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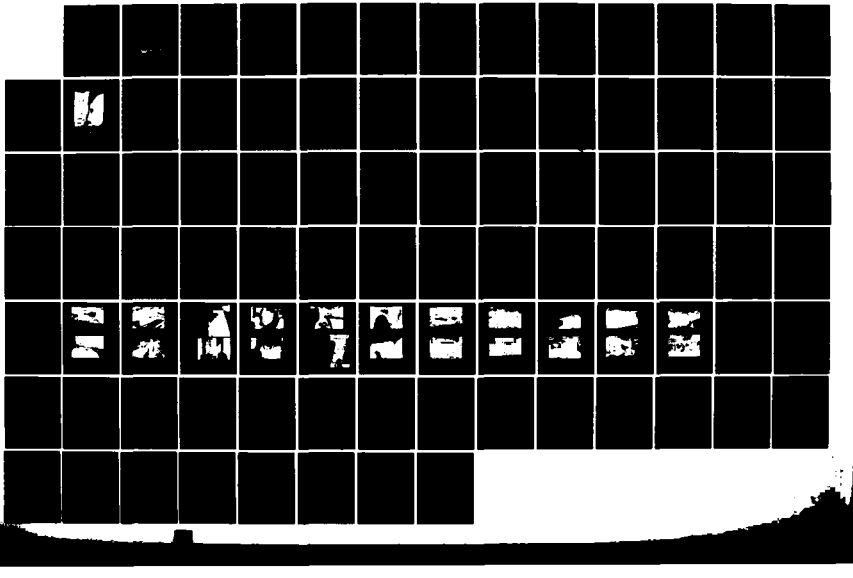

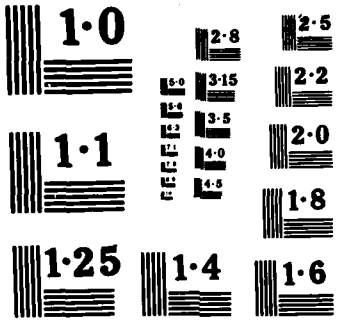

MERRIMACK RIVER BASIN

HARRISVILLE, NEW HAMPSHIRE

HARRISVILLE POND DAM

NH 00065

NHWRB 109.08

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

MAY 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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18. SUPPLEMENTARY NOTES

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

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

DAMS, INSPECTION, DAM SAFETY,
Merrimack River Basin
Harrisville New Hampshire
Nabanusit Brook

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

The dam is a dry rubble masonry and earth dam. The dam has a maximum height of 21 ft. and is about 75 ft. long. The dam is judged to be in fair condition. It is intermediate in size with a high hazard potential. Modification is necessary to improve the hydraulic and hydrological condition of the dam.

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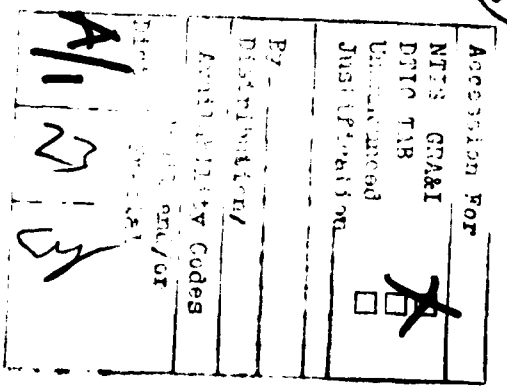
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:

NEDED-E

SEP 6 1978



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

Dear Governor Gallen:

Inclosed is a copy of the Harrisville Pond Dam Phase I Inspection Report, which was 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. A brief assessment is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Harrisville Pond Dam would likely be exceeded by floods greater than 2.5 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Our screening criteria specifies that a dam of this class which does not have sufficient spillway capacity to discharge fifty (50) percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam 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.

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. 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. During periods of unusually heavy precipitation, round-the-clock surveillance should be provided.

NEDED-E
Honorable Hugh J. Gallen

I have approved 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 non-Federal Dam Inspection Program.

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

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

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

Sincerely,

Max B. Scheider

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

HARRISVILLE POND DAM

NH 00065

NHWRB 109.08

MERRIMACK RIVER BASIN
HARRISVILLE, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH 00065
Name of Dam:	Harrisville Pond Dam
Town:	Harrisville
County and State:	Cheshire, New Hampshire
Stream:	Nubanusit Brook
Date of Inspection:	May 22, 1978

Brief Assessment

Harrisville Pond Dam is a dry rubble masonry and earth dam which was constructed around 1886. The dam has a maximum height of 21 feet and is approximately 75 feet long. It is serving as the foundation of the north wall of a 2-story mill building. The spillway, located in the western end, is 3 feet 7 inches wide with a 2.5-foot high opening in the wall.

Based on the visual inspection, available records, and past operational performance, the dam is judged to be in fair condition. Water was observed seeping out of the downstream face of the dam and at the gate structure. Settlement was noted east of the gate structure. Continuance of this classification depends on proper operations and maintenance of the dam.

This dam falls under the category of high hazard potential, and it is intermediate in size. The test flood peak inflow is equal to the Probable Maximum Flood, 16,500 cfs, and the test flood peak outflow is 14,289 cfs. Hydraulic analysis indicates that the maximum surchage pool elevation is 1329.4, approximately 11.4 feet above the spillway crest. The spillway in the body of the dam together with the waste sluice will pass approximately 2.5% of the test flood peak outflow without overtopping the country road above the by pass culvert. Therefore, the spillway capacity is inadequate. The test flood would overtop the county road by 8.9 feet.

As stated in Section 7, within 1 year after receipt of this Phase I report, the owner, Mr. John J. Colony, Jr., should retain the services of a competent engineer and implement the results of his evaluation of the following:

1. The modification necessary to improve the hydraulic and hydrologic condition of the dam.

2. The extent of submergence in Eastview and Harrisville in the event of failure of this dam.

The following operating and maintenance measures, as stated in Section 7.3, should also be implemented:

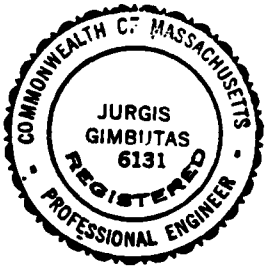
1. Leaks through the face of the dam should be monitored regularly until such time it can be repaired.

2. Reestablish the proper grade of the settled area east of the gate structure.

3. An operating and maintenance manual for the project should be prepared.

4. A program of technical annual periodic inspection of the project features should be prepared and initiated. This program should assure that all features of the foundation of the mill building within the discharge channel are continually maintained.

5. Surveillance and a warning system should be developed for periods of unusually heavy rains and runoff.



FAY, SPOFFORD & THORNDIKE, INC.
By

Jurgis Gimbutas, P.E.
Project Engineer

Richard W. Albrecht, P.E.
Vice President

This Phase I Inspection Report on Harrisville 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

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

Fred J. Ravens Jr

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

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

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

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

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

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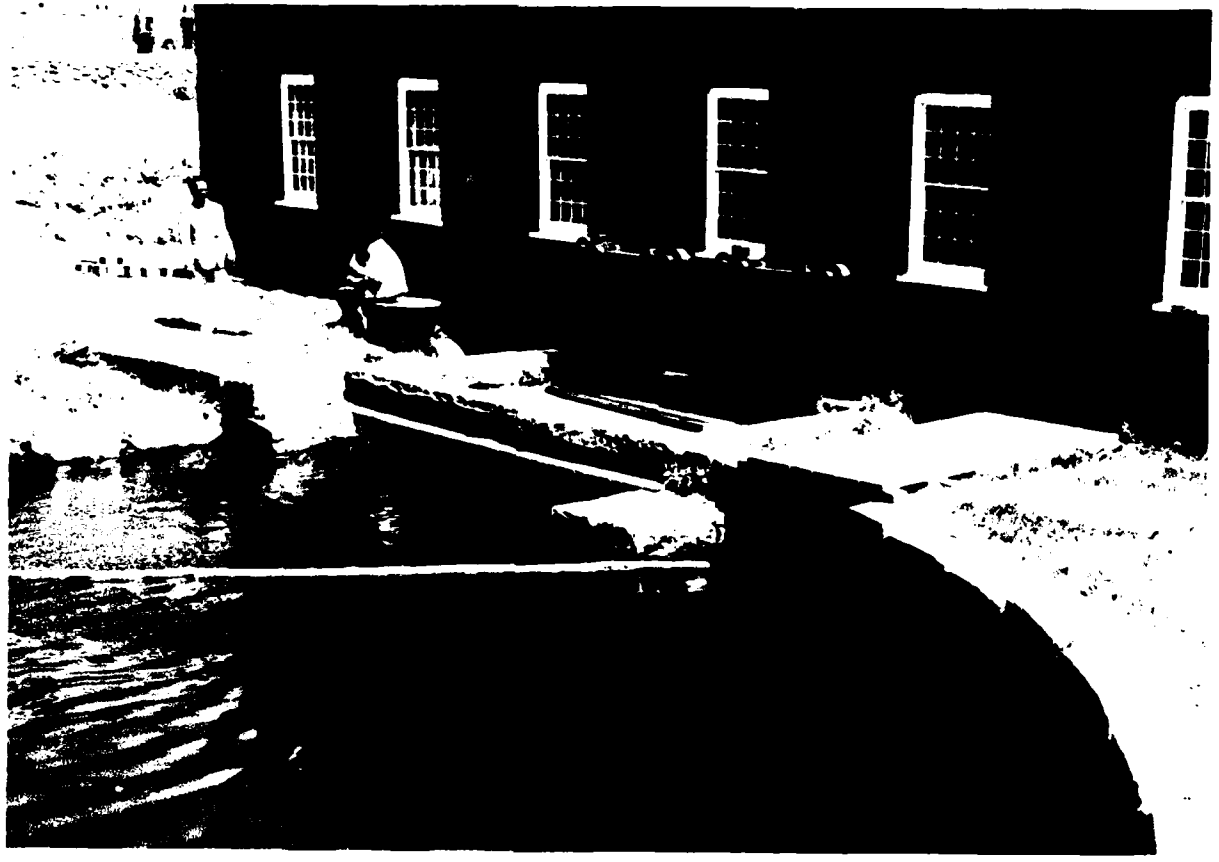
OVERVIEW PHOTOGRAPH



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HARRISVILLE DAM, LOOKING SOUTHEAST
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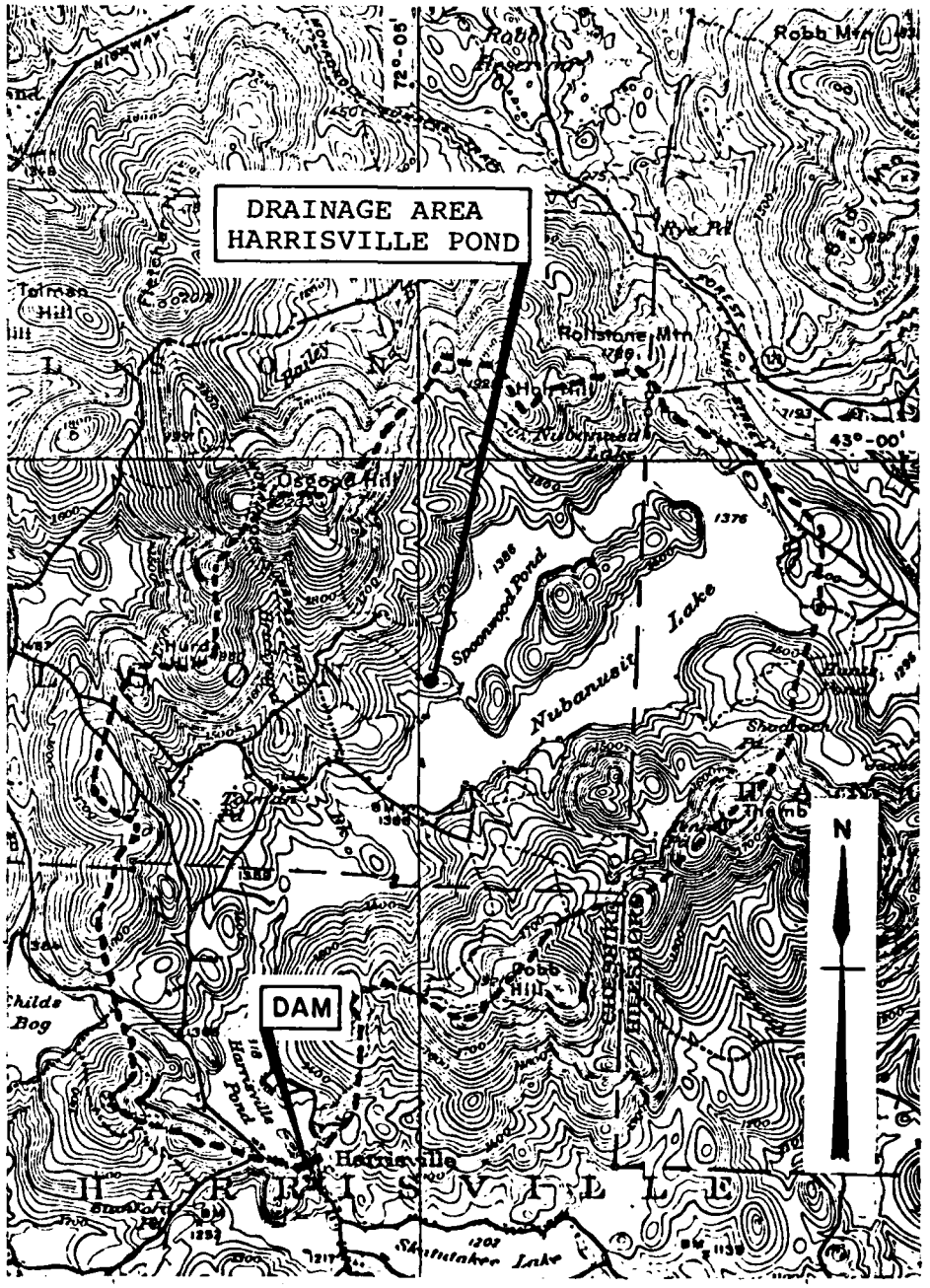

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UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

NEW HAMPSHIRE

MONADNOCK QUADRANGLE 1949
AMS 6569 I-SERIES V712

LOVEWELL MOUNTAIN QUADRANGLE 1957
AMS 6570 II-SERIES V712

HARRISVILLE 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. Fay, Spofford & Thorndike, Inc., Engineers, have 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 was issued to Fay, Spofford & Thorndike, Inc., under a letter of May 3, 1978, from Mr. Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0308 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) To update, verify, and complete the National Inventory of Dams.

1.2 Description of Project

a. Location

Harrisville Pond Dam, locally called the "Upper Pond Dam," is located near the southwest bay of Harrisville Pond, which is a natural pond. It is located in the southwestern part of New Hampshire in the center of the Town of Harrisville, near the Post Office, and about 10 miles east of Keene. Tolman Pond, Brick Yard Brook, and two conservation reservoirs, namely, Spoonwood Lake and Nubanusit Lake, drain into Harrisville Pond. Harrisville Pond drains into Skatutakee Lake,

which in turn drains into Nubanusit Brook, Contoocook River, and finally into the Merrimack River.

b. Description of Dam

The dam, built in 1886, is of stone masonry, 21 feet high, 75 feet long, and approximately 14 feet wide. The spillway, which is located in the western end, is 3 feet 7 inches wide and is approximately 2.5 feet below the top of the dam. Approximately in the center of the dam, there are four gates, 2 feet by 3 feet each, and all are operated by rack and pinnion. Two gates open into a penstock, the other two open into a 6-foot high, 4-foot wide outlet conduit. The penstock pipe, 4 feet in diameter, is not in use (Photographs No. 7, 8, 9, and 10, Appendix C).

A two-story mill building was built adjacent to this dam with the dam serving as a foundation for the north wall. The abutments of this masonry dam are of earth, granite faced (Photographs No. 1 and 2, Appendix C).

The intake channel consists of two small ponds connected by two culverts under roads crossing parallel to the dam. The first bridge, which is near the dam, has a 14.5-foot by 10-foot opening, with a 4-foot freeboard. The second bridge, which is near Harrisville Pond, has an 11-foot by 7-foot opening with a 1.5-foot freeboard (Photographs No. 17 and 18, Appendix C).

At the southeast bay of the Harrisville Pond, approximately 400 feet north of the intake channel, there is an rudimentary type weir and a culvert under a road. This weir is about 16 feet long, curved in plan, and has approximately a 1-foot drop. The discharge from the 4-foot culvert reenters the outlet channel below the toy shop (Photographs No. 19, 20, 21, and 22, Appendix C).

c. Size Classification

The storage capacity at the spillway crest is 2,000 acre-feet, which falls in the range $\geq$ 1,000 and $<$ 50,000 acre-feet. Therefore, the dam is classified as intermediate in size.

d. Hazard Classification

In the event of failure of this dam, the lower Skatutakee Dam might fail by domino effect and the village of Eastview, which is at a distance of about 2 1/2 miles downstream of Harrisville Pond Dam, will be in danger of being flooded. The mill building, toy shop, and the Filtrine Manufacturing Mills which are located downstream would be

damaged with eventual loss of the lives of the people in these structures. It is estimated that in the event of failure of this dam, loss of more than a few lives and excessive property damage could occur. Therefore, this dam falls in the category of high hazard potential.

e. Ownership

The oldest available inventory, dated 1925, gives the Cheshire Mills as the owner. The earliest available letter, signed by the present owner, Mr. John J. Colony, Jr., of the Cheshire Woolen Co. of Harrisville, New Hampshire, telephone 603-827-3402, was dated in 1942.

f. Operator

The owner: Mr. John J. Colony, Jr., (see Section 1.2.e.).

g. Purpose of the Dam

The pond behind the dam had been supplying water power for the Cheshire Woolens Co. mills until 1942, when electrically driven machinery was installed. However, the Filtrine Manufacturing Co. mills still depend on the water coming downstream. They need the water power to operate the hydro-electric turbine of the Northern Water Power Co. and to supply water for the fire protection system of the mill. The Northern Water Power Co. is a tenant of the Filtrine Manufacturing Co.

Currently, Harrisville Pond is being used primarily for recreational purposes.

h. Design and Construction History

There is no available data on the original design and construction of this dam. This dam was probably constructed around 1886, and no records of alterations are available. According to inspection reports and questionnaires, dated 1937, the dam was in good repair with the gates in operable condition, as they presently exist.

In 1974, some leaks were noticed near the penstock which was not and presently is not in use. In 1976, leakage through the stonework of the dam was observed on the downstream side. The water level was drawn down below the normal full pond level and the voids located and repaired. These voids occurred in the top few feet of the fill between the intake channel stonework and the dam stonework. Some settlement of backfill is visible in a small area on the east side of the intake structure.

In May, 1978, the old wooden planking over the intake structure was replaced by new flooring.

i. Normal Operation Procedures

The responsibility of operating the reservoir rests with the owner, Mr. John J. Colony, Jr. As the penstock was abandoned in 1942, and the spillway is ungated, the only control available is by two gates which are operable by rack and pinion. These gates open into the 6-foot high, 4-foot wide outlet conduit. During storms in the spring, both gates are kept open. If the water level in Harrisville Pond rises above a certain level, which level is not known from the project records, the water from the pond will pass over the rudimentary type weir at the southeast bay of Harrisville Pond.

1.3 Pertinent Data

a. Drainage Area

Harrisville Pond, as shown on the U.S.G.S. map, is located on Nubanusit Brook Watershed. This reservoir is a natural one and it has a drainage area of 10 square miles. The drainage area is best characterized as heavily wooded and its topography is undulated and rolling.

b. Discharge at Dam Site

(1) Outlet works (conduits) are permanently closed. The penstock is 4 feet in diameter and has an invert elevation of 1305.3 (estimated). The sluice opening is approximately 6 feet by 4 feet with an invert elevation of 1305.3 (estimated).

397.0 cfs through sluice at Elevation 1329.4.

(2) The maximum known flood at the dam site is the flood of September 21-24, 1938, magnitude not recorded.

(3) Ungated spillway capacity at the top of dam - not applicable.

(4) Ungated spillway capacity at test flood maximum pool.

123 cfs at Elevation 1329.4.

(5) Flow through 4-inch pipe culvert test flood maximum pool.

290.0 cfs at Elevation 1329.4.

c. Elevation (Feet above MSL)

(1) The top of the dam serves as a foundation of the north wall of a two-story mill building, which is adjacent to this dam.

(2) Test flood maximum pool elevation is 1329.40.

(3) The full flood control pool - unknown.

(4) The recreation pool (assumed from USGS data) is 1318.

(5) The spillway crest (assumed from USGS data) is 1318.

(6) The stream bed at the centerline of the dam is 1297 (estimated).

(7) The maximum tail water is 1304 (estimated).

d. Reservoir

(1) The length of the maximum pool is 7,500 feet (estimated).

(2) The length of recreation pool is 5,000 feet (estimated).

(3) The length of flood control pool is 6,000 feet (estimated).

e. Storage (Acre-Feet)

(1) Top of dam - not applicable.

(2) Test flood maximum pool elevation - 5,397 acre-feet.

(3) The flood control pool - unknown.

(4) The recreation pool - 2,000 acre-feet.

(5) Spillway crest - 2,000 acre-feet.

f. Reservoir Surface (Acres)

(1) The top of the dam - not applicable.

(2) Test flood maximum pool elevation - 358 acres.

(3) The flood control pool - unknown.

(4) The recreation pool - 119 acres.

(5) The spillway crest - 119 acres.

g. Dam

(1)	Type	Dry rubble masonry and earth fill
(2)	Length	75 feet
(3)	Height	21 feet
(4)	Top width	Approximately 14 feet
(5)	Side slopes	
	(a) Upstream	Vertical
	(b) Downstream	Vertical
(6)	Zoning	Not applicable
(7)	Impervious core	Not applicable
(8)	Cutoff	None
(9)	Grout curtain	None

h. Spillway

(1)	Type	Ungated weir
(2)	Length of weir	3 feet 7 inches
(3)	Crest elevation	1318 (estimated)
(4)	Gates	None

(5) U/S channel — Pond

i. Regulating Outlets

The regulating outlet consists of an approximately 4-foot wide, 6-foot high waste sluice opening at the downstream face and a 4-foot diameter penstock. These are adjacent to each other. The flow through each outlet is controlled by two manually operated gates. Each gate is approximately 2 feet by 3 feet in dimension.

(1)	Invert	Elevation 1305.3
(2)	Size	48-inch diameter
(3)	Description	Steel penstock
(4)	Control mechanism	Two gates, manually operated
(5)	Other	
	(a) Invert	1305 (estimated)
	(b) Size	Width - approximately 4 feet Depth - approximately 6 feet Length - approximately 14 feet
	(c) Description	Stone masonry waste sluice opening
	(d) Control mechanism	Two gates, manually operated

SECTION 2 - ENGINEERING DATA

2.1 Design

No original design data was disclosed for Harrisville Pond Dam.

2.2 Construction

No engineering data are available on the construction of this dam.

2.3 Operation

No engineering operational data were disclosed.

For information pertaining to the history of previous failures or deficiencies, refer to Section 1. For operational porocedures refer to Sections 1.2.i and 4.

2.4 Evaluation

a. Availability

Pertinent structural, geotechnical, hydrologic, and hydraulic data, which formed the basis of the design of the dam, are available on a very limited basis. The hydraulic and hydrologic determinations for design, as collected from project records, were obtained by rule of thumb techniques.

b. Adequacy

Sufficient engineering data are avilable for a Phase I inspection.

c. Validity

The available engineering data is considered valid on the basis of the results of the visual inspection.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

The Phase I inspection of the Harrisville Pond Dam was performed on May 22, 1978. A copy of the inspection check list is included in Appendix A.

a. General

In general, the soil and rock features are in good condition. The only concrete observed was the topping placed on the apron walls.

b. Dam

No evidence of vertical or horizontal misalignment was observed. There is no indication of sloughing, bulging, or movement of the slopes, nor is there evidence of piping.

Water was observed seeping out of the downstream face of the dam on either side of the gates.

Within approximately 4 feet east of the gate structure adjacent to the mill building, the top portion of the dam has settled to a maximum depth of 4 feet. At the time of the inspection, water, minor in nature, was flowing in the vicinity of the gate structure into this depression. There is no apparent distress of the wall of the mill as a result of this settlement.

c. Appurtenant Structures

At the time of our inspection, all four sluice gates were closed. Water was observed flowing through the penstock, which indicates that the two gates opening into the penstock are leaking. The east gate, which controls the flow through the waste sluice opening, was leaking. The gates and their lifting mechanism are in operable condition. The approach to and the accessibility to the operating platform is well maintained.

The 48-inch steel penstock is in poor condition. A hole was observed in the top of the penstock near the dam. Leakage was also observed at the bottom of the penstock.

On the upstream side of the dam, the masonry is backfilled, except for the intake structure which is under water. Therefore, the

upstream face of the masonry could not be seen. Inside of the mill building, the exposed face of rubble masonry appears to be sound.

The rudimentary type weir at the southeast bay of Harrisville Pond, and the 4 foot diameter circular pipe under the country road, approximately 400 feet east of the dam, are in fair condition. Observation indicates that this weir is primitively constructed with miscellaneous materials such as loose stone and wood. The approach and discharge channel and side slopes were observed to be in good condition.

The superstructure of both concrete bridges over the intake channel appears to be in good condition. The concrete abutments have deteriorated at the water level, exposing the aggregates.

d. Reservoir Area

Harrisville Pond is located on the Nubanusit Brook watershed. The surface area of the pond is 119 acres. The reservoir area is accessible and its shoreline is heavily wooded.

e. Downstream Channel

The initial 45 feet of this channel was found to be the basement of the mill building, the next 60 feet, a stone-lined channel, and the next 20 feet, an opening in the foundation of the toy shop. Columns supporting the mill floor were observed in the channel. It appears that these columns were either repaired or replaced recently. Brick work in both the mill building and the toy shop appears to be in good condition. Debris was observed in the basement of the mill building. The quantity of debris will not impede the flow in the channel.

The downstream channel and side slopes were observed to be in good condition.

3.2 Evaluation

The observed condition of the dam is fair. The potential problems observed during the visual inspection are listed as follows:

(1) Leaks through the face of the dam and at the gate structure.

(2) Settlement east of the gate structure.

(3) Potential for overtopping of the country road at the by pass culvert.

(4) Potential for floods to rise against the wall of the building above the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

Mr. John J. Colony, Jr. has operated Harrisville Pond Dam since about 1942. The Pond level is maintained by a broad-crested spillway located at the western end of the dam. The flow is controlled by stop logs manually operated. The Pond can be lowered by the opening of two gates, which are operable by rack and pinion.

4.2 Maintenance of Dam

The maintenance of Harrisville Pond Dam is the responsibility of Mr. John J. Colony, Jr., of the Cheshire Woolen Co. of Harrisville.

4.3 Maintenance of Operating Facilities

No written maintenance procedures were disclosed for Harrisville Pond Dam. As the penstock is not used, the question of its operation does not arise. The possibility and/or permissibility of the gate operations controlling the flow through the sluice opening is not known. In view of the location of the foundation of the building, there is a possibility of the building being undermined if the gates are left open. The approach to and the accessibilty to the operating platform is well maintained. Maintenance of the facilities for operating stop logs across the broad-crested spillway in the body of dam is satisfactory.

4.4 Description of any Warning System in Effect

A flood warning system is non-existent.

4.5 Evaluation

The current operation and maintenance procedure for Harrisville Pond Dam are inadequate to ensure that all problems can be remedied within a reasonable period of time.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

(1) This dam falls under the category of high hazard potential and it is intermediater in size. Using the "Recommended Guidelines for Safety Inspection of Dams", the recommended spillway test flood peak inflow is equal to the Probable Maximum flood. The spillway test flood inflow hydrograph, estimated, is furnished in Appendix D. The spillway test flood peak inflow is 16,500 cfs.

(2) The estimated peak outflow corresponding to the spillway test flood inflow is about 14,289 cfs. Refer to Appendix D for further details.

(3) The pond storage capacity versus the elevation, an estimated capacity curve is furnished in Appendix D.

(4) The composite discharge rating curve for the spillway, waste sluice and the country roadway above the 4 foot diameter culvert pipe is included in Appendix D.

(5) The hydrologic map of the watershed above the dam site, including reservoir area, water course and principal stream flow, is included in Appendix D.

b. Experience Data

With the exception of sketchy information, past flood details are not available for Harrisville Pond Dam. Precipitation records for the area are available. It is noted that significant amounts of rainfall up to 12.43 inches, which was more than 3.5 times the monthly average rainfall, occurred in the month of September, 1938. The flood of September 21-24, 1938, is considered to be the maximum flood that has occurred. On the basis of regional frequency studies, the flood of 1938, corresponds to a 100-year flood.

All floods in the past were handled by opening the gates and using the culvert at the southeast bay of the lake.

c. Visual Observations

The valley cross section immediately below the dam is not sufficiently wide to convey the peak outflow from the reservoir. This cross section is approximately 8 feet by 8 feet.

Harrisville Pond Dam is provided with a rudimentary type weir, which leads into a 4-foot diameter circular pipe under a country road. The invert of the culvert pipe in relation to the crest elevation of the spillway in the body of the dam is not determinable without additional data.

d. Overtopping Potential

The dam is unusual since it forms part of the foundation of a mill building. The question of overtopping does not arise in the case of this dam. The length of the spillway is too small to handle the spillway test flood peak inflow that might result from 10 square miles of the drainage area of Harrisville Pond. Due to the unavailability of information, it is assumed that as soon as the water surface in the pond reaches Elevation 1320.5 there will be an overflow over the country road. To develop the composite discharge rating curve, flow through the waste sluice, spillway, and over the country road are only considered. It is also assumed that flow over the roadway would occur over an effective length of 200 feet. Based on these assumptions, an approximate composite rating curve for the spillway, the waste sluice, and the overflow over the roadway has been estimated and is furnished in Appendix D. The maximum pool elevation corresponding to the spillway test flood peak outflow is approximately 1329.4. The maximum surcharge height over the crest of the spillway is about 11.4 feet.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The upstream slope could not be seen due to the fact that it was under water. The slopes do not show any erosion or weak areas. The visual inspection revealed the following evidence of possible stability problems:

(1) Leaks through the face of the dam and at the gate structure.

(2) Settlement east of the gate structure.

Visual inspection of the stone masonry did not reveal any evidence of instability.

b. Design and Construction Data

There are rough sketches in the inspection report dated 1937, but there are no structural computations. There are no other design and construction data available.

c. Operating Records

Except for memorandums and correspondence listed in Appendix B, other operating records are not available at the office of the New Hampshire Water Resources Board.

d. Post-Construction Changes

None recorded.

e. Seismic Stability

This dam is located in Seismic Zone 2 and in accordance with recommended Phase I guidelines does not warrant seismic analyses.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

Based on visual inspection, available records and past operational performance, the dam is judged to be in fair condition.

b. Adequacy of Information

An adequate assessment of the dam consistent with the scope of a Phase I investigation has been made based upon the visual inspection and available information.

c. Urgency

All recommendations and remedial measures enumerated below should be implemented within 1 year of receipt of this Phase I report by the owner.

d. Need for Additional Investigation

The information available from the visual inspection is adequate to identify the potential problem of overtopping. This problem will require the attention of a competent engineer who will have to make additional engineering studies to design or specify remedial meaures to rectify the problem.

7.2 Recommendations

It is recommended that the owner retain the services of a competent engineer to do the following:

(1) In view of the inadequate spillway capacity, it is considered advisable to conduct detailed studies. These studies should evaluate the possible extent of damage in Harrisville and Eastview in the event of failure of this dam and the downstream Skatutakee Dam by domino effect.

(2) A study should be made to determine the modifications necessary to the rudimentary type weir and the culvert under the country road and its downstream channel to accommodate flood condition. Suggested modifications are lowering and increasing the size of the culvert, and enlarging the downstream channel to accommodate flood conditions. It should also include the feasibility of extending the discharge

channel of the overflow weir beyond the lower dam. During extreme flood events and spring runoff, this channel extension would be used and for the normal flow, the existing channel would be used.

7.3 Remedial Measures

It is considered important that the following operating and maintenance procedures be attended to as early as practical:

a. Leaks through the face of the dam should be monitored regularly until such time they can be repaired.

b. Proper grade of the settlement area east of the gate structure should be reestablished.

c. An operating and maintenance manual for the project should be prepared.

d. A program of technical annual periodic inspection of the project features should be prepared and initiated. This program should assure that all features of the foundation of the mill building within the discharge channel are continually maintained.

e. Because the dam is located upstream of a populated area, round-the-clock surveillance should be provided during periods of high precipitation.

f. The owner should develop a formal warning system. An operational procedure to follow in event of an emergency should also be adopted.

7.4 Alternatives

Until the hydraulic and hydrologic condition of this dam is improved, the pond should be operated at a lower level to provide more storage during extreme flood events and spring runoff.

APPENDIX A

VISUAL INSPECTION CHECK LISTS

APPENDIX A

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Harrisville Pond Dam DATE May 22, 1978

TIME 930 - 1400

WEATHER Sunny

W.S. ELEV. 1318.7 U.S. DN.S.

PARTY:

1.	Jurgis Gimbutas, P.E.	Team Captain - Structural and Concrete
2.	Harvey H. Stoller, P.E.	Soils, Geology and Foundations
3.	V. Rao Maddineni, P.E.	Hydraulics and Hydrology
4.		
5.		

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Dam Embankments	H. H. Stoller	Fair
2.	Outlet Works - Penstock	J. Gimbutas	Poor
3.	Outlet Works - Waste Sluice Opening	J. Gimbutas	Fair
4.	Spillway Weir	J. Gimbutas	Good
5.	Approach and Discharge Channels	V. R. Maddineni H. H. Stoller	Good
6.	Rudimentary Type Weir	V. R. Maddineni H. H. Stoller	Fair
7.	Approach and Discharge Channels	V. R. Maddineni H. H. Stoller	Good
8.	Pond and Downstream Channel	V. R. Maddineni	Good

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE Dam Embankment

DISCIPLINE Soils & Foundation NAME Harry M. Miller

PROJECT FEATURE

DISCIPLINE NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM EMBANKMENT	
Crest Elevation	1320.5 (Estimated)
Current Pool Elevation	1318.7 (Estimated)
Maximum Impoundment to Date	Unknown
Surface Cracks	None observed
Pavement Condition	None
Movement or Settlement of Crest	East side of gate structure (see narrative)
Lateral Movement	None oberved
Vertical Alignment	No visual vertical misalignment observed
Horizontal Alignment	No visual horizontal misalignment observed
Condition at Abutment and at Concrete Structures	No concrete structures

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE Dam Embankment

DISCIPLINE Soils & Foundation NAME Henry H. Hill

PROJECT FEATURE _____

DISCIPLINE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	None observed
Sloughing or Erosion of Slopes or Abutments	None observed
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or Near Toes	None
Unusual Embankment or Downstream Seepage	See narrative
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE Outlet Works

DISCIPLINE Structures NAME [illegible]

PROJECT FEATURE _____

DISCIPLINE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
OUTLET WORKS - WASTE SLUICE OPENING	
General Condition of Stonework	Fair
Erosion or Cavitation	None observed
Condition at Joints	Good
Gates	Two, manually operated
OUTLET WORKS - PENSTOCK	
Size	48-inch steel pipe
General Condition	Poor, has a hole near the dam
Gates	Two, manually operated

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE Spillway Weir

DISCIPLINE Structures NAME [illegible]

PROJECT FEATURE Approach Channel

DISCIPLINE Soils & Foundation NAME [illegible]

DISCIPLINE Hydraulics & Hydrology NAME [illegible]

AREA EVALUATED	CONDITION
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Approach Channel	With water above crest elevation, floor not visible
b. Weir and Training Walls	
General Condition of Stonework	Good

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE _____

DISCIPLINE _____ NAME _____

PROJECT FEATURE Discharge Channel

DISCIPLINE Soils & Foundation NAME Henry H. Ittel

DISCIPLINE Hydraulics & Hydrology NAME C. Paul Mackenzie

AREA EVALUATED	CONDITION
c. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Channel	Good condition
Other Obstructions	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE

DISCIPLINE NAME

PROJECT FEATURE Rudimentary Type Weir Channels

DISCIPLINE Soils & Foundation NAME Henry H. Stiller

DISCIPLINE Hydraulics & Hydrology NAME L. Phil Nicholson

AREA EVALUATED	CONDITION
OUTLET WORKS - RUDIMENTARY TYPE WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Approach Channel	Could not be seen
b. Weir	
General Condition	Fair condition, constructed with miscellaneous materials
c. Discharge Channel	
General Condition	Good

PERIODIC INSPECTION CHECK LIST

PROJECT Harrisville Pond Dam DATE May 22, 1978

PROJECT FEATURE _____

DISCIPLINE _____ NAME _____

PROJECT FEATURE Rudimentary Type Weir Channels

DISCIPLINE Soils & Foundation NAME Harry H. Heller

DISCIPLINE Hydraulics & Hydrology NAME [illegible]

AREA EVALUATED	CONDITION
Loose Rock Overhanging Channel	None observed
Trees Overhanging Channel	None observed
Floor of Channel	Good condition
Other Obstructions	None observed

APPENDIX B

EXISTING AVAILABLE INFORMATION

APPENDIX B

1. Listing of Records and their Location

New Hampshire Water Resources Board in Concord, New Hampshire, 37 Pleasant Street, have a file of records and correspondence from 1937-1977, filed under Town/Dam No. 109.08.

The documents of importance to design and maintenance are the following:

(1) December 12, 1938. Two pages of data on Reservoirs and Water Developments in New Hampshire. By the New Hampshire Water Control Commission. Tabulated by AAN & RLT.

(2) July 13, 1942. Questionaire. Water Powers of New Hampshire. By the New Hampshire Water Resources Board. Signed by Mr. Joe L. Colony, Jr. (for the owner).

(3) January 28, 1948. Questionnaire (similar to above).

(4) March 18, 1977. Letter from Filtrine Manufacturing Co., Mr. John P. Hansel, president, to Mr. Vern Knowlton, New Hampshire Water Resources Board, regarding application for the right to operate the dams on Nubanusit Brook.

2. Copies of Past Inspection Records

Included with this report are the following past inspection reports:

(1) October 8, 1937 - By the New Hampshire Water Resources Board, including sketches, some dimensions, two pages.

(2) December 12, 1938 - By the New Hampshire Water Control Commission, tabulated by AAN & RLT, one page.

(3) October 18, 1974 - By the New Hampshire Water Resources Board, one page.

(4) December 12, 1975 - By the New Hampshire Water Resources Board, signed by Mr. S. Burritt. Includes a key plan with dimensions of openings, four pages.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Merrimack NO. 8 109.08 11
RIVER Harrisville Pond MILES FROM MOUTH ______ D.A.SQ.MI [illegible]
TOWN Harrisville OWNER Cheshire Mills
LOCAL NAME OF DAM formerly Upper Pond.
BUILT [illegible] DESCRIPTION [illegible] Masonry [illegible]

POND AREA-ACRES 119.28 DRAWDOWN FT. ______ POND CAPACITY-ACRE FT. ______
HEIGHT-TOP TO BED OF STREAM-FT. ~~18~~ 21 MAX. ______ MIN. ______
OVERALL LENGTH OF DAM-FT. 75 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. " 50 None FREEBOARD-FT. ______
FLASHBOARDS-TYPE,HEIGHT ABOVE CREST ______

WASTE GATES-NO.	WIDTH	MAX.OPENING	DEPTH SILL BELOW CREST
1	6	6	15 below top
1	6	6	penstock gate.

REMARKS Condition Fair. Condition under old building such as to undermine foundation if gate wide open.

30 into Skatutakee Lake, [illegible] St, Contoocook R.

Coordinates from A.E.
42° 55' + 3500 yds.
72° 05' + 1250 yds.

POWER DEVELOPMENT

UNITS NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
	225	10	"		
	total for 3 dams		USGS list		

USE water power for woolen mill

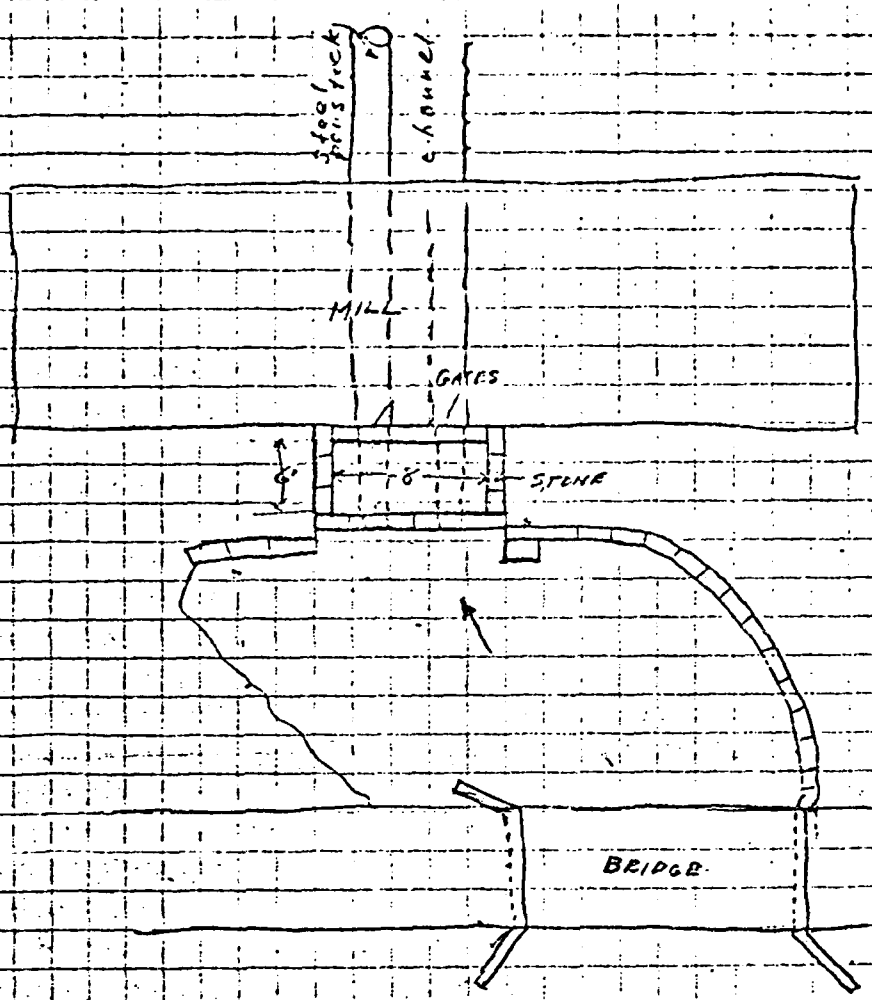
REMARKS Primary HP 89. ck time 22.3
A.E. got information from F. Sundstrom C-220
Show [illegible] Chief Engineer. Old spillway is planked up as per sketch.
4' dia steel penstock to upper mill [illegible]. Power taken to Stone mill by out door rope drive. Waste gate under old building, water goes to pond above stone mill. New brick building electrically operated by bought current.

10/27/36 AE

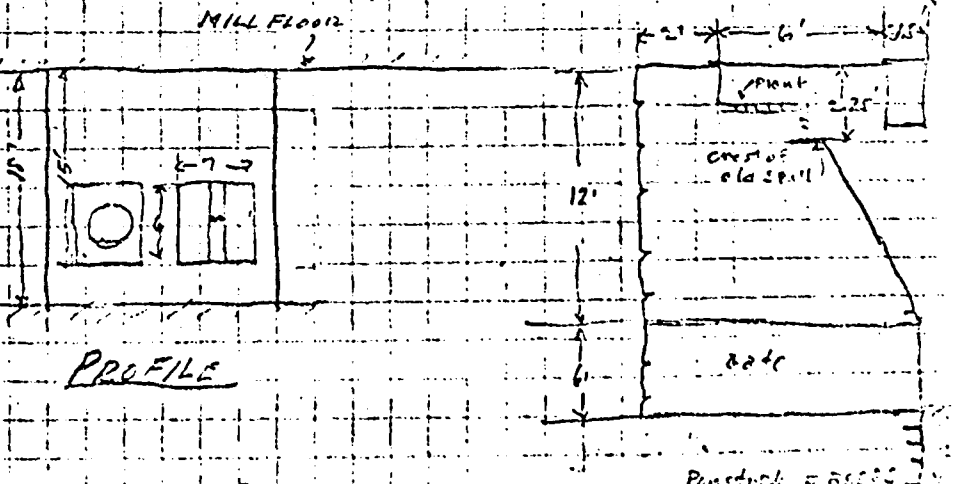
DATE 1975

[illegible]

HARRISVILLE POND DAM-HARRISVILLE 109.08



PLAN



PROFILE

Penstock F[illegible] and water gate opens under building

DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 103.08

Town Harrisville : County Cheshire

Stream Harrisville Pond

Basin-Primary Merrimack R. : Secondary Nubanusit Brook

Local Name

Coordinates—Lat. 42 55' + 10,500' : Long. 72 05' + 3750'

GENERAL DATA

Drainage area: Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 8.64 Sq. Mi.

Overall length of dam 75' ft.: Date of Construction 1883

Height: Stream bed to highest elev. 21' ft.: Max. Structure ft.

Cost—Dam : Reservoir

DESCRIPTION Masonery- Stone Earth & Concrete

Waste Gates

Type

Number 1 : Size 6 ft. high x 6 ft. wide

Elevation Invert 15 : Total Area 36 72 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 (none)

Length—Total ft.: Net ft.

Height of permanent section—Max. ft.: Min. ft.

Flashboards—Type : Height ft.

Elevation—Permanent Crest : Top of Flashboard

Flood Capacity cfs.: cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. ft.: Min. ft.

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

OWNER Cheshire Mills

REMARKS Power - Woolen Mill

Tabulation By A.A.N. & R.L.T Date December 12, 1938

Concord, N. H. 03301

DAM SAFETY INSPECTION REPORT FORM

Town: Harrisville Dam Number: 109.03

Inspected by: SSB Date: 18 OCT 1974

Local name of dam or water body: _____

Owner: _____ Address: _____

Owner was/was not interviewed during inspection.

Drainage Area: _____ sq. mi. Stream: _____

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

Foundation: Type _____, Seepage present at toe - Yes/No, _____

Spillway: Type Stoplog, Freeboard over perm. crest: 2.5,

Width 3.5' x 2.5, 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 2x3 ± Capacity _____ Type Rack Pinion

Lifting apparatus _____ Operational condition ?

Changes since construction or last inspection: _____

Downstream development: _____

This dam would, would not be a menace if it failed.

Suggested reinspection date: _____

Remarks: Saw Logs 4' Penstock N/T used

NEW HAMPSHIRE
WATER RESOURCES BOARD

SITE EVALUATION DATA

OWNER: John Colony Jr TELEPHONE NO.

MAILING ADDRESS: Harrisville

SITE LOCATION (TOWN OR CITY) Harrisville

NAME OF STREAM OR WATERBODY: Harrisville

QUADRANGLE: LOCATION

HEIGHT OF (PROPOSED, EXISTING) DAM 21 LENGTH 75'

TYPE OF (~~PROPOSED~~, (EXISTING) STRUCTURE

DRAINAGE AREA 1095 m POND AREA 119A

AVAILABLE ARTIFICIAL STORAGE: PERMANENT: TEMPORARY: TOTAL 2-202

EXISTING DEVELOPMENT DOWNSTREAM OF (PROPOSED, EXISTING) STRUCTURE Shop Mill other dams

POTENTIAL DEVELOPMENT DOWNSTREAM OF (~~PROPOSED~~, (EXISTING) STRUCTURE Limited

POTENTIAL DAMAGE DOWNSTREAM OF STRUCTURE (EXPLAIN IN DETAIL AND INCLUDE ANY POTENTIAL LOSS OF LIFE ESTIMATE) Washout of Toy shop and damage To mill Possable loss of Life from People in Mill

OTHER COMMENTS:

CLASS OF STRUCTURE -- ~~NON-MENACE~~ (MENACE) ~~A B~~ (C) DAM # 109.08

DATE OF INSPECTION: 12 Dec 75

SIGNED [signature]
SIGNATURE

DATE:

NEW HAMPSHIRE WATER RESOURCES BOARD

INSPECTION REPORT

Town: Harrisville Dam Number: 109.03

Name of Dam, Stream and/or Water Body: Harrisville Lake

Owner: John Cleary Jr. Telephone Number:

Mailing Address: Harrisville

Max. Height of Dam: 21' Pond Area: 119.34 Length of Dam: 75'

FOUNDATION:

OUTLET WORKS: Spillway 3'7" wide 2.5' Freeboard. Overflow 2" higher than Spillway goes under Road with 4' Dia Culvert. Water From overflow comes in below mill. 4 Gates 2'x3' all work 2 goes to penstock Penstock

ABUTMENTS: Granite Face with earth Behind Good Shape

EMBANKMENT:

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

SPILLWAY: Length: 3' 7" Freeboard: 2' 6"

SEEPAGE: Location, estimated quantity, etc.

Seepage Through Left Side ground settled on embankment above outlet

Changes Since Construction or Last Inspection:

Tail Water Conditions:

Tail water has Appox 3x3 outlet through bld.

Overall Condition of Dam: Fair

Contact With Owner: yes

Date of Inspection: 12 Dec 75 Suggested Reinspection Date 1977

Class of Dam: Menace C

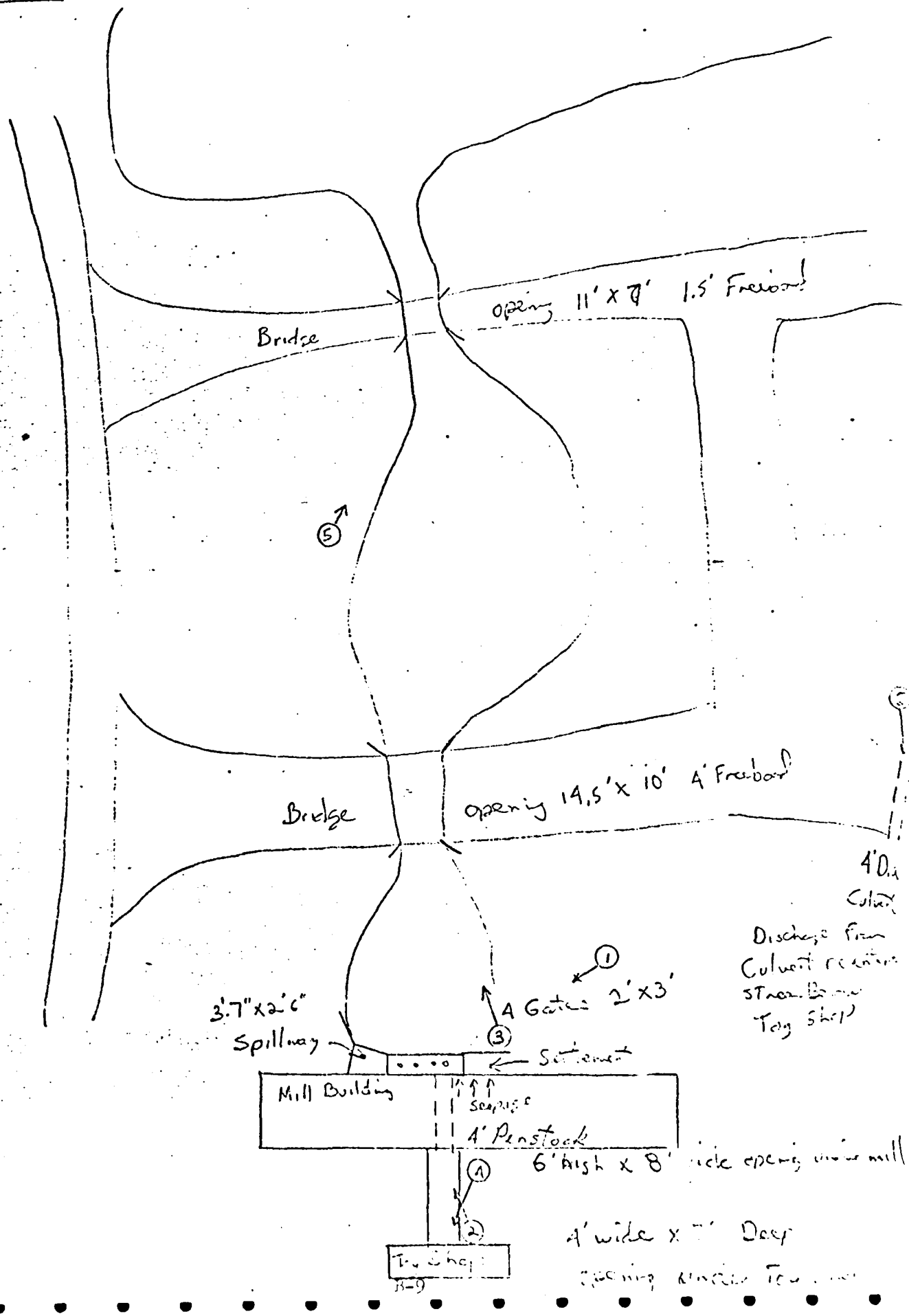
Signature S Burnett

Date

Dam No. 129.03

COMMENTS: Rocks below overflow crest at culvert should be removed To improve Flow

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

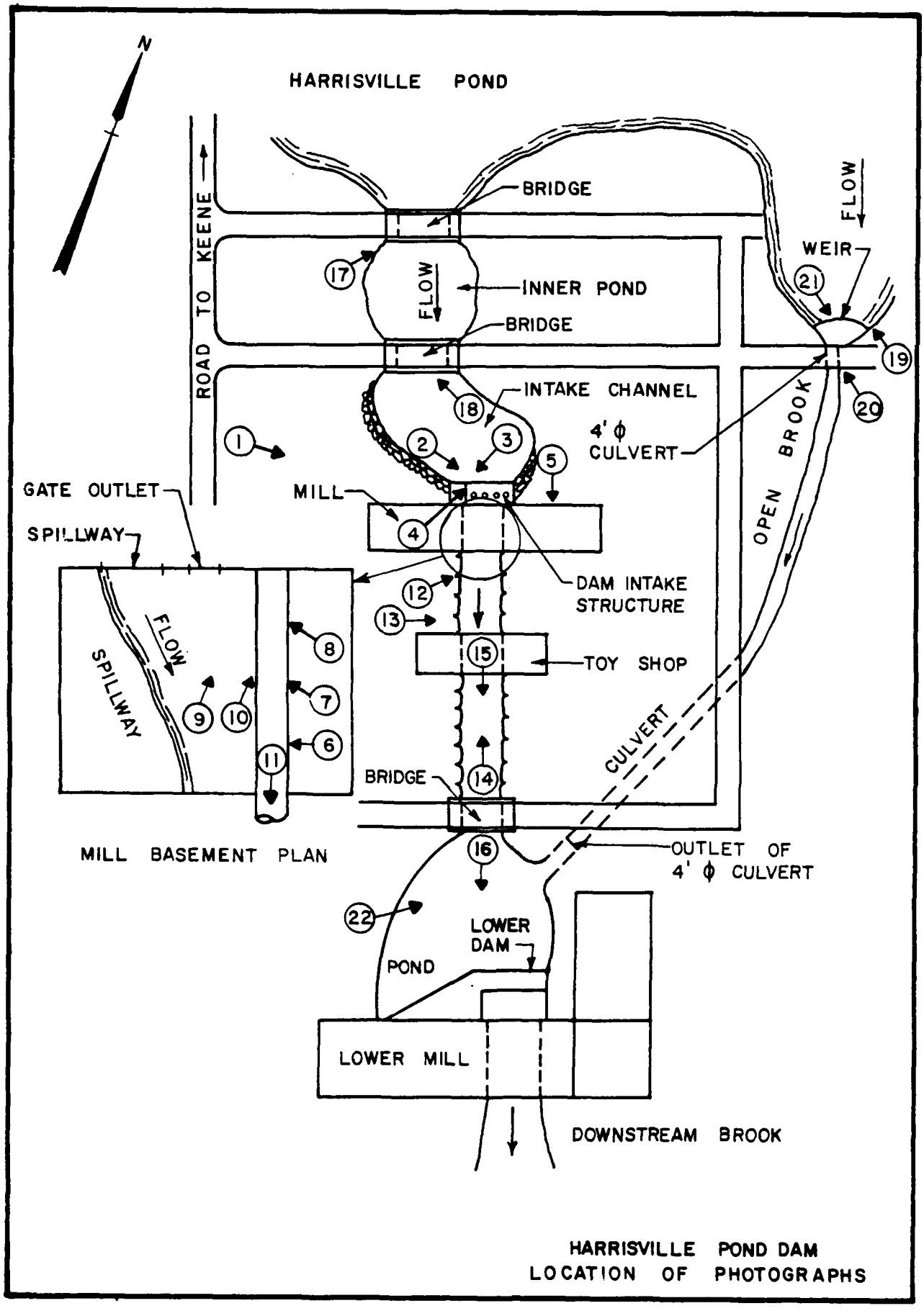


APPENDIX C

PHOTOGRAPHS

APPENDIX C

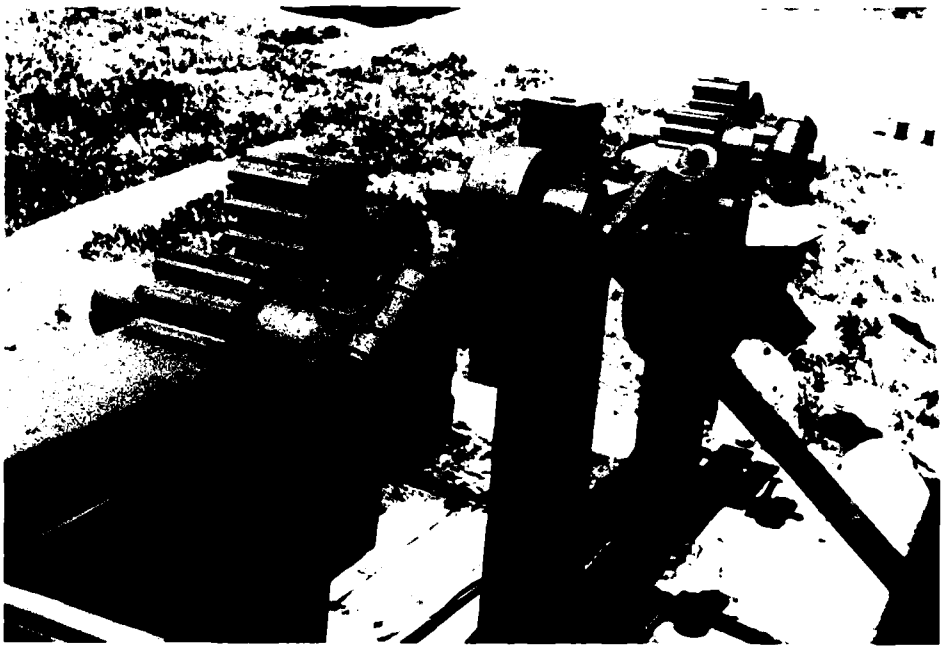
REPRESENTATIVE PHOTOGRAPHS OF PROJECT


N
HARRISVILLE POND
ROAD TO KEENE
BRIDGE
FLOW
WEIR
INNER POND
BRIDGE
INTAKE CHANNEL
4' ϕ CULVERT
OPEN BROOK
GATE OUTLET
MILL
SPILLWAY
DAM INTAKE STRUCTURE
TOY SHOP
CULVERT
BRIDGE
OUTLET OF 4' ϕ CULVERT
MILL BASEMENT PLAN
LOWER DAM
POND
LOWER MILL
DOWNSTREAM BROOK
HARRISVILLE POND DAM
LOCATION OF PHOTOGRAPHS

1. Intake Channel and the Dam Intake Structure, Looking Northeast.

2. Intake Structure. Right - Intake Conduit to Powerhouse. Mill Building Built on Top of Dam.

3. Rack-and-Pinion Gate Operators Over the Intake Structure.



4. Detail of Rack-and-Pinion Gate Operators.

5. Settlement of Backfill Near the Intake Structure, Looking Downstream into the Basement Window

6. Columns Supporting the Mill Floor Over the Basement Which is Part of the Downstream Channel.

7. Dam Looking Upstream from the Basement of the M...
Left - Spillway; Right - Abandoned Penstock;
Center - Sluice Opening.

8. Spillway and Sluice Openi... ...
Inside of the Basement.

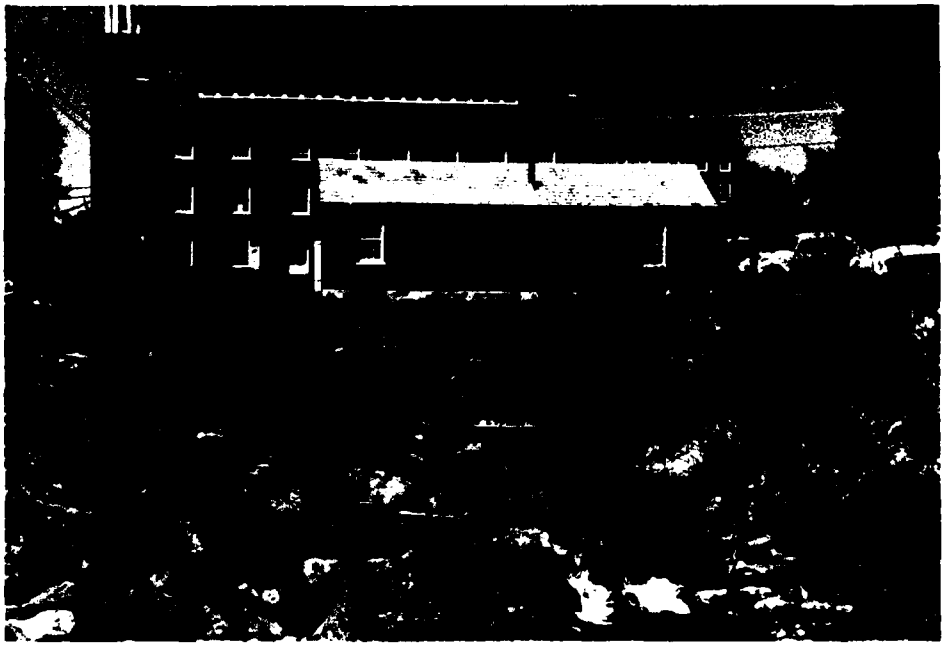
9. Penstock, Upper End, With a Hole on Top Near the Intake Structure.

10. Dam Masonry Looking Upstream from the Basement of the Mill. Abandoned Penstock to the Left.

11. Penstock (Abandoned), Lower End and the Downstream Channel, Looking from the Basement of the Mill Building.

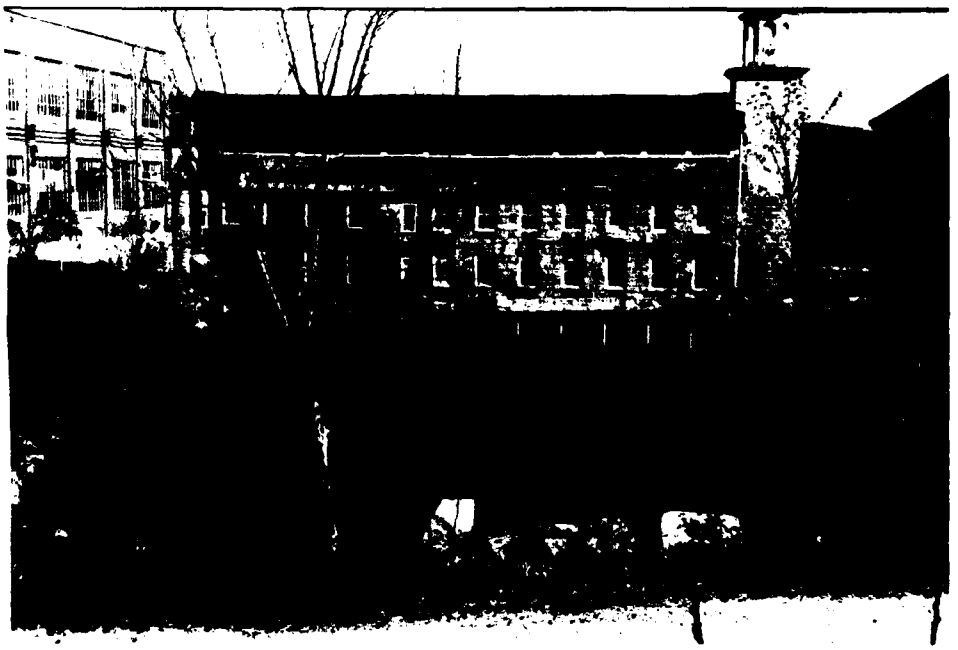
12. Penstock Coming Out of the Basement of Mill Building.

13. Upper Mill (Over the Dam) and the Toy Shop (Right). Downstream Channel Below These Buildings.

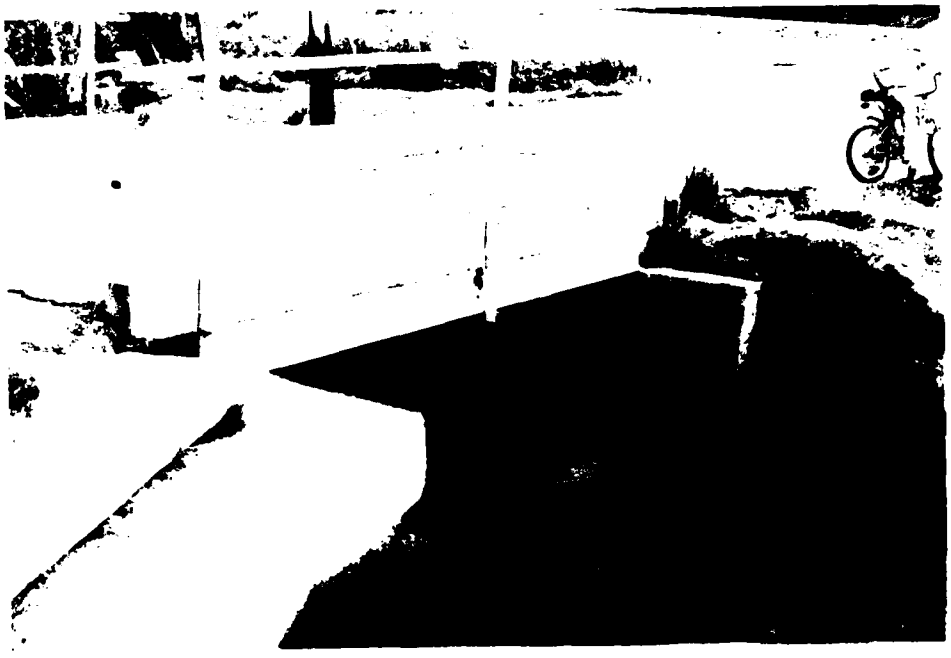


14. Downstream Channel Looking Up. Toy Shop Straddles this Channel, the Upper Mill is in Background With the Dam Under it.

15. Downstream Channel, Looking from the Toy Shop.

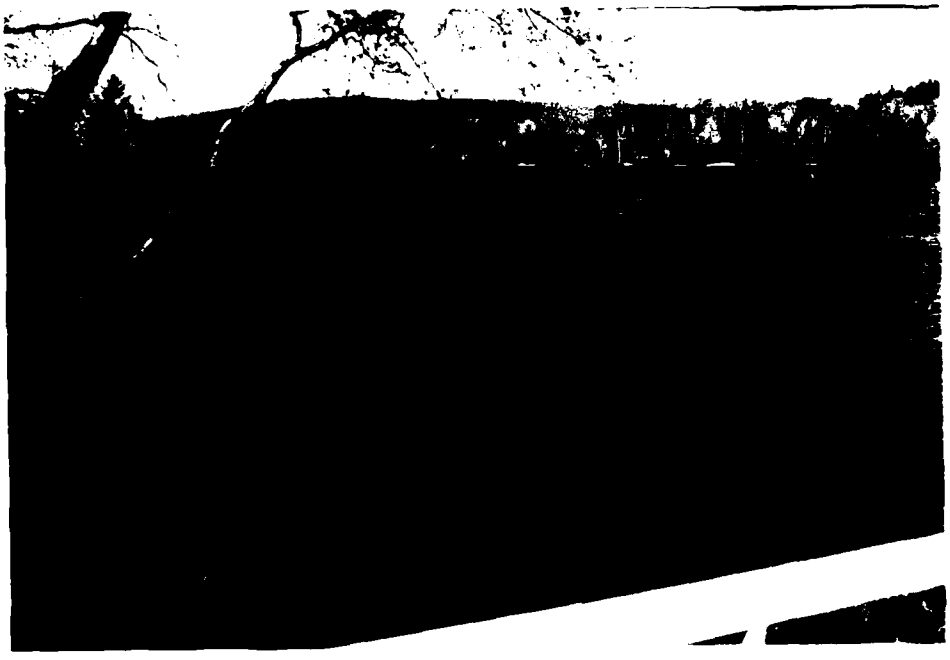


16. Lower Mill and Pond, Looking from the Road Below the Toy Shop.



27. Bridge Over Tunnel From Barrier [illegible] Inner Port.

[illegible]



19. Harrisville Pond Looking West, With [illegible] in Front.

[illegible]. Four-Foot Diameter Culvert Looking East, [illegible]

21. Four-Foot Diameter Culvert Looking East, Downstream.

22. Discharge of Four-Foot Diameter Culvert to the Pond Below the Toy Shop.

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

FAY, SPOFFORD & THORNDIKE, INC
ENGINEERS
BOSTON

PROJECT EN-611(10)

FILE NUMBER EN-611
SHEET NUMBER 1 of 5
DATE 7-26-78
COMPUTED BY [illegible]
CHECKED BY

SUBJECT NATIONAL DAM INSP. PROGRAM
HARRISVILLE POND DAM.

Total drainage area of Harrisville Pond at dam

= 16.6 square miles

The drainage area of Harrisville Pond is characterized by rolling topography. Hence, from guide curves furnished by the Corps of Engineers, it is found that

Probable maximum flood Peak inflow
= 1650 x 10 cfs
= 16,500 cfs.

According to size classification, Harrisville Pond dam is intermediate in size.

According to hazard classification, Harrisville dam falls under the category of high hazard dam.

Therefore, the adopted spillway test flood Peak inflow (Q_{P_1}) = 16,500 cfs

FAY, SPOFFORD & THORNDIKE, INC
ENGINEERS
BOSTON

PROJECT EN-666(10)

FILE NUMBER EN-22
SHEET NUMBER 2 OF
DATE 1-21-
COMPUTED BY
CHECKED BY

SUBJECT HAEFELEVILLE POND

SPILLWAY TEST FLOOD INFLOW HYDROGRAPH

Max. Length of Travel = 31,700 ft.

Diff. in Elevation = 466 ft.

$$T_c = \frac{(31,700)^{1.15}}{7700 \times (466)^{0.38}} \text{ hrs.}$$

$$= \frac{1500\,44}{7700 \times 10.327}$$

$$= 1.886 \text{ hrs.}$$

$$\simeq 2.0 \text{ hrs.}$$

SPILLWAY TEST FLOOD PEAK INFLOW = 16,500 cfs.

FAY, SPOFFORD & THORNDIKE, INC
ENGINEERS
BOSTON

PROJECT EN-006(10)

FILE NUMBER EN-001
SHEET NUMBER 3 OF
DATE 7-23-[illegible]
COMPUTED BY [illegible]
CHECKED BY

SUBJECT HAVERHILL POND

SPILLWAY TEST FLOOD INFLOW HYDROGRAPH
(BASED ON SCS DIMENSIONLESS HYDROGRAPH)

T_c = 2.0 hrs.

Q_p = 16,500 hrs.

T (hrs)	T/Tp	Q/Qp	Q (CFS)
0.50	0.25	0.05	825
1.00	0.50	0.18	2970
1.50	0.75	0.73	12045
2.00	1.00	1.00	16500
2.50	1.25	0.80	13200
3.00	1.50	0.40	6600
3.50	1.75	0.25	4125
4.00	2.00	0.17	2805
5.50	2.75	0.06	990
7.00	3.50	0.02	330
8.00	4.00	0.01	165

FAY, SPOFFORD & THORNDIKE, INC
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BOSTON

PROJECT EN-006(10)

FILE NUMBER EN-00.
SHEET NUMBER A 6 2
DATE 7-23-1972
COMPUTED BY VEM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
ESTIMATION OF CAPACITY CURVE

It is assumed that the spillway crest ELEV. = 1318.0
Surface area of lake at ELE. 1318 = 11.0 acres.

ELEVATION	STORAGE (acre-feet)
1318.0	2000
1318.5	2060
1319.0	2119
1320.0	2239
1321.0	2358
1322.0	2478
1325.0	2835
1330.0	3432
1335.0	4029

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PROJECT EN-601 (10)

FILE NUMBER EN-114
SHEET NUMBER 5 OF
DATE 7-28-1972
COMPUTED BY VRM.
CHECKED BY

SUBJECT HARRISVILLE POND

DISCHARGE RATING TABLE FOR THE WASTEE SLUICE.

INVERT ELEVATION OF WASTE SLUICE = 1305.3
ELEVATION OF THE CENTER OF SLUICE = 1308.3.
H.W.M. of Waste Sluice = 4 x 6 = 24 Sq. feet.
Assume
C_d = 0.45 (Ref. to P. 537 for pipe discharge).

$$Q_{W.S} = C_d \cdot A \cdot \sqrt{2gy} = 0.45 \times 24 \times 8\sqrt{y} = 86.4\sqrt{y}$$

ELEV.	y	$Q_{W.S}$
1318	9.70	269.0
1318.5	10.20	276.0
1319.0	10.70	283.0
1319.5	11.20	289.0
1320.0	11.70	296.0
1320.5	12.20	302.0
1321.5	13.20	314.0
1322.5	14.20	326.0
1323.5	15.20	337.0
1324.5	16.20	348.0
1325.5	17.20	358.0
1326.5	18.20	369.0
1328.5	20.20	388.0
1330.5	22.20	407.0
1332.5	24.20	425.0
1329.4	21.10	397.0

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PROJECT EN-006 (10)

FILE NUMBER EN-006
SHEET NUMBER 6 OF
DATE 11-6-1978
COMPUTED BY VRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM.
DISCHARGE RATING TABLE FOR
SPILLWAY.

Assume that the spillway crest ELEV = 1318.0

SPILLWAY LENGTH = 3 feet 7 inches
= 3.58 feet.

The height of opening in the wall above the spillway crest = 2.5 feet.

It is assumed here that the elevation of the country road above 4 feet diameter road culvert pipe = 1320.5.

It means, that as soon as the water surface elevation in the pond rises above ELEV. 1320.5 during floods, there will be overflow over the roadway. It is also assumed that the effective length of the roadway = 200 feet.

DISCHARGE OVER SPILLWAY.

HEAD	ELE.	
$H_1 = 0.5$	1318.5	$Q_s = 2.8 \times 3.58 \times (.5)^{3/2} = 3.5$ cfs
$H_1 = 1.0$	1319.0	$Q_s = 2.8 \times 3.58 \times 1 = 10.0$ cfs
$H_1 = 1.5$	1319.5	$Q_s = 2.8 \times 3.58 \times (1.5)^{3/2} = 18.4$ cfs
$H_1 = 2.0$	1320.0	$Q_s = 2.8 \times 3.58 \times (2)^{3/2} = 28.35$ cfs
$H_1 = 2.5$	1320.5	$Q_s = 2.8 \times 3.58 \times (2.5)^{3/2} = 39.59$ "

For $H_1 > 2.5$, the opening functions as a rectangular orifice.

$$Q = C \cdot A \cdot \sqrt{2gh}.$$

Let $C = 0.54$.

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PROJECT EN-601 (10)

FILE NUMBER EN-626
SHEET NUMBER 7
DATE 11-6-1956
COMPUTED BY VRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
DISCHARGE RATING TABLE FOR
SPILLWAY.

$A = 3.58 \times 2.5 = 8.95$ □'

$C A \sqrt{2g} = 0.54 \times 8.95 \times 8.02 = 38.76$

$Q = 38.76 \sqrt{h}$

$H_1 = 3.5$	1321.5	$Q_s = 38.76\sqrt{2.25}$	$= 58.0$	cfs
$H_1 = 4.5$	1322.5	$Q_s = 38.76\sqrt{3.25}$	$= 70.0$	"
$H_1 = 5.5$	1323.5	$Q_s = 38.76\sqrt{4.25}$	$= 80.0$	
$H_1 = 6.6$	1324.5	$Q_s = 38.76\sqrt{5.25}$	$= 89.0$	
$H_1 = 7.5$	1325.5	$Q_s = 38.76\sqrt{6.25}$	$= 97.0$	
$H_1 = 8.5$	1326.5	$Q_s = 38.76\sqrt{7.25}$	$= 104.0$	
$H_1 = 10.5$	1328.5	$Q_s = 38.76\sqrt{9.25}$	$= 118.0$	
$H_1 = 12.5$	1330.5	$Q_s = 38.76\sqrt{11.25}$	$= 130.0$	
$H_1 = 14.5$	1332.5	$Q_s = 38.76\sqrt{13.25}$	$= 141.0$	"
@ $H_1 = 11.40$		$Q_s = 38.76\sqrt{10.15}$	$= 123.0$	"

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PROJECT EN-006(16)

FILE NUMBER EN-106
SHEET NUMBER 8 OF
DATE 11-6-1978
COMPUTED BY EBM
CHECKED BY

SUBJECT HARRISVILLE POND DAM

RATING TABLE FOR ROADWAY

$Q = 2.6 \times 200 \times H^{3/2}$
$= 520 H^{3/2}$

H	ELEVATION	$Q_2 = 520H^{3/2}$
1.0	1321.5	520.0
2.0	1322.5	1471.0
3.0	1323.5	2702.0
4.0	1324.5	4160.0
5.0	1325.5	5814.0
6.0	1326.5	7642.0
8.0	1328.5	11766.0
10.0	1330.5	16444.0
12.0	1332.5	21,615.0

Discharge through the 4 feet diameter pipe culvert under the roadway is ignored as its contribution is negligibly small. It is also assumed that the invert elevation of the pipe culvert is about 7-feet below the top of roadway. That is, invert elevation of
Pipe culvert = 1313.5'.

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PROJECT EN-006(10)

FILE NUMBER EL-016
SHEET NUMBER 7
DATE 11-6-1972
COMPUTED BY WRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
COMPOSITE DISCHARGE RATING
TABLE.

ELEV.	SPILLWAY DISCHARGE Q_S	WASTE SLUICE $Q_{W.S}$	FLOW OVER ROADWAY Q_{RW}	TOTAL Q
1318.0	0.0	269		269.0
1318.5	3.5	276		280.0
1319.0	10.0	283		293.0
1319.5	18.4	289		308.0
1320.0	28.35	296		324.0
1320.5	39.59	302	0.0	342.0
1321.5	58.00	314	521.0	893.0
1322.5	70.00	326	1471.0	1867.0
1323.5	80.00	337	2702.0	3119.0
1324.5	89.00	348	4160.0	4597.0
1325.5	97.00	358	5814.0	6269.0
1326.5	104.00	369	7642.0	8115.0
1328.5	118.00	388	11766.0	12272.0
1330.5	130.00	407	16444.0	16981.0
1332.5	141.00	425	21615.0	22181.0

DISCHARGE THROUGH PIPE CULVERT @ ELEV. 1239.40

Assume Type 5 flow i.e. the culvert entrance is submerged, and the tail water is below the crown at the outlet.

$Q = C A_0 \sqrt{2g(h_1 - z)}$

$\frac{h_1 - z}{D} = \frac{15.9}{4} = 4.0$

$C = 0.72$.

$Q = 0.72 \times \frac{\pi}{4} \times 4^2 \cdot \sqrt{64.4 \times 15.9}$ (Assume $z = 0$.

$= 9.048 \times 32.0$

$= 290.0$ cfs.

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PROJECT EN-006(10)

FILE NUMBER EN-006
SHEET NUMBER 10 OF
DATE 11-24-1976
COMPUTED BY CRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW

SPILLWAY TEST FLOOD PEAK INFLOW (Q_{P_I})
= 16,500 cfs.

TRIAL #1:

Assume inflow volume = 19" of runoff from D.A.

Available surcharge storage upto top of roadway above emergency spillway culvert Pipe is 7 feet above spillway crest.

$$= \frac{119 \times 7.0}{10 \times 640} \times 12$$

= 1.56 inches of runoff from D.A.

$$\frac{\text{Pond surcharge storage}}{\text{Inflow runoff vol.}} = \frac{1.56}{19}$$

$$= 0.082$$

Referring to figure 17-11 in SCS NEH, Section 4

$$\frac{\text{OUTFLOW PEAK RATE}}{\text{INFLOW PEAK RATE}} = 0.94$$

∴ OUTFLOW PEAK RATE = 0.94 x 16500
= 15,510 cfs.

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PROJECT EN-CLE (11)

FILE NUMBER EN-P-1
SHEET NUMBER 11 OF
DATE 11-6-14
COMPUTED BY VEM
CHECKED BY

SUBJECT - HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW

TRIAL #2:

From the composite rating curve, the above outflow peak rate corresponds to ELEV. 1329.90

i.e. surcharge height above the spillway crest
= 11.90 feet.

∴ Vol. of surcharge storage (STOR$_1$)

$$= \frac{119 \times 11.90}{10 \times 640} \times 12$$

= 2.655 inches of runoff from D.A.

∴ Peak outflow $Q_{P_2} = Q_{P_1}\left(1 - \frac{STOR_1}{19}\right)$

$= 16,500\left(1 - \frac{2.655}{19}\right)$

$= 16500\,(1 - 0.140)$

= 14,190 cfs.

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PROJECT EN-COL(10)

FILE NUMBER EN-C.6
SHEET NUMBER 12 OF
DATE 11-6-1972
COMPUTED BY VRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW.

TRIAL #3:

From the composite discharge rating curve the above outflow peak rate corresponds to ELEV. 1329.35

i.e. surcharge ht. above the spillway crest

= 11.35 feet.

∴ Vol. of surcharge storage ($STOR_1$)

$$= \frac{119 \times 11.35}{10 \times 640} \times 12$$

= 0.211 inches of runoff from D.A.

∴ Peak outflow $Q_{P_2} = 16500\left(1 - \frac{0.211}{19}\right)$

$= 16,500\,(1 - 0.011)$

$= 14,685$ cfs.

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PROJECT EN-006 (10)

FILE NUMBER EN-006
SHEET NUMBER 13 OF
DATE 11-6-1978
COMPUTED BY VRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW

TRIAL #4:

From the composite discharge rating curve the above outflow peak rate corresponds to ELEV. 1329.5

i.e. Surcharge ht. above the Spillway crest

= 11.5 feet.

∴ Vol. of Surcharge Storage (STR_2)

$$= \frac{119 \times 11.5}{10 \times 640} \times 12$$

= 2.566 inches of runoff from D.A.

∴ Peak outflow $Q_{P_2} = 16,500 \left(1 - \frac{2.566}{19}\right)$

$= 16,500 (1 - 0.135)$

$= 14,272.0$ cfs.

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ENGINEERS
BOSTON

PROJECT EN-006 (10)

FILE NUMBER EN-006
SHEET NUMBER 14 OF
DATE 11-6-1958
COMPUTED BY VEM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW

TRIAL # 5 :

From the composite discharge rating curve, the above outflow peak rate corresponds to ELEV. 1329.35

i.e. surcharge ht. above the spillway crest
= 11.35 feet.

Vol. of surcharge storage ($STOR_2$)

$$= \frac{119 \times 11.35}{10 \times 640} \times 12$$

$$= 2.53 \text{ inches of runoff from D.A.}$$

Average of $STOR_1$ and $STOR_2$

$$= \frac{2.561 + 2.53}{2}$$

$$= 2.548 \text{ inches of runoff from D.A.}$$

$$\therefore \text{PEAK OUTFLOW} = 16,500 \left(1 - \frac{2.548}{19}\right)$$

$$= 16,500 (1 - 0.134)$$

$$= 14,289 \text{ cfs.}$$

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BOSTON

PROJECT EN-006(10)

FILE NUMBER EN-006
SHEET NUMBER 15 OF
DATE 11-6-1972
COMPUTED BY VRM
CHECKED BY

SUBJECT HARRISVILLE POND DAM
TO DETERMINE PEAK OUTFLOW.

∴ The corresponding maximum pool elevation = 1329.40.

∴ Maximum surcharge ht = 11.40 feet.

At the maximum pool elevation, the spillway can pass 123.0 cfs.

Here, the question of overtopping the dam does not arise as the dam forms the foundation of the northern wall of a two-storey mill building.

Roadway over the culvert pipe would be overtopped by 8.9 feet.

Without overtopping the roadway, (i.e. at ELEV. 1320.5), the spillway and the waste sluice together can pass only about 342 cfs.

That is about 2.5 % of the TEST FLOOD PEAK OUTFLOW.

FAY, SPOFFORD & THORNDIKE, INC
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BOSTON

PROJECT EN-006(10).

FILE NUMBER EN-016
SHEET NUMBER 1 OF
DATE 11-6-1979
COMPUTED BY VRM.
CHECKED BY

SUBJECT HARRISVILLE POND DAM.
ESTIMATION OF DEPTH OF FLOOD WATER IN THE VICINITY OF DAMAGE IMPACT AREA DUE TO BREACH IN THE DAM AT RESERVOIR FULL CONDITION.

As explained in section 1.2d, it is not possible to generate downstream dam failure hydrograph in the vicinity of damage impact area using USGS topo map on which the contours are at 20-foot intervals.

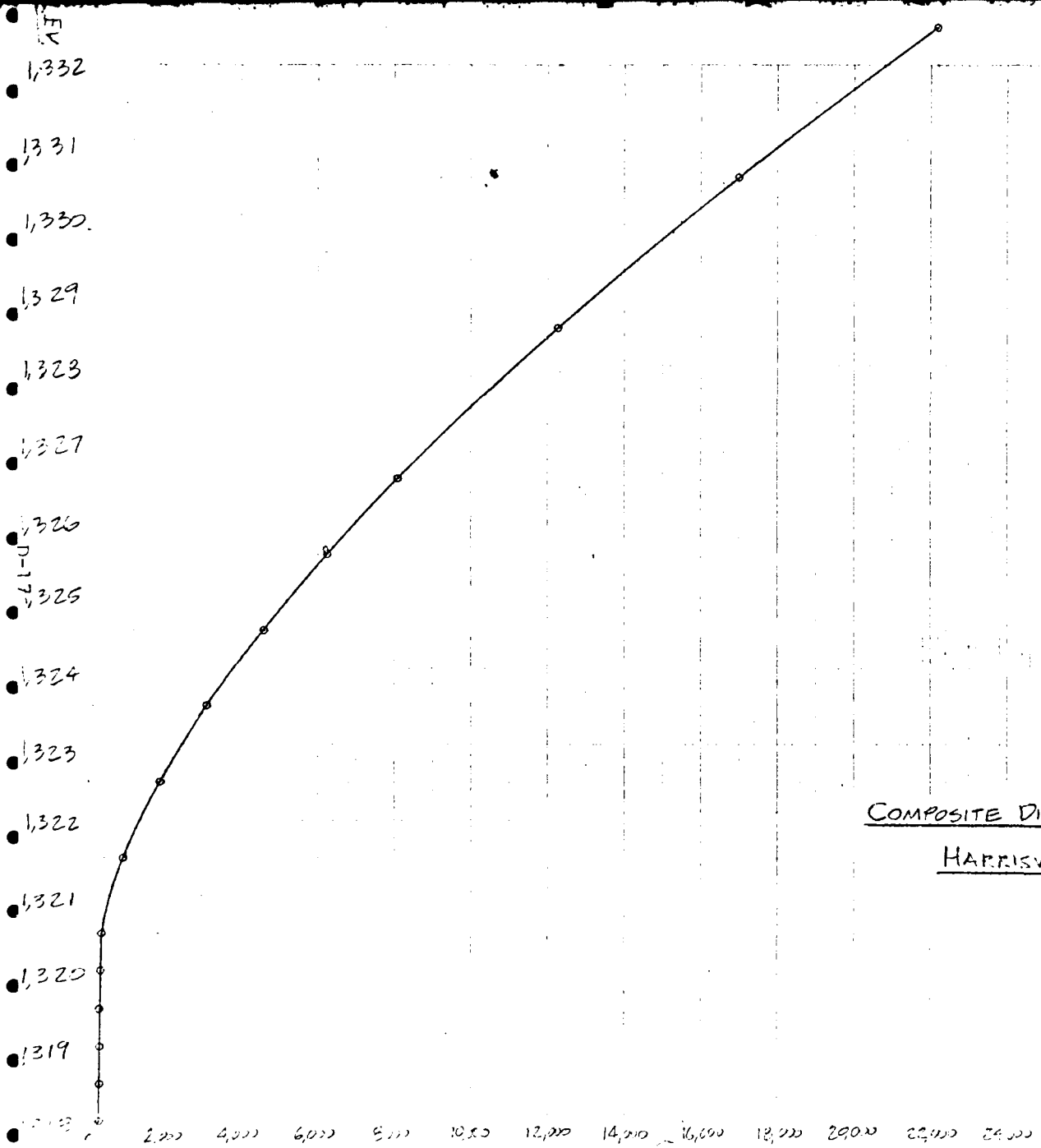
Besides, no other topographic map is available for the area.
From the knowledge of the damage impact area, in the vicinity of Eastview village which is at a distance of 2½ miles downstream of Harrisville Pond Dam, a ball park estimate has been made as follows:

Depth of water above the streambed at F.E.L

= 1318 − 1297
= 21 feet.

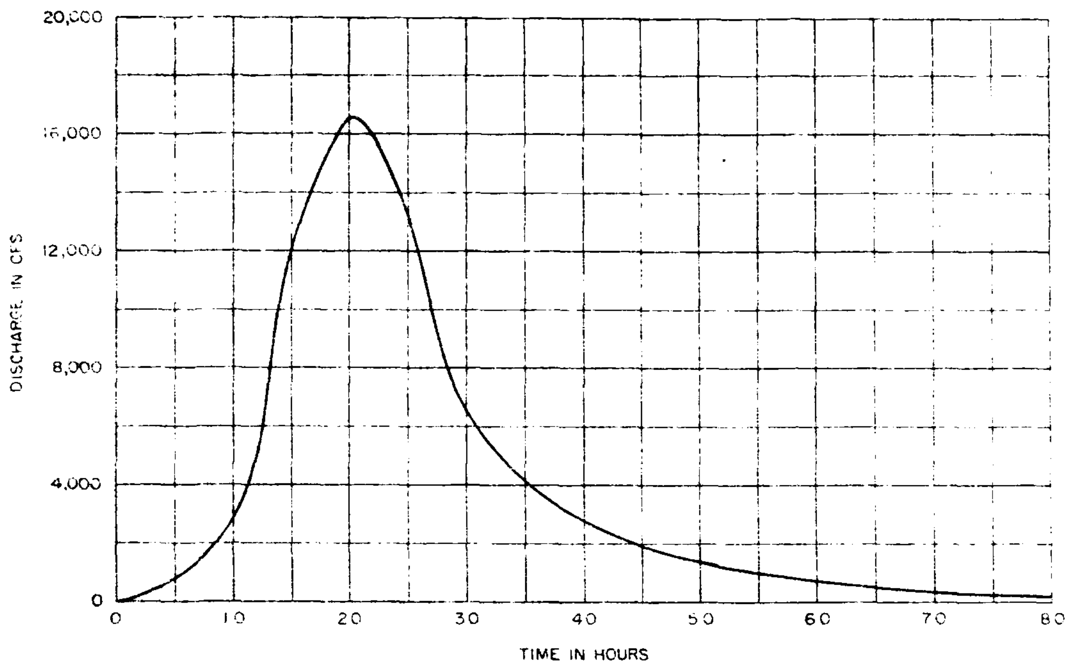
Height of flood wave at damage impact area is estimated to be about 14 feet.
Width of water spread at damage impact area is approximately indicated on the USGS map included in APPENDIX-D.

NATIONAL DAM INSP. PROGRAM



COMPOSITE DISCHARGE RATING CURVE

HARRISVILLE POND DAM



SPILLWAY TEST FLOOD INFLOW HYDROGRAPH

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON, MASS.

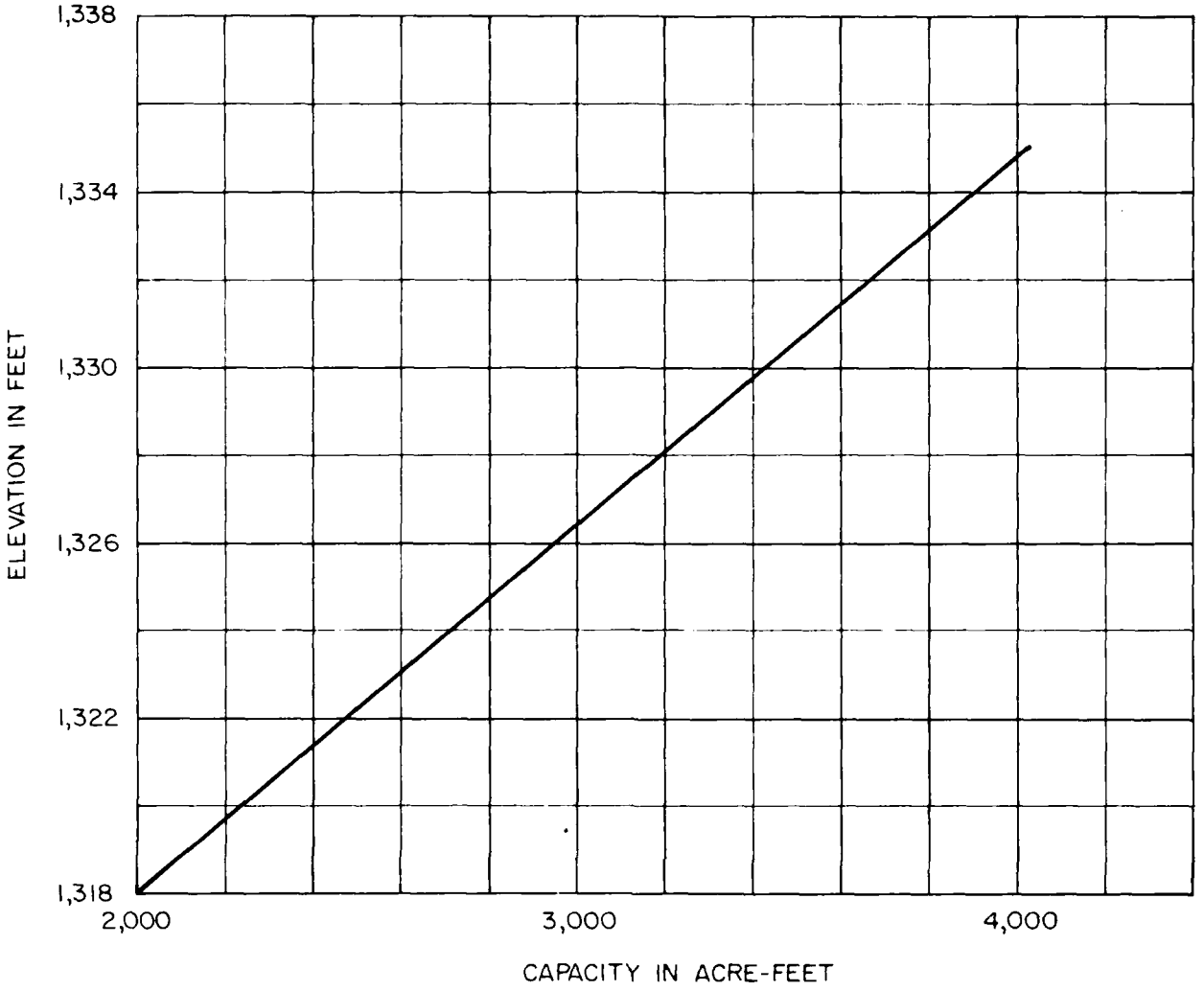
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

HARRISVILLE POND DAM

NEW HAMPSHIRE

SCALE AS SHOWN
DATE AUGUST 197[illegible]



STORAGE CAPACITY – ELEVATION CURVE

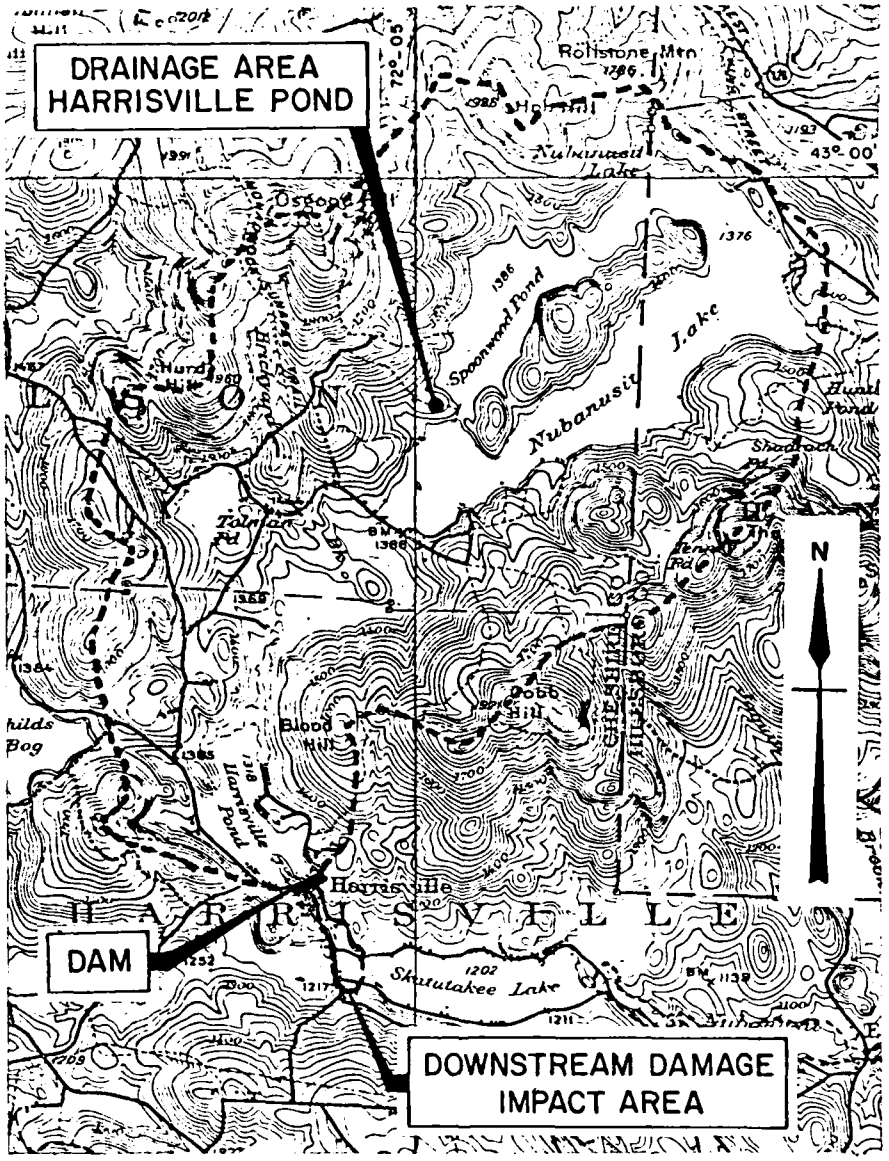
FAY, SPOFFORD & THORNDIKE, INC. ENGINEERS BOSTON, MASS.	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

HARRISVILLE POND DAM

NEW HAMPSHIRE

SCALE	AS SHOWN
DATE	AUGUST, 1978



SCALE 1:62500 (ACTUAL)

UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

NEW HAMPSHIRE
MONADNOCK QUADRANGLE 1949
AMS 6569 I-SERIES V712
LOVEWELL MOUNTAIN QUADRANGLE 1957
AMS 6570 II-SERIES V712

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1) STATE	(1) IDENTITY NUMBER	(1) INVEGON	(1) STATE	(1) COUNTY	(1) CONGR DIST	(1) STATE	(1) COUNTY	(1) CONGR DIST	(1) NAME	(9) LATITUDE (NORTH)	(10) LONGITUDE (WEST)	(11) REPORT DATE DAY	MO	YR
NH	65	NED	NH	005	02				HARRISVILLE POND DAM	4256.7	7205.9	15	AUG	78

(11) POPULAR NAME	(11) NAME OF IMPOUNDMENT
UPPER POND DAM	HARRISVILLE POND

(11) REGION	(12) BASIN	(11) RIVER OR STREAM	(11) NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	(11) DIST FROM DAM (MI.)	(11) POPULATION
01	08	NUBANUSIT BROOK	HARRISVILLE	0	650

(11) TYPE OF DAM	(11) YEAR COMPLETED	(11) PURPOSES	(11) STRUC. HEIGHT (FT.)	(11) HYDRAU. HEIGHT (FT.)	(11) IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	NORMAL (ACRE-FT.)	INSPECTION DIST	OWN	FED K	PRV/FED	SCS A	VER/DATE
REEGPG	1886	RO	22	21	2298	2000	NED	N	N	N	N	10AUG78

(11) REMARKS

(11) D/S HAS	(11) SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (F.F.)	(11) MAXIMUM DISCHARGE (FT.)	(11) VOLUME OF DAM (CY)	(11) POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	(11) NAVIGATION LOCKS NO	LENGTH (F.F.)	WIDTH (F.F.)	LENGTH (F.F.)	WIDTH (F.F.)	LENGTH (F.F.)	WIDTH (F.F.)	LENGTH (F.F.)	WIDTH (F.F.)
1	75	N	4	175	800											

(11) OWNER	(11) ENGINEERING BY	(11) CONSTRUCTION BY
JOHN COLONY JR		

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

(11) INSPECTION BY	(11) INSPECTION DATE DAY	MO	YR	(11) AUTHORITY FOR INSPECTION
FAY SPOFFORD + THORNDIKE, INC	22	MAY	78	PL92-367

(11) REMARKS

END

FILMED

8-85

DTIC