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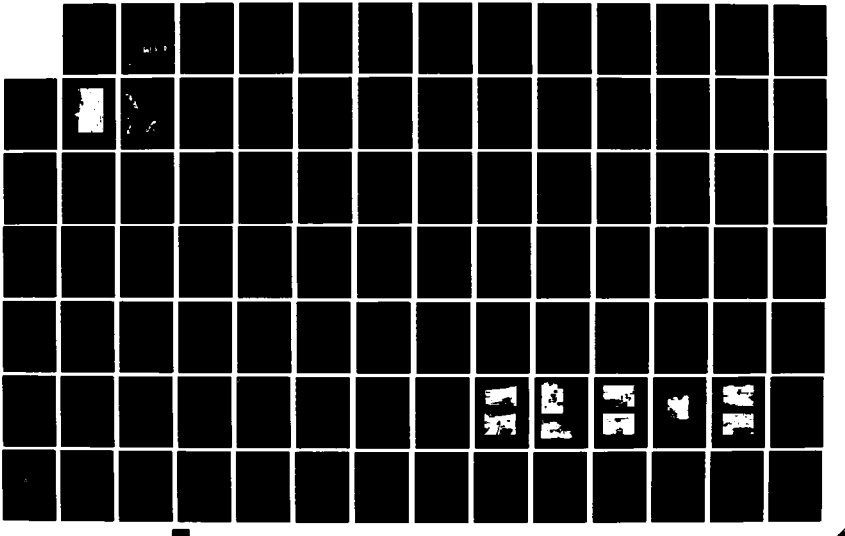

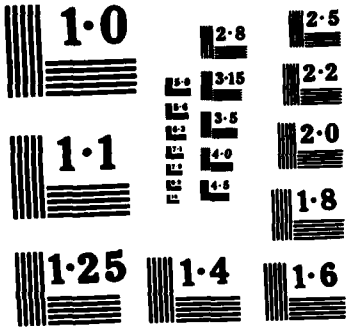

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AD-A157 234

MERRIMACK RIVER BASIN
BRISTOL, NEW HAMPSHIRE

INTERNATIONAL PACKINGS CORPORATION

LOWER DAM
NH-00480

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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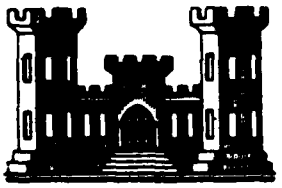

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NEW ENGLAND DIVISION, CORPS OF ENGINEERS
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APRIL 1979

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18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Bristol, New Hampshire
Newfound River

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

THe dam is about 14 ft. high and 87 ft. long. The dam is considered to be in poor condition . Major concerns regarding the safety of the dam include underseepage, downstream scour, among others. The test flood is ½ the PMF. The annual shutdown and major maintenance should be continued with records to be kept of such work.

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

REPLY TO
ATTENTION OF:
NEDED-E

JUN 18 1979

Mr. Roger L. Young, Plant Engineer
International Packings Corporation
Pleasant Street
Bristol, New Hampshire 03222

Dear Mr. Young:

Forwarded herewith for your information and use is a copy of the Inspection Report on the International Packings Corporation Lower Dam. This inspection was made under the authority of Public Law 92-367 by the firm of E.C. Jordan Co., Inc., Portland, Maine under the direction and supervision of the Corps of Engineers. Copies of the finished report have been forwarded to the Governor and the Water Resources Board, the cooperating agency for the State of New Hampshire.

Section 7 of the report contains an evaluation and recommendations. If you have any questions concerning this report, we suggest that you contact the Water Resources Board first. Then, if there are further questions contact the Project Management Branch, Engineering Division of this office. We thank you for your cooperation and assistance in carrying out this program.

Sincerely yours,

Joe B. Fryar

Incl
As Stated

JOE B. FRYAR
Chief, Engineering Division

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424 TRAPELO ROAD
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REPLY TO
ATTENTION OF:

NEDED-E

JUN 19 1979

Mr. George M. McGee, Sr.
Chairman, New Hampshire Water Resources Board
State of New Hampshire
Concord, New Hampshire 03301

Dear Mr. McGee:

Forwarded herewith for your information and use is a copy of the Inspection Report on International Packings Corporation Lower Dam. This inspection was performed in accordance with Public Law 92-367 under the direction of the Corps of Engineers. Copies of the finished report have been forwarded to the Governor and the owner. We thank you for your cooperation and assistance in carrying out this program and hope this report will help you to develop an effective dam safety program.

Sincerely yours,

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

Incl
As stated

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

REPLY TO
ATTENTION OF:
NEDED

JUN 12 1979

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 International Packings Corporation Lower 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, International Packings Corporation, Pleasant Street, Bristol, New Hampshire 03222, ATTN: Mr. Roger L. Young, Plant Engineer.

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,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

MERRIMACK RIVER BASIN
BRISTOL, NEW HAMPSHIRE

INTERNATIONAL PACKINGS CORPORATION
LOWER DAM

NH-00480

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

NH-00480

INTERNATIONAL PACKINGS CORPORATION
LOWER DAM

BRISTOL

GRAFTON COUNTY, NEW HAMPSHIRE

NEWFOUND RIVER

November 21, 1978

BRIEF ASSESSMENT

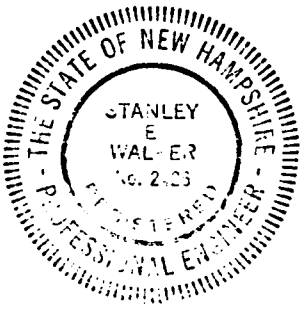
The International Packings Corporation Lower Dam is a timber crib gravity dam with concrete abutment wing walls. The dam is about 14 feet in height and about 87 feet in length between abutments.

Based on the visual inspection and reports of past operational performance, the International Packings Corporation Lower Dam is considered to be in poor condition. Major concerns regarding the safety of the dam include underseepage, downstream scour, deterioration of timbers, serface deterioration and lack of freeboard both at the reservoir banks and between spillway and service bridge.

The International Packings Corporation Lower Dam is a small size dam classified as having a significant hazard potential. In accordance with Corps of Engineers' guidelines for the determination of spillway adequacy, the test flood is one-half the Probable Maximum Flood (PMF). The test flood is estimated to be 12,760 cfs. The spillway could pass 44 percent of the one-half PMF with all stop logs removed. However, the dam is not a hydraulic control once flooding benins to occur, because the upstream valley section allows a routing of flow upstream of the dam around the north end of the dam. Therefore, during the PMF or one-half PMF occurrence, considerable flooding would be occurring downstream. Thus the spillway is not considered seriously inadequate under Corps of Engineers' Guidelines because a failure caused by over-

topping would not significantly increase the downstream hazard potential above that which existed just before failure occurred. Since the dam is a timber crib gravity structure, it can be considered generally stable during overtopping, with the assumption that underseepage and downstream scour conditions are corrected and deteriorated timber crib members are replaced.

As outlined in Section 7 of this report, the downstream scour and underseepage should be evaluated further by a qualified engineer, and recommendations for curtailment of these conditions be prepared and implemented. The following items of remedial maintenance should also be performed; 1) replacement of missing stoplog lift hooks; 2) repair of spalled concrete; 3) repair of deteriorated wood members of the structure; 4) provision of 24 hour surveillance during flood events; 5) development of a warning system; and 6) and institute a program of annual periodic technical inspections. These actions should be implemented within 12 months of receipt of this report by the owner. The annual shutdown and major maintenance should be continued with records to be kept of such work.



EDWARD C. JORDAN CO., INC.

Stanley E. Walker, P.E.
Project Officer

This Phase I Inspection Report on International Packings Corporation Lower 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 W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual 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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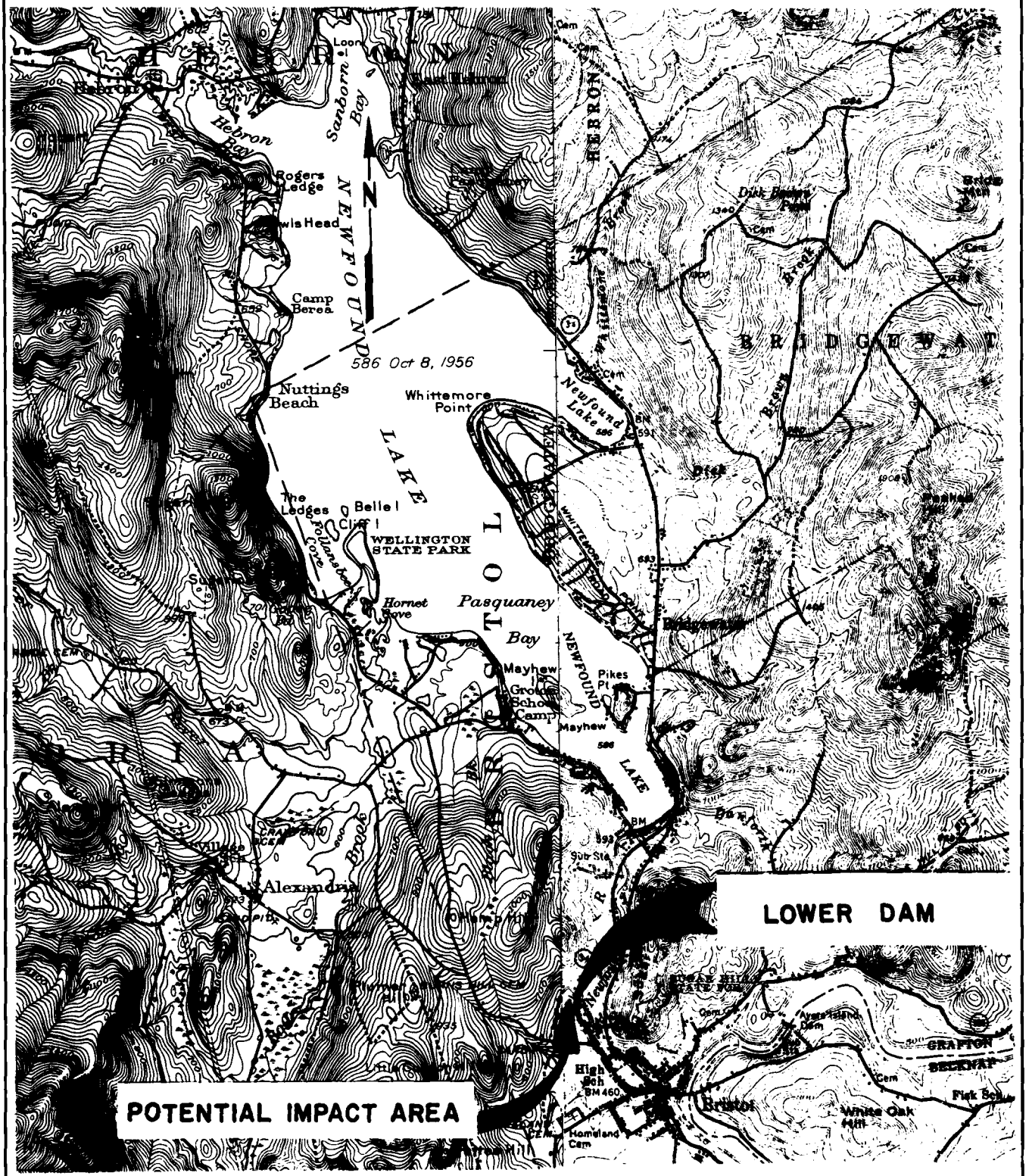


U.S. GEOLOGICAL SURVEY MAP
CARDIGAN , N.H. QUADRANGLE
HOLDERNESS , N.H. QUADRANGLE

0 1 2 3 MILES

EDWARD C. JORDAN CO., INC. PORTLAND, MAINE	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

INTERNATIONAL PACKINGS CORP.

LOWER DAM
LOCATION MAP

NEWFOUND RIVER — MAINE

207.3 07 — SCALE AS SHOWN — DATE MARCH 1978

PHASE I INSPECTION REPORT

INTERNATIONAL PACKINGS CORPORATION

LOWER DAM

SECTION 1

PROJECT INFORMATION

1.1 GENERAL

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Edward C. Jordan Co., Inc. has been retained by the New England Division to inspect and report on selected dams in the States of Maine and New Hampshire. Authorization and notice to proceed were issued to Edward C. Jordan Co., Inc. under a letter of December 1, 1978 from Max B. Scheider, Colonel, Corps of Engineers. Contract No. DACW33-79-C-0017 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 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. The International Packings Corporation Lower Dam is located on the Newfound River in the town of Bristol, New Hampshire. N 43° 36.0', W 71°-44.9'.

b. Description of Dam and Appurtenances. The International Packings Corporation Lower Dam is a timber crib dam with concrete abutment-wing walls. The dam is a "run-of-the-river" dam situated in a broad and relatively flat section of the valley of the Newfound River. The river makes a sharp bend both above and below the dam site.

The dam is approximately 14 feet in height, with a spillway structure length of about 87 feet. It appears to be founded on soil.

Appurtenant to the dam is a gated canal with concrete sidewalls which diverts water to a power house. After passing through the generator, the water exits through an underground tail race to a channel which rejoins the Newfound River several hundred feet below the dam.

Plan and profile sketches of the dam and appurtenant features are presented in Appendix B.

c. Size Classification. The IPC Lower Dam is classified as a small size dam, based on its height (14 feet) and storage capacity (31 acre-feet).

d. Hazard Classification. In the event of failure of the dam, approximately ten commercial and residential buildings located within a distance of 1,500 feet below the dam would be damaged. Flood depths vary with the distance downstream of the dam. Because of the small volume of the reservoir storage and the flatness of the overbank areas, the flood peak would be rapidly attenuated. The commercial/ industrial buildings located directly downstream of the dam on the north bank would suffer the greatest damage. Also of some concern is a propane storage tank located about 100 feet below the dam; if the tank were dislodged from its concrete cradle during a flood event, the tank could pose a serious hazard to downstream residents. Flood depths just below the dam would be two to three feet.

General flooding in the reach downstream of the dam begins at a discharge of 2,000 to 2,500 cfs. The flood peak from failure was estimated to be 3,491 cfs which corresponds to a stage of 7.2 feet at a distance of 100 feet below the dam. Flood stage is at 4.5 to 5 feet in this area. Flood peak from failure would diminish to about 1,700 cfs within 1,500 feet of the dam. This is considered to be below the general flood level. However, some minor localized high water may still occur.

The duration of the flow from dam failure would be very short. It would take approximately 13 minutes for the reservoir to empty. It is estimated that in no reach of the stream would water be above general flood level for more than 10 minutes.

All of the above discharges do not consider the flow already occurring. With stop logs in place as at the time of inspection, the discharge at the dam with water surface at top of dam would be about 570 cfs. Given this as a base flow at time of failure, downstream water levels would be raised about 0.5 feet above the level resulting from failure alone.

If the spillway were discharging at maximum capacity, a significant flood event would already be occurring downstream and there would not be a significant increase in downstream hazard due to failure of the dam by overtopping.

Based on the above discussion, the International Packings Corporation Lower Dam is given a "significant" hazard potential classification.

e. Ownership.

Current Owner:	International Packings Corporation Pleasant Street Bristol, New Hampshire 03222
Previous Owner and dates:	Dodge-Davis Manufacturing Co. 1934-1949

f. Operator. Roger L. Young, Plant Engineer
International Packings Corp.
Tel: 1-603-744-2281

g. Purpose of Dam. This dam is used for hydroelectric power generation to supplement the power requirements of the International Packings Corporation manufacturing facility in Bristol.

h. Design and Construction History. There is very little design data pertinent to this dam, and that available is limited to information relating to the generating equip-

ment. The designer of the structure is not known. According to the current owner, the Dodge-Davis Manufacturing Co. constructed the dam about 1934. The International Packings Corporation overhauled the structure in 1973, at which time a concrete apron was added to the upstream face, new timber uprights were installed on the stop log sections, a steel I-beam was installed at the top of the dam, and the low-level outlet was furnished with a steel gate. No plans for this remodeling are available.

i. Normal Operating Procedure. The International Packings Corporation Lower Dam is used to supply water to a 100-foot long power canal located on the south bank just upstream of the dam. A gate house is located at the upstream end of the canal. The stop log spillway is maintained at a level sufficient to provide water for power generation. The invert of the canal is 6.9 feet below the top of dam. During low and normal flows, stop logs are maintained at maximum height. In anticipation of high flows, stop logs are manually removed. If maintenance is required to the spillway section, the water level is lowered and the low level outlet is opened. The low level outlet can only be opened from the upstream apron. Stop logs are not removed during periods of turbine shutdown. When power is being generated, periodic daily checks are reportedly made of the generating equipment and trash screens. The stop logs are not designed to automatically fail during overtopping conditions. Once overtopping of the dam occurred, it would be very difficult to remove the stop logs.

1.3 PERTINENT DATA

a. Drainage Areas. The drainage area above the International Packings Corporation Lower Dam is 96.1 square miles. The basin is primarily forested with slopes varying from moderate to steep. Elevation in the basin ranges from 3,121 feet (MSL) at Mount Cardigan to about 480 feet at the dam. About 7% of the entire drainage area consists of surface water at Newfound Lake which is located about 1.2 miles upstream of the International Packings Corporation Lower Dam. A dam on Newfound Lake regulates the discharge to the Newfound River. The drainage area above the Newfound Lake Dam is 95.0 square miles. Newfound Lake has a capacity of 38,800 acre-feet.

b. Discharge at Damsite. Based on data collected during the visual inspection and discussion with New Hampshire Water Resources Board personnel and the owner, the following discharges were estimated. All discharges assume a water level at top of dam.

(1) Maximum flood at damsite is unknown. The flood of July 1973 was estimated to be 3,500 cfs.

(2) Stop log spillway capacity at time of inspection - 570 cfs (one port full open, top of remaining stop logs 1 foot below top of dam).

(3) Stop log spillway capacity (all stop logs in-place) - 130 cfs.

(4) Spillway capacity (all stop logs removed) is 5,600 cfs.

(5) Total spillway flow at PMF is 11,635 cfs at flood elevation of 493.6 feet.

(6) Total spillway flow at 1/2 PMF is 6,592 cfs at flood elevation of 490.0 feet.

(7) Total project discharge at PMF elevation of 493.6 feet is 30,000 cfs.

(8) Total project discharge at 1/2 PMF elevation of 490.0 feet is 12,780 cfs.

c. Elevation. During the field inspection, no physical reference of the dam elevation to mean sea level was readily available. New Hampshire Water Resources Board records dating to 1939 indicate an elevation at the top of the south abutment of about 489.2 feet. Using this as an assumed datum, pertinent elevations at the International Packings Corporation Lower Dam site are as follows:

Item	Approximate Elevation Above MSL
(1) Streambed at centerline of dam	474.8
(2) Maximum tailwater	Unknown
(3) Invert at entrance to power house canal	482.3

Item	Approximate Elevation Above MSL
(4) Normal pool	487.9
(5) Full flood control pool	489.2
(6) Spillway crest (at lowest point)	481.8
(7) Design surcharge	Unknown
(8) Top of dam (at abutment)	489.2
(9) Test flood elevation (PMF)	493.6
(10) 1/2 PMF elevation	490.0

d. Reservoir. The lengths of the reservoir at normal pool (top of stop log spillway) and maximum pool were estimated using average streambed slopes.

Item	Length (ft.)
Normal Pool	600
Top of Dam	700

e. Storage

Item	Storage
Top of Dam	31
Normal Pool	20

f. Reservoir Surface

Item	Surface Area(ac)
Top of Dam	2.8
Normal Pool	2.1

g. Dam.

(1) Type - The dam is a timber crib gravity dam with concrete abutment-wing walls.

(2) Length - The length between abutments is approximately 87 feet. The northerly wing-wall extends from the abutment at an angle upstream of about 45° for a distance of about 35 feet; the southerly wing-wall extends upstream about 30 feet where it meets the gate to the power house canal.

(3) Height - The top height of the dam from top of abutment to level of streambed downstream is about 14 feet.

(4) Top Width - See Plan and Cross-sections in Appendix B.

(5) Side Slopes - See Plan and Cross-sections in Appendix B.

(6) Zoning - None.

(7) Impervious Core - None.

(8) Cutoff - Cutoff is formed by sloped plank apron covered with concrete on upstream side of dam, with a mud seal.

(9) Grout Curtain - None.

h. Diversion and Regulating Tunnel. Not applicable.

i. Spillway.

(1) Type - The spillway of the dam consists of timber cribwork supporting timber columns which contain slots for stop logs. The stop log spillway runs the entire length of the timber crib structure.

(2) Length - The spillway is approximately 87 feet long. There are 18 stop log bays at 4.5 feet wide by 5 to 6 feet high.

(3) Crest Elevation - Approximately 481.8 feet (MSL) at the low point, based on assumed datum as discussed above.

(4) Gates - Control gates for the spillway are stop logs across its entire length. Stop logs must be manually removed, as there is no hoisting equipment. A low level outlet gate is provided in the concrete apron on the upstream side of the dam; this gate is a manually operated bulk-head type door which can be operated only during low-water conditions.

(5) Upstream Channel - The upstream approach to the spillway has an apparent slope of 16 feet per 1000 feet and is clear of debris and sediment. No loose rock or trees overhanging the channel. The stream makes a sharp bend as it approaches the dam, and passes beneath a highway bridge as it nears the dam site (see photograph 8, Appendix C); this bridge causes a restriction in the approach channel. Some minor sedimentation is evident in the reservoir.

(6) Downstream Channel - The channel of the Newfound River below the spillway is steep and rocky, with relatively flat overbanks containing some small trees and brush. The overbank is generally low in relation to the stream channel.

A significant amount of scour has occurred at the toe of the dam. The scouring ranges from 1 to 4 feet deep and extends 20 to 30 feet downstream.

j. Regulating Outlets

(1) Inverts: Spillway stop log gates - elevation varies from 481.8 to 482.8 (MSL). Power house canal gates - elevation 482.3 (MSL).

(2) 18 stop log gates at 5 to 6 feet high by 4.5 feet wide. 3 canal gates at 6.5 feet high. The width varies from 4 ft., 3 in. to 5 ft., 5 in. Low level outlet - 3 ft. square.

(See Plan and Cross-section sketches in Appendix B)

(3) Description - Spillway stop log gates consist of individual wood plank stop logs which are manually removed or inserted. These stop logs are supported in slots in timber uprights; there are 18 of these stop log sections across the length of the spillway.

The power house canal gates consist of three timber vertical lift gates operated by hoisting equipment housed at the inlet to the canal.

The low level outlet gate is located in the concrete apron which has been installed over the cribwork on the upstream side of the dam. This gate is a three-panel metal bulkhead-type door and can only be operated when the pond has been drained to a low-water condition.

(4) Control mechanisms -

Spillway stop logs - None.
Canal gates - Manually operated hoisting equipment.
Low level outlet - none.

SECTION 2

ENGINEERING DATA

2.1 DESIGN

Essentially no design data were available for the International Packings Corporation Lower Dam. Drawings of proposed generating equipment for use at the site are on file in the company's plant in Bristol, together with miscellaneous data pertaining to that equipment (See Appendix B).

2.2 CONSTRUCTION

No engineering data were available regarding construction of the dam.

2.3 Operation

No engineering operational data were disclosed.

2.4 EVALUATION

a. Availability. There are essentially no engineering data or plans available that would be useful in evaluating the integrity of the International Packings Corporation Lower Dam.

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, performance history and engineering judgment.

c. Validity. Not applicable.

SECTION 3

VISUAL INSPECTION

3.1 FINDINGS

a. General. The International Packings Corporation Lower Dam is a timber crib dam with concrete abutment-wing walls. The dam appears to be founded on soil and is located in a broad, relatively flat section of the valley. The Newfound River makes a sharp bend both above and below the dam site. The dam is a run of the river dam with very little impoundment area or storage capacity.

b. Dam.

(1) Structural - The visual inspection of the dam structure revealed that the various elements of the dam are in generally poor condition. See Appendix A for detailed inspection findings. The structure consists of concrete abutments and wing walls with a timber cribwork supporting timber columns and stop logs which form the spillway. See Appendix B for plan, profile and cross-section sketches, and Appendix C for photographs.

The visual inspection of the dam resulted in the following major findings:

(a) The spillway section and downstream apron of the dam show evidence of settlement and deflection downstream. Settlement of the apron of at least 4 inches has occurred (see overview photograph). Downstream deflection of the stop log section of the spillway of 5 to 7 inches at its' center is evident. (see Appendix C, photograph 2)

(b) Significant scour has occurred downstream of the apron below the spillway. (see photograph 9) Some undermining of the timber cribs is evident.

(c) Direct leakage from the upstream face of the dam to the downstream toe is occurring. This was evidenced by eroded depressions and flow

into the depressions along the upstream face of the dam (see photograph 4) and flow from the toe. Past attempts to prevent this seepage are evident; these attempted repairs have not been successful.

(d) Many of the timber members in the cribwork and some of the planking show signs of deterioration. Some timber has rotted seriously, other pieces are cracked or split and some planks are broken.

(e) The concrete abutments and wing walls are badly spalled in many areas. (see photograph 3)

(f) Stop logs and stop log supports are in generally good condition. The lifting hooks on some of the stop logs are broken, inhibiting easy removal of these stop logs.

(2) Hydraulics - At the time of visual inspection the flow of the river was estimated to be 2 to 5 cfs, all of which was flowing beneath or through the dam structure. It was noted that only about one foot of freeboard exists between the top of the stop logs and the bottom of the service bridge beams. It was also noted that very little freeboard exists between the top of the stop logs and the top of retaining walls upstream of the abutments on both the north and south sides of the impoundment; in fact, the elevation of the top of the concrete abutments is greater than the low points along the reservoir storage area.

Evidence at the dam suggests that the stop logs (which must be removed manually) are not always removed to add capacity to the spillway. Overtopping of stop logs in the spillway apparently occurs frequently.

c. Appurtenant Structures. South of the spillway section of the dam is the gate works and canal to the power house. Below the power house is a covered tailrace to the downstream channel. The gate works and gates were found to be in fair condition and apparently operable, however the gate house is being used for storage and access to the gate hoists is impeded. The canal is in

generally fair condition; however, considerable spalling of concrete side walls was noted. The bridge over the canal appears to be in good condition. At the inlet to the canal is a log boom which is attached to the shore at its' upstream end by a rope. This log could become loose and swing into the spillway causing obstruction or damage. The trash rack above the power house was observed to be heavily laden with debris. The tailrace is in very poor condition. Erosion has occurred in the floor and beneath support piers and the timber roof has collapsed in one area. See Appendix A for detailed findings.

d. Reservoir Area. At the time of inspection, on 11/21/78, the reservoir was nearly empty. Only a very small flow was being released from the Newfound Lake Dam located upstream. The International Packings Corporation reservoir had been drained by leakage through eroded depressions located upstream of the concrete apron. Three active leaks were discovered. There is evidence of previous attempts to repair the leaks; these have not succeeded. (See photograph 4.)

Some sediment has accumulated in the reservoir area; however, the accumulated sediment is not sufficient to impede flow to the spillway or cause blockage of the approach channel.

The Route 3A highway bridge located approximately 150 feet above the dam causes a restriction in the approach channel to the dam.

e. Downstream Channel. The channel of the Newfound River below the dam is steep and rocky with relatively flat overbanks containing some small tree and brush growth. The overbank is generally low in relation to the stream channel.

A significant amount of scour has occurred at the toe of the dam. The depth of scour ranges from 1 to 4 feet. The scour has occurred for a distance of 20 to 30 feet downstream.

3.2 EVALUATION

Based on the visual inspection, the dam appears to be in poor condition. The timber spillway section of the dam shows

evidence of deterioration, settlement, and lateral displacement. Leakage is occurring through and beneath the spillway section of the dam. A very small amount of freeboard exists between the top of the stop logs and service bridge and at the wing walls compared to the top of the stop logs. As outlined in Section 7, rehabilitative construction and maintenance are necessary to assure the long-term safety of the structure.

SECTION 4

OPERATING PROCEDURES

4.1 PROCEDURES

The International Packings Corporation Lower Dam is used to supply water to the canal located on the south bank just upstream of the dam. A gated power house sits at the end of the 100-foot long canal. The stop log spillway is maintained at a level sufficient to provide water for power generation. The inlet to the canal is 6.9 feet below the top of dam. During low and normal flows, stop logs are maintained at maximum height. In preparation for high flows, stop logs are reportedly manually removed. If maintenance of the spillway section is required, water level is lowered and the low level outlet is opened. The low level outlet can only be opened from the upstream apron. There are no other controlled outlets for this dam. There is evidence of frequent overflow of the stop log spillway. Stop logs are not always removed during periods of turbine shutdown. When power is being generated, periodic daily checks are made of the generating equipment and trash screens. There is an operation log for the generating equipment, located at the power house; otherwise, there are no records of operation and maintenance of the dam.

4.2 MAINTENANCE OF DAM

Maintenance of the dam is on an as needed basis. According to the plant engineer at International Packings Corporation, the dam is shut down once a year for checking and maintenance. There are no maintenance records available.

4.3 MAINTENANCE OF OPERATING FACILITIES

While the spillway stop logs and stop log supports are generally in good condition, some stop log hooks are missing. The inlet gates to the power house canal appear to be operable, but the gate house is used for storing material which presently impedes use of the hoisting equipment. Aside from the once-a-year maintenance effort and attention to immediate conditions needing repair, it appears that there is no scheduled maintenance program for the dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no automatic warning system or remote monitoring system in effect. In cases of impending high runoff, the New Hampshire Water Resources Board (which operates a dam upstream at Newfound Lake) contacts the International Packings Corporation.

4.5 EVALUATION

Aside from an annual maintenance program for the International Packings Corporation Lower Dam, there is an apparent lack of attention to the upkeep of the dam. Spalling of concrete in many parts of the structure and appurtenances, deteriorated timber work, and broken stop log hooks are in need of repair. A more thorough ongoing maintenance program appears warranted.

Attempted repairs of leaks located just upstream of the concrete apron of the dam were noted during the visual inspection. These repairs have not been successful.

The lack of a warning system or some form of remote monitoring of the dam is of concern, in that the dam has very little freeboard and is not subject to continued surveillance. Personnel who monitor the dam are located several miles from the structure at the International Packings Corporation Plant.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. General. The International Packings Corporation Lower Dam is a run of the river dam constructed for low head hydroelectric power production. The structure consists of a stop log spillway above a timber crib dam, concrete wingwalls, and an inlet to a penstock canal with three individual gates. The gates were at various stages of closure, none being fully closed, at the time of inspection. The power production features of the dam are operable. Flow at the dam is highly regulated by Newfound Lake Dam which is located about 1.2 miles upstream of the International Packings Corporation Lower Dam.

b. Design Data. There are no design data available.

c. Experience Data. There are no published hydrologic data for the Newfound River Basin. However, for the last three years the New Hampshire Water Resources Board has maintained a flow record of the discharges from Newfound Lake. The maximum flow in these records is 1,280 cfs. According to personnel of the New Hampshire Water Resources Board, no damage occurred downstream of Newfound Lake during this release.

d. Visual Observations. Water level at the International Packings Corporation Lower Dam is controlled by the stop log spillway at high and normal flows. At very low flows, leakage through the dam may equal or exceed inflow. Gates to the power canal are reportedly left open with inflow to the power house being controlled by the gate at the power house. The tailrace of the power house, although not affecting dam stability, is considered to be unsafe and is not protected from trespass. There is a low level service gate located in the concrete apron of the spillway structure which passes low flows during maintenance of the spillway.

e. Test Flood Analysis. The International Packings Corporation Lower Dam is classified as having a significant hazard potential. To determine the adequacy of the spillway, the "Probable Maximum Flood" (PMF) was developed and applied to the dam. Discharges at the International

Packings Corporation Lower Dam are controlled by Newfound Lake. The drainage area above the International Packings Corporation Lower Dam was planimetered from U.S.G.S. quad sheets (1" = 1 mile) and determined to be 96.1 square miles. The drainage area was classified as mountainous. The slope of the longest channel above Newfound Lake averages about 140 feet/mile. Elevations range from 3,121 feet at Mount Cardigan to about 580 feet at the Newfound Lake Dam. The PMF flow into the Newfound Lake was estimated to be 114,000 cfs, using the Corps of Engineers "Preliminary Guidance for Estimating Probable Maximum Discharges." The flood flow was routed through Newfound Lake using HEC-1. (see Appendix D) The peak outflow from the dam was determined to be 28,700 cfs. The one-half PMF was also routed through Newfound Lake. Peak outflow of the one-half PMF was determined to 12,100 cfs.

The intervening drainage area between Newfound Lake Dam and International Packings Corporation Lower Dam is 1.1 square miles. The PMF inflow from this part of the total drainage area would be 1,320 cfs. The one-half PMF contribution from the intervening drainage is 660 cfs. The International Packings Corporation Upper Dam, located upstream from the dam under current study, does not diminish the peak due to surcharge storage. Therefore, the PMF at the International Packings Corporation Lower Dam is 30,000 cfs. The one-half PMF inflow is 12,760 cfs.

The spillway of the International Packings Corporation Lower Dam has a capacity of about 5,600 cfs with all stop logs removed and water surface elevation at top of dam. The spillway could pass 19 percent of the PMF and 44 percent of the one-half PMF. However, the dam is not a hydraulic control once overbank flow occurs upstream of the dam and reservoir. Flooding just upstream of the reservoir occurs at a discharge of about 2,000 to 2,500 cfs. At flows greater than this, water would begin to flow around the dam to the north, completely bypassing the dam. (see Appendix D)

A PMF of 30,000 cfs would overtop the dam by about 4.4 feet. The one-half PMF would overtop the dam by about 0.8 feet.

During the PMF or one-half PMF occurrence, considerable flooding would already be occurring downstream of the

dam. The spillway is not considered seriously inadequate according to the guidelines of ETL 1100-2-234 because failure caused by overtopping would not significantly increase the downstream hazard potential above that which existed just before failure occurred. Since the dam is a timber crib structure, it can be considered as being generally stable during overtopping conditions provided the current downstream scour and underseepage conditions are remedied.

f. Dam Failure Analysis. The dam failure analysis relied upon the "rule of thumb" guidance outlined in an attachment to ETL 1100-2-234. The storage barns and business office of the lumber company located on the north bank just below the dam (see Photograph #9) would incur significant damage. The areas surrounding a large propane tank bolted to a concrete platform about 100 feet below the dam on the south bank could be flooded. If the bolts or concrete supporting structure were to fail during a flood event, the propane tank could pose a serious hazard. The flood peak from failure at the dam was computed to be 3,491 cfs which corresponds to a stage of 7.2 feet at a distance of 100 feet below the dam. Because of the small volume of storage in the reservoir, the dam failure peak is rapidly attenuated. At a distance of 1,000 feet below the dam, peak flow is reduced to 2,200 cfs with a stage of 6 to 6.5 feet. Flood stage in this reach is estimated to be about 5 feet. At a distance of 1,500 feet below the dam, peak flow would be 1,700 cfs corresponding to a stage of about 4 feet. General flooding in the reach concerned begins at a discharge of 2,000 to 2,500 cfs. Within 1,500 feet downstream of the dam, the peak flow from failure would drop below flood level and no significant damage would occur downstream of this area.

Based on the rule of thumb guidelines provided by the Corps of Engineers, it was estimated that it would take 13 minutes to empty the reservoir. Just below the dam, discharge would be above flood level for about 6 to 8 minutes. At a distance of 1,000 feet below the dam, general flood level would be exceeded for less than 4 minutes.

None of the above discharges consider the flow already occurring. Given the condition of the dam at the time of inspection, the discharge at the dam with water surface at top of dam was computed to be about 570 cfs.

Given this as a base flow at time of failure, downstream water levels would be raised about 0.5 feet above the level resulting from failure alone. If the dam were to fail while the spillway was discharging at maximum capacity (5,600), the increase in downstream flood stages would be insignificant. During large flood flows, a high tailwater condition exists at the dam.

The dam should remain stable during overtopping conditions if the underseepage from the upstream apron is properly repaired and the downstream scour is remedied. It is important that any further scour be prevented and the current effects of scour be repaired.

SECTION 6

STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Based on the visual observations, the International Packings Corporation Lower Dam appears to be in poor structural condition. The timber cribwork section of the dam has settled and deflected downstream at the center. Substantial underseepage and leakage is occurring and apparently erosion of some of the foundation soils has occurred. Undermining of the downstream toe of the cribwork has also occurred. Some of the timber members and planking show evidence of rot and many are cracked, split or broken.

The concrete abutments and wing walls are badly spalled. These sections of the dam show no signs of movement, however.

b. Design and Construction Data. No data concerning original design or construction of this dam were disclosed in this investigation.

c. Operating Records. None available.

d. Post-Construction Changes. In 1973, the spillway structure was overhauled. A concrete apron was installed over the existing crib work on the upstream side of the dam and furnished with a steel door low level outlet gate. New timber uprights were provided for the stop log sections. A steel I-beam and cable were added at the top of the stop log uprights. At the time of inspection, November 21st, the pond level was below the bottom of the stop log section and the cable was slack, thus providing little support for these uprights. However, at the time of the November 30th followup inspection, the pond was full and the cable was taut.

The new timber uprights remain in generally good condition. The older timber crib work shows deterioration, with some members showing signs of rot or cracking. The surfaces of the older concrete portions of the dam have deteriorated over time, as evidenced by considerable spalling in some areas; these concrete sections have apparently received little maintenance in recent years.

e. Seismic Stability. The dam is located in Seismic Zone No. 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 International Packings Corporation Lower Dam is in poor condition. Major concerns relative to the dam's physical condition are identified as follows:

(1) Seepage under the structure is taking place as evidenced by eroded depressions and inflow along the upstream face and by flow from beneath the toe.

(2) There has been considerable scour of the streambed just below the toe of the dam to a depth of one to four feet. Some resultant undermining of the timber crib structure underlying the spillway apron is evident.

(3) The older timber structure of the dam and some of the planking show signs of deterioration. Some timber has rotted seriously, while other pieces are cracked or split and some planks are broken.

(4) A pronounced settlement and downstream deflection of the spillway structure have occurred.

(5) Deterioration of some of the concrete is evident, particularly at the north abutment of the spillway which is pitted in places to a depth of 12 inches and at the east wingwall of the canal entrance which is very seriously eroded.

(6) There is a lack of freeboard between the top of the spillway stop logs and the service bridge. Also, there is a lack of freeboard on the reservoir banks relative to the top of the dam.

b. Adequacy of Information. The information available relative to this dam is very limited. Consequently, assessment of the condition of the dam must be based primarily on the visual inspection, the past operational performance of the dam, and engineering judgment.

c. Urgency. Based on the poor condition of the dam, recommendations and remedial measures outlined below should be implemented within 12 months of receipt of this report by the owner.

d. Need for Additional Investigation. Additional investigation is not considered necessary for the current (Phase I) assessment.

7.2 RECOMMENDATIONS

The existing seepage under the dam and the scour of the channel downstream of the spillway apron are considered potentially serious conditions. The settlement and deflection of the structure is also serious. It is therefore recommended that further evaluation of these conditions be made by qualified engineers, and that recommendations be formulated and implemented to curtail both underseepage and downstream scour. It is also recommended that a qualified engineer evaluate the possibility of modifying the existing spillway to allow automatic release of stop logs during overtopping conditions.

7.3 REMEDIAL MEASURES

a. Operating and Maintenance Procedures. The routine annual inspection and maintenance program by International Packings Corporation personnel should be continued. This annual inspection should be supplemented by a more frequent program of maintenance of the operational features of the dam (gates, stop logs, lifting mechanisms). Records should be kept of all maintenance work performed. The following specific maintenance and operating procedures should also be implemented:

(1) Replace missing or broken stop log lift hooks.

(2) Repair spalled concrete throughout the structure.

(3) Repair rotted or broken timber members and planking.

(4) Provide the log boom located at the penstock canal entrance with a more secure anchorage than the rope tie-line now used.

(5) Provide for 24 hour surveillance of the structure during flood conditions.

(6) Develop a plan for a formal warning system which could be used in the event of an emergency.

(7) Provide for annual inspection of the facility by qualified engineers.

7.4 ALTERNATIVES

An alternative to implementing the recommendations and remedial measures outlined above would be the removal of the dam. Such removal should be under the supervision of a qualified engineer, with consideration given to the potential release of accumulated sediments and other potential environmental impacts which could result from removing the structure.

Another alternative would be the permanent removal of stop logs to reduce the dam's potential hazard under low-flow conditions. Removal of the stop logs as an interim measure until the above outlined recommendations and remedial measures can be implemented may also be considered.

APPENDIX A

VISUAL INSPECTION CHECKLIST
AND
SUPPLEMENTARY INSPECTION NOTES

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT International Packings Corporation Lower Dam

DATE 11-21-78

TIME P.M.

WEATHER Snow-Cold

W.S. ELEV. 480+ U.S. 475+ DN.S.

PARTY:

1. Stephen Cole
2. John Devine
3. David Nyman
4. Timothy Noonan
5. Daniel Lane
6.
7.
8.
9.
10.

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Geotechnical	Cole	
2.	Hydraulics/Hydrology	Devine	
3.	Structural	Cole, Devine, Nyman	
4.	Civil	Nyman	
5.	Survey	Noonan, Lane	
6.	Photography	Devine, Noonan	
7.			
8.	Review Inspection		
9.	November 30, 1978	Walker, Horstmann	

Water level in reservoir was within several inches of top of stop logs in timber spillway. The cable extending from north to south at the the level of the I-beam and walkway was taut at full pond.

NOTE: See Supplementary Inspection Notes Following Checklist

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam — DATE 11-21-78

PROJECT FEATURE Embankment — NAME Cole

DISCIPLINE Geotechnical — NAME

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	488.6±
Current Pool Elevation	480 ±
Maximum Impoundment to Date	Overtopped?
Surface Cracks	None observed
Pavement Condition	Turf - okay
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alignment	Okay but very little freeboard
Horizontal Alignment	Okay
Condition at Abutment and at Concrete Structures	Okay
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	None
Sloughing or Erosion of Slopes or Abutments	Some erosion downstream of both north and south abutments.
Vegetation	Grass, bushes

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT (cont.)	
Rock Slope Protection - Riprap Failures	Some loss of slope protection from stream banks below north & south abutments
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam DATE 11-21-78

PROJECT FEATURE Intake Channel/Structure NAME Cole, Nyman

DISCIPLINE Geotechnical, Structural H/H NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE[1]	
a. Approach Channel	
Slope Conditions	Concrete and masonry retaining walls, upstream wall in poor condition.
Bottom Conditions	Some silt, no debris.
Rock Slides or Falls	None
Log Boom	Attached by rope only on upstream end.
Debris	None
Condition of Concrete Lining	No lining
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Spalled
Stop Logs and Slots	None
Debris Screen	None

[1] Low level, low flow outlet trap door through cribwork, and power house canal.

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam DATE 11-21-78

PROJECT FEATURE Control Tower NAME Cole, Nyman

DISCIPLINE Geotechnical, Structural H/H NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - CONTROL TOWER[1]	
a. Masonry and Structural	
General Condition	Fair
Condition of Joints	Okay
Spalling	Some spalling, side walls
Visible Reinforcing	None
Rusting or Staining of Concrete	Minor staining
Any Seepage or Efflorescence	None Evident
Joint Alignment	Okay
Unusual Seepage or Leaks in Gate Chamber	None
Cracks	Horizontal cracks in canal walls
Rusting or Corrosion of Steel	None
b. Mechanical and Electrical	
Air Vents	N/A
Float Wells	N/A
Gate Hoist	Appear operable, gates open, gate house full of stored materials
Elevator	N/A

[1]Outlet to power house.

AREA EVALUATED	CONDITIONS
OUTLET WORKS - CONTROL TOWER (cont.)	
Hydraulic System	N/A
Service Gates	Timber - okay
Emergency Gates	N/A
Lightning Protection System	N/A
Emergency Power System	N/A
Wiring and Lighting System	N/A

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam DATE 11-21-78

PROJECT FEATURE Transition & Conduit NAME Cole, Nyman

DISCIPLINE Geotechnical, Structural H/H NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - TRANSITION AND CONDUIT[1]	
General Condition of Stone Masonry	Fair to poor
Rust or Staining on Stone Masonry	Some staining
Spalling	Severe spall, roof
Erosion or Cavitation	Floor eroded, undermining of support piers
Cracking	Not observed
Alignment of Monoliths	N/A
Alignment of Joints	N/A
Numbering of Monoliths	N/A

[1] Tailrace from power house.

NOTE: Tailrace has timber roof or concrete over timber. Timber roof collapsed in one area. Timber seriously deteriorated throughout.

PERIODIC INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam DATE 11-21-78

PROJECT FEATURE Outlet Structure/Channel NAME Cole, Nyman

DISCIPLINE Geotechnical, Structural H/H NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL[1]	
General Condition of Stone Masonry	Fair - masonry loose
Rust or Staining	N/A
Spalling	N/A
Erosion or Cavitation	Erosion of floor
Visible Reinforcing	N/A
Any Seepage or Efflorescence	None
Condition at Joints	N/A
Drain holes	None
Channel	-
Loose Rock or Trees Overhanging Channel	Trees both sides of channel
Condition of Discharge Channel	Clear, unobstructed

[1] Tailrace from power house.

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam — DATE 11-21-78

PROJECT FEATURE Spillway — NAME Cole, Nyman

DISCIPLINE Geotechnical, Structural H/H — NAME Devine

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Clear, *unobstructed*
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Silted, no debris
b. Weir and Training Walls[1]	
General Condition of Concrete and Masonry	Fair, some spall & erosion
Rust or Staining	Some rust & lime stain
Spalling	Severe
Any Visible Reinforcing	None
Any Seepage or Efflorescence	None
Drain Holes	None
c. Discharge Channel	
General Condition	Clear, unobstructed

[1] Timber weir, concrete walls.

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Cont.)	
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Trees on banks both sides of channel
Floor of Channel	Severe scour below spillway - some undermining
Other Obstructions	None
	NOTE: Timber weir has settled and deflected downstream at center. Timber in fair condition.

INSPECTION CHECKLIST

PROJECT International Packings Corporation Lower Dam — DATE 11-21-78

PROJECT FEATURE Service Bridge — NAME Cole

DISCIPLINE Structural — NAME Nyman

AREA EVALUATED	CONDITION
OUTLET WORKS - SERVICE BRIDGE	
a. Super Structure	
Bearings	Timber - okay
Anchor Bolts	Okay
Bridge Seat	Okay
Longitudinal Members	Okay - timber
Under Side of Deck	Okay
Secondary Bracing	Okay - timber
Deck	Okay - timber
Drainage System	N/A
Railings	Good
Expansion Joints	N/A
Paint	Railing good - none on timber deck or beams
b. Abutment & Piers	
General Condition of Concrete	Fair
Alignment of Abutment	Okay
Approach to Bridge	Good
Condition of Seat & Backwall	Okay

SUPPLEMENTARY INSPECTION NOTES

INTERNATIONAL PACKING COMPANY

LOWER DAM

BRISTOL, NEW HAMPSHIRE

APPENDIX A

The dam consists of concrete abutments and training walls with a timber spillway. Appurtenant to the dam is a gate works to a canal and power house with a tailrace discharging to the downstream channel.

1. CONCRETE STRUCTURES IN GENERAL

A. Concrete Surfaces In General

The concrete wing walls at the dam were found to be in generally poor condition. Substantial spalling and erosion of the concrete has occurred (especially the north abutment on the downstream side of spillway). No reinforcing steel is presently exposed. The sidewalls of the canal to the power house were also found to be spalled in several areas. No reinforcing steel is exposed.

B. Structural Cracking

No structural cracks were observed in the concrete portions of the dam.

C. Movement, Horizontal and Vertical Alignment

No evidence of substantial settlement or horizontal movement was observed in the concrete portions of the dam.

D. Junctions

The junctions between the concrete and timber sections of the dam were found to be generally in good condition with no evidence of significant movement. Some leakage was noted. A junction in the south wing wall at the corner between the wing wall and the canal section was found to be open indicating some movement.

E. Drains

No foundation or joint drains were observed in the concrete portions of the structure.

F. Water Passages

The wing walls of the dam were found to be spalled and show some signs of erosion. In particular, the north abutment exhibits severe spalling. The east wing wall of the canal is also deteriorated. Otherwise, no significant erosion of concrete surfaces is evident.

G. Seepage or Leakage

No significant seepage or leakage was observed through or below the faces of the concrete portions of the dam.

H. Monolith Joints, Construction Joints

The joint at the corner between the southerly wing wall or training wall in the canal was found to be open a small amount. No other joints were observed to be open.

I. Foundation

The foundation of the concrete structures at the dam is apparently placed on soil, likely glacial till. No evidence of foundation distress or undermining was noted.

J. Abutments

The abutments of the dam consist of the concrete training walls at the end of the timber section and are apparently founded on soil, likely glacial till. The abutments of the dam show no signs of instability. Some minor seepage was observed downstream of the northerly abutment, in the form of an iron spring.

2. EMBANKMENT STRUCTURES

The only embankment structures at the dam are small areas of backfill behind the abutments of the dam. The embankment structures show no signs of instability or distress.

A. Settlement

No settlement of the embankment section of the dam was observed.

B. Slope Stability

The embankment sections of the dam are retained by concrete, stone masonry or timber crib walls. No evidence of instability was observed.

C. Seepage

An iron spring is located just downstream of the north abutment. The volume of seepage was less than 1 gpm at the time of inspection. No evidence of erosion or piping of materials from this spring was noted.

D. Drainage Systems

No drainage systems were observed or are known to exist in the dam.

E. Slope Protection

The embankment sections of the dam are retained by concrete, stone masonry or timber crib walls. No serious erosion or slope instability was noted.

3. TIMBER STRUCTURE IN GENERAL

The spillway section of the dam is constructed of timber cribwork with timber columns forming stoplog slots.

The timber columns are supported at their top by tie rods which run diagonally down to the upstream toe of the dam. A cable extending from the south to the north abutment also supports the top of the stop log columns. The tie rods were found to be corroded but in generally good condition.

A. Condition of Timber

The planking of the dam was found to be in generally fair condition. Some of the planking showed signs of serious deterioration, cracking, rotting and also in some areas the planking was found to be broken due to the action of ice. The timber columns which support the stoplogs are found to be in generally good condition with no serious rot in evidence.

B. Movement, Horizontal and Vertical Alignment

The timber section of the dam shows signs of settlement in at least two areas; the downstream sill has settled as much as 4 or more inches. The stoplog section as well as the cribs appear to have deflected downstream at least 5 to 7 inches at the midpoint of the dam.

C. Junctions

The junctions between the timber sections and the concrete training walls appear to be in generally fair to good condition. Substantial leakage is occurring through these junctions. Substantial movement has not occurred.

D. Seepage or Leakage

A substantial flow of water was occuring down through the timber cribwork of the dam at the time of inspection. The flow of the stream was estimated to be 2 to 5 cfs, all of which was flowing through and beneath the timber crib section of the dam. Several holes at the upstream toe of the timber crib were observed and water going down through these holes was observed to be flowing out of the downstream face of the cribwork. Some undermining has occurred at the downstream toe of the cribwork which has probably caused the settlement and downstream movement of the structure.

4. SPILLWAY STRUCTURES

The spillway structure consists of the timber section of the dam with stoplogs across its entire length.

A. Control Gates and Operating Machinery

The control gates are stoplogs located at the top of the spillway. The stoplogs have to be manually removed. There is no hoisting equipment available. It was noted that some hooks on the stoplogs have broken, which would make removal of these stoplogs difficult.

B. Unlined Saddle Spillways

It appears that during high flow conditions, the northerly upstream bank may be overtopped with flow

going through a parking area and road returning to the stream channel below the dam. No erosion is evident, however. Flow is also likely to occur over the sidewall of the canal in the southerly bank and returns to the stream below the dam. Some erosion was noted on the stream bank below the dam on the southerly side.

C. Approach and Outlet Channels

The approach and outlet channel to the spillway was found to be clear and unobstructed. There is a boom log located across the inlet canal to the power house on the southerly side of the spillway. It was noted that the upstream end of the boom log was attached to the shore by a small rope, not by a chain. This log could become loose and swing into the spillway section of the dam, causing an obstruction or damage to the spillway.

D. Stilling Basin

The stilling basin downstream of the spillway consists of a timber deck on top of the cribwork. It was found that the deck was in fair condition and that many planks were broken and others were rotted. Downstream of this deck substantial scouring has occurred. Erosion has occurred in the streambed and some undermining of the cribwork has apparently occurred. This has apparently contributed to the settlement and deflection of the spillway section of the dam.

5. OUTLET WORKS

The only outlet works at the dam, other than the stoplog section in the spillway, consists of a steel trap door located in the upstream face of the timber spillway deck. These outlet works can only be operated in low water conditions to maintain flow downstream through the cribwork for maintenance to the facility.

The canal and gate works upstream of the power house form an outlet only if water is allowed to flow through the generator turbine and out the tailrace. This structure could be used as an outlet for the dam.

A. Intake Structure

The inlet structure at the canal consists of concrete wing walls. There is a log boom upstream of the inlet

structure. It was observed that the inlet is clear and unobstructed.

B. Operating and Emergency Control Gates

The control gates at the canal consist of three vertical lift gates. The gates and hoisting equipment were found to be in generally good condition, however, the gate house is presently used for storage, and operation of the gates is not presently possible due to the amount of material stored in the gate house.

C. Conduit, Sluices and Water Passages

The interior surface of the canal was found to be in fair condition. Substantial spalling of the concrete side walls and erosion of the side walls has occurred. The floor of the canal was found to be in good condition.

D. Stilling Basin

Downstream of the power house the tailrace is an enclosed structure with stone masonry sidewalls and a timber and/or a concrete roof. This tailrace runs at least 150 feet downstream to the stream channel. This covered tailrace was found to be in very poor condition. It has no concrete floor, substantial erosion has occurred in the bottom, and undermining of the concrete support piers and also some of the stone masonry walls is evident. The roof of this tailrace was found to be in very poor condition; the timber being seriously rotted, exposed concrete being seriously spalled and in one area the timber roof was found to have collapsed. It appears presently that the tailrace would clog if substantial flow was allowed to pass through the tailrace from the power house.

E. Approach and Outlet Channels

The approach channel to the power house canal was found to be clear and unobstructed, however, the trash rack immediately upstream of the power house was heavily covered by leaves, brush and debris. The downstream channel consists of the tailrace which, as discussed above, is in very poor condition. The outlet channel of the main stream below the tailrace is clear and unobstructed.

6. INSTRUMENTATION

None.

7. RESERVOIR

A. Shore Line. No active or inactive landslide areas were observed.

B. Sedimentation. There is a small amount of sediment accumulated in the reservoir area; however, it is not sufficient to impede flow to the dam or significantly decrease reservoir storage. Newfound Lake controls the amount of sediment delivered to the reservoir.

C. Potential Upstream Hazard Area. A real estate office located on the north bank of the dam would be flooded to a shallow depth (<1') with water at top of dam because of a low area in the reservoir shoreline. However, general flooding would probably be occurring before water was at top of dam during flood events.

D. Watershed Runoff Potential. The drainage basin has remained primarily rural and forested.

8. DOWNSTREAM CHANNEL

The channel downstream of the IPC Lower Dam is not capable of handling moderate to high flows without considerable overbanks flow occurring. In the event of failure of the dam, approximately 10 commercial, industrial, and residential buildings within 1500 feet of the dam would be flooded to depths of 1 to 3 feet.

9. OPERATION AND MAINTENANCE FEATURES

A. Operation

Operation of the dam at high head is continued even during times of no power production. Maintenance is on an as-needed basis, with once-a-year shutdown for maintenance of this facility. No records are kept.

B. Maintenance

It was noted that maintenance is apparently done on the dam on as-needed basis, however, little maintenance has

been done on the dam recently. The timber section shows signs of rot and deterioration, the cable which supports the stop log columns is loose, the stop logs are missing several lifting hooks, and the gate house is cluttered with stored materials.

APPENDIX B

ENGINEERING DATA

This appendix lists the engineering data collected either from project records and other sources of data developed as a result of the visual inspection. The contents of this appendix are listed below.

Appendix	Description
B-1	General Project Data
B-2	Past Inspection Reports

APPENDIX B-1

GENERAL PROJECT DATA

I. The following material relative to the International Packings Corporation Lower Dam is on file at that firm's Bristol, New Hampshire plant.

A. Drawing No. 30482: One type "Z" vertical shaft turbine unit for Dodge Davis Mfg. Co., 1922.

B. Miscellaneous information relating to generating equipment.

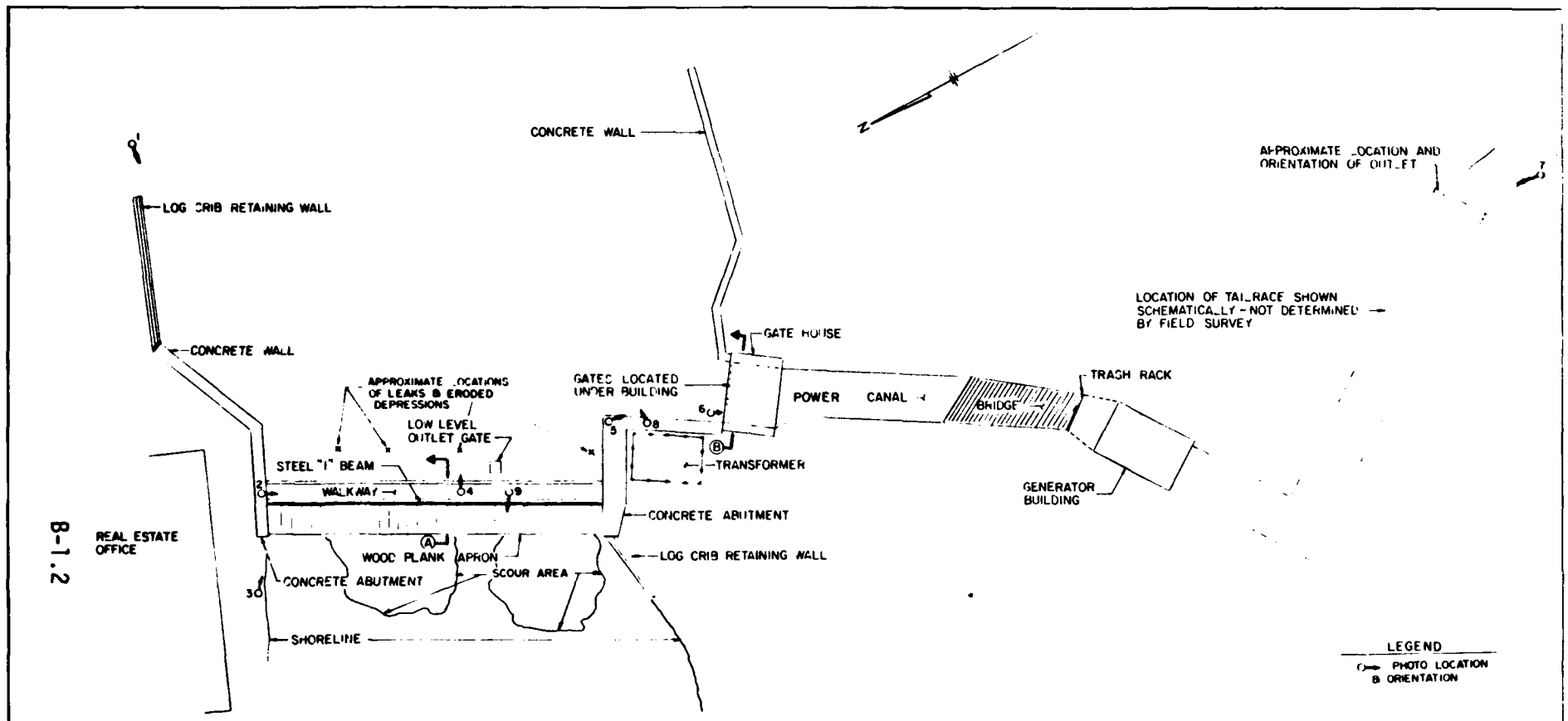
II. The following material is available at the office of the New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire:

A. Periodic inspection reports, copies of which are attached as Appendix B-2 of this report.

B. Photographs taken of dam at various times during the period 1934 to present.

C. Miscellaneous correspondence and survey data.

III. The following plan, profile and cross-sections of the dam were developed from a limited stadia survey performed during visual inspection, field notes taken by inspection team members, and photographs taken during the visual inspection. The survey was referenced to an arbitrary local datum. Approximate U.S.G.S. elevations were obtained by adding 388.8 to the local reference.



8-1.2

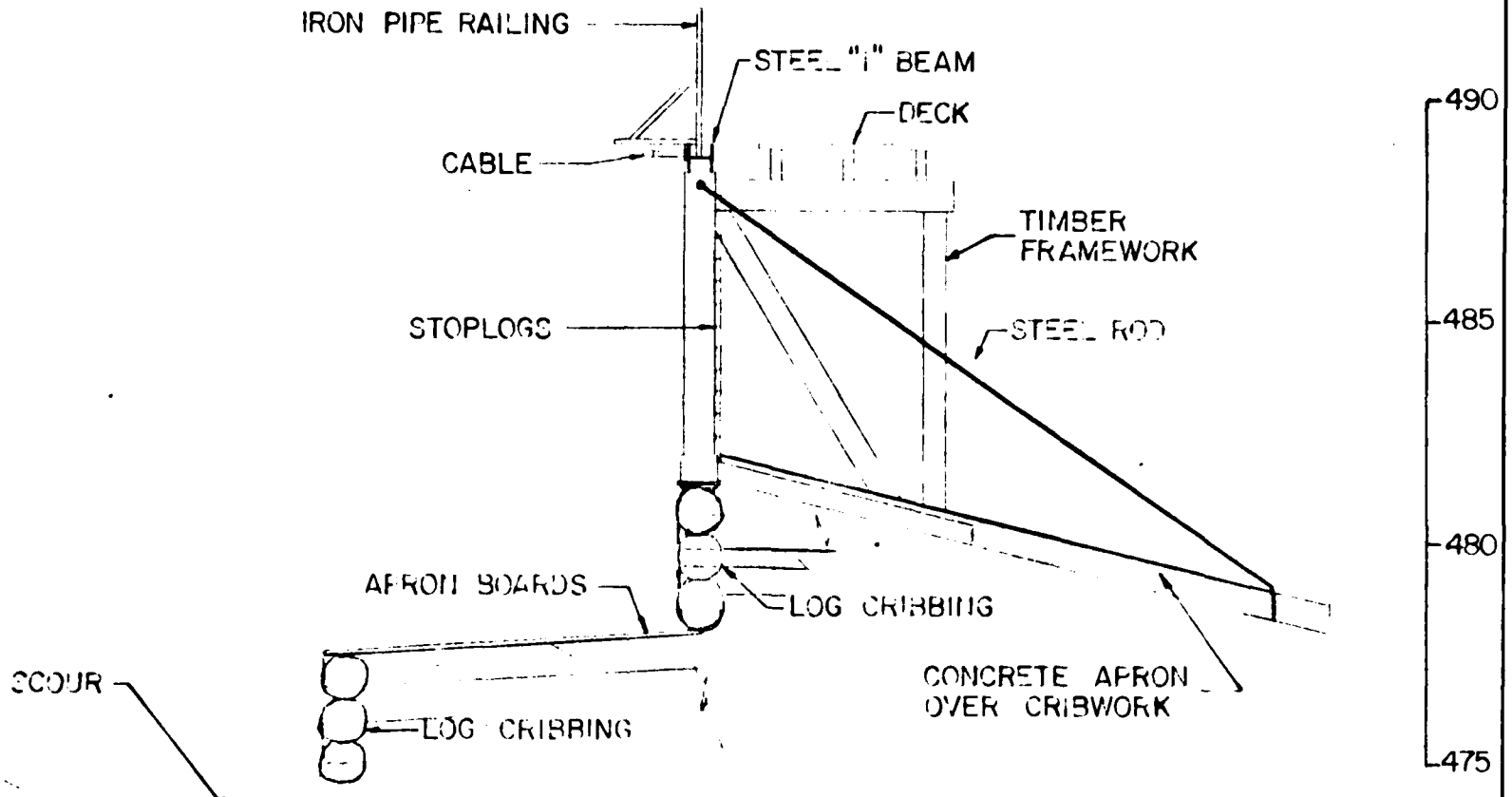
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

INTERNATIONAL PACKINGS CORPORATION

LOWER DAM

PLAN AND PROFILE

NEWFOUND RIVER NEW HAMPSHIRE



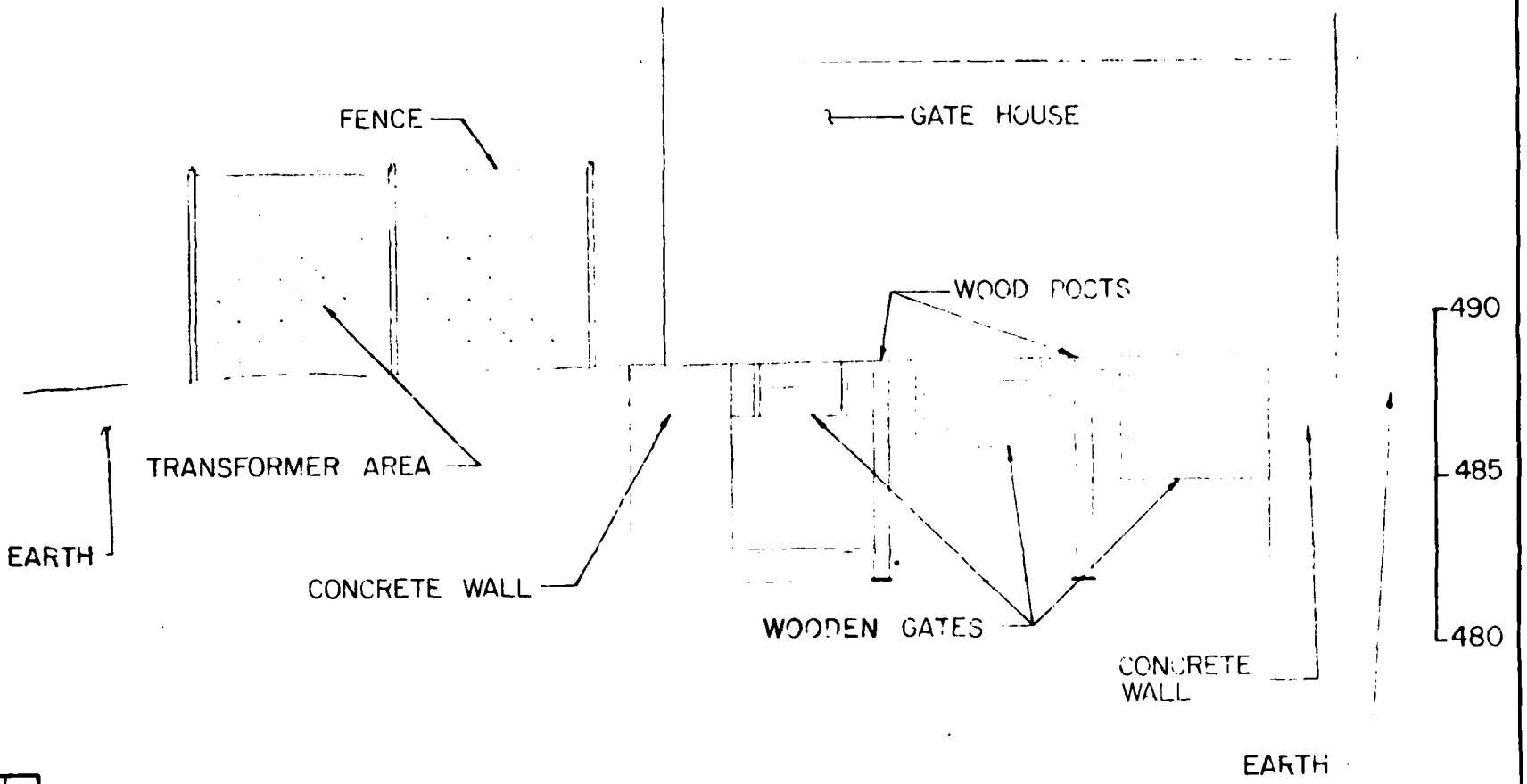
SECTION A

B-1.3

NATIONAL PROGRAM OF INSPECTION OF NON FED DAMS

INTERNATIONAL PACKINGS CORP - LOWER DAM

CROSS SECTION



SECTION B

B-1.4

INTERNATIONAL PACKINGS
CORP - LOWER DAM
CROSS SECTION

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

EDWARD J. JORDAN CO., INC.
PORTLAND, MAINE

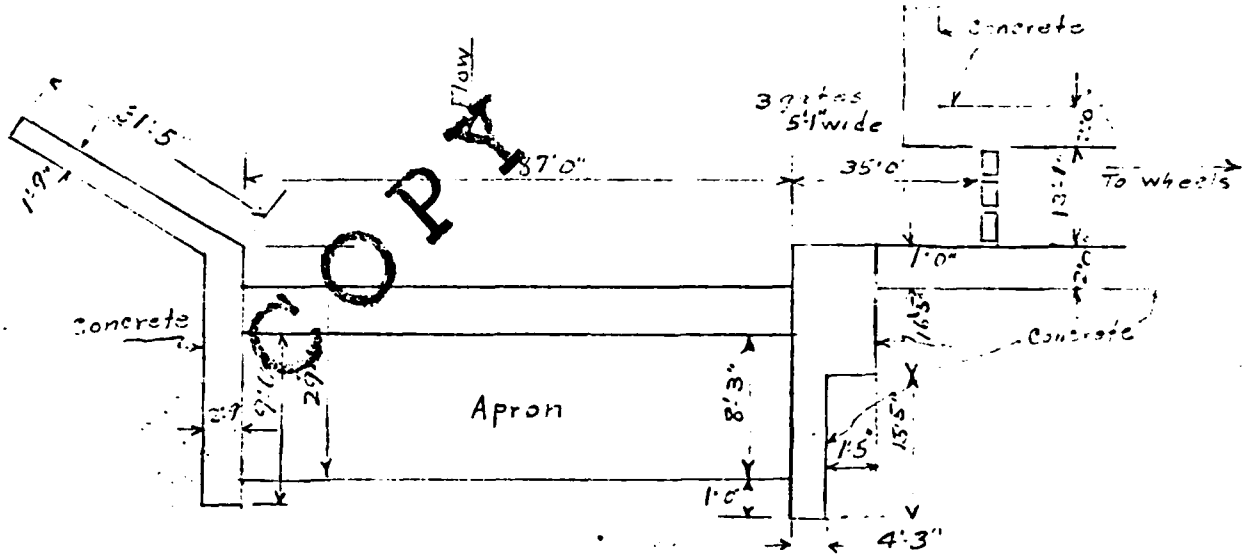
SCALE AS SHOWN
DATE JAN 1979

20799.07

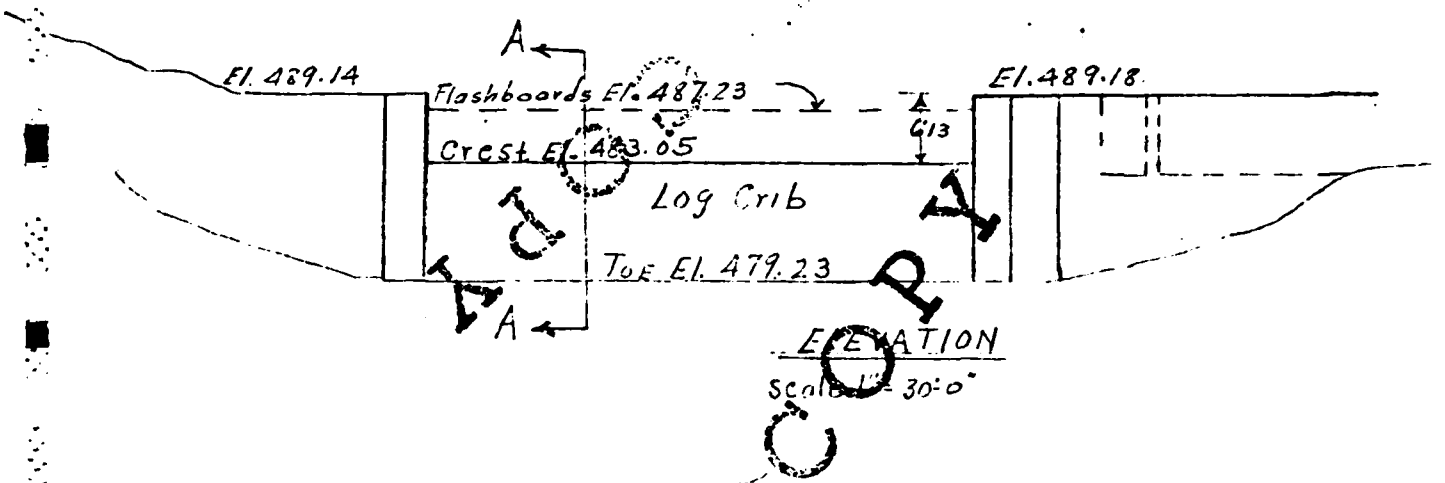
APPENDIX B-2

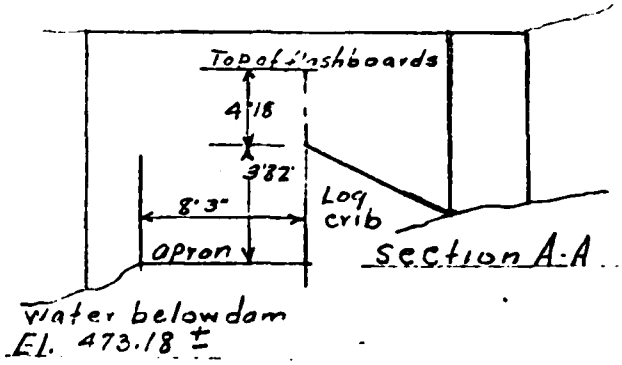
PAST INSPECTION REPORTS

Attached are copies of inspection reports pertaining to the International Packing Corporation Lower Dam on file with the New Hampshire Water Resources Board in Concord, New Hampshire.



PLAN





Note: Inspections apparently made in 1934 and 1939. No copies of inspection reports found in file for these dates.

DCN

M E M O R A N D U M

DATE: March 2, 1973

FROM: Robert B. Chamberlin, Civil Engineer

SUBJECT: Inspection of Newfound River Dam - No. 131.07

TO: Vernon A. Knowlton,
Chief Engineer, Water Resources Board

COPY

On February 28, 1973, I inspected this dam following a telephone complaint by Bill Swain, of the Corps of Engineers on February 23 concerning the bending of this dam.

The dam is a log crib structure of hard-pan foundation. Height of dam is about four feet and has four foot of flash boards which are held in place by a number of wooden frames. At some time in the past, the flash board structure was reinforced with a cable which runs through the abutments and along the downstream side of the flashboard structure. (See pictures).

Near the abutments there is an obvious bending toward the downstream, while the center section appears to be straight. No visibility was available to the dam itself, due to about a foot of water going over two-thirds of the spillway.

COPY

RBC:js

Robert B. Chamberlin

STATE OF NEW HAMPSHIRE

INTER-DEPARTMENT COMMUNICATION

DATE November 21, 1977

FROM Stephen C. Burritt, Civil Engineer AT (OFFICE) Water Resources Board

SUBJECT Dam 31.07 Bristol, N. H.

TO File

COPY

This dam looks to be in good shape. At the time of inspection the dam was passing about 3" to 6". The old wooden beam holding up the stoplogs has been replaced by a steel wide flange beam, and it still has a bow in it (see photo).

This dam should be inspected in the summer.

COPY

IPC Lower Dam

WATER RESOURCES BOARD
37 Pleasant Street
Concord, N.H. 03301
TELEPHONE 271-34

COPY

October 23, 1978

International Packing Corp.
Bristol,
New Hampshire 03222

Dear Sirs:

Under the provisions of RSA Chapter 482, Sections 8 through 15, the New Hampshire Water Resources Board is authorized to inspect all dams in the State which by reason of their physical condition, height and location may be a menace to the public safety.

The dam structure (No. 31.03 & 07) located Bristol, New Hampshire-Newfound River was inspected on October 19, 1978 and as a result of this inspection, certain discrepancies were found which should require corrective measures in order to protect the integrity of the structure. (See attached sheet.)

Your dam has been classified by the Board as a non-menace dam and with this classification, the State will not insist that the item(s) noted on the attached be corrected, but it is advisable that corrective measures be voluntarily initiated to protect the integrity of the structure.

Should you make the repairs and/or maintenance items on the attached sheet in the waters of the State, you will need a permit from the Special Board. Applications can be obtained by writing or calling the Special Board Office, 37 Pleasant Street, Concord, New Hampshire 03301, telephone no. 271-2147.

Please feel free to call or write if you have any questions regarding the evaluation of your structure.

COPY

Sincerely,

George McGee Sr.

George M. McGee, Sr.,
Chairman

GMM:paf
Enc.

cc:

Dam No. 31.03 Newfound River inspected on October 19, 1978

Visual Discrepancies (31.03 Upper Dam)

1- Spalled concrete should be repaired at the following locations:

a- The wing walls at the stop log section on the right canal,

b- The left abutment near the powerhouse,

c- The downstream side of the powerhouse.

2- The large crack in the downstream wing wall between the spillway and powerhouse should be repaired.

3- There are a few large trees growing very near the concrete and stone appurtenances which should be cut and treated to prevent regrowth. The roots of trees displace stones, crack concrete and increase seepage through earthen embankments.

Dam No. 31.07 Newfound River inspected on October 19, 1978

Visual Discrepancies (31.07 Lower Dam)

1- The right spillway abutment is badly spalled and should be patched or completely refaced.

2- The left abutment at the head gates is extremely deteriorated and should be reconstructed.

3- There are two trees growing at the downstream end of the left abutment which should be cut and chemically treated to prevent regrowth.

P. S. - Please contact Mr. McGee by telephone (271-3406) to arrange for purchase of cinders.

COPY

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: BRISTOL Dam Number: 31.07

Name of Dam, Stream and/or Water Body: NEW FOUND RIVER

Owner: IPC Telephone Number:

Mailing Address: Groveton NH 03582

Max. Height of Dam: 16' Pond Area: ½ ACRE Length of Dam: 293'

FOUNDATION: EARTH

OUTLET WORKS: 87' SPILLWAY 6.2' TOTAL FREEBOARD 1.5 ACTUAL DUE TO STOP LOG
-POND DRAIN W/ STEEL DOOR
1.5 FREEBOARD @ FULL POND

LEAKS BADLY ACCORDING TO OWNERS
NOT OBSERVED DUE TO TAILWATER

ABUTMENTS: RT ABUT - EXTREME SPALLING

LT ABUT @ HEAD GATES TO WHEEL PIT COMPLETELY SPALLED

~~EMBANKMENT~~ 8'x10' UNDERGROUND TAIL RACE

Note: Give Sizing, Condition and detailed description for each item, if applicable.

Dam No. 31.07

SPILLWAY: Length: 87' Freeboard: 1.5' W/STOP LOGS IN
6.2 W/ NO STOP LOGS

SEEPAGE: Location, estimated quantity, etc.

20 - 30 CFS THROUGH TOE NOT OBSERVED

Changes Since Construction or Last Inspection:

CONC U/S APRON NEW CATWALK, I BEAM,
STOP LOG SUPPORTS, STEEL TIE BACKS
RECONSTRUCTED IN 1973
HEAD GATE " 1978

~~Tail Water Conditions:~~ CONCRETE ENCASEMENT AROUND WHEEL HOUSE 1978

Overall Condition of Dam: FAIR TO GOOD - SPALLED ABUTMENTS

Contact With Owner: YES

Date of Inspection: 10/19/78 Suggested Reinspection Date

Class of Dam: NON-MENACE

Signature Kenneth Olson

Date 10/19/78

COPY

Dam No. 31.07

COMMENTS:

(1) SPALLED RT. ABUT

(2) SPALLED ABUT @ HEAD GATES

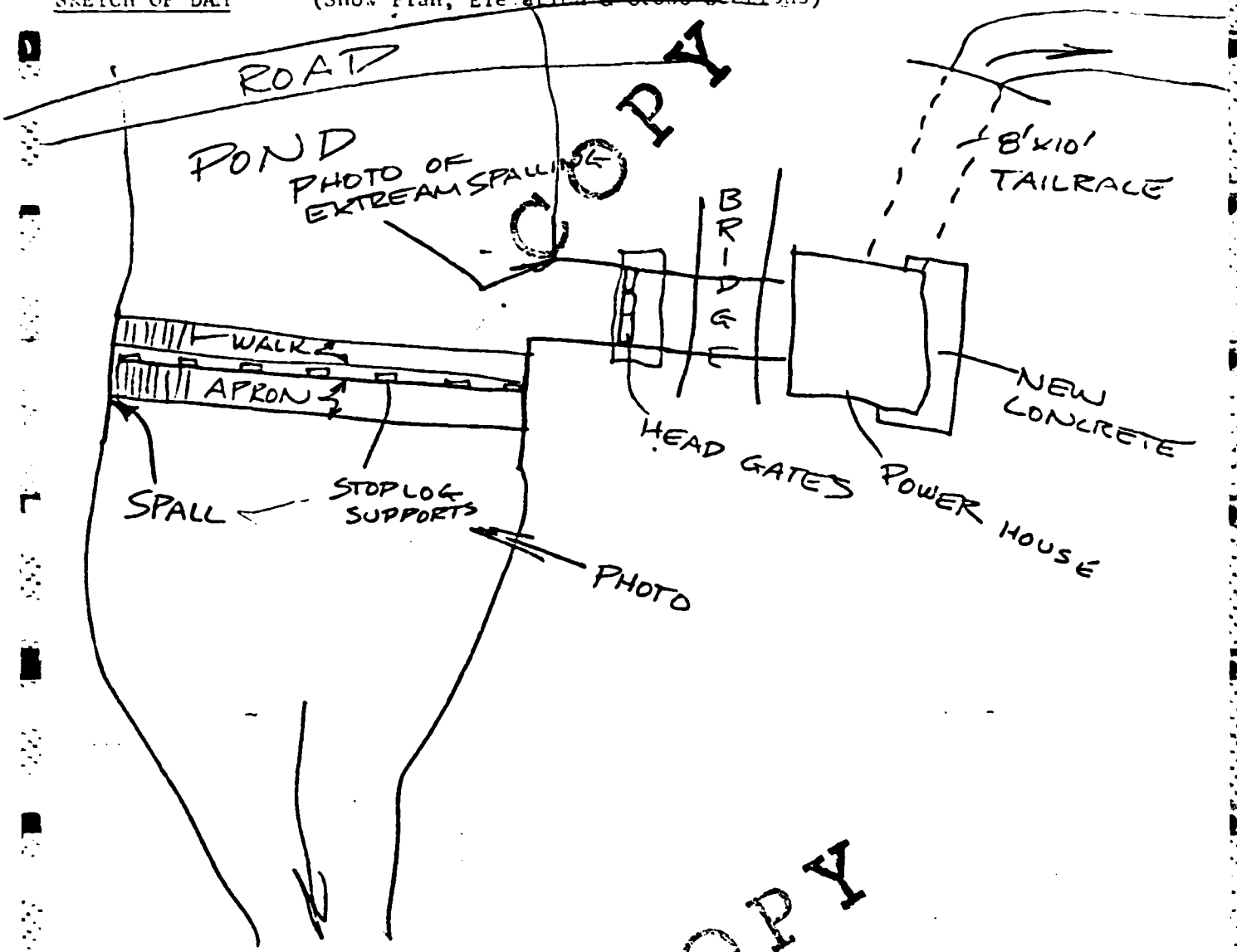
(3) 2 SMALL TREES @ LT ABUT

COPY

COPY

Dam No. 31.07

SKETCH OF DAM (Show Plan, Elevation & Cross Sections)



COPY

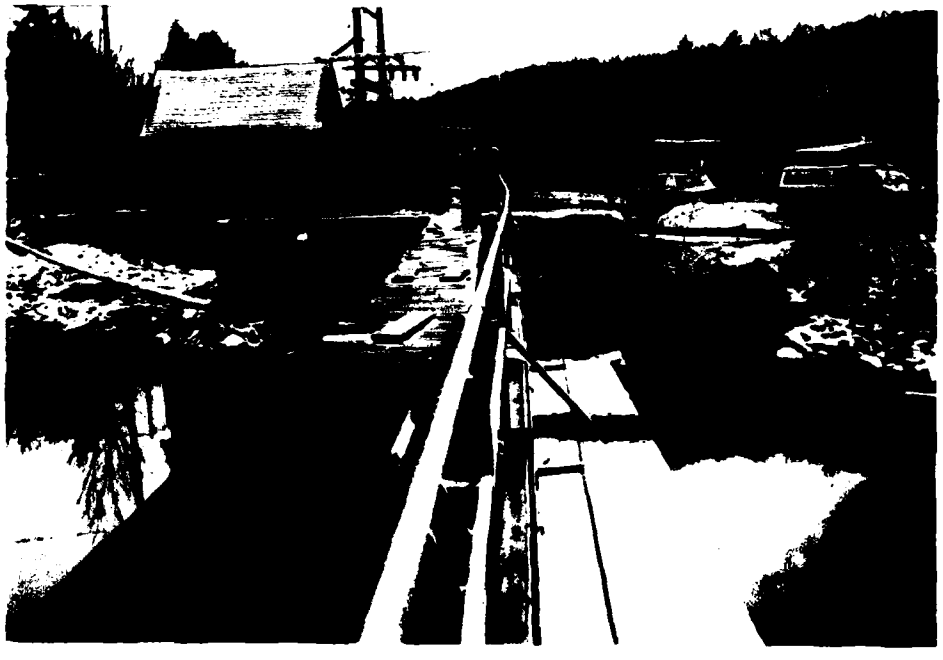
COPY

APPENDIX C

PHOTOGRAPHS

The following are photographs referenced in this report. See Sheet B-1.3 for photograph locations and orientations.

1
UPSTREAM FACE OF DAM; INLET CANAL TO POWERHOUSE IS AT LEFT



2
VIEW OF SPILLWAY STRUCTURE FROM NORTH END; NOTE DEFLECTION OF STRUCTURE TOWARD DOWNSTREAM

3

NORTH ABUTMENT; NOTE SPALLING OF CONCRETE

4

SEEP ADJACENT TO UPSTREAM APRON; COBBLES & RUBBER SHEET ARE EVIDENCE OF ATTEMPTED REPAIR

5
INLET TO CANAL TO POWERHOUSE; NOTE DETERIORATION OF LEFT (EAST) WING WALL

6
POWERHOUSE CANAL; NOTE SPALLING OF SIDE WALLS

7
TAIL RACE OUTLET; POWERHOUSE IS IN BACKGROUND; CANAL & DAM ARE TO RIGHT OF POWERHOUSE

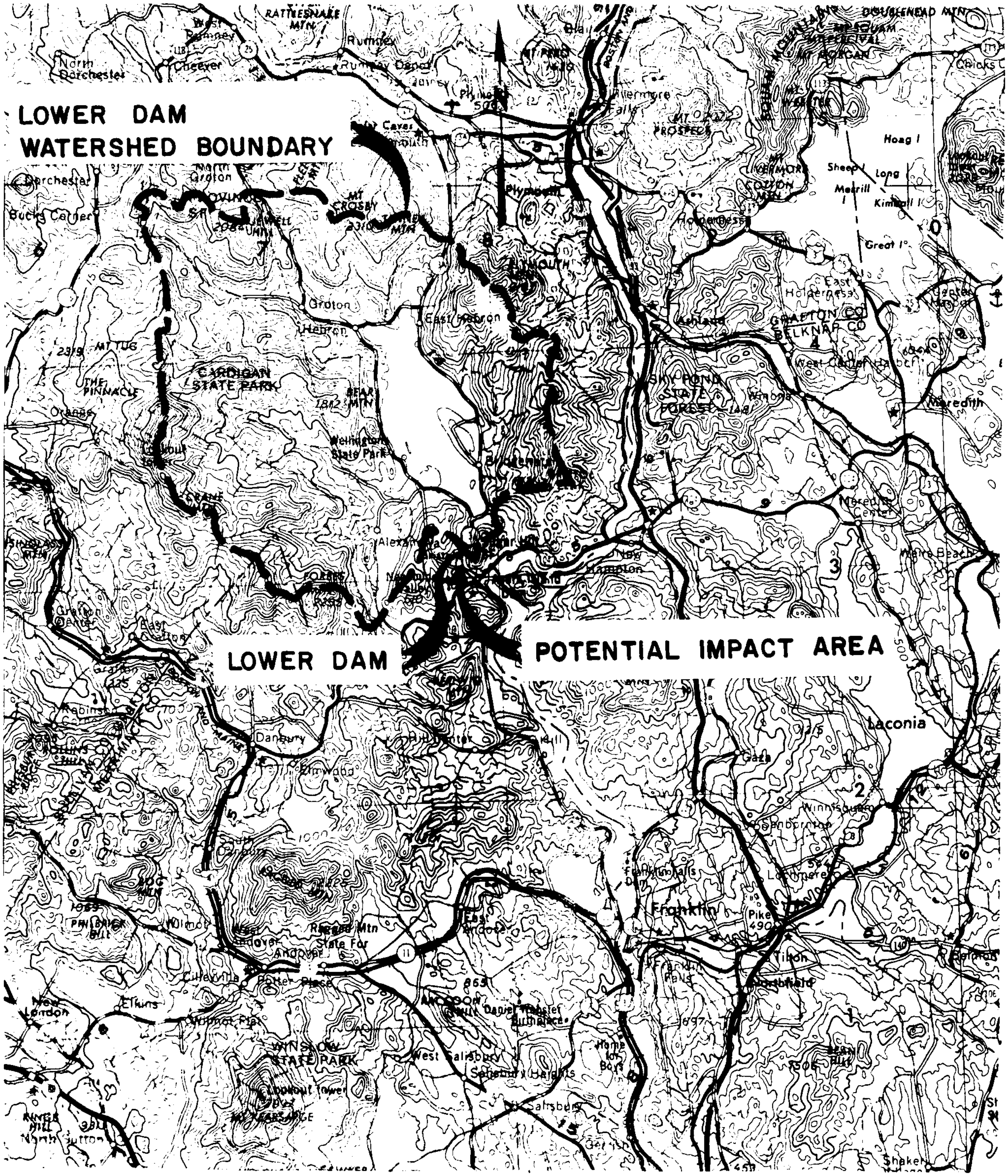
8
BRIDGE IMMEDIATELY UPSTREAM FROM DAM

9
DOWNSTREAM VIEW; DEEPER WATER IN FOREGROUND IS RESULT
OF SCOUR IMMEDIATELY BELOW DAM

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Hydrologic computations pertinent to this investigation are attached. The following figure shows the Newfound River watershed at the International Packings Corporation Lower Dam.



U.S. GEOLOGICAL SURVEY MAP
CARDIGAN, N.H. QUADRANGLE
HOLDERNESS, N.H. QUADRANGLE
PLYMOUTH, N.H. QUADRANGLE
RUMNEY, N.H. QUADRANGLE

0 5 10 15 MILES

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

INTERNATIONAL PACKINGS CORP.
LOWER DAM
DRAINAGE AREA MAP

NEWFOUND RIVER N.H.

20799	07		SCALE	AS SHOWN
			DATE	MARCH 1979

PROJECT	COMP BY	JOB NO.
SCE DAM INSPECTION PROGRAM	JJD	20797-07
IPC LOWER DAM	CHK BY	DATE
	DTB	12-19-78

Test Flood Analysis

All flow at the IPC Lower Dam is affected by the storage-discharge relationships of the Newfound Lake Dam. The drainage area above Newfound Lake Dam is 95.0 square miles. The drainage area above the IPC Lower Dam is 96.1 square miles.

The PMF and ½ PMF flood flows are to be routed through Newfound Lake. The routed flow will then be added to the contribution from the remaining drainage (1.1 mi^2) to determine the peaks discharge rates of the PMF and ½ PMF. The fact that the peaks will be out of sink due to routing is not considered.

Slope of the longest channel $\cong$ 140 Ft/mile
Terrain is hilly to mountainous

- Using 'mountainous' curve of Guide Curves:

  PMF = 1,200 csm × 95.0 mi^2 = 114,000 cfs (peak to be routed)
  ½ PMF to be routed = 57,000 cfs

- Storage Routing (using HEC-1)
  - A) Inflow hydrograph
    1. PMF peak = 114,000 cfs
    2. ½ PMF peak = 57,000 cfs
    3. Time to peak:

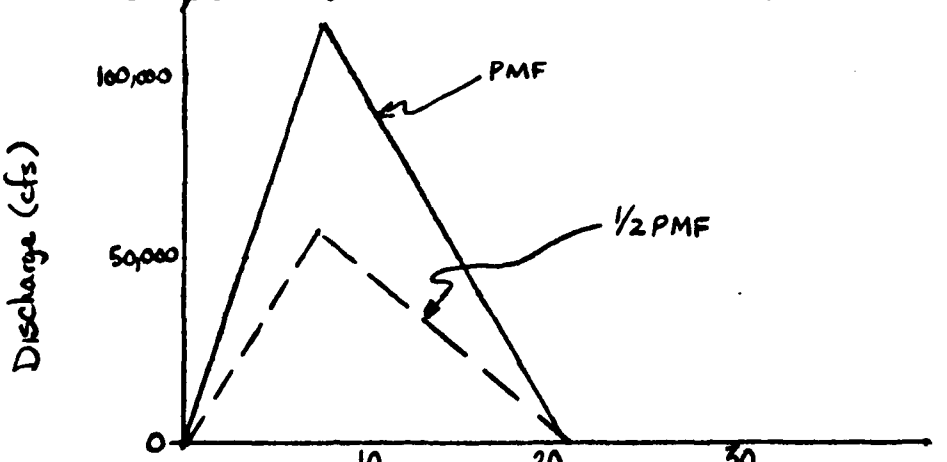
       19" runoff from 95 mi^2 = 96,267 A-F (total area under hydrograph)

       $96{,}267 = \frac{1}{2}(114{,}000) \times B$

       $$B = \frac{2(96{,}267)}{114{,}000} \times 43{,}560 \frac{ft^2}{ec} = 73{,}568 \text{ sec} = 20.4 \text{ hours}$$

       (20.4 hours: total time of runoff)

       Time to peak = 20.4 ÷ 2.67 = 7.6 Hours $\cong$ 7.5 hours



PROJECT	COMP BY JJD	JOB NO. 2379A-07
	CHK BY BTS	DATE 12-9-75

B) Storage - Discharge Relationship

Data on Newfound Lake:

Newfound Lake is presently owned and operated by the New Hampshire Water Resources Board. The primary purpose of the dam is for lake level control for recreation on Newfound Lake. A minimum release to the Newfound River is provided. During the winter months, normal operating procedure provides for maintenance of the lake level at 4.2 ft with respect to the USGS water surface elevation gage located at the dam. During the summer month, normal operating procedure provides for maintenance of the lake level at 6.5 ft (storage = 35,470 ac.-ft.). For the initial storage volume in the HEC-1 routing subroutine, we input 35,470 acre-feet.

An area-capacity table for Newfound Lake is included in this Appendix.

- capacity at full pond elevation of 589.1 ft [1] = 38,800 A-F
- area at full pond elev = 4,100 acres
- capacity at elev 588.4' (6.5' on USGS reservoir elevation gage) = 35,470 A-F
- there is a storage capacity of about 13,200 acre-feet below reservoir level of 1.3'
- area at elevation 600 ft = 5,500 acres (from USGS quad)
  interval capacity = $\left(\frac{5500+4100}{2}\right) \times 10.9'$ = 52,320 A-F

  total capacity at 600 ft = 91,120 A-F
- area at elevation 620 ft = 7,350 acres (from USGS quad)
  interval capacity = $\left(\frac{5500+7350}{2}\right) \times 20'$ = 128,500 A-F

  total capacity = 219,620 A-F

[1] Elevations obtained from N.H. Water Resources Board.

[redacted] LAKE [redacted]TORAGE
IN
CUBIC FEET PER SECOND

USGS GAGE Elev. Ft.	Tenths of Feet										Ave.	Inche
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Diff.	Runof
1.00	0	0	0	119 1/	322	532	735	938	1141	1344	200	5.10
2.00	1554	1757	1967	2170	2380	2590	2793	3003	3213	3423	210	4.47
3.00	3633	3843	4053	4263	4473	4690	4900	5110	5327	5537	210	3.67
4.00	5745	5971	6181	6398	6615	6832	7049	7259	7483	7700	220	2.82
5.00	7917	8134	8351	8568	8792	9009	9233	9450	9674	9891	220	1,97
6.00	10115	10339	10563	10780	11004	11228	11459	11683	11907	12131	220	1.10
7.00	12362	12586	12810*	13041	13272	13496	13727	13958	14182	14413	230	0.21/
8.00	14644	14874	15104	15334	15564	15794	16024	16254	16484	16714	230	0.69
9.00	16944	17184	17424	17664	17904	18144	18384	18624	18864	19104	240	1.59
10.00	19344	19584	19824	20064	20304	20544*					240	2.54
												3.02*

D-5

[redacted] Lower Dam

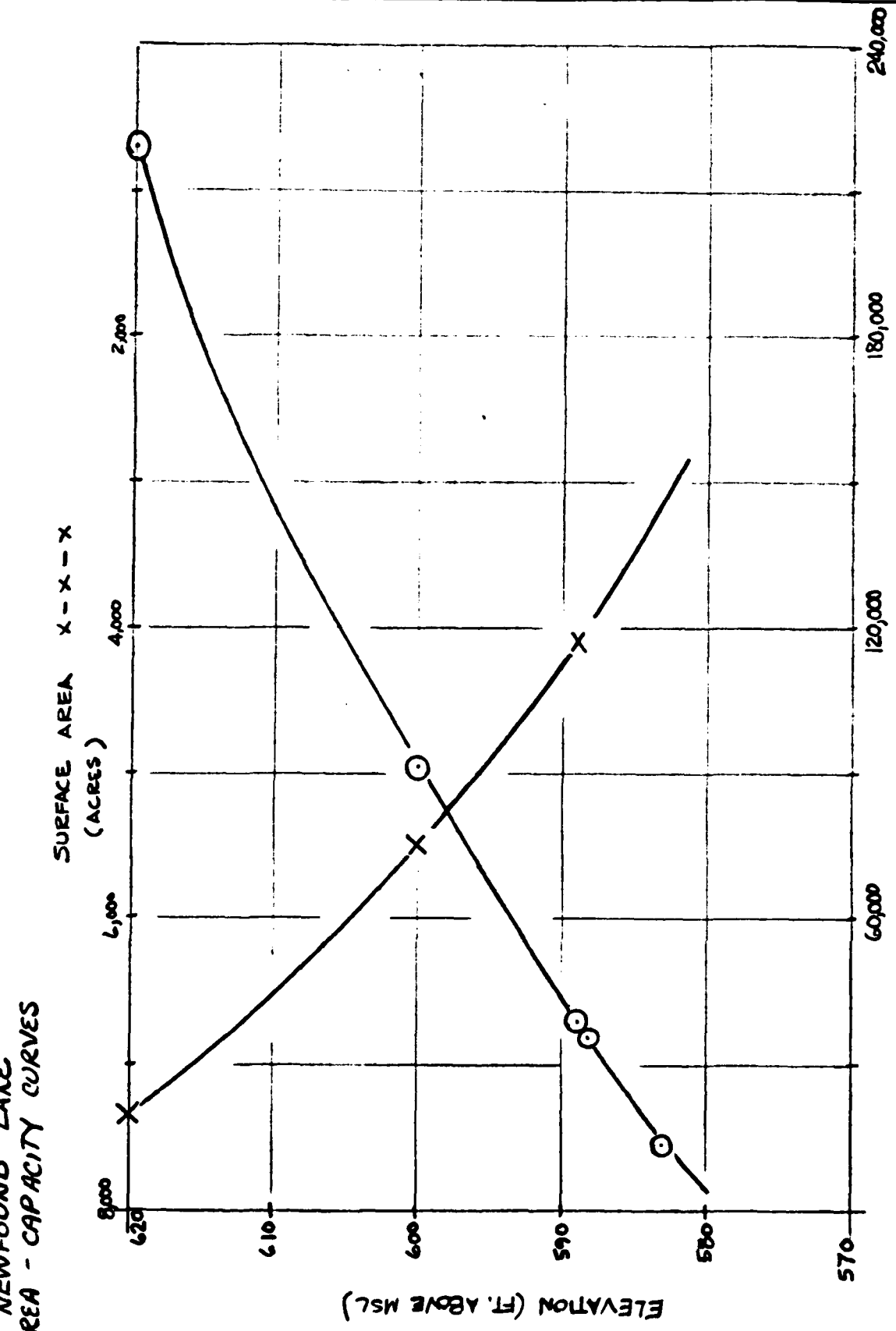
Gross D.A.	95.05 Sq. Mi.
Surface Area	4106 Acres
Full Pond	Elev. 7.24 USGS Gage
Gate Sill	Elev. -2.15
Zero of Gage	581.88 USGS Gage
Dam Gage	Elev. 7.24 USGS = 108"
1" Runoff = 2535 cfs = 1.16' on Lake	

Based on USGS Capacity Table dated 11/25/42
Computed by V.A.K. - 4/4/74

Note: Storage is given in cfs-days. There is storage below elevation 1.3' on gage; approximately 13,200 acre-feet. Discharge from the spillway is controlled by a sandbar upstream of the dam. The sandbar control

EDWARD C. JORDAN CO., INC.

PROJECT	COMP BY JJD	JOB NO. 2079.37
	CHK BY BTB	DATE 12-19-79



PROJECT	COMP BY JJD	JOB NO. 20791-07
	CHK BY BTB	DATE 12-20-78

B) Storage - Discharge Relationship

Newfound Lake Dam and Spillway:

The top of dam at Newfound Lake is at elevation 592.4'. The dam is 110' long. There are three distinct spillway sections. Weir "A" consists of 3 stop log sections measuring 12.7 ft high by 4.0 ft wide. Floor elevation of weir "A" is about 579.7 ft. Weir "B" also consists of 3 stop log sections measuring 12.7 ft high by 6 ft wide. Floor elevation of weir "B" is 579.7 ft. A sandbar upstream of the dam impedes flow below elevation 584.2 ft (~2.3 ft on USGS gage on reservoir). It is assumed there is no discharge with reservoir water surface elevation $\leq$ 584.2 ft.

Weir "C" consists of 6 bay spillways measuring 7.2 ft wide by 6.2 ft high. Floor elevation of weir "C" is 586.2 ft.

C) Summary of storage - discharge data

Elev (ft)	Storage (A-F)	Discharge (cfs)
580.2	4,000	0
581.2	6,000	0
582.2	10,000	0
583.2	13,000	0
584.2	18,000	0
585.2	23,000	1,018
586.2	28,000	1,308
587.2	31,000	1,735
588.2	35,000	2,282
589.2	40,000	2,923
590.2	45,000	3,649
591.2		
592.2		
593.2	58,000	6,980
594.2		
595.2	67,000	10,310

Elev. (Ft.)	Storage (A-F)	Discharge (cfs)
598.2	82,000	16,009
600.2	94,000	20,117
605.2	117,000	35,697
610.2	146,000	52,928
615.2	171,000	71,192
620.0	220,000	89,763

PROJECT	COMP BY	JOB NO.
RATING CURVE - Newfound Lake Dam Spillway	JJD	2070-01
	CHK BY	DATE
	BTB	12-20-12

ASSUME FLOW IS GOVERNED BY $Q = CLH^{3/2}$ AND SPILLWAY ACTS AS A BROAD-CRESTED WEIR OR WEIR WITH TRAPEZOIDAL CROSS-SECTION.

Upstream sandbar impedes discharge below elevation 584.2 ft (2.3 ft on USGS reservoir elevation gage). Top of dam elevation = 592.4 ft. Discharge at 584.2 ft = 0.0 cfs. Bottom of bay spillways = 586.2 ft. Elevation of gate sill = 579.7 ft

Elevation (ft)	Discharge through weir "A" 1/ (cfs)					Discharge through weir "B" 2/ (cfs)				
	H	C 3/	L	Q_S	Q_T	H	C 3/	L	Q_S	Q_T
584.7	5.0	2.63	4	118	353	5.0	2.63	6		529
585.2	5.5				407	5.5				611
	6.0				464	6.0				696
586.2	6.5				523	6.5				785
	7.0				585	7.0				877
587.2	7.5				648	7.5				972
	8.0				714	8.0				1,071
588.2	8.5				782	8.5				1,173
	9.0				852	9.0				1,278
589.2	9.5				924	9.5				1,386
	10.0				998	10.0				1,497
590.2	10.5				1,074	10.5				1,611
	11.0				1,151	11.0				1,727
591.2	11.5				1,231	11.5				1,846
	12.0				1,312	12.0				1,968
592.2	12.5				1,395	12.5				2,092
TOP OF DAM 592.4	12.7				1,428	12.7				2,143
593.2	13.5				1,565	13.5				2,348
594.2	14.5				1,743	14.5				2,614
595.2	15.5				1,926	15.5				2,889
596.2	16.5				2,115	16.5				3,173
597.2	17.5				2,310	17.5				3,466
598.2	18.5				2,511	18.5				3,766
599.2	19.5				2,718	19.5				4,076
600.2	20.5				2,929	20.5				4,394
601.2	21.5				3,146	21.5				4,719
602.2	22.5				3,368	22.5				5,053
603.2	23.5				3,595	23.5				5,393
604.2	24.5				3,827	24.6				5,741

PROJECT	COMP BY JJD	JOB NO. 20799-07
	CHK BY BTB	DATE 12-20-75

Flow through Weirs "A" and "B" (cont.)

Elevation (ft)	H	C	L_A	L_B	Q_A	Q_B
605.2	25.5	2.63	4	6	4,064	6,096
606.2	26.5				4,305	6,458
607.2	27.5				4,551	6,827
608.2	28.5				4,802	7,203
609.2	29.5				5,057	7,585
610.2	30.5				5,316	7,974
611.2	31.5				5,580	8,369
612.2	32.5				5,847	8,771
613.2	33.5				6,119	9,179
614.2	34.5				6,395	9,593
615.2	35.5				6,675	10,010
616.2	36.5				6,960	10,439
617.2	37.5				7,247	10,871
618.2	38.5				7,539	11,309
619.2	39.5				7,835	11,752
620.0	40.3				8,074	12,111

PROJECT	COMP BY	JOB NO.
RATING CURVE - Newfound Lake Dam Spillway	JJD	
	CHK BY	DATE
	BTR	12-20-78

BAY SPILLWAYS - Total of 6 bays w/ dimensions of 7.2' wide by 6.2' high
Bottom of bay elevation = 536.2'

Elevation (ft)	H	Discharge through weir "C" [4] (cfs) C	L	Q_s	Q_T
536.7	0.5	2.61	7.2		40
587.2	1.0	2.67			115
587.7	1.5	2.66			211
	2.0	2.68			327
588.7	2.5	2.72			465
	3.0	2.73			613
589.7	3.5	2.76			781
	4.0	2.79			964
590.7	4.5	2.88			1,188
591.2	5.0	3.07			1,483
591.7	5.5	3.32			1,850
592.2	6.0	↓			2,108
592.4	6.2	-	↓		2,214
(TOP OF DAM)[5]					
593.2	7.0				2,656
594.2	8.0				3,245
595.2	9.0				3,872
596.2	10.0				4,536
597.2	11.0				5,233
598.2	12.0				5,962
599.2	13.0	↓			6,723
600.2	14.0				7,513
601.2	15.0				8,332
602.2	16.0				9,179
603.2	17.0				10,053
604.2	18.0				10,953
605.2	19.0				11,878
606.2	20.0				12,828
607.2	21.0				13,802
608.2	22.0				14,800
609.2	23.0	↓	↓		15,820
610.2	24.0				16,863
612.2	26.0				19,014
614.2	28.0				21,250
616.2	30.0				23,567
618.2	32.0				25,963
619.2	33.0				27,189
620.0	33.8	↓	↓	↓	28,184

[1] Weir "A" is the stop log spillway section closest to the right abutment looking upstream. There are 3 individual sections w/ dimensions of 4' wide by 10½' high. Q_s represents flow through a single section, Q_T is the total flow through the weir

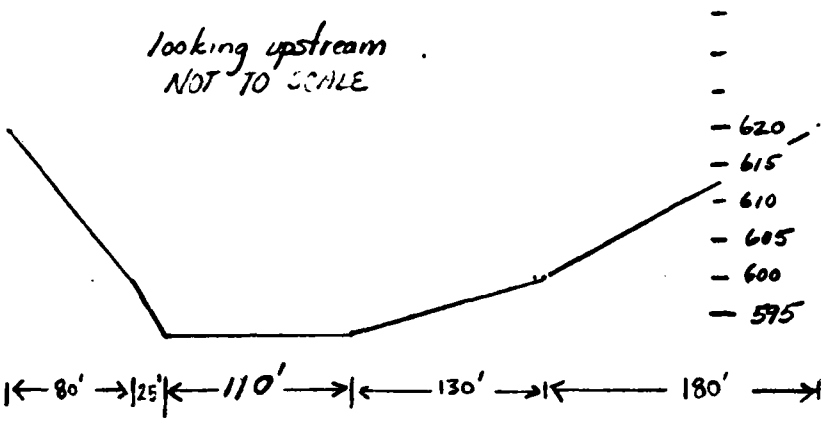
[2] Weir "B" is the middle stop log spillway section consisting of three individual sections with maximum dimensions of 6' wide by 10½' high. Q_s represents flow through a single section, Q_T is the total flow through the weir

[3] 'C' values from Brater & King "Handbook of Hydraulics", Table 5-3, pg 5-40.

[4] Weir "C" is the bay spillway section which consists of 6 bays

PROJECT	COMP BY	JOB NO.
RATING CURVE - Newfound Dam	JJD	2074[illegible]
Dam Overflows	CHK BY	DATE
	BTF	12-21-18

Cross-section at dam (top of dam at 592.4, length = 120')



Dam overflow:

Dam width already accounted for in weirs "A" + "B" + "C" = 73.2 ft - remainder of dam acts as a broad-crested weir upon overflow (110' - 73.2' = 36.8 ft)

Overflow over dam discharge determined below:

Elevation (ft)	H	C	L	Q
592.4	0		36.8	0
593.4	1.0	2.63	36.8	97
594.4	2.0			274
595.4	3.0			503
596.4	4.0			774
597.4	5.0			1,082
598.4	6.0			1,422
599.4	7.0			1,793
600.4	8.0			2,190
601.4	9.0			2,613
602.4	10.0			3,060
603.4	11.0			3,531
604.4	12.0			4,023
605.4	13.0			4,537
606.4	14.0			5,070
607.4	15.0			5,623
608.4	16.0			6,194
609.4	17.0			6,784
610.4	18.0			7,391
612.4	20.0			8,657
614.4	22.0			9,987
616.4	24.0			11,379
618.4	26.0			12,831
620.0	27.6			14,033
	[illegible]			

Overbank flow estimate

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

at elev 600', $A = \frac{1}{2}(25')(7.6) + \frac{1}{2}(7.6)(130')$

$A = 589\ ft^2$

$P = 130 + 26 = 156$

$R = 3.776$ $R^{2/3} = 2.424$

$S = .0095$ (from USGS map)

$S^{1/2} = .097$

$n = .065$

$Q = 3,166$ cfs

at elev 620', $A = 589 + \frac{1}{2}(20)(80)$

$+ \frac{1}{2}(180)(20) = 3185$

$P = 156 + 181 + 82 = 419$

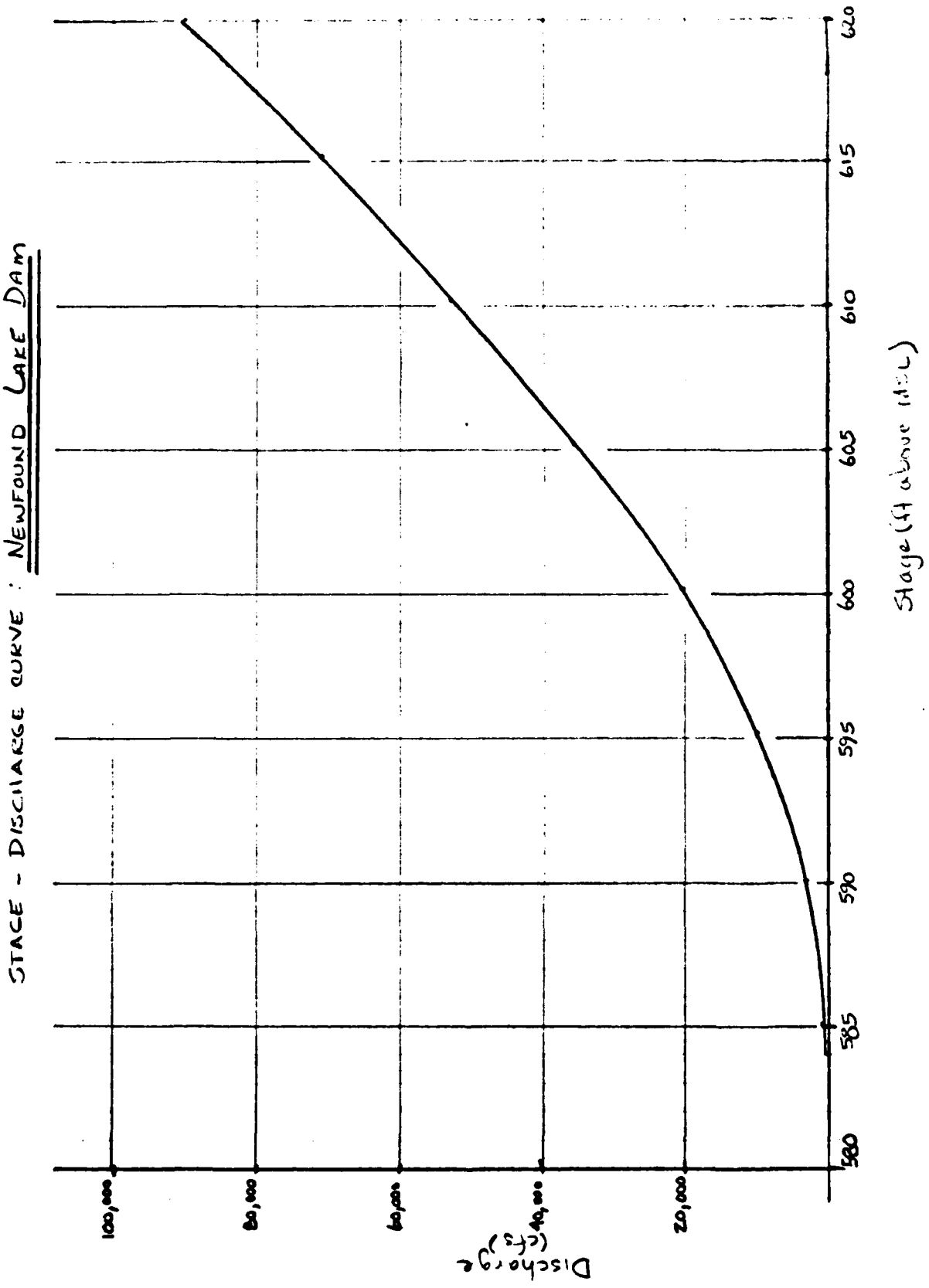
$R = 7.610$ $R^{2/3} = 3.869$

$S^{1/2} = .097$

$Q = 27,361$ cfs

Assume a linear rating curve for overflow

PROJECT	COMP BY	JOB NO.
IPC LOWER DAM	[illegible]	[illegible]-03
Stage - Discharge Relation : Newfound Lake	CHK BY	DATE
	JTB	12-12-75



****
1 VERSION DATED JAN 1973
IED AUG 74
= NO. 01
****

ROUTING OF PMF AND $\frac{1}{2}$ PMF FLOODS

THRU NEWFOUND LAKE

C.O.E. DAM INSPECTION PROGRAM
ROUTING OF PMF THRU NEWFOUND LAKE FOR STUDY OF IPC DAMS
JOB NO. 20799-07 AND 08

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
12	2	30	0	0	0	0	2	4	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

1/2 PMF INFLOW HYDROGRAPH TO NEWFOUND LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
100	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	95.00	0.00	0.00	0.00	0.000	0	0	0

IPC Lower Dam

HYDROGRAPH ROUTING

ROUTING THRU NEWFOUND LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
100	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

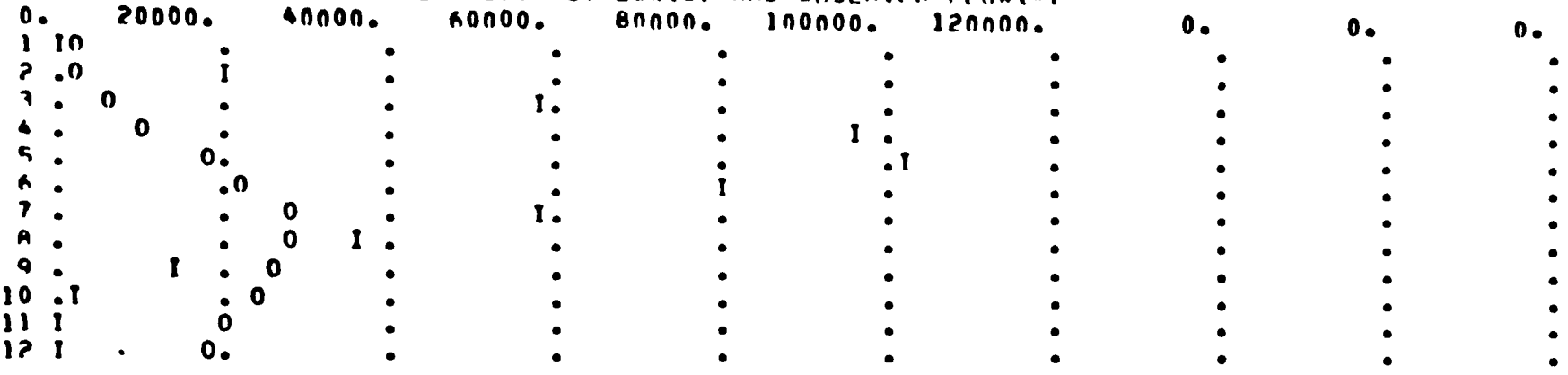
NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	35470.

PAGE=	23000.	40000.	58000.	67000.	82000.	94000.	117000.	146000.	171000.	2200
FLOW=	1018.	2923.	6980.	10310.	16009.	20117.	35687.	52928.	71192.	897

IPC Lower Dam

STATION 100

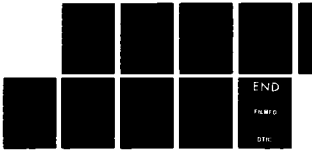
INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

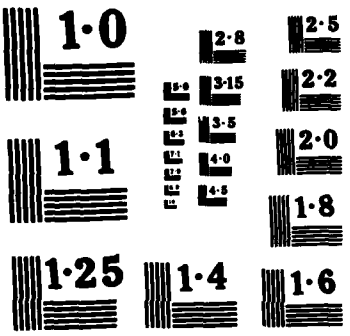


IPC Lower Dam

AD-A157 234 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
INTERNATIONAL PACKING..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 79

UNCLASSIFIED F/G 13/13 NL





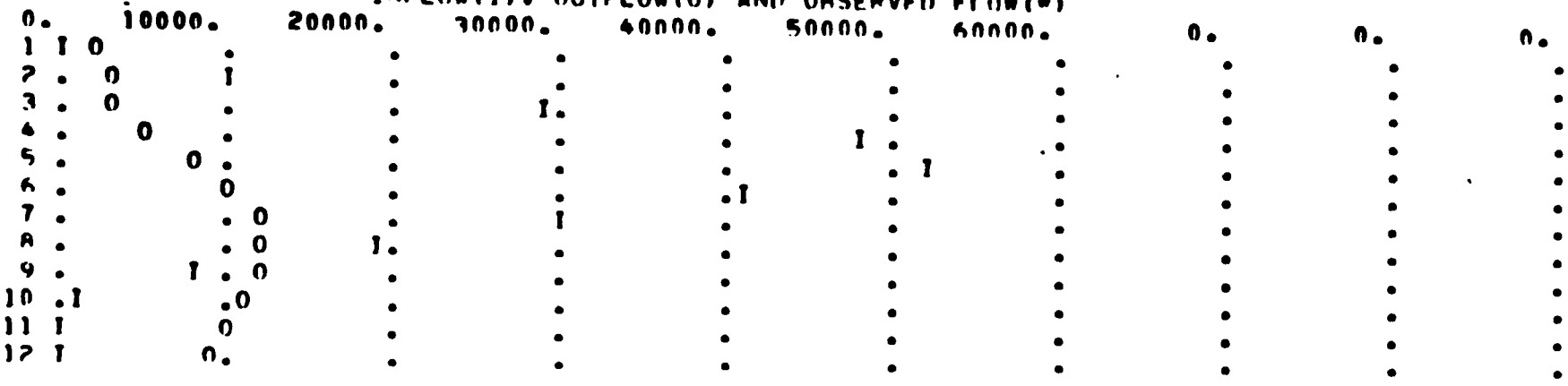
NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

RUNOFF SUMMARY. AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	100	114000.	102867.	51557.	38668.	95.00
ROUTED TO	100	28722.	28170.	21839.	17224.	95.00

IPC Lower Dam

STATION 100


INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)
0. 10000. 20000. 30000. 40000. 50000. 60000. 0. 0. 0.

RUNOFF SUMMARY. AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	100	57000.	51519.	26064.	19548.	95.00
ROUTED TO	100	12117.	11949.	9905.	8112.	95.00

PROJECT	COMP BY	JOB NO.
COE DAM INSPECTION PROGRAM IPC Lower Dam	JJD	20799-07
	CHK BY BTB	DATE 12-21-78

Spillway Capacity of IPC Lower Dam

The only spillway provided at the Lower IPC Dam is the stop-log spillway. The spillway consists of 18 stop-log sections measuring 4½ ft wide by 5.7' high, the height being measured to the top of the stop-log supports. Average height from spillway crest to top of dam is 7ft. Individual section capacity is determined below

H	C	L	Q
0.5	3.25	4.5	5.2
1.0	3.41	"	15
1.5	3.57	"	30
2.0	3.65	"	46
2.5	3.70	"	66
3.0	3.72	"	87
3.5	3.72	"	110
4.0	3.73	"	134
4.5	"	"	160
5.0	"	"	188
5.7	"	"	228
6.0	"	"	247
7.0	"	"	311
8.0	"	"	380
10.0	"	"	531

Note: "C" values from "Handbook of Hydraulics", King & Brater, Table 5-11

(1) Total capacity = 18 x 311 = 5,600 cfs

(2) Spillway capacity at inspection = 311 + 255 ≅ 570 cfs (one port open full, others open to an avg. of 1.0 ft)

(3) " " with all stoplogs in place (H=.63') ≅ 130 cfs

Inflow from remaining 1.1 square miles = 1,320 cfs for PMF (660 cfs for ½PMF)

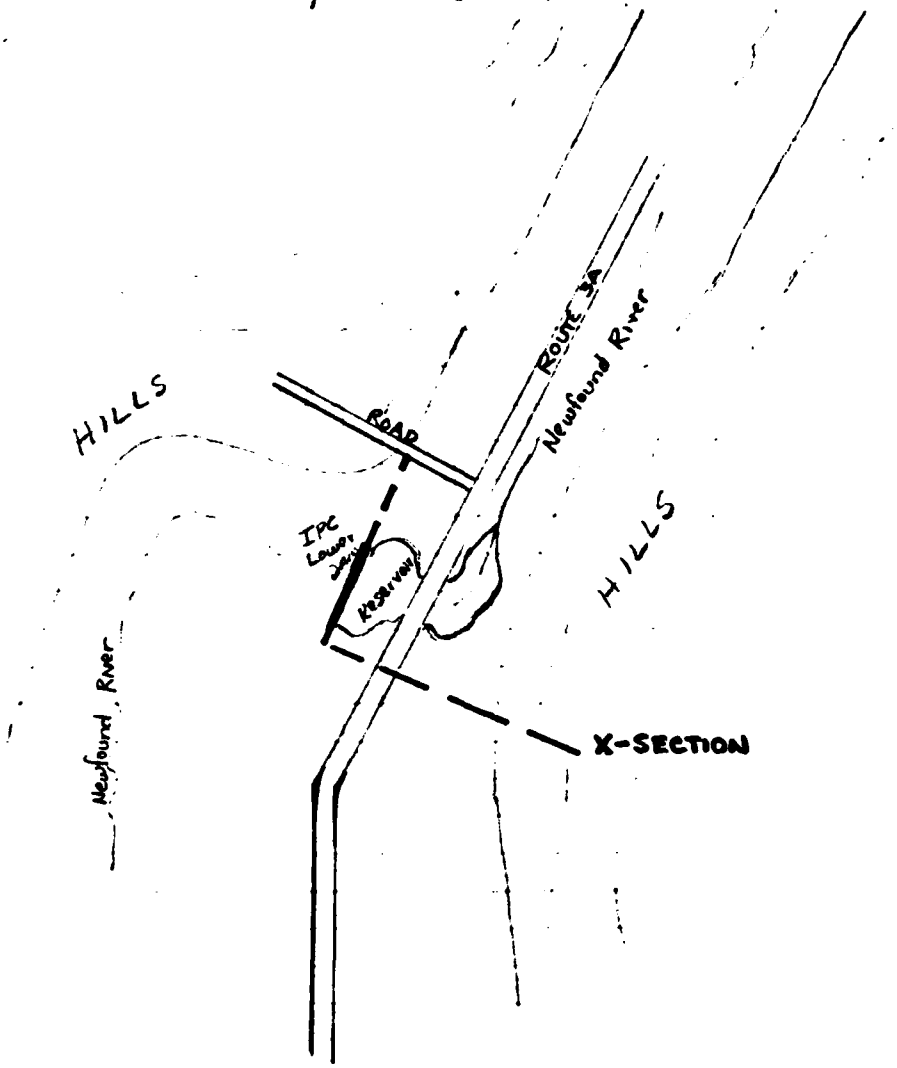
PMF = 28,722 + 1320 ≅ 30,000 cfs

½ PMF = 12,117 + 660 ≅ 12,780 cfs

Spillway is capable of passing 19% of the PMF and 44% of the ½ PMF without overtopping. However, the PMF is approximately equal to PMF + flow from dam failure. The IPC Lower Dam is not a hydraulic control once overbank flow occurs upstream of the dam and reservoir. The valley section, and to a much lesser extent, the highway (Rt. 3A) grade, will control flow in the valley. The river makes a 90° bend just above the dam. The overbank flow will flow around the dam to the north and eventually to the south.

PROJECT	COMP BY JJD	JOB NO. 2079-07
	CHK BY BTB	DATE 1-2-79

Upstream of the IPC Lower Dam, the Newfound River flows in a relatively narrow and steep valley section. Just upstream of the dam, the valley suddenly widens considerably. The IPC Lower Dam sits higher than the floodplain to the north. The rough sketch below shows a plan view of the valley. It is estimated that overbank flow begins to occur at a flow rate of about 2,000 second-feet in the narrow valley section just upstream of the dam.



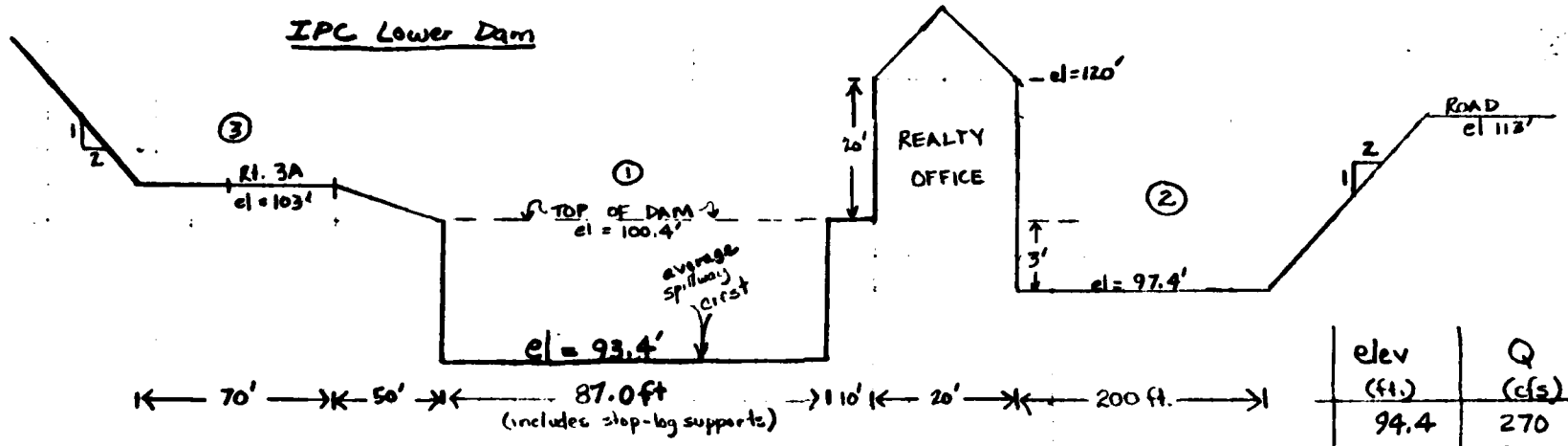
The x-section location is shown by a dashed line. This x-section is used to determine height of PMF and ½ PMF flows.

X - section at dam
NOT TO SCALE

Looking downstream

NOTE : Elevations were taken from survey during inspection and are not meant to express actual elevations.

IPC Lower Dam



elev (ft.)	Q (cfs)
94.4	270
95.4	828
96.4	1,566
97.4	2,412
98.4	4,029
99.4	6,464
100.4	9,665

Flow at top of dam :

① service spillway flow = 5,600 cfs

② $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$ with $n = .065$, $S = 3/150 = .020$

$A = 600 + 9 = 609\ ft^2$, $P = 205.2$, $R = 2.968$, $R^{2/3} = 2.065$

$Q = 4{,}065$

Total Q @ top of dam = 9,665 cfs

	Discharge from non-spillway section								Spillway discharge	Total discharge
ELEV	$\frac{1.486}{n}$	A	P	R	$R^{2/3}$	S	$S^{1/2}$	Qns	Qs	Qt
103	22.9	1,226	268	4.575	2.756	.020	.141	10,910	8,986	19,896
104	22.9	1,589	350	4.540	2.739	.020	.141	14,053	10,427	24,480
105	22.9	1,928	354	5.446	3.095	.020	.141	19,267	11,937	31,204
106										

PMF elev = 104.8 ft

½ PMF elev = 101.2 ft

PROJECT

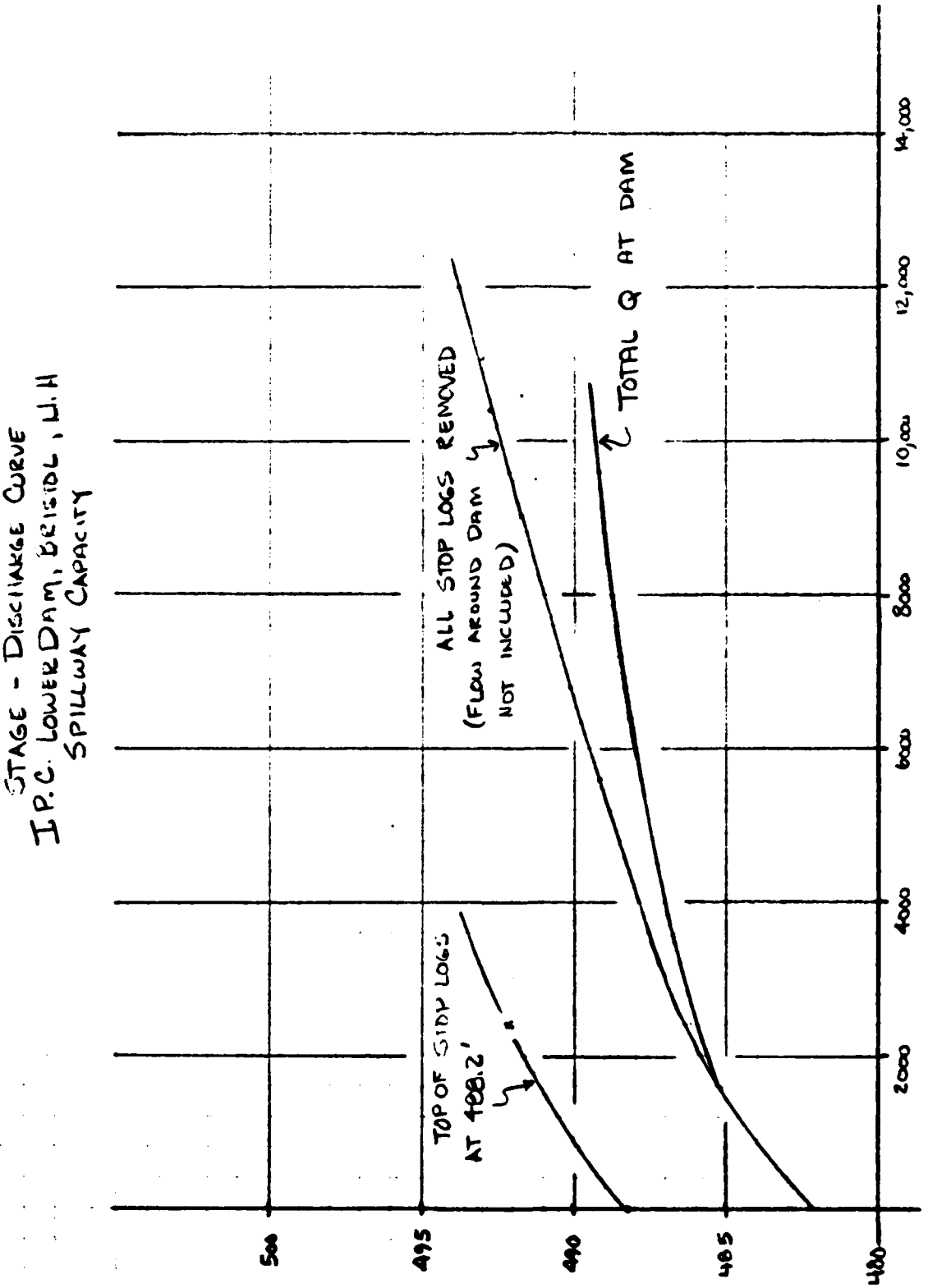
CHK BY SJT2

DATE 1-2-79

JOB NO. 2579.07

D-21

PROJECT	COMP BY	JOB NO.
I.P.C. Lower Dam Stage - Discharge Curve	JSD	20749-07
	CHK BY BTL	DATE 1-4-79



PROJECT	COMP BY JJD	JOB NO. [illegible]
	CHK BY BTB	DATE 1-2-79

A PMF of 30,000 cfs would overtop the dam by 4.4 ft and a ½ PMF of 12,780 cfs would overtop the dam by 0.8 ft.

The spillway should not be considered seriously inadequate according to the guidelines of ETL 1100-2-234 because failure from overtopping would not significantly increase the downstream hazard above what it was just before failure occurred. A major flood would be occurring in the valley at the time overtopping occurs. Flow at top of dam, including the flow that would be occurring north of the dam, amounts to about 10,000 cfs. This represents a very significant flood event downstream of the dam.

In addition, based on conversations with the owner, there is evidence that the spillway section becomes submerged at high flows – flows that utilize most of the spillway capacity. In comparing stages of the flood flow from failure at the dam (using $^2/_3$ H) and at a cross-section 100' below the dam, no evidence of submergence caused by backwater effects was recognized. However, these stage estimates are very rough and do not provide a detailed picture.

PROJECT	COMP BY	JOB NO.
COE DAM INSPECTION PROGRAM	JJD	20797-07
LOWER IPC DAM	CHK BY	DATE
		12-12-78

DAM FAILURE ANALYSIS

a) Reservoir storage at time of failure, S (100.4 − 89.3) = 11.1'

S = 2.8 acres × 11.1 ft = 31 acre-feet

b) Peak Failure Outflow

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

Y_o = 100.4 − 86.0 = 14.4 ft

W_b = 38 ft (.4 × 95 ft)

Q_{pl} = 3,491

A dam breach would most likely occur by failure of the timber crib due to loss of foundation material.

Normal operating procedure for the IPC Lower Dam consists of keeping the stop-logs in place to maintain maximum head for power production. Evidence at the dam indicates that flow has occurred over the top of the stop-logs during this operational procedure. In anticipation of high flows, spillway stop-logs are removed to prevent overtopping.

With water surface at top of dam and dam in the condition observed during inspection, discharge from the dam would be

- through open port, Q = 311 second-feet
- over spillway section
  avg. H = 1.0', L = 76.5', ∴ C = 3.41, ∴ Q = 260 cfs
- Q_{TOTAL} = 570 cfs

With water surface at top of dam, and stop-logs removed

$$Q = 18 \times 3.73 \times 7^{3/2} \times 4.5 = 5{,}595 \text{ cfs}$$

With stop-logs in place, there is very little freeboard existing between the top of stop-logs and the walkway. With water at top of dam, some overtopping along reservoir shoreline would occur.

Time for reservoir to empty:

$$T = \frac{12.1\, S}{\frac{1}{2} Q_p} = .21 \text{ hrs} \cong 13 \text{ minutes}$$

PROJECT	COMP BY	JOB NO.
	CHK BY	DATE

A) @ cross-section #1 (~100 ft. downstream of dam)

$Q = 3,491$ cfs

Stage $= (439.2^{1/} - 432.0^{1/}) = 7.2$ ft

B) @ cross-section #2A (~1,000 ft. downstream of dam)

$S = 31$ acre-feet

$q_{p1} = 3,491$ cfs

trial stage $= (475.1^{1/} - 468.0^{1/}) = 7.1$ ft

$V_1 = \left(\frac{758 + 592}{2}\right) \times 900 \times \frac{1}{43,560} = 14$ acre-feet

$q_{p2} = 3491\left(1 - \frac{14}{31}\right) = 1,914$ cfs

$V_2 = \left(\frac{380 + 500}{2}\right) \times 900 \times \frac{1}{43,560} = 9.1$ A-F

$V_{AVE} = 11.6$ A-F

$Q_{2A} = 3,491\left(1 - \frac{11.6}{31}\right) = 2,185$ cfs

Stage $= (474.2^{1/} - 468^{1/}) = 6.2$ ft

C) @ cross-section #2B (~1,500 downstream of dam)

$Q_{2A} = 2,185$ cfs

trial stage $= (463.2^{1/} - 459^{1/}) = 4.2$ ft

$V_1 = \left(\frac{418 + 872}{2}\right) \times 500 \times \frac{1}{43,560} = 7.4$ A-F

$q_3 = 2185\left(1 - \frac{7.4}{31}\right) = 1,663$

$V_2 = \left(\frac{351 + 692}{2}\right) \times 500 \times \frac{1}{43,560} = 6.0$ A-F

$V_{AVE} = 6.7$ A-F

$Q_{2B} = 2,185\left(1 - \frac{6.7}{31}\right) = 1,712$ cfs

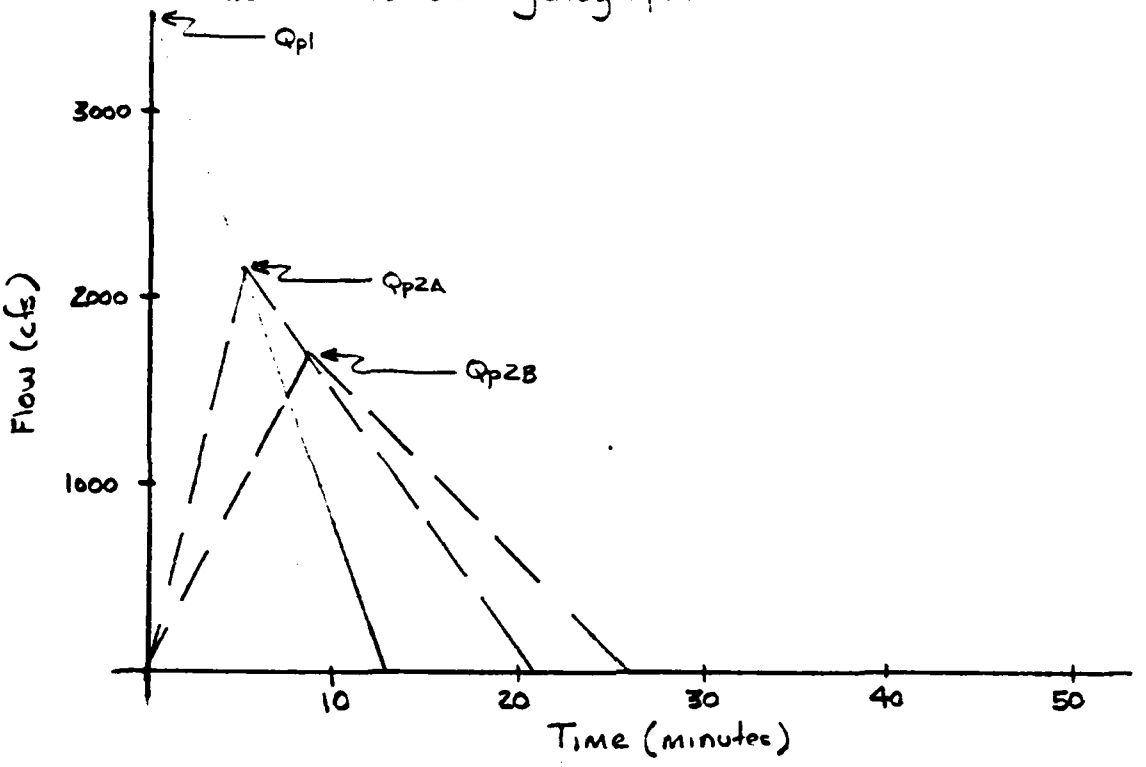
Stage at X-sect 2B $= (462.9^{1/} - 459^{1/}) = 3.9$ ft

The peak has dropped sufficiently below general flood level to cease posing a significant hazard (general flood level = 2,000 to 2,300 cfs according to N.H. Water Resources Board personnel).

1/ All elevations contained in the dam failure analysis were obtained by estimating cross-section streambed elevations from 1" = 1 mile USGS quadrangles and are not directly related to actual elevations of the dam!

PROJECT	COMP BY	JOB NO.
	JCL	[illegible]-7
	CHK BY	DATE
		2-13-78

Downstream Dam Failure Hydrographs



General

From conversations with personnel of the New Hampshire Water Resources Board, it was determined that general flooding begins at flows of about 2,000 to 2,500 cfs in the reach below the IPC Lower Dam. As shown in the above hydrographs, below x-sect #2B, no significant flooding would occur. There may be possibility of some localized, minor damage occurring; however, a extremely detailed analysis would have to be undertaken. Above x-sect #2B, some general flooding occurs. However, flood discharges are maintained for less than ~ 8 minutes. Maximum flood levels from failure would occur just downstream of the dam and would be approximately 2 to 3 feet. There are no residences located in this area. Within 1,000 feet of the dam, the flood peak from failure has dropped sufficiently to cease posing a significant hazard, although some minor flooding may still occur.

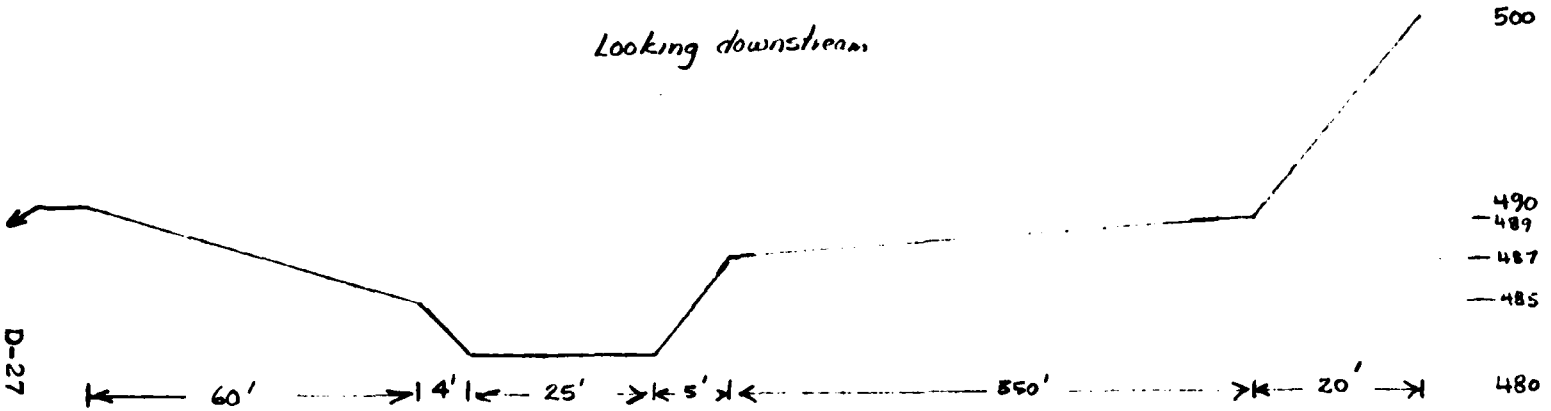
HAZARD CLASSIFICATION - "SIGNIFICANT": No more than a few inhabitable structures, some notable economic losses

Cross - Section #1

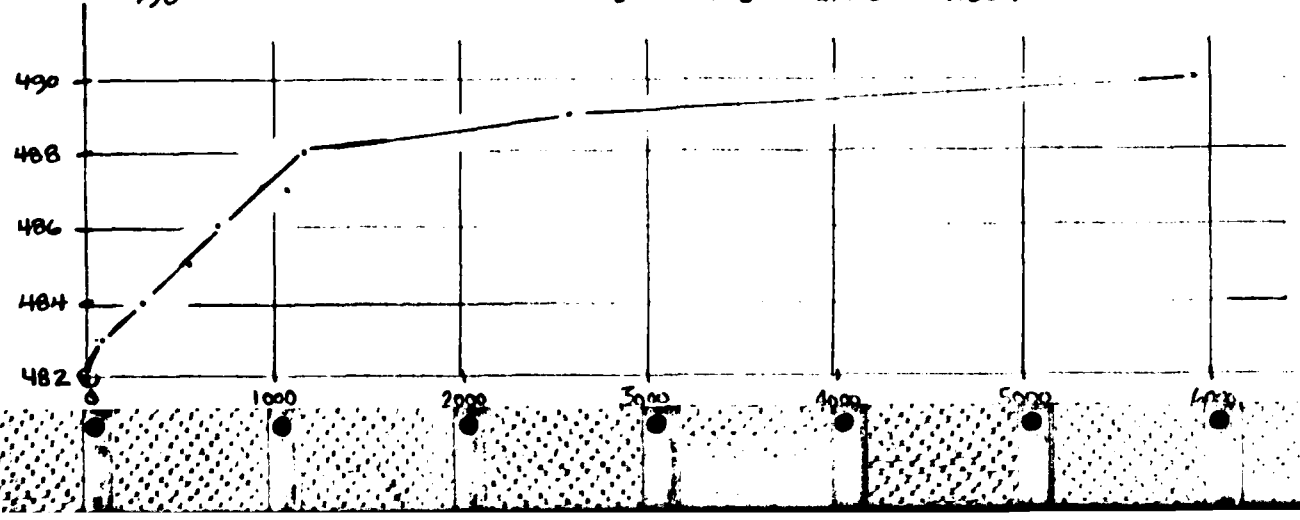
Location : about 100' below dam.
All dimensions in feet
NOT TO SCALE

X-section from field inspection and USGS quad (1" = 1 mile)

Looking downstream



Wse	n	1.486/n	A	P	R	$R^{2/3}$	S	$S^{1/2}$	Q
483	.055	27.0	27.2	29.9	.910	.939	.016	.126	86
484	.055	"	58.9	32.5	1.812	1.486	"	"	298
485	"	"	88.5	35.2	2.514	1.849	"	"	556
486	.065	22.9	127.5	48.6	2.623	1.901	"	"	699
487	"	"	179.5	60.0	2.992	2.075	"	"	1,074
488	"	"	331	247	1.340	1.215	"	"	1,160
489	"	"	670	434	1.544	1.336	"	"	2,582
490	"	"	1108	448	2.473	1.827	"	"	5,839



D-27 IPC Lower Dam

PROJECT

COMP BY JU

CHK BY

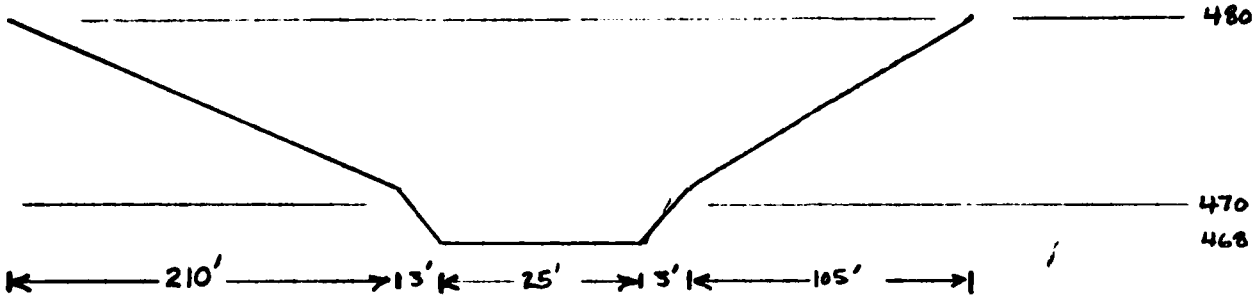
JOB NO. 27799-07

DATE 12-11-79

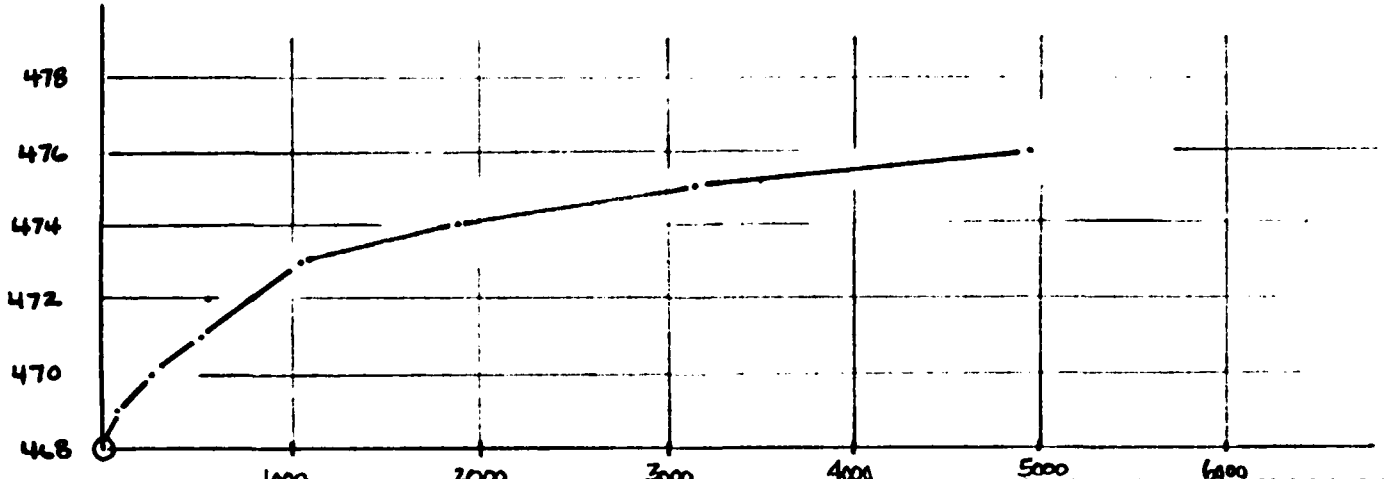
Cross-section #2A

Location: about 1000' below dam.
All dimensions in feet
NOT TO SCALE

X-section from USGS quad and field inspection



wse	n	$1.486/n$	A	P	R	$R^{2/3}$	S	$S^{1/2}$	Q
469	.055	27.0	26	27.8	.935	.956	.016	.126	85
470	"	"	54	30.7	1.759	1.457	"	"	268
471	"	"	84	33.5	2.507	1.846	"	"	527
472	.065	22.9	138	78.5	1.752	1.453	"	"	576
473	"	"	236	124	1.911	1.540	"	"	1,048
474	"	"	380	169	2.255	1.720	"	"	1,886
475	"	"	569	214	2.665	1.922	"	"	3,156
476	"	"	803	259	3.106	2.127	"	"	4,929



PROJECT

COMP BY

CHK BY

DATE

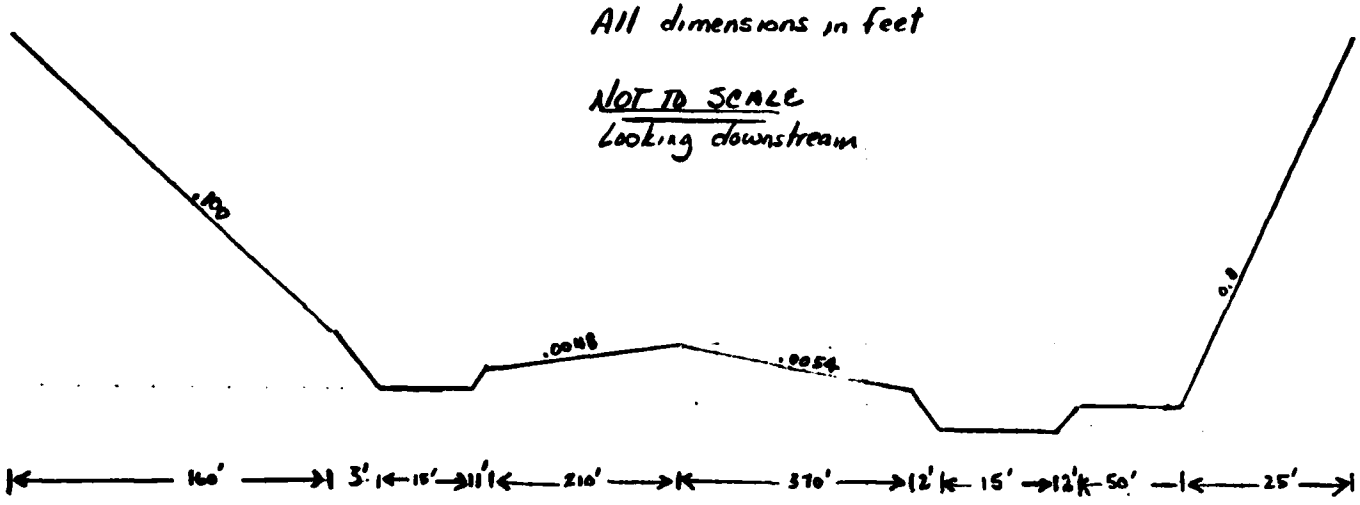
JOB NO.

D-28 IPC Lower Dam

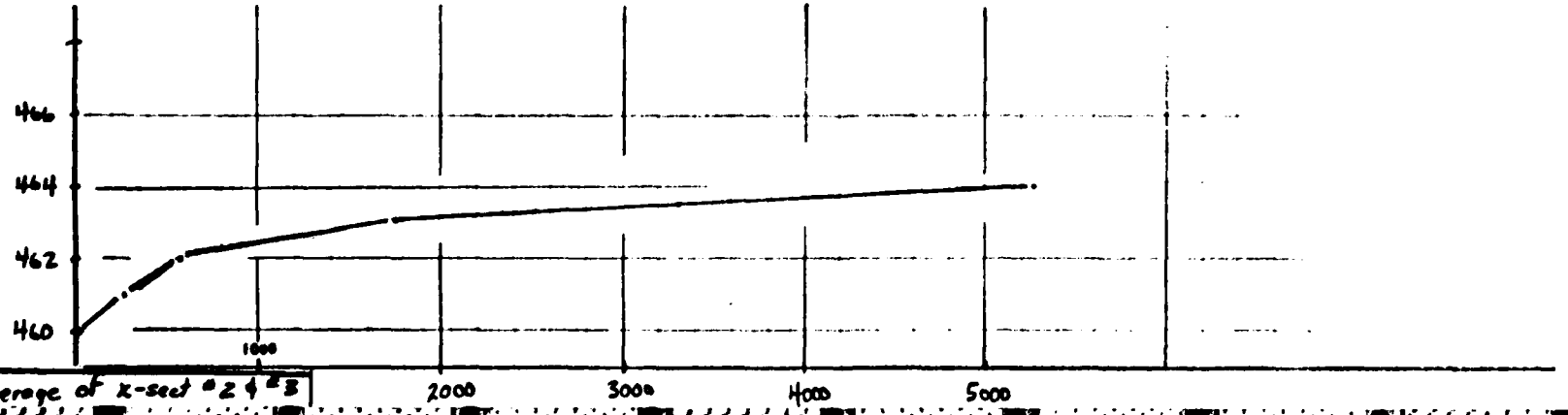
cross-section # 2B (from USGS quad)
(approx 500' downstream of x-section # 2A)

All dimensions in feet

NOT TO SCALE
Looking downstream



WSE	n	1.486/n	A	P	R	$R^{2/3}$	S [1]	$S^{1/2}$	Q
460	.055	27.0	16.5	18.7	.882	.920	.0099	.099	3.8
461	.055	"	85.6	71.7	1.193	1.125	.0099	.099	257
462	.065	22.9	265	276	0.960	0.973	.0099	.099	584
463	.065	22.9	736	671	1.097	1.064	.0099	.099	1,775
464	.065	22.9	1,416	674	2.100	1.640	.0099	.099	5,263



[1] Average of x-sect # 2 & 3

D-29 IPC Lower Dam

PROJECT

COMP BY

CHK BY

JOB NO.

DATE 2-11-79

APPENDIX E

Information as Contained in the National Inventory of Dams

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST.	(7) STATE	(8) COUNTY	(9) CONGR DIST.	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
NH	49[illegible]	ED	[illegible]	009	02				INTERNATIONAL PACKINGS CORP LOWER DAM	4530.0	7144.9	1/APR79

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
INTERNATL PACKINGS CORP-LOWER DAM	

(15) REGION/BASIN	(16) RIVER OR STREAM	(17) NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	(18) DIST FROM DAM (MI.)	(19) POPULATION
1 [illegible]5	NEWPOND RIVER	BRISTOL	1	1700

(20) TYPE OF DAM	(21) YEAR COMPLETED	(22) PURPOSES	(23) STRUCTURAL HEIGHT (FT.)	(24) HYDRAULIC HEIGHT (FT.)	(25) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	(25) IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)
[illegible]	1954	H	16	14	31	20

DIST DAM FED H PRV/FED SCS A VER/DATE
FED N N N N 1/APR79

(26) REMARKS
[illegible]-LOWER DAM WITH CONC. ABUTMENTS

(27) U.S. HAS	(28) SPILLWAY LENGTH	(28) SPILLWAY TYPE	(28) SPILLWAY WIDTH	(29) MAXIMUM DISCHARGE (FT.)	(30) VOLUME OF DAM (CY)	(31) POWER CAPACITY INSTALLED (MW)	(31) POWER CAPACITY PROPOSED (MW)	(32) NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
[illegible]	87	C	87	5600												

(33) OWNER	(34) ENGINEERING BY	(35) CONSTRUCTION BY
[illegible]ATL PACKINGS CORP		DOUGLE-DAVIS [illegible] CO

(36) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
[illegible] WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

(37) INSPECTION BY	(38) INSPECTION DATE DAY | MO | YR	(39) AUTHORITY FOR INSPECTION
EDWARD C JORDAN CO INC	21NOV78	PUBLIC LAW 92-367 AUG1972

(40) REMARKS
[illegible] WITHOUT ST PLUGS

END

FILMED

9-85

DTIC