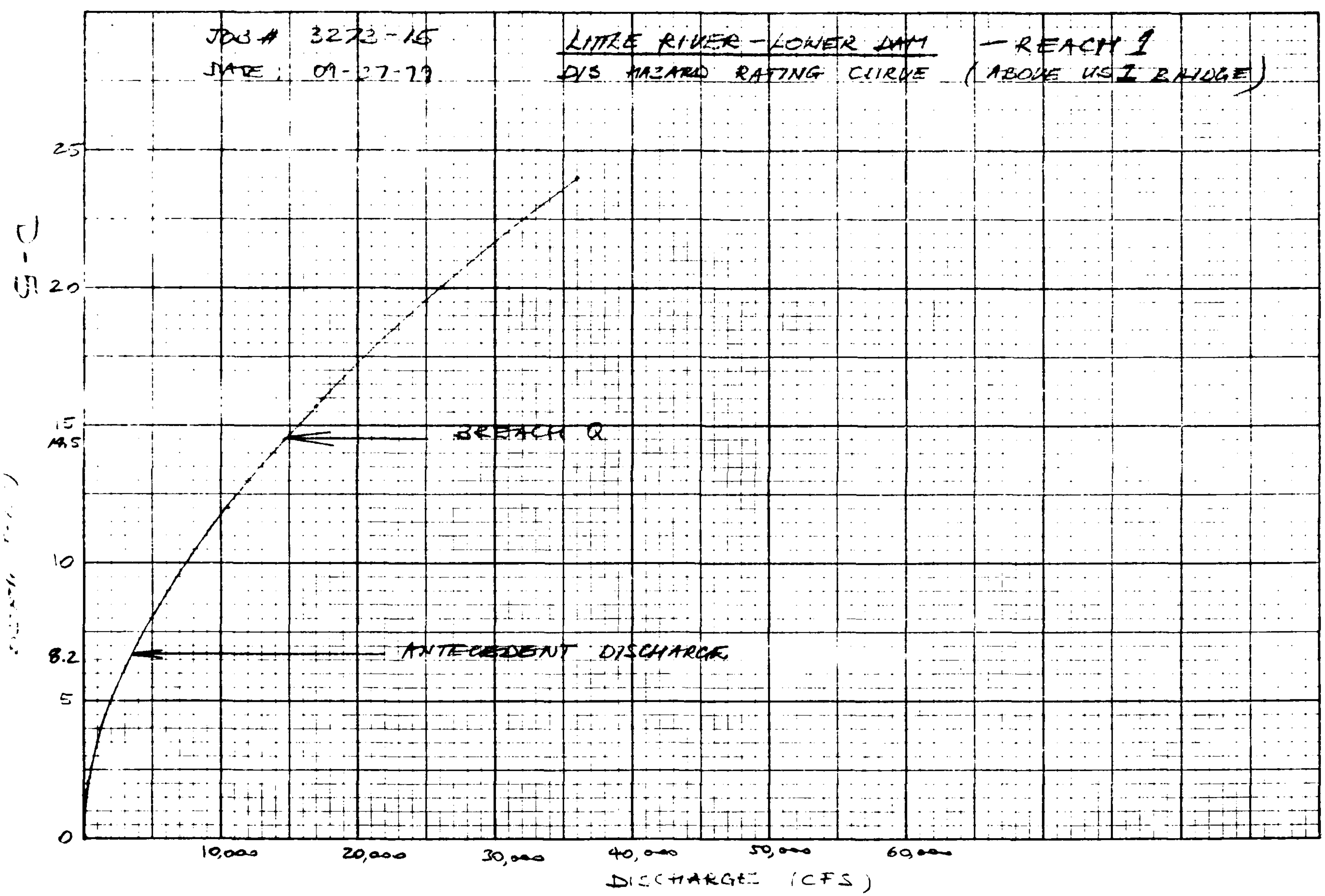
$K_f = \frac{29 \times .032^2 \times 37}{8.[illegible]^{4/3}} = .08$

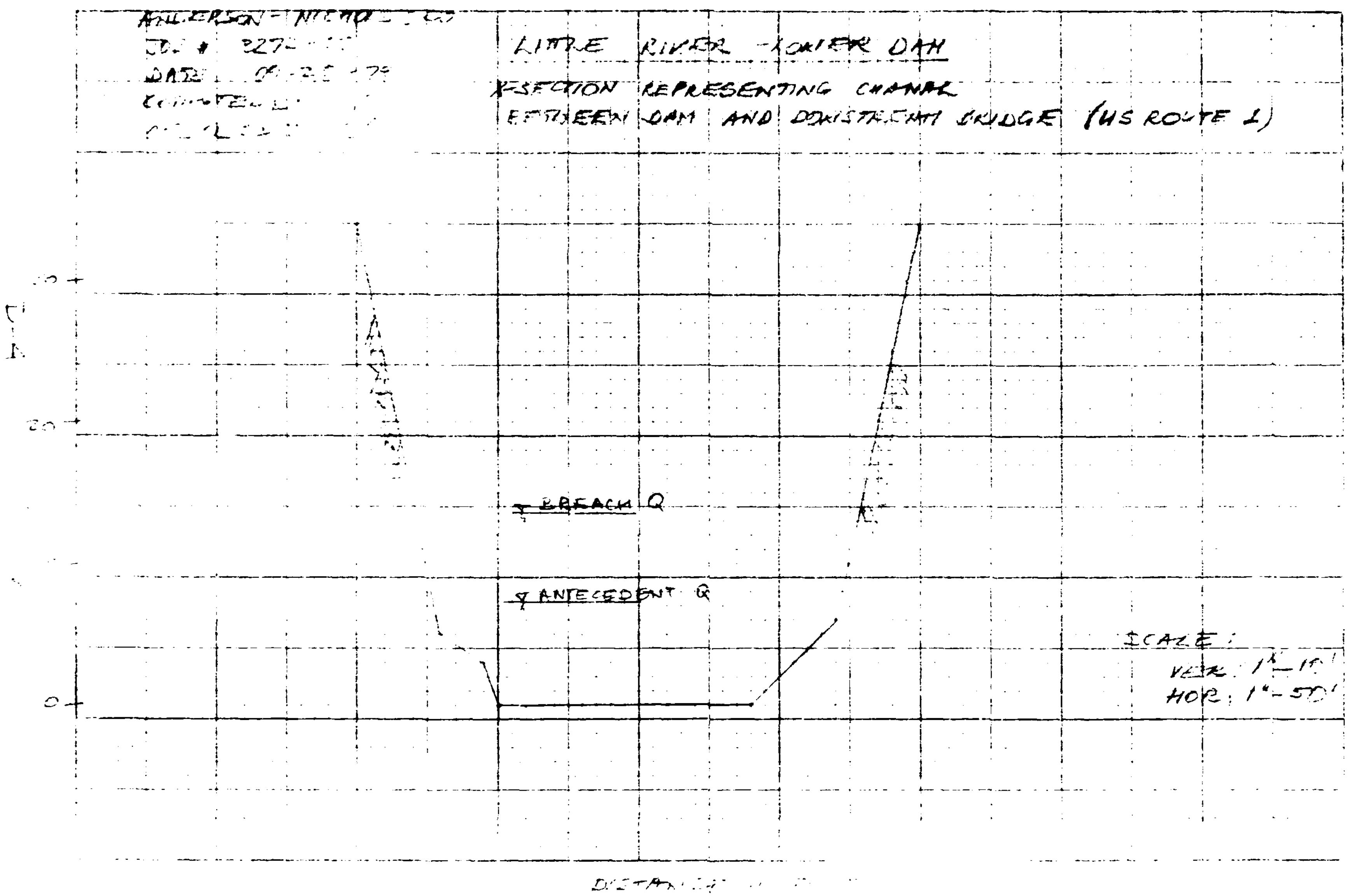
L = LENGTH OF BRIDGE = 37'
n = FOR CONCRETE BRIDGE DIM
EARTH BOTTOM = .032
K = HYDRAULIC [illegible]
INTAKE AND EXIT LOSSES = 1.10

$1.10 + .08 = 1.18$

$K = \frac{1}{C^2} = 1.18$

$C = .92$


JOB # 3273-16
DATE: 09-27-79
LITTLE RIVER - LOWER DAM - REACH 1
D/S HAZARD RATING CURVE (ABOVE US 1 BRIDGE)
BREACH Q
ANTECEDENT DISCHARGE
14.5
8.2
0
5
10
15
20
25
10,000
20,000
30,000
40,000
50,000
60,000
DISCHARGE (CFS)


LITTLE RIVER - LOWER DAM
X-SECTION REPRESENTING CHANNEL
BETWEEN DAM AND DOWNSTREAM BRIDGE (US ROUTE 1)
BREACH Q
ANTECEDENT Q
SCALE:
VER: 1"-10'
HOR: 1"-50'
0

Anderson-Nichols & Company, Inc.

Subject: HJH

Sheet No. ___ of ___
Date: 10-18-79
Computed: ___
Checked: LW

JOB NO. 3273-16

LITTLE RIVER - LOWER DAM

BREACH ANALYSIS - CONT'D

REACH #1

USE A TYPICAL CROSS SECTION ALONG THE DOWNSTREAM REACH FROM THE DAM TO THE U.S. ROUTE 1 BRIDGE FOR A DISTANCE OF 400 FEET

DEVELOP A RATING CURVE FOR THIS SECTION BY USE OF MANNING'S EQUATION $Q = \frac{1.49}{n} \cdot A \cdot R^{2/3} \cdot S^{1/2}$ *

$n = .05 \qquad S = .0025$

DEPTH [FT]	AREA	WPER	Q [CFS]
4	416	124	1,380
8	969	149	4,974
12	1567	160	10,509
16	2199	172	17,605
20	2864	184	26,150
24	3563	195	36,085
28	4295	207	47,378
32	5062	218	60,016

* 'n' - ROUGHNESS COEFFICIENT
A - AREA OF X-SECTION IN SQUARE FEET
R - A/WETTED PERIMETER
S - SLOPE OF REACH

Anderson-Nichols & Company, Inc. Subject: H & H

Sheet No. ___ of ___
Date ___
Computed ___
Checked ___

JOB NO. 3293 . 15 LITTLE RIVER – LOWER DAM

SQUARES IN. SCALE 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

BREACH ANALYSIS

DETERMINE EFFECTS OF BREACH AT TOP OF DAM TO CLASSIFY DOWNSTREAM HAZARD CONDITIONS.

$$Q_p = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2}$$

W_b – BREACH WIDTH

g – 32.2 FT/SEC²

Y_o – POOL ELEV. – [illegible] RIVER BED

W_b = 126 × .4 = 50

ASSUME BREACH [illegible] OCCURS AT TOP OF THE DAM [illegible] [illegible].5

Y_o = 30.3 – 1.3 = 29

Q = 13,129 CFS

Q THROUGH SPILLWAY OTHER THAN WHERE [illegible]

L = 91 – 50 = 41 FT

H = 30.3 – 25 = 5.3 FT

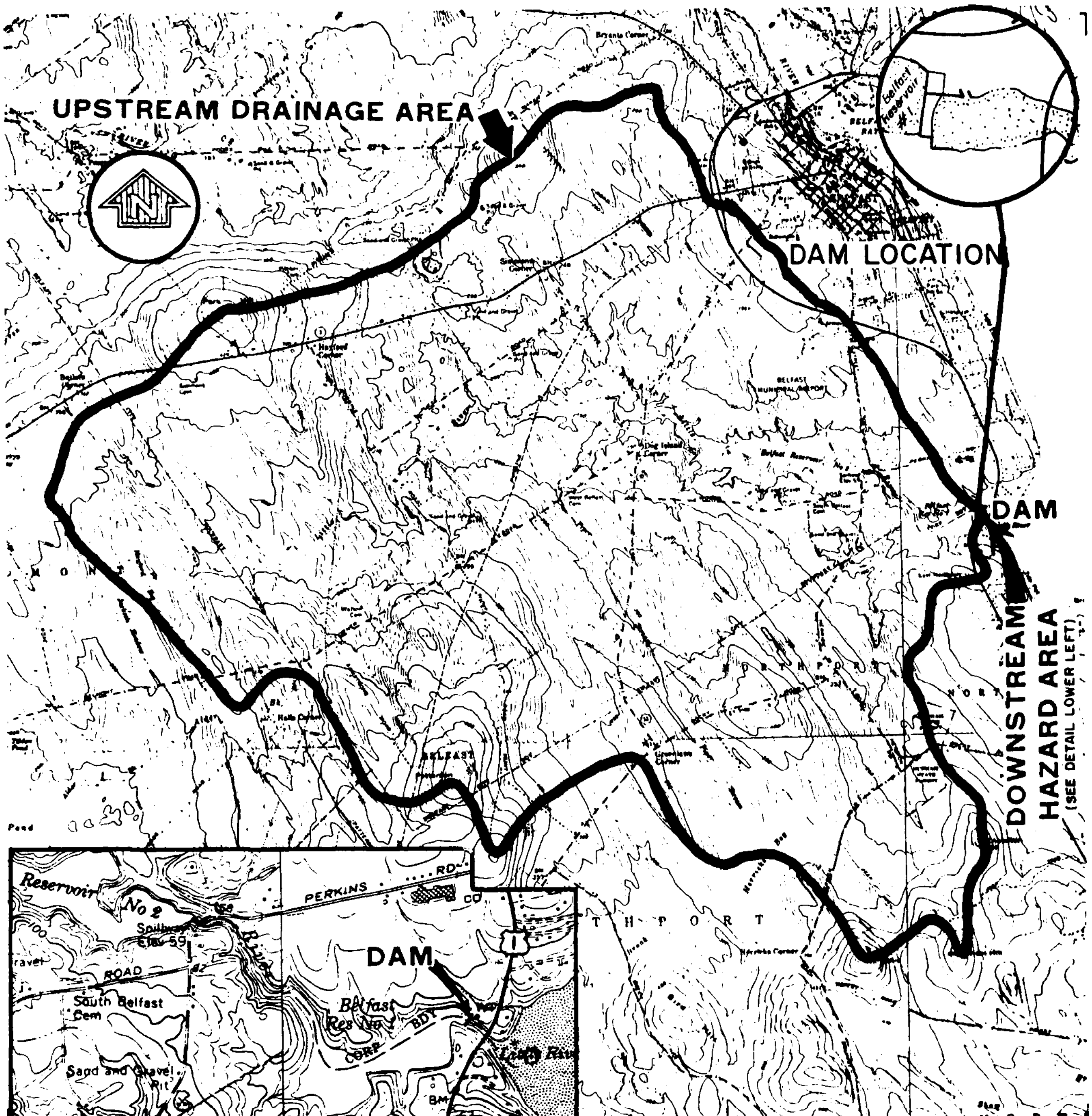
C = 3.3

$Q = C \cdot L \cdot H^{3/2}$ = 1650 CFS

TOTAL BREACH Q = 14,780 CFS

ANTECEDENT DISCHARGE (SPILLWAY CAPACITY AT TOP OF DAM)

$Q = 3.3 \cdot 91 \cdot 5.3^{3/2}$ = 2665 CFS



NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LITTLE RIVER LOWER DAM
BELFAST, MAINE

REGIONAL VICINITY MAP

NOVEMBER 1979

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

ANDERSON-NICHOLS & CO., INC   CONCORD, N.H.

SCALE IN MILES

0 1 2

MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEETS. BELFAST, ME., 1960. REVISED 1973. SEARSPORT, ME., 1973. LINCOLNVILLE, ME., 1960, REVISED 1973. ISLESBORO, ME., 1973.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

September 17, 1979
Figure 12 - Looking downstream at U.S. Route 1 bridge from the north abutment of the dam.

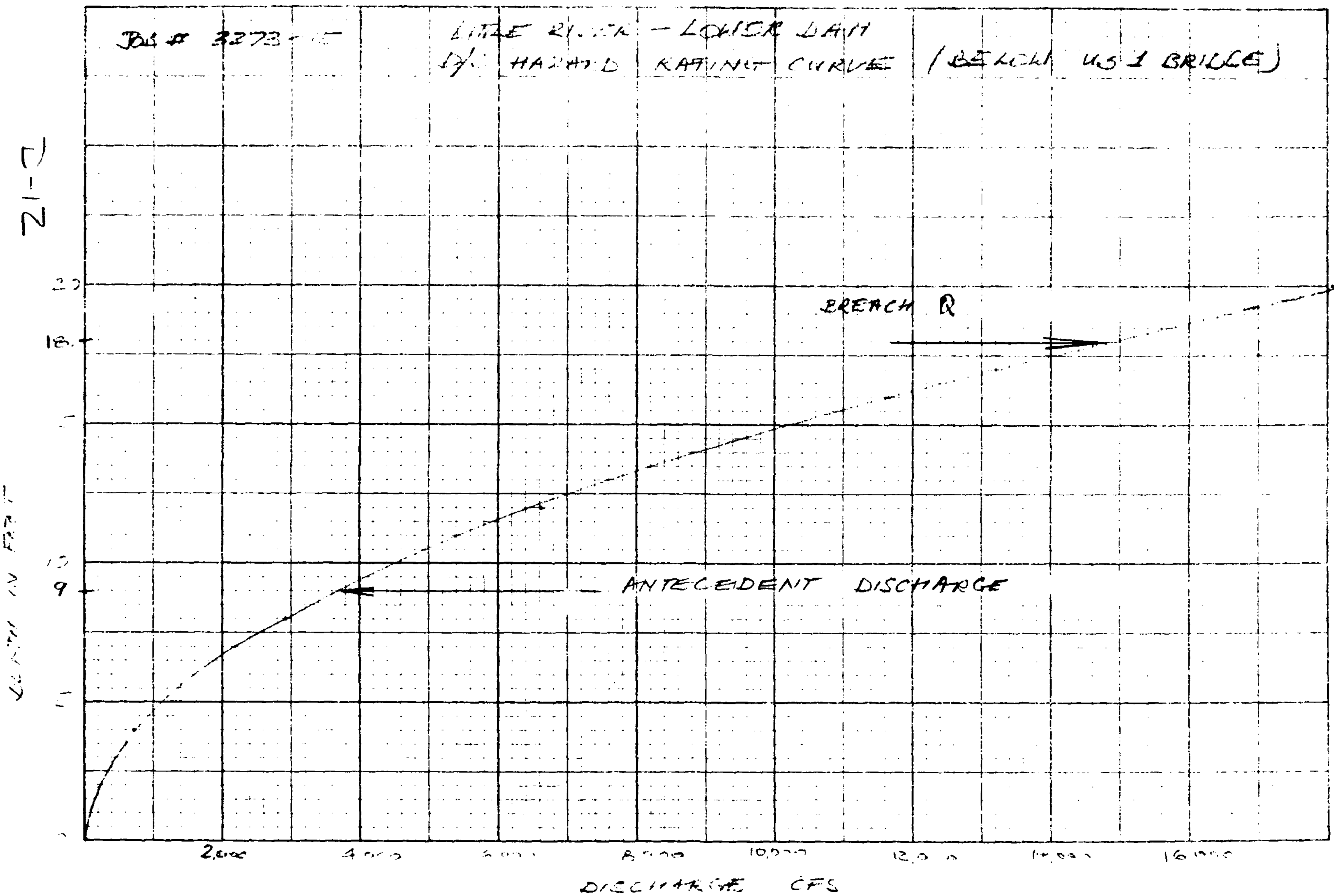
September 17, 1979
Figure 13 - Looking north at downstream channel below the U.S. Route 1 bridge just before confluence with the Atlantic Ocean.

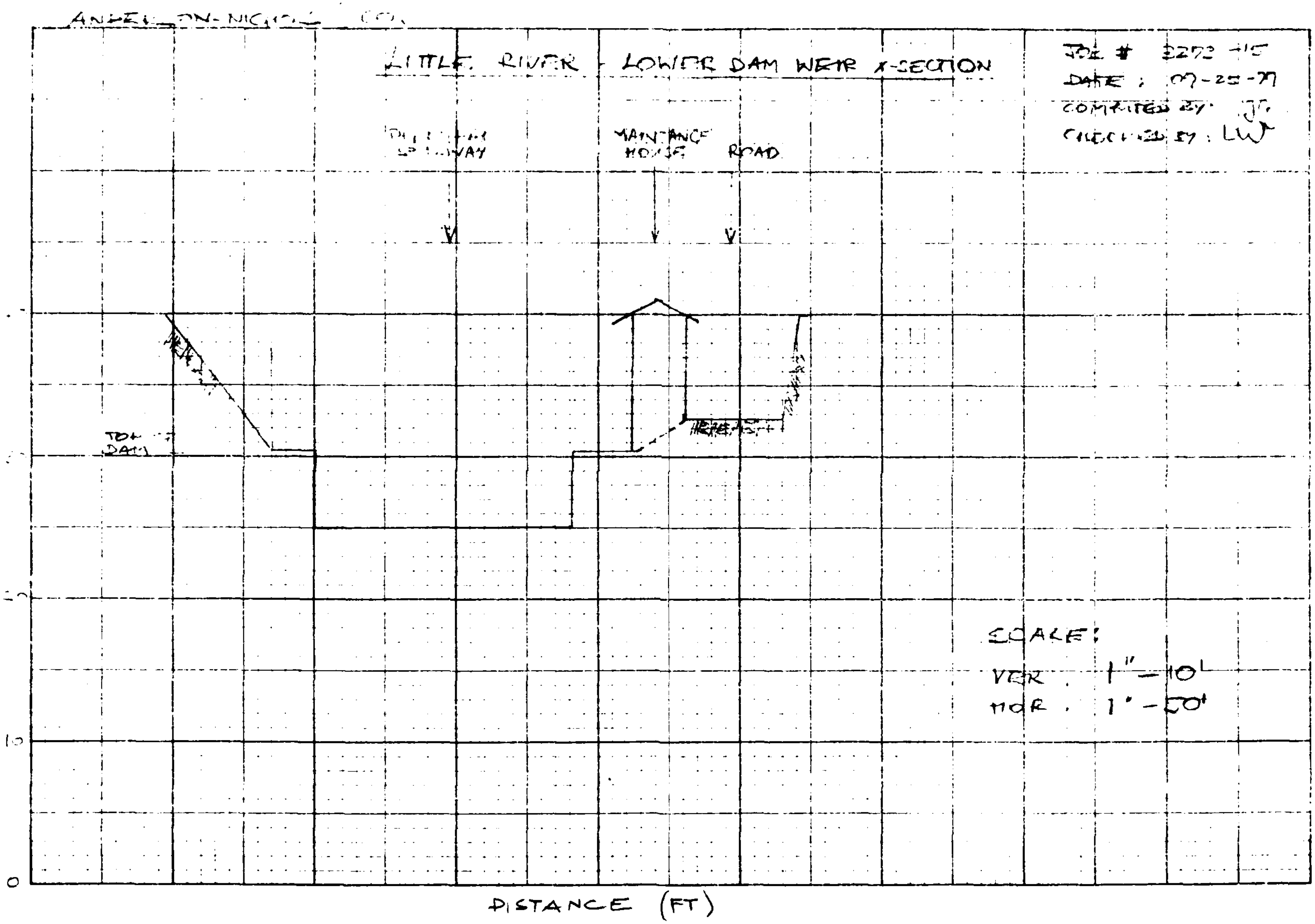
September 17, 1979

Figure 10 - View of the north bank of the downstream channel from the U.S. Route 1 bridge.

September 17, 1979

Figure 11 - Looking upstream at the reservoir from the north abutment.


JOB # 3273
- LOWER DAM
HAZARD RATING CURVE
US 1 BRIDGE)
BREACH Q
ANTECEDENT DISCHARGE
20
18.
9
2,000
10,000
16,000
DISCHARGE CFS


ANDERSON-NICHOLS CO.
LITTLE RIVER - LOWER DAM WEIR X-SECTION
JOB # 3272-15
DATE: 07-25-79
COMPUTED BY: JG
CHECKED BY: LW
MAINTANCE HOUSE
ROAD
TOP OF DAM
SCALE:
VER. 1" = 10'
HOR. 1" = 50'
0
10
DISTANCE (FT)

Anderson-Nichols & Company, Inc.

Subject HSH

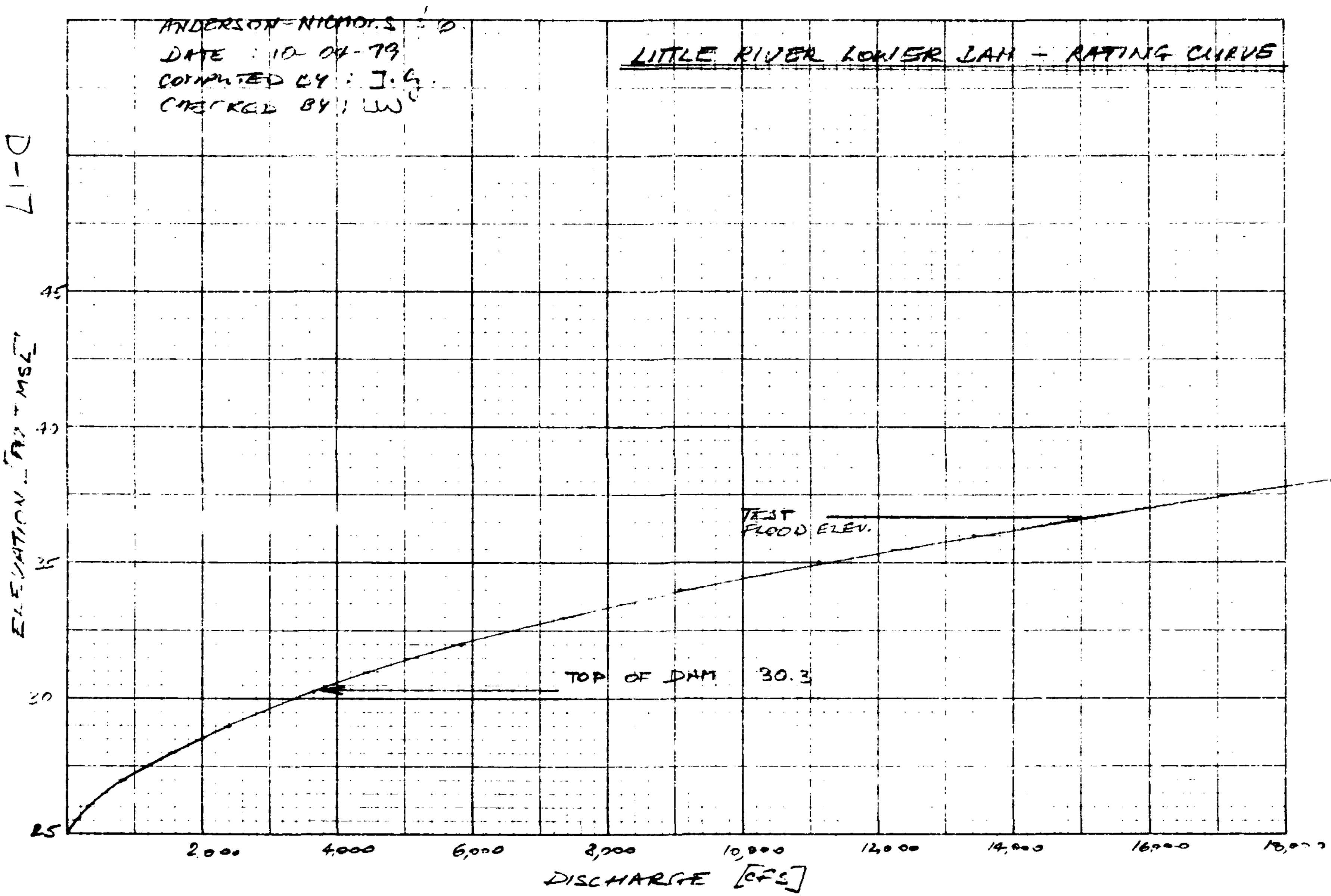
JOB NO. 2272 – 15

Sheet No. ____ of ____
Date 10 [illegible] 79
Computed ____
Checked LW

LITTLE RIVER LOWER DAM – RATING CURVE CALCULATION

	FLOW OVER THE SPILLWAY				FLOW OVER THE TOP OF THE DAM				FLOW OVER THE SIDE SLOPES				TOTAL
ELEV. (FEET)	C VALUE	L (FEET)	H (FEET)	Q (CFS)	C VALUE	L (FEET)	H (FEET)	Q (CFS)	C VALUE	L (FEET)	H (FEET)	Q (CFS)	Q (CFS)
25	3.3	91.	0										0.
26		91	1	300.									300.
27		91	2	850.									850.
28		91	[illegible]	1560.									1560.
29		[illegible]	4	[illegible]									2400.
TOP OF DAM 30		[illegible]	[illegible]	[illegible]									3665.
[illegible]		[illegible]	[illegible]	[illegible]	3.0	37.5	0.7	66.					4480.
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	37.5	1.7	[illegible]	2.6	3	1.7	10.	5830
33.		[illegible]	[illegible]	[illegible]	[illegible]	37.5	[illegible]	[illegible]	[illegible]	5	2.4	52	7330.
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	37.5	[illegible]	801.	[illegible]	40	1.3	165	9080
[illegible]		[illegible]	10	[illegible]	[illegible]	37.5	[illegible]	1116.	[illegible]	50	2.2	488.	11130.
[illegible]		91	[illegible]	[illegible]		37.5	[illegible]	1520.	[illegible]	55	3.2	972.	13410.
[illegible]		91	[illegible]	[illegible]483		37.5	[illegible]	1951.	[illegible]	60	4.2	1498.	15930.
38		[illegible]	12	[illegible]		37.5	7.7	2404.	[illegible]	65	5.2	2320.	18670
39		91	14	15730		37.5	8.7	2887.		70	6.2	3099	21716.

$Q = CLH^{3/2}$



ANDERSON-NICHOLS & CO.
DATE : 10-04-79
COMPUTED BY : J.G.
CHECKED BY : LW
LITTLE RIVER LOWER DAM - RATING CURVE
TEST FLOOD ELEV.
TOP OF DAM 30.3
ELEVATION [FT - MSL]
25
30
35
40
45
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
DISCHARGE [CFS]

derson-Nichols & Company, Inc.

Subject H-11

Sheet No. ___ of ___
Date ___ 79
Computed ___
Checked ___

JOB NO. 2273-[illegible]

LITTLE [illegible] [illegible] DAM

STORAGE - [illegible] CURVE CALCULATION

NORMAL STORAGE (SPILLWAY CREST - 20[illegible] FT MSL) — 3[illegible] AC.-FT.

NOTE: 3[illegible]0 AC-FT WAS OBTAINED BY ESTIMATING AVERAGE DEPTH OF RESERVOIR — 10 FEET AND PLANIMETERING SURFACE OF RESERVOIR FROM QUAD SHEET — 3[illegible] AC. 1[illegible] AC-FT (5[illegible] MIL GAL) LISTED AS IMPOUNDING CAPACITY IN APPLICATION FOR DAM REGISTRATION (SEE APPENDIX B) IS NOT REASONABLE.

USING "FRUSTRUM OF PYRAMID [illegible]" AND PLANIMETERED SURFACE AREAS, DEVELOP POINTS FOR A STORAGE - ELEVATION CURVE.

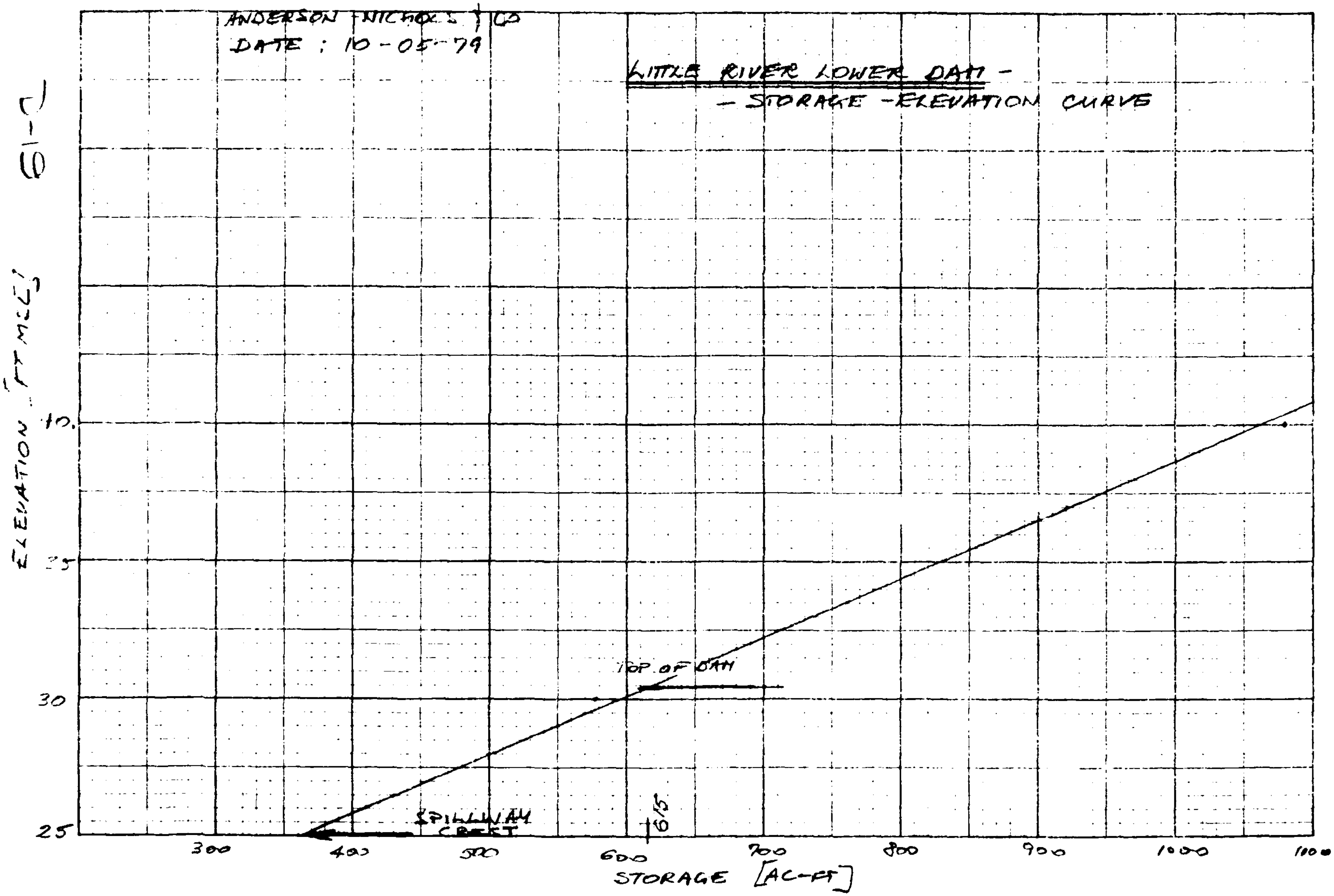
$$V = \frac{h}{3}\left(b_1 + b_2 + \sqrt{b_1 b_2}\right)$$

h - ELEV. ABOVE NORMAL POOL
b_1 - NORMAL POOL SURFACE
b_2 - ENLARGED POOL SURFACE

[illegible] ELEV. [illegible] FEET MSL
SURFACE AREA — 46 AC
$V = \frac{1}{3}[illegible](3[illegible] + 46 + \sqrt{3[illegible] \cdot 46})$ = 70[illegible] AC-FT
TOTAL STORAGE — [illegible] AC FT

[illegible] ELEV. [illegible] MSL
SURFACE AREA — 55 AC
$V = \frac{1}{3}\,10(46 + 55 + \sqrt{46 \cdot 55})$ = 504 AC-FT
TOTAL STORAGE — 1081 AC-FT

D-18


ANDERSON-NICHOLS & CO
DATE: 10-05-79
LITTLE RIVER LOWER DAM -
- STORAGE - ELEVATION CURVE
TOP OF DAM
SPILLWAY CREST
615
ELEVATION [FT MSL]
40
35
30
25
300
400
500
600
700
800
900
1000
1100
STORAGE [AC-FT]

LITTLE RIVER – LOWER DAM

STEP # 2a

DETERMINE SURCHARGE HEIGHT TO PASS Q_{p_1} of 15,920. TO OBTAIN THIS, A DISCHARGE RATING CURVE MUST BE CALCULATED FOR LOWER RESERVOIR DAM. OUTFLOW WOULD OCCUR FIRST OVER THE PRINCIPAL SPILLWAY. HIGHER FLOOD WATERS WILL FLOW OVER THE DAM EMBANKMENTS AND SIDE SLOPES. SIZE OF EMERGENCY GATE IS UNKNOWN AND HAS NOT BEEN OPENED FOR 20 YEARS. THEREFORE FLOW THROUGH GATE WILL NOT BE INCLUDED IN CALCULATIONS. OUTFLOW THROUGH WATER SUPPLY PUMP WHICH AVERAGES DAILY 275 GPM IS INSIGNIFICANT TO STUDY.

$$Q_{p_1} = 15{,}920 \text{ CFS} \Longrightarrow 37.0 \text{ FT MSL}$$

STEP # 2b

DETERMINE VOLUME OF SURCHARGE IN INCHES OF RUNOFF

$$Q_{p_1} = 15{,}920 \text{ CFS} \longrightarrow 37.0 \text{ FT MSL}$$

STORAGE AT 37.0 FT MSL ⟶ 920 AC-FT

STORAGE AT 25.0 FT MSL (SPILLWAY CREST) ⟶ 370 AC-FT

$$550 \text{ AC-FT} \times \frac{1}{16.5 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} \times 12 \frac{\text{IN}}{\text{FT}} = .61'' \text{ RUNOFF}$$

(STOR 1)

STEP # 2c

$$Q_{p2} = Q_{p_1} \times \left(1 - \frac{\text{STOR 1}}{9.5''}\right)$$

$$Q_{p2} = 15{,}920 \text{ CFS} \times \left(1 - \frac{.61''}{9.5''}\right) = \underline{14{,}900 \text{ CFS}}$$

LITTLE RIVER - LOWER DAM

STEP # 3a

DETERMINE SURCHARGE HEIGHT TO PASS Q_{P2}

Q_{P2} = 14,900 CFS → 36.6 FT MSL → 900 AC-FT

$$530 \text{ AC-FT} \times \frac{1}{16.8 \text{ MI}^2} \times \frac{1 \text{ MI}^2}{640 \text{ AC}} \times 12 \frac{\text{IN}}{\text{FT}} = .59'' \text{ RUNOFF}$$

(STOR 2)

STEP # 3b

AVERAGE STOR 1 & STOR 2

$$\frac{.61'' + .59''}{2} = .60'' \text{ RUNOFF}$$

$$.60'' \times \frac{16.8 \text{ MI}^2}{1} \times \frac{640 \text{ AC}}{1} \times \frac{1}{12} \frac{\text{FT}}{\text{IN}} = 538 \text{ AC-FT}$$

538 AC-FT + 370 = 908 AC-FT

908 AC-FT → 36.7 FT MSL ⇒ 15,000 CFS

TEST FLOOD — ½ PMF

TEST FLOOD DISCHARGE — 15,000 CFS (@ 36.7' MSL)

TOP OF DAM — 30.3 (FT MSL) THEREFORE DAM EMBANKMENT WOULD BE OVERTOPPED BY ABOUT 6.4 FT DURING TEST FLOOD CONDITIONS.

TOP OF DAM — 30.3 FT MSL — STORAGE 615 AC-FT.

SPILLWAY CAPACITY @ TOP OF DAM IS 3665 CFS WHICH IS EQUIVALENT TO 24 PERCENT OF THE TEST FLOOD.

APPENDIX E

INFORMATION AS
CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR
ME	2??	NED	ME	027	01				LITTLE RIVER LOWER DAM	4427.7	6859.4	05NOV79

POPULAR NAME	NAME OF IMPOUNDMENT
LOWER DAM	BELFAST RESERVOIR NUMBER 1

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI)	POPULATION
01	03	LITTLE RIVER	NORTHPORT	1	1000

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE FT)	NORMAL (ACRE FT)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
CTRGOT	1943	S	31	30	615	370	NED	N	N	N	N	

REMARKS

21-DOWNSTREAM STONE WALL

D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT)	MAXIMUM DISCHARGE (FT)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NO	NAVIGATION LOCKS LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
2	126	U	91	3665												

OWNER	ENGINEERING BY	CONSTRUCTION BY
BELFAST WATER DISTRICT		

REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE DAY MO YR	AUTHORITY FOR INSPECTION
ANDERSON-NICHOLS + COMPANY INC	17SEP79	PL 92-367

REMARKS

END

FILMED

8-85

DTIC

WRIGHT-PIERCE

Engineering a Better Environment