

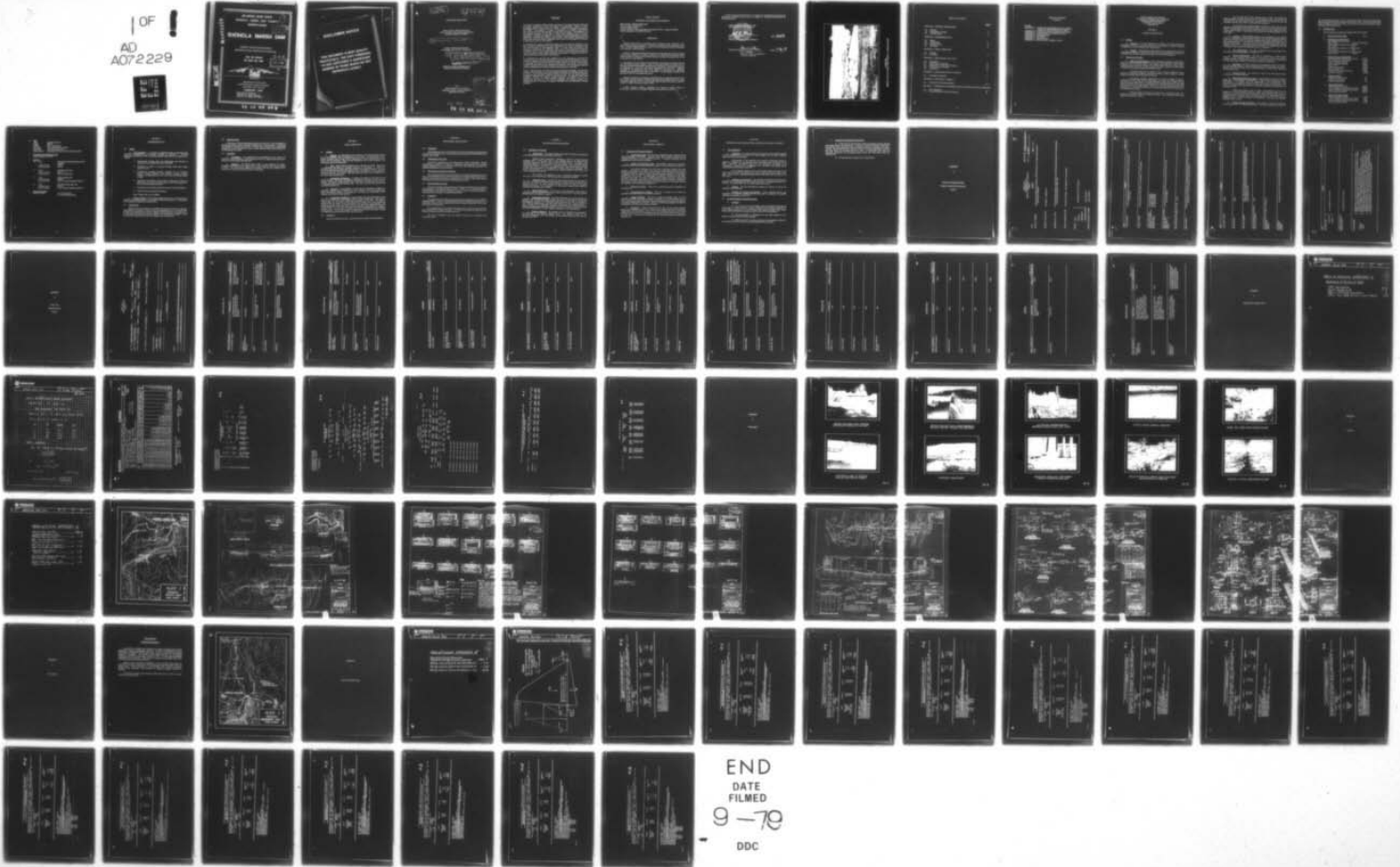
AD-A072 229

O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA JUSTIN--ETC F/G 13/2  
NATIONAL DAM INSPECTION PROGRAM. SHOHOLA MARSH DAM (NDI-PA 0041--ETC(U)  
FEB 79 DACW31-79-C-0010

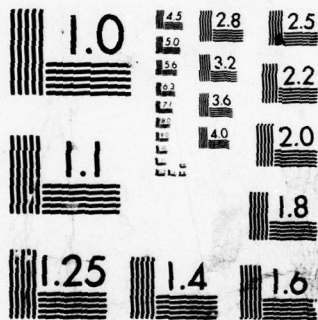
UNCLASSIFIED

NL

1 OF 1  
AD  
A072229



END  
DATE  
FILMED  
9-79  
DDC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

AD A 072229

DELAWARE RIVER BASIN  
SHOHOLA CREEK, PIKE COUNTY  
PENNSYLVANIA

①

LEVEL

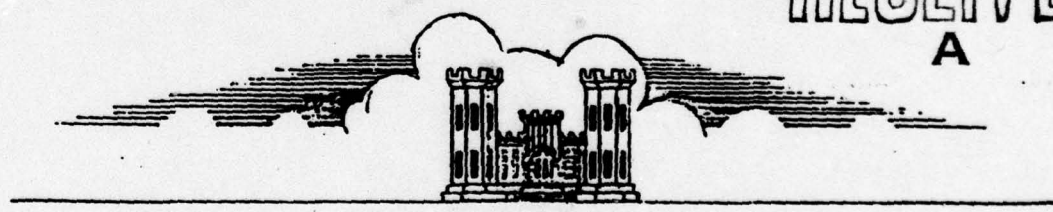
# SHOHOLA MARSH DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

NDI-PA 00412  
PA DER 52-158

DDC  
RECEIVED  
AUG 6 1979  
A

DDC FILE COPY



PREPARED FOR

DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT, CORPS OF ENGINEERS  
BALTIMORE, MARYLAND 21203

FEBRUARY 1979

Distribution Unlimited  
Approved for Public Release  
Contract No. DACW31-79-C-0010

79 08 06 069

## **DISCLAIMER NOTICE**

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

12 89p

11 Feb 79

DELAWARE RIVER BASIN

Name of Dam: Shohola Marsh Dam  
County & State: Pike County, Pennsylvania  
Inventory Number: PA 00412

15 DACW31-79-C-0010

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

6 National Dam Inspection Program.  
Shohola Marsh Dam (NDI-PA 00412, PA  
DER 52-158), Delaware River Basin,  
Shohola Creek, Pike County, Pennsylvania.  
Phase I Inspection Report.

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.  
JUSTIN & COURTNEY DIVISION

For:

DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, MD 21203

Accession For	
NTIS G&I	<input checked="" type="checkbox"/>
DCC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution _____	
Availability Codes	
Dist.	Avail and/or special
A 23	CP

410 760

79 08 06 06 9

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design 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 REPORT

### NATIONAL DAM INSPECTION PROGRAM

Name of Dam: Shohola Marsh Dam

State Located: Pennsylvania

County Located: Pike

Stream: Shohola Creek Coordinates: Latitudes  $41^{\circ}23.4'$  Longitude  $74^{\circ}58.2'$

Date of Inspection: November 22, 1978

ABSTRACT  
↓

### ASSESSMENT

Shohola Marsh Dam is a concrete gravity structure which impounds a 1137 acre lake at normal pool elevation. Construction of the dam was completed in July, 1968. Shohola Marsh Reservoir is owned by the Pennsylvania Game Commission and is used as a wildlife habitat.

Based on visual observations made during the field inspection, the dam appears to be in good condition. The dam is classified as a "high" hazard structure which indicates there is potential for extensive property damage and possible loss of life in the event of a dam failure.

Examination of the results of the hydrologic and hydraulic analyses indicates that the existing spillway system is able to pass approximately 63 percent of the Probable Maximum Flood (PMF) without being overtopped. It appears the spillways are designed for heads less than those associated with the PMF. Negative pressures on the downstream face of the spillway would develop for discharges exceeding approximately 30 percent of the PMF. For discharges in excess of 50 percent of the PMF, cavitation may occur.

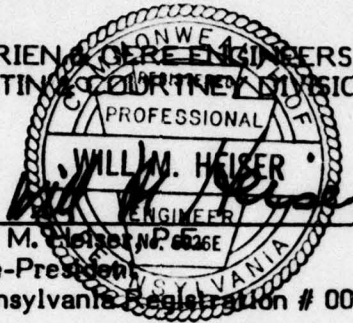
Stability analyses of the spillway system and the non-overflow portion of the dam reveal that the resultant of forces falls outside the middle third of the base for loadings associated with 1.) Normal and 5 kips per square foot (ksf) ice load, 2.)  $\frac{1}{2}$  PMF, 3.) Water to the top of dam, 4.) PMF.

Further detailed stability, hydrologic and hydraulic studies should be performed to determine if remedial measures are necessary at this time.

↑  
ABSTRACT

A flood warning system should be developed and implemented because of the downstream population areas which are subject to flooding during periods of high precipitation.

O'BRIEN & KEENE ENGINEERS, INC.  
JUSTIN G. O'BRIEN, DISTRICT ENGINEER



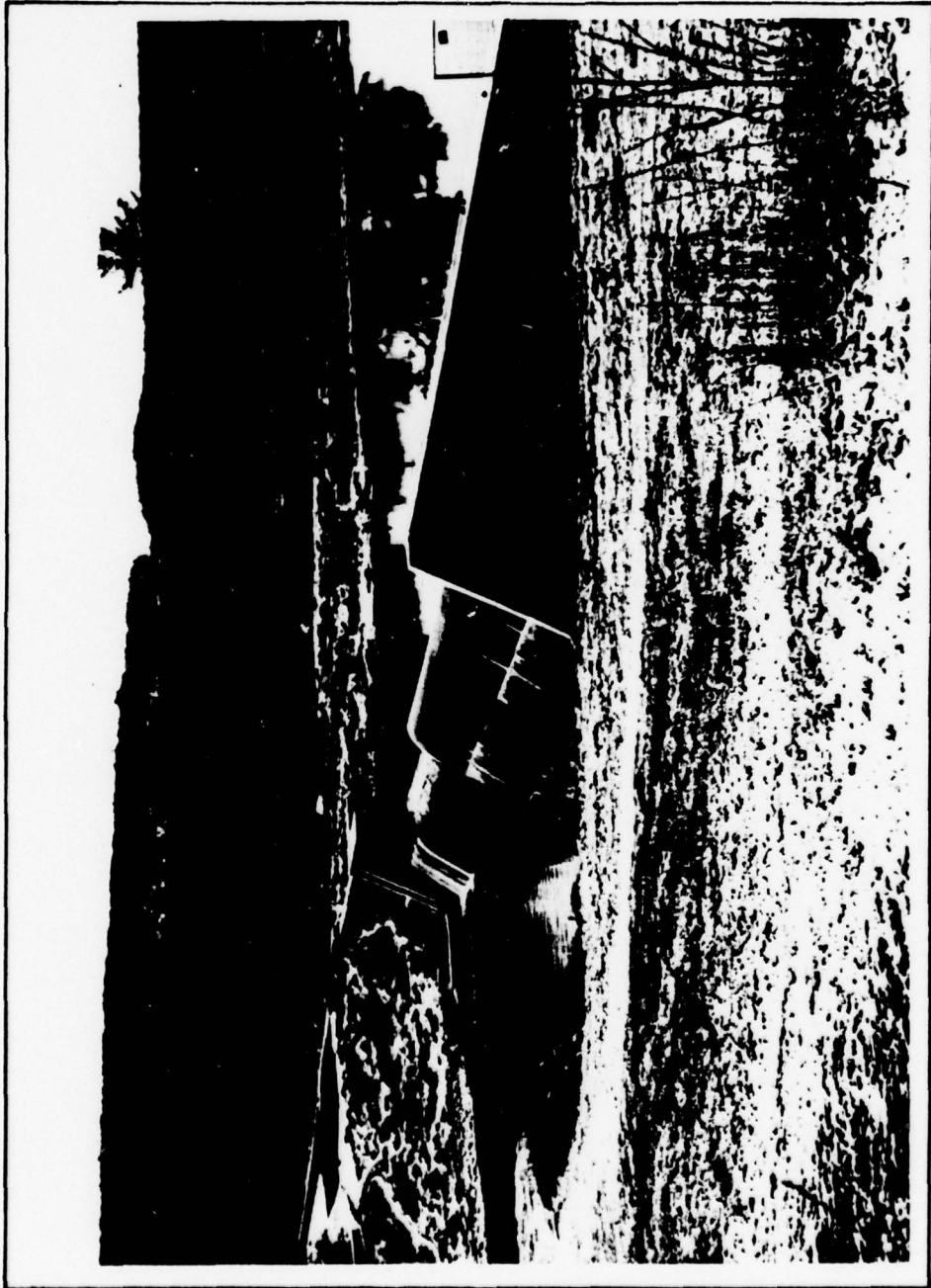
Will M. Heiser No. 006926-E  
Vice-President  
Pennsylvania Registration # 006926-E

Date: 3/15/79

APPROVED BY

G. K. WITHERS  
Colonel, Corps of Engineers  
District Engineer

Date: 11 Apr 79



*OVERVIEW  
SHOHOLA FALLS DAM, PIKE COUNTY, PENNSYLVANIA*

## TABLE OF CONTENTS

	<u>PAGE</u>
<b>SECTION 1 - PROJECT INFORMATION</b>	
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	3
<b>SECTION 2 - ENGINEERING DATA</b>	
2.1 Design	5
2.2 Construction	5
2.3 Operation Data	6
2.4 Evaluation	6
<b>SECTION 3 - VISUAL INSPECTION</b>	
3.1 Findings	7
3.2 Evaluation	7
<b>SECTION 4 - OPERATIONAL FEATURES</b>	
4.1 Procedures	8
4.2 Maintenance of the Dam	8
4.3 Maintenance of Operating Facilities	8
4.4 Warning System in Effect	8
4.5 Evaluation	8
<b>SECTION 5 - HYDRAULICS AND HYDROLOGY</b>	
5.1 Evaluation of Features	9
<b>SECTION 6 - STRUCTURAL STABILITY</b>	
6.1 Evaluation of Structural Stability	10
<b>SECTION 7 - ASSESSMENT, RCOMMENDATIONS, PROPOSED REMEDIAL MEASURES</b>	
7.1 Dam Assessment	11
7.2 Recommendations, Remedial Measures	11

**TABLE OF CONTENTS**  
**(Continued)**

**PLATES**

- APPENDIX A - CHECKLIST, ENGINEERING DATA, DESIGN,  
CONSTRUCTION, OPERATION, PHASE I**
- APPENDIX B - CHECKLIST, VISUAL INSPECTION, PHASE I**
- APPENDIX C - HYDROLOGIC & HYDRAULIC DATA**
- APPENDIX D - PHOTOGRAPHS**
- APPENDIX E - DRAWINGS**
- APPENDIX F - SITE GEOLOGY**
- APPENDIX G - STRUCTURAL STABILITY DATA**

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
SHOHOLA MARSH RESERVOIR  
NATIONAL ID #PA 00412  
DER #52-158

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

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

1.2 Description of Project

a. Dam and Appurtenances. (From information supplied by the Department of Environmental Resources, Commonwealth of Pennsylvania.) Shohola Marsh Reservoir has a concrete gravity dam approximately 800 feet long, with a maximum height of 34 feet. In order to utilize the lake at different surface levels, a combination of spillway openings has been provided.

The base of the dam is seated in rock a minimum depth of 2 feet. Because of fractures prevalent in the rock foundation, a grout curtain is provided along the upstream edge of the base of the dam.

The gravity overflow sections have a maximum height of approximately 25 feet with a base width, at this height, of 23 feet. The overflow sections are formed in an ogee shape. An energy dissipating roller bucket with an 8 foot radius is provided at the toe of the ogee sections. A 25-foot long basin is provided beyond the end of the roller bucket. The end of the basin slopes upward on a 1.5 horizontal to 1 vertical (1.5H:1V) slope in the direction of flow and is covered with a 2-foot blanket of riprap.

The non-overflow sections of the dam have a 3-foot top width. The upstream face batter varies from 1H:5V to 1H:20V. The downstream face slope varies from 1H:1.7V to 1H:4V.

At the right end of the concrete dam an earth fill embankment (maximum height 12 feet) is used to tie into the original ground. This fill has a 20 foot top width and side slopes of 3H:1V. A cut-off trench is extended into the rock foundation and the grout curtain is extended into this region.

The reservoir can be drawn down by means of a 3 foot wide by 4 foot high sluice gate located in the overflow section. The invert of this opening is Elev. 1140.0. The discharge from the sluice gate flows onto the roller bucket at the toe of the overflow section. Stop logs and a trash rack are provided upstream of the sluice gate.

b. Location. Shohola Marsh Reservoir was constructed across Shohola Creek at a point approximately 1000 feet south of the U.S. #6 (Roosevelt Highway) crossing of Shohola Creek in Dingman Township, Pike County, Pennsylvania. The site is approximately 13 miles east of Hawley, Pennsylvania and 10 miles west of Milford, Pennsylvania. The dam site is shown on USGS Quadrangle entitled, "Shohola, PA.-N.Y." at coordinates N41°23.4', W74°58.2'. A regional location plan of Shohola Marsh Reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as an "Intermediate" size dam based on its storage capacity of 13,000 Ac. Ft.

d. Hazard Classification. The dam is classified as a "High" hazard structure. This is based on the potential in the event of failure for extensive property damage and possible loss of life. A number of homes are located within the flood plain approximately 1½ miles downstream of the structure.

e. Ownership. The dam is owned by the Pennsylvania Game Commission. All correspondence should be sent to Pennsylvania Game Commission, Mr. Glenn L. Bowers, Executive Director, South Office Building, P.O. Box 1567, Harrisburg, Pennsylvania, 17120

f. Purpose of Dam. The reservoir is used by the Pennsylvania Game Commission as a wild life habitat.

g. Design and Construction History. The application to construct Shohola Marsh Dam was submitted on November 15, 1966, by the Pennsylvania Game Commission. The "Report Upon the Application of the Pennsylvania Game Commission" was prepared on February 8, 1967, by the State of Pennsylvania. The permit to construct Shohola Marsh Dam was issued by the State of Pennsylvania on February 14, 1967.

Construction began on May 17, 1967. Correspondence located in the Department of Environmental Resources (DER) files indicates that it took 8 months to complete the first 20% of construction and only 6 additional months to complete the job. Foundation rock excavation was the item which caused the slow progress during the first 8 months of construction. The dam was officially completed July 31, 1968.

h. Normal Operating Procedures. The reservoir is normally maintained at Elevation 1154.0. By removing stop logs in the service spillway, the reservoir

can be lowered to Elevation 1151.0. By use of the 3 foot wide by 4 foot high sluice gate the impoundment can be lowered to Elevation 1140.0. The hoist for the sluice gate is located on the service bridge. The reservoir is lowered periodically to grow crops for water fowl feeding.

### 1.3 Pertinent Data

(From information supplied by Pennsylvania DER & USGS)

a.	<u>Drainage Area (sq. miles)</u>	54.0
b.	<u>Discharge at Dam Site (cfs)</u>	
	Max. known flood at dam site	
	Elev. 1158.0	2,770 in 1972 (Agnes)
	Gated Spillway capacity at normal pool	
	Elev. 1154.0	200
	Gated Spillway capacity at maximum pool	
	Elev. 1165.0	277
	Ungated spillway capacity at maximum pool	
	Elev. 1165.0	21,140
c.	<u>Elevation (Feet, USGS Datum)</u>	
	Service spillway with stop logs removed	1151.0
	Service spillway (normal pool)	1154.0
	Lower emergency spillway	1158.0
	Upper emergency spillway	1163.0
	Top of dam	1165.0
	Reservoir drain invert	1140.0
	Service bridge floor	1165.0
	Streambed at centerline of dam	1138.0
	Maximum tailwater	1150.0+
d.	<u>Reservoir (miles)</u>	
	Length of maximum pool	4.1
	Length of normal pool	3.2
	Fetch at normal pool	1.0
e.	<u>Storage (Acre-Feet)</u>	
	Normal pool, Elev. 1154.0	12,610
	Lower emergency spillway, Elev. 1158.0	17,270
	Upper emergency spillway, Elev. 1163.0	23,450
	Top of dam, Elev. 1165.0	26,450
f.	<u>Reservoir Surface (Acres)</u>	
	Normal pool, Elev. 1154.0	1,137
	Lower emergency spillway, Elev. 1158.0	1,230
	Upper emergency spillway, Elev. 1163.0	1,340
	Top of Dam, Elev. 1165.0	1,380

- g. Dam  
 Type Concrete Gravity  
 Length 800 Ft.  
 Height 34 Ft. (maximum)  
 Top width 3 Ft. non-overflow sections  
 Side Slope Refer to section 1.2.a  
 Grout curtain Full length of dam to 40 feet below structure
- h. Diversion and Regulating Tunnel  
 Does not apply to this site
- i. Spillway  
 1) Type Concrete truncated ogee weir (with stoplogs)  
 Length of weir 24.0 Ft.  
 Crest elevation 1151.0
- 2) Type Concrete ogee weir  
 Length of weir 68.0 Ft.  
 Crest elevation 1154.0 Normal Pool
- 3) Type Concrete ogee weir  
 Length of weir 100.0 Ft.  
 Crest elevation 1158.0 Lower Emergency Spillway
- 4) Type Concrete square edge weir  
 Length of weir 125.0 Ft.  
 Crest elevation 1163.0 Upper Emergency Spillway
- j. Regulating Outlets  
Reservoir Drain 3 Ft. horizontal by  
 4 Ft. vertical sluice gate

SECTION 2  
ENGINEERING DATA

2.1 Design

a. Data Available. A summary of engineering data on Shohola Marsh Reservoir is presented on the checklist attached as Appendix A. Principal documents obtained from DER containing pertinent data used for this report are as follows.

1. "Application", "Report Upon the Application", and "Permit" to construct Shohola Marsh Dam, DER, 1966-1967.
2. "Tabulation of Bids" to construct Shohola Marsh Dam issued March 29, 1967.
3. "Construction Progress Reports" prepared by Mr. Frederick Futchko, Project Engineer, Dam Section, Gannett Fleming Corddry and Carpenter, Inc. from, May 31, 1967, through August 7, 1968.
4. "Application for Permit to Draw Dam or Other Body of Water in Accordance with the Act of December 15, 1959" and approval of same for Shohola Marsh Reservoir.
5. Photographs made during construction and at the final inspection.
6. Complete set of construction drawings.

Note: Design data is not available.

b. Design Features. The principal design features for the structure are shown on the drawings enclosed in Appendix E as Plates 1 through 6. A description of the features is discussed in Section 1.2.a.

2.2 Construction

Based on the documentation in the DER files and the construction drawings, supplemented by discussion with the Owner's representative, it is concluded that the dam was constructed as designed. Gannett Fleming Corddry and Carpenter Inc. of Harrisburg, Pennsylvania was the designer and construction manager. Burly Construction Corporation, Hewitt, New Jersey, was the contractor.

### 2.3 Operation Data

There are no formal operating procedures for the dam. A 24-foot length of the service spillway varies in elevation between Elev. 1151.0 and Elev. 1154.0 with the placing or removing of stop logs. Minimum flow requirements are maintained through the 3-foot horizontal by 4-foot vertical reservoir drain gate which has an invert elevation of 1140.0

### 2.4 Evaluation

a. Availability. All engineering data reproduced in this report and studied for this investigation were provided by DER and supplemented by conversations with the Owner's representative.

b. Adequacy. The entire design folder is not available for review. Reasonably accurate stability analyses were made using the information provided by DER. The drawings are legible and complete, and the dam appears to be constructed in general conformance with the drawings.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. The observations and comments of the field inspection team are in the checklist which is Appendix B of this report. The appearance of the facility indicates that the dam and its appurtenances were constructed in accordance with the drawings. They are well maintained and in good condition. No underwater areas were inspected.

b. Dam. Some hairline cracking of the concrete was noted. There were no significant indications or evidence observed of distortions in vertical or horizontal alignment or grade that would indicate movement of the dam. The sixth section of the dam from the right abutment bows out slightly in the downstream face from the rest of the dam. This may have been due to the arrangement of formwork during construction.

c. Appurtenant Structures. A railing was broken on the stairs to the service bridge. The Game Commission representative assured us this would be welded. The service bridge platform has a difference in elevation of about  $\frac{1}{2}$  inch in adjoining portions of the concrete floor. The floor may have been poured that way during construction.

d. Reservoir. Reconnaissance of the reservoir disclosed no evidence of significant siltation, slope instability, or other features that would significantly affect the storage capacity of the reservoir. The slopes on the perimeter of the reservoir are mild and well vegetated.

e. Downstream Conditions. Approximately 60 yards downstream of the dam the flow drops over Shohola Falls which is about 40 feet high. U.S. route 6 crosses over the creek about 1,000 feet downstream of the dam. The highway bridge offers no restriction to flow because the creek is in a deep gorge and clearance for the bridge is at least 70 feet. From the falls to approximately 1-1/4 miles downstream of the falls, the creek flows through a deep gorge on a slope in excess of 4%. In the event of failure, the next 9 miles would be the potential damage region. The channel gradient is approximately 0.7% in this reach. Slopes are vegetated, generally stable, and in good condition.

3.2 Evaluation

No serious deficiencies were observed during the Phase I Visual Inspection.

## SECTION 4

### OPERATIONAL PROCEDURES

#### 4.1 Procedures

The Pennsylvania Game Commission has written operating procedures which are covered in Section 1.2.h. Normal operating procedures for this structure do not require a dam tender.

#### 4.2 Maintenance of the Dam

The dam is maintained by the Pennsylvania Game Commission. Normal maintenance is reported to consist of keeping the spillways free of all debris, keeping vegetation cut in the vicinity of the dam, and constantly being alert for possible deterioration of the structure.

#### 4.3 Maintenance of Operating Facilities

The operating facilities are maintained by the Pennsylvania Game Commission. Normal maintenance is reported to consist of annually creosoting the service spillway stop logs and cleaning and lubricating the reservoir drain gate system. The Game Commission has written maintenance procedures.

#### 4.4 Warning System in Effect

There is no formal warning system or procedure established to be followed during periods of exceedingly heavy rainfall. However, it is understood that a representative of the Game Commission is always in the vicinity and available to warn downstream residents of impending high flows.

#### 4.5 Evaluation

The operation and maintenance procedures are satisfactory for the Shohola Marsh Reservoir. A formal warning system should be implemented because of the possibility of loss of life and significant property damage downstream in the event of a failure of the structure.

The representative of the Game Commission told us that the reservoir drain gate is operated on a regular schedule. He would have operated the gate hoist, but he did not have the crank for the hoist with him.

The dam is accessible under all weather conditions for inspection and emergency action.

## SECTION 5

### HYDRAULICS AND HYDROLOGY

#### 5.1 Evaluation of Features

a. Design Data. The original design information is limited to statements in the Application Report dated February 8, 1967.

Shohola Marsh Reservoir's watershed is about 12 miles long and averages about 5 miles wide, with a total drainage area of 54 square miles. Elevations range from 2000 to 1154 at normal reservoir level. The slope of the watershed adjacent to the reservoir is about 10 percent. The watershed is nearly 100 percent wooded. Portions of the watershed are State Game Lands and State Forests while the balance of the watershed is open to private development. The runoff characteristics of the watershed may undergo change in the future as a result of private development.

The spillway was designed to have a maximum discharge of 21,950 cfs., the "C" curve criterion for this drainage area as specified by DER.

b. Experience Data. Rainfall and water level records are not kept for this dam. The Game Commission representative said that during Tropical Storm Agnes (June, 1972), the water reached elevation 1158.0, the crest of the lower emergency spillway. This corresponds to a discharge of approximately 2,800 cfs (assuming the stoplogs were in place).

c. Visual Observations. On the day of the inspection, there were no indications that the spillways of the dam would be obstructed, or would not operate satisfactorily in the event of a storm.

d. Overtopping Potential. The PMF hydrograph was routed through the reservoir with the starting water surface elevation at the crest of the service spillway (Elev. 1154.0). The inflow and outflow peaks for the PMF are 52,070 cfs and 39,804 cfs respectively. The PMF would overtop the dam by approximately 3 feet. Review of the hydrologic analysis indicates that the spillway system is capable of passing approximately 63 percent of the PMF without overtopping of the non-overflow portions of the dam. Refer to Appendix C for computations.

e. Spillway Adequacy. The spillway system is classified as "inadequate" for discharge of the Spillway Design Flood. The spillway system is not "seriously inadequate" since the spillway can adequately discharge more than 50 percent of the PMF.

SECTION 6  
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. No structural inadequacies were noted during the visual inspection of the dam. However, some minor surface cracking of the concrete was noted on the non-overflow sections. A complete inspection was not possible due to the overflow conditions.

b. Design & Construction Data. All available material was reviewed. Detailed listing of this data is included in Appendix A and is discussed in Section 2.

The service spillway and the lower emergency spillway are ogee sections. The shape of the crest is such that for heads associated with flows in excess of 30 percent of the PMF, the lower nappe of the overflow can be expected to separate from the spillway face, producing negative pressures on the downstream face of the dam. For discharges in excess of 50 percent of the PMF, cavitation may result. The area of subatmospheric pressure along the downstream face of the structure also adds to the overturning effect of the dam. Analysis of the effect of these negative pressures is beyond the scope of this report and are not included in the calculations, Appendix G.

c. Operating Records. There are no operating records maintained for this structure.

d. Post-Construction changes. There are no reports nor is there any evidence that modifications were made to this dam.

e. Seismic Stability. The dam is located in Seismic Zone 1 of the "Seismic Zone Map of Contiguous States". Normally it can be considered that if a dam in this zone is stable under static loading conditions it can be assumed safe for any expected earthquake conditions. Refer to the following paragraph for stability evaluations of various static loading conditions.

f. Evaluation. Stability analyses of the dam for the entire overflow portion and a typical section of the non-overflow portion show that the stability requirements for overturning are not met: the foundation reaction is not in the middle third of the base for discharges ranging from normal flow with ice load to the PMF event. The computer printouts for the stability analyses are included in Appendix G.

## SECTION 7

### ASSESSMENT, RECOMMENDATIONS, PROPOSED REMEDIAL MEASURES

#### 7.1 Dam Assessment

a. Evaluation. The visual inspection and review of the material supplied by DER indicates that the structure is in good condition and was built in general conformance with the drawings.

Examination of the hydrologic and hydraulic calculations shown in Appendix C indicate that the spillway system will pass about 63 percent of the PMF. Therefore, the spillway system of the structure is considered to be "Inadequate". As pointed out in paragraph 6.1.b, cavitation may develop during flows exceeding 50 percent of the PMF.

The foundation reaction is not in the middle third of the base for the entire overflow portion and typical section taken in the non-overflow portion of the dam. This is true for discharges ranging from normal flow with ice load to the PMF event.

b. Adequacy of Information. The available information along with visual observations are considered to be sufficient to make a reasonable assessment of the dam. The design folder was not made available for review.

c. Urgency. The recommendations presented in Section 7.2 should be implemented immediately.

d. Necessity for Further Investigation. Further detailed stability and hydrologic and hydraulic studies should be performed to determine if remedial measures are necessary at this time.

#### 7.2 Recommendations, Remedial Measures

##### a. Facilities.

1) The owner should take necessary action to supplement file records of this dam to include stability analyses indicating the structure's capability to resist sliding, overturning and overstressing when subject to water levels where failure would significantly increase potential for loss of life downstream.

2) Recommendations to strengthen the dam would depend on the results of further detailed stability analyses.

3) Measures should be taken to protect the downstream surface of the overflow sections to prevent damage associated with cavitation.

b. Operation & Maintenance Procedures.

1) In the event of failure there could be extensive property damage and possible loss of life downstream. Therefore, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream residents that high flows are expected along the creek. If abnormally high flows are expected, procedures for evacuating people within the flood plain should be implemented.

2) The dam should be inspected on a yearly basis.

**APPENDIX**

**A**

**Check List Engineering Data  
Design, Construction, Operation  
Phase I**

NAME OF DAM Shohola Marsh Reservoirs

ID # PA 00412

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE 1

Sheet 1 of 4

REMARKS

ITEM

AS-BUILT DRAWINGS There are no "As-Built" drawings, but DER files have an 11 sheet full size set of construction drawings.

REGIONAL VICINITY MAP See Plate 1, Appendix E.

CONSTRUCTION HISTORY GFC&C's Project Engineer, Dam Section provided progress reports of the construction and these reports are in DER files.

TYPICAL SECTIONS OF DAM Provided by GFC&C. See Appendix E for drawings.

OUTLETS - PLAIN

DETAILS

CONSTRAINTS

DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS

See Appendix E for drawings.

None available

None available

ITEM

REMARKS

DESIGN REPORTS

Design drawings were prepared by GFC&C (1966) 11/11 sheets were in DER files.

GEOLOGY REPORTS

None provided in DER files. See Appendix F of this report.

DESIGN COMPUTATIONS  
HYDROLOGY & HYDRAULICS  
DAM STABILITY  
SEEPAGE STUDIES

No data available  
No data available  
No data available  
No data available

MATERIALS INVESTIGATIONS  
BORING RECORDS  
LABORATORY }  
FIELD }

Complete set of logs of drill holes and test pits are part of the set of drawings.

POST-CONSTRUCTION SURVEYS OF DAM None

BORROW SOURCES

Concrete gravity overflow dam. Embankment material taken from within work area limits. It is only needed for abutment tie-ins.

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	None. Game Commission representative noted that highest water level has been to the crest of the lower Emergency Spillway (El.1158.0) during Agnes in 1972.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	Records are kept in Pennsylvania Game Commission files.

ITEM

REMARKS

SPILLWAY PLAN

SECTIONS

DETAILS

See Appendix E for details

OPERATING EQUIPMENT  
PLANS & DETAILS

See Appendix E for details

MISCELLANEOUS

Material  
in DER  
files

1. "Application" to construct Shohola Marsh Reservoir issued November 15, 1966.
2. "Report upon the Application of the Pennsylvania Game Commission" by Joseph J. Ellam, Hydraulic Engineer, DER, dated February 8, 1967.
3. "Permit" to construct Shohola Marsh Reservoir issued February 14, 1967.
4. "Tabulation of Bids" to construct Shohola Marsh Reservoir issued March 29, 1967.
5. "Construction Progress Reports" prepared by Mr. Frederick Futchko, Project Engineer, Dam Section, GFC&C, Inc. from May 31, 1967 through August 7, 1968.
6. "Application for Permit to Draw Dam or Other Body of Water in Accordance with the Act of December 15, 1959." and approval of same for Shohola Marsh Reservoir.
7. Photographs made during construction and at the final inspection.

**APPENDIX**

**B**

**Check List**

**Visual Inspection**

**Phase I**

CHECK LIST  
VISUAL INSPECTION  
PHASE I

Sheet 1 of 11

Name Dam Shohola Marsh Reservoir County Pike State Pennsylvania National ID # PA 00412  
Type of Dam Concrete Gravity Hazard Category High  
Date(s) Inspection 11-22-78 Weather Cold, Cloudy Temperature 30°-35°-F

Pool Elevation at Time of Inspection ±1154.5 M.S.L. Tailwater at Time of Inspection ±1140.0 M.S.L.

Inspection Personnel:

George Elias David Campbell  
Leonard Beck Robert Bowers  
Leonard Beck Recorder

Remarks:

Mr. Wilmer R. Peoples, Land Manager, Pennsylvania Game Commission accompanied us  
and answered questions during our inspection.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	No leakage observed since flow over the service spillway was occurring at the time of inspection.	Should be inspected when no flow is occurring over the spillways.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	No problems	None
DRAINS	Could not be seen under water in roller buckets	3" diam. drain holes 10' c.c. in the roller bucket of both the service & lower emergency spillways shown on drawings.
WATER PASSAGES	None	None
FOUNDATION	Sandstone and shale outcrops around dam & in creek channel downstream.	As shown on the drawings the dam is built a minimum of 2 feet into the shale and sandstone foundation.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Minor cracking in non-overflow sections of the dam on both the left and right side.	The service spillway could not be investigated because of flow over it.
STRUCTURAL CRACKING	None observed	Same as above
VERTICAL AND HORIZONTAL ALIGNMENT	Slight variance in horizontal alignment probably due to forming during construction.	None
MOHLITH JOINTS	No problems	None
CONSTRUCTION JOINTS	No problems	None

EMBANKMENT

Sheet 4 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SURFACE CRACKS

None observed

None

UNUSUAL MOVEMENT OR  
CRACKING AT OR BEYOND  
THE TOE

None observed

None

SLOUGHING OR EROSION OF  
EMBANKMENT AND ABUTMENT  
SLOPES

None observed

None

VERTICAL AND HORIZONTAL  
ALIGNMENT OF THE CREST

No distortions observed

None

RIPRAP FAILURES

None observed

None

EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF                      OBSERVATIONS                      REMARKS OR RECOMMENDATIONS

Drains

None

None

JUNCTION OF EMBANKMENT  
AND ABUTMENT, SPILLWAY  
AND DAM

No discontinuities  
observed

None

ANY NOTICEABLE SEEPAGE

None observed

None

STAFF GAGE AND RECORDER

None

None

OUTLET WORKS

Sheet 6 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	None
INTAKE STRUCTURE	Under water at time of investigation	Trash rack protection shown on drawings.
OUTLET STRUCTURE	No obstructions to flow noted	None
OUTLET CHANNEL	No problems observed	None
EMERGENCY GATE	under water at time of investigation	3' horizontal by 4' vertical sluice gate shown on drawings.

UNGATED SPILLWAY

Sheet 7 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CONCRETE WEIR	There were no obstructions for the service and the emergency spillways.	Refer to section 7.2 for suggested measures to be taken for high flows over both the service and emergency spillway weirs.
APPROACH CHANNEL	There were no obstructions for the service and the emergency spillways.	None
DISCHARGE CHANNEL	There were no obstructions for the service and the emergency spillways	None
BRIDGE AND PIERS	There's about a $\frac{1}{2}$ " difference in the pours of the floor of the service bridge.	This probably happened when the floor was poured.

GATED SPILLWAY

Sheet 8 of 11

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

Sheet 9 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION

MONUMENTATION/SURVEYS

None

None

OBSERVATION WELLS

None

None

WEIRS

None

None

PIEZOMETERS

None

None

OTHER

None

None

RESERVOIR

Sheet 10 of 11

VISUAL EXAMINATION OF      OBSERVATIONS      REMARKS OR RECOMMENDATIONS

SLOPES

Gentle slopes, heavily  
vegetated, no signs of  
slides

None

SEDIMENTATION

Insignificant

None

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The channel flows through a steep rocky gorge for the first 1-1/4 miles downstream of the dam. From the gorge to the Delaware River the creek flows through a boulder strewn valley.	None
SLOPES	Through the gorge, the channel slope is better than 4%. Downstream of the gorge the channel gradient is about 0.7%. Where observed the side slopes appear stable.	None
APPROXIMATE NO. OF HOMES AND POPULATION	There are at least 11 homes in the flood plain area downstream of dam (Approx. 50 people)	A formal warning system should be developed & implemented. Procedures for evacuating people within the flood plain should be implemented.

APPENDIX

C

Hydrologic & Hydraulic Data

SUBJECT	SHEET	BY	DATE	JOB NO
Shohda Marsh Dam				

TABLE OF CONTENTS APPENDIX C

Hydrologic & Hydraulic Data

PMP Calculations	sk 1
Snyder Coefficients	" 1
Stage vs. Discharge Computations	" 2
HECI - Dam Safety Version Computer Output	" 3-7

~~1/12/79~~ 1/23/79

HEC 1, DAM SAFETY VERSION PROGRAM CALCULATIONS

DRAINAGE AREA : 54 SQUARE MILES

PMP CALCULATIONS (HMS REPORT 33)

AREA IS IN ZONE 1 OF PMP ALL SEASON ENVELOPE (FIG. 2)

 24 HR., 200 SQ. MI. RAWFALL  $\approx$  22"

HR	%	RAWFALL	DRF
6	91	20.0"	20.0"
12	105	23.1"	3.1"
24	115	25.3"	2.2"
48	122	26.8"	1.5"

SNYDER COEFFICIENTS

 FROM INFO. PROVIDED BY COE (BALT. DISTRICT) ZONE #1

$$C_p = 0.45$$

 AND  $C_t = 1.23$ 

$$t_p = C_t (L \cdot L_{ca})^{0.3}$$

 $L \approx 17.5$  miles

 $L_{ca} \approx 5.7$  miles

$$t_p = 1.23 (17.5 \cdot 5.7)^{0.3} = 4.89 \text{ HR.}$$

Project: Alvord Dam, Stage No. Discharge    SHEET: 52-158    DATE: 11/20/74    DRAWN BY: [Signature]    CHECKED BY: DSC

2 air sp. we edged weir = 3.10 & C for edge weir = 4.0 (Chow. Open Channels)  
 @ Elev. 1154.0 Spine edged weir 24' long.  $C_{fs} = 3.1 \times 24 = 74.4$   
 @ Elev. 1154.0 Edge weir 68' long.  $C_{fs} = 4.0 \times 68 = 272.0$   
 @ Elev. 1153.0 Edge weir 100' long.  $C_{fs} = 4.0 \times 100 = 400.0$   
 @ Elev. 1163.0 Spine edged weir 125' long.  $C_{fs} = 3.1 \times 125 = 387.5$   
 @ Elev. 1165.0 Spine edged weir 216' long.  $C_{fs} = 3.1 \times 216 = 670.0$   
 @ Elev. 1166.5 Spine edged weir (assumed) 230' long.  $C_{fs} = 3.1 \times 230 = 713.0$

L = 17.5 miles  
 L<sub>cs</sub> = 5.7 miles

Elev.	Spine edged weir E		Edge weir E (El. 1154.0)		Edge weir E (El. 1153.0)		Spine edged weir E		Spine edged weir E		Spine edged weir E		Total Q (C.F.S.)
	h <sub>weir</sub>	Q <sub>weir</sub>	h <sub>weir</sub>	Q <sub>weir</sub>	h <sub>weir</sub>	Q <sub>weir</sub>	h <sub>weir</sub>	Q <sub>weir</sub>	h <sub>weir</sub>	Q <sub>weir</sub>	h <sub>weir</sub>	Q <sub>weir</sub>	
1154.0	0	0	0	0	0	0	0	0	0	0	0	0	0
1154.5	0.5	2,354	0.5	96	0	0	0	0	0	0	0	0	122
1155.0	1.0	1.0	1.0	272	0	0	0	0	0	0	0	0	342
1156.0	2.0	2.83	2.1	770	0	0	0	0	0	0	0	0	981
1158.0	4.0	8.0	4.0	2,176	0	0	0	0	0	0	0	0	2,771
1158.5	4.5	9.55	4.5	2,578	0.5	140	0	0	0	0	0	0	3,449
1159.0	5.0	11.18	5.0	3,044	1.0	400	0	0	0	0	0	0	4,275
1160.0	6.0	14.70	6.0	3,998	2.0	1,132	0	0	0	0	0	0	6,224
1161.5	7.5	20.54	7.5	5,587	3.5	2,620	0	0	0	0	0	0	9,725
1163.0	9.0	27.0	9.0	7,344	5.0	4,472	0	0	0	0	0	0	13,825
1163.5	9.5	29.28	9.5	7,964	5.5	5,160	0.5	136	0	0	0	0	15,438
1164.0	10.0	31.62	10.0	8,601	6.0	5,880	1.0	388	0	0	0	0	17,222
1165.0	11.0	36.48	11.0	9,723	7.0	6,408	2.0	1,077	0	0	0	0	21,142
1166.0	12.0	41.57	12.0	11,097	8.0	7,263	3.0	2,014	1.0	670	0	0	26,135
1166.5	12.5	44.49	12.5	12,020	8.5	7,912	3.5	2,538	1.5	1,844	0	0	29,991
1168.0	14.0	52.38	14.0	14,247	10.0	10,648	5.0	4,332	3.0	5,204	1.5	1,844	39,920
1169.0	15.0	58.09	15.0	15,800	11.0	11,992	6.0	5,976	4.0	6,360	2.5	3,925	44,586

Reservoir Drain Discharge (Original Flow)

Q = 0.66 m<sup>3</sup>/s @ 2.4 m<sup>1/2</sup>  
 Q = 5.7174 m<sup>3</sup>/s @ 4.4 m<sup>1/2</sup>

Q = 200 cfs @ 2.00 cfs  
 Q = 57.74 cfs @ 5.72 cfs

Q = 116.50 cfs @ 11.65 cfs  
 Q = 277 cfs @ 27.7 cfs

.....  
 FLOOD HYDROGRAPH PACKAGE (MEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 25 SEP 78  
 .....

LINE	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT
1	A1	0		A1	0		A1	0	
2	A2	0		A2	0		A2	0	
3	A3	0		A3	0		A3	0	
4	H1	100		H1	100		H1	100	
5	J1	0.2		J1	0.2		J1	0.2	
6	K1	0		K1	0		K1	0	
7	M1	1		M1	1		M1	1	
8	P1	0		P1	0		P1	0	
9	T1	0.45		T1	0.45		T1	0.45	
10	X1	-1.5		X1	-1.5		X1	-1.5	
11	K1	1		K1	1		K1	1	
12	Y1	1		Y1	1		Y1	1	
13	Y4	1154		Y4	1154		Y4	1154	
14	Y5	1163.5		Y5	1163.5		Y5	1163.5	
15	Y5	15438		Y5	15438		Y5	15438	
16	SS	0		SS	0		SS	0	
17	SE	1134		SE	1134		SE	1134	
18	S5	1154		S5	1154		S5	1154	
19	S0	1165		S0	1165		S0	1165	
20	K	99		K	99		K	99	
21									
22									
23									
24									
25									
26									
27									

NATIONAL DAM INSPECTION PROGRAM  
 SHOHOLA FALLS DAM  
 PMF HYDROGRAPH

LINE	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT
1	A1	0		A1	0		A1	0	
2	A2	0		A2	0		A2	0	
3	A3	0		A3	0		A3	0	
4	H1	100		H1	100		H1	100	
5	J1	0.2		J1	0.2		J1	0.2	
6	K1	0		K1	0		K1	0	
7	M1	1		M1	1		M1	1	
8	P1	0		P1	0		P1	0	
9	T1	0.45		T1	0.45		T1	0.45	
10	X1	-1.5		X1	-1.5		X1	-1.5	
11	K1	1		K1	1		K1	1	
12	Y1	1		Y1	1		Y1	1	
13	Y4	1154		Y4	1154		Y4	1154	
14	Y5	1163.5		Y5	1163.5		Y5	1163.5	
15	Y5	15438		Y5	15438		Y5	15438	
16	SS	0		SS	0		SS	0	
17	SE	1134		SE	1134		SE	1134	
18	S5	1154		S5	1154		S5	1154	
19	S0	1165		S0	1165		S0	1165	
20	K	99		K	99		K	99	
21									
22									
23									
24									
25									
26									
27									

ROUTING THROUGH RESERVOIR

LINE	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT	PARAMETER	VALUE	UNIT
1	A1	0		A1	0		A1	0	
2	A2	0		A2	0		A2	0	
3	A3	0		A3	0		A3	0	
4	H1	100		H1	100		H1	100	
5	J1	0.2		J1	0.2		J1	0.2	
6	K1	0		K1	0		K1	0	
7	M1	1		M1	1		M1	1	
8	P1	0		P1	0		P1	0	
9	T1	0.45		T1	0.45		T1	0.45	
10	X1	-1.5		X1	-1.5		X1	-1.5	
11	K1	1		K1	1		K1	1	
12	Y1	1		Y1	1		Y1	1	
13	Y4	1154		Y4	1154		Y4	1154	
14	Y5	1163.5		Y5	1163.5		Y5	1163.5	
15	Y5	15438		Y5	15438		Y5	15438	
16	SS	0		SS	0		SS	0	
17	SE	1134		SE	1134		SE	1134	
18	S5	1154		S5	1154		S5	1154	
19	S0	1165		S0	1165		S0	1165	
20	K	99		K	99		K	99	
21									
22									
23									
24									
25									
26									
27									

943



SA 5

.....

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAD	ICOMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	IAUTO
A2	1	0	0	0	0	1	0	0
ROUTING DATA								
QLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR		
0.0	0.00	1	1	0	0	0		
MSTPS								
1	0	LAG	AMSKK	X	TSK	STORA	ISPRAT	
		0	0.000	0.000	0.000	12730.	-1	
STAGE	1154.00	1155.00	1156.00	1158.00	1158.50	1159.00	1160.00	1163.00
	1163.50	1164.00	1166.00	1168.00	1170.00			
FLOW	0.00	346.00	981.00	2771.00	3449.00	4273.00	6224.00	13025.00
	15438.00	17222.00	25465.00	35124.00	45974.00			
CAPACITY=	0.	3090.	7590.	12730.	17300.	23640.	26480.	34180.
ELEVATION=	1139.	1144.	1149.	1154.	1158.	1163.	1165.	1170.

TOPEL COOU EXPD DAMWID  
1165.0 3.1 1.5 230.

- PEAK OUTFLOW IS 4596. AT TIME 52.00 HOURS
- PEAK OUTFLOW IS 8184. AT TIME 51.00 HOURS
- PEAK OUTFLOW IS 11969. AT TIME 50.00 HOURS
- PEAK OUTFLOW IS 15887. AT TIME 50.00 HOURS
- PEAK OUTFLOW IS 20098. AT TIME 49.00 HOURS
- PEAK OUTFLOW IS 24629. AT TIME 49.00 HOURS
- PEAK OUTFLOW IS 29411. AT TIME 49.00 HOURS
- PEAK OUTFLOW IS 34366. AT TIME 48.00 HOURS
- PEAK OUTFLOW IS 39804. AT TIME 48.00 HOURS

44 6

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS  
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)  
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
HYDROGRAPH AT	A1	54.00 ( 134.86)	1	10414. ( 294.89)	15621. ( 442.34)	20829. ( 589.78)	26035. ( 737.23)	31242. ( 884.87)	36449. ( 1032.12)	41656. ( 1179.96)	46863. ( 1327.81)	52070. ( 1474.95)
	A2	54.00 ( 139.86)	1	4596. ( 130.13)	8184. ( 231.73)	11969. ( 338.92)	15887. ( 449.86)	20098. ( 569.12)	24629. ( 697.42)	29411. ( 832.83)	34366. ( 973.14)	39804. ( 1127.11)

94 7

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

ELEVATION  
STORAGE  
OUTFLOW

INITIAL VALUE  
1154.00  
12730.  
0.

SPILLWAY CREST  
1154.00  
12730.  
0.

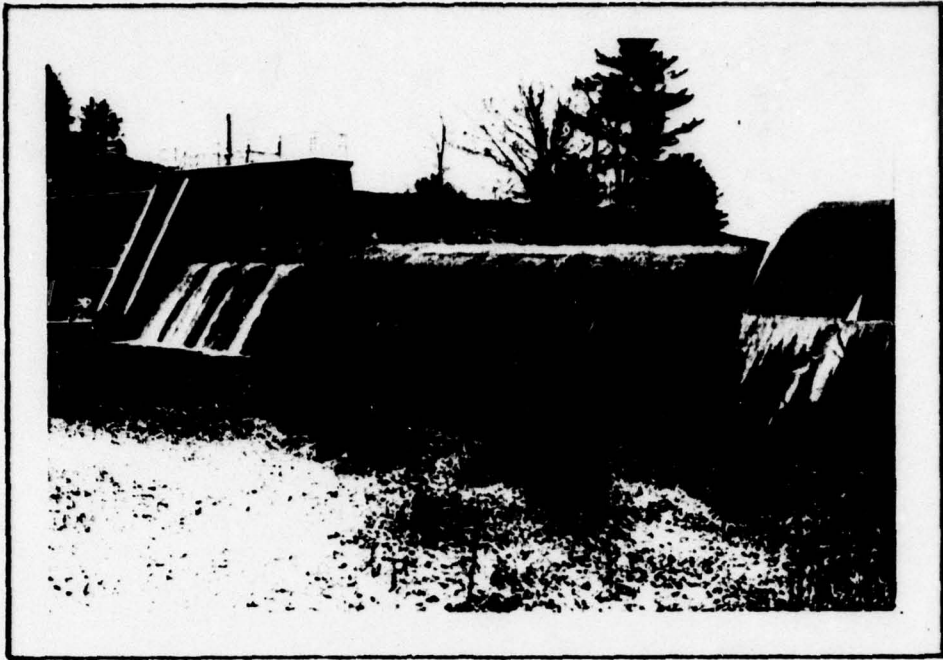
TOP OF DAM  
1165.00  
26480.  
21162.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1159.17	0.00	18924.	4596.	0.00	52.00	0.00
.30	1160.84	0.00	20923.	8184.	0.00	51.00	0.00
.40	1162.32	0.00	22785.	11969.	0.00	50.00	0.00
.50	1163.63	0.00	24529.	15887.	0.00	50.00	0.00
.60	1164.73	0.00	26102.	20098.	0.00	49.00	0.00
.70	1165.71	.71	27571.	24629.	6.00	49.00	0.00
.80	1166.54	1.54	28846.	29411.	9.00	49.00	0.00
.90	1167.32	2.32	30054.	34366.	11.00	48.00	0.00
1.00	1168.05	3.05	31184.	39804.	12.00	48.00	0.00

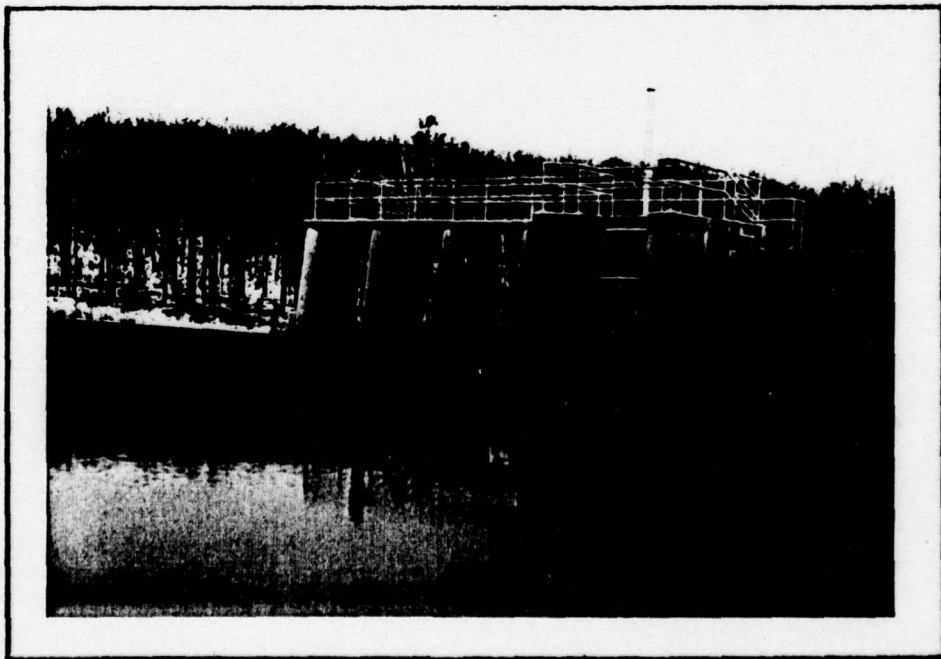
**APPENDIX**

**D**

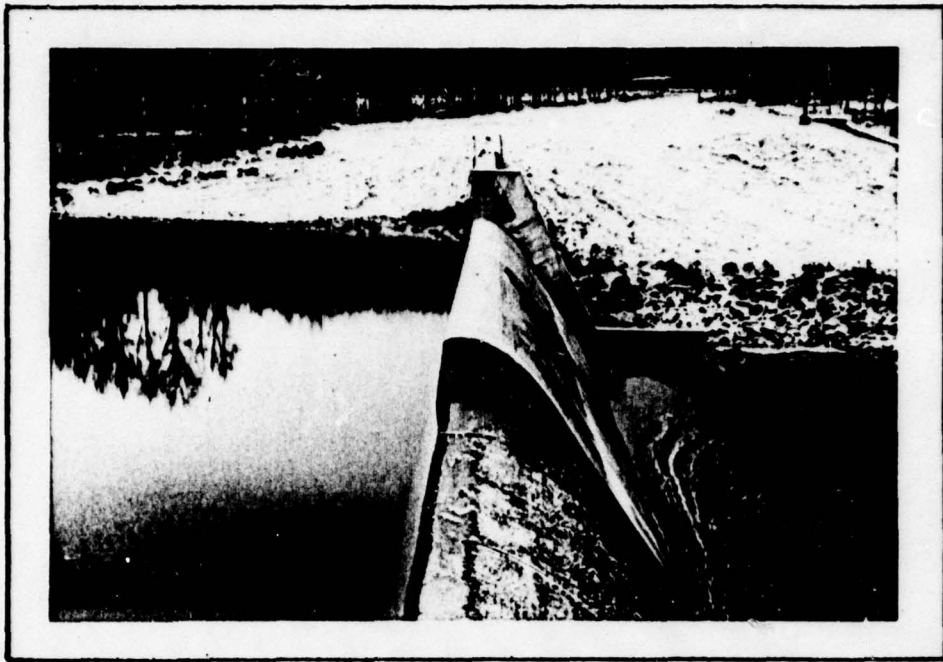
**Photographs**



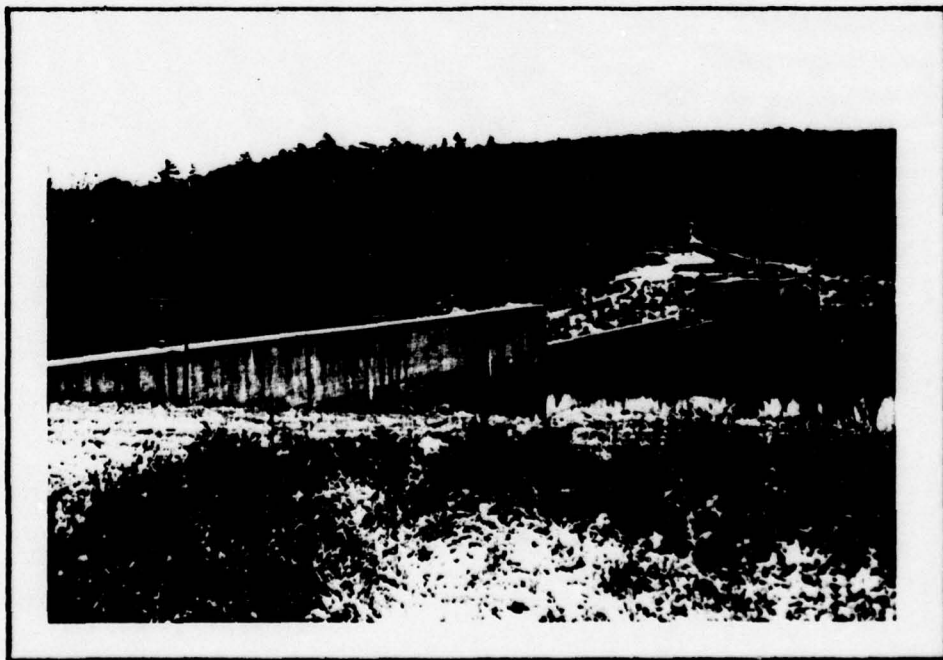
*SERVICE SPILLWAY WITH STOPLOG  
CONTROLLED PORTION TO THE LEFT*



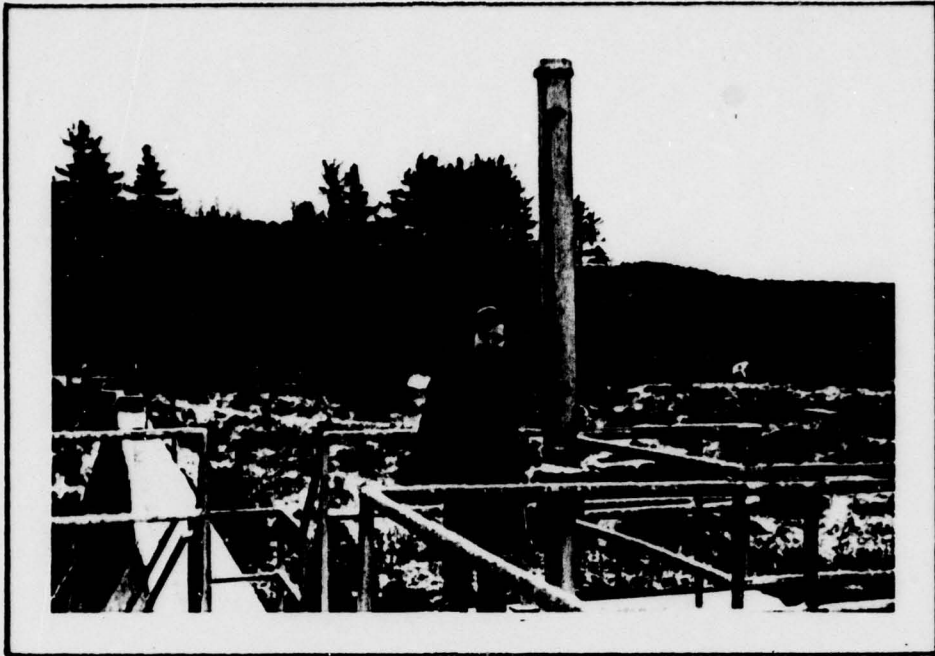
*UPSTREAM VIEW OF SERVICE  
SPILLWAY AND OUTLET WORKS*



*SERVICE SPILLWAY AND LOWER EMERGENCY  
SPILLWAY LOOKING TOWARDS LEFT ABUTMENT*



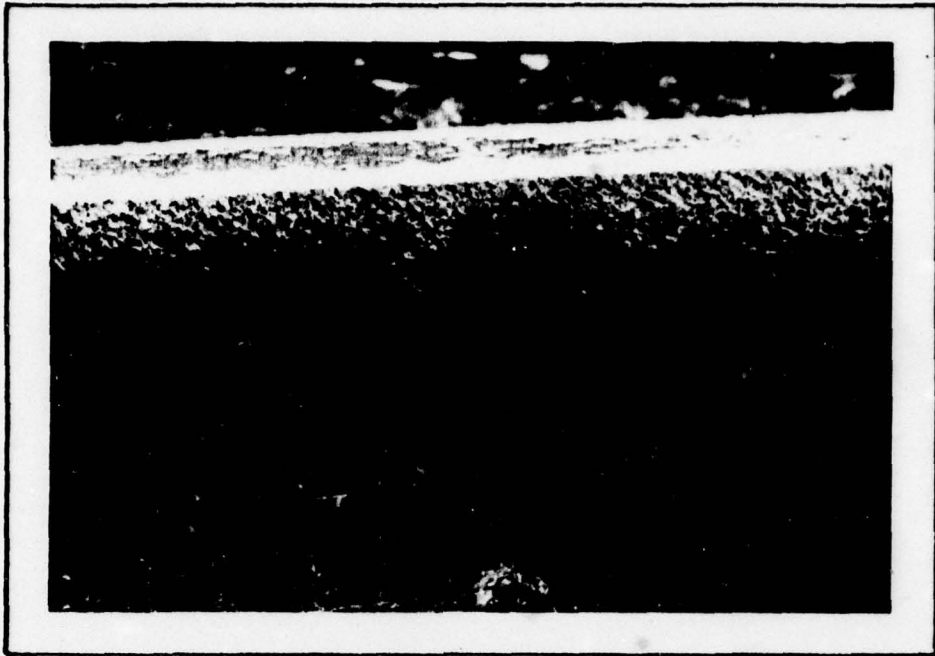
*UPSTREAM VIEW OF DAM*



*ON SERVICE BRIDGE SHOWING  
RESERVOIR DRAIN HOIST AND STEM*



*RESERVOIR DRAIN AND STOP LOGGED  
PORTION OF SERVICE SPILLWAY*



*TYPICAL MINOR SURFACE CRACKING*



*FALLS OF SHOHOLA CREEK ABOUT 100 YARDS  
DOWNSTREAM OF THE DAM*



*GORGE 300 YARDS DOWNSTREAM OF DAM*



*CHANNEL 3 MILES DOWNSTREAM OF DAM*

APPENDIX

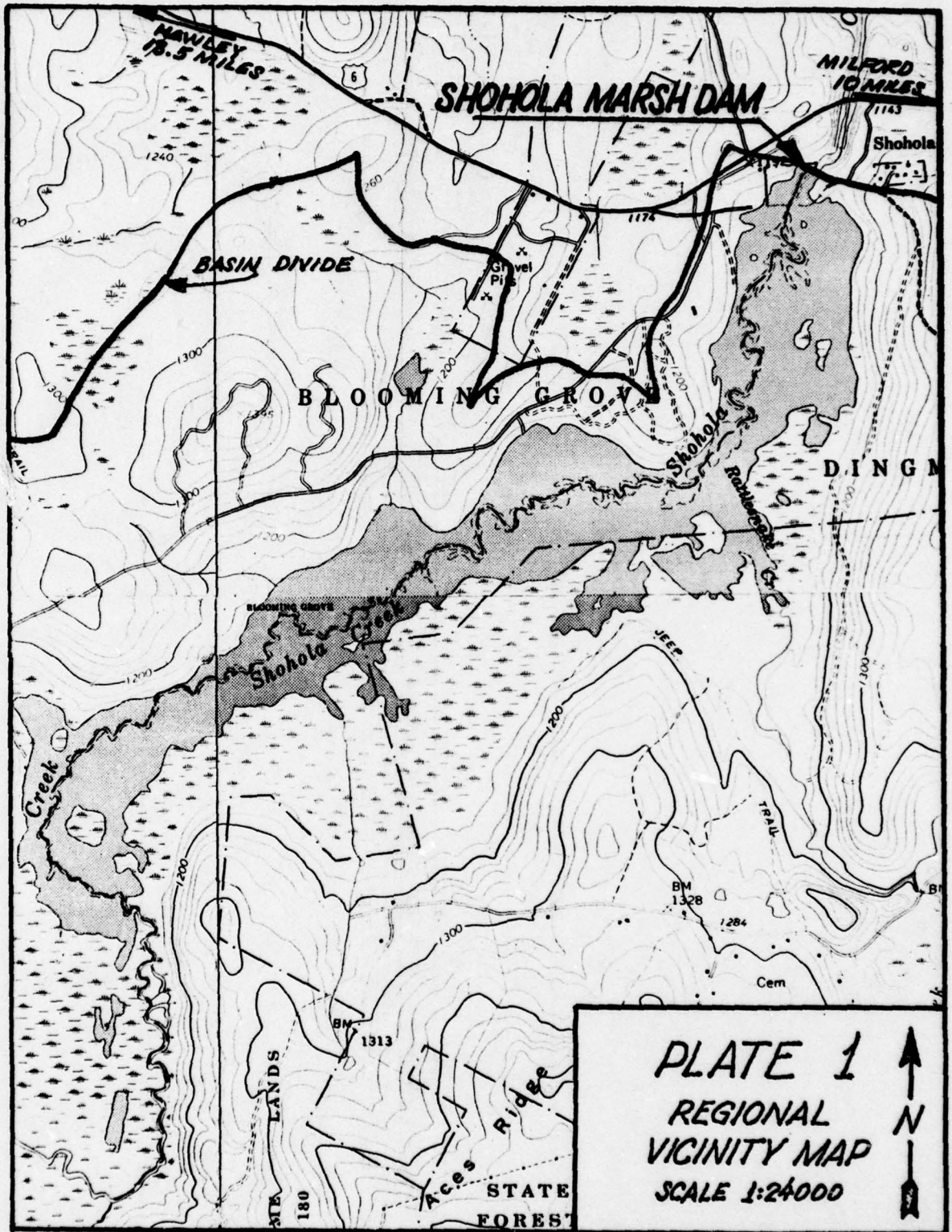
E

Drawings

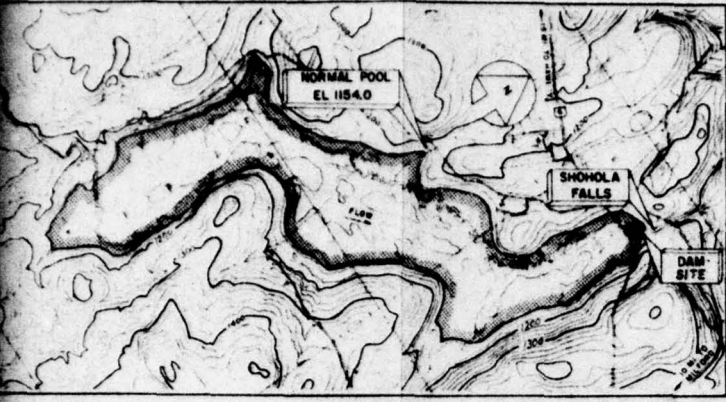


Table of Contents APPENDIX E

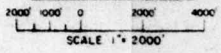
Regional Vicinity Map	Plate 1
Location & Reservoir Maps, General Plan and Profile	" 2
Dam Site Foundation Exploration - Logs of Core Borings	" 3
Dam Site Foundation Exploration - Logs of Core Borings & Test Holes	" 4
Foundation Excavation - Grouting Details	" 5
Service & Emergency Spillways, Non-Overflow Sections	" 6
Outlet Works & Wingwalls - Plan, Sections & Details	" 7







**RESERVOIR MAP**

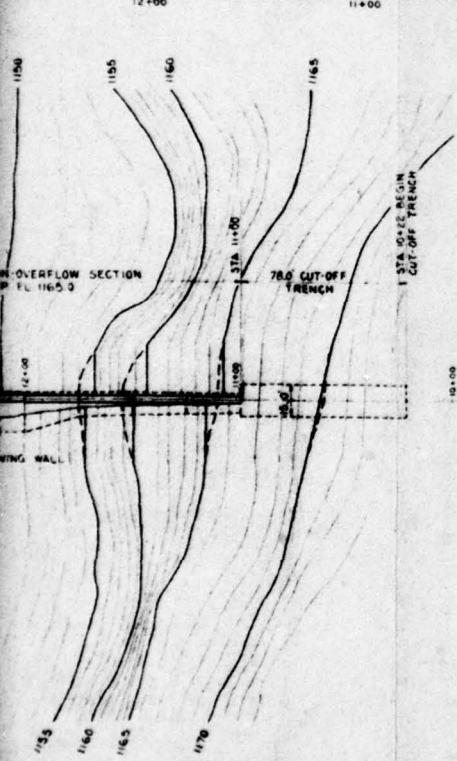
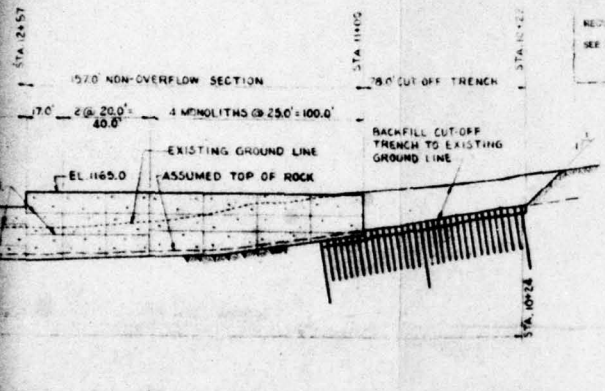


NOTE: RESERVOIR MAP TOPOGRAPHY BASED ON PROVISIONAL MAPS BY U.S. GEOLOGICAL SURVEY.

57-158-2

RECEIVED BY THE WATER & POWER RESOURCES DIVISION, DEPARTMENT OF FORESTS & WATERS ON THE DAY OF FEB 18 1938

NEED FOR



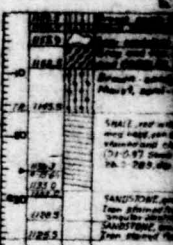
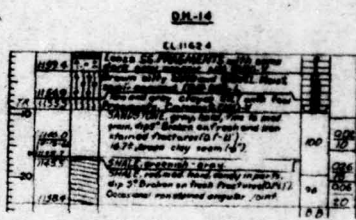
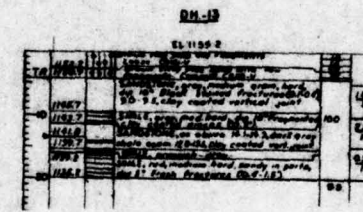
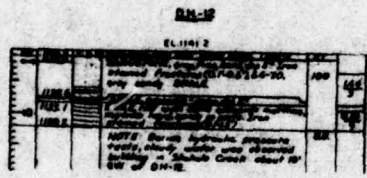
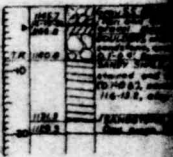
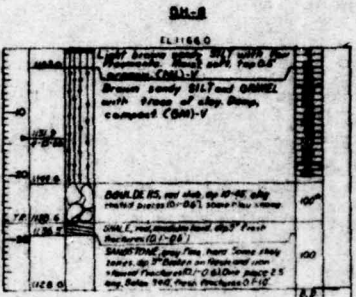
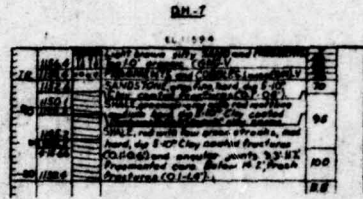
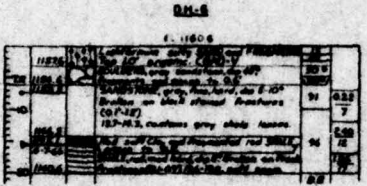
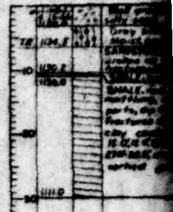
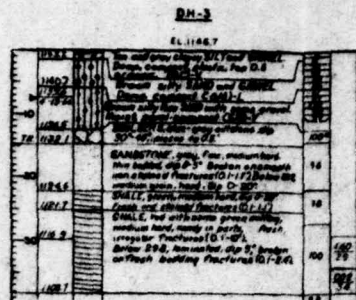
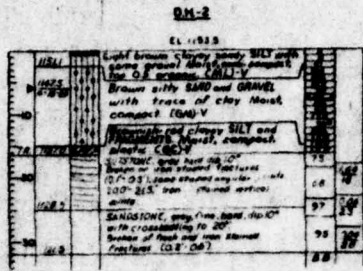
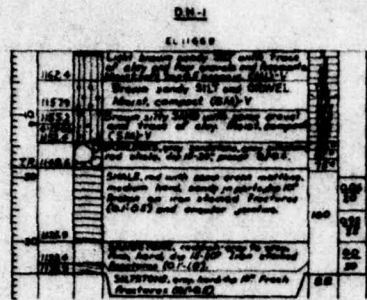
- GENERAL NOTES:**
1. SECTIONS ARE INDICATED BY THE UPPER NUMBER INDICATES THE SHEET ON WHICH THE SECTION IS CUT OR SHOWN, AND THE LOWER NUMBER INDICATES THE SECTION NUMBER.
  2. PAYMENT ITEM NUMBERS ARE INDICATED THUS (6).
  3. FOR SITE TOPOGRAPHY AND PROJECT LAYOUT SEE SHEET 3.
  4. ALL AREAS AFFECTED BY CONSTRUCTION WILL BE TOPSOILED AND SEEDED AS DESIGNATED BY THE ENGINEER AND THE BUREAU.

**PLATE #2**

REVISED			
SPECIAL CORRECTIONS			
<b>APPROVALS</b>			
APPROVED BY DIRECTOR OF ENGINEERING AND CONSTRUCTION			
APPROVAL REQUIRED BY SUPERVISOR ENGINEER/ENGINEER IN CHARGE OF CONSTRUCTION			
APPROVED FOR DEPT.			
DESIGNED BY	DRAWN BY		
ACCEPTED BY	CONTRACTOR		
BY BUREAU OF ENGINEERING AND CONSTRUCTION			
ARCH	STRUC	MECH	ELEC
<b>PROJECT NO. G.C. 5485-0</b>			
<b>LOCATION AND RESERVOIR MAPS, GENERAL PLAN AND PROFILE</b>			
<b>CONSTRUCTION OF SHOHOLA DAM</b>			
<b>STATE GAME LANDS NO 150</b>			
<b>SHOHOLA FALLS, PIKE COUNTY, PENNSYLVANIA</b>			
<b>EDWARD T. FLEMING, CHIEF ENGINEER, THE BUREAU OF ENGINEERING</b>			
DATE	DESIGNED BY	DRAWN BY	SHEET NO.
	EDWARD T. FLEMING	RAYMOND J. SHAFER	2
SCALE	DEPT. OF PROPERTY AND SUPPLIES		
AS SHOWN	PERMITS DIVISION, SECRETARY		
	HARRISBURG, PENNSYLVANIA		

ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE

2



**LEGEND**

DEPTH IN FEET	ELEVATION	SYMBOLS	DESCRIPTION	BLOWS PER FOOT OF 300 HANMER FALLING IN ON SAMPLING SPOON	WATER CONTENT IN OVERBURDEN	AVERAGE WATER LOSS IN CU FT PER SQ FT PRESSURE IN PSI
11489	11489	(Symbol)	Light brown clayey SILT with fine sandstone (M.L.V.)	10	18.5	100
11490	11490	(Symbol)	Brown clayey SAND and GRAVEL	15	18.5	100
11491	11491	(Symbol)	COBBLES and FRAGMENTS, gray sandstone and gravel, GRAVEL in 0.2' sandstone fractures (O.2'S)	15	18.5	100
11492	11492	(Symbol)	SANDSTONE, gray, fine to medium grained, 5-10' Fresh fractures (O.2'-2'), comp stamped 185-184, some dark stain traces	15	18.5	100

- SYMBOLS OVERBURDEN**
- (Symbol) Organic material, topsoil, sod, roots
  - (Symbol) Silty CLAY (CL)
  - (Symbol) Clayey SILT or clayey SAND and GRAVEL FRAGMENTS (SC)
  - (Symbol) Silty SAND (SM)
  - (Symbol) SAND and GRAVEL (SP-SM)
  - (Symbol) SAND and GRAVEL (SP-GM)
  - (Symbol) GRAVEL or FRAGMENTS with silty SAND (GW) or (GW-GC)
  - (Symbol) BOULDERS and COBBLES

**GENERAL NOTES**

- 1 DRILL HOLES (DH) WERE ACCOMPLISHED BY A 3" I.D. x 2.0' LONG SPOON (UNLESS OTHERWISE SPECIFIED). THESE SAMPLE SPOONS ARE FALLING 10". HOWEVER, IN SOME CASES FACILITATE ADVANCING THE BORING, BIT UNLESS OTHERWISE SPECIFIED.
- 2 THE BORINGS INCLUDED ON THESE DRILL HOLES ARE THE IMMEDIATE AREA OF THE WORK PRESENTED IN THE FOUNDATION EXPLAN.
- 3 LETTER SYMBOLS SUCH AS SC, GC, CL, SM, SP, GW, OR GW-GC, INDICATE SOIL CLASSIFICATION SYSTEM (M.L.V.).
- 4 THE GROUND WATER LEVEL SHOWN IN THESE DRILL HOLES WAS STABILIZED IN THE HOLES NOT NECESSARILY THE LEVEL AT WHICH THE DRILLING OPERATION.
- 5 DESCRIPTION OF SOILS GIVEN ON THE JAR SAMPLES. PRESENCE OF BOULDERS WAS A REFUSAL IN THE DRIVING OF THE BORING. HOWEVER, THAT IN MANY CASES MAY HAVE BEEN PENETRATED BY SOIL IN THE LOSS OF THE DRILL HOLES. IN THE RIGHT HAND COLUMN OF THE LOGS DUE TO A COBBLE OR SMALL BOULDER.
- 6 WATER CONTENTS SHOWN IN RIGHT HAND COLUMN ARE THE WATER CONTENTS IN SOIL RECOVERED ALL WATER CONTENT MATERIAL UNLESS OTHERWISE NOTED.
- 7 TEST PITS (TP) ARE MACHINE DUG.

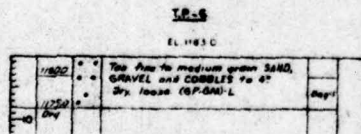
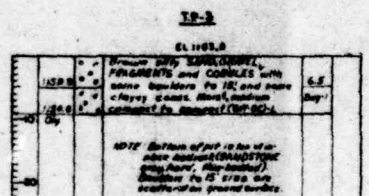
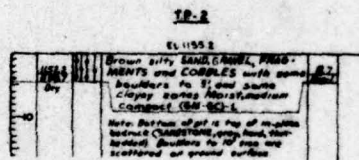
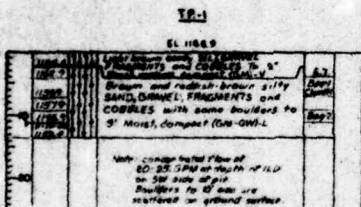
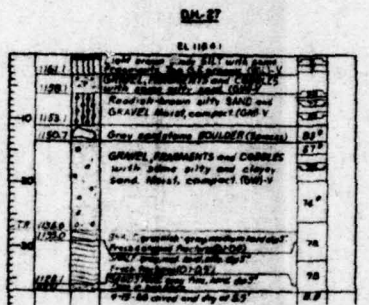
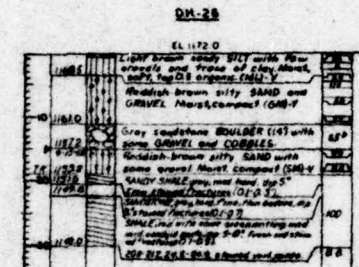
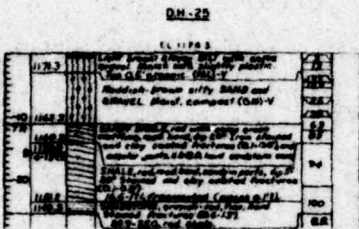
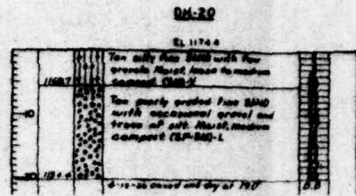
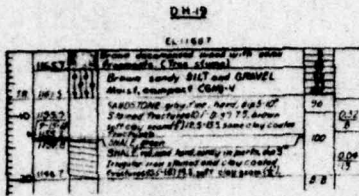
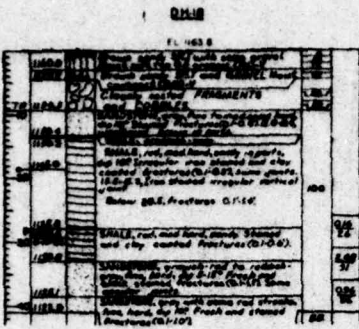
**ROCK**

- (Symbol) SHALE
- (Symbol) SANDSTONE
- (Symbol) SILTSTONE or SANDY SHALE

TOP OF ROCK  
PARTIAL LOSS OF DRILL WATER  
LOSS OF DRILL WATER  
GROUND WATER ELEV.  
DATE OF READING

V - VISUAL CLASSIFICATION  
L - LABORATORY CLASSIFICATION  
O - DENOTES CORE DRILLING IN OVERBURDEN

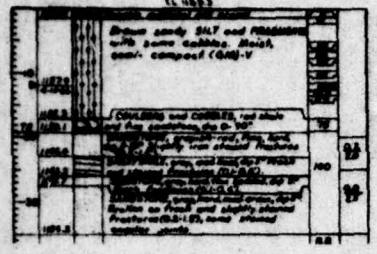




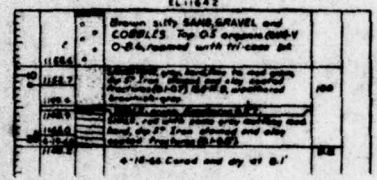
**GENERAL NOTES:**  
1. See location map on page 1 of this report.  
2. See section log on page 2 of this report.

52-158-5  
 RECEIVED IN THE OFFICE OF THE WATER & POWER  
 ENGINEER IN CHARGE, STATE OF FLORIDA  
 WATER ON 7/11/47

DM-22  
 EL 1173.6  
 Show sandy SILT and FRAGMENTS  
 with some GASTROPOD shells,  
 some composed (G.S.V)



DM-20  
 EL 1163.2  
 washed GRAVEL and COBBLES  
 and silty sandstone  
 composed with fine sand bit



DM-4  
 EL 1177.6  
 silty sand, GRAVEL and  
 COBBLES with some boulders  
 and some clayey sand  
 composed (G.S.V)

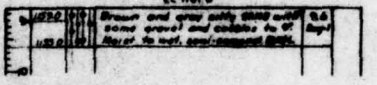
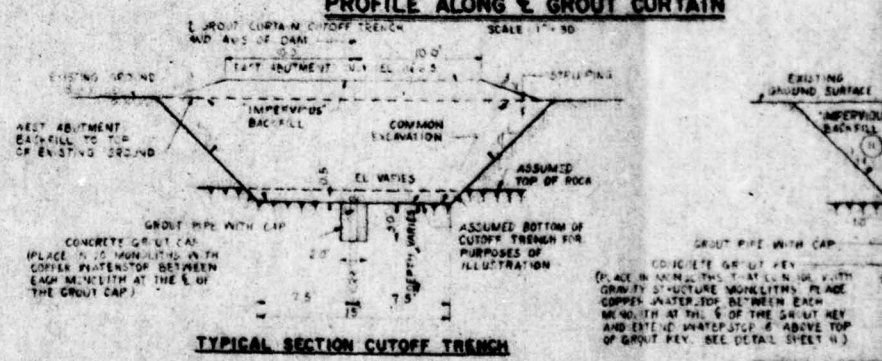
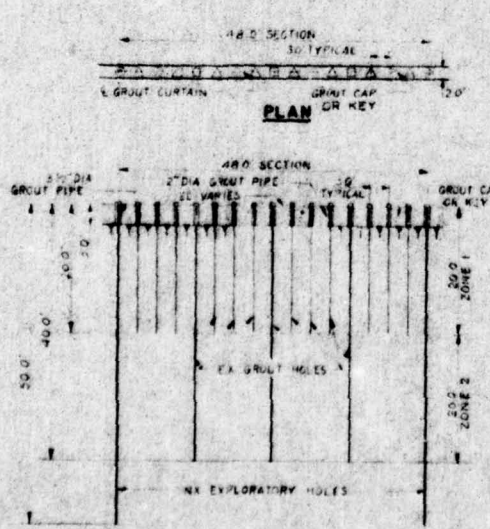
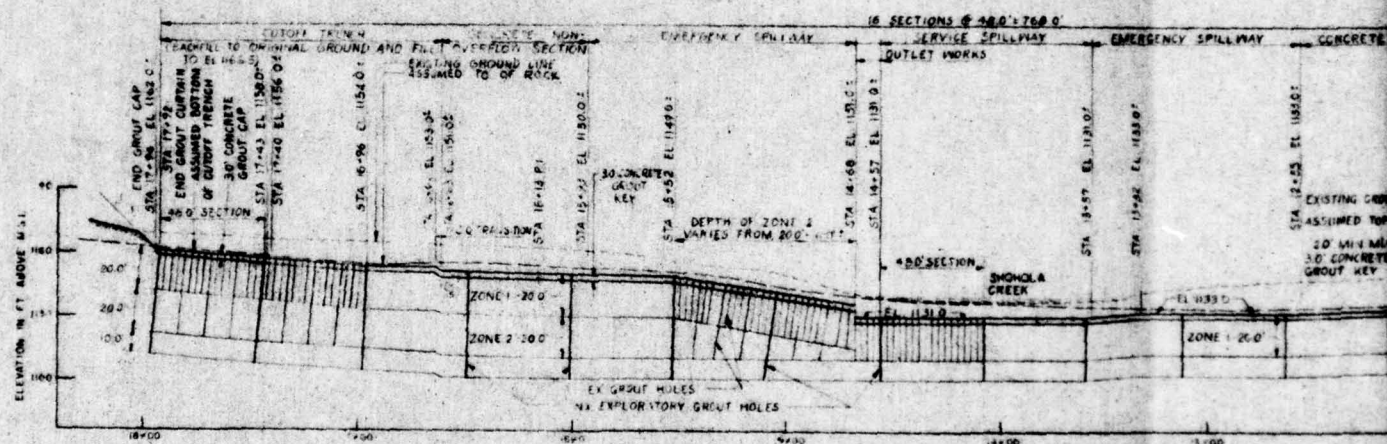
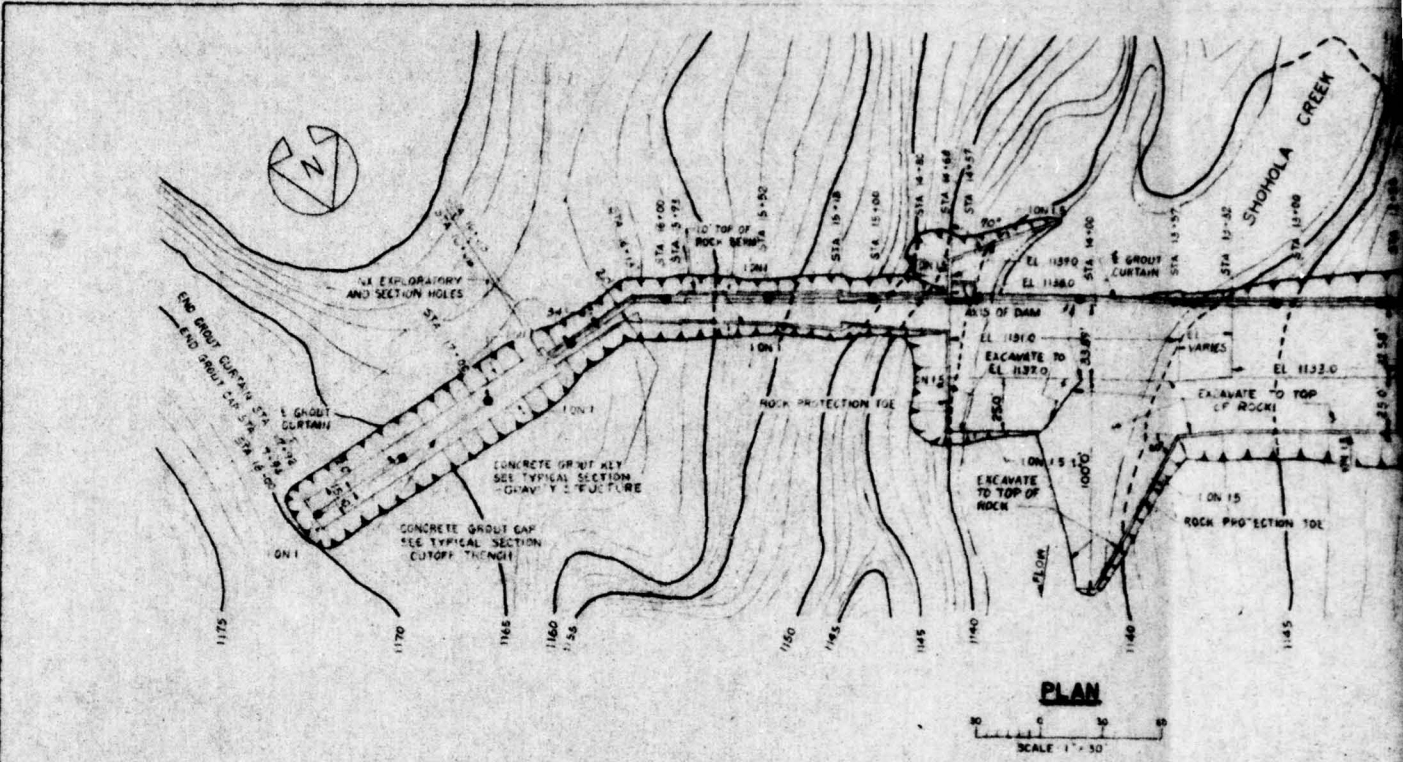


PLATE # 4

REVISED			
APPROVALS			
DESIGNED BY: _____			
CHECKED BY: _____			
APPROVED BY: _____			
DATE: _____			
PROJECT NO. G.C. 5493-0			
DAM SITE FOUNDATION EXPLORATION - LOSS OF CORE BORINGS AND TEST PITS			
CONSTRUCTION OF SHONOLA DAM STATE GAME LANDS NO. 180 SHONOLA, HILLS, FLORIDA			
COUNTY: FLORIDA COUNTY: G. CONTRACTOR: _____			
SCALE: AS SHOWN	DEPT. OF PROPERTY AND SURVEYS	FORWARD C. J. HARTMAN, SECRETARY	RECEIVED

ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE ENGINEER AT THE SITE

2



**NOTE**

- USE 1/2" DIA. BLACK STEEL PIPE FOR 12" DIA. GROUT HOLES
- USE 2" DIA. BLACK STEEL PIPE FOR 12" DIA. GROUT HOLES
- IF EXPANSION PLUG IS USED THE TOP OF PLUG SHALL BE DRILLED TO 2" DIA. CEMENT PIPE INTO HOLE AFTER DRILLING IS COMPLETE
- GROUT PIPES THROUGH CONCRETE GROUT CAP AND KEY SHALL BE ACCURATELY PLACED AND FIRMLY SUPPORTED FROM TO PLACING CONCRETE
- GROUT PIPES STAKING ABOVE THE GROUT KEY ARE WITHIN THE CONCRETE MONOLITH. SMALL RE LEFT IN PLACE. ALL OTHER GROUT PIPES SHALL BE CUT FLUSH AFTER GROUTING IS COMPLETE

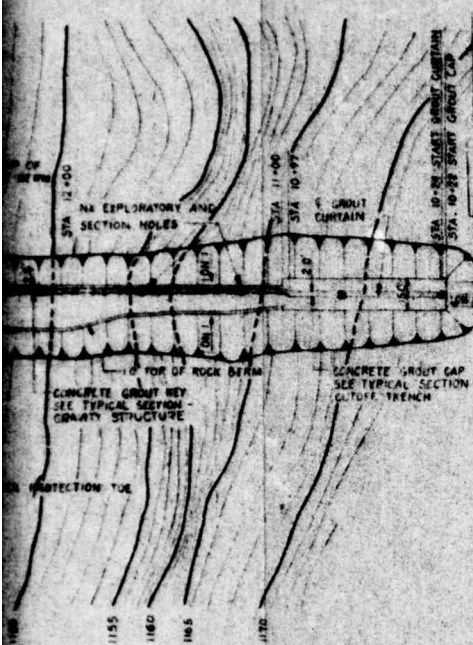
**GENERAL NOTES**

- CONCRETE GROUT KEY SHALL BE PLACED AT EL. 1133.0' WITH GRADUALLY TAPERING MONOLITH. PLACE COPPER WATER PIPES BETWEEN EACH MONOLITH AT THE 6" OF THE GROUT KEY AND EXTEND WHATEVER IS ABOVE TOP OF GROUT KEY. SEE DETAIL SHEET (4)
- CONCRETE GROUT KEY SHALL BE PLACED AT EL. 1133.0' WITH GRADUALLY TAPERING MONOLITH. PLACE COPPER WATER PIPES BETWEEN EACH MONOLITH AT THE 6" OF THE GROUT KEY AND EXTEND WHATEVER IS ABOVE TOP OF GROUT KEY. SEE DETAIL SHEET (4)

**GROUTING DETAILS**

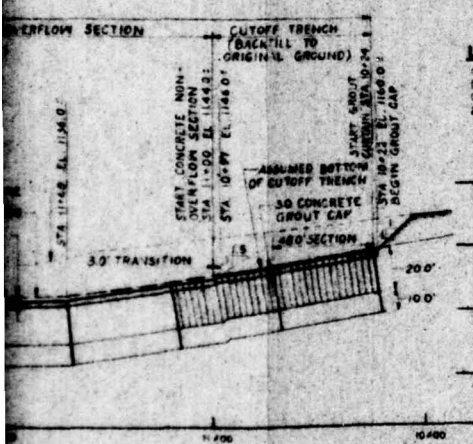
NOT TO SCALE

SR-158-6



RECEIVED AT THE STATE ENGINEER'S OFFICE  
 PROJECT NO. SR-158-6  
 DATE: 11/14/48  
 BY: [Signature]

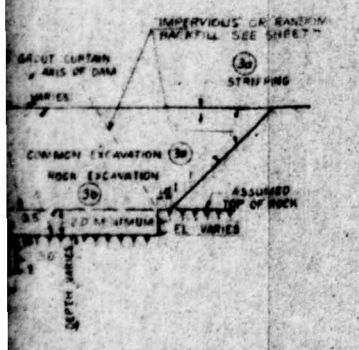
SCALE: \_\_\_\_\_  
 DATE: \_\_\_\_\_



**LEGEND**

- ⊙ 3" DIA. EXPLORATORY HOLE
- 1 1/2" DIA. PRIMARY HOLE
- 1 1/2" DIA. SECONDARY HOLE
- △ 1 1/2" DIA. TERTIARY HOLE

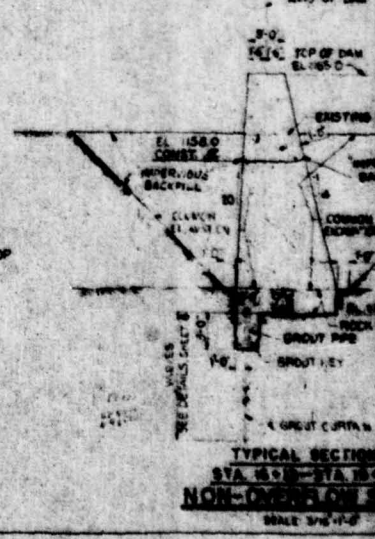
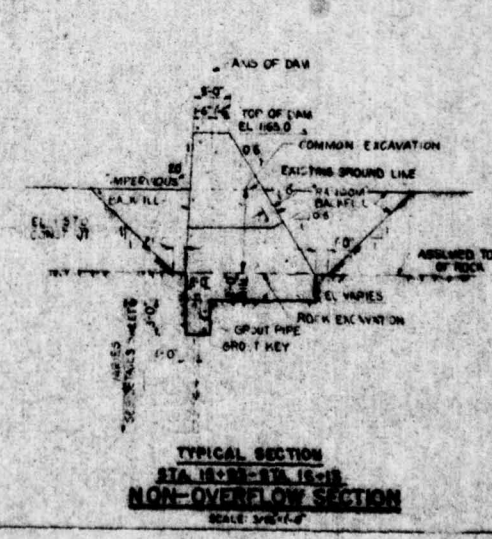
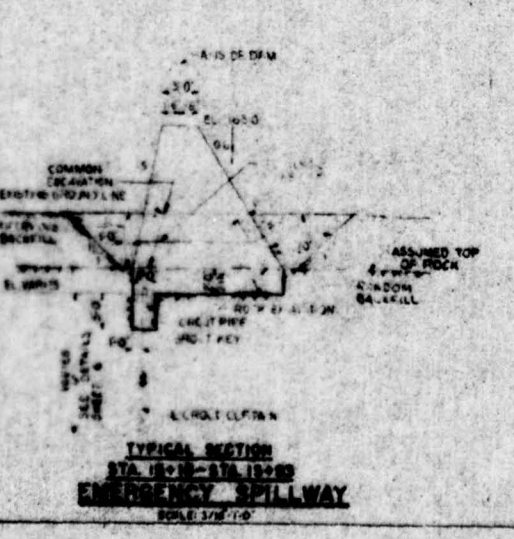
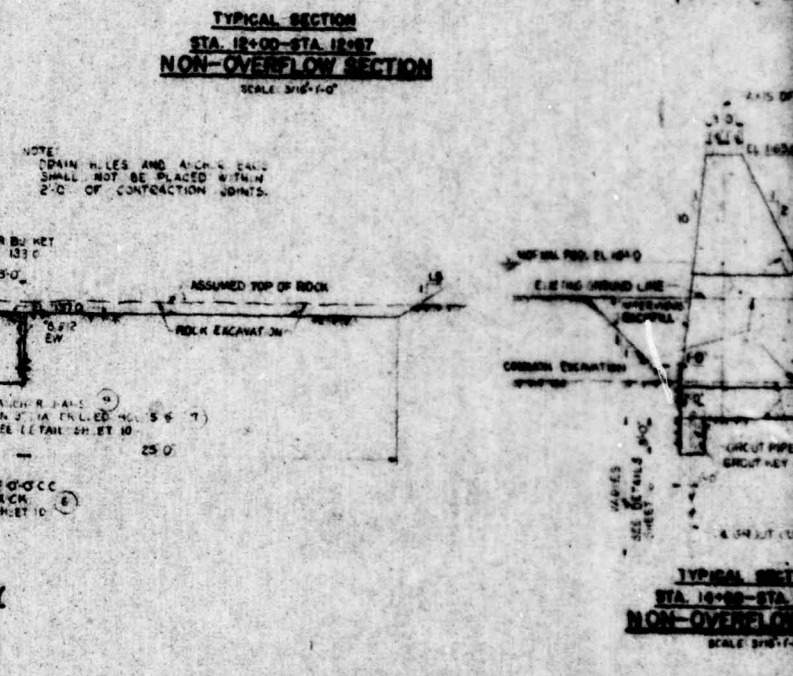
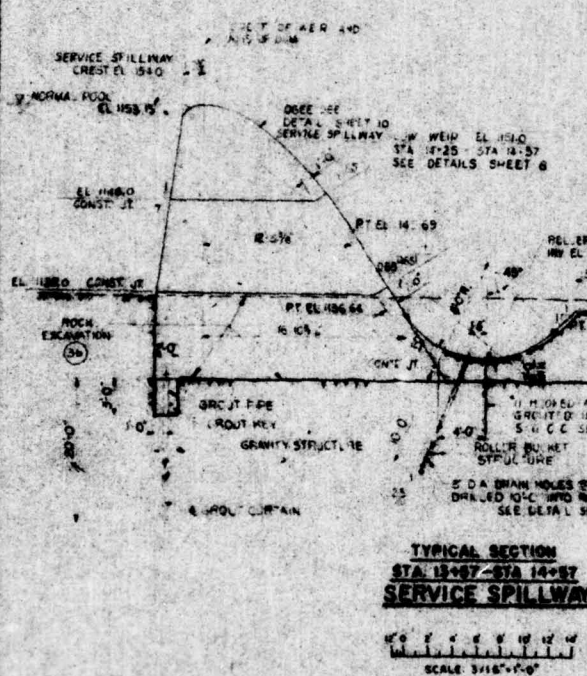
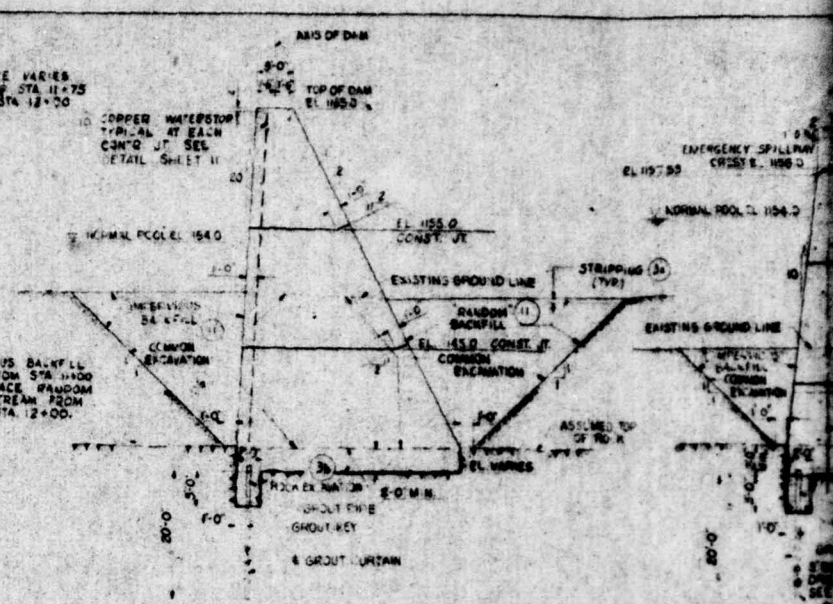
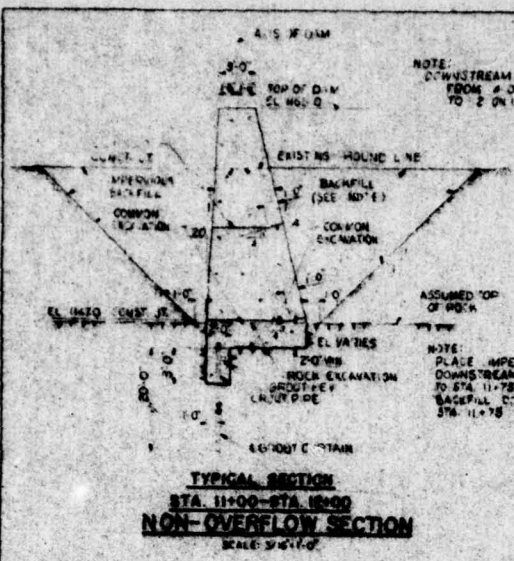
**PLATE #5**



REVISED	
APPROVALS	
DESIGNED BY: [Signature]	
CHECKED BY: [Signature]	
APPROVED BY: [Signature]	
PROJECT NO. BC 5493-0	
FOUNDATION EXCAVATION - GROUTING DETAILS	
CONSTRUCTION OF SHILOH DAM	
STATE GAME LANDS NO. 180	
SHILOH DAM, FINE GROUTING DETAILS	
CONSTRUCTION COMPANY & CONTRACTOR, INC.	
DATE: 11/14/48	
SCALE: AS SHOWN	
BY: [Signature]	

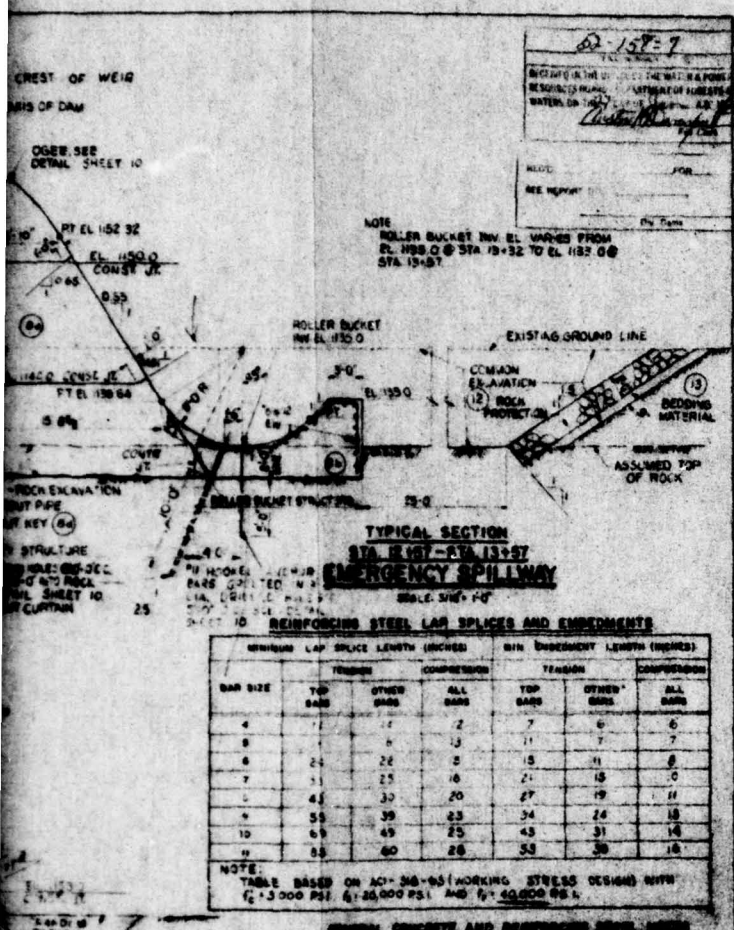
**GRAVITY STRUCTURE**

EXPLORATORY HOLES WILL BE PAID FOR UNDER ITEM 50  
 SECTION HOLES WILL BE PAID FOR UNDER ITEM 50  
 ALL DIMENSIONS AND EXISTING CONDITIONS SHALL BE  
 CHECKED AND VERIFIED BY THE CONTRACTOR ON SITE



62-157-7  
 ALL DIMENSIONS IN THIS DRAWING ARE TO FACE UNLESS OTHERWISE SPECIFIED.  
 REVISIONS SHALL BE MADE BY THE DESIGNER OR HIS REPRESENTATIVE.  
 WATER, OR THE DESIGNER'S REPRESENTATIVE.  
 DATE: 10/1/58  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]  
 TITLE: [Blank]  
 FOR: [Blank]  
 SEE SHEET: [Blank]  
 BY: [Blank]

NOTE  
 ROLLER BUCKET INV. EL. VARIED FROM  
 EL. 1188.0 @ STA. 13+32 TO EL. 1187.0 @  
 STA. 13+87.



**TYPICAL SECTION  
 STA. 13+17 - STA. 13+87  
 EMERGENCY SPILLWAY**  
 SCALE: 1/4\"/>

**REINFORCING STEEL LAP SPLICES AND EMBEDMENTS**

BAR SIZE	MINIMUM LAP SPICE LENGTH (INCHES)			MIN EMBEDMENT LENGTH (INCHES)		
	TENSION	COMPRESSION	ALL BARS	TENSION	COMPRESSION	ALL BARS
4	12	12	2	7	6	6
5	14	14	3	11	7	7
6	24	24	5	15	11	8
7	33	25	10	21	15	10
8	42	30	20	27	19	11
9	55	39	25	34	24	13
10	68	45	25	43	31	14
11	85	60	28	53	39	16

NOTE  
 TABLE BASED ON ACI 308-65 (WORKING STRESS DESIGN) WITH  
 $f_c = 3,000$  PSI,  $f_y = 36,000$  PSI, AND  $f_y = 40,000$  PSI.

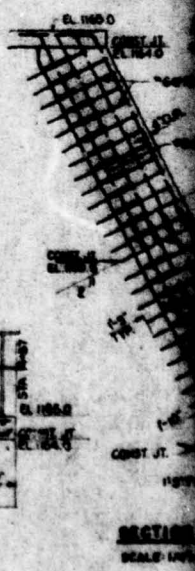
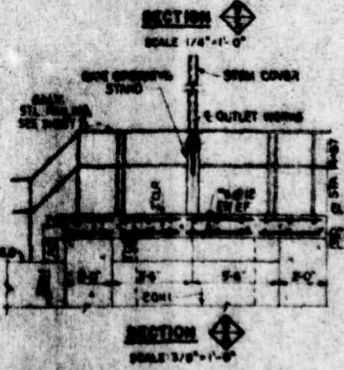
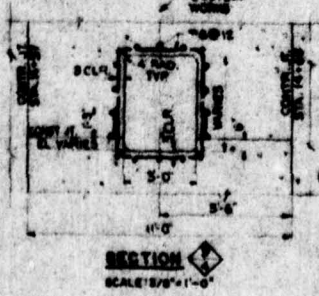
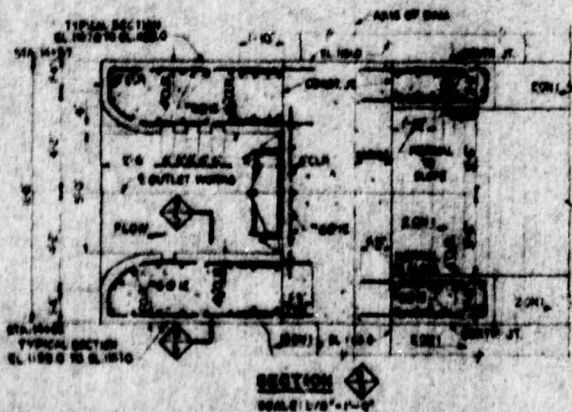
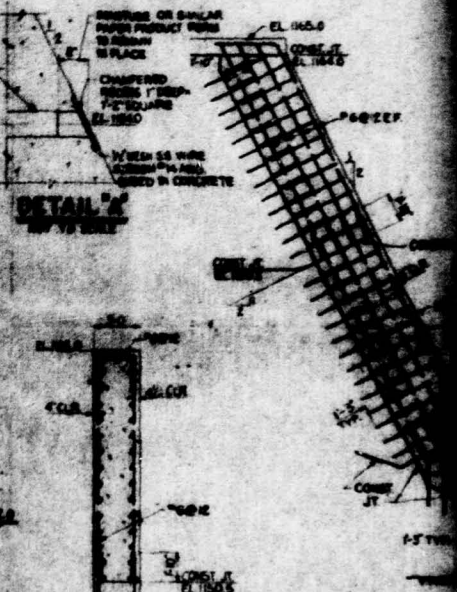
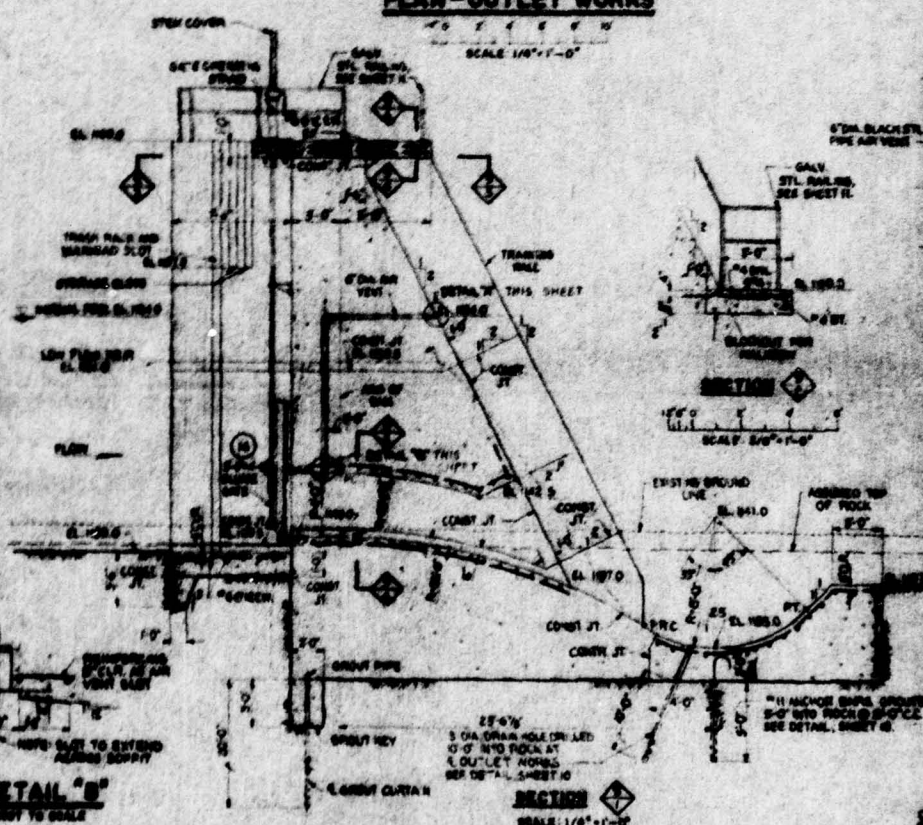
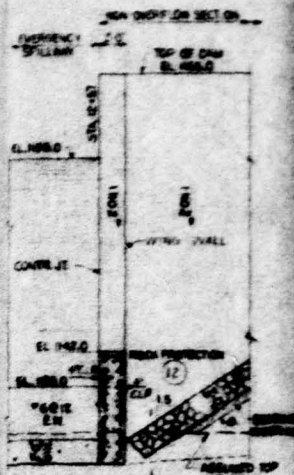
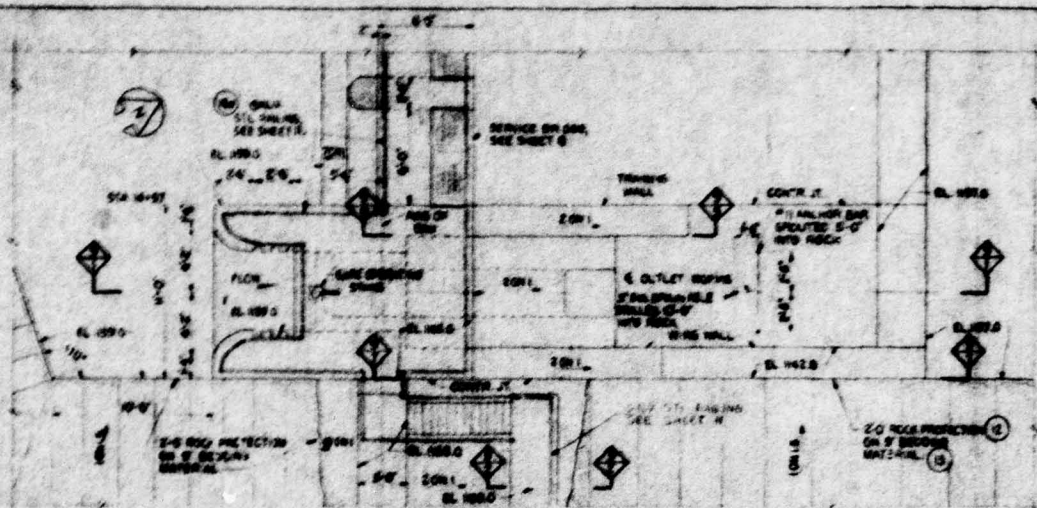
- GENERAL NOTES AND REQUIREMENTS FOR CONSTRUCTION**
1. ALL EXPOSED EDGES OF CONCRETE SHALL BE FINISHED TO A FINISH OF 1/4\"/>
  - 2. ALL REINFORCING STEEL SPLICE LAPS AND EMBEDMENTS SHALL BE IN ACCORDANCE WITH THE A.C.I. STANDARD BUILDING CODE REQUIREMENTS FOR REINFORCING CONCRETE (ACI 308-65) SEE W/16 FOR SAME.
  - 3. ALL BAR BENDING DETAILS SHALL BE IN ACCORDANCE WITH A.C.I. STANDARDS UNLESS OTHERWISE SHOWN.
  - 4. REINFORCING STEEL SHALL NOT BE PLACED WITHIN 3\"/>
  - 5. ALL GRAVITY DAM CONCRETE WILL BE PAID FOR UNDER ITEM 80.
  - 6. ALL ROLLER BUCKET CONCRETE WILL BE PAID FOR UNDER ITEM 80.
  - 7. ALL WALLS, PIERS AND SLABS WILL BE PAID FOR UNDER ITEM 80.
  - 8. ALL GROUT CUR AND KEY CONCRETE WILL BE PAID FOR UNDER ITEM 80.
  - 9. ALL REINFORCING STEEL WILL BE PAID FOR UNDER ITEM 80.

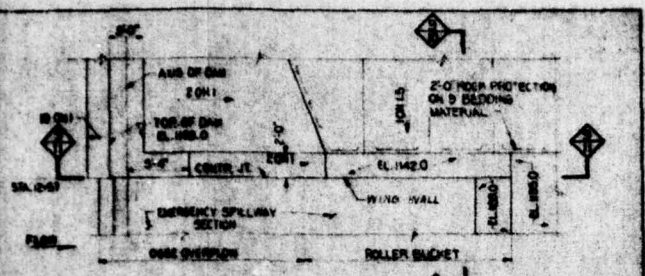
**GENERAL NOTES**  
 FOR OTHER GENERAL NOTES SEE SHEET 2.

**PLATE #6**  
 REVISED

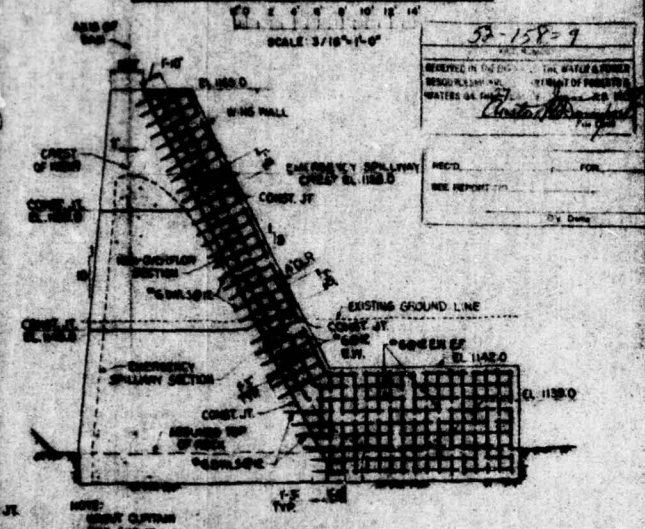
DATE	APPROVED BY	CHECKED BY
<b>APPROVALS</b>		
DESIGNED BY: [Blank]		
CHECKED BY: [Blank]		
APPROVED BY: [Blank]		
ACCEPTED BY: [Blank]		
BY: [Blank]		
BUREAU OF ENGINEERING AND CONSTRUCTION CHECKED BY: [Blank]		
NO.	STAGE	DATE
<b>PROJECT NO. 62-5488-0</b>		
SERVICE AND EMERGENCY SPILLWAYS, DAM - DIVISION OF CONSTRUCTION, DEPARTMENT OF TRANSPORTATION, STATE GAME LANDS, INDIANA JOHN W. WALKER, JR. DISTRICT ENGINEER		
DATE	REVISION BY	REVISION NO.
DATE	REVISION BY	REVISION NO.

2





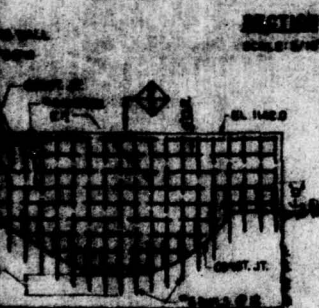
**PLAN - WING WALL - STA. 12+57**



52-158-9

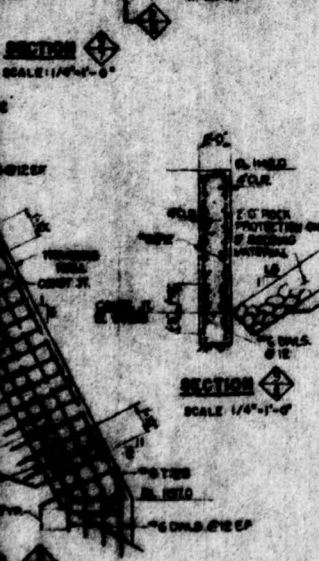
RECEIVED IN THE OFFICE OF THE WATER COMMISSION  
 REGIONAL ENGINEER  
 WATERS OF CALIFORNIA  
 [Signature]

REC'D. FOR  
 SEE REPORT NO. [ ]



GENERAL NOTE:  
 1. FOR ALL CONCRETE WORK, USE 4000 P.S.I.  
 2. FOR OTHER GENERAL NOTES, SEE DRAWING

**PLATE # 7**



REVISED			
NO.	DATE	BY	REVISION
APPROVALS			
DESIGNED BY			
CHECKED BY			
APPROVED BY			
BUREAU OF ENGINEERING AND CONSTRUCTION CREATED BY			
DATE	STATUS	DESK	FILE
PROJECT NO. 66-0405-0			
OUTLET BARRAGE AND WING WALLS - PLAN, SECTION AND ELEVATION			
SOUTH BAY OF CALIFORNIA DAM			
STATE WATER PROJECT NO. 100			
SOUTH BAY OF CALIFORNIA DAM			
GENERAL PLANS SHEET 5 OF 10			
ENGINEERS			
[Signature]			
[Signature]			
[Signature]			
[Signature]			

ALL DIMENSIONS AND SPACING CONDITIONS SHALL BE CHECKED AND VERIFIED BY THE CONTRACTOR AT THE SITE

APPENDIX

F

Site Geology

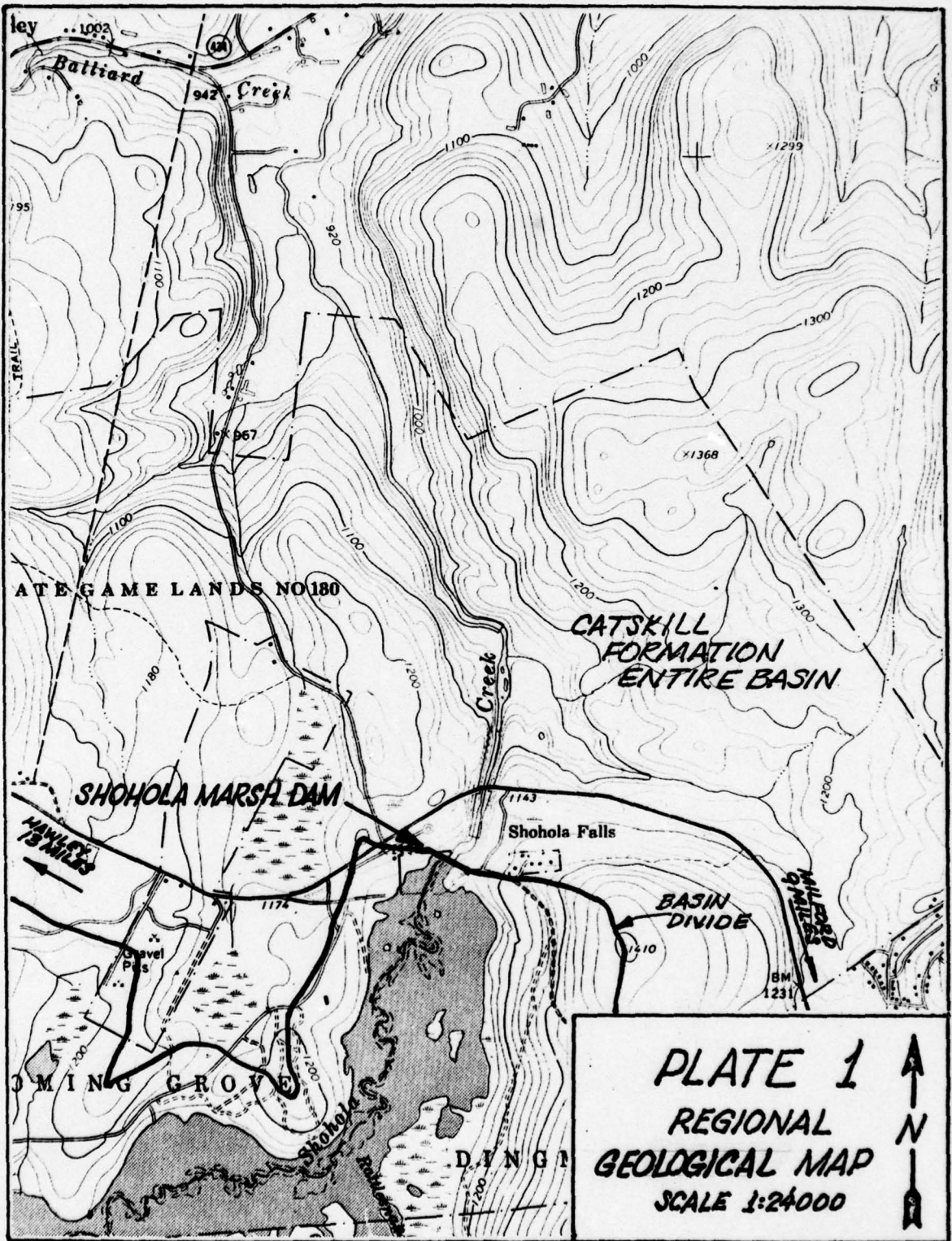
## SITE GEOLOGY

### Shohola Marsh Reservoir

Shohola Dam and Reservoir is located in the Eastern Glaciated section of the Appalachian Plateau physiographic province. The site is underlain by varying thicknesses of Pleistocene glacial debris and till which mantle the Devonian age shales and sandstones. The bedrock units, which form part of the Catskill formation, dip gently to the north at about  $5^{\circ}$  to  $8^{\circ}$ . In local zones crossbedded sandstones dip to nearly  $20^{\circ}$ . These units may represent the southeast limb of the minor fold known as the Shohola syncline.

Bedrock units forming the foundation of the concrete gravity dam are fractured and jointed as described in the logs of exploratory holes made during the design stage. These weaknesses in the foundation were treated by pressure grouting which apparently was successful in reducing seepage beneath the structure.

No faulting or other major structural defects are known to exist in this area of the Appalachian Plateau.



**PLATE 1**  
**REGIONAL**  
**GEOLOGICAL MAP**  
**SCALE 1:24000**

APPENDIX

G

Structural Stability Data

SUBJECT

*Shohola Marsh Dam*

SHEET

BY

DATE

JOB NO

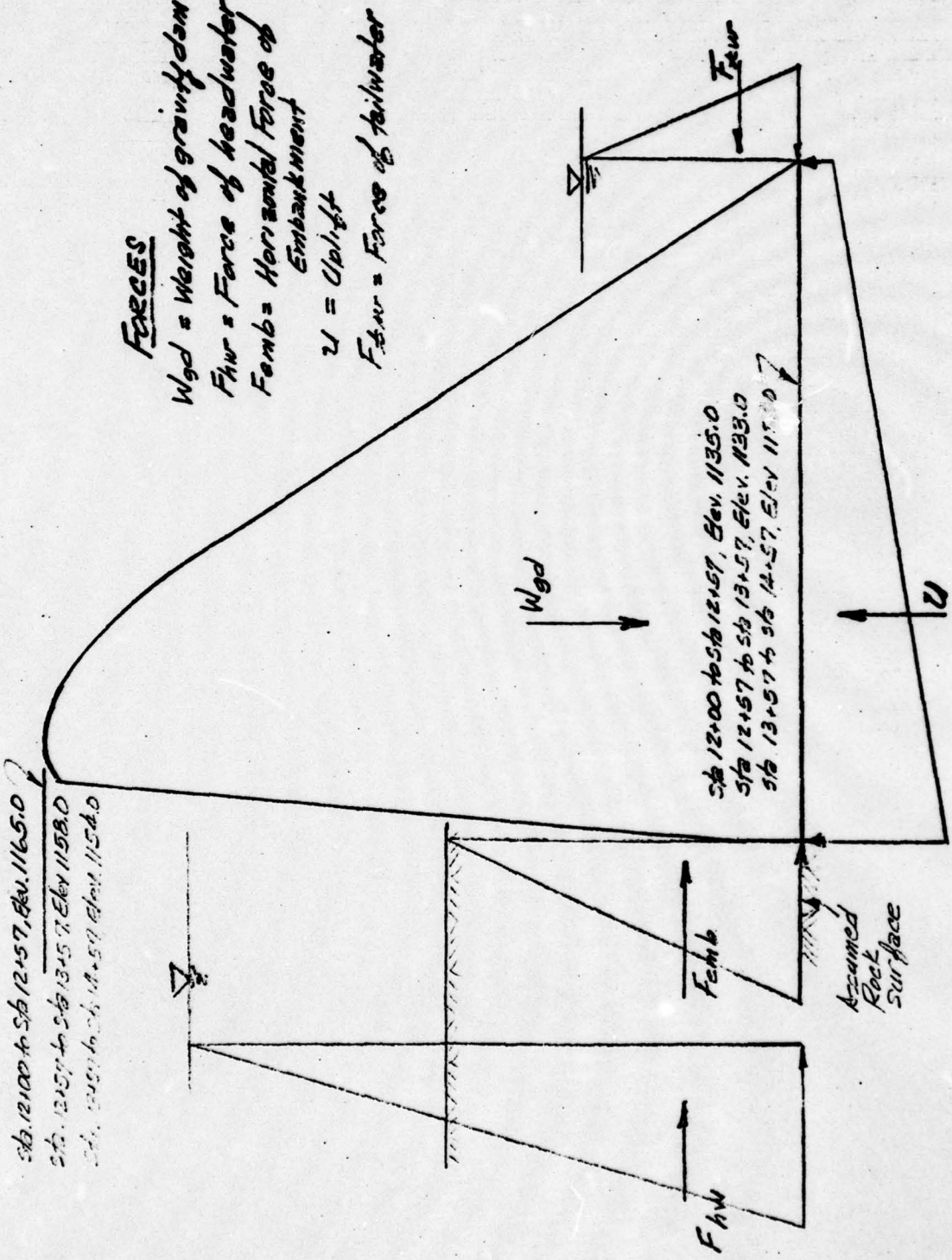
*Table of Contents APPENDIX G*

<i>Generalized Loading Diagram for Structural Stability Analyses of the Dam</i>	<i>Sheet 1</i>
<i>Stability Analyses of Dam, sta. 12+00 to Sta. 12+57</i>	<i>" 2-6</i>
<i>Stability Analyses of Dam, Sta. 12+57 to Sta. 13+57</i>	<i>" 7-11</i>
<i>Stability Analyses of Dam, sta. 13+57 to sta. 14+57</i>	<i>" 12-16</i>

SUBJECT	SHEET	BY	DATE	JOB NO
Shohola Fall Dam	1	JH	3/13/79	

Generalized Loading Diagram for Structural Stability Analyses of the Dam

- FORCES**
- $W_{gd}$  = Weight of gravity dam
  - $F_{hw}$  = Force of headwater
  - $F_{emb}$  = Horizontal Force of Embankment
  - $U$  = Uplift
  - $F_{tw}$  = Force of tailwater



Sh 2

\*\*\*\*\*  
 STA. 12+00 TO 12+57 NON-OVERFLOW SECTION SHOHOLA MARSH DAM  
 NORMAL FLOOD  
 \*\*\*\*\*

PASE ELEVATION= 1135.00FT. TOP ELEVATION= 1165.00FT. BASE WIDTH= 18.50FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATION= 0.0006 (HORIZ), 0.0006 (VERT)  
 SILT ELEVATION= 1150.00FT. SILT DENSITY(SUBMERGED)= 69.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 18.50FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION PERCENT OF HEADWATER  
 .00  
 18.50 67.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	49.01	11.36	556.96	71.26
HEADWATER	11.26	6.33		
TAILWATER	.63	1.50	.95	
UPLIFT	9.98	10.71		106.85
SILT	2.55	5.00		12.74
D/S SOIL (VERT)	7.00	2.50	17.50	
D/S SOIL (HORIZ)	7.00	5.00	35.00	
			610.40	190.85

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 6.18 KIPS  
 NET VERTICAL FORCE= 46.03 KIPS  
 NET MOMENT= 419.55KIP-FEET  
 X-BAR OF FOUNDATION REACTION= 9.11 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= .14 FEET  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 18.04 PSI\*\*\*\*\*HEEL= 16.52 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 3.20  
 SLIDING FACTOR OF SAFETY= 5.21  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .13  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 26.77(SHEAR ACROSS FULL BASE WIDTH)  
 \*\*\*\*\*

SH 3

\*\*\*\*\*  
 STA. 17+00 TO 17+57 NON-OVERFLOW SECTION SHOHOLA MARSH DAM  
 MARCH 1961  
 \*\*\*\*\*

BASE ELEVATION= 1135.00FT. TOP ELEVATION= 1165.00FT. BASE WIDTH= 18.50FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATION= .000G (HORIZ).000G (VERT)  
 SILT ELEVATION= 1150.00FT. SILT DENSITY(SUBMERGED)= 48.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 18.50FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF HEADWATER  
 .00 24.00  
 18.50 67.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	49.01	11.34	556.96	71.26
HEADWATER	11.24	6.33		
TAILWATER	.63	1.50	.95	106.85
UPLIFT	9.98	10.71		12.74
SILT	2.55	5.00		
D/S SOIL (VERT)	7.00	2.50	17.50	137.50
D/S SOIL (HORIZ)	7.00	5.00	35.00	*****
ICE LOAD	5.00	27.50	*****	328.35
			610.40	*****

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 11.18 KIPS  
 NET VERTICAL FORCE= 46.03 KIPS  
 X-BAR OF FOUNDATION REACTION= 6.13 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 3.12 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*TENSION AT HEEL OF DAM\*\*\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 34.78 PSI\*\*\*\*\*HEEL= -.22 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.86  
 SLIDING FACTOR OF SAFETY= 2.89  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .24  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 14.80(SHEAR ACROSS FULL BASE WIDTH)

SA 4

\*\*\*\*\*  
 STA. 12+00 TO 12+57 NON-OVERFLOW SECTION SHOHOLA MARSH DAM  
 TOP OF DAM  
 \*\*\*\*\*

BASE ELEVATION= 1135.00FT. TOP ELEVATION= 1165.00FT. BASE WIDTH= 18.50FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1165.00FT. TAILWATER ELEVATION= 1149.00FT. EARTHQUAKE ACCELERATION= .000G (HORIZ) .000G (VERT)  
 SILT ELEVATION= 1150.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 18.50FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF HEADWATER  
 .00 47.00  
 18.50 67.00

\*\*\*\*\*

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	49.01	11.36	556.96	280.52
HEADWATER	28.08	9.99	28.51	193.28
TAILWATER	6.12	4.66		12.74
UPLIFT	19.74	9.79		
SILT	2.55	5.00	17.50	
D/S SOIL (VERT)	7.00	2.50	35.00	
D/S SOIL (HORIZ)		5.00	637.97	

\*\*\*\*\*

NET HORIZONTAL FORCE= 17.51 KIPS  
 NET VERTICAL FORCE= 36.27 KIPS  
 NET MOMENT= 151.43KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 4.18 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 5.07 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 36.02 PSIF\*\*\*\*\*HEEL= -8.77 PSIF\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.31  
 SLIDING FACTOR OF SAFETY= 1.45  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .48  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 9.06(SHEAR ACROSS FULL BASE WIDTH)

SH 5

\*\*\*\*\*  
 STA. 12+00 TO 12+57 NON-OVERFLOW SECTION SHOHOLA MARSH DAM  
 \*\*\*\*\*

\*\*\*\*\*  
 BASE ELEVATION= 1135.00FT. TOP ELEVATION= 1165.00FT. BASE WIDTH= 18.50FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1168.10FT. TAILWATER ELEVATION= 1152.00FT. EARTHQUAKE ACCELERATION\*\*\*.000G (HORIZ).0000G (VERT)  
 SILT ELEVATION= 1150.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF. SILT FRICTION COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 18.50FT. FRICTION FACTOR= .70  
 \*\*\*\*\*

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2  
 STATION PERCENT OF HEADWATER

.00 51.00  
 18.50 67.00  
 \*\*\*\*\*

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	49.01	11.36	556.96	367.85
HEADWATER	33.88	10.86		
TAILWATER	9.02	5.66	51.04	
UPLIFT	22.54	9.67		217.96
SILT	2.55	5.00		12.74
			608.00	598.55

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 27.41 KIPS  
 NET VERTICAL FORCE= 26.47 KIPS  
 NET MOMENT= 9.45KIP-FEET  
 X-BAR OF FOUNDATION REACTION= .36 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= -8.89 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 38.59 PSI\*\*\*\*\*HEEL= -18.72 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.02  
 SLIDING FACTOR OF SAFETY= .68  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.04  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 5.53(SHEAR -ACROSS FULL-BASE WIDTH)  
 NUMBER OF STATIONS TO DESCRIBE DAM= 4  
 STATION ELEVATION  
 .00 1137.00  
 14.00 1165.00  
 17.00 1165.00  
 18.50 1137.00  
 \*\*\*\*\*

\*STOP\* 0

9h 6

\*\*\*\*\*  
 STA. 12+00 TO 12+57 NON-OVERFLOW SECTION SHOHOLA MARSH DAM  
 172 FT  
 \*\*\*\*\*

BASE ELEVATION= 1135.00FT, TOP ELEVATION= 1165.00FT, BASE WIDTH= 18.50FT, DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1162.00FT, TAILWATER ELEVATION= 1149.00FT, EARTHQUAKE ACCELERATION= .0006 (HORIZ), .0006 (VERT)  
 SILT ELEVATION= 1150.00FT, SILT DENSITY(SUBMERGED)= 68.00PCF, SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI, SHEAR WIDTH= 13.50FT, FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION  
 PERCENT OF  
 HEADWATER  
 .00 47.00  
 18.50 67.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	49.01	11.32	556.56	204.50
HEADWATER	22.74	8.99		
TAILWATER	6.12	4.66	20.51	173.75
UPLIFT	17.77	9.72		12.74
SILT	2.55	5.00		
D/S SOIL (VERT)	7.00	2.50	17.50	
D/S SOIL (HORIZ)	7.00	5.00	33.00	
			637.97	391.18

NET HORIZONTAL FORCE= 12.18 KIPS  
 NET VERTICAL FORCE= 38.24 KIPS  
 NET MOMENT= 246.78KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 6.45-Feet  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 2.80 FEET  
 FOUNDATION REACTION PRESSURES= 27.33 PSI  
 OVERTURNING FACTOR OF SAFETY= 1.63  
 SLIDING FACTOR OF SAFETY= 2.20  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .32  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 13.14(SHEAR ACROSS FULL BASE WIDTH)  
 NUMBER OF STATIONS TO DESCRIBE DAM= 4

STATION  
 ELEVATION  
 .00 1137.00  
 14.00 1165.00  
 17.00 1165.00  
 18.50 1137.00

Sh 1

\*\*\*\*\*  
 STA. 12+57 TO 13+57 LOWER EMERGENCY SPILLWAY - SHOHOLA MARSH DAM  
 \*\*\*\*\*

\*\*\*\*\*  
 NORMAL FLOW  
 \*\*\*\*\*

BASE ELEVATION= 1133.00FT. TOP ELEVATION= 1158.00FT. BASE WIDTH= 23.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATION= .0006 (HORIZ) .0006 (VERT)  
 SILT ELEVATION= 1145.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 23.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF  
 HEADWATER

.00  
 23.00  
 31.00  
 67.00

\*\*\*\*\*

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	48.83	13.71	669.22	96.22
HEADWATER	13.74	6.99		
TAILWATER	1.32	2.16	2.85	
UPLIFT	14.77	12.91		190.63
SILT	1.63	4.00		6.52
			672.07	293.37

\*\*\*\*\*

NET HORIZONTAL FORCE= 14.07 KIPS  
 NET VERTICAL FORCE= 34.06 KIPS  
 NET MOMENT= 378.70KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 11.12 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= .38 FEET  
 FOUNDATION REACTION PRESSURES= 11.31 PSI/HEEL= 9.26 PSI/TOE= 11.31 PSI/HEEL= 9.26 PSI/TOE  
 OVERTURNING FACTOR OF SAFETY= 2.29  
 SLIDING FACTOR OF SAFETY= 1.69  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .41  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 13.46(SHEAR ACROSS FULL BASE WIDTH)

sh 8

\*\*\*\*\* STA. 12+57 TO 13+57 LOWER EMERGENCY SPILLWAY - SHOHOLA MARSH DAM \*\*\*\*\*

MURRAY TULL AND ICE LIAISON

\*\*\*\*\*  
BASE ELEVATION= 1133.00FT. TOP ELEVATION= 1158.00FT. BASE WIDTH= 23.00FT. DENSITY= 145.00PCF  
HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATIONS\*\*0.000G (HORIZ) .000G (VERT)  
SILT ELEVATION= 1145.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
SHEAR STRESS= 50.00PSI SHEAR WIDTH= 23.00FT. FRICTION FACTOR= .70  
\*\*\*\*\*

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF HEADWATER

.00 31.00  
23.00 67.00

LOADING FORCE(KIPS) ARM(FEET) STABILIZING MOMENT OVERTURNING MOMENT  
WEIGHT OF DAM 48.83 13.71 669.22 96.22  
HEADWATER 13.76 6.99  
TAILWATER 1.32 2.16  
UPLIFT 14.77 12.91 2.85  
SILT 1.63 4.00 190.63  
ICE LOAD 5.00 20.50 102.50

\*\*\*\*\*  
NET HORIZONTAL FORCE= 19.07 KIPS  
NET VERTICAL FORCE= 34.06 KIPS  
NET MOMENT= 276.20KIP-Feet  
X-BAR OF FOUNDATION REACTION= 8.11 FEET  
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 3.39 FEET  
FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 19.38 PSI\*\*\*\*\*HEEL= 1.19 PSI\*\*\*\*\*  
OVERTURNING FACTOR OF SAFETY= 1.70  
SLIDING FACTOR OF SAFETY= 1.25  
DEVELOPED FRICTION FACTOR (NO SHEAR)= .56  
SLIDING WITH SHEAR FACTOR OF SAFETY= 9.93(SHEAR ACROSS FULL BASE WIDTH)  
\*\*\*\*\*

549

\*\*\*\*\*  
 SIA. 12+57 TO 13+57 LOWER EMERGENCY SPILLWAY - SHOHOLA MARSH DAM  
 \*\*\*\*\*  
 TOP OF DAM  
 \*\*\*\*\*

BASE ELEVATION= 1133.00FT. TOP ELEVATION= 1156.00FT. BASE WIDTH= 23.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1145.00FT. TAILWATER ELEVATION= 1149.00FT. EARTHQUAKE ACCELERATION= .0006 (HORIZ) .0006 (VERT)  
 SILT ELEVATION= 1145.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 23.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCIBE UPLIFT= 2

PERCENT OF HEADWATER  
 .00  
 23.00  
 67.00

LOADING	FORCE(KIPS)	ARM(Feet)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	48.83	13.71	669.22	299.00
HEADWATER	30.42	9.83	42.56	323.93
TAILWATER	7.99	12.06		6.52
UPLIFT	26.87	4.00		*****
SILT	1.63		711.77	629.45

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 24.06 KIPS  
 NET VERTICAL FORCE= 21.96 KIPS  
 NET MOMENT= 82.32KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 3.75 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 7.75 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*TENSION AT HEEL OF DAM\*\*\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 20.04 PSI\*\*\*\*\*HEEL= -6.78 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.13  
 SLIDING FACTOR OF SAFETY= .64  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.10  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 7.52(SHEAR ACROSS FULL BASE WIDTH)

SH 10

\*\*\*\*\*  
 STA. 12+57 TO 13+57 LOWER EMERGENCY SPILLWAY - SHOHOLA MARSH DAM  
 DURABLE PAVIUM FLOOD  
 \*\*\*\*\*

BASE ELEVATION= 1133.00FT. TOP ELEVATION= 1158.00FT. BASE WIDTH= 23.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1168.10FT. TAILWATER ELEVATION= 1152.00FT. EARTHQUAKE ACCELERATION\*\*\*.000G (VERT)  
 SILT ELEVATION= 1145.00FT. SILT DENSITY(SUBMERGED)= 68.00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 23.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2  
 PERCENT OF HEADWATER  
 .00 54.00  
 23.00 67.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	48.83	13.71	669.22	359.45
HEADWATER	35.26	10.20		
TAILWATER	11.26	6.33	71.26	363.04
UPLIFT	30.48	11.91		6.52
SILT	1.63	4.00		729.01

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 25.62 KIPS  
 NET VERTICAL FORCE= 18.35 KIPS  
 NET MOMENT= 11.46KIP-Feet  
 X-BAR OF FOUNDATION REACTION= .62 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 10.88 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*TENSION AT HEEL OF DAM\*\*\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*HEEL= 21.26 PSI\*\*\*\*\*HEEL= 10.18 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.02  
 SLIDING FACTOR OF SAFETY= .50  
 DEVELOPED FRICTION FACTOR (NO-SHEAR)= 1.40  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 6.96(SHEAR ACROSS FULL BASE WIDTH)  
 STATIONS OF Ogee PORTION OF SECTION ARE 12.75 AND 19.50  
 EQUATION OF Ogee CURVATURE IS Y= .16239\*\*\*1.85  
 NUMBER OF STATIONS TO DESCRIBE DAM= 5  
 STATION ELEVATION  
 .00 1133.00  
 12.75 1152.32  
 19.50 1158.00  
 20.50 1157.56  
 23.00 1135.00

SH 11

\*\*\*\*\*  
 STA. 12457 TO 13457 LOWER EMERGENCY SPILLWAY - SHOHOLA HAKSHI DAM  
 \*\*\*\*\*

\*\*\*\*\*  
 17.17 M  
 \*\*\*\*\*

RAGE ELEVATION= 1133.00FT. TOP ELEVATION= 1159.00FT. BASE WIDTH= 23.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1163.65FT. TAILWATER ELEVATION= 1147.00FT. EARTHQUAKE ACCELERATION= .000G (HORIZ) .000G (VERT)  
 SILT ELEVATION= 1145.00FT. SILT DENSITY(SUBMERGED)= 69.00PCF SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 23.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION PERCENT OF HEADWATER  
 .00 50.00  
 23.00 67.00  
 \*\*\*\*\*

\*\*\*\*\*

LOADING	FORCE (KIPS)	ARM (FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	48.83	13.71	669.22	272.67
HEADWATER	28.31	9.63		
TAILWATER	7.99	5.33	42.56	310.27
UPLIFT	25.73	12.06		6.52
SILT	1.63	4.00	*****	*****
			711.77	587.46

\*\*\*\*\*

NET HORIZONTAL FORCE= 21.96 KIPS  
 NET VERTICAL FORCE= 23.09 KIPS  
 NET MOMENT= 122.11 KIP-Feet  
 X-DIR OF FOUNDATION REACTION= 5.30 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 6.20 FEET  
 \*\*\*\*\* FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE \*\*\*\*\*  
 FOUNDATION REACTION PRESSURE= \*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.21  
 SLIDING FACTOR OF SAFETY= .74  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .95  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 8.28 (SHEAR ACROSS FULL BASE WIDTH)

SH 12

\*\*\*\*\*  
 SIA. 13457 TO 14157 SERVICE SPILLWAY SHOHOLA MARSH DAM  
 NORMAL POOL  
 \*\*\*\*\*

BASE ELEVATION= 1131.00FT. TOP ELEVATION= 1154.00FT. BASE WIDTH= 24.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATION= .000G (HORIZ), .000G (VERT)  
 SILT ELEVATION= .00FT. SILT DENSITY (SUBMERGED)= .00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 24.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION PERCENT OF HEADWATER  
 .00 37.00  
 24.00 67.00

\*\*\*\*\*

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	52.58	13.88	729.90	126.41
HEADWATER	16.50	7.66		
TAILWATER	2.25	2.83	6.38	235.60
UPLIFT	17.91	13.15	***	362.01
			736.28	

\*\*\*\*\*

NET HORIZONTAL FORCE= 14.25 KIPS  
 NET VERTICAL FORCE= 34.66 KIPS  
 NET MOMENT= 374.27KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 10.80 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 1.20 FEET  
 FOUNDATION REACTION PRESSURES= 13.05 PSI SHEEL= 7.01 PSI  
 OVERTURNING FACTOR OF SAFETY= 2.03  
 SLIDING FACTOR OF SAFETY= 1.70  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .41  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 13.63(SHEAR ACROSS FULL BASE WIDTH)

Sh 13

\*\*\*\*\*  
SIA. 13457 TO 14457 SERVICE SPILLWAY SHOMOLA MARSH DAM  
MURMAN FLOOD GATE ICE WALL  
\*\*\*\*\*

BASE ELEVATION= 1131.00FT. TOP ELEVATION= 1154.00FT. BASE WIDTH= 24.00FT. DENSITY= 145.00PCF  
HEADWATER ELEVATION= 1154.00FT. TAILWATER ELEVATION= 1139.50FT. EARTHQUAKE ACCELERATION= .0006 (HORIZ), .0006 (VERT)  
SILT ELEVATION= .00FT. SILT DENSITY (SUBMERGED)= .00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
SHEAR STRESS= 50.00PSI SHEAR WIDTH= 24.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2  
STATION PERCENT OF HEADWATER

.00 37.00  
24.00 67.00

LOADING  
WEIGHT OF DAM  
HEADWATER  
TAILWATER  
UPLIFT  
ICE LOAD

52.58  
16.50  
2.25  
17.91  
5.00

ARM( FEET)

13.88  
7.66  
2.83  
13.15  
22.50

FORCE(KIPS)

729.90  
6.38  
\*\*\*\*\*  
736.28

STABILIZING  
MOMENT

126.41  
235.60  
112.50  
\*\*\*\*\*  
474.51

OVERTURNING  
MOMENT

\*\*\*\*\*  
NET HORIZONTAL FORCE= 19.25 KIPS  
NET VERTICAL FORCE= 34.66 KIPS  
NET MOMENT= 261.77KIP- FEET  
X-BAR OF FOUNDATION REACTION= 7.55 FEET  
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 4.45 FEET  
\*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*TENSION AT HEEL OF DAM\*\*\*\*\*  
FOUNDATION REACTION PRESSURES\*\*\*\*\*TOL= 21.14 PSIS\*\*\*\*\*HEEL= -1.13 PSIS\*\*\*\*\*  
OVERTURNING FACTOR OF SAFETY= 1.55  
SLIDING FACTOR OF SAFETY= 1.26  
DEVELOPED FRICTION FACTOR (NO SHEAR)= .54  
SLIDING WITH SHEAR FACTOR OF SAFETY= 10.24(SHEAR ACROSS FULL BASE WIDTH)  
\*\*\*\*\*

Sh 14

\*\*\*\*\*  
SIA. 13457 TO 14457 SEFWICF SPILLWAY SHOHOLA MARSH DAM  
TOP OF DAM

\*\*\*\*\*

BASE ELEVATION= 1131.00FT. TOP ELEVATION= 1154.00FT. BASE WIDTH= 24.00FT. DENSITY= 145.00PCF  
HEADWATER ELEVATION= 1165.00FT. TAILWATER ELEVATION= 1149.00FT. EARTHQUAKE ACCELERATION= 0.000G (HORIZ). 0.000G (VERT)  
SILT ELEVATION= .00FT. SILT DENSITY(SUBMERGED)= .00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
SHEAR STRESS= 50.00PSI. SHEAR WIDTH= 24.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF  
HEADWATER  
24.00  
.00  
53.00  
67.00

\*\*\*\*\*

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	52.58	13.88	729.90	308.09
HEADWATER	32.29	9.54		
TAILWATER	10.11	5.99	60.59	380.87
UPLIFT	30.55	12.47		688.96
			790.49	

\*\*\*\*\*

NET HORIZONTAL FORCE= 22.18 KIPS  
NET VERTICAL FORCE= 22.03 KIPS  
NET MOMENT= 101.53 KIP-Feet  
X-BAR OF FOUNDATION REACTION= 4.61 FEET  
ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 7.39 FEET  
\*\*\*\*\* FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE \*\*\*\*\* TENSION AT HEEL OF DAM \*\*\*\*\*  
FOUNDATION REACTION PRESSURES \*\*\*\*\* TOE= 18.15 PSI \*\*\*\*\* HEEL= -5.40 PSI \*\*\*\*\*  
OVERTURNING FACTOR OF SAFETY= 1.15  
SLIDING FACTOR OF SAFETY= .70  
DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.01  
SLIDING WITH SHEAR FACTOR OF SAFETY= 8.48 (SHEAR ACROSS FULL BASE WIDTH)

SH 15

\*\*\*\*\*  
 STA. 13+57 TO 14+57 SERVICE SPILLWAY, SHIMOLA MARSH DAM  
 KONGALE MAXIMUM FLOOD  
 \*\*\*\*\*

BASE ELEVATION= 1131.00FT. TOP ELEVATION= 1124.00FT. BASE WIDTH= 24.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1148.10FT. TAILWATER ELEVATION= 1152.00FT. EARTHQUAKE ACCELERATION= .0006 (HORIZ), .0006 (VERT)  
 SILT ELEVATION= .00FT. SILT DENSITY(SUBMERGED)= .00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00PSI SHEAR WIDTH= 24.00FT. FRICTION FACTOR= .70

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

PERCENT OF  
 HEADWATER  
 .00  
 24.00  
 57.00

LOADING	FORCE(KIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	52.58	13.88	729.90	359.26
HEADWATER	36.74	9.78		
TAILWATER	13.76	6.99	96.22	424.49
UPLIFT	34.45	12.32	*****	*****
			826.12	783.74

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 22.98 KIPS  
 NET VERTICAL FORCE= 18.13 KIPS  
 NET MOMENT= 42.37KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 2.34 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 9.66 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*TENSION AT HEEL OF DAM\*\*\*  
 FOUNDATION REACTION PRESSURES\*\*\*\*\*TOE= 17.92 PSI\*\*\*\*\*HEEL= -7.43 PSI\*\*\*\*\*  
 OVERTURNING FACTOR OF SAFETY= 1.05  
 SLIDING FACTOR OF SAFETY= .55  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= 1.27  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 8.07(SHEAR ACROSS FULL BASE WIDTH)  
 STATIONS OF Ogee PORTION OF SECTION ARE 8.00 AND 20.28  
 EQUATION OF Ogee CURVATURE IS  $y = .09864x^2 + 1.85$   
 NUMBER OF STATIONS TO DESCRIBE DAM= 5  
 ELEVATION  
 .00 1131.00  
 8.00 1143.49  
 20.28 1154.00  
 22.13 1153.15  
 24.30 1138.00  
 \*\*\*\*\*  
 \*STOP\* 0

D

Sh 16

\*\*\*\*\*  
 STA. 13+57 TO 14+77 SERVICE SPILLWAY BRIDGE OVER DAM  
 172 FPM  
 \*\*\*\*\*

\*\*\*\*\*  
 BASE ELEVATION= 1131.00FT. TOP ELEVATION= 1154.00FT. BASE WIDTH= 24.00FT. DENSITY= 145.00PCF  
 HEADWATER ELEVATION= 1163.65FT. TAILWATER ELEVATION= 1147.00FT. EARTHQUAKE ACCELERATION= 0.000G (HORIZ), 0.000G (VERT)  
 SILT ELEVATION= .00FT. SILT DENSITY(SUBMERGED)= .00PCF. SILT PRESSURE COEFFICIENT(K)= .33  
 SHEAR STRESS= 50.00FSI. SHEAR WIDTH= 24.00FT. FRICTION FACTOR= .70  
 \*\*\*\*\*

NUMBER OF STATIONS TO DESCRIBE UPLIFT= 2

STATION PERCENT OF HEADWATER  
 .00 53.00  
 24.00 67.00  
 \*\*\*\*\*

LOADING	FORCE(NIPS)	ARM(FEET)	STABILIZING MOMENT	OVERTURNING MOMENT
WEIGHT OF DAM	52.58	13.08	729.50	285.81
HEADWATER	30.35	9.42		
TAILWATER	10.11	5.79	60.59	345.75
UPLIFT	29.34	12.47	*****	*****
			790.49	651.55

\*\*\*\*\*  
 NET HORIZONTAL FORCE= 20.25 NIPS  
 NET VERTICAL FORCE= 23.24 NIPS  
 NET MOMENT= 136.94KIP-Feet  
 X-BAR OF FOUNDATION REACTION= 5.93 FEET  
 ECCENTRICITY OF FOUNDATION REACTION FROM CENTER= 4.02 FEET  
 \*\*\*\*\*FOUNDATION REACTION NOT IN CENTRAL THIRD OF BASE\*\*\*\*\*  
 FOUNDATION REACTION PRESSURE\*\*\*\*\*  
 SLIDING FACTOR OF SAFETY= 1.21  
 DEVELOPED FRICTION FACTOR (NO SHEAR)= .87  
 SLIDING WITH SHEAR FACTOR OF SAFETY= 9.34(SHEAR ACROSS FULL BASE WIDTH)  
 STATIONS OF Ogee PORTION OF SECTION ARE 8.00 AND 20.20  
 EQUATION OF Ogee CURVATURE IS Y= .09864X<sup>2</sup>+1.05  
 NUMBER OF STATIONS TO DESCRIBE DAM= 5  
 STATION ELEVATION  
 .00 1131.00  
 8.00 1143.69  
 20.20 1154.00  
 22.13 1153.15  
 24.30 1138.00  
 \*\*\*\*\*

\*STOP\* 0