MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A
MERRIMACK RIVER BASIN
PEMBROKE, NEW HAMPSHIRE

BUCK STREET EAST DAM
NH 00445
NHWRB NO. 190.06

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

FEBRUARY 1979
Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

The dam is a composite structure consisting of cut granite masonry and concrete with an overall length of about 53.5 ft. and a maximum structural height of 11.75 ft. The dam is generally in good condition. It is small in size with a low hazard potential. It is recommended that provisions be made by the owner to repair the scoured concrete portion of the outlet works sluiceway structure and to remove the debris from the upstream face of the dam.
DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.
Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding to you a copy of the Buck Street East 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, New Hampshire Water Resources Board, Concord, New Hampshire 03301.

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.

Sincerely yours,

Incl
As stated

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer
BUCK STREET EAST DAM
NH 00445
NHWRB 90.06

MERRIMACK RIVER BASIN
PEMBROKE, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
LETTER OF TRANSMITTAL
FROM THE CORPS OF ENGINEERS TO THE STATE
TO BE SUPPLIED BY THE CORPS OF ENGINEERS
Buck Street East Dam is a composite structure consisting of cut-granite masonry and concrete with an overall length of approximately 53.5 feet and a maximum structural height of about 11.75 feet. The dam was originally constructed in 1923. Engineering data available consisted of a set of plans dated 1967 and 1968 showing additions and improvements made to the dam in about 1969. No construction specifications or design calculations were available.

The visual inspection indicated that the dam was in generally good condition. The inspection revealed loss of joint mortar on the vertical downstream face of the spillway section, scouring of concrete on the lower portion of the outlet works sluiceway structure and a broken lock on the gate house structure. Also, the inspection revealed loss of mortar in the joints between the cut-granite blocks of the masonry training wall along the east side of the channel and debris located at the upstream face of the dam.

Based on its small size and low hazard classification in accordance with the Corps guidelines, the test flood is equal to a 100 year storm. The spillway will pass only about 17 percent of the test flood and is considered inadequate. The nonoverflow section would be overtopped by 9.9 feet under test flood conditions.

It is recommended that provisions be made by the owner to repair the scoured concrete portion of the outlet works sluiceway structure, replace the broken lock on the gate
house to avoid unauthorized use of the gates and to remove the debris from the upstream face of the dam. Also, the spillway section and left training wall of the downstream channel should be monitored periodically. Should seepage become evident, further provisions for repairing the joints of these cut-block sections should be considered.

The recommendations and remedial measures are described in Section 7 and should be addressed by the owner within two years after receipt of this Phase I - Inspection Report.

Gordon H. Slaney, Jr., P.E.
Project Engineer

Howard, Needles, Tammen & Bergendoff
Boston, Massachusetts
This Phase I Inspection Report on Buck Street East Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

JOSEPH A. MCELROY, MEMBER
Foundation & Materials Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH W. FINEGAN, JR., CHAIRMAN
Chief, Reservoir Control Center
Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division
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 continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an 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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- **APPENDIX E - INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS**
1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Howard, Needles, Tammen & Bergendoff 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 Howard, Needles, Tammen & Bergendoff under a letter of October 23, 1978, from John P. Chandler, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0356 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) To 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) To encourage and prepare the states to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location. Buck Street East Dam is located on the Suncook River, approximately 5.3 miles upstream from its confluence with the Merrimack River, in the Town of Pembroke, New Hampshire. The dam is shown in U.S.G.S. Quadrangle, Suncook, New Hampshire, with coordinates approximately N43°09'36", W71°24'24", Merrimack County, New Hampshire. The location of Buck Street East Dam is shown on the Location Map immediately preceding this page.
b. Description of Dam and Appurtenances. Buck Street East Dam is a composite structure, approximately 53.5 feet long, consisting of cut-granite masonry and concrete. The structural height of the dam, measured from the river bed elevation to the top of the spillway, is about 8.0 feet. From the top of the spillway to the dam crest measures approximately 3.75 feet, giving a total height of 11.75 feet. The appurtenant works consist of a cut-granite masonry spillway, an outlet works consisting of a sluiceway with mechanically controlled wooden gates, and a concrete block gate house.

Figure 1, located in Appendix B, shows the plan of the dam and its appurtenant structures. Photographs of each structure are shown in Appendix C.

c. Size Classification. Small (hydraulic height - 11.75 feet high, storage - 413 acre-feet) based on both storage being less than 1000 acre-feet and height being less than 40 feet as given in Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. The dam's potential for damage rates it as a low hazard. A major breach of the Buck Street East Dam could result in some minimal flooding to a trailer park located 400 feet downstream of the dam. Three miles downstream of the dam there are about 7 dwellings which could expect flooding as a result of dam failure. The increased effect from breach of dam would probably be minimal and no loss of life, due to dam breach, would be expected.

e. Ownership. This dam is owned by the New Hampshire Water Resources Board, Concord, New Hampshire 03301.

f. Operator. This dam is maintained and operated by the State of New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301. Chairman of the Water Resources Board is Mr. George M. McGee, Sr.; Mr. Vernon Knowlton is Chief Engineer. Telephone No. (603)271-1110.

g. Purpose of Dam. This dam is used for recreational purposes for the State Park located just upstream of the dam.

h. Design and Construction History. The dam at Buck Street East was originally constructed in about 1923 for the Suncook Mills Company to regulate the supply of water for power generation. No plans of the original construction
are available. About 1969 the outlet works structures were reconstructed by the New Hampshire Water Resources Board in conjunction with the Department of Fish and Game. No design or construction data were disclosed for this dam.

i. Normal Operating Procedure. No written operational procedures were disclosed for this dam. Normally the sluice gates in the outlet works are left open from mid October thru the winter months allowing the water level to be maintained at the natural river channel elevation. In the spring the gates are closed. During the summer months the water level is controlled by the spillway elevation, thus producing the recreational pool for the State Park.

1.3 Pertinent Data

a. Drainage Area. The drainage area tributary to Buck Street East Dam consists of approximately 240 square miles of flat to rolling, wooded terrain. Pittsfield is the only major town within the basin. Topographic elevation in the watershed ranges from 2384 to 280 feet MSL.

As this is a "run of the river" type dam the reservoir area is very small in comparison with the total watershed. The nearby area is wooded and has fairly even terrain. An abandoned road (Buck Street) crosses 25 feet upstream of the dam and Route 28 crosses 150' upstream. The reservoir area between the East Dam and Buck Street is filled with debris.

b. Discharge at Dam Site

(1) The outlet works for Buck Street East Dam consist of two 5.33 feet wide gates set on a concrete platform at the streambed elevation. There are no other outlet works on the East Dam. Invert elevation is 279.83 feet MSL.

(2) The maximum discharge at the Buck Street site is estimated to have been 18,500 cfs during the March 1936 flood. As the Buck Street East Dam is hydraulically interconnected with the Buck Street West Dam, it is estimated that the Buck Street East Dam passes approximately 18 percent of the river flow.

(3) The spillway capacity with the water surface at the top of dam is approximately 785 cfs at elevation 290.75.

(4) The spillway capacity with the water surface at the test flood elevation of 300.45 is approximately 3420 cfs.
The total project discharge for the East Dam is 3420 cfs at elevation 300.45. It should be noted that the full test flood discharge at Buck Street flows over both the Buck Street East Dam and the Buck Street West Dam. Further details are given in Section 5 of this report.

c. Elevation (feet above MSL)
(1) Streambed at centerline of dam - 279.83.
(2) Maximum tailwater - 297.3 (est.)
(3) Upstream portal invert diversion tunnel - none.
(4) Recreation pool - 287.0.
(5) Full flood control pool - N/A.
(6) Spillway crest (permanent spillway) - 287.0.
(7) Design surcharge - unknown.
(8) Top Dam - 290.75.
(9) Test Flood Surcharge - 300.45.
d. Reservoir (miles)
(1) Length of Maximum Pool - N/A.
(2) Length of Recreational Pool - N/A.
(3) Length of Flood Control Pool - N/A.
e. Storage (Gross Acre-Feet)
(1) Recreation Pool - 84.
(2) Flood Control Pool - N/A.
(3) Spillway Crest Pool - 84.
(4) Top of Dam - 413.
f. Reservoir Surface (Acres)
(1) Recreation Pool - 43
(2) Flood Control Pool - N/A.
(3) Spillway Crest - 43.
(4) Test Flood Pool - 120.
(5) Top Dam - 69.

**g. Dam**

(1) Type - masonry granite.
(2) Length - 53.5 feet, overall.
(3) Height - 11.72.
(4) Top Width - 8.0.
(5) Side Slopes - US = N/A; DS = N/A.
(6) Zoning - unknown.
(7) Impervious core - none.
(8) Cutoff - unknown.
(9) Grout Curtain - unknown.
(10) Other - none.

**h. Diversion and Regulating Tunnel**

None.

**i. Spillway**

(1) Type - masonry weir.
(2) Length of Weir - 32 feet.
(3) Crest Elevation - 287.0.
(4) Gates - none.
(5) U/S Channel - none.

(6) Downstream Channel. The channel immediately downstream of the dam is the easterly channel of the Suncook River. The streambed is a 50 foot wide rock bottom channel which joins the westerly channel of the river approximately 400 feet downstream of the dam.
j. Regulating Outlets. River level is regulated by two 5.33 foot wide gates with the inverts set at the approximate streambed elevation of 279.83. The gates are operated mechanically from a gate house constructed immediately above the waterway opening.
SECTION 2
ENGINEERING DATA

2.1 Design

The dam at Buck Street East was originally constructed in about 1923 for the Suncook Mills Company to regulate the supply of water for power generation. No plans or design data for the original construction are available. In 1969, the outlet works structure of the dam was reconstructed by the State of New Hampshire Water Resources Board in conjunction with the Department of Fish and Game.

A set of drawings (2 sheets) dated 1967 and 1968 showing these additions and improvements to the existing dam was the only design information found. No in-depth engineering calculations were found.

2.2 Construction

No construction records were available for use in evaluating the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 Evaluation

A. Availability. Engineering data available for Buck Street East Dam is limited to the set of plans mentioned above. These plans are on file at the New Hampshire Water Resources Board.

b. Adequacy. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Validity. The field investigation indicated that the external features of Buck Street East Dam substantially agree with those shown on the available plans.
SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Buck Street East Dam was made on November 16, 1978. The inspection team consisted of personnel from Howard, Needles, Tammen & Bergendoff and Geotechnical Engineers, Inc. A representative of the State of New Hampshire Water Resources Board was also present for the inspection. Inspection checklists, completed during the visual inspection are included in Appendix A. At the time of the inspection, the water level was approximately 3 feet -11 inches below the permanent spillway elevation. No water was passing over the spillway. The upstream face of the dam could only be inspected above this water level.

b. Dam. The dam consists of a stone-masonry overflow gravity section about 32 feet long and a twin-box stoplog section with an overall width of about 21 feet. The stoplog section consists of stone-masonry walls faced with concrete at each end, and a central concrete wall between the two boxes as shown in Photo 4.

The joints between the cut-stone blocks on the sloping top surface of the overflow section are filled with mortar which is in good condition (Photo 2). The joints between the cut-stone blocks on the vertical downstream face of the overflow section contain a few remnants of mortar, but most of the joints contain no mortar as shown in Photo 6.

Bedrock is visible in the channel immediately downstream of the dam, which is consistent with available records which indicate that the dam is built on "ledge". It appears that the right abutment is bedrock. The left abutment is hidden from view by training walls both upstream and downstream of the dam. No leakage was apparent through the dam or through the foundations and abutments; the presence of tailwater at the time of the inspection would have hidden foundation leakage if any were occurring.

Brush and several trees, about 6 to 8 inches in diameter, on the right abutment close to the dam were apparently cut a few months prior to the inspection. The stumps of the trees were still in place.

c. Appurtenant Structures. Visual inspection of the stone masonry spillway, outlet works with its structural components and spillway/sluciceway discharge channel did not reveal any evidence of stability problems. The concrete
surface at the sluiceway structure appeared to be new and in good condition. The spillway granite blocks are also in good condition, and there appeared to be no movements between the blocks.

The outlet works consists of a sluiceway structure (Photos 11, 12 and 13) with two wooden mechanically operated control gates and a concrete block gate house. The sluiceway structure is formed by the left training wall and the stone masonry pier separating the sluiceway and the spillway structures. The concrete facing, middle pier and apron slab of the outlet works were added during the reconstruction program, conducted in 1974 by the New Hampshire Water Resources Board. The concrete surface above the spillway crest elevation appeared to be in good condition with some scouring noted below this level. The sluiceway has two controlled openings, each 5.25 feet wide by 16 feet high. The gates (Photo 13) were not operated but visual inspection indicated that they were in good condition, and they were reported to be operational. The concrete block gate house was in good condition except for a broken lock on the doorway.

The spillway structure consists of large cut-granite blocks with mortar joints. Visual inspection revealed that the granite blocks and their alignment are in good condition. The joints between the blocks on the vertical downstream face, however, contain only remnants of mortar, most joints having no mortar (Photos 3 and 6). The spillway structure is founded on bedrock.

There is a cut-granite masonry training wall on the east side of the channel immediately downstream of the concrete stoplog structure. The mortar is missing locally from the joints between the cut-granite blocks, particularly in the lower section of the wall close to the tailwater level. Where the bottom of the wall can be seen above tailwater level, it rests on bedrock. No seepage was discharging from the joints between the cut-granite blocks at the time of the inspection.

d. Reservoir Area. The reservoir area at the Buck Street site is insignificant in terms of impoundage as both dams at this site are primarily run of the river type dams. The area in the vicinity of the dam consists of rolling, wooded terrain with some fields scattered throughout the area. A major state roadway (Route 28) crosses the river approximately 150 feet upstream of the dam. The abandoned Buck Street bridge crosses the river about 25 feet upstream of the dam. There were many large logs and stumps noted along the shores of the river. Heavy debris was also noted in the area between the abandoned Buck Street bridge and the dam.
e. Downstream Channel. The downstream channel has a ledge bottom for a short distance downstream at which point it appears to change to a rock strewn channel. There are many trees located along the shore but none of any consequence overhanging the channel. During the inspection, water was flowing at a depth of approximately 2 feet. The main Suncook River, beyond where the east and west branches join, appeared to be relatively clean with tree lined banks.

3.2 Evaluation

Visual inspection of the Buck Street East Dam indicates that the dam appears to be in generally good condition. The visual inspection confirms that the foundation of the dam and the right abutment are both bedrock. The nature of the left abutment could not be determined from the visual inspection since it was hidden by cut-granite masonry training walls both upstream and downstream of the dam, but the lack of visible seepage from the open joints of the downstream training wall indicates that the abutment is sound. The inspection revealed the following:

(a) Loss of joint mortar on the vertical downstream face of the spillway section.

(b) Scouring of concrete on the lower portion of the outlet works sluiceway structure.

(c) Broken lock on the gate house structure.

(d) Loss of mortar in the joints between the cut-granite blocks of the masonry training wall along the east side of the channel.

(e) Debris located at the upstream face of the dam.
SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedure

The Buck Street East Dam is used primarily to create an impoundment of water on the Suncook River, which impoundment is used for recreational purposes. The normal operational procedure for this dam is to open the sluice gate in the outlet works structure in about mid-October of each year, allowing the water level to be maintained at the natural river channel elevation during the winter months. In the spring, the gates are closed. During the summer months the water level is controlled by the spillway elevation, thus producing the recreational pool. It should be noted that the Buck Street East Dam is hydraulically interconnected with the Buck Street West Dam as they are separated only by an island in the Suncook River Channel.

4.2 Maintenance of Dam

This dam is visited by one of the State of New Hampshire Water Resources Board's dam operators approximately once per week. During these visits water levels are recorded, brush is cut as necessary, oiling of gates and painting are done as necessary and any major deficiencies that may be noted are reported to the Water Resources Board.

4.3 Maintenance of Operating Facilities

Maintenance on the outlet works facilities is done on an as needed basis.

4.4 Description of Warning Systems

There are no warning systems in effect at this facility.

4.5 Evaluation

The current operation and maintenance procedures for Buck Street East Dam are inadequate to insure that all problems encountered can be remedied within a reasonable period of time. The owner should establish a written operation and maintenance procedure as well as establishing a warning system to follow in event of flood flow conditions or imminent dam failure.
SECTION 5
HYDROLOGY AND HYDRAULIC ANALYSIS

5.1 Evaluation of Features

a. General. Buck Street East Dam is a composite structure consisting of cut-granite masonry and concrete having a total length of approximately 53.5 feet and a maximum structural height of about 11.75 feet. The appurtenant works consist of a spillway section and an outlet works structure. The spillway has a maximum opening of 32 feet wide by approximately 4 feet high. The outlet works structure consists of two mechanically operated 5.33 foot wide by 6.0 foot high wooden gates and a rock bottom outlet channel.

The dam is located on the Suncook River and creates an impoundment of water primarily used for recreational purposes. The Buck Street East Dam is hydraulically interconnected with the Buck Street West Dam as they are separated only by an island in the channel of the Suncook River. Buck Street East Dam is classified as being small in size having a maximum storage of about 413 acre-feet.

b. Design Data. No hydrologic or hydraulic design data were disclosed for Buck Street East Dam.

c. Experience Data. The maximum flow of 18,500 cfs for the March 1936 flood was estimated from the recorded maximum flow of 12,900 cfs at Chichester, New Hampshire. As indicated above, the Buck Street East Dam is hydraulically interconnected with the Buck Street West Dam. The Buck Street East Dam passes approximately 13 percent of river flows. No water level records were in evidence for the Buck Street location.

d. Visual Observation. No evidence of damage to any portion of the project from overtopping was visible at the time of the inspection.

e. Overtopping Potential. As no detailed design or operational information are available, hydrologic evaluation was performed using dam information gathered by field inspection, watershed size and an estimated test flood equal to the flood of record or approximately 1/4 the Probable Maximum Flood (PMF). Based on a drainage area of 240 square miles the test flood inflow at the Buck Street site was estimated to be 18,500 cfs. At this point it is noted that the 18,500 cfs test flood flow is for the Buck Street East

5 - 1
Dam as well as the Buck Street West Dam which is located 150 feet west of the Buck Street East Dam. These dams are hydraulically interconnected as they are separated only by an island in the Suncook River. Following the guidance given for estimating the effect of surcharge storage on the test flood discharge results in a peak outflow of 18,310 cfs. Approximately 18% of the test flood discharge passes on the east side of the island. As the maximum spillway capacity of the Buck Street East Dam is only 785 cfs (approximately 17 percent of the easterly flow) the Buck Street Dam will be overtopped by 9.7 ft. As this dam is a low "run of the river" type dam it is subjected to backwater conditions. The estimated tailwater for the test flood was accounted for in the surcharge analysis.

f. Dam Failure Analysis. The impact of failure of the dam at maximum pool (top of dam) was assessed using the "Rule of Thumb" Guidance for Estimating Downstream Dam Failure Hydrographs issued by the Corps of Engineers. The analysis included the reach of river from the dam to the Route 3 bridge in Suncook, New Hampshire. Failure of Buck Street East Dam at maximum pool would probably result in an increase of 1.2 feet over the stage resulting from full spillway flow, or from 9.6 to 10.8 feet. The full spillway discharge downstream also includes flow from the West Dam. It should be noted that the downstream stage for the test flood is estimated to be 18 feet.

The increase in flow from breach of dam could result in some flooding in a trailer park (not shown on USGS map) located 400 feet downstream of the dam. Approximately 3 miles downstream of the dam there are about 7 dwellings located on the banks of the Suncook River that would experience flooding due to the flows that would be expected from full spillway condition. The increased effect from breach of dam would probably be minimal and no loss of life, due to dam breach, would be expected.

Channel storage will attenuate the flood wave so that it will be insignificant when compared to channel flows by the time it reaches the Route 3 bridge in Suncook.
SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. There was no evidence of structural instability due to geotechnical conditions. The foundation and right abutment of the dam appear to be founded on bedrock and there was no visible seepage discharging. The left abutment is hidden from view by cut-granite masonry training walls immediately upstream and downstream of the dam, but the absence of any seepage discharge from open joints in the wall downstream of the dam is indirect evidence that the left abutment is sound.

b. Design and Construction Data. The original dam was built in 1923, but none of the design and construction data are available. There is a drawing dated 1962 which shows a plan view of the dam. The evaluation of structural stability, therefore, must be based primarily on the information from the visual inspection.

c. Operating Records. No operating records were available for evaluation.

d. Post-Construction Changes. The outlet works structure was reconstructed in 1969. There are two sheets of drawings dated 1967 and 1968, respectively, which show details of the rehabilitation work for the outlet works structure.

e. Seismic Stability. The dam is located in Seismic Zone 2, and in accordance with recommended Phase I guidelines does not warrant seismic analysis.
SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The visual inspection indicates that the Buck Street East Dam is in generally good condition. The inspection revealed the following:

(1) Loss of joint mortar on the vertical downstream face of the spillway section.

(2) Scouring of concrete on the lower portion of the outlet works sluiceway structure.

(3) Broken lock on the gate house structure.

(4) Loss of mortar in the joints between the cut-granite blocks of the masonry training wall along the east side of the channel.

(5) Debris located at the upstream face of the dam.

The hydraulic analysis reveals that the dam cannot pass the required test flood.

b. Adequacy of Information. The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgement.

c. Urgency. This dam is in generally good condition. The recommendations and remedial measures presented in Sections 7.2 and 7.3 should be implemented by the owner within two years after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation. No additional investigation is needed to complete Phase I.

7.2 Recommendations

Due to the dam's small size and low hazard classification, no further hydraulic analysis is recommended.
7.3 Remedial Measures

(a) The scoured concrete portion of the outlet works sluiceway section should be repaired.

(b) The broken lock on the gate house should be replaced to avoid unauthorized use of the outlet gates.

(c) The spillway section and left training wall of the downstream channel should be monitored periodically. Should seepage become evident, further provisions for repairing the joints of these cut-block sections should be considered.

(d) The debris located at the upstream face of the dam should be removed.

(e) A written operational procedure and warning system to follow in the event of flood flow conditions or imminent dam failure should be developed.

(f) The technical inspection program should be continued on a bi-annual basis.

7.4 Alternatives

There are no practical alternatives to the recommendations of Sections 7.2 and 7.3.
APPENDIX A

INSPECTION CHECKLIST
## VISUAL INSPECTION CHECK LIST
### PARTY ORGANIZATION

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>DATE</th>
<th>TIME</th>
<th>WEATHER</th>
<th>W.S. ELEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buck Street East Dam</td>
<td>November 16, 1978</td>
<td>9:00 a.m.</td>
<td>Sunny, Cool</td>
<td>283.1 U.S. 279.2 DN.S</td>
</tr>
</tbody>
</table>

### PARTY:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gordon Slaney</td>
</tr>
<tr>
<td>2.</td>
<td>Stan Mazur</td>
</tr>
<tr>
<td>3.</td>
<td>Ronald Hirschfeld</td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
</tbody>
</table>

### PROJECT FEATURE

<table>
<thead>
<tr>
<th></th>
<th>INSPECTED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Dam</td>
</tr>
<tr>
<td>2.</td>
<td>Spillway/Outlet Works</td>
</tr>
<tr>
<td>3.</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT Buck Street East Dam

DATE November 16, 1978

PROJECT FEATURE Dam

DISCIPLINE Geotechnical Engineer

NAME R. Hirschfeld

AREA EVALUATED

<table>
<thead>
<tr>
<th>DAM EMBANKMENT</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crest Elevation</td>
<td>No embankment. Dam consists of cut-stone masonry, with recently constructed concrete stoplog structure.</td>
</tr>
<tr>
<td>Current Pool Elevation</td>
<td></td>
</tr>
<tr>
<td>Maximum Impoundment to Date</td>
<td></td>
</tr>
<tr>
<td>Surface Cracks</td>
<td></td>
</tr>
<tr>
<td>Pavement Condition</td>
<td></td>
</tr>
<tr>
<td>Movement or Settlement of Crest</td>
<td></td>
</tr>
<tr>
<td>Lateral Movement</td>
<td></td>
</tr>
<tr>
<td>Vertical Alignment</td>
<td></td>
</tr>
<tr>
<td>Horizontal Alignment</td>
<td></td>
</tr>
<tr>
<td>Condition at Abutment and at Concrete Structures</td>
<td></td>
</tr>
<tr>
<td>Indications of Movement of Structural Items on Slopes</td>
<td></td>
</tr>
<tr>
<td>Trespassing on Slopes</td>
<td></td>
</tr>
<tr>
<td>Sloughing or Erosion of Slopes or Abutments</td>
<td></td>
</tr>
<tr>
<td>Rock Slope Protection - Riprap Failures</td>
<td></td>
</tr>
<tr>
<td>Unusual Movement or Cracking at or near Toes</td>
<td></td>
</tr>
<tr>
<td>Unusual Embankment or Downstream Seepage</td>
<td></td>
</tr>
<tr>
<td>Piping or Boils</td>
<td></td>
</tr>
<tr>
<td>Foundation Drainage Features</td>
<td></td>
</tr>
<tr>
<td>Toe Drains</td>
<td></td>
</tr>
<tr>
<td>Instrumentation System</td>
<td></td>
</tr>
</tbody>
</table>
### PERIODIC INSPECTION CHECK LIST

**PROJECT** Buck Street East Dam  
**DATE** November 16, 1978

**PROJECT FEATURE** Intake Channel/Structure  
**NAME** R. Hirshfeld

**DISCIPLINE** Structural/Hydraulic/Geotechnical  
**NAME** G. Slaney, S. Mazur

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</strong></td>
<td></td>
</tr>
<tr>
<td>a. Approach Channel</td>
<td></td>
</tr>
<tr>
<td>Slope Conditions</td>
<td>Good, unused highway bridge across channel about 20 ft. upstream of dam.</td>
</tr>
<tr>
<td>Bottom Conditions</td>
<td>Bedrock.</td>
</tr>
<tr>
<td>Rock Slides or Falls</td>
<td>None.</td>
</tr>
<tr>
<td>Log Boom</td>
<td></td>
</tr>
<tr>
<td>Debris</td>
<td></td>
</tr>
<tr>
<td>Condition of Concrete Lining</td>
<td></td>
</tr>
<tr>
<td>Drains or Weep Holes</td>
<td>None.</td>
</tr>
<tr>
<td>b. Intake Structure</td>
<td></td>
</tr>
<tr>
<td>Condition of Concrete</td>
<td>Stone-masonry walls faced with concrete, good condition.</td>
</tr>
<tr>
<td>Stop Logs and Slots</td>
<td>Wooden gates, good condition.</td>
</tr>
<tr>
<td>AREA EVALUATED</td>
<td>CONDITION</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------</td>
</tr>
<tr>
<td>OUTLET WORKS - CONTROL TOWER</td>
<td>Stone-masonry and concrete structure with mechanically controlled wooden gates.</td>
</tr>
<tr>
<td>a. Concrete and Structural</td>
<td>General Condition&lt;br&gt;Condition of Joints&lt;br&gt;Spalling&lt;br&gt;Visible Reinforcing&lt;br&gt;Rusting or Staining of Concrete&lt;br&gt;Any Seepage or Efflorescence&lt;br&gt;Joint Alignment&lt;br&gt;Unusual Seepage or Leaks in Gate Chamber&lt;br&gt;Cracks&lt;br&gt;Rusting or Corrosion of Steel</td>
</tr>
<tr>
<td>b. Mechanical and Electrical</td>
<td>Mechanical control for wooden gates appear to be in good condition.</td>
</tr>
<tr>
<td>Air Vents</td>
<td>Float Wells&lt;br&gt;Crane Hoist&lt;br&gt;Elevator&lt;br&gt;Hydraulic System&lt;br&gt;Service Gates&lt;br&gt;Emergency Gates&lt;br&gt;Lightning Protection System&lt;br&gt;Emergency Power System&lt;br&gt;Wiring and Lighting System</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT Buck Street East Dam
PROJECT FEATURE Transition and Conduit
DISCIPLINE Structural Engineer
DATE November 16, 1978
NAME Stan Mazur

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - TRANSITION AND CONDUIT</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>None.</td>
</tr>
<tr>
<td>Rust or Staining on Concrete</td>
<td></td>
</tr>
<tr>
<td>Spalling</td>
<td></td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td></td>
</tr>
<tr>
<td>Cracking</td>
<td></td>
</tr>
<tr>
<td>Alignment of Monoliths</td>
<td></td>
</tr>
<tr>
<td>Alignment of Joints</td>
<td></td>
</tr>
<tr>
<td>Numbering of Monoliths</td>
<td></td>
</tr>
<tr>
<td>AREA EVALUATED</td>
<td>CONDITION</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</td>
<td>Sluiceway which is only way of outletting water other than the spillway consists of mechanically controlled wooden gates. Gates and fascia concrete are in good condition. Good. Some Staining. None observed. Structure is founded on bedrock foundation. None. None observed. Appear to be in good condition. None. Some trees overhanging channel. Good.</td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td></td>
</tr>
<tr>
<td>Rust or Staining</td>
<td></td>
</tr>
<tr>
<td>Spalling</td>
<td></td>
</tr>
<tr>
<td>Erosion or Cavitation</td>
<td></td>
</tr>
<tr>
<td>Visible Reinforcing</td>
<td></td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td></td>
</tr>
<tr>
<td>Condition at Joints</td>
<td></td>
</tr>
<tr>
<td>Drain Holes</td>
<td></td>
</tr>
<tr>
<td>Channel</td>
<td></td>
</tr>
<tr>
<td>Loose Rock or Trees Overhanging Channel</td>
<td></td>
</tr>
<tr>
<td>Condition of Discharge Channel</td>
<td></td>
</tr>
</tbody>
</table>
### PERIODIC INSPECTION CHECK LIST

**PROJECT** Buck Street East Dam  
**DATE** November 16, 1978  
**PROJECT FEATURE** Spillway/Channel  
**DISCIPLINE** Structural/Hydraulic/Geotechnical  
**NAME** R. Hirschfeld  
**ENGINEERS** Mazur, G. Slaney

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</strong></td>
<td></td>
</tr>
<tr>
<td>a. Approach Channel</td>
<td></td>
</tr>
<tr>
<td>General Condition</td>
<td>Good, unused highway bridge across channel about 20 ft. upstream of dam.</td>
</tr>
<tr>
<td>Loose Rock Overhanding Channel</td>
<td>None.</td>
</tr>
<tr>
<td>Trees Overhanding Channel</td>
<td>Some trees.</td>
</tr>
<tr>
<td>Floor of Approach Channel</td>
<td>Bedrock.</td>
</tr>
<tr>
<td>b. Weir and Training Walls</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td>Cut-granite masonry spillway with mortar. The mortar is missing locally from the joints between the granite blocks, particularly in lower sections.</td>
</tr>
<tr>
<td>Rust or Staining</td>
<td></td>
</tr>
<tr>
<td>Spalling</td>
<td></td>
</tr>
<tr>
<td>Any Visible Reinforcing</td>
<td></td>
</tr>
<tr>
<td>Any Seepage or Efflorescence</td>
<td></td>
</tr>
<tr>
<td>Drain Holes</td>
<td>None.</td>
</tr>
<tr>
<td>c. Discharge Channel</td>
<td></td>
</tr>
<tr>
<td>General Channel</td>
<td>Good.</td>
</tr>
<tr>
<td>Loose Rock Overhanding Channel</td>
<td>None.</td>
</tr>
<tr>
<td>Trees Overhanding Channel</td>
<td>Some trees overhanding channel.</td>
</tr>
<tr>
<td>Floor of Channel</td>
<td>Bedrock.</td>
</tr>
<tr>
<td>Other Obstructions</td>
<td>One log and one piece of cut stone (about $1\frac{1}{4}' \times 1\frac{1}{4}' \times 5'$) in channel.</td>
</tr>
</tbody>
</table>
PERIODIC INSPECTION CHECK LIST

PROJECT Buck Street East Dam           DATE November 16, 1978
PROJECT FEATURE Service Bridge        NAME Stan Mazur
DISCIPLINE Structural Engineer

<table>
<thead>
<tr>
<th>AREA EVALUATED</th>
<th>CONDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTLET WORKS - SERVICE BRIDGE</td>
<td>None.</td>
</tr>
<tr>
<td>a. Super Structure</td>
<td></td>
</tr>
<tr>
<td>Bearings</td>
<td></td>
</tr>
<tr>
<td>Anchor Bolts</td>
<td></td>
</tr>
<tr>
<td>Bridge Seat</td>
<td></td>
</tr>
<tr>
<td>Longitudinal Members</td>
<td></td>
</tr>
<tr>
<td>Under Side of Deck</td>
<td></td>
</tr>
<tr>
<td>Secondary Bracing</td>
<td></td>
</tr>
<tr>
<td>Deck</td>
<td></td>
</tr>
<tr>
<td>Drainage System</td>
<td></td>
</tr>
<tr>
<td>Railings</td>
<td></td>
</tr>
<tr>
<td>Expansion Joints</td>
<td></td>
</tr>
<tr>
<td>Paint</td>
<td></td>
</tr>
<tr>
<td>b. Abutment &amp; Piers</td>
<td></td>
</tr>
<tr>
<td>General Condition of Concrete</td>
<td></td>
</tr>
<tr>
<td>Alignment of Abutment</td>
<td></td>
</tr>
<tr>
<td>Approach to Bridge</td>
<td></td>
</tr>
<tr>
<td>Condition of Seat &amp; Backwall</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX B

ENGINEERING DATA

1. LIST OF DESIGN, CONSTRUCTION AND MAINTENANCE RECORDS

2. PAST INSPECTION REPORTS

3. PLAN AND DETAILS
AVAILABLE ENGINEERING DATA

A set of drawings (2 sheets), dated 1967 and 1968, showing plans and details of the additions and improvements made to the dam in 1969 is available at the State of New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire 03301.
PAST INSPECTION REPORTS
On July 26, 1977 I checked the condition of the Buck Street Dam in Pembroke. There are a lot of logs and tree branches in front of the gate section. The right gate was open about 6" and some branches were washed under preventing its closing. There is too much trash that is too large to be removed by hand. I would recommend that the crane with clamshell be used for this. It would take about 1 day of crane time to complete this work.

SCB: njk

See Dam Log
SUNCOOK RIVER IN PEMBROKE
Suncook Mills
August 2, 1934
BUCK STREET DRY, PETROKE

April 1, 1963

East of Island
In accordance with Section 20 of Chapter 133, Laws of 1937, the above dam was inspected by me on __________ accompanied by __________.

NOTES ON PHYSICAL CONDITION

Abutments

Spillway

Gates

Other

CHANGES SINCE LAST INSPECTION

FUTURE INSPECTIONS

This dam (is) (is not) a menace because __________

REMARKS

This report must be filed immediately

[Signature]
INSPECTOR

(Additional Notes Over)
APPENDIX C

PHOTOGRAPHS

FOR LOCATION OF PHOTOS, SEE FIGURE 1
LOCATED IN APPENDIX B
PHOTO NO. 1 - Series of two photos (1 & 2) taken clockwise showing upstream channel and debris against upstream face of dam.

PHOTO NO. 2 - (See Photo No. 1).
PHOTO NO. 3 - Series of two photos (3 & 4) taken clockwise from left side of downstream channel showing right abutment, masonry spillway section, concrete sluiceway structure, and downstream training wall on left abutment.

PHOTO NO. 4 - (See Photo No. 3).
PHOTO NO. 5 - Series of three photos (5, 6 & 7) taken clockwise from right side of downstream channel showing downstream side of dam.

PHOTO NO. 6 - (See Photo No. 5).
PHOTO NO. 7 - (See Photo No. 5).

PHOTO NO. 8 - View of training wall on left side of channel downstream from concrete stoplog structure showing absence of mortar in joints near water level.
PHOTO NO. 9 - View of dam's upstream face from unused roadway upstream.

PHOTO NO. 10 - View of spillway structure and discharge channel from unused roadway upstream.
PHOTO NO. 11 - Upstream face of sluiceway structure.

PHOTO NO. 12 - Downstream face of sluiceway structure.
PHOTO NO. 15 - View from left abutment showing dam and unused roadway bridge upstream of dam

PHOTO NO. 16 - View looking downstream, under unused highway bridge from east bank of channel toward upstream face of dam.
PHOTO NO. 17 - Series of four photos (17, 18, 19 & 20) taken clockwise from downstream channel showing sluice-way structure, left training wall and discharge (river) channel.

PHOTO NO. 18 - (See Photo No. 17).
PHOTO NO. 19 - (See Photo No. 17).

PHOTO NO. 20 - (See Photo No. 17).
APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS
HYDRAULICS & HYDROLOGY

Buck Street East Dam is located in Pembroke, NH across the Suncook, River in the Merrimack River Basin.

CLASSIFICATION
Size: Small
Hazard: Low

Basic Data
D.A. = 240 ft³/sec.
Upstream Basin: Flat-costal.

Reservoir:
Normal Storage: elev. 284.4
84 acre-ft
Max. Storage: elev 291.0
400 acre-ft

Surface area
Normal - 25 acres
Max. - 70 acres

Dam: Stone Masonary & granite block
Length: 53.5 ft
Height: 10.92 ft

Spillway: weir
Length: 32 ft
Crest elev. 287.0

Outlet: Concrete invert w piers
2 openings @ 5.33'
Plan Buck St. Dams

Route 18 South

East Dam

S.T.

ISLAND

West Dam

Spillway

Spillway

Gatehouse
Step 1 Calculation of Spillway Design Flood

Classification: Size: Small  
Hazard: Low

Hydrologic Evaluation Guideline recommends

SDF = 100 yr to 50 yr frequency

Size classification is in mid-range for storage capacity and low range for height.

Use 100 yr flood for SDF.

Gaging Sta. at Chichester, N.H. 157 sq mi D.A.

MAR 1936  Q 12,900 cfs Max discharge

100 yr Flood Discharge from: "Water Resources Investigation Merrimack River Basin" CDF, Waltham, Ma., August 1972

Table C-7 in Appendices

100 yr discharge Natural Flood Peak = 12,100 cfs

\[
\frac{12,100 \text{ cfs}}{157 \text{ sq mi}} = 77 \text{ cfm}
\]

At Buck STREET D.A. = 240 sq mi.

77 cfm x 240 sq mi. = 18,480 cfs

USE 18,500 cfs for SDF
Step 3  Calculation of Surcharge

Spillway Design Flood = 18,500 cfs

As the Buck Street Dams are hydraulically interconnected the following calculations to develop the stage-discharge curve include the spillways of both dams.

At the East Consider:
1. Gate closed
2. Gate house is the easterly boundary of flow

At the West Dam consider:
1. Stop logs in place to elev. 286.19
2. End of westerly cutoff wall west flow boundary

General Considerations
1. Negligible flow over island as it is heavily wooded and of varying elevations

**East Dam**

**Spillway**

\[ Q_E = CLH_E^{3/2} \]

\[ Q_E = 3.38(32)H_E^{3/2} \]

\[ Q_E = 108H_E^{3/2} \]
West Dam

Stop logs in outlet works to elev. 286.19. Same as spillway crest elevation. To simplify calculation consider flow over stop logs in outlet works as part of spillway flow.

\[ Q_w = CLH_w^{3/2} \]

- Elev 286.19
- \( C = 3.75 \)
- \( L_{\text{spillway}} = 75 \text{ ft} \)
- \( L_{\text{outlet}} = 12 \text{ ft} \)

\[ Q_w = 3.75(12 + 75) H_w^{3/2} \]

\[ Q_w = 326 H_w^{3/2} \]

In addition to the spillway there is an additional 56.5 ft of abutment and cutoff wall facing upstream. Use broad crest ed weir hydraulics

\[ Q_A = CLH_A^{3/2} \]

crest elevation of walls & abutments
- 291.32 w/e 291.3
- \( C = 2.65 \)
- \( L = 56.5 \)

\[ Q_A = 2.65(56.5) H_A^{3/2} = 150 H_A^{3/2} \]

**TABLE 1**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Discharge</th>
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<tbody>
<tr>
<td>Water Surface</td>
<td>He</td>
</tr>
<tr>
<td>290.75</td>
<td>375</td>
</tr>
<tr>
<td>291.30</td>
<td>430</td>
</tr>
<tr>
<td>293.0</td>
<td>60</td>
</tr>
</tbody>
</table>

D. S. TW. Submerges both spillways
Submerged Weirs

\[ Q = Q_1 \left[ 1 - \left( \frac{H_2}{H_1} \right)^{1.5} \right]^{3.85} \]

- **Q**: Actual Discharge
- **Q**: Free Discharge
- **H**: Head above weir
downstream side
- **H**: Head used for **Q**

\[ H_2 = TW \text{ elev} - \text{weir crest} \]

<table>
<thead>
<tr>
<th>Section</th>
<th><strong>H</strong></th>
<th><strong>H</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>West Dam Abutments</td>
<td>H+0</td>
<td>TW-291.3</td>
</tr>
<tr>
<td>East Dam</td>
<td>H+4.3</td>
<td>TW-287.0</td>
</tr>
<tr>
<td>West Dam</td>
<td>H+5.1</td>
<td>TW-286.2</td>
</tr>
</tbody>
</table>

Solve: weir submergence equation, trial & error

\[ Q_T = \sum Q_1 \left[ 1 - \left( \frac{H_2}{H_1} \right)^{1.5} \right]^{3.85} \]

\[ Q_T = 150H^{1.5} \left[ 1 - \left( \frac{H_2}{H} \right)^{1.5} \right]^{3.85} + 108(H+4.3)^{1.5} \left[ 1 - \left( \frac{H_2}{H} \right)^{1.5} \right]^{3.85} + 326(H+5.1)^{1.5} \left[ 1 - \left( \frac{H_2}{H} \right)^{1.5} \right]^{3.85} \]

- **West Dam Abutments**
- **East Dam**
- **West Dam**

1. From Fig. 2, find **TW** elev. For a given Total **Q**
2. Using **TW**, calculate **H**2 for each section
3. Assume upstream trial w.s. elevation, subtract abutment elevation to obtain **H**
4. Substitute values in above expression to obtain trial **Q**
   match to given **Q**, if equal, **H**+291.3 = upstream w.s. elevation
TABLE 2

<table>
<thead>
<tr>
<th>Elev</th>
<th>T.W.</th>
<th>Q_T</th>
<th>Q_A</th>
<th>Q_E</th>
<th>Q_W</th>
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<tbody>
<tr>
<td>295.25</td>
<td>291.9</td>
<td>10,000</td>
<td>1155</td>
<td>2030</td>
<td>6815</td>
</tr>
<tr>
<td>296.65</td>
<td>293.4</td>
<td>12000</td>
<td>1665</td>
<td>2400</td>
<td>7940</td>
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<tr>
<td>298.0</td>
<td>294.75</td>
<td>14000</td>
<td>2180</td>
<td>2790</td>
<td>9130</td>
</tr>
<tr>
<td>300.65</td>
<td>297.3</td>
<td>18,500</td>
<td>3250</td>
<td>3610</td>
<td>11,640</td>
</tr>
</tbody>
</table>

Step 4: Effect of Surcharge Storage

MPFR = 19", MPF = 240 x 300 = 72,000cf

\[
\begin{align*}
100 \text{ yr} R: & \quad Q_{100} \times 19 = \frac{18,500}{72,000} \times 19 = 4.88 \text{ in} \\
Q_{P1} &= 18,500 \text{cf} \\
\text{Surcharge, } e &\text{lev } 300.65 - 286.2 = 14.45 \\
\text{Vol of surcharge} &\text{,} \\
Stor_1 &= \frac{\left(\frac{14.45}{100}\right)(150 \times 74.45)}{43360 \text{ cu ft per acre ft}} \times 12 \text{ in/acre ft} \\
&= \frac{240}{240} \text{ cu in/ft} = 0.05 \text{ in} \\
\text{See pg for storage vol computation} \\
\end{align*}
\]

\[
\begin{align*}
Q_{p2} &= Q_{p1} \left(1 - \frac{Stor_1}{4.88}\right) = 18,500 \left(1 - \frac{0.05}{4.88}\right) = 18,310 \text{ cf} \\
\text{Surcharge } 2 &= 14.25
\end{align*}
\]
\[ Stor_2 = (\text{Surcharge})^2 \times (0.000224) = 0.05 \text{ in} \]

\[ Stor_{ave} = \frac{Stor_1 + Stor_2}{2} = \frac{0.05 + 0.05}{2} = 0.05 \text{ in} \]

\[ Q_{p3} = Q_{p1} \left(1 - \frac{Stor_{ave}}{4.88}\right) = 18300 \left(1 - \frac{0.05}{4.88}\right) = 18310 \text{ cfs} \]

Store values within <1% use \( Q_{p3} \) as outflow

Outflow = 18310 cfs

Stage 300.45 or 14.25 ft above West Dam spillway

At the spillway design flood 18310 cfs

West Dam - 14890 cfs 82.7%
East Dam - 3420 cfs 18.3%

Conclusions

1. Both Buck St. East & Buck St. West act together hydraulically as one dam across the Suncook River.

2. The spillway & storage capacity of both dams combined can safely pass 23% of the test flow of 18310 cfs.
   - Combined Spillways 4720 cfs
   - East Dam 965 cfs
   - West Dam 3755 cfs

3. Reservoir storage will reduce the SDF at the outlet from 18500 cfs to 18310 cfs or by 1.7%.

4. At the test discharge of 18310 cfs the East Dam crest will be overtopped by 9.7 ft and the West Dam crest by 9.15 ft.
Figure 2
Estimate of Downstream Failure Hydrograph

"Rule of Thumb Method"

**Step 1: Estimate of Reservoir Capacity**

See Buck Street West Dam for calculations
Pool height on Buck St. West
controls
Therefore

- Normal Storage: 84 acre-ft
- Max. Storage: 400 acre-ft
- Net Storage: 316 acre-ft

**Step 2: Peak Failure Outflow**

\[ Q_p = \frac{3}{2} \sqrt{g} W_0 y_0^{3/2} \]

- \( W_0 = \) width of breach = 75' = 9,000 ft
- \( y_0 = \) total height from river bed to TP = 25' = 304 ft

\[ Q_p = \frac{3}{2} \sqrt{g} (90)(304)(12)^{3/2} = 2115 \text{ cfs} \]

**Step 3: Stage Discharge Curve**

\( S = 0.0006 \frac{1}{ft} \)

\( L = 19,500 \text{ ft} \)

\( n = 0.03 \)
Step 4

Reach Outflow

\[ L = 11,000 \text{ft} \]
\[ Q_{P1} = 2115 \text{ cfs} \]
\[ \text{Stage}_1 = 5.4 \text{ ft} \]
\[ \text{area}_1 = 598 \text{ ft}^2 \]
\[ V_1 = \frac{598 \times 11,000}{43,560} = 151 \text{ acre-ft} \leq \frac{316}{2} \]

Reach length O.K.

\[ Q_{P2_{\text{TRIAL}}} = Q_{P1} \left(1 - \frac{V_1}{5}\right) = 2115 \left(1 - \frac{151}{316}\right) = 1104 \text{ cfs} \]
\[ \text{Stage}_2 = 3.7 \text{ ft} \]
\[ \text{area}_2 = 397 \text{ ft}^2 \]
\[ V_2 = \frac{397 \times 11,000}{43,560} = 100 \text{ acre-ft} \]
\[ V_{\text{AVE}} = \frac{V_1 + V_2}{2} = \frac{151 + 100}{2} = 125.5 \text{ acre-ft} \]

\[ Q_{P2} = Q_{P1} \left(1 - \frac{V_{\text{AVE}}}{5}\right) = 2115 \left(1 - \frac{125.5}{316}\right) = 1270 \text{ cfs} \]

Outflow = 1270 cfs  Stage = 4.0 ft
**Estimate of Downstream Dam Failure Hydrograph**

by "Rule of Thumb METHOD"  

**Step 1** Estimate of Reservoir Storage at time of failure:

- No data on reservoir volume estimate

**Ave streambed slope near dam:** 0.0006

**Stream width:** 100'

**Depth at dam (Normal pool):** 12'

\[ \text{Volume} = \frac{1}{2} \times \text{width} \times \text{depth} \times \text{length} \]

\[ \frac{1}{2} (100)(12.5)(100) = 84,000 \text{ cubic feet} \]

**Normal Storage:** 275 acre-feet

**Max Storage at crest of dam**

**Depth:** 12.5 ft

\[ \frac{120'(150' \times 120)}{43,560 \text{ cu ft/acre-ft}} = 413 \text{ acre-ft} \]

**Max Storage:** 880 acre-feet

Use 880 acre-feet for S

**Step 2** Peak Failure Outflow

\[ Q_p = 0.67 \sqrt{g} W_b L^0.5 \]

**W_b = width of breach:** 40% of dam length

**L = Total height from river bed to max pool elev**
BUCK STREET EAST DAM

POSSIBLE FLOOD DAMAGE AREA DUE TO DAM FAILURE

NATIONAL PROGRAM OF INSPECTION OF NON FEDERAL DAMS
BUCK STREET EAST DAM
POSSIBLE FLOOD DAMAGE AREA

Pembroke, New Hampshire
U.S.G.S Quad. Suncook, N.H.

Scale: 1:24,000
APPENDIX E

INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS
### INVENTORY OF DAMS IN THE UNITED STATES

<table>
<thead>
<tr>
<th>STATE</th>
<th>COUNTY</th>
<th>NAME</th>
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<th>RIVER OR STREAM</th>
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<th>POPULATION</th>
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<th>STRUC MUT HT (FT)</th>
<th>HYDRAUL HT (FT)</th>
<th>EROSION CONTROL CAPACITIES</th>
<th>INT UN FROM PRIV/SED SCG</th>
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<tr>
<td>FLOOD ONLY</td>
<td>1924</td>
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<td>1.0</td>
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<th>D.E.S</th>
<th>SPILLWAY</th>
<th>MAXIMUM DISCHARGE (F.P.)</th>
<th>VOLUME OF DAM (C.F.)</th>
<th>POWER CAPACITY</th>
<th>NAVIGATION LOCKS</th>
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