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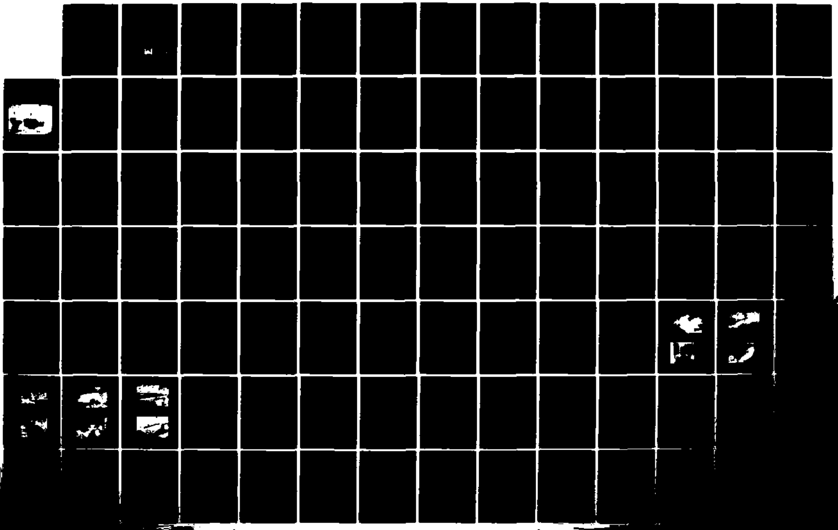

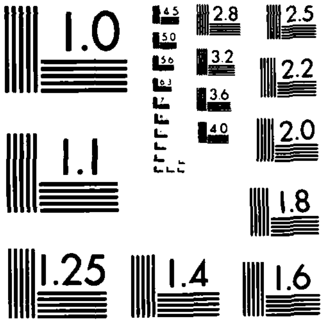

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CONNECTICUT RIVER BASIN
SWANZEY, NEW HAMPSHIRE

UPPER WILSON POND DAM

NH 00202

NHWRB 232.06

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

AUGUST 1981

UNCLASSIFIED

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Connecticut River Basin
Swanzy, New Hampshire
Wilson Brook, a tributary of the Ashuelot River

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

THe dam is constructed of reinforced concrete and earth fill. It is about 225 ft. long and 16.6 ft. high. The dam is small in size with a high hazard potential. The dam is in poor condition at the present time. The spillway is capable of passing 5% of the Test Flood routed peak outflow.

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DEPARTMENT OF DEFENSE UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION. CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM. MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED-E

SEP 09 1981

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, NH 03301

Dear Governor Gallen:

Inclosed is a copy of the Upper Wilson Pond Dam (NH-00202) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis.

The preliminary hydrologic analysis indicated that the spillway capacity would likely be exceeded by floods greater than three percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam classified as high hazard with a spillway capacity insufficient to discharge fifty percent of the PMF be judged as having a seriously inadequate spillway. As a result, this dam is assessed as unsafe, non-emergency until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as that term would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

We recommend that within twelve months from the date of this report the owner of the dam engage the services of a qualified registered engineer to determine further the potential of overtopping the dam and the need for and the means to increase project discharge capacity. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed and round-the-clock surveillance should be provided during periods of unusually heavy precipitation or high project discharge.

SEP 0 9 1981

NEDED-E
Honorable Hugh J. Gallen

I approve the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the program.

Copies of this report have been forwarded to the Water Resources Board and to the owner, Town of Swanzey. Copies will be available to the public in thirty days.

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

Sincerely,

C E Edgar III

C. E. EDGAR, III
Colonel, Corps of Engineers
Division Engineer

Accession For
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Justification

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NATIONAL DAM INSPECTION

PHASE I INSPECTION REPORT

Identification No.:	NH00202
NHWRB No.:	232.06
Name of Dam:	Upper Wilson Pond Dam
Town:	Swanzey
County and State:	Cheshire, New Hampshire
Stream:	Wilson Brook, a tributary of the Ashuelot River
Date of Inspection:	October 17, 1980

BRIEF ASSESSMENT

The Upper Wilson Pond Dam is located on Wilson Brook approximately one-half mile upstream of Lower Wilson Pond, and approximately 2 miles upstream of the confluence with the Ashuelot River. It can be reached from a town road which intersects State Route 12 in Swanzey, New Hampshire.

The dam is constructed of reinforced concrete and earth fill. It is approximately 225 feet long and 16.6 feet high. The overflow type spillway has a crest length of 36.5 feet at its control section. The spillway narrows to 22 feet at its downstream end (see overview photo). The top-of-dam elevation is 1.6 feet above the spillway crest, which is 15 feet above the streambed. There is a 6-foot-high earth dike to the left of the dam. The dike extends approximately 375 feet along the left bank of the reservoir. The maximum impoundment at this dam is 66 acre-feet.

The original design and construction are unknown. According to records of the New Hamsphire Water Resources Board, the dam was constructed prior to 1925 to provide electric power for Keene Gas and Electric Company. It presently serves only recreational purposes.

The drainage area upstream of this dam is largely affected by a diversion dam on the Branch River. This structure divides flow from the watershed between the Branch River and Wilson Brook, which enters Upper Wilson Pond. About 90 square miles of rolling terrain, mostly forested with some pasture, contributes flow to the diversion structure. Forty-seven square miles of this drainage area is controlled by the upstream Otter Brook Dam. The remaining 43 square miles in uncontrolled. At high flow conditions, most of the flow from the uncontrolled watershed continues down the Branch River. The flow contribution from the 50- to 60-acre area flowing directly into Upper Wilson Pond is small, by comparison, under all flow conditions. The dam is SMALL in size, and its hazard potential classification is HIGH since appreciable economic loss and loss of more than a few lives could result in the event of a dam failure. The appropriate Test Flood for a dam classified SMALL in size with a HIGH hazard potential would be between one-half the Probable Maximum Flood and the Probable Maximum Flood (PMF). One half of the PMF has been adopted as the appropriate Test Flood.

The analysis in Appendix D shows a one-half PMF inflow of 4,850 cfs for the dam. Attenuation due to storage in the reservoir is negligible. The Test Flood outflow is 4,850 cfs with the water surface at 508.4 feet (NGVD), which is 1.8 feet above the top-of-dam. The spillway is capable of passing 5% of the Test Flood routed peak outflow.

The dam is in POOR condition at the present time. It is recommended that the owner retain the services of a qualified registered professional engineer to evaluate the hydraulic adequacy of the spillway, to evaluate the condition of the existing headgate and penstock, and to make recommendations for the a low level outlet. Remedial measures to be undertaken by the owner include repairs of eroded concrete at the interface of the spillway and sidewalls, implementing annual maintenance and inspection programs, and developing a formal written system for warning downstream residents, and officials in the event of an emergency. These engineering studies and remedial measures should be implemented by the owner within one year of receipt of this Phase I Inspection Report.

WILLIAM S. ZOINO
No. 3226

William S. Zoino

William S. Zoino
NH Registration No. 3226

NICHOLAS ANTHONY CAMPAGNA, JR.
No. 21,006
CIVIL

Nicholas A. Campagna, Jr.

Nicholas A. Campagna, Jr.
California Registration No. 21006

This Phase I Inspection Report on Upper Wilson Pond Dam (NH 00202) 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.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

JW Finegan

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared in accordance with 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 expenditiously 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 investigations, and anaylses 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 the need for any 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 whether 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 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 in the future. Only through continued care and inspection can unsafe conditions be detected.

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

The Phase I Investigation does not include an assessment of the need for fences, gates, "no trespassing" signs, repairs to existing fences and railings, or other items which may be needed to minimize trespassing and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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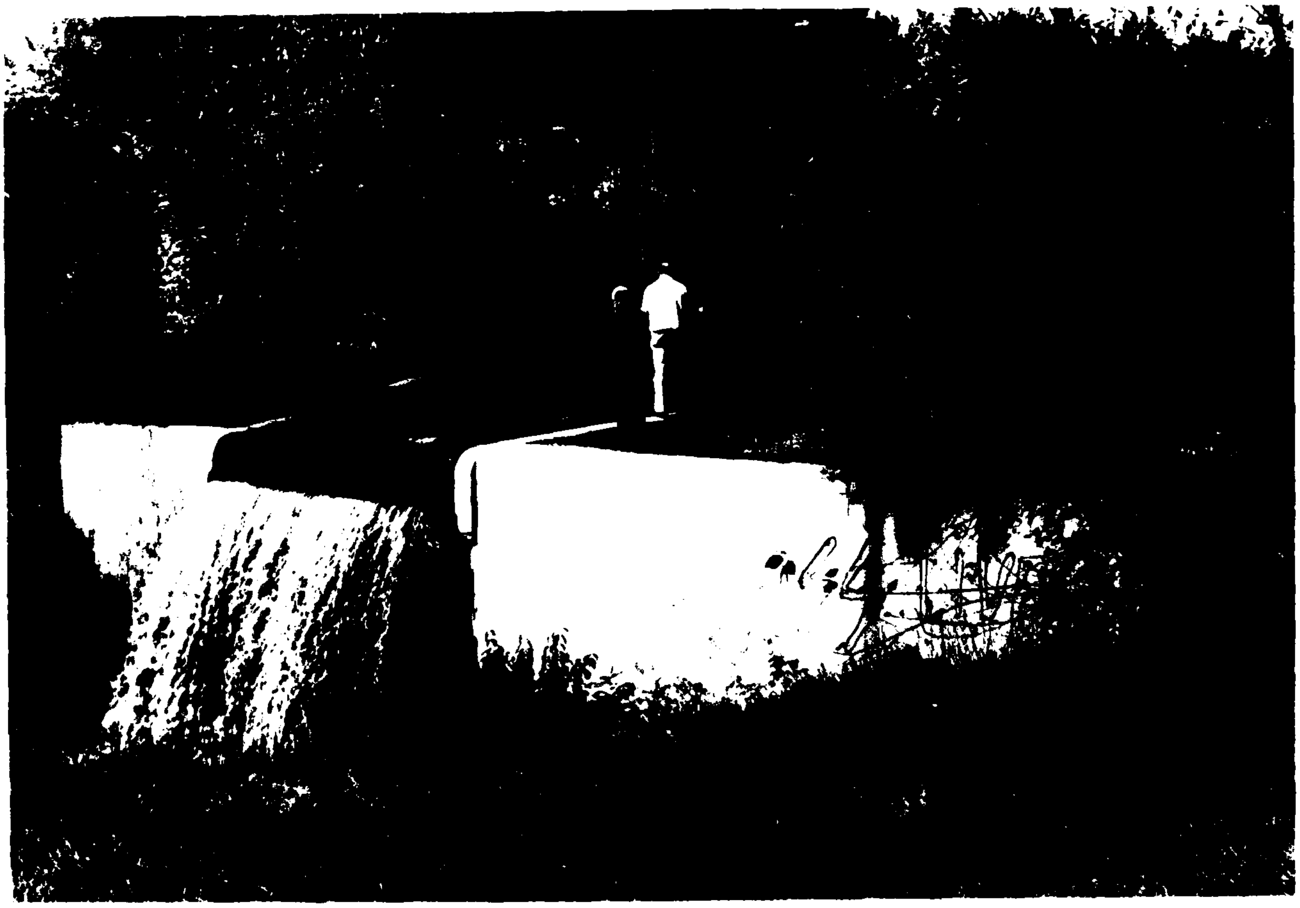
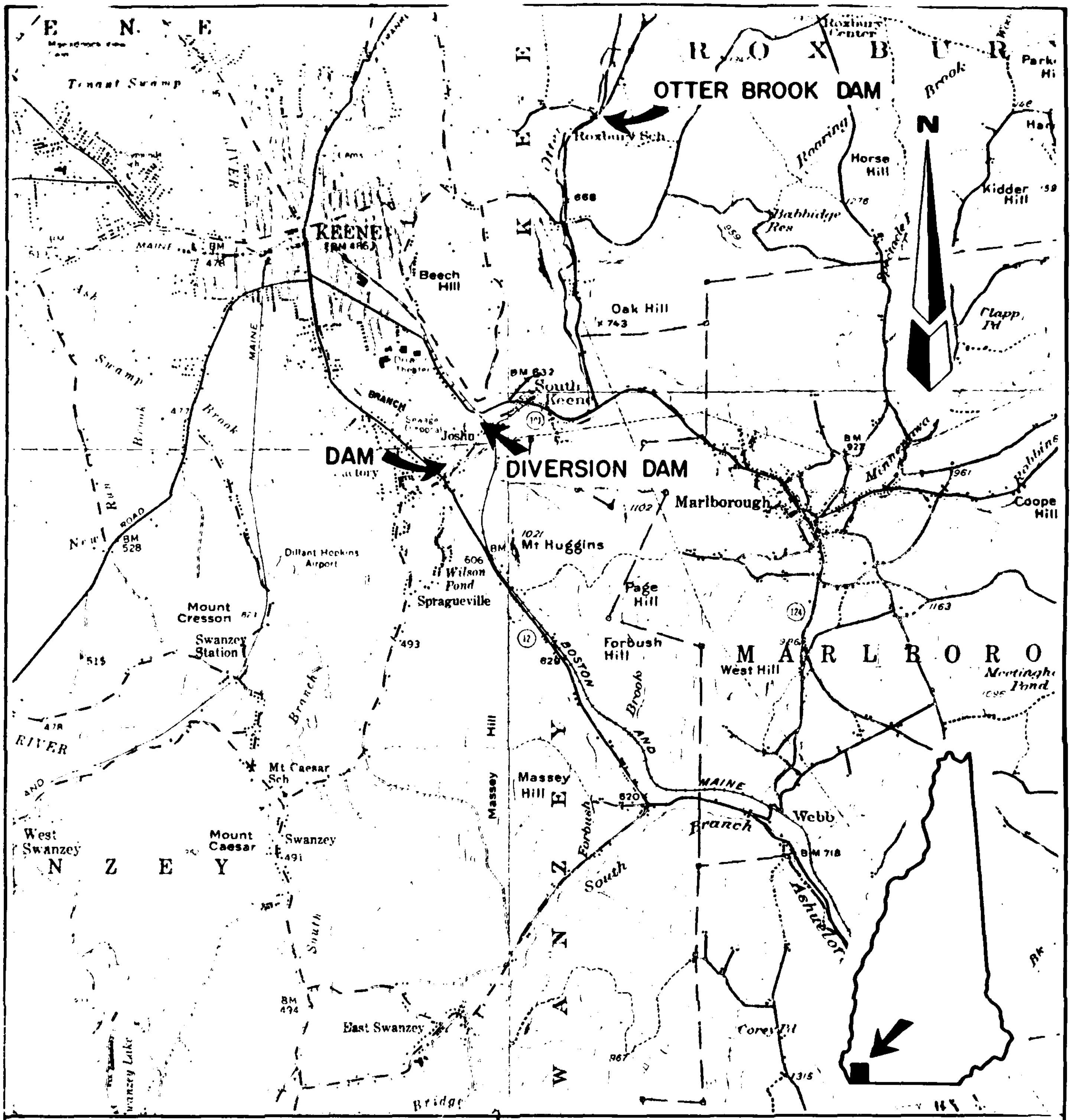
APPENDICES



Overview of Dam



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FROM: USGS KEENE N.H.- VT & MONADNOCK QUADRANGLE MAPS

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION PLAN

FILE No. 2605

UPPER WILSON POND DAM
SWANZEY, NEW HAMPSHIRE

SCALE AS SHOWN
DATE OCT 1980

National Dam Inspection Program

Phase I Inspection Report

Upper Wilson Pond 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. Goldberg-Zoino & Associates, Inc. (GZA) has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed were issued to GZA under a letter of September 23, 1980, from Colonel William E. Hodgson, Jr., Corps of Engineers. Additional investigation of the upstream diversion structure was authorized under a letter of April 29, 1981, from Colonel William E. Hodgson, Jr. Contract No. DACW 33-80-C-0055 has been assigned by the Corps of Engineers for this work.

(b) Purpose

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

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

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

1.2 Description of Dam

(a) Location

The Upper Wilson Pond Dam is located on Wilson Brook, a tributary of the Ashuelot River, approximately one half mile upstream of Lower Wilson Pond Dam in Swanzey, New Hampshire. It can be reached from a town road which intersects State Route 12 in Swanzey, New Hampshire. The dam is shown on USGS Keene, New Hampshire Quadrangle, at approximate coordinates N4254.5, W7215.5 (see location map on Page vi). Page B-2 is a site plan for this dam.

(b) Description of Dam and Appurtenances

The Upper Wilson Dam is a concrete and earthfill structure with a concrete spillway, a vertical stem gate, and a 6-foot steel penstock. The total length of the dam is 600 feet, and its height is 16.6 feet. A plan for this dam is shown in Appendix B on Page B-2. The components noted on that figure are described below. A diversion structure on the Branch River, just upstream of Upper Wilson Pond, controls the inflow to this dam. A plan and cross section of the diversion structure are presented in Appendix B.

(1) Principal Spillway

The principal spillway is a concrete, broad-crested weir, which tapers from 36.5 feet wide at the control section to 22 feet wide at the downstream end. The crest of the spillway is at approximate elevation 505 feet (NGVD).

(2) Head Gate

The only outlet at this dam is the head gate, which is a vertical stem slide gate 8 feet by 8.5 feet. The gate is operated by a hand wheel located above the concrete gate housing. The invert elevation of the gate is unknown. The gate leads to a 6-foot-diameter steel penstock which once extended 200 feet downstream to an abandoned powerhouse. According to records of the New Hampshire Water Resources Board, a portion of this penstock has been removed, and the gate has been blocked with earthfill.

(3) Right Earth Embankment

An earthfill embankment extends approximately 120 feet from the right side of the gate structure to the right abutment. A concrete corewall extends 55 feet through this embankment from the gate structure.

(4) Left Earth Embankment

An earthfill embankment extends approximately 75 feet to the left of the spillway. The maximum height of the embankment is 16.5 feet. The material and foundation conditions of this embankment are unknown. The side slopes are approximately 2 horizontal to 1 vertical.

(5) Earth Dike

A 375-foot-long earth dike extends to the left of the left embankment. This dike is 2 to 6 feet high, and its side slopes are approximately 2 horizontal to 1 vertical.

(c) Size Classification

The dam's maximum impoundment of 66 acre-feet and height of 16.5 feet place it in the SMALL size category according to the Corps of Engineers' Recommended Guidelines.

(d) Hazard Potential Classification

The hazard potential classification for this dam is HIGH because of the appreciable economic losses and potential for loss of more than a few lives downstream in the event of dam failure. Section 5 of this report presents a more detailed discussion of the hazard potential.

(e) Ownership

The dam is presently owned by the Town of Swanzey, New Hampshire. Correspondence should be addressed to the Selectmen, Swanzey, New Hampshire, 03431.

(f) Operator

The operation of the dam is controlled by the Town of Swanzey, New Hampshire. The Town offices can be reached by telephone at (603) 352-7411 or (603) 352-5143.

(g) Purpose of the Dam

The purpose of the dam is to impound water for recreational purposes. At one time, the dam was used to generate hydroelectric power.

(h) Design and Construction History

The original design and date of construction are unknown. The records of the New Hampshire Water Resources Board indicate that the dam was constructed prior to 1925 as a stone masonry and earthfill dam.

(i) Normal Operating Procedure

No formal operating procedures exist for this dam. There are no operable outlet works at the site and no means available to regulate the reservoir. No operating procedures exist for the diversion structure upstream, and the gate at the diversion is inoperable.

1.3 Pertinent Data

(a) Drainage Area

The drainage area for this dam covers 90.1 square miles. It is made up primarily of rolling woodland with some minor pasture. Approximately 90 square miles is controlled by a diversion dam on the Branch River. The diversion dam divides flow between the Branch River and Wilson Brook, which leads to Upper Wilson Pond. Of the 90 square miles draining to the dam, 47 square miles are controlled by the Corps of Engineers' Otter Brook Dam.

(b) Discharge at Dam Site

(1) Outlet Works

There are no operable outlet works at this dam site.

(2) Maximum Known Flood

There is no data available for the Maximum Known Flood at this dam site.

(3) Ungated Spillway Capacity at Top of Dam

The capacity of the spillway with the reservoir at top-of-dam elevation (506.6 feet NGVD) is 239 cfs.

(4) Ungated Spillway Capacity at Test Flood

The Test Flood overtops the dam by 1.8 feet. The flow over the spillway at this level (508.4 feet NGVD) is 755 cfs.

(5) Gated Spillway Capacity at Normal Pool

There are no gated spillways.

(6) Gated Spillway Capacity at Test Flood

There are no gated spillways.

(7) Total Spillway Capacity at Test Flood

The Test Flood overtops the dam by 1.8 feet. The flow over the spillway at this level (508.4 feet NGVD) is 755 cfs.

(8) Total Project Discharge at Top of Dam

The total project discharge at top-of-dam elevation (506.6 feet NGVD) is 239 cfs.

(9) Total Project Discharge at Test Flood Elevation

The total project discharge at Test Flood elevation (508.4 feet NGVD) is 4,850 cfs.

(c) Elevation (feet above NGVD)

(1) Streambed at toe of dam: Approximately 490.0

(2) Bottom of cutoff: Unknown

(3) Maximum tailwater: Unknown

(4) Recreation pool: Approximately 505.0

(5) Full flood control pool: Not applicable

(6) Spillway crest: Approximately 505.0

(7) Design surcharge: Unknown

(8) Top of dam: 506.6

(9) Test flood surcharge: 508.4

(d) Reservoir (length in feet)

(1) Normal pool: 1,200

(2) Flood control pool: Not applicable

(3) Spillway crest pool: 1,200

(4) Top of dam: 1,200

(5) Test flood pool: 1,200

(e) Storage (acre-feet)

(1) Normal pool: 50

(2) Flood control pool: Not applicable

(3) Spillway crest pool: 50

(4) Top of dam pool: 66

(5) Test flood pool: 84

(f) Reservoir Surface (acres)

(1) Normal pool: 10

(2) Flood control pool: Not applicable

(3) Spillway crest pool: 10

(4) Test flood: 10

(5) Top of dam: 10

(g) Dam

(1) Type: Gravity, overflow, concrete and earthfill

(2) Length: Approximately 600 feet

(3) Height: Approximately 16.6 feet

(4) Top width: Approximately 24 feet, variable

(5) Side slopes: Approximately 2 horizontal to 1 vertical

(6) Zoning: Homogeneous

(7) Impervious core: Unknown

(8) Cutoff: Unknown

(9) Grout curtain: None

(h) Dike

(1) Type: Earth embankment

(2) Length: Approximately 375 feet

(3) Height: Approximately 6 feet

(4) Top width: Approximately 8 feet

(5) Side slopes: 2 horizontal to 1 vertical

(6) Zoning: Homogeneous

(7) Impervious core: None

(8) Cutoff: Unknown

(9) Grout curtain: None

(i) Diversion and Regulating Tunnel

Not applicable

(j) Spillway

(1) Type: Concrete, broad-crested weir

(2) Length of weir: 36.5 narrowing to 22 feet

(3) Crest elevation: 505.0 feet (NGVD)

(4) Gates: Spillways not equipped with gates

(5) Upstream channel: Reservoir

(6) Downstream channel: Wilson Brook, rocky, shallow gradient

(k) Regulating Outlets

The only former regulating outlet has reportedly been plugged with earthfill.

Section 2: Engineering Data

2.1 Design Data

None of the original design drawings or calculations are available for this dam. Significantly lacking are data concerning the length and depth of any cutoff and the foundation conditions.

2.2 Construction Records

No construction records are available for this dam.

2.3 Operational Records

No operational records are available for this dam.

2.4 Evaluation of Data

(a) Availability

The lack of detailed design and construction data warrants an unsatisfactory assessment for availability.

(b) Adequacy

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment of the dam is based primarily on the visual inspection, past performance, and sound engineering judgment.

(c) Validity

Since the observations of the inspection team generally confirm the information contained in the records of the New Hampshire Water Resources Board, a satisfactory evaluation for validity is indicated.

Section 3: Visual Inspection

3.1 Findings

(a) General

The Upper Wilson Pond Dam is in poor condition at the present time.

(b) Dam

(1) Spillway (See Photos 4, 8, and overview)

This structure consists of a tapered, broad-crested weir with 12-inch-wide, and 19-inch-high concrete sidewalls. There are concrete cutoff walls on either side of the spillway. There are concrete training walls on both sides of the upstream end of the spillway, and concrete retaining walls on both sides of the downstream end of the spillway.

The concrete surface of the spillway has been subjected to minor surface erosion which can be attributed to cavitation and ice damage. The interface between the sidewalls and the spillway has eroded over its entire length. The erosion is up to 2 inches deep, and can be attributed to cavitation. The downstream end of the spillway has eroded over its entire vertical face. This erosion can be attributed to cavitation and ice damage. Erosion has also occurred at the interface of the downstream end of the sidewalls.

The left upstream cutoff wall has a vertical crack located immediately adjacent to the sidewall return. An additional crack is located approximately 4 feet from the sidewall. The right upstream cutoff wall extends from the spillway sidewall to the sluice gate structure, and then into the right bank as a core wall. This core wall is in good condition, with no evidence of spalls, cracks, or efflorescence.

The left and right downstream retaining walls consist of concrete. These walls were originally 15 inches in their top widths with a back batter of 3 in 12. Subsequent construction consisted of facing these walls with an additional 8 inches of concrete.

These walls are in good condition, with the exception of minor efflorescence at vertical construction joints in the concrete facing. There are no visible spalls or cracks.

(2) Head Gate (See Photos 5, 6, and 7)

The head-gate operating mechanism is located on a double platform. The lower portion consists of concrete-faced stone masonry on its downstream end and sides, and cemented stone masonry on its upstream end. The upper portion consists of cemented stone masonry. Minor seepage is flowing through the lower platform concrete facing at the spillway crest elevation. There is considerable random cracking in the facing, with efflorescence, including minor exudation.

The hand-wheel gate-operating mechanism, which actuates two rack gears on timber stems, is no longer operable. The stems of the gate are rotted, and earthfill has been placed in the waterway in front of the gate. An 8-inch-diameter penstock vent pipe is located approximately 2 feet downstream of the concrete-faced platform. A 10-inch, vertical, cast iron pipe is located on the right bank, approximately 10 feet upstream of the sluice gate, which is the former housing of the telemetering system.

(3) Penstock

Available records indicate that the penstock was a 6-foot-diameter steel pipe, which passed downstream under the roadway to a power generating station. The records also indicate that the section of the penstock below the road has been removed.

(4) Earthfill Embankments

The earthfill embankments on either side of the spillway are in fair condition, with much brush and small tree growth. There is evidence of erosion around the left retaining wall and an erosion gully in the downstream left slope. Some steel bars have been driven into the upstream left slope as a soil retention measure.

(5) Earth Dike (See Photos 1 and 2)

There is an earth dike approximately 375 feet long and up to 6 feet high constructed along the left upstream bank. This dike is in fair condition with numerous large trees.

(c) Reservoir Area (See Photo 1)

The shore of the reservoir area is generally shallow to medium sloping woodland. It appears to be stable and in good condition.

(d) Downstream Channel (See Photos 9 and 10)

The downstream channel is Wilson Brook, which is rocky and strewn with debris.

3.2 Evaluation

The dam is in poor condition, and its appurtenant structures are generally in poor condition. The problem areas noted during the visual inspection are listed as follows:

(a) The head gate has been permanently sealed, leaving no means of lowering the reservoir.

(b) Erosion gullies exist on the downstream slopes.

(c) There is heavy tree growth on the earth dike. The loss of a tree could cause failure of the dike due to uprooting or rotting of the roots.

(d) There is erosion of concrete at the spillway interfaces.

Section 4: Operational and Maintenance Procedures

4.1 Operational Procedures

(a) General

No written operational procedures exist for this dam. The dam is normally self-regulating. There are no operable outlet works for this dam.

(b) Description of any Warning System in Effect

There is no warning system in effect at this dam.

4.2 Maintenance Procedures

(a) General

No formal maintenance program exists for the dam, and maintenance is performed infrequently.

(b) Operating Facilities

No formal maintenance program exists, and maintenance is performed infrequently.

4.3 Evaluation

Emphasis on routine maintenance will assist the owner in assuring the long-term safety of the dam and operating facilities. A formal, written, downstream emergency warning system should be developed for this dam.

Section 5: Evaluation of Hydraulic/Hydrologic Features

5.1 General

Upper Wilson Pond is an earth embankment with a concrete spillway on Wilson Brook, a tributary of the Ashuelot River, which is a tributary of the Connecticut River. The dam is located three-tenths of a mile upstream of Route 12 in Swanzey, New Hampshire.

Upper Wilson Pond is formed by a 600-foot-long earth embankment and dike. The dam is about 17 feet high at the outlet. The principal spillway is a 36.5-foot concrete weir located just upstream of a 12.5-foot by 8-foot arch culvert, where Wilson Brook crosses a two-lane country road. A gate structure to the right of the spillway orginally controlled flows to a penstock and power station, but the gate is now inoperable, and a portion of the penstock has been removed.

The reservoir behind the dam has a surface area of about ten acres at normal pool. The reservoir stores about 65.8 acre-feet at the dam crest. The dam crest elevation is only 1.6 feet higher than the spillway crest. Thus, very little freeboard exists above the normal water level of the pond.

The principal spillway consists of a concrete slab with a crest width of 36.5 feet. This slab slopes down at 1.5 inches per foot, and narrows to 22 feet wide. Concrete wing walls form the abutments at either side, extending to a height of 19 inches above the spillway crest. The earth embankment extends 75 feet beyond the wing wall to the right, and to the left, it merges with a dike along the shoreline that extends about 400 feet beyond the wing wall.

A two-lane country road with a 12.5-foot by 8-foot arch culvert crosses the stream about 40 feet below the dam. A house and small business are located between the 400-foot section of dike and this road on land varying from 1 foot to 3 feet lower than the top of the dike. The former powerhouse, just downstream, has recently been used as a home. This structure is about 4 feet above the stream channel.

Downstream of the road, Wilson Brook flows at a rather steep grade from about 850 feet to the location where it crosses Route 12. A group of ten to twelve cabins is located at the downstream end of this reach, 5 to 6 feet above the stream channel.

The stream passes under Route 12 through a pair of 12.5-foot by 8-foot arch culverts. About 200 feet beyond Route 12, Wilson Brook enters Lower Wilson Pond. Lower Wilson Pond Dam is the subject of a separate Dam Safety Inspection Report. No areas that would be affected by Upper Wilson Pond Dam are located downstream of Lower Wilson Pond.

The watershed area upstream of Upper Wilson Pond Dam is largely affected by a diversion dam on the Branch River, which divides flow from a very large watershed between the Branch River and Wilson Brook, which enters the pond. About 90 square miles of rolling terrain, mostly forested with some pasture, contributes to the point of divide. The diversion structure on the Branch River consists of a run of the river main dam with the remnants of some abandoned diversion works in the left abutment (see Sketches on Pages B-2B and B-2C). The main dam is a 98-foot-long, concrete, ogee spillway that spans the river. On either side of the river, levees extend for several hundred feet upstream to a height of 5 to 6 feet above the streambed to provide a small ponding area. The diversion works originally supported the lifting mechanism for a 9-feet-wide by 4.5-feet-high steel sluice gate that controlled flows to a 500-foot-long by 10-foot-wide channel that enters Upper Wilson Pond. The lifting mechanism to this gate has now been removed. The gate itself has been removed from its guide slots and is now displaced a few feet downstream at the skewed angle so that an opening about one foot wide occurs that allows perhaps 20 cfs to pass on to the Wilson Brook Channel at normal water levels. At higher flow conditions, most of the flow from the contributing watershed would pass over the main dam spillway and through a break in the right bank levee to continue down the Branch River. The flow contribution from the 50- to 60-acre area flowing directly into Upper Wilson Pond, however, would be small compared to the diverted Branch River discharge under all flow conditions.

5.2 Design Data

Data sources available for Upper Wilson Pond Dam include a sketch of the dam dated October 21, 1937, by the Public Service Commission of New Hampshire; the New Hampshire Water Resources Board's "Inventory of Dams and Water Power Developments," dated

October 27, 1937; The New Hampshire Water Control Commission's "Data on Dams and Water Power Developments in New Hampshire," dated September 14, 1939; and a USGS "Report on Developed Water Power," dated June, 1919. Also available were inspection reports by the New Hampshire Water Resources Board dated December 5, 1974, and November 9, 1978. The original hydraulic calculations were not available for this dam.

5.3 Experience Data

No records for flow or stage are known to be available for Upper Wilson Pond Dam or the area immediately downstream.

5.4 Test Flood Analysis

The hydrologic conditions of interest in this Phase I investigation are those required to assess the dam's overtopping potential and its ability to allow an appropriately large flood to pass safely. This requires use of the discharge and storage characteristics of the structure to evaluate the impact of an appropriately sized Test Flood. The original hydraulic and hydrologic design analyses are not available for this dam.

Guidelines for establishing a recommended Test Flood, based on the size and hazard classification of a dam, are specified in the "Recommended Guidelines" of the Corps of Engineers. The impoundment of less than 1,000 acre-feet and the height of less than 40 feet classify this dam as a SMALL structure.

The appropriate hazard classification for this dam is HIGH because of the significant economic losses and potential for loss of more that a few lives downstream in the event of failure of the dam. As shown in the Dam Failure Analysis section, the increase in flooding caused by failure could cause extensive property damage and loss of life at the Route 12 crossing, 900 feet downstream of the dam.

As shown in Table 3 of the "Recommended Guidelines," the appropriate Test Flood for a dam classified as SMALL in size with a HIGH hazard potential would be between one-half the probable maximum flood (PMF), and the PMF. Since the dam height of 17 feet and the impoundment of 66 acre-feet are on the low side of the small size catagory, one half of the PMF flood in the appropriate Test Flood.

Peak Flood flows reaching Upper Wilson Pond are largely determined by the hydraulics of a diverson structure on the Branch River, just upsteam of the pond. About 90 square miles of rolling terrain, mostly forested with pasture, contributes to this point, where some is diverted into Wilson Brook. The flow contribution into Upper Wilson Pond from the small (50-acre to 60-acre) area draining directly into the pond is very small, compared to that from the diversion, under all flow conditions.

The Test Flood inflow to Upper Wilson Pond is determined as a portion of the corresponding total Test Flood inflow at the diversion dam on the Branch River. Of the 90-square-mile area draining to the diversion structure, 47 square miles is controlled by the Corps of Engineers' Otter Brook Dam.

The remaining, uncontrolled 43-square-mile drainage area would produce a peak Probable Maximum Flood (PMF) discharge of 1,200 cfs per square mile, or a peak Test Flood (1/2 PMF) inflow at the diverson of 25,800 cfs. This would create a stage of 9.3 feet above the diversion spillway, which would send 4,850 cfs to Upper Wilson Pond Dam. The inflow from the 0.1-square-mile direct drainage to Upper Wilson Pond at the time of occurrence of this peak would be negligible by comparison.

Attenuation in Upper Wilson Pond would also be negligible for a flow of this magnitude. The peak Test Flood outflow of 4,850 cfs would cause a stage of 3.4 feet (508.4 feet NGVD), or 1.8 feet above the abutments. The spillway capacity with water level at the top of the dam is only 5% at the peat Test Flood outflow.

5.5 Dam Failure Analysis

The downstream flows that would result from the failure of Upper Wilson Pond Dam have been estimated using the procedure suggested in "Rule of Thumb Guidelines for Estimating Downstream Dam Failure Hydrographs." The failure is assumed to occur with the water surface elevation at the level of the abutments at 506.6 feet msl. The outflow prior to dam failure would be 239 cfs, creating a tailwater of about 4.2 feet in the channel downstream of the dam.

An alternative mode of failure that warrants some consideration is failure of the dike section of the dam embankment. About 100 feet east of the dike are a house and a small business structure, about 1 foot to 3 feet lower than the top of the dike. These two buildings might be damaged in the event of dike failure, whereas they probably would not be if the failure were to occur near the main spillway section. There would probably be little danger of loss of life for dike failure because depths of flooding would only be 1 foot to 2 feet. Flow from failure would rejoin Wilson Brook and continue downstream after passing these two structures, and create a lower downstream hazard potential than would failure of the main dam section as described below.

About 40 feet downstream of the toe of the spillway, Wilson Brook is crossed by a two-lane road having a 12.5-foot by 8-foot CMP arch culvert. The pre-failure flow of 239 cfs would create a stage of about 4.2 feet at the bridge. The peak dam failure flow of 4,950 cfs would create a stage of 14.1 feet, 2.9 feet over the top of the roadway. This might well cause damage to the bridge structure.

Downstream of this bridge, Wilson Brook runs about 360 feet in a reach where attenuation would be negligible due to limited storage available and short length. The pre-failure flow of 239 cfs would create a flow of 2.2 feet in this channel, which would be increased by 9.0 feet by the failure flow of 4,950 cfs.

The only structure in this reach is the former powerhouse for the dam. This structure has recently been used as a dwelling, and is located about 5 feet above the channel. Dam failure would cause 5 feet to 7 feet of flooding at this structure and would present a threat of loss of life.

For the next 500 feet downstream, to Route 12, the pre-failure flow of 239 cfs would create a stage of 2 feet to 3 feet, which would be increased to 7 feet to 8 feet by the dam failure flow. A group of ten to twelve cabins is located at the downstream end of this reach, 5 feet to 6 feet above the stream channel. These would be flooded by backwater at the Route 12 bridge from the flow of 4,530 cfs after failure, which would cause a flood stage of 13.6 feet, 2.6 feet above the roadway. This could cause damage to the Route 12 bridge, and would cause 8 feet to 10 feet of flooding at the cabins upstream of the road, clearly threatening lives and property.

Immediately downstream of Route 12 are a hotel and an automobile repair shop, which are both 12 feet above the stream and might receive minor flooding due to dam failure. Within 200 feet of Route 12, Wilson Brook enters Lower Wilson Pond Dam, where the flow would be attenuated and cause no further damage.

The chart on the following page summarizes the downstream effects of the failure of Upper Wilson Pond Dam. The hazard classification for this dam is considered to the HIGH because of the potential for loss of more than a few lives at the cabins located at the Route 12 crossing if the dam should fail.

Location	Location # (see map)	Distance D/S from Dam (ft.)	# of Structures	Level Above Stream (ft.)	Flow & Stage		Comments
					Before Failure	After Failure	
1st Bridge	-	40	1 bridge	11.2 ft. (road level)	239 cfs 4.2 ft.	4950 cfs 14.1 ft.	Possible damage to Bridge.
just D/S of Bridge	-	100	1 house	4	239 cfs 2.2 ft.	4950 cfs 9.9 ft.	Danger of loss of Life.
Route 12 Bridge	1	900	10-12 cabins just D/S 1 motel 1 auto shop	5-6	239 cfs 2.2 ft.	4530 cfs 13.6 ft.	Possible damage to bridge, danger of loss of life at cabins.
Lower Wilson Pond Dam	1	4400	20-25 house roadway	5+ 3.5	239 cfs 3.6 ft.	820 cfs 4.3 ft.	Increase level of flow over roadway - possible damage.

Section 6: Structural Stability

6.1 Evaluation of Structural Stability

(a) Visual Observations

The Upper Wilson Pond dam is in fair condition at the present time. Some minor cracking and spalling of concrete were noted. No structural deficiencies were noted which would warrant further investigations.

(b) Design and Construction Records

No plans or calculations of value to a stability assessment are available for this dam.

6.2 Design and Construction Data

No records of structural stability analyses are available for this dam.

6.3 Post Construction Changes

A concrete facing was added to the downstream end of the spillway and the retaining walls. Records indicate that the penstock has been severed and the head gate plugged.

6.4 Seismic Stability

The dam is located in seismic zone No. 2 and, in accordance with the recommended Phase I guidelines, does not warrant seismic analysis.

Section 7: Assessment, Recommendations, and Remedial Measures

7.1 Dam Assessment

(a) Condition

The Upper Wilson Pond dam is in poor condition at the present time.

(b) Adequacy of Information

The lack of in-depth engineering data does not permit a definitive review. Therefore, the adequacy of the dam cannot be assessed from the standpoint of reviewing design and construction data. This assessment is based primarily on the visual inspection, past performance, and sound engineering judgment.

(c) Urgency

The engineering studies and improvement described herein should be implemented by the owner within one year of receipt of this Phase 1 Inspection Report.

7.2 Recommendations

It is recommended that the services of a qualified registered professsional engineer be retained to:

(a) Perform more detailed hydrologic and hydraulic studies to determine the need and means to increase the project discharge capacity and the dam's ability to withstand overtopping.

(b) Investigate the condition of the existing head gate and penstock.

(c) Make recommendations for a low-level outlet to provide a means of lowering the reservoir in an emergency.

(d) Develop a method for removing the all tree growth and root systems from the earth dike.

The owner should implement the findings of these studies.

7.3 Remedial Measures

It is recommended that the following remedial measures be undertaken by the owner:

(a) Repair the eroded concrete at the interface of the spillway and sidewalls.

(b) Implement a program of annual technical inspections of the dam and its appurtenances, including operation of all outlet works.

(c) Develop a plan for surveillance of the project area during flood periods and prepare a formal plan for warning the downstream residents and the appropriate officials in the event of an emergency.

(d) Implement and intensify a program of diligent and periodic maintenance, including, but not limited to: mowing embankment slopes; backfilling drainage gullies with suitable, well-tamped soil; and removing brush from slopes.

7.4 Alternatives

There are no practical alternatives to the above recommendations.

APPENDIX A

VISUAL CHECKLIST WITH COMMENTS

Inspection Team Organization

DATE: October 17, 1980

PROJECT: NH00202
Upper Wilson Pond Dam
Swanzey, New Hampshire
NHWRB No. 232.06

WEATHER: Clear, warm

INSPECTION TEAM:

Nicholas A. Campagna	Goldberg-Zoino & Assoc.	Team Captain
William S. Zoino	GZA	Soils
Jeffrey M. Hardin	GZA	Soils
Andrew Christo	Andrew Christo Engineers	Structures
Paul Razgha	ACE	Structures
Carl Razgha	ACE	Structures

NHWRB Representative Present - Gary Kerr

NOTE: Tom Gooch and Richard Laramie of Resource Analysis Inc. performed the hydrologic inspection of this dam on October 3, 1980.

Mr. Jeff Hardin and Mr. Richard Laramie observed the upstream diversion structure on June 18, 1981.

UPPER WILSON POND DAM
Swanzey, New Hampshire.

October 17, 1980
NH00202

CHECKLIST FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITIONS AND REMARKS
GENERAL		
Crest Elevation		506.6 feet NGVD
Current Pool Elevation		505 feet NGVD
Maximum Impoundment to Date		No data
Surface Cracks		None noted
Pavement Condition		Not applicable
Movement or Settlement of Crest		None noted
Lateral Movement		None noted
Vertical Alignment		Good
Horizontal Alignment		Good
Condition at Abutment and at Concrete Structure		Some erosion of left embankment near spillway, steel bars placed for protection.
Indications of Movement of Structural Items on Slopes		None noted
Trespassing on Slopes		None noted
Vegetation on Slopes		Heavy tree growth on left embankment and earth dike.

CHECKLIST FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITIONS AND REMARKS
Sloughing or Erosion of Slope or Abutments		Some erosion of left upstream and downstream slopes.
Rock Slope Protection-Riprap Failure		None
Unusual Movement or Cracking at or near Toes		None
Unusual Embankment or Downstream Seepage		None
Piping or Boils		None
Foundation Drainage Features		None
Toe Drains		None
Instrumentation System		None
<u>SPILLWAY</u>		
General Condition of Concrete		Minor surface erosion attributable to cavitation and ice damage. Interface between sidewalls and spillway eroded up to 2 inches deep. Horizontal contruction joint eroded over full length of spillway 2 inches by 2 inches. Vertical

UPPER WILSON POND DAM
Swanzey, New Hampshire.

October 17, 1980
NH00292

CHECKLIST FOR VISUAL INSPECTION

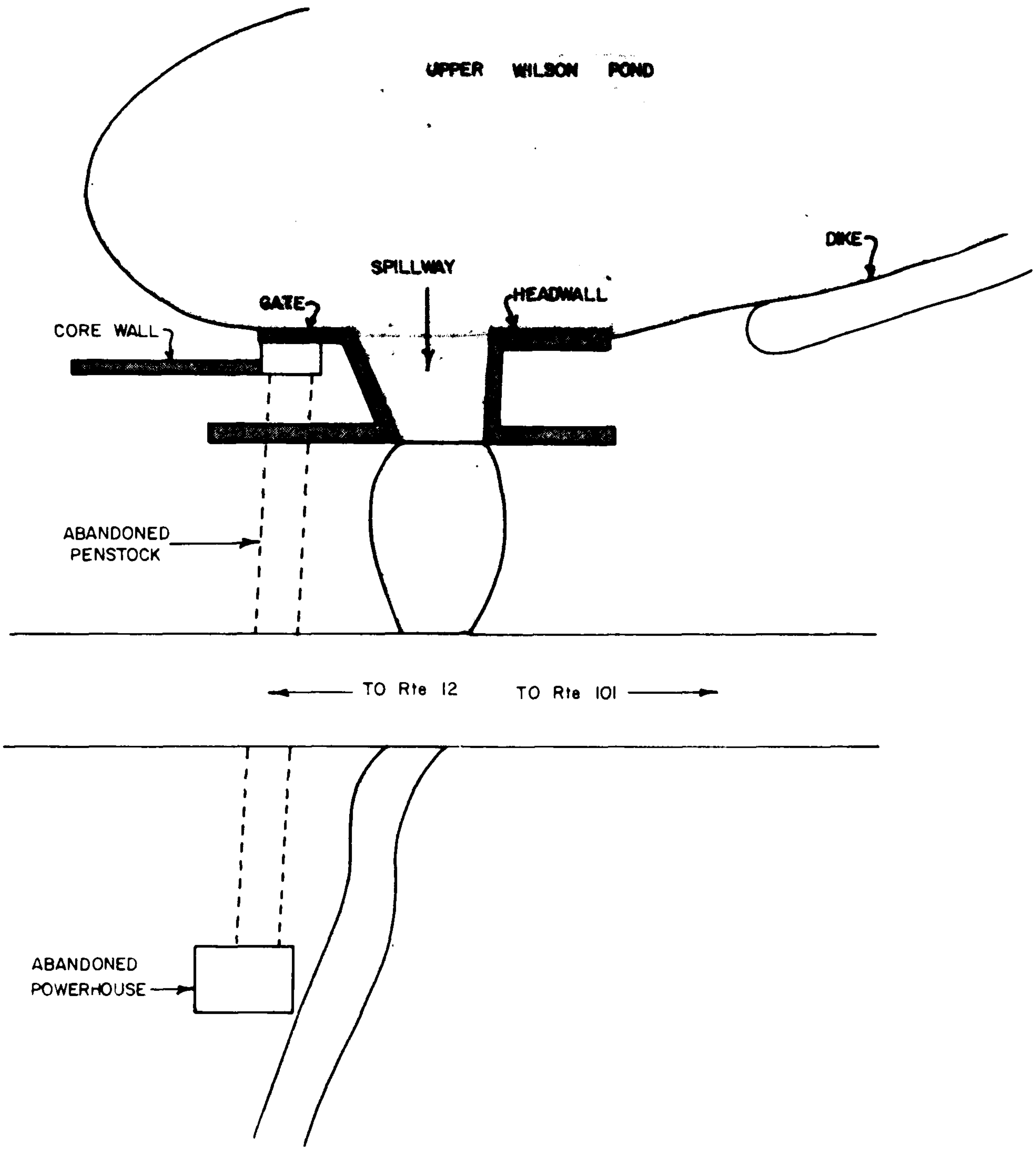
AREA EVALUATED	BY	CONDITIONS AND REMARKS
		face of downstream end of spillway eroded including interface with sidewall.
Rust or Staining		None
Spalling		None
Visible Reinforcing		None
Seepage or Efflorescence		None
Drain Holes		None
<u>LEFT UPSTREAM CUTOFF WALL</u>		
General Condition of Concrete		Two vertical cracks near the sidewall return.
Rust or Staining		None
Spalling		None
Visible Reinforcing		None
Seepage or Efflorescence		None
Drain Holes		None
<u>RIGHT UPSTREAM CUT-OFF WALL</u>		
General Condition of Concrete		Good
Rust or Staining		None
Spalling		None

CHECKLIST FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITIONS AND REMARKS
Visible Reinforcing		None
Seepage or Efflorescence		None
Drain Holes		None
LEFT AND RIGHT DOWNSTREAM RETAINING WALLS		
General Condition of Concrete		Good
Rust or Staining		None
Spalling		None
Visible Reinforcing		None
Seepage or Efflorescence		Right wall - none; left wall shows minor efflorescence at a vertical construction joint.
Drain Holes		None
HEAD GATE		Gate mechanism partially removed. Timber gate stems rotted. Earth fill placed in front of gate. Penstock apparently severed upstream of highway. Seepage through concrete-faced stone masonry platform of waste gate. Considerable random cracking of concrete facing with efflorescence and minor exudation. Minor seepage through platform at approximate impoundment pool elevation.

APPENDIX B

ENGINEERING DATA



GOLDBERG ZOINO & ASSOCIATES, INC
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

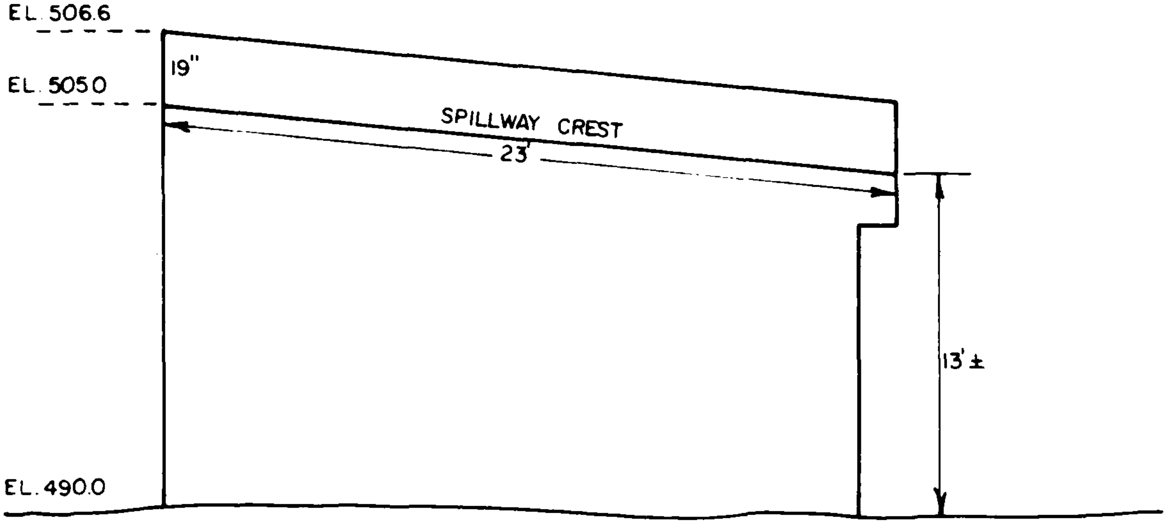
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

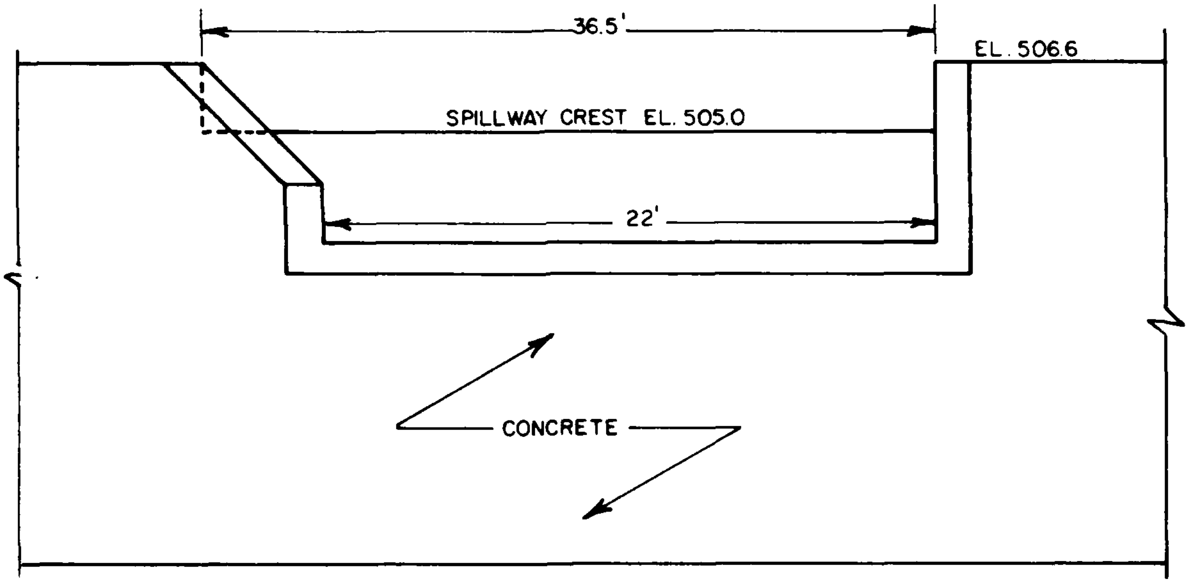
SITE PLAN

FILE No 2605

UPPER WILSON POND DAM
SWANZEY, NEW HAMPSHIRE

SCALE SCHEMATIC
DATE OCT 1980





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U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

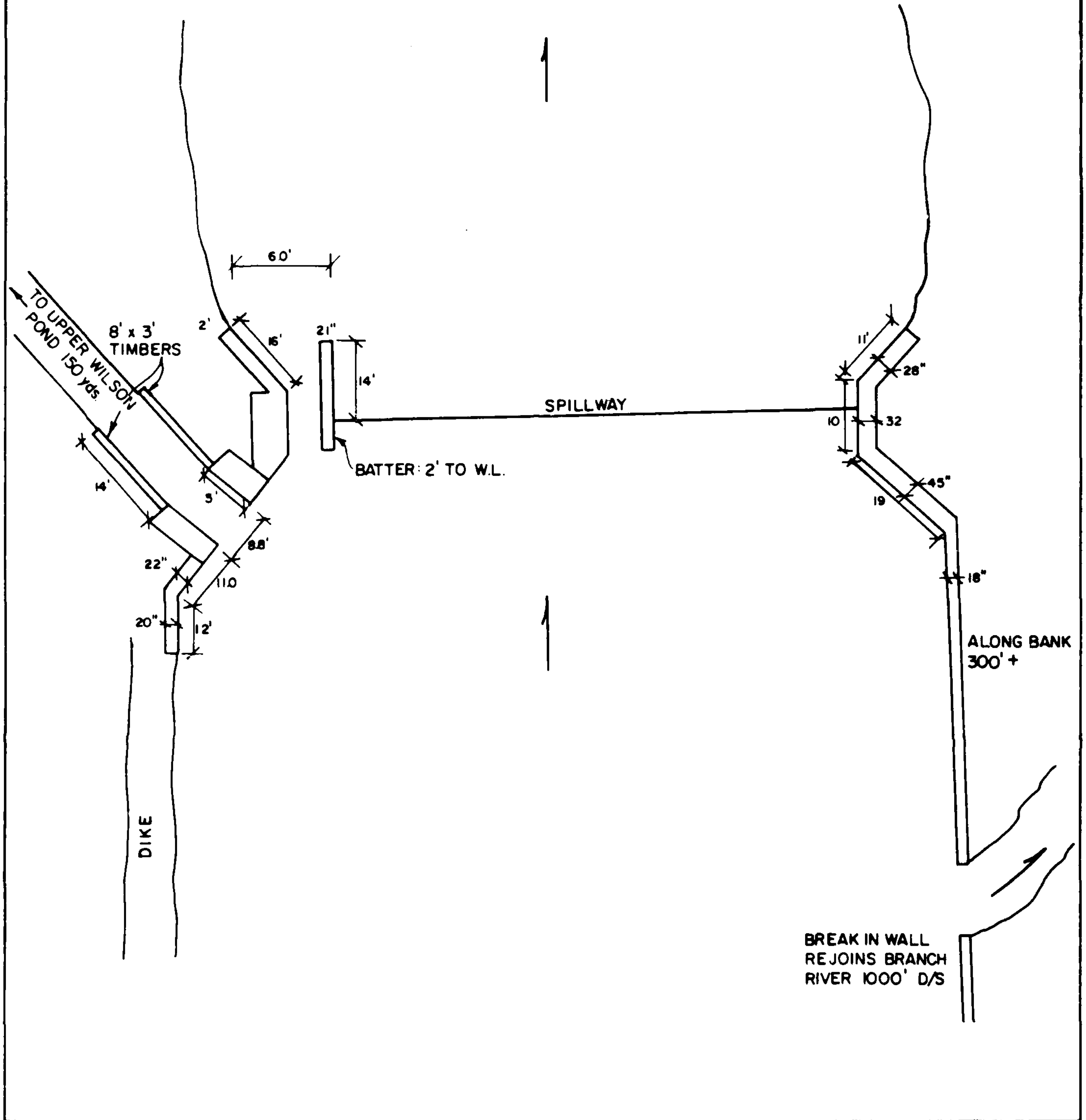
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

SPILLWAY CROSS SECTION

UPPER WILSON DAM
SWANSEY, NEW HAMPSHIRE

FILE No. 2605

SCALE NOT TO SCALE
DATE JUNE 1981



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U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BRANCH RIVER DIVERSION STRUCTURE

UPPER WILSON DAM

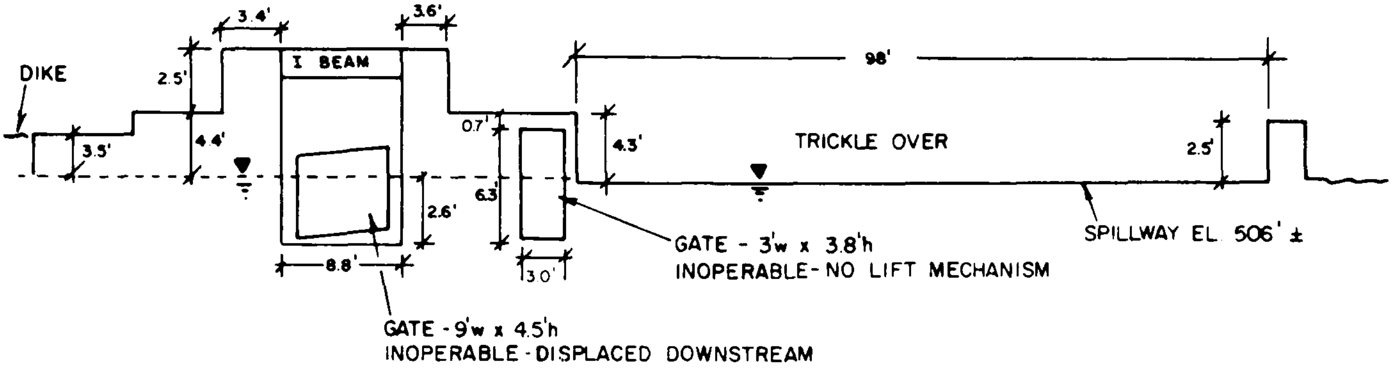
KEENE, NEW HAMPSHIRE

SCALE NOT TO SCALE

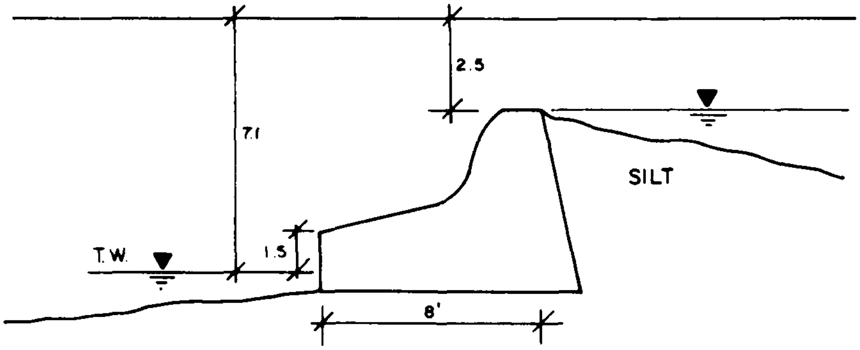
DATE JUNE 1981

FILE No 2605

SHEET 1 of 2



ELEVATION VIEW



SECTION AT RIGHT ABUTMENT

GOLDBERG ZOINO & ASSOCIATES, INC
GEOTECHNICAL - GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

BRANCH RIVER DIVERSION STRUCTURE

FILE No 2605

UPPER WILSON DAM

KEENE, NEW HAMPSHIRE

SCALE NOT TO SCALE

DATE JUNE 1981

SHEET 2 of 2

State of New Hampshire
WATER RESOURCES BOARD
37 Pleasant Street
Concord, N.H. 03301
TELEPHONE 271-3406

November 9, 1978

Board of Selectmen
Town of Swanzey
Swanzey, New Hampshire 03431

Dear Sirs:

On November 8, 1978 an engineer from our Office inspected the Wilson Pond Dam (No. 232.10) and the Upper Wilson Pond Dam (No. 232.06) near the airport.

There are several maintenance items which require your attention.

At the Upper Dam (No. 232.06) there are numerous small and sprout trees growing on the dam near concrete appurtenances which should be cut. It is suggested that you chemically treat the stumps after cutting to avoid the necessary re-cutting of the sprouts every few years.

At the Wilson Pond Dam (No. 232.10) there are some trees near the concrete outlet structure which require similar treatment. Also, there was considerable leakage through the gate area which should be stopped. The gate may not be flush with the sill or there may be some deterioration in the area. This should be watched to see if the situation worsens. The concrete which supports the I beam which supports the gate lifting mechanism is showing signs of gradual deterioration. This concrete should be checked yearly to determine the rate of deterioration and plan on repairs when needed.

If you have any questions please contact us at your convenience.

Sincerely,

George McGee Sr.

George M. McGee, Sr.,
Chairman

GMM:KS:paf

MEMO

Date: November 9, 1978

To: Vernon A. Knowlton,
Chief Engineer

From: Ken Stern,
Water Resources Engineer

Subject: Wilson Ponds No. 232.06 and 232.10

232.06

Six inches of new concrete was placed on the downstream face to repair the previously deteriorated concrete.

There are numerous sprout trees growing on the dam that should be cut to prevent damage to the walls.

No seepage was observed and the dam appeared to be in good condition.

232.10

The dam appears to be in relatively good condition.

The gate mechanism is in good condition but there is substantial leakage at the bottom of the gate. The gate may not be down hard on the Sill or the sill may be eroded in one corner. The leak does not jeopardize the structure and will probably be fixed if it causes a lowering of the pond level next summer. Silt may seal it before then.

There is one concrete area which supports the I beam which supports the gate lifting mechanism which is showing signs of deterioration. Repairs are not deemed necessary at the present but the concrete should be checked on a bi-yearly basis.

Two trees growing near the concrete outlet should be cut.

Ken

KS:paf

M E M O

Date: November 9, 1978

To: Vernon A. Knowlton,
Chief Engineer

From: Ken Stern,
Water Resources Engineer

Subject: Wilson Ponds No. 232.06 and 232.10

232.06

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There is one concrete area which supports the I beam which supports the gate lifting mechanism which is showing signs of deterioration. Repairs are not deemed necessary at the present but the concrete should be checked on a bi-yearly basis.

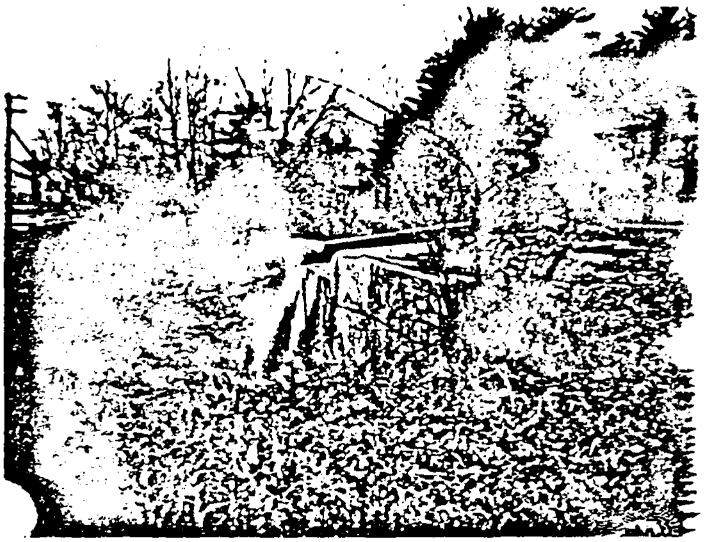
Two trees growing near the concrete outlet should be cut.

Ken

KS:paf

Dam No. 232.06 inspected by Ken Stern 11/8/78

6" new concrete facing
numerous small trees
(sprouts from previous stumps?)



File

RECEIVED
G.M.M.Sr.
JAN 17 1975
NEW HAMPSHIRE
WATER RESOURCES BOARD

TOWN OF SWANZEY
SELECTMEN'S OFFICE
P. O. BOX 12
EAST SWANZEY, N. H. 03446

January 15, 1975

State of New Hampshire
Water Resources Board
37 Pleasant Street
Concord, New Hampshire 03301

Att'n: Mr. George McGee, Sr., Chairman

Dear Sir:

In reply to your letter of December 17, 1974 referring to Dam #232.06. We will have our highway department crew cut the trees on the earth works at the dam. The concrete repairs will be made in the spring.

The only gate this dam ever had was one that controlled the flow to a small generator once used by the Public Service Co. of N.H. Several years ago we removed the conduit that led from the gate to the power house where it crossed the road. The gateway was covered with earth so that water will not come through.

The dam in its present state withstood the 1936 and 38 floods. We believe it needs no operational gate to be safe.

Very truly yours,

David M. Perry
J. H. Moe Jr.
Harry E. Kenney Jr.
Selectmen
of
Swanzey

Vern

State of New Hampshire
WATER RESOURCES BOARD
37 Pleasant St.
CONCORD 03301

December 17th, 1974

Town of Swanzey
Town Office
Swanzey, NH

Attention: Mr. David M. Perry, Chairman
Board of Selectmen

CERTIFIED MAIL

Dear Mr. Perry:

On December 5th, 1974, an engineer of the New Hampshire Water Resources Board inspected your dam located on Upper Wilson Pond in the Town of Swanzey.

This dam, # 232.06 in the files of the New Hampshire Water Resources Board, is classified as a menace structure, and as such, must be maintained in a manner so that this structure would not endanger the public safety, nor become a "Dam in Disrepair".

As a result of this inspection, the several items noted on the attached sheet were found to be deficient and should be corrected immediately.

Under the provisions of Chapter 482:42-59, by petition from the selectmen of the town of mayor of any municipality or upon its own motion, the Board may conduct a public hearing for the determining of whether or not said dam is a "Dam in Disrepair". Should such a finding be determined, the owner would be requested to make the repairs within a specified time period. Upon failure to do so, the town, by the provisions of these statutes, may take the dam.

This office would appreciate receipt of your proposed schedule of these repairs, within 30 days receipt of this letter, and should no response be received within this time period, the Board may direct that a public hearing be conducted and a formal order be issued requiring that the necessary repairs be made or that this dam be breached.

If you have any questions regarding the above, please contact us at your convenience.

Very truly yours,

~~George M. McGee, Sr.~~
Chairman

gmmg/vak:js
enclosure

Town of Swanzey
Swanzey, NH

Attention: Mr. David M. Perry, Chairman
Board of Selectmen

RE: REPAIRS -- NECESSARY TO DAM, SWANZEY - #232.06

1. Trees are to be removed from the embankments.

2. Concrete on the downstream side of the spillway is to be repaired.

3. It appears that the gates are inoperative. If this dam cannot pass a flood flow without these gates then they shall be made operative.

deb

N. H. WATER RESOURCES BOARD
Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Swanzey

Dam Number: 232.06

Inspected by: SCB

Date: 5 Dec 1974

Local name of dam or water body:

Owner:

Address:

Owner was/was not interviewed during inspection.

Drainage Area: 84 sq. mi.

Stream:

Pond Area: Acre, Storage Ac-Ft. Max. Head Ft.

Foundation: Type , Seepage present at toe - Yes/[✓ No]

Spillway: Type , Freeboard over perm. crest: 19",

Width overflow, Flashboard height None,

Max. Capacity c.f.s.

Embankment: Type , Cover Width ,

Upstream slope to 1; Downstream slope to 1

Abutments: Type , Condition: Good, Fair, Poor

Gates or Pond Drain: Size Capacity Type

Lifting apparatus Operational condition NO!

Changes since construction or last inspection:

Downstream development: 12' x 8' H, Box Arch under Road!

This dam [✓ would]/would not be a menace if it failed.

Suggested reinspection date:

Remarks: Trees are To be Removed From The Embankment Concrete on Down Stream side of spillway eroded Bars showing

232.06 – Upper Wilson Pd

Dam generaly in good condition. Swimmers have eroded fill around left end of dam making lowered about 3" – needs some fill in this spot, right away

Aug 14, 1947

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 232.06 ✓

Town Swanzey ✓ : County Cheshire ✓

Stream Upper Pd. Outlet ✓

Basin-Primary Connecticut R. ✓ : Secondary Ashuelot R. ✓

Local Name

Coordinates—Lat. : Long.

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 84 81.15 +- Sq. Mi.

Overall length of dam 275 ✓ ft.: Date of Construction

Height: Stream bed to highest elev. 16.5 ✓ ft.: Max. Structure 14.5 ' 14'10" ft.

Cost—Dam : Reservoir

DESCRIPTION Earth stone and concrete ✓

Waste Gates

Type Stone

Number 1 : Size 8.5 ✓ ft. high x 8 ft. wide

Elevation Invert : Total Area sq. ft.

Hoist

Waste Gates Conduit

Number : Materials

Size ft.: Length ft.: Area sq. ft.

Embankment

Type

Height—Max. ft.: Min. ft.

Top—Width : Elev. ft.

Slopes—Upstream on : Downstream on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction Masonry ✓

Length—Total 37.5 tapers to 20 ft.: Net ft.

Height of permanent section—Max. 14'10 ft.: Min. 14 ft.

Flashboards—Type None : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials: Rock, concrete

Freeboard: Max. 24" ft.: Min. 19" ft.

Headworks to Power Devel.—(See "Data on Power Development")

OWNER Public Service of N.H. ✓

REMARKS Condition good

Tabulation By RLT Date 9/14/39

B&B21284

7206

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON WATER POWER DEVELOPMENTS IN NEW HAMPSHIRE

LOCATION **AT DAM NO.** 232.06

Town Swanzey : County Cheshire

Stream Upper Pond Outlet

Basin-Primary Conn.R. : Secondary Ashuelot R.

Local Name

GENERAL DATA

Head-Max. 21 ft.: Min. ft.: Ave. ft.

Date of Construction : Use of Power Industrial

Pondage ac. ft.: Storage ac. ft.

DESCRIPTION

Racks

Size of Rack Opening

Size of Bar : Material

Area: Gross Sq. Ft.: Net sq. ft.

Head Gates

Type Mechanical

Number : Size ft. high x ft. wide

Elevation of Invert : Total Area sq. ft.

Hoist

Penstock

Number 1 : Material

Size : Length

Turbines

Number 1 : Makers 27" Twin Hercules

Rating HP. per unit : Total Capacity 160, (P.S.225) HP.

Max. Dement C.F.S., per unit : Total cfs.

Drive

Type

Generator

Number 1

Make

Rating KW., per unit 120 ; Total Capacity K. W.

Exciter

Number : Make

Rating-per unit : Total Capacity K. W.

OUTPUT—KWHRS

19...... : 19......
19...... : 19......
19...... : 19......
19...... : 19......
19...... : 19......

OWNER Public Service Co., of NH.

Tabulation By RLT Date 9/14/39

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Connecticut NO. 6 232.06 84 USGS

RIVER Upper Pond MILES FROM MOUTH 2.2 D.A.SQ.MI 89.75 AE

TOWN Swanzey OWNER Public Service Co. of N.H.

LOCAL NAME OF DAM / (Keene Gas & Elec Co. PSC)

BUILT ______ DESCRIPTION Earth, stone & concrete

Earth fill, masonry spillway section.

POND AREA-ACRES ______ DRAWDOWN FT. ______ POND CAPACITY-ACRE FT. ______

HEIGHT-TOP TO BED OF STREAM-FT. 16.5 MAX. ______ MIN. ______

OVERALL LENGTH OF DAM-FT. 275± MAX.FLOOD HEIGHT ABOVE CREST-FT. ______

PERMANENT CREST ELEV.U.S.G.S. ______ LOCAL GAGE ______

TAILWATER ELEV.U.S.G.S. ______ LOCAL GAGE ______

SPILLWAY LENGTHS-FT. [illegible] FREEBOARD-FT. [illegible]

FLASHBOARDS-TYPE,HEIGHT ABOVE CREST [illegible]

WASTE GATES-NO	WIDTH	MAX.OPENING	DEPTH SILL BELOW CREST
1	5	5.5	

REMARKS Dam & Automatic power house with 1 horizontal unit between Otter Brook & Wilson Pond

Mouth Wilson Pond Bk 24.7 Mi from Mouth Ashuelot R.

Condition Good 1925

POWER DEVELOPMENT

UNITS NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
		~~18 AE~~		120 AE	27 ~~[illegible]~~
		~~15 USGS~~		120 USGS	Hercules
	160	21)	PSC		
	~~150~~	~~17~~ }			

USE Public Utility

REMARKS 6' [illegible]

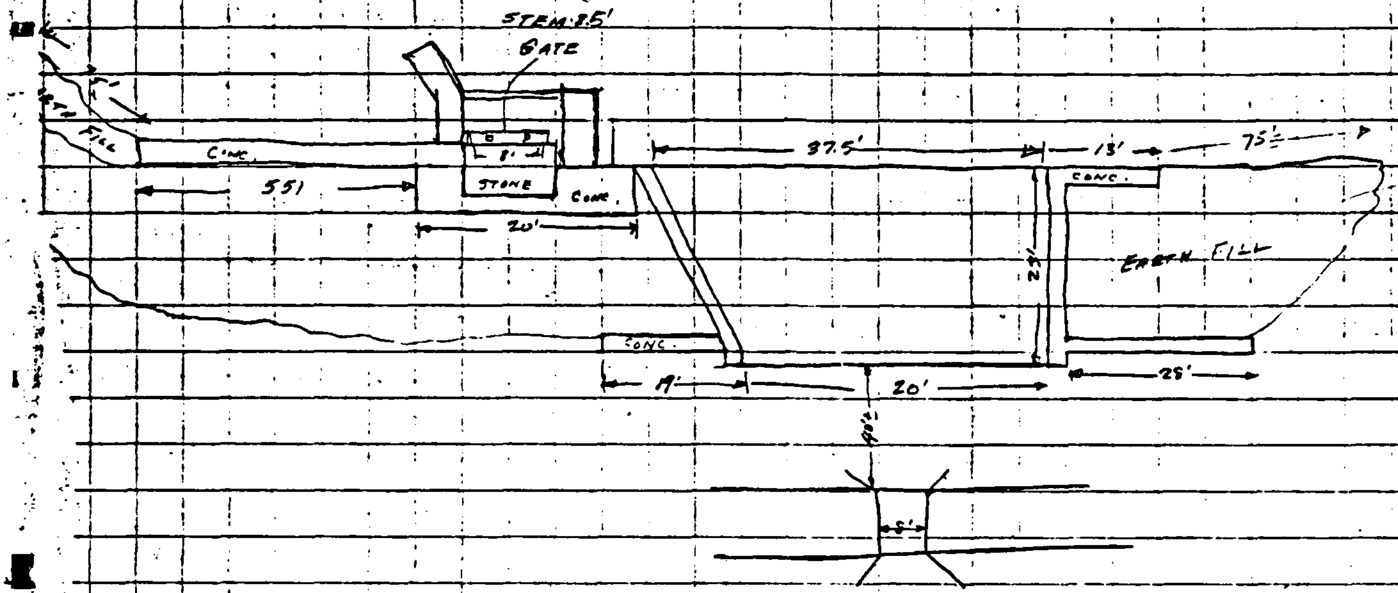
DATE AE 1931 PSC 1935

12/28/37 HR-1 S.H.S.

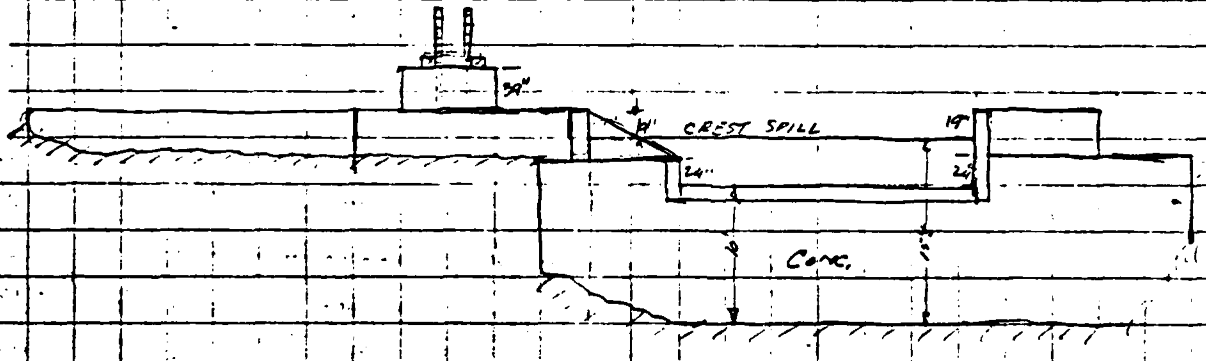
No

P.S. N.H. - UPPER POND DAM - SWANZEY 10/21/37

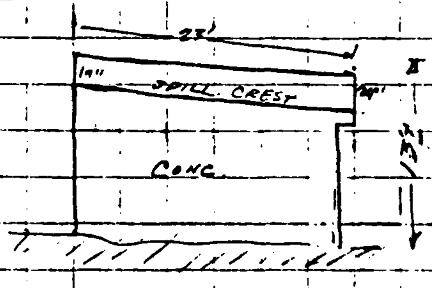
232.06



PLAN



ELEVATION



X-SECTION

232.06

Swanzey - Inspected June 18, 1930

Public Service Company of N. H.

This dam is located just north of Troy on the Troy-Keene road in the town of Swanzey and is known as Plant No. 2. Concrete dam with concrete spillway, concrete faced with rock and earth fill. Gates O. K. There is considerable digging of gravel in the pit southwest of the dam which should not continue too much as there may be a breaking out of the earth walls along the southwest slope.

DIVI-14.

File No. Washington 23
Field N. H. 1114.

232.06
.10

DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

REPORT ON DEVELOPED WATER POWER

1. Name of stream on which power is located Otter Branch of Ashuelot River

2. Location of plant: ¼ Sec. , T. , R.
Town or City Keene , County Cheshire, State N. H.

3. Location of point of diversion Wilson Pond, So. Keene

4. Name and address of owner or operator Keene Gas & Electric Co.
Keene, N. H.

5. Operating head, fore bay to tailrace see below feet.

6. Water wheels:

	Head	No.	Kind	Make	Size	Rated capacity, horsepower (total)
232.06	21	1	Twin	Hercules	27"	
	17	1	Twin	McCormick	33"	
					Total	500

7. How many and what wheels are operated during the low-water season?
Both

8. What is the ordinary length of such low-water season? Varies

9. Generators: No. 2 Total rated capacity (KVA) 300 K. W.

10. Use of power Public Utility

11. Average number of hours per day plant runs 10

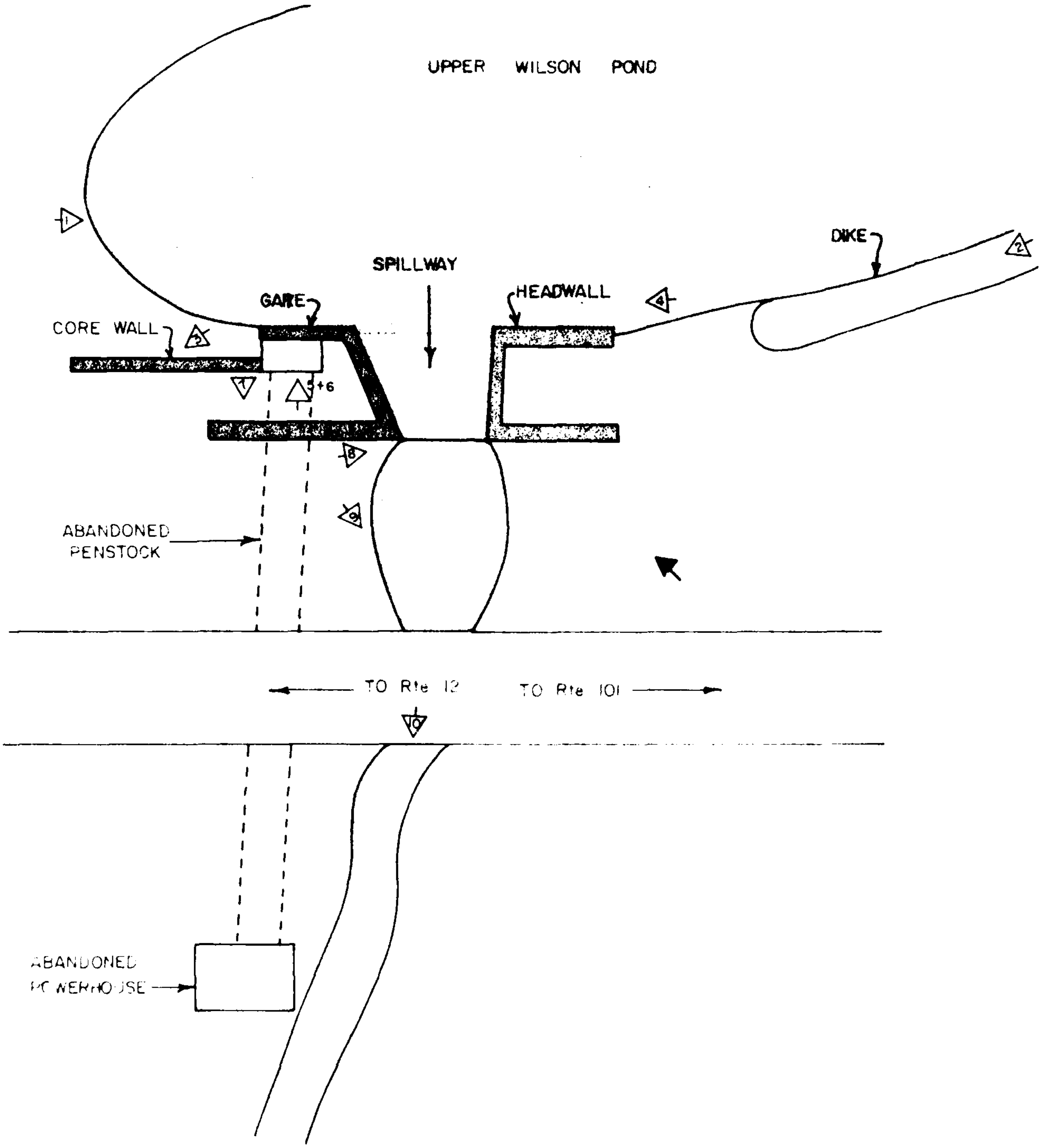
12. Auxiliary power Other electric plants of same company.

13. Storage reservoirs in addition to storage at dam small ones.
Number Total capacity Unknown

14. Date June 1919 Prepared by B. L. Bigwood

APPENDIX C

PHOTOGRAPHS



➤ OVERVIEW PHOTO

▷ APPENDIX C PHOTO

FILE No 26.5

GOLDBERG, ZOINO & ASSOCIATES INC
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

PHOTO LOCATION PLAN

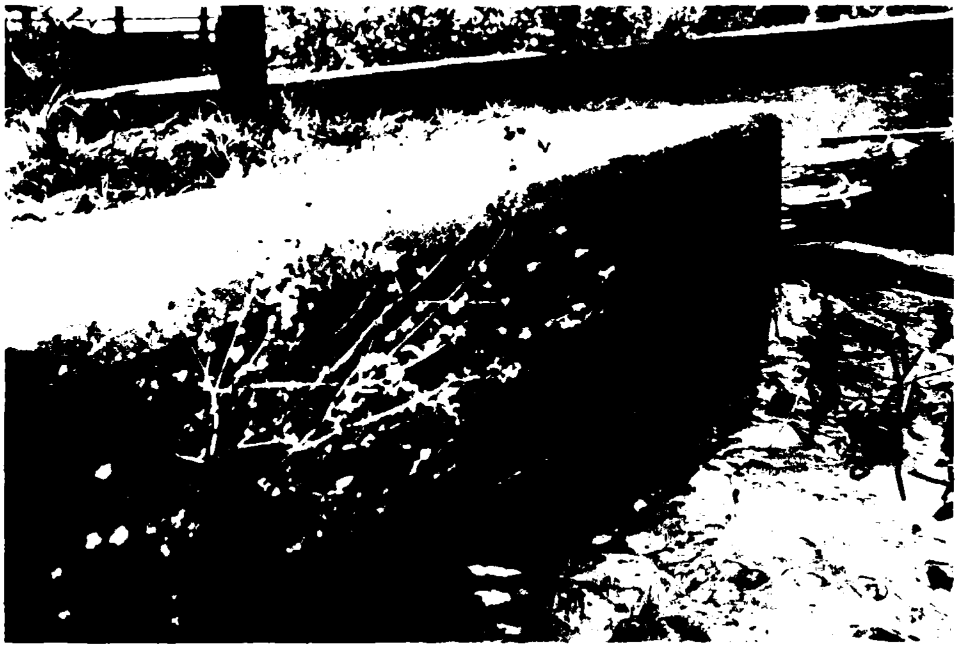
UPPER WILSON POND DAM SWANZEY, NEW HAMPSHIRE

SCALE SCHEMATIC
DATE OCT 1980

1. Reservoir Area and Upstream Side of Associated Dike

2. Crest of Dike Along Left Upstream Bank

3. Core Wall to Right of Spillway



4. Head Wall to Left of Spillway - Note Deterioration of Concrete

5. Downstream Side of Intake Structure and Gate Control Mechanism

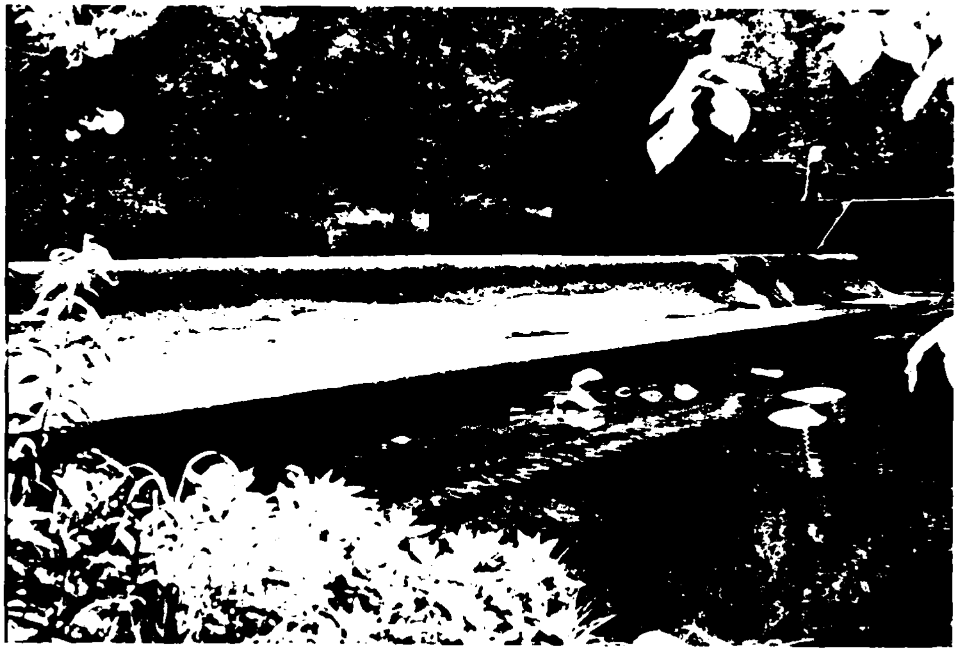
6. Detail of Lower Right Corner of Intake Structure Shown Above - Note Seepage Through Cracks in Concrete

7. Detail of Gate Control Mechanism - Note Gate is not Operable

8. Detail of Downstream End of Spillway - Note Deterioration of Concrete

9. Culvert Approximately 50 Feet Downstream of Dam

10. Stream Channel Downstream of Culvert



11. Overview of Diversion Structure on Branch River. Note: Flow to Upper Wilson Passes Through Gate at Left Abutment

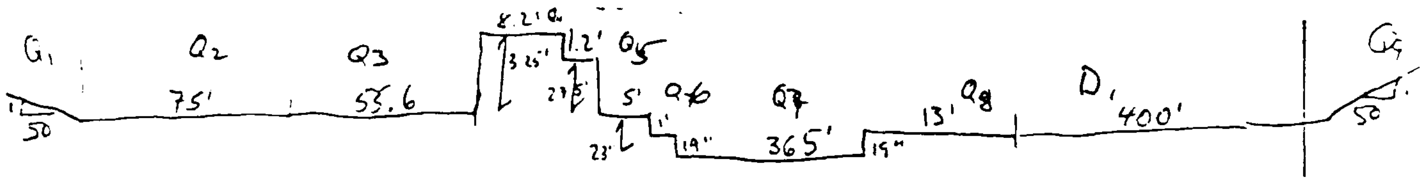
12. Gate Structure at Left Abutment of Diversion Structure

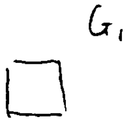
APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

Upper Wilson Pond Dam

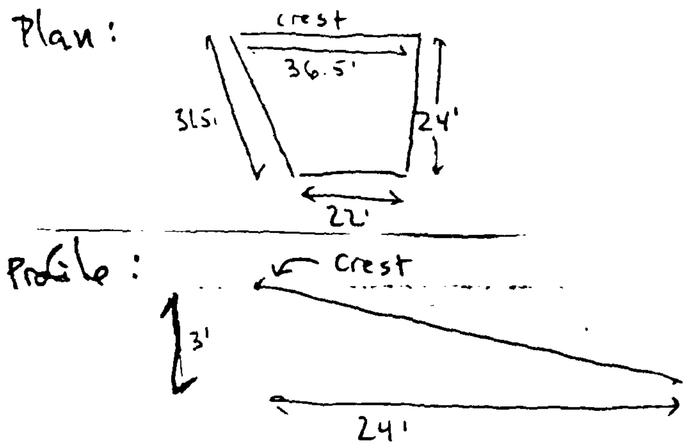
The elevation schematic of Upper Wilson Pond Dam given below is based on field notes, a 1937 dam sketch, and USGS topo. information. The elevations (above Mean Sea Level) are based on an assumed spillway elevation of 505 ft. msl, which was estimated from the USGS Quad.





Stage-Discharge Curve

Upper Wilson Pond Dam is an earth embankment with a concrete spillway. The spillway is unusually shaped, with a concrete surface sloping down at 0.125 ft./ft. from the crest for 24 feet as the width narrows from 36.5' to 22':



This can be treated as a sharp-crested weir with a 36.5 ft. crest length.

There are concrete wing walls extending 70 ft. to the left and 13 ft. to the right of the spillway, and earth dikes beyond them 75 ft. to the left and about 400 ft. to the right. A gate structure is on the left wing wall, but the gate associated with the dam is no longer operable. It will be assumed to be closed for these computations. Therefore, for all h:

$G_1 = 0$

<u>for $0 \leq h \leq 1.58$ ft.</u>

$$Q_1 = Q_2 = Q_3 = Q_4 = Q_5 = Q_6 = Q_8 = Q_9 = D_1 = 0$$

$$Q_7 = 3.3\ (36.5)\ h^{\frac{3}{2}}$$

C = 3.3 for a sharp-crested weir

<u>for $1.58 \leq h \leq 1.92$</u>

$$Q_6 = 3.0(1)\ (h-1.58)^{\frac{3}{2}}$$

$$Q_8 = 3.0(13)\ (h-1.58)^{\frac{3}{2}}$$

C = 3.0 for a broad-crested concrete weir

$$D_1 = 2.8(400)\ (h-1.58)^{\frac{3}{2}}$$

$$Q_9 = 2.8(50)\ (h-1.58)\ (.5(h-1.58))^{\frac{3}{2}}$$

C = 2.8 for a broad-crested earth weir

All others unchanged

for $1.92 \leq h \leq 4.67$

$$Q_1 = 2.8(50)\ (h-1.92)\ (.5(h-1.92))^{\frac{3}{2}}$$

$$Q_2 = 2.8(75)\ (h-1.92)^{\frac{3}{2}}$$

$$Q_3 = 3.0\ (55.6)\ (h-1.92)^{\frac{3}{2}}$$

$$Q_5 = 3.0(5)\ (h-1.92)^{\frac{3}{2}}$$

All others unchanged

for $4.68 \leq h \leq 5.17$

$$Q_4 = 2.8(1.2)\ (h-4.67)^{\frac{3}{2}}$$

All others unchanged

for $h \geq 5.17$

$$Q_4 = 2.8(1.2)\ (h-4.67)^{\frac{3}{2}} + 2.8\ (8.2)\ (h-5.17)^{\frac{3}{2}}$$

All others unchanged

The Basic Program which follows calculates a stage-discharge relationship for the Upper Wilson Pond Dam.

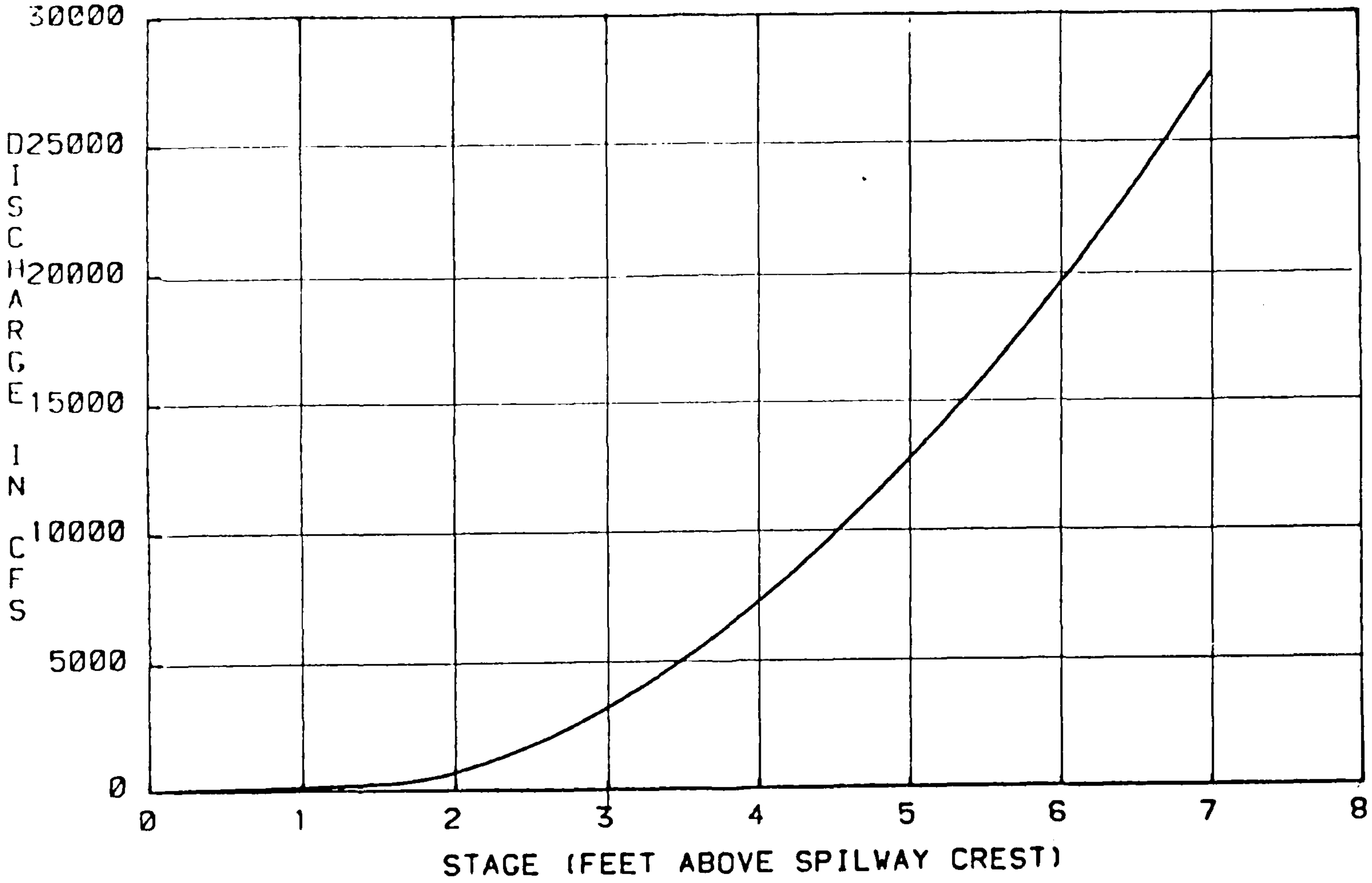
```
LIST
100 REM - STAGE/DISCHARGE CURVE FOR UPPER WILSON POND DAM
110 REM - STORED ON TAPE B-1 FILE 17
120 PAGE
130 PRINT USING 140:
140 IMA 10T"STAGE VS. DISCHARGE RELATIONSHIP FOR UPPER WILSON POND DAM"
150 PRINT USING 160:
160 IMAGE /  6T"HEAD "                    30T"DISCHARGE"
170 PRINT USING 180:
180 IMAGE 1T"(FT. ABOVE S/W)"32T"(CFS)"
190 PRINT USING 200:
200 IMAGE 17T "TOTAL   SPILLWAY   WALLS   LT.DIKE   RT.DIKE   NAT GRND."
210 FOR H=0 TO 7 STEP 0.25
220 O1=0
230 O2=0
240 O3=0
250 O4=0
260 O5=0
270 O6=0
280 O8=0
290 O9=0
300 D1=0
310 O7=3.3*36.5*H↑1.5
320 IF H<=1.58 THEN 460
330 O6=3*1*(H-1.58)↑1.5
340 O8=3*13*(H-1.58)↑1.5
350 D1=2.8*400*(H-1.58)↑1.5
360 O9=2.8*50*(H-1.58)*(0.5*(H-1.58))↑1.5
370 IF H<=1.92 THEN 460
380 O1=2.8*50*(H-1.92)*(0.5*(H-1.92))↑1.5
390 O2=2.8*75*(H-1.92)↑1.5
400 O3=3*55.6*(H-1.92)↑1.5
410 O5=3*5*(H-1.92)↑1.5
420 IF H<=4.67 THEN 460
430 O4=3*1.2*(H-4.67)↑1.5
```

```
440 IF H<=5.17 THEN 460
450 Q4=2.8*8.2*(H-5.17)↑1.5+2.8*1.2*(H-4.67)↑1.5
460 T1=Q3+Q4+Q5+Q6+Q8
470 T2=Q1+Q9
480 T3=T1+T2+Q7+D1+Q2
500 PRINT USING 510:H,T3,Q7,T1,Q2,D1,T2
510 IMAGE 6D.2D,12D,10D ,9D,9D,10D,11D
520 NEXT H
530 END
```

STAGE VS. DISCHARGE RELATIONSHIP FOR UPPER WILSON POND DAM

HEAD (FT. ABOVE S/W)	DISCHARGE (CFS)					
	TOTAL	SPILLWAY	WALLS	LT.DIKE	RT.DIKE	NAT GRND.
0.00	0	0	0	0	0	0
0.25	15	15	0	0	0	0
0.50	43	43	0	0	0	0
0.75	78	78	0	0	0	0
1.00	120	120	0	0	0	0
1.25	168	168	0	0	0	0
1.50	221	221	0	0	0	0
1.75	361	279	3	0	79	1
2.00	672	341	16	5	305	6
2.25	1139	407	57	40	614	21
2.50	1727	476	117	93	988	53
2.75	2420	549	191	159	1417	104
3.00	3211	626	275	236	1895	179
3.25	4094	706	369	322	2417	279
3.50	5066	789	473	417	2980	408
3.75	6127	875	584	520	3580	568
4.00	7273	964	703	630	4216	760
4.25	8505	1055	830	747	4886	987
4.50	9822	1150	963	870	5588	1250
4.75	11223	1247	1103	1000	6321	1552
5.00	12709	1347	1249	1135	7084	1895
5.25	14280	1449	1402	1276	7874	2279
5.50	15939	1554	1564	1422	8693	2706
5.75	17685	1661	1734	1574	9537	3179
6.00	19517	1770	1911	1731	10408	3697
6.25	21435	1882	2094	1892	11303	4264
6.50	23441	1996	2284	2058	12223	4880
6.75	25533	2112	2479	2229	13166	5546
7.00	27712	2231	2680	2404	14132	6264

STAGE-DISCHARGE CURVE FOR WILSON POND DAM



Stage Storage Curve

The surface area of upper Wilson Pond with the water surface at the spillway crest is about 10 acres. The storage at this elevation is about 50 acre-feet.

Assuming a 10 acre surface and no spreading as the pond rises:

Surcharge storage = 10h

Total storage = 50 + 10h

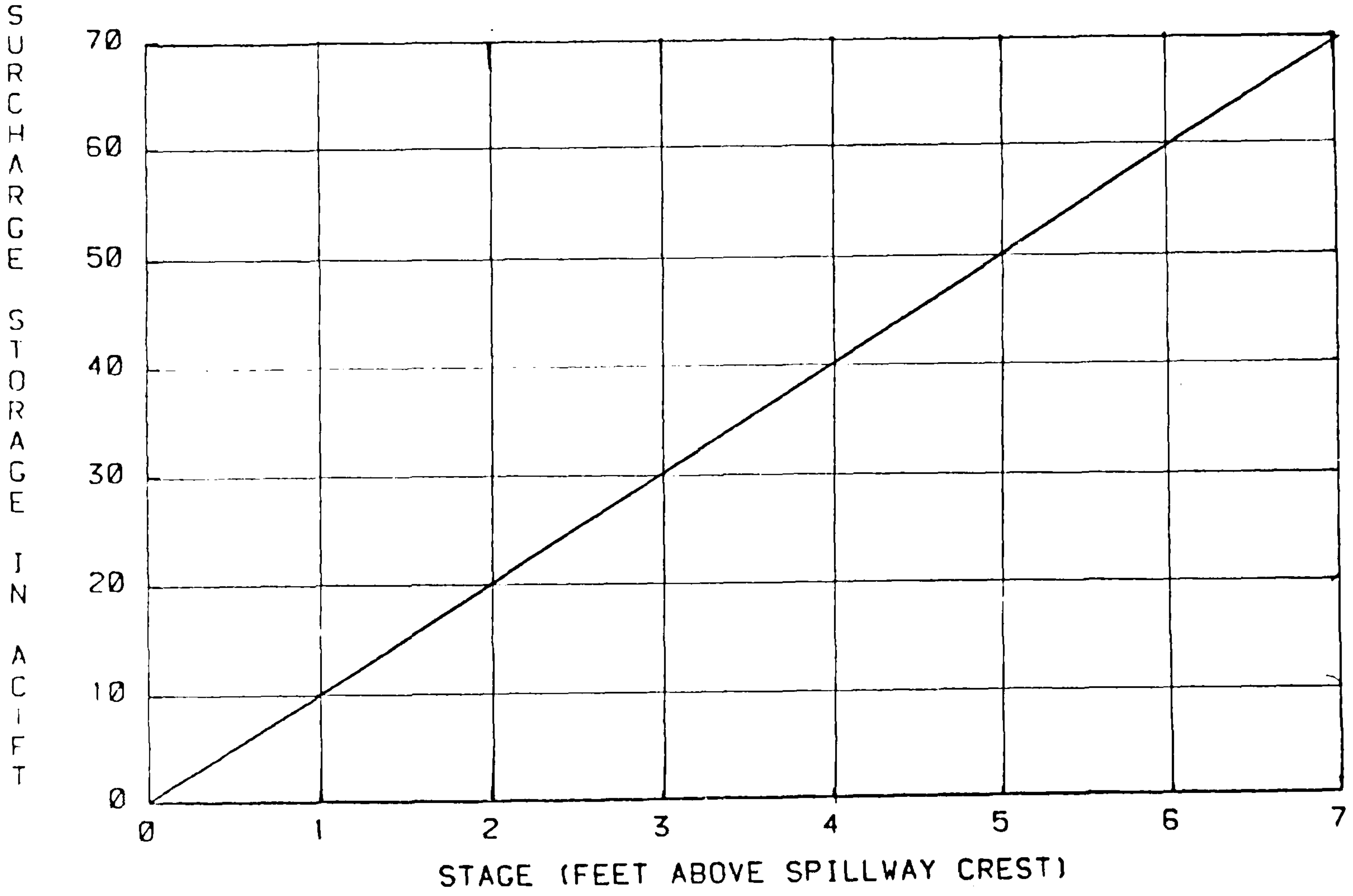
Surcharge storage to the toe of the right abutment

(h = 1.58) is 1.58(10) = 15.8 ac-ft.

Total Storage is 50 + 15.8 = 65.8 ac-ft.

The stage-surcharge storage curve is given on the next page.

STAGE-SURCHARGE STORAGE RELATIONSHIP FOR UPPER WILSON POND



Dam Failure Analysis

Dam failure is assumed to occur when the water overtops the concrete wall on the right abutment at $h = 1.58$, 506.58 ft. MSL.

Normal outflow = 239 cfs

$$\text{Breach outflow} = Q_{p1} = \frac{8}{27}\sqrt{g}\ \ W_b\, Y_o^{\frac{3}{2}}$$

Y_o = the height of the water surface above the channel invert = 15.5 ft. + 1.58 ft. = 17 ft.

W_b = Width of breach = 40% of the width of the dam at its ½ height. The dam width at the ½ height is about 100 feet, so $W_b = .4(100) = 40$ ft.

$$Q_{p1} = \frac{8}{27}\sqrt{32.2}\ \ (40)17^{\frac{3}{2}} = 4710 \text{ cfs}$$

Peak failure outflow = 239 cfs + 4710 cfs = 4950 cfs

Storage released by failure = 65.8 ac-ft. (see p. D-8).

Another possible mode of failure is failure of the 400' long dike to the right of the spillway. This dike is only about 3 feet high, so $W_{bdike} = .4(400) = 160$; $Y_o\text{dike} = 3$.

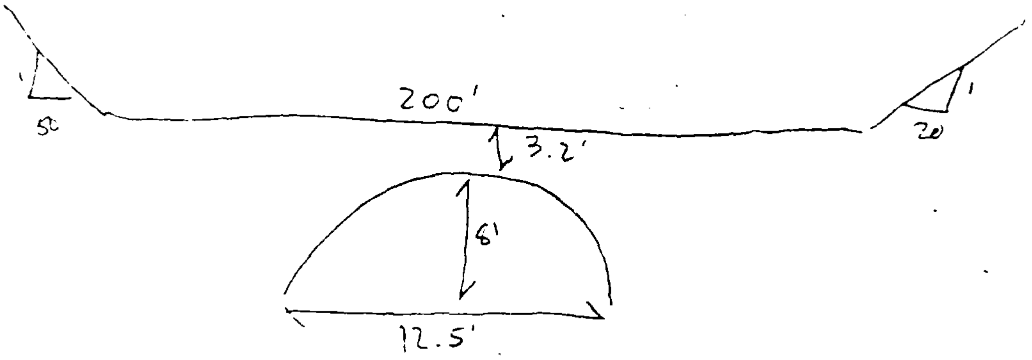
$$Q_{Dike} = \frac{8}{27}\sqrt{32.2}\ \ (160)\ 3^{\frac{3}{2}} = 1400 \text{ cfs}$$

This flow would spread over the area downstream of the dike, which has no clearly defined flow path.

About 100 feet east of the dike are a house and a small business, about 1-3 feet lower than the top of the dike. These two buildings would be damaged by flooding from failure of the dike, although there would be little danger of loss of life. Flow from the failure of the dike would rejoin Winnewawa Brook and proceed downstream after passing these two structures.

In terms of the impact of failure downstream, we will consider flows resulting from failure of the main dam.

About 40 feet downstream of the toe of the spillway, Winnewawa Brook is crossed by a two lane road. The bridge opening sketch below is based on field notes:



The flow through the 12.5' x 8' arch culvert (which is a corrugated metal pipe with a granite headwall and 40° angle wing wall) is determined from the Federal Highway Administration's Hydraulic Engineering Circular 5, "Hydraulics Charts for the Selection of Highway Culverts," assuming inlet control.

Flow over the roadway was calculated as weir flow:

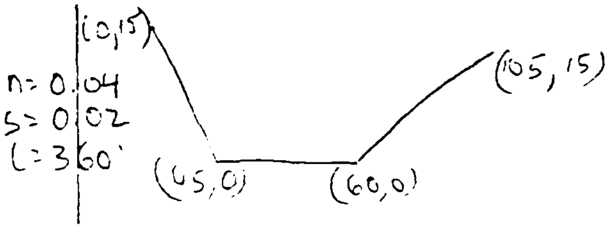
$$Q_{road} = 2.8(20)\ (h-11.2)\ (.5(h-11.2))^{\frac{3}{2}} + 2.8(200)\ (h-11.2)^{\frac{3}{2}}$$

$$+ 2.8(50)\ (h-11.2)\ (.5(h-11.2))^{\frac{3}{2}}$$

Stage (feet)	(Headwater/ 8 feet)	$Q_{culvert}$ Chart 6 HEC-5)	Q_{road}	Q_{Total}
3	0.375	120	0	120
4	0.5	220	0	230
5	0.625	340	0	340
6	0.75	450	0	450
7	0.875	540	0	540
8	1.0	630	0	630
9	1.125	720	0	720
10	1.25	810	0	810
11	1.375	890	0	890
11.2	1.40	930	0	930
12	1.5	980	440	1420
13	1.625	1070	1650	2720
14	1.75	1160	3530	4690
15	1.875	1250	6100	7350

The prefailure flow of 239 cfs would create a stage of about 4.2 feet at the bridge. The peak dam failure flow of 4950 cfs would create a stage of 14.1 feet, 2.9 feet over the top of the roadway. This might well cause damage to the bridge structure.

Downstream of this bridge, Minnewawa Brook runs about 360 feet with this typical channel:



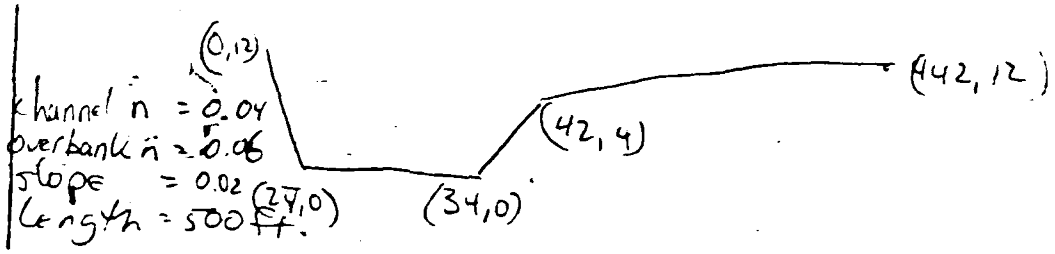
A Stage vs. normal flow relationship for this reach is given on the next page. Attenuation in this reach would be negligible due to the limited storage available and short length. The pre-failure flow of 239 cfs would create a flow of 2.2 feet in this channel, which would be increased to 9.9 feet by the failure flow of 4950 cfs.

The only structure in this reach was formerly a power plant serving the dam at the upstream end of the reach. This structure is now a dwelling, and is located about 4 feet above the channel. Dam failure would cause 5-6 feet of flooding at this house, and present a threat of loss of life.

For the next 500 feet downstream, to Route 12, this is a typical section:

```
===== DATA FOR THE COMBINED SYSTEM =====
    DEPTH        ELEV        AREA        WPER        HYD-R        AR2/3        O
     ft.          ft.        ft↑2         ft.         ft.                      cfs
-------------------------------------------------------------------------------------
     0.00         0.0         0.0         0.0         0.0          0.0          0.0
     0.50         0.5         8.3        18.2         0.5          4.9         17.1
     1.00         1.0        18.0        21.3         0.8         16.1         56.5
     1.50         1.5        29.3        24.5         1.2         32.9        115.6
     2.00         2.0        42.0        27.6         1.5         55.5        194.9
     2.50         2.5        56.3        30.8         1.8         84.0        295.1
     3.00         3.0        72.0        34.0         2.1        118.8        417.2
     3.50         3.5        89.3        37.1         2.4        160.1        562.4
     4.00         4.0       108.0        40.3         2.7        208.4        731.8
     4.50         4.5       128.3        43.5         3.0        263.9        926.7
     5.00         5.0       150.0        46.6         3.2        326.9       1148.1
     5.50         5.5       173.3        49.8         3.5        397.9       1397.3
     6.00         6.0       198.0        52.9         3.7        477.0       1675.4
     6.50         6.5       224.3        56.1         4.0        564.8       1983.5
     7.00         7.0       252.0        59.3         4.3        661.4       2322.8
     7.50         7.5       281.3        62.4         4.5        767.1       2694.3
     8.00         8.0       312.0        65.6         4.8        882.4       3099.2
     8.50         8.5       344.3        68.8         5.0       1007.5       3538.4
     9.00         9.0       378.0        71.9         5.3       1142.7       4013.2
     9.50         9.5       413.3        75.1         5.5       1288.2       4524.5
    10.00        10.0       450.0        78.2         5.8       1444.5       5073.3
    10.50        10.5       488.3        81.4         6.0       1611.7       5660.7
    11.00        11.0       528.0        84.6         6.2       1790.3       6287.7
    11.50        11.5       569.3        87.7         6.5       1980.3       6955.2
    12.00        12.0       612.0        90.9         6.7       2182.2       7664.3
    12.50        12.5       656.3        94.1         7.0       2396.2       8415.9
    13.00        13.0       702.0        97.2         7.2       2622.6       9211.0
    13.50        13.5       749.3       100.4         7.5       2861.6      10050.5
    14.00        14.0       798.0       103.5         7.7       3113.6      10935.4
    14.50        14.5       848.3       106.7         7.9       3378.7      11866.6
    15.00        15.0       900.0       109.9         8.2       3657.3      12845.1
```

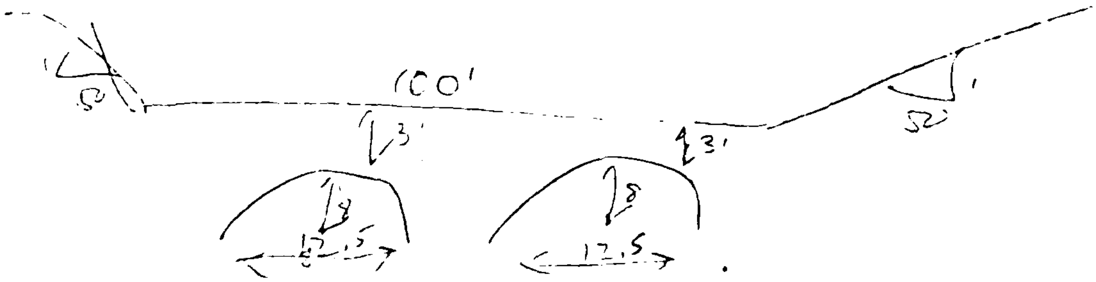
channel 40 to 400 feet downstream of dam Stage vs. flow



The stage normal flow relationship for this reach is given on the next page. The pre-failure flow of 239 cfs would create a stage of 2.2 feet, which would be increased to 7.8 feet at the upstream end of the reach by the dam failure flow of 4950 cfs. The attenuation in this reach is calculated on page D-17.

The attenuated flow at the downstream end of the reach would be 4530 cfs, creating a stage of 7.7 feet. The only development in this reach is a group of 10-12 cabins at the downstream end of the reach 5-6 feet above the stream channel. They would be flooded by backwater from the Route 12 bridge as calculated below.

At the downstream end of this reach Winnewawa Brook passes under Route 12, which has this hydraulic section:



```
===== DATA FOR THE COMBINED SYSTEM =====
  DEPTH       ELEV        AREA        WPER        HYD-R       AR2/3       Q
   ft.         ft.        ft↑2         ft.         ft.                    cfs
---------------------------------------------------------------------------------
   0.00        0.0         0.0         0.0         0.0         0.0         0.0
   0.50        0.5         5.5        12.2         0.4         3.2        17.0
   1.00        1.0        12.0        14.5         0.8        10.6        55.8
   1.50        1.5        19.5        16.7         1.2        21.6       113.9
   2.00        2.0        28.0        18.9         1.5        36.3       191.4
   2.50        2.5        37.5        21.2         1.8        54.9       289.1
   3.00        3.0        48.0        23.4         2.0        77.5       408.0
   3.50        3.5        59.5        25.7         2.3       104.3       549.2
   4.00        4.0        72.0        27.9         2.6       135.5       713.8
   4.50        4.5        91.5        54.0         1.7       130.0       930.2
   5.00        5.0       124.0        80.1         1.5       165.9      1208.1
   5.50        5.5       169.5       106.3         1.6       231.4      1570.9
   6.00        6.0       228.0       132.4         1.7       327.6      2037.7
   6.50        6.5       299.5       158.5         1.9       457.8      2625.7
   7.00        7.0       384.0       184.6         2.1       625.7      3350.8
   7.50        7.5       481.5       210.7         2.3       835.3      4227.7
   8.00        8.0       592.0       236.9         2.5      1090.3      5270.7
   8.50        8.5       715.5       263.0         2.7      1394.4      6493.1
   9.00        9.0       852.0       289.1         2.9      1751.3      7907.8
   9.50        9.5      1001.5       315.2         3.2      2164.3      9527.5
  10.00       10.0      1164.0       341.4         3.4      2637.0     11364.1
  10.50       10.5      1339.5       367.5         3.6      3172.6     13429.4
  11.00       11.0      1528.0       393.6         3.9      3774.2     15735.0
  11.50       11.5      1729.5       419.7         4.1      4445.2     18291.9
  12.00       12.0      1944.0       445.9         4.4      5188.4     21111.1
```

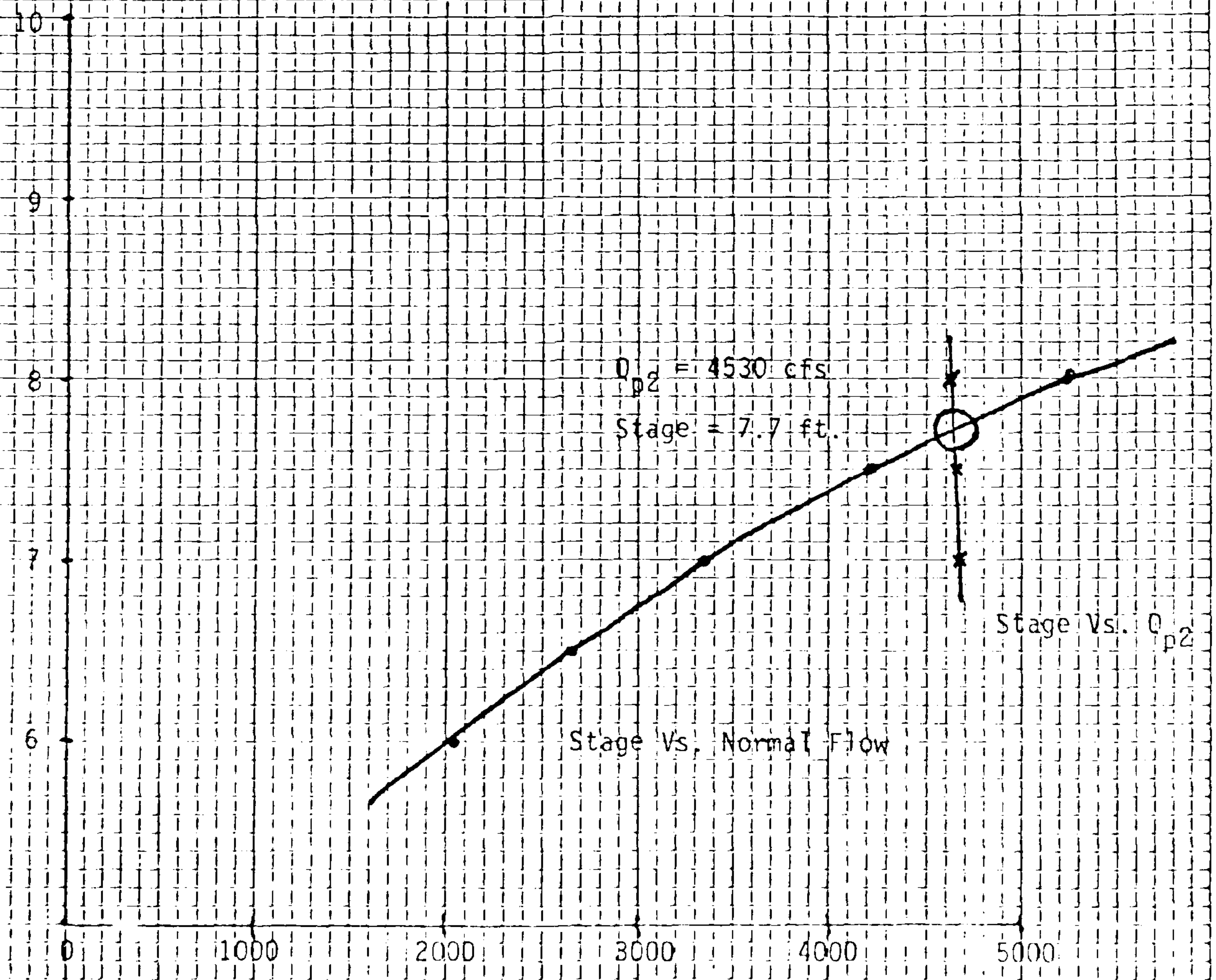
Channel just upstream of Rte 12 - Stage vs. normal flow

Attenuated Peak Dam Failure Flow at Route 12

Q_2 = pre-failure flow + $Q_{p1}(1 - \frac{\text{Reach Storage}}{\text{Storage released by dam failure}})$ = 239 + 4170$(1 - \frac{\text{STOR}}{65.8})$. STOR = (Average flow area - pre-failure area) (length)

$= (\frac{547.8 + \text{Area D/S}}{2} - 32.6)\ (500)\ (\frac{1}{43560})$

Stage (ft.)	Area D/S (sq. ft.)	STOR (ac-ft)	Q_2
7	384	4.97	4590
7.5	481.5	5.53	4550
8	592	6.17	4507



As before, culvert flow is taken from FHWA HEC-5, and $Q_{road} = 2(2.8)\ (50)\ (h-11)\ (0.5(h-11))^{\frac{3}{2}} + 2.8(100)\ (h-11)^{\frac{3}{2}}$

Stage (feet)	(Headwater/ /8 ft.)	$Q_{culvert}$ Chart 6 HEC-5 X2	Q_{road}	Q_{Total}
3	0.375	240	0	240
4	0.5	440	0	440
5	0.625	680	0	680
6	0.75	900	0	900
7	0.875	1080	0	1080
8	1.00	1260	0	1260
9	1.125	1440	0	1440
10	1.25	1620	0	1620
11	1.375	1780	0	1780
12	1.5	1960	380	2340
13	1.675	2140	1350	3490
14	1.75	2320	3000	5320

The pre-failure flow of 239 cfs would cause a stage of about 3 feet. The flow after failure 4530 cfs would cause a stage of 13.6 feet, 2.6 feet above the roadway. This could cause damage to the Route 12 bridge, and would cause 8-10 feet of flooding at the cabins upstream of the road, clearly threatening lives and property.

Immediately downstream of Route 12 are a hotel and an automobile repair shop, which are both 12 feet above the stream and might receive minor flooding due to the dam failure.

Within 200 feet of Route 12, Winnewawa Brook enters Lower Wilson Pond Dam.

The stage versus discharge program give in on the next two pages is taken from the separate report on Lower Wilson Pond Dam, assuming that gate on the dam is closed. Note that the pre-failure flow of 239 cfs would produce a stage 3.6 feet above the stop-log crest which would overtop the roadway embankment which forms Lower Wilson Pond Dam by 0.1 feet. The surface area of Lower Wilson Pond is 80 acres, so to store the entire volume of water released by the failure of Upper Wilson Pond Dam (65.8 ac-ft) would raise the level of Lower Wilson Pond by a maximum of 0.82 feet.

The attenuation in Lower Wilson Pond Dam is estimated on page D-22. The estimated peak stage if 4.3 ft., an increase of 0.7 feet, with a peak flow of 820 cfs. The increased stage over the Route 32

```
100 REM - STAGE/DISCHARGE CURVE FOR lower WILSON POND DAM
110 REM - STORED ON TAPE B-1 FILE 18
120 PAGE
130 PRINT USING 140,
140 IMA 10T"STAGE VS. DISCHARGE RELATIONSHIP FOR lower WILSON POND DAM"
150 PRINT USING 160,
160 IMAGE /  6T"HEAD "          30T"DISCHARGE"
170 PRINT USING 180,
180 IMAGE 1T"(FT. ABOVE S/W)"32T"(CFS)"
190 PRINT USING 200,
200 IMAGE 24T "TOTAL        SPILLWAY       ROAD      "
205 PRINT ""
210 FOR H=0 TO 7 STEP 0.25
220 O1=0
230 O2=0
240 O3=0
250 O4=0
260 O5=0
270 O1=3.3*3*H↑1.5
280 IF H<=1 THEN 330
290 O2=3*10.4*(H-1)↑1.5
300 O3=3*2*(H-1)↑1.5
310 IF H<=3.5 THEN 330
320 O5=2.8*300*(H-3.5)↑1.5
330 O4=61.5*(H+9.5)↑0.5
331 IF O4<O1+O2+O3 THEN 333
332 O4=O1+O2+O3
333 REM
360 T1=O4+O5
370 PRINT USING 380:H,T1,O4,O5
380 IMAGE 6D.2D,18D,20D ,17D
390 NEXT H
400 END
```

STAGE VS. DISCHARGE RELATIONSHIP FOR lower WILSON POND DAM

HEAD (FT. ABOVE S/W)	DISCHARGE (CFS) TOTAL	SPILLWAY	ROAD
0.00	0	0	0
0.25	1	1	0
0.50	4	4	0
0.75	6	6	0
1.00	10	10	0
1.25	18	18	0
1.50	31	31	0
1.75	47	47	0
2.00	65	65	0
2.25	85	85	0
2.50	107	107	0
2.75	131	131	0
3.00	157	157	0
3.25	184	184	0
3.50	212	212	0
3.75	329	224	105
4.00	523	226	297
4.25	774	228	546
4.50	1070	230	840
4.75	1406	232	1174
5.00	1777	234	1543
5.25	2181	236	1945
5.50	2614	238	2376
5.75	3075	240	2835
6.00	3563	242	3320
6.25	4075	244	3831
6.50	4611	246	4365
6.75	5169	248	4922
7.00	5750	250	5500

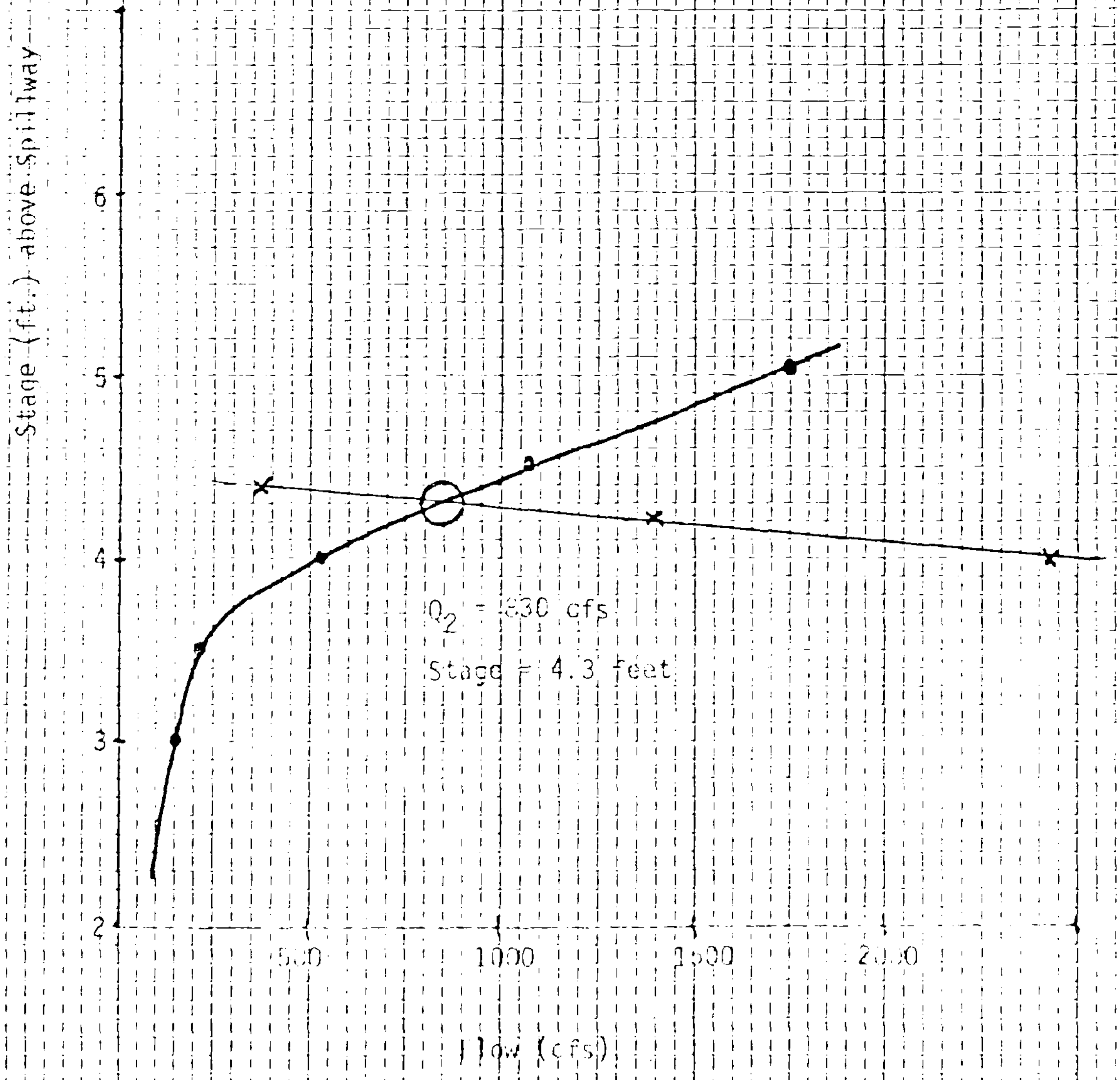
Attenuation of Dam Failure Flow in Lower Wilson Pond

$$Q_2 = \text{Pre-failure Flow} + Q_{p1}\left(1 - \frac{\text{STOR}}{\text{Storage Released}}\right)$$

$$Q_{p1} = 4530 - 239 = 4290$$

$$\text{STOR} = 80\ \text{Ac}(\text{Stage} - 3.6)$$

Stage (ft.)	Stage above Pre-Failure Level (ft.)	STOR (ac.ft)	Q_2 (cfs)
4.0	0.40	32	2440
4.2	0.60	48	1400
4.4	0.80	64	360



Q_2 = 830 cfs

Stage = 4.3 feet

roadway embankment from 0.1 to 0.8 feet might add to or cause damage to that structure. In addition, there are 20-30 houses near the shore of Lower Wilson Pond. However, most or all are more than 4.3 feet above the spillway level.

Downstream of Lower Wilson Pond Dam, Wilson Brook flows through the Keene Airport in a swampy, flat area and on to the Ashuelot River. No further damage is expected to result from the failure of Upper Wilson Pond Dam.

That chart on the next page summarizes the downstream effects of the failure of Upper Wilson Pond Dam.

Location	Location # (see map)	Distance D/S from Dam (ft.)	# of Structures	Level Above Stream (ft.)	Flow & Stage		Comments
					Before Failure	After Failure	
1st Bridge	-	40	1 bridge	11.2 ft. (road level)	239 cfs 4.2 ft.	4950 cfs 14.1 ft.	Possible damage to Bridge.
just D/S of Bridge	-	100	1 house	4	239 cfs 2.2 ft.	4950 cfs 9.9 ft.	Danger of loss of Life.
Route 12 Bridge	1	900	10-12 cabins just D/S 1 motel 1 auto shop	5-6	239 cfs 2.2 ft.	4530 cfs 13.6 ft.	Possible damage to bridge, danger of loss of life at cabins.
Lower Wilson Pond Dam	1	4400	20-25 house roadway	5+ 3.5	239 cfs 3.6 ft.	820 cfs 4.3 ft.	Increase level of flow over roadway - possible damage.

AD-A156 451 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS 2/2
UPPER WILSON POND DAM (U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV AUG 81

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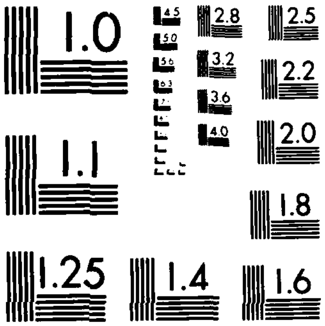


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Test Flood Analysis

Size classification: SMALL (height < 25 ft.; storage < 1000 ac-ft.)

Hazard Classification: HIGH based on significant economic damages to 1 house, 10-12 cabins, and three roadways - two of which are minor highways - and one the chance of the loss of more than a few lives in the event of dam failure.

According to the "Recommended Guidelines," the hazard classification and dam size indicates a test flood between one-half of the probable maximum flood (PMF) and the PMF. Since the hazard potential is on the low side of HIGH, we will use one-half of the PMF as a Test Flood inflow.

Peak Flood flows reaching Upper Wilson Pond are largely determined by the hydraulics of a diversion structure on the Branch just upstream of the pond. About 90 square miles of rolling terrain that is mostly forested, but includes some pasture and fields, contribute to this point where the flow may split - some to continue down the Branch and some to be diverted into Wilson Brook. The flow contribution into Upper Wilson Pond from the small (50 to 60 acre) area draining directly into the pond is very small compared to that from the diversion under all flow conditions.

To determine the Test Flood inflow to Upper Wilson Pond, we will determine the Test Flood inflow at the dam on the Branch and find what portion goes to Upper Wilson Pond. Of the 90 square mile area draining to the diversion on the Branch, 47 square miles is controlled by the

Corps of Engineers' Otter Brook Dam. The Otter Brook Dam has a flood retention capacity of 17,600 AF, or:

$$\frac{17600\ \text{AF}}{47\ \text{SM}} \times \frac{1\ \text{SM}}{640\ \text{A}} \times \frac{12\ \text{inches}}{1\ \text{foot}} = 7.0\ \text{inches of runoff}$$

This is a significant portion of the Test Flood (½ PMF) runoff of $\frac{19}{2}$ = 9.5 inches, so it may be assumed that the dam will be operated to hold back flows from this portion of the basin when peak flow are being generated in the uncontrolled portion. Therefore, 47 square miles are considered non-contributing to the Test Flood flow.

The Test Flood discharge for the uncontrolled area at the Branch diversion structure is determined as follows:

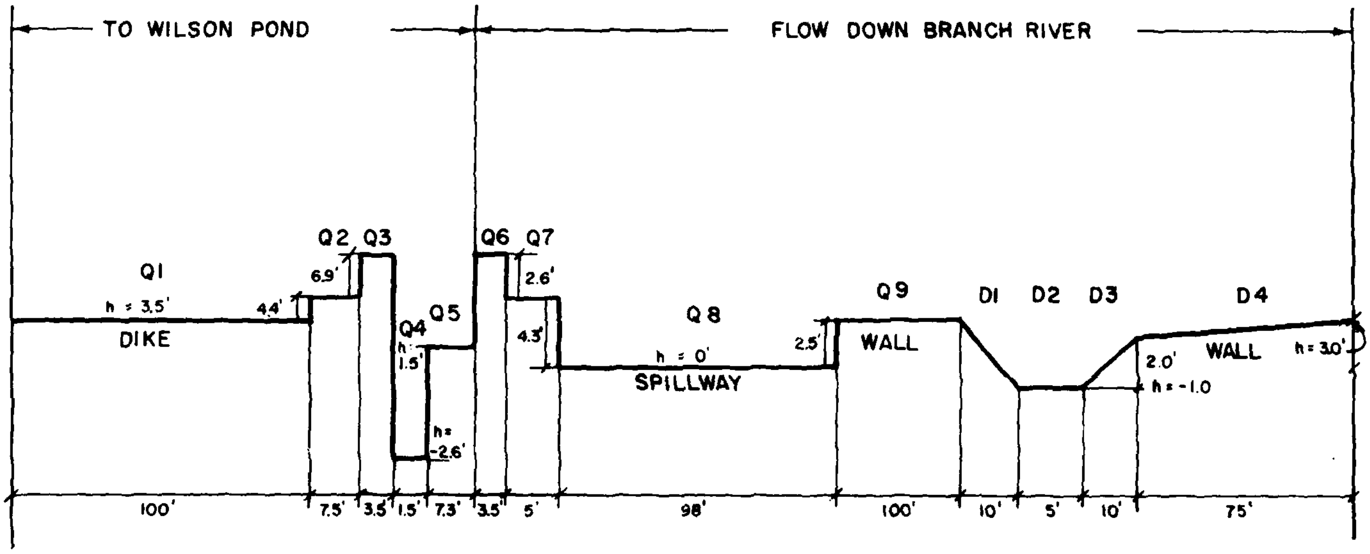
Drainage Area = 90 - 47 = 43 square miles

PMF Discharge Rate = 1200 CSM (from "Maximum Probable Flood Peak Flow Rates" for rolling topography curve).

½ PMF Test Flood Inflow = 43 x 1200 x ½

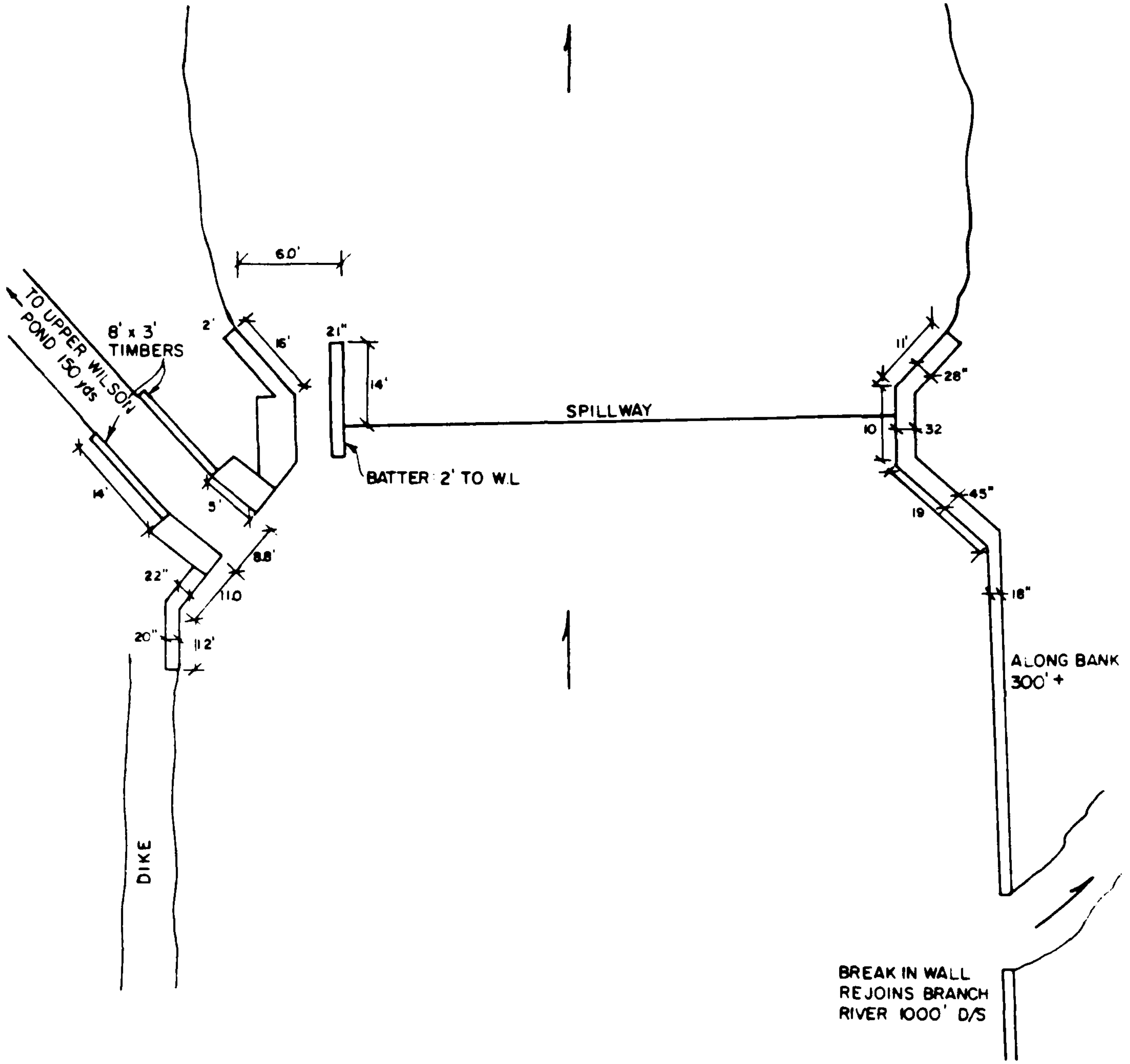
= 25800 cfs

The following pages indicate the characteristics of the Branch diversion structure where this 25800 cfs Test Flood inflow would occur. An elevation schematic for establishing its hydraulic characteristics is as follows:

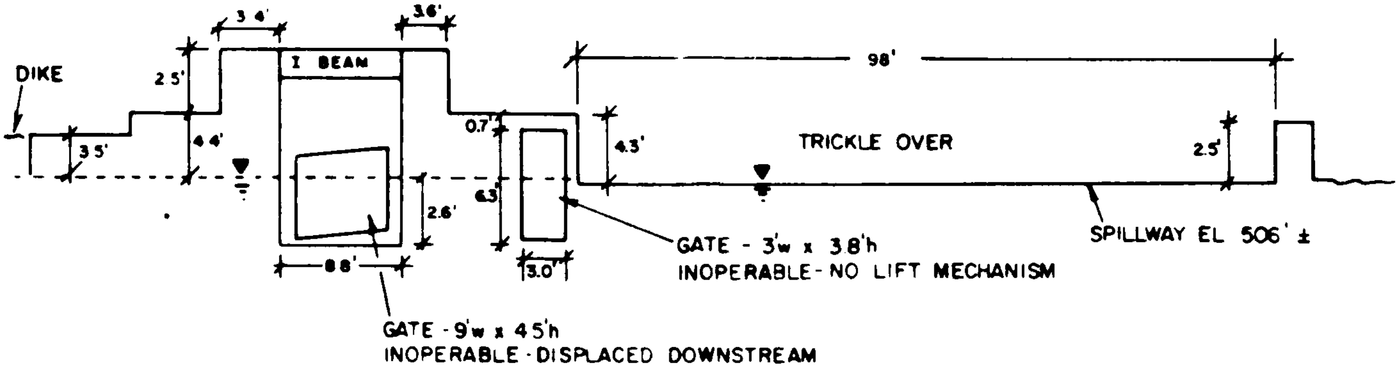


(NOT TO SCALE)

BRANCH RIVER DIVERSION STRUCTURE

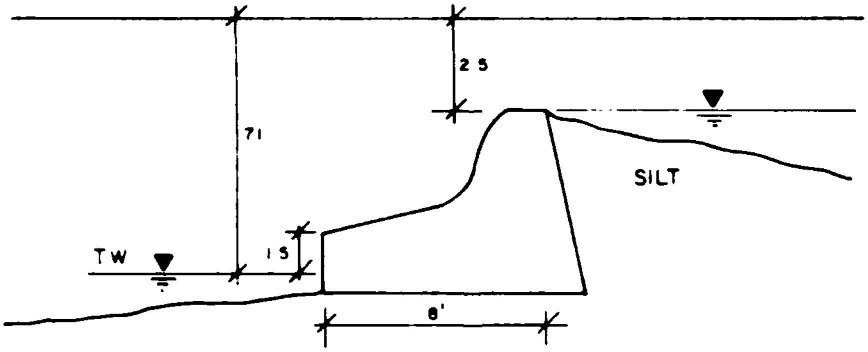


BRANCH RIVER DIVERSION STRUCTURE



ELEVATION VIEW

(NOT TO SCALE)



SECTION AT RIGHT ABUTMENT

(NOT TO SCALE)

BRANCH RIVER DIVERSION STRUCTURE

Diversion Dam Stage vs. Discharge Calculations

For h = 0:

$$Q_4 = 2.8(1.5)\ (h + 2.6)^{\frac{3}{2}}$$

$$D_1 = 2.8\left(\frac{10.0}{3.5}\right)\ (h + 1)\ (0.5(h + 1)^{\frac{3}{2}}$$

$$D_2 = 2.8(5)\ (h + 1)^{\frac{3}{2}}$$

$$D_3 = 2.8\left(\frac{10.0}{2.0}\right)\ (h + 1)\ (0.5(h + 1))^{\frac{3}{2}}$$

All others = 0

For $0 \leq h \leq 1$, Add:

$$Q_8 = 3.3(98)\ (h)^{\frac{3}{2}}$$

For $1 < h \leq 1.5$, Add:

$$D_3 = 2.8(10)\ (h)^{\frac{3}{2}}$$

$$D_4 = 3.0\left(\frac{75}{2}\right)\ (0.5(h - 1))^{\frac{3}{2}}$$

For $1.5 < h \leq 2.5$; Add:

$$Q_5 = 3.3(7.3)\ (h - 1.5)^{\frac{3}{2}}$$

For $2.5 < h \leq 3.0$; Add:

$$Q_9 = 3.0(100)\ (h - 2.5)^{\frac{3}{2}}$$

$$D_1 = 2.8(10)\ ((\frac{3.5}{2}) + (h - 2.5))^{\frac{3}{2}}$$

For $3.0 < h \leq 3.5$; Add:

$$D_4 = 3.0(75)\ (h - 2)^{\frac{3}{2}}$$

For $3.5 < h \leq 4.3$; Add:

$$Q_1 = 2.8(100)\ (h - 3.5)^{\frac{3}{2}}$$

For $4.3 < h \leq 6.9$; Add:

$$Q_7 = 3.0(5)\ (h - 4.3)^{\frac{3}{2}}$$

$$Q_2 = 3.0(7.5)\ (h - 4.4)^{\frac{3}{2}}$$

For $h > 6.9$, Add:

$$Q_3 = 3.0(3.5)\ (h - 6.9)^{\frac{3}{2}}$$

$$Q_6 = Q_3$$

Flow to Upper Wilson Pond = $Q_1 + Q_2 + Q_3 + Q_4 + Q_5$

Flow Continuing Down the Branch = $Q_6 + Q_7 + Q_8 + Q_9 + D_1 + D_2 + D_3 + D_4$

A basic program for calculating the stage-discharge relationship for this structure is given on the next 3 pages. As can be seen from these results, a Test Flood inflow of 25,800 cfs at this location create a stage of 9.3 feet and would send 4850 cfs to Upper Wilson Pond. The inflow from the 0.1 square mile direct drainage to Upper Wilson Pond at the time of occurence of this peak would be negligible by comparison.

Attenuation in Upper Wilson Pond would also be negligible for a flow of this magnitude. The peak test flood outflow of 4850 cfs, would (from page D-6) cause a stage of 3.4 feet (508.4 feet MSL) or 1.8 feet above the abutments.

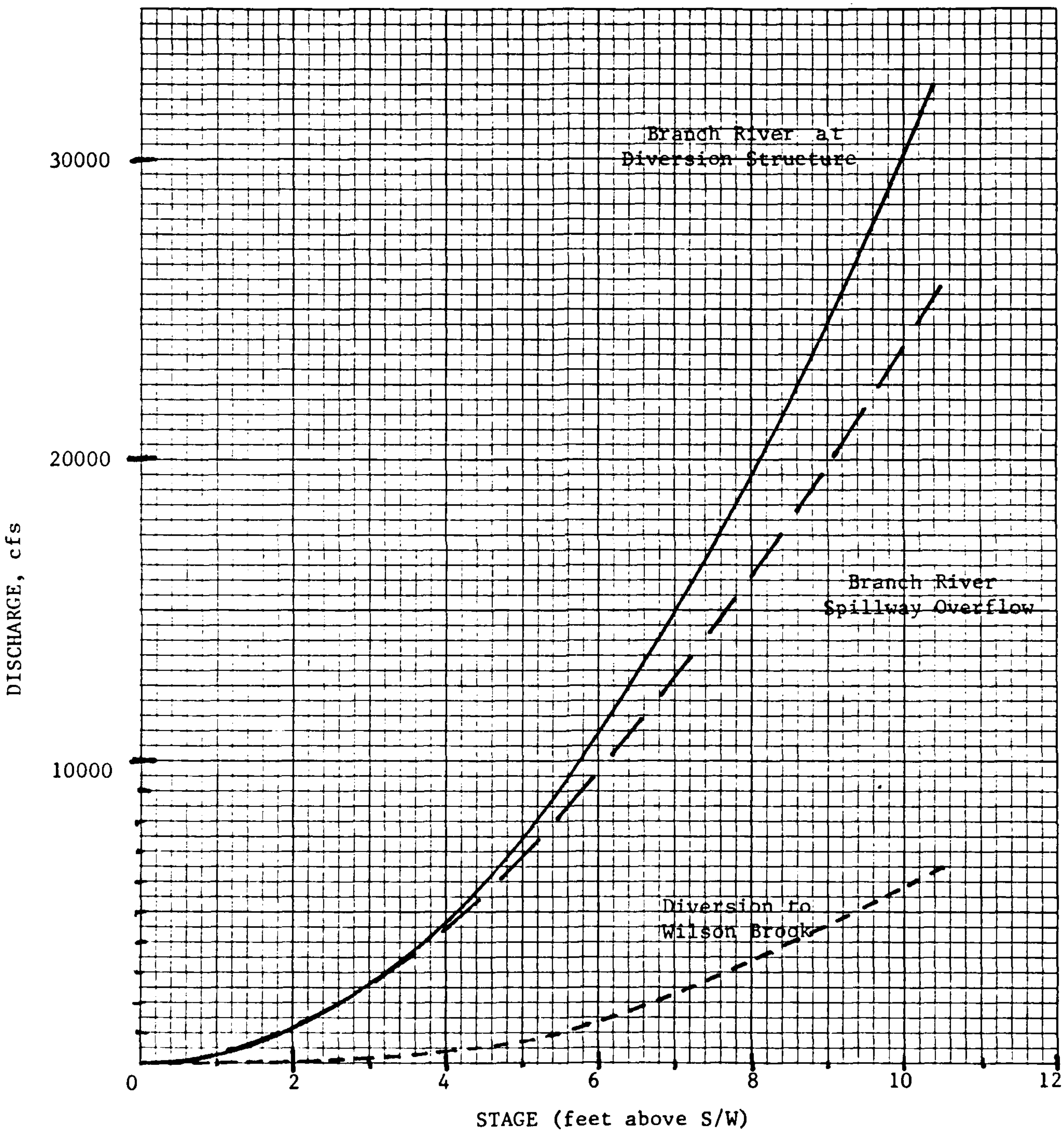
```
LIST
100 REM - STAGE/DISCHARGE CURVE FOR DAM ON THE BRANCH
110 REM - STORED ON DISK TAC
120 PAGE
130 PRINT "STAGE VS. DISCHARGE RELATIONSHIP FOR THE DAM ON THE BRANCH"
140 PRINT USING 150:
150 IMAGE /  6T"HEAD"                38T"DISCHARGE"
160 PRINT USING 170:
170 IMAGE 1T"(FT. ABOVE S/W)"40T"(CFS)"
180 PRINT USING 190:
190 IMAGE 20T "TOTAL            TO WILSON POND         T0 THE BRANCH"
200 PRINT ""
210 FOR H=0 TO 10 STEP 0.5
220 O1=0
230 O2=0
240 O3=0
250 O5=0
260 O6=0
270 O7=0
280 O8=0
290 O9=0
330 D4=0
350 O4=2.8*1.5*(H+2.6)↑1.5
355 D1=2.8*2.86*(H+1)*(0.5*(H+1))↑1.5
360 D2=2.8*5*(H+1)↑1.5
365 D3=2.8*5*(H+1)*(0.5*(H+1))↑1.5
370 IF H<0 THEN 550
372 O8=3.3*98*H↑1.5
375 IF H<=1 THEN 550
380 D3=2.8*10*(1+H-1)↑1.5
390 D4=3*75/2*(0.5*(H-1))↑1.5
400 IF H<=1.5 THEN 550
410 O5=3.3*7.3*(H-1.5)↑1.5
420 IF H<=2.5 THEN 550
430 O9=3*100*(H-2.5)↑1.5
```

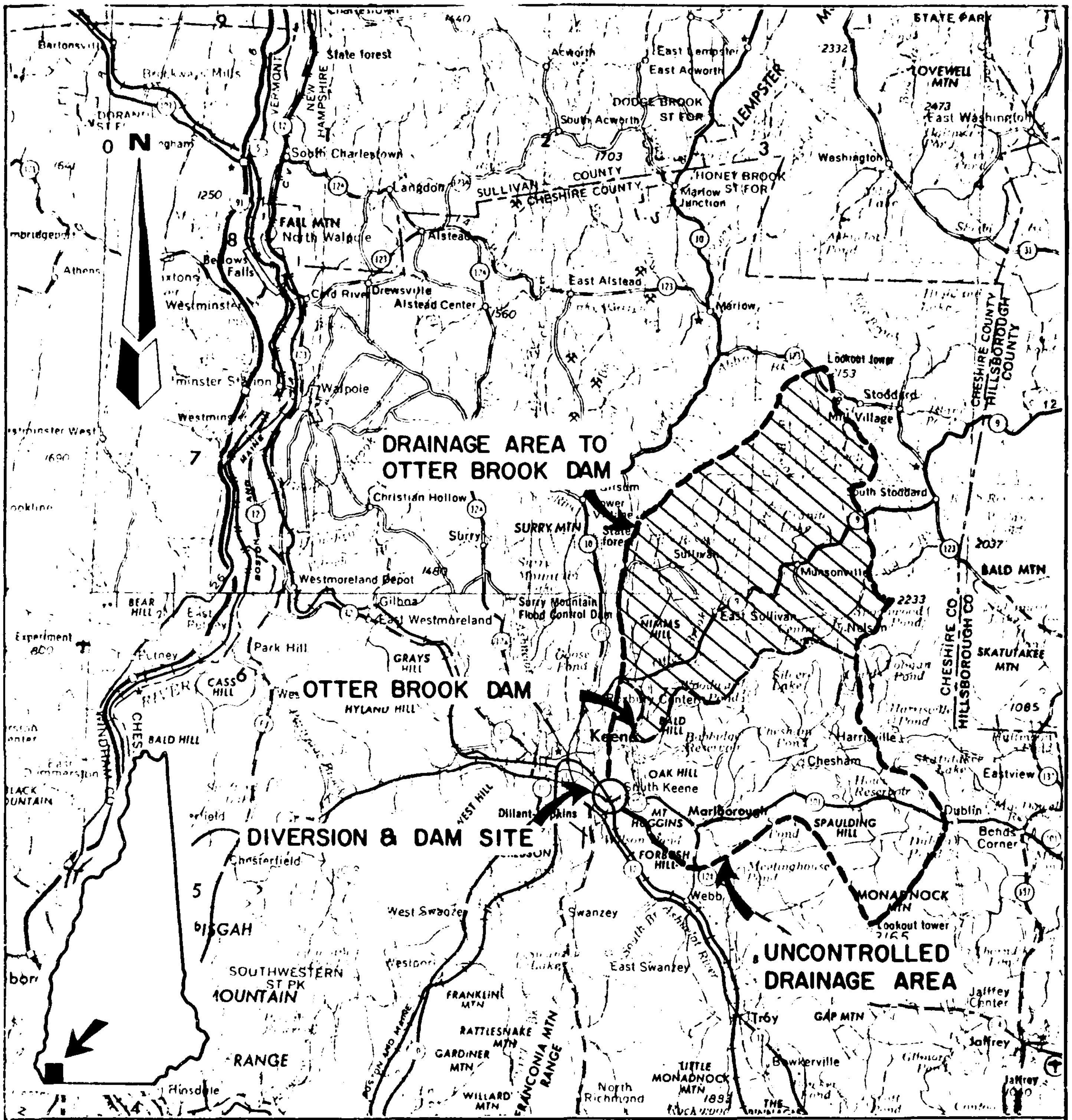
```
435 D1=2.8*10*(1.75+H-2.5)↑1.5
440 IF H<=3 THEN 550
450 D4=3*75*(1+H-3)↑1.5
460 IF H<=3.5 THEN 550
470 O1=2.8*100*(H-3.5)↑1.5
480 IF H<=4.3 THEN 550
490 O7=3*5*(H-4.3)↑1.5
500 IF H<=4.4 THEN 550
510 O2=3*7.5*(H-4.4)↑1.5
520 IF H<=6.9 THEN 550
530 O3=3*3.5*(H-6.9)↑1.5
540 O6=O3
550 T1=O1+O2+O3+O4+O5
560 T2=O6+O7+O8+O9+D1+D2+D3+D4
570 T3=T1+T2
580 PRINT USING 590:H,T3,T1,T2
590 IMAGE 6D.2D,15D,22D,22D
600 NEXT H
610 END
```

STAGE VS. DISCHARGE RELATIONSHIP FOR THE DAM ON THE BRANCH

HEAD (FT. ABOVE S/W)	DISCHARGE (CFS)		
	TOTAL	TO WILSON POND	TO THE BRANCH
0.00	39	18	22
0.50	184	23	162
1.00	436	29	407
1.50	778	35	743
2.00	1201	50	1151
2.50	1691	72	1619
3.00	2351	100	2251
3.50	3407	131	3276
4.00	4585	265	4319
4.50	5963	485	5478
5.00	7514	771	6744
5.50	9214	1107	8106
6.00	11046	1488	9558
6.50	13002	1908	11094
7.00	15072	2364	12709
7.50	17259	2857	14403
8.00	19554	3383	16171
8.50	21950	3940	18010
9.00	24444	4526	19917
9.50	27030	5140	21890
10.00	29706	5780	23925

STAGE-DISCHARGE CURVES FOR THE BRANCH DIVERSION





-SCALE-
1:250,000

FROM USGS GLENS FALLS AND ALBANY

GOLDBERG ZOINO & ASSOCIATES, INC.
GEOTECHNICAL-GEOHYDROLOGICAL CONSULTANTS
NEWTON UPPER FALLS, MASSACHUSETTS

U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DRAINAGE AREA MAP

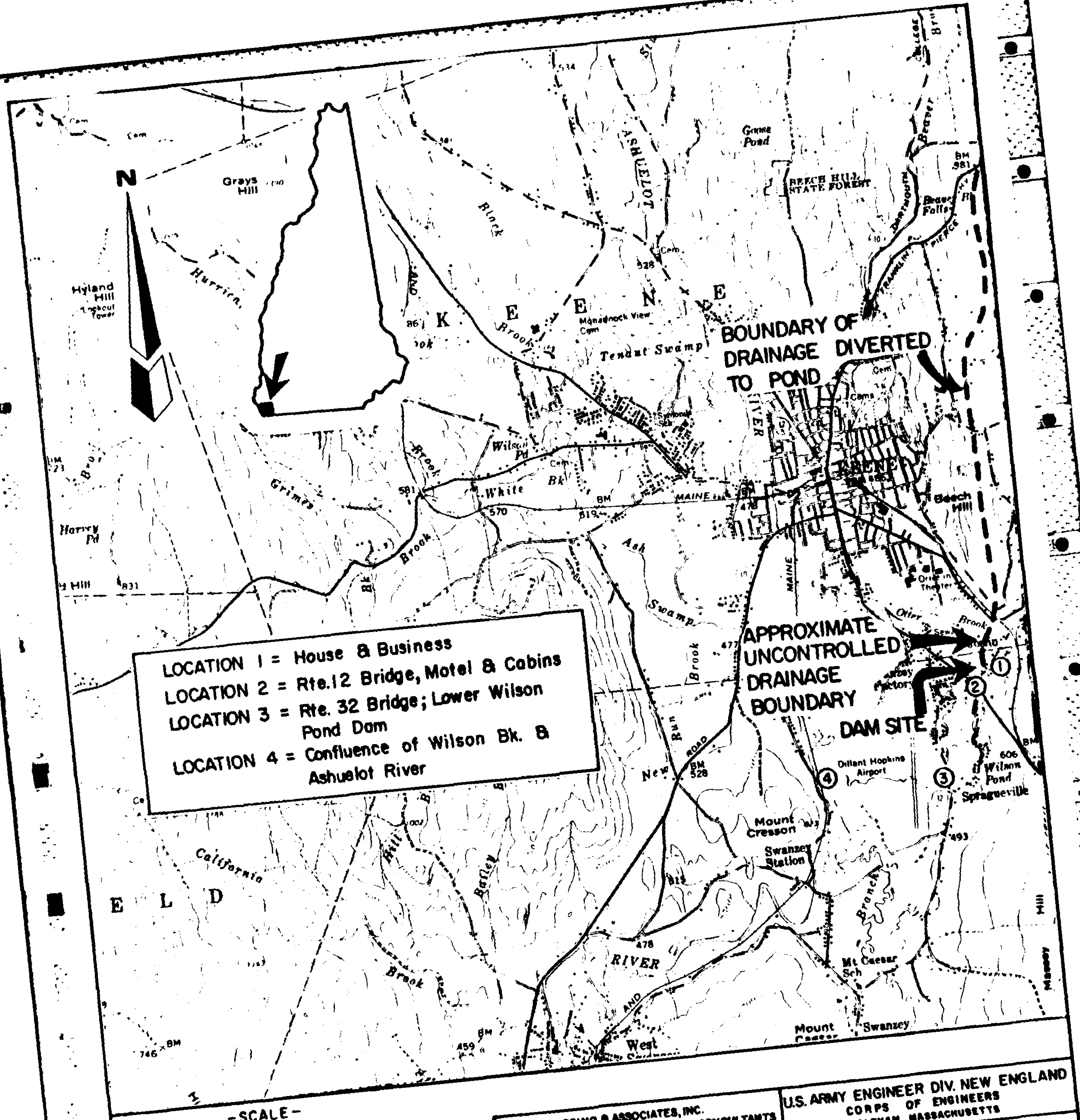
UPPER WILSON POND DAM

SWANZEY, NEW HAMPSHIRE

SCALE AS SHOWN

DATE OCT. 1980

FILE No 2605



LOCATION 1 = House & Business
LOCATION 2 = Rte.12 Bridge, Motel & Cabins
LOCATION 3 = Rte. 32 Bridge; Lower Wilson Pond Dam
LOCATION 4 = Confluence of Wilson Bk. & Ashuelot River

-SCALE-
0 1/2 1 2 (MILES)
FROM. USGS KEENE, NEW HAMPSHIRE
QUADRANGLE MAP

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CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

LOCATION AND DOWNSTREAM HAZARD MAP

UPPER WILSON POND DAM
KEENE, NEW HAMPSHIRE
SCALE AS SHOWN
DATE OCT 1980
FILE No. 2605

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME