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SOUTHERN MAINE COASTAL BASIN
YORK, MAINE

MIDDLE POND DAM
ME 0019C

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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NEW ENGLAND DIVISION, CORPS OF ENGINEERS
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The overall length of the whole facility is about 440 ft. with a maximum height of about 31 ft. The dam is in fair condition. There were no conditions which would warrant urgent remedial action. The dam is small in size with a hazard potential if significant. The owner of the dam should engage a qualified engineer qualified in the design and construction of dams to investigate the static and seismic stability of the dam.		

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424 TRAPELO ROAD
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REPLY TO
ATTENTION OF
NEDED

JUL 22 1980

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

Dear Governor Brennan:

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

A copy of this report has been forwarded to the Department of Agriculture cooperating agency for the State of Maine. In addition, a copy of the report has also been furnished the owner, Kittery Water District, 17 State Road, Kittery, Maine 03904.

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

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

Sincerely,

A handwritten signature in cursive script, appearing to read "Max B. Scheider", is written over the typed name.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

SOUTHERN MAINE COASTAL BASIN
YORK, MAINE

MIDDLE POND DAM
ME 00190

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

APRIL 1980

NATIONAL DAM INSPECTION PROGRAM
PHASE I INVESTIGATION REPORT

Identification No.: ME 00190
Name of Dam: Middle Pond
Town: York
County and State: York, Maine
Stream: Cider Hill Creek tributary to
the York River
Date of Site Visit: 16 November 1979

BRIEF ASSESSMENT

Middle Pond Dam consists of three sections; a very small earth fill dike, a concrete dike with an overflow-type spillway and a composite stone and concrete masonry dam. The three sections are separated by outcropping bedrock. The overall length of the facility, including the bedrock outcrops, is approximately 440 ft. with a maximum height of about 31 ft. The dam and associated reservoir form part of the public water supply for the Kittery Water District.

Due to the extent of downstream development that would be affected in the event the dam were to fail, Middle Pond Dam has been determined to have a "significant" hazard potential classification in accordance with Corps of Engineers guidelines.

The dam is in fair condition, based on a visual examination of the structure. Although deficiencies were noted, there was no evidence of settlement, lateral movement or other signs of structural failure, or other conditions which would warrant urgent remedial action.

Based on the "small" size and "significant" hazard potential classifications in accordance with the Corps of Engineers guidelines, the test flood selected for this dam is 1/4 the Probable Maximum Flood (1/4 PMF). Hydraulic analyses indicate that the routed test flood outflow of 210 cfs (inflow 300 cfs or 250 csm) would overtop the dam by about 0.2 ft. without flashboards in place and by about 0.3 ft. with flashboards. With the water level at the top of dam, the spillway capacity without flashboards is approximately 120 cfs, which is 57 percent of the test flood outflow.

The Kittery Water District, owner of the dam, should engage a registered professional engineer qualified in the design and construction of dams to investigate the static and seismic stability of the dam, the seepage through the dam, the need and means of providing erosion protection along the downstream toe, and the need to and means for increasing the project discharge capacity including the suitability of the reservoir drain, as outlined in Section 7.2. Any necessary modifications resulting from the

investigations, and remedial measures, including removing the flashboards, repairing eroded and spalled concrete, providing access to the gate house during high project discharges, clearing trees and brush at the site, and operating the water supply and reservoir drain gate valves, as outlined in Section 7.3, should be implemented by the Owner within one year after receipt of this report. The Owner should also prepare a formal operations and maintenance manual for the dam and establish an emergency preparedness plan and downstream warning system.

HALEY & ALDRICH, INC.
by:



Harl Aldrich
President



This Phase I Inspection Report on Middle Pond 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.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Richard J. DiBuono

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering 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, DC 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

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

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm run-off), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential. Consideration of downstream flooding other than in the event of a dam failure is beyond the scope of this investigation.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be

needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
LETTER OF TRANSMITTAL	
BRIEF ASSESSMENT	
REVIEW BOARD PAGE	
PREFACE	i-ii
TABLE OF CONTENTS	iii-v
OVERVIEW PHOTO	vi
LOCATION MAP	vii

REPORT

1. PROJECT INFORMATION	
1.1 General	1-1
a. Authority	1-1
b. Purpose of Inspection	1-1
1.2 Description of Project	1-2
a. Location	1-2
b. Description of Dam and Appurtenances	1-2
c. Size Classification	1-3
d. Hazard Classification	1-3
e. Ownership	1-3
f. Operator	1-3
g. Purpose of Dam	1-3
h. Design and Construction History	1-3
i. Normal Operational Procedures	1-4
1.3 Pertinent Data	1-4
2. ENGINEERING DATA	
2.1 Design Data	2-1
2.2 Construction Data	2-1
2.3 Operation Data	2-1
2.4 Evaluation of Data	2-1
3. VISUAL EXAMINATION	
3.1 Findings	3-1

TABLE OF CONTENTS

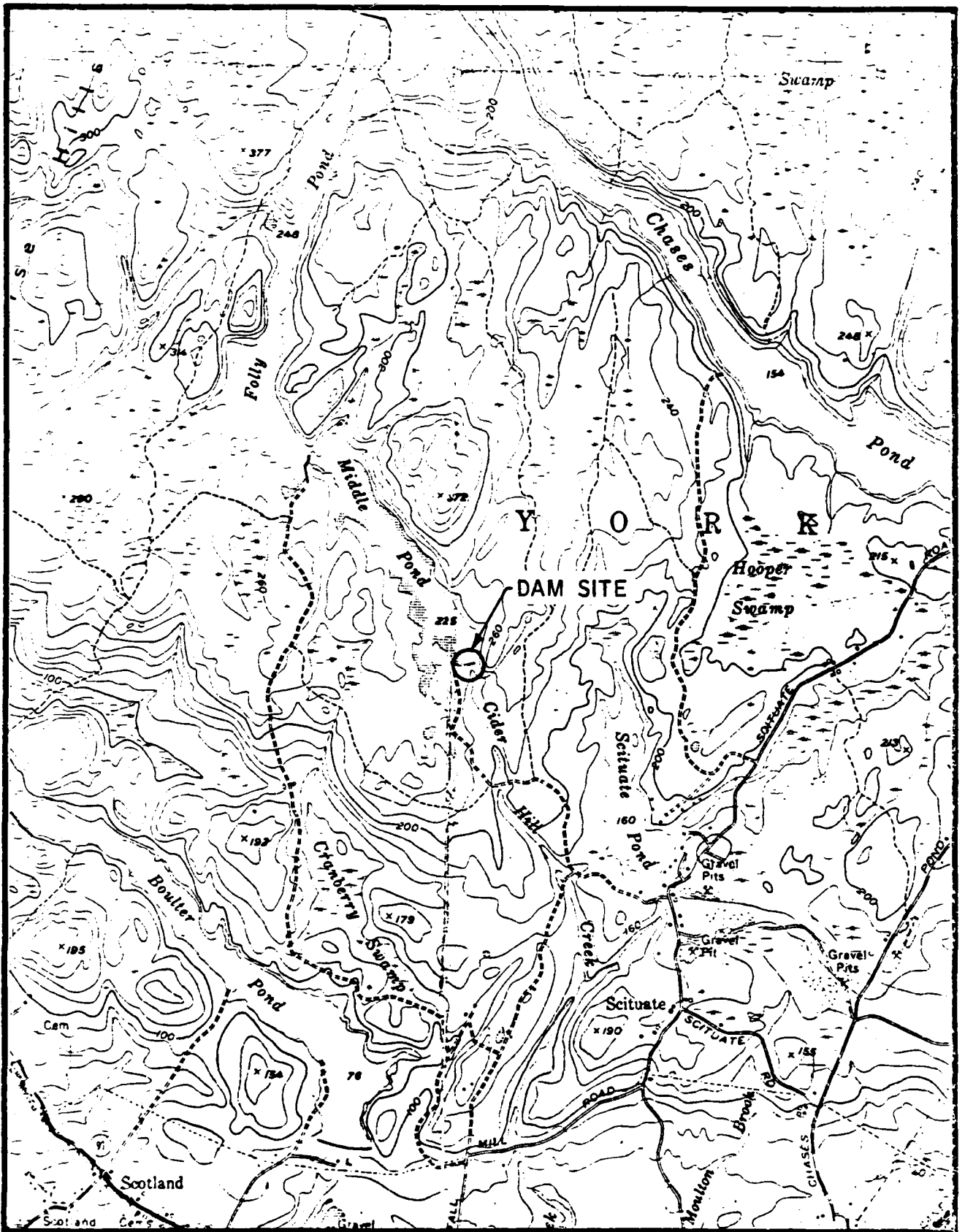
	<u>Page</u>
a. General	3-1
b. Dam	3-1
c. Appurtenant Structures	3-2
d. Reservoir Area	3-2
e. Downstream Channel	3-2
3.2 Evaluation	3-2
4. OPERATIONAL AND MAINTENANCE PROCEDURES	
4.1 Operational Procedures	4-1
a. General	4-1
b. Description of any Warning System in Effect	4-1
4.2 Maintenance Procedures	4-1
a. General	4-1
b. Operating Facilities	4-1
4.3 Evaluation	4-1
5. EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES	
5.1 General	5-1
5.2 Design Data	5-1
5.3 Experience Data	5-1
5.4 Test Flood Analysis	5-1
5.5 Dam Failure Analysis	5-2
6. EVALUATION OF STRUCTURAL STABILITY	
6.1 Visual Observations	6-1
6.2 Design and Construction Data	6-1
6.3 Post-Construction Changes	6-1
6.4 Seismic Stability	6-1

TABLE OF CONTENTS

	<u>Page</u>
7. ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES	
7.1 Dam Assessment	7-1
a. Condition	7-1
b. Adequacy of Information	7-1
c. Urgency	7-1
7.2 Recommendations	7-1
7.3 Remedial Measures	7-2
a. Operation and Maintenance Procedures	7-2
7.4 Alternatives	7-3
APPENDIX A - INSPECTION CHECKLIST	A-1
APPENDIX B - ENGINEERING DATA	B-1
APPENDIX C - PHOTOGRAPHS	C-1
APPENDIX D - HYDRAULIC AND HYDROLOGIC COMPUTATIONS	D-1
APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	E-1

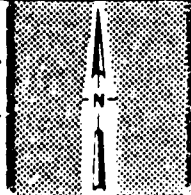


1. Overview of Middle Pond Dam from left side of dam



FILE NO. 4454 A37

DAM: Middle Pond
 IDENTIFICATION NO. ME 00190



LOCATION MAP
 U.S.G.S. QUADRANGLE
 YORK HARBOR, ME
 APPROX. SCALE: 1" = 2000'

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MIDDLE POND DAM
ME 00190

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, 8 August 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.

Haley & Aldrich, Inc. has been retained by the New England Division to inspect and report on selected dams in the States of New Hampshire and Maine. Authorization and notice to proceed were issued to Haley & Aldrich, Inc. under a letter dated 31 October 1979 from Colonel William E. Hodgson, Jr., Corps of Engineers. Contract No. DACW33-80-C-0009 has been assigned by the Corps of Engineers for this work. Camp, Dresser & McKee, Inc. was retained as consultant to Haley & Aldrich, Inc. on the structural, mechanical/ electrical and hydraulic/hydrologic aspects of the investigation.

b. Purpose of Inspection. The primary purposes of the National Dam Inspection Program are to:

1. Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests
2. Encourage and prepare the states to initiate effective dam safety programs for non-Federal dams.
3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location. The dam is located at the southeastern end of the reservoir it forms, Middle Pond, in York, Maine, as shown on the Location Map, page vii. The latitude and longitude of the dam site are N43°11.0' and W70°41.2'. Spillway discharge is conveyed by Cider Hill Creek approximately 2.4 mi. to a tidal estuary of the York River.

b. Description of Dam and Appurtenances. Middle Pond Dam consists of three distinct sections; a very small earth fill dike with concrete core wall on the right, concrete dike with overflow spillway and a composite stone and concrete masonry dam located to the left. A gate house with connecting water supply pipelines is incorporated with the composite masonry dam section that comprises the primary portion of the facility. The three sections are separated by bedrock outcrops which form the abutments at the ends of each section. The overall crest length of the facility, including the bedrock outcrops, is approximately 440 ft. and the maximum height is 31 ft.

The earth fill dike is approximately 77 ft. long with an associated height of about 3 ft. and has a 9-in. wide concrete core wall. Both upstream and downstream slopes are 1.5 horizontal to 1 vertical. Exposed bedrock separates the earth and concrete dikes by about 11 ft.

The concrete dike extends for a length of approximately 78 ft. and has a maximum height of approximately 8 ft. at the overflow-type spillway. The spillway is 2 ft. in width and 14 ft. in length with provisions for 2 ft. of flashboards. Two short concrete walls extend downstream from the dike, adjacent to the spillway, and serve as training walls forming a discharge area at the downstream side. The channel from this area is not readily definable as flow spreads out and is conveyed overland to the channel for Cider Hill Creek. The second bedrock outcrop separates the concrete dike from the dam by about 14 ft.

The gravity dam has a crest length of 261 ft. At the left end, 34 ft. of this alignment is angled upstream forming a return section at the abutment. The maximum height of the facility occurs at the gate house and is made up of 25 ft. of stone masonry with a 6 ft. concrete cap. Water is conveyed from the reservoir, through the gate house by pipelines, to the water supply facilities of the Kittery Water District.

c. Size Classification. The storage to the top of Middle Pond Dam is estimated to be 920 acre-ft., and the corresponding hydraulic height of the dam is approximately 31 ft. Storage of less than 1,000 acre-ft. and a height of less than 40 ft. classifies this dam in the "small" size category according to the guidelines established by the Corps of Engineers.

d. Hazard Classification. Dam failure analysis computations in Appendix D, which are based on Corps of Engineers "Guidance for Estimating Downstream Dam Failure Hydrographs", demonstrate why this dam has been determined to have a "significant" hazard potential classification. A failure of the dam would jeopardize the occupants of one home located approximately 1.5 mi. downstream of the dam.

e. Ownership. The name, address and phone number of the current owner of Middle Pond Dam are:

Kittery Water District
17 State Road
Kittery, Maine 03904
Phone (207) 439-1128

The Kittery Water District has owned the dam since about 1907.

f. Operator. Mr. Ed Junkins, Superintendent Kittery Water District, is responsible for operation, maintenance and safety of the dam. Mr. Junkins has been with the Kittery Water District since 1957 and his phone number is (207) 439-1128.

g. Purpose of Dam. The dam and associated reservoir presently provide a public water supply for the Kittery Water District. The Kittery Water District serves the Town of Kittery, part of York, and Eliot, and the Portsmouth Naval Base. The original purpose of the dam was to provide a water supply for the Portsmouth Naval Base.

h. Design and Construction History. A stone masonry dam was constructed at the project site in about 1901. The Superintendent of the Kittery Water District reported that the dam was designed by Mr. A.W. Gowan, (deceased), Civil Engineer from York Village, Maine. From photographs taken at the site during the construction of the dam, it is believed that the dam was built by personnel employed by Mr. Frank Jones, (deceased). Mr. Frank Jones was the original owner of the dam and of the Agamenticus Water Co., a private water supply company.

The height of the dam was increased by superimposing a 6-ft. high concrete section upon the stone masonry and constructing the concrete and earth dikes to the right of the dam. It is reported that this work was performed in 1948.

i. Normal Operating Procedures. There is no formal written procedure for the operation of the dam. Water is withdrawn continuously via one 12-in. and one 14-in. diameter pipeline in response to demand by the Kittery Water District. Reservoir water levels are recorded weekly. The 2-ft. of flashboards on the spillway are removed during the spring and replaced after snow-melt.

1.3 Pertinent Data

All elevations reported herein are based on a reservoir level, spillway crest elevation, at El. 225 National Geodetic Vertical Datum (NGVD) as given on the York Harbor, Maine, Quadrangle Map. Based on a comparison with information provided by the Superintendent of the Kittery Water District, the USGS reservoir level appears reasonable.

a. Drainage Area. The drainage area tributary to the dam site is 1.2 sq. mi. The watershed is completely undeveloped, heavily forested and under the control of the Kittery Water District. Approximately 0.7 sq. mi. or about 60 percent of the moderately rolling drainage area is tributary to Folly Pond which is immediately upstream of Middle Pond. The surface areas of Folly and Middle Ponds comprise about 10 percent of the total watershed.

b. Discharge at Dam Site

1. Outlet works..... Gated 12-in. diameter drain from gate house. Estimated invert El. 196.0 outlet conditions are unknown.
2. Maximum known flood at dam site..... Unknown
3. Ungated spillway capacity at top of dam (without flashboards)..... 120 cfs at El. 227.0 (with flashboards)..... 0 cfs at El. 227.0
4. Ungated spillway capacity at test flood pool elevation (without flashboards)..... 130 cfs at El. 227.2 (with flashboards)..... 10 cfs at El. 227.3
5. Gated spillway capacity at normal pool elevation..... Not applicable
6. Gated spillway capacity at test flood pool elevation... Not applicable

- 7. Total spillway capacity at test flood pool elevation... 130 cfs at El. 227.2
- 8. Total project discharge at test flood pool elevation... 210 cfs at El. 227.2

c. Elevation (ft. above NGVD)

- 1. Streambed at centerline of dam..... 196.0
- 2. Maximum tailwater..... Unknown
- 3. Upstream portal invert diversion tunnel..... Not applicable
- 4. Normal pool..... 227.0
- 5. Full flood control pool..... Not applicable
- 6. Spillway crest (without flashboards)..... 225.0 (with flashboards)..... 227.0
- 7. Design surcharge-original design..... Unknown
- 8. Top of dam..... 227.0
- 9. Test flood surcharge (without flashboards)..... 227.2 (with flashboards)..... 227.3

d. Length of Reservoir (mi. estimated)

- 1. Normal pool..... 0.7
- 2. Flood control pool..... Not applicable
- 3. Spillway crest..... 0.6
- 4. Top of dam..... 0.7
- 5. Test flood pool..... 0.8

e. Storage (acre-ft.)

- 1. Normal pool..... 920
- 2. Flood control pool..... Not applicable
- 3. Spillway crest..... 840
- 4. Top of dam..... 920
- 5. Test flood pool..... 927

f. Reservoir Surface (acres)

- 1. Normal pool..... 42
- 2. Flood control pool..... Not applicable
- 3. Spillway crest..... 37
- 4. Top of dam..... 42
- 5. Test flood pool..... 43

g. Dam

1. Type..... Masonry gravity (stone with concrete cap), a low earth dike and a concrete dike with spillway
2. Crest length..... 440 ft.
3. Height..... 31 ft.
4. Top width..... 3 ft. 6 in.
5. Side slopes..... Masonry dam and concrete dike battered at about 1H to 12V D/S; 5H to 12V U/S
6. Zoning..... Unknown
7. Impervious core..... Details unknown
8. Cutoff..... Founded on ledge
9. Grout curtain..... Unknown
10. Other..... Small earth fill dike at right has slopes of 1.5 H to 1.0 V both U/S and D/S with 2 ft. crest width and 9-in. thick concrete core wall founded on ledge

h. Diversion and Regulating Tunnel Not applicable

i. Spillway

1. Type..... Broad crested, 2.0-ft. wide concrete weir
2. Length of weir..... 14 ft.
3. Crest elevation..... 225.0
4. Gates..... None (flashboards are a maximum of 2 ft. in height)
5. U/S channel..... Middle Pond
6. D/S channel..... Overland flow from dam to Cider Hill Creek
7. General..... With flashboards in place, the dam and spillway become full overflow sections with a crest at El. 227.0 and a total length of approximately 340 ft.

j. Regulating Outlets. The reservoir drain consists of a 12-in. pipeline which is gated at the reservoir gate house. There is a gated 12-in. tee on the reservoir drain within the gate house for dewatering of the gate chamber. The estimated invert of the reservoir drain is El. 196.0.

A 12-in. and a 14-in. water transmission main also leave the gate house for Kittery, Maine. The invert elevations of these mains are unknown.

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No design data for the original dam or any post-construction modifications to the dam were located and none are believed to exist.

2.2 Construction Data

Photos of the original construction in 1901 and of the 1948 modification to the dam's height can be viewed at the offices of the Kittery Water District.

One drawing (see Appendix page B-2) showing a typical cross-section of the earth dike, main section of the masonry dam at the gate house and elevation view of the facility was provided by the Superintendent of the Kittery Water District. This is the only engineering drawing of the facility known to exist.

2.3 Operation Data

No operational data, other than the reservoir levels and water usage records, were located.

2.4 Evaluation of Data

a. Availability. A list of the engineering data available for use in preparing this report is included in page B-1. Selected documents from the listing are also included in Appendix B.

b. Adequacy. There was a lack of engineering data available to aid in the evaluation of Middle Pond Dam. This Phase I assessment was therefore based primarily on visual examination, preliminary hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement.

c. Validity. In general, the available data located were not applicable to an engineering evaluation of the dam.

SECTION 3 - VISUAL EXAMINATION

3.1 Findings

a. General. The Phase I visual examination of Middle Pond Dam was conducted on 16 November 1979. The upstream water surface elevation was about 0.3 ft. below the top of the dam and spillway flashboards that day.

In general, the project was found to be in fair condition. The reservoir level was high and wind driven waves were overtopping the dam and dikes. Though this condition obscured certain portions of the facility, as described below, several deficiencies which require correction were observed.

A visual inspection check list is included in Appendix A and selected photographs of the project are given in Appendix C. A "Site Plan Sketch", page C-1, shows the direction of view for each photograph.

b. Dam. The 3-ft. high earth embankment, or dike, at the right side of the dam, Photo No. 2, is in satisfactory condition. The high reservoir level submerged the upstream slope and made examination of features on that side impossible. The crest is grown over with mature trees with exposed root systems, Photo No. 3. The horizontal and vertical alignment of the crest is indeterminate due to this condition. During the site examination water was ponded along the downstream side of the dike from recent rainfall and overtopping waves. Exposed bedrock occurs immediately downstream of the dike and at some locations is within 1 to 2 ft. of the crest elevation. The concrete core wall in the dike is believed to be bearing on rock.

The concrete dike, Photo No. 4, is in fair to good condition. Efflorescence, spalling and erosion of the concrete is apparent but considered minor. The day of the site examination water was leaking through the flashboards as would be expected from the high reservoir level. The flashboard supports were rusted but both boards and pins appeared serviceable. Immediately downstream of the spillway section there are many trees, alive and dead, obstructing the discharge area, Photo No. 5.

The horizontal and vertical alignment of the composite stone and concrete dam was fair, Photo No. 6. A detailed determination of the masonry condition was not practical during the site examination due to the wind driven waves breaking over portions of the dam, Photo No. 7. However, the condition of the masonry visible, Photo Nos. 8 and 9, was generally fair to poor with efflorescence and seepage observed at many locations. Concrete spalling and

deterioration were typically worse at the joints of the concrete cap and at the stone-concrete masonry contact. Though there were numerous voids and spalling of the mortar between the stones of the older masonry, no failed areas of fallen stone were apparent.

c. Appurtenant Structures. The gate house was not readily accessible because the entrance is kept closed by two large boards, Photo No. 7, bolted to the brick wall of the gate house. Without the appropriate tools, and keys to the gate house door, an attempt to gain access was not made. The Superintendent of the Kittery Water District, present during the site examination, reported that the gate chamber was last drained and inspected during 1977. The exterior of the gate house appeared to be in good condition, Photo Nos. 1 and 6. Water was reportedly being withdrawn from the pond through the gate house transmission mains during the inspection.

The bedrock outcrops and area immediately downstream of the dam and dike are overgrown with trees and brush. There is no formal spill area at the downstream toe, Photo No. 10, for overtopping waves and there is little development of a formal discharge channel.

d. Reservoir Area. Middle Pond is bordered by undeveloped, heavily forested rolling terrain. The pond is long and narrow having a length of about 4,000 ft. and an average width of only about 400 ft. There is no significant probability of landslides into the reservoir affecting the safety of the dam. No conditions were noted which could result in a sudden increase in sediment load into the reservoir.

e. Downstream Channel. Cider Hill Creek conveys flows from the dam approximately 2.4 mi. to its confluence with the tidal portion of the York River. Approximately 1.5 mi. downstream of the dam is a 14-ft. high roadway embankment with a 10-ft. diameter CMP culvert. About 0.7 mi. further downstream is the 13-ft. high Route 91 roadway embankment with a 10-ft. square box culvert.

3.2 Evaluation

Based on the visual examination conducted on 16 November 1979, Middle Pond Dam is considered to be in fair condition. However, the remedial measures outlined in Section 7.3 should be implemented to correct the noted deficiencies in the earth and concrete dikes, composite masonry dam and the areas pertinent to the facility that are grown over with brush and trees.

SECTION 4 - OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. In general, there are no formal procedures to provide routine maintenance and satisfactory operation of the dam. The 2 ft. of flashboards on the spillway are removed during the spring.

b. Description of any Warning System in Effect. There is no warning system or emergency preparedness plan in effect for this structure.

4.2 Maintenance Peocedures

a. General. There are no established procedures or manuals for inspection and maintenance of the dam. The dam is visually checked by the Operator and reservoir level readings are taken once a week.

b. Operating Facilities. The dam does not appear to receive regular maintenance. There is no formal plan to maintain the flashboards or reservoir drain and control, and to keep the discharge area free of debris. The operability of the reservoir drain was not demonstrated during the site visit.

4.3 Evaluation

The Owner should prepare an operations and maintenance manual for the dam. The manual should delineate the routine operational procedures and maintenance work to be done on the dam to provide satisfactory operation and minimize deterioration of the facility. For example, an annual observation and maintenace program should be established to examine the dam, control vegetation growth and maintain slopes, walls and channels. A formal procedure should be established for the insertion and removal of flashboards. Incorporated in this procedure should be a procedure to operate the reservoir drain periodically.

Since failure of the dam would probably cause loss of life and property damage downstream, the Owner should also prepare and implement a formal emergency preparedness plan and warning system.

SECTION 5 - EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The Middle Pond Dam is a water supply reservoir dam. Two feet of flashboards are maintained on the spillway such that the normal reservoir level is at top of dam. The shape of the reservoir is long and narrow having a length of about 4,000 ft. and an average width of about 400 ft. Folly Pond Dam and Reservoir is located immediately upstream of Middle Pond and together the surface area of the two ponds comprise about 10 percent of the total 1.2 sq. mi. drainage area.

5.2 Design Data

No available hydraulic/hydrologic design data were located for the dam.

5.3 Experience Data

There are no records of any major hydrological occurrences at Middle Pond Dam. According to the Owner, the reservoir is filled to the top of dam (2 ft. of flashboards in spillway) and the maximum annual water level due to wave action results in minor overtopping.

5.4 Test Flood Analysis

Based on Corps of Engineers Guidelines, the recommended test flood range for the size "small" and hazard potential "significant" is the 100 year flood to 1/2 PMF (Probable Maximum Flood). The 1/4 PMF was selected for the test flood as an approximation of the low end of this range and as only one existing structure would be impacted by a failure of the dam. The 1/4 PMF was determined using the Corps of Engineers Guidelines for "Estimating Maximum Probable Discharge" in Phase I Dam Safety Investigations. The 1.2 sq. mi. drainage area consists of rolling terrain with considerable swamps and marsh. Since about 60 percent of the watershed is tributary to Folly Pond which discharges to Middle Pond, a PMF inflow rate of 1,000 csm was selected base on the Guidelines' "flat coastal" curve which results in a test flood inflow (1/4 PMF) of 300 cfs.

Surcharge storage routing of the test flood inflow was performed for two conditions: 1) no flashboards on the spillway and 2) 2 feet of flashboards in place. The routed test flood outflow

was determined to be 210 cfs under both conditions at pond levels of El. 227.2 and El. 227.3, respectively. With no flashboards, the capacity of the spillway with pond level at top of dam is approximately 120 cfs or 57 percent of the routed test flood outflow and the dam would be overtopped by about 0.2 ft. With the flashboards in place, the test flood would overtop the dam by about 0.3 ft. Consequently, Middle Pond Dam is considered hydraulically inadequate to pass the selected test flood.

5.5 Dam Failure Analysis

Based on the Corps of Engineers Guidelines for estimating dam failure hydrographs, and assuming that a failure would occur along 40 percent of the mid-height length of the stone and concrete masonry dam with pond level at top of dam, the peak failure outflow is estimated to be 11,000 cfs. Assuming the flashboards are in place, there would be no spillway discharge prior to failure. As a result of a dam failure, the roadway embankment over Cider Hill Creek located approximately 1.5 mi. downstream would be overtopped by about 4 ft. A house located on the left bank adjacent to the roadway would also be flooded to depth of about 4 ft. The 10-ft. diameter CMP culvert and roadway embankment would be severely damaged. Approximately 0.7 mi. further downstream, the flood wave would overtop Route 91 by about 2.5 ft. before entering the tidal portion of the York River. Although no structures would appear to be jeopardized by the overtopping of Route 91, the roadway and 10-ft. square box culvert could potentially be washed out.

The potential loss of life from a dam failure is a few and the dam is accordingly classified in the "significant" hazard category.

SECTION 6 - EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

There was no visual evidence of major settlement, lateral movement or other signs of structural instability in the masonry or earth portions of Middle Pond Dam. The reservoir water surface was near the top of the dam and wind blown waves were breaking over the dam and spillway during the site examination, making a detailed examination of the facility impractical.

6.2 Design and Construction Data

No design plans or construction data were located for the facility. A sketch of the facility showing cross-sections of the masonry dam, gate house and earth dike, is included on a drawing provided by the Kittery Water District dated June 1972, (see Appendix page B-2). The masonry dam cross-section shown on the drawing indicates a configuration which would have a structural stability factor of safety below that normally used for dams of comparable height. The indicated factor of safety warrants further investigation of the dam's configuration and structural stability.

6.3 Post-Construction Changes

The height of the dam is reported to have been increased by 6 ft. in 1948. No other material post-construction changes are known.

6.4 Seismic Stability

Middle Pond Dam is located in a Seismic Zone 2 and in accordance with Recommended Phase I Guidelines does not normally warrant seismic analysis. However, since the given cross-section of the masonry dam indicates a low static stability factor of safety, the seismic stability of this structure is questionable and should also be investigated.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS
AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual examination of Middle Pond Dam revealed that the structure was in fair condition. Although there were no signs of impending structural failure or other conditions which would warrant urgent remedial action, deficiencies warranting investigation and repairs were noted.

Based on the results of computations included in Appendix D and described in Section 5, the spillway is not capable of passing the test flood, which for this structure is the 1/4 PMF. The routed test flood outflow of 210 cfs (inflow 300 cfs or 250 csm) would overtop the dam by about 0.2 ft. without flashboards in place and by about 0.3 ft. with flashboards. With the water level at the top of dam, the spillway capacity without flashboards is about 120 cfs, which is 57 percent of the routed test flood outflow.

b. Adequacy of Information. This evaluation of the dam is based primarily on visual examination, approximate hydraulic and hydrologic computations, consideration of past performance and application of engineering judgement. Generally, the information available or obtained within the scope of this investigation was adequate for the purposes of a Phase I assessment. However, it is recommended that additional information regarding the stability of the dam be obtained, as outlined in Section 7.2.

c. Urgency. The recommendations for additional investigations and remedial measures outlined in Section 7.2 and 7.3, respectively, should be undertaken by the Owner and completed within one year after receipt of this report.

7.2 Recommendations

It is recommended that the Owner engage a registered professional engineer qualified in the design and construction of dams to undertake the following investigations:

1. Investigate the static and seismic stability of the masonry dam to determine if and to what degree structural modifications are necessary.

2. Investigate the seepage through the masonry to determine if and to what degree remedial actions are necessary.
3. Investigate the need for erosion protection along the downstream toe of the dam and dikes. This investigation should identify both the areas requiring erosion protection and means of providing it.
4. Perform detailed hydrologic-hydraulic studies to determine the needs to and means for increasing the project discharge capacity and investigate the suitability of the reservoir drain.

The Owner should then implement corrective measures on the basis of these engineering investigations.

7.3 Remedial Measures

Although the dam is generally in fair condition, it is considered important that the following items be accomplished.

a. Operation and Maintenance Procedures. The following should be undertaken by the Owner:

1. Remove the spillway flashboards so as to provide 2 ft. of freeboard during dry weather. Flashboards should not be replaced pending the results of the recommended hydrologic-hydraulic studies.
2. Repair eroded and spalled concrete areas at the masonry dam and concrete dike. All deteriorated and weak concrete should be removed prior to patching the concrete.
3. Provide a safe means of access to the gate house and into the gate chamber when overtopping discharges occur at the dam. Consideration should be given to the construction of a raised walkway with railing across the top of the dam.
4. Clear trees and brush for a distance equal to twice the adjacent height of the structure immediately downstream of the masonry dam and dikes. Clear trees and brush from the spillway discharge area and downstream channel.

5. Cut and remove the trees located on the crest and slopes of the earth dike. Roots from these trees could damage the concrete core wall and/or interpenetrate the cracks of the bedrock initiating a failure in this structure. Also, if trees on the dike were to be blown over the root systems would probably cause considerable damage as they were uprooted.

As the core wall bears on rock, after the trees are cut the stumps may be left in place. However, the Operator should make periodic visual observations noting carefully the development of wet areas not attributable to local runoff from precipitation or highwater overtopping.

6. Operate the water supply pipeline gate valves and reservoir drain mechanism at the gate structure to insure their operability. In addition, a procedure should be established to operate the reservoir drain periodically.
7. Prepare an operations and maintenance manual for the dam. The manual should include provisions for annual technical inspection of the dam and for round-the-clock surveillance of the dam during periods of heavy precipitation and high project discharges. The procedures should delineate the routine operational procedures and maintenance work to be done on the dam to ensure safe, satisfactory operation and to minimize deterioration of the facility.
8. Develop a written emergency preparedness plan and warning system to be used in the event of impending failure of the dam or other emergency conditions. The plan should be developed in cooperation with local officials and downstream inhabitants.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A - INSPECTION CHECK LIST

	<u>Page</u>
<u>VISUAL INSPECTION PARTY ORGANIZATION</u>	A-1
<u>VISUAL INSPECTION CHECK LIST</u>	
Dike Embankment	A-2
Dam, Spillway, Approach and Discharge Channels	A-2

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

Dam: Middle Pond

Date: 16 November 1979

Time: 1130-1300

Weather: Clear, windy and cold (20-30°F)

Water Surface Elevation Upstream: El. 226.7 (0.3 ft. below top
of dam)

Stream Flow: Unknown

Inspection Party:

Harl P. Aldrich, Jr.	- Soils/Geology
Charles R. Nickerson Haley & Aldrich, Inc.	
Roger W. Wood	- Structural/Mechanical
Joseph E. Downing Camp, Dresser & McKee, Inc.	- Hydraulic/Hydrologic

Present During Inspection:

Ed Junkins, Superintendent Kittery Water District

**VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM**

DAM: Middle Pond DATE: 16 Nov. 1979

AREA EVALUATED	CONDITION
<p><u>DIKE EMBANKMENT</u> (Extreme right end of dam)</p> <p>Crest Elevation Current Pool Elevation Maximum Impoundment to Date General Remarks</p>	<p>El. 227 (Same as top of concrete dike) El. 226.7 Unknown This 2-3-ft. high earth embankment, constructed when the dam was raised, is about 77 ft. long. It has a 9 in. concrete core wall bearing on rock. The top of the "embankment" is about 1 ft. wide. The structure has numerous trees with exposed root systems. Very little would happen if the embankment were breached since bedrock occurs within 2 to 3 ft. of ground surface. The condition is considered satisfactory as-is.</p>
<p><u>DAM, SPILLWAY, APPROACH AND DISCHARGE CHANNELS</u></p> <p>a. <u>Approach Channel</u></p> <p>General Condition Loose Rock Overhanging Channel Trees Overhanging Channel Floor of Approach Channel</p> <p>b. <u>Dam and Spillway Weir</u></p> <p>General Condition of Concrete Rust or Staining Spalling Any Visible Reinforcing Any Seepage or Efflorescence Drain Holes</p>	<p>No formal approach channel - structures right at pool</p> <p>Good</p> <p>None observed None observed Not visible</p> <p>Dam has concrete cap on stone masonry. Visible portions of spillway are concrete</p> <p>Fair (spalling, efflorescence, and erosion present). Eroded joint with vegetation present at spillway</p> <p>None observed Spalling at top of dam and at joints None observed Many locations</p> <p>None observed</p>

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Middle Pond

DATE: 16 Nov. 1979

AREA EVALUATED	CONDITION
<p>c. <u>Discharge Channel</u></p> <p>General Condition Loose Rock Overhanging Channel Trees Overhanging Channel Floor of Channel</p>	<p>Poor - rocky and wooded stream None observed</p> <p>Many trees and brush Rocky</p>

FILE NO 4454

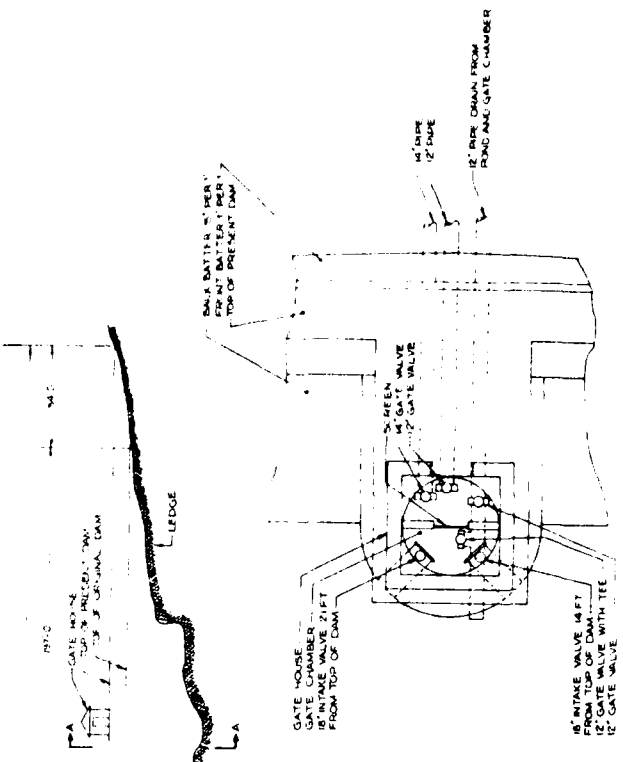
APPENDIX B - ENGINEERING DATA

	<u>Page</u>
<u>LIST OF AVAILABLE DATA</u>	B-1
<u>PRIOR INSPECTION REPORTS</u>	
None available	
<u>DRAWING</u>	
"Diagram of Water Reservoir System in Town of York Detailing Pipelines & Dam", Kittery Water District Kittery, Maine, June 1972	B-2

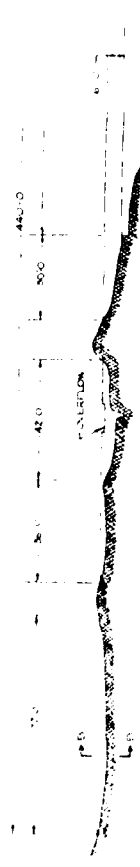
LIST OF AVAILABLE DATA
MIDDLE POND DAM

<u>Document</u>	<u>Contents</u>	<u>Location</u>
"War Time Improvements to the System of the Kittery Water District" by Paul F. Howard	Reprint from the Journal of the Maine Water Utilities Association, dated May 1945	Whitman & Howard, Inc. 45 Williams Street Wellesley, MA 02181
"New Boulder Dam and Reservoir" by Paul F. Howard	Reprint from the Journal of the Maine Water Utilities Association, dated July 1950	Whitman & Howard, Inc.
Application for Dam Registration	State of Maine Registration form, dated 7 March 1977	Maine Soil and Water Conservation Commission Department of Agriculture State of Maine State Office Building Augusta, Maine 04333

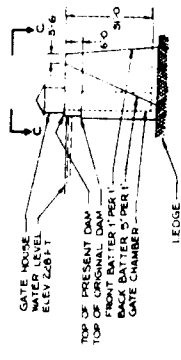
DETAIL 'A'
MIDDLE POND DAM



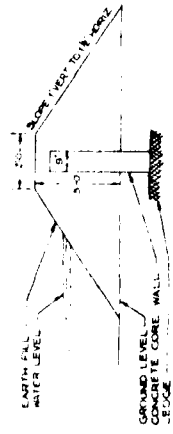
PLAN C-C
SCALE 1/2\"/>



ELEVATION
LOOKING TOWARDS POND
SCALE: 1\"/>



SECTION A-A
SCALE 1/4\"/>



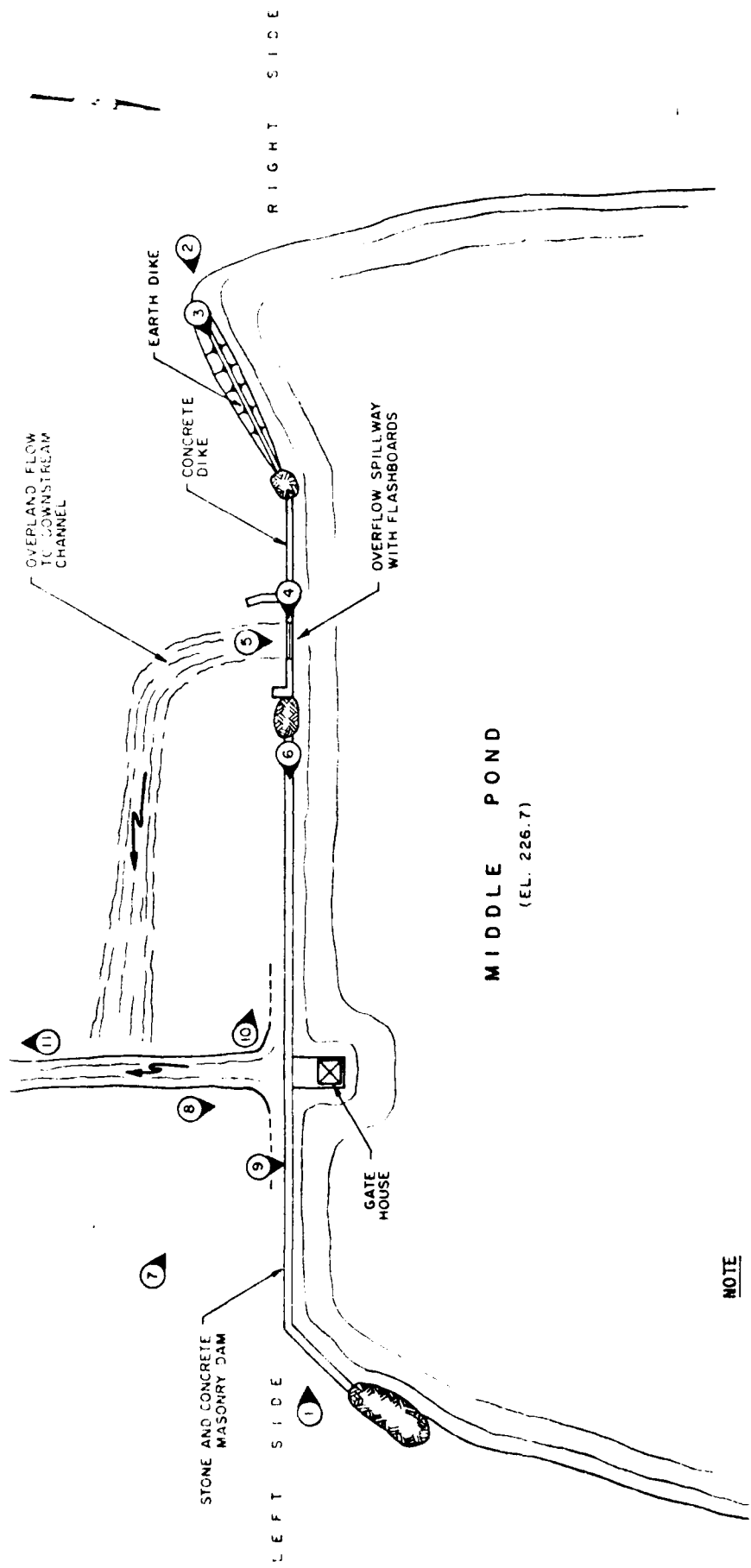
SECTION B-B
SCALE 1/2\"/>

APPENDIX C - PHOTOGRAPHS

<u>LOCATION PLAN</u>	<u>Page</u>
Site Plan Sketch	C-1

PHOTOGRAPHS

<u>No.</u>	<u>Title</u>	<u>Roll</u>	<u>Frame</u>	<u>Page</u>
1.	Overview of Middle Pond Dam from left side of dam	17	4A	vi
2.	Earth dike from right side of dam	17	16A	C-2
3.	Mature tree growth over crest of earth dike	17	18A	C-2
4.	Alignment of concrete dike and spillway	17	13A	C-3
5.	Spillway, with water overtopping flashboards, and discharge area	17	10A	C-3
6.	Alignment of composite masonry dam and gate house	17	21A	C-4
7.	Wind driven waves overtopping masonry dam; note boarded gate house entrance	17	3A	C-4
8.	Maximum section of dam, downstream	17	1A	C-5
9.	Efflorescence and deterioration of concrete at top of dam	17	6A	C-5
10.	Overtopping water flowing to downstream channel along toe of dam	17	7A	C-6
11.	Downstream channel	17	8A	C-6



Middle Pond Dam
York, ME

SITE PLAN SKETCH

Approx. Scale: 1"=40' April 1980

C-1

NOTE

PLAN DEVELOPED FROM "DIAGRAM OF WATER RESERVOIR SYSTEM IN TOWN OF YORK DETAILING PIPELINES & DAMS", BY KITTERY WATER DISTRICT, KITTERY, MAINE, DATED JUNE 1972 (SEE APPENDIX PAGE B-3) AND FIELD OBSERVATIONS MADE ON 16 NOVEMBER 1979.

LEGEND

② PHOTO NUMBER AND DIRECTION OF VIEW

HALEY & ALDRICH, INC.
CAMBRIDGE, MASSACHUSETTS



2. Earth dike from right side of dam



3. Mature tree
growth over
crest of earth
dike



4. Alignment of concrete dike and spillway



5. Spillway, with water overtopping flashboards, and discharge area



7. Wind driven waves overtopping masonry dam; note boarded gate house entrance



6. Alignment of composite masonry dam and gate house



8. Maximum section of dam, downstream



9. Efflorescence and deterioration of concrete
at top of dam



10. Overtopping water
flowing to down-
stream channel
along toe of
dam



11. Downstream channel

APPENDIX D - HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Maps

Page

Drainage Area Map

D-1

Dam Failure Impact Area Map

D-2

Computations

Elevations, Surface, Storage Capacities and Size
Classification

D-3

Hazard Classification, Test Flood Determination
and Stage-Discharge Relationships

D-4

Surcharge-Storage Routing

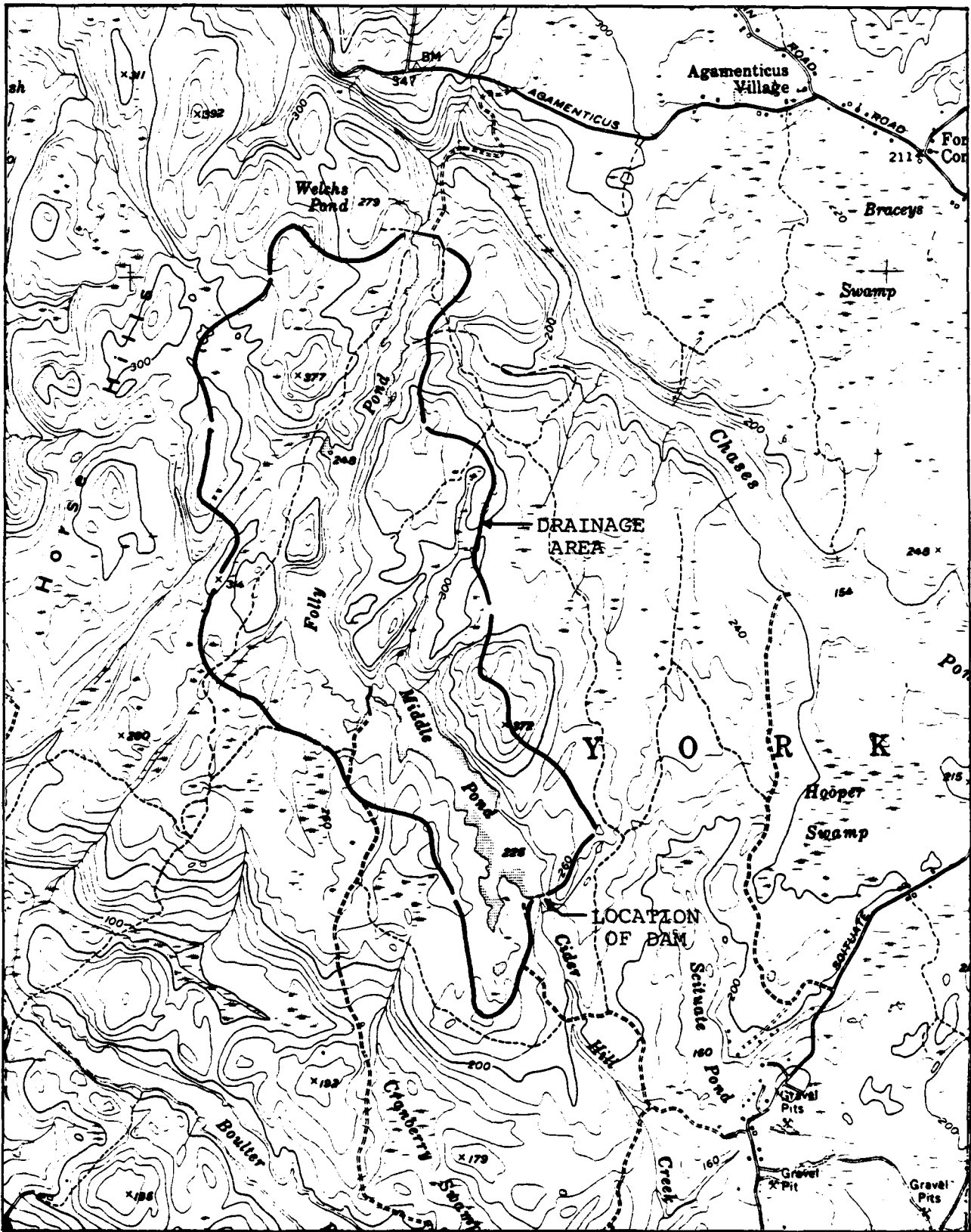
D-5

Stage-Discharge and Storage Elevation Curves

D-6

Dam Failure Analysis

D-8

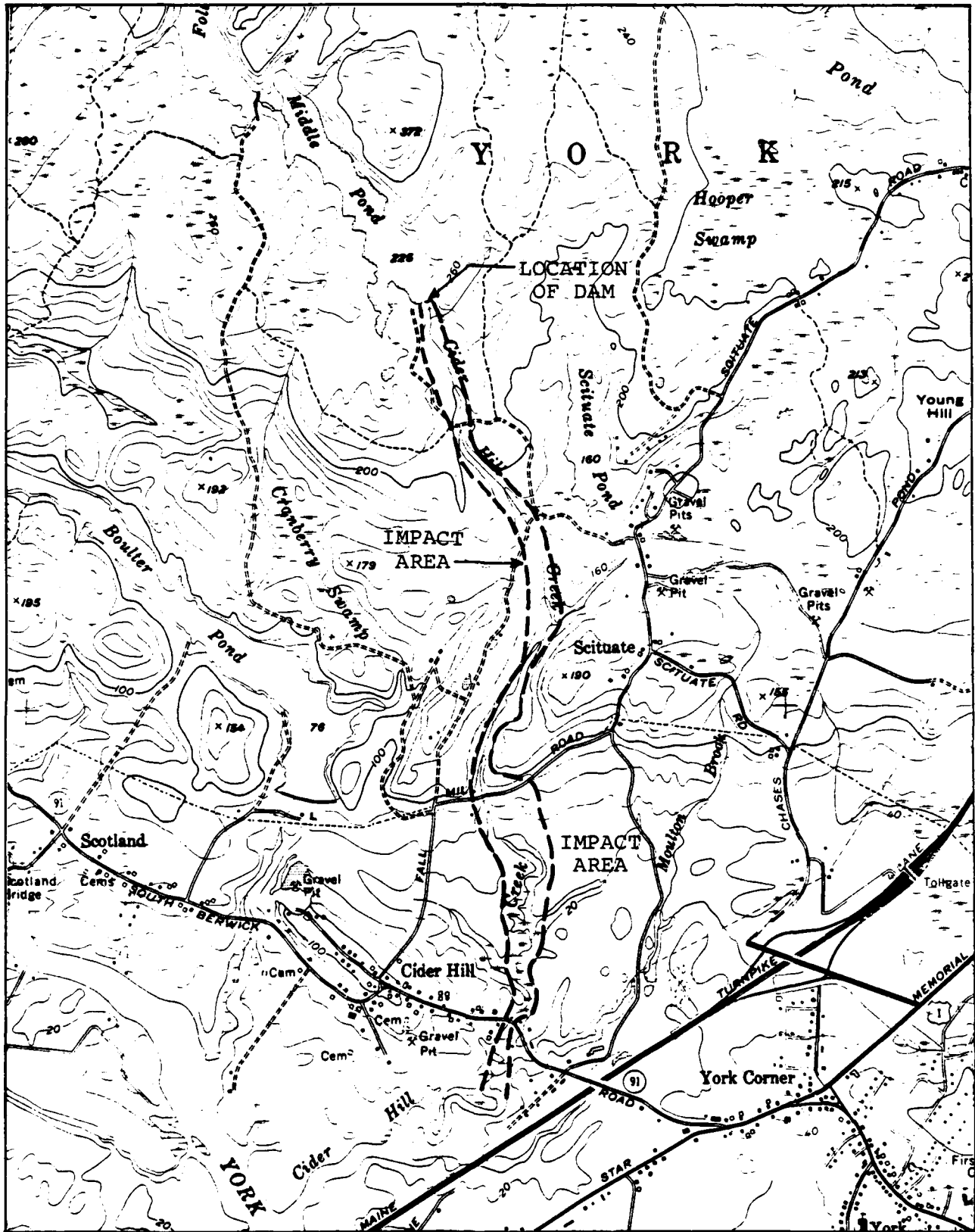


MIDDLE POND DAM
ME 00190



DRAINAGE AREA MAP

APPROX. SCALE: 1" = 2000'



MIDDLE POND DAM
ME 00190



DAM FAILURE IMPACT
AREA MAP

APPROX. SCALE: 1" = 2000'

ELEVATIONS (USGS datum)

Top of dam = El. 227.0
 Toe of dam = El. 196.0
 Spillway crest = El. 225.0

Note: There are no established elev. for the dam.
 Above elev. assume Pond Elev. of 225.0 shown
 on USGS Quad.: York Harbor, Me. 1973 rev., to
 be equal to spillway crest.

SURFACE AREAS

D.A. = 758 acres = 1.2 sq. mi.
 W.S. area at elev. 225.0 = 37 acres
 W.S. area at elev. 227.0 = 42 acres
 Est. area at elev. 230.0 = 50 acres

D.A. tributary to Folly Pond which discharges to Middle
 Pond is 455 ac. = 0.7 mi² or ~60% of total D.A.

STORAGE CAPACITIES

Maximum capacity (El. 227.0) is reported to be
 300 MG = 920 ac-ft.

Storage between El. 225.0 and 227.0
 = $\frac{37+42}{2} \times 2 = 79$ ac-ft

\therefore Storage at El. 225 = 920 - 79 = 841 ac-ft.

Storage at El. 230.0 = 920 + $\frac{42+50}{2} \times 3 = 1058$ ac-ft.

SIZE CLASSIFICATION

Height = 227.0 - 196.0 = 31 ft. < 40 ft.

Storage @ top of dam (El. 227.0) = 920 ac-ft. < 1000 ac-ft.

\therefore Size is SMALL

HAZARD CLASSIFICATION

A dam failure would create the potential for loss of life in one house located approx. 1.5 miles d/s of dam.

∴ Hazard is SIGNIFICANT

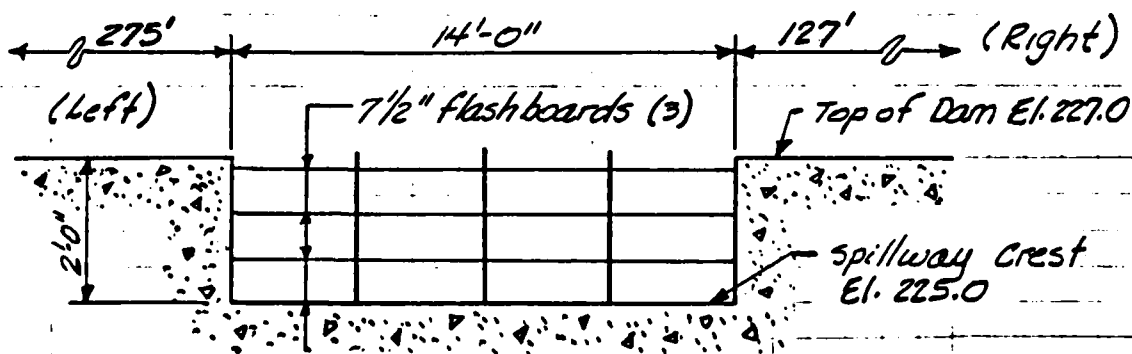
TEST FLOOD DETERMINATION

For a small size and significant hazard, COE Guidelines give test flood range of 100-YR Flood (1/4 PMF) to 1/2 PMF (Probable Maximum Flood). Adopt 1/4 PMF for test flood.

The drainage area consists of Rolling Terrain drained by numerous swamps and marshes typical of Flat & Coastal. Approx. 0.7 sq. mi. or 60% of the drainage area is tributary to Folly Pond which is ups of Middle Pond. Therefore, use Flat & Coastal Guideline curve to develop inflow rate to Middle Pond.

$$\begin{aligned} \text{then test Flood inflow} &= 1.2 \text{ sq. mi.} \times 1000 \text{ csm} \times 1/4 \\ &= 300 \text{ cfs} \end{aligned}$$

STAGE-DISCHARGE RELATIONSHIPS



Top widths of weir:
 Overflow spillway & top of dam to the right = 8'-0"
 Top of dam to the left = 3'-6"

W. S. ELEV.	SPILLWAY				DAM				TOTAL FLOW Qw/O FLASH/ Qw/FLASH.
	WITHOUT FLASHB'DS		WITH FLASHB'DS		LEFT OF SPILL. L=275'		RIGHT OF SPILL. L=127'		
	C	Q	C	Q	C	Q	C	Q	
225.0	.	0							0/0
225.5	2.65	13							13/0
226.0	2.70	38							38/0
226.5	2.80	72							72/0
227.0	3.00	120	-	0	-	0	-	0	120/0
227.25	3.05	145	3.30	6	2.65	91	2.65	42	278/139
227.5	3.15	175	3.35	17	2.65	260	2.65	120	555/397

SURCHARGE - STORAGE ROUTING

A. Without Flashboards

Test Flood Inflow = 300 cfs = Q_{P1}
 Surge Height to pass Q_{P1} = 227.27
 $STOR_1 = \frac{91 \text{ ac-ft} \times 12 \text{"/ft.}}{758 \text{ acres}} = 1.44 \text{''}$

$$Q_{P2} = Q_{P1} \left(1 - \frac{STOR_1}{4.75}\right) = 300 \left(1 - \frac{1.44}{4.75}\right) = 210 \text{ cfs}$$

Surge Height to pass Q_{P2} = 227.17

$$STOR_2 = \frac{86 \text{ ac-ft} \times 12 \text{"/ft.}}{758 \text{ ac.}} = 1.36 \text{''}$$

$$STOR_A = \frac{1.36 + 1.44}{2} = 1.40 \text{''}$$

$$Q_{P3} = 300 \left(1 - \frac{1.40}{4.75}\right) = 212 \text{ cfs, say } 210 \text{ cfs @ El. } 227.17$$

B. With Flashboards

Test Flood Inflow = 300 cfs = Q_{P1}
 Surge Height to pass Q_{P1} = 227.4
 $STOR_1 = \frac{97 \text{ ac-ft} \times 12 \text{"/ft.}}{758 \text{ ac.}} = 1.54 \text{''}$

$$Q_{P2} = 300 \left(1 - \frac{1.54}{4.75}\right) = 203 \text{ cfs}$$

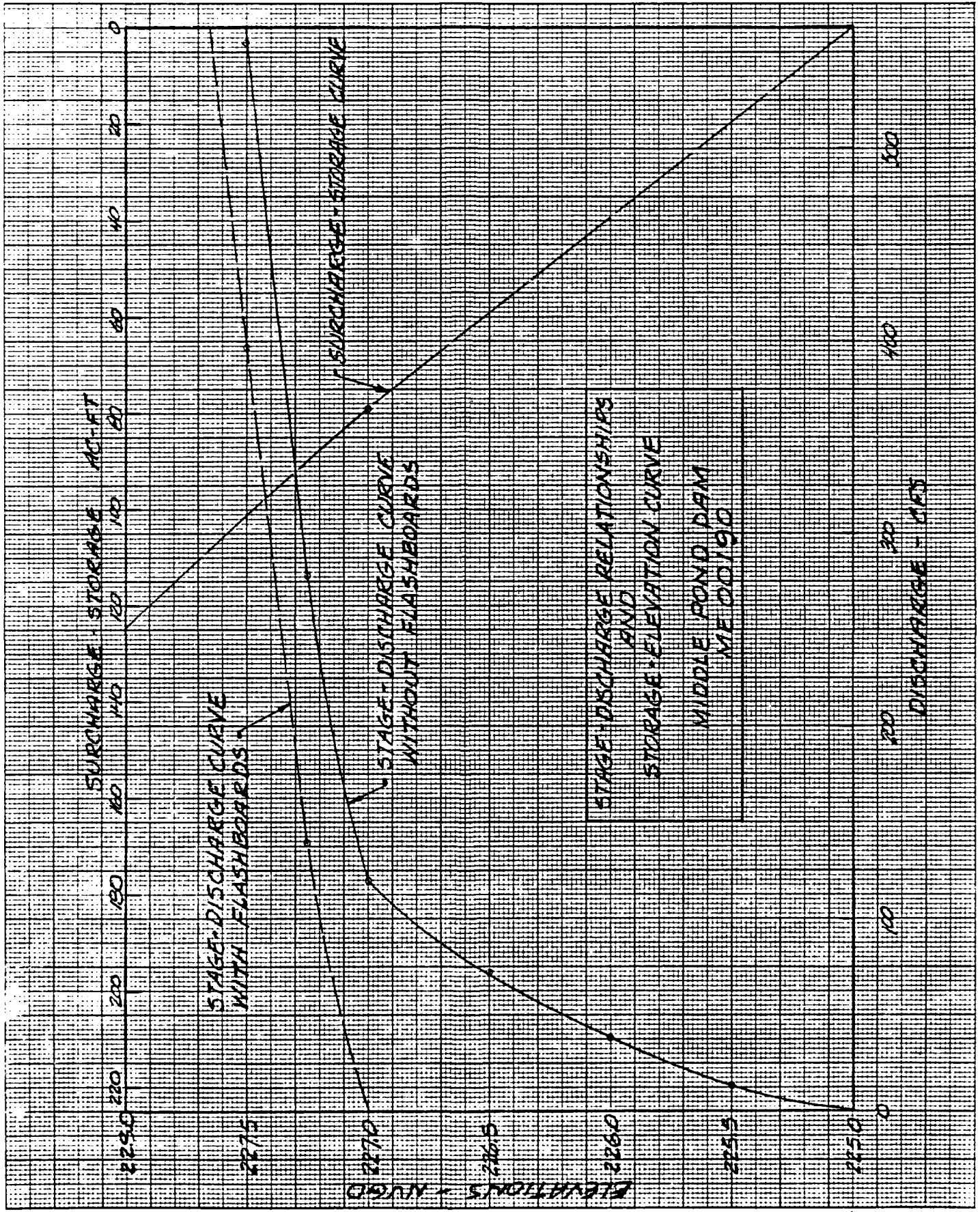
Surge Height to pass Q_{P2} = 227.31

$$STOR_2 = \frac{93 \text{ ac-ft} \times 12 \text{"/ft.}}{758 \text{ ac.}} = 1.47 \text{''}$$

$$STOR_A = \frac{1.47 + 1.54}{2} = 1.505 \text{''}$$

$$Q_{P3} = 300 \left(1 - \frac{1.505}{4.75}\right) = 205 \text{ cfs @ El. } 227.32$$

3.31 1.1M 200 3 DIVI IN STC ECTF DEE 3. NO MAR 4



For practical purposes, the routed test flood outflow is the same either with or without the flashboards in place.

Normal operating procedure is to remove the flashboards during the spring and to replace them after snow-melt.

With the flashboards removed, the test flood would overtop the dam by approx. 2 inches. and with the flashboards in place by approx. 4 inches.

DAM FAILURE ANALYSIS

Assume water surface at top of dam and flashboards in place

$Q_s \text{ spillway} = 0 \text{ cfs}$

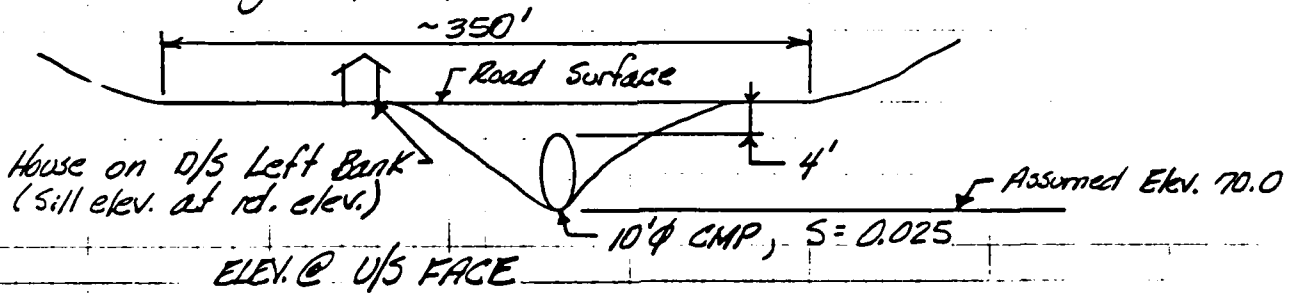
$Q_f \text{ failure} = 8/27 \sqrt{g} W_b Y_o^{3/2}$

where $W_b = 40\%$ of mid-height length of 95 ft.
 $Y_o =$ height of 31 ft.

then $Q_f = 8/27 \sqrt{32.2} (0.4 \times 95) (31)^{1.5} = 11,000 \text{ cfs}$

REACH NO. 1

The first downstream control is a 10 ft. ϕ CMP culvert located approx. 1.5 miles d/s of the dam. The natural channel from the dam to the culvert is thru undeveloped, wooded terrain at an average channel slope of 0.02. There is no significant storage in this reach.

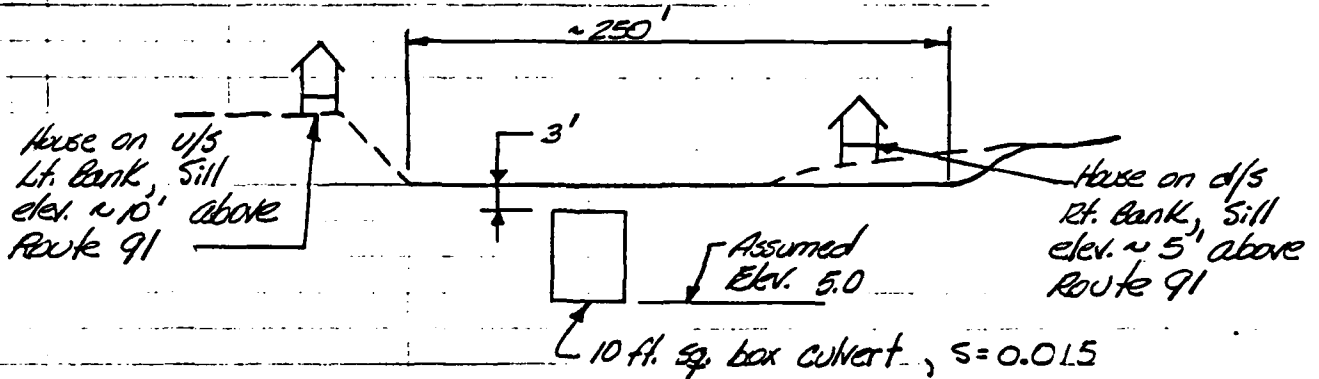


Elev.	Q culvert	Q weir	Total Q (cfs)
70.0	0	0	0
80.0	1700	0	1700 cfs
84.0	2000	0	2000
85.0	2100	950	3050
86.0	2150	2650	4800
87.0	2200	4900	7100
88.0	2270	7560	9830

\therefore depth over roadway ≈ 4 ft, potential loss of life to occupants of house on left bank, few

REACH NO. 2

Approx. 0.7 miles downstream is the Rte. 91 culvert.



Elev.	Q culvert	Q weir	Total Q (cfs)
5.0	0	0	0
15.0	2,240	0	2,240
18.0	2,460	0	2,460
19.0	2,550	675	3,225
20.0	2,640	1,910	4,550
21.0	2,730	3,510	6,240
22.0	2,810	5,400	8,210
23.0	2,890	7,550	10,440

From USGS Quad, channel storage $\approx 1/2$ Middle Reservoir Storage.

$$\text{then } Q_{p2} = 10,000 (1 - 0.5) = 5,000 \text{ cfs}$$

then stage at Rte. 91 culvert = Elev. 20.3
or about 2.5' above road. The road and culvert would be severely damaged but there is no apparent potential for loss of life.

\therefore Hazard Classification is SIGNIFICANT

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

NOT AVAILABLE AT THIS TIME

END

FILMED

7-85

DTIC