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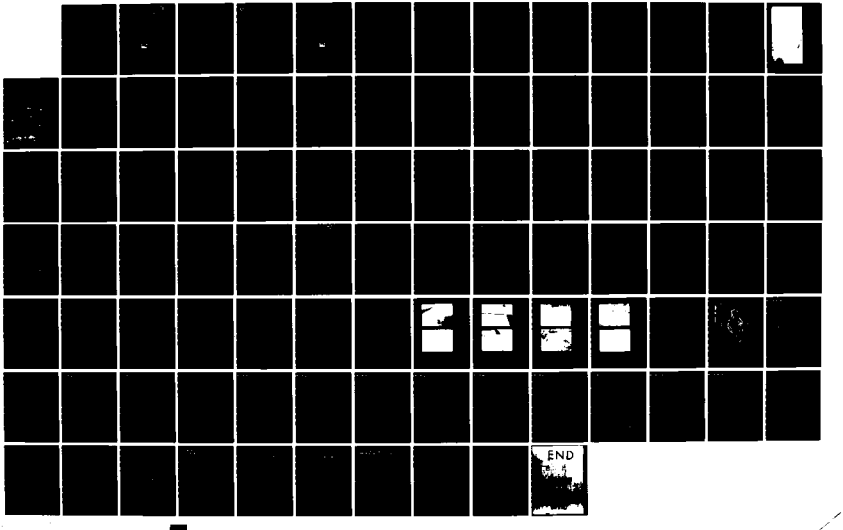

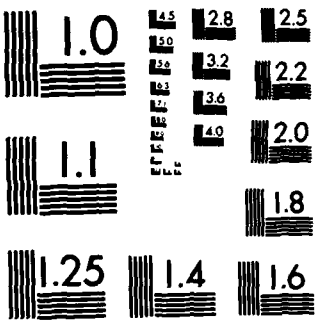

CONNECTICUT RIVER BASIN

HEBRON, CONNECTICUT

AMSTON LAKE DAM

CT 00544

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

JUNE 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Amston Lake Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
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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,

Connecticut River Basin
Hebron, Connecticut

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

The dam is an earth embankment approximately 10 feet wide at the top and 400 feet long with the top approximately 10 feet above the streambed of an unnamed tributary to Raymond Brook. Based upon the visual inspection at the site and past performance, the dam is judged to be in poor condition. Based upon the size (Intermediate) and hazard classification (Significant) of the dam, the test flood will be equivalent to ½ the PMF.

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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

DEC 5 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

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

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, the Amston Lake Company.

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

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

Sincerely,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

CONNECTICUT RIVER BASIN

HEBRON, CONNECTICUT

AMSTON LAKE DAM

CT 00544

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

JUNE 1979

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	AMSTON LAKE DAM
Inventory Number:	CT 00544
State Located:	CONNECTICUT
County Located:	TOLLAND
Town Located:	HEBRON
Stream:	TRIBUTARY TO RAYMOND BROOK
Owner:	THE AMSTON LAKE COMPANY
Date of Inspection:	APRIL 5, 1979
Inspection Team:	CALVIN GOLDSMITH
	PETER HEYNEN, P.E.
	THEODORE STEVENS
	GONZALO CASTRO, P.E.

The dam is an earth embankment approximately 10 feet wide at the top and 400 feet long with the top approximately 10 feet above the streambed of an unnamed tributary to Raymond Brook. A central portion of the earth dam is comprised of a high area of natural ground to within a horizontal distance of 20 feet from the left spillway abutment. The spillway is a 15 foot long broad crested concrete weir of trapezoidal cross-section with vertical concrete training walls. The low level outlet is an approximately 1 foot square conduit through the spillway section. The flow through the conduit is regulated by a hand operated submerged gate mechanism adjacent to the upstream face of the spillway section.

Based upon the visual inspection at the site and past performance, the dam is judged to be in poor condition. There was erosion evident on the upstream slope and crest of the dam, as well as numerous footpaths on the downstream slope. There were also significant amounts of seepage observed on the downstream slope and along the downstream toe of the dam. Other deficiencies include trees and brush on the dam embankment and a low beach area adjacent to the left end of the dam.

Based upon the size (Intermediate) and hazard classification (Significant) of the dam in accordance with Corps of Engineers Guidelines, the test flood will be equivalent to one-half the Probable Maximum Flood (PMF). Peak inflow to the reservoir is 1200 cfs; peak outflow is 160 cfs with the dam maintaining a 0.2 foot freeboard.

Based upon hydraulics computations, the spillway capacity is 180 cfs which is equivalent to 113 percent of the routed Test Flood outflow. It should be noted that the above figures assume the low area at the left end of the dam to be raised to the top of the dam. An analysis of the hydraulic conditions as they exist is presented in Appendix D and summarized in Section 5 of this report.

It is recommended that further studies be undertaken by a registered professional engineer qualified in dam design and inspection to prepare plans and specifications to raise the low area adjacent to the left end of the dam.

The engineer should also investigate the origin and significance of the seepage along the downstream slope with respect to the composition and foundation materials of the dam. Recommendations should be made for the control or elimination of the seeps, as well as for a program of follow-up monitoring of seepage.

The above recommendations, and any further remedial measures, as discussed in Section 7, should be instituted within one year of the owner's receipt of this report, with the exception of the seepage investigation which should be initiated immediately upon the owner's receipt of this report.

Peter M. Heynen

Peter M. Heynen, P.E.
Project Manager
Cahn Engineers, Inc.

STATE OF CONNECTICUT
PETER M. HEYNEN
NO. 9618
REGISTERED
PROFESSIONAL ENGINEER

Edgar B. Vinal, Jr.

Edgar B. Vinal, Jr. P.E.
Senior Vice President
Cahn Engineers, Inc.

STATE OF CONNECTICUT
EDGAR B. VINAL, JR.
No. 4198
REGISTERED
PROFESSIONAL ENGINEER

This Phase I Inspection Report on Amston Lake 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.

Joseph A. McElroy

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. 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 would necessarily represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions there of. 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 neccessarily 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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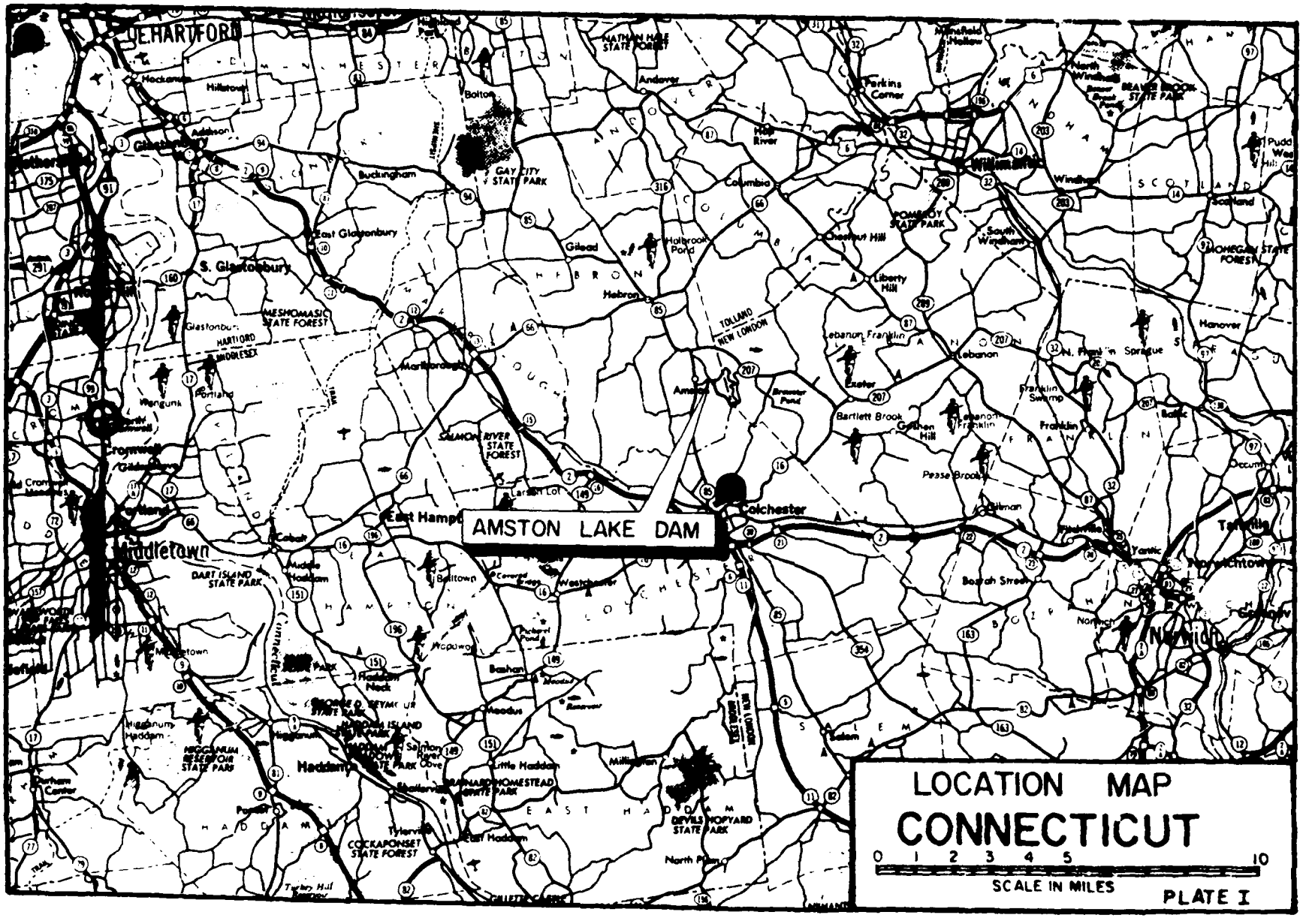
APPENDICES

OVERVIEW PHOTO
(MARCH, 1979)

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	AMSTON LAKE DAM	HEBRON	DATE June, '79
CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED DAMS	TR - RAYMOND BROOK	CONNECTICUT	CE # 27 595 KB PAGE viii


E. HARTFORD
AMSTON LAKE DAM
Middletown
Colchester
S. Glastonbury
East Hampton
Norwich
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5 10
SCALE IN MILES
PLATE I

PHASE I INSPECTION REPORT

AMSTON LAKE DAM

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of November 28, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW 33-79-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dam.

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

c. Scope of Inspection Pogram - The scope of this Phase I inspection report includes:

1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required

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

1.2 DESCRIPTION OF PROJECT

a. Location - The dam is located on an unnamed tributary to Raymond Brook in a rural area of the town of Hebron, County of Tolland, State of Connecticut. The dam is shown on the Columbia USGS Quadrangle Map having coordinates latitude N 41°37.6' and longitude W 72°20.1'.

b. Description of Dam and Appurtenances - The 400 foot long dam is an earth embankment, the top of which at elevation 526.5, is approximately 10 feet above the streambed of an unnamed tributary to Raymond Brook. Near the center of the dam is an area of high ground which, in effect, separates the dam into two sections which arch concavely with respect to the lake to form a continuous curved shoreline. Riprap is virtually absent from the upstream slope of the dam, rendering it highly susceptible to wave erosion. Trees are growing on the crest and two rather extensive swales have developed along the upstream slope. The crest of the dam, typically 10 feet wide, is covered with sand and is used extensively as a footpath, thus giving it a rather uneven surface. The downstream slope is covered with very thick, thorny underbrush. Many large trees are growing at the toe of the slope forming an extensive root mat from which a large amount of seepage is emanating. The concrete spillway section, located at the center of the right section of the dam, is 15 feet in length and has a crest elevation of 524. The low level outlet at invert elevation 518.5 is located directly beneath the spillway with a submerged gate mechanism adjacent to the vertical upstream face of the spillway. The dam has been in its present configuration since 1963 when the downstream slope was extended on a 3 to 1 inclination beyond a dry laid stone retaining wall which was previously at the toe of the dam. Gravel fill was used in this construction, which included raising the top of the dam to a uniform elevation 2.5 feet above the spillway crest and refinishing the upstream slope at a 2 to 1 grade. It is not known if the dam contains a corewall, nor is it known upon what the embankments or spillway section are founded.

c. Size Classification - INTERMEDIATE - The dam impounds 1200 acre - feet of water with the lake level at the top of the dam, which at elevation 526.5, is 10 feet above the streambed. According to the Recommended Guidelines, this dam is classified as intermediate in size.

d. Hazard Classification - SIGNIFICANT - The dam is located approximately one-half mile upstream from two low-lying houses, near Route 85 and adjacent to the stream. Should the dam breach there is potential for loss of life at these downstream residences.

e. Ownership - The Amston Lake Company
Amston Lake, Connecticut, 06231
Mr. Murray Ostraeger (203) 537-1805

According to the present owner, the dam was originally built to supply water to mills downstream and owned by a P.W. Turner. Turner named the lake "North Pond" and the area was known as "Turnerville". Subsequently Max Aimes took ownership of the dam, renaming the Lake "Amston Lake". Eventually the present owner, the Amston Lake Company, an affiliate of the now defunct Ron-Day Company, took control of the dam and surrounding area.

f. Operator - None. There are no daily operations of the dam which is normally unattended.

g. Purpose of Dam - Recreational

h. Design and Construction History - The following information is believed to be accurate based on the available plans and correspondence, which are included in Appendix B.

The dam was originally constructed in 1910, however nothing is known of the engineering or method of construction of the original dam. From its condition, the concrete spillway section appears to post-date the original dam construction, but apparently, was installed at some time prior to 1934 when H.E. Daggett, Civil Engineer from Meriden, Connecticut surveyed the area below and including the dam, and on a drawing dated July, 1934 depicted the spillway as it presently exists. Further, in 1945, B.H. Palmer of Chandler and Palmer Engineers of Norwich, Connecticut inspected the dam and, in a letter of June 28, 1945 (Appendix B-4) described the spillway as it now appears. Palmer also noted the existence of substantial seepage through the dam and suggested some possible

corrective measures, however no action was taken at that time. In 1963, John J. Mozzochi and Associates inspected the dam for the State of Connecticut, Water Resources Commission (B-6). Based upon Mozzochi's recommendations the Commission found the dam to be unsafe and ordered that it be repaired by the Amston Lake Company (B-7). Plans and specifications for repairs to the dam were prepared by B.H. Palmer of Chandler and Palmer and construction work was done by Seymour Adelman of Fitchville, Connecticut. The work consisted of the removal of brush and trees from the embankment and the repair of the embankments with material which was specified as "good earth and gravel with a minimum of large stones" (B-10) and shown on the drawings simply as "gravel fill". The repairs entailed raising the embankment to a level 30 inches above the spillway crest while grading the downstream slope to 3 horizontal to 1 vertical, and the upstream slope to 2 horizontal to 1 vertical. It was necessary to remove portions of the top of the dry-laid stone retaining wall to establish the desired downstream slope, however the wall was left standing to one foot below the finished grade. The work was substantially completed during the autumn of 1963 and was unanimously approved by the Water Resources Commission in June 1964 (B-16). Although the repair work was designed by the same engineer who had reported substantial seepage through the dam in 1945, 18 years prior to the repairs, there is no mention of seepage in any of the available correspondence connected with the 1963 repairs.

i. Normal Operational Procedures - Normal operational procedures consist of a yearly lowering of the lake level by the owner to a maximum of 5.5 feet below the spillway crest to allow owners of lakefront property to perform shoreline repairs.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 1.0 square miles of moderately developed rolling terrain of which the lake area comprises nearly 30 percent.

b. Discharge at Damsite - Discharge from the facility is by means of the 1 square foot low level outlet conduit, the spillway, and, at water levels more than 0.8 feet above the spillway crest, water will pass through the low area at the left end of the dam.

1. Outlet Works (conduits):	
One 1'x1' (approx) @ Invert Elevation:	518.5
2. Maximum known flood at damsite:	N/A
3. Ungated spillway capacity @ top of dam elevation 526.5:	180 cfs. (low area raised to elevation 526.5)
elevation 524.8:	32 cfs. (at bottom elevation of low area)
elevation 526.5:	890 cfs. (including overflow at low area) (See Appendix D-7)
4. Ungated spillway capacity @ test flood elevation 526.3:	160 cfs. (low area raised to elevation 526.5)
5. Gated spillway capacity @ normal pool elevation:	N/A
6. Gated spillway capacity @ test flood elevation:	N/A
7. Total spillway capacity @ test flood elevation 526.3:	160 cfs. (low area raised to elevation 526.5)
8. Total project discharge @ test flood elevation 525.8:	380 cfs. (low area open)

c. Elevations (feet Above Mean Sea Level)

1. Streambed at centerline of dam:	516.5

2.	Maximum tailwater:	N/A
3.	Upstream portal invert diversion tunnel:	N/A
4.	Recreational pool:	524
5.	Full flood control pool:	N/A
6.	Spillway crest:	524
7.	Design surcharge (original design):	N/A
8.	Top of dam: Bottom of low area:	526.5 524.8
9.	Test flood design surcharge:	526.3 (low area raised to elevation 526.5)

d. Reservoir

1.	Length of maximum pool:	4,500 + ft.
2.	Length of recreation pool:	4,500 ft.
3.	Length of flood control pool:	N/A

e. Storage

1.	Recreation pool:	740± acre - ft.
2.	Flood control pool:	N/A
3.	Spillway crest pool:	740± acre - ft.
4.	Top of dam:	1200± acre - ft.
5.	Test flood pool:	1200± acre - ft.

f. Reservoir Surface

1.	Recreation pool:	180 acres
2.	Flood control pool:	N/A
3.	Spillway crest:	180 acres
4.	Test flood pool:	190± acres
5.	Top of dam:	190± acres

g. Dam

1. Type	Earth and Gravel Embankments, Concrete Spillway
2. Length:	400 ft.
3. Height:	10 ft.
4. Top width:	10 ft.
5. Side slopes:	2 H to 1 V (upstream) 3 H to 1 V (downstream)
6. Zoning:	N/A
7. Impervious Core:	N/A
8. Cutoff:	N/A
9. Grout curtain:	N/A
10. Other:	N/A

h. Diversion and Regulating Tunnel - N/A

1. Type:	
2. Length:	
3. Closure:	
4. Access:	
5. Regulating facilities:	

i. Spillway

1. Type:	Broadcrested concrete weir of trapezoidal cross section
2. Length of weir:	15 ft.
3. Crest elevation:	524
4. Gates:	None
5. Upstream Channel:	Lake bottom, vertical concrete face

6. Downstream Channel:	Gravel streambed
7. General:	N/A

j. Regulating Outlets

1. Invert:	518.5
2. Size:	1'x 1'
3. Description:	Concrete conduit beneath spillway
4. Control mechanism:	Submerged valve on upstream face of concrete spillway section
5. Other:	N/A

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Available Data - The available data consists of a 1945 inspection report by Benjamin H. Palmer, a 1963 inspection report and repair recommendations by John J. Mozzochi and Associates, and specifications and drawings by Chandler and Palmer for the 1963 repairs to the dam.

b. Design Features - The repair plans which were reportedly carried out satisfactorily, differ somewhat from what was actually observed in the field; the plans specified a 3 horizontal to 1 vertical downstream slope while the actual slope was observed to be slightly steeper. Also, seepage that was detected in 1945 and still exists today was not mentioned at all in any of the 1963 correspondence concerning repairs to the dam.

c. Design Data - There were no engineering values, assumptions, test results or calculations available for the original construction or for the 1963 repairs.

2.2 CONSTRUCTION

a. Available Data - The only construction data is a letter dated June 10, 1964 from Mozzochi to the Water Resources Commission reporting the satisfactory completion of construction and the record of a subsequent vote of the Water Resources Commission to grant final approval.

b. Construction Considerations - No information was available.

2.3 OPERATIONS

Lake level readings are apparently not taken. To our knowledge the dam spillway capacity has never been exceeded. No formal operations records are known to exist.

2.4 EVALUATION

a. Availability - Existing data was provided by the State of Connecticut Water Resources Unit, the owner, and Chandler, Palmer and King Engineers of Norwich, Connecticut. The owner made the facility available for visual inspection.

b. Adequacy - The limited amount of detailed engineering data available was generally inadequate to perform an in-depth assessment of the dam, therefore, the final assessment of this dam must be based primarily on visual inspection, performance history, hydraulics computations of spillway capacity and approximate hydrologic judgements.

c. Validity - A comparison of record data and visual observations reveals no observable significant discrepencies in the record data other than as previously stated in Section 2.1b

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a General - The general condition of the dam is poor. Inspection revealed some areas in need of immediate attention, in particular, the extensive seepage along the toe of the left earth section, as well as seepage on the downstream slope at the right end of the dam, an uneven, unprotected crest, an eroded unprotected upstream slope and trees growing in various places on the dam. At the time of our inspection, there were approximately two inches of water flowing over the spillway. Also at the time of our inspection, there were three people fishing from the dam.

b. Dam

Crest - The crest of the dam is covered with gravelly sand and is used extensively as a footpath, thus there is little or no vegetation growth on the crest rendering it highly susceptible to erosion (Appendix C, photos 1 and 2). The crest is uneven along its entire length, with depressions adjacent to both sides of the spillway (Photo 3). At the left end of the dam the crest grades into a beach area which is actually up to 2 feet lower than the top of the dam. This substantially reduces the effective freeboard of the dam.

Downstream Slope - The downstream slope is covered by a heavy growth of underbrush and small trees through which several footpaths exist (Photos 5 and 8). There are many large trees at the toe of the slope which form, especially at the left end of the dam, a continuous root mat which is saturated and from which substantial seepage is emanating (Photo 7). The seepage flow is confined within an approximately two foot wide stream channel running along the toe of the left earth section (Photo 8). During inspection, all areas along the toe that were probed yielded seepage flow, many exhibited small boils, and most of the seepage was observed to be carrying a moderate amount of yellowish brown colored fine sediments. There is evidence of piping shown by the yellowish brown silty sand immediately downstream of the seeps. When probing the soil at exit points of the seeps, it was found that a ruler could penetrate easily 5 inches into the silty sand indicating a local quick condition.

Approximately 25 feet to the right of the spillway, a seep was detected approximately one-third of the way up the slope from the toe (Photos 5 and 6). The position of the seep on the slope indicates that only a small amount of head is lost by the water seeping through the dam. This may be an indication of a potentially unsafe condition due to the possibility that the embankment may be structurally unstable under greater heads, and it may become less stable with time as the seep increases in size. There is evidence of soil transport by the seep as indicated by the depression at the exit point from the slope.

Upstream Slope - The upstream slope is generally inclined at two horizontal to one vertical and riprap is virtually absent rendering the slope highly susceptible to wave erosion (Photo 1). Indeed, two extensive swales, one near the left end of the dam and one immediately to the left of the spillway, (Photo 2) have developed and will probably continue to erode unless some corrective action is taken. Along a good portion of the embankment, the upstream slope is held in place by small deciduous trees and brush, the roots of which, although they may help to bind the soil in place, may also provide paths for seepage through the dam. It is possible that trees growing on the upstream slope to the right of the spillway are partially responsible for the seepage below on the downstream slope.

Spillway - The spillway section consists of vertical concrete training walls on both sides of and contiguous with a 15 foot long broad-crested concrete weir of trapezoidal cross section, with slots for flashboards (Photo 3). All of the concrete appears to be in good condition with only one long crack running down the center of the overflow section, and minor spalling of the cap at the juncture of the upstream retaining walls and spillway training walls. It is not known if the concrete spillway section is founded on rock, however its close proximity to a rock outcrop at the area of high ground to the left of the spillway and an apparent rock outcrop beneath the right downstream corner of the spillway section indicate that it may indeed be founded on rock. Erosion due to trespassing is existent around both the upstream and downstream wingwalls of the spillway section (Photo 4). In his 1945 inspection report on Amston Lake Dam, B.H. Palmer described two "substantial" seeps on either side of the spillway which he felt were coming through the dam along the side walls of the concrete abutment. Our inspection did not reveal these seeps, however, they may become apparent under higher water levels in the lake.

c. Appurtenant Structures - A one foot by one foot conduit exists beneath the center of the spillway at invert elevation 518.5. The gate valve is attached to the upstream face of the spillway and is submerged, therefore its exact nature could not be determined.

A 4 inch diameter water pipe enters the dam low on the downstream slope near the left end and exits from the crest in the natural ground area, as shown on the plan of the dam in Appendix B (Plate No. 2). While it may provide seepage paths in the future, at present the pipe does not appear to be a concern.

d. Reservoir Area - The area around Amston Lake is heavily developed and probably will continue to be further developed, so somewhat of an increase in runoff potential and sedimentation due to construction can be expected. It is possible that some of the lake front cottages would experience backwater flooding at the maximum storage water surface elevation.

e. Downstream Channel - The natural streambed downstream of the spillway is a well-confined, narrow, steep-sided channel with a gravelly channel bottom. The stream meanders slightly through a wooded area with some trees overhanging the channel to a small pond approximately 300 feet downstream of the dam.

3.2 EVALUATION

Based upon the visual inspection, it was possible to assess the dam as being generally in poor condition. The following features which could influence the future condition and/or stability of the dam were identified.

1. The seeps could potentially increase in flow and sediment content, leading to erosion that would threaten the stability of the dam.

2. The lack of upstream slope or crest protection has already led to substantial erosion which is likely to continue in the future.

3. The root mat of the large trees at the toe of the downstream slope is saturated and may be primarily responsible for much seepage through the dam. If any of these trees were to be uprooted, the resultant cavity could increase the seepage and produce piping of the embankment soils.

4. The roots of the trees growing on the upstream slope of the dam could provide seepage paths through the dam.

5. Erosion due to trespassing, especially at the spillway training walls is likely to continue and worsen.

6. The low area at the left end of the embankment reduces the effective freeboard of the dam and could result in serious erosion at the left end of the dam if flow through the low area should occur.

7. The exact nature and purpose of the water pipe observed on the downstream slope and crest are unknown. The pipe may possibly provide seepage paths in the future.

SECTION 4: OPERATIONAL PROCEDURES

4.1 REGULATING PROCEDURES

According to the owner, the low level outlet is operated and the lake level taken down every autumn to allow residents around the lake to perform maintenance on their waterfronts. A valve stem extension is used to manually operate the submerged gate valve from the spillway crest. Lake level readings are not taken.

4.2 MAINTENANCE OF DAM

The extensive growth of trees and brush on the dam indicates that maintenance is rarely, if ever, done on the dam, however according to the owner, debris is cleared and brush is cut periodically, with a maintenance visit scheduled for May 8, 1979. No periodic inspection schedule is in effect and the owner indicated that he was not aware of the substantial seepage through the dam.

4.3 MAINTENANCE OF OPERATING FACILITIES

The low level outlet is serviced as needed when the lake level is lowered.

4.4 DESCRIPTION OF ANY FORMAL WARNING SYSTEM IN EFFECT

No formal warning system is in effect.

4.5 EVALUATION

Operation and maintenance procedures do not exist. A formal program of operation and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1c. Remedial operation and maintenance recommendations are presented in Section 7.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. General - The project is basically a high storage-low spillage type project with the lake area comprising nearly 30% of the drainage area. The peak outflow figures of both the dam and spillway are dependent upon what conditions are assumed with respect to the low area at the left end of the dam. Analyses were performed assuming the low area to be both existing and filled in.

b. Design Data - No computations could be found for the original dam construction.

c. Experience Data - No information on serious problem situations arising at the dam was found, and it does not appear the dam has been overtopped. The maximum height of water over the spillway is not known.

d. Visual Observations - The most notable hydrologic feature of the dam is the low area at the beach adjacent to the left end of the dam, which at its low point is only 0.8 feet above the spillway crest and in effect becomes an auxiliary spillway at stages higher than 524.8. The low area discharges along the toe of the dam which could cause undercutting of the toe and compromise the dam stability under heavy flow conditions.

e. Test Flood Analysis - The test flood for this significant hazard, intermediate size dam is equivalent to one-half the Probable Maximum Flood (PMF) of 1200 cubic feet per second (cfs). Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges", dated March, 1978, peak inflow to the reservoir is 1200 cfs (Appendix D-10); peak outflow (Test Flood) is 160 cfs with the dam maintaining a 0.2 foot freeboard. Based upon our hydraulics computations, the capacity of the spillway to the top of the dam is 180 cfs, which is equivalent to approximately 113% of the 160 cfs routed Test Flood outflow which applies if the low area is raised. The spillway capacity to the first point of overflow at the low area as it exists presently is 32 cfs (D-7).

f. Dam Failure Analysis - Utilizing the April, 1978, "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs", the peak failure outflow from the dam breaching would be 3370 cubic feet per second. A breach of the dam would result in a rise on the order of 2.8 feet in the water level of the stream at the initial impact area, which corresponds to an increase in the water level from a depth of approximately 1.4 feet just before the breach, to a depth of approximately 4.2 feet just after the breach. This rapid rise in the water level would affect two low-lying houses along the stream channel at the initial impact area (D-14).

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - There was no evidence of immediate structural instability, however the seepage and piping observed along the downstream slope have potential for causing a substantial lessening of the stability of the dam or possibly even a breach of the dam.

b. Design and Construction Data - There is very little design and construction data available for this dam, therefore it was not possible to perform an in-depth assessment of the structural stability of the dam.

c. Operating Records - There are no operating records indicating stability problems at the dam in the past.

d. Post Construction Changes - The 1963 and 1964 modifications consisted of flattening the downstream slope and reshaping the upstream slope. A downstream vertical wall of unknown construction existed along the downstream toe of a portion of the dam and was reportedly covered by the added downstream earth fill. The effects of the modifications on the dam stability are difficult to assess, as there is no definitive information on the modifications such as fill gradations or locations of the fill and the buried downstream stonewall. The effect of the fill on stability is also a function of the relative permeabilities of the new fill and the soil of the original dam, which are not known.

e. Seismic Stability - The dam is in Seismic Zone 1 and according to the Recommended Guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Condition - Based upon the visual inspection of the site and its past performance, the dam appears to be in poor condition. No evidence of immediate structural instability was observed in the dam. The embankment is generally in poor condition with several areas of concern. Areas requiring attention include the substantial amount of seepage, the lack of protection and erosion of the upstream slope and crest, the tree growth on the slopes, and the low area at the left end of the dam.

Based upon "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978, peak inflow to the reservoir is 1200 cubic feet per second; peak outflow (Test Flood) is 160 cubic feet per second with the dam maintaining a 0.2 foot freeboard. Based upon our hydraulics computations, the spillway capacity is 180 cubic feet per second, which is equivalent to approximately 113% of the routed Test Flood outflow, assuming the low area at the left end of the dam to be filled.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the dam must be based solely on visual inspection, past performance of the dam, and sound engineering judgement.

c. Urgency - The recommendation concerning the seepage (7.2.1) should be implemented immediately, and the remaining measures presented in Section 7.2 and 7.3 should be implemented within one year of the owner's receipt of this report.

d. Need for Additional Information - There is a need for more information as recommended in Section 7.2

7.2 RECOMMENDATIONS

A registered professional engineer qualified in dam design, repair and inspection should perform the following:

1. An investigation of the origin and significance of the seepage as it concerns the composition of the dam and foundation materials. As will probably be deemed necessary by the investigation, recommendations should be made for elimination of some or all of the seeps. Recommendations should also be made for the subsequent monitoring of the seepage on a regular basis to determine the effectiveness of any measures taken to limit or eliminate the seepage.

2. A study to develop plans and specifications to raise the low area adjacent to the left end of the dam to the top of the dam, elevation 526.5.

3. An investigation to develop a plan of removal of the trees on the dam and within 20' of the toe of the dam. The engineer should also make recommendations for the proper backfilling of any excavations due to removal of the trees.

4. An investigation to develop a plan to repair the dam to the proper elevation and slopes where erosion has occured. Protective measures such as placing riprap on the upstream slope and planting vegetation such as sod on the crest and downstream slopes should be taken to prevent erosion from reoccuring. The low areas on the crest adjacent to the spillway walls should be filled in. Any further substantial subsidence in these two areas should be investigated and corrective measures recommended.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures - The following measures should be undertaken within the time frame indicated in Section 7.1c, and continued on a regular basis.

1. Round-the-clock surveillance should be provided by the owner during periods of unusually heavy precipitation. The owner should develop a formal warning system with local officials for alerting downstream residents in case of an emergency.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

3. A program of detailed inspections by a registered professional engineer qualifed in dam inspection should be instituted on an annual basis. The inspections should be technical in nature and should include the operation of the low level outlet works.

4. The owner should investigate the purpose and nature of the 4" water pipes in the dam by contacting the person or persons responsible for them. The point of exit of the pipe on the downstream slope should be monitored for any evidence of seepage.

7.4 ALTERNATIVES

There are no alternatives to the above recommendations other than draining the lake.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT AMSTON LAKE DAM DATE: 4/5/79

TIME: 10:00 AM

WEATHER: OVERCAST, 55°F

W.S. ELEV. 524./ U.S. _____ DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. CALVIN GOLOSMITH	CG	CAHN ENGINEERS, INC.
2. THEODORE STEVENS	TS	CAHN ENGINEERS, INC.
3. PETER HEYNEN	PH	CAHN ENGINEERS, INC.
4. GONZALO CASTRO	GC	GEOTECHNICAL ENGINEERS, INC.
5.		
6.		

PROJECT FEATURE	INSPECTED BY	REMARKS
1. EARTH DAM EMBANKMENT	CG, TS, PH, GC	
2. INTAKE VALVE	CG, TS, PH	
3. 1'x1' CONDUIT THROUGH SPILLWAY	CG, TS, PH	
4. CONDUIT OUTLET	CG, TS, PH	
5. CONCRETE SPILLWAY SECTION	CG, TS, PH, GC	
6.		
7.		
8.		
9.		
10.		
11.		
12.		

PERIODIC INSPECTION CHECK LIST

PROJECT AMSTON LAKE DAM DATE 4/5/79

PROJECT FEATURE EARTH DAM EMBANKMENT BY CG, TS, PH, GC

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	526.5 ±
Current Pool Elevation	524.1 ±
Maximum Impoundment to Date	NOT KNOWN
Surface Cracks	NONE OBSERVED
Pavement Condition	N/A
Movement or Settlement of Crest	NONE OBSERVED
Lateral Movement	TOO IRREGULAR TO JUDGE
Vertical Alignment	
Horizontal Alignment	
Condition at Abutment and at Concrete Structures	EROSION ADJACENT TO SPILLWAY WALLS.
Indications of Movement of Structural Items on Slopes	N/A
Trespassing on Slopes	SEVERAL FOOTPATHS, ESP. AROUND SPILLWAY WALLS
Sloughing or Erosion of Slopes or Abutments	MUCH EROSION OF U/S SLOPE SOME EROSION & SLOUGHING OF D/S SLOPE
Rock Slope Protection-Riprap Failures	NO RIPRAP PROTECTION
Unusual Movement or Cracking at or Near Toes	NONE OBSERVED
Unusual Embankment or Downstream Seepage	LARGE SEEP AREA @ TOE, LEFT END SEEP ON SLOPE RIGHT OF SPILLWAY
Piping or Boils	SOME INDICATION OF PIPING ASSOCIATED WITH SEEPS
Foundation Drainage Features	
Toe Drains	NONE KNOWN
Instrumentation System	NONE KNOWN

PERIODIC INSPECTION CHECK LIST

PROJECT AMSTON LAKE DAM DATE 4/5/79

PROJECT FEATURE INTAKE VALVE BY CG, TS, PH

AREA EVALUATED		CONDITION
OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE		
a) Approach Channel		NO CHANNEL
Slope Conditions		
Bottom Conditions		
Rock Slides or Falls		
Log Boom		
Debris		
Condition of Concrete Lining		
Drains or Weep Holes		
b) Intake Structure		GATE VALVE SUBMERGED-ATTACHED TO U/S FACE OF SPILLWAY AND OPERATED BY MEANS OF VALVE. EXTENSION CONCRETE @ SPILLWAY IN GOOD CONDITION
Condition of Concrete		
Stop Logs and Slots		

PERIODIC INSPECTION CHECK LIST

PROJECT AMSTON LAKE DAM DATE 4/5/79

PROJECT FEATURE 1'x1' SQUARE CONDUIT THROUGH SPILLWAY SECTION BY CG, TS, PH

AREA EVALUATED	CONDITION
OUTLET WORKS-TRANSITION AND CONDUIT	
General Condition of Concrete	APPEARED GOOD
Rust or Staining on Concrete	NONE OBSERVED
Spalling	NONE OBSERVED
Erosion or Cavitation	NONE OBSERVED
Cracking	ONE LONG LONGITUDINAL CRACK ALONG SPILLWAY ABOVE CONDUIT
Alignment of Monoliths	N/A
Alignment of Joints	
Numbering of Monoliths	
	NOTE: OBSERVATION OF CONDUIT OUTLET VERY LIMITED DUE TO WATER FLOWING OVER SPILLWAY SECTION AT TIME OF INSPECTION

PERIODIC INSPECTION CHECK LIST

PROJECT JAMESTOWN LOCAL DAM DATE 4/5/79

PROJECT FEATURE CONDUIT OUTLET BY CG, TS, PH

AREA EVALUATED		CONDITION
OUTLET WORKS-OUTLET STRUCTURE AND OUTLET CHANNEL		
General Condition of Concrete		APPEARED GOOD
Rust or Staining		NONE OBSERVED
Spalling		NONE OBSERVED
Erosion or Cavitation		NONE OBSERVED
Visible Reinforcing		NONE OBSERVED
Any Seepage or Efflorescence		NONE OBSERVED
Condition at Joints		N/A
Drain Holes		N/A
Channel		OUTLET @ D/S END OF SPILLWAY SECTION AND INTO SPILLWAY DISCHARGE CHANNEL - NATURAL STREAMBED W/ TREES OVERHANGING CHANNEL
Loose Rock or Trees Overhanging Channel		
Condition of Discharge Channel		CHANNEL WELL CONFINED W/ GRAVELLY BOTTOM

PERIODIC INSPECTION CHECK LIST

PROJECT AMSTON LAKE DAM DATE 4/5/77

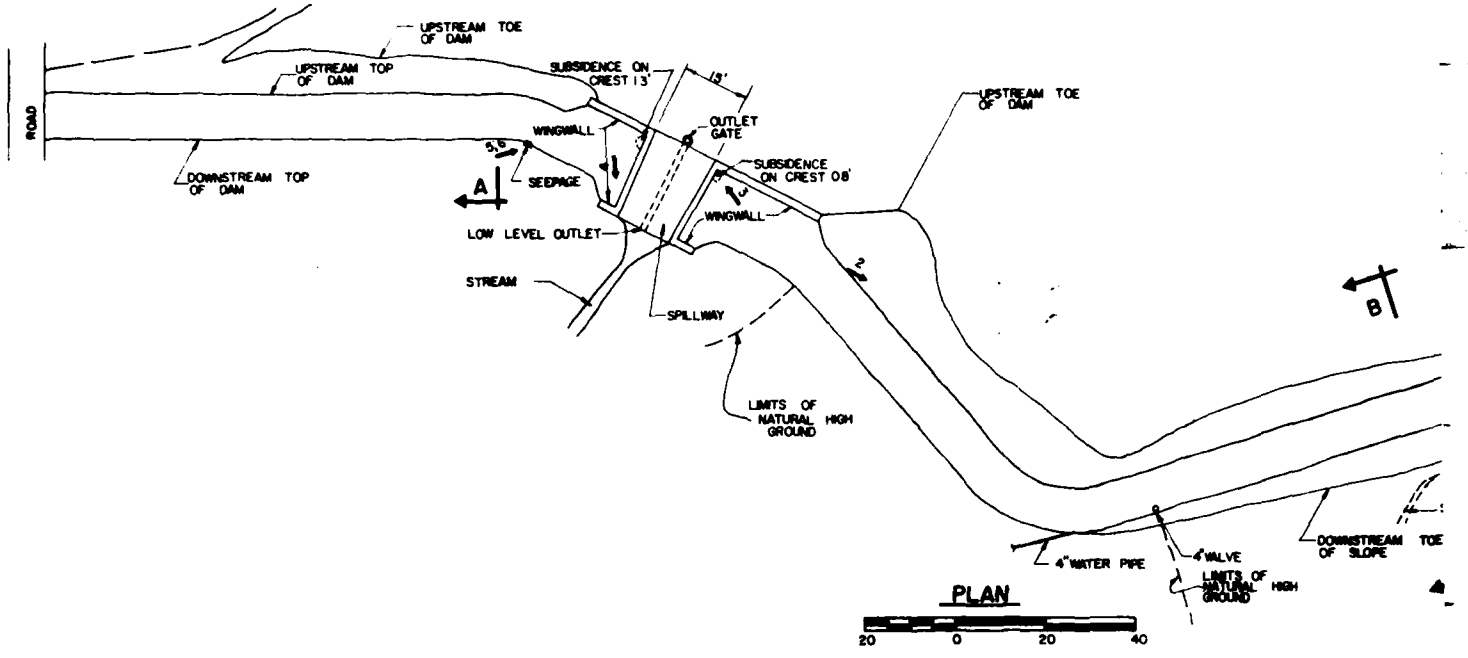
PROJECT FEATURE CONCRETE SPILLWAY SECTION BY CG, TS, PH, GC

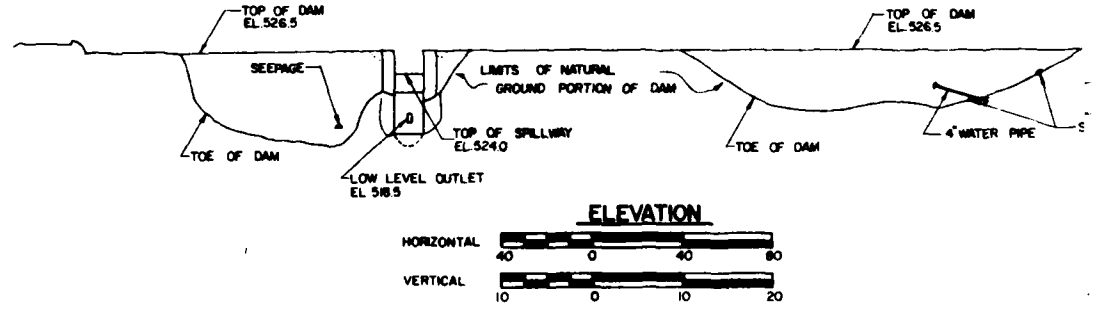
AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		
a) Approach Channel		NO CHANNEL - LAKE BOTTOM
General Condition		
Loose Rock Overhanging Channel		
Trees Overhanging Channel		
Floor of Approach Channel		
b) Weir and Training Walls		
General Condition of Concrete		GOOD - ONE LONG CRACK DOWN CENTER OF SPILLWAY
Rust or Staining		NONE OBSERVED
Spalling		MINOR DETERIORATION OF CAP @ U/S END OF TRAINING WALLS
Any Visible Reinforcing		NONE OBSERVED
Any Seepage of Efflorescence		NONE OBSERVED
Drain Holes		NO DRAIN HOLES OBSERVED
c) Discharge Channel		NATURAL STREAM BED
General Condition		GOOD - NARROW, STEEP-SIDED
Loose Rock Overhanging Channel		NONE OBSERVED
Trees Overhanging Channel		SEVERAL
Floor of Channel		GRAVELLY
Other Obstructions		PLYWOOD AND OTHER DEBRIS @ SPILLWAY DISCHARGE

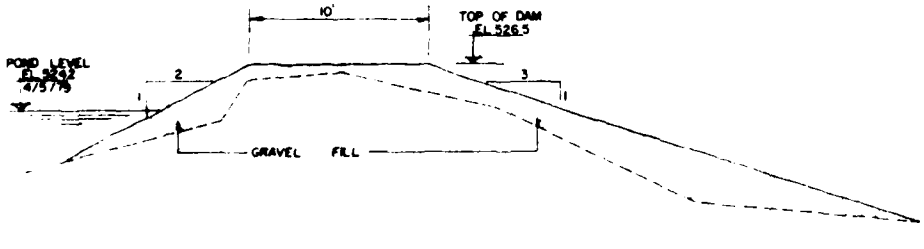
APPENDIX B

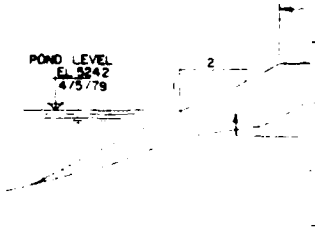
ENGINEERING DATA AND CORRESPONDENCE

AMSTON LAKE





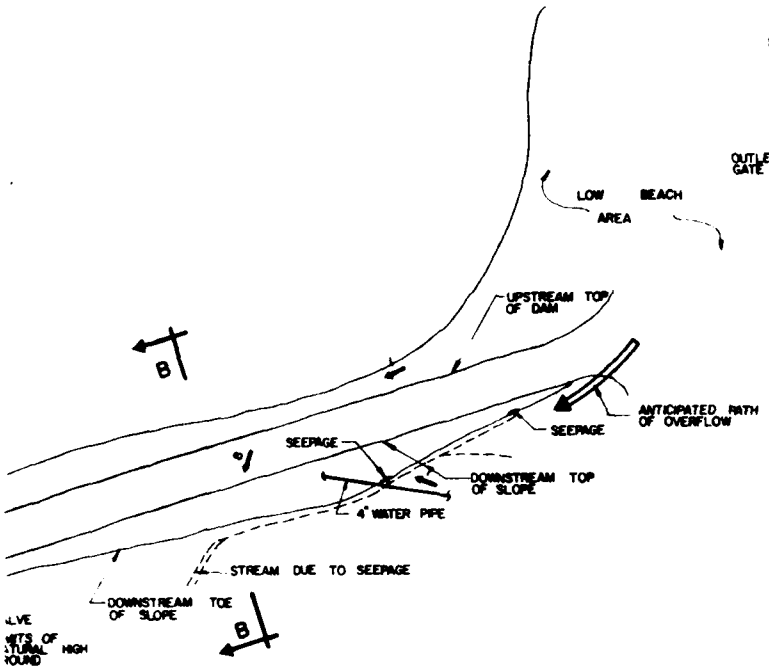


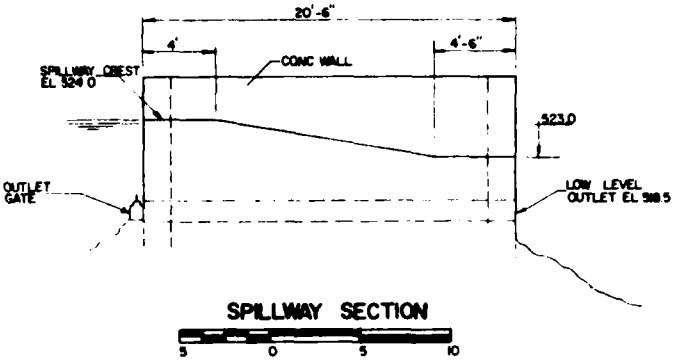


SECTION A-A

5 0 5 10

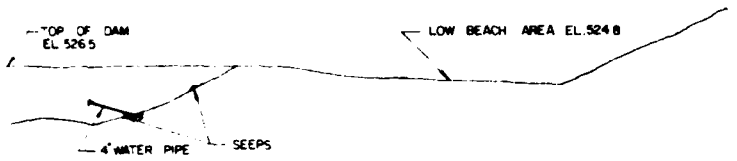
1





SPILLWAY SECTION

5 0 5 10

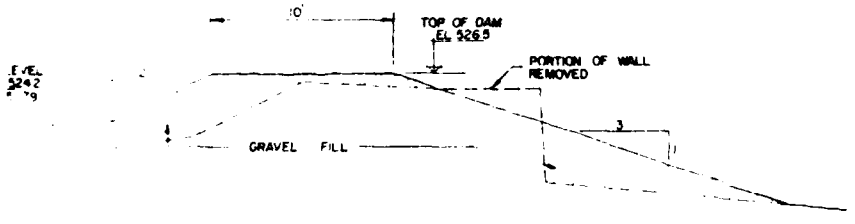


NOTES:

1. THIS PLAN WAS COMPILED FROM A PLAN ENTITLED "REPAIRS TO AMSTON LAKE DAM" DATED SEPTEMBER 4, 1963 BY CHANDLER & PALMER ENGINEERS AND FROM ROUGH FIELD SURVEY MEASUREMENTS. DIMENSIONS SHOWN ARE APPROXIMATE NOT ALL STRUCTURAL AND/OR TOPOGRAPHIC FEATURES ARE IDENTIFIED.

2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM, THEREFORE THE WATER SURFACE ELEVATION OF AMSTON LAKE AS SHOWN ON THE USGS COLCHESTER AND COLUMBIA QUADRANGLE MAPS WAS ASSUMED TO BE THE SPILLWAY CREST ELEVATION ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION USING A CONVERSION FROM CHANDLER & PALMER SURVEY OF THE DAM WHICH SET THE SPILLWAY CREST AT ELEVATION 1000

3. $\frac{2}{\Leftarrow}$ PICTURE NUMBER AND DIRECTION



SECTION B-B

4 0 5 10

CAHN ENGINEERS INC WALLINGFORD, CONNECTICUT ENGINEER		U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS			
AMSTON LAKE DAM			
TR- RAYMOND BROOK		HEBRON, CONNECTICUT	
DRAWN BY	CHECKED BY	APPROVED BY	SCALE. AS NOTED
M N	CCG	[illegible]	DATE JUNE 1979 / PLATE - 2

(2)

AMSTON LAKE DAM EXISTING PLANS

"Site of Proposed Club House at Lake Amston"
Town of Hebron, Conn.
H.E. Daggett, Civil Engineers
Meriden, Conn.
July, 1934

"Repairs to Amston Lake Dam"
Town of Hebron, Conn.
Chandler and Palmer, Engineers
Norwich, Conn.
Sept. 4, 1963

SUMMARY OF DATA AND CORRESPONDENCE

DATE	TO	FROM	SUBJECT	PAGE
No date	Files	State Board for the Supervision of Dams	Inventory Data	B-3
June 28, 1945	S.H. Wadhams, State Board of Supervision of Dams	B.H. Palmer Chandler & Palmer Engineers, Norwich, Conn.	Dam inspection and report of leakage	B-4
May 1, 1963	William S. Wise, Director Water Resources Commission	John J. Mozzochi Assoc., Civil Engineers	Dam inspection report	B-6
May 16, 1963	William Day, President, Amston Lake Company	William S.Wise,	Order to repair dam	B-7
Sept. 3, 1963	Amston Lake Company	Chandler & Palmer Engineers, Norwich, Conn.	Specifications for repairs to dam (general items deleted)	B-9
Sept. 17, 1963	Seymour Adelman Fitchville, Conn.	Amston Lake Company	Contract for repairs to Dam	B-12
June 10, 1964	William S. Wise	John J. Mozzochi	Final inspection of dam	B-15
June 15, 1964	Files	State Board for the Supervision of Dams	Approval for final certification of repair project	B-16

CT 5:

C

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

Name of Dam or Pond 33 Amston Lake

Code No. SL 14.9 RY 1.9 [illegible] U1.2

LAT. 41°37.6'
LONG. 72°24.3'

Location of Structure:

Town Hebron

Name of Stream Tr Raymond Brook

U.S.G.S. Quad. Columbia

Owner Amston Lake & MAINTENANCE COOP

Address ~~25 Church St~~ Deep Wood Drive

~~Colchester~~ Hebron

ATTN: MR. OSTRAGER 537-1805

Pond Used For REC

Dimensions of Pond: Width _____ Length _____ Area 185 Acres ±

Total Length of Dam 410' ±

Length of Spillway 12 ±

Depth of Water Below Spillway Level (Downstream) 8' ±

Height of Abutments Above Spillway 2' ± 3'

Type of Spillway Construction [illegible]

Type of Dike Construction [illegible]

Downstream Conditions [illegible]

Summary of File Data found unsafe by Palmer #5 no action

Remarks [illegible]

CHANDLER & PALMER
CIVIL ENGINEERS
ROOMS 114-116 THAYER BUILDING
TELEPHONE 2255

SHEPARD B. PALMER
BENJAMIN H. PALMER, JR.

MEMBERS AMERICAN AND CONNECTICUT SOCIETIES OF CIVIL ENGINEERS

DAMS
WATER SUPPLIES
SEWERAGE
APPRAISALS
REPORTS
SURVEYS

66-1-1

NORWICH, CONN.,
June 28, 1945

Re: Lake Amston

General Sanford H. Wadhams
State Board of Supervision of Dams
State Office Building
Hartford, Connecticut

Dear General Wadhams:-

I visited Lake Amston yesterday and inspected the Dam. This Dam is located in the Town of ~~Marlborough~~ Hebron fairly near the Lebanon Town line. There is a good sized pond and the drainage area is about 1½ square miles.

The Dam is located at the Northwesterly end of the pond and consists of an earth embankment laid up between stone walls which were apparently laid dry. There is one section of concrete at the spillway. The overflow section is about 14' feet wide and 28 inches deep. There is a concrete slab on the bottom of this spillway which carries it across the dam section. No water was coming over the spillway yesterday afternoon, although we had a hard rain the day before.

There are four substantial leaks coming through the Dam. One is located near the Northeasterly end of the dam and it looks as though there might have been an old stone culvert. There is evidence of the stones at both sides of the dam and it looked to me as though it may have been an old culvert that was filled in and made part of the dam. There is a substantial stream of water coming through this.

There are two substantial leaks on either side of the concrete spillway; apparently when this concrete section was put in, no attempt was made to provide a cut-off line on the sides of the abutment walls, and the water is working itself through the dam along the side walls of this concrete abutment. There is still another leak toward the Southwesterly end of the dam where an appreciable stream of water appears to be coming right through the old embankment.

B-4

I talked with some of the boys who live around there and they said that at times the water did come over the spillway but they also said that the water dropped down quite a bit in the pond during the summer due to the leaks. From my inspection I would say that these leaks are of fairly long duration and I do not think that the dam is in any immediate danger of collapse. The water that is coming through is good and clear and is apparently not taking any embankment with it. I did not see any draw-off pipe provided for drawing down the pond.

In order to correct these conditions I think it would be necessary to lower the water in the pond some and then to provide a tight line of either sheeting or a concrete core-wall at the locations described above. This is a condition which should be remedied, although I do not think there is any immediate cause for worry.

Very truly yours,

B. H. Palmer.

BHP/EW

JOHN J. MOZZOCHI AND ASSOCIATES
CIVIL ENGINEERS

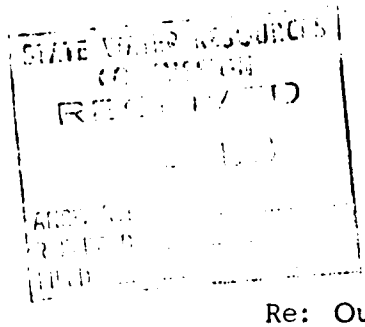
JOHN J. MOZZOCHI
ASSOCIATES
OWEN J. WHITE
JOHN LUCHS, JR.
ECTOR L. GIOVANNINI

GLASTONBURY, CONN.
817 HEBRON AVENUE
PHONE 633-9401

PROVIDENCE 3, R. I.
800 DYER STREET
PHONE GAspee 1-0420

REPLY TO: Glastonbury

May 1, 1963



William S. Wise-Director
Water Resources Commission
State Office Building
Hartford 15, Connecticut

Re: Our File 57-73-42
Amston Lake Dam
Amston, Connecticut

Dear Mr. Wise:

In accordance with instructions from Robert McCabe, I made an inspection of the referenced dam on Friday April 26th.

This is an earthen dam about 200 feet long with a concrete spillway about 16 feet wide having a freeboard of 1-1/2 ft. The dam is about 10 feet high and for about 1/2 its length, there is a very loose dry stone wall on its downstream face.

This dam has a relatively small drainage area of 765 acres of which the lake itself comprises 180 acres. I calculate that the spillway, with no freeboard, has a capacity of about 90 CFS. This is ample for a 100-year storm run-off.

This dam is in immediate need of the following work:

1. Remove all trees and bushes from the earthen dike;
2. Reconstruct the earth dike throughout, and especially around the spillway, to a minimum section at least 10 ft. wide at the top with 3 horizontal to 1 vertical downstream slope and 2:1 upstream slopes with a minimum freeboard of 2-1/2';
3. If flashboards are ever inserted in the spillway, additional freeboard should be provided equal in height to the flashboards.

Very truly yours,

John J. Mozzochi and Associates
Civil Engineers

JJM:hk

B-6

STATE OF CONNECTICUT

WATER RESOURCES COMMISSION
STATE OFFICE BUILDING - HARTFORD 15, CONNECTICUT

May 16, 1963

Mr. William Day, President
The Amston Lake Company
127 Roger Road
New Haven, Connecticut

Dear Sir:

According to the records in this office the so-called Amston Lake Dam located in the Town of Hebron is under the ownership of the Amston Lake Company.

Section 25-110 of the 1958 Revision of the General Statutes places under the jurisdiction of this Commission all dams, "which, by breaking away or otherwise, might endanger life or property." The Commission finds that the failure of this dam would endanger life or property.

In accordance with Section 25-111 of the General Statutes this dam has been inspected and found to be in an unsafe condition. The statute states in part: . . "If, after any inspection described herein, the commission finds any such structure to be in an unsafe condition, it shall order the person, firm or corporation owning or having control thereof to place it in a safe condition or to remove it, and shall fix the time within which such order shall be carried out."

F I N D I N G

Based on the engineers report covering the inspection of this dam the Water Resources Commission finds the structure to be in an unsafe condition. It also finds that certain repairs or alterations are necessary to place the structure in a safe condition.

B-7

The repairs or alterations to be made should include but are not necessarily limited to the following items:

1. Remove all trees and bushes from the earthen dike.
2. Reconstruct the earth dike throughout and especially around the spillway.
3. If flashboards are ever inserted in the spillway additional freeboard should be provided equal in height to the flashboards.

ORDER

In accordance with Section 25-111 of the General Statutes you are hereby ordered to make the repairs or alterations necessary to place the structure in a safe category or to remove the structure.

Any repairs or alterations to the structure or its removal shall be carried out in accordance with engineering plans and specifications prepared by a registered engineer and submitted to this Commission for approval and for the issuance of a permit prior to any construction or demolition work in accordance with Section 25-112 of the General Statutes.

The Commission shall be notified within two weeks what steps you plan to take to repair or remove the structure. The work shall be completed by September 15, 1963.

Very truly yours,

WATER RESOURCES COMMISSION

By_____
William S. Wise, Director

WSW:mac

REPAIRS TO DAM AT AMSTON LAKE

Town of Marlborough

Amston Lake Company

Owner

Plans and Specifications
prepared by

CHANDLER & PALMER
Room 114 Thayer Building
Norwich, Connecticut

Benjamin H. Palmer, Engineer
License #67

September 3, 1963

19. Removal of Brush and Trees

Some of the brush and trees have all ready been removed from the area of the dike. This Contractor shall clean up any brush existing at the time of his inspection and shall remove any other trees located within the area of the work. Trees so removed shall be cut off close to the ground and the limbs sawed up and entirely removed from the premises. Cut off all stumps close to the ground.

20. Rebuilding of Earth Dike

At the present time, there is a concrete spillway with concrete abutment walls 28" high above the spillway section. No work is required on this concrete spillway under this contract.

In numerous places, the earth on the top of the dike has eroded away or washed away leaving the holes in the top of the dike. It is the intention of the Contract to bring in sufficient fill to raise up the embankment to a level which will be 30" above the spillway section. The top of this dike shall be at least 10 feet in width and the upstream side shall then slope down to the water with a slope of one foot vertically and two horizontally. The downstream slope shall be sloped off on the basis of one foot vertically to three feet horizontally. Care shall be taken to properly grade the slopes to a uniform slope and sufficient batter boards shall be used to accomplish this purpose.

The material used for this grading purpose shall be good earth and gravel with a minimum of large stones. The downstream slope shall be covered with 4" of good loam which shall be raked and rolled and properly seeded. The top ten feet of the embankment and the upstream slope may be left in gravel at the option of the Contractor.

21. Flash Boards

No flash boards are included at the present time on the spillway section and none are contemplated in this work. The only repair work on the spillway is a small piece of concrete at the center which has chipped off and shall be repaired by the Contractor.

22. Source of Fill

The Contractor shall determine where he may obtain suitable material for making the fill called for above. There are no materials directly available at the site and will be required to bring in fill to cover the work. Contractor is to provide all trucking and equipment for spreading the material and properly grading it.

23. Grading and Seeding

After the loam is properly spread and graded, he shall hand rake it and rool it and seed it. He shall furnish bone meal or other powdered fertilizer and shall scatter this over the seeded area together with the grass seed. Apply bone meal at the rate of two pounds per 100 sqare feet. For the grass seed use a mixture of three pounds of white clover, five pounds of Red Top, three pounds of chewing Fescus and nine pounds of Kentucky Bluegrass applied at the rate of one-half pound per 100 square feet.

Contractor shall see that all of the grass takes hold and if any of the loam is washed out, he shall replace it and reseed as necessary to get a proper job. In the event that seeding cannot be completed in the Fall of 1963, then the Contractor will be expected to come back in the spring of 1964 and touch up all washed out areas and reseed the slopes at the time, if necessary.

C O N T R A C T

THIS AGREEMENT made the 17th day of SEPTEMBER in the year Nineteen Hundred and SIXTY-THREE by and between SEYMOUR ADELMAN of FITCHVILLE, CONNECTICUT hereinafter called the Contractor, and THE AMSTON LAKE COMPANY of HEBRON, CONNECTICUT hereinafter called the Owner.

WITNESSETH, that the Contractor and the Owner for the considerations hereinafter named agree as follows:

Article 1. Scope of Work

The Contractor shall furnish all of the materials and perform all of the work shown on the Drawings and described in the Specifications entitled "REPAIRS TO DAM AT AMSTON LAKE, TOWN OF HEBRON, CONNECTICUT" prepared by CHANDLER & PALMER, ENGINEERS, NORWICH, CONNECTICUT

Article 2. Time of Completion

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The work to be performed under this Contract shall be commenced NOT LATER THAN OCTOBER 21, 1963 and shall be substantially completed NOVEMBER 21, 1963

Article 3. The Contract Sum

The Owner shall pay the Contractor for the performance of the Contract, subject to additions and deductions provided therein, in current funds as follows: TWO THOUSAND EIGHT HUNDRED AND EIGHTY DOLLARS ($2,880)

Article 4. Progress Payments

The Owner will pay the Contractor the full amount of the Contract payment to be made within 15 days following the completion of the work and acceptance of the Engineer.

Article 5. The Contract Documents

The Contract Documents consist of the Specifications and Drawings together with this Agreement. The Specifications are dated SEPTEMBER 3, 1963 and the Plan is dated SEPTEMBER 4, 1963

IN WITNESS WHEREOF the parties hereto have executed this Agreement, the day and year first above written.

SEYMOUR ADELMAN - CONTRACTOR

Witness

Seymour Adelman

AMSTON LAKE COMPANY

Witness

William Day, President

Witness

Mrs. Alex Bouchaine

COPY

JOHN J. MOZZOCHI AND ASSOCIATES
CIVIL ENGINEERS

GLASTONBURY, CONN.
217 HEBRON AVENUE
PHONE 633-9401

PROVIDENCE 3, R. I.
300 DYER STREET
PHONE GAspee 1-0430

JOHN J. MOZZOCHI
ASSOCIATES
OWEN J. WHITE
JOHN LUCHS, Jr.
ECTOR L. GIOVANNINI

REPLY TO: Glastonbury

June 10, 1964

William S. Wise-Director
Water Resources Commission
State Office Building
Hartford 15, Connecticut

Re: Our File 57-73-42
Amston Lake Dam
Amston, Connecticut

Dear Mr. Wise:

A final inspection was made of the referenced dam on June 9, 1964, and all phases of the plans and specifications were found to be completed in a satisfactory manner.

I recommend that a final certificate be issued for this project.

Very truly yours,

John J. Mozzochi and Associates
Civil Engineers

JJM:hk
cc: B Palmer

B-15

SUPERVISION OF DAMS - continued

Amston - Amston Lake Dam

The Commission noted that a final inspection has been made of this Dam by John J. Mozzochi, Consultant to the Commission and that all phases of the plans and specifications were found to be completed in a satisfactory manner. The Commission therefore unanimously VOTED approval and directed that the Final Certificate be issued for this project.

Lebanon - Williams Pond Dam

The Commission considered a letter received from Lawrence M. Gilman, owner, regarding repairs made to this Dam in 1963. It was noted that some repairs have been made at the dam but the owner failed to submit plans and obtain a permit from the Commission. Removal of trees from embankment and correction of several leaks remain to be done. After some discussion the Commission unanimously VOTED to ask Mr. Gilman to submit an engineer's report on the repairs which have been made at this dam and advise whether further work is contemplated to correct the remaining conditions.

STRUCTURES IN NAVIGABLE WATERS AND DREDGING

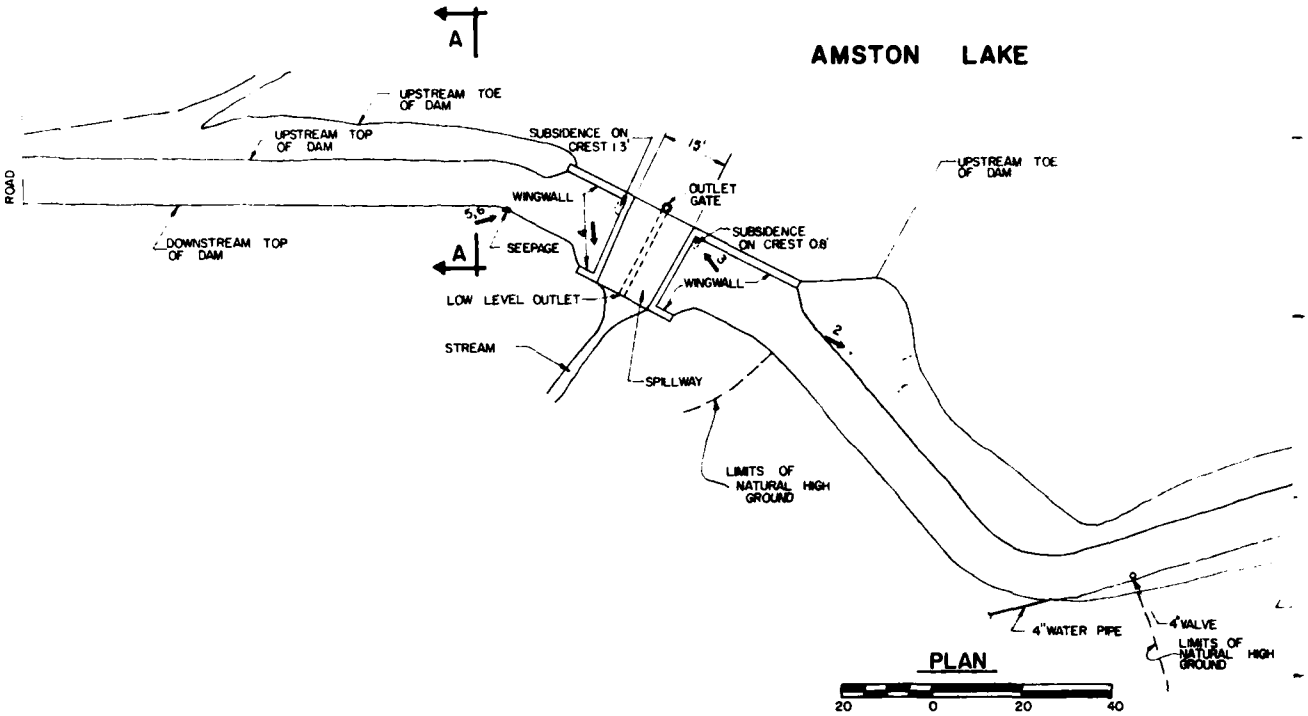
Old Lyme - John Hall - c/o John G. Holbrook & Son, Agent

The Commission considered an application received from John Hall for a permit to construct, install, and maintain a pile and timber ramp 42 feet 6 inches by 4 feet, a timber crib 8 feet 6 inches by 8 feet 6 inches, a pile and timber pier 45 feet by 4 feet and necessary mooring piles, in the Connecticut River, approximately 900 feet north of the Raymond Baldwin Bridge at Old Lyme, Connecticut. After some discussion the Commission unanimously VOTED to approve this application and directed that the proper Certificate be issued.

APPENDIX C

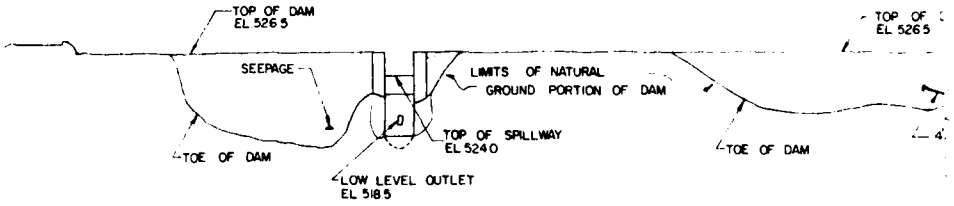
DETAIL PHOTOGRAPHS

AMSTON LAKE



PLAN

20 0 20 40



ELEVATION

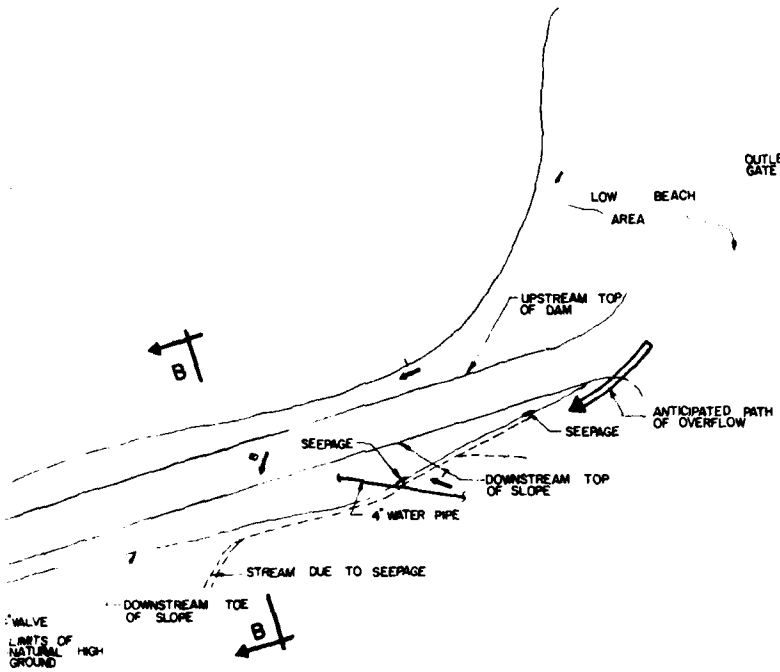
HORIZONTAL 40 0 40 80

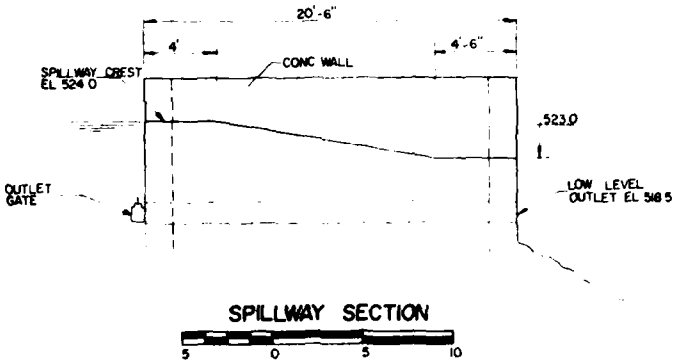
VERTICAL 10 0 10 20

SECTION A-A

5 0 5 10

(1)





SPILLWAY SECTION

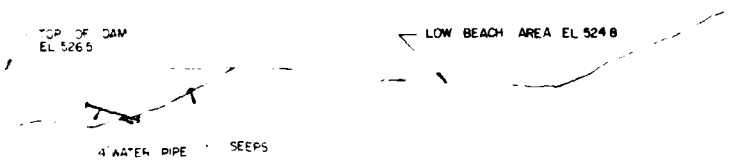
5 0 5 10

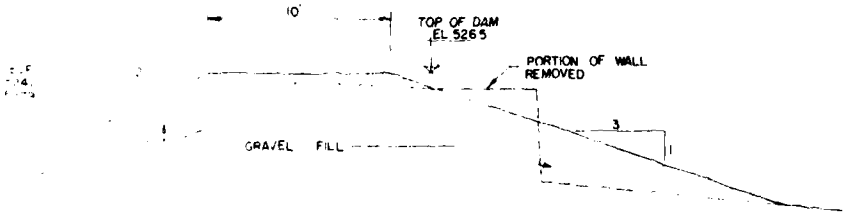
NOTES:

1. THIS PLAN WAS COMPILED FROM A PLAN ENTITLED "REPAIRS TO AMSTON LAKE DAM" DATED SEPTEMBER 4, 1963 BY CHANDLER & PALMER ENGINEERS AND FROM ROUGH FIELD SURVEY MEASUREMENTS. DIMENSIONS SHOWN ARE APPROXIMATE. NOT ALL STRUCTURAL AND/OR TOPOGRAPHIC FEATURES ARE IDENTIFIED.

2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM, THEREFORE THE WATER SURFACE ELEVATION OF AMSTON LAKE AS SHOWN ON THE USGS COLCHESTER AND COLUMBIA QUADRANGLE MAPS WAS ASSUMED TO BE THE SPILLWAY CREST ELEVATION. ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION USING A CONVERSION FROM CHANDLER & PALMER SURVEY OF THE DAM WHICH SET THE SPILLWAY CREST AT ELEVATION 100.0

3. $\overset{2}{\leftarrow}$ PICTURE NUMBER AND DIRECTION





SECTION B-B

5 0 5 10

CAHN ENGINEERS INC WALLINGFORD, CONNECTICUT ENGINEER	U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PHOTOGRAPH LOCATION PLAN

AMSTON LAKE DAM

TR-RAYMOND BROOK HEBRON, CONNECTICUT

DRAWN BY	CHECKED BY	APPROVED BY	SCALE AS NOTED	
[illegible]	CEC	PMH	DATE JUNE 1979	PLATE - 2A

(2)

PHOTO 1 - Unprotected upstream slope and crest. Note trees growing on slope, exposed roots in foreground and absence of vegetation on crest.

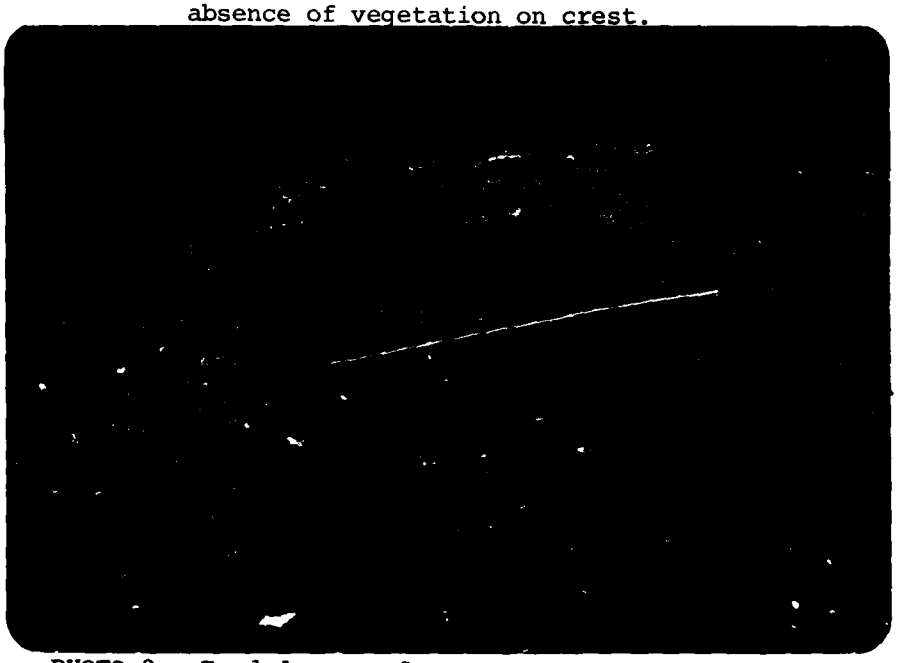


PHOTO 2 - Eroded area of upstream slope to left of spillway Seen also in upper left corner of Photo 1.

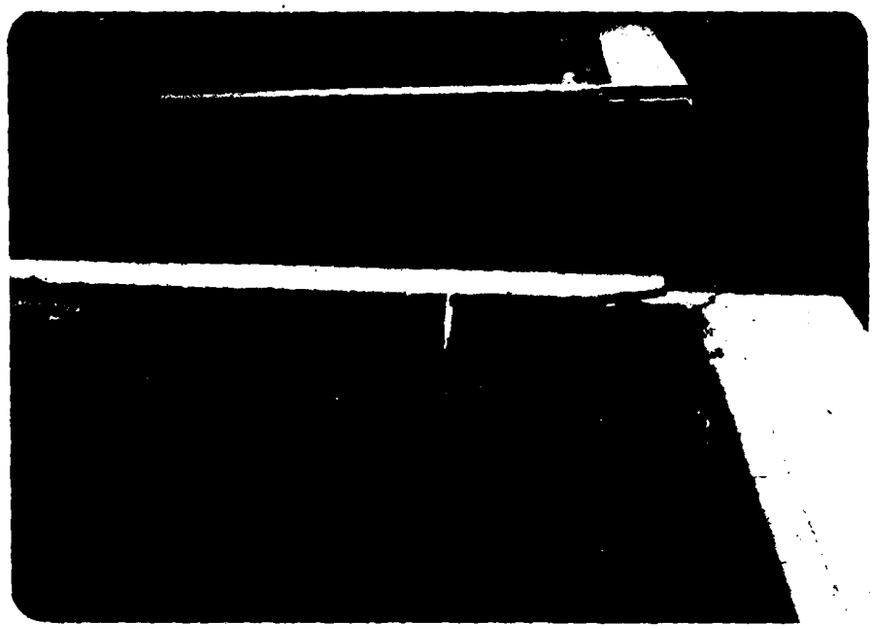


PHOTO 3 - Depressed areas on crest adjacent to spillway. Note slot for flashboards.

PHOTO 4 - Erosion due to trespassing at right downstream retaining wall of spillway section.

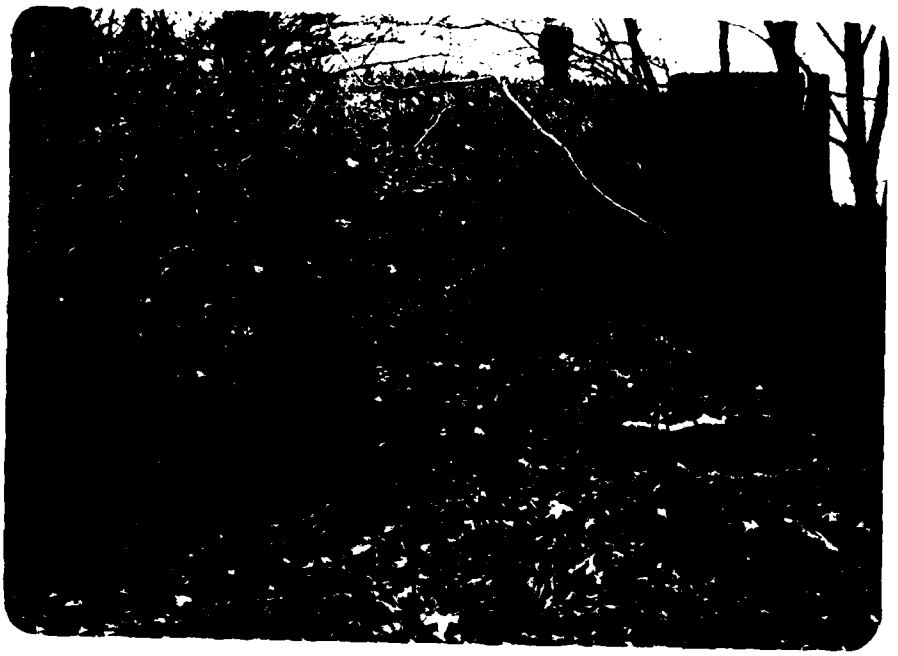


PHOTO 5 - Seep (at folding ruler) on slope to right of spillway. Note also footpath on slope.

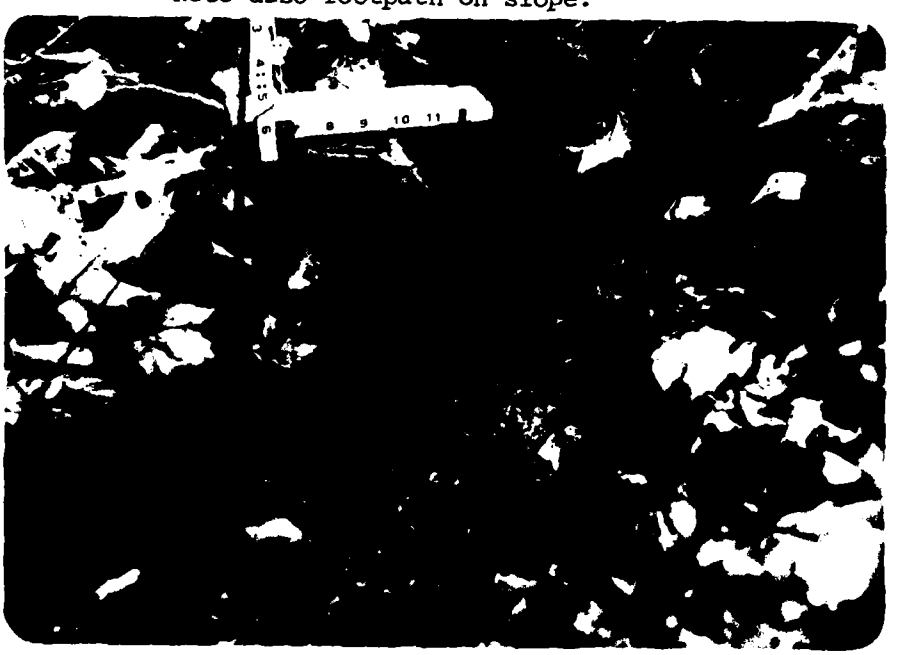


PHOTO 6 - Close-up of seep.

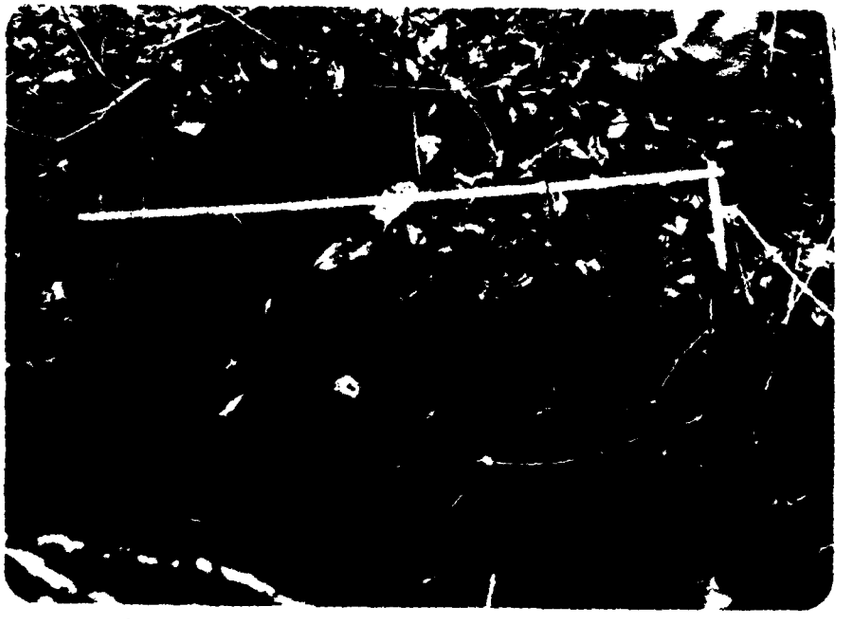


PHOTO 7 - Seepage from root mat near left end of dam. Note transport of yellowish brown silt indicating piping through dam.

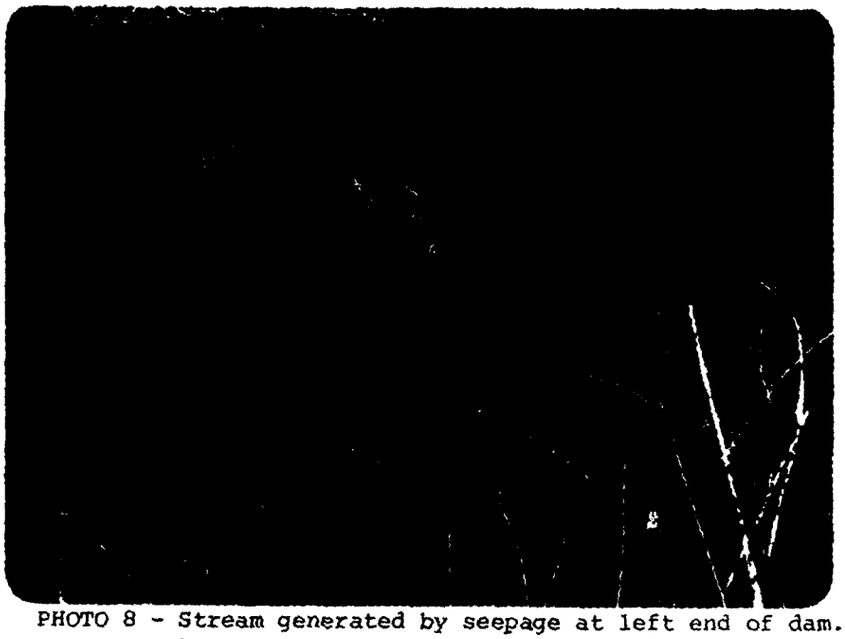


PHOTO 8 - Stream generated by seepage at left end of dam. Note heavy vegetation on downstream slope.

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS

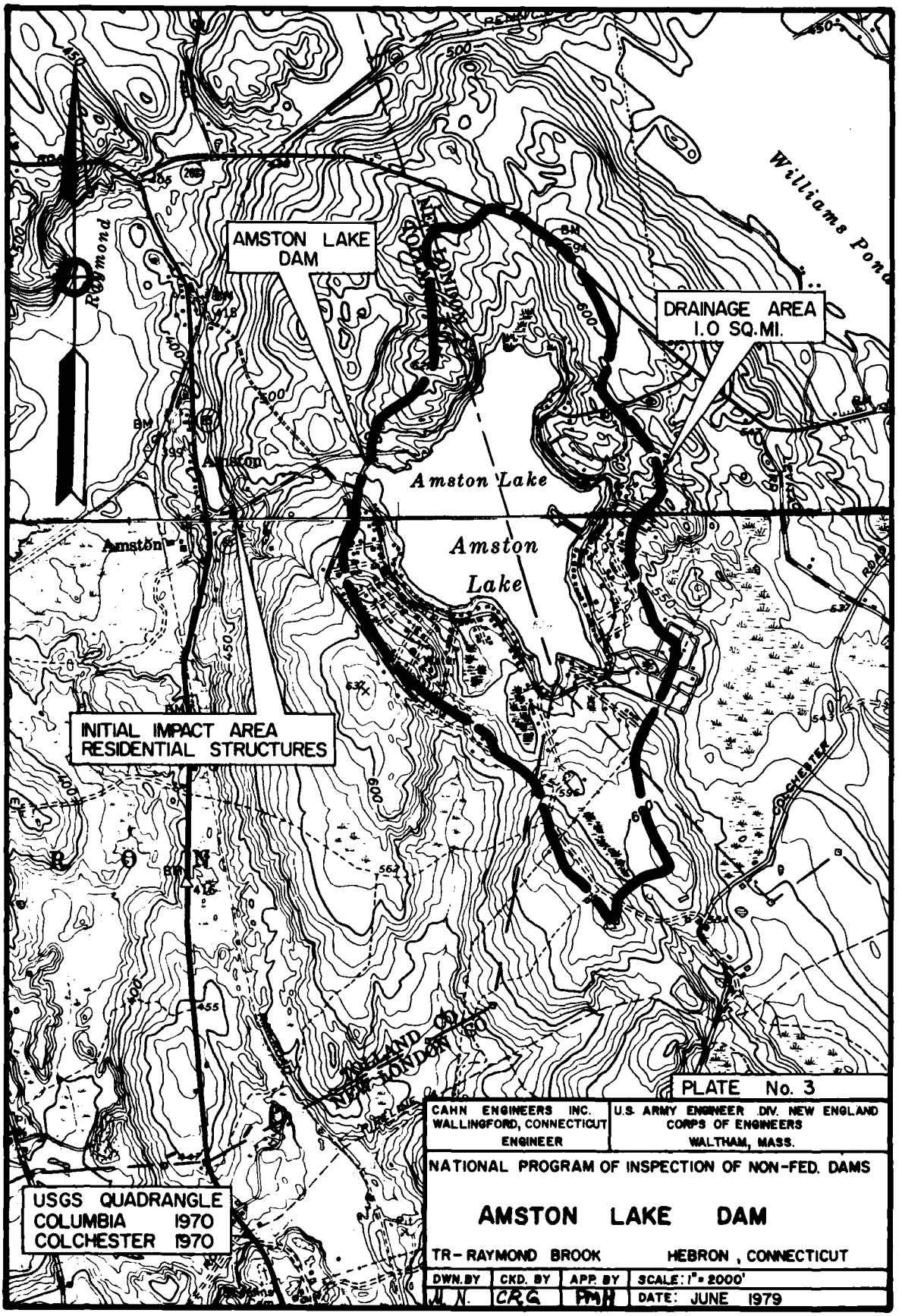


PLATE No. 3

CAHN ENGINEERS INC. WALLINGFORD, CONNECTICUT ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

AMSTON LAKE DAM

TR- RAYMOND BROOK HEBRON, CONNECTICUT

DWN. BY	CKD. BY	APP. BY	SCALE: 1" = 2000'
J.N.	C.R.G.	P.M.H.	DATE: JUNE 1979

HYDROLOGIC/HYDRAULIC INSPECTION

AMSTON LAKE DAM, HEBRON, CT.

I) PERFORMANCE AT TEST FLOOD CONDITIONS:

1) MAXIMUM PROBABLE FLOOD

a) WATERSHED CLASSIFIED AS "ROLLING"

b) WATERSHED AREA: DA. ≅ 1.0 sq mi

NOTE: USGS, HARTFORD OFFICE: DA = 1.01 sq mi; J.J. MOZZOCHI & ASSOC., LETTER TO WATER RESOURCES COMM. DATED 5/1/63: DA ≅ 765 AC ≅ 1.2 sq mi.; CE CHECK: DA. = 1.03 sq mi

c) FROM NED-ACE "PRELIMINARY GUIDANCE FOR ESTIMATING MAX. PROBABLE DISCHARGES" GUIDE CURVE FOR PMF - PEAK FLOW RATES EXTRAPOLATION TO DA'S < 2 sq mi

PMF ≅ 2400 CFS/sq mi

d) PEAK INFLOW: PMF ≅ 2400 × 1.0 ≅ 2400 CFS

2) SPILLWAY DESIGN FLOOD (SDF)

a) CLASSIFICATION OF DAM ACCORDING TO NED-ACE RECOMMENDED GUIDELINES:

i) SIZE: STORAGE (MAX) ≅ 1200 AC-FT (1000 < S < 50000 ACFT)
HEIGHT ≅ 10' (6 < H < 25 FT)

D-1

STORAGE: FROM U.S. INVENTORY OF DAMS (CONN. NO 514; CERTIFIED OF 3/28/78)
NORMAL STORAGE (MEASURED AT FLOWLINE): 240 ACFT; MAX. STORAGE: 925 AC-FT (?);

AMSTON LAKE DAM

2.a,c - Cont'd) SIZE CLASSIFICATION

STORAGE (Cont'd): C.E. ROUGH CHECK BY ASSUMING MAX. STORAGE "S" EQUAL TO (±) 0.56 THE HEIGHT x AREA; $S \doteq 975^{AC\,FT}$ (LAKE ASSUMED TO BE FORMED OVER A SWAMP AND HAVING (±) A BOTTOM AREA MIN. ⅓ THE SURFACE AREA). SO ASSUME "S" AT FLOW LINE $S \doteq 700^{AC\,FT}$. LAKE AREA AT FLOW LINE (± ELEV. 524 MSL - USGS MAPS): $A \doteq 180^{ACRE}$ (MOZZOCHI & ASSOC.), $A \doteq 185^{AC}$ (DEP, WATER & RELATED RESOURCES INVENTORY SHEET); C.E MEASURE $A = 178^{AC}$ AND $A = 212^{AC}$ @ EL. 530; SURCHARGE AREA $\doteq 190^{AC}$; MAX. STORAGE "S" = 700 + 190 x 2.5 = $1200^{AC\,FT}$

HEIGHT: ESTIMATED FROM ELEVS. IN AVAIL. CHANDLER & PALMER DWG, DATED SEPT. 4, 1963 AND MOZZOCHI & ASSOC. LETTER TO WATER RES. COMM. DATED 5/4/63.

(ii) HAZARD POTENTIAL: THE DAM IS LOCATED ¼ FROM LOW HOUSES ALONG RAYMOND BROOK. PRIMARILY, TWO HOUSES (±) ½ MI. D/S NEAR RTE 85.

(iii) CLASSIFICATION:

SIZE: INTERMEDIATE

HAZARD: SIGNIFICANT

b) SDF = ½ PMF = 1200 CFS PMF = 2400 CFS

3) SURCHARGE AT PEAK INFLOWS:

a) PEAK INFLOW: $Q_I = 1200^{CFS}$ Q_I - PMF = 2400 CFS

*NOTE: MAX. STORAGE IS TAKEN TO THE TOP OF DAM, NOT TO THE BOTTOM ELEV. OF THE SWALE @ THE BEACH, BECAUSE OF THE REASONS GIVEN IN THE COURSE OF THESE COMPUTATIONS; PARTICULARLY, ON P. 11, SECT. 1, b.

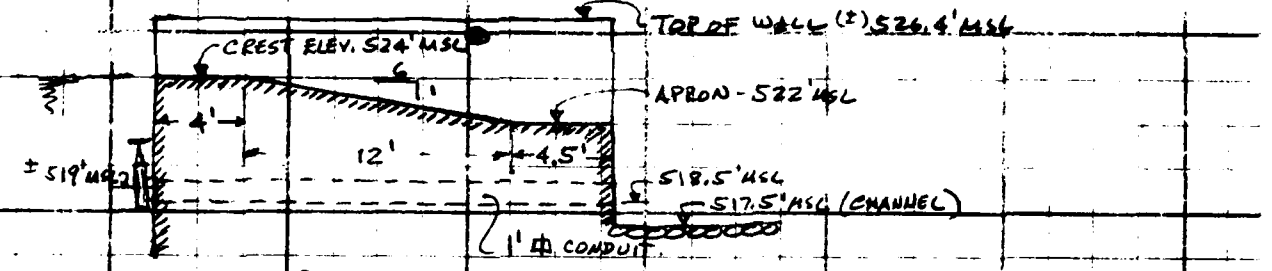
AMSTON LAKE DAM

3-Cont'd) SURCHARGE AT PEAK INFLOWS

b) SPILLWAY (OUTFLOW) RATING CURVE

i) SPILLWAY

THE SPILLWAY IS A BROAD CRESTED SPILLWAY OF TRAPEZOIDAL CROSS SECTION WITH VERTICAL U/S FACE AND SLOPING (6"H TO 1"V) D/S FACE. (CE FIELD OBSERVATIONS OF 4/25/79). THE U/S VERTICAL DEPTH OF THE SPILLWAY FACE IS P=5' (MIN.). IN PLAN, THE SPILLWAY AT THE CREST IS 15' WIDE AND THE TRAINING WALLS CLOSE IN TO A D/S WIDTH OF 12' AT THE END OF THE CONCRETE APRON. THE BREADTH AT THE CREST IS 4'. THE HEIGHT BETWEEN THE SPILLWAY CREST (ELEV. (±) 524' MSL) AND THE TOP OF THE DAM (ELEV. (±) 526.5' MSL) IS H=2.5'. A SWALE AT THE BEACH TO THE LEFT OF THE DAM (±EL. 524.8) IS HOWEVER, THE LOW OVERFLOW POINT OF THE DAM (H=0.8').



NOTE: AMSTON LAKE W.S. ELEV. 524' MSL SHOWN ON USGS, COLCHESTER, CT. QUADRANGLE SHEET OF 1953 PHOTOREVISED IN 1970 IS TAKEN AS SPILLWAY CREST ELEV.

∴ ASSUME SPILLWAY DISCHARGE COEFFICIENT. C=3.0

USING THE CREST ELEVATION AS DATUM (ELEV. 524' MSL) THE

AMSTON LAKE DAM

3,6 (Cont'd) OUTFLOW RATING CURVE

SPILLWAY DISCHARGE IS APPROXIMATED BY:

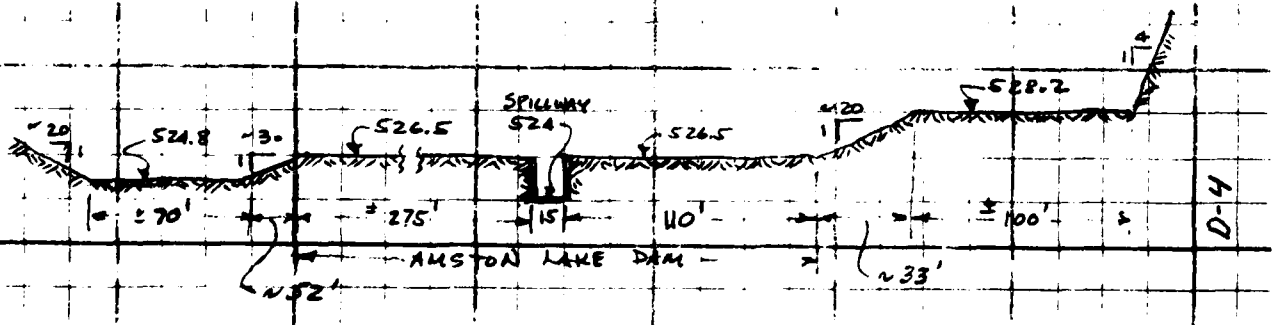
$Q_S = 45 H^{3/2}$ ($C = 3.0$, $L = 15'$)

ii) EXTENSION OF RATING CURVE FOR SURCHARGE HEADS OVERTOPPING THE DAM.

THE DAM IS AN EARTH/GRAVEL FILL EMBANKMENT EXTENDING AT BOTH SIDES OF THE SPILLWAY. THE TOP OF THE DAM AT (±) ELEV. 526.5' MSL HAS A TOTAL LENGTH OF (±) 385' (~275' TO THE LEFT AND ~110' TO THE RIGHT OF THE SPWY.)

TO THE LEFT OF THE EMBANKMENT, THE TERRAIN DROPS TO (±) ELEV. 524.8' MSL IN A DISTANCE OF (±) 52' (~30" TO 1' SLOPE) FORMING A SWALE (±) 20' WIDE AT THE BOTTOM BEFORE RISING AGAIN AT (±) 20" TO 1' SLOPE. THE SWALE IS AT THE BEACH AREA OF THE LAKE.

TO THE RIGHT, THE TERRAIN RISES AT (±) 20" TO 1' SLOPE TO (±) ELEV. 528.2' MSL (4.2' ABOVE SPILLWAY) THEN CONTINUES (±) HORIZONTAL FOR APPROX. 100' BEFORE RAISING AGAIN AT (±) 4" TO 1' SLOPE A MINIMUM OF 12' (VERTICAL).



ALSTON LAKE DAM

3.6 (Cont'd) OUTFLOW RATING CURVE

ASSUME C = 2.8 FOR THE EARTH EMBANKMENT
C = 2.5 FOR THE OVERFLOW AT THE SIDES OF THE DAM

ASSUMING ALSO EQUIVALENT LENGTHS FOR THE PORTIONS OF SLOPING TERRAIN AT THE SIDES OF THE DAM AND SWALE. THE FOLLOWING FORMULAS ARE DEVELOPED TO APPROXIMATE THE OVERFLOW (SEE PROFILE SKETCH ON PREVIOUS PAGE):

1') TOP OF DAM (BOTH SIDES OF SPILLWAY):

$L_D = 275 + 110 = 385'$ $\therefore Q_D = 1080\,(H-2.5)^{3/2}$ $(C=2.8)$

2') LEFT SIDE:

a') BETWEEN DAM AND SWALE:

$(L_L')_1 = \frac{2}{3}\left(\frac{30}{1}\right)(H-0.8)$ (20) $\therefore (Q_L')_1 = 50\,(H-0.8)^{5/2}$; $(H \le 2.5')$

NOTE: FOR HEADS $H > 2.5'$ THE SLOPING BOTTOM IS DISCONTINUED AND $(L_L'')_1 = 52'$. THEREFORE, THE Q EQUATION CHANGES TO ONE FOR CONSTANT LENGTH FOR WHICH THE HEAD HAS BEEN ADJUSTED TO OBTAIN (±) THE SAME RESULT W/EITHER FORMULA AT THE TRANSIT. DEPTH.

$(L_L'')_1 = 52'$ $(Q_L'')_1 = 130\,(H-1.2)^{3/2}$ $(H > 2.5')$

b') FLAT PORTION AT SWALE:

$(L_L)_2 = 70'$ $\therefore (Q_L)_2 = 180\,(H-0.8)^{3/2}$

AMSTON LAKE DAM

3.6 - (Cont'd) OUTFLOW RATING CURVE

2') (Cont'd) LEFT SIDE:

c') SLOPING PORTION TO THE LEFT OF THE SPILLWAY:

$$(L_L')_3 = \frac{2}{5}\left(\frac{20}{1}\right)(H-0.8) \quad \therefore \quad (Q_L')_3 = \underline{33(H-0.8)^{3/2}}$$
(13.3)

3') RIGHT SIDE:

a') SLOPING PORTION TO THE RIGHT OF THE DAM:

$$(L_R')_1 = \frac{2}{5}\left(\frac{20}{1}\right)(H-2.5) \quad \therefore \quad (Q_R')_1 = \underline{33(H-2.5)^{3/2}}, (H \leq 4.2')$$
(13.3)

NOTE: AS EXPLAINED IN PREVIOUS PAGE 4, (2',a') FOR A SIMILAR CONDITION.

$$(L_R'')_1 = 33' \quad \therefore \quad (Q_R'')_1 = \underline{83(H-2.9)^{3/2}}, (H > 4.2')$$

b') FLAT PORTION FOLLOWING TO THE RIGHT:

$$(L_R)_2 = 100' \quad \therefore \quad (Q_R)_2 = \underline{250(H-5.2)^{3/2}}$$

c') SLOPING PORTION BEYOND

$$(L_R')_3 = \frac{2}{5}\left(\frac{4}{1}\right)(H-5.2) \quad \therefore \quad (Q_R')_3 = \underline{6.7(H-5.2)^{3/2}}$$
(2.67)

AMSTON LAKE DAM

3.b (Cont'd) OUTFLOW RATING CURVE

THEREFORE, THE TOTAL OVERFLOW RATING CURVE CAN BE APPROXIMATED BY:

$$Q = Q_s + Q_D + (Q_L^*)_1 + (Q_L)_2 + (Q_L')_3 + (Q_R^*)_1 + (Q_R)_2 + (Q_R')_3$$

WHERE THE EXPRESSIONS FOR $(Q_L^*)_1$ AND $(Q_R^*)_1$ WILL VARY, AS EXPLAINED BEFORE, DEPENDING ON THE SURCHARGE DEPTH.

THE RESULTING OUTFLOW RATING CURVE IS PLOTTED ON NEXT PAGE

c) SPILLWAY CAPACITY

i) TO THE SWALE LOW POINT ELEVATION (529.8' MSL)

$H = 0.8'$ $\therefore$ $Q_s' \simeq 32^{CFS}$ ($\pm$ 2.7% of Q_{P_1}; $\pm$ 1.3% of Q_{P_1}')

ii) TO TOP OF DAM (ASSUMING NO SWALE OVERFLOW)

$H = 2.5'$ $\therefore$ $Q_s'' \simeq 180^{CFS}$ ($\pm$ 15% of Q_{P_1}; $\pm$ 7.4% of Q_{P_1}')

iii) TO TOP OF DAM INCLUDING SWALE OVERFLOW

$H = 2.5'$ $\therefore$ $Q_s''' \simeq 890^{CFS}$ ($\pm$ 72% of Q_{P_1}; $\pm$ 37% of Q_{P_1}')

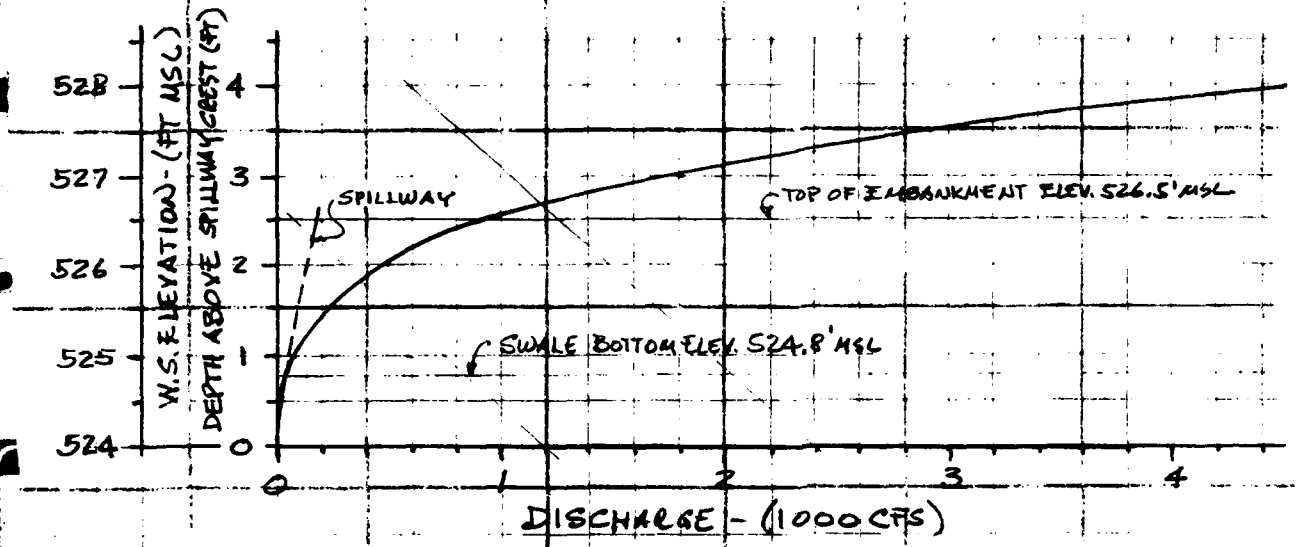
d) SURCHARGE HEIGHT TO PASS Q_{P_1}:

i) @ $Q_{P_1} = \frac{1}{2}$ PMF $= 1200^{CFS}$ $H_1 \simeq 2.7'$

ii) @ $Q_{P_1}' =$ PMF $= 2400^{CFS}$ $H_1' \simeq 3.2'$

AMSTON LAKE DAM

3-Cont'd) OUTFLOW RATING CURVE



4) EFFECT OF SURCHARGE STORAGE ON MAX. PROBABLE DISCHARGES (OUTFLOW)

a) RESERVOIR (LAKE) AREA @ FLOWLINE: *$A_o = 180^{AC.}$

*SEE "STORAGE" ON P.2 OF THESE COMPUTATIONS. C.E. MEASURES $A = 178^{AC.}$ @ ELEV. 524' MSL (COLUMBIA/COLCHESTER CT., USGS QUAD. SHEETS 1:24000, 1970)
$A = 212^{AC.}$ @ ELEV. 530' MSL.

∴ ASSUME AVE. LAKE AREA WITHIN EXPECTED SURCHARGE, $A = 190^{AC.}$

b) ASSUME NORMAL POOL LEVEL AT SPILLWAY CREST (ELEV. 524' MSL)

c) WATERSHED AREA: D.A. = 1.0 SQ MI (SEE P.1 OF THESE COMPS.)

D-8

AUSTON LAKE DAM

A-Cont'd) EFFECT OF SURCHARGE STORAGE ON PEAK OUTFLOW

d) DISCHARGE (Q_{P_2}) AT VARIOUS HYPOTHETICAL SURCHARGE DEPTHS:

$H = 4'$ $V = 190 \times 4 = 760$ AC-FT $\therefore S = \frac{760}{1 \times 53.3} = 14.3''$

$H = 2.5'$ $V = 475$ AC-FT $S = 8.91''$

$H = 1'$ $V = 190$ AC-FT $S = 3.56''$

$\therefore$ FROM APPROXIMATE STORAGE ROUTING NED-ACE GUIDELINES (19" MAX. PROBABLE R.O. IN NEW ENGLAND)

$Q_{P_2} = Q_{P_1}\left(1 - \frac{S}{2.5}\right)$ AND FOR FULL PMF: $Q'_{P_2} = Q'_{P_1}\left(1 - \frac{S}{19}\right)$

$\therefore$ FOR THE ABOVE HYPOTHETICAL SURCHARGES:

$H = 4'$ —
$H = 2.5'$ $Q_{P_2} = 74$ CFS
$H = 1'$ $Q_{P_2} = 750$ CFS

$Q'_{P_2} = 600$ CFS
$Q'_{P_2} = 1270$ CFS

ACTUALLY, FOR $H = 0$; $Q_{P_2} = 1200$ CFS, $Q'_{P_2} = 2400$ CFS

e) PEAK OUTFLOW (Q_S)

USING NED-ACE GUIDELINES "SURCHARGE STORAGE ROUTING" INTERMEDIATE METHOD (SEE P. 8 OF THESE COMPUTATIONS)

$Q_{P_S} = 380$ CFS $H_S = 1.8'$ FOR $Q_P = \frac{1}{2}$ PMF

$Q'_{P_S} = 1180$ CFS $H'_S = 2.7'$ FOR $Q'_P =$ PMF

AMSTON LAKE DAM

4-Cont'd) EFFECT OF SURCHARGE ON PEAK OUTFLOW

f) SPILLWAY CAPACITY RATIO TO OUTFLOW

i) SPWY CAPACITY TO THE SWALE LOW POINT (AT BEACH): $Q_S \doteq 32^{CFS}$
∴ THE SPILLWAY CAPACITY IS (±) 8.4% THE OUTFLOW @ ½ PMF (TEST FLOOD) AND (±) 2.7% THE OUTFLOW AT PMF.

ii) SPILLWAY CAPACITY TO TOP OF DAM (ASSUMING NO SWALE OVERFLOW):
IF THE SWALE AT THE BEACH IS CLOSED AND THE LOW PT. RAISED TO THE ELEV. OF THE TOP OF THE DAM, THUS ALLOWING ONLY DISCHARGE THRU THE EXISTING SPILLWAY, THE OUTFLOW DISCHARGE AT Q_{P_1} = ½ PMF WOULD BE (±) $Q''_{P_2} \doteq 160^{CFS}$ AND $H''_2 \doteq 2.3'$ (THE DAM IS NOT OVER-TOPPED AT THIS FLOOD) AND THE SPILLWAY CAPACITY TO TOP OF DAM ($Q''_S \doteq 180^{CFS}$) WOULD BE (±) 113% THE OUTFLOW Q''_{P_2} AT ½ PMF. (SEE P.P. 7 AND 8 OF THESE COMPS.)

iii) SPILLWAY CAPACITY TO TOP OF DAM INCLUDING THE SWALE OVERFLOW:

$Q'''_S \doteq 890^{CFS}$ (±) 230% OF Q_{P_3} AND (±) 75% OF Q'_{P_3}

5) SUMMARY:
a) PEAK INFLOW: Q_{P_1} = ½ PMF = 1200 CFS Q'_{P_1} = PMF = 2400 CFS
b) PEAK OUTFLOW: $Q_{P_3} \doteq 380$ CFS $Q'_{P_3} = 1180$ CFS
c) SPILLWAY CAPACITY TO FIRST POINT OF OVERFLOW (SWALE): $Q_S \doteq 32$ CFS
OR, (±) 8.4% OF Q_{P_3} AND (±) 2.7% OF Q'_{P_3} (SEE 4, f ABOVE)

THEREFORE, AT SDF = ½ PMF, ALTHOUGH THE ACTUAL DAM IS NOT OVERTOPPED, THERE IS AN OVERFLOW OF (±) 1' THRU THE SWALE AT THE BEACH (W.S.EL. 525.8' MSL) OR, AN AVE. SURCHARGE OF (±) 1.8' ABOVE THE SPILLWAY CREST. AT FULL PMF, THE DAM/SWALE ARE OVERTOPPED (W.S.EL. ± 26.7' MSL) OR, 2.7' ABOVE SPWY.

AMSTON LAKE DAM

II) DOWNSTREAM FAILURE HAZARD

1) PEAK FLOOD AND STAGE IMMEDIATELY D/S FROM DAM:

a) BREACH WIDTH:

i) MID-HEIGHT (±) ELEV. 519' MSL ($524 - \frac{10}{2} = 519'$ MSL)
* SEE P. 1 OF THESE COMPS.

∴ ii) APPROX. MID-HEIGHT LENGTH:

ALTHOUGH AMSTON LAKE DAM IS AT THE TOP A CONTINUOUS STRUCTURE, ACTUALLY THE DAM IS FORMED BY TWO SEPARATE SECTIONS THAT TIE IN THE MIDDLE TO NATURAL GROUND (APPARENTLY A ROCK OUTCROP). BOTH SECTIONS ARE APPROXIMATELY 10' HIGH AND ARE (±) 126' AND 160' LONG, (RIGHT & LEFT) RESPECTIVELY, AT MID-HEIGHT. (C.E. FIELD SURVEY / OBSERVATIONS OF 4/25/79).
THEREFORE ASSUME APPROX. MID-HEIGHT LENGTH $L_m \cong 160'$

iii) BREACH WIDTH (SEE NED-ACE D/S DAM FAILURE GUIDELINES).

$W = 0.4 \times 160 = 64'$ ∴ ASSUME $W_b \cong 60'$

b) PEAK FAILURE OUTFLOW (Q_{pf})

ASSUME SURCHARGE TO TOP OF DAM (ELEV. 256.5' MSL) BECAUSE ALTHOUGH THE MAX. SURCHARGE AT TEST FLOOD (½ PMF) IS (±) 1.5' LOWER DUE TO OVERFLOW THRU THE SWALE AT THE LEFT SIDE (BEACH), IT IS POSSIBLE THAT THIS LOW AREA MAY BE EVENTUALLY RAISED. UNDER THESE CONDITIONS, THE SURCHARGE AT TEST FLOOD WILL BE JUST BELOW (±0.2') THE TOP OF THE DAM.

AMSTON LAKE DAM

1,6-Cont'd) PEAK FAILURE OUTFLOW

i) HEIGHT AT TIME OF FAILURE: $Y_o = 10'$

ii) SPILLWAY DISCHARGE: $Q_s = 180^{CFS}$ (NO DISCH. THRU SWALE)

iii) BREACH OUTFLOW (Q_b):

$$Q_b = \frac{8}{27} W_b \sqrt{g}\, y_o^{3/2} = 3190^{CFS}$$

iv) PEAK FAILURE OUTFLOW (Q_{p_1}): $Q_{p_1} = Q_s + Q_b = 180 + 3190 = \underline{\underline{3370^{CFS}}}$

NOTE: IF SURCHARGE AT TIME OF FAILURE IS ASSUMED AT U/S FOR MAX. SURCHARGE AT TEST FLOOD WITH OVERFLOW THRU THE SWALE, THEN $Y_o' = 8.5'$; $Q_s' = 380^{CFS}$ (SPILLWAY + SWALE) AND $Q_b' = 2500^{CFS}$ OR A TOTAL PEAK FAILURE OUTFLOW OF $Q_{p_1}' = 2880^{CFS}$. THEREFORE, THIS CONDITION BEING STUDIED IS MORE CRITICAL.

c) FLOOD DEPTH IMMEDIATELY D/S FROM DAM:

$$Y = 0.44\, Y_o = \underline{4.4'}$$

2) ESTIMATE OF D/S DAM FAILURE CONDITIONS AT IMPACT AREA.

(SEE NED-ACE GUIDELINES FOR ESTIMATING D/S DAM FAILURE HYDROGRAPH)

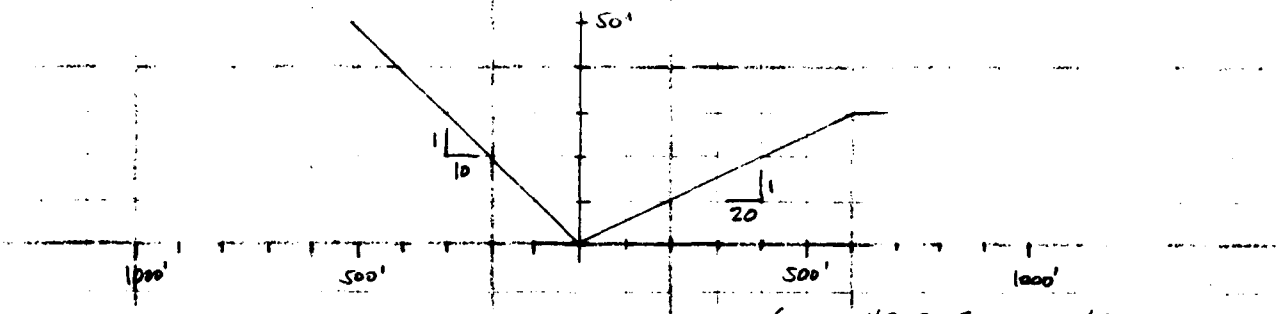
a) RESERVOIR STORAGE AT TIME OF FAILURE: $S = 1200^{AC-FT}$ *
$S/2 = 600^{AC-FT}$

*SEE P.P. 1 & 2 OF THESE COMPUTATIONS

AMSTON LAKE DAM

2-Cont'd) D/S DAM FAILURE CONDITIONS AT IMPACT AREA

b) TYPICAL D/S CROSS SECTION & RATING CURVES:

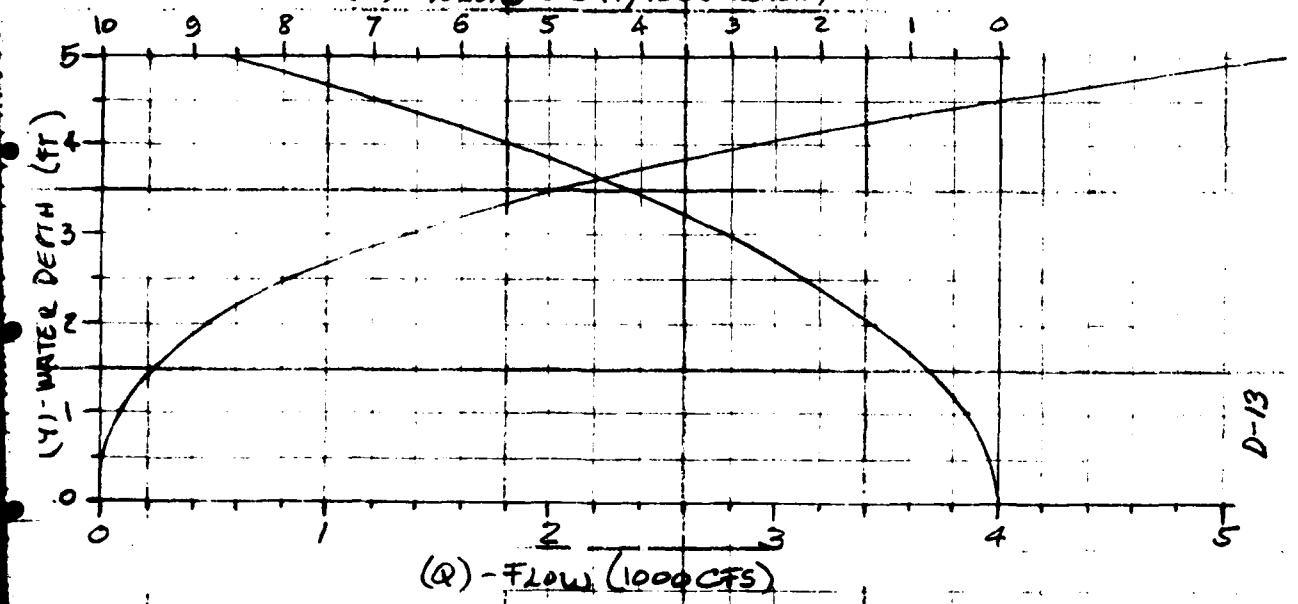


(FROM USGS, COLUMBIA / COLCHESTER, CT. QUADRANGLE SHEETS, PHOTOREVISED 1970, SCALE 1:24000)

ASSUME: i) $n = 0.040$

ii) SLOPE: $S_o \approx 4.2\%$ (DROPS 50' IN $\pm$1200')

c) RATING CURVES (D/S CROSS SECTION)



AMSTON LAKE DAM

2-Cont'd) D/S DAM FAILURE CONDITIONS AT IMPACT AREA

d) REACH OUTFLOW (Q_{P_3})

i) ASSUME REACH LENGTH $L = 2400'$ (AMSTON LAKE DAM TO IMPACT AREA)

ii) @ $Q_{P_1} = 3370^{CFS}$ $\therefore Y_1 \doteq 4.23'$ $\therefore V_1 \doteq 14.8^{AC-FT}$ $\angle \frac{S}{2}$ dwl $(\frac{S}{2} = 600^{AC-FT})$

iii) $Q_{P_2} = Q_{P_1}\left(1 - \frac{V_1}{S}\right) \doteq 3330^{CFS}$ $\therefore Y_2 \doteq 4.21'$ $\therefore V_2 \doteq 14.7^{AC-FT}$

iv) AVE VOLUME IN REACH: $V_{AVE} \doteq 14.7^{AC-FT}$

v) $\therefore Q_{P_3} \doteq 3330^{CFS}$ $Y_2 \doteq 4.21$, SAY, $Y_2 \doteq 4.2'$ (AT IMPACT AREA)

e) APPROXIMATE STAGE JUST BEFORE FAILURE:

$Q = Q_{P_2} \doteq 180^{CFS}$ $\therefore Y_S \doteq 1.41'$, SAY, $Y_S \doteq 1.4'$

f) RAISE IN STAGE AFTER FAILURE: $\Delta Y \doteq 2.8'$ (AT IMPACT AREA)

3) SUMMARY:

a) PEAK FAILURE OUTFLOW: $Q_{P_1} \doteq 3370^{CFS}$
b) REACH OUTFLOW: $Q_{P_3} \doteq 3330^{CFS}$
c) FLOOD DEPTH IMMEDIATELY D/S FROM DAM: $Y_2 \doteq 4.4'$
d) APPROXIMATE STAGE AT IMPACT AREA JUST BEFORE FAILURE: $Y_S \doteq 1.4'$
e) APPROXIMATE STAGE AT IMPACT AREA AFTER FAILURE: $Y_3 \doteq 4.2'$
f) RAISE IN STAGE AT IMPACT AREA AFTER FAILURE: $\Delta Y \doteq 2.8'$

41-0

PRELIMINARY GUIDANCE
FOR ESTIMATING
MAXIMUM PROBABLE DISCHARGES
IN
PHASE I DAM SAFETY
INVESTIGATIONS

New England Division
Corps of Engineers

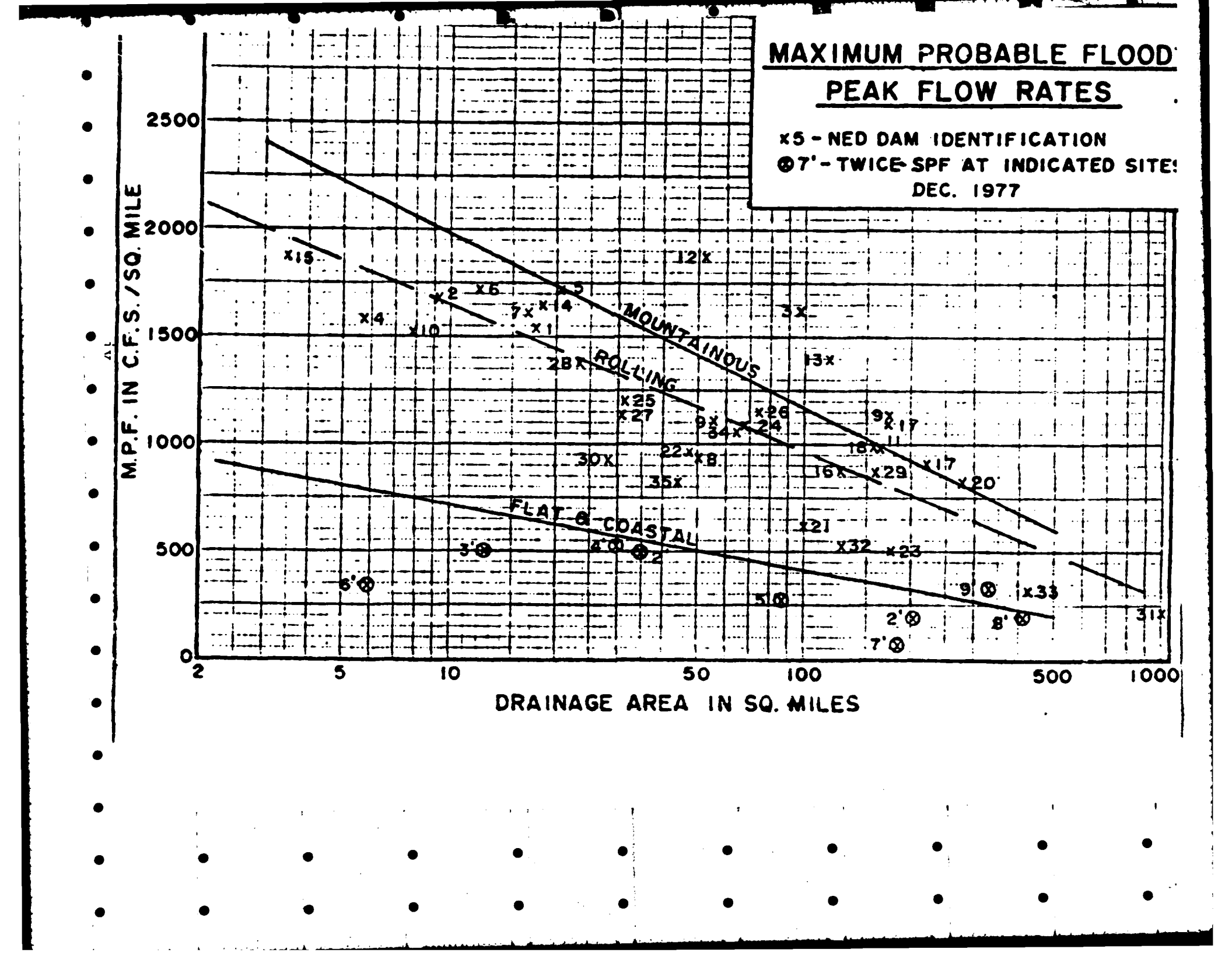
March 1978

MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

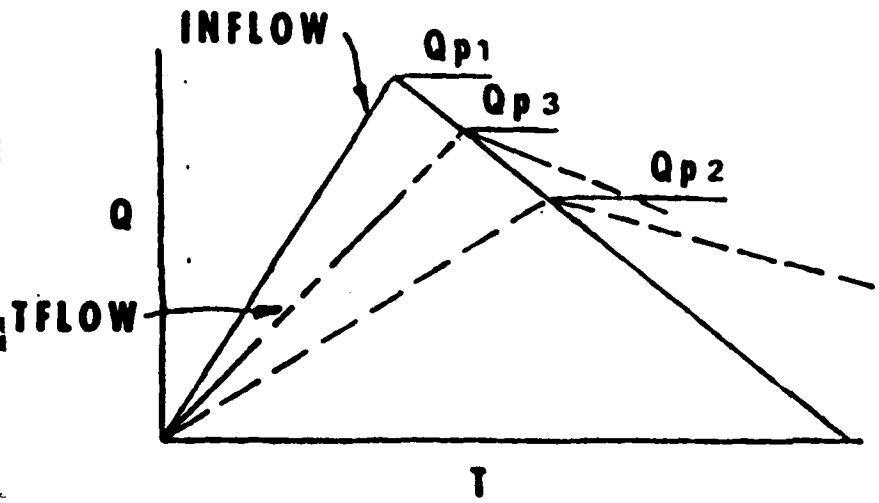
	Project	Q (cfs)	D.A. (sq. mi.)	MPF cfs/sq. mi.
1.	Hall Meadow Brook	26,600	17.2	1,546
2.	East Branch	15,500	9.25	1,675
3.	Thomaston	158,000	97.2	1,625
4.	Northfield Brook	9,000	5.7	1,580
5.	Black Rock	35,000	20.4	1,715
6.	Hancock Brook	20,700	12.0	1,725
7.	Hop Brook	26,400	16.4	1,610
8.	Tully	47,000	50.0	940
9.	Barre Falls	61,000	55.0	1,109
10.	Conant Brook	11,900	7.8	1,525
11.	Knightville	160,000	162.0	987
12.	Littleville	98,000	52.3	1,870
13.	Colebrook River	165,000	118.0	1,400
14.	Mad River	30,000	18.2	1,650
15.	Sucker Brook	6,500	3.43	1,895
16.	Union Village	110,000	126.0	873
17.	North Hartland	199,000	220.0	904
18.	North Springfield	157,000	158.0	994
19.	Ball Mountain	190,000	172.0	1,105
20.	Townshend	228,000	106.0(278 total)	820
21.	Surry Mountain	63,000	100.0	630
22.	Otter Brook	45,000	47.0	957
23.	Birch Hill	88,500	175.0	505
24.	East Brimfield	73,900	67.5	1,095
25.	Westville	38,400	99.5(32 net)	1,200
26.	West Thompson	85,000	173.5(74 net)	1,150
27.	Hodges Village	35,600	31.1	1,145
28.	Buffumville	36,500	26.5	1,377
29.	Mansfield Hollow	125,000	159.0	786
30.	West Hill	26,000	28.0	928
31.	Franklin Falls	210,000	1000.0	210
32.	Blackwater	66,500	128.0	520
33.	Hopkinton	135,000	426.0	316
34.	Everett	68,000	64.0	1,062
35.	MacDowell	36,300	44.0	825

MAXIMUM PROBABLE FLOWS BASED ON TWICE THE STANDARD PROJECT FLOOD (Flat and Coastal Areas)

River	SPF (cfs)	D.A. (sq. mi.)	MPF (cfs/sq. mi.)
1. Pawtuxet River	19,000	200	190
2. Mill River (R.I.)	8,500	34	500
3. Peters River (R.I.)	3,200	13	490
4. Kettle Brook	8,000	30	530
5. Sudbury River.	11,700	86	270
6. Indian Brook (Hopk.)	1,000	5.9	340
7. Charles River.	6,000	184	65
8. Blackstone River.	43,000	416	200
9. Quinebaug River	55,000	331	330


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000
MOUNTAINOUS
ROLLING
FLAT & COASTAL
x15
x4
x10
x2
x6
x5
x14
x1
12x
3x
13x
28x
x25
x27
9x
34x
x26
x24
9x
x17
18x
x17
x20
16x
x29
30x
22x
x8
35x
x21
x32
x23
3'⊗
4'⊗
2
6'⊗
5⊗
9'⊗
x33
2'⊗
8'⊗
7'⊗
31x

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".

SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Qp_2"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "Qp_3".

c. If Surcharge Height for Qp_3 and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "Qp_3"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "Qp_4"

c. Surcharge Height for Qp_4 and "New $STOR_{Avg}$" should Agree closely

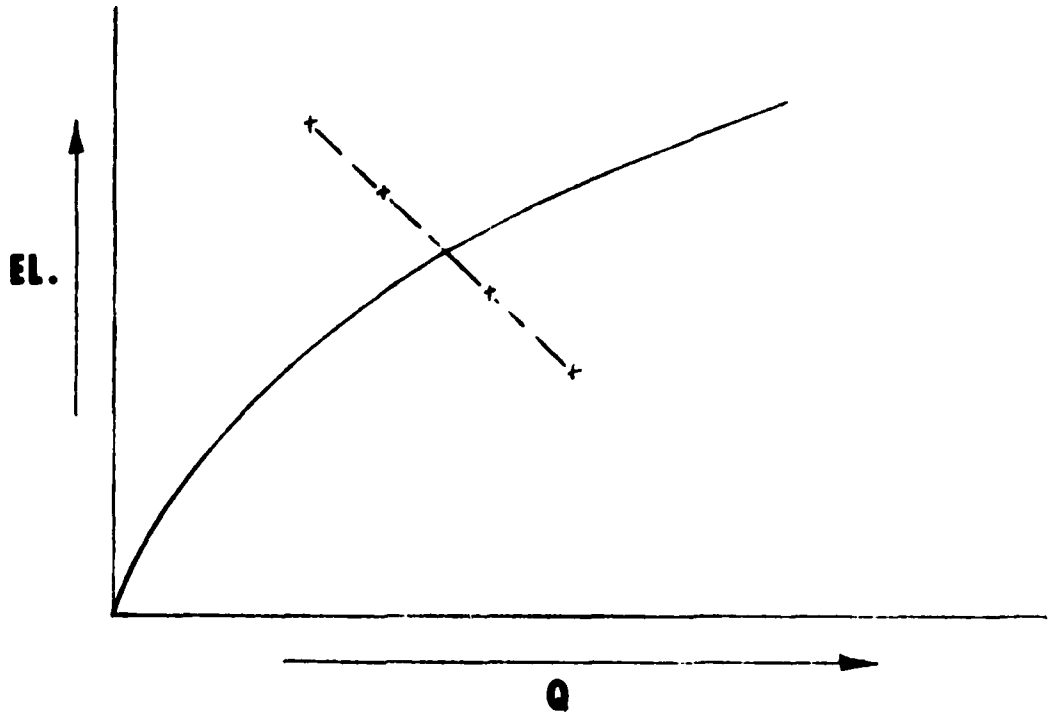
SURCHARGE STORAGE ROUTING ALTERNATE

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR}{19}\right)$$

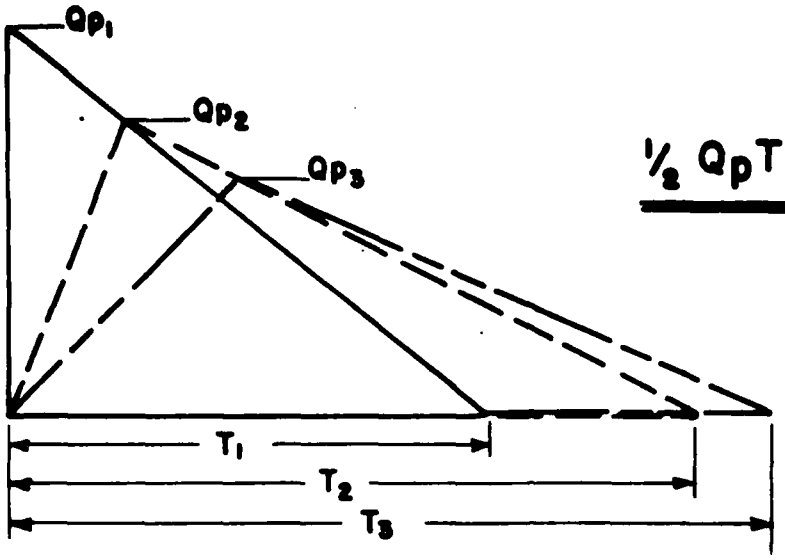
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

FOR KNOWN Q_{p1} AND 19" R.O.

Q_{p2} STOR EL.



"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS



$\frac{1}{2} Q_p T = 12 S$

STEP 1: DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

STEP 2: DETERMINE PEAK FAILURE OUTFLOW (Q_{p1}).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g} Y_o^{\frac{3}{2}}$$

W_b = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

Y_o = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

STEP 3: USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

STEP 4: ESTIMATE REACH OUTFLOW (Q_{p2}) USING FOLLOWING ITERATION.

A. APPLY Q_{p1} TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME (V_1) IN REACH IN AC-FT. (NOTE: IF V_1 EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL Q_{p2}.

$$Qp_2(\text{TRIAL}) = Qp_1 (1 - \frac{V_1}{S})$$

C. COMPUTE V_2 USING Q_{p2} (TRIAL).

D. AVERAGE V_1 AND V_2 AND COMPUTE Q_{p2}.

$$Qp_2 = Qp_1 (1 - \frac{V_{avg}}{S})$$

STEP 5: FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY	MO	YR
CT	544	NED	CT	013	01				AMSTON LAKE DAM	4137.6	7220.1	01	JUN	79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	AMSTON LAKE

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI.)	(20) POPULATION
01	08	TR-RAYMOND BROOK	AMSTON	1	800

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT.)	(25) HYDRAULIC HEIGHT (FT.)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(27) NORMAL (ACRE-FT.)	DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
REPGOT	1910	R	11	10	1200	740	NED	N	N	N	N	

(28) REMARKS
20-ESTIMATE 21-STONE + GRAVEL EMBANKMENTS

(29) D/S HAS	(30) SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	(31) MAXIMUM DISCHARGE (FT.)	(32) VOLUME OF DAM (CY)	(33) POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	(34) NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
2	400	U	15	180												

(36) OWNER	(37) ENGINEERING BY	(38) CONSTRUCTION BY
THE AMSTON LAKE COMPANY	UNKNOWN	UNKNOWN

(39) REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES	CT WATER RESOURCES

(40) INSPECTION BY	(41) INSPECTION DATE DAY	MO	YR	(42) AUTHORITY FOR INSPECTION
CAHN ENGINEERS INC	05	APR	79	PL 92-367

(43) REMARKS
33-32CFS IF LOW AREA NOT RAISED

END

FILMED

DTIC