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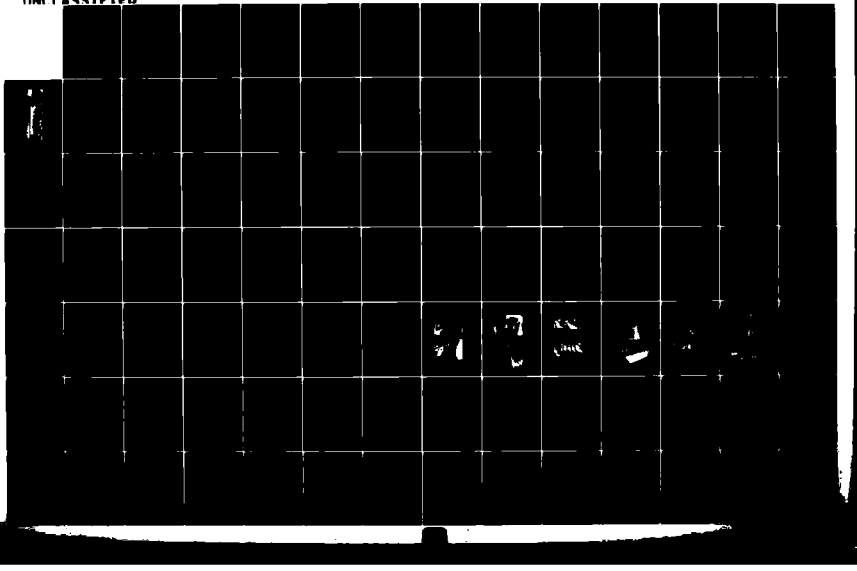

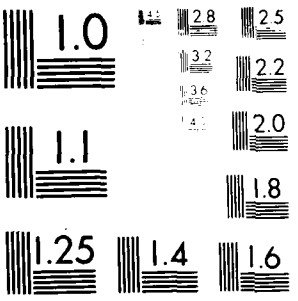

MICROCOPY RESOLUTION TEST CHART

AD-A156 321

ANDROSCOGGIN RIVER BASIN

ERROL, NEW HAMPSHIRE

ERROL DAM

NH 00161

NHWRB 80.01

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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JUL 3 1985

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

MAY 1979

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

DAMS, INSPECTION, DAM SAFETY,

Androscoggin River Basin
Errol, New Hampshire
Androscoggin River

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

The dam was constructed of rock filled timber crib and an earth dike. The maximum height of the dam is 20 ft. The dam is considered to be in fair condition. Continuance of this classification depends on proper operations and maintenance of the dam. It is large in size with a high hazard potential . There are various remedial measures which should be implemendted by the owner.

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NEDED

SEP

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

Dear Governor Gallen:

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

A copy of this report has been forwarded to the Water Resources Board, the cooperating agency for the State of New Hampshire. In addition, a copy of the report has also been furnished the owner, Union Water Power Company, 150 Main Street, Lewiston, Maine 04240.

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

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

Sincerely yours,

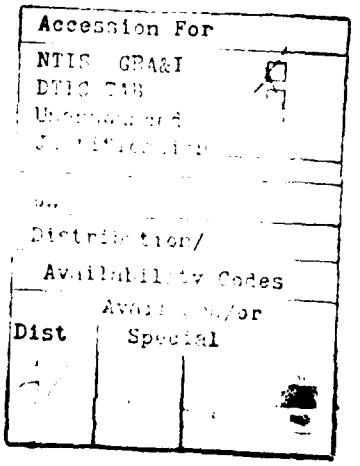
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

ERROL DAM

NH 00161

NHWRB 80.01



ANDROSCOGGIN RIVER BASIN
ERROL, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT

Identification No.:	NH 00161
Name of Dam:	Errol Dam
Town:	Errol
County & State:	Coos, New Hampshire
Stream:	Androscoggin River
Date of Inspection:	June 29, 1978

BRIEF ASSESSMENT

The towns of Errol and Berlin are located 1/2 mile and 8 miles, respectively, downstream of the Errol Dam. Errol Dam was constructed of rock-filled timber crib and an earth dike. The maximum height of the dam is 20 feet. The distance between abutments is 184 feet, and the total width of the sluice gates is 121 feet. This dam has twelve sluice gates and no spillway, and therefore, it may be called a barrage. It was built on crib foundation with a wooden plank apron.

Based on visual inspection and hydraulic/hydrologic evaluation, the overall condition of the dam is considered to be fair. The old timber cribs were observed to be in fair condition. Some leakage at the gates and cribs was noted. Visual inspection did not reveal any evidence of instability. 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 large in size. The test flood peak inflow of 175,000 cfs would result in a peak outflow of about 108,000 cfs at the dam after routing through the upstream lake. Hydraulic analysis indicates that such a flood would produce an upstream level to Elevation 1269.4 ft. msl, overtopping the earth dike section of the dam by about 17.4 feet. The estimated tailwater at the dam under such a flood condition would be in the order of 1259 which would also be several feet over the top of the dam at Elevation 1252 ft. msl. It would, therefore, not be possible to provide sufficient spillway capacity at this project to prevent overtopping of the dam under test flood conditions. With this type of structure, it is important to have sufficient discharge capacity so that during a major flood the difference between headwater and tailwater would not be sufficiently great to produce a major surge if the dam were breached. Preliminary tailwater computations indicate that with a normal full pool discharge capacity of 16,000 cfs there would be little difference between headwater and tailwater and with the pool at top of the dam, the discharge would be an estimated 40,000 cfs and the differential head in the order of 3 feet.

Within two years after receipt of this Phase I report by the owner, more detailed hydraulic studies are recommended to better establish the discharge and tailwater characteristics of the project and the extent of damage that might occur at the dam and in downstream areas in the event of a major flood.

The following remedial measures, as stated in Section 7.3, should be implemented:

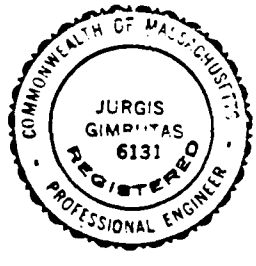
1. Maintenance program of the owner should be continued. This would include his ongoing program of replacing all the wooden crib piers by precast concrete crib piers.

2. Vegetation should be removed from the dike embankment except for grass that prevents slope erosion.

3. A program of technical biannual periodic inspection of the project features should be prepared and initiated.

4. Surveillance and a formal warning system be developed for periods of usually 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 Errol Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

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

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

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
Chief, Engineering Division

PREFACE

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

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the 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 provided 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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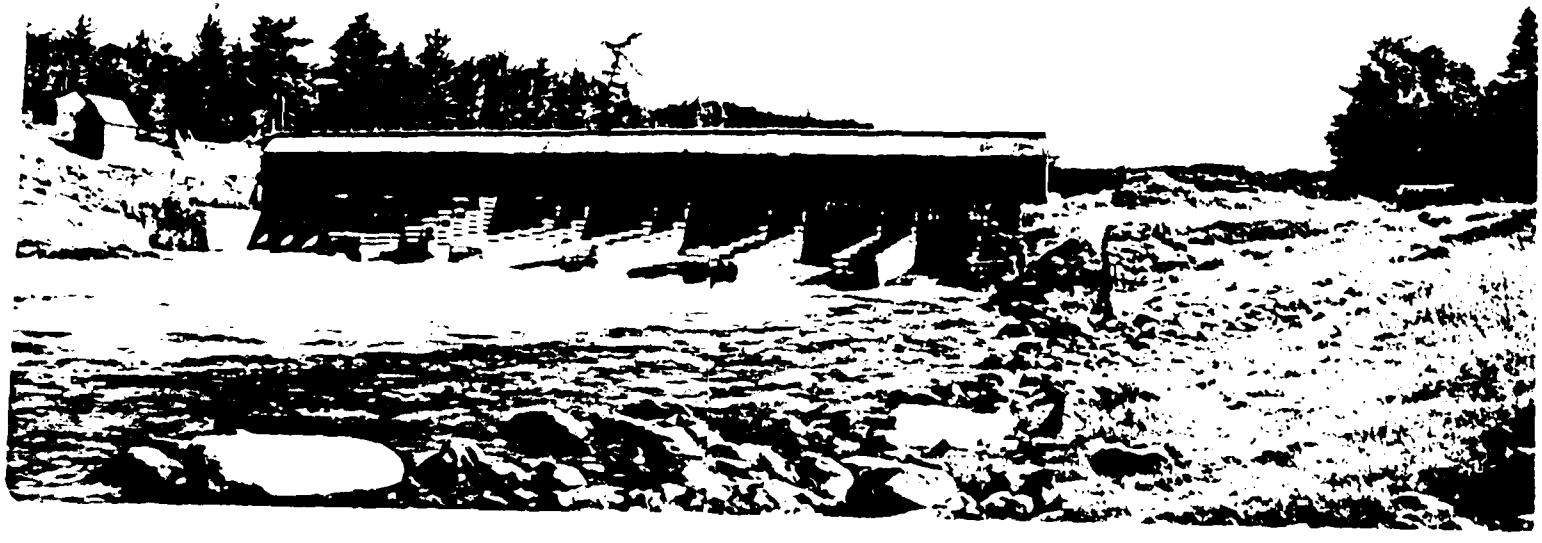
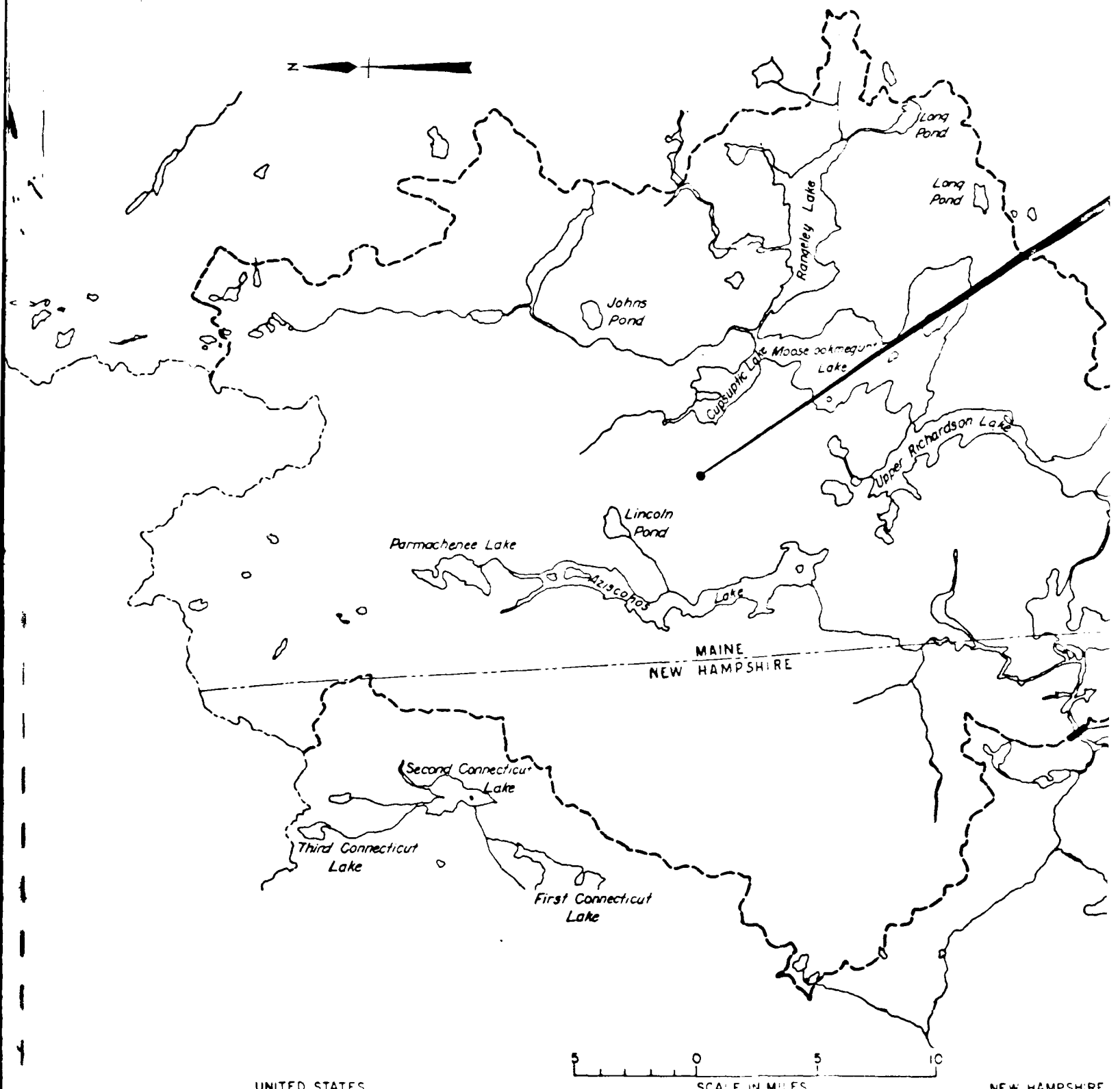
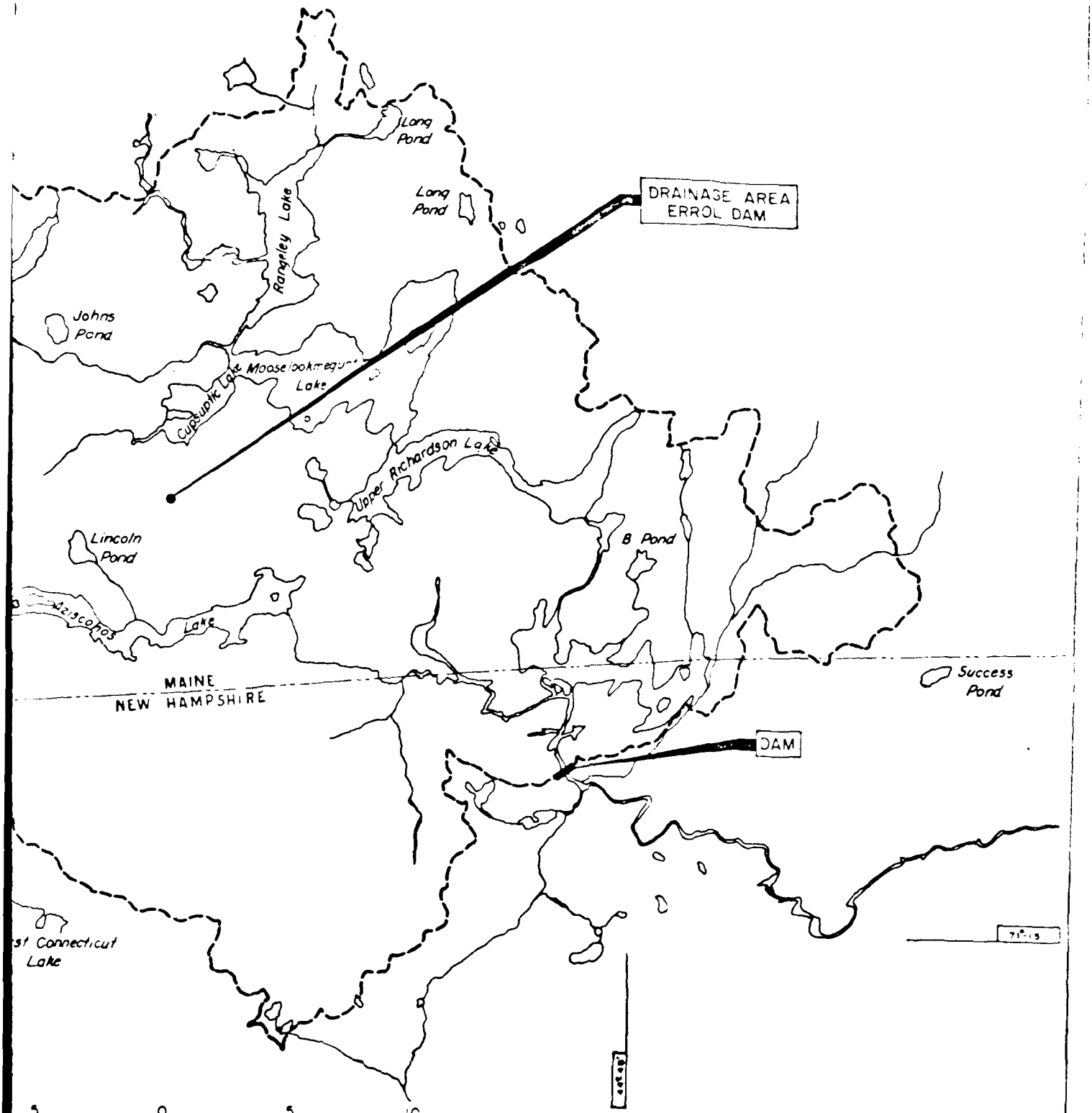


ERROL DAM ON THE DOWNSTREAM SIDE, SHOWING FULL LENGTH OF GATE HOUSE
Negative Nos. 11-3 and 11-2



UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

NEW HAMPSHIRE
SECOND CONNECTICUT LAK
INDIAN STREAM QUAD
ERROL QUADRANG
MILAN QUADRAN
MOOSE BOG QUADRA
NEW HAMPS
DIXVILLE QUADR



NEW HAMPSHIRE - MAINE
SECOND CONNECTICUT LAKE QUADRANGLE 1927
INDIAN STREAM QUADRANGLE 1925
ERROL QUADRANGLE 1930
MILAN QUADRANGLE 1930
MOOSE BOG QUADRANGLE 1927

NEW HAMPSHIRE
DIXVILLE QUADRANGLE 1930

MAINE
TIM MTN QUADRANGLE 1970
JIM POND QUADRANGLE 1969
QUILL HILL QUADRANGLE 1969
OQUOSSOC QUADRANGLE 1940
CUPSUPTIC QUADRANGLE 1931
RANGELEY QUADRANGLE 1933-43
BLACK MTN QUADRANGLE 1969
ARNOLD POND QUADRANGLE 1932
CHAIN OF PONDS QUADRANGLE 1969
OLD SPECK MTN QUADRANGLE 1943
KENNEBAGO LAKE QUADRANGLE 1970

ERROL 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., 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. DACW33-78-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

Errol Dam is located in the town of Errol, which is in the northern part of the state of New Hampshire. The dam is built across the Androscoggin River, about three miles west of the confluence of the outlet of Umbagog Lake and the mouth of Magalloway River. In the center of the town, approximately 1/2 mile downstream of the dam, the river makes a turn to the south. The dam is 167.1 miles above the tidewater at Brunswick, Maine.

b. Description of Dam

Errol Dam is a rock-filled crib structure made of timber, concrete, and steel. The crib is 4 feet to 6 feet deep and extends from heel to toe and from the south abutment to the north abutment. On this crib foundation, the crib piers were constructed and between these piers, the wooden gates were installed. There is a wooden plank flooring in each bay in front of and in back of each sluice opening up to the end of the crib piers. This wooden plank flooring was anchored to the cribs below the riverbed. The maximum structural height is 20 feet, and the length between the abutments is 184 feet.

As there is no spillway, the flow is controlled by twelve gates which are located for the full length of the dam. Five of the gates are 15 feet wide and 10 feet high and are referred to as sluice gates (Photographs No. 1, 5, and 6, Appendix C). Seven of the gates are near the northwest abutment and are 10 feet high, with the widths varying from 5 to 7 feet. The sills of these seven gates are at Elevation 1232.0, 20 feet below the permanent crest of the dam, and they are referred to as deep gates (Photographs No. 6 and 12, Appendix C). The sills of the sluice gates are several feet higher than the sills of the deep gates. The total width of all gates is 121 feet. The gates are separated by piers or king posts with braces. The structural support of this dam consists of a series of piers. They are either concrete or timber cribs, filled with stone (Photographs No. 2, 3, 5, and 7, Appendix C).

There is a gate house for the full length of the dam. It is a wooden structure covered with corrugated metal housing the gate operating equipment. Rodney Hunt hoists were installed on all deep gates except the small northerly gate. An electric motor is provided for every two deep gates with the option to connect the electric motor to one or two gates at a time. The five large sluice gates are mechanically operated by a movable gasoline driven pulley and belt, as reported in the 1971 inspection. An additional movable gasoline motor drive is provided for backup. Either of the two movable gasoline motors being used to operate the large sluice gates can also be used for the operation of the deep gates (Photographs No. 1, 9, and 10, Appendix C).

On the left bank of the river, there is an earth dike abutting the southeast abutment of the dam (Photograph No. 12, Appendix C). The total length of the dike is about 230 feet. There is a 103-foot long concrete core wall adjacent to the dam abutment, with the bottom at Elevation 1240 and the top at Elevation 1252. Recently to reinforce the old concrete core wall, steel sheet piling was driven on the upstream side of that abutment. This new cut-off wall is 40 feet long with 9 feet extending into the river on the upstream side of

the dam. The bottom elevation of the sheet piling is 1225. The top elevation is approximately 1252.

There is a footbridge from one abutment to the other on the upstream side of the gate house (Photographs No. 2 and 4, Appendix C).

c. Size CLassification

The storage capacity of Umbagog Lake at average spring fill elevation of 1247.0 is 80,000 acre-feet, which is greater than 50,000 acre-feet. Therefore, on the basis of Table 1, Size Classification, in the "Recommended Guidelines for Safety Inspection of Dams," furnished by the Corps of Engineers, Errol Dam is classified as large.

d. Hazard Classification

In the event of failure of this dam, the town of Errol and the town of Berlin, which are at a distance of about 1/2 mile and 8 miles downstream of the dam, respectively, will be in danger of being flooded. The depth of water at the possible damage impact area, as shown in Appendix D, is estimated. It is also estimated that in the event of failure of this dam, loss of more than a few lives and excessive property damage would probably occur. Therefore, on the basis of Table 2, Hazard Potential Classification, in the "Recommended Guidelines for Safety Inspection of Dams," furnished by the Corps of Engineers, this dam falls in the category of high hazard potential.

e. Ownership

The Union Water Power Company was and is the owner of the Errol Dam and has control of the use and flow of the waters of the Androscoggin River and its tributaries. This company is a water storage and industrial water sales company established in 1878. Prior to that time, Androscoggin River Improvement Co. owned the old Errol Dam, which was replaced by the present dam in 1887.

f. Operator

The Union Water Power Co., 150 Main Street, Lewiston, Maine 04240, telephone (207) 784-4501, is the operator through its agent Mr. William M. Groove. There is a local attendant, Mr. Carl Littlehale, who lives near the dam and is on duty twenty-four hours a day.

g. Purpose of Dam

The purpose of this dam is to store water and regulate the flow from Umbagog Lake for generation of power in several downstream plants. Prior to 1880, all dams in this system were used to regulate

the flow for log driving. Presently, log driving is a secondary purpose of the dam as the conservation of water is the primary purpose.

h. Design and Construction History

The first Errol Dam was built in 1853, as a part of a system to facilitate log driving. The present dam was built in 1887, as a timber crib structure, after the original dam was washed out. Available data indicate that the dam is founded on both ledge and hardpan.

Since 1947, the Union Water Power Co. has been replacing the timber cribs on the downstream side with precast concrete cribs. In 1950, six principal piers on the upstream side were reconstructed in timber with all cribs or piers filled with stone. These repairs were approved by the New Hampshire Water Resources Board. During the following years, additional repairs were done on the downstream side of the gates and all five sluice gates were rebuilt.

The maintenance program in 1962, included extensive reconstruction, such as, replacement of all king posts and braces; renewal of all deep gates; replanking of flooring and aprons, and driving of steel sheet piling on the upstream side. The petition for this reconstruction was granted to the owner by the New Hampshire Water Resources Board on December 18, 1961. During 1963 and 1964, the remaining timber cribs on the downstream side were replaced by precast concrete cribs.

In 1972, a 2-inch, hand-placed plank cut-off wall reinforced with polyethelene was constructed upstream of the dam with new stone placed to the elevation of the existing concrete cap. The wood walkway was replaced with steel grating.

Since 1968, Rodney Hunt hoists have been installed at all deep gates, except at No. 12, and at two sluice gates, Nos. 3 and 4. In 1977, a wooden sluice crib pier on the upstream side was replaced by a new precast concrete pier.

i. Normal Operational Procedure

This dam is operated jointly with Aziscohos Reservoir and the Middle, Upper, and Rangley Dams to insure that the regulated flow at Berlin will be maintained at not less than 1,550 cfs. Impoundment is increased during the spring runoffs to ensure sufficient storage for this flow during late summer.

An attendant is on duty twenty-four hours a day and lives near the dam site. Therefore, around-the-clock surveillance is provided. The attendant adjusts the rate of flow by using a calibration

chart, discharge vs. gate openings. Flow rates may be varied at the discretion of the attendant or at the direction of the Union Water Power Co.

The dam is inspected yearly by Androscoggin Reservoir Co., of which the Union Water Power Co. is a member. Remedial action is taken at their recommendation. Independent consultants have been retained at irregular intervals to inspect this dam.

1.3 Pertinent Data

a. Drainage Area

Umbagog Lake is a natural one. Errol Dam was constructed across the Androscoggin River, about 3 miles west from the outlet in Umbagog Lake. The total drainage area above the dam is 1,095 square miles. The watershed area is heavily wooded and of mountainous topography.

b. Discharge at Dam Site

(1) There are no conduits, but there are twelve sluice gates.

(2) The maximum known flood at the dam site is the flood of 1917, and the corresponding maximum level of record is 18.75 or 1250.75 msl.

(3) The ungated spillway capacity is not applicable as there is no spillway.

(4) The total discharge capacity of all the gates when they are fully opened is 16,300 cfs.

c. Elevation (Feet above MSL)

(1) Top of dam - 1252.0.

(2) Maximum pool elevation 1269.4. This value is obtained by routing test flood peak inflow through Umbagog Lake.

(3) Full lake pool - 1247.0. It is assumed that the recreation pool elevation is the same as the average spring fill elevation.

(4) Invert elevation of deep gates - 1232.0.

(5) Invert elevation of sluice gates - 1237.0.

(6) Stream bed at centerline of dam - 1228. (estimated).

(7) Maximum tail water elevation 1259.5. This value corresponds to the test flood peak outflow from the tail water rating curve below the dam site. Refer to Appendix D.

d. Reservoir

(1) Length of maximum pool - 11 miles (estimated).

(2) Length of full lake - 10 miles (estimated).

e. Storage (Acre-Feet)

The following values have been estimated from project records:

(1) Full lake pool - 80,000 acre-feet.

(2) Design surcharge - unknown.

(3) Top of dam - 105,000 acre-feet.

f. Reservoir Surface (Acres)

(1) Top of dam - 10,100 acres (estimated).

(2) Full lake level - 8,850 acres (estimated).

g. Dam

(1)	Type	Rock filled crib
(2)	Length	184 feet
(3)	Height	20 feet
(4)	Top width	30 feet
(5)	Side slopes	Vertical
(6)	Zoning	None
(7)	Impervious core	None

(8) Cutoff	2-inch planks reinforced with polyethylene at upstream toe
(9) Grout curtain	None
h. Spillway	None
i. Regulating Outlet	
(1) 5 sluice gates	
(a) Invert	1237.0 msl
(b) Dimensions	15 feet wide by 10 feet high
(c) Description	Wooden gates
(d) Control mechanism	Electric and gasoline motors with manual backup
(2) 7 deep gates	
(a) Invert	1232.0 msl
(b) Dimensions	5 gates - 7 feet wide by 10 feet high; 1 gate - 6 feet wide by 10 feet high; 1 gate - 5 feet wide by 10 feet high
(c) Description	Wooden gates with Rodney Hunt hoists
(d) Control mechanism	Electric and gasoline motors with manual back-up, one gate nonoperable
j. Dike	
(1) Type	Earth embankment
(2) Length	Approximately 550 feet
(3) Height	Approximately 20 feet
(4) Top width	21 feet

(5)	Side Slopes	1 vertical to 2 horizontal
(6)	Cutoff	Steel sheeting and concrete core wall adjacent to the northeast abutment

SECTION 2 - ENGINEERING DATA

2.1 Design

No original design data was disclosed for Errol Dam. Borings, dated 1930 and 1944, and a ledge topographic map was obtained from project records. The borings in 1944 were drilled for a new dam to replace the existing dam. See Appendix B for the borings drilled in 1930. The sketches of the sluice gates identifying pertinent hydraulic features and dimensions relevant to the determination of the discharge capacity are included in Appendix B.

2.2 Construction

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

2.3 Operation

The gate openings from the south abutment are numbered 1, 2, 3, 4, and 5, and they are called sluice gates. For operational purposes, a hydraulic engineer prepared a calibration chart which reads "Head on sill of sluice gates versus discharge for different openings (as a parameter)." A similar calibration chart was prepared for the deep gates numbered 6, 7, 8, 9, 10, 11, and 12. The operator uses these two calibration charts and the gage reading to determine the number of gates to be opened and the required opening of each gate.

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 limited basis.

b. Adequacy

Sufficient engineering data are available 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

a. General

The Phase I inspection of Errol Dam was performed on June 29, 1978. A copy of the inspection check list is included in Appendix A.

In general, the soil and rock features are in good condition. The steel and concrete structures were observed to be in good condition, see subparagraph c.

b. Dam

The dam is in good condition. No evidence of vertical or horizontal misalignments was observed nor was there any evidence of seepage or piping.

The dam was observed to consist of both timber and precast concrete cribs. The exposed parts of the timber cribs are old wood, but not rotten, with just a few visible checks and vertical cracks. Therefore, it can be considered to be in fair condition. The precast concrete cribs were observed to be in good condition. Leakage of the gates and cribs was noted.

c. Appurtenant Structures

The concrete of the north abutment above the water level was observed to be in good condition. Joint alignment is generally good, and no erosion was noted. The steel footbridge and the aluminum railing was in good condition with the longitudinal members rusting in places. Field observations indicate that the gate house, a wooden structure covered with corrugated metal, is in good condition.

d. Dike

The dike is in fair condition with no evidence of vertical or horizontal misalignments. There is no indication of sloughing, bulging, or movement of the slopes; nor is there evidence of seepage or piping. No riprap was observed on either slopes.

Vegetation was noted on both the upstream and downstream slope and top of the dam. There are small bushes, trees, and grass on both slopes. (Photograph No. 12, Appendic C.)

e. Reservoir Area

Umbagog Lake is a natural one. The storage area of the lake is about 15.8 square miles. The lake is surrounded by mountains and dense forest.

f. Downstream Channel

The downstream channel and side slopes are in good condition.

3.2 Evaluation

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

a. Questionable condition of the old timber cribs underwater.

b. Potential for overtopping.

c. Leakage of the gates.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The Union Water Power Company has operated Errol Dam since it was constructed in 1887. The only control available to maintain or lower the lake level is the twelve sluice gates. These gates are operated by electric and gasoline motors with manual backup. This dam is operated jointly with Aziscohos Reservoir and the Middle, Upper, and Rangley Dams to ensure that the regulated flow at Berlin will be maintained at not less than 1,550 cfs.

4.2 Maintenance of Dam

The maintenance of Errol Dam is the responsibility of the Union Water Power Co. who controls the use and flow of the waters of the Androscoggin River and its tributaries. Since 1947, the Union Water Power Company has been replacing the timber cribs on the downstream side by similar precast concrete structures. In 1950, six principal piers on the upstream side were reconstructed in timber. In the following years, additional repairs were done, see Section 1.2h.

4.3 Maintenance of Operating Facilities

The dam is inspected yearly by the owner's engineering staff and daily by the attendant residing near the dam site. Maintenance of the facilities to operate the sluice gates controlling the flow through the sluice openings is considered to be good.

4.4 Description of any Warning System in Effect

There are four reservoirs upstream of Umbagog Lake, and they are all owned by Union Water Power Co. The operators of these reservoirs are in contact by radio, and therefore, they do have a flood warning system.

4.5 Evaluation

The operational and maintenance procedures consisting of daily and yearly inspections should ensure that all problems encountered 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 large in size. Using the "Recommended Guidelines for Safety Inspection of Dams," the recommended spillway test flood peak inflow would be equal to the probable maximum flood. Since the basin of this dam has so much storage, the probable maximum flood peak inflow is not applicable.

Flood studies conducted in 1959, by Chas. T. Main, Inc., for a proposed dam approximately 1/2 mile downstream from this dam, yield a spillway inflow hydrograph with a peak value of 175,000 cfs. Therefore, the adopted test flood peak inflow is 175,000 cfs.

(2) The computed peak outflow corresponding to the routed test flood peak inflow through Umbagog Lake (assuming earth dike remains intact after being overtopped) is 108,500 cfs. Refer to Appendix D for details.

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

(4) The discharge rating curve for the twelve sluices is furnished in Appendix D.

(5) The composite discharge rating curve for pool levels above the top of earth dike (assuming earth dike and barrage structure remain intact) is furnished in Appendix D.

(6) The tail water discharge rating curve immediately below the dam site, including elevation corresponding to computed peak outflow is furnished in Appendix D.

(7) The hydrologic map of the watershed above the dam (barrage) site, including the reservoir area and the watercourse, is furnished in Appendix D.

b. Experience Data

Major floods occurred in 1917 and 1969. The maximum water surface level attained during the flood of 1917 was 1250.75. The maximum flow recorded for May, 1969, was 16,300 cfs. All the gates were required to be fully opened during the floods of 1917 and 1969.

c. Visual Observations

At the time of inspection, rate of flow through the sluices into the downstream channel was 2,500 cfs. All the sluice gates are vertical lift gates. These gates slide along the channels of I-beams. The width of Androscoggin River bed immediately downstream of the dam is about 150 feet. The side slopes of the river are not steep. The left bank is approximately 10 to 12 feet high, and the right bank is about 20 to 25 feet high. In 1947, about 0.4 of a mile downstream of the dam, U.S.G.S. established a stream gaging station (Indian Bay Gage) at Errol.

Near Errol Dam there are two stage gaging stations. One is a lake gage and the second one is near the dam. The lake gage reading at the time of inspection was 13.75 or 1245.75 msl.

Minor leakage of water through the edges of Sluice Gate No. 1 (adjacent to the south abutment) was noticed.

d. Overtopping Potential

The test flood peak inflow of 175,000 cfs would result in a peak outflow of about 108,000 cfs at the dam after routing through the upstream lake. Such a flood would produce an upstream level to Elevation 1269.4 ft. msl, overtopping the earth dike section of the dam by about 17.4 feet. The estimated tailwater at the dam under such a flood condition would be in the order of 1259 which would also be several feet over the top of the dam. It would, therefore, not be possible to provide sufficient spillway capacity at this project to prevent overtopping of the dam under test flood conditions. With this type of structure, it is important to have sufficient discharge capacity so that during a major flood the difference between headwater and tailwater would not be sufficiently great to produce a major surfge if the dam were breached. Preliminary tailwater computations indicate that with a normal full pool discharge capacity of 16,000 cfs there would be little difference between headwater and tailwater and with the pool at top of dam, the discharge would be an estimated 40,000 cfs and the differential head in the order of 3 feet.

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The upstream slopes could not be seen due to the fact that it was underwater. The slopes of the dike do not show any erosion or other weak areas. The visual inspection revealed that the only evidence of possible stability problems is the condition of the existing old timber cribs.

Visual inspection of the concrete abutments and the cribs did not reveal any evidence of instability.

b. Design and Construction Data

No design computations are available, but drawings dated 1962 and 1977 were obtained from the project records.

c. Operating Records

The operating records of this dam can be found at the office of the owner, Union Water Power Co.

d. Post-Construction Changes

Available records indicate that improvements to this dam have been made on a regular basis. All changes were to upgrade the structural elements of the dam with no design changes.

Replacement of the timber cribs with precast concrete was started in 1944, and is still in progress.

e. Seismic Stability

The dam is located in Seismic Zone 2 and, in accordance with recommended Phase I guidelines, does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS, & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

The visual inspection indicates that the Errol Dam is in good condition. Based on hydraulic/hydrologic evaluation, this dam is judged to be in fair condition. Therefore, the overall condition of the dam is fair.

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

The recommendations and remedial measures enumerated in Sections 7.2 and 7.3 should be implemented within 2 years 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 requires the attention of a competent engineer who will have to make additional engineering studies to design or specify remedial measures to rectify this problem. If left unattended, this problem could lead to instability of the structure.

7.2 Recommendations

It is recommended that a more detailed hydraulic study be made to better establish the discharge and tailwater characteristics of the project and the extent of damage that might occur at the dam and in downstream areas in the event of a major flood.

7.3 Remedial Measures

Although the dam is generally maintained in good condition, it is considered important that the following operating and maintenance procedures be attended to as early as practical:

a. The old timber cribs were observed to be in fair condition. Nevertheless, the owner should continue his ongoing program of replacing all the wooden crib piers by precast concrete crib piers.

b. Vegetation should be removed from the dike embankment except for grass that prevents slope erosion.

c. Maintenance program of the owner should be continued.

d. A program of technical, annual periodic inspection of the project features should be prepared and initiated.

e. As the dam is 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 the event of an emergency should be adopted.

7.4 Alternatives

None recommended.

APPENDIX A

VISUAL INSPECTION CHECK LISTS

APPENDIX A

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Errol Dam DATE June 29, 1978

TIME 830 - 1230

WEATHER Sunny

W.S. ELEV. 1245.4 U.S. DN.S.

PARTY:

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

PROJECT FEATURE	INSPECTED BY	REMARKS
1. Dam	H. H. Stoller	Good
2. Dike Embankment	H. H. Stoller	Fair
3. Gate House	J. Gimbutas	Good
4. Approach and Discharge Channels	H. H. Stoller V. R. Maddineni	Good
5. Footbridge	J. Gimbutas	Good
6. Reservoir and Downstream Channel	V. R. Maddineni	Good

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Dam

DISCIPLINE Soils & Foundations NAME [signature]

PROJECT FEATURE

DISCIPLINE NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
DAM	
Crest Elevation	1252.0
Current Pool Elevation	1245.4
Maximum Impoundment to Date	1250.75 (in the year 1917)
Surface Cracks	None
Pavement Condition	None
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	No visual vertical misalignment
Horizontal Alignment	No visual horizontal misalignment
Condition at Abutment and at Concrete Structures	Normal

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Dam

DISCIPLINE Soils & Foundations NAME [signature]

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 observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None
Timber Cribs	Fair Condition - See Section 3
Precast Concrete Cribs	Good Condition

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Dike Embankment

DISCIPLINE Soils & Foundations NAME [signature]

PROJECT FEATURE _____

DISCIPLINE _____ NAME _____

DISCIPLINE _____ NAME _____

AREA EVALUATED	CONDITION
DIKE EMBANKMENT	
Crest Elevation	1252.0
Current Pool Elevation	1245.4
Maximum Impoundment to Date	1250.75 (in the year 1917)
Surface Cracks	None observed
Pavement Condition	None
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	No visual vertical misalignment
Horizontal Alignment	No visual horizontal misalignment
Condition at Abutment and at Concrete Structures	Normal

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Dike Embankment

DISCIPLINE Soils & Foundations NAME [signature]

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 observed
Unusual Embankment or Downstream Seepage	None observed
Piping or Boils	None observed
Foundation Drainage Features	None
Toe Drains	None
Instrumentation System	None

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Gate House

DISCIPLINE Structures NAME [redacted]

PROJECT FEATURE

DISCIPLINE NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - GATE HOUSE	
a. Structural	
General Condition	Good (wood structure covered with corrugated metal)
Unusual Seepage or Leaks in Gate Chamber	Leakage, minor in nature
b. Mechanical and Electrical	
Air Vents	None
Float Wells	None
Crane Hoist	Appears to be in good condition
Elevator	None
Hydraulic System	None
Service Gates	Twelve gates - one gate non-operable
Emergency Gates	None

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Gate House

DISCIPLINE Structures NAME

PROJECT FEATURE

DISCIPLINE NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
Lightning Protection System	None
Emergency Power System	Gasoline motor with manual backup
Wiring and Lighting System	Operating condition

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE

DISCIPLINE NAME

PROJECT FEATURE Approach and Discharge Channels

DISCIPLINE Soils & Foundations NAME

DISCIPLINE Hydraulics & Hydrology NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - 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	Water at Elevation 1254.4, floor of channel could not be observed
b. Discharge Channel	
General Condition	Good
Loose Rock Overhanging Channel	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE

DISCIPLINE NAME

PROJECT FEATURE Discharge Channel

DISCIPLINE Soils & Foundations NAME

DISCIPLINE Hydraulics & Hydrology NAME

AREA EVALUATED	CONDITION
Trees Overhanging Channel	None observed
Floor of Channel	Could not be observed
Other Obstructions	None observed

PERIODIC INSPECTION CHECK LIST

PROJECT Errol Dam DATE June 29, 1978

PROJECT FEATURE Footbridge

DISCIPLINE Structures NAME [illegible]

PROJECT FEATURE

DISCIPLINE NAME

DISCIPLINE NAME

AREA EVALUATED	CONDITION
OUTLET WORKS - FOOTBRIDGE	
a. Superstructure	
Bearings	None
Anchor Bolts	Good condition
Bridge Seat	None
Longitudinal Members	Steel L's, rusting in places
Underside of Deck	Good condition
Secondary Bracing	None
Deck	Good condition (steel grating)
Railings	Good condition
Expansion Joints	None

APPENDIX B

EXISTING AVAILABLE INFORMATION

APPENDIX B

1. Listing of Records and Their Location

The New Hampshire Water Resources Board, 37 Pleasant Street, Concord, New Hampshire, has three folders of records and correspondence dated 1924 to 1977, and filed under Town/Dam No. 80.01, Errol Town/Errol Dam.

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

(1) 1924 to 1925. Inventory card on Errol Town Dam No. 1, owned by the Union Water Power Co.

(2) July 15, 1928. Photograph showing downstream view of dam with six wooden cribs or piers.

(3) May, 1950 to June, 1951. Correspondence between the Union Water Power Co. and the Water Control Commission in Concord, regarding temporary repairs of the dam, including small sketches.

(4) Two charts showing average daily flows of Androscoggin River at Berlin, New Hampshire, in 1952.

(5) Thirteen charts showing average daily flows of Androscoggin River near Gorham, New Hampshire, from 1942 to 1953.

(6) April, 1953. Hydraulic charts regarding the new Errol project, by Chas. T. Main, Inc., Boston, Massachusetts.

(7) May 1, 1957. Brief description of Errol Dam by Mr. Paul W. Bean of Union Water Power Co.

(8) November, 1959 and November, 1961. Outlines and petition for maintenance repairs of the dam, from Mr. Paul W. Bean, Agent, Union Water Power Co. to the New Hampshire Water Resources Board. Petition was granted on December 18, 1961.

(9) May 6, 1966. Letter from Mr. Paul W. Beam to Mr. Moore of Concord, regarding dimensions of dam.

(10) June 12, 1969. Report from Mr. G. M. McGee, Sr., Chairman, New Hampshire Water Resources Board, to Representative G. J. Fortier of Berlin, New Hampshire, regarding proper maintenance and safety of Errol Dam.

(11) May, 1969. Tabulation of precipitation at Errol Dam in the spring of 1969.

(12) May, 1970 to April, 1971. Correspondence between several interested parties regarding yearly flooding along Route 16 near Errol Dam. These letters contain valuable hydrological data.

(13) Charts showing flows at Errol, New Hampshire, and levels of Lake Umbagog from 1964 to 1973.

(14) March 20, 1974. Three photographs taken from the Army Corps of Engineers' Dam Inventory Program.

(15) January 17, 1975. FIA Flood Hazard Boundary Maps, town of Errol (ten pages).

(16) March 31, 1976. Statistical data on sizes of the reservoirs in the town of Errol, with a small map showing Androscoggin River drainage area.

(17) November 14, 1977. Application for repair to Errol Dam, by the Union Water Power Co. to the New Hamsphire Water Resources Board.

Mr. William M. Grove, Agent for the Union Water Power Co., 150 Main Street, Lewiston, Maine, made available to us the following data:

(1) Test borings drilled in September, 1944, by Mr. M. J. O'Kelly, driller, and plan of location of borings made on May 15, 1947 (fifteen pages).

(2) Headwater storage on the Androscoggin River, November, 1948, by Mr. F. W. Harris.

(3) Hydrologic study, January, 1959, by Chas. T. Main, Inc.

(4) Revised in 1975. Operation of Androscoggin River storage system, pamphlet by the Union Water Power Co. (fifteen pages).

(5) Report of 1977. Inspection by Chas. T. Main, Inc.

2. Copies of Past Inspection Reports

The following copies of past inspection reports are included in this report:

(1) August 6, 1936. By the New Hampshire Water Resources Board.

(2) November 29, 1938. By the New Hampshire Water Control Commission, initialed by AAN & RLT (two pages).

(3) October 26, 1972. By the New Hampshire Water Resources Board, Mr. Robert B. Chamberlin.

(4) October 4, 1977. By Mr. J. Goodrich of Chas. T. Main, Inc., and Mr. W. Grove of Union Water Power Co. (two pages)

3. Drawings

The New Hampshire Water Resources Board is in possession of prints listed below and showing the layout of the dam, sections, and some details:

*(1) July, and November, 1930. Boring location plan, test pits, drill hole layouts, Errol Dam, by the New England Public Service Co., Engineering Department.

(2) January, 1948. Plan showing proposed flowage of Errol Dam, size 16 inches by 33 inches, colored map showing Umbagog Lake and surroundings.

(3) May, 1948. Preliminary study, location plan, and access roads to proposed Errol Dam, by the Union Water Power Co., Lewiston, Maine.

(4) December, 1948. Errol 1275 Dam, ledge topography, "Plan B," by Union Water Power Co.

(5) April, 1958. Exhibit Sheets J, K, L-1, and L-2, Errol Project: general map, detailed map, plan and sections, and profile and sections, by Chas. T. Main, Inc., for the New Hampshire Water Resources Board (never constructed).

(6) January, 1975. 1275 Dam, Sheet E-79, Topographic Layout; Sheet E-78, Main Dam Section, by the Union Water Power Co.

Mr. W. M. Grove of the Union Water Power Co. made available to us the following drawings from the files in his office in Lewiston, Maine.

*(1) July, 1944, Revised June, 1978. Drawing No. ES-24, Sketch-Diagram, Errol Dam, by Mr. Paul W. Bean, Union Water Power Co.

*Reduced copies are included with this report.

(2) March, 1963 (Revised). Reconstruction of the deep gates, plan and section, Drawing Nos. E-92 and E-93, by Union Water Power Co.

(3) December, 1977 (Revision). Rebuilt sluice pier, Drawing No. E-103, by Union Water Power Co.

(4) July, 1978 (Revision). Sketched diagram - Errol Dam (original date July 1, 1944).

*Reduced copies are included with this report.

NEW HAMPSHIRE WATER RESOURCES BOARD

INVENTORY OF DAMS AND WATER POWER DEVELOPMENTS

DAM

BASIN Androscoggin NO. 1 — — I-5270
RIVER Androscoggin MILES FROM MOUTH D.A.SQ.MI.
TOWN Errol OWNER Union Water Power Co. Lewiston
LOCAL NAME OF DAM
BUILT DESCRIPTION Crib — Timber on ledge & earth

POND AREA-ACRES 13.8 (10,100 Umbagog Lake) DRAWDOWN FT. POND CAPACITY-ACRE FT.
HEIGHT-TOP TO BED OF STREAM-FT. 14.5 MAX. MIN.
OVERALL LENGTH OF DAM-FT. MAX.FLOOD HEIGHT ABOVE CREST-FT.
PERMANENT CREST ELEV.U.S.G.S. 1246.3 LOCAL GAGE
TAILWATER ELEV.U.S.G.S. 1231.8 LOCAL GAGE
SPILLWAY LENGTHS-FT. None FREEBOARD-FT.
FLASHBOARDS-TYPE, HEIGHT ABOVE CREST None
WASTE GATES-NO. WIDTH MAX. OPENING DEPTH SILL BELOW CREST

REMARKS Gates control flow. Card gives height of dam as 30 ft. Elevations from
JB Condition Good

POWER DEVELOPMENT

UNITS	NO.	RATED HP	HEAD FEET	C.F.S. FULL GATE	KW	MAKE
	1		14.5			

USE Conservation

REMARKS Log Driving Wheel not used
Storage in Umbagog Lake Controlled by this dam.

DATE 8/6/36

NEW HAMPSHIRE WATER CONTROL COMMISSION

DATA ON DAMS IN NEW HAMPSHIRE

LOCATION STATE NO. 80.01

Town Errol : County Coos

Stream Androscoggin River

Basin-Primary Androscoggin River : Secondary

Local Name

Coordinates—Lat. 44° 45' +13,800 : Long. 71° 5' +11,000

GENERAL DATA

Drainage area: Controlled ..... Sq. Mi.: Uncontrolled ..... Sq. Mi.: Total 1095 Sq. M.

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

Height: Stream bed to highest elev. 20' ft.: Max. Structure 1827- f

Cost—Dam : Reservoir

DESCRIPTION Crib- Timber on Ledge- Earth

Waste Gates

Type

Number : Size ..... ft. high x ..... ft. wi

Elevation Invert : Total Area ..... sq. f

Hoist

Waste Gates Conduit

Number : Materials

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

Embankment

Type

Height—Max. ..... ft.: Min. f

Top—Width : Elev. f

Slopes—Upstream ..... on : Downstream ..... on

Length—Right of Spillway : Left of Spillway

Spillway

Materials of Construction (Gates) (no spillway)

Length—Total ..... ft.: Net f

Height of permanent section—max. ..... ft.: Min. f

Flashboards—Type : Height f

Elevation—Permanent Crest 1246.3 : Top of Flashboard

Flood Capacity ..... cfs.: ..... cfs/sq. mi.

Abutments

Materials:

Freeboard: Max. ft.: Min. f

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

OWNER Union Water Power Co. Lewiston Me.

REMARKS Use Log Driving- Conservation

NEW HAMPSHIRE WATER CONTROL COMMISSION
DATA ON RESERVOIRS & PONDS IN NEW HAMPSHIRE

LOCATION AT DAM NO. 80.01

Town Errol : County Coos

Stream Androscoggin River

Basin—Primary Androscoggin : Secondary

Local Name

DRAINAGE AREA

Controlled Sq. Mi.: Uncontrolled Sq. Mi.: Total 1095 Sq Mi Sq. M

ELEVATION vs. WATER SURFACE AREA vs. VOLUME

Point	Head Feet	Surface Area Acres	Volume Acre Ft.
(1) Max. Flood Height			
(2) Top of Flashboards			
(3) Permanent Crest			
(4) Normal Drawdown	10	15.8 Sept.?	72,000
(5) Max. Drawdown			
(6) Original Pond	U.S.G.S. 1254		

Base Used : Coef. to change to U.S.G.S. Base

RESERVOIR CAPACITY

	Total Volume	Useable Volume
Drawdown	ft.	ft.
Volume	ac. ft.	ac. ft.
Acre ft. per sq. mi.		
Inches per sq. mi.		

USE OF WATER (Conservation—Log Driving)

OWNER Union Water Power Co Lewiston Me

REMARKS Wheel (Not used)

Tabulation By A A N & R L T Date November 29, 1938.

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

DAM SAFETY INSPECTION REPORT FORM

Town: Errol Dam Number: 80.01

Inspected by: Robert E. Chamberlin Date: October 26 19[illegible]

Local name of dam or water body: Errol Dam, Lake Umbagog

Owner: _____ Address: _____

Owner was/was not interviewed during inspection.

Drainage Area: 1095 sq. mi. Stream: Androscoggin River

Pond Area: 8850 Acre, Storage 45000 (165000 M.F.) Ac-Ft. Max. Head 20 ± F.

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

Spillway: Type Gates only, Freeboard over perm. crest: 5

Width 121' width of gates, Flashboard height _____

Max. Capacity _____ c.f.s.

Embankment: Type _____, Cover _____ Width _____

Upstream slope _____ to 1; Downstream slope _____ to 1

Abutments: Type Crib, Condition: Good, Fair, Poor

Gates or Pond Drain: Size _____ Capacity _____ Type _____

Lifting apparatus _____ Operational condition _____

Changes since construction or last inspection: Metal on right gate sections recently primed. Crib piers are in alignment. Gate house secure. Has a very good overall appearance.

Downstream development: _____

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

Suggested reinspection date: _____

Remarks: _____

UNION WATER POWER COMPANY

ANDROSCOGGIN RESERVIOR COMPANY

LEWISTON, MAINE

REPORT OF 1977 INSPECTION

OF

UNION WATER POWER COMPANY
AND
ANDROSCOGGIN RESERVIOR COMPANY
INSTALLATIONS

NOVEMBER, 1977

Inspection and Report
by
CHAS. T. MAIN, INC.
Boston, Massachusetts

MAIN

III. ERROL DAM AND DIKE

On October 4, 1977, the structures were inspected by J. Goodrich and W. Grove accompanied by Mr. Carl Littlehale, dam attendant. The staff gage water level of the dam was 14.45. The lake reading (1/4 mile) upstream was 14.90. Full pond water level is 15.0 and maximum level of record is 18.75 (occurred in 1913).

All gates were discharging a total of 2500 c.f.s. at the time of inspection. The total discharge capability of all gates is 16,000 c.f.s. Downstream flooding will occur at discharges over 8000 c.f.s.

Dike construction upstream of the Errol Dam forms a constriction in the river creating a rise in water level to occur upstream of the dam. This rise in water level which can amount to 3 ft. + represents increased storage capability and is used in determining river releases and pond levels at Errol Dam. A USGS stream gaging station is located just below the river constriction.

As reported in 1971 the entire dam structure appeared in sound condition. A hand placed 2" plank cutoff wall reinforced with polyethelene placed upstream was constructed in 1972 with new stone placed to elevation of the existing concrete cap.

The wood walkway was replaced with steel grating. During 1973, concrete header blocks were waterproofed by spraying with linseed oil.

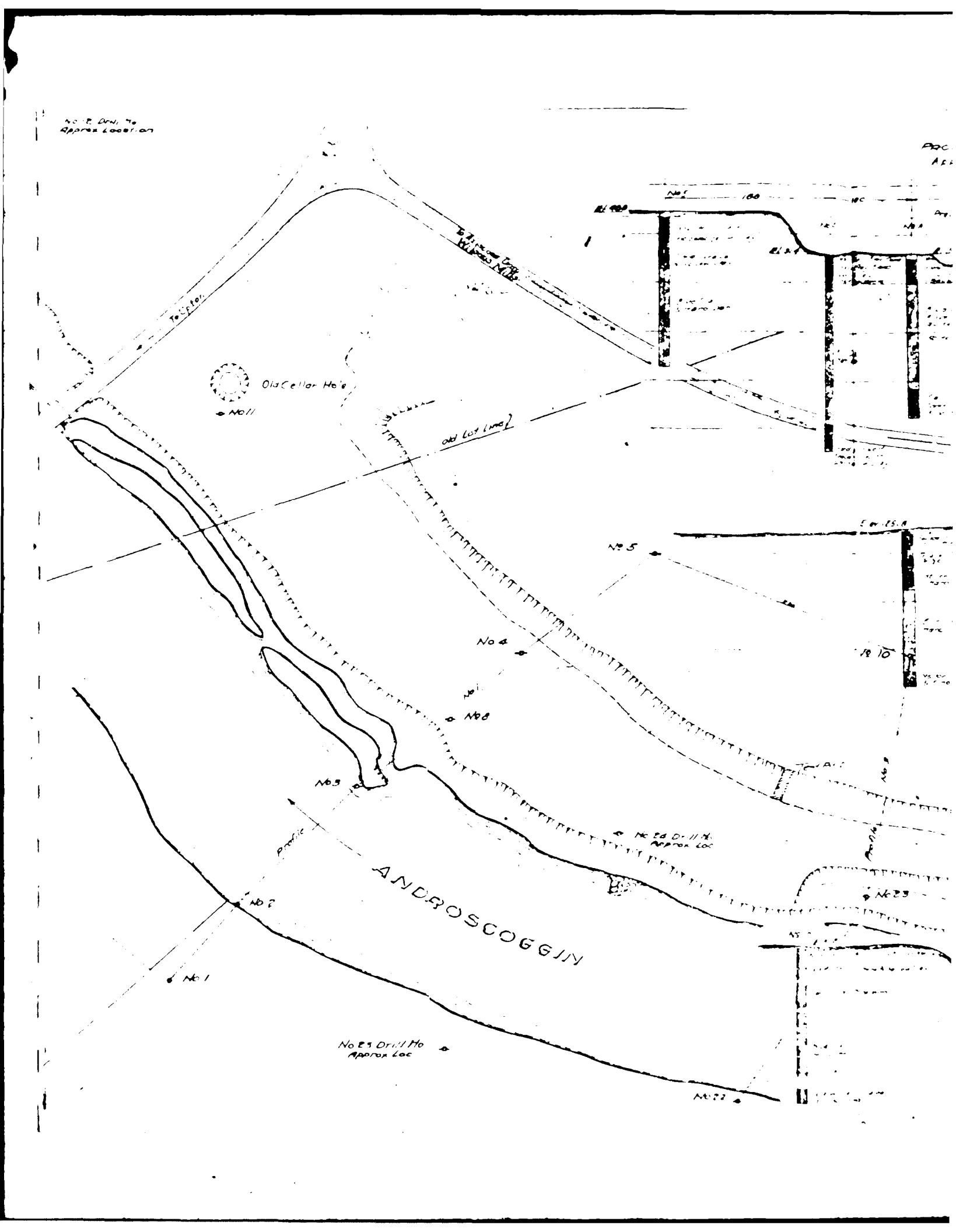
Rodney Hunt hoists were installed on all deep gates except the small northerly gate. An electric motor is provided for each two deep gates with provision made to connect the electric motor to one or two gates at a time. The five large sluice gates are mechanically operated by a movable gasoline driven pulley and belt as reported in the 1971 inspection. An additional movable gasoline motor drive is provided for back-up. Either of the two mechanical gasoline motor drives for the large sluice gates can be used to also drive the deep gates.

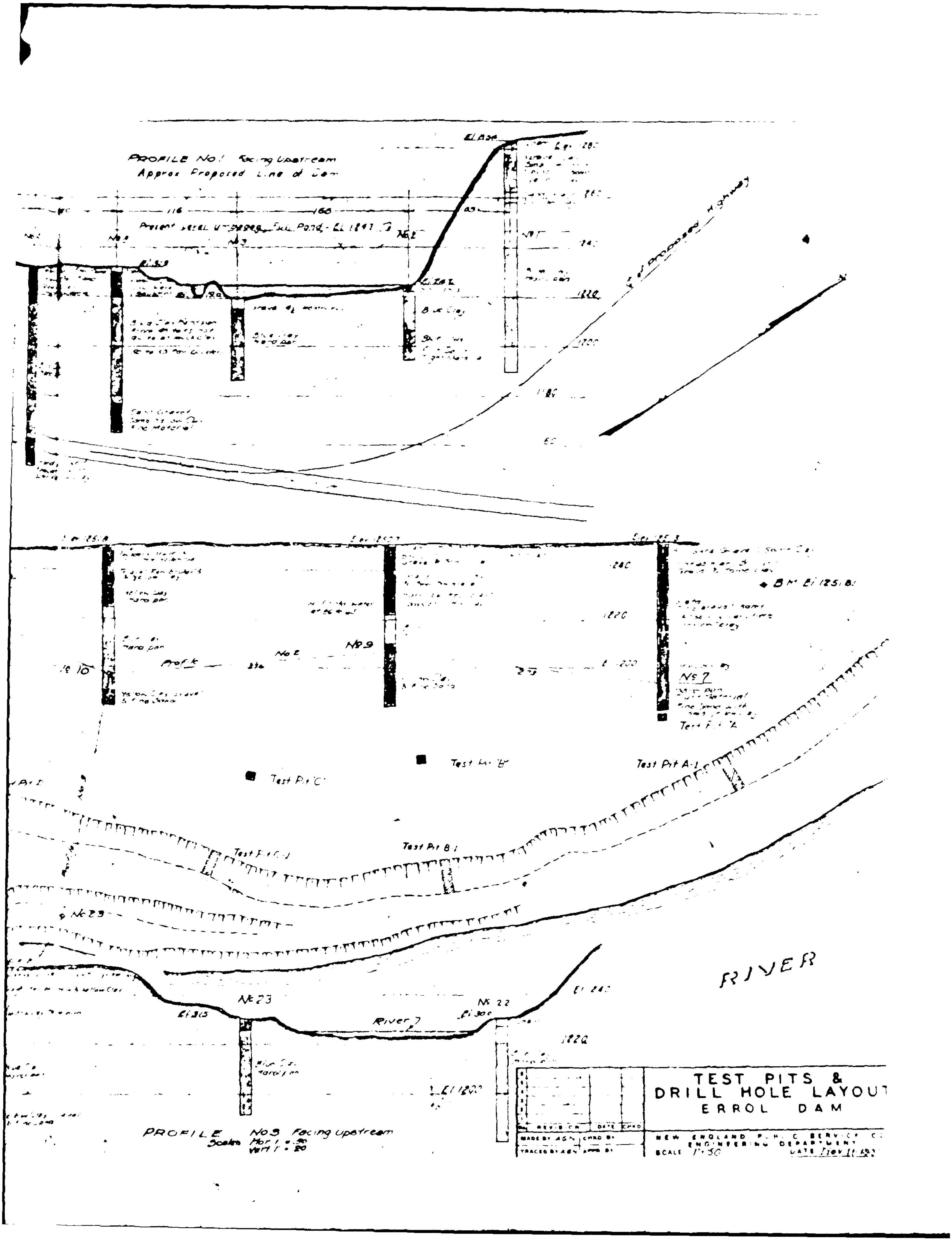
Portions of the dike construction discussed above are heavily wooded but under normal conditions are above water level and dry.

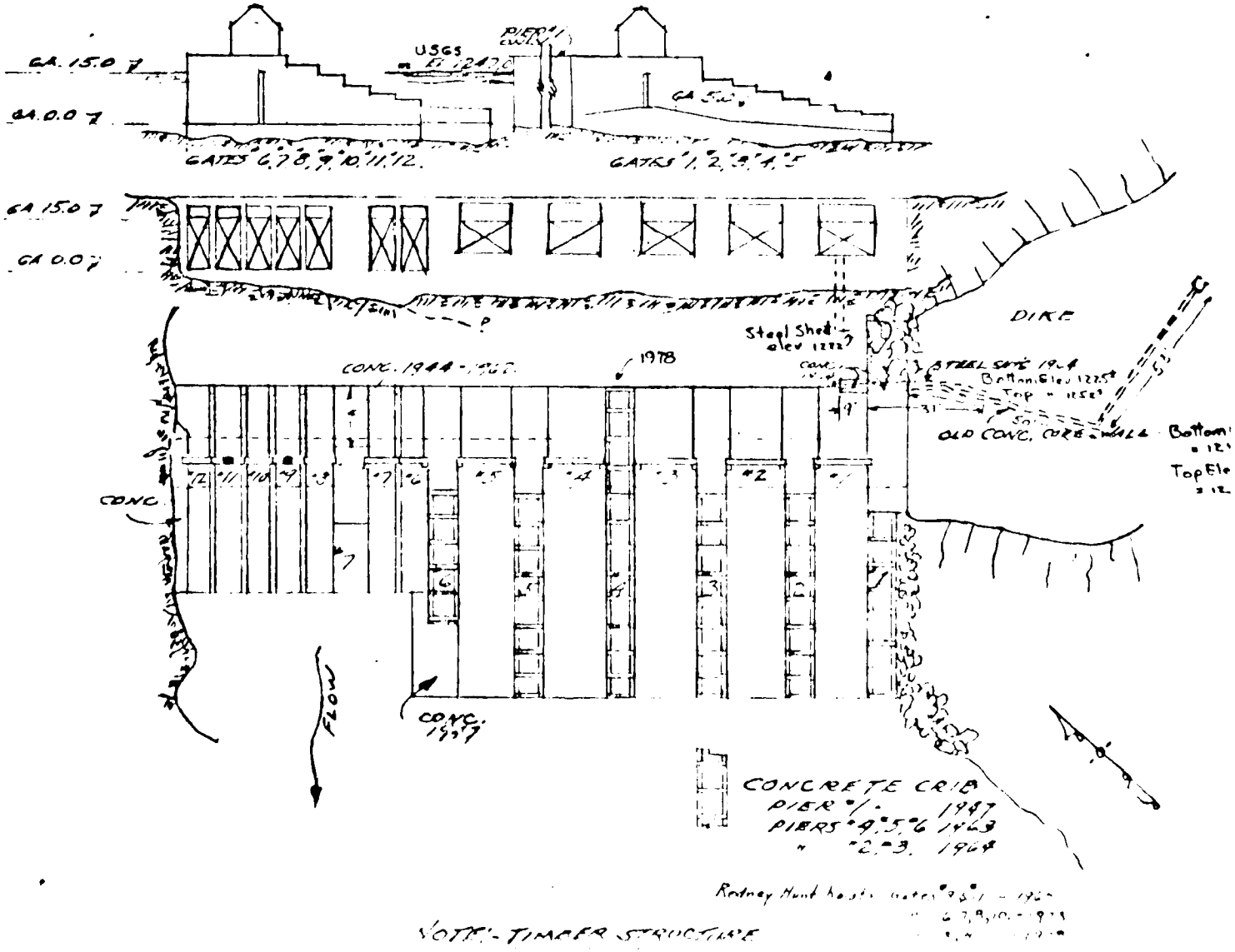
As reported in 1971, the Errol Dam and dike are in sound and satisfactory condition. Ideally, the dike should be cleared of brush and tree growth but this condition has been continuing over the history of the project and has been dicussed in the past reports.

Recommendation

As a consequence of the wooded growth which has developed over the years, continuation of the observation program shown in Appendix C, should be carried out at the dike area to ascertain a stable seepage condition. This condition, however, is not considered to constitute a major hazard for this dam. B-10


No 2 Drill Ho
Approx Location
Old Cellar Hole
No 11
Old Lot Lines
No 5
No 4
No 10
No 8
No 3
No 28 Drill Ho
Approx Loc
ANDROSCOGGIN
No 2
No 1
No 23
No 29 Drill Ho
Approx Loc
No 22


PROFILE No. 1 Facing Upstream
Approx. Proposed Line of Dam
Blue Clay
RIVER
Test Pit 'C'
Test Pit 'B'
Test Pit A-1
Test Pit B-1
No. 23
No. 22
No. 9
No. 7
BM El 1251.8
PROFILE No. 3 Facing Upstream
TEST PITS &
DRILL HOLE LAYOUT
ERROL DAM



REPAIR JOB NO. _____

COMPLETED _____

PRINT MARKED BY _____

DWG NO. FS-21

SKETCH & DIAGRAM

ERROL, N.H.

UNION WATER POWER CO.

LEWISTON, MAINE

PAUL M. BEAN, ASST. MGR.

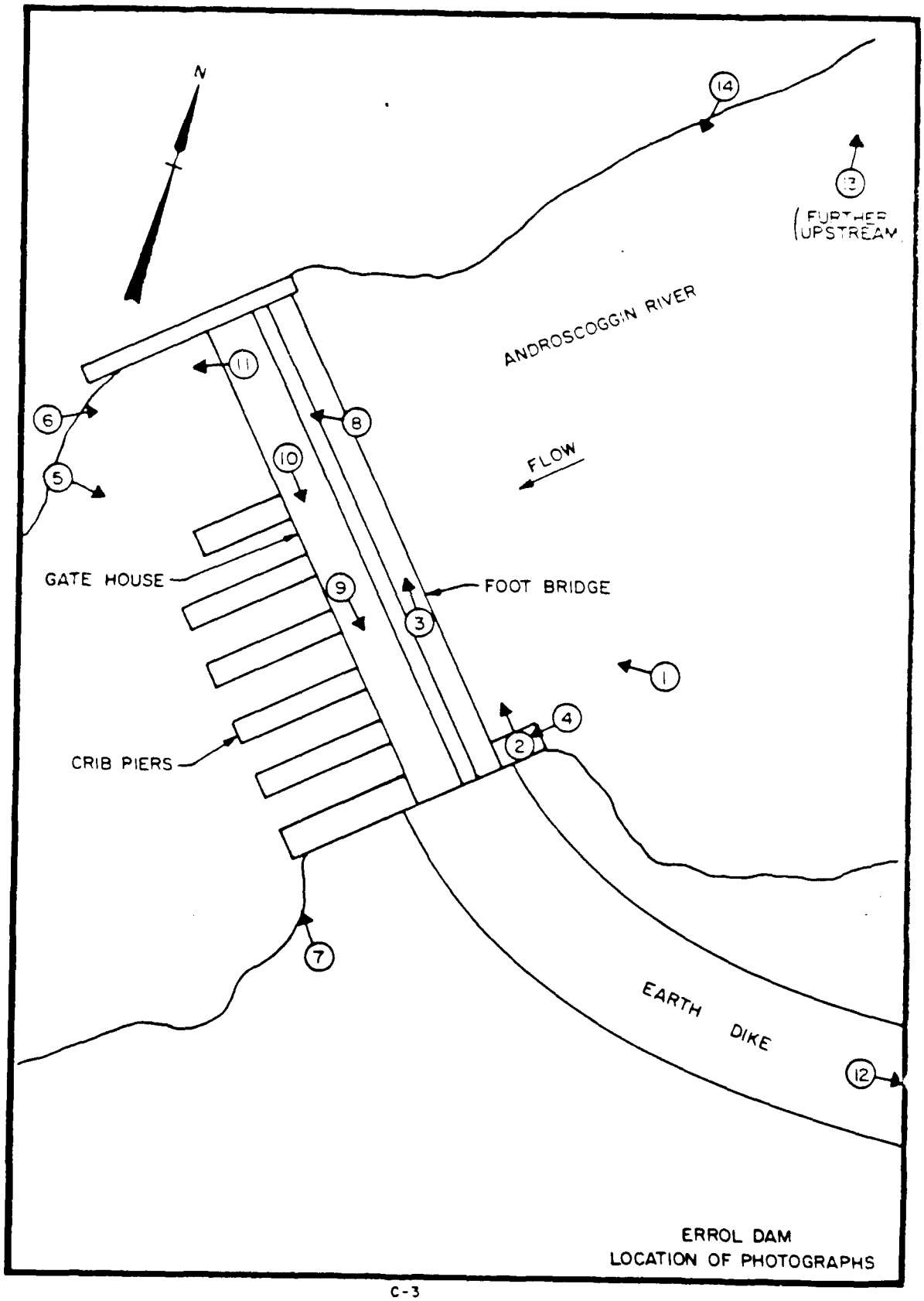
APPENDIX C

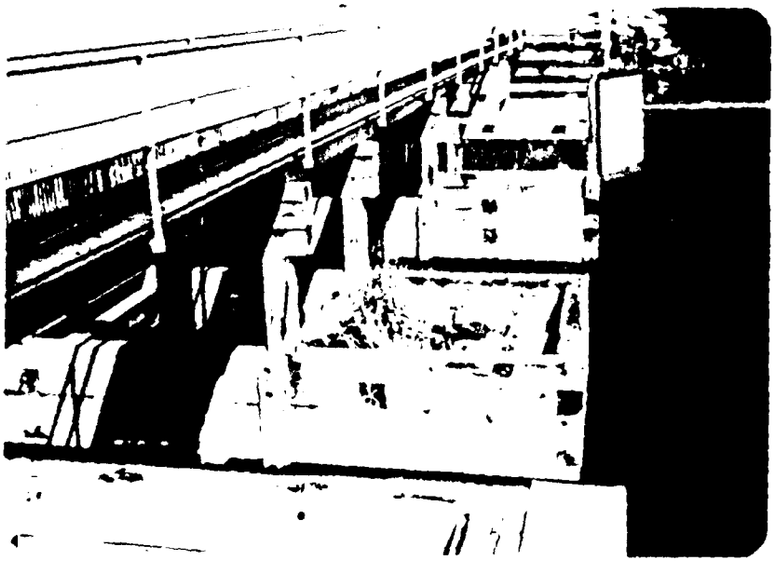
PHOTOGRAPHS

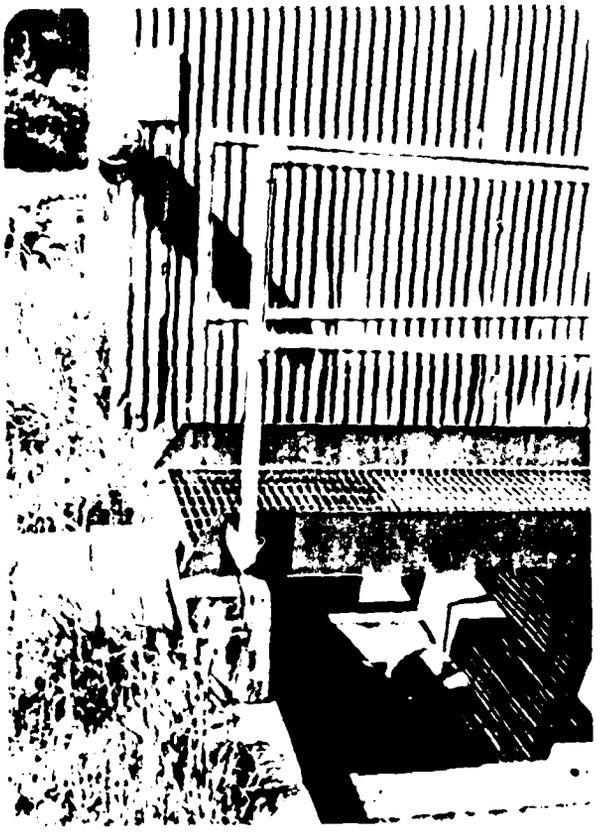
APPENDIX C

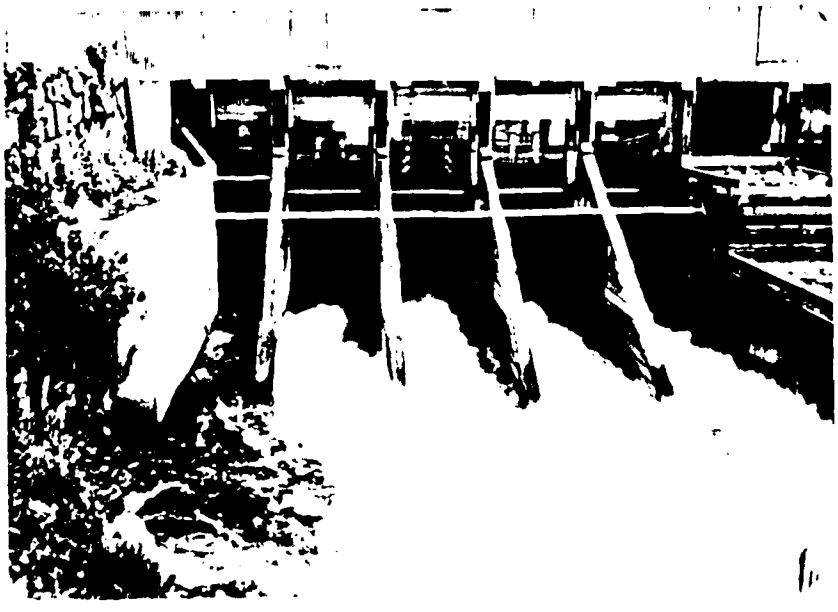
REPRESENTATIVE PHOTOGRAPHS OF PROJECT

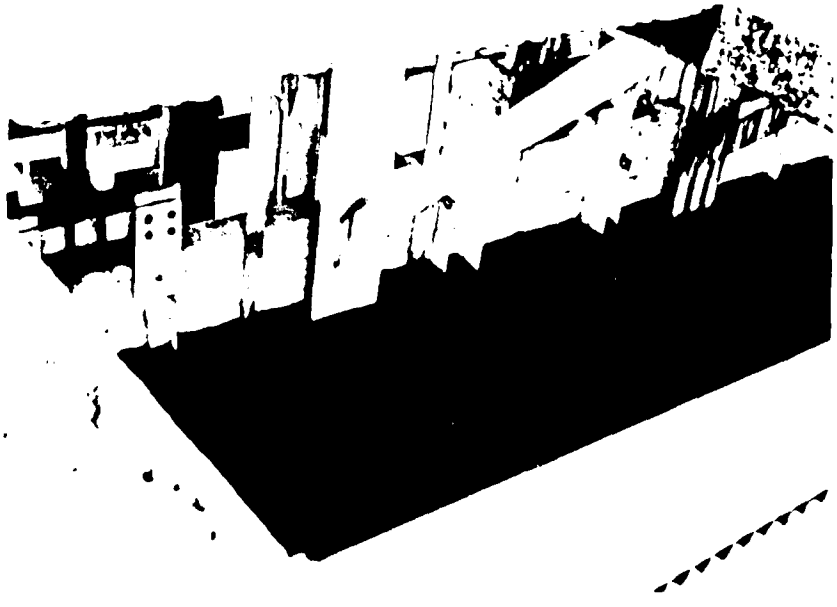
No.		Negative No.	Page
11.	Extension of north abutment downstream.	11-33A	C-9
12.	Top of earth dike, looking southeast away from dam.	11-25	C-9
13.	Right bank of Androscoggin River, showing a culvert under Route 16, about 1500 feet upstream of the Errol Dam.	11-30A	C-10
14.	Androscoggin River approaching the Errol Dam, looking southwest.	11-27	C-10


N
14
13
FURTHER UPSTREAM
ANDROSCOGGIN RIVER
11
6
8
10
5
FLOW
GATE HOUSE
9
FOOT BRIDGE
3
1
4
2
CRIB PIERS
7
EARTH DIKE
12
ERROL DAM
LOCATION OF PHOTOGRAPHS









APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

APPENDIX-D

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON

PROJECT [illegible]

FILE NUMBER [illegible]
SHEET NUMBER [illegible]
DATE [illegible]
COMPUTED BY [illegible]
CHECKED BY

SUBJECT [illegible]
[illegible]

Total drainage area of Umbagog Lake at Errol Dam

= 1095 Square miles

The drainage area is characterized by mountainous topography. The [illegible] curves [illegible] may not be applicable [illegible] storage [illegible] on the upper lakes.

Detailed flood studies conducted in [illegible] for the proposed [illegible] project on Androscoggin River just ½ mile downstream of the existing Errol dam, resulted in a spillway test flood inflow hydrograph with a peak value of 175,000 cfs.

It is considered to be a reasonable value obtained from a possible assumption that all the upstream lakes would be full at the start of the storm including Umbagog Lake.

∴ Adopted spillway test flood peak inflow

= 175,000 cfs.

FAY SPOFFORD & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EN-C61(2)

FILE NUMBER EN-[illegible]
SHEET NUMBER 2[illegible]
DATE 10/[illegible]
COMPUTED BY [illegible]

SUBJECT EARLY DAM

DISCHARGE RATING TABLE FOR DEEP GATES AND SLUICE GATES.

CHECKED BY

ELEVATION (MSL)	HEAD ON DEEP GATES (FT)	DEEP GATES Q_1 (CFS)	HEAD ON SLUICE GATES (FT)	SLUICE GATES Q_2 (CFS)	TOTAL $Q = Q_1 + Q_2$ (CFS)
1232	0				
1233	1				
1234	2				
1235	3				
1236	4	1249			1249
1237	5	1709	0	0	1709
1238	6	2234	1	320	2554
1239	7	2760	2	650	3410
1240	8	3350	3	1150	4500
1241	9	3943	4	1800	5743
1242	10	4633	5	2550	7183
1243	11	5389	6	3400	8789
1244	12	6177	7	4400	10577
1245	13	7031	8	5450	12481
1246	14	7886	9	6550	12436
1247	15	8740	10	7650	16390
1248	16	9693	11	8800	18493
1249	17	10580	12	9950	20530
1250	18	11500	13	11000	22500
1251	19	12420	14	12175	24595
1252	20	13340	15	13300	26640

NOTE: REFER TO CALIBRATION PLOTS FOR FLOW THROUGH DEEP GATES AND SLUICE GATES ON PAGES 14 & 15. THEY ARE THE BASIS FOR THE TABLE PRESENTED ABOVE. REFER TO PLOT ON PAGE 16.

PAY BRADFORD & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EM-504 (2)

FILE NUMBER E-M-504
SHEET NUMBER 3 OF
DATE 12-21-
COMPUTED BY
CHECKED BY

SUBJECT EBELL DAM

RATING TABLE FOR EL. OVER DIKE.

Assume the dike remains intact after being overtopped.

Effective length of the dike = 230 feet.

Rating curve for the dike above ELEV. 1252.0

$$Q = 2.6 \times 230 \times H^{3/2} = 598 \times H^{3/2}$$

ELEV.	H (ft)	Q (cfs)
1252	0	0
1253	1	598
1254	2	1691
1255	3	3107
1256	4	4784
1257	5	6686
1258	6	8789
1259	7	11,075
1260	8	13,531
1265	13	28,029
1270	18	45,668
1275	23	65,962
1280	28	88,601
1285	33	113,363
1290	38	140,080
1295	43	168,618

ENGINEERS BOSTON

PROJECT [illegible]

SHEET NUMBER 4 : E

DATE 12-22-[illegible]

SUBJECT FROL DAM

COMPUTED BY

CHECKED BY

COMPOSITE RATING TABLE

ELEV.	FLOW THROUGH DEEP GATES AND SLUICES	FLOW OVER DIKE	TOTAL
1236	1,249		1,249
1237	1,709		1,709
1238	2,554		2,554
1239	3,410		3,410
1240	4,500		4,500
1241	5,743		5,743
1242	7,183		7,183
1243	8,789		8,789
1244	10,577		10,577
1245	12,481		12,481
1246	12,436		12,436
1247	16,390		16,390
1248	15,493		15,493
1249	20,530		20,530
1250	22,500		22,500
1251	24,595		24,595
1252	26,640	0	26,640
1253	28,800	598	29,398
1254	31,000	1,691	32,691
1255	33,000	3,107	36,107
1256	35,200	4,784	39,984
1257	37,200	6,686	43,886
1258	39,300	8,789	48,089
1259	41,700	11,075	52,775
1260	43,600	13,531	57,131
1265	54,200	28,029	82,229
1270	65,000	45,668	110,668
1275	76,000	65,962	141,962
1280	86,800	88,601	175,401
1285	97,800	113,363	211,163
1290	109,000	140,030	249,030

REFER TO PLOT ON PAGE 17.

APPENDIX D

PAY BROOKFORD & THORNDIKE INC. Engineers Boston

PROJECT EN-[illegible](2)

FILE NUMBER EN-[illegible]
SHEET NUMBER 5 OF
DATE 9-29-78
COMPUTED BY FMM
CHECKED BY

SUBJECT EPPING SPA - DEVELOPMENT OF TAILWATER RATING CURVE (APPROXIMATE METHOD)

NATIONAL DAM INSP. PROGRAM

$n = 0.045$ (To 10' depth) $\quad n = 0.050$ (over 10' depth)

$C = \frac{1.486}{.045} = 33.02$ $\quad C = \frac{1.486}{.050} = 29.72$

S_b = mean bed slope = 0.002225, $S_b^{1/2} = 0.0472$

REFER TO PLOTS ON PAGES 18 & 19.

ELEV.	DEPTH	a	p	r	$r^{2/3}$	C	K_d	$S_b^{1/2}$	Q
1232	0	0	0	0	0	—	—	—	
1237	5	525	155	3.39	2.2567	33.02	39,120	0.0472	1,850
1242	10	1,510	286	5.28	3.0322	33.02	151,190	.0472	7,140
1247	15	3,585	531	6.75	3.5716	29.72	380,540	.0472	17,960
1252	20	6,835	769	8.89	4.2914	29.72	871,740	.0472	41,150
1257	25	11,285	997	11.32	5.0415	29.72	1,690,870	.0472	79,810
1262	30	16,835	1,195	14.13	5.8447	29.72	2,933,000	.0472	138,440
1267	35	23,260	1,350	17.23	6.6710	29.72	4,611,580	.0472	217,670
1272	40	30,435	1,520	20.02	7.3732	29.72	6,669,270	.0472	314,790
1277	45	38,510	1,722	22.36	7.9368	29.72	9,093,800	.0472	428,760
1282	50	47,585	1,920	24.78	8.4996	29.72	12,020,357	.0472	567,360
1287	55	57,585	2,080	27.68	9.1505	29.72	15,660,405	.0472	739,170
1292	60	68,385	2,245	30.46	9.7533	29.72	19,822,628	.0472	935,630
1297	65	79,935	2,377	33.63	10.4188	29.72	24,751,610	.0472	1,168,280

FAY SPOFFORD & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EN-COE(2)

FILE NUMBER E-[illegible]
SHEET NUMBER 6 OF [illegible]
DATE 10-21-[illegible]
COMPUTED BY [illegible]
CHECKED BY

SUBJECT EERS DAM

TO DETERMINE PEAK OUTFLOW

TEST FLOOD PEAK INFLOW (Q_A)
= 175,000 cfs

TRIAL #1:

Assume test flood inflow volume
= 15 inches of runoff from D.A

Available storage upto top of earth dikes
i.e. ELEV. 1252

$$= \frac{9475 \times 20}{1095 \times 640} \times 12$$

= 3.245 inches of runoff from D.A

$$\frac{\text{Lake detention vol.}}{\text{Inflow runoff vol.}} = \frac{3.245}{15}$$

$$= 0.216$$

Referring to Figure 17-11 in SCS NEH, Section 4
Corresponding

$$\frac{\text{Outflow Peak Rate}}{\text{Inflow Peak Rate}} = 0.92$$

Outflow Peak Rate = 0.92 × 175,000 cfs
= 161,000 cfs

FAY SPOFFORD & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EH-601(2)

FILE NUMBER [illegible]
SHEET NUMBER 7 of [illegible]
DATE 12-28-[illegible]
COMPUTED BY [illegible]
CHECKED BY [illegible]

SUBJECT EERIE DAM

TO DETERMINE PEAK OUTFLOW

TRIAL #2:

From the computed rating curve, the above outflow Peak rate (inflow) corresponds to ELEV. 1278.0

i.e. Surcharge height above the top of bell of siphon gates

= 46 feet

∴ Vol. of surcharge storage (STOR)

$$= \frac{8850 \times 46}{10.5 \times 640} \times 12$$

= 6.96 inches of runoff from D.A.

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

$$= 175{,}000\left(1 - \frac{6.96}{15}\right)$$

$$= 175{,}000\left(1 - 0.464\right)$$

$$= 175{,}000 \times 0.536$$

$$= 93{,}800 \text{ cfs.}$$

PAY BROFFORD & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EN-606(2)

FILE NUMBER E/1-611
SHEET NUMBER 2 OF
DATE 12-22-1972
COMPUTED BY [illegible]
CHECKED BY

SUBJECT EAGLE DAM
TO DETERMINE PEAK OUTFLOW

TRIAL #3 :

From the composite discharge values curve the above outflow Peak rate corresponds to ELEV. 1267.0

i.e. Surcharge height above the top of sill of slide gates = 35 feet.

∴ Volume of discharge storage (STOR)

$$= \frac{6850 \times 35}{1095 \times 640} \times 12$$

$$= 5.304 \text{ inches of runoff from D.A.}$$

∴ Peak outflow $Q_{P_2} = 175{,}000\left(1 - \frac{5.304}{15}\right)$

$$= 175{,}000\,(1 - 0.354)$$

$$= 175{,}000 \times 0.646$$

$$= 113{,}050 \text{ cfs.}$$

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON

PROJECT EA-066(2)

FILE NUMBER E[illegible]
SHEET NUMBER [illegible]
DATE 12-2[illegible]
COMPUTED BY [illegible]
CHECKED BY

SUBJECT EFFECT OF DAM
TO DETERMINE PEAK OUTFLOW

TRIAL #4:

From the composite discharge rating curve the above outflow peak rate corresponds to elevation 4

i.e. Surcharge height above the lip of spillway dam gates = 38.4 feet.

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

$$= \frac{8850 \times 38.4}{1095 \times 640} \times 12$$

$$= 5.82 \text{ inches of run off from D.A.}$$

∴ Peak outflow $Q_{f_2} = 175{,}000 \left(1 - \frac{5.82}{15}\right)$

$$= 175{,}000 \left(1 - 0.388\right)$$

$$= 175{,}000 \times 0.612$$

$$= \underline{107{,}100 \text{ cfs}}$$

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON

PROJECT [illegible]

FILE NUMBER [illegible]
SHEET NUMBER [illegible]
DATE 12-25-1972
COMPUTED BY [illegible]
CHECKED BY

SUBJECT EFFECT OF DAM
TO DETERMINE PEAK OUTFLOW

TRIAL #5:

From the complete discharge rating curve the above outflow peak rate corresponds to elevation

i.e. Surcharge height above the retarding level of the gates

= 37.6 feet.

∴ Vol. of surcharge storage ($STOR_1$)

$$= \frac{8850 \times 37.6}{1095 \times 640} \times 12$$

$$= 5.698 \text{ inches of runoff from S.A}$$

∴ Peak outflow $Q_{P_2} = 175{,}000 \left(1 - \frac{5.698}{15}\right)$

$$= 175{,}000 \left(1 - 0.38\right)$$

$$= 175{,}000 \times 0.62$$

$$= \underline{108{,}500 \text{ CFS}}$$

PAY BROCKLEBANK & THORNDIKE INC
ENGINEERS
BOSTON

PROJECT EN-111-2)

FILE NUMBER EN-111-2
SHEET NUMBER 11 of F
DATE 12-__-1977
COMPUTED BY J.E.H.
CHECKED BY

SUBJECT EARTH DAM

TO DETERMINE PEAK OUTFLOW

TRIAL #6:

From the corresponding discharge during which the above outflow peak rate corresponds to ELEV. 1269.7

i.e. Surcharge height above the top of all of gates

= 37.7 feet

∴ Volume of Surcharge storage ($STOR_2$)

$$= \frac{8850 \times 37.7}{1575 \times 640} \times 12$$

= 5.713 inches of runoff from D.A

Average of $STOR_1$ and $STOR_2$

$$= \frac{5.698 + 5.713}{2}$$

= 5.706 inches of runoff from D.A

∴ PEAK OUTFLOW (Q_{P_2}) $= 175{,}000\left(1 - \frac{5.706}{15}\right)$

$= 175{,}000(1 - 0.380)$

$= 108{,}500$ cfs

FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON

PROJECT EN-006(2)

FILE NUMBER [illegible]
SHEET NUMBER [illegible]
DATE [illegible]
COMPUTED BY [illegible]
CHECKED BY

SUBJECT ERROL DAM
TO DETERMINE PEAK OUTFLOW

Assuming the earth dike remains in tact after being overtopped, and the barrage at the [illegible] remains in tact after being submerged, the above computed peak outflow corresponding ELEV. 126.4 ft. in the composite discharge rating curve.

Therefore, the earth dike would be overtopped due to test flood peak inflow by [illegible] feet.

TEST FLOOD PEAK OUTFLOW = 105,500 CFS.

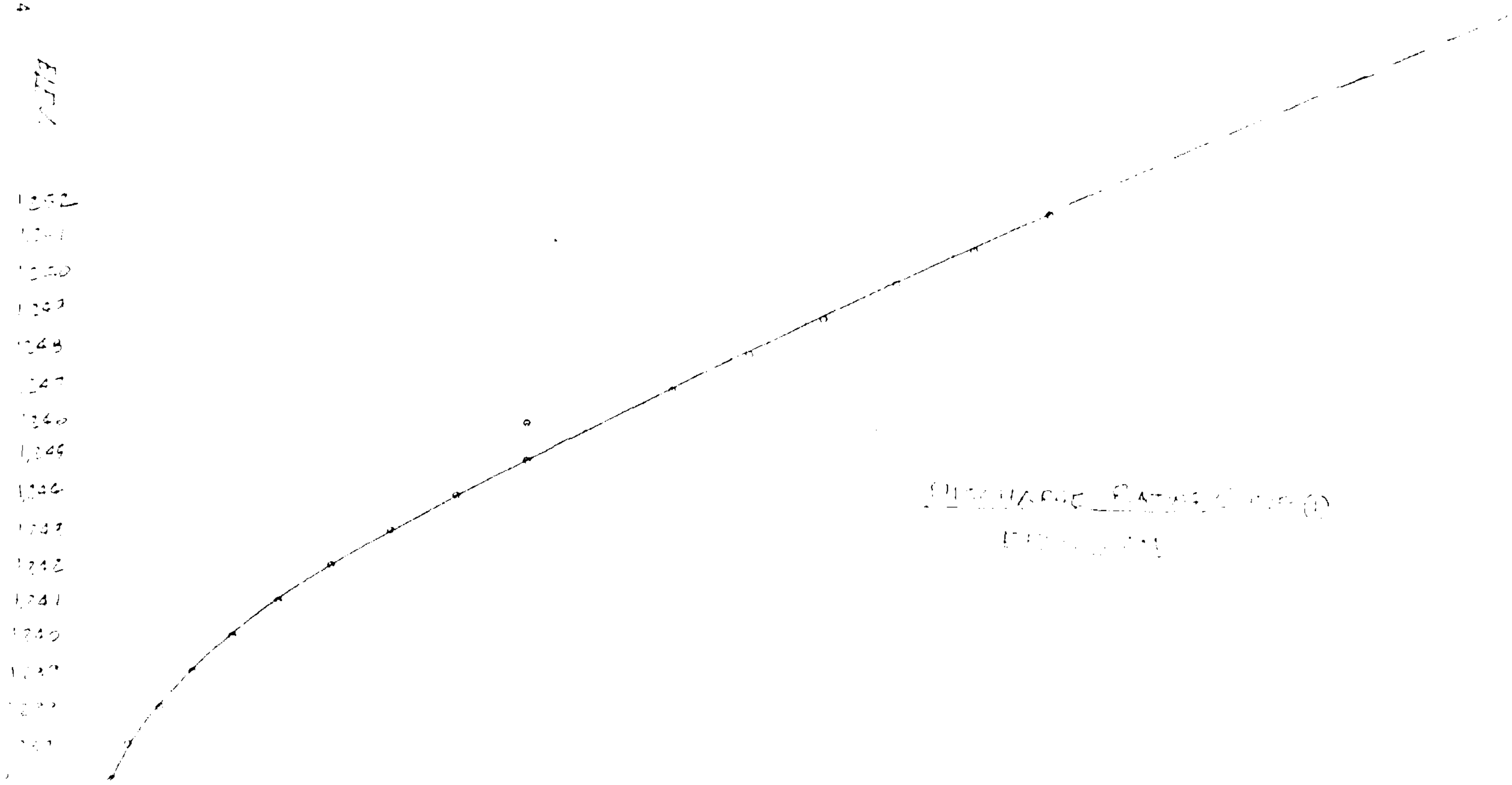
Tailwater rating curve for Androscoggin River just below Errol Dam (or approximately barrage) is computed and included in APPENDIX - D (refer to pages 5, 19, and 21).

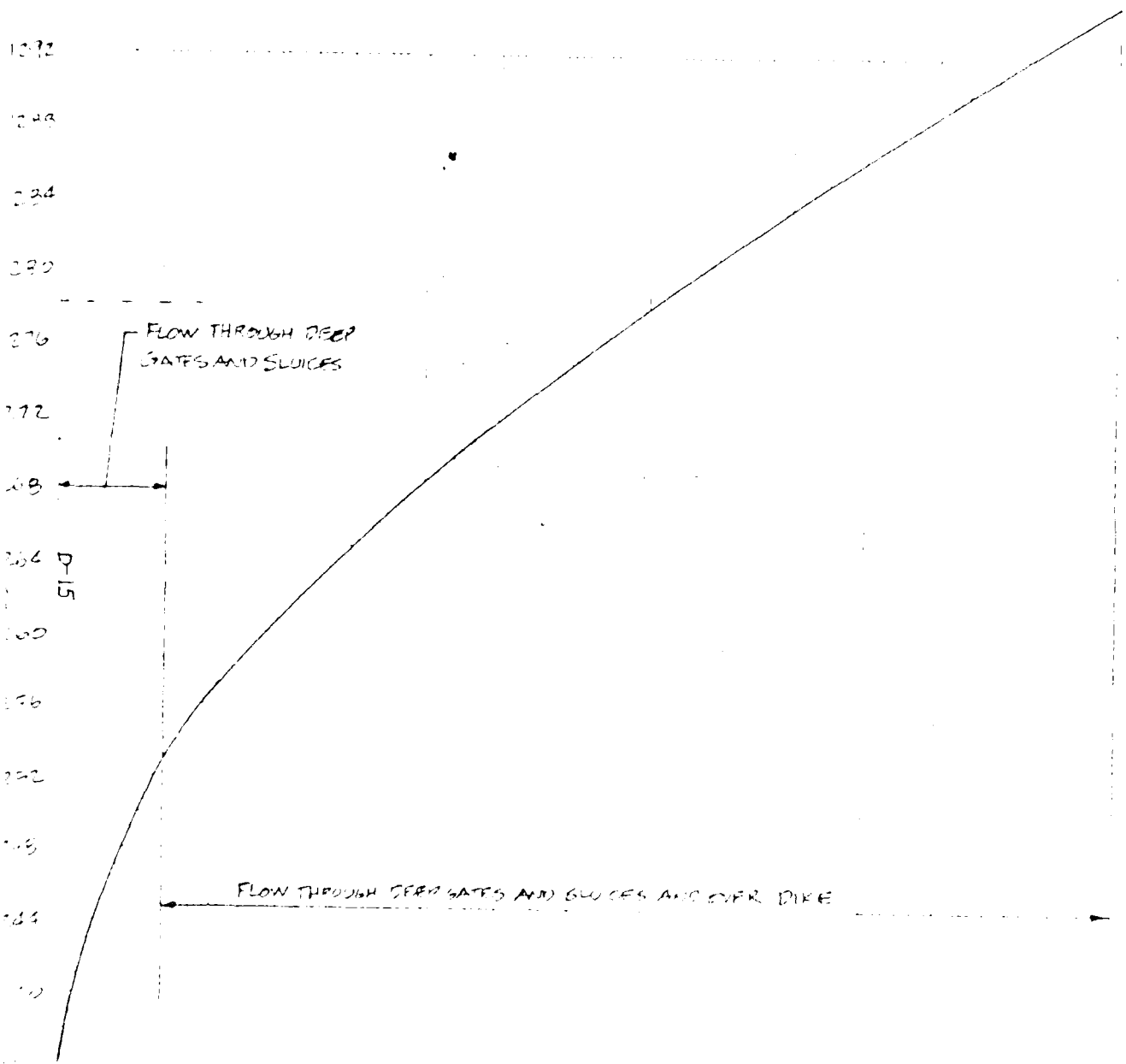
Corresponding to peak outflow, the water surface elevation in the Androscoggin river

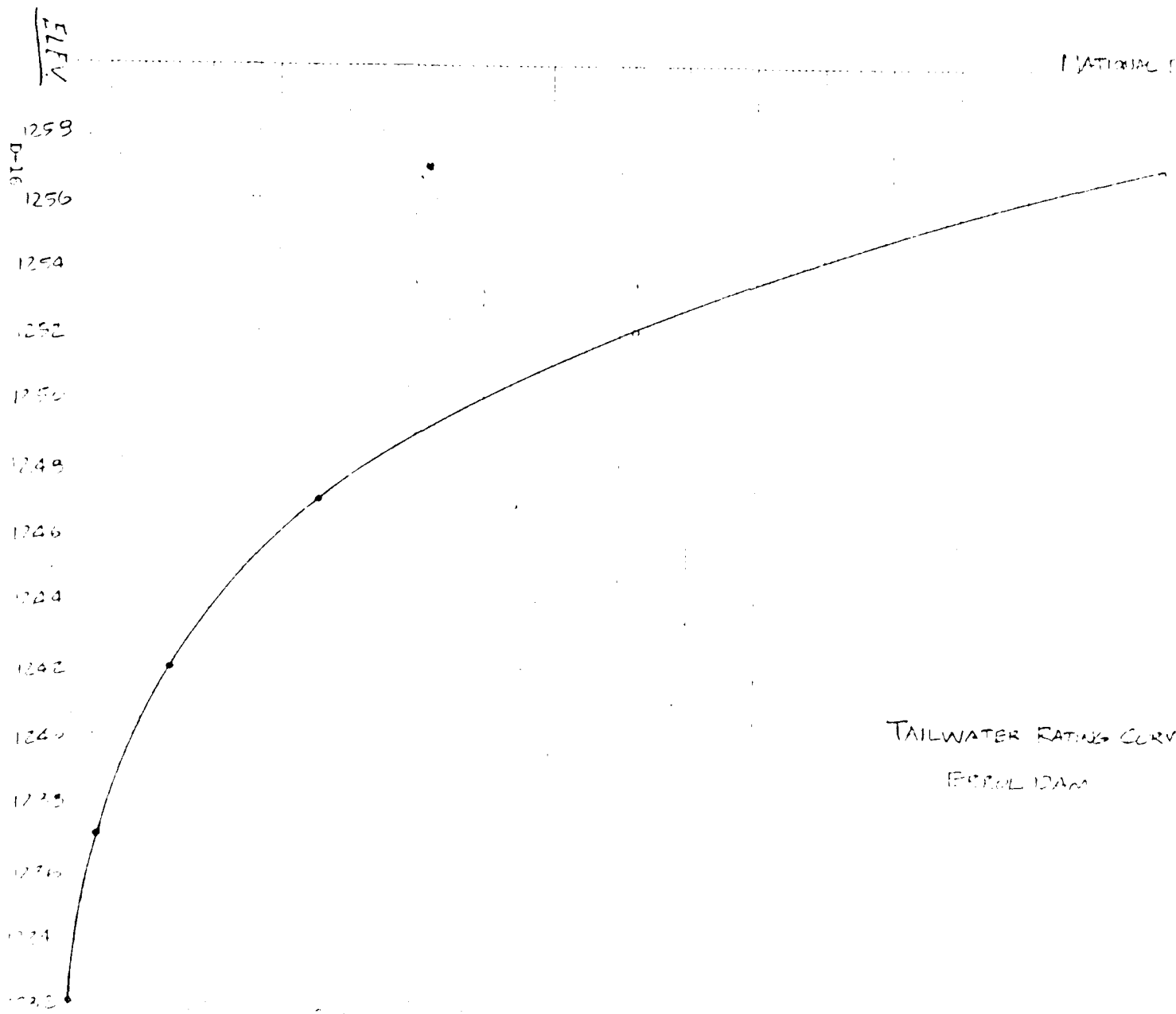
FAY, SPOFFORD & THORNDIKE, INC.
ENGINEERS
BOSTON

PROJECT

SUBJECT

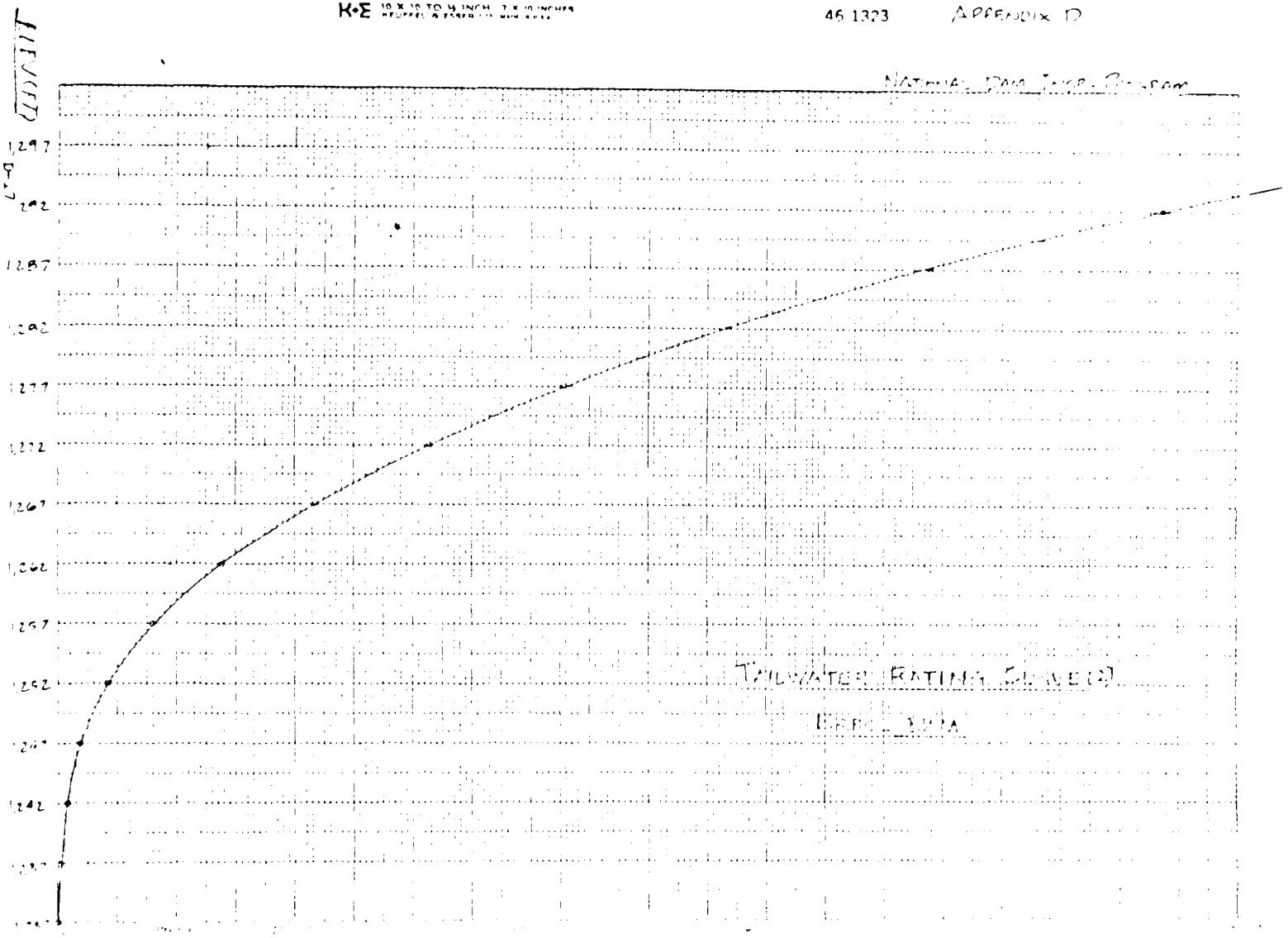

ELEV.

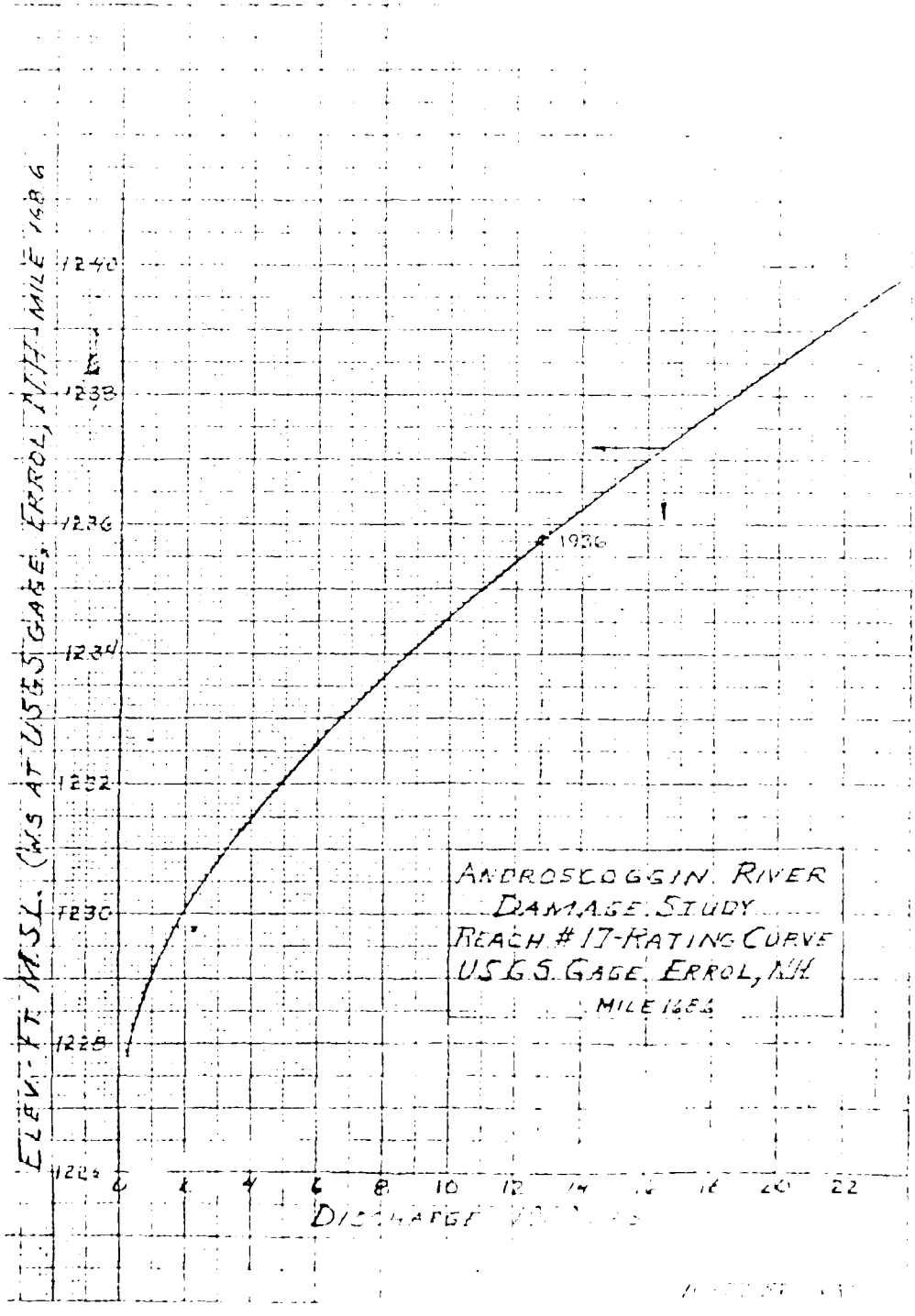

FLOW THROUGH DEEP GATES AND SLUICES
FLOW THROUGH DEEP GATES AND SLUICES AND OVER DIKE

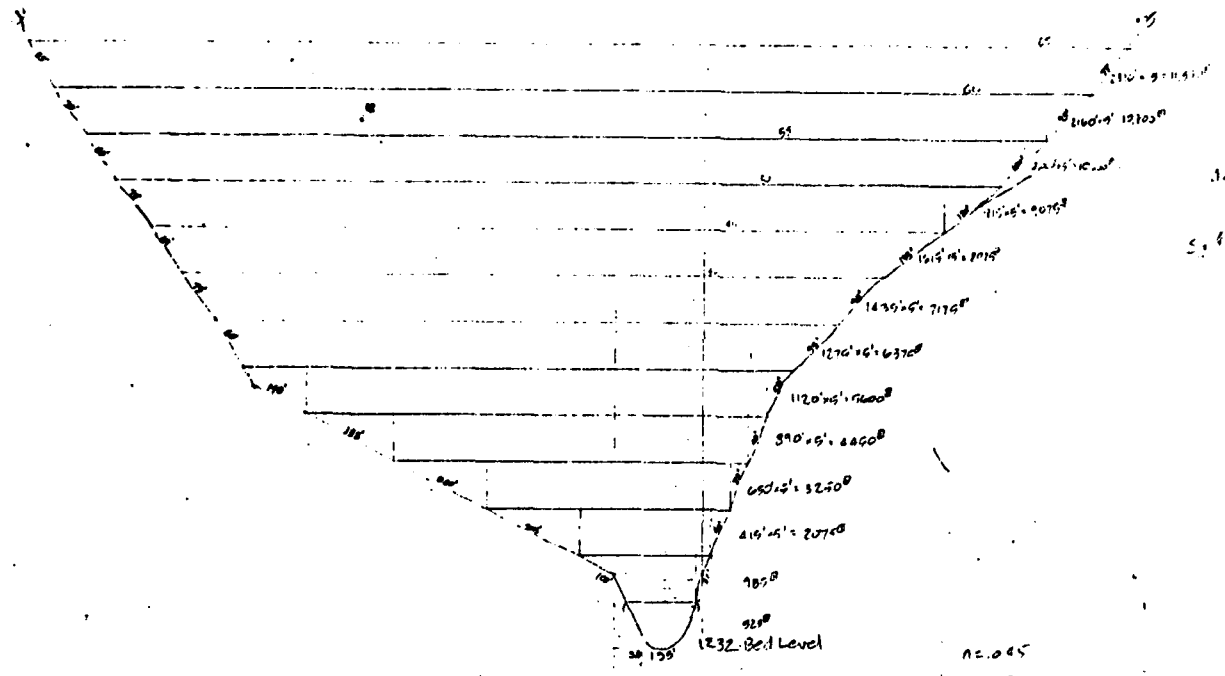


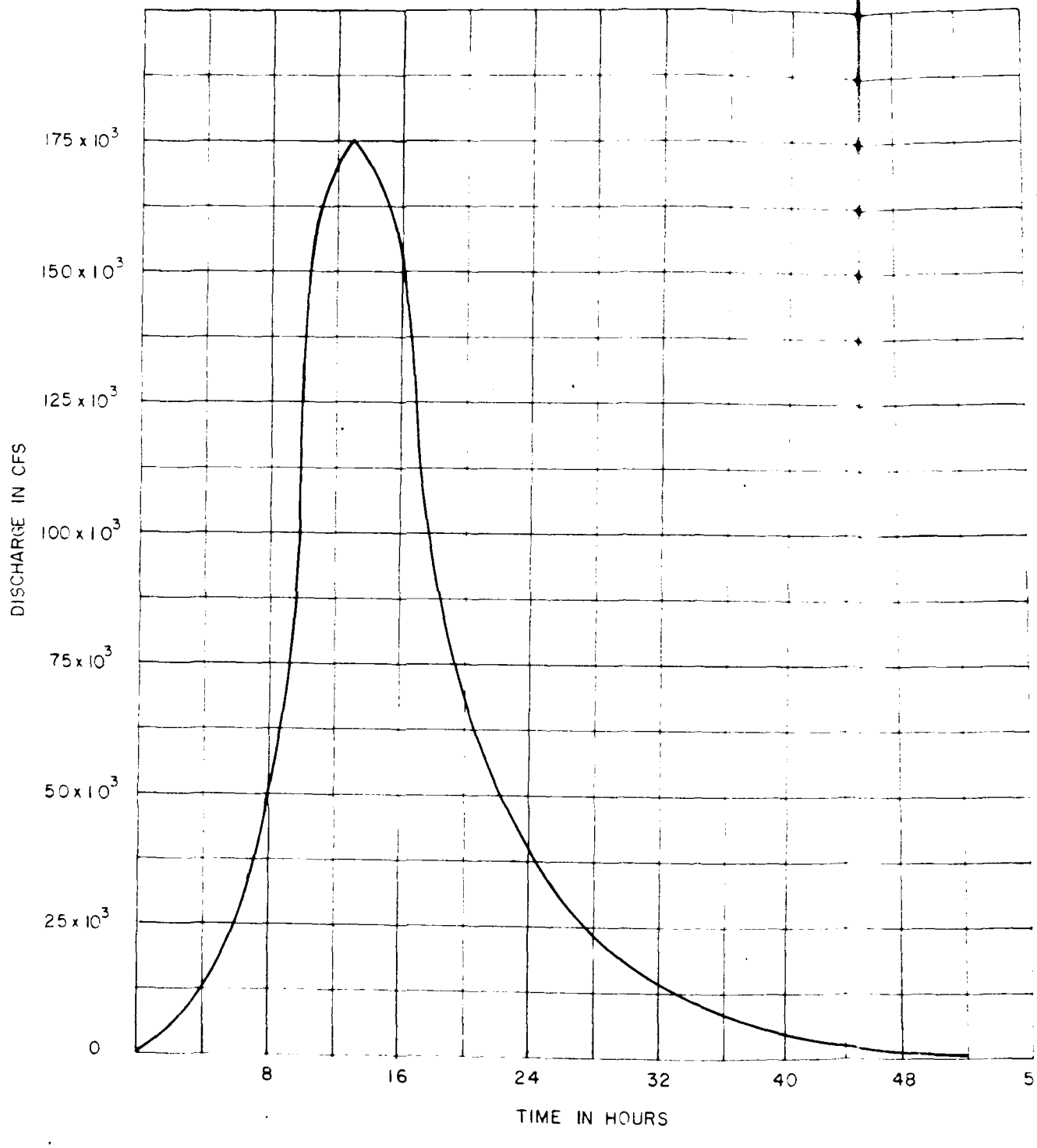
TAILWATER RATING CURVE (1)

FOSSIL DAM

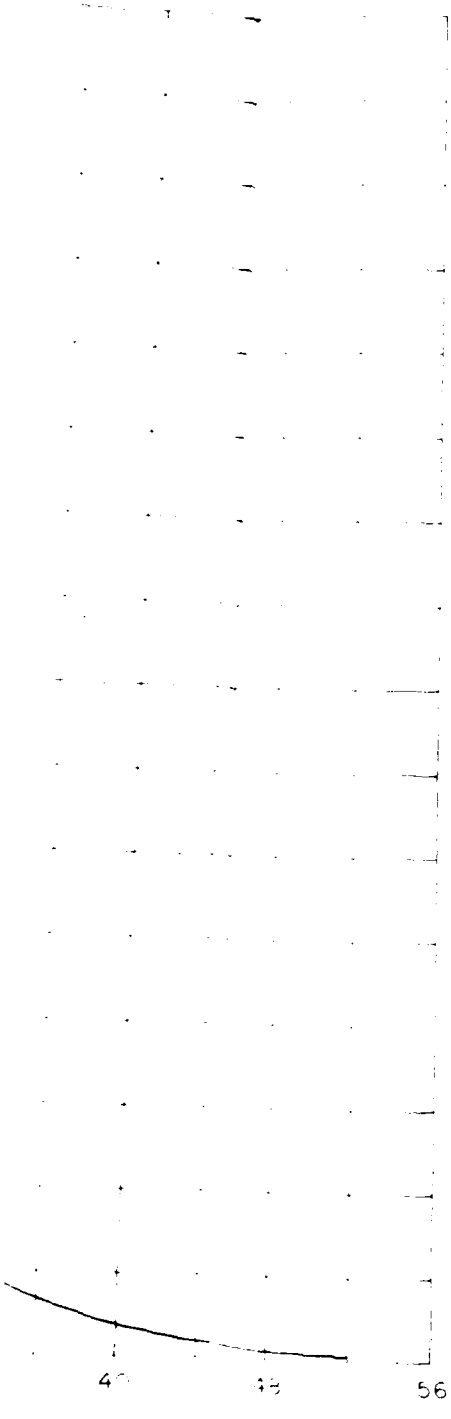

NATIONAL DAM SAFETY PROGRAM
ELEVATION (FEET)
1,297
1,292
1,287
1,282
1,277
1,272
1,267
1,262
1,257
1,252
1,247
1,242
TAILWATER RATING CURVE
DEC. 1978


ELEV. FT. M.S.L. (WS AT USGS GAGE, ERROL, N.H.) MILE 168.6
1240
1238
1236
1234
1232
1230
1228
1226
1936
ANDROSCOGGIN RIVER
DAMAGE STUDY
REACH #17-RATING CURVE
U.S.G.S. GAGE, ERROL, N.H.
MILE 168.6


1232 Bed Level



SPILLWAY TEST FLOOD INFLOW HYDROGRAPH



/ HYDROGRAF-

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

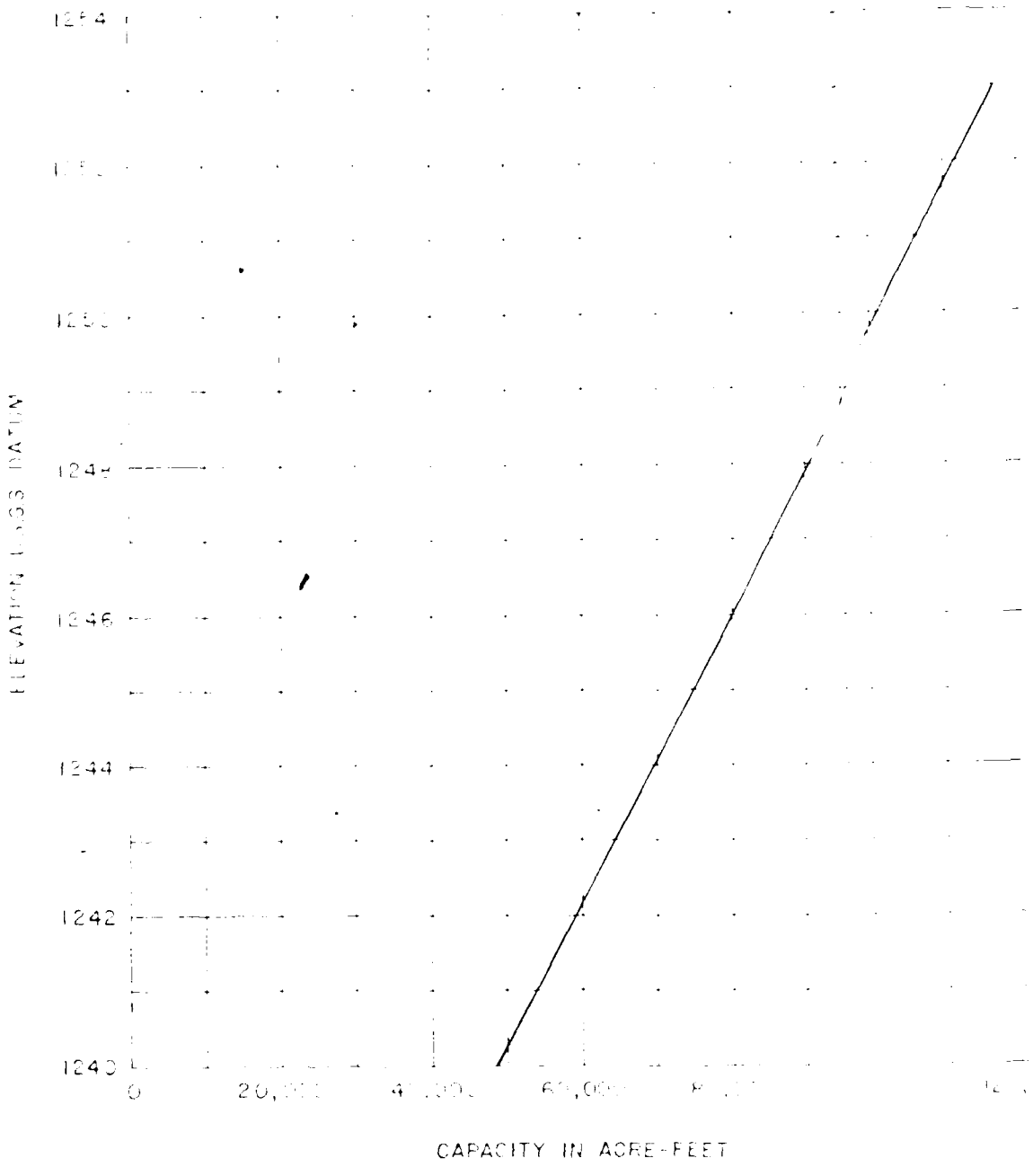
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAM

ERROL DAM

ANDROSCOGGIN RIVER — NEW HAMPSH--

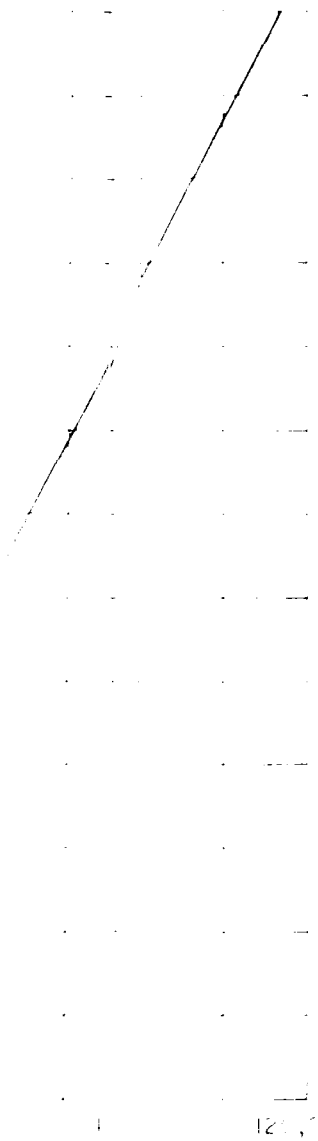
SCALE AS SHOWN

DATE AUGUST, 1978



STORAGE CAPACITY-ELEVATION CURVE

1665 (LOCAL DATUM) - 825 [illegible] (ESTIMATED)



N CURV

TIMATED)

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

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

NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS

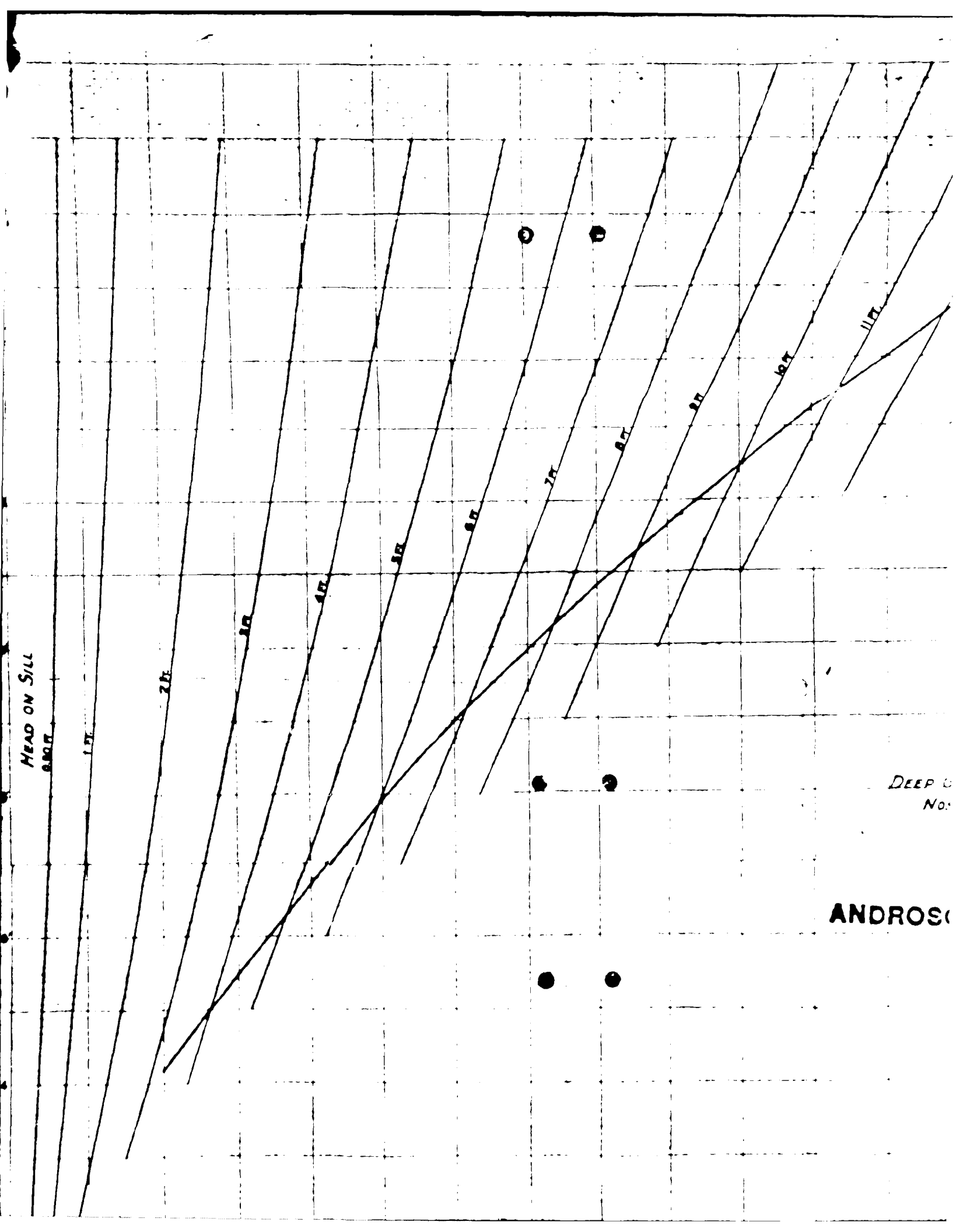
ERROL DAM

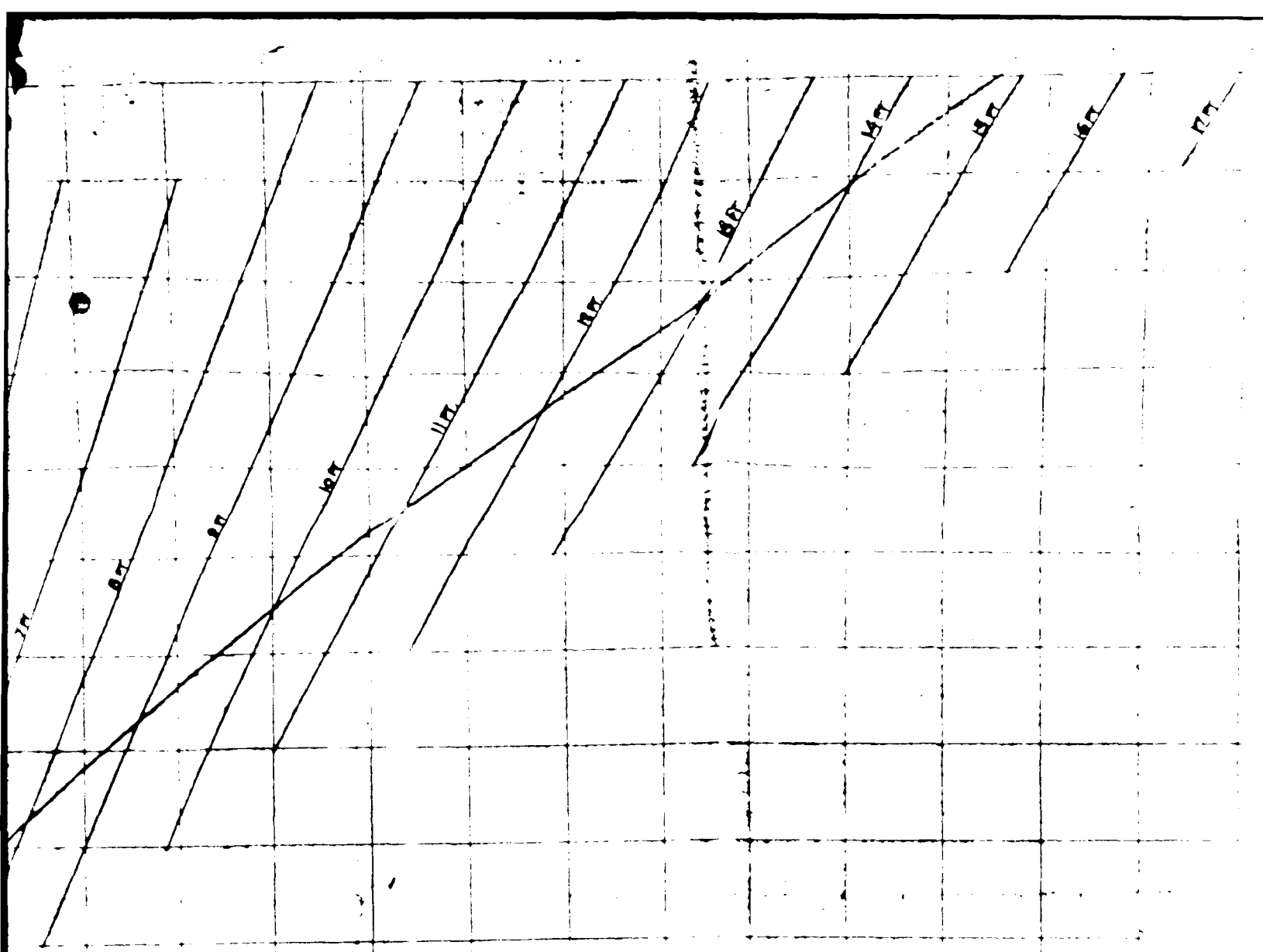
ANDR[illegible] RIVER

NEW HAMPSHIRE

SCALE AS SHOWN

DATE AUGUST, 19[illegible]

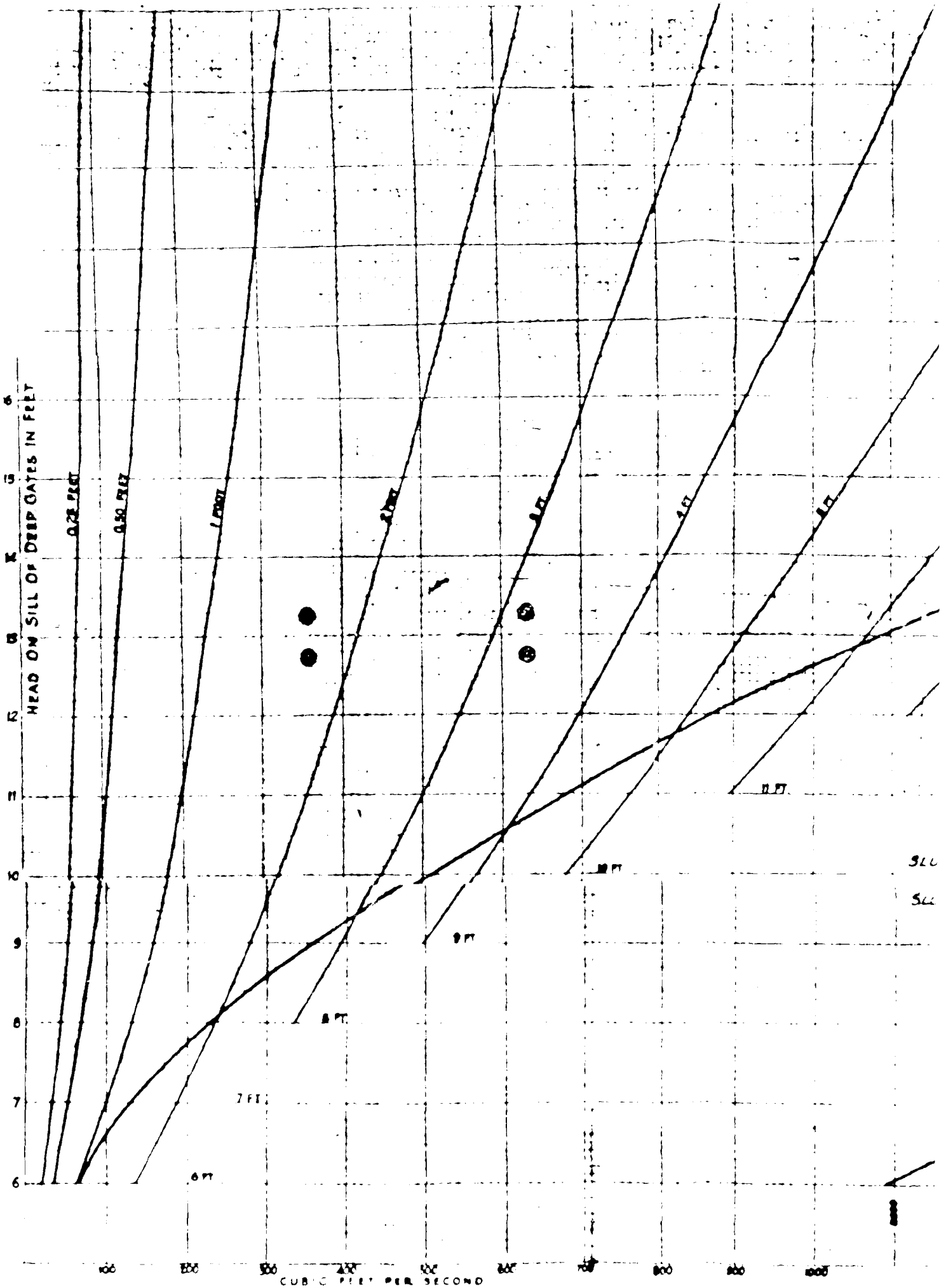

HEAD ON SILL
DEEP
NO.
ANDROS

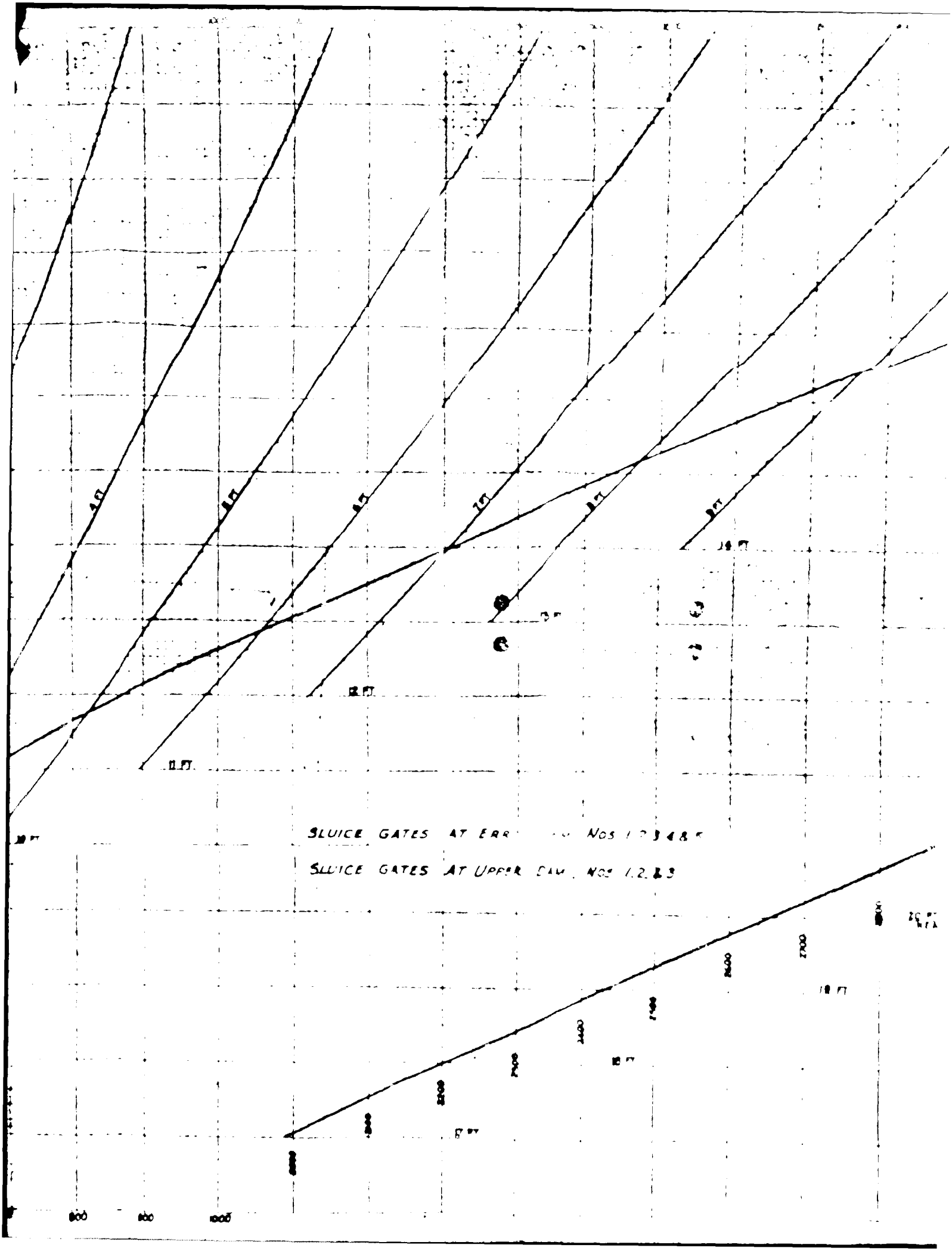


DEEP GATES AT ERROL DAM
NOS. 6, 7, 8, 9, 10, 11, & 12
SUB-AREA B-2

ANDROSCOGGIN BASIN

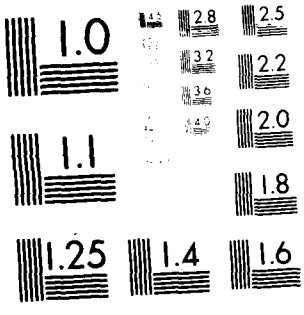
Data compiled from records of
Union Water Power Company


HEAD ON SILL OF DEEP GATES IN FEET
0.25 FEET
0.50 FEET
1.00 FT
2.00 FT
3.00 FT
4.00 FT
5.00 FT
6 FT
7 FEET
8 FT
9 FT
10 FT
11 FT
CUBIC FEET PER SECOND

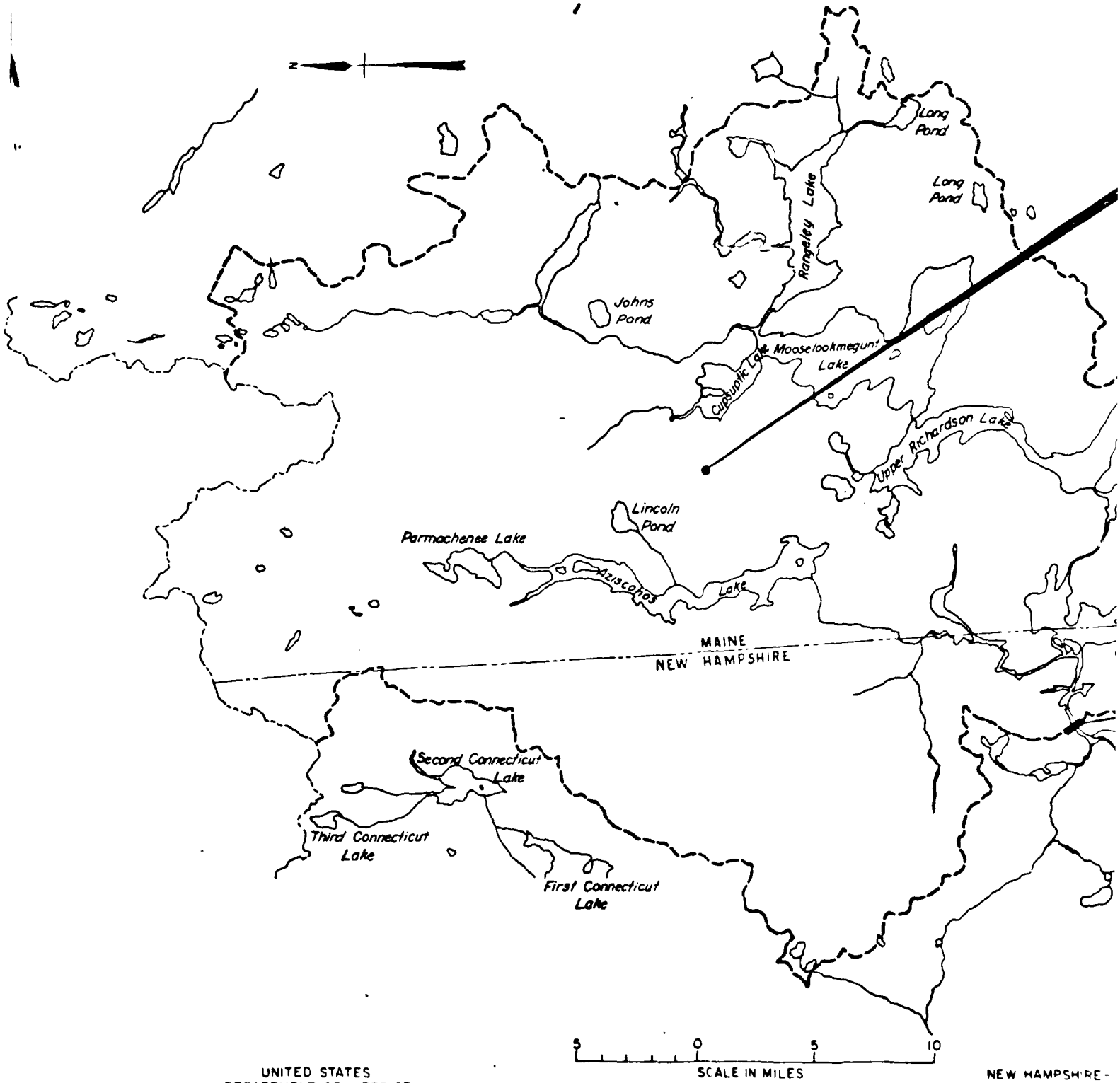

SLUICE GATES AT ERR ... NOS 1 2 3 4 5
SLUICE GATES AT UPPER DAM, NOS 1, 2, & 3

AD-A156 321 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS ERROL DAM (NH 00101)..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV MAY 79 2/2

UNCLASSIFIED F/G 13/13 NL



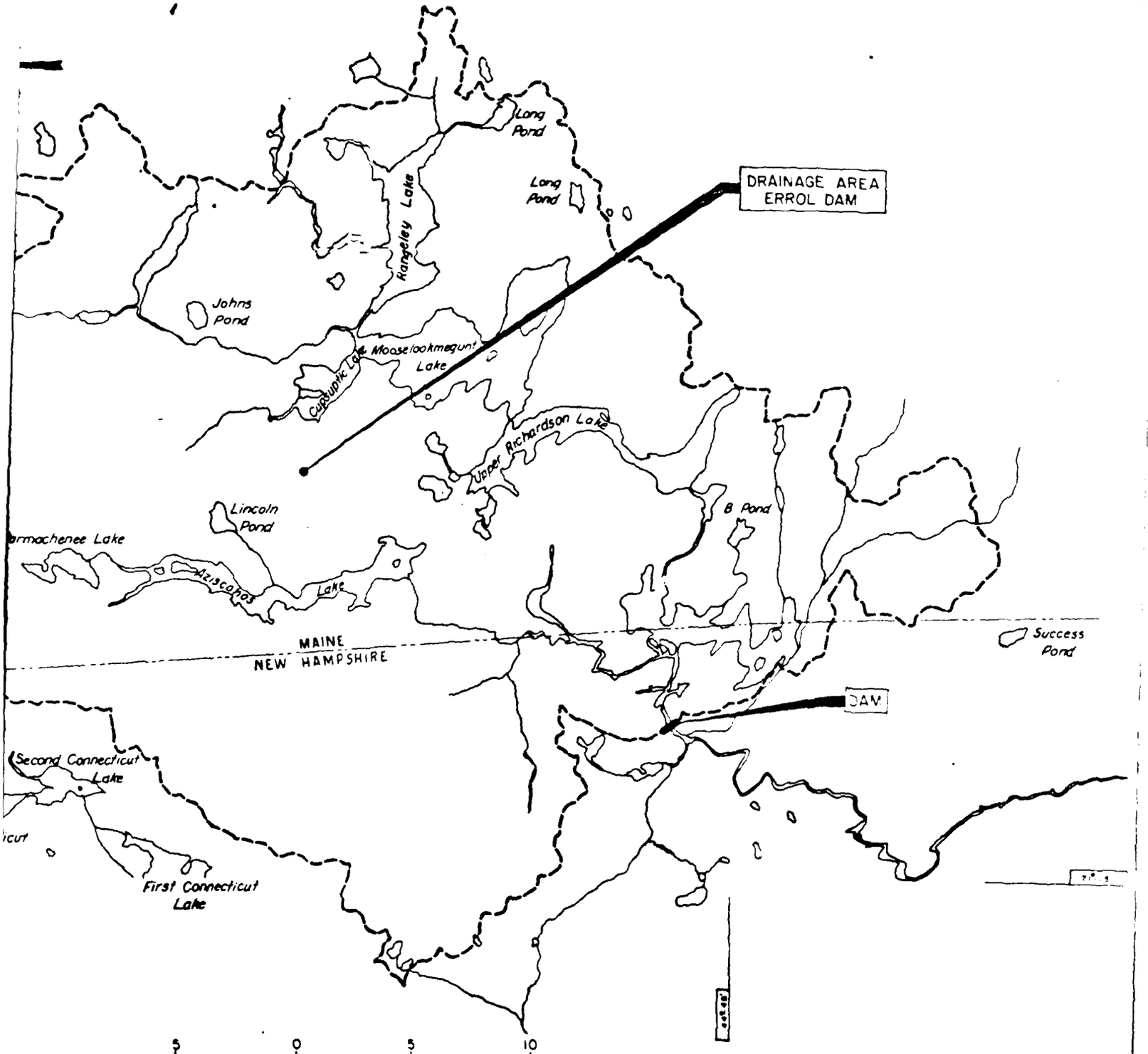
MICROCOPY RESOLUTION TEST CHART



UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

NEW HAMPSHIRE-
SECOND CONNECTICUT LAKE
INDIAN STREAM QUADR
ERROL QUADRANGL
MILAN QUADRANGL
MOOSE BOG QUADRAN

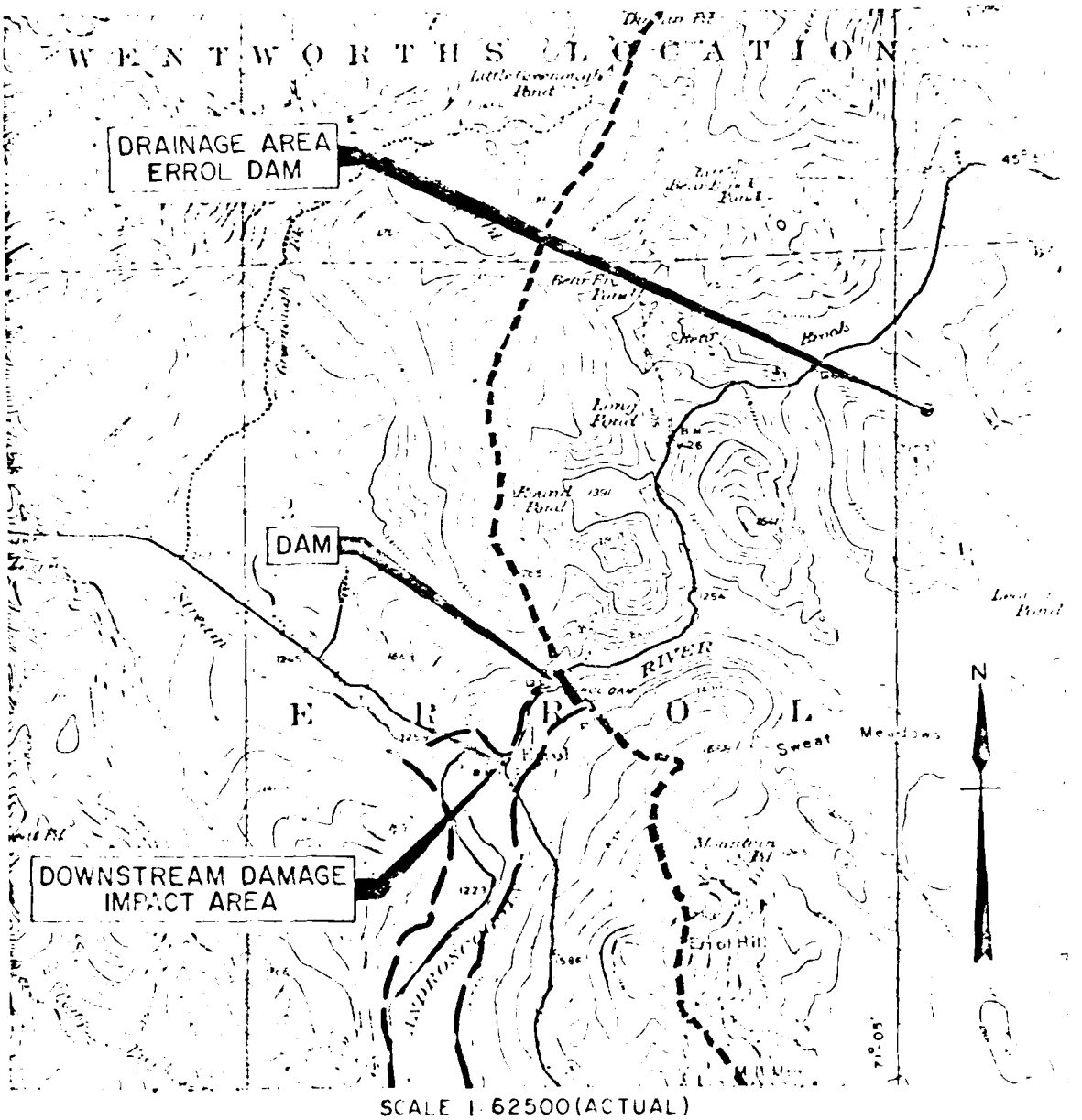
NEW HAMPSH
DIXVILLE QUADRAN



NEW HAMPSHIRE-MAINE
SECOND CONNECTICUT LAKE QUADRANGLE 1927
INDIAN STREAM QUADRANGLE 1925
ERROL QUADRANGLE 1931
MILAN QUADRANGLE 1931
MOOSE BOG QUADRANGLE 1927

NEW HAMPSHIRE
DIXVILLE QUADRANGLE 1930

MAINE
TIM MTN QUADRANGLE 1970
JIM POND QUADRANGLE 1969
QUILL HILL QUADRANGLE 1969
OQUOSSOC QUADRANGLE 1940
CUPSUPTIC QUADRANGLE 1931
RANGELEY QUADRANGLE 1933-49
BLACK MTN QUADRANGLE 1969
ARNOLD POND QUADRANGLE 1932
CHAIN OF PONDS QUADRANGLE 1969
OLD SPECK MTN QUADRANGLE 1943
KENNEBAGO LAKE QUADRANGLE 1970



SCALE 1:62500 (ACTUAL)

UNITED STATES
DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY

NEW HAMPSHIRE - MAINE
ERROL QUADRANGLE 1930

D

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	NAME (9)	(10)	(11)	REPORT DATE (12)
STATE	ENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	LATITUDE (NORTH)	LONGITUDE (WEST)	DAY | MO | YR
NH	16	NED	NH	007	02				ERROL DAM	4447.3	7107.5	05SEP78

POPULAR NAME (13)	NAME OF IMPOUNDMENT (14)
	UMBAGOG LAKE (BRAGS BAY)

(15) REGION	(16) BASIN	RIVER OR STREAM (17)	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE (18)	(19) DIST FROM DAM (MI)	(20) POPULATION
01	03	ANDROSCOGGIN RIVER	ERROL	1	200

(21) TYPE OF DAM	(22) YEAR COMPLETED	(23) PURPOSES	(24) STRUCTURAL HEIGHT (FT)	(25) HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES (26) MAXIMUM (ACRE-FT)	(27) NORMAL (ACRE-FT)	(28) INSPECTION BY FED	(29) STATE	(30) PRIV/FED	(31) SCS ACT 566	(32) VER/DATE
ERCITDPG	1887	SR	20	15	105000	80000	NED	N	N	N	N	15SEP78

REMARKS (33)

(34) D/S HAS WARNING SYSTEM	SPILLWAY (35) LENGTH (FT)	SPILLWAY TYPE	SPILLWAY WIDTH (FT)	MAXIMUM DISCHARGE (CFS) (36)	VOLUME OF DAM (CY) (37)	POWER CAPACITY (38) INSTALLED (MW)	POWER CAPACITY (39) PROPOSED (MW)	(40) NH	NAVIGATION LOCKS (41) LENGTH (FT)	(42) WIDTH (FT)	(43) LENGTH (FT)	(44) WIDTH (FT)	(45) LENGTH (FT)	(46) WIDTH (FT)	(47) LENGTH (FT)	(48) WIDTH (FT)
1	730	C	184	16500	6000											

OWNER (49)	ENGINEERING BY (50)	CONSTRUCTION BY (51)
UNION WATER POWER CO	OWNER	OWNER

REGULATORY AGENCY (52) DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NH WATER RES BD	NH WATER RES BD	NH WATER RES BD	NH WATER RES BD

INSPECTION BY (53)	INSPECTION DATE DAY | MO | YR (54)	AUTHORITY FOR INSPECTION (55)
FAY SPOFFORD & THORNDIKE, INC.	30JUN78	PL92-367

REMARKS (56)

END

DATE
FILMED

8-85

DTIC