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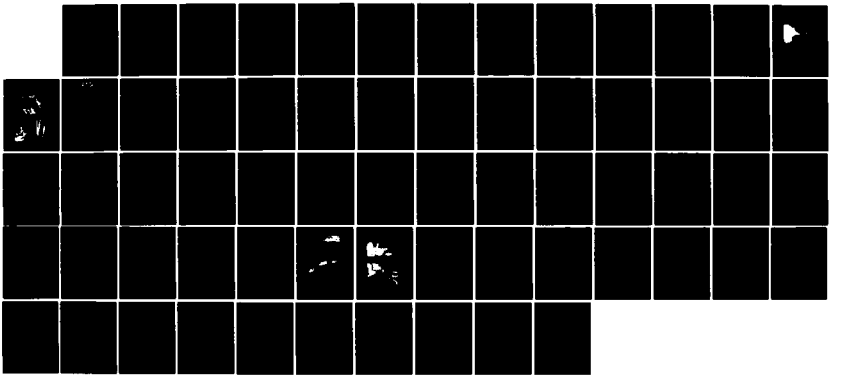

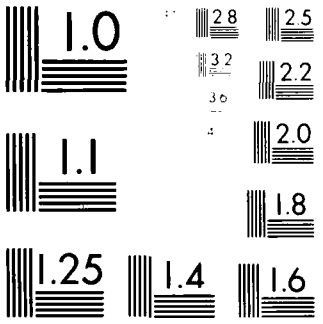

MERRIMACK RIVER BASIN
NELSON, NEW HAMPSHIRE

SPOONWOOD POND DAM

NH 00338

NHWRB 116.03

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

AUGUST 1978

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

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

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
Newton, New Hampshire
Nubanusit Brook, Tributary to Contoocook River

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

The dam is an earth embankment 250 ft. long with a maximum height of [illegible] ft. It is small in size with a low hazard potential. The dam, which has withstood severe floods without failure or evident distress in the past, is in fair condition, but it is noted that the pond was empty at the time of inspection. The dam must be reinspected at full pool. While the hazard to life and property around the lake in the event of failure is low, the possible effects of a failure on the dam are of considerable concern.

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

NEDED

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

NOV

Dear Governor Thomson:

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

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Mr. John J. Colony, c/o Harrisville Designs, Harrisville, New Hampshire 03450.

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

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

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

SPOONWOOD POND DAM

NH 00338

MERRIMACK RIVER BASIN
NELSON, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Inventory No.:	NH 00338
NHWRB No.:	116.03
Name of Dam:	SPOONWOOD POND
Town:	Nelson
County and State:	Cheshire County, New Hampshire
Stream:	Nubanusit Brook, Tributary to Contoocook River
Date of Inspection:	18 July 1978

BRIEF ASSESSMENT

Spoonwood Pond Dam is basically an earth embankment 280 feet long and with a maximum height of approximately 12 feet. The embankment includes a 24 inch diameter cast iron pipe with gate valve and a 10 foot long spillway constructed of granite slabs. Initial construction took place in 1855 with probable alterations in the 1890 - 1910 period. No original plans are available. Outflows discharge directly into Nubanusit Lake which, in turn, flows into Nubanusit Brook and eventually into the Contoocook River. At the time of inspection, the impoundment was drawn down, the outlet gate being in an open position.

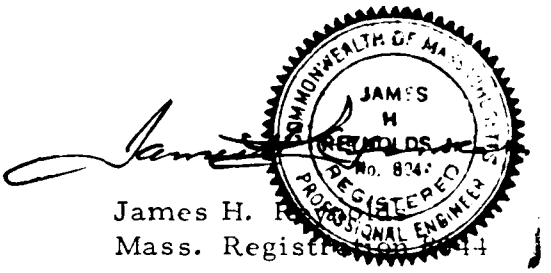
The drainage area consists of 1.9 square miles of steeply sloping, heavily forested terrain. The dam's normal impoundment of the quite shallow pond is 500 acre-feet which catagorizes it as SMALL. The hazard potential classification of LOW results from the lack of any significant hazard to the downstream Nubanusit Lake Dam and properties surrounding Nubanusit Lake.

The dam, which has withstood several severe floods without failure or evident distress in the past, is in FAIR condition at the present time, but it is to be noted that the pond was empty at the time of inspection. The dam must be reinspected at full pool. Deficiencies in the areas of inadequate spillway capacity, erosion of earth embankments and tree growth on the embankments require correction by the owner within 1 to 2 years after receipt of the Phase I Inspection Report. Based on size and hazard classifications in accordance with Corps guidelines, the test flood is in the range of the 50-100 year flood. The test flood, with an inflow of 750 cfs (400 csm) results in an outflow of 160 cfs (85 csm) and would overtop the dam; therefore the spillway is considered inadequate.

While the hazard to life and property around Nubanusit Lake in the event of failure is low, the potential effects of a failure on the Nubanusit Lake Dam are of considerable concern. Since an analysis to verify this hazard is beyond the scope of a Phase I investigation, the report recommends that the appropriate agency initiate such an analysis as a follow up to this inspection. A second study to analyze the potential for some type of increased spillway capacity to preclude overtopping is also necessary.

Operationally, the owner controls the dam in a responsible manner, particularly in coordinating anticipated flows with the Corps regional dam tenders. The dam does, however, require an increased level of routine maintenance such as erosion repair and tree removal.

William S. Zoino, P.E.
NH Registration 3226



James H. Reynolds
Mass. Registration No. 8044

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

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

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

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

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Overview of dam from downstream

Overview of left abutment from spillway area

Overview from left abutment

[illegible] ENGINEERING CONSULTANTS
[illegible] TECHNICAL CONSULTANTS
[illegible] UPPER FALLS, MASS.

U.S. ARMY ENGINEER [illegible] NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS

LOCUS PLAN

PHASE I INSPECTION REPORT

SPOONWOOD POND DAM, NH 00338

NHWRB 116.03

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

(b) Purpose

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

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

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

(c) Scope

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

1.2 Description of Project

(a) Location

The dam lies between Spoonwood Pond and Nubanusit Lake, approximately 1.8 miles northeast of the Nubanusit dam. Nubanusit Brook drains through a series of lakes, ponds and reservoirs to the Contoocook River, a tributary of the Merrimack. The site is only accessible by boat, with the Hancock public landing off Route 123 providing the nearest launching point. The portion of the USGS Monadnock, New Hampshire quadrangle presented previously shows this locus. Figure 1 of Appendix B presents a detail of the site developed from a town plot plan.

(b) Description of Dam and Appurtenances

The dam consists of a 280 foot long earth embankment with a maximum height of approximately 12 feet (Figs. 2 and 3). The embankment includes a 10 foot long spillway constructed of granite slabs and a 24-inch diameter cast iron pipe with gate valve (Fig. 3). The downstream side of the dam near the spillway and cast iron pipe consists of a vertical wall of natural, unmortared stone. The dam has some riprap on both the upstream and downstream slopes.

(c) Size Classification

The dam's normal impoundment of 500 acre-feet and 12 foot height places it in the SMALL category as defined in the "Recommended Guidelines." The pond is essentially on a plateau and is rather shallow; the downstream height of the dam is somewhat deceptive (Photo 3).

(d) Hazard Potential Classification

The effect of a failure of Spoonwood Lake Dam upon the downstream Nubanusit Dam was investigated under conservative assumptions and was found to cause no more than a 1.1 foot rise in Nubanusit Lake which could not significantly damage adjacent property or overtop the dam. Thus, a hazard potential classification of LOW is indicated.

(e) Ownership

The dam's owner is Mr. John Colony, c/o Harrisville Designs, Harrisville, N.H. 03450. His phone number is 603-827-3334.

(f) Operator

Mr. Colony, his brother Charles and his son John J. Colony III control the operation of the dam.

(g) Purpose

The primary purpose of the dam is to store water for industrial processing and possible private power generation in the Harrisville area. Because Nubanusit Lake generally satisfies most of the downstream requirements, the owner rarely operates the Spoonwood Pond Dam: only at the end of the summer or during periods of drought is it necessary to open Spoonwood. While storage is the primary purpose, recreational use is far more common.

(h) Design and Construction History

The history of this dam is somewhat obscure. A 1924 New Hampshire Water Resources Board (NHWRB) report indicates that construction took place in 1890 and that one F. Upton was the architect/engineer. This time period coincides with the alteration of Nubanusit Lake Dam to its present configuration. The owner, whose family has always owned the dam, believes that initial construction was in 1855 and that in 1910 the owners rebuilt the upper portion and added the spillway. No plans for the structure are available.

(i) Normal Operational Procedure

The owner generally opens the gate at Spoonwood in late summer to draw down the pond in anticipation of the spring runoff. Due to the difficulty involved in reaching the dam and in opening the gate, other discharges are infrequent, occurring only when necessary to meet summer recreation pool elevation in Nubanusit Lake as mandated by the NHWRB.

1.3 Pertinent Data

(a) Drainage Areas

Spoonwood Pond receives runoff from a 1200 acre drainage area (1.9 s.m.). The terrain is heavily forested and steeply sloping on all sides of the pond. There is no development of any kind around Spoonwood and local residents foresee none in the immediate future.

(b) Discharge at the Dam Site

There are no formal records in existence concerning the discharge at the dam. The owner reports that the flood accompanying the hurricane of 1938, which approached a 100 year flood in this basin, did not overtop the dam. During a period of many years both before and after that time, he has never seen water rise more than one foot in the spillway.

(1) Outlet Works: 24 inch gated pipe, invert 1375 MSL (est)

(2) Ungated Spillway capacity at maximum pool: 80 cfs with pool at elevation 1387.9 ± MSL at crest of spillway abutment

(c) Elevation (ft. above MSL)

(1) Top Dam - 1388±

(2) Spillway Test Flood pool level - 1388.2±

(3) Full flood control pool - Not Applicable

(4) Recreation pool - 1386 ±

(5) Spillway crest - 1386 ±

(6) Streambed at centerline of dam - 1376.9 (est)

(7) Maximum tailwater - 1379 (est)

(d) Reservoir

(1) Length of Maximum pool - 1 mile

(2) Storage - Normal - 500 acre feet @ 1386 ±
Maximum - 775 acre feet @ 1387.9 ±
(shallow pond-downstream height of dam deceptive)

(3) Surface - top of dam: 145 acres

(e) Dam

(1) Type - Earth and Stone Fill

(2) Length - 280 ft.

(3) Height - 12 ft.

(4) Top Width - 12 ft.

(5) Side Slopes - Vertical D/S, 3:1 U/S

(6) Zoning, Cutoff, Grout Curtain - no information

(g) Spillway

(1) Type - Flat granite slab with 23 inch high side walls

(2) Length of weir - 10.0 ft.

(3) Crest elevation - 1386

(4) Gates - None

(5) U/S Channel - Spoonwood Pond

(6) D/S Channel - Nubanusit Lake

(h) Regulating Outlets

The dam includes a 24-inch diameter cast iron pipe with gate valve for regulating discharges. The invert of the pipe is at Elevation 1375± feet, MSL. A long-handled key operates the valve from a point on the right downstream side of the spillway (Photo 3).

SECTION 2 - ENGINEERING DATA

2.1 Design

Neither Mr. Colony, whose family has owned the dam since its construction, nor the NHWRB have any original design drawings. The present structure is generally quite simple and incorporates no unusual design features. The design appears adequate for its intended purpose, having survived over 100 years and having successfully passed a probable 100 year flood in 1938.

2.2 Construction

No construction records for the dam are available. Visual inspection of the embankments and outlet works revealed no major construction deficiencies. In general, the quality of the construction is as good as can be expected for a structure of this type built during this period.

2.3 Operation

The NHWRB has all records of dam operations from 1973 to the present and requires Mr. Colony to report all operations every two weeks. The owner also maintains records from 1965, when he first initiated formal record-keeping, to 1973.

2.4 Evaluation

(a) Availability

As mentioned above, the original plans for this dam are not available, if indeed they still exist. Previous inspection and inventory reports, sketches and correspondence concerning the dam, supplemented by the observations of the inspection team and interviews with the owner, form the basis of the information presented here.

(b) Adequacy

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

(c) Validity

The visual inspection, owner's observations and hydrological analyses are of sufficient validity as to permit satisfactory evaluations.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

(a) General

The Spoonwood Pond Dam is in FAIR condition at the present time and requires no immediate remedial measures for continued safe operation under normal conditions. It does, however, require some maintenance work, the details of which Section 7 presents.

At the time of the inspection, a broken turning nut caused the valve to be fixed in the open position. In consequence, the pond was fully drawn down to natural stream elevation, or about 5.5 feet below spillway crest. The bottom of the pond is heavily bouldered.

(b) Dam

(1) Embankment (Overview photos, Photo 1)

The two embankment sections which flank the spillway show no evidence of vertical or horizontal movement. The drawn down condition of the pond precluded any observation of seepage which might occur under head. Both embankments had a significant number of large, mature trees growing along their entire length. There is evidence of erosion all along the dam, particularly in the areas of the portages. Riprap protection was random and generally inadequate.

(2) Spillway (Photos 2 and 3)

The granite slabs which form the spillway are in good condition, although some of the previously leaded joints are now open. The upstream end of the spillway has lost some of its support owing to erosion of the underlying soil. The dry rubble stone masonry under the downstream end of the spillway contains many voids, some as deep as 6 feet. The owner indicates that no seepage occurs through these voids, even under full pond.

(3) Outlet Pipe

Both ends of the pipe were under water despite the drawn down condition of the pond. Massive boulders with large interstices cover the upstream end and serve as a crude, but effective, screen for debris. The gate valve in the pipe is not operative due to a broken turning nut on its stem.

(c) Appurtenant Structures

The dam has no appurtenant structures.

(d) Reservoir (Photo 4)

An inspection of the reservoir shore revealed no evidence of movement or other instability. An examination of the surrounding watershed detected no work in progress or recently completed which might increase the flow of sediment into the lake or which might adversely affect the runoff characteristics of the basin.

(e) Downstream Channel

The dam discharges directly into Nubanusit Lake. There are no downstream conditions which adversely affect the operation of the dam or which pose a hazard to the safety of the dam.

3.2 Evaluation

The visual inspection of the dam supplemented by information provided by the owner permitted a generally satisfactory evaluation of those features which affect the safety and stability of this structure. Perhaps, a confirmatory inspection, suggested by the NHWRB, is necessary when the pond fills to its normal level. Subject to this follow-up inspection, the visual inspection revealed the dam to be in FAIR condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

At the end of the summer, when Nubanusit Lake begins to drop below its mandated levels, Mr. Colony opens the valve and it remains open until the onset of freezing weather. At this time, he closes the gate in anticipation of the spring runoff and it generally remains closed until the end of the next summer. Other operations are infrequent, the valve being opened only in the event Nubanusit falls significantly below its required levels. The locked Nubanusit gatehouse contains the operating key for the gate valve.

4.2 Maintenance of Dam

The owner visits the dam several times during the year and notes any required maintenance. The repair of a portage over the dam by which sportsmen haul boats is an area receiving regular attention, generally additional fill and riprap. While significant problems seem to be expeditiously handled, numerous trees are growing on the dam, there are several eroded areas and the spillway is deteriorating.

4.3 Maintenance of Operating Facilities

The gate valve on the cast iron pipe requires periodic lubrication of its moving parts. At the time of the inspection, the gate was inoperative and was scheduled for repair before the winter.

4.4 Description of Any Warning System in Effect

The owner coordinates closely with the Corps of Engineers' dam tenders at McDowell Dam and Otter Brook Dam to anticipate snowmelt and rainfall runoff and further relies on his own periodic visits plus reports from local residents using Nubanusit and Spoonwood for any indications of problems with the dam. In the event of potential flooding, the owner closely monitors the dam at Nubanusit, an action which also provides him with some knowledge of the situation at Spoonwood.

4.5 Evaluation

Given the location of this dam and its performance history, the operational procedures warrant a satisfactory evaluation.

SECTION 5 - HYDRAULIC /HYDROLOGIC

5.1 Evaluation of Features

(a) Design Data

The available data sources for the Spoonwood Pond Dam include several inspection reports by the New Hampshire Water Resources Board (NHWRB) and correspondence between NHWRB and the dam's owners (John and Charles Colony) pertaining to maintenance and operation of Spoonwood Pond and Nubanusit Lake Dams.

Some of Spoonwood Pond Dam's basic characteristics are given in the 1934 "Inventory of Dams and Water Power Developments" by the NHWRB and the "Data on Dams in New Hampshire" dated April 11, 1938 by the New Hampshire Water Control Commission.

None of these sources contain the design data for the dam.

(b) Experience Data

There are no available records of flood flows at Spoonwood Pond, which is relatively inaccessible.

(c) Visual Observations

The hydraulic visual inspection concentrated on the outlet works which consist of the spillway and gated outlet conduit. The 10-foot long spillway has a nearly flat surface composed of 10-inch thick granite slabs and a crest 23 inches below the top of the dam. There is no impediment to flow. The outlet conduit is a 24-inch diameter cast iron pipe with a gate valve operated by a large turn key kept at the Nubanusit gate house. Neither end of the conduit could be observed directly as they are located below rock rubble in the upstream and downstream channels. The upstream rubble serves as a natural screen, preventing debris from entering the pipe.

It is estimated that the crown of the pipe is 3 to 4 feet below the observed water levels. Normally, the valve would be closed.

At the time of the inspection, however, a broken turning nut caused the valve to be fixed in the open position. In consequence, the pond was fully drawn down to natural stream elevation, or about 5.5 feet below spillway crest. The bottom of the pond is heavily bouldered.

(d) Overtopping Potential

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

The "Recommended Guidelines" of the Corps of Engineers specify procedures for determining the Spillway Test Flood (STF) for a dam, based on its size and hazard potential classifications. As shown in Table 3 of the Guidelines, a dam classified as SMALL in size with a LOW hazard potential should have an STF between the 50- and 100-year peak flows.

The 50- and 100-year peak flows were calculated using several alternative methodologies. The first used the regression equations from United States Geological Survey Water Resource Investigation 78-47. The resulting estimates were 530 cfs for the 50-year peak and 670 cfs for the 100-year peak. The Rational Formula was used with a time of concentration of 1 hour and a runoff coefficient of 0.3. It yielded a 100-year estimate of 848 cfs. An estimate based on total runoff volume was also determined. That estimate assumed a triangular hydrograph with a 12-hour base and a total runoff of 4 inches from the basin. The resulting estimate for the 100-year peak flow was 792 cfs.

If a range of possible STF values is indicated, the Corps' "Recommended Guidelines" suggest using the magnitude which most closely relates to the risk involved. Since the risk for Spoonwood Pond Dam is within the LOW category, an estimate of 750 cfs was selected as the inflow STF.

The Storage-Stage curve used to determine attenuation of the STF by storage is based on the assumption that surcharge storage is equivalent to the product of the surcharge in feet above the spillway crest and the normal surface area of the pond (145 acres). This curve is shown in Appendix D.

The discharge capacity of Spoonwood Pond is controlled by outlet characteristics and the water level in Spoonwood Pond. As discussed, the outlets include the 24-inch diameter cast iron pipe controlled by a screw valve, a 10-foot spillway and the 270 foot dam crest itself which is some 1.92 feet above the spillway crest. There is another potential outlet through a natural low point at the south end of the pond. However, this low area is about five feet above the spillway crest and, consequently, would not discharge until the dam was severely overtopped. For the purposes of this analysis, it is assumed that the 24 inch cast iron pipe would be only partly open and that flows through it would be negligible as compared to spillway flows. The spillway and the dam crest are treated as broad-crested weirs and the slopes at the ends of the dam are assumed to be 20:1.

The Stage-Discharge curve in Appendix D illustrates the total outflow for a given stage. For a total runoff consistent with the selected inflow STF, application of the procedure suggested by the New England District of the Corps of Engineers in "Estimating the Effect of Surcharge Storage on Maximum Probable Discharges" results in an outflow STF of 160 cfs. As can be seen from the Stage-Discharge curve, this represents a head of 2.12 feet above the spillway crest. Thus, the dam crest would be overtopped by about 0.2 feet.

5.2 Hydraulic/Hydrologic Evaluation

Spoonwood Pond Dam has a spillway capacity of approximately 80 cfs under current conditions. Even with the surcharge storage provided by the pond's large surface area, the 100-year flood flow is significantly greater than this value. Thus, there is a chance of overtopping the dam in any year.

This evaluation assumed that the 24-inch gate valve would be closed. This assumption is based on the normal closed position of the valve and the inaccessibility of the dam, especially in bad weather, as it can be reached only by boat. If the valve were opened wider, the approximate outflow, with the lake elevation just below overtopping the dam crest, would be 40 cfs. This would not prevent overtopping for the Spillway Test Flood, but would reduce the extent of overtopping.

5.3 Downstream Dam Failure Hazard Estimates

The outflow from Spoonwood Pond immediately enters Nubanusit Lake, which is the subject of a separate Phase I Inspection Report. Although failure of Spoonwood Pond Dam might raise the levels in Nubanusit Lake fairly quickly, the magnitude of the increase would not be sufficient to endanger life or cause property damage. The primary dam failure hazard is associated with the possibility that the failure of this dam could directly contribute to the failure of Nubanusit Dam and, therefore, represent a hazard to areas downstream of that location.

The impact of a Spoonwood Dam failure on the safety of Nubanusit Lake Dam can readily be evaluated based on the total storage volume behind Spoonwood Dam and the surface area of Nubanusit Lake. If failure occurred when the spillway abutments were overtopped the total storage in Spoonwood Pond is estimated as 775 acre-feet. The normal surface area of Nubanusit Lake is 715 acres. Thus, at a maximum, the rise in Nubanusit Lake as a result of the failure of Spoonwood Dam would be 1.1 feet. Given that the normal pool elevation of Nubanusit allows for a minimum of 2.5 feet of freeboard, the failure of Spoonwood alone does not pose a threat to the safety of Nubanusit Lake. In addition a 1.1 foot rise does not threaten any lakeshore property.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

(a) Visual Observations

There are no design data available for review of the structural stability of the dam. The field investigation and findings do not indicate any displacements and/or distress indices of such magnitude as to warrant structural stability calculations based on assumed sectional properties and technical values. Subsequent inspection must be made for confirmation after Spoonwood Pond has been restored to normal pool.

(b) Design and Construction Data

As noted earlier, an intense data search in several agencies failed to uncover basic documentation on design and construction for either the existing dam or any predecessors.

(c) Operating Records

Good records are available for the owner for operations between 1965 and 1973 and parallel documentation is maintained by the New Hampshire Water Resources Board since 1973.

(d) Post Construction Changes

None

(e) Seismic Stability

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

SECTION 7 - ASSESSMENT, RECOMMENDATIONS, AND REMEDIAL MEASUREMENTS

7.1 Dam Assessment

(a) Condition

Except for the inoperative gate, scheduled for early repair, the condition of Spoonwood Lake Dam is FAIR. The dam has successfully withstood many severe floods in the past and it appears stable. However, the dam was inspected when Spoonwood's impoundment was drawn down and, thus, no potential deficiencies under head could be observed.

(b) Urgency

General improvements recommended herein should be implemented by the owner over the next 1 to 2 years after receipt of the Phase I Inspection Report. However, for recreational and storage reasons, the defective gate should be repaired as soon as convenient.

(c) Need for Additional Information

With the exception of the reinspection under full pond, no additional information is necessary.

7.2 Recommendations

The spillway discharge capacity is not considered adequate, and it is recommended that engineering studies be initiated to investigate optimum methods of developing a moderate improvement in emergency discharge capacity for an appropriate design flood. The dam should be reinspected at full pond to detect possible seepage or other undesirable characteristics. It is suggested that the NHWRB might appropriately undertake this follow-up inspection.

The extensive tree growth at this dam presents a significant problem in terms of conventional repair. In essence, removal of the trees and roots would require a virtual rebuilding of the entire dam. The sufficiency of merely cutting the trees down to avoid uprooting in a storm is doubtful, as the subsequent rotting of the root structure might provide flow paths for water. Because of the low hazard potential classification of the dam, the expense necessary for complete removal does not appear warranted. For these reasons, it is recommended that a study by made to determine the

most practical and economical method for resolving this problem.

7.3 Remedial Measures

(a) Alternatives

At the sacrifice of a very desirable recreational and storage facility, the gate valve could be left open and unrepaired and the total volume thus be made available for flood storage.

(b) Operational Maintenance Procedures

Implementation of the following measures will assist the owners in assuring the long-term safe operation of this dam.

(1) Repair the gate valve.

(2) Remove uprooted trees and reshape and riprap the former root zones.

(3) In accordance with the recommendations of the study mentioned above, remove all trees and other vegetation from the embankment.

(4) Repair all eroded areas on both embankments, particularly behind the spillway and at the portages and place additional riprap where required to insure future protection.

(5) Seal all joints between the granite spillway slabs.

(6) Watch for potential leaks through the extensive voids in the dry rubble stone masonry.

(7) Institute formal periodic inspections on at least an annual basis. Since the site is accessible only by boat, the owner should provide continual surveillance in the area during periods of unusually heavy precipitation.

(8) The owner should develop a formal warning system with local officials for alerting dam stream residents in case of emergency.

APPENDIX A

VISUAL INSPECTION CHECK LISTS

INSPECTION TEAM ORGANIZATION

Date: 18 July 1978 - 9:00 a.m.
NH 00338
SPOONWOOD POND DAM
Nelson, New Hampshire
Nubanusit Brook (Tributary of Contoocook River)
NHWRB 116.03

Weather: Sunny, warm

Inspection Team

James H. Reynolds	Goldberg, Zoino, Dunnicliff & Associates, Inc. (GZDA)	Team Captain
Nicholas A. Campigna	GZDA	Soils
Robert Minutoli	GZDA	Soils
Andrew Christo	Andrew Christo Engineers, Inc.	Structural & Concrete
Richard L. Laramie	Resource Analysis, Inc.	Hydrology

Owner's Representative

Mr. John Colony

Transport

Dr. Norris Robertson

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
DAM EMBANKMENT & WALLS		
Surface Cracks	[illegible]	None
Movement or Settlement of Crest	[illegible]	None
Lateral Movement	[illegible]	None
Vertical Alignment	[illegible]	Good
Rubble Masonry	[illegible]	Large voids, upstream and downstream
Trees and growth	[illegible]	Many large mature trees on embankment
Trespassing on Slopes	[illegible]	Two boat portages - heavy wear
Sloughing or Erosion of Slopes or Abutments	[illegible]	Heavy erosion, right side of spillway upstream - earth removal, exposing rubble walls.
Rock Slope Protection - Riprap Failures	[illegible]	Riprap randomly placed, local - bed dislodging. Locally replaced by rubble wall.
Unusual Movement or Cracking at or near Toes	[illegible]	None
Unusual Embankment or Downstream seepage	[illegible]	Pond fully drawn down. Detection of possible seepage, piping, boils or leakage through dam must await reinspection after restoration to normal pool.
Piping or Boils	[illegible]	None

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
SPILLWAY		
General Condition of Granite	[illegible]	Good
Lead Joints		Good, some now open
Movement		None
Cracks		Training walls cracked, present for many decades
Weep Holes		None
Obstructions		None
Stop-Logs	K	None
INLET CHANNEL		Drawn down, unobstructed, heavily bouldered
24-INCH DRAIN OUTLET		
Operating Condition of Valve	[illegible]	Turning nut broken - Inoperative, fixed in open position
Pipe Inlet	[illegible]	Submerged, not visible. Covered with boulders and slabs serving as debris screen
Pipe Outlet	[illegible]	Submerged, not visible. Water turbulence above outlet evident.
OUTLET CHANNEL		
Obstructions	[illegible]	None - Direct discharge to Nubanusit Lake

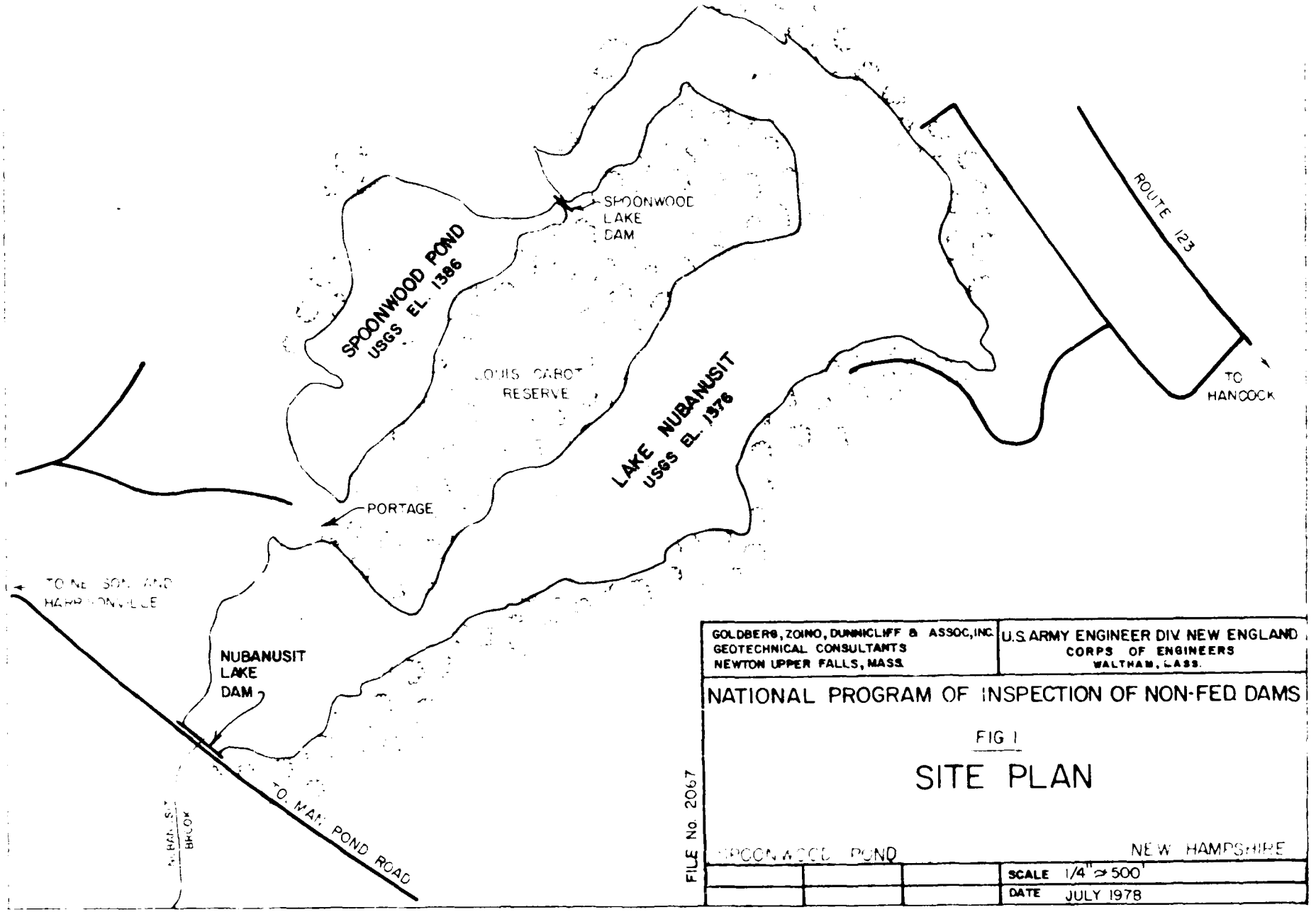
CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
Control of Debris		No debris around downstream side of dam.
Trees Overhanging Channel		Many trees overhanging spillway and on both sides of dam downstream.
EXISTENCE OF GAGES		No gage
RESERVOIR		
Shoreline		
Evidence of slides		None noted
Potential for slides		Entire shore appears stable
Sedimentation		None noted
Upstream hazard areas in the event of backflooding		No development on lake
Changes in nature of watershed (Agriculture, Logging, Construction, etc.)		None noted - watershed primarily heavy forest
DOWNSTREAM CHANNEL		
Restraints on dam operation		None
Potential flooded areas		98 cottages around Nubanusit Lake, few subject to some flooding if lake rises 2 - 3 feet

CHECK LISTS FOR VISUAL INSPECTION

AREA EVALUATED	BY	CONDITION & REMARKS
OPERATION & MAINTENANCE FEATURES		
Reservoir Regulation Plan		
Normal procedures		Gate opened in late summer to assist keeping Nubanusit Lake up - gate closed in early winter in anticipation of spring runoff and remains closed during summer
Emergency procedures		Access to dam very difficult if not impossible during adverse weather conditions
Compliance with designated plan		Not evaluated as no formal plan exists and no records maintained
Maintenance		
Quality		Additional attention to routine maintenance such as removal of trees, repair of erosion and care of valve appear necessary
Adequacy		Not evaluated as no significant maintenance apparent in recent years

APPENDIX B



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GEOTECHNICAL CONSULTANTS
NEWTON UPPER FALLS, MASS.

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

FIG 1

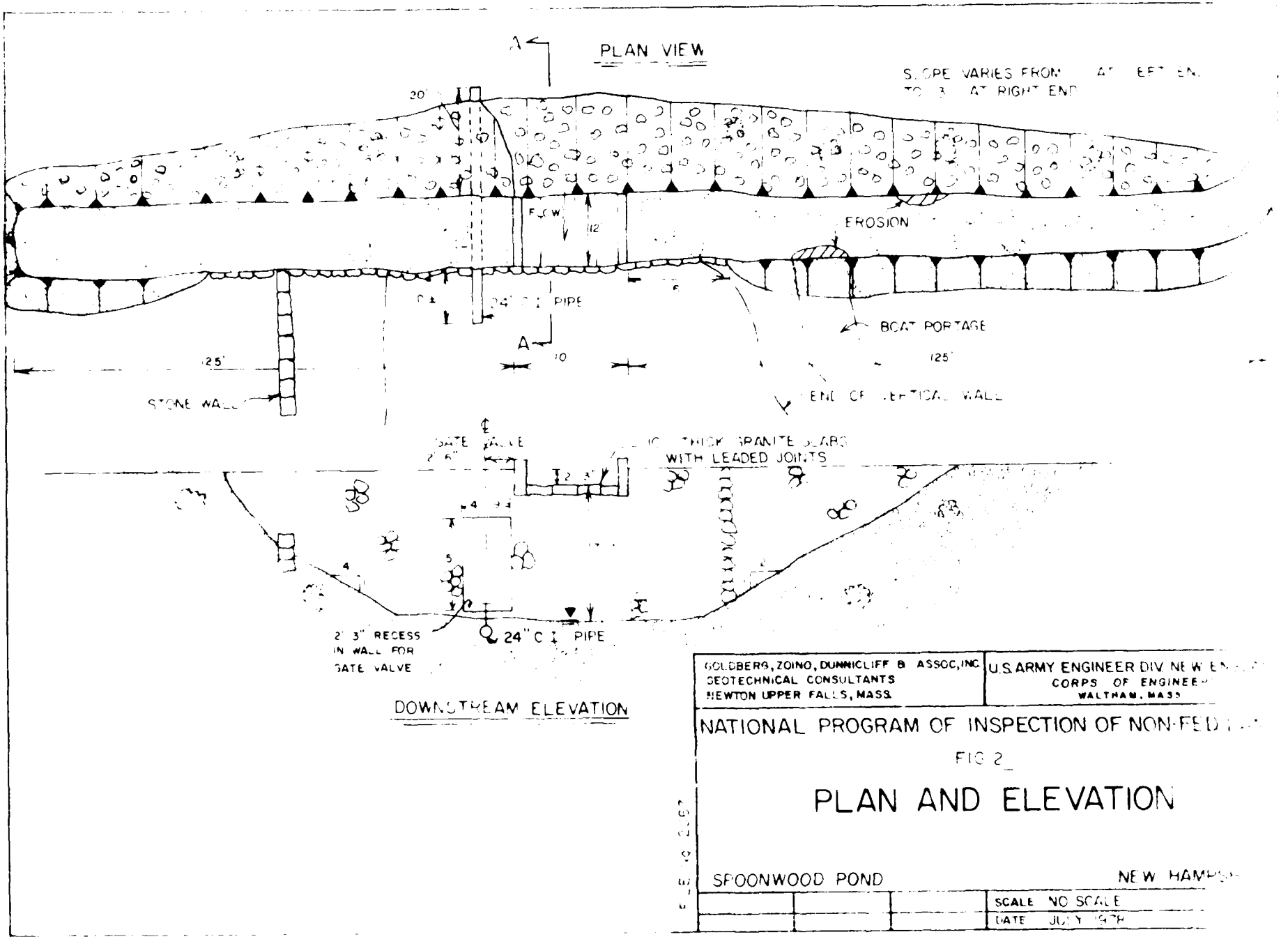
SITE PLAN

FILE No. 2067

SPOONWOOD POND NEW HAMPSHIRE

SCALE 1/4" = 500'

DATE JULY 1978



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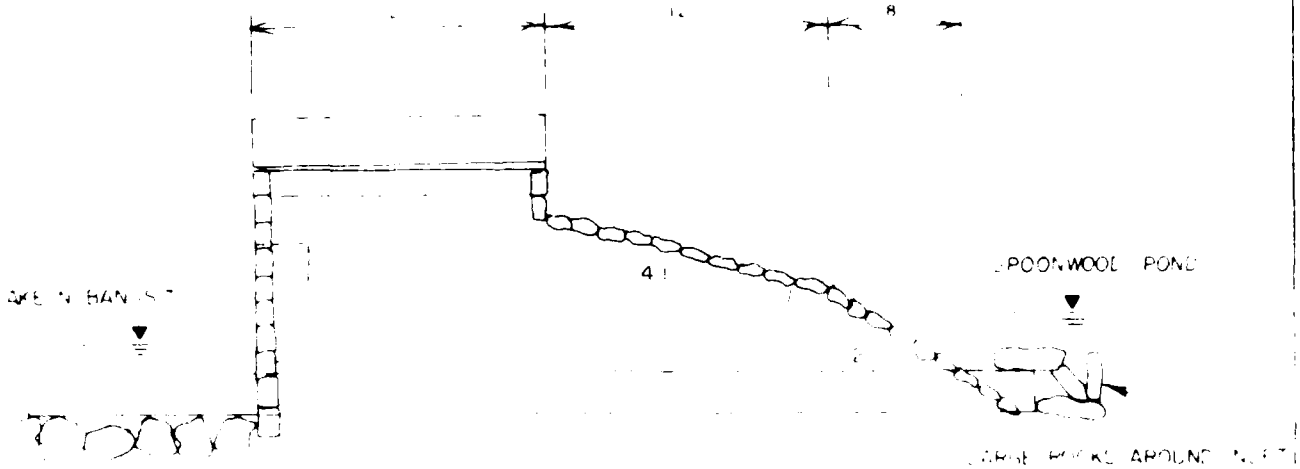
NATIONAL PROGRAM OF INSPECTION OF NON-FED...

FIG 2

PLAN AND ELEVATION

SPOONWOOD POND NEW HAMP...

			SCALE NO SCALE
			DATE JULY 19...



SECTION THRU SPILL WAY

NOTE SPOONWOOD POND DRAWNDOWN DURING TIME OF INSPECTION

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FIG 3

SECTION VIEW

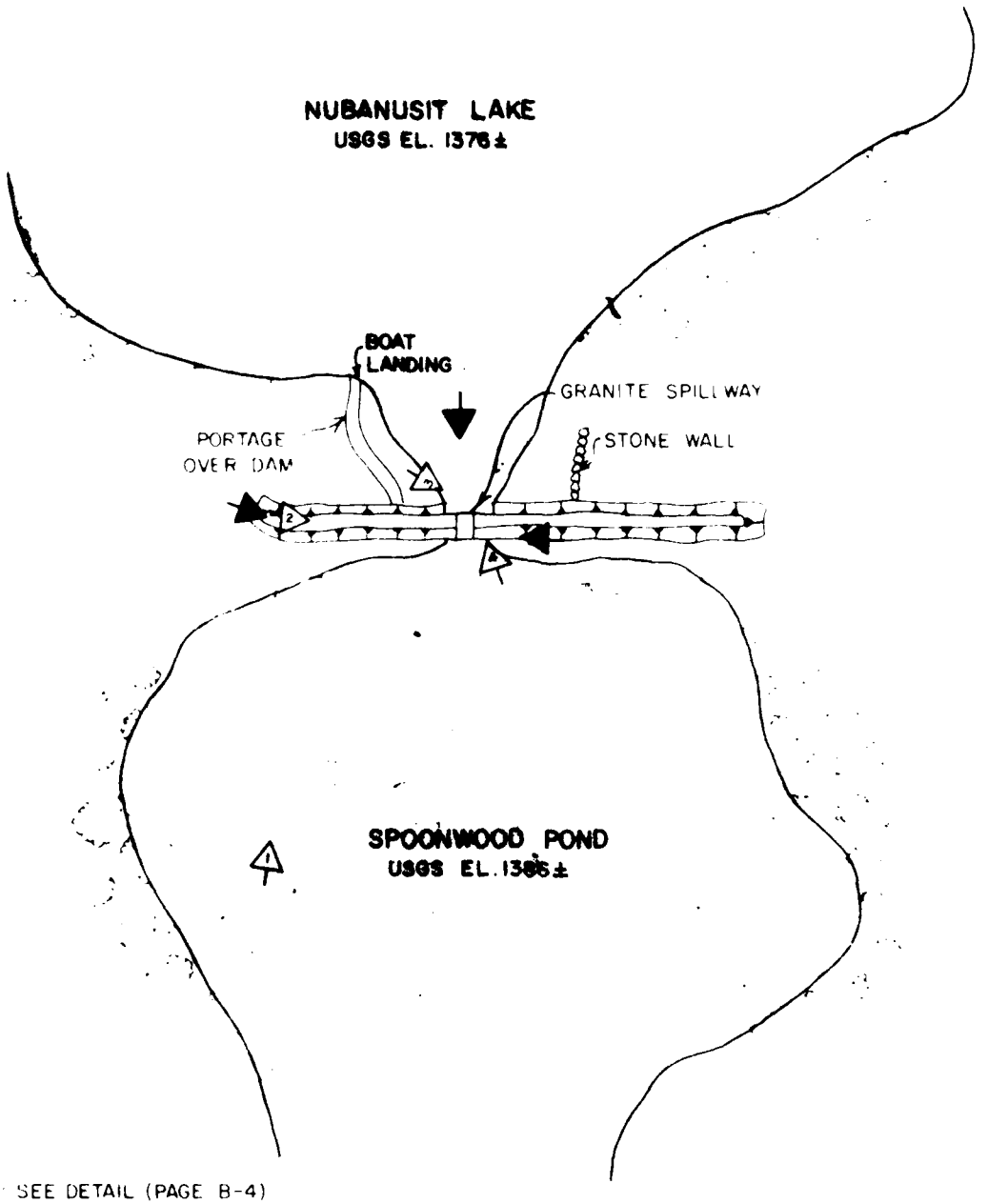
SPOONWOOD POND — NEW HAMPSHIRE

FILE No. 2067

			SCALE 1" = 10'
			DATE JULY 1979

APPENDIX C

SELECTED PHOTOGRAPHS



NOTE: SEE DETAIL (PAGE B-4) FOR DAM DIMENSIONS

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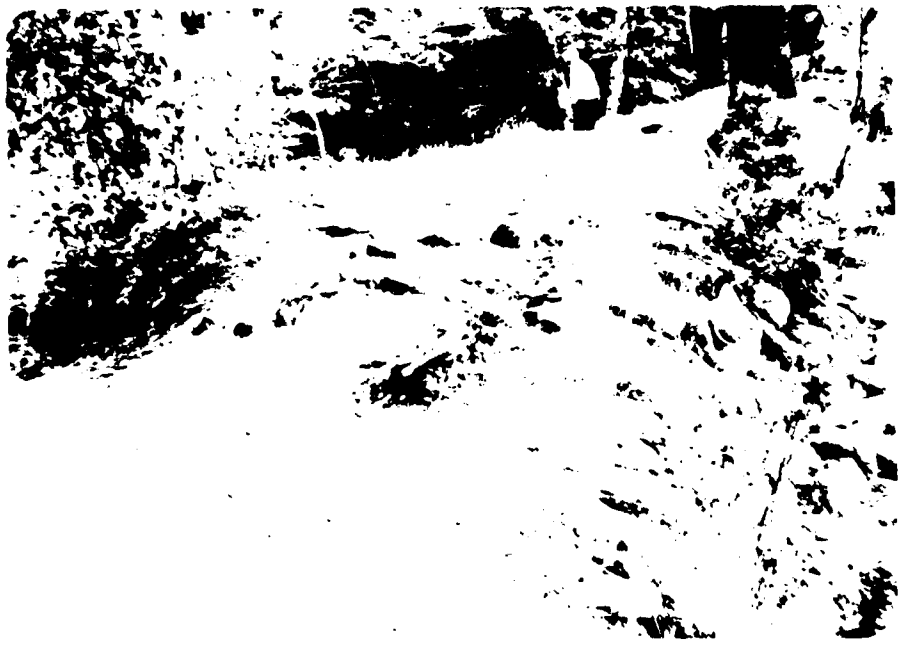
LOCATION AND ORIENTATION OF PHOTOS

FILE No. 2067

SPOONWOOD POND NEW HAMPSHIRE

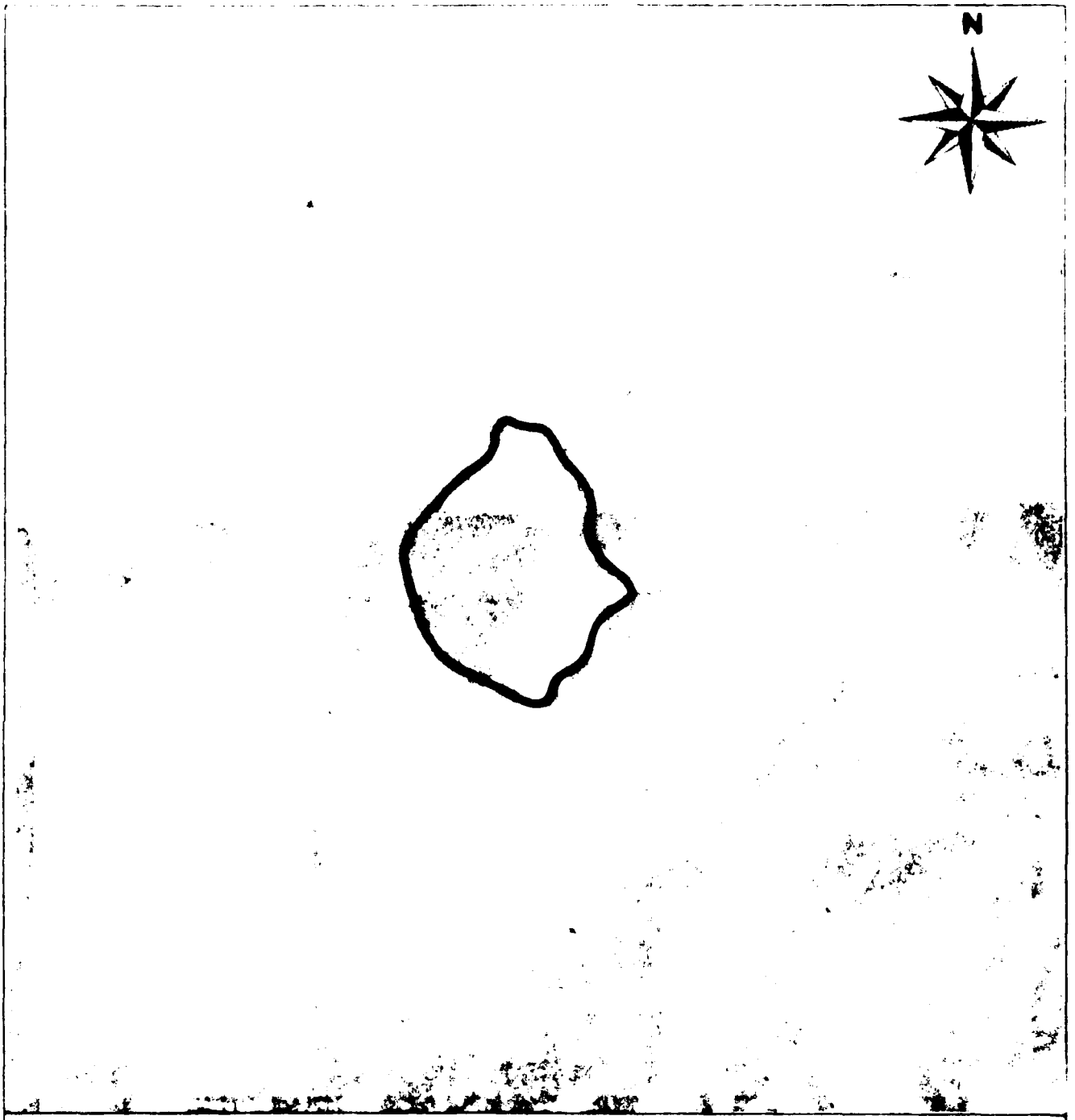
SCALE 1"=100'

DATE JULY



3. View of spillway and area containing gate valve downstream left side

4. Detail of spillway construction from upstream right side



0 1/2 2 miles

FROM USGS MONADNOCK, N.H. QUADRANGLE MAP

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NEWTON UPPER FALLS, MASS

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WALTHAM, MASS.

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DRAINAGE AREA

SPOONWOOD POND — NEW HAMPSHIRE

FILE No. 2067

SCALE AS SHOWN
DATE

Lesson 14a Spillway Test Flood TCC 9-15-76 1/10

[illegible] Chesterfield Control

[illegible] Spillway Test Flood [illegible]

[illegible] Lake rises [illegible] Although there [illegible] above Dubuque [illegible] Spoonwood Pool [illegible] ought to [illegible] flood [illegible]

[illegible] Spillway [illegible]

[illegible] Natural Surface [illegible] $2{,}0' \times 2(145) = 2180$

[illegible] $175 \times 290 = 1015$ ft

[illegible] Assumes no spreading as Lake rises, [illegible] in Nubanusit [illegible] of Spoonwood at normal [illegible] elevation: $\frac{1015}{315} = 1.1'$

[illegible] Assume [illegible]

SPILLWAY TEST FLOOD

Stay [illegible] flood

[illegible] determine [illegible] we will use [illegible] a regression [illegible] Water Resources [illegible] Geologic [illegible]

Regional Report I [illegible] a representative [illegible] for gages near the [illegible] (Spoonwood, Illinois [illegible] Spoonwood, Wisconsin)

DAMS 148 Sycamore Road Pond 7-19-78 cjf

AREA = 1.84 mi² = 1178 acres

SLOPE: 1 total length = 1 mile

El at 1% = 1460

El at 85% = 1100

$\frac{1460 - 1100}{15.1}$ = 24 ft/mile

$P_{50} = .62 A^{.605} S^{.154} T^{-.310} = .62(1184)^{.605}(24)^{.154}(2.5)^{2.5}$

= 127 cfs

$P_{100} = .25 A^{.756} S^{.154} T^{-.310} = .25(1184)^{.756}(24)^{.154}(2.5)^{2.5}$

= 191 cfs

The LeBlanc method is only fairly large standard error for small drainage areas.

As a check we will determine two alternative estimates of the Q_{100}.

DAMS INC. Spillway Design Date 7-11-78

Spillway Rating

RATING METHOD

T_c = 1 hour

[illegible], 100-year rainfall = 7.4"

C = 0.3

AREA = [illegible] acres

Q = [illegible] 848 cfs

Result - Check

[illegible]

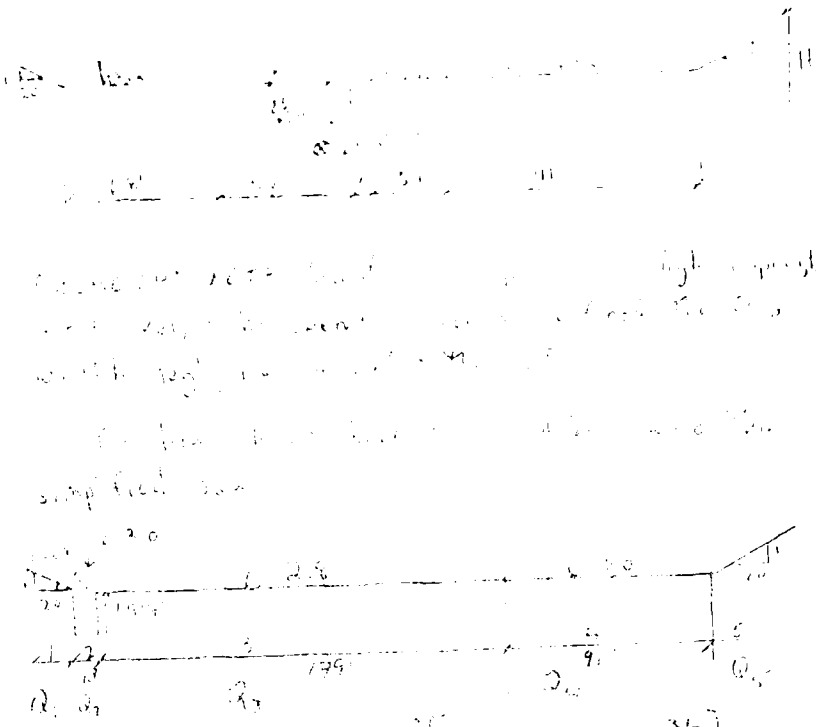
$\frac{A}{T_c}$ · 1.87 in/hr · 61 [illegible] = 342.5 acre-ft
= 4779 cfs

Area [illegible]

4779 [illegible]

H = 792 cfs

Conclusion: Spillway design of 1/2 PMF is adequate with [illegible] and the routing of Ross Hydrograph is selected 750 cfs as the SDF.



```
LIST
100 REM STAGE DISCHARGE CALC FOR SPOONWOOD POND DAM JOB 148
110 PAGE
120 C1=3
130 C2=2.8
140 E=1.5
150 PRINT "TOTAL DISCHARGE FROM SPOONWOOD POND DAM AS FUNC OF HEAD"
160 PRINT USING 170:
170 IMAGE // 2T"HEAD"30T"DISCHARGE"
180 PRINT USING 190:
190 IMAGE 10T"TOTAL      Q1       Q2       Q3       Q4       Q5"
200 FOR H=0.1 TO 3 STEP 0.1
210 Q2=C1*10*H^E
220 Q1=0
230 Q0=0
240 Q4=0
250 Q5=0
260 IF H<=1.917 THEN 310
270 Q1=C2*(20*(H-1.917))*(0.5*(H-1.917))^E
280 Q3=C2*(79*(H-1.917))^E
290 Q4=C1*50*(H-1.917)^E
300 Q5=Q1
310 Q7=Q1+Q2+Q3+Q4+Q5
320 PRINT USING 330:H,Q7,Q1,Q2,Q3,Q4,Q5
330 IMAGE 2T.2D,10.8D,8D,8D,8D,8D,8D
340 NEXT H
350 END
```

6 of 11

TOTAL DISCHARGE FROM SPOONWOOD POND DAM AS FUNC OF HEAD

HEAD	TOTAL	DISCHARGE			
		01	02	04	05
.00	.00	.00	.00	.00	.00
.01	.00	.00	.00	.00	.00
.02	.00	.00	.00	.00	.00
.03	.00	.00	.00	.00	.00
.04	.00	.00	.00	.00	.00
.05	.00	.00	.00	.00	.00
.06	.00	.00	.00	.00	.00
.07	.00	.00	.00	.00	.00
.08	.00	.00	.00	.00	.00
.09	.00	.00	.00	.00	.00
.10	.00	.00	.00	.00	.00
.11	.00	.00	.00	.00	.00
.12	.00	.00	.00	.00	.00
.13	.00	.00	.00	.00	.00
.14	.00	.00	.00	.00	.00
.15	.00	.00	.00	.00	.00
.16	.00	.00	.00	.00	.00
.17	.00	.00	.00	.00	.00
.18	.00	.00	.00	.00	.00
.19	.00	.00	.00	.00	.00
.20	.00	.00	.00	.00	.00
.21	.00	.00	.00	.00	.00
.22	.00	.00	.00	.00	.00
.23	.00	.00	.00	.00	.00
.24	.00	.00	.00	.00	.00
.25	.00	.00	.00	.00	.00
.26	.00	.00	.00	.00	.00
.27	.00	.00	.00	.00	.00
.28	.00	.00	.00	.00	.00
.29	.00	.00	.00	.00	.00
.30	.00	.00	.00	.00	.00
.31	.00	.00	.00	.00	.00
.32	.00	.00	.00	.00	.00
.33	.00	.00	.00	.00	.00
.34	.00	.00	.00	.00	.00
.35	.00	.00	.00	.00	.00
.36	.00	.00	.00	.00	.00
.37	.00	.00	.00	.00	.00
.38	.00	.00	.00	.00	.00
.39	.00	.00	.00	.00	.00
.40	.00	.00	.00	.00	.00
.41	.00	.00	.00	.00	.00
.42	.00	.00	.00	.00	.00
.43	.00	.00	.00	.00	.00
.44	.00	.00	.00	.00	.00
.45	.00	.00	.00	.00	.00
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.47	.00	.00	.00	.00	.00
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.82	.00	.00	.00	.00	.00
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.84	.00	.00	.00	.00	.00
.85	.00	.00	.00	.00	.00
.86	.00	.00	.00	.00	.00
.87	.00	.00	.00	.00	.00
.88	.00	.00	.00	.00	.00
.89	.00	.00	.00	.00	.00
.90	.00	.00	.00	.00	.00
.91	.00	.00	.00	.00	.00
.92	.00	.00	.00	.00	.00
.93	.00	.00	.00	.00	.00
.94	.00	.00	.00	.00	.00
.95	.00	.00	.00	.00	.00
.96	.00	.00	.00	.00	.00
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.98	.00	.00	.00	.00	.00
.99	.00	.00	.00	.00	.00
1.00	.00	.00	.00	.00	.00
1.01	.00	.00	.00	.00	.00
1.02	.00	.00	.00	.00	.00
1.03	.00	.00	.00	.00	.00
1.04	.00	.00	.00	.00	.00
1.05	.00	.00	.00	.00	.00
1.06	.00	.00	.00	.00	.00
1.07	.00	.00	.00	.00	.00
1.08	.00	.00	.00	.00	.00
1.09	.00	.00	.00	.00	.00
1.10	.00	.00	.00	.00	.00
1.11	.00	.00	.00	.00	.00
1.12	.00	.00	.00	.00	.00
1.13	.00	.00	.00	.00	.00
1.14	.00	.00	.00	.00	.00
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1.16	.00	.00	.00	.00	.00
1.17	.00	.00	.00	.00	.00
1.18	.00	.00	.00	.00	.00
1.19	.00	.00	.00	.00	.00
1.20	.00	.00	.00	.00	.00
1.21	.00	.00	.00	.00	.00
1.22	.00	.00	.00	.00	.00
1.23	.00	.00	.00	.00	.00
1.24	.00	.00	.00	.00	.00
1.25	.00	.00	.00	.00	.00
1.26	.00	.00	.00	.00	.00
1.27	.00	.00	.00	.00	.00
1.28	.00	.00	.00	.00	.00
1.29	.00	.00	.00	.00	.00
1.30	.00	.00	.00	.00	.00
1.31	.00	.00	.00	.00	.00
1.32	.00	.00	.00	.00	.00
1.33	.00	.00	.00	.00	.00
1.34	.00	.00	.00	.00	.00
1.35	.00	.00	.00	.00	.00
1.36	.00	.00	.00	.00	.00
1.37	.00	.00	.00	.00	.00
1.38	.00	.00	.00	.00	.00
1.39	.00	.00	.00	.00	.00
1.40	.00	.00	.00	.00	.00
1.41	.00	.00	.00	.00	.00
1.42	.00	.00	.00	.00	.00
1.43	.00	.00	.00	.00	.00
1.44	.00	.00	.00	.00	.00
1.45	.00	.00	.00	.00	.00
1.46	.00	.00	.00	.00	.00
1.47	.00	.00	.00	.00	.00
1.48	.00	.00	.00	.00	.00
1.49	.00	.00	.00	.00	.00
1.50	.00	.00	.00	.00	.00
1.51	.00	.00	.00	.00	.00
1.52	.00	.00	.00	.00	.00
1.53	.00	.00	.00	.00	.00
1.54	.00	.00	.00	.00	.00
1.55	.00	.00	.00	.00	.00
1.56	.00	.00	.00	.00	.00
1.57	.00	.00	.00	.00	.00
1.58	.00	.00	.00	.00	.00
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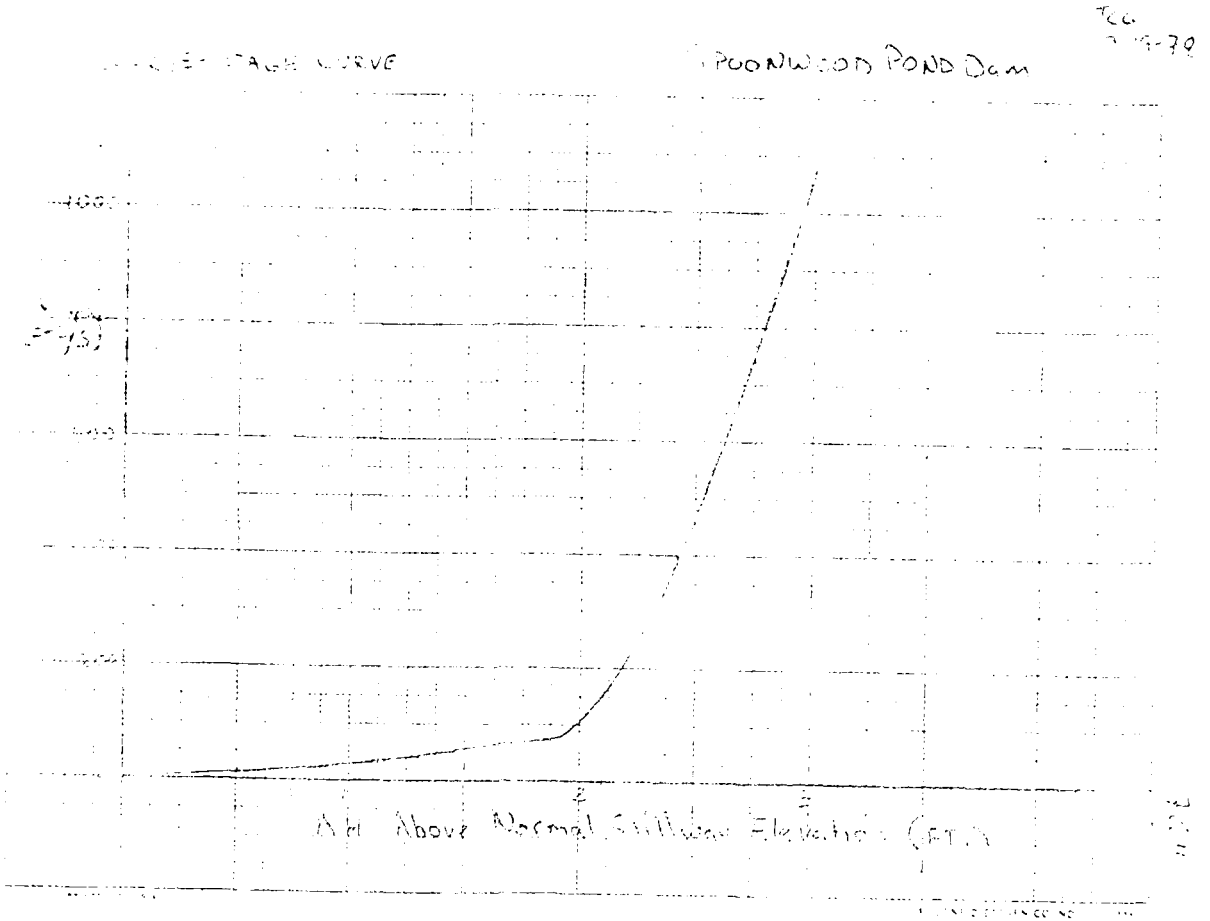

POONWOOD POND Dam
Ft Above Normal Spillway Elevation (Ft.)

Dams 148 Spoonwood Pond TEL

Storage - Stage Relationship

Surface Area of pond at Normal level = 145 acres

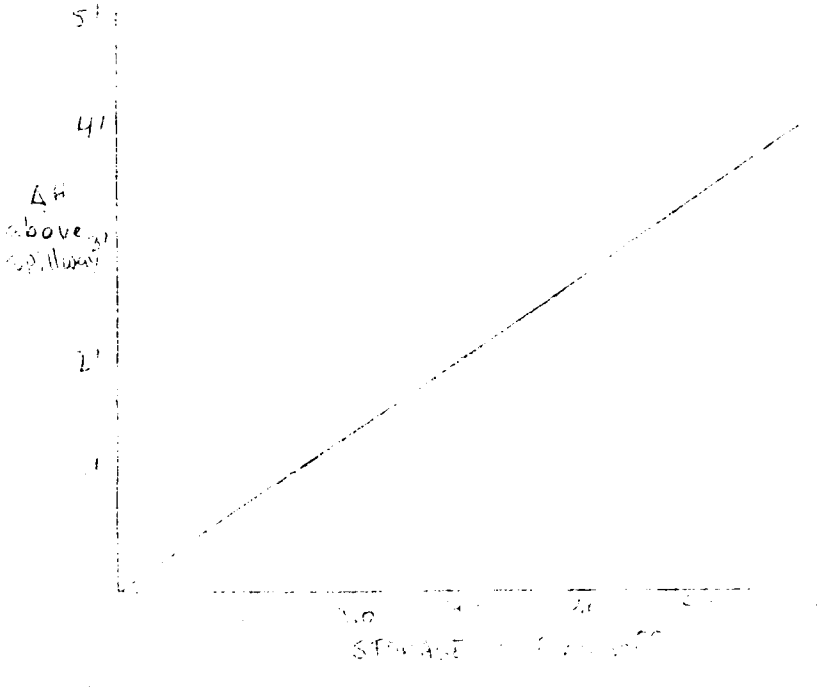
= .2266 sq. mi.

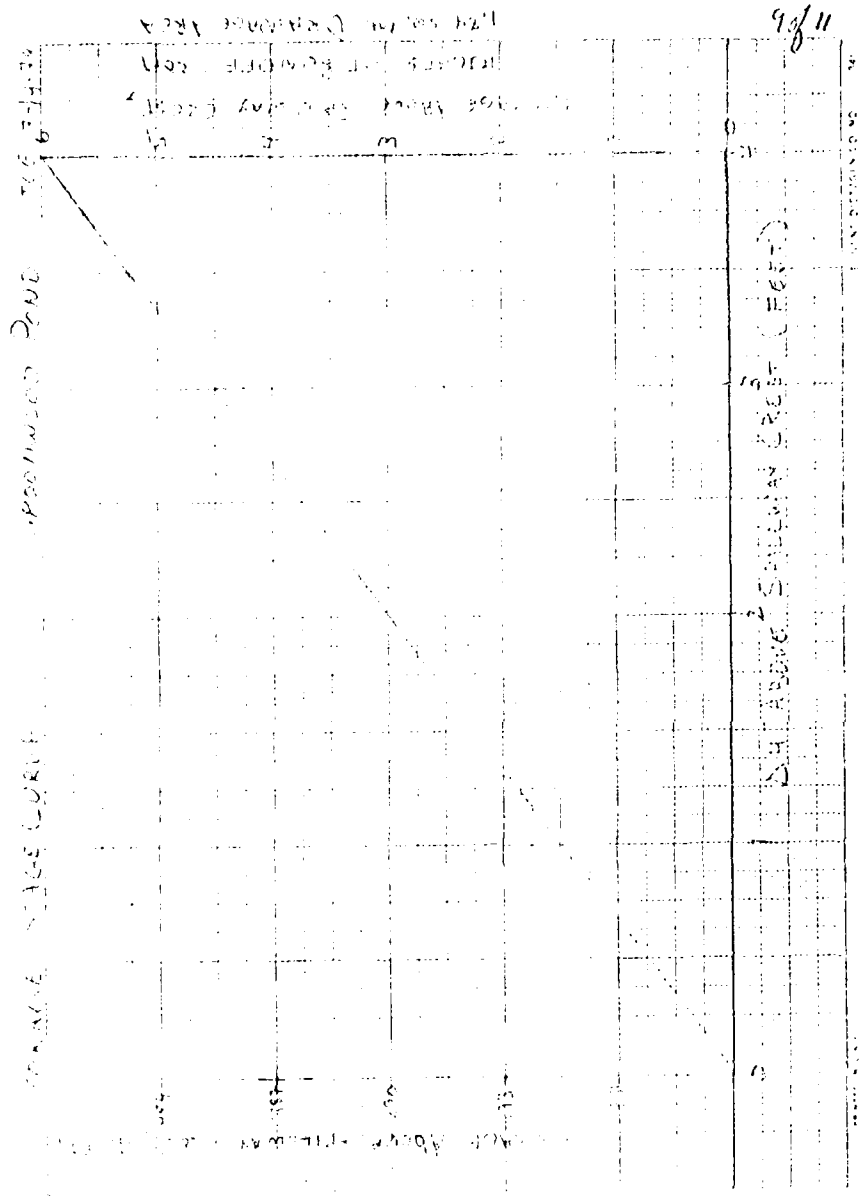
1" of runoff would cause

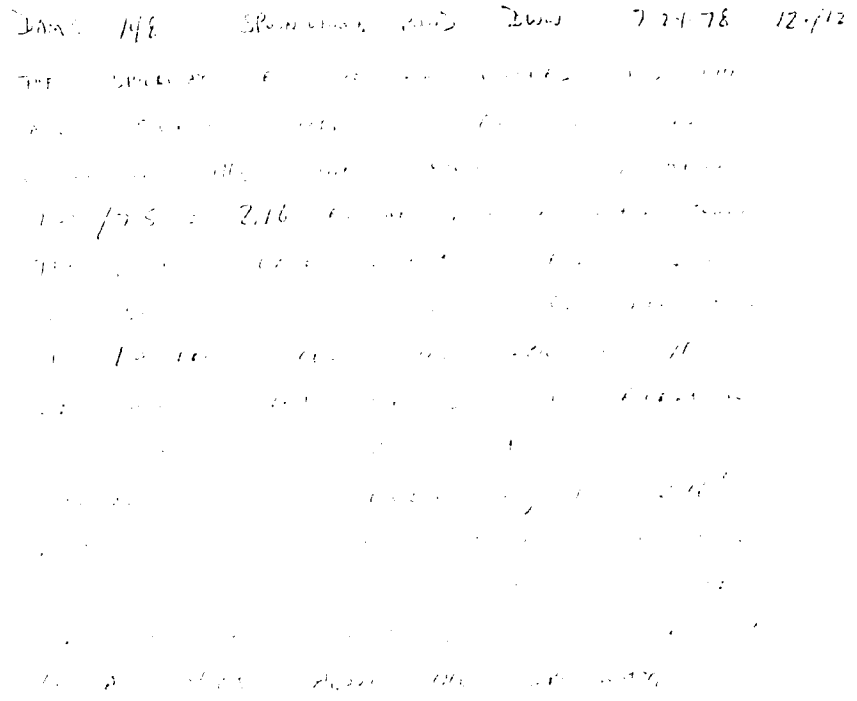
$\frac{1"(1178 \text{ acres})}{145 \text{ acres}}$ = 8.12" rise in water surface

1" of rise = .148" of runoff

use 1" = 1.5" run off







APPENDIX E

REVISED INVENTORY FORMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(2) IDENTITY NUMBER	(3) DIVISION	(4) STATE	(5) COUNTY	(6) CONGR DIST	(7) STATE	(8) COUNTY	(9) CONGR DIST	(9) NAME	(10) LATITUDE (NORTH)	(11) LONGITUDE (WEST)	(12) REPORT DATE DAY | MO | YR
NH	338	NED	NH	005	02				SPOONWOOD POND DAM	4259.6	7203.9	06SEP78

(13) POPULAR NAME	(14) NAME OF IMPOUNDMENT
	SPOONWOOD POND

(15) REGION	(16) BASIN	(17) RIVER OR STREAM	(18) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(19) DIST FROM DAM (MI)	(20) POPULATION
01	08	NUBANUSIT BROOK	HARRISVILLE	4	500

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT)	(25) HYDRAULIC HEIGHT (FT)	(26) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	(27) NORMAL (ACRE-FT)
REEMPG	1855	SRH	13	10	725	500

DIST	OWN	FED R	PRV/FED	SCS A	VER/DATE
NED	N	N	N	N	17AUG78

(28) REMARKS

(29) DAM HAS	(30) SPILLWAY CREST LENGTH (FT)	(31) SPILLWAY TYPE	(32) SPILLWAY WIDTH (FT)	(33) MAXIMUM DISCHARGE (FT)	(34) VOLUME OF DAM (CY)	(35) POWER CAPACITY INSTALLED (MW)	(36) POWER CAPACITY PROPOSED (MW)	(37) NAVIGATION LOCKS NO	(38) LENGTH (FT)	(39) WIDTH (FT)	(40) LENGTH (FT)	(41) WIDTH (FT)	(42) LENGTH (FT)	(43) WIDTH (FT)	(44) LENGTH (FT)	(45) WIDTH (FT)
2	279	U	11	695	5300											

(46) OWNER	(47) ENGINEERING BY	(48) CONSTRUCTION BY
JOHN J COLONY JR		

(49) REGULATORY AGENCY DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

(50) INSPECTION BY	(51) INSPECTION DATE DAY | MO | YR	(52) AUTHORITY FOR INSPECTION
GOLDBERG ZOINO DUNNICLIFF + ASSOC	19JUL78	PL 92-367

(53) REMARKS

END

FILMED

8-85

DTIC