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NATIONAL DAM SAFETY PROGRAM. LAKE PARSIPPANY DYKE NUMBER 1 (NJ---ETC(U)
JUN 79 R J MCDERMOTT, J E GRIBBIN

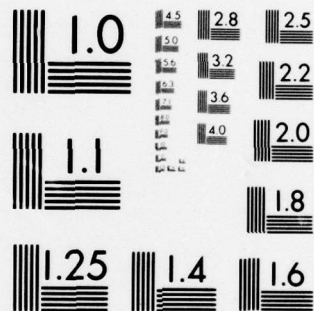
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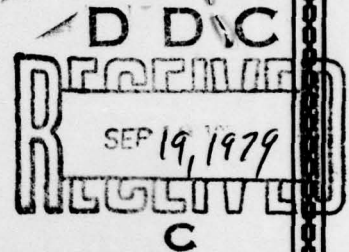
LEVEL II

LAKE PARSIPPANY DYKE

NO 1

NJ 00356

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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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 ade- quacy. 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.		

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IN REPLY REFER TO
NAPEN-D

12 SEP 1979

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

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Lake Parsippany Dyke No. 1 Dam in Morris 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, Lake Parsippany Dyke No. 1, 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 fair overall condition. Lake Parsippany Dyke No. 1 is one of three embankments that impound Lake Parsippany. In addition to this Dyke, Lake Parsippany Dam and Dyke No. 2 impound the lake. The spillway for Lake Parsippany is located at Lake Parsippany Dam (NJ00355). To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Trees, brush and weeds should be removed from the embankment and an adequate ground cover established.

(2) Riprap on the upstream face of the embankment should be thoroughly renovated to form a uniform surface and provide adequate slope protection.

(3) The dyke crest should be protected from pedestrian traffic by an appropriate pavement.

b. 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. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

NAPEN-D

Honorable Brendan T. Byrne

c. A detailed topographic survey of the dyke and the area around the dyke should be made within one year from the date of approval of this report. The survey should be related to existing construction drawings and should become part of the permanent records of the dyke.

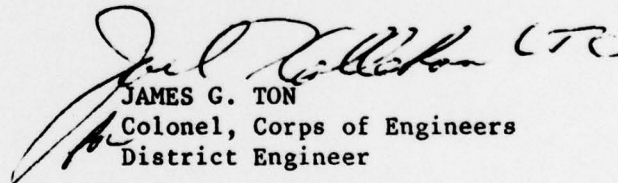
A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congresswoman Millicent Fenwick of the Fifth District. Under 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,

1 Incl
As stated


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

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

LAKE PARSIPPANY DYKE NO. 1 (NJ00356)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 23 April 1979 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.

Lake Parsippany Dyke No. 1, 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 fair overall condition. Lake Parsippany Dyke No. 1 is one of three embankments that impound Lake Parsippany. In addition to this Dyke, Lake Parsippany Dam and Dyke No. 2 impound the lake. The spillway for Lake Parsippany is located at Lake Parsippany Dam (NJ00355). To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Trees, brush and weeds should be removed from the embankment and an adequate ground cover established.

(2) Riprap on the upstream face of the embankment should be thoroughly renovated to form a uniform surface and provide adequate slope protection.

(3) The dyke crest should be protected from pedestrian traffic by an appropriate pavement.

b. 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. An annual site inspection should be conducted using a visual inspection check list similar to the one used in this report.

c. A detailed topographic survey of the dyke and the area around the dyke should be made within one year from the date of approval of this report. The survey should be related to existing construction drawings and should become part of the permanent records of the dyke.

APPROVED: 

JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE:  11/24/79

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Parsippany Dyke No. 1, I.D.NJ00356
State Located: New Jersey
County Located: Morris
Drainage Basin: Passaic River
Stream: Eastmans Brook
Date of Inspection: April 23, 1979

Assessment of General Condition of Dyke

Based on visual inspection, available records and Phase I engineering analyses, Lake Parsippany Dyke No. 1 is assessed as being in fair overall condition.

Based on investigations of the downstream flood plain made in connection with this report, it is recommended that the hazard potential classification be downgraded from high to significant hazard.

The spillway discharging water from Lake Parsippany is located at Lake Parsippany Dam, approximately 2500 feet east of Lake Parsippany Dyke No. 1.

Hydraulic and hydrologic analyses of the spillway indicate that Dyke No. 1 would be overtopped as a result of the Spillway Design Flood (SDF). The SDF for Lake Parsippany Dyke No. 1 is equal to one-half the probable maximum flood. The spillway at Lake Parsippany Dam is capable of passing approximately 41 percent of the probable maximum flood or 82 percent of the SDF.

Therefore, the owner should engage a qualified professional engineer in the near future to perform accurate hydraulic and hydrologic analyses relating to spillway capacity. Based on the findings of the analyses, remedial measures should be undertaken to correct the inadequate condition of the spillway. One possible remedial measure to be considered is a regrading of the entire dyke to form a level crest with elevation equal to 297.0 which is the original design elevation of the dyke crest. Similar measures should also be implemented in connection with Lake Parsippany Dyke No. 2, located approximately 3500 feet east of Dyke No. 1.

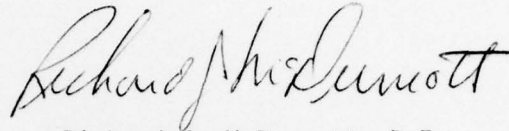
Trees and brush on the embankment should be removed in the near future.

Riprap on the upstream face of dyke should be thoroughly renovated in the near future to form a uniform surface and provide adequate slope protection.

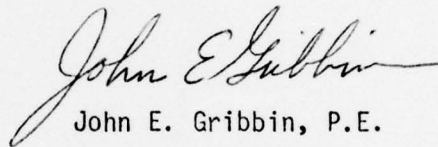
The owner should in the near future implement a program of periodic inspection and maintenance for the dyke which would include a topographic survey to provide a record of existing conditions. Repairs should be made as required and annual maintenance should include removal of adverse vegetation from the embankment, repair of riprap and filling and sodding of any eroded surfaces.

Lake Parsippany Dyke No. 1 is one of three embankments that impound Lake Parsippany. In addition to the dyke, Lake Parsippany Dam and Dyke No. 2 impound the lake. Remedial measures to correct the inadequate conditions

of Lake Parsippany Dyke No. 1 and Dyke No. 2 should be performed in conjunction with remedial measures for the dam as specified in the "Phase I Inspection Report, National Dam Safety Program, Lake Parsippany Dam, Morris County, New Jersey, Fed. Inventory Number NJ00355," dated May 1979.

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

Richard J. McDermott, P.E.

A handwritten signature in cursive script, reading "John E. Gribbin".

John E. Gribbin, P.E.



OVERVIEW - LAKE PARSIPPANY DYKE NO. 1

23 APRIL 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 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

LAKE PARSIPPANY DYKE NO. 1, I.D. NJ00356

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

Lake Parsippany Dyke No. 1 was inspected on April 23, 1979 to generally assess the structural integrity and operational adequacy of the dyke and appurtenances.

1.2 Description of Project

a. Description of Dyke

Lake Parsippany Dyke No. 1 is an 8-foot high earthfill embankment with no spillway. A timber core wall is located within the embankment along its entire length. The embankment is composed of clay fill and is protected with riprap on its upstream face. Concrete capping has been poured on the upper section of the riprap in some areas. The overall crest length of the embankment is 1150 feet and is aligned approximately north/south. Both upstream and downstream faces have approximately 2.5 horizontal to 1 vertical slope. Immediately downstream and parallel to the dyke is a paved road 22 feet in width. Near the center of the dyke, on its upstream side, there is a concrete dock structure oriented parallel to the embankment.

b. Location

Lake Parsippany Dyke No. 1 is located in the Township of Parsippany-Troy Hills, Morris County, New Jersey. The north/south oriented dyke impounds Lake Parsippany in conjunction with Lake Parsippany Dam and Dyke No. 2. Located at the southwest end of the lake, Dyke No. 1 is adjacent to Halsey Road which is a local road serving the Lake Parsippany community.

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>	<u>Economic Loss</u>
	(Extent of Development)	(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)

The following characteristics relating to size and downstream hazard for Lake Parsippany Dyke No. 1 have been determined for this Phase I assessment:

Storage: 862 Acre-feet

Height: 8 feet

Potential Loss of Life:

Eight dwellings are located about 40 feet downstream from the embankment along Halsey Road in a relatively flat area. In case of failure due to overtopping, the dwellings and road would be inundated by about 1 foot above ground level.

Potential Economic Loss:

Halsey Road and all buildings downstream from the dyke, 8 dwellings, one tavern and one service station, would be subject to water damage as a result of failure due to overtopping.

Therefore, Lake Parsippany Dyke No. 1 is classified as "Small" size and "Significant" hazard potential.

d. Ownership

Lake Parsippany Dyke No. 1 is owned by Lake Parsippany Property Association, P.O. Box 62, Parsippany, N.J. 07054

e. Purpose of Dyke

The purpose of the dyke is impoundment of a recreational lake facility for a residential development. The lake is also impounded by Lake Parsippany Dam and Dyke No. 2.

f. Design and Construction History

Lake Parsippany Dyke No. 1 was constructed in 1933 as part of a real estate development. The dyke was built concurrently with Lake Parsippany Dam and Dyke No. 2 by W. Wickstrom, who was both the engineer and builder. All work on the dam and dykes was completed by the end of July 1933. On September 16, 1935 it was reported that part of the dyke had settled and downstream embankment had been eroded. No record is available to indicate that any repair was done.

Subsequent to the construction of the dyke, the area immediately downstream was filled and a row of buildings was constructed.

g. Normal Operational Procedures

The dyke is maintained by the Lake Parsippany Property Owners Association. There is no fixed schedule of maintenance; repairs are made as the need arises.

1.3 Pertinent Data

a. Drainage area

1.12 square miles

b. Discharge at Damsite

Maximum Known flood of Lake
Parsippany

May 1968 hurricane -
inflow magnitude unknown

Outlet works at pool elevation
Spillway capacity at top
of dam

N.A.

N.A.

c. Elevation (Feet above MSL)

Top of Dyke No. 1	296.0
Top of Dyke No. 2	296.0
Maximum pool-design surcharge	296.1
Full flood control pool	N.A.
Recreation pool	293.7
Spillway crest	N.A.
Stream bed at centerline of dam	N.A.
Maximum tailwater	N.A.

d. Reservoir

Length of maximum pool	3000 feet
Length of recreation pool	2,800 feet (scaled)
Length of flood control pool	N.A.

e. Storage (Acre-feet)

Recreation pool	459 acre-feet
Flood control pool	N.A.
Design surcharge	887 acre-feet
Top of dyke	862 acre-feet

f. Reservoir Surface (Acres)

Top of dyke	219 acres (Estimated)
Maximum Pool	230 acres (Estimated)
Flood control pool	N.A.
Recreation pool	151 acres
Spillway crest	N.A.

g. Dyke No. 1

Type	Earthfill
Length	1150 feet
Hydraulic height	8 feet
Side slopes - Upstream	2.5 horiz. to 1 vert.
- Downstream	2.5 horiz. to 1 vert.
Zoning	Clay Fill
Impervious core	N.A.
Cutoff	Timber sheeting
Grout curtain	N.A.

h. Diversion and Regulating Tunnel N.A.

i. Spillway None

Type	N.A.
Length of weir	N.A.
Crest elevation	N.A.
Gates	N.A.
Upstream channel	N.A.
Downstream channel	N.A.

j. Regulating Outlets None

SECTION 2: ENGINEERING DATA

2.1 Design

The following plans are available: "Plan of Proposed Dam and Dykes; Halseytown, Parsippany-Troy Hills Township" by W. Wickstrom, dated January 6, 1933.

Calculations showing drainage area and peak runoff are available in NJDEP file. A soil description of the foundation at the dam site by Wickstrom is: "loam and decayed vegetation on 6 feet of grey clay." Foundation clay is described by Wickstrom to be "in good condition with no sand pockets."

2.2 Construction

Two inspection reports during construction confirmed that foundation clay was "in good condition." Two more site inspections indicated construction was progressing satisfactorily. It was reported that construction was completed on July 31, 1933. In September of 1935, it was reported that the embankment had settled. However, no record of repair work as a result of this inspection is available in the NJDEP file.

2.3 Operation

No operation of the dyke is performed by the owner due to the absence of spillway and outlet works. The spillway and outlet works for Lake Parsippany are located at Lake Parsippany Dam.

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, correspondence and inspection reports. The file is available for inspection at the offices of the Bureau of Flood Plain Management, 1474 Prospect Street, Trenton, N. J.

b. Adequacy

The available information forms a fairly complete description of the subject dyke and is considered to be of significant assistance in the performance of a Phase I evaluation. A list of absent information is included in paragraph 7.1.b.

c. Validity

Most information that could be verified is valid within a reasonable allowance for error.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The inspection of Lake Parsippany Dyke No. 1 was performed on April 23, 1979 by staff members 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 dyke, concrete dock and adjacent areas were examined.
2. The embankment and concrete dock were measured and key elevations determined by a surveyor's level.
3. The embankment and adjacent areas were photographed.

b. Dyke No. 1

The dyke embankment appears to be uniformly aligned horizontally. The vertical alignment is irregular with three significant depressions in the crest resulting in an overall variation in elevation of 0.6 feet. The lowest elevation of the crest is 296.0 (N.G.V.D.) which corresponds to the elevation of the crest of Lake Parsippany Dam and Dyke No. 2. A 100-foot long concrete dock is located near the mid-section of the dyke and is oriented parallel to the center line of embankment and on its upstream side. The upstream side of the dock platform is at a lower elevation than the downstream side. This difference in elevation could be as originally constructed or due to subsequent settlement. The concrete surface of the platform is in good condition. The concrete sides and adjacent riprap show significant deterioration on both the north and south ends.

Riprap on the embankment appears to be in generally good condition below the water surface and in generally poor condition above the water surface. Most of the riprap has concrete capping on its upper portion to reduce disturbance by pedestrians. The concrete capping is uneven in alignment and extensively cracked and undermined. Numerous trees are located on the upstream slope of embankment and roots were observed along the entire upstream slope.

The generalized soils description of the dam consists of alluvial soil composed of a wide range of grain sizes sorted into rough, intermingled layers by successive stages of water action. The alluvial soil overlies stratified glacial drift deposited by melt waters flowing from the Wisconsin glacier. The glacial drift is composed of assorted, relatively homogeneous materials consisting predominantly of sand and gravel, with some silt and clay in depressions.

A soil description of the foundation at the dam site by W. Wickstrom made at the time of construction is "loam and decayed vegetation on 6 feet of grey clay". (See paragraph 2.1.)

c. Appurtenant Structures

Dyke No. 1 is one of three embankments impounding Lake Parsippany. The spillway and outlet works for the lake are located at the main dam.

d. Reservoir Area

Lake Parsippany is approximately triangular in shape with maximum width of about 2800 feet. It is surrounded with a densely populated residential area. The overall topography of

the watershed area is described as rolling hills. Many home-sites surrounding the lake include docks and other lake related structures.

e. Downstream Area

Immediately downstream of the dyke is a 22 foot wide paved road which was constructed on the same embankment as the dyke at an elevation 3 feet below the dyke crest. Downstream of the road is a row of 10 buildings, with front yards at the same grade as the road. There is no channel downstream from the dyke at present nor was one present when the dyke was constructed.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The level of water in Lake Parsippany is regulated naturally by discharge over the concrete weir located at Lake Parsippany Dam. No regulation of the lake takes place at Dyke No. 1.

4.2 Maintenance of the Dyke

There is no program of regular inspection and maintenance of the dyke. Maintenance is performed on an "as needed" basis. There is no known record of installation of the concrete capping. The concrete dock was reportedly built in 1948-1949 as a diving dock. Reportedly, it is no longer used for diving purposes.

4.3 Maintenance of Operating Facilities

Operating facilities for the lake are located at Lake Parsippany Dam. Maintenance of these facilities is performed on an as needed basis.

4.4 Description of Warning System

Reportedly, there is no warning system in use at the present time.

4.5 Evaluation of Operational Adequacy

Reportedly, the dyke has not been overtopped since it was constructed in 1933.

Maintenance documentation is poor and the maintenance program for the dyke appears to be insufficient in the following areas:

1. Trees and brush on embankment.
2. Erosion on crest and side of embankment
3. Poor condition of concrete capping and riprap on upstream face of embankment.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

Size and hazard classification were used in conjunction with "Recommended Guidelines for Safety Inspection of Dams" published by the U.S. Army Corps of Engineers to establish the SDF (Spillway Design flood) for Lake Parsippany Dyke No. 1. The appropriate design range for this facility is 100-year to 1/2 PMF (Probable Maximum Flood). Since the characteristics for Lake Parsippany Dyke No. 1 as described in paragraph 1.2.c, fall in the higher end of the prescribed range, 1/2 PMF is used as the SDF.

The inflow hydrograph for Lake Parsippany Dyke No. 1 was calculated using Soil Conservation Service Triangular Unit Hydrograph with the curvilinear transformation and the HEC-1-DB computer program. General hydrologic characteristics used in this method were computed using USGS quadrangles and aerial photographs. The drainage area contributing to Lake Parsippany is 1.12 square miles. Most of the watershed is completely developed. The SDF peak was computed to be 3025 c.f.s.

Reservoir storage capacities were estimated using surface areas measured from USGS quadrangles. Discharge rates for the spillway located at Lake Parsippany Dam were computed by the use of a weir formula appropriate for the configuration of its overflow section. (See Appendix 4).

The SDF inflow hydrograph was routed through the spillway at Lake Parsippany Dam using the HEC-1-DB computer program. The routing indicated that the dam and both dykes, No 1 and No. 2, would be overtopped by the SDF. All three embankments have equal crest elevations of 296.0. Computations indicate that overtopping in a non-breach condition would occur for about 2.3 hours with a maximum flow height above the dyke crest of approximately 0.1 feet and a maximum combined discharge of 830 c.f.s.

b. Experience Data

Reportedly, Lake Parsippany Dyke No. 1 has not been overtopped since it was constructed in 1933. Reportedly, in May 1968 a hurricane resulted in lake stage within approximately 8 inches of the dyke crest.

c. Visual Observation

At the time of the field inspection there was no evidence of recent overtopping of the dyke.

d. Overtopping potential

As indicated above, a storm of magnitude equal to the SDF would cause overtopping of the dyke to a height of about 0.1 feet with a peak discharge of 830 c.f.s. in a non-breach condition. The spillway at Lake Parsippany Dam is capable of passing approximately 41 percent of the PMF with lake level equal to the crest of dam and dykes.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

In general, the dyke appeared, at the time of inspection, to be outwardly structurally stable. Low points along the crest of embankment appear to be a result of erosion and not differential settlement. The condition of the timber corewall cannot be observed. The cause of the slope of the concrete dock as described in paragraph 3.1.b is not outwardly apparent.

b. Design and Construction Data

Analysis of structural stability and construction data for the embankment is not available.

c. Operating Records

No operation is performed in connection with the dyke due to the absence of a spillway and outlet works.

d. Post Construction Changes

Since Lake Parsippany Dyke No. 1 was constructed, the following changes have taken place:

1. Concrete capping was poured on the upper section of portions of riprap on the upstream face.
2. The concrete diving platform was reportedly constructed in 1948-1949.

3. On the downstream side of the embankment, along its entire length, fill has been placed for a distance of approximately 140 feet downstream to bring the ground elevation to that of the roadway. Buildings were constructed in the area of the fill.

e. Seismic Stability

Lake Parsippany Dyke No. 1 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 stable under static loading conditions. Lake Parsippany Dyke No. 1 appeared, at the time of inspection, to be stable under static loading conditions.

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 at the main dam of Lake Parsippany is assessed as being inadequate. The spillway is not able to pass the SDF designated for the dam without an overtopping of the main dam and two dykes.

Outwardly, the structural integrity of the dyke appears to be adequate based on field inspection. No reported or written evidence was found that would contradict this assessment.

b. Adequacy of Information

Information sources for this study include: 1) field inspections, 2) plans, reports and correspondence in NJDEP files, 3) USGS quadrangle, 4) aerial photography from Morris County and 5) consultation with the Lake Superintendent of Lake Parsippany Property Owners Association.

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 gaging records.
2. Maintenance documentation.
3. Topographic survey.
4. Soil report.

c. Necessity for Additional Data/Evaluation

Although some data pertaining to Lake Parsippany Dyke No. 1 are not available, additional data are not considered imperative for this Phase I evaluation.

7.2 Recommendations

a. Remedial Measures

Based on hydraulic and hydrologic analyses outlined in paragraph 5.1.a and Appendix 4, the spillway for Lake Parsippany Dam is considered to be inadequate. Therefore, it is recommended that a qualified professional engineer be engaged in the near future to perform more accurate hydraulic and hydrologic analyses relating to the spillway capacity. The analyses should more accurately determine runoff characteristics of the drainage basin for Lake Parsippany.

Based on the findings of these analyses, the dyke should be modified to prevent overtopping of the embankment resulting from a storm equivalent to the SDF. One possible remedial measure to be considered is a regrading of the entire dyke to form a level crest with elevation equal to 297.0 which is the design elevation of the dyke crest. The regrading should be

based on a detailed design by a qualified professional engineer. Similar measures should also be implemented in connection with Lake Parsippany Dyke No. 2.

In addition to the above, it is recommended that the owner, in the near future, undertake the following remedial measures.

1. Trees, brush and weeds should be removed from the embankment and an adequate ground cover established.
2. Riprap on the upstream face of embankment should be thoroughly renovated to form a uniform surface and provide adequate slope protection.
3. The dyke crest should be protected from pedestrian traffic by an appropriate pavement.

The implementation of each of the above remedial measures will require detailed studies and design as well as the obtaining of applicable NJDEP approvals.

Lake Parsippany Dyke No. 1 is one of three embankments that impound Lake Parsippany. In addition to the dyke, Lake Parsippany Dam and Dyke No. 2 impound the lake. Remedial measures to correct the inadequate conditions of Lake Parsippany Dyke No. 1 and Dyke No. 2 should be performed in conjunction with remedial measures for the dam as specified in "Phase I Inspection Report, National Dam Safety Program, Lake Parsippany Dam, Morris County, New Jersey, Fed. Inventory Number NJ00355," dated May 1979.

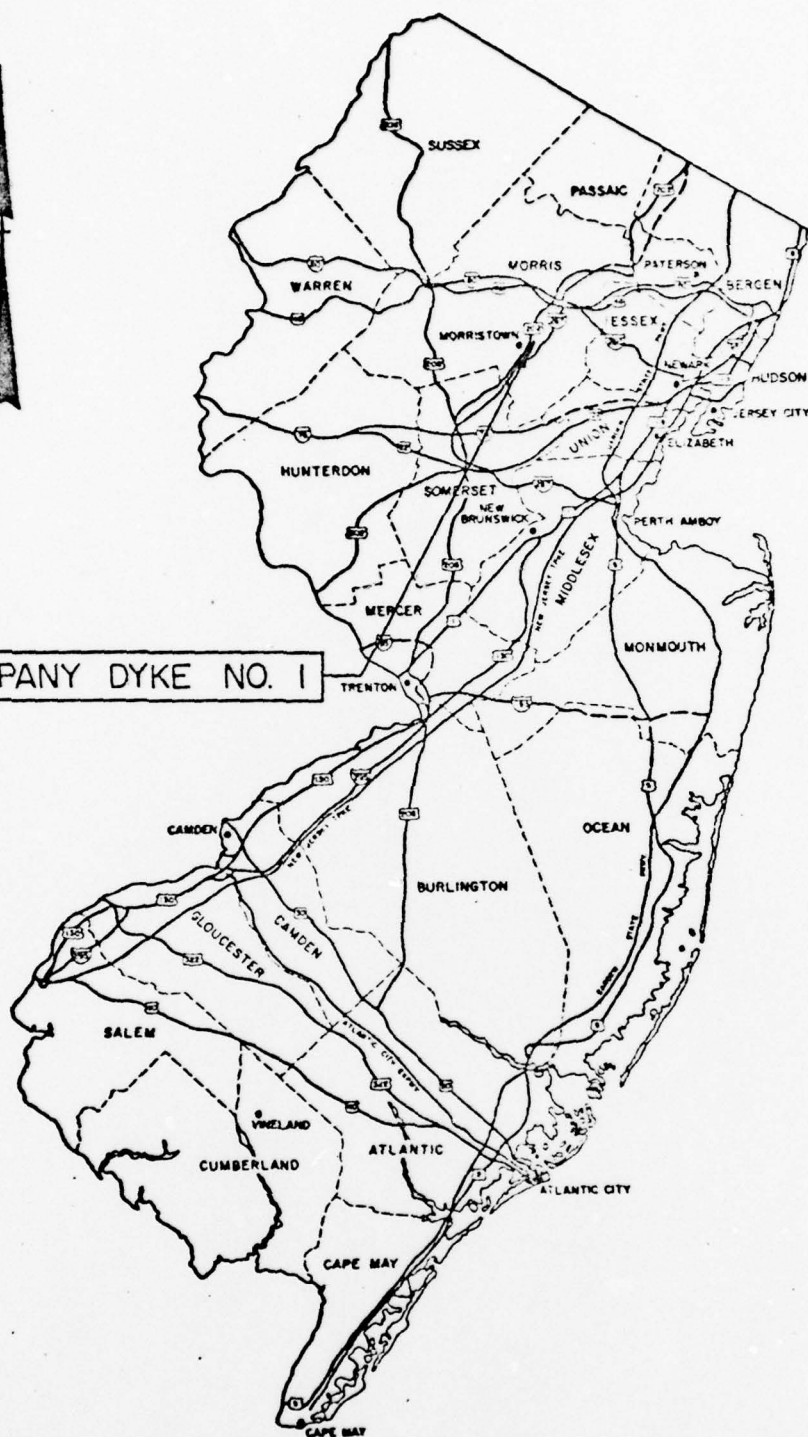
b. Maintenance

In the near future, the owner of the dyke should initiate 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 by a qualified professional engineer should be made annually and reported on a standardized check-list form. Repairs should be made as required and the following maintenance should be performed annually: remove trees and brush from the embankment, repair the riprap, fill and sod any eroded surfaces.

c. Additional Studies

A detailed topographic survey of the dyke and the area around the dyke should be undertaken in the near future by a qualified licensed land surveyor or professional engineer. The survey should be related to existing construction drawings and should become part of the permanent records of the dyke.

PLATES



LAKE PARSIPPANY DYKE NO. 1

PLATE I

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

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

INSPECTION AND EVALUATION OF DAMS

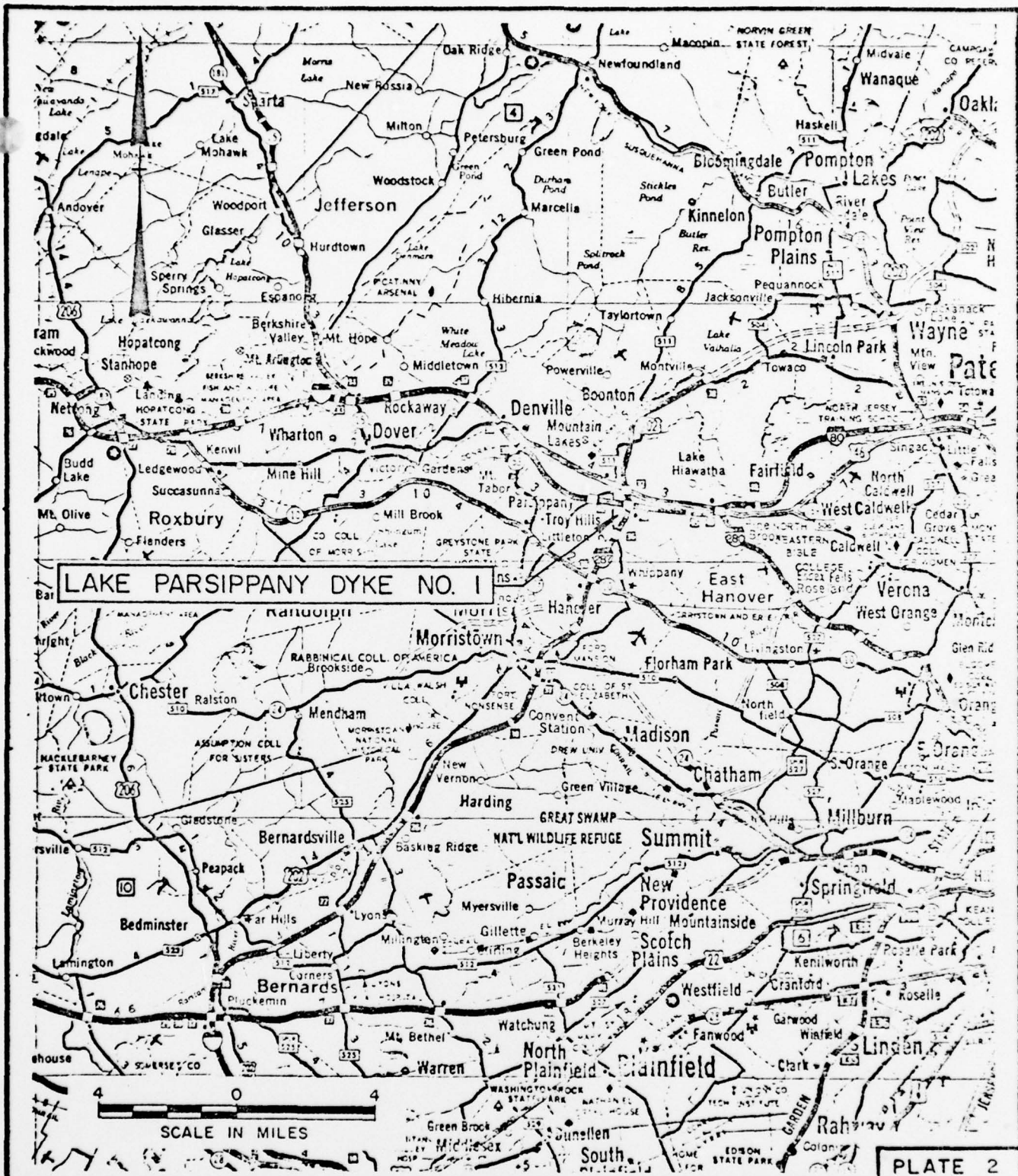
KEY MAP

LAKE PARSIPPANY DYKE NO. 1

I.D. N.J. 00356

SCALE: NONE

DATE: MAY, 1979



STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

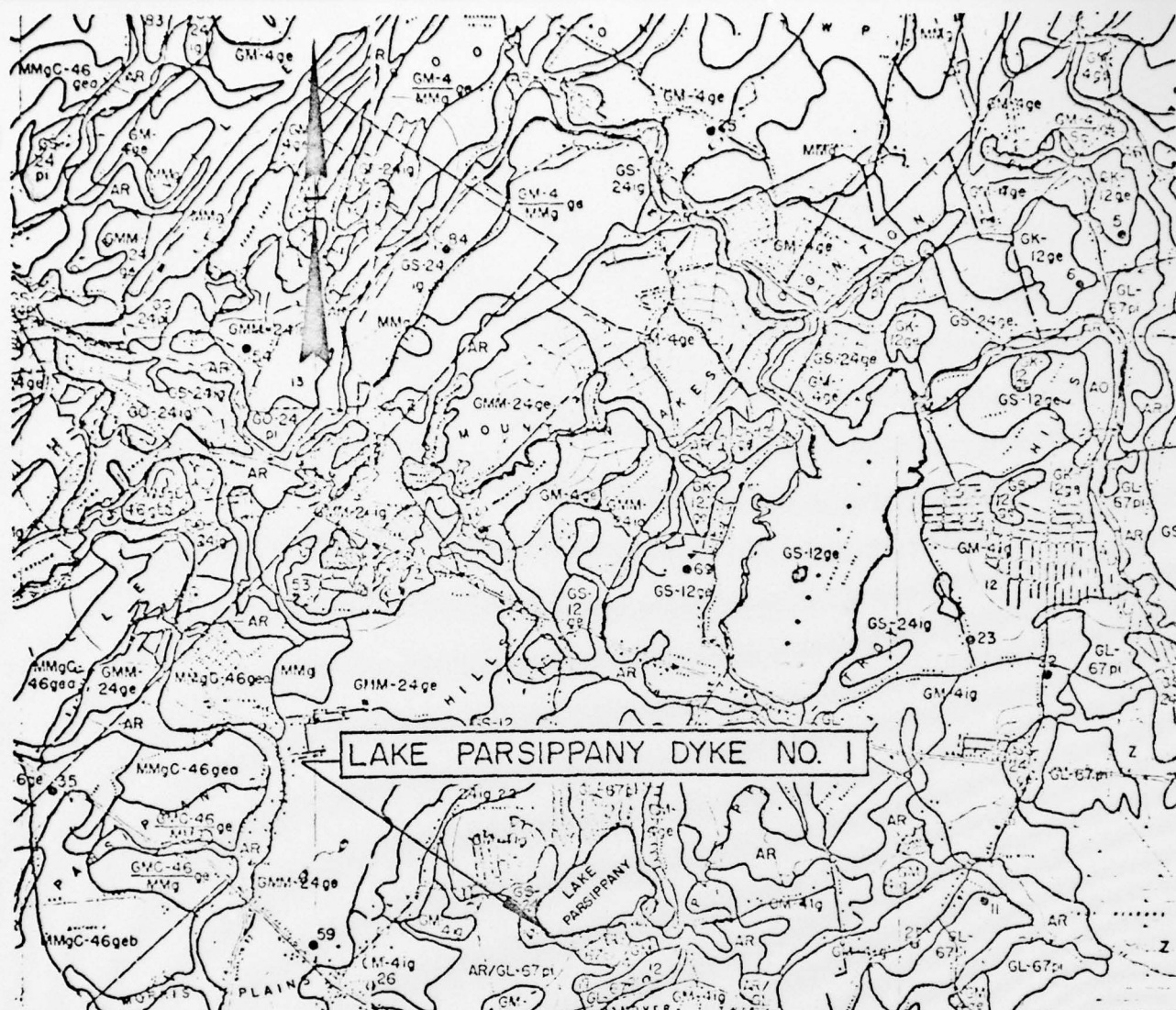
DIVISION OF WATER RESOURCES
N.J. DEPT. OF ENVIR. PROTECTION
TRENTON, NEW JERSEY

INSPECTION AND EVALUATION OF DAMS
VICINITY MAP
LAKE PARSIPPANY DYKE NO. 1

I.D. N.J. 00356

SCALE: AS SHOWN

DATE: MAY, 1979



Legend

AR Recent alluvium composed of stratified materials deposited by streams.

GS-24 Assorted, relatively homogeneous materials consisting predominantly of sand and gravel, with some silt and clay in depressions, deposited by melt-waters flowing from the Wisconsin glacier.

Note: Information taken from Rutgers University Soil Survey of New Jersey, Report No. 9, Morris County, and Geologic Map of New Jersey prepared by Lewis and Kummel.

PLATE 3

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

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

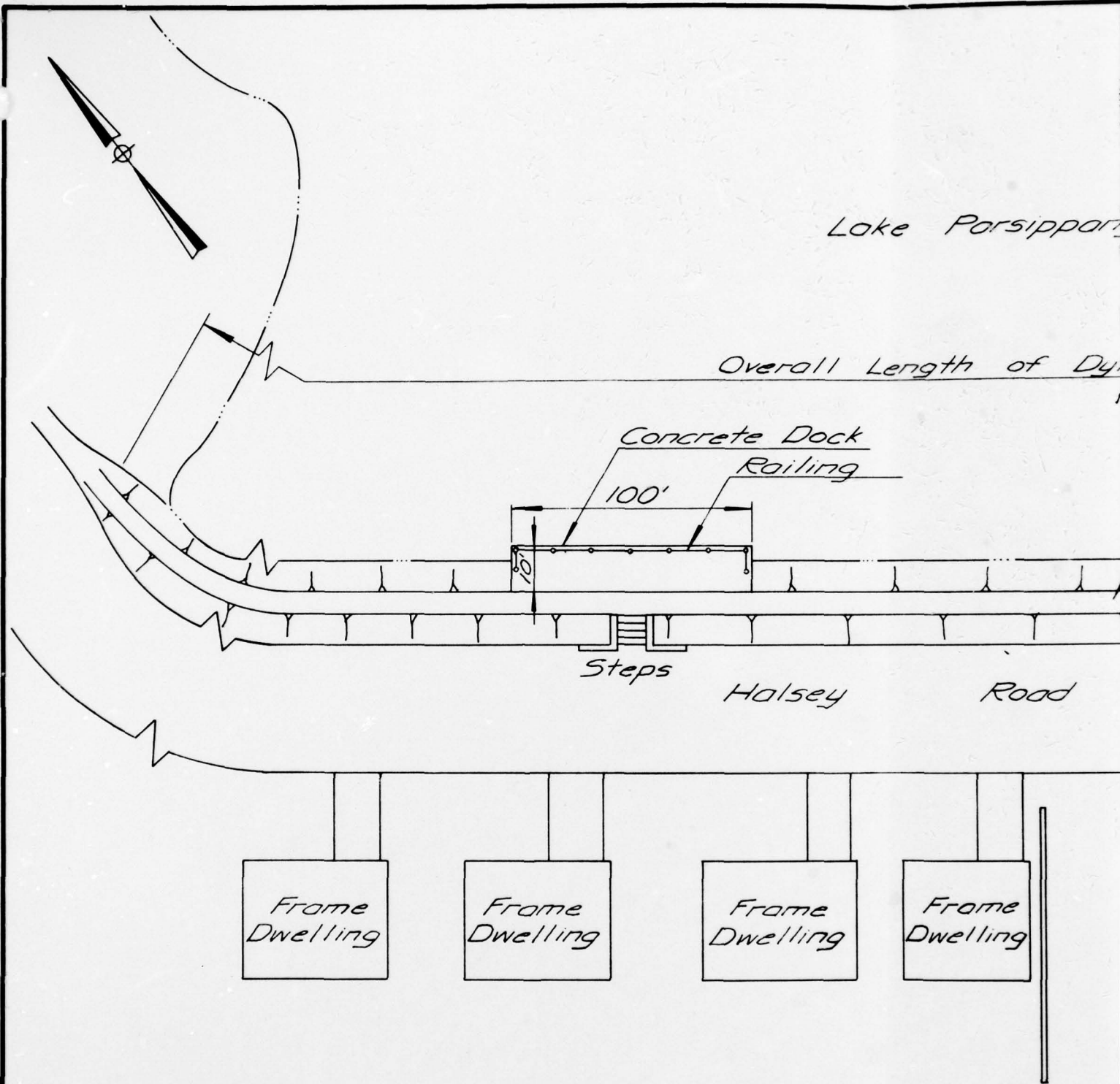
INSPECTION AND EVALUATION OF DAMS
SOIL MAP

LAKE PARSIPPANY DYKE NO. 1

I.D. N.J. 00356

SCALE: NONE

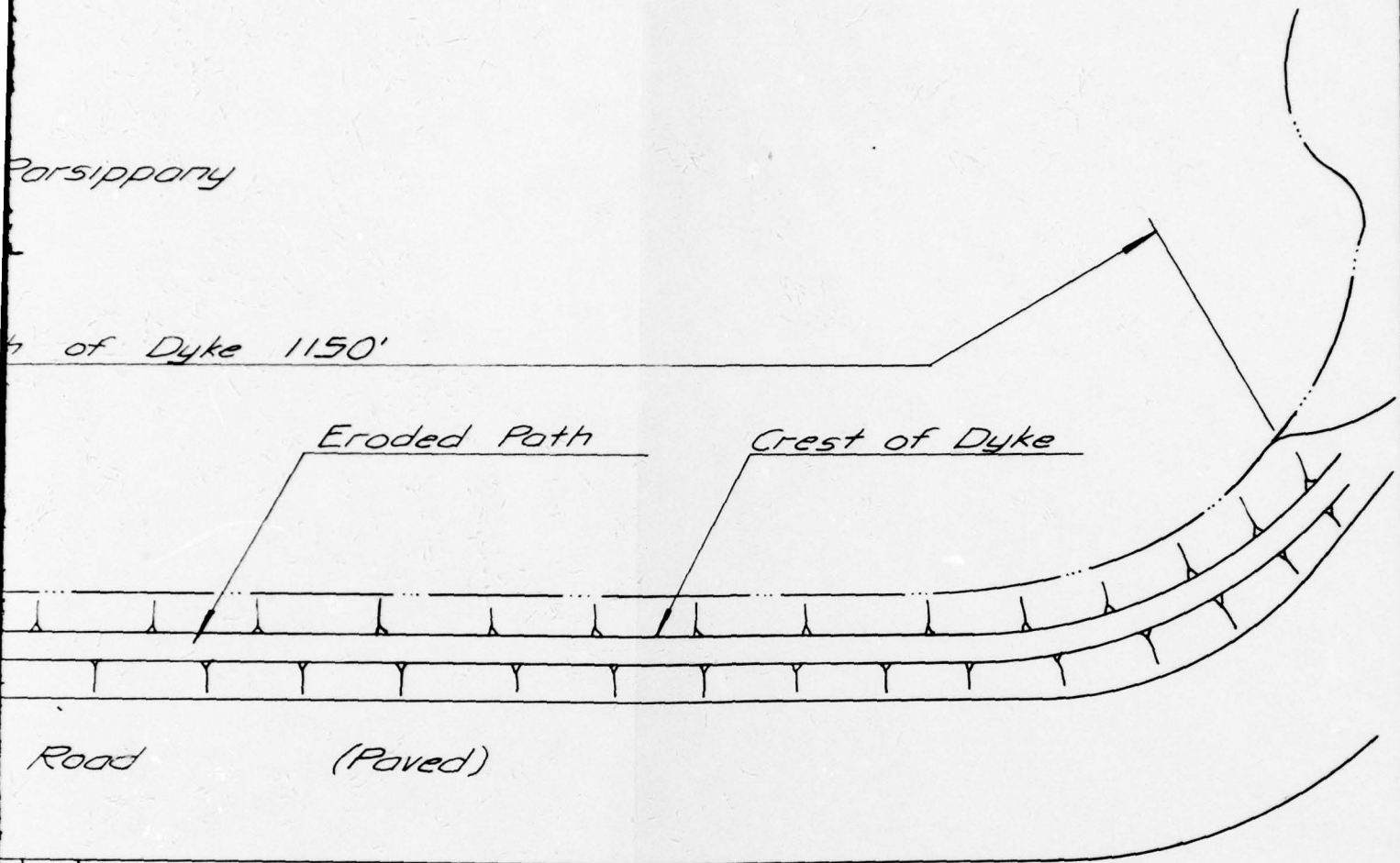
DATE: MAY, 1979



Note: Information taken from
field inspection April 23, 1979.

Parsippany

h of Dyke 1150'



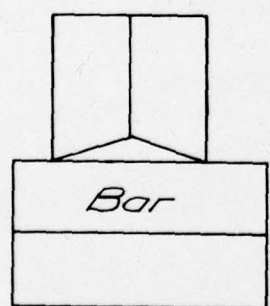
Eroded Path

Crest of Dyke

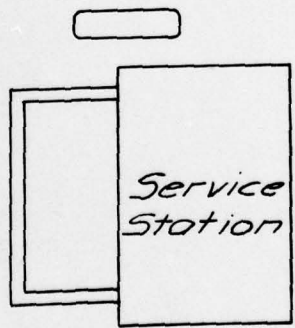
Road (Paved)

Parking Lot

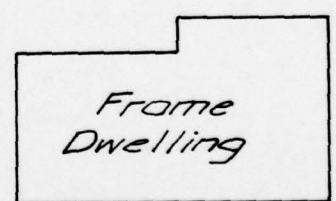
ome
elling



Bar



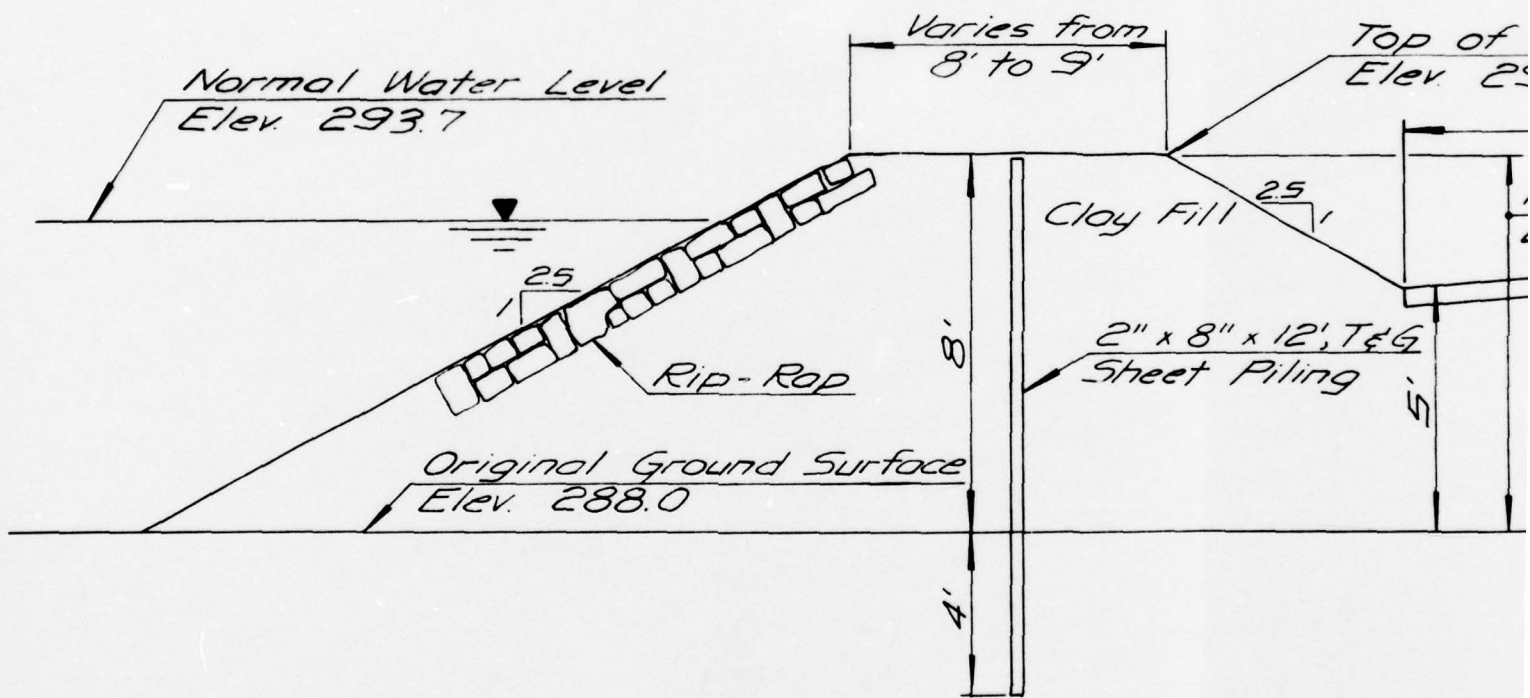
Service
Station



Frame
Dwelling

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 LAKE PARSIPPANY DYKE NO. 1			
I.D. N.J. 00356		SCALE: NOT TO SCALE	
		DATE: MAY, 1979	



Note: Information taken from plans prepared by C.W. Wickstorm dated Jan. 6, 1933 and field inspection April 23, 1979.

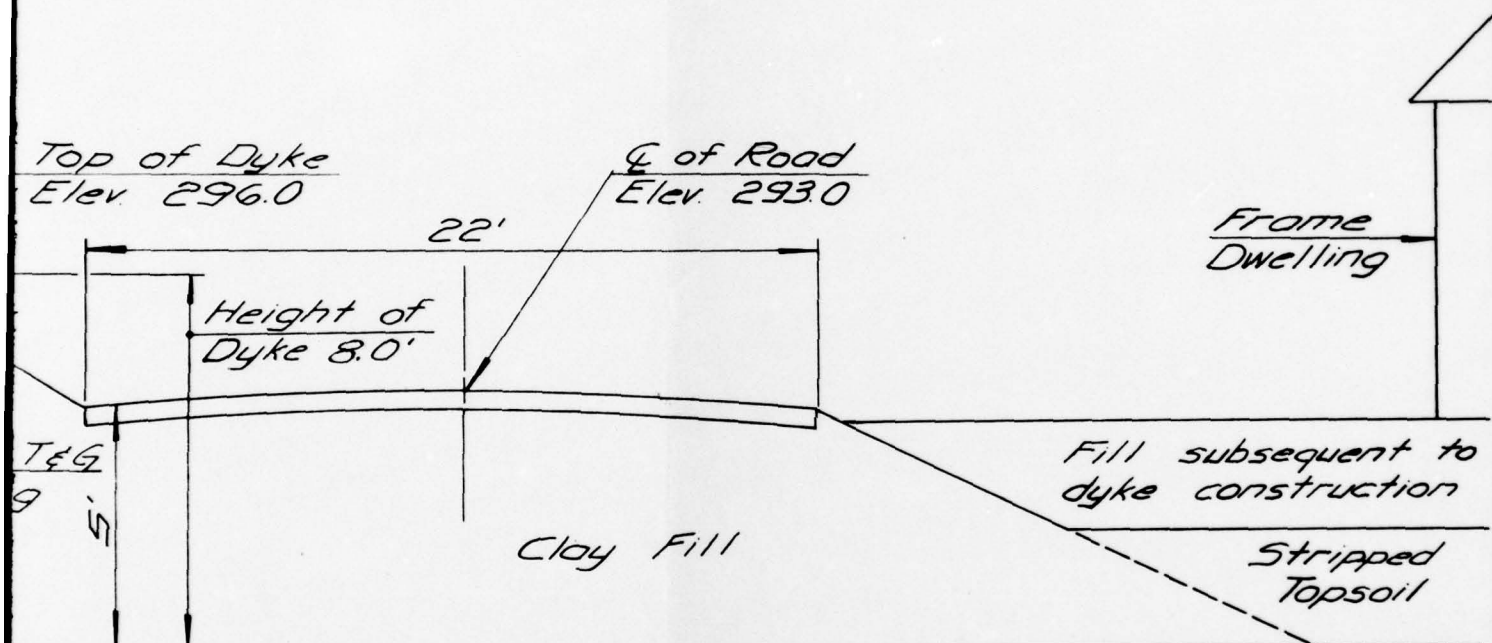


PLATE 5

STORCH ENGINEERS
FLORHAM PARK, NEW JERSEY

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

INSPECTION AND EVALUATION OF DAMS

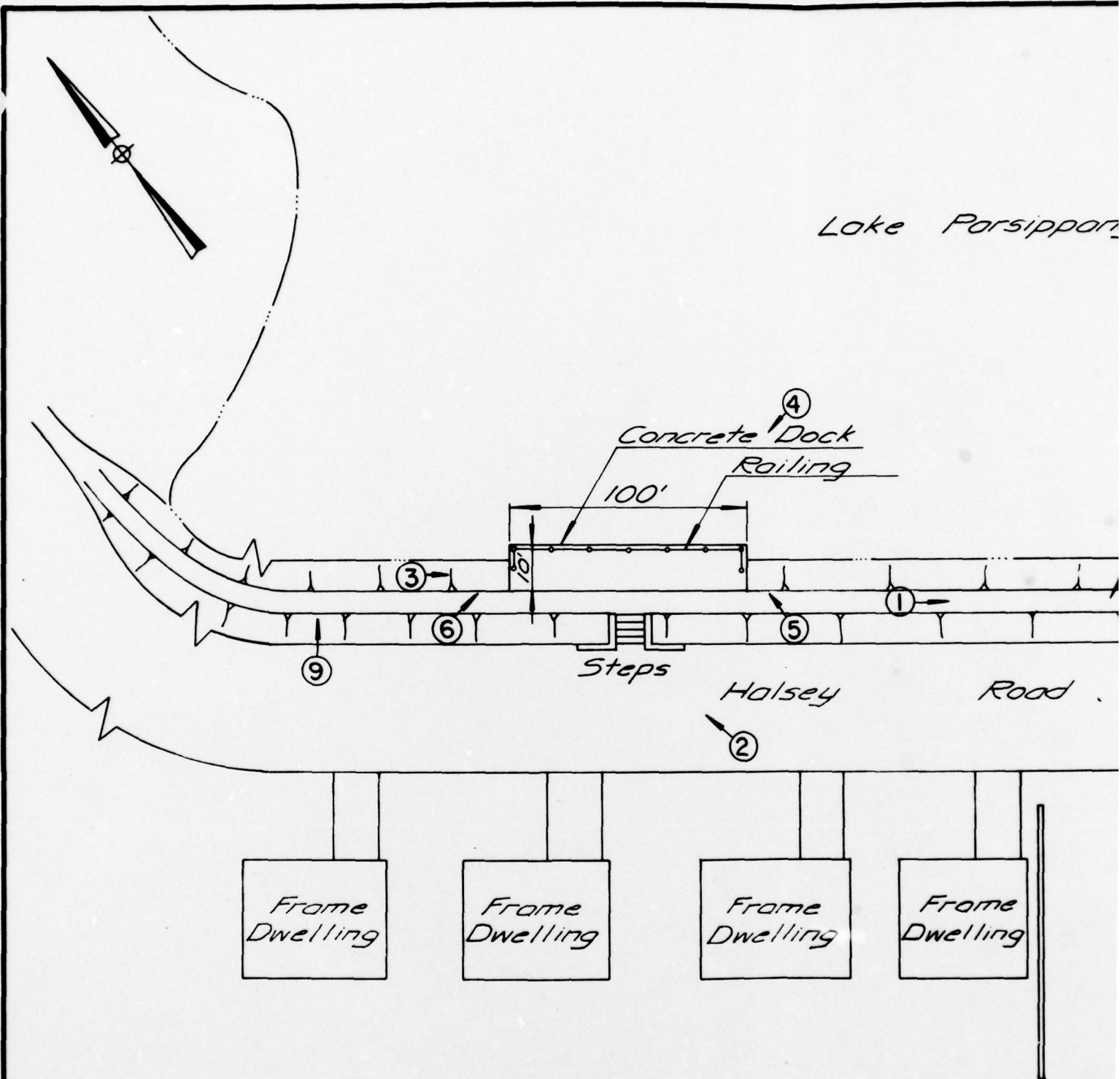
DYKE SECTION

LAKE PARSIPPANY DYKE NO. 1

I.D. N.J. 00356

SCALE: NOT TO SCALE

DATE: MAY, 1979



Note: Information taken from
field inspection April 23, 1979.

Parsippany

Eroded Path

Crest of Dyke

⑦

⑩

⑧

Road (Paved)

Parking Lot

Bar

Service
Station

Frame
Dwelling

OVERVIEW

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
PHOTO LOCATION PLAN
LAKE PARSIPPANY DYKE NO. 1

I.D. N.J. 00356

SCALE: NOT TO SCALE

DATE: MAY, 1979

APPENDIX 1

Check List - Visual Inspection

Check List - Engineering Data

Check List
Visual Inspection
Phase I

Name of Dam Lake Parsippany County Morris State New Jersey Coordinators NJDEP
Dike No. 1

Date(s) Inspection 4/23/79 Weather Fair Temperature 80°F

Pool Elevation at Time of Inspection 293.7 M.S.L. Tailwater at Time of Inspection N.A. M.S.L.

Inspection Personnel:

<u>John Gribbin</u>	<u>David Hoyt</u>
<u>Ronald Lai</u>	<u>Joseph Fox</u>
<u>Richard McDermott</u>	

John Gribbin Recorder

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	N.A.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N.A.	
DRAINS	N.A.	
WATER PASSAGES	N.A.	
FOUNDATION	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT	N.A.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N.A.	
STRUCTURAL CRACKING	N.A.	
CONSTRUCTION JOINTS	N.A.	
MONOLITH JOINTS	N.A.	
LEAKAGE	N.A.	
SEEPAGE	N.A.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	Trees located on upstream slopes, crest generally bare. Downstream face generally covered with grass. Concrete dock on upstream side of dyke has upstream deck elevation lower than downstream deck elevation. Concrete in generally good condition with some deterioration at north and south ends.	Slope of deck of dock could be as originally constructed or due to subsequent settlement. Some of the original driving platform piles are visible in the lake adjacent to the dock.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N.A.	Junction of embankment and concrete dock generally satisfactory with some erosion at north and south end of dock
ANY NOTICEABLE SEEPAGE	None	
STAFF GAGE AND RECORDER	None	
DRAINS	None	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Significant erosion on crest of embankment for the entire length.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Irregular vertical alignment of crest, Crest elevation varies approx. 0.6'. Horizontal alignment generally straight.	
RIPRAP FAILURES	Riprap above water level in poor condition. Concrete capping on riprap is uneven, extensively cracked and undermined.	Trees growing through concrete capping on riprap.

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SURFACES IN OUTLET CONDUIT	N.A.	Outlet used to lower lake is located at another facility on the impoundment.
INTAKE STRUCTURE	N.A.	
OUTLET STRUCTURE	N.A.	
OUTLET CHANNEL	N.A.	
GATE AND GATE HOUSING	N.A.	

SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
GENERAL	N.A.	Dyke does not contain a spillway. Spillway for lake is located at another facility on the impoundment.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	N.A.	
OBSERVATION WELLS	N.A.	
WEIRS	N.A.	
PIEZOMETERS	N.A.	
OTHER	N.A.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Slope of lake banks approx. 4%.	
SEDIMENTATION	Not known.	
STRUCTURES ALONG BANKS	Homes are located along banks all around lake. Many homesites include docks and other lake related structures at the shoreline.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	N.A.	No channel downstream of dyke.
SLOPES	N.A.	
STRUCTURES ALONG BANKS	N.A.	Ten buildings, including eight dwellings downstream of dyke and road.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
DAM - PLAN	Plans titled "Proposed Dam and Dykes, Halseytown, Parsippany-Troy Hills Township, Morris County, N. J. "
SECTIONS	(4 Sheets) prepared by W. Wickstrom, dated Jan. 6, 1933.
SPILLWAY - PLAN	Not applicable
SECTIONS	-
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Not applicable
OUTLETS - PLAN	Not applicable
DETAILS	-
CONSTRAINTS	-
DISCHARGE RATINGS	-
HYDRAULIC/HYDROLOGIC DATA	Limited (NJDEP FILE)
RAINFALL/RESERVOIR RECORDS	Not available
CONSTRUCTION HISTORY	Limited (NJDEP FILE)
LOCATION MAP	Available in Wickstrom drawings.

ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Limited in NJDEP file Not available Not available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Inspection reports in NJDEP file (limited)
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Not available

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	Available in NJDEP file (limited)
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None

APPENDIX 2

Photographs



PHOTO 1
CREST OF DYKE

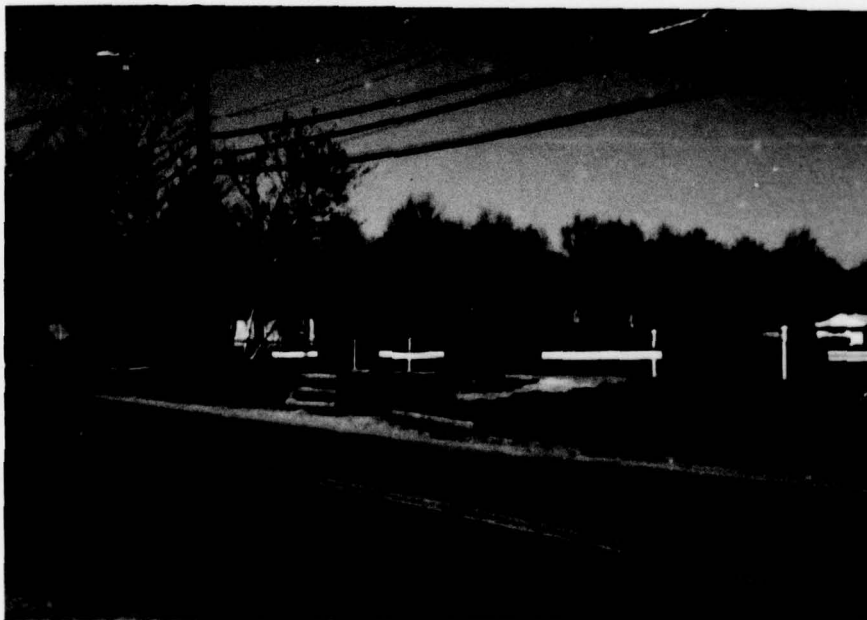


PHOTO 2
DOWNSTREAM FACE OF DYKE AT CONCRETE DOCK

LAKE PARSIPPANY DYKE NO. 1
23 APRIL 1979



PHOTO 3
CONCRETE DOCK



PHOTO 4
UPSTREAM FACE OF CONCRETE DOCK

LAKE PARSIPPANY DYKE NO. 1
23 APRIL 1979



PHOTO 5

DETERIORATION OF SOUTH END OF CONCRETE DOCK

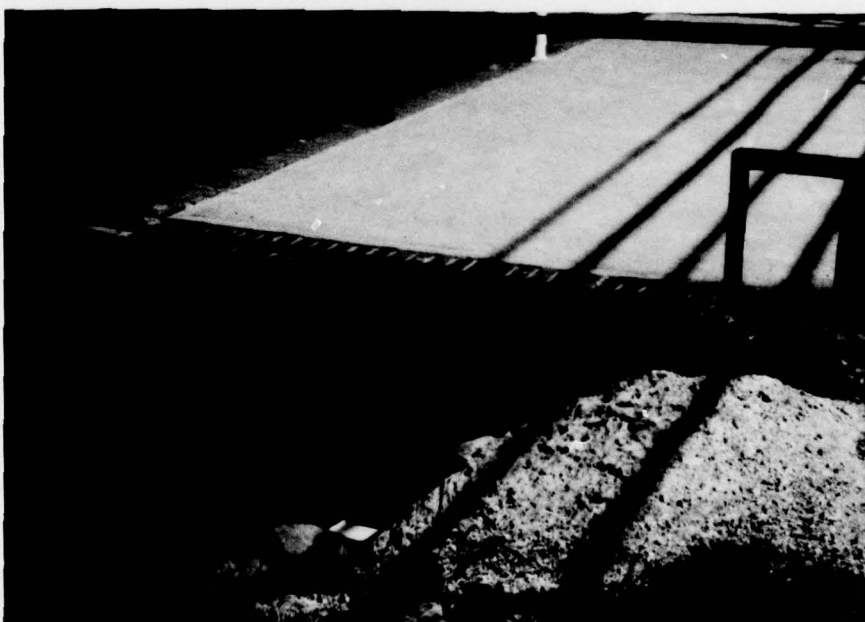


PHOTO 6

DETERIORATION OF NORTH END OF CONCRETE DOCK

LAKE PARSIPPANY DYKE NO. 1
23 APRIL 1979



PHOTO 7
UPSTREAM FACE OF DYKE



PHOTO 8
DOWNSTREAM FACE OF DYKE

LAKE PARSIPPANY DYKE NO. 1
23 APRIL 1979

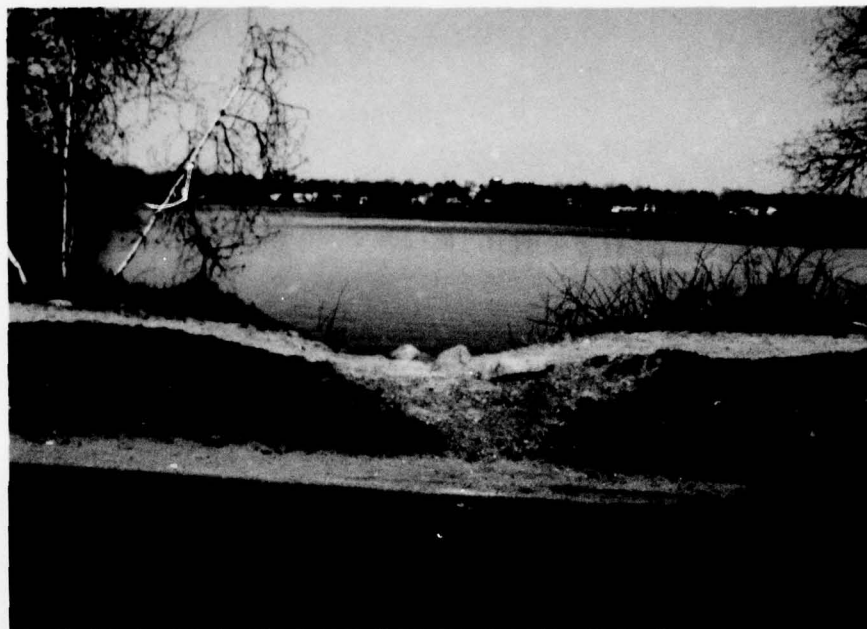


PHOTO 9
EROSION OF CREST OF DYKE



PHOTO 10
CONCRETE REPAIR TO EMBANKMENT

LAKE PARSIPPANY DYKE NO. 1
23 APRIL 1979

APPENDIX 3

Engineering Data

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Mostly Residential

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 293.7 (459 Ac-ft)

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

ELEVATION MAXIMUM DESIGN POOL: 296.1

ELEVATION TOP DAM: 296

SPILLWAY CREST: None

- a. Elevation N.A.
- b. Type N.A.
- c. Width N.A.
- d. Length N.A.
- e. Location Spillover N.A.
- f. Number and Type of Gates N.A.

OUTLET WORKS: None (Located at Lake Parsippany Dam)

- a. Type N.A.
- b. Location N.A.
- c. Entrance inverts N.A.
- d. Exit inverts N.A.
- e. Emergency draindown facilities: N.A.

HYDROMETEOROLOGICAL GAGES: None (Located at Lake Parsippany Dam)

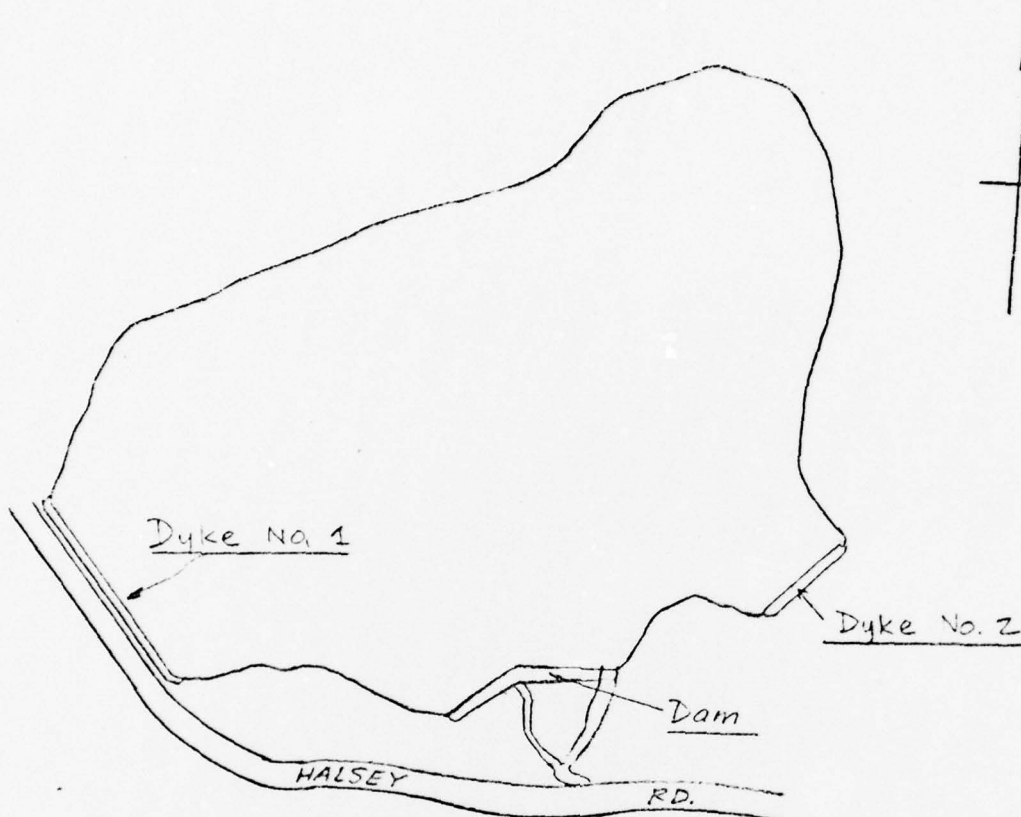
- a. Type N.A.
- b. Location N.A.
- c. Records N.A.

MAXIMUM NON-DAMAGING DISCHARGE:

(Lake stage equal to top of dam) N.A.

APPENDIX 4

Hydrologic Computations

Project Lake Parsippany Dyke No. 1Made By RL Date 5-11-791132 BChkd By DJP Date 5-16-79

Overall Plan of Lake Parsippany

Length of Dam	750 feet
Length of Dyke No. 1	1150 feet
Length of Dyke No. 2	460 feet
Length of overflow areas	175 feet
Original design dam crest elev.	297.0 MSL
Existing dam crest elev.	296.0 MSL
Normal pool elev.	294.0 MSL

Overtopping will occur along the dam and two dykes at the same time. The effective overtopped length of the dyke = 2535 feet

Infiltration Data

Drainage area is heavily populated.

use initial infiltration 1.0 in

constant infiltration 0.1 in/hr.

Time of Concentration

By SCS TR-55

Length of overland flow = 4013 ft.

vel. of travel = 1.2 ft/sec

slope = 2.8 %

T_c = 3344 sec
0.93 hr.

Time of Concentration

By "Design of Small Dams"
SCS nomograph

$H = 26'$

$L = 4013$ ft.

$T_c = 0.58$ hr.

Project Lake Parsippany Dyke No 1 Made By KL Date 4-26-79
113-E Chkd By DMP Date 4-27-79Time of ConcentrationRef Pg. 14-36
"Handbook of Applied
Hydrology" by Chow

$$t_c^{2.4} = \frac{2}{3} \frac{L^n}{\sqrt{S}}$$

 t_c = time of concentration in min. L = length of overland flow in ft S = Slope n = 0.4 Roughness coef. for grass

$$t_c = 1 \text{ hr.}$$

For input

$$\text{use } T_c = 0.9 \text{ hr.}$$

$$\text{Lag} = \underline{\underline{0.54 \text{ hr.}}}$$

Project Lake Tassipping Dyke No 1 Made By AL Date 4-26-77
11325 Chkd By DHF Date 4-27-77Lake Storage Volume

Information from USGS & Aerial Photos

Elev. (M.S.L.)	Surface Area (Ac)
284	0
294	151
300	354
320	496

HEC-1-DB program will develop
storage capacity from surface area
and elev.

STORCH ENGINEERS

Sheet 5 of 10

Project Lake Parsippany Dyke No. 1 Made By RL Date 4-26-79
1132 E Chkd By DHP Date 4-27-79

Since Dyke No. 1 water level is directly controlled by The spillway at Lake Parsippany Dam. The following spillway discharge calculations for The dam are enclosed.

STORCH ENGINEERS

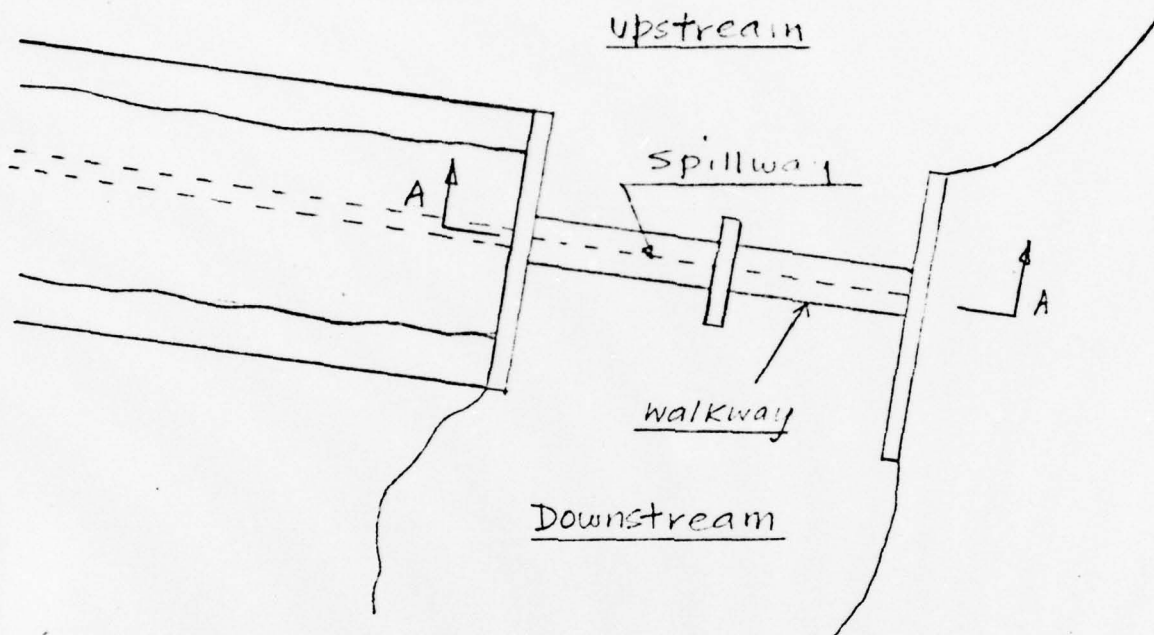
Sheet 6 of 10

Project Lake Parsippany Dam

Made By RL Date 4-26-79

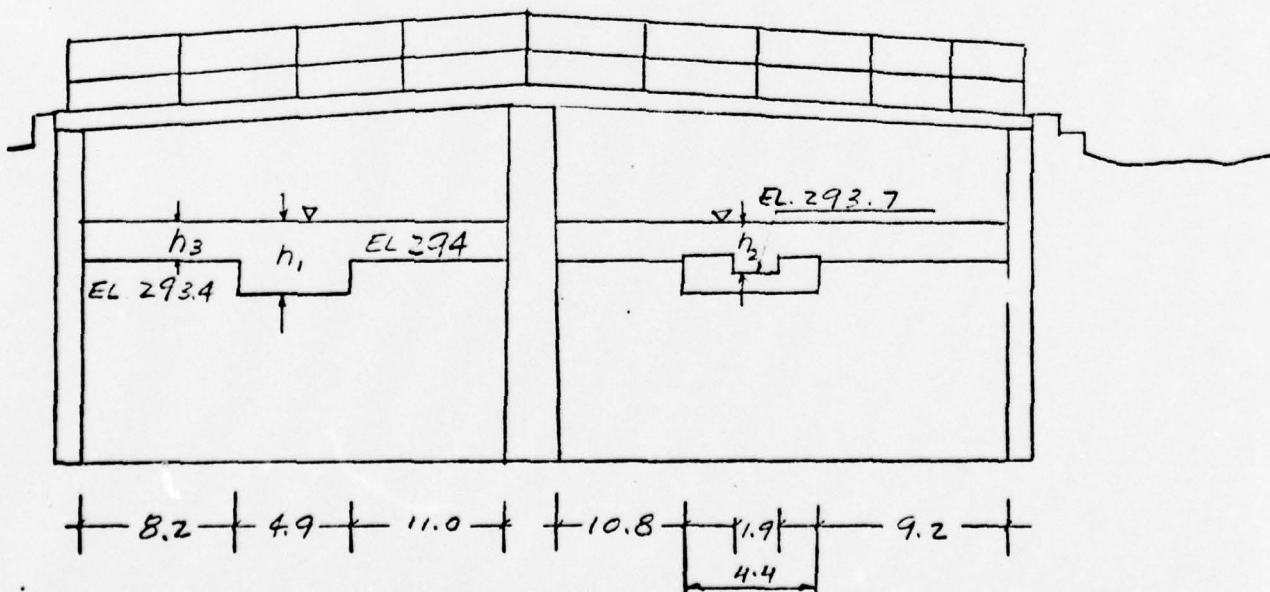
1132 B

Chkd By DHP Date 4-27-79



SPILLWAY PLAN

NOT TO SCALE



SECTION A-A

Spillway Discharge

Spillway discharge flows over weirs at three levels with effective lengths L_1 , L_2 and L_3 respectively. All three are assumed to be weirs with triangular sections and coef. $C = 3.6$ and discharge given by:

$$Q = C L h^{3/2}$$

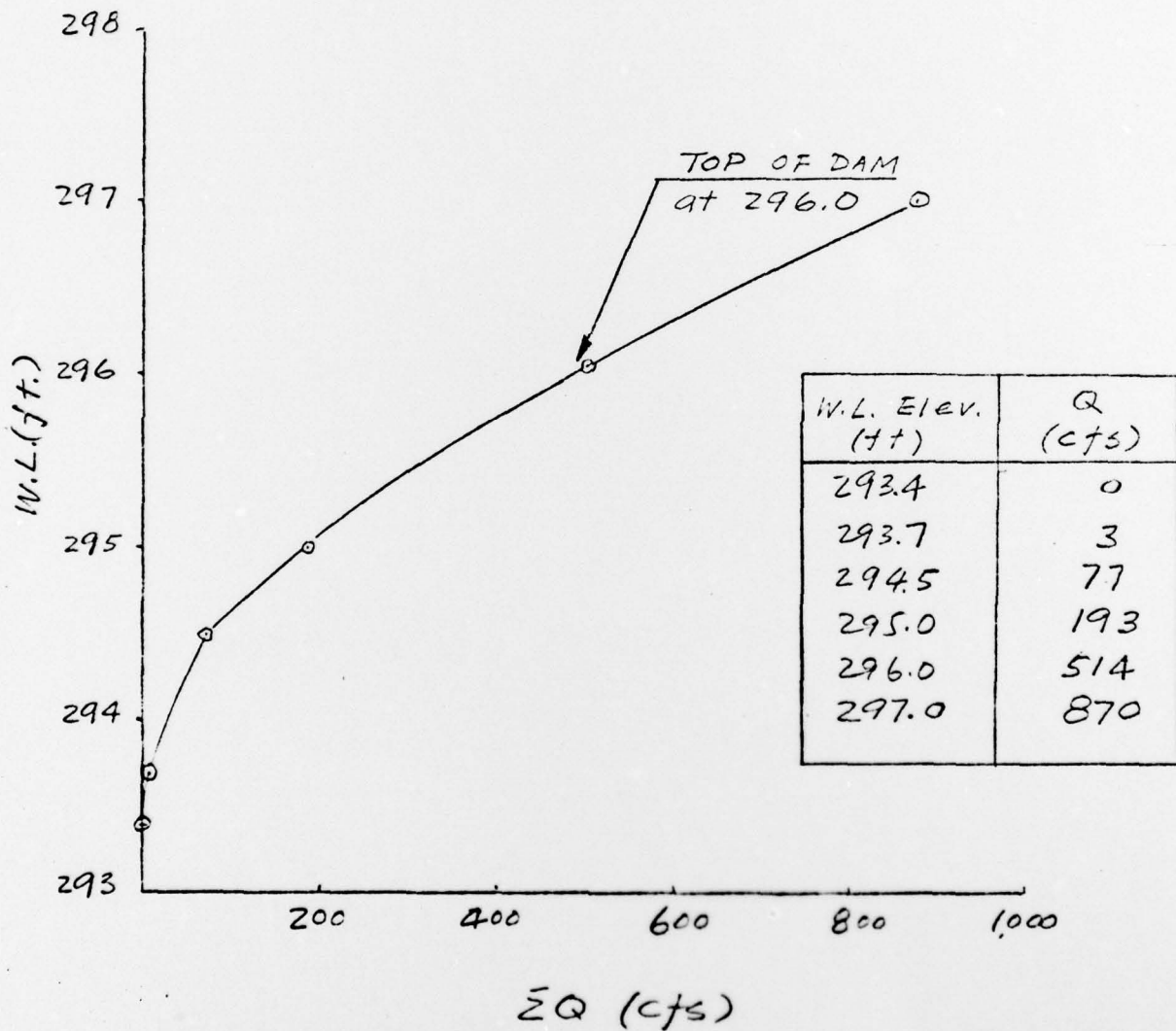
Ref. Pg 5-48 Handbook of Hydraulics
King et al.

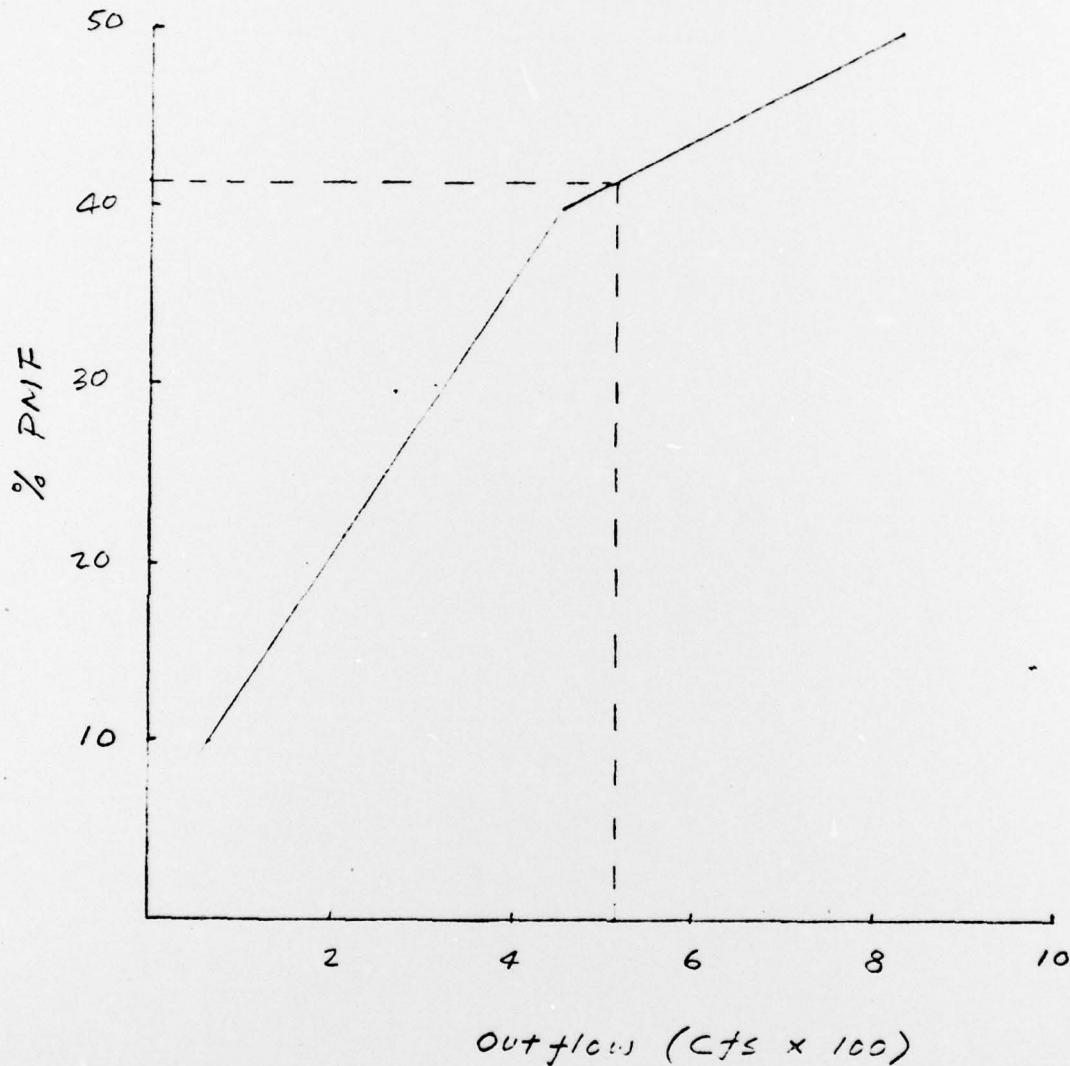
At water elevation = 297, tailwater is estimated to be 3.6 ft. by using Manning's formula and downstream sections. An adjustment factor 0.94 is applied to the discharge Ref. Pg 5-18 (King, et al.)

<u>Weir crest elev.</u>	<u>Effective length in ft.</u>
Primary 293.4	$L_1 = 4.9$
Secondary 293.7	$L_2 = 1.9$
Tertiary 294.0	$L_3 = 40.9$

Stage Discharge Tabulation

W. L. Elev.	n_1	h_2 (ft.)	h_3	Q_1	Q_2 (cfs)	Q_3	ΣQ
293.4	0	0	0	0	0	0	0
293.7	0.3	0	0	3	0	0	3
294.5	1.1	0.8	0.5	20	5	52	77
295.0	1.6	1.3	1.0	36	10	147	193
296.0	2.6	2.3	2.0	74	24	416	514
297.0	3.6	3.3	3.0	121	41	765	870

Stage-Discharge Curvefor spillway

Project Lake Park Spring DamMade By RL Date 5-7-7932 BChkd By DM Date 5-16-79Overtopping Potential

Overtopping occurs at elev. 296 with $Q = 514$ cfs

\therefore Combination of dam and two dykes can pass approx. 41.5 % PMF.

HEC-1-DB COMPUTATIONS

[illegible]

.....
F-300 HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
.....

RJV DATE# 73/05/04
TIME# 10.38.34

NATIONAL DAM SAFETY PROGRAM
LAKE PARSIPPANY DAM NEW JERSEY
MULTI-RATIO PMF ROUTING

NG	NHR	NMIN	IDAY	JOB SPECIFICATION				IPLT	IPRT	NSTAN
150	0	5	0	IHR	IMIN	METRC		0	3	0
			JOPER	NWT	LROPT	TRACE				
			5	0	0	0				

MULTI-PLAN ANALYSES TO BE PERFORMED
RTIOS= .50 .40 .30 .20 .10
NPLAN= 1 NRTO= 5 LRTO= 1

..... SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO LAKE PARSIPPANY DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
LAKE	0	0	0	0	0	I	0	0

IMYOG	IUNG	TAREA	SNAP	HYDROGRAPH DATA				RATIO	ISNOW	ISAME	LOCAL
1	2	1.12	0.00	TRSDA	TRSPC			0.000	0	I	0
				1.12	0.00						

PRECIP DATA				R48	R72	R96
SPEE	PMS	R6	R12	0.00	0.00	0.00
0.00	25.00	100.00	109.00			

TRSPC COMPUTED BY THE PROGRAM IS .800

LROPI	STKR	DLTKR	RIIOL	ESAIN	RIIOX	STRTL	CNSTL	ALSNK	RTIMP
0	0.00	0.00	1.00	0.00	1.00	1.00	.10	0.00	0.00

LOSS DATA
SIRKS 0.00
LAGE .54
TC= 0.00
UNIT HYDROGRAPH DATA

RECESSION DATA				RTIO3= 2.00
STR12=	-1.00	GRCSNE	-0.05	

UNIT HYDROGRAPH 34 END OF PERIOD ORIGINATES, TCE

56.	165.	333.	566.	779.	898.	0.00	HOURS	LAGE	.54	VOL= 1.00	695.
548.	415.	328.	258.	210.	167.	130.	130.	103.	895.	807.	65.
51.	41.	32.	26.	20.	15.	13.	13.	10.	103.	82.	67.
5.	4.	3.	1.								

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	1.
1.01	.10	2	.01	0.00	.01	1.
1.01	.15	3	.01	0.00	.01	1.
1.01	.20	4	.01	0.00	.01	1.
1.01	.25	5	.01	0.00	.01	1.
1.01	.30	6	.01	0.00	.01	1.
1.01	.35	7	.01	0.00	.01	1.
1.01	.40	8	.01	0.00	.01	1.
1.01	.45	9	.01	0.00	.01	1.
1.01	.50	10	.01	0.00	.01	1.
1.01	.55	11	.01	0.00	.01	1.
1.01	1.00	12	.01	0.00	.01	0.
1.01	1.05	13	.01	0.00	.01	0.
1.01	1.10	14	.01	0.00	.01	0.
1.01	1.15	15	.01	0.00	.01	0.
1.01	1.20	16	.01	0.00	.01	0.
1.01	1.25	17	.01	0.00	.01	0.
1.01	1.30	18	.01	0.00	.01	0.
1.01	1.35	19	.01	0.00	.01	0.
1.01	1.40	20	.01	0.00	.01	0.
1.01	1.45	21	.01	0.00	.01	0.
1.01	1.50	22	.01	0.00	.01	0.
1.01	1.55	23	.01	0.00	.01	0.
1.01	2.00	24	.01	0.00	.01	0.
1.01	2.05	25	.01	0.00	.01	0.
1.01	2.10	26	.01	0.00	.01	0.
1.01	2.15	27	.01	0.00	.01	0.
1.01	2.20	28	.01	0.00	.01	0.
1.01	2.25	29	.01	0.00	.01	0.
1.01	2.30	30	.01	0.00	.01	0.
1.01	2.35	31	.01	0.00	.01	0.
1.01	2.40	32	.01	0.00	.01	0.
1.01	2.45	33	.01	0.00	.01	0.
1.01	2.50	34	.01	0.00	.01	0.
1.01	2.55	35	.01	0.00	.01	0.
1.01	3.00	36	.01	0.00	.01	0.
1.01	3.05	37	.01	0.00	.01	0.
1.01	3.10	38	.01	0.00	.01	0.
1.01	3.15	39	.01	0.00	.01	0.
1.01	3.20	40	.01	0.00	.01	0.
1.01	3.25	41	.01	0.00	.01	0.
1.01	3.30	42	.01	0.00	.01	0.
1.01	3.35	43	.01	0.00	.01	0.
1.01	3.40	44	.01	0.00	.01	0.
1.01	3.45	45	.01	0.00	.01	0.
1.01	3.50	46	.01	0.00	.01	0.
1.01	3.55	47	.01	0.00	.01	0.
1.01	4.00	48	.01	0.00	.01	0.
1.01	4.05	49	.01	0.00	.01	0.
1.01	4.10	50	.01	0.00	.01	0.
1.01	4.15	51	.01	0.00	.01	0.
1.01	4.20	52	.01	0.00	.01	0.
1.01	4.25	53	.01	0.00	.01	0.
1.01	4.30	54	.01	0.00	.01	0.
1.01	4.35	55	.01	0.00	.01	0.
1.01	4.40	56	.01	0.00	.01	0.
1.01	4.45	57	.01	0.00	.01	0.
1.01	4.50	58	.01	0.00	.01	0.
1.01	4.55	59	.01	0.00	.01	0.
1.01	5.00	60	.01	0.00	.01	0.
1.01	5.05	61	.01	0.00	.01	0.
1.01	5.10	62	.01	0.00	.01	0.
1.01	5.15	63	.01	0.00	.01	0.
1.01	5.20	64	.01	0.00	.01	0.
1.01	5.25	65	.01	0.00	.01	0.
1.01	5.30	66	.01	0.00	.01	0.
1.01	5.35	67	.01	0.00	.01	0.
1.01	5.40	68	.01	0.00	.01	0.
1.01	5.45	69	.01	0.00	.01	0.
1.01	5.50	70	.01	0.00	.01	0.
1.01	5.55	71	.01	0.00	.01	0.
1.01	6.00	72	.01	0.00	.01	0.
1.01	6.05	73	.03	0.00	.03	0.
1.01	6.10	74	.03	0.00	.03	0.
1.01	6.15	75	.03	0.00	.03	0.

MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q

1.01	6.20	76	.03	0.00	.03	0.
1.01	6.25	77	.03	0.00	.03	0.
1.01	6.30	78	.03	0.00	.03	0.
1.01	6.35	79	.03	0.00	.03	0.
1.01	6.40	80	.03	0.00	.03	0.
1.01	6.45	81	.03	0.00	.03	0.
1.01	6.50	82	.03	0.00	.03	0.
1.01	6.55	83	.03	0.00	.03	0.
1.01	7.00	84	.03	0.00	.03	0.
1.01	7.05	85	.03	0.00	.03	0.
1.01	7.10	86	.03	0.00	.03	0.
1.01	7.15	87	.03	.01	.02	1.
1.01	7.20	88	.03	.02	.01	3.
1.01	7.25	89	.03	.02	.01	7.
1.01	7.30	90	.03	.02	.01	15.
1.01	7.35	91	.03	.02	.01	26.
1.01	7.40	92	.03	.02	.01	41.
1.01	7.45	93	.03	.02	.01	56.
1.01	7.50	94	.03	.02	.01	71.
1.01	7.55	95	.03	.02	.01	85.
1.01	8.00	96	.03	.02	.01	97.
1.01	8.05	97	.03	.02	.01	108.
1.01	8.10	98	.03	.02	.01	115.
1.01	8.15	99	.03	.02	.01	121.
1.01	8.20	100	.03	.02	.01	126.
1.01	8.25	101	.03	.02	.01	130.
1.01	8.30	102	.03	.02	.01	133.
1.01	8.35	103	.03	.02	.01	135.
1.01	8.40	104	.03	.02	.01	137.
1.01	8.45	105	.03	.02	.01	139.
1.01	8.50	106	.03	.02	.01	140.
1.01	8.55	107	.03	.02	.01	141.
1.01	9.00	108	.03	.02	.01	142.
1.01	9.05	109	.03	.02	.01	142.
1.01	9.10	110	.03	.02	.01	143.
1.01	9.15	111	.03	.02	.01	143.
1.01	9.20	112	.03	.02	.01	144.
1.01	9.25	113	.03	.02	.01	144.
1.01	9.30	114	.03	.02	.01	144.
1.01	9.35	115	.03	.02	.01	144.
1.01	9.40	116	.03	.02	.01	144.
1.01	9.45	117	.03	.02	.01	144.
1.01	9.50	118	.03	.02	.01	144.
1.01	9.55	119	.03	.02	.01	144.
1.01	10.00	120	.03	.02	.01	144.
1.01	10.05	121	.03	.02	.01	144.
1.01	10.10	122	.03	.02	.01	144.
1.01	10.15	123	.03	.02	.01	144.
1.01	10.20	124	.03	.02	.01	144.
1.01	10.25	125	.03	.02	.01	144.
1.01	10.30	126	.03	.02	.01	144.
1.01	10.35	127	.03	.02	.01	144.
1.01	10.40	128	.03	.02	.01	144.
1.01	10.45	129	.03	.02	.01	144.
1.01	10.50	130	.03	.02	.01	144.
1.01	10.55	131	.03	.02	.01	144.
1.01	11.00	132	.03	.02	.01	144.
1.01	11.05	133	.03	.02	.01	144.
1.01	11.10	134	.03	.02	.01	144.
1.01	11.15	135	.03	.02	.01	144.
1.01	11.20	136	.03	.02	.01	144.
1.01	11.25	137	.03	.02	.01	144.
1.01	11.30	138	.03	.02	.01	144.
1.01	11.35	139	.03	.02	.01	144.
1.01	11.40	140	.03	.02	.01	144.
1.01	11.45	141	.03	.02	.01	144.
1.01	11.50	142	.03	.02	.01	144.
1.01	11.55	143	.03	.02	.01	144.
1.01	12.00	144	.03	.02	.01	144.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP 0
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1.01	12.05	145	.17	.16	.01	152.
1.01	12.10	146	.17	.16	.01	176.
1.01	12.15	147	.17	.16	.01	223.
1.01	12.20	148	.17	.16	.01	303.
1.01	12.25	149	.17	.16	.01	414.
1.01	12.30	150	.17	.16	.01	541.
0.00	0.00	151	.17	.16	.01	673.
0.00	0.00	152	.17	.16	.01	799.
0.00	0.00	153	.17	.16	.01	914.
0.00	0.00	154	.17	.16	.01	1012.
0.00	0.00	155	.17	.16	.01	1090.
0.00	0.00	156	.17	.16	.01	1149.
0.00	0.00	157	.20	.19	.01	1197.
0.00	0.00	158	.20	.19	.01	1219.
0.00	0.00	159	.20	.19	.01	1220.
0.00	0.00	160	.20	.19	.01	1322.
0.00	0.00	161	.20	.19	.01	1367.
0.00	0.00	162	.20	.19	.01	1411.
0.00	0.00	163	.20	.19	.01	1454.
0.00	0.00	164	.20	.19	.01	1493.
0.00	0.00	165	.20	.19	.01	1527.
0.00	0.00	166	.20	.19	.01	1556.
0.00	0.00	167	.20	.19	.01	1579.
0.00	0.00	168	.20	.19	.01	1596.
0.00	0.00	169	.25	.24	.01	1613.
0.00	0.00	170	.25	.24	.01	1632.
0.00	0.00	171	.25	.24	.01	1658.
0.00	0.00	172	.25	.24	.01	1693.
0.00	0.00	173	.25	.24	.01	1737.
0.00	0.00	174	.25	.24	.01	1787.
0.00	0.00	175	.25	.24	.01	1837.
0.00	0.00	176	.25	.24	.01	1884.
0.00	0.00	177	.25	.24	.01	1927.
0.00	0.00	178	.25	.24	.01	1963.
0.00	0.00	179	.25	.24	.01	1991.
0.00	0.00	180	.25	.24	.01	2013.
0.00	0.00	181	.15	.14	.01	2025.
0.00	0.00	182	.30	.30	.01	2030.
0.00	0.00	183	.30	.30	.01	2034.
0.00	0.00	184	.46	.46	.01	2046.
0.00	0.00	185	.53	.52	.01	2092.
0.00	0.00	186	1.29	1.28	.01	2234.
0.00	0.00	187	2.13	2.12	.01	2567.
0.00	0.00	188	.84	.83	.01	3105.
0.00	0.00	189	.53	.52	.01	3838.
0.00	0.00	190	.46	.45	.01	4685.
0.00	0.00	191	.30	.30	.01	5426.
0.00	0.00	192	.30	.30	.01	5889.
0.00	0.00	193	.23	.23	.01	6050.
0.00	0.00	194	.23	.23	.01	5941.
0.00	0.00	195	.23	.23	.01	5619.
0.00	0.00	196	.23	.23	.01	5152.
0.00	0.00	197	.23	.23	.01	4595.
0.00	0.00	198	.23	.23	.01	4073.
0.00	0.00	199	.23	.23	.01	3649.
0.00	0.00	200	.23	.23	.01	3303.
0.00	0.00	201	.23	.23	.01	3030.
0.00	0.00	202	.23	.23	.01	2606.
0.00	0.00	203	.23	.23	.01	2625.
0.00	0.00	204	.23	.23	.01	2485.
0.00	0.00	205	.18	.18	.01	2372.
0.00	0.00	206	.18	.18	.01	2274.
0.00	0.00	207	.18	.18	.01	2187.
0.00	0.00	208	.18	.18	.01	2104.
0.00	0.00	209	.18	.18	.01	2022.
0.00	0.00	210	.18	.18	.01	1942.
0.00	0.00	211	.18	.18	.01	1868.
0.00	0.00	212	.18	.18	.01	1802.
0.00	0.00	213	.18	.18	.01	1745.
0.00	0.00	214	.18	.18	.01	1697.
0.00	0.00	215	.18	.18	.01	1660.
0.00	0.00	216	.18	.18	.01	1630.
0.00	0.00	217	.01	.00	.01	1596.
0.00	0.00	218	.01	.00	.01	1548.
0.00	0.00	219	.01	.00	.01	1475.

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP O
0.00	0.00	220	.01	.00	.01	1365.
0.00	0.00	221	.01	.00	.01	1222.
0.00	0.00	222	.01	.00	.01	1062.
0.00	0.00	223	.01	.00	.01	899.
0.00	0.00	224	.01	.00	.01	743.
0.00	0.00	225	.01	.00	.01	603.
0.00	0.00	226	.01	.00	.01	483.
0.00	0.00	227	.01	.00	.01	378.
0.00	0.00	228	.01	.00	.01	316.
0.00	0.00	229	.01	.00	.01	287.
0.00	0.00	230	.01	.00	.01	258.
0.00	0.00	231	.01	.00	.01	250.
0.00	0.00	232	.01	.00	.01	233.
0.00	0.00	233	.01	.00	.01	218.
0.00	0.00	234	.01	.00	.01	203.
0.00	0.00	235	.01	.00	.01	189.
0.00	0.00	236	.01	.00	.01	177.
0.00	0.00	237	.01	.00	.01	165.
0.00	0.00	238	.01	.00	.01	154.
0.00	0.00	239	.01	.00	.01	144.
0.00	0.00	240	.01	.00	.01	134.
0.00	0.00	241	.01	.00	.01	125.
0.00	0.00	242	.01	.00	.01	117.
0.00	0.00	243	.01	.00	.01	109.
0.00	0.00	244	.01	.00	.01	102.
0.00	0.00	245	.01	.00	.01	95.
0.00	0.00	246	.01	.00	.01	88.
0.00	0.00	247	.01	.00	.01	82.
0.00	0.00	248	.01	.00	.01	77.
0.00	0.00	249	.01	.00	.01	72.
0.00	0.00	250	.01	.00	.01	67.
0.00	0.00	251	.01	.00	.01	63.
0.00	0.00	252	.01	.00	.01	58.
0.00	0.00	253	.01	.00	.01	54.
0.00	0.00	254	.01	.00	.01	51.
0.00	0.00	255	.01	.00	.01	47.
0.00	0.00	256	.01	.00	.01	44.
0.00	0.00	257	.01	.00	.01	43.
0.00	0.00	258	.01	.00	.01	43.
0.00	0.00	259	.01	.00	.01	43.
0.00	0.00	260	.01	.00	.01	43.
0.00	0.00	261	.01	.00	.01	43.
0.00	0.00	262	.01	.00	.01	43.
0.00	0.00	263	.01	.00	.01	43.
0.00	0.00	264	.01	.00	.01	43.
0.00	0.00	265	.01	.00	.01	43.
0.00	0.00	266	.01	.00	.01	43.
0.00	0.00	267	.01	.00	.01	43.
0.00	0.00	268	.01	.00	.01	43.
0.00	0.00	269	.01	.00	.01	43.
0.00	0.00	270	.01	.00	.01	43.
0.00	0.00	271	.01	.00	.01	43.
0.00	0.00	272	.01	.00	.01	43.
0.00	0.00	273	.01	.00	.01	43.
0.00	0.00	274	.01	.00	.01	43.
0.00	0.00	275	.01	.00	.01	43.
0.00	0.00	276	.01	.00	.01	43.
0.00	0.00	277	.01	.00	.01	43.
0.00	0.00	278	.01	.00	.01	43.
0.00	0.00	279	.01	.00	.01	43.
0.00	0.00	280	.01	.00	.01	43.
0.00	0.00	281	.01	.00	.01	43.
0.00	0.00	282	.01	.00	.01	43.
0.00	0.00	283	.01	.00	.01	43.
0.00	0.00	284	.01	.00	.01	43.
0.00	0.00	285	.01	.00	.01	43.
0.00	0.00	286	.01	.00	.01	43.
0.00	0.00	287	.01	.00	.01	43.
0.00	0.00	288	.01	.00	.01	43.

SUM 23.40 20.72 2.68 180713.
(594.) (526.) (68.) (5117.22)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6050.	2270.	628.	628.	180722.
CMS	171.	64.	18.	18.	5117.
INCHES		18.86	20.85	20.85	20.85
MM		478.95	529.52	529.52	529.52
AC-FT		1126.	1245.	1245.	1245.
THOUS CU M		1389.	1535.	1535.	1535.

HYDROGRAPH AT STA LAKE FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3025.	1135.	314.	314.	90361.
CMS	86.	32.	9.	9.	2553.
INCHES		9.43	10.42	10.42	10.42
MM		239.47	264.76	264.76	264.76
AC-FT		563.	622.	622.	622.
THOUS CU M		694.	768.	768.	768.

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RATIO OF PME	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TOP OF DAM MAX HOURS	TIME OF FAILURE HOURS
0.00	296.12	12	887.	830.	2	17.92	0.00
0.40	295.81	0.00	824.	454.	0.00	18.50	0.00
0.80	295.39	0.00	740.	317.	0.00	18.58	0.00
1.20	294.91	0.00	558.	173.	0.00	18.58	0.00
1.60	294.43	0.00	558.	15.	0.00	18.75	0.00

APPENDIX 5

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