

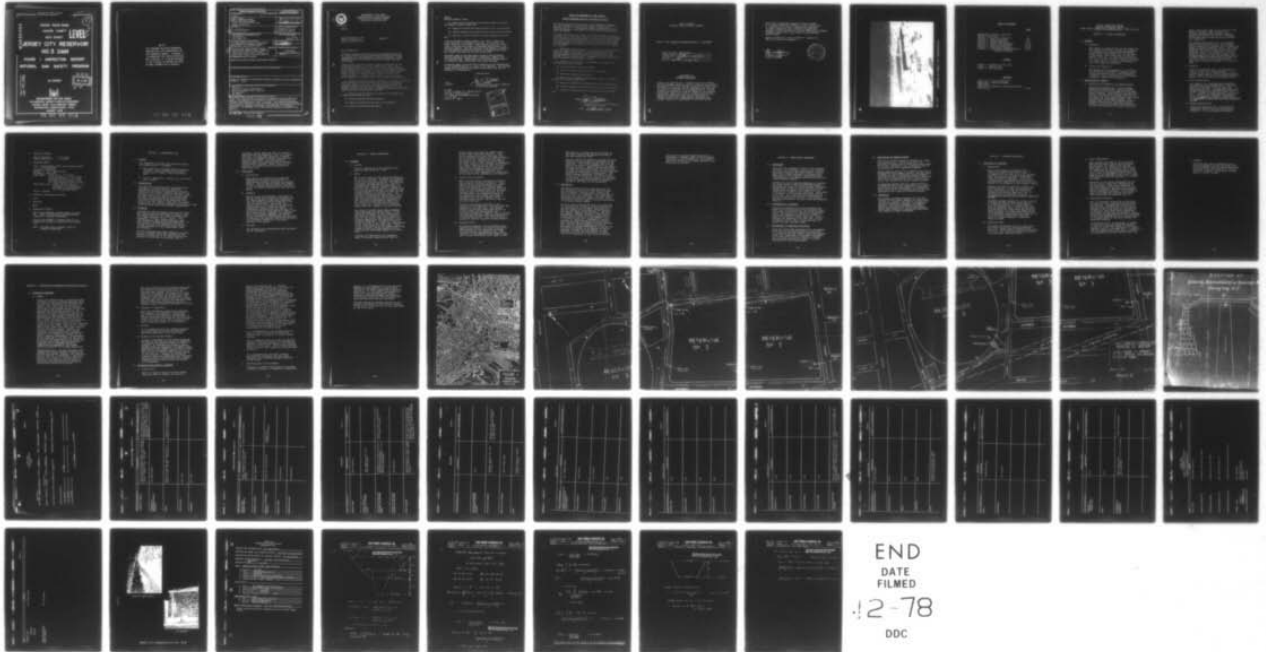
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NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2  
NATIONAL DAM SAFETY PROGRAM. JERSEY CITY RESERVOIR NUMBER 3 DAM--ETC(U)  
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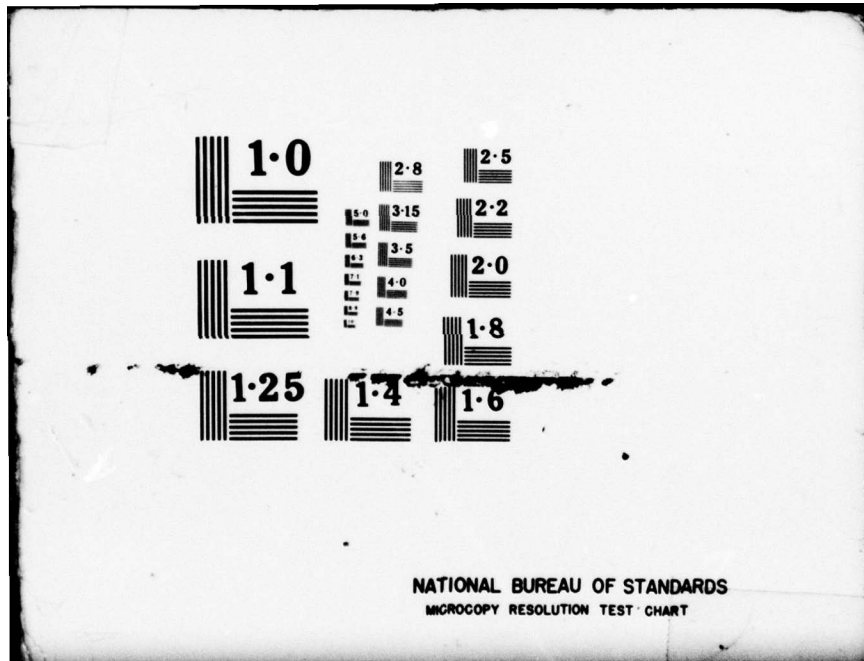
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HUDSON RIVER BASIN

HUDSON COUNTY

NEW JERSEY

**LEVEL**

**JERSEY CITY RESERVOIR  
NO.3 DAM**

**PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM**

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NJ 00524

DDC  
OCT 10 1978  
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**DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE - 2D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106**

**AUGUST 1978**

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00524	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Jersey City Reservoir No. 3 Dam Hudson County, N.J.		5. TYPE OF REPORT & PERIOD COVERED <b>9</b> FINAL rept.
7. AUTHOR(s) <b>10</b> F. Keith/Jolls P.E.		6. PERFORMING ORG. REPORT NUMBER
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18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams--N.J. National Dam Safety Program Phase I Jersey City Reservoir No. 3 Dam, N.J. Dam Inspection Dam Safety		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

JAB



IN REPLY REFER TO

NAPEN-D

DEPARTMENT OF THE ARMY  
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS  
CUSTOM HOUSE-2 D & CHESTNUT STREETS  
PHILADELPHIA, PENNSYLVANIA 19106

Honorable Brendan T. Byrne  
Governor of New Jersey  
Trenton, New Jersey 08621

19 SEP 1973

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Jersey City Reservoir No. 3 Dam in Hudson County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given on the first three pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Jersey City Reservoir No. 3 Dam, a high hazard potential structure, is judged to be in fair overall condition. It is a pumped storage reservoir fed by pipelines from Boonton Reservoir, and has no natural stream inflow. Since there is sufficient storage volume to contain the Probable Maximum Precipitation (PMP) event without overtopping, a spillway is not required. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one year from the date of approval of this report, engineering studies and analyses should be performed by a qualified professional consultant, engaged by the owner, to perform further foundation and structural stability studies, including investigation of the rip-rap sloughing and leak in the west wall. Any remedial measures found necessary should be initiated within calendar year 1979.

b. Within one year from the date of approval of this report, the following actions should be taken.

- (1) Provide additional drawdown capability.
- (2) Clear the overflow pipe and restore it to operation.
- (3) Provide an alarm and warning system.

NAPEN-D  
Honorable Brendan T. Byrne

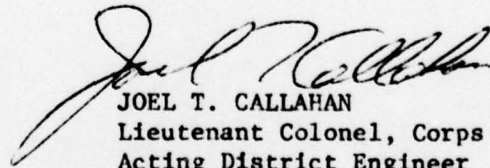
- (4) Remove brush and sapplings from the earth portion of the walls and maintain a suitable ground cover.
- (5) Repoint and maintain the mortared surfaces of the exterior walls.
- (6) Consider upgrading and automating the gate house control equipment.
- (7) Establish a system of periodic dam safety inspections for this dam.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Joseph LeFante of the Fourteenth District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,

  
JOEL T. CALLAHAN  
Lieutenant Colonel, Corps of Engineers  
Acting District Engineer

1 Incl  
As stated

Cy furn:  
Mr. Dirk C. Hofman, P.E., Deputy Director  
Division of Water Resources  
N. J. Dept. of Environmental Protection  
P.O. Box 2809  
Trenton, NJ 08625

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JERSEY CITY RESERVOIR NO. 3 DAM (NJ00524)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

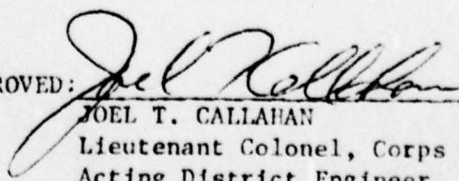
This dam was inspected on 24 June 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

The Jersey City Reservoir No. 3 Dam, a high hazard potential structure, is judged to be in fair overall condition. It is a pumped storage reservoir fed by pipelines from Boonton Reservoir, and has no natural stream inflow. Since there is sufficient storage volume to contain the Probable Maximum Precipitation (PMP) event without overtopping, a spillway is not required. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Within one year from the date of approval of this report, engineering studies and analyses should be performed by a qualified professional consultant, engaged by the owner, to perform further foundation and structural stability studies, including investigation of the rip-rap sloughing and leak in the west wall. Any remedial measures found necessary should be initiated within calendar year 1979.

b. Within one year from the date of approval of this report, the following actions should be taken.

- (1) Provide additional drawdown capability.
- (2) Clear the overflow pipe and restore it to operation.
- (3) Provide an alarm and warning system.
- (4) Remove brush and sapplings from the earth portion of the walls and maintain a suitable ground cover.
- (5) Repoint and maintain the mortared surfaces of the exterior walls.
- (6) Consider upgrading and automating the gate house control equipment.
- (7) Establish a system of periodic dam safety inspections for this dam.

APPROVED: 

JOEL T. CALLAHAN

Lieutenant Colonel, Corps of Engineers  
Acting District Engineer

DATE: 19 September 1978

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Jersey City Reservoir No. 3 NJ 00524

State Located New Jersey  
County Located Hudson  
Coordinates Lat.4044.4 - Long.7403.5  
Stream None  
Date of Inspection 24 June 1978

ASSESSMENT OF  
GENERAL CONDITIONS

Jersey City Reservoir No. 3 appears to be in a stable but questionable condition and is in need of wall repair. Escalation of the leak through the west wall could lead to hazardous settlement of the embankment and eventual collapse or breaching of the perimeter walls. Failure could cause significant property damage to surrounding residential areas and result in a major loss of life. Sufficient engineering data was not available to adjudge anything but a questionable assessment and further studies are recommended in the near future.

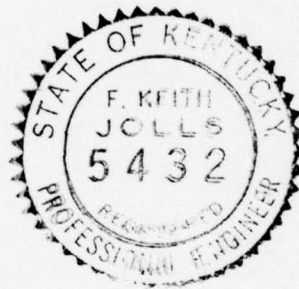


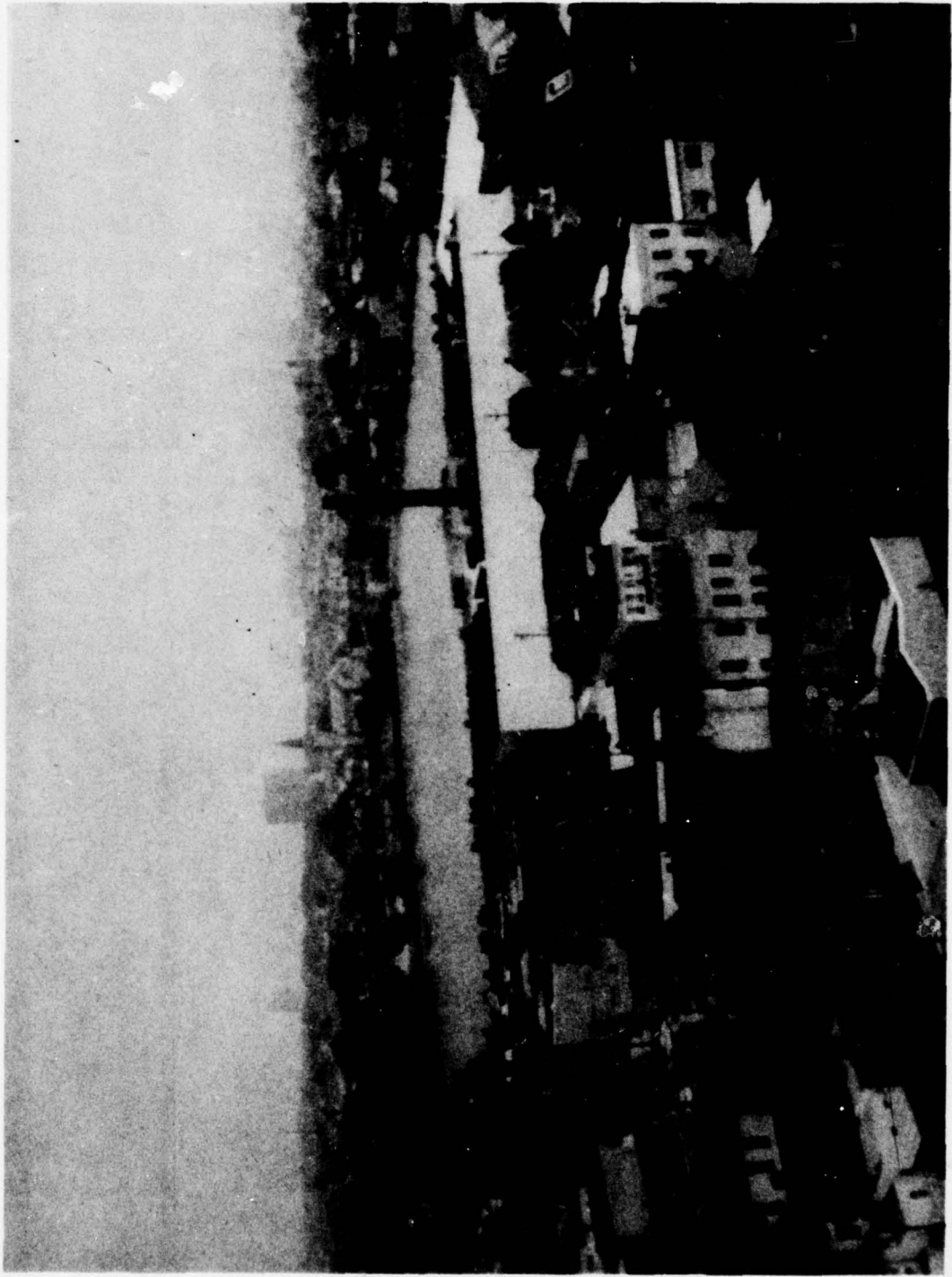
Additional recommended remedial actions include:

- 1) an alarm system be installed
- 2) the overflow pipe be cleared and returned to controllable operation
- 3) remove vegetation root systems
- 4) upgrade and automate control equipment
- 5) provide additional drawdown/discharge capability in the form of a distribution system bypass.

There is sufficient storage volume to contain the PMP event without overtopping.

  
F. Keith Jolls P.E.  
Project Manager





JULY 1978

OVERVIEW OF JERSEY CITY RESERVOIR # 3

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PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM JERSEY CITY RESERVOIR NO. 3 FED# NJ 00524

SECTION 1 - 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 FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Jersey City Reservoir No. 3 and appurtenant structures, and to determine if it constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Reservoir and Appurtenances

Jersey City Reservoir No. 3 is a man-made, earth-filled, rectangular masonry structure utilized by the City of Jersey City for water supply purposes. Constructed in the late 19th century, the reservoir is about 2900 feet in perimeter with walls ranging from six to fifteen feet above the surrounding streets. The exterior face of the walls consists of ashlar masonry which rests on a concrete footing founded on bedrock. The earth fill portion of the wall section contains a puddle core which

ranges from 4 feet wide at the top to 6.5 feet thick at the base. The interior face consists of spall-backed riprap on slopes ranging from 1.5:1 to 2:1 to 1:1. The walls are 25 feet thick at the top and are covered with vegetation.

The influent gate house is on the northwest corner of the reservoir wall. The influent piping consists of 5 gravity-flow 16" mains with manually operated butterfly valves. The screen house and 36" effluent pipe is located at the southeast corner of the reservoir. The only other structure on the reservoir wall is an abandoned gate house near the southwest corner. A large diameter overflow pipe is located near the screen house at invert elevation 126. This pipe is reportedly plugged at the present time.

b. Location

Jersey City Reservoir No. 3 is located in the City of Jersey City, Hudson County. It is bounded on the east by Central Avenue, on the west by Summit Avenue, on the north by Reservoir Avenue, and on the south by Jefferson Street.

c. Size Classification

The reservoir is a man-made pool completely surrounded by stone masonry walls. The walls range in height from 6' to 15' above the surrounding streets. The hydraulic head at the designed normal pool elevation ranges from 2' to 12'. Storage at that elevation is 132 acre-feet. Based on the foregoing, the reservoir is in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

Jersey City Reservoir No. 3 is located in a residential area of the city known as the "Heights". It is surrounded by apartment



buildings, private residences, small businesses and a community park and swimming pool. To the immediate south and downslope are a depressed highway, a railroad track in deep cut, a railroad tunnel, a public school, a fire station, a hospital and several major traffic arteries. Failure of the containing walls could cause very extensive property damage and a calamitous loss of life. Accordingly, Jersey City Reservoir No. 3 is classified as high hazard.

e. Ownership

The reservoir is owned by the City of Jersey City, City Hall, 280 Grove Street, Jersey City, New Jersey, 07302.

f. Purpose of Dam

The reservoir is utilized as an in-city water supply which, owing to the elevation of its location, provides most of Jersey City with potable water by gravity flow.

g. Design and Construction History

This Jersey City reservoir was apparently designed by personnel of the Jersey City Board of Public Works in the year 1873. Details of construction are unknown at this time although various plans indicate a history of continuing revisions and upgrading of appurtenances since the original construction.

h. Normal Operating Procedures

City personnel are on duty at Reservoir No. 3 on a 24 hour/day schedule. Apart from grounds keeping and weather station observations, major duties of these personnel consist of monitoring and control of water levels in the reservoir. The water pressure in the mains is recorded automatically on 24-hour charts. Water levels are recorded hourly from a stage gage near the gate house. Normal operations appear to be carried out by an experienced, competent staff.

With the exception of periods of very high water usage during the summer months, the water level in the reservoir is adjusted only once a day. Water level in the reservoir is normally allowed to be drawdown slightly during the daylight hours. In the evening when water usage decreases, the inflow is increased and the reservoir is allowed to refill to the operating elevation by gravity flow from the Boonton Reservoir. Every morning the day shift readjusts the influent valves.

1.3 PERTINENT DATA

a. Drainage Area

Not applicable. All inflow to the reservoir is via transmission lines from Boonton Reservoir. Catchment area at the reservoir is 11.5 acres.

b. Discharge from Reservoir

Maximum discharge capacity of the effluent line is 150 cfs at a hydraulic head of 23'. (Theoretical - limited by city consumption).

c. Elevation (Ft. above MSL)

Top of reservoir walls	-	130.0
Normal design pool	-	126.0
Operating pool	-	122.5 - 123.5
Influent piping invert	-	120.0
Effluent piping invert	-	101.0
Reservoir bottom	-	100.0
Surrounding streets	-	114.0 to 124.0

d. Reservoir

Length of maximum pool - 1000 feet (+)

e. Storage

Normal design pool	-	132 acre-feet
Top of reservoir	-	178 acre-feet

f. Reservoir Surface

Top of reservoir - 11.5 acres  
Normal design pool - 11.2 acres

g. Reservoir Walls

Type - Stone masonry face; spall backed riprap  
interior slope.

Perimeter - 2880 feet

Height - 6' to 15' above street

Top Width - 25.0 feet

Side Slopes - Outer face: 1:12 batter;  
interior slope is 1.5 to 1 down  
to elevation 118.0, 2 to 1 from  
elevation 118.0 to 112.0, and 1  
to 1 from elevation 112.0 to 100.0.

Impervious Core - Puddle core 4' wide at  
elevation 128.0 increasing in  
thickness to approximately  
6.5' at elevation 100.0.

Zoning - Unknown

h. Diversion and Regulating Tunnel

None

i. Spillway

None

j. Regulating Outlets

One 36 inch diameter effluent pipe at invert  
101. One 36" inch diameter overflow pipe at  
invert 126 (plugged at present).

Five 16 inch diameter influent pipes (2 are  
inoperative and one is subverted for facility  
use).

Note: All pipe sizes hereafter refer to  
diameter dimensions.



## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

The information available for review of Jersey City Reservoir No. 3 included:

- 1) Many engineering drawings depicting piping, stonework, superstructures and building details which ranged in date from 1873 to 1954.
- 2) U.S.G.S. Quadrangle - Jersey City, New Jersey scale 1:24000.

### 2.2 CONSTRUCTION

Few construction drawings were available which, although not clearly labeled, apparently represented as-builts or construction progress drawings of the masonry stonework portion of the reservoir wall in the vicinity of the gate house. No other construction reports or drawings were available and nothing more is known concerning the actual construction which apparently took place in the late 1800's. There does not appear to have been any structural changes or additions to the reservoir walls since the original construction.

### 2.3 OPERATION

Although the original design indicated the normal pool level would be maintained at elevation 126, the present practice is to keep the water level at a lower elevation (122.5 - 123.5). This expediency is in part necessitated by a small leak through the west wall at elevation 123. It also serves to provide additional freeboard storage capacity to accommodate heavy rainfall or reduce pressure in the transmission lines from Boonton.

The 36" discharge pipe always remains in an open position although valves are available on the reservoir grounds and in the street outside the reservoir to shut down the effluent pipe if

necessary. While there are five 16" influent pipes entering the reservoir, only one is being utilized. A second pipe serves as a standby and a third is capped to provide water for the reservoir facilities. The two remaining influent pipes are inoperative due to broken or malfunctioning controls. Water levels in the reservoir are checked hourly and adjusted at least once a day.

#### 2.4 EVALUATION

##### a. Availability

While there are numerous old engineering drawings pertaining to Reservoir No. 3, they consist primarily of piping or building details. Nothing was available with respect to the structural design criteria, specifications, or stability analysis for the reservoir walls.

##### b. Adequacy

Review of the one structural (see Figure 3) and two construction drawings indicates that the design appears to have been consistent with the prevailing state-of-the-art at the time of construction. The design and construction of the reservoir has obviously withstood the test of time and field inspections indicate that the reservoir was well built and the walls appear to date, to be structurally sound. However, the available data is considered inadequate for design review and further investigations are required to ascertain the physical conditions and assess the structural stability of the entire perimeter wall system.

##### c. Validity

The validity of the engineering data available is not challenged.



## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

#### a. General

On-site inspections of the reservoir took place on June 24 and 30, 1978.

#### b. Walls

The exterior walls of the Reservoir appear to be in fair condition. Alignment and plumbness of the walls are quite true and only superficial mortar cracking was noted. A slight leak or seepage was observed one foot above the sidewalk level near the southwest corner of the west wall on Summit Avenue. Communication with City personnel on duty indicates the leak is approximately at elevation 123 MSL and has existed unchanged for several years. The reservoir was reportedly lowered some 5 years ago and an inspection of the riprap surface near the leak was performed by personnel of the engineering department of Jersey City. No corrective action has been taken since that inspection. Copies of the inspection report were not located in the City records.

The interior sloping faces appear somewhat less sound than the exterior walls. A few inches of settlement of the riprap blocks was noted at several locations, notably at a point on the inside slope of the west wall directly opposite the leak described in the preceding paragraph. In addition, several inches of creep of the riprap was noted further to the north along this same slope. Minor lineal irregularities of the slopes were noted around the entire inside perimeter of the reservoir but these slips appear to be quite old.

Although not observed by the inspection team, it has been reported that there is

another small leak near the eastern corner of the north rim of the reservoir. This leak reputedly occurs when the water level in the reservoir is near its maximum elevation and is said to be smaller than the leak on the western rim. During the winter months the water level in this reservoir is maintained at a lower elevation in an effort to control both leaks. The top of the wall is grass covered earth embankment and in some areas overgrown with brush and saplings. No settlement or other detrimental irregularities of the crest of the embankment were observed.

c. Appurtenant Structures

There are three major structures located on the perimeter rim of the reservoir. These consist of the existing control (or "gate") house containing five 16" influent pipes (and their respective mechanically operated gates) on the northwest corner of the basin; a screen house, 36" overflow pipe, and 36" effluent pipe at the southeast corner of the reservoir; and a former gate house on the western rim of the reservoir which contains pumps, valves, and piping that are no longer utilized.

The house and piping facilities on the western rim have apparently been shut down and inoperative for many years. The present influent and effluent structures as well as their controls and appurtenances are extremely antiquated. However, they do perform the functions for which they were designed in a satisfactory manner. The overflow pipe is plugged at present (location of plug unknown).

d. Reservoir Area

The general condition of the reservoir area appears satisfactory. No signs of excessive deterioration to the containing structure was noted despite its advanced age. Some vandalism to the abandoned gate house on the west rim was observed but this seems to have

been kept at a minimum due to the height of the walls, fencing and personnel on duty in the area around the clock.

The main tunnel of the Erie-Lackawanna Railroad passes below and slightly to the south of the reservoir. Some slight seepage flow into the tunnel has occurred continuously for at least the past 35 years. Despite routine maintenance and some special grouting work, the flow rate of about 10 gallons per minute has not noticeably increased or decreased in recent years. The tunnel seepage apparently is greater in the vicinity of the reservoir, but is not limited to that area. It was not possible to attribute the tunnel seepage exclusively to reservoir leakage on the basis of the inspection.

### 3.2 EVALUATION

The primary concern of the inspection team was the structural integrity of the reservoir walls and the hydraulic controls which regulate the water elevation and consequently the pressures to which the walls are subjected. The major aspect regarding the hydraulic controls relates to the overtopping potential should a control malfunction or an outlet become plugged.

The only visual indications which call attention to the structural integrity of this reservoir is the leak which occurs at water elevation 123.0 and the movement or settlement of the riprap on the interior slope of the reservoir. The movement appears somewhat limited in extent but no records are available as to the actual amount of settlement, the time of the movement, or if it is still continuing. Although all visible surfaces are highly weathered which indicates that movement may have ceased or slowed considerably, the leak which apparently led to the settlement is probably symptomatic of the age of the structure and may be a precursor of future problems. Because the leak appears to have stabilized over the last five years, no undue concern was expressed as long as the lower pool



level and the constant monitoring vigil is maintained. Likewise, there is small concern regarding the old equipment as its condition has little effect on the safety aspects of the reservoir wall system.

2.1.1. EVALUATION

The primary concern of the Inspector is the structural integrity of the reservoir wall and the hydrostatic conditions which produce the water pressure and the pressure in the air which the wall is subjected. The water pressure against the reservoir wall is related to the depth of the water in the reservoir and the depth of the water in the air which is subjected to the water pressure. The water pressure in the air is related to the depth of the water in the air which is subjected to the water pressure.

The only visual indication which will indicate to the structural integrity of the reservoir is the loss which occurs at water elevations 15.0 and the movement or settlement of the floor on the interior side of the reservoir. The movement of the floor is related to the extent of the settlement and the amount of settlement. The amount of settlement is related to the depth of the water in the air which is subjected to the water pressure. The water pressure in the air is related to the depth of the water in the air which is subjected to the water pressure. The water pressure in the air is related to the depth of the water in the air which is subjected to the water pressure.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There are city personnel on duty at the reservoir 24 hours a day including (4 men on the day shift and 2 men on each of the night shifts). Routine operations consist primarily of regulating the water level in the reservoir, monitoring flows and pressures in the piping system and maintaining a small weather station.

Although the normal pool was designed at elevation 126, water level is usually maintained between elevation 122.5 and 123.5 during normal operations. The butterfly valves to one of the five 16 inch intake pipes is opened in the evening and the reservoir is allowed to fill overnight. The inflow is decreased in the morning and usually remains so all day. Water use and piping pressures are monitored and recorded hourly. At the present time all operations in the gate house are conducted manually.

### 4.2 MAINTENANCE OF RESERVOIR

There do not seem to be any set procedures for inspection or maintenance of the reservoir other than mowing the grass on the top of the reservoir walls. The present city policy with respect to maintenance apparently limits that function to repair of critically urgent items only. While a proposal was submitted a few years ago to grout the western rim in order to seal the leak, no action, to date, has been taken.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

There are plans under preparation for new pumping facilities to the piping system and eventually it is planned that the valves, regulating devices, water level recordings, and monitoring equipment in the gate house will be automated. However, due to funding limitations, there is no date scheduled for these improvements.



#### 4.4 DESCRIPTION OF WARNING SYSTEM

There is no warning system in existence at Jersey City Reservoir No. 3 which would alert the operators to malfunction or failures in the system or to alert residents in the surrounding area of the possibility of an impending disaster.

Should complete failure of a reservoir wall and an accompanying flood appear imminent, the only means available to warn and evacuate nearby residents would be the public communication media (radio and television) or possibly the use of roving police patrol cars mounted with public address systems.

A subsurface failure could go unnoticed for an extended period of time, depending on its extent, since only a visual observation of a decreasing water elevation in the reservoir would alert the operators to this type of foundation failure.

#### 4.5. EVALUATION

The present procedures employed at this water storage facility appear adequate for day-to-day operations. However, the lack of periodic and specific inspection procedures, the complete absence of an internal hazardous-condition monitoring system as well as an early-warning public alert system is a significant deficiency with respect to safety procedures.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

#### a. Design Data

Water enters Jersey City Reservoir No. 3 either as rainfall over the 11.5 acre catchment area or by one of five 16" influent pipes which are fed by gravity transmission lines from Boonton Reservoir. Since the influent piping is regulated, only rainfall and discharge capabilities were evaluated with respect to the adequacy of the hydraulic design.

Although the size of reservoir is small, the hazard potential is high. A precipitation event equivalent to a PMF was selected to evaluate the hydraulic capacity of the 36" discharge pipe in accordance with the Recommended Guidelines for the Safety Inspection of Dams.

Hydrometeorological Report No. 33 was utilized to obtain the PMP for this region which is 26 inches of rainfall in a 6 hour period. This is equivalent to 1.1 million cubic feet over the catchment area. Since the reservoir is maintained 3 to 4 feet below design level, there is always 7 to 8 feet of freeboard with a corresponding available storage volume of up to 3.9 million cubic feet, more than 3 times the volume necessary to completely contain the PMP.

#### b. Experience Data

No history of excessive flows or dangerously high water levels have been reported from this site. Water level is routinely maintained 2.5 to 3.5 feet below the design elevation of the normal pool (elevation 126.0).

c. Visual Observations

Minor seepage was noted at the base of the west wall on Summit Avenue which confirmed the existence of a leak in the vicinity. Water level in the reservoir at the time of the inspection was at elevation 121.5, about 1.5 feet below the reported elevation of the leak. Thus, no assessment could be made with respect to the magnitude of the leak at normal pool elevation although reputedly, it is minor in nature.

Operation of the control mechanisms for one of the influent pipes were observed during the inspection. These valves appeared to function adequately although two of the five pipes are reportedly shut down and unusable due to inoperative controls. A third pipe is said to be capped and utilized as a direct water supply for the reservoir facility.

d. Overtopping Potential

With all equipment functioning as designed, the potential for overtopping appears almost non-existent. Personnel who are on duty at the gate house 24 hours per day take hourly readings of the water level in the reservoir. If the level rises above normal operating elevations the flow into the reservoir from the gravity transmission lines can be decreased or shut down entirely either at the gate house or by check valves on the lines outside the reservoir facility.

As indicated above, the reservoir is capable of containing the peak hourly PMP rainfall as well as 3 times the rainfall entering the reservoir from a 6 hour PMP event. In addition, the 36" overflow pipe, when open, is capable of accommodating 150,000 cubic feet per hour.



e. Drawdown

Utilizing only the 36" discharge pipe it would be possible to lower the water level in the reservoir from the normal design pool elevation of 126 to elevation 112 (2 feet below the elevation of the lowest adjacent street) in about 16 days.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

#### a. Visual Observations

Little detrimental evidence was uncovered at Reservoir No. 3 to indicate the existence of a serious instability problem. The settlement of riprap on the interior slope is considered minor in nature although a more serious problem could develop if the cause of the movement is not corrected and higher pool stages are maintained.

Although the joints between the masonry blocks which form the outer portion of the reservoir is need of repointing, the walls were straight, and appear to be in a stable condition overall.

#### b. Design and Construction Data

Design calculations and the original stability analyses were not available for the reservoir. Only one structural drawing (prepared in the 1870's) depicting a section of the walls, core and embankment, was available for review (Figure 3).

The reservoir is apparently founded on the underlying diabase bedrock formation. A concrete footing was poured beneath the exterior walls to correct undulations of the bedrock surface however, the bottom of the reservoir basin is apparently unlined. Since the surface of the bedrock contains numerous cooling fractures and joints it is possible that considerable quantities of water may pass into the underlying fractured bedrock. The bedrock is a very hard diabase of the Palisades formation and its durability is not affected by the passage of water.

c. Operating Records

No records or logs are maintained at this reservoir for operations other than water consumptions, transmission line pressure, and water elevation in the reservoir.

d. Post Construction Changes

No apparent modifications have been made to the walls since their original construction. However, the influent piping and gate house were relocated from the southwest rim of the basin to the northwest corner in the early 1900's to accommodate transmission lines from Boonton Reservoir.

e. Seismic Stability

The reservoir walls are founded on diabase bedrock and is in seismic Zone 1. It may be assumed the seismic forces would have only negligible effect on the structural stability. However, it should be noted that an inactive fault has been mapped immediately to the west of the reservoir. Additional evaluation of this zone may be warranted in light of continuing minor (less than 3 on the Richter Scale) seismic activity along the Ramapo Fault 25 miles to the west.



## SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/REMEDIAL MEASURES

### 7.1 RESERVOIR ASSESSMENT

#### a. Safety

Jersey City Reservoir No. 3, which has stood for about 100 years, appears basically sound and exhibits few signs of its advanced age. However, the slumping of small sections of riprap on the inner slope of the reservoir and a small leak through the wall in the same area warrant additional evaluation. The reservoir which was designed to contain 132 acre feet of water at pool elevation 126 is maintained at approximate elevation 122-123 and therefore only contains about 88 acre feet. While the water level is maintained at its present operational level there would appear to be only minor hazard to the structural integrity of the walls. This is not to imply that a higher water elevation might create a serious structural hazard. However, the condition of the perimeter walls remains extremely questionable and the assessment is subject to the limitations inherent in the visual inspection procedures. An assessment of the magnitude of the leak with the water level at an elevation equal to or higher than the design pool cannot be made since this condition was not observed during the inspections and apparently this higher operating elevation is no longer maintained.

Safeguards exist in the form of backup valve systems which assure standby control of the influent and effluent systems. The reservoir has the capacity to accommodate a PMP event. However, the absence of a backup method of dewatering the reservoir and the lack of a functional overflow system are considered defects which should be corrected.

The close proximity of the numerous waterlines and sewers in the surrounding street system also presents a potential hazard to the reservoir wall system. The bursting of these mains could undermine and collapse the street adjacent to the outer toe of the walls. The resultant loss of passive foundation resistance and increased scour outside the reservoir could present a more serious hazard to the wall structure than an internal overtopping condition.

b. Adequacy of Information

While the information available to evaluate the hydraulic and hydrologic capabilities of the reservoir were adequate, insufficient design and construction data was available to allow a definitive evaluation of the structural stability of the walls. The availability of data is therefore deemed to be inadequate.

c. Urgency

It is recommended that the remedial measures and additional evaluations described below should be undertaken in the near future.

d. Necessity for Further Studies

Further investigation of the riprap sloughing and leak in the west wall should be undertaken to determine the cause and extent of these problems. An evaluation of alarm or warning systems should be undertaken to determine their applicability with respect to the alert requirements of the surrounding community as well as the need for an internal early warning system at the reservoir. Because the structural stability cannot be established with reasonable reliance based on the available data, further foundation and structural stability studies are recommended.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives

There are several courses of action which should be taken to improve the safety of

Jersey City Reservoir No. 3. Further investigation and evaluation of the leak and riprap settlement at the west wall is recommended and some form of corrective action such as grouting or repositioning of the riprap should be undertaken based on the results of the investigation. It is further recommended that the City of Jersey City evaluate their own requirements for an internal alarm system to alert operators of a possible or impending failure. A system of this nature may take the form of an automatic water level recorder with an alarm system to indicate rapid changes in water elevation. In conjunction with an operator's alarm is the requirement for a community warning system to alert residents in the surrounding area of hazardous conditions. This system may take the form of public address devices in conjunction with sirens or roving patrol cars. Both alert systems should be tested at regular intervals and a program should be undertaken to inform nearby residents as to the significance of the alert system.

It is recommended that the plugged overflow pipe be cleared and valves be installed, if none exist at present, to control outflow pressure.

It is recommended that the brush and saplings growing on the earth portion of the walls be removed to prevent root damage to the internal structure of the walls. The mortared surfaces of the exterior walls should be repointed where necessary.

It is suggested that the owner consider upgrading and automating the gate house regulatory and recording equipment sometime in the future.

b. O&M Maintenance and Procedures

Although the present O&M procedures are being diligently pursued in a competent, workmanlike



manner, it is recommended that city personnel employed at the reservoir be additionally trained in the safety inspection of dams and reservoirs. It is further recommended that after training, these personnel conduct frequent, regularly schedule inspections of the facility as well as tests of safety and alarm systems once they are installed.

Standard operating procedures should include periodic maintenance of the exterior surfaces of the walls as well as care of the landscaping on top of the wall.



**FIGURE 1**  
REGIONAL  
VICINITY MAP  
SCALE 1:24,000



CARLTON

AVE

AVE

MONTRÖSE

N

ST

LAKE

TROY

BOULEVARD

A

16"

A

NOTE

A	-	1328	LINE FT OF IRON PICKET FENCE
B	-	70	" " " " " "
C	-	1358	" " " " " " EXPANDED METAL
D	-	619	" " " " " " CYCLONE CHAIN LINK

WHICH INCLUDES 18 LINE FT OF IRON PICKET FENCE

RESERVOIR

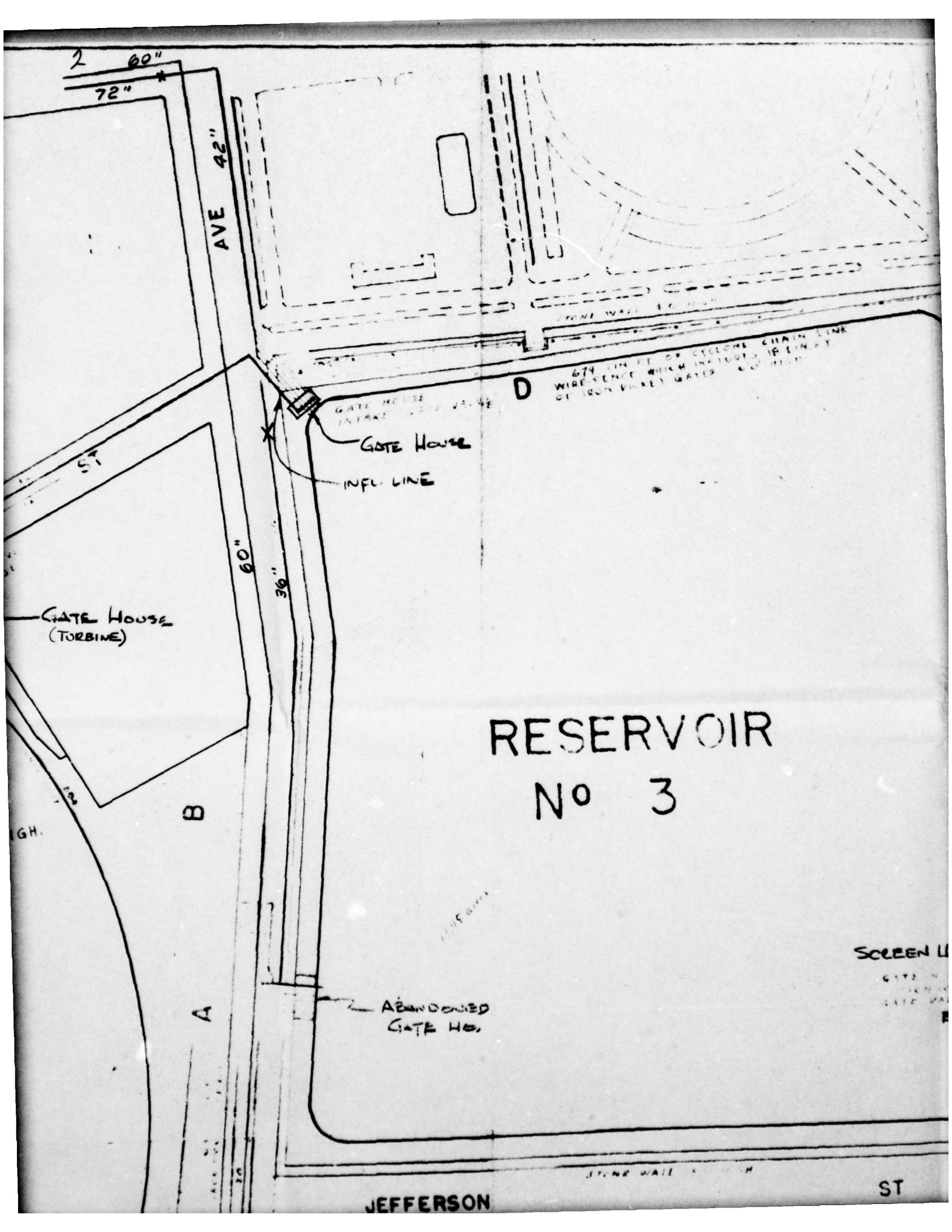
No 2

ST

C

ST





2 60"  
72"

AVE 42"

GATE HOUSE  
(TURBINE)

GATE HOUSE  
INTERNAL VALVE

GATE HOUSE

INFL. LINE

D

674 LIN. FT. OF CYCLOPS CHAIN LINK  
WIRE FENCE WHICH INCLUDES 18 LIN. FT.  
OF IRON PILE GATES 40' HIGH

RESERVOIR

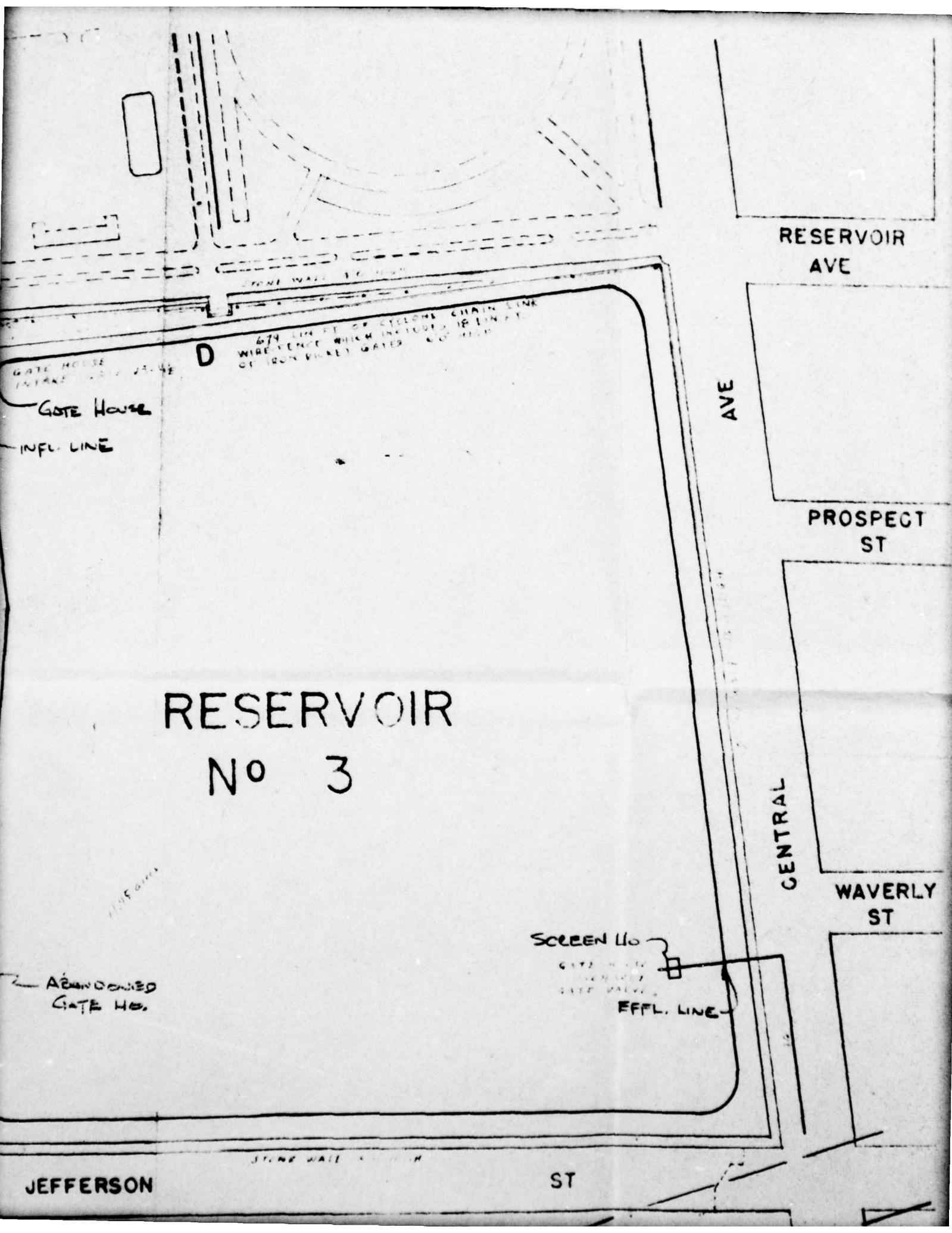
No 3

ABANDONED  
GATE HO.

SCREEN LI

JEFFERSON

ST



RESERVOIR  
AVE

AVE

PROSPECT  
ST

RESERVOIR  
No 3

CENTRAL

WAVERLY  
ST

SCREEN 110

GATE VALVE  
EFFL. LINE

EFFL. LINE

STONE WALL 12' HIGH

JEFFERSON

ST

GATE HOUSE  
INFL. LINE

GATE HOUSE

INFL. LINE

ABANDONED  
GATE HO.

BOULEVARD

CLIFF ST

STAGG ST

SPRUCE

FLOYD ST

HUDSON

ST

ST

GOLLARD

A

C

NOTE  
 A - 1328 LIN FT OF IRON  
 B - 20  
 C - 1358  
 D - 619  
 WHICH INCLUDES 18 LIN FT

RESE  
 N

13300

D

A



16"

16"  $\phi$  INFLUENT LINE

WIRE FENCE 6' HIGH  
METAL CHAIN LINK WIRE FENCE  
IRON PICKET GATES 6'0" HIGH

RESERV  
No 3

RESERVOIR  
2

B

A

ABANDONED GATE HO.

30"  $\phi$  OVERFLOW

SCREEN HOUSE

EFFLUENT PIPING

JEFFERSON

D.L. & W

AVE

SUMMIT

BEACON

LAIDLAW

C

2

# RESERVOIR

## No 3

1155 ft

ABANDONED  
GATE HO.

SCREEN 110

GATE HO.  
SCREEN HO.  
GATE HO.

EFFL. LINE

CENTRAL

WAVERLY  
ST

JEFFERSON

ST

D.L. & W.R.R. TUNNEL

AVE

DEPARTMENT OF PUBLIC WORKS - JERSEY CITY, N. J.

### BUREAU OF WATER

PLAN SHOWING J.C. PROPERTY  
AT HIGH SERVICE AND PRESENT  
PROTECTIVE FENCE.

SCALE: 1"=100'

DESIGNED BY T. J. NEELY  
MAY 15, 1904

Figure 2

CHIEF ENGINEER

19

DIRECTOR

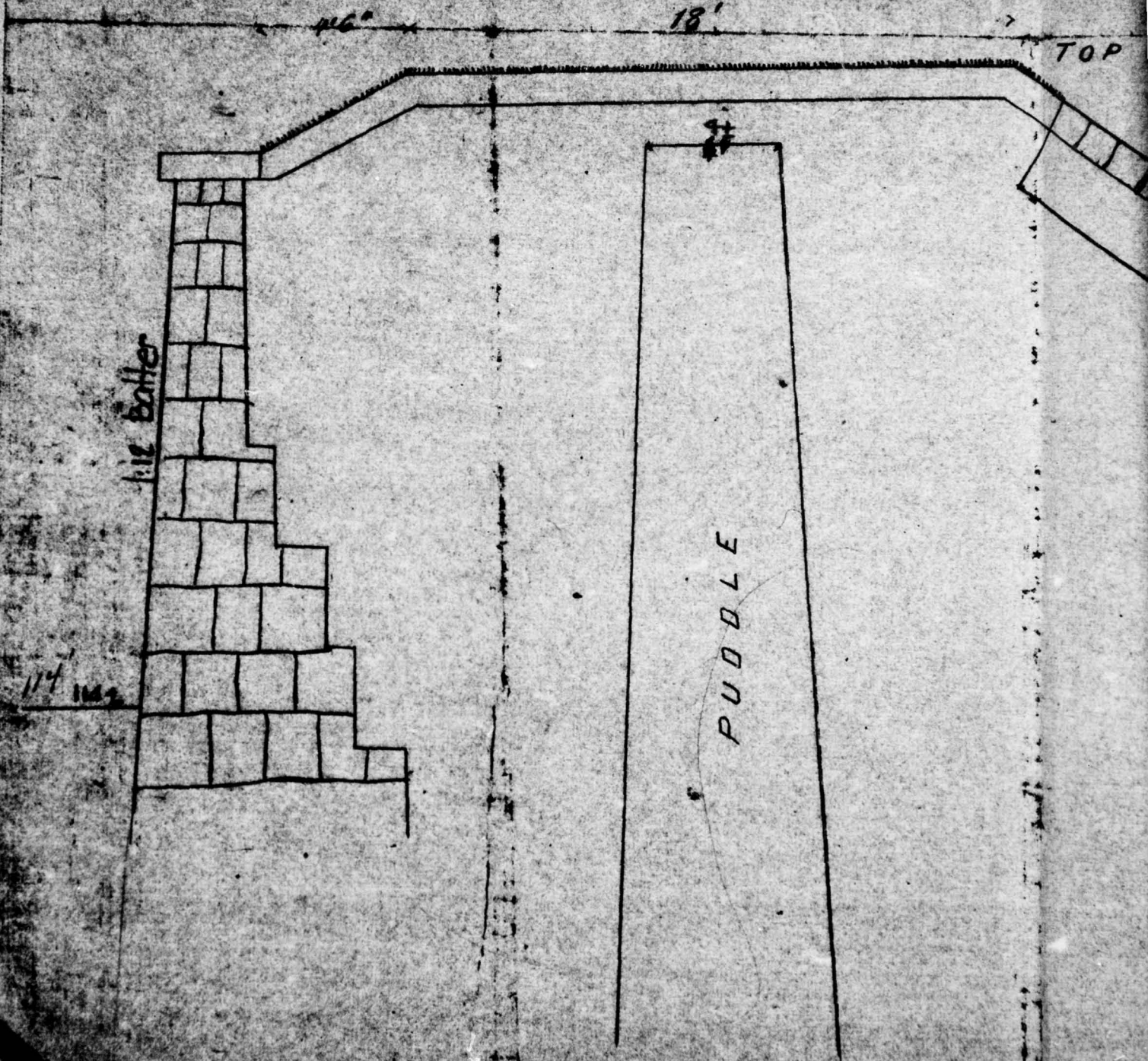
NO. 12-B-23

ACON

AVE



SECTION OF  
*Easterly Embankment of Reservoir No.*  
*Jersey City N. J.*



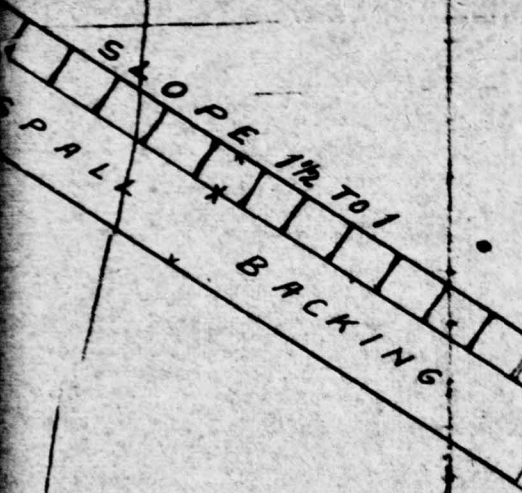
101 25 R



Scale: 1/4" = 1 foot.

BANK ELEVATION 130'

WATER LINE ELEVATION



Elevation 118'

SLOPE 2 TO 1

Scale:  $\frac{1}{4}$  inch = 1 foot.

Jc + 3  
Typ. Wall Section

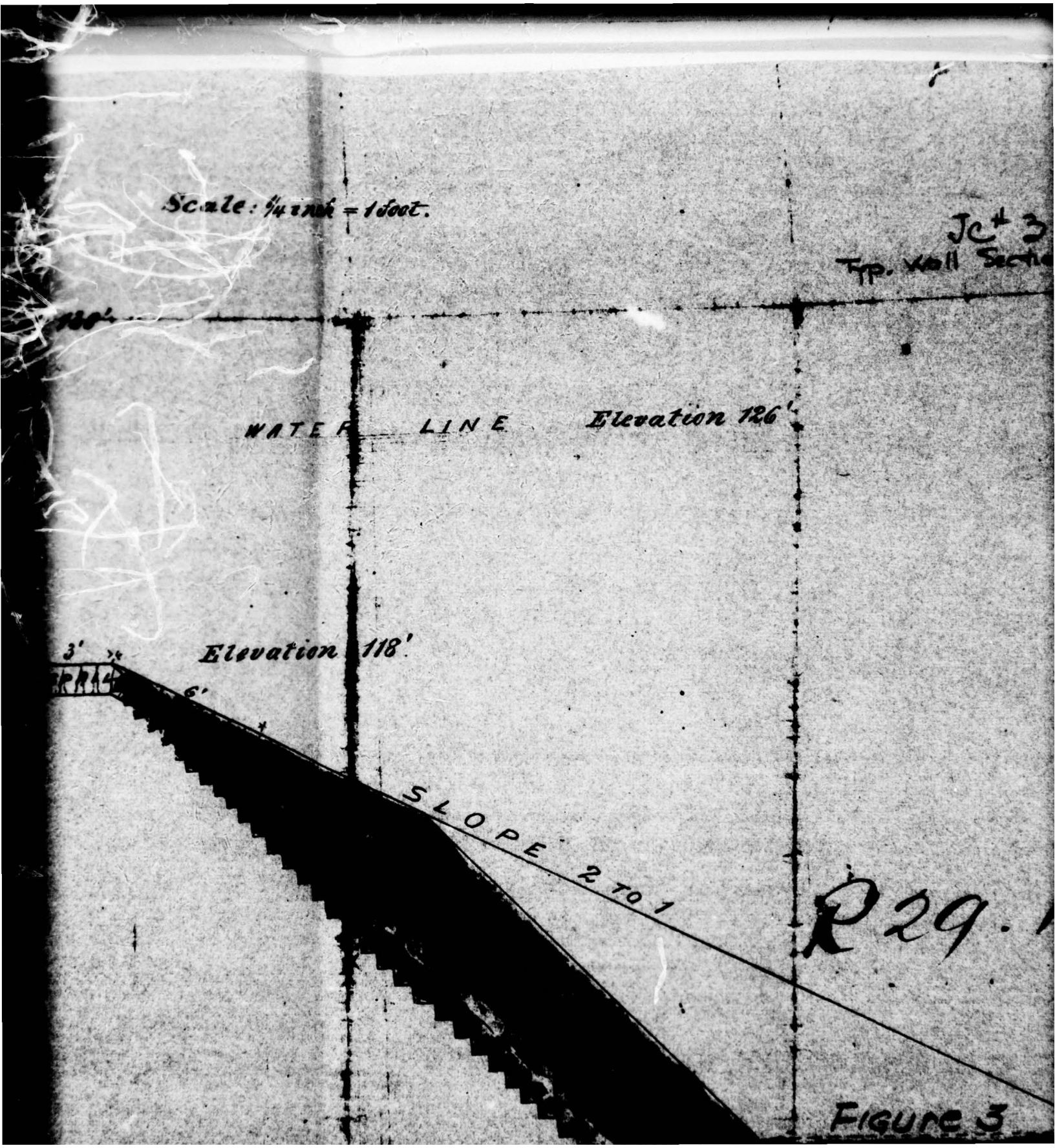
WATER LINE Elevation 126'

Elevation 118'

SLOPE 2 TO 1

R 29.

Figure 3





SHEET 1

Check List  
Visual Inspection  
Phase 1

Reservoir Name ~~XXX~~ Jersey City NO. 3 County Hudson State New Jersey Coordinators NUDEP

Date(s) Inspection June 24, 30, 1978 Weather Overcast Temperature 75 F.

Pool Elevation at Time of Inspection 121.5 M.S.L. Tailwater at Time of Inspection N/A M.S.L.

Inspection Personnel:

K. Jolls \_\_\_\_\_ R. Lang \_\_\_\_\_  
M. Carter \_\_\_\_\_  
T. Chapter \_\_\_\_\_  
T. Chapter Recorder



CONCRETE/MASONRY RESERVOIR

SHEET 2

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Slight leak through masonry of westerly wall observed about a foot above sidewalk level. Approx. elev. 121 MSL	Leak reported to be at elev. 123. Reservoir water level at time of observation about 121.5. - Recommend further evaluation & remedial measures.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not Applicable.	
DRAINS	Water not passing into overflow at approx. elev. 126 MSL - SE corner of Res.	Overflow reportedly plugged. Advise it be reopened.
WATER PASSAGES	None seen.	
FOUNDATION	Not seen.	

CONCRETE/MASONRY DAMS RESERVOIR

SHEET 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Minor cracking of joint mortar between outer wall masonry blocks.	Repointing necessary
STRUCTURAL CRACKING	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT	Outer wall satisfactory	Alignment true. 1:12 batter on walls.
MONOLITH JOINTS	Satisfactory	
CONSTRUCTION JOINTS	Satisfactory	

EMBANKMENT

SHEET 4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed (inner toe of wall under water).	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Movement of riprap described below possibly caused by erosion on settlement of underlying embankment	Suggest further investigation and remedial measures.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Satisfactory	
RIPRAP FAILURES	Some settlement and/or sloughing of riprap on inner western wall.	Suggest further investigation as to cause of settlement and appropriate corrective measures. Cause probably related to leakage on Sheet No. 2.



VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	Seepage through west wall at elev. 123	Suggest further investigation by owner & remedial action in near future
STAFF GAGE AND RECORDER	Water height gage	
DRAINS	Overflow drain at approx. invert. 121-123	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N/A (masonry walls)	
INTAKE STRUCTURE	Not Visible	
OUTLET STRUCTURE	Not Visible	
OUTLET CHANNEL	N/A	
EMERGENCY GATE	N/A	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	



GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	Five 16" intake pipes contain butterfly valves operated manually by wheels in the gatehouse. Stop logs in front of valves.	Only 2 of five intakes are operative or available for use.

INSTRUMENTATION

REMARKS OR RECOMMENDATIONS

VISUAL EXAMINATION

OBSERVATIONS

MONUMENTATION/SURVEYS

None observed

OBSERVATION WELLS

None

WEIRS

None

PIEZOMETERS

None

OTHER

Influent line pressure gages.  
Hourly discharge/rate gage.

RESERVOIR

VISUAL EXAMINATION OF SLOPES	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	Described above	
SEDIMENTATION	Not visible	



DOWNSTREAM CHANNEL

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>CONDITION</u> ( <u>OBSTRUCTIONS,</u> <u>DEBRIS, ETC.</u> )	N/A	
<u>SLOPES</u>	N/A	
<u>APPROXIMATE NO.</u> <u>OF HOMES AND</u> <u>POPULATION</u>	Dense urban area. Pop. estimated at 10's of thousand per square mile.	Unable to be estimated.

SHEET 1

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
JERSEY CITY RESERVOIR NO. 3

ITEM	REMARKS
PLAN OF DAM	Available from J.C.
REGIONAL VICINITY MAP	Available from U.S.G.S. Quad.
CONSTRUCTION HISTORY	Construction circa 1870's
TYPICAL SECTIONS OF DAM	One available from J.C.
HYDROLOGIC/HYDRAULIC DATA	Piping details available from J.C.
OUTLETS - PLAN	Not Available
- DETAILS - CONSTRAINTS - DISCHARGE RATINGS	Available from J.C. Available from J.C. Available
RAINFALL/RESERVOIR RECORDS	Available

ITEMREMARKS

## DESIGN REPORTS

None available

## GEOLOGY REPORTS

None available - Bedrock geology deduced from State  
Geologic mapDESIGN COMPUTATIONS  
HYDROLOGY & HYDRAULICS  
DAM STABILITY  
SEEPAGE STUDIESNot available  
Calculated from piping details and Hydromet. #33.  
Not available  
Not availableMATERIALS INVESTIGATIONS  
BORING RECORDS  
LABORATORY  
FIELDNot available  
Not available  
Not available  
Not available

## POST-CONSTRUCTION SURVEYS OF DAM

Not Available

## BORROW SOURCES.

Unknown



ITEM	REMARKS
MONITORING SYSTEMS	Water level gage at gate house - Water pressure recorders for intake lines - Water consumption (discharge) records.
MODIFICATIONS	Intake functions moved from southwest corner to northwest corner of reservoir in early 1900's.
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	Unknown Not available
MAINTENANCE OPERATION RECORDS	Available

ITEM \_\_\_\_\_ REMARKS \_\_\_\_\_

SPILLWAY PLAN

Not Applicable

SECTIONS

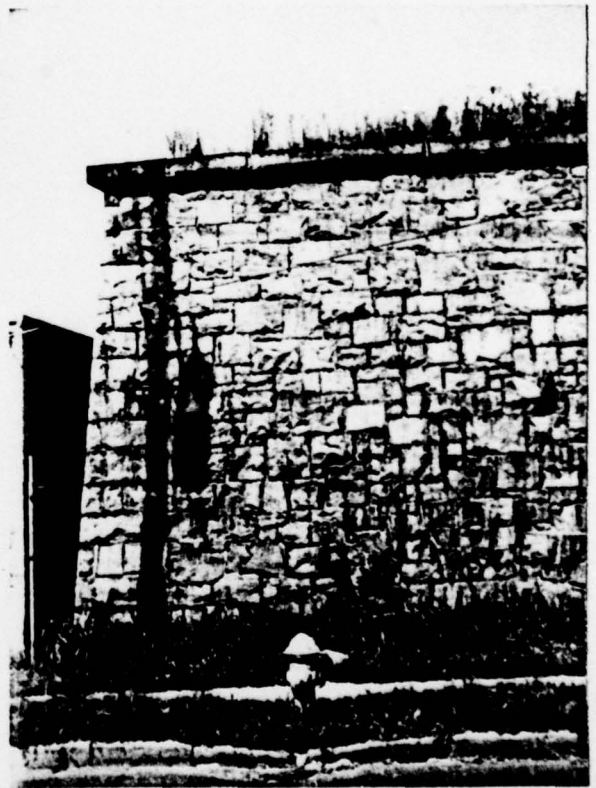
DETAILS

OPERATING EQUIPMENT  
PLANS & DETAILS

Not Available



LEAK AT WEST WALL



SE CORNER

Jc 4 3

JERSEY CITY RESERVOIR # 3 - JULY 1978



CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Not Applicable

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 126 MSL (132 Acre-Feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not Applicable

ELEVATION MAXIMUM DESIGN POOL: 130 MSL (178 Acre-Feet)  
RESERVOIR:

ELEVATION TOP ~~BANK~~: 130 MSL

CREST: Entire perimeter of wall (same elevation)

- a. Elevation 130 MSL
- b. Type Stone Masonry Walls
- c. Width 25 Feet
- d. Length 2880 feet around perimeter
- e. Location Spillover Drain pipe Southeast Corner (El. 126<sup>+</sup>)
- f. Number and Type of Gates None

OUTLET WORKS: \_\_\_\_\_

- a. Type 36" diameter discharge pipe
- b. Location Southeast corner of reservoir
- c. Entrance inverts 101 MSL
- d. Exit inverts Unknown
- e. Emergency draindown facilities Same

HYDROMETEOROLOGICAL GAGES: \_\_\_\_\_

- a. Type Graduated precipitation
- b. Location Next to gate house
- c. Records Hourly readings

MAXIMUM NON-DAMAGING DISCHARGE: 150 cfs (Calculated capacity)\*

\*Actual capacity governed by consumption rate in City Water Supply System.

BY D.J.M. DATE 8-75

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A1 0

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

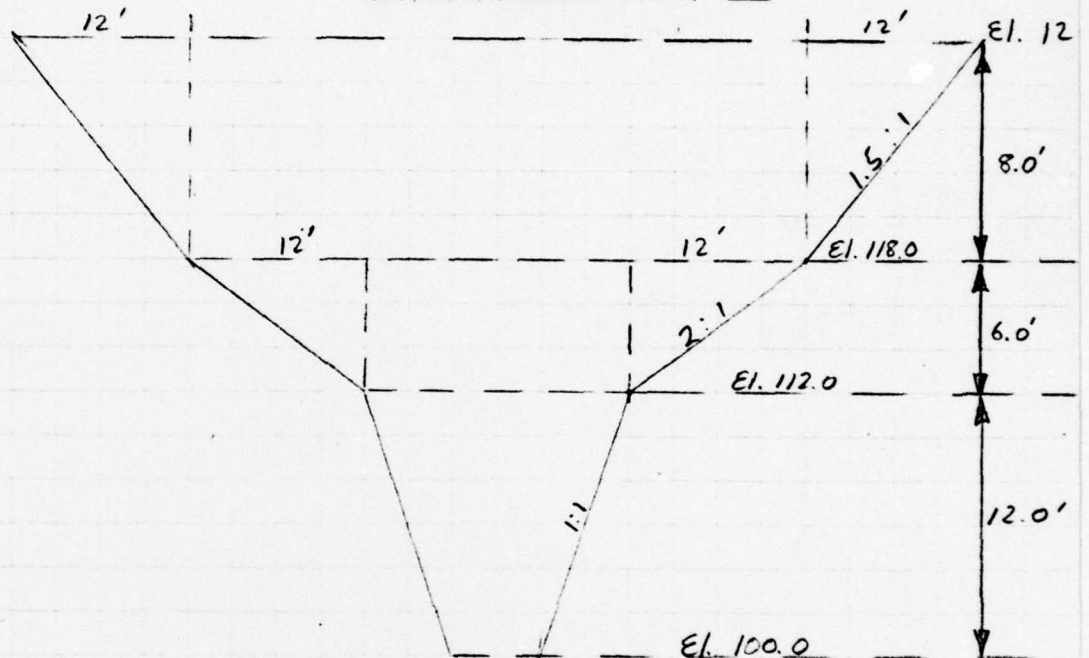
Jersey City Reservoir #3

PROJECT C222

SUBJECT APPROXIMATE DRAWDOWN CALCULATION to El. 112.0

Rectangle 300 x 610

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FROM COPY FURNISHED TO DDC



$$\text{Area at top} = 4.88 \times 10^5 \text{ sq ft } (300' \times 610')$$

$$\begin{aligned} \text{at elevation } 118.0 &= (300 - 24) \times (610 - 24) \\ &= 454736 \text{ sq feet} \end{aligned}$$

$$\begin{aligned} \text{at elevation } 112.0 &= (300 - 48) \times (610 - 48) \\ &= 422624 \text{ sq feet} \end{aligned}$$

Assumptions :

Rate of discharge is limited by the daily consumption

BY DJM DATE 2-76

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A2 OF

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

Jersey City Reservoir

PROJECT C272

SUBJECT \_\_\_\_\_

Drawdown Calculations

Estimated requirements from this reservoir

= 3 million gallons

≈ 401,000 cubic feet / day

Taken in four stages:

① - El. 126 → 122

② - El. 122 → 118

③ - El. 118 → 114

④ - El. 114 → 112

Volume of ① :- (El. 126 → 122)

$$\text{Area at El 122} = \left( \frac{488,000 - 454,736}{8} \times 4 \right) + 454,736 = 471,368 \text{ Sq. ft.}$$

$$\text{Vol} = 471,368 \times 4 + \left( \frac{488,000 - 471,368}{2} \right) \times 4$$

$$= 1,918,736 \text{ cubic feet}$$

$$\text{time} = \frac{1,918,736}{401,000} = 4.78 \text{ days}$$

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Volume of ② (El. 122 → 118)

$$= \left( \frac{471,368 + 454,736}{2} \right) \times 4$$

$$= 1,852,208 \text{ cubic feet}$$



BY D. J. M. DATE 2-78

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A3 OF

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

Jersey City Reservoir  
Drawdown Calculations

PROJECT C222

SUBJECT \_\_\_\_\_

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$$\text{time} = \frac{1,852,208}{401,000} = 4.62 \text{ days}$$

Volume of ③ (El. 118  $\rightarrow$  114)

$$\text{Area at El. 114} = \left( \frac{4,547,336 - 4,226,224}{6} \right) \times 2 + 4,226,224 = 4,333,228 \text{ sq feet}$$

$$Vol = \left( \frac{4,547,336 + 4,333,228}{2} \right) \times 4 \text{ cubic feet}$$

$$= 1,776,128$$

$$\text{Time} = \frac{\text{Rate of Discharge from table} = 121 \text{ cfs}}{1,776,128} \\ = \frac{1,776,128}{401,000}$$

$$= 4.43 \text{ days}$$

Volume of ④ (El. 114  $\rightarrow$  112)

$$= \left( \frac{4,333,228 + 4,226,224}{2} \right) \times 2 = 8,559,452 \text{ cubic feet}$$

$$\text{time} = \frac{8,559,452}{401,000} = 2.13 \text{ days}$$

$$\text{Drawdown time to El. 112.0} = 2.13 + 4.43 + 4.62 + 4.78 = 15.96 \text{ d}$$

BY D. J. M. DATE 8-78

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A4 0

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

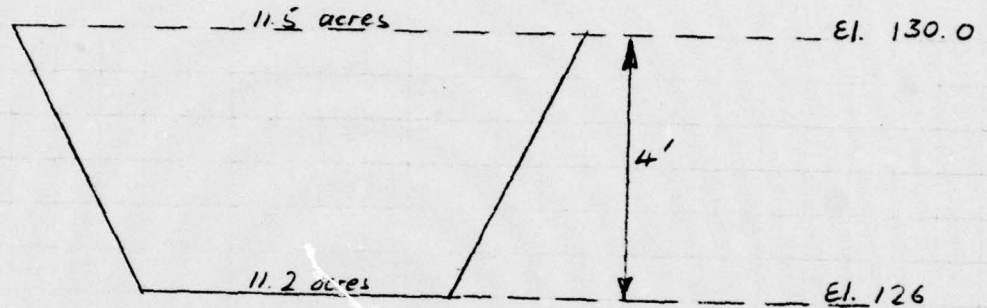
JERSEY CITY DAM

PROJECT C222

SUBJECT \_\_\_\_\_

Storage capacity of reservoir when full

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Volume between El. 126 & El. 130

$$= 11.2 \times 4 + \frac{(11.5 - 11.2) \times 4}{2} = 45.4 \text{ acre feet}$$

Storage below El. 126 = 132 acre feet

$\therefore$  Storage at El. 130 = 177.4

$\approx$  178 acre feet

BY J.C. DATE 5-1-78

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A5 OF 0

CHKD. BY \_\_\_\_\_ DATE \_\_\_\_\_

Jersey City Reservoir No. 3

PROJECT \_\_\_\_\_

SUBJECT Precipitation For PMP Event

From Hydromet. Report No. 33

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6 hour PMP = 26 inches

Catchment area = 11.5 Acre

1 hour = 48% of 6 hour event or 12.48 inches

$$\left( \frac{12.48 \times 11.5}{12} \right) \times 43,560 \approx 521,000 \text{ (ft)}^3/\text{hour (maximum)}$$

$$\left( \frac{26 \times 11.5}{12} \right) \times 43,560 \approx 1,085,000 \text{ (ft)}^3/6 \text{ hour (maximum)}$$