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| 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 Wappingers Falls Dam Dutchess County Wappinger Creek | | |
| 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. The examination of documents and the visual inspection of Wappingers Falls Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigations and remedial actions. | | |

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Using Corps of Engineers screening criteria for the initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 5.9 percent of the Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, 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 failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

The structural stability analysis based on available information and visual inspection indicates that the stability against sliding of the dam is adequate for all cases except unusual loading; one-half PMF, and extreme loading; PMF. The stability against overturning is inadequate for all cases.

It is therefore recommended that within 3 months of notification to the owner, a detailed hydrological and hydraulic investigations be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. At the same time structural stability analysis of the dam should be performed. Within twelve (12) months of the date of notification to the owner, any modification to the structure deemed necessary as a result of investigations, to achieve a spillway capacity adequate to discharge the outflow from at least one-half PMF should have been completed. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

In addition, the dam has a number of problem areas which, if left uncorrected, have the potential for the development of hazardous conditions and must be corrected within twelve (12) months.

The following are the recommended measures which must be corrected:

1. The operating mechanisms for the reservoir outlets should be repaired.
2. The wing walls on the left and right abutments should be repaired and the areas behind them backfilled.
3. The widespread missing masonry blocks and joints lacking mortar in the downstream face of the dam should be repaired.
4. The seepage through the downstream face of the dam and spillway should be controlled and monitored at biweekly intervals with the aid of collectors and weirs so that any increase in or change in characteristics of the flow may be noted.
5. The overflow section of the sluiceway should be repaired.
6. Remove vegetation on and around the structures and provide a program of periodic cutting.
7. After repair of the outlets, the reservoir should be lowered and the D.E.C. should be notified to allow for the inspection of the downstream face of the structure.

HUDSON RIVER BASIN
WAPPINGERS FALLS

DUTCHESS COUNTY, NEW YORK
INVENTORY NO. N.Y. 3

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1980

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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 investigations, 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 "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
 NATIONAL DAM SAFETY PROGRAM.
 WAPPINGERS FALLS DAM
 (I.D. NO. N.Y. 3,
 D.E.C. NO. 613A),
 HUDSON RIVER BASIN,
 DUTCHESS COUNTY, NEW YORK.

Phase I Inspection Report

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
WAPPINGERS FALLS DAM
I.D. NO. N.Y. 3
D.E.C. NO. 613A
HUDSON RIVER BASIN
DUTCHESS COUNTY, NEW YORK

Name of Dam: Wappingers Falls Dam (I.D. No. N.Y. 3)
State Located: New York
County Located: Dutchess
Stream: Wappingers Creek
Basin: Hudson River
Date of Inspection: June 12, 1980

ASSESSMENT

The examination of documents and the visual inspection of Wappingers Falls Dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigations and remedial actions.

Using Corps of Engineers screening criteria for the initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 5.9 percent of the Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, 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 failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

The structural stability analysis based on available information and visual inspection indicates that the stability against sliding of the dam is adequate for all cases except unusual loading; one-half PMF, and extreme loading; PMF. The stability against overturning is inadequate for all cases.

It is therefore recommended that within 3 months of notification to the owner, a detailed hydrological and hydraulic investigations be undertaken to more accurately determine the site specific characteristics of the watershed and their affect upon the overtopping potential of the dam. At the same time structural stability analysis of the dam should be performed. Within twelve (12) months of the date of notification to the owner, any modification to the structure deemed necessary as a result of investigations, to achieve a spillway capacity adequate to discharge the outflow from at least one-half PMF should have been completed. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

In addition, the dam has a number of problem areas which, if left uncorrected, have the potential for the development of hazardous conditions and must be corrected within twelve (12) months.

The following are the recommended measures which must be corrected:

1. The operating mechanisms for the reservoir outlets should be repaired.
2. The wing walls on the left and right abutments should be repaired and the areas behind them backfilled.
3. The widespread missing masonry blocks and joints lacking mortar in the downstream face of the dam should be repaired.
4. The seepage through the downstream face of the dam and spillway should be controlled and monitored at biweekly intervals with the aid of collectors and weirs so that any increase in or change in characteristics of the flow may be noted.
5. The overflow section of the sluiceway should be repaired.
6. Remove vegetation on and around the structures and provide a program of periodic cutting.
7. After repair of the outlets, the reservoir should be lowered and the D.E.C. should be notified to allow for the inspection of the downstream face of the structure.

8. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly maintenance and lubrication of the reservoir outlet system. Document this information for future reference. The emergency action plan described in Section 7.1d should be maintained and updated periodically during the life of the structure.



Eugene O'Brien, P.E.
New York No. 29823

Approved by:



Col. W.M. Smith, Jr.
New York District Engineer

Date:

30 Sep 80



1. OVERVIEW OF DAM.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
WAPPINGERS FALLS DAM
I.D. NO. N.Y. 3
D.E.C. NO. 613A
HUDSON RIVER BASIN
DUTCHESS COUNTY, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the State of New York, Department of Environmental Conservation by letter dated 7 January 1980, in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, 8 August 1972.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing conditions 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 THE PROJECT

a. Description of the Dam and Appurtenant Structures

The Wappingers Falls Dam is a water level control structure composed of a 171 foot long masonry and concrete gravity overflow structure with a maximum height of about 20 feet. A concrete topped masonry spillway section 3 feet higher and about 30 feet long adjoins the east side of the dam. There are two reservoir outlets about four feet square, which feed a sluiceway leading to a 9 foot diameter riveted steel penstock. The reservoir outlets are controlled by metal-clad wood rack and pinion manually operated slide gates. The top of the dam is equipped with piers to support flashboards; although no flashboards were in place.

Along both abutments there are concreted masonry wing walls. The left wall extends several hundred feet upstream, whereas the right wall is about 20 feet long.

The main overflow dam section was constructed in several stages and is for the most part masonry. It is capped by concrete on both the older and newer masonry sections. It is backfilled on its upstream side with silt, sand and rock.

b. Location

Wappingers Falls Dam is located on Wappingers Creek within the Village of Wappingers Falls. It is about 750 feet east of W. Main Street (Rt. 9D) and about 1½ miles southwest of The New York and Albany Post Road (Rt. 9). The dam is in a residential area of the Village of Wappingers Falls directly upstream of the main village center.

c. Size Classification

The dam is 20 feet high and has a reservoir with a storage capacity of 123 acre-feet and therefore is classified as a small dam.

d. Hazard Classification

The dam is in the "high" hazard potential category because of the close proximity of the dam to residences and its location within the Village of Wappingers Falls.

e. Ownership

Wappingers Falls Dam is owned by the Village of Wappingers Falls, Spring St., Wappingers Falls, N.Y., 12590, Tel. No. (914) 297-8773. The person to contact is Mr. Leo Lowney - Village Clerk.

f. Purpose of Dam

The dam was originally constructed to supply water by means of a sluiceway to a power generator for industrial use. The reservoir is currently not being utilized except for minor recreational purposes. Future usage of the water for power generation has been given under contract to Electro-Ecology of Convent Station, N.J.

g. Design and Construction History

The dam was built in 1872, redesigned and reconstructed in 1910 and with the current section completed in 1919. There are no design or construction drawings of the original construction, or of the second stage design and construction. There is however an as-built drawing showing plan, elevation and a typical section which exists following the work carried out in 1919. This is included in Appendix A.

h. Normal Operating Procedure

There is no normal operating procedure for the dam. Water flows over the main section of the dam for most of the year, varying only with seasonal inflows. The gates that feed the sluiceway are not operable.

1.3 PERTINENT DATA

- | | |
|--|------|
| a. <u>Drainage Area</u> (sq. mi.) | 199 |
| b. <u>Discharge at Damsite</u> (cfs) | |
| <u>Ungated Spillways</u> at Maximum Pool | 5050 |

- c. Elevation (Feet above MSL -
USGS Datum)
- | | |
|-------------------------------|------|
| Top of West Abutment End Wall | 84.3 |
| Top of Overflow - Dam | 80 |
| Top of Spillway "Step" | 83 |
| Invert Reservoir Outlets | 70 |
- d. Reservoir
- | | |
|--|--------------|
| Length of Normal Pool (feet) | Not computed |
| Surface Area of Maximum Pool, acres | 109.8 |
| Surface Area of Normal Pool, acres | 101 |
- e. Storage
- | | |
|-----------------------|-----|
| Reservoir (acre-feet) | 655 |
|-----------------------|-----|
- f. Dam
- | | |
|-----------------------|--------------------------------------|
| Type | Masonry-concrete gravity overflow |
| Length (feet) | 216 |
| Crest Elevation (MSL) | 80 feet |
| Crest Width | 9 feet |
| Grout Curtain | None known |
- g. Spillway
- | | |
|--------------------|---|
| Type | Two broad crested overflow sections |
| Length (feet) | 1 @ 171 1 @ 32 |
| Crest Elevations | 1 @ 80 1 @ 83 |
| Upstream Channel | None |
| Downstream Channel | Full width of spillway, rock bottomed |
- h. Reservoir Outlets
- Upstream - Two 4 foot square outlets controlled by wood rack and pinion slide gates, which feed a sluiceway pass through a structure located to the east of the overflow section of the dam. It is not possible to ascertain exact invert levels of the outlets, but they are approximated to be at El 70.
- Downstream - The outlets for the reservoir discharge into a sluiceway which leads to a riveted steel penstock about 300 feet downstream of the dam.

SECTION 2 - ENGINEERING DATA

2.1 GEOLOGY

The records of the owner contain no data on site geology. However, there is data available in the literature dealing with the general geology of the dam and reservoir. The dam is located in the Hudson Lowlands physiographic province of New York State. These lowland areas have gentle relief and are underlain by Ordovician shales that have been exposed by the erosion of overlying Silurian and Devonian limestones. Bedrock in the Wappingers Falls dam area is of the Normanskill formation of the Taconic Area Trenton Group. The rock members in the Normanskill include graywacke, black and gray shales, chert, and red and green slate. Outcrops at the dam-site confirm the existence of these types of rock in the area.

2.2 SUBSURFACE INVESTIGATION

No subsurface investigation could be located for the dam. However, the General Soils Map of New York State, prepared by the Cornell University Experiment Station (1968) indicates that surficial soils in the vicinity of the dam are of the Troy-Cossayuna Association. These soils, developed from a thick layer of till derived from slate bedrock, are dominantly deep and moderately to well drained. Soil types are medium textured, non-stony to stony, and found on 3 to 5 percent convex slopes on the tops and sides of hills.

2.3 DAM AND APPURTENANT STRUCTURES

There are virtually no records or drawings available with regard to the original construction of the dam (1872) or the first reconstruction in 1910. There is an as-built drawing of the dam which includes a plan, elevation and typical section of the dam. No drawings could be located of repairs done to the left abutment in 1973 (See Appendix A).

2.4 CONSTRUCTION RECORDS

No information has been located in relation to the construction of the project. The name(s) of the contractor(s) is (are) unknown.

2.5 OPERATION RECORDS

In recent years, there has been no regular operation of the dam and no records are kept of the reservoir operation. The dam is checked occasionally by the Village Superintendent of Highways, but no regular maintenance is carried out and

no systematic monitoring of the performance of the dam is in effect. The dam is cleared of dead trees and other debris on an as-needed basis.

2.6 EVALUATION OF DATA

The data available, along with site inspection and personal interviews, is sufficient to perform a Phase I inspection.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of Wappingers Falls Dam was made on June 12, 1980. The weather was fair and the temperature was 65-70°F. Water flow over the main section of the dam was about 0.5 feet deep. As a result, close-up inspection of the downstream face of the dam was not possible.

b. Main Dam

The main dam shows no signs of major distress or structural problems. The vertical and horizontal alignment of the crest appears to be unchanged. There are severe cracks and gaps in the masonry and masonry joints on the downstream face of the dam. The following adverse conditions were also noted:

1. There is a large quantity of observable seepage through joints in the downstream face of the dam and spillway.

2. The end wall on the right abutment is in very poor condition.

3. An approximately 40 foot long section of the wing wall upstream of the outlets on the left abutment has fallen away with erosion of ground behind the wall.

4. There is a large amount of vegetation growing on or near the structures.

c. Spillway and Tailrace

The masonry on the downstream face of the spillway is in poor condition. Mortar is missing from joints and seepage of 3 to 5 gpm is present on the lower sections. Drains which were installed during improvements in 1973 are operating properly but do not appear to be sufficient. The top surface of the spillway is in good condition. The downstream tailrace of the spillway is in good condition and, for the most part, free of debris.

d. Reservoir Outlets

The regulating gates for the two 4 foot square outlets are not in operating condition due to broken or missing racks on the rack and pinion controls. The sluiceway which leads from these outlets to a 9 foot penstock is in very poor condition with the right wall having failed several hundred feet downstream of the dam. It is reported that this section of the sluiceway was an overflow section.

e. Reservoir Area

There are neither slides, rockfalls, sloughing or other signs of instability in the vicinity of the dam. There

were no objectionable amounts of floating debris in the reservoir at the time of the inspection. It is reported however that following several periods of heavy storms, the dam requires clearing away of debris brought downstream.

3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed, there is no indication that the dam is in imminent danger. A number of the deficiencies observed in the previous paragraphs are minor and should be corrected by the owner's maintenance forces. Other conditions described above, however, represent conditions which may have potential for further deterioration and for this reason these conditions need to be further investigated or corrected.

Significant conditions were observed which require immediate investigation to determine the extent of corrective action necessary to insure the stability of the dam and appurtenances. The following is a summary of the problem areas encountered with the appropriate recommended action:

1. There are currently no reservoir outlets due to closed, inoperable gates. These gates should be repaired.
2. The land area to the left of the reservoir is not protected due to the broken wing wall. This wall should be repaired and the area backfilled.
3. The widespread missing masonry blocks and joints lacking mortar on the downstream face of the dam should be repaired.
4. The seepage through the downstream face of the dam and spillway should be controlled and monitored at bi-weekly intervals with the aid of collectors and weirs.
5. The wing wall on the right abutment of the dam should be repaired.
6. The overflow section of the sluiceway should be repaired.
7. Remove vegetation on and around the structures and provide a program of periodic cutting.
8. After repair of the outlets, the reservoir should be lowered and the D.E.C. should be notified to allow for the inspection of the downstream face of the structure.

9. Provide a program of periodic inspection and maintenance of the dam and appurtenances, including yearly operation and lubrication of the reservoir drain system. Document this information for future reference. The emergency action plan described in Section 7.1d should be maintained and updated periodically during the life of the structure.

SECTION 4 - OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no operating procedures for the Wappingers Falls Dam. Water flows almost continuously over the 171 foot length of the main dam. The reservoir outlets are not opened and at present are both inoperable.

4.2 MAINTENANCE OF THE DAM

There is no regular maintenance schedule of the dam. The dam is checked occasionally and when complaints are registered by the Village Superintendent of Highways. Repairs have been carried out in the past when serious inadequacies were determined (left abutment, 1973); however, the dam, wing walls, and its operating mechanisms and outlets are in very poor condition. General maintenance is only performed on an absolutely "as-needed" basis.

4.3 WARNING SYSTEM IN EFFECT

There are no warning systems in effect or in preparation.

4.4 EVALUATION

The overall maintenance of Wappingers Falls Dam is considered to be inadequate in the following areas:

- a. Controls and gates for reservoir outlets do not operate.
- b. Wing walls on both the left and right abutments are broken and missing.
- c. There is seepage and missing stones in the masonry on the downstream face of the dam and left abutment wall.
- d. The walls of the sluiceway are crumbled and missing.
- e. No formal operation and maintenance manual exists for the project.
- f. Vegetation was noted on dam and appurtenances.

SECTION 5 - HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

Wappingers Falls Dam is located on Wappingers Creek approximately one mile above its junction with the Hudson River at Wappingers Falls, Dutchess County, New York, Hydrologic Unit Code 02020008. The Wappingers Creek basin, upstream of the dam, is approximately 199 square miles, about 30 miles long with a maximum width of 12 miles. The two major tributaries within the basin are Little Wappingers Creek and E. Branch Wappingers Creek. Relief in the basin rises from a water level, El 80, to ridges above El 500.

5.2 ANALYSIS CRITERIA

The analysis of the spillway capacity of Wappingers Falls Dam was performed using the U.S. Army Corps of Engineers HEC-1 computer program (Ref. 1). A Standard Project Flood (SPF) hydrograph (Ref. 2) developed for the Wappingers Creek basin, with a peak of 42,800 cfs, was input directly into the program, which then flood routed this hydrograph using the "Modified Puls" method over the spillway. In accordance with recommended guidelines of the U.S. Army Corps of Engineers (Ref. 4), the analysis was also performed with the Probable Maximum Flood (PMF) which was assumed to be twice the SPF.

5.3 SPILLWAY CAPACITY

The total crest length of Wappingers Falls Dam spillways is comprised of the total length of the main dam, plus a 30 foot spillway section. The computed discharge with the water level at El 84.3, top of the lower west abutment wall (4.3 feet above main dam crest and 1.3 feet above the second spillway crest) is 5050 cfs.

5.4 RESERVOIR CAPACITY

The normal capacity of the reservoir, as reported in the COE Dam Inventory was 123 acre-feet. The surcharge storage computed between 80 feet MSL (crest/top of dam elevation) and 85 feet MSL (approximate height of west abutment wing wall) is 532 acre-feet, which is equivalent to 0.05 inches of runoff over the entire basin. The total capacity is therefore 655 acre-feet.

5.5 FLOODS OF RECORD

The maximum flood discharge as measured by the USGS gaging station 01372500 was 18,600 cfs in August 1955 (103 CSM) (Ref. 3). The gage is located 4.5 miles NE of the Village of Wappingers Falls, and upstream of the dam.

5.6 OVERTOPPING POTENTIAL

The HEC-1 DB analysis indicates that the depth of water over the dam is as follows:

| | |
|---------------|--|
| PMF | 23.7 feet over west abutment end wall |
| 1/2 PMF (SPF) | 12.1 feet over west abutment end wall |

Because the dam is basically a water level control structure, there is essentially no surcharge storage and inflow approximately equals outflow. The peak outflow for 1/2 PMF is 43,012 cfs and for the PMF is 85,912 cfs.

5.7 EVALUATION

The dam is basically a water level control structure and has no capacity to mitigate flood flows. The dam does not have sufficient spillway capacity to pass either the PMF or one-half the PMF without overtopping the dam and appurtenant structures. The overtopping could cause the failure of the dam thus significantly increasing the hazard to the loss of life downstream. Therefore, the spillway is assessed as being seriously inadequate.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations did not indicate existing problems with the structure of the dam. The observed seepage through the downstream face and the missing mortar and stones is not considered to represent a current unstable or otherwise dangerous condition. Continued deterioration of this condition however could result in instability and dangerous conditions.

b. Design and Construction Data

There exists no design computations or other data regarding the structural stability of the dam and the spillway. There is one drawing showing the "as-built" plan, elevation and a typical section. Some dam features - the left abutment wall in particular, have been modified relative to this drawing. These modifications, however, do not effect the stability analysis.

c. Stability Analysis

The structural stability, of what was determined from the drawings to be the maximum typical section, was analyzed. The following table shows the loading cases considered and the results of the analysis. The detailed computations are included as Appendix E.

| <u>Loading Case</u> | <u>Overturning</u> | <u>Sliding Factor of Safety (See Appendix E)</u> |
|---|----------------------------------|--|
| I) Normal loading condition with reservoir level at spillway crest, no ice load | 0.7 ft outside middle 1/3 | 2.14 |
| II) Normal loading condition with reservoir at spillway crest, with ice load | 3.5 ft outside middle 1/3 | 1.63 |
| III) Unusual loading; one-half PMF water overtopping dam by 12.1 feet | 7.6 ft outside middle 1/2 | 0.75 |
| IV) Extreme loading: PMF water overtopping the dam by 24.3 feet | 28.4 ft outside middle 1/2 | 0.29 |
| V) Unusual loading: earthquake reservoir level at spillway crest, 0.05 g earthquake force | 0.2 ft outside middle 1/2 | 1.78 |

On the basis of the structural stability analysis performed during the investigation, the structural stability of the dam against overturning was determined to be inadequate for all cases. The stability of the dam against sliding was determined to be adequate for all cases except unusual loading 1/2 PMF and extreme loading: Full PMF.

Since exact geometry, foundation conditions upstream, backfill characteristics and extent, as well as the extent and magnitude of the uplift pressure are unknown, it is recommended that a more detailed structural stability analysis be performed. Field investigations should be done to obtain more information regarding the extent and characteristics of the backfill and foundation materials, as well as the quality and condition of the observable masonry of the structure. Based on the results of the analysis, modifications to the dam should be recommended as required.

d. Operating Records

There are no records of the regulating gates operation. The gates are currently inoperable and in a closed position, making draining of the reservoir in an emergency impossible.

e. Post-Construction Changes

The Wappingers Falls Dam was constructed in three separate stages. The first construction was in 1872, the second in 1910 and the third, which resulted in the present configuration, was completed in 1919. Only one change has been made in the structure since completion of the third stage construction. This was to the left abutment wall and resulted in an increased stability to that area of the dam. Due to a heavy seepage condition, the area was covered with concrete, end walls built and drains installed. The concrete installed is in good condition and the drains appear to be functioning.

f. Seismic Stability

The dam is located in Zone 2 therefore a stability analysis was carried out using a normal reservoir loading (water level at spillway crest) and 0.05 g earthquake factor with Zanger's method. The resulting analysis showed the dam to be safe against sliding but inadequate against overturning.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Examination of the available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers screening criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 5.9 percent of the Probable Maximum Flood (PMF). The overtopping of the dam could result in a failure of the dam thus increasing the hazard to loss of life downstream. The spillway is, therefore, adjudged as "seriously inadequate" and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a "seriously inadequate" spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, 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 failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

The structural stability analyses based on available information and visual inspection indicates that the stability against sliding for the dam is adequate for all cases except one-half PMF and full PMF whereas the stability against overturning is inadequate for all cases.

b. Adequacy of Information

The information and data available were adequate for performance of this investigation.

c. Need for Additional Investigations

A detailed investigation of the structural stability of the dam is required. This should include field investigations to determine the exact geometry and characteristics of the backfill.

d. Urgency

The additional hydrologic/hydraulic investigations and the structural stability investigations which are required must be initiated within 3 months from the date of notification. Within 12 months of notification, remedial measures as a result of these investigations must be initiated, with completion of these measures during the following year. In the interim, develop an emergency action plan for the notification of downstream residents and proper around-the-clock surveillance of the dam during periods of extreme runoff. The other problem areas listed below must be corrected within one year from notification.

7.2 RECOMMENDED MEASURES

1. The operating mechanisms for the reservoir outlets should be repaired.
2. The wing walls on the left and right abutments should be repaired and the areas behind them backfilled.
3. The widespread missing masonry blocks and joints lacking mortar in the downstream face of the dam should be repaired.
4. The seepage through the downstream face of the dam and spillway should be controlled and monitored at biweekly intervals with the aid of collectors and weirs so that any increase in or change in characteristics of the flow may be noted.
5. The overflow section of the sluiceway should be repaired.
6. Remove vegetation on and around the structures and provide a program of periodic cutting.
7. After repair of the outlets, the reservoir should be lowered and the D.E.C. should be notified to allow for the inspection of the downstream face of the structures.
8. Provide a program of periodic inspection and maintenance of the dam and appurtenances including yearly operation and lubrication of the reservoir outlet system. Document this information for future reference. The emergency action plan described in Section 7.1d should be maintained and updated periodically during the life of the structure.

DRAWINGS

APPENDIX A

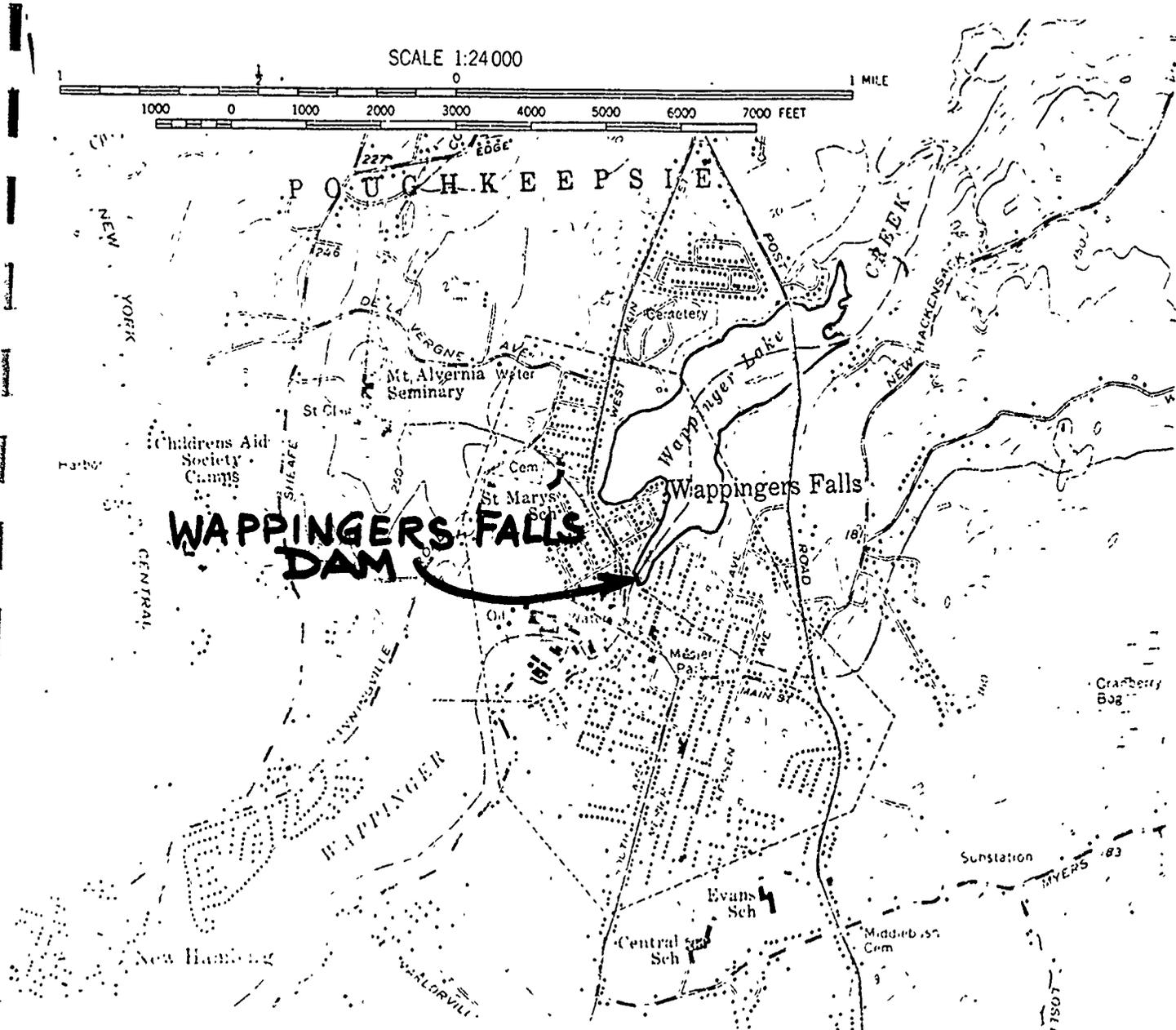
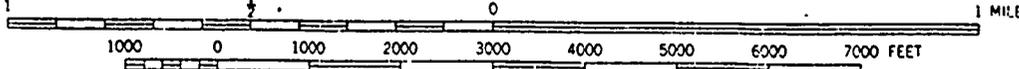


SCALE: 1 inch = 11.2 Miles

VICINITY MAP
WAPPINGERS FALLS DAM

WAPPINGERS FALLS QUAD
New York

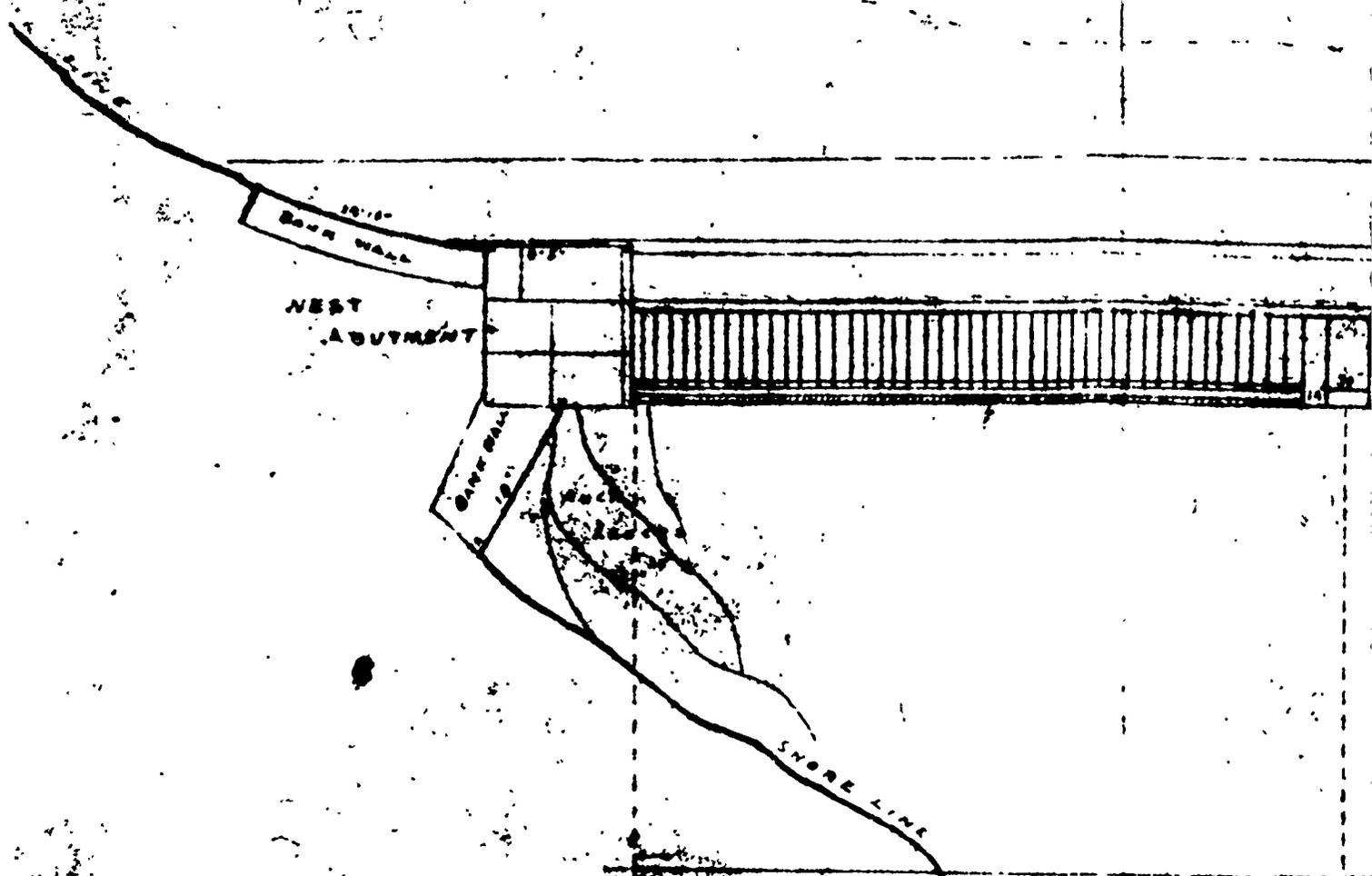
SCALE 1:24 000



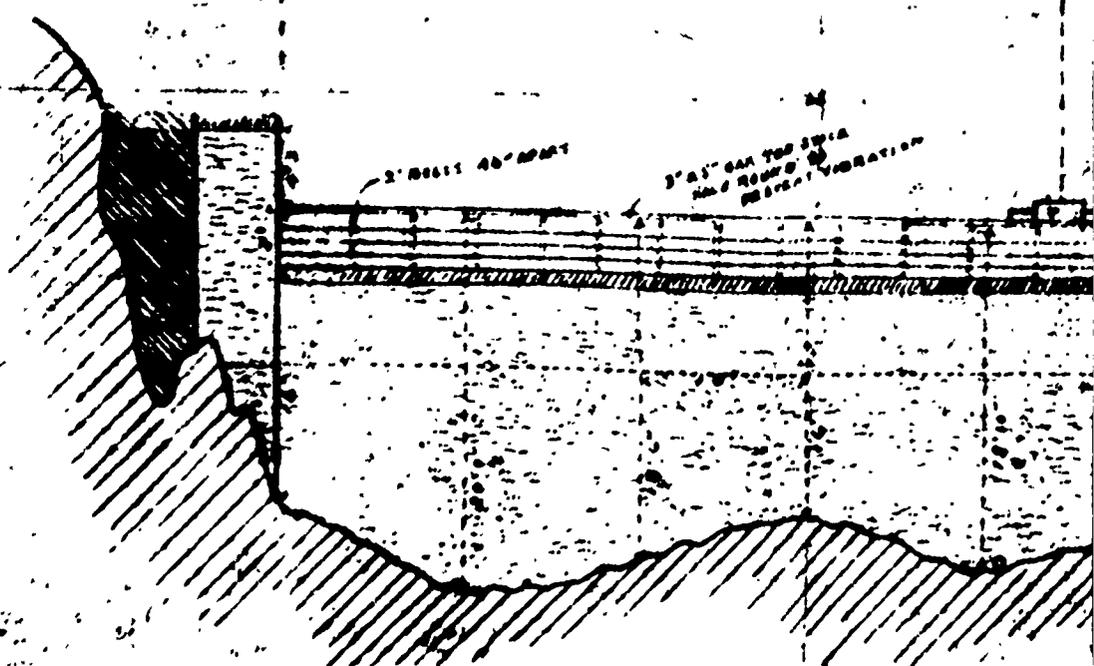
**WAPPINGERS FALLS
DAM**

TOPOGRAPHIC MAP
WAPPINGERS FALLS DAM

1



43' 11"



2

SILT AND STONE BACKING

3° SLOPE ON BATTER

FIRST SLOPE

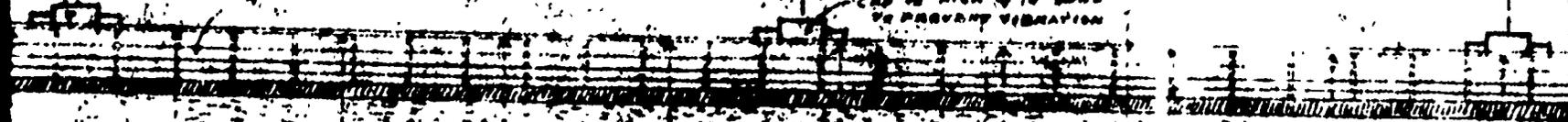


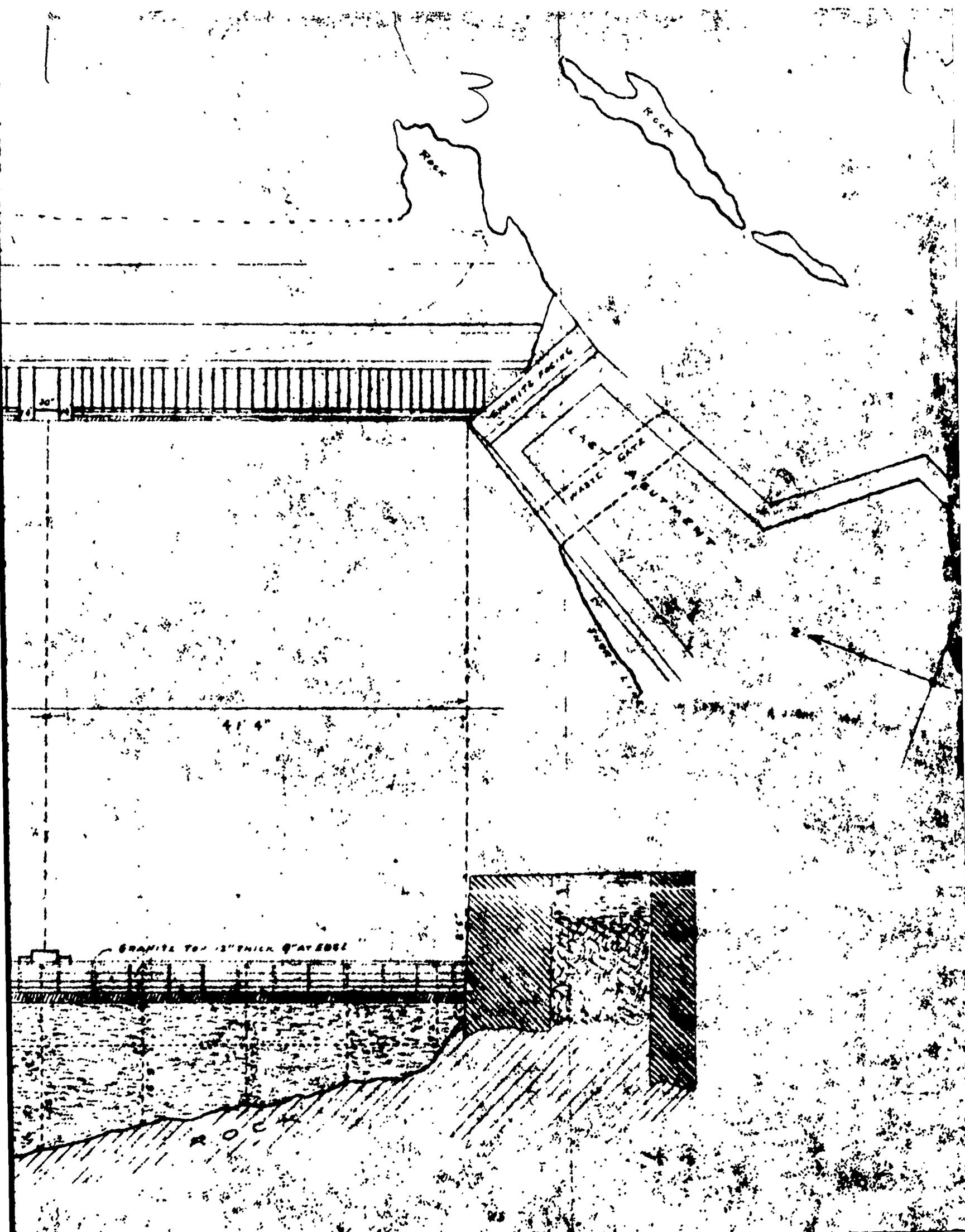
171' 8"

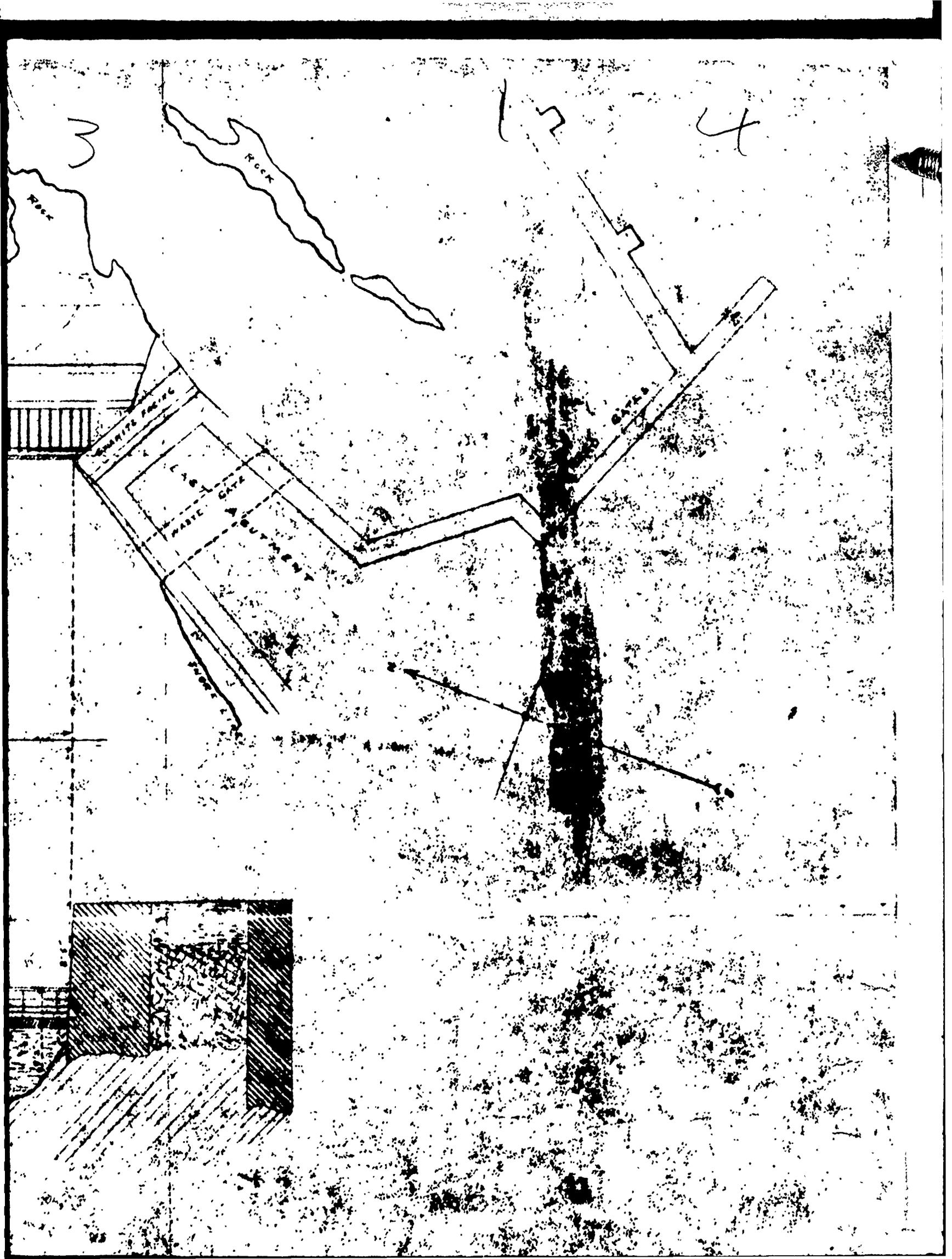
43' 7"

42' 10"

10" HIGH 4" DIA
TO PREVENT VIBRATION

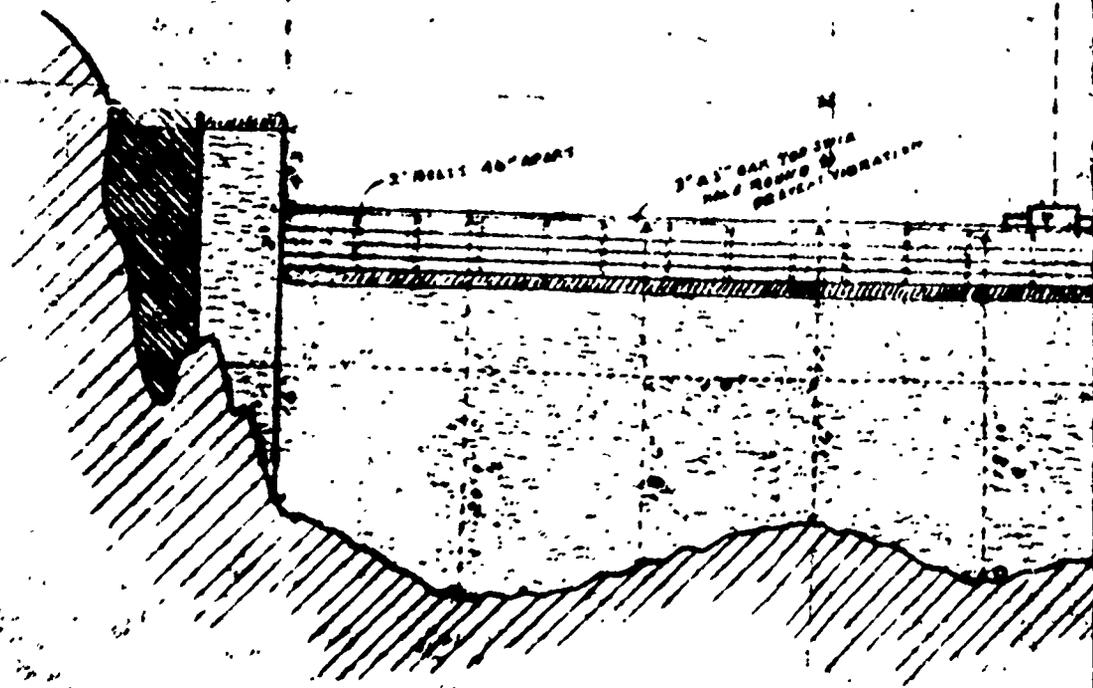






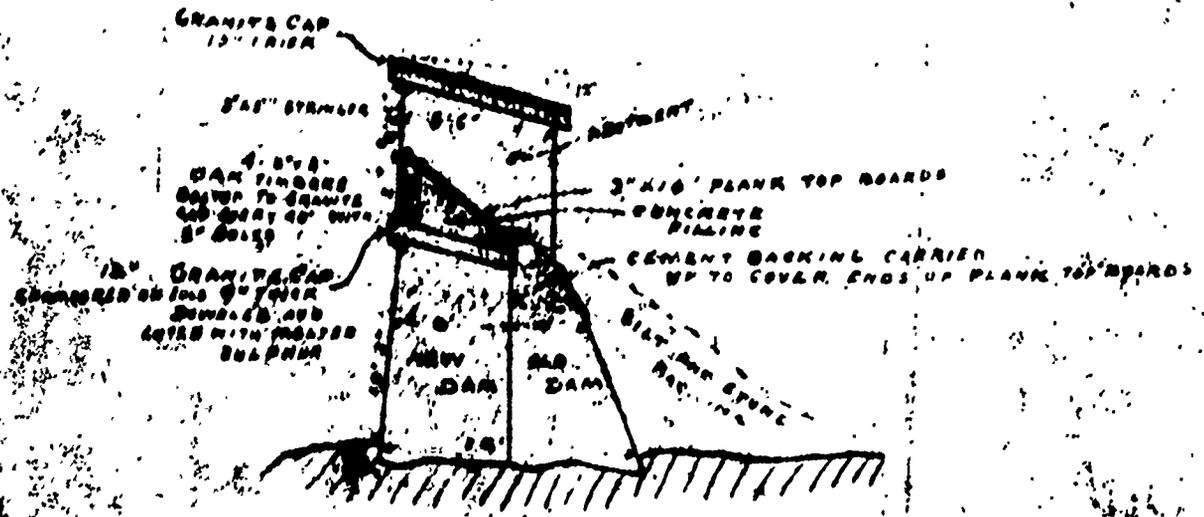
SHORE LINE

43' 11"



2" BOLT 40" APART

3" DIA GAL TOP SURF
HOLD RODS IN
GRAVEL VIBRATION



GRANITE CAP
12" THICK

4" DIA DAM FINGERS

BOLT TO GRANITE
40" APART WITH
2" BOLTS

3" DIA PLANK TOP BOARDS
CONCRETE
PILING
CEMENT BACKING CARRIED
UP TO COVER ENDS OF PLANK TOP BOARDS

NEW DAM

OLD DAM

SILT AND STONE

SECTION OF DAM AT
WEST END

5

171' 8"

43' 7"

42' 10"

4-6' 0" DIA.

CAP 18" HIGH & 18" WIDE
TO PREVENT VIBRATION

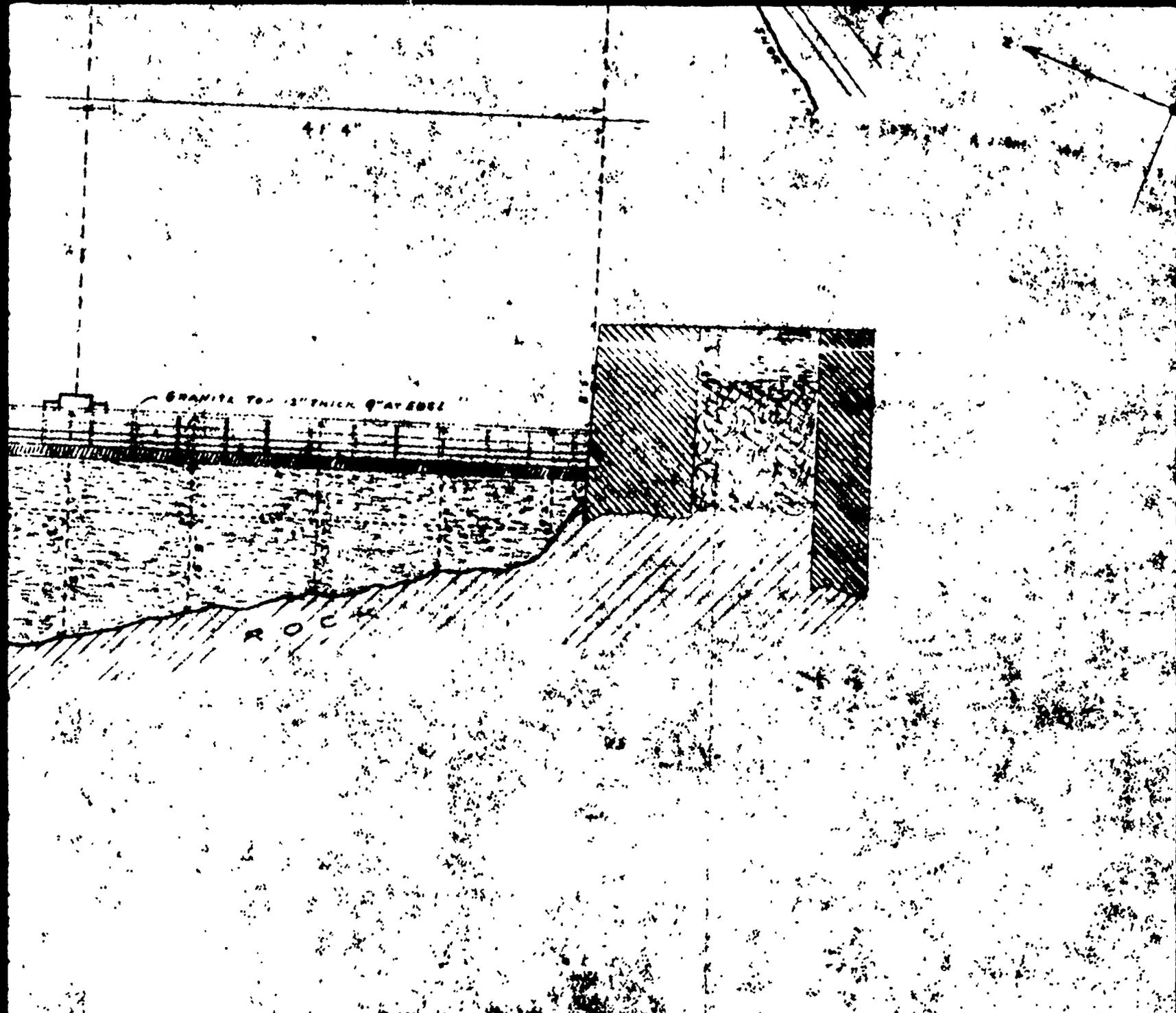


CLINTO

DU

**DRYING
SCALE**

6

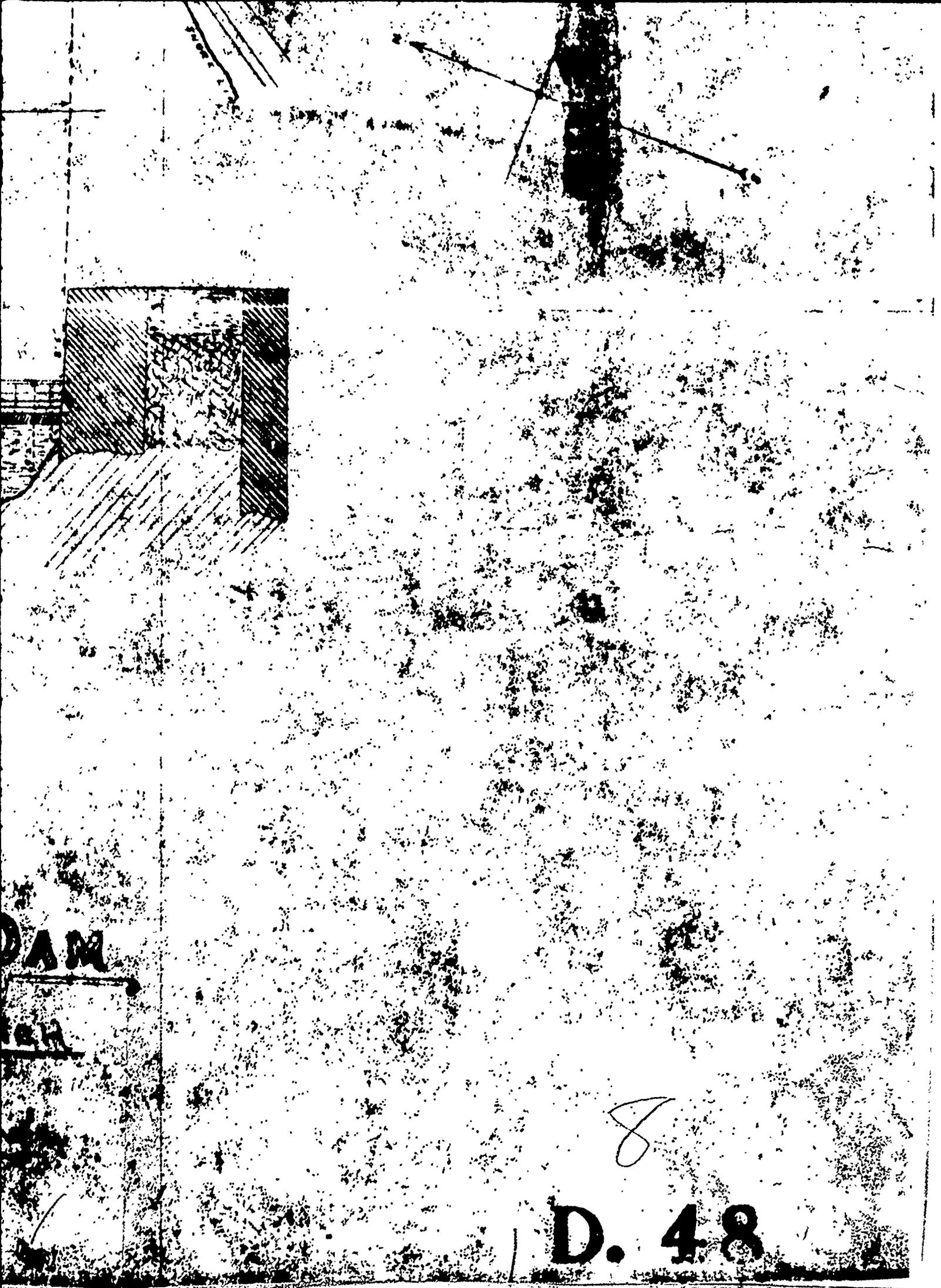


ANTON COMPANY DAM

DUTCHESS BRANCH

G. R. W.

DESIGN DIVISION BY
SCALE 1/2" = 1'-0"



DAM.
12A

8
D. 48

PHOTOGRAPHS

APPENDIX B



2. VIEW OF UPSTREAM SIDE AND ALONG CREST
OF DAM LOOKING NORTH.



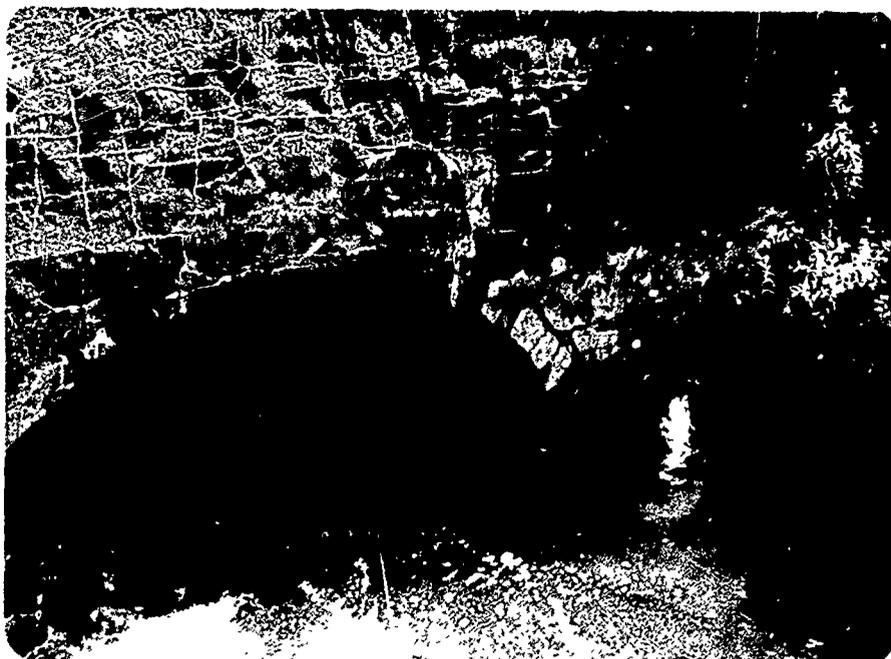
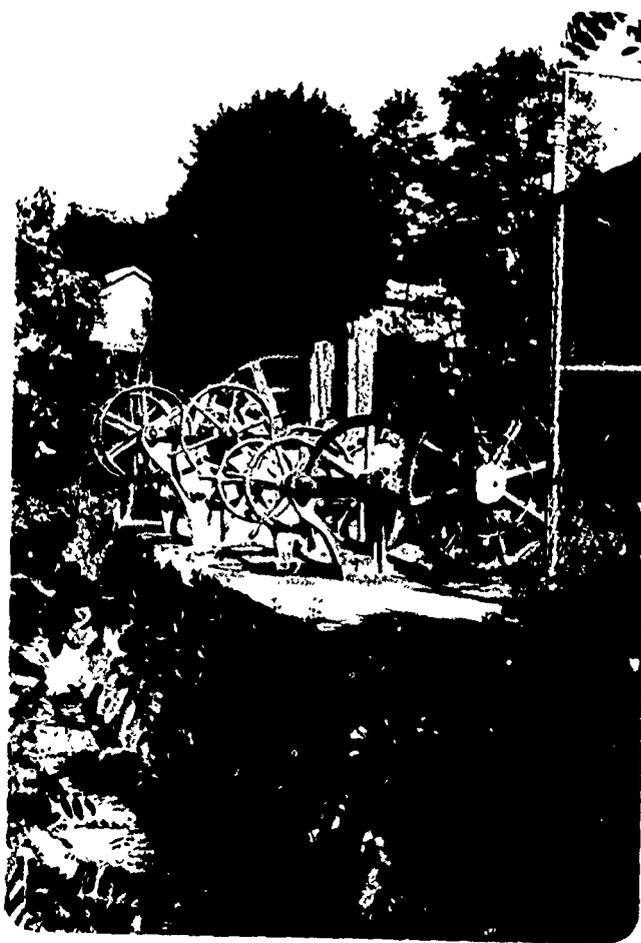
3. UPSTREAM VIEW OF SLUICeway OUTLET
GATE STRUCTURE.

4. CLOSE UP VIEW OF
UPSTREAM SLUICE-
WAY OUTLET GATE
CONTROL STRUC-
TURE. NOTE:
MISSING AND
BROKEN "RACKS".



5. VIEW OF LEFT ABUTMENT NEAR SLUICEWAY OUTLET
GATE STRUCTURE. NOTE: MISSING AND BROKEN WINGWALL.

6. DOWNSTREAM VIEW
OF SLUICeway
GATE CONTROL
STRUCTURE.



7. VIEW OF OUTLETS INTO SLUICeway,
LOOKING UPSTREAM.
NOTE: FLOW THROUGH JAMMED,
CLOSED GATE.

8. VIEW LOOKING DOWN-
STREAM INTO SLUICE-
WAY. NOTE: BROKEN
WALL ON RIGHT SIDE
OF SPILLWAY.



9. VIEW OF STREAM BELOW DAM LOOKING UPSTREAM
TOWARDS THE DAM.

VISUAL INSPECTION CHECKLIST

APPENDIX C

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Wappinger Falls

Fed. I.D. # NYA DEC Dam No. 613A

River Basin Hudson

Location: Town Wappinger Falls County Dutchess

Stream Name Wappinger Creek

Tributary of Hudson River

Latitude (N) 41°36' N Longitude (W) 73°55'

Type of Dam Masonry Gravity - Concrete capped

Hazard Category High

Date(s) of Inspection June 12 1980

Weather Conditions Fair 70°

Reservoir Level at Time of Inspection 0.5 feet flowing over spillway

b. Inspection Personnel H Feldman -

J Fiteni Jr

c. Persons Contacted (Including Address & Phone No.)

Mr Leo Lowney - Village Clerk, Mr Sparki Sidoti Highway
Supt - Village of Wappinger Falls, Spring St. Wappinger Falls, N.Y.

d. History:

Date Constructed 1872 Date(s) Reconstructed 1910

1919

Designer Not known

Constructed By Not known

Owner Village of Wappinger Falls

Embankment - Not Applicable

a. Characteristics

- (1) Embankment Material _____

- (2) Cutoff Type _____

- (3) Impervious Core _____

- (4) Internal Drainage System _____

- (5) Miscellaneous _____

b. Crest

- (1) Vertical Alignment _____

- (2) Horizontal Alignment _____

- (3) Surface Cracks _____

- (4) Miscellaneous _____

c. Upstream Slope

- (1) Slope (Estimate) (V:H) _____

- (2) Undesirable Growth or Debris, Animal Burrows _____

- (3) Sloughing, Subsidence or Depressions _____

(4) Slope Protection _____

(5) Surface Cracks or Movement at Toe _____

d. Downstream Slope

(1) Slope (Estimate - V:H) _____

(2) Undesirable Growth or Debris, Animal Burrows _____

(3) Sloughing, Subsidence or Depressions _____

(4) Surface Cracks or Movement at Toe _____

(5) Seepage _____

(6) External Drainage System (Ditches, Trenches; Blanket) _____

(7) Condition Around Outlet Structure _____

(8) Seepage Beyond Toe _____

e. Abutments - Embankment Contact

(1) Erosion at Contact _____

(2) Seepage Along Contact _____

3) Drainage System

a. Description of System - Weep holes in left abutment

Spillway Step

b. Condition of System Operating

c. Discharge from Drainage System Varies 1 gpm to 5 gpm

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None in Force

5) Reservoir

- a. Slopes Stable - Rock on Rt. abutment -
gently sloping overburden elsewhere
- b. Sedimentation Very heavy
- c. Unusual Conditions Which Affect Dam _____

6) Area Downstream of Dam

- a. Downstream Hazard (No. of Homes, Highways, etc.) High -
Village directly downstream
- b. Seepage, Unusual Growth Seepage through left spillway
step
- c. Evidence of Movement Beyond Toe of Dam None
- d. Condition of Downstream Channel Bedrock generally
clear.

7) Spillway(s) (Including Discharge Conveyance Channel)

- a. General Entire Main dam acts as
spillway - Secondary step 2 1/2 feet
higher 32 feet long.
- b. Condition of Service Spillway good.

c. Condition of Auxiliary Spillway good - some seepage
underneath

d. Condition of Discharge Conveyance Channel. clear - bedrock
steep sided

f) Reservoir Drain/Outlet

Type: Pipe _____ Conduit (2) Other _____

Material: Concrete Metal _____ Other _____

Size: _____ Length 10 feet

Invert Elevations: Entrance _____ Exit _____

Physical Condition (Describe): _____ Unobservable

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

Hydraulic Capability: _____

Means of Control: Gate Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable Other _____

Present Condition (Describe): Conduits for 1 stone way
gone in 1960's and bit of structure remains.

b) Structural

a. Concrete Surfaces Appear to be good

b. Structural Cracking None observed

c. Movement - Horizontal & Vertical Alignment (Settlement) None
evident

d. Junctions with Abutments or Embankments appear good -
joint walls are crumbling

e. Drains - Foundation, Joint, Face None

f. Water Passages, Conduits, Sluices movable and
sluice walls crumbling

g. Seepage or Leakage through movable gate
and under "A" pileway" walls

h. Joints - Construction, etc. None

i. Foundation Sound Bedrock - generally
sedimentary.

j. Abutments Rock

k. Control Gates inoperable or low level outlets

l. Approach & Outlet Channels outlet channel clear -
No approach channel

m. Energy Dissipators (Plunge Pool, etc.) None

n. Intake Structures None

o. Stability

p. Miscellaneous

HYDROLOGY AND HYDRAULICS CALCULATIONS

APPENDIX D

TAMS

Job No. 155-03 Sheet 1 of 4
 Project W-PPIJGER FALLS PHASE I INSPECTIONS Date JUNE 24, 1962
 Subject Hydrologic/Hydrologic Computations By J L C
ELEVATION/SURCHARGE STORAGE Ch'k. by _____

| ELEVATION (FT) | AREA (Ac) | Δ H (FT) | MEAN AREA (Ac) | Δ VOLUME (Ac FT) | SURCHARGE STORAGE (Ac FT) |
|-------------------|--------------|-------------|----------------------|------------------------|---------------------------------|
| 80 | 101 | | | | 0 |
| 81 | 103 | 1.0 | 102 | 102 | 102 |
| 82 | 105.1 | 1.0 | 104.05 | 104.05 | 206.05 |
| 83 | 107.15 | 1.0 | 106.1 | 106.1 | 312.15 |
| 85 | 111.25 | 2.0 | 109.8 | 219.6 | 531.75 |
| 90 | 121.5 | 5.0 | 116.4 | 582.0 | 1113.75 |
| 100 | 140 | 10.0 | 130.75 | 1307.5 | 2420. |

Surcharge storage at El 85 is equivalent to
 0.05" of runoff over the entire drainage basin

HILLTOP ENGINEERING CORPORATION
 1000 ...
 ...

TAMS

Job No. 1551-03

Sheet 2 of 4

Project WAPPINGER FALLS DAM Phase 1 Inspection

Date JUNE 24 19

Subject Hydrologic/Hydraulic Computations

By D.L.G.

Ch'k. by _____

Assume Coef $C = 3.30$ $L_D = 172'$ $L_S = 30'$

| EL. | H | Q_D | Q_S | Q_{TOTAL} |
|-----|----|-------|-------|-------------|
| 80 | 0 | 0 | | 0 |
| 81 | 1 | 570 | | 570 |
| 83 | 3 | 2950 | | 2950 |
| 85 | 5 | 6350 | 230 | 6580 |
| 90 | 10 | 17950 | 1480 | 19430 |
| 100 | 20 | 50770 | 5610 | 56380 |

[Faint grid lines and illegible text at the bottom of the page]

TABLE 8
WAPPINGER CREEK (Cont'd)

3-HOUR SPF HYDROGRAPH AT NODE 107

| Time (hr) | Discharge | Time (hr) | Discharge |
|-----------|-----------|-----------|-----------|
| 3 | 173 | 66 | 4307 |
| 6 | 171 | 69 | 10527 |
| 9 | 168 | 72 | 20405 |
| 12 | 161 | 75 | 32518 |
| 15 | 140 | 78 | 41168 |
| 18 | 122 | 91 | 42816 |
| 21 | 106 | 94 | 39007 |
| 24 | 92 | 97 | 32628 |
| 27 | 80 | 100 | 26754 |
| 30 | 69 | 103 | 22148 |
| 33 | 60 | 106 | 19133 |
| 36 | 52 | 109 | 16607 |
| 39 | 45 | 112 | 14414 |
| 42 | 39 | 115 | 12511 |
| 45 | 34 | 118 | 10860 |
| 48 | 30 | 121 | 9426 |
| 51 | 26 | 124 | 8182 |
| 54 | 22 | 127 | 7101 |
| 57 | 19 | 130 | 6164 |
| 60 | 95 | 133 | 5350 |
| 63 | 958 | 136 | 4644 |

FROM: LOWER HUDSON RIVER BASIN HYDROLOGIC FLOOD ROUTING MODEL
WATER RESOURCES ENG. INC. Jan. 1977

TAMS

Job No. 1551-03 Sheet 4 of 4
 Project WAPPINGER FALLS DAM INSPECTION. Date JUNE 25, 19
 Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D L C.
D/S Valley Cross Sections. Ch'k. by _____

| STATION | DISTANCE | ELEVATION. | |
|---------------|----------|------------|------------|
| STATION 600 | | | |
| SLOPE 0.0283 | 5850 | 90 | |
| | 5940 | 80 | |
| | 5942 | 50 | |
| | 5944 | 48 | |
| | 6004 | 48 | |
| | 6020 | 50 | |
| | 6025 | 70 | |
| | 6100 | 80 | |
| | 6170 | 90 | |
| STATION 30 00 | | | |
| SLOPE 0.0196 | 2820 | 30 | |
| | 2825 | 20 | |
| | 2830 | 10 | |
| | 2900 | 8 | |
| | 2905 | 1 | * Estimate |
| | 2992 | 1 | * Estimate |
| | 3100 | 8 | |
| | 3130 | 10 | |
| | 3190 | 20 | |
| | 3220 | 30 | |

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 42816. 41452. 32101. 16156. 389266.
 1212. 1174. 909. 457. 11023.
 INCHES 1.94 6.00 9.06 9.10
 MN 49.22 152.46 230.20 231.09
 AC-FT 20555. 63671. 96137. 96512.
 THOUS CU M 23354. 78538. 118583. 119046.

HYDROGRAPH ROUTING

RESERVOIR ROUTING
 ISTAQ 10 ICOMP 1 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IAUTO 0
 ROUTING DATA
 QLOSS 0.0 CLOSS 0.00 AVG 0.00 IRES 1 ISAME 1 IOPT 0 IPMP 0 LSTR 0
 NSTPS 1 NSTDL 0 LAG 0 AMSKK X TSK STORA ISPRAT -1

STAGE 80.00 81.00 83.00 85.00 90.00 100.00
 FLOW 0.00 570.00 2950.00 6580.00 19430.00 56380.00
 CAPACITY= 0. 102. 206. 312. 532. 1114. 2420.
 ELEVATION= 80. 81. 82. 83. 85. 90. 100.

CREL SPWID COOW EXPW ELEV COOL CAREA EXPL
 80.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

DAM DATA

TOPEL 84.3
 COOD 0.0
 EXPD 1.5
 DAMWID 10000.

STATION 10, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

| STAGE | OUTFLOW | | STORAGE | |
|--------|---------|--------|---------|--------|
| | TOPEL | COOD | EXPD | DAMWID |
| 263. | 333. | 338. | 331. | 306. |
| 134. | 116. | 101. | 87. | 76. |
| 1015. | 6432. | 18726. | 37678. | 61403. |
| 45502. | 38033. | 33964. | 29384. | 25557. |
| 10980. | 9565. | 2763. | 0. | 0. |
| 51. | 60. | 59. | 55. | 48. |
| 24. | 18. | 16. | 14. | 12. |
| 141. | 523. | 1759. | 2598. | 3273. |
| 2036. | 1803. | 1466. | 1331. | 1210. |
| 731. | 667. | 295. | 0. | 0. |
| 155. | 178. | 205. | 236. | 270. |
| 101. | 43. | 50. | 58. | 66. |
| 55015. | 67233. | 79549. | 85912. | 80519. |
| 12664. | 14559. | 16841. | 19257. | 22155. |
| 28. | 32. | 37. | 42. | 48. |
| 18. | 8. | 9. | 10. | 12. |
| 2372. | 2804. | 3239. | 3464. | 3664. |
| 808. | 893. | 997. | 1106. | 1210. |

STAGE 80.5 80.6 80.6 80.5 80.5 80.4 80.4 80.3 80.3
 RD.2 RD.4 RD.4 RD.3 RD.4 RD.2

3500 3.8 1. 13 1.21
 INCHES 98.52 304.81 460.48 467.42
 MM 41143 127298 192311 193122
 AC-FT 50750 157020 237212 238213
 THOUS CU M

S

STATION 10, PLAN 1, RATIO 2
 END-OF-PERIOD HYDROGRAPH ORDINATES

| | 142. | 166. | 169. | 153. | 135. | 118. | 103. | 89. | 77. |
|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| OUTFLOW | 67. | 58. | 50. | 38. | 33. | 29. | 25. | 21. | 51. |
| | 440. | 2946. | 9166. | 30884. | 40158. | 43012. | 39743. | 33634. | 27498. |
| | 22756. | 19464. | 17127. | 12860. | 11140. | 9680. | 8397. | 7290. | 6348. |
| | 5554. | 4819. | 1674. | 0. | | | | | |
| STORAGE | 25. | 30. | 30. | 27. | 24. | 21. | 18. | 16. | 14. |
| | 12. | 10. | 9. | 7. | 6. | 5. | 4. | 4. | 4. |
| | 79. | 312. | 649. | 1519. | 1847. | 1948. | 1832. | 1616. | 1399. |
| | 1232. | 1115. | 1010. | 816. | 739. | 672. | 614. | 564. | 518. |
| | 470. | 425. | 199. | 0. | | | | | |
| STAGE | 80.2 | 80.3 | 80.3 | 80.3 | 80.2 | 80.2 | 80.2 | 80.2 | 80.1 |
| | 80.1 | 80.1 | 80.1 | 80.1 | 80.1 | 80.1 | 80.0 | 80.0 | 80.1 |
| | 80.8 | 83.0 | 86.0 | 93.1 | 95.6 | 96.4 | 95.5 | 93.8 | 92.2 |
| | 90.9 | 90.0 | 89.1 | 88.2 | 86.8 | 86.2 | 85.7 | 85.3 | 84.9 |
| | 84.4 | 84.0 | 81.9 | 80.0 | | | | | |

PEAK OUTFLOW IS 43012 AT TIME 81.00 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|--------|--------|---------|---------|--------------|
| CFS | 43012. | 41481. | 32077. | 16157. | 389405. |
| CMS | 1218. | 1175. | 908. | 458. | 11027. |
| INCHES | 1.94 | 6.00 | 6.00 | 9.06 | 9.10 |
| MM | 49.25 | 152.34 | 230.20 | 231.18 | 96547. |
| AC-FT | 20569. | 63623. | 96141. | 96547. | 119089. |
| THOUS CU M | 25372. | 78478. | 118388. | | |

HYDROGRAPH ROUTING

CHANNEL ROUTING WAPPINGER CREEK STN 6+00

| | ISTAQ | ICOMP | IECON | ITAPE | JPLI | JPRI | INAME | ISTAGE | IAUTO |
|--------------|-------|-------|-------|-------|-------|-------|--------|--------|-------|
| | 100 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | | |
| QLOSS | CLOSS | AVG | IRRES | ISAME | IOPT | IPMP | | LSTR | |
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | | 0 | |
| NSTPS | NSTDL | LAG | ANSKK | X | TSK | STORA | ISPRAT | | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0. | 0. | | |

| | | | | | | | | | |
|--------|--------|--------|--------|---------|--------|--------|--------|--------|--------|
| 279. | 32. | 299. | 39. | OUTFLOW | 16. | 235. | 0. | 189. | 0. |
| 142. | 0. | 107. | 0. | 277. | 80. | 61. | 0. | 46. | 27. |
| 452. | 2907. | 9175. | 18355. | 30891. | 40130. | 43034. | 39729. | 33662. | 27485. |
| 22782. | 19447. | 17151. | 14743. | 12882. | 11124. | 9701. | 8381. | 7311. | 6331. |
| 5574. | 4803. | 1709. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

| | | | | | | | | | |
|-----|-----|-----|-----|-------|-----|-----|-----|-----|----|
| 0. | 0. | 1. | 0. | STOR. | 0. | 0. | 0. | 0. | 0. |
| 1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 13. | 3. | 7. | 11. | 15. | 18. | 18. | 16. | 14. | 6. |
| 5. | 11. | 10. | 9. | 8. | 7. | 7. | 6. | 6. | 6. |

| | | | | | | | | | |
|------|------|------|------|-------|------|------|------|------|------|
| 48.5 | 48.1 | 48.5 | 48.1 | STAGE | 48.0 | 48.4 | 48.0 | 48.3 | 48.0 |
| 48.3 | 48.0 | 48.2 | 48.1 | 48.1 | 48.0 | 48.1 | 48.0 | 48.1 | 48.0 |
| 48.8 | 51.5 | 54.9 | 58.3 | 62.0 | 64.3 | 65.0 | 64.2 | 62.7 | 61.1 |
| 59.7 | 58.7 | 57.9 | 57.1 | 56.4 | 55.7 | 55.1 | 54.5 | 54.0 | 53.5 |
| 53.1 | 52.7 | 50.6 | 48.0 | 48.0 | | | | | |

| | | | | |
|------------|--------|---------|---------|--------------|
| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 43034. | 41482. | 32077. | 16157. | 389450. |
| CFS | 1175. | 908. | 458. | 11028. |
| CMS | 1.94 | 6.00 | 9.06 | |
| INCHES | 49.25 | 152.54 | 230.21 | 231.20 |
| AC-FT | 20569. | 63623. | 96143. | 96558. |
| THOUS CU M | 25372. | 78478. | 118590. | 119102. |

MAXIMUM STAGE IS 65.0
 MAXIMUM STORAGE = 18.

 HYDROGRAPH ROUTING

| | | | | | | | | |
|-----------------|-----------|-------|-------|-------|-------|-------|--------|-------|
| CHANNEL ROUTING | STN 30+00 | | | | | | | |
| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
| 200 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | |
| QLOSS | AVG | IPRES | ISAME | IOPT | IPMP | LSTR | | |
| 0.0 | 0.00 | 1 | 1 | 0 | 0 | 0 | | |
| NSTPS | NSTOL | LAG | AMSK | X | TSK | STORA | ISPRAT | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | 0 | 0 | |

 NORMAL DEPTH CHANNEL ROUTING

CHANNEL ROUTING STN 30+00

ISTAT 200 IECON 0 ITAPE 0 JPLT 0 JPR1 0 INAME 1 IAUTO 0
 ICOMP 1 IRES 1 IOPT 0 IPMP 0 LSTR 0
 QLOSS 0.0 CROSS 0.000 AVG 0.000 ISAME 1
 NSTPS 1 NSTOL 0 LAG 0 AMSKK 0 X TSK STORA 0.0 ISPRAT 0

NORMAL DEPTH CHANNEL ROUTING

QN(1) .0300 QN(2) .0300 QN(3) 1.0 ELNVT 1.0 ELMAX 30.0 RLNTH 2400. SEL .01960

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
 2820.00 30.00 2825.00 20.00 2830.00 10.00 2900.00 8.00 2908.00 1.00
 2992.00 1.00 3100.00 8.00 3130.00 10.00

| STORAGE | 0.00 | 8.13 | 18.38 | 30.76 | 45.27 | 62.27 | 84.92 | 110.19 | 135.52 | 160.92 |
|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | 186.38 | 211.90 | 237.49 | 263.14 | 288.86 | 314.64 | 340.48 | 366.39 | 392.36 | 418.40 |
| OUTFLOW | 0.00 | 1284.92 | 4407.87 | 9311.69 | 16089.87 | 22974.64 | 31804.61 | 48998.83 | 69061.57 | 91805.33 |
| | 117085.30 | 144784.97 | 174807.76 | 207071.74 | 241506.26 | 278049.47 | 316646.64 | 357248.25 | 399812.01 | 444296.11 |
| STAGE | 1.00 | 2.53 | 4.05 | 5.58 | 7.11 | 8.63 | 10.16 | 11.68 | 13.21 | 14.74 |
| | 16.26 | 17.79 | 19.32 | 20.84 | 22.37 | 23.89 | 25.42 | 26.95 | 28.47 | 30.00 |
| FLOW | 0.00 | 1284.92 | 4407.87 | 9311.69 | 16089.87 | 22974.64 | 31804.61 | 48998.83 | 69061.57 | 91805.33 |
| | 117085.30 | 144784.97 | 174807.76 | 207071.74 | 241506.26 | 278049.47 | 316646.64 | 357248.25 | 399812.01 | 444296.11 |

STATION 200, PLAN 1, RTIO 1

| OUTFLOW | 74. | 74. | 74. | 74. | 74. | 74. | 74. | 74. | 74. | 74. |
|---------|-------|------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 631. | 106. | 37479. | 61293. | 80412. | 85958. | 79573. | 67344. | 55052. | 12666. |
| | 1363. | 183. | 926. | 6349. | 18539. | 34024. | 29411. | 25618. | 22173. | 19304. |
| | 105. | 34. | 105. | 34. | 105. | 34. | 105. | 34. | 105. | 34. |

STOR

| STOR | 0. | 4. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
|------|------|-----|------|------|------|------|------|------|-----|-----|
| | 3. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. |
| | 23. | 93. | 126. | 148. | 154. | 147. | 133. | 118. | 38. | 38. |
| | 105. | 88. | 69. | 60. | 53. | 47. | 42. | 38. | 38. | 38. |
| | 34. | 14. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |

STAGE

| STAGE | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
|-------|------|------|------|------|------|------|------|------|------|------|
| | 1.7 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| | 2.3 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| | 1.2 | 4.7 | 10.7 | 12.6 | 14.0 | 14.3 | 13.9 | 13.1 | 12.1 | 12.2 |
| | 2.1 | 10.8 | 10.4 | 9.7 | 8.5 | 7.8 | 7.3 | 6.8 | 6.3 | 6.3 |
| | 11.4 | 10.8 | 10.4 | 9.7 | 8.5 | 7.8 | 7.3 | 6.8 | 6.3 | 6.3 |
| | 6.0 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 |

| | | | | | | | | |
|--------------|---------|------|------|------|------|------|------|------|
| 105. | 95. | 88. | 79. | 69. | 154. | 147. | 133. | 118. |
| 2.3 | 1.0 | 1.7 | 1.1 | 1.6 | 1.1 | 1.1 | 1.3 | 1.1 |
| 1.2 | 1.1 | 1.1 | 1.1 | 1.1 | 1.0 | 1.1 | 1.0 | 1.2 |
| 2.1 | 4.7 | 7.6 | 10.7 | 12.6 | 14.3 | 13.9 | 13.1 | 12.1 |
| 11.4 | 10.8 | 10.4 | 9.7 | 9.1 | 7.8 | 7.3 | 6.8 | 6.3 |
| 6.0 | 5.6 | 3.3 | 1.0 | 1.0 | | | | |
| STAGE | | | | | | | | |
| | 1.6 | | | | | | | |
| | 1.1 | | | | | | | |
| | 1.1 | | | | | | | |
| | 14.0 | | | | | | | |
| | 8.5 | | | | | | | |
| | 1.0 | | | | | | | |
| TOTAL VOLUME | | | | | | | | |
| | 779246. | | | | | | | |
| | 220665. | | | | | | | |
| | 18.21 | | | | | | | |
| | 462.61 | | | | | | | |
| | 193202. | | | | | | | |
| | 238311. | | | | | | | |
| 10 | | | | | | | | |

MAXIMUM STORAGE = 154.

MAXIMUM STAGE IS 14.3

STATION 200, PLAN 1, RTIO 2

| | | | | | | | | |
|--------------|---------|--------|--------|--------|--------|--------|--------|--------|
| 531. | 0. | 315. | 37. | 37. | 204. | 39. | 145. | 49. |
| 91. | 53. | 54. | 51. | 28. | 12. | 47. | 1. | 68. |
| 400. | 2878. | 9069. | 18295. | 30697. | 40201. | 39868. | 33597. | 27657. |
| 22712. | 19580. | 17068. | 14866. | 12795. | 11238. | 8489. | 7229. | 6430. |
| 5494. | 4895. | 1699. | 83. | 0. | 9615. | | | |
| OUTFLOW | | | | | | | | |
| | 267. | | | | | | | |
| | 2. | | | | | | | |
| | 0. | | | | | | | |
| | 13. | | | | | | | |
| | 54. | | | | | | | |
| | 20. | | | | | | | |
| STOR | | | | | | | | |
| | 0. | | | | | | | |
| | 0. | | | | | | | |
| | 30. | | | | | | | |
| | 62. | | | | | | | |
| | 21. | | | | | | | |
| | 1. | | | | | | | |
| | 0. | | | | | | | |
| | 0. | | | | | | | |
| | 1. | | | | | | | |
| | 0. | | | | | | | |
| | 0. | | | | | | | |
| | 97. | | | | | | | |
| | 33. | | | | | | | |
| | 0. | | | | | | | |
| | 1.0 | | | | | | | |
| | 1.1 | | | | | | | |
| | 3.3 | | | | | | | |
| | 7.9 | | | | | | | |
| | 8.6 | | | | | | | |
| | 4.4 | | | | | | | |
| STAGE | | | | | | | | |
| | 1.3 | | | | | | | |
| | 1.0 | | | | | | | |
| | 1.0 | | | | | | | |
| | 10.0 | | | | | | | |
| | 6.4 | | | | | | | |
| | 1.0 | | | | | | | |
| TOTAL VOLUME | | | | | | | | |
| | 32075. | | | | | | | |
| | 908. | | | | | | | |
| | 6.00 | | | | | | | |
| | 152.33 | | | | | | | |
| | 63620. | | | | | | | |
| | 78474. | | | | | | | |
| THOUS CU M | | | | | | | | |
| | 118590. | | | | | | | |

MAXIMUM STORAGE = 101.

MAXIMUM STAGE IS 11.1

| | | | | | | | | |
|--------------|---------|-----|-----|-----|------|-----|-----|-----|
| 3. | 0. | 2. | 0. | 0. | 1. | 0. | 1. | 0. |
| 1. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 3. | 13. | 30. | 51. | 87. | 101. | 97. | 88. | 74. |
| 62. | 54. | 48. | 43. | 33. | 31. | 29. | 26. | 23. |
| 21. | 20. | 9. | 1. | 0. | | | | |
| STAGE | | | | | | | | |
| | 1.0 | | | | | | | |
| | 1.1 | | | | | | | |
| | 3.3 | | | | | | | |
| | 7.9 | | | | | | | |
| | 8.6 | | | | | | | |
| | 4.4 | | | | | | | |
| TOTAL VOLUME | | | | | | | | |
| | 32075. | | | | | | | |
| | 908. | | | | | | | |
| | 6.00 | | | | | | | |
| | 152.33 | | | | | | | |
| | 63620. | | | | | | | |
| | 78474. | | | | | | | |
| THOUS CU M | | | | | | | | |
| | 118590. | | | | | | | |

MAXIMUM STORAGE = 101.

MAXIMUM STAGE IS 11.1

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)

(11)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1 RATIO 2
 2.00 1.00

| | | | | | |
|---------------|-----|---------------------|---|----------------------|----------------------|
| HYDROGRAPH AT | 1 | 199.00 (515.41) | 1 | 85632. (2424.83) | 42816. (1212.41) |
| ROUTED TO | 10 | 199.00 (515.41) | 1 | 85912. (2432.75) | 43012. (1217.98) |
| ROUTED TO | 100 | 199.00 (515.41) | 1 | 85958. (2434.06) | 43034. (1218.58) |
| ROUTED TO | 200 | 199.00 (515.41) | 1 | 85958. (2434.05) | 42930. (1215.66) |

SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 | | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|-------------------|-------|---------------|----------------|------------|
| ELEVATION STORAGE | 80.00 | 80.00 | 80.00 | 84.30 |
| OUTFLOW | 0. | 0. | 0. | 455. |
| | | | | 5310. |

| RATIO OF R.F. S.F. | 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 |
|--------------------|----------------------------|------------------------|-----------------------|---------------------|-------------------------|---------------------------|-----------------------|
| 2.00 | 107.99 | 23.69 | 3464. | 85912. | 63.00 | 81.00 | 0.00 |
| 1.00 | 96.38 | 12.08 | 1948. | 43012. | 57.00 | 81.00 | 0.00 |

PLAN 1 STATION 100

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|-------|------------------|------------------|------------|
| 2.00 | 85958. | 73.4 | 81.00 |
| 1.00 | 43034. | 65.0 | 81.00 |

PLAN 1 STATION 200

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|-------|------------------|------------------|------------|
| 2.00 | 85958. | 14.3 | 81.00 |
| 1.00 | 42930. | 11.1 | 81.00 |

STRUCTURAL STABILITY ANALYSES

APPENDIX E

TAMS

Job No. 1551-03

Sheet 1 of 12

Project NYS DAM Inspection - Wappingers Falls

Date 8-18-80

Subject Stability Analysis

By JTF

Ch'k. by _____

Assumptions

- 1) The unit weights used are as follows:
Masonry - 165 lbs cu ft.
Concrete - 150 lbs cu ft.
Backfill - 125 lbs cu ft.
- 2) Ice load of 5 kips/ft² acting about 1 ft from top of the dam (C.O.E. Criteria)
- 3) Angle of internal resistance of rock foundation is 45° based on observations and engineering judgement.
- 4) Dam site is in seismic zone 2
- 5) At rest earth pressure for upstream fill, with $\phi = 30^\circ$, $K_0 = 0.50$.

Loading Conditions

- Case I - Normal Load; Lake at Spillway Crest Elev. 80'
No Ice Load
- Case II - Normal Load; Lake at Spillway Crest Elev. 80'
With Ice Load
- Case III - Unusual Loading; Lake Level at 1/2 PMF
- Case IV - Extreme Loading; Lake Level at PMF
- Case V - Unusual Loading; Lake Level at Spillway crest and earthquake force of 0.05g applied.

Stability Criteria

- a) Overturning - Cases I and II - Resultant in middle third
Cases III, IV, V - Resultant in middle half
- b) Sliding - Cases I and II, friction factor of safety ≥ 1.5
Cases III and IV, friction factor of safety ≥ 1.25
Cases V, friction factor of safety ≥ 1.1

TAMS

Joh No. 1551-03

Sheet 2 of 12

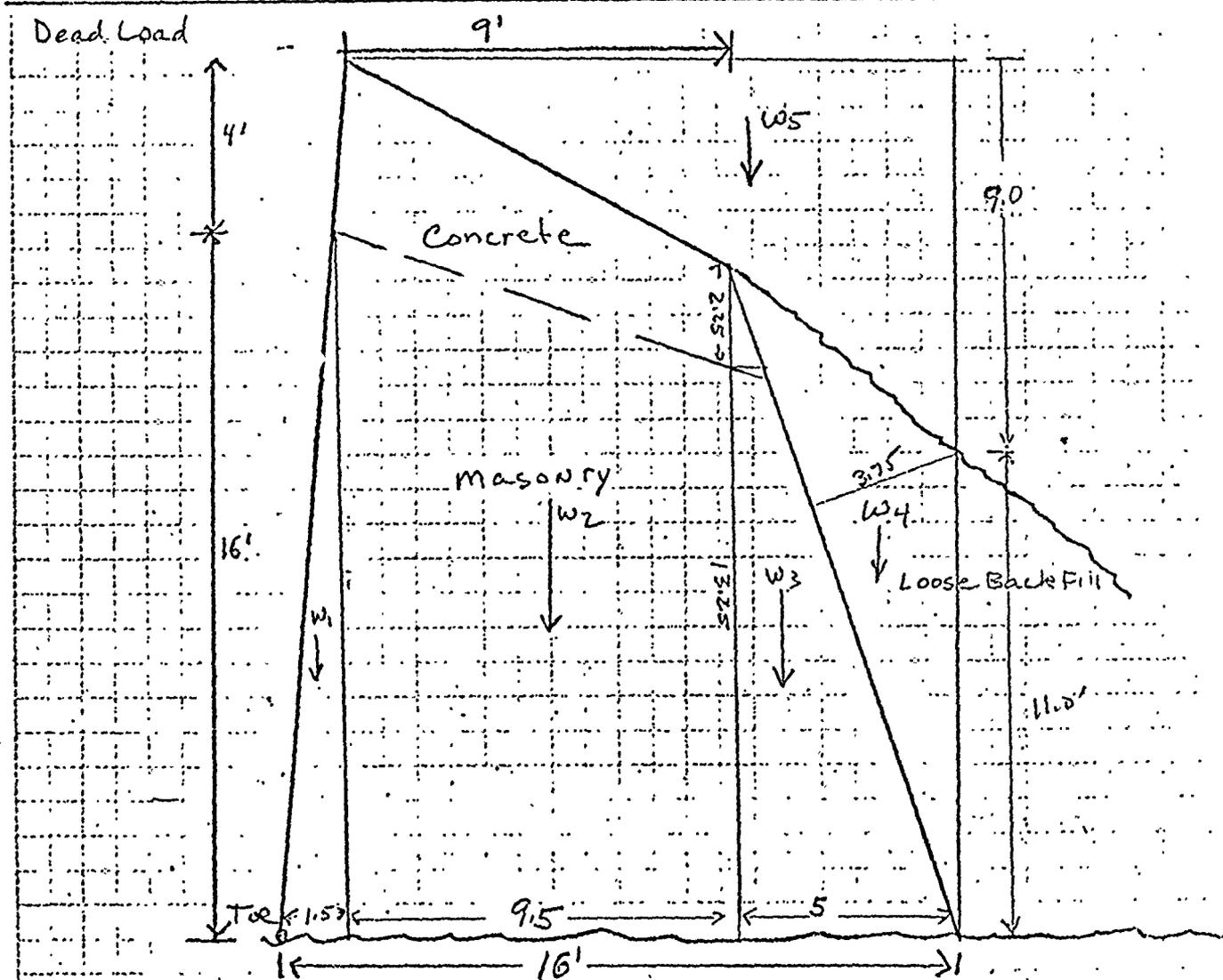
Project NYS Dam Inspection - Wappingers Falls

Date 8-18-80

Subject Stability Analysis

By JJF

Ch'k. by _____



EM about toe

Structures

$$w_1 = \frac{1}{2} (16) (1.5) (0.165)$$

$$F(\text{kips}) \times MA(\text{ft}) = MR (\text{ft-kips})$$

$$w_2 = \frac{16 + 13.25}{2} (9.5) (0.165) + \frac{(2.25 + 4)}{2} (9.5) (0.150)$$

$$= 1.98 \times 1.0 = 11.98$$

$$w_3 = 0.75 (2.5) (\frac{1}{2}) (0.150) + \frac{(0.75 + 5)}{2} (11.25) (0.115)$$

$$= 27.38 \times 6.25 = 171.12$$

$$= 6.43 \times 12.67 = 81.42$$

Backfill:

$$w_4 = 3.75 (16.5) (\frac{1}{2}) (0.125)$$

$$= 3.87 \times 14.35 = 55.49$$

water

$$w_5 = \frac{1}{2} (16) (9) (0.0624)$$

$$= 4.49 \times 11.33 = 50.89$$

$$EFV = 44.15 \text{ kips}$$

$$EMR = 360.90 \text{ ft-kips}$$

TAMS

Job No. 1551-03

Sheet 3 of 12

Project NYS Dam Insp. - Wappingers Falls

Date 8-18-80

Subject Stability Analysis

By JJP

Ch'k. by _____

Dead Load (con't)

$$\bar{y} = \frac{360.90}{44.15} = \underline{8.17} \text{ Ft.}$$

$$\bar{y} = \frac{1.98(5.33) + 27.38(8.88) + 6.43(5.17) + 3.87(10.34) + (4.49)16.25}{44.15}$$

$$\bar{y} = \underline{9.05} \text{ Ft}$$

TAMS

Job No. 1551-03

Sheet 4 of 12

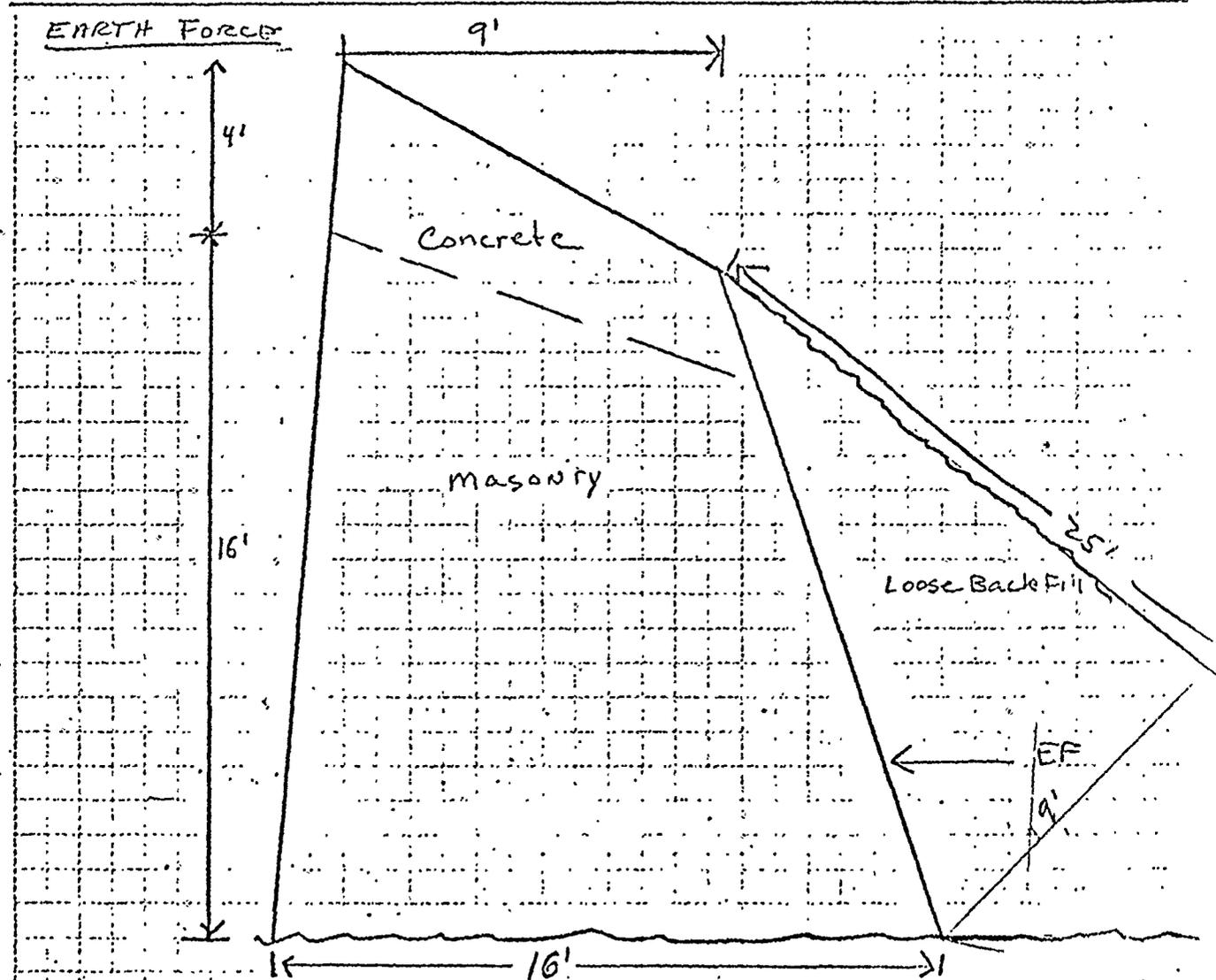
Project NYS Dam Inspection - Wappingers Falls

Date 8-18-97

Subject Stability Analysis

By JJF

Ch'k. by _____



$$EF = (0.50 \times \frac{1}{2} (25')(9')(0.0626)) = \frac{FL(\text{kips}) \times MA(Ft)}{3.5 \times 3.33} = \frac{M_0}{11.7} \text{ Ft-kips}$$

Ice Load

$$\frac{F(\text{kips})}{5.0} \times \frac{MA}{19.5} = \frac{M_0}{97.5} \text{ (Ft-kips)}$$

TAMS

Job No. 1551-03

Sheet 5 of 12

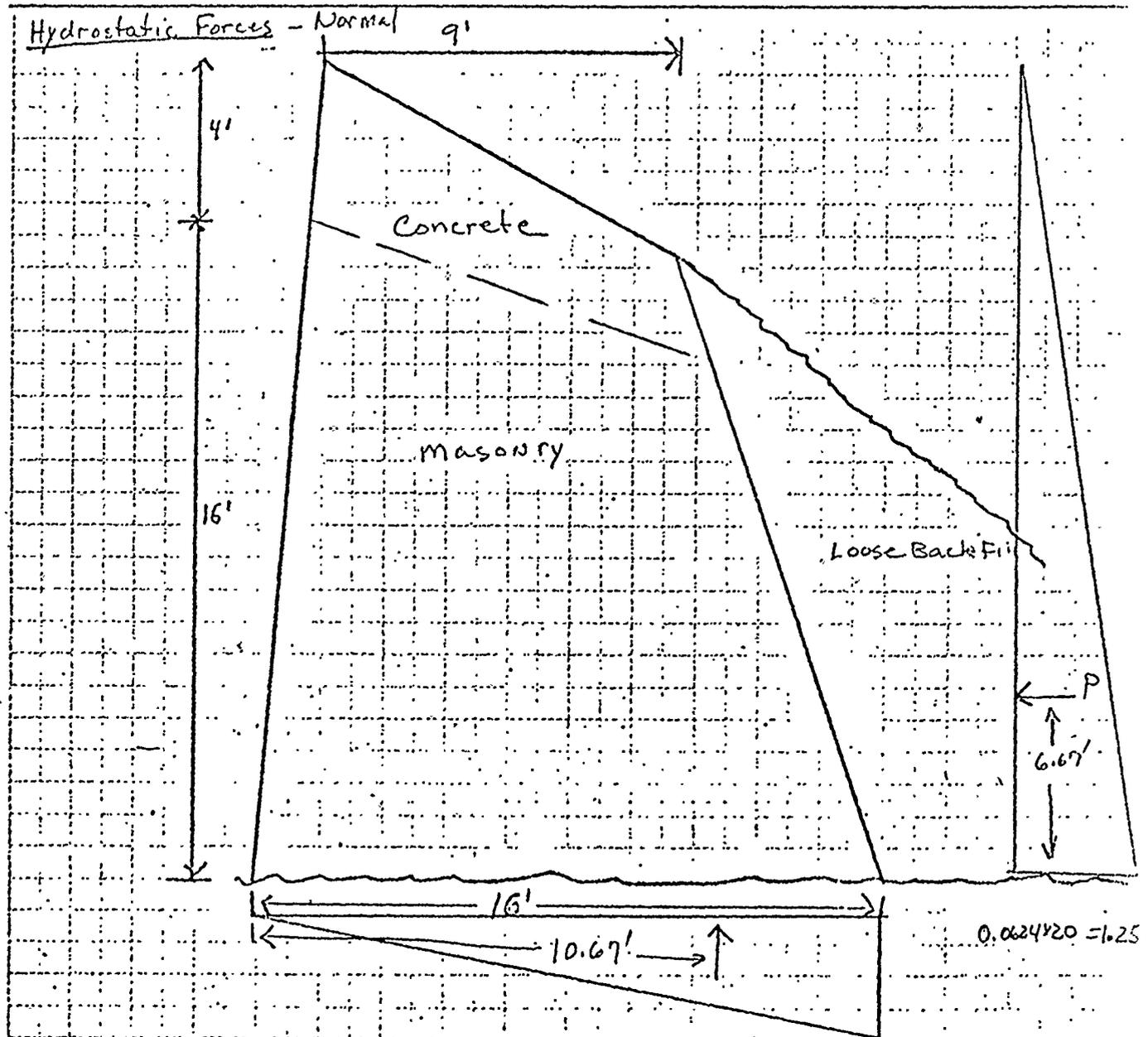
Project NYS Dam Inspection - Wappingers Falls

Date 8-18-80

Subject Stability Analysis

By JJF

Ch'k. by _____



E.M. Toe

$$P = \frac{1}{2} (1.25)(20) =$$

$$U = \frac{1}{2} (1.25)(16) =$$

| | | |
|---------------------|-----|-----------------|
| $F(kips) \times MA$ | $=$ | $M_o (Ft-kips)$ |
| 12.5×6.67 | | 83.38 |
| 10×10.67 | | 106.7 |
| | | <u>190.1</u> |

$$\uparrow F_v = 10 \text{ (kips)}$$

$$\leftarrow F_H = 12.5 \text{ (kips)}$$

$$\checkmark M_o = 190.1 \text{ (Ft-kips)}$$

TAMS

Job No. 1551-03

Sheet 6 of 12

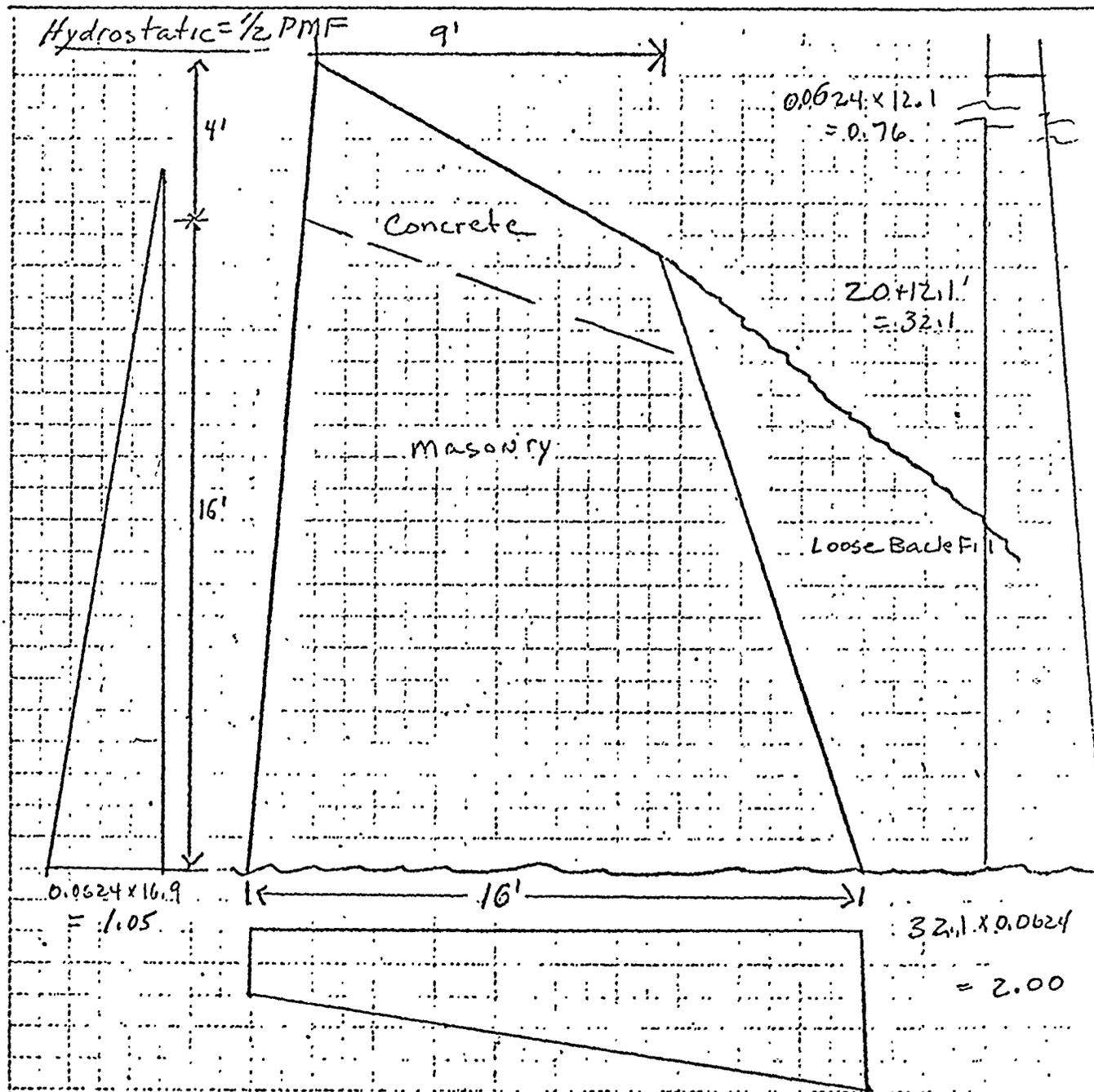
Project NYS Dam Inspection - Wappingers Falls

Date 8-18-81

Subject Stability Analysis

By JJF

Ch'k. by _____



$$P_H = \left[\frac{2.00 + 0.76}{2} \right] (22.0)$$

$$P_V = \frac{1}{2} (1.05) (16.9) (0.6)$$

$$U = \left[\frac{2.00 + 1.05}{2} \right] (16)$$

$$\frac{F \text{ (kips)} \times MA \text{ (ft)}}{27.6 \times 8.5} = \frac{M_O}{234.6} \text{ or } \frac{M_R}{29.81} \text{ (ft-kips)}$$

$$= \frac{15.32 \times 5.6}{24.4 \times 8.85} = \frac{215.2}{449.8} \quad \frac{29.81}{29.81}$$

$$= \frac{215.2}{449.8} \quad \frac{29.81}{29.81}$$

$$F_H = 22.28 \text{ (kips)} M_O = 449.8 \text{ (ft-kips)}$$

$$F_V = 24.4 \text{ (kips)} M_R = 29.81 \text{ (ft-kips)}$$

TAMS

Job No. 1551-03

Project NYS Dam Inspection - Wappingers Falls

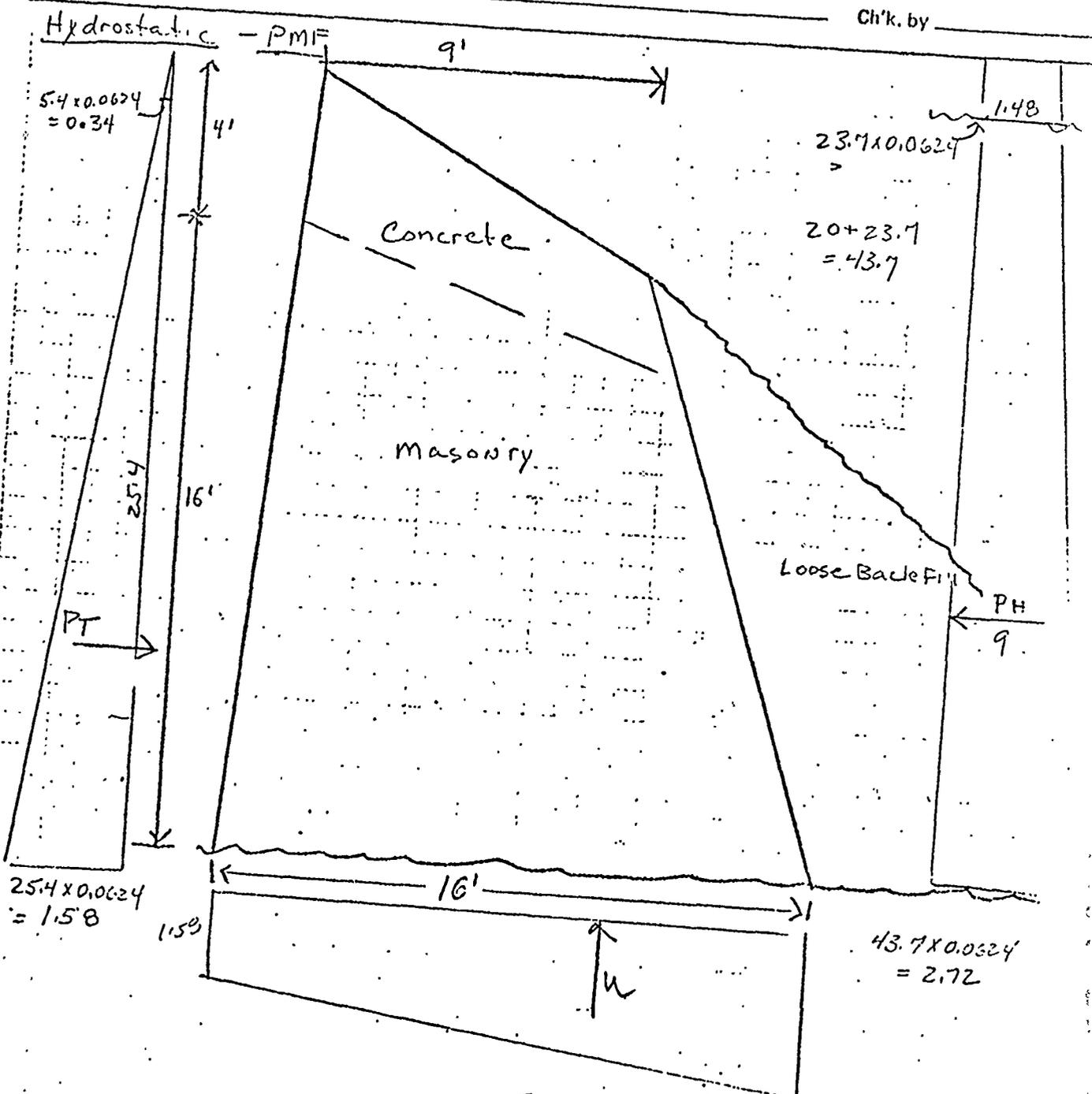
Subject Stability Analysis

Sheet 7 of 12

Date 9-18-91

By JJF

Ch'k. by _____



$$\begin{aligned}
 P_H &= \frac{1.48 + 2.72}{2} (20) &= \frac{F \text{ (kips)} \times M_H \text{ (ft)}}{42.0 \times 9.0} &= \frac{M_O}{378.0} \text{ or } \frac{M_C}{90.4} \\
 P_T &= \frac{1.58 + 0.34}{2} (20) (0.6) &= 11.52 \times 7.85 &= 90.4 \\
 U &= \frac{2.72 + 1.58}{2} (16) &= 34.4 \times 8.7 &= \frac{297.28}{677.28} \times 10.4
 \end{aligned}$$

$$\begin{aligned}
 F_H &= 30.5 \leftarrow \text{(kips)} & M_O &= 677.28 \text{ (ft-kips)} \\
 F_V &= 34.4 \uparrow \text{(kips)} & M_R &= 90.4 \text{ (ft-kips)}
 \end{aligned}$$

TAMS

Job No. 1551-03

Sheet 8 of 12

Project N.Y.S. Dam - 1.5.1 - Wappingers Falls

Date 3-13-50

Subject Stability Analysis

By JIF

Ch'k. by _____

Case I - Normal Load - Without Ice

| | F_v (kips) | F_H (kips) | M_1 (Ft-kips) | M_2 (Ft-kips) |
|-------------|--------------|--------------|-----------------|-----------------|
| Dead Load | 44.15 | | 360.9 | |
| EARTH Force | | 3.5 | | 11.7 |
| Hydrostatic | 10 ↑ | 12.5 | | 190.1 |
| | <u>34.15</u> | <u>16.0</u> | <u>360.9</u> | <u>201.8</u> |

$$EM = 361 - 201.8 = 159.2 \text{ (Ft-kips)}$$

$$\bar{r} = \frac{159.2}{34.15} = 4.6'$$

No good out in center 1/3

$$\bar{e} = \frac{16}{2} - 4.6 = 3.4'$$

$$\bar{p} = \frac{34.15}{16} \left(1 \pm \frac{6 \times 3.4}{16} \right) \frac{1000}{144} = 14.82 \pm 18.9$$

= 33.72 psi Toe
= -4.03 psi heel

Friction Factor of Safety

$$FFS = \frac{34.15 (\tan 45^\circ)}{16.0} = 2.14 \quad \text{OK}$$

TAMS

Job No. 1551-0?

Sheet 9 of 12

Project NYS Dam Insp. - Wappingers Falls

Date 8-19-77

Subject Stability Analysis

By JF

Ch'k. by _____

Case II - Normal Load With Ice

| | F_V (kips) | F_H (kips) | M_R (ft-kips) | M_O (ft-kips) |
|-------------|--------------|--------------|-----------------|-----------------|
| Dead Load | 44.15 ↓ | | 360.9 | |
| Earth Force | | 31.5 | | 11.7 |
| Hydrostatic | 10 ↑ | 12.5 | | 190.1 |
| <u>Ice</u> | <u>34.15</u> | <u>5.0</u> | <u>360.9</u> | <u>97.5</u> |
| | | <u>21.0</u> | | <u>299.3</u> |

$$EM = 360.9 - 299.3 = 61.6 \text{ (ft-kips)}$$

$$\bar{x} = \frac{61.6}{34.15} = 1.8 \text{ ft.} \quad \text{No good}$$

$$\bar{e} = \frac{16}{2} - 1.8 = 6.20 \text{ ft.}$$

$$\bar{p} = \frac{34.15}{16} \left(1 \pm \frac{6(6.20)}{16} \right) \left(\frac{1500}{144} \right) = 14.82 \pm 34.5 = 49.28 \text{ psi } \bar{p}$$

$= -19.6 \text{ psi } \bar{p}_{\text{acc}}$

Friction Factor of Safety

$$FFS = \frac{34.15 \tan 45^\circ}{21.0} = \underline{\underline{1.63}} \text{ OK}$$

TAMS

Job No. 1551-03

Sheet 10 of 12

Project NYS Dam Insp. - Wappingers Falls

Date 8-13-80

Subject Stability Analysis

By JF

Ch'k. by _____

Case III - 1/2 PMF

| | F _V (kips) | F _H (kips) | M _R (ft-kips) | M _O (ft-kips) |
|-------------|-----------------------|-----------------------|--------------------------|--------------------------|
| Dead Load | 44.15 | | 360.9 | |
| Hydrostatic | 24.4 ↑ | 22.8 ← | 29.81 | 449.8 |
| Earth Force | | 3.5 | | 11.7 |
| | <u>19.75</u> | <u>26.3</u> | <u>390.71</u> | <u>461.5</u> |

$$\Sigma M = 390.71 - 461.5 = -70.79 \text{ (ft-kips)}$$

$$\bar{y} = \frac{-70.79}{19.75} = -3.58 \quad \text{No good (outside of base)}$$

$\bar{e} =$ outside of base

Friction Factor of Safety

$$\frac{19.75 \tan 45^\circ}{26.3} = 0.75 \quad \text{No good}$$

TAMS

Job No. 1551-03
 Project NYS Dam Insp. Wappingers Falls
 Subject Stability Analysis

Sheet 11 of 12
 Date 8-18-80
 By JJF
 Ch'k. by _____

Case II - PMF

| | <u>F_V (kips)</u> | <u>F_H (kips)</u> | <u>M_R (ft-kips)</u> | <u>M_O (ft-kips)</u> |
|-------------|-----------------------------|-----------------------------|--------------------------------|--------------------------------|
| Dead Load | 44.15 | | 360.9 | |
| Hydrostatic | 34.4 | 30.5 | 90.4 | 677.28 |
| EARTH FORCE | | 3.5 | | 11.7 |
| | <u>9.75</u> | <u>33.5</u> | <u>451.35</u> | <u>689.0</u> |

$$\Sigma M = 451.35 - 689.0 = -237.65 \text{ (ft-kips)}$$

$$N = \frac{-237.65}{9.75} = -24.37 \text{ outside Base}$$

No good

$e =$ outside base

Friction Factor of Safety

$$\frac{9.75}{33.5} \tan 45^\circ = 0.29 - \text{No good}$$

TAMS

Job No. 1551-03

Sheet 12 of 12

Project Nys Dam Insp. - Wappingers Falls

Date 8-18-93

Subject Stability Analysis

By JJF

Ch'k. by _____

Case IV - Unusual Loading - Earthquake = 0.05g

ZONE Z = 0.05g
Zang. & Coefficient C = 0.64

① Hydrodynamic Forces

$$P = 0.64 \times 0.05 \times 0.0624 \times (20)^2 = 0.80 \text{ kips}$$

$$M_p = (0.4)(20)(0.80) = 6.39 \text{ ft-kips}$$

② Dynamic Forces

$$W_F = 0.64 \times 0.05 \times 35 = 0.11 \text{ kips}$$

$$M_{WF} = 0.11 (3.33M) = 0.37 \text{ ft-kips}$$

$$W_D = 0.05 (44.15) = 2.21 \text{ kips}$$

$$M_{WD} = 2.21 (9.05ft) = 20.0 \text{ ft-kips}$$

| | FU (kips) | FH (kips) | M _o (ft-kips) | M _R (ft-kips) |
|--------------|--------------|--------------|--------------------------|--------------------------|
| Dead Load | 44.15 ↓ | | | 360.90 |
| Hydrostatic | 10 ↑ | 12.5 ← | 190.1 | |
| Earth Force | | 3.5 ← | 11.7 | |
| Hydrodynamic | | 0.8 ← | 6.39 | |
| Dynamic | | 2.32 ← | 20.37 | |
| | <u>34.15</u> | <u>19.12</u> | <u>228.56</u> | <u>360.9</u> |

$$\Sigma M = 360.9 - 228.56 = 132.34 \text{ ft-kips}$$

$$\bar{x} = \frac{132.34}{34.15} = 3.88 \text{ ft}$$

No good - outside middle 1/2

$$\bar{e} = \frac{16}{2} - 3.88 = 4.1 \text{ ft}$$

$$\bar{p} = \frac{34.15}{16} \left(1 \pm \frac{6 \times 4.1}{16} \right) \frac{1000}{144} = 14.82 \pm 23.34 = 38.16 \text{ psi Toe}$$

- 8.52 psi Heel

Friction Factor of safety

$$\frac{34.15 \tan 45^\circ}{19.12} = 1.78$$

OK

REFERENCES

APPENDIX F

References

1. "HEC-1 Flood Hydrograph Package for Dam Safety Investigations", U.S. Army Corps of Engineers, September, 1978.
2. "Lower Hudson River Basin Hydrolic Flood Routing Model" for New York District Corps of Engineers, Water Resources Engineers, Inc., January, 1977.
3. "Water Resources Data for New York", Volume 1, New York excluding Long Island, USGS Water Data-Report NY 79-1. Prepared by State of New York and Other agencies.
4. "Recommended Guidelines for Safety Inspection of Dams", Department of the Army, Office of the Chief of Engineers, Appendix D.
5. "The Geology of New York State", by Broughton, J.E. et al., N.Y. State Museum and Science Service, Geological Survey, Albany, New York, Map and Chart Series: No.5, 1962.
6. "Soil Association Map of New York State", by M.G. Cline, New York State College of Agriculture, Cornell University, Ithaca, New York, February, 1963.
7. "Orange County Soils. Soil Association Leaflet 2", by E.G. Knox, et al., New York State College of Agriculture, Cornell University, Ithaca, New York, October 1, 1954.

OTHER DATA

APPENDIX G

Village of Wappingers Falls

INCORPORATED 1871

MESIER HOMESTEAD, DUTCHESS COUNTY, WAPPINGERS FALLS, N.Y. 12590

OFFICE OF VILLAGE CLERK

April 25, 1980

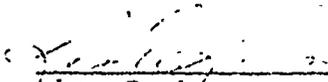
Re: National Dam Inspection Program
Inspection of Wappingers Falls Dam

Tams
The Tank Building
655 Third Avenue
New York, N.Y. 10017

Attn. J. Patel:

In reference to the above, I am enclosing a copy of a map showing the construction of the dam along with a report from the Water Resources Commission. This is the only information I can forward you regarding your engineering data questionnaire. If you have any further questions, please contact me.

Very truly yours,



Leo D. Lowney
Village Clerk

RECEIVED

APR 29 1980

SOILS SECTION

STATE OF NEW YORK
WATER RESOURCES COMMISSION

*now under
Bureau of
Water
Regulation*

CONSERVATION DEPARTMENT, ALBANY, NEW YORK 12226

October 22, 1969

*Review
section
to be*

Honorable Peter Furnari
Mayor, Village of Wappingers Falls
Meiser Homestead
Wappingers Falls, New York

Dear Mayor Furnari:

Re: Dam # 613A
Village of Wappingers Falls
Dutchess County

On October 9, 1969 we wrote to Mr. David C. Schoentag, Dutchess County Executive, to inform him of the recent inspection of five dams in Dutchess County, including the above dam located across Wappingers Creek in the Village of Wappingers Falls. A copy of this letter was forwarded to you for information.

At that time, we were unaware that the Village of Wappingers Falls was the owner of the structure referred to in that letter as Item No. 4, Wappingers Falls Dam.

The dam is located across Wappingers Creek approximately 500 feet upstream of the New York State Highway No. 9D Bridge in the Village of Wappingers Falls, and was constructed in or about the year 1872. The area draining into the impoundment is approximately 194 square miles. The main body of the dam consists of a stone masonry overflow structure across the entire width of the Creek with masonry gravity retaining walls located on both sides of the overflow section. The original masonry overflow structure had a base width of 14 feet with an overall height of 12 feet. Since the original construction, the height of the dam has been raised and flashboards added.

On the day of inspection, a considerable amount of water was flowing over the spillway section which precluded a close inspection of the downstream face of the dam. A large amount of floating debris was lodged on the top of the spillway section which decreased the efficiency of the spillway. The flashboards and pipe supports for the flashboards were bent and displaced indicating that the flashboard system has not been properly maintained and has probably been damaged in the past by large floating tree trunks passing over the spillway during heavy runoff periods.

COMMISSIONERS
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of Local Government

ADVISORY MEMBERS
L. M. DUMM
DAVID C. KIGHTON
R. CARO T. MCGUIRE
MICHAEL PETRUSKA

SECRETARY
ROBERT S. DREW
GL 7-3495

October 22, 1969

Many jets of water were observed to be issuing from between the joints of the downstream face of the stone masonry overflow section. Due to water flowing over the top of the dam, it was not possible to observe the total amount of seepage from the downstream face or the actual location of the leakage.

The right side abutment looking upstream includes a sluice gate with a rising stem operating mechanism and flume to discharge water at the base of the dam. A large amount of water was observed flowing in the flume near the sluice gate. The sluice gate was probably in a partly opened position to allow for the flow of water through the flume.

The visible portions of the concrete retaining walls are apparently in poor condition. Due to the age of the structure and apparent lack of maintenance work during recent years, it appears that some repairs are required.

In view of the above, it is recommended that the Village Board of Trustees be appraised of the condition of the structure and the responsibilities of the Village in maintaining a safe structure for impounding water. It is recommended that the Village engage the services of a licensed Professional Engineer to thoroughly investigate the conditions of the dam, recommend repairs or reconstruction, as required, and prepare the necessary plans and specifications and application for permit for submission to the Water Resources Commission for approval. ✓

Immediate action should be undertaken to investigate the condition of the operating mechanism of the sluice gate and put it in working order. The sluice gate should then be opened by gradual steps to release water so that the water level in the pond is lowered to a level at least two feet below the elevation of the top of the spillway. Village forces should then be alerted to operate the sluice gate as required to maintain the recommended lower pond level through the winter months.

When the lake level is lowered to eliminate water flowing over the spillway, it will then be possible to inspect the downstream face of the dam and its foundation. We would be glad to accompany your consulting engineer on the inspection.

Village forces should be instructed to periodically remove floating debris that becomes lodged in the spillway which would restrict the passage of water during peak flows and also cause damage to the flashboard system. It is not recommended that any repairs be made at this time to the flashboards until after the re-inspection. Further investigation may indicate that the flashboards will have to be removed to facilitate repairs or reduce the hydrostatic pressure acting on the dam.

Honorable Peter Furnari

- 3 -

October 22, 1969

The Water Resources Commission is designated by statute with the responsibility of review of new and existing dams that come within the provisions of the Law. Permits are required for the construction, repair or reconstruction of dams in accordance with the enclosed copy of Rules and Regulations for issuance of permits. Under Section 429-e, the Commission has broad powers of enforcement of structural modifications that may be required to improve existing dams that are unsafe. Enclosed is an excerpt of that portion of the Law and also appropriate application forms for permit.

We would appreciate being informed of progress by the Village in lowering the water level for re-inspection of the dam. If you have any questions or further information on this matter, please feel free to contact this office.

Very truly yours,

T. P. CURRAN
Central Permit Agent .

Encls.

cc: D. Schoentag
L. Fein
A. Moon
W. McKeon



New York State Department of Environmental Conservation
Albany N Y 1220: Division of Resource Management Services
Bureau of Water Regulation

Henry L. Diamond
Commissioner

December 1, 1972

Honorable Peter C. Funari, Mayor
Village of Wappingers Falls
Wappingers Falls, New York 12590

Dear Mayor Funari:

Department of Transportation
Registered Dam No. 613A
Wappingers Lake

The above dam was brought to my attention. After reviewing the file, I made an inspection on November 27, 1972.

The following comments are based on my review and inspection:

1. The abutment section between the overflow and the wastebay is in serious condition. Comparison of photos taken in April and November reveal an enlargement of the eroded area.
2. You were advised in April to do something as a stopgap measure to prevent further deleterious effect of water to the abutment. This would have helped maintain the structural integrity of the abutment.
3. The water is presently pouring into the abutment between two large stone blocks. If this condition is allowed to continue the anchors for these stones will become loosened and eventually undermined.
4. A failure resulting from the above condition will probably wash out the abutment entirely and do extensive damage to the wastebay, sluice-gate area and penstock.
5. I do not feel that a serious hazard exists downstream because of the type of failure that may occur. The breach will be very slow at first and enlarge over a span of time. I do not believe that a sudden failure with a high energy wave will

- 2 -

occur. The channel of bedrock is well defined and containment of the water can be expected.

6. The penstock is in good shape and it looks as if it is being used. Is this being used to generate power? What is the Village's position relative to owning the penstock and any power-generating capacity?

In summary, the jam is the Village's problem. The danger downstream has been evaluated. Several recommendations have been suggested. The Village in turn must either act or accept the inevitable breach of the abutment.

Very truly yours,



Stanford Zeccolo
Senior Hydraulic Engineer

SZ/gd

cc: LeRoy Fein
F. R. Pagano



DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, N. Y. 10007

REPLY TO
ATTENTION OF:

DAWEN-Cb

11 December 1972

Mr. James J. Lyons
Village Attorney
Village of Wappingers Falls
Robert Park Homestead
Wappingers Falls, New York 12590

Dear Mr. Lyons:

This is in reply to your letter of 6 October 1972 concerning the possibility of a bank erosion project in the Village of Wappingers Falls under authority of Section 14 of the 1946 Flood Control Act.

Members of my staff have conducted several field reconnaissances of the site being considered for bank protection. After a careful analysis of the situation concerning the collapsed and damaged portions of retaining wall, it is the considered opinion of my staff that this work could not be undertaken under the subject authority.

This decision is based on the following pertinent information:

- a. Repair or reconstruction of approximately 50 feet of the collapsed wall and about 30 feet of the wall section presently being supported by a pipe, and required additional items of work such as lands, easements and rights of way, roadway resurfacing material, a cofferdam, excavation and backfill, is estimated to cost in excess of \$50,000, and probably actually closer to \$100,000.
- b. The construction of retaining walls would provide protection against erosion to the left bank of Wappingers Lake. Landward of this bank of Wappingers Lake lies a gravel roadway which extends approximately 60 feet from High Street.
- c. It is considered that the maximum effect of erosive velocities in this area if the retaining wall was not in place would be to erode the unprotected bank to the natural angle of repose or at a slope of 1 foot vertical to 2 feet horizontal. This would represent the loss of a strip of basically undeveloped land estimated at 30 x 80 feet, or about 1/20 acre.

NANEN-Cb

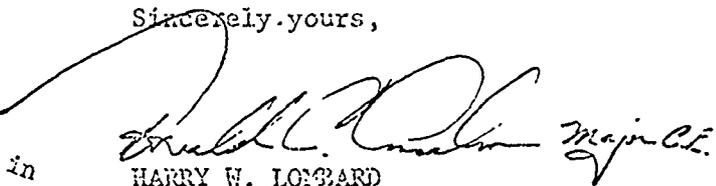
Mr. James J. Lyons

d. It is considered that the benefits attached to the preservation of the portion of gravel road would not justify the reconstruction cost of the retaining walls.

I am forwarding a copy of this letter to the New York State Department of Environmental Conservation for their information.

Sincerely yours,

For and in
the absence of


HARRY W. LOMBARD
Colonel, Corps of Engineers
District Engineer

CF:
Mr. Eldred Rich
New York State Department
of Environmental Conservation
50 Wolf Road
Albany, New York 12201

Mr. Donald Synnett, Mayor

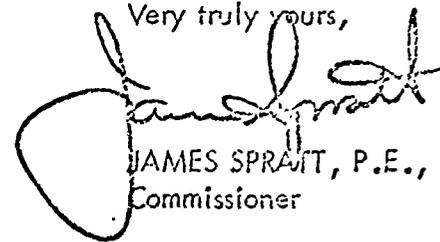
-2-

January 6, 1978

The first solution, of course, depends upon the availability of land, owned by other persons, that encompasses the flume. If this property cannot be attained, then the second alternate would be for the Village to design a proper spillway at either end of the existing dam that would take the water from the lake over a designed spillway so that the impact of the falls vibrating the rocks can be eliminated. With the use of a properly designed spillway, the water can be physically dropped twenty feet without creating the vibrations that are now prevalent.

These comments are, of course, based on a quick field review, however, I believe they are indicative of the conditions and they represent a reasonable solution to the problem. If you have any further need for our help, please so advise, and I will be happy to meet with you.

Very truly yours,



JAMES SPRATT, P.E.,
Commissioner

JS:r

cc: J. DePaola, Director of Civil Defense

cc: E. Schueler, County Executive

cc: R. Steller, Director of Operations

(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

613 A
LH

DAM REPORT

August, 191*5*
(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 *Wappinger Falls* Dam.

This dam is situated upon the *Wappinger Creek* in the Town of *Wappinger and Po Keepsio*, *Dutchess* County, about *0* from the Village ~~WAAA~~ of *Wappinger Falls*.

The distance *down* stream from the dam, to the *N. Van Albany Post Road Bridge* is about *500 Feet*.

The dam is now owned by *Larnut P. Winko + Bleachery* and was built in or about the year *1872*, and was extensively repaired or reconstructed during the year *1910*.

As it now stands, the spillway portion of this dam is built of *timber + Masonry* and the other portions are built of *Masonry and Concrete*.

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*.

The total length of this dam is 216 feet. The spillway or waste-weir portion, is about 171 feet long, and the crest of the spillway is about 5 1/2 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: 4'x4' gate shown in sluice - 9' steel pipe to Mill

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 seems to be strong although of peculiar & partly old construction. Should a washout occur the road bridge below might be carried away and surely great damage to the concern owing the dam owned result as their buildings are directly below. No other damage would be liable to occur.

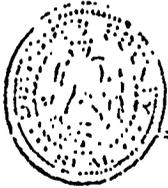
Reported by L. D. Seymour
(Signature)

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

Wolcott N.Y.

(Name of place)

(SEE OTHER SIDE)



County of Dutchess

Poughkeepsie, New York 12601

BOARD OF REPRESENTATIVES

DISTRICT III - Town of Poughkeepsie

JOSEPH V. POILLUCCI

COMMITTEES
 Refuse Disposal
 Water Agency
 Public Works

July 6, 1970

Honorable Emeel S. Betros
 98th District
 Dutchess County
 The Assembly, State of New York
 Albany, New York

Dear Emeel :

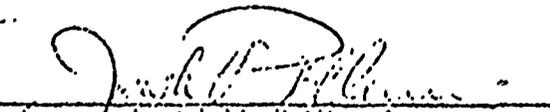
I am writing to confirm our recent conversation concerning Wappingers Lake and to acknowledge receipt of your letter dated June 26, 1970.

As you know, I have been unsuccessful in my attempt to obtain funds for the cleaning and dredging of Wappingers Lake. I am somewhat disappointed, but nevertheless determined to see this project through to a successful conclusion.

Since you made part of the inspection tour around the lake and read my report, you are therefore quite knowledgeable about existing conditions. Realizing the urgency of this matter, I am requesting that you contact Mr. Henry L. Diamond, the new commissioner of the state's Department of Environmental Conservation concerning the prospects of obtaining financial assistance.

Thank you for your interest and I hope to hear favorably from you.

Sincerely,



 Joseph V. Poillucci
 County Representative

JVP:cc



THE ASSEMBLY
STATE OF NEW YORK
ALBANY

EMEEL S. BETROS
98TH DISTRICT
DUTCHESS COUNTY

July 30, 1970

Hon. Henry L. Diamond
Commissioner
New York State Department
of Environmental Conservation
Albany, New York

Dear Commissioner Diamond:

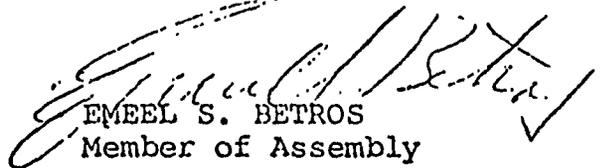
I enclose herewith copy of letter received from Representative Joseph V. Poillucci of our County Board of Representatives and I would ask that you review same and give me your thoughts relative thereto.

The Village of Wappingers Falls would like to do something to clean up Wappingers Lake. It can be made into an extremely desirable and beautiful area, but as usual, one of the stumbling blocks is financing.

Will you also advise whether any State financing may be available.

Thank you for your co-operation.

Cordially yours,


EMEEL S. BETROS
Member of Assembly

ESB:bam

Enclosure

cc: Mr. Joseph V. Poillucci

7 AUG 7C 15: 07

11/15/05

ENGINEERING REPORT
WAPPINGERS LAKE DAM

The Wappingers Lake Dam was originally constructed in 1872. This dam failed and was rebuilt in 1910 by adding a new masonry structure downstream from the original structure. In 1919 the dam was again repaired and raised to its present height.

The dam structure is actually a spillway section 171' in length with a gate structure located at the easterly edge of the dam.

Two gates, 6'-0" x 7'-6", control the water flow to a raceway which feeds water to a 9' pen stock. The water is used to generate power at the Wappingers bleachery.

Throughout the history of the dam considerable trouble has been experienced with vibrations which occur when water goes over the dam during periods of high flow. A vacuum is created between the under side of the water and the dam face. The vibrations are caused by the alternate making and breaking of the vacuum. This is an undesirable condition and could be dangerous. 4-1

The down-stream face of the dam is leaking badly. It appeared that most of the leakage was taking place between the top of the old dam and the addition that was added in 1919. The retaining wall along the east bank shows sign of failure and should be replaced. The wood slide bar on the east gate is broken making this gate inoperable. The raceway wall along the creek is leaking very badly in several places.

The services of the firm of Damos & Moore was engaged by us to render an opinion as to the stability of the dam.

A copy of their report is attached as part of this report. Our firm concurs with the Damos & Moore report in that the existing dam is unsafe and considerable repair work would be required to preserve the water tight integrity of the structure and cause it to be safe from possible future failure.

As the purchase of the dam is being considered by the municipality certain corrective measures should be taken concurrently with its purchase. Namely,

1. A new spillway section should be constructed along the downstream face of the existing dam. This section should have a curved face so that the water spilling over the dam would follow the dam shape. Thus eliminating the vibrations that are now present during periods of high water. In addition this construction would reinforce the existing dam and preserve its water-tight integrity. 4-2

2.

2. The existing gates should be repaired.
3. The retaining wall along the east bank should be replaced.
4. All masonry abutment structures should be repaired.
5. The use of the existing raceway should be eliminated except when it is necessary to drain the lake.

It is our estimate that the cost of the above repairs would be in the neighborhood of \$100,000 to \$150,000. This figure should be substantiated with a more detailed report.

Respectfully submitted,

Milton Chazon, P. E.

DAMES & MOORE
 CONSULTANTS IN APPLIED EARTH SCIENCES
 SOIL MECHANICS • ENGINEERING GEOLOGY • GEOPHYSICS

ATLANTA
 CHICAGO
 HONOLULU
 HOUSTON
 LOS ANGELES
 NEW YORK
 PORTLAND
 SALT LAKE CITY
 SAN FRANCISCO
 SEATTLE

100 CHURCH STREET • NEW YORK 7, NEW YORK • CORTLANDT 7-1810
 PARTNERS: GARDNER M. REYNOLDS • J. FRANK BRENNAN
 ASSOCIATES: ROBERT M. PERRY • JOSEPH A. FISCHER

October 22, 1965

Mr. Milton Chazen
 Nine Cannon Street
 Poughkeepsie, New York

Dear Mr. Chazen:

Report
 Inspection of Masonry Dam
 Wappingers Falls Dam
 New York State Park Commission
 Village of Wappingers Falls
Wappingers Falls, New York

This letter is written to present our conclusions following an inspection on October 16, 1965, by the writer of a dam located in the town of Wappingers Falls, New York, designated as the Wappingers Falls Dam.

It is understood that this dam restrains water in Wappingers Creek, and that the resulting lake is about a mile and one-half long. The original date of construction of the dam is not known to us; however, it is understood that it may be on the order of 50 to 60 years old. It is further understood that sometime subsequent to the original dam construction there was a failure of a portion of the dam and the dam was rebuilt. Following the reconstruction, the resulting dam section was approximately 14 feet in width at the base and 12 feet in width at the crest. The overall total height of the dam is about 16 feet.

The purpose of the inspection of the dam was to develop an opinion regarding the stability of the dam and its condition to stand as a dam in future years.

On the inspection of the dam, the writer was able to observe the downstream face, which is essentially vertical, and to observe the rock on which the base of the dam is founded and the abutments into the ends of the dam, are anchored.

DAMES & MOORE

Mr. Milton Chazen
 October 22, 1965
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The dam is apparently composed of relatively flat slabs of rock joined together by mortar. The rock was not identified; however, based on a general knowledge of the geology of the area, it is presumed that it is of sedimentary origin.

From the inspection, it is believed that there should be no major concern regarding the dam in connection with the foundation support and the stability of the abutments. However, the dam itself was leaking badly at the time of the inspection in a number of places. The water was moving through joints between the masonry and coming out on the downstream side. It is understood that during periods of high water when there is three to four feet of water flowing over the dam above the crest of the dam that vibrations are set up in the rock which are transmitted several hundred feet from the dam and can be felt in homes and other structures located nearby.

It is our conclusion, from the information available to us, that the condition of the dam, from an overall standpoint, is unsafe. The fact that there is appreciable leakage through the dam section would indicate that this condition might deteriorate with a resulting increase in flow of water to a sufficient extent wherein there would be a complete failure of a section of the dam.

The vibrations that are felt in adjacent areas when high water is flowing over the dam are probably due to the impact of the water on the underlying rock as it drops from the crest of the rock surface. This could be overcome by constructing an ogee section on the downstream face of the dam to eliminate the impact forces as the water strikes the stream bed on the downstream side.

In conclusion, it is our opinion that the dam cannot be relied upon to function satisfactorily in the future for any determinable period of time. It is believed that there may be substantial liability to the dam owners because of the possible damages to facilities existing downstream from the dam if the dam fails.

The dam, in our opinion, should be replaced with a modern structure in which modern design techniques and knowledge are incorporated.

Yours very truly,

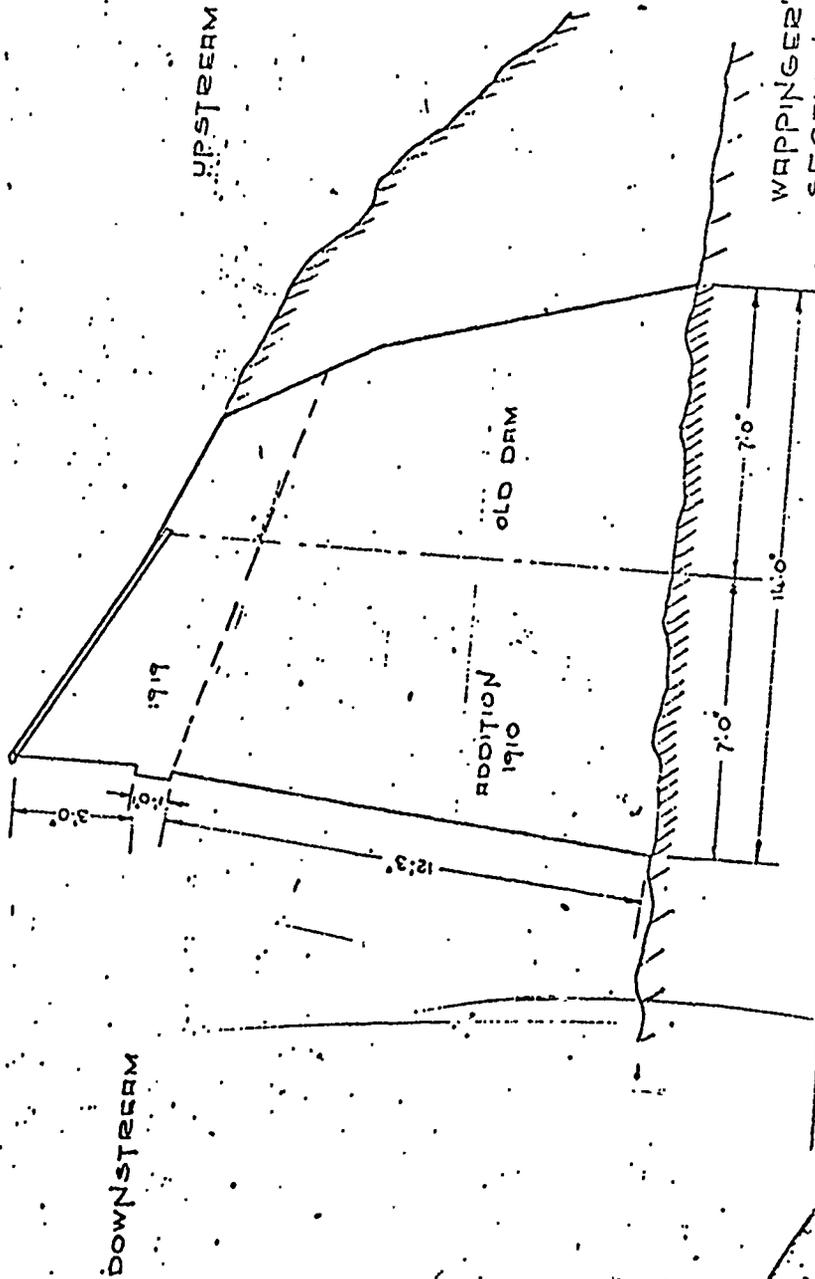
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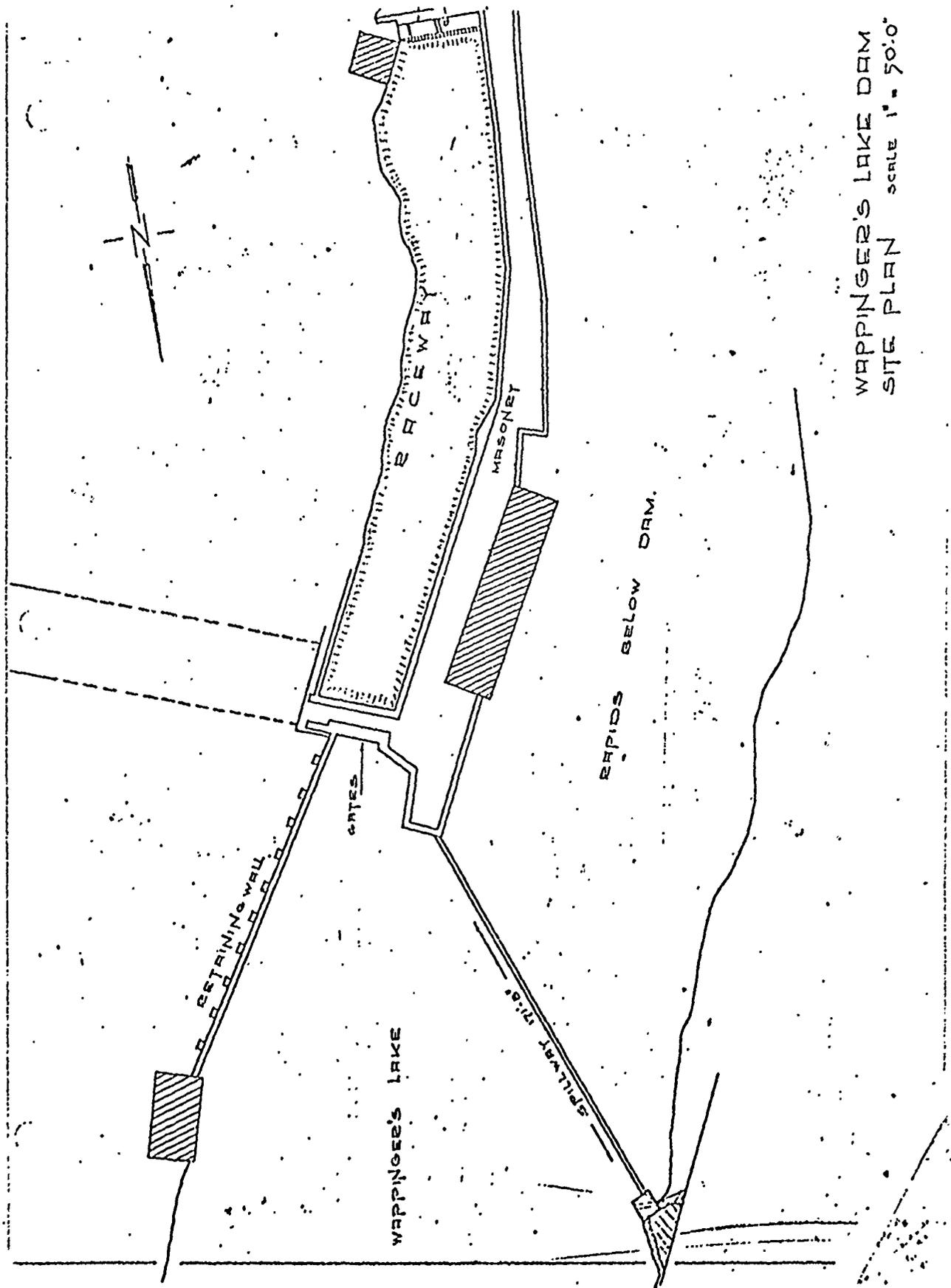
GMR NC

(3 copies submitted)

TYPICAL DAM SECTION
SCALE 1" = 40' 0"



WAPPINGER'S LAKE DAM
SECTION
SCALE 1" = 40' 0"



WAPPINGER'S LAKE DAM
SITE PLAN SCALE 1" = 50' 0"