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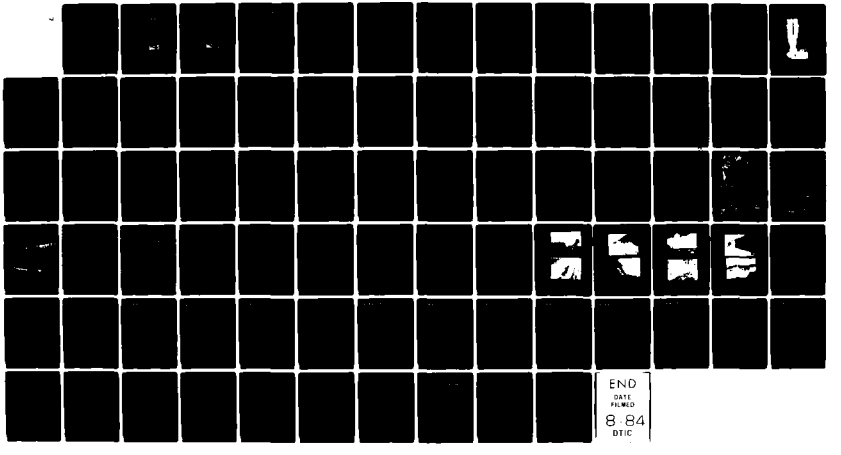

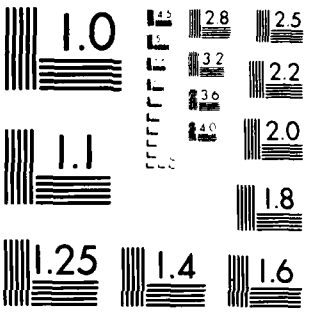

HOUSATONIC RIVER BASIN
DERBY, CONNECTICUT

UPPER ANSONIA RESERVOIR DAM
CT 00029

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

SEPTEMBER, 1980

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle): Housatonic River Basin Derby, Conn., Upper Ansonia Reservoir Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
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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,

Housatonic River Basin, Derby Conn.
[redacted] Ansonia Reservoir Dam

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

The Upper Ansonia Reservoir Dam was built around 1887 and presently impounds a water supply reservoir. The "Main Dam" is a masonry gravity structure with a total length of approx. 345 ft., including a 20.5 ft. long spillway and a masonry intake structure. The top of the masonry dam, at elevation 309.7, is 2.7 ft above the spillway crest, 20.8 ft. above the streambed at the downstream toe of the dam, and varies in width from 3 to 4.5 ft. A bedrock outcrop separates a 200 ft. long masonry and earth dike from left end of the Main Dam and separated from the dike by a small knoll is the "East Dam", which consists of a masonry gravity upstream wall and a downstream embankment.

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BRIEF ASSESSMENT

PHASE I INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

Name of Dam:	UPPER ANSONIA RESERVOIR DAM
Inventory Number	CT 00029
State:	CONNECTICUT
County:	NEW HAVEN
Town:	DERBY
Stream:	TRIBUTARY TO NAUGATUCK RIVER
Owner:	ANSONIA-DERBY WATER COMPANY
Date of Inspection:	AUGUST 8, 1980
Inspection Team:	PETER HEYNEN, P.E.
	HECTOR MORENO, P.E.
	THEODORE STEVENS
	ROBERT JAHN

The Upper Ansonia Reservoir Dam was built around 1887 and presently impounds a water supply reservoir. As shown on Sheets B-1 to B-3, it consists of a masonry gravity dam, a masonry and earth dam and a masonry and earth dike. The "Main Dam" is a masonry gravity structure with a total length of approximately 345 feet, including a 20.5 foot long spillway and a masonry intake structure. The top of the masonry dam, at elevation 309.7 (NGVD), is 2.7 feet above the spillway crest, 20.8 feet above the streambed at the downstream toe of the dam, and varies in width from 3 to 4.5 feet. A bedrock outcrop separates a 200 foot long masonry and earth dike from the left end of the Main Dam. The dike has a top elevation of 309.5 and is approximately 7 feet high. Approximately 700 feet left of the Main Dam and separated from the dike by a small knoll is the "East Dam", (See Sheet B-1), which consists of a masonry gravity upstream wall and a downstream embankment. The East Dam has a total length of approximately 423 feet, consisting of two sections separated by a low bedrock outcrop which rises to within 5 feet of the top of the dam. The left section is 227 feet in length and 16.2 feet in height and the right section is 196 feet in length and 11 feet in height. The East Dam has a top elevation of 310.0, a top width of 4 to 4.8 feet and does not have a spillway. With the reservoir level to the top of the project, the reservoir impounds approximately 310 acre-feet of water.

In accordance with U.S. Army Corps of Engineers Guidelines, Upper Ansonia Reservoir Dam is classified as a high hazard, small size dam. The test flood for the project is equivalent to the Probable Maximum Flood (PMF). Peak inflow to the reservoir at test flood is 1,200 cubic feet per second (cfs); peak outflow is 870 cfs with the low point of the dike overtopped by 0.6 feet and the dam by 0.4 feet. The spillway capacity with the reservoir level to the lowest point along the top of the dike is 240 cfs, which is equivalent to 28% of the routed test flood outflow.

Based upon the visual inspection at the site and past performance, the project is judged to be in fair condition. No evidence of instability of the project was observed. However, there are items which require attention, such as seepage, trees and brush on and at the toe of the dam and dike, and deterioration of the masonry intake structure.

It is recommended that the owner retain the services of a registered professional engineer to perform a more detailed hydraulic/hydrologic analysis of the adequacy of the existing project discharge. Other items of importance are monitoring of seepage, removal of trees and brush and repair of the masonry intake structure.

The above recommendations and further remedial measures presented in Section 7 should be instituted within one year of the owner's receipt of this report.

Peter M. Heynen, P.E.
Project Manager - Geotechnical
Cahn Engineers, Inc.

STATE OF CONNECTICUT
PETER M. HEYNEN
No. 9618
REGISTERED
PROFESSIONAL ENGINEER

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

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

A-1

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

ARAMAST MAHTESIAN, Member
Geotechnical Engineering Branch
Engineering Division

CARNEY M. TERZIAN, Member
Design Branch
Engineering Division

RICHARD DIBUONO, 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 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.

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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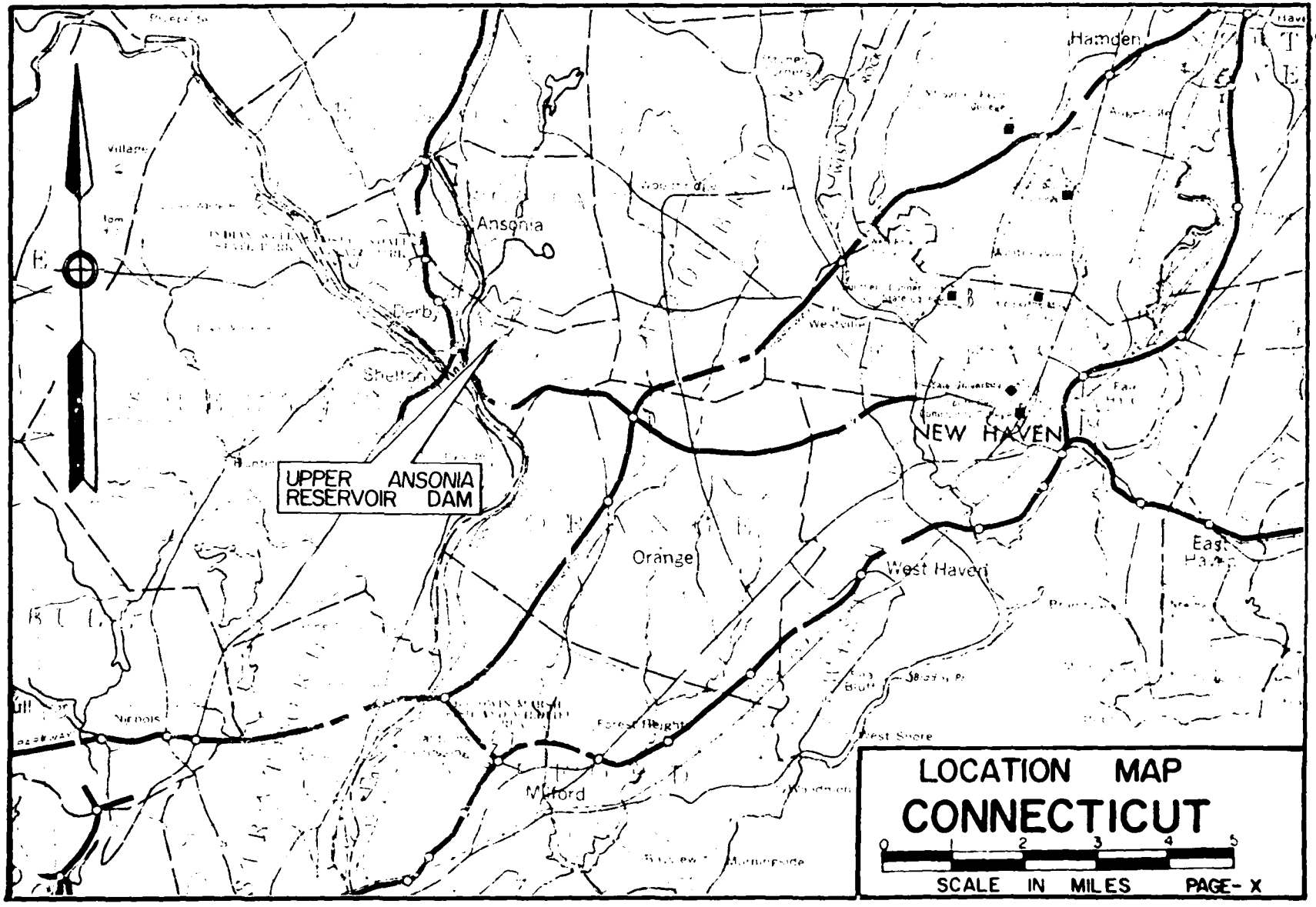
APPENDICES

OVERVIEW PHOTO
(August, 1980)

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Upper Ansonia Res. Dam	Derby	DATE Sept. '80
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED DAMS	Tr-Naugatuck River	CONNECTICUT	CE # 27 785 KC PAGE ix


Hamden
Ansonia
Derby
Shelton
UPPER ANSONIA
RESERVOIR DAM
NEW HAVEN
Orange
West Haven
East
Milford
LOCATION MAP
CONNECTICUT
0 1 2 3 4 5
SCALE IN MILES
PAGE- X

PHASE I INSPECTION REPORT

UPPER ANSONIA RESERVOIR 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 does not pass judgement on the safety or stability of the dam other than on a visual basis. The inspection is to identify those features of the dam which need corrective action and/or further study.

1.2 DESCRIPTION OF PROJECT

a. Location - The Upper Ansonia Reservoir Dam is located on an unnamed tributary to the Naugatuck River in the Housatonic River Basin in a suburban area of the Town of Derby, County of New Haven, State of Connecticut. The dam is shown on the Ansonia USGS Quadrangle Map, having coordinates latitude N41°19.2' and longitude W73°04.4'. The Lower Ansonia Reservoir is located approximately 550 feet downstream.

b. Description of Dam and Appurtenances - As shown on Sheets B-1 through B-3, the project consists of the 345 foot long Main Dam, the 423 foot long East Dam, and a 200 foot long dike to the left of the Main Dam.

The Main Dam, shown on Sheet B-2, is a 20.8 foot high masonry gravity structure and contains a 20.5 foot long spillway and the outlet facilities for the project. According to existing drawings, the dam was raised approximately 5 feet by addition of masonry to the downstream face of an old masonry dam. The old dam, with an approximate top elevation of 305, has an earth embankment on its upstream side. The upstream face of the portion of the present dam rising above the old dam is at a batter of approximately 1 horizontal to 4 vertical. In the area of the spillway, where the dam reaches its greatest height, the downstream face is tiered, with each tier having a batter of approximately 1 horizontal to 9 vertical. The entire dam appears to be founded on bedrock, except for a 116 foot long section at the right end. This section of the dam has embankments upstream and downstream of the masonry wall.

A bedrock outcrop separates the left end of the dam from a 200 foot long, 7 foot high dike which consists of an upstream masonry wall and a downstream earth embankment. The dike appears to be founded on bedrock and has a vertical upstream face, a top width of about 25 feet and a downstream slope inclined at approximately 4 horizontal to 1 vertical.

The 423 foot long East Dam appears to be founded on bedrock and consists of a masonry wall with an earth embankment on its downstream side. The wall has a vertical upstream face and an approximate top elevation of 310. The embankment has an approximate top elevation of 307, a top width of about 10 feet and a downstream slope inclined at approximately 2 horizontal to 1 vertical. A low bedrock ridge, rising to approximate elevation 305, separates the East Dam into a 227 foot long, 16.2 foot high left section and a 196 foot long, 11 foot high right section. Profiles of the dike and East Dam are shown on Sheet B-3.

The masonry intake structure for the project is located to the right of the spillway and approximately 15 feet from the upstream face of the Main Dam. The structure is not accessible from the dam, due to the condition of the service bridge, but appears to contain control mechanisms to a 12 inch cast iron low-level outlet and a 12 inch supply pipe which is gated to either feed into the Lower Reservoir or bypass the Lower Reservoir and feed directly to a chlorination house. The approximate invert elevations of the low-level outlet and the supply pipe are 290 and 295, respectively.

c. Size Classification - (SMALL) - The project is 20.8 feet in height and with the reservoir level to the top of the dam, impounds approximately 310 acre-feet of water. According to recommended guidelines, a dam with this maximum storage is classified as small in size.

d. Hazard Classification - (HIGH) - If the dam were breached, there is potential for loss of more than a few lives and extensive property damage in an urban area of Derby approximately 3000 feet downstream of the dam.

e. Ownership - Ansonia-Derby Water Company
230 Beaver Street
Ansonia, Connecticut 06401
Mr. Fredrick Elliott (Superintendent)
(203) 735-1888 (Work)
(203) 734-0288 (Home)

The dam was built and owned by the now defunct Birmingham Water Company and acquired by the present owner around 1970.

f. Operator - Mr. William Clark (203) 734-6641

g. Purpose of Dam - The dam impounds a public water supply reservoir for the towns of Ansonia and Derby.

h. Design and Construction History - Very little is known of the original design and construction of the project. The Main Dam appears today as it is shown on an undated, anonymous drawing entitled "Plan of Overflow Dam at Storage Reservoir of Birmingham Water Co." (Sheet B-2). As described in Section 1.2.b, the drawing depicts a raising of the dam. The storage of the reservoir is shown on an 1887 drawing by H.S. Whipple, Civil and Sanitary Engineer; however, it is not known if this date coincides with any construction at the site.

i. Normal Operational Procedures - Normally, the gate to the water supply main is kept open. This line can be controlled farther downstream to either feed into the Lower Reservoir or to bypass it and feed directly to a chlorination station below the Lower Reservoir.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 0.43 square miles of sparsely to heavily developed rolling to mountainous terrain.

b. Discharge at Damsite - Discharge is over the spillway, through the 12 inch supply pipe, and through the 12 inch low-level outlet.

1. Outlet Works (Conduits)

12 inch low-level outlet @ invert el. 290.0±:	19± cfs (reservoir level to top of dam)

2. Maximum flood at damsite:	N/A (water released through low-level outlet if reservoir level rises above spillway crest)
3. Ungated spillway capacity @ top of dike el. 309.5:	240 cfs
top of dam el. 309.7:	270 cfs
4. Ungated spillway capacity @ test flood el. 310.1:	340 cfs
5. Gated spillway capacity @ normal pool:	N/A
6. Gated spillway capacity @ test flood:	N/A
7. Total spillway capacity @ test flood el. 310.1:	340 cfs
8. Total project discharge @ top of dike el. 309.5:	259± cfs
9. Total project discharge @ test flood el. 310.1:	870 cfs

c. Elevations - Elevations are on National Geodetic Vertical Datum (NGVD), based on an assumed spillway crest elevation of 307.0, which corresponds to the reservoir water surface elevation shown on USGS Ansonia Quadrangle Map, 1972.

1. Streambed at toe of Main Dam:	289.2±
Ground surface at toe of East Dam:	294.0±
Ground surface at toe of Dike:	302.5±
2. Bottom of cutoff:	289.0± (Main Dam - others not known)
3. Maximum tailwater:	Not known
4. Normal pool:	307.0±
5. Full flood control pool:	N/A
6. Spillway crest (ungated):	307.0 (Assumed datum)
7. Design surcharge (original design):	Not known
8. Top of Main Dam:	309.7±
Top of East Dam:	310.0±
Top of dike:	309.5±
9. Test flood surcharge:	310.1

d. Reservoir Length

1. Normal pool:	3,100± ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	3,100± ft.
4. Top of dam pool:	3,200± ft.
5. Test flood pool:	3,200± ft.

e. Reservoir Storage

1. Normal pool:	196± acre-ft.
2. Flood control pool:	N/A
3. Spillway crest pool:	196± acre-ft.
4. Top of dam pool:	310± acre-ft.
5. Test flood pool:	330± acre-ft.

f. Reservoir Surface

1. Normal pool:	34± acres
2. Flood control pool:	N/A
3. Spillway crest pool:	34± acres
4. Top of dam pool:	37.1± acres
5. Test flood pool:	37.7± acres

g. Dam

1. Type:	Masonry gravity structures with upstream and/or downstream embankments
2. Length	
Main Dam:	345 ft.
East Dam:	423 ft.
Dike:	200 ft.
3. Height	
Main Dam:	20.8 ft.
East Dam:	16.2 ft.
Dike:	7.0 ft.
4. Top width:	3-4.8 ft. (both dams) 25 ft. (dike)

5. Side slopes	
Main Dam:	upstream batter - 1H to 4V downstream batter - 1H to 9V (tiered)
East Dam:	upstream batter - vertical downstream slope - 2H to 1V
Dike:	upstream batter - vertical downstream slope 4H to 1V
6. Zoning:	Earth embankments on upstream and/or downstream side of masonry wall
7. Impervious core:	Masonry walls
8. Cutoff:	Founded on rock, except for right end of Main Dam
9. Grout curtain:	N/A
10. Other:	N/A
h. Diversion and Regulating Tunnel	N/A
i. Spillway	
1. Type:	Broad-crested masonry weir of trapezoidal cross-section
2. Length of weir:	20.5 ft.
3. Crest elevation:	307.0 (Assumed datum)
4. Gates:	N/A
5. Upstream channel:	None
6. Downstream channel:	Riprap splash apron to channel lined with dry-laid masonry walls.
7. General:	Concrete cap and stanchions for stop planks

j. Regulating Outlets

Low-level outlet

1. Invert:	290.0±
2. Size:	12 inch diameter
3. Description:	Cast iron
4. Control mechanism:	Manual
5. Other:	N/A

Supply Pipe

1. Invert:	Not known
2. Size:	12 inch diameter
3. Description:	Cast iron
4. Control mechanism:	Manual
5. Other:	N/A

SECTION 2: ENGINEERING DATA

2.1 DESIGN DATA

The available data consists of inventory data by the State of Connecticut, correspondence concerning placement of flashboards at the dam in 1942, and drawings of the project by the Birmingham Water Company. The drawings consist of an 1887 drawing by H.S. Whipple, Civil and Sanitary Engineer showing the reservoir storage and two undated, anonymous drawings entitled "Plan of Overflow Dam at Storage Reservoir of Birmingham Water Company" and "Plan of Masonry in Addition to that of Main Dam of Birmingham Water Co's. Storage Reservoir" (See Appendix B).

The drawings and correspondence indicate the design features stated previously in this report.

2.2 CONSTRUCTION DATA - No information is available.

2.3 OPERATIONS

Reservoir level readings are taken daily at the dam. No formal operations records are known to exist.

2.4 EVALUATION OF DATA

a. Availability - Available data was provided by the State of Connecticut and the owner. The owner made the project available for visual inspection.

b. Adequacy - The limited amount of detailed engineering data available was inadequate to perform an in-depth assessment of the dam, therefore, the final assessment of this dam must be based primarily on visual inspection, performance history, hydraulic computations of spillway capacity and hydrologic estimates

c. Validity - A comparison of record data and visual observations reveals no significant discrepancies in the record data.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The project is in fair condition. The inspection revealed several areas requiring maintenance and monitoring. At the time of inspection, the reservoir level was 1.1 feet below the spillway crest at elevation 305.9.

b. Dam

Main Dam

Top of Dam - The top of the dam consists of the top of the masonry wall and is in good condition (Photos 1 & 3). Minor cracking and spalling of the mortar joints was noted.

Upstream Face - The masonry upstream face of the dam is in good condition. The stone blocks are in good condition, exhibiting almost no weathering. The mortar joints, which were repointed in 1969, are in fair condition with minor cracking and spalling noted. Weedy vegetation is growing from cracks in the mortar on the upstream face and top of the wall. For a length of approximately 140 feet at the left end of the Main dam, up to 1.5 feet of concrete has been added to the upstream face, including the upstream face of the spillway (Photo 1). This concrete is in good condition, except for some cracking and loss of material at the right end of the spillway.

Downstream Face - The downstream face of the Main Dam is in fair condition. Seepage was noted exiting from several locations on the downstream face below elevation 300, or approximately 6 feet below the upstream water level. All seepage was clear and no major individual seeps were observed. The quantity of seepage could not be measured, but is estimated to total less than 10 gallons per minute (gpm). The masonry is in fair condition with some cracking and spalling of the mortar joints and a later mortar resurfacing. Weedy vegetation is growing from cracks in the mortar, especially in the tiered area where there is wetness due to seepage (Photo 2). There is extremely dense brush growth at the toe of the dam, making inspection of some areas on the downstream face impossible. The 116 foot long section at the right end of the dam includes an earth embankment on the downstream side of the masonry wall. Extremely dense brush covers this entire embankment (Photo 3).

Spillway - The spillway is in good condition. Cracking of the concrete cap and sidewall was noted at the right end of the spillway. A little grass is growing from joints in the concrete and there is minor spalling of the spillway crest (Photo 7).

Dike to Left of Main Dam

Top of Dike - The top of the dike embankment is level with the top of the masonry wall and is in good condition, with thick grass cover (Photo 4).

Upstream Face - The masonry wall on the upstream side of the embankment is in good condition. It appears to be founded on bedrock. At the left end, the ground surface extends upstream from the wall and brush growth is present in this area (Photo 4).

Downstream Slope - Due to the presence of numerous large trees and brush, the downstream slope is in poor condition. However, no seepage, sloughing or erosion was observed.

East Dam

Top of Dam - The top of the embankment on the downstream side of the masonry wall is 3 feet lower than the top of the wall and is covered with low vegetation and some brush. Also, there is a row of pine trees along the downstream edge of the top of the embankment.

Upstream Face - The masonry of the upstream face of the East Dam is similar in appearance to that of the Main Dam and is in good condition (Photo 5).

Downstream Slope - Low vegetation, such as ferns, and some brush is present on the downstream slope. There are several trees growing in a wet, swampy area at the toe. Seepage was observed to be emanating along the toe of the slope, where the toe is at or below elevation 300, or approximately 6 feet below the upstream water level. All seepage was clear and no major individual seeps were noted. The quantity of seepage could not be measured, but is estimated to total less than 6 gpm (Photo 6). All seepage is through the left section of the dam which is 16.2 feet in height and separated from the 11 foot high right section by a natural rock ridge which has a top elevation approximately 5 feet below the top of the dam.

c. Appurtenant Structures - The masonry intake structure is in poor condition (Photo 8). The mortar joints of the structure are extensively cracked and/or leached. The wood service bridge from the dam has partially collapsed, making access to the intake structure unsafe. Reportedly, 12 inch gate valves which control the low-level outlet and supply line are operable. Due to the unsafe condition of the service bridge, the gate valve stems and stands could not be inspected.

d. Reservoir Area - The area surrounding the reservoir is wooded and undeveloped, except for a 400 foot long section along the west shoreline, where Prindle Avenue is located.

e. Downstream Channel - The downstream channel to the Lower Reservoir is approximately 4 feet high by 4 feet wide and lined with dry-laid masonry.

3.2 EVALUATION

Based upon the visual inspection, the project is in fair condition. The manner in which the features identified in Section 3.1 could affect the future condition and/or stability of the project is as follows:

1. Trees and brush on the dam embankments and at the toe of the masonry dam could be uprooted, causing damage to the structures. Penetration of root systems could cause displacement of masonry blocks and/or provide seepage paths through the dams.

2. Continued deterioration of the masonry intake structure could threaten its stability.

3. The service bridge to the intake structure could collapse, making access to the structure from the dam impossible.

4. Seepage through the dams could cause leaching of mortar joints of the masonry walls or internal erosion of the earth embankments.

5. Continued cracking of the mortar joints could weaken the masonry portions of the project.

SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

4.1 OPERATIONAL PROCEDURES

a. General - From the dam, water is normally released via the 12 inch supply pipe, which is controlled to either feed the Lower Reservoir or bypass it and feed directly to a chlorination station downstream of the Lower Dam. Reservoir level readings are taken daily. If the reservoir level rises above the spillway crest, the low-level outlet is opened in order to maintain as much freeboard as possible.

b. Description of Any Warning System in Effect - The owner maintains surveillance of the dam during unusually high precipitation and/or reservoir levels. Should a problem arise at the dam, the owner would contact the local Civil Defense.

4.2 MAINTENANCE PROCEDURES

a. General - The masonry portions of the project were repointed in 1969 and are maintained on an as-needed basis. No maintenance is performed to the embankment portions of the project.

b. Operating Facilities - The operating facilities are exercised and lubricated on a regular basis.

4.3 EVALUATION

The operational and maintenance procedures are fair. A formal program of operational and maintenance procedures should be implemented, including documentation to provide records for future reference. Remedial operational and maintenance procedures are presented in Section 7.3.

SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 GENERAL

The Upper Ansonia Reservoir Dam watershed is 0.43 square miles of rolling to mountainous wooded terrain. The dam impoundment is presently used for public water supply purposes.

The reservoir is impounded by a masonry and earth dam, a masonry and earth dike, and a masonry dam which includes a spillway section. It is basically a high surcharge storage - low spillage type project. The available storage reduces the outflow from a Probable Maximum Flood (PMF) of 1200 cubic feet per second (cfs) to 870 cfs and the ½ PMF outflow from 600 cfs to 310 cfs.

5.2 DESIGN DATA

No computations were available for the original design of the dam.

5.3 EXPERIENCE DATA

Although daily lake level readings have been taken since the Ansonia-Derby Water Company acquired the dam, they do not necessarily reflect peak flows because the Water Company opens the low-level outlet when water begins to flow over the spillway crest. During heavy precipitation experienced in January 1979, the reservoir level rose from a low of 26½ inches below the spillway crest on Jan. 1 to a high of 1½ inches above the spillway crest on Jan. 25.

5.4 VISUAL OBSERVATIONS

The top of the dam has an elevation of 309.7. The dike to the left of the dam has a top elevation that varies from 309.5 near the dam to 310 at the other end. The East Dam has a top elevation of 310. At test flood, a road depression at Prindle Avenue (See Sheet B-1) allows a flow of approximately 30 cfs to divert from the watershed above elevation 310.

5.5 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 to Mountainous) and the watershed area of 0.43 square miles, a PMF of 1200 cfs or 2800 cfs per square mile is estimated at the damsite. In accordance with the size (small) and hazard (high) classification, the range of test floods to be considered is from the ½ PMF to the PMF. Based on the degree of hazard associated with a breach of the dam, the test flood for Upper Ansonia Reservoir Dam is equivalent to the PMF. The pond level at the start of the test flood is considered to be at spillway crest elevation 307. The peak outflow for the test flood is estimated at 870 cfs and this flow will overtop the low point of the dike by 0.6 feet. Based on hydraulics computations, the spillway capacity to the first point of overflow of the project is 240 cfs, which is equivalent to 28% of the routed test flood outflow (Appendix D-6).

5.6 DAM FAILURE ANALYSIS

The dam failure analysis is based on the April, 1978 Army Corps of Engineers "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs". Since a breach of any part of the project would affect the same downstream areas, the most critical condition, a breach of the East Dam, is analyzed. With the pond level at the top of the dike, peak outflow before failure of the East Dam would be about 240 cfs and the peak failure outflow from the dam breaching would total about 8,600 cfs. This sudden outflow would cause the Lower Ansonia Reservoir Dam to be overtopped by 2.8 feet and cause a rise in the water level of the stream at the initial impact area from a depth of 0.9 feet just before the breach to a depth of about 5.9 feet shortly after the breach. This rapid, 5.0 foot increase in water level will inundate numerous houses by up to 5 feet, possibly causing the loss of more than a few lives as well as substantial economic loss (Appendix D-14). Based on the dam failure analysis, Upper Ansonia Reservoir Dam is classified as a high hazard dam.

SECTION 6: EVALUATION OF STRUCTURAL STABILITY

6.1 VISUAL OBSERVATIONS

The visual inspection did not reveal any indications of stability problems. The project consists of 3 masonry gravity structures and is founded on a dense gray schist bedrock for the majority of its length. The right end of the Main dam does not appear to be founded on bedrock, but the actual foundation conditions could not be observed. Items described in section 3, such as trees and brush on the embankments, deterioration of the masonry intake structure and service bridge, and seepage through the dams are not stability concerns at the present time.

6.2 DESIGN AND CONSTRUCTION DATA

Drawings of the project depict cross-sections of the masonry portions of the Main Dam, the East Dam, and the dike to the left of the Main Dam. Where the Main Dam is approximately 20 feet high, the masonry has a top width of 4.5 feet and a base width of approximately 24 feet. In addition, the drawings show an earth embankment with an approximate top elevation of 305 on the upstream side of the masonry dam. The drawings confirm that most of the Main Dam is founded on bedrock, but show it keyed into rock only for a length of approximately 48 feet. Where the East Dam reaches it maximum height of 16 feet, the upstream masonry wall is shown to be 4.8 feet wide at its top and 6 feet wide at its base. The upstream masonry wall of the dike is shown to be 3 feet wide at the top and base. These drawings also show the volume of masonry used.

6.3 POST-CONSTRUCTION CHANGES

At some unknown date, the original dam was raised 5 feet to its present height. At some later date, the masonry was repointed and concrete was added to a portion of the upstream face of the Main Dam. These post-construction changes do not appear to impair the structural stability of the project.

6.4 SEISMIC STABILITY

The project is in Seismic Zone 1, and according to recommended guidelines, need not be evaluated for seismic stability.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 PROJECT ASSESSMENT

a. Condition - Based upon the visual inspection at the site and past performance, the project is in fair condition. No evidence of instability was observed in the masonry walls, spillway, or embankments; however, there are several items which require maintenance, repair and monitoring.

Based upon the U.S. Army Corps of Engineers' "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978, the watershed area and classification, and hydraulic/-hydrologic computations, peak inflow to the reservoir at test flood is 1200 cfs; peak outflow is 870 cfs, with the project overtopped by 0.6 feet. Based upon hydraulics computations, the spillway capacity to the top of the project is 240 cfs, which is equivalent to 28% of the routed test flood outflow.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the project must be based on visual inspection, past performance and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented within one year of the owner's receipt of this report.

7.2 RECOMMENDATIONS

It is recommended that further studies be made by a registered professional engineer qualified in dam design and inspection pertaining to the following items. Recommendations made by the engineer should be implemented by the owner.

1. Removal of all trees and brush from the project and from within 10 feet of the toe of the dam. This should include proper backfilling of root cavities with selected soils.

2. Investigation of the origin and significance of seepage through the Main Dam and the East Dam and establishment of a seepage monitoring program.

3. A more detailed hydraulic/hydrologic analysis, including an assessment of the ability of the masonry structures to withstand overtopping.

7.3 REMEDIAL MEASURES

a. Operation and Maintenance Procedures - The following measures should be undertaken by the owner within the length of time indicated in section 7.1.c, and continued on a regular basis:

1. Round-the-clock surveillance should be provided during periods of heavy precipitation or high project discharges. A formal downstream warning system should be developed, to be used in case of emergencies at the dam.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

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

4. After removal of trees and brush, grassy vegetation should be established on the embankments.

5. The cracked or leached mortar joints of the masonry intake structure and the other masonry portions of the project should be repaired.

6. The service bridge to the intake structure should be replaced.

7.4 ALTERNATIVES

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

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Upper Ansonia Reservoir Dam

DATE: Aug. 8, 1980
TIME: 10:00 am
WEATHER: Hazy, humid, 80°
W.S. ELEV. 305.9 U.S. Dry DN.S

PARTY:	INITIALS:	DISCIPLINE:
1. Peter Heynen	PH	Geotechnical
2. Theodore Stevens	TS	Geotechnical
3. Hector Moreno	HM	Hydraulics
4. Robert Jahn	RJ	Hydraulics
5.		
6.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Main Dam	PH, TS, HM, RJ	
2.	East Dam	PH, TS, HM, RJ	
3.	Dike	PH, TS, HM, RJ	
4.	Intake Structure	PH, TS, HM, RJ	
5.	Spillway	PH, TS, HM, RJ	
6.			
7.			
8.			
9.			
10.			
11.			
12.			

PERIODIC INSPECTION CHECK LIST

PROJECT Upper Ansonia Res. Dam DATE 8-8-80

PROJECT FEATURE Main Dam BY PH, TS, HM, RS

AREA EVALUATED		CONDITION
DAM EMBANKMENT		
Crest Elevation		309.7
Current Pool Elevation		305.9
Maximum Impoundment to Date		307.1 ± (known)
Surface Cracks		Minor cracking of mortar
Pavement Condition		N/A
Movement or Settlement of Crest		None observed
Lateral Movement		None observed
Vertical Alignment		Appears good
Horizontal Alignment		Appears good
Condition at Abutment and at Concrete Structures		Good
Indications of Movement of Structural Items on Slopes		N/A
Trespassing on Slopes		N/A
Sloughing or Erosion of Slopes or Abutments		None observed
Rock Slope Protection-Riprap Failures		N/A
Unusual Movement or Cracking at or Near Toes		None observed
Unusual Embankment or Downstream Seepage		Minor seepage ±10 gpm tot.
Piping or Boils		None observed
Foundation Drainage Features		N/A
Toe Drains		N/A
Instrumentation System		N/A

PERIODIC INSPECTION CHECK LIST

PROJECT Upper Ansonia Res. Dam DATE 8-8-80

PROJECT FEATURE East Dam BY PH, TS, HM, RJ

AREA EVALUATED		CONDITION
DAM EMBANKMENT		
Crest Elevation		310.0
Current Pool Elevation		305.9
Maximum Impoundment to Date		307.1± (known)
Surface Cracks		Minor cracking of mortar
Pavement Condition		N/A
Movement or Settlement of Crest		None observed
Lateral Movement		None observed
Vertical Alignment		Appears good
Horizontal Alignment		Appears good
Condition at Abutment and at Concrete Structures		Good
Indications of Movement of Structural Items on Slopes		N/A
Trespassing on Slopes		None observed
Sloughing or Erosion of Slopes or Abutments		None observed
Rock Slope Protection-Riprap Failures		N/A
Unusual Movement or Cracking at or Near Toes		None observed
Unusual Embankment or Downstream Seepage		Minor (±6 gpm total)
Piping or Boils		None observed
Foundation Drainage Features		N/A
Toe Drains		N/A
Instrumentation System		N/A

PERIODIC INSPECTION CHECK LIST

PROJECT Upper Ansonia Res. Dam DATE 8-8-80

PROJECT FEATURE Dike BY PH, TS, RJ, HM

AREA EVALUATED		CONDITION
DIKE EMBANKMENT		
Crest Elevation		309.5
Current Pool Elevation		305.9
Maximum Impoundment to Date		307.1± (known)
Surface Cracks		Minor cracks in mortar
Pavement Condition		N/A
Movement or Settlement of Crest		None observed
Lateral Movement		None observed
Vertical Alignment		Appears good
Horizontal Alignment		Top el varies 309.5–310.0
Condition at Abutment and at Concrete Structures		Good
Indications of Movement of Structural Items on Slopes		N/A
Sloughing or Erosion of Slopes or Abutments		None observed
Rock Slope Protection-Riprap Failures		None observed
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		N/A
Toe Drains		N/A
Instrumentation System		N/A
Trespassing on Slopes		None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Upper Ansonia Res. Dam DATE 8-8-80

PROJECT FEATURE Intake Structure BY PH, TS, HM, RJ

AREA EVALUATED		CONDITION
OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE		
a) Approach Channel		Could not observe approach channel - intake structure located in reservoir ±15' from upstream edge of dam.
Slope Conditions		
Bottom Conditions		
Rock Slides or Falls		
Log Boom		Wood service bridge to structure partially collapsed, making access unsafe.
Debris		
Condition of Concrete Lining		
Drains or Weep Holes		
b) Intake Structure		
Condition of ~~Concrete~~ Masonry		Poor - much cracking and leaching of mortar joints
Stop Logs and Slots		Could not observe

PERIODIC INSPECTION CHECK LIST

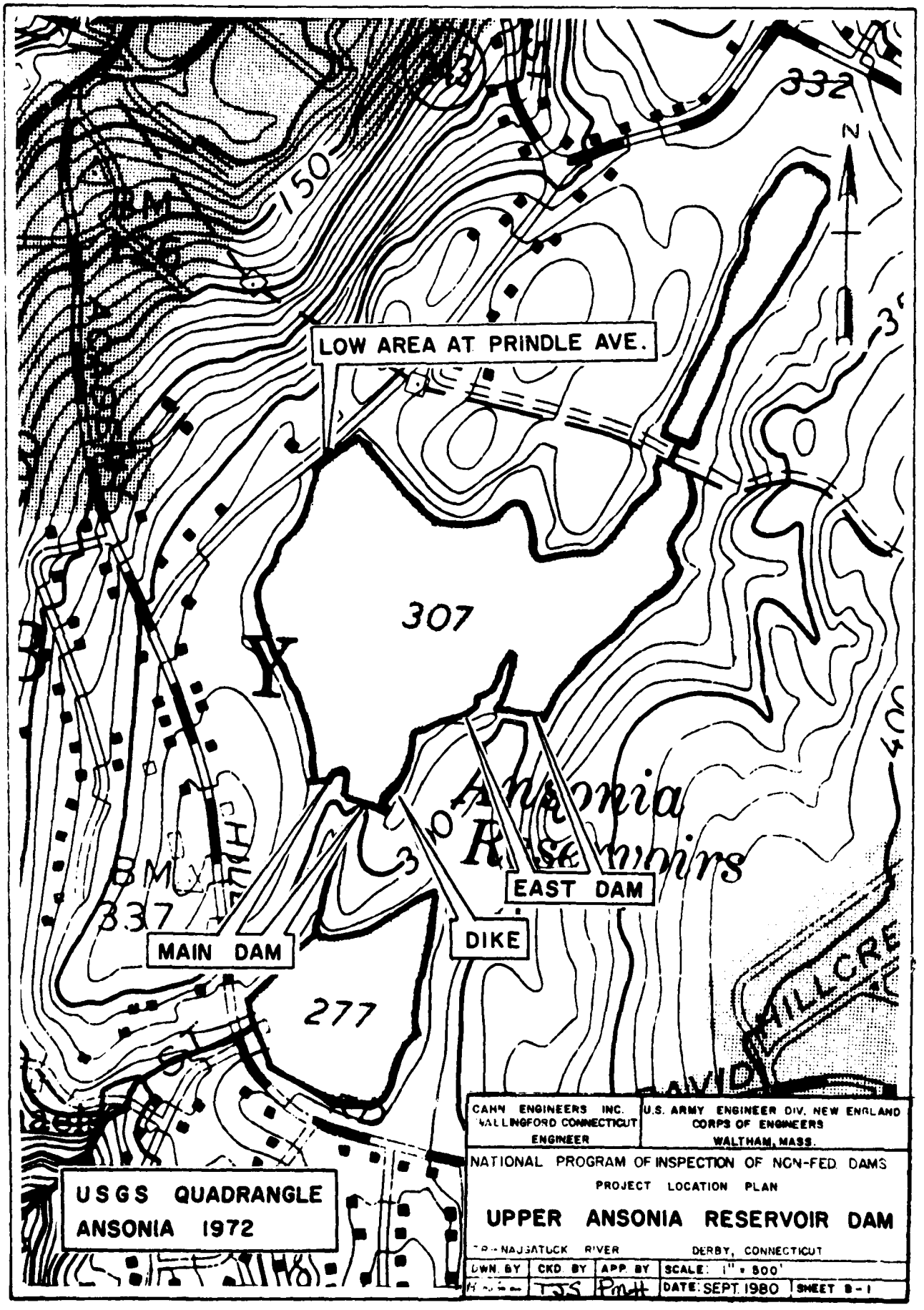
PROJECT Upper Ansonia Res. Dam DATE 8-8-80

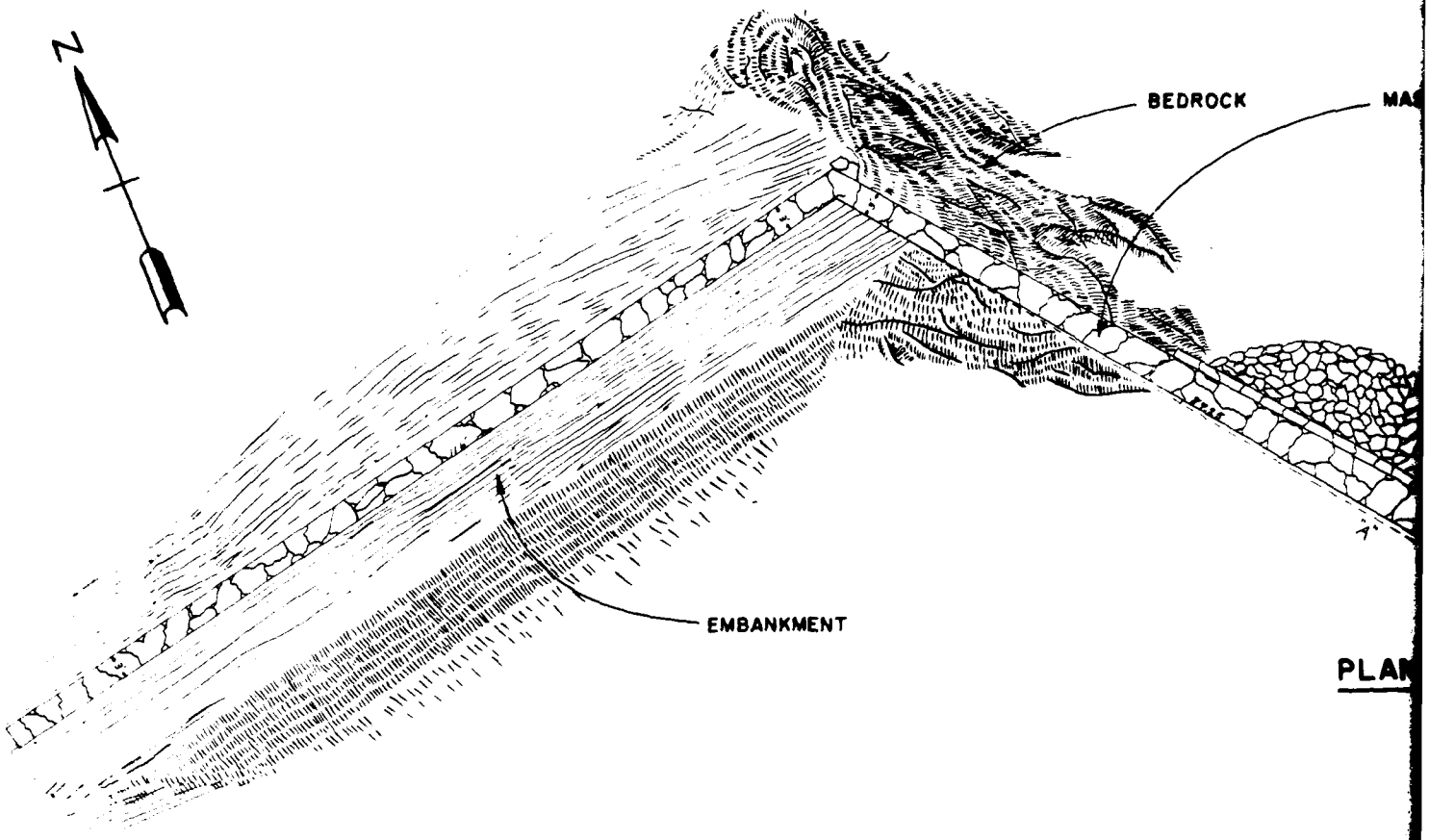
PROJECT FEATURE Spillway BY PH, TS, HM, RJ

AREA EVALUATED		CONDITION
OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS		
a) Approach Channel		
General Condition		Appears good
Loose Rock Overhanging Channel		None observed
Trees Overhanging Channel		None observed
Floor of Approach Channel		Could not observe
b) Weir and Training Walls		
General Condition of Concrete		Good
Rust or Staining		None observed
Spalling		Minor cracking - right end
Any Visible Reinforcing		No
Any Seepage or Efflorescence		Minor seepage from D/S face
Drain Holes		N/A
c) Discharge Channel		
General Condition		Fair
Loose Rock Overhanging Channel		Dry-laid walls - fallen rocks in places
Trees Overhanging Channel		Yes - channel thru wooded area
Floor of Channel		Gravel, cobbles
Other Obstructions		None observed

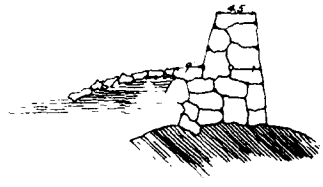
APPENDIX B

ENGINEERING DATA AND CORRESPONDENCE

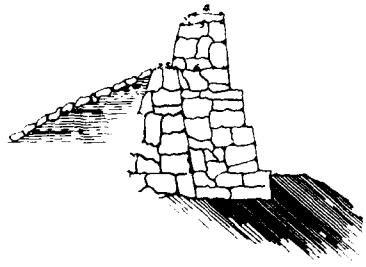

LOW AREA AT PRINDLE AVE.
EAST DAM
DIKE
MAIN DAM
USGS QUADRANGLE
ANSONIA 1972
CANN ENGINEERS INC.
NALLINGFORD CONNECTICUT
ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENRLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PROJECT LOCATION PLAN
UPPER ANSONIA RESERVOIR DAM
NAUGATUCK RIVER
DERBY, CONNECTICUT
DWN. BY
CKD. BY
APP. BY
TJS
Pratt
SCALE: 1" = 800'
DATE: SEPT. 1980
SHEET 8-1



PLAN



SECTION AT 'A'.



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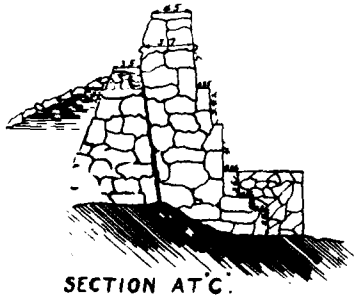
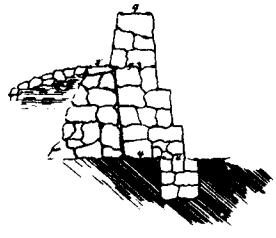


SECTION AT 'C'.



SECTION AT 'D'.

SECTIONS

NOTES

1. THIS SH
DRAWING
RESERVO
1" = 10',

2 NO ELE
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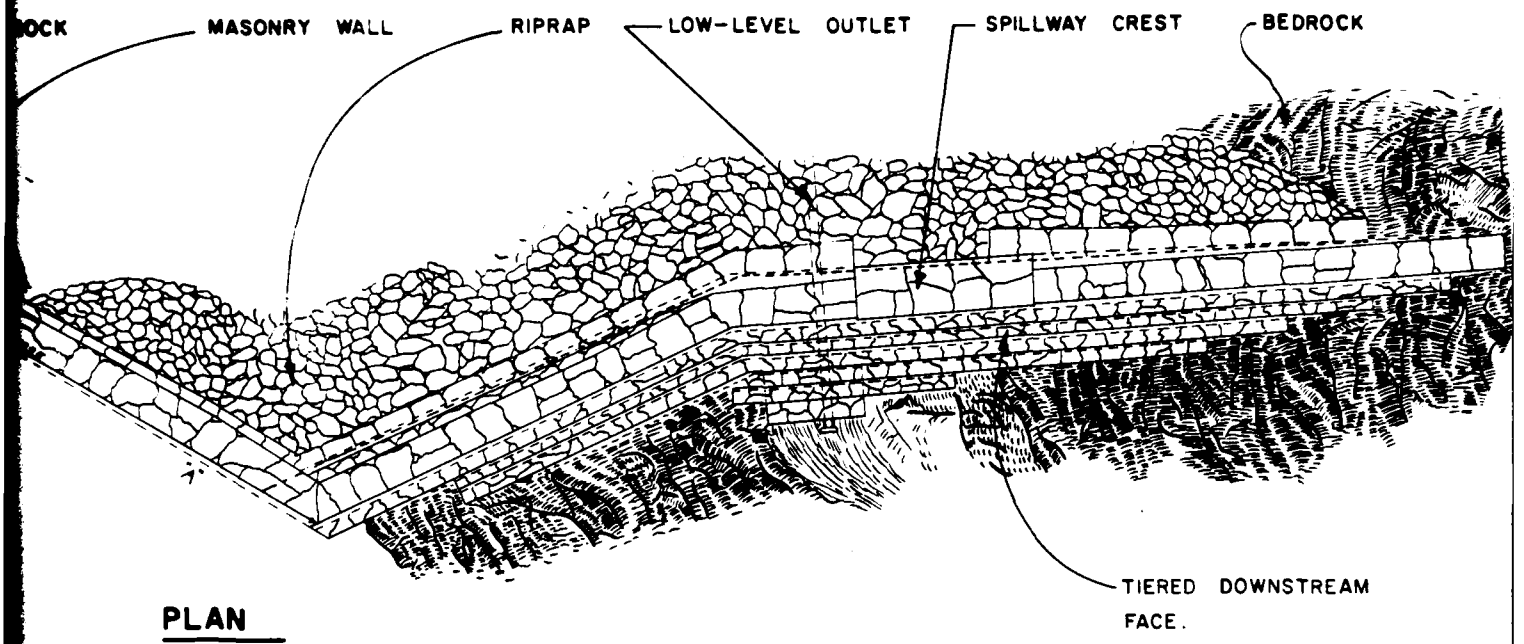
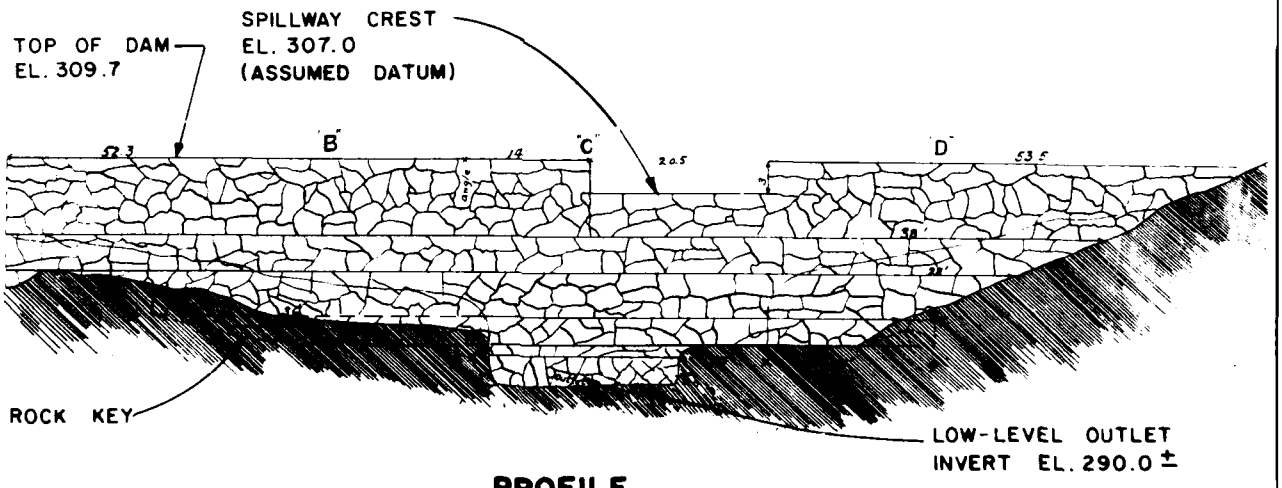


PLAN



PROFILE

NOTES :

1. THIS SHEET WAS COMPILED FROM AN ANONYMOUS, UNDATED DRAWING ENTITLED " PLAN OF OVERFLOW DAM AT STORAGE RESERVOIR OF BIRMINGHAM WATER CO. " SCALE : HORIZONTAL 1" = 10', VERTICAL 1" = 8'.

2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM, THEREFORE THE WATER SURFACE ELEVATION OF 307.0 FOR THE RESERVOIR SHOWN ON THE U.S.G.S. ANSONIA QUADRANGLE MAP WAS ASSUMED TO BE THE N.G.V.D. ELEVATION OF THE SPILLWAY CREST. ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION.

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

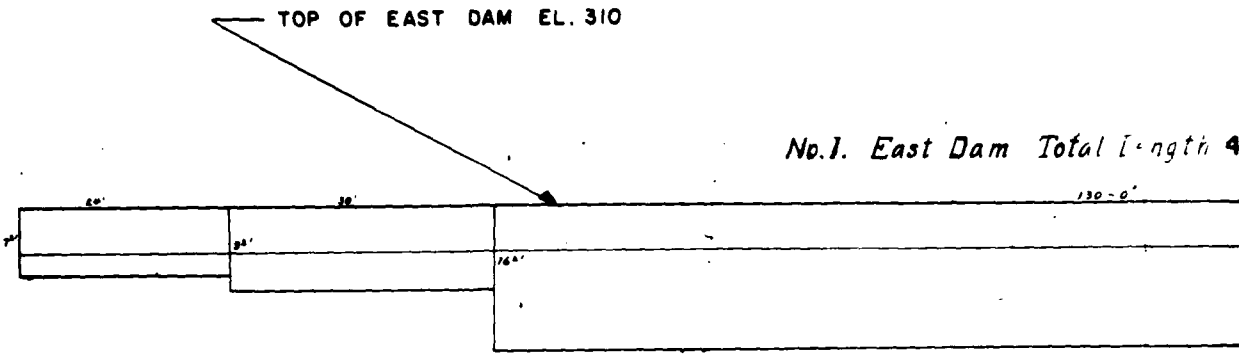
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

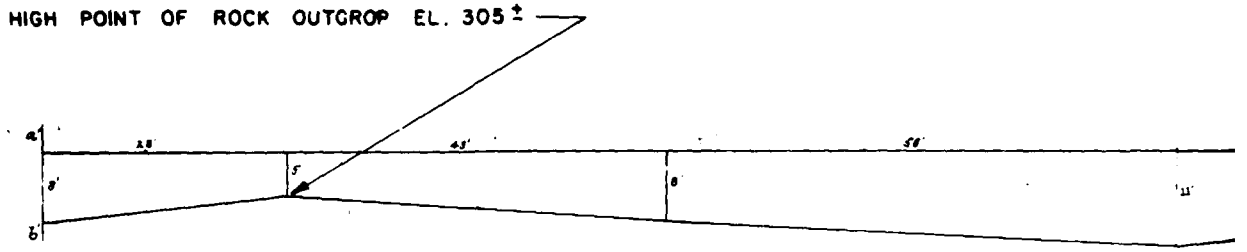
MAIN DAM - PLAN, PROFILE & SECTIONS

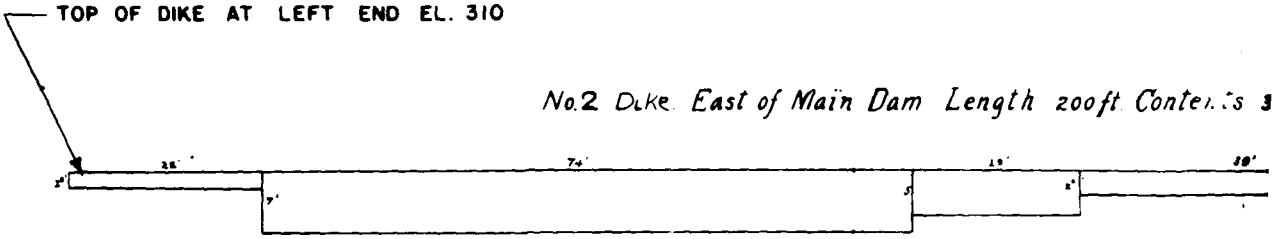
UPPER ANSONIA RESERVOIR DAM

TR - NAUGATUCK RIVER DERBY, CONNECTICUT

DWN. BY	CKD. BY	APP. BY	SCALE: H: 1" = 20', V: 1" = 16'
R.F.	TJS	PMA	DATE: SEPT 1980 SHEET 8 - 2





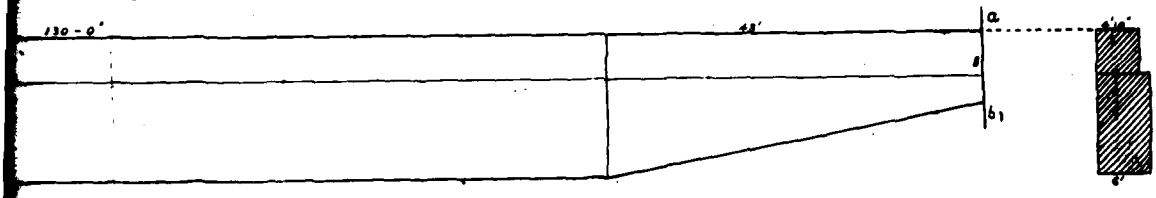


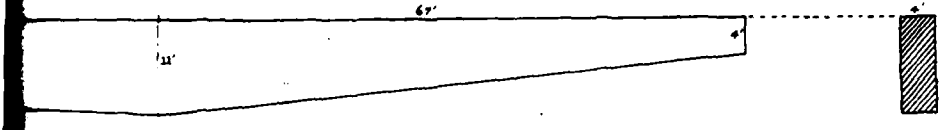
NOTES :

1. THIS SHEET WAS COMPILED FROM AN ANONYMOUS, UNDATED DRAWING ENTITLED " PLAN OF MASONRY IN ADDITION TO THAT OF MAIN DAM OF BIRMINGHAM WATER COS. STORAGE RESERVOIR " SCALE : 1" = 10'

2. NO ELEVATIONS WERE AVAILABLE FOR THE DAM. THEREFORE THE WATER SURFACE ELEVATION OF 307.0 FOR THE RESERVOIR SHOWN ON THE U.S.G.S. ANSON, A QUADRANGLE MAP WAS ASSUMED TO BE THE N.G.V.D. ELEVATION OF THE SPILLWAY CREST. ALL OTHER ELEVATIONS SHOWN ARE REFERENCED TO THE ASSUMED SPILLWAY CREST ELEVATION

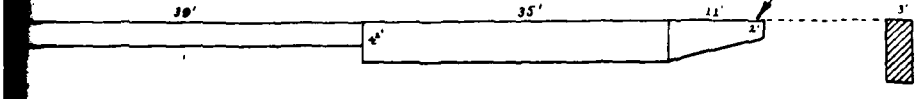
tal Length 423 *Contents* 23,556 *cu ft*





LOW POINT OF TOP OF DIKE
EL. 309.5

ft. Contents 3701 *cu. ft.*



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			
EAST DAM & DIKE — PROFILES			
UPPER ANSONIA RESERVOIR DAM			
TR - NAUGATUCK RIVER		DEEP B... BROOK OUT	
DWN BY	CKD. BY	APP. BY	SCALE: 1" = 20' H & V
R.F.	TSS		DATE: SEPT 1980
			SHEET B - 3

UPPER ANSONIA RESERVOIR DAM

EXISTING PLANS

"Capacity of Upper Reservoir - Derby Hill"
Birmingham Water Company
H.S. Whipple, Civil and Sanitary Engineer
Feb. 26, 1887

"Plan of Overflow Dam at Storage Reservoir of Birmingham Water Co."
anonymous
undated

"Plan of Masonry in addition to that of Main Dam of Birmingham Water Co's. Storage Reservoir
anonymous
undated

SUMMARY OF DATA AND CORRESPONDENCE

July 17, 1942 V. B. Carke

The Birmingham Water Company
Derby, Conn.

Dear Sirs:

Through your Engineer, Mr. Clarence M. Blair a request has been made for permission to install flash-boards on the #1 and #2 Dams at Derby Hill.

I have investigated this matter and permission is hereby granted for you to install these flash-boards not over 10 inches in height.

I believe you should make some provision so that if any appreciable amount of water flows over these flash boards they can be removed in sections so that there will not be over 10 inches of water over the masonry spillway.

Very truly yours,

Engineer, for
State Board of Supervision of Dams

VBC:M

Copies to: C.M. Blair, Engineer
General Sanford B. Wadhams, Chairman

7

CT 29

STATE BOARD FOR THE SUPERVISION OF DAMS
INVENTORY DATA

NAME OF DAM OR POND Ansonia Res

CODE NO. [illegible]

LOCATION OF STRUCTURE:

Town Derby

Name of Stream Tributary to Naugatuck

U.S.C.S. Quad. Ansonia Long. 73-4.7 Lat. 41-21.3

OWNER: Ansonia Derby Water Company

Address Derby CT 06483

Telephone

Pond Used For: Reservior Da 0.155M

Dimensions of Pond: Width _____ Length _____ Area 31.3

Depth of Water below Spillway Level (Downstream) 7

Total Length of Dam _____ Length of Spillway _____

Height of Abutments above Spillway 3

Type of Spillway Construction _____

Type of Dike Construction _____

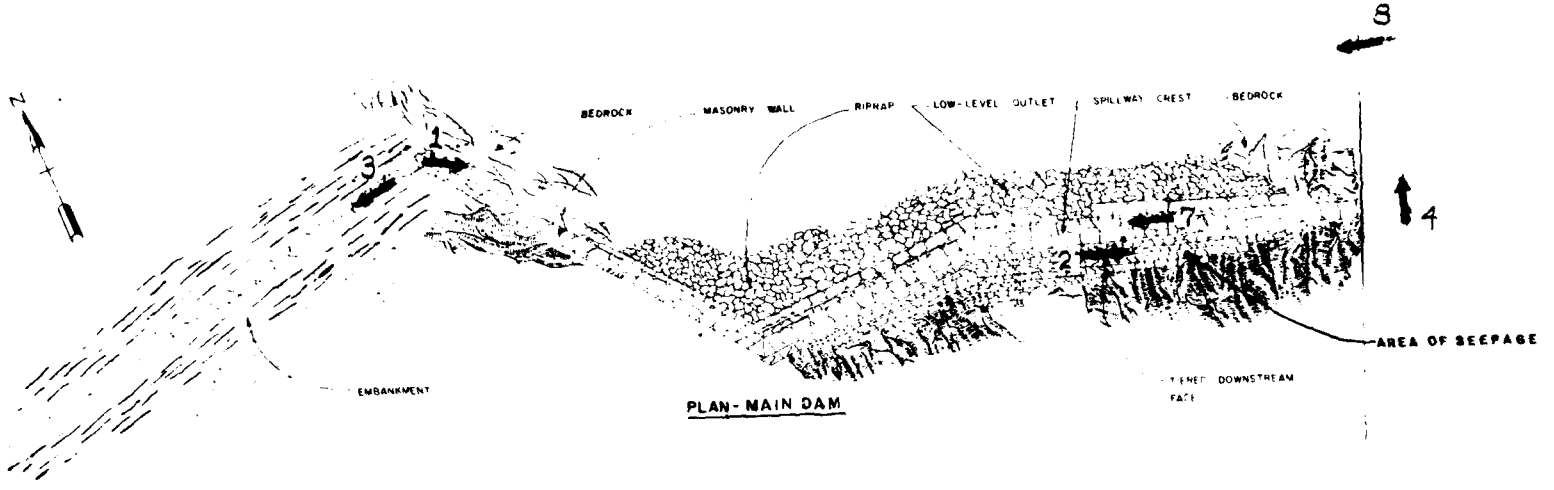
Downstream Conditions _____

Summary of File Data _____

Remarks This pond was formed by construction of two dikes and a dam. It is a structure of major importance and Board Member should inspect it or at least obtain information from Water Company.

APPENDIX C

DETAIL PHOTOGRAPHS



PLAN - MAIN DAM

1 PHOTO NUMBER AND DIRECTION

NOTE: PHOTOS 5 & 6 ARE OF THE EAST DAM & ARE NOT SHOWN ON THIS PLAN.

PHOTO LOCATION PLAN

UPPER ANSONIA RES. DAM

SHEET C-1

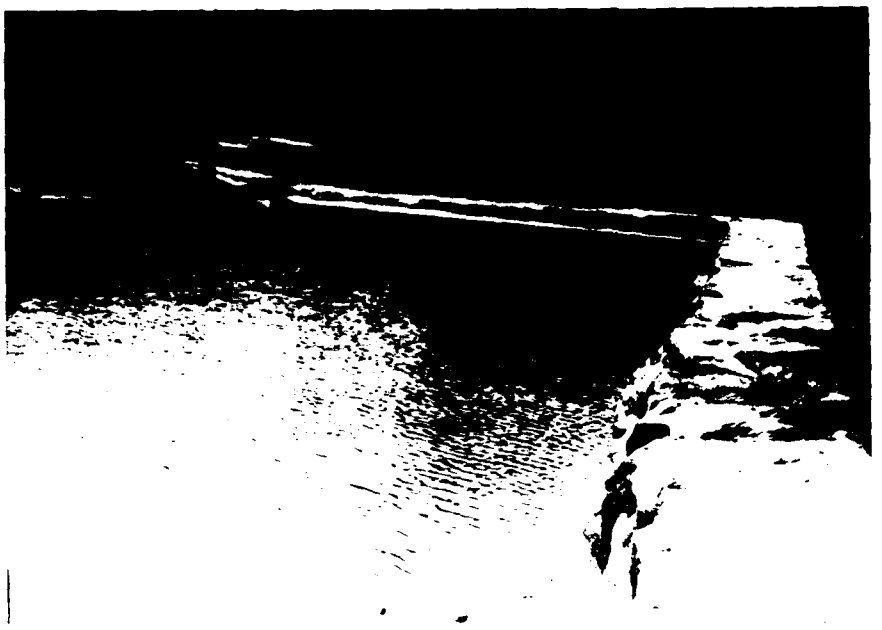


Photo 1 - Upstream face and top of Main Dam (8/8/80).

Photo 2 - Seepage and vegetation on downstream face of Main Dam (8/8/80).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS. AHN ENGINEERS, INC WALLINGFORD, CONN ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Upper Ansonia Pond Tr- Naugatuck River Derby, Connecticut DATE Sept. 1980

Photo 3 - Right end of Main Dam, looking [illegible] dense vegetation on downstream slope [illegible] (3/8/80).

Photo 4 - Dike to left of Main Dam (3/8/80).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS CAHN ENGINEERS INC [illegible] ENGINEER	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	Upper Ansonia Res. for Ir-Naugatuck River Derby, Connecticut CE # 27 735 [illegible] DATE Sept. '80 PAGE

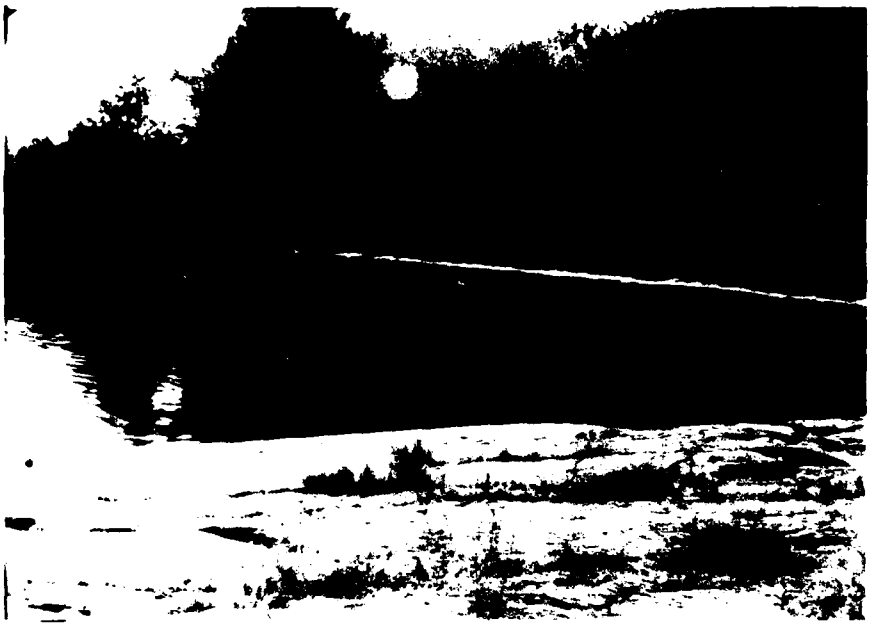


Photo 5 - Upstream face of left section of East Dam (8/8/80).

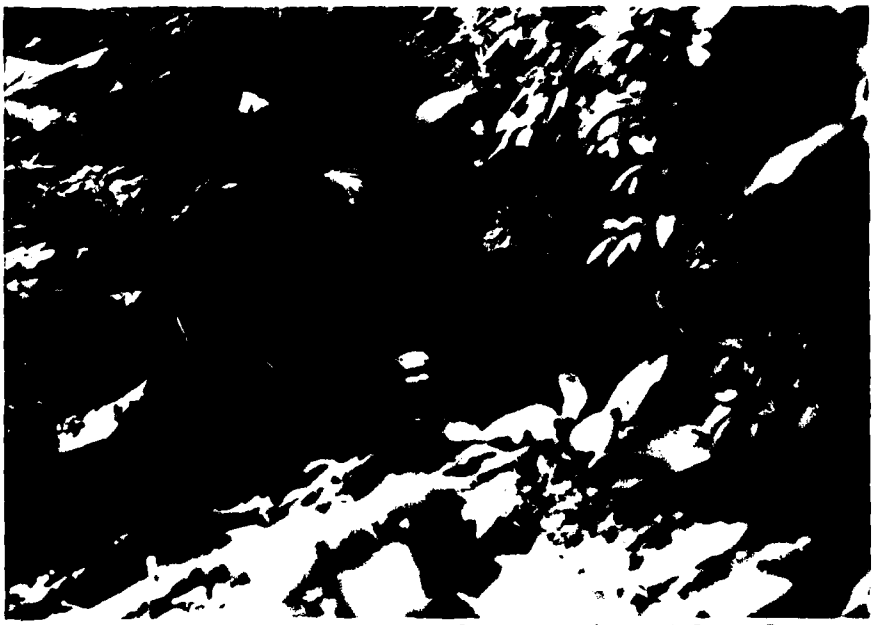


Photo 6 - Seepage at toe of left section of East Dam (8/8/80).

US ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	NATIONAL PROGRAM OF	Upper Ansonia Res. Dam Tr-Naugatuck River Derby, Connecticut CE # 27 785 KC DATE Sept. '80 PAGE C-5
CAHN ENGINEERS INC WALLINGFORD, CONN ENGINEER	INSPECTION OF NON-FED. DAMS	

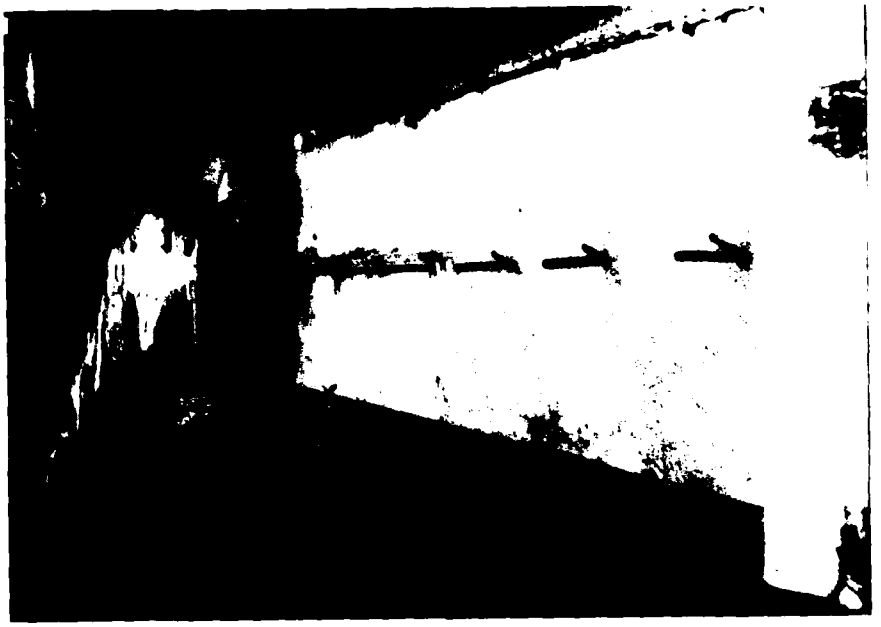


Photo 7 - Spillway crest (8/8/80).

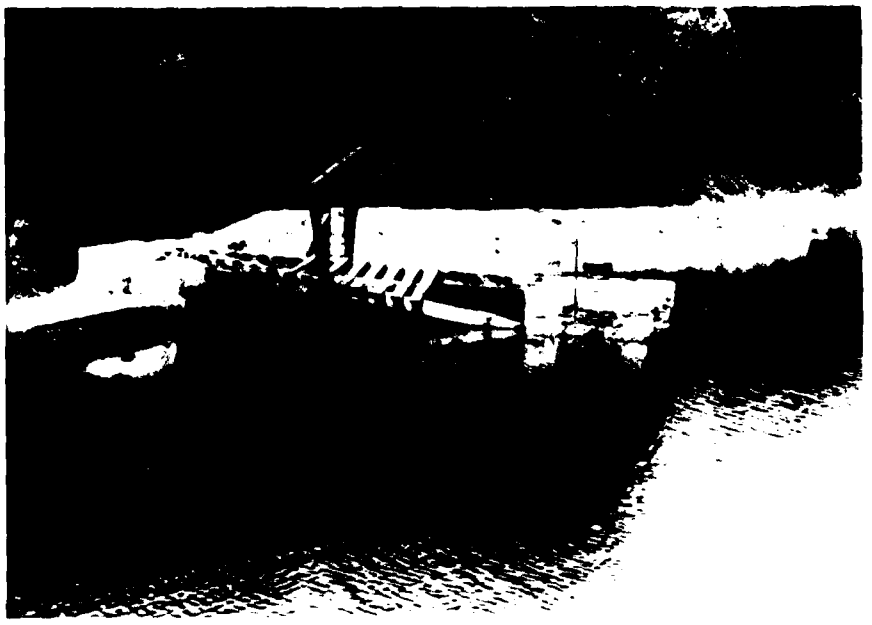
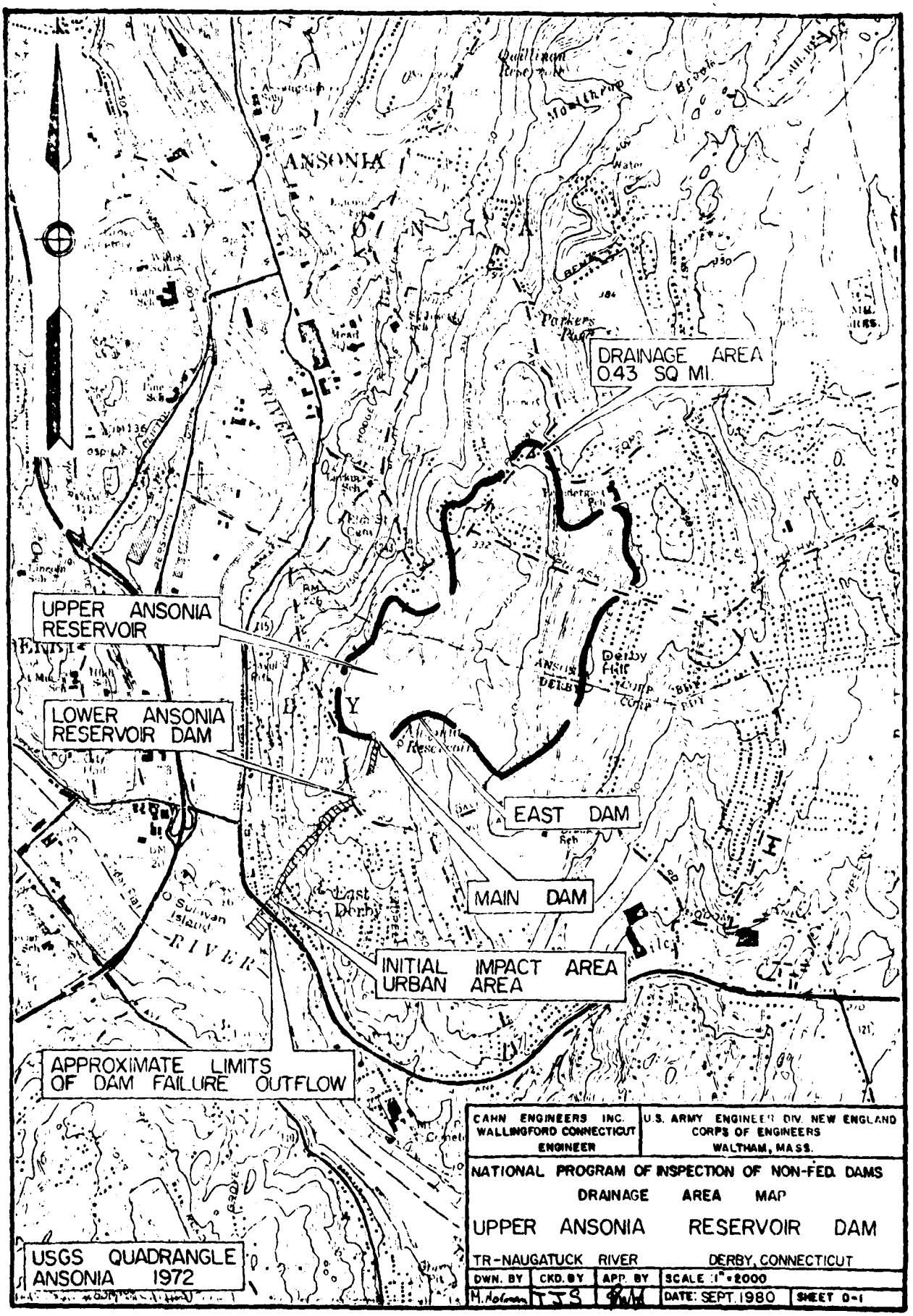


Photo 8 - Intake structure and service bridge (8/8/80).

APPENDIX D

HYDRAULICS/HYDROLOGIC COMPUTATIONS



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

UPPER ANSONIA RESERVOIR DAM

TR-NAUGATUCK RIVER DERBY, CONNECTICUT

DWN. BY	CKD. BY	APP. BY	SCALE 1" = 2000	
M. Holman	TJS	[illegible]	DATE: SEPT. 1980	SHEET 0-1

HYDROLOGIC/HYDRAULIC INSPECTION

UPPER ANSONIA (DERBY) RESERVOIR, DERBY, CT.

I) PERFORMANCE AT PEAK FLOOD CONDITIONS

1) PROBABLE MAXIMUM FLOOD (PMF)

a) WATERSHED CLASSIFIED AS "ROLLING" TO "MOUNTAINOUS"

b) WATERSHED AREA: D.A. = 2.43 SQ MI

NOTE: D.A. FROM CONN. D.E.P. BULLETIN No. 1, 1972 (GAZETTEER OF NATURAL DRAINAGE AREAS), p. 66

c) PEAK FLOODS (FROM NED-ACE GUIDELINES - GUIDE CURVES FOR PMF)

i) FROM GUIDE CURVES BY EXTRAPOLATION TO D.A. < 2 SQ MI

$$CSM \doteq 2800 \text{ CFS/SQ MI}$$

ii) PMF = $2800 \times 0.43 = \underline{1200}$ CFS

iii) ½ PMF = $\underline{600}$ CFS

2) SURCHARGE AT PEAK INFLOWS (PMF AND ½ PMF)

a) OUTFLOW RATING CURVE

(1) SPILLWAY AND OUTFLOW PROFILE FOR SURCHARGES OVERTOPPING THE DAM.

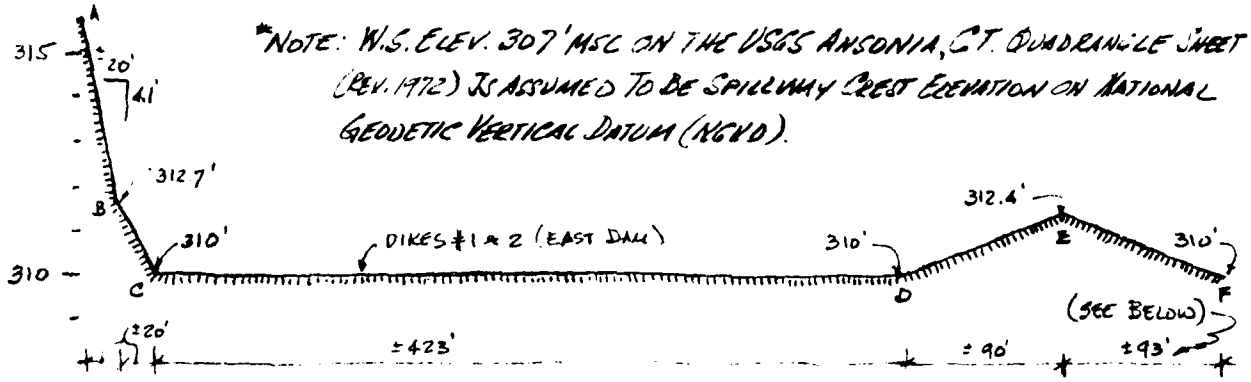
SPILLWAY (1) 20.5' LONG, BROAD CRESTED (W ≈ 5.7'), VERTICAL FACES. STONE MASONRY DAM AND DIKES AT VARIOUS LOCATIONS ALONG THE LAKE SHORE AND ALSO, OTHER TERRAIN DEPRESSIONS (ALONG PRINDLE AVE.) WHICH ARE POTENTIAL OVERFLOW AREAS. (SEE OVERFLOW PROFILE(S) p. D.2).

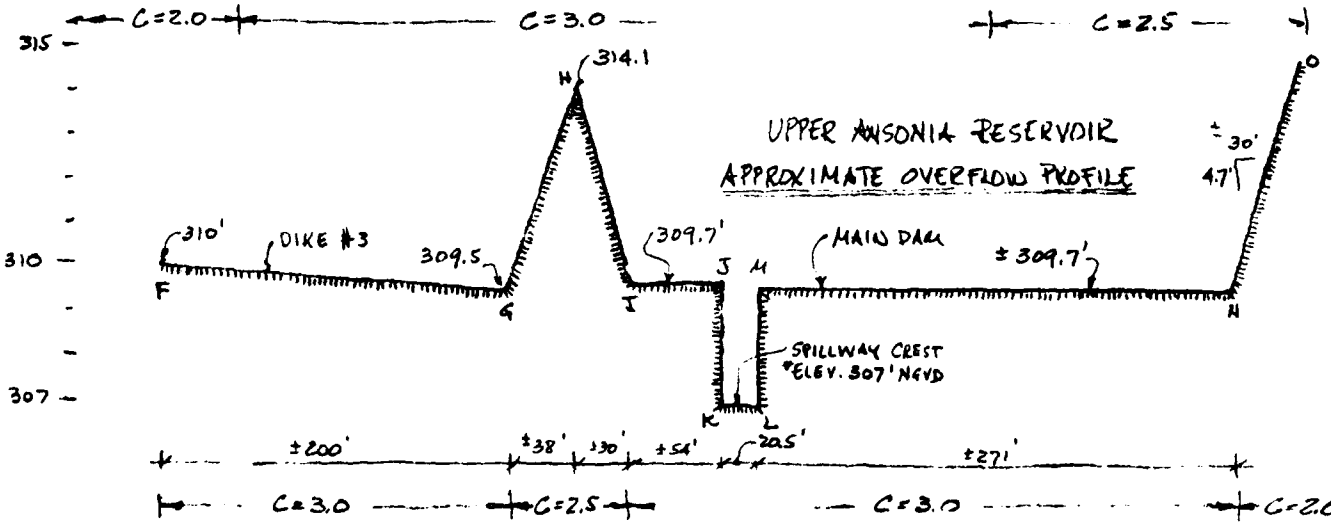
Cahn Engineers Inc. — Consulting Engineers

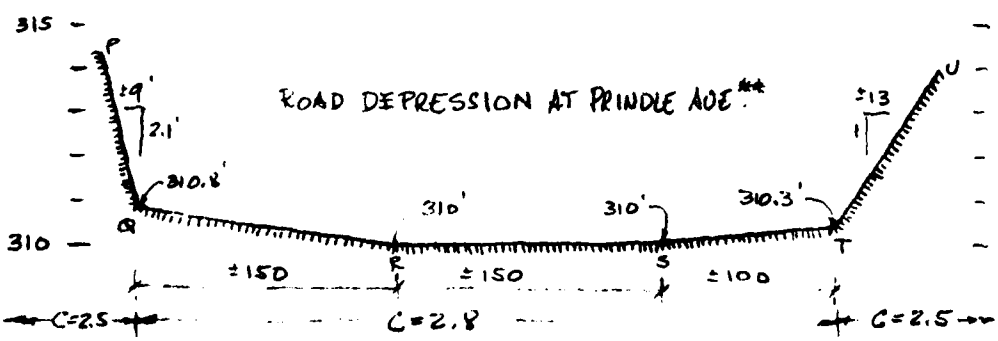
Project: NON-FEDERAL DAMS INSPECTION — Sheet D-2 of 14
Computed By: [illegible] — Checked By: CAR — Date: 7/15/80
Field Book Ref. — Other Refs. CE#27-785-HA — Revisions

ASSUME C=3.0 FOR THE SPILLWAY, DAM AND MASONRY DIKES OVERFLOW, C=2.8 FOR OVERFLOW ALONG THE PAVED ROAD DEPRESSION ON PRINDLE AVE AND C=2.5 AND C=2.0 FOR THE ADJACENT TERRAIN OVERFLOW, DEPENDING UPON THE KIND AND THICKNESS OF THE GROUND COVER (SEE FLOWFIELDS) BELOW).

*NOTE: W.S. ELEV. 307' MSL ON THE USGS ANSONIA, CT. QUADRANGLE SHEET (REV. 1972) IS ASSUMED TO BE SPILLWAY CREST ELEVATION ON NATIONAL GEODETIC VERTICAL DATUM (NGVD).







** OTHER POSSIBLE OVERFLOWS TO PRINDLE AVE ARE ABOVE (±) ELEV. 315 AND THEREFORE ASSUMED TO BE BEYOND MAX. FLOOD WATER LEVELS.

DATA FROM ANSONIA WATER CO. MAPS "PLAN OF OVERFLOW DAM AT STORAGE RESERVOIR OF BIRMINGHAM WATER CO." AND "PLAN OF MASONRY IN ADDITION TO THAT OF MAIN DAM OF BIRMINGHAM WATER CO." AND C.E. OBSERVATIONS ON 5/20/80 BY [illegible] P.E.

4) FROM INSPECTION OF THE OVERFLOW PROFILE (P. D-2) IT IS EVIDENT (-)
BOOSE THE MINIMUM HEAD TO PASS THE PMF = 1700 CFS IS ABOUT
THEREFORE THE OVERFLOW RATING CURVE FOR THE CAUSE OF FLOOD OVER
"HALIFAX" CONSIDERED CAN BE APPROXIMATED AS FOLLOWS:

1') SECTION BC*: $Q_{BC} = 0.4 \times {}^{30}/_{3.0} \times 2.0(H-3)^{3/2} = \underline{1.73(H-3)^{3/2}}$, $H \leq 5.7'$

2') SECTION CD (DIKES #1 & #2):
$Q_{CD} = 3.0 \times 423 (H-3)^{3/2} = \underline{1270(H-3)^{3/2}}$

3') SECTION DEF: $Q_{DEF} = 0.4 \times {}^{183}/_{24} \times 2.5 (H-3)^{5/2} = \underline{76.3 (H-3)^{5/2}}$; $H \leq 5.4'$

4') SECTION FG (DIKE #3):
$(Q_{FG})_1 = 0.4 \times 400 \times 3.0 (H-2.5)^{5/2} = \underline{480(H-2.5)^{5/2}}$; $H \leq 3.0'$

$(Q_{FG})_2 = 480 [(H-2.5)^{5/2} - (H-3)^{5/2}]$; $H > 3.0'$

5') SECTION GH: $Q_{GH} = 0.4 \times {}^{38}/_{4.6} \times 2.5 (H-2.5)^{5/2} = \underline{8.26 (H-2.5)^{5/2}}$, $H \geq 3.1'$

6') SECTION HI: $Q_{HJ} = 0.4 \times {}^{30}/_{4.4} \times 2.5 (H-2.7)^{5/2} = \underline{6.82 (H-2.7)^{5/2}}$, $H \geq 3.1'$

7') SECTIONS IJ AND MN (MAIN DAM):
$Q_{IJ,MN} = 3.0 \times 325 (H-2.7)^{3/2} = \underline{975 (H-2.7)^{3/2}}$

8') SPILLWAY (SECTION KL):
$Q_S = Q_{KL} = 3.0 \times 20.5 H^{3/2} = \underline{61.5 H^{3/2}}$

9') SECTION NO: $Q_{NO} = 0.4 \times {}^{30}/_{4.7} \times 2.0 (H-2.7)^{5/2} = \underline{5.11 (H-2.7)^{5/2}}$

*NOTE FLOW OVER JOINED SECTIONS BY APPLICATION OF FORMULA GIVEN BY THE USGS ON "MEASUREMENT OF PEAK DISCHARGE AT DAMS BY INDIRECT METHODS" BY H. HULSING (APPLICATIONS OF HYDRAULICS).

$Q = \frac{2CL}{5(h_a - h_b)} \left[h_a^{5/2} - h_b^{5/2} \right]$ WHERE: Q = DISCH ; C = DISCH. COEFF ; L = LENGTH ; h_a & h_b = TOTAL HEAD REFERRED TO HIGHER & LOWER ENDS OF WEIR RESPECTIVELY

PRINDLE AVE. - ROAD DEPRESSION):

10') SECTION PQ: $Q_{PQ} = 2.1 \times {}^{9}/_{2.1} \times 2.5 (H-3.8)^{5/2} = \underline{4.29(H-3.8)^{5/2}}$

11') SECTION QR: $(Q_{QR})_1 = 0.4 \times {}^{150}/_{0.8} \times 2.8 (H-3)^{5/2} = \underline{210(H-3)^{5/2}}$; $H \leq 3.8'$

$(Q_{QR})_2 = \underline{210\left[(H-3)^{5/2} - (H-3.8)^{5/2}\right]}$; $H > 3.8'$

12') SECTION RS: $Q_{RS} = 2.8 \times 150 (H-3)^{3/2} = \underline{420(H-3)^{3/2}}$

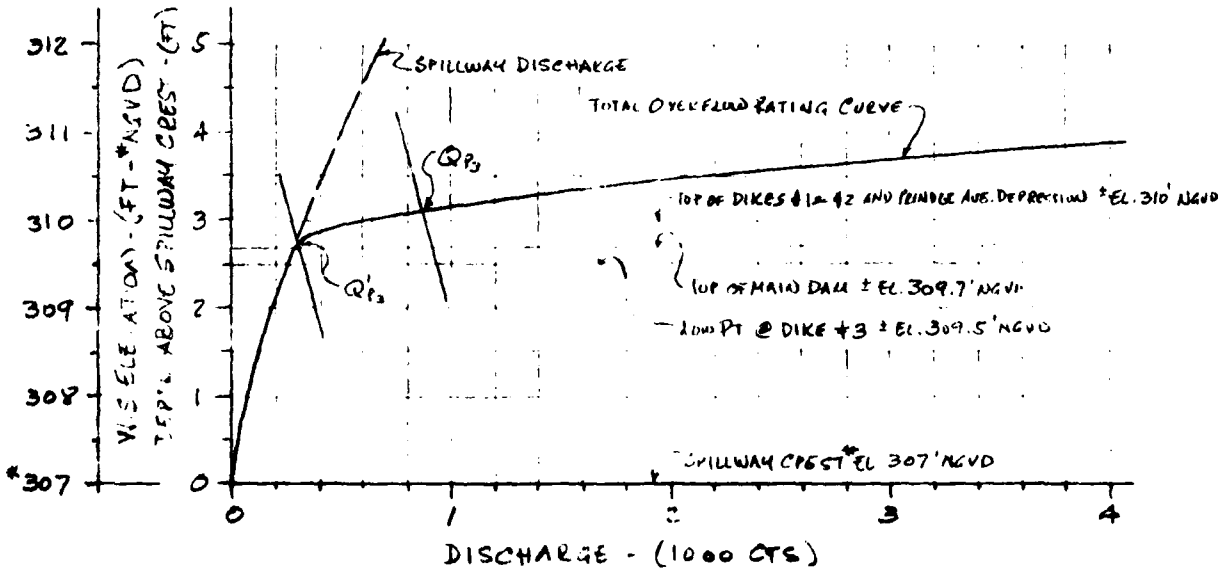
13') SECTION ST: $(Q_{ST})_1 = 0.4 \times {}^{100}/_{0.3} \times 2.8 (H-3)^{5/2} = \underline{373(H-3)^{5/2}}$; $H \leq 3.3'$

$(Q_{ST})_2 = \underline{373\left[(H-3)^{5/2} - (H-3.3)^{5/2}\right]}$; $H > 3.3$

14') SECTION TU: $Q_{TU} = 0.4 \times 13 \times 2.5 (H-3.3)^{5/2} = \underline{13(H-3.3)^{5/2}}$

THE TOTAL OVERFLOW IS APPROXIMATED BY THE SUM OF ALL THE APPLICABLE FORMULAE ON ITEMS (1') THRU (14').

iii) UPPER ANSONIA RESERVOIR DAM - OUTFLOW RATING CURVE



*SEE NOTE p. D-2

b) SURCHARGE HEIGHTS TO PASS PEAK INFLOWS (Q_I & Q'_I)

c) @ Q_I - PMF = 1200 CFS $H_1 \doteq 5.2'$

d) @ $Q'_I = \frac{1}{2}$ PMF = 600 CFS $H'_1 \doteq 3.0'$

c) EFFECT OF SURCHARGE STORAGE - PEAK OUTFLOWS

1) AVE LAKE AREA ($\bar{A}$) WITHIN EXPECTED SURCHARGE

1') LAKE AREA AT FLOWLINE (EL 307' NGVD)* $A_{WL} = 34.0$ AC

2') AREA AT CONTOUR 310' NGVD (USGS)* $A_{310} = 41.3$ AC

∴ AVE AREA WITHIN EXPECTED SURCHARGE (±)3' $\bar{A} = 37.7$ AC

*NOTE AREAS FROM USGS ANSONIA, CT. QUAD. SHEET (REV 1972) SCALE 1"=2000' - SAME PORTION OF RESERVOIR (BELOW ANSONIA DERBY TOWN BOUNDARY) MEASURED @ 37.7 AC. THIS IS EQUAL TO THE AREA GIVEN ON ANSONIA WATER CO. DRAWING "RESERVOIR No. 3" BY H.S. WHIPPLE, DATED 2/26/1887. - (SEE CURVE P. D-6)

ii) ASSUME NORMAL POOL AT FLOWLINE ELEV. 307' NGVD

iii) VARIENCE: $\Delta H \doteq 2.43$ FT/MI (SEE P. D-1)

iv) PEAK OUTFLOWS (Q_{I_3} & Q'_{I_3})

(DETERMINED ON THE OUTFLOW RATING CURVE P. D-4, BY USING THE ANNUAL ROUTING NED-ACE GUIDELINE: "SURCHARGE-STORAGE ROUTING" ALTERNATE METHOD AND 19" MAX. PROBABLE P.O. IN NEW ENGLAND)

** $Q_{I_3} \doteq 870$ CFS $H_3 \doteq 3.14'$ SAY, $H_3 \doteq 3.1'$ (ELEV 310.1' NGVD)

$Q_{I_3} \doteq 310$ CFS $H'_3 \doteq 2.8'$ (ELEV 309.8' NGVD)

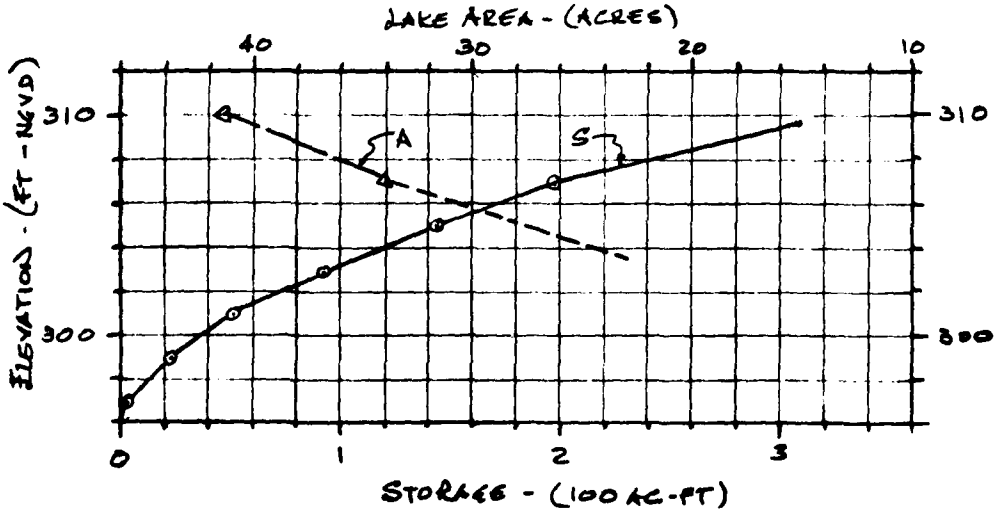
** (±) 30 CFS THROUGH ROAD DEPRESSION AT PRINDLE AVE (± ELEV. 310 NGVD)

3) SPILLWAY CAPACITY RATIO TO PEAK OUTFLOWS:

SPILLWAY CAPACITY TO:	SURCH* H (FT)	W.S. ELEV. (FT-NGVD)	SPILLWAY CAPACITY (CFS)	SPILLWAY CAPACITY AS % OF PEAK OUTFLOWS	
				Q_{PF} (870 CFS)	Q'_{PF} (310 CFS)
LOW POINT**	2.5	309.5	240	28	77
TOP OF DAM	2.7	309.7	270	31	87
1/2 PMF	2.8	309.8	290	—	94
PMF	3.1	310.1	340	39	—

*SURCHARGE ABOVE THE SPILLWAY CREST
**LOW POINT AT DIKE #3 (SEE PROFILE P. D-2)

4) RESERVOIR AREA/STORAGE CURVES - UPPER ANSONIA RESERVOIR



⊙DATA FROM ANSONIA WATER CO. DWG. "RESERVOIR NO 2" BY H.G. WHIPPLE, DATED 2/26/1887
△AREAS FROM USGS ANSONIA, CT. QUAD. SHEET (REV. 1972)
NOTE - SEE PP. D-5 (AREAS) AND D-11 (STORAGE)

UPPER ANSONIA RESERVOIR DAM

II) DOWNSTREAM FAILURE HAZARD

1) POTENTIAL IMPACT AREA

UPPER ANSONIA RESERVOIR IS LOCATED (±) 500' U/S FROM THE LOWER RESERVOIR. BOTH DISCHARGE INTO AN UNNAMED STREAM WHICH INITIALLY, RUNS PARALLEL TO HIGH ST., DERBY, FOR (±) 500'. THEN, AFTER FALLING (±) 200' ON A VERY STEEP COURSE, (±) 1200' LONG, THE STREAM IS PIPED UNDER A FULLY DEVELOPED, LOWER SECTION OF DERBY TO ITS OUTLET IN THE NAUGATUCK RIVER. ONLY ONE HOUSE WITH FIRST FLOOR ELEV. OF (±) 8.6' ABOVE THE STREAM IS LOCATED ON HIGH ST. THE LOWER SECTION OF DERBY CONTAINS, HOWEVER, NUMEROUS HOMES AND THEREFORE, IT IS CONSIDERED TO BE A POTENTIAL IMPACT AREA IN CASE OF FAILURE OF THE DAM.

2) FAILURE AT UPPER ANSONIA RESERVOIR DAM.

ASSUME DISCHARGE TO TOP OF DAM ELEV. 301.7' NGVD.

FAILURE AT UPPER ANSONIA RESERVOIR DAM COULD OCCUR AT EITHER THE MAIN DAM OR AT ONE OF THE DIKES FORMING THE RESERVOIR. HOWEVER, THE FLOOD PRODUCED BY FAILURE OF ANY OF THESE STRUCTURES WILL AFFECT ESSENTIALLY THE SAME U/S AREA. THEREFORE, CONDITIONS AT THE IMPACT AREAS WILL BE ONLY ANALYZED FOR THE LARGEST FLOOD FLOW PRODUCED BY FAILURE OF ONE OF THESE STRUCTURES.

a) FAILURE OF MAIN DAM:

i) HEIGHT OF DAM* $H_d = 20.8'$ (STREAMBED ELEV. (±) 288.9' NGVD)

ii) MID-HEIGHT LENGTH* $\ell_d = 61'$

*FROM ANSONIA WATER CO. MAPS AND C.E. FIELD MEASUREMENTS ON 5/20/80 BY HH & EJ.

(iii) BREACH WIDTH (MAIN DAM) - (SEE NED ACE 2/5 DAM FAILURE GUIDELINES

$W_b = 3.4 \times 61 = 20.4'$: ASSUME $W_{b_0} = \underline{\underline{21.4'}}$

(iv) ASSUMED WATER DEPTH AT TIME OF FAILURE: $Y_0 = \underline{\underline{20.6'}}$
(LOW PT. @ DIKE #3)

v) SPILLWAY DISCHARGE AT TIME OF FAILURE: $Q_S = 240$ CFS (SEE P. D-6)

vi) BREACH OUTFLOW (SEE NED ACE GUIDELINES)

$$Q_{b_0} = \frac{8}{27} W_b \sqrt{g}\, Y_0^{3/2} = 3840 \text{ CFS}$$

vii) PEAK FAILURE OUTFLOW $(Q_{P_1})_3$ (MAIN DAM) TO LOWER ANSONIA RESERVOIR

$(Q_{P_1})_0 = Q_S + Q_{b_0} = 4080$ CFS SAY, $(Q_{P_1})_0 = \underline{\underline{4100}}$ CFS

viii) FLOOD DEPTH* IMMEDIATELY D/S FROM MAIN DAM.

$Y_D = 0.44 \times Y_0 = \underline{\underline{9.1'}}$

*(FROM RETREATING WAVE THEORY APPLIED TO DAM FAILURE)

b) FAILURE OF DIKE #1 ("EAST DAM")

i) HEIGHT OF DIKE**: $H_{DK_1} = 16.2'$

ii) MID HEIGHT LENGTH**: $L_{DK_1} = 500'$

iii) BREACH WIDTH - (SEE NED-ACE GUIDELINES)

$W_{BK_1} = 0.4 \times 500 = 80'$: ASSUME $W_{b_{DK_1}} = \underline{\underline{80'}}$

** FROM ANSONIA WATER CO. MAPS AND C.E. FIELD MEASUREMENTS ON 5/28/80.
(DIKE #1 IS CALLED "EAST DAM" OR "WALL #1" ON THE ORIGINAL DRAWINGS).

(c) ASSUMED LAKE DEPTH AT TIME OF FAILURE (DIKE #1): $Y_{o_{DK_1}} = 15.7'$
(CREST TO LOW PT. @ DIKE #3; EL. 302.5' – TOP OF DIKE EL. 318.2')

(d) SPILLWAY DISCHARGE AT TIME OF FAILURE: $Q_{s} = 240^{cfs}$ (SEE PP. D-6 & D-8)

(e) BREACH OUTFLOW (SEE NED-ACE GUIDELINES)

$$Q_{b_{DK_1}} = \frac{8}{27} W_b \sqrt{g}\, Y_o^{3/2} = 8370^{cfs}$$

(f) PEAK FAILURE OUTFLOW $(Q_{P_1})_{DK_1}$ (DIKE #1) TO LOWER ANSONIA RESERVOIR.

$$(Q_{P_1})_{DK_1} = Q_s + Q_{b_{DK_1}} = 8610^{cfs} \quad \text{SAY, } (Q_{P_1})_{DK_1} = \underline{8600}^{cfs}$$

(g) FLOOD DEPTH IMMEDIATELY D/S FROM DIKE #1.

$$Y_{DK_1} = 0.44\, Y_o = \underline{6.9'}$$

BECAUSE THE REMAINING DIKES ARE BOTH, LOWER AND SHORTER AT MID-HEIGHT, THE PEAK OUTFLOWS RESULTING FROM THEIR FAILURE, ARE LESS CRITICAL THAN THE PEAK FLOW ESTIMATED ABOVE FOR DIKE #1.

3) ESTIMATE OF D/S FAILURE CONDITIONS AT POTENTIAL IMPACT AREA.

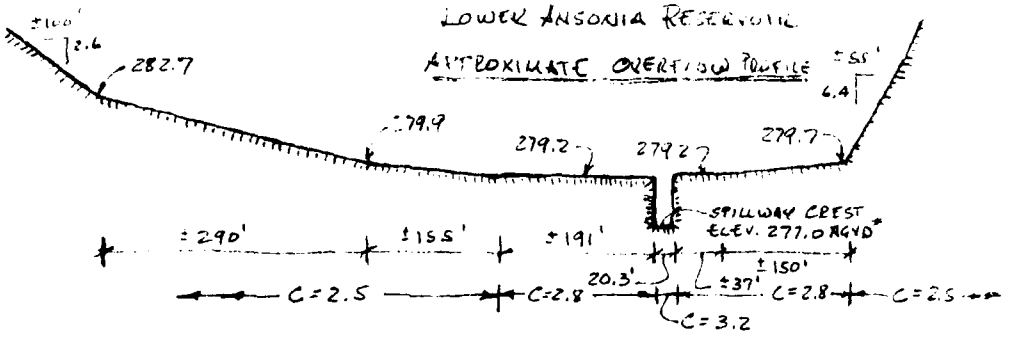
(SEE NED-ACE GUIDELINES FOR ESTIMATING D/S FAILURE HYDROGRAPHS)

a) PEAK FLOW REDUCTION BY CHANNEL STORAGE IN THE CHANNEL REACH (500' TO 700' LONG) CONNECTING THE UPPER AND LOWER RESERVOIRS WILL BE NEGLECTED. THEREFORE, PEAK INFLOW TO LOWER ANSONIA RESERVOIR UPON FAILURE OF THE UPPER ANSONIA DAM (ACCURACY THE DIKE #1) IS APPROX. $(Q_{P_1})_{LA} = \underline{8600}^{cfs}$

FROM DATA ON THE ANSONIA WATER CO. DWG "PLAN AND ELEVATION OF DAM AT THE LOWER RESERVOIR OF THE BIRMINGHAM WATER CO." AND "RESERVOIR NO. 1" AND C.C. FIELD OBSERVATIONS ON 5/28/80, THE LOWER ANSONIA RESERVOIR DAM - OVERFLOW

PROFILE AND CORRESPONDING RATING CURVE ARE APPROXIMATED AS FOLLOWS (SEE ALSO, C.E H/H CALC. FOR LOWER ANSONIA RESERVOIR PHASE I INSPECTION REPORT)

a) OVERFLOW PROFILE

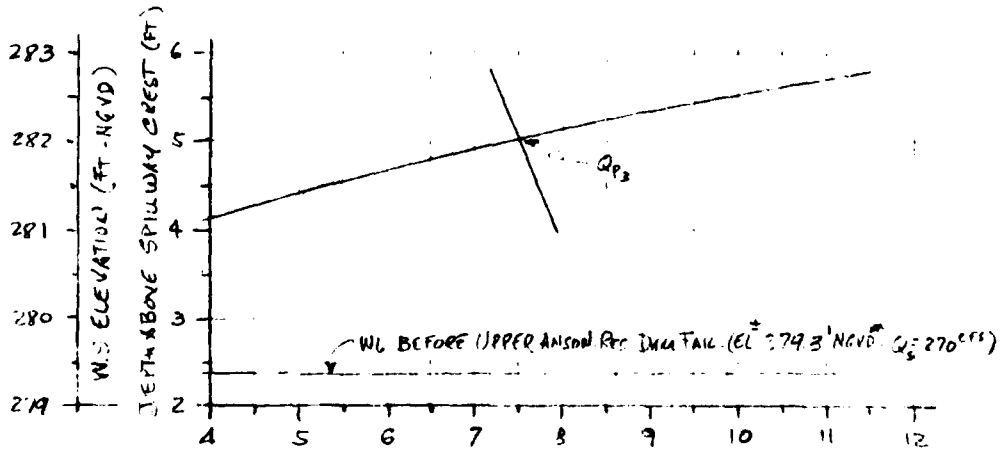


*NOTE: W.S. ELEV. 277' MSL ON THE USGS ANSONIA, CT QUAD. SHEET (REV. 1972) IS ASSUMED TO BE SPILLWAY CREST ELEVATION ON NATIONAL GEODETIC VERTICAL DATUM (NGVD)

b) RATING CURVE

THE TOTAL OVERFLOW IS APPROXIMATED BY THE FOLLOWING EQUATION AND RATING CURVE (SEE SIMILAR DEVELOPMENT ON PP. D-3 & D-4)

$$Q = 65H^{3/2} + 638(H-2.2)^{3/2} + 557(H-2.2)^{5/2} - 327(H-2.7)^{5/2} - 117(H-2.9)^{5/2} - 6[illegible]$$



*W.S EL. 297.3 NGVD ≡ (±) TOP OF DAM.

THE CHANNEL "A" FROM THE ANSONIA RESERVOIRS IS DIVIDED IN 3 REACHES (SEE P. D-7, SECT. 1). THE 1ST REACH IS (±) 500' LONG, V-SHAPED WITH (±) 15H AND 5H TO 1V SIDE SLOPES AND AVE. REACH SLOPE OF 3.5%. THE 2ND REACH IS VERY STEEP (±) 18% SLOPE, (±) 1200' LONG AND V-SHAPED WITH (±) 3H TO 1V SIDE SLOPES. THE LOWER REACH WHERE THE STREAM IS PIPED, FORMS A VALLEY (±) 100' WIDE WITH (±) 10H TO 1V SIDE SLOPES, AND WITH AVE. REACH SLOPE OF (±) 2%. NO REDUCTION TO PEAK FLOWS, BECAUSE OF CHANNEL STORAGE, IS CONSIDERED IN THIS CHANNEL. (ASSUME $n = 0.070$ FOR ALL 3 REACHES AT FLOOD STAGE)

b) UPPER ANSONIA RESERVOIR STORAGE AT TIME OF FAILURE:

$$S_{MAX} \cong 310^{AC-FT}$$

(FROM STORAGE DATA ON THE ANSONIA WATER CO. DWG. "RESERVOIR NO 2" BY H.S. WHIPPLE, DATED FEB. 26, 1887: $S_{NL} = 64^{MG} \cong 196^{AC-FT}$ AND C.E. SURCHARGE STORAGE TO TOP OF DAM ESTIMATE $S_o \cong 113^{AC-FT}$) - SEE CURVE P. D-6

C) APPROXIMATE STAGE & FLOW DRAIN AFTER FAILURE:

c') LOWER ANSONIA RESERVOIR:

PEAK INFLOW TO L.A.R.: $(Q_{P_{I,LA}} \cong 8600^{CFS}$ (see p. D-9)

FROM C.E. AREA/SURCH STORAGE ESTIMATES OF LOWER ANSONIA RES.:
AVE. AREA BETWEEN ELEV. 277' AND 285' NGVD: $\bar{A}_1 = 10.3^{AC}$
AVE. AREA BETWEEN ELEV. 280' AND 290' NGVD: $\bar{A}_2 = 15.2^{AC}$
SURCH STORAGE FULL, PREVIOUS TO FAILURE: $S_o \cong 25.3^{AC-FT}$ ($Q_S = 240^{CFS}$; $H = 2.28'$)

THEREFORE, FROM APPROX. ROUTING (NED-ACE GUIDELINES) THE OUTFLOW OF LOWER ANSONIA RESERVOIR $(Q_{P_3})_{LA}$ IS ESTIMATED AT:

$(Q_{P_3})_{LA} = \underline{7500}^{CFS}$ $(H_3)_{LA} \cong 5.0'$ (SEE RATING CURVE, P. D-10)

(DAM OVERTOPPED (±) 2.8' - (±) W.S. ELEV. 282.0 NGVD)

(i) 1ST REACH D/S FROM LOWER ANSONIA RESERVOIR (HIGH ST. AREA)

$(Q_{p_1})_1 = (Q_{p_3})_1 \approx \underline{7500}$ CFS ∴ $(y_3)_1 \approx \underline{7.9'}$ $(y_c \approx 8.1')$ [illegible]

(ii) 2ND REACH D/S FROM L.A. RESERVOIR

$(Q_{p_1})_2 = (Q_{p_3})_2 \approx 7500$ CFS ∴ $(y_3)_2 \approx 9.9'$ $(y_c \approx 13')$ $(v_n \approx 75$ [illegible]$)$

(iii) LOWER (3RD) REACH D/S FROM L.A. RESERVOIR (LOWER DERBY AREA)

$(Q_{p_1})_3 = (Q_{p_3})_3 \approx \underline{7500}$ CFS ∴ $(y_3)_3 \approx \underline{5.9'}$

d) APPROXIMATE STAGE BEFORE FAILURE, D/S FROM L.A. RESERVOIR.

$Q_s \approx \underline{240}$ CFS ∴

i) 1ST REACH : $(y_s)_1 \approx \underline{2.2'}$

ii) 2ND REACH : $(y_s)_2 \approx 2.7'$ $(y_c \approx 3.3)$ $(v_n \approx 11$ FPS$)$

(iii) 3RD REACH : $(y_s)_3 \approx \underline{0.9'}$ (CAPACITY OF EXISTING CONDUIT [illegible]

e) RAISE IN STAGE D/S FROM L.A. RESERVOIR.

i) 1ST REACH : $(\Delta y)_1 \approx \underline{5.7'}$ (HIGH ST. AREA)

ii) 2ND REACH : $(\Delta y)_2 \approx 7.2'$

iii) 3RD REACH : $(\Delta y)_3 \approx \underline{5.0'}$ (LOWER DERBY AREA)

III) SELECTION OF TEST FLOOD:

1) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES.

a) SIZE: *STORAGE (MAX) = 310 AC-FT (50 < S < 1000 AC-FT)
*HEIGHT = 20.8' (H < 25 FT)

*STORAGE: SEE P. D-11; HEIGHT: SEE P. D-7 (DIKE #1: H_{DK_1} = 16.2' SEE P. D-8)

∴ SIZE CLASSIFICATION: SMALL

b) HAZARD POTENTIAL: AS A RESULT OF THE D/S FAILURE ANALYSIS AND IN VIEW OF THE IMPACT THAT FAILURE OF UPPER ANSONIA RESERVOIR DAM/DIKES MAY HAVE ON THE POTENTIAL IMPACT AREAS (P. D-7), THE DAM IS CLASSIFIED AS HAVING:

HAZARD CLASSIFICATION: HIGH

2) TEST FLOOD: PMF = 1200 CFS

THIS SELECTION IS BASED ON THE RESULTS OF THE PREVIOUS ANALYSIS AND CLASSIFICATION.

UPPER ANSONIA RESERVOIR DAM

IV) SUMMARY

1) TEST FLOOD = PMF ≈ 1200 CFS
(PARALLEL COMPUTATIONS HAVE BEEN MADE FOR ½ PMF ≈ 600 CFS AND ARE ALSO SUMMARIZED BELOW)

2) PERFORMANCE AT PEAK FLOOD CONDITIONS:

a) PEAK INFLOWS: $Q_{I_1} = PMF \approx 1200$ CFS $Q'_{I_1} = \frac{1}{2} PMF \approx 600$ CFS
b) PEAK OUTFLOWS: $Q_{I_3} \approx 870$ CFS $Q'_{I_3} \approx 310$ CFS
c) SPILLWAY CAPACITY: (SEE TABLE p. D-6)
d) PERFORMANCE:
i) AT TEST FLOOD: OVERTOPPED (±) 0.6' ABOVE LOW PT. @ DIKE #3 (WS EL. 310.1 IN #6)
ii) AT ½ PMF: OVERTOPPED (±) 0.3' ABOVE LOW PT. @ DIKE #3 (WS EL. 309.8 IN #6)

3) DOWNSTREAM FAILURE CONDITIONS:
a) PEAK FAILURE OUTFLOW: $Q_{F_1} = 8600$ CFS (DIKE #1); (MAIN DAM: $Q_{F_2} \approx 4103$ CFS)
b) FLOOD DEPTH IMMEDIATELY D/S FROM DAM: $Y_0 \approx 6.9'$ (DIKE #1); (MAIN DAM: $Y_0 \approx 7.1'$)
c) CONDITIONS AT THE HIGH ST. AREA:
STAGE BEFORE FAILURE: $Y_S \approx 2.2'$ ($Q_S \approx 240$ CFS)
STAGE AFTER FAILURE: $Y_3 \approx 7.9'$ ($Q_S \approx 7500$ CFS)
RAISE IN STAGE AFTER FAILURE: $\Delta Y \approx 5.7'$
d) CONDITIONS AT THE INITIAL IMPACT AREA (LOWER SECTION OF DEREY)
STAGE BEFORE FAILURE: $Y_S \approx 0.9'$ ($Q_S \approx 240$ CFS)
STAGE AFTER FAILURE: $Y_3 \approx 5.9'$ ($Q_S \approx 7500$ CFS)
RAISE IN STAGE AFTER FAILURE: $\Delta Y \approx 5.0'$

PRELIMINARY GUIDANCE

FOR ESTIMATING

MAXIMUM PROBABLE DISCHARGES

IN

PHASE I DAM SAFETY

INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

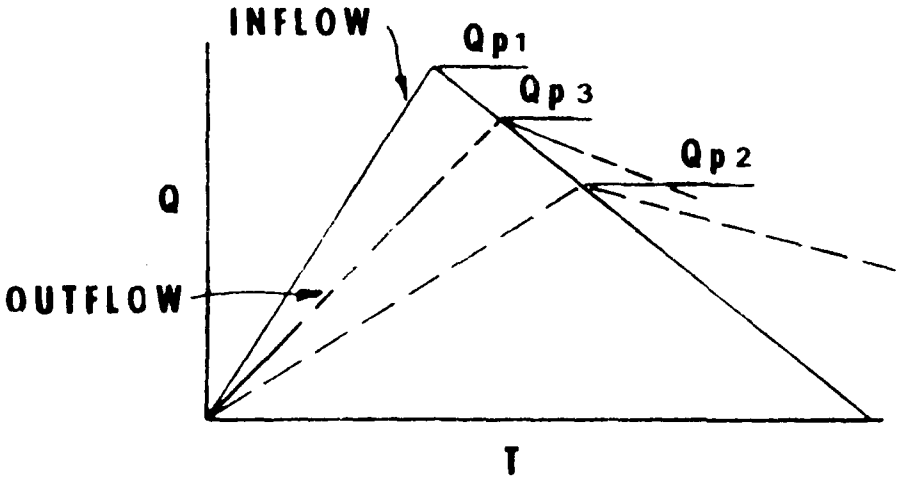
MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

	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 (Qp_1) from Guide Curves.

STEP 2: a. Determine Surcharge Height To Pass "Qp_1".

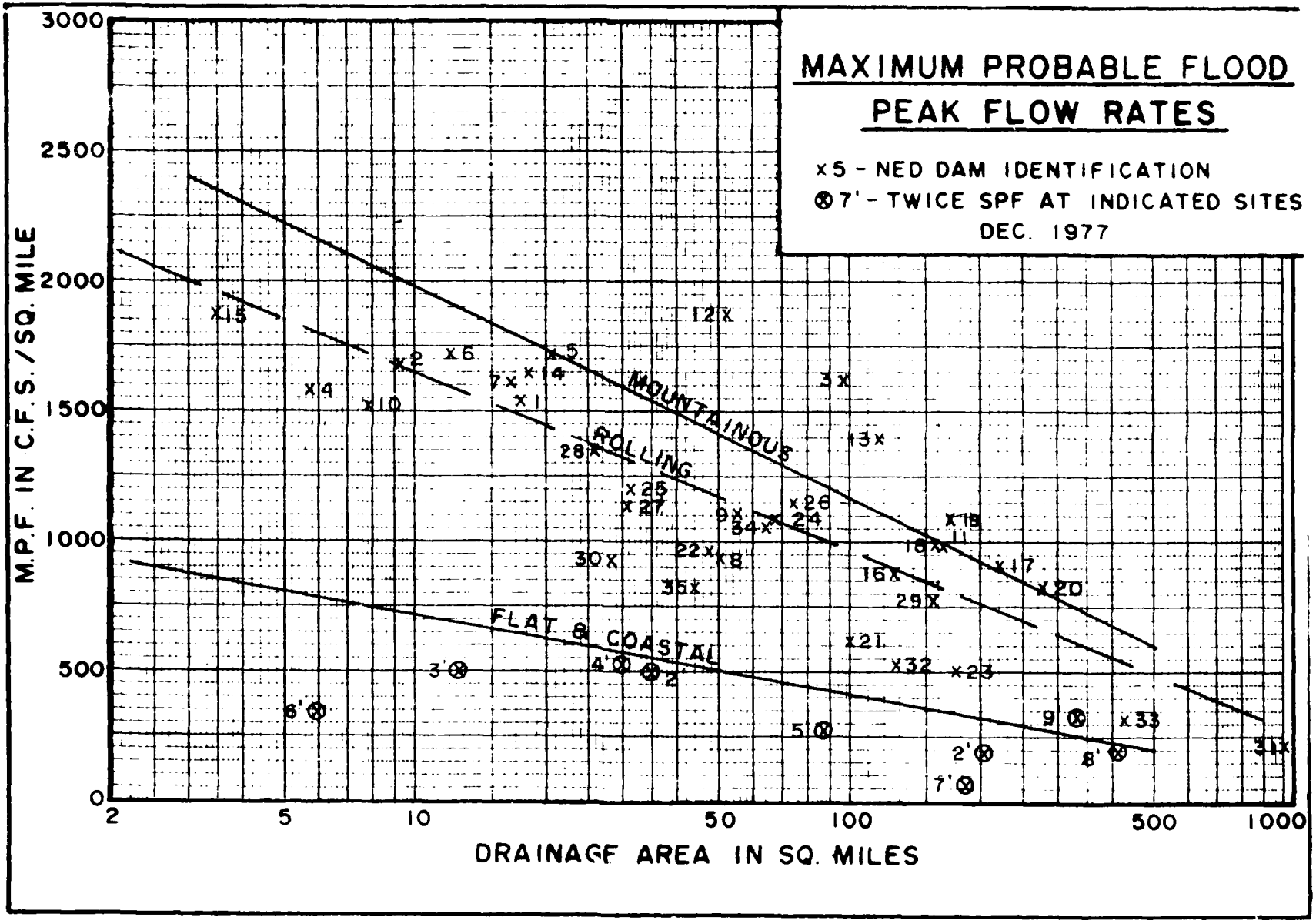
b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

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

$$Qp_2 = Qp_1 \times \left(1 - \frac{STOR_1}{19}\right)$$

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

b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "Qp_3".


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
M.P.F. IN C.F.S./SQ. MILE
DRAINAGE AREA IN SQ. MILES
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000
MOUNTAINOUS
ROLLING
FLAT & COASTAL
x15
x4
x10
x2
x6
x5
7x
x14
x1
28x
12x
3x
13x
x25
x27
9x
x26
x24
84x
x18
11
18x
x17
x20
16x
29x
30x
22x
x8
36x
x21
x32
x23
3⊗
4⊗
2
6'⊗
5'⊗
9⊗
x33
2'⊗
8'
7'⊗
31x

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

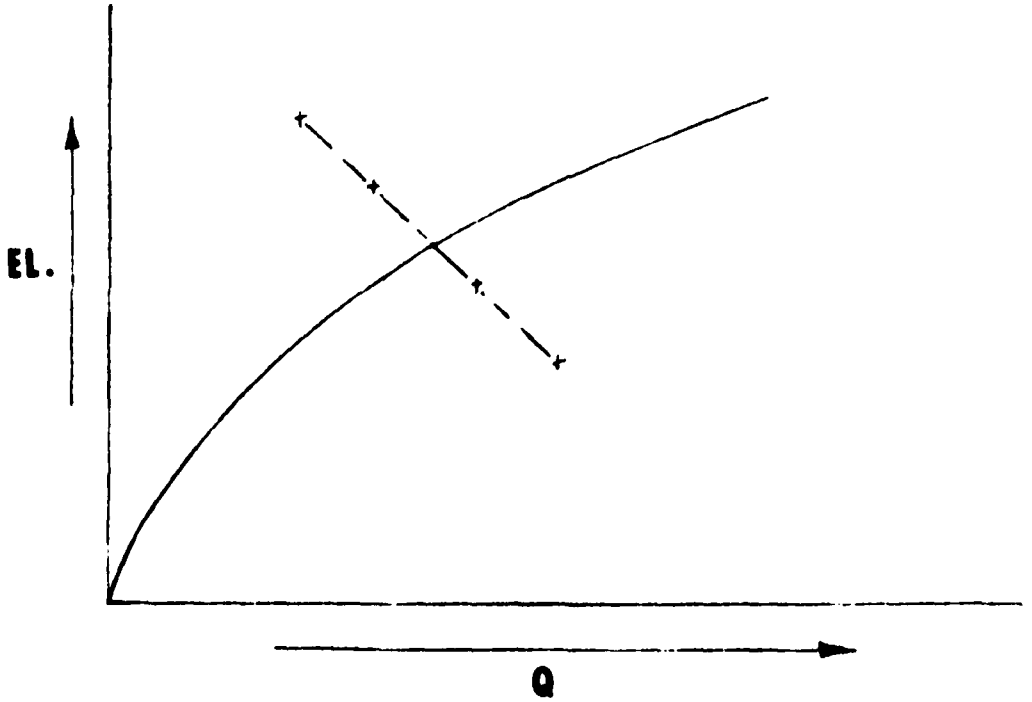
SURCHARGE STORAGE ROUTING ALTERNATE

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

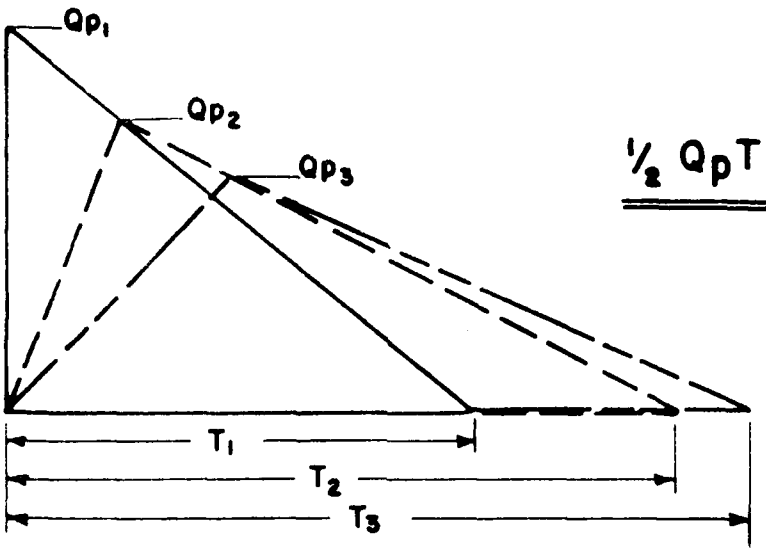
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

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}).

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

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}.

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

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

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

$$Qp_2 = Qp_1 (1 - \frac{V_{AVG}}{S})$$

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

APRIL 1978

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS