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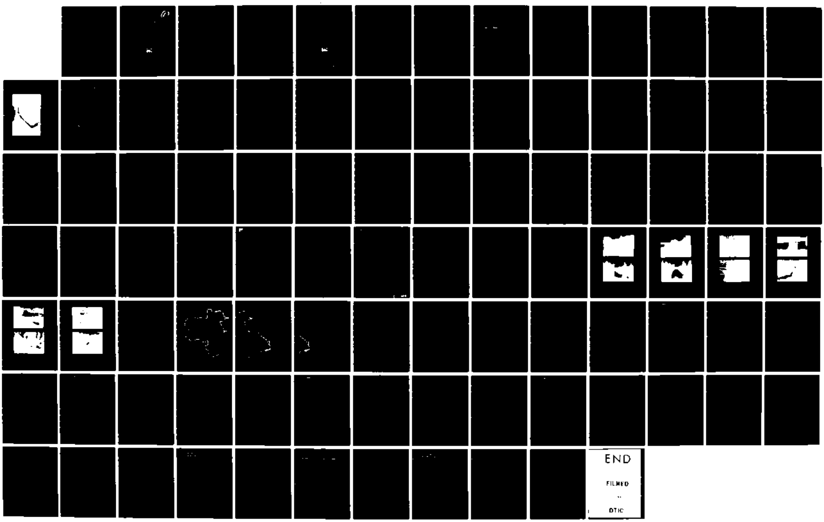

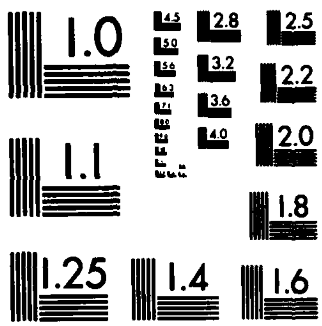

MICROCOPY RESOLUTION TEST CHART
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THAMES RIVER BASIN

WOODSTOCK, CONNECTICUT

BUNGEE LAKE LOWER DAM
CT 00441

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

DECEMBER 1980

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Bungee Lake Lower Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		12. REPORT DATE December 1980
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Thames River Basin
Woodstock, Connecticut

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

The Bungee Lake Lower Dam is an earth embankment impounding a maximum of 1435 acre-feet of water on Bungee Brook in Woodstock , Conn. The project totals approximately 1400 feet in length, including two knolls which divide the dam into three embankments. In accordance with the Army Corps of Engineers Guidelines, Bungee Lake Lower Dam is classified as a significant hazard, intermediate size dam. The test flood range is from one-half the PMF to the PMF. Based upon the visual inspection at the site and past performance of the dam, the project is judged to be in poor condition.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

JUL 09 1981

Honorable William A. O'Neill
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor O'Neill:

Inclosed is a copy of the Bungee Lake Lower Dam (CT-00441) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. I approve 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 vitally important.

Copies of this report have been forwarded to the Department of Environmental Protection, and to the owner, Mr. Joseph Campert, RFD #1, Woodstock, CT. Copies will be available to the public in thirty days.

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

Sincerely,

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

Incl
As stated

THAMES RIVER BASIN

WOODSTOCK, CONNECTICUT

BUNGEE LAKE LOWER DAM
CT 00441

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

DECEMBER 1980

BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	BUNGEE LAKE LOWER DAM
Inventory Number:	CT 00441
State Located:	CONNECTICUT
County Located:	WINDHAM
Town Located:	WOODSTOCK
Stream:	BUNGEE BROOK
Owner:	JOSEPH CAMPERT
Date of Inspection:	NOVEMBER 14, 1980
Inspection Team:	PETER M. HEYNEN, P.E.
	JAY A COSTELLO
	MURALI ATLURU, P.E.

The Bungee Lake Lower Dam, built in 1964 to provide a recreational facility, is an earth embankment impounding a maximum of 1435 acre-feet of water on Bungee Brook in Woodstock, Connecticut. The project totals approximately 1400 feet in length, including two knolls which divide the dam into three embankments. The right embankment is 390 feet long not including spillway, 30 feet wide at the top and 11.0 feet high. The center embankment is 250 feet in length, 30 feet wide at the top and 16 feet in height. The left embankment is 150 feet long, 30 feet wide at the top and is about 15.5 feet in height. The spillway is located at the far right end of the dam and consists of three 20 foot wide sections separated by two concrete piers, and a wing wall at each end of the spillway (See Sheet B-1). The weir is a concrete ogee section with a concrete energy dissipator located 20 feet downstream. The low-level outlet is a 21 inch corrugated metal pipe with a wooden sluice gate to control flow at the upstream end.

In accordance with the Army Corps of Engineers Guidelines, Bungee Lake Lower Dam is classified as a significant hazard, intermediate size dam. The test flood range is from one-half the Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). The test flood for Bungee Lake Lower Dam is selected as equivalent to the 1/2 PMF. Peak inflow to the lake at the test flood is 5350 cubic feet per second (cfs) and peak outflow is 3700 cfs with a low area at the knoll between the central and left embankments overtopped by 2.8 feet and the left embankment overtopped by 0.8 feet. The spillway capacity with the lake level to the top of the left embankment (elevation 598.0) is 1775 cfs, or 48% of the routed test flood outflow. Flow through the low area, with the lake level at the top of the left embankment, is estimated to be 470 cfs.

Based upon the visual inspection at the site and past performance of the dam, the project is judged to be in poor condition. There are items requiring repair, maintenance and monitoring such as severe deterioration of the concrete structures, slope erosion, dumping of miscellaneous material on the downstream slope, lack of riprap protection on the upstream slope and seepage.

It is recommended that the owner initiate further studies to be performed by a registered professional engineer. These studies should include; 1) a detailed analysis to more accurately determine the adequacy of the project discharge capacity and the project overtopping potential, 2) a geotechnical investigation to determine the properties of the miscellaneous fill being placed along the downstream slope and its affect on the performance of the project, 3) a program for repair of the bridge over the spillway and the concrete structures at the spillway 4) evaluation of the condition of the sluice gate and outlet works, 5) regrade the spillway channel to design grade and provide proper protection against erosion, 6) provide riprap protection on the upstream slope between the expected high and low water elevations and at the outlet discharge channel, 7) remove trees from the slopes and toe of the embankments, 8) a program to monitor and evaluate the seepage at the toe of the embankments. Recommended corrective procedures addressing these items should be established by the engineer and implemented by the owner.

Repairs to the concrete structures at the spillway and investigation of the miscellaneous fill at the downstream slope should be instituted within 6 (six) months of the owners receipt of this report. Corrective measures addressing the remaining further studies presented above and remedial measures presented in Section 7.3, should be instituted within 1 (one) year from the owner's receipt of this report.

Peter M. Heynen, P.E.
Chief Geotechnical Engineer
Cahn Engineers, Inc.

STATE OF CONNECTICUT PETER M. HEYNEN No. 9518 REGISTERED PROFESSIONAL ENGINEER

C. Michael Horton, P.E.
Chief Engineer
Cahn Engineers, Inc.

STATE OF CONNECTICUT CLARENCE M. HORTON No. 8433 REGISTERED PROFESSIONAL ENGINEER

This Phase I Inspection Report on Bungee Lake Lower Dam (CT-00441) 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 judgement and practice, and is hereby submitted for approval.

ARAMAST MAHTESIAN, MEMBER
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Water Control 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 these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

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

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

The Phase I Investigation does <u>not</u> 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.

The information contained in this report is based on the limited investigation described above and is not warranted to indicate the actual condition of the dam. The integrity of the dam can only be determined by a means of a monitoring program and/or a detailed physical investigation. The accuracy of available data is assumed where not in obvious conflict with facts observable during the visual inspection.

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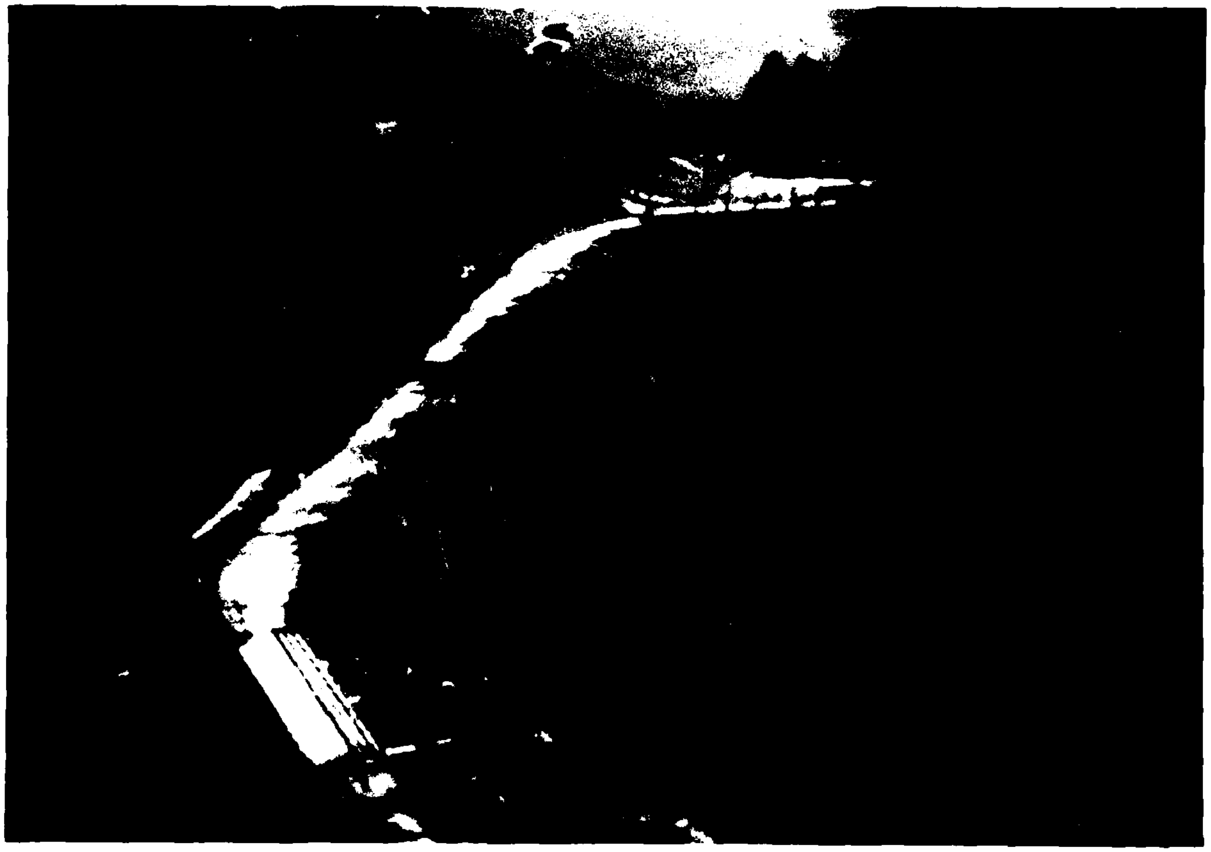
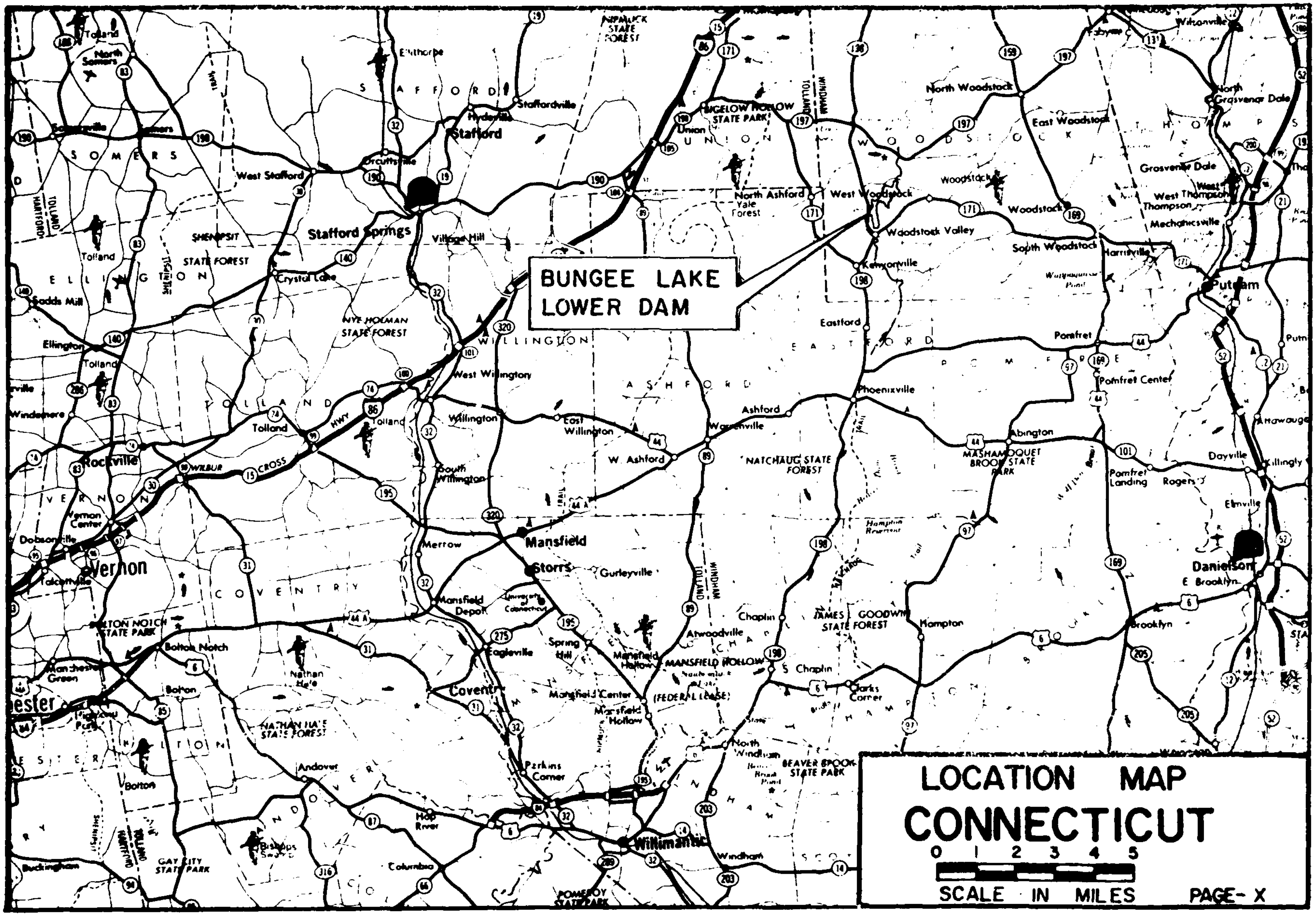
APPENDICES



OVERVIEW PHOTO
(February, 1980)

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF	Bungee Lake Lower Dam	Woodstock	DATE Dec., 1980
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER	INSPECTION OF NON-FED DAMS	Bungee Brook	CONNECTICUT	CE # 27 785 KF PAGE ix


BUNGEE LAKE
LOWER DAM
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5
SCALE IN MILES
PAGE- X
Stafford Springs
Stafford
Staffordville
Mansfield
Storrs
Vernon
Rockville
Willimantic
Putnam
Danielson
Woodstock
West Woodstock
Woodstock Valley
Eastford
Ashford
Willington
Tolland
Coventry
Pomfret
Hampton
Chaplin
Union
BIGELOW HOLLOW STATE PARK
NATCHAUG STATE FOREST
NYE HOLMAN STATE FOREST
SHENIPSIT STATE FOREST
NATHAN HALE STATE FOREST
JAMES L. GOODWIN STATE FOREST
MANSFIELD HOLLOW (FEDERAL LEASE)

PHASE I INSPECTION REPORT

BUNGEE LAKE LOWER DAM

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of April 14, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0052 has been assigned by the Corps of Engineers for this work.

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

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

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

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

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

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

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

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

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

It should be noted that this report passes judgment only on those factors of safety and stability which can be determined by a visual surface examination. The inspection is to identify those visually apparent features of the dam which evidence the need for corrective action and/or further study and investigation.

1.2 DESCRIPTION OF PROJECT

a. Location - The dam is located on Bungee Brook (Thames River Basin) in a rural area in the town of Woodstock, County of Windham, State of Connecticut. The dam is shown on the Eastford USGS Quandrangle Map, having coordinates latitude N41°57.0' and longitude W72°40.5.

b. Description of Dam and Appurtenances - The project is approximately 1400 feet in total length, has an unpaved road along the top and is divided into three embankments by two small knolls (See Sheet B-1). There is a core of impervious material which measures approximately 20 feet wide at the base and 10 feet wide at the top, which is 1.5 feet below the top of the dam. A concrete spillway section is located at the right end of the dam and a corrugated metal low-level outlet is located at the center of the dam.

The right embankment is 390 feet long (not including the spillway), 30 feet wide at the top and 11 feet high. The top of this embankment, at elevation 598.8, is 4.8 feet above the spillway crest. The center embankment is 250 feet long, 16 feet high, 30 feet wide at the top (elevation 598.5), and 4.5 feet above the spillway crest. The left embankment is 150 feet in length, 15.5 feet high, 30 feet wide at the top and 4.0 feet above the spillway crest. The top of the left embankment, elevation 598.0, is assumed to be the top of the dam for all calculations. The upstream slope of all three embankments is inclined at 2 horizontal to 1 vertical. There was little or no riprap visible on the upstream slopes, with a sparse protective cover of weeds and brush above the waterline. The downstream slopes are inclined at 1.5 horizontal to 1 vertical with a cover of weeds, brush and small trees. The owner has been placing fill along the downstream slope, altering the geometry of the dam from the original design dimensions. The width at the top of the dam has been increased from 20 feet to 30 feet and the angle of the downstream slope has been increased from 2 horizontal to 1 vertical to 1.5 horizontal to 1 vertical.

The spillway consists of three 20 foot wide sections, which are divided by concrete piers used to support the wooden bridge spanning the spillway. The weir is a concrete ogee section with a crest elevation of 594.0. Concrete wing walls are located at each end of the spillway and an energy dissipator is located 20± feet downstream from the weir (See Sheet B-1 for dimensions). The bridge which spans the spillway allows 4 feet of clearance between the spillway crest and the low chord of the bridge.

A concrete intake and gate structure is located at the upstream slope of the center embankment (See Sheet B-1). This structure provides wingwalls around the intake and supports the gate mechanism, which is a hand-operated screw type stem to raise and lower a wooden sluice gate. The outlet is a 21 inch corrugated metal pipe which extends 74± feet to the toe of the embankment. There is no outlet headwall, the upstream invert of the pipe is 583.5 and the downstream invert is 583.0.

c. Size Classification - INTERMEDIATE - The dam impounds 1435 acre-feet of water with the lake level at the top of the left embankment, which is at elevation 598.0. The left embankment is 15.5 feet high, the center embankment is 16 feet high and the right embankment 11 feet in height. According to the Recommended Guidelines, a dam with this maximum storage capacity is classified as intermediate in size.

d. Hazard Classification - SIGNIFICANT - If the dam were breached, there is a potential for the loss of a few lives at a house located 7.5 feet above the streambed of Bungee Brook appproximately 4200 feet downstream from the dam. The water in the stream in this area is expected to rise to a depth of 9.5 feet, thereby inundating the first floor of this house with 2± feet of water having a velocity of more than 5 feet per second. Also, a culvert under State Route 171 would be damaged as well as the road itself. See Sheet D-1 in Appendix D.

e. Ownership - Joseph Campert
R.F.D. #1
Woodstock, Conn (203)-794-1612

f. Operator - Same (See Ownership above)

g. Purpose of Dam - The dam was constructed in 1964 to provide lake front property and a recreational facility.

h. Design and Construction History - The dam was designed in the early 1960's with plans prepared by J. A. Whitelaw of Bloomfield, Connecticut. The design was approved in November, 1963 and construction began in December, 1963. As construction progressed, some minor changes were made. These include: 1.) altering the shape of the dam at both ends to provide more lake front property and shortening the dam by some 250 feet, 2.) moving the spillway from the center embankment to the far right end of the dam, 3.) moving the outlet from the right embankment to the center embankment, 4.) slightly decreasing the size of the outlet pipe, 5.) changing the intake and gate configuration. Also, the owner has been dumping fill on the downstream slope, widening the top of the embankments and increasing the angle of the slope.

i. Normal Operational Procedures - The 21 inch low-level outlet is kept partially open (3 inches of water in pipe at outlet) to maintain minimum flows in Bungee Brook. The lake level is normally maintained at the spillway crest, elevation 594.0. The owner reports that, in anticipation of storms, he opens the outlet to provide added storage.

1.3 PERTINENT DATA

a. Drainage Area - 5.92 square miles of rolling, wooded terrain located in the Thames River Basin and which is sparsely developed at this time, but is being continuously developed along the lake front. There is another dam (Bungee Lake Upper Dam) located approximately 1200 feet upstream and forming the upper lake. This lake is about 3 feet above the lower lake and has a surface area of 110 acres and a drainage area of 5.5 square miles. Black Pond and Chamberlain Pond are also included in the drainage area.

b. Discharge at Damsite - Normal discharge is over the spillway and through the low-level outlet pipe. Elevations listed below are N.G.V.D. based on existing plans and field inspections.

1. Outlet works (conduits): 21 inch corrugated metal low-level outlet at upstream invert elevation 583.5:	65 cfs
2. Maximum flood at damsite:	Unknown
3. Ungated spillway capacity @ top of dam el. 598.0:	1775 cfs
4. Ungated spillway capacity @ test flood el. 598.8:	2370 cfs
5. Gated spillway capacity @ normal pool el:	N/A
6. Overflow through low area @ top of dam el. 598.0:	470 cfs
7. Total spillway capacity @ test flood el. 598.8:	2870 cfs
8. Total project discharge @ top of dam el. 598.0:	2310 cfs
9. Total project discharge @ test flood el. 598.8:	3700 cfs

c. Elevations (All elevations are N.G.V.D. based on existing plans and field investigations)

1. Streambed at toe of dam:	582.5
2. Bottom of cutoff:	N/A
3. Maximum tailwater:	Unknown
4. Normal pool:	594.0
5. Full flood control pool:	N/A
6. Spillway crest:	594.0
7. Design surcharge (original design):	597.0
8. Top of dam:	
left embankment	598.0
right embankment	598.8
center embankment	598.5
9. Test flood surcharge:	598.8

d. <u>Reservoir</u> (Length in feet)

1. Normal pool:	3700 ft.
2. Flood Control pool:	N/A
3. Spillway crest pool:	3700 ft.
4. Top of dam pool:	3900 ft.
5. Test flood pool:	4200 ft.

e. <u>Storage</u> (Acre-feet)

1. Normal pool:	690 acre-ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	690 acre-ft.
4. Top of dam pool:	1435 acre-ft.
5. Test flood pool:	1770 acre-ft.

f. <u>Reservoir Surface</u> (Acres)

1. Normal pool:	177 acres
2. Flood control pool:	N/A
3. Spillway crest pool:	177 acres
4. Top of dam pool:	208 acres
5. Test flood pool:	209 acres

g. <u>Dam</u>

1. Type:	Earth embankment
2. Length:	1400 ft. (Total)
left embankment	150 ft.
right embankment	390 ft.
center embankment	250 ft.
3. Height:	
left embankment	15.5 ft.
right embankment	11 ft.
center embankment	16 ft.
4. Top width:	30 ft.
5. Side slopes:	2H to 1V (Upstream) 1.5H to 1V (Downstream)

6. Zoning:	N/A
7. Impervious Core:	Impervious Fill
8. Cutoff:	N/A
9. Grout curtain:	N/A
10. Other:	Impervious fill core is 10 ft. wide at top, 20 ft. wide at base, top is 1.5 feet below top of dam.

h. <u>Diversion and Regulating Tunnel</u> - N/A

i. <u>Spillway</u>

1. Type:	Ungated concrete ogee section with energy dissipator
2. Length of weir:	Total length=60 ft; 3 sections @ 20 ft. each
3. Crest elevation:	594.0
4. Gates:	N/A
5. Upstream Channel:	Flat, sand and gravel
6. Downstream Channel:	Natural stream, brush, rocks, debris
7. General:	Energy dissipator 20 ft. d/s from weir has top el. 588.0/

j. <u>Regulating Outlet</u>

1. Invert:	583.0 (d/s) 583.5 (u/s)
2. Size:	21 inch
3. Description:	74±' long corrugated metal pipe
4. Control Mechanism:	Hand operated stem to lower & raise wood gate.
5. Other:	Concrete intake and gate structure at u/s slope.

SECTION 2: ENGINEERING DATA

2.1 DESIGN

The available plans are a set of 3 sheets prepared by J.A. Whitelaw of Bloomfield, Connecticut in 1963. These include plan, profile, typical sections, spillway design data and spillway and outlet details. Parts of these plans are no longer valid due to changes during construction (See 2.4c - Validity).

2.2 CONSTRUCTION

There is no data available for the original construction of the dam.

2.3 OPERATION

There are no lake level readings taken at the dam. The owner reports that he opens the outlet in anticipation of storms and that the spillway capacity has never been exceeded. There are no formal operation records in existence.

2.4 EVALUATION

a. Availability - Existing data was provided by the State of Connecticut and by the owner, Mr. Joseph Campert. The owner made the project available for visual inspection.

b. Adequacy - The limited amount of engineering data available is inadequate to perform an in-depth assessment of the dam, therefore, the assessment of this dam must be based on visual inspection, hydraulic computations, hydrologic judgements and information provided verbally by the owner.

c. Validity - During construction, several features of the dam were altered but did not significantly change the design. These included: 1) Changing the shape at each end of the dam to provide more lake front property 2) moving the spillway to the far right end of the dam 3) moving the outlet to the center embankment, decreasing the pipe diameter from 24 to 21 inches 4) making the gate and intake structures as one structure and moving it out farther from the top of the dam, thereby eliminating the cast iron inlet pipe 5) changing the gate mechanism from a cast iron sluice gate to a wooden gate 6) increasing the width of the top of the dam from 20 to 30 feet and thereby increasing the downstream slope from 2H:1V to 1.5H:1V.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - Based upon the visual inspection performed on November 14, 1980, the condition of the dam is judged to be poor. The inspection revealed items requiring various levels of maintenance, monitoring and repair. The lake level was at elevation 593.5 with no water flowing over the spillway.

b. Dam

Top of Dam - The top of the embankments are slightly irregular and have an unpaved road extending the length of the dam (Photo 3 and Photo 4). The elevation of the top of the embankments is not the same at each section, with the lowest elevation (598.0) at the left embankment.

Upstream Slope - The upstream slope of all three embankments has very little riprap or protective growth (Photo 1 and Photo 2). However, there is brush and weeds growing along the waterline. Erosion and some slight sloughing of this slope is resulting from the lack of protection.

Downstream Slope - The downstream slope is quite irregular, steep and overgrown with brush and trees up to 6 inches in diameter (Photo 5). The owner has been placing fill along the downstream slope, which increases the angle from the original slope as designed and constructed in 1964. Also, residents living along the lake have been dumping stumps, brush, and other miscellaneous debris on the downstream slope of the left embankment (Photo 6). There are several small seeps (water clear) emanating along the toe of each embankment, resulting in wet soggy areas at the base and part way up the downstream slopes. The miscellaneous fill and debris covers the slopes and toe of the dam and makes it difficult to determine if the seepage and soggy areas at the toe of the embankments is foundation seepage or seepage through the embankments. The ground at the toe along the entire length of the dam is soft and swampy (See Sheet B-1).

Spillway - The concrete at the spillway is in poor condition (Photos 9, 10, 11, 12). The wingwalls, bridge piers and energy dissipator all have severe erosion and spalling, revealing large cobbles used in the concrete mix. The section of energy dissipator at the left side of the spillway has failed completely, resulting in erosion of the spillway discharge channel in this area (Photo 12). Some seepage (less than 1/2 gpm) was noted at the left downstream side of the spillway structure (Photo 11). There is some orange-brown staining in this area but the clarity of the seepage could not be determined. Also, there is brush and trees growing in the spillway discharge channel as well as logs and other debris deposited during high flows.

c. Appurtenant Structures - The intake and gate structure have been combined into one structure. The concrete is in fair condition with some spalling at the top of the structure. The metal pipes supporting the gate mechanism are rusting (Photo 7). The gate mechanism appears to be in good condition but could use some grease. The gate was not operated during the inspection but was reported to be operational by the owner. The gate was partially open, with 3 inches of water in the pipe at the outlet, during the inspection (Photo 8). There is no outlet headwall and the sluice gate at the intake could not be observed.

The timber beams which support the bridge extending across the spillway are infested with insects and rotting. The deck planks appear to be in good condition.

d. Reservoir Area - The area surrounding the lake is steep-sided, wooded and moderately developed.

e. Downstream Channel - The downstream channel runs in the natural bed of Bungee Brook and is undeveloped to the initial impact area.

3.2 EVALUATION

Based upon the visual inspection, this dam is assessed as being in poor condition. The following features which could influence the future condition and/or stability of the dam were identified.

1. Severe deterioration of the concrete at the spillway wingwalls and bridge piers will lead to failure of the spillway structure and possible seepage through and/or erosion of the right embankment during periods of high water.

2. Severe deterioration of the energy dissipator is causing erosion of the spillway discharge channel. This erosion will continue to increase if the energy dissipator and spillway channel are not repaired. The lack of proper riprap protection in the channel below the energy dissipator is further aggrevating this problem.

3. The poor condition of the timber beams supporting the bridge over the spillway could lead to failure of the bridge. Failure of this bridge during high project discharge would block the spillway and severely reduce the project discharge capacity, thereby possibly overtopping the dam and resulting in failure of the project.

4. The growth of brush and trees, if left unchecked, could result in root penetration and weakening of the dam by uprooting or providing seepage paths through the embankment.

5. The lack of proper riprap and protective growth on the upstream slope could result in erosion and sloughing of this slope.

6. The lack of downstream slope and channel protection at the outlet could result in erosion at the toe of the center embankment and possible sloughing of the downstream slope in this area.

7. Possible seepage at the toe of the embankments could lead to instability of the earth embankment if material is carried from the embankment.

8. Placement of miscellaneous fill and debris on the downstream slope makes it difficult to evaluate seepage through the embankment and may adversely affect the stability of the dam.

SECTION 4: OPERATION PROCEDURES

4.1 REGULATING PROCEDURES

a. General - No formal operation procedure exists other than maintaining the outlet in a partially open position to provide minimum flows in the downstream reaches of Bungee Brook. The owner reports that the lake level was lowered in October 1980 so that the upper lake could be lowered enough to allow lakefront repairs. The lake was 0.5 feet below the spillway crest during the inspection in November, 1980. The owner also mentioned that he opens the gate in anticipation of storms.

b. Description of any formal warning system in effect -No formal warning system is in effect.

4.2 MAINTENANCE PROCEDURES

a. General - There is no formal maintenance procedures at the dam.

b. Operating Facilities - No formal program for maintenance of the operating facilities is in effect.

4.3 EVALUATION

A formal program of operation and maintenance procedures should be implemented, including documentation of lake levels for future reference. Also, a formal warning system should be developed within the time frame indicated in Section 7.1(c). Remedial operation and maintenance recommendations are presented in Section 7.

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The watershed is 5.92 square miles of rolling and mostly wooded terrain with very little development except for residential development around the Lake. Black Pond and Chamberlain Pond are within this watershed, in addition to some fairly significant swamps. The maximum impoundment to the top of the dam (El. 598) is estimated to be 1435 acre-feet and estimated storage below spillway crest is 678 acre-feet.

The dam is classified as being intermediate in size and having a significant hazard classification.

5.2 DESIGN DATA

Design drawings prepared by Mr. J.A. Whitelaw dated October 15, 1963 are available and provide a design high water and spillway design flow. However, no detailed hydraulic/hydrologic design data or computations could be found. It should be noted that the actual construction of the dam project somewhat deviated from these design drawings.

5.3 EXPERIENCE DATA

No information on any serious problem situations arising at the dam or downstream reaches of the dam was found. The maximum previous discharge is unknown.

5.4 TEST FLOOD ANALYSIS

Based upon the U.S. Army Corps of Engineers' "Preliminary Guidance For Estimating Maximum Probable Discharges" dated March 1978, the watershed classification (rolling) and the drainage area of 5.92 square miles, a PMF of 10,700 cfs, or 1800 cfs per square mile, is estimated at the damsite. The dam is classified as a significant hazard, intermediate size dam, and therefore the test flood range to be considered is from the ½ PMF to the PMF. Based on the low degree of expected economic loss, the test flood for Bungee Lake Lower Dam is selected as the ½ PMF.

The test flood peak inflow is estimated to be 5350 cfs and peak outflow is 3700 cfs with the left embankment overtopped by 0.8 feet, and the low area between the central and left embankments overtopped by 2.8 feet. The spillway capacity with the lake level to the top of the left embankment (elevation 598.0) is 1775 cfs, which is 48% of the routed test flood outflow. The spillway capacity at test flood conditions (lake level to elevation 598.8) is 2370 cfs, which is 64% of the peak outflow. Overflow at the low area is estimated to be 470 cfs with the lake to elevation 598.0 and 900 cfs at the test flood conditions. Filling in the low area does not significantly increase the test flood surcharge elevation. Using this low area as an auxiliary spillway will increase the discharge capacity from 48% to 61% assuming the lake level is to the top of the dam, and from 64% to 88% at the test flood conditions.

5.5 DAM FAILURE ANALYSIS

A house located 4200± feet downstream from the dam has its ground floor situated 7.5 feet above the streambed of Bungee Brook and would probably be impacted upon failure of the dam. Also, Route 171 and the culvert carrying Bungee Brook under Route 171 are expected to experience flooding and some damage should the dam breach. This area including the house and Route 171 is designated as the initial impact area and is shown as such on Sheet D-1.

Utilizing the Corps of Engineers April 1978 "Rule of Thumb Guidance for Estimating Downstream Failure Hydrographs", the peak failure outflow due to dam breach is estimated to be 33,700 cfs with an estimated flood depth of 7 feet immediately downstream of the dam. The flood routing was performed for peak failure outflow with pool to the top of the left embankment, elevation 598.0. With the low area at the knoll between the left and central embankments filled in, the prefailure flow in the stream at the initial impact area is estimated to be 1775 cfs, causing a depth of 3.4 feet. After dam failure, the flood depth is expected to increase by 6.2 feet. With the low area remaining open for discharge, the prefailure flow in the stream at the impact area is estimated to be 2247 cfs causing a depth of 3.7 feet. After failure, the flood stage is estimated to increase by 5.9 feet at this impact area.

In either case, the rapid rise of the stream at the initial impact area would increase the depth of water in Bungee Brook to 9.6 feet, thereby increasing the water velocity to 5.4 fps. This flood depth and water velocity would inundate the house at the initial impact area with 2± feet of water as well as damage the culvert under Route 171, which does not have the capacity to pass the 23,100 cfs of water expected. Under these flooding conditions at the initial impact area, the potential exists for the loss of a few lives as well as some economic loss.

Based upon the hydraulic/hydrologic analysis and the potential for loss of a few lives, the dam has a significant hazard classification.

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL INSPECTION

The dam consists of three embankments divided by two small knolls (See Sheet B-1). There is a spillway at the right end and a 21 inch low-level outlet at the center. The top of the dam is 30 feet wide, the upstream slope is inclined at 2 horizontal to 1 vertical and the downstream slope is inclined at 1.5 horizontal to 1 vertical. The owner has been dumping fill along the downstream slope, which widens the top of the dam 10 feet and increases the downstream slope from the original 2 horizontal to 1 vertical. There is an impervious fill core which is 1.5 below the top of dam and measures 10 feet wide at the top and 20 feet wide at the base. No evidence of toe drains, peizometers or other seepage control or monitoring devices were found at the dam.

The visual inspection revealed serious deterioration of the concrete structures at the spillway, dumping of miscellaneous fill on the downstream slope and a wet area with possible seepage all along the toe of the embankments. Also, there is very little riprap or protective cover on the upstream slope and trees and brush on the downstream slope. There is no headwall for the downstream end of the 21 inch low-level outlet and no protection for the outlet discharge channel or downstream slope.

The dam is a relatively young structure, and as indicated by the severe deterioration of the concrete structures, the uneven elevation of the top of the dam and the lack of proper slope protection, the dam may not have been built using the best construction techniques. The placing of fill along the downstream slope may be causing high pore pressures and raising the phreatic surface in the embankment, thereby creating conditions not anticipated in the original design. Because of these problems, the young age of the dam and possible seepage through the embankment, the dam is judged to be in poor condition. Recommendations for the above items, as well as others described in Section 3, are presented in Section 7.

6.2 DESIGN AND CONSTRUCTION DATA

The dam has been altered somewhat from the design drawings available. These changes include:

1. The length and shape of the dam have been changed to provide more lakefront property.

2. The spillway has been moved to the far right end of the dam.

3. The low-level outlet has been moved to the center embankment and the diameter decreased from 24 inches to 21 inches.

4. The intake structure and gate structure were combined, moving the intake farther out from the top of the dam and eliminating the cast iron intake pipe.

5. The cast iron gate valve was changed to a wooden gate.

6. The top of the dam is not at the same elevation as the design elevation of 599.5.

   right embankment - 598.8
   center embankment - 598.5
   left embankment - 598.0

6.3 POST CONSTRUCTION CHANGES

There have been no changes to the dam since its construction in 1964 other than the addition of fill on the downstream slope.

6.4 SEISMIC STABILITY

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

SECTION 7: ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. condition - Based upon the visual inspection of the site and past performance, the dam is judged to be in poor condition. There are items requiring repair, maintenance and monitoring. These include concrete repair, removal of trees and brush, and seepage monitoring.

Based upon the "Preliminary Guidance for Estimating Maximum Probable Discharge" dated March, 1978 and hydraulic/hydrologic computations, peak inflow to the lake is 5350 cfs; peak outflow is 3700 cfs with the left embankment overtopped by 0.8 feet. The spillway capacity with the lake to the top of the left embankment (el. 598.0) is 1775 cfs; which is equivalent to 48% of the routed test flood outflow.

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

c. Urgency - It is recommended that repair to the concrete structures at the spillway and investigation of the miscellaneous fill at the downstream slope be instituted within 6 (six) months of the owner's receipt of this report. Corrective measures addressing the remaining items presented in Section 7.2 and 7.3 should be implemented within 1 (one) year of the owner's receipt of this report.

7.2 RECOMMENDATIONS

It is recommended that the owner initiate further studies to be performed by a registered professional engineer qualified in dam design and inspection and pertaining to the following items. Recommended corrective procedures should be established by the engineer and implemented by the owner.

1. A detailed hydraulic/hydrologic study to more accurately determine the spillway capacity, overtopping potential, and any necessary solutions for improvement. This should include an evaluation of the low area as an auxiliary spillway.

2. A geotechnical investigation to determine the properties of the miscellaneous fill being placed on the downstream slope and its affect on the performance of the project. All dumping of fill or debris on the downstream slope should be discontinued.

3. Repair to the concrete structures at the spillway including the wingwalls, bridge piers and energy dissipator. The timber beams supporting the bridge over the spillway should be replaced.

4. Placement of riprap in the spillway discharge channel below the energy dissipator as shown in the design plans.

5. Investigation into the origin and significance of the wet areas at the toe of the embankments. Tree stumps, brush and other miscellaneous debris should be removed from the slopes to locate seepage. A program for monitoring any seepage found should be established so as to determine the affects of the seepage on the stability of the project and any necessary corrective measures.

6. Some form of support should be provided for the downstream end of the outlet pipe and riprap placed in the outlet channel to protect against erosion of the channel and downstream slope.

7. Remove large trees from the slopes of the dam. This should include removal of root systems, proper backfilling and re-establishment of protective growth.

8. Riprap protection should be placed on the upstream slope between the expected high and low water elevations, with a protective growth established between the riprap and the top of the dam.

9. Procedures should be established to determine the condition and adequacy of the wooden gate and outlet works.

7.3 REMEDIAL MEASURES

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

1. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference. A program for monthly inspection by the owner or owner representative should be developed and include proper documentation.

2. A comprehensive program of inspection by a registered professional engineer qualified in dam design and inspection should be instituted on an annual basis.

3. The owner should develop and implement a downstream warning system in case of emergencies at the dam.

4. Stairs or a platform, to provide access to the gate mechanism, should be installed. However, access should be restricted by some means such as fencing, so as to discourage vandalism.

5. The spillway discharge channel should be cleared of trees brush and debris. This should be continued on a regular basis.

6. Brush on the slopes should be removed and the protective cover re-established.

7.4 ALTERNATIVES

The study has identified no practical alternatives to the above recommendations.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Bungee Lake Lower Dam

DATE: November 14, 1980

TIME: 1:00 PM - 5:00 PM

WEATHER: Cloudy, 50°F

W.S. ELEV. 593.5 U.S.

_______ U.S.

PARTY:	INITIALS:	DISCIPLINE:
1. Peter M. Heyen	PMH	Cahn Inc. - Geotech.
2. Jay A. Costello	JAC	Cahn Inc. - Geotech
3. Murali Atluru	MA	D.T.C. - H & H
4. Frank Segaline	FS	Cahn Inc. - Survey
5.		
6.		

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Embankment	PMH, JAC, MA, FS	
2. Spillway	PMH, JAC, MA, FS	
3. Intake Structure	PMH, JAC, MA, FS	
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

PERIODIC INSPECTION CHECK LIST

Page A-2

PROJECT Bungee Lake Lower Dam   DATE Nov. 14, 1980

PROJECT FEATURE Embankment   BY JAC, PMH, MA, FS

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	598.0 NGVD
Current Pool Elevation	593.5 NGVD
Maximum Impoundment to Date	Unknown
Surface Cracks	None
Pavement Condition	N/A
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Appears good
Horizontal Alignment	Appears good
Condition at Abutment and at Concrete Structures	Appears good
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	yes - some erosion on u/s slope and d/s slope near outlet
Sloughing or Erosion of Slopes or Abutments	None visable
Rock Slope Protection-Riprap Failures	Missing riprap
Unusual Movement or Cracking at or Near Toes	None
Unusual Embankment or Downstream Seepage	Wet & swampy along toe - seepage visable at far left embankment
Piping or Boils	None
Foundation Drainage Features	None observed
Toe Drains	None observed
Instrumentation System	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Bungee Lake Lower Dam DATE Nov. 14, 1980

PROJECT FEATURE Spillway BY PMH, JAC, MA, FS

AREA EVALUATED	CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a) Approach Channel	
General Condition	Flat, sand & gravel
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Clear of debris
b) Weir and Training Walls	
General Condition of Concrete	Poor
Rust or Staining	Orange-brown color left, d/s side of energy dissipator
Spalling	Severe spalling of wing walls, piers and energy dissipator
Any Visible Reinforcing	None observed
Any Seepage or Efflorescence	Less than 0.5 gpm at left, d/s side of energy dissipator
Drain Holes	None observed
c) Discharge Channel	
General Condition	Poor - trees & debris in channel, erosion, poorly defined
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	Trees & brush growing in channel
Floor of Channel	Large erosion at left side
Other Obstructions	Logs, debris

PERIODIC INSPECTION CHECK LIST

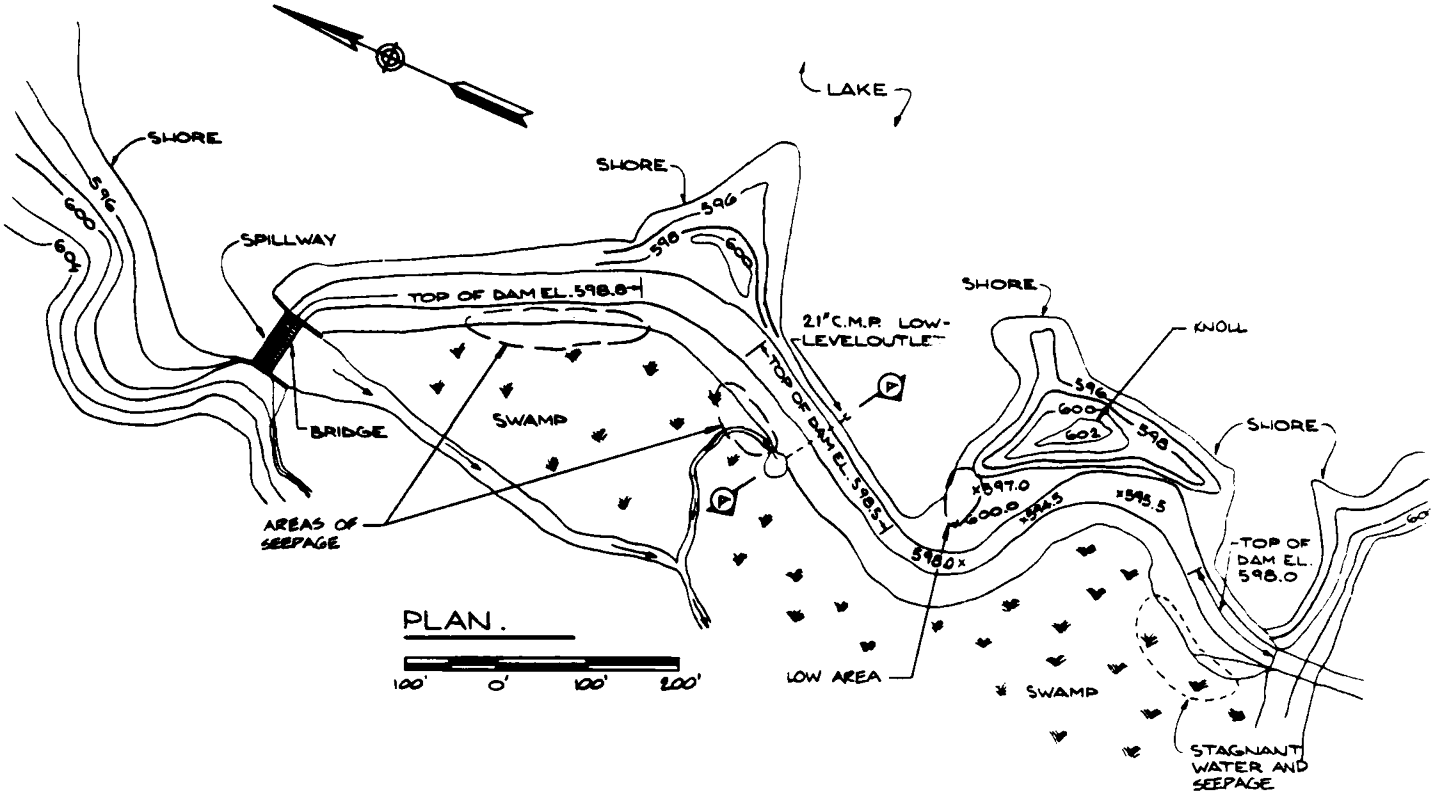
PROJECT Bungee Lake Lower Dam DATE Nov. 14, 1980

PROJECT FEATURE Intake Structure BY JAC, PMH, MA, FS

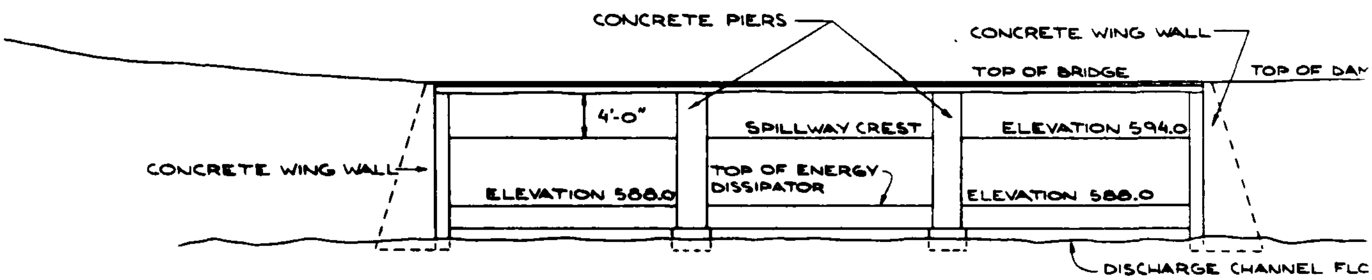
AREA EVALUATED		CONDITION
OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE		Concrete intake structure with wood sluicegate
a) Approach Channel		
Slope Conditions		Good
Bottom Conditions		Good
Rock Slides or Falls		None
Log Boom		}
Debris		}
Condition of Concrete Lining		}
Drains or Weep Holes		}
b) Intake Structure		
Condition of Concrete		Good
Stop Logs and Slots		Wood sluice not observed

APPENDIX B

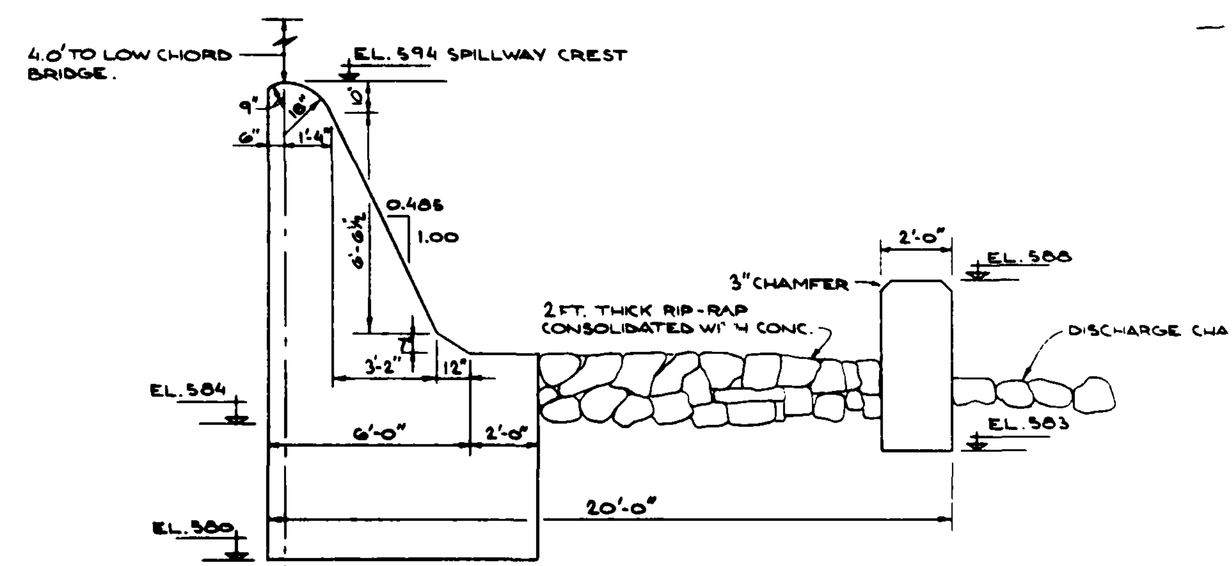
ENGINEERING DATA AND CORRESPONDENCE



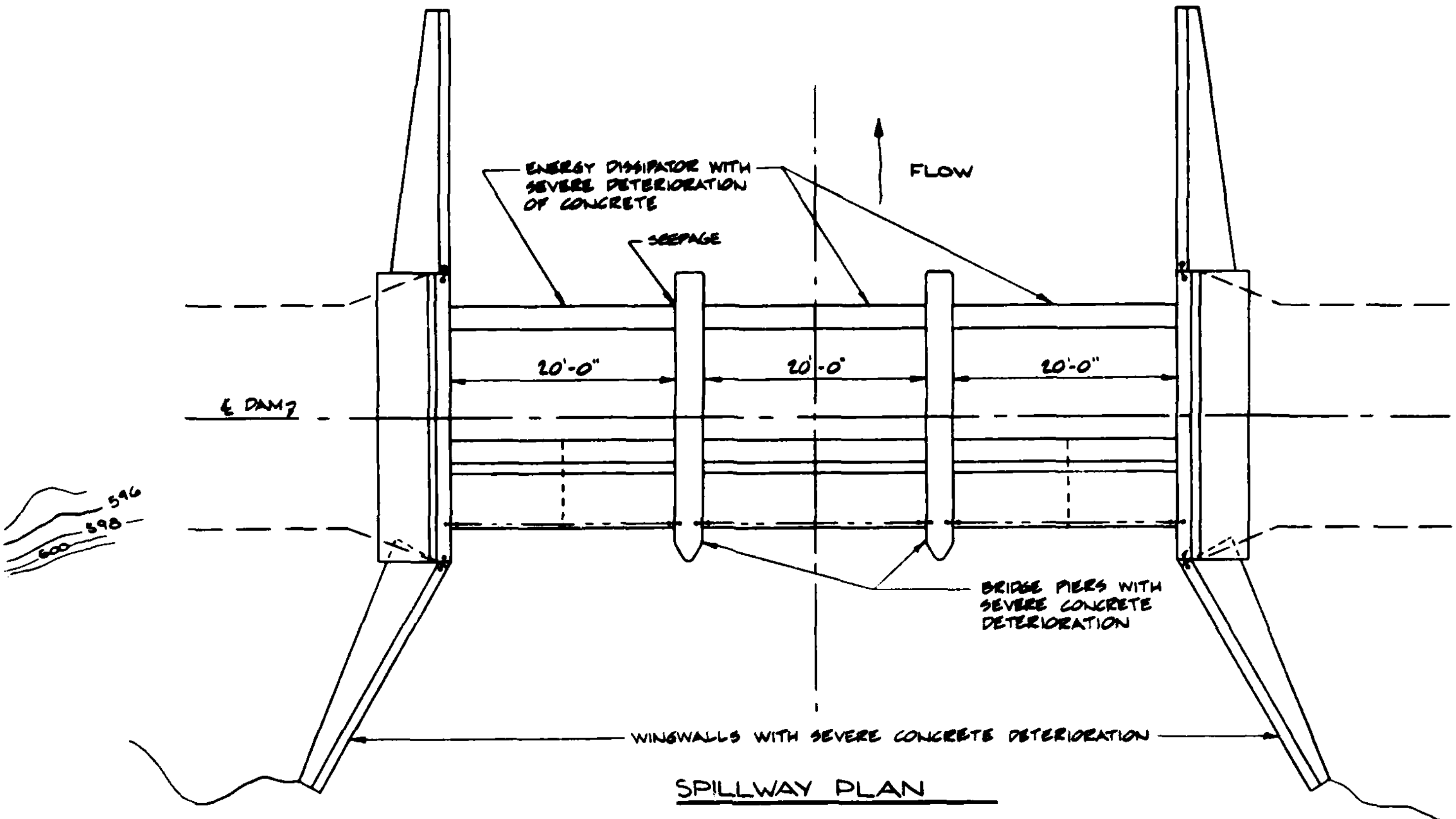
PLAN.



SPILLWAY PROFILE FROM DOWNSTREAM.

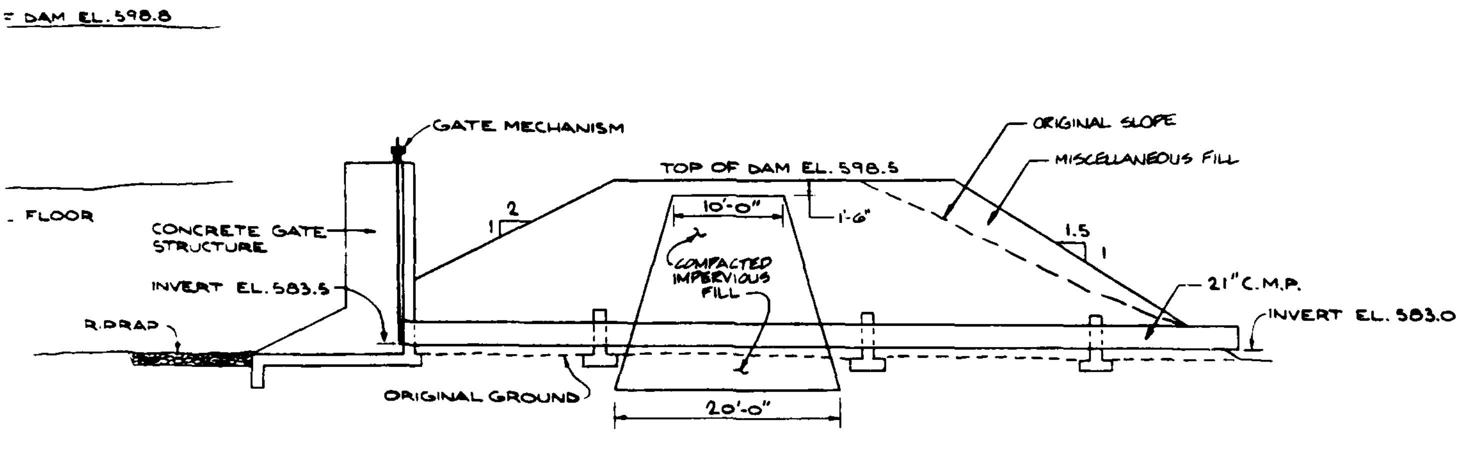


SPILLWAY SECTION.



SPILLWAY PLAN

8' 4' 0' 8' 16'



SECTION (A-A)

8' 4' 0' 8' 16'

CHANNEL

NOTES:

1. THIS PLAN COMPILED FROM EXISTING PLANS & CAHN ENGINEER'S INSPECTION DATED NOVEMBER 14, 1980. NOT ALL TOPOGRAPHIC AND/OR STRUCTURAL FEATURES ARE NECESSARILY IDENTIFIED.
2. ALL ELEVATIONS ARE APPROXIMATE NATIONAL GEODETIC VERTICAL DATUM. THE SPILLWAY CREST ELEVATION IS 594.0 AS SHOWN ON EXISTING DRAWINGS. ALL OTHER ELEVATIONS ARE REFERENCED TO THE SPILLWAY CREST.

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PLAN, ELEVATION & SECTION

BUNGEE LAKE LOWER DAM

BUNGEE BROOK — WOODSTOCK, CONN.

DRAWN BY	CHECKED BY	APPROVED BY	SCALE AS NOTED	
R.F.	JAC	PMH	DATE DEC. 1980	SHEET B-1

BUNGEE LAKE LOWER DAM

EXISTING PLANS

"Lower Campert Dam"
October 23, 1963
J. A. Whitelaw
Bloomfield, Conn.
3 Sheets

Cross Sections and Fill Volumes
No date, no Signature
4 Sheets

Revision to Outlet Configuration
No date
Jet Lines, Inc.
Bloomfield, Conn.
1 Sheet

SUMMARY OF DATA AND CORRESPONDENCE

DATE	TO	FROM	SUBJECT	PAGE
Nov. 4, 1963	Mr. B. H. Palmer Chandler & Palmer, Civil Engineers	J. A. Whitelaw	Transmittal of plans and increasing spillway capacity	B-3
Nov. 12, 1963	Mr. William P. Sander State Water Resource Commission	B. H. Palmer, Chandler & Palmer, Civil Engineers	General Information	B-4
Nov. 15, 1963	Mr. Joseph Campert	William S. Wise, Water Resources Commission	Approval for Construction	B-5
Jan. 3, 1980	Files	Water Resources Commission	Inventory Data	B-8

November 4, 1963

Mr. B. H. Palmer
Chandler & Palmer
114-116 Thayer Building
Norwich, Connecticut

Re: Lower Campert Dam
Woodstock, Conn.

Dear Mr. Palmer:

I am transmitting, herewith, four (4) prints of the now completed design drawings for the proposed Lower Campert Dam for your approval.

Following our meeting in the field and receipt of your letter of August 14, the spillway section was widened to decrease the maximum (100 year flood) head from 4 feet to 3 feet and the top of dam raised by 1.5 feet. This now gives us 2.5 feet freeboard above flood pool.

Your other suggestions pertaining to rip-rap and drain structures have also been incorporated into the final design.

Should further information or additional design changes be necessary, please advise.

Yours very truly,

J. A. Whitelaw
8 Duncaster Road
Bloomfield, Connecticut

JAW/reb
Encls.

BENJAMIN H. PALMER
SHEPARD B. PALMER

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

DAMS
WATER SUPPLIES
SEWERAGE
APPRAISALS
REPORTS
SURVEYS

MEMBERS AMERICAN AND CONNECTICUT SOCIETIES
OF CIVIL ENGINEERS

NORWICH, CONN.

November 1?, 1963

STATE WATER RESOURCES COMMISSION
RECEIVED
NOV 14 1963
ANSWERED.......
REFERRED.......
FILED.......

State Water Resources Commission
State of Connecticut
State Office Building
Hartford 15, Connecticut

Attention: Mr. William P. Sander,
Engineer-Geologist

Dear Sir:

In August of 1963 I met with Mr. J.A. Whitelaw at the Lower Cumpert Dam at Woodstock, Connecticut. We discussed several features of the proposed new dam. This past week I received four (4) sets of plans covering the design of the new Lower Cumpert Dam. I am sending along three (3) sets of these for your records, and am retaining one set for my office.

1. IDENTIFICATION

a) Request of Mr. J.A. Whitelaw, November 4, 1963.
b) Lower Cumpert Dam
c) Dam is located in the Town of Woodstock at Latitude, North, [illegible] 56 minutes 57 seconds and Longitude, [illegible] degrees 4 minutes [illegible]
d) As far as I know, the owner is [illegible] of West [illegible], Connecticut
e) There is no question to ownership.

2. [illegible] OF HAZARD

a) The dam is large enough and the pond is large enough that damage would occur if the dam failed.
b) There are no special hazards at the dam site.
c) The dam, if it failed, might endanger life.

3. STRUCTURE

a) Construction materials and dams and dimensions are [illegible] accompanying plans.
b) Foundation conditions are good as far as can be determined.

-1-

3. STRUCTURE - continued

c) Spillway is 60 feet long, designed for a capacity of 1200 c.f.s.

d) The above design allows for 2½ feet of freeboard.

e) Dam is not yet built so that there are no leaks or cracks.

4. HYDROLOGY

a) Drainage area is seven square miles.

b) Design discharge is calculated at 1200 c.f.s., which seems ample for this location. Since this is a small drainage area, the factor of judgment has to be considered, rather than relying solely on formula.

c) Capacity is 1200 c.f.s. with three feet of water going over the dam.

d) It is not expected that this capacity will be exceeded, but there is an extra foot which can be counted on without having the dam overtopped.

5. SAFETY

This is a new structure not yet built.

6. REQUIREMENTS

This is a new dam and any items under this heading do not apply.

7. SUMMARY OF FACTS

Plans are submitted by a Registered Engineer for this particular design and all factors appear to be properly handled.

8. CONCLUSION

Paragraphs 5 & 6 do not apply in this case.

9. RECOMMENDATION

It is my opinion that the plans as submitted, meet the requirements of the State and that a preliminary permit for construction should be issued.

Very truly yours,

CHANDLER & PALMER

B. H. Palmer

B. H. Palmer

BHP/air
Enclosures

November 15, 1963

CONSTRUCTION PERMIT FOR DAM

Lower Campert Dam
Woodstock, Connecticut

Mr. Joseph Campert
West Woodstock, Connecticut

Dear Mr. Campert:

Your application for Construction Permit to construct a dam in the Town of Woodstock in accordance with the attached plans prepared by J. A. Whitelaw, dated October 15, 1963 has been considered and the construction described therein is hereby approved only under the following conditions:

1. The Commission shall be notified

   A) When construction is started -- 12-9-63 - verbally from owner
   B) When foundation is excavated
   C) When the dam is completed and before water is impounded
   D) When project is completed and ready for final inspection

This permit, with the attached set of plans and specifications, must be kept at the site of the work and made available to the Commission at any time during the construction. This permit covers the construction as described in the attached documents. If any changes are contemplated, the Commission must be notified and supplementary approval obtained.

If the construction authorized by this construction permit is not started within two years of the date of this permit and completed within four years of the same date, this permit must be renewed.

Your attention is directed to Section 25-115 of the 1958 Revision of the General Statutes - "Liability of owner or operator. Nothing in this chapter and no order, approval or advice of the Commission or a member thereof, shall relieve any owner or operator of such a structure from his legal duties, obligations and liabilities resulting from such ownership or operation.

No action for damages sustained through the partial or total failure of any structure or its maintenance shall be brought or maintained against the state, a member of the Commission or the Commission, or its employees or agents, by reason of supervision of such structure exercised by the Commission under this chapter."

The Commission cannot convey or waive any property right in any lands of the State, nor is this permit to be construed as giving any property rights in real estate or material or any exclusive privileges, nor does it authorize any injury to private property or the invasion of private rights or any infringement of federal, state or local laws or regulations.

Your attention is also directed to Section 26-134 of the 1958 Revision of the General Statutes - "Obstructing Streams. No person shall, unless authorized by the director, prevent the passing of fish in any stream or through the outlet or inlet of any pond or stream by means of any rack, screen, weir or other obstruction or fail, within ten days after service upon him of a copy of an order issued by the Director, to remove such obstruction." The address of the State Board of Fisheries and Game is State Office Building, Hartford, Connecticut.

Very truly yours,

William S. Wise
Director

WSW:dlp

enc.

[illegible] RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

7

Inventoried By VEG

Date 1-3-80

Name of Dam or Pond BUNGEE LAKE (LOWER DAM)

Code No. W 7

Nearest Street Location

Town WOODSTOCK

U.S.G.S. Quad. EASTFORD

Name of Stream BUNGEE BRK

Owner JOSEPH CAMPERI

Address RTE 1

WOODSTOCK

Pond Used For RECREATION DA 5.91 SM

Dimensions of Pond: Width ______ Length ______ Area ~~[illegible]~~ 75 A

Total Length of Dam 1650' Length of Spillway 60'

Location of Spillway WEST SIDE OF LAKE

Height of Pond Above Stream Bed 12'

Height of Embankment Above Spillway 4'

Type of Spillway Construction CONC.

Type of Dike Construction EARTH FILL

1964

Downstream Conditions RTE. 198

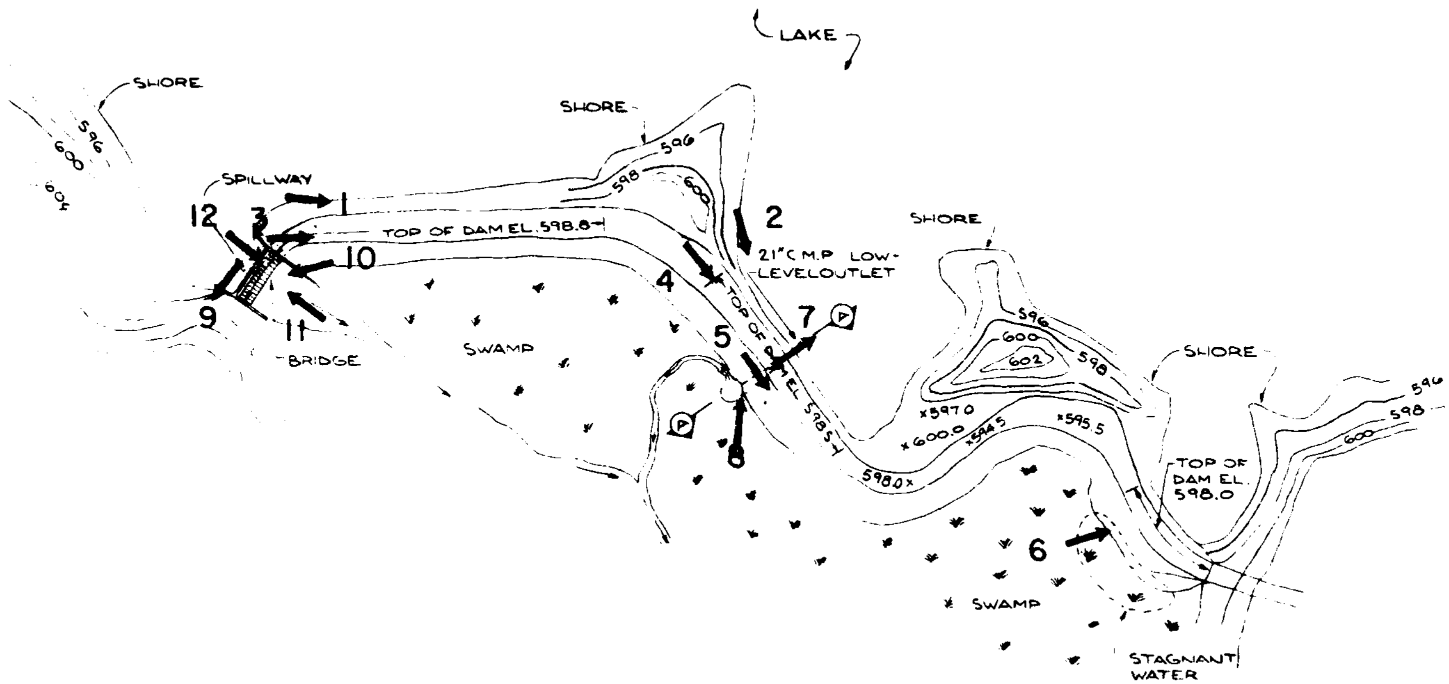
Summary of File Data

Remarks

Would Failure Cause Damage? YES Class B

APPENDIX C

DETAIL PHOTOGRAPHS



LEGEND

PHOTO NUMBER AND DIRECTION

PHOTO LOCATION PLAN

BUNGEE LAKE LOWER DAM

SHEET C-1

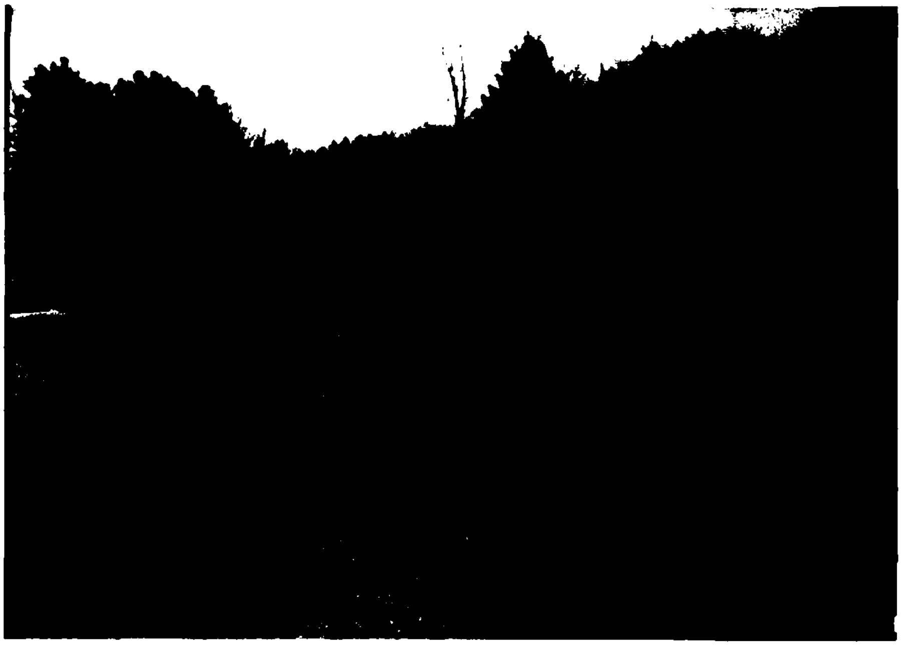


Photo 1 - Upstream slope of right embankment (Nov., 1980).

Photo 2 - Upstream slope of center embankment. Intake and gate structure at center of photo (Nov., 1980).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bungee Lake Lower Dam Bungee Brook Woodstock, Conn.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER		CE# 27 785 KF DATE Dec., 1980 PAGE C-1

Photo 3 - Top of right embankment from spillway (Nov., 1980).

Photo 4 - Top of center embankment (Nov., 1980).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bungee Lake Lower Dam Bungee Brook Woodstock, Conn. CE # 27 785 KF DATE Dec., 1980 PAGE C-2

Photo 5 - Downstream slope of center embankment (Nov., 1980)

Photo 6 - Downstream slope of right embankment. Note swampy area at toe (Nov.,1980).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bungee Lake Lower Dam Bungee Brook Woodstock, Conn.
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER		CE # 27 785 KF DATE Dec., 1980 PAGE C-3

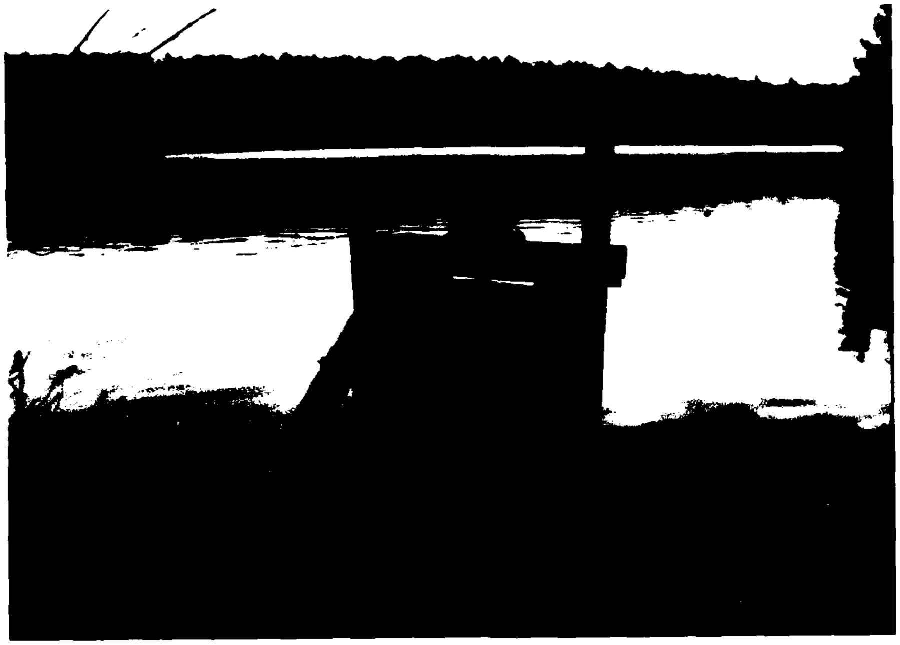


Photo 7 - Intake and gate structure at upstream slope of center embankment (Nov., 1980).

Photo 8 - 21" low-level outlet at toe of center embankment (Nov., 1980).

US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bungee Lake Lower Dam Bungee Brook Woodstock, Conn. CE# 27 785 KF
CAHN ENGINEERS INC. WALLINGFORD, CONN. ENGINEER		DATE Dec., 1980 PAGE C-4

Photo 9 - Right wing wall and spillway weir. Note wooden bridge over spillway and severe deterioration of concrete. (Nov., 1980).

Photo 10 - Downstream end of spillway, deterioration of concrete at energy dissipators and bridge piers. Note the lack of riprap and the brush and debris in channel (Nov.,1980).

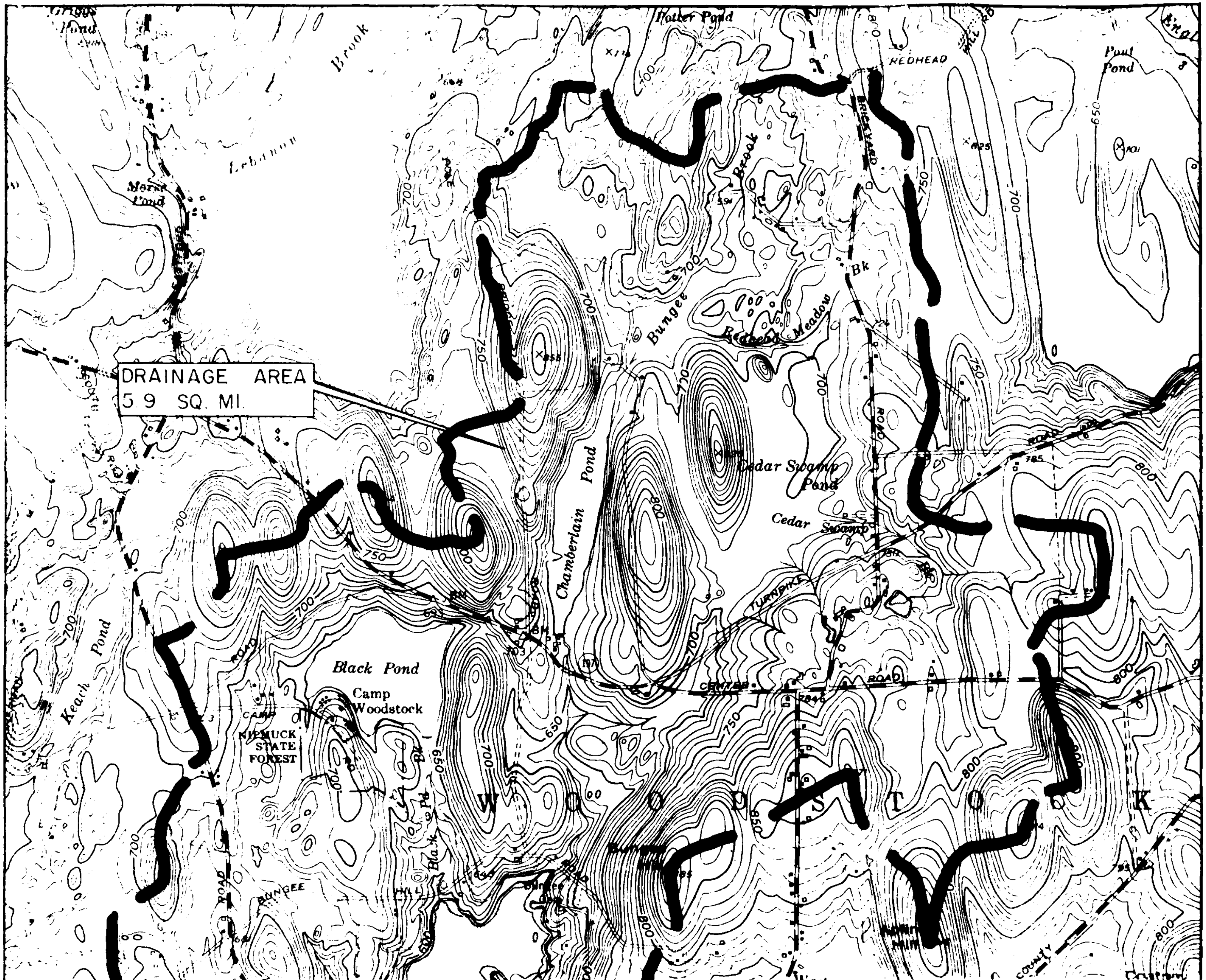
US ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Bungee Lake Lower Dam Bungee Brook Woodstock, Conn. CE # 27 785 KF
CAHN ENGINEERS INC. WALLINGFORD, CONN ENGINEER		DATE Dec.,1980 PAGE C-5

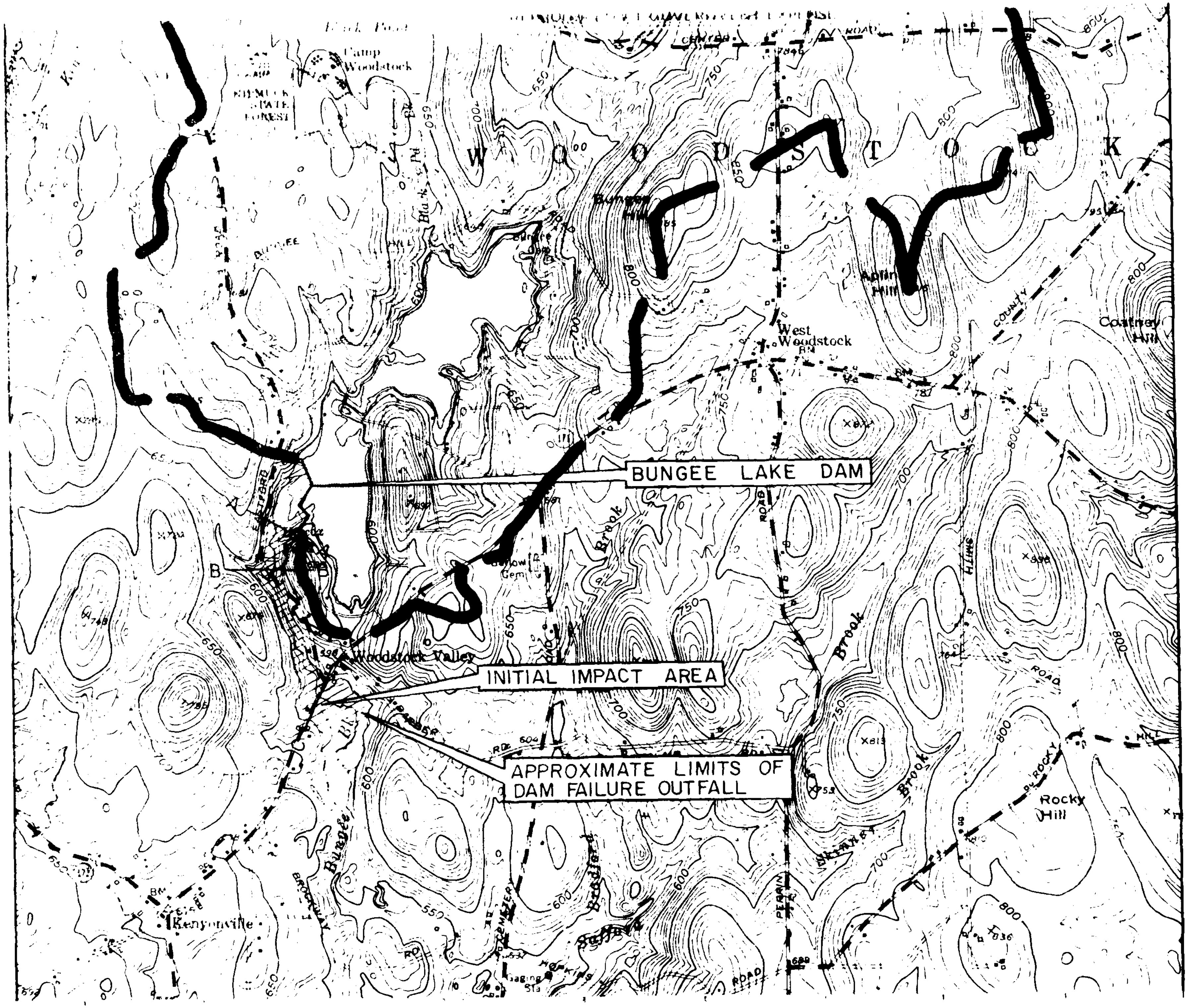
Photo 11 - Seepage and staining at base of the spillway structure (Nov., 1980).

Photo 12 - Failure of energy dissipator at left side of spillway and the resulting erosion of the spillway Channel (Nov., 1980).

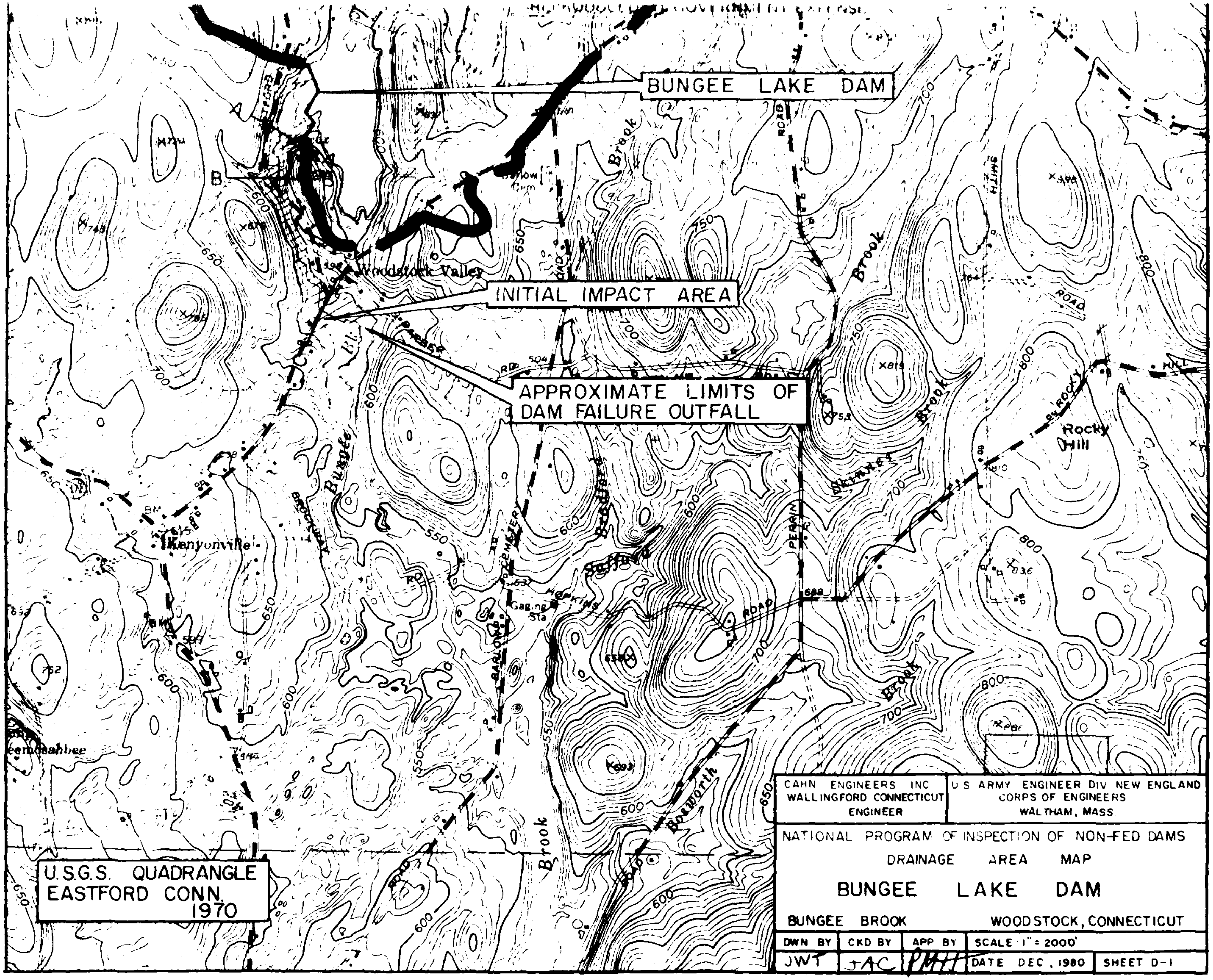
APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS


DRAINAGE AREA
5.9 SQ. MI.
Potter Pond
Brook
Lebanon
Pond
REDHEAD
BRICKYARD
Bungee
Redhead Meadow
Bk
Cedar Swamp Pond
Cedar Swamp
Chamberlain Pond
TURNPIKE
CENTER
ROAD
Black Pond
Camp Woodstock
CAMP
NIPMUCK STATE FOREST
Keach Pond
BUNGEE
HILL
WOODSTOCK
COUNTY
Black Pd
Bk


BUNGEE LAKE DAM
INITIAL IMPACT AREA
APPROXIMATE LIMITS OF
DAM FAILURE OUTFALL
W O O D S T O C K
West Woodstock
Camp Woodstock
Woodstock Valley
Kenyonville
Rocky Hill
Bungee Hill
Brook
Bungee
Bradford

2


BUNGEE LAKE DAM
INITIAL IMPACT AREA
APPROXIMATE LIMITS OF DAM FAILURE OUTFALL
U.S.G.S. QUADRANGLE EASTFORD CONN. 1970
Woodstock Valley
Kenyonville
Rocky Hill
Bungee
Brook
Bosworth
CAHN ENGINEERS INC WALLINGFORD CONNECTICUT ENGINEER
U S ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS
DRAINAGE AREA MAP
BUNGEE LAKE DAM
BUNGEE BROOK
WOODSTOCK, CONNECTICUT
DWN BY JWT
CKD BY JAC
APP BY
SCALE 1" = 2000'
DATE DEC, 1980
SHEET D-1

3

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 1 OF 22
NEW ENGLAND DIVISION COMPUTED BY [illegible] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY [illegible] DATE 12/9/80

PERFORMANCE AT PEAK FLOOD CONDITIONS

PROBABLE MAXIMUM FLOOD (PMF) DETERMINATION -

DRAINAGE AREA - 5.92 sq. mi. BY PLANIMETERING THE USGS QUAD SHEET

WATERSHED CLASSIFICATION - "ROLLING" MOSTLY WOODED WITH VERY LITTLE DEVELOPMENT MUCH OF THE DEVELOPMENT IS RESIDENTIAL AROUND THE LAKE. BLACK POND AND CHAMBERLAIN POND ARE WITHIN THE WATERSHED, IN ADDITION TO SOME FAIRLY SIGNIFICANT SWAMPS.

PMF PEAK INFLOW -

FROM THE CORPS OF ENGINEERS DECEMBER 1977 PEAK FLOW RATE GUIDE CURVES FOR A DRAINAGE AREA OF 5.92 SQ. MI.

THE SELECTED INTENSITY = 1800 CFS/SQ. MI. FOR THE ABOVE DESCRIBED WATERSHED.

∴ PMF PEAK INFLOW = 1800 × 5.92 = 10,700 CFS

SIZE CLASSIFICATION -

FOR THE PURPOSE OF DETERMINING PROJECT SIZE, THE MAXIMUM STORAGE ELEVATION IS CONSIDERED EQUAL TO THE TOP OF DAM.

TOP OF DAM = EL. 598 NGVD* (DEPRESSED SECTION)

TOE OF THE DAM = EL. 582.5 NGVD

HEIGHT OF DAM = EL. 598 - EL. 582.5 = 15.5 FT

* THE USGS MAP DOES NOT INDICATE THE W.S. ELEVN AT THE DAM. FOR THE PURPOSE OF THIS ANALYSIS, THE SPILLWAY CREST ELVN. IS ASSUMED AS NORMAL POOL ELVN. THE OCTOBER 1963 CONSTRUCTION DRAWINGS SHOW 594 AS THE SPILLWAY CREST AND POOL ELVN. THIS ELEVATION IS ASSUMED TO BE APPROX. ON NATIONAL GEODETIC VERTICAL DATUM (NGVD). ALL OTHER ELEVNS. ARE REFERENCED TO THIS ASSUMED ELVN AND ARE OBTAINED BASED ON INFORMATION FURNISHED BY CANN INC.

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 2 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY E Butch Bob[signature] DATE 12/9/80

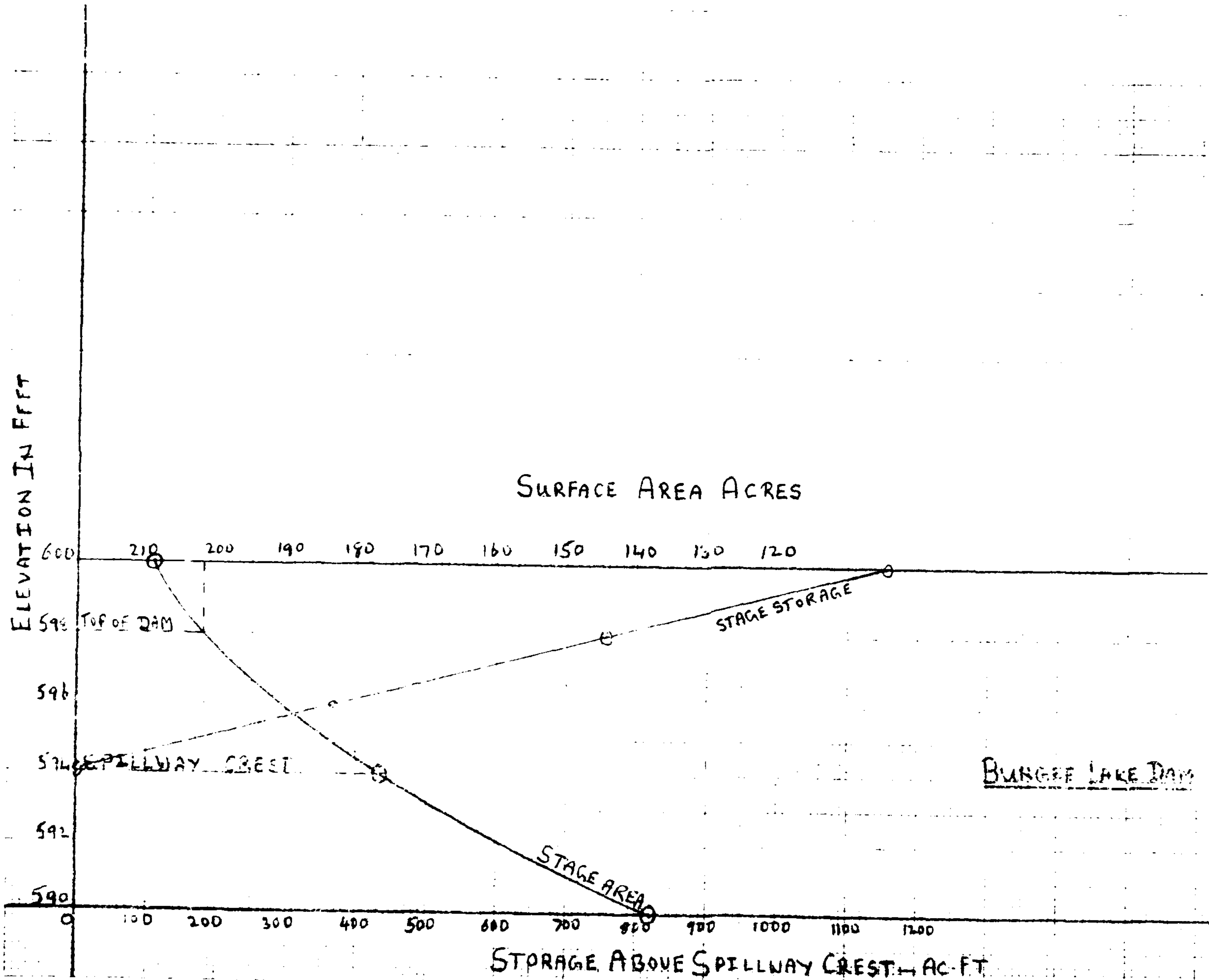
PLANIMETERING FROM USGS MAP FOR LAKE SURFACE AREAS –
AT EL 590 = 138 ACRES
AT EL 594 (SPILLWAY CREST) = 177 AC
AT EL 600 = 209 AC
(AREAS OF BOTH THE UPPER & LOWER LAKES ARE INCLUDED)
A STAGE - LAKE AREA CURVE IS PLOTTED (SHEET 3)
FROM THIS CURVE, LAKE AREA AT TOP OF DAM = 202 AC.
AVERAGE LAKE AREA BETWEEN SPILLWAY CREST AND TOP OF DAM = 189.5 AC.
STORAGE BETWEEN SPILLWAY CREST & TOP OF DAM = 4 × 189.5 = 758 AC·FT

ESTIMATED STORAGE BELOW SPILLWAY CREST = $\frac{1}{3}bh$
(b = 177 Ac, h = EL. 594 – EL. 582.5 = 11.5) = $\frac{1}{3} \times 177 \times 11.5$
= 678 AC.FT.

∴ MAXIMUM IMPOUNDMENT TO TOP OF DAM = 758 + 678
≅ 1435 AC·FT

A STAGE - STORAGE CURVE IS PLOTTED ON SHEET 3
THUS ACCORDING TO CORPS OF ENGINEERS GUIDE LINES TABLE 1, THE BUNGEE LAKE DAM IS CLASSIFIED AS INTERMEDIATE BASED UPON THE STORAGE CAPACITY OF 1435 AC FT (> 1000 AC·FT & < 50,000 AC·FT) EVEN THOUGH THE HEIGHT OF THE DAM IS ONLY 15.5 FT

SHEET 3 OF 22
[illegible] 12/8/80
B. Butler Baker 12/9/80



HAZARD POTENTIAL

SIGNIFICANT HAZARD POTENTIAL, BASED UPON DAM BREACH ANALYSIS AND RELATIVE LOCATIONS OF HOUSES AND OTHER STRUCTURES.

A DETAILED DISCUSSION OF FAILURE HAZARD POTENTIAL IS INCLUDED AT THE END OF BREACH ANALYSIS SECTION OF APPENDIX-D-

SELECTION OF TEST FLOOD -

FOR THE INTERMEDIATE SIZE AND SIGNIFICANT HAZARD POTENTIAL CLASSIFICATION. TABLE 3 OF CORPS OF ENGINEERS RECOMMENDED GUIDELINES, THE TEST FLOOD COULD BE IN THE $\frac{1}{2}$ PMF TO PMF RANGE.

BASED UPON THE INVOLVED RISK POTENTIAL DOWNSTREAM OF THE DAM.

LOWER END OF THIS RANGE IS SELECTED.

TEST FLOOD $= \frac{1}{2}$ PMF

TEST FLOOD PEAK INFLOW: $\frac{1}{2} \times 10,700 = 5,350$ CFS

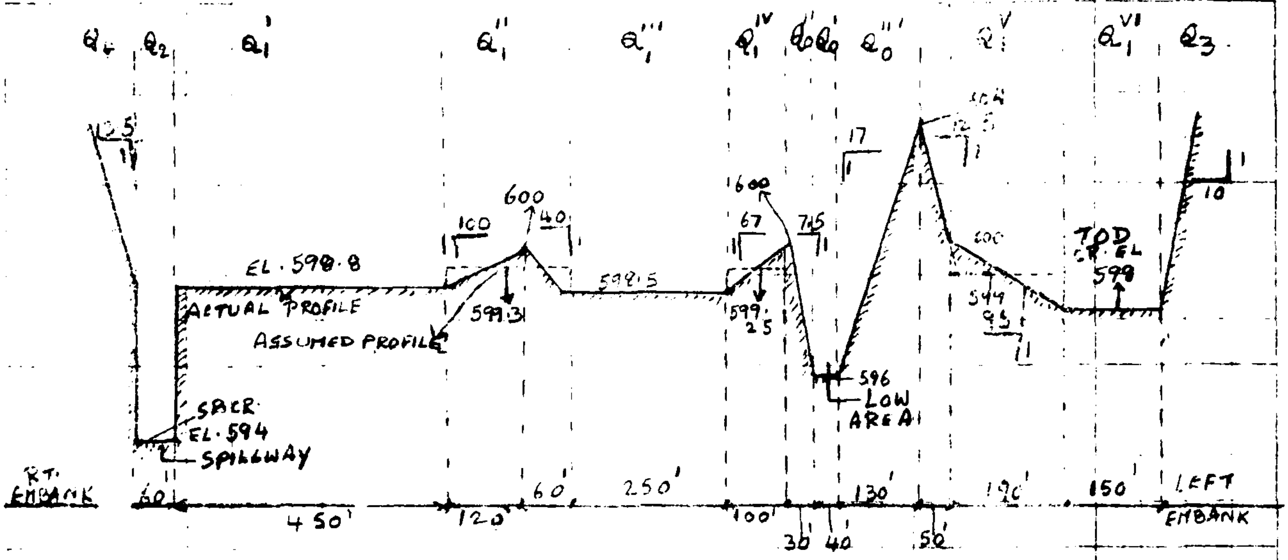
$\therefore$ TOTAL STORM VOLUME $= \frac{9\frac{1}{2}}{12} \times 5.92 \times 640 = 3,000$ AC. FT.

THUS, MAX^{M} STORAGE OF 758 AC. FT IS ONLY 21.4% OF THIS STORM VOLUME.

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 5 OF 22
NEW ENGLAND DIVISION COMPUTED BY [illegible] DATE 1/2/81
BUNGEE LAKE DAM (LOWER) CHECKED BY E. Butcher [illegible] DATE 1/5/81

COMPOSITE DISCHARGE RATING CURVE



APPROXIMATE POTENTIAL OVERFLOW PROFILE
(Based upon Cahn Inc. Field Information)

DAM

$Q_1' = CLH^{3/2}$ L = 450' Cr. EL. 598.8 C = 2.8 Assumed (Faulkner)
$= 1260 H^{3/2}$

$Q_1'' = 504 H^{3/2}$ L = 180' Cr. El. 599.3 C = 2.8

$Q_1''' = 700 H^{3/2}$ L = 250' Cr. El. 598.5 C = 2.8

$Q_1^{IV} = 280 H^{3/2}$ L = 100' Cr. El. 599.25 C = 2.8

$Q_1^{V} = 532 H^{3/2}$ L = 190' Cr. El. = 599 C = 2.8

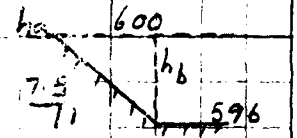
$Q_1^{VI} = 420 H^{3/2}$ L = 150' Cr. El. 598 C = 2.8

LOW AREA

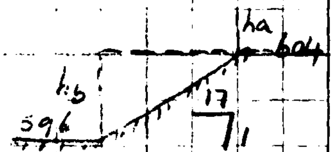
$Q_0' = 112 H^{3/2}$ L = 40' Cr EL = 596 C = 2.8

$Q_0'' = \frac{2}{5} \frac{CL(h_b^{5/2} - h_a^{5/2})}{(h_b - h_a)}$ * C = 2.8 Cr El = 596 h_a = 0 upto El. 600

$= 8.4\, h_b^{5/2}$



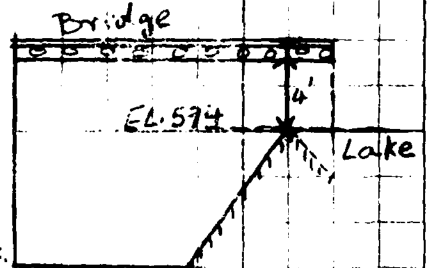
SIMILARLY $Q_0''' = 19.0\, h_b^{5/2}$ C = 2.8 Cr El = 596 h_a = 0 upto El. 604



TOTAL $Q_0 = Q_0' + Q_0'' + Q_0'''$

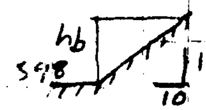
SPILLWAY $Q_2 = CLH^{3/2}$

FOR SPILLWAY WITH A ROUND CRESTED SHAPE C = 3.7 ASSUMED L = 60'
(Ref: Handbook of applied Hydrology by Ven Te Chow. Chapter 7). VALUE OF C IS ASSUMED TO INCLUDE THE EFFECT OF THE BRIDGE.

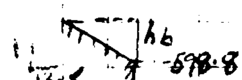


$Q_2 = 3.7 \times 60 \times H^{3/2}$
$= \underline{222 H^{3/2}}$ H = 4' TO TOP OF DAM.

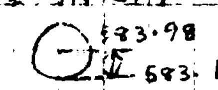
LEFT EMBANKMENT $Q_3 = \frac{2}{5} \frac{CL(h_b^{5/2} - h_a^{5/2})}{(h_b - h_a)}$ * $= 11.2\, h_b^{5/2}$ C = 2.8 Cr EL = 598



R. EMBANKMENT — SIMILARLY $Q_4 = 15.1\, h_b^{5/2}$ Cr El = 598.8



LOWER LEVEL OUTLET — 21" CORRUGATED METAL PIPE. INVERT 583.1 NGVD, TOD = 598 NGVD.
HEAD OVER THE PIPE = 598 − 584 = 14' WITH POOL AT TOP OF DAM.



$Q_5 = CA\sqrt{2gH} = \frac{\pi d^2}{4}\sqrt{2 \times 32.2 \times 14} = \underline{72 \text{ CFS}}$ NEGLECTING LOSSES.

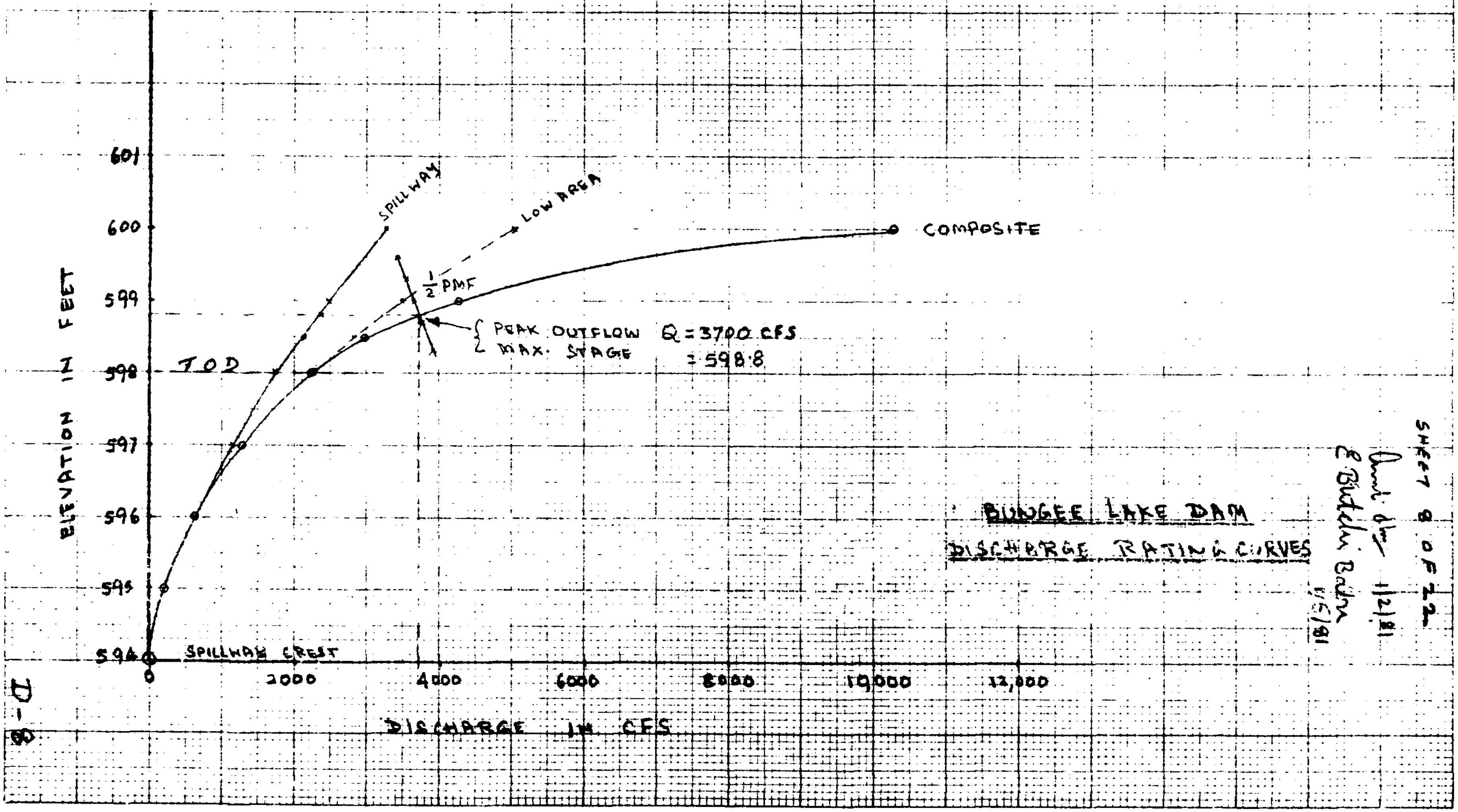
* USGS Recommended formula for more precise discharge over inclined dam/embankment crest (Ref: Measurement of peak discharges at dam by indirect methods, USGS book 3, Chapter A-5, Page 3-4 1968)

TABULATION OF DISCHARGE RATES (CFS)

	ELVN	SP. WAY Q_2	LOW AREA OF DAM Q'_0	Q''_0	Q'''_0	TOTAL Q_0	DAM Q'_1	Q''_1	Q'''_1	Q^{IV}_1	Q^{V}_1	Q^{VI}_1	TOTAL DAM Q_1	L. EMB Q_3	RT EMB Q_4	TOTAL Q
SP. CR	594	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	595	222	0	0	0	0	0	0	0	0	0	0	0	0	0	222
LOW AREA CREST	596	630	0	0	0	0	0	0	0	0	0	0	0	0	0	630
	597	1154	112	8	19	139	0	0	0	0	0	0	0	0	0	1293
TOD	598	1775	317	48	107	472	0	0	0	0	0	0	0	0	0	2247
	598.5	2119	443	83	188	714	0	0	0	0	0	148	148	2	0	2983
TEST FLOOD	598.8	2370	535	110	255	900	0	0	115	0	0	309	424	6	0	3700
	599	2484	582	131	296	1009	113	0	247	0	0	420	780	11	0	4284
	600	3262	896	269	608	1773	1656	295	1286	182	532	1188	5139	63	24	10,261

DISCHARGE THROUGH THE LOW LEVEL OUTLET BEING SMALL (72 CFS) IS NEGLECTED.

DISCHARGE RATING CURVES FOR TOTAL Q (COMPOSITE), SPILLWAY, AND LOW AREA ARE SHOWN ON SHEET 8.


601
600
599
598
597
596
595
594
ELEVATION IN FEET
0
2000
4000
6000
8000
10,000
12,000
DISCHARGE IN CFS
SPILLWAY
LOW AREA
COMPOSITE
1/2 PMF
PEAK OUTFLOW Q = 3700 CFS
MAX. STAGE = 598.8
TOD
SPILLWAY CREST
BUNGEE LAKE DAM
DISCHARGE RATING CURVES
1/2/81
1/5/81

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 9 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 1/2/81
BUNGEE LAKE DAM (LOWER) CHECKED BY E Butler Baker DATE 1/5/81

DETERMINATION OF PEAK OUTFLOW
BY USING THE CORPS OF ENGINEERS "SURCHARGE STORAGE ROUTING" ALTERNATE METHOD:
FOR 5350 CFS ($\frac{1}{2}$ PMF) THE DISCHARGE RATING CURVE GIVES ELVN = 599.3
FROM STAGE-STORAGE CURVE FOR THIS ELVN - STORAGE = 1015 ACFT.

$$STOR_i = \frac{1015 \times 12}{5.92 \times 640} = 3.21'' \text{ RUN-OFF}$$

$$QP_i = QP_1 \left(1 - \frac{STOR_i}{9.5}\right)$$

① STORi INCHES	② $\left(1-\frac{STOR_i}{9.5}\right)$	③ STORi ACFT ① × $\frac{5.92 \times 640}{12}$	④ QPi CFS ② × 5350	⑤ ELVN FROM STORAGE CURVE USING ③
3.4	0.64	1073.5	3424	599.6
3.21	0.66	1013.5	3531	599.3
3.00	0.68	947	3638	599.0
2.80	0.70	884	3745	598.7
2.60	0.73	820	3905	598.3

COLUMNS ④ AND ⑤ ARE PLOTTED ON DISCHARGE RATING CURVE FROM WHICH

$\frac{1}{2}$ PMF PEAK OUTFLOW Q = 3700 CFS

MAXM STAGE = 598.8 NGVD
TOP OF DAM = 598.0

THE DAM IS EXPECTED TO BE OVERTOPPED BY 2.8 FT AT LOW AREA AND BY 0.8 FT AT THE LEFT EMBANKMENT SECTION.

BREACH ANALYSIS – DOWNSTREAM FAILURE HAZARD.

BREACH OUTFLOW $Q_b = \frac{8}{27} \times W_b \times \sqrt{g} \times Y_o^{3/2}$

BASED UPON CORPS OF ENGINEERS "RULE OF THUMB" GUIDANCE FOR ESTIMATING D/S DAM FAILURE HYDROGRAHS.

WATER DEPTH AT TIME OF FAILURE $Y_o = 15.5'$ WITH POOL AT TOP OF DAM (EL. 598)

ESTIMATED BREACH WIDTH W_b = 40% OF MID-HEIGHT LENGTH OF DAM
= 40% OF 782' ≅ 310'

(MID-HEIGHT LENGTH BASED ON OCTOBER 1963 CONST. DRAWINGS & CAHN INGSFIELD INFORMATION)

$\therefore Q_b = \frac{8}{27} \times 310 \times \sqrt{32.2} \times (15.5)^{3/2} = 31,800$ CFS

PEAK FAILURE OUTFLOW (Q_P) = Q_b + SPILLWAY DISCHARGE + OUTLET PIPE WITH POOL AT TOP OF DAM

= 31,800 + 1775 + 72 ≅ 33,700 CFS

ESTIMATED FAILURE FLOOD DEPTH IMMEDIATELY D/S FROM DAM ≅ $0.44\,Y_o = 0.44 \times 15.5$ = 7 FT

PERFORM DOWNSTREAM ROUTING OF PEAK FAILURE OUTFLOW

SELECT A SECTION AA 1050' DOWN STREAM OF THE DAM USING MANNING'S EQUATION

$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$ WHERE $n = 0.07$ ASSUMED AND $S = 0.0052$ ESTIMATED FROM USGS MAP

$= 1.53 \times A \times R^{2/3}$

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 11 OF 22
NEW ENGLAND DIVISION COMPUTED BY [illegible] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY E. Butler [illegible] DATE 12/9/80

ELVN	A, sq. FT	P	R = A/P	$R^{2/3}$	Q CFS
574.5	0	—	—	—	—
575	9	35	0.26	0.41	6
580	1030	375	2.75	1.96	3090
585	3088	448	6.9	3.6	17,000
590	5530	526	10.5	4.8	40,600

STAGE-AREA AND STAGE-DISCHARGE CURVES ARE PLOTTED FOR SECTION AA FOR PEAK FAILURE OUTFLOW QP_1 = 33,700 CFS. ELVN = 588.75 FROM STAGE DISCHARGE CURVE

AND STAGE AREA CURVE GIVES AREA = 4880 SQ. FT.

VOLUME OF REACH $V_1 = \frac{1050 \times 4880}{43,560} = 118$ AC. FT.

TRIAL $QP_2 = QP_1 \left(1 - \frac{V_1}{S}\right)$, WHERE S = TOTAL STORAGE TO TOP OF DAM.

$= 33,700 \left(1 - \frac{118}{1435}\right) = 30,900$ CFS.

FOR THIS QP_2 THE STAGE-DISCHARGE CURVE GIVES

ELVN = 588.3

AND AREA = 4640 SQ. FT

$\therefore V_2 = \frac{1050 \times 4640}{43,560} = 112$ AC. FT.

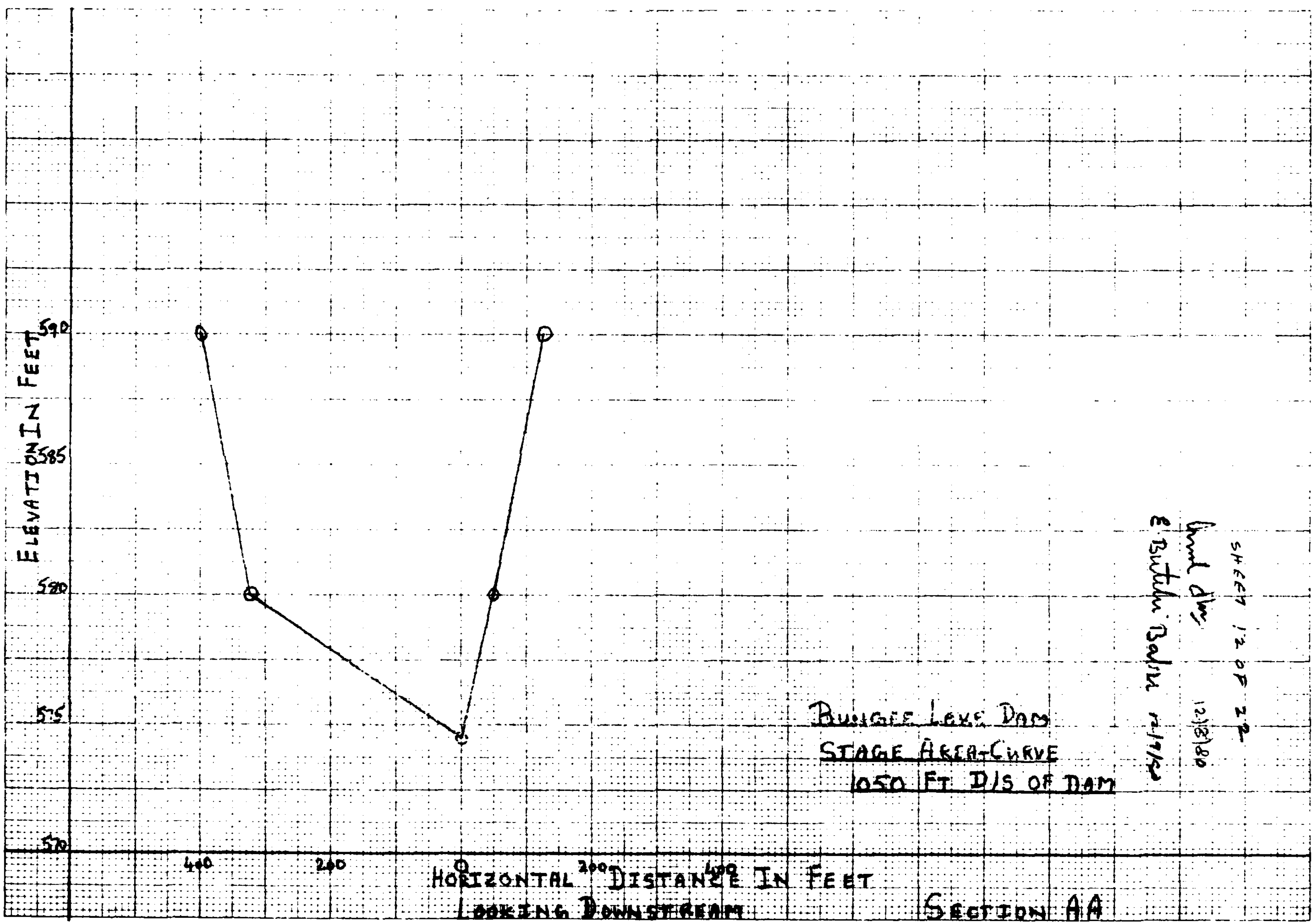
RECOMPUTING $QP_2 = 33,700 \left(1 - \frac{\frac{118+112}{2}}{1435}\right) = 31,000$ CFS

FLOOD DEPTH AT SECTION AA = EL 588.3 − EL 574.5
= 13.8 FT.

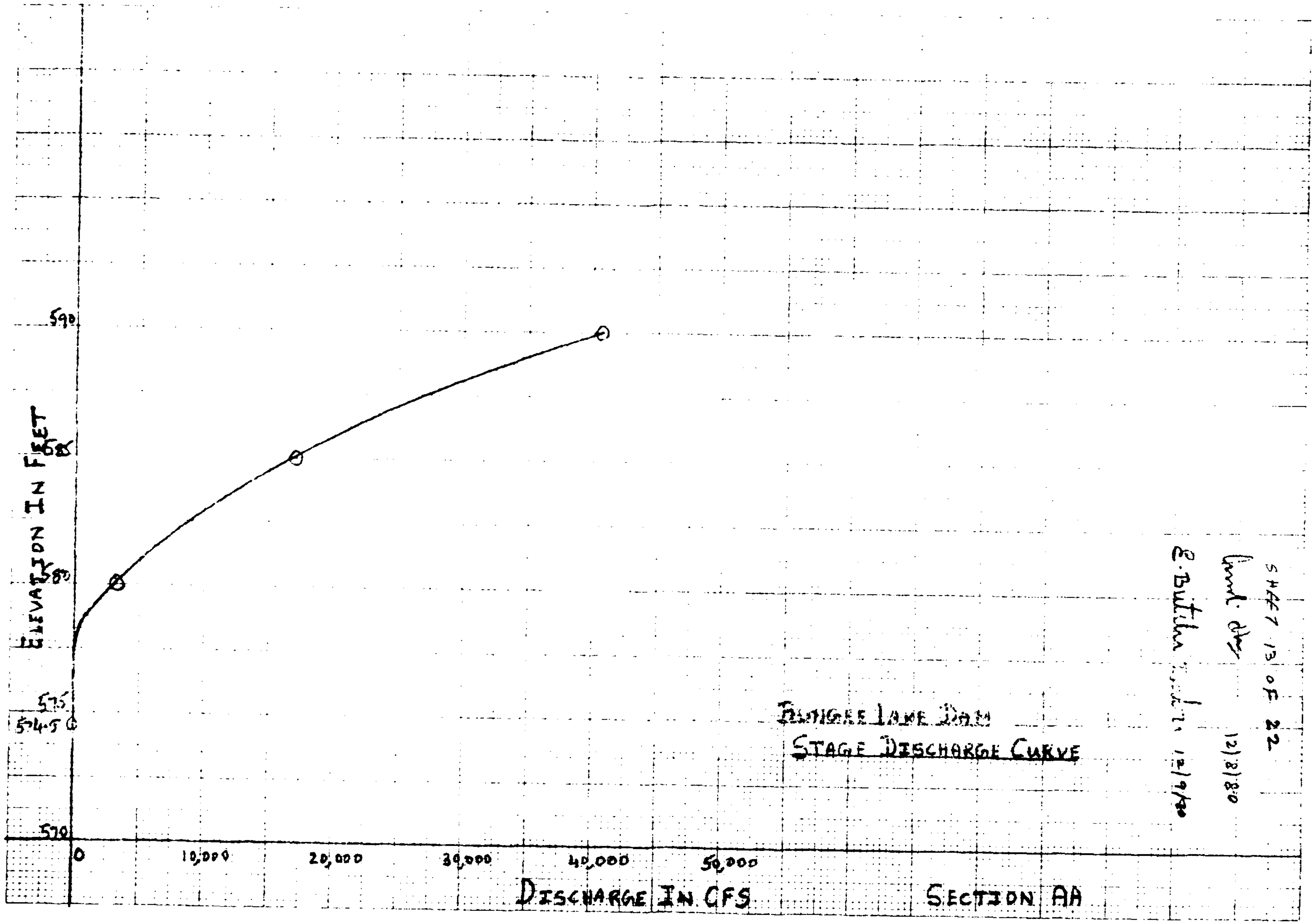
FLOOD STAGE AT SECTION AA = 588.3

AND VELOCITY AT SECTION AA = $\frac{31,000}{4640}$ = 6.5 FPS

THE HOUSE ADJACENT TO THIS SECTION IS 25^{+} FT ABOVE THE STREAM.



SHEET 12 OF 22
12/18/80
E Butchi Babu 12/19/80
BUNGEE LAKE DAM
STAGE AREA-CURVE
1050 FT D/S OF DAM
ELEVATION IN FEET
590
585
580
575
570
400
200
0
200
400
HORIZONTAL DISTANCE IN FEET
LOOKING DOWNSTREAM
SECTION AA



20 Squares to the Inch

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 14 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY E. Butler DATE 12/9/80

SELECTING A SECTION BB 800' D/S OF SECTION AA

THIS COMPUTATION IS MADE TO ESTIMATE THE DEPTH OF FLOOD WATER ADJACENT TO STATE ROUTE 198 ON WHICH A HOUSE IS LOCATED

$Q = \frac{1.486}{n} \times A \times R^{2/3} \times s^{1/2}$ $n = 0.07$ ASSUMED

$= 1.6 \times A \times R^{2/3}$ $s = 0.0056$ ESTIMATED FROM USGS MAP

ELVN	A SQ. FT	P	R = A/P	$R^{2/3}$	Q CFS
570	0	—	—	—	—
575	345	138	2.5	1.84	1,000
580	1375	275	5	2.92	6,400
585	3032	388	7.8	3.93	19,100
590	5250	500	10.5	4.8	40,300

STAGE AREA AND STAGE DISCHARGE CURVES ARE PLOTTED FOR QP_1 = 31,000 CFS, ELVN = 588.12 AND FROM STAGE AREA CURVE, AREA = 4346 SQ. FT

VOLUME OF REACH $V_1 = \frac{800 \times 4346}{43560} = 80$ AC FT

STORAGE REMAINING $= 1435 - \frac{118+112}{2} = 1320$ AC FT

TRIAL $QP_2 = QP_1 \left(1 - \frac{V_1}{S}\right)$

$= 31,000\left(1 - \frac{80}{1320}\right) = 29,100$ CFS

FOR 29,100 CFS, ELVN = 587.75 AND AREA = 4195 SQ FT

$V_2 = \frac{800 \times 4185}{43560} = 77$ AC FT

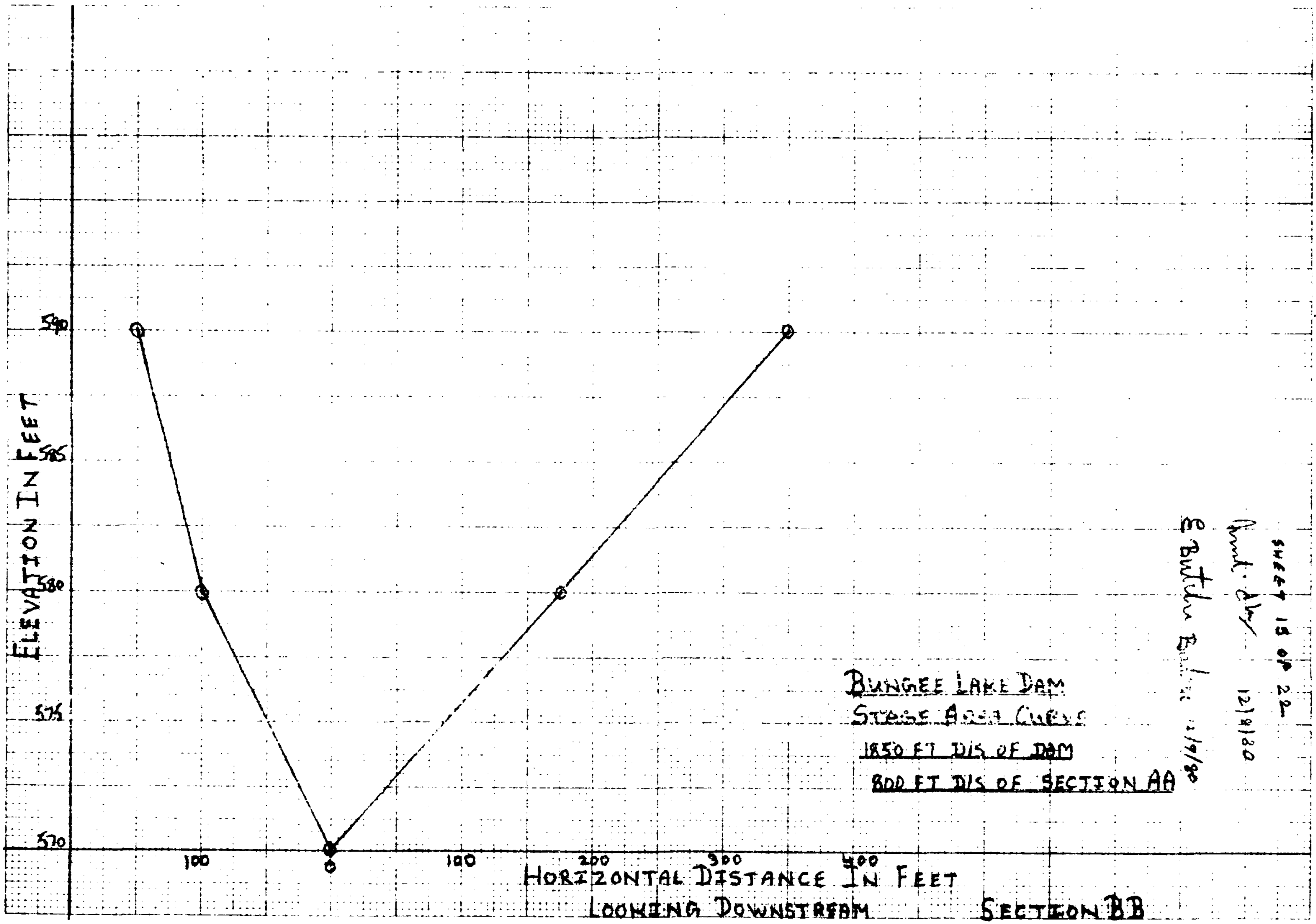
RECOMPUTING $QP_2 = 31,000\left(1 - \frac{\frac{80+77}{2}}{1320}\right) = 29,100$ CFS

FLOOD STAGE ≅ 587.8

DEPTH OF FLOOD WATER = EL 587.8 − EL 570 = 17.8 FT AT SECTION BB

VELOCITY AT SECTION BB $= \frac{29,100}{4185} \cong 7$ FPS

THE HOUSE IS LOCATED ABOVE THIS ESTIMATED FLOOD DEPTH.

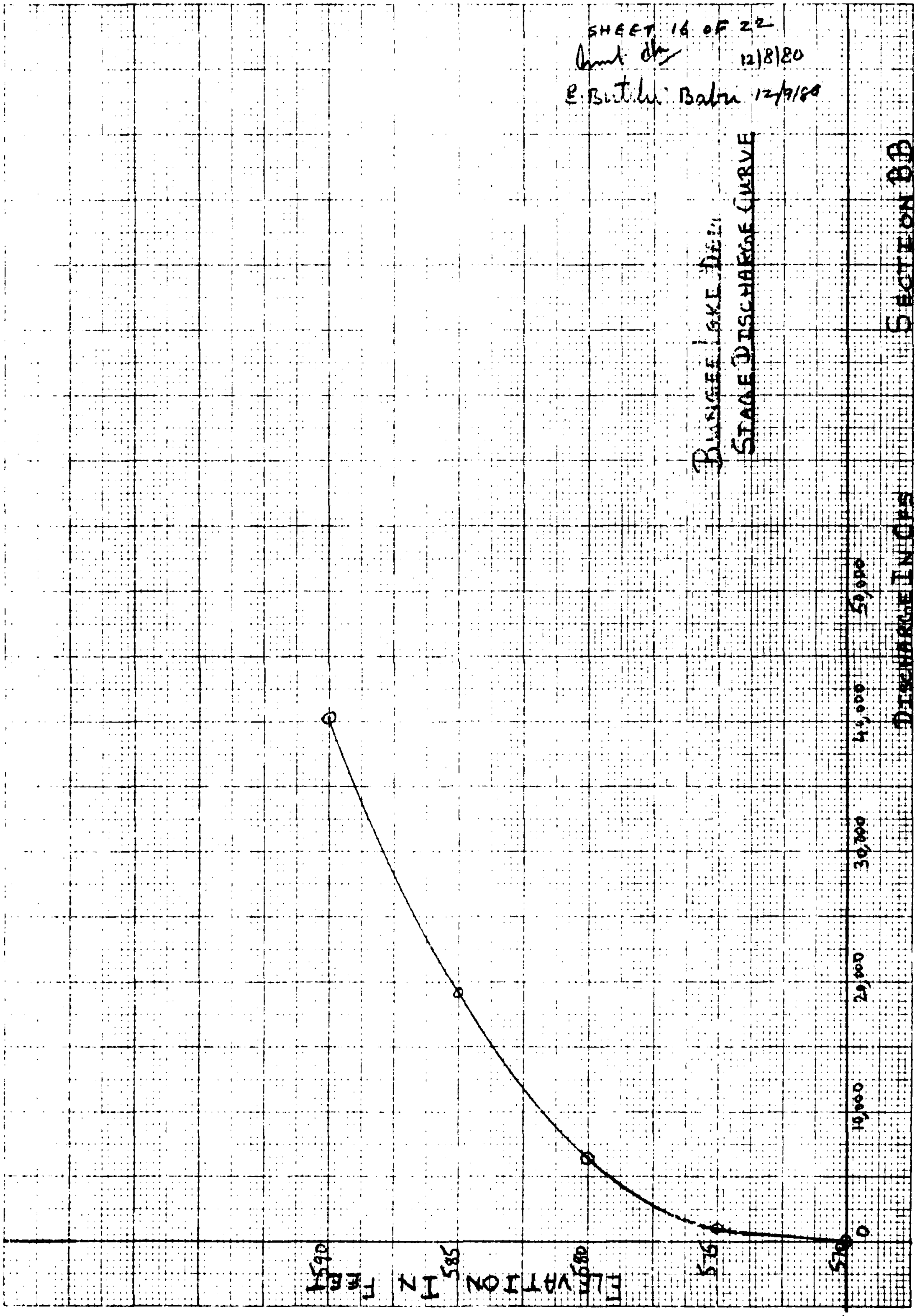


20 Squares to the Inch

SHEET 16 OF 22

12/8/80

12/9/80



20 Squares to the Inch

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS
NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 17 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY E. Butilas DATE 12/9/80

SELECT A SECTION CC 2400' D/S OF SECTION BB

THIS COMPUTATION IS MADE TO ESTIMATE FLOOD DEPTH ADJACENT TO STATE ROUTE 171 CULVERT. A HOUSE IS LOCATED IN THE VICINITY.

$Q = \frac{1.486}{n} \times A \times R^{2/3} \times S^{1/2}$ n = 0.06 ASSUMED

$= 1.8 \times A \times R^{2/3}$ S = 0.0054 EST. FROM USGS MAP

ELVN	A SQ.FT	P	R = A/P	$R^{2/3}$	Q CFS
557	0	—	—	—	—
560	525	350	1.5	1.31	1,250
565	3095	678	4.6	2.8	15,600
570	7275	1000	7.3	3.8	49,800

STAGE-AREA AND STAGE-DISCHARGE CURVES ARE PLOTTED. FOR QP_1 = 29,100 CFS, ELVN = 567.62 AND FROM STAGE-AREA CURVE, AREA = 5060 SQ.FT.

VOLUME OF REACH $V_1 = \frac{2400 \times 5060}{43,560} = 278$ AC.FT

STORAGE REMAINING $= 1320 - \frac{80+77}{2} = 1240$ AC FT

TRIAL $QP_2 = QP_1 \left(1 - \frac{V_1}{S}\right)$

$= 29,100 \left(1 - \frac{278}{1240}\right) = 22,600$ CFS

FOR 22,600 CFS, ELVN = 566.5 AND AREA = 4165 SQ FT

$V_2 = \frac{2400 \times 4165}{43560} = 230$ AC.FT

RECOMPUTING $QP_2 = 29,100 \left(1 - \frac{\frac{278+230}{2}}{1240}\right)$

≅ 23,100 CFS

∴ FLOOD STAGE ≅ 566.6

∴ DEPTH OF FLOOD WATER = EL 566.6 − EL 557

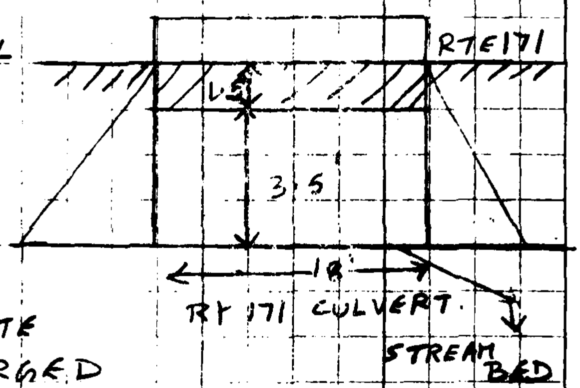
= 9.6 FT SECTION CC

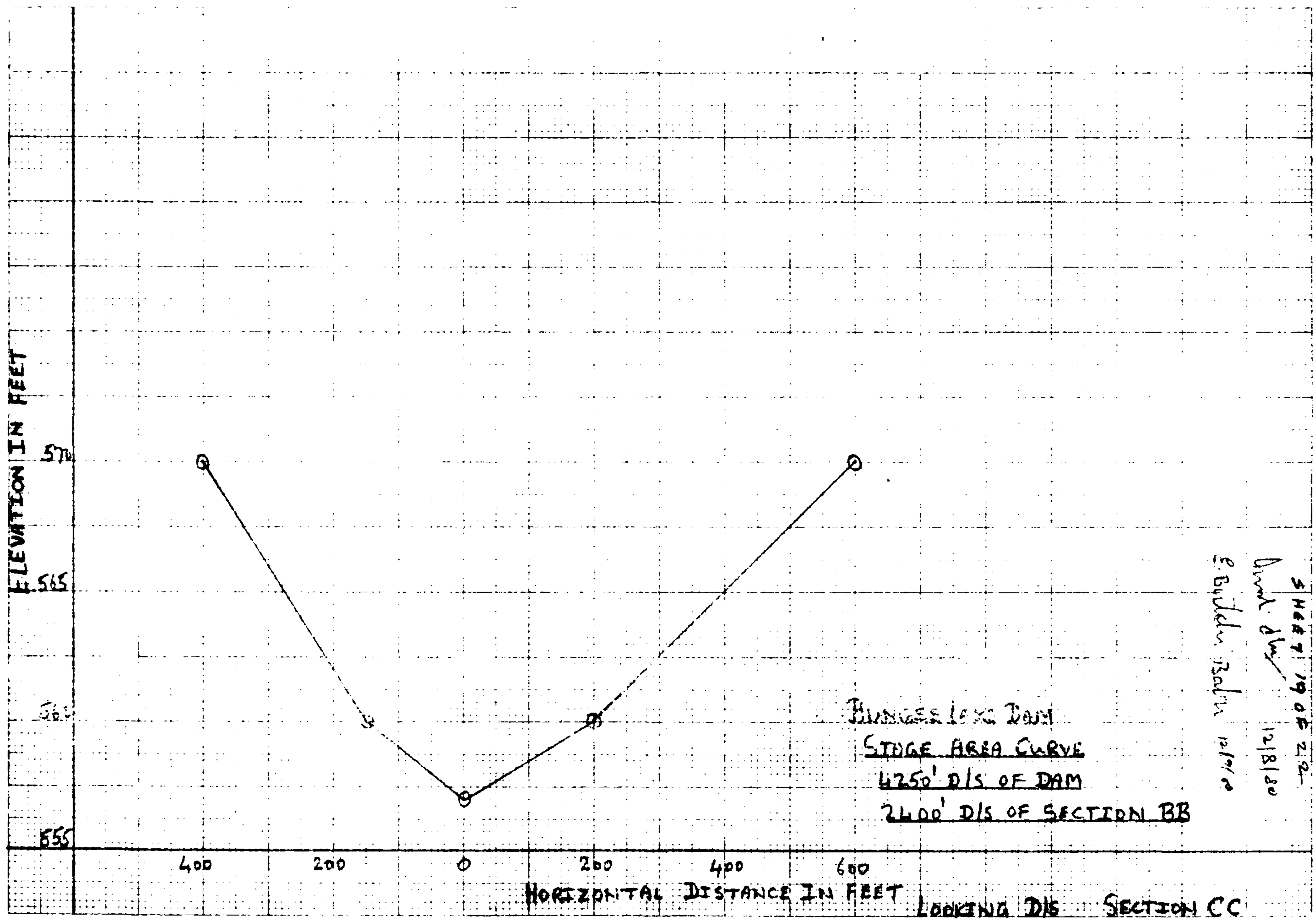
VELOCITY AT SECTION CC = $\frac{23,100}{4265}$ = 5.4 FPS

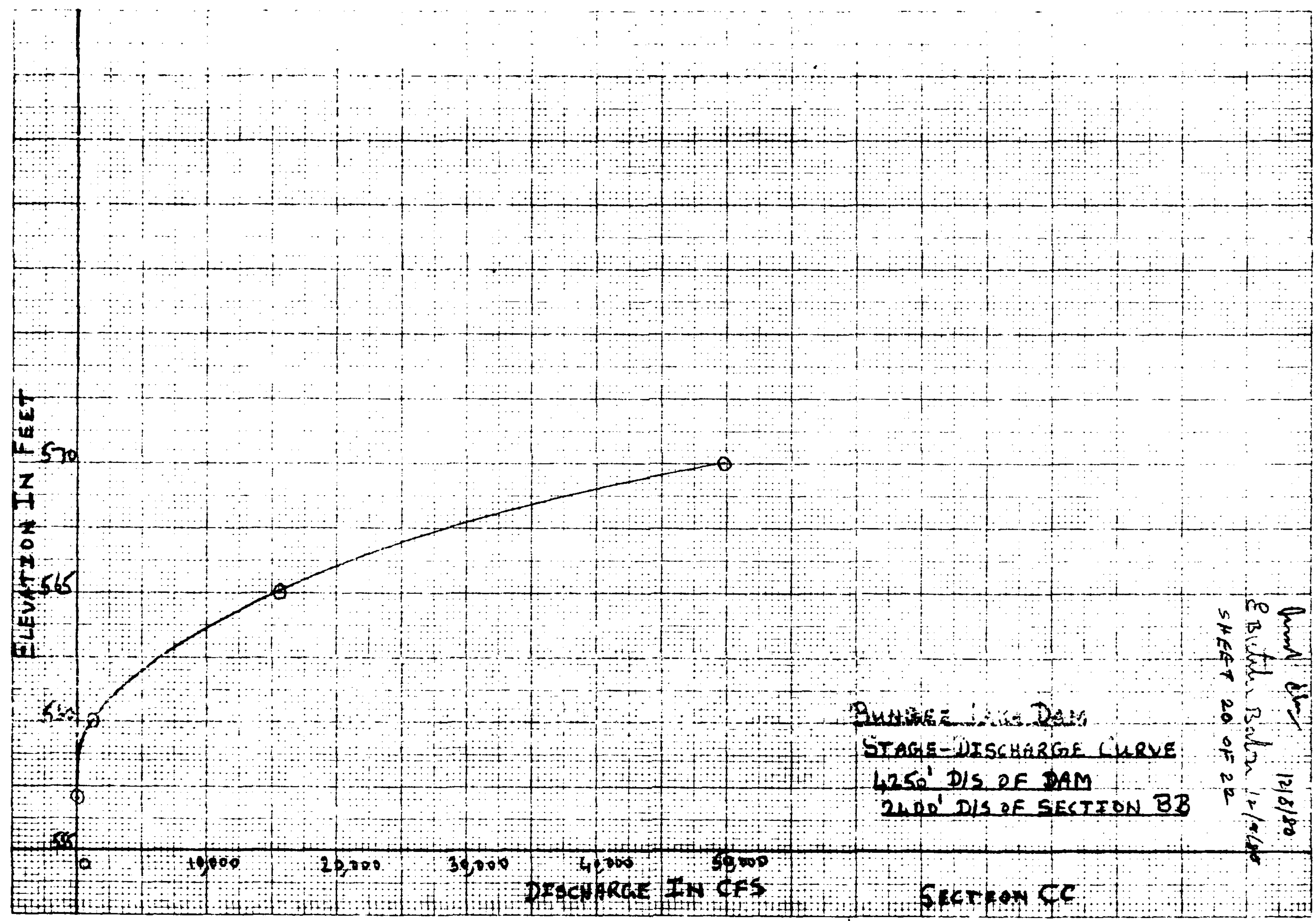
DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 18 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY E. Butler Bain DATE 12/9/80

FIRST FLOOR OF THE HOUSE IS ESTIMATED TO BE 7.5± ABOVE THE STREAM BED; HENCE THIS HOUSE HAS A POTENTIAL FOR FLOODING BY 2± FT OF WATER. DISCHARGE CAPACITY OF THE RECTANGULAR CONCRETE CULVERT ON STATE ROUTE 171 IS ESTIMATED PER OPEN-CHANNEL HYDRAULICS BY VEN TE CHOW SECTION 17-8. FOR TYPE 3 CULVERT THE DISCHARGE CAPACITY = 4100 ± CFS FOR THE DAM BREACH CONDITION. THUS. THE STATE ROUTE 171 WILL BE SUBMERGED WITH 4.5'± OF FLOOD WATER.




SHEET 19 OF 22
12/8/80
Burgess Lake Dam
STAGE AREA CURVE
4250' D/S OF DAM
2400' D/S OF SECTION BB
ELEVATION IN FEET
570
565
555
400
200
0
200
400
600
HORIZONTAL DISTANCE IN FEET
LOOKING D/S SECTION CC



BUNKER LAKE DAM

STAGE-DISCHARGE CURVE

4250' D/S OF DAM

2400' D/S OF SECTION BB

SECTION CC

12/8/80

12/10/80

SHEET 20 OF 22

DIVERSIFIED TECHNOLOGIES CORP. CONSULTING ENGINEERS NORTH HAVEN, CONN.

PROJECT NON FEDERAL DAM INSPECTION PROJECT NO. 80-10-20 SHEET 21 OF 22
NEW ENGLAND DIVISION COMPUTED BY [signature] DATE 12/8/80
BUNGEE LAKE DAM (LOWER) CHECKED BY [signature] DATE 12/9/80

FAILURE HAZARD POTENTIAL

SUMMARY OF BREACH ANALYSIS RESULTS:

LOCATION	DISTANCE FROM DAM FT.	PEAK FLOW RATE CFS	FLOOD STAGE	FLOOD DEPTH FT.	VEL FPS
DAM	0	33,700	589.5	7	—
AA	1050	31,000	588.3	13.8	6.5
BB	1850	29,100	587.8	17.8	7
CC	4250	23,100	566.6	9.6	5.4

AT SECTION CC, THE STATE ROUTE 171 CULVERT HAS AN OPENING OF 3.5'x18' AND THE PAVEMENT IS ONLY 5' ABOVE THE STREAM BED. THEREFORE, THE LARGE FLOW AT SECTION CC HAS A POTENTIAL OF DAMAGING THIS CULVERT AND SUBMERGING THE STATE HIGHWAY BY 4.5'± OF FLOOD WATER. IN ADDITION, A RESIDENCE LOCATED APPROXIMATELY 250 FT FROM THE STREAM IS ESTIMATED TO BE 7.5'± (FIRST FLOOR) ABOVE THE STREAM BED. THUS, AT DAM BREACH THE 1ST FLOOR OF THIS RESIDENCE IS EXPECTED TO BE FLOODED BY 2'± OF WATER AND HAS A POTENTIAL FOR LOSS OF A FEW LIVES, DUE TO DAM FAILURE WITH POOL AT EL. 598 (CREST OF THE DAM AT LEFT EMBANK. SECTION) THUS, A HAZARD POTENTIAL OF SIGNIFICANT MAGNITUDE IS CONSIDERED LIKELY.

NOTE: ROUTING WAS ALSO PERFORMED KEEPING STORAGE VOLUME (S) CONSTANT. THE RESULTING FLOOD STAGE & DEPTH VALUES OBTAINED ARE NEARLY THE SAME.

SUMMARY- HYDRAULIC/HYDROLOGIC COMPUTATIONS

PERFORMANCE AT PEAK FLOOD CONDITIONS:	
PEAK INFLOW (TEST FLOOD ½ PMF)	5,350 CFS
PEAK OUTFLOW	3,700 CFS
SPILL. CAP. TO TOP OF DAM (EL.598 NGVD)	1,775 CFS
SPILL. CAP. TO TOP OF DAM % OF PEAK OUTFLOW	48
SPILL. CAP. TO PEAK FLOOD ELVN (EL.598.8 NGVD)	2,370 CFS
SPILL. CAP. TO PEAK FLOOD ELVN % OF PEAK OUTFLOW	64
CAP. TO LOW AREA OF DAM. TO PEAK FLOOD ELVN (Q_0)	900 CFS
CAP. OF LOW AREA OF DAM % OF PEAK OUTFLOW	24
PERFORMANCE:	
MAXIMUM POOL ELVN	598.8 NGVD
MAX. SURCHARGE HEIGHT ABOVE SPILL. CREST	4.8 FT
LOW AREA OF THE DAM OVERTOPPED	2.8 FT
CREST OF THE DAM (EL.598) OVERTOPPED	0.8 FT
DOWNSTREAM FAILURE CONDITIONS:	
PEAK FAILURE OUTFLOW WITH POOL @ EL. 598	33,700 CFS
FLOOD DEPTH IMMEDIATELY D/S FROM DAM	7 FT
CONDITIONS AT IMPACT AREA: SECTION CC (STREAM BED ELVN 557)	
EST. STAGE BEFORE FAILURE WITH 1775 CFS (LOW AREA FILLED)	560.4 NGVD
EST. STAGE AFTER FAILURE WITH 23,100 CFS	566.6 NGVD
EST. RAISE IN STAGE AFTER FAILURE (LOW AREA FILLED) ΔY	6.2 FT
EST. STAGE BEFORE FAILURE WITH 2247 CFS (LOW AREA INTACT)	560.7 NGVD
EST. RAISE IN STAGE AFTER FAILURE (LOW AREA INTACT) ΔY	5.9 FT

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

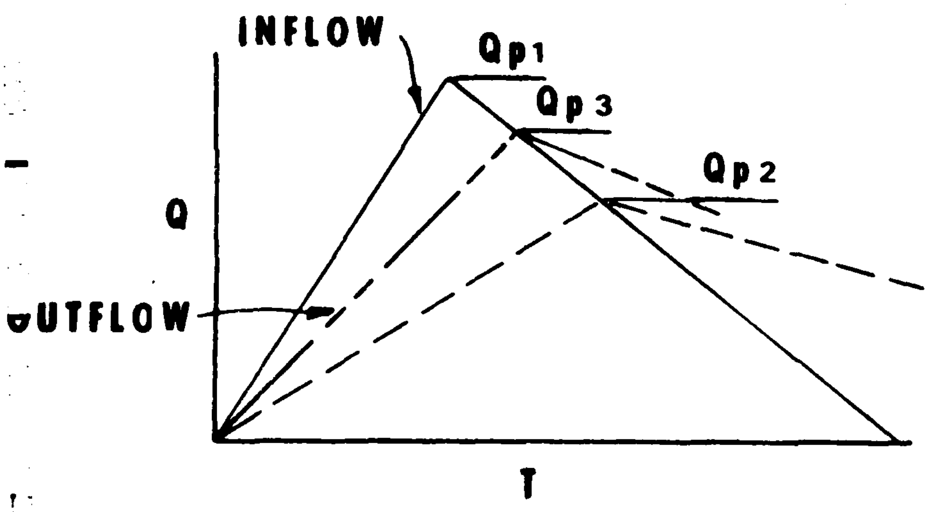
MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

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

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

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

ESTIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES



STEP 1: Determine Peak Inflow (Q_{p1}) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Q_{p1}".

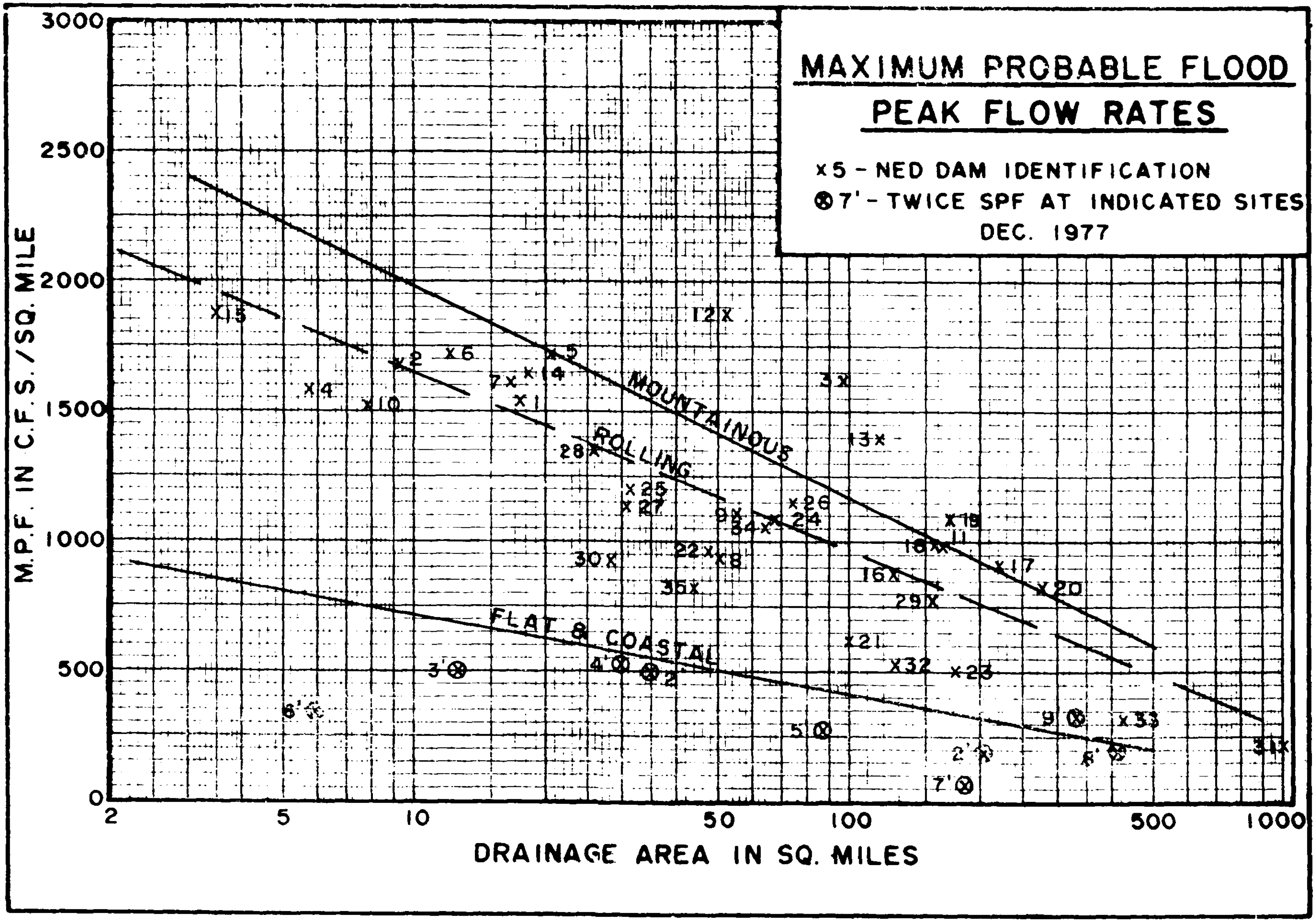
b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

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

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR_1}{19}\right)$$

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "Q_{p2}"

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Q_{p3}".


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
MOUNTAINOUS
ROLLING
FLAT & COASTAL
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
0
500
1000
1500
2000
2500
3000
2
5
10
50
100
500
1000

SURCHARGE STORAGE ROUTING SUPPLEMENT

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

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

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

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

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

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

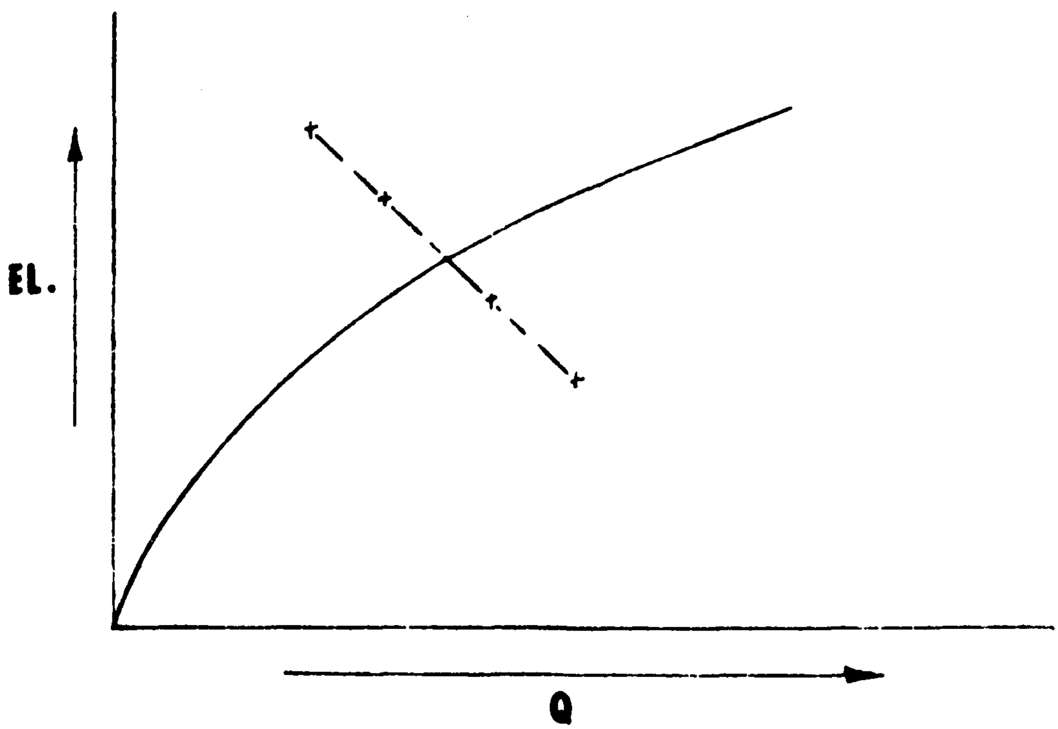
SURCHARGE STORAGE ROUTING ALTERNATE

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

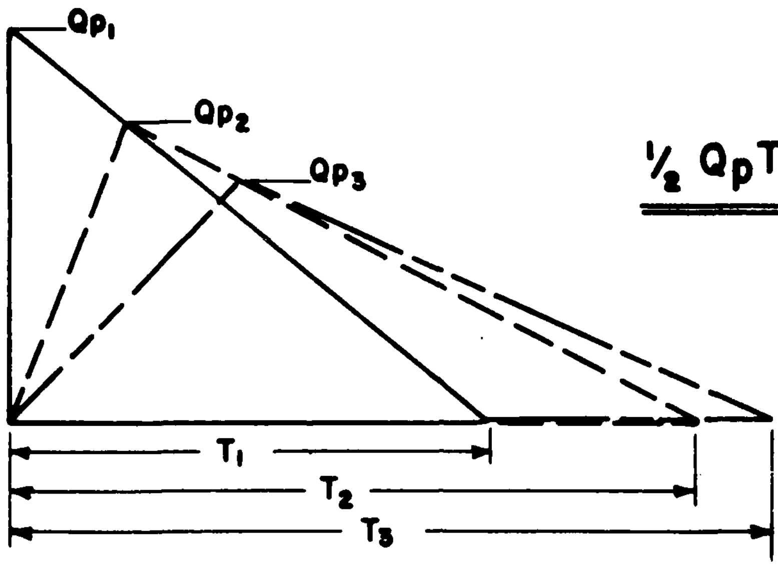
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

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

Q_{p2}	STOR	EL.



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



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

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

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

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

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

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

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

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

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

B. DETERMINE TRIAL Q_{p2}.

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

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

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

$$Qp_2 = Qp_1\left(1 - \frac{V_{ave}}{S}\right)$$

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

APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

20 Squares to the Inch

D-19

END

FILMED

10-84

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