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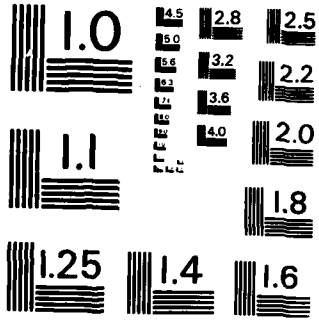
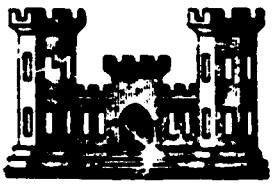


THAMES RIVER BASIN
SPRAGUE, CONNECTICUT

PAPERMILL POND DAM

CT. 00471

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

DECEMBER 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: CT 00471	2. GOVT ACCESSION NO.: AD-A144746
3. RECIPIENT'S CATALOG NUMBER:	
4. TITLE (and Subtitle): Papermill Pond Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED: INSPECTION REPORT
	6. PERFORMING ORG. REPORT NUMBER:
7. AUTHOR(s): U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION	8. CONTRACT OR GRANT NUMBER(s):
9. PERFORMING ORGANIZATION NAME AND ADDRESS:	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS:
11. CONTROLLING OFFICE NAME AND ADDRESS: DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254	12. REPORT DATE: December 1979 13. NUMBER OF PAGES: 50
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office):	15. SECURITY CLASS. (of this report): UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE:

16. DISTRIBUTION STATEMENT (of this Report)

APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

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,
Thames River Basin
Sprague, Connecticut

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

Papermill Pond Dam is a 573 ft. long composite rubble masonry, concrete, and earth embankment dam consisting of a 124.5 ft. long gravity masonry overflow section, an 84 ft. long earth embankment to the right of the overflow section and a 365 ft. long earth embankment to the left of the overflow section. The dam is judged to be in generally good condition, but is rated as in fair condition owing to the absence of a dewatering facility. Based on storage, the size classification is intermediate. The dam has been classified as having a significant hazard potential. Based upon the guidelines the recommended test flood ranges from a ½ PMF to a full PMF.

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PAPERMILL POND DAM

CT 00471

THAMES RIVER
SPRAGUE, CONNECTICUT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NEDED-W	Review of Non-Federal Dam Inspection Draft Report

TO Chairman, Dam Safety Review Board

FROM Chief, Water Control Branch

DATE 8 Jan 1980

CMT 1 Messrs. Manley/McMillan/ /mm/540

NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS
DRAFT REPORT REVIEW COMMENTS
PAPERMILL POND DAM, IDENTITY NO. CT 00471
WATER CONTROL BRANCH

Page	Comments
Brief Assessment 2nd page	✓Suggest adding (1) "a detailed hydrologic-hydraulic investigation to assess further..."
IV & D-7	Can we get better reproductions of these plates?
2	✓1st para., 2nd sentence - leave out "the and the spillway."
3	✓1.2.h. - "abailable" should be "available."
4 & 6	✓What is basis for assumed elevation of 111.0 ft. NGVD.
13	✓In section 5, should mention if routings done assuming flashboards in or out.
14	✓last paragraph - should mention the possibility of "loss of few lives" as you did on page 3 under hazard classification.
D-13	✓Can you put a grid on this plate?
D-11	✓For 1/2 PMF formula should be $\frac{stor_1}{9.5"}$ instead of $\frac{stor_1}{19"}$

COOPER

✓Plate D-3 - bottom should be acre-feet instead of CFS.

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	CT 00471
Name of Dam:	Papermill Pond Dam
Town:	Sprague
County and State:	New London, Connecticut
Stream:	Little River
Date of Inspection:	31 October 1979

BRIEF ASSESSMENT

Papermill Pond Dam is a 573 ft. long composite rubble masonry, concrete, and earth embankment dam consisting of a 124.5 ft. long gravity masonry overflow section, an 84 ft. long earth embankment to the right of the overflow section and a 365 ft. long earth embankment to the left of the overflow section. About 160 ft. of the upstream face of the left embankment is paved with concrete. It is a run-of-the-river dam which is used for storing process water for a paper mill located upstream on the left bank of the river. In the left embankment there is an intake which controlled flows through a conduit to a turbine facility in a mill building located immediately downstream of the dam. The turbine has been abandoned and the mill building is in the process of being razed. The spillway for the dam is equipped with 2.3 ft. high permanent wooden flashboards.

The reservoir is about 4,000 ft. long and has a saddle on the right rim about 2,300 ft. upstream of the dam. The surface area of the pond at spillway level is about 51 acres. The drainage area above the dam is about 37 sq. mi., the maximum storage to the top of dam is about 1,275 acre-ft., and height of the dam is about 30 ft. Based on storage, the size classification is intermediate. A breach of the dam could damage an industrial building, a railroad spur, a local road, two houses and two other buildings. Therefore, the dam has been classified as having a significant hazard potential. Based upon the guidelines the recommended test flood ranges from a ½ PMF to a full PMF. A test flood equal to the ½ PMF, (11,200 cfs) was selected.

The routed test flood outflow of 10,800 cfs overtops the right embankment by about 1.2 ft. and the left embankment by about 0.4 ft. The spillway can pass 7,750 cfs or about 72 percent of the routed test flood outflow without overtopping the right embankment.

The dam is judged to be in generally good condition, but is rated as in fair condition owing to the absence of a dewatering facility. There is brush growth on both embankments. Mortar is missing from the joints of the rubble masonry section of the spillway. There is a crack in the concrete apron on the left embankment and the construction joints of the apron have opened up. Minor erosion has taken place on the downstream slope of the left embankment.

Within one year after receipt of this Phase I Inspection Report, the owner, the Federal Paper Board Company, should retain the services of a registered professional engineer and implement the results of his evaluation of the following: (1) a detailed hydrologic-hydraulic investigation to assess further the potential for overtopping including the saddle on the right reservoir rim, the adequacy of the spillway and the removal of the flashboards; (2) study the feasibility of converting the turbine conduit into an outlet facility and using it as a means to safely drain the pond; and (3) determine whether the upstream rubble masonry wall in the left embankment section should be overlaid with concrete.

The owner should also implement the following operating and maintenance measures: (1) repoint mortar joints in the rubble spillway face and spillway training walls; (2) clean and repair the transverse crack in the concrete slab on the left abutment; (3) clean and fill the construction joints in the concrete slab on the left embankment with a bitumastic filler; (4) clear the brush which is growing on both embankments; (5) fill in the erosion gullies on the downstream slope of the left embankment; (6) monitor the turbine intake sluice for leakage and repair as necessary; (7) develop a formal surveillance and flood warning plan, including round-the-clock monitoring during periods of heavy precipitation; and (8) institute procedures for an annual periodic technical inspection of the dam and its appurtanent structures.

Peter B. Dyson
Project Manager

PREFACE

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

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

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

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

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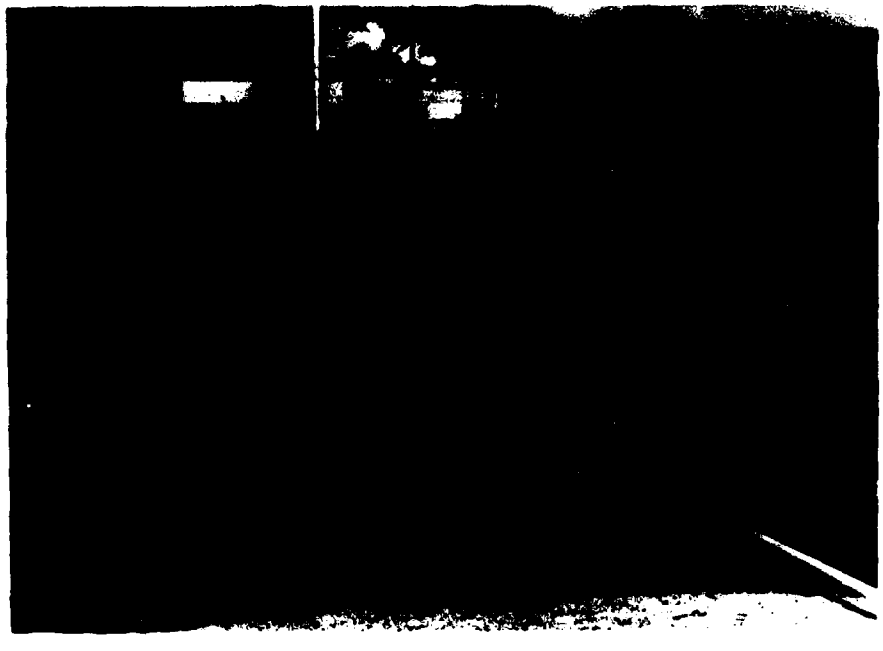
Overview of Dam from left spillway training wall.



Overview of Dam from right spillway training wall.

LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PAPERMILL POND DAM

NORWICH, CT. QUADRANGLE

THAMES RIVER BASIN STATE-CT.

SCALE 1:24000

DATE

PHASE I INSPECTION REPORT

PAPERMILL POND DAM CT 00471

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. Louis Berger & Associates, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Louis Berger & Associates, Inc. under a letter of 28 September 1979 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW33-79-C-0051, Job Change No. 2 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection

(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 assist the States to initiate quickly effective dam safety programs for non-Federal dams.

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

1.2 Description of Project

a. Location. Papermill Pond Dam is located on the Little River about 2.2 miles upstream from the River's confluence with the Shetucket River. The damsite is near the community of Versailles, in the town of Sprague, New London County, Connecticut. It is shown on U.S.G.S. Quadrangle, Norwich, Connecticut with coordinates at approximately N 41°37' 12", W 72°02' 37".

b. Description of Dam and Appurtenances. Papermill Pond Dam is a run-of-the-river dam believed to have been constructed in the 1870's as a diversion dam to furnish water power for a mill downstream. At the time of the inspection some old papermill buildings immediately below the dam were being razed. The dam is about 573 ft. long, about 30 ft. high, and essentially consists of a masonry gravity overflow section with earth embankments on each side of it.

The embankment of the right of the spillway is about 84 ft. long and 18 ft. wide at its narrowest point. A vertical concrete retaining wall extends along 60 ft. of its upstream face. The embankment to the left side of the spillway is about 365 ft. long and has a crest width of about 12 ft. An

outlet conduit through the embankment leads to a turbine in the abandoned mill. Between the intake structure and the spillway the slopes of the embankment are regular. The downstream slope is about 1½ horizontal to 1 vertical. The upstream slope above normal reservoir level is 2 horizontal to 1 vertical and is paved with concrete. Below the water line a vertical rubble masonry wall retains the embankment. To the left of the outlet structure the cross-section of the embankment is irregular and there is a building and an old concrete pad on the crest. Two effluent pipes run along the entire length of the left embankment.

The 124.5 ft. wide rubble masonry and concrete spillway has a permanent wooden flashboard structure installed on its crest. This structure is about 2.3 ft. high and has stainless steel sheeting installed on its upstream face. The crest of the flashboard structure is about 2.5 ft. upstream of the spillway's downstream face, which has a batter of about 12 vertical to 1 horizontal. In 1959 concrete training walls were constructed upstream of the spillway crest. Downstream of the crest the training walls are constructed of mortared rubble masonry of earlier vintage.

About 160 ft. to the left of the spillway there is a concrete intake structure which is 10 ft. wide, containing a rack and pinion hand operated wooden sluice gate which regulates flows into a penstock about 5 ft. dia. connected to a turbine housed in the basement of the old mill. A tail race leads from the turbine back to the Little River. The concrete walls of the intake structure were built in 1959, when the upstream concrete spillway training walls and concrete apron on the embankment were also built.

c. Size Classification. Papermill Pond Dam has a hydraulic height of about 30 ft. above downstream river level, and impounds a normal storage of about 766 acre-ft. to spillway crest level and a maximum of about 1,275 acre-ft. to top of dam. In accordance with the size and capacity criteria given in Recommended Guidelines for Safety Inspection of Dams, the project falls into the intermediate category on the basis of capacity and is therefore classified accordingly.

d. Hazard Classification. The Little River immediately below Papermill Pond Dam flows along a 3,200 ft. reach to the Penn Central Railroad crossing located just below Bushnell Hollow Road. Within this reach, at a point about 800 ft. below the dam, the river takes a sharp bend to the right. The outer bank of the river at this point appears to be very unstable and shows signs of extensive erosion. A railroad spur and an industrial building close to the river could sustain significant property damage by undermining should a breach of the dam occur. Bushnell Hollow Road would also be flooded owing to a breach of the dam, as would one house located on the left bank of the river between Bushnell Hollow Road and the Penn Central Railroad. A masonry arch culvert carries the river under the 50 ft. high railroad embankment. It is estimated that this restriction would reduce the breach flood surge downstream of the railroad by as much as 75 percent. In the reach beyond the railroad, the Little River flows over the Versailles Pond Dam and then joins the Shetucket River at a point about 2.2 miles below the dam. It is estimated that the reduced peak flow would pass over the Versailles Pond Dam

with about 0.5 ft. of freeboard. One house and two small buildings on the shores of Versailles Pond would probably be flooded. Beyond the Versailles Pond Dam an abandoned mill structure would be flooded. Downstream of this mill the stream gradient is rather steep and it is not anticipated that any further significant flooding would take place.

A sudden failure of the dam could therefore cause the loss of a few lives and result in appreciable community and industrial economic losses. Consequently, Papermill Pond Dam has been classified as having a significant hazard potential, in accordance with the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership. Papermill Pond Dam is owned by the Federal Paper Board Company, Division of Brooklyn Cooperage Company, Sprague, Connecticut 06383.

f. Operator. Mr. Robert Charette, Divisional Engineer, Federal Paper Board Company, Division of Brooklyn Cooperage Company, Sprague, Connecticut 06383. Telephone: (203) 822-8201.

g. Purpose of Dam. The dam impounds water used for processing in the paper mill located just upstream of the dam.

h. Design and Construction History. No information is available regarding design and construction of the original 19th century dam. In 1959 it is reported that the dam underwent modifications. At that time the upstream concrete spillway training walls were added, the upstream face of the left embankment was partially paved with concrete, and the intake to the turbine was reconstructed. It was also planned to cover the rubble masonry wall on the upstream side of the left embankment with concrete. However, this work was never completed and reinforcing steel still projects from the lower edge of the concrete on the upstream face. The only drawing retrieved is a property plan which is shown in Appendix B.

i. Normal Operating Procedure. There are no operational procedures for Papermill Pond Dam. The spillway flashboards are permanently installed and appear to be kept in good repair. The turbine intake is closed and disused.

1.3 Pertinent Data

a. Drainage Area. The drainage area above Papermill Pond Dam consists of about 37 sq. mi., described in general as rolling terrain. The longest circuitous stream course contributing to the pond is about 18.5 miles long with an elevation difference of about 620 ft., or at a slope of about 33.3 ft. per mile. The drainage area has a length of about 16.7 miles and a maximum width of about 4.4 miles, with an average width of about 2.7 miles. The basin consists of both open fields and forested areas, with scattered population throughout the area.

b. Discharge at Damsite.

(1) Outlet works conduit. There is no regulating outlet for Papermill Pond Dam. However, the turbine conduit could possibly be converted for use as a regulating outlet.

(2) Maximum Known Flood at Damsite. Surcharge records were said to have been maintained by the owner for a brief period of years, but were not retrieved. There appear to be no records of extreme high flood inflows into Papermill Pond, nor of spillway releases and surcharge heads during such inflows.

(3) Ungated Spillway Capacity at Top of Dam. The total spillway capacity at top of right abutment, elevation 117.5 N.G.V.D. is 7,750 cfs (flashboards assumed in place).

(4) Ungated Spillway Capacity at Test Flood Elevation. The ungated spillway capacity is about 10,350 cfs at test flood elevation 118.72 N.G.V.D. (flashboards assumed in place).

(5) Gated Spillway Capacity at Normal Pool Elevation. Not applicable.

(6) Gated Spillway Capacity at Test Flood Elevation. Not applicable.

(7) Total Spillway Capacity at Test Flood Elevation. The total spillway capacity at the test flood elevation is the same as (4) above, 10,350 cfs at elevation 118.72 N.G.V.D.

(8) Total Project Discharge at Test Flood Elevation. The total project discharge at test flood is 11,000 cfs at elevation 118.85 N.G.V.D.

c. Elevations (Ft. N.G.V.D.)

(1) Streambed at centerline of dam - 87.7

(2) Maximum tailwater - Not available

(3) Upstream portal invert diversion tunnel - Not applicable

(4) Recreation pool - Not applicable

(5) Full flood control pool - Not applicable

(6) Ungated spillway crest - 111.0 (Reservoir elevation from USGS sheet. Assumed top of permanent flashboards, all other elevations relative to spillway crest.)

(7) Design surcharge (original design) - Unknown

(8) Top of non-overflow right abutment - 117.5
Top of non-overflow left abutment - 118.3

(9) Test flood design surcharge - 118.72

d. Reservoir

(1) Length of maximum pool - 4,000 ft.

(2) Length of recreation pool - Not applicable

(3) Length of flood control pool - Not applicable

e. Storage (acre-ft.)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3) Spillway crest pool El. 111.0 - 766

(4) Top of non-overflow right abutment El. 117.5 - 1,275

(5) Test flood pool El. 118.72 - 1,410

f. Reservoir Surface (acres)

(1) Recreation pool - Not applicable

(2) Flood control pool - Not applicable

(3)Spillway crest El. 111.0 - 51.4

(4) Top of non-overflow right abutment El. 117.5 - 104.5

(5) Test flood pool El. 118.72 - 114.0

g. Dam

(1) Type - Rubble masonry gravity overflow section and rubble masonry concrete, and earth non-overflow sections.

(2) Length - 573 ft.

(3) Height - 30 ft. ±

(4) Top width - 12 ft. on earth embankment right of spillway, the remainder varies

(5) Side slopes - overflow section - Downstream 12 vertical to 1 horizontal. Upstream unkown
Left earth embankment - upstream - 2 horizontal to 1 vertical
downstream - 1½ horizontal to 1 vertical

(6) Zoning - Unknown

(7) Impervious core - Unknown

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel - Not applicable

i. Spillway

(1) Type - Masonry gravity, straight drop with permanent flashboards

(2) Length of weir - 124.5 ft.

(3) Crest elevation - 111.0 N.G.V.D. (Assumed top of flashboards - reservoir elev. from USGS sheet)

(4) Gates - None

(5) Upstream channel - Natural river channel

(6) Downstream channel - Natural river channel

j. Regulating Outlets (Abandoned Power Facility)

(1) Invert - Unknown

(2) Size - Unknown

(3) Description - Sluiceway regulating flows to circular 5 ft. pipe which leads to abandoned turbine

(4) Control Mechanism - Hand operated, rack and pinion sluice gate

SECTION 2 - ENGINEERING DATA

2.1 Design Data

No data on the design of the dam or appurtenances has been recovered and probably none exists. During the course of the inspection a property plan showing the dam and pond was obtained and a copy is included in Appendix B.

2.2 Construction Data

No records or correspondence regarding construction have been found. According to the owner's representative at the inspection, the dam underwent major modifications in 1959, when concrete spillway training walls were constructed upstream of the spillway's crest. A 160 ft. long concrete apron was constructed on the upstream slope of the left embankment and the intake to the turbine facility was also reconstructed. A concrete covering planned for the upstream rubble masonry wall on the left embankment was never constructed. No records of these 1959 modifications could be located.

2.3 Operation Data

A record of surcharge heights at the crest of the dam was said to have been maintained for a few years, but nothing was recovered. This practice has been discontinued and there appear to be no other formal records of operation.

2.4 Evaluation of Data

a. Availability. Since no engineering data is available, it is not possible to make an assessment of the safety of the dam. The basis of the information presented in this report is principally the visual observations of the inspection team.

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

c. Validity. Not applicable

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General. The visual inspection of Papermill Pond Dam took place on 31 October 1979. On that date the water was about 0.1 ft. above the spillway crest. The discharge over the spillway was estimated to be about 13 cfs. There was no evidence of any major problems, but a few items require attention (see Section 7.3). The dam was judged to be in only fair condition owing to the absence of any dewatering facility.

b. Dam. The dam is a run-of-the-river dam with an overall length of about 573 ft. It currently provides process water for a paper mill located upstream on the left shore of the reservoir. At one time the stored water was used for driving a turbine in the abandoned mill located just downstream of the dam. This mill was in the process of being razed. The intake to the turbine appeared to be in good condition and the conduit could possibly be modified to serve as a regulating outlet for the dam.

The dam basically consists of a 124.5 ft. long gravity masonry spillway, an 84 ft. long earth embankment to the right of the spillway and a 365 ft. long earth embankment to the left of the spillway. The dam has a hydraulic height of about 30 ft.

The right embankment is of irregular shape and is about 18 ft. wide at its narrowest point. A vertical concrete wall extends along 60 ft. of the upstream face of the embankment and appeared to be in good condition. The right embankment is 0.8 ft. lower than the left embankment (see Overview Photo).

The left embankment is of uniform cross-section for a distance of about 160 ft. to the left of the spillway. It has a crest width of 12 ft. The downstream slope is about 1½ horizontal to 1 vertical and the upstream slope is 2 horizontal to 1 vertical. The upstream slope is paved with concrete, which was added in 1959. Approximately 5 ft. from the left training wall of the spillway there was a transverse crack in the slab. There was also evidence of minor differential settlement (less than ½ in.) which probably caused this crack. Construction joints, approximately 35 to 50 ft. apart, had opened laterally as much as ½ in. Overall the slab was generally in good condition (see Photo Nos. 1 & 2 in Appendix C).

Minor brush growth had taken a firm stand along the crest and downstream slope of the embankment (see Photo No. 3, Appendix C). This growth could cause uplift of the slab if allowed to mature.

Reinforcing steel to connect the concrete slab to a concrete cover of the rubble masonry wall on the upstream side of the embankment was left projecting from the slab, but this work was never completed (see Photo No. 3, 4, & 5, Appendix C).

Just to the left of the concrete apron is the intake to the turbine facility.

Beyond the intake the embankment is of irregular cross-section for a distance of about 200 ft. to where it intercepts natural ground. The upstream slope of the embankment was protected by a coarse concrete fill roughly placed on the upstream slope. There was also an old brick building and a deteriorated concrete pad on the crest of the embankment. The downstream slope showed evidence of minor soil erosion, particularly in the area of the aluminum effluent pipes, and was quite irregular in shape. There was some minor brush growth on the crest.

There was no evidence of seepage along either embankment. Minor brush growth was extensive on both embankments. There was also some minor erosion at the toe near the end of the left training wall of the spillway.

c. Appurtenant Structures. The overflow section or spillway of the dam is a rubble masonry gravity structure with mortared joints. There is a concrete cap about 1 ft. high across the crest. The downstream face of the spillway has a slight batter of about 12 vertical to 1 horizontal. The upstream face of the structure could not be seen as there was earth and silt up against it. Surmounted on the concrete cap of the spillway was a permanently installed wooden flashboard structure which is 2.3 ft. high. The upstream face of the structure had a stainless steel sheet face. The flashboards were mounted in a sloping position, at about a 60 degree angle from a downstream horizontal line. The spillway has rubble masonry downstream training walls and concrete training walls upstream of the crest. The spillway appeared to be in good condition, with the exception of some minor spalling of mortar from the joints of the rubble masonry downstream face, and localized areas of missing mortar in the joints of the training walls. In general, the concrete walls appeared to be in good condition with no cracks or distress noted (see Photo Nos. 6,7,8 & 9, Appendix C).

About 160 ft. to the left of the spillway is the intake structure for an abandoned turbine located in the mill building at the downstream toe of the dam. Flows are controlled by a rack and pinion hand operated sluice gate of undetermined size. A trash rack was located about 2.5 ft. upstream of the sluice gate. In the basement of the mill building, an approximately 5 ft. dia. steel pipe leads from the basement foundation wall to the abandoned turbine. Therefore, it was assumed that this 5 ft. dia. steel pipe is the penstock extending from the intake structure, through the left embankment, to the mill building basement (see Photo Nos. 10,11, & 12, Appendix C). Below the turbine a tailrace leads back to the Little River at a point about 300 ft. downstream of the dam spillway. In general the inlet structure appeared to be in good condition.

d. Reservoir Area. The reservoir behind the dam is a ponding of the Little River. The reservoir shorelines appeared stable with no evidence of movement. A pumping station for papermill process water is located on the left shoreline.

e. Downstream Channel. Immediately downstream of the spillway the channel bottom is scattered with rocks. At a point about 800 ft. downstream, where the river makes a sharp bend to the right, the river bed is gravel.

A railroad spur and industrial building are located in close proximity to the left bank of the river in this area. The bank appeared somewhat unstable and signs of erosion were evident (see Photo Nos. 13 & 14, Appendix C). About 2,000 ft. below this point the river first passes under Bushnell Hollow Road and then under the Penn Central Railroad. The water passes under the railroad through a masonry arch culvert which would serve as a significant control during times of high flow (see Photo Nos. 15 & 16, Appendix C). At about 2.2 miles below the dam the Little River joins the Shetucket River. Between the Penn Central Railroad and the Shetucket River is the Versailles Pond Dam which has about 9.5 ft. of freeboard.

3.2 Evaluation

In general, the visual inspection adequately revealed key characteristics of the dam as they may relate to its stability and integrity, permitting as assessment to be made of those features affecting the safety of the structure. Minor erosion of the downstream slope of the left embankment was evident in two areas. The concrete apron was cracked near the spillway, and the apron's construction joints had separated slightly. Mortar was randomly missing from the rubble masonry spillway and its downstream training walls. Scattered growth appeared on both the left and right embankments. Of major concern is the lack of a regulating outlet for the facility and for this reason the dam was judged to be in only fair condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The Federal Paper Board Company is the owner and operator of the dam. There are no documented operating procedures for the dam.

4.2 Maintenance of Dam

No specific maintenance program is in effect at Papermill Pond Dam. However, the inspection indicated that the dam has been fairly well maintained in the past.

4.3 Maintenance of Operating Facilities

The turbine facility for the dam has been abandoned. The intake sluice gate is closed and no leakage was noted. The flashboard structure appeared to be in good condition. There are no other operating facilities for the dam.

4.4 Description of any Warning System in Effect

No warning system is in effect at Papermill Pond Dam.

4.5 Evaluation

The reservoir behind the dam is now used as a source of process water. Maintenance of the dam involves surveillance regarding seeps, repair of the rubble masonry and concrete, maintenance of the turbine intake sluice gate, keeping the spillway clear of debris, and maintaining the flashboard structure. The owner should establish a formal warning system for the dam in the event of an emergency.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. General. Papermill Pond Dam is a run-of-the-river type project, which furnishes process water for a paper mill located upstream on the left bank. It is basically a low storage - high spillage facility. It consists of a rubble masonry spillway, earth embankments on either side of the spillway, and the intake for an abandoned turbine facility. The dam impounds a normal storage of about 766 acre-ft. with provisions for an additional 506 acre-ft. of capacity in its surcharge space to top of dam. The spillway is capable of discharging about 7,750 cfs with the surcharge to the top of the dam. The general topographic characteristics of the 37 sq. mi. drainage basin is best described as rolling terrain. The drainage area measures about 16.7 miles long and has an average width of about 2.7 miles and rises from elevation 111.0 at spillway crest to elevation 812. The drainage area is predominately forested.

b. Design Data. No hydrologic or hydraulic design data was retrieved for Papermill Pond Dam.

c. Experience Data. Surcharge heights at the crest of the dam were said to have been maintained by the owner for a brief period of time, but were not recovered. The practice has been discontinued and no other records are available in regard to past operation of the dam, nor of surcharge encroachments and surcharges through the spillway during periods of high flow. The maximum past inflows are unknown.

d. Visual Observations. There is no present evidence either along the reservoir or in the downstream channel to indicate high water levels or signs of major spillway outflows. No one contacted could recollect any such occurrences.

e. Test Flood Analysis. Reservoir area and capacity curves and tables, for use in flood routing, are shown on Sheets D-2 and D-3, Appendix D. For determining surface areas and surcharge capacities, planimetered areas were taken from contours delineated on U.S.G.S. 2,000 ft. per in. quadrangle sheets.

The test flood chosen to evaluate the hydrologic and hydraulic capacity of Papermill Pond Dam was selected in accordance with the criteria presented in the Recommended Guidelines for Safety Inspection of Dams. Since this dam is classified as intermediate with a significant hazard potential, a test flood of a magnitude with a range of ½ PMF to a full PMF is recommended. A test flood of a magnitude corresponding to ½ PMF was selected as being appropriate, since only two homes are subject to damage in the area downstream of the dam.

Precipitation data were obtained from Hydrometerological Report No. 33, which for the Connecticut area approximates 24.0 in. of 6 hour point rainfall over a 10 square mile area. This value was then reduced by 14 percent for depth-area-duration relationship and then further reduced by 14.4 percent to allow for basin size, shape, and fit factors. About 2 percent was then subtracted

for infilitration losses to arrive at the excess rainfall used to prepare an inflow hydrograph. The six hour rainfall was distributed into one hour incremental periods as suggested in COE Publication EC 1110-2-1411.

A triangular incremental unit graph was assumed for the inflow hydrographs, using a computed lag time value of 15.35 hours to derive at a time-to-peak for the triangular hydrograph of 13 hours (see computations on Sheets D-7 thru D-9, Appendix D). A PMF inflow hydrograph is shown on Sheet D-10, Appendix D, indicating a peak inflow of about 22,400 cfs or a CSM of about 605. The PMF value was then divided by two to arrive at a test flood inflow value of 11,200 cfs.

Discharge tables and curves for the spillway and for over the top of the dam are shown on Sheets D-4 thru D-6, Appendix D.

A flood routing was performed for the test flood, assuming that the flashboards remain in place. The results of this routing are shown on Sheet D-11, and are summarized as follows:

Test Flood	Test Flood Inflow cfs	Max. Res. El. ft.	Max. Head Over Right Embankment ft.	Max. Head Over Left Embankment ft.	Routed Test Flood Outflow cfs
½ PMF	11,200	118.72	1.22	0.42	10,800

From the above table it can be seen that the project will not pass the routed test flood outflow without overtopping the right embankment by 1.22 ft. and the left embankment by 0.42 ft. The project, however, can handle 72 percent of the routed test flood outflow without overtopping the right embankment.

It should be noted that there is a saddle on the right reservoir rim about 2,300 ft. upstream of the dam. From the U.S.G.S. quadrangle sheet it does not appear that this area would be overtopped by the test flood outflow. However, a more detailed investigation should be carried out in order to verify this condition.

f. Dam Failure Analysis. A breach owing to structural failure of the dam by piping or sloughing is a possibility. For this analysis a breach was assumed with the water level at the top of the right embankment. The "rule of thumb" criteria suggested in the NED March 1978 Guidance Report was used for the breach analysis. With a breach width of about 36 percent of the dam length, equal to 208 ft., an outflow of about 56,800 cfs would be realized (see Sheets D-12 thru D-16, Appendix D).

Below the dam the Little River first flows along a 3,200 ft. long reach which extends to the Penn Central Railroad crossing. Within this reach, about 800 ft. below the dam, the river takes a sharp bend to the right. The outer bank of the river at this point appears to be very unstable and easily erodible. A railroad spur and an industrial building could sustain damage by undermining

if a breach of the dam occurred.

At the Penn Central Railroad crossing a masonry arch culvert carries the river under a 50 ft. high embankment. It is estimated that this restriction would reduce the downstream breach flood surge by as much as 75 percent.

The stage upstream of the railroad crossing would be about 32 ft. and Bushnell Hill Road located about 500 ft. above the railroad crossing would be flooded. One house located on the left bank of the river below Bushnell Hill Road would sustain significant flood damage. In the reach below the railroad, the Little River passes over Versailles Pond Dam and then joins the Shetucket River at a point about 2.2 miles below the dam. It is estimated that the reduced peak flow would pass over the Versailles Pond Dam with about 0.5 ft. of freeboard. One house and two small buildings located on the shores of Versailles Pond Dam would probably sustain some flood damage from the surcharge. Beyond the Versailles Pond Dam an abandoned mill structure would be flooded. Downstream of the Versailles Pond Dam the stream gradient is relatively steep and it is not anticipated that any further significant flood damage would occur.

In summary, a breach of the dam could cause flood damage to two homes, two other buildings and a local road, and could cause damage to a railroad spur and an industrial building, with the possibility of the loss of a few lives. (Appendix D, Sheet No. D-17, shows the area of potential flooding.)

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. There are no design calculations, as-built drawings or other data which would permit the preparation of structural stability computations. The dam is now stable and is in fair condition. Deficiencies described below and in Section 7 should be corrected.

The field investigation revealed the following:

(1) Need for repointing of mortar in the joints of the masonry rubble walls of the spillway gravity section and training walls.

(2) A transverse crack in the concrete slab of the upstream face of the gravity section should be cleaned out and repaired. This crack is located approximately 5 feet left of the left training wall of the spillway.

(3) Minor brush should be cleared from the crest and slopes of the embankment sections of the dam.

(4) Fill in erosion gullies on the downstream slope of the embankment left of the intake structure with suitable compacted fill.

(5) Clean and fill construction joints in concrete slab on upstream face of the embankment with bitumastic filler.

b. Design and Construction Data. No plans or calculations of value to a stability assessment are available.

c. Operating Records. There are no operating records of value to a stability assessment.

d. Post Construction Changes. Concrete overlays to the rubble masonry walls were constructed in 1959 and included the upper portions of the right and left training walls of the spillway and the walls of the intake structure. A concrete slab was added to the sloping part of the upstream face of the left embankment section; however, the vertical masonry portion of this upstream face was not concreted.

e. Seismic Stability. The dam is located in Seismic Zone No. 1 and in accordance with recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7
ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. On the basis of the Phase I visual examination, Papermill Pond Dam appears to be in generally good condition, but is rated as in only fair condition owing to the lack of dewatering facilities. The deficiencies revealed indicate that a further investigation should be carried out and that some remedial work is needed. The major concerns of the overall integrity of the dam are as follows:

(1) The spillway can only pass 72 percent of the routed test flood outflow.

(2) The absence of any useable dewatering facility.

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

c. Urgency. The recommendations and remedial measures enumerated below should be implemented by the owner within one year after reciept of this Phase I Inspection Report.

d. Need for Additional Investigations. Additional investigations are required as recommended in Para. 7.2.

7.2 Recommendations

It is recommended that the owner should retain the services of a registered professional engineer experienced in the design of earth dams to make investigations and studies of the following, and if proved necessary, to design appropriate remedial works.

(1) Make a thorough study of the hydrology of the drainage basin. Review the spillway adequacy in relation to the potential overtopping of the earth embankments and the saddle on the right reservoir rim. The removal of the flashboards should also be considered.

(2) Study the feasibility of converting the turbine conduit into an outlet facility and using it as a means to safely drain the pond.

(3) Determine whether the vertical upstream face of the rubble masonry wall in the embankment section left of the spillway should be overlaid with concrete as originally intended.

(4) Investigate the structural stability of the overflow section with the flashboards in place.

7.3 Remedial Measures.

a. Operating and Maintenance Procedures.

(1) Repoint mortar in the joints of the masonry rubble spillway face and spillway training walls.

(2) Clean and repair the transverse crack in the concrete slab on the left embankment.

(3) On the upstream face of the left embankment, clean and fill the construction joints in the concrete slab with a bitumastic joint filler.

(4) Brush should be cleared from the embankments on both sides of the spillway on a regular annual basis.

(5) Fill in erosion gullies on the downstream slope of the left embankment with suitable material, well compacted.

(6) Monitor the turbine intake sluice gate for leakeage and repair as necessary.

(7) Develop a formal surveillance and flood warning plan, including round-the-clock monitoring during periods of heavy precipitation.

(8) Institute procedures for an annual periodic technical inspection of the dam and its appurtenant structures.

7.4 Alternatives

There are no feasible alternatives.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST
PARTY ORGANIZATION

PROJECT PAPERMILL POND DAM

DATE 31 October 1979

TIME 10:30 AM

WEATHER Sunny/Warm

W.S. ELEV. 111.1 U.S. ____ DN.S.

PARTY:

1. Pasquale E. Corsetti
2. Roger F. Berry
3. William S. Zoino
4. Peter B. Dyson
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____

	PROJECT FEATURE	INSPECTED BY	REMARKS
1.	Hydrologic/Hydraulic	Roger F. Berry	LBA
2.	Soils/Structural	William S. Zoino	GZD
3.	General Features	Peter B. Dyson	LBA
4.	General Features	Pasquale E. Corsetti	LBA
5.			
6.			
7.			
8.			
9.			
10.			

LBA - Louis Berger & Associates, Inc.
GZD - Goldberg, Zoino, Dunnicliff & Assoc., Inc.

PERIODIC INSPECTION CHECKLIST

PROJECT PAPERMILL POND DAM DATE 31 October 1979

PROJECT FEATURE Earth Embankment NAME

DISCIPLINE Soils/Structural NAME William S. Zoino

AREA EVALUATED	CONDITIONS
DAM EMBANKMENT	
Crest Elevation	117.5 ft. (right embankment) 118.3 ft. (left embankment)
Current Pool Elevation	111.1
Maximum Impoundment to Date	Unknown
Surface Cracks	Transverse crack in concrete slab in left embankment, 5 ft. left of spillway.
Pavement Condition	None
Movement or Settlement of Crest	None
Lateral Movement	None
Vertical Alginment	Good
Horizontal Alignment	Good, but earth embankment left of turbine outlet is irregular
Condition at Abutment and at Concrete Structures	Good - concrete overlay missing on upstream side of left embankment
Indications of Movement of Structural Items on Slopes	None
Trespassing on Slopes	Minor
Sloughing or Erosion of Slopes or Abutments	Minor erosion on downstream side of left embankment near spillway training wall and left of turbine outlet.
Rock Slope Protection - Riprap Failures	None
Unusual Movement or Cracking at or near Toes	None
Unusual Embankment or Downstream Seepage	None
Piping or Boils	None
Foundation Drainage Features	Not applicable
Toe Drains	Not applicable
Instrumentation System	Not applicable

Light brush growth on crest and slopes of embankments.

PERIODIC INSPECTION CHECKLIST

PROJECT PAPERMILL POND DAM DATE 31 October 1979

PROJECT FEATURE Turbine Inlet Structure NAME Roger F. Berry

DISCIPLINE Hydraulics/Structures NAME William S. Zoino

AREA EVALUATED	CONDITIONS
OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE	
a. Approach Channel	Vertical Concrete Walls
Slope Conditions	N.A.
Bottom Conditions	Unknown
Rock Slides or Falls	None
Log Boom	N.A.
Debris	None
Condition of Concrete Lining	Good
Drains or Weep Holes	None
b. Intake Structure	
Condition of Concrete	Good
Stop Logs and Slots	Debris Screen (Good)

PERIODIC INSPECTION CHECKLIST

PROJECT PAPERMILL POND DAM DATE 31 October 1979

PROJECT FEATURE Spillway NAME Roger F. Berry

DISCIPLINE Hydraulics/Structures NAME William S. Zoino

AREA EVALUATED	CONDITIONS
OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS	
a. Approach Channel	
General Condition	Good
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Unknown
b. Weir and Training Walls	
General Condition of Concrete	Good
Rust or Staining	None evident
Spalling	None evident
Any Visible Reinforcing	No
Any Seepage or Efflorescence	Unknown
Drain Holes	Yes
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	Yes
Floor of Channel	Rocky
Other Obstructions	Supports for utility pipe crossings downstream.

Mortar missing from rubble masonry spillway walls, and spillway face.

PERIODIC INSPECTION CHECKLIST

PROJECT PAPERMILL POND DAM DATE _____

PROJECT FEATURE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITIONS
Dike Embankment	N.A.
Outlet Works - Control Tower	N.A.
Outlet Works - Transition and Conduit	N.A.
Outlet Works - Outlet Structure and Outlet Channel	N.A.
Outlet Works - Service Bridge	N.A.

APPENDIX B

ENGINEERING DATA

No. 3

WATER RESOURCES COMMISSION
SUPERVISION OF DAMS
INVENTORY DATA

CT 471

Inventoried By

Date

18

Class 3

Name of Dam or Pond Paper Mill Pond high hazard

Code No. S 2.9 LT 2.3

Nearest Street Location

Town Sprague Long 72-2.6

U.S.G.S. Quad. Norwich Lat 41-37.2

Name of Stream ~~Division~~ Brook

Owner Federal Paper Board Co. Inc A Brook Corporation

Address Sprague, CT 06330

822-8201

OK 12/78

OK 7/73

Pond Used For HYDRO-ELEC.

Dimensions of Pond: Width _____ Length _____ Area 61.A

Total Length of Dam 2[illegible] Length of Spillway 100+

Location of Spillway main South

Height of Pond Above Stream Bed 30'

Height of Embankment Above Spillway 10'

Type of Spillway Construction [illegible]

Type of Dike Construction Fill

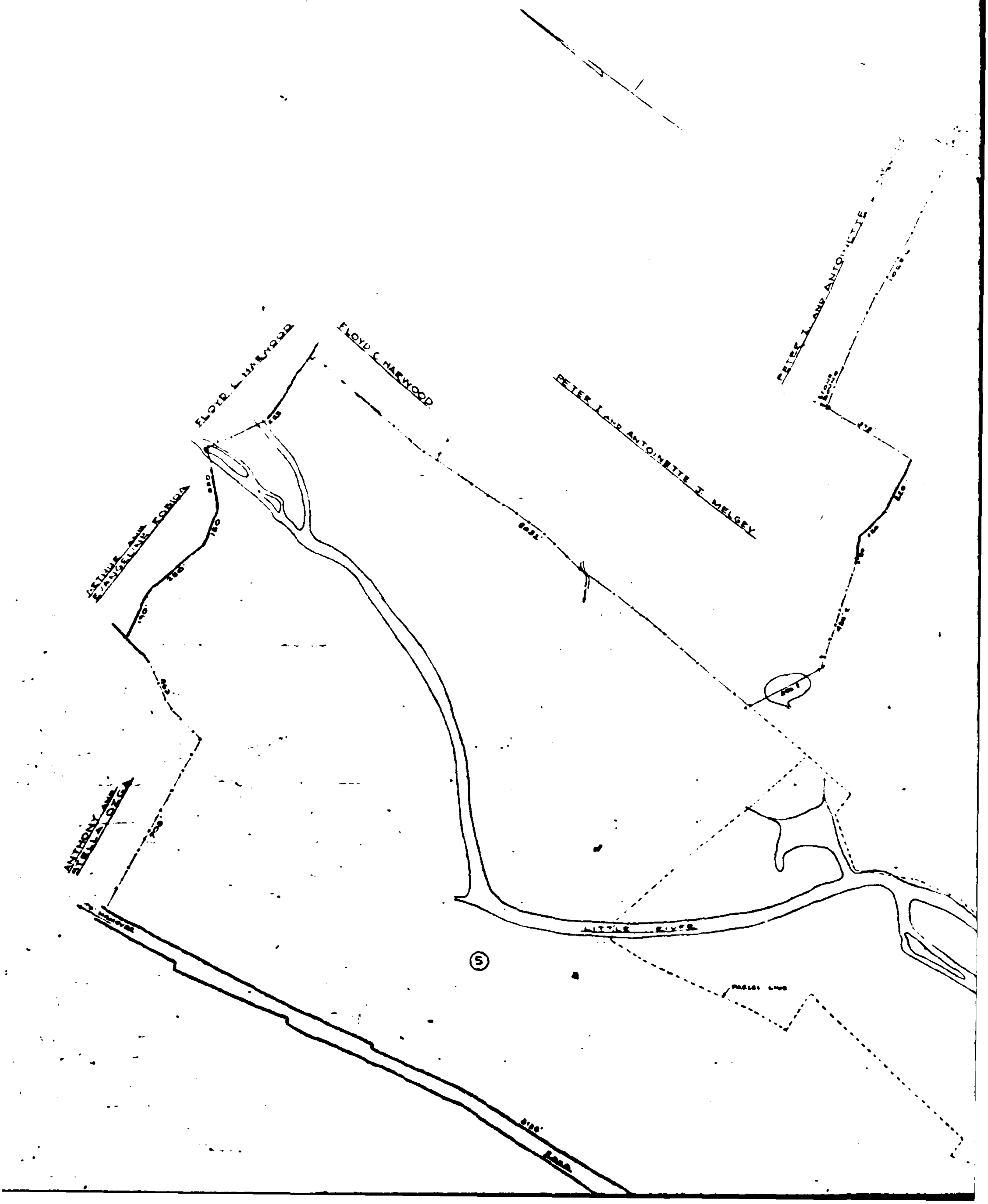
Downstream Conditions [illegible]

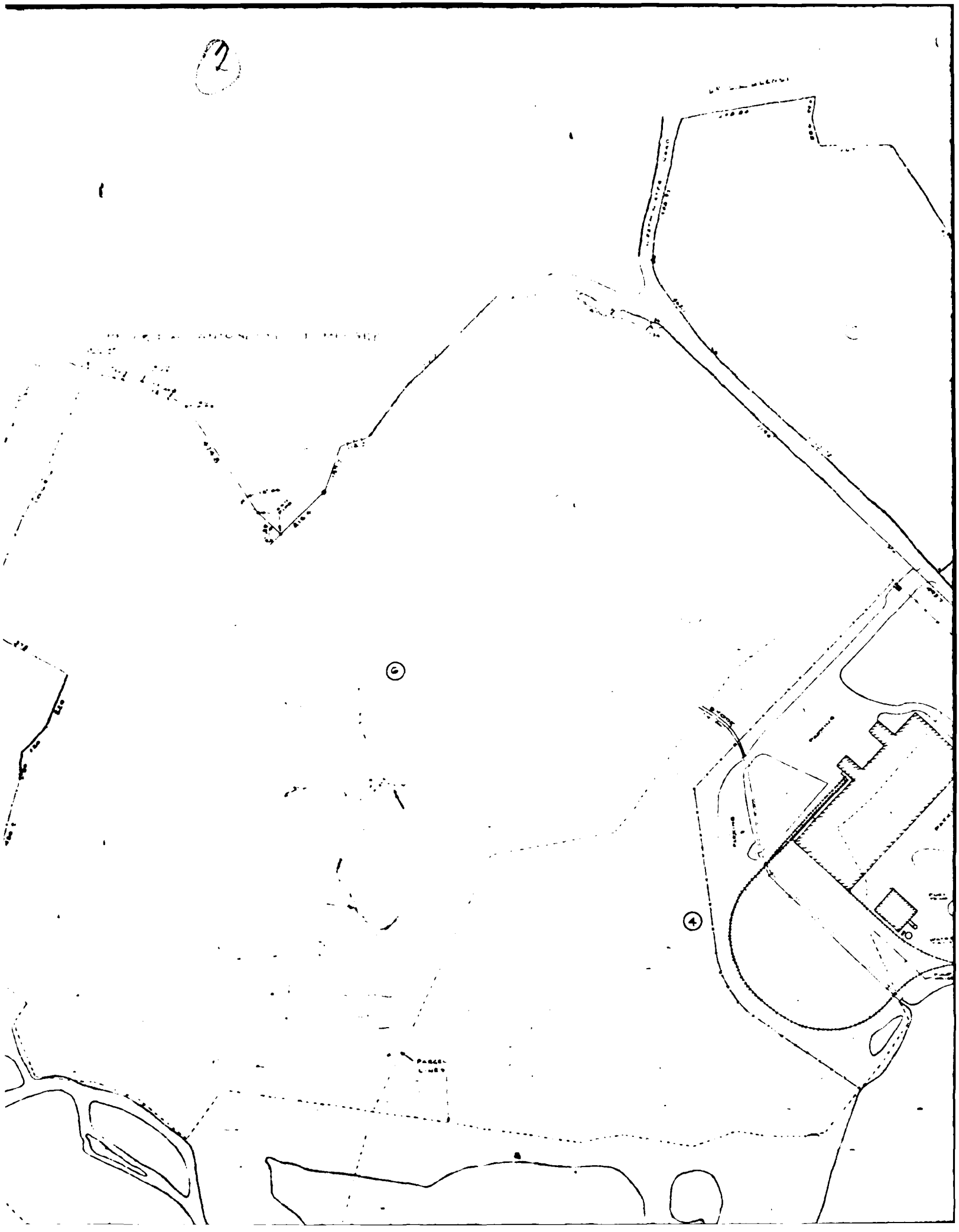
Summary of File Data

Remarks

B-1

Would Failure Cause Damage? [illegible]


FLOYD C HARWOOD
FLOYD C HARWOOD
PETER I AND ANTOINETTE T. MELGEY
LITTLE RIVER
5
ROAD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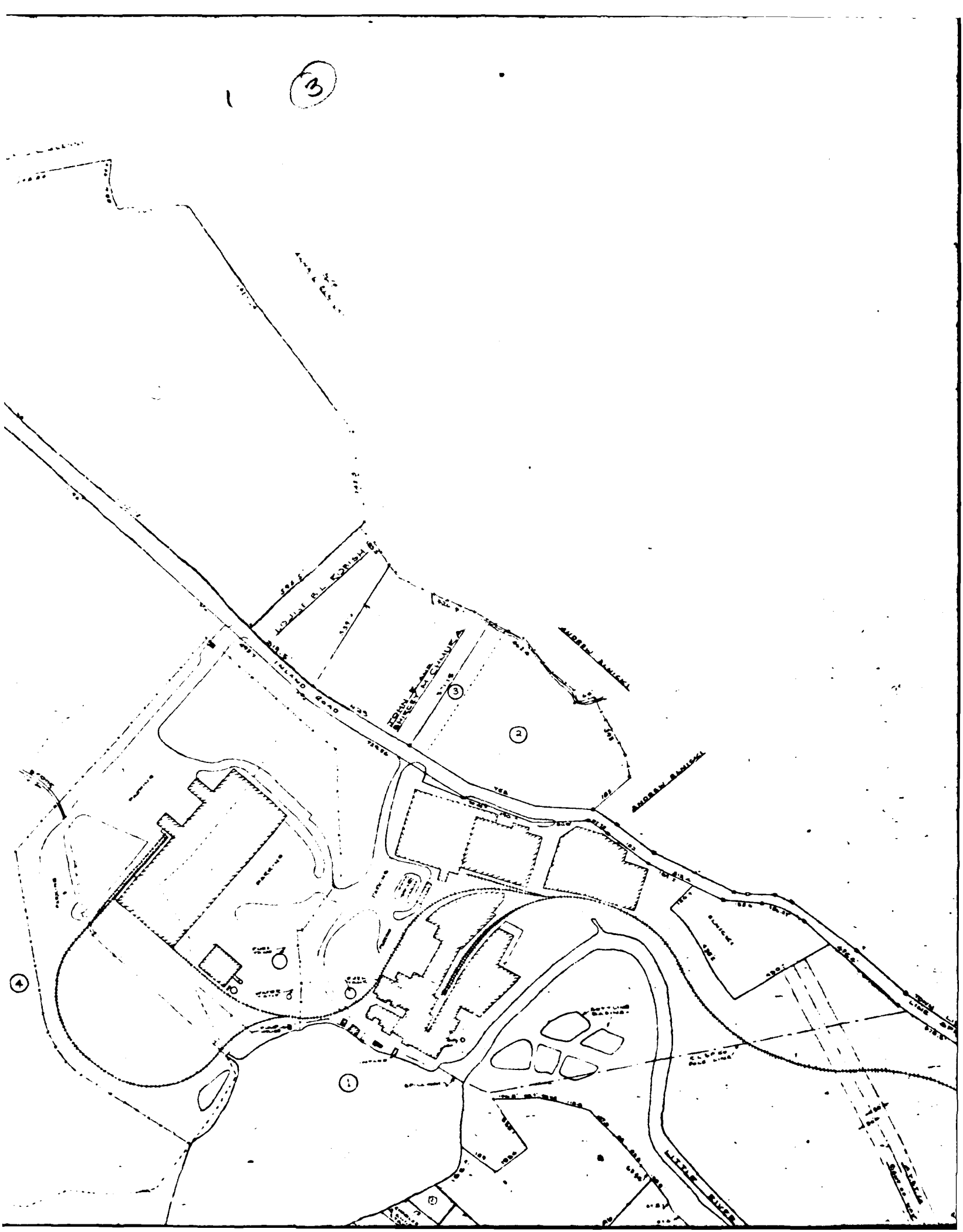
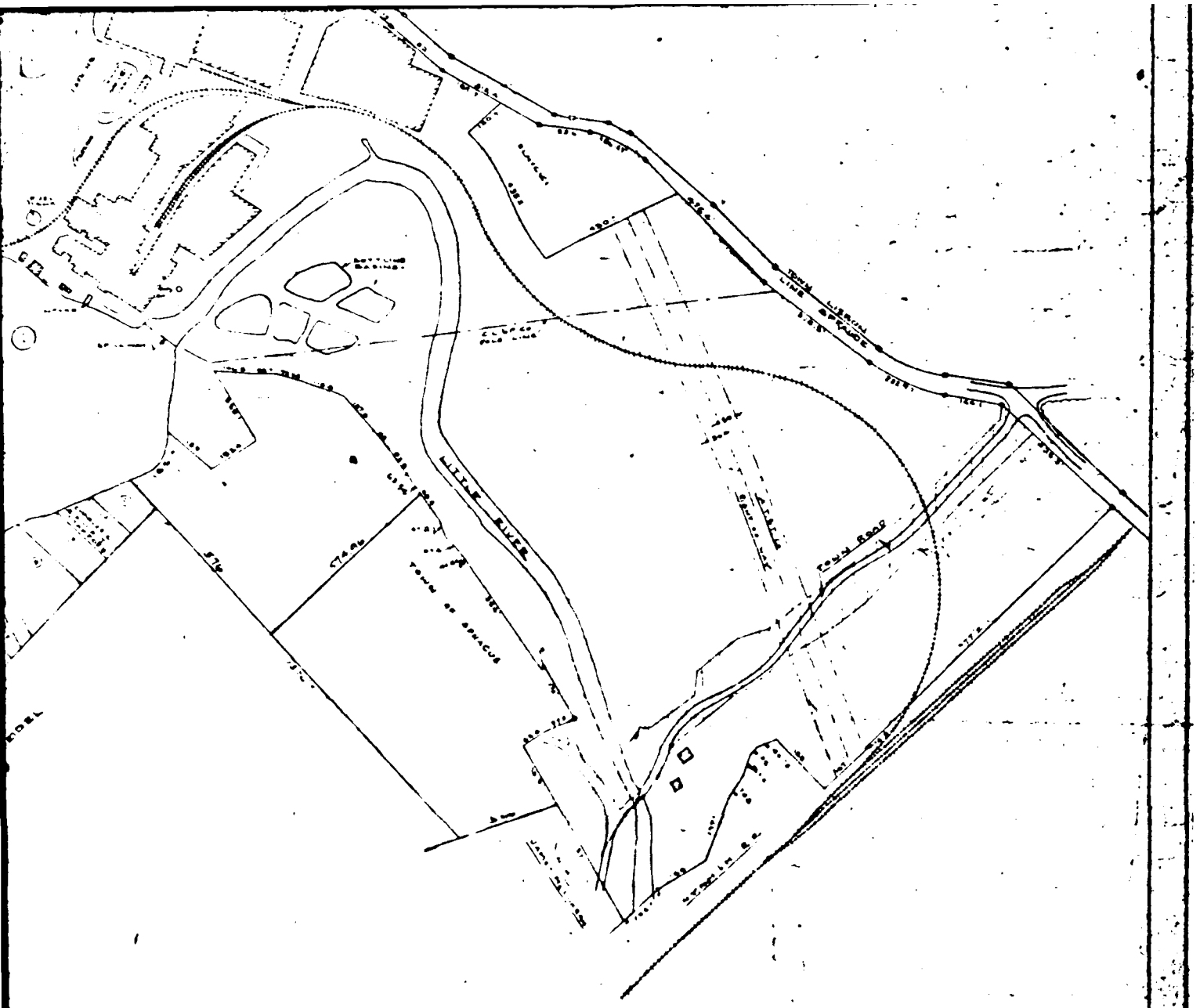

1
3
INLAND ROAD
AUBURN RAILROAD
AUBURN RAILROAD
1
2
3
4



PLAN OF PROPERTY OF

FEDERAL PAPER BOARD COMPANY, INC.

IN THE

TOWNS OF SPRAGUE AND LISBON, CONNECTICUT

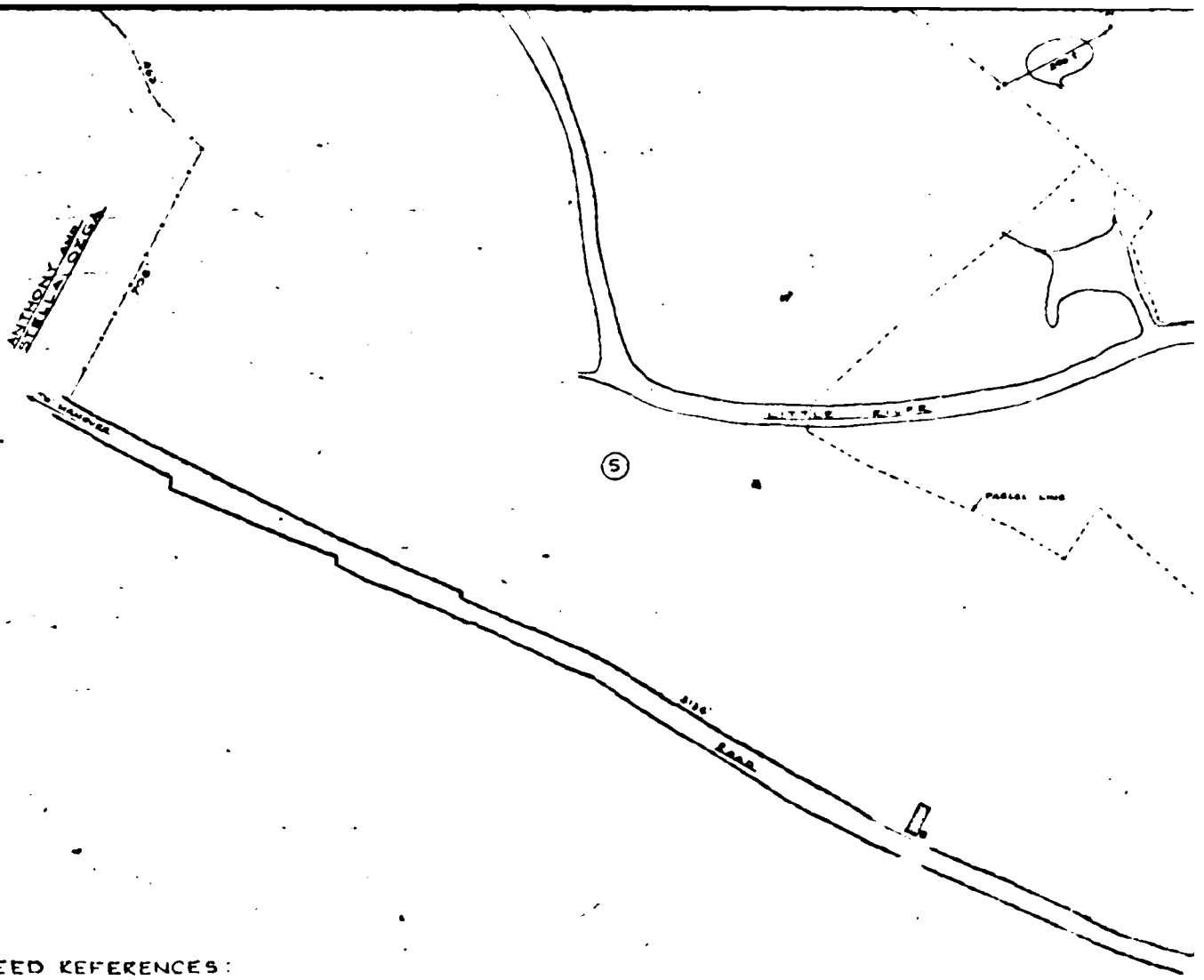
SCALE: 1" = 200 FEET

CHANDLER & PALMER, ENGRS. NORWICH, CONNECTICUT

NOVEMBER 1963

ADDITIONS DEC. 19, 1968
DEC. 23, 1969

B-2



DEED REFERENCES:

(1) CERTIFICATE OF MERGER, FEDERAL PAPER BOARD COMPANY, INC TO MERGE INLAND PAPER BOARD COMPANY, INC.
S L R VOL 13 PG 35 36 MARCH 18 1963

(2) LOUISE BREED ROBISH TO FEDERAL PAPER BOARD COMPANY, INC
L L R VOL 21 PG 285 OCTOBER 24, 1956

(3) LOUISE BREED ROBISH TO FEDERAL PAPER BOARD COMPANY, INC.
L L R VOL 21 PG 295 JANUARY 7, 1957

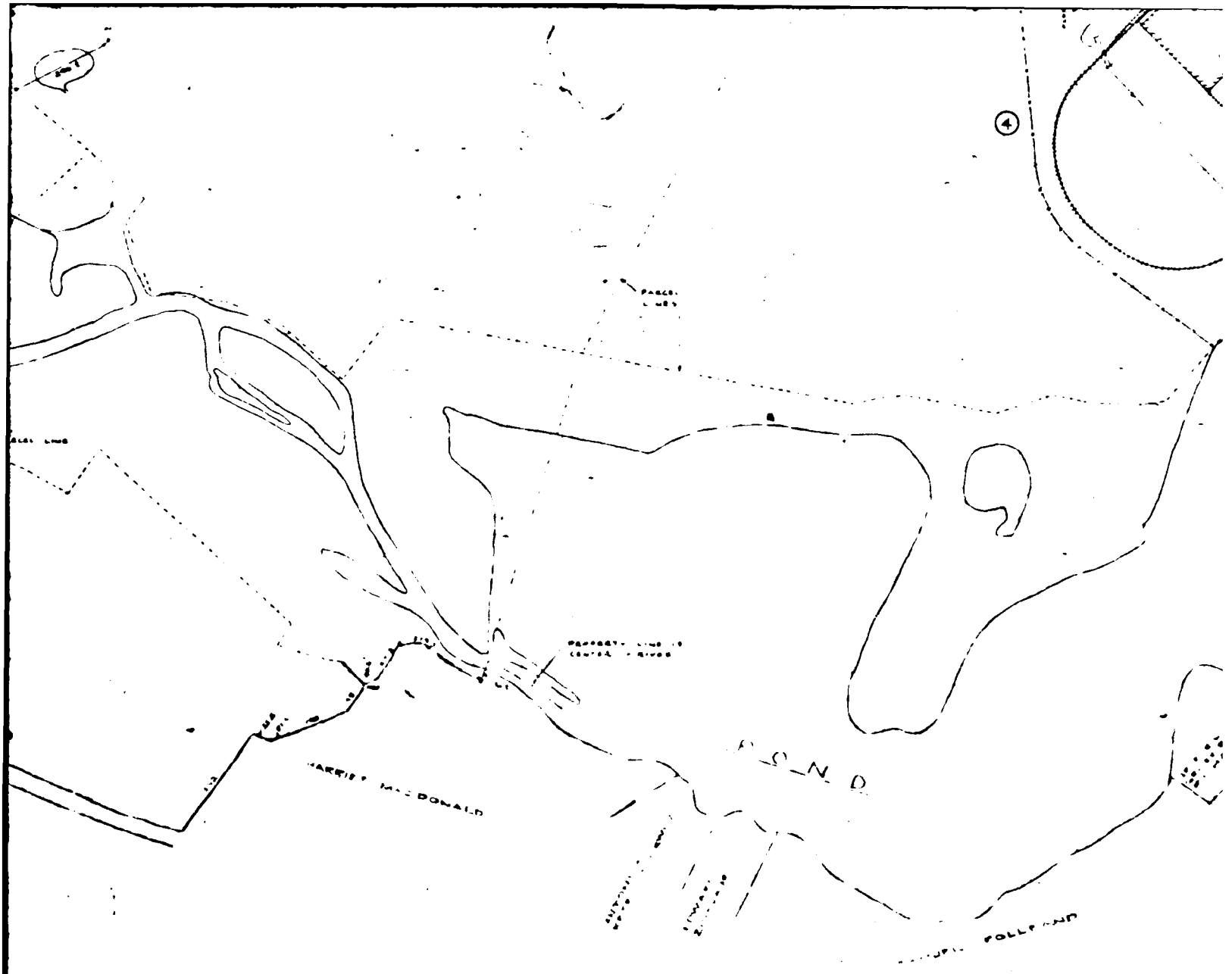
(4) PAUL ARPIN TO FEDERAL PAPER BOARD COMPANY, INC.
S L R VOL 15 PG 275 NOVEMBER 4, 1960

(5) EST OF WALTER MICHAELSON TO FEDERAL PAPER BOARD COMPANY, INC.
S L R VOL 18 PG 337 APRIL 16, 1961

(6) LOUISE B L ROBISH TO FEDERAL PAPER BOARD COMPANY, INC.
SLR VOL 19 PG 9 11 SEPTEMBER 7, 1962

(7) LOUISE B L ROBISH TO FEDERAL PAPER BOARD COMPANY, INC.
L L R VOL 23, PG 443 444 SEPTEMBER 18, 1962

(5)



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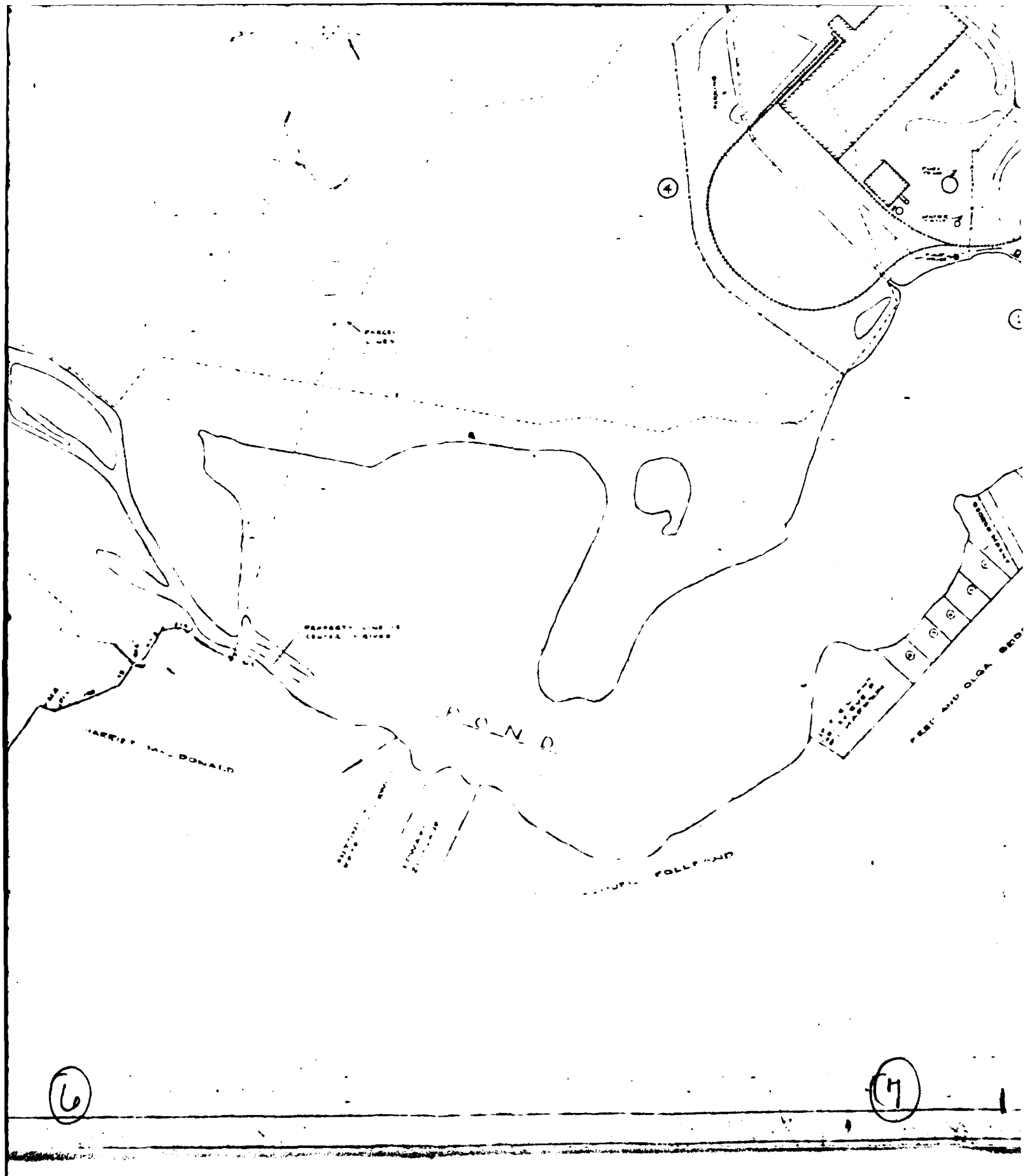
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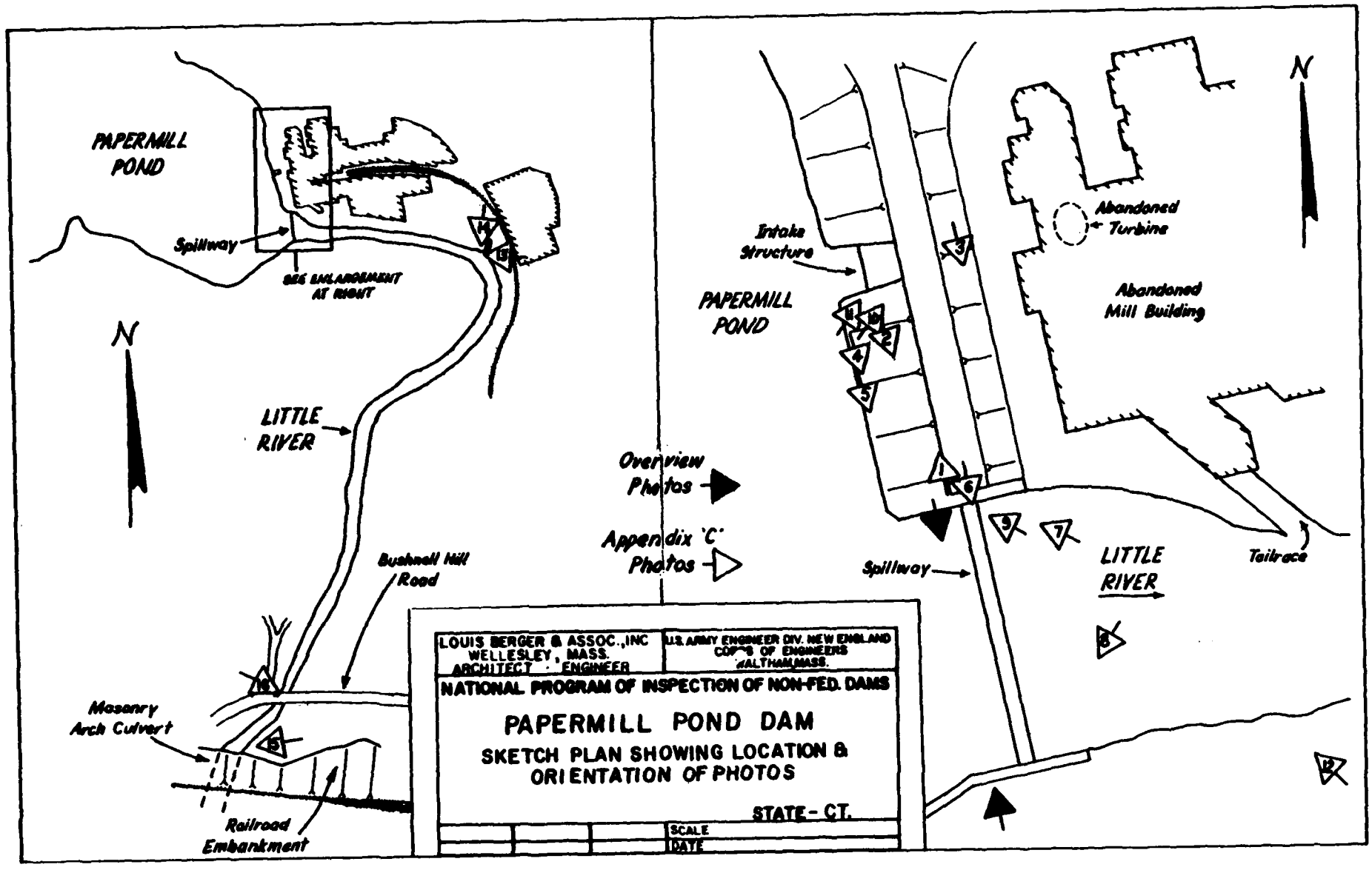
APPENDIX C

PHOTOGRAPHS

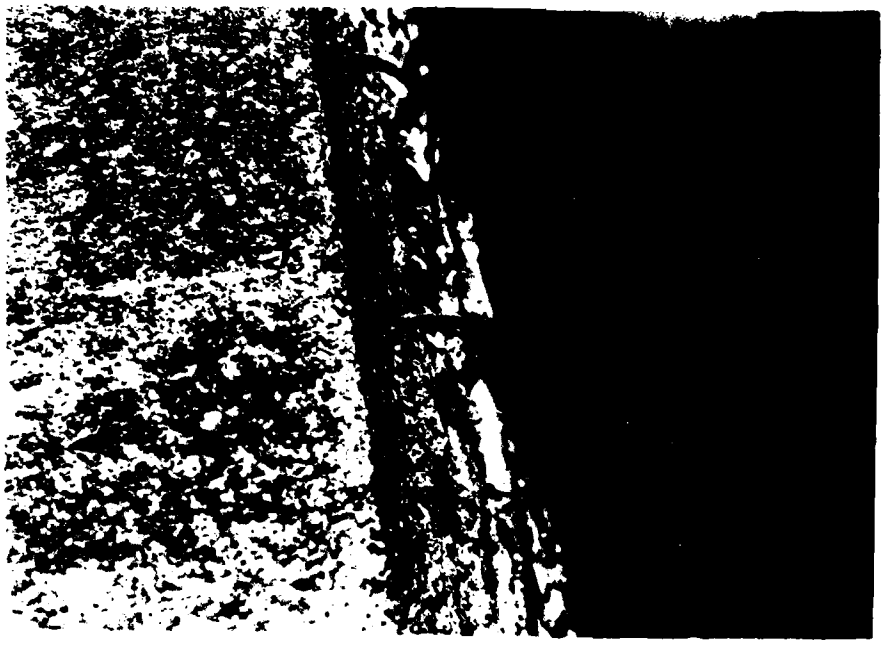

PAPERMILL POND
Spillway
SEE ENLARGEMENT AT RIGHT
N
LITTLE RIVER
Bushnell Hill Road
Masonry Arch Culvert
Railroad Embankment
Overview Photos
Appendix 'C' Photos
Intake Structure
PAPERMILL POND
Abandoned Turbine
Abandoned Mill Building
N
Spillway
LITTLE RIVER
Tailrace
LOUIS BERGER & ASSOC., INC
WELLESLEY, MASS.
ARCHITECT - ENGINEER
U.S. ARMY ENGINEER DIV. NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
PAPERMILL POND DAM
SKETCH PLAN SHOWING LOCATION & ORIENTATION OF PHOTOS
STATE - CT.
SCALE
DATE

1. Upstream face and crest of left embankment

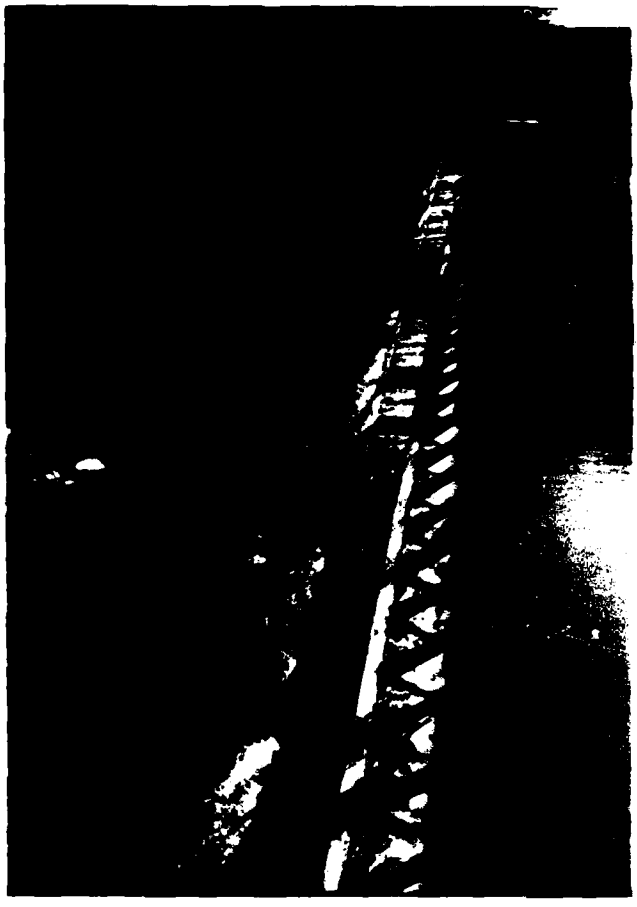
2. Concrete apron on upstream face of left embankment

3. Brush growth on downstream slope of left embankment

4. Reinforcing steel along upstream vertical rubble masonry face.



5. Detail of reinforcing steel vertical rubble masonry wall

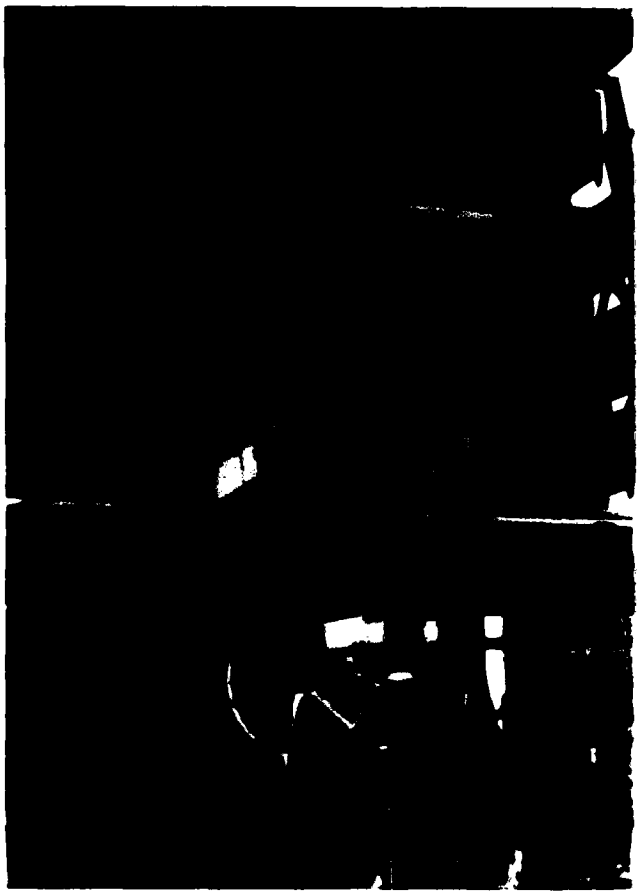


6. Spillway crest with flashboards.

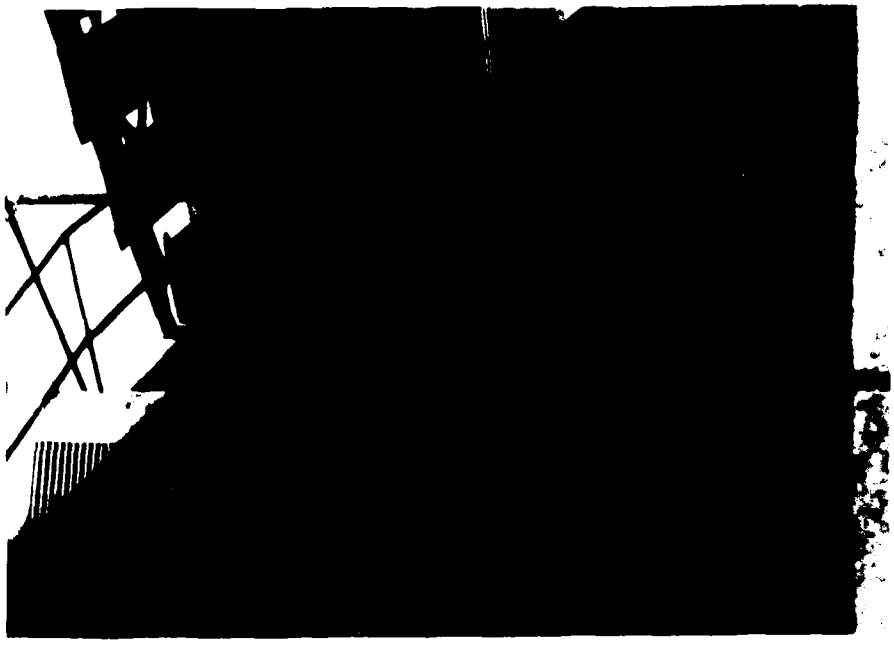
7. Left downstream rubble masonry training wall

8. Right downstream rubble masonry training wall

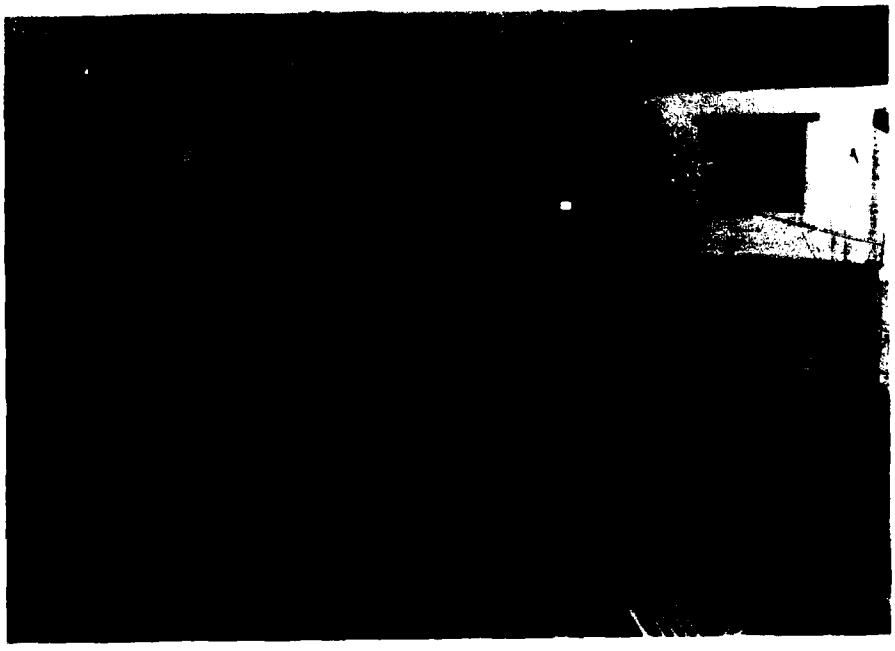
9. Missing mortar from joints of left downstream rubble masonry training wall



10. Rack and pinion sluice gate at inlet structure



11. Trashrack and sluice gate



12. Tailrace outlet from abandoned turbine

13. Downstream channel at bend in river looking upstream towards dam

14. Downstream channel at bend in river looking downstream

15. Masonry arch culvert carrying the Little River under the railroad embankment

16. Bushnell Hill Road Bridge over the Little River

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

BY JKH DATE 4/5/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF ...
CHKD. BY ... DATE ... INSPECTION OF DAMS - CONN & RI PROJECT ...
SUBJECT PAPERMILL POND - DRAINAGE AREA

FIND: ENTIRE AREA ABOVE POND

PLANIMETER No 3651 - ?
INDEX @ 89.9
1.0 = 1 sq in

U.S.G.S. Sheet	Ave Reading (sq in.)
Norwich, Conn.	3.90
Scotland, Conn.	(14.4 x 4.7) + 9.30 + 4.84 + 10.7 + 37.89 = 130.48
Hampton, Conn.	26.54 + 38.57 + 15.07 + 16.70 + 26.70 = 123.58

Total = 257.96

Scale $(1")^2 = (2{,}000')^2$ 4,000,000 sq ft/sq in.

$$\text{Area} = \frac{257.96 \text{ sq in} \times 4 \times 10^6 \text{ sq ft/sq in}}{43{,}560 \text{ sq ft/Acre}} = \boxed{23{,}687.79 \text{ Acres}}$$

$$23{,}687.79 \text{ Acres} \div 640 \text{ Acres/sq in} = \boxed{37.01 \text{ sq mi}}$$

BY RFB DATE 11-21-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF
CHKD. BY DATE INSPECTION OF DAMS PROJECT
SUBJECT PAPER MILL POND DAM, CAPACITY CURVES

AREA AT NORMAL POOL ELEV 111.0

READ #2 15.99 READ #3 16.56 AVE = 0.56 IN²
" #1 15.43 " #2 15.99 AREA = 51.4 ACRES
.56 .57

AREA AT ELEV. 120.0 (ASSUMING WATER GOES THROUGH SWALE SOUTH OF POND)

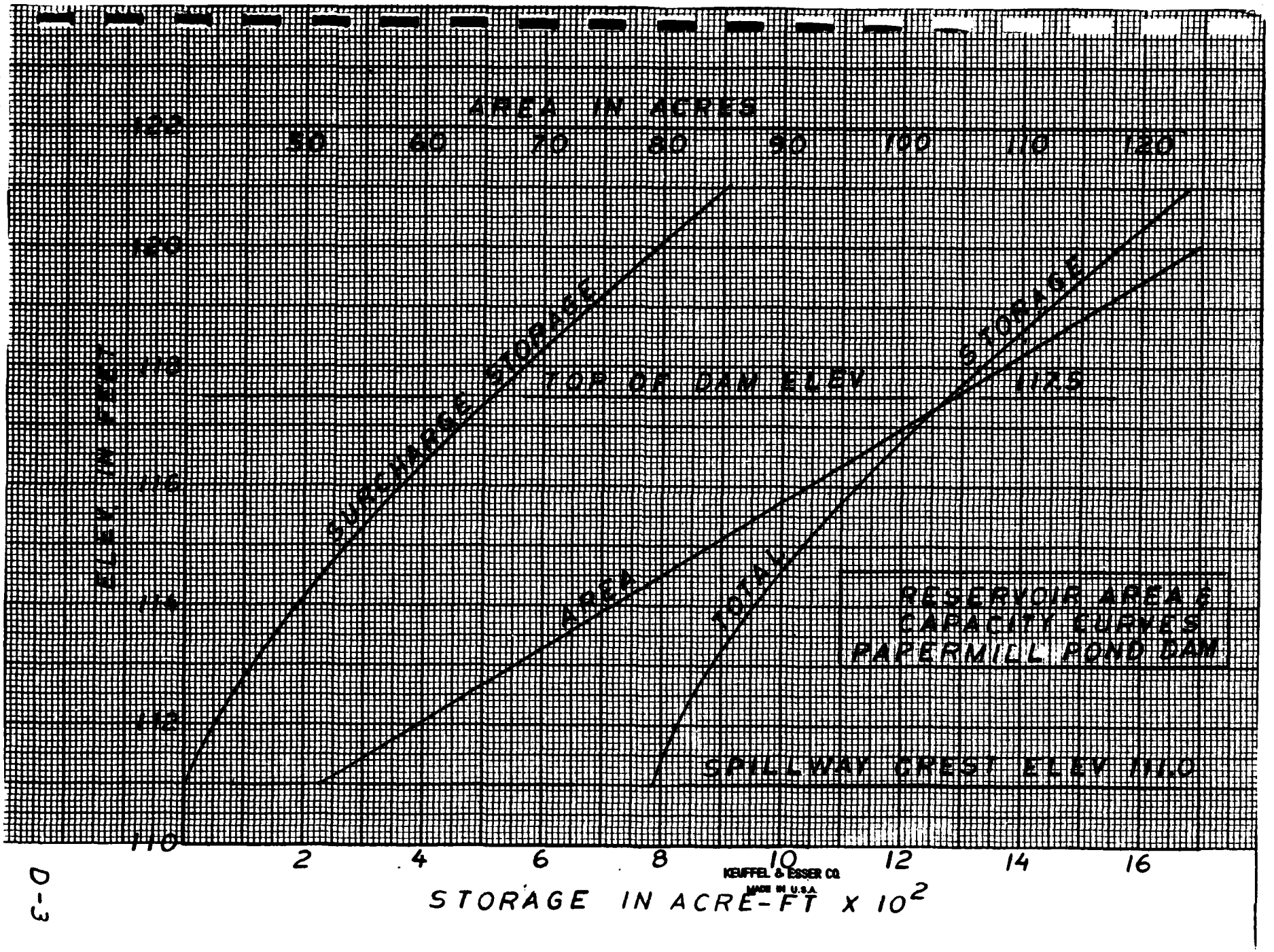
READ #2 18.12 READ #3 19.75 AVE = 1.64 IN²
" #1 16.46 " #2 18.12 AREA = 149.7 ACRES
1.66 1.63

AREA AT ELEV 120 (ASSUMING WATER DOES NOT PASS THROUGH SWALE)

READ #2 26.40 READ #3 27.76 AVE = 1.36 IN²
" #1 25.04 " #2 26.40 AREA = 124.9 ACRES
1.36 1.36

ELEV. FT	AREA ACRES	AVE. AREA	ΔH	Δ STOR	TOTAL STORAGE	SURCHARGE STORAGE
111	51.4				766	
112	59.6	55.5	1	55.5	822	56
113	67.7	63.6	1	63.6	885	119
114	75.9	71.8	1	71.8	957	191
115	84.1	80.0	1	80.0	1037	271
116	92.2	88.2	1	88.2	1125	359
117	100.4	96.3	1	96.3	1221	455
118	108.6	104.5	1	104.5	1326	560
119	116.7	112.6	1	112.6	1438	672
120	124.9	120.8	1	120.8	1559	793

STORAGE @ ELEV 111 = (51.4)(29.8)/2 = 766 ACRE-FT

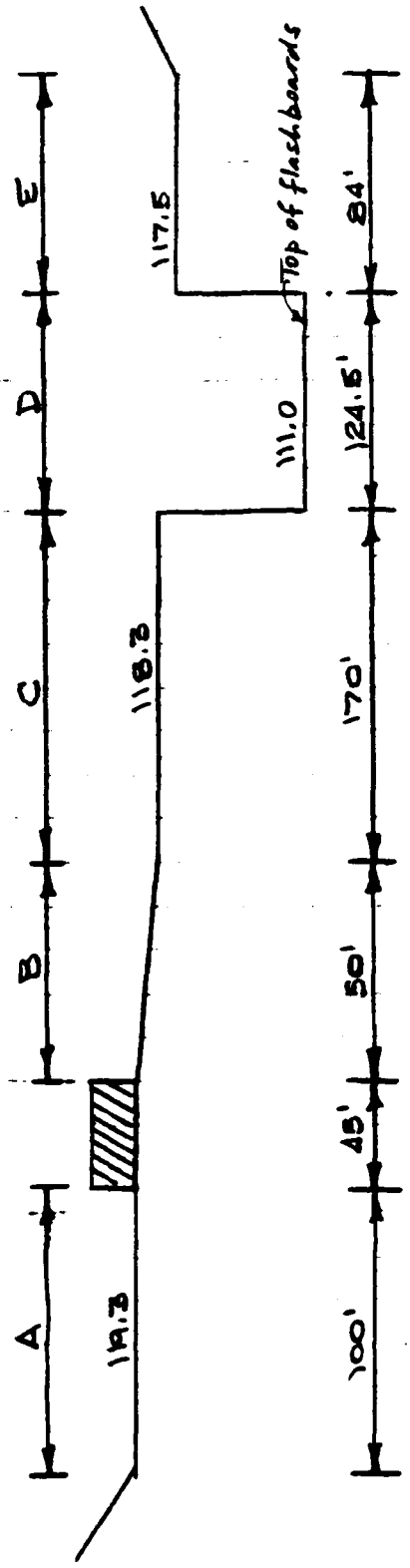

AREA IN ACRES
50
60
70
80
90
100
110
120
140
ELEVATION IN FEET
110
112
114
116
118
TOP OF DAM ELEV 118.5
SPILLWAY CREST ELEV 111.0
RESERVOIR AREA & CAPACITY CURVES
PARERMILL POND DAM
2
4
6
8
10
12
14
16
KEUFFEL & ESSER CO.
MADE IN U.S.A.
STORAGE IN ACRE-FT X 10²

D-3

BY RFB DATE 11-21-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT PAPERMILL POND DAM, DISCHARGE CAPACITY



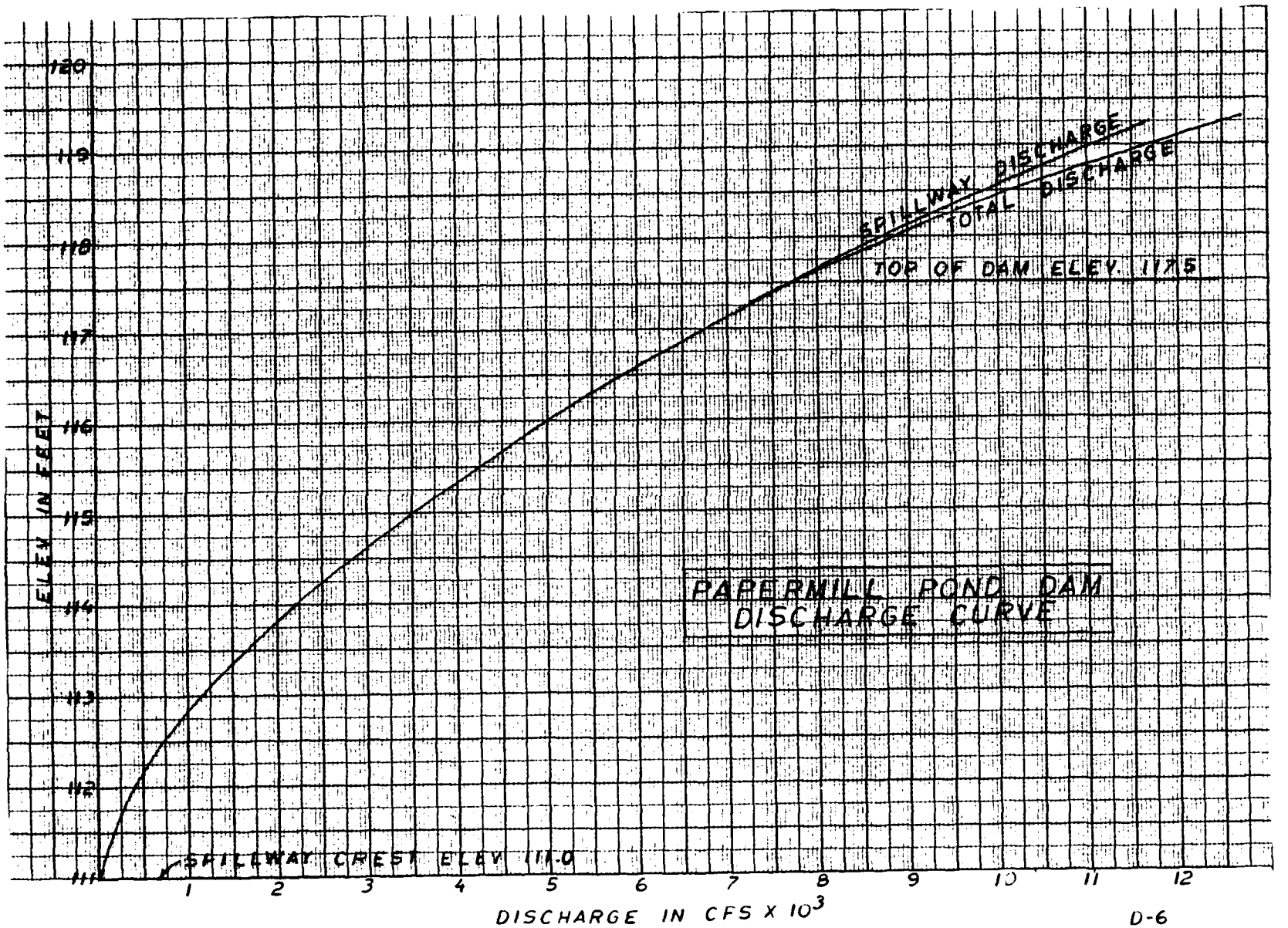
Elev Ft	A, C=2.6 L	A, C=2.6 H	A, C=2.6 Q	B, C=2.7 L	B, C=2.7 H	B, C=2.7 Q	C, C=2.7 L	C, C=2.7 H	C, C=2.7 Q	D, C varies L	D, C varies H	D, C varies C	D, C varies Q
111	100	0	0	50	0	0	170	0		124.5	0	3.2	398
112		0	0		0	0		0			1	3.3	1162
113		0	0		0	0		0			2	3.4	2200
114		0	0		0	0		0			3	3.5	3486
115		0	0		0	0		0			4	3.6	5011
116		0	0		0	0		0			5	3.75	7737
117.5		0	0		0	0		0			6.5	3.8	8762
118.1		0	0		0	0		0			7	3.83	9405
118.3		0	0		0	0		0	459		7.3	3.93	11700
119.3		.7	152		.5	48		1	1017		8.3	4.0	13446
120		1.7	576	50	1.2	177	170	1.7	2036	124.5	9	4.1	16142
121	100				2.2	440		2.7			10		

BY REB DATE 11-21-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT PAPERMILL POND DAM - DISCHARGE CAPACITY

ELEV	E, C = 2.5			TOTAL
FT	L	H	Q	Q
111	84	0	0	0
112		0	0	400
113		0	0	1160
114		0	0	2200
115		0	0	3490
116		0	0	5010
117.5		0	0	7740
118		.5	74	8840
118.3		.8	150	9560
119.3		1.8	507	12710
120		2.5	830	15620
121	84	3.5	1375	20570


120
119
118
117
116
115
114
113
112
111
ELEV IN FEET
SPILLWAY DISCHARGE
TOTAL DISCHARGE
TOP OF DAM ELEV. 117.5
PAPERMILL POND DAM
DISCHARGE CURVE
SPILLWAY CREST ELEV 111.0
1
2
3
4
5
6
7
8
9
10
11
12
DISCHARGE IN CFS X 10^3

BY RFB DATE 9-11-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF ...
CHKD. BY ... DATE ... INSPECTION OF DAMS PROJECT ...
SUBJECT PAPER MILL POND, INFLOW HYDROGRAPH

DRAINAGE AREA (TOTAL) = 37.01 SQ. MI

BY INSPECTION WATER SURFACE < 25% OF TOTAL

NOW LENGTH OF LONGEST WATER COURSE, L = 98,000

L = 18.56 MI

Δ ELEV DIFFERENCE = 730 - 111 = 619 FT

$\therefore$ SLOPE = $\frac{619}{18.56}$ = 33.35 FT/MI & $\sqrt{S}$ = 5.78

Now $\frac{L L_c}{\sqrt{S}} = \frac{(18.56)(18.56)}{2(5.78)} = 29.80$

$\left(\frac{L L_c}{\sqrt{S}}\right)^{0.33} = (29.80)^{0.33} = 3.07$

LAG = $K\left(\frac{L L_c}{\sqrt{S}}\right)^{0.33} = 3.07\,K$

ASSUME K = 5.0 HRS (REFER TO "CURVE B", MOUNTAINOUS REGION, MIXED TERRAIN, B OF REC

LAG = 5.0 (3.07) = 15.35 HRS

$T_p = 0.41D + 0.82\,LAG$, D = 1.0 HRS

$T_p = 0.41(1) + 0.82(15.35)$

$T_p = 0.41 + 12.59 = 13$ HRS

CHECK VELOCITY $T_c = \frac{T_p - .5D}{0.6} = 20.8$

$V = \frac{L}{T_c(3600)} = \frac{98,000}{(20.8)(3600)} = 1.31$ FT/SEC

0.1K

$T_R = 1.67\ T_p = 1.67(13) = 21.71$ HRS

$T_B = T_p + T_R = 13 + 21.71 = 34.71$ HRS

---

q_p = PEAK RATE IN CFS

$$q_p = \frac{484\ A\ Q}{T_p}$$

A = DRAINAGE AREA
Q = RUNOFF IN INCHS

$$q_p = \frac{484\ (37.01)(1)}{13} = 1378 \text{ CFS}$$

PMP = PROBABLE MAXIMUM PRECIPITATION

IS 24" FOR CONNECTICUT

DEPTH - AREA - DURATION RELATIONSHIP (FIG 16 DESIGN OF SMALL DAMS) IS 86% FOR D.A = 37 SQ MI

86% OF 24" = 20.64"

FIT FACTOR REDUCTION = 14.44% FOR D.A = 37 SQ MI

(100 - 14.44)% OF 20.64" = 17.7"

LESS 0.4 INCHS FOR INFILTRATION

MAXIMUM RUNOFF = 17.3"

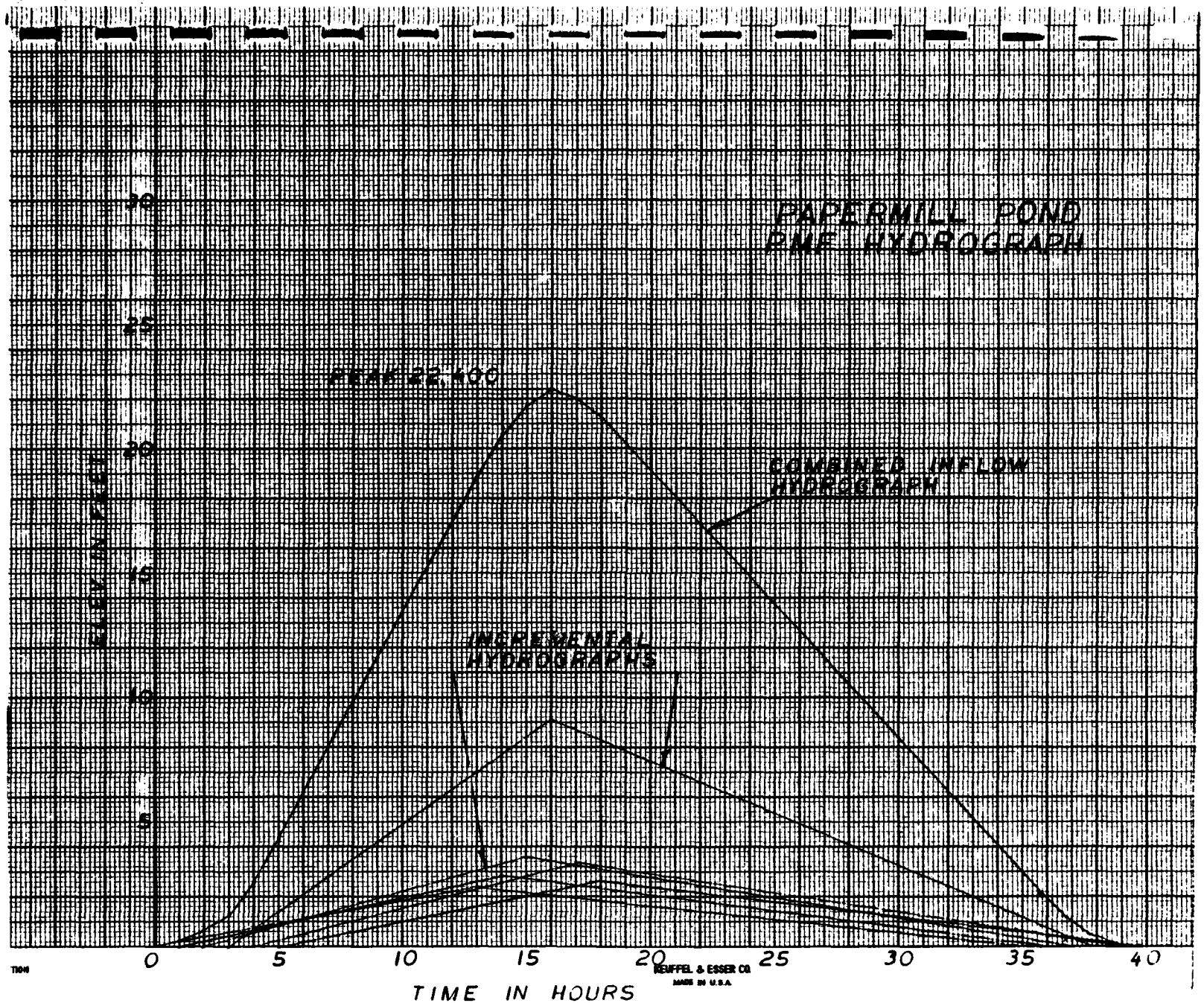
BY RFB DATE 9-11-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 3 OF ...
CHKD. BY ... DATE ... INSPECTION OF DAMS PROJECT ...
SUBJECT PAPER MILL POND, INDIAN HYDROGRAPHS

FLOOD HYDROGRAPH FOR PMF

$q_p = 1378$

TIME HOURS	RAINFALL %	RAINFALL INCHS	Q_p CFS	TIME BEGIN	TIME PEAK	TIME END
0.0	-	-				
1.0	10	1.73	2384	0	13	34.7
2.0	12	2.08	2866	1.0	14	35.7
3.0	15	2.60	3583	2.0	15	36.7
4.0	38	6.37	9054	3.0	16	37.7
5.0	14	2.42	3335	4.0	17	38.7
6.0	11	1.90	2618	5.0	18	39.7

* DISTRIBUTION OF MAXIMUM 6 HOUR SPS OR PMP IN PERCENT OF 6 HOUR AMOUNT PER EM 110-2-1411


PAPER MILL POND
PMF HYDROGRAPH
PEAK = 22,400
COMBINED INFLOW HYDROGRAPH
INCREMENTAL HYDROGRAPHS
30
25
20
15
10
5
0
5
10
15
20
25
30
35
40
TIME IN HOURS
KEUFFEL & ESSER CO.
MADE IN U.S.A.

BY RFB DATE 11-23-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF
CHKD. BY DATE INSPECTION OF DAMS PROJECT
SUBJECT PAPERMILL POND DAM, RESERVOIR ROUTING

ROUTE ½ PMF, DRAINAGE AREA = 37.01 SQ MI = 23,687 ACRES

STEP 1 Q_{p_1} = 11,200 CFS

STEP 2 a SURCHARGE HEIGHT = 118.85 FT

b. VOLUME OF SURCHARGE = 660 ACRE-FT

$$STOR_1 = \frac{660 \text{ ACRE FT}}{23{,}687 \text{ ACRES}} \times 12 \text{ IN/FT} = 0.33 \text{ INCHS}$$

c. $$Q_{p_2} = Q_{p_1} \times \left(1 - \frac{0.33}{9.5}\right)$$

$$= 11{,}200 \left(1 - \frac{0.33}{9.5}\right)$$

$$= 10{,}811 \text{ CFS}$$

STEP 3

a SURCHARGE HT, Q_{p_2} = 118.72 FT

b. VOLUME OF SURCHARGE = 650 ACRE-FT

$$STOR_2 = \frac{650 \text{ ACRE FT}}{23{,}687 \text{ ACRE-FT}} \times 12 \text{ IN/FT} = 0.33 \text{ INCHS}$$

BY INSPECTION Q_{p_3} = 10,811, SAY 10,800 CFS

FROM RATING CURVE STAGE = 118.72 FT

SPILLWAY INADEQUATE TO PASS ½ PMF

RIGHT ABUTMENT OVERTOPPED BY 1.22 FT
LEFT DIKE OVERTOPPED BY 0.42 FT

BY RFB DATE 11-23-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 1 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT PAPERMILL POND DAM, FAILURE ANALYSIS

ASSUME DAM FAILS WHEN WATER LEVEL IS AT TOP OF RIGHT ABUTMENT ELEV 117.5.

STORAGE @ ELEV 117.5 FT, S = 1275 ACRE FT

ASSUME LENGTH TO FAIL IS 100% OF TOTAL LENGTH OF RIGHT ABUTMENT & SPILLWAY

$W = 100\%$ OF $(84 + 124.5) \cong 208.5$

$H = Y_o = 29.8$ FT

$Q_{P_1} = 8/27\ W \sqrt{g}\ Y_o^{3/2}$

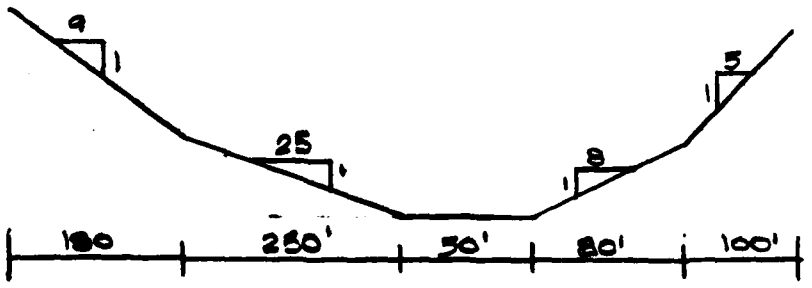
$Q_{P_1} = 1.68(208)(29.8)^{3/2} = 56{,}845$

$Q_{SPILLWAY} = 7{,}750$ CFS,

TOTAL $Q_{P_1} = 56{,}845$

SAY $Q_{P_1} = 56{,}800$ CFS

REACH 1 DAM TO PENN CENTRAL RR
STA 0+00 TO 32+00



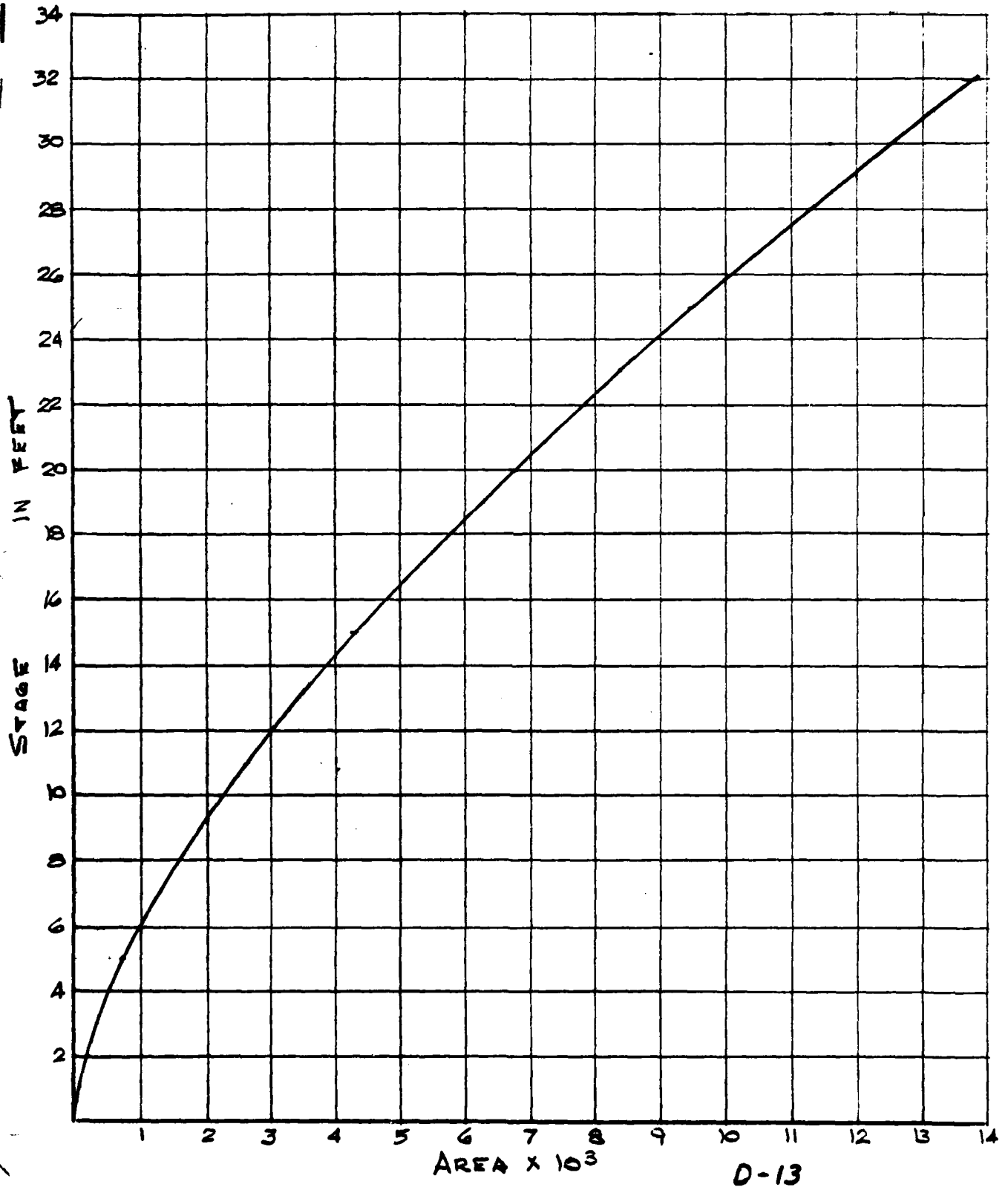
STAGE	AREA
5	662
10	2150
15	4225
20	6650
25	9425
30	12550

FOR VOLUME PURPOSES ONLY

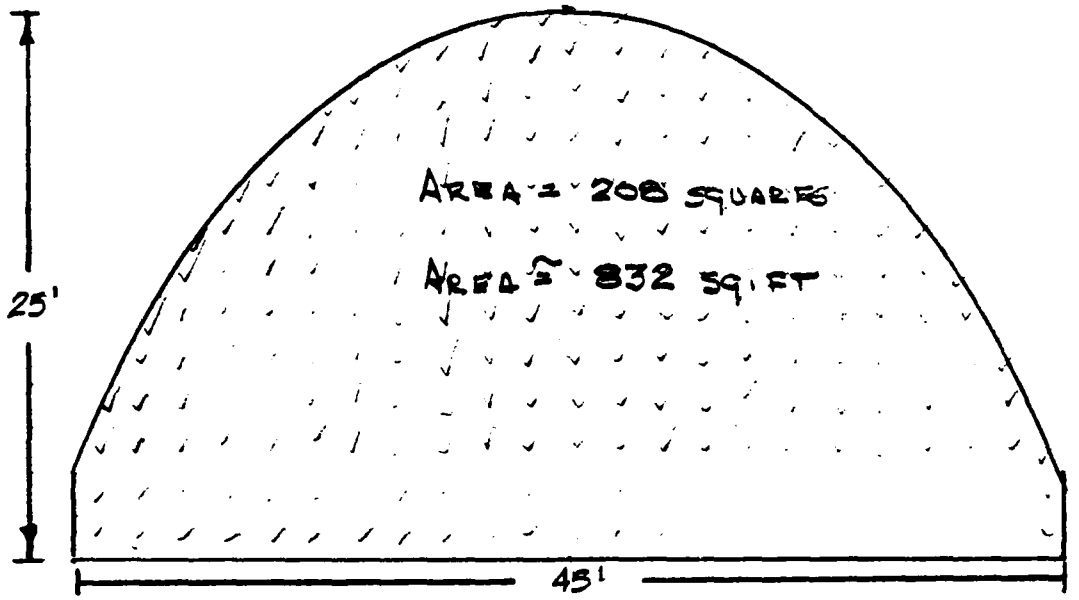
BY RFB DATE 11-23-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 2 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT PAPERMILL POND DAM, FAILURE ANALYSIS



D-13



PENN CENTRAL RR CROSSING, STA 32+00
SCALE 1/4 INCH = 2 FT, 1 SQ = 4 SQ FT

FIND VELOCITY THRU ARCH FOR Q_{P1}

$$V = \frac{56,800}{832} = 68 \text{ FT/SEC} \qquad \frac{V^2}{2g} = 71.8 \text{ FT}$$

NOT POSSIBLE, WATER SURFACE WILL SEEK LEVEL OF RESERVOIR SURFACE

WHAT IS MAXIMUM DISCHARGE THAT CAN BE PASSED THROUGH ARCH, INVERT AT ARCH IS ABOUT 98
MAXIMUM HEAD UPSTREAM OF ARCH = 117.5 - 98 = 29.5
OR SAY $Y_o + 2 = 29.8 + 2 = 31.8$ FT, SAY 32.0 FT

HEIGHT OF WATER - HEIGHT ARCH = $1.5 h_v = 7.0$
WHERE h_v = VELOCITY HEAD

$h_v = \frac{7.0}{1.5} = 4.67 = \frac{V^2}{29}$ ∴ $V = [4.67 \times 2(32.2)]^{1/2}$

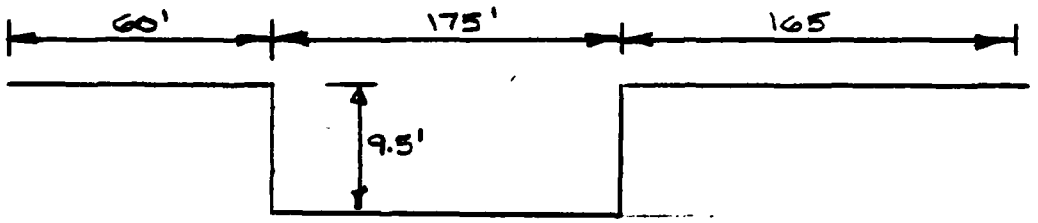
$V = (300.7)^{1/2} = 17.3$ FT/SEC

SAY VELOCITY THROUGH ARCH = 17.3 FT/SEC

$Q_{P2} = VA = 17.3(832) = 14,393$ CFS

REACH 2

WHAT IS STAGE AT VERSAILLES POND DAM FOR $Q_{P2} = 14,400$ CFS



VERSAILLES POND DAM

$Q = CLH^{3/2}$ $H^{3/2} = \frac{Q}{CL} = \frac{14,400 \text{ CFS}}{3.1(175)}$

$H^{3/2} = 26.54$ $H = 8.9$ FT

8.9 FT < 9.5 FT, WILL NOT OVERTOP

FOR $Q_{SPILLWAY}$ $H^{3/2} = \frac{7,750}{3.1(175)}$

$H^{3/2} = 14.28$ $H = 5.9$ FT

$\Delta H = 3.0$ FT

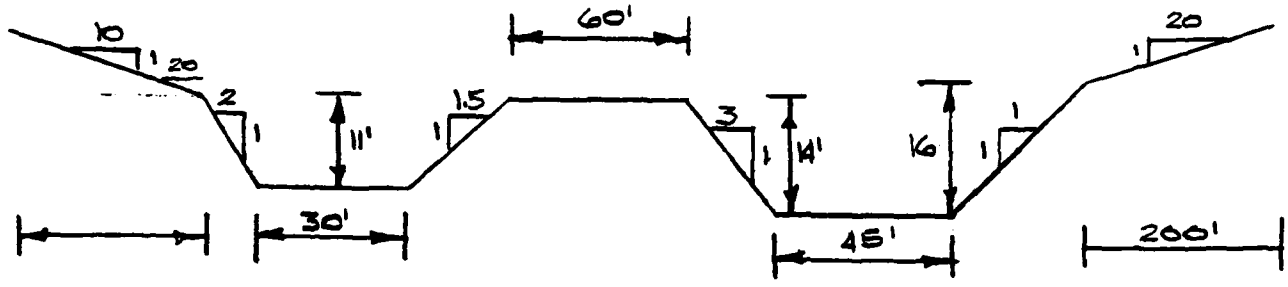
BY RFB DATE 11-23-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. 5 OF

CHKD. BY DATE INSPECTION OF DAMS PROJECT

SUBJECT PAPER MILL POND DAM, FAILURE ANALYSIS

REACH 3, VERSAILLES POND DAM TO SHETUCKET RIVER

$S = \frac{10}{400}$, $S^{1/2} = 0.158$, $n = 0.07$ $Q = 3.35\ AR^{2/3}$

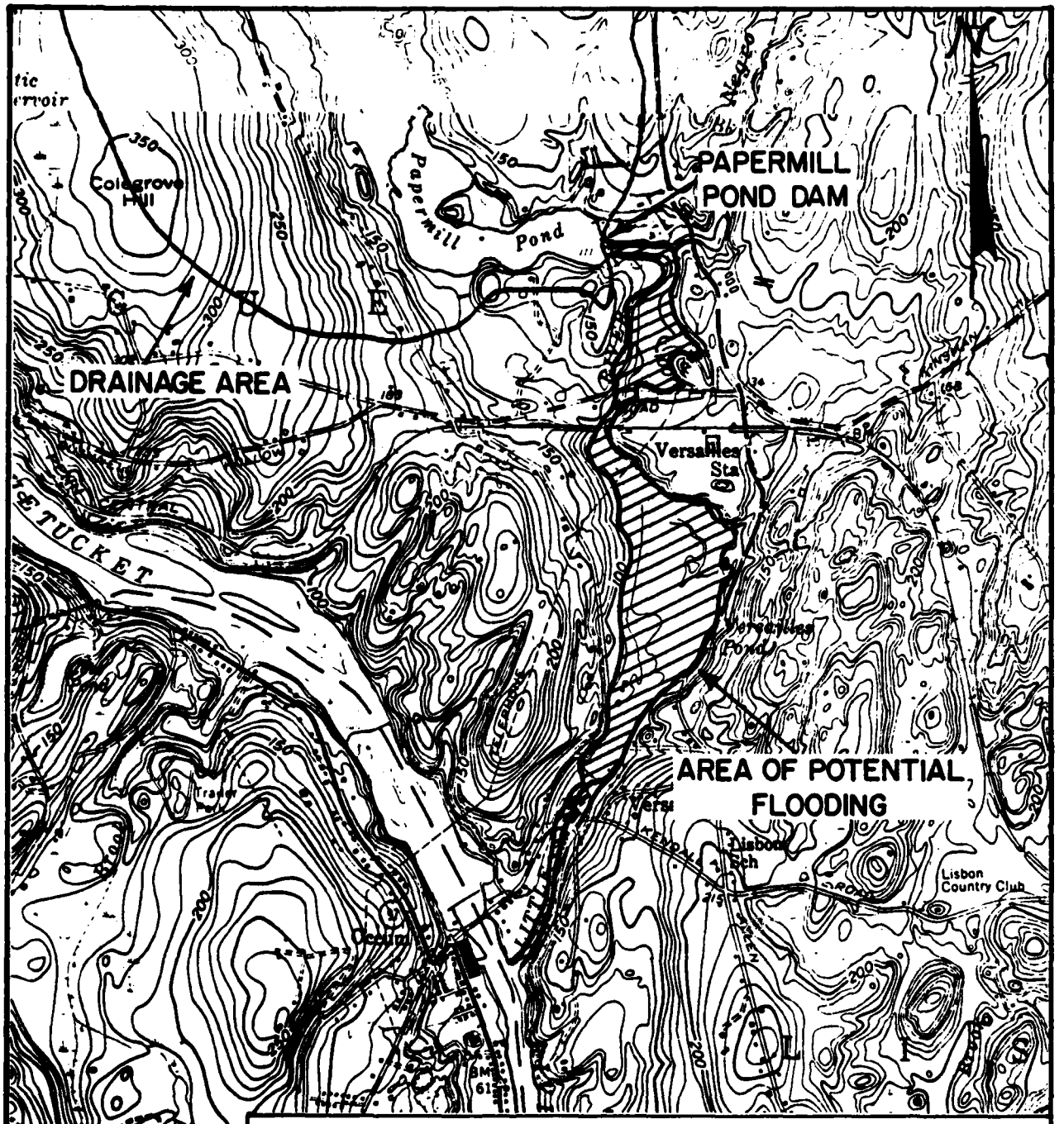


X SECTION JUST BELOW ROADWAY.

STAGE	AREA	P	R	$R^{2/3}$	Q
3	153	58.4	2.62	1.90	974
6	448	113.9	3.93	2.49	3737
10	946	149.0	6.35	3.43	10870
14	1564	183.5	8.52	4.18	21,900
16	2045	286.4	7.14	3.71	25,416
20	3291	367.5	8.96	4.32	47,628

BY INSPECTION BANKS WILL NOT OVERTOP FOR $Q = 14{,}400$ CFS.

DAMAGE IS LIMITED TO REACH # 1



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

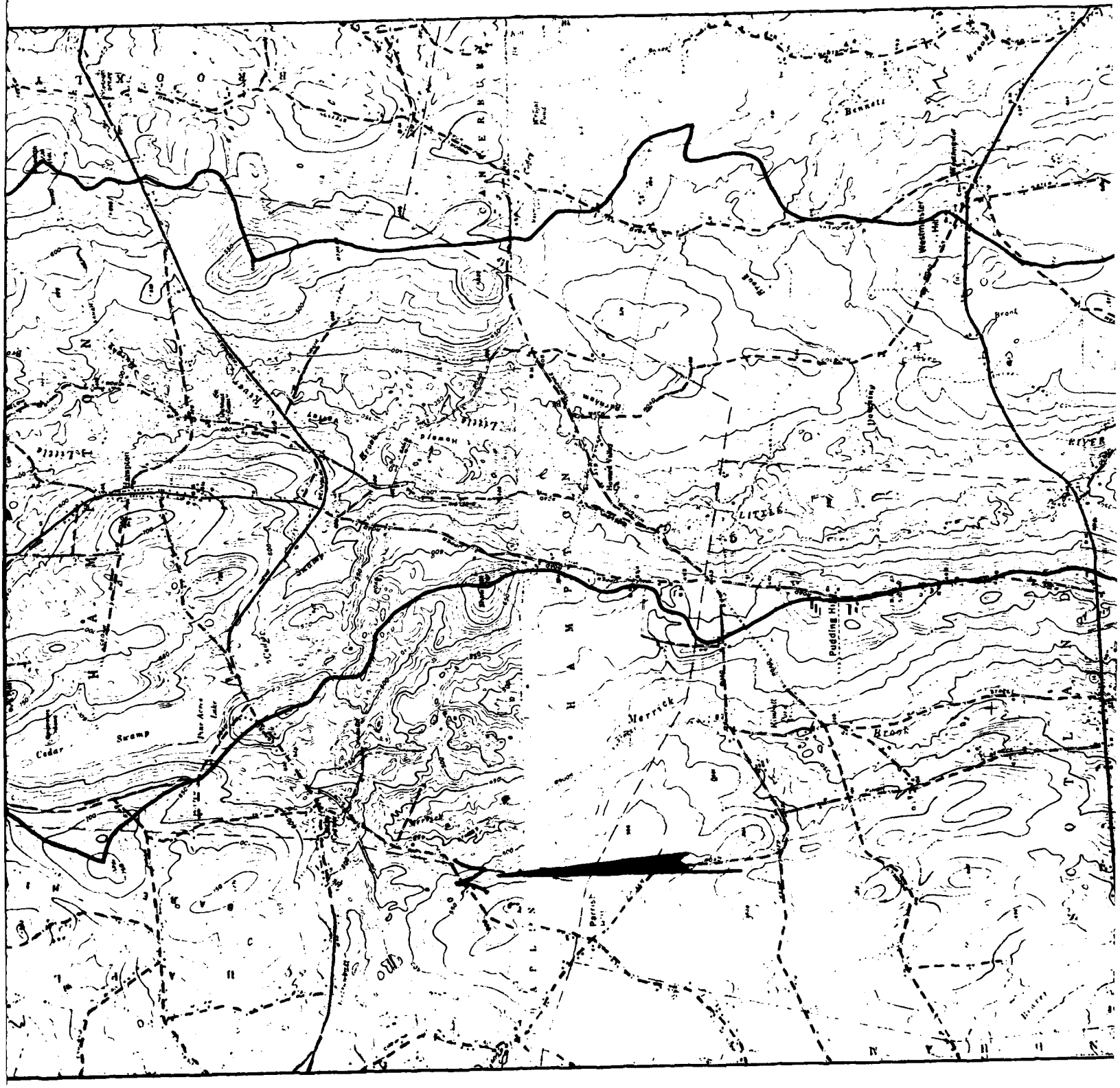
PAPERMILL POND DAM

AREA OF POTENTIAL FLOODING

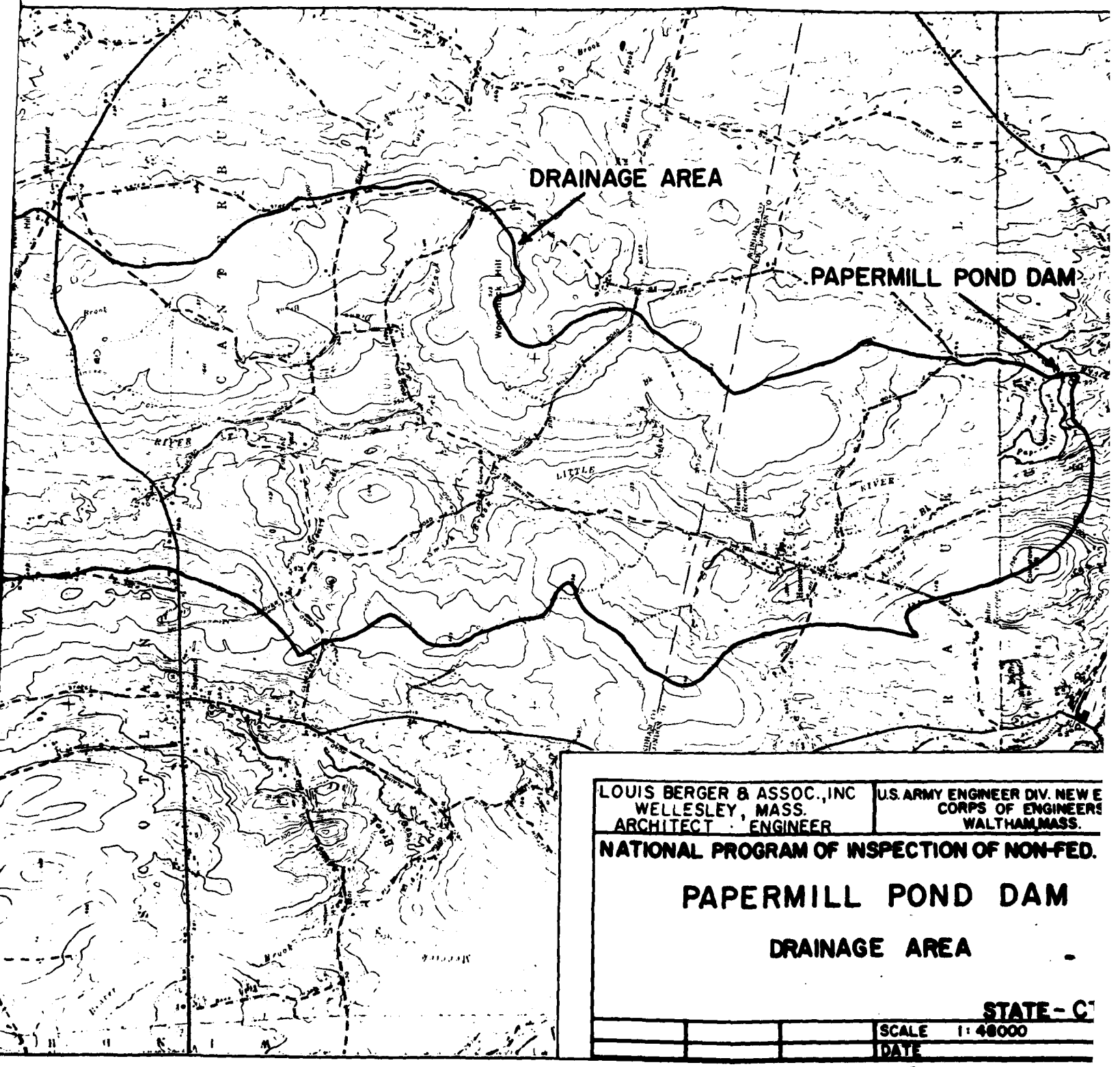
STATE - CT.

			SCALE 1:24000
			DATE

(1)


Bennett
Brant
LITTLE
Pudding Hill
Merrick
Beaver
Cedar
Swamp
Pine Arms Lake

(2)



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW E CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED.

PAPERMILL POND DAM

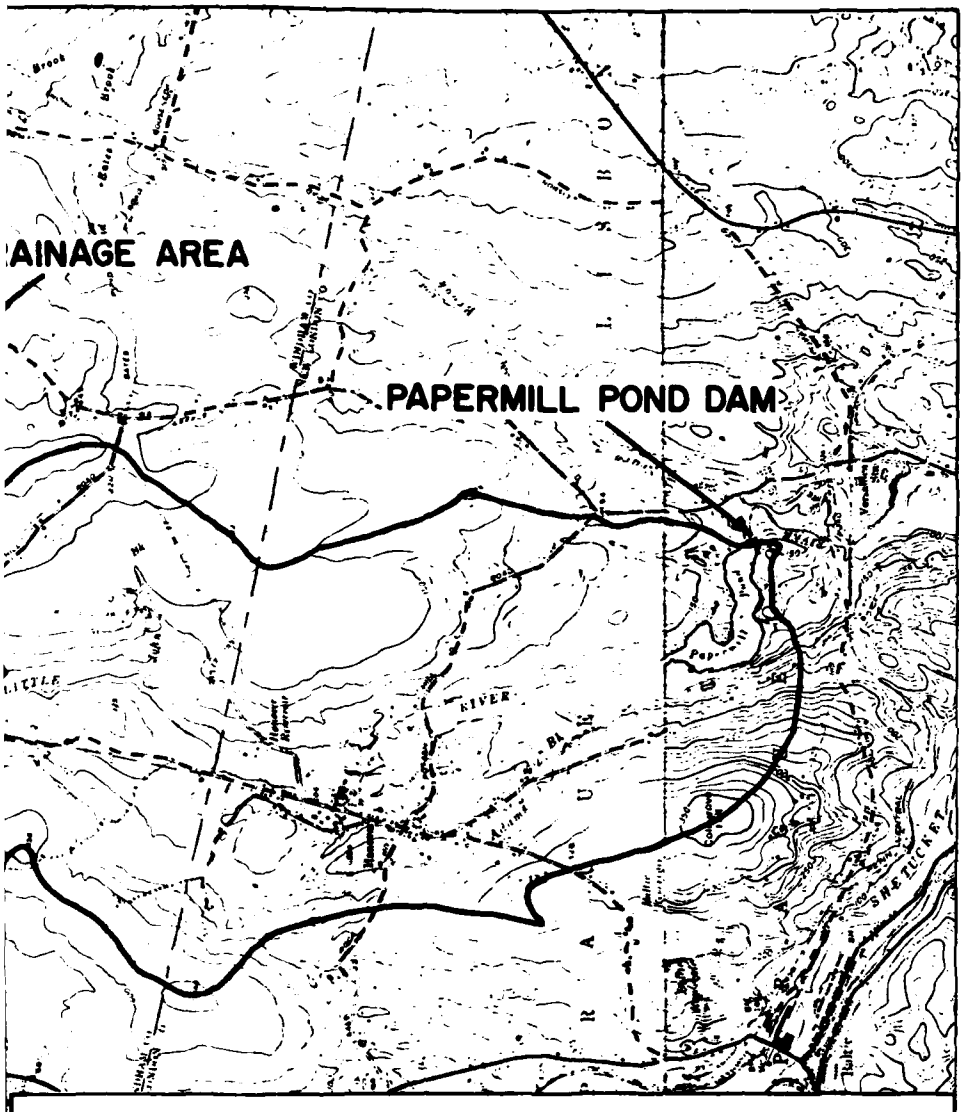
DRAINAGE AREA

STATE - CT

			SCALE 1:48000
			DATE

D-18

(3)



LOUIS BERGER & ASSOC., INC WELLESLEY, MASS. ARCHITECT · ENGINEER	U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS.

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

PAPERMILL POND DAM

DRAINAGE AREA

STATE - CT.

SCALE 1:48000

DATE

D-18

(4)

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS