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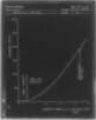
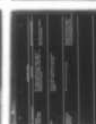
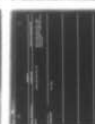
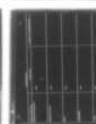
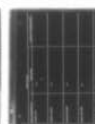
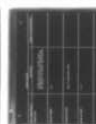
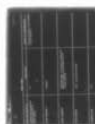
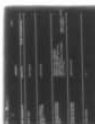
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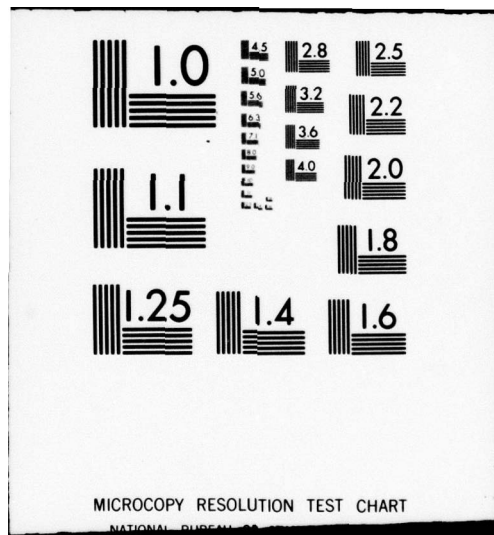
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ATLANTIC COAST BASIN
MILL CREEK, OCEAN COUNTY
NEW JERSEY

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MANAHAWKIN LAKE DAM

NJ 00057

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

Manahawkin Lake Dam (NJ 00057). Atlantic
Coast Basin, Mill Creek, Ocean County,
New Jersey. Phase 1 Inspection Report.



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Final rept.,

Richard J. /McDermott

DACW61-78-C-0124

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JUN 1 1979

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table><tbody><tr><td>Dams</td><td>Safety</td></tr><tr><td>Embankments</td><td>Visual Inspection</td></tr><tr><td>Spillway</td><td>National Dam Safety Act Report</td></tr><tr><td>Structural Analysis</td><td>Manahawkin Lake Dam</td></tr></tbody></table>			Dams	Safety	Embankments	Visual Inspection	Spillway	National Dam Safety Act Report	Structural Analysis	Manahawkin Lake Dam
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DEPARTMENT OF THE ARMY
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IN REPLY REFER TO

NAPEN-D

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

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14 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Manahawkin Lake Dam in Ocean 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 in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Manahawkin Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is adequate. To insure the continued functioning of the dam and its impoundment, the following remedial actions are recommended to be undertaken within one year from the date of approval of this report:

- a. Repair eroded areas on the dam embankment and provide a suitable ground cover. A protective coating should be applied to exposed steel sheet piling before placing fill.
- b. Inspect and repair the concrete spillway as necessary.
- c. A detailed topographic survey of the dam and vicinity should be made.
- d. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. Records of pond levels should be kept during routine visits and during severe storms. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

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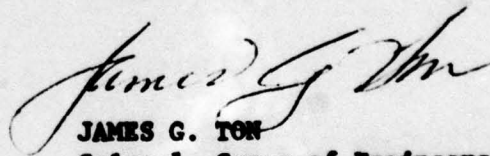
Honorable Brendan T. Byrne

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 William J. Hughes of the Second District. Under the provision 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,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

MANAHAWKIN LAKE DAM (NJ00057)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 20 December 1978 by Storch Engineers 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.

Manahawkin Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is adequate. To insure the continued functioning of the dam and its impoundment, the following remedial actions are recommended to be undertaken within one year from the date of approval of this report:

- a. Repair eroded areas on the dam embankment and provide a suitable ground cover. A protective coating should be applied to exposed steel sheet piling before placing fill.
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- d. The owner should upgrade the operating and maintenance procedures by issuing a manual and check list for recommended procedures. Inspection and maintenance visits should be logged. Records of pond levels should be kept during routine visits and during severe storms. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

APPROVED: _____

James G. Tom
JAMES G. TOM
Colonel, Corps of Engineers
District Engineer

DATE: _____

7 May 79

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Nam of Dam:	Manahawkin Lake Dam, I.D. NJ00057
State Located:	New Jersey
County Located:	Ocean
Drainage Basin:	Atlantic Coastal
Stream:	Mill Creek
Date of Inspection:	December 20, 1978

Assessment of General Condition of Dam

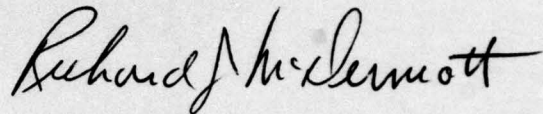
Based on visual inspection, available records, past operational performance and engineering analyses, Manahawkin Lake Dam is assessed as being in good overall condition.

The spillway is capable of passing the designated spillway design flood (100-year storm) when the water level in the lake is equal to the dam crest elevation and, therefore, is assessed as being adequate.

The concrete spillway appears to be structurally sound, although its surface appears to be slightly eroded. The spillway surface should be protected and any cracks and spalls not visible at the time of inspection should be repaired in the near future by sand blasting, grouting where needed and coating with epoxy.

The embankment is generally free of settlement and appears to be structurally sound. However, a portion of it is eroded causing the corewall and steel sheet piles to be exposed. This condition should be repaired in the near future by filling and compacting so that the dam crest is made level. A protective coating should be applied to the steel sheet piles before filling. In addition, a suitable stand of grass should be established on the bare sections of the embankment in the near future.

The owner should implement in the near future a program of periodic inspection and maintenance for the dam which would also include a topographic survey as required to develop as-built drawings based on the original construction plans. As part of the inspection and maintenance program, the lake would be lowered at least every five years at which time the lake should be cleaned and the submerged portions of the dam, spillway and outlet works inspected and repaired.

A handwritten signature in cursive script, reading "Richard J. McDermott".

Richard J. McDermott, P.E.





OVERVIEW PHOTO - MANAHAWKIN LAKE DAM

20 DEC. 1978

TABLE OF CONTENTS

	<u>Page</u>
ASSESSMENT OF GENERAL CONDITION OF DAM	i
OVERVIEW PHOTO	iii
TABLE OF CONTENTS	iv
PREFACE	vi
SECTION 1 - PROJECT INFORMATION	1
1.1 General	
1.2 Description of Project	
1.3 Pertinent Data	
SECTION 2 - ENGINEERING DATA	10
2.1 Design	
2.2 Construction	
2.3 Operation	
2.4 Evaluation	
SECTION 3 - VISUAL INSPECTION	14
3.1 Findings	
SECTION 4 - OPERATIONAL PROCEDURES	17
4.1 Procedures	
4.2 Maintenance of Dam	
4.3 Maintenance of Operating Facilities	
4.4 Description of Warning System	
4.5 Evaluation	

TABLE OF CONTENTS (cont.)

	<u>Page</u>
SECTION 5 - HYDRAULIC/HYDROLOGIC	19
5.1 Evaluation of Features	
SECTION 6 - STRUCTURAL STABILITY	21
6.1 Evaluation of Structural Stability	
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS	23
7.1 Dam Assessment	
7.2 Recommendations	
PLATES	
1 KEY MAP	
2 VICINITY MAP	
3 GEOLOGIC MAP	
4 GENERAL PLAN	
5 SPILLWAY SECTIONS	
6 PHOTO LOCATION PLAN	
APPENDICES	
1 Check List - Visual Inspection	
Check List - Engineering Data	
2 Photographs	
3 Engineering Data	
4 Hydrologic Computations	
5 Bibliography	

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 30214. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that the unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

MANAHAWKIN LAKE DAM, I.D. NJ00057

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

Public Law 92-367, August 8, 1972 authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The Division of Water Resources of the New Jersey Department of Environmental Protection (NJDEP) in cooperation with the Philadelphia District of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the State of New Jersey. Storch Engineers has been retained by the NJDEP to inspect and report on a selected group of these dams. The NJDEP is under agreement with the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of Manahawkin Lake Dam was made on December 20, 1978. The purpose of the inspection was to make a general assessment of the structural integrity and operational adequacy of the dam structure and its appurtenances.

1.2 Description of Project

a. Description

Manahawkin Lake Dam is an earthfill dam with an uncontrolled concrete overflow spillway with a curved shape and two gated corrugated metal pipe outlets. The embankment is sandy and generally free of vegetation with the exception of some grass on its downstream face. Water which passes over the spillway discharges into a downstream channel with timber bulkhead sides.

The concrete spillway is formed over a curved ring of steel sheet piles. The sheet piles are connected on each side of the spillway to a timber core wall within the embankment. Timber bulkheads form the edge of the lake on each side of the spillway for distances of approximately 30 feet to the west and approximately 150 feet to the east. In addition, a buried bulkhead extends from the spillway westward along the rear edge of a beach area adjacent to the dam for a distance of approximately 660 feet.

Having an overall length of 900 feet, the embankment consists of three portions as follows: 1.) a center portion with an overall length of 110 feet and top width of 8 feet lies on either side of the spillway, 2.) a low berm approximately 2 feet high extends westward along the rear edge of the beach area adjacent to the dam for a distance of approximately 640 feet, and 3.) a 150-foot long bulkhead extends along the edge of the lake east of the spillway. The spillway crest has an overall crest length of 70.2 feet and a downstream channel which tapers

from a width of 55 feet to a width of 36 feet within 75 feet of the spillway. Designed for two staged operation, the spillway crest has a primary stage 30 feet long at elevation 23.6 and two secondary stages each of which is 20.1 feet long and at elevation 24.2. (Note: all references to the spillway crest elevation will be to the primary stage elevation of 23.6 unless otherwise noted).

The spillway crest lies 4.2 feet below the elevation of the dam crest and 8.1 feet above the elevation of the downstream channel bottom.

Each of the two outlets consists of a 30-inch corrugated metal pipe which penetrates the spillway. A manually operated slide gate is contained in a concrete manhole located approximately midway between the inlet and outlet ends of each pipe.

b. Location

Manahawkin Lake Dam is located in the Township of Stafford, Ocean County, New Jersey. Constructed across Mill Creek, it impounds Manahawkin Lake which is located in a residential area near the intersection of Routes 9 and 180. Principal access to the dam is through a parking area which is entered from Route 9.

c. Size and Hazard Classification

Size and Hazard Classification criteria presented in "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers are as follows:

SIZE CLASSIFICATION

<u>Category</u>	<u>Impoundment</u>	
	<u>Storage (Ac-ft)</u>	<u>Height (Ft)</u>
Small	< 1000 and ≥ 50	< 40 and ≥ 25
Intermediate	≥ 1000 and < 50,000	≥ 40 and < 100
Large	$\geq 50,000$	≥ 100

HAZARD POTENTIAL CLASSIFICATION

<u>Category</u>	<u>Loss of Life</u> (Extent of Development)	<u>Economic Loss</u> (Extent of Development)
Low	None expected (no permanent structures for human habitation)	Minimal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive community, industry or agriculture)

Manahawkin Lake Dam is classified as "Small" size and "Significant" hazard due to the following applicable data:

Structural Height = 12 feet

Maximum Impoundment = 435 acre-feet

Potential Loss of Life: No homes in downstream flood plain as delineated by SDF outflow.

Potential Economic Loss: Three highway bridges within 1/4 mile of dam. Route 180 bridge would be overtopped by breach outflow. Service Station 2000 feet downstream of dam would be flooded by breach outflow.

d. Ownership

Manahawkin Lake Dam is owned by the County of Ocean, Court House, Toms River, New Jersey 08753.

e. Purpose of Dam

The purpose of the dam is the impoundment of a recreational lake facility.

f. Design and Construction History

The earthfill embankment together with a timber spillway was constructed prior to 1929; it was described as being "very old" in that year. In 1960, an inspection by the State of New Jersey revealed that the dam was in poor

condition and in need of immediate repair. Subsequently, the dam and lake were acquired by the Township of Stafford and then deeded to the County of Ocean. The Engineering Department of Ocean County designed a new spillway in 1964 which was constructed in 1968 by David Wright, Inc. The spillway reconstruction project included the construction of bulkheads along the edge of the lake on each side of the spillway for distances of approximately 30 feet to the west and approximately 150 feet to the east, as well as the construction of bulkheads on each side of the downstream channel for a distance of approximately 75 feet. In addition, corewalls were constructed in the embankment for a distance of approximately 50 feet on each side of the spillway and the embankments regraded. The present outlet works were also constructed as part of the project.

Plans for the present spillway and appurtenances mentioned above were prepared by Richard E. Lane, P.E., Assistant Ocean County Engineer, and dated June, 1964.

g. Normal Operational Procedures

The dam and appurtenances are maintained by the Ocean County Bridge Department. There is no fixed schedule of maintenance; rather, the Ocean County Bridge Department repairs and maintains the embankment, spillway, appurtenances and lake as needed.

The outlet pipes are used to drain the lake to facilitate repairs and sediment and debris removal. They are not used for emergency purposes during storms.

1.3 Pertinent Data

a. Drainage Area = 19.7 square miles

b. Discharge at Dam Site:

Maximum known flood at damsite	Unknown
Outlet works at pool elevation	84 c.f.s.
Diversion tunnel low pool outlet at pool elevation	N.A.
Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at pool elevation	N.A.
Gated spillway capacity at top of dam	N.A.
Ungated spillway capacity at top of dam	1908 c.f.s.
 Total Spillway Capacity at top of dam	 1908 c.f.s.

c. Elevation (Feet above MSL)

Top Dam	28.0
Maximum pool design surcharge	28.0
Full flood control pool	N.A.
Recreation pool	23.7
Spillway crest - Primary	23.6
- Secondary	24.2
Upstream portal invert diversion tunnel	N.A.
Stream bed at centerline of dam	16.2
Maximum tailwater	20± (Estimated)

d. Reservoir

Length of maximum pool	4270 feet
Length of recreation pool	3900 feet
Length of flood control pool	N.A.

e. Storage (acre-feet)

Recreation pool	127 acre-feet
Flood control pool	N.A.
Design surcharge	400 acre-feet
Top of Dam	400 acre-feet

f. Reservoir Surface (Acres)

Top of dam	73 acres
Maximum pool	73 acres
Flood control pool	N.A.
Recreation pool	54 acres
Spillway pool	54 acres

g. Dam

Type	Earthfill
Length	900 feet
Height (Center Section 110 ft. long)	12 feet
Top Width (Center Section)	8 feet
Side Slopes (Center Section)	
- Upstream	4 horiz to 1 vert.
- Downstream	1.5 horiz. to 1 vert.
Zoning	Unknown
Impervious Core	Timber core wall
Cut off	Steel Sheet Piling
Grout Curtain	Unknown

h. Diversions and Regulating Tunnel

N.A.

i. Spillway

Type

Curved overflow

Primary Crest

Length

30 feet

Elevation

23.6 feet

Secondary Crest

Length

40.2 feet

Elevation

24.2

Gates

N.A.

Upstream channel

N.A.

Downstream Channel

Rectangular section
with timber sides.

j. Regulating Outlets

2 - 30 CMP with gate in manhole

SECTION 2: ENGINEERING DATA

2.1 Design

No plans or calculations pertaining to the original construction of the dam could be obtained. However, information was generated at the time of the spillway reconstruction in 1968 and is available. As mentioned in paragraph of 1.2.f., plans were prepared in 1964 including the following:

1. Plan of dam and appurtenances
2. Plan, elevation and section of spillway
3. Details of spillway crest and dam appurtenances
4. Logs of two borings made in the spillway area
5. Profile and cross-sections of downstream channel
6. Estimate of construction quantities
7. Location of dam

In addition, calculations pertaining to the reconstruction were obtained. These include hydraulic analyses of the spillway and downstream channel as well as hydrologic analyses of the drainage basin.

Design of the spillway in 1964 was based on the requirement that the spillway be able to pass the design flood while maintaining a minimum freeboard of 1.5 feet. The design flood peak intensity was computed to be 1170 cfs. The capacity of the spillway was computed to be 1280 cfs with lake stage at elevation 27.0 which allows 1.5 feet of freeboard.

2.2 Construction

No records are available pertaining to the construction of the original dam which was built prior to 1929. The spillway, outlet works and bulkheads were constructed in 1968 and certified as being completed in accordance with the approved plans and specifications by Lawrence F. Wagner, Ocean County Engineer on January 21, 1969.

2.3 Operation

No records of operation of the lake or dam are available. Seven past inspection reports have been obtained and are summarized as follows:

Prior to reconstruction of spillway:

5-10-29: Timber sluice type spillway in poor condition; timbers rotted.

9-29-60: Both the control structures and those parts of the embankment adjacent thereto in need of immediate repairs.

3-16-67: Dam structurally unstable. Downstream face of embankment eroded and concrete walls abraded to a point of failure.

During reconstruction of spillway:

5-13-68: Construction work found to be progressing satisfactorily.

Subsequent to reconstruction of spillway:

7-7-70: Spillway maintained according to approved plans. Spillway in good condition.

8-5-71: Spillway maintained according to approved plans. Spillway in good condition.

7-11-72: Spillway is being maintained according to the approved plans. Spillway is in good condition.

2.4 Evaluation

a. Availability

Available engineering information is limited to that which is on file at the NJDEP. The NJDEP file contains copies of plans, calculations, correspondence and photographs available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N.J. Available from the Ocean County Engineering Department are plans of the spillway which duplicate those in the NJDEP file.

b. Adequacy

The available information forms a fairly complete description of the subject dam with a few exceptions which are listed in paragraph 7.1.b.

c. Validity

That information which was able to be verified was valid within a reasonable allowance for error. Data found in the NJDEP file which is at variance with the findings of this inspection and evaluation are noted in paragraph 7.1.b.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Manahawkin Lake Dam took place on December 20, 1978 by members of the staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix 1. The following procedures were employed for the inspection:

1. The embankment of the dam, appurtenant structures and adjacent areas were examined.
2. The embankment and accessible appurtenant structures were measured and key elevations determined by hand level.
3. The embankment and appurtenant structures and adjacent areas were photographed.
4. A member of the staff of the Ocean County Engineering Department was present to assist in the inspection.

b. Dam

The dam embankment is uniformly aligned horizontally.

The surface generally is sandy and bare with some areas of grass on the downstream face in the vicinity of the spillway. The embankment east of the spillway is essentially free of erosion while the embankment west of the spillway is eroded to the extent that the timber corewall and steel sheet piles are exposed and the crest elevation has been decreased by approximately 0.5 feet.

The majority of the embankment west of the spillway consists of a long sandy berm approximately 2 feet high (crest elevation 28.5) and forming a crest located between a beach area and commercially developed property along Route 180. The only section of the 900-foot long dam that consists of an embankment higher than two feet is located adjacent to both ends of the spillway and has a total crest length of 110 feet (including the spillway crest length).

No evidence of cracking, settling or seepage was noted in the dam nor were any animal holes observed.

The generalized soils description of the dam site consists of shallow surface alluvial deposits of stratified silty sand with varying amounts of gravel deposited during the Quaternary Period and known as the Cape May Formation in the Geologic Map of New Jersey prepared by Lewis and Kummel. The shallow surface soils are underlain by alluvial deposits of stratified fine micaceous quartz sand with small amounts of silt with local thin layers of gravel and clay deposited during the Tertiary Period and known as the Kirkwood Sands.

Bedrock is in excess of 100 feet below the ground surface. It is assumed that the dam is founded on the silty sands of the Cape May Formation.

c. Appurtenant Structures

The crest of the spillway appeared to be uniformly aligned, although a major part of it was submerged by overflow at the time of inspection. Water was flowing over the

primary (elev. 23.6) crest of the spillway and, therefore, the condition of much of the spillway surface was not clearly observed. In the sections of the spillway that were dry, some eroding of the concrete surface was observed. In general, however, all concrete appeared to be in good condition.

Reportedly, the outlet equipment is in good working condition, although its operation was not observed at the time of inspection. The 30-inch diameter CM pipes were observed at their outlet ends and appeared to be in good condition. The manholes housing the outlet gates were observed to be in good condition.

d. Reservoir Area

Manahawkin Lake, having a shape suggesting a rectangle, is approximately 3/4 mile long with an average width of 600 feet. It is located primarily in a residential area with the exception of its upstream end which lies in an undeveloped, wooded area.

Along most of its length, the lake has moderately sloping shores, while the land at its upstream end is relatively flat. A few docks are located along the edge of the lake where residential development has taken place.

e. Downstream Channel

The spillway outflows into Mill Creek which, in the proximity of the dam, is a straight channel with an earth bottom and timber bulkhead sides. It has a fairly uniform bed free of weeds, pools, obstructions and debris. A bridge crosses the stream approximately 250 feet downstream from the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Manahawkin Lake is regulated naturally by discharge over the two stage spillway of Manahawkin Lake Dam. The two staged crest has fixed elevations. Whenever necessary for maintenance and repair the lake is lowered by opening the outlet gates of the two 30-inch diameter pipes. The lake reportedly has not been drained for a period of at least five years. It is estimated that the time needed to drain the lake is approximately 1 to 2 days.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance of the dam and appurtenant structures. One of the provisions of the permit for reconstruction of the spillway specified that "an annual report shall be submitted describing the existing conditions" of the dam embankment, spillway and appurtenances. However, only three of the required annual reports have been written. The last of these was completed in 1972. Maintenance is performed by the Ocean County Bridge Department as the need arises.

4.3 Maintenance of Operating Facilities

The slide-gates and the operating mechanisms used to open and close them are maintained by the Ocean County Bridge Department as the need arises. It could not be determined when the outlet conduits were last maintained.

4.4 Description of any Warning System in Effect

There is no warning system in service now and none was utilized in the past.

4.5 Evaluation of Operational Adequacy

The operation of the spillway, since its reconstruction in 1968 has been successful to the extent that the dam has not been overtopped since then.

The maintenance program for the dam appears to have been fairly adequate. The spillway and top of dam are in good condition. However, some areas of maintenance have not been adequately performed, such as the following:

1. Erosion of embankment not adequately treated; corewall and sheet piles allowed to become exposed.
2. Erosion at end of bulkhead on west side of downstream channel not adequately treated.
3. Bare areas on embankment not restored with grass.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The intensity of storm water runoff that the spillway should be able to handle is based on the size and hazard classification of the dam. This runoff intensity, called the spillway design flood (SDF), is described in terms of return frequency or probable maximum flood (PMF) depending on the extent of the dam's size and potential hazard. According to the "Recommended Guidelines for Safety Inspection of Dams", published by the U.S. Army Corps of Engineers, the SDF for Manahawkin Lake Dam falls in a range of 100-year frequency to 1/2PMF. In this case, the low end of the range, 100-year frequency, is chosen since the factors used to select size and hazard classification are on the low side of their respective ranges.

The peak 100-year flood is 1660 cfs as calculated in accordance with analytical procedures contained in Special Report 38 published by the NJDEP.

Computations used to determine the spillway discharge capacity are contained in Appendix 4. The spillway was assumed to have outflow characteristics of a broad crested weir with breadth equal to two feet.

The spillway discharge (with water level at the dam crest) was computed to be 1908 c.f.s. The dam crest elevation was taken to be 28.0 to account for the erosion in the vicinity of the spillway. Since the computed

discharge is greater than the computed SDF peak (1660 c.f.s.), the spillway is considered to be adequate according to criteria developed by the U.S. Army Corps of Engineers.

b. Experience Data

No records are available that would document the proper operation of the dam and spillway since the spillway reconstruction in 1968. No records of lake levels are maintained.

c. Visual Observations

No evidence was found at the time of inspection that would indicate that the dam had been overtopped.

d. Overtopping Potential

As indicated in paragraph 5.1.a., the dam would not be overtopped during storms equivalent to the designated SDF. Detailed hydraulic and hydrologic analyses are contained in Appendix 4.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The embankment appeared, at the time of inspection, to be structurally sound with no evidence of cracks or differential settlement.

b. Design and Construction Data

The analysis of structural stability and construction data for the embankment are not available. The only design and construction data available for the spillway are the drawings prepared by Richard E. Lane, Assistant Ocean County Engineer, prepared in 1964.

c. Operating Records

There are no operating records available for the dam. The water level of Manahawkin Lake is not monitored.

d. Post Construction Changes

Since Manahawkin Lake Dam was reconstructed in 1968, there have been very few changes to the dam or the area surrounding it that could have significant effect on its structural integrity. The following changes have occurred:

1. Vegetation has grown on the embankment.
2. The embankment has become eroded.

e. Seismic Stability

Manahawkin Lake Dam is located in Seismic Zone 1 as defined in "Recommended Guidelines for Safety Inspection of Dams" which is a zone of very low seismic activity. Experience indicates that dams in Seismic Zone 1 will have adequate stability under seismic loading conditions if they have adequate stability under static loading conditions. Manahawkin Lake Dam appeared to be stable under static loading conditions at the time of inspection.

SECTION 7: ASSESSMENT AND RECOMMENDATIONS

7.1 Dam Assessment

a. Safety

Based on hydraulic and hydrologic analyses outlined in Section 5 and Appendix 4, the spillway of Manahawkin Lake Dam is considered to be adequate according to criteria developed by the U. S. Army Corps of Engineers.

The structural integrity of the dam appears to be adequate based on visual field investigations. No report nor written evidence was found that would contradict that assessment.

Therefore, based on hydraulic and structural considerations, Manahawkin Lake Dam is assessed as being satisfactory in relation to guidelines developed by the U.S. Army Corps of Engineers.

b. Adequacy of Information

Information was gathered from several sources, including: 1.) field investigation, 2.) plans, calculations and correspondence in NJDEP files, 3.) USGS quadrangle sheet, 4.) aerial photography from Ocean County, and 5.) consultation with Ocean County Engineering Department. The information obtained is sufficient to allow a Phase I assessment as outlined in "Recommended Guidelines for Safety Inspection of Dams."

Some of the absent data are as follows:

1. Stream and lake elevation gauging records.
2. Description of dam embankment fill materials.
3. Annual inspection reports subsequent to 1972.

c. **Necessity for Additional Data/Evaluation**

Although some data pertaining to Manahawkin Lake Dam are not available, additional data are not considered imperative for this Phase I evaluation due to the size and hazard potential classifications of the dam and its general appearance of structural integrity.

7.2 **Recommendations**

a. **Remedial Measures**

Based on visual inspection of Manahawkin Lake Dam and pertinent data obtained as part of this evaluation, it is recommended that the owner undertake the following remedial measures in the near future:

1. The eroded areas on the dam embankment should be properly filled and compacted in such a way that the dam crest is made uniform at elevation 28.5. A protective coating should be applied to the exposed steel sheet piling before placing fill.
2. A suitable stand of grass should be established on the bare sections of the embankment.

3. The concrete spillway should be thoroughly inspected and repaired as outlined below:

- a. Drain the lake to an elevation equal to the invert of the outlet pipe.
- b. Sand blast all concrete, pressure grout any major cracks and patch all spalls and eroded surfaces.
- c. Apply an epoxy preservative coating to all surfaces.

The implementation of the above measures will require proper detailed design and the obtaining of applicable NJDEP approvals.

b. Maintenance

The owner of the dam should initiate, in the near future, a program of periodic inspection and maintenance, the complete records of which to be kept on file and made available to the public. A visual inspection of the dam and appurtenances by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made when required and the following maintenance should be performed annually: remove trees and brush from the embankment, fill and sod any eroded surfaces of the embankment and clear the downstream channel. In addition, the lake should be lowered at least every five years at which time the lake should be cleaned and submerged portions of the dam and appurtenances inspected and repaired.

c. **Additional Studies**

A detailed topographic survey of the dam and area around the dam based on USGS datum should be undertaken by a qualified licensed land surveyor or professional engineer in the near future. The survey map should be related to existing construction drawings and should become part of the permanent record mentioned in paragraph 7.2.b.

PLATES

MANAHAWKIN LAKE DAM

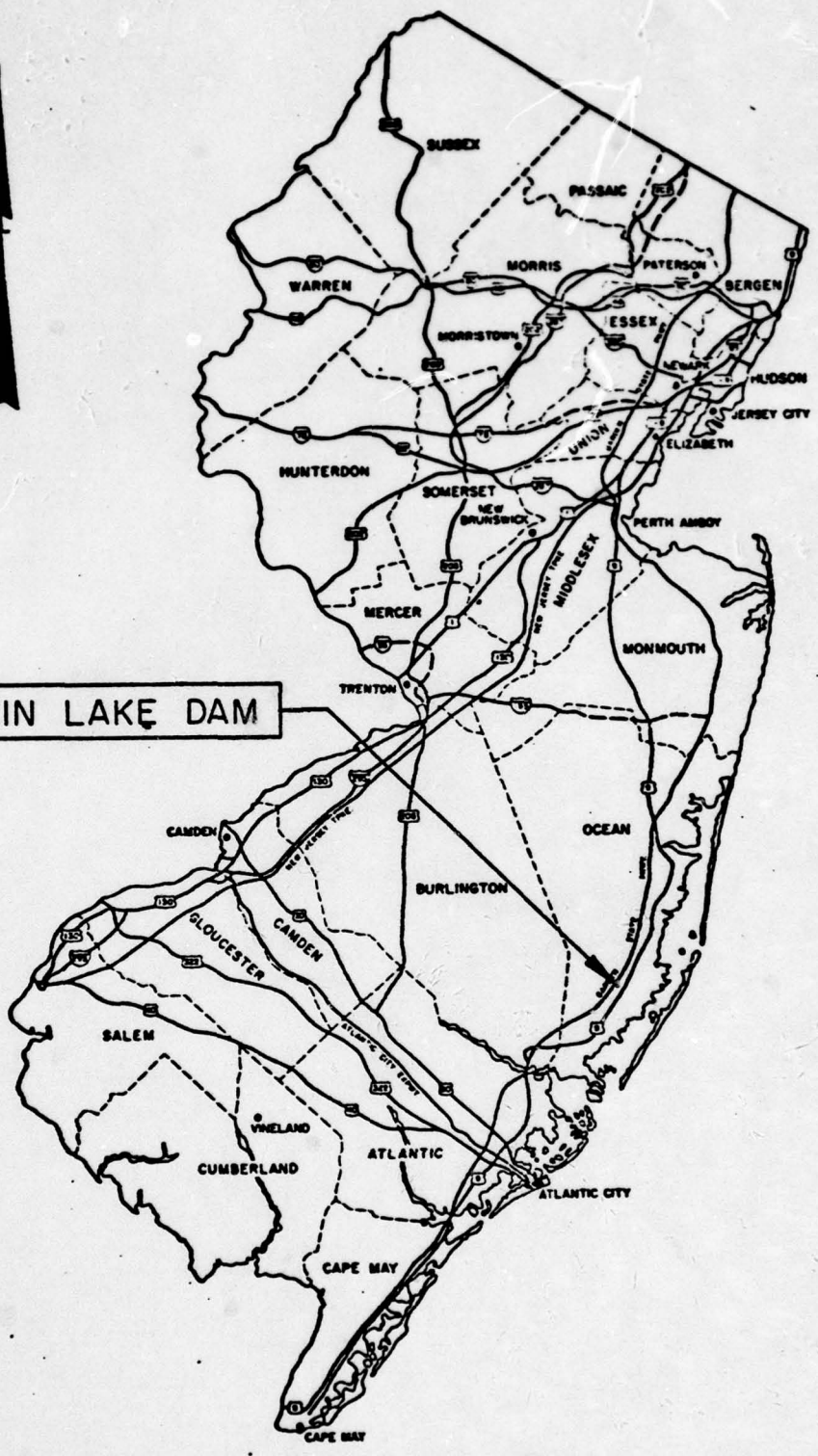


PLATE I

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY		INSPECTION AND EVALUATION OF DAMS	
DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY		KEY MAP	
		MANAHAWKIN LAKE DAM	
		I.D. N.J. 00057	SCALE: NONE
		DATE: FEBRUARY, 1979	

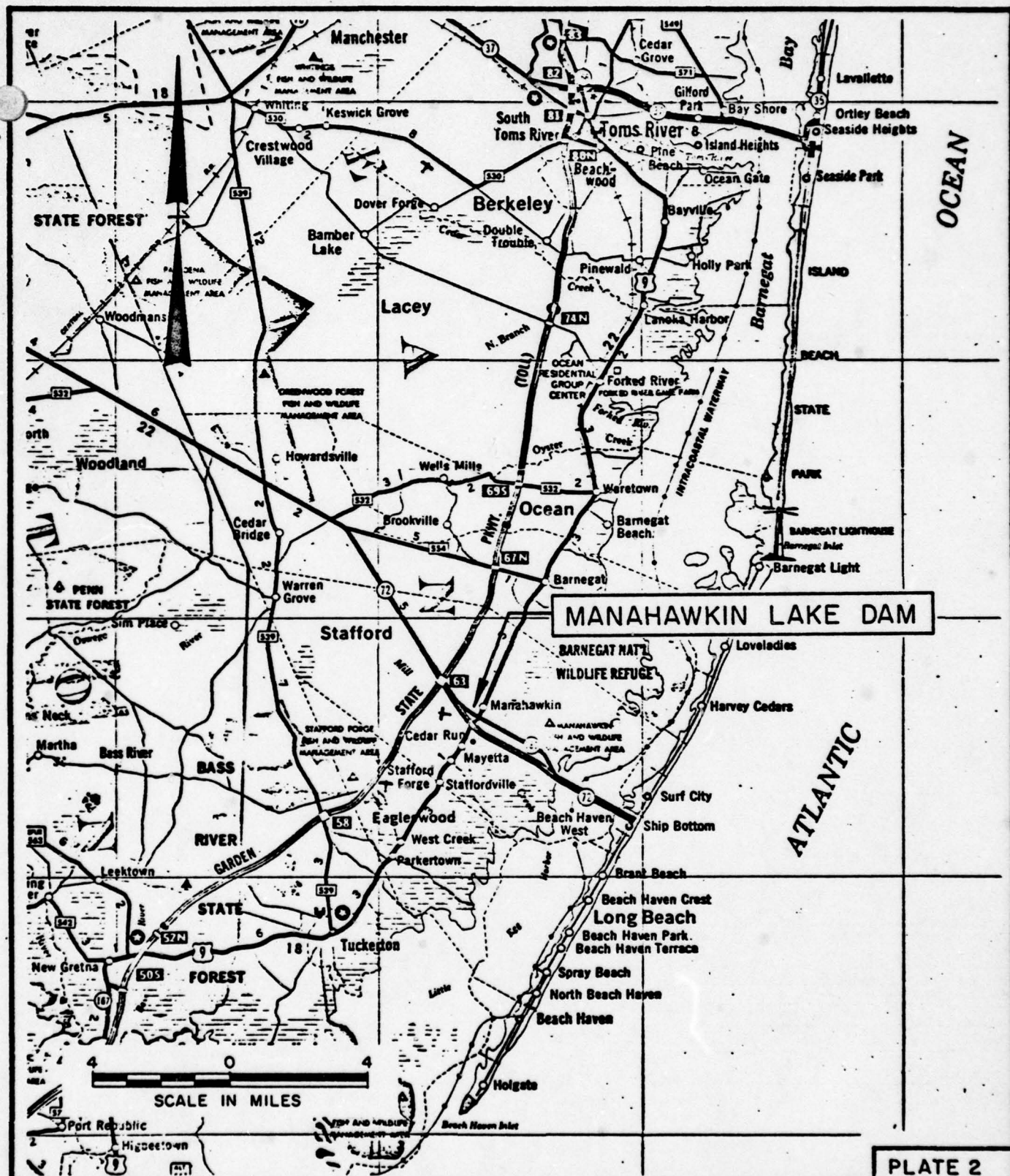


PLATE 2

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

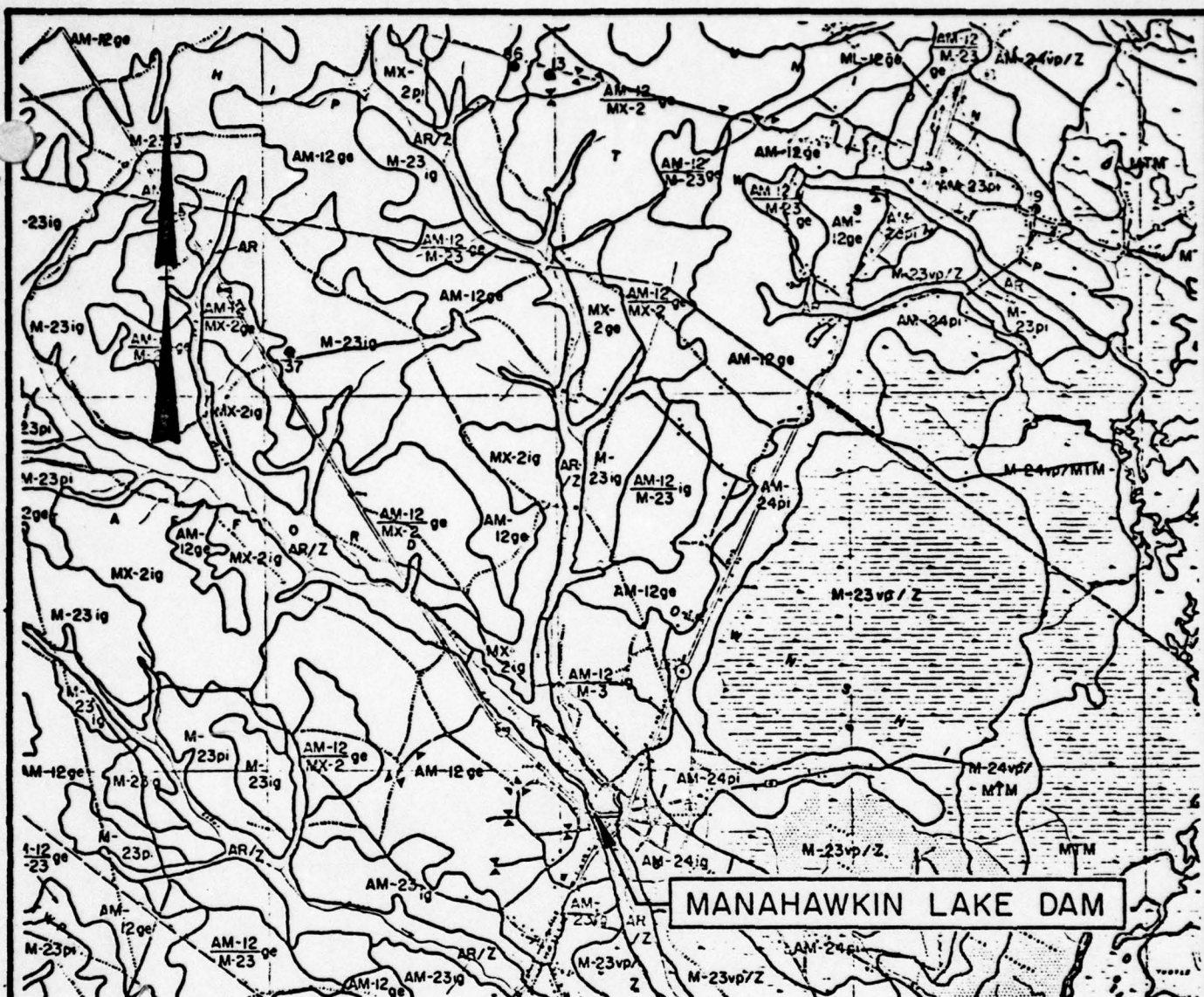
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS VICINITY MAP MANAHAWKIN LAKE DAM

I.D. N.J. 00057

SCALE: AS SHOWN

DATE: FEBRUARY, 1979



Legend

- AR/Z Stratified, swampy alluvium
- F Area under a particular type of agricultural development.
Underlying material identified by adjoining map units.
- AM-12 Alluvial, stratified materials deposited during the Quarternary period. (Cape May formation.)
- M-3 Stratified materials deposited during the Tertiary period
(Kirkwood Sand formations.)

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS

GEOLOGIC MAP MANAHAWKIN LAKE DAM

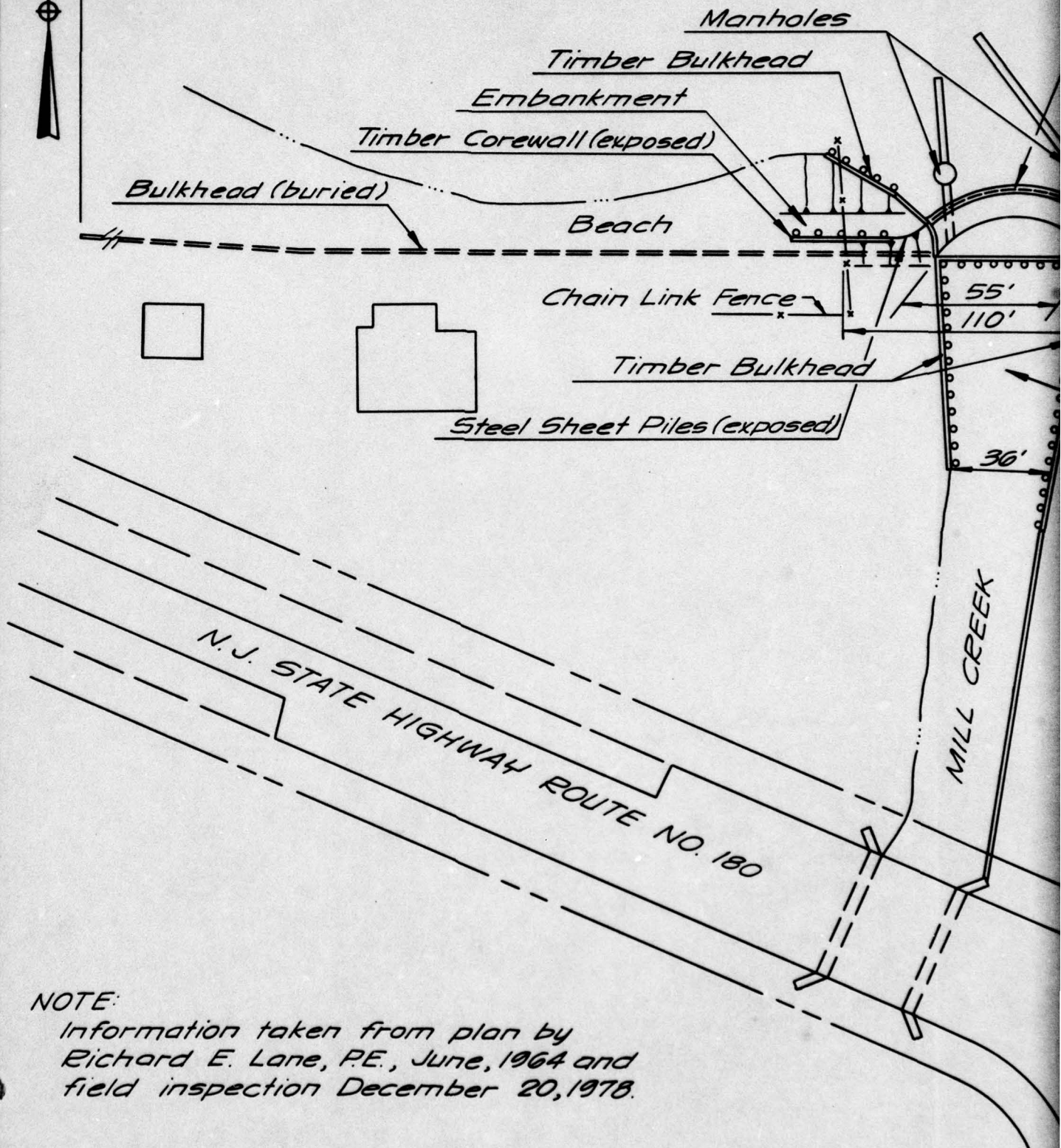
I.D.N.J. 00057

SCALE: NONE

DATE: FEBRUARY, 1979

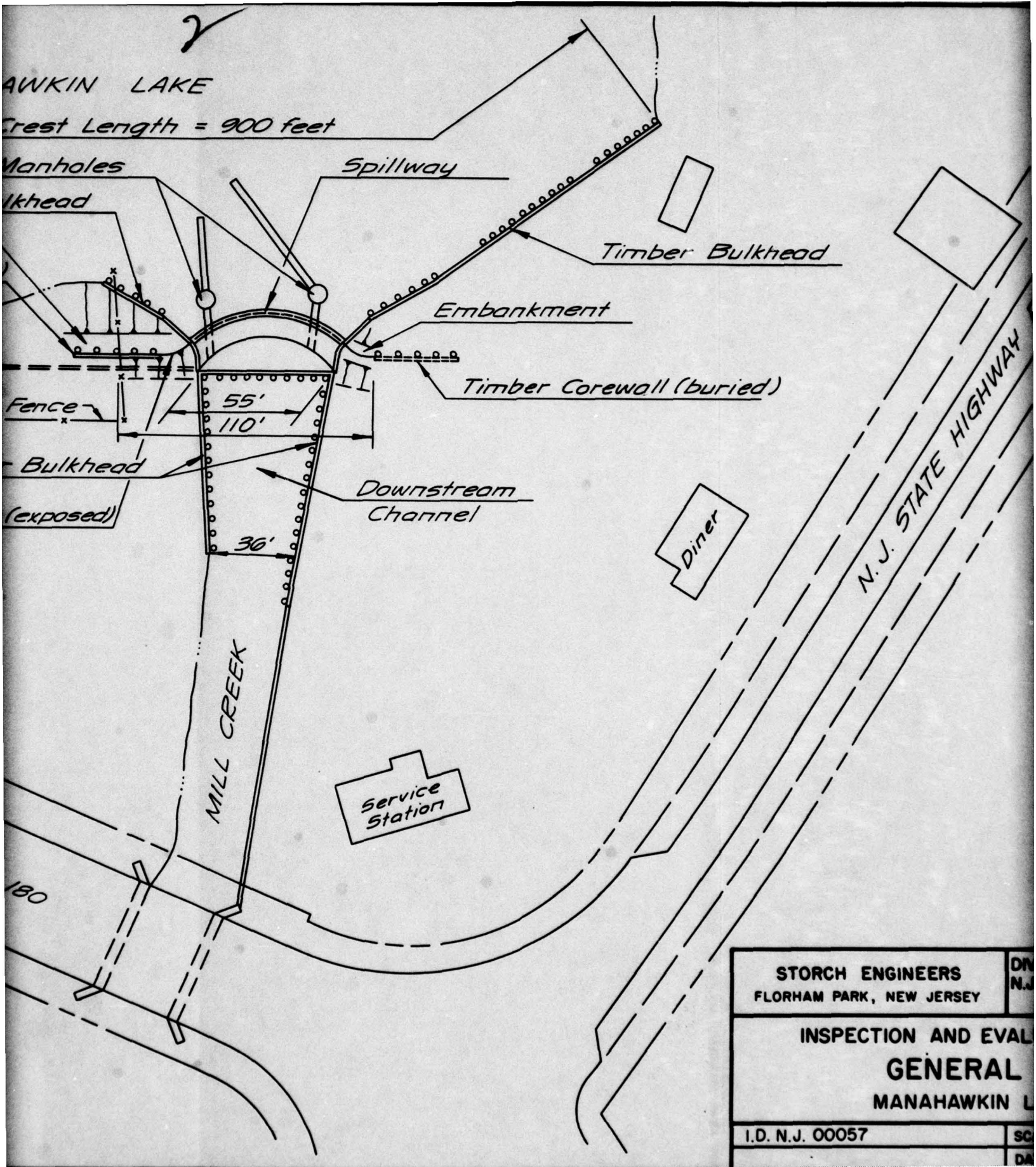
MANAHAWKIN LAKE

Total Dam Crest Length = 900 feet



NOTE:

Information taken from plan by
Richard E. Lane, P.E., June, 1964 and
field inspection December 20, 1978.



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

INSPECTION AND EVALUATION
GENERAL
MANAHAWKIN LAKE

I.D. N.J. 00057

DN
N.J.

SC
DA

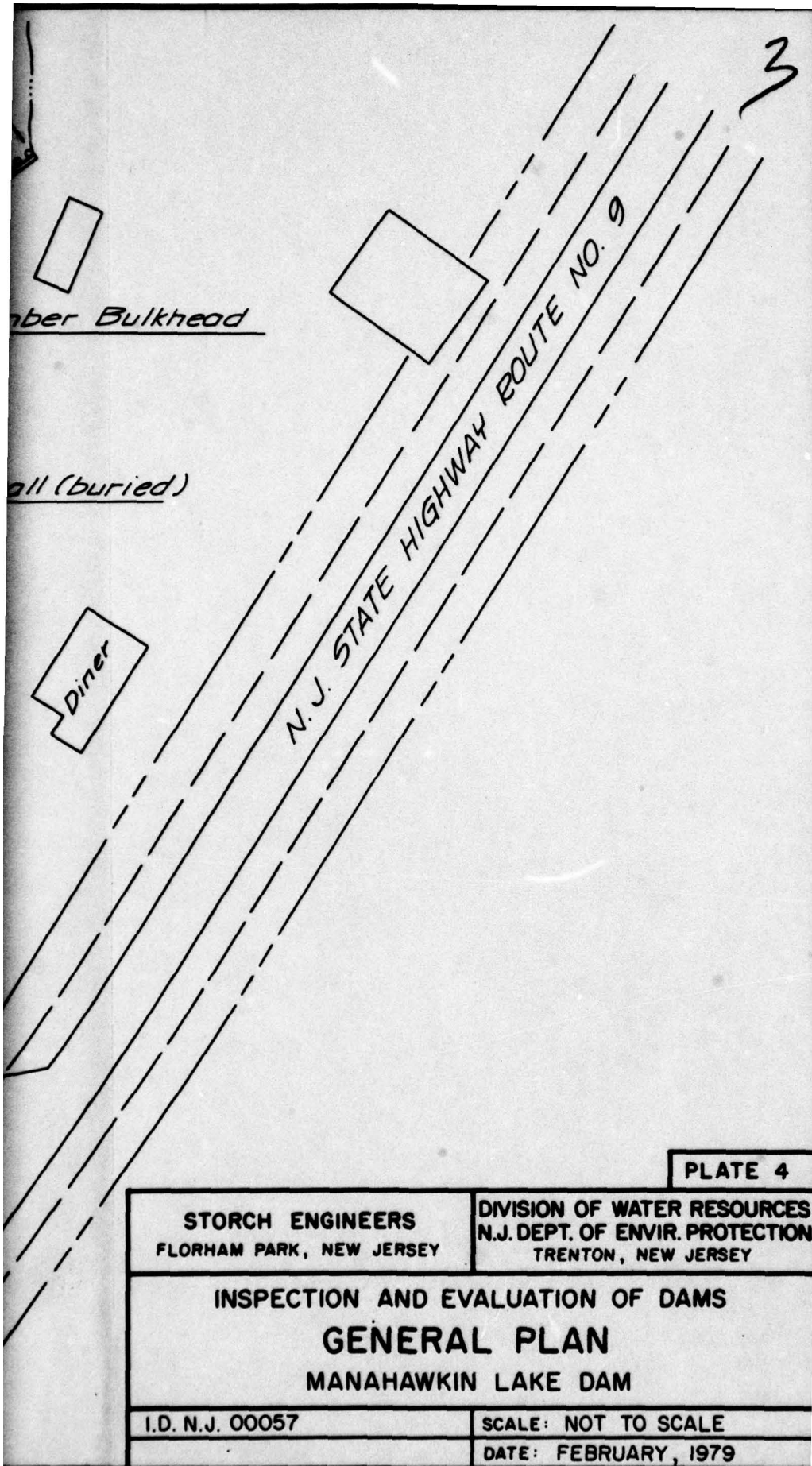


PLATE 4

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

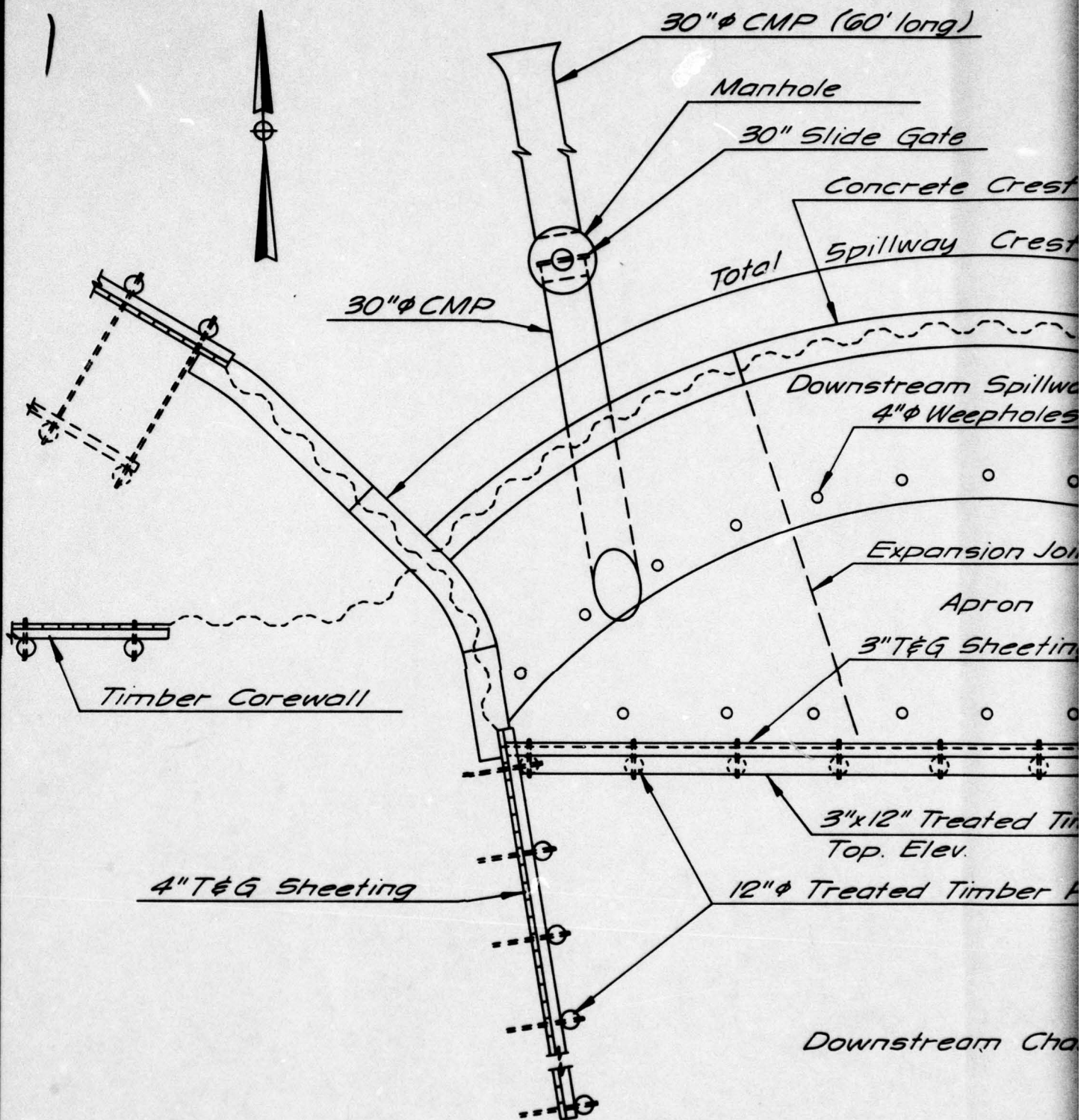
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS
GENERAL PLAN
MANAHAWKIN LAKE DAM

I.D. N.J. 00057

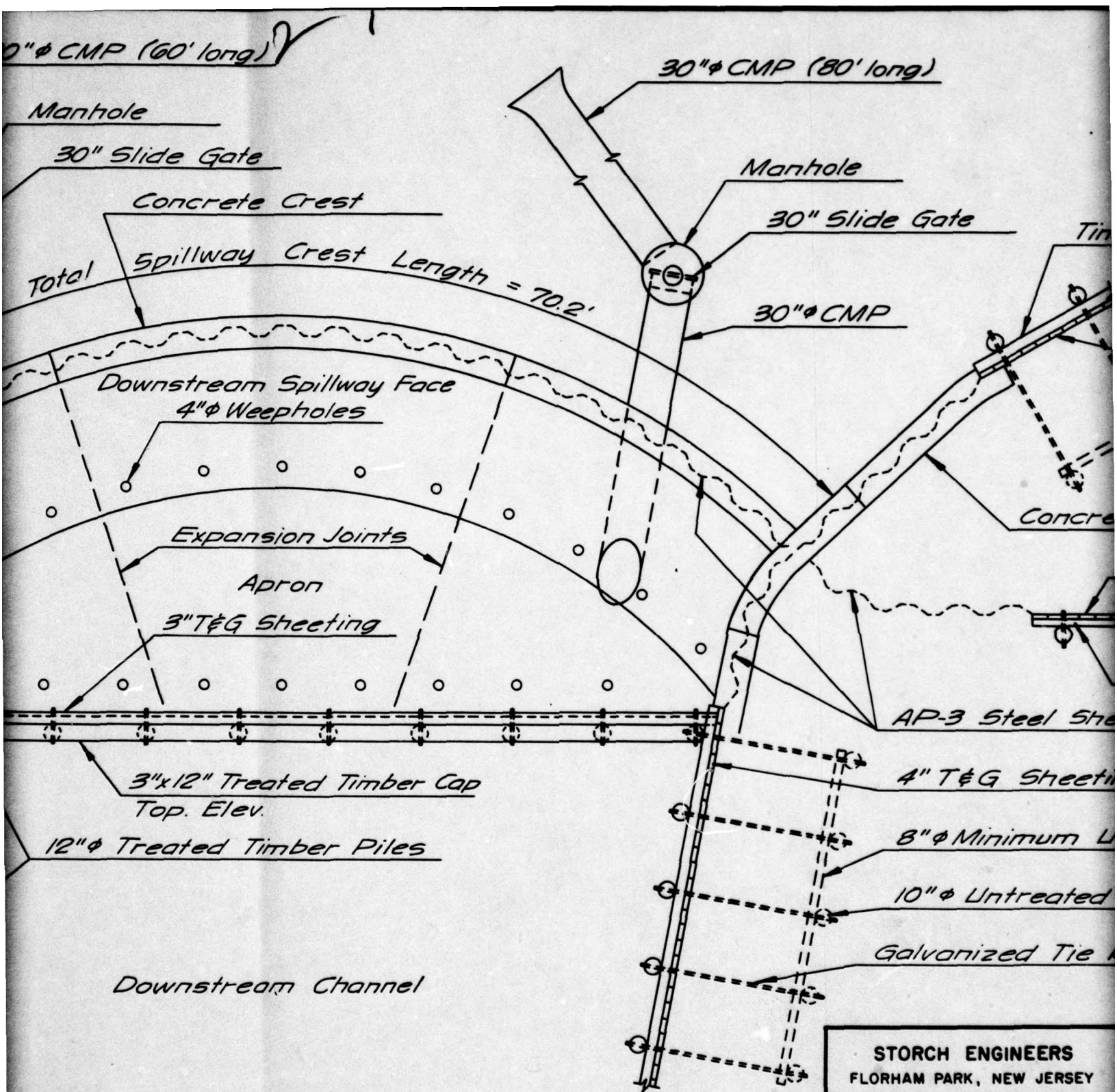
SCALE: NOT TO SCALE

DATE: FEBRUARY, 1979



NOTE:

Information taken from plan by
 Richard E. Lane, P.E., June, 1964 and
 field inspection December 20, 1970.



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

INSPECTION AND EVALUATION
SPILLWAY
MANAHAWKAN

I.D. N.J. 00057

CMP (80' long)

3

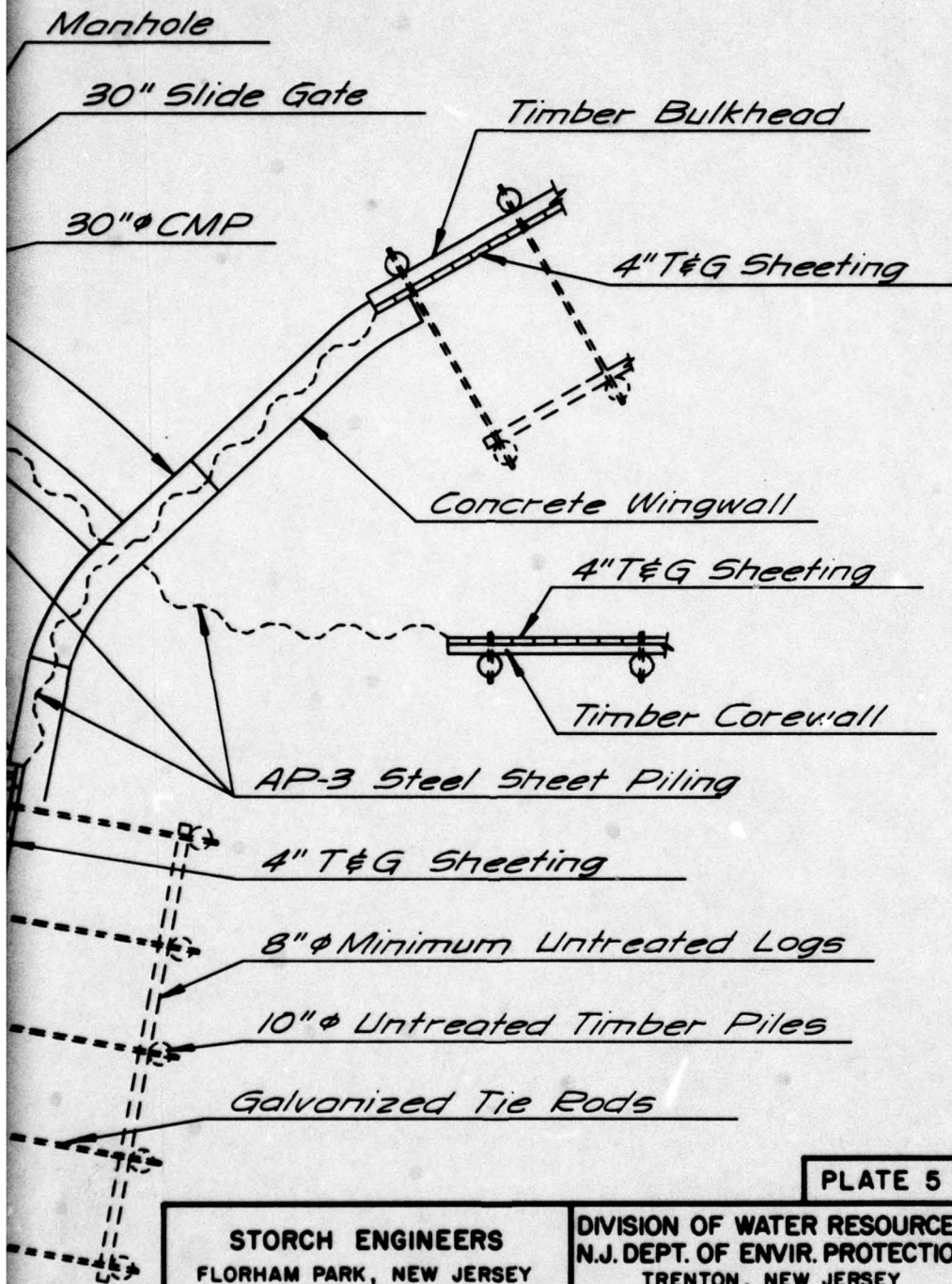


PLATE 5

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

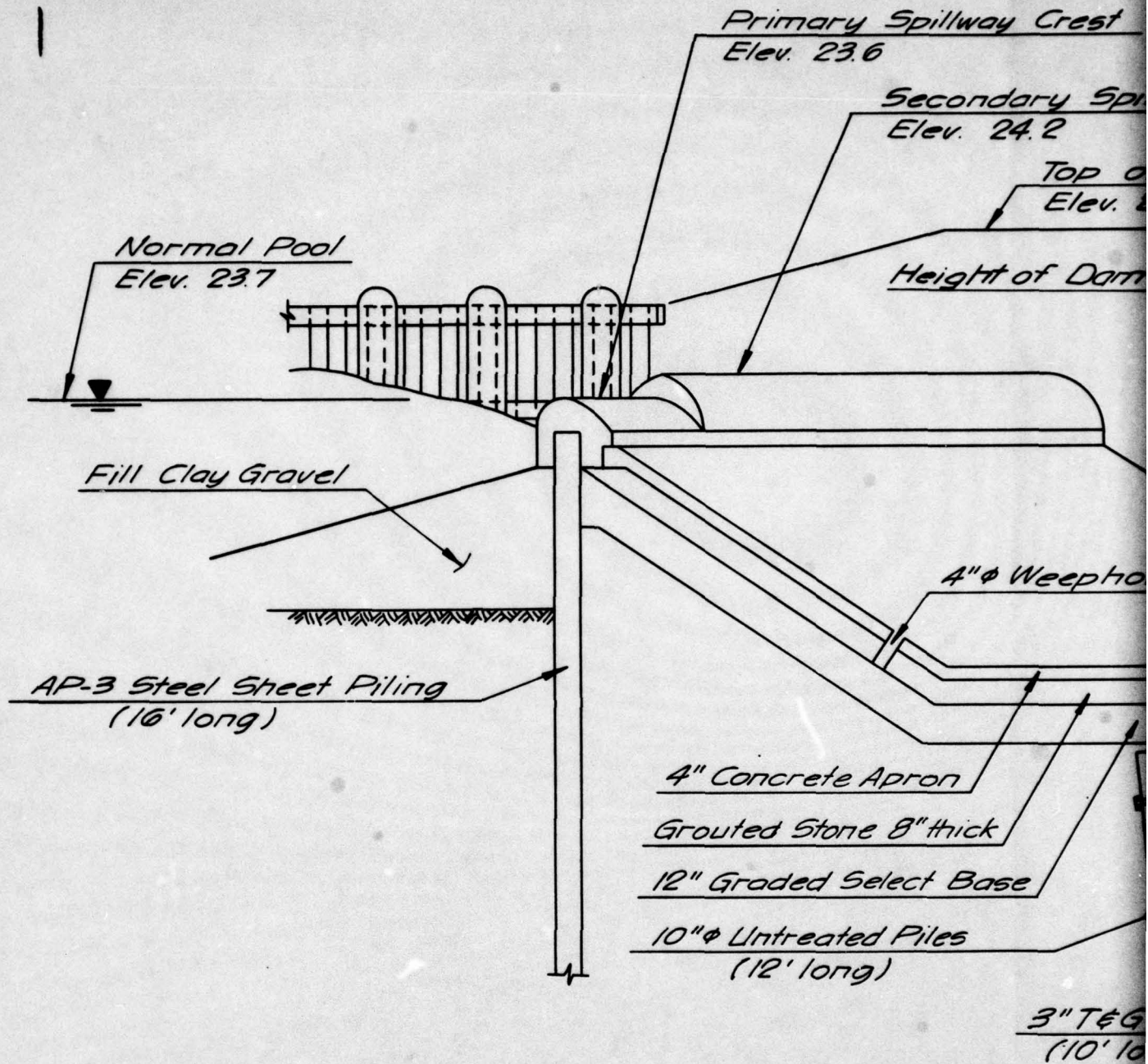
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS
SPILLWAY PLAN
MANAHAWKIN LAKE DAM

I.D. N.J. 00057

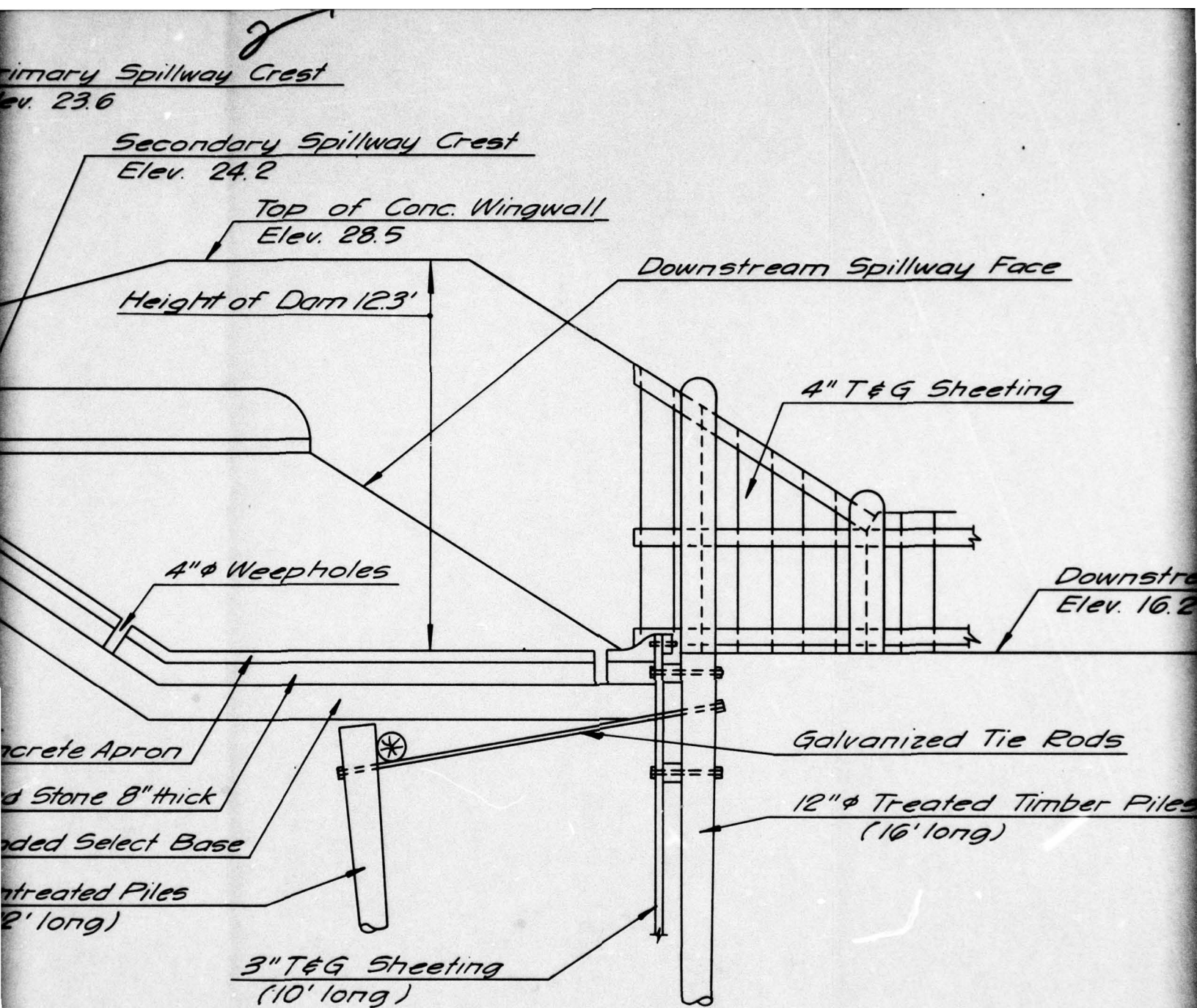
SCALE: NOT TO SCALE

DATE: FEBRUARY, 1979



NOTE:

Information taken from plan by
Richard E. Lane, P.E., June, 1964 and
field inspection December 20, 1978.



STORCH ENGINEERS
 FLORHAM PARK, NEW JERSEY

DM
 N.J.

INSPECTION AND EVALUATION
 SPILLWAY STRUCTURE
 MANAHAWKIN LAKE

I.D. N.J. 00057

SCALE

DATE

3

Downstream Spillway Face

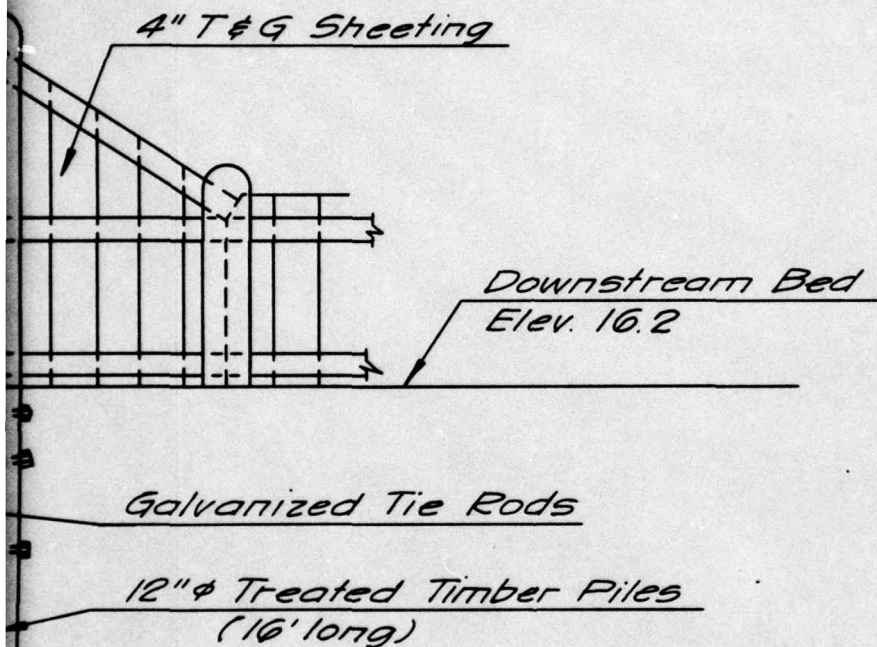


PLATE 6

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

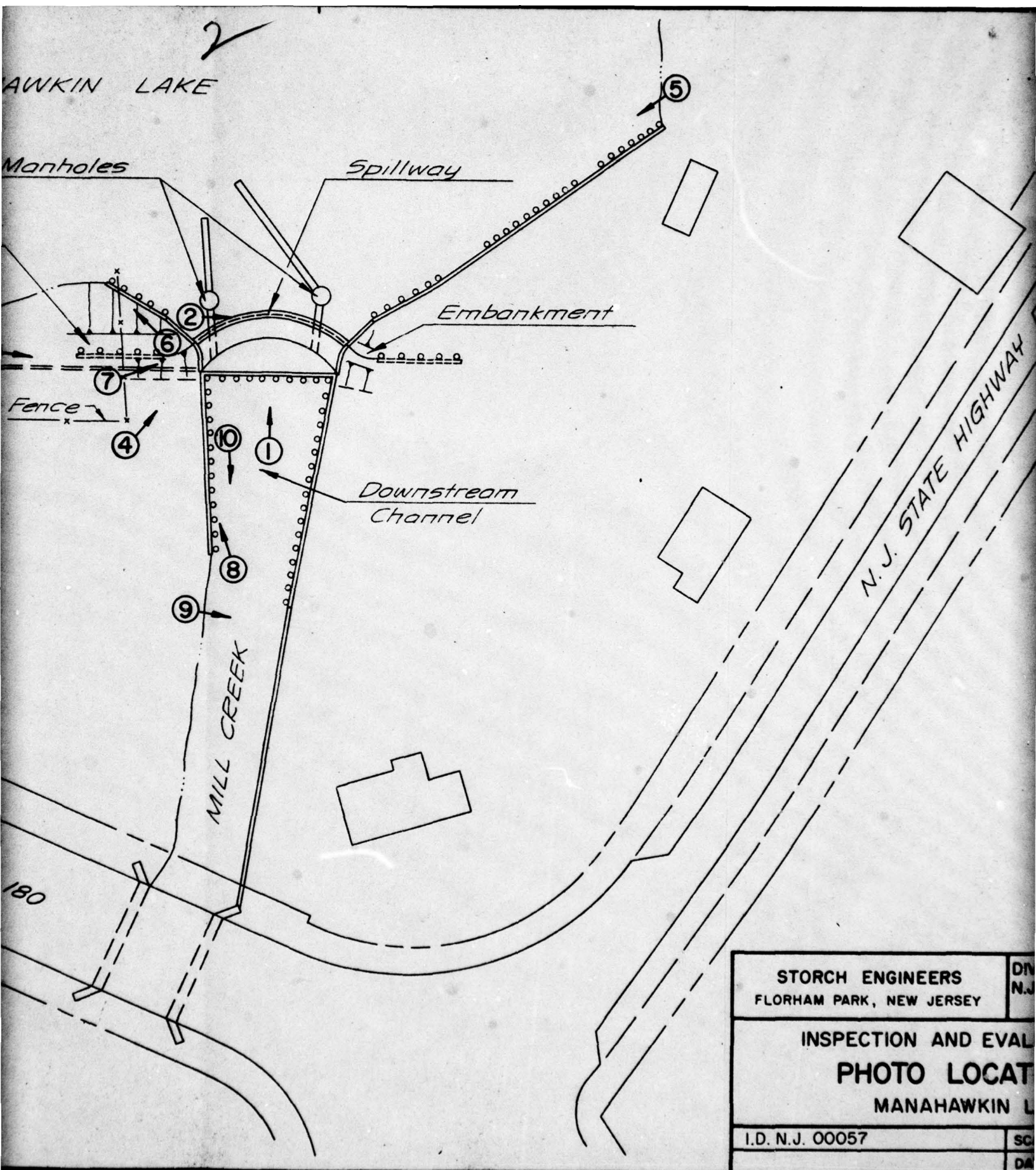
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS
SPILLWAY SECTION
MANAHAWKIN LAKE DAM

I.D. N.J. 00057

SCALE: NOT TO SCALE

DATE: FEBRUARY, 1979



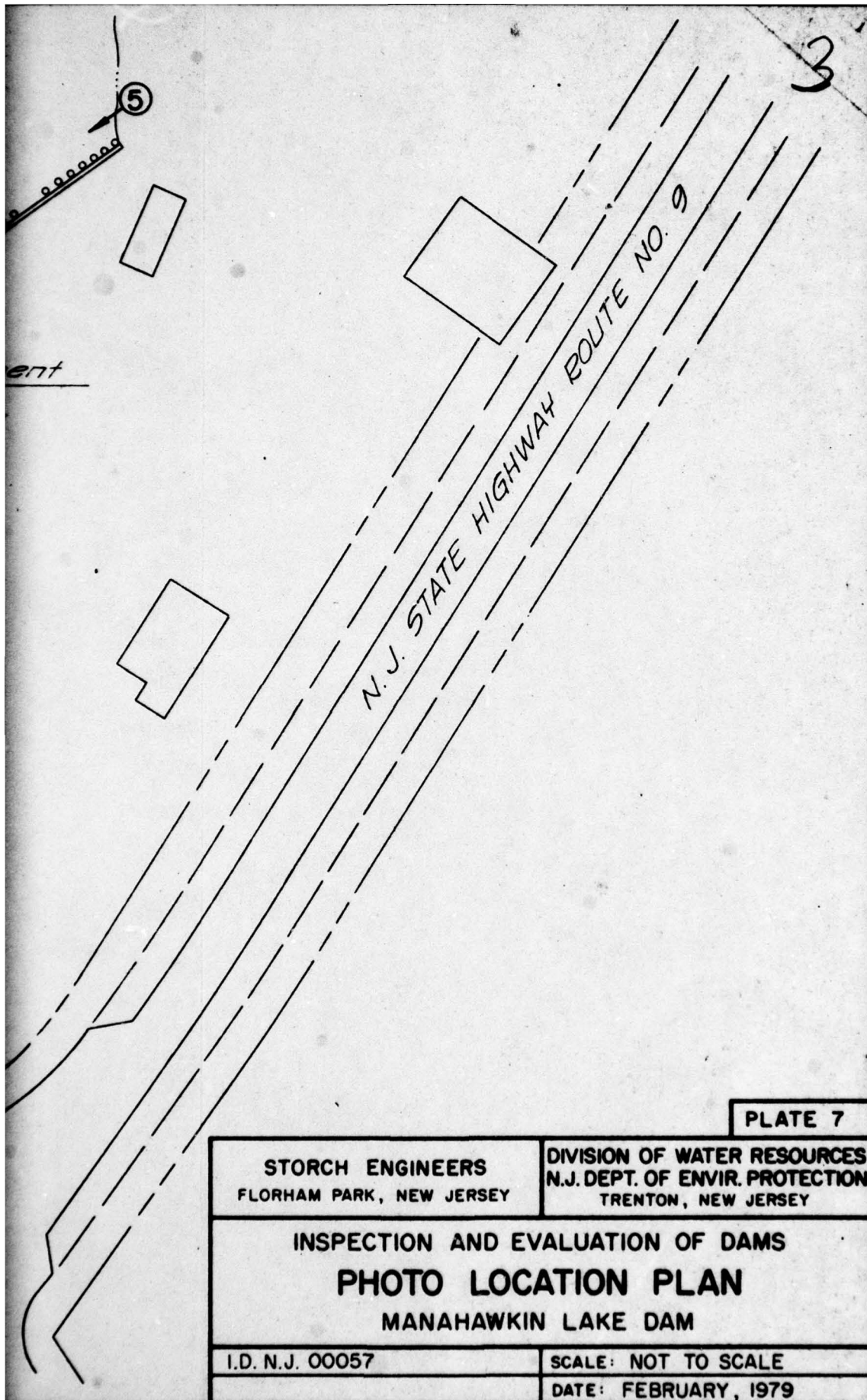


PLATE 7

STORCH ENGINEERS FLORHAM PARK, NEW JERSEY	DIVISION OF WATER RESOURCES N.J. DEPT. OF ENVIR. PROTECTION TRENTON, NEW JERSEY
INSPECTION AND EVALUATION OF DAMS PHOTO LOCATION PLAN MANAHAWKIN LAKE DAM	
I.D. N.J. 00057	SCALE: NOT TO SCALE DATE: FEBRUARY, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase 1

Name Dam Manahawkin Lake County Ocean State N.J. Coordinators N.J. DEP

Date(s) Inspection 12/20/78 Weather Cloudy Temperature 30°F

Pool Elevation at Time of Inspection 24.1 M.S.L. Tailwater at Time of Inspection 18.1 M.S.L.

Inspection Personnel:

J. Gribbin

R. McDermott

D. Buckelew

A. Miller

J. Gribbin Recorder

Present: Bill Britton, Ocean County

CONCRETE/MASONRY DAMS

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SEE PAGE ON LEAKAGE

N.A.

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

N.A.

DRAINS

N.A.

WATER PASSAGES

N.A.

FOUNDATION

N.A.

CONCRETE/MASONRY DAMS

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SURFACE CRACKS
CONCRETE SURFACES

N.A.

STRUCTURAL CRACKING

N.A.

VERTICAL AND HORIZONTAL
ALIGNMENT

N.A.

MONOLITH JOINTS

N.A.

CONSTRUCTION JOINTS

N.A.

EMBANKMENT

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SURFACE CRACKS

None Observed

UNUSUAL MOVEMENT OR
CRACKING AT OR BEYOND
THE TOE

None Observed

SLOUGHING OR EROSION OF
EMBANKMENT AND ADJUTMENT
SLOPES

Downstream face of embankment
adjacent to west wingwall of
spillway eroded; steel sheet piles
exposed and rusted.

Timber corewall exposed on embankment
west of spillway.

Exposed corewall could be
due to sloughing.

VERTICAL AND HORIZONTAL
ALIGNMENT OF THE CREST

Appeared straight

RIPRAP FAILURES

N.A.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Embankment is sandy and bare except for some grass on downstream face	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	East wingwall: junction and embankment in good condition West wingwall: embankment eroded; junction in good condition	
ANY NOTICEABLE SEEPAGE	None observed	
STAFF GAGE AND RECORDER	N.A.	
DRAINS	N.A.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	Concrete surfaces of gate manholes in good condition
INTAKE STRUCTURE	Submerged	
OUTLET STRUCTURE	Submerged except for opening in downstream face of spillway, which appeared to be in good condition.	
OUTLET CHANNEL	Refer to downstream channel.	
EMERGENCY GATE	N.A.	

UNGATED SPILLWAY

REMARKS OR RECOMMENDATIONS

VISUAL EXAMINATION OF

OBSERVATIONS

CONCRETE WEIR

Aligned true to plans. Surface of weir and downstream face eroded; aggregate somewhat exposed. No cracks or spalls observed.

APPROACH CHANNEL

N. A.

DISCHARGE CHANNEL

Refer to downstream channel

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	N.A.	

INSTRUMENTATION

REMARKS OR RECOMMENDATIONS

VISUAL EXAMINATION

NONUMENTATION/SURVEYS

OBSERVATIONS

NONE

OBSERVATION WELLS

NONE

WEIRS

NONE

PIEZOMETERS

NONE

OTHER

NONE

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Slopes range from 2% to 5%.

Beach along south shore. Residential development along east and west shores. Wooded area along north shore.

SEDIMENTATION

• Not known

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)

Well formed channel with vertical sides for
75' downstream of spillway. Some erosion
observed at end of bulkhead on west side. No
obstructions observed

West bank at end of bulkhead
should be protected.

SLOPES

Vertical timber bulkheads; except portion
of west bank: approx. 3:1 slope grass
covered

APPROXIMATE NO.
OF HOMES AND
POPULATION

None in the vicinity of the dam.

Service station and automobile
showroom in vicinity of dam.
Not in downstream flood plain
of dam as delineated by SDF outflow

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

REMARKS

ITEM

PLAN OF DAM

Plans of proposed spillway by Richard E. Lane, P.E.,
 Assistant Ocean County Engineer dated June 1964.

REGIONAL VICINITY MAP

Available

CONSTRUCTION HISTORY

Original construction: no data available
 Spillway reconstruction: data available

TYPICAL SECTIONS OF DAM

Not available

HYDROLOGIC/HYDRAULIC DATA

Available: NJDEP File

OUTLETS - PLAN

Available: Lane Drawings

- DETAILS

Available: Lane Drawings

- CONSTRAINTS
 - DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS

Not available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Inspection Reports available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported N.A. N.A.
MAINTENANCE OPERATION RECORDS	Not available

ITEM

REMARKS

DESIGN REPORTS

Not available

GEOLOGY REPORTS

Not available

**DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES**

Available
Not available
Not available

**MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD**

Available (2 borings)
Not available
Not available

POST-CONSTRUCTION SURVEYS OF DAM

Not available

BORROW SOURCES.

Not available

ITEM

REMARKS

SPILLWAY PLAN

Available. See Lane plans referenced earlier.

SECTIONS

DETAILS

OPERATING EQUIPMENT
PLANS & DETAILS

Available, See Lane plans referenced earlier.

APPENDIX 2

Photographs



PHOTO 1
SPILLWAY



PHOTO 2
CONCRETE MANHOLE FOR SLIDE GATE,
OUTLET PIPE IN SPILLWAY DOWNSTREAM FACE,

20 DEC. 1978



PHOTO 3
UPSTREAM FACE OF DAM

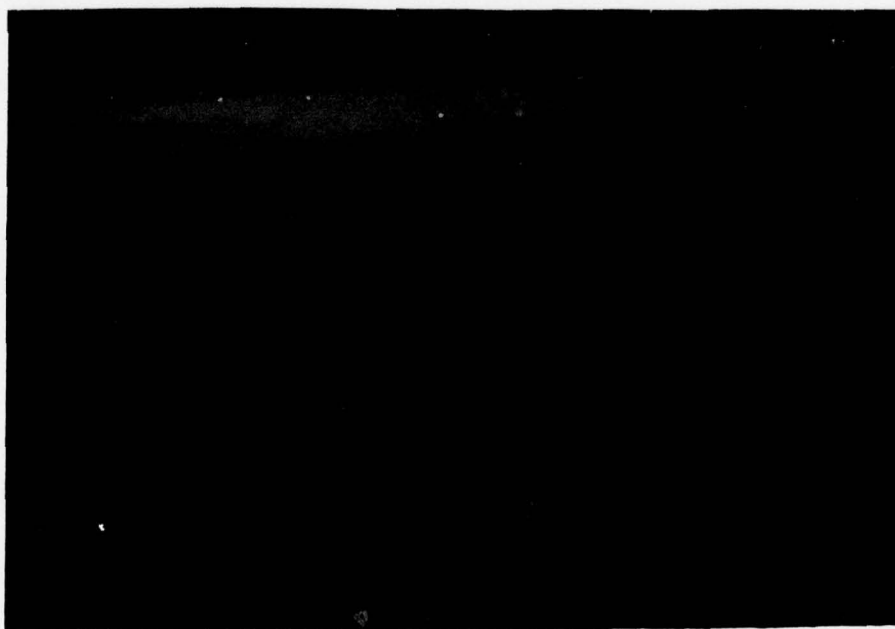


PHOTO 4
DOWNSTREAM FACE OF DAM

20 DEC. 1978



PHOTO 5

BULKHEAD ALONG EDGE OF LAKE,
EAST OF SPILLWAY

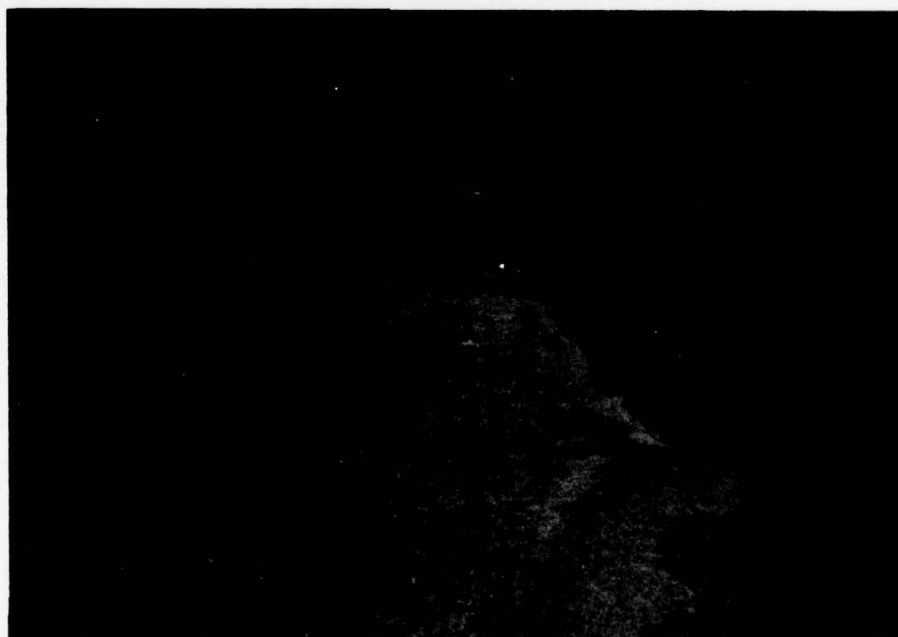


PHOTO 6

BULKHEAD ALONG EDGE OF LAKE,
WEST OF SPILLWAY

20 DEC. 1978



PHOTO 7

EXPOSED STEEL SHEET PILING
WEST OF CONCRETE WINGWALL



PHOTO 8

BULKHEAD ALONG WEST SIDE
OF DOWNSTREAM CHANNEL

20 DEC. 1978



PHOTO 9

BULKHEAD ALONG EAST SIDE
OF DOWNSTREAM CHANNEL



PHOTO 10

DOWNSTREAM CHANNEL AND ROAD BRIDGE

20 DEC. 1978

APPENDIX 3

Engineering Data

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded with one large housing development

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 23.7(127 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N.A.

ELEVATION MAXIMUM DESIGN POOL: 28.0

ELEVATION TOP DAM: 28.0

SPILLWAY CREST: Curved reinforced concrete

a. Elevation 24.2 (Secondary crest, length 40.2 feet)
23.6 (Primary crest, length 30 feet)

b. Type uncontrolled overflow

c. Width 25 inches

d. Length 70.2 feet (total)

e. Location Spillover entire length of spillway

f. Number and Type of Gates None

OUTLET WORKS: 2 - 30" Diam. pipes

a. Type Corrugated metal pipes

b. Location through spillway

c. Entrance inverts 17.88 (plans)

d. Exit inverts 16.80 (plans)

e. Emergency draindown facilities: Slide gates in manholes

HYDROMETEOROLOGICAL GAGES:

a. Type N. A.

b. Location N. A.

c. Records N. A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) 1908 c.f.s.

APPENDIX 4

Hydrologic Computations

100-year Flood (Peak Discharge)

(Reference: Special Report #38)

1. Drainage Area = 19.7 sq. mi.

2. Main Channel Slope (s):

Length of main channel = 6.5 mi.

Elev. at 0.65 mi (10%) from lake = 34

Elev. at 5.5 mi (85%) from lake = 105

$$s = \frac{105 - 34}{4.875} = 14.6 \text{ ft./mi.}$$

3. Surface Storage Index

Area of lakes and swamps
as measured from USGS
quadrangle =

1.10 sq. mi.

$$S_t = \frac{1.10}{19.7} \times 100 + 1 = 6.58 \%$$

4. Manmade impervious cover index I:

Population of drainage area = ~ 6500 people

$$\text{Population density (D)} = \frac{6500}{19.7} = 330 \text{ persons/sq. mi.}$$

STORCH ENGINEERS

Sheet 2 of 6

Project 1132

Made By JG Date 2/8/79

Manahawkin Lake Dam

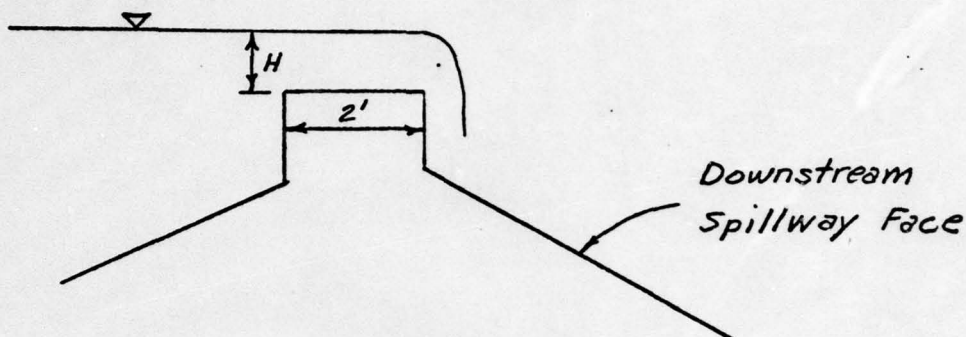
Chkd By _____ Date _____

$$I = 0.117 D^{0.792 - 0.039 \log D}$$

$$I = 6.5 \%$$

5. 100-year flood peak discharge Q_{100} :

$$\begin{aligned} Q_{100} &= 136 A^{0.84} S^{0.26} S_t^{-0.51} I^{0.14} \\ &= 136 (19.7)^{0.84} (14.6)^{0.26} (6.58)^{-0.51} (6.5)^{0.14} \\ &= 136 (12.23) (2.01) (.383) (1.30) \\ &= \underline{\underline{1660 \text{ cfs}}} \end{aligned}$$

Spillway Discharge

(Reference: King, et.al, Handbook of Hydraulics, 1963)

The spillway crest will be taken as a broad crested weir with breadth = 2'. Discharge is given by

$$Q = CLH^{3/2}$$

where

Q = discharge in cfs

C = coefficient (dependent on H)

L = length of crest in ft.

H = head over crest in ft.

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Sheet 4 of 6Project 1132Made By JG Date 2/7/79Manahawkin Lake Dam

Chkd By _____ Date _____

Primary Crest L = 30'			Secondary Crest L = 40.2'			
H (ft.)	C	Q (c.f.s.)	H (ft.)	C	Q (c.f.s.)	Total Q (c.f.s.)
0	-	0	0	-	0	0
0.6	2.61	36	0	-	0	36
1.0	2.66	80	0.4	2.61	27	107
2.0	2.85	242	1.4	2.77	184	426
3.0	3.20	499	2.4	3.03	453	952
4.0	3.32	797	3.4	3.32	837	1634
4.4	3.32	919	3.8	3.32	989	1908

STORCH ENGINEERS

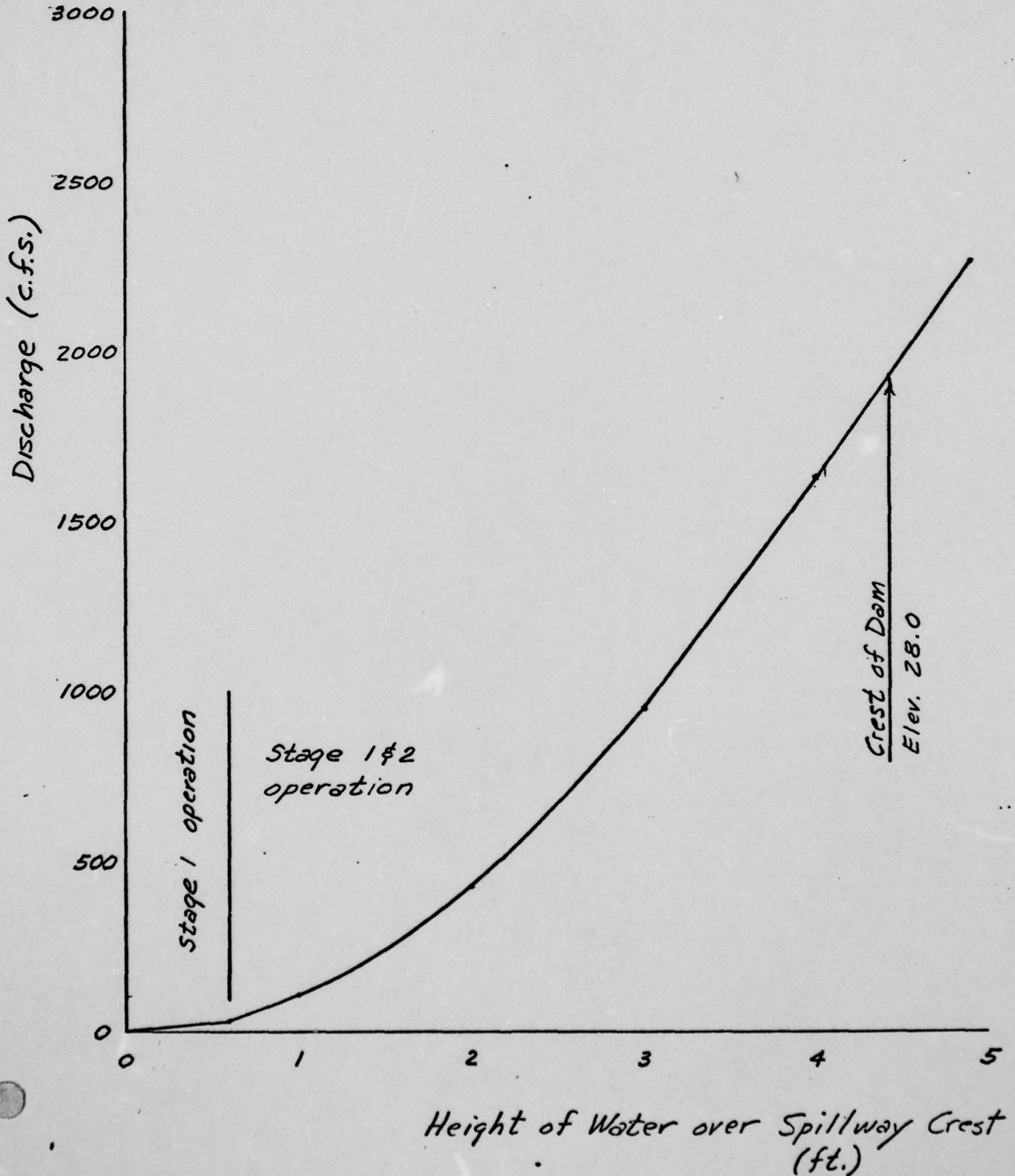
Sheet 5 of 6

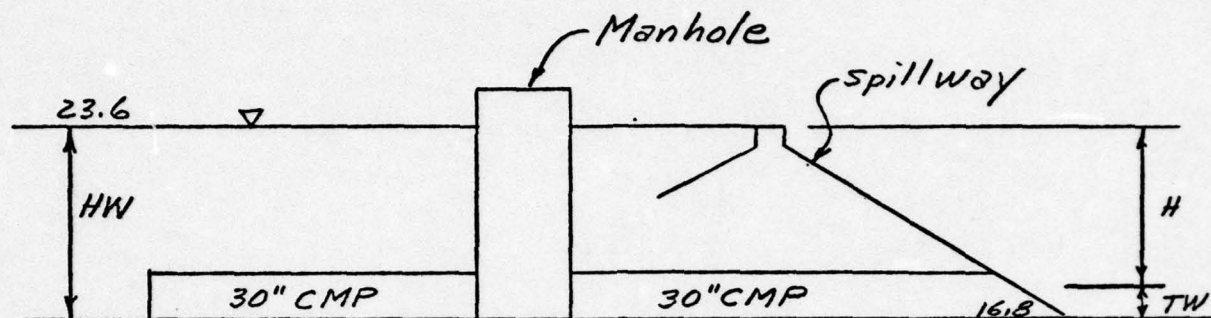
Project #1132

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Manahawkin Lake Dam

Chkd By _____ Date _____



Capacity of Outlet Works

(Reference: Hydraulic Charts for the selection of Highway Culverts, 1965)

Pipe will function under outlet control

$$D = 2.5'$$

$$\text{Length} = 60'$$

$$HW = 23.6 - 16.8 = 6.8' \text{ (Normal lake stage)}$$

$$TW = \frac{D + d_c}{2} \quad H = HW - TW$$

Lake Stage	HW (ft)	H (ft)	Q (cfs)	2Q (cfs)
23.6	6.8	4.5	42	84
22.6	5.8	3.5	37	74
21.6	4.8	2.6	32	64
20.6	3.8	1.7	26	52
19.6	2.8	1.0	20	40

APPENDIX 5

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