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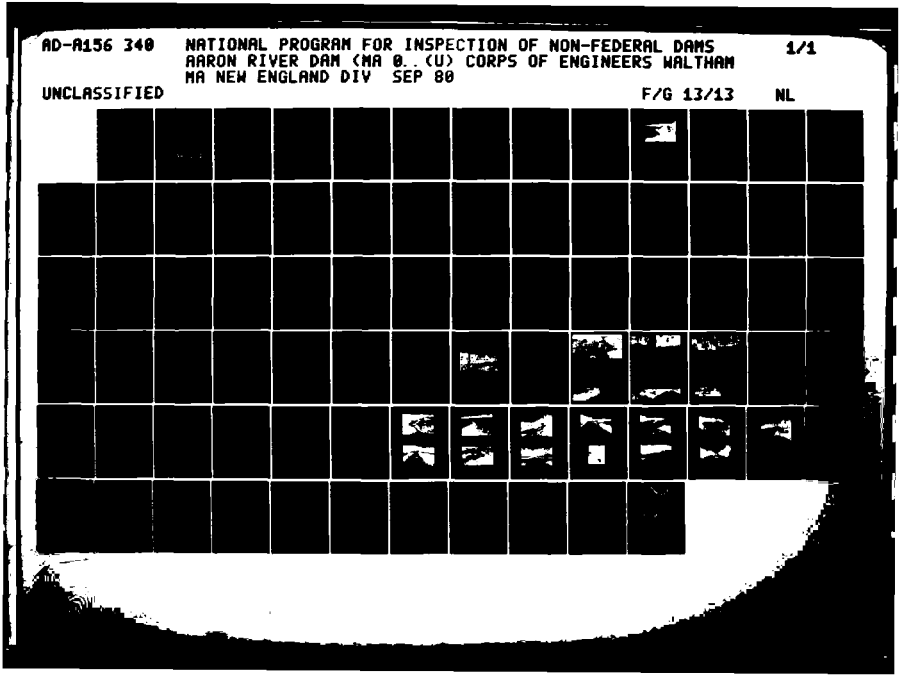

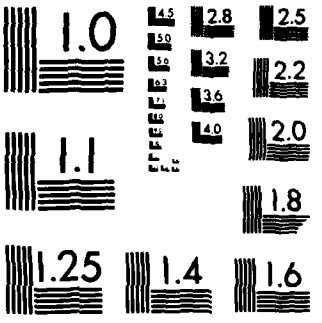

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MASSACHUSETTS COASTAL BASIN
COHASSET, MASSACHUSETTS

AARON RIVER DAM
MA 01280

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

SEPTEMBER 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 01280	2. GOVT ACCESSION NO. AD-A156340	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Aarpn River Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE September 1980 13. NUMBER OF PAGES 55
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Massachusetts Coastal Basin
Cohasset, Massachusetts
Aaron River

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

The dam is about 900 ft. long with a maximum height of about 29.5 ft. The facility was found to be in good condition but is rated fair because seismic analysis is lacking for the facility. It is intermediate in size woth a hazard potential of high. Incestigations are recommended to assess the seismic ability and to establish criteria for monitoring the existing piezometers.

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AARON RIVER DAM
MA 01280

MASSACHUSETTS COASTAL BASIN
COHASSET, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification: MA 01280
Name of Dam: AARON RIVER DAM
Town: TOWN OF COHASSET
County and State: NORFOLK COUNTY, MASSACHUSETTS
Stream: AARON RIVER
Date of Inspection: 28 JULY 1980

BRIEF ASSESSMENT

Aaron River Dam, construction in 1978, is approximately 300 ft. long excluding the spillway and has a maximum height of approximately 29.5 ft. It consists of an earth embankment with a riprapped upstream face and a loamed and seeded crest and upper portion of the downstream face. The bottom portion of the face has a crushed stone berm and riprapped downstream toe. Both the gate operator for the low level intake and the fish ladder are present at the right side of the dam. The principal spillway is located at the left abutment. The facility also has an emergency spillway in the form of a grassed and riprapped embankment in a separate swale about 1/4 mile to the left of the dam.

The facility was found to be in good condition but is rated as fair according to Corps of Engineer Guideline as seismic analysis is lacking for the facility.

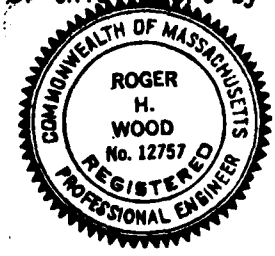
Based on the size classification, intermediate, and hazard potential classification, high, in accordance with Corps of Engineers Guidelines, the spillway test flood is the Probable Maximum Flood. Hydraulic analyses indicate that the principal spillway capacity at test flood stage is approximately 3,180 cfs and the routed test flood outflow is 3,500 cfs (inflow of 3,840 cfs or 800 csm). Approximately 320 cfs would discharge through the emergency spillway and fishway outlet under test flood condition. The estimated test flood stage is about 2.8 ft. below the top of dam. The total discharge capacity of the spillways is 13,520 cfs or 385 percent of the routed test flood outflow with the reservoir stage at the top of the dam.

Investigations are recommended to assess the seismic stability of the facility and to establish criteria for monitoring the existing piezometers. Recommended remedial measures include the mowing of grass on the emergency spillway, the restoration of riprap wave protection, the establishing of an access road to the emergency spillway, performing maintenance work on the fishway intake, principal spillway and emergency spillway, and the locating and maintenance of all existing piezometers. The Owner should develop a formal maintenance program, operational procedure, and emergency procedures plan and should institute a program of biennial technical inspections. The remedial measures and recommendations should be performed as discussed in Section 7 within two years of receipt of this report by the Owner.

CAMP DRESSER & McKEE INC.

Roger H. Wood

Roger H. Wood
Vice President



PREFACE

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

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

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

Phase I 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 runoff), 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 aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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APPENDIXES

1. OVERVIEW OF DAM FROM RIGHT ABUTMENT.

DAM Aaron River Dam

IDENTIFICATION NO. MA 01280

LOCATION MAP

USGS QUADRANGLE COHASSET, MA

APPROX. SCALE: 1" = 2083'

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

AARON RIVER DAM
MA 01280

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 responsiblity of supervising the inspection of dams within the New England Region.

Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under a letter of 27 March 1979, from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-79-C-0053 has been assigned by the Corps of Engineers for this work. Contract Modification No. P0004, effective 18 July 1980, was subsequently issued by Colonel William E. Hodgson, Jr., Corps of Engineers. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for the soils and geological portions of the work.

b. Purpose - The primary purpose of the investigation is 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 assist the States to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location - Aaron River Dam is located at the end of Beechwood Street in the Town of Cohasset, Massachusetts, about 1.4 miles southwest of State Route 3A, as shown on the report's Location Map. The dam impounds the waters of the Aaron River to form a water supply impoundment. Aaron River becomes Bound Brook as it flows to Cohasset Harbor, a distance of approximately 3 miles away. The coordinates for the dam are 70 degrees-49.4 minutes Longitude and 42 degrees-12.6 minutes Latitude.

b. Description of Dam and Appurtenances - The Aaron River Dam consists of an earth embankment which has a low level outlet pipe near the center, a combination high level intake and fishway outlet structure to the right which connects to a fish ladder along the right toe of the embankment and a spillway at the left abutment. In addition, there is an emergency spillway formed by a low embankment located approximately 1,250 ft. beyond the left abutment of the dam. A generalized plan showing the dam and appurtenances is included in Appendix C.

The dam is about 900 ft. long, 29.5 ft. high and 12 ft. wide at the crest. The upstream face is sloped at 2.5H to 1V and has riprap wave protection on the upper part. The grass covered downstream slope is at 2H to 1V, with a 10-ft. wide crushed stone berm along the toe. The crest has a gravel surface.

A typical embankment section is included in Appendix B. The dam embankment was constructed according to "Alternate B" as shown on the contract plans.

The central and upstream portions consist of "impervious fill" which was manufactured by mixing on-site glacial till and silt materials. The impervious zone extends to rock along the dam centerline.

The downstream portion of the dam is "random fill" which is drained by a chimney and blanket drain consisting of free draining sand and gravel. Seepage is collected and discharged by a system of pipes located in the toe berm. Ten piezometers were installed to monitor seepage conditions within the dam embankment.

The emergency spillway embankment is about 160 ft. long, 6 ft. high and 12 ft. wide at the crest. The upstream face is at 6H to 1V, with crushed stone and grass cover. There is a 3 ft. wide riprap berm along the upstream toe. The downstream face is at 2H to 1V and has riprap erosion protection. The crest is grass-covered. The embankment consists of a central and upstream zone of impervious fill which extends to glacial till or rock along the centerline. The downstream portion is random fill.

The principal spillway is a gravity concrete section with an ogee crest founded on and keyed into ledge. The crest has an irregular alignment roughly in the form of a "z". The total weir length is 230 feet of which 45 feet has a crest elevation of 66.0 while the remaining portion has a crest elevation of 65.0. Water flowing over the weir drops into a rock cut discharge channel for a major length of the weir alignment with flow from the remaining length of weir discharging onto exposed ledge before eventually dropping into the rock cut channel.

The low level outlet, which also serves as the reservoir drain, has a reinforced concrete box drop inlet with an invert elevation of 45.0 at the connecting 24-inch RCP conduit. An inclined trash screen within the drop inlet guards the conduit entrance. The low level outlet is controlled by a sluice gate at the end of the intake pipe within the concrete vault located at the upstream edge of the crest near the center of the dam. The gate operator is a manual crank type floor stand positioned on top of the vault. A 24-inch RCP conduit with an invert elevation of 43.25 leaves the concrete vault and discharges into an open channel at the toe of the dam.

The fishway near the right end of dam also serves as the high level intake. The intake structure extends approximately 35 feet into the reservoir from the upstream edge of the crest. The outer 20 feet is a reinforced concrete "U" type channel, 2 feet wide by 5 feet deep with an invert elevation of 59.5. Grating placed on top of the channel forms an access walkway to the manually operated fishway gate at the outer end. Water from the intake passes just beneath the crest of the dam in a 48" wide by 72" high corrugated aluminum conduit. The conduit discharges into a 24-inch wide by 60-inch high (min.) baffled reinforced concrete fish ladder placed along the valley side slope. Flow from the fish ladder discharges into a riprapped trapazoidal channel at the toe of the dam embankment.

c. Size classification - The maximum height of the dam is approximately 29.5 ft. and the estimated total storage capacity at the top of the dam is 2,350 acre-feet. According to Guidelines established by the Corps of Engineers, the dam is classified in the intermediate category based on storage capacity.

d. Hazard Classification - The results of the dam failure analysis indicate that about 50 houses, the Town of Cohasset Water Treatment Plant and several roadways would be affected by the flood wave and the potential loss of life would be in excess of 10 persons. Consequently, the dam is classified in the "high" hazard category.

e. Ownership - The dam is owned by the Town of Cohasset, Massachusetts. The Owner is represented by Mr. Edwin H. Pratt, Water Department Superintendent. His business address is 339 King Street, Cohasset, Massachusetts 02025, Tel. (617) 383-0057.

f. Operator - Mr. Edwin H. Pratt, Superintendent Water Department, is assigned responsibility for operation of the dam. His business address is 339 King Street, Cohasset, Massachusetts 02025, Tel. (617) 383-0057.

g. Purpose of the Dam - The Aaron River Dam provides water storage and regulates its release to a downstream pond which is used for water supply to the Town of Cohasset.

h. Design and Construction History - The dam was designed in 1976 by SEA Consultants, Inc., 54 Canal Street, Boston, Massachusetts 02114, with Goldberg, Zoino, and Associates as the geotechnical consultants. The construction was completed in 1978 by Arthur Schofield, Inc., Contractor. Records of the construction are available at SEA Consultants, Inc.

i. Normal Operating Procedure - There is no established procedure for the operation of the dam. The spillways have a fixed weir crest, and require no adjustment. The fishway gate can be adjusted to regulate the reservoir discharge to the Water Treatment Plant depending on the water supply demand of the Town of Cohasset. The reservoir level may be lowered to EL. 59.5 by adjusting the fishway gate. Below EL. 59.5, reservoir discharge is through the 24-inch reservoir drain. Maintenance of the facility is performed on the basis of need.

1.3 Pertinent Data - Elevations given in this report are on National Gedoetic Vertical Datum (NGVD) formerly referred to as Mean Sea Level.

Field measurements indicated a top of dam elevation 1.5-ft. higher than that shown on the design drawings. Discussions with the designer indicated the dam was built higher than the design elevation to allow for settlement. In addition, it was decided not to seed the crest of the dam but rather to add 6-inches of gravel to the finished crest.

a. Drainage Area - The drainage area tributary to the dam site is 4.8 square miles of flat and coastal terrain. It is mostly undeveloped land and includes the southeast section of Wompatuck State Park and several swamps. Aaron River Reservoir accounts for approximately 5 percent of the total drainage area.

b. Discharge at Dam Site - There are no records of significant discharges at the dam site. The operator indicated that once in the spring of 1979, there was some minor discharge over the principal spillway, but no measurements were taken.

(1) Outlet works size: 24-inch reinforced concrete pipe. Capacity with reservoir at principal spillway elevation is 80 cfs.

(2) Maximum known flood at dam site: None

(3) Ungated spillway capacity at top of dam:

Principal Spillway: 10,375 cfs at 70.5 elev.
Emergency Spillway: 3,145 cfs at 70.5 elev.

(4) Ungated principal spillway capacity at test flood elevation: 3,180 cfs at 67.7 elev.

(5) Gated spillway capacity at normal pool elevation: N/A

(6) Gated spillway capacity at test flood elevation: N/A

(7) Total spillway capacity at test flood elevation:

Principal spillway:	3,180 cfs at 67.7 elev.
Emergency spillway:	280 cfs at 67.7 elev.

(8) Total Project discharge at test flood elevation:

Principal Spillway:	3,180 cfs at 67.7 elev.
Emergency spillway:	280 cfs at 67.7 elev.
Fishway:	40 cfs at 67.7 elev.
Total:	3,500 cfs at 67.7 elev.

c. Elevation (ft. above NGVD)

(1)	Streambed at toe of dam	41.0
(2)	Test flood tailwater	50.0
(3)	Upstream portal invert diversion tunnel	N/A
(4)	Normal pool	65.0
(5)	Full flood control pool	N/A
(6)	Spillway crest: Principal spillway	65.0
	Emergency spillway	67.0
(7)	Design surcharge (Original Design)	66.0
(8)	Top of dam	70.5
(9)	Test flood surcharge	67.7

d. Length of Reservoir (miles estimated)

(1)	Normal pool	0.8
(2)	Flood control pool	N/A
(3)	Spillway crest pool	0.8
(4)	Pool at top of dam	1.2
(5)	Test flood pool	1.0

e. Storage (acre-feet)

(1)	Normal pool	1,470
(2)	Flood control pool	N/A
(3)	Spillway crest pool	1,470
(4)	Top of dam	2,350
(5)	Test flood pool	1,895

f. Reservoir Surface (acres)

(1)	Normal pool	143
(2)	Flood-control pool	N/A
(3)	Spillway crest pool	143
(4)	Test flood pool	158
(5)	Top of dam	178

g. Embankments

		Main Dam	Emergency Spillway Weir
(1)	Type	Zoned Earth	Zoned Earth
(2)	Length	900 ft.	160 ft.
(3)	Height	29.5 ft.	6 ft.
(4)	Top width	12 ft.	12 ft.
(5)	Side Slopes:		
	Upstream	2.5H to 1V	6H to 1V (with riprap toe berm)
	Downstream	2H to 1V	2H to 1V
(6)	Zoning	Impervious fill upstream, random fill downstream	
(7)	Impervious Core	Compacted glacial till/silt mixture	
(8)	Cutoff	To rock	To glacial till
(9)	Grout Curtain	None	None

h. Diversion and Regulating Tunnel ..... None

i. Spillway

(1) Type ..... Principal Spillway: Ogee-shaped concrete weir
Emergency Spillway: Riprapped earth weir

(2) Length of Weir..... Principal Spillway: 230 ft.
Emergency Spillway: 160 ft.

(3) Crest elevation..Principal Spillway: 185 ft. at EL. 65.0, and 45 ft. at EL. 66.0

Emergency Spillway: EL. 67.0

(4) Gates ..... None

(5) U/S Channel ..... Irregular natual ground with rock outcrops in areas.

(6) D/S Channel .....Excavated channel through rock formation for a weir length of about 150 ft.; Irregular rock formation surface for other 80 ft. of weir length.

j. Regulating Outlets - The regulating outlets for this structure consist of a movable fishway gate at the intake to the fish ladder and a 24-in. reinforced concrete pipe reservoir drain, both located to the right of center of the dam. The fishway gate crest elevation may vary from a maximum of 63.0 to a minimum of 59.5. The invert elevation to the reservoir drain is 45.0. The reservoir drain is controlled manually by a gate operator at the crest of the dam. Both the fish ladder and the reservoir drain discharge to a riprapped channel at the right toe of the dam.

SECTION 2: ENGINEERING DATA

2.1 Design Records - Design data in the form of plans, specifications, a soils report, and an application to the State for authorization to construct the dam were located at SEA Consultants, Inc., 54 Canal Street, Boston, Massachusetts 02114. The soils report is also available from Goldberg, Zoino, and Associates, 30 Tower Road, Newton, Massachusetts.

2.2 Construction Records - Construction records for this project are located at SEA Consultants, Inc.

2.3 Operation Records - No operation records other than piezometer readings taken when the reservoir was first filled, and again a few months after, were located for this facility.

2.4 Evaluation

a. Availability - The soils report and the peizometer readings are available at Goldberg, Zoino and Associates. Other documents described above are available at SEA Consultants, Inc.

b. Validity - The available data are in good agreement with conditions observed during the site examination with the exception of the elevation of top of dam. Field measurements indicated a top of dam elevation 1.5-ft. higher than that shown on the design drawings. Discussions with the designer confirmed the dam was constructed to a higher elevation than shown on the plans.

c. Adequacy - The available data, in combination with the visual evaluation described in the following section, is adequate for the purpose of the Phase I investigation.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General - The Phase I visual examination of the Aaron River Dam was conducted on 28 July 1980.

In general, the earthen embankment, principal and emergency spillways and appurtenances were observed to be in good condition. The reservoir level at the time of the site examination was 3.0 ft. below the weir crest.

Visual inspection checklists for the site visit are included in Appendix A and selected photographs are given in Appendix C.

b. Dam - Visual observations of the dam, principal spillway and emergency spillway earthen weir revealed no evidence of lateral movement, settlement or other indication of instability. The following items were noted at the dam:

(1) The downstream slope has a reasonably good grass cover and was mowed as shown in Photos 1 and 3. Some weeds were present in the riprap and along the toe berm.

(2) The upstream riprap wave protection is in generally good condition as indicated by Photo 4. However, a few stones have been dislodged (apparently by trespassers) near the fishway.

(3) There was no visible evidence of seepage along the toe, although observations were limited by the presence of tailwater in the discharge channel as indicated in Photo 3. The outlet pipes from the toe drain system were not discernable.

(4) Two of the ten piezometers shown on the plans (P-8 and P-9) were not located.

The following items were noted at the emergency spillway earthen weir:

(1) The crest has a good grass cover, but was not mowed. Some weeds were growing in the riprap as shown in Photo 12 .

(2) There was an accumulation of driftwood near the left end of the embankment.

(3) The discharge channel has started to become overgrown with brush as shown in Photo 13.

(4) There is no defined path or road for access to the emergency spillway.

The following items were noted at the principal spillway:

(1) Two boulders are present in the discharge channel immediately adjacent to the spillway weirs as shown in Photo 5.

(2) Cracks in the spillay weir have been recently sealed.

c. Appurtenant Structures - The visible portions of the low level outlet works, as shown in Photos 8 and 9, are in excellent condition. Only some slight efflorescence was observed on the interior of the control vault. The fishway shown in Photos 10 and 11 was also noted to be in excellent condition. Some minor logs were observed partially obstructing the intake and they were removed during the inspection. One section of hand railing on the right hand side of the intake accessway has been vandalized.

d. Reservoir Area - Aaron River Reservoir is surrounded by moderate to flat terrain which is moderately forested. The shoreline of the pond is totally undeveloped. There appears to be no significant potential for landslides into the pond which would create waves that might overtop the dam. No conditions were noted that could result in a sudden increase in sediment load into the pond.

e. Downstream Channel - Discharges from the principal spillway pass through a rock cut to an improved riprapped channel at the toe of dam as shown in Photos 2, 6 and 7 before becoming the Aaron River. This river passes under Doane Street and joins Herring Brook flowing from Lily Pond to form Bound Brook. Bound Brook passes under Beechwood Street and State Route 3A, traverses North Scituate and discharges into Cohasset Harbor at the Cohasset - Scituate, Massachusetts town line. The waterway from the dam to North Scituate is on a flat gradient and passes through a series of swamps. The control structure shown in Photo 14 controls the water level in the upper portion of Bound Brook, Herring Brook and Lily Pond. The channels upstream of the control structure to Lily Pond were excavated during the construction of the dam to improve their flow characteristics. The Doane Street and Beechwood Street areas adjacent to the waterway are developed and Bound Brook passes through North Scituate which is a developed area. Discharges from the emergency spillway would flow over a cleared strip of land which has started to become overgrown with brush as shown in Photo 13. The flow would enter a swamp upstream of Doane Street and join the downstream waterways from the swamp that abuts Lily Pond, Herring Brook and the Aaron River downstream of Doane Street. With the exception of the flow passing over Doane Street, the flow would be passing through underdeveloped areas.

3.2 Evaluation - The dam is considered to be in good condition based on visual observations. A few minor deficiencies require maintenance, as detailed in Section 7.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures - In general, there is no formally established routine for the operation of the dam. The reservoir level is established by the water consumption needs of the Town of Cohasset. The reservoir drain is normally closed and some flow is maintained through the fish ladder.

4.2 Maintenance of the Dam - There is no established formal maintenance program for the dam. The operator indicated that the dam is inspected and maintained on the basis of need.

4.3 Maintenance of Operating Facilities - Water is released from the reservoir to meet minimum flow requirements in Bound Brook (1cfs) and water supply requirements of the Town through the fishway intake. At reservoir levels below EL. 59.5, water may be released from the reservoir through the 24-inch diameter reservoir drain. Maintenance of the fish ladder and the reservoir drain is performed on a need basis. Although the operability of these facilities was not demonstrated during the site inspection, they are both reported to be in good operating order and no conditions were observed which would indicate otherwise.

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

4.5 Evaluation - Maintenance of the facility is being performed on the basis of need. There is currently no formal operational procedures in effect for Aaron River Dam. Formal operational procedures, maintenance programs, warning system and emergency preparedness plans should be established.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General - Aaron River Dam is an earth embankment project on the Aaron River and forms a water supply impoundment in the southwest corner of Cohasset, Massachusetts. The watershed is 4.8 square miles of mostly undeveloped land including the southeast section of the Wampatuck State Park. The drainage area is flat and coastal with considerable upstream storage. At principal spillway crest (El. 65.0 NGVD) the reservoir storage is about 1,470 acre-ft, increasing to 1,780 acre-ft. at the emergency spillway crest (El. 67.0) and about 2,350 acre-ft. at the top of the dam (El. 70.5) The principal spillway, which has no facilities for flashboards, is ogee shaped and is about 230 feet long. The emergency spillway is a 160 ft. long riprapped earthen weir with crest El. 67.0 It is located about 1,250 ft. to the left of the principal spillway and is separated from it by natural high ground.

The length of the dam, not including the principal spillway which is located to the left of the dam, is about 900 ft. The overall height of the dam is about 29.5 ft. The reservoir drain is a 24-in. reinforced concrete pipe located to the right of center of the dam and is controlled from a gate operator on the crest of the dam. Further to the right is an intake to a fishway which discharges to a riprapped open channel at the toe of the dam. The dam is basically a high spillage-low surcharge project.

b. Design Data - The following hydraulic/hydrologic design data for the dam was obtained from SEA Consultants, Inc. 54 Canal Street, Boston, MA 02114.

Drainage Area, (square miles)	4.8
Peak Outflow (100-year flood), (cfs)	550
Design Storm Duration, (hours)	24
Peak Hour Rainfall Intensity, (in/hr)	2.7
Runoff, (inches)	5.0
Design Flood Level Elev. (NGVD), (FT.)	66.0

c. Experience Data - There have been no major floods since the dam was put into operation late in 1978. The owner representative indicated that there was some discharge from the principal spillway in the spring of 1979, but there were no measurements taken of the reservoir level.

d. Visual Observations - The visual inspection of the dam was made on 28 July 1980. At the time, the reservoir water level was about 3.0 ft. below the principal spillway crest level (65.0 NGVD). The average freeboard at the dam was about 8.5 ft. The principal spillway approach channel was shallow with rock outcrops

in areas. There were also some rock out-crops against the downstream face of the spillway crest which would influence discharge. The spillway discharges into an excavated rock channel leading to a riprapped channel along the toe of the dam. The outlet works was closed during the inspection.

e. Test Flood Analysis - Based on the Corps of Engineers Guidelines, the recommended test flood for the size, intermediate, and the hazard potential, high, is the PMF (Probable Maximum Flood). The test flood was determined using the Corps of Engineers "Guidelines for Estimating Maximum Probable Discharge in Phase I Dam Safety Investigations". Based on a flat and coastal drainage area, a PMF peak inflow rate of 800 cfs per square mile was selected for the 4.8 square mile drainage area. The resulting peak test flood inflow is 3,840 cfs.

Surgharge storage routing resulted in a routed test flood outflow of 3,500 cfs at a stage of 67.7. The dam would not be overtopped and would maintain about 2.8 ft. of freeboard. The depth of water over the principal spillway would be about 2.7 ft. and the depth of water over the emergency spillway would be about 0.7 ft. The principal spillway capacity at the test flood elevation would be about 3,180 cfs or approximately 91 percent of the routed test flood outflow. The remaining 9 percent would discharge through the emergency spillway and the fishway outlet. The outlet works capacity at spillway crest elevation is approximately 80 cfs.

f. Dam Failure Analysis - Based on the Corps of Engineers Guidelines for estimating Dam Failure Hydrographs, and assuming a failure would occur along 40 percent of the mid-height length of the dam with water at test flood stage (El. 67.7), the dam failure outflow is approximately 51,000 cfs. The project test flood discharge prior to a dam failure is 3,500 cfs for a total outflow of 54,500 cfs. The project discharge prior to a failure would flood one house at Doane Street by 1.0 to 1.5 ft., Doane Street would be overtopped by about 1.5 ft. and the Old Cohasset Water Treatment Facility would be flooded by about 1.0 ft. It is estimated that no other structures would be affected. After a dam failure, the combined outflow of 54,500 cfs would affect subtantial residential development, the new Cohasset Water Treatment Plant, State Route 3A and several other roadways with a resulting "high" hazard. The area between the dam and Doane Street would be the most severely affected. Doane Street is only about 1000 ft. downstream of the dam and the reach has no storage capacity which could attenuate the flood wave. Doane Street would be overtopped by about 14 ft. and 25 houses would be flooded in this area. Downstream of Doane Street the flood wave would attenuate significantly in the swamp. Still, in the reach between Doane Street and Beachwood Street, 12 houses would be flooded by about 3 ft. of water or less. The old Water Treatment Plant would be flooded by about 4 ft. and the new Treatment Plant Facility by about 1.5 to 2 ft. Beechwood Street would be overtopped by 3 to 3.5 ft.

Subsequent downstream streets, including State Route 3A, would be overtopped by 1 to 1.5 ft. About 15 houses would be affected by 1 ft. of water or less before the reservoir storage would empty to the Cohasset Harbor.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations - No evidence of instability was observed during the site examination on 28 July 1980.

b. Design and Construction Data - Available records include Plans and Specifications, a Geotechnical Engineering Report and a published article describing earthwork operations. Based on a review of this data, it is considered that the dam, principal spillway and emergency spillway earthen weir should have adequate margins of safety for stability under static conditions.

c. Operating Records - The only available operating records relating to structural stability are two sets of piezometer readings. The piezometers were read in January 1979, at the completion of the first reservoir filling, and again in March 1979. This data indicates that the internal chimney drain is effective in limiting pore water pressures within the downstream portion of the dam embankment.

d. Post Construction Changes - There have been no known structural modifications to the embankments since construction.

e. Seismic Stability - The Aaron River Dam is locatd within Seismic Zone 3 and, in accordance with recommended Corps of Engineer's Guidelines, suitable analyses relative to the vulnerability of the dam to seismic events should be on record. Seismic analyses are not available. Therefore, the stability of the dam under seismic loading conditions is not substantiated.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - Based on the visual examination and review of available records, the dam and spillways were found to be in good condition but are rated in fair condition due to lack of siesmic analysis.

b. Adequacy of Information - The evaluation of the facility has been based on the visual examination, consideration of available documents and past performance and application of engineering judgement. The information available or obtained has generally been adequate for the purposes of the Phase I assessment. However, it is recommended that additional information relative to seismic stability be obtained as outlined in Section 7.2.

c. Urgency - The recommendations for additional investigations and remedial work, outlined in Sections 7.2 and 7.3, respectively, should be completed by the Owner within 2 years after receipt of this report.

7.2 Recommendations

It is recommended that the Owner arrange for the following to be performed by a registered professional engineer qualified and experienced in dam design:

1) Assess the vulnerability of the dam embankment to seismic events by performing appropriate engineering analyses.

2) Establish criteria for regular monitoring of the existing piezometers.

The Owner should implement corrective action if required based on the results of the above engineering evaluation.

7.3 Remedial Measures

a. Operation and Maintenance Procedures - The following work should be performed by the Owner:

(1) Mow the emergency spillway embankment and remove accumulated debris. Both dam and spillway embankments should be mowed at least once per year to facilitate visual inspection.

(2) Restore riprap wave protection as required.

(3) Locate and maintain all existing piezometers. Monitor piezometers on a regular basis. Long term changes in piezometer water levels may indicate the need for maintenance of the toe drain system.

(4) Restore the fishway accessway railing.

(5) Clear brush from the emergency spillway discharge channel.

(6) Establish an access way to the emergency spillway to facilitate its maintenance.

(7) Remove weeds and brush from riprap and crushed stone sections of dam to insure that the growth does not become unmanageable.

(8) Remove loose stones and boulders from the principal spillway discharge channel.

(9) Develop a formal operation and maintenance manual for the facility.

(10) Establish an emergency preparedness plan and warning system in cooperation with downstream officials and institute a program of biennial technical inspections.

7.4 Alternatives - There are no practical alternatives recommended.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION PARTY ORGANIZATION

NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam

DATE: 28 July 1980

TIME: 1:30 PM

WEATHER: Sunny

WATER SURFACE ELEVATION UPSTREAM: 62 (NGVD)

STREAM FLOW: Minor (some discharge through fishway)

INSPECTION PARTY:

1. Roger H. Wood, CDM
2. Joseph E. Downing, CDM
3. Joseph R. Araujo, CDM
4. John W. Critchfield, H&A
5. Douglas G. Gifford, H&A

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Structural/Operations	Roger H. Wood	
2. Hydraulics/Hydrology	Joseph E. Downing and Joseph R. Araujo	
3. Embankments	Douglas Gifford and John Critchfield	
4.		

PRESENT DURING INSPECTION:

1. Edwin H. Pratt, Superintendent Water Department, Owner Representative and Operator
2.
3.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam DATE: 28 July 1980
EMBANKMENT: DAM

CHECK LIST	CONDITION
1. Upstream Slope	1.
a. Vegetation	a. Few weeds in riprap.
b. Sloughing or Erosion	b. None apparent.
c. Rock Slope Protection - Riprap Failures	c. Few riprap stones dislodged.
d. Animal Burrows	d. None observed.
2. Crest	2.
a. Vegetation	a. Gravel, with isolated weeds.
b. Sloughing or Erosion	b. None apparent.
c. Surface cracks	c. None apparent.
d. Movement or Settlement	d. None apparent.
3. Downstream Slope	3.
a. Vegetation	a. Grass and weeds, mowed.
b. Sloughing or Erosion	b. None apparent.
c. Surface Cracks	c. None apparent.
d. Animal Burrows	d. None observed.
e. Movement or Cracking near toe	e. None apparent.
f. Unusual Embankment or Downstream Seepage	f. None observed (tailwater present in fishway ditch).
g. Piping or Boils	g. None observed.
h. Foundation Drainage Features	h,i Internal chimney drain with collector pipe at toe.
i. Toe Drains	
4. General	4.
a. Lateral Movement	a. None apparent.
b. Vertical Alignment	b. Good.
c. Horizontal Alignment	c. Good.
d. Condition at Abutments and at Structures	d. Good.
e. Indications of Movement of Structural Items	e. None observed.
f. Trespassing	f. Frequent (hole in fence).
g. Instrumentation Systems	g. Found 8 of 10 piezometers.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam DATE: 28 July 1980

SPILLWAY: PRINCIPAL

CHECK LIST	CONDITION
1. Approach Channel	1.
a. General Condition	a. Good.
b. Obstructions	b. Small log in channel.
c. Log Boom etc.	c. None.
2. Weir	2.
a. Flashboards	a. None.
b. Weir Elev. Control (Gate)	b. None.
c. Vegetation	c. None observed.
d. Seepage or Efflorescence	d. 2 minor efflorescent spots.
e. Rust or Stains	e. None observed.
f. Cracks	f. Sealed.
g. Condition of Joints	g. Excellent.
h. Spalls, Voids or Erosion	h. No material condition observed.
i. Visible Reinforcement	i. None.
j. General Struct. Condition	j. Excellent.
3. Discharge Channel	3.
a. Apron	a. None.
b. Stilling Basin	b. Rock ledge (2 boulders)
c. Channel Floor	c. Good (ledge). Minor loose rock and vegetation.
d. Vegetation	d. Minor.
e. Seepage	e. None observed.
f. Obstructions	f. Two boulders present.
g. General Struct. Condition	g. Good.
4. Walls	4a Right Side
a. Wall Location _____	(1) None observed.
(1) Vegetation	(2) None observed.
(2) Seepage or Efflorescence	(3) None observed.
(3) Rust or Stains	(4) None observed. Minor crack at weir.
(4) Cracks	(5) None observed.
(5) Condition of Joints	(6) None observed.
(6) Spalls, Voids or Erosion	(7) None observed.
(7) Visible Reinforcement	(8) Excellent.
(8) General Struct. Condition	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam DATE: 28 July 1980
OUTLET WORKS: RESERVOIR DRAIN

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates	1. Within pond, not observed.
2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks	2. a. Good. b. None. c. None. d. Sluice gate good. e. Not observed. f. Efflorescence one foot down from top.
3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks	3. a. Excellent. b. None observed. c. None observed. d. None observed.
4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection	4. a., b and d through f - not applicable. c. Manually operated gate.
5. Other	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam DATE: 28 July 1980
OUTLET WORKS: FISHWAY

CHECK LIST	CONDITION
1. Inlet	1.
a. Obstructions	a. Two minor logs.
b. Channel	b. Within pond.
c. Structure	c. None.
d. Screens	d. None.
e. Stop Logs	e. None.
f. Gates	f. Excellent condition.
2. Control Facility	2.
a. Structure	a. Excellent(one railing missing left side)
b. Screens	b. None.
c. Stop Logs	c. None.
d. Gates	d. See 1 f.
e. Conduit	e. None observed.
f. Seepage or Leaks	f. None observed.
3. Outlet	3.
a. Structure	a. Fish ladder - excellent condition.
b. Erosion or Cavitation	b. None observed.
c. Obstructions	c. None observed.
d. Seepage or Leaks	d. None observed.
4. Mechanical and Electrical	4.
a. Crane Hoist	a. N/A.
b. Hydraulic System	b. N/A.
c. Service Power	c. Manual operation.
d. Emergency Power	d. N/A.
e. Lighting	e. N/A.
f. Lightning Protection	f. N/A.
5. Other	

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Aaron River Dam DATE: 28 July 1980
EMBANKMENT: EMERGENCY SPILLWAY (earthen weir)

CHECK LIST	CONDITION
1. Upstream Slope	1.
a. Vegetation	a. Few weeds in riprap.
b. Sloughing or Erosion	b. None observed.
c. Rock Slope Protection - Riprap Failures	c. None observed.
d. Animal Burrows	d. None observed.
2. Crest	2.
a. Vegetation	a. Grass and weeds.
b. Sloughing or Erosion	b. None observed.
c. Surface cracks	c. None observed.
d. Movement or Settlement	d. None observed.
3. Downstream Slope	3.
a. Vegetation	a. Few weeds in riprap.
b. Sloughing or Erosion	b. None observed.
c. Surface Cracks	c. None observed.
d. Animal Burrows	d. None observed.
e. Movement or Cracking near toe	e. None apparent.
f. Unusual Embankment or Downstream Seepage	f. None observed.
g. Piping or Boils	g. None observed.
h. Foundation Drainage Features	h. None.
i. Toe Drains	i. None.
4. General	4.
a. Lateral Movement	a. None apparent.
b. Vertical Alignment	b. Good.
c. Horizontal Alignment	c. Good.
d. Condition at Abutments and at Structures	d. Good.
e. Indications of Movement of Structural Items	e. No structural items.
f. Trespassing	f. Frequent (campfire on crest, right end).
g. Instrumentation Systems	g. None.

APPENDIX B

ENGINEERING DATA

LIST OF AVAILABLE DOCUMENTS

DOCUMENT	LOCATION
1. Complete set of Design Drawings, Specifications, Soils Report, Design File and Construction Records.	SEA Consultants, Inc. 54 Canal Street Boston, MA 02114
2. Soils Report	Goldberg, Zoino, and Associates 30 Tower Road Newton, MA

The Commonwealth of Massachusetts

EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGR.
DIVISION OF WATERWAYS

100 Nashua Street, Boston 02114

APPLICATION FOR AUTHORIZATION TO CONSTRUCT OR ALTER
~~A RESERVOIR~~, RESERVOIR DAM OR MILL DAM

Aaron River Dam, Cohasset, Mass.

JURISDICTION - General Laws - Chapter 253, s. 44 et seq. as amended by Chapter 706 of the Acts of 1975

The approval of the Commissioner shall not apply to small dams, constructed for irrigation or for other purposes, the breaking of which would involve no risk to life or property, nor to standpipes or tanks, nor to a dam where the area draining into the pond formed thereby does not exceed one square mile; unless the dam is more than ten feet in height above the natural bed of the stream at any point, or unless the quantity of water which the dam impounds exceeds one million gallons. However, information must be submitted to enable the Commissioner to determine whether approval is necessary.

Approval of this plan does not release the applicant from the requirement of a license under G. L. Chapter 91, if such a license is necessary.

Revised 12/25/75

Part "A"

JURISDICTIONAL DETERMINATION
(check the appropriate column)

	Yes	No
1. Is there a risk to Life and Property downstream in the event of failure?	X	
2. Does the area draining into the pond exceed one square mile?	X	
3. Does the height of the dam exceed 10 ft. above the natural bed of the stream at any point?	X	
4. Does the volume of water impounded at maximum pool level exceed one million gallons?	X	

If the answer to any one of the above questions is Yes, then the Commissioner of Environmental Quality Engineering has jurisdiction. Proceed with Part B of this application.

If the answers to all four of the above questions are no, please submit backup information for a review by this Department for our jurisdictional determination. The backup information should include at least:

a. A copy of a topographic map clearly indicating the location of the dam and the effective drainage area.

b. A sketch showing the maximum section of the dam indicating its height, as measured from the lowest point of the streambed.

c. Calculations for the volume of water impounded at the maximum design pool level.

d. A brief statement pertaining to downstream conditions with respect to risk to life and property.

e. The signature of applicant and engineer.

Part "B"

GENERAL INFORMATION

1. Location (City-Town) Cohasset

2. Detailed description of dam location

~~At westerly end of Beechwood St., near the easterly limit~~ of the Wompatuck State Park. About 1.4 miles southwesterly from Route 3A; and 0.2 miles westerly from Doane Street and Summer Street.

3. Present or Prospective Owner(s)

Name(s) Town of Cohasset, c/o Board of Water Commissioners
Street 43 Elm Street
City/Town Cohasset, State Mass. Zip 02025
Telephone (617) 383-0057

4. Name of U.S. Geological Survey Map Quadrangle
Cohasset, Mass.

5. Name of Reservoir or Waterway Aaron River/Bound Brook

6. Is there specific legislative authority to construct the dam

Yes (X) Identify Chapter 1163 of1973
No ( ) An Act relating to the Improvement of the water supply for the town of Cohasset.

7. Purpose for the dam Municipal Water Supply

8. Nature of the work

Proposed dam	(x)
Alteration of existing dam	( )
Major repair of existing dam	( )

Part "B" (continued)

HAZARD EVALUATION

(Downstream field investigation)

1. The estimated number of people that could be affected by overtopping or failure of the structure, and to what degree they would be affected.

Overtopping flood level alone would not affect any people directly. Failure of the dam would affect about 30 people downstream by flooding of their properties.

2. The number of properties (homes, buildings etc.) and the estimated extent of damage by overtopping or failure Overtopping flood level alone would inundate about 60 additional acres around the reservoir. Failure of the dam would flood about 140 additional acres downstream including less than 10 homes.

3. Roads (type) or other structures that could be affected by overtopping or failure Beechwood Street, Doane Street, the Old Water Treatment Plant Road, Bound Brook Control Structure.

4. Additional Information:

Under existing conditions there is flooding potential of certain properties downstream in the area of Doane Street, Lily Pond and North Scituate. The Aaron River Dam would regulate flows to some extent and lessen the flooding potential.

Part "B" (continued)

HYDROLOGIC CONSIDERATIONS

Procedures for hydrologic design as contained in the latest edition of the U. S. Department of the Interior, Bureau of Reclamation "Design of Small Dams"

1. Peak Outflow (100 yr) 550 c.f.s.
2. Design storm duration 24 hours.
3. Rainfall Intensity (Peak Hour) 2.7 "/hr.
   Percent Runoff Varies% Rainfall=6.8"; Runoff=5.0" inches.
4. Contributory Drainage Area 4.8 sq.mi.
   (attach a copy of U. S. Topographic Map with the outline of the drainage divide).
5. Previous Known flood of record Elev. 51.5 ± at Doane St.
   (month) March (year) 1968
6. Design maximum flood level elevation 66.0.
7. Additional information: A two foot wide gated fishway will carry excess runoff from frequent storms. The principal spillway will overflow generally during greater than 5-year storms. The emergency spillway would operate only during rare storms in excess of 100-year frequency.

Part "B" (continued)

DESIGN CRITERIA

1. Datum used:
   (a) M.S.L. of 1929 Yes.
   (b) Assumed ---.
   (c) Other ---.

2. Maximum height of the dam 26.0 ft.
   (a) Top elevation of dam 69.0.
   (b) Top elevation of spillway 65.0.

3. Volume of water impounded, at maximum design pool level. 1570 ac-ft = 513.mil gallons

4. Present river bed or channel elevation @ dam 43. ±.

5. Normal pool elev. 63.0.
   surface area 129 ac.

6. Maximum pool elev. 66.0.
   surface area 148 ac.

7. Type of structure (earth, concrete, etc)
   Earth Embankment.

8. Crest width 12 ft.

9. Freeboard, as measured from the maximum design pool level 3.0.

10. Length of Principal spillway 200 ft.

11. Description of principal spillway Ogee concrete weir with shute spillway in rock.

12. Emergency spillway Yes (X) No ( )
    If yes, describe Low earth embankment with stone protection - Crest @ 67.0.

13. Gates Yes (X) Number 1 @ Fishway. Size 2' x 3.5'
    No ( ) 1 @ low level outlet 24

14. Nature of slope protection (riprap, vegetated etc.) Riprap (above elev.-55.0 face and below elev. 49.0 at toe downstream.)
    loamed and seeded (top and downstream face)

15. Stop log structure(s)
    Yes ( ) Mechanical ( ) Manual ( )
    No (X)

Part "B" (continued)

SUBSURFACE INVESTIGATION

Boring logs, analysis and recommendations to accompany this application.

See Plans and Specifications.

CONSTRUCTION DRAWINGS

(Submit 2 copies with this application) Names & addresses of property owners for all parcels of land within the flowage area must be clearly indicated on the plan.

CONSTRUCTION SPECIFICATIONS

(Submit 2 copies with this application)

CERTIFICATION OF INSPECTION DURING CONSTRUCTION

Inspecting agent (Must be approved by the Design Engineer)

Name S E A Consultants, Inc.

Street 90 Canal Street

City/Town Boston, State Mass. Zip 02114

Telephone (617) 742-1133

Inspection during construction periods will be conducted by the approved engineer on a full-time basis. Bi-monthly progress reports are to be submitted to the Massachusetts Department of E.Q.E. (local District office) with copies submitted to the owner and design engineer.

Inspector signature Paul C. Ross Date 2/24/76

Applicant signature [signature] Date 2/24/76

Design engineer Paul C. Ross Date 2/24/76

Part "B" (continued)

SIGNATURE SHEET

APPLICANT

Name Town of Cohasset - Board of Water Commissioners

Street 43 Elm Street

City/Town Cohasset, State Mass. Zip 02025

Telephone (617) 383-0057

Signature [signature] Date 1/24/74

CONSULTANT ENGINEER FIRM

Name S E A Consultants, Inc.

Street 90 Canal Street

City/Town Boston, State Mass. Zip 02114

Telephone (617) 742-1133

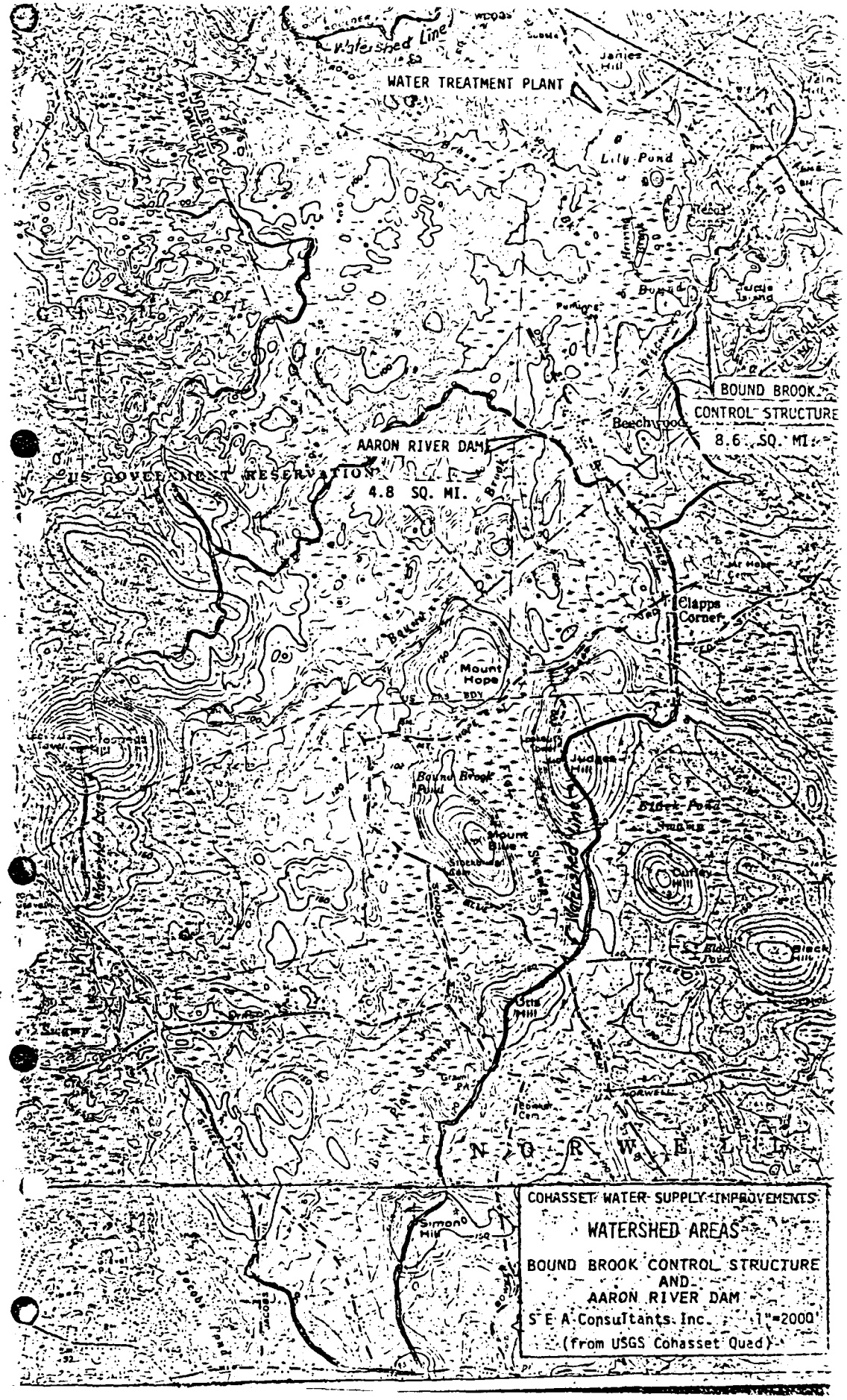
*Signature and P.E. Stamp [signature] Date 2/24/74

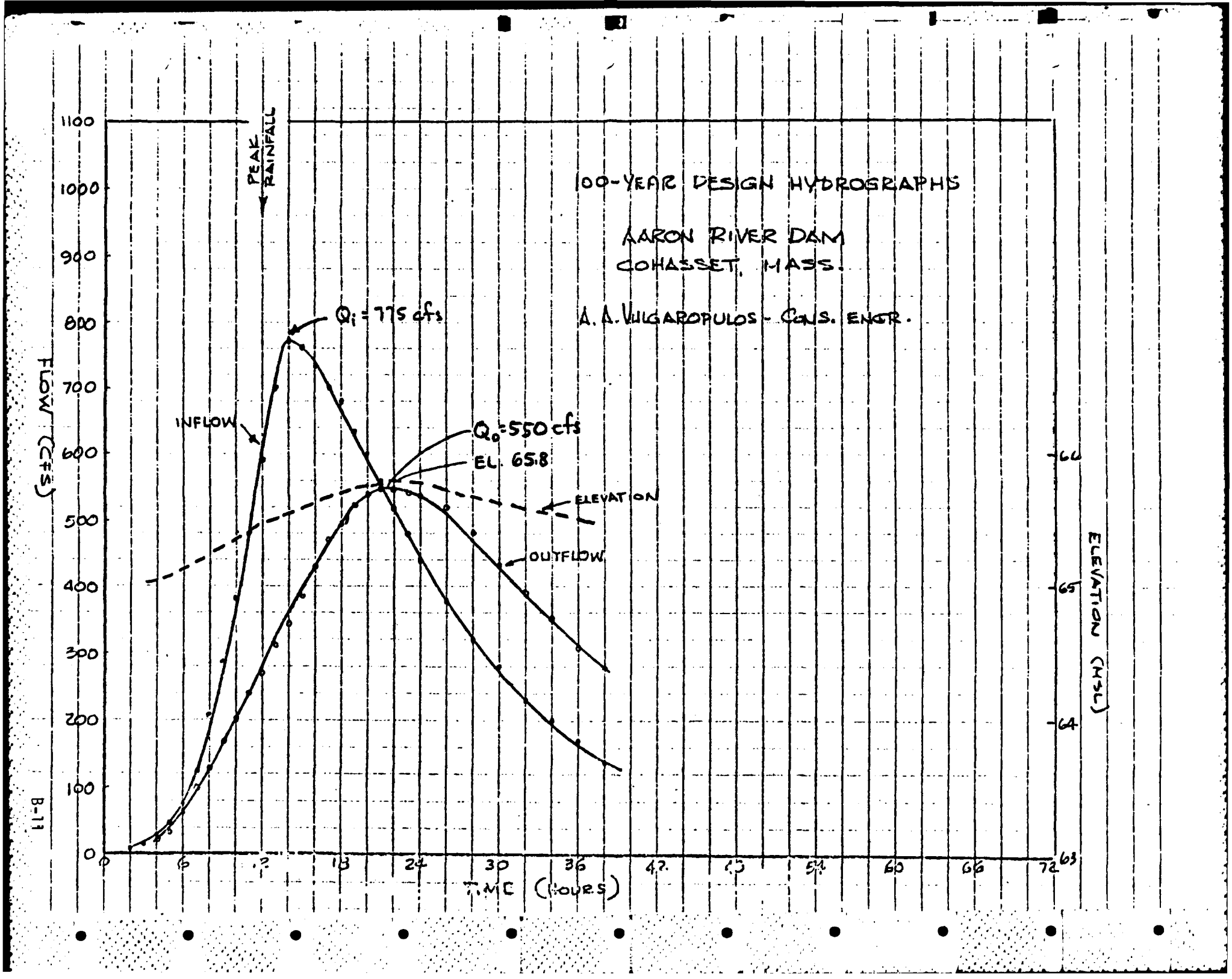
*(P.E. STAMP & SIGNATURE REQUIRED ON ALL SUBMITTALS)

Final or "as built" drawings are to be submitted to this office upon completion of the project.

No alterations shall be made without the prior review and approval of the Commissioner.

FAILURE TO COMPLY WITH THE TERMS OF THIS APPLICATION WILL AUTOMATICALLY CAUSE REVOCATION OF THE COMMISSIONER'S APPROVAL.

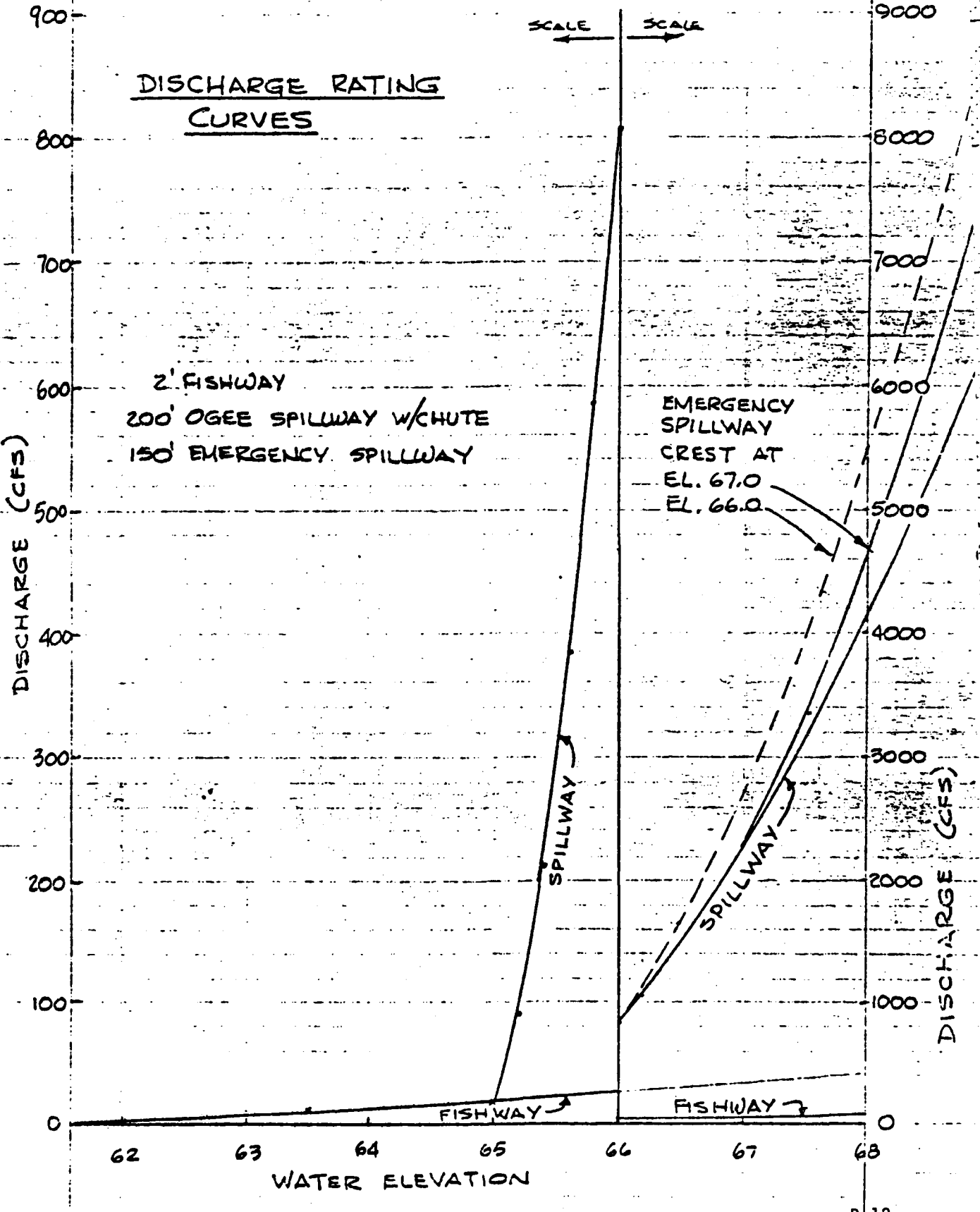

Watershed Line
WATER TREATMENT PLANT
Lily Pond
BOUND BROOK
CONTROL STRUCTURE
8.6 SQ. MI.
AARON RIVER DAM
US COAST GUARD RESERVATION
4.8 SQ. MI.
Beechwood
Clapps Corner
Mount Hope
Bound Brook
Mount Blue
Judges Hill
Simons Hill
COHASSET WATER SUPPLY IMPROVEMENTS
WATERSHED AREAS
BOUND BROOK CONTROL STRUCTURE
AND
AARON RIVER DAM
S E A Consultants Inc. 1"=2000'
(from USGS Cohasset Quad)


100-YEAR DESIGN HYDROGRAPHS
AARON RIVER DAM
COHASSET, MASS.
A. A. VULGAROPULOS - CONS. ENGR.
PEAK RAINFALL
Q_i = 775 cfs
Q_o = 550 cfs
EL. 65.8
INFLOW
OUTFLOW
ELEVATION
FLOW (CFS)
ELEVATION (MSL)
TIME (HOURS)
0
100
200
300
400
500
600
700
800
900
1000
1100
63
64
65
66
6
12
18
24
30
36
42
48
54
60
66
72

ATHANASIOS A. VULGAROPULOS
CIVIL AND HYDRAULIC ENGINEER
26 TUDOR ST., WALTHAM 54, MASS.

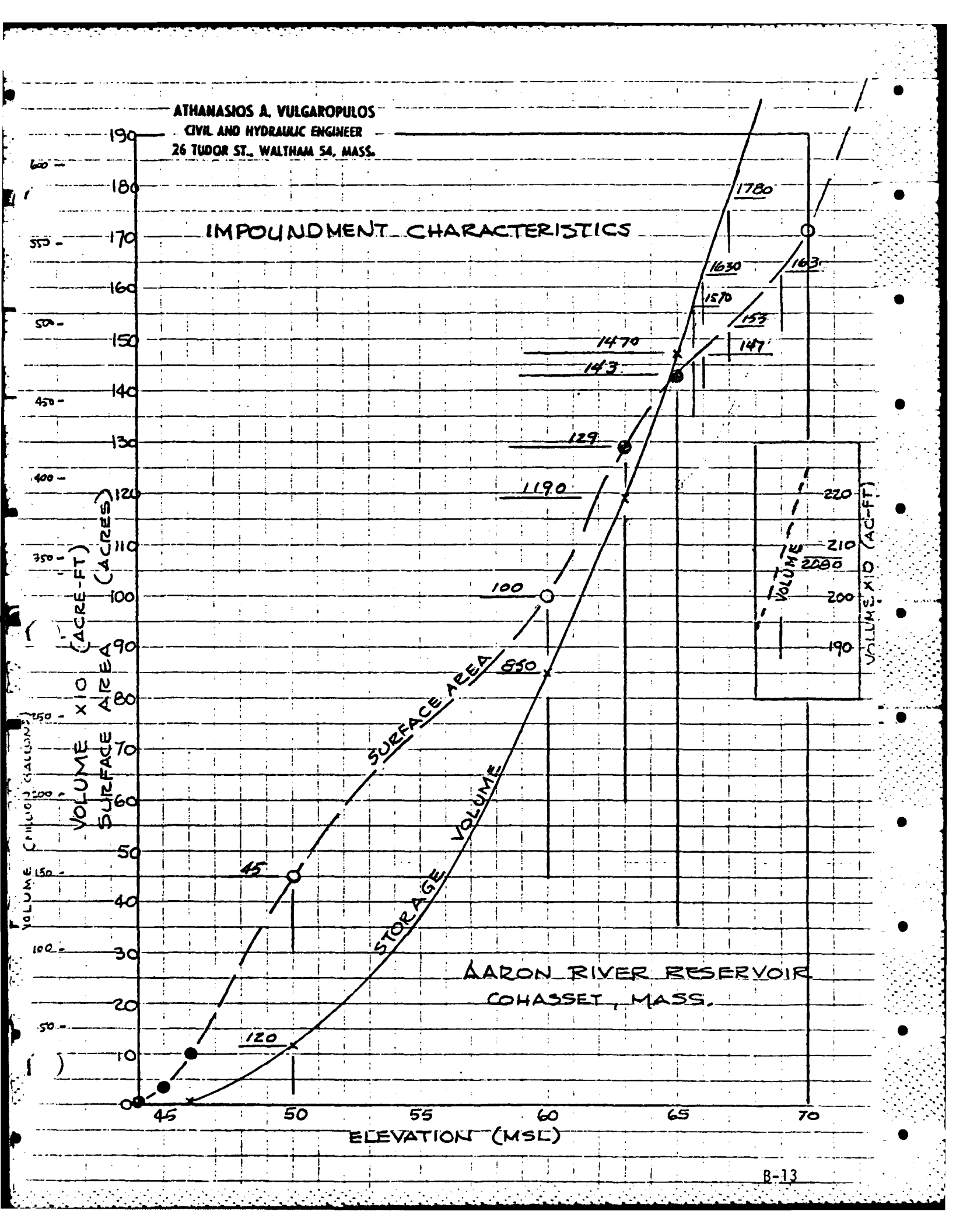
AARON RIVER DAM, COHASSET, MASS.

DISCHARGE RATING CURVES



ATHANASIOS A. VULGAROPULOS
CIVIL AND HYDRAULIC ENGINEER
26 TUDOR ST., WALTHAM 54, MASS.

IMPOUNDMENT CHARACTERISTICS



AARON RIVER RESERVOIR
COHASSET, MASS.

Cohasset Water Supply Improvements Program

1978 - 1979

Board Of Water Commissioners

John W. Hobbs
William I. Montouri
Lot E. Bates

Consulting Engineers

S·E·A Consultants Inc.
Engineers / Planners
Boston, Ma.

Superintendent
Cohasset Water Department

Edwin H. Pratt

This Folder Published Through Courtesy Of The Cohasset Savings Bank.....

THE THREE ELEMENTS OF COHASSET'S IMPROVED WATER SUPPLY

1 AARON RIVER DAM AND RESERVOIR

The Aaron River Dam is an earth-fill dam approximately 900 feet long and approximately 25 feet high. An impervious fill cutoff wall prevents seepage beneath the dam structure and a concrete ogee spillway protects the dam from overtopping under flood conditions. The Reservoir created by the dam holds about 323 million gallons of water and has a surface area of about 150 acres, 129 of which lie within Wampatuck State Park. A fish ladder has been constructed at the dam to allow fish to migrate to and from the reservoir. The dam contains approximately 57,000 cubic yards of various types of fill material including 40,000 cubic yards of impervious fill material for the core. Permanent monitoring wells have been installed to observe water level fluctuations both upstream and downstream of the dam. Water level is controlled by a weir gate at the entrance to the fish ladder. A low level outlet pipe is used only to drain the reservoir in emergencies or for maintenance. In addition to the concrete ogee overflow spillway, an earthen emergency spillway protects the dam from overtopping during periods of very high rainfall and runoff.

The construction cost of the dam and reservoir was $900,000.
Arthur Schofield, Inc.
Contractor

2 BOUND BROOK CONTROL STRUCTURE

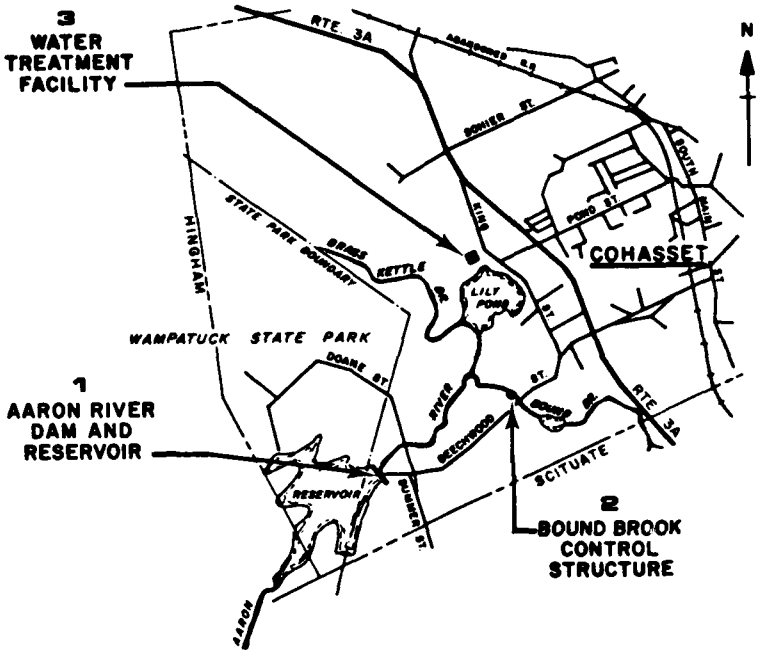
The Bound Brook Control Structure is a reinforced concrete structure at the Beechwood Street bridge which provides control of the water surface elevation in Lily Pond by means of adjustable gates. It is designed to maintain the water level in Lily Pond between elevations 42 and 45 and has a hydraulic capacity of 600 cubic feet per second. A fish ladder was also incorporated into the design and construction to encourage the eventual introduction of fish runs from the Atlantic Ocean to the new Aaron River Reservoir. It is required that a minimum flow of 1 cubic foot per second be maintained at all times in Bound Brook below the control structure. In order to provide for this requirement, and to supplement the water supply in Lily Pond for the water treatment facility, releases of water will be made from the Aaron River Dam during periods of low precipitation and runoff. The control structure at Bound Brook diverts this released water to Lily Pond by adjustment of the movable weir gates. The stream channels upstream of the control structure, including Bound Brook and Herring Brook, were excavated to provide increased flow capacity from the dam to the control structure.

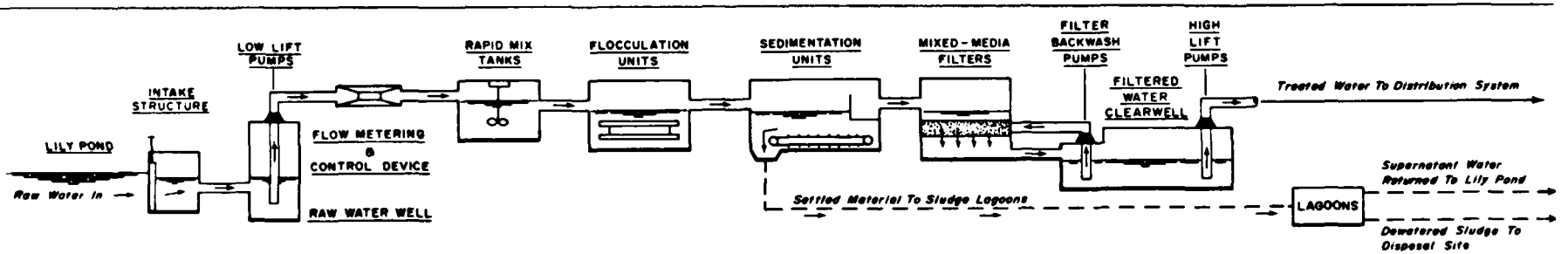
The construction cost for the Bound Brook Control Structure was $43,000.
Jay M. Cashman, Inc.
Contractor

3 WATER TREATMENT FACILITY

The Cohasset Water Treatment Facility is designed to treat an average flow of 1.2 million gallons per day and a peak flow of 3.0 million gallons per day. Hydraulic units have been designed with expansion capability of 4.5 million gallons per day capacity. The facility employs both physical and chemical means for treating high color content raw water. Color values range from 30 to over 250 units. The raw water also contains iron, manganese, and other characteristics which exceed acceptable limits. The treatment process includes fine and coarse screening, rapid mixing, flocculation, settling, filtration, pre- and post-chlorination, fluoridation, and chemical addition for coagulation and pH adjustment. A laboratory and control room are located on the upper level of the treatment plant. The building also houses administrative offices for the Cohasset Water Department consisting of a secretarial office, superintendent's office, conference room, personnel room, and engineering office. A natural gas-powered standby electric generator, five bay garage and two sludge lagoons are located on the site separate from the main building.

The construction cost for the treatment facility, garage, and sludge lagoons was $1,900,000.
A. Bonfatti & Co., Inc.
Contractor





HOW COHASSET'S WATER IS PURIFIED

Cohasset's new water treatment facility employs the latest technological advancements in water treatment. Here is the step-by-step process:

Raw water from Lily Pond flows to the intake structure containing coarse and fine screens and upon entering the plant passes through a flow metering and control device. This metering device, in addition to measuring the quantity of flow, also provides an automatic signal for controlling amounts of chemicals fed into the water.

Coagulating chemicals are added to the water in rapid mix tanks and are rapidly and thoroughly mixed in the water.

The chemically treated water then flows to flocculation units where the tiny coagulated particles are brought into contact with each other by slowly revolving paddles. This causes the particles to cling to each other, or "floc", and thus to increase in size so that they will settle more rapidly in the sedimentation units.

In the sedimentation units, the water is held for a sufficient time to allow the floc to settle. The clarified water then passes on to the filters. The settled particles are removed by mechanical equipment to sludge lagoons for dewatering. The water from the lagoons is then returned to the pond and sludge is removed to a disposal area.

The filters consist of a 30-inch layered bed of two materials, each of different particle size and density: anthracite coal and silica sand.

These materials provide a gradation of particle size from coarse to fine in the direction of flow through the filter. The filter bed rests on a 10-inch gravel layer. The level of water above the surface of the media in the filters automatically controls the amount of water entering the treatment plant and passing through the various treatment units.

After the water passes through the filters it moves to a clear well or filtered water reservoir. There it is chlorinated and pumped into the town's water distribution system. If the rate of output of the treatment plant exceeds the rate of consumption, the water is pumped to the standpipe on the top of Bear Hill where it is stored for use during periods of peak demand.

Cohasset, Mass. earth dam begins to rise at swamp site as Schofield workers lay and compact impervious fill manufactured in field by blending on-site glacial till and silt. The equipment shown includes, l. to r., a John Deere tractor propelling an Essex vibratory compactor, a Cat #641 scraper, a Galio0 grader, Hopto #900 hoe and John Deere #310 dozer.

Firm Makes Fill For Cohasset Dam By Blending The On-Site Soil

Contractor Schofield and designers eliminate need for borrow by concocting impervious fill for dam in field

A Fiat-Allis HD-21 dozer pushes a Michigan #381 scraper during early earthwork on the cut-off trench. Layered soil consisted of two feet of peat, eight feet of sand and gravel, eight feet of silt, seven feet of till, and a bottom layer of fractured granite.

BY MANUFACTURING specified backfill material right on the construction site and using a simple but effective dewatering system, the design/build team for a 1000-foot-long earth dam in Cohasset, Mass. was able to save both time and money.

General contractor Arthur Schofield Inc. and a design group that included designers SEA Consultants, geotechnical engineers Goldberg Zoino Dunnicliff, hydrologist Arthur Vulgaropulos, geotechnical engineers McPhail Associates and a retired Perini Corp. project manager, Cesare Cueroni, were able to build the 25-foot-high dam using "unsuitable" material in a swamp without installing a wellpoint or deep well system.

The dam is being built across the Aaron River to create a 325,000,000-gallon reservoir to supplement the

A Hopto #900 excavator digs into the tough layer of till as the cut-off trench nears bottom. Once the trench was completed, it was filled with impervious fill to prevent water seepage.

After fractured rock was scraped from the bottom of the trench, workers cleaned it with blasts of high-pressure air using a 2½-in. hose supplied by a 600 cfm Ingersoll-Rand compressor.

town's water supply. It is part of a $8⅜ million project to boost the community's water system so that water-use bans in effect during summers for the last ten years may be eliminated. Also being built is a three-million-gallon water treatment plant, expected to be completed by general contractor A. Bonfatti early this year.

To prevent water from seeping or "piping" through the earth dam, the consultants incorporated a "cut-off" trench into its design. Before dam construction began, a trench resembling a truncated "V" was dug to remove the natural pervious soil. It was replaced by an impervious blend of soils, then the dam was continued upward, using the same blend of materials. The final cross-section of the dam resembles a hexagon with shorter top and bottom sides. The side slopes of the dam are 2:1, while the trench sides slope at 1½:1. Overall depth of the structure, from the 10-foot wide trench bottom to the 12-foot-wide road on top, is roughly 50 feet.

The original soil at the site of the dam was composed of layers of five distinct materials: a two-foot, top layer of peat (with water table at ground level), an eight-foot layer of sand and gravel, an eight-foot layer of silt, a seven-foot layer of till, and at the bottom, a layer of fractured granite.

Although no one layer was suitable for use as backfill material, the team noticed that the silt and till, if mixed properly, would produce the impervious material they needed. By themselves, the till was too coarse, and the silt contained too many fines.

Through calculations followed by trial-and-error blending, the team settled on a mixing procedure that let them use all on-site material to build the dam.

Soil excavated from the cut-off trench was brought to an area nearby on the site roughly the size of a football field. Two Michigan rear dump wagons and a Hopto 900 backhoe worked together to remove till and fractured rock, while a Cat 641 and two Michigan 381 scrapers removed the silt, sand and gravel and peat.

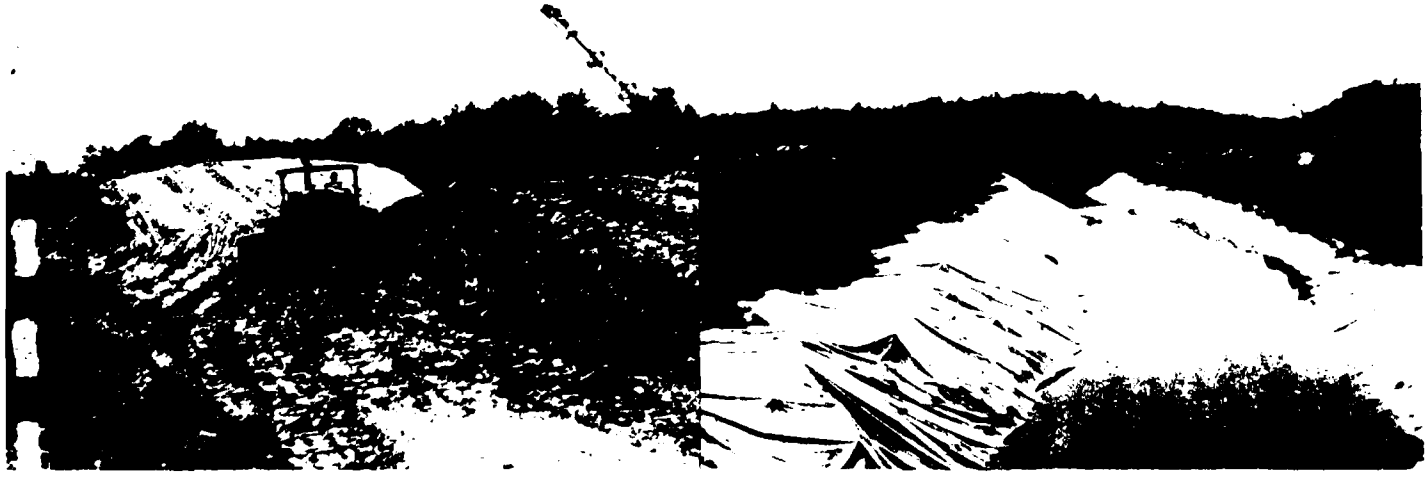
At the mixing area, the till and silt were laid down alternately in 12-inch lifts, until a six-foot-tall "sandwich" of silt and till was built up. If the soil was wet, as it was many times because of heavy rains during the early stages of the job, a Fiat-Allis HD-21 bulldozer first towed a sheepsfoot or harrow over the material which helped to dry it out. The actual mixing was accomplished by a Cat D-9 bulldozer.

The D-9 mixed the material by pushing along the edge of the soil sandwich, so that it sliced across all six of the stacked layers of silt and till. By continuously shaving off the edge of this sandwich, the dozer's blade kept turning over and mixing the two soils, forming a blend of material that met the specifications for imperviousness.

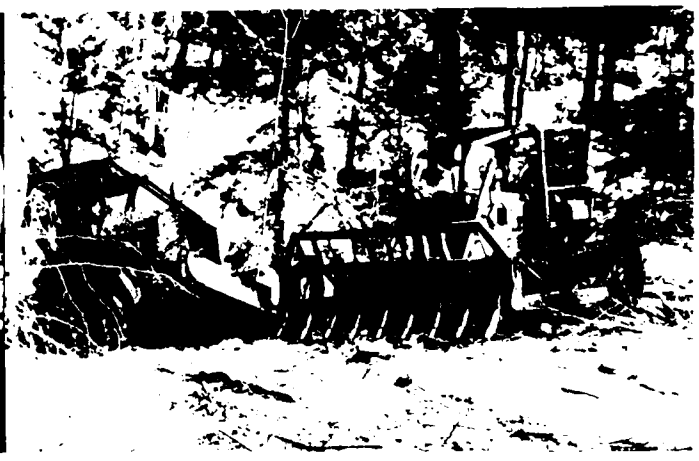
Rock that was scraped from the bottom of the cut-off trench was stockpiled for later use as rip rap on the upstream face of the dam. If the rock pieces exceeded the 250-lb. maximum allowed by the specifications, they were broken up by a Northwest

At the mixing area, a Cat D-9 slices into the edge of a sandwich of alternate layers of till and silt. The dozer blade turns over the soil, producing a mixture that is impervious.

The Aaron River, which will feed the new reservoir, is bypassed around the construction area in a polyethylene-lined ditch that helped to keep the cut-off trench area dry for workers.



Jim Webber, John Ayres, Bill Zoino, Ed Pratt, Fred Aufiero, Howard Rice, Cesare Cueroni, Ed Robinson, Frank Cambridge, Arthur Schofield, John Roma, Arthur Vulgaropulos.



A Case skidder and a Cat dozer work during the very early stages of the Cohasset project. Clearing operations and brook widening were performed during the winter of 1976-1977.

crane dropping a three-ton demolition ball. After the trench bottom was scraped by the Hopto 900, a crew used a 600 cfm Ingersoll-Rand compressor and 2½-inch hose to clean off the bottom with blasts of high-pressure air. Then fill operations began.

Compaction of the impervious dam fill material was critical, so following deposition of each lift of the fill by the Cat and Michigan scrapers it was consolidated by an Essex vibratory compactor towed by a John Deere tractor. Compaction had to be at least 95 percent, and was checked constantly by Goldberg, Zoino, Dunnicliff. Approximately 60,000 cubic yards of fill were required to construct the dam.

Water handling at first was thought to be the biggest problem for the design/build team. They had built an eight-foot-tall cofferdam of impervious fill and a 600-foot-long diversion channel to shunt the Aaron River around the site away from the construction crews, but there was still plenty of water at the dam site itself. A deep well or wellpoint system was considered by the team, but they then decided to first try digging a sump in the middle of the dam site, and pumping the area dry.

Four three-inch electric submersible pumps -- two Flygts and two Gorman Rupps -- were placed in the fast-filling sump. Surprisingly, the simple system dropped the water table dramatically, right down to the rock bottom of the cut-off trench. Piezometers were placed all around the site to monitor water levels, and they registered what the workmen already knew — the area was nearly chalk dry. Helping to keep it dry was the fact that the Aaron River diversion ditch, at hydrologist Vulgaropulos' suggestion, had been lined with polyethylene sheeting. Hence, no water was allowed to seep from the diversion trench into the dam area.

When the dam is completed, water from the new reservoir behind it will be fed into a brook downstream by means of a Waterman Sluice Gate and pipe on the reservoir floor. The brook, which feeds into the town's main water supply at Lilly Pond, has been widened, deepened and lined with rip rap for about 600 feet to increase flows.

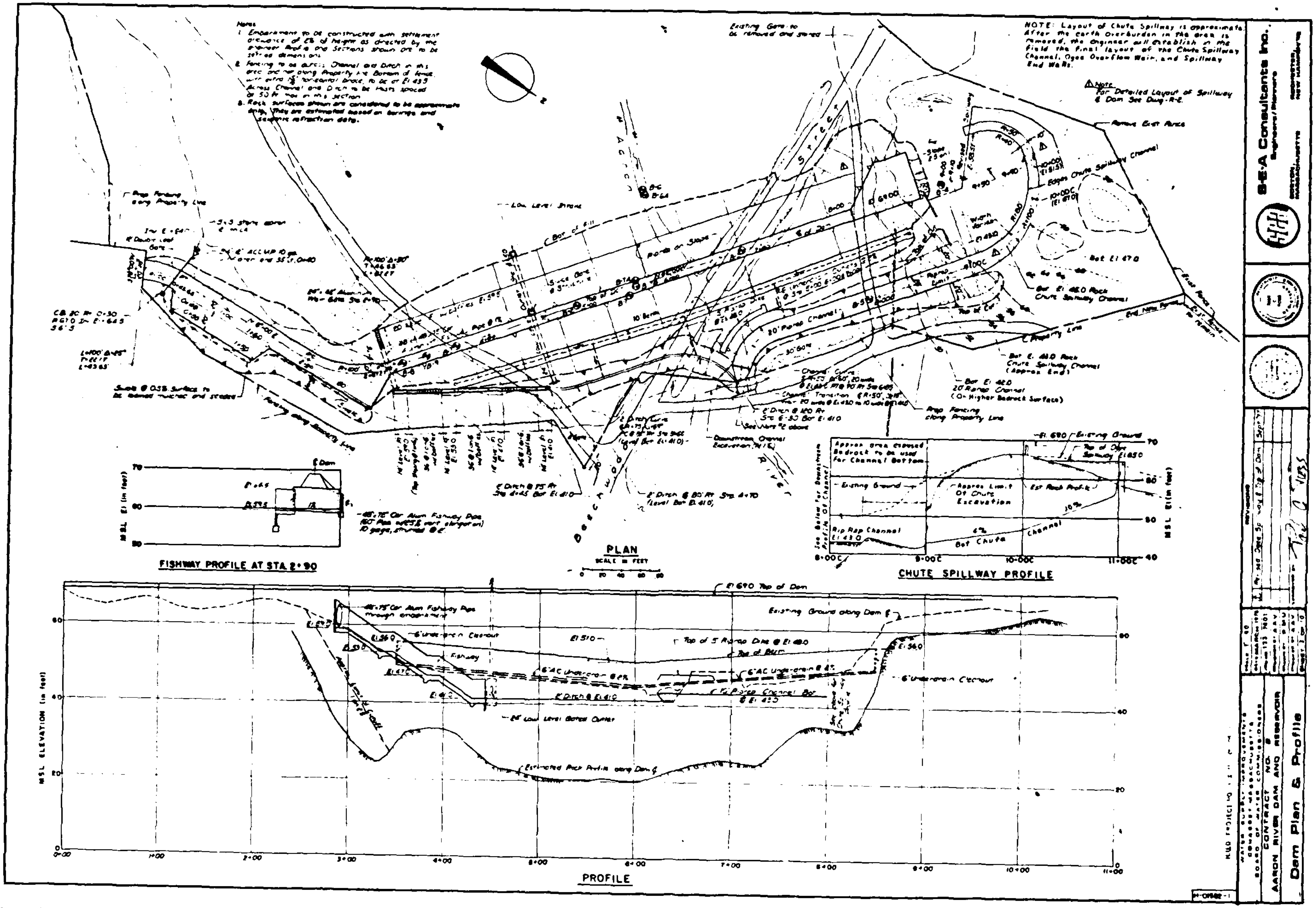
This brook improvement was done in the middle of the winter of '76-'77, when the job first began. Schofield decided to take advantage of the bearing capacity of the frozen swamp. The contractor walked three cranes out on the icy soil (Northwest, Koehring and Link-Belt) to the banks of the brook. Holes were drilled through three huge boulders which were then lashed to the wire ropes of the cranes, and repeatedly dropped to break up the 1½-foot ice covering the brook. Next, the cranes were equipped with draglines to excavate and enlarge the brook.

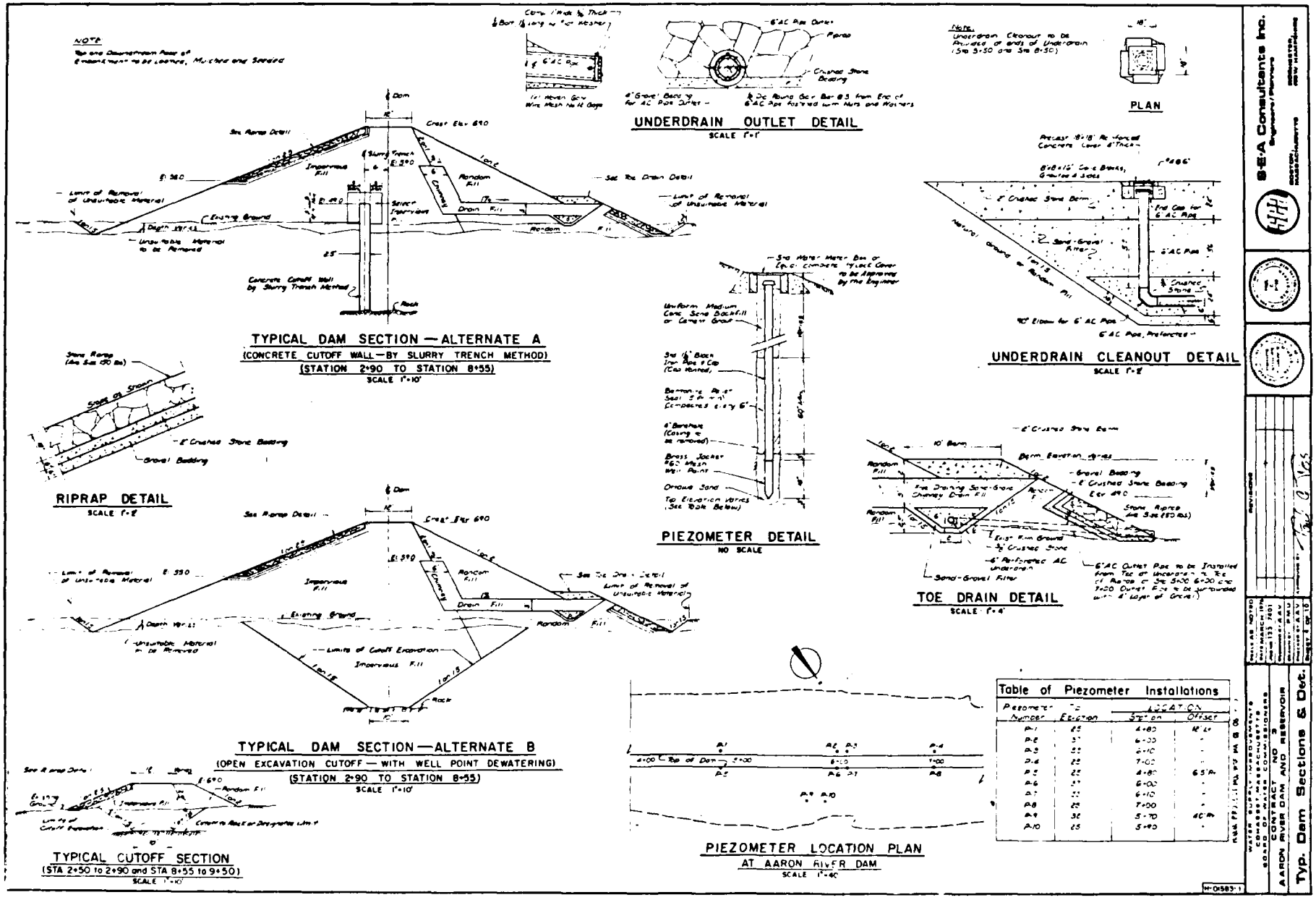
The Cohasset Dam and the new water treatment plant were scheduled to be finished by the time this report went to press. When the new system is operational sometime this Spring, it will be capable of supplying up to three million gallons per day of pure drinking water — enough to serve the community until the year 2000.

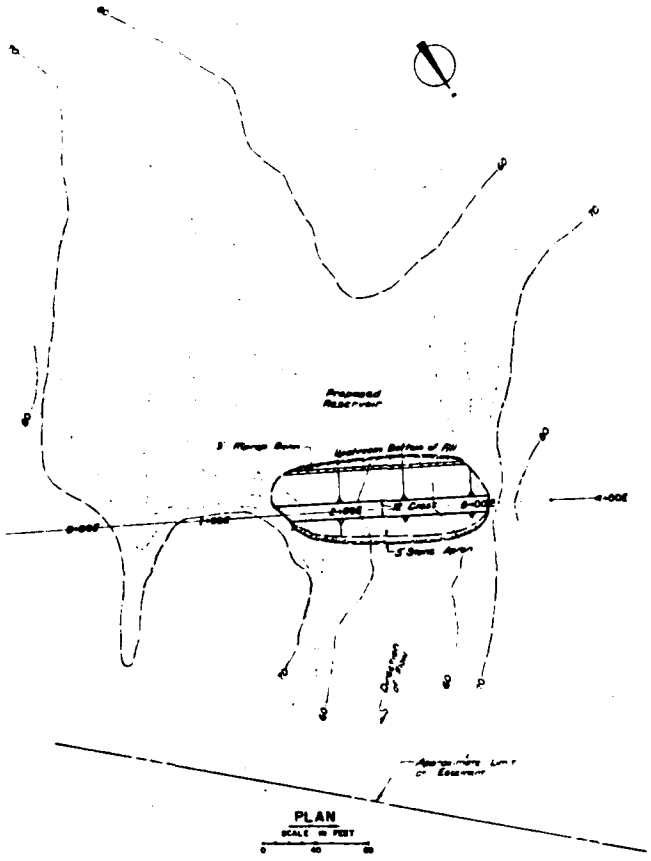
Key personnel on the $3.7 million improvement program are: for the town, Ed Pratt, water superintendent; for Arthur Schofield Inc., Arthur Schofield, president, Howard Rice, superintendent, Keith Banks, asst. superintendent, John Roma, project engineer, and Virginia Ober, project coordinator; for SEA Consultants Inc., Fred Aufiero, SEA project manager, and Ed Robinson, SEA resident engineer; for Goldberg Zoino, Dunnicliff Associates, Jim Webber, John Ayres and Bill Zoino; for McPhail Associates, Robert McPhail and Robert Hoyler; consultants Cesare Cueroni and Arthur Vulgaropulos; and for A. Bonfatti Inc., builders of the water treatment plant, Frank Cambridge, superintendent.

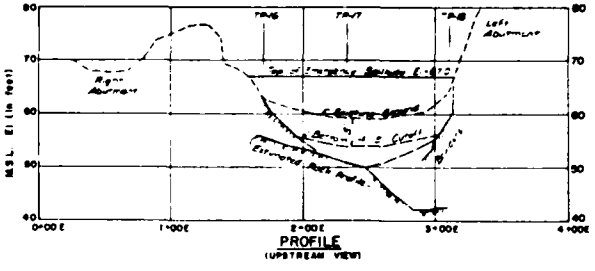
A Warner Swasey Hopto loads unsuitable peat material onto a Mack haul truck. Approximately two feet of peat had to be disposed of. Note water table is right up to ground level.

Reprinted from NEW ENGLAND CONSTRUCTION February 13, 1978 issue

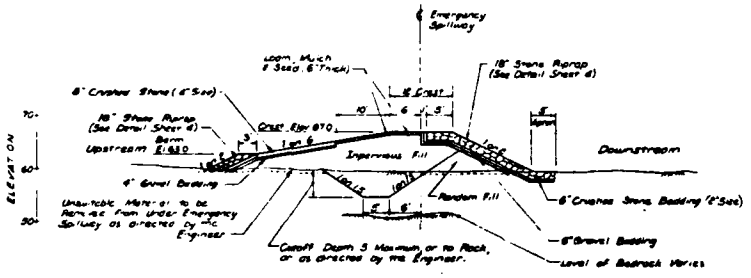

S-E-A Consultants Inc.
Dam Plan & Profile
AARON RIVER DAM AND RESERVOIR
CONTRACT NO. 8
NOTE: Layout of Chute Spillway is approximate. After the earth Overburden in this area is removed, the Engineer will establish in the field the final layout of the Chute Spillway Channel, Ogee Overflow Weir, and Spillway End Walls.
PLAN
FISHWAY PROFILE AT STA 2+90
CHUTE SPILLWAY PROFILE
PROFILE
MSL ELEVATION (in feet)
Estimated Rock Profile along Dam ℄
Existing Ground along Dam ℄
El 69.0 Top of Dam


NOTE
Top and Downstream Areas of Embankment to be Loamed, Mulched and Seeded
Dam
Crest Elev 690
See Ramp Detail
Slurry Trench
Impervious Fill
Random Fill
Drain Fill
Chimney
Select Impervious Fill
See Toe Drain Detail
Limit of Removal of Unsuitable Material
Existing Ground
Unsuitable Material to be Removed
Concrete Cutoff Wall by Slurry Trench Method
Rock
TYPICAL DAM SECTION — ALTERNATE A
(CONCRETE CUTOFF WALL — BY SLURRY TRENCH METHOD)
(STATION 2+90 TO STATION 8+55)
SCALE 1"=10'
Cone Plug & Thick
Bar Welded to Pipe Washer
Wire Mesh No 14 Gage
6" AC Pipe Outlet
Flange
Crushed Stone Bedding
6" Gravel Bedding for AC Pipe Outlet
3/4" Dia Round Bar Bar @ 3 from End of 6" AC Pipe Fastened with Nuts and Washers
UNDERDRAIN OUTLET DETAIL
SCALE 1"=1'
Note
Underdrain Cleanout to be Provided at ends of Underdrain (Sta 5+50 and Sta 8+50)
18"
PLAN
Precast 18"x18" Reinforced Concrete Cover 6" Thick
8"x8"x16" Concrete Blocks, Grouted & Solid
f'c=4000
6" Crushed Stone Base
Sand-Gravel Filter
6" AC Pipe
Natural Ground or Random Fill
1on1.5
1on2
Fine Cap for 6" AC Pipe
1/2" Crushed Stone
90° Elbow for 6" AC Pipe
6" AC Pipe, Perforated
UNDERDRAIN CLEANOUT DETAIL
SCALE 1"=1'
Stone Range (No Size 150 lbs)
Stone on Stream
6" Crushed Stone Bedding
Gravel Bedding
RIPRAP DETAIL
SCALE 1"=1'
Dam
See Ramp Detail
Crest Elev 690
Limit of Removal of Unsuitable Material
Impervious Fill
Random Fill
Drain Fill
Chimney
See Toe Drain Detail
Limit of Removal of Unsuitable Material
Existing Ground
Unsuitable Material to be Removed
Limits of Cutoff Excavation
Impervious Fill
Rock
TYPICAL DAM SECTION — ALTERNATE B
(OPEN EXCAVATION CUTOFF — WITH WELL POINT DEWATERING)
(STATION 2+90 TO STATION 8+55)
SCALE 1"=10'
See Ramp Detail
Existing Ground
Random Fill
Impervious Fill
Limits of Cutoff Excavation
Concrete Rock or Designated Unit
TYPICAL CUTOFF SECTION
(STA 2+50 to 2+90 and STA 8+55 to 9+50)
SCALE 1"=10'
Sta Metal Meter Box or Equal Concrete Valve Cover to be Approved by the Engineer
Uniform Medium Cone Sand Backfill or Cement Grout
Sta 1" Black Iron Pipe & Cap (Cap Welded)
Bentonite Pellet Seal 5 ft min Compacted Every 6'
6" Borehole (Casing to be removed)
Brass Jacket #60 Mesh Well Point
Orifice Sand
Top Elevation Varies (See Table Below)
PIEZOMETER DETAIL
NO SCALE
10' Berm
Berm Elevation Varies
Gravel Bedding
6" Crushed Stone Bedding Elev 690
Fine Draining Sand-Stone Chimney Drain Fill
Random Fill
Stone Rip-Rap Min Size 150 lbs
Existing Ground
1/2" Crushed Stone
6" Perforated AC Underdrain
Sand-Gravel Filter
6" AC Outlet Pipe to be Installed from Toe of Underdrain at Toe of Ramp at Sta 5+00, 6+30 etc 7+20 Outlet End to be Surrounded with 4' Layer of Gravel
TOE DRAIN DETAIL
SCALE 1"=4'
Top of Dam
PIEZOMETER LOCATION PLAN
AT AARON RIVER DAM
SCALE 1"=40'
Table of Piezometer Installations
Piezometer Number | Tip Elevation | Location Station | Location Offset
P-1 | 65 | 4+80 | 16' Lt
P-2 | 51 | 6+30 | -
P-3 | 55 | 6+10 | -
P-4 | 25 | 7+00 | -
P-5 | 25 | 4+80 | 65' Rt
P-6 | 51 | 6+00 | -
P-7 | 55 | 6+10 | -
P-8 | 25 | 7+00 | -
P-9 | 36 | 5+70 | 40' Rt
P-10 | 25 | 5+90 | -
S-E-A Consultants Inc.
Engineers/Planners
WATER SUPPLY IMPROVEMENTS
COMMONWEALTH OF MASSACHUSETTS
BOARD OF WATER COMMISSIONERS
AARON RIVER DAM AND RESERVOIR
CONTRACT NO 3
Typ. Dam Sections & Det.
Sheet 7 of 15



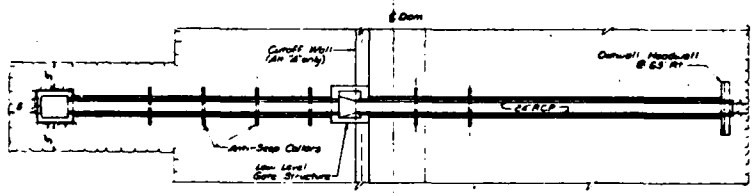


EMERGENCY SPILLWAY

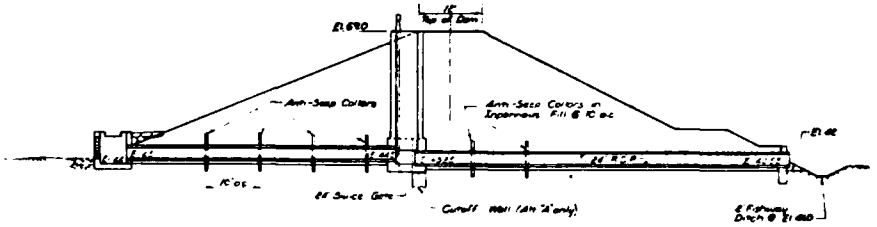


TYPICAL EMERGENCY SPILLWAY SECTION

SCALE: 1"= 10'



PLAN



PROFILE

LOW LEVEL OUTLET

(STATION 4+50)

SCALE 1"=10'

M.D.C. PROJECT NO. WW 184 (8 OF 11)

H-01584-1

S·E·A Consultants Inc.
Engineers / Planners

WATER SUPPLY DISTRICTS
COMMONWEALTH OF MASSACHUSETTS
BOARD OF WATER COMMISSIONERS

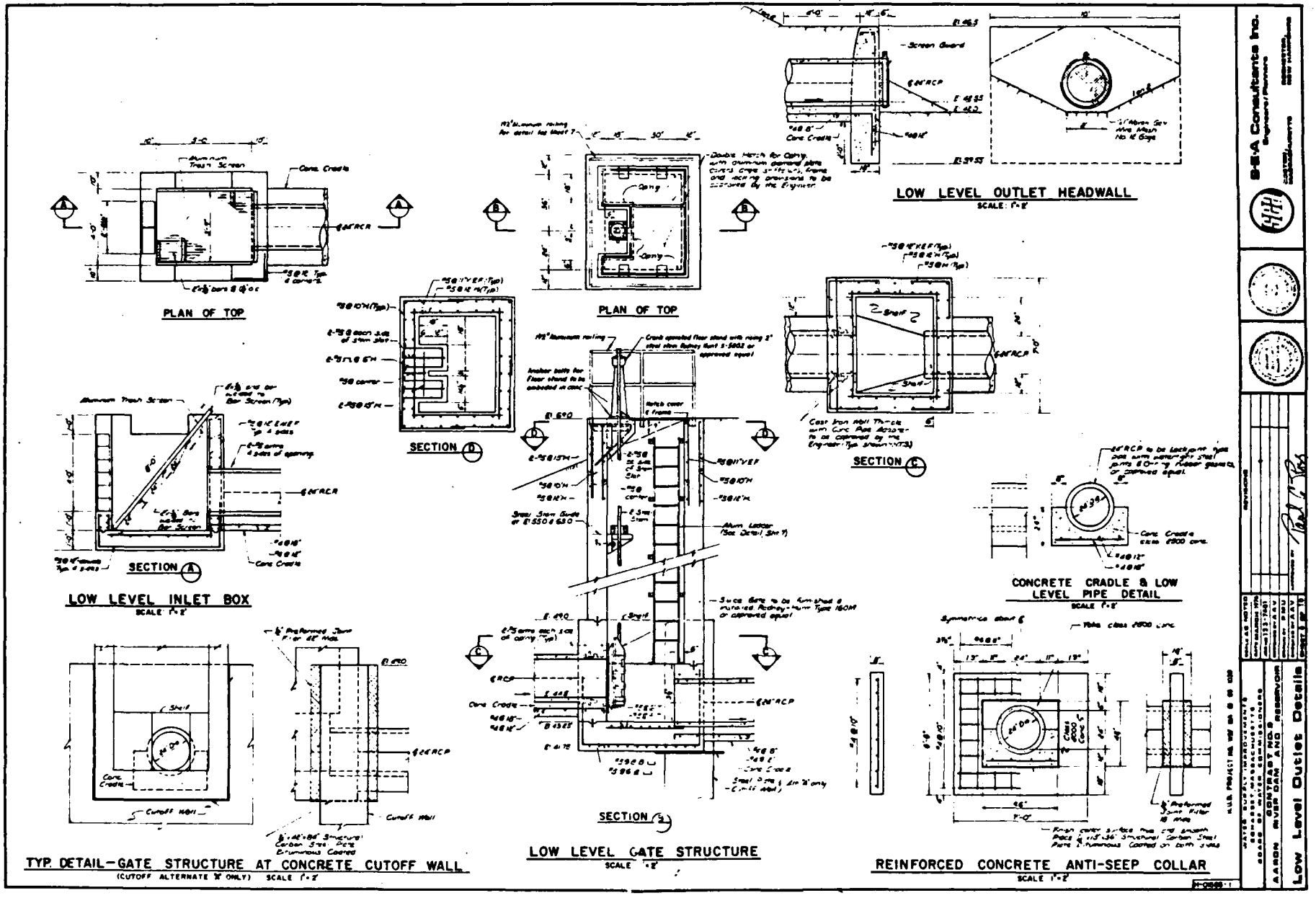
CONTRACT NO. 5

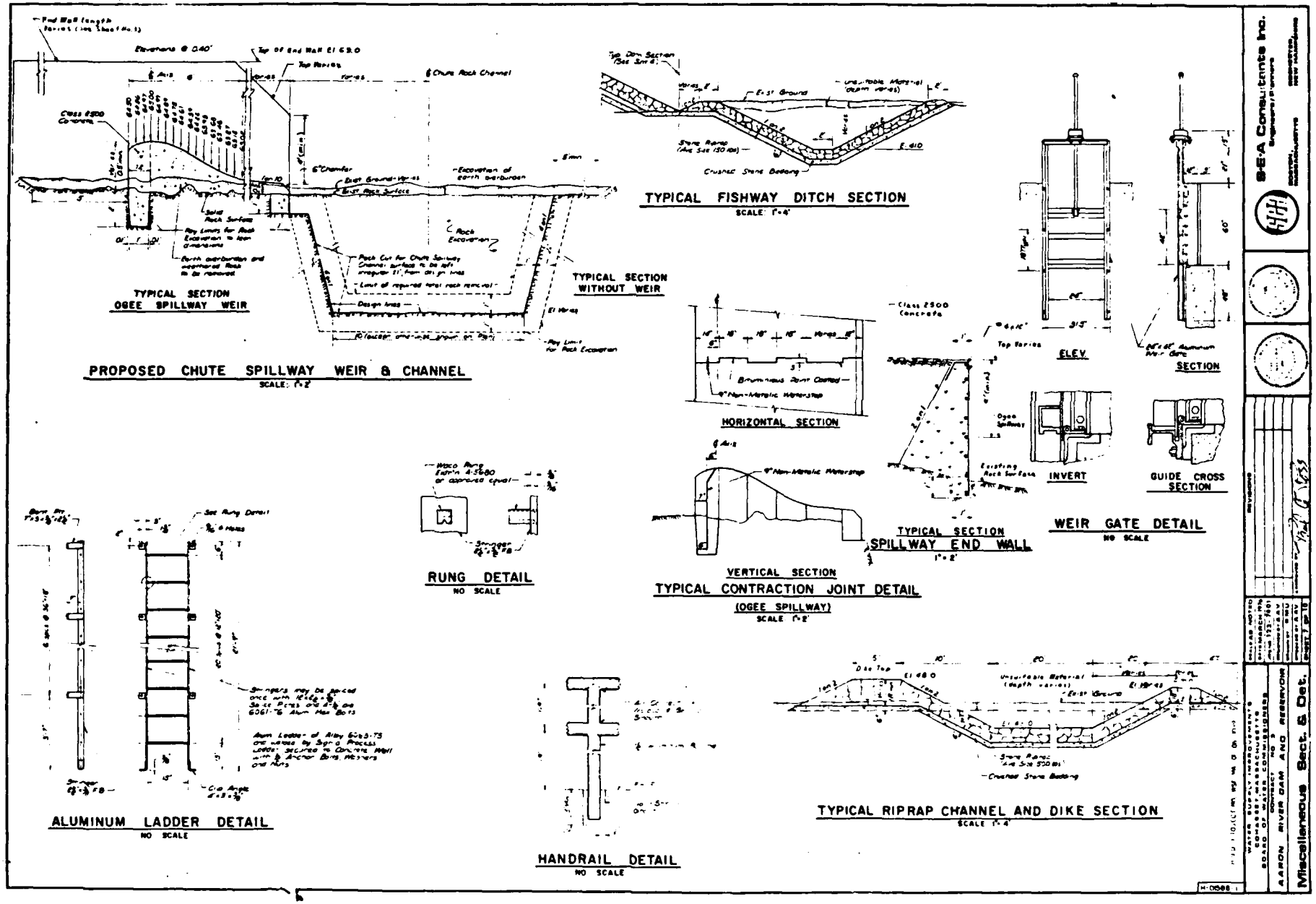
AARON RIVER DAM AND RESERVOIR

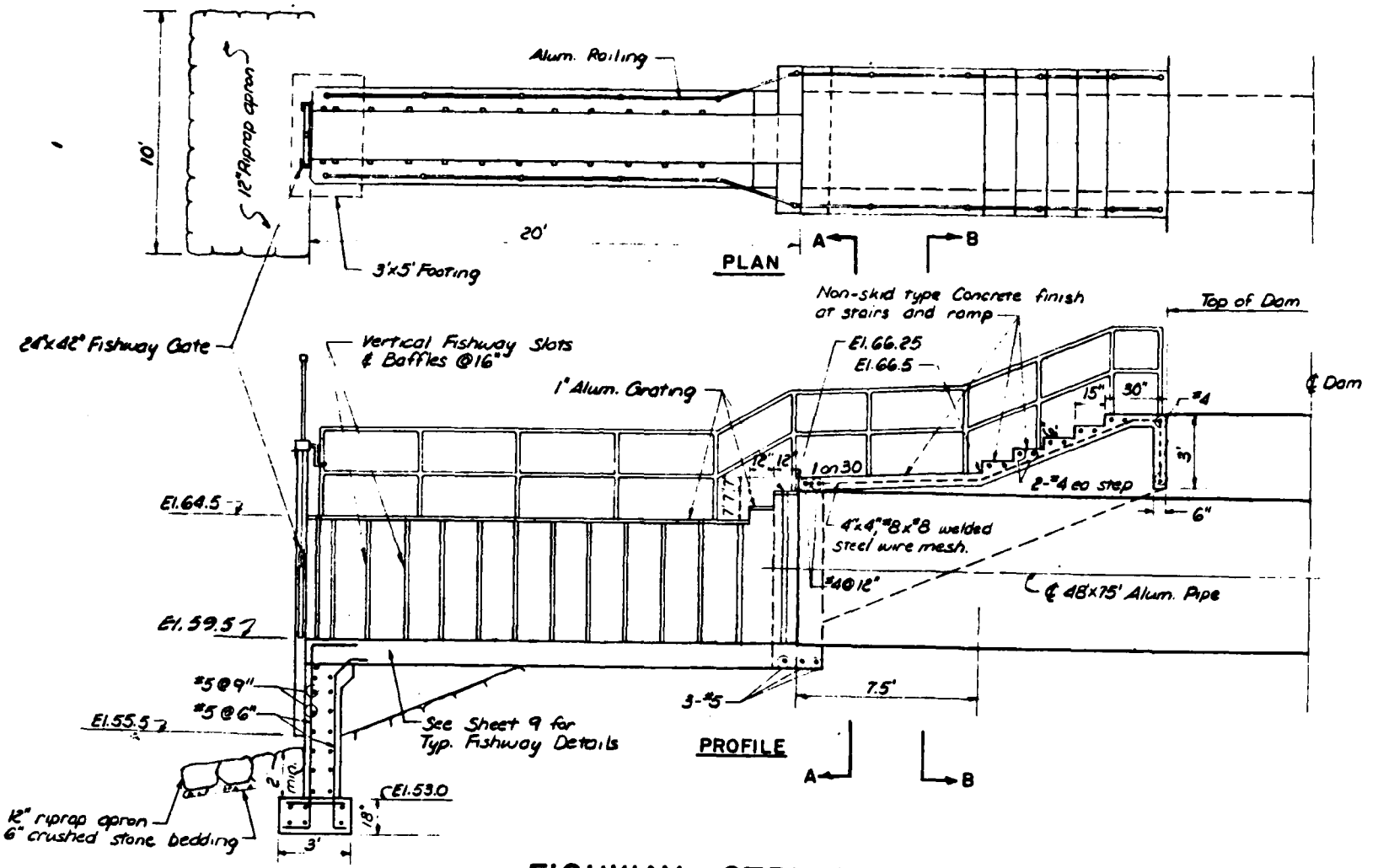
Emergency Spillway & L.L. Outlet

ISSUED NOTED

SHEET 3 OF 18


LOW LEVEL OUTLET HEADWALL
SCALE: 1"=2'
PLAN OF TOP
PLAN OF TOP
SECTION
SECTION
SECTION
LOW LEVEL INLET BOX
SCALE: 1"=2'
SECTION
LOW LEVEL GATE STRUCTURE
SCALE 1"=2'
CONCRETE CRADLE & LOW LEVEL PIPE DETAIL
SCALE 1"=2'
TYP. DETAIL-GATE STRUCTURE AT CONCRETE CUTOFF WALL
(CUTOFF ALTERNATE 'B' ONLY) SCALE 1"=2'
REINFORCED CONCRETE ANTI-SEEP COLLAR
SCALE 1"=2'
B-E-A Consultants Inc.
Low Level Outlet Details


TYPICAL SECTION
OGEE SPILLWAY WEIR
TYPICAL SECTION
WITHOUT WEIR
PROPOSED CHUTE SPILLWAY WEIR & CHANNEL
SCALE: 1"=2'
TYPICAL FISHWAY DITCH SECTION
SCALE: 1"=4'
HORIZONTAL SECTION
ELEV.
SECTION
INVERT
GUIDE CROSS SECTION
WEIR GATE DETAIL
NO SCALE
TYPICAL SECTION
SPILLWAY END WALL
1"=2'
VERTICAL SECTION
TYPICAL CONTRACTION JOINT DETAIL
(OGEE SPILLWAY)
SCALE 1"=2'
RUNG DETAIL
NO SCALE
ALUMINUM LADDER DETAIL
NO SCALE
HANDRAIL DETAIL
NO SCALE
TYPICAL RIPRAP CHANNEL AND DIKE SECTION
SCALE 1"=4'
S-E-A Consultants Inc.
Miscellaneous Sect. & Det.
AARON RIVER DAM AND RESERVOIR
BOARD OF WATER COMMISSIONERS
WATER SUPPLY IMPROVEMENTS
CONTRACT NO. 5
Sheet 7 of 10



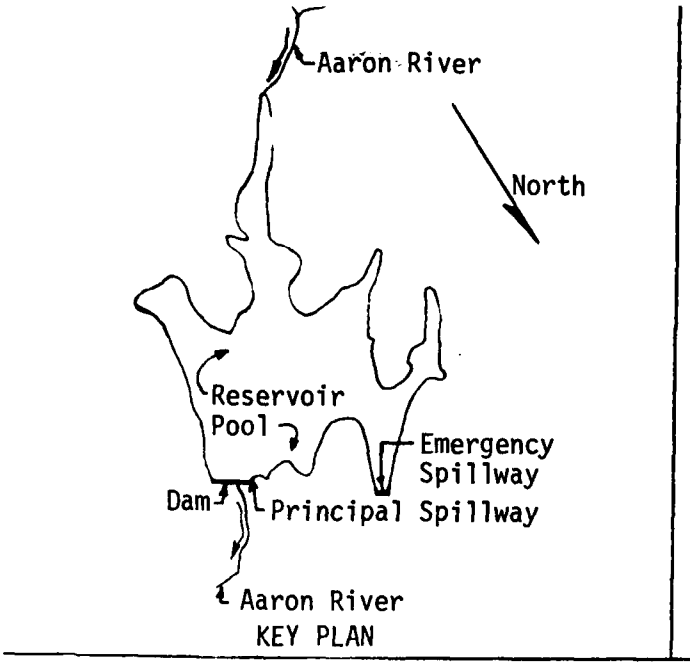
FISHWAY STRUCTURE AT UPSTREAM SIDE OF DAM

SCALE: 1" = 4'

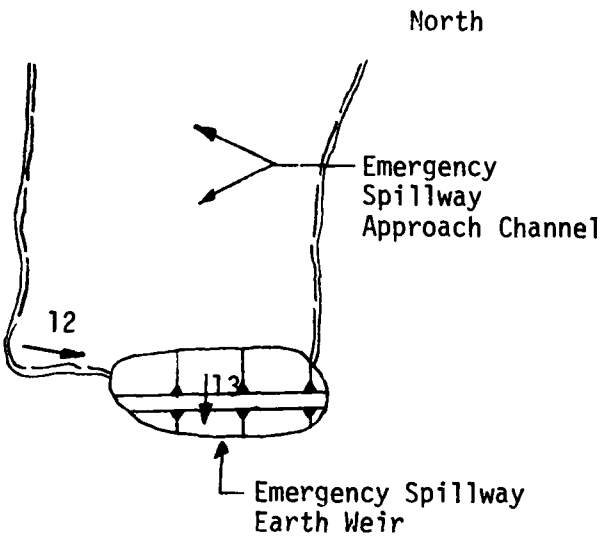
"Excerpt from Design Drawing No. 8 of 10"

APPENDIX C

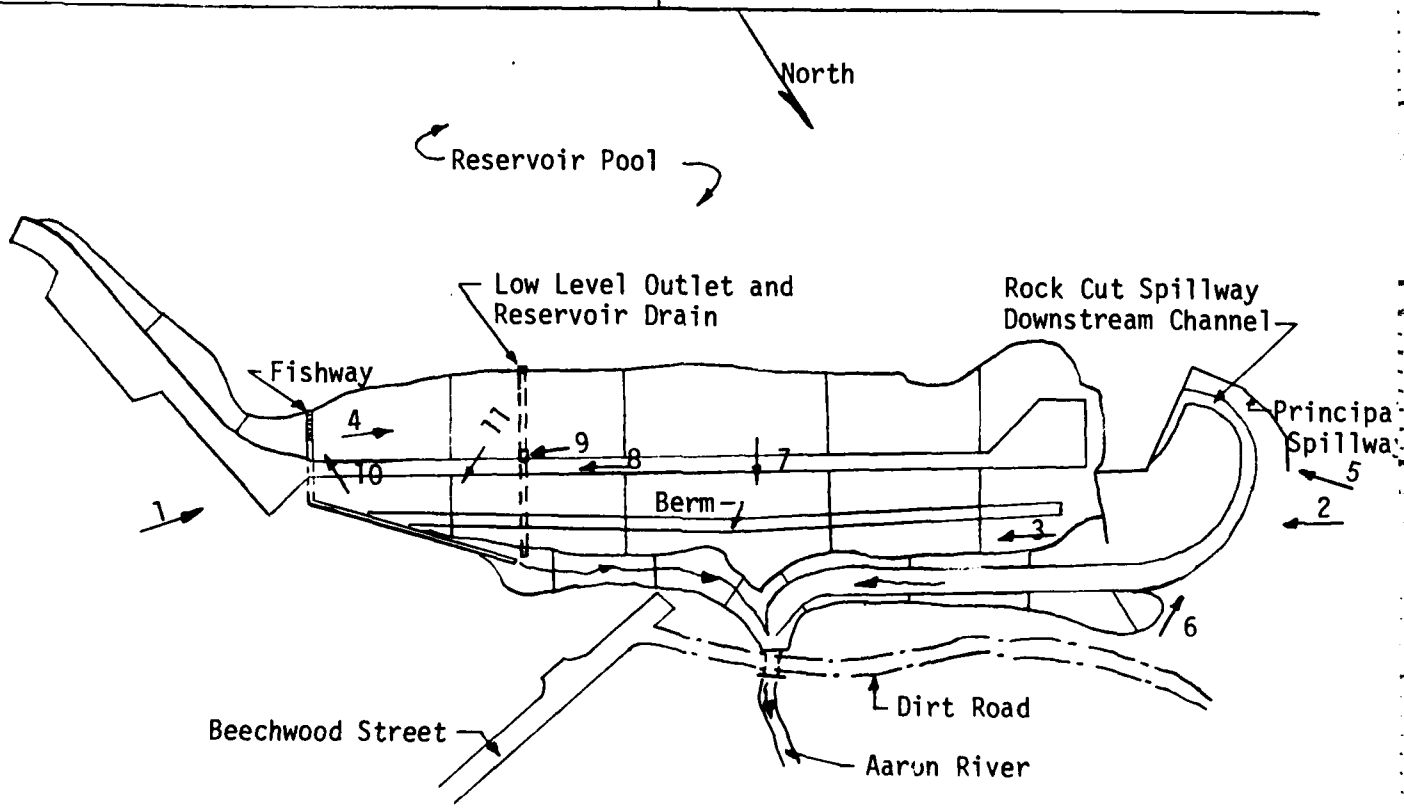
SELECTED PHOTOGRAPHS OF PROJECT



KEY PLAN



PLAN OF EMERGENCY SPILLWAY



PLAN OF DAM

NOTES:
1. PLAN BASED ON MARCH 1976 DESIGN DRAWING AND CDM FIELD OBSERVATIONS.
2. 1 DENOTES PHOTOGRAPH NUMBER AND DIRECTION OF VIEW.

CAMP DRESSER & McKEE, INC. BOSTON, MASSACHUSETTS	U.S.ARMY ENG. DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MA.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION OF PHOTOGRAPHS

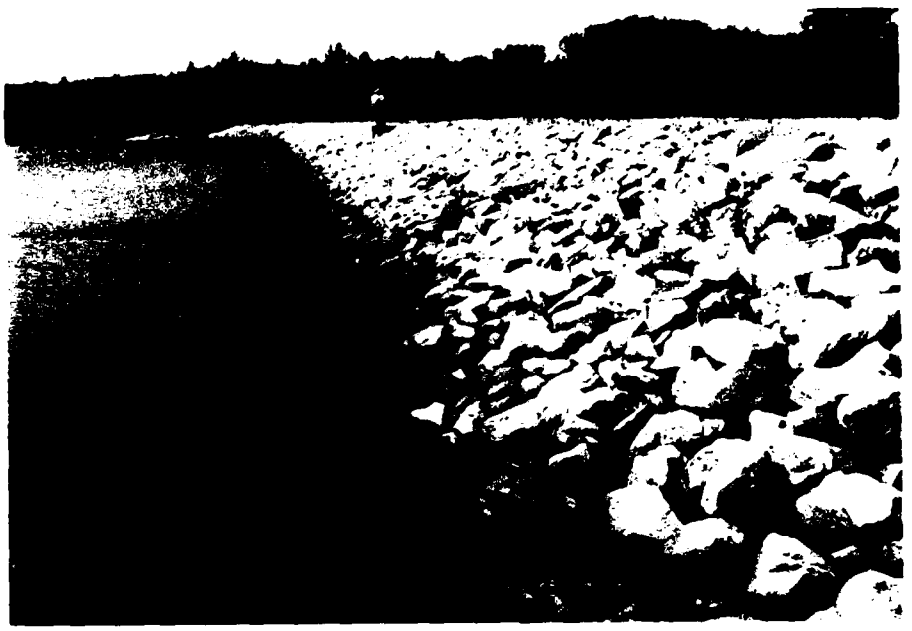
AARON RIVER DAM COHASSET, MASSACHUSETTS

Scale: Not To Scale

Date. September, 1980

2. OVERVIEW OF DAM FROM LEFT ABUTMENT WITH PORTION OF PRINCIPAL SPILLWAY DISCHARGE CHANNEL IN FOREGROUND.

3. DOWNSTREAM FACE OF DAM LOOKING TOWARDS RIGHT ABUTMENT.



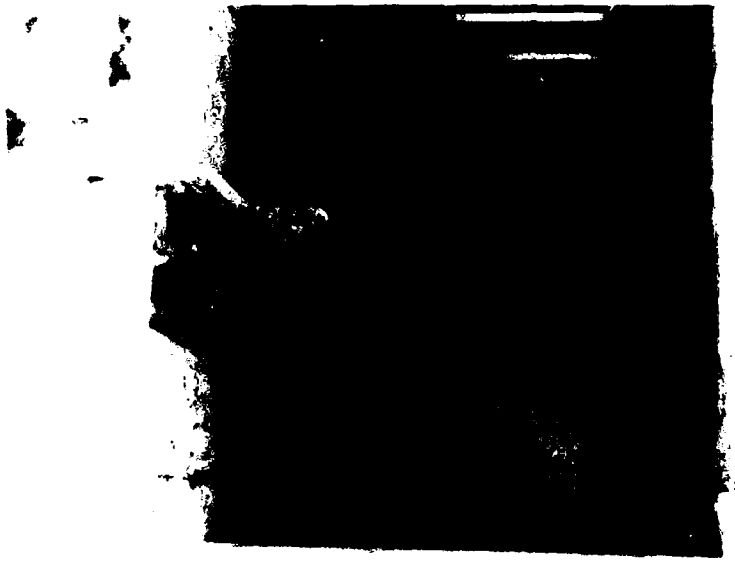
1. UPSTREAM FACE OF DAM SHOWING RIPRAP WAVE PROTECTION AND RESERVOIR DRAIN GATE OPERATOR.

5. VIEW OF PRINCIPAL SPILLWAY FROM LEFT ABUTMENT.

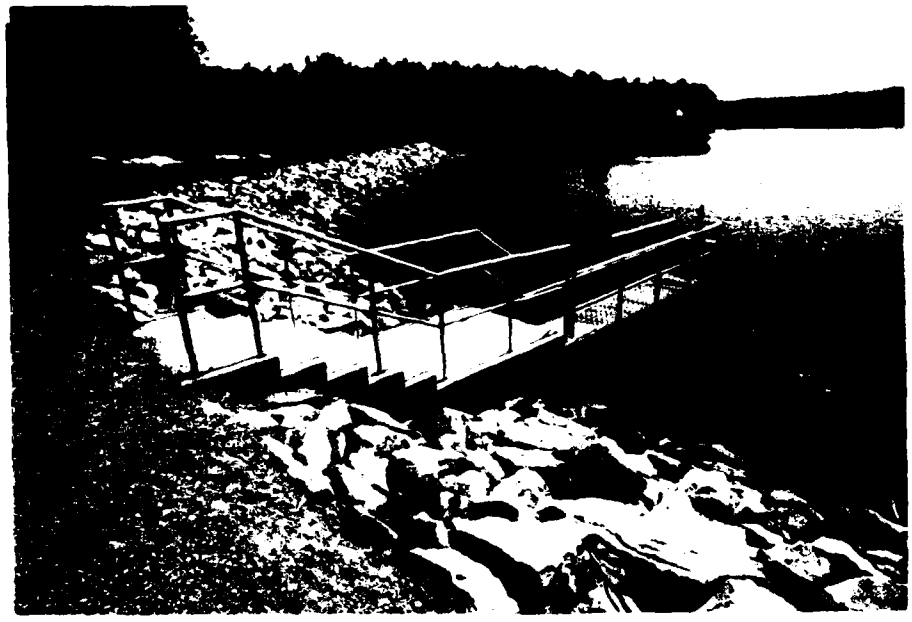
6. VIEW OF PRINCIPAL SPILLWAY DISCHARGE CHANNEL FROM DOWNSTREAM.

7. VIEW OF DOWNSTREAM CHANNEL FROM CREST OF DAM.

8. RESERVOIR DRAIN GATE OPERATOR AND TOP OF ACCESS VAULT.



9. INTERIOR VIEW OF RESERVOIR DRAIN ACCESS VAULT.



10. FISHWAY INLET STRUCTURE NEAR RIGHT ABUTMENT OF DAM.

11. VIEW OF FISH LADDER FROM CREST OF DAM.

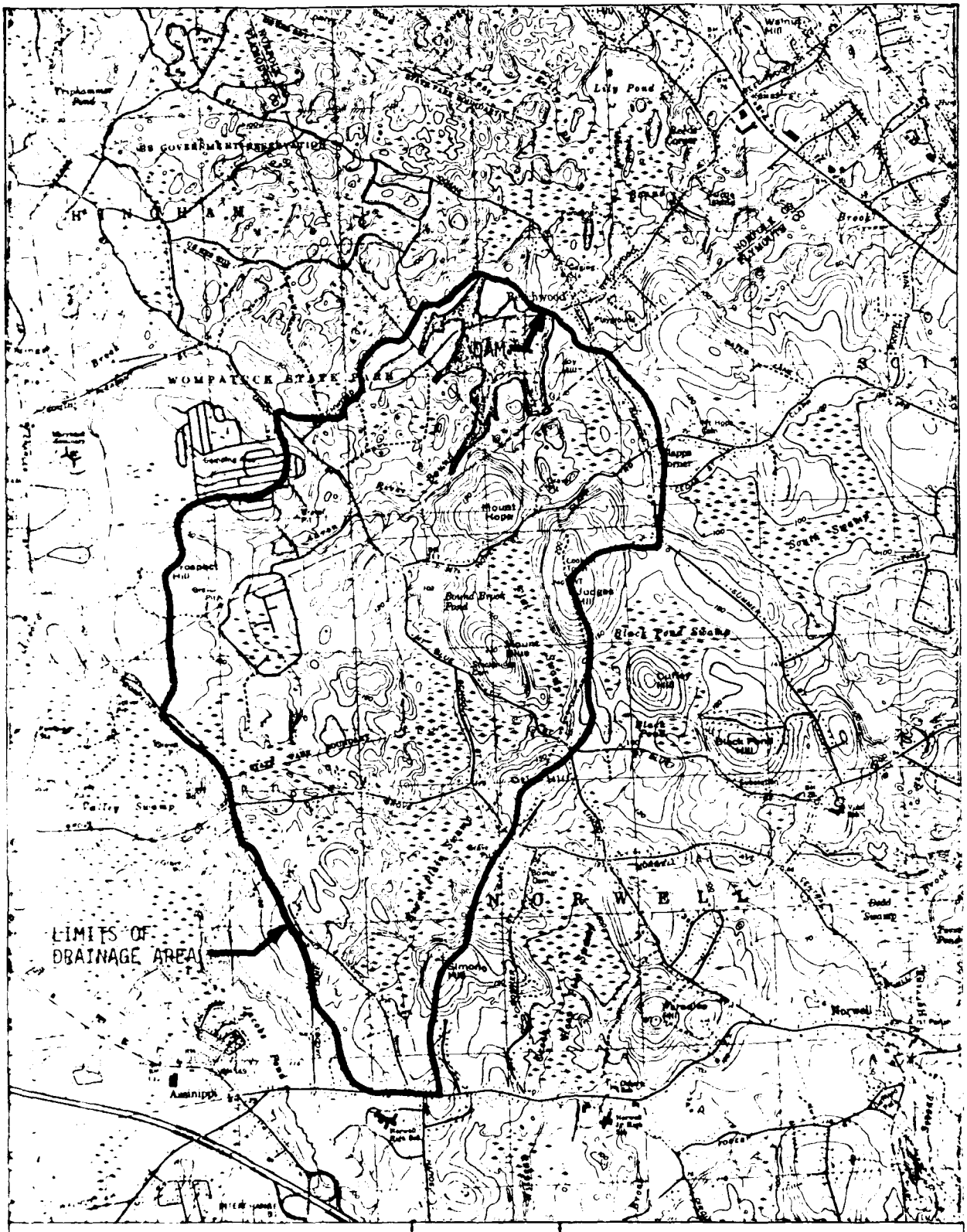
12. OVERVIEW OF EMERGENCY SPILLWAY FROM RIGHT ABUTMENT.

13. VIEW OF DOWNSTREAM CHANNEL FROM THE EMERGENCY SPILLWAY.

14. BOUND BROOK CONTROL STRUCTURE LOCATED AT BEECHWOOD STREET, APPROXIMATELY 1.2 MILES DOWNSTREAM OF THE DAM.

APPENDIX D

HYDRAULIC AND HYDROLOGIC COMPUTATIONS



DAM Aaron River Dam IDENTIFICATION NO. MA 01280		DRAINAGE AREA MAP APPROX. SCALE: 1" = 3280'

DAM Aaron River Dam

IDENTIFICATION NO. MA 01280

DAM FAILURE IMPACT AREA MAP

APPROX. SCALE: 1" = 2083'

CAMP DRESSER & McKEE CLIENT COE JOB NO 380-6-RT-26 COMPUTED BY Joe A.
PROJECT Dam Safety Enespection DATE CHECKED 8-7-80 DATE 8-1-80
DETAIL Aaron River Dam CHECKED BY JED PAGE NO 1-7

ELEVATIONS

All elevations refer to National Geodetic Vertical Datum (NGVD)

Top of Dam 70.5
Toe of Dam 41.0
Reservoir Drain Invert (24-in RCP) 42.55
Principal Spillway Crest – 185-feet @ El. 65.0; 45-feet @ El. 66.0
Emergency Spillway Crest 67.0
Fishway Invert (48"x75" Aluminum Pipe) 59.5; The weir crest gate is moveable.

SURFACE AREAS

Drainage Area ≈ 4.8 sq. mi. (from SEA dam construction application to the Comm. of Mass. Div. of Waterway
Reservoir Surface Areas:
@ Principal Spillway Crest, El. 65.0, ≈ 143 acres (from SEA computations
@ Emergency Spillway Crest, El. 67.0, ≈ 153 acres ("
@ Top of Dam , El. 70.5, ≈ 178 acres "

RESERVOIR STORAGE

@ Principal Spillway Crest, Storage ≈ 1470 ac-ft (from SEA comps)
@ Emergency spillway Crest, Storage ≈ 1780 ac-ft "
@ Top of Dam, storage ≈ 2350 "

TEST FLOOD DETERMINATION

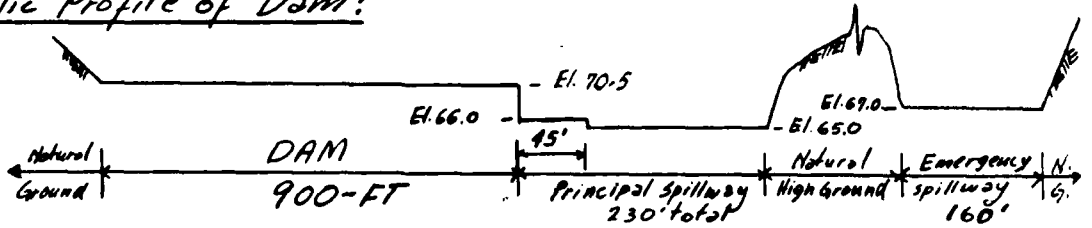
Based on an hydraulic height of 29.5-ft and a storage at top of dam of 2350 ac-ft, the size classification is INTERMEDIATE

Based on the HIGH hazard resulting from a dam failure and an INTERMEDIATE size classification, the COE guidelines recommend a test flood for the Aaron River Dam to be a PMF

The drainage are is flat and coastal with some scattered development. Therefore, use the flat and coastal curve of the NED Corps of Engineers "Preliminary Guidance for Estimating Discharges in Phase I Dam Safety Investigations".

∴ PMF = 800 cfs/sq. mi × 4.8 sq. mi. = 3,840 cfs

Hydraulic Profile of Dam:



STAGE-DISCHARGE RELATIONSHIP

Reservoir Water Surface Elevation (NGVD)	PRINCIPAL SPILLWAY DISCHARGE[1]				Emergency Spillway Flow C = 3.0; L = 160' Crest El. = 67.0	Fishway Discharge (see note 2 below for explanation)	TOTAL DISCHARGE (cfs)
	C-value	L = 185-ft Crest El. 65.0	C-value	L = 45-ft Crest El. 66.0			
65.0	—	0	—	—	—	21	21
65.5	3.2	209	—	—	—	25	234
66.0	3.25	601	—	0	—	29	630
66.5	3.3	1122	3.2	51	—	32	1205
67.0	3.35	1753	3.25	146	0	34	1933
67.5	3.4	2486	3.3	273	170	37	2966
68.0	3.45	3316	3.35	426	480	39	4261
68.5	3.5	4240	3.4	605	882	42	5769
69.0	3.55	5254	3.45	807	1358	44	7463
70.5	3.7	8829	3.6	1546	3143	50	13,568

Notes: 1 - The C-values for the principal spillway reflect field conditions.
2 - The Fishway discharge will vary depending on the position of the movable weir gate crest. For this report it is assumed that the the weir crest is at its highest elevation of 63.0. Then, $Q = CA\sqrt{2gH} = (6.0)(1.5\times2)\sqrt{64.4\times(70.1-63.}$

SURCHARGE-STORAGE ROUTING

Peak Test Flood Inflow = 3,840 cfs; Surcharge El. 67.85

$STOR_1 = \frac{\text{Surcharge Storage}}{\text{Drainage Area}} = \frac{450 \text{ ac-ft} \times 12 \text{ in/ft}}{3072 \text{ acres}} = 1.76 \text{ inches}$

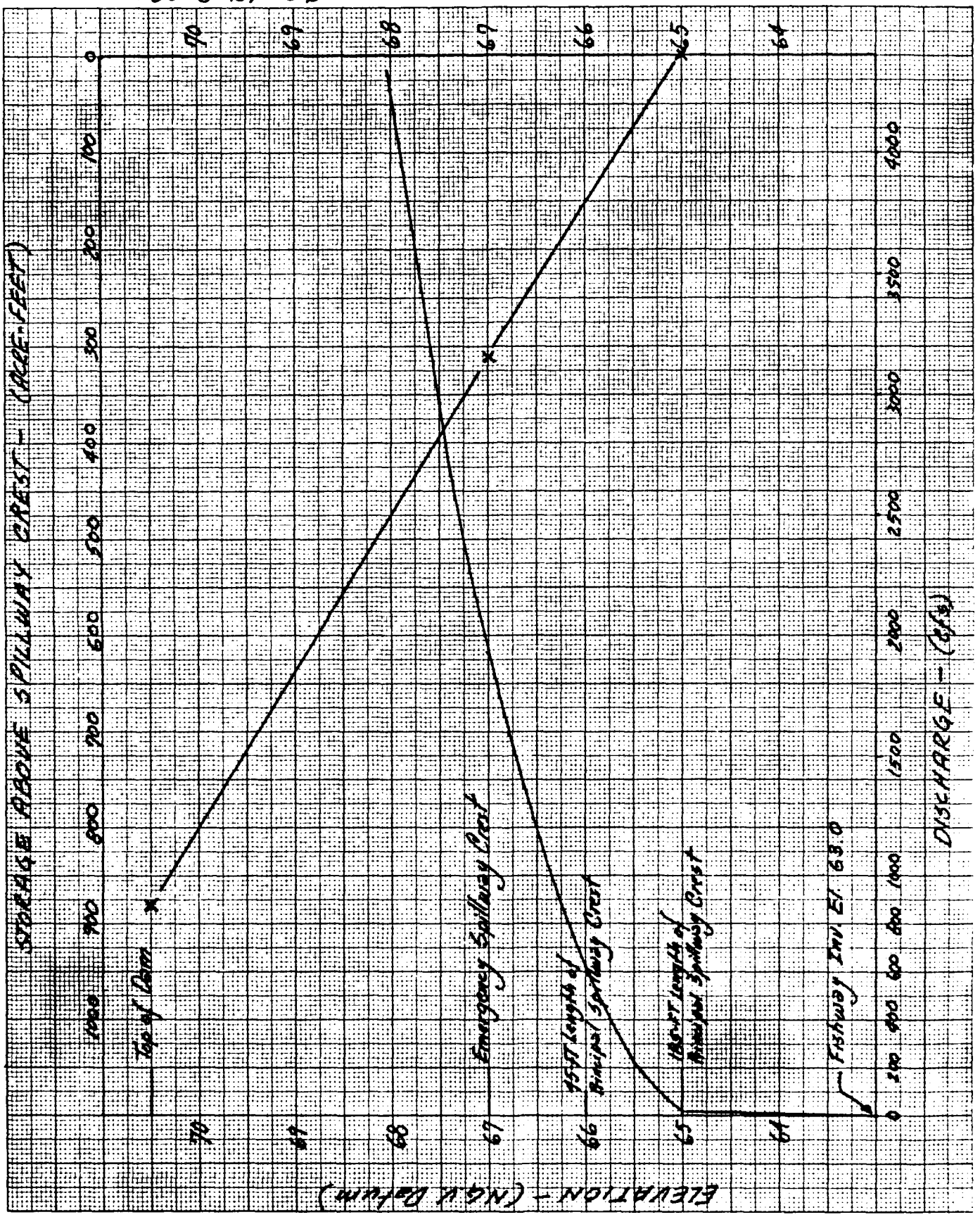
$\text{Outflow, } Q_{p_1} = Q_p\left(1 - \frac{STOR_1}{19}\right) = 3{,}840\left(1 - \frac{1.76}{19}\right) = 3484 \text{ cfs} \rightarrow \text{El. } 67.7$

$STOR_2 = (425\times12)/3072 = 1.66\text{-in}; \quad STOR_{AVG} = (1.76+1.66)/2 = 1.71\text{-in}$

$Q_{p_2} = 3840\left(1 - \frac{1.71}{19}\right) = 3494, \text{ say } 3{,}500 \text{ cfs} \rightarrow \text{El. } 67.7$

∴ Peak Test Flood Inflow ≈ 3,840 cfs

Routed Test Flood Outflow ≈ 3,500 cfs @ Surcharge El. 67.7 (NGVD)



DRAIN PIPE CAPACITY @ Spillway Crest

$Q = CA\sqrt{2gH}$ where $C \approx 0.75$; $A = \pi r^2 = 3.14(1)^2 = 3.14$ sq. ft
H = Spillway Crest El. − ℄ 24-in Drain Inlet
$= 65 - 46 = 19$ ft

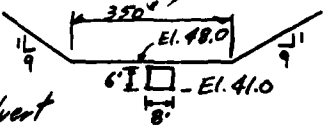
$Q \approx 0.75(3.14)\sqrt{64.4(19)} \approx 80$ cfs

TAILWATER ANALYSIS

A. @ Spillway – A visual examination of the area immediately downstream of the spillway indicated areas where tailwater would definetely affect the spillway discharge effeciency. This is due to rock outcrops near the spillway. This reduced spillway effeciency is reflected in the choice of C-values for estimating the spillway discharge.

B. @ Toe of Dam – Discharge from the reservoir (via the fishway, the principal spillway or the reservoir drain – the emergency spillway discharges at a remote point east of the dam) converges at a culvert about 50 feet from the toe of dam. This structure acts to pond water U/S to toe of the dam due to its limited hydraulic capacity.

Estimate the tailwater El. @ toe of Dam:



Sec. Geometry @ Toe of Dam Culvert

Stage-Discharge Relationship

Water Elevation (NGVD)	Culvert Capacity $Q = 0.7(48)\sqrt{64.4H}$	Weir Capacity $Q = 2.6LH^{1.5}$	Total Capacity (cfs)
50	660	2840	3500

∴ Tailwater on toe of Dam @ Routed Test Flood Outflow (3500 cfs) is at approximately El. 50.0. This is just about the top of rip rap on the toe of the dam and about a foot lower than the top of the lowest point on the crushed stone berm.

DAM FAILURE ANALYSIS

Project Discharge prior to dam failure ≈ Routed Test Flood Outflow
≈ 3,500 cfs @ stage 67.7 (NGVD)

Such a discharge would affect one house @ Doane Street by about 1 to 1.5 ft. of water (Doane St. is located ≈ 1000-ft D/S of Dam). Doane Street would be overtopped by about 1.5 feet. Downstream of Doane St. the existing swamps would attenuate the peak but would surcharge to about roadway level. No additional houses would be affected, except for the old Cohasset Water Treatment which would be flooded by about one foot of water. This facility is no longer used and has been replaced by a new facility near Lily Pond which would not be flooded.

Dam Failure Outflow, Q

$$Q = 8/27 (g)^{1/2} (W_b) (Y_o)^{1.5}, \text{ where:}$$

W_b = Max. of 40% of the dam's mid-height length
= 220-ft

Y_o = Height of Failure Section
= (67.7 − 41.0)
= 26.7-ft

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

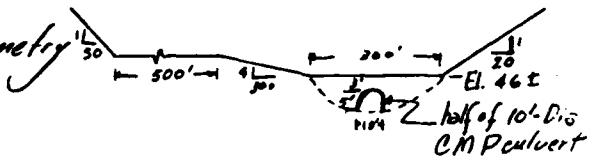
$$Q = 8/27 (32.2)^{1/2} (220) (26.7)^{1.5}$$
$$\approx 51{,}000 \text{ cfs}$$

∴ Total Outflow ≈ 51,000 + 3,500 = 54,500 cfs

The results of the dam failure are as follows:

REACH 1 — Aaron River Dam to Doane Street, located about 1000-ft downstream.

Approx. Sect. Geometry



Stage-Discharge Relationship:

Water Depth over Roadway (ft)	Culvert Capacity @ C = 0.7 (cfs)	Roadway Capacity $Q = \frac{1.49}{0.05} AR^{2/3} (0.0005)^{1/2}$ (cfs)	Total Capacity (cfs)
10	900	23,800	24,700
15	1050	58,600	59,650

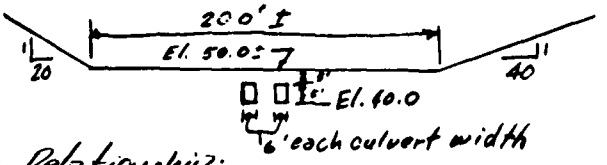
∴ @ an outflow of 54,500 cfs the roadway would be overtopped by about 14 feet. About 25 houses would be affected by varying depths up to 10 feet. About 15 of these are on the upstream side of the road and would be most severely affected

REACH 2 - Doane Street to Beechwood Street located about 5500-ft downstream of the dam.

The Town of Cohasset installed a fish ladder and a gated structure to regulate low flows. The gates are operated to allow discharges from the reservoir to be diverted to Lily Pond which serves as a water supply to the town. A minimum flow is maintained through the fish ladder. This control structure only regulates low flows; the twin stone culvert under Beechwood Street controls the hydraulics at significant outflows.

Given the significant storage upstream of Beechwood Street, assume that the routed test flood outflow will surcharge the swamp to about roadway elevation.

X-Section Geometry



Stage-Discharge-Surcharge Storage Relationship:

WSE @ Roadway	Culvert Flow @ C = 0.60	Flow Over Roadway $Q = \frac{1.49}{0.05} A R^{2/3} (0.0025)^{1/2}$	Total Flow (cfs)	Surcharge Storage (ac-ft) Assume stage of 50.0 @ Q = 3,500 cfs
50	790	—	790	Existing Storage Prior to Failure
55	1020	6,000	7,020	2560
60	1210	25,300	26,510	5120
65	1370	62,200	63,570	8392

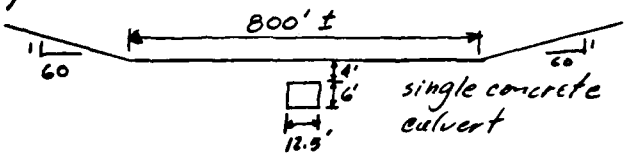
The reservoir storage at the routed test flood outflow stage of 67.7 is about 1900 ac-ft. The available surcharge storage in the swamp between Doane Street and Beechwood Street far exceeds the Aaron River reservoir storage at the time of failure. Therefore the dam failure outflow would attenuate in the swamp with a significantly reduced outflow at Beechwood St. The stage in the swamp would rise about 9.5 feet to accomodate the storage outflow from the reservoir at the time of failure. This indicates an outflow of about 5,150 cfs @ Beechwood Street — say the outflow is 5,000 cfs. This is very conservative since some of the reservoir storage would have discharged past Beechwood Street by the time the dam releases its storage. The WSE @ the roadway would be 53.5 ± @ Q = 5,000 cfs

About twenty to twenty-five (20-25) houses would be affected in Reach 2. About half of these, which are located around t...

Doane Street area would be affected by 5 to 7 feet of water. The other homes located further downstream would be affected by about 3 feet of water or less. The old Cohasset Water treatment Plant would be flooded by 4-feet of water, and the new one by about 1.5 to 2.0 feet of water.

REACH 3 - Beechwood Street to State Route 3A, located about 5000-ft D/S of Beechwood St.

Approx. Section Geometry:



Stage-Discharge Relationship:

Water Depth over Roadway (ft)	Culvert Capacity @ C = 0.7 (cfs)	Weir Capacity @ C = 2.8 (cfs)	Total Capacity (cfs)
zero	1115	—	1115
1	1190	2575	3765
1.5	1230	5040	6270

@ a discharge of 5000 cfs the roadway would be overtopped by 1 to 1.5 feet, given no attenuation of the peak outflow from Beechwood Street. However, this reach as well as the areas downstream of Rt 3A down to the Cohasset Harbor, where the brook discharges, are very flat and would attenuate the dam failure peak outflow.

There would be five houses affected in this reach by 1 to 1.5 feet of water. Downstream of Rt 3A the hydraulic characteristics of the area are similar to those at Route 3A. One would expect the three roadways downstream to be slightly overtopped and about 15 houses to be affected by a foot or less of water.

The impact of a failure of the Aaron River Dam would result in a HIGH hazard, especially to those people and structures between the dam and the Doane Street area. The houses downstr. of the Doane Street area would not be as severely impacted.

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

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