This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

The examination of documents and the visual inspection of Browns Reservoir Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.
Using the Corps of Engineers "Screening Criteria" for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped for all storms in excess of 38% of the PMF (Probable Maximum Flood). The spillway is, therefore, adjudged as "seriously inadequate", and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in the spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to loss of life downstream of the dam.

It is, therefore, recommended that within 3 months of notification to the owner, detailed hydrologic/hydraulic investigations of the structure be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. The results of these investigations will determine the appropriate remedial measures which will be required to achieve a spillway capacity adequate to discharge the outflow from at least the 1/2 PMF. The investigations should be completed within 1 year and remedial measures completed during the following year. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance of the structure must be provided during these periods.

In addition the dam has a number of problem areas, which if left uncorrected, have the potential for the development of potentially hazardous conditions, and must be corrected within 1 year. These areas are:

1. Monitor the seepage at the toe of slope below the outlet works, at bi-weekly intervals with the aid of weirs. Also monitor the soft wet area below the right spillway buttress.
2. Repair the deteriorated concrete of the spillway and spillway buttresses.
3. Remove the vegetation observed on the embankments and along the downstream channels. Provide a program of periodic cutting and mowing of these surfaces.
4. Repair the minor erosion observed on the downstream slopes of the embankments near the spillway buttresses.
5. Investigate the condition of the wet well and the valves within the gate house. Repair as required to return these valves to operational status. The valves in the gate house should be used for control instead of those in the outlet chamber to reduce the internal pressures within the pipe and embankment.
6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of all valves. Document this information for future reference. The emergency action plan described in section 7.1d should be maintained and updated periodically during the life of the structure.
LONG ISLAND BASIN

BROWNS RESERVOIR DAM

WESTCHESTER COUNTY NEW YORK

INVENTORY NO. N.Y. 763

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

JULY, 1980

APPROVED FOR PUBLIC RELEASE;
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PREFACE

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

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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

Name of Dam: Browns Reservoir (I.D. No. NY 763)
State Located: New York
County Located: Westchester
Stream: Silver Mine River
Date of Inspection: July 9, 1980

ASSESSMENT

The examination of documents and the visual inspection of Browns Reservoir Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers "Screening Criteria" for the initial review of spillway adequacy, it has been determined that the embankment would be overtopped for all storms in excess of 38% of the PMF (Probable Maximum Flood). The spillway is, therefore, adjudged as "seriously inadequate", and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean that there appears to be a serious deficiency in the spillway capacity and if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard to loss of life downstream of the dam.

It is, therefore, recommended that within 3 months of notification to the owner, detailed hydrologic/hydraulic investigations of the structure be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. The results of these investigations will determine the appropriate remedial measures which will be required to achieve a spillway capacity adequate to discharge the outflow from at least the 1/2 PMF. The investigations should be completed within 1 year and remedial measures completed during the following year. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance of the structure must be provided during these periods.

In addition the dam has a number of problem areas, which if left uncorrected, have the potential for the development of potentially hazardous conditions, and must be corrected within 1 year. These areas are:
1. Monitor the seepage at the toe of slope below the outlet works, at bi-weekly intervals with the aid of weirs. Also monitor the soft wet area below the right spillway buttress.

2. Repair the deteriorated concrete of the spillway and spillway buttresses.

3. Remove the vegetation observed on the embankments and along the downstream channels. Provide a program of periodic cutting and mowing of these surfaces.

4. Repair the minor erosion observed on the downstream slopes of the embankments near the spillway buttresses.

5. Investigate the condition of the wet well and the valves within the gate house. Repair as required to return these valves to operational status. The valves in the gate house should be used for control instead of those in the outlet chamber to reduce the internal pressures within the pipe and embankment.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of all valves. Document this information for future reference. The emergency action plan described in section 7.1d should be maintained and updated periodically during the life of the structure.

George Koch
Chief, Dam Safety Section
New York State Department of Environmental Conservation
NY License No. 45937

Approved By:

Colonel W. M. Smith Jr.
New York District Engineer

Date: 30? Sep 88
Photo #1 Overview of Brown's Reservoir Dam
SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority
The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection
Evaluation of the existing conditions of the subject dam to identify deficiencies and hazardous conditions, determine if they constitute hazards to human life and property and recommend measures where necessary.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances
Browns Reservoir Dam consists of a 175.5 feet long stepped concrete spillway constructed between 2 homogeneous earth embankments (left embankment length=200 feet, right embankment length=1000 feet), the maximum height of which is 48 feet. The upstream slopes of the earth embankments are 1 vertical on 2 horizontal, the downstream slopes are 1 on 1.5, and the crest of the dam is 14 feet wide. A concrete and cyclopean core wall, located along the centerline of the embankments, extends from 1.5 feet below the crest to a variable depth. Plans indicate that the core wall is 2 feet wide at the top and slopes outward at a rate of 3/4 inches per foot on both the upstream and downstream faces. A gate house and gate chamber located near the right abutment of the right embankment contains three gate valves which control the flow through a 6 inch, 16 inch and 30 inch pipe. The 6 inch pipe provides drainage within the well. The 16 and 30 inch pipes provide discharge from the reservoir to augment the capacity of the 2 downstream reservoirs, which supply water to the City of Norwalk, Connecticut. An outlet chamber at the downstream toe of the embankment also contains valves for the 16 and 30 inch pipes. These valves are currently used to control the downstream discharge.

b. Location
The dam is located on the Silver Mine River, approximately 6 miles north of the city of Norwalk, Connecticut.

c. Size
The dam is 48 feet high and impounds approximately 890 acre-feet. The dam is classified as "intermediate" in size (40 to 100 feet in height).
d. Hazard Classification
The dam is classified as "high" hazard due to the potential for a chain reaction failure situation of the dams within the Silver Mine River Basin which are above the City of Norwalk.

e. Ownership
The dam is owned and operated by the City of Norwalk, First Water District, Mr. William Leahy, Superintendent of Filter Plant & Watershed, 3 Beldon Avenue, Norwalk, Connecticut. Telephone: (203)966-1473.

f. Purpose of the Dam
The dam provides storage for the supply of water to the City of Norwalk, Connecticut.

g. Design and Construction
The dam was designed by Charles M. Wood, and was built in 1910 by the Jabson Hacker Co., New York, N.Y. The dam was raised in 1924 from elevation 414 to its present height at elevation 420, by Frank B. Hastings, contractor, the engineer was Samuel W. Hoyt Jr. Company Inc. All available information concerning the construction and reconstruction has been included in Appendix F. The dam is composed of a concrete spillway constructed between two earth embankments, the maximum height of which is 48 feet.

h. Normal Operating Procedures
All flows in excess of the demand for water by the City of Norwalk are discharged over the spillway.

1.3 PERTINENT DATA

a. Drainage Area (sq. mi.) 7.56

b. Discharge at Dam (cfs)
   Spillway at Maximum High Water 3931
   Reservoir Drain at Normal Water Elevation 190

c. Elevations (USGS Datum)
   Top of Dam 436.
   Spillway Crest 432.
   Reservoir Drain Invert 390.

d. Reservoir (acres)
   Surface Area at Top of Dam 55.
   Surface Area at Crest of Dam 44.

e. Storage Capacity (acre feet)
   Top of Dam 1067
   Spillway Crest 891

f. Dam
   Type: Homogeneous Earth with cyclopean concrete core wall.
   Length (ft): 1200.
   Slopes upstream 2:1
      downstream 1 1/2:1
   Crest Width (ft): 14'
g. **Spillway**
   Type: Stepped concrete overflow structure.
   Weir Length (ft): 175.5'

h. **Reservoir Drain**
   Type: Two concrete encased pipes 16 & 30 inches.
   Control: Manual control valves at the gate and toe of the dam.
SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

Browns Reservoir Dam is located in the "New England Uplands" physiographic province of New York State. Maximum relief is in the Hudson Highlands, where elevations range from 800 feet below sea level (bedrock of the Hudson River Valley) to more than 1500 feet. Rocks in these uplands are either metamorphic or igneous, and land forms are closely related to their durability. Strong topographic linearity characterizes the Hudson Highlands; most of the ridges and valleys follow the northeast-southwest strike of the metamorphosed rocks.

The "Landforms and Bedrock Geology of New York State" prepared University of the State of New York indicates that the bedrock in the vicinity of the dam is the Hartland Formation - basal amphibolite overlain by pelitic schists. (Middle Ordovician through lower Cambrian rocks initially deformed by the Taconic Orogeny (435-455 million years ago) and subsequently by the Acadian Orogeny.) The "Generalized Tectonic-Metamorphic Map of New York", compiled by Fisher, Isachsen, and Richard (1971) indicates that the tectonic unit in the vicinity of the dam is "eugeosynclinal (rise-rock)" thrust sheets, intensely deformed with carbonate slivers along faults.

The "Preliminary Brittle Structures Map of New York" developed by Isachsen and McKendree (1977), does not indicate the presence of any faulting or other brittle deformations within the vicinity of the dam or impoundment. Several topographic linear features are present to the north and west, but are a significant distance from the dam.

2.2 SUBSURFACE INVESTIGATION

No subsurface investigation could be located for the dam. The "General Soil Map of New York State" prepared by Cornell University Agriculture Experiment Station, indicates that the surficial soils are Charlton Soils of glacial till origin. These soils are formed on unstratified variable glacial till and residuum predominantly from schists but in places including gneiss and granite. The soils are stony silt and sand with a trace of clay. In places ledgy pieces and boulders are numerous. Rock outcrops are common, but the depth to rock is extremely variable. The overall drainage and permeability is good. The soil is also considered erodible due to the limited clay content.

2.3 DAM AND APPURtenant STRUCTURES

The dam was built in 1910 by the Jabson Hooker Co., New York, N.Y.; the engineer was Charles M. Wood. The dam was raised in 1924 to its present height by the contractor Frank B. Hastings; the engineer was Samuel W. Hoyt Jr. Company, Inc. All available information concerning the construction and reconstruction has been included in Appendix F. The dam is composed of a concrete spillway and two earth embankments the maximum height of which is 48 feet.
2.4 **CONSTRUCTION RECORDS**

No construction records were located for the dam.

2.5 **OPERATION RECORDS**

All operation records are on file with the owner.

2.6 **EVALUATION OF DATA**

The data presented in this report has been, in part, compiled from information obtained from Mr. Robert Mercurio and Mr. Harry Everson of the City of Norwalk, Connecticut. This information appears adequate and reliable for Phase I inspection purposes.
SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General
Visual inspection of Browns Reservoir Dam was conducted on July 9, 1980. The weather was clear and the temperature ranged in the upper 60's. The water surface at the time of the inspection was just cresting the spillway.

b. Spillway
The concrete spillway located near the left abutment of the dam is stepped to dissipate the energy of the overflow. The construction joints are deteriorated and require repair. Spillway flow masked careful examination of the downstream face. No significant seepage was observed and no seepage was reported by the maintenance staff. (See Photo #1) The approach channel is riprapped and appears to be in good condition. A few stones have been displaced. (See Photo #2) Gravel and stone was noted at the base of the spillway. This area is in good condition. The top surfaces of the spillway buttresses are deteriorated (particularly the left buttress) and require repairs. (See Photos #1 & 2). The horizontal and vertical alignment of the spillway appears to be good.

c. Embankment
The embankment is divided into 2 sections by the spillway. The left embankment is in generally good condition. (See Photo #2) Some vegetation was observed on the upstream face near the water line (See Photo #4), and some slight erosion is present near the crest of the embankment left of the left spillway buttress (See Photo #3).

The right embankment is in good condition with the following exceptions:

1. Extensive tree and brush growth on the downstream slope. Some of the trees have been removed by maintenance forces in the vicinity of the spillway, and it was reported that this program would be instituted along the remainder of the embankment. (See Photos #4 & 5)

2. In the vicinity of the spillway approximately 50 feet beyond the toe of the embankment a soft wet area is present, with water seeking vegetation. Mowing equipment has rutted the surface and water is laying in this area. This area may be the result of the backwater at the base of the spillway. (See Photo #3) No evidence of active seepage was observed. Evidence of erosion of the downstream slope about 20 feet from the right spillway buttress was noted. (See Photo #6)

3. In the area adjacent to the downstream toe and slightly to the left of the gate house, seepage was evident at a rate of 5 to 10 gpm. (See Photo #10) The seepage appeared to be originating from an area downstream of the embankment, and was flowing toward the embankment and then turning to the right and flowing toward the outlet works for the gatehouse. No evidence of particle migration was noted.
4. On the left side of the concrete outlet structure, 5 separate and distinct areas were observed in which seepage was flowing toward the outlet structure. (See Photos #8 & 9) Some minor sediment was noted at several locations where the seepage was discharging into the backwater adjacent to the outlet structure. The flows appeared to be clear and no active particle migration was observed. Some of the flow appears to be originating from an elevated area of natural origin, left of the outlet structure. One of the flows originates on the right side near the embankment, flows parallel to the toe and emerges on the left side of the outlet structure. This seepage is being ponded by the irregular grade near the toe, and has a rusty appearance, but the flow is clear. The total quantity of seepage from all areas is estimated to be 20 to 30 gpm. It is possible that some of the flow is related to rains of the previous day. The maintenance staff reports that this seepage has been present for at least 6 years.

While the slopes of the right embankment appears to be steep, no evidence of sliding, sloughing, depressions, or seepage was observed on the slopes, along the crest or at the abutments.

d. Outlet Works
The 1909 plans indicate that the outlet works, located near the right abutment of the right earth embankment, consists of a masonry and concrete gatehouse atop a concrete gate chamber. Three gate valves controls, for a 6", 16", and 30" pipe, were observed in the gate house at the crest of the embankment. (See Photo #7) The outlet chamber (referred to as the "outlet parapet wall" in the 1909 plans) at the downstream toe of the embankment contains two valves (for 16 and 30 inch pipes). (See Photo #8) No valve was observed for the 6" pipe, which appears to be a drain for removal of water within the gate chamber. Maintenance forces were unaware of the existence of the valves within the gate chamber, indicating that these valves had not been operated for some time. Control of the outflow is provided by the downstream valves in the outlet chamber, which indicates that the upstream valves are open at least partially. All valves should be investigated and returned to operational status.

e. Downstream Channels
The downstream channel below the outlet chamber is heavily vegetated. (See Photo #9) The downstream channel below the spillway is also vegetated heavily. This vegetation should be removed to prevent blockage of the outflow.

f. Reservoir
There are no visible signs of instability or sedimentation problems within the reservoir area.

3.2 EVALUATION

The problem areas observed during the inspection and the recommended remedial actions are as follows:

1. The seepage observed along the toe of the dam requires monitoring at bi-weekly intervals with aid of weirs.
2. The soft wet area below the right spillway buttress requires monitoring.

3. The construction joints of the spillway and the spillway buttresses are deteriorated and require repair.

4. Extensive tree and brush growth was observed on the right embankment, the upstream slope of the left embankment and the downstream channels. This vegetation should be cut as soon as possible and a program of periodic cutting and mowing of these surfaces instituted.

5. Minor erosion was observed on the downstream slopes of the embankments near the spillway buttresses. Regrade and seed as required to restore these slopes to their original configuration.

6. Investigate the condition of all valves. Restore these valves, to operational status. Operate the 6 inch drain so that the water within the wet wall is removed and inspect the wall and appurtenances thoroughly. Initiate repairs as required. Use of the upstream valves for control of releases will reduce the internal pressure within the pipes.

7. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of all valves. Document this information for future reference. Also develop an emergency action plan.
SECTION 4:  OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

The normal water surface elevation is approximated by the crest of the spillway. Water can be released to the downstream channel by the outlet works via the 16 and 30 inch diameter pipes which are currently controlled by the valves in the outlet chamber. By using the valves in the gate house, instead of those in the outlet chamber, excess pressure within the pipe and the embankment will be eliminated. The invert elevation of these pipes within the gate house is 372. A 6 inch diameter pipe and valve located within the gate house may be used to drain the gate house wet wall.

4.2 MAINTENANCE OF THE DAM

Maintenance of the dam is not considered adequate as evidenced by the deterioration of the spillway, extensive vegetation on the embankment and the unoperated valves within the gate house.

4.3 WARNING SYSTEM

There is no warning system in effect or in preparation.

4.4 EVALUATION

The dam and appurtenances have not been maintained in satisfactory condition as noted in "Section 3: Visual Inspection."
SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed of Browns Reservoir was made using the USGS quadrangles for Peach Lake, Pound Ridge, New York and Bethel, Norwalk North Connecticut. The basin consists of woodlands and fields with many residences in the lower portion. Relief is moderate, with some upland storage in the form of swampy areas and small ponds. The total area is 7.56 square miles.

5.2 ANALYSIS CRITERIA

The analysis of the spillway capacity of the dam and storage of the reservoir was performed using the Corps of Engineers HEC-1 computer model. The unit hydrograph was defined using the Snyder Synthetic Unit Hydrograph Method and the Modified Puls routing procedure was incorporated. The Probable Maximum Precipitation (PMP) used was 21.7 inches (24 hrs, 200 sq. mi) from Hydrometeorological Report No. 33. Several floods were selected (%'s PMF) for analysis in accordance with recommended guidelines of the Corps of Engineers. The PMF inflow of 10,466 cfs, was routed through the reservoir and the peak outflow was determined to be 10,457 cfs.

5.3 SPILLWAY CAPACITY

A single stepped, masonry overflow spillway is located near the left abutment. It has a width of 175.5' and has a capacity of 3931. cfs at top of dam. Top of dam is 4 feet above spillway crest. There is no auxiliary or emergency spillway at Browns Reservoir.

5.4 RESERVOIR CAPACITY

Normal flood control storage capacity of the reservoir between the spillway crest and top of dam is 176. acre feet. This volume represents a total runoff of .44 inches from the basin.

5.5 FLOODS OF RECORD

Maximum flow observed in the spillway was about 1.5', resulting in an estimated flow of 860 cfs. This flow occurred during September 1975.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 3931. cfs before overtopping would occur.

This capacity results in the ability to pass only 38% of the PMF with very little attenuation.

5.7 EVALUATION

The dam will be overtopped in all storms greater than 38% of the PMF. The spillway is, therefore, considered to be seriously inadequate.
SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations
No signs of major distress were observed in connection with the earth embankment or the spillway section. However, seepage was observed at the toe of the right embankment near the gate house, and a soft wet area was noted below the right spillway buttress.

b. Design and Construction Data
No design or construction data could be located concerning the structural stability of the dam.

c. Post-Construction Changes
In 1924, the dam was raised from a crest elevation of 414 to elevation 420. (See Appendix F)

6.2 STABILITY ANALYSIS

A stability analysis was conducted for the concrete gravity spillway section. The results of the analysis are as follows:

<table>
<thead>
<tr>
<th>Case</th>
<th>Description of Loading Conditions</th>
<th>Location of Resultant Factor of Safety from Toe</th>
<th>Factor of Safety Overturning</th>
<th>Factor of Safety Sliding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal Operating conditions, reservoir at El. 416.5 (spillway crest), full uplift, no tailwater.</td>
<td>8.8</td>
<td>3.20</td>
<td>3.31</td>
</tr>
<tr>
<td>2</td>
<td>Same as Case 1, with 5.0 kips/ft. ice load</td>
<td>5.4</td>
<td>1.73</td>
<td>1.41</td>
</tr>
<tr>
<td>3</td>
<td>Water at 1/2 PMF level (El. 420.8) uplift as in Case 1, tailwater = 4.3 feet</td>
<td>8.5</td>
<td>2.30</td>
<td>1.80</td>
</tr>
<tr>
<td>4</td>
<td>Water at PMF level (El. 421.6) uplift as in Case 1, tailwater = 5.1 feet</td>
<td>8.4</td>
<td>2.19</td>
<td>1.67</td>
</tr>
<tr>
<td>5</td>
<td>Normal conditions as in Case 1, with seismic forces: = 0.1 (seismic Zone 3)</td>
<td>7.5</td>
<td>2.39</td>
<td>2.06</td>
</tr>
</tbody>
</table>

Note: The bottom surface of the dam has been idealized to simplify the analysis. Compare the analyzed section (Appendix E) with the spillway section in Appendix F. Elevations are based on plan datum.

Location of middle 1/3 is 5.0 to 10.0 feet from the toe.
These results indicate that the spillway portion analyzed has factors of safety in excess of that recommended by the Corps of Engineers. The spillway is, therefore, considered to have adequate factors of safety for stability.
SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety
The Phase I Inspection of Browns Reservoir Dam revealed that the spillway is “seriously inadequate”, based on the Corps of Engineers “screening criteria”, and outflows from any storm in excess of 38% of the PMF will overtop the dam. This overtopping could cause breaching of the earth embankment and the resulting flood-wave would significantly increase the hazard to downstream residents. For these reasons the dam has been assessed as unsafe, non-emergency.

b. Adequacy of Information
The information reviewed is considered adequate for Phase I Inspection purposes.

c. Need for Additional Investigation
Since the spillway is considered to be seriously inadequate, additional hydrologic/hydraulic investigations are required to more accurately determine the site specific characteristics of the watershed. After these investigations have been completed, remedial measures must be initiated to provide spillway capacity sufficient to discharge the outflow from the 1/2 PMF event.

d. Urgency
The additional hydrologic/hydraulic investigations must be initiated within 3 months of notification to the owner. Within 1 year, remedial measures as a result of these investigations must be initiated, with completion of these measured during the following year. In the interim, develop an emergency action plan for the notification of downstream residents and the proper governmental authorities in the event of overtopping, and provide around-the-clock surveillance of the dam during periods of extreme run-off. The problem areas listed below must be corrected within 1 year of notification.

7.2 RECOMMENDED MEASURES

1. Monitor the seepage at the toe of slope below the outlet works, at bi-weekly intervals with the aid of weirs. Also monitor the soft wet area below the right spillway buttress.

2. Repair the deteriorated concrete of the spillway and spillway buttresses.

3. Remove the vegetation observed on the embankments and along the downstream channels. Provide a program of periodic cutting and mowing of these surfaces.

4. Repair the minor erosion observed on the downstream slopes of the embankments near the spillway buttresses.

5. Investigate the condition of the wet wall and the valves within the gate house. Repair the valves as required and return to operational status. The valves in the gate house should be used for control instead of those in the outlet chamber to reduced the internal pressures.
within the pipe and embankment.

6. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of all valves. Document this information for future reference. The emergency action plan described in section 7.1d should be maintained and updated periodically during the life of the structure.
Photo #2 Spillway Looking at Left Embankment

Photo #3 Spillway Looking at Right Embankment
Photo #4 Upstream Face - Left Embankment

Photo #5 Crest - Right Embankment
Photo #6 Erosion of Right Embankment near spillway

Photo #7 Valve Control in Gate House
Photo #10 Seepage Left of Outlet Structure
APPENDIX B

VISUAL INSPECTION CHECKLIST
VISUAL INSPECTION CHECKLIST

1) Basic Data
   a. General
      Name of Dam: Brown Reservoir
      Fed. I.D. #: NT 763
      DEC Dam No.: 23 2SE-4361
      River Basin: Long Island
      Location: Town Lewishore County Westchester
      Stream Name: Silvermine River
      Tributary of: Long Island Sound
      Latitude (N): 41° 12' 59"
      Longitude (W): 73° 29' 40"
      Type of Dam: Homogeneous earth embankment, w. concrete spillway
      Hazard Category: C - High
      Date(s) of Inspection: Jul. 9, 1980
      Weather Conditions: Clear upper 60's
      Reservoir Level at Time of Inspection: Approximately 44 ft. above spillway

   b. Inspection Personnel: James C. Walsh, Red. P McNamara...

   c. Persons Contacted (Including Address & Phone No.):
      Robert Mertens, Harvey Everson, Muscoot Reservoir division,
      Norwalk, Conn. District 3 Office, 1371 Route 7, Norwalk, Conn.
      (203) 926-1473 - Mr. William Land - Sup.
      Mrs. P. Pino & Mr. Land...

   d. History:
      Date Constructed: Jul. 6, 1930
      Date(s) Reconstructed: 1976
      Designer:...
      Constructed By:...
      Owner:...
2) **Embankment**

a. Characteristics

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1</td>
<td>Embankment Material</td>
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<tr>
<td>2</td>
<td>Cutoff Type</td>
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<td>3</td>
<td>Impervious Core</td>
</tr>
<tr>
<td>4</td>
<td>Internal Drainage System</td>
</tr>
<tr>
<td>5</td>
<td>Miscellaneous</td>
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</tbody>
</table>

b. Crest

<p>| | |</p>
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<tr>
<td>1</td>
<td>Vertical Alignment</td>
</tr>
<tr>
<td>2</td>
<td>Horizontal Alignment</td>
</tr>
<tr>
<td>3</td>
<td>Surface Cracks</td>
</tr>
<tr>
<td>4</td>
<td>Miscellaneous</td>
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</tbody>
</table>

c. Upstream Slope

<p>| | |</p>
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<tr>
<td>1</td>
<td>Slope (Estimate) (V:H)</td>
</tr>
<tr>
<td>2</td>
<td>Undesirable Growth or Debris, Animal Burrows</td>
</tr>
<tr>
<td>3</td>
<td>Sloughing, Subsidence or Depressions</td>
</tr>
</tbody>
</table>
(4) Slope Protection

______________________________

(5) Surface Cracks or Movement at Toe

______________________________

\[ \text{d. Downstream Slope} \]

(1) Slope (Estimate - V:H) ______ 1:5 ________

(2) Undesirable Growth or Debris, Animal Burrows

______________________________

(3) Sloughing, Subsidence or Depressions

______________________________

(4) Surface Cracks or Movement at Toe

______________________________

(5) Seepage

______________________________

(6) External Drainage System (Ditches, Trenches; Blanket)

______________________________

(7) Condition Around Outlet Structure

______________________________

(8) Seepage Beyond Toe

______________________________

e. Abutments - Embankment Contact

______________________________
3) Drainage System
   a. Description of System
      __________________________
      __________________________
      __________________________
      __________________________
      __________________________
   b. Condition of System
      __________________________
      __________________________
      __________________________
      __________________________
      __________________________
   c. Discharge from Drainage System
      __________________________
      __________________________
      __________________________
      __________________________
      __________________________

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
   __________________________
5) Reservoir
   a. Slopes ____________________________
   b. Sedimentation ____________________________
   c. Unusual Conditions Which Affect Dam
      Sealls Res up to 3 1/2 miles from town

6) Area Downstream of Dam
   a. Downstream Hazard (No. of Homes, Highways, etc.)__________________________
      2 1/2 miles downstream, Norwalk = 3 miles
   b. Seepage, Unusual Growth ____________________________
   c. Evidence of Movement Beyond Toe of Dam
   d. Condition of Downstream Channel ____________________________

7) Spillway(s) (Including Discharge Conveyance Channel)
   a. General ________________
   b. Condition of Service Spillway ________________
c. Condition of Auxiliary Spillway


d. Condition of Discharge Conveyance Channel


8) Reservoir Drain/Outlet

Type: Pipe Conduit Other

Material: Concrete Metal Other

Size: \( \frac{\text{in.}}{\text{ft}} \) Length \( \frac{\text{in.}}{\text{ft}} \)

Invert Elevations: Entrance Exit

Physical Condition (Describe): Unobservable

Material:

Joints: Alignment

Structural Integrity:

Hydraulic Capability:

Means of Control: Gate Valve Uncontrolled

Operation: Operable Inoperable Other

Present Condition (Describe):
9) Structural
   a. Concrete Surfaces
      [Blank space for notes]
   b. Structural Cracking
      [Blank space for notes]
   c. Movement - Horizontal & Vertical Alignment (Settlement)
      [Blank space for notes]
   d. Junctions with Abutments or Embankments
      [Blank space for notes]
   e. Drains - Foundation, Joint, Face
      [Blank space for notes]
   f. Water Passages, Conduits, Sluices
      [Blank space for notes]
   g. Seepage or Leakage
      [Blank space for notes]
h. Joints - Construction, etc.

i. Foundation

j. Abutments

k. Control Gates

l. Approach & Outlet Channels

m. Energy Dissipators (Plunge Pool, etc.)

n. Intake Structures

o. Stability

p. Miscellaneous
# CHECK LIST FOR DAMS
## HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

### AREA-CAPACITY DATA:

<table>
<thead>
<tr>
<th></th>
<th>Elevation (ft.)</th>
<th>Surface Area (acres)</th>
<th>Storage Capacity (acre-ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Top of Dam</td>
<td>436</td>
<td>55</td>
</tr>
<tr>
<td>2)</td>
<td>Design High Water (Max. Design Pool)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3)</td>
<td>Auxiliary Spillway Crest</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4)</td>
<td>Pool Level with Flashboards</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5)</td>
<td>Service Spillway Crest</td>
<td>432</td>
<td>44</td>
</tr>
</tbody>
</table>

### DISCHARGES

<table>
<thead>
<tr>
<th></th>
<th>Volume (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Average Daily</td>
</tr>
<tr>
<td>2)</td>
<td>Spillway @ Maximum High Water - Top of Dam -</td>
</tr>
<tr>
<td>3)</td>
<td>Spillway @ Design High Water</td>
</tr>
<tr>
<td>4)</td>
<td>Spillway @ Auxiliary Spillway Crest Elevation</td>
</tr>
<tr>
<td>5)</td>
<td>Low Level Outlet</td>
</tr>
<tr>
<td>6)</td>
<td>Total (of all facilities) @ Maximum High Water</td>
</tr>
<tr>
<td>7)</td>
<td>Maximum Known Flood</td>
</tr>
<tr>
<td>8)</td>
<td>At Time of Inspection</td>
</tr>
</tbody>
</table>
**CREST:**

- **Type:** Homogeneous earth embankment core wall
- **Width:** 14'
- **Length:** 1200'
- **Spillover:** Left center, stepped concrete
- **Location:**

<table>
<thead>
<tr>
<th>SPILLWAY</th>
<th>SERVICE</th>
<th>Elevation</th>
<th>AUXILIARY</th>
<th>Type</th>
<th>Width</th>
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<td>432.0</td>
<td></td>
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<tr>
<td></td>
<td>Spilled concrete overflow</td>
<td></td>
<td></td>
<td>125.5</td>
<td></td>
</tr>
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<td>Type</td>
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</tr>
<tr>
<td></td>
<td>Width</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Type of Control</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Uncontrolled</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Controlled:</td>
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</tr>
<tr>
<td></td>
<td>Type</td>
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</tr>
<tr>
<td></td>
<td>(Flashboards; gate)</td>
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<tr>
<td></td>
<td>Number</td>
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<tr>
<td></td>
<td>Size/Length</td>
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<td></td>
<td>Invert Material</td>
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<tr>
<td></td>
<td>Anticipated Length of operating service</td>
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<td></td>
<td>Chute Length</td>
<td></td>
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<tr>
<td></td>
<td>Height Between Spillway Crest &amp; Approach Channel Invert (Weir_Flow)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**ELEVATION:** 436.0
HYDROMETEOROLOGICAL GAGES:
Type: None
Location: 
Records:
  Date - 
  Max. Reading -

FLOOD WATER CONTROL SYSTEM:
Warning System: None

Method of Controlled Releases (mechanisms):
16" + 30" Reservoir drain
To feed lower water supply reservoir
DRAINAGE AREA: 7.56 SQ. MILES

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: wooded - some residential
Terrain - Relief: moderate slope - well-drained drainage paths
Surface - Soil: good permeability
Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

NONE

Potential Sedimentation problem areas (natural or man-made; present or future)

NONE IMPORTANT

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

NO

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: NONE
Elevation: 

Reservoir:

Length @ Maximum Pool 2500 ft. (Miles)
Length of Shoreline (at Spillway Crest) 7200 ft. (Miles)
**MULTI-PERIOD ANALYSES TO BE PERFORMED**

**METHOLOGY**

- **I**: 0, 1, 2, 3, 4, 5
- **C**: 0, 1, 2, 3, 4, 5
- **P**: 0, 1, 2, 3, 4, 5
- **T**: 0, 1, 2, 3, 4, 5
- **R**: 0, 1, 2, 3, 4, 5

**HYDROGRAPHIC DATA**

- IN-FOC 100, 150, 200, 250, 300
- LOCAL 100, 150, 200, 250, 300

**RECESSION DATA**

- APPROXIMATE CLARK COEFFICIENTS
- GIVEN: 0.05, 0.10, 0.15
- TIME TO REACH 0.05, 0.10, 0.15
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<th>STATION</th>
<th>PLAN</th>
<th>PATIC</th>
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<tr>
<td>421.0</td>
</tr>
<tr>
<td>420.0</td>
</tr>
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</table>

| 282.0 | 272.0 | 262.0 | 252.0 | 242.0 | 232.0 | 222.0 | 212.0 | 202.0 | 192.0 | 182.0 | 172.0 | 162.0 | 152.0 |

*Note: The table represents data related to flow and storage levels at different stations and times.*
**Title:** The data in the place of the level outlet is not within range of given elevations in storage-elevation data

**Note:** The reservoir should begin at 12,000

**Situation In:** ALL DEPARTMENT/AGENCY ELEVATION: 420 ft

### Table: End-of-Period Hydrograph Estimates

<table>
<thead>
<tr>
<th>Station</th>
<th>Plan</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>2</td>
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### Table: Storage

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<th>Plan</th>
<th>Ratio</th>
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<tr>
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### Table: Stage

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<th>Plan</th>
<th>Ratio</th>
</tr>
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<tbody>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

(Area: 1500 ft²)

**Source:**

(Calculator: John Doe, 2023)

**Note:**

1. The data provided is for demonstration purposes only.
2. The actual data may vary depending on the specific conditions.
3. Please consult the official data sources for the most accurate information.

---

**Legend:**

- **Stage:** Water level in feet.
- **Storage:** Water volume in acre-feet.

---

**Contact:** John Doe, johndoe@example.com

---

**Disclaimer:** The information provided is for educational purposes and should not be used for decision-making without further verification.
<table>
<thead>
<tr>
<th>OPERATION</th>
<th>STATION</th>
<th>50/60</th>
<th>RATIO 1</th>
<th>RATIO 2</th>
<th>RATIO 3</th>
<th>RATIO 4</th>
<th>RATIO 5</th>
<th>RATIO 6</th>
<th>RATIO 7</th>
<th>RATIO 8</th>
<th>RATIO 9</th>
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<tbody>
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<td>MILLING</td>
<td>MILL</td>
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<tr>
<td>DRILLING</td>
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APPENDIX D

REFERENCES


APPENDIX E

STABILITY ANALYSIS
## INPUT FOR STABILITY ANALYSIS PROGRAM

<table>
<thead>
<tr>
<th>Input Location</th>
<th>Input Parameter Description</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>Unit Weight of Dam (K/ft.$^3$)</td>
</tr>
<tr>
<td>1</td>
<td>Area of Segment #1 (ft.$^2$)</td>
</tr>
<tr>
<td>2</td>
<td>Location of Center of Gravity from toe (ft.) Segment #1</td>
</tr>
<tr>
<td>3</td>
<td>Area of Segment #2 (ft.$^2$)</td>
</tr>
<tr>
<td>4</td>
<td>Location of CG from toe, Seg. #2 (ft.)</td>
</tr>
<tr>
<td>5</td>
<td>Area of Segment #3 (ft.$^2$)</td>
</tr>
<tr>
<td>6</td>
<td>Location of CG from toe, Sg. #3 (ft.)</td>
</tr>
<tr>
<td>7</td>
<td>Total Base Width of Dam (ft.)</td>
</tr>
<tr>
<td>8</td>
<td>Height of Dam (ft.)</td>
</tr>
<tr>
<td>9</td>
<td>Ice Loading (K/L.F.)</td>
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<tr>
<td>10</td>
<td>Coefficient of Sliding</td>
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<td>11</td>
<td>Unit Weight of Soil (K/ft.$^3$)</td>
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<td>12</td>
<td>Coefficient of Active Soil Pressure - Ka</td>
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<tr>
<td>13</td>
<td>Coefficient of Passive Soil Pressure - Kp</td>
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<tr>
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<td>Height of Water over Top of Dam (ft.)</td>
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<td>15</td>
<td>Height of Soil for Active Pressure (ft.)</td>
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<tr>
<td>16</td>
<td>Height of Soil for Passive Pressure (ft.)</td>
</tr>
<tr>
<td>17</td>
<td>Height of Water in Tailrace Channel (ft.)</td>
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<tr>
<td>18</td>
<td>Unit Weight of Water (K/ft.$^3$)</td>
</tr>
<tr>
<td>19</td>
<td>Area of Segment #4 (ft.$^2$)</td>
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<td>20</td>
<td>Location of CG from toe, Seg. #4 (ft.)</td>
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<td>46</td>
<td>Height of Ice Load or Active Water</td>
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<tr>
<td>49</td>
<td>Location of Foundation Drains from Heel (ft.)</td>
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<td>50</td>
<td>Seismic Coefficient ($\alpha$).</td>
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<tr>
<td>Location</td>
<td>Case I</td>
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<tr>
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</tr>
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<td>20</td>
<td>3.3</td>
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<td>44</td>
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<tr>
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<td>0.00</td>
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</table>
**BROWNS RESERVOIR DAM**  
**STABILITY ANALYSIS**  
**SPILLWAY SECTION**

**Case I Normal Loading**  
(a) 3.195850742  
(b) 8.84157392  
(c) 3.305628559

**Case II Ice Loading**  
(a) 1.73275628  
(b) 5.439646124  
(c) 1.40873738

**Case III 1/2 PMF**  
(a) 2.300116325  
(b) 8.49243432  
(c) 1.86441433

**Case IV PMF**  
(a) 2.191315294  
(b) 8.447686112  
(c) 1.670853056

**Case V Seismic Loading**  
(a) 2.39455755  
(b) 7.49427455  
(c) 2.064795441

**NOTE:**  
(a) is the factor of safety for overturning;  
(b) is the location of the resultant from the toe;  
(c) is the factor of safety for sliding.
APPENDIX F

DRAWINGS
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DRAWING NUMBER</th>
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<tbody>
<tr>
<td>GENERAL PLAN</td>
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<tr>
<td>GATE CHAMBER and PIPE PLAN (1909)</td>
<td>Sheet No 7</td>
</tr>
<tr>
<td>GATE CHAMBER and PARAPET WALL DETAIL PLAN (1909)</td>
<td>Sheet No 8</td>
</tr>
<tr>
<td>PLAN (1924)</td>
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<tr>
<td>SECTIONs (1924)</td>
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<td>SPILLWAY &amp; GATEHOUSE WALL (1924)</td>
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<tr>
<td>SECTIONs (1924)</td>
<td>4</td>
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PLANS AND DETAILS OF PROPOSED WORK AT
BROWN RESERVOIR
FOR THE
FIRST TAXING DISTRICT
OF THE
CITY OF NORWALK, CONN.
FEB. 1924

District Commissioners
John D. Milne
Edward J. Finnegan
Wallace Dann.

PRIVATE ROAD

BROWN RESERVOIR

Bottom of slope

Scale 1/
Notice

After completing these plans it was decided to substitute common embankment for puddle fill on the downstream side of core wall and to substitute sand and gravel joints for cement grout in repairing work on upstream slope of dam.
PLANS AND DETAILS
OF PROPOSED WORK AT
DROWN RESERVOIR
FOR THE
FIRST TAXING DISTRICT
OF THE
CITY OF NORWALK, CONN.

District Commissioners
D. Milne
ward J. Finnegan
place Dann.

Scales as noted
FEB. 1924. The Samuel W. Hoyt, Jr.,
Engineers.
SECTION THRU STA. 8+00  SCALE 1"=5'
SHOWING NEW DAM

SECTION THRU STA 13+00  Scale 1"=5'
SHOWING NEW DAM.
(FOR OTHER SECTIONS SEE SHEET NO. A)
NEW DAM

HRU STA. 13+00  Scale 1"=5'

Estimation Hard Pan Foundation

Proposed Flow Line, Elev. 416.5

Earth fill puddle

Present surface of ground

Slope 2 to 1

Sloping rammed 3" into fill and grouted with 1-3-5 concrete
PLAN SHOWING GATE HOUSE & WALL
(See Section on Sheet 4)
After completing these plans it was decided to substitute common embankment for cutstone fill on the downstream side of core. You will also substitute sand and gravel for cement grout in paving work on upstream slope of dam.
PLANS AND DETAILS
OF PROPOSED WORK AT
BROWN RESERVOIR
FOR THE
FIRST TAXING DISTRICT
OF THE
CITY OF NORWALK, CONN.

Scales as noted

FEB. 1924

The Samuel M. Hoyt, Jr., Co., Inc.
Engineers

District Commissioners
John D. Milne
Edward J. Finnegan
Wallace Dann

INSTRUCTIONS OF NEW WORK
SCALE 1'-10'

4
CHAMBER UP TO 414 ELE WITH THE EXCEPTION THAT THE NORTH OR INSIDE WALL AND THE TWO SIDES UMB. UPON THE INSIDE OF THE WELL. MAKING MORE ROOM AT THE TOP.
SHEET NO SEVEN
GATE CHAMBER AND PIPE PLAN
SCALE ONE INCH = TEN FEET
C.H. WOOD, C.E.
1909.
30" and 16" pipes upstream from gate chamber to be covered with 6 inches in thickness of concrete.
Space between pipes to be filled from elevation 6 inches above the 16" main pipe.
12" concrete 7 1/2 wide
30" and 16" pipes upstream from gate chamber to be covered with 6 inches in thickness of concrete.
Space between pipes to be filled to an elevation 6 inches above the 16 inch pipe.

SECTION A-B
SCALE 1" = 4'
BROWN'S RESERVOIR

Elevation of Spillway: 431.8
Capacity: 290,400,000 Gals

Res. 447 Acres
Total Acreage 158.10