AD-A075 838 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. NEW ROCHELLE RESERVOIR NUMBER 1 DA--ETC(U)
AUG 79 G KOCH DACW51-79-C-0001

UNCLASSIFIED NL

1 OF 2
ADA 075838

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report New Rochelle Reservoir No. 1 Hutchinson River Basin, Westchester County, New York Inventory No. N.Y. 20	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(a) George Koch, P.E.	8. CONTRACT OR GRANT NUMBER(s) DACW-51-79-C-0001
9. PERFORMING ORGANIZATION NAME AND ADDRESS New York State Department of Environmental Conservation/ 50 Wolf Road Albany, New York 12233	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS New York State Department of Environmental Conservation/ 50 Wolf Road Albany, New York 12233	12. REPORT DATE 8 Aug 1979 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Department of the Army 26 Federal Plaza/ New York District, CofE New York, New York 10007	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

Dam

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

National Dam Safety Program, New Rochelle Reservoir Number 1 (Inventory Number NY 20), Hutchinson River Basin, Hutchinson River, Westchester County, New York, Phase I Inspection Report,

18. SUPPLEMENTARY NOTES

DDC RECEIVED OCT 30 1979 A

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

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
New Rochelle Reservoir No. 1
Hutchinson River
Westchester County

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

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

New Rochelle Reservoir No. 1 was judged to be unsafe-non-emergency. Areas of seepage on the downstream toe of the southwestern dike were found. The stability analysis indicates unsatisfactory safety factors under certain loadings, and the spillway is seriously inadequate.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED 393 970

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

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 frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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 "Probably 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.

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NEW ROCHELLE RESERVOIR No. 1 DAM NY 20
LONG ISLAND RIVER BASIN

TABLE OF CONTENTS

PHASE 1 REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	New Rochelle Reservoir No. 1 Dam I.D. No. NY 20
State Located:	New York
County Located:	Westchester
Watershed:	Hutchinson River Basin
Stream:	Hutchinson River
Dates of Inspections:	November 16, 1978 December 27, 1978

ASSESSMENT

Based on the visual inspections and a review of available information, the New Rochelle Reservoir No. 1 Dam has been assigned an "unsafe-non-emergency" classification. The unsafe classification is assigned based on the following definition provided by the Corps of Engineers: "a dam with deficiencies of such a nature that if left uncorrected, could result in the failure of the dam with subsequent loss of lives or substantial property damage".

The dam is a relatively long dam consisting of two earth dikes and a central masonry section. A number of deficiencies exist on this structure, some of which are rather serious.

Attention should be given within 3 months of the date of approval of this report, to the wet area at the downstream toe of the southwestern dike. If this condition worsens, the integrity of the dike may be compromised. The stability of the dike should be investigated, and a method of treatment to control or eliminate the seepage in the wet area must be designed and constructed.

Stability analyses for the masonry section of this structure indicate that the factors of safety for all conditions analyzed are unsatisfactory. Further field investigation and stability studies are required to better assess the structural integrity of the dam. These studies should be commenced within 6 months of the date of approval of this report and completed within 12 months.

Using the Corps of Engineer's Screening Criteria for initial review of spillway adequacy, it has been determined that the non-overflow portion of the masonry segment of the dam would be overtopped for all storms exceeding 18% of the Probable Maximum Flood (PMF). The stability analyses performed for this section indicate that the safety factors against sliding drop below 1.0 for flows over the masonry from either the PMF or ½ the PMF. The results of the HEC-1 Dam Break Computer analyses indicate that the total failure of the masonry section of the dam will have a serious impact on the Hutchinson River Parkway thereby increasing the downstream danger of loss of life. The spillway is, therefore, judged as seriously inadequate.

There are several additional deficiencies on this structure which should be corrected. Trees and brush on the earth dikes should be cut. The erosion gully on the southwestern dike should be filled. The downstream channel beyond the toe of the spillway needs to be rehabilitated, especially the concrete apron. Provisions should be made to provide an operational reservoir drain. The crest of the southwestern dike should be raised to a uniform elevation of 194.0 to reduce the possibility of the earth dike being overtopped. A system of around-the-clock surveillance during periods of unusually high flows and a plan for evacuating the downstream residents in the event of overtopping of the non-overflow masonry section of the dam should be implemented.

George Koch

George Koch,
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

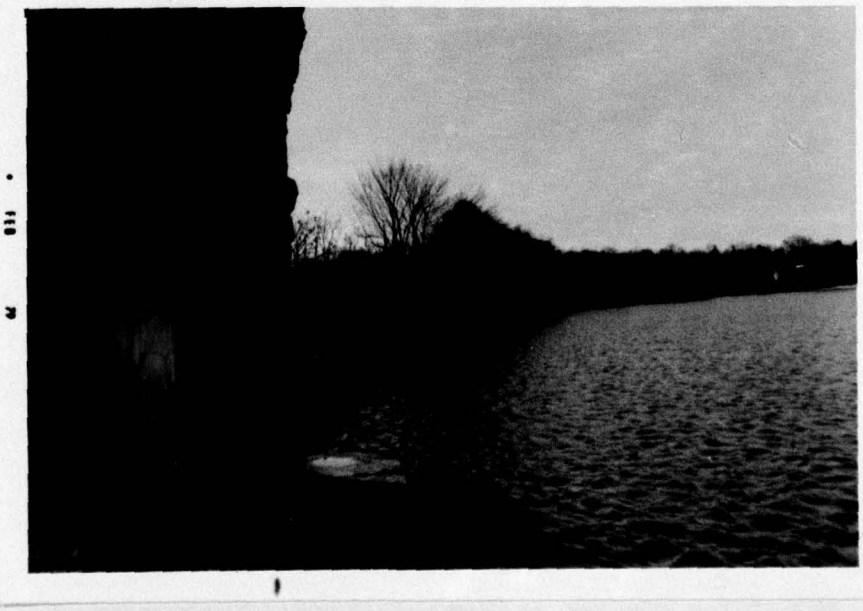
Clark H. Benn

Col. Clark H. Benn
New York District Engineer

Date:

8 August 79

NEW ROCHELLE RESERVOIR No. 1 DAM
OVERVIEW - NORTHEASTERN END



OVERVIEW - SOUTHWESTERN END

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NEW ROCHELLE RESERVOIR No. 1 DAM NY 20
HUTCHINSON RIVER BASIN
WESTCHESTER COUNTY, N.Y.

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase 1 inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing condition of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenant Structures

The New Rochelle Reservoir No. 1 Dam is a relatively long dam on the southern end of the impoundment. The dam consists of a masonry section about 680 feet long with an earth dike on each end. The service spillway is an overflow channel near the center of the masonry section.

The masonry portion of the dam is composed of stone blocks and mortar. This section is 680 feet long and varies from a height of about 30 feet near the center of the structure down to about 6 feet at the northeastern end. The service spillway is located within this segment.

The spillway is about 265 feet from the northeastern end of the masonry section. It is 30 feet wide and has a crest elevation 4 feet lower than the crest of the rest of the masonry section. The spillway has a crest width of 6 feet and then slopes off at approximately a 2 vertical on 1 horizontal slope. The bottom and sides of the channel are lined with stone block to carry the water well beyond the downstream toe of the dam.

There is a stone building, referred to on the plans as the "gate house", located 150 feet from the southwestern end of the masonry section. Old inspection reports indicate that there were several pipes which passed through the gate house. However, the spot where these pipes exited has been sealed and so the reservoir now has no drain.

The earth dikes extend beyond the ends of the masonry section. The northeastern dike is approximately 75 feet long and 6 feet high. The southwestern dike is about 700 feet long and 10 feet high. The top elevation of each dike is about 2 feet higher than the crest elevation of the masonry portion of the dam. Both dikes are covered with brush and trees.

b. Location

The New Rochelle Reservoir No. 1 Dam is located at the southern end of the reservoir. The town line dividing the Town of Eastchester and the City of New Rochelle passes through the dam near the service spillway. Therefore, a portion of the dam lies in each of these municipalities. The reservoir outlets into the Hutchinson River, with New Rochelle Reservoirs Nos. 2 and 3 both on the river less than a mile downstream of this dam.

c. Size Classification

This dam is approximately 30 feet high and the reservoir has a storage capacity of 1043 acre-feet. Therefore, the dam is in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The dam is classified as "high" hazard due to the presence of the Hutchinson River Parkway immediately downstream of the dam. In addition, plans have been presented to the Planning Board of the Town of Eastchester for the construction of 85 townhouses on the parcel of land which includes the downstream slope of the southwestern earth dike.

e. Ownership

This dam lies in two municipalities and there appears to be at least three owners. Based on the information available, the City of New Rochelle owns the portion of the structure which is within their city limits. The masonry portion of the dam in the Town of Eastchester is owned by the Fred French Investing Company. This company also owns the upstream portion of the earthen dike on the Eastchester end (southwestern end) of the structure. The downstream portion of this dike is owned by Robert F. Lusk.

f. Purpose of Dam

This reservoir was originally owned and used by the New Rochelle Water Company. The reservoir is no longer used by the water company. Presently, the reservoir is used primarily for recreational purposes.

g. Design and Construction History

Based on the records available, the dam was constructed in 1894. No construction plans were available for the structure, so it was not possible to determine the exact date of construction or the name of the designer.

h. Normal Operation Procedures

Water flows over an ungated spillway.

1.3 PERTINENT DATA

a. Drainage area (acres)	1292
b. Discharge at Dam (cfs)	
Spillway (water level at top of masonry portion)	744
c. Elevation	
Top of earth berms (Top of Dam)	193.9
Top of Masonry Portion	191.9
Service spillway crest	187.9
d. Reservoir (acres)	
Surface area at top of earth berms	92
Surface area at top of masonry portion	81
Surface area at Crest of Service Spillway	62
e. Storage Capacity (acre-feet)	
Top of earth berms	1043
Top of masonry portion	869
Service spillway crest	582
f. Dam	
Masonry dam with earthen dike on either end	
Dam length (ft)	
Northeastern dike (Approx.)	75
Masonry Portion	675
Southwestern dike (Approx.)	700
Masonry Portion	
Upstream Face : Vertical; Downstream Face:	3 vertical on 2 horiz.
Crest Elevation	191.9
Crest Width (ft)	6
Earth Dikes	
Upstream slopes:	About 1 on 3 (V : H)
Downstream slopes:	Varies from 1 on 1.5 to 1 on 3 (V : H)
Crest Elevation	193.9
Crest Width (ft)	6 - 8
g. Spillway	
Type: Ungated overflow channel having a crest width of 6 feet and a drop of 12 feet	
Length:	30 feet
h. Reservoir Drain:	None

SECTION 2: ENGINEERING DATA

2.1 DESIGN

a. Geology

The New Rochelle Reservoir No. 1 Dam is located in the Manhattan Hills section of the New England Uplands physiographic province of New York State. This province consists of low hilly terrain of gentle relief. The bedrock in the area, formed during the Cambrian and Ordivician eras has been intensely metamorphosed, heavily injected and re-crystallized. Shale, slate, schist, gneiss and quartzite are among the types of rock in this area. The surficial soils are the result of glaciations during the Cenozoic Era, the last of which was the Wisconson glaciation.

b. Subsurface Information

No records from subsurface investigations which may have been done at the time of construction of this dam were available. However, two other sources provided limited data. First, inspection reports from 1913 and 1915 state that the dam is founded on rock. In addition, a boring program consisting of forty-nine 2½ inch diameter drill holes was undertaken in 1978 by the developers of the proposed townhouses on the parcel of land downstream of the southwestern dike Several of these holes were near the downstream toe of the embankment. Based on this information, the subsurface conditions are generally several feet of sand and gravel underlain by rock at a depth of from 3 to 9 feet.

2.2 CONSTRUCTION RECORDS

No construction records were available for this structure.

2.3 OPERATION RECORDS

There were no operating or water level records available for this structure.

2.4 EVALUATION OF DATA

The only pieces of data available to assist in the preparation of this report were two New York State Conservation Commission inspection reports from 1913 and 1915, and a plan of the southwestern earth dike prepared by the developer of the proposed townhouse complex downstream of the dam. While the information available concerning this dam was rather limited, it appears to be adequate and reliable for the purpose of the Phase 1 Inspection.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of New Rochelle Reservoir No. 1 Dam was conducted on November 16, 1978. A follow-up inspection was held on December 27, 1978. The weather for both inspections was clear with temperatures ranging from the mid-thirties to the mid-forties. Water was flowing over the spillway at a depth of approximately 1/2 inch at the time of the inspection.

b. Masonry Section

The masonry section appeared to be in satisfactory condition. There were no signs of distress or movement. The stones on the downstream face in one small area near the stone block building were wet from apparent seepage. While several of the blocks were wet, there was no actual flow noted coming through the joints. An inspection of the area immediately downstream of the toe of the masonry revealed no wet areas or soft sections.

c. Spillway

The spillway channel was in satisfactory condition. There was some mortar missing from the joints between blocks near the spillway crest, but generally the spillway was in satisfactory condition.

d. Earth Dikes

A wet area was noted at the downstream toe of the southwestern dike. This wet area extended for a distance of over 100 feet along the dike. The toe was saturated and the soil in the area was very soft.

Related to this area was another wet area which was 50 to 100 feet beyond the toe of the dike. This section was extremely wet with water ponded throughout the area. Judging from the vegetation, it does not appear that this area has been in its present wet condition for a long period of time (i.e. the area does not look like a swamp).

There were several spots within the wet area, where water was flowing. Probing at the point where one of the flows appeared, a cast iron drain pipe surrounded by pea gravel was uncovered. Most of the flow was coming from the pipe. It was not possible to determine where the pipe originated or whether it was originally installed to act as drainage system for the dam.

Several small areas of erosion were observed on the southwestern dike. A few isolated spots on the upstream slope had been scoured. There was an erosion gully in the area where the embankment section ties into the masonry section. This gully was about 4 feet wide and 1½ feet deep and ran from near the embankment crest down the slope on the downstream side.

No wet areas or scoured areas were noted on the northeastern dike.

e. Downstream Channel

The service spillway flows are carried away from the dam in a channel which flows perpendicular to the dam for about 100 feet and then takes a right-angle bend. The water then flows along the toe of the Hutchinson River Parkway embankment. The channel beyond the point where the stone block lining of the spillway ends consists of concrete over earth and boulders for approximately 50 feet. The channel is cut into the earth beyond that point. The concrete is deteriorated with many cracks and holes. The area beneath the end of the concrete has been scoured by flows in the channel. The scour hole extends about 1 foot under the end of the concrete slab on the north side and 3 feet under on the south side. The earth channel is not lined and is littered with debris. However, due to the drop between the spillway crest and the downstream channel, it does not appear that the deficiencies in the channel would affect the dam.

3.2 EVALUATION OF OBSERVATIONS

Visual observations revealed a number of minor defects on this structure and several more serious defects. The serious defects which were noted are as follows:

1. Existence of a wet area near the downstream toe of the southwestern dike This wet area seems to have appeared relatively recently and is probably due to seepage through the dam.

2. Apparent lack of a reservoir drain.

The following minor defects were observed:

1. Brush and trees growing on both dikes.

2. Erosion at several spots on the southwestern dike, especially the gully near the intersection of the embankment with the masonry section.

3. Minor seepage between some blocks near the gate house.

4. The poor condition of the downstream channel beyond the toe of the dam especially the scour hole beneath the end of the concrete apron.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURE

Normal water surface elevation is approximately at the crest of the spillway. Downstream flows are uncontrolled over the spillway. The reservoir provides 287 acre feet of storage between the crest of the service spillway and the top of the non-overflow masonry segment of the dam and an additional 174 acre feet between the top of the masonry and the top of the earth berms.

4.2 MAINTENANCE OF DAM

There was no record of any maintenance having been done on this dam for a number of years.

4.3 WARNING SYSTEM IN EFFECT

No apparent warning system is present.

4.4 EVALUATION

A comprehensive maintenance program is required for this dam. Brush and trees should be removed from the earth dikes. In addition, the service spillway and the non-overflow masonry section should be inspected on a regular basis and maintained as necessary.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the contributing watershed to New Rochelle Reservoir No. 1 was made using the USGS 7.5 minute quadrangle sheet for Mount Vernon, NY. The watershed consists of a heavily developed urban area and a lightly wooded area, some of which has been developed. Relief ranges from flat to moderate. The rectangularly shaped drainage area is approximately 1292 acres in size.

5.2 ANALYSIS CRITERIA

No hydrologic/hydraulic information was available regarding the original design for this dam. Therefore, the analysis of the spillway capacity of the dam was performed using the Corps of Engineers HEC-1 (Dam Break Version) computer program; incorporating the "Snyder Synthetic Unit Hydrograph method" and the "Modified Puls" flood routing procedure. The spillway design flood selected for analysis was the Probable Maximum Flood (PMF) in accordance with recommended guidelines of the U.S. Army Corps of Engineers.

5.3 SPILLWAY CAPACITY

The spillway, located within the masonry portion of the structure has a crest 6 feet wide and is 30 feet long. There is a drop of about 12 feet between the spillway crest and the exit channel.

For the purposes of the hydrologic/hydraulic analysis, the non-overflow masonry segment was assumed to be the top of the dam. This model was used since no provisions had been made on the dam or immediately downstream to allow the flow of water over this section. Therefore, in the computer analysis what is referred to as the top of dam, is actually the top of the non-overflow masonry section. The earth dikes on either end of the structure have a top elevation of 193.9, which is two feet higher than the top of the masonry.

Hydraulically, the spillway itself was analyzed as a sharp-crested weir having a discharge coefficient C of 3.1. The computed spillway discharge capacity when the reservoir level reaches the top of the non-overflow masonry section was 744 cfs.

The spillway does not have sufficient capacity for discharging the peak outflow from either the PMF or the 1/2 PMF. For the PMF, the peak inflow is 4036 cfs and the peak outflow is 4009 cfs. For the 1/2 PMF, the peak inflow is 2018 cfs and the peak outflow is 1923 cfs.

5.4 RESERVOIR CAPACITY

Normal reservoir capacity when the water surface is at the service spillway crest elevation is 582 acre-feet. Surcharge storage capacity to the top of the non-overflow masonry section is an additional 287 acre feet, which is equivalent to a runoff depth of 2.66 inches over the drainage area. Additional storage capacity of 174 acre-feet, an equivalent of 1.6 inches of runoff, exists to the elevation of the top-of-berm.

5.5 FLOODS OF RECORD

No information was available regarding the occurrence of the maximum known flood.

5.6 OVERTOPPING POTENTIAL

Analysis using the PMF and 1/2 PMF indicates that the spillway does not have sufficient discharge capacity. For a PMF peak outflow of 4009 cfs, the service spillway capacity of744 is only 18%. Hence, the non-overflow masonry section would be overtopped to a computed depth of 1.3 feet for this outflow. While generally the tops of the earth dikes are two feet above the top of the non-overflow masonry section, due to variations in the crest elevation of the dikes, it is not possible to state definitively that this flow would not overtop portions of the dikes as well.

For the peak outflow from 1/2 PMF, the non-overflow masonry section would be overtopped to a computed depth of 0.64 feet.

5.7 EVALUATION

Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the non-overflow masonry section would be overtopped for all storms exceeding 18% of the PMF.

A downstream flood wave analysis indicates that water surface levels would rise high enough to endanger motorists on the Hutchinson River Parkway. Hence, dam failure from overtopping would significantly increase the hazard to loss of life downstream. Since the overtopping of the non-overflow masonry section would present a stability problem and possibily a scour problem at the downstream toe, the spillway is assessed as being seriously inadequate. This means that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and possible failure of the masonry portion of the dam would take place.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations of the dam revealed an area of seepage at the downstream toe of the southwest dike. The fact that this portion of the dike is wet could affect the stability of this segment. There was no indication of any movement in this area. There were no other signs of major distress on the dam. The remaining portions of the dike and the masonry section all appeared to be relatively stable.

b. Design and Construction Data

No design computations or other data concerning the structural stability of the dam were available. Construction records could not be located.

c. Data Review and Stability Evaluation

The sole sources of structural and subsurface information were the 1913 and 1915 N.Y. State Conservation Commission inspection reports. Due to the limited data, certain assumptions concerning the dam and its foundation conditions had to be made.

No stability analysis was performed for either of the earth dikes. The northeastern dike showed no signs of distress and so no analysis would be required for this section. The wet area at the downstream toe of the southwestern dike could cause a stability problem on this part of the structure. Due to the lack of information concerning the composition of the embankment and the foundation soils, it was not possible to perform a stability analysis for this dike.

A structural analysis was performed for the masonry portion of the dam. This analysis was based on the cross section shown on the 1915 inspection report and on measurements of the dam made during the inspection. The study used a structural stability analysis program written for the TEXAS INSTRUMENTS TI-59 Calculator. The following conditions were analyzed:

a. Normal conditions with reservoir at spillway crest.
b. PMF, water flowing over the top of the non-overflow masonry section to a depth of 1.3 feet.
c. One-half PMF, water flowing over the top of the non-overflow masonry section to a depth of .64 feet.
d. Reservoir at spillway crest with ice load of 5000 lb/ft.

The analyses performed (See Appendix E) indicate that the factors of safety against overturning and sliding are as follows:

Case	Factors of Safety	
	Overturning	Sliding
a. Reservoir Level at spillway Crest, No ice	1.82	1.35
b. PMF, Water flowing over masonry section to depth of 1.3 ft, no ice	1.45	0.88
c. 1/2 PMF, Water flowing over masonry section to depth of .60 ft., no ice	1.51	0.93

d. Reservoir Level at Spillway crest, Ice load of 5000 lb/ft	1.40	1.05

These factors of safety indicate a critical deficiency in the stability of this structure. However, the analysis was performed using a cross section from the 1915 inspection report. It was not possible to determine what the depth of embedment was for the downstream toe from the information available. For the purpose of the analysis, no passive resistance at the downstream toe was included. A more detailed investigation is required to arrive at a more accurate cross section of the masonry section and to determine whether any passive pressure should be included in the analysis.

d. Seismic Stability

The dam is located in Seismic Zone No. 1. Due to the location of the structure, a seismic stability analysis is not warranted.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

The Phase I inspection of the New Rochelle Reservoir No. 1 Dam revealed conditions which if allowed to deteriorate further, could constitute a serious hazard. The most severe problem is the wet area at the downstream toe of the southwestern dike. Due to the seepage in this area, the stability of the dike is questionable. Remedial measures should be taken to correct this problem before it worsens.

In addition to this problem which may deteriorate unless repaired, this structure has several basic deficiencies. First, the service spillway does not have sufficient discharge capacity to pass the outflow from either the PMF or 1/2 PMF. Due to this inadequate capacity, flows from these large storms will overtop the non-overflow portion of the masonry segment. This section is not equipped to handle high velocity flows. There is no means of dissipating energy at the downstream toe, so until it has been proven that the dam is founded on sound rock, the erosion resistance at the toe will be a matter of concern.

The stability analyses which were performed for this structuer indicate that the factors of safety against both overturning and sliding are less than those recommended by the Corps of Engineers. Due to the lack of information, these analyses were performed by making certain conservative assumptions concerning foundation conditions and depth of embedment of the downstream toe, so the actual safety factors may be higher than those calculated.

The final serious deficiency on this structure is the apparent lack of a reservoir drain. Since there is no drain or regulating outlet, it is not possible to lower the water surface in front of the dam below the service spillway crest without using drastic measures.

b. Adequacy of Information

The information available for the preparation of this report was extremely limited. No construction plans, subsurface information or hydrologic data were available with the exception of the information concerning the southwestern dike provided by the developers of the townhouses proposed for this area. The inspection reports from 1913 and 1915 and observations made during the visual inspections of this structure made for this report were the primary sources of information regarding the dam.

c. Need for Additional Investigations

An investigation of the masonry section is required to better assess the structural stability of the dam. This investigation should be an indepth analysis of the structure. Accurate cross sections of the dam should be obtained to determine the exact dimensions of the structure. An exploration program should be undertaken to determine the subsurface conditions in the vicinity of the dam. Estimation of the depth of soil above the downstream toe of the dam and determination of whether the dam is founded on soil or rock should be two primary goals of the exploration program.

Additional hydrologic/hydraulic investigations are also recommended to more reliably determine the PMF peak outflow. These studies should consider specific site characteristics of the watershed such as surcharge storage capacity both within the drainage area and at the dam.

A stability analysis of the southwestern dike should be performed to determine whether the seepage in this area has reduced the stability of the dike to critical levels.

d. Urgency

The problem of the wet area at the toe of the southwestern dike should be addressed and repairs commenced within 3 months of the date of approval of this report. Unless actions are taken in this area, the situation could deteriorate further and jeopardize the stability of the dike.

Investigation of the remaining deficiencies should begin within 3 months of the date of approval of this report by the owner. These investigations should be completed and the necessary modifications should be commenced within 1 year of the date of notification.

7.2 RECOMMENDED MEASURES

a. A method of treatment to eliminate or control the seepage in the wet area at the downstream toe of the southwestern dike must be designed and constructed.

b. An investigation of the stability of the southwestern dike should be performed.

c. An investigation of the structural stability of the masonry portion of the dam should be undertaken.

d. Hydrologic/hydraulic investigations are required to resolve the fact that the spillway capacity is inadequate.

The above measures are of major importance and should be addressed within the time frames previously outlined. The following measures are not as critical but the recommended measures should be followed within 12 months of the date of approval of this report.

a. All trees and brush should be cut from each of the dikes. This area should then be inspected periodically for signs of decay of the roots which might result in increased seepage.

b. The erosion gully on the southwestern dike should be filled.

c. The downstream channel beyond the end of the spillway should be rehabilitated. Special attention should be given to the scour hole under the concrete apron.

d. The area on the masonry portion of the dam where the seepage between blocks was noted should be monitored to assure that this condition is not worsening.

e. Provisions should be made to provide an operational reservoir drain.

f. Raise low areas on crest of southwestern dike to assure that crest elevation is at least 194.0.

7.3 PROPOSED ACTIONS BY OWNERS

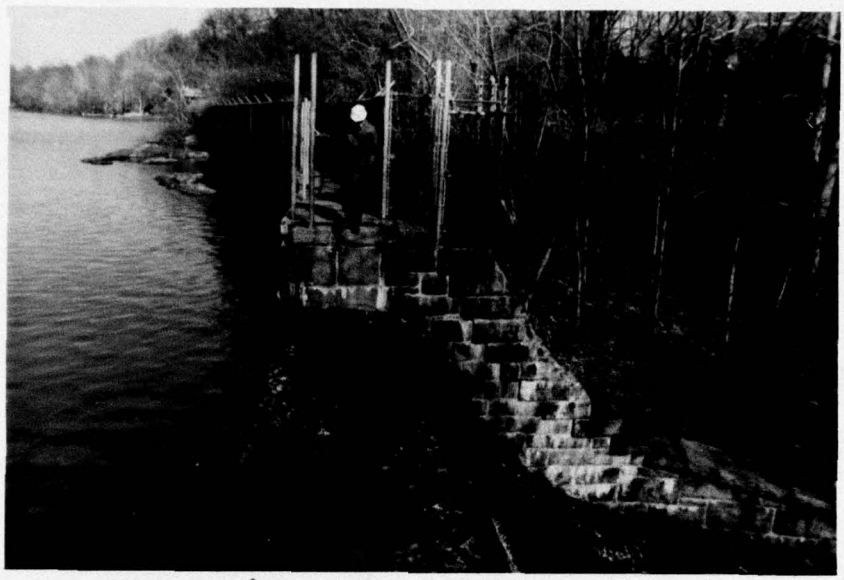
As stated in Section 1.2d, it has been proposed to construct 85 townhouses on the parcel of land which includes the sownstream slope of the southwestern dike. A deed restriction prohibits excavation within 20 feet of the downstream toe of the dike. To comply with this restriction, the developer has proposed constructing at existing grade and then backfilling the foundations to provide the required cover. The result of this backfilling

would be to raise the grade along much of the downstream slope effectively flattening the slope.

The developer has also applied for a permit from the New York State Department of Environmental Conservation to place a drainage blanket over the wet area on the downstream toe of the southwestern dike. This blanket would be a graded filter composed of filter fabric, gravel and rock.

APPENDIX A

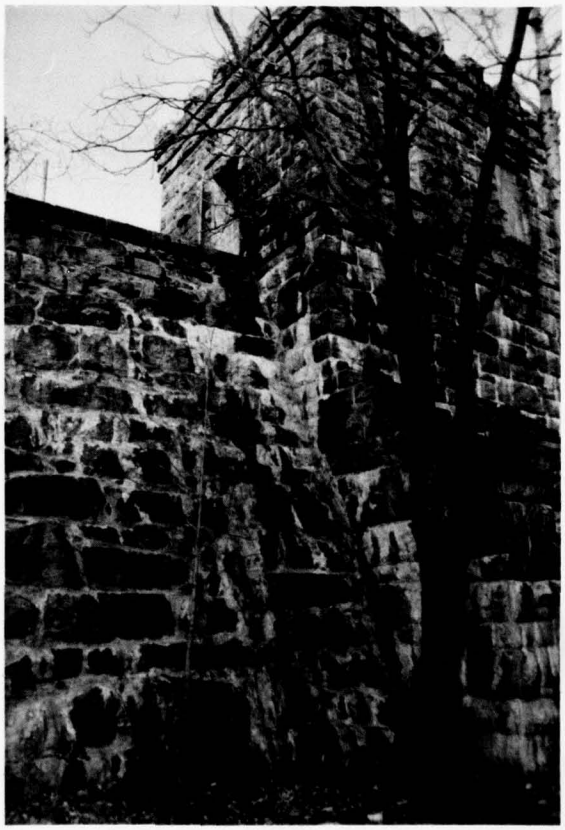
PHOTOGRAPHS



SPILLWAY CREST

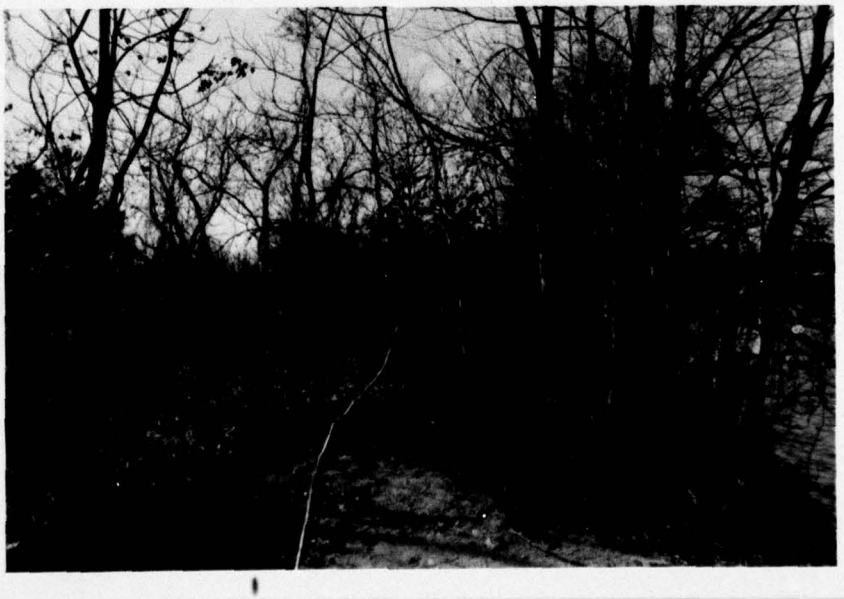
SERVICE SPILLWAY LOOKING UPSTREAM

CREST OF NON-OVERFLOW MASONRY SECTION
WITH "GATE HOUSE"



"GATE HOUSE" LOOKING UPSTREAM - NOTE
DISCOLORATION ON BLOCKS DUE TO AREA SEEPAGE

DOWNSTREAM TOE OF MASONRY SECTION



CREST OF SOUTHWESTERN DIKE - NOTE
EROSION GULLY IN FOREGROUND

APPENDIX B

ENGINEERING DATA CHECKLIST

Check List
Engineering Data
Design Construction Operation

Name of Dam NEW ROCHELLE RESERVOIR No. 1

I.D. # N.Y. 20

Item	Remarks		
	Plans	Details	Typical Sections
Dam	NONE		
Spillway(s)	NONE		
Outlet(s)	NONE		
Design Reports	NONE		
Design Computations			
Discharge Rating Curves			
Dam Stability			
Seepage Studies			
Subsurface and Materials Investigations			

Item	Remarks	NEW ROCHELLE RES. No. 1
Construction History	NONE	
Surveys, Modifications, Post-Construction Engineering Studies and Reports	SURVEY OF SOUTHWESTERN BERM - DONE BY TOWNHOUSE DEVELOPERS	
Accidents or Failure of Dam Description, Reports	NONE	
Operation and Maintenance Records Operation Manual	NONE	

APPENDIX C

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam NEW ROCHELLE RES. No. 1 DAM

I.D. # N.Y. 20

Location: Town EASTCHESTER & NEW ROCHELLE County WESTCHESTER

Stream Name HUTCHINSON RIVER

Tributary of _____

Longitude (W), Latitude (N) 73°47.9'W 40°57.4'N

Hazard Category C

Date(s) of Inspection 11/16/78 12/27/78

Weather Conditions 45° SUNNY 35° SUNNY

b. Inspection Personnel W. LYNICK, R. WARRENDER

c. Persons Contacted _____

d. History:

Date Constructed 1894

Owner CITY OF NEW ROCHELLE, FRED FRENCH INVESTING Co, ROBERT LUSK

Designer UNKNOWN

Constructed by UNKNOWN

2) Technical Data

Type of Dam MASONRY WITH EARTH BERMS

Drainage Area 1292 ACRES

Height 30 Length 1300

Upstream Slope VARIES Downstream Slope VARIES

2) Technical Data (Cont'd.)

External Drains: on Downstream Face N/A @ Downstream Toe N/A

Internal Components:

Impervious Core N/A

Drains N/A

Cutoff Type N/A

Grout Curtain N/A

3) Embankment

EARTH BERMS ON EITHER END OF DAM

a. Crest

(1) Vertical Alignment BOTH OKAY

(2) Horizontal Alignment BOTH CURVED TO FORM END OF LAKE.

(3) Surface Cracks NONE APPARENT ON EITHER BERM

(4) Miscellaneous CREST OF SOUTHWEST BERM WAS A PATH. ALL VEGITATION WAS GONE HERE.

b. Slopes

(1) Undesirable Growth or Debris, Animal Burrows BOTH BERMS COVERED WITH TREES & BRUSH. TREES UP TO 1' DIAMETER

(2) Sloughing, Subsidence or Depressions SEVERAL GULLIES FROM CREST ON SOUTHWEST BERM

(3) Slope Protection RIP-RAP (STONE BLOCK) ON UPSTREAM SLOPE OF ~~EMB~~ BERMS

(4) Surface Cracks or Movement at Toe NONE

(5) Seepage WET AREA NOTED ALONG THE TOE OF THE SOUTHWEST BERM

(6) Condition Around Outlet Structure N/A

c. Abutments

EACH EARTH BERM TIES INTO MASONRY SECTION AT AN ABUTMENT.

(1) Erosion at Embankment and Abutment Contact SOUTHWEST BERM - GULLY ALONG MASONRY ABUTMENT. ERODED SO AT ABUTMENT EMBANKMENT ONLY 1.5' HIGHER THAN MASONRY

(2) Seepage along Contact of Embankment and Abutment NONE

(3) Seepage at toe or along downstream face NO SEEPAGE AT ABUTMENTS

d. Downstream Area - below embankment

(1) Subsidence, Depressions, etc. SOME DEPRESSIONS IN WET AREA NOTED BELOW

(2) Seepage, unusual growth LARGE WET AREA - APPEARS TO BE SEEPAGE 50'-100' BEYOND DOWNSTREAM TOE OF SOUTH WEST BERM. FLOWING WATER NOTED

(3) Evidence of surface movement beyond embankment toe NONE

(4) Miscellaneous

e. Drainage System

A DRAINAGE PIPE SURROUNDED WITH PEA GRAVEL WAS NOTED IN THE WET AREA BEYOND THE DOWNSTREAM TOE. IT WAS NOT POSSIBLE TO DETERMINE WHERE THIS PIPE ORIGINATES.

(1) Condition of relief wells, drains, etc. _____

(2) Discharge from Drainage System THE PIPE WHICH WAS FOUND HAD A SLIGHT DISCHARGE COMING OUT.

4) Instrumentation

(1) Monumentation/Surveys NONE

(2) Observation Wells NONE

(3) Weirs NONE

(4) Piezometers NONE

(5) Other

5) Reservoir

a. Slopes OKAY

b. Sedimentation NONE NOTED

5) Spillway(s) (including tail race channel)

a. General SERVICE SPILLWAY CHANNEL WITH IN MASONRY SECTION OF DAM

b. Principle Spillway STONE BLOCK CHANNEL - 30' WIDE NO JOINT OPENINGS EXCEPT AT CREST LEVEL & ROUNDING AT OVERFLOW DROP

c. Emergency or Auxiliary Spillway NONE

d. Condition of Tail race channel SOME WHAT DETERIORATED VOID UNDER END OF CONCRETE APRON - EXTENDS 1 FOOT UNDER ON NORTH END & 3 FEET UNDER ON SOUTH

e. Stability of Channel side/slopes OKAY - LINED WITH STONE BLOCKS

7) Downstream Channel

SPILLWAY FLOWS DOWN & TURNS AT THE HUTCHINSON RIVER PARKWAY - THEN FLOWS ALONG TOE

a. Condition (debris, etc.) CHANNEL HAS MISCELLANEOUS BRUSH AND DEBRIS.

b. Slopes

c. Approximate number of homes NO HOMES IMMEDIATELY DOWNSTREAM AT PRESENT - PROPOSED TOWNHOUSES ON SOUTHWEST HUTCHINSON RIVER PARKWAY JUST DOWNSTREAM.

8) Miscellaneous STRONG & SEPTIC ODOR ~~COMING~~ & FLOW COMING FROM A BROKEN PIPE DOWNSTREAM OF DAM NEAR SPILLWAY CHANNEL.

9) Structural

a. ~~Concrete~~ Stone Block Surfaces ENTIRE ~~DAM~~ MASONRY DAM & ABUTMENTS ARE STONE BLOCK. - INCLUDING OLD GATEHOUSE NEAR CENTER

b. Structural Cracking FILLER BETWEEN BLOCKS IS MISSING IN SOME JOINTS NEXT TO SPILLWAY CREST

c. Movement - Horizontal & Vertical Alignment (Settlement)

d. Junctions with Abutments or Embankments JUNCTION BETWEEN MASONRY & ABUTMENTS - OKAY

e. Drains - Foundation, Joint, Face

f. Water passages, conduits, sluices GATE HOUSE IN CENTER PROBABLY HAD CONDUITS PASSING THROUGH IT BUT THE ENTIRE HOUSE HAS BEEN SEALED WITH CONCRETE BLOCK

g. Seepage or Leakage VERY MINOR SEEPAGE THROUGH STONE BLOCKS JUST SOUTH OF GATE HOUSE. BLOCKS WERE WET BUT THERE WAS NO FLOW OF WATER, ~~THROUGH~~ IT.

h. Joints - Construction, etc. OKAY

i. Foundation

j. Abutments

k. Control Gates IMPOSSIBLE TO DETERMINE WHETHER ANY EXIST.

l. Approach & Outlet Channels OUTLET CHANNEL WELL BEYOND DOWNSTREAM IS IN POOR CONDITION

m. Energy Dissipators (plunge pool, etc.)

n. Intake Structures

o. Stability

p. Miscellaneous A FENCE RAN ALONG CREST - WENT ALONG ENTIRE UPSTREAM FACE & ALONG PART OF THE DOWNSTREAM ~~UPSTREAM~~ FACE

APPENDIX D

HYDROLOGIC/HYDRAULIC

ENGINEERING DATA AND COMPUTATIONS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam (TOP OF EARTH BERMS)	193.9	92	1043
2) Design High Water (~~Max.~~ ~~Design~~ ~~Pool~~) (TOP OF MASONRY)	191.9	81.5	869
3) Auxiliary Spillway Crest	N/A		
4) Pool Level with Flashboards	N/A		
5) Service Spillway Crest	187.9	62.4	582

DISCHARGES

	Volume (cfs)
1) Average Daily	N/A
2) Spillway @ ~~Maximum~~ ~~High~~ ~~Water~~ W.S. AT TOP OF MASONRY	744
3) Spillway @ Design High Water	
4) Spillway @ Auxiliary Spillway Crest Elevation	
5) Low Level Outlet	N/A
6) Total (of all facilities) @ Maximum High Water	
7) Maximum Known Flood	UNKNOWN

CREST: ELEVATION: 191.9

Type: MASONRY

Width: 6' Length: 675'

Spillover SPILLWAY CHANNEL

Location CENTER OF SECTION

SPILLWAY:

PRINCIPAL		EMERGENCY
187.9	Elevation	
SHARP-CRESTED	Type	NONE
6'	Width	
	Type of Control	
✓	Uncontrolled	
	Controlled:	
	Type (Flashboards; gate)	
	Number	
	Size/Length	
	Invert Material	
	Anticipated Length of operating service	
13' TO CHANNEL	Chute Length	
N/A	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

OUTLET STRUCTURES/EMERGENCY DRAWDOWN FACILITIES:

Type: Gate _____ Sluice _____ Conduit _____ Penstock _____

Shape : NONE

Size: _____

Elevations: Entrance Invert _____

Exit Invert _____

Tailrace Channel: Elevation _____

HYDROMETEROLOGICAL GAGES:

Type : N/A

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

_____

Method of Controlled Releases (mechanisms):

NONE

_____

DRAINAGE AREA: 1292 ACRES

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: URBAN & HEAVILY DEVELOPED + PARKLAND

Terrain - Relief: FLAT TO MODERATE

Surface - Soil: SAND - SILT

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

MODERATE TO HIGH

Potential Sedimentation problem areas (natural or man-made; present or future)

NONE OBVIOUS

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

POSSIBLE FLOODING OF HUTCHINSON RIVER PARKWAY

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: EITHER END OF MASONRY

Elevation: 193.9

Reservoir:

Length @ Maximum Pool 2.65 (Miles)

Length of Shoreline (@ Spillway Crest) N/A (Miles)

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RESERVOIR NO. 1 - (NY-20)	1/		
SUBJECT		**COMPUTED BY**	**DATE**
SURFACE AREAS - H&H		WCL	2/15/79

USGS 7.5 QUAD. - MOUNT VERNON
SCALE: 1" = 2000' 1 SQ IN = 91.827 ACRES = 0.14348 SQ MILES

PLANIMETER (CALIBRATION):
OK — (2.01 = 2 SQ IN)

	(IN^2)	(ACRES)	(SQ. MILES)	
DRAINAGE AREA:	14.07	1292	2.02	←
LAKE SURFACE AREA:	0.68	62.4	0.10	

ELEVATION:
USGS (1956) = 184
DEVELOPMENT (TOWNHOUSES @ EASTCHESTER) (1978) = 187.90 ←

SNYDER SYNTHETIC UNIT HYDROGRAPH:
L = (7.0") = 14000' = 2.65 MILES
L_{CA} = (3.4") = 6800' = 1.29 MILES

CORPS GUIDELINES:
SIZE CLASSIFICATION: SMALL
HT = 28'
STORAGE (CONIC METHOD) = $\frac{Ah}{3} = \frac{(62.4)(28)}{3}$ = 582.4 AC-FT

HAZARD CLASSIFICATION: HIGH

SPILLWAY DESIGN FLOOD: 1/2 PMF PMF
DEC CRITERIA (NEW DAM) (0.6) PMF
RATIOS: 0.5 0.6 1.0 ←

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RESV. No. 1	2/		
SUBJECT		**COMPUTED BY**	**DATE**
SNYDER SYNTHETIC UNIT HYDROGRAPH		WCL	2/15/79

$t_p = C_t (L \cdot L_{CA})^{0.3}$ $L = 2.65$ $L_{CA} = 1.29$ — LAG TIME

$t_p = 2.89$ HRS C_t — USE 2.0

$t_r = \frac{t_p}{5.5}$ — DURATION - UNIT RAINFALL

$= 0.525$ HRS USE 0.5-HR UNIT HYDROGRAPH ←

$t_{pr} = t_p + 0.25(t_r - t_r)$ — ADJUSTED LAG TIME

$= 2.89 + 0.25(0.5 - 0.525)$

$= 2.89 - 0.006$

$t_{pr} = 2.88$ HRS USE $T_p = 3.0$ HRS LAG TIME ←

USE $C_p = 0.625$ ←

HR #33 PMP RAINFALL:

ZONE 1 NEAR ZONE 6 PMP RAIN = 22" (200 SQ MILE - 24 HR) ←

(USE LOWER LIMIT = 10 SQ MI.)

			PMP (AVE)	
6 HR	111	113	112	
12 HR	123	123	123	RATIO
24 HR	133	134	133	
48 HR	142	142	142	

TRSPC: $T.F. = 1 - \frac{.3008}{(2.02)^{.17718}}$

$T.F. = 0.734$ ←

LOSS DATA: INITIAL = 1.0"

CONTINUOUS = 0.1"

% OF D.A. - IMPERVIOUS = 5%

BASE FLOW: 2 cfs/SQ MILE

2 X 2.02 = 4 cfs

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RESV. No. 1	3/		
SUBJECT		**COMPUTED BY**	**DATE**
RESERVOIR [ELEV - AREA - STORAGE] - (HEC 1-DB)		WCL	2/15/79

CONIC METHOD + GENERATION OF VALUES:

		AREA (ACRES)	VOL (AF)
CREST (SRVC SPILLWAY):	ELEV. = 187.9	62.4	582.4

VOL = 582.4 AC-FT = $\frac{h}{3}(A)$ = $\frac{h}{3}(62.4\ AC)$

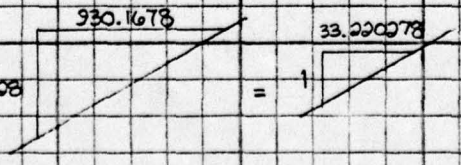
$h = 28'$

APEX OF CONE:	ELEV. = 159.9	0 (ACRES)	—
NON-OVERFLOW SECTION: (MASONRY PORTION - DAM)	ELEV. = 191.9	81.5	869.3
TOP OF DAM: (EARTH PORTION - BERM)	ELEV. = 193.9	92.0	1043

CONIC METHOD (AREA-VOLUME): $A = \pi R^2$ $VOL = \frac{\pi}{3} R^2 h$

ELEV.	AREA (ACRES)	RADIUS	AREA (ACRES)	h	VOL (AC-FT)	ΔV
193.9	—	1129.4894	92.0	34'	1043	—
						173.7
191.9	—	1063.0489	81.5	32'	869.3	—
						286.9
187.9	62.4	930.1678	62.4	28'	582.4	—

SIDE SLOPE RATIO:



$= 1$

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

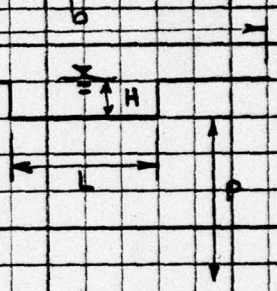
JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RESV. No. 1	4/		
SUBJECT		**COMPUTED BY**	**DATE**
WEIR COEFFICIENTS		WCL	2/15/79

REF: HANDBOOK OF HYDRAULICS (5TH ED.)
KING & BRATER

SITUATION: HORIZONTAL RECTANGULAR SHARP-CRESTED WEIR WITH END CONTRACTIONS

$Q = CLH^{3/2}$

SERVICE SPILLWAY



P = 28'
L = 30'
b = 562'

(FIG 5-3 pg 5-14)

H	H/P	L/b	C_e	$\frac{b}{L}$	L
4'	0.14	0.053	3.1	+0.008	30.008
2'	0.07	0.053	3.15	+0.008	30.008

∴ USE C = 3.1
L = 30'

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RES. NO. 1 DAM	5		
SUBJECT		**COMPUTED BY**	**DATE**
OUTFLOW COMPUTATIONS		RLW	2/27/79

WATER SURFACE AT ELEVATION 191.9 (TOP OF NON OVERFLOW SECTION)

FLOW OVER SERVICE SPILLWAY ONLY

$Q = c L H^{3/2} = (3.1)(30)(4)^{3/2} = 744$ cfs

WATER SURFACE AT ELEVATION 193.9 (TOP OF EARTH BERMS)

FLOW OVER SERVICE SPILLWAY

$Q = (3.1)(30)(6)^{3/2} = 1367$ cfs

FLOW OVER NON OVER FLOW SECTION

$Q = (3.1)(628)(2)^{3/2} = 5506$ cfs

TOTAL OUTFLOW = 6873 cfs

```
**********************************
OJD HYDROGRAPH PACKAGE (HEC-1)
M SAFETY VERSION     JULY 1978
LAST MODIFICATION  26 FEB 79
MODIFIED FOR HONEYWELL APR 79
**********************************

**************************************
IS PROGRAM IS CURRENTLY BEING MODIFIED
 RUN ON THE OGS HONEYWELL SYSTEM

EASE REPORT ANY UNUSUAL OPERATING PROBLEMS
 MIKE TILLSON (RM. 423) PH: 7-5666
**************************************
  1              A NEW ROCHELLE RESERVOIR NO.1 DAM   NY-20   LONG ISLAND RIVER BASIN
  2              A PMF WITH RATIOS - ANALYSIS INCLUDING DOWNSTREAM FLOOD WAVE
  3              A DATE 6/4/79
  4              B    100       0      30       0       0       0       0       0       0       0
  5              B1     5
  6              J      1       3       1
  7              J1   0.5     0.6     1.0
  8              K      0       1                                       1
  9              K1                                INFLOW HYDROGRAPH
 10              M      1       1    2.02            2.02       0                       1
 11              P      0      22     112     123     133     142
 12              T                                                1.0     0.1             0.05
 13              W      3    .625       0
 14              X      4       4       1
 15              K      1       1                                       1
 16              K1                       ROUTED HYDROGRAPH AT DAM - NO BREACH
 17              Y      0       0       0       1       1
 18              Y1     1                                       -187.9       0
 19              $A     0    62.4    81.5
 20              $E 159.9   187.9   191.9
 21              $$ 187.9      30     3.1     1.5
 22              $D 191.9     3.1     1.5     628
 23              K     99
 24              A
 25              A
 26              A
 27              A
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FORMULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.50	RATIO 2 0.60	RATIO 3 1.00
HYDROGRAPH AT	1	2.02 (0.30E 19)	1	2018. (57.14)(	2421. 68.57)(	4036. 114.28)(
ROUTED TO	1	2.02 (0.30E 19)	1	1923. (54.44)(	2371. 67.14)(	4009. 113.52)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	187.90	187.90	191.90
STORAGE	582.	582.	869.
OUTFLOW	0.	0.	744.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	192.54	0.64	922.	1923.	5.50	43.50	0.
0.60	192.70	0.80	936.	2371.	6.50	43.00	0.
1.00	193.20	1.30	979.	4009.	9.00	43.00	0.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 79
**********************************
     1  A NEW ROCHELLE RESERVOIR NO.1 DAM   NY-20   LONG ISLAND RIVER BASIN
     2  A PMF WITH RATIOS - ANALYSIS INCLUDING DOWNSTREAM FLOOD WAVE
     3  A DATE  3/13/79          INCLUDING DAM FAILURE
     4  B    100       0       30       0       0       0       0       0       0       0
     5  B1     5
     6  J      1       3       1
     7  J1   0.5     0.6     1.0
     8  K      0       1                                       1
     9  K1                                INFLOW HYDROGRAPH
    10  M      1       1    2.02            2.02       0                               1
    11  P      0      22     112     123     133     142
    12  T                                                   1.0     0.1             0.05
    13  W      3   0.625
    14  X      4       4       1
    15  K      1       1                                       1
    16  K1                        ROUTED HYDROGRAPH AT DAM - WITH BREACH (RECTANGULAR)
    17  Y                                 1       1
    18  Y1     1                                           -187.9       0
    19  SA     0    62.4
    20  SE 159.9   187.9
    21  SS 187.9      30     3.1     1.5
    22  SD 191.9     3.1     1.5     626
    23  SB 382.5       0   175.7     0.1   187.9   192.4
    24  K      1    1000                                       1
    25  K1     LOCATION                       TOE OF DAM
    26  Y                                 1       1
    27  Y1     1
    28  Y6  0.05    0.05    0.05     173     190      20   0.153
    29  Y7    20     190     260     180     489     176     490     173     510     173
    30  Y7   511     176     860     180    1660     190
    31  K      1    1360                                       1
    32  K1     LOCATION                    MILL ROAD RAMPS
    33  Y                                 1       1
    34  Y1     1
    35  Y6  0.02    0.02    0.05     146     160     360   0.075
    36  Y7   140     160     210     148     289     148     290     146     310     146
    37  Y7   311     148     350     150     460     160                                 6
    38  K      1    1840                                       1
    39  K1     LOCATION                   ELEV 140 POINT
    40  Y                                 1       1
    41  Y1     1
    42  Y6  0.02    0.02    0.08     140     160     480   0.012
    43  Y7   100     160     260     142     389     142     390     140     410     140
    44  Y7   411     142     590     143     720     160
    45  K      1    2120                                       1
    46  K1     LOCATION                       LEFT BEND
    47  Y                                 1       1
    48  Y1     1
    49  Y6  0.04    0.05     0.1     139     150     280  0.0036
    50  Y7   120     150     340     140     385     140     390     139     430     139
```

```
Y7   435    140    600    140    680    150
K      1   2420                                  1
K1     LOCATION                 APPROACH TO CONSTRICTION
Y                                 1      1
Y1     1
Y6  0.05    0.1    0.1    135    150    300   0.013
Y7   140    150    260    140    289    137     290    135    320    135
Y7   325    137    600    140    740    150
K      1   2820                                  1
K1     LOCATION                      CONSTRICTION
Y                                 1      1
Y1     1
Y6  0.05    0.1    0.1    127    150    400    0.02
Y7   130    150    240    140    289    130     290    127    310    127
Y7   311    130    360    130    520    145
K      1   3040                                  1
K1     LOCATION                      PARKWAY EXIT
Y                                 1      1
Y1     1
Y6  0.05    0.1    0.1    126    150    220  0.0045
Y7   360    138    520    130    589    129     590    126    610    126
Y7   611    129    640    130    820    150
K     99
```

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********************************

RUN  DATE= 03/12/79
     TIME= 13.00.57.
```

NEW ROCHELLE RESERVOIR NO.1 DAM NY-20 LONG ISLAND RIVER BASIN
PMF WITH RATIOS - ANALYSIS INCLUDING DOWNSTREAM FLOOD WAVE
DATE 3/12/79 INCLUDING DAM FAILURE

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	30	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 3 LRTIO= 1
RTIOS= .50 .60 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.02	0.00	2.02	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	112.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.10	0.00	.05

UNIT HYDROGRAPH DATA
TP= 3.00 CP= .63 NTA= 0

RECESSION DATA
STRTQ= 4.00 QRCSN= 4.00 RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.86 AND R= 5.37 INTERVALS

UNIT HYDROGRAPH 33 END-OF-PERIOD ORDINATES, LAG= 2.99 HOURS, CP= .63 VOL= 1.00

17.	64.	125.	193.	247.	275.	273.	240.	199.	165.
137.	114.	94.	78.	65.	54.	45.	37.	31.	26.
21.	18.	15.	12.	10.	8.	7.	6.	5.	4.
3.	3.	2.							

1.01	.30	1	.00	.00	.00	4.	1.02	1.30	51	.06	.01	.05	17.
1.01	1.00	2	.00	.00	.00	4.	1.02	2.00	52	.06	.01	.05	18.
1.01	1.30	3	.00	.00	.00	4.	1.02	2.30	53	.06	.01	.05	19.
1.01	2.00	4	.00	.00	.00	4.	1.02	3.00	54	.06	.01	.05	21.
1.01	2.30	5	.00	.00	.00	4.	1.02	3.30	55	.06	.01	.05	23.
1.01	3.00	6	.00	.00	.00	4.	1.02	4.00	56	.06	.01	.05	24.
1.01	3.30	7	.00	.00	.00	4.	1.02	4.30	57	.06	.01	.05	26.
1.01	4.00	8	.00	.00	.00	4.	1.02	5.00	58	.06	.01	.05	27.
1.01	4.30	9	.00	.00	.00	4.	1.02	5.30	59	.06	.01	.05	28.
1.01	5.00	10	.00	.00	.00	4.	1.02	6.00	60	.06	.01	.05	29.
1.01	5.30	11	.00	.00	.00	4.	1.02	6.30	61	.16	.11	.05	31.
1.01	6.00	12	.00	.00	.00	4.	1.02	7.00	62	.16	.11	.05	39.
1.01	6.30	13	.01	.00	.01	4.	1.02	7.30	63	.16	.11	.05	52.
1.01	7.00	14	.01	.00	.01	4.	1.02	8.00	64	.16	.11	.05	72.
1.01	7.30	15	.01	.00	.01	5.	1.02	8.30	65	.16	.11	.05	98.
1.01	8.00	16	.01	.00	.01	5.	1.02	9.00	66	.16	.11	.05	126.
1.01	8.30	17	.01	.00	.01	5.	1.02	9.30	67	.16	.11	.05	154.
1.01	9.00	18	.01	.00	.01	5.	1.02	10.00	68	.16	.11	.05	179.
1.01	9.30	19	.01	.00	.01	5.	1.02	10.30	69	.16	.11	.05	200.
1.01	10.00	20	.01	.00	.01	5.	1.02	11.00	70	.16	.11	.05	217.
1.01	10.30	21	.01	.00	.01	5.	1.02	11.30	71	.16	.11	.05	231.
1.01	11.00	22	.01	.00	.01	5.	1.02	12.00	72	.16	.11	.05	243.
1.01	11.30	23	.01	.00	.01	5.	1.02	12.30	73	.99	.94	.05	287.
1.01	12.00	24	.01	.00	.01	5.	1.02	13.00	74	.99	.94	.05	328.
1.01	12.30	25	.07	.00	.06	5.	1.02	13.30	75	1.18	1.14	.05	443.
1.01	13.00	26	.07	.00	.06	6.	1.02	14.00	76	1.18	1.14	.05	620.
1.01	13.30	27	.08	.00	.08	6.	1.02	14.30	77	1.48	1.43	.05	858.
1.01	14.00	28	.08	.00	.08	6.	1.02	15.00	78	1.48	1.43	.05	1146.
1.01	14.30	29	.10	.01	.10	7.	1.02	15.30	79	1.80	1.75	.05	1466.
1.01	15.00	30	.10	.01	.10	8.	1.02	16.00	80	5.69	5.65	.05	1866.
1.01	15.30	31	.12	.01	.12	9.	1.02	16.30	81	1.38	1.33	.05	2374.
1.01	16.00	32	.39	.17	.22	13.	1.02	17.00	82	1.38	1.33	.05	2919.
1.01	16.30	33	.09	.05	.05	23.	1.02	17.30	83	1.08	1.04	.05	3433.
1.01	17.00	34	.09	.05	.05	36.	1.02	18.00	84	1.08	1.04	.05	3831.
1.01	17.30	35	.07	.03	.05	53.	1.02	18.30	85	.09	.04	.05	4036.
1.01	18.00	36	.07	.03	.05	69.	1.02	19.00	86	.09	.04	.05	4003.
1.01	18.30	37	.01	.00	.01	81.	1.02	19.30	87	.09	.04	.05	3740.
1.01	19.00	38	.01	.00	.01	87.	1.02	20.00	88	.09	.04	.05	3353.
1.01	19.30	39	.01	.00	.01	85.	1.02	20.30	89	.09	.04	.05	2933.
1.01	20.00	40	.01	.00	.01	78.	1.02	21.00	90	.09	.04	.05	2510.
1.01	20.30	41	.01	.00	.01	69.	1.02	21.30	91	.09	.04	.05	2114.
1.01	21.00	42	.01	.00	.01	60.	1.02	22.00	92	.09	.04	.05	1773.
1.01	21.30	43	.01	.00	.01	51.	1.02	22.30	93	.09	.04	.05	1489.
1.01	22.00	44	.01	.00	.01	43.	1.02	23.00	94	.09	.04	.05	1254.
1.01	22.30	45	.01	.00	.01	36.	1.02	23.30	95	.09	.04	.05	1059.
1.01	23.00	46	.01	.00	.01	31.	1.03	0.00	96	.09	.04	.05	897.
1.01	23.30	47	.01	.00	.01	26.	1.03	.30	97	0.00	0.00	0.00	762.
1.02	0.00	48	.01	.00	.01	23.	1.03	1.00	98	0.00	0.00	0.00	648.
1.02	.30	49	.06	.01	.05	20.	1.03	1.30	99	0.00	0.00	0.00	550.
1.02	1.00	50	.06	.01	.05	18.	1.03	2.00	100	0.00	0.00	0.00	465.
									SUM	24.99	21.48	3.51	54086.
										(635.)	(546.)	(89.)	(1530.98)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4036.	3089.	1099.	538.	53835.
CMS	114.	87.	31.	15.	1524.
INCHES		14.22	20.24	20.66	20.66
MM		361.29	514.20	524.75	524.75
AC-FT		1532.	2180.	2225.	2225.
THOUS CU M		1889.	2689.	2744.	2744.

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	3.	3.	3.	4.	4.
5.	7.	11.	18.	26.	34.	41.	43.	42.	39.
35.	30.	25.	21.	18.	15.	13.	11.	10.	9.
9.	9.	9.	10.	11.	12.	13.	14.	14.	14.
16.	19.	26.	36.	49.	63.	77.	90.	100.	109.
116.	122.	134.	164.	221.	310.	429.	573.	733.	933.
1187.	1459.	1717.	1915.	2018.	2001.	1870.	1677.	1466.	1255.
1057.	886.	745.	627.	529.	448.	381.	324.	275.	233.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2018.	1544.	550.	269.	26917.
CMS	57.	44.	16.	8.	762.
INCHES		7.11	10.12	10.33	10.33
MM		180.65	257.10	262.38	262.38
AC-FT		766.	1090.	1112.	1112.
THOUS CU M		945.	1344.	1372.	1372.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

2.	2.	2.	2.	2.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	4.	4.	4.	5.
6.	8.	14.	22.	32.	41.	49.	52.	51.	47.
41.	36.	30.	26.	22.	19.	16.	14.	12.	11.
10.	11.	11.	12.	14.	15.	16.	16.	17.	17.
19.	23.	31.	43.	59.	76.	93.	108.	120.	130.
139.	146.	160.	197.	266.	372.	515.	688.	879.	1120.
1424.	1751.	2060.	2299.	2421.	2402.	2244.	2012.	1760.	1506.
1269.	1064.	894.	752.	635.	538.	457.	389.	330.	279.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2421.	1853.	659.	323.	32301.
CMS	69.	52.	19.	9.	915.
INCHES		8.53	12.15	12.40	12.40
MM		216.78	308.52	314.85	314.85
AC-FT		919.	1308.	1335.	1335.
THOUS CU M		1134.	1613.	1646.	1646.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

4.	4.	4.	4.	4.	4.	4.	4.	4.	4.
4.	4.	4.	4.	5.	5.	5.	5.	5.	5.
5.	5.	5.	5.	5.	6.	6.	6.	7.	8.
9.	13.	23.	36.	53.	69.	81.	87.	85.	78.
69.	60.	51.	43.	36.	31.	26.	23.	20.	18.
17.	18.	19.	21.	23.	24.	26.	27.	28.	29.
31.	39.	52.	72.	98.	126.	154.	179.	200.	217.
231.	243.	267.	328.	443.	620.	858.	1146.	1466.	1866.
2374.	2919.	3433.	3831.	4036.	4003.	3740.	3353.	2933.	2510.
2114.	1773.	1489.	1254.	1059.	897.	762.	648.	550.	465.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4036.	3089.	1099.	538.	53835.
CMS	114.	87.	31.	15.	1524.
INCHES		14.22	20.24	20.66	20.66
MM		361.29	514.20	524.75	524.75
AC-FT		1532.	2180.	2225.	2225.
THOUS CU M		1889.	2689.	2744.	2744.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTED HYDROGRAPH AT DAM - WITH BREACH (RECTANGULAR)

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-138.	0

SURFACE AREA=	0.	62.
CAPACITY=	0.	582.
ELEVATION=	160.	188.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
187.9	30.0	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
191.9	3.1	1.5	628.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
383.	0.00	175.70	.10	187.90	192.40

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 159.90
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 187.90

STATION 1, PLAN 1, RATIO 1

BEGIN DAM FAILURE AT 43.00 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	4.	5.	6.	8.
9.	10.	10.	11.	11.	12.	12.	12.	12.	12.
11.	11.	11.	11.	11.	11.	11.	11.	11.	12.
12.	12.	12.	13.	15.	17.	19.	23.	27.	31.
35.	42.	47.	54.	64.	80.	104.	139.	183.	255.
344.	459.	600.	776.	1439.	1908.	3565.	1221.	1663.	1281.
1126.	938.	791.	667.	564.	479.	408.	348.	296.	252.

STORAGE

582.	583.	583.	583.	583.	583.	583.	583.	583.	583.
583.	583.	583.	584.	584.	584.	584.	584.	584.	584.
584.	584.	584.	584.	584.	585.	585.	585.	585.	585.
585.	585.	586.	586.	587.	588.	590.	591.	593.	594.
595.	596.	597.	598.	598.	598.	598.	598.	598.	598.
598.	598.	598.	598.	598.	598.	598.	598.	598.	598.

125.	124.	123.	119.	117.	116.	115.	114.	113.	112.

STAGE

187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	188.0	188.0	188.0	188.0	188.0	188.0	188.1	188.1
188.1	188.1	188.1	188.1	188.1	188.1	188.2	188.2	188.2	188.1
188.1	188.1	188.1	188.1	188.1	188.1	188.1	188.1	188.1	188.1
188.2	188.2	188.2	188.2	188.2	188.2	188.3	188.3	188.3	188.4
188.4	188.5	188.5	188.6	188.7	188.8	189.0	189.2	189.5	189.9
190.3	190.8	191.4	191.9	192.4	192.5	177.8	176.7	177.0	176.8
176.7	176.6	176.5	176.4	176.3	176.2	176.2	176.1	176.1	176.1

PEAK OUTFLOW IS 61225. AT TIME 43.10 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3565.	1334.	424.	205.	20505.
CMS	101.	38.	12.	6.	581.
INCHES		6.14	7.80	7.87	7.87
MM		156.04	198.24	199.87	199.87
AC-FT		661.	840.	847.	847.
THOUS CU M		816.	1037.	1045.	1045.

OVN

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 159.90
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 187.90

STATION 1, PLAN 1, RATIO 2

BEGIN DAM FAILURE AT 42.00 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	3.	5.	6.	8.	10.
11.	12.	13.	14.	15.	15.	15.	15.	15.	15.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
15.	15.	15.	17.	18.	21.	24.	29.	34.	39.
46.	32.	60.	68.	81.	100.	130.	175.	236.	320.
430.	573.	746.	1597.	4017.	1881.	2457.	2027.	1845.	1573.
1338.	1124.	946.	798.	675.	573.	487.	416.	354.	301.

STORAGE

582.	583.	583.	583.	583.	583.	583.	583.	583.	583.
583.	584.	584.	584.	584.	584.	584.	584.	584.	584.
584.	585.	585.	585.	585.	585.	585.	585.	585.	586.
586.	586.	586.	587.	588.	589.	591.	593.	595.	596.
598.	599.	600.	600.	601.	601.	601.	601.	601.	601.
601.	600.	600.	600.	600.	600.	600.	600.	600.	601.
601.	601.	601.	602.	604.	606.	608.	611.	615.	618.
622.	626.	630.	635.	641.	651.	664.	683.	707.	736.
773.	818.	870.	911.	156.	134.	141.	136.	134.	131.
128.	125.	123.	121.	119.	117.	116.	115.	114.	113.

STAGE

187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.1	188.1	188.1
188.1	188.2	188.2	188.2	188.2	188.2	188.2	188.2	188.2	188.2
188.2	188.2	188.2	188.2	188.2	188.2	188.2	188.2	188.2	188.2
188.2	188.2	188.2	188.2	188.2	188.3	188.3	188.4	188.4	188.5
188.5	188.6	188.6	188.7	188.8	189.0	189.2	189.4	189.8	190.2
190.7	191.3	191.9	192.4	178.0	177.1	177.3	177.1	177.0	176.9
176.8	176.7	176.6	176.5	176.4	176.3	176.3	176.2	176.1	176.1

PEAK OUTFLOW IS 60941. AT TIME 42.10 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4017.	1693.	534.	258.	25839.
CMS	114.	48.	15.	7.	732.
INCHES		7.80	9.83	9.92	9.92
MM		198.02	249.78	251.86	251.86
AC-FT		839.	1059.	1068.	1068.
THOUS CU M		1035.	1306.	1317.	1317.

*OVN

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 159.90
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 187.90

STATION 1, PLAN 1, RATIO 3

BEGIN DAM FAILURE AT 41.00 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	3.	3.	4.	5.	7.	10.	13.	17.	20.
23.	25.	27.	28.	29.	29.	29.	29.	28.	28.
27.	26.	26.	26.	25.	25.	25.	25.	26.	26.
26.	26.	28.	30.	33.	38.	45.	53.	63.	74.
86.	98.	111.	128.	152.	188.	245.	328.	442.	594.
847.	2179.	4925.	3170.	4201.	3954.	3843.	3443.	3041.	2616.
2216.	1862.	1566.	1321.	1117.	947.	806.	686.	585.	497.

STORAGE

583.	583.	583.	583.	583.	583.	584.	584.	584.	584.
584.	584.	585.	585.	585.	585.	585.	585.	585.	586.
586.	586.	586.	586.	586.	587.	587.	587.	587.	587.
588.	588.	589.	590.	591.	594.	596.	599.	602.	605.
607.	609.	610.	611.	611.	611.	611.	611.	611.	611.
610.	610.	610.	609.	609.	609.	609.	609.	609.	609.
609.	610.	611.	612.	614.	617.	621.	626.	632.	638.
643.	649.	656.	663.	673.	688.	710.	739.	777.	825.
862.	927.	165.	148.	158.	156.	155.	151.	147.	142.
138.	134.	131.	128.	125.	123.	121.	119.	118.	116.

STAGE

187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9
187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	187.9	188.0
188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0	188.0
188.0	188.0	188.0	188.0	188.0	188.1	188.1	188.2	188.2	188.2
188.3	188.3	188.3	188.3	188.4	188.4	188.4	188.4	188.4	188.3
188.3	188.3	188.3	188.3	188.3	188.3	188.3	188.3	188.3	188.3
188.3	188.3	188.3	188.4	188.4	188.4	188.5	188.6	188.7	188.8
188.8	188.9	189.0	189.1	189.3	189.5	189.8	190.2	190.7	191.3
192.0	192.6	178.3	177.6	178.0	177.9	177.9	177.7	177.6	177.4
177.2	177.1	176.9	176.8	176.7	176.6	176.5	176.4	176.3	176.3

PEAK OUTFLOW IS 62151. AT TIME 41.10 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4925.	3057.	971.	470.	47048.
CMS	139.	87.	28.	13.	1332.
INCHES		14.08	17.89	18.06	18.06
MM		357.55	454.50	458.60	458.60
AC-FT		1516.	1927.	1944.	1944.
THOUS CU M		1870.	2377.	2398.	2398.

OVN

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

LOCATION TOL. OF DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1000	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.0500	.0500	173.0	190.0	20.	.15300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

20.00 190.00 260.00 180.00 489.00 176.00 490.00 173.00 510.00 173.00
511.00 176.00 660.00 180.00 1660.00 190.00

STORAGE	0.00	.01	.02	.03	.05	.12	.24	.42	.64	.
	1.23	1.58	1.96	2.39	2.85	3.35	3.89	4.47	5.09	5.
OUTFLOW	0.00	186.94	575.50	1101.10	1909.32	4116.57	8875.07	17095.02	29727.10	47868.
	71105.62	99802.61	134325.92	175040.00	222304.25	276471.96	337889.94	406898.53	483831.83	569017.
STAGE	173.00	173.87	174.79	175.68	176.58	177.47	178.37	179.26	180.16	181.
	181.95	182.84	183.74	184.63	185.53	186.42	187.32	188.21	189.11	190.
FLOW	0.00	186.94	575.50	1101.10	1909.32	4116.57	8875.07	17095.02	29727.10	47868.
	71105.62	99802.61	134325.92	175040.00	222304.25	276471.96	337889.94	406898.53	483831.83	569017.

STATION 1000, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	3.	4.	5.	6.	8.
9.	10.	10.	11.	11.	12.	12.	12.	12.	12.
11.	11.	11.	11.	11.	11.	11.	11.	11.	12.
12.	12.	12.	13.	15.	17.	19.	23.	27.	31.
36.	42.	47.	54.	64.	80.	104.	139.	188.	255.
344.	459.	600.	776.	988.	1908.	3562.	1227.	1656.	1268.
1119.	945.	784.	674.	558.	486.	401.	355.	290.	259.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.2
173.2	173.2	173.2	173.3	173.3	173.4	173.5	173.7	173.9	174.1
174.3	174.5	174.8	175.1	176.1	176.6	177.2	175.8	176.3	175.9
175.7	175.4	175.1	175.0	174.7	174.6	174.4	174.3	174.1	174.1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3562.	1334.	424.	205.	20505.
CMS	101.	38.	12.	6.	581.
INCHES		6.14	7.80	7.87	7.87
MM		156.04	198.24	199.87	199.87
AC-FT		661.	840.	847.	847.
THOUS CU M		816.	1037.	1045.	1045.

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 177.2

STATION 1000, PLAN 1, RTIO 2

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	3.	5.	6.	2.	10.
11.	12.	13.	14.	15.	15.	15.	15.	15.	15.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
15.	15.	15.	16.	18.	21.	24.	29.	34.	39.
46.	52.	60.	68.	81.	100.	130.	175.	236.	320.
430.	573.	746.	1596.	4015.	1837.	2451.	2034.	1837.	1581.
1331.	1132.	939.	806.	658.	580.	480.	423.	347.	309.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0

173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.2	173.2
173.2	173.3	173.3	173.3	173.4	173.5	173.6	173.8	174.0	174.2
174.5	174.9	175.1	176.2	177.4	176.6	176.8	176.6	176.5	176.2
175.9	175.7	175.4	175.2	174.9	174.8	174.6	174.4	174.3	174.2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4015.	1693.	534.	258.	25838.
CMS	114.	48.	15.	7.	732.
INCHES		7.80	9.83	9.92	9.92
MM		198.02	249.77	251.86	251.86
AC-FT		839.	1059.	1068.	1068.
THOUS CU M		1035.	1306.	1317.	1317.

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 177.4

STATION 1000, PLAN 1, RTIO 3

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	2.	2.	2.	2.
2.	2.	3.	4.	5.	7.	10.	13.	17.	20.
23.	25.	27.	28.	29.	29.	29.	29.	28.	28.
27.	26.	26.	26.	25.	25.	25.	25.	26.	26.
26.	26.	28.	30.	33.	38.	45.	53.	63.	74.
86.	98.	111.	129.	152.	188.	245.	328.	442.	594.
897.	2177.	4922.	3175.	4195.	3961.	3836.	3450.	3034.	2623.
2210.	1869.	1559.	1328.	1110.	954.	799.	693.	573.	504.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STAGE

173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.0
173.0	173.0	173.0	173.0	173.0	173.0	173.0	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1	173.1
173.1	173.1	173.1	173.1	173.2	173.2	173.2	173.3	173.3	173.4
173.4	173.5	173.5	173.6	173.7	173.9	174.0	174.2	174.5	174.8
175.3	176.7	177.6	177.1	177.5	177.4	177.4	177.2	177.0	176.9
176.7	176.5	176.2	175.9	175.7	175.4	175.2	175.0	174.8	174.6

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4922.	3057.	971.	470.	47048.
CMS	139.	87.	28.	13.	1332.
INCHES		14.08	17.89	18.05	18.05

CFS	4524.	3050.	470.	470.	1329.	
CMS	131.	87.	27.	13.	1329.	
INCHES		14.07	17.86	18.02	18.02	
MM		357.45	453.62	457.65	457.65	
AC-FT		1515.	1923.	1940.	1940.	
THOUS CU M		1869.	2372.	2393.	2393.	

MAXIMUM STORAGE = 8.

MAXIMUM STAGE IS 141.5

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

LOCATION CONSTRICTION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2820	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0500	.1000	.1000	127.0	150.0	400.	.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

180.00 150.00 240.00 140.00 289.00 130.00 290.00 127.00 310.00 127.00
311.00 150.00 360.00 150.00 520.00 145.00

STORAGE	0.00	.23	.46	1.02	2.02	3.23	4.66	6.29	8.13	10.
	12.44	14.91	17.60	20.52	23.65	27.02	30.51	34.09	37.75	41.
OUTFLOW	0.00	55.30	168.87	382.18	885.53	1682.68	2800.40	4270.63	6125.86	8398.
	11118.45	14304.30	17971.33	22194.48	27006.04	32534.06	39352.20	46825.57	54958.98	63758.
STAGE	127.00	128.21	129.42	130.63	131.84	133.05	134.26	135.47	136.68	137.
	139.11	140.32	141.53	142.74	143.95	145.16	146.37	147.58	148.79	150.
FLOW	0.00	55.30	168.87	382.18	885.53	1682.68	2800.40	4270.63	6125.86	8398.
	11118.45	14304.30	17971.33	22194.48	27006.04	32534.06	39352.20	46825.57	54958.98	63758.

STATION 2820, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.

STORAGE	0.00	.23	.46	1.02	2.02	3.23	4.66	6.29	8.13	10.1
	12.44	14.91	17.60	20.52	23.65	27.02	30.51	34.09	37.75	41.4
OUTFLOW	0.00	55.30	168.87	382.18	885.53	1682.68	2800.40	4270.63	6125.86	8398.0
	11118.45	14304.30	17971.33	22194.48	27006.04	32534.06	39352.20	46825.57	54958.98	63758.3
STAGE	127.00	128.21	129.42	130.63	131.84	133.05	134.26	135.47	136.68	137.8
	139.11	140.32	141.53	142.74	143.95	145.16	146.37	147.58	148.79	150.0
FLOW	0.00	55.30	168.87	382.18	885.53	1682.68	2800.40	4270.63	6125.86	8398.0
	11118.45	14304.30	17971.33	22194.48	27006.04	32534.06	39352.20	46825.57	54958.98	63758.3

STATION 2820, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	2.	2.	3.	4.	6.	7.
8.	9.	10.	11.	11.	12.	12.	12.	12.	12.
12.	11.	11.	11.	11.	11.	11.	11.	11.	12.
12.	12.	12.	13.	14.	16.	18.	21.	25.	30.
34.	40.	45.	52.	61.	75.	96.	129.	175.	236.
319.	432.	570.	734.	1300.	1913.	3169.	2056.	1028.	1749.
933.	1050.	830.	628.	667.	413.	494.	304.	349.	239.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	1.
1.	1.	1.	2.	3.	4.	5.	4.	2.	3.
2.	2.	2.	2.	2.	1.	1.	1.	1.	1.

STAGE

127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.1	127.1	127.1	127.1	127.2
127.2	127.2	127.2	127.2	127.2	127.3	127.3	127.3	127.3	127.3
127.3	127.2	127.2	127.2	127.2	127.2	127.2	127.2	127.2	127.3
127.3	127.3	127.3	127.3	127.3	127.3	127.4	127.5	127.6	127.6
127.8	127.9	128.0	128.1	128.3	128.4	128.6	129.0	129.5	129.8
130.3	130.6	131.1	131.5	132.5	133.3	134.6	133.5	132.1	133.1
131.9	132.1	131.7	131.2	131.3	130.7	130.9	130.2	130.4	129.8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3169.	1334.	422.	204.	20436.
CMS	90.	38.	12.	6.	579.
INCHES		6.14	7.78	7.84	7.84
MM		156.06	197.61	199.20	199.20
AC-FT		662.	838.	844.	844.
THOUS CU M		816.	1033.	1042.	1042.

MAXIMUM STORAGE = 5.

MAXIMUM STAGE IS 134.6

1.	1.	1.	4.	2.	3.	4.	6.	7.	9.
11.	12.	13.	14.	14.	15.	15.	15.	15.	15.
15.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	15.	15.	16.	17.	20.	23.	27.	32.	37.
44.	50.	57.	66.	77.	94.	122.	163.	219.	296.
402.	543.	705.	1365.	3592.	2666.	1790.	2562.	1573.	1778.
1324.	1145.	1032.	753.	773.	527.	558.	390.	394.	300.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	2.	3.	6.	4.	3.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.

STAGE

127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.1	127.1	127.1	127.2	127.2
127.2	127.3	127.3	127.3	127.3	127.3	127.3	127.3	127.3	127.3
127.3	127.3	127.3	127.3	127.3	127.3	127.3	127.3	127.3	127.3
127.3	127.3	127.3	127.4	127.4	127.4	127.5	127.6	127.7	127.8
128.0	128.1	128.2	128.3	128.4	128.6	128.9	129.4	129.7	130.1
130.7	131.0	131.4	132.6	134.9	134.1	133.2	134.0	132.9	133.2
132.5	132.2	132.1	131.5	131.6	131.0	131.1	130.7	130.7	130.2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3592.	1693.	532.	258.	25755.
CMS	102.	48.	15.	7.	729.
INCHES		7.80	9.80	9.88	9.88
MM		198.07	249.02	251.05	251.05
AC-FT		840.	1056.	1064.	1064.
THOUS CU M		1036.	1302.	1313.	1313.

MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 134.9

STATION 2920, PLAN 1, RTIO 3

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	3.	3.	4.	6.	9.	12.	15.	19.
22.	24.	26.	27.	28.	29.	29.	29.	28.	28.
27.	27.	26.	26.	26.	25.	25.	25.	25.	26.
26.	26.	27.	29.	31.	36.	42.	50.	60.	71.
82.	95.	108.	124.	145.	178.	228.	304.	414.	561.
816.	1664.	4538.	3820.	3513.	4497.	3490.	3756.	2932.	2752.
2263.	1882.	1667.	1296.	1219.	912.	886.	669.	635.	495.

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
2.	3.	7.	6.	5.	7.	5.	6.	5.	5.
4.	3.	3.	3.	3.	2.	2.	2.	2.	1.

STAGE

127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0	127.0
127.0	127.1	127.1	127.1	127.1	127.1	127.2	127.3	127.3	127.4
127.5	127.5	127.6	127.6	127.6	127.6	127.6	127.6	127.6	127.6
127.6	127.6	127.6	127.6	127.6	127.6	127.6	127.6	127.6	127.6
127.6	127.6	127.6	127.6	127.7	127.8	127.9	128.1	128.3	128.4
128.5	128.6	128.8	128.9	129.2	129.5	129.8	130.2	130.7	131.1
131.7	133.2	135.6	135.1	134.9	135.6	134.8	135.0	134.4	134.2
133.7	133.3	133.0	132.5	132.3	131.9	131.8	131.3	131.2	130.9

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4638.	3058.	969.	469.	46920.
CMS	129.	87.	27.	13.	1329.
INCHES		14.08	17.85	18.01	18.01
MM		357.65	453.35	457.35	457.35
AC-FT		1516.	1922.	1939.	1939.
THOUS CU M		1870.	2371.	2392.	2392.

MAXIMUM STORAGE = 7.

MAXIMUM STAGE IS 135.6

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

LOCATION PARKWAY EXIT

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3040	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.0500	.1000	.1000	126.0	150.0	220.	.00450

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

360.00	134.00	520.00	130.00	589.00	129.00	590.00	126.00	610.00	126.00

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .60	RATIO 3 1.00
HYDROGRAPH AT	1	2.02	1	2018.	2421.	4036.
	(	5.23)	(	57.14)(	68.57)(	114.23)(
ROUTED TO	1	2.02	1	3565.	4017.	4925.
	(	5.23)	(	100.95)(	113.76)(	139.45)(
ROUTED TO	1000	2.02	1	3562.	4015.	4922.
	(	5.23)	(	100.88)(	113.68)(	139.38)(
ROUTED TO	1360	2.02	1	3536.	3992.	4902.
	(	5.23)	(	100.12)(	113.04)(	138.81)(
ROUTED TO	1840	2.02	1	3440.	3902.	4830.
	(	5.23)	(	97.40)(	110.49)(	136.77)(
ROUTED TO	2120	2.02	1	3330.	3789.	4726.
	(	5.23)	(	94.29)(	107.30)(	133.81)(
ROUTED TO	2420	2.02	1	3236.	3684.	4628.
	(	5.23)	(	91.64)(	104.31)(	131.06)(
ROUTED TO	2820	2.02	1	3169.	3592.	4538.
	(	5.23)	(	89.73)(	101.72)(	128.49)(
ROUTED TO	3040	2.02	1	3113.	3516.	4526.
	(	5.23)	(	88.16)(	99.55)(	128.15)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	187.90	187.90	191.90
STORAGE	582.	582.	869.
OUTFLOW	0.	0.	744.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	192.52	.62	920.	61225.	1.55	43.10	43.00
.60	192.41	.51	911.	60941.	1.05	42.10	42.00
1.00	192.60	.70	927.	62151.	1.05	41.10	41.00

PLAN 1 STATION 1000

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3562.	177.2	43.50
.60	4015.	177.4	42.50
1.00	4922.	177.6	41.50

PLAN 1 STATION 1360

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3536.	148.8	43.50
.60	3992.	149.0	42.50
1.00	4902.	149.1	41.50

PLAN 1 STATION 1840

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3440.	143.4	43.50
.60	3902.	143.5	42.50
1.00	4830.	143.7	41.50

PLAN 1 STATION 2120

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3330.	143.4	43.50
.60	3789.	143.7	42.50
1.00	4726.	144.2	41.50

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3440.	143.4	43.50
.60	3902.	143.5	42.50
1.00	4830.	143.7	41.50

PLAN 1 STATION 2120

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3330.	143.4	43.50
.60	3789.	143.7	42.50
1.00	4726.	144.2	41.50

PLAN 1 STATION 2420

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3236.	140.8	43.50
.60	3684.	141.0	42.50
1.00	4628.	141.5	41.50

PLAN 1 STATION 2820

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3169.	134.6	43.50
.60	3592.	134.9	42.50
1.00	4538.	135.6	41.50

PLAN 1 STATION 3040

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3113.	134.0	43.50
.60	3516.	134.3	42.50
1.00	4526.	135.1	43.00

APPENDIX E

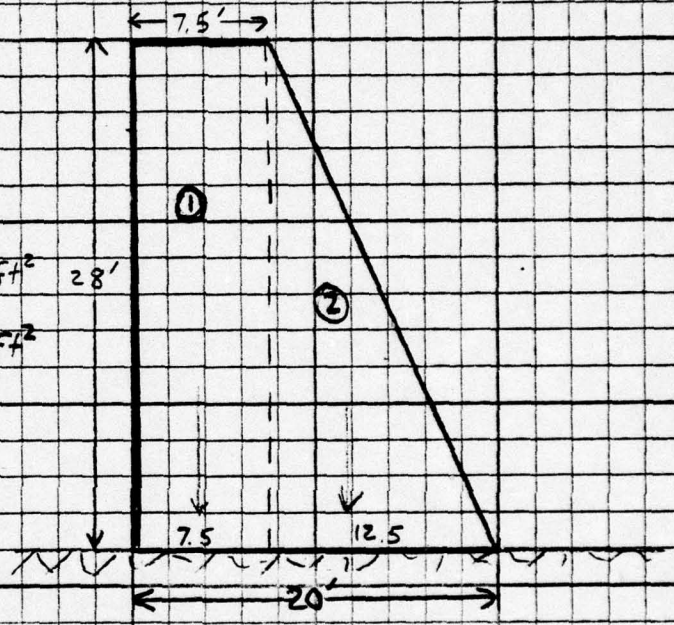
STRUCTURAL STABILITY ANALYSES

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
NEW ROCHELLE RESERVOIR No. 1 DAM	1		
SUBJECT		**COMPUTED BY**	**DATE**
STABILITY ANALYSIS		RLW	2/22/79

APPROXIMATE SECTION OF DAM



$\gamma_{DAM} = .150$

$f = .60$

AREA SECTION ① = 210 ft²

AREA SECTION ② = 175 ft²

INPUT TO STABILITY ANALYSIS PROGRAM

INPUT ENTRY	PROGRAM No.
Unit Weight of Dam (K/ft^3)	0
Area of Segment No. 1 (ft^2)	1
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2
Area of Segment No. 2 (ft^2)	3
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4
Area of Segment No. 3 (ft^2)	5
Distance from Center of Gravity of Segment No. 3 to Downstream Tow (ft)	6
Base Width of Dam (Total) (ft)	7
Height of Dam (ft)	8
Ice Loading (K/L ft.)	9
Coefficient of Sliding	10
Unit Weight of Soil (K/ft^3)	11
Active Soil Coefficient - Ka	12
Passive Soil Coefficient - Kp	13
Height of Water over Top of Dam or Spillway (ft)	14
Height of Soil for Active Pressure (ft)	15
Height of Soil for Passive Pressure (ft)	16
Height of Water in Tailrace Channel (ft)	17
Weight of Water (K/ft^3)	18
Area of Segment No. 4 (ft^2)	19
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20
Height of Ice Load or Active Water (ft)	46

INPUT AND RESULTS FROM STRUCTURAL STABILITY ANALYSIS PROGRAM

NORMAL CONDITIONS
WATER AT SERVICE
SPILLWAY CREST
NO ICE LOAD

```
                0
     0.15
     0.15       RCL
                  1
    210.
    210.        RCL
                  2
    16.25
    16.25       RCL
                  3
    175.
    175.        RCL
                  4
    8.3375
    8.3375      RCL
                  7
     20.
     20.        RCL
                  8
     28.
     28.        RCL
                  9
      0.
      0.        RCL
                 10
     0.6
     0.6        RCL
                 14
      0.
      0.        RCL
                 18
   0.0624
   0.0624       RCL
                 46
     24.
```

1. 1.82368461
2. 8.19413017
3. 1.344751603

1. Safety Factor vs. Overturning
2. Distance From Toe of Resultant
3. Safety Factor vs. Sliding

PMF - FLOW OVER
NON-OVERFLOW SECTION
NO ICE LOAD

```
     0.15       RCL
                  1
    210.
    210.        RCL
                  2
    16.25
    16.25       RCL
                  3
    175.
    175.        RCL
                  4
    8.3375
    8.3375      RCL
                  7
     20.
     20.        RCL
                  8
     28.
     28.        RCL
                  9
      0.
      0.        RCL
                 10
     0.6
     0.6        RCL
                 14
     1.3
     1.3        RCL
                 18
   0.0624
   0.0624       RCL
                 46
     28.
```

1. 1.450227054
2. 5.748085353
3. .8858274079

INPUT AND RESULTS FROM STRUCTURAL STABILITY ANALYSIS PROGRAM

1/2 PMF - FLOW
OVER NON-OVERFLOW
SECTION
NO ICE LOAD

```
                0
                
0.15            RCL
                1
210.
210.            RCL
                2
16.25
16.25           RCL
                3
175.
175.            RCL
                4
8.3375
8.3375          RCL
                7
20.
20.             RCL
                8
28.
28.             RCL
                9
0.
0.              RCL
                10
0.6
0.6             RCL
                14
0.6
0.6             RCL
                19
0.0624
0.0624          RCL
                46
28.
```

1. 1.519421681
2. 6.260214492
3. .9385725576

ICE LOAD OF 5000psf
WATER AT SERVICE
SPILLWAY CREST

```
                0
0.15
0.15            RCL
                1
210.
210.            RCL
                2
16.25
16.25           RCL
                3
175.
175.            RCL
                4
8.3375
8.3375          RCL
                7
20.
20.             RCL
                8
28.
28.             RCL
                9
5.
5.              RCL
                10
0.6
0.6             RCL
                14
0.
0.              RCL
                18
0.0624
0.0624          RCL
                46
24.
```

1. Safety Factor vs. Overturning
2. Distance From Toe of Resultant
3. Safety Factor vs. Sliding

1. 1.40339298
2. 5.214836263
3. 1.052047782

APPENDIX F

REFERENCES

APPENDIX F

REFERENCES

1) U.S. Department of Commerce, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, May 1961.

2) H.W. King and E.F. Brater, Handbook of Hydraulics, 5th edition, McGraw-Hill, 1963.

3) University of the State of New York, Geology of New York, Education Leaflet 20, Reprinted 1973.

4) Elwyn E. Seelye, Design, 3rd edition, John Wiley and Sons, Inc., 1960

APPENDIX G

DRAWINGS

FORM IW51. 6-18-12-2000 (18-15288)

(NOTICE: After filling out one of these forms as completely as possible for each dam in your district, return it at once to the Conservation Commission, Albany.)

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DAM REPORT

March 15th, 1912
(Date)

CONSERVATION COMMISSION,

DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known as the Cottage Corner Dam.

This dam is situated upon the Hutchinson River
(Give name of stream)
in the Town of Eastchester, Westchester County,
about 1 mile from the Village ~~or City of~~ Tuckahoe
(State distance)
The distance Down stream from the dam, to the Long Island R.R.,
(Up or down) (Give name of nearest important stream or of a bridge)
is about 2 miles.
(State distance)

The dam is now owned by New Rochelle Water Co
(Give name in full)
and was built in or about the year 1899, and was extensively repaired or reconstructed during the year ——.

As it now stands, the spillway portion of this dam is built of Stone & Cement
(State whether of masonry, concrete or timber)
and the other portions are built of Stone & Cement
(State whether of masonry, concrete, earth or timber with or without rock fill)

As nearly as I can learn, the character of the foundation bed under the spillway portion of the dam is Rock and under the remaining portions such foundation bed is Rock.

201 Dams & Reservoirs

The total length of this dam is 660 feet. The spillway or waste-weir portion, is about 28 feet long, and the crest of the spillway is about 4 feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used for drawing off the water from behind the dam, are as follows: One 12 inch Iron pipe at

State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly any leaks or cracks which you may have observed.) There are no leaks and the Dam is in first class condition

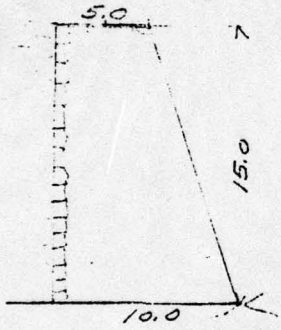
Reported by Benjamin M Bailey
(Signature)

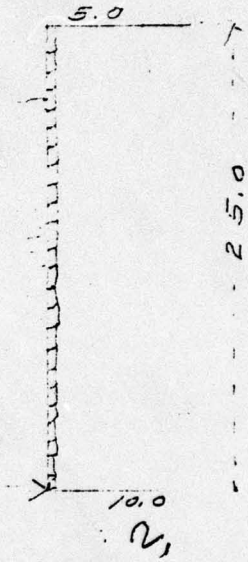
R F D Route 1
(Address—Street and number, P. O. Box or R. F. D. route)

White Plains
(Name of place)

(SEE OTHER SIDE)

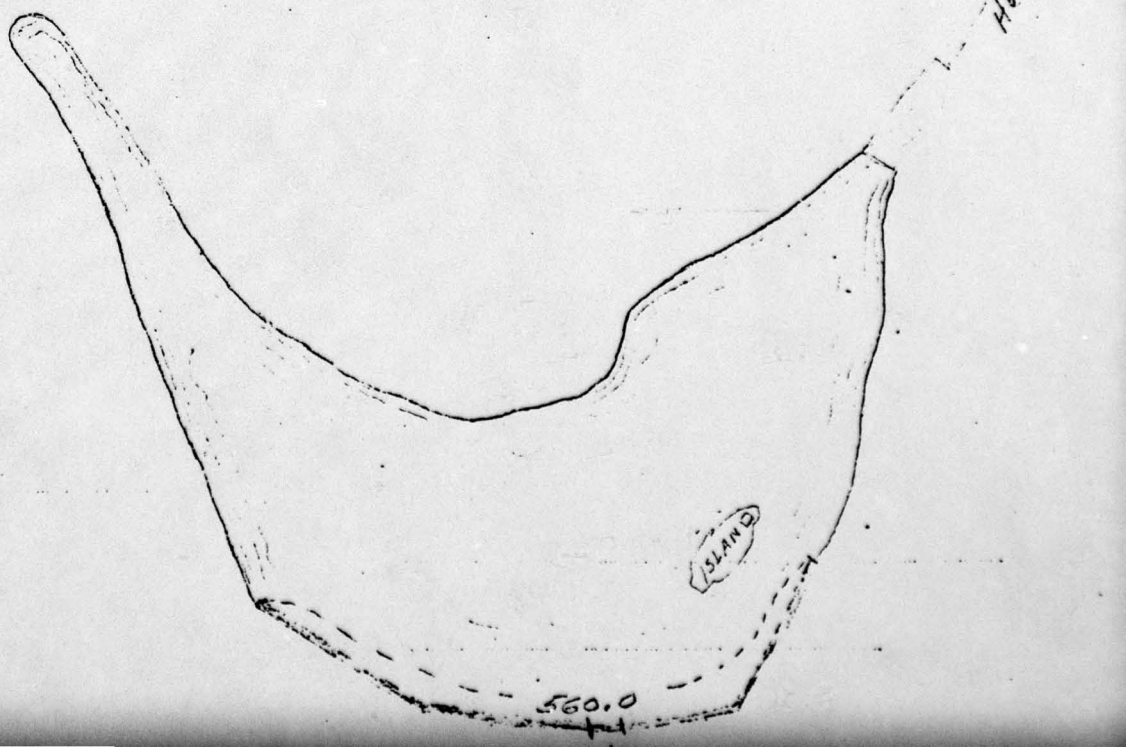
(In the space below, make one sketch showing the form and dimensions of a cross section through the spillway or waste-weir of this dam, and a second sketch showing the same information for a cross section through the other portion of the dam. Show particularly the greatest height of the dam above the stream bed, its thickness at the top, and thickness at the bottom, as nearly as you can learn.)





2,

(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings or other conspicuous objects in the vicinity.



207 LH

Form IW-31. 11-6-11-1929 (16-1938) Acc. 382

(NOTICE: After filling out one of these forms as completely as possible for each dam in your district, return it at once to the Conservation Commission, Albany.)

STATE OF NEW YORK

CONSERVATION COMMISSION

ALBANY

DAM REPORT

June 21st, 1910
(Date)

CONSERVATION COMMISSION,

DIVISION OF INLAND WATERS.

GENTLEMEN:

I have the honor to make the following report in relation to the structure known as the No 1 Reservoir New Rochelle Water Co.

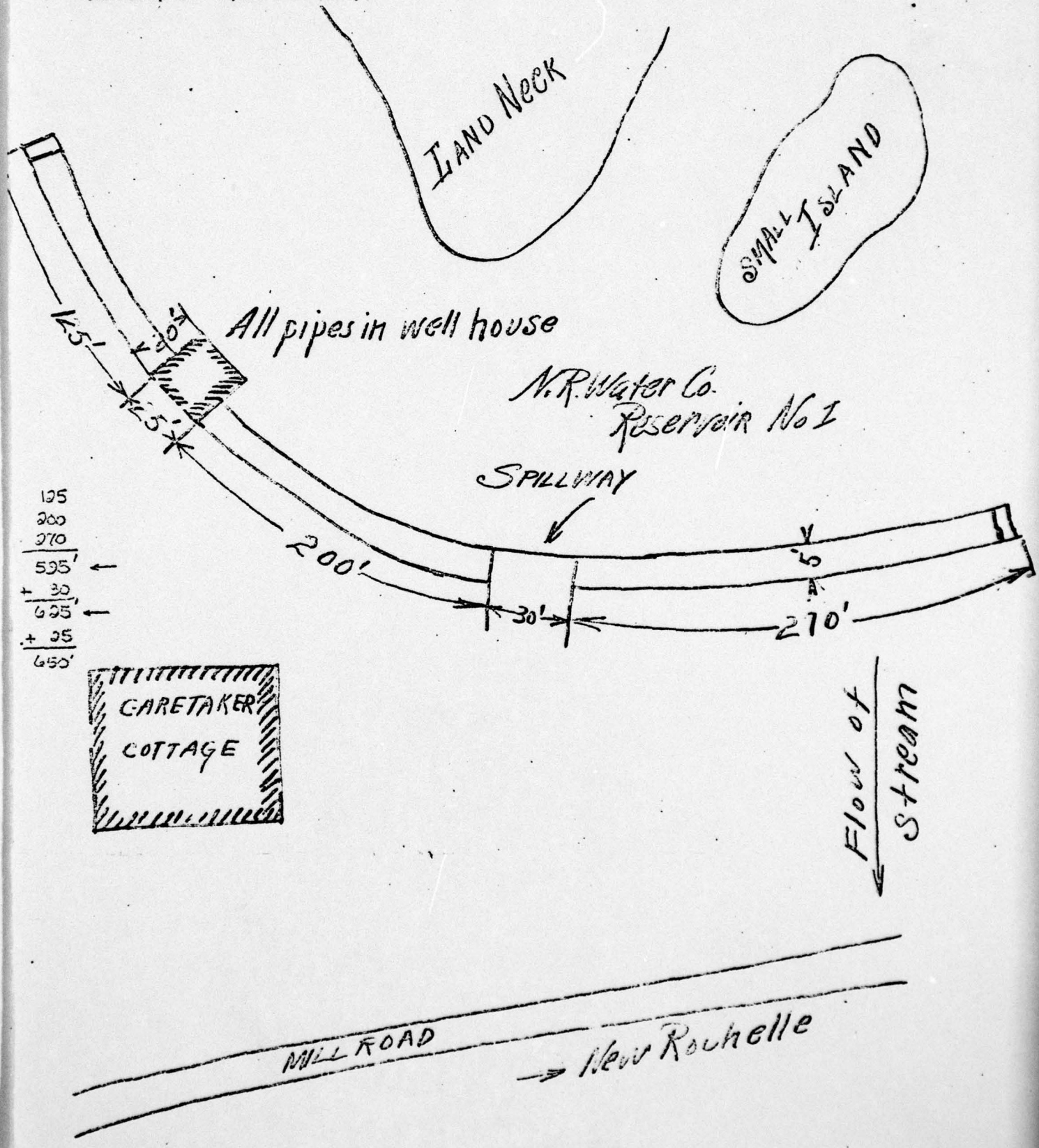
This dam is situated upon the Hutchinson River
(Give name of stream)
in the Town of East Chester, Westchester County,
about four miles (State distance) from the Village ~~or~~ City Hall in City of New Rochelle.
The distance down (Up or down) stream from the dam, to the Mill Road
(Give name of nearest important stream or of a bridge)
is about 500 feet
(State distance)

The dam is now owned by the N.R. Water Co. (Leslie Estate)
(Give name and address in full)
and was built in or about the year 1888, and was extensively repaired or reconstructed during the year 1894.

As it now stands, the spillway portion of this dam is built of Rock
(State whether of masonry, concrete or timber)
and the other portions are built of Rock
(State whether of masonry, concrete, earth or timber with or without rock fill)

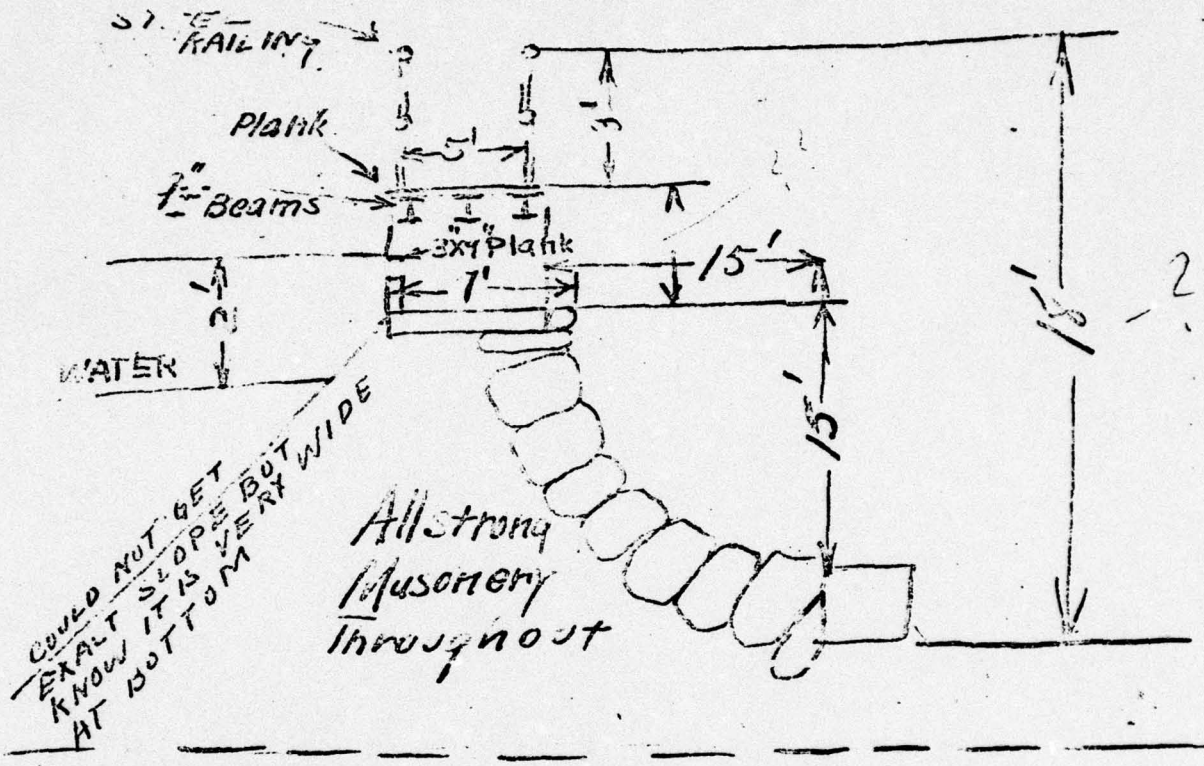
As nearly as I can learn, the character of the foundation bed under the spillway portion of the dam is Rock and under the remaining portions such foundation bed is Rock.

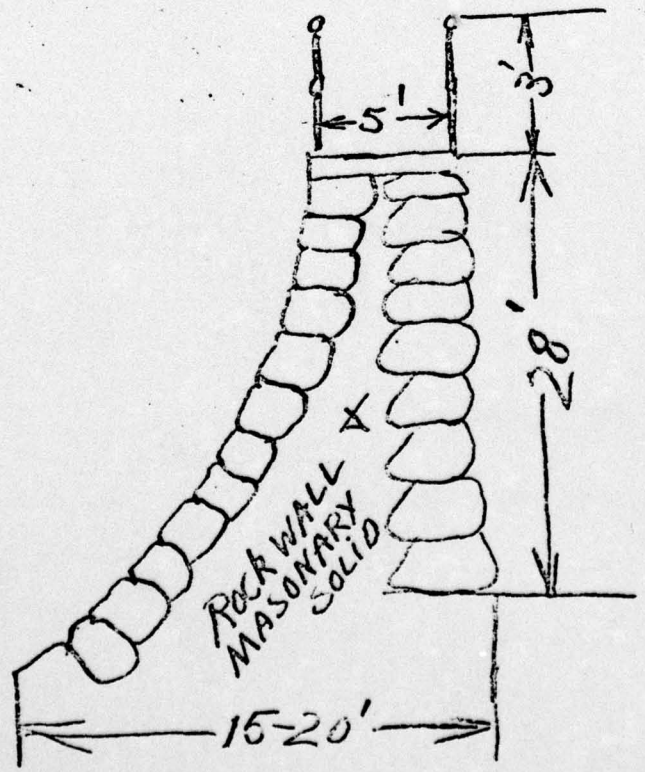
(In the space below, make a third sketch showing the general plan of the dam, and its approximate position in relation to buildings or other conspicuous objects in the vicinity.)



(In the space below, make one sketch showing the form and dimensions of a cross section through the spillway or waste-weir of this dam, and a second sketch showing the same information for a cross section through the other portion of the dam. Show particularly the greatest height of the dam above the stream bed, its thickness at the top, and thickness at the bottom, as nearly as you can learn.)

CROSS SECTION OF SPILLWAY PORTION





OTHER SECTION OF DAM

The total length of this dam is 650 feet. The spillway or waste-weir portion, is about 30 feet long, and the crest of the spillway is about Two feet below the top of the dam.

The number, size and location of discharge pipes, waste pipes or gates which may be used for drawing off the water from behind the dam, are as follows: 24" Blow Off 12" Main and 2—24" Mains

At the time of this inspection the water level above the dam was 2' ft. 0 in. below the crest of the spillway.

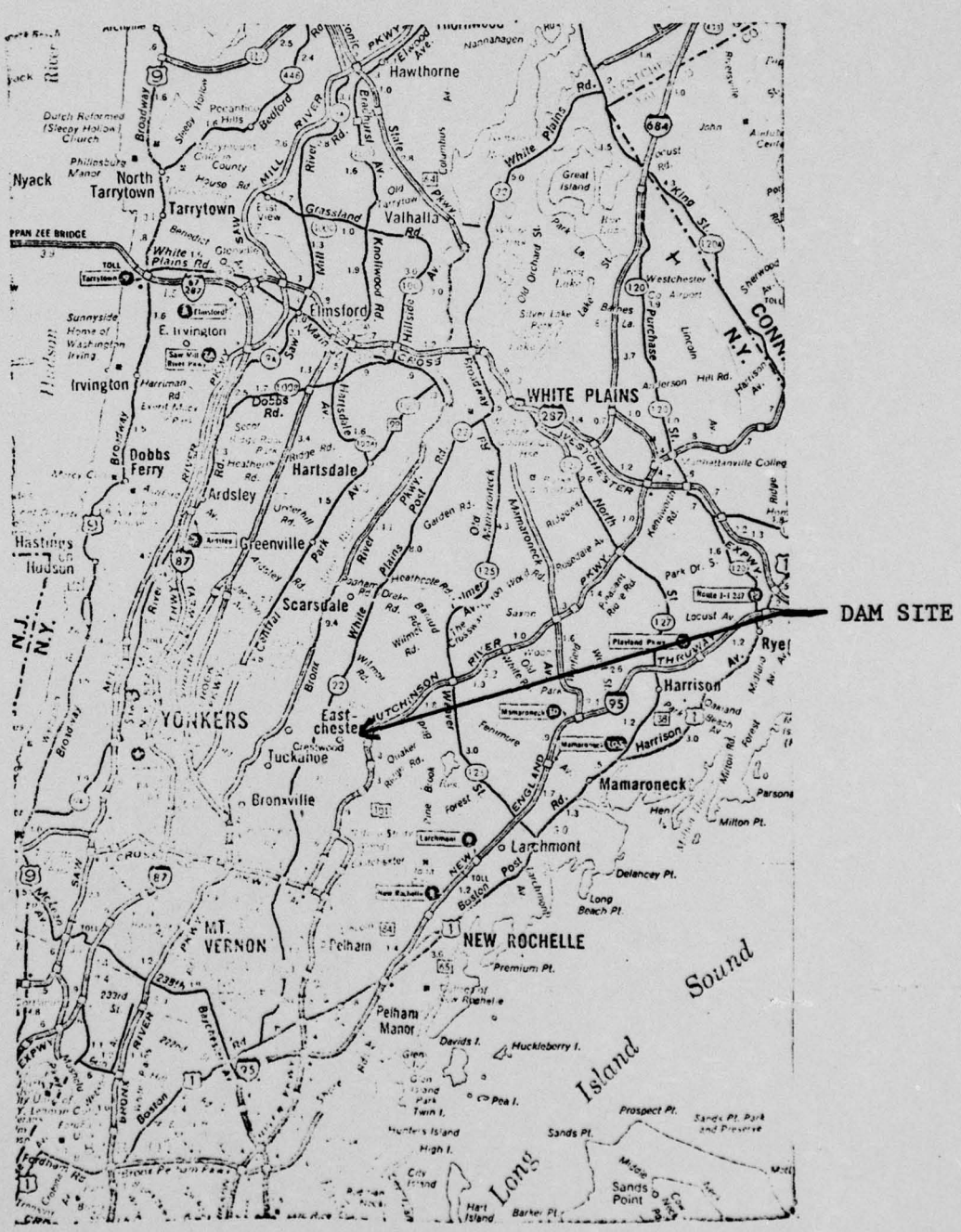
(State briefly, in the space below, whether, in your judgment, this dam is in good condition, or bad condition, describing particularly any leaks or cracks which you may have observed.)

This dam was in excellent condition throughout and well taken care of. Should a rupture occurs, most of the resulting damage would be to property owned by the owners of the dam and one or two roads that would probably be washed out.

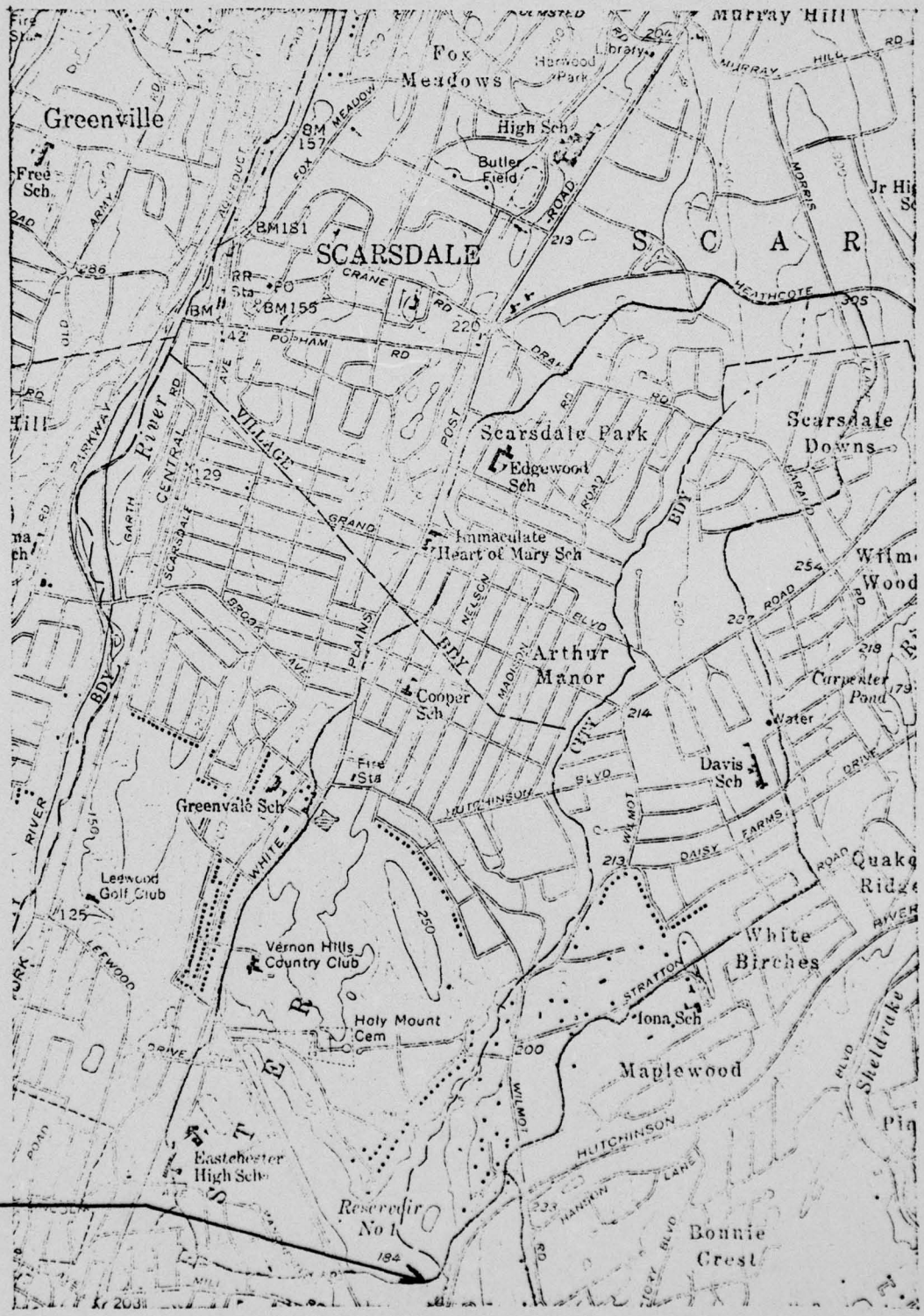
Reported by L. L. Lyman
(Signature)

Box 178
(Address—Street and number, P. O. Box or R. F. D. route)

Wilcox Wyo.
(Name of place)



VICINITY MAP
NEW ROCHELLE RESERVOIR
No. 1 DAM

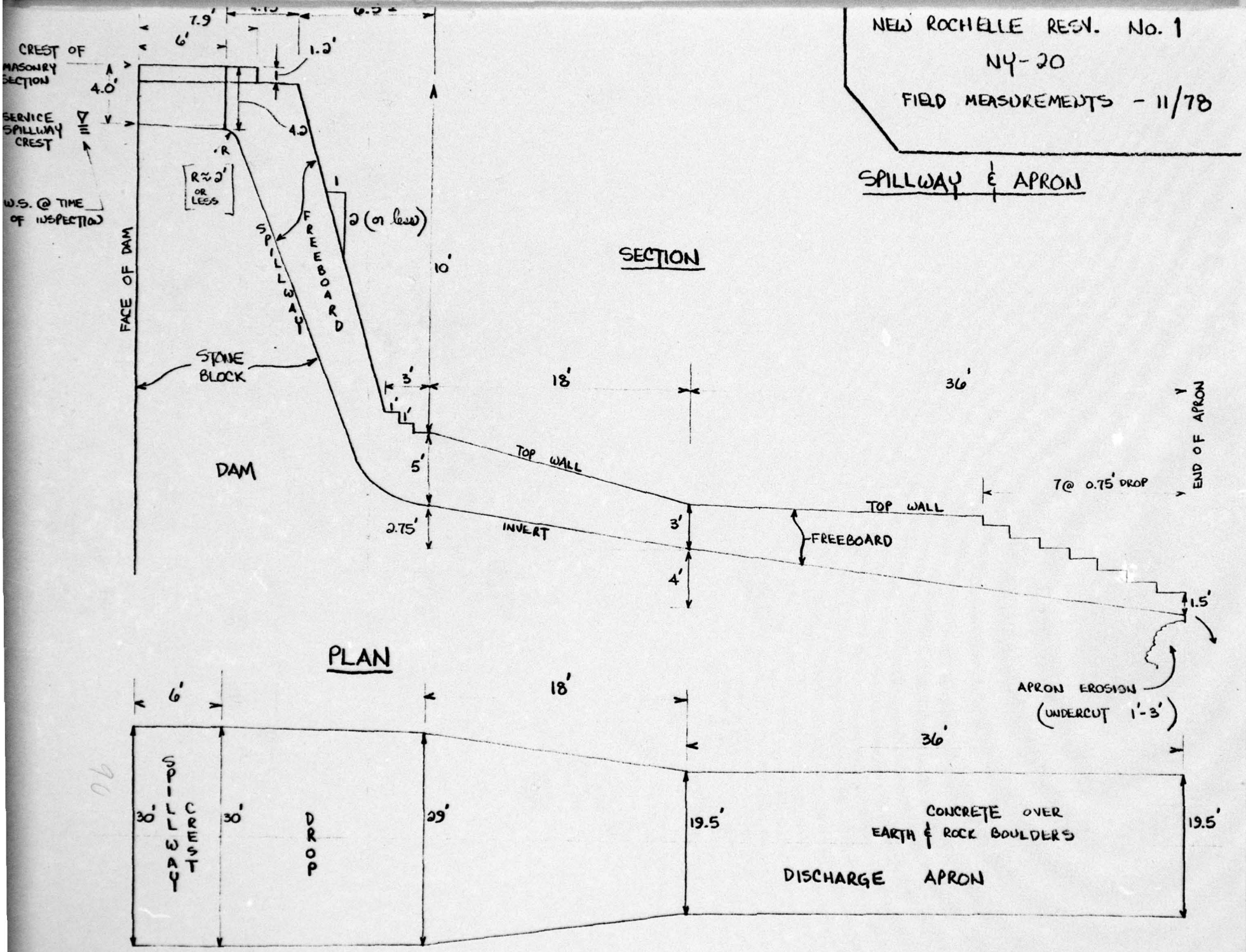


TOPOGRAPHIC MAP
NEW ROCHELLE RESERVOIR
No. 1 DAM

NEW ROCHELLE RESV. No. 1

NY-20

FIELD MEASUREMENTS - 11/78

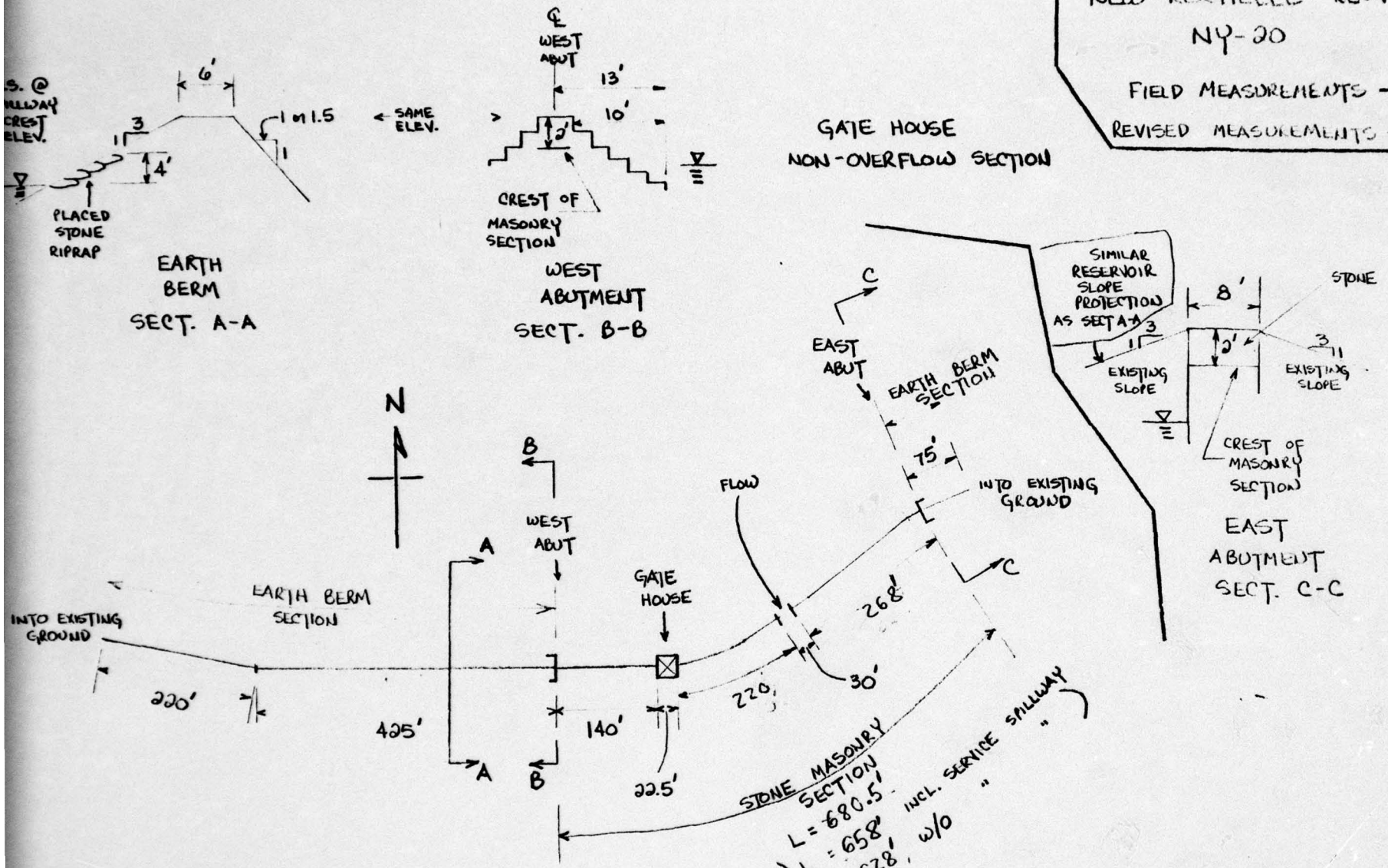


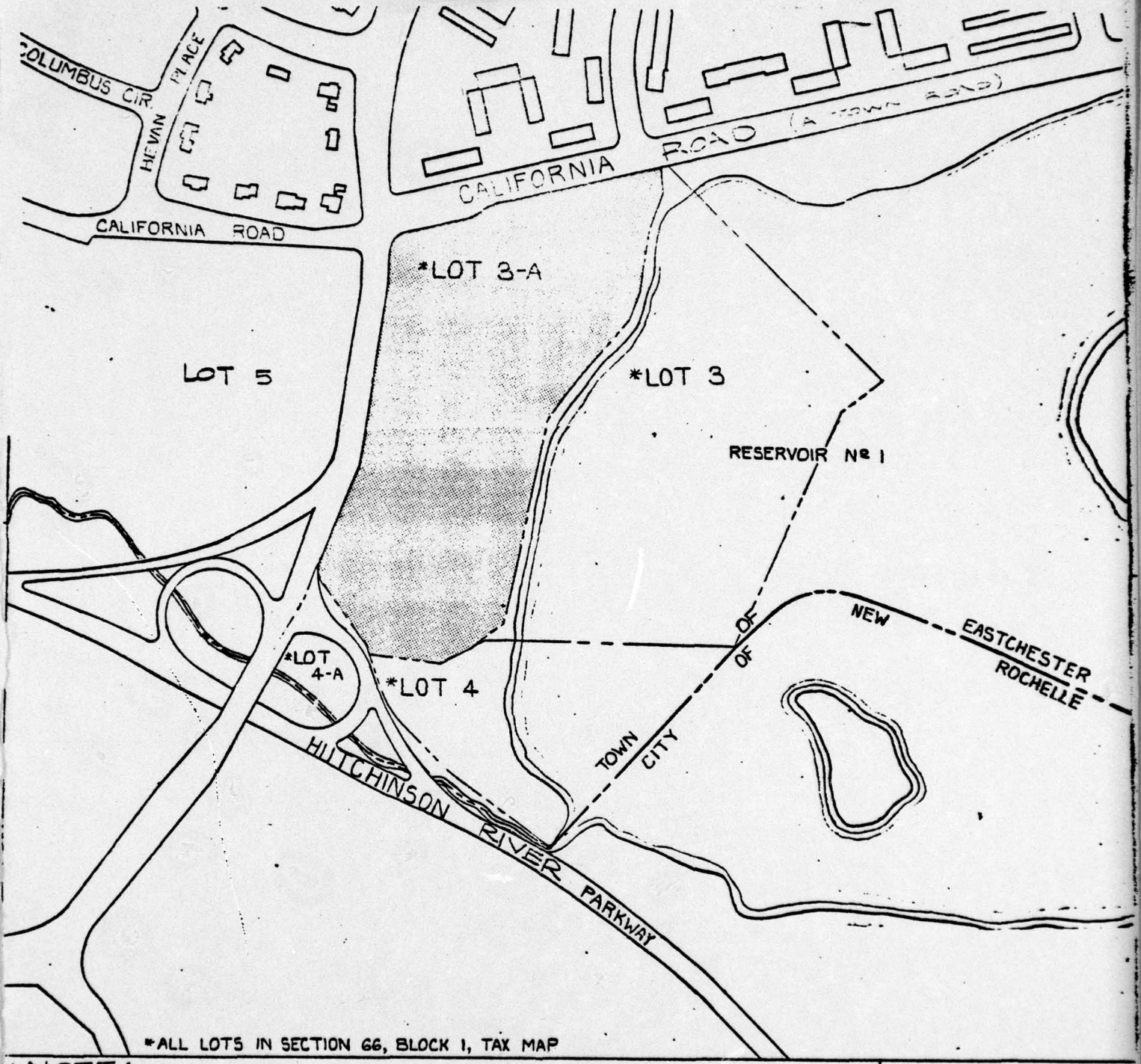
NEW ROCHELLE RESV. No. 1

NY-20

FIELD MEASUREMENTS - 11/78

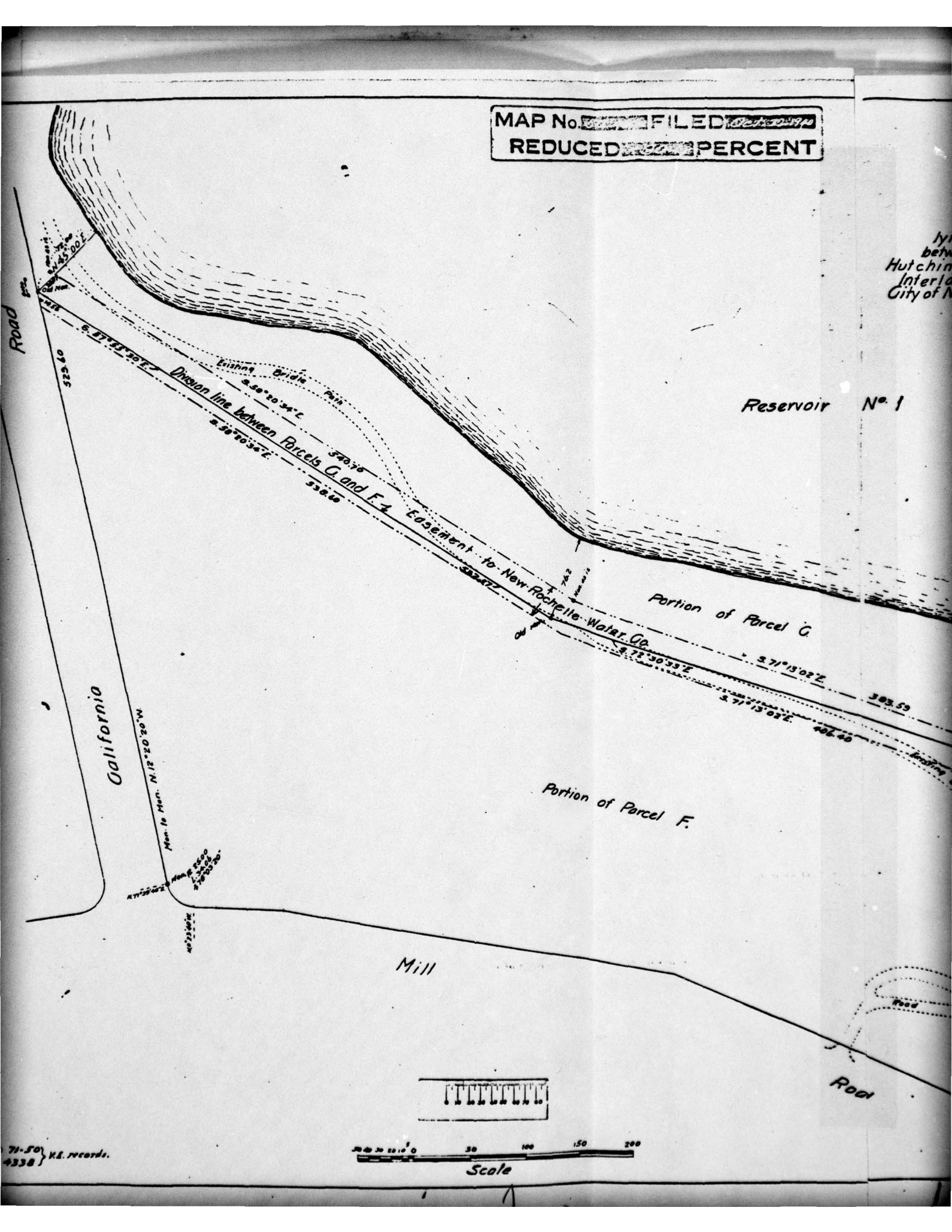
REVISED MEASUREMENTS - 3/79





NOTE:

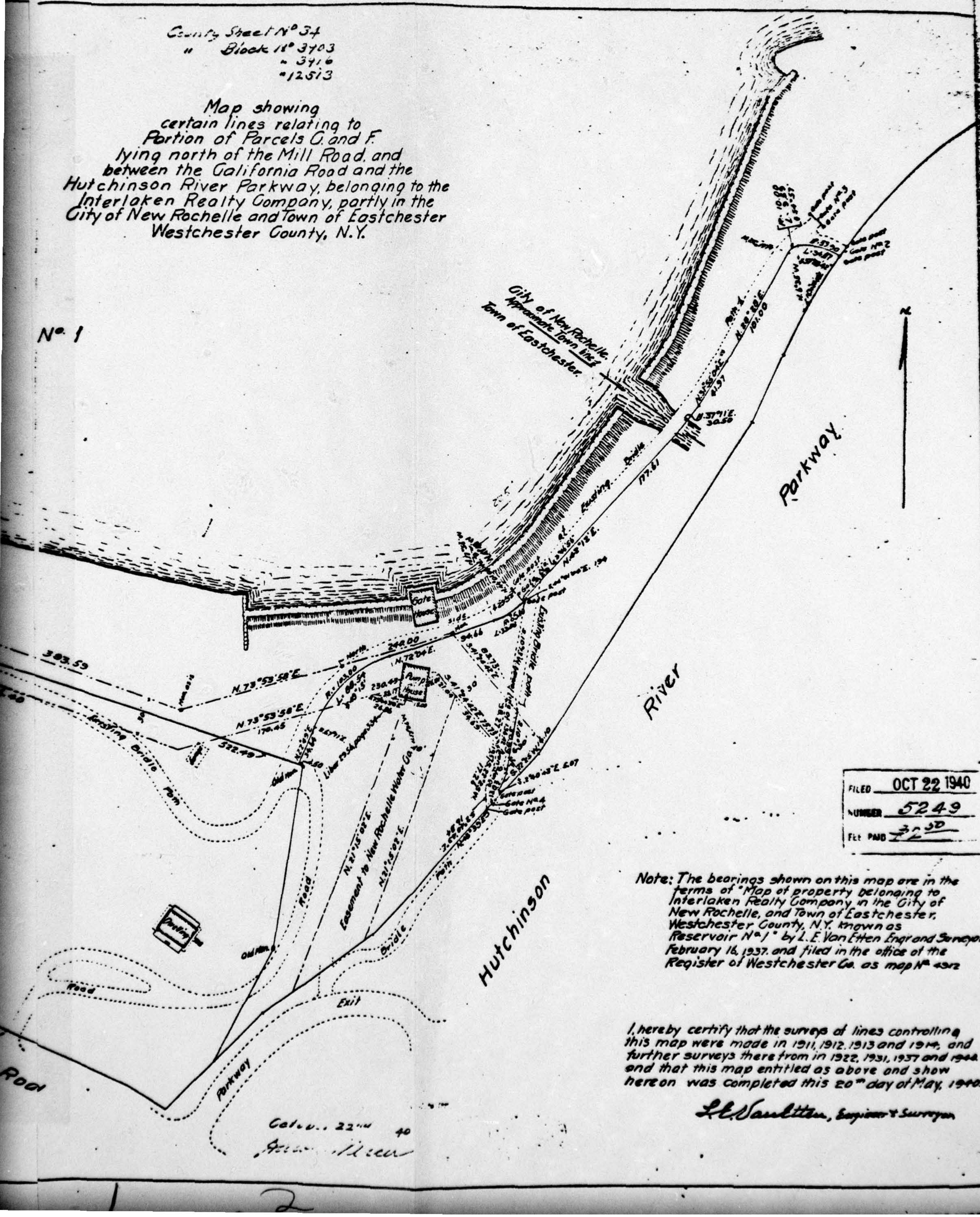
1. SITE AREA MAP DATA TAKEN FROM THE ZONING MAP OF TOWN OF EASTCHESTER AS PREPARED BY GABRIEL E. SENOR, CONSULTING ENGINEER-SURVEYOR, SCARSDALE, N. Y.
2. DETAIL SITE AREA MAP DATA TAKEN FROM THE TAX MAPS OF THE TOWN OF EASTCHESTER AS PREPARED BY GABRIEL E. SENOR, CONSULTING ENGINEER SURVEYOR, SCARSDALE, N. Y.
3. THE SITE LIES WITHIN THE FOLLOWING GENERAL IMPROVEMENT DISTRICTS, ALL OF WHICH ARE TOWN WIDE:
   SCHOOL DISTRICT Nº 1
   EASTCHESTER FIRE DISTRICT
   SEWER DISTRICT TOWN OF EASTCHESTER
   WATER DISTRICT NEW ROCHELLE WATER CO.
4. THE OWNERS OF ADJACENT LOTS ARE:
   LOT 3: FRED F. FRENCH INVESTING CO.
   LOT 4: FRED F. FRENCH INVESTING CO
   LOT 4-A: EAST HUDSON PARKWAY AUTHORITY
5. THE SUBDIVIDER AND OWNER OF RECORD OF LOT 3-A IS ROBERT F. LUSK.
6. THE BENEFICIAL OWNERS OF LOT 3-A ARE ROBERT F. LUSK, WILLIAM CANNELLA, OWEN A. MANDEVILLE JR., AS EXECUTOR OF THE LAST WILL AND TESTAMENT OF OWEN A. MANDEVILLE AND C. ROBERT COUTELL.
7. ~~THE ADDRESS OF ALL OWNERS IS: 202 MAMARONECK~~


MAP No. FILED
REDUCED PERCENT
Road
Existing Bridle Path
S. 58° 20' 34" E.
540.76
S. 38° 20' 34" E.
538.66
S. 37° 53' 30" E.
525.00
Division line between Parcels G and F-1
Easement to New Rochelle Water Co.
Reservoir No. 1
Portion of Parcel G
Portion of Parcel F
S. 72° 30' 53" E.
S. 71° 13' 02" E.
303.59
406.40
California
Mon. to Mon.
N. 12° 02' W.
Mill
Road
Scale
50 0 50 100 150 200

County Sheet No 34
" Block No 3403
" 3416
" 12513

Map showing certain lines relating to Portion of Parcels C. and F. lying north of the Mill Road. and between the California Road and the Hutchinson River Parkway, belonging to the Interlaken Realty Company, partly in the City of New Rochelle and Town of Eastchester Westchester County, N.Y.

No. 1



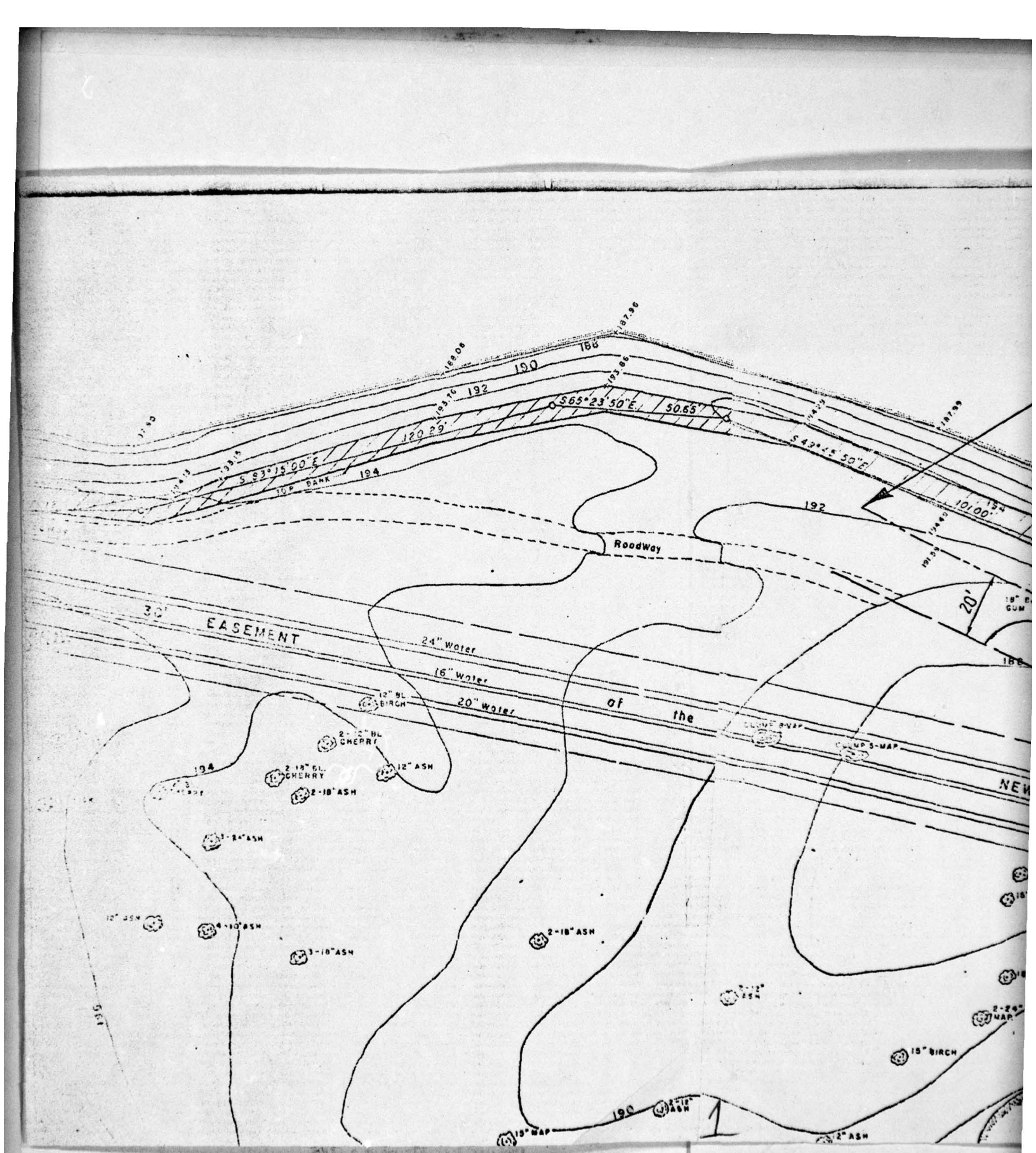
Note: The bearings shown on this map are in the terms of "Map of property belonging to Interlaken Realty Company in the City of New Rochelle, and Town of Eastchester, Westchester County, N.Y. known as Reservoir No 1" by L. E. Van Etten Engr and Surveyor. February 16, 1937. and filed in the office of the Register of Westchester Co. as map No 4312

I, hereby certify that the surveys of lines controlling this map were made in 1911, 1912, 1913 and 1914, and further surveys there from in 1922, 1931, 1937 and 1940. and that this map entitled as above and shown hereon was completed this 20th day of May, 1940.

L. E. Van Etten, Engineer & Surveyor

FILED OCT 22 1940
NUMBER 5249
FEE PAID [illegible]

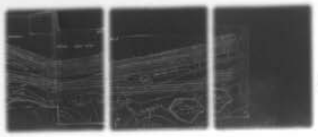
Calc... 22nd 40


S 65° 23' 50" E
50.65'
120.29'
S 93° 15' 00" E
TOP BANK
S 42° 15' 50" E
101.00'
Roadway
30' EASEMENT
24" Water
16" Water
20" Water
of the
20'
188
190
192
194
196
12" BL BIRCH
2-18" BL CHERRY
12" ASH
2-18" ASH
3-24" ASH
4-10" ASH
3-18" ASH
2-18" ASH
15" BIRCH
15" MAP
2" ASH
UP 5-MAP
NEW

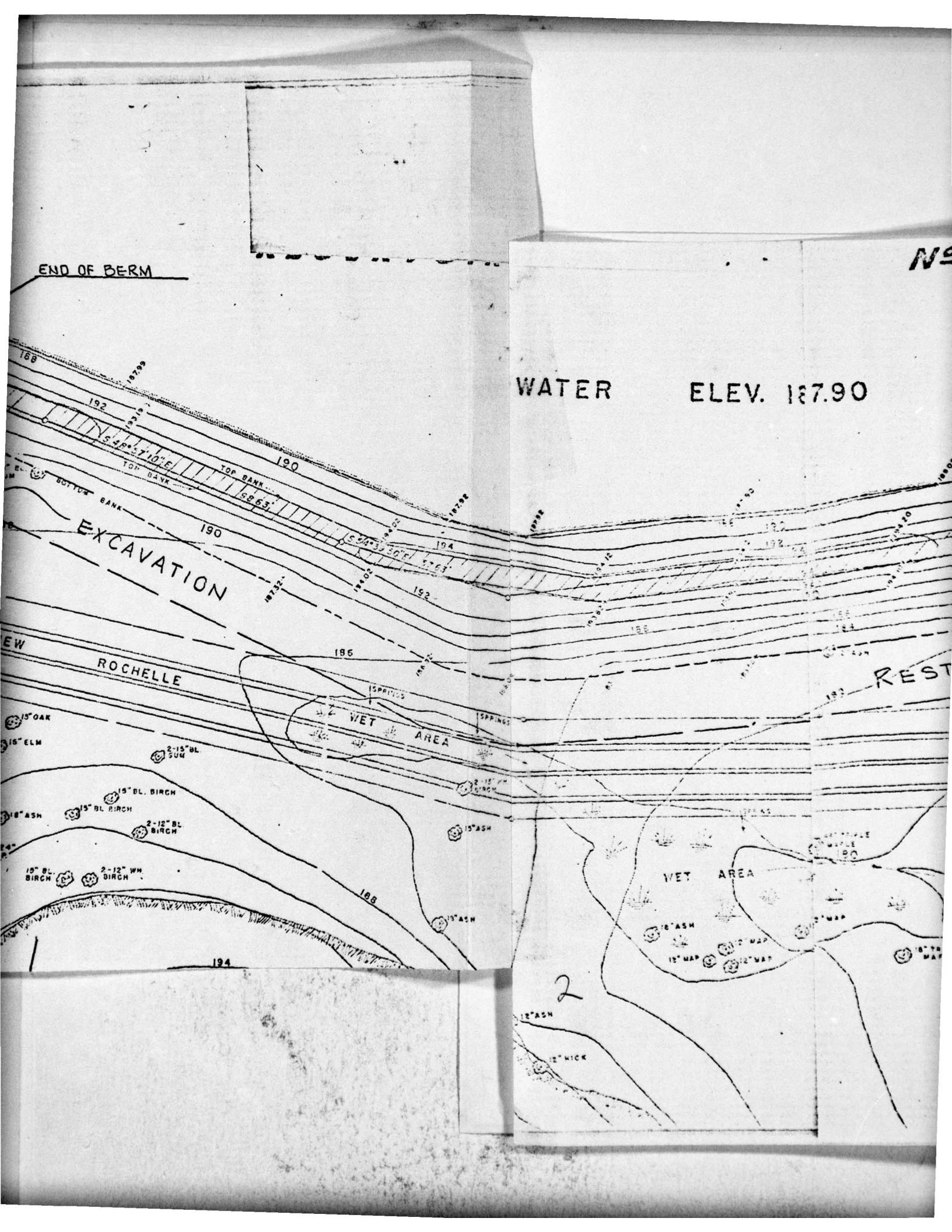
AD-A075 838 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. NEW ROCHELLE RESERVOIR NUMBER 1 DA--ETC(U)
AUG 79 G KOCH DACW51-79-C-0001

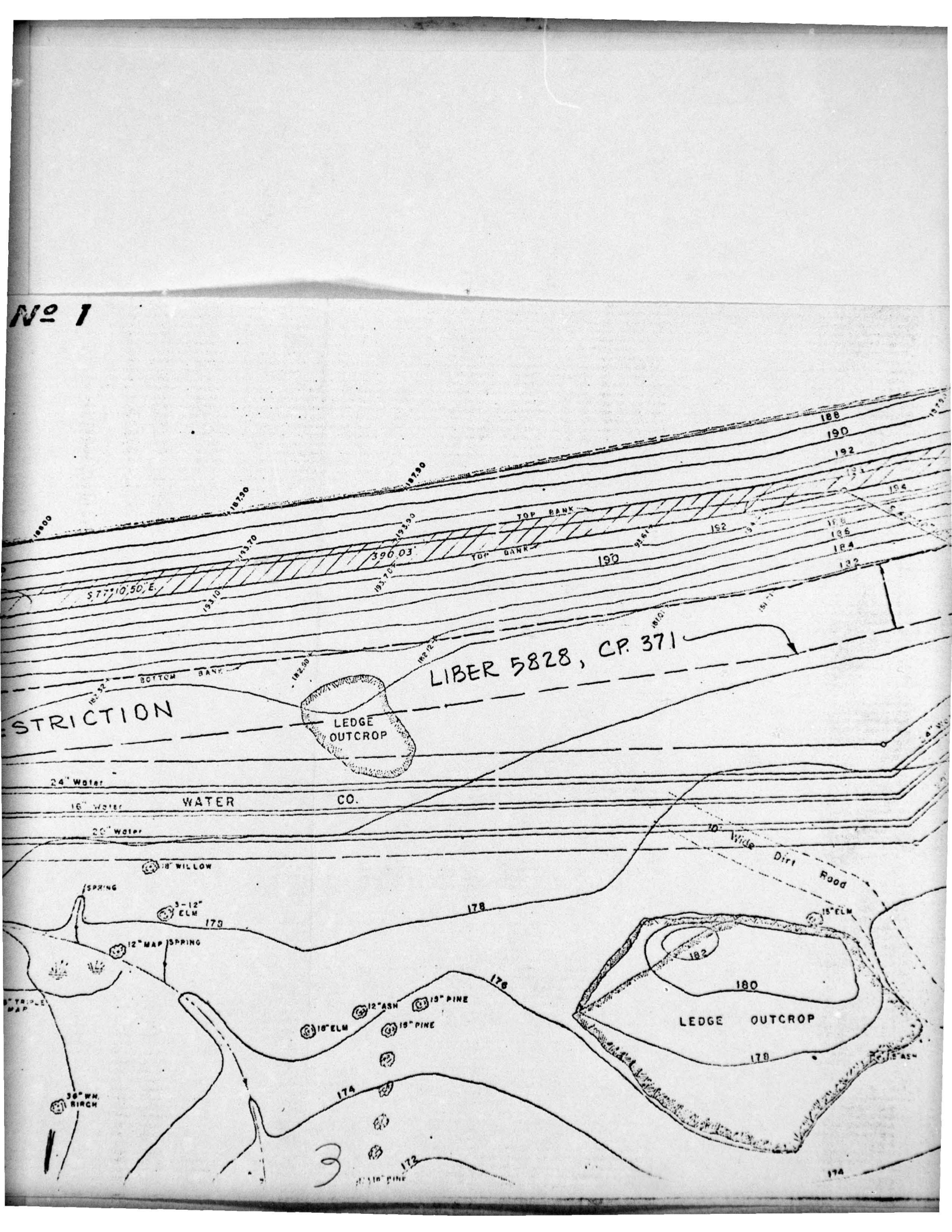
UNCLASSIFIED NL

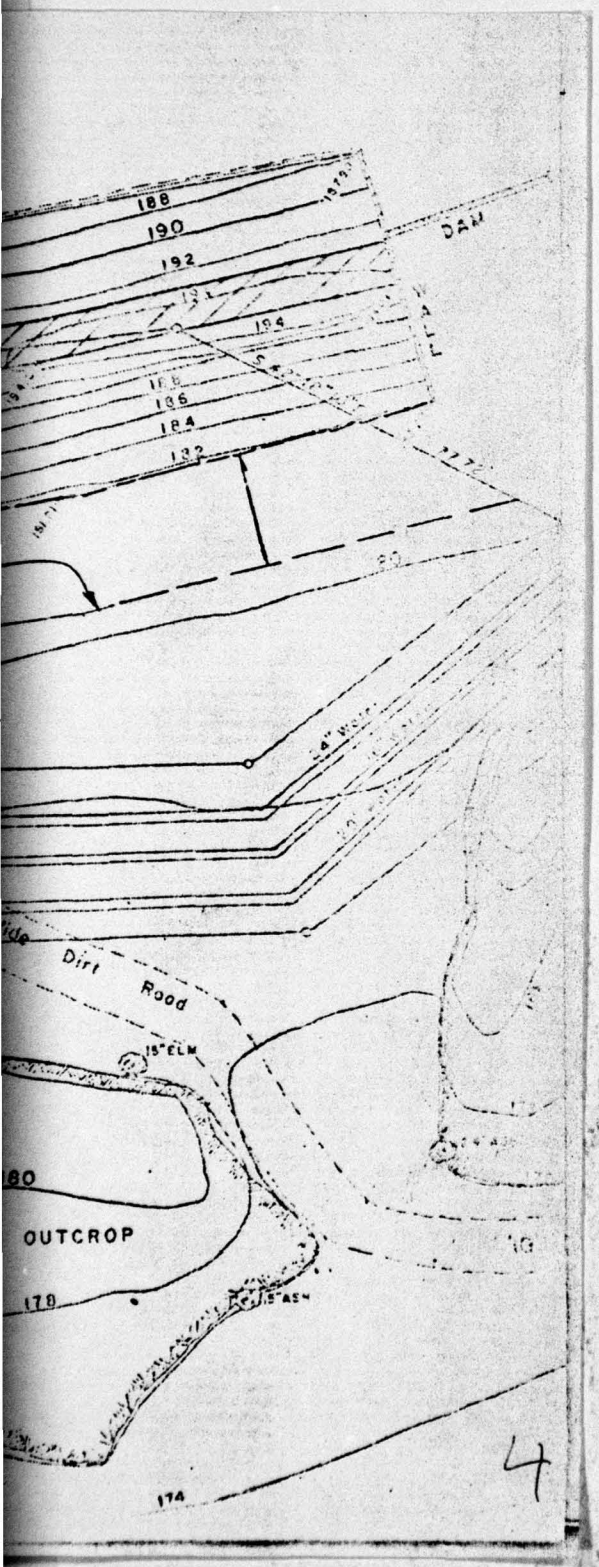
2 OF 2
ADA 075838



END
DATE FILMED
12-79
DDC


END OF BERM
WATER ELEV. 187.90
EXCAVATION
ROCHELLE
WET AREA
WET AREA
TOP BANK
BOTTOM BANK
S 48° 37' 10" E
S 24° 33' 30" E
15" OAK
16" ELM
2-15" BL SUM
15" BL. BIRCH
15" BL BIRCH
18" ASH
2-12" BL BIRCH
15" BL BIRCH
2-12" WH BIRCH
15" ASH
15" ASH
12" ASH
12" HICK
12" MAP
12" MAP
12" MAP
2
168
190
192
194
186
188


No 1
LIBER 5828, CP. 371
ESTRICTION
LEDGE OUTCROP
TOP BANK
BOTTOM BANK
396.03'
S 77°10'50" E
24" Water
16" Water
20" Water
WATER CO.
10' Wide Dirt Road
18" WILLOW
SPRING
3-12" ELM
12" MAP
SPRING
12" ASH
15" PINE
16" ELM
15" PINE
36" WH. BIRCH
LEDGE OUTCROP
15" ELM
15" ASH
178
180
182
174
172
176
190
192
188


188
190
192
194
186
184
182
DAM
Dirt
Road
15" ELM
OUTCROP
178
174
4