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THAMES RIVER BASIN
NORWICH, CONNECTICUT



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BOG MEADOW RESERVOIR DAM
CT 00208

PHASE 1 INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam at Bog Meadow Reservoir is an earth embankment approx. 280 ft. long, 17 ft. high with an average crest width of 30 ft. As a result of the visual inspection and the review of limited available data regarding this facility, the dam is considered to be in POOR condition. This dam is classified as SMALL in size and a SIGNIFICANT hazard structure in accordance with the Corps of Engineers.		



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

REPLY TO
ATTENTION OF

NEDED

AUG 16 1979

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

Dear Governor Grasso:

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

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, the City of Norwich, Water Department, Norwich, Connecticut 06360, ATTN: Mr. Humphrey Leary, Superintendent.

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

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

Sincerely yours,

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

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THAMES RIVER BASIN
 NORWICH, CONNECTICUT



BOG MEADOW RESERVOIR DAM
 CT 00208

PHASE I INSPECTION REPORT
 NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

Identification No.: CT 00208
Name of Dam: Bog Meadow Reservoir Dam
Town: Norwich
County and State: New London County, Connecticut
Stream: Norwichtown Brook
Date of Inspection: 8 December 1978

Brief Assessment

The dam at Bog Meadow Reservoir is an earth embankment approximately 280 feet long, 17 feet high with an average crest width of 30 feet. The dam was constructed, reportedly, in 1893 by the City of Norwich, its present owner, and was operated as a supplemental supply to their water system. At present the reservoir is abandoned as a water supply and is leased for recreational purposes. A stone masonry uncontrolled spillway is located at the right abutment of the dam. The outlet works is located near the left abutment and consists of a reinforced concrete intake structure, 2-24" inch diameter conduits through the dam, and a gated outlet below the embankment. Discharges from both the spillway and outlet works flow into Norwichtown Brook.

As a result of the visual inspection and the review of limited available data regarding this facility, the dam is considered to be in POOR condition. To assure the long term performance of this structure, several items of concern require attention: the apparent seepage along the downstream toe of the dam, the eroded and worn embankment slopes and crest, the deteriorated spillway stonework, the overgrowth of brush and small trees, and the sloughing of the stone armor protection on the upstream slope of the dam.

This dam is classified as SMALL in size and a SIGNIFICANT hazard structure in accordance with the recommended guidelines established by the Corps of Engineers. The test flood for this dam is equal to one half the Probable Maximum Flood (PMF). The test flood has an outflow discharge equal to 772 CFS which is less than the maximum capacity of the spillway. The maximum capacity of the spillway, under a stillwater condition is equal to 819 CFS and represents more than 100 percent of the test flood outflow. However, it should be noted that the test flood outflow, under stillwater conditions, will produce a reservoir pool water level that has a freeboard allowance of only 0.20 feet below the top of the dam.

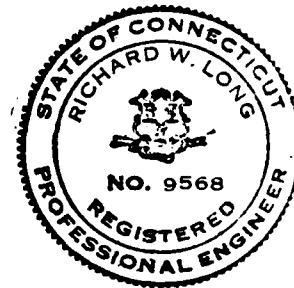
It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to accomplish the following: evaluate and design a seepage monitoring system to record the seepage flow; repair and install riprap on the upstream slope of the dam; reconstruct the spillway; restore eroded areas of the embankment and clear vegetal growth from the dam and its appurtenances.

Recommendations and remedial measures listed above and detailed in Section 7 should be implemented by the Owner within a one year period after receipt of this Phase I Inspection Report.

C-E MAGUIRE, INC.



Richard W. Long, P.E.
Vice President



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

Joseph A. McElroy

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

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joseph W. Finegan, Jr.

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

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding

that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an 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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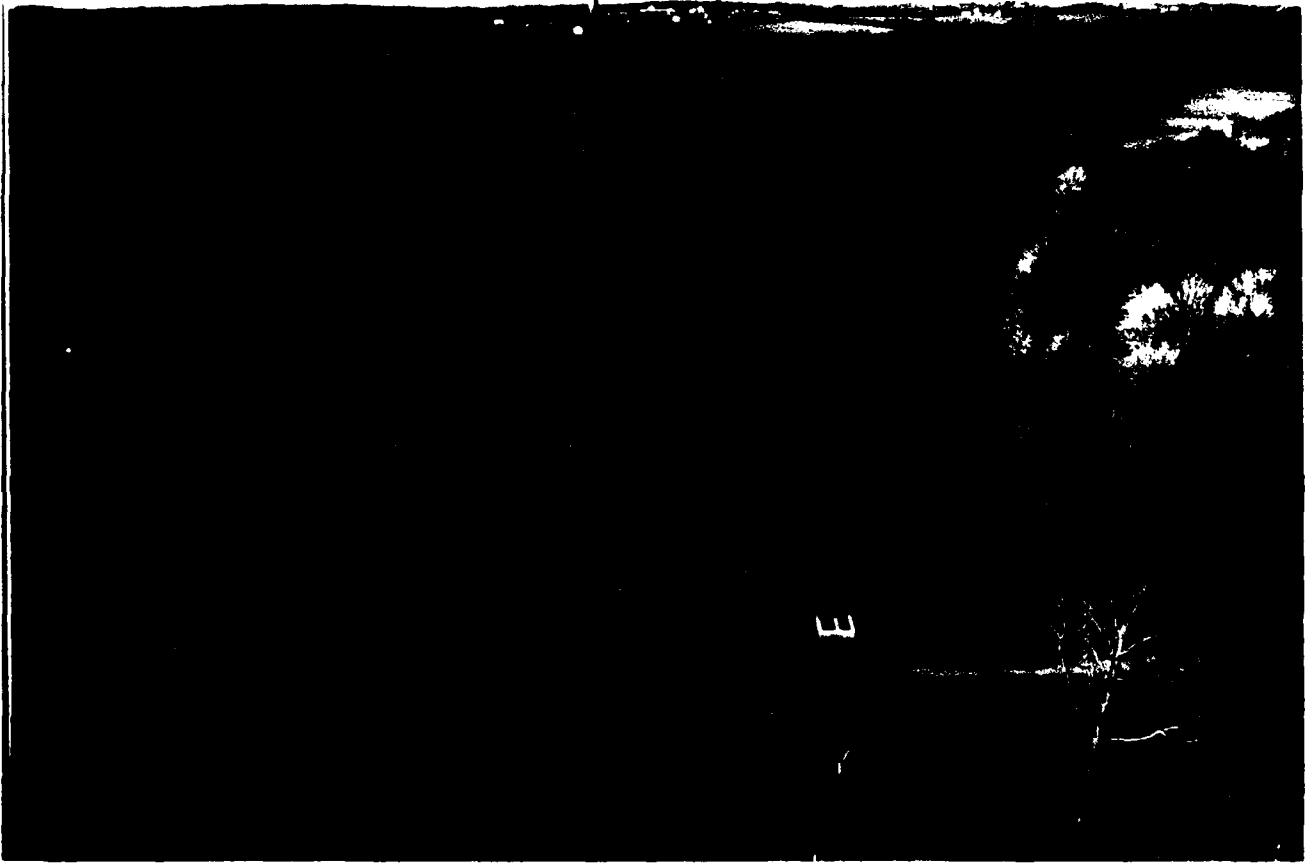
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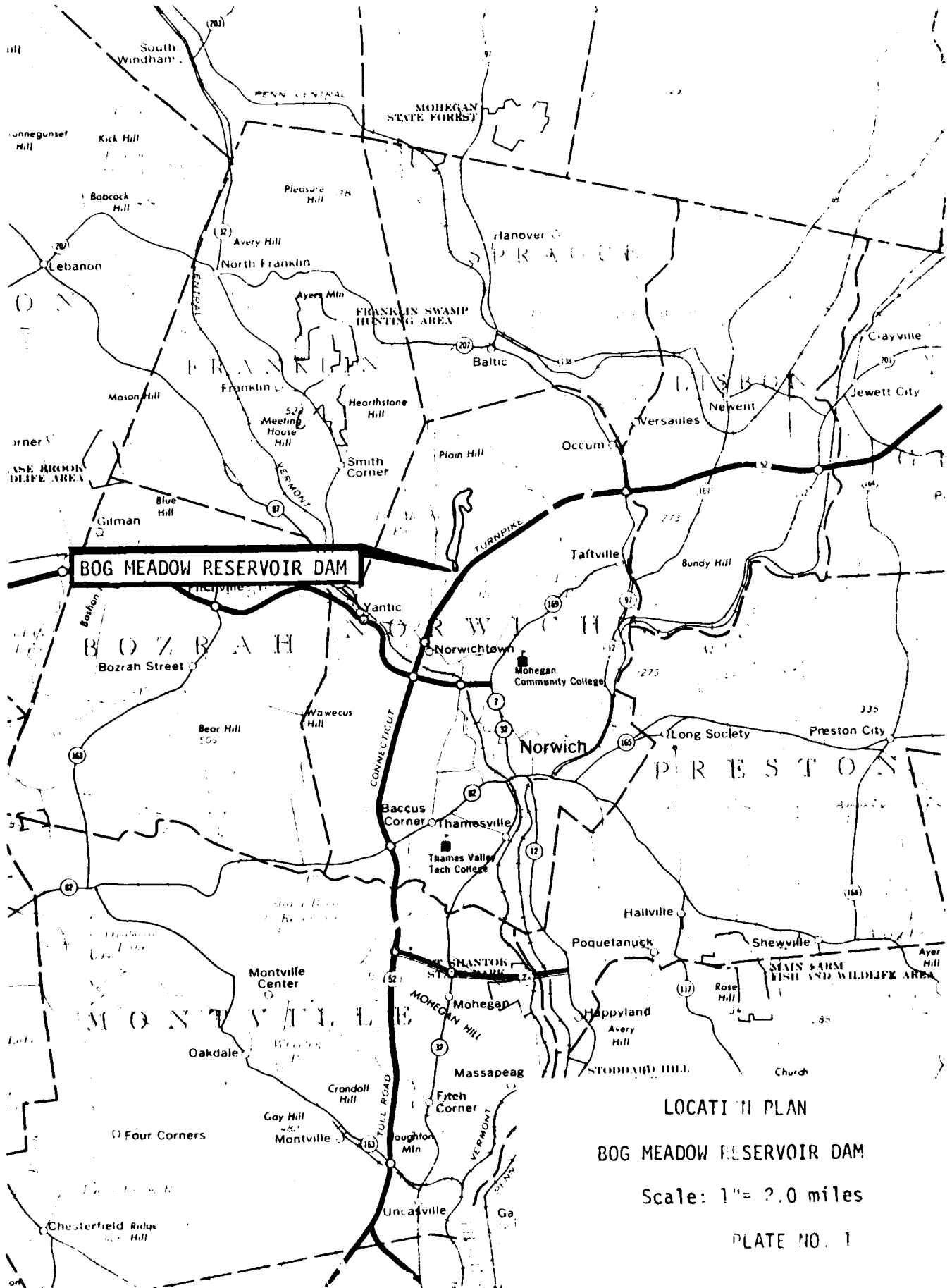
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OVERVIEW PHOTO - BOG MEADOW RESERVOIR DAM



NATIONAL DAM INSPECTION PROGRAM

PHASE I - INSPECTION REPORT

NAME OF DAM: BOG MEADOW RESERVOIR DAM

SECTION 1

PROJECT INFORMATION

1.1 General

- a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. C-E Maguire, Inc., has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to C-E Maguire, Inc., under a letter from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0015 has been assigned by the Corps of Engineers for this work.
- b. Purpose.
 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. To update, verify and complete the National Inventory of Dams.

1.2 Description of the Project

- a. Location. Bog Meadow Reservoir Dam is

located in New London County, Connecticut, approximately 1.5 miles north of the village of Norwichtown (See Plate No. 1). The dam impounds water from Norwichtown Brook which drains a 1.2 square mile watershed of a rolling, wooded terrain. Bog Meadow Reservoir has a surface area of about 45 acres and is aligned in a north-south orientation with the dam located at the most southerly point. The dam, watershed and reservoir are no longer used for water supply but are maintained for recreational use.

b. Description of the Dam and Appurtenances.

The Bog Meadow Reservoir Dam is an earth embankment structure approximately 280 feet long (including spillway), 17 feet high and has an average crest width of 30 feet. The upstream face of the embankment is sloped at 2H to 1V and is protected by riprap. The downstream slope is approximately 2H to 1V and is grass covered. The spillway is an uncontrolled overflow masonry structure located at the right abutment of the dam. The spillway weir is approximately 21 feet long and extends from the embankment to a bedrock outcrop at the right abutment. The outlet works consist of a reinforced concrete intake structure, two 24 inch diameter conduits and an outlet valve manhole and head-wall structure downstream from the dam. The intake structure is a two bayed reinforced concrete structure approximately 12 feet by 12 feet located at the left abutment of the dam. Each bay has stop log slots and screens to protect the inlets. The conduits are 24 inch diameter cast iron pipes which pass through the embankment. One conduit leads to a valve manhole and outlet below the dam; the second leads directly into the water system for the City of Norwich. Outflows from the dam to the distribution system are controlled by a gate valve, on the line, located below the dam. (See Site Plan - Appendix B-3). The outlet structure below the dam is a rubble stone masonry manhole protecting a manually operated gate valve which discharges flows from the reservoir into Norwichtown Brook.

- c. Size Classification. Bog Meadow Reservoir Dam has an impoundment capacity at the top of the dam (Elev. 264.0 NGVD) equal to 525 Ac.-Ft. and a height of 17.0 feet. Both of these parameters place this structure in the SMALL classification.
- d. Hazard Classification. This dam is classified as a SIGNIFICANT hazard structure because it is located in a predominantly rural area where its failure discharge can cause damage due to high velocity, impact from debris, and flooding to isolated homes (3), secondary or primary highways (Ct. Route 52) and interruption of utility service (those utilities adjacent to and within the right of way of Rt. 52). The estimated water depth due to the possible dam failure discharge of 9420 cfs may range from 11.0 feet at the dam to 5.0 feet at a distance of 1000 feet.
- e. Ownership. Bog Meadow Reservoir Dam is owned by the City of Norwich, Connecticut and maintained by the Water Department of that City. The City at present leases the facility to the Norwich Fish and Game Club for shoreline fishing.
- f. Operator.

Operating personnel are under the direction of:

Mr. Humphrey Leary
Superintendent of Water
City of Norwich, CT
(203) 887-2555

- g. Purpose of the Dam. This reservoir was initially part of the water supply system for the City of Norwich. It was operated as a supplemental supply to Fairview Reservoir a nearby surface supply in the system. Bog Meadow Reservoir was also held in reserve to supplement the system during the reconstruction and raising of Deep River Reservoir in 1971. However, the Bog Meadow supply has not been used, reportedly, in the past thirty years

in the water supply system and is at present leased for recreational use.

- h. Design and Construction History. This facility was constructed in 1893 for the City of Norwich. The consulting engineering firm of Chandler and Palmer, Civil Engineers, Thayer Building, Norwich, Connecticut were the designers and also supervised the construction. The reservoir was established as a supplemental supply to the water system for the City and recently has served as a back-up supply during the upgrading of Deep River Reservoir another surface water supply in the Norwich system. There are no records of any subsequent repair or rehabilitation work to the dam or its appurtenances.
- i. Normal Operating Procedure. This reservoir has not been used, reportedly, for the past thirty years. There are no records of its operation prior to that. Both the 24 inch diameter conduit leading to the water supply distribution system for the City of Norwich and the 24 inch diameter conduit that discharges into Norwichtown Brook, below the dam, are closed and all reservoir flows pass over the spillway.

1.3 Pertinent Data

- a. Drainage Area. The Bog Meadow Reservoir is located in New London County in southeastern Connecticut. The drainage basin lies in a plain area approximately 1.5 miles north of Norwichtown. The basin is generally rectangular in shape with a length of approximately 1.8 miles and an average width of 0.75 miles, resulting in a total drainage area of 1.2 square miles. (See the Drainage Basin Map in Appendix D). Ten percent of the watershed area is swampy and capable of storing some runoff from the terrain. The topography is generally rolling with elevations ranging from a high of about 440 NGVD to a low of about 259 NGVD at the spillway crest. Basin

slopes average 0.02 to 0.05 ft/ft and are considered moderate to steep. The time of concentration for the entire watershed is less than 40 minutes and is relatively small, increasing the likelihood that all surface runoff will peak simultaneously at the reservoir during a high intensity storm event.

b. Discharge at Dam Site. There is no history of discharge data available for this dam. Listed below are calculated discharge data for the spillway and the outlet works:

- | | |
|---|---|
| 1. Outlet Works: | Rectangular Concrete Intake Structure with 2-24 inch dia. cast iron conduits 1- conduit to the water distribution system 1- conduit to discharge below the dam. (Invert Elev. 247.0±) |
| 2. Maximum known flood at dam site | Unknown |
| 3. Overflow Spillway capacity at maximum pool level (Top of Dam-Elev. 264.0) | 819 CFS |
| 4. Gated outlet capacity at normal pool level (Spillway Crest Elev. 259.0) | 27 CFS |
| 5. Gated outlet capacity at maximum pool level (Top of Dam) | 32 CFS |
| 6. Total discharge capacity of spillway and outlet structure at maximum pool level (Top of Dam) | 851 CFS |
| 7. Overflow spillway capacity at "test | |

	flood" level (Elev. 263.80)	770 CFS
8.	Gated outlet capa- city at "test flood" level	32 CFS
9.	Total overflow dis- charge capacity of spillway and outlet structure at "test flood" level	802 CFS
C.	<u>Elevation</u> (Ft. above NGVD)	
1.	Top of dam	264.0
2.	Test Flood Pool Level	263.8
3.	Flood Control Pool	N/A
4.	Recreation Pool	259.0
5.	Spillway Crest	259.0
6.	Upstream invert of outlet works	247.0±
7.	Streambed downstream	247.0±
8.	Recorded Maximum Tail- water	Unknown
d.	<u>Reservoir Length</u> (Feet Scaled)	
1.	Length of Maximum Pool	5000
2.	Length of Recrea- tion Pool	5000
3.	Length of Flood Control Pool	N/A
e.	<u>Storage</u> (Ac-Ft) total	
1.	Water Supply Pool @ Spillway Crest	300

- | | | |
|----|--|-----|
| 2. | Flood Control Pool | N/A |
| 3. | Test Flood Level | 525 |
| 4. | Top of Dam | 525 |
| 5. | Net Storage between top of dam and spillway crest is 225 Ac.Ft. and represents 3.52 inches of runoff from the drainage area of 1.20 sq. miles. | |
| 6. | One foot of surcharge storage equals 0.70 inches of runoff from the drainage area of 1.20 sq. miles. | |

f. Reservoir Surface (Acres)

- | | | |
|----|--------------------|-----|
| 1. | Top of Dam | 45 |
| 2. | Maximum Pool | 45 |
| 3. | Flood Control Pool | N/A |
| 4. | Recreation Pool | 45 |
| 5. | Spillway crest | 45 |

g. Dam

- | | | |
|----|-----------------------------|------------------|
| 1. | Type | Earth Embankment |
| 2. | Length (including spillway) | 280 feet |
| 3. | Height | 17 feet |

4.	Top Width	30 feet (avg.)
5.	Side Slopes	Upstream: 2H:1V Downstream: 2H:1V
6.	Zoning	Unknown
7.	Impervious Core	Unknown
8.	Cut off	Unknown
9.	Grout Curtain	Unknown
10.	Other	-----

h. Spillway

1.	Type	Overflow weir, vertical overfall sharp crested
2.	Length of Weir	Gross=26.0 ft.; effective=22.0 ft.
3.	Crest Elevation	259.0
4.	Gates	Uncontrolled
5.	U/S Channel	Natural Bed
6.	D/S Channel	Natural Bed w/stone and concrete apron
7.	Design Surcharge	Unknown
8.	General	-----

i. Regulating Outlets

Refer to Paragraph 1.2b "Description of Dam and Appurtenances" for description of Outlet works.

1.	Downstream Invert	247.0±
2.	Size	24 inch dia. pipe

- | | | |
|----|-------------------|---|
| 3. | Description | Cast Iron |
| 4. | Control Mechanism | 24 inch dia. gate valve in manhole chamber below the dam. |
| 5. | Other | ----- |

SECTION 2

ENGINEERING DATA

2.1 Design. The following documents which contain the principal information regarding this dam were reviewed in the preparation of this report:

Proposed Plans - "Bog Meadow Reservoir Dam" - City of Norwich, Connecticut, Norwich Water Department.

2.2 Construction: No record of construction or repairs exist.

2.3 Operation: No record of operation for this facility has been maintained.

2.4 Evaluation:

- a. Availability: There are no plans, specifications or computations available from the Owner, County or State Offices regarding the design, construction or subsequent repairs for this dam.
- b. Adequacy: The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.
- c. Validity: The validity of the limited data must be verified.

SECTION 3

VISUAL INSPECTION

3.1 Findings

- a. General. Based on the visual inspection, the dam at Bog Meadow Reservoir appears to be in POOR condition. The main embankment of the dam shows signs of extreme wear and erosion and lack of proper maintenance. The upstream slope exhibits several locations where the stone armor protection has sloughed exposing soil materials to wave action. The slope is undulating and irregular. The crest and downstream slope shows evidence of severe ruts and gullies caused by motorbikes and pedestrian trespass. The downstream slope is also overgrown with vegetation. The spillway is constructed of rubble masonry and has dislodged stonework and large void areas. Flows in the downstream channel curve sharply at the toe of the embankment, passing along the toe to a point where they enter a restricting stone box culvert leading away from the dam. During high flow periods this could subject the toe to potential erosion.

It was reported by representatives of the Norwich Water Department that the reservoir has been abandoned for use as a water supply and that very little maintenance has occurred at the facility in recent years.

- b. Dam:

Upstream Slope:

The upstream slope of the dam is in fair to poor condition. It is generally covered with riprap with grass and weeds growing between the pieces of riprap, as shown in Photo C-1. Numerous windows were exposed in the riprap and a small animal hole was observed in the upstream slope at Sta. 1+10. In several areas of the upstream slope the riprap has sloughed down the upstream slope into the pond, leaving a vertical soil surface

exposed. Photo C-1 also shows a riprap failure near the spillway. At this location and at the other failures, the vertical soil face has been eroded, and the exposed soil is wet and soft.

There has been considerable erosion and sloughing at the junction of the left wall of the spillway and the upstream slope and crest of the dam. At Sta. 2+60, the concrete intake structure is located on the upstream slope. Riprap is sparse around the structure. On the upstream slope above the structure, there has been about 8 to 10 in. of erosion and settlement (Photo C-8). Some trees up to about 6 in. in diameter are growing on the upstream slope between approximately Sta. 3+10 and 3+40.

Crest:

The crest is grass-covered except for a soil path which has been worn along the centerline of the crest (Photo C-3). There are motorcycle tracks and ruts at several locations on the crest which also has an undulating appearance. On the downstream edge of the crest at Sta. 1+50, there is an 8 in. diameter stump. As described above, considerable erosion has occurred at the junction of the left wall of the spillway and the crest and upstream slope of the dam.

Downstream Slope:

The downstream slope of the dam is generally in fair to poor condition and covered with grass, tall weeds, brush, and some small trees (Photo C-4). There are numerous small stumps about 2 in. in diameter on the slope, a large decaying 12 in. diameter stump at Sta. 1+05, and an 8 in. diameter stump at Sta. 1+80. Deep erosion paths have been cut into the slope by motorcycles, pedestrians, and erosion at Stas. 3+40, 2+95, 2+58, 2+48, 2+36, 2+28, and 1+10 (Photos C-3, 4, 13, 14). The erosion path at Sta. 2+28 is about 12 in. deep. In addition to these paths, there are

other erosion areas on the downstream slope of the dam. Substantial erosion has occurred at the junction of the left spillway wall and the downstream slope.

Between Sta. 1+00 and approximately 1+60, the water in the downstream channel flows very close to the downstream toe of the dam. From about Sta. 1+30 to 1+60, the downstream toe has been eroded resulting in a 2 ft. high vertical slope. There is an apparent seepage zone downstream of the eroded toe at Sta. 1+30 to 1+60 (Photo C-15). The area is wet and soft down to about 6 in. A small flow of water was observed. The water had an oil-like surface appearance and did not appear to be carrying any fines which would suggest internal erosion in the embankment.

- c. Appurtenant Structures. The intake structure for the outlet works was constructed of reinforced concrete. This structure has some evidence of spalling but generally was in fair condition. No screens were observed at the intakes and were presumed to be either in storage or missing. No debris was observed obstructing the bays of this structure. (See Photo C-8).

Below the dam a field stone masonry manhole on the 24 inch dia. cast iron conduit housed the control gate for the dam. The gate was not operated during the inspection but was reported to have been opened in the past year. The outlet conduit within the manhole was corroded. (See Photo C-9, 10).

The spillway at the right abutment of the dam was in poor condition. Water was exiting through the joints of the weir section. Trees and brush were growing through the cobbles of the downstream channel bed. At the left abutment of the weir section a slot had been provided in a concrete abutment structure for flashboards. Its counterpart at the right abutment was missing. (See Photo C-6, 7).

- d. Downstream Channel. From the spillway to the downstream toe of the dam, the downstream

channel is bounded to the left by a stone masonry wall and to the right by natural ground. The channel makes a right-angle turn to the left at the toe of the dam and water flows approximately parallel to the downstream toe of the dam from Sta. 1+00 to about Sta. 1+60. At this point, the channel makes a right-angle turn downstream. The floor of the downstream channel consists of natural ground containing loose rocks. There are trees and brush growing in the channel. As described above, the water in the channel flows adjacent to the downstream toe of the dam from Sta. 1+00 to 1+60.

A roadway embankment has been constructed across the downstream spillway channel about 75 ft. downstream of the dam. There is 2.5 x 5.0 ft. stone masonry culvert in the roadway embankment for the water to pass through. This box culvert appears to be restrictive for downstream flows and could cause a backwater condition against the downstream toe of the dam that could impact on the stability of that slope. Downstream of the roadway embankment the spillway channel empties into Norwichtown Brook, a natural streambed. (See Photo C-11, 12).

- e. Reservoir Area. Generally the reservoir perimeter shoreline appears to be heavily wooded with moderate to flat terrain. This heavy growth should preclude the occurrence of slides or sloughs and subsequent sedimentation. However, this heavy growth near the approach to the dam and particularly the spillway should be monitored under a regular program to insure that it does not become floating debris and an obstruction to flows. (See Overview Photo).

3.2 Evaluation:

Based on the visual inspection, the overall dam condition appears to be POOR. There are several areas which require attention.

- a. There are deep erosion paths existing on the downstream slope. Erosion has also occurred at the junction of the dam and the left wall of the spillway and in the area around the valve chamber on the upstream slope. Continued erosion in these areas may lead to future problems if not remedied. Animal burrows on the upstream slope should be backfilled to grade and grassed.
- b. Numerous windows are evident in the riprap on the upstream slope. At several locations the riprap has sloughed down the upstream slope into the pond leaving a vertical soil face which is susceptible to erosion.
- c. The downstream channel from the spillway is located adjacent to the downstream toe of the dam from Sta. 1+00 to about 1+60. The downstream toe has been eroded in this area. Continued erosion will affect the long-term performance of the dam. Evaluate the backwater condition created by the downstream stone box culvert.
- d. The trees and brush on the upstream and downstream slopes can lead to future seepage problems. The tree roots can create seepage paths for the water if the trees are allowed to grow without limit.
- e. The trees growing in and along the downstream channel can restrict the flow through the channel.
- f. The seepage area between Sta. 1+30 and 1+60 should be monitored as described in Section 7.3.
- g. The spillway structure needs to be refurbished with the stonework regouted.

SECTION 4

OPERATIONAL PROCEDURES

- 4.1 Prodecures. There is no operation of the reservoir at this time, nor has there been for the major part of the last 30 years, hence there are no formal operating procedures. Bog Meadow Reservoir was used initially as a supplemental supply to Fairview Reservoir, which was discontinued about 30 years ago. In approximately 1972, the Reservoir was used as an auxiliary water supply when Deep River Reservoir, another surface water supply in the system, was modified. Bog Meadow is now leased to the Norwich Fish and Game Club, a private sports club, and is used by them solely for recreational purposes.
- 4.2 Maintenance of the Dam. There has been no maintenance of the dam by the Norwich Water Department because the reservoir is essentially abandoned.
- 4.3 Maintenance of the Operating Facilities. The operating facilities of Bog Meadow Reservoir Dam have not been maintained with the exception of the exercising of the 24" outlet gate in 1978.
- 4.4 Description of Any Warning System in Effect.
Impending storms or intense rainfalls are monitored, as a rule, by Water Department operations personnel from weather forecasts and the U.S. Weather Service (NOAA). During critical periods of high reservoir levels and approaching intense storm activity, both operating and engineering staff are on call.
There is no pre-planned warning system for the failure of the Bog Meadow Reservoir Dam. An emergency action plan must be developed so that operating personnel can notify authorities for mobilization of State or local emergency forces, organize remedial measures to minimize or prevent complete failure when possible, and have an awareness of the locations of supplies, standby equipment and materials.
- 4.5 Evaluation. The Dam and its appurtenances at Bog Meadow have been leased to the Norwich Fish and

Game Club by the Water Department and there has been very limited, if any, maintenance of the dam or its operating facilities, since that time. There are no existing operational or maintenance procedures, nor any formal warning system in effect. An emergency action plan needs to be formulated and posted to insure proper and expedient action during critical periods.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General. Bog Meadow Reservoir Dam, constructed by the City of Norwich in 1893, is located on Norwichtown Brook about 1.5 miles north of Norwichtown, Connecticut. The reservoir served as a supplemental supply to the water distribution system of the City of Norwich initially but has been abandoned and unused by the Water Department for the past 30 years. The dam has an overflow spillway with a length of 21.0 feet which is 7.5% of the total length of the dam. This impoundment has a total storage capacity of 300 Ac.-Ft. at elevation 259.0, the overflow spillway crest, that is equivalent to 4.69 inches of runoff from a drainage area of 1.20 sq. miles. Each foot of depth in the reservoir above spillway crest can accommodate 45 Ac.-Ft. of volume of water equivalent to 0.70 inches of runoff. With a total of 225 Ac.-Ft. of surcharge storage available, this dam is basically a large storage facility. The maximum spillway capacity of 819 CFS represents more than 100 percent of the "test flood" discharge and therefore this dam is classified as a low spillage facility. Since the dam is an earth embankment, it is considered less stable against overtopping and erosion.

b. Design Data.

Specific available as-built data is limited for this watershed and for the structures of the Bog Meadow Reservoir Dam. In lieu of existing as-built information, U.S.G.S. Topographic Maps (Scale 1"=2000') were utilized to develop hydrologic parameters such as drainage area, reservoir surface area, basin slopes, time of concentration and other runoff characteristics. Elevation - storage relationships for the reservoir were approxi-

mated (See Appendix D). Surcharge storage was computed assuming that the surface area remained constant above the spillway crest. Some of the pertinent hydraulic design data was obtained and/or confirmed by actual field measurements at the time of the visual field inspection.

Overflow values (routing procedures) and dam failure profiles were computed in accordance with the guidelines developed by the Corps of Engineers. Professional judgment was used in calculating final values outlined in this report, which are quite approximate and should not be considered a substitute for actual detail analysis.

- c. Experience Data. No historical data for recorded discharges or water surface levels is available for this dam or the watershed.

- d. Visual Observations.
 - 1. The crest of the embankment is undulating and irregular and needs to be re-dressed and restored to its design crest elevation.
 - 2. Riprap protection on the upstream slope has sloughed exposing embankment soil materials to erosion from wave action.
 - 3. The intake was unprotected from the accululation of debris and sediment which potentially could obstruct the intake structure and prevent regulation of the water surface.
 - 4. The spillway slab and side walls require restoration as well as the removal of vegetation.
 - 5. Backwater caused by the downstream culvert below the dam needs to be re-evaluated to reduce its potential for erosion of the toe.

- e. Test Flood Analysis. Recommended guidelines for the safety inspection of dams by the Corps of Engineers were used for the selection of the "Test Flood". This dam is classified as small in size and a significant hazard structure. Guidelines for these classifications indicate that a storm event equal in magnitude to the 100-year frequency storm to one half the Probable Maximum Flood (PMF) be used as a range for the "Test Flood". Ten percent of the 1.2 sq. mile drainage basin is swampy and tends to dampen the runoff peaks. Basin slopes range from 0.02 to 0.05 and are considered moderate and rolling. A "Test Flood" equal to one half the PMF was adopted and was calculated to be 1000 CSM or 1195 CFS for this drainage area. Outflow discharges for this inflow were estimated at 772 CFS. Additional data developed in this investigation is listed in a table format at the end of this section.

The spillway capacity is hydraulically adequate to pass the "Test Flood" and overtopping of the dam from this storm event would not occur. The inflow and outflow discharge values for this test flood are 1195 CFS and 772 CFS, respectively. The maximum outflow capacity of the spillway, in a stillwater condition, without overtopping of the dam is equal to 819 CFS which represents more than 100 percent of the "Test Flood" outflow discharge. This discharge, however, will produce a water surface level 0.20 feet below the top of the dam. The overtopping discharges for lesser magnitudes and frequencies have been calculated using approximate methods and are listed in the Table at the end of this section. Spillway and outlet rating curves have been calculated and are listed in Appendix D of this report.

At the spillway crest elevation of 259.0 (NGVD), the capacity of the outlet structure is equal to 32 CFS. It will require 16.8 hrs. to lower the reservoir level the first foot assuming the surface area of the reservoir pool is 45 acres.

- f. Dam Failure Analysis. This dam is classified as a significant hazard structure because it is located in a predominantly rural area where its failure discharge can cause damage due to high velocity, impact from debris, and flooding to isolated homes (3), secondary or primary highways (Ct. Route 52) and interruption of utility service (those utilities located adjacent to and within the right of way of Route 52).

The calculated dam failure discharge of 9420 CFS with the impounded water level at the top of the dam will produce an approximate water surface elevation of 258.0 immediately downstream from the dam. This discharge will raise the water surface approximately 6.0 feet from the depth just prior to failure when the discharge is 819 CFS and the depth of flow is 5.0 feet. Normal uniform flow, based on Manning's formula will occur approximately 1000 feet downstream from the dam with a depth of flow equal to 5.0 feet. For that distance of 1000 feet from the dam, the depth of flow will decrease from 11.0 feet to 5.0 feet. Water surface elevations due to failure of the dam are computed and are listed in Appendix D. Probable consequences including the prime impact areas, if the dam were to fail, are also listed in Appendix D.

BOG MEADOW RESERVOIR DAM

INFLOW, OUTFLOW AND SURCHARGE DATA

FREQUENCY IN YEARS	24-HOUR TOTAL RAINFALL IN INCHES	24-HOUR* EFFEC- TIVE RAINFALL IN INCHES	MAXIMUM INFLOW IN C.F.S.	MAXIMUM** OUTFLOW IN C.F.S.	SURCHARGE STORAGE IN C.F.S.	SURCHARGE STORAGE ELEVATION
10	5.0	2.6	263	148	2.0	261.0
50	6.5	4.1	434	260	2.33	261.33
100	7.0	4.6	508	304	22.57	261.57
1/2 PMF TEST FLOOD	11.9	9.5	1195	772	4.80	263.80

*Infiltration assumed as 0.1"/hour

**Lake assumed initially full at spillway crest elevation 259.0
(Top of dam = 264.0).

NOTES:

1. $Q_{10}; Q_{50}; Q_{100}$; inflow discharges computed by approximate methodology of Soil Conservation Service.
2. "Test Flood" computation based on COE instructions and guidelines.
3. Maximum capacity of the spillway without overtopping the dam elevation 264.0 is equal to 772 C.F.S.
4. All discharges indicated are dependent upon the continued integrity of upstream storage reservoirs.
5. Test Flood = Half PMF = 1000 CSM = 1195 CFS
(D.A. = 1.20 sq. miles).

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations.

The dam is an earthen embankment. The crest of the dam is covered with grass and there is a path worn bare along the entire length of the crest at the center line. The upstream slope is covered with riprap and grass. At several areas of the upstream slope, the riprap is absent and the underlying soil is exposed.

The downstream slope is covered with grass, tall weeds, brush and small trees. There are many erosion paths up to 12 in. deep extending from the crest to the downstream toe. Along the toe of the dam between Sta. 1+30 to 1+60, there was some evidence that seepage was discharging at the time of the inspection. Numerous stumps up to 12 in. diameter were present on the slope.

b. Design and Construction Data.

There is insufficient design and construction data to permit a formal evaluation of stability. There is, for example, inadequate information concerning zoning in the earth dam or the types of soil materials used in the embankment.

c. Operating Records.

There is no recorded information indicating past stability problems.

d. Post-Construction Changes.

Erosion has occurred on the upstream and downstream slopes. If the erosion is allowed to continue, the stability of the dam will be

decreased in the future.

e. Seismic Stability.

Bog Meadow Reservoir Dam is in Seismic Zone 1 and, hence, needs not be evaluated for seismic stability according to the Corps of Engineers' Recommended Guidelines.

SECTION 7
ASSESSMENT, RECOMMENDATIONS
AND REMEDIAL MEASURES

7.1 Dam Assessment.

a. Condition.

Based on a visual inspection, the dam appears to be in POOR condition. There are some features which could render the dam unsafe in the future if they are not corrected as recommended in Section 7.2 and 7.3.

b. Adequacy of Information.

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assured from the standpoint of reviewing design and construction data; but is based primarily on visual inspection, past performance history, and engineering judgement.

c. Urgency.

The recommendations and remedial measures presented below should be implemented by the Owner within one year from receipt of the Phase I report.

d. Need for Additional Investigation.

No information or observations indicate that Bog Meadow Dam requires a comprehensive investigation at this time. However, the recommendations and remedial measures outlined in 7.2 and 7.3 will require additional engineering inputs, analysis and designs.

7.2 Recommendations.

It is recommended that the Owner engage the services of an engineer experienced in the design of earth dams to conduct the following:

- a. The riprap on the upstream slope should be evaluated and repaired as needed. Suitable riprap protection should be installed in all unprotected areas on the upstream slope. Animal burrows should be backfilled to grade and grassed.
- b. The downstream toe should be repaired in the areas where it has been eroded.
- c. Provisions should be taken to ensure that flow in the downstream channel from the spillway does not erode the downstream toe of the dam.
- d. The erosion paths on the downstream slope should be repaired.
- e. The large diameter stumps (8" and 12") referenced in Section 3.1b on the downstream toe should be removed and the slope repaired.
- f. The apparent seepage along the downstream toe should be investigated. A collection system should be designed so that the quantity and turbidity of the seepage can be monitored on a regular basis. Records of the quantity of seepage, its color and solids content, the location of the exit points, as well as photographs should be included in the monitoring record.
- g. Repair and reconstruction of the spillway should be undertaken. Provision for the installation of stop logs in the reconstruction should not be considered due to the present minimal freeboard allowance of the dam.
- h. An evaluation of the dam stability at the downstream toe due to the backwater condition created by the downstream restrictive stone box culvert should be made.

- i. Planning for this facility should also consider relocating the control mechanism on the outlet works to the upstream side of the dam to eliminate a continuously pressurized pipe, the potential for pipe failure and internal erosion of the dam.

7.3 Remedial Measures.

a. Operating and Maintenance Procedures.

1. The Owner should clear the trees and brush for a distance of 30 feet downstream from the embankment toe and maintain that area in an open and clear condition.
2. The Owner should take such action as is necessary to prevent trespass on the crest, slopes and abutments of the dam and its appurtenances, particularly on those grass areas subject to erosion.
3. The intake bays of the outlet works should be cleaned. Replace the screens and secure them from vandalism in order that withdrawals from the impoundment can be made without the potential for obstructions to the flow.
4. A program should be implemented for the regular recording of data for such items as: Water surface levels, discharges, and time of drawdown to assist those responsible for the monitoring and operation of the structure.
5. Develop and "post" an emergency action plan including a warning system in order to prevent or minimize the impact of dam failure. It should include the expedient action to be taken, authorities to be contacted, and locations of emergency equipment and materials.
6. Continue the technical inspection of this facility on an annual frequency.

7.4 Alternatives.

Referring to the correspondence listed in Appendix B-2 from the State of Connecticut and as an alternate to the recommendations and remedial measures outlined in this report, the Owner should open the 24 inch diameter outlet works gate and leave it open until improvements have been made to reduce the hazard potential for this dam.

APPENDIX A
INSPECTION CHECK LIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT BOG MEADOW RESERVOIR DAM DATE December 8, 1978

TIME 10:00 A.M.

WEATHER 50°; SHOWERS

W.S.ELEV. _____ U.S. _____ D.S.

PARTY :

- | | |
|------------------------|-------------------------------------|
| 1. <u>A. REED</u> | 6. <u>H. LEARY - SUPT. OF WATER</u> |
| 2. <u>R. BROWN</u> | 7. _____ |
| 3. <u>S. KHANNA</u> | 8. _____ |
| 4. <u>R. MURDOCK</u> | 9. _____ |
| 5. <u>S. WHITESIDE</u> | 10. _____ |

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>DAM EMBANKMENT</u></p> <p>Crest Elevation</p> <p>Current Pool Elevation</p> <p>Maximum Impoundment to Date</p> <p>Surface Cracks</p> <p>Pavement Condition</p> <p>Movement or Settlement of Crest</p> <p>Lateral Movement</p> <p>Vertical Alignment</p> <p>Horizontal Alignment</p> <p>Condition at Abutment and at Concrete Structures.</p> <p>Indications of Movement of Structural Items on Slopes</p> <p>Trespassing on Slopes.</p> <p>Sloughing or Erosion of Slopes or Abutments</p> <p>Rock Slope Protection - Riprap Failures</p> <p>Unusual Movement or Cracking at or Near Toe</p>	<p>264.0</p> <p>259.07</p> <p>Unknown</p> <p>None observed</p> <p>Crest is unpaved (gravel & grass surface).</p> <p>Erosion settlement left of spillway.</p> <p>None observed.</p> <p>Crest is undulating, Motorcycle paths trespassing on crest.</p> <p>Good</p> <p>Erosion at junction of dam and left stone masonry training wall of spillway.</p> <p>None observed.</p> <p>Several deep motorcycle paths cut and eroded across downstream slope.</p> <p>Erosion zones evident on upstream and downstream slopes in addition to above paths, D/S toe eroded at Sta. 1+50.</p> <p>Several riprap failures w/sloughing of riprap down upstream slope, numerous windows in riprap.</p> <p>None observed.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>DAM EMBANKMENT (Cont.)</u></p> <p>Unusual Embankment or Downstream Seepage</p> <p>Piping or Boils</p> <p>Foundation Drainage Features</p> <p>Toe Drains</p> <p>Instrumentation System</p> <p>Vegetation</p>	<p>Seepage zone D/S of D/S toe at Sta. 1+50.</p> <p>None observed.</p> <p>None observed.</p> <p>None observed.</p> <p>None observed.</p> <p>Grass, bushes, and small trees growing on downstream slope, several cut stumps on crest and downstream slopes. Some grass areas on crest.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u></p>	<p>Under water, not observed.</p>
<p>a. Approach Channel</p> <p>Slope Conditions</p> <p>Bottom Conditions</p> <p>Rock Slides or Falls</p> <p>Log Boom</p> <p>Debris</p> <p>Condition of Concrete Lining</p> <p>Drains or Weep Holes</p>	<p>Straight Natural Channel</p> <p>Underwater not observable</p> <p>Underwater</p> <p>Underwater</p> <p>None</p> <p>None observable</p> <p>N/A</p> <p>N/A</p>
<p>b. Intake Structure</p> <p>Condition of Concrete</p> <p>Stop Logs and Slots</p>	<p>Reinforced Concrete 12' x 12' with 2 bays for intakes. No screens or trash racks visible. Concrete badly spalled and some settlement and erosion noted around structure. Stop log slots were constructed integrally with structure but not at site.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - CONTROL TOWER</u> a. Concrete and Structural b. Mechanical and Electrical	N/A N/A

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978

INSPECTOR _____ DISCIPLINE _____

INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - TRANSITION AND CONDUIT</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining on Concrete</p> <p>Spalling.</p> <p>Erosion or Cavitation</p> <p>Cracking</p> <p>Alignment of Monoliths</p> <p>Alignment of Joints</p> <p>Numbering of Monoliths</p>	<p>2 - 24 inch diameter conduits pass thru the dam. One leads to the water distribution system. The second, terminates below the dam and allows discharges to re-enter Norwichtown Brook. Manhole on pipeline houses control gate for operation.</p>

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u></p> <p>General Condition of Concrete</p> <p>Rust or Staining</p> <p>Spalling</p> <p>Erosion or Cavitation</p> <p>Visible Reinforcing</p> <p>Any Seepage or Efflorescence</p> <p>Condition at Joints</p> <p>Drain holes</p> <p>Channel</p> <p>Loose Rock or Trees Overhanging Channel</p> <p>Condition of Discharge Channel</p>	<p>24-inch diameter cast iron pipe with field stone headwall below the dam. Discharges flow into a natural stream below dam. Stream overgrown with vegetation and is meandering.</p> <p>None observed</p> <p>Stream bed through woods</p> <p>Yes</p> <p>Fair</p>

PERIODIC INSPECTION CHECK LIST

PROJECT BOG MEADOW DAM DATE December 8, 1978
 INSPECTOR _____ DISCIPLINE _____
 INSPECTOR _____ DISCIPLINE _____

AREA EVALUATED	CONDITION
<p><u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u></p>	
<p>a. Approach Channel</p>	<p>Underwater, not observed Straight, natural bed.</p>
<p> General Condition</p>	
<p> Loose Rock Overhanging Channel</p>	<p>Underwater</p>
<p> Trees Overhanging Channel</p>	
<p> Floor of Approach Channel</p>	<p>Natural stony bed</p>
<p>b. Weir</p>	
<p> General Condition of Concrete</p>	<p>Fair</p>
<p> Rust or Staining</p>	<p>None observed</p>
<p> Spalling</p>	<p>Extreme right side of weir badly spalled and deteriorated.</p>
<p> Any Visible Reinforcing</p>	<p>None observed</p>
<p> Any Seepage or Efflorescence</p>	<p>None observed</p>
<p> Drain Holes</p>	<p>None observed</p>
<p>c. Discharge Channel</p>	
<p> General Condition</p>	<p>Fair, flows close to D/S toe of dam.</p>
<p> Loose Rock Overhanging Channel</p>	<p>Loose rocks lying in channel</p>
<p> Trees Overhanging Channel</p>	<p>Yes</p>
<p> Floor of Channel</p>	<p>Trees and bushes growing in channel</p>
<p> Other Obstructions</p>	<p>Roadway embankment with small culvert over channel.</p>

APPENDIX B
ENGINEERING DATA

APPENDIX B-1

DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS AND LOCATION

Victor J. Galgowski, Dam Safety Engineer
Department of Environmental Protection
State Office Building
165 Capital Avenue
Hartford, Connecticut 06115

Humphrey Leary, Superintendent Water Division
Department of Public Utilities
P. O. Box 1008
34 Shetucket Street
Norwich, Connecticut 06360

APPENDIX B-2

COPIES OF PAST INSPECTION REPORTS



STATE OF CONNECTICUT

WATER RESOURCES COMMISSION

STATE OFFICE BUILDING • HARTFORD, CONNECTICUT 06115

February 5, 1969

Memo to: File
From: William H. O'Brien III
Subject: Bog Meadow Dam - Norwich

On January 23, 1969 the undersigned inspected the subject dam in the company of Mr. Humphrey Leary, Superintendent of the Town of Norwich Public Utilities Department.

This dam is owned by the town of Norwich but is rented by a local fish and game club for one dollar a year with the understanding that they maintain it. The City does not use this reservoir.

The amount of maintenance work required at this dam should be brought to the attention of the owner and corrected by same. The following items were noted at the time of inspection:

1. The training wall at the spillway requires straightening and pointing-up.
2. There is a large eroded area approximately 10 x 15 feet near the spillway which should be filled in, loamed and seeded.
3. The tree at the base of the downstream slope should be removed. This slope appears to have sluffed off in one small area approximately 50 feet east of the spillway. This should be filled in with free-draining material, loamed and seeded.
4. The downstream embankment has bare spots which should be loamed and seeded.
5. Brush and debris should be removed from the toe of the dam.
6. The concrete inlet structure is very deteriorated and should be repaired and equipped with trash racks.


Civil Engineer

WHOIII:vhb

BENJAMIN H. PALMER
SHEPARD D. PALMER

CHANDLER & PALMER
CIVIL ENGINEERS
114-116 THAYER BUILDING
TELEPHONE 887-5640

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NORWICH, CONN. 05360

August 13, 1969

Department of Public Utilities,
City of Norwich,
34 Shotucket Street,
Norwich, Connecticut.

Attention: Mr. John Parsons

Re: Taftville Reservoir #3,
Bog Meadow Reservoir,
Taftville Reservoir #1

Dear Mr. Parsons: Taftville Reservoir #3

Taftville Reservoir #3 is shown on the Norwich, Connecticut, Map of the U. S. Geological Survey. It is located North $41^{\circ} 34' 40''$ and West $72^{\circ} 3' 15''$. It is located downstream from #2 Reservoir, and it is north of the Village of Taftville.

The total drainage area of both the #2 Reservoir and the #3 Reservoir only amounts to .27 square miles. As a matter of fact the overflow, if any, from the #2 Reservoir flows down into #3 Reservoir, and usually #2 Reservoir is below full pond. So that the actual drainage of #3 Reservoir is even smaller than mentioned above.

However, a situation could exist under a heavy storm where #2 Reservoir is full and the total run off would come down into #3 Reservoir. On the basis of a maximum discharge of 250 cubic feet per second per square mile, this would amount to about 68 cubic feet per second at the #3 Reservoir under extreme conditions.

The Reservoir has apparently not been used for sometime and there was very little water when I visited it on August 8th, 1969. The only spillway constructed into the Dam is a 24" Akron pipe on the west side of the Dam.

Department of Public Utilities
(Mr. John Parsons)

-2- August 13, 1969

I know the Dam has been there a good many years and it apparently was adequate to take any storm flows. However, it would not figure in extreme conditions to take 60 cubic feet per second. If the Dam is not to be used, it would seem to me best to bulldoze out a section of the west side of the Dam. The area to be bulldozed should be at least 20 feet wide and down to the level of the present 24" pipe. After this is bulldozed out it should be covered with some loam and seeded so that this really becomes a spillway. The 20 foot width and 2 foot depth would be more than adequate to take care of any flood flows. Apparently this area is where the original brook ran and it would not be difficult to do this work.

The present gatehouse is in poor condition with no cover over the top and has been filled in with debris by vandals. I think both sections of the spillway should be cleaned out and a plank roof put over the top with padlocks to keep children from falling in there.

I don't have any information as to just what pipe leads through the Dam down to the pump house below, but when the work is being done perhaps one or two of these pipes could be left open so normally any flow would go through the pipes and not over the spillway. At the present time a 4" cast iron pipe is running about half full and this seems to keep the pond down to a very low level.

If this work is done I am sure there would be no danger insofar as the Dam giving away or causing any trouble downstream.

The Dam itself is of earth construction approximately 150 feet long and seems to be in reasonably good condition except the gatehouse and pump house below have badly deteriorated.

BOG MEADOW RESERVOIR

I inspected Bog Meadow Reservoir on August 9, 1969, and the concrete on the inlet structure has deteriorated rather badly.

Department of Public Utilities
(Mr. John Parsons)

-2-

August 13, 1969

There is a wire fence around this to keep children away but two or three of the posts have broken loose and have fallen down. I would recommend that the loose concrete on the structure be chipped off until good solid concrete is obtained and then wire mesh could be nailed to the concrete and a cement finish floated over to build it up to its original condition. When this is done, the two fence posts should be reset and the wire fence brought up to standard.

TAFTVILLE RESERVOIR #1

About a week ago I gave you a report on the level of the Dam at Taftville Reservoir #1, and you already have that report.

I believe that this takes care of all items you asked me to look into..

Very truly yours,,

G.H. Palmer

Chandler & Palmer

BHP:nds



STATE OF CONNECTICUT

WATER RESOURCES COMMISSION

STATE OFFICE BUILDING C HARTFORD, CONNECTICUT 06115

November 6, 1969

Mr. John Desmond
Supt. of Purchasing and Stores
Department of Public Utilities
City of Norwich
P. O. Box 1008 - 34 Shetucket Street
Norwich, Connecticut 06360

Subject: 1. Stonybrook Reservoir Dams 1 & 2, Montville
2. Cherry Lane Dam (at Stonybrook) Montville
3. Taftville Reservoir #2, Norwich
✓ 4. Bog Meadow Reservoir Dam, Norwich

Dear Mr. Desmond:

In answer to your letter of October 27, 1969 and enclosed specifications for repairs to the subject dams, we have the following comments:

1. Stonybrook Reservoir, Montville

Dam #1 - O.K.
Dam #2 - O.K.

We request that you advise us when this reservoir is full. (water up to the spillway) so that we may have the seepage at the toe checked under this condition.

2. Cherry Lane Dam (at Stonybrook), Montville - O.K.
3. Taftville Reservoir #2, Norwich - O.K.

We have not as yet received the comments of our consultant on the "low grassed area" in the top of the dam and the leakage around the waste pipe. Please advise us when this reservoir is full also.

4. Bog Meadow Reservoir Dam, Norwich

- a) The work called for does not include items 1 thru 4 of our memo dated February 5, 1969, a copy of which has been sent to you. We would like to know in some detail (a sketch would be helpful) exactly what will be done to correct these items. When this has been received, we will decide if a Construction Permit is necessary. It is not anticipated that one would be required.
- b) We would like more detail on the installation of the chain link wire fence at the inlet structure. It should be designed so that it can not become clogged thereby decreasing the capacity of the spillway. Please submit a drawing of the proposed installation.

Mr. John Desmond

-2-

November 6, 1969

- c) A Construction Permit is not required for the work in your specifications and they are fine as far as they go.

Please advise us as the work is completed at each reservoir. We will plan to inspect them from time to time as the schedule permits.

Very truly yours,

William H. O'Brien III
Civil Engineer

WHOIII:hm

San Inspection Report

Town: Monrovia

Date of Inspection: Feb. 28, 1974

Name of Impoundment: Big Mountain Reservoir

Remarks: The condition of this structure is the same as when last inspected in 1969. It shows signs of deterioration. 1. A small area north of the spillway section needs to be filled and stabilized.

2. The spillway is deteriorating. The planks which serve as support to the concrete sides have deteriorated and should be replaced.

3. Brush should be removed from the downstream slope of the dam.

4. There has been a great deal of motor vehicle traffic

Recommendations: on the slopes of the dam. An effort should be made to control this use as it has caused the slope protection off of the slope.

5. The concrete intake structure has been sealed with concrete.

Owner notified: Phone _____ (date)

Letter: _____ (date)

Robert E. Linneman
(Inspector's Signature)

CHANDLER & PALMER
CIVIL ENGINEERS
114-116 THAYER BUILDING
TELEPHONE 887-5640

DAMS
WATER SUPPLIES
SEWERAGE
APPRAISALS
REPORTS
SURVEYS

BENJAMIN H. PALMER
LEOPARD B. PALMER

MEMBERS AMERICAN AND CONNECTICUT SOCIETIES
OF CIVIL ENGINEERS

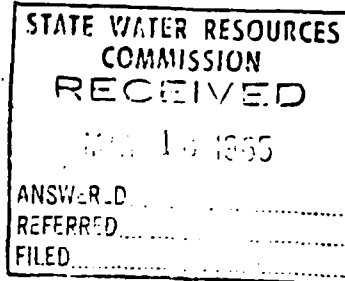
NORWICH, CONN.

May 14, 1965

Re: Bog Meadow Reservoir
Norwich, Connecticut

State Water Resources Commission
State Office Building
Hartford (15) Connecticut

Attention: Mr. William P. Sander
Engineer - Geologist



Dear Sir:-

I report as follows on the Bog Meadow Reservoir Dam.

1. Identification

- A. Letter of Water Resources Commission dated May 5, 1965.
- B. Bog Meadow Reservoir Pond and Dam.
- C. "Norwich" Geological Sheet. Latitude N. 41° 34' 8"
Longitude W. 72° 5' 48".
- D. City of Norwich Public Utilities Dept. Tel. 887-2555.
- E. No question of Ownership.

2. Factors of Hazard

- A. Dam is an earth dam about 500 feet long with a masonry core wall in center. Upstream side is on a slope of 2 to 1 and paved and lower slope is 2 to 1 and grassed and seeded. Spillway is 30 feet long with 3 foot high abutment walls.
 - a. It would be destructive if dam failed. It is a short distance North of Connecticut Turnpike.
 - b. It would be damaging if dam failed at any time.
- B. Overflow from reservoir passes under the Connecticut Turnpike about 1,000 feet South of dam.
- C. Yes a failure would endanger life and property.

3. Structure

- A. This is an earth dam about 500 feet long. From information in our office I am sure it has a masonry core wall. Dam is 20 feet wide on top with an upstream slope of 2 to 1 and stone paving. Downstream slope is 2 to 1 and grassed and seeded. Dam is about 18 feet high above original brook and averages about 10 feet high for most of its length.

- B. This dam is at least 60 years old. No definite knowledge of foundation conditions. However, our old plans do indicate a masonry core wall down to good solid tight ground.
- C. Thirty foot wide spillway 3 feet deep. Spillway appears to be 3-12" x 12" timbers on top of concrete pad. Capacity with water 2 feet deep and 1 foot freeboard is 282 c.f.s.
- D. One foot freeboard allowed in "C" above. Dam would be overtopped if water kept rising.
- E. Dam appears in good condition. No erosion or other depreciation.

4. Hydrology

- A. Drainage area is 1.2 square miles.
- B. $Q_m = .70 \times A \times S$
 $= .70 \times 1.2 \times 60$
 $= 50.4 \text{ c.f.s.}$
Q for 100 years = $3.7 \times 50.4 = 186 \text{ c.f.s.}$
- C. Spillway would carry this much with $1\frac{1}{2}$ foot freeboard.
- D. I do not expect the capacity of spillway would be exceeded.

5. Safety

- A. No. The dam is safe.
- B. None.
- C. Not likely to fail.
- D. No.

6. Requirements

- A. There are a few small trees on dam that should be cut.
- B. Anytime.
- C. No.
- D. No other work.

7. Summary

Dam is in good shape and outside of a few trees to be cut, does not need any other work.

Conclusion

8. See 7 above.

9. Recommendation

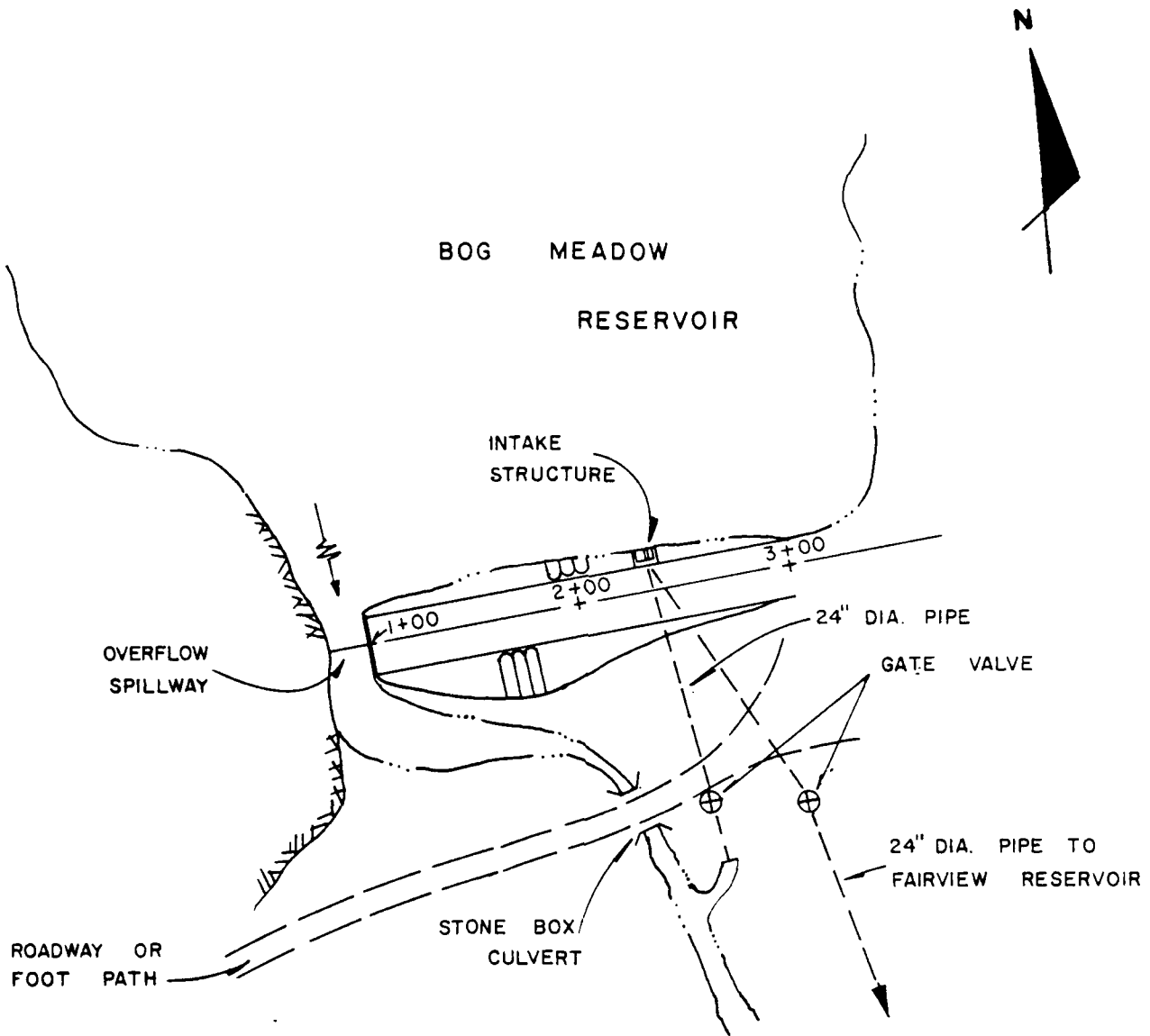
I recommend that a letter of advice be sent to Public Utilities Department, Shetucket Street, Norwich, Connecticut in regard to "6A" above.

Very truly yours,

BHP/ew

APPENDIX B-3

RECORD DRAWINGS AND SKETCHES

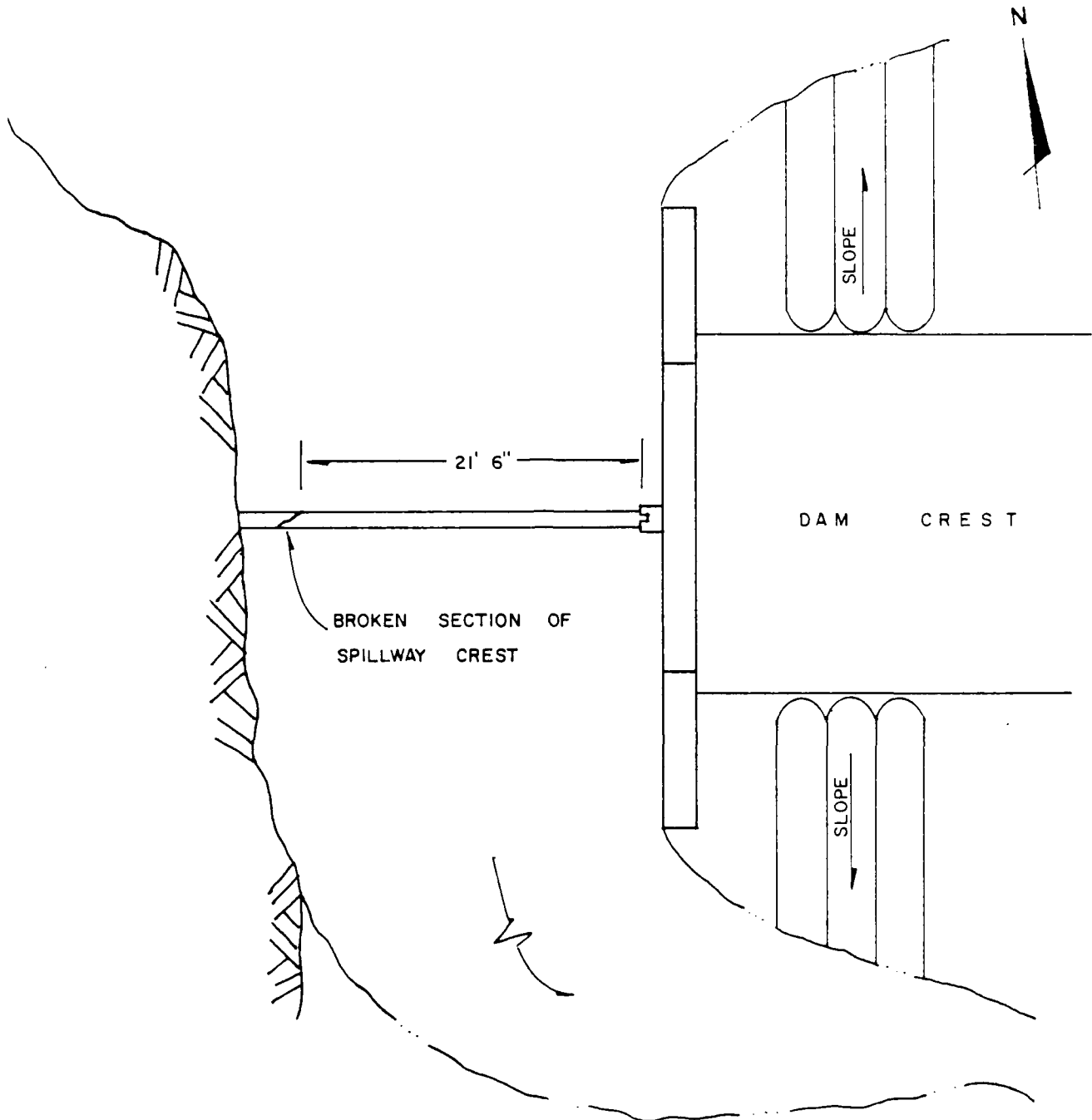


BOG MEADOW RESERVOIR

PLAN

NO SCALE

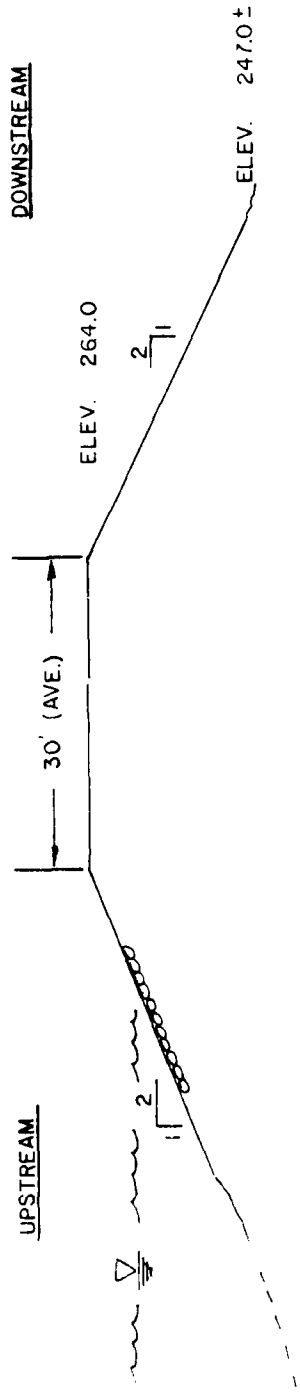
BOG MEADOW DAM
SITE PLAN



PLAN

SCALE 1" = 10'

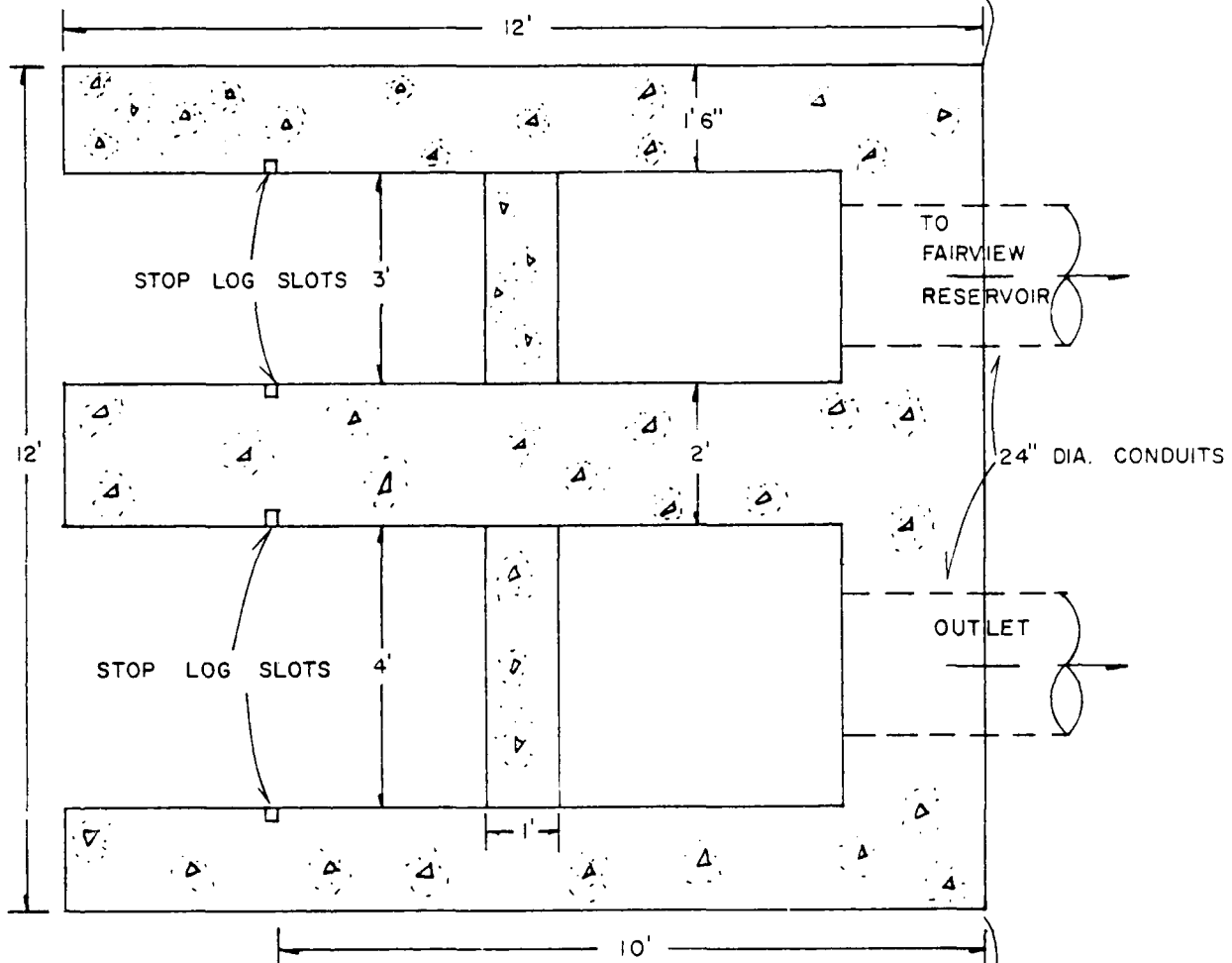
BOG MEADOW DAM
SPILLWAY PLAN VIEW



DAM CROSS SECTION

NOT TO SCALE

BOG MEADOW DAM
CROSS SECTION



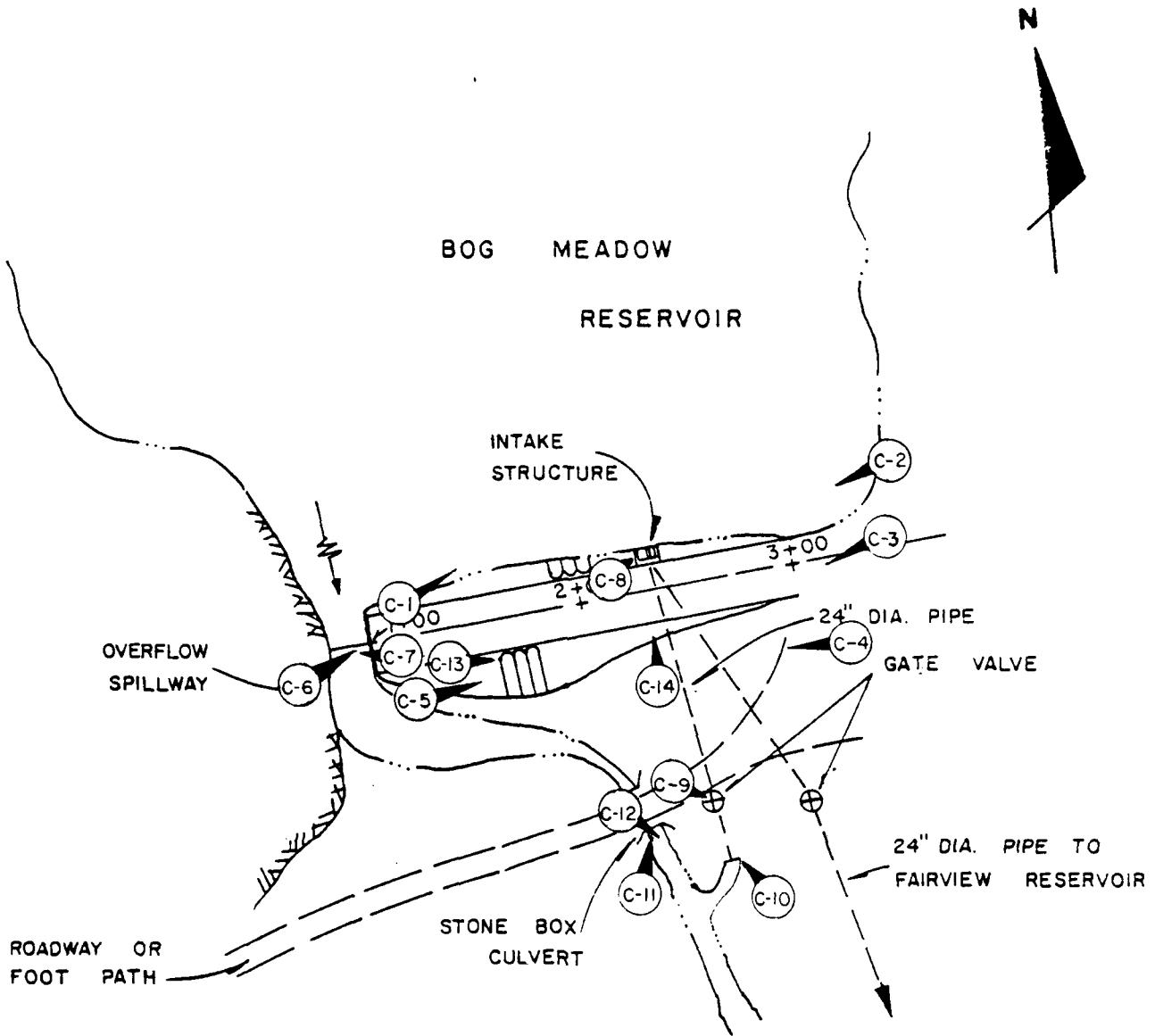
PLAN

SCALE : 3/8" = 1' 0"

BOG MEADOW DAM
OUTLET STRUCTURE

APPENDIX C

PHOTOGRAPHS



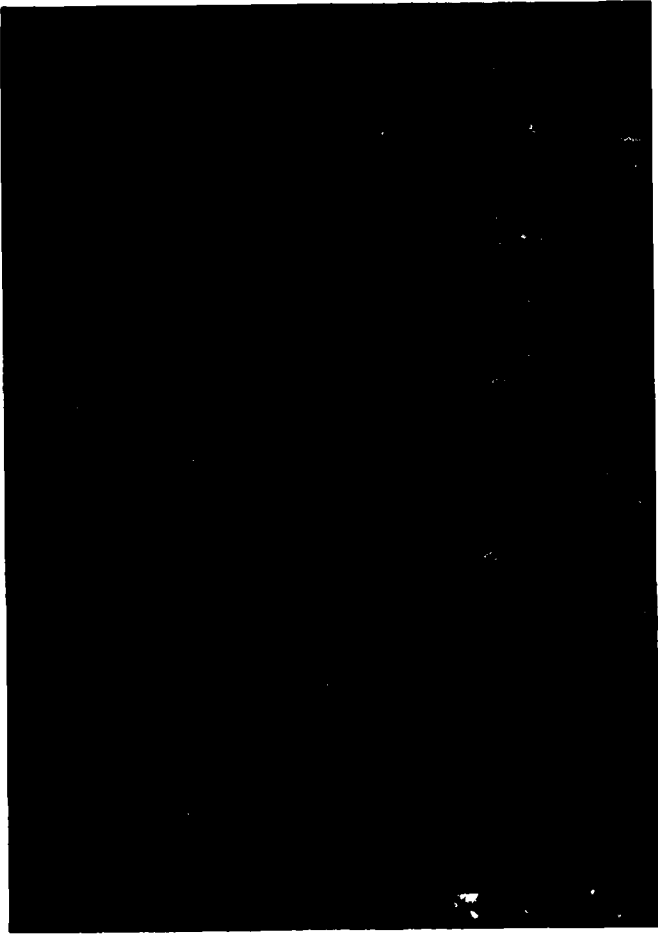
BOG MEADOW RESERVOIR

PLAN

NO SCALE

BOG MEADOW DAM

PHOTO INDEX



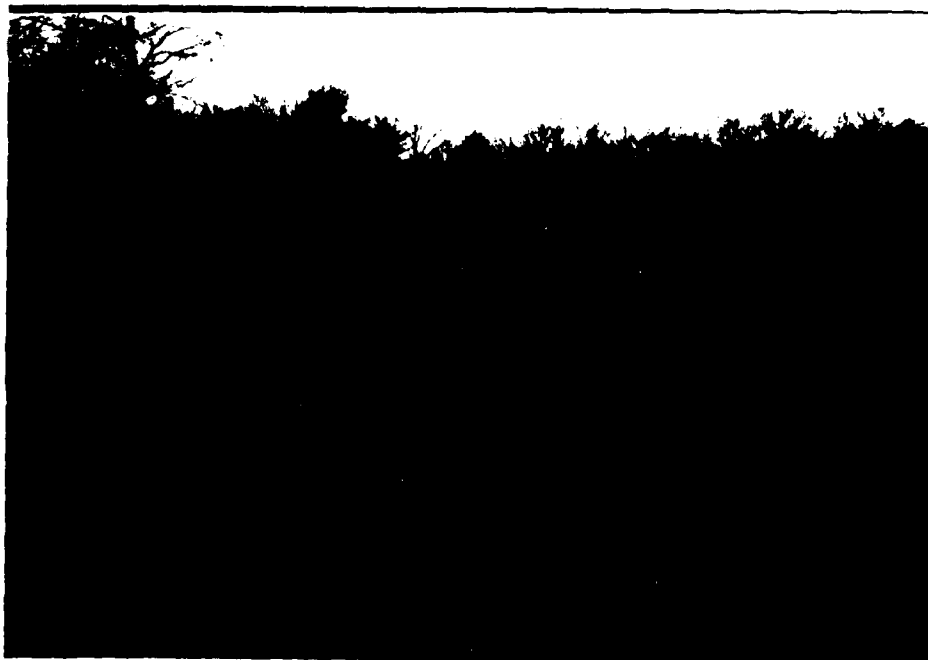
C-1 UPSTREAM SLOPE OF DAM
EMBANKMENT - LOOKING FROM RIGHT
ABUTMENT AREA. NOTE DISLODGED
RIPRAP.



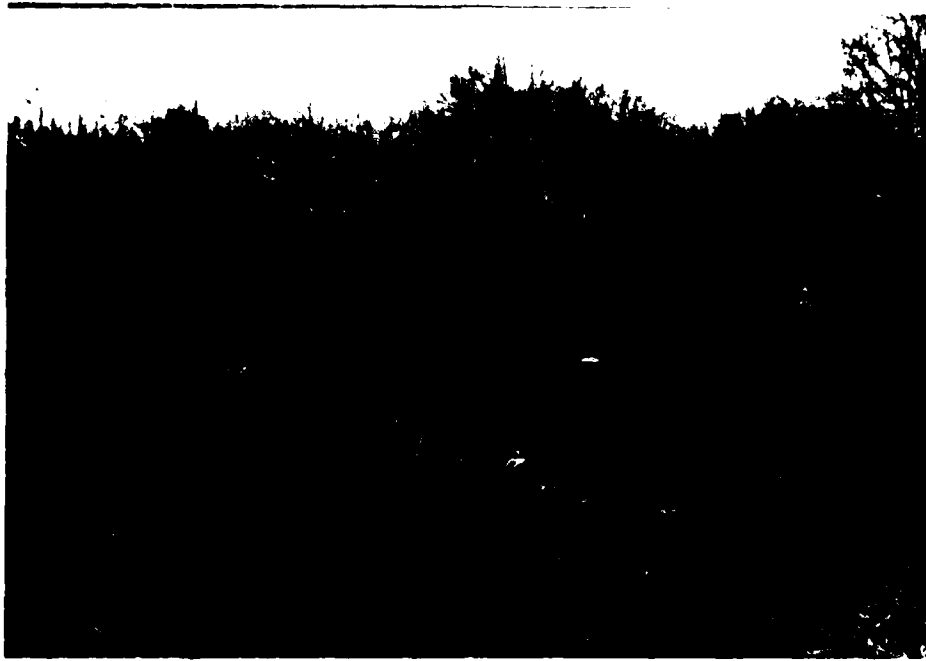
C-2 UPSTREAM SLOPE OF MAIN EMBANKMENT - LOOKING FROM LEFT
ABUTMENT AREA. INTAKE STRUCTURE FOR OUTLET WORKS IN FORE-
GROUND.



C-3 CREST OF DAM.



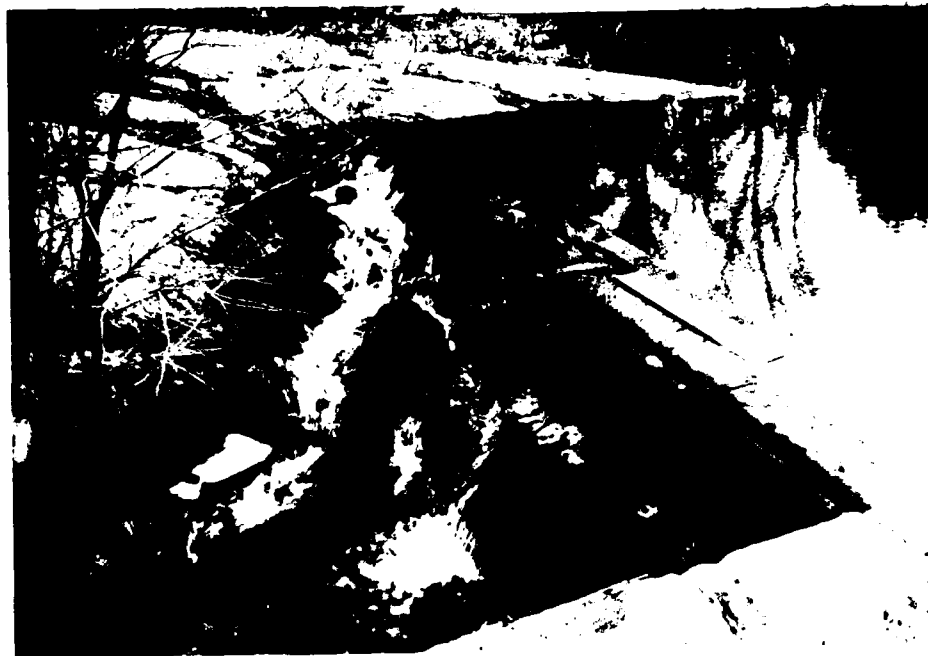
C-4 DOWNSTREAM SLOPE OF EMBANKMENT - LOOKING FROM LEFT
ABUTMENT AREA.



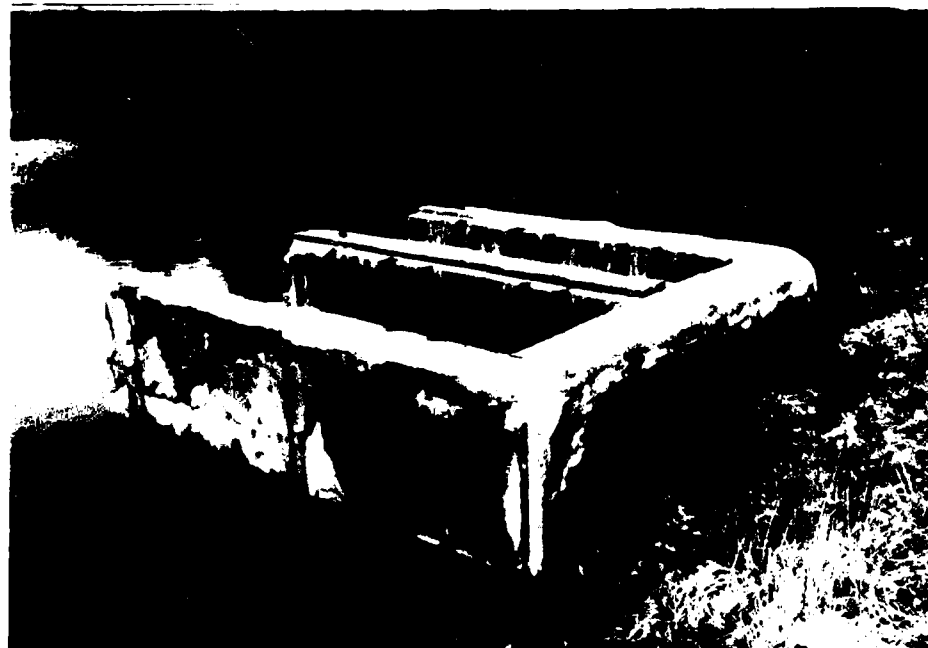
C-5 DOWNSTREAM SLOPE OF EMBANKMENT - LOOKING FROM RIGHT ABUTMENT AREA.



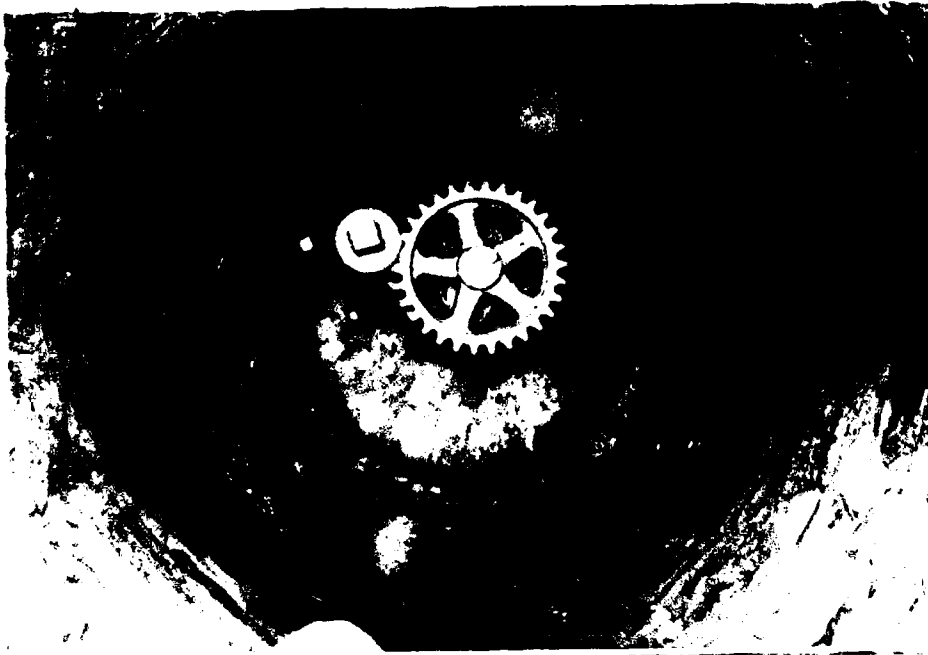
C-6 SPILLWAY



C-7 SPILLWAY



C-8 INTAKE STRUCTURE FOR OUTLET WORKS.



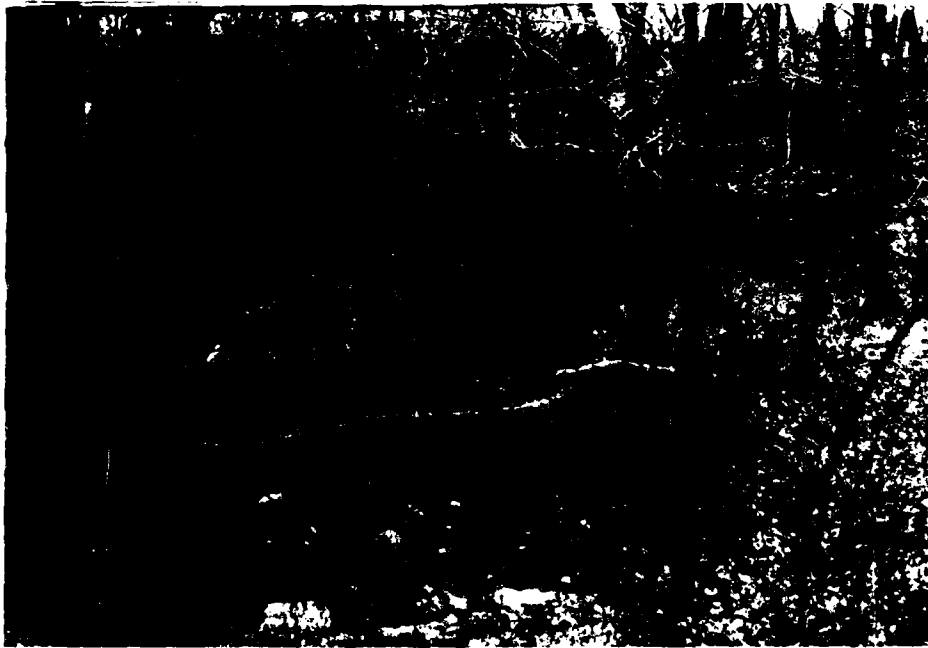
C-9 CONTROL GATE TO DISCHARGE WATER BELOW DAM.



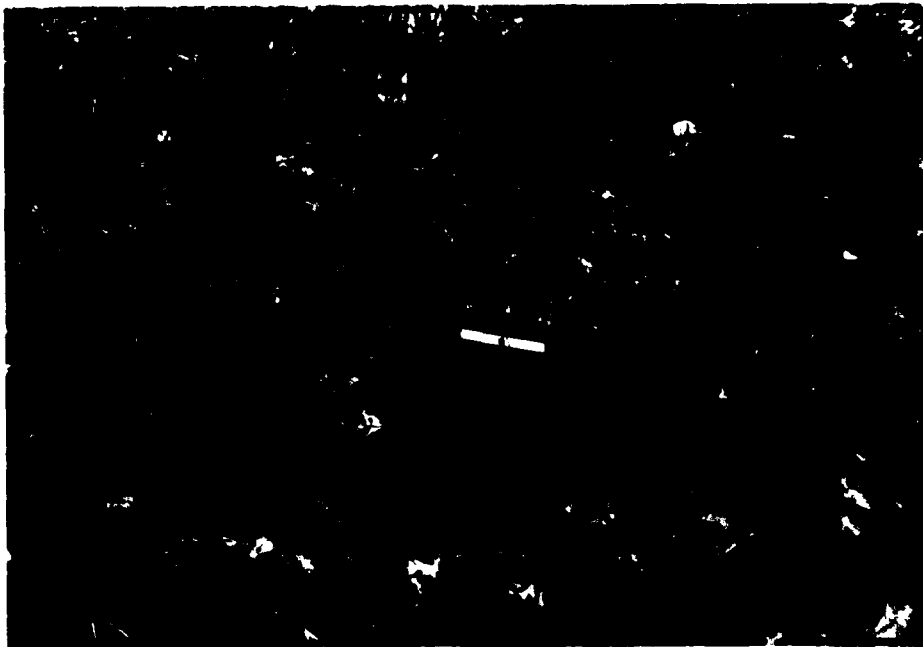
C-10 CONTROL GATE OUTLET.



C-11 STONE BOX CULVERT JUST BELOW DAM IN SPILLWAY CHANNEL.



C-12 DOWNSTREAM CHANNEL BELOW CULVERT.



C-13 TYPICAL ROTTING STUMP ON DOWNSTREAM EMBANKMENT SLOPE.



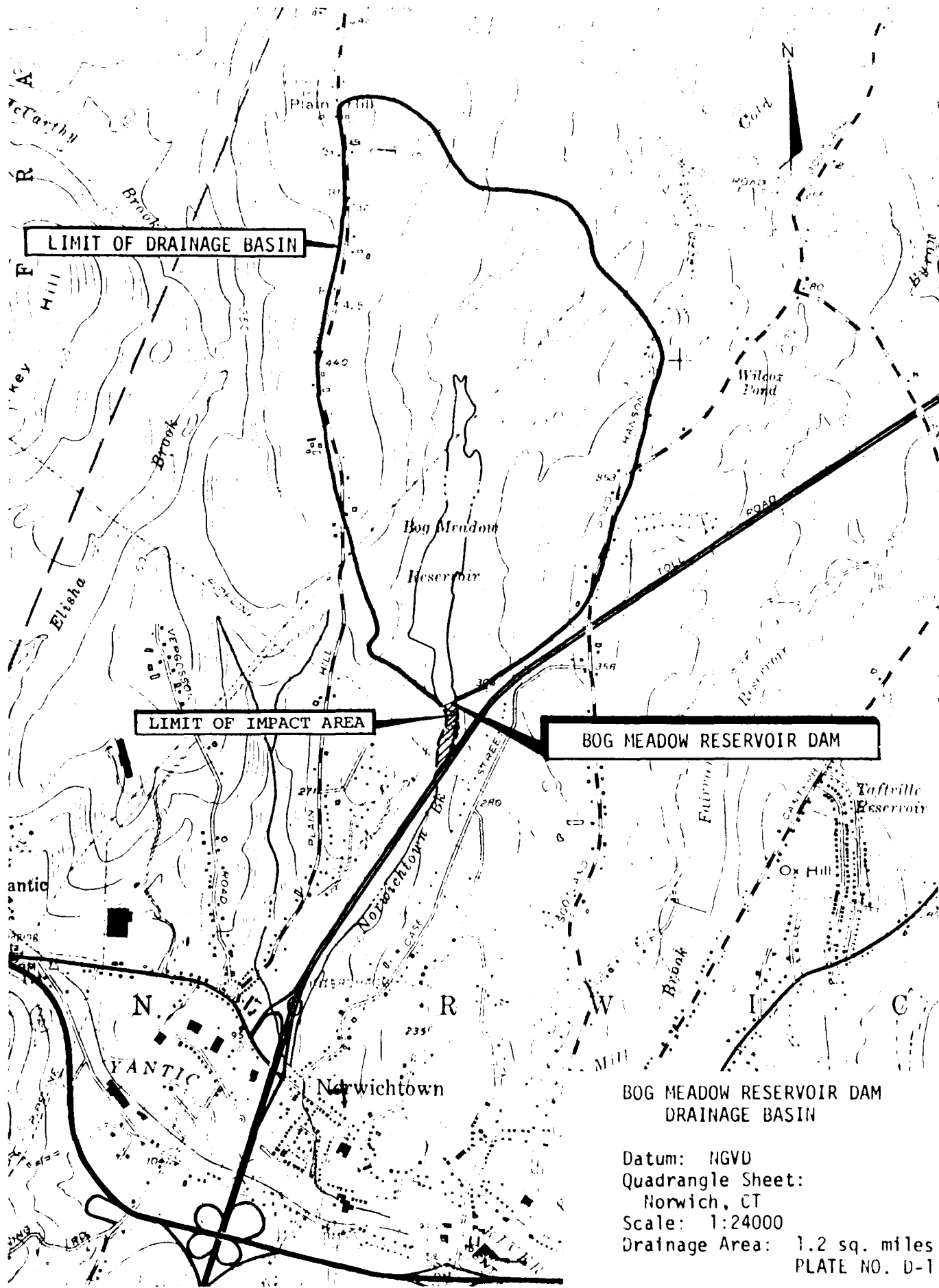
C-14 ERODED GULLEYS IN MAIN EMBANKMENT.



C-15 SEEPAGE EXITING AT DOWN-
STREAM TOE.

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS



LIMIT OF DRAINAGE BASIN

LIMIT OF IMPACT AREA

BOG MEADOW RESERVOIR DAM

BOG MEADOW RESERVOIR DAM
DRAINAGE BASIN

Datum: NGVD
 Quadrangle Sheet:
 Norwich, CT
 Scale: 1:24000
 Drainage Area: 1.2 sq. miles
 PLATE NO. D-1

"Rule of Thumb Guidance for Estimating
Downstream Dam Failure Discharge"

BASIC DATA

Name of dam Bog Meadow Reservoir Name of town Norwichtown
 Drainage area = 1.20 sq. mi., Top of dam 264.0 NGVD
 Spillway type = overflow, vertical drop; sharp Crest of spillway 259.0 NGVD
 Surface area at crest elevation = 0.07 sq. mi. = 45 acres
 Reservoir bottom near dam = 247.0 NGVD
 Assumed side slopes of embankments 2:1
 Depth of reservoir at dam site 17.0 = y_0 = 17.0 ft.
 Mid-height elevation of dam = 255.50 NGVD
 Length of dam at crest = 250 feet
 Length of dam at mid-height = 316 feet
80 of dam length at mid-height = W_b = 80 feet

Step 1:

Elevation (NGVD)	Estimated Storage in AC-FT
264.0	525
263.0	480
262.0	435
261.0	390
260.0	345
259.0	300

Step 2:

$$Q_{p1} = \frac{3}{27} W_b \sqrt{g} y_0^{3/2}$$

$$= \underline{1.68} W_b y_0^{3/2} = \underline{9420} \text{ CFS}$$

NOTE: Failure of dam is assumed to be instantaneous when pool reaches top of dam, and is a partial width - full depth failure.

Estimated Maximum Probable Discharges - Inflow and Outflow Values Date of Inspection: 12/8/78

Name of Dam Bog Meadow Reservoir Dam Location of Dam Norwichtown Bk., Town Norwichtown, Connecticut

Water shed Characterization Moderately steep; upstream storages in swamps; is swampy or occupied by storage reservoirs 0.12 sq. miles of drainage area

Adopted "Test" flood = Half mpf = 1000 CSM = 1195 CFS; Re = Effective Rainfall = 9.5 inches

D.A. = Drainage Area (Gross) = 1.20 Square Miles; Basin Slope = 0.02-0.05 hence; Moderate to steep

S.A. = Surface Area of Reservoir = 0.07 Square Miles; Time of Concentration is approximately 40 minutes

Shape and Type of Spillway = overflow weir; vertical overfall; sharp crest

B = Width of Spillway = 22.0 feet; C = Coefficient of Discharge = (3.40 friction) = 3.33

Maximum Capacity of Spillway Without Overtopping = 819 CFS = 100% of test flood outflow

Top of Dam Elevation = 264.0; Spillway Crest Elevation = 259.0

Overflow portion of Length of Dam = 200 ft.; C = Coefficient of discharge for Dam = N/A

Name of Dam	Test Flood Qp CSM	Inflow Characteristics		Outflow Characteristics First Approximation			Outflow Characteristics Second Approximation			Outflow Characteristics Third Approximation (Adopted)		
		h0 In feet	S0 In in.	Qp1 CFS	h1 In ft.	S1 In in.	Qp2 CFS	h2 In ft.	S2 In in.	Qp3 CFS	h3 In ft.	S3 In in.
1	2	4	5	6	7	8	9	10	11	12	13	14
100-YR 423	508	3.63	2.54	508	3.63	2.54	--	--	--	1.80	2.57	304
50-YR 1000	1195	6.42	4.49	819	5.0	3.52	--	--	--	3.36	4.80	772

Qp = discharge h = surcharge height; S = Storage in inches HOFF = Outflow discharge values are computed with: It is assumed that Dam is maintained at crest elevation of 264.00 CFS guidelines.

A. Size Classification

Height of dam = 17.0 ft.; hence SMALL
 Storage capacity at top of dam (elev. 264.0) = 525 AC-FT.; hence SMALL
 Adopted size classification SMALL

B.i) Hazard Potential

This is a standby source of water supply reservoir to supplement Fairview Reservoir for the City of Norwich. Its failure can cause damage to roads and highways as well.

ii) Impact of Failure of Dam at Maximum Pool (Top of Dam)

It is estimated from the rule of "thumb" failure hydrograph, that the following adverse impacts are a possibility by the failure of this dam.

- a) Loss of life no; - to - lives can be lost.
- b) Loss of homes no; - to - homes can be lost.
- c) Loss of buildings no; - to - buildings can be lost.
- d) Loss of highways or roads yes; 2 roads can be damaged.
- e) Loss of bridges yes; 1 to 2 bridges can be lost.
- f) Miscellaneous yes; loss of water supply source to Norwich.

The failure profile can affect a distance of 1000 feet from the dam. For water surface elevation, see next page in Appendix D.

C. Adopted Classifications

<u>HAZARD</u>	<u>SIZE</u>	<u>TEST FLOOD RANGE</u>
<u>SIGNIFICANT</u>	<u>SMALL</u>	<u>100 year to 1PMF</u>
Adopted Test Flood =	<u>HALF</u> PMF =	<u>1000</u> CSM
	=	<u>1195</u> CFS

D. Overtopping Potential

Drainage Area = 1.2 sq. miles
 Spillway crest elevation = 259.0 NGVD
 Top of Dam Elevation = 264.0 NGVD
 Maximum spillway discharge
 Capacity without overtopping of dam = 819 CFS
 "test flood" inflow discharge = 1195 CFS
 "test flood" outflow discharge = 772 CFS
 % of "test flood" overflow carried by spillway without overtopping = 100%
 "test flood" outflow discharge portion which overflows over the dam = -
 % of test flood which overflows over the dam = -

BOG MEADOW RESERVOIR DAM

COMPUTATIONS FOR
 SPILLWAY RATING CURVE AND
 OUTLET RATING CURVE COMPUTATIONS

EFFECTIVE
 Spillway width = 22.0 feet; Spillway crest elevation = 259.0 NGVD

Length of dam = 350 feet; Top of dam elevation = 264.0 NGVD

Overflow length of dam = 200 feet

C = 3.33 for spillway and 3.00 for dam

i) SPILLWAY RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Spillway Discharge (CFS)	Remarks
259.0	0	Spillway crest elevation Test flood elevation Top of Dam (assumed it is maintained at this level)
260.0	73	
261.0	207	
262.0	381	
263.0	586	
263.80	770	
264.0	819	

ii) OUTLET RATING CURVE COMPUTATIONS

Elevation (ft.) NGVD	Discharge (CFS)	Remarks
248.0	0	
250.0	11	
252.0	16	
254.0	20	
256.0	23	
258.0	26	
260.0	28	
262.0	30	
264.0	32	

- NOTE: 1. Maximum spilling capacity = 819 CFS
 2. Maximum outlet capacity =
 3. Total Discharge capacity =

BOG MEADOW RESERVOIR

Dam Failure Analysis

1. Failure discharge with pool at top of dam (elev.) = 9420 CFS
2. Depth of water in reservoir at time of failure = 17.0 ft.
3. Maximum depth of flow downstream of dam)
at time of failure) = 11.0 ft.
4. Water surface elevation just downstream)
of dam at time of failure) = 258.0 NGVD

The failure discharge of 9420 CFS will enter Norwichtown Brook and flow downstream 1000 feet until the brook Route 52. There is significant valley storage in this 1000 feet length of brook to reduce the discharge substantially. Also due to roughness characteristics, obstructions and frictional losses, it is very likely that the unsteady dam failure flow will dissipate its wave and kinetic energy and thus convert to steady and uniform flow obeying Manning's formulae ^{further} feet downstream. The failure profile will have the following hydraulic characteristics:

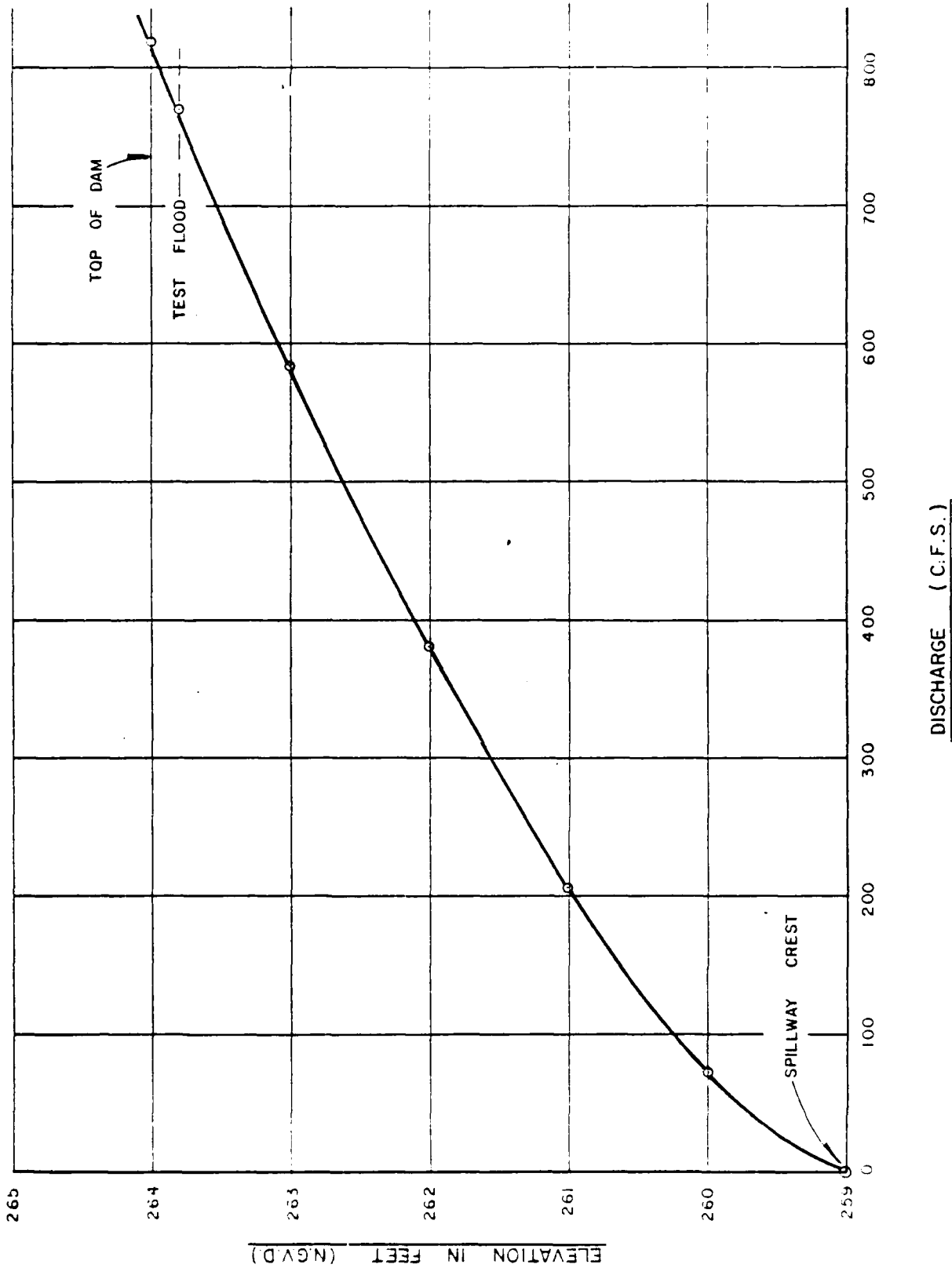
DISTANCE FROM THE DAM	WATER SURFACE ELEVATION NGVD	REMARKS
0+00	264.0	Upstream of dam
0+00	258.0	Downstream of dam
1+00	256.0	
2+00	254.0	
3+00	252.0	
4+00	248.0	
5+00	247.0	
6+00	246.7	
7+00	246.3	
8+00	246.0	
9+00	245.5	
10+00	244.5	

Beyond 1000 feet and until the brook joins Yantic River, the failure discharge will flow in the below given channel characteristics:

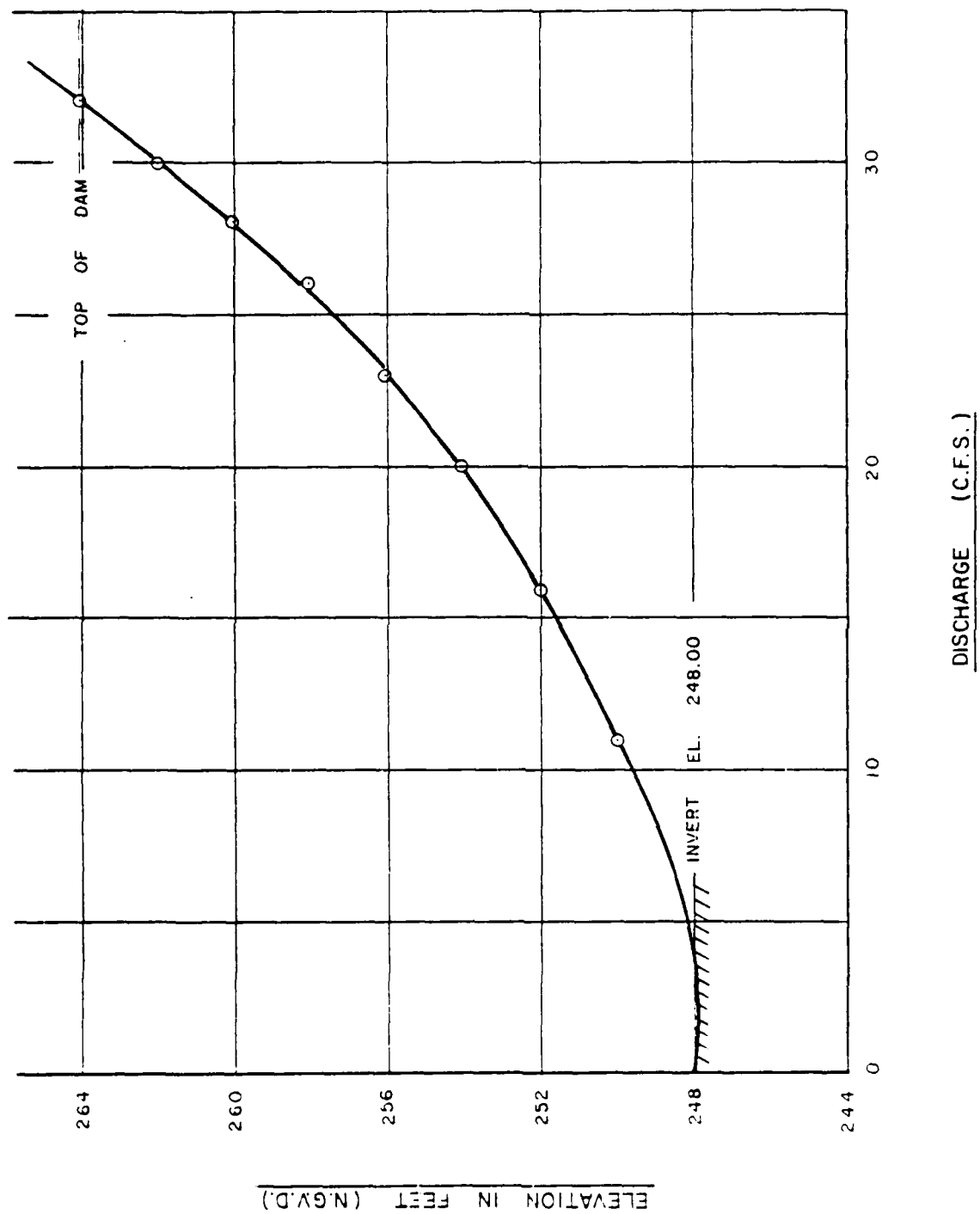
$Q =$ 7000 CFS; $S =$ 0.01

$n =$ 0.05; $b =$ 100 ft. +; $d =$ 5.0 ft.

Side slopes = 1V or 2H.



BOG MEADOW RESERVOIR DAM
 SPILLWAY RATING CURVE



BOG MEADOW RESERVOIR DAM
OUTLET RATING CURVE

APPENDIX E

INFORMATION AS CONTAINED IN THE
NATIONAL INVENTORY OF DAMS



INVENTORY OF DAMS IN THE UNITED STATES

IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGRESS DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
204	VED	CT	011	02	HUG MEADOW RESERVOIR DAM	4134.1	7205.0	23 APR 79

POPULAR NAME	NAME OF IMPOUNDMENT			
	BUG MEADOW RESERVOIR			
REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01 07	HURONICHTUAN BROOK	NORWICH	1	7500

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	HYDRAULIC HEIGHT (FT.)	IMPOUNDING CAPACITIES (ACRE-FT.)	DIST UMN	FED R	PKV/PED	SUS A	VER/DATE
			17	17						
RECTANG	1993	RS								

REMARKS

D/S HAS	SPILLWAY CREST LENGTH	TYPE	WIDTH (FT.)	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CY)	POWER CAPACITY		NAVIGATION LOCKS						
						INSTALLED (MW)	PROPOSED (MW)	NO.	LENGTH (FT.)	WIDTH (FT.)	DEPTH (FT.)	WPT		
2	200	U	22	819	5650									

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF NORWICH	CHADLER + PALMER	UNKNOWN

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	CT DEP

INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
CE MAGUIRE INC	08 DEC 78	PL 92-367

REMARKS: