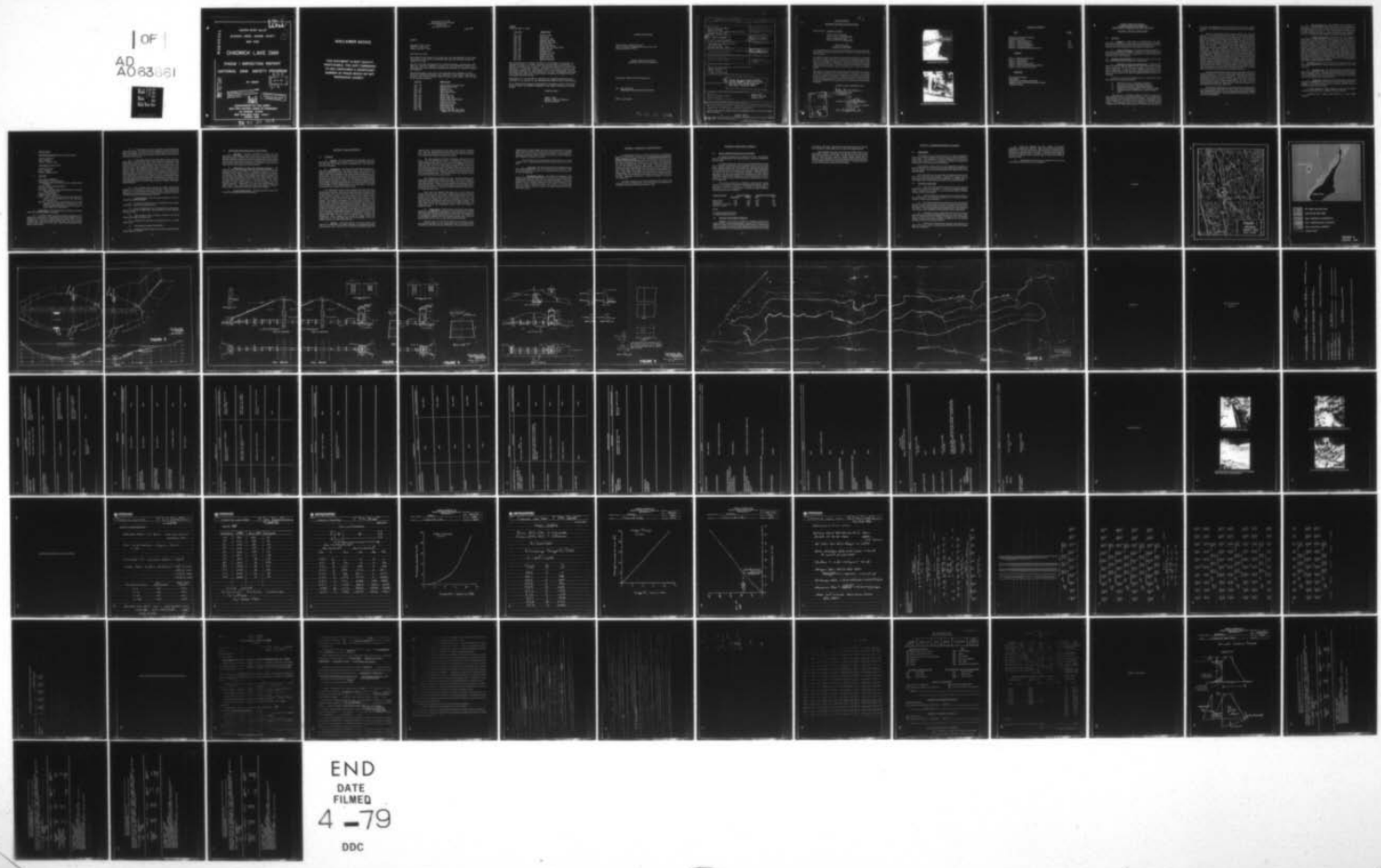
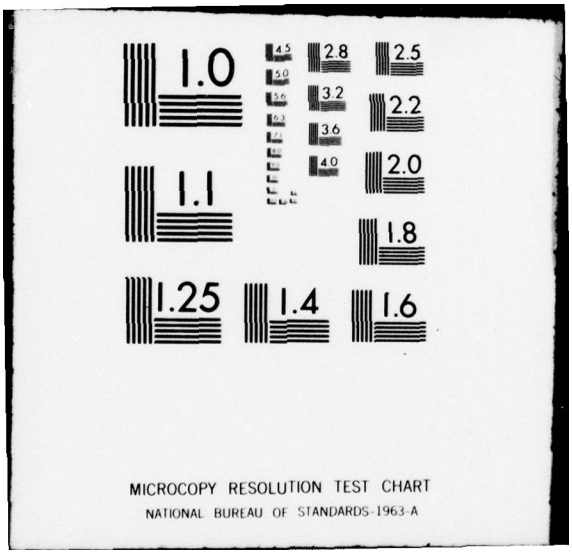
AD-A063 861 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. CHADWICK LAKE DAM (NY00509), HUDSO--ETC(U)
SEP 78 J J WILLIAMS DACW51-78-C-0035
UNCLASSIFIED NL



END
DATE FILMED
4 -79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL II

(4)

HUDSON RIVER VALLEY

QUASSAIK CREEK, ORANGE COUNTY

NEW YORK

CHADWICK LAKE DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NY 00509

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

AUGUST 1978

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, NEW YORK
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10007

2 OCT 1978

NANEN-F

Honorable Hugh L. Carey
Governor of New York
Albany, New York 12224

Dear Governor Carey:

The purpose of this letter is to inform you of a clarification of the guidelines used by this office in assessing dams under the National Program of Inspection of Dams.

Office of the Chief of Engineers has recently provided a clarification that dams with seriously inadequate spillways are to be assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The following dams in your state have previously been assessed as having seriously inadequate spillways, with capability to pass safely only the percentage of the probable maximum flood as noted in each report. They are now to be assessed as unsafe:

I.D. NO.	NAME OF DAM
N.Y. 59	Lower Warwick Reservoir Dam
N.Y. 4	Salisbury Mills Dam
N.Y. 45	Amawalk Dam
N.Y. 418	Jamesville Dam
N.Y. 685	Colliersville Dam
N.Y. 6	Delta Dam
N.Y. 421	Oneida City Dam
N.Y. 39	Croton Falls Dam
N.Y. 509	Chadwick Dam (Plattenkill)
N.Y. 66	Boyds Corner Dam
N.Y. 397	Cranberry Lake Dam
N.Y. 708	Seneca Falls Dam
N.Y. 332	Lake Sebago Dam
N.Y. 338	Indian Brook Dam
N.Y. 33	Lower(S) Wicopee Dam (Lower Hudson W.S. for Peekskill)

NANEN-F
Honorable Hugh L. Carey

I.D. NO.	NAME OF DAM
N.Y. 49	Pocantico Dam
N.Y. 445	Attica Dam
N.Y. 658	Cork Center Dam
N.Y. 153	Jackson Creek Dam
N.Y. 172	Lake Algonquin Dam
N.Y. 318	Sixth Lake Dam
N.Y. 13	Butlet Storage Dam
N.Y. 90	Putnam Lake (Bog Brook Dam)
N.Y. 166	Pecks Lake Dam
N.Y. 674	Bradford Dam
N.Y. 75	Sturgeon Pool Dam
N.Y. 414	Skaneateles Dam
N.Y. 155	Indian Lake Dam
N.Y. 472	Newton Falls Dam
N.Y. 362	Buckhorn Lake Dam

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.

Consequently, it is advisable to implement the recommendations previously furnished in the reports for the above-mentioned dams as soon as practicable.

It is requested that owners of these dams be furnished a copy of this letter and that copies be permanently appended to all reports previously furnished to you.

Sincerely yours,

CLARK H. BENN
Colonel, Corps of Engineers
District Engineer

HUDSON RIVER BASIN

Name of Dam: Chadwick Lake Dam
County and State: Orange County, State of New York
Inventory Number: NY 509

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared by: O'Brien and Gere Engineers, Inc.

For: New York State
Department of Environmental Conservation

Date: July 26, 1978

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Phase I Inspection Report
Chadwick Lake Dam
Hudson River Basin, Orange County, New York
Inventory No. N.Y. 509

5. TYPE OF REPORT & PERIOD COVERED
Phase I Inspection Report
National Dam Safety Program

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
(10) John J. Williams ~~P.E.~~

8. CONTRACT OR GRANT NUMBER(s)
(15) DACW51-78-C-0035

9. PERFORMING ORGANIZATION NAME AND ADDRESS
O'Brien and Gere Engineers, Inc.
1301 Buckley Road
Syracuse, New York 13221

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
New York State Department of Environmental Conservation / 50 Wolf Road
Albany, New York 12233

12. REPORT DATE
(11) 21 Sep~~tember~~ 1978

13. NUMBER OF PAGES

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
Department of the Army
26 Federal Plaza / New York District, CofE
New York, New York 10007

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

(12) 83 p.

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

(6) **National Dam Safety Program. Chadwick Lake Dam (NY~~0~~5~~0~~9), Hudson River Valley, Quassaick Creek, Orange County, New York. Phase I Inspection Report.**

18. SUPPLEMENTARY NOTES

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
Orange County
Chadwick Lake Dam
Quassaik 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.

Chadwick Lake Dam was judged unsafe, non-emergency due to a seriously inadequate spillway.

393 970

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

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Chadwick Lake Dam

State Located: New York
County Located: Orange County
Stream: Quassaick Creek
Date of Inspection: June 26, 1978

ASSESSMENT OF GENERAL CONDITIONS

A considerable portion of the earth embankment of the Chadwick Lake Dam (formerly known as Plattekill Dam) is heavily overgrown with trees and underbrush.

The spillway section was analyzed for stability and found to be unstable for the ice loading condition. In addition, the foundation reaction was found to be outside of the middle third for the reservoir elevation at the top of the embankment. The spillway should be strengthened to provide adequate factors of safety. Inspection of the concrete spillway structure revealed serious spalling, some undermining and a need for surface repair.

The spillway was found to be capable of passing only 36 per cent of the PMF before overtopping of the embankment. Therefore, the spillway should be considered seriously inadequate as described in Engineering Technical Letter no. 1110-2-234. Around the clock surveillance should be provided during periods of unusually heavy rainfall. A warning system should be established for the protection of downstream residents and businesses.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams, P.E.
Vice President

Approved by: Clark H. Benn
Clark H. Benn
Colonel, Corps of Engineers
District Engineer

Date: 21 September 78

UPSTREAM VIEW OF DAM

DOWNSTREAM SLOPE OF EMBANKMENT

TABLE OF CONTENTS

TEXT	PAGE
Assessment of General Conditions	
Overall View of Dam	
Section 1 - Project Information	1-6
Section 2 - Visual Inspection	7-9
Section 3 - Hydraulic/Hydrologic	10
Section 4 - Structural Stability	11-12
Section 5 - Assessment/Remedial Measures	13-14

FIGURES

Figure 1 - Regional Vicinity Map
Figure 2 - Geologic Map
Figure 3 - General Plan
Figure 4 - Details of Outlet Pipe
Figure 5 - Plans and Sections Discharge Pipe
Figure 6 - Flow Line and Land Map

APPENDIX

Field Inspection Report
Photographs
Hydraulic and Hydrologic Calculations
Application Data and Previous Inspection Report
Stability Analyses

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM CHADWICK LAKE DAM ID# NY 509

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority - This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract #1467.021 between O'Brien and Gere Engineers, Inc., and the New York State Department of Environmental Conservation.

b. Purpose of Inspection - The purpose of this inspection is to evaluate the structural and hydraulic conditions of Chadwick Lake Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 PROJECT DESCRIPTION (From drawings on file with the New York State Department of Environmental Conservation).

a. Description of Dam and Appurtenances - Chadwick Lake Dam and Chadwick Lake are located in the Town of Newburgh in Orange County, about four and one half miles northwest of the center of the City of Newburgh. In the year 1926, Chadwick Lake Dam (formerly known as Plattekill Dam) was constructed across Quassaick Creek, which drains into the Hudson River along the southern boundary of the City of Newburgh.

The dam is an earth fill embankment with a concrete core wall and consists of the following materials:

1. Upstream earth fill - materials not indicated
2. Core wall - concrete, no reinforcing indicated
3. Downstream earth fill - materials not indicated
4. Upstream face of embankment - Rock paving, 12" thick
5. Downstream face of embankment - Top soil facing, 12" thick.

The dam has a maximum height of about 37 feet and is approximately 570 feet long including the spillway. The top width of the dam is 20 feet wide and consists of an earth surface. The upstream slope is 2½ horizontal to 1 vertical and has a rock-paved face (riprap set in place). The downstream slope is 2 horizontal to 1 vertical covered originally with a 12" deep layer of topsoil. The topsoil layer extends over

the top of the embankment to the upstream rock paved surface. Refer to Figure 5 for details showing the transverse section of the embankment.

There are two separate outlet works to release water from the reservoir. One, located along the upstream toe of the embankment approximately at the center of the dam, consists of a 36-inch cast iron pipe and a concrete inlet structure, with trash rack. The pipe has a series of 8 concrete cut-off walls, located along the pipe at the pipe joints. Flow is controlled by means of a 36" gate valve located at the outlet end of the pipe. The gate valve and its gear reduction handwheel operator is located in a concrete and brick gatehouse near the downstream toe of the embankment. Figure 5 shows the details of this outlet pipe. The other outlet works is located alongside the left abutment of the spillway and consists of two 30-inch cast iron pipes and a concrete inlet structure, with trash rack, set in the upstream slope of the embankment. The pipes have a series of 3 concrete cut-off walls and outlet into a concrete slope protection structure. The concrete slope protection structure slopes downward with a drop of 3 feet in a length of 18 feet. Flow is controlled by means of two 30-inch gate valves, located with their geared handwheel operators in a concrete and brick gatehouse. Figure 6 shows the details of this outlet works. The elevations of the two different outlet works are such that the 36-inch pipe may be used to drain the reservoir, and the two 30-inch pipes may be used to release water from about ten feet below the normal pool elevation.

The dam and appurtenant structures were originally built for the Newburgh Bleachery to insure a steady water supply for the Bleachery located downstream in the City of Newburgh. The Bleachery has been discontinued and the dam and reservoir are owned by the City of Newburgh and used as a source for water supply. The water filtration plant is located a short distance downstream of the dam. The area surrounding the reservoir is also used for recreational purposes and is maintained by the city water department.

Neither the "Application for the Construction or Reconstruction of a Dam" originally filed with the State of New York, Department of State Engineer and Surveyor nor the existing plans indicate who designed the dam and appurtenances. Details concerning the construction history were not made available.

b. Size Classification - The Chadwick Lake reservoir was designed for a storage volume of 800 million gallons (2,450 acre-feet) at the spillway crest elevation of 450 feet mean sea level (MSL). The maximum height of the dam is 37 feet. Since the normal storage volume is 2,450 acre-feet, the dam is in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

c. Hazard Classification Chadwick Lake Dam creates an impoundment of 2,450 acre-feet. Failure of this dam would release a flood wave of extreme magnitude. The immediate effect would be to seriously damage or destroy the water filtration plant of the City of Newburgh, shutting off its source of potable water. The flood wave would then continue downstream causing serious damage to homes, highways, utilities and businesses. The valley of Quassaick Creek is lightly populated immediately downstream of the dam, and the community of Gardnertown is located about $1\frac{1}{2}$ miles downstream. From that point, an additional 2 to $2\frac{1}{2}$ miles downstream to Glenwood Park and the City of Newburgh, the housing density increases significantly and the potential loss of life can be considered high. Therefore, the Chadwick Lake Dam is in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.3 PERTINENT DATA (From information furnished by the New York State Department of Environmental Conservation and the visual inspection)

a. Drainage Area - The drainage area of Chadwick Lake is about 13.5 square miles. This has been confirmed from use of United States Geological Survey quadrangle sheets (7.5 minute) for Newburgh, N.Y. and Clintondale, N.Y. The surface area of the lake is 0.41 square miles at the spillway crest (elevation 450.0).

b. Discharges - Discharge from the lake can be accomplished through the operation of one 36" gate valve and two 30" gate valves. In addition a new intake structure with a pumped discharge has been installed to supply the filter plant.

A small discharge is being released to augment the spillway overflow and maintain flow in Quassaick Creek downstream.

Chadwick Lake is being used primarily as a water supply reservoir.

c. Reservoir Data

Normal Operating Pool (Spillway Elevation 450.0)

Length - 8,500 feet
Area - 260 acres
Volume - 2,450 acre-feet

Top of Dam (Elevation 455.0)

Length - 8,700 feet
Area - 278 acres
Volume - 3,840 acre-feet

d. Dam Data

Type - earth embankment
Top Elevation - 455.0 feet (MSL)
Streambed elevation at centerline of dam - Approximately 418 feet
Length - 570 feet, including spillway
Top width - 20 feet
Side slopes - upstream slope 2½:1 (horizontal to vertical); downstream slope 2:1
Zoning - none indicated
Impervious Core - concrete
Cutoff - plans indicate a concrete core wall carried to rock or a firm foundation about 7 to 8 feet below the reservoir bed
Spillway - concrete, gravity cross-section, with concrete abutment wing walls, built on ledge rock. The plans and visual inspection are not in agreement as to the shape of the cross-section

e. Outlet Works - The outlet works now installed at the dam consist of three main elements as follows:

1) Two 30-inch cast iron pipes are located alongside the left abutment of the spillway. These pipes are set at an elevation so as to release water from a level 10 feet below the spillway crest. Flow is controlled by a 30-inch manually operated gate valve on each pipe located at the outlet end of the pipe. Under normal conditions these pipes are seldom used.

2) A 36-inch cast iron pipe is located at approximately the center of the dam. This pipe is set at an elevation with its invert 30 feet below the spillway crest level and was originally used to drain the lake. Flow is controlled by a 36-inch manually operated gate valve located at the outlet end of the pipe.

3) A new intake structure has been added to obtain water for water supply to the filtration plant. This consists of a cylindrical metal intake tower mounted on the inlet structure for the 36-inch pipe. This structure supports a low head propellor type pump which delivers water over the top of dam, through a 12-inch pipe, to the supply pipe to the filtration plant. This enables the plant operator to draw water from the lake at a higher level than the 36-inch pipe in order to provide a better quality of water. The pump is driven by a 10 horsepower motor; the 12-inch discharge pipe lies on the downstream surface of the embankment. At its lower end, near the toe of slope, this pipe is interconnected with the 36-inch cast iron pipe through a 20-inch connection and there is a 24-inch pipe supplying the filtration plant. The 36-inch pipe is capped with a blind flange and there is a 12-inch blow-off pipe for releases to Quassaick Creek if desired.

4) Two "octupus" type aerators have been installed just upstream of the upstream toe of the embankment to improve the oxygen content of the water being drawn from the lake. These aerators are supplied by a 2-inch pipe from a 15-horsepower air compressor located on the lake shore near the left abutment of the dam.

f. Engineering Data - The information available for review of Chadwick Lake Dam included:

1) A set of four drawings for the Plattekill Dam (now known as Chadwick Lake Dam) and appurtenances.

2) Copy of "Application for the Construction or Reconstruction of a Dam" for Plattekill Dam, filed December 23, 1925, approved February 1, 1926

3) Copy of Parts 1 and 2, Inventory of Dams in the United States, giving data on Plattekill Dam.

4) Rainfall Data filed with the application, 2), for the years 1900 to 1918.

5) Dam Inspection Report, dated 9/18/74

6) Testing Laboratory Report for sand and cement briquettes, dated December 23, 1926.

1.4 OPERATING AND MAINTENANCE PROCEDURES

a. Operation - Normal withdrawal of water from the reservoir for water supply purposes is by means of the intake structure described in item e. 3). above. The reservoir may be drained part way (to elevation 439.0) by means of the two 30-inch outlet pipes. The use of the 36-inch outlet pipe to drain the reservoir completely (to elevation 420.0) would require removal of the 36-inch blind flange at the pipe outlet to make use of the full capacity of the 36-inch pipe.

b. Maintenance of Dam and Operating Facilities - The growth of large trees and dense underbrush on the earth embankment are indications of poor maintenance. The spillway structure is in need of extensive surface repair to correct spalling and undermining damage. The spillway inlet channel needs dredging and clearing to provide free flow of water to the spillway. The spillway outlet channel needs clearing of trees, brush and debris to provide a free flow outlet channel. All of the above should be carried out on a continuing basis. The intake structure for water supply appears to be well maintained and is in constant operation. According to the water plant superintendent, the outlet valves on the 36-inch and two 30-inch drain pipes are operated twice a year to insure their operating condition when needed.

c. Flood Warning System - Operating personnel stated that no flood warning system has been established.

SECTION 2 - VISUAL INSPECTION

2.1 FINDINGS

a. General - The field inspection of Chadwick Lake Dam took place on June 26, 1978. The lake water surface elevation was about 451 feet Mean Sea Level during the inspection visit. No underwater areas were inspected.

b. Embankment - The riprap on the upstream face appears to have been hand placed, but is not grouted in place. The top surface is a lightly macadamized surface with loosely placed large stones. The upstream face has considerable small brush and grass growing at the top of the slope. From the size of the trees their root systems should be extensive. Several trees had been cut off near their base, leaving a short stump and the root system in place. At one location a tree had broken off and fallen, creating some problems. The earth fill displaced by the root movement has been replaced by about 3 feet of stone fill, according to Mr. Haffen, the Plant Superintendent of the Filter Plant. New riprap has been placed to reinforce the existing riprap.

The downstream face is well covered with brush and trees, virtually a wooded area. There are no significant signs of seepage on the upper portion. There is some surface wetness near the toe, which could be from surface run-off. In an area near the left abutment of the spillway there is an exposed rock face just below the toe. This rock face has a depth of about 12 feet and drops down to the spillway outlet channel. The exposed rock appears to be a hard shale formation. The spillway outlet channel runs parallel to the downstream toe in this area, and is strewn with many large boulders and debris. Since the outlet channel runs parallel to the toe and water from the spillway flows in random directions among the boulders, it is difficult to check for seepage at the toe. At the main outlet valve house there is an open 8-inch pipe flowing partially full (estimated at about $\frac{1}{2}$ cubic feet per second). This flow is dispersed among the boulders and underbrush along the toe. Immediately below the toe at the left abutment is a marshy area. Whether the water creating this is caused by seepage through the embankment or from side slope sources is not discernable. There is no visible evidence of erosion of the earth fill.

c. Spillway - The plans indicate a concrete gravity type spillway, 175 feet long, with vertical upstream face, sloping downstream face, an ogee crest, and earth fill to elevation 448.0 (MSL) against the

upstream face. The concrete is shown about 2 feet into the underlying rock. Near the right abutment the gravity section becomes a concrete sill, 4 feet wide and about 3 feet deep into the rock. The entire spillway is set between two concrete abutment wing walls.

The visual inspection showed considerable variation from the plans. The left abutment wing wall is in satisfactory condition with minor spalling of the concrete. The crest of the spillway is flat with a length of about 30 feet set 1 foot lower than the remainder of the crest. The lower part has 1 foot high stoplogs installed to the level of the remainder of the spillway, and the remainder of the spillway crest has 2 rows of sandbags along its entire length. This effects an increase in the lake level of about 1 foot. During the inspection, water was spilling only over the stop logged crest. The upstream face of the spillway is silted almost up to the top of the concrete crest.

The downstream sloping face of the concrete spillway shows considerable spalling with exposed aggregate. The concrete appears to have been poured directly on the rock surface and there is moderate undermining evident. There is a large gouge running lengthwise about 3 feet below the crest, with the concrete being in better condition above the gouge than below it. It appears as though repairs have been made to the original spillway crest.

Flow from the spillway discharges into a wide ledge rock channel; a portion of the rock surface is concreted to provide a smoother surface and to close the rock seams. Numerous trees and brush are now growing in this channel and are rooted in the seams of the rock. The channel drops off rapidly and in parts very abruptly into an area filled with loose rock and boulders, which serves as an energy dissipator. The entire outlet channel turns to the left and runs roughly parallel to the downstream toe of the embankment until it joins the channel of Quassaick Creek.

d. Outlet Works - Flow from the two 30-inch outlet pipes, adjacent to the spillway, is discharged into the spillway outlet channel. The 30-inch gate valves are contained in a brick and concrete gatehouse built integrally to the spillway left abutment wing wall. The gatehouse is in satisfactory condition. The two manually operated gate valves are operated about twice a year to insure their operating condition.

The gate valve for the 36-inch outlet pipe is located in a brick and concrete gatehouse at the downstream toe of the embankment. According to the water plant superintendent, this pipe is seldom used to

release water for water supply because of the poor quality of the water drawn from the bottom of the lake. The 30-inch gate valve is operated about twice a year to insure its operating condition. The full capacity of this pipe could not be used to drain the lake without first removing the blind flange now in place on its outlet.

The new intake tower and discharge pump installation is in good condition and is operating satisfactorily to provide water to the filter plant.

e. Lake Area - The natural valley walls surrounding the lake have moderate slopes and are well covered with trees and brush. Some of the surrounding area is used as a recreational area under control of the City of Newburgh.

f. Downstream Channel - The channel of Quassaick Creek follows an irregular path downstream of Chadwick Lake, passing through Gardnertown, Glenwood Park and four small lakes before joining the Hudson River at the south boundary of the City of Newburgh. The water filtration plant is located immediately downstream of Chadwick Lake Dam at a bend in Quassaick Creek and is located at a potentially vulnerable location, since it presents a probable constriction to flood flows in the creek.

SECTION 3 - HYDROLOGY AND HYDRAULICS

The design flood used for Chadwick Lake Dam is the Probable Maximum Flood (PMF) according to the Recommended Guidelines for Safety Inspection of Dams. The PMF was calculated from the 6 hour Probable Maximum Precipitation, using a loss rate of .1 inches per hour. The flood hydrograph was developed from the Snyder unit hydrograph using average coefficients. Flood routing was performed assuming the two 30 inch diameter discharge pipes closed. The peak inflow and outflow rates were calculated as 15,500 cfs and 15,100 cfs respectively. The outflow peak would overtop the embankment by approximately 2.6 feet. Peak inflow and outflow rates for one-half of the PMF were calculated as 7,750 cfs and 7,150 cfs respectively. The spillway capacity of about 4,800 cfs corresponds to the outflow related to 36 per cent of the PMF. Therefore, the spillway is seriously inadequate, as cited by ETL 1110-2-234.

Drawdown analysis was performed assuming inflow equals 2 cfs per square mile of drainage area. The time required to drawdown the reservoir to elevation 439 is approximately 17 days.

SECTION 4 - STRUCTURAL STABILITY

4.1 VISUAL OBSERVATIONS AND DATA REVIEWS

No design calculations were available for review. The composition and characteristics of the material used in the earth embankment are not known.

A stability analysis was made for the concrete spillway structure at its maximum cross-section, using dimensions as given in the existing plans, modified based on the visual inspection. Factual data pertaining to foundation conditions are not available. The rolled earth embankment on the upstream face of the spillway was assumed to reduce the uplift at the heel to 50 per cent of headwater pressure. Therefore, design assumptions concerning foundation rock characteristics were based on information obtained from "Application for the Construction or Reconstruction of a Dam" data and field observations made during the course of the inspection.

This stability analysis (see Appendix) indicates the spillway structure to be stable for normal pool and earthquake loadings. Tension was found to develop in the heel of the spillway for the condition of headwater at the top of embankment. For the ice loading condition, overturning instability is indicated.

Loading Condition	Factors of Safety		Foundation Pressures (psi)	
	Overturning	Sliding[1]	Heel	Toe[2]
Normal Pool	2.35	14.1	10.2	3.8
Earthquake	2.22	13.2	11.0	3.0
Reservoir @ Top of Dam	1.28	10.2	14.6	-3.8
Ice Load (5 kips)	.97	7.8	29.2	-15.1

Notes:

1) Sliding includes 50 psi shear
2) Negative indicates tension

4.2 GEOLOGY AND SEISMIC STABILITY

Chadwick Lake Dam is located on Quassaick Creek in the Hudson-Mohawk Lowlands physiographic province, a lowland underlain by Ordovician shales and containing gently rounded hills in a broad valley. The dam and reservoir rests on gently dipping black shales of the Trenton group, described in the geologic map of New York (Lower Hudson Sheet)

as the Snake Hill Shale. Shale bedrock forms the foundation of the dam and, according to design data, lies a few feet below ground surface.

The immediate area does not contain any notable faults or rock weaknesses; however, the Ramapo fault extends into the area several miles to the southeast of the dam. Recent recorded seismic activity along the fault has been noted; this seismic activity should pose no problems to the stability of the dam as located within Seismic Risk Zone 1 of the Seismic Zone Map of Contiguous States. It appears that static stability calculations are satisfactory for design.

SECTION 5 - ASSESSMENT/REMEDIAL MEASURES

5.1 ASSESSMENT

The riprap on the upstream slope of the earth embankment appears to have been adequate to provide protection against erosion and wave action. The appurtenant structures associated with the various outlet works appear to be in satisfactory condition and should not adversely affect the safety of the embankment.

The presence of large trees on the embankment represents a potential hazard: the trees could be uprooted during severe storms, and the root systems may provide seepage paths that could lead to future piping problems.

The outlet pipes are not provided with upstream flow control. The pipes are always under pressure. Uncontrolled leakage from the pipes could cause piping through the embankment. In addition, there is no available means of providing maintenance on the existing controls.

5.2 REMEDIAL MEASURES

1) All trees on the embankment should be cut off as near the embankment surface as practicable. A further investigation should be made to determine the extent of the root systems before remedial measures can be recommended.

2) All brush should be removed from the downstream slope of the embankment so that periodic inspections can be made to detect seepage or monitor the embankment.

3) The spillway should be strengthened to provide adequate factors of safety for all loading conditions. The downstream face of the spillway structure should be given a concrete coating to seal and repair the surface. This coating should also be placed so as to seal the base of the structure to the underlying rock and prevent further undermining.

4) The spillway outlet channel should be cleared of all trees, brush and debris to provide unimpeded flow over the rock channel. Open seams in the rock bed of the channel immediately below the spillway should be sealed with grout or gunite to minimize ice and freezing damage, and prevent further plant growth.

5) Silt should be removed from upstream of the spillway to a depth of 3 feet or more to discourage plant growth which will impede flow over the spillway.

6) Since the spillway has been classed as seriously inadequate, arrangements should be made to provide around-the-clock surveillance of the dam and spillway during periods of unusually heavy rainfall in the drainage basin of the lake. A warning system should be established to provide warning to residents and businesses downstream of the dam in sufficient time to prevent loss of life and to minimize property damage.

7) Consideration should be given to upstream control for the outlet pipes for safety and ease of maintenance.

FIGURES

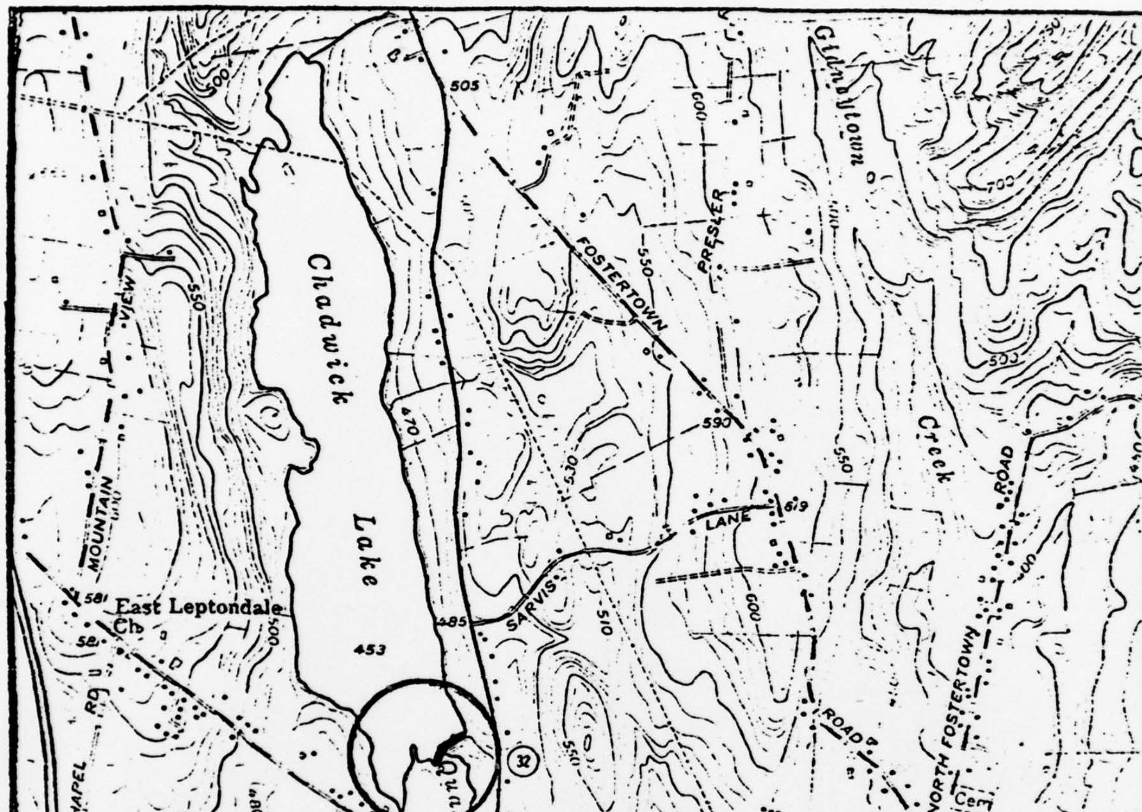
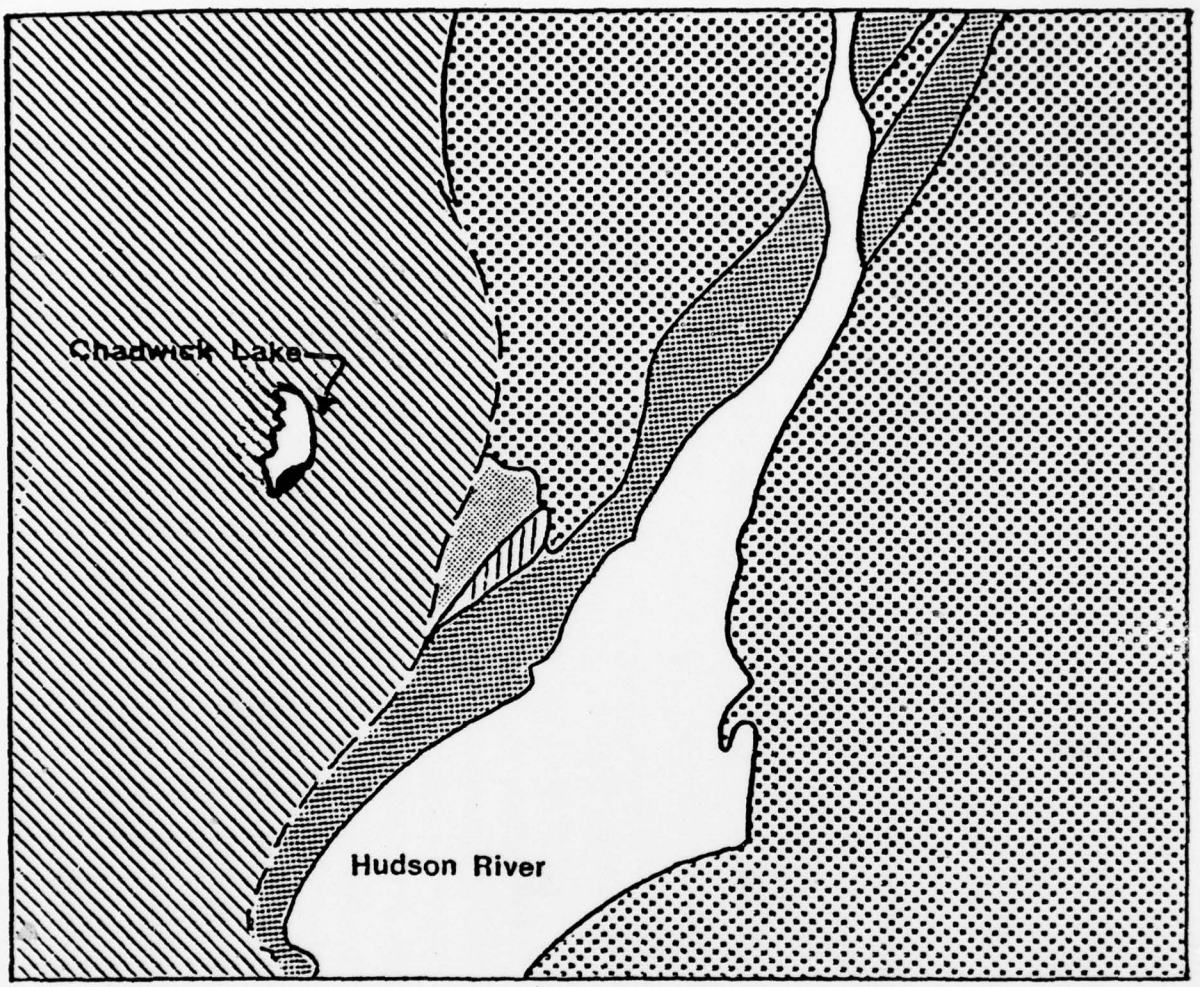


FIGURE I
REGIONAL
VICINITY MAP
SCALE 1:24000
N



On- black and grey shale

Osh-Stoney Point Shale

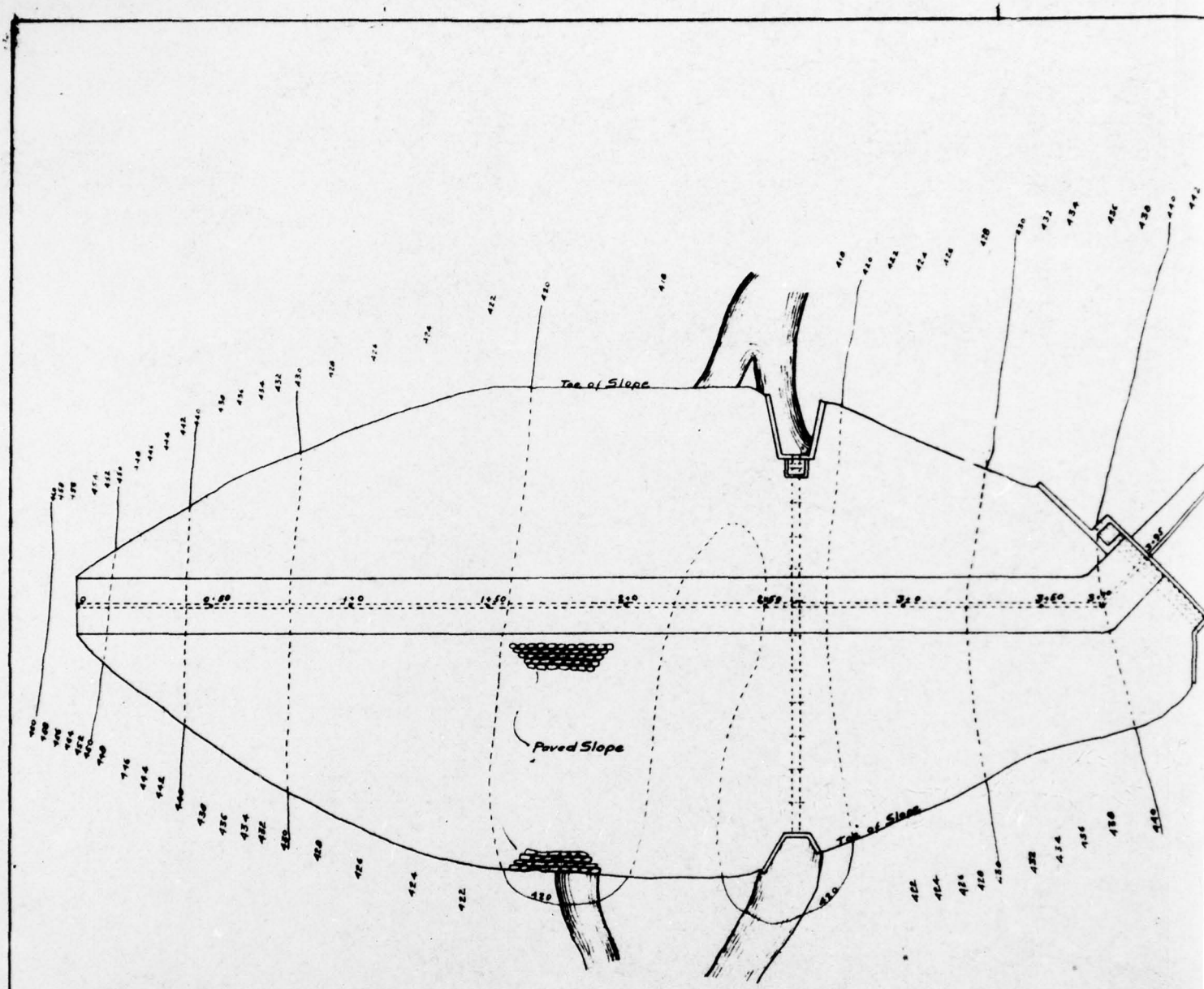
Cpg - Poughquag orthoquartzite

OCs - undifferentiated carbonates

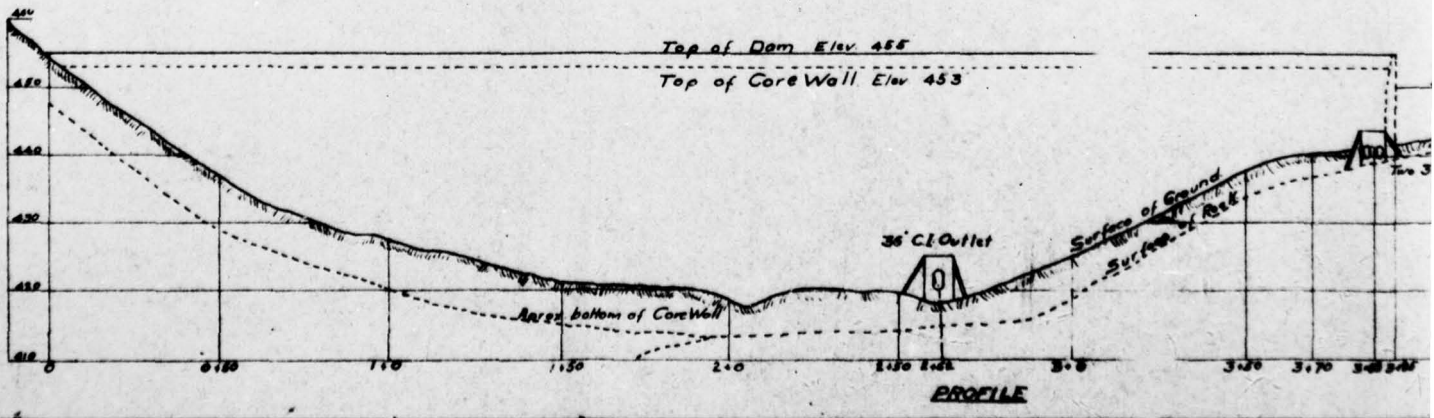
qtcs - non-rusty paragneiss

Raritan Fault

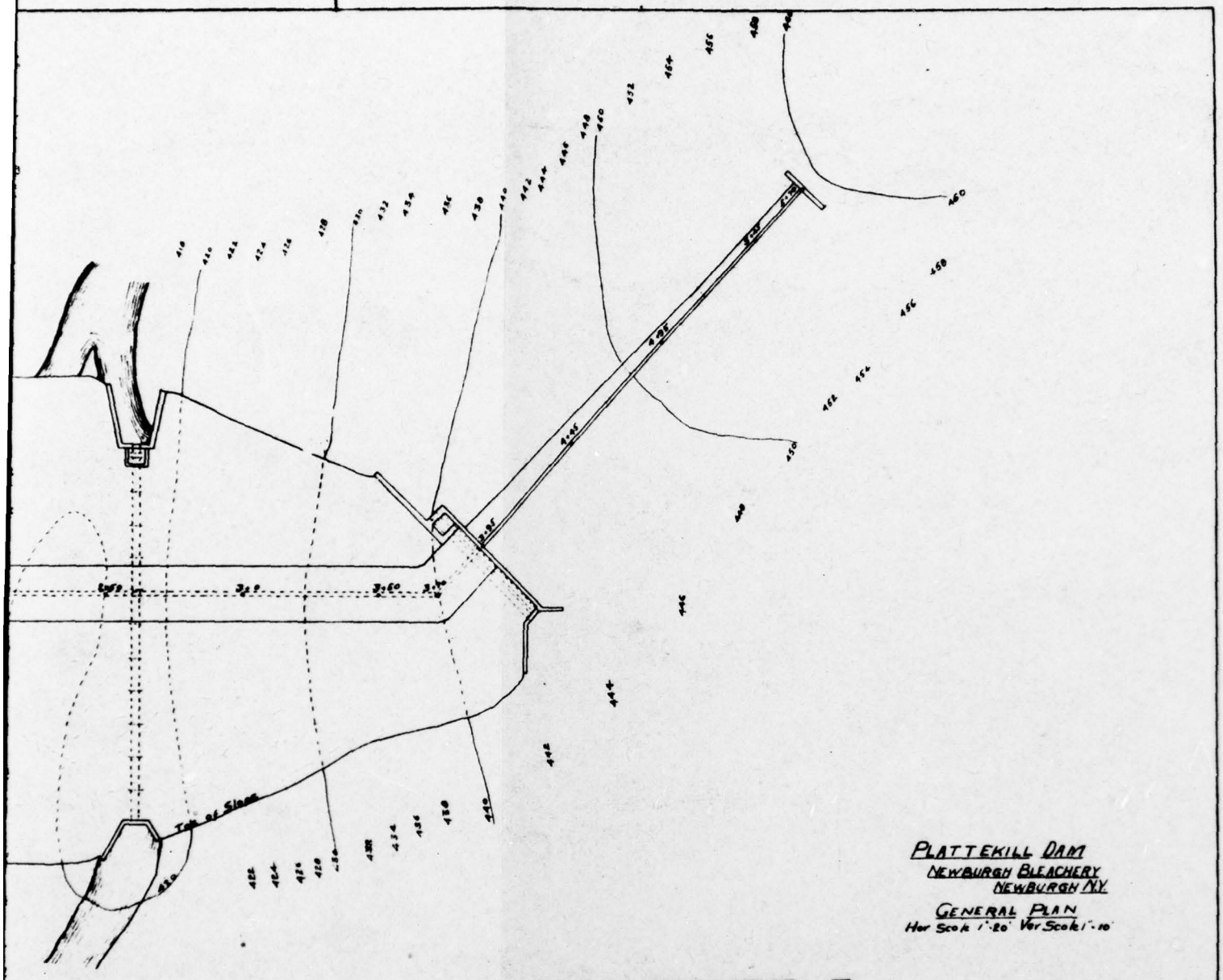
FIGURE 2
GEOLOGIC MAP



PLAN



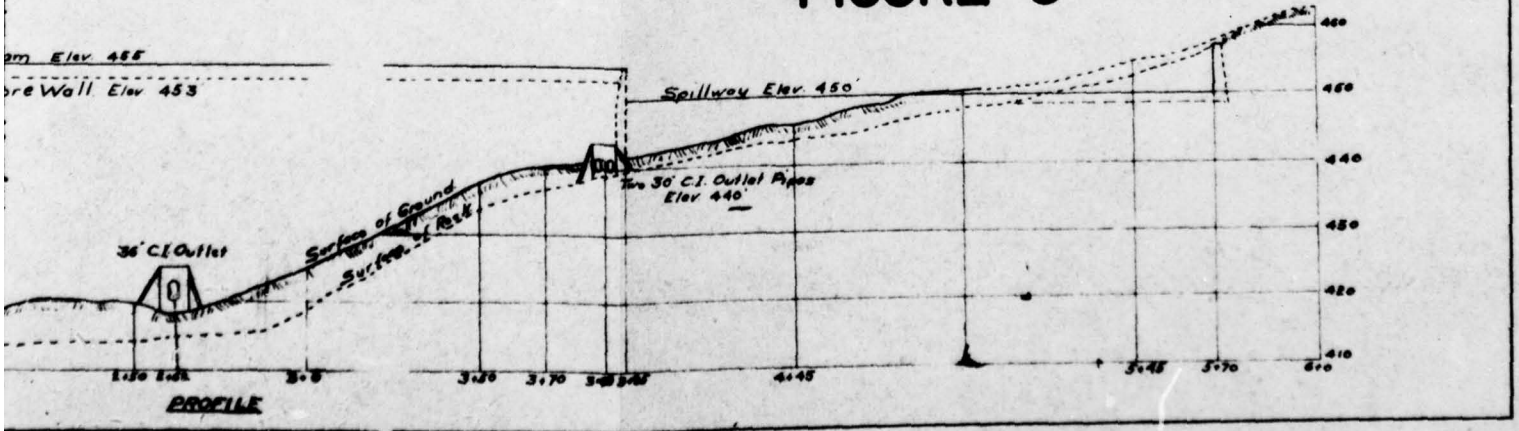
PROFILE

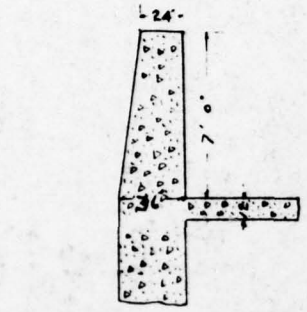


PLATTEKILL DAM
NEWBURGH BLEACHERY
NEWBURGH N.Y.

GENERAL PLAN
Hor Scale 1"=20' Ver Scale 1"=10'

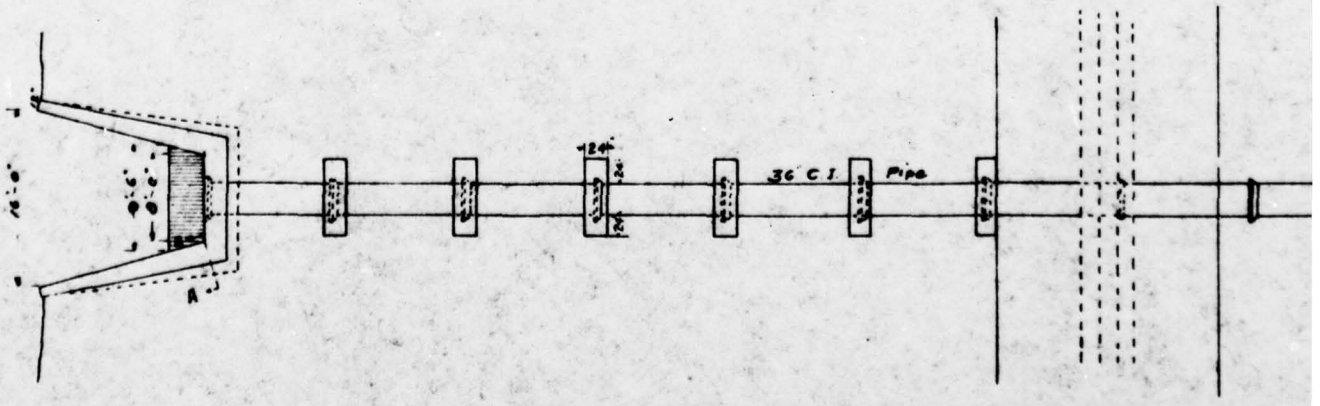
FIGURE 3



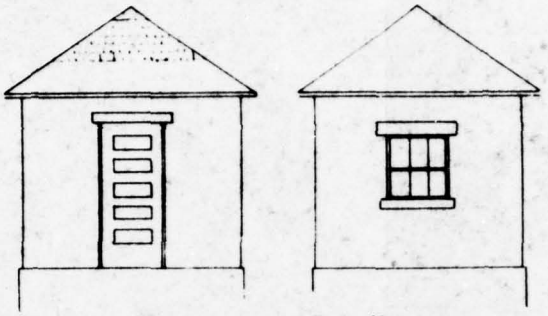


Section Wall A-A
Scale 1/4" = 1'

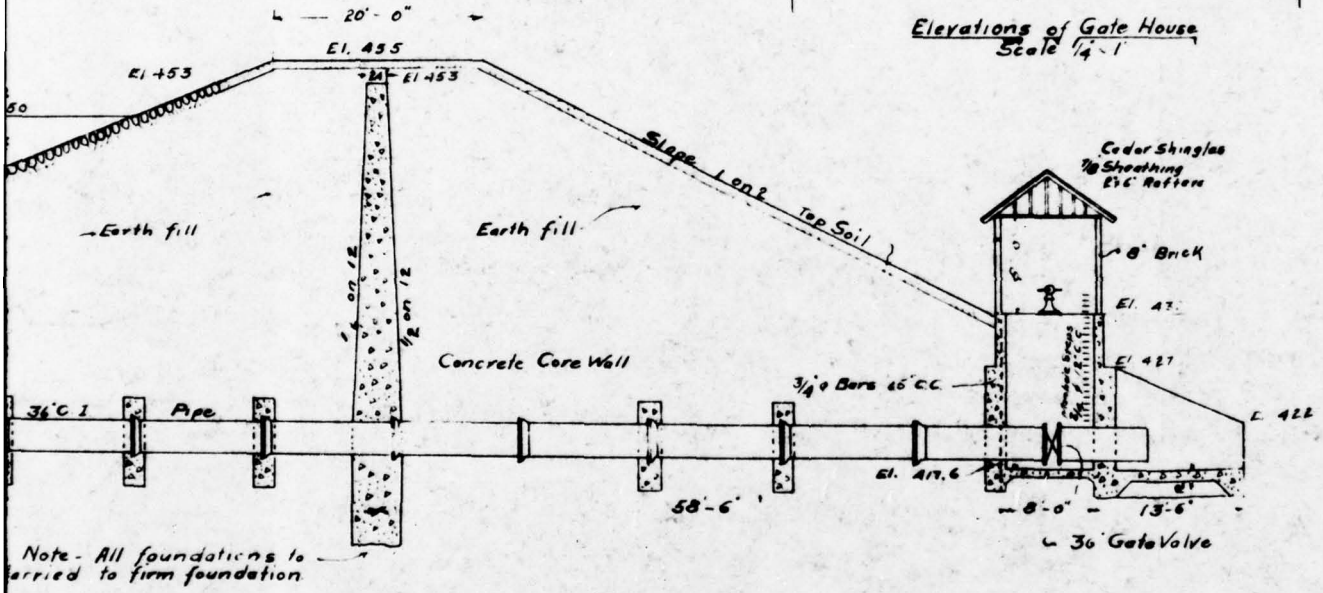
SECTION Sta. 2+62



PLAN Sta. 2+62

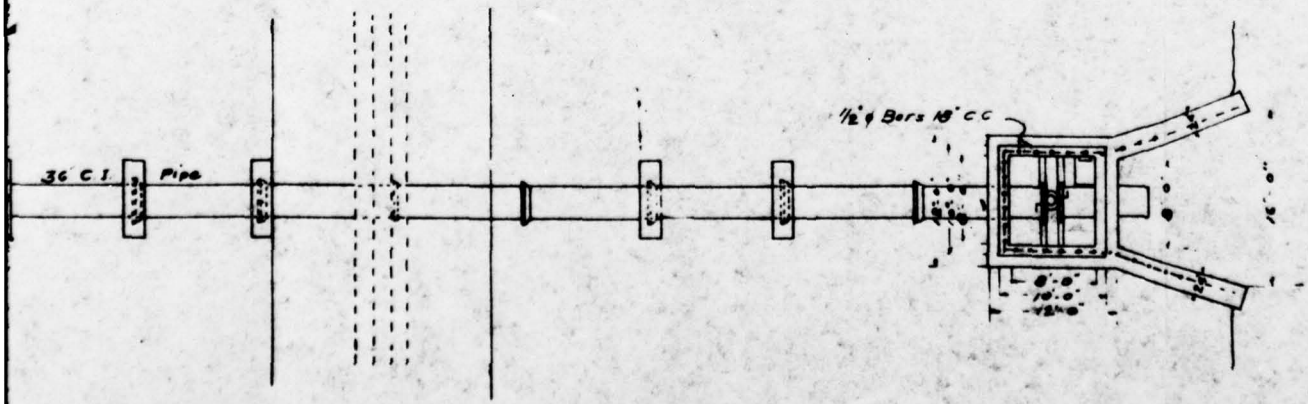


Elevations of Gate House
Scale 1/4" = 1'



Note - All foundations to be carried to firm foundation

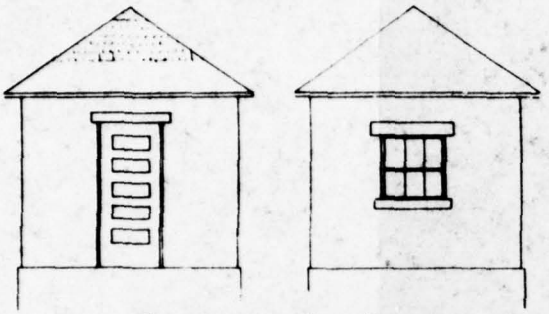
SECTION Sta 2+62



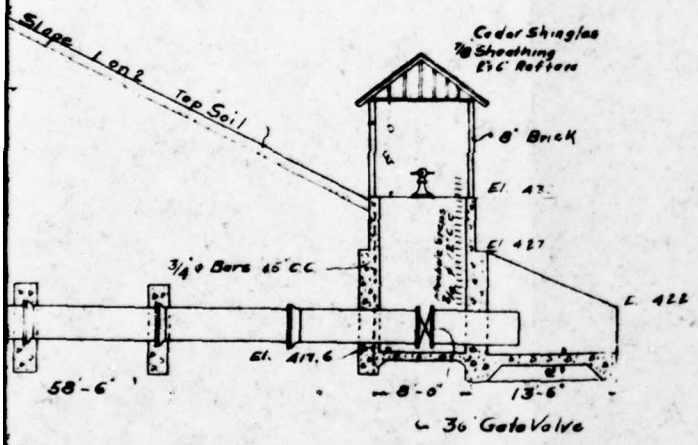
PLAN Sta 2+62

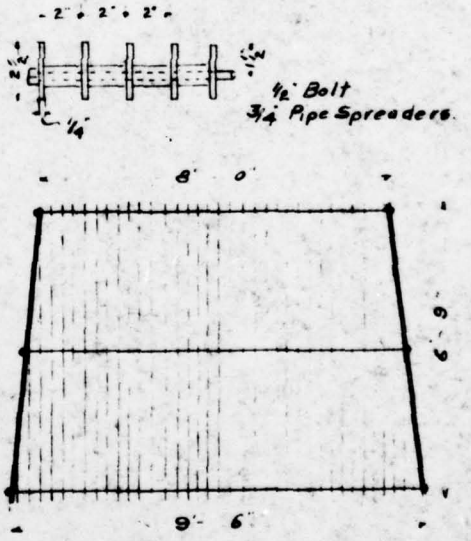
Detail
Sca

FIGURE

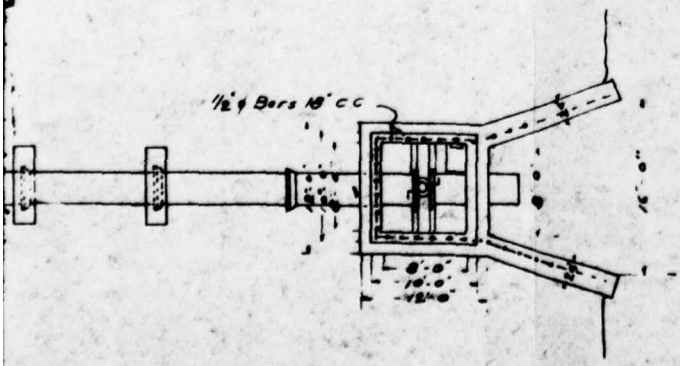


Elevations of Gate House
Scale 1/4 - 1





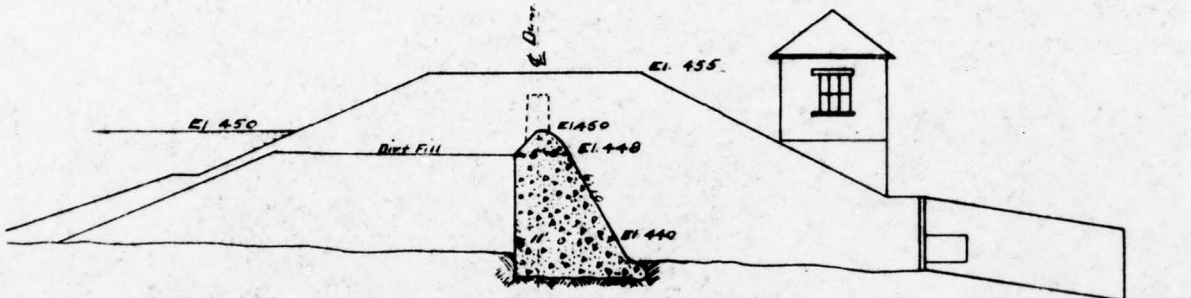
Details of Trash Rack
Scales 1/4 and 3/4



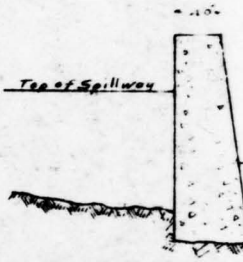
PLATTEKILL DAM
NEWBURGH BLEACHERY
NEWBURGH N.Y.

Details of Outlet Pipe
Scale 1/8 - 1

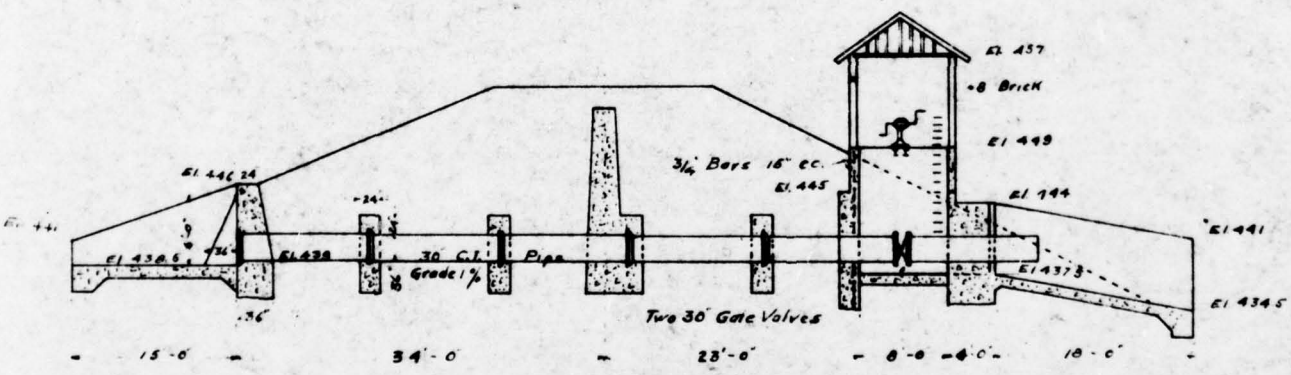
FIGURE 4



ELEV. AT STA. 3+95

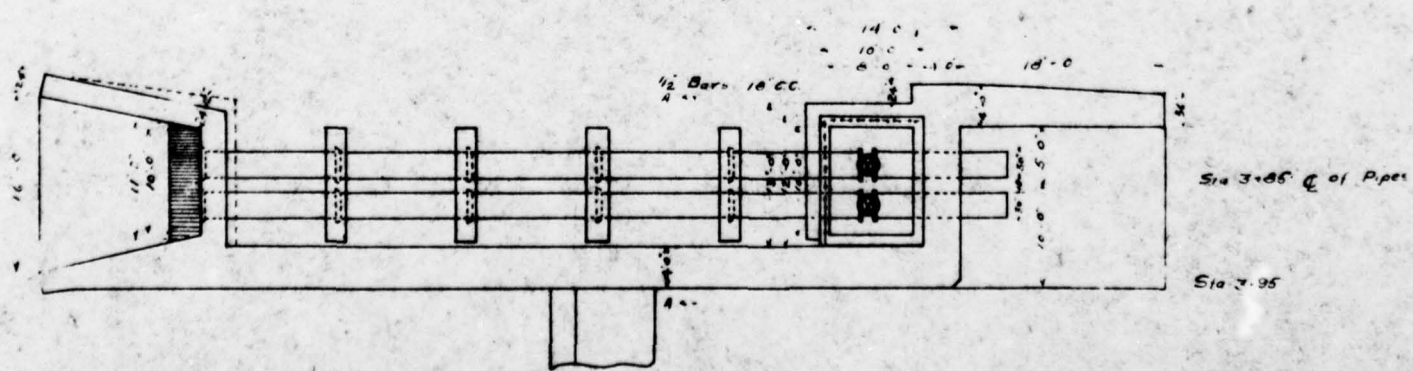


SEC. A

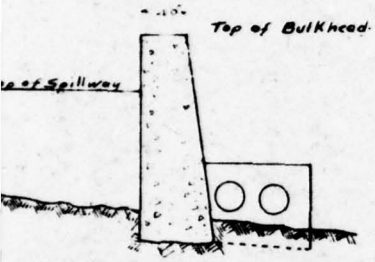


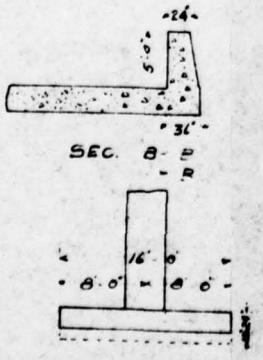
SEC. AT STA. 3+85

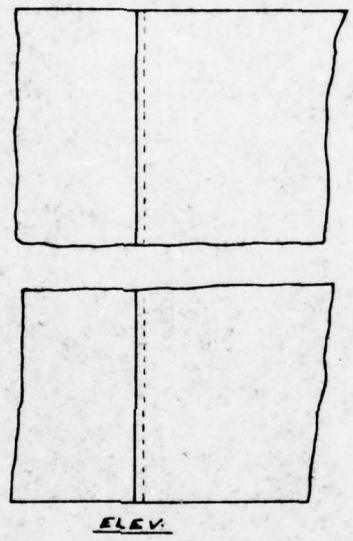
SEC. AT STA

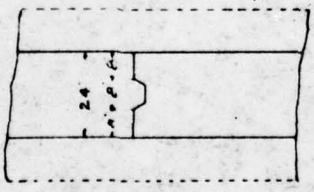


PLAN AT STA 3+85









PLAN OF EXPANSION JOINT
IN CORE WALL
Scale 1/2" = 1'

Note All walls to have expansion joints at least every 50 ft also where core wall and spillway sections join on bulkhead section. All joints to be coated with Asphaltic Joint Compound.

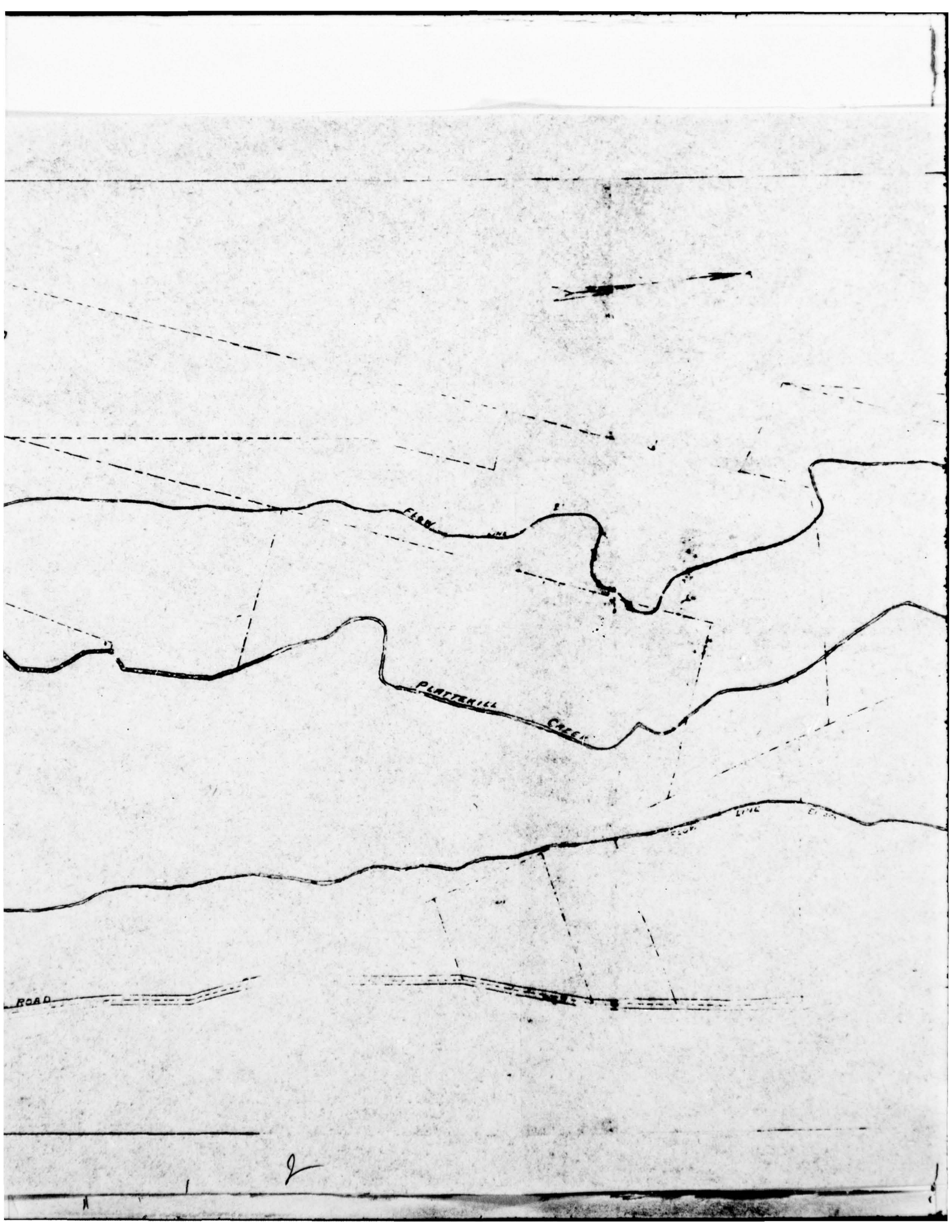
PLAT TEKILL DAM
NEWBURGH BLEACHERY
NEWBURGH N.Y.

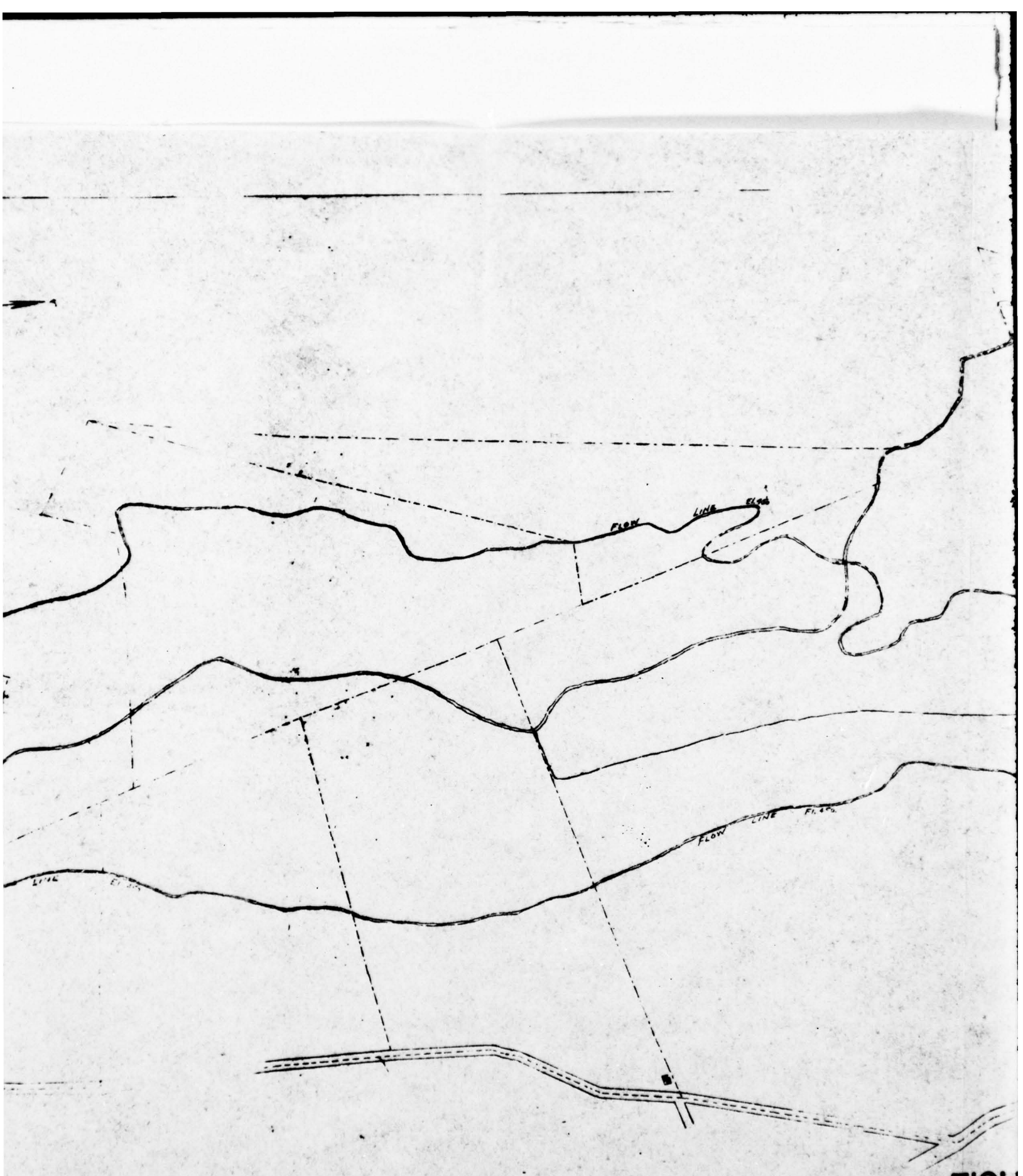
PLANS AND SEC DISCHARGE PIPE
Scale 1/8" = 1'

FIGURE 5

2


To Hurleyville
NORTH PLANK ROAD
To Woodstock
CRONOMER VALLEY
PLATTEKILL ROAD


FISH
PLEASANT HILL CREEK
ROAD



FIGU

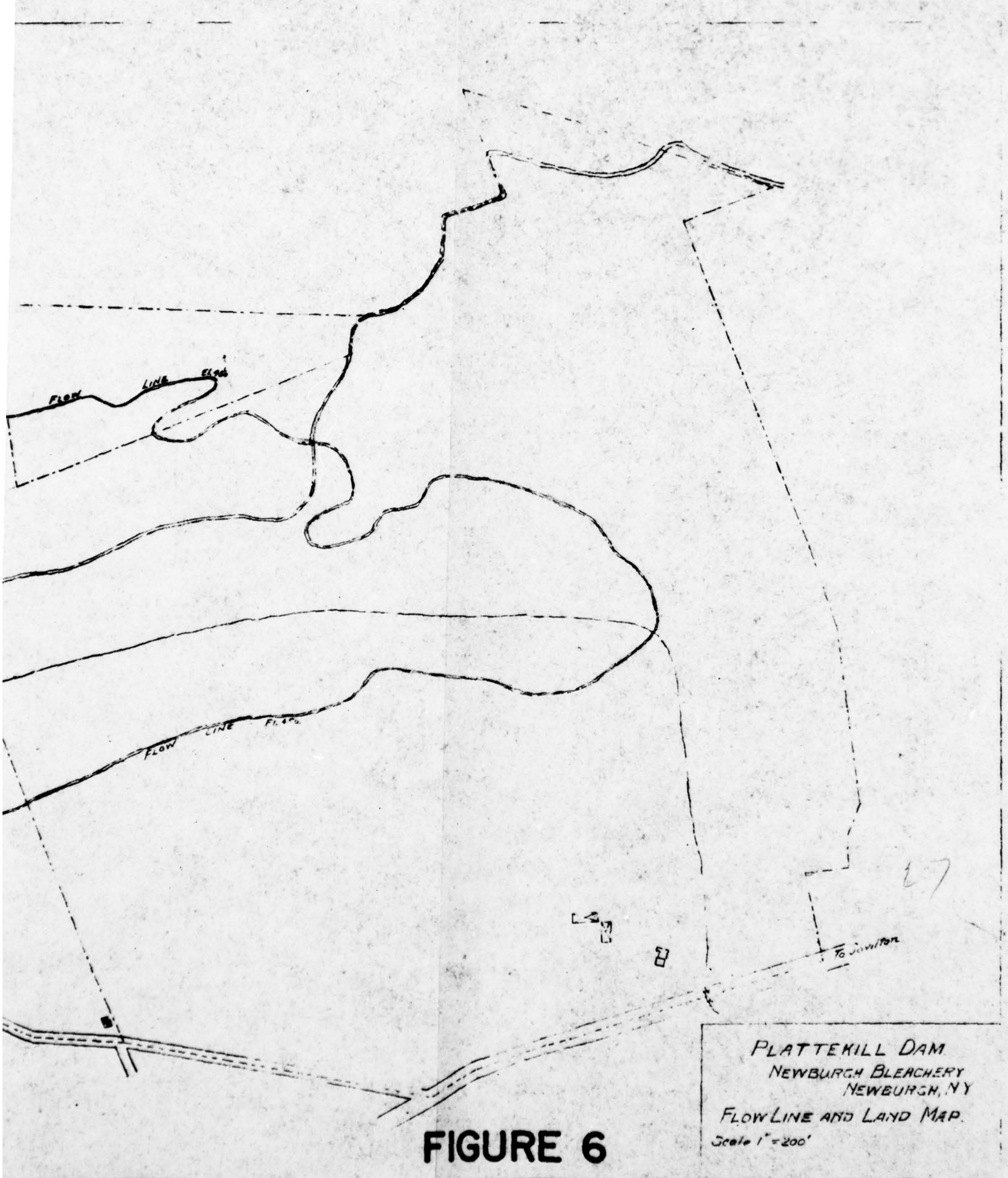

FLOW LINE
FLOW LINE
PLATTEKILL DAM
NEWBURGH BLEACHERY
NEWBURGH, NY
FLOW LINE AND LAND MAP.
Scale 1" = 200'

FIGURE 6

APPENDIX

FIELD INSPECTION
REPORT

Check List
Visual Inspection
Phase 1

Name Dam Chadwick Lake Dam County Orange State New York Coordinators _____

Date(s) Inspection June 26, 1978 Weather Partly Cloudy Temperature 72° F

Pool Elevation at Time of Inspection 451.0± M.S.L. Tailwater at Time of Inspection ----- M.S.L.

Inspection Personnel:

Mr. George C. Elias — Mr. James Ryan

Mr. Francis E. Falcone

Mr. Charles A. Richardson

Mr. James Ryan Recorder

Accompanied by:

Mr. Jess Haffen, Plant Superintendent, Chadwick Lake Filter Plant, City of Newburgh, New York.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
UPSTREAM SLOPE	Trees and brush above riprap.	Clear all trees and brush. Do not remove tree root system.
DOWNSTREAM SLOPE	Heavy brush, large trees, wooded.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	In good condition at all junctions.	None.
ANY NOTICEABLE SEEPAGE	Not observable.	Brush and trees should be removed and periodic inspection made.
STAFF GAGE AND RECORDER	None.	Not essential, but would be good to monitor changes in lake level.
DRAINS	None observed from embankment.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	None.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	None.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	None.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	No settlement observed.	None.
RIPRAP FAILURES	None observed.	None.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Spalling and exposure of aggregate. Erosion at base.	Gunite surface repairs and sealing of base.
APPROACH CHANNEL	Filled with silt almost to weir elevation. Plant growth in approach.	Remove silt to a depth to discourage plant growth.
DISCHARGE CHANNEL	Numerous trees, brush and debris.	Should be cleared to provide free flow.
BRIDGE AND PIERS	None.	None.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate slopes, well wooded.	None.
SEDIMENTATION	Very little observed except in spillway area.	None.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	None needed.
OBSERVATION WELLS	None.	None needed.
WEIRS	None.	None needed.
PIEZOMETERS	None.	None needed.
OTHER	None.	None.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None. Outlet pipes are cast iron.	None.
INTAKE STRUCTURE	Concrete inlet structures not observable. Water supply intake structure in very good condition.	None.
OUTLET STRUCTURE	Concrete in good condition.	None.
OUTLET CHANNEL	Natural channel only.	None.
EMERGENCY GATE	None.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Considerable debris and trees immediately below dam.	Should be cleared to provide free flow.
SLOPES		
APPROXIMATE NO. OF HOMES AND POPULATION		

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Only in application for construction.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Laboratory report on sand and cement tests.
POST-CONSTRUCTION SURVEYS OF DAM	Dam Inspection Report, 9/18/74.
BORROW SOURCES.	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Possibly to spillway crest.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plan filed with NYDEC. See figs.
REGIONAL VICINITY MAP	None.
CONSTRUCTION HISTORY	Unknown.
TYPICAL SECTIONS OF DAM	Plans filed with NYDEC. See figs.
HYDROLOGIC/HYDRAULIC DATA	Filed with NYDEC - Application for Construction Storage given as 800,000,000 gallons and 18,365 acre-feet. Believe acre-feet should be 2,450.
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	Plans filed with NYDEC. See figs.
RAINFALL/RESERVOIR RECORDS	Rainfall records (before construction) filed with NYDEC.

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	Plans filed with NYDEC.
DETAILS	See figs.
OPERATING EQUIPMENT PLANS & DETAILS	Plans filed with NYDEC. See figs.

PHOTOGRAPHS

VIEW ALONG SPILLWAY CREST

DOWNSTREAM FACE OF SPILLWAY SHOWING
SPALLING AND UNDERMINING

SPILLWAY OUTLET CHANNEL ABOVE DROP-OFF

SPILLWAY OUTLET CHANNEL DOWNSTREAM

HYDROLOGIC/HYDRAULIC CALCULATIONS

O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CHADWICK LAKE DAM	1	CAR	7/5/78	1467.021.1

Checked DBC

PMP COMPUTATIONS

DRAINAGE AREA = 13.5 sq. mi. From USGS Quad's & application data.

PMP - 6 Hr. duration 10 sq. mi., Zone 1
= 24"

Isohyetal "fit" reduction factor = 19.56%

Depth - Area - Duration adjustment = 97% (0-6 Hrs.
108% (0-12 Hr:
117% (0-24 Hr
124% (0-48 H

Duration, hours	% Adjustment	Total PMP, inches
0-6	97	23.3
0-12	108	25.9
0-24	117	28.1
0-48	124	29.8

Adjusted 6 Hr. PMP = 23.3 - 23.3(19.56%) = 18.7"

12 HR. PMP = 25.9 - 25.9(19.56%) = 20.8"

SECOND SIX HOURS 2.1"

O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CHADWICK LAKE DAM	2	FEF	7/30/98	1467-021-116

Checked DBC

HOURLY PMP

TIME (HRS.)	ΣPMP	INCR. PMP	DISTRIBUTION
1.0	9.35	9.35	.25
2.0	12.16	2.81	.25
3.0	14.03	1.87	.45
4.0	15.90	1.87	.45
5.0	17.39	1.49	1.31
6.0	18.70	1.31	1.49
7.0	19.15	.45	2.81
8.0	19.60	.45	9.35
9.0	19.95	.35	1.87
10.0	20.30	.35	1.87
11.0	20.55	.25	.35
12.0	20.80	.25	.35

$C_t = 2.0$ $C_p = .625$

$T_p = 2 \times (L \times L_{CA})^{.3}$ $L = 10$ miles $L_{CA} = 4.5$ miles

$T_p = 6.27$ hrs.

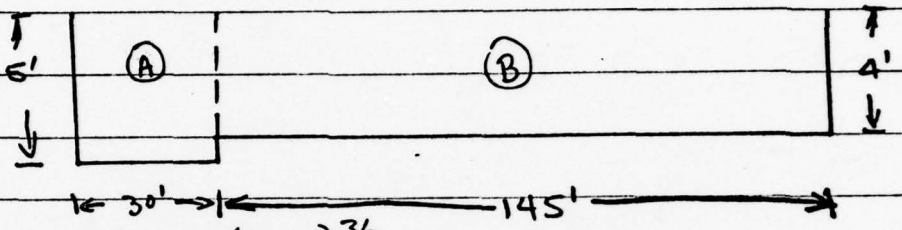
$t_R = T_p / 5.5 \approx 1$ hr.

JUSTIN & COURTNEY
DIVISION OF O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CHADWICK LAKE DAM		DBC	8/23/78	

Checked REH

SPILLWAY DISCHARGE



$Q_{OT} = 3.1 \times 400 \times (H-5)^{3/2}$

$Q_A = 3.2 \times 30 \times H^{3/2}$ $\qquad$ $Q_B = 3.2 \times 145 \times (H-1)^{3/2}$

Elev.	H	Q_A	Q_B	Q_{OT}	EQ
450	0	0	0	0	0
451	1	96	0	0	96
452	2	272	464	0	736
453	3	499	1312	0	1811
454	4	768	2411	0	3179
455	5	1073	3712	0	4785
456	6	1411	5188	1240	7839
457	7	1778	6819	3507	12104
458	8	2172	8593	6443	17208
459	9	2592	10499	9920	23011

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. _____ OF _____

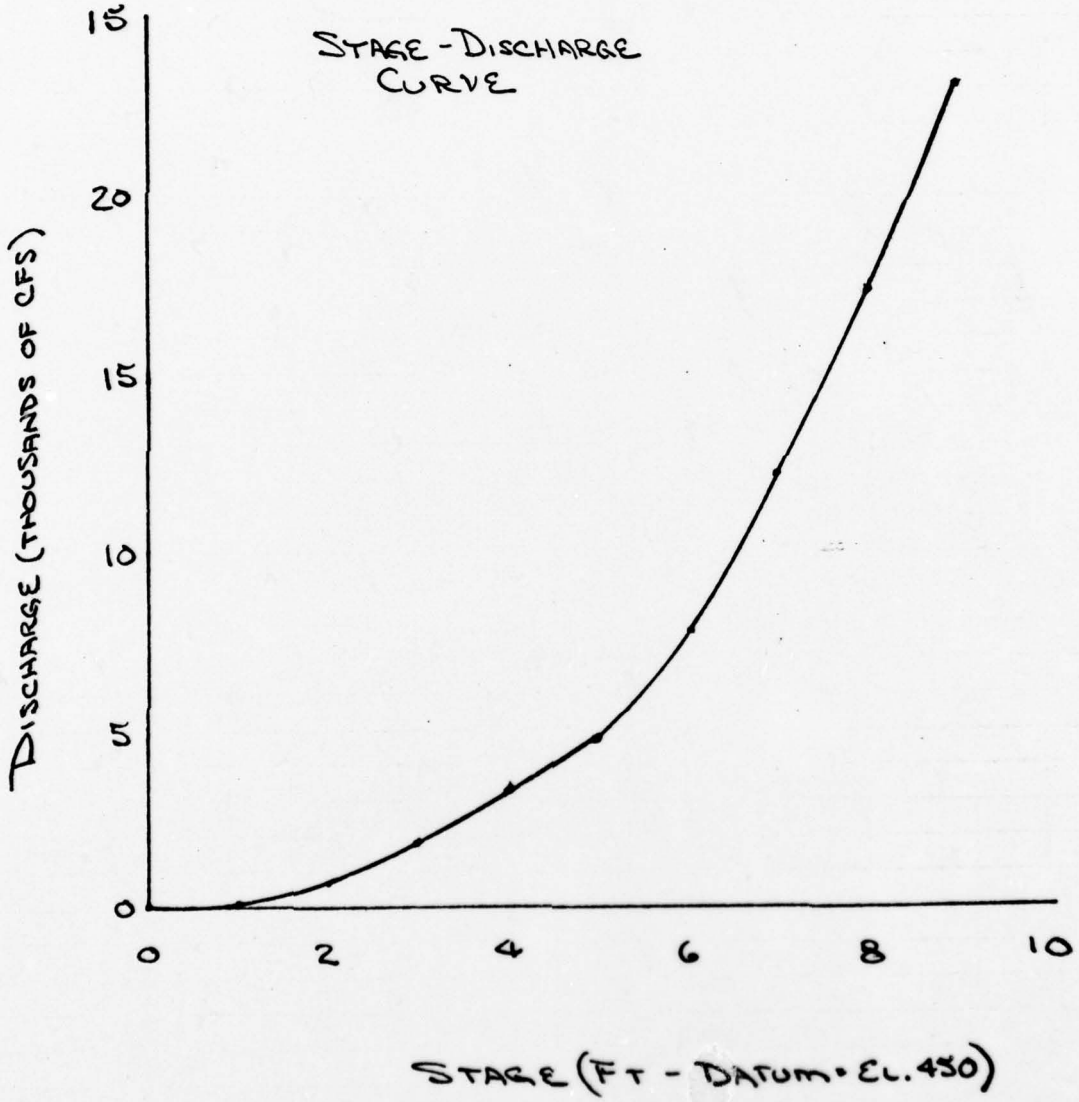
NAME OF CLIENT NYSDEC

DATE 8/23/78

PROJECT Chadwick Lake

COMP. BY DBC

CHECKED BY REH



JUSTIN & COURTNEY
DIVISION OF O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CHADWICK LAKE DAM		DBC	8/23/78	

Checked REH

STAGE - STORAGE

Area @ El. 450 ≃ 260 acres
Area @ El. 455 ≃ 278 acres

$$A = 3.6H + 260$$

& Surcharge Storage $(S) = \int A\,dH$

$$\therefore S = 1.8H^2 + 260H$$

Elev.	H	S
450	0	0
451	1	262
452	2	527
453	3	796
454	4	1069
455	5	1345
456	6	1625
457	7	1908
458	8	2195
459	9	2486

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. _____ OF _____

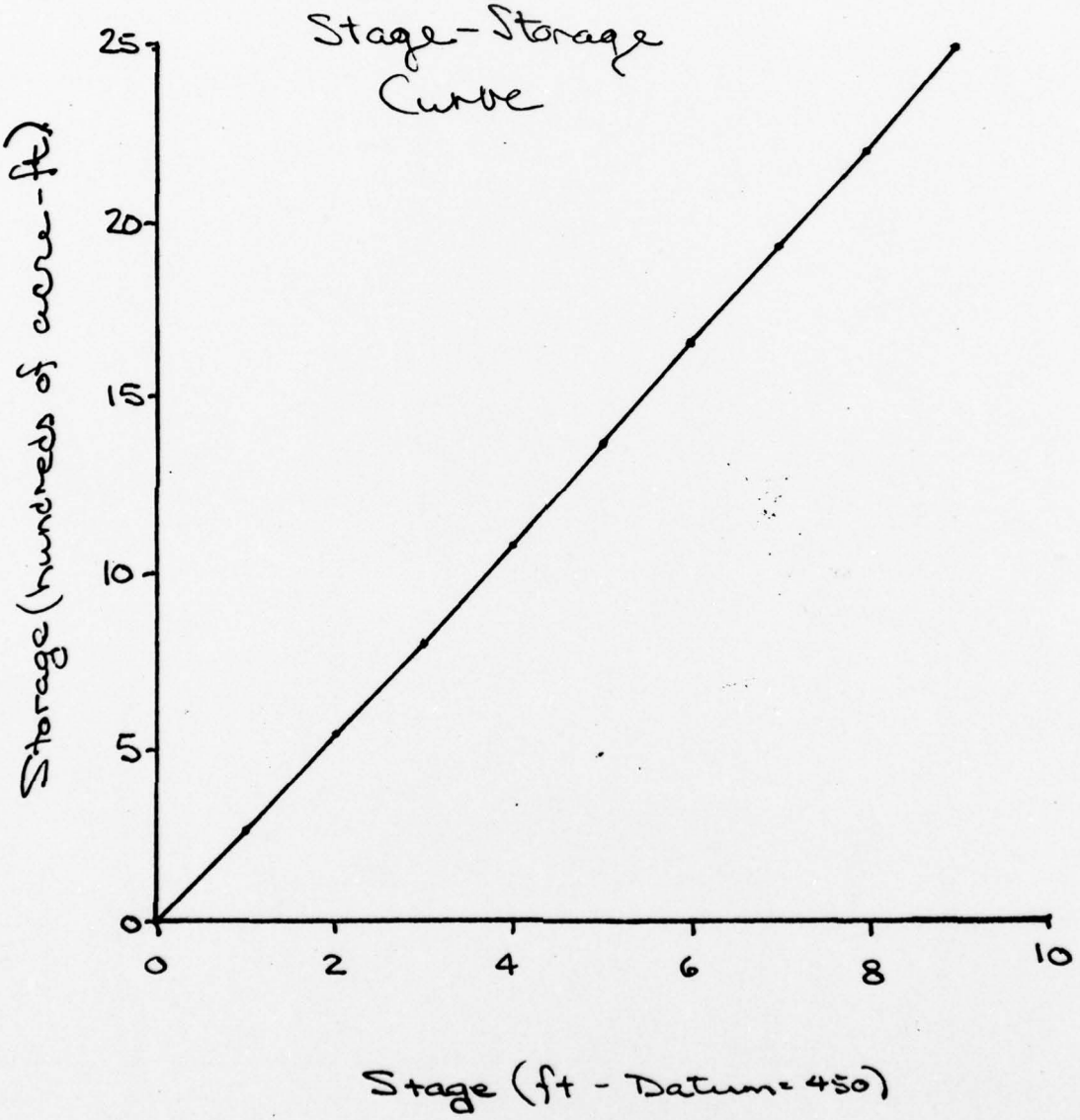
NAME OF CLIENT NYSDEC

DATE 8/23/78

PROJECT Chadwick Lake

COMP. BY DBE

CHECKED BY REH



JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. _____ OF _____

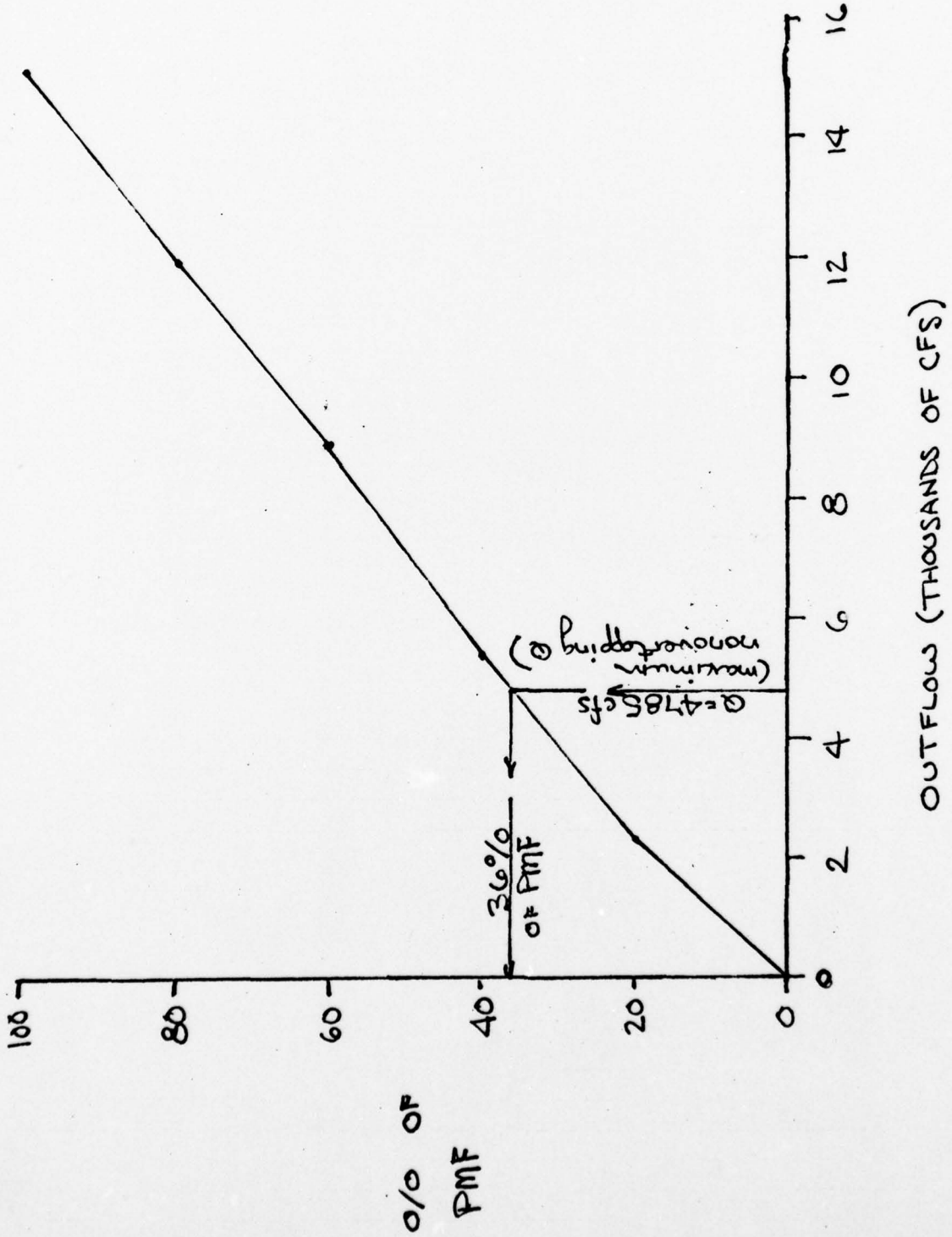
NAME OF CLIENT NYSDEC

DATE 8/27/78

PROJECT Chadwick Lake

COMP. BY DBC

CHECKED BY REH



O'BRIEN & GERE ENGINEERS

SUBJECT	SHEET	BY	DATE	JOB NO
CHADWICK LAKE DAM	7A	COOK	7/17/78	1467.021.11

Checked DBC

DRAWDOWN TIME CALC.

Spillway Crest Elev. (Normal Pool) 450.0
Invert of 2-30" Pipes 439.0
11.0' drawdo

36" Pipe has blind flange on outlet.

Aver. discharge rate, 2-30" pipes = 104 cfs
to invert of pipe inlet.

Inflow = 2 cfs × 13.5 sq.mi. = 27 cfs

Storage - Elev. 450 to Elev. 439.0

$\frac{260+220}{2} \times 11 \times 43{,}560 = 1.15 \times 10^8$ c.f.

Discharge Rate = $(104-27) \times 3600 = 27.72 \times 10^4$ c.f./hr.

Drawdown Time = $\frac{1.15 \times 10^8}{27.72 \times 10^4} = 415$ Hrs. = 17.3 days.

Does not include drawdown below
Elev. 439.0

```
**********
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
**********

                                CHADWICK LAKE DAM
                                  PMF HYDROLOGY
                          NATIONAL DAM INSPECTION PROGRAM

                                JOB SPECIFICATION
      NQ   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
      50     1     0     1     0     0     0     0     0     0
                          JOPER       NWT
                              5         0

                        MULTI-PLAN ANALYSES TO BE PERFORMED
                              NPLAN= 1 NRTIO= 5 LRTIO= 1
            RTIOS=    .20    .40    .60    .80   1.00

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

                          SUB-AREA RUNOFF COMPUTATION
      ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT  INAME
          1       0       0       0      0      0      0

                            HYDROGRAPH DATA
    IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
        0       1   13.50    0.00    0.00    0.00   0.000       0       0       0

                               PRECIP DATA
                          NP   STORM     DAJ     DAK
                          12    0.00    0.00    0.00
                          PRECIP PATTERN
     .25     .25     .45     .45    1.31    1.49    2.81    9.35    1.87    1.87
     .35     .35

                              LOSS DATA
    STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
     0.00    0.00    1.00    0.00    0.00    1.00    0.00     .10    0.00    0.00

                          UNIT HYDROGRAPH DATA
                        TP=  6.27    CP= .63    NTA=  0

                              RECESSION DATA
                        STRTQ=    0.00    QRCSN=    0.00    RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.29 AND R= 5.66 INTERVALS

     UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES, LAG=   6.25 HOURS, CP=  .63  VOL= 1.00
     51.     186.     369.     569.     744.     852.     882.     813.     689.     577.
    483.     405.     339.     284.     238.     199.     167.     140.     117.      98.
     82.      69.      58.      48.      40.      34.      28.      24.      20.      17.
     14.      12.      10.       8.

                            END-OF-PERIOD FLOW
                          TIME   RAIN   EXCS    COMP Q
```

1	5	0	1.31	1.21	453.
1	6	0	1.49	1.39	864.
1	7	0	2.81	2.71	1563.
1	8	0	9.35	9.25	2990.
1	9	0	1.87	1.77	5337.
1	10	0	1.87	1.77	8226.
1	11	0	.35	.25	11215.
1	12	0	.35	.25	13697.
1	13	0	0.00	0.00	15179.
1	14	0	0.00	0.00	15477.
1	15	0	0.00	0.00	14507.
1	16	0	0.00	0.00	12777.
1	17	0	0.00	0.00	10947.
1	18	0	0.00	0.00	9244.
1	19	0	0.00	0.00	7764.
1	20	0	0.00	0.00	6505.
1	21	0	0.00	0.00	5449.
1	22	0	0.00	0.00	4564.
1	23	0	0.00	0.00	3823.
2	0	0	0.00	0.00	3202.
2	1	0	0.00	0.00	2682.
2	2	0	0.00	0.00	2247.
2	3	0	0.00	0.00	1882.
2	4	0	0.00	0.00	1576.
2	5	0	0.00	0.00	1320.
2	6	0	0.00	0.00	1106.
2	7	0	0.00	0.00	926.
2	8	0	0.00	0.00	776.
2	9	0	0.00	0.00	650.
2	10	0	0.00	0.00	544.
2	11	0	0.00	0.00	455.
2	12	0	0.00	0.00	380.
2	13	0	0.00	0.00	316.
2	14	0	0.00	0.00	262.
2	15	0	0.00	0.00	211.
2	16	0	0.00	0.00	167.
2	17	0	0.00	0.00	122.
2	18	0	0.00	0.00	38.
2	19	0	0.00	0.00	20.
2	20	0	0.00	0.00	5.
2	21	0	0.00	0.00	2.
2	22	0	0.00	0.00	0.
2	23	0	0.00	0.00	0.
3	0	0	0.00	0.00	0.
3	1	0	0.00	0.00	0.
3	2	0	0.00	0.00	0.
		SUM	20.80	19.60	169839.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15477.	13809.	6803.	3397.	169837.
INCHES		9.52	18.75	19.50	19.50
AC-FT		6851.	13501.	14043.	14043.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

2.	7.	20.	45.	91.	173.	313.	598.	1067.	1645.
2243.	2739.	3036.	3095.	2901.	2555.	2189.	1843.	1553.	1301.
1090.	913.	765.	640.	535.	449.	376.	315.	264.	221.
185.	155.	130.	109.	91.	76.	63.	52.	42.	33.
24.	8.	4.	1.	0.	0.	0.	0.	0.	0.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

3.	14.	40.	90.	181.	346.	625.	1196.	2135.	3290.
4486.	5479.	6072.	6191.	5803.	5111.	4379.	3698.	3105.	2602.
2179.	1826.	1529.	1281.	1073.	899.	753.	630.	528.	442.
371.	310.	260.	218.	182.	152.	126.	105.	85.	67.
43.	15.	8.	2.	1.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6191.	5523.	2721.	1359.	67935.
INCHES		3.81	7.50	7.80	7.80
AC-FT		2740.	5400.	5617.	5617.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

5.	21.	61.	134.	272.	518.	938.	1794.	3202.	4936.
6729.	8218.	9107.	9286.	8704.	7666.	6568.	5546.	4658.	3903.
3269.	2738.	2294.	1921.	1609.	1348.	1129.	946.	792.	664.
556.	466.	390.	327.	273.	228.	190.	157.	127.	100.
73.	23.	12.	3.	1.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9296.	8285.	4082.	2039.	101902.
INCHES		5.71	11.25	11.70	11.70
AC-FT		4110.	8101.	8426.	8426.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

6.	28.	81.	179.	362.	691.	1250.	2392.	4270.	6581.
8972.	10957.	12143.	12381.	11605.	10222.	8758.	7395.	6211.	5204.
4359.	3651.	3058.	2562.	2146.	1797.	1505.	1261.	1056.	885.
741.	621.	520.	435.	364.	304.	253.	210.	169.	134.
97.	31.	16.	4.	2.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12381.	11047.	5443.	2717.	135870.
INCHES		7.61	15.00	15.60	15.60
AC-FT		5481.	10801.	11235.	11235.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 5

8.	36.	101.	224.	453.	864.	1563.	2990.	5337.	8226.
11215.	13697.	15179.	15477.	14507.	12777.	10947.	9244.	7764.	6505.
5449.	4564.	3823.	3202.	2682.	2247.	1882.	1576.	1320.	1106.
926.	776.	650.	544.	455.	380.	316.	262.	211.	167.
122.	38.	20.	5.	2.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15477.	13809.	6803.	3397.	169837.
INCHES		9.52	18.75	19.50	19.50
AC-FT		6851.	13501.	14043.	14043.

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

HYDROGRAPH ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
2	1	0	0	0	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	1

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

2.	2.	2.	3.	5.	9.	16.	29.	53.	92.
405.	811.	1399.	1884.	2267.	2425.	2407.	2274.	2077.	1854.
1650.	1473.	1293.	1126.	974.	837.	724.	655.	589.	526.
467.	413.	364.	320.	280.	244.	213.	195.	160.	139.
119.	99.	94.	91.	88.	86.	83.	81.	78.	76.

STOR

4.	4.	5.	8.	13.	23.	43.	78.	144.	250.
390.	546.	693.	811.	887.	919.	915.	888.	849.	805.
759.	711.	666.	625.	596.	552.	522.	494.	466.	440.
416.	393.	373.	355.	338.	323.	310.	299.	288.	279.
271.	263.	256.	248.	241.	234.	227.	220.	214.	207.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2425.	2222.	1218.	631.	31548.
INCHES		1.53	3.36	3.62	3.62
AC-FT		1103.	2417.	2609.	2609.

STATION 2, PLAN 1, RTIO 2

3.	3.	4.	6.	10.	17.	31.	57.	153.	617.
1478.	2610.	3763.	4681.	5436.	5449.	5011.	4549.	4104.	3619.
3147.	2754.	2385.	2049.	1760.	1541.	1338.	1155.	992.	848.
728.	657.	590.	526.	467.	412.	363.	318.	277.	241.
208.	176.	146.	120.	99.	94.	91.	88.	85.	83.

STOR

8.	9.	11.	16.	26.	47.	85.	157.	286.	478.
713.	956.	1169.	1327.	1405.	1406.	1366.	1304.	1228.	1145.
1063.	984.	911.	843.	783.	728.	678.	632.	591.	555.
524.	494.	466.	440.	416.	393.	373.	354.	337.	322.
308.	295.	283.	272.	263.	255.	248.	240.	233.	226.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5449.	4872.	2553.	1307.	65341.
INCHES		3.36	7.04	7.50	7.50
AC-FT		2417.	5066.	5403.	5403.

STATION 2, PLAN 1, RTIO 3

5.	5.	6.	9.	14.	26.	47.	86.	473.	1345.
2787.	4553.	6966.	8473.	8874.	8345.	7486.	6598.	5669.	4806.
4325.	3813.	3310.	2882.	2499.	2149.	1837.	1606.	1397.	1207.
1038.	888.	758.	677.	609.	544.	493.	427.	375.	328.
284.	241.	201.	165.	136.	111.	95.	92.	90.	87.

STOR

12.	13.	16.	24.	39.	70.	128.	235.	418.	679.
931.	1305.	1545.	1667.	1634.	1659.	1593.	1511.	1426.	1347.
1266.	1178.	1092.	1010.	933.	863.	801.	745.	692.	645.
603.	565.	532.	503.	474.	447.	422.	399.	378.	358.
340.	322.	305.	291.	278.	268.	260.	252.	245.	237.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8874.	7790.	3900.	1985.	99226.
INCHES		5.37	10.75	11.40	11.40
AC-FT		3865.	7740.	8205.	8205.

STATION 2, PLAN 1, RTIO 4

6.	6.	8.	12.	19.	34.	62.	210.	799.	2174.
4215.	7444.	10503.	11853.	11961.	11157.	9877.	8495.	7319.	6318.
5363.	4619.	4129.	3618.	3133.	2735.	2363.	2027.	1743.	1524.
1323.	1141.	979.	837.	721.	651.	593.	519.	460.	404.

1398.	1317.	1232.	1144.	1060.	980.	906.	839.	779.	724.
674.	628.	588.	552.	521.	492.	464.	437.	413.	389.
368.	346.	325.	307.	292.	280.	269.	261.	253.	245.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11961.	10641.	5251.	2663.	133149.
INCHES		7.33	14.47	15.23	15.23
AC-FT		5279.	10420.	11010.	11010.

STATION 2, PLAN 1, RTIO 5

8.	8.	10.	14.	24.	43.	78.	385.	1259.	3037.
6107.	10573.	13688.	15077.	15005.	13850.	12166.	10571.	8984.	7617.
6598.	5609.	4750.	4270.	3755.	3255.	2838.	2457.	2111.	1804.
1581.	1374.	1187.	1020.	872.	743.	669.	600.	534.	472.
412.	352.	293.	242.	199.	163.	133.	109.	95.	92.

STOR

21.	22.	27.	39.	66.	117.	213.	382.	658.	1041.
1466.	1806.	1997.	2075.	2071.	2006.	1911.	1806.	1701.	1605.
1511.	1421.	1339.	1257.	1168.	1082.	1001.	925.	856.	794.
738.	687.	640.	598.	561.	529.	499.	471.	443.	417.
393.	368.	344.	323.	305.	290.	277.	267.	259.	251.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15077.	13393.	6597.	3342.	167094.
INCHES		9.23	18.18	19.19	19.19
AC-FT		6645.	13092.	13817.	13817.

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

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS .20	.40	.60	.80	1.00
HYDROGRAPH AT	1	1	3095.	6191.	9286.	12381.	15477.
		2	0.	0.	0.	0.	0.
ROUTED TO	2	1	2425.	5449.	8874.	11961.	15077.
		2	0.	0.	0.	0.	0.

APPLICATION DATA AND PREVIOUS INSPECTION REPORT

3-28-21-1000 (?-1925)

STATE OF NEW YORK

DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received [illegible] Dam No. 585 L.H. Watershed

Disposition [illegible] Serial No. 585 [illegible]

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed drawings, marked Plans and specifications for Plattekill Dam

herewith submitted for the {construction / reconstruction} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about Nov 1926 (Date)

1. The dam will be on Quassaick Creek flowing into Hudson River in the town of Newburgh, County of Orange and 1700' North of intersection of the Newburgh-Wallkill and Cronomer Valley [illegible] (Give distance and direction from some village, bridge, road or mouth of a stream)

2. The name and address of the owner is Newburgh Bleachery, Newburgh, N.Y.

3. The dam will be used for Power, Manufacturing purposes & Real Estate developement

4. Will any part of the dam be built upon or its pond flood any State lands? No

5. The watershed at the proposed dam draining into the pond to be formed thereby is 13.5 square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of 260 acres and will impound [illegible] cubic feet of water.

7. The lowest part of the natural shore of the pond is 18 feet vertically above the spillcrest, and everywhere else the shore will be at least [illegible] feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was .... cubic feet per second on .... (Date) [illegible] Rainfall [illegible]

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam [illegible] and other property [illegible]

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite shale, slate, limestone, etc.) [illegible]

11. The material of the right bank, in the direction with the current, is Shale; at the spillcrest elevation this material has a top slope of 2" inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of 40 feet, and the top surface extends for a vertical height of ..... feet above the spillcrest.

12. The material of the left bank is Hard clay has a top slope of 4 inches to a foot horizontal, a thickness of unknown feet, and a height of 25 feet.

13 State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. Shale, hard. Outcrop shows some weathering. Clay hard, blue. Practically impervious.

14. If the bed is in layers, are the layers horizontal or inclined? Inclined If inclined what is the direction of the horizontal outcropping relative to the axis of the main dam and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping Horizontal outcropping about 30° in relation to axis of dam. Inclination of layers 40° from perpendicular.

15. What is the thickness of the layers? About 6"

16. Are there any porous seams or fissures? No

17. WASTES. The spillway of the above proposed dam will be 175 feet long in the clear; the waters will be held at the right end by a Concrete bulkhead the top of which will be 5 feet above the spillcrest, and have a top width of 2 feet; and at the left end by a Concrete bulkhead the top of which will be 5 feet above the spillcrest, and have a top width of 4 feet.

18. There will be also for flood discharge a pipe 36" inches inside diameter and the bottom will be 30 feet below the spillcrest, a sluice or gate 36" in diameter feet wide in the clear by ..... feet high, and the bottom will be 30 feet below the spillcrest. Also 2-30" pipes with 30" gate valves 10' below spillcrest

19. APRON. Below the proposed dam there will be an apron built of Spillway will be on ledge rock feet long across the stream, ... feet wide and ..... feet thick. The downstream side of the apron will have a thickness of ..... feet for a width of ..... feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings in triplicate of the proposed structure, one set of which will be returned if they are approved. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed; giving the shape,

the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the dam.

Where plans or working drawings could give all the dimensions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the application any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer. State the assumed ice and uplift pressures and the conditions on which based.

21. SKETCHES. For small and unimportant structures, if plans have not been made, on the back of this application make a sketch to scale for each different cross-section at the highest point; giving the height and the depth under the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material, and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top widths and top lengths from the upstream face of the spillcrest; and outline the apron. Also sketch an elevation of each end of the dam with a cross section of the banks, giving the depth and width excavated into the banks.

22. ELEVATIONS. Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at the ends of the spill; of the spillcrest for the above proposed dam; and of the spillcrest of any adjacent dams.

23. SAMPLES. When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand, one-half a cubic foot is desired (exclusive of any stone over ¼ inch in size mixed therewith); for cement, three pints; and for the natural bed, twenty cubic inches if of ledge and one-half a cubic foot if of soil.

24. INSPECTION. State how inspection is to be provided for during construction. .....

Competent Engineer employed by the Owner.

25. WATER SUPPLY. Are the waters impounded by the above dam to be used for a public water supply? No

Has an application under the provisions of Article IX of the Conservation Law for such use been made to the Water Control Commission, Albany, N. Y? No

PART I — INVENTORY OF DAMS IN THE UNITED STATES
(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions

NAME
PLATTENKILL DAM

POPULAR NAME	NAME OF IMPOUNDMENT
	[illegible] LAKE

RIVER OR STREAM	NEAREST DOWNSTREAM CITY – TOWN – VILLAGE
[illegible] CREEK	[illegible]

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEIGHT (FT)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT)
RE	1925		35	30		[illegible] ?

REMARKS

[illegible] BY ESTIMATE

PART II - INVENTORY OF DAMS IN THE UNITED STATES
(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions

	DRIVEWAY		VOLUME OF DAM (CY)	POWER CAPACITY		NAVIGATION LOCKS			
				INSTALLED (MW)	PROPOSED (MW)	LENGTH (FT)	WIDTH (FT)	LENGTH (FT)	WIDTH (FT)
0	175								

OWNER	ENGINEERING BY	CONSTRUCTION BY
NEWBURGH [illegible] CITY OF NEWBURGH	CURTIS-HARPER	

REGULATORY AGENCY

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE

INSPECTION BY	INSPECTION DATE (DAY MO YR)	AUTHORITY FOR INSPECTION
		[illegible]

REMARKS

1-01-633 30-UNKNOWN 33-UNKNOWN 34-UNKNOWN

[illegible]

18365 [illegible]

4[illegible]) 200,000,000 [illegible] ?

[illegible] RAINFALL 19[illegible] ----1924

[illegible]	[illegible]	JAN	FEB	[illegible]	APR	[illegible]	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
[illegible]	[illegible].49	[illegible]	4.89	[illegible]	1.09	[illegible].07	3.28	[illegible].51	1.69	2.22	2.08	3.76	2.26
[illegible]1	[illegible]	1.[illegible]	0.04	5.17	3.06	3.79	2.61	[illegible].62	9.89	5.26	2.02	2.21	5.26
[illegible]	47.75	[illegible]	5.16	4.27	3.69	[illegible]	3.77	5.59	1.81	3.86	5.12	0.93	5.07
[illegible]	[illegible].33	2.[illegible]	4.47	[illegible]	3.08	0.99	11.67	2.57	11.04	2.01	10.16	1.77	1.[illegible]
[illegible]	[illegible].20	3.[illegible]	2.20	2.57	5.26	[illegible].16	3.85	3.00	3.29	5.01	4.07	1.29	2.30
[illegible]905	[illegible].28	0.16	1.20	4.00	2.06	2.06	2.75	4.22	5.31	3.18	2.20	3.22	2.96
190[illegible]	60.37	1.42	2.06	2.87	3.91	5.07	2.93	7.01	3.18	2.12	3.80	1.54	2.51
1907	[illegible].26	4.[illegible]	2.40	3.36	3.25	3.90	3.12	2.61	0.83	9.64	7.69	3.30	3.37
190[illegible]	[illegible].40	3.[illegible]	5.16	3.83	4.43	7.56	2.63	2.14	2.84	1.59	2.42	9.77	1.54
190[illegible]	45.60	4.54	3.57	3.83	6.55	2.65	3.25	[illegible].24	5.24	3.71	1.05	2.64	3.[illegible]
1910	41.07	0.01	4.79	1.46	5.95	4.08	4.85	2.09	4.20	3.23	1.05	4.79	2.19
1911	[illegible].29	2.96	3.37	4.45	3.16	0.93	6.01	1.99	3.75	2.67	3.10	2.95	3.93
1912	40.17	2.19	2.56	5.90	6.46	4.05	1.80	0.91	3.29	1.96	3.82	2.23	4.55
1913	47.23	3.35	2.85	6.30	4.24	3.70	0.45	0.39	4.30	3.45	3.44	3.85	3.73
1914	33.95	2.90	1.30	4.30	4.46	2.89	3.76	3.49	2.65	0.30	3.09	3.44	3.49
1915	47.57	5.54	5.56	0.12	2.03	2.79	3.05	5.59	3.57	2.73	3.06	2.90	5.63
1916	55.24	1.48	2.39	1.65	2.57	7.20	4.24	3.57	1.99	3.64	0.39	3.50	2.56
1917	[illegible]	2.29	1.29	2.41	1.70	3.95	4.04	3.17	4.15	1.04	5.35	0.09	1.69
19[illegible]	50.67	2.36	2.59	1.11	2.90	2.85	1.09	3.30	[illegible]	3.37	1.59	2.37	3.72
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Newburgh W.S.

DAM INSPECTION REPORT
(By Visual Inspection)

a Number	River Basin	Town	County	Hazard Class*	Date & Inspector
593	L. Hudson	Newburgh	Orange	C	9/1/78 K

Type of Construction

- [x] Earth w/concrete spillway
- [ ] Earth w/drop inlet pipe
- [ ] Earth w/stone or riprap spillway
- [ ] Concrete
- [ ] Stone
- [ ] Timber

Use

- [x] Water Supply
- [ ] Power
- [x] Recreation
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandor

Estimated Impoundment Size

- [ ] 1-5 acres
- [ ] 5-10 acres
- [x] Over 10 acres

Estimated Height of Dam above Streambe

- [ ] Under 10 feet
- [ ] 10-25 feet
- [x] Over 25 feet

Condition of Spillway

- [x] Service satisfactory
- [ ] In need of repair or maintenance
- [x] Auxiliary satisfactory
- [ ] In need of repair or maintenar

Explain: _____

_____

Condition of Non-Overflow Section

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: _____

Trees

Condition of Mechanical Equipment

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: _____

_____

Evaluation (From Visual Inspection)

- [x] No defects observed beyond normal maintenance
- [ ] Repairs required beyond normal maintenance

*Explain Hazard Classification

STATE OF NEW YORK
DEPARTMENT OF STATE ENGINEER AND SURVEYOR
TESTING LABORATORY
ALBANY

Tests of Sand from [illegible] N. Y.,
for use on Contract No. [illegible] Division.
S.E.
Contract Sample No. 153 taken [illegible]; received at Laboratory [illegible]; made up Dec. 15 1926
Sand is [illegible]

Percentage of Voids 27.1; Loam [illegible]; Organic matter [illegible]
Parts of sand to cement by weight / bulk :— 2.75 sand to 1 cement. Per cent water used ±11
Temperature of water used in mixing [illegible] Fahr. Briquettes kept in moist air 24 hours and then immersed.
Cement used in tests, Standard Brand. This cement tested as follows:—
Sets (determined by Vicat needle):—Initial, { in [illegible] min. / Minim. requirement 45 min. }; hard, { in [illegible] min. / Max. requirement 600 min. }
Constancy of Volume Tests:—Normal air [illegible]: Normal water [illegible]; Accelerated [illegible]
Fineness (per cent passing standard sieve No. 100) [illegible] (Requirement, 92%)
" (" " " " " No. 200) [illegible] (Requirement, 78%)

TENSILE STRENGTH IN POUNDS PER SQUARE INCH						SIZE OF SAND	
STANDARD SAND		NATURAL SAND		WASHED SAND		PASSING SIEVE	
7 Days	28 Days	7 Days	28 Days	7 Days	28 Days	No.	Per Cent
315		305				2	100.0
300		325				4	96.0
325		285				6	86.8
320		295				10	70.2
325		330				20	49.4
1585		1540				30	35.4
317		308				40	24.8
						60	13.8
						74	9.4
						100	4.2
						140	2.0
						200	1.0

Remarks:

I CERTIFY *that this is a true abstract taken from the records of tests* [illegible] 1926

[illegible]
Sr. Ass't Engineer in Charge of Tests

STABILITY ANALYSES

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. _____ OF _____

DATE 8/27/18

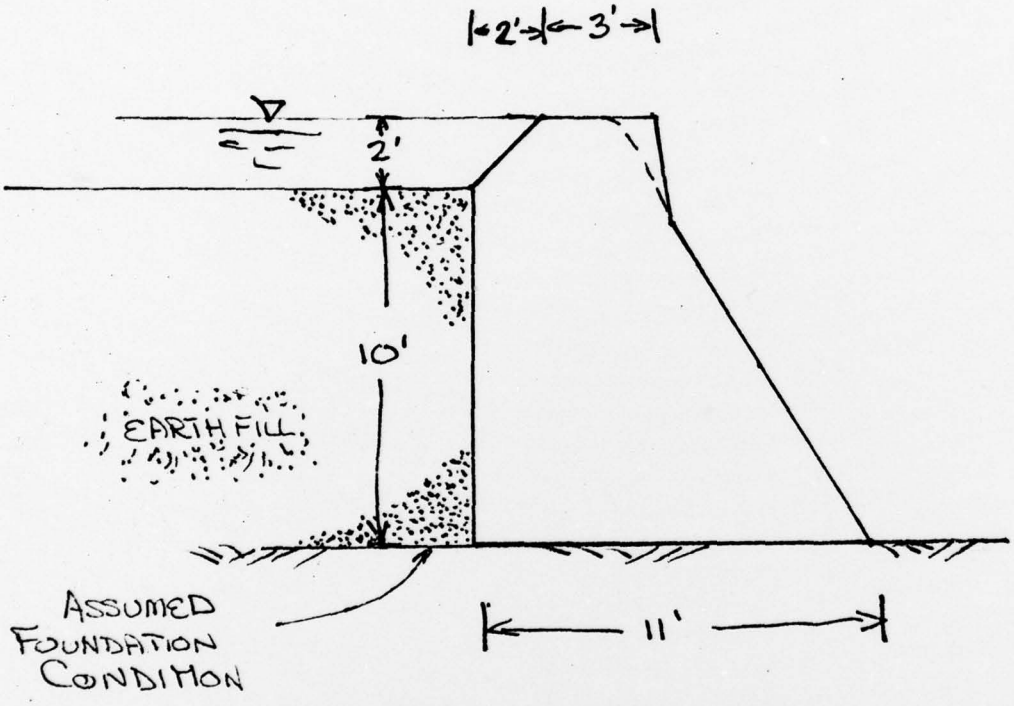
NAME OF CLIENT NYSDEC

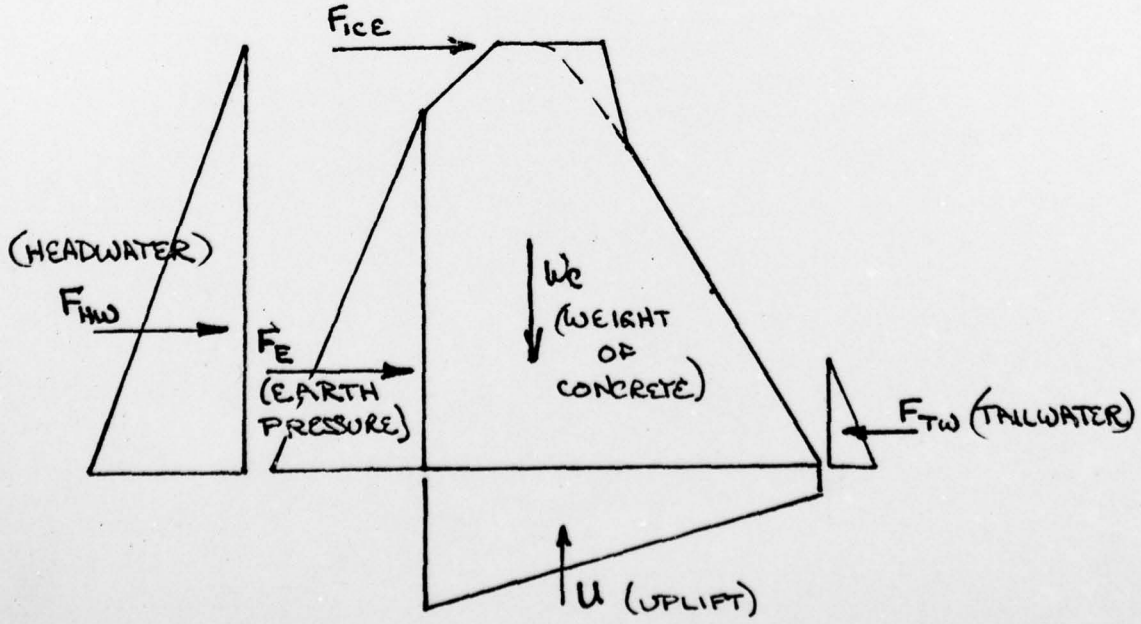
COMP. BY DRC

PROJECT CHADWICK LAKE DAM

CHECKED BY _____

SPILLWAY STABILITY ANALYSIS





****

STABILITY ANALYSIS-CHADWICK LAKE SPILLWAY
NORMAL POOL

****

BASE ELEVATION= 438.00FT. TOP ELEVATION= 450.00FT. BASE WIDTH= 11.00FT. DENSITY= 145.00PCF
HEADWATER ELEVATION= 450.00FT. TAILWATER ELEVATION= 0.00FT. EARTHQUAKE ACCELERATION=.000G (HORIZ)..000G (VERT)
SILT ELEVATION= 448.00FT. SILT DENSITY(SUBMERGED)= 95.00PCF SILT PRESSURE COEFFICIENT(K)= .33
SHEAR STRESS= 50.00PSI SHEAR WIDTH= 11.00FT. FRICTION FACTOR= .60

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION	PERCENT OF HEADWATER
0.00	0.00
11.00	50.00

****

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	13.20	6.84	90.24	
HEADWATER	4.49	4.00		17.95
UPLIFT	2.06	7.33		15.10
SILT	1.58	3.33		5.27
			*********	*********
			90.24	38.33

****

NET HORIZONTAL FORCE= 6.07 KIPS
NET VERTICAL FORCE= 11.14 KIPS
NET MOMENT= 51.91KIP-FEET
X-BAR OF FOUNDATION REACTION= 4.66 FEET
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= .84 FEET
FOUNDATION REACTION PRESSURES********TOE= 10.24 PSI********HEEL= 3.82 PSI********
OVERTURNING FACTOR OF SAFETY= 2.35
SLIDING FACTOR OF SAFETY= 1.10
DEVELOPED FRICTION FACTOR (NO SHEAR)= .55
SLIDING WITH SHEAR FACTOR OF SAFETY= 14.14(SHEAR ACROSS FULL BASE WIDTH)

STABILITY ANALYSIS-CHADWICK LAKE SPILLWAY
NORMAL POOL AND EARTHQUAKE(A=.025G)

[illegible] FT. TOP ELEVATION= 450.00FT. BASE WIDTH= 11.00FT. DENSITY= 145.00PCF
[illegible] ELEVATION= 450.00FT. TAILWATER ELEVATION= 0.00FT. EARTHQUAKE ACCELERATION=.025G (HORIZ),.000G (VERT)
[illegible] FT. SILT DENSITY(SUBMERGED)= 95.00PCF SILT PRESSURE COEFFICIENT(K)= .33
[illegible] PSI SHEAR WIDTH= 11.00FT. FRICTION FACTOR= .60

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION	PERCENT OF HEADWATER
3.00	0.00
11.00	50.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	13.20	6.84	90.24	
HEADWATER	4.49	4.00		17.95
UPLIFT	2.06	7.33		15.10
EARTHQUAKE INDUCED LOADINGS				
INERTIA-WATER	.12	4.80		.59
HORIZONTAL INERTIA-DAM	.33	5.06		1.67
SILT	1.58	3.33		5.27
			90.24	40.58

NET HORIZONTAL FORCE= 6.53 KIPS
NET VERTICAL FORCE= 11.14 KIPS
NET MOMENT= 49.66KIP-FEET
X-BAR OF FOUNDATION REACTION= 4.46 FEET
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 1.04 FEET
FOUNDATION REACTION PRESSURES*******TOE= 11.02 PSI*******HEEL= 3.04 PSI********
OVERTURNING FACTOR OF SAFETY= 2.22
SLIDING FACTOR OF SAFETY= 1.02
DEVELOPED FRICTION FACTOR (NO SHEAR)= .59
SLIDING WITH SHEAR FACTOR OF SAFETY= 13.16(SHEAR ACROSS FULL BASE WIDTH)

STABILITY ANALYSIS-CHADWICK LAKE SPILLWAY
MAXIMUM NONOVERTOPPING POOL

BASE ELEVATION= 438.00FT. TOP ELEVATION= 450.00FT. BASE WIDTH= 11.00FT. DENSITY= 145.00PCF
HEADWATER ELEVATION= 455.00FT. TAILWATER ELEVATION= 445.00FT. EARTHQUAKE ACCELERATION***.000G (HORIZ)..000G (VERT)
SILT ELEVATION= 448.00FT. SILT DENSITY(SUBMERGED)= 95.00PCF SILT PRESSURE COEFFICIENT(K)= .33
SHEAR STRESS= 50.00PSI SHEAR WIDTH= 11.00FT. FRICTION FACTOR= .60

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION	PERCENT OF HEADWATER
0.00	30.00
11.00	50.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	13.20	6.84	90.24	
HEADWATER	8.24	4.91		40.44
TAILWATER	1.53	2.33	3.56	
UPLIFT	4.67	5.96		27.81
SILT	1.58	3.33		5.27
			*********	*********
			93.80	73.52

NET HORIZONTAL FORCE= 8.29 KIPS
NET VERTICAL FORCE= 8.53 KIPS
NET MOMENT= 20.28KIP-FEET
X-BAR OF FOUNDATION REACTION= 2.38 FEET
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 3.12 FEET
**********FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE*****TENSION AT HEEL OF DAM*****
FOUNDATION REACTION PRESSURES*******TOE= 14.55 PSI*******HEEL= -3.78 PSI*******
OVERTURNING FACTOR OF SAFETY= 1.28
SLIDING FACTOR OF SAFETY= .62
DEVELOPED FRICTION FACTOR (NO SHEAR)= .97
SLIDING WITH SHEAR FACTOR OF SAFETY= 10.17(SHEAR ACROSS FULL BASE WIDTH)

STABILITY ANALYSIS-CHADWICK LAKE SPILLWAY
NORMAL POOL AND ICE LOAD

BASE ELEVATION= 439.00FT. TOP ELEVATION= 450.00FT. BASE WIDTH= 11.00FT. DENSITY= 145.00PCF
HEADWATER ELEVATION= 450.00FT. TAILWATER ELEVATION= 0.00FT. EARTHQUAKE ACCELERATION***.000G (HORIZ),.000G (VERT)
SILT ELEVATION= 446.00FT. SILT DENSITY(SUBMERGED)= 95.00PCF SILT PRESSURE COEFFICIENT(K)= .33
SHEAR STRESS= 50.00PSI SHEAR WIDTH= 11.00FT. FRICTION FACTOR= .60

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION	PERCENT OF HEADWATER
0.00	0.00
11.00	50.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	13.20	6.84	90.24	
HEADWATER	4.49	4.00		17.95
UPLIFT	2.06	7.33		15.10
SILT	1.58	3.33		5.27
ICE LOAD	5.00	11.00		55.00
			*********	*********
			90.24	93.33

NET HORIZONTAL FORCE= 11.07 KIPS
NET VERTICAL FORCE= 11.14 KIPS
NET MOMENT= -3.09KIP-FEET
X-BAR OF FOUNDATION REACTION= -.28 FEET
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 5.78 FEET
**********FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE*****TENSION AT HEEL OF DAM*****
FOUNDATION REACTION PRESSURES*******TOE= 29.18 PSI*******HEEL= -15.12 PSI*******
OVERTURNING FACTOR OF SAFETY= .97
SLIDING FACTOR OF SAFETY= .60
DEVELOPED FRICTION FACTOR (NO SHEAR)= .99
SLIDING WITH SHEAR FACTOR OF SAFETY= 7.75(SHEAR ACROSS FULL BASE WIDTH)