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NATIONAL BUREAU OF STANDARDS

MERRIMACK RIVER BASIN FRANKLIN, NEW HAMPSHIRE

CHANCE BROOK DAM NH 00410

NHWRB 87.15

# PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM



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# DEPARTMENT OF THE ARMY NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

**AUGUST** 1978



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

REPLY TO ATTENTION OF:

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Honorable Meldrim Thomson, Jr. Governor of the State of New Hampshire State House Concord, New Hampshire 03301

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Dear Governor Thomson:

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

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, the New Hampshire Water Resources Board, State of New Hampshire, Concord, New Hampshire 03301, ATTN: Mr. George M. McGee, Sr., Chairman.

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

I wish to take this opportunity to thank you and the Water Resources Board for your cooperation in carrying out this program.

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Sincerely yours,

Colonel, Corps of Engineers Division Engineer

Incl As stated

# CHANCE BROOK DAM

NH 00410

# MERRIMACK RIVER BASIN FRANKLIN, NEW HAMPSHIRE

# PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION REPORT

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# NATIONAL DAM INSPECTION PROGRAM PHASE I INSPECTION REPORT

Identification No. :	NH 00410
NHWRB No.:	87.15
Name of Dam:	CHANCE BROOK DAM
Town:	Franklin
County and State:	Merrimack County, New Hampshire
Stream:	Chance Brook, Tributary to Pemigewasset River
Date of Inspection:	1 June 1978

#### BRIEF ASSESSMENT

Chance Brook Dam is located in Franklin, New Hampshire approximately one mile southeast of the Webster Lake outlet. The dam is a 14-foot high concrete gravity structure with a 110 foot long ogee spillway, a three-bay sluiceway with stop-logs, and a 4 foot by 4.5 foot gated sluiceway. The stop-log bays are each approximately 3-1/2 feet wide. The dam impounds water in Chance Pond and Webster Lake for recreational use. The downstream brook flows into the Pemigewasset River, which eventually discharges into the Merrimack River.

The drainage area of the dam is 19.5 square miles with rolling topography. The dam impounds a maximum of 2650 acre-feet with the pool at the top of abutments. Accordingly, the dam is classified as INTERMEDIATE in size. Its hazard classification is HIGH because of the populated area downstream of the dam. Based on size and hazard classification in accordance with Corps' guidelines, the Spillway Test Flood is equivalent to the Probable Maximum Flood (PMF).

For a dam of these characteristics, a Spillway Test Flood (STF) inflow of 24,000 cfs was selected for the entire drainage area above the dam. However, the B & M Railroad embankment about three quarters of a mile upstream of the dam restricts flow so that the STF peak discharge computed would not reach the dam. The embankment is 41 feet high with 13.6 feet x 14 feet granite arch culvert passing beneath. As long as the railroad embankment does not fail, the STF at the dam is 4000 cfs. This flow (4000 cfs) can be discharged over the dam without overtopping assuming all stop-logs in place and the sluice gate closed. However, if the railroad embankment failed during the STF, the dam would almost certainly be overtopped, even though the spillway has a capacity of 7000 cfs.

The condition of the dam is considered GOOD, with minor repairs and additional investigations to be made by the owner within 2 to 3 years from date of receipt of the Phase I Inspection Report. Recommendations include repair of the sluice gate operating mechanism support and inspection and evaluation of the upstream railroad embankment and culvert to determine if it can retain an appropriate design flood without failure. The owner should also consider delegating a local official to open the outlet works in an emergency to decrease response time.

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

Charles ,

CHARLES G. TIERSCH, Chairman Chief, Foundation and Materials Branch Engineering Division

FRED J. RAVENS, Jr., Member Chief, Design Branch Engineering Division

)

SAUL COOPER, Member

Chief, Water Control Branch Engineering Division

APPROVAL RECOMMENDED:

ac B. Fryan

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 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 the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

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

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

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Overview from right abutment



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i.

Overview from left abutment



# PHASE I INSPECTION REPORT CHANCE BROOK DAM, NH 00410 NHWRB 87.15

#### SECTION 1 - PROJECT INFORMATION

#### 1.1 General

## (a) <u>Authority</u>

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. Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZD under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0303 has been assigned by the Corps of Engineers for this work.

(b) <u>Purpose</u>

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

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

(c) Scope

The program provides for the inspection of non-Federal dams in the high hazard potential category based upon location of the dams and those dams in the significant hazard potential category believed to represent an immediate danger based on condition of the dams.

#### 1.2 Description of Project

## (a) Location

Chance Brook Dam is located in the Merrimack River Basin on Chance Brook, approximately one mile southeast of the Webster Lake outlet and one mile west of Franklin. The locus is shown on the USGS Penacook, N.H. quadrangle. The relation of the dam to other features is shown on Figure 1 of Appendix B. Chance Brook flows into the Pemigewasset River, a tributary of the Merrimack River.

#### (b) Description of Dam and Appurtenances

The dam and appurtenances consist of a concrete gravity ogee type spillway structure, a concrete abutment and a gate house structure. A three bay sluiceway with stop-logs is located between the gate house structure and the right abutment. A concrete training wall is located on the right bank immediately downstream of the sluiceway. A concrete walk spans over the sluiceway. A steel handrail is located around the perimeter of the sluiceway outlet along the training wall, walkway and gate house structure. A wood frame gate house is supported on the gate house structure. All structures are founded on bedrock. Plans of this dam and appurtenant structures are not available (See overview photographs and Figures 1, 2 and 3, Appendix B for orientation).

The spillway structure is approximately 110 feet in length. This structure is laid out as an inverted vee in plan with an apex angle of approximately 110 degrees at its midpoint. The height of the spillway varies from 2 to 8 feet. The right abutment is approximately 22.5 feet long and 3.0 feet wide on its top surface. Bedrock outcrops form the left abutment.

The wood framed gate house, which is approximately 10.5 feet square, is supported on a concrete gate structure 14 feet long and 10.5 feet wide. A 5 foot square timber sluice gate is operated from within this gate house. This sluice gate controls a 4 foot wide by 4.5 foot high waterway opening. The gate is operated by a pedestal mounted hand crank. The pedestal is mounted on two steel channel sections set on the concrete floor slab. The three bay sluiceway consists of three openings, 3.75 feet, 4.17 feet and 3.75 feet wide, respectively. Two intermediate steel stop-logs guides are set in cut-outs in the sluiceway invert and are fastened to the walkway fascia. Stop-logs have been set in place. A concrete walkway 4.17 feet wide and 15 inches thick spans over the three bay sluiceway.

#### (c) <u>Size Classification</u>

The dam impounds a maximum of 2,650 acre feet at elevation 404.2 MSL. Since the dam impounds more than 1,000 acre feet but less than 50,000 acre feet, the dam is classified as INTERMEDIATE according to the "Recommended Guidelines."

# (d) <u>Hazard Classification</u>

The area downstream of the dam is a built-up section of the city of Franklin. Because of the potential loss of lives and extensive economic loss if the dam failed, the dam's potential hazard classification is HIGH.

#### (e) <u>Ownership</u>

The present owner of the dam is the New Hampshire Water Resources Board (NHWRB). The Board purchased the dam from Mr. George B. Horne on September 21, 1960.

Records in the files of the NHWRB indicate that in 1934 and 1938 the dam was owned by Franklin Needle Company and was used to power a sawmill on the downstream side of the structure. However, the configuration and type of dam was different than the present one. It appears that this old granite block dam was replaced by the present concrete one some time between 1938 and 1960.

#### (f) <u>Operator</u>

The operation of the dam is controlled by the New Hampshire Water Resources Board. Key officials are as follows:

> George McGee, Chairman Vernon Knowlton, Chief Engineer Donald Rapoza, Assistant Chief Engineer Gary Kerr, Staff Engineer

The Board's telephone number is 603-271-3406. Alternatively, the Board may be reached through the State Capital at 603-271-1110.

## (g) Purpose of Dam

The dam was originally established to generate power for a mill. Since that time the dam has been reconstructed and now serves only as a recreational resource.

#### (h) Design and Construction History

The original granite block dam, which was constructed to generate power for a saw mill, was constructed in 1873. According to a NHWRB sketch of 1939, the granite blocks were founded on bedrock with a 4.9 foot wide gate cut into the bedrock 16 feet from the left abutment. There was also a 30 inch diameter penstock cut into the bedrock about 11 feet from the right abutment.

Sometime between 1938 and 1960 the saw mill was torn down, the penstock was removed and a concrete dam with ogee spillway was constructed. In September 1960 the NHWRB purchased the dam. In early 1973 the NHWRB constructed the three bay sluiceway with stop-logs to provide for the entire dam, sufficient discharge capacity for the 100 year storm, or 3300 cfs as determined from the Kennison-Colby formula. This is considerably more than can be passed by any of several upstream structures, as will be discussed.

# (i) <u>Normal Operation Procedures</u>

The dam is tended by a member of the NHWRB or its staff on a week to ten day basis in the summer and on a two week interval in the winter. A log book of all visits is maintained in the Board's file. 1-4 The NHWRB maintains the stop-logs at spillway crest elevation during the summer recreational season (June 1 to mid October). If the New Hampshire Fish and Game Department notifies NHWRB that the water temperatures downstream of the dam are getting too high, NHWRB opens the gate to release cooler water.

Around mid-October the NHWRB begins pulling stop-logs to drawdown the pond level about 1-1/2 to 2 feet below the spillway crest. After periods of heavy rain the gate is opened to help maintain this drawdown level. After the winter snowmelt, the NHWRB begins replacing the stop-logs to develop a full pond at spillway crest elevation by June 1.

#### 1.3 <u>Pertinent Data</u>

(a) Drainage Area

The drainage area above the dam has rolling topography with an area of 19.5 square miles. The drainage area above the B & M Railroad culvert is 17.3 square miles.

(b) Discharge at Damsite - See Stage-Discharge Curve, Appendix D.

- Outlet works: Gated sluiceway 4 ft. x 4.5 ft; invert El. 392.2
   Three bay sluiceway with stop-logs - 10.5 ft. wide; invert El. 393.7
- Maximum known flood at dam site: 1200 ± cfs (since 1960)
- (3) Spillway capacity at maximum pool: 7000 cfs at El. 404.2
- (4) Gated sluiceway at full pool: 135 cfs at El. 398.6 (fully open)
  Sluiceway with stop-logs: 0 cfs at El. 398.6 (stoplogs in place)
- (5) Gated sluiceway capacity at maximum pool: 200 cfs at El. 404.2 (fully open)
   Sluiceway with stop-logs: 300 cfs at El. 40402 (stoplogs in place)
- (6) Total discharge capacity at maximum pool: 7500 cfs at El. 404.2

- (c) <u>Elevation (ft. above MSL)</u>
  - (1) Top of Dam: 404.2
  - (2) Recreation pool: 398.6
  - (3) Spillway crest: 398.6
  - (4) Invert stop-log sluice: 393.7
  - (5) Invert sluice gate: 392.2
  - (6) Streambed at downstream toe: 390

# (d) <u>Reservoir</u>

- Length of maximum pool: 2.5 mi.
   Chance Pond 0.75 mi.; Webster Lake 1.75 mi.
- (2) Length of recreation pool: 2.5 mi.

# (e) <u>Storage</u> (acre-feet)

- (1) Recreation pool: 1100 at El. 398.6
- (2) Top of dam: 2650 (approximately) at el. 404.2
- (f) <u>Reservoir Surface</u> (acres)
  - (1) Recreation pool: 575
  - (2) Top of dam: 675
- (g) <u>Dam</u>
  - (1) Type: Concrete gravity
  - (2) Length: 133 ft.
  - (3) Height: 14 ft.

# (h) <u>Spillway</u>

- (1) Type: Concrete Ogee
- (2) Length of weir: 110 feet
- (3) Crest elevation: 398.7 feet msl

# (i) <u>Regulation Outlets</u>

The regulating outlets consist of a three bay sluiceway with stop-logs and a manually operated gated sluiceway.

The openings of the three bay sluiceway are 3.75 feet, 4.17 feet, and 3.75 feet wide, respectively with invert elevation 393.7 feet. The stop-logs in each bay are pulled and replaced by hand and lifting hook and only one or at most two boards can be so removed under head.

The gated sluiceway consists of a five foot square timber sluice gate which controls a 4 foot by 4.5 foot concrete waterway opening. The invert of the opening is elevation 392.2 feet. The gate is operated by a pedestal mounted hand crank which is in a wood framed gate house.

# SECTION 2 - ENGINEERING DATA

# 2.1 Design

The only design data available for the present dam is a 1976 report by the NHWRB which indicates the flow capacity of Chance Brook Dam is in excess of 3300 cfs or the 100 year flood flow frequency (Kennison-Colby method). No plans or other design data of the dam could be located in the NHWRB files.

# 2.2 Construction

There is no known information on the construction of the dam other than the renovations which were done in 1973 by the NHWRB. In early 1973 the NHWRB's construction crew installed the three bay stoplog sluiceway.

#### 2.3 Operation

Adequate information is available on the operation of the dam. the NHWRB has a well established schedule of visits and operational procedures. A good overall review of operation, as they relate to the unusual drainage area features, is contained in Appendix B, a Report by the NHWRB to the Governor of New Hampshire.

#### 2.4 Evaluation of Data

#### (a) <u>Availability</u>

The prime data source is the June 1, 1978 visual inspection supplemented by conversations with staff members of the NHWRB. Definitive engineering design data are not available.

#### (b) <u>Adequacy</u>

The lack of indepth engineering data did not permit a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data. The evaluation is based primarily on visual inspection, past performance history, and engineering judgment.

#### (c) <u>Validity</u>

The visual inspection and hydrological analyses are of sufficient validity to permit satisfactory evaluations.

#### SECTION 3 - VISUAL INSPECTION

#### 3.1 <u>Findings</u>

#### (a) General

Chance Brook Dam is in good condition at the present time. There were no findings that indicate the dam is unsafe.

#### (b) Dam

#### (1) Spillway (Photo 4)

Observations of the downstream face of the concrete spillway have revealed that there are many random, but generally minor, longitudinal cracks in the structure and one vertical crack. A horizontal crack approximately one foot below the spillway crest is prevalent over approximately 75 percent of its length. Additional horizontal cracks, varying from 5 to 30 feet in length, are prevalent throughout the downstream face of the spillway. These horizontal cracks show evidence of spalling and adjacent efflourescence, but none of the cracking is of structural significance.

A horizontal construction joint approximately 5 feet below the spillway crest was observed. This open joint starts approximately 10 feet from the gate house structure and extends in a northeasterly direction for approximately 15 feet.

A vertical crack approximately 1 inch wide at the crest and gradually tapering to a width of approximately 1/4 inch is located approximately 30 feet northeast of the gate house structure.

The upstream side of the spillway cannot be inspected due to normal water conditions.

(2) Gate House Structure (Photos 1, 2 and 5)

The inlet side of this structure has been subjected to minor erosion at the spillway crest. Fine random cracking and efflourescence is, to a limited extent, present above this erosion.

The balance of the upstream face of this structure is in good condition with the exception of minor erosion and fine random cracking in the sidewalls adjacent to the invert. A horizontal construction joint at the base of this structure adjacent to the spillway has slightly spalled and efflouresced. The balance of the downstream face of this structure and the sidewalls adjacent to the spillway are in good condition.

The wood frame gate house is in good condition.

(3) Sluice Gate

The timber sluice gate, rising stem pedestal crank mechanism are in good condition. However, the pedestal base which consists of two 8 inch by 2-1/2 inch steel channel sections is unstable. Instability is due to shearing of an anchor bolt at the end of one channel and has permitted the channel to misalign and "float." This condition has caused the pedestal apparatus to tilt out of plumb and to bind slightly at some points in the gate's travel.

# (4) <u>Sluiceway</u> (Photo 3)

The concrete sluiceway is in good condition and does not show any evidence of checking, cracking, or spalling. The structural steel stop-log guides and the stop-logs are in good condition.

(5) <u>Abutments</u>

The concrete at the right abutment is in good condition without any apparent evidence of settlement or displacement. There is no evidence of cracking, checking, or spalling.





At the left abutment the concrete ogee spillway ties in to a steeply sloping bedrock outcrop. The bedrock is a massive, fine to medium grained, dark gray, micaceous, garnetiferous schist with occasional quartz seams varying from one inch to one foot thick. Jointing is irregular, but continuous high angle joints strike approximately east-west. They are spaced three to four feet apart and are tight. There is one prominent joint near the top of the left abutment that dips about 30 degrees downstream and appears to be open. At the time of June 1, 1978 inspection, water was flowing over the spillway and over the joint. However, a photo taken a month earlier when the lake level was a few inches below the spillway crest indicates there was no flow through the joint at that time.

No seepage was noted at either abutment.

## (c) <u>Appurtenant Structures</u>

(1) Training Wall

The training wall on the right bank adjacent to the sluiceway structure is in good condition and does not show any evidence of checking, cracking, or spalling.

#### (2) Concrete Walkway and Steel Handrail

These supporting facilities are in excellent condition.

(d) <u>Reservoir Area</u> (Photos 7, 8 and 9)

The reservoir area is made up of two bodies of water, Webster Lake and Chance Pond, connected by a channel approximately 0.8 miles northwest of the dam. The channel connects the outlet of Webster Lake at the north end with Chance Pond at the south end. This channel passes through a culvert under State Route 11 and through a stone arch culvert beneath the Boston and Maine Railroad embankment.

About 0.4 miles upstream of the dam, the Carr Street embankment crosses Chance Pond. There is a 10-foot diameter corrugated steel culvert through this embankment. The slopes along the right side of Chance Pond are stable and generally less than 6 feet high. Along the left side of Chance Pond the slopes vary from low near the left abutment of the dam to 25 to 30 feet high upstream. These slopes are relatively stable, but there is some evidence of soil creep near the toe of the steeper slope, as evidenced by the slight tilting of a few trees toward the reservoir.

#### (e) <u>Downstream Channel</u> (Photos 5 and 6)

Immediately downstream of the dam there are two channels with an island in the middle. About 100 feet downstream of the dam these channels merge into one. The channels have bedrock bottoms with occasional boulders. Some debris has collected at the toe of the spillway and the shores of the channel. However, there are no significant obstacles to flow.

The sides of the channel are relatively steep, bedrock controlled and stable.

#### 3.2 Evaluation

The visual inspection adequately reveals key characteristics of the dam to permit satisfactory evaluation of those items which affect the stability and safety of the structure. The dam and its appurtenant works are in GOOD condition.

#### SECTION 4 - OPERATIONAL PROCEDURE

#### 4.1 Procedures

As noted earlier in Section 1.2 (i), a member of the NHWRB or its staff visits this dam on a 7 to 10 day cycle during the summer and on a two week cycle during the winter. The NHWRB maintains a log book of all visits. During the summer recreational season (June 1 to mid-October) the NHWRB maintains the stop logs in the sluiceway at spillway crest elevation. If the New Hampshire Fish and Game Department determine that downstream water temperature are too high, the NHWRB opens the sluice gate to draw off cooler water from the bottom of the reservoir.

During the rest of the year the NHWRB draws down the water level about 1-1/2 to 2 feet below spillway crest elevation. This is normally controlled by pulling stop-logs, but after periods of heavy rain the sluice gate is also opened to control the water level.

After the winter snowmelt the NHWRB replaces the stop logs to bring the water level to spillway crest elevation by June 1.

#### 4.2 <u>Maintenance of Dam</u>

No specific program of maintenance is currently established. The NHWRB visits the dam on a regular basis and reports any maintenance problems to the engineering section. They, in turn, assess the problem and initiate whatever corrective measures are necessary.

#### 4.3 Maintenance at Operating Facilities

The maintenance of the operating facilities is treated in the same manner as maintenance of the dam discussed in Section 4.2 above.

#### 4.4 Warning Systems

The NHWRB relies on its regularly scheduled site visits to detect any problems which would adversely affect dam safety. Also, after periods of heavy rain, the NHWRB schedules prompt visits to the dam to observe conditions and open discharge works as needed. The continuous interest of local residents who are quick to respond to variations in water levels also provides an informed secondary warning system. Ample evidence of this can be found in NHWRB's correspondence and phone logs.

# 4.5 Evaluation

In view of the characteristics of the dam and the NHWRB's regularly scheduled site visits, the operational procedures seem adequate.



#### SECTION 5 - HYDROLOGIC/HYDRAULIC

# 5.1 Evaluation of Features

#### (a) <u>Design Data</u>

The available data sources for the Chance Brook Dam include several prior inventories and inspection reports by the New Hampshire Water Resources Board (NHWRB), several letters and memoranda regarding high water levels in Webster Lake and all of the background material for flood plain mapping of Chance Brook for the Flood Insurance Study (FIS) of the Town of Franklin, New Hampshire. This last study was carried out by Anderson-Nichols Company, Inc. of Concord, New Hampshire.

Some of the basic characteristics of the dam are listed in the December 1, 1938, "Data on Dams in New Hampshire" by the New Hampshire Water Control Commission and in "Inventory of Dams in the United States" by the Corps of Engineers. In addition there exists a November 1976 report by the NHWRB relating to the high water level problems in Webster Lake.

None of these sources contains the design data for the dam, although they include some discharge calculations for both the dam and the upstream channel.

#### (b) Experience Data

The New Hampshire Water Resources Board has maintained daily records of water levels in Chance Pond and Webster Lake since assuming ownership in 1960. There are two gauges, one at the Chance Brook Dam with a reading of 0.0 at full lake (datum 397.7 MSL) and one at Legasee Beach on Webster Lake with a reading of 2.90 at full lake (datum 394.8 MSL). The highest stage recorded since 1960 is 2.20 feet above full lake at the gauge on the dam on April 23, 1969. This is equivalent to a flow of roughly 1200 cfs.

On July 5-6, 1973 the Legasee Beach gauge reached 3.9 but this was due to a sand bag dike that had been installed to hold the lake elevation, while at the dam the water had been drawn down to permit construction of the new sluiceway with stop-logs. At the time of the July 1973 storm, the gauge at the dam read approximately 2.5 feet.

Several complaints about the level in Webster Lake and the operation of the dam have been received by the NHWRB. However, it is the opinion of the NHWRB that these problems are caused by the natural variability in lake levels and the flow constraints between Webster Lake and Chance Pond Dam.

#### (c) <u>Visual Observations</u>

Chance Brook Dam controls the flow through Chance Brook from Webster Lake on its way to the Pemigewasset River in Franklin, New Hampshire. The structure consists of an ogee spillway about 105 feet in length, a gate house with an orifice opening roughly 4 feet by 4.5 feet and a stop-log spillway with three sets of stop-logs, each roughly 3.5 feet in width. Normal pool elevation is just below the crest of the spillway, which results in a "full lake" condition. The measurements taken during the inspection visit to the dam generally agree with the detailed survey data provided by Anderson-Nichols Company, Inc. for their FIS in Franklin.

Several constrictions in Chance Brook between Webster Lake and Chance Brook Dam were noted during the inspection visit. These constrictions could very well reduce the flow capacity in the brook and cause high water levels in Webster Lake during small floods. Only the Boston and Maine railroad bridge would severely restrict flows during a severe flood such as the Spillway Test Flood. All of the others would be overtopped and thus not significantly affect the flows reaching the dam. Basic data on these constrictions is as follows:

- Carr Street: 10 ft. diameter corregated steel culvert with accumulated rocks and other debris on the invert. Road embankment allows for an 11.4 ft. depth of headwater. Invert = 393.5 MSL
- R. R. Culvert: Split stone with mortar; vertical sides and arched top (Dimensions: 13.6 ft. wide x 14.0 ft. at crown). Sand, rock and debris for the stream bed. Height of embankment allows for a headwater of 38 ft. Invert = 395.0 MSL
- Rte. 11: Concrete box culvert with sand, rock and collected debris for a stream bed (dimensions: 13.2 ft. wide x 8 ft. high). Headwater conditions and lakeside development allows for a maximum pond elevation of 405.7 or 10.3 ft. depth without severe damage. Invert = 394.6 MSL (in sand) 5-2

# (d) Overtopping Potential

The Phase I investigation studies hydrologic conditions in order to assess the adequacy of the dam in terms of its overtopping potential and its ability to allow an appropriately large flood to pass safely. This involves comparison of a Spillway Test Flood (STF) with dam discharge and storage capacities.

The "Recommended Guidelines" of the Corps of Engineers specify procedures for determining the STF for a dam, based on its size and hazard classifications. As shown in Table 3 of the Guidelines, a dam classified as INTERMEDIATE in size with a HIGH hazard potential should have an STF equal to the Probable Maximum Flood (PMF).

The PMF is estimated using the chart of "Maximum Probable Flood Peak Flow Rates" obtained from the New England Division of the Corps of Engineers. The drainage basin above Chance Brook Dam has "rolling" topography with an area of 19.5 square miles. If the PMF is reduced slightly to account for the influence of Highland Lake, the resulting runoff rate is 1250 csm and the STF inflow discharge is about 24,000 cfs, with an assumed runoff of 19".

The B & M railroad bridge would act as a flow restriction, thus the STF peak discharge computed above would not reach the dam if the railroad embankment were not overtopped or breached. The lake must rise above 420 MSL before an alternative outlet, specifically a highway underpass 800 feet to the west of the culvert, would function.

The flow at the dam was computed by routing an assumed PMF through Webster Lake to determine the associated flow through the railroad culvert to the dam. The routing is shown in Appendix D and gives a maximum flow of 3130 cfs with the water level behind the railroad dike 23.4 feet above the invert of the culvert, or 17.9 feet above normal lake elevation.

The flow of 3130 cfs does not account for the 2.2 square miles which drain into Chance Pond between the culvert and the dam. Using the Corps of Engineers' guidelines, this area would have a PMF of 3000 to 4000 cfs, which could be expected to pass the dam before the peak outflow from Webster Lake would occur. However, since there would be some contribution from this flow at the time of peak outflow, the STF for Chance taken as 4000 cfs. This value assumes that the railway dike will hold at a water level of 17.9 feet above normal lake elevation. 5-3 The flow from Chance Brook Dam is controlled by the 105 foot spillway, the 4 foot by 4.5 foot orifice gate and the 10.5 foot stop-log spillway. In this analysis, the stop-logs are assumed to be in place at the same level as the spillway.

In their previous FIS work, Anderson-Nichols Company, Inc. developed a rating curve assuming that the stop-logs were in place and the gate fully open (see Appendix D). According to this curve, the STF of 4000 cfs would result in a water surface elevation 3.8 feet over normal pool elevation. If the gate were closed, the maximum water level would be 3.9 feet over normal pool elevation. Neither of these levels presents any risk of overtopping the abutments, as they are at least 5.5 feet above the normal pool. The maximum discharge capacity of the dam at elevation 404.2 MSL is 7500 cfs.

Thus, as long as the railway dike which separates Webster Lake from Chance Pond holds, there seems to be little likelihood of overtopping Chance Brook Dam. However, if this dike were to fail, the dam would almost certainly be overtopped.

#### 5.2 Hydrologic/Hydraulic Evaluation

An extrapolation of Anderson-Nichols' rating curve from their FIS work indicates that Chance Brook Dam would convey a flow of about 8000 cfs at 5.5 feet above normal pool elevation, which is the height of the dam's west abutment. If the B & M Railway Dike at the outlet of Webster Lake does not fail, this flow would not be approached under STF conditions. However, if the dike were to fail, flow at the Chance Brook Dam could be as large as or greater than the Webster Lake peak PMF inflow of 22,000 cfs. In this case, the west abutment of Chance Brook Dam would be overtopped by several feet.

In summary, Chance Brook Dam will not be overtopped if the B & M dike holds, but it will be overtopped by several feet if the dike fails. The assessment of the adequacy of the B & M dike to withstand the STF-generated stages was beyond the scope of these Phase I investigations.

# 5.3 Downstream Dam Failure Hazard Estimates

The downstream flood hazards resulting from a failure of Chance Brook Dam are estimated using the procedure set forth in "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs," New England Division of the Corps of Engineers, April 1978. This procedure calls for considering the downstream attenuation of dam failure hydrographs in computing flows and flooding depths. The calculations take into account the hydraulic and storage characteristics of stream reached downstream of the dam.

For the purposes of these calculations, failure is assumed to occur at the peak water level under STF conditions, with the B & M railroad bridge intact. These conditions result in a pond level of 3.8 feet above the spillway crest or 1.7 feet below overtopping depth.

Chance Brook downstream of the dam is divided into three reaches for the analysis. The first extends from the dam to the Kimball Street Bridge, the second from the Kimball Street Bridge to the second B & M railroad bridge, and the third from the railroad bridge to the Main Street Bridge. For each reach, a typical cross-section from the FIS data was used to determine normal flow depths or the estimated peak flows. In addition, an approximate rating curve for the B & M railroad bridge at the downstream end of Reach 2 was developed since it was anticipated that Reach 2 would be subjected to the greatest potential flooding.

The analysis indicates that a depth of approximately 15 feet above the invert of the railroad bridge would result. This would be sufficient to cause moderate flood damages to structures along the south bank of the stream in Reach 2. In Reach 1, the flood depths would overflow the natural banks, but the lack of nearby structures would limit flood damages. In Reach 3, the extreme slope limits the depth of flooding, but high velocities could possibly cause severe damage to bridge abutments downstream.

It should be noted that failure of the railroad dike at the outlet of Webster Lake would, in times of high water, result in a flood flow far greater than that generated by failure of Chance Brook Dam alone. Indeed, the dam's failure would become incidental due to the volume of water already released from the dike.

While it is beyond the scope of these Phase I investigations to study the structural soundness and hydraulic implications of the B & M railroad dike, this is an important area for further study.

#### SECTION 6 - STRUCTURAL STABILITY

#### 6.1 Evaluation of Structural Stability

## (a) <u>Visual Observations</u>

There are no design data available for review of the structural stability of the dam and appurtenant structures. The extensive field investigations and findings do not indicate any displacement and/or distress which would warrant the preparation of structural stability calculations based on assumed sectional properties and technical values.

Observations during the inspection period have revealed various minor deficiencies which can be attributed to alternate freeze and thaw cycles resulting in spalling and cracking of concrete and minor maintenance required on the sluice gate crank pedestal support.

## (1) <u>Spillway</u>

The horizontal joints in the spillway structure can be attributed to lack of quality control in placement of concrete. These joints are randomly dispersed througout the structure and do not pose any factor detrimental to the stability of the structure. The vertical crack in the spillway is the result of a faulty construction joint which has been subjected to minor cavitation.

#### (2) Gate House Structure

Minor erosion with resulting fine random cracking and efflourescence of concrete is the result of alternate freeze and thaw cycles due to the near constant water surface elevation in the lake during the winter.

#### (3) Sluice Gate Support Assembly

The shearing of an anchor bolt on this assembly suggests previous problems with vertical alignment of the sluice gate. The prudent operation of the sluice gate, as demonstrated by a representative of the NHWRB, can circumvent any operational problems provided that experienced personnel maintain the facility.
#### (b) Design and Construction Data

According to the "Inventory of Dams in the U.S.A." dated 12 March 1974, the dam was originally completed in 1873. Subsequent to this date the entire original structure, including an adjacent mill were removed. Historical records indicate that the original dam, a stone structure, was in existence in 1938. Additional research has revealed that the present day dam was constructed prior to 1960. Furthermore the gate house structure was constructed subsequent to 1938 based on materials and construction technology. The three bay sluiceway was constructed by the NHWRB in 1973 to provide additional discharge capacity. Further design and construction data are not available.

#### (c) <u>Operating Records</u>

The NHWRB has good records since its assumption of ownership in 1960.

#### (d) Post Construction Changes

Since the present day concrete dam was constructed sometime prior to 1960, the only noted change was the addition of the three-bay stop-log sluiceway which was constructed by the NHWRB in 1973.

#### (e) Seismic Stability

The dam is located in Seismic Zone No. 2 and in accordance with recommended Phase I guidelines does not warrant seismic analyses.

6-2

### SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

### 7.1 Dam Assessment

#### (a) <u>Condition</u>

The visual inspection revealed no deficiencies of major concern. The dam is in GOOD condition. There is adequate spillway capacity to pass the Spillway Test Flood provided the B & M railroad embankment at the outlet of Webster Lake does not fail.

#### (b) Adequacy of Information

The information available is adequate as a basis on which to form evaluations.

#### (c) <u>Urgency</u>

The sluice gate operating mechanism support should be repaired by the owner, and the railroad embankment should be investigated within the next two to three years after receipt of the Phase I Investigation Report.

#### (d) Need for Additional Information

Available information indicates no necessity for additional information at this time, other than supplementary studies recommended below.

### 7.2 <u>Recommendations</u>

During large floods the upstream B & M railroad embankment with limited size culvert acts as a dam. An investigation and evaluation of this embankment should be made to determine if it is capable of retaining an appropriate design flood without failure and to field check the elevation data taken from the 5 foot contour map which indicates that no other outlet to the lake is available below elevation 420 MSL.

7-1

### 7.3 <u>Remedial Measures</u>

### (a) <u>Alternatives</u>

An alternative to evaluating the railroad embankment's performance as a dam might appear to be the provision of sufficient discharge capacity beneath the embankment to prevent detention during an appropriate design flood. However, the viability of the alternate is lessened by the then necessary provision of added discharge capacity at the Chance Brook Dam.

#### (b) O & M Procedures

Without the services of a skilled operator knowledgeable in the operating characteristics of the sluice gate, this gate conceivably can be subject to failure. Due to the lack of restraint of the operating mechanism support it is recommended that the owner repair this to allow sluice gate operation without unusual stress or binding to the timber gate.

To decrease the response time in opening the outlet works in an emergency, the NHWRB should consider delegating some operational responsibility to a local official such as the police or fire chief. This individual would maintain a set of keys to the gate house with instructions on removing stop-logs and operating the sluice gate in an emergency, as directed by the NHWRB.

Removal of all debris from the immediate downstream channel will insure unimpeded flow.



## APPENDIX A

## VISUAL INSPECTION CHECKLIST



### INSPECTION TEAM ORGANIZATION

- Date: 1 June 1978, 8:45 a.m.
- Project: Chance Brook Dam, NH 00410 Franklin, New Hampshire Chance Pond Brook NHWRB 87.15
- Weather: Sunny, warm, moderate breeze

### Inspection Team

James H. Reynolds	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZD)	Team Captain
William S. Zoino	GZD	Soils
John E. Ayres	GZD	Geology
Nicholas A. Campagna	GZD	Soils
Andrew Christo	Andrew Christo Engineers, Inc. (ACE)	Structural & Concrete
Andrew Christo Paul Razgha	-	

## State Official Present

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Ken Stern, New Hampshire Water Resources Board

Chance Brook Dam Franklin, N.H.

### June 1, 1978 NH 00410

CHECK LISTS FOR VISUAL INSPECTION AREA EVALUATED ΒY CONDITION & REMARKS Dam Superstructure nac Vertical Alignment Good Horizontal Alignment Good Settlement None Lateral Movement None Downstream Seepage None Concrete Good Foundation Drainage Features nac-None Outlet Works Spillway Random horizontal open joints it c with evidence of spalling and adjacent efflourescence. One vertical crack. Sluice Gate Inlet Ac Minor erosion at spillway crest elevation, fine random cracking and effburescence. Sluice Gate Outlet Ac. Minor erosion and fine random cracking in sidewall adjacent to invert. Horizontal joint, slight spalling and efflourescence. Sluice Gate Timber gate and operations Ać mechanism in good condition. Pedestal base unstable and must be repaired. Sluiceway トこ Good Stop-logs and supports Good ハン

Chance Brook Danı Franklin, N.H.

June 1, 1978 NH 00410

#### CHECK LISTS FOR VISUAL INSPECTION AREA EVALUATED BY CONDITION & REMARKS Abutments Right abutment concrete NC Good nac Seepage None Left abutment hac Massive bedrock with tight ioints Appurtenant Structures Training Wall 1.2 Good Wood Frame Gatehouse Good Ar\_ Concrete walkway and steel سي مذي handrail Good Reservoir Shoreline nac Generally stable, minor soil creep at toe of steep slopes on left shoreline, evidenced by slight tilting of trees toward reservoir, 500 to 600 feet upstream of dam. Upstream hazard in the event of backflooding Numerous shore front houses Micsubject to inundation if water rises more than 3 feet above spillway crest. Downstream Channel Debris Mac Numerous logs and branches Trees overhanging channel None hac No major obstructions, occa-Obstructions hac sional boulders.

A-4

# Appendix B

Fig. 1	Site Plan I	<u>Page</u> B-2
Fig. 2	Plan of Dam	B - 3
Fig. 3	Plan and Elevation of Dam	B-4
	List of pertinent records not included and their location	B - 5
	Review of Webster Lake Operation dated Nov 76 prepared by the NHWRB for the State Governor	B-6









The following records are maintained by the NHWRB at their Concord offices:

(1) A letter dated 6 May 76 from the Mayor of Franklin, NH to the NHWRB concern the control of Webster Lake.

(2) A letter dated 25 Jul 63 from an unknown agency to the Public Utilities Commission concerning the lake level.

(3) An undated report from 1961 by the NHWRB concerning their investigation of a high water complaint at the lake.

The Board can be reached at 603-271-3406 or through 603-271-1110.

#### REVIEW OF WEBSTER LAKE OPERATION

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FOR

1) Governor's Office

2) Mayor of Franklin, New Hampshire

BY New Hampshire Water Resources Board

November 1976

#### WEBSTER LAKE AND CHANCE POND

#### HYDRAULICS REVIEWED

#### INTRODUCTION

A stretch of pondage approximately 4500 feet beginning at the outlet of Webster Lake and ending at the Water Resources Board's dam has been studied many times for various reasons over the past years. This review has been prompted by correspondence from the Governor's office and from the Mayor's office of Franklin. They relate to complaints of spring-time "high water" and mismanagement of the lake and Chance Pond Brook. Within this stretch there are five man-made structures, each with different hydraulic characteristics and flow capacities, across the brook. Chance Pond, as controlled by the dam, is a flooded portion of the brook which backs up to the outlet of Webster Lake and thus effects the level of the lake. See accompanying photos and map.

During the course of this study, a variety of information sources were tapped with the bulk coming from the Board's record files. The remaining portion from interviews of local residents and information from personnel of the City Managers office of Franklin.

#### BACKGROUND INFORMATION

This Board's records include information dated in the early 1930s to the present concerning the lake and the dam, part of which is a diary of pond levels from 1970 to the present. This report contains several hydrographs of the gages at the dam and Webster Lake.

The purpose of the hydrograph is to indicate how the pond stage fluctuates with time. Pond stage, or elevation, is a measure of the amount of the water in storage; which is directly affected by inflow from the surrounding area and the outflow through the dam or stream channel. If inflow exceeds outflow, then the stage increases and vise versa. Also included on the hydrographs is the sequence of operations at the dam. As can be seen from the graphs, when an operation is accomplished the two pond stages are affected in either rise or fall of the pond surface.

An interpretation of these hydrographs brings to light several ideas which are discussed below. These charts indicate the following basic data and were chosen for being representative of the era with the most complete available gage readings.

- 1. U.S.G.S. Gage readings at Legasse Beach
- 2. Gage readings at the Webster Lake dam
- The relative positions of the gate and stoplogs at the dam as it is operated.

Each hydrograph legend is self-explanatory. The first and probably most

"bvious is that during a given calendar year the summer months exhibit a reasonably table pond elevation while late Fall, Winter and early Spring are marked with fluctustions. This is caused by the Fall and Winter drawdown operation, and Spring snow melt and rains. It also indicates that operations at the dam such as opening the gate or pulling stoplogs rapidly drains Chance Pond, but that Webster Lake is lowered more slowly.

When the pond levels are fairly stable there appears to be a differential of 0.1 ft. to 0.2 ft. in the gage heights. Since the difference is small and steady, it is probably due to the two gages having a different datum. The slight variations are probably caused by misreading or recording of the gage. Even with this constant error, valid assumptions and recommendations can be made to take corrective action.

The single, most important observation is that whenever an operation, such as pulling stop logs or opening the gate, is accomplished, the pond at the dam is lowered significantly more than Webster Lake. It should also be noted that the converse is true. This situation is due to upstream conditions limiting the inflow to Chance Pond and thereby restricting the overall flow capacity of the dam.

#### BASIC FACTS

Starting at the Lake and working downstream the restricting man-made structures are as listed below:

- 1. Foot bridge near U.S.G.S. gage at Legasee Beach
- 2. Rte. #11 Bridge
- 3. Boston & Maine Railroad Bridge
- 4. Carr Street corregated metal bridge
- 5. Webster Lake dam

In addition to these there are three major natural conditions which cause a varying effect on the stream flow. These are:

- 1. A constantly changing outlet elevation of Webster Lake.
- 2. The ever-changing swamp conditions that exist between the railroad bridge and the open water of Chance Pond.
- 3. The sand from Legasse Beach as it drifts through the Rte. ll and railroad bridges, and into the swamp. It also eventually drifts all the way down to the dam and silts in Chance Pond.

The flow capacities of these various conditions as outlined above see tabulated here for easy reference.

Webster Lake Dam

In excess of 3300 cfs or the 100 yr. flood flow frequency (Kennison-Colby method)

Carr Street	800 cfs without flow over road and backwater elevation to 404.76 (Design Capacity)
Natural Channel (thru x-section)	945 cfs @ elev. 405.0
R. R. Culvert	1294 cfs @ elev. 405.0
Rt. 11	800 cfs to F.G. ( $w$ /sand as stream bed)
	900 cfs to F.G. (w/invert cleaned to concrete slab)

#### CHANNEL AND BASIC STRUCTURE DETAILS

- Dam: 105 ft. long concrete ogee spillway; 4 ft. x 4 ft. gate and 3 4 ft. long stop log bays.
- Carr Street: 10 ft. diameter corregated steel culvert with accumulated rocks and other debris on the invert. Road enbankment allows for an 11.4 ft. depth of headwater.
- Natural Channel @ X-section: Double channel with send and rock stream bed and bushes growing on the sides of the stream banks.
- R. R. Culvert: Split stone with mortar; vertical sides and arched top (Dimensions: 13.6 ft. wide x 14.0 ft. at crown). Sand, rock and debris for the stream bed. Height of enbankment allows for a headwater of 38 ft. However, upstream development severly limits available headwater.
- Rte. 11: Concrete box culvert with sand, rock and collected debris for a stream bed (dimensions: 13.2 ft. wide x 8 ft. high). Headwater conditions and lakeside development allows for a maximum pond elevation of 405.7 or 10.3 ft. depth without severe damage.

U.S.G.S. Gage reads 2.90 at full pond and would read 8.00 at 405.7.

#### DISCUSSION

In reviewing the structures it becomes self-evident that the dam has the greatest flood flow capacity and the Carr Street culvert the least from a design standpoint. The actual flow at Carr Street is reduced below design figures due to the presence of debris, rocks, and silt that are partially blocking it. However, the Rt. 11 bridge is a close second due to the lakeside development limiting the available headwater depth. The only structure which could take the flow of a

100-year storm without damage to the surrounding area is the dam at Chance Pond. The backwater from the dam would not innundate Carr Street. However, the culvert has such a limited capacity that flow over the road would occur. This would also cause a backwater effect through all of the other structures and thus raise the level of Webster Lake. It has been estimated by the Baker Engineers of Harrisburg, Pa., for a HUD preliminary flood study, that at flood stage Webster Lake would be 6.8' above full pond. This translates to a gage reading of 9.7' or elev. of 407.8. Unfortunately many cottages, septic systems, wells, etc. are located below the 405.0' elev.; so the amount of damage and flooding would be serious.

Two isolated complaints of "high water" have been filed and reviewed during the course of this study. One is related to the bridge over Sucker Brook on Lake Shore Drive. Field investigations indicate an active beaver dam downstream of the bridge that causes a pond to form under the bridge and thus reduces the overall flow capacity of the brook and structure. The remedy would be to remove the beaver and dam.

The other complaint involves a house recently built along Rt. 11 and in close proximity to a seasonal stream. The basic complaint deals with the high lake levels of the June - July 1973 storm. The owner, Mr. Whiting says that the Lake backs up into the culvert and floods the area when the gage approaches 3.6 and causes damage at stage 4.0' plus. His preference would be 0.9' and 1.9' gage height for winter and summer respectively.

The primary reason for this report is to respond to the Webster Lake Association and the Mayor of Franklin regarding the charge of mismanagement of the dam at Webster Lake. The various groups and individuals around the lake, and the State statutes governing the management and operation of State controlled dams dictate that an exceptionally small tolerance in the fluctuation of the Lake and pond is to be required. This tolerance of 1.5 inches from the anticipated pond level for a stipulated time is just not feasible. Given the restrictive flow conditions upstream of the dam and the hydrological aspects of the drainage area, the tight control of the Lake and pond surfaces is not possible even with continuous operations at the dam. The hydrographs substantiate this situation. For example, one inch of runoff from the entire drainage area has the potential for raising the lake nearly 30 inches, or 2.5 feet! Using the Baker Engineers' estimate for the 100-year flood the Lake would rise 6.8 feet. If this depth were added to a "full bood , then the surface would be at elev. 407.8 feet (9.7' on gage). The dam could be wide open and this would still occur. Even if the Lake were down to the natural conditions, that is with the streambed controlling the elevation of the pond, a 6.8 foot rise would mean a flood stage of 403.3 or 5.1 on the beach gage. It should be quite obvious from the preceding discussion that even a moderate rain storm adversely affects the Lake levels regardless of any human influences. Then compounding the situation by constructing restrictive bridges and a dam to maintain an artifically high pond level only worsens the situation. As people encroach upon the Lake and stipulate demands not physically possible the net result becomes damage to the environment and the surrounding buildings.

It has been suggested that the winter lake level be drawn down 1' or 1' '-om "full pond" and stabilized there until the springtime whereupon "full lake" wc . again be strickly maintained. This type of operation is fairly common and possible except that a stabilized pond level for the Webster Lake drainage system we to its hydrologic nature is not possible. In areas where the Lake or pond is spring-fed with only minor runoff (no surface streams) contributing to the stored water, a stable pond elevation is possible. Webster Lake, however, does not meet this criteria. Due to the numerous streams, swamps and other lakes all contributing to Webster Lake the water surface will fluctuate uncontrollably. With the restrictions is indicated previously an even higher than"normal" lake level develops. This situation occurs for each and every storm regardless of the duration or so-called frequency of reoccurence.

In a review of the outlet channel under Route 11 several assumptions were made:

- 1. Dam open full and Chance Pond drained.
- 2. Carr Street did not exist.
- Natural channel restrictions eliminated downstream of the railroad bridge.

This allows the outlet channel (w/beach) to control the lake level and would be considered as natural as possible with the existing lakeside development. With a pond stage of 3.0 on the gage (0.1' above "full pond") the outflow would be 200° - cfs. If that level were lower by 2.1 feet (0.9' on gage), then a mere 80-35 s would be flowing. If a 15-year storm were to hit the drainage area, then a peak flow of 750 to 800 cfs would be entering the Route 11 bridge area.

Since this far exceeds the low flow stage, the Lake would naturally rise until the flow through the bridge area equaled 750-800 cfs (estimated to be elev. 405'). So even without the dam or Carr Street bridge a natural rise of pond elev. would occur for each storm with flows that exceed the discharge through the system prior to the storm. This being the case fluctuations in lake surface elev. must be acknowledged and anticipated.

#### CONCLUSIONS & RECOMMENDATIONS

The drainage for Webster Lake is a "wet" system with many small ponds ind swamps, and streams all contributing a flow of water to the Lake. Since nature, it best, is only somewhat predictable, management of this natural resource can be difficult and at times even hazardous. Due to the hydraulics and hydrological bonditions, controlling the lake level via the dam at Chance Pond to within a 1.5 such tolerance is simply not a feasible demand. Two feet to 2.5 feet is more realistic and history proves that point.

There are three primary problem areas, namely:

- Carr Street culvert is significantly undersized for the volume of water it must carry.
- 2. Rt. 11 bridge flow capacity is reduced from optimum by sand and debris silting in the channel from the lake outlet through the "swamp" to Chance Pond.
- 3. Lakeside development is encroaching upon the shoreline and significantly reducing the areas over which the lake previously flowed without causing damage.

The remedies are simple - remove the problems.

- 1. The Carr Street road enbankment and entire culvertshould be removed completely to eliminate the primary restriction of storm flood flows. An alternative would be to increase the size of the culvert to pass the 100-year storm. This would be on the order of a bridge with a waterway opening 10' high by 30' wide.
- 2. The silt and debris that exists in the outlet channel should be removed to re-establish the previously determined elev. of the stream bed at Legasse Beach. This would also require a better control of the movement of sand from the beach exists today. The stream gradient from the lake to the dam should be of uniform slope, and this can be accomplished by dredging and removing the accumulated silt.
- 3. The operation of the dam could be modified to:
  - a) Extend the drawdown period to include the spring snow melt and high runoff and fill the Lake after this time period has passed.
  - b) Increase the drawdown from one foot to three or four feet to accumulate snow melt and spring runoff in storage.
  - c) Incorporate both 3a + 3b into one operation. This is the much preferred operational remedy to the problem.

This in effect would be returning the lake to its "natural"conditions in the winter months and allowing the sand bar at the beach to control the level on Webster Lake.

> 4. The problem of the existing lakeside development does not have an acceptable simple solution. Due to the nature and location of these encroachments upon the shoreline, the inhabitants must acknowledge the anticipated fluctuations of the lake and enjoy all of the consequences.

## APPENDIX C

## SELECTED PHOTOGRAPHS

C-1





1. Detail of gatehouse inlet from upstream



2. Detail of gatehouse outlet from downstream right side

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3. Sluiceway outlet from downstream right side



4. Detail of spillway crest from downstream

C - 4





# 6. View of downstream channel from gatehouse

C-6

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## APPENDIX D

## HYDROLOGIC AND HYDRAULIC COMPUTATIONS

FOR

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## CHANCE BROOK DAM



CHANCE POND # 9 7-11-79 DWW P/0339 DAMS 148 WEBSIER LAKE

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POND DAM IS USED CONTRAC To THE CHANCE 5.vod AS CHANCE WEBSTER LAKE AS WELL ٥F BASED IN THE IMPOURDMENT VOLVME IT IS CLASSIFIED AS WEDITER LAKE LOCATION OF THE 7"E INTERMEDIATE SIZE, SECTION OF FRANKLIN DOWNSTREAM BUILT UP HAZARD OF THE DAM REQUIRES A HIGH . CLASSIFICATION oF

GIVEN AN INTERMEDIAIL SIZE AND HIGH HAZARD SDF = PMF. THE CURVE FULL A DRAINAGE FROM THE C.O.E. RUNOFF RATE AREA OF 19.5 SUMI THE \* 1250 CSM IF WE CREDIT HIGHLAND WITH SOME INFLUENCE SO THAT A VALOE LAICE BELOW THE "ROLLING" LINE IS APPROPRIATE. 24000 CFS. SDF2 THE RESULTIUL

BUT - BOJH THE ANDERSON-NICHES WORK ON THE HUD F.I.S. AND A NHWRB REPORT TO THE MATUR OF FRANKLIN, NOV. 76, DISCUSS THE FACT THAT THELE IS SIGNIFICANT RESIRICTANS TO FLOW AT THE OUTLET OF WEDSTER LAKE, UPSTERAM OF THE DAM.

CHANCE POND # 9 7-11-79 DWW P 2039 DAMS 144 WEBSTER LAKE FOUND THAT ROUTING THE QU, QS, ANCO PIDS, AND QSD. INFLOWS THROW WEDSTER LAKE CONSIDENTIONS AT THE OUTFLOW 7#E RECOGNIZING

RELICED OUTFLOW

A SIMILAR ROUTING WAS NECESSARY FOR THE PMF. BASED ON THE 1250 CSM RATE AND A REDUCED AREA OF 17.3 SIME FEELING WEDSTER LAKE THE PEAK INFCOM WAS ESTIMATED AS: 17.4(1252) = 21625 \* 22000 CFS.

RESULTED IN VERY MUCH

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FOR A ROUTING IT IS NECESSARY TO ASSIGN A HYDRO ORAPH SHAPE. ANCO (SEE ATIMHID SHEET) ESTIMATED A TIME OF CONCERNICATION OF 17.2 HRS. BUT FOR THE RISING LIMP OF THE HYDROGRAPH II HOURS MAS SELECTED. HE ACCFOTED THE II HOURS AS AN ACCOUNTABLE APPROXIMATION.

THE COE CONSIDERS THE MAXIMUM PROBABLE RUNDEF TO EQUAL 19" THUS IT WAS NECESSARY TO DEVELOPE A HYDROGRAPH WITH A PEAK OF 22:00 CFS AT 11 HOURS IND A TOTAL VOLUME EQUAL TO A 19" RUNDEF, ATTACHED IS THE ADOPTED HYDROGRAPH OF INFLOW TO WEBSTER LAKE,

Websier Late / Anderson-Nichols & Company, Inc. R. tina NOB NO. 279936 12 13 1 Representative Determination of it (time of conjuntiation) 2 Divide path of flow into five reaches to account for slope changes & both overland flow and flow Through Takes (Highland & Webster) te = time of concentration; his L. length of reach; teet Use equation t = L "15 7700 H 0.38 9 10 H = elebation difference 11 Kirpich between highest & lowest 12 points in teet luı Ruch 1: from divide near Taunton Hill to swampy 16 area of contour crossing of 660'. Length = 1.34 nules ; Height = 1020-660 ++ 17 18 te = . 37/ hrs 19 20 Reach 2 from 660 contour 40 Highland Lake Length : 135 miles ; Height : 660 675 ft 21 22 tc = 1.252 hrs Reach 3: across Highland Lake Length = 0.9 miles, Height = 2011 (24) 23 24 25 28 ; 27 te = 4.05 hrs. Neach + from Highland Lake to Webster Lake 28 29 Through Sucker Brook 30 Length +.85 miles; Height + 0+5 + 401 31 32 + = 1.88 hrs. 33 Reach 5. from inlet to outlet of Webster Laire 34 Longth = 110 miles , Height = .25/1(3.) 35 36 t = 4.69 hrs. 37 38 total time of concentration = 1221 hrs. 39





148 CHANCE POND #9 7-11-79 DWW P. 60/31 WEBSTER LAKE DAMS

THE DISCHARGE - STAGE RELATIONSHIP To SET WE WILLYES A RATING CURVE DEUE LOPED BY ANCO سن بدرى HFC-Z AND BACKWATELING THROUGH THE RAILROAD CULVERT, THE Assumption 15 MADE THAT AT THE VERY HIGH FLON LEVELS 7116 B+M RAILROAD CULVERT BECOMES THE CRITICAL CONTROL SECTION, THE ATTACHED ANCO COMPUTER OUTPUT FOR THE SECTION # 1.63 WAS SECOND USED REPORTATIONS 70 A CULVERT INTERT JE 395.0 MSL. THESE WERE PLOTTED ON LOG - LOG PAPER AND The "LINEAR" ADPRIXIMATIONS DETERMINED, H 15 DISTANCE AQUE ELFY. 295 WHFRE

FOR H< 15 log Q = 2.0959 (log H)+.8388

Fin H 215 log Q = log H + 2.1271

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 DAMS 148 CHAME POND #9 7-11-79 DWW P.11039 WEBSTER LAKE
FOR THE STORAGE- STAGE RELATIONSHIP THE ANCO COMPUTATIONS OF AREAS AT ELEVATIONS 400, 405, 410, AND 415 NERE USED, AND THEN THE INCREMENTAL STORAGE ABOJE FLEV. 399 PLOTTED. FROM THIS TWO FUNCTIONS WERE DERIVID COHERE H is IN FEET ACOVE 395 SEE ATLACHED SHEETS. H = (S/GGG.G7) + Y SX 8000 H = ((S-8000)/750) + 1214 SZ8000 WHERE S = 5700000 + 1214 SZ8000 WHERE S = 5700000000000000000000000000000000000



.son-Nichols & Company, Inc. JOB NO. 2 3 4 20 21 22 23 24 NUESTRE LAKE CONTRA DEPEND •, Verene 16412. 2196 S 2822 618 -641 and rest Accepto 12325 661.---3451 - - 2 4.45 Haran Madda 120.--3722 -717? 416.6 11:2 1.2.215 769. — 5917 . 523,-415.2 AL 3.157 To berech a leader dessue reastance i revenue 20 Second 5 1, ( 5, + 13, + 13, 15, ) 21 22 5.1 4.20 23 V Slipferin Converses ) + 641 acre ici 24 25 Lista - to a today tos 26 22 5 (5) (1.01 601 + 1661 + 410 ) = 3451 con lat 28 29 an we have a the the track 5 15) (469+ 120+ 110+69) = 3422 acre here 32 24 - Juniter Juniter of a 110 - 415 -V-3(2)(++++ 8.2++ ky. 2) 3919 mm her 17 38



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THE TECHTRONX INFLOW HTUROGRAFH. ASSUMED THE OF THE PROGRAM AND OUTPUT ARE

A LISTING ATTACHED.







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448 H=(U3-8080)/758+12+4 458 IF H(15 THEN 480 468 L=LCT(H)+2.1271 478 GO TO 499 488 L=2.8959\$LGT(H)+8.8388 498 Q1=107L 518 PRINT USING 520:T,U3,12,0,H 528 INAGE 4D.2D,8D,9D,9D,9D,2D 538 O=Q1 548 NEXT K 558 END

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ROUTING OF PMF THROUGH WEBSTER LAKE

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I' ROUTING OF PMF THROUGH WEBSTER LAKE

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P. 22 - 33-

DAMS 148 CHANCE POND #9 7-13-79 DWW 223939 WEBSTER LAKE

THE RESULTS OF THE ROUTING INDICATE THAT OUTFLOW PEAK WOULD OCCUR AT THE 20.5 HOURS AFTER THE START 3F THE FQUAL 3300 cfs. THUS THE STORM AND PEAK INFLOW OF 22,000 afs HAS BEEN 85 %, THE PEAK ATTENVATES BY OF THE LAKE WOND BE LY.S FEET STALE CULVER 19 FEF ---INVERT or THE 18.18 Poor ELEVATION . A NORMAL ABOIL THE TUPOGRAPHIC MAPS USE -27 CHIFCK OF THE Anco F1,2 THE FLOND INJURANLE 57-04 THAT AN ELEVATION OF 419.5 15 INDICATES HINY OF FEASILLS WITHOUT OJERTSPRING THE BANKS SURROUNDING THE LAKE 1..2 DISCHARGING IN AN ALTERNATE DIRECTION. PMF MAGNITUDE EVENT WOULD THUS AN CAUSE SEVERE FLOUDING TO THE AREA SURROUNDING WEBSTER LAKE BUT THE PEAK FLOW EXPERIENCED AT THE LIMITED. THIS ASSUMES DAM WIND RE THAT THE RAILROAD EMBANKMENT COULD WITHSTADD 19' OF HEAD ABIE NUMAL POW ELEUNTION.

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DAMS 148 CHANCE PUND #9 7-13-75 DWW p,24.939 WEBSTER LAKE A CONTINUITY CHECK WAS PERFORMED TO INSULE THAT THE DIFFERENCE IN AREA RENEATH THE INFLOW + OSIFLOW ATDROGRAPHS EQUALED THE CHANCE IN STURAGE. TOTAL VOLOME OF INFLOW IN ZZ HUNAS = 7.128×10 ft 2 TOTAL USLIME OF OUTFLOW IN ZZ HOURS= 1.359 ×108 AS 14400 AF 1000 AF STURAGE (EL= STURAGE (EL= ) = FINAL ) = INITIAL 13400 AF CHANGE IN STURASE = DIFFE REALE IN HYDROGRAPHS = 7.128 ALLS 1.359 ALLS 43560 = 13240 AF CONTINUITY ERRIG = 13400 = 1.29. THIS IS ACCEPTABLE

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D-27

DAMS 148 CHANCE POND #19 7-13.79 DWW p260/39 WEBSTER LAKE THE USE OF 3300 CFR Ar THE TEST DAM DOE, NOT CHANCE Pino FUL THE ACCOUNT FOR THE ADDITIONAL DRAINAGE NIZEA DOWNOTILEAM OF THE RR CULVERY AND UPSTREAM OF THE THAM & 2.2 SUMI. A PAF FROM A RASIN 111 1.11 IN Accord Arte E 2.2 SQMJ ALOVE WOULD OF H WITH THE COE CULLES YIELD 1500-2000 CSM 3000 -> 4000 cfo. THE RUNOFF FROM or REASONADLY ERPECTES BASIN" CAN 2 E "Low" R THE TO PASS OUT OF THE BASIN BEFORE THE PEAK OCCUR. BUT FROM WERSTER wourd LAKE LOWER BASIN A TAIL FROM THE GIVEN THAT BE IN THE RIVER HYDROGRAPH WOULD STILL THE INCREASE. TO HAIE SELECTED WE 4000 CFS WEOSTER LAKE OUTFLAN TO CHANCE POND DAM FOR THE SDF. AT SDF= 4000 cfo.

### DAMS 118 CHANCE POND # 9 7-13-79 DWW P.27939 WEBSTER LAKE

AS PART OF THE FLOOD INSULANCE STUDY ANCO DEVELOPED A STAKE- DISCHARE CURVE FIR THE CHANCE POND DAMI (ATTACHED)

THE RATIONS CORIE ASSUMES THAT STUPLOS ALLE IN PLACE TO APPROX. THE SAME ELEVATION AS THE SMILWAY AND THAT THE ORAFILE WITH GATE IS WIDE OPEN.

IF THE GATE. IS OPEN THE STABE REJULTING FROM A YOUN OFS DISCHARGE WINN BE YOZ.S Fr (MSL).

IF THE GATE WERE FUL SUME REASON CUMPLETELY CLOSED THE STAGE REQUIRES WOULD BE RAMED BY ABOUT ON FERT 70 147.6 FT (MSL)

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THESE EVENATIONS REPRESENT 3.8 FT OF FLOW OVER THE SPILLWAY, BUT THIS WOULD NOT OVER TOP THE ABUTMENTS OF THE DAM.

THUS AS LOND AS THE RAILROAD CULVERT HULDS AND SERVES TO ATTENNATE FLOWS ABUS THE DAM THE PUTENTIAL FOR OFFIC TUPPING IS VERT SMALL.

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WEBSTER LANG  

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 $STEP 4.$   
Reach 1:  
 $a_{P_1} = 4590 cf_5$   
 $H: 6.9 ft.$   
 $AREH at 6.9 ft = 1030 s_2.ft.$   
 $v_1 = L \cdot Area = \frac{1390(1030)}{43,560} = 32.9 qc - ft \le \frac{1}{2}5$   
 $a_{P2}T = Q_{P1}(1 - \frac{32.4}{375}) = 4190 cf_5$   
 $H= 6.6 ft$   
 $v_2 = \frac{1390(970)}{43560} = 30.9 ac - ft \le \frac{1}{2}5$   
 $Vave = 31.9 qc - ft$   
 $a_{P2} = 4590 (1 - \frac{31.5}{375}) = 4200 cf_5$   
 $H= 6.6$   
Reach 2:  $O_{P1}: 4200$   
 $H: 12.1 ft$   
 $V_1 = \frac{1560(760)}{43560} = 27.2 ac - ft \le \frac{1}{2}5$   
 $Q_{P2}T = Q_{P1}(1 - \frac{27.2}{375}) = 3895$   
 $H= 11.9 ft$   
 $V_2 = \frac{1560(720)}{43560} = 25.4 ac - ft \le \frac{1}{2}5$ 

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310/ 39 Webster Lake TCG July 14, 1978 CALCULATION OF DONNETREAM DAM FAILURE FLOOD STAGES - BASED ON CUE 'Rule of Thumb" Guidelines, April 1978. STEP 1 Reservoir Storage at Time of Failure (Chance Brook Pond only): Assume Failure when Water surface is at peak of PIMF Stage, 3.8 ft over the spillwaycrest. S= Normal Storage + Surcharge Storage = 23 2 (10') \*+ 23(3.8) = 230+ 87 = 317ac-ft 1. ≈ surface are, chance Brook Pond Assumed de 1th, Chance Pond. ¥ STEP 2: Peak Failure Dutflow, Q7, W5= 57' (,4x140)  $Q_{P_1} = \frac{8}{27} W_b \sqrt{g} / \frac{3}{27}$ Y.= 9' = 2544cfs However, the flow over the dam without a breach i's 4000 cfs. It seems obvious that dam failure should increase, rather than decrease the flow. Therefore, we will undertake a more detailed

calculation of Flow after failure.

D=33



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= 223+2588+ 2090+186= 5087 cfs ~ 5090cfs

STEP 3: The cross-sections for the downstream reaches = hown on the U.C.G.S. TO po Map are plotted on the attached cheet. Computer out put tables of the Stage-discharge relation-hips are attached.

The cross-sections used are from the Anderson-Nichols ED. F.I.S. Work.





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NATIONAL BUREAU OF STANDARDS MICROCOPY RESOLUTION TEST CHART

Webster Lake TCL 7-10-78 34 539 Reach 1 - Dam to Kimball St. Bridge L= 1390' 0,425 495,425 5-576 445,420 205 395 10-,04 40,405 215,342.6 315,372.6 ••• Reach z - kimball St. Bridge to RR Bridge ••• 2 12=15601 0.023 1 = .04 .0,400 ¥5,388.9 7,410.7 476,420 165,369.2 2110,365,6 210,365.6 1239,3646 21,5636 235,3046 Reach 3 - RR Bridge to Main St. Bridge 6-770' 5=.048 n=.04 3,335 1,582 25,375 325.545 15310 285.375 225,365 370 75,305 275,362 265,362 8730.5 92,359.5 140.364.5

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HEBSTER LAKE DAM -

REACH 1

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REACH 2

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WEBSTER LAKE DAM

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REACH 3

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HEBSTER LAKE DAM

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Webster Lake TCG July 14, 1972 39 5 39 Vare= 27.94ac-ft. QP2= 4540 (1-27.14) = 4140 cfs H= 12.1 Reach 3: Qp1= 4140 +1= 3.2ft U.= 215 (770) \_ 3,80 ac-ft 6 45 43560 ÷ Qp2= 4140 (1- 3.1)= 4090 H= 3.2 St, no attenuation 2

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### APPENDIX E

## INFORMATION AS CONTAINED IN

### THE NATIONAL INVENTORY OF DAMS

Image: Construction of the second	Iff before       Iff before <th>Image: Construction of the second of the</th> <th>Officient     Openantial     Openantial       Image: Contract and the contex and the</th> <th>0     0     0     0     0       nn     013     02     methods     methods       0     0     methods     montant     methods       0     0     0     methods     montant       0     0     0     0     montant       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       &lt;</th> <th>LATITUDE LANGUTUE ANORTHI (NEST) 4327,0 7140.2</th> <th></th>	Image: Construction of the second of the	Officient     Openantial     Openantial       Image: Contract and the contex and the	0     0     0     0     0       nn     013     02     methods     methods       0     0     methods     montant     methods       0     0     0     methods     montant       0     0     0     0     montant       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       0     0     0     0     0       <	LATITUDE LANGUTUE ANORTHI (NEST) 4327,0 7140.2	
Implify	min p[1] [2]     month     month     month     month       min p[1] [2]     month     month     month     month       month     month     month     month     month       mont     month <t< th=""><th>min p(1)     p(2)     min p(1)     p(2)     min p(1)     p(2)     p</th><th>Implifying the second of th</th><th>Mn         013         02         ML         ME         ME</th><th>4327.0 7140.2</th><th>• •</th></t<>	min p(1)     p(2)     min p(1)     p(2)     min p(1)     p(2)     p	Implifying the second of th	Mn         013         02         ML         ME	4327.0 7140.2	• •
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05     CHANCE PUND BRUON     FRANKLIN     1     7242       0     0     0     0     0     0       17406     0     0     0     0     0       17406     0     0     0     0     0     0       17406     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0     0       17406     0     0     0     0     0     0     0     0       1731     0     110     700     0     0     0     0     0       0     0     0     0     0     0     0     0     0 <td>05     CHANCE POND BROOK     FRANKLIN     1     7242       0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       133     0     110     100     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0       133     0     110     100     0     0     0     0       0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0       0     0     0     0     0</td> <td>1       1</td> <td>Image: Contract: Pound Brand       F A ANKL IN       1       7.242         Image: Contract: Pound Brand       Image: Contract: Pound Brand       Image: Contract: Pound Brand       Image: Contract: Pound Brand         Image: Contract: Pound Brand       Image: Contract: Pou</td> <td>05     CHANCE PUND BRUOK       0     0     0    0     0     0    0<td>FROM DAW</td><td>-</td></td>	05     CHANCE POND BROOK     FRANKLIN     1     7242       0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     0     1100       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       133     0     110     100     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0       133     0     110     100     0     0     0     0       0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0       0     0     0     0     0	1       1	Image: Contract: Pound Brand       F A ANKL IN       1       7.242         Image: Contract: Pound Brand       Image: Contract: Pound Brand       Image: Contract: Pound Brand       Image: Contract: Pound Brand         Image: Contract: Pound Brand       Image: Contract: Pou	05     CHANCE PUND BRUOK       0     0     0    0     0     0    0 <td>FROM DAW</td> <td>-</td>	FROM DAW	-
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TYTE OF DAM WELFER PURPOSES HIGGY WITH WORLES DIST OWN FLO N PULVED BELA VENDER PG 00 00 F0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Mileting     Milet	Model         Model <th< td=""><td>Mercensul         VEAR         Mercensul         Near         VEAR         Mercensul         Near         VEAR         Mercensul         Near         Near         VEAR         Near         Near&lt;</td><td>VFE OF DAM     VEAR     PURPOSES     Neposes       PG     1873     R       PG     1873     R       PG     PURPOSES     Neposes       PG     PURPOSES     Neposes       PG     PG     PURPOSES       PG     PG     PG       PG     PG       PG     PG       PG     PG       PG     PG       PG       PG       PG   &lt;</td><td></td><td></td></th<>	Mercensul         VEAR         Mercensul         Near         VEAR         Mercensul         Near         VEAR         Mercensul         Near         Near         VEAR         Near         Near<	VFE OF DAM     VEAR     PURPOSES     Neposes       PG     1873     R       PG     1873     R       PG     PURPOSES     Neposes       PG     PURPOSES     Neposes       PG     PG     PURPOSES       PG     PG     PG       PG     PG       PG     PG       PG     PG       PG     PG       PG       PG       PG   <		
PG     1973     R     15     14     2650     1100     N     N     N       PG     1973     R     15     14     2650     1100     NED     N     N     N       PG     P	VG     1873     R     15     14     2650     1100     N     N     N       REMARS     0     0     0     0     0     0     0     0       REMARS     131     10     100     0     0     0     0     0     0       REMARS     133     10     100     0     0     0     0     0     0     0       REMARS     0     0     0     0     0     0     0     0     0       REMARS     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0     0       0     0     0     0     0     0     0     0     0       0     0<	VG     1973     N     15     14     2650     1100     N     N     N       N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N       N     N     N     N     N     N     N     N     N     N     N	PG         1873         N         15         14         2550         1100         N	PG     1873     R <ul> <li> <ul></ul></li></ul>	MPOUNDING CAPACITIES DIST OWN FED R	N N N N N
Image: Construction of the co	Relative     Relative       Relative     R	BEMARK     BEMARK       0	BELLENK     REMARKS       REMARKS     REMARKS	RECONSTRUCTION RATER HLS BD NATER HLS BD NH MATER NH	2650 1100 NED N N	
REMARS       Image: Strain of the s	REMARKS       OB     OB     OB     OB     OB     OB     OB     OB       SERILIAT     TOT     TOT     TOT     OD     OD     OD     OD       SERILIAT     TOT     TOT     TOT     OD     OD     OD     OD     OD       SERILIAT     TOT     TOT     OD     OD     DO     OD     OD     OD       SERILIAT     TOT     TOT     OD     OD     OD     OD     OD     OD       SERILIAT     TOT     OD     OD     OD     OD     OD     OD       ATER MES BD     ONNER     ENGINEEINIG BY     CONSTRUCTION BY     OD     OD     OD       ONNER     ONNER     ONNER     ENGINEEINIG BY     CONSTRUCTION BY     OD     OD       ONNER     ONNER     ONNER     ONNER     NH MATER RES BD     OD     OD       ONNER     ONNER     ONNER     ONNER     OD     OD     OD       ONNER     ONNER     ONNER     OD     OD     OD     OD       ONNE     OD     OD     OD     OD     OD     OD       O     O     OD     OD     OD     OD     OD       ON     O     <	Relation     Relation       0 <td>RAMRS</td> <td>(a)     (b)     (c)     (c)     (c)       (c)     (c)     (c)     (c)     (c)       (c)     (c)</td> <td></td> <td></td>	RAMRS	(a)     (b)     (c)     (c)     (c)       (c)     (c)		
O     O     O     O     O     O     O     O       SPILLIM/ TURGET     VILLIM/ CONTINUE     VILLI	O     O     O     O     O     O       SPALLMANT     SPALLMANT     ONNEL     ANALOGY     ANALOGY     ONNEL     ONNEL     ONNEL     ANALOGY     ONNEL     ANALOGY     ANALOGY     ANALOGY     ONNEL     ANALOGY     ONNEL     ANALOGY     ONNEL     ANALOGY     ANALOGY     ONNEL     ANALOGY     ONNEL     ANALOGY     ONNEL     ANALOGY     ONNEL     ANALOGY     ONNEL     ONNE     ONNEL     ONNE     ONNEL     ONNE     ONNE<	O       O <tho< th=""> <tho< th=""> <tho< th=""></tho<></tho<></tho<>	0       0	(a)     (b)     (c)     (c)       SPLLWAY     SPLLWAY     SPLLWAY       SPLLWAY     SPLLWAY       SPLLWAY     NACHARUK       ONNER     NACHARUK       ONNER     NACHARUK       ONNER     NH       MATER     NH       MATER     NH       MATER     NH       MATER     NH       MATER     NONE       MARPECTION     NONE       MARPECTION     NUNICLIFF		
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