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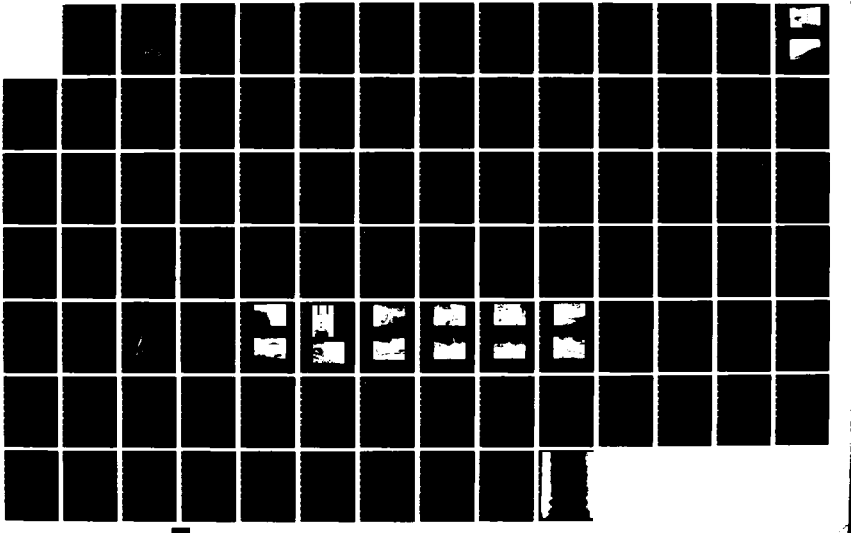
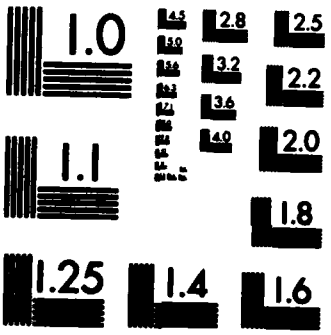
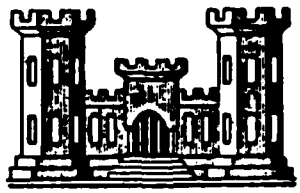




PARK RIVER BASIN
WEST HARTFORD, CONNECTICUT

HARTFORD RESERVOIR NO. 5 DAM
CT 00004

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

APRIL 1980

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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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,
PARK RIVER BASIN
HARTFORD CONN.

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

Hartford Reservoir No.5 Dam is a 96-year old earth embankment, approximately 550 ft. long with a maximum height of 24 ft., which impounds water prior to transfer to the City of Hartford water filtration facility. Under normal operating conditions, water from two upstream reservoirs (Nepaug and Barkhamsted) flows via the Nepaug Conduit into Reservoir No.5 for eventual transfer to the filtration plant. Surcharge water is discharged through the spillway and is conveyed to Hartford Reservoir No.1 for use at the downstream power generation facilities.

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

REPLY TO
ATTENTION OF
NEDED

MAY 30 1980

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

Dear Governor Grasso:

Inclosed is a copy of the Hartford Reservoir No. 5 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, Metropolitan District, Hartford, Connecticut 06101.

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

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

Sincerely,

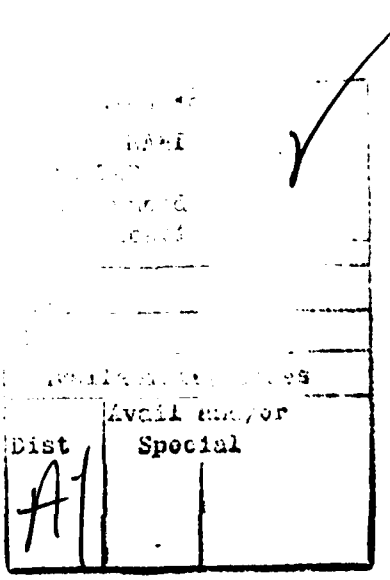
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

HARTFORD RESERVOIR NO. 5

CT 00004

PARK RIVER BASIN
HARTFORD, CONNECTICUT



PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

Identification No.:	CT 00004
Name of Dam:	Hartford Reservoir No. 5 Dam
City:	West Hartford
County and State:	Hartford County, Connecticut
Stream:	Unnamed Tributary to Spice Brook
Date of Inspection:	November 13, 1979

BRIEF ASSESSMENT

Hartford Reservoir No. 5 Dam is a 96-year old earth embankment, approximately 550 feet long with a maximum height of 24 feet, which impounds water prior to transfer to the City of Hartford water filtration facility. Under normal operating conditions, water from two upstream reservoirs (Nepaug and Barkhamsted) flows via the Nepaug Conduit into Reservoir No. 5 for eventual transfer to the filtration plant. Surcharge water is discharged through the spillway and is conveyed to Hartford Reservoir No. 1 for use at the downstream power generation facilities.

The watershed for Hartford Reservoir No. 5 encompasses approximately 1.1 square miles of forested, mountainous land. The normal pool reservoir surface area is about 25 acres, with a corresponding storage capacity of 156 acre-feet. The maximum storage capacity of the reservoir is 301 acre-feet. Based on the maximum height of 24 feet and maximum storage capacity of 301 acre-feet, Hartford Reservoir No. 5 Dam is classified in the "Small" size category. The potential hazard area that would be damaged by floodwaters in the event of a breaching of the dam is located about 7,000 feet downstream of Hartford Reservoir No. 5 Dam. A dam failure would result in appreciable property damage, but it is unlikely that any lives would be lost. Therefore, the dam is classified in the "Significant" hazard potential category. The recommended test flood range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Based on the potential for excessive property damage to several residences downstream, the selected test flood is one-half of the PMF.

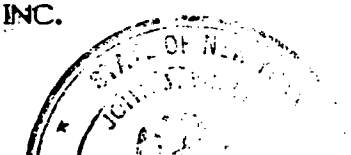
The peak inflow and outflow rates for the test flood at Hartford Reservoir No. 5 Dam were computed to be 1,140 cfs and 1,080 cfs, respectively. The peak outflow corresponds to a reservoir stage of 3.1 feet above the spillway crest, or 2.1 feet below the top of the dam. The spillway is capable of discharging 100 percent of the routed test flood outflow without overtopping of the embankment.

On the date of the inspection, Hartford Reservoir No. 5 Dam appeared to be in fair condition. The only structural deficiency noted was sloughing of the riprap, which appeared to be a result of the steepness of the upstream slope. In addition, trees growing on the downstream face of the embankment are potential hazards to the structural integrity of the dam.

Within one year after receipt of the Phase I Inspection Report, a qualified registered Professional Engineer should be retained by the Owner to: (1) Investigate the cause of the riprap sloughing; (2) investigate the stability of the upstream slope; and (3) direct the removal of trees from the downstream face of the dam and from the vicinity of the downstream toe.

The owner should also implement the following operations and maintenance procedures: (1) Repair the sloughed riprap in accordance with the findings of the above recommended investigation; (2) clear the debris from the toe drain outlet pipes; (3) repair the deteriorated concrete on the gatehouse; (4) develop a formal surveillance and flood warning plan; (5) institute a program of annual periodic technical inspection; and (6) operate the gates periodically throughout the year.

O'BRIEN & GERE ENGINEERS, INC.



Date 28 APRIL 1980

John S. Williams, P.E.
Vice President
New York Registration No. 050794

This Phase I Inspection Report on Hartford Reservoir No. 5 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD DIBUONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

TABLE OF CONTENTS

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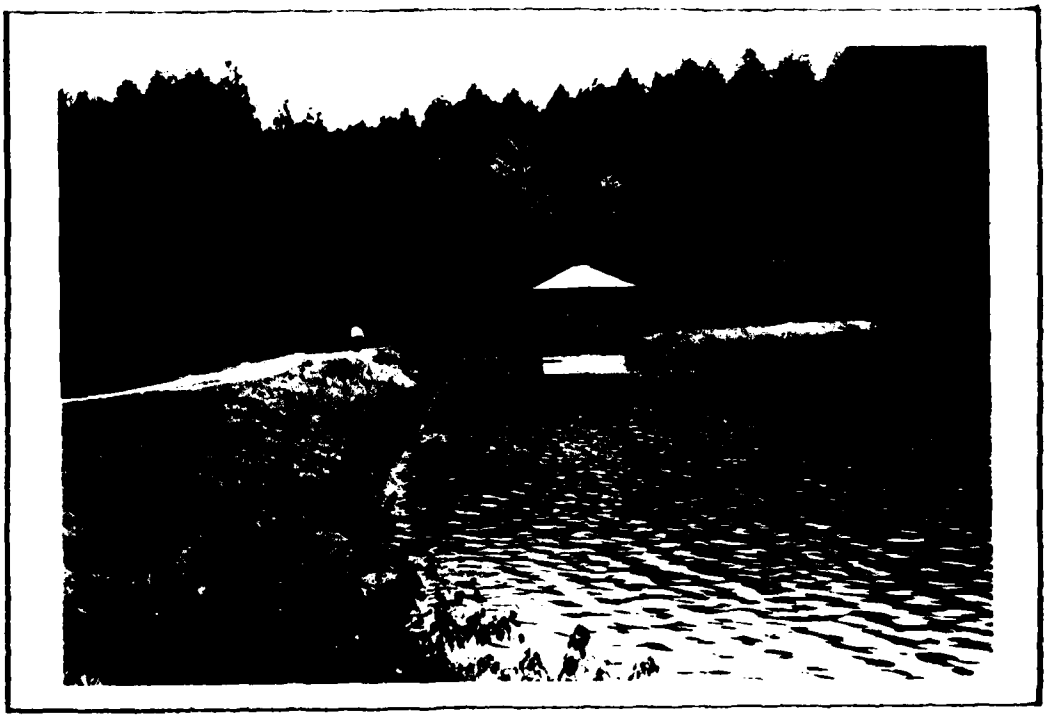
APPENDICES



UPSTREAM VIEW OF THE DAM AND GATEHOUSE AS OBSERVED FROM THE LEFT ABUTMENT. (11/13/79)

DOWNSTREAM VIEW OF THE DAM AS OBSERVED FROM THE LEFT ABUTMENT. (11/13/79)

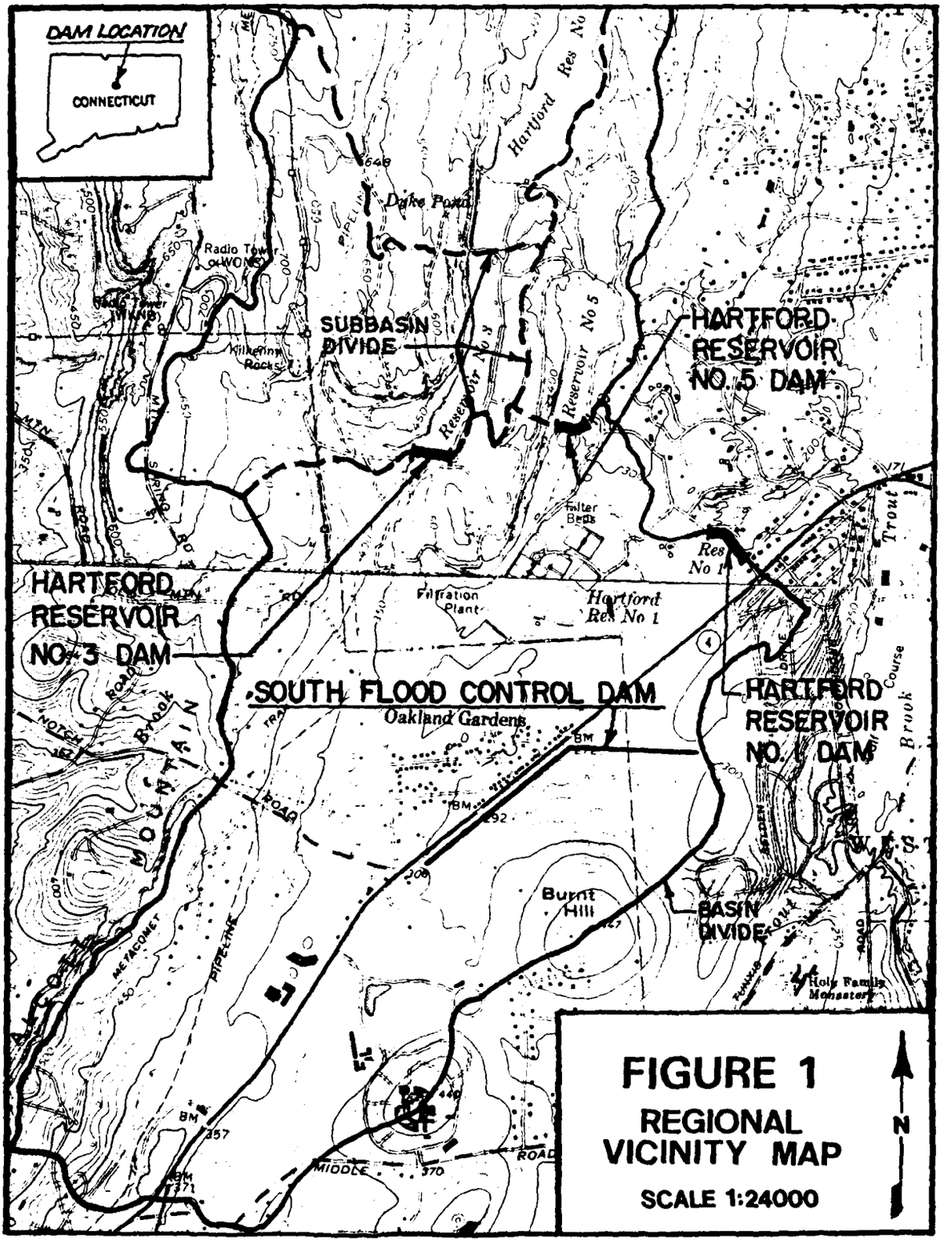


FIGURE 1

REGIONAL VICINITY MAP

SCALE 1:24000

NATIONAL DAM INSPECTION PROGRAM
PHASE 1 INSPECTION REPORT
HARTFORD RESERVOIR NO. 5 DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act (Public Law 92-367) was passed by Congress on August 8, 1972. Under this Act, the Secretary of the Army was authorized to initiate, through the Corps of Engineers, the National Program for Inspection of Dams throughout the United States. Responsibility for supervising inspection of dams in the New England Region has been assigned to the New England Division of the Corps of Engineers.

O'Brien & Gere Engineers, Inc. has been retained by the New England Division to inspect and report on selected non-federal dams in the State of Connecticut. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 6, 1979 and signed by Col. William E. Hodgson, Jr. Contract No. DACW 33-80-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose. The purpose of inspecting and evaluating non-federal dams is to:

1) Identify conditions which threaten public safety and make the Owner aware of any deficiencies so that he may correct them in a timely manner.

2) Encourage and prepare the State to initiate an effective dam safety program for non-federal dams as soon as possible.

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

1.2 Description of Project (Information with regard to this dam was obtained from the Hartford Metropolitan District)

a. Location. Hartford Reservoir No. 5 is located in the town of West Hartford, Connecticut. Portions of the USGS Quadrangle maps entitled "Avon, Conn." and "New Britain, Conn." have been included as Figure 1 on page vi of this report to illustrate the location. USGS reference coordinates for this site are N 41°45.3' and W 72°47.1'.

Outflow from the reservoir is normally conveyed to the filtration plant for processing prior to flowing to the City of Hartford water distribution system. In the event the rate of inflow exceeds the capabilities of the outlet facilities, water will be discharged through the spillway and continue via an open channel for a distance of about 2,200 feet to Reservoir No. 1. Outflow from Reservoir No. 1 is discharged into Spice Brook which flows into Trout Brook about 4,000 feet downstream of Reservoir No. 1. Trout Brook discharges into the South Branch of Park River about 8 miles downstream of Hartford Reservoir No. 1 Dam.

The initial flood impact area consists of several residences located approximately 7,000 feet downstream of Hartford Reservoir No. 5 Dam. Many other residential flood impact areas are located in the ensuing miles along Trout Brook.

b. Description of Dam and Appurtenances. Hartford Reservoir No. 5 Dam is located at the southern end of the impoundment and consists of an earth embankment, approximately 550 feet long with a maximum height of 24 feet.

The embankment has the following major features:

1) The upstream face of the embankment slopes at approximately 1.5 H:1V and is protected with riprap from an unknown depth below the normal pool elevation to about 2.2 feet above the normal pool surface.

2) The crest of the dam is about 10 feet wide and is approximately half covered with grass and half bare earth.

3) The downstream face of the embankment is on a slope of approximately 2H:1V and is grass-covered. The dam was raised in 1964 by extending the upstream face and reconstructing the downstream portion of the embankment. Therefore, a 4-foot thick section along the downstream face of the dam is composed of more recent fill material.

4) During the raising of the embankment, an internal drainage system was incorporated into the dam. The drainage system consists of a 2-foot wide bank run gravel layer which parallels the downstream face of the dam (about 3 feet in from the face) and extends from 4 feet below the top of the dam to the coarse gravel drain at the downstream toe (See Page B-4 for a detailed drawing).

The spillway is a 62-foot long, 3-foot wide concrete weir located at the left abutment. The spillway was constructed in 1964 and directs discharge towards Hartford Reservoir No. 1.

Inflow to Hartford Reservoir No. 5 may occur from the following three sources outside the drainage area:

1) The Nepaug Conduit may direct flow from the Barkhamsted and Nepaug Reservoirs to Reservoir No. 5 (or to the filtration plant located downstream of the dam). A 42-inch diameter gate valve regulates flow from this conduit into the reservoir at the gatehouse.

2) Two pipes, a 24-inch diameter tile pipe and a 30-inch diameter reinforced concrete pipe, are available to convey flow from Hartford Reservoir No. 6 to Reservoir No. 5.

3) A 20-inch diameter outlet pipe at Hartford Reservoir No. 3 may direct water through an open channel to Reservoir No. 6.

Outflow from Hartford Reservoir No. 5 may occur over the spillway, through a 16-inch diameter low level drain pipe, or through the Nepaug Conduit to the filtration plant. The reservoir functions as a balancing reservoir so that, depending on the hydraulic conditions, water may flow into or out of the reservoir via the Nepaug Conduit. Flow through the conduit must be cut off at the upstream reservoirs in order for flow to occur from Reservoir No. 5 to the filtration plant.

c. Size Classification. Hartford Reservoir No. 5 Dam has a maximum height of 24 feet which is less than the upper limit of 40 feet for "Small" size dams. The reservoir has a maximum storage capacity of 301 acre-feet which is less than the upper limit of 1,000 acre-feet for "Small" size dams. Therefore, Hartford Reservoir No. 5 Dam is classified in the "Small" size category.

d. Hazard Classification. The initial downstream damage area consists of several homes located approximately 7,000 feet downstream of Hartford Reservoir No. 5 Dam. The sill elevation of the lowest house at this location was estimated to be 2 feet above the channel banks of the stream. A breach of Hartford Reservoir No. 5 Dam with the reservoir surface at the top of the dam would result in a flow depth of 2.3 feet above the channel banks, or 0.3 feet above the sill elevation of the lowest house at the downstream damage area. A flood of this magnitude would cause appeciable property damage, but it is unlikely that any lives would be lost. Therefore, Hartford Reservoir No. 5 Dam is classified in the "Significant" hazard potential category.

e. Ownership. The dam is owned by the Metropolitan District; 555 Main Street; P.O. Box 800; Hartford Connecticut; 06101. Telephone: 203-278-7850.

f. Operator. Mr. Richard Allen, Purification Engineer for the Hartford Metropolitan District, is responsible for operation of the West Hartford reservoir system.

g. Purpose of Dam. The dam was constructed in 1884 for the purpose of impounding water for the City of Hartford water distribution system. Since that time, reservoirs and interconnecting aqueducts have been constructed in outlying areas and the function of Reservoir No. 5 has become that of a "balancing" reservoir to help regulate flows to the water filtration plant, depending upon hydraulic conditions.

h. Design and Construction History. Since the original construction of the dam in 1884, the only known modifications were made in 1964 when the spillway was reconstructed, the dam was raised by 2 feet, an internal drainage system was installed, and new steps to the gatehouse access walk were constructed. Drawings of these improvements are included in Appendix B.

i. Normal Operating Procedures. Hartford Reservoir No. 5 acts as a "balancing" reservoir to help regulate flows through the Nepaug Conduit to the water filtration plant. Under normal operating conditions, the Reservoir No. 5 sluice gate will remain open and allow flow to enter or leave the reservoir, depending upon hydraulic conditions. In addition, two pipes may be used to convey water from Reservoir No. 6 to Reservoir No. 5 in the event that a sufficient supply is not available from the Nepaug and Barkhamsted Reservoirs. Should the available storage be exceeded, water will flow through the spillway and through an open channel to Reservoir No. 1. During periods of high demand, water can be transferred from Reservoir No.3 to Reservoir No. 5.

In emergency situations, when high quantities of runoff are anticipated, operating personnel will open a valve on the low level discharge pipe to help lower the impoundment.

1.3 Pertinent Data

a. Drainage Area. The area draining to Hartford Reservoir No. 5 encompasses approximately 1.1 square miles of primarily mountainous, forested land. The watershed topography ranges from Elevation 800 along the Talcott Mountain Range to Elevation 319.7 at the reservoir normal pool elevation. There has been no development within the drainage area.

Hartford Reservoir No. 2, with a normal pool surface area of 44 acres, is located upstream of Hartford Reservoir No. 5 within the drainage basin. Another reservoir, formed by Talcott Dam, is located partially within the drainage basin. Discharge from the Talcott Dam impoundment flows in two directions, so that only a portion of the Talcott Dam drainage area flows into the Hartford Reservoir No. 5 watershed. The percentage of the drainage area considered was assumed to be proportional to the relative spillway size at each end of the Talcott Reservoir.

b. Discharge at Damsite.

1. Outlet works. Depending upon hydraulic conditions at interconnecting reservoirs, and at the filtration plant, flow through the Nepaug Conduit may be into or out of Reservoir No. 5. In general, flow is into Reservoir No. 5 during the evening and out of the reservoir to the filtration plant during the day. This conduit is 48 inches in diameter, tapering to 42 inches in diameter at the reservoir gatehouse, and is normally not regulated.

A 16-inch diameter low level discharge pipe has been provided to lower the impoundment for maintenance purposes or to drain the reservoir in the event the water becomes contaminated. The estimated discharge capacity of this low level pipe is 30 cfs.

2. Maximum Known Flood. The flood of record at Hartford Reservoir No. 5 Dam occurred over a three-day period in August, 1955, during Hurricane Diane. A maximum depth of flow of two feet over the spillway crest was recorded at Reservoir No. 5. However, the spillway has been reconstructed and raised one foot since that time.

3. Ungated Spillway Capacity at the Top of the Dam. The capacity of the spillway at the top of dam Elevation 324.9, is 2,330 cfs.

4. Ungated Spillway Capacity at Test Flood Elevation. At test flood Elevation 322.8, the spillway capacity is 1,080 cfs.

5. Gated Spillway Capacity at Normal Pool Elevation. Not Applicable.

6. Gated Spillway Capacity at Test Flood Elevation. Not Applicable.

7. Total Spillway Capacity at Test Flood Elevation. At test flood Elevation 322.8, the total spillway capacity is 1,080 cfs.

8. Total Project Discharge at the Top of the Dam. At the top of dam Elevation 324.9, the total project discharge, including the low level discharge, is approximately 2,360 cfs.

9. Total Project Discharge at Test Flood Elevation. At test flood Elevation 322.8, the total project discharge, including the low level discharge, is approximately 1,110 cfs.

c. Elevation. (NGVD)

Streambed at Toe of Dam	301±
Bottom of Cutoff	Unknown
Maximum Tailwater	Unknown
Normal Pool	319.7
Full Flood Control Pool	N/A
Spillway Crest (Ungated)	319.7
Design Surcharge (Original Design)	Unknown
Top of Dam	324.9
Test Flood Surcharge	322.8

d. Reservoir Length. (Feet)

Normal Pool	3,500
Flood Control Pool	N/A
Spillway Crest Pool	3,500
Top of Dam Pool	3,600
Test Flood Pool	3,560

e. Storage. (Acre-Feet)

Normal Pool	156
Flood Control Pool	N/A
Spillway Crest Pool	156
Top of Dam Pool	301
Test Flood Pool	239

f. Reservoir Surface Area. (Acres)

Normal Pool	25
Flood Control Pool	N/A
Spillway Crest Pool	25
Top of Dam Pool	31
Test Flood Pool	28

g. Dam Data.

Type	Earth Embankment
Length	550 feet
Height	24 feet
Top Width	10 feet
Side Slopes (Upstream)	1.5H:1V
(Downstream)	2H:1V
Zoning	Unknown
Impervious Core	According to a 1964 drawing, the dam is believed to contain a concrete or masonry corewall
Cutoff	Unknown
Grout Curtain	Unknown

h. Diversion and Regulating Tunnel. Not Applicable

i. Spillway.

Type	Drop spillway with a 3-foot wide concrete weir
Length of Weir	62 feet
Crest Elevation	319.7
Gates	None
Upstream Channel	None
Downstream Channel	Trapezoidal earth channel leading to Hartford Reservoir No. 1

j. Regulating Outlet.

Invert Elevation	$303^{\pm}$
Size	16-inch Diameter
Description	Cast Iron Pipe
Control Mechanism	Gate Valve

SECTION 2

ENGINEERING DATA

2.1 Design

No design information, with respect to the original construction of Hartford Reservoir No. 5 Dam, is available. The only available information is included in Appendix B, where details of the 1964 modifications to the dam have been included.

2.2 Construction

Original construction information for the Hartford Reservoir No. 5 Dam is not available. Details of the dam modifications made in 1964 are included in Appendix B.

2.3 Operation

Under normal operating conditions, the 42-inch diameter regulating sluice gate at the Reservoir No. 5 gatehouse is left open. This permits flow to enter or leave the reservoir, via the Nepaug Conduit, depending upon hydraulic conditions at the filtration plant.

In emergency situations, flow may be transferred to Reservoir No. 5 from Reservoirs 3 and/or 6. Water from Reservoir No.3 may be discharged through a 20-inch diameter sluice gate to an open channel and conveyed to Reservoir No. 5. Flow from Reservoir No. 6 is possible through two conduits interconnecting the reservoirs.

2.4 Evaluation.

a. Availability. Topographic maps and drawings of modifications made to the dam in 1964 may be obtained from the Metropolitan District. Copies of the drawings are included in Appendix B.

b. Adequacy. Sufficient information has been obtained during the field investigation, from available drawings, and through telephone conversations with Metropolitan District personnel, to conduct a Phase I dam evaluation.

c. Validity. It appears that the information obtained from the Metropolitan District is valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Hartford Reservoir No. 5 was inspected on November 13, 1979. At the time of the inspection, the pool elevation was approximately 5.7 feet below the top of the dam. Underwater areas were not inspected.

A checklist of observations and comments made during the inspection is included as Appendix A.

b. Dam. The dam consists of an earth embankment approximately 550 feet long with a maximum height of 24 feet. The following features were observed during the field inspection:

1. The upstream face of the dam is sloped at approximately 1.5H:1V, is grass-covered along the upper portion of the face, and has small riprap stones randomly placed along the lower portion of the exposed face. The riprapped portion of the visible slope appears to be steeper than the grass-covered portion. Due to the steepness of the slope in this location, the top portion of the riprap has sloughed several inches, exposing the underlying embankment. It is not known how far the riprap extends below the water surface.

2. The crest of the dam is approximately 10 feet wide, and at the time of inspection, was approximately 5.7 feet above pool elevation. A well-traveled access path extends across the top of the dam from the vicinity of the gatehouse to the left abutment. The remainder of the dam crest is grass-covered.

3. The downstream embankment slope is approximately 2H:1V and is covered with grass. Numerous large trees are growing from the downstream face of the dam between the gatehouse and the right abutment.

A marshy area located approximately 100 feet downstream of the dam, near the right abutment, was observed during the inspection. This area appeared to be the result of surface runoff rather than embankment seepage.

In addition, a series of five 6-inch diameter vitrified clay and corrugated metal pipes were noted along the downstream toe of the dam between the gatehouse and the right abutment. These pipes which are spaced at 15-foot intervals are the outlets from the toe drain. At the time of the inspection, the pipes were obscured by vegetation, clogged with debris, and appeared to have been dry for some time.

Photos of the conditions observed during the field inspection have been included in Appendix C.

c. Appurtenant Structures. The spillway section and training walls appeared to be in good condition on the date of the inspection. The spillway, constructed in 1964, showed no evidence of concrete deterioration. Drawings of the 1964 spillway modifications are included in Appendix B.

A masonry and concrete gatehouse is located about 30 feet upstream of the crest approximately at the longitudinal center of the dam. The gatehouse appears to be in good condition, with the exception of some concrete deterioration near the water surface. The grass-covered access walkway and concrete steps also appear to be in good condition.

The gatehouse contains a rising stem operator for the 42-inch diameter sluice gate which is used to regulate flow in the Nepaug Conduit. The sluice gate was installed in 1958 and appears to be in good operating condition. A drawing of the sluice gate mechanism is included in Appendix B.

d. Reservoir Area. The reservoir slopes are heavily wooded and mountainous with slopes ranging from 10 to 40 percent. No signs of reservoir slope instability or excessive siltation were observed on the date of the inspection.

e. Downstream Channel. The spillway outlet channel and the low level discharge pipe outlet channel join approximately 300 feet downstream of the dam and continue downstream to Hartford Reservoir No. 1. The spillway outlet channel appears to be free of major obstructions. The low level discharge pipe outlet channel is constricted in several locations by fallen trees and rocks. However, due to the limited capacity of the 16-inch diameter low level discharge pipe, no appreciable restrictions to flow should occur.

3.2 Evaluation

The steepness of the upstream slope and the sloughing of the riprap are conditions which indicate possible slope stability problems. In addition, the portion of the embankment exposed by the sloughing of the riprap is subject to erosion.

The root systems of the trees growing from the downstream face of the dam present hazards to the structural integrity of the embankment. High winds could uproot the trees and dislodge portions of the embankment while the roots create potential seepage paths through the dam.

The obstructed toe drain outlet pipes may be a hindrance to the proper functioning of the drainage system.

Recommendations and remedial measures are discussed in Section 7.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. Mr. Richard Allen, Purification Engineer for the Hartford Metropolitan District, is responsible for operation of the West Hartford reservoir system. According to Mr. Allen, the primary functions of Reservoir No. 5 are to impound water for eventual treatment at the City of Hartford water filtration plant, and to act as a "balancing" reservoir for flows supplied via the Nepaug Conduit from the Barkhamsted and Nepaug Reservoirs.

Under normal operating conditions, the sluice gate at the Reservoir No. 5 gatehouse is left open so that flow into and out of the reservoir is not impeded. This condition enables the reservoir to perform a "balancing" function by relieving pressure build-ups at different locations in the system.

Several improvements have been made since the original design of the reservoir to help increase the flexibility of its operation. Water from Barkhamsted Reservoir, which once had to flow to Reservoir No. 6 prior to being transferred to Reservoir No. 5, is now conveyed directly to Reservoir No. 5. The two conduits interconnecting Reservoir No. 6 and Reservoir No. 5 are normally not used, but may be put into service by opening gate valves at Reservoir No. 6. In addition, a 20-inch diameter sluice gate has been installed at the northeastern corner of Reservoir No. 3, which enables a transfer of water from Reservoir No. 3 to Reservoir No. 5 in emergency situations.

The 16-inch diameter low level discharge pipe is normally operated only to lower the impoundment for maintenance purposes or to provide additional storage capacity in anticipation of large quantities of runoff. If the pool level should rise above the crest of the spillway, water would be discharged to an open channel and conveyed to Reservoir No. 1 for use in the production of hydroelectric power.

b. Description of Any Warning System In Effect. Currently, no formal warning system is in effect at this site. According to the Owner's representative, Mr. Peter Revill, a maintenance foreman would monitor pool levels during periods of unusually high runoff.

4.2 Maintenance Procedures

a. General. The Metropolitan District employs a maintenance crew, headed by Mr. Rudy Wegscherder, who operate and maintain the West Hartford reservoir system. Maintenance of the grounds is performed on a routine basis.

b. Operating Facilities. According to the Owner's representative, gate and sluice valves throughout the reservoir system are kept in good operating condition. The valve on the low level discharge pipe was last operated in April, 1979; all others have been operated since that time.

4.3 Evaluation

In general, maintenance of the dam and appurtenant structures is considered good. However, periodic technical inspections should be performed in order to detect such deficiencies as riprap sloughing, slope movement, and clogged drain pipes. Also, trees should not be permitted to grow on the face of the embankment.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The drainage area for Hartford Reservoir No. 5 encompasses about 1.1 square miles of primarily mountainous, forested land. The watershed topography ranges from Elevation 800 along the Talcott Mountain Range to Elevation 319.7 at the reservoir normal pool elevation. There has been no development within the drainage area.

5.2 Design Data

According to the Owner's representative, hydraulic and hydrologic data from the original design of the dam is not available. Improvements to the dam, made in 1964, were designed based upon the peak rate of runoff anticipated during a 34-hour, 18.25-inch rainfall.

5.3 Experience Data

The flood of record at Hartford occurred in August, 1955, as a result of rain which fell over a three-day period during Hurricane Diane. A maximum depth of flow of two feet over the Reservoir No. 5 spillway was recorded. However, since that time, the spillway crest has been enlarged and raised one foot.

5.4 Test Flood Analysis

The recommended test flood range for a "Small" size, "Significant" hazard dam is from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Based upon the potential for extensive property damage to several residences downstream of Hartford Reservoir No. 1, one-half of the PMF has been selected as the test flood.

Hydraulic and hydrologic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from Snyder unit hydrographs using average coefficients, an initial infiltration of zero, and a constant loss rate of 0.05 inches per hour. The Hop Brook Adjustment Factor was applied to reduce the Probable Maximum Precipitation, based upon the size of the drainage area. Stage vs. discharge and stage vs. storage relationships were developed for Hartford Reservoirs 2 and 5 and input to the computer for the purpose of routing the test flood through Reservoirs 2 and 5. Water surface elevations at each reservoir were assumed to be at their respective spillway crest at the beginning of the hypothetical storm event.

The peak inflow and outflow rates for the test flood at Hartford Reservoir No. 5 Dam were computed to be 1,140 cfs and 1,080 cfs, respectively. The peak outflow corresponds to a reservoir stage of 3.1 feet above the spillway crest, or 2.1 feet below the top of the dam. The spillway discharge capacity is 2,330 cfs. The spillway is capable of discharging 100 percent of the routed test flood outflow without overtopping of the embankment.

5.5 Dam Failure Analysis

Failure of the embankment was simulated by the HEC-1-DB computer program assuming a 240-foot wide by 20-foot deep breach with vertical side slopes developing within 2 hours. The failure was assumed to occur with the reservoir surface at the top of dam elevation. The resulting breach outflow was routed through Hartford Reservoir No. 1 and downstream to the potential damage center, located 2,000 feet downstream of Hartford Reservoir No. 1 Dam. The approximated channel cross-section at this point is shown on Page D-9. The failure analysis indicated that a breaching of the dam would result in a stream depth of 4.3 feet, or 2.3 feet above the channel banks, with a corresponding flow of 1,600 cfs at the damage area. The estimated sill elevation of the lowest house in this area is 2 feet above the channel banks. Therefore, the breach flood would inundate the house with 0.3 feet of water. Appreciable property damage but little or no loss of life would occur.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

The only structural deficiency noted during the visual inspection was sloughing of the riprap which appeared to be due to the steepness of the upstream slope. Further riprap sliding could result in erosion of the exposed portion of the upstream face or possible slope failures.

In addition, the trees on the downstream face of the embankment present hazards to the structural stability of the dam. The root systems of the trees create potential seepage paths through the dam and could also dislodge portions of the embankment if the trees were uprooted during severe wind conditions.

6.2 Design and Construction Data

According to the Owner's representative, no original design or original construction data is available for Hartford Reservoir No. 5 Dam.

6.3 Post Construction Changes

The following modifications were made to the original structure in 1964: (1) The dam was raised 2 feet, (2) the spillway was reconstructed and raised one foot, (3) an internal drainage system (including toe drains) was installed, and (4) new steps to the gatehouse access walkway were constructed. Drawings of these improvements are included in Appendix B.

6.4 Seismic Stability

Hartford Reservoir No. 5 Dam is located in Seismic Zone 1 on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 need not be evaluated for seismic stability, according to the Recommended Guidelines for Phase I dam inspections.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Based upon the visual inspection, Hartford Reservoir No. 5 Dam appears to be in fair condition. The only apparent deficiency is the riprap sloughing which indicates the possiblity of upstream slope stability problems. In addition, the presence of trees on the downstream face of the embankment creates potential hazards to the structural integrity of the embankment.

b. Adequacy of Information. Sufficient information has been obtained through field observations, from data furnished by the Metropolitan District and through telephone conversations with Metropolitan District personnel, to conduct a Phase I dam evaluation.

c. Urgency. The recommendations and remedial measures presented in Sections 7.2 and 7.3 should be implemented within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the Owner retain the services of a qualified registered professional engineer for the following purposes:

1. To investigate the cause of the riprap sloughing.

2. To investigate the stability of the upstream slope.

3. To direct the removal of trees from the downstream face of the dam and from the vicinity of the downstream toe and fill the remaining voids with suitable, thoroughly compacted material.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The following operation and maintenance procedures should be implemented by the Owner:

1. Repair the sloughed riprap in accordance with the findings of the above recommended investigation.

2. Clear the debris from the toe drain outlet pipes.

3. Repair the deteriorated concrete on the gatehouse.

4. Develop a formal surveillance and flood warning plan.

5. Institute a program of annual periodic technical inspection.

6. Operate the gates periodically throughout the year.

7.4 Alternatives

No valid alternatives to the recommendations and remedial measures described above are considered feasible for this site.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: Hartford Reservoir No. 5

National I.D. #: CT 00004

Location: Hartford, Connecticut

Type of Dam: Earth Embankment

Inspection Date(s): November 13, 1979

Weather: Cloudy, Mid 50's

Pool Elevation: 319± MSL

Inspection Team

Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Rodney Georges	Bryant & Associates	Hydrology/Hydraulics

*Mr. John J. Williams, Vice-President, O'Brien & Gere has visited the site but not necessarily in conjunction with the inspection team.

Owner's Representative

Mr. Peter Revill, Chief Design Engineer; Metropolitan Distrct; Hartford, Connecticut.

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 5 Dam

National I.D. #: CT 00004

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	324.9
Current Pool Elevation	319±
Maximum Impoundment to Date	220 Acre-feet ± (1955)
Surface Cracks	None Observed
Pavement Condition	None
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	No misalignment observed
Horizontal Alignment	No misalignment observed
Condition at Abutment and at Concrete Structures	Trees on abutment; otherwise no deficiencies noted
Indications of Movements of Structural Items on Slopes	None
Trespassing on Slopes	Not significant
Vegetation on Slopes	Mostly grass covered; some trees
Sloughing or Erosion of Slopes or Abutments	Sloughing at top edge of riprap on u/s face
Rock Slope Protection - Riprap Failures	Several failures and subsidence observed

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 5 Dam

National I.D. #: CT 00004

Date(s): November 13,1979

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (Con't)	
Unusual Movement or Cracking at or near Toes	None Observed
Unusual Embankment or Downstream Seepage	None Observed
Piping or Boils	None Observed
Foundation Drainage Features	Unknown
Toe Drains	(5) 6-inch diameter CM and VC pipes at toe of western side of d/s slope. *Dry, filled with debris.*
Instrumentation System	N/A

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 5 Dam

National I.D. #: CT 00004

Date(s): November 13,1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	None
General Condition	N/A
Loose Rock Overhanging Channel	N/A
Trees Overhanging Channel	N/A
Floor of Approach Channel	N/A
b. Weir and Training Walls	Built in 1964
General Condition of Concrete	Very good
Rust or Staining	None Observed
Spalling	None Observed
Any Visible Reinforcing	None Observed
Any Seepage or Efflorescence	None Observed
Drain Holes	None Observed
c. Discharge Channel	
General Condition	Fair, w/restrictions

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 5 Dam

National I.D. #: CT 00004

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)	
Loose Rock Overhanging Channel	Insignificant
Trees Overhanging Channel	Few
Floor of Channel	Stones and fallen trees
Other Obstructions	(2) d/s bridges

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 5 Dam

National I.D. #: CT 00004

Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER	
a. Concrete and Structural	
General Condition	Masonry-good; concrete has some spalling
Condition of Joints	Few cracks
Spalling	On foundation of gatehouse near water surface elevation
Visible Reinforcing	None Observed
Rusting or Staining of Concrete	None Observed
Any Seepage or Efflorescense	None Observed
Joint Alignment	Random size stones are well jointed
Unusual Seepage or Leaks in Gate Chamber	None Observed
Cracks	Slight cracks only
Rusting or Corrosion of Steel	None Observed
b. Mechanical and Electrical	
Air Vents	at soffit
Float Wells	See drawing - Appendix B
Crane Hoist	See drawing - Appendix B

APPENDIX B

ENGINEERING DATA

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR NO. 5 DAM				

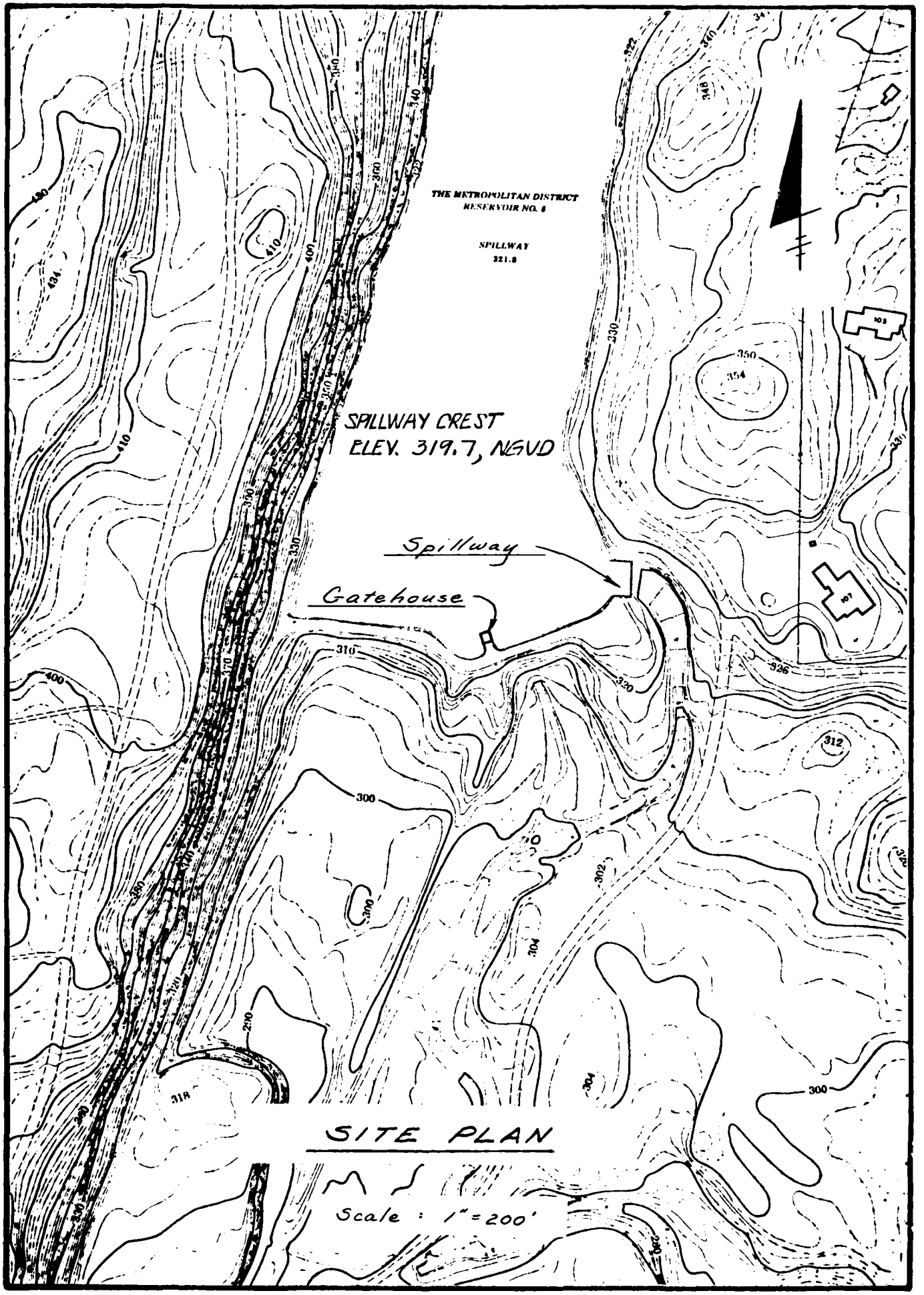
APPENDIX B

ENGINEERING DATA

TABLE OF CONTENTS

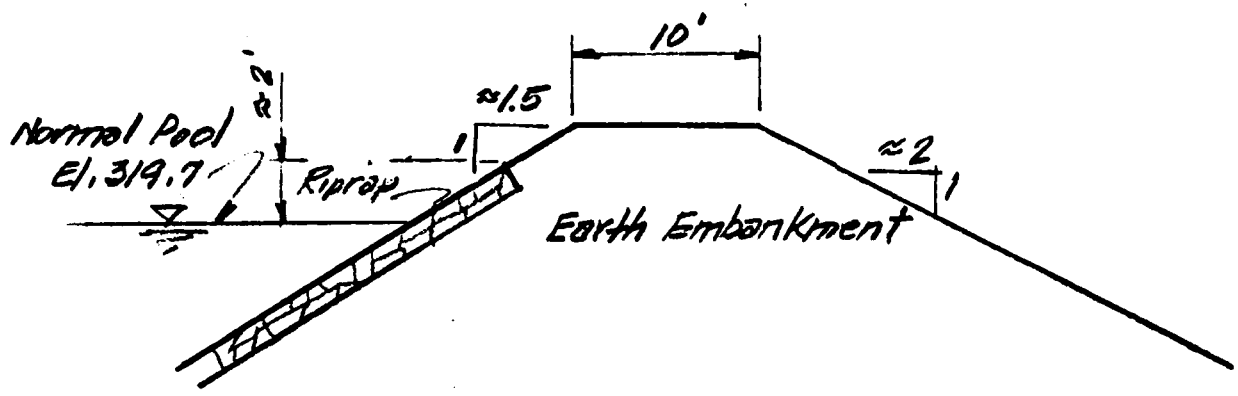
NOTE:

INFORMATION INCLUDED IN THIS APPENDIX WAS PROVIDED BY THE CITY OF HARTFORD METROPOLITAN DISTRICT. UNLESS OTHERWISE NOTED ELEVATIONS REFER TO METROPOLITAN DISTRICT DATUM.


THE METROPOLITAN DISTRICT
RESERVOIR NO. 4
SPILLWAY
321.8
SPILLWAY CREST
ELEV. 319.7, NGVD
Spillway
Gatehouse
SITE PLAN
Scale : 1" = 200'

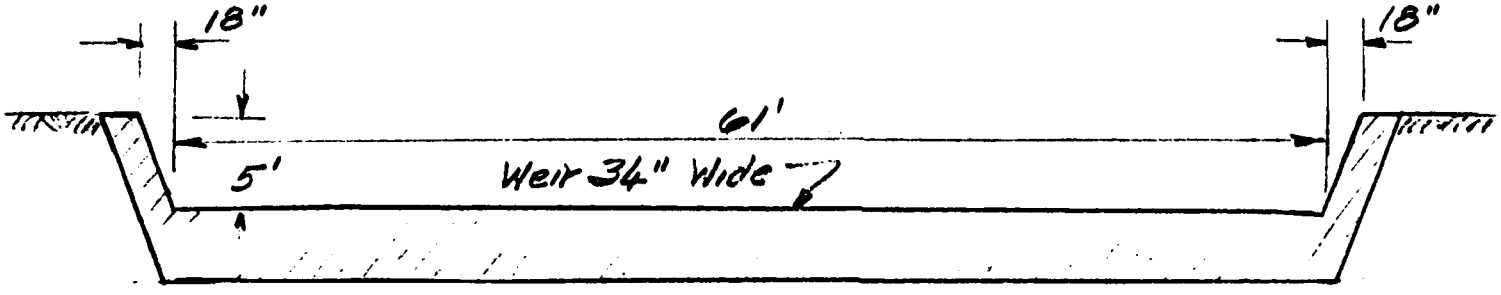
O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RES. NO. 5 DAM	B-2		3/27/80	2060-001



TYPICAL DAM SECTION

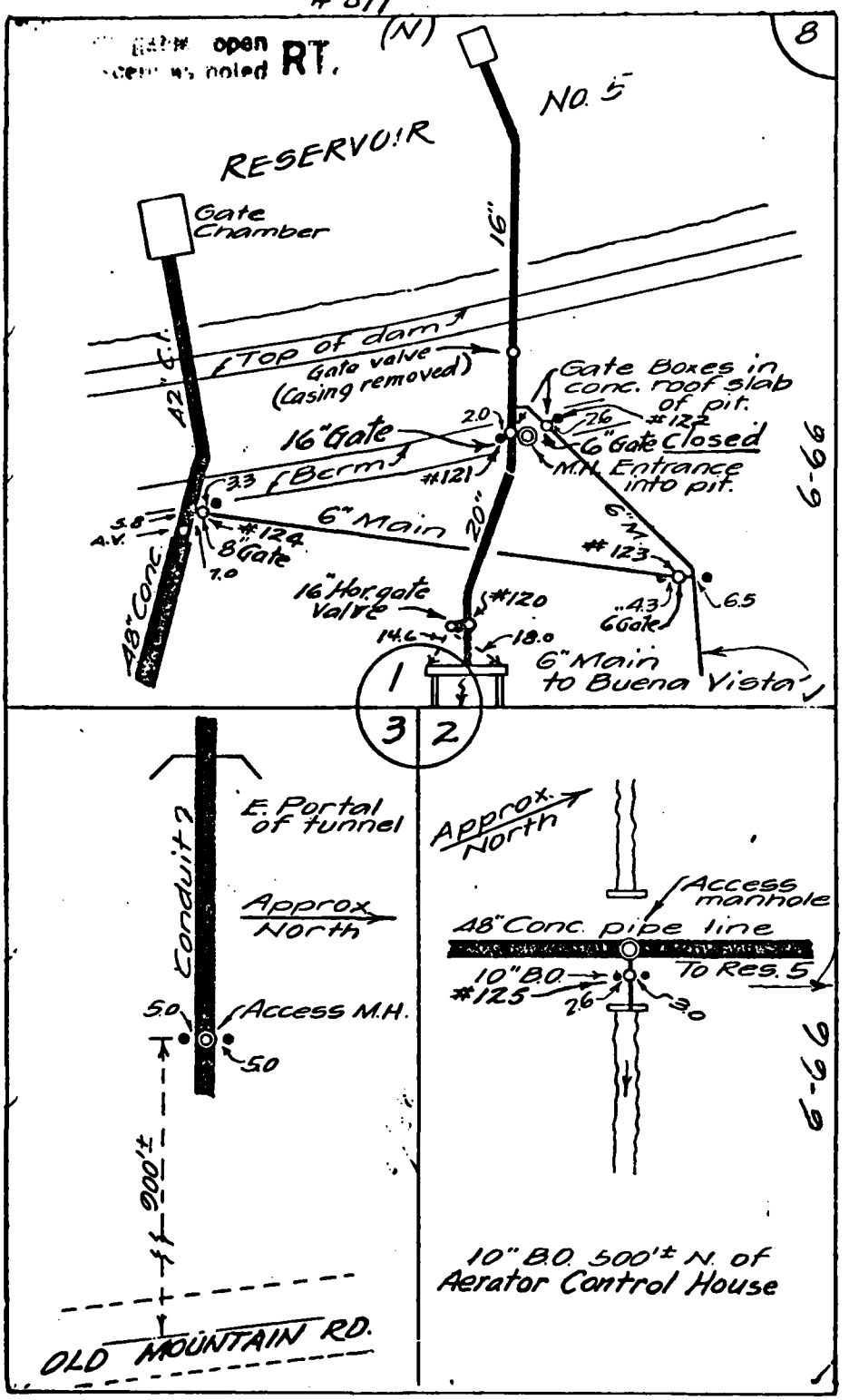
SCALE 1" = 10'



SPILLWAY SECTION

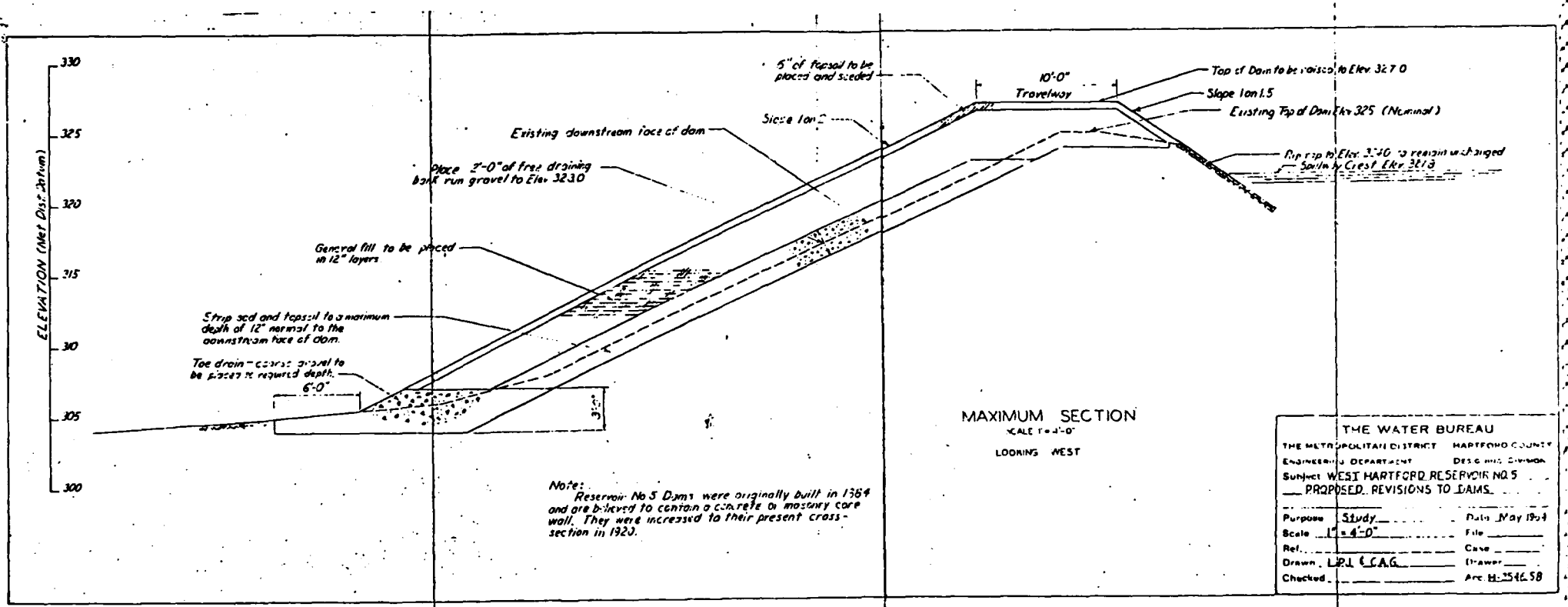
SCALE 1" = 10'

B-2



VALVE TIES

(from Gate Book F)



MAXIMUM SECTION

SCALE 1"=4'-0"

LOOKING WEST

Note:
Reservoir No 5 Dams were originally built in 1864 and are believed to contain a concrete or masonry core wall. They were increased to their present cross-section in 1920.

THE WATER BUREAU

THE METROPOLITAN DISTRICT HARTFORD COUNTY

ENGINEERING DEPARTMENT DESIGN DIVISION

Subject WEST HARTFORD RESERVOIR NO 5

PROPOSED REVISIONS TO DAMS

Purpose Study Date May 1964

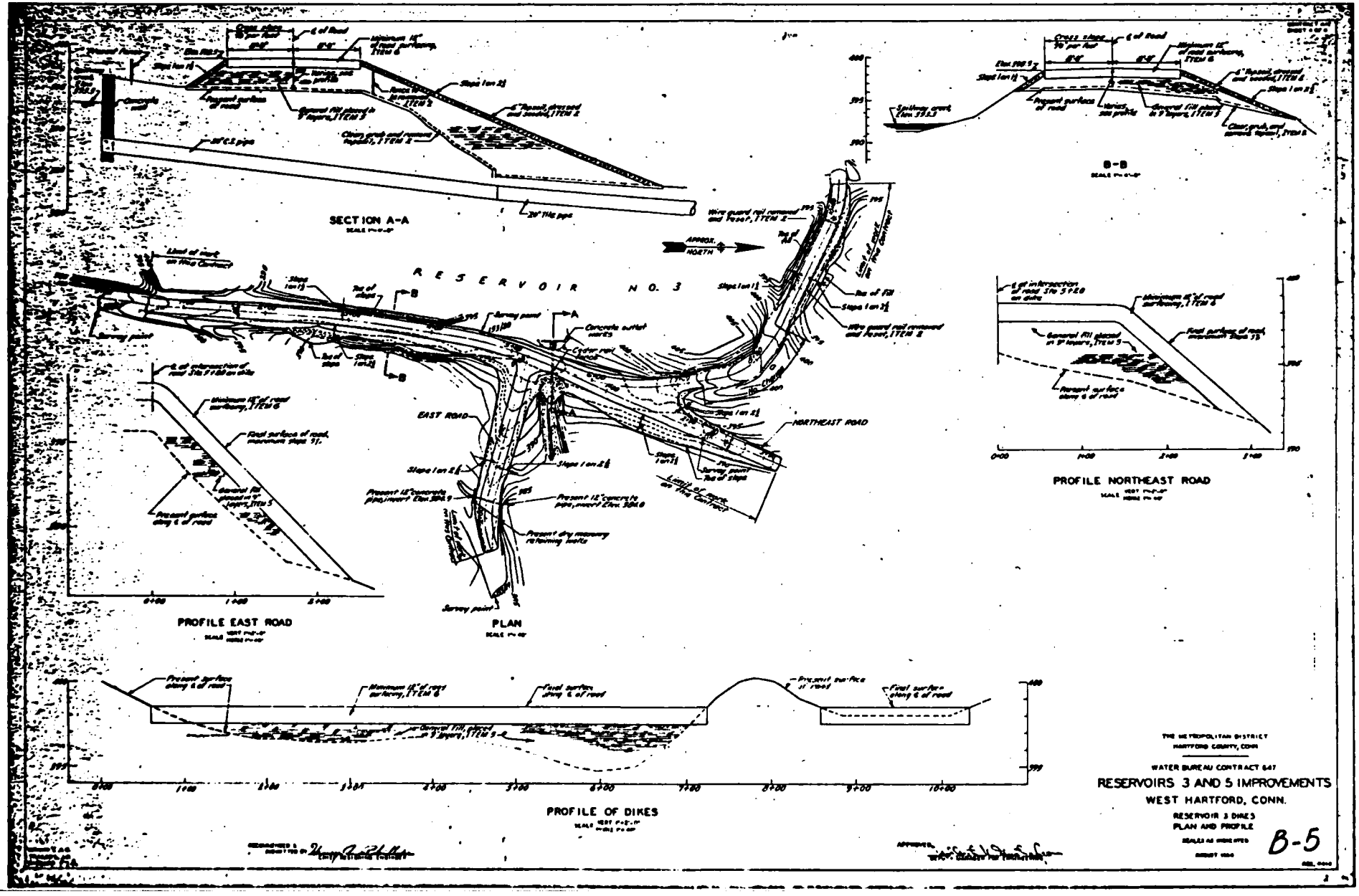
Scale 1" = 4'-0" File

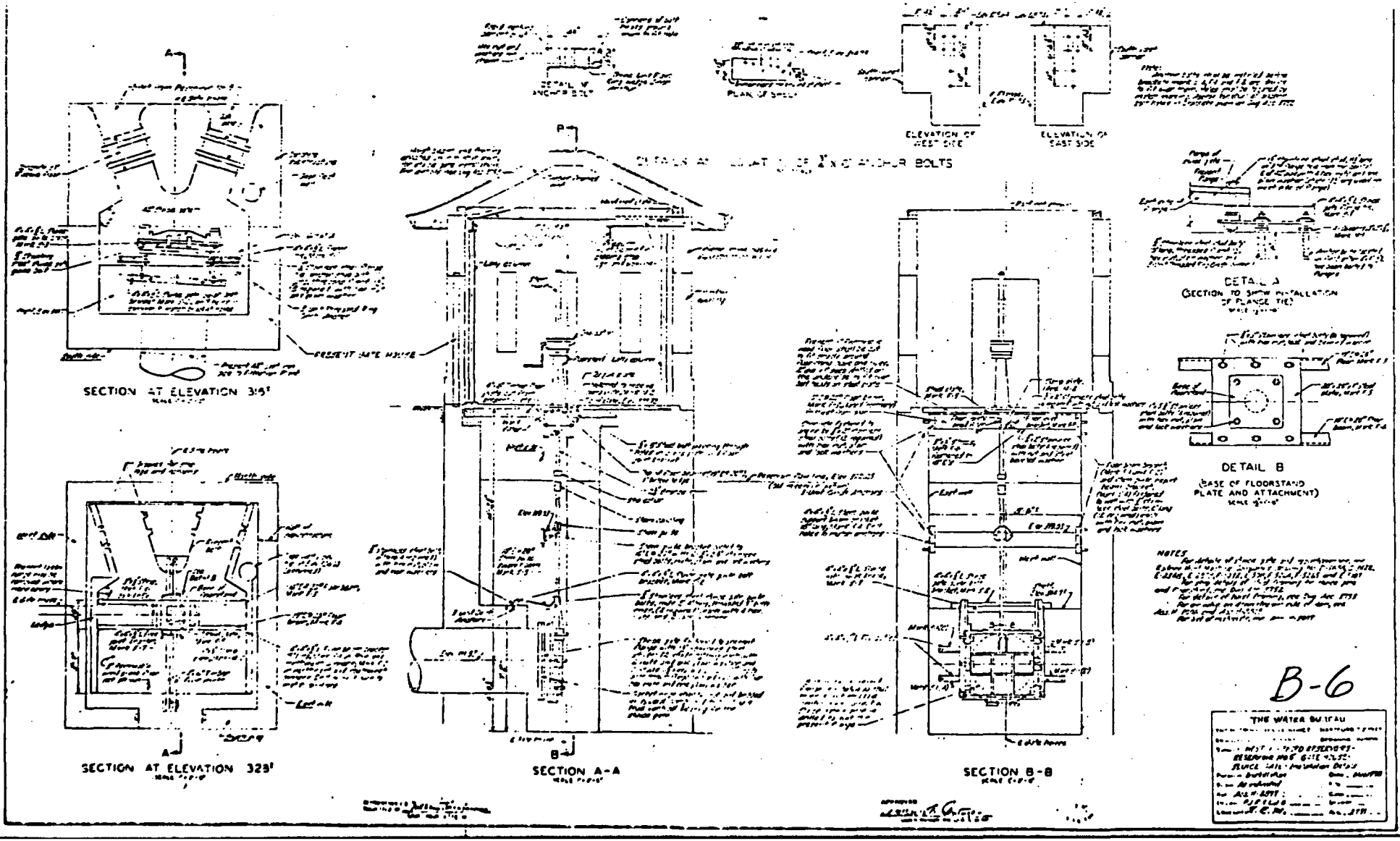
Ref. Case

Drawn LPL C.A.G. Drawer

Checked Acc. H-2546.58

B-4


SECTION A-A
B-B
RESERVOIR NO. 3
EAST ROAD
NORTHEAST ROAD
PROFILE EAST ROAD
PLAN
PROFILE NORTHEAST ROAD
PROFILE OF DIKES
THE METROPOLITAN DISTRICT
HARTFORD COUNTY, CONN.
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN.
RESERVOIR 3 DIKES
PLAN AND PROFILE
B-5


SECTION AT ELEVATION 315'
SECTION AT ELEVATION 329'
SECTION A-A
SECTION B-B
DETAIL A
(SECTION TO SHOW INSTALLATION OF FLANGE TIE)
DETAIL B
(BASE OF FLOORSTAND PLATE AND ATTACHMENT)
ELEVATION OF WEST SIDE
ELEVATION OF EAST SIDE
PLAN OF SHELL
NOTES
B-6
THE WATER BUREAU

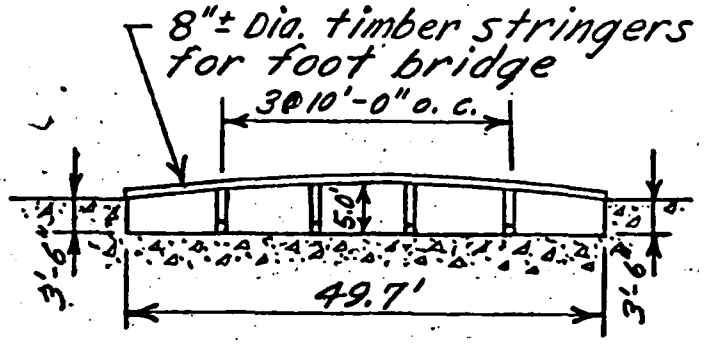
Form 6-E 7-1952

The Water Bureau of
The Metropolitan District
Office of the Manager

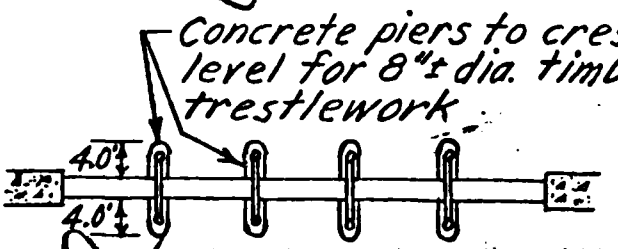
Subject WEST HARTFORD RESERVOIRS- Reservoir #5

File No.
Acc. No. H-2771.
Date June 1952

Computer T.E.M. Checked by

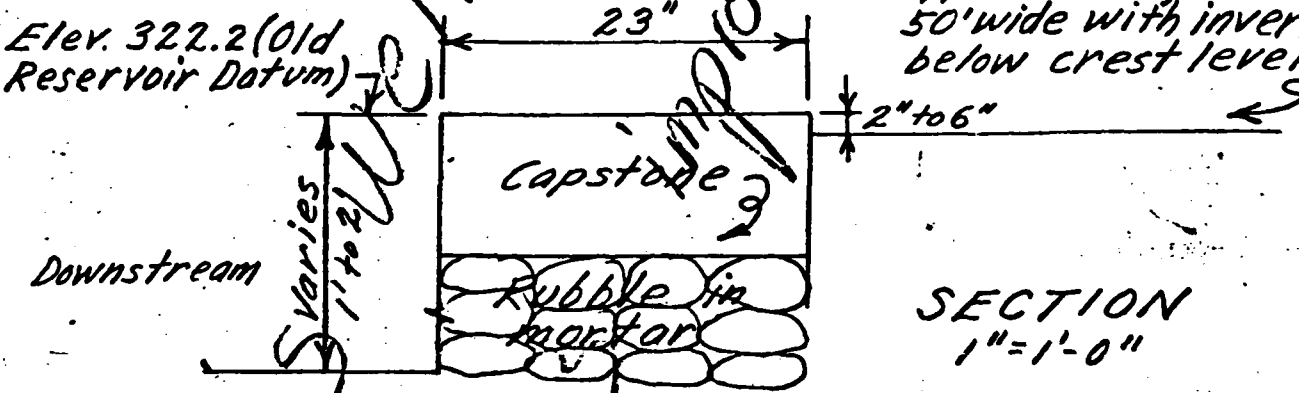


ELEVATION
1" = 20'



PLAN
1" = 20'

Approach channel is approximately 50' long and 50' wide with invert 6"± below crest level



SECTION
1" = 1'-0"

WEIR DETAILS

DAM DATA:

Present minimum freeboard is 3.1' on dam proper
Maximum height of dam is 25'± (based on downstream toe)
Top width is 8'±
Downstream slope is 1 on 2±
Dam: with a stone masonry core, rock fill downstream of core and earth fill upstream of core

BLOW-OFF DATA (Based on approx. computation and reservoir at Elev. 322.2)

#8/1 - 16" to 20" Pipe will discharge 24± c.f.s. (by Brook into Res. #1)
Invert elev 300.7' (Acc H-2771.27)

SUBMITTED BY William Doremus
Chief Designing Engineer

APPROVED
Deputy Manager and Chief Engineer

B-7

Joseph Morritt & Co.
1951 - Albuquerque

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
NE DAM INSPECTIONS	1/2			2060.001

HARTFORD RESERVOIRS 1, 3 & 5

PERTINENT DATA

	HARTFORD RESERVOIR NO: 1	3	5
I. GENERAL:			
Main River	Trout Brook & S. Branch Park River		
Use	Power pond Waste Pool	Reserve Water Supply	Water Supply Balancing
When Built	1864 - 1867 Rebuilt 1868	1875	1884
Comments	Improved 1967	Improved 1964	Improved 1964
II. ELEVATIONS & DATUMS:			
USGS: Flow Line	256.5'	391.2'	319.7'
MDC: Flow Line	258.6'	393.3'	321.8'
Const: Flow Line	259.0'	393.7'	322.3'
Const.: Bottom	225.0'	357.0'	303.0'
III. CAPACITY (MG):			
Available for Stored Use	132	96	68
Below Avail Level	5.5	50	15
IV. MISCELLANEOUS:			
Flow Line Area (Ac)	27	28	25
Maximum Depth (ft.)	34	36	19
Watershed Area (sq. mi.)	4.3	0.6	1.4

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
NE DAM INSPECTIONS	2/2			2060.001

HARTFORD RESERVOIRS 1, 3 & 5

PERTINENT DATA (Cont.)

	HARTFORD RESERVOIR NO: 1	3	5
IV. MISCELLANEOUS (CONT.)			
Ave. Annual Rainfall	44.3" (61.4" Max. & 28.9 Min.)		
Ave. Annual Runoff	NA	1.9 Billion Gallons	
Design Fld. Runoff	1964 improvements: 18¼" in 34 hours		
V. SPILLWAY INFORMATION:			
Length (Feet)	45	23	62
Design Flow Head (Feet)	8.3*	3.9*	2.5
Design Flow (cfs)	4,000*	400*	700
Freeboard Above Crest (Feet)	8.8	5.2	5.2

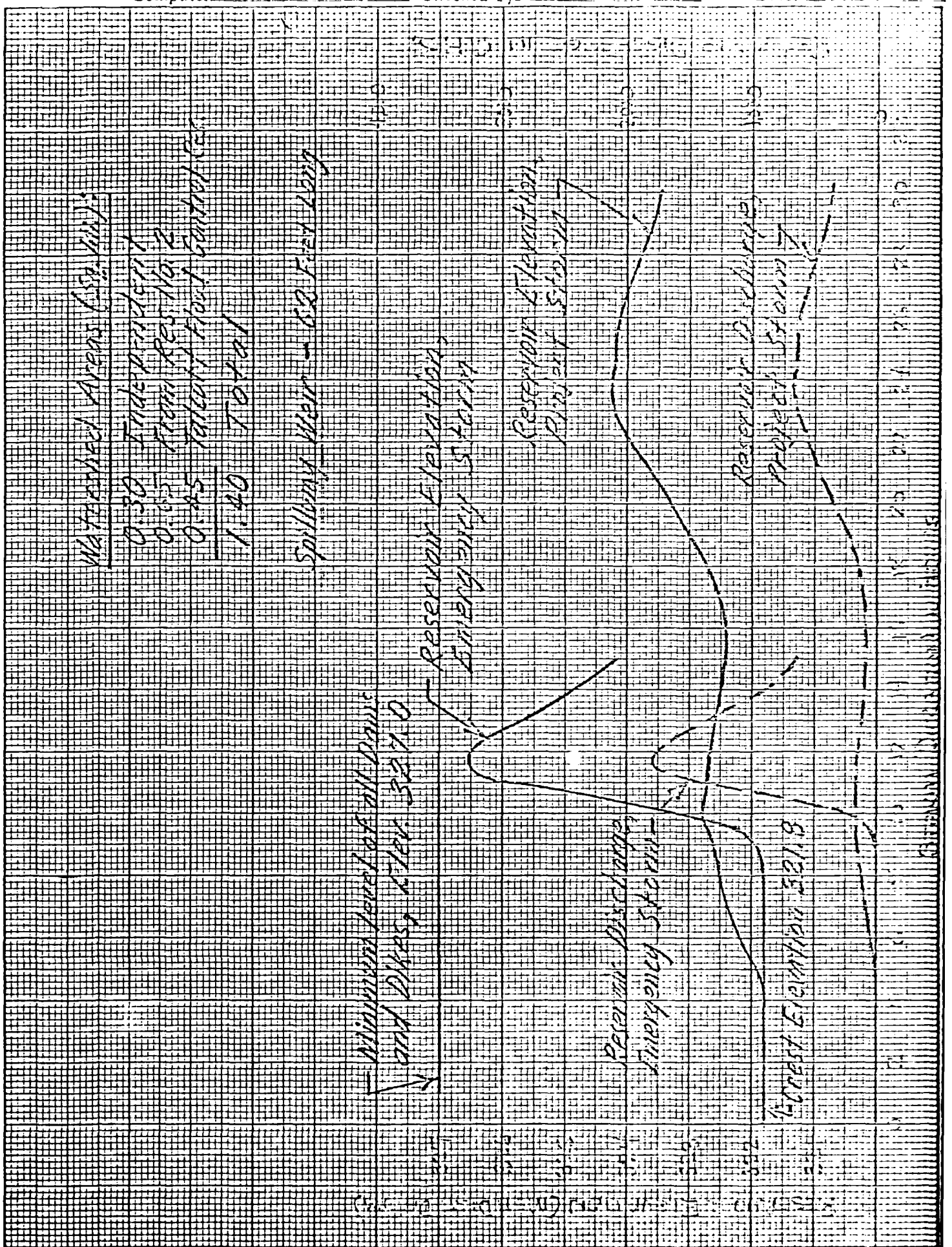
* With Emergency Spillway.

THE WATER BUREAU OF
THE METROPOLITAN DISTRICT

of Drainage Systems - Hartford

Acc. No. [illegible]

Computer SPLATSW Checked by _____ Date [illegible]



B-10

WATER SUPPLY
SEWERAGE

THE METROPOLITAN DISTRICT
555 MAIN STREET - P.O. BOX 800
HARTFORD, CT 06101

TELEPHONE
278-7850

3-PJR:jok

February 15, 1980

File: West Hartford Dam Inspection

Mr. Leneord Beck
O'Brien and Gere
1617 J. F. Kennedy Blvd.
Suite 1760
Philadelphia, PA 19103

Dear Len:

In reply to your request for data on the Talcott Reservoir, I have taken the following data from the construction drawings. (I assume you have our 1" = 200 ft. scale maps of the area for location purposes.)

South Dam: principal spillway is a 30" pipe through dam, emergency spillway is 40 ft. wide, crest at Elev. 452.5.

North Dam: principal spillway is a 30" pipe through the dam, emergency spillway is 90 ft., crest at Elev. 452.5.

Both emergency spillways are grassed earth with crests 30' long (i.e. parallel to flow) and approach and discharge slopes ranging from 2 to 7%. The design high water level is at Elev. 455.4.

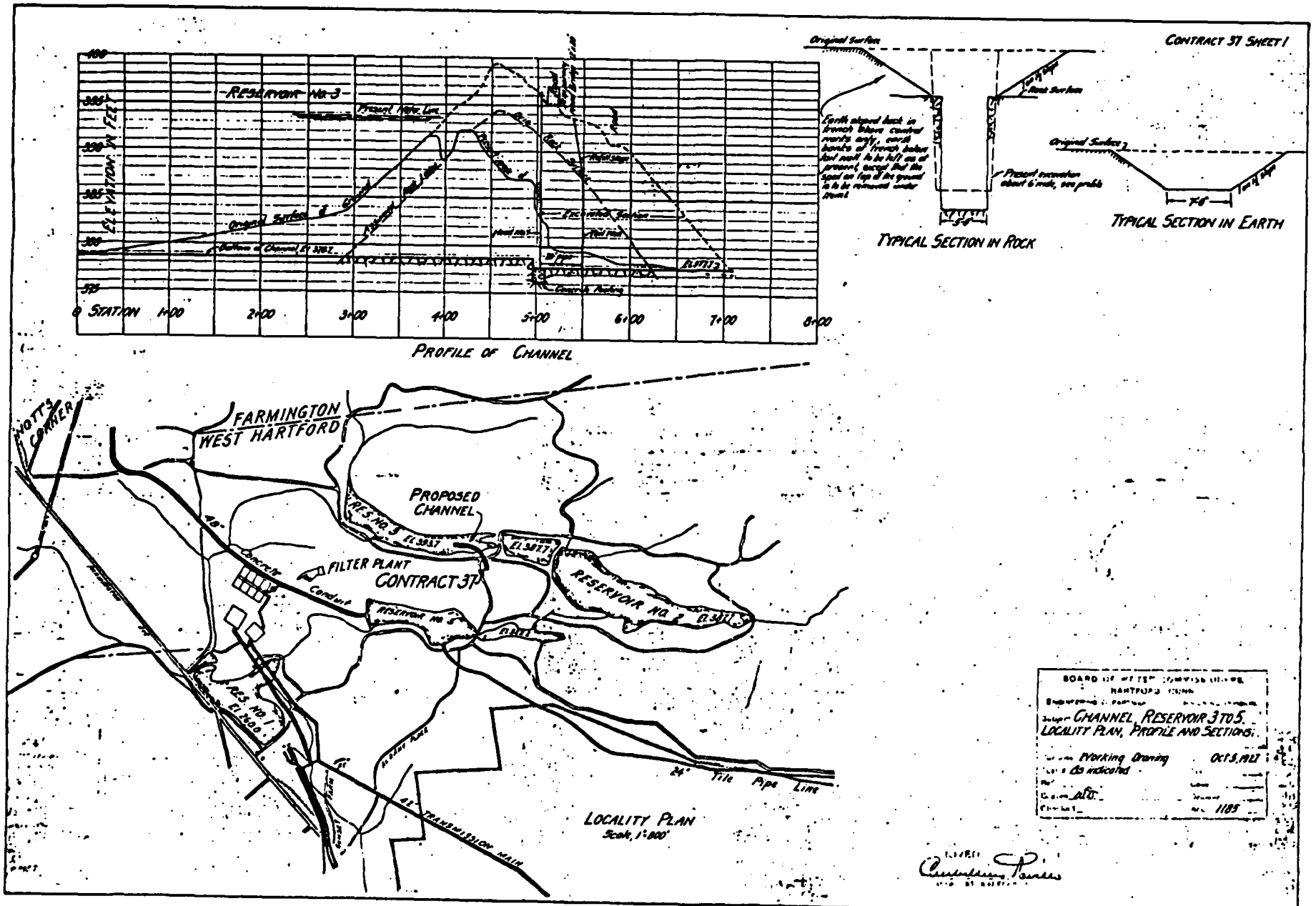
As I recollect, the spillways are designed to drain their proportionate share of the watershed. Our records state that 0.5 sq. mile of Reservoir No. 2 watershed lies above the flood control dam. I hope this information is of help to you.

Sincerely,

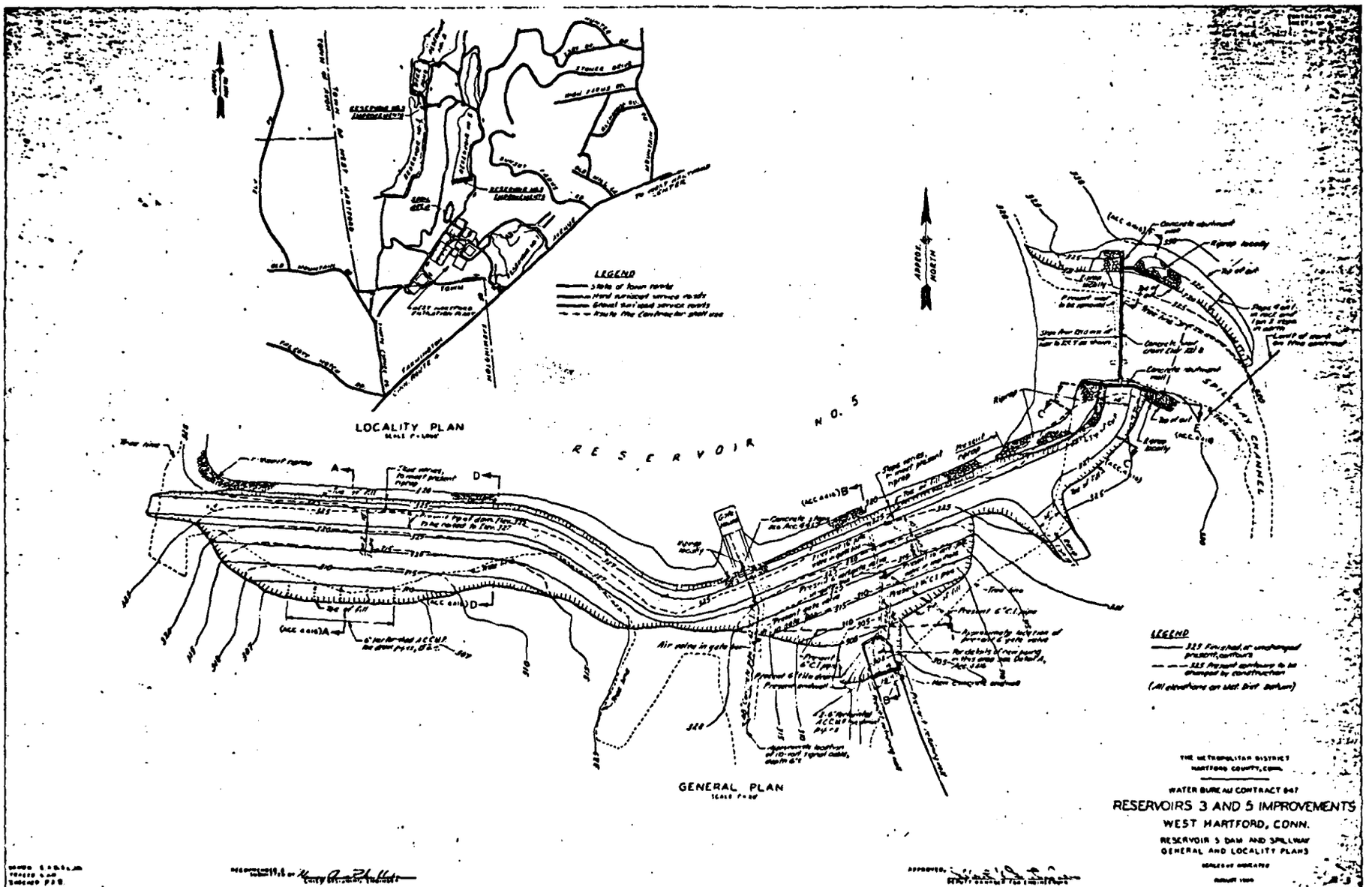
Peter J. Revill

Peter J. Revill,
Chief Design Engineer

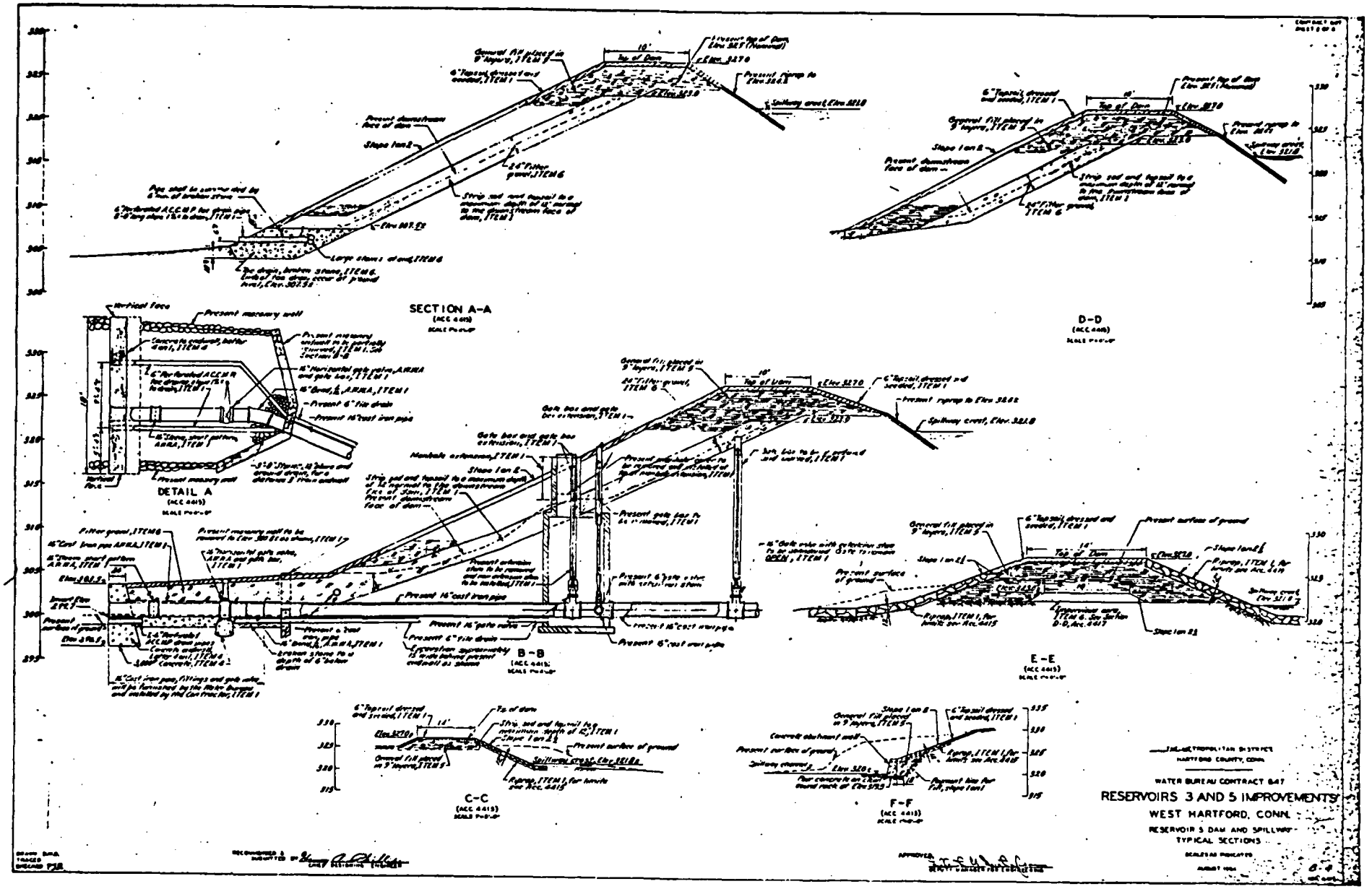
B-11


CONTRACT 37 SHEET 1
Reservoir No 3
Present Water Line
Original Surface
Bottom of Channel El 380±
Elevation in Feet
Station
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
PROFILE OF CHANNEL
Original Surface
Earth sloped back in trench where conduit rests only, earth banks of trench below that must be left as at present, except that the spoil or top of the ground is to be removed under pavt.
Present excavation about 6 inch, see profile
TYPICAL SECTION IN ROCK
Original Surface
TYPICAL SECTION IN EARTH
WOTT'S CORNER
FARMINGTON
WEST HARTFORD
PROPOSED CHANNEL
RES. NO 3 El 397.7
El 397.7
FILTER PLANT CONTRACT 37
Concrete Conduit
RESERVOIR NO 4
El 397.7
RESERVOIR NO 5
El 397.7
RES. NO 1 El 390.0
24" Tile Pipe Line
42" TRANSMISSION MAIN
LOCALITY PLAN
Scale, 1:800'
BOARD OF WATER COMMISSIONERS
HARTFORD CONN
CHANNEL, RESERVOIR 3 TO 5.
LOCALITY PLAN, PROFILE AND SECTIONS.
Working Drawing
Oct 5, 1927
as indicated
1185

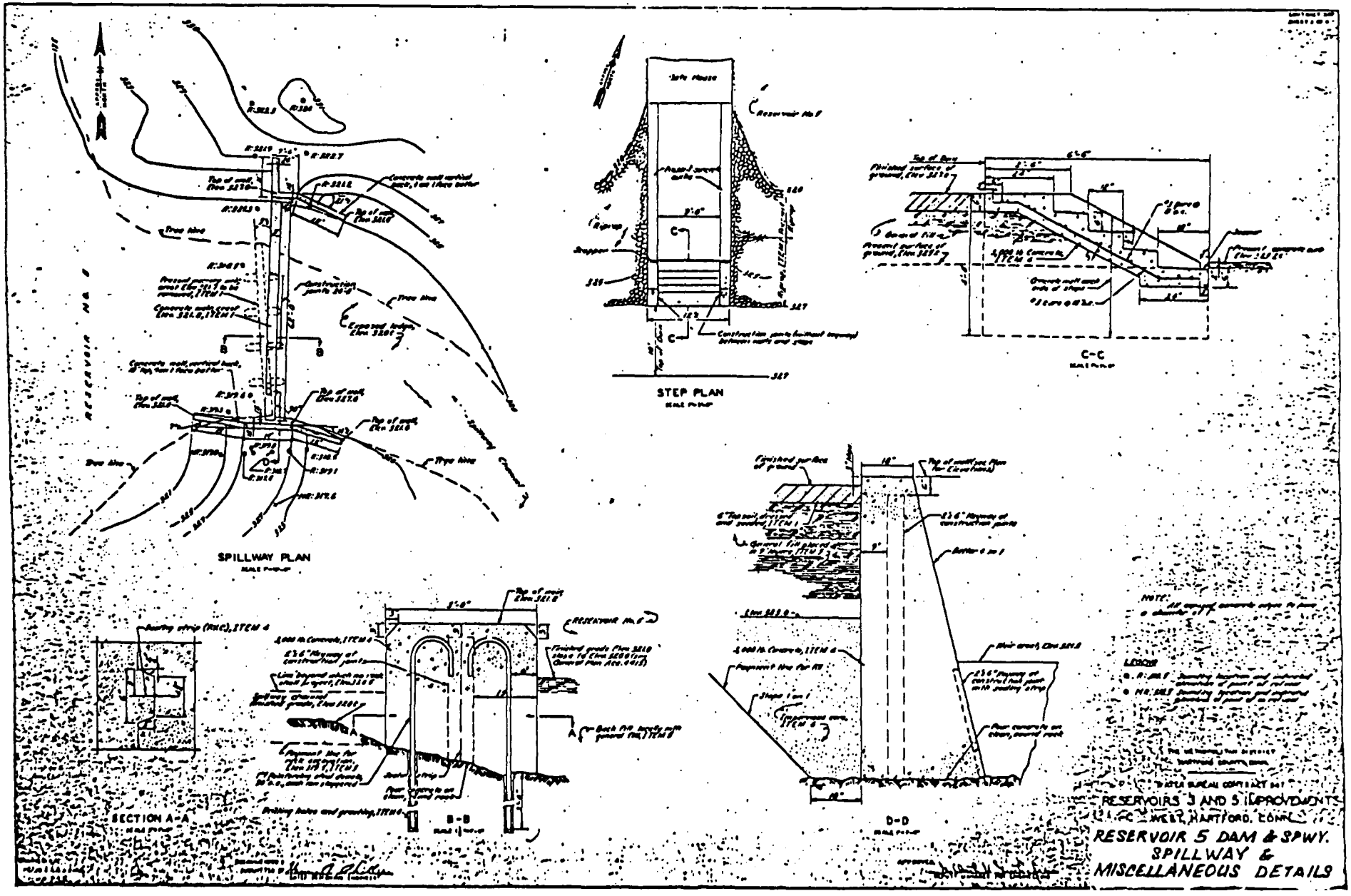
B-12


LOCALITY PLAN
RESERVOIR NO. 5
GENERAL PLAN
LEGEND
THE METROPOLITAN DISTRICT
HARTFORD COUNTY, CONN.
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN.
RESERVOIR 5 DAM AND SPILLWAY
GENERAL AND LOCALITY PLANS

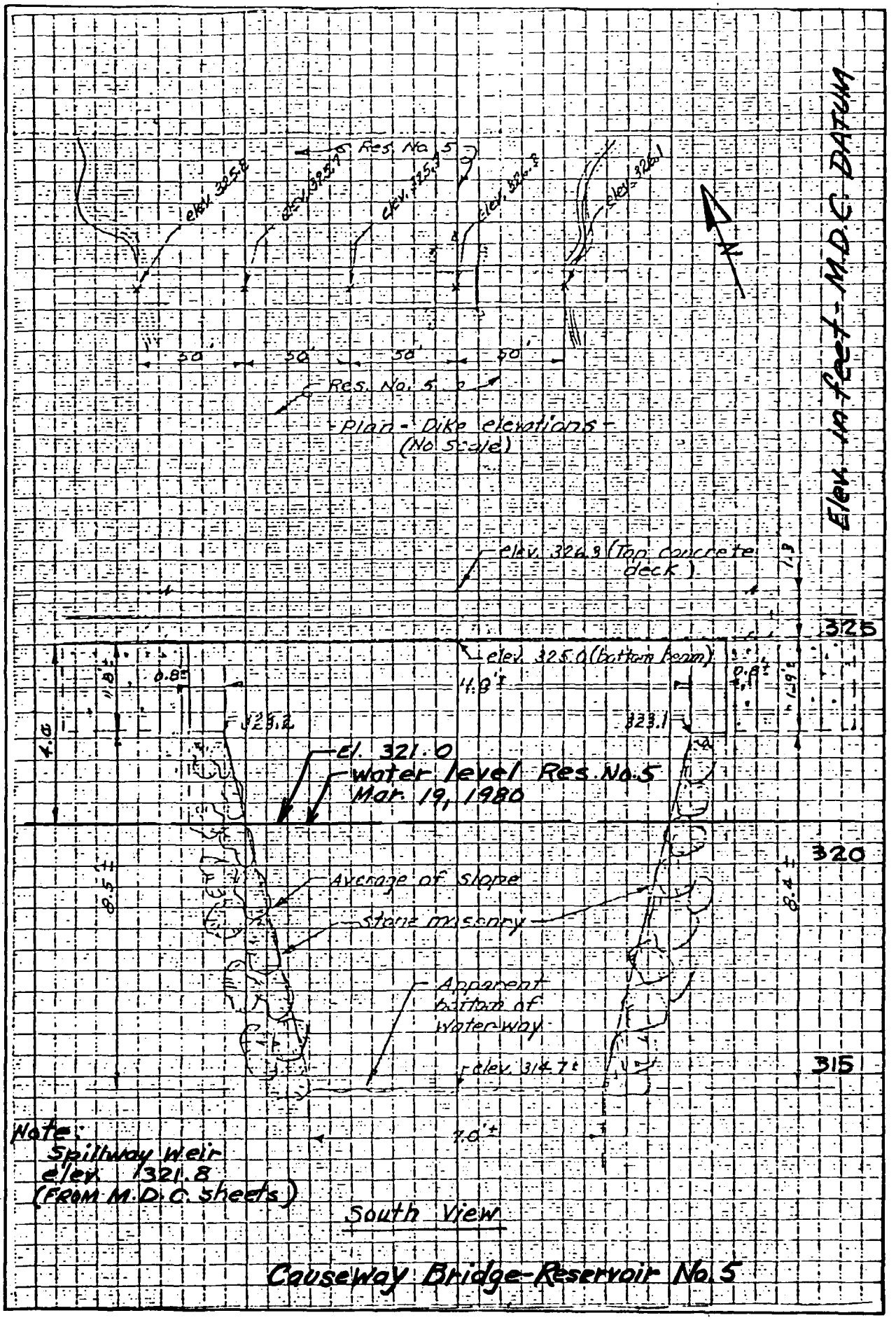
B-13


SECTION A-A
(ACC 4415)
D-D
(ACC 4415)
DETAIL A
(ACC 4415)
B-B
(ACC 4415)
E-E
(ACC 4415)
C-C
(ACC 4415)
F-F
(ACC 4415)
METROPOLITAN DISTRICT
HARTFORD COUNTY, CONN.
WATER BUREAU CONTRACT 647
RESERVOIRS 3 AND 5 IMPROVEMENTS
WEST HARTFORD, CONN.
RESERVOIR 5 DAM AND SPILLWAY
TYPICAL SECTIONS

B-14


SPILLWAY PLAN
STEP PLAN
C-C
SECTION A-A
B-B
D-D
RESERVOIR 5 DAM & SPWY.
SPILLWAY &
MISCELLANEOUS DETAILS

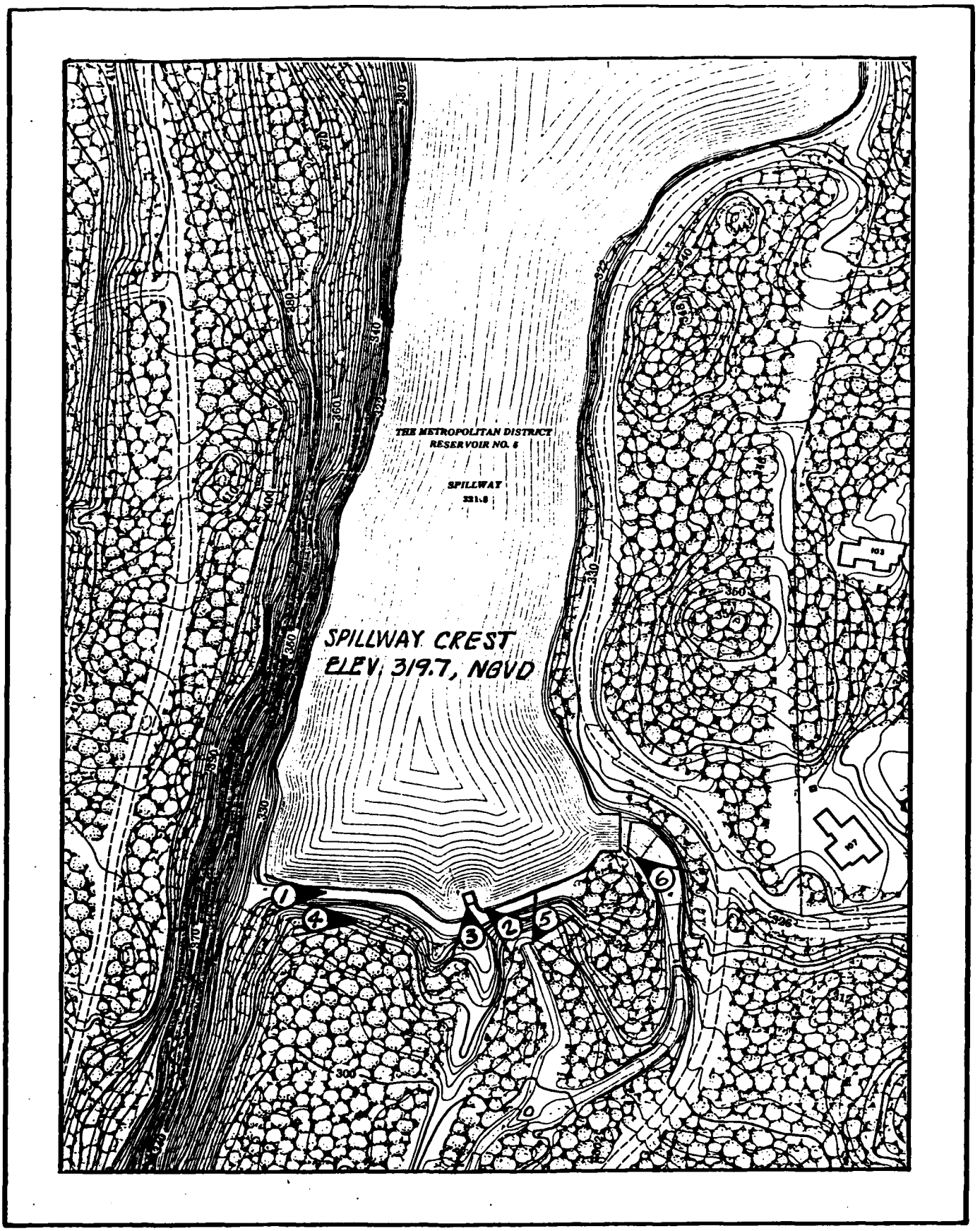
R-15


Elev. in feet - M.D.C. Datum
Res. No. 5
elev. 325.8
elev. 325.8
elev. 325.8
elev. 325.8
elev. 326.1
50'
50'
50'
50'
Res. No. 5
Plan - Dike elevations - (No Scale)
N
elev. 326.9 (Top concrete deck)
1.1'
325
elev. 325.0 (bottom beam)
4.3'±
0.8'±
11.8'±
328.2
323.1
el. 321.0
Water level Res. No. 5
Mar. 19, 1980
320
Average of slope
Stone masonry
Apparent bottom of waterway
elev. 314.7±
315
7.0'±
Note:
Spillway Weir
elev. 321.8
(From M.D.C. sheets)
South View
Causeway Bridge-Reservoir No. 5

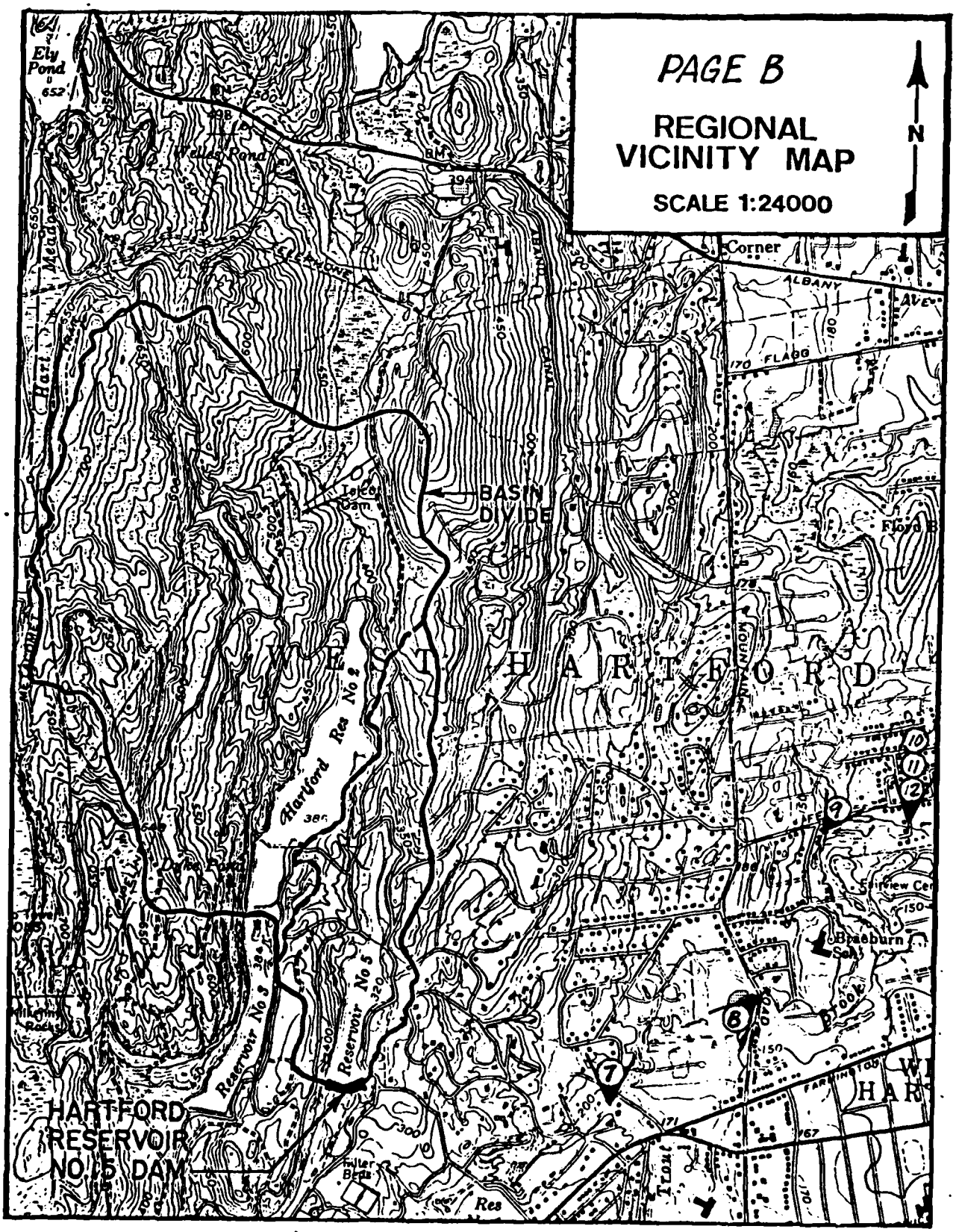
APPENDIX C

PHOTOGRAPHS

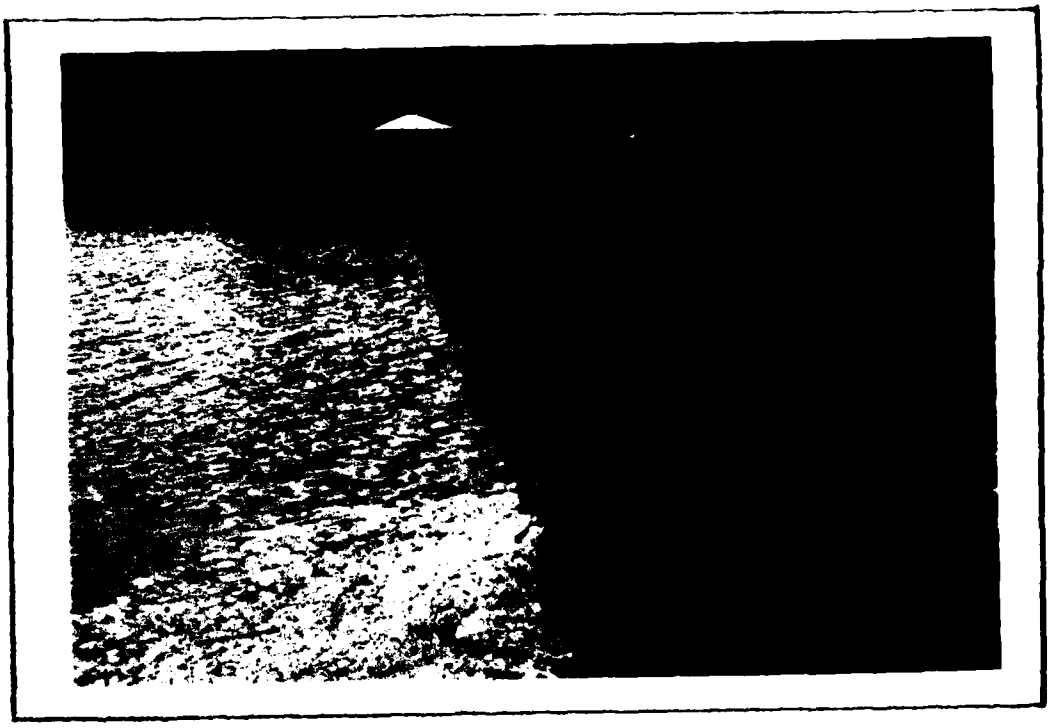
APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT



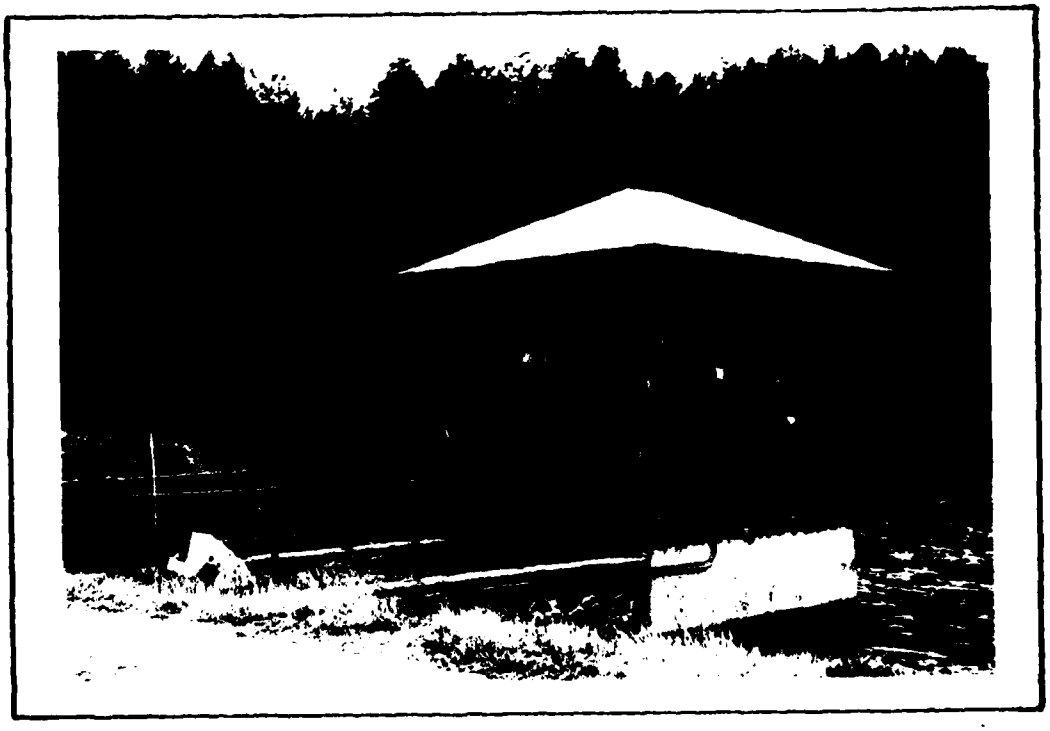
LEGEND (1) THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO



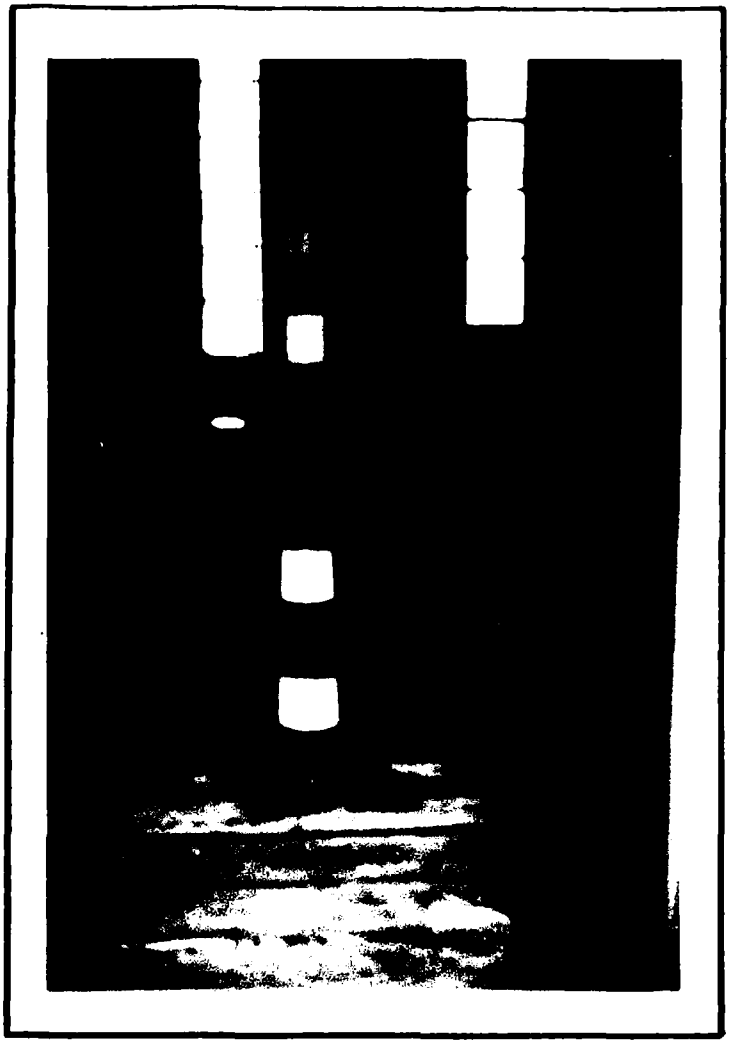
LEGEND (7) THE LOCATION AND DIRECTION IN WHICH EACH PHOTO WAS TAKEN AND THE NUMBER OF THE PHOTO



1. UPSTREAM FACE OF THE DAM SHOWING DETAILS OF THE VEGETATIVE COVER AND RIPRAP PROTECTION. (11/13/79)



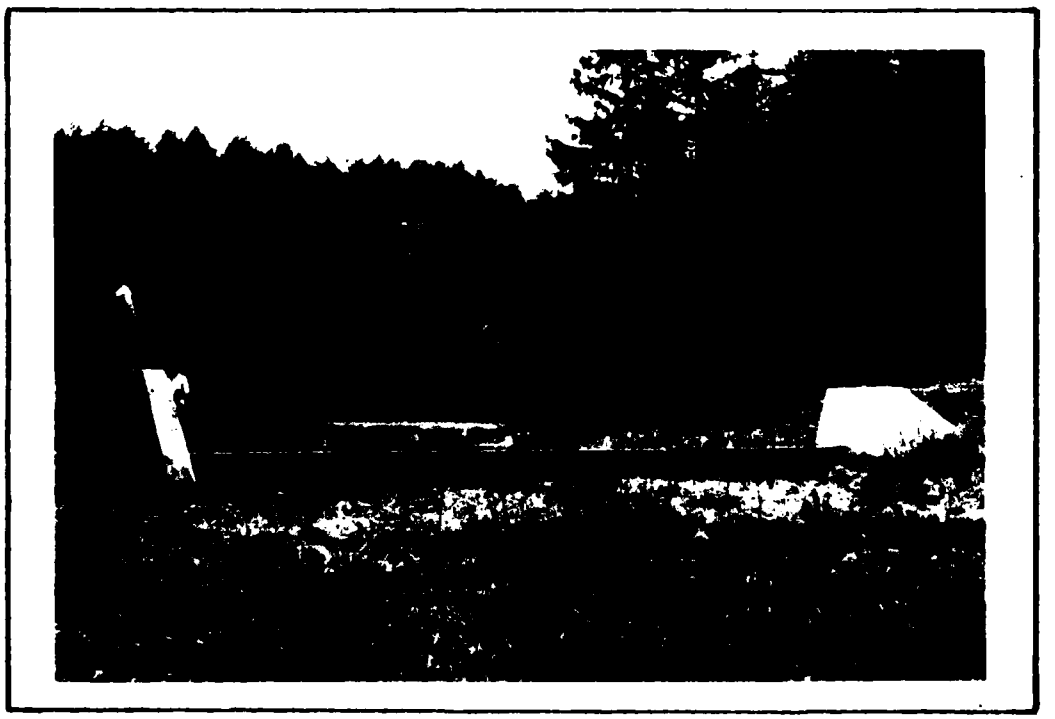
2. APPROACH TO GATEHOUSE AND MASONRY GATEHOUSE. (11/13/79)



3. GATE HOIST AND STEM INSIDE THE GATEHOUSE. (11/13/79)

4. DOWNSTREAM FACE OF THE DAM SHOWING SIZEABLE TREES GROWING ON THE EMBANKMENT. (11/13/79)

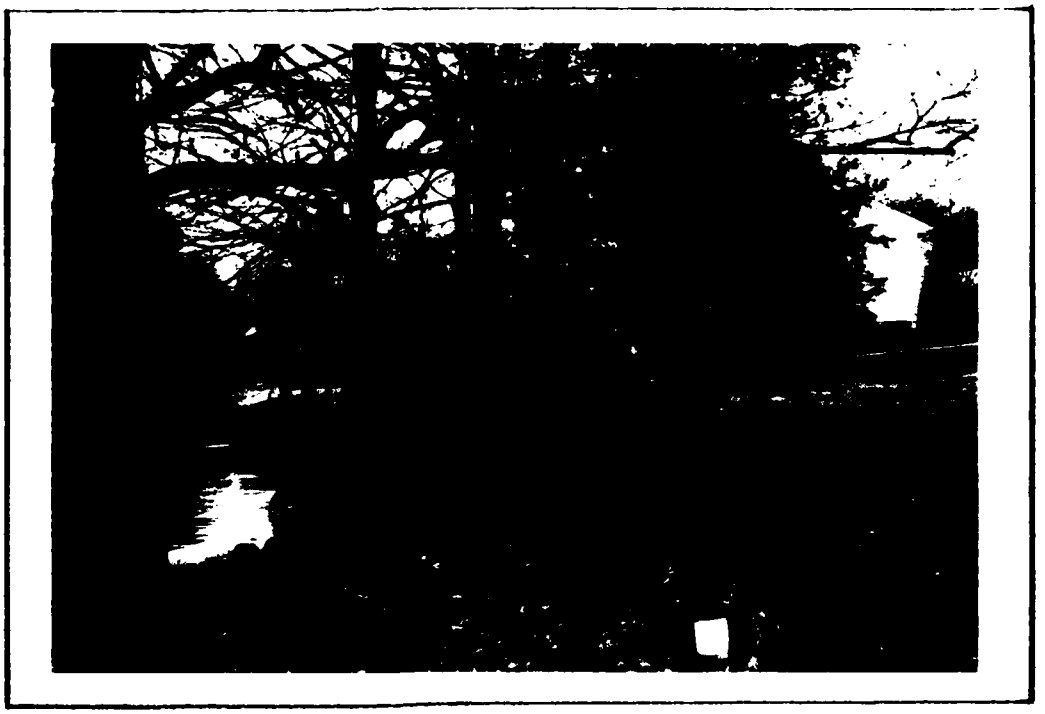
5. OUTLET CHANNEL FOR THE RESERVOIR DRAIN SYSTEM. (11/13/79)



6. LOOKING UPSTREAM AT THE SPILLWAY WEIR SECTION ON THE LEFT SIDE OF THE RESERVOIR. (11/13/79)

7. POTENTIAL DAMAGE AREA ABOUT 1.3 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

8. POTENTIAL DAMAGE AREA ABOUT 1.8 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



9. POTENTIAL DAMAGE AREA ABOUT 2.7 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

10. POTENTIAL DAMAGE AREA ABOUT 2.9 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

11. POTENTIAL DAMAGE AREA ABOUT 2.9 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

12. POTENTIAL DAMAGE AREA ABOUT 2.9 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RES. NO. 5 DAM				

APPENDIX D

HYDRAULICS & HYDROLOGIC COMPUTATIONS

TABLE OF CONTENTS

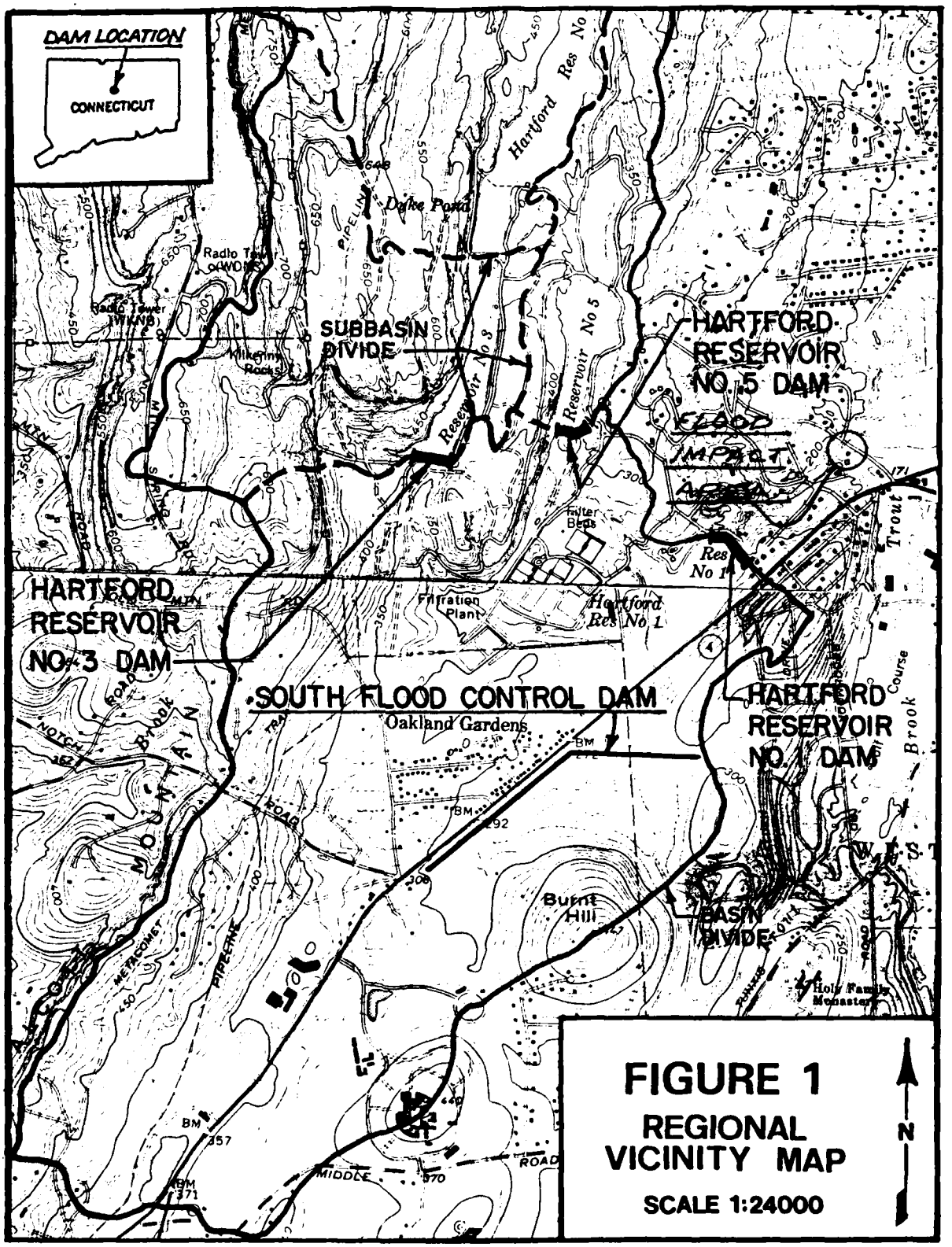


FIGURE 1

REGIONAL VICINITY MAP

SCALE 1:24000

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO D-2 OF D-23
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR DAM #5 H&H

DRAINAGE AREA (SUB AREA) = 0.27 Sq.Mi

TOTAL DRAINAGE AREA = 3.89 SQUARE MILES

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 0.57$ Mi. $L_{ca} = 0.15$ Mi.

$$T_p = C_t \times (L \times L_{ca})^{.3}$$

$$T_p = 2 \times (0.57 \times 0.15)^{.3} \simeq 0.96 \text{ HOURS}$$

USE $T_p = 1.0$ HOURS

PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

6hr % OF INDEX FOR THIS BASIN = 111
12hr % " " " " = 124
24hr % " " " " = 133

STAGE STORAGE

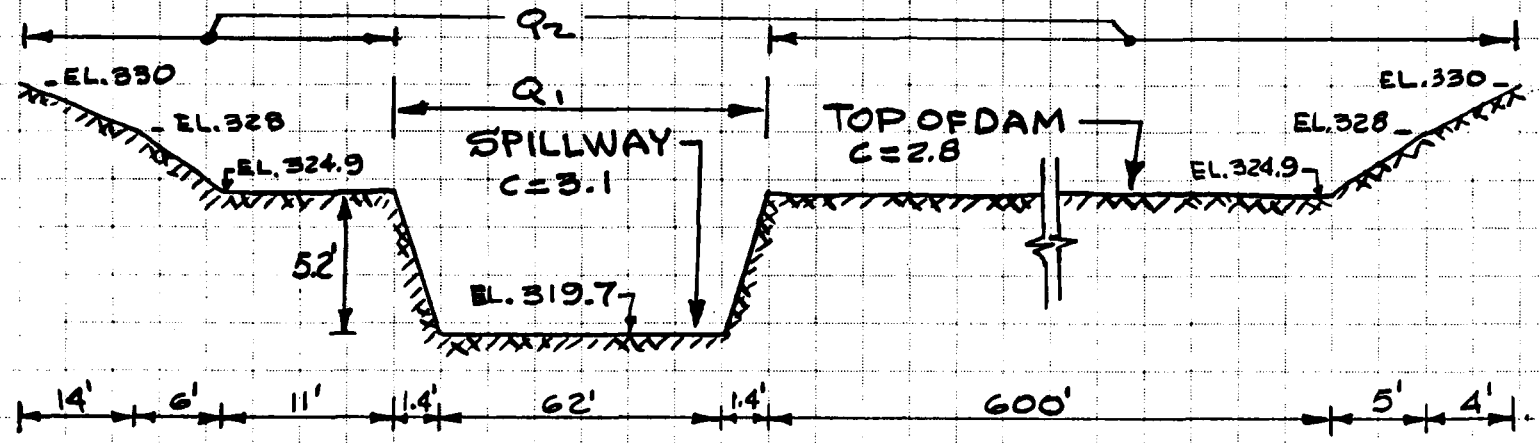
	ELEV. (MSL)(NVGD)	AREA (AC.)	STORAGE (AC.FT.) (COMPUTED BY HEC-1 PROGRAM)
	301.0	0	0
NORMAL POOL	319.7	25	156
	330.0	37	473

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO D-3 OF D-23
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR DAM #5 H&H

TOP OF DAM & SPILLWAY ELEVATION



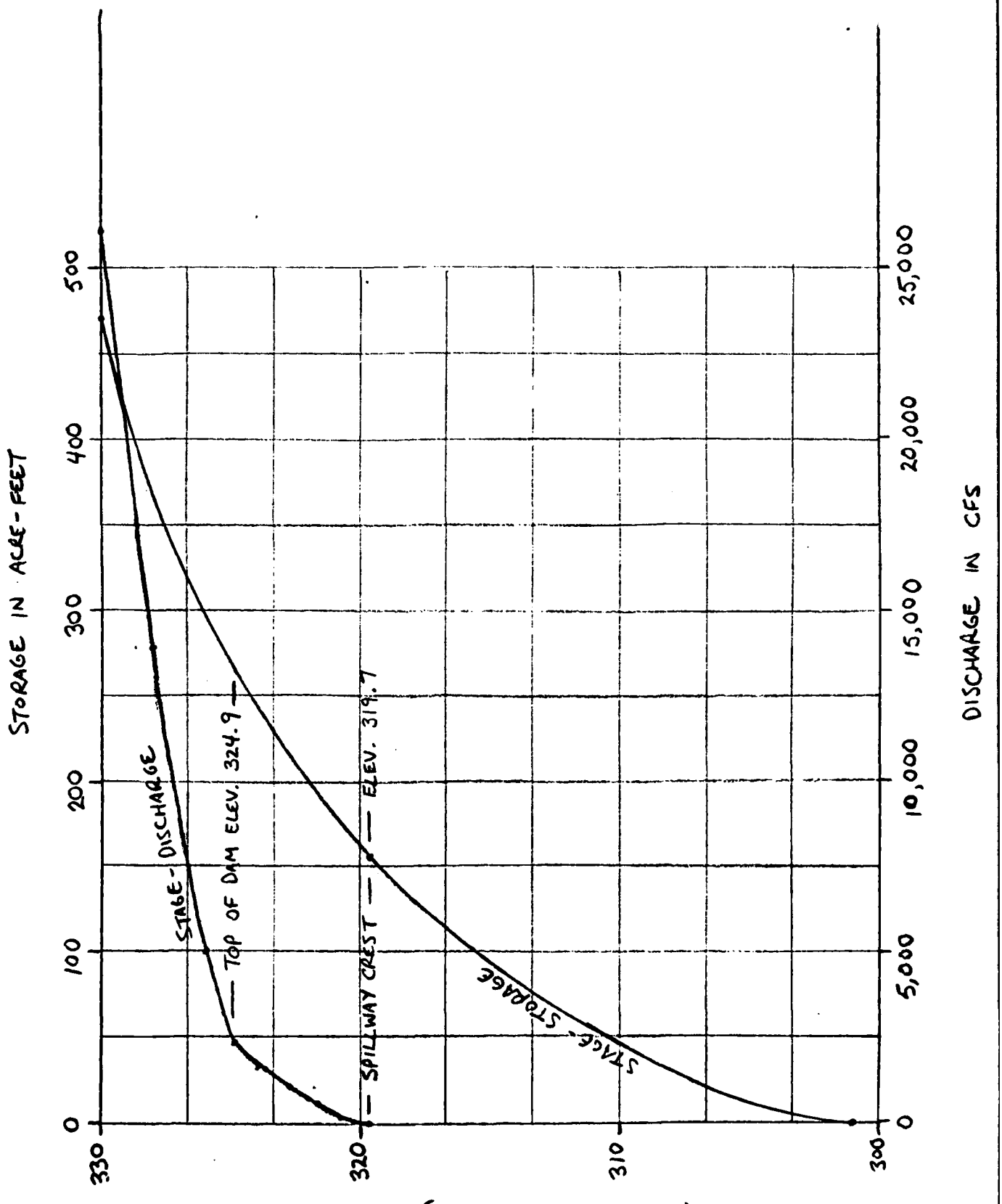
STAGE DISCHARGE

$Q = CLH^{1.5}$ $H = 0$ @ CORRESPONDING CREST

ELEVATION NGVD	H Ft.	Q1 CFS.	H Ft.	Q2 CFS.	ΣQ CFS.
319.7	0	0			0
320.7	1	193			193
321.7	2	548			548
322.7	3	1,012			1,012
323.7	4	1,564			1,564
324.9	5.2	2,330	0	0	2,330
326.0	6.3	3,040	1.1	1,980	5,020
328.0	8.3	4,596	3.1	9,353	13,949
330.0	10.3	6,353	5.1	19,736	26,089

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
STAGE - STORAGE & STAGE - DISCHARGE CURVES	D-4	RRB	2/80	2060-001



BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO D-5 OF D-23
CALCULATED BY R.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR DAM #2 H&H

DRAINAGE AREA = 0.81 Sq.Mi

THIS DRAINAGE AREA REFLECTS THE EFFECTS OF DRAINAGE FROM A PORTION OF THE TALCOTT FLOOD CONTROL RESERVOIR LOCATED UPSTREAM OF HARTFORD RESERVOIR # 2

SNYDER HYDROGRAPH COEFFICIENTS

$C_t = 2.0$ $C_p = 0.5$

T_p COMPUTATIONS

$L = 1.0$ Mi. $L_{ca} = 0.4$ Mi.

$$T_p = C_t \times (L \times L_{ca})^{.3}$$

$$T_p = 2 \times (1.0 \times 0.4)^{.3} \simeq 1.5 \text{ HOURS}$$

PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

6hr % OF INDEX FOR THIS BASIN = 111
12hr % " " " " = 124
24hr % " " " " = 133

STAGE STORAGE

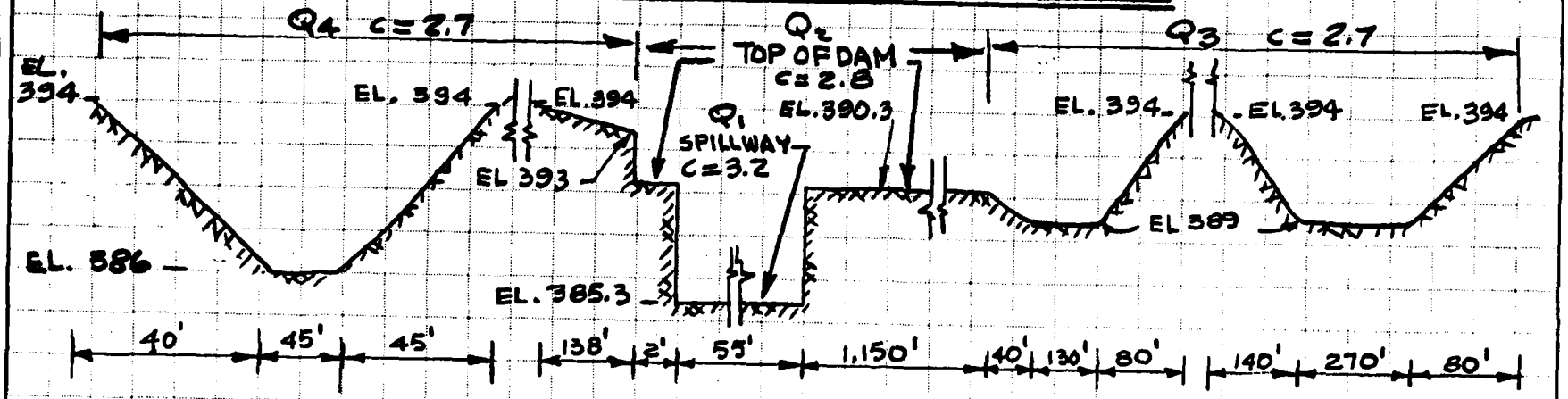
SURCHARGE CAPACITY

	ELEV. (NGVD)	AREA (AC)	STORAGE (A-FT.) (COMPUTED BY HEC-1 PROGRAM)
NORMAL POOL	385.3	44	0
	390.0	52	225
	400.0	70	833

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO 0-6 OF D-23
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR DAM #2 H&H



STAGE DISCHARGE

$Q = CLH^{1.5}$ H=0 @ CORRESPONDING CREST

ELEVATION NGVD	H Ft.	Q1 CFS	H Ft.	Q2 CFS	H Ft.	Q3 CFS	H Ft.	Q4 CFS	ΣQ CFS
385.3	0	0							0
386.0	.7	103					0	0	103
387.0	1.7	390					1	125	515
388.0	2.7	781					2	370	1,151
389.0	3.7	1,253			0	0	3	707	1,960
390.3	5.0	1,968	0	0	1.3	1,634	4.3	1,277	4,879
392.0	6.7	3,052	1.7	7,150	3.0	5,920	6.0	2,247	18,369
393.0	7.7	3,760	2.7	14,310	4.0	9,294	7.0	2,940	30,304
394.0	8.7	4,516	3.7	22,957	5.0	13,247	8.0	3,724	44,444

NOTE: ABOVE 394.0 RESERVOIR #2 SPILLS INTO RESERVOIR #3

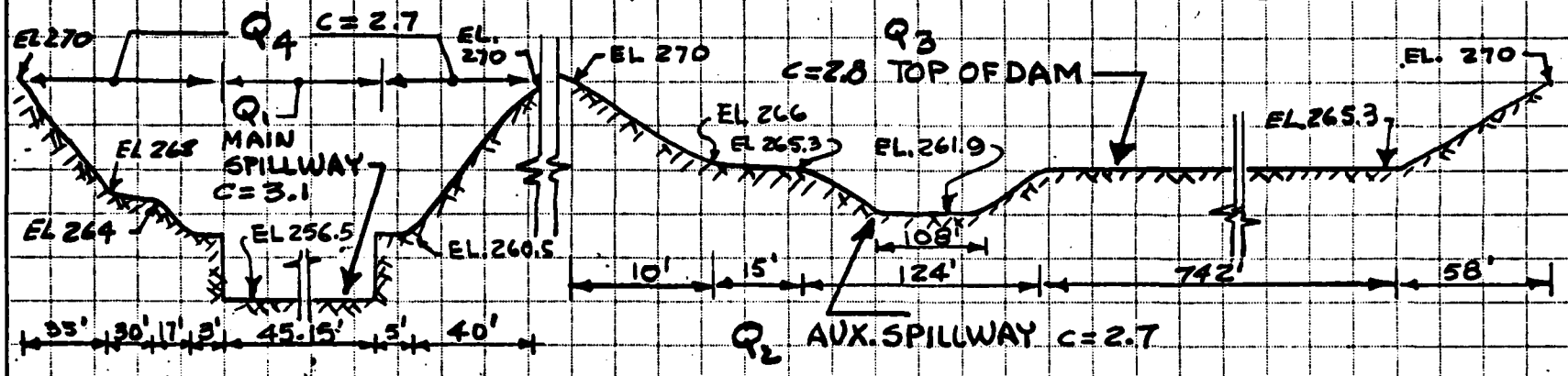
BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060 - 001
SHEET NO. D-7 OF D-23
CALCULATED BY E.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

INFORMATION FOR DOWNSTREAM BREACH ROUTING THROUGH HARTFORD RESERVOIR #1

HARTFORD RESERVOIR DAM #1 H&H

TOP OF DAM & SPILLWAYS ELEVATION H=0 @ CORRESPONDING CREST



STAGE DISCHARGE

$Q = CLH^{1.5}$

ELEVATION NGVD	H Ft.	Q_1 CFS	H	Q_2 CFS	H	Q_3 CFS	H	Q_4 CFS	ΣQ CFS
256.5	0	0							0
257.5	1	140							140
258.5	2	396							396
259.5	3	727							727
260.5	4	1,120					0	0	1,120
261.9	5.4	1,756	0	0			1.4	48	1,804
265.3	8.8	3,654	3.4	1,871	0	0	4.8	604	6,129
266.0	9.5	4,098	4.1	2,490	0.7	1,236	5.5	702	8,526
268.0	11.5	5,458	6.1	4,595	2.7	9,404	7.5	11,375	20,832
270.0	13.5	6,942	8.1	7,149	4.7	21,597	9.5	22,330	38,018

STAGE-STORAGE DATA

ELEV. (NGVD)	225	256.5	260	270
AREA (ACRES)	0	27	35	68
STORAGE (A-FT. → COMP. BY HEC-1 PROGRAM)	0	284	392	898

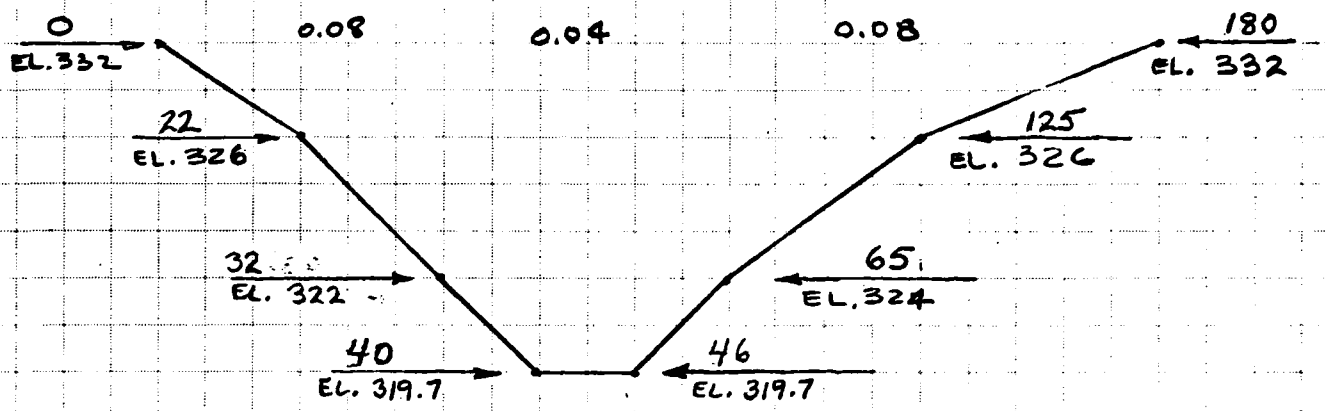
BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060.001
SHEET NO. D-8 OF D-23
CALCULATED BY R.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE

HARTFORD RESERVOIR #5 H&H cont'd

(1)

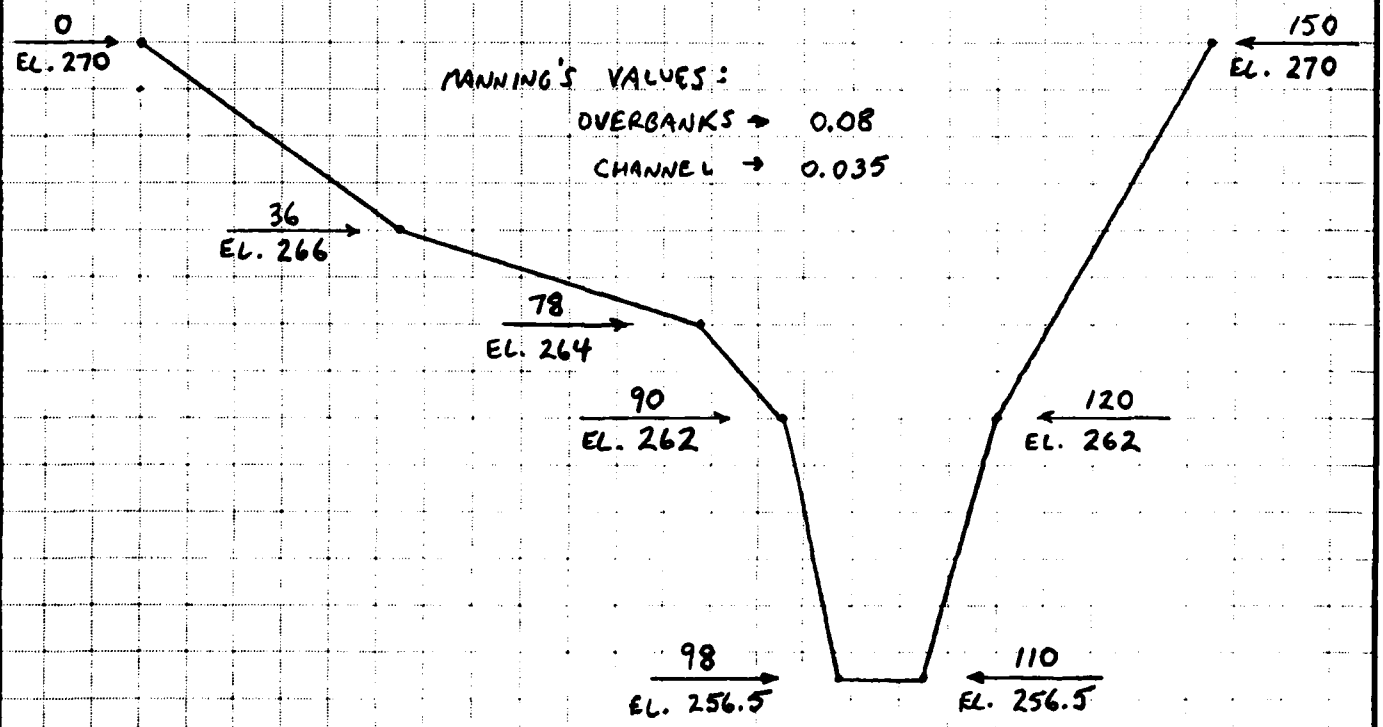
CHANNEL CROSS-SECTION AT RESERVOIR #5 FROM #2
CHANNEL LENGTH = 1,350'
SLOPE = 0.04



(2) CHANNEL CROSS-SECTION AT RESERVOIR # 1 FROM # 5 (FOR BREACH OUTFLOW DOWNSTREAM):

CHANNEL LENGTH = 2,200'
SLOPE = 0.025

MANNING'S VALUES:
OVERBANKS → 0.08
CHANNEL → 0.035



O'BRIEN & GERE ENGINEERS, INC.

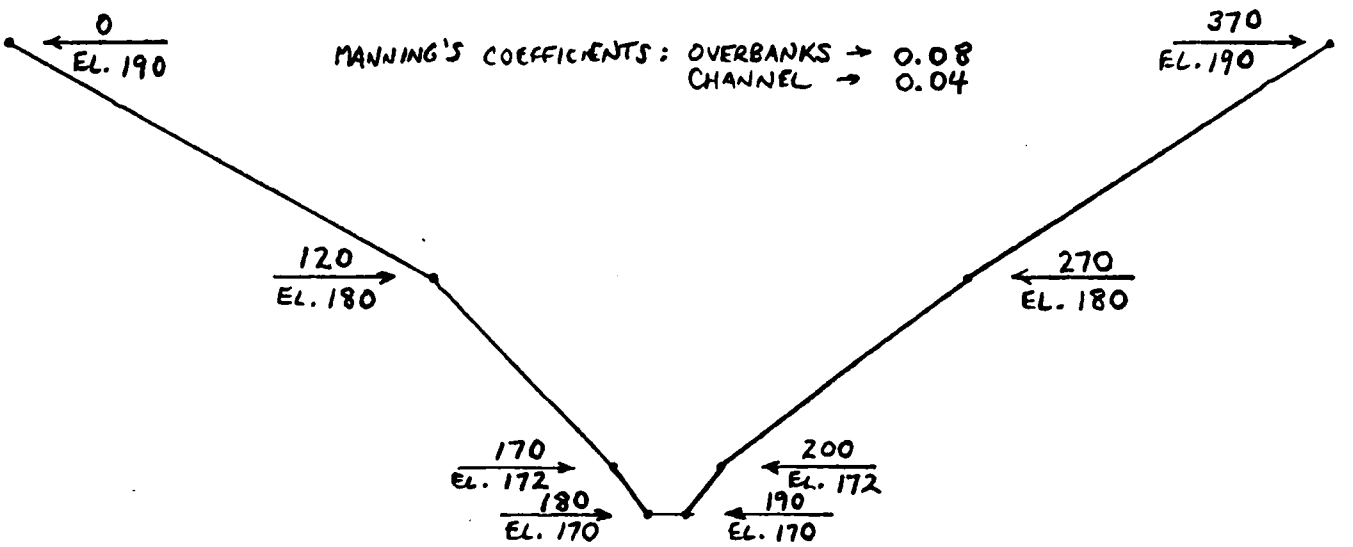
SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR DAM # 5	D-9	RRB	2/80	2060-001

DOWNSTREAM CROSS-SECTIONS FOR BREACHED OUTFLOW (CONT)

(3) CHANNEL CROSS-SECTION AT HAZARD CENTER DOWNSTREAM OF DAM # 1:

CHANNEL LENGTH = 2,000'

SLOPE = 0.025



FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

HARTFORD RESERVOIR #5 DAM FLOOD ROUTINGS
WITHOUT BREACHING

INPUT

```
     1  A1   HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR DAM NO. 5
     2  A2        NATIONAL DAM INSPECTION PROGRAM
     3  A3        NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4  H    300     0     15      0      0      0      0      0     -4      0
     5  B1     5
     6  J      1     9      1
     7  J1    .2    .3     .4     .5     .6     .7     .8     .9    1.0
     8  K      0   HAD-2                                   1
     9  K1       INFLOW TO RESERVOIR 2
    10  M      1     1    .81                3.89                      1
    11  P      0  21.5     111     124     133
    12  T                                                0.0    0.05
    13  W    1.5   0.5
    14  X   -1.7  -0.1       2
    15  K      1   HAD-2                                   1
    16  K1       ROUTED OUTFLOW FROM RESERVOIR 2
    17  Y                                  1      1
    18  Y1     1                                      -385.3     -1
    19  Y4 385.3   386.0   387.0   388.0   389.0   390.3   392.0   393.0   394.0
    20  Y5     0     103     515    1151    1960    4879   18369   30304   44444
    21  SA    44      52      70
    22  SE 385.3     390     400
    23  SS 385.3
    24  SD 390.3
    25  K      1   CHA-1                                   1
    26  K1       CHANNEL ROUTING 2 TO 5
    27  Y                                  1      1
    28  Y1     1                                        -1
    29  Y6  0.08    0.04    0.08   319.7     332    1350    0.04
    30  Y7     0     332      22     326      32     322      40   319.7      46   319.7
    31  Y7    65     324     125     326     180     332
    32  K      0   HAD-5                                   1
    33  K1       INFLOW TO RES. 5 LESS RES. 2
    34  M      1     1    0.27                3.89                      1
    35  P      0  21.5     111     124     133
    36  T                                                  0    0.05
    37  W    1.0   0.5
    38  X   -1.7  -0.1       2
    39  K      2   TOTAL                                   1
    40  K1       COMBINE HYDROGRAPHS
    41  K      1   HAD-5                                   1
    42  K1       ROUTED OUTFLOW FROM RESERVOIR 5
    43  Y                                  1      1
    44  Y1     1                                      -319.7     -1
    45  Y4 319.7   320.7   321.7   322.7   323.7   324.9   326.0   328.0   330.0
    46  Y5     0     193     548    1012    1564    2330    5020   13949   26089
    47  SA     0      25      37
    48  SE   301   319.7     330
    49  SS 319.7
    50  SD 324.9
```

0.01

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 02/25/80.
TIME= 10.01.49.

HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR DAM NO. 5
NATIONAL DAM INSPECTION PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

PERCENTAGES OF PMF → RTIOS= .20 .30 .40 .50 .60 .70 .80 .90 1.00

********** ********** ********** ********** **********

LOCAL RUNOFF TO HARTFORD RESERVOIR #2

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
MAP=2	0	0	0	0	0	1	20	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.61	0.00	3.89	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	111.00	124.00	133.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.50 CP= .50 NTA= 0

RECESSION DATA
STRTQ= -1.70 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 46 END-OF-PERIOD ORDINATES, LAG= 1.51 HOURS, CP= .50 VOL= 1.00

10.	38.	77.	119.	154.	174.	174.	158.	140.	123.	
109.	96.	85.	75.	66.	58.	51.	45.	40.	35.	
31.	27.	24.	21.	19.	17.	15.	13.	11.	10.	
9.	8.	7.	6.	5.	5.	4.	4.	3.	3.	
3.	2.	2.	2.	2.	1.					

D-11

0 END-OF-PERIOD FLOW

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 22.88 21.68 1.20 44285.
(581.1) (551.1) (30.1) (1310.05)

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM RESERVOIR 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAD=2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-385.	-1

STAGE	385.30	386.00	387.00	388.00	389.00	390.30	392.00	393.00	394.00
FLOW	0.00	103.00	515.00	1151.00	1960.00	4879.00	18369.00	30304.00	44444.00

STAGE-DISCHARGE DATA FOR H.R. # 2

SURFACE AREA=	44.	52.	70.
CAPACITY=	0.	225.	833.
ELEVATION=	385.	390.	400.

STAGE-STORAGE DATA FOR H.R. # 2

SPILLWAY CREST ELEVATION →

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
385.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COQD	EXPD	DAMWID
390.3	0.0	0.0	0.

PEAK OUTFLOW IS 313. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 480. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 672. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 856. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 1035. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 1220. AT TIME 18.00 HOURS

PEAK OUTFLOW IS 1413. AT TIME 18.00 HOURS

PEAK OUTFLOW IS 1599. AT TIME 18.00 HOURS

PEAK OUTFLOW IS 1782. AT TIME 18.00 HOURS

ROUTED OUTFLOWS FROM H.R. # 2 FOR VARIOUS FLOODS

CHANNEL ROUTING FROM RESERVOIR # 2 TO RESERVOIR # 5

HYDROGRAPH ROUTING

CHANNEL ROUTING 2 TO 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
CHA-1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0800	.0400	.0800	319.7	332.0	1350.	.04000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 332.00 22.00 326.00 32.00 322.00 40.00 319.70 46.00 319.70
65.00 324.00 125.00 326.00 180.00 332.00

STORAGE	0.00	.17	.45	.82	1.30	1.87	2.53	3.30	4.43	5.97
	7.93	10.13	12.49	15.02	17.71	20.57	23.60	26.79	30.16	33.68
OUTFLOW	0.00	25.69	97.63	225.32	428.00	713.53	1075.27	1546.71	2176.91	2950.30
	3899.00	5046.22	6367.80	7863.18	9533.74	11381.86	13410.52	15623.11	18023.21	20614.58
STAGE	319.70	320.35	320.99	321.64	322.29	322.94	323.58	324.23	324.88	325.53
	326.17	326.82	327.47	328.12	328.76	329.41	330.06	330.71	331.35	332.00
FLOW	0.00	25.69	97.63	225.32	428.00	713.53	1075.27	1546.71	2176.91	2950.30
	3899.00	5046.22	6367.80	7863.18	9533.74	11381.86	13410.52	15623.11	18023.21	20614.58

MAXIMUM STAGE IS 321.9

MAXIMUM STAGE IS 322.4

MAXIMUM STAGE IS 322.8

MAXIMUM STAGE IS 323.2

MAXIMUM STAGE IS 323.5

MAXIMUM STAGE IS 323.8

MAXIMUM STAGE IS 324.0

MAXIMUM STAGE IS 324.3

MAXIMUM STAGE IS 324.5

LOCAL RUNOFF TO HARTFORD RESERVOIR #5

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RES. 5 LESS RES. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAD-5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.27	0.00	3.89	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.50	111.00	124.00	133.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	0.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.00 CP= .50 NTA= 0

RECESSION DATA

STRTQ= -1.70 QRCSN= -.10 RTIOR= 2.00

UNIT HYDROGRAPH 30 END-OF-PERIOD ORDINATES, LAG= 1.00 HOURS, CP= .50 VOL= 1.00

9.	33.	63.	85.	86.	74.	61.	50.	41.	34.
28.	23.	19.	16.	13.	11.	9.	7.	6.	5.
4.	3.	3.	2.	2.	2.	1.	1.	1.	1.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	22.88	21.68	1.20	15596.
										(581.)	(551.)	(30.)	(441.63)

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

COMBINING LOCAL RUNOFF TO #5 AND OUTFLOW FROM #2 AT #5

COMBINE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
TOTAL	2	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM RESERVOIR 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAD-5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-320.	-1

STAGE	319.70	320.70	321.70	322.70	323.70	324.90	326.00	328.00	330.00
FLOW	0.00	193.00	548.00	1012.00	1564.00	2330.00	5020.00	13949.00	26089.00

STAGE - DISCHARGE DATA FOR H.R.# 5

SURFACE AREA=	0.	25.	37.
CAPACITY=	0.	156.	473.
ELEVATION=	301.	320.	330.

STAGE-STORAGE DATA FOR H.R.# 5

	CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
SPILLWAY CREST ELEVATION →	319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

	TOPEL	COQD	EXPD	DAMWID
TOP OF DAM ELEVATION →	324.9	0.0	0.0	0.

PEAK OUTFLOW IS 382. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 600. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 842. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 1082. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 1320. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 1555. AT TIME 18.50 HOURS

PEAK OUTFLOW IS 1806. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 2051. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 2288. AT TIME 18.25 HOURS

ROUTED OUTFLOWS FROM H.R. # 5 FOR VARIOUS FLOODS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	HAD-2	.81 (2.10)	1	397. (11.23)	595. (16.85)	794. (22.47)	992. (28.09)	1190. (33.70)	1389. (39.32)	1587. (44.94)	1785. (50.56)	1984. (56.17)
ROUTED TO	HAD-2	.81 (2.10)	1	313. (8.86)	480. (13.60)	672. (19.03)	856. (24.25)	1035. (29.31)	1220. (34.56)	1413. (40.01)	1599. (45.28)	1782. (50.45)
ROUTED TO	CHA-1	.81 (2.10)	1	313. (8.86)	480. (13.59)	672. (19.02)	856. (24.25)	1035. (29.32)	1221. (34.56)	1413. (40.01)	1599. (45.27)	1782. (50.45)
HYDROGRAPH AT	HAD-5	.27 (.70)	1	164. (4.64)	246. (6.96)	328. (9.28)	410. (11.60)	491. (13.92)	573. (16.24)	655. (18.55)	737. (20.87)	819. (23.19)
2 COMBINED	TOTAL	1.08 (2.80)	1	415. (11.76)	639. (18.10)	893. (25.30)	1141. (32.32)	1383. (39.17)	1628. (46.10)	1888. (53.47)	2139. (60.58)	2384. (67.51)
ROUTED TO	HAD-5	1.08 (2.80)	1	382. (10.81)	600. (17.00)	842. (23.83)	1082. (30.65)	1320. (37.38)	1555. (44.03)	1806. (51.15)	2051. (58.07)	2288. (64.80)

LOCAL RUNOFF TO H.R. # 2

ROUTED OUTFLOW FROM H.R. # 2

H.R. # 2 OUTFLOW ROUTED TO H.R. # 5

LOCAL RUNOFF TO H.R. # 5

COMBINED INFLOWS TO H.R. # 5

ROUTED OUTFLOW FROM H.R. # 5

HARTFORD RESERVOIR #2 DAM
FLOOD ROUTING RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	385.30	385.30	390.30
STORAGE	0.	0.	241.
OUTFLOW	0.	0.	4879. → H.R. #2 SPILLWAY DISCHARGE CAPACITY

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	386.51	0.00	54.	313.	0.00	18.50	0.00
.30	386.92	0.00	73.	480.	0.00	18.50	0.00
.40	387.25	0.00	89.	672.	0.00	18.25	0.00
TEST FLOOD → .50	387.54	0.00	103.	856.	0.00	18.25	0.00
.60	387.82	0.00	116.	1035.	0.00	18.25	0.00
.70	388.09	0.00	129.	1220.	0.00	18.00	0.00
.80	388.32	0.00	141.	1413.	0.00	18.00	0.00
.90	388.55	0.00	152.	1599.	0.00	18.00	0.00
1.00	388.78	0.00	163.	1782.	0.00	18.00	0.00

CHANNEL BETWEEN RESERVOIRS #2 & #5 → PLAN 1 STATION CHA-1

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	313.	321.9	18.75
.30	480.	322.4	18.50
.40	672.	322.8	18.25
TEST FLOOD → .50	856.	323.2	18.25
.60	1035.	323.5	18.25
.70	1221.	323.8	18.00
.80	1413.	324.0	18.00
.90	1599.	324.3	18.00
1.00	1782.	324.5	18.00

HARTFORD RESERVOIR #5 DAM
FLOOD ROUTING RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	319.70	319.70	324.90
STORAGE	156.	156.	301.
OUTFLOW	0.	0.	2330. → SPILLWAY DISCHARGE CAPACITY FOR H.R. #5

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	321.23	0.00	195.	382.	0.00	19.00	0.00
.30	321.81	0.00	211.	600.	0.00	18.75	0.00
.40	322.33	0.00	225.	842.	0.00	18.75	0.00
TEST FLOOD → .50	322.83	0.00	239.	1082.	0.00	18.50	0.00
.60	323.26	0.00	252.	1320.	0.00	18.50	0.00
.70	323.68	0.00	264.	1555.	0.00	18.50	0.00
.80	324.08	0.00	276.	1806.	0.00	18.25	0.00
.90	324.46	0.00	287.	2051.	0.00	18.25	0.00
1.00	324.83	0.00	299.	2288.	0.00	18.25	0.00

TEST FLOOD ELEVATION

ROUTED TEST FLOOD OUTFLOW

L-10

HARTFORD RESERVOIR #5 DAM BREACH (WITH RESERVOIR SURFACE AT TOP OF DAM)
OUTFLOW ROUTED TO DAMAGE CENTER

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
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INPUT

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     1          A
     2          A2                  NATIONAL DAM INSPECTION PROGRAM
     3          A3                NEW ENGLAND DIVISION - CORPS OF ENGINEERS
     4          N    300       0         5         0         0         0         0         0         4         0
     5          N1     5
     6          J      1         1         1
     7          J1     0
     8          K      1    HAD-5                                                  1
     9          K1         ROUTED OUTFLOW FROM RESERVOIR 5
    10          Y                                              1         1
    11          Y1     1                                                        -324.9        -1
    12          Y4 319.7     320.7     321.7     322.7     323.7     324.9     326.0     328.0     330.0
    13          Y5     0       193       548      1012      1564      2330      5020     13949     26089
    14          $A     0        25        37
    15          $E   301     319.7       330
    16          $S 319.7
    17          $D 324.9
    18          $R   240       .01       305         2     324.9     324.9
    19          K      1    DS-H                                                   1
    20          K1         CHANNEL ROUTING FROM RES. 5 TO RES. 1
    21          Y                                              1         1
    22          Y1     1                                                          -1
    23          Y6  0.08     0.035     0.08     256.5       270      2200      .025
    24          Y7     0       270       30       266        78       264        90       262        98     256.5
    25          Y7   110     256.5      120       262       150       270
    26          K      1    HAD-1                                                  1
    27          K1         RESERVOIR 5 ROUTING  THROUGH RESERVOIR 1
    28          Y                                              1         1
    29          Y1     1                                                        -256.5        -1
    30          Y4 256.5     257.5     258.5     259.5     260.5     261.9     265.3     266.0     268.0     270.0
    31          Y5     0       140       396       727      1120      1804      6120      8526     20832     38018
    32          $A     0        27        35        68
    33          $E   225     256.5       260       270
    34          $S 256.5
    35          $D 265.3
    36          K      1    HAZARD                                                 1
    37          K1         CHANNEL ROUTING TO HAZARD CENTER 1
    38          Y                                              1         1
    39          Y1     1                                                          -1
    40          Y6  0.08     0.04      0.08      170       190      2000      .025
    41          Y7     0       190       120       180       170       172       180       170       190       170
    42          Y7   200       172       270       180       370       190
    43          K     99
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81-0

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 02/27/80.
TIME= 13.44.20.

HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR NO 5
NATIONAL DAM INSPECTION PROGRAM
NEW ENGLAND DIVISION - CORPS OF ENGINEERS

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	-4	0

JOPEN	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

NO INFLOW → RTIOS= 0.00

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HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM RESERVOIR 5

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
HAJ-5	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	325.	-1

STAGE	319.70	320.70	321.70	322.70	323.70	324.90	326.00	328.00	330.00
FLOW	0.00	193.00	548.00	1012.00	1564.00	2330.00	5020.00	13949.00	26089.00

} H.R. # 5 STAGE - DISCHARGE DATA

SURFACE AREA=	0.	25.	87.
CAPACITY=	0.	156.	473.
ELEVATION=	301.	320.	330.

} H.R. # 5 STAGE - STORAGE DATA

SPILLWAY CREST ELEVATION →

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
319.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOP OF DAM ELEVATION →

TOPEL	COOD	EXPD	DAMWID
324.9	0.0	0.0	0.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	MSEL	FAILEL
240.	.01	305.00	2.00	324.90	324.90

} BREACH DIMENSIONS - FAILURE BEGINS IMMEDIATELY WITH RESERVOIR SURFACE AT TOP OF DAM

BEGIN DAM FAILURE AT 0.00 HOURS

PEAK OUTFLOW IS 2725. AT TIME .83 HOURS

→ MAXIMUM BREACH DISCHARGE

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HYDROGRAPH ROUTING

BREACH OUTFLOW ROUTED TO RESERVOIR # 1

CHANNEL ROUTING FROM RES. 5 TO RES. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DS-8	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0400	.0350	.0400	256.5	270.0	2200.	.02500

} CHANNEL CHARACTERISTICS

CROSS SECTION COORDINATES - STA,ELEV,STA,ELEV - ETC

0.00	270.00	36.00	266.00	78.00	264.00	90.00	262.00	98.00	256.50	} CHANNEL CROSS-SECTION AT UPSTREAM END OF RESERVOIR # 1
110.00	256.50	120.00	262.00	150.00	270.00					

STORAGE	0.00	.47	1.03	1.67	2.39	3.20	4.09	5.06	6.12	7.39
	8.90	10.70	13.07	16.08	19.65	23.57	27.81	32.38	37.28	42.50
OUTFLOW	0.00	46.50	150.65	302.75	500.63	744.06	1033.70	1370.64	1718.46	2041.95
	2469.72	3096.70	3951.86	4941.43	6092.44	7403.76	8870.55	10495.92	12283.64	14237.82
STAGE	256.50	257.21	257.92	258.63	259.34	260.05	260.76	261.47	262.18	262.89
	263.61	264.32	265.03	265.74	266.45	267.16	267.87	268.58	269.29	270.00
FLOW	0.00	46.50	150.65	302.75	500.63	744.06	1033.70	1370.64	1718.46	2041.95
	2469.72	3096.70	3951.86	4941.43	6092.44	7403.76	8870.55	10495.92	12283.64	14237.82

} STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE DOWNSTREAM CHANNEL

MAXIMUM STAGE IS 261.0 → STREAM ELEVATION AT H.R. # 1

0-20

BREACH OUTFLOW ROUTED THROUGH RESERVOIR # 1

HYDROGRAPH ROUTING

~~RESERVOIR 5 ROUTING THROUGH RESERVOIR 1~~

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	HAD-1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPHAT
1	0	0	0.000	0.000	0.000	-257.	-1

~~STAGE~~	~~256.50~~	~~257.50~~	~~258.50~~	~~259.50~~	~~260.50~~	~~261.90~~	~~265.30~~	~~266.00~~	~~268.00~~	~~270.00~~
FLOW	0.00	140.00	396.00	727.00	1120.00	1804.00	6129.00	8526.00	20832.00	38018.00

STAGE - DISCHARGE DATA FOR H.R. # 1

SURFACE AREA=	0.	27.	35.	68.
~~CAPACITY=~~	~~0.~~	~~284.~~	~~342.~~	~~848.~~
ELEVATION=	225.	257.	260.	270.

STAGE - STORAGE DATA FOR H.R. # 1

SPILLWAY CREST ELEVATION → 256.5

CHEL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
256.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

	TOPEL	COQD	EXPD	DAMWID
~~TOP OF DAM ELEVATION~~ →	~~268.3~~	0.0	0.0	0.

PEAK OUTFLOW IS 1605. AT TIME 1.33 HOURS

↳ PEAK DISCHARGE FROM BREACH OUTFLOW

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BREACH OUTFLOW ROUTED TO DAMAGE CENTER

~~HYDROGRAPH ROUTING~~

CHANNEL ROUTING TO HAZARD CENTER 1

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	HAZARD	1	0	0	0	0	1	0	0

~~ROUTING DATA~~

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	-1.	0

~~NORMAL DEPTH CHANNEL ROUTING~~

	QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
	.0400	.0400	.0800	170.0	190.0	2000.	.02500

CHANNEL CHARACTERISTICS

~~CROSS SECTION COORDINATES - STA,ELEV,STA,ELEV - ETC~~

	0.00	190.00	120.00	180.00	170.00	172.00	180.00	170.00	190.00	170.00
	200.00	172.00	270.00	180.00	370.00	190.00				

CHANNEL CROSS-SECTION AT HAZARD CENTER

STORAGE	0.00	.74	1.99	3.89	6.56	10.00	14.20	19.16	24.88	31.37
	38.66	47.03	56.52	67.12	78.85	91.70	105.66	120.74	136.95	154.27
OUTFLOW	0.00	79.83	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45
STAGE	170.00	171.05	172.11	173.16	174.21	175.26	176.32	177.37	178.42	179.47
	180.53	181.58	182.63	183.68	184.74	185.79	186.84	187.89	188.95	190.00
FLOW	0.00	79.83	321.14	822.33	1557.50	2549.67	3821.33	5394.56	7290.94	9531.51
	12072.80	14978.34	18352.22	22223.78	26623.11	31580.21	37124.56	43285.11	50090.16	57567.45

STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE ↓ DOWNSTREAM CHANNEL

MAXIMUM STAGE IS 174.3 ← STREAM ELEVATION AT DAMAGE AREA

HARTFORD RESERVOIR # 5 DAM
BREACH OUTFLOW RESULTS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	324.90	319.70	324.90
~~STORAGE~~	~~301.~~	~~156.~~	~~301.~~
OUTFLOW	2330.	0.	2330. → SPILLWAY DISCHARGE CAPACITY FOR H.R. # 5

RATIO OF ~~PMF~~	MAXIMUM RESERVOIR ~~W.S.ELEV~~	MAXIMUM DEPTH ~~OVER DAM~~	MAXIMUM STORAGE ~~AC-FT~~	MAXIMUM OUTFLOW CFS	DURATION ~~OVER TOP~~ HOURS	TIME OF MAX OUTFLOW ~~HOURS~~	TIME OF FAILURE ~~HOURS~~
0.00	324.64	0.00	301.	2725. → MAXIMUM BREACH DISCHARGE	0.00	.83	0.00

CHANNEL BETWEEN RESERVOIRS # 5 & # 1 → PLAN 1 STATION DS-8

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	2711.	263.9	.92

ROUTED BREACH OUTFLOW RESULTS
AT HARTFORD RESERVOIR # 1 DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	256.50	256.50	265.30
~~STORAGE~~	~~284.~~	~~284.~~	~~619.~~
OUTFLOW	0.	0.	6129. → H.R. # 1 SPILLWAY DISCHARGE CAPACITY

RATIO OF ~~PMF~~	MAXIMUM RESERVOIR ~~W.S.ELEV~~	MAXIMUM DEPTH ~~OVER DAM~~	MAXIMUM STORAGE ~~AC-FT~~	MAXIMUM OUTFLOW CFS	DURATION ~~OVER TOP~~ HOURS	TIME OF MAX OUTFLOW ~~HOURS~~	TIME OF FAILURE ~~HOURS~~
0.00	261.49	0.00	447.	1605.	0.00	1.33	0.00

CHANNEL AT DAMAGE CENTER → PLAN 1 STATION HAZARD

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
0.00	1605. → PEAK FLOW AT DAMAGE AREA	174.3 → STREAM ELEVATION AT DAMAGE AREA	1.42

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

END

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