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NATIONAL DAM INSPECTION PROGRAM. SHANGRI-LA DAM (NDI-PA-00248, --ETC(U)
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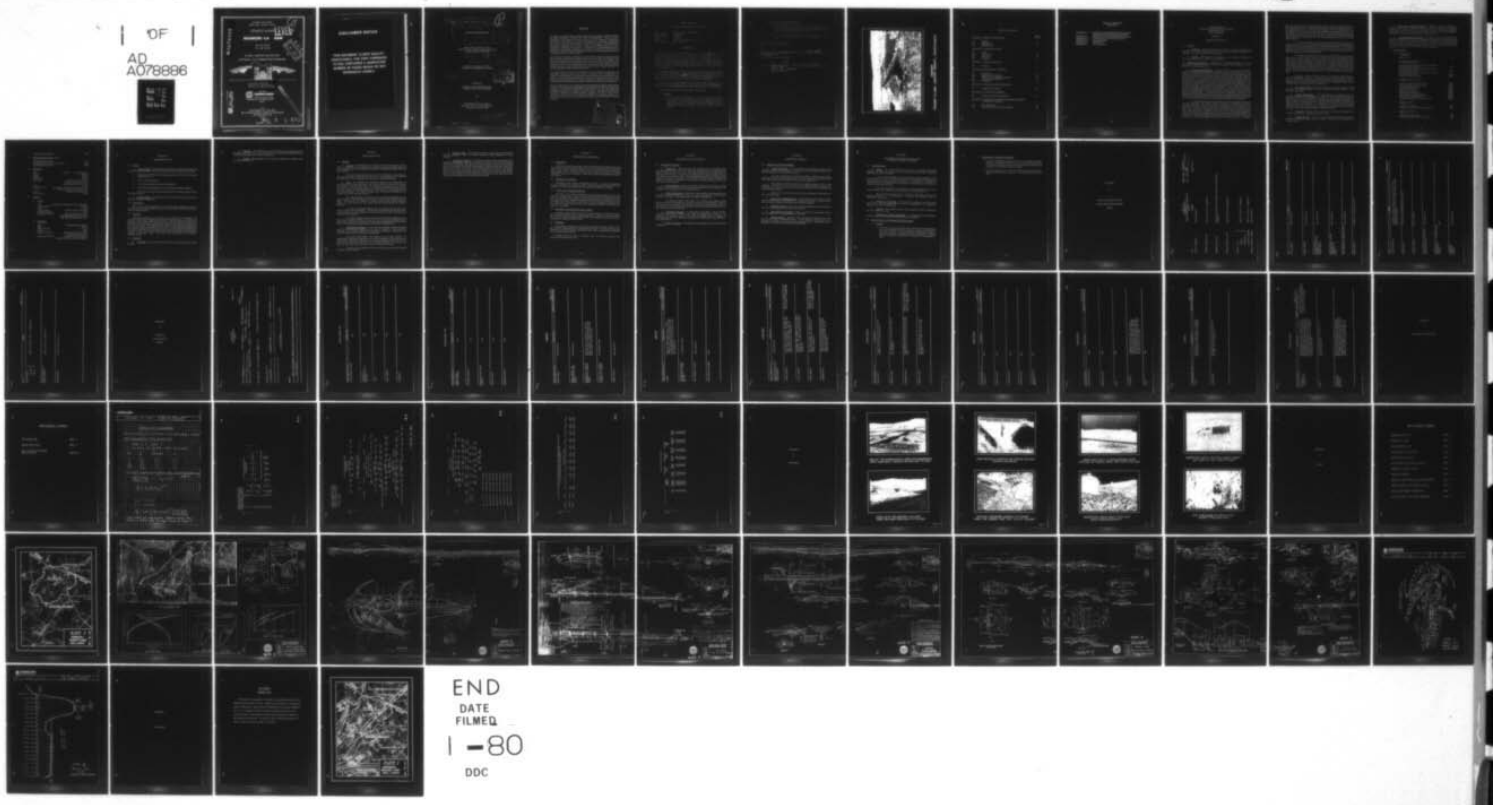

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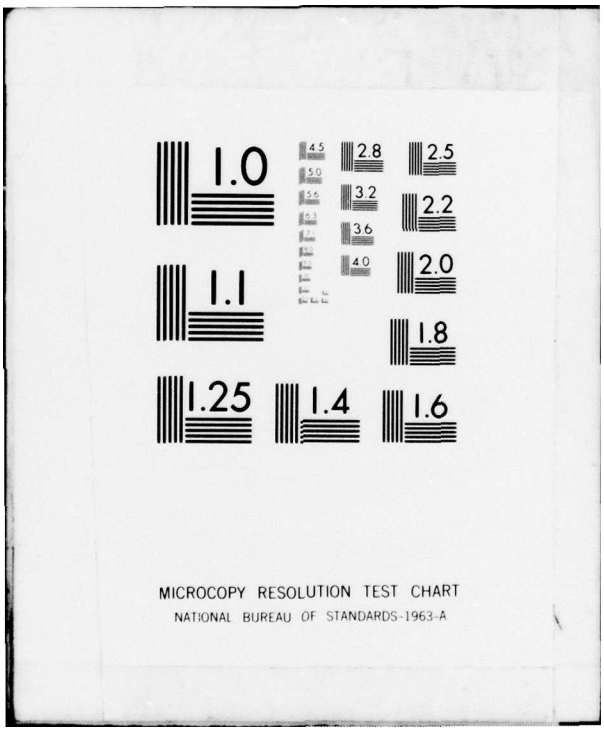
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DELAWARE RIVER BASIN
BROAD RUN, CHESTER COUNTY

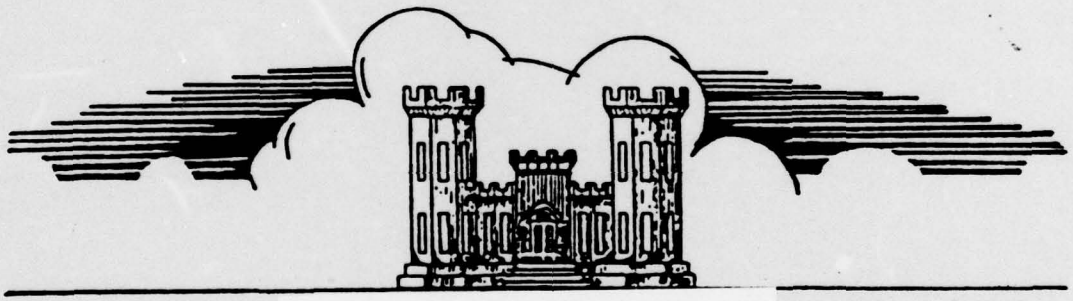
PENNSYLVANIA

LEVEL II

SHANGRI-LA DAM

NDI-PA 00248
PA DER 15-295

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared By
O'BRIEN & GERE
Justin & Courtney Division
PHILADELPHIA, PENNSYLVANIA
19103

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

AUGUST 1979

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(6) National Dam Inspection Program. Shangri-La Dam (NDI-PA-00248, PA DER 15-295), DELAWARE RIVER BASIN, Broad Run, Chester County, Pennsylvania. Phase I Inspection Report,

Name of Dam: Shangri-La Dam
County & State: Chester County, Pennsylvania
Inventory Number: PA00248

(10) John J. Williams

(11) Aug 79

(12) 71

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

(15) DACW31-79-C-0010

Prepared by:

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

For

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

410760

JCB

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:	Shangri-La Dam ID #PA00248
State Located:	Pennsylvania
County Located:	Chester
Stream:	Broad Run
Coordinates:	Latitude 39° 47.0', Longitude 75° 44.4'
Date of Inspection:	June 12, 1979

ASSESSMENT

Shangri-La Dam is a homogeneous, impervious, earth embankment with a downstream layer of random fill. The dam is approximately 800 feet long with a maximum height of 32 feet and is provided with a vertical sand drain in the downstream section. The level of the reservoir is controlled by means of a rectangular, reinforced concrete, drop inlet spillway (service spillway) located near the right abutment (looking downstream). A 150-foot wide, grass covered spillway (emergency spillway) provides additional discharge capacity and is also located in the right abutment area. The dam was constructed to impound a reservoir for recreational purposes.

Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway system (service and emergency spillway) is capable of passing the entire Probable Maximum Flood (PMF) without the dam being overtopped. The selected Spillway Design Flood ~~(SDF)~~ for this "Small" size, "High" hazard structure is the PMF. Therefore, the spillway system is classified as "Adequate".

Based on visual observations, discussions with the Owner's representative, and review of the information obtained from the Pennsylvania Department of Environmental Resources ~~(DER)~~, Shangri-La Dam appears to be in good condition.

Recommendations and Remedial Measures are as follows:

a. Facilities.

1. The trees, brush, and weeds that have overgrown the embankment and downstream area should be removed to permit more detailed inspection of the dam. If any distress such as sloughing, cracking or seepage is observed, the condition should be evaluated by a licensed professional engineer experienced in the design and construction of dams.

b. Operation and Maintenance Procedures.

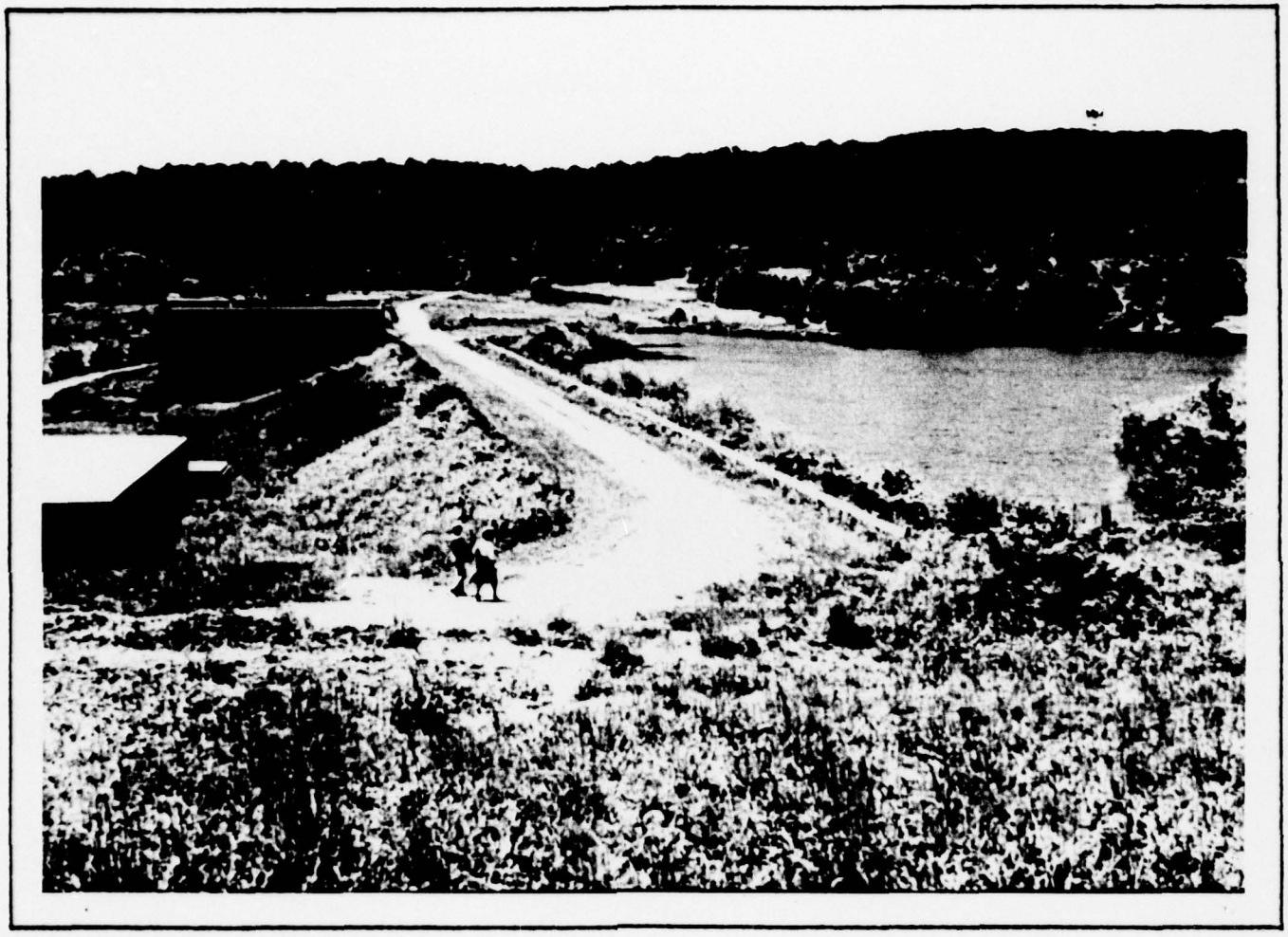
1. A regular maintenance program should be developed and implemented. This program should include, but not be limited to, cutting of the brush and weeds on a regular basis and periodic inspection and operation of the reservoir drain sluice gates.

2. A formal warning system should be established within the downstream building to notify occupants of any impending peril to the dam.

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

John K. Williams Date: 5 Sept. 1979
John J. Williams, P.E.
Vice President
Pennsylvania Registration PE006920E

Approved by: James W. Peck Date: 19 Sep 1979
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



OVERVIEW
SHANGRI LA DAM, CHESTER COUNTY, PENNSYLVANIA

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(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
SHANGRI-LA DAM
NDI ID #PA00248

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 determine if Shangri-La Dam constitutes a hazard to human life or property.

1.2 Description of Project (Based upon information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania)

a. Dam and Appurtenances. Shangri-La Dam is an earth embankment approximately 800 feet in length with a maximum height of about 32 feet. The dam impounds a reservoir with a surface area of 25.5 acres and a storage capacity of 208 acre-feet at normal pool. The crest of the dam is 25 feet wide. The side slopes are 2.5 horizontal to 1 vertical (2.5H:1V) from the dam crest (Elevation 272.0) to Elevation 262.0. At this elevation the upstream slope continues at 3.5H:1V and the downstream slopes grades to the toe at 3H:1V (see Plate 5 in Appendix E). The embankment is composed of a homogeneous impervious fill with a downstream shell of random backfill. The upstream slope is protected by a 12-inch thick layer of dumped riprap placed on a 6-inch thick sand blanket. A key trench of impervious material, symmetrical about the dam axis, extends a maximum of 10 feet below the base of the embankment. The key trench has a maximum bottom width of 11 feet and side slopes of 1H:1V. An 18-inch thick vertical sand drain is located 27 feet downstream of the dam axis and extends a distance of 660 feet between abutments. The drain contains a 6-inch diameter perforated corrugated metal pipe (CMP) which drains into a CMP outlet buried in a horizontal filter blanket in the streambed.

A service spillway and an emergency spillway are provided in the area of the right abutment. The service spillway consists of a rectangular, reinforced concrete, drop inlet structure (see Plate 7 in Appendix E). The upstream crest length at Elev. 265.9 is 25.3 feet long and the combined length of the side weirs at Elev. 266.0 is 56 feet. The interior walls of the inlet structure have a slope of 1H:1V and drop from the spillway crest to Elev. 256.6. The concrete trapezoidal section is maintained at a 2 percent slope for a distance of 56 feet downstream. At this point the spillway discharge channel descends on a slope of 1H:1V and directs discharge into a concrete stilling basin with a floor elevation of 247.0. The stilling

basin contains chute blocks, baffles, and an end sill. The entire concrete section of the discharge channel is provided with a sand and perforated pipe underdrain system. The trapezoidal section is maintained downstream of the stilling basin and is riprapped for about 110 feet. At this point the discharge channel turns to the left and follows the stream valley side slope where three riprapped drop structures containing concrete overflow weirs have been constructed at 100-foot intervals. Approximately 450 feet beyond the turn, the discharge channel joins the original stream channel.

The emergency spillway is a trapezoidal earth channel also located in the right abutment area. The service spillway is located within the emergency spillway channel and both spillways lead into the same discharge channel. The emergency spillway channel is 150 feet wide with side slopes of 2H:1V on the cut near the embankment and 3H:1V on the abutment slope. The channel extends approximately 200 feet upstream and 350 feet downstream.

The outlet works consist of an 18-inch diameter reinforced concrete pipe placed on a concrete cradle. The pipe is provided with reinforced concrete anti-seep collars at 24-foot intervals and discharges flow into a reinforced concrete impact basin energy dissipator. The outlet pipe is provided with an upper and a lower intake structure (see Plate 4 in Appendix E). A vertical 6-inch diameter steel pipe, equipped with an 8-inch diameter sluice gate at Elevation 250.0, is connected to the outlet pipe approximately 20 feet from the upstream toe to form the upper intake. The lower intake consists of a 24-inch diameter flap gate on the upstream end of the 18-inch diameter outlet pipe with an invert elevation of approximately 242.

b. Location. Shangri-La Dam is located on Broad Run, approximately 4 miles southeast of Avondale, PA. The dam lies within Garden Township in Chester County. The dam site is shown on the USGS Quadrangle entitled "Kennett Square, Pennsylvania" at coordinates N 39° 47.0', W 75° 44.4'. A regional location plan of Shangri-La Dam is enclosed as Plate 1, Appendix E.

c. Size Classification. Based on the maximum storage capacity of 398 acre-feet and maximum height of 32 feet, Shangri-La Dam is classified in the "Small" size category.

d. Hazard Classification. A 3-story structure is constructed into the downstream portion of the embankment. The third floor of the building may be entered from the crest of the dam. Although it is not currently occupied on a regular basis, community activities are occasionally held within the building and daily occupancy is scheduled for the future. Another structure which is only partially completed is located at the downstream toe near the left abutment. Therefore, a dam failure could result in loss of lives and extensive property damage. Shangri-La Dam is therefore considered a "High" hazard dam.

e. Ownership. Shangri-La Dam is owned by Mrs. Eleanor Reynolds, Green Valley Farms, R.D. #1, Avondale, Pennsylvania 19311.

f. Purpose of Dam. The dam was originally constructed to impound a reservoir for recreation and irrigation purposes. Presently, the reservoir serves neither purpose.

g. Design and Construction History. Shangri-La Dam was designed by Gideon Yachin of GEO - Technical Services, Consulting Engineers & Geologists, Harrisburg, PA. Construction of the dam began in July of 1966 and was completed in October of 1969. The construction work was carried out by Dominic DiFilippo of Green Valley Farms under the supervision of Gideon Yachin.

h. Normal Operating Procedures. The reservoir surface is normally maintained at Elevation 266.0 (the service spillway crest elevation for the side weirs). According to the design drawings, withdrawal and releases from the reservoir would be done through the upper intake by operating the 8-inch diameter slide gate. Complete reservoir drawdown within 72 hours can be accomplished through the lower intake by operation of the 24-inch diameter flap gate.

1.3 Pertinent Data

a. Drainage Area.

Square Miles	1.3

b. Discharge at Dam Site. (cfs)

Service Spillway (reservoir surface at emergency spillway crest, Elev. 267.6)	500
Service Spillway Capacity (reservoir surface at top of dam, Elev. 272.0)	1,650
Emergency Spillway Capacity (reservoir surface at top of dam Elev. 272.0)	3,750
Combined Spillway Capacity	5,400

c. Elevation. (feet above MSL)

Service Spillway Crest (front wall)	265.9
Service Spillway Crest (side walls)	266.0
Emergency Spillway Crest	267.6
Top of Dam (Design)	272.0
Top of Dam (low point)	271.96
Outlet Works Upper Intake	250.0+
Outlet Works Lower Intake Invert	242.0±
Outlet Pipe Invert (outlet end)	240.5±
Streambed Elevation at Downstream Toe	240.0±

d. Reservoir. (miles)

Length of Normal Pool	0.44
Length of Maximum Non-Overtopping Pool	0.51

e. Storage. (acre-feet)

Normal Pool, Elev. 266.0	208
Emergency Spillway Crest, Elev. 267.6	248

Top of Dam, Elev. 272.0	398

f. Reservoir Surface Area. (acres)

Normal Pool, Elev. 266.0	25.5
Emergency Spillway Crest, Elev. 267.6	28.5
Top of Dam, Elev. 272.0	41.0

g. Dam Data.

Type	Compacted Earth Embankment
Length	800 feet
Height	32 feet
Crest Width	25 feet
Side Slopes	2.5H:1V above Elev. 262.0; 3.5H:1V upstream and 3H:1V downstream below Elev. 262.0
Zoning	None
Impervious Core	Homogeneous, impervious embankment with thin downstream shell of random fill.
Cutoff	Impervious Cutoff Trench
Grout Curtain	None

h. Spillways.

1) Service

Type	Rectangular, reinforced concrete drop inlet.
Length of Weir	81.3 feet
Gates	None
Crest Elevation	Upstream 265.9; Sides 266.0
Upstream Channel	None
Downstream Channel	450-foot long channel with 3 riprapped drop structures at 100-foot intervals (See Section 1.2.a).

2) Emergency

Type	Trapezoidal Earth Channel
Width	150 feet
Crest Elevation	267.6
Gates	None
Upstream Channel	200-foot long curved channel graded into the reservoir.
Downstream Channel	350-foot long curved channel graded toward the original streambed.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The information available in the DER main office files in Harrisburg, Pennsylvania, for review of Shangri-La Dam includes the following:

1. "Application", "Report Upon the Application", and "Permit" to construct Shangri-La Dam.

2. Set of 12 design drawings.

3. Construction progress reports and photographs.

4. Miscellaneous correspondence, memoranda, and inspection reports.

Piezometric records were also obtained from Mr. Gideon Yachin of GEO-Technical Services.

b. Design Features. The design features are described in Section 1.2.a and shown on the plates in Appendix E.

2.2 Construction

Based on the field investigation and the information available in the construction reports, the dam appears to have been constructed in general conformance with the design drawings.

2.3 Operation

Operational procedures are limited to the control of the upstream and downstream gates which regulate flow through the outlet works. A hand wheel for operation of the upper intake slide gate and a chain for operation of the lower intake flap gate are located at the top of the upstream face and are accessible from the crest of the dam. Two additional sluice gates are provided at the downstream toe where the outlet pipe branches into two pipes. One gate controls discharge into the impact basin from the 18-inch diameter reservoir drain pipe and the other gate controls flow from the 10-inch diameter pipe which terminates in a concrete box adjacent to the impact basin. The 10-inch pipe was provided for a proposed irrigation system.

2.4 Evaluation

a. Availability. The engineering data utilized in this report were provided by DER.

b. Adequacy. The information provided by DER, visual observations and discussions with Mrs. Jackie Powell, Secretary to Mrs. Eleanor Reynolds, the Owner, is considered adequate for a Phase I investigation.

c. Validity. There appears to be no reason to question the validity of the data obtained from DER.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The field inspection of Shangri-La Dam took place on June 12, 1979. At the time of the inspection, the reservoir surface was slightly above the service spillway crest (front wall), Elevation 265.9. No underwater areas of the dam were inspected.

The observations and comments of the field inspection team appear in the checklist which is Appendix B of this report. The appearance of the facility indicates that the dam and its appurtenances are marginally maintained.

b. Dam. The upstream and downstream slopes of the embankment are covered with thick weeds and brush which make it difficult to assess the condition of the slopes. Several small areas which supported no vegetation were observed near the top of the downstream slope in the general vicinity of the outlet works. The upper portion of the downstream slope in this vicinity is considerably steeper than the remainder of the slope indicating that some surface sloughing of the random fill material may have occurred.

The visible portion of the riprap on the upstream slope appears to be in good condition. Concrete slabs are interspersed with the riprap along the upstream slope. According to Mr. Yachin, the design engineer, the concrete segments perform the same function as the riprap and were placed purely for aesthetic purposes.

A 3-story, brick-faced building has been constructed into the downstream portion of the embankment. The building is situated so that the third floor may be entered from the downstream edge of the crest of the dam. The purpose of this structure is unknown.

The design drawings indicate that the knoll located immediately to the left of the emergency spillway was to be cut to the top of dam design elevation (Elev. 272.0). However, the survey of the dam crest revealed that the knoll ranges from 8 to 10 inches above design elevation (see Plate 9 in Appendix E).

c. Appurtenant Structures. The service and emergency spillways appeared to be in good operating condition on the date of inspection. The three drop structures in the service spillway discharge channel could not be inspected due to the thick growth of brush and weeds in the channel.

The outlet works impact basin appears to be in good condition. A trapezoidal, riprap-lined stilling basin is located immediately downstream of the impact basin. During the inspection, water was discharging into the basin from a 6-inch diameter galvanized steel pipe which provides drainage in the area of the building. The entire outlet area was overgrown with weeds and brush.

At the time of the inspection, the chain which operates the lower intake flap gate was not observed.

d. Reservoir Area. The reservoir side slopes average about 10 percent and are well vegetated. There is no visible evidence of slope instability or excess siltation.

e. Downstream Channel. The spillway discharge channel and outlet works channel were overgrown with weeds and brush and could not be properly inspected. According to the design drawings, the discharge channel merges with the natural stream at a stilling basin located approximately 200 feet downstream of the outlet works impact basin. There are no inhabitable structures along the downstream channel in the area that would be subject to flooding in the event of a dam failure. However, the two bottom floors of the 3-story structure located in the downstream portion of the embankment would be flooded in the event of a dam failure and many lives could be endangered if the building were occupied.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

The 8-inch diameter slide gate with an invert elevation of 250.0 on the upper intake and the 24-inch diameter flap gate with an invert elevation of 242.0 on the lower intake provide upstream control of the outlet pipe for reservoir drawdown. Sluice gates on the 10-inch and 18-inch pipes at the downstream toe provide additional control of the outlet pipe. There are no other known operational features for the dam.

4.2 Maintenance of the Dam

According to the Owner's representative, there is no regular maintenance program established for Shangri-La Dam. Periodic inspections are performed by employees of Green Valley Farms and maintenance is performed as needed.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, the operating gates are not maintained on a regular basis. At the time of inspection, the concrete structure upon which the upstream gate controls are located was overgrown with bushes and was not readily accessible. During the inspection, the hand wheel for operation of the 8-inch sluice gate was provided by Mrs. Powell. However, an adapter is required to fit the wheel to the gate stem; therefore, the operating condition of the sluice gate could not be assessed.

4.4 Description of any Warning Systems in Effect

According to Mrs. Powell, there is no formal system of warning the downstream building occupants of an impending dam failure. However, the water level in the reservoir could be readily monitored from the building since the third floor overlooks the crest of the embankment.

4.5 Evaluation

The overgrown vegetation on the embankment slopes and in the vicinity of the dam indicates a general lack of maintenance at the site. A regular inspection and maintenance program should be established which would include periodic operation of the drawdown control gates.

It appears that 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. Shangri-La Dam has a drainage area of 1.3 square miles and impounds a reservoir with a normal pool storage capacity of 208 acre-feet. Ground elevations range from 442 in the upper reaches of the drainage basin to 265.9 at the normal pool. The slopes of the drainage basin adjacent to the reservoir vary between 2 and 20 percent. The drainage basin is about 25 percent wooded while the remainder of the basin is divided about equally between cropland and pasture. The runoff characteristics of the basin may undergo change in the future as a result of development.

b. Experience Data. There are no known reservoir level records or rainfall records kept for this dam. Records of piezometers located along the length of the embankment were obtained from Mr. Gideon Yachin.

c. Visual Observations. On the date of the inspection, there appeared to be no adverse conditions that would restrict the proper functioning of the hydraulic features of the dam. Further observations are given in Appendix B.

The Spillway Design Flood (SDF) for a "Small" size, "High" hazard structure is given as a range from one-half of the PMF to the full PMF. Based on the location of the building in the downstream portion of the embankment and the high probability of loss of life if the building were occupied during a dam failure, the SDF was chosen to be the full PMF.

d. Overtopping Potential. The peak inflow and outflow rates for the SDF were determined to be 4,238 cfs and 4,028 cfs, respectively. Based on the hydrologic and hydraulic analyses, the combined spillway system is capable of discharging the full PMF without overtopping of the embankment (see Appendix C for computations).

e. Spillway Adequacy. The Shangri-La Dam spillway system is classified as "Adequate".

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The steep slope in the uppermost portion of the downstream face and the bare spots immediately below are possible indications of surface sloughing in the random fill material.

The thick overgrowth of vegetation prohibits a detailed visual examination of the surface of the embankment. The root systems of the larger bushes could also create potential seepage paths through the embankment.

The structural features of the service spillway appear to be in good condition. On the date of the inspection, the spillway discharge channel was overgrown with weeds so that the three drop structures located in the channel could not be inspected properly.

Based on the restricted visual observations, the embankment appears to be structurally stable.

b. Design and Construction Data. Design drawings, construction progress reports, and construction photographs were obtained from DER. However, there were no design calculations included in the provided information.

c. Operating Records. There are no official operating records maintained for this dam, according to the Owner's representative.

d. Post-Construction Changes. There is no record of any changes made to the dam subsequent to the completion of construction.

e. Seismic Stability. Shangri-La Dam is located in Seismic Zone 1 on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 is generally considered to be safe under any expected Zone 1 earthquake loading conditions if it is stable under static loading conditions.

SECTION 7

ASSESSMENT, RECOMMENDATIONS, AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual inspection and review of available information indicate that Shangri-La Dam is in good condition, however the thick overgrowth prohibits a complete assessment.

Minor surface sloughing of the random fill material appears to have occurred near the top of the downstream slope. This sloughing does not appear to have affected the stability of the embankment in any manner. However, the displaced material and steepened slope could subject the downstream face to further sliding and potential instability.

The thick overgrowth of vegetation on the dam, spillways and outlet channels hinders the assessment of the dam based on surface appearance.

The combined spillway system is capable of discharging the full PMF without overtopping of the embankment. Therefore, the spillway system is classified as "Adequate".

b. Adequacy of Information. The information available from DER, visual observations, and discussions with the Owner's representative are considered adequate for a Phase I investigation.

c. Urgency. The remedial measures recommended in Section 7.2 should be effected as soon as possible.

d. Necessity for Further Investigation. The stability of the embankment should be evaluated subsequent to the removal of the overgrowth.

7.2 Recommendations and Proposed Remedial Measures

a. Facilities.

1. The trees, brush, and weeds that have overgrown the dam, spillways and outlet channels should be removed to permit more detailed inspection of the dam. If any distress such as sloughing, cracking, or seepage is observed, the condition should be evaluated by a licensed professional engineer experienced in the design and construction of dams.

b. Operation and Maintenance Procedures

1. A regular maintenance program should be developed and implemented. This program should include, but not be limited to, cutting of the brush and weeds on a regular basis and periodic inspection and operation of the reservoir drain sluice gates.

2. A formal warning system should be established within the downstream building to notify occupants of any impending peril to the dam.

APPENDIX

A

Check List Engineering Data

Design, Construction, Operation

Phase I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Shangri-La

ID # PA 00248

ITEM	REMARKS
AS-BUILT DRAWINGS	None available.
REGIONAL VICINITY MAP	Refer to Plate 1, Appendix E.
CONSTRUCTION HISTORY	Detailed construction progress reports were obtained from DER.
TYPICAL SECTIONS OF DAM	Refer to Plate 5, Appendix E.
OUTLETS - PLAN	Refer to Plate 4, Appendix E.
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	Refer to Plate 2, Appendix E.
RAINFALL/RESERVOIR RECORDS	None available.

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	Reported in progress reports.

ITEM	REMARKS
MONITORING SYSTEMS	Piezometer records during the reservoir filling stage were obtained from Mr. Gideon Yachin of GEO-Technical Services.
MODIFICATIONS	There are no modifications on record.
HIGH POOL RECORDS	None available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None available.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Refer to Plates 6 and 7 in Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	Refer to Plate 4, Appendix E.
MISCELLANEOUS	Refer to Section 2.1.a

APPENDIX

B

Check List

Visual Inspection

Phase I

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Shangri-La County Chester State Pennsylvania National ID # PA 00248

Type of Dam Earth Hazard Category High

Date(s) Inspection June 12, 1979 Weather Clear Temperature 70° F

Pool Elevation at Time of Inspection 266.0 M.S.L. Tailwater at Time of Inspection 240 ± M.S.L.

Inspection Personnel:

J. J. Williams Leonard R. Beck Robert R. Bowers

J. J. Williams Recorder

Remarks:

Mrs. Jackie Powell, secretary to Mrs. Eleanor Reynolds the owner, was also present during the inspection.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Portions of the random fill material near the top of the downstream slope appear to have sloughed, leaving the slope steeper near the crest.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No problems noted.	
RIPRAP FAILURES	None observed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	Water was discharging from a 6-inch diameter pipe, which provides drainage in the downstream building area, into the outlet works stilling basin during the inspection.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems noted.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	The intake structure was submerged and could not be inspected. The upper and lower intake sluice gates were not operated during the inspection.	Periodic operation of the sluice gate is recommended.
OUTLET STRUCTURE	The impact basin appears to be in good condition. No flow was occuring through either of the outlet pipes during the inspection.	
OUTLET CHANNEL	The outlet channel was overgrown with weeds and brush at the time of the of the inspection.	Removal of the weeds and brush to permit more detailed inspection is recommended.
EMERGENCY GATE	There are four sluice gates for controlling the flow through the outlet works; two upstream gates and two downstream gates.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The entire concrete drop inlet section appears to be in good condition.	
APPROACH CHANNEL	The emergency spillway approach channel was submerged.	
DISCHARGE CHANNEL	The discharge channel was overgrown with weeds and brush at the time of the inspection.	Removal of the weeds and brush to permit more detailed inspection is recommended.
BRIDGE AND PIERS	The service bridge and the pier in the spillway channel appear to be in good condition.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	Piezometer records taken during the reservoir-filling stage were obtained from GEO-Technical Services. Several of the piezometers were destroyed when the building was constructed, but most of them are still in place.	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes appear to average about 10% and are fairly well vegetated.	
SEDIMENTATION	No excessive siltation was apparent on the date of the inspection.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The spillway discharge channel and the outlet channel join at a stilling basin approximately 200 feet downstream of the outlet works impact basin. The natural stream channel continues from that point. The entire downstream area is overgrown with weeds and brush.	The weeds and brush should be removed to permit more detailed inspection of the channel.
SLOPES	The downstream channel continues on a grade of about 1.0%.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are no homes along the downstream channel within the potential damage area. The damage center would be the building in the downstream portion of the dam. The number of occupants in the building is variable and could possibly exceed 100.	

APPENDIX

C

Hydrologic & Hydraulic Data

TABLE OF CONTENTS - APPENDIX C

O'BRIEN & GERE

PROJECT	SHEET	BY	DATE	JOB NO.
SHANGRI LA DAM	1	SM	4/9/79	

HYDROLOGY CALCULATIONS

DRAINAGE AREA (PLANIMETERED ON USGS QUAD SHEET): 1.25 $MI.^2$

PMP CALCULATIONS (HMS REPORT 33)

AREA IS IN ZONE 6

∴ 24-hours, 200 Sq. Mile PMP = 23.5 inches

HR	%	RAINFALL	Δ
6	113	26.6"	26.6"
12	123	28.9"	2.3"
24	132	31.0"	2.1"
48	142	33.4"	2.4"

SNYDER COEFFICIENTS (information provided by Balt. COE Area 10)

$C_p = 0.60$ $C_t = 1.25$

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

$L_{ca} = 0.72$ mi.

$L = 1.46$ mi

$$t_p = 1.25 (1.46 \times 0.72)^{0.3} = 1.27 \text{ HR}$$

STAGE-STORAGE AND STAGE-DISCHARGE INFORMATION FOR THE HEC-1 PROGRAM IS OBTAINED FROM THE CURVES SHOWN ON PLATE 2 IN APPENDIX E.

```
***********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
***********************************
    1          A1                      NATIONAL DAM INSPECTUON PROGRAM
    2          A2                                 SHANGRI LA DAM
    3          A3                                 PMF HYDROGRAPH
    4          B      150       0      30       0       0       0       0       0      -4       0
    5          B1       5
    6          J        1       9       1
    7          J1     0.2     0.3     0.4     0.5     0.6     0.7     0.8     0.9     1.0
    8          K        0  INFLOW                                       1
    9          K1                        RUNOFF TO SHANGRI LA DAM RESERVOIR
   10          M        1       1     1.3                                               1
   11          P        0    23.5     113     123     132     142
   12          T                                                        1    0.05
   13          W     1.27     0.6
   14          X     -1.5   -0.05       2
   15          K        1  OUTFLO                                       1
   16          K1                      ROUTING THROUGH SHANGRI LA DAM RESERVOIR
   17          Y                                1       1
   18          Y1       1                                            -266      -1
   19          Y4     266     267     268     269     270     271     272
   20          Y5       0     260     950    2100    3100    4200    5400
   21          $S       0       6      31      86     208     398     673
   22          $E     243     250     255     260     266     272     280
   23          $$     266
   24          $D     272     3.1     1.5     800
   25          K       99
```

Sh 2

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

RUN DATE= 06/19/79.
TIME= 13.17.52.

NATIONAL DAM INSPECTION PROGRAM
SHANGRI LA DAM
PMF HYDROGRAPH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .20 .30 .40 .50 .60 .70 .80 .90 1.00

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

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO SHANGRI LA DAM RESERVOIR

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW		0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.30	0.00	1.30	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LRUPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.27 CP= .60 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 15 END-OF-PERIOD ORDINATES, LAG= 1.27 HOURS, CP= .60 VOL= 1.00

84.	274.	376.	311.	208.	140.	94.	63.	42.	28.
19.	13.	8.	6.	4.					

0 END-OF-PERIOD FLOW

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

Sh 3

SUM	26.70	24.30	2.40	42763.
	(678.)	(617.)	(61.)	(1210.91)

HYDROGRAPH ROUTING

ROUTING THROUGH SHANGRI LA DAM RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTFLO	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-266.	-1

STAGE	266.00	267.00	268.00	269.00	270.00	271.00	272.00
FLOW	0.00	260.00	950.00	2100.00	3100.00	4200.00	5400.00
CAPACITY=	0.	6.	31.	86.	208.	398.	673.
ELEVATION=	243.	250.	255.	260.	266.	272.	280.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
266.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
272.0	3.1	1.5	800.

PEAK OUTFLOW IS 773. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1204. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1614. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 2019. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 2411. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 2808. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 3214. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 3622. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 4028. AT TIME 41.50 HOURS

Sh 4

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 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	INFLOW	1.30	1	848.	1272.	1695.	2119.	2543.	2967.	3391.	3815.	4238.
		(3.37)	(	24.00)(	36.01)(	48.01)(	60.01)(	72.01)(	84.01)(	96.01)(	108.02)(	120.02)
ROUTED TO	OUTFLO	1.30	1	773.	1204.	1614.	2019.	2411.	2808.	3214.	3622.	4028.
		(3.37)	(	21.88)(	34.10)(	45.71)(	57.16)(	68.27)(	79.51)(	91.02)(	102.58)(	114.07)

Sh 5

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	266.00	266.00	272.00
STORAGE	208.	208.	398.
OUTFLOW	0.	0.	5400.

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	267.74	0.00	263.	773.	0.00	41.50	0.00
.30	268.22	0.00	278.	1204.	0.00	41.50	0.00
.40	268.58	0.00	290.	1614.	0.00	41.50	0.00
.50	268.93	0.00	301.	2019.	0.00	41.50	0.00
.60	269.31	0.00	313.	2411.	0.00	41.50	0.00
.70	269.71	0.00	325.	2808.	0.00	41.50	0.00
.80	270.10	0.00	338.	3214.	0.00	41.50	0.00
.90	270.47	0.00	350.	3622.	0.00	41.50	0.00
1.00	270.84	0.00	361.	4028.	0.00	41.50	0.00

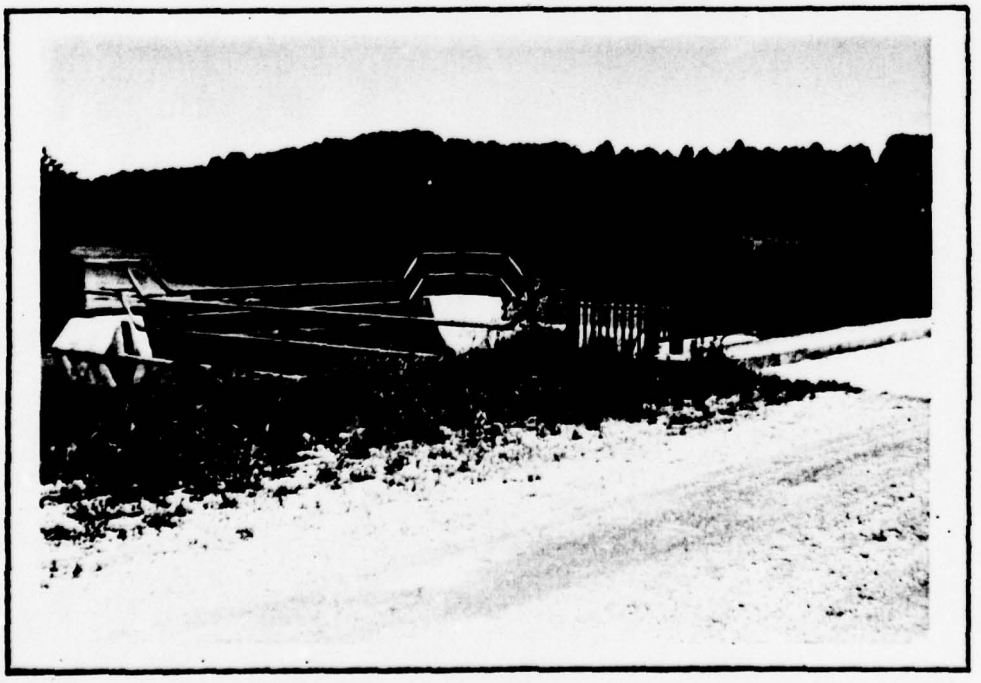
Sh 6

APPENDIX

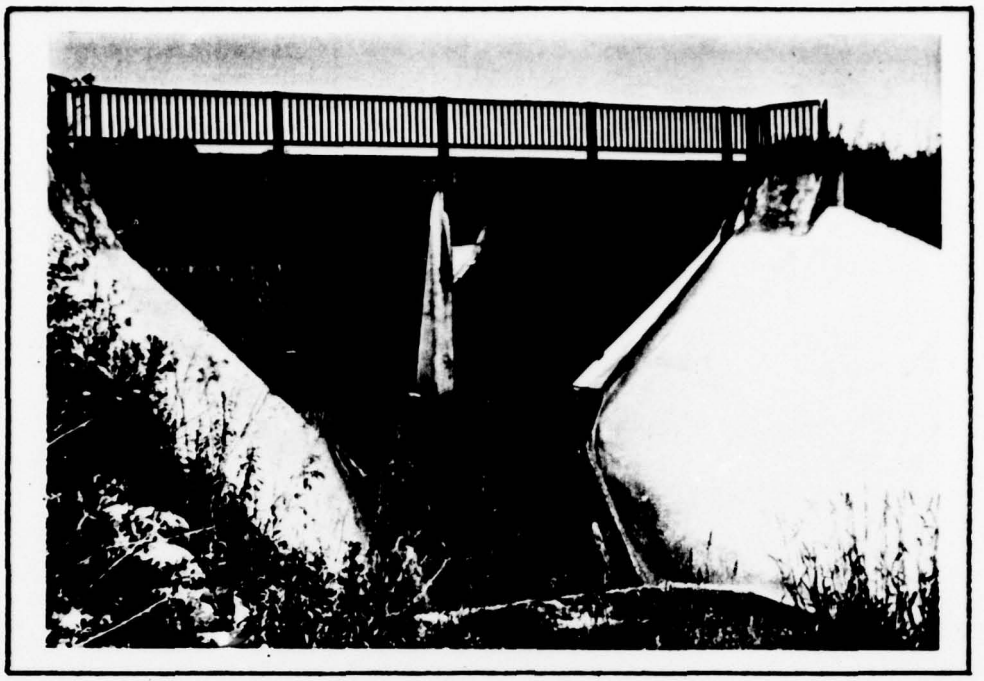
D

Photographs

VIEW OF THE EMBANKMENT FROM THE DOWNSTREAM RIGHT ABUTMENT SHOWING THE SPILLWAY SYSTEM

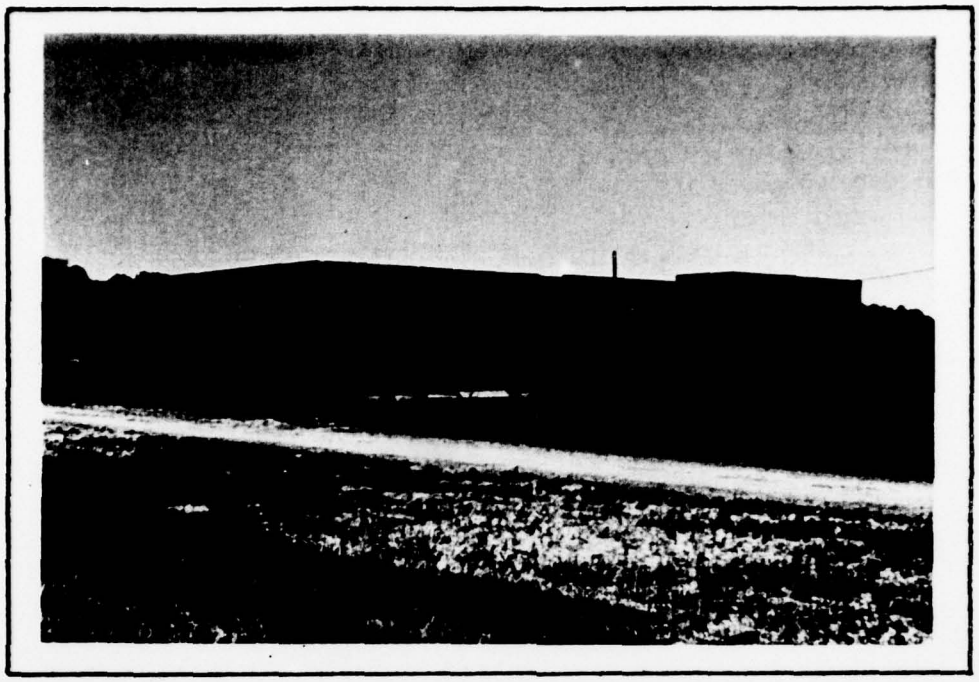


CLOSE UP OF THE SERVICE SPILLWAY NEAR THE RIGHT ABUTMENT OF THE DAM



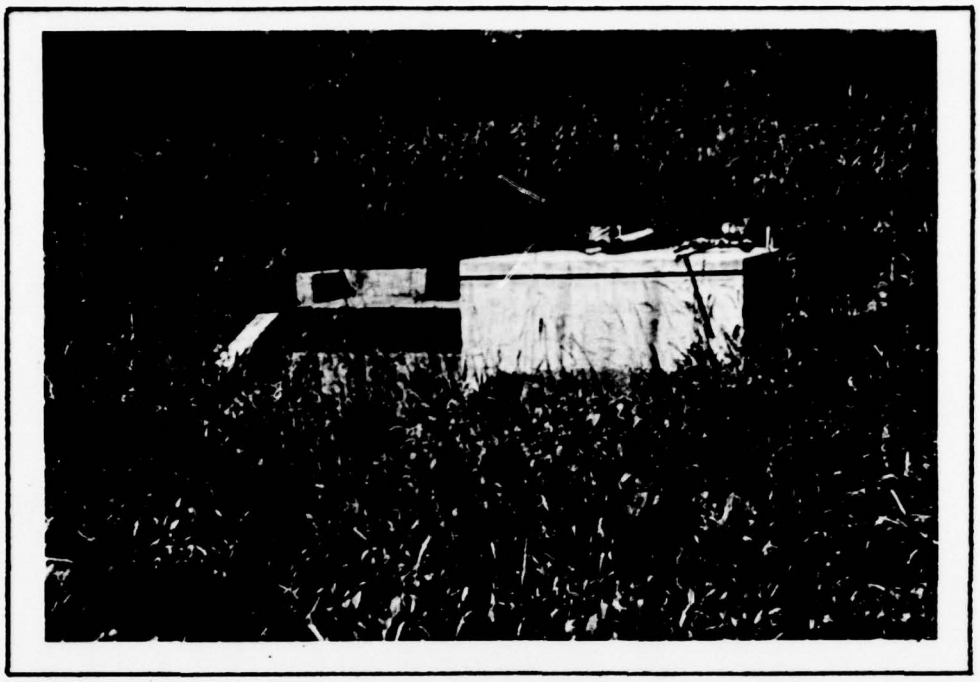
DROP SECTIONS THROUGH THE SERVICE SPILLWAY
LOOKING UPSTREAM

SPILLWAY DISCHARGE CHANNEL AS VIEWED
FROM THE BRIDGE OVER THE SERVICE SPILLWAY



STRUCTURE BUILT IN CONJUNCTION WITH
THE DAM AS VIEWED FROM THE TOP OF THE DAM

RESERVOIR DRAIN HOIST STEM AND
HOIST MOUNTING BLOCK



RESERVOIR DRAIN SYSTEM IMPACT BASIN
AND BOX OUTLET STRUCTURES

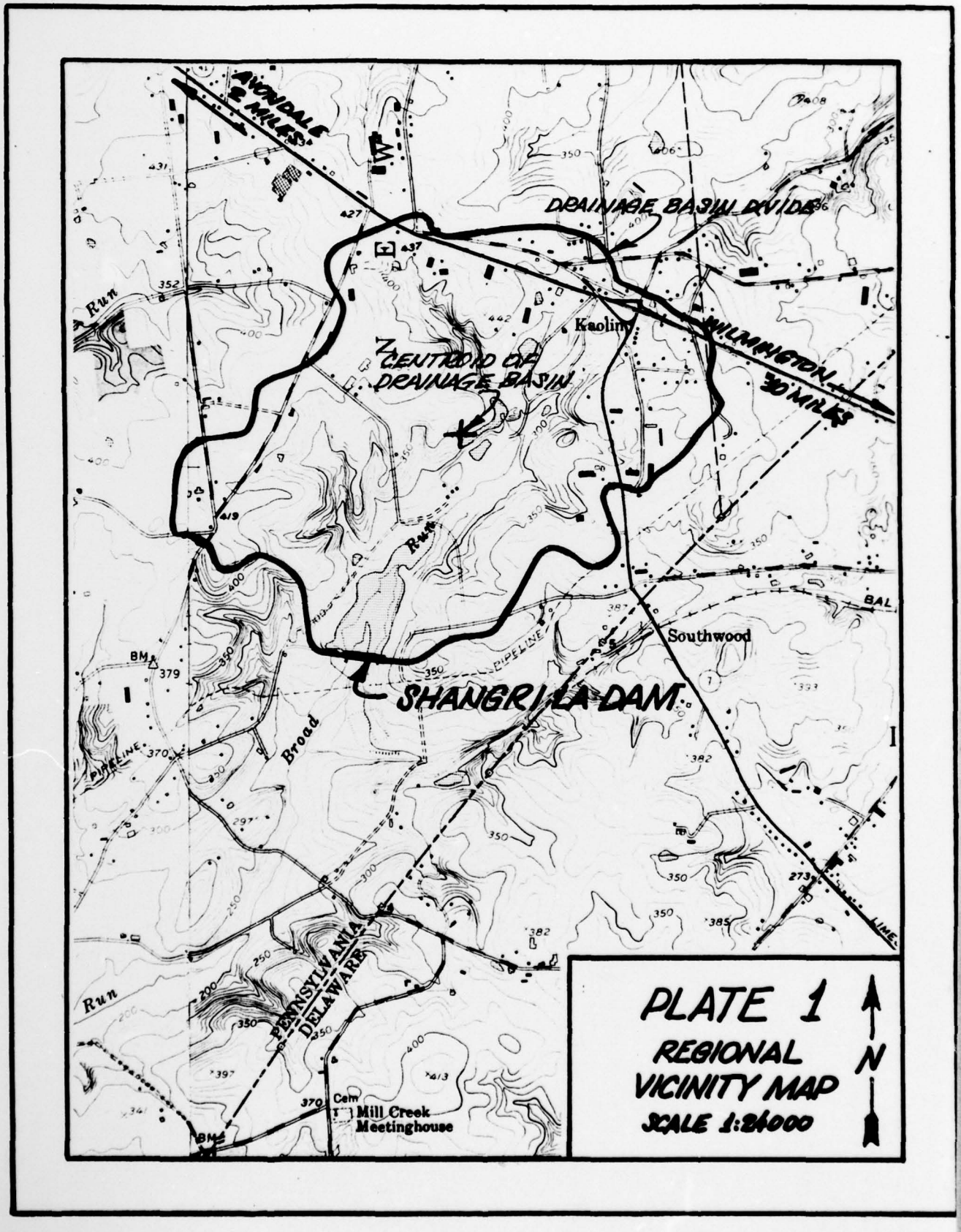
PIPE DISCHARGE IN THE OUTLET
WORKS STILLING BASIN

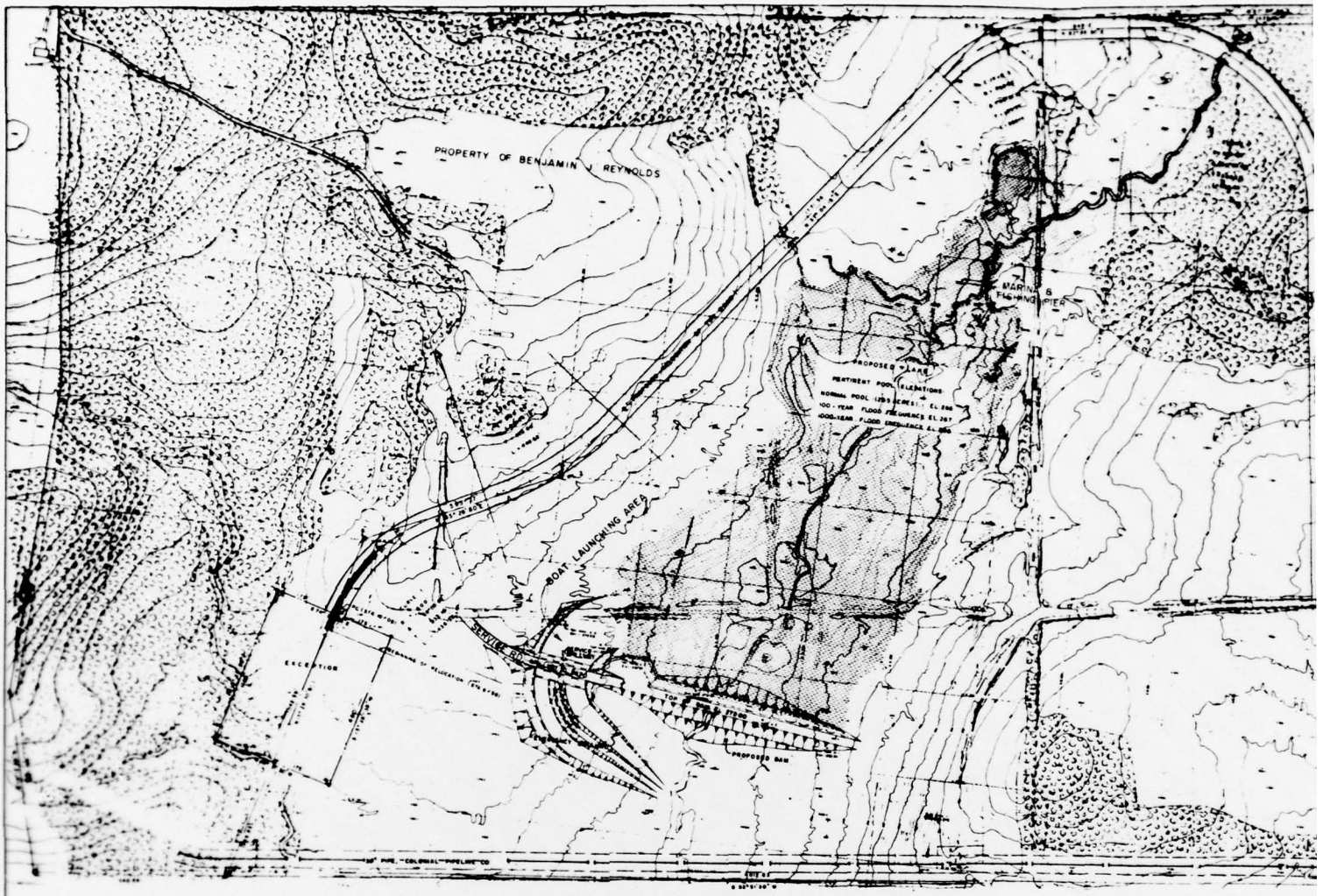
APPENDIX

E

Drawings

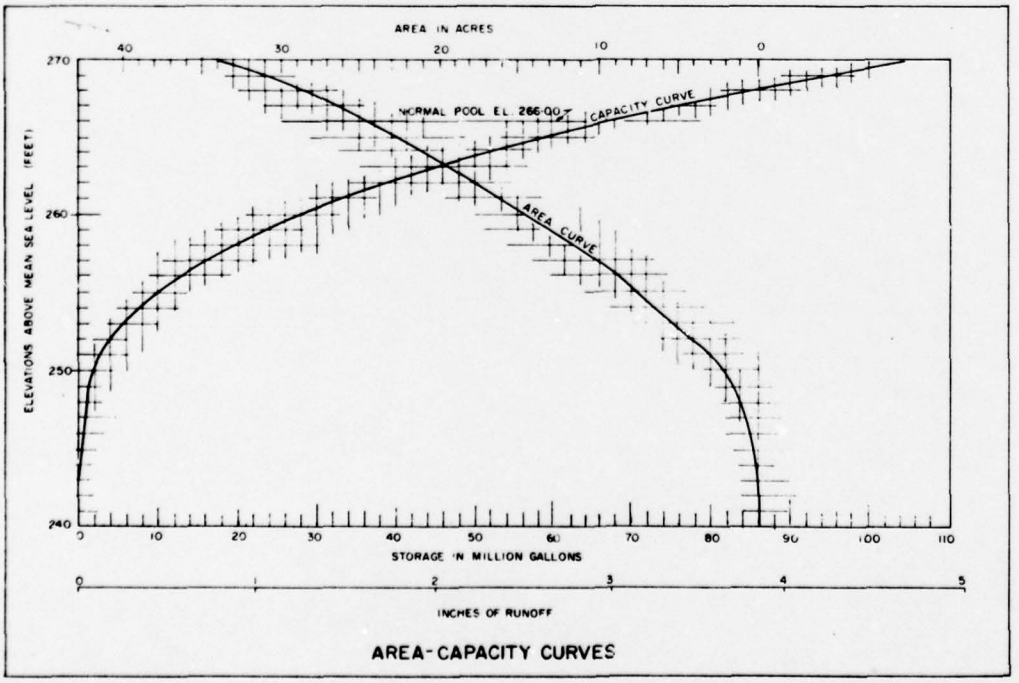
TABLE OF CONTENTS - APPENDIX E


AVONDALE 2 MILES
DRAINAGE BASIN DIVIDE
CENTROID OF DRAINAGE BASIN
WILMINGTON 30 MILES
Kaolin
Run
Broad
SHANGRI-LA DAM
Southwood
PIPELINE
BM
379
BAL
PENNSYLVANIA
DELAWARE
Mill Creek
Meetinghouse
Cem
PLATE 1
REGIONAL
VICINITY MAP
SCALE 1:24000
N

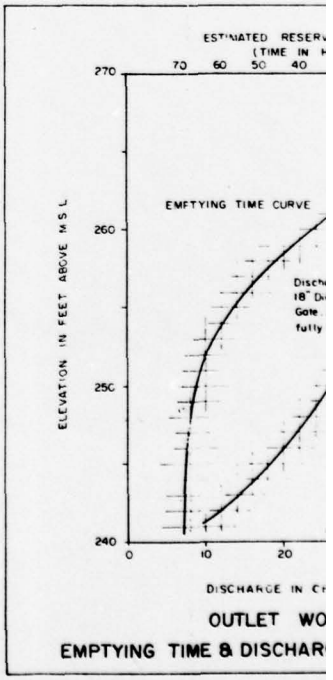


PLAN OF RESERVOIR AREA

Scale 1" = 200'



AREA-CAPACITY CURVES



OUTLET WO

EMPTYING TIME & DISCHAR

RECD _____ FOR _____

BSE REPORT NO. _____

Div. Dams

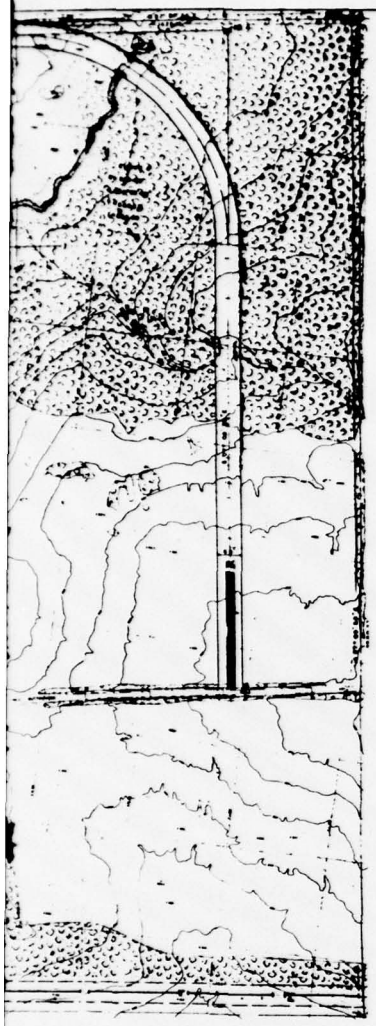
15-295-2
FILE NUMBER

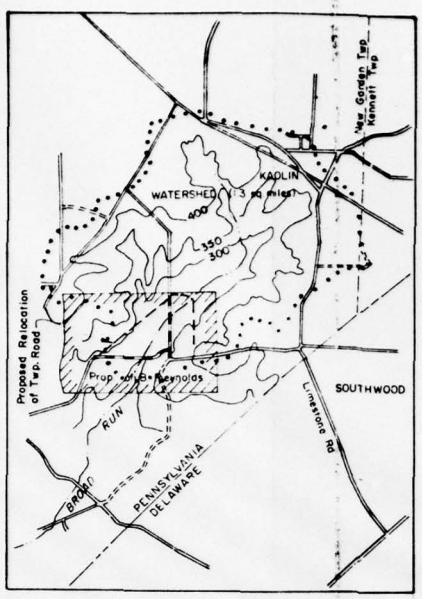
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THE 19 DAY OF July A.D. 19[illegible]

Chester H. Darnell
Prothonotary

JUL 26 1966

O. H. McConnell
Chief Engineer

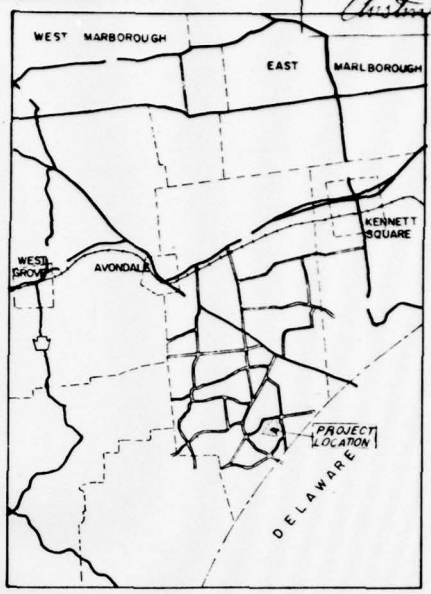




SITE MAP

1000' 0 1000' 2000' 3000' 4000'

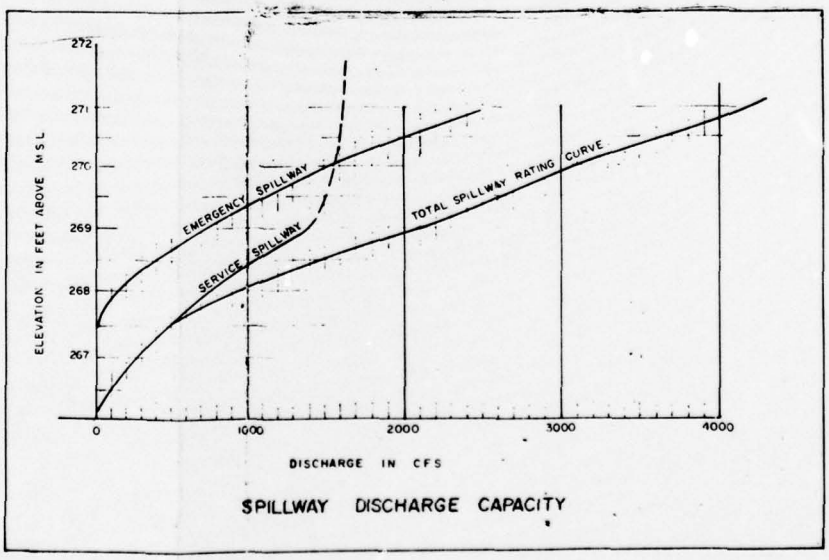
SCALE



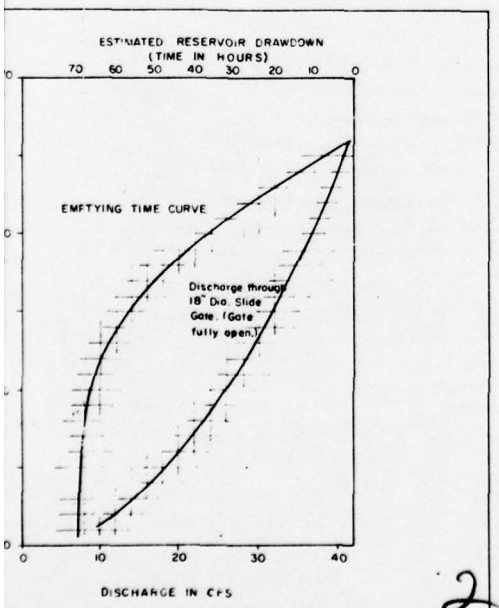
LOCATION MAP

1 1/2 0 1M 2M 3M

SCALE



SPILLWAY DISCHARGE CAPACITY



OUTLET WORKS

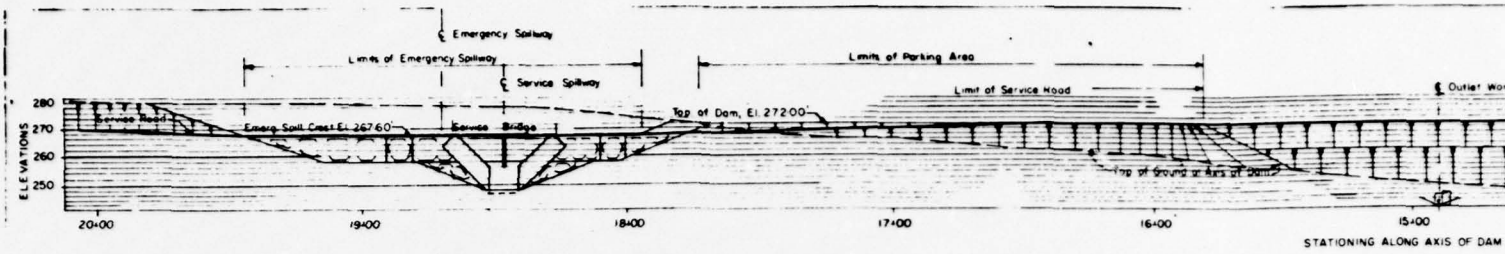
YING TIME & DISCHARGE RATING CURVE

2

GIDEON YACHIN

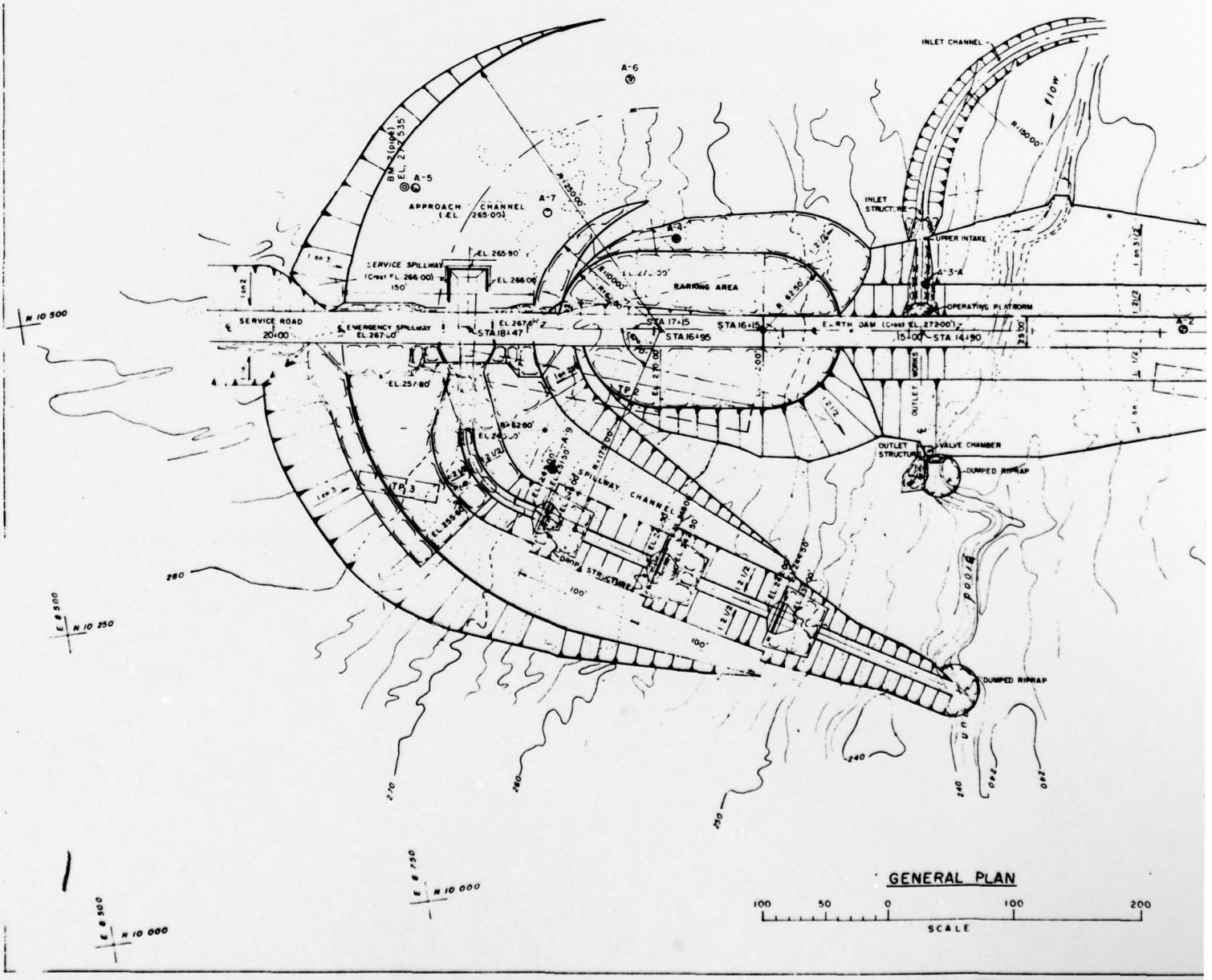
PLATE 2

SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP. CHESTER CO., PA	
DRAWN GY TRACED PHS CHECKED GY APPROVED	LOCATION & SITE MAPS PLAN OF RESERVOIR AREA AREA CAPACITY & RATING CURVES
DATE JULY, 1966	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.
	SHEET NO. 1



ELEVATION

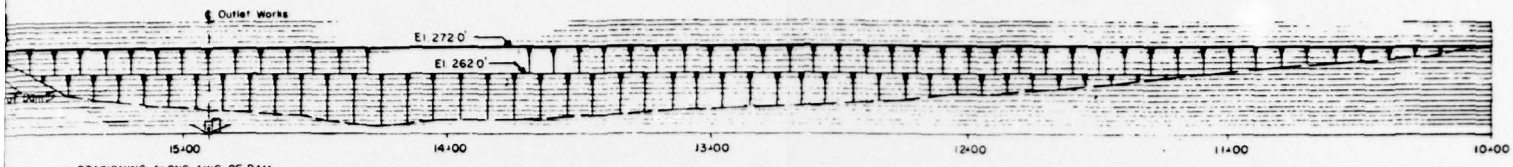
(LOOKING UPSTREAM)



GENERAL PLAN

100 50 0 100 200

SCALE



STATIONING ALONG AXIS OF DAM

ELEVATION

(LOOKING UPSTREAM)

15-295-3
FILE NUMBER

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THE 13 DAY OF July A.D. 19 66

File Clerk

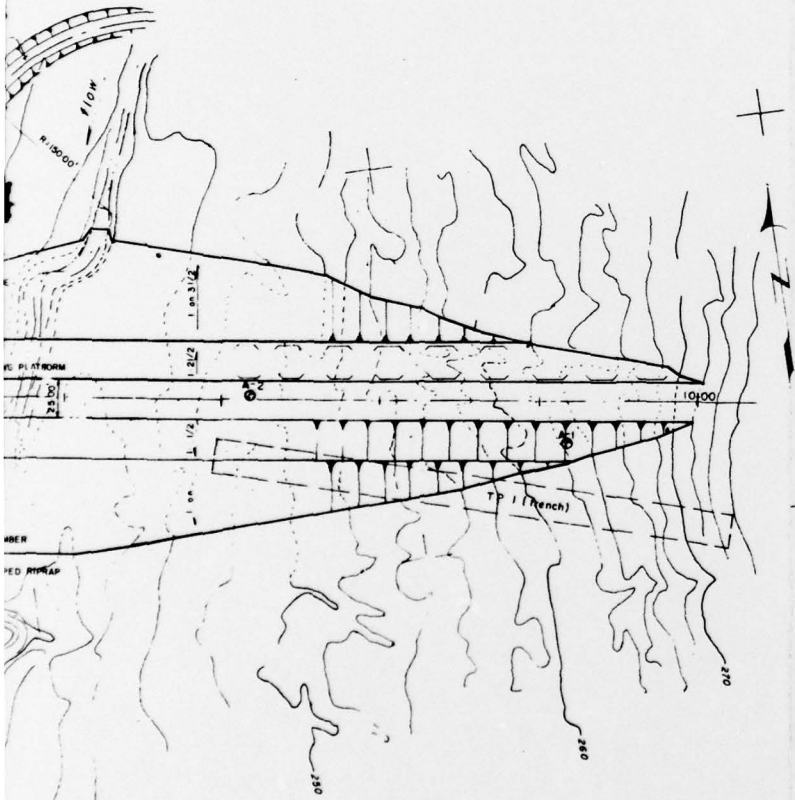
RECD. _____ FOR _____

SEE REPORT NO. _____

Div. Dams

JUL 26 1966

C. R. McConnell
Chief Engineer



BM 1 (pipe)
@ EL 320.275

LEGEND

○ A-2	TEST HOLE NO. 2
TP 3	TEST PIT NO. 3
	EARTHEN SLOPE
	DUMPED RIPRAP

GENERAL NOTES:

1. Topographic survey prepared by Keystone Mapping Co., Inc. of York, Pa. and G.D. Houtman & Son, Chester Co., Pa.; March, 1959.
2. For logs of Test Holes, Test Pits, Geologic Section and Soil Characteristics, see "Soil and Foundations Conditions at the Damsite," in the attached Specifications.

PLATE 3

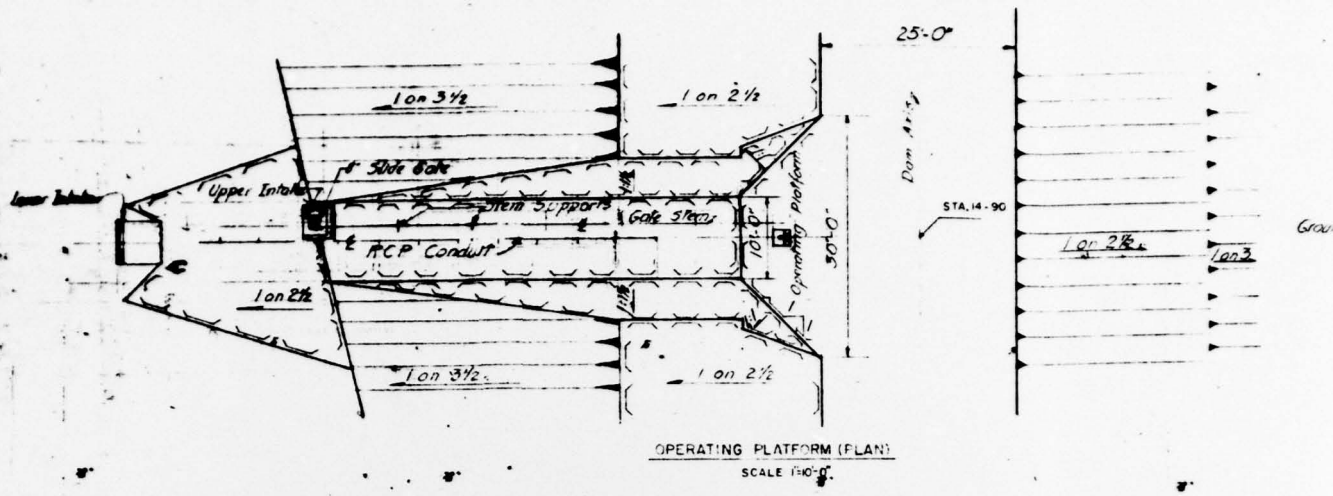
SHANGRI-LA DAM & RESERVOIR PROPERTY OF BENJAMIN J. REYNOLDS NEW GARDEN TWP. CHESTER CO. PA.	
DRAWN GY TRACED CHECKED GY APPROVED Gideon Yachin	GENERAL PLAN & ELEVATION
DATE JULY, 1966	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.
	SHEET NO. 2

COMMONWEALTH OF PENNSYLVANIA
GIDEON YACHIN
PROFESSIONAL ENGINEER

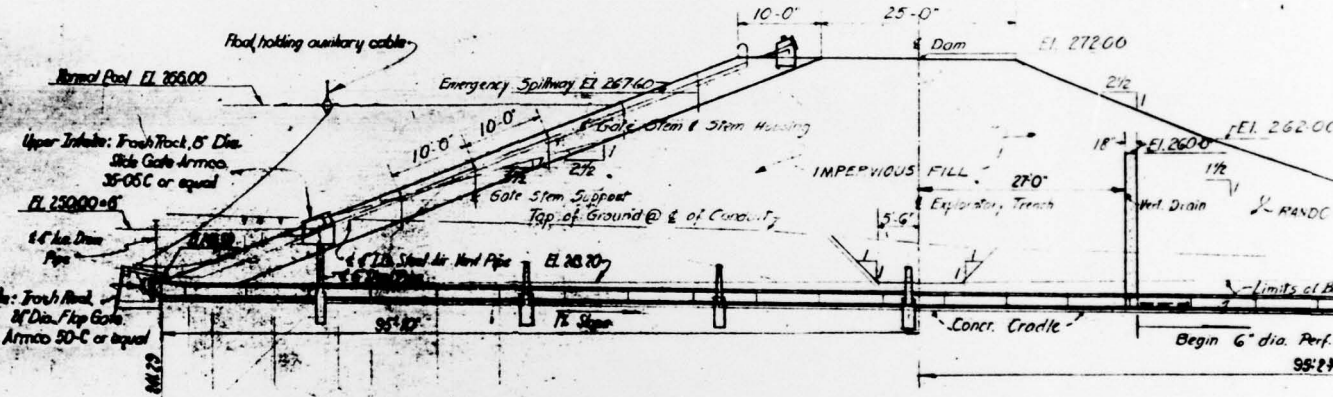
LAN

100 200

2



OPERATING PLATFORM (PLAN)
SCALE 1"=10'-0"



SECTION A-A
SCALE 1"=10'-0"

OPERATION & CONTROL OF GATES

(1) The size of the Conduit is governed by the requirement to Drain Down the Reservoir within 72 hours (see 'Rating Curves & Emptying Time, Sheet 1)

(2) With the exception of (1) above, withdrawal and releases from the Reservoir would be done through the Upper Intake, equipped with an 8"-dia. Slide Gate. The 24"-dia. Flap Gate, located in the Lower Intake, would be normally closed.

(3) Under prevailing conditions, described in (1) above, the 24"-dia. Flap Gate shall be opened. The procedure to open the Flap Gate is as follows:

a. Water Level in Reservoir, above elevation of Upper Intake

a-1. Close downstream 18"-dia. Slide Gate

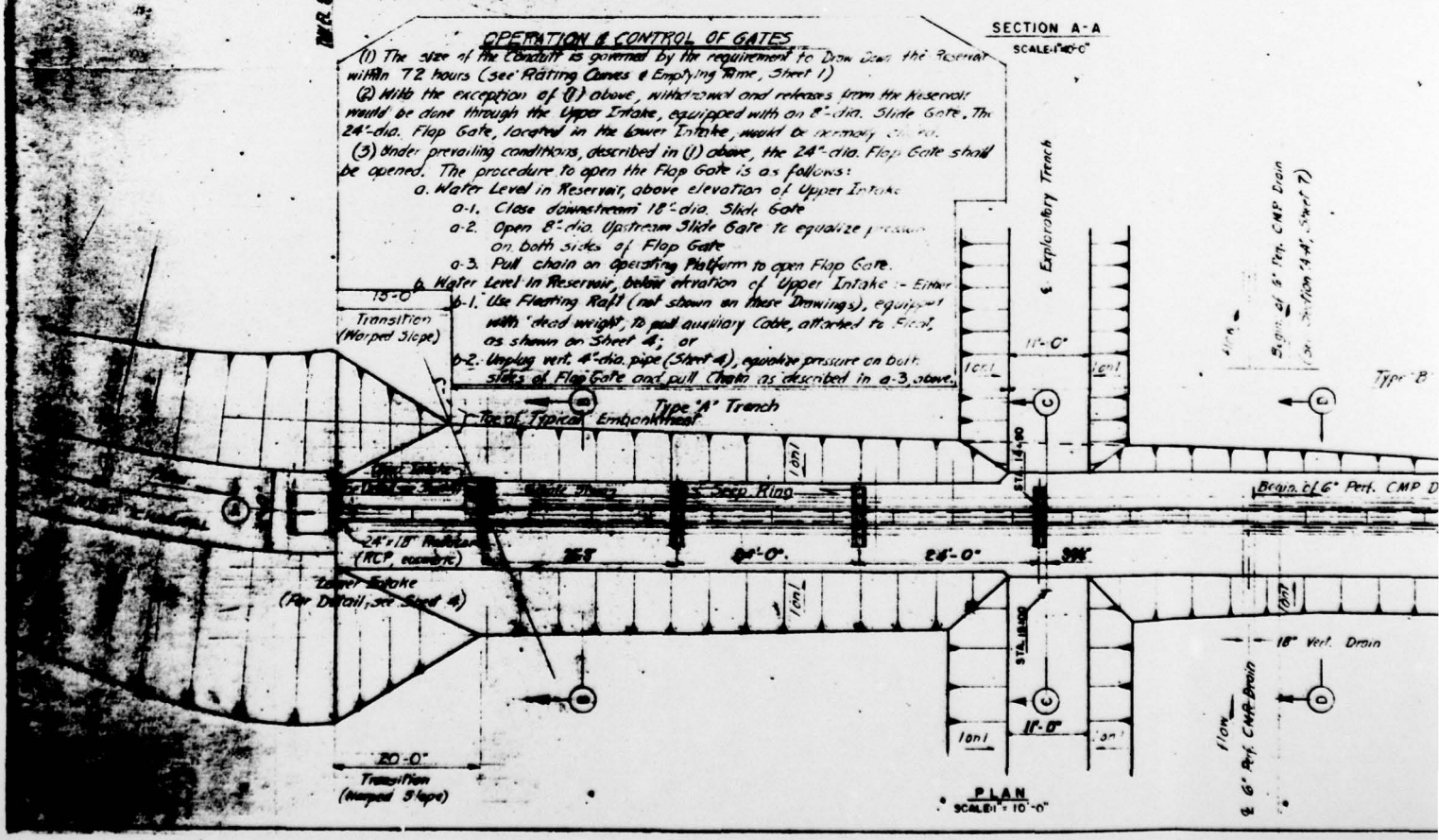
a-2. Open 8"-dia. Upstream Slide Gate to equalize pressure on both sides of Flap Gate

a-3. Pull chain on Operating Platform to open Flap Gate.

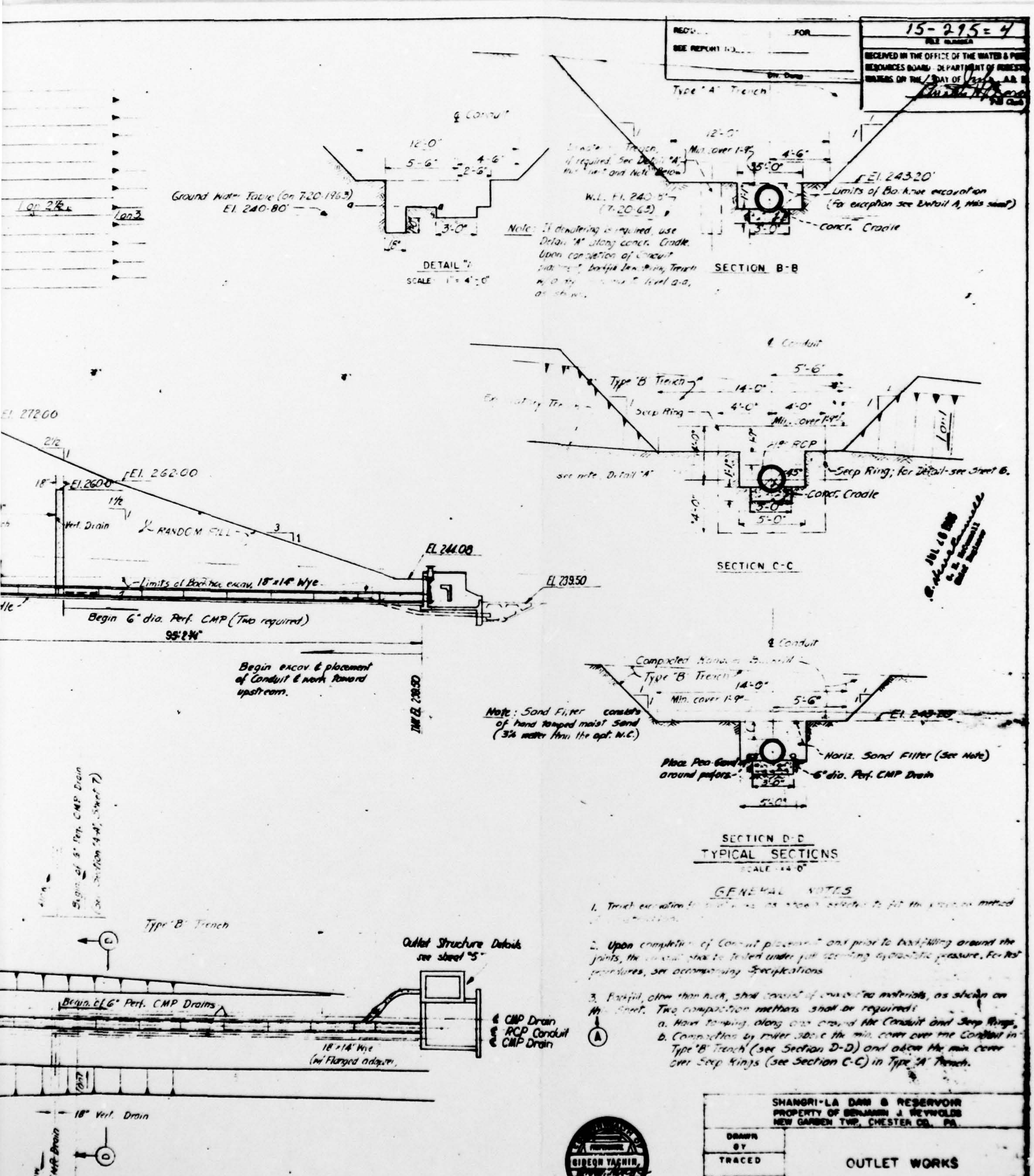
b. Water Level in Reservoir, below elevation of Upper Intake - Either

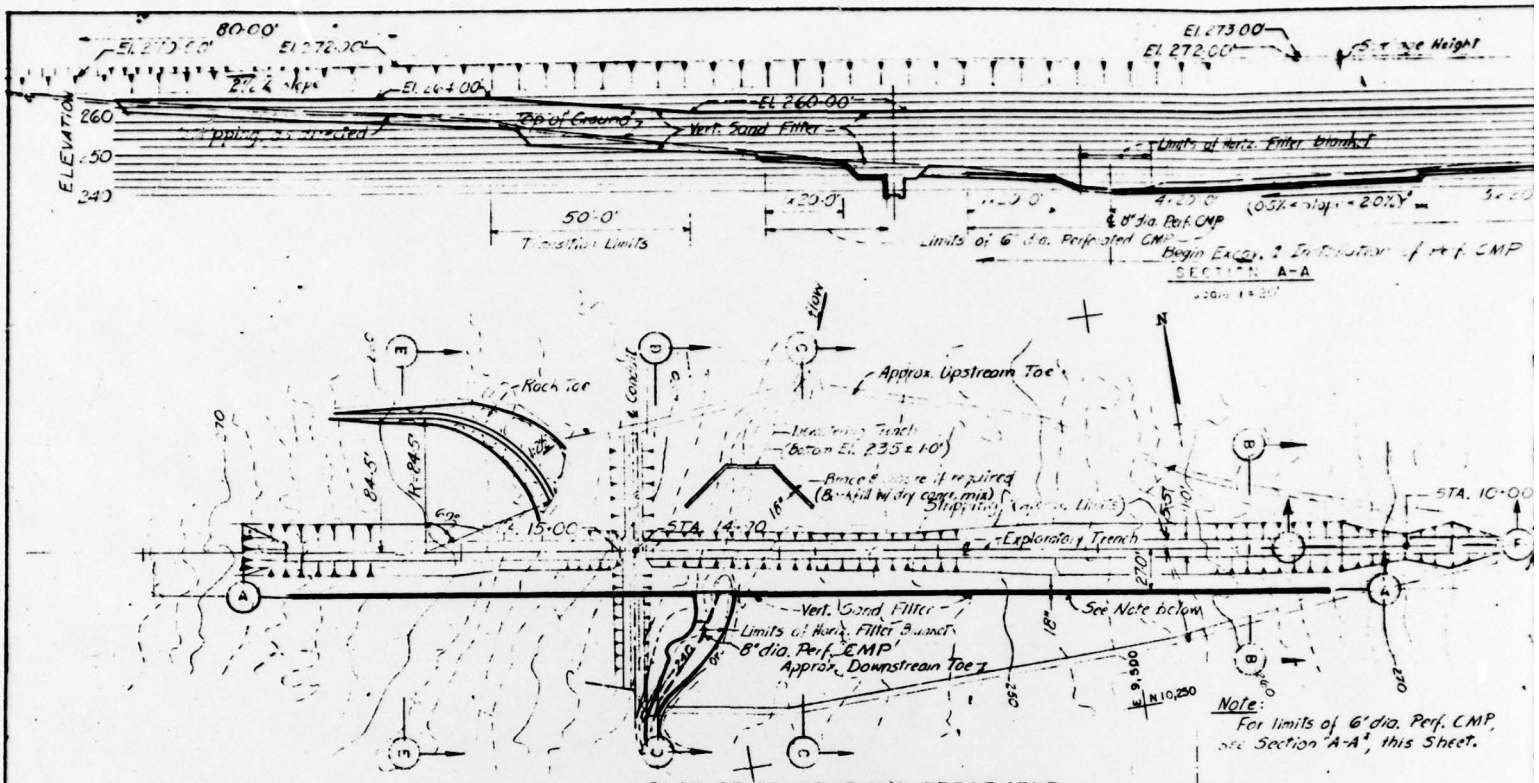
b-1. Use Floating Raft (not shown on these Drawings), equipped with 'dead weight', to pull auxiliary Cable, attached to Flap, as shown on Sheet 4; or

b-2. Unplug vert. 4"-dia. pipe (Sheet 4), equalize pressure on both sides of Flap Gate and pull Chain as described in a-3, above.

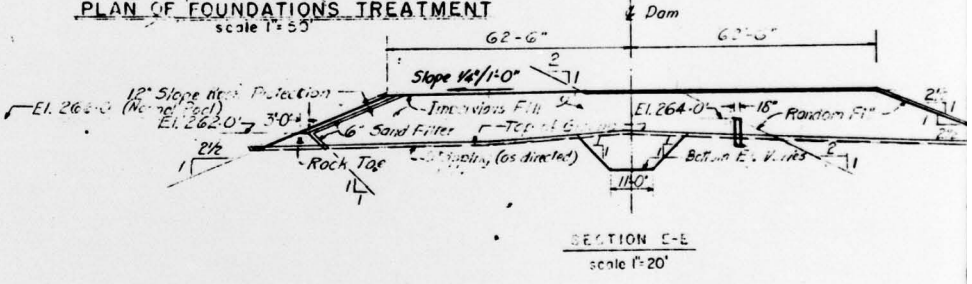


PLAN
SCALE 1" = 10'-0"

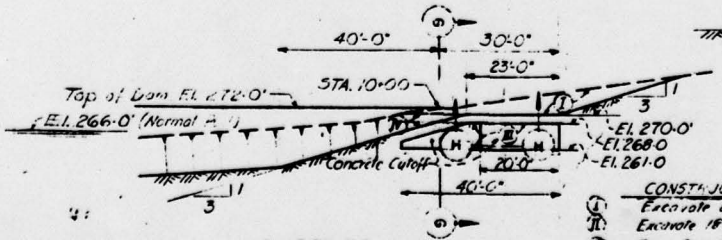

15-295=4
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD
Type "A" Trench
℄ Conduit
12'-0"
5'-6"
4'-6"
2'-6"
3'-0"
Ground Water Table (on 7-20-1963)
El. 240.80'
DETAIL "A"
Note: If dewatering is required, use Detail "A" along concr. Cradle.
Min. cover 1'-9"
5'-0"
El. 243.20'
Limits of Backhoe excavation
(For exception see Detail A, this sheet)
Concr. Cradle
SECTION B-B
Type "B" Trench
14'-0"
4'-0"
Seep Ring
Seep Ring; for Detail-see Sheet 6.
see note, Detail "A"
SECTION C-C
El. 272.00
El. 262.00
El. 260.0
Perf. Drain
RANDOM FILL
Limits of Backhoe excav.
18"x14" Wye
El. 244.08
El. 239.50
Begin 6" dia. Perf. CMP (Two required)
Begin excav. & placement of Conduit & work toward upstream.
Note: Sand Filter consists of hand tamped moist Sand (3% wetter than the opt. W.C.)
Min. cover 1'-9"
Horiz. Sand Filter (See Note)
Place Pea-Gravel around perfors.
6" dia. Perf. CMP Drain
SECTION D-D
TYPICAL SECTIONS
GENERAL NOTES
1. Trench excavation ... as shown, selected to fit the ... method of construction.
2. Upon completion of Conduit placement and prior to backfilling around the joints, the conduit shall be tested under full operating hydrostatic pressure. For test procedures, see accompanying Specifications.
3. Backfill, other than rock, shall consist of compacted materials, as shown on this sheet. Two compaction methods shall be required:
a. Hand tamping along and around the Conduit and Seep Rings.
b. Compaction by roller above the min. cover over the Conduit in Type "B" Trench (see Section D-D) and above the min. cover over Seep Rings (see Section C-C) in Type "A" Trench.
Type "B" Trench
Outlet Structure Details see sheet "5"
Begin of 6" Perf. CMP Drains
℄ CMP Drain
℄ RCP Conduit
℄ CMP Drain
18"x14" Wye (w/ Flanged adapter)
18" Vert. Drain
SHANGRI-LA DAM & RESERVOIR
PROPERTY OF BENJAMIN J. REYNOLDS
NEW GARDEN TWP, CHESTER CO., PA.
DRAWN BY
TRACED
CHECKED BY
APPROVED
OUTLET WORKS
PLAN, SECTIONS & DETAILS
DATE JULY, 1966
GEO-Technical Services
CONSULTING ENGINEERS & GEOLOGISTS
HARRISBURG, PA.
GIDEON YACHIN
2
PLATE 4



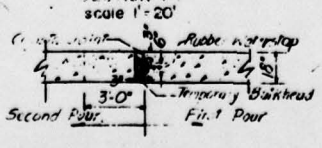
PLAN OF FOUNDATIONS TREATMENT
scale 1" = 50'



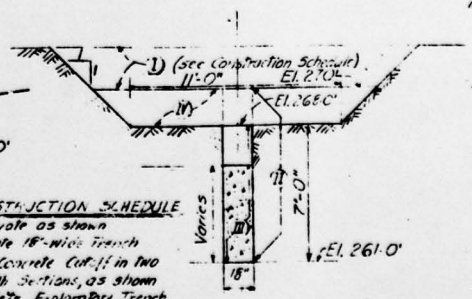
SECTION E-E
scale 1" = 20'



SECTION F-F
scale 1" = 20'

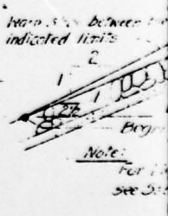


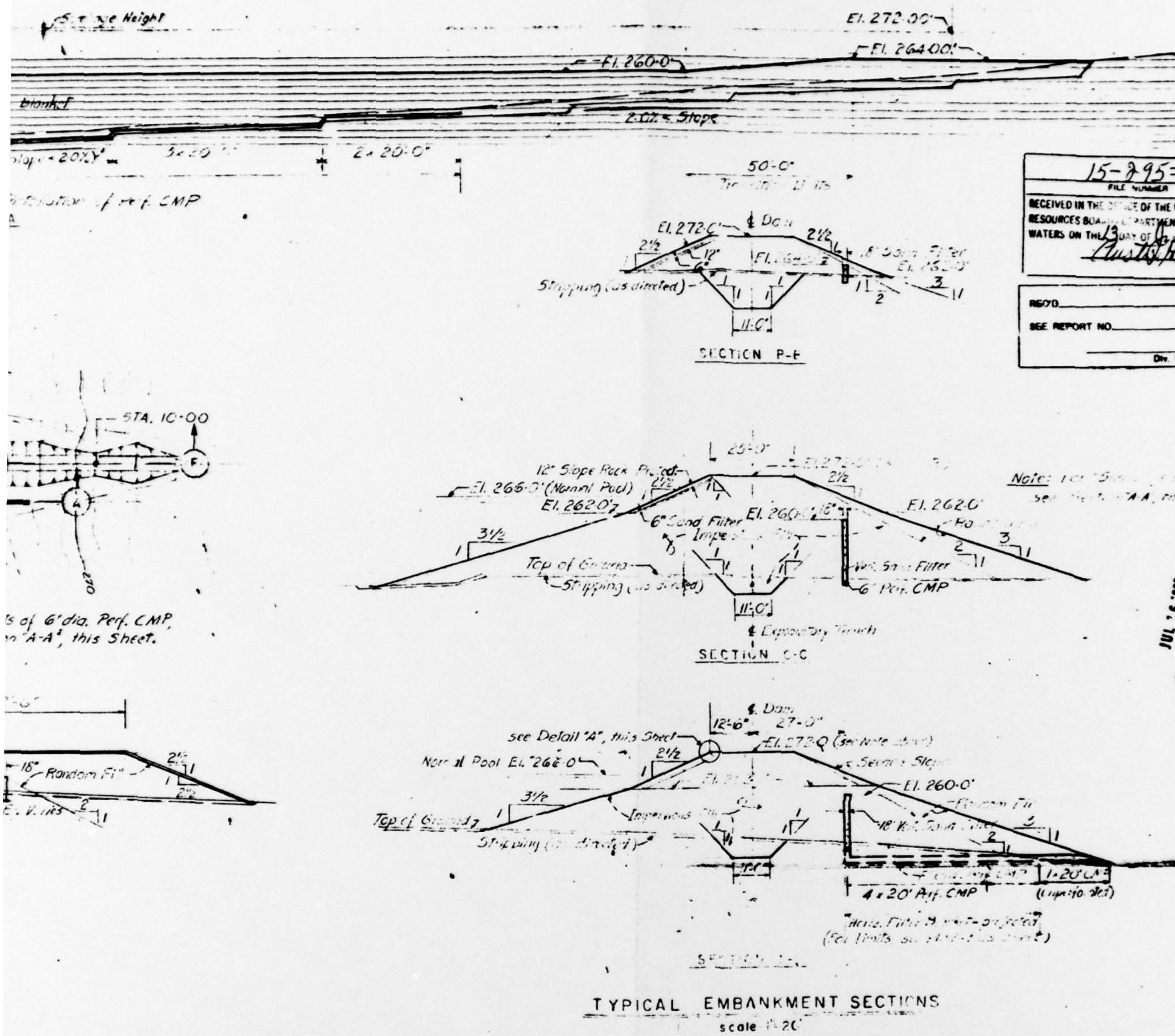
SECTION H-H
scale 1" = 4'-0"

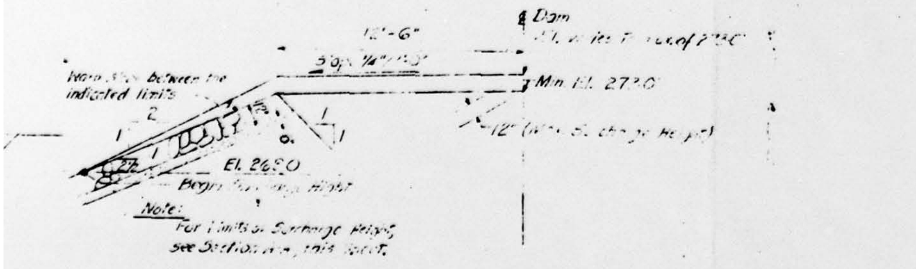


CONSTRUCTION SCHEDULE
- I. Excavate as shown
- II. Excavate 18'-wide Trench
- III. Pour Concrete Cutoff in two monolith Sections, as shown
- IV. Complete Exploratory Trench excavation, as shown

SECTION G-G
scale: 1"-4'-0"







15-295=8
FILE NUMBER
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THE 13 DAY OF July A.D. 1966
File Clerk

REC'D ____ FOR ____
SEE REPORT NO. ____
Div. Dams

JUL 26 1966

GENERAL NOTES

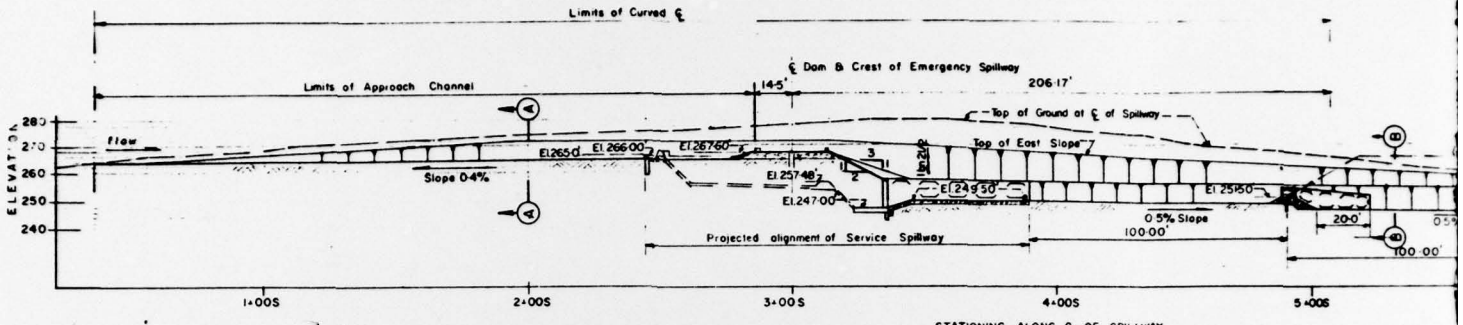
1. Stripping of at least 12-inches, or as directed by the Engineer. Limits of Stripping as shown on this Sheet (Stripping ...).
2. Extent of Exploratory Trench is shown on Plan of Foundations Treatment. Max. anticipated depth of trench is 10 feet, unless otherwise directed in the field by the Engineer.
3. Begin excav. and installation of Perforated CMP, as shown on Section "A-A" of this Sheet; and backfill with Filter Material (Sand) to top of ground.
4. Place 18" Vert. Sand Filter in lifts not to exceed 5 feet in height, upon the completion of compacted embankment material of similar vertical intervals. Sand shall be placed in an 18-inch-wide trench, the bottom of which to penetrate into a previous lift of Vert. Sand Filter, to insure uninterrupted, continuous Vert. Sand Filter.

PLATE 5

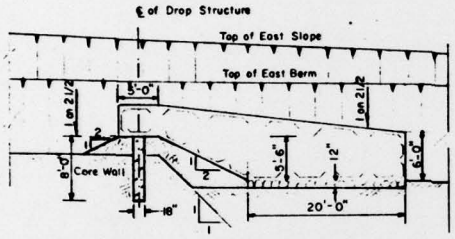
SHANGRI-LA DAM & RESERVOIR
PROPERTY OF BENJAMIN J. REYNOLDS
NEW GARDEN TWP., CHESTER CO., PA.

DRAWN BY	EMBANKMENT
TRACED	SECTIONS & DETAILS
CHECKED BY	FOUNDATIONS TREATMENT
APPROVED	
DATE JULY, 1966	CONSULTING ENGINEERS & GEOLOGISTS

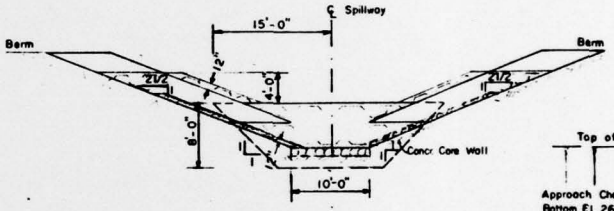
2



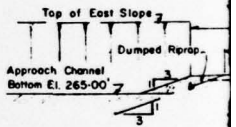
PROFILE

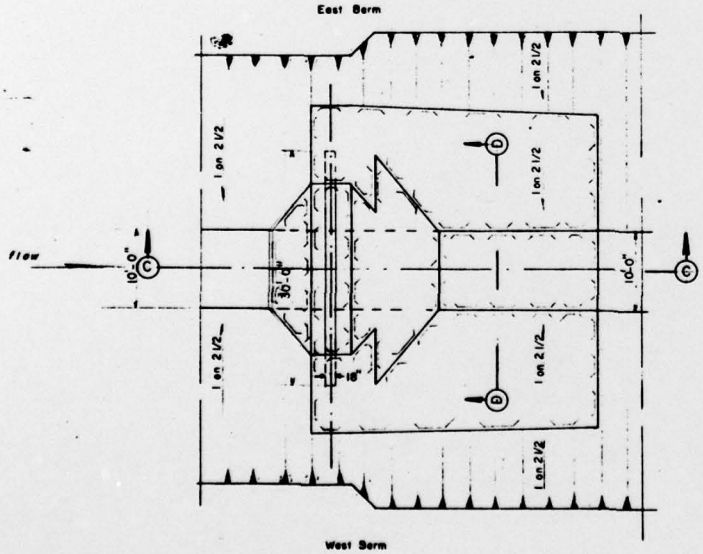


SECTION C-C

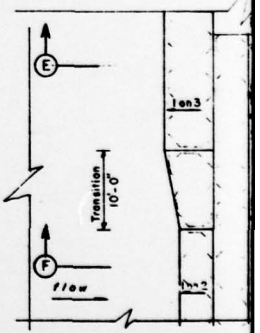


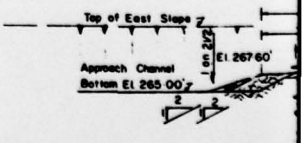
SECTION D-D





PLAN





TYPICAL "DROP-STRUCTURE" DETAIL

SCALE: 1" = 10'-0"

TYPI

15-295=9

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SEE REPORT NO. ________

Dr. Date

JUL 26 1966
C. H. McConnell
Chief Engineer

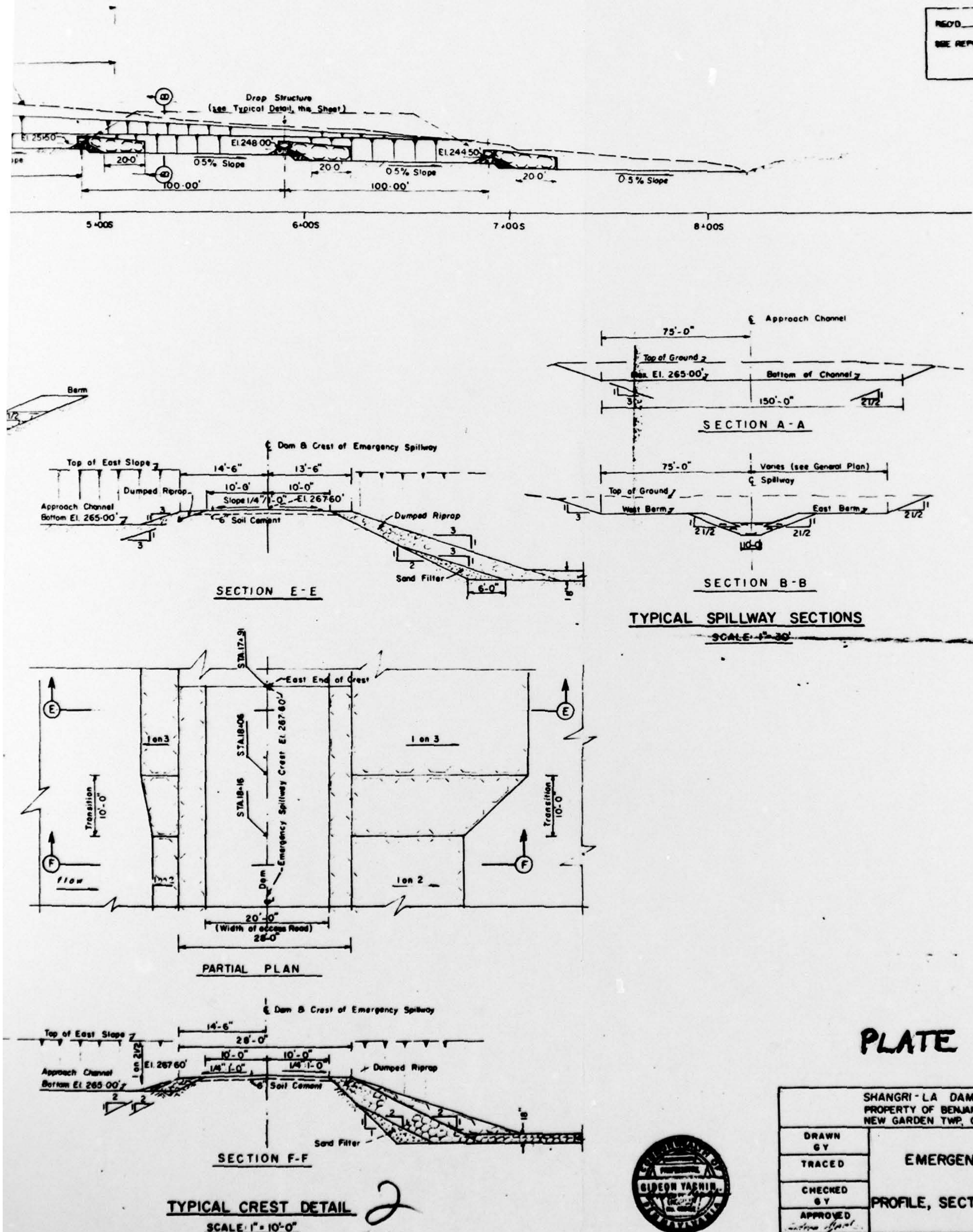


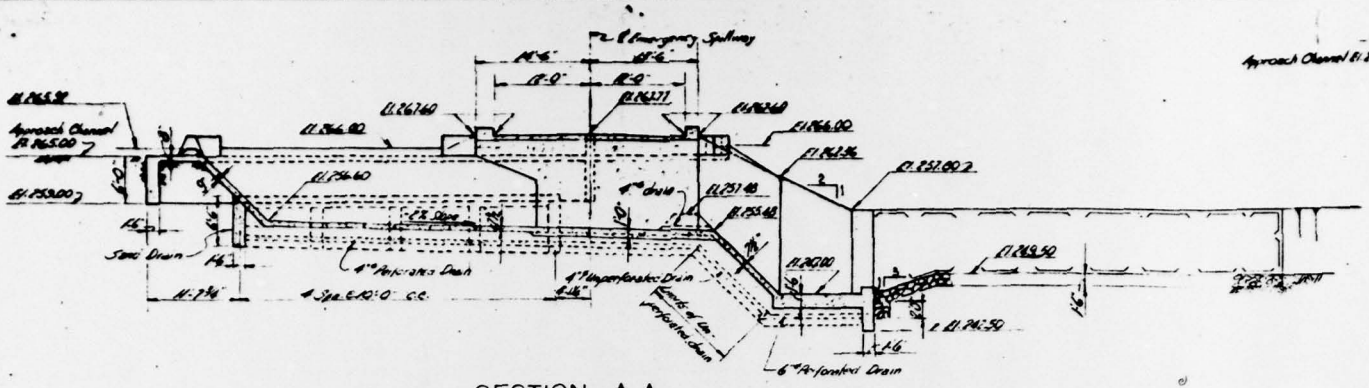
PLATE 6

PLATE 6

SHANGRI-LA DAM & RESERVOIR
PROPERTY OF BENJAMIN J. REYNOLDS
NEW GARDEN TWP, CHESTER CO., PA.

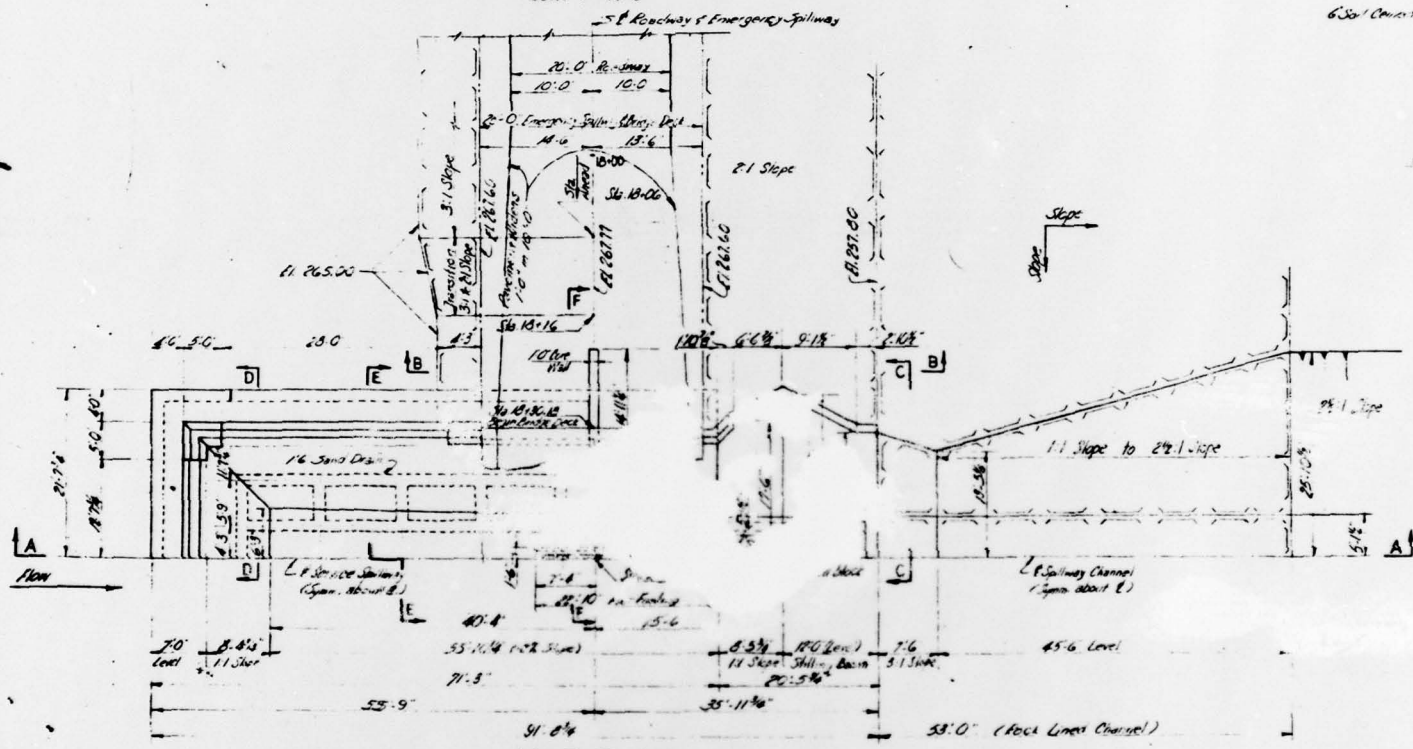
DRAWN G.Y.	EMERGENCY SPILLWAY
TRACED	
CHECKED G.Y.	PROFILE, SECTIONS & DETAILS
APPROVED	
DATE JULY, 1966	GEO-Technical Services, CONSULTING ENGINEERS & GEOLOGISTS, HARRISBURG, PA. — SHEET NO. 8

REGISTERED PROFESSIONAL ENGINEER GIDEON YACHIN COMMONWEALTH OF PENNSYLVANIA



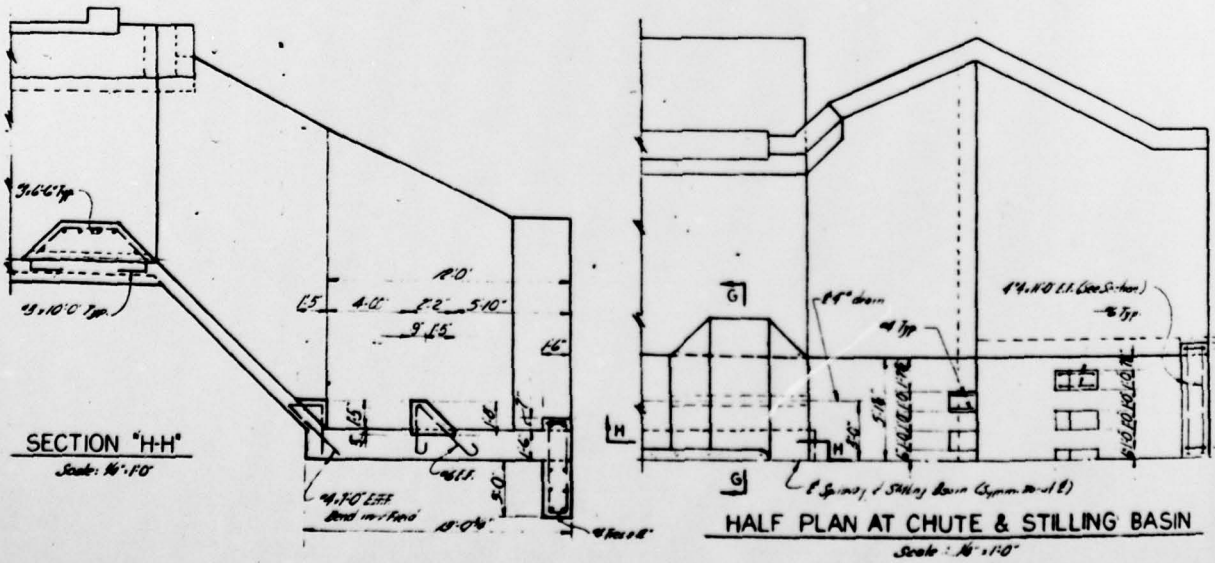
SECTION A-A

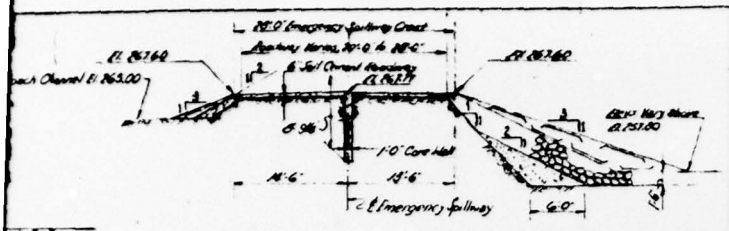
Scale: 1" = 10'-0"



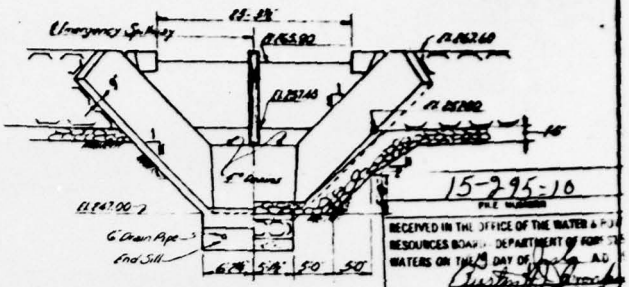
HALF PLAN

Scale: 1" = 10'-0"





SECTION "B-B"
Scale 1" = 10'-0"



SECTION "C-C"
Scale 1" = 10'-0"

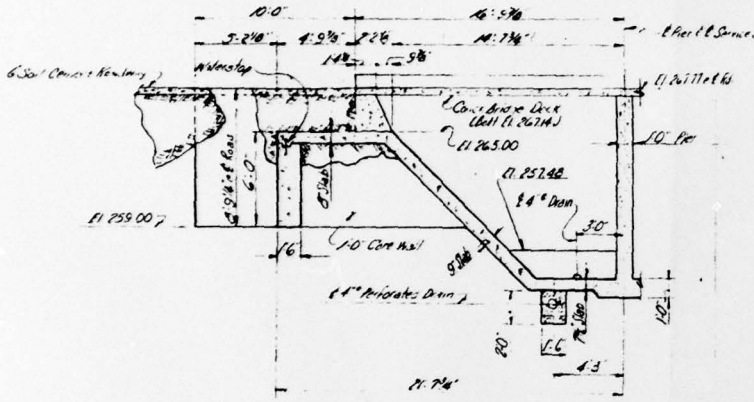
15-295-10

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD DEPARTMENT OF FORESTS AND WATERS ON THIS DAY OF A.D.

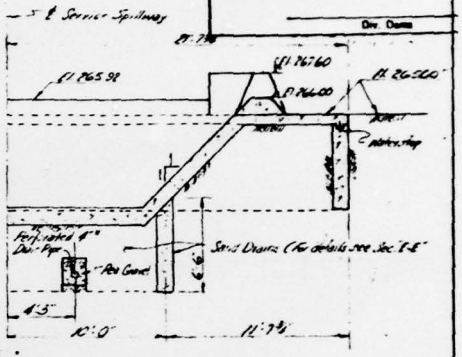
REC'D FOR

SRE REPORT NO.

Div. Dams

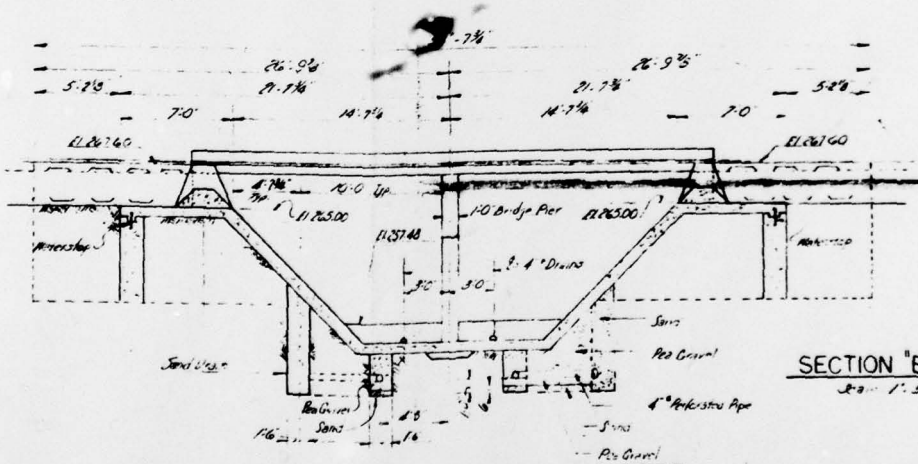


SECTION "F-F"
Scale 1" = 5'-0"



SECTION "D-D"
Scale 1" = 5'-0"

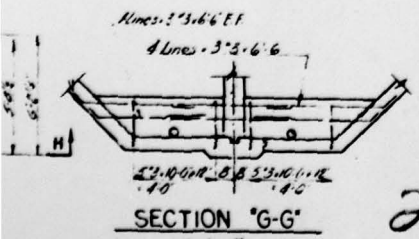
JUL 26 1966
C. H. Becknell
Chief Engineer



SECTION "E-E"
Scale 1" = 5'-0"

GENERAL NOTES

- Start excavation of Service Spillway after completion of Emergency Spillway, crest elev. 2676.0 approximately El 2650.0
- Particular care shall be exercised to prevent overcut in the Service Spillway excavations.
- Excavate trenches for concrete cut-off and fillets as shown, prior to the completion of the excavation to bottom of floor slab.
- Provide rubber or plastic waterstops as shown.
- For reinforcement details see Sheet No. 10.
- For class of concrete, required strength and type of mixes, see accompanying specifications.



SECTION "G-G"
Scale 1/8" = 1'-0"

PLATE 1

SHANGRI-LA DAM & RESERVOIR
PROPERTY OF BENJAMIN J. REYNOLDS
NEW GARDEN TWP., CHESTER CO., PA.

DRAWN JRH	SERVICE SPILLWAY
TRACED JRH	PLAN, SECTIONS & DETAILS
CHECKED	
APPROVED Gideon Yachin	
DATE JULY, 1966	GEO-Technical Services CONSULTING ENGINEERS & GEOLOGISTS HARRISBURG, PA.
	SHEET NO. 9

O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
SHANGRI-LA DAM				

PLATE 8

GENERAL PLAN
DRAWING SHOWING
PROBLEM AREAS

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO
SHANGRI LA DAM	9	RRB	6/79	

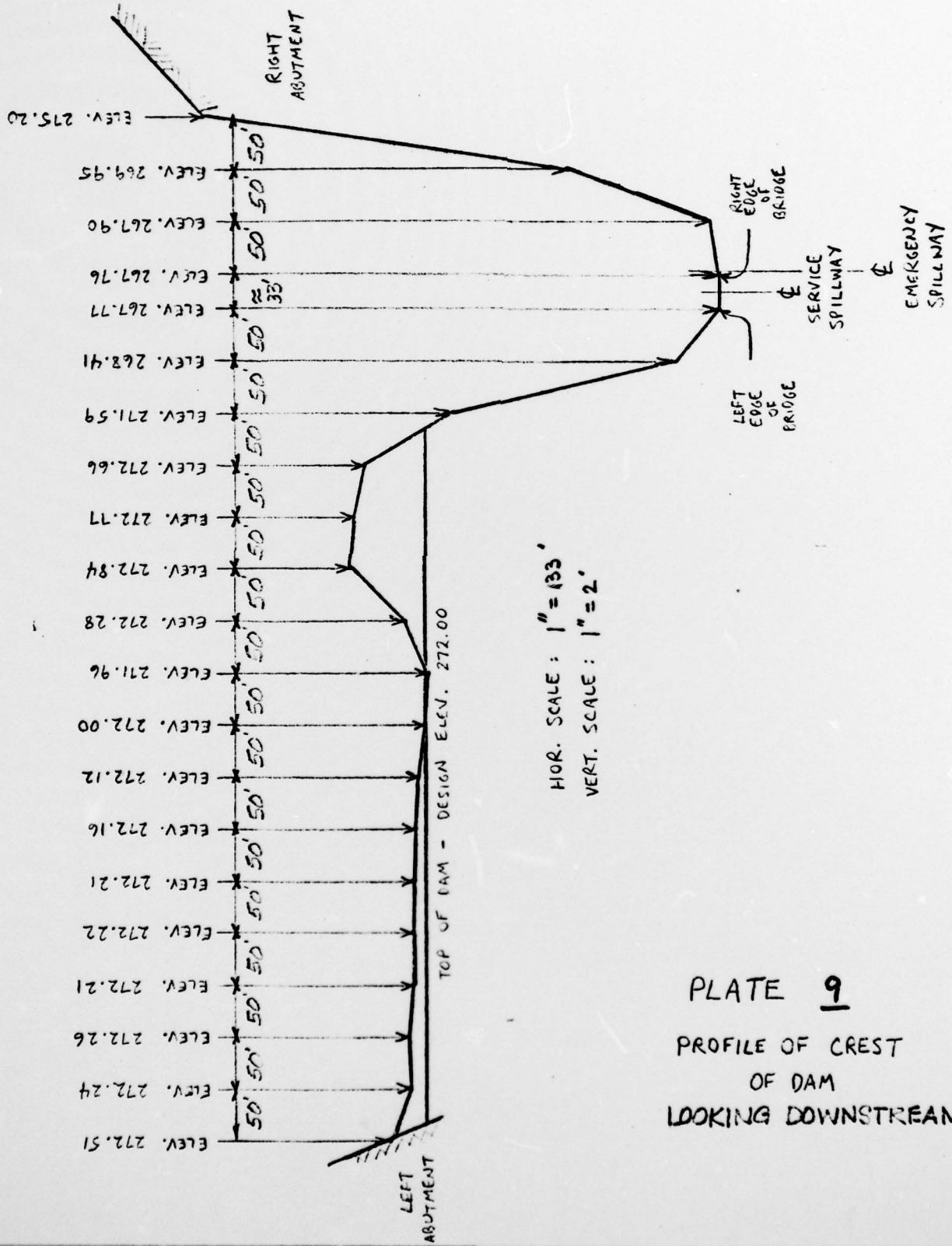


PLATE 9

PROFILE OF CREST
OF DAM
LOOKING DOWNSTREAM

APPENDIX

F

Site Geology

SITE GEOLOGY

SHANGRI-LA DAM

The Shangri-La impoundment is located in the Upland section of the Piedmont physiographic province. Bedrock at the dam site is composed of complex metamorphics dating from the Precambrian to the Lower Paleozoic eras. It is probable that the rock units present at the site are a hornblende gneiss with pegmatitic dykes and oligoclase mica schists of the Wissahickon formation. No faults or major structural defects are noted in the vicinity of the dam or reservoir.

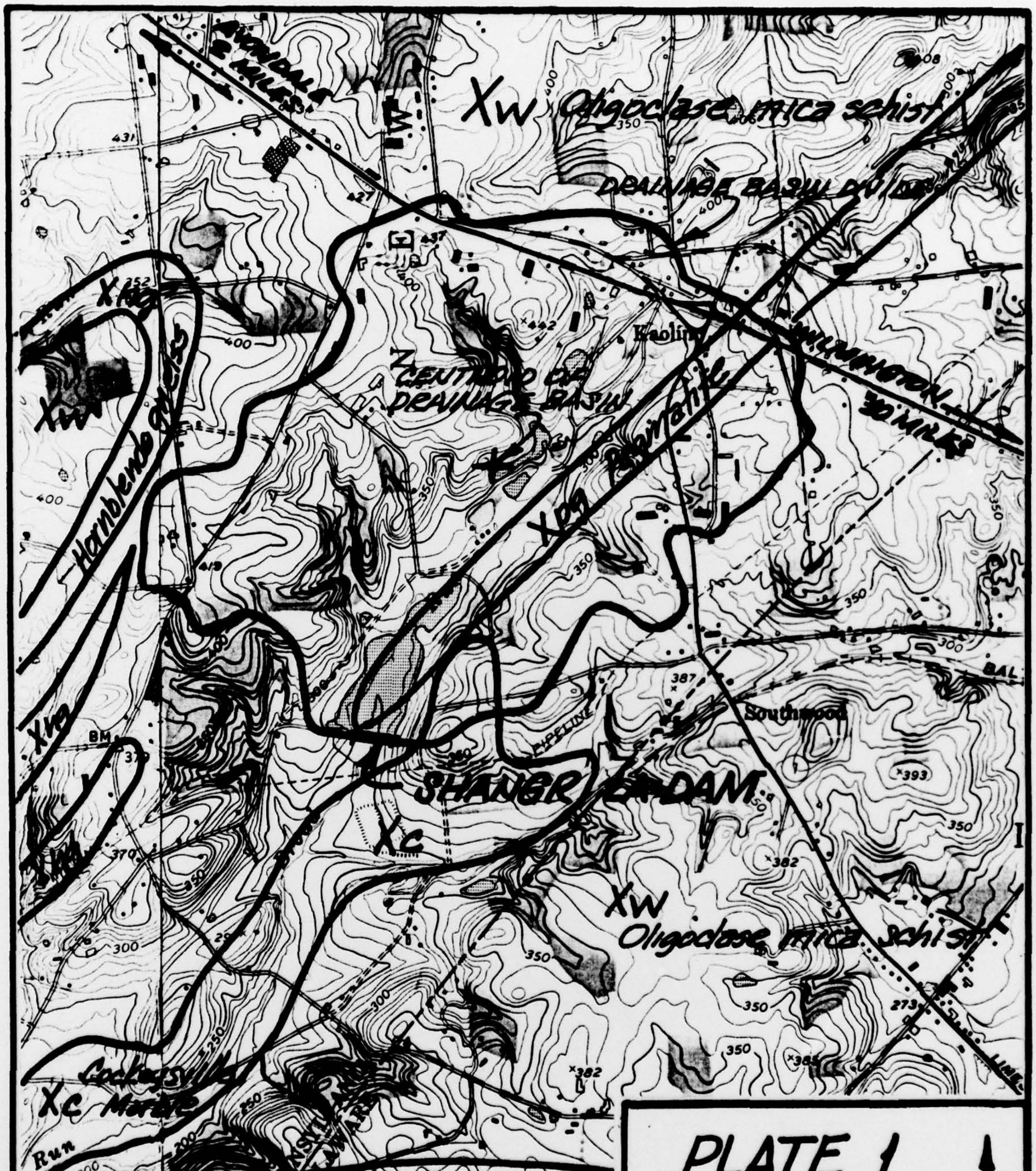


PLATE 1
REGIONAL GEOLOGY MAP
SCALE 1:24000
N