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D'APPOLONIA CONSULTING ENGINEERS INC PITTSBURGH PA
NATIONAL DAM INSPECTION PROGRAM. INDIAN LAKE DAM (NDI ID NUMBER--ETC(U)
JUL 78

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DACW31-78-C-0049
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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Indian Lake Dam
STATE LOCATED: Pennsylvania
STREAM: Calendar Run, secondary tributary of Stoney Creek, a tributary
of the Conemaugh River
DATE OF INSPECTION: (May 17 and 30, 1978),

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection, as revealed by the visual observations, and the review of available information, the condition of Indian Lake Dam is assessed to require immediate further investigation to determine its structural stability and appropriate measures for controlling seepage through the embankment.

Field observations show that wet areas and slope irregularities exist on the downstream face of the dam, which suggests potential instability of the embankment. Various seepages on the left abutment also require further evaluation, to determine the effect of these conditions on the overall performance of the dam.

The outlet pipe gate, which is the only emergency drawdown facility for the impoundment, is inoperative and should be repaired immediately.

Based on the recommended spillway evaluation procedure, the capacity of the spillway was found to be adequate to pass the recommended flow of probable maximum flood.

It is recommended that the owner should develop a formal warning system to alert the downstream residents in the event of emergencies.

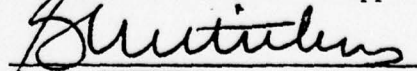


Lawrence D. Andersen, P.E.
Vice President



APPROVED BY;

Except that I recommend that the lake be drawn down to elevation 2250 until the studies recommended in my 19 July 78 letter to Governor Shapp have been performed.



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

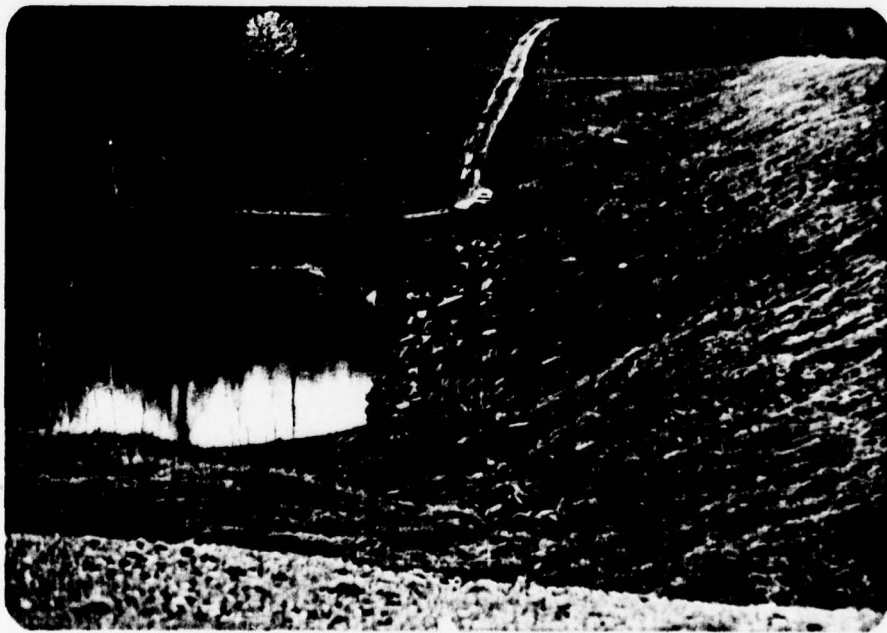
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INDIAN LAKE DAM
MAY 16, 1978



Upstream Face



Downstream Face

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⑥ National Dam Inspection Program, Indian
Lake Dam (NDI ID Number 228), Ohio
River Basin, Calendars Run, Somerset
County, Pennsylvania. Phase I Inspection
Report.

⑮ DACW 34-78-C-0049 | ⑪ Jul 78

⑫ 65 p.

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PHASE I
NATIONAL DAM INSPECTION PROGRAM
INDIAN LAKE DAM
NDI I.D. NO. 228
DER I.D. NO. 56-103

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. The dam consists of an earth embankment 960 feet long, with a maximum height of 71 feet from the downstream toe. The combined primary and emergency spillway is located through the left abutment (looking downstream) (Plate 1). The spillway consists of a shallow approach channel terminating at a steep, concrete chute spillway. The flow through the reservoir is controlled by the 150-foot-wide crest of the chute spillway at a level of 11 feet below the dam crest. The chute spillway discharges into a plunge pool which spills directly into Lake Stoneycreek. The outlet for the dam consists of a 36-inch corrugated metal pipe located midway between the abutments. Flow through the drainpipe is controlled by a hydraulically operated gate located on the upstream end of the pipe. This pipe is the only emergency drawdown facility for the dam. The dam impounds 19,200 acre-feet of water at normal pool level.

b. Location. Indian Lake Dam is located (Plate 2) on Calendar Run, a secondary tributary of Stoney Creek immediately upstream of Lake Stoneycreek. It is a recreational lake two miles northeast of Shanksville in the Borough of Indian Lake, Somerset County, Pennsylvania.

Indian Lake Dam impounds a 541-acre reservoir at normal pool level and spills into Lake Stoneycreek which has a lake surface area of 170 acres. Lake Stoneycreek discharges into Rhoads Creek, which passes through the eastern edge of the town of Shanksville and joins Stoney Creek about 1000 feet south of the town. A major portion of

the town, which includes about 50 homes and various commercial buildings, is considered to be within the flood plain of Rhoads Creek. It is estimated that a failure of Indian Lake Dam would also result in the failure of Lake Stoneycreek Dam, and the combined discharge would cause significant loss of life and property damage in Shanksville.

Failure of Indian Lake Dam would also cause significant property damage and possible loss of life in the homes located around Lake Stoneycreek, since many of these homes (about 50) are located below the crest level of Lake Stoneycreek Dam and would be flooded before the dam overtopped.

c. Size Classification. Intermediate (based on 71-foot height).

d. Hazard Classification. High.

e. Ownership. Borough of Indian Lake. (Address: Mr. C. A. Gregory, Borough Manager, Indian Lake Borough, R. D. 1, Indian Lake, Central City, Pennsylvania 15926).

f. Purpose of Dam. Recreation.

g. Design and Construction History. The dam was designed by E. D'Appolonia Associates of Pittsburgh, Pennsylvania. It was constructed by the forces of the owner and construction was completed in 1964.

h. Normal Operating Procedure. The reservoir is maintained at the spillway crest, Elevation 2280, leaving 11 feet of freeboard to the top of the dam. All flow occurring when pool is at or above the spillway elevation is discharged through the spillway. It was reported by the borough manager that the outlet pipe for the dam has been inoperative for several years.

1.3 Pertinent Data

a. Drainage Area - 13.7 square miles

b. Discharge at Dam Site

Maximum known flood at dam site - Unknown

Warm water outlet at pool elevation - N/A

Diversion tunnel low pool outlet at pool elevation - N/A

Diversion tunnel outlet at pool elevation - 330 cfs

Gated spillway capacity at pool elevation - N/A

Gated spillway capacity at maximum pool elevation - N/A

Ungated spillway capacity at maximum pool elevation -

13,000 cfs at Elevation 2291

Total spillway capacity at maximum pool elevation - 13,000 cfs at Elevation 2291

c. Elevation (USGS Datum) (feet)

Top of dam - 2291
Maximum pool-design surcharge - N/A
Full flood control pool - N/A
Recreation pool - 2280
Spillway crest - 2280
Upstream portal invert diversion tunnel - N/A
Downstream portal invert diversion tunnel - N/A
Streambed at center line of dam - 2227+
Maximum tailwater - 2241

d. Reservoir (feet)

Length of maximum pool - 13,000 at Elevation 2291
Length of recreation pool - 12,000
Length of flood control pool - N/A

e. Storage (acre-feet)

Recreation pool (normal pool) - 19,200
Flood control pool - N/A
Design surcharge - N/A
Top of dam - 26,044

f. Reservoir Surface (acres)

Top of dam - 770
Maximum pool - N/A
Flood control pool - N/A
Recreation pool - 541
Spillway crest - 541

g. Dam

Type - Earth
Length (crest excluding spillway) - 960 feet
Height - 71 feet
Top width - 20 feet
Side slopes - 2:1, downstream; 2.5:1, upstream
Zoning - No
Impervious core - Homogeneous impervious embankment
Cutoff - Yes
Grout curtain - N/A

h. Diversion and Regulating Tunnel

Type - Corrugated metal pipe
Length - 290 feet
Closure - Upstream sluice gate
Access - Valve control on crest (nonfunctional)
Regulating facilities - None

i. Spillway

Type - Concrete broad-crested weir

Length of weir - 150 feet

Crest elevation - 2280 feet

Gates - N/A

Upstream channel - 156-foot-wide trapezoidal approach channel

Downstream channel - Lake Stoneycreek

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. A report prepared by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), dated September 7, 1962, summarizes most of the hydrologic and hydraulic design data which are available for the project. The report states the criteria used for the design of the spillway.

(2) Embankment. The embankment design is based on a report entitled, Design Data for Indian Lake Dam, dated 1962, prepared by E. D'Appolonia Associates for Neilan Engineers, Inc., of Somerset, Pennsylvania.

The report includes results of geologic reconnaissance of the site, subsurface exploration, laboratory testing programs, and recommendations for the embankment design.

(3) Appurtenant Structures. Structural design data for the appurtenant facilities were not available.

b. Design Features

(1) Embankment. A review of design drawings and the engineering report shows the following main features of the project:

- (a) As designed, the dam is essentially a homogeneous embankment with an impervious blanket extending upstream to the cutoff trench and a downstream rock toe drain. A filter zone of material separates the earth fill and rock toe (Plate 3).
- (b) The embankment was designed to have an upstream slope of 2-1/2 to one (horizontal to vertical) and a downstream slope of two to one.
- (c) The impervious blanket was designed to cover an area approximately 200 feet wide along the upstream toe extending from the valley bottom to the top of the left abutment. The minimum specified thickness of the blanket was 10 feet. At the upstream end of the impervious blanket, a cutoff was excavated down to the foundation rock level and backfilled with impervious material.

(2) Appurtenant Structures. Appurtenant structures for the dam consist of a spillway and outlet works. The spillway structures include a shallow approach channel, a control weir, a concrete spillway chute, and a flip-bucket stilling basin. Plate 1 shows the location of the spillway. The details of the control section, chute, and the stilling basin are shown in Plate 4. The crest of the uncontrolled weir of the spillway is at Elevation 2280. Flow from the weir discharges into a 150-foot-wide chute section which terminates at a flip-bucket at Elevation 2230. Design drawings indicate that the flip-bucket was founded on rock and tied to the foundation with grouted anchor rods. Plate 5 illustrates the cross section of the dam at the outlet works. The outlet pipe for the dam is a concrete encased, 36-inch corrugated metal pipe. Flow through the pipe is controlled by a hydraulically operated sluice gate on the upstream end of the pipe. The design includes cutoff collars around the pipe to control seepage along the pipe.

c. Design Data

(1) Hydrology and Hydraulics. The 1962 PennDER report states that according to the criteria in effect at the time of the design, the spillway was required to pass 10,365 cubic feet per second (cfs). It is further stated that the spillway is capable of passing this flow with a freeboard of 5.7 feet. Design drawings show that the discharge capacity of the outlet pipe is 330 cfs when water level is at Elevation 2280.

(2) Dam. The embankment design was based on the geology and soils report prepared by E. D'Appolonia Associates. The report includes a description of the subsurface conditions and the types of laboratory tests conducted on the foundation and borrow materials. Based on the direct shear test results, the strength parameters for the embankment material were reported to be: internal friction angle, $\phi = 30$ degrees; and cohesion, 1000 pounds per square foot. The report summarized the results of seepage and slope stability analyses. Using coefficients of permeability of 1×10^{-7} and 1×10^{-4} for embankment and foundation materials, respectively, the seepage through the dam was calculated to be 100 gallons per day per foot within the dam. Under steady seepage conditions, the safety factors for the downstream and upstream slopes were reported to be 1.7 and 2.9, respectively.

The report also included recommendations for installing piezometers at two stations. At each station, three piezometers were to be installed along a line normal to the center line of the dam to measure pore pressures or phreatic surface within the rolled fill sections. It was also recommended that three piezometers be installed in the bedrock to measure pore pressures within the rock. No information was found to indicate that these piezometers were installed.

(3) Appurtenant Structures. Very limited structural design calculations were available for the appurtenant structures. The available calculations indicate that the spillway chute side retaining walls were designed for an earth pressure equivalent to 35 pounds per cubic foot fluid pressure.

2.2 Construction. Construction drawings prepared by Neilan Engineers and E. D'Appolonia Associates, various construction photographs, and field progress reports were available for review. Based on this information, it was determined that the construction followed the requirements of the design. No reference was found to indicate any unusual problems during construction of the dam.

2.3 Operation. There are no formal operating records available for the dam. The dam is a recreational lake and discharges through an uncontrolled spillway.

A 36-inch pipe controlled by an upstream sluice gate is the only low-level outlet facility for the reservoir and it is currently nonfunctional.

2.4 Other Investigations. The available information includes various state reports prepared prior to and during construction. The dam was inspected by the state in 1972 and 1976. The reports of these inspections are available in PennDER files.

2.5 Evaluation

a. Availability. Available information was obtained from PennDER and E. D'Appolonia Associates files.

b. Adequacy

(1) Hydrology and Hydraulics. The reported results of the hydrology and hydraulic analyses indicate that the design followed the criteria set forth by the Commonwealth of Pennsylvania, Department of Forests and Waters, applicable at the time of the design.

(2) Embankment. Review of the geotechnical aspects of the design indicates that the design generally followed currently accepted practice for such an analysis. The design included seepage and stability analyses based on permeability and strength parameters obtained from laboratory test results.

(3) Appurtenant Structures. Review of design drawings indicates that as designed there are no significant design deficiencies that should affect the overall performance of the appurtenant structures.

c. Operating Records. No formal operating records are available for the dam. The manager of Indian Borough reported that the outlet pipe sluice gate has been inoperative for several years.

d. Post-Construction Changes. As reported by PennDER, embankment and abutments were grouted shortly after filling of the lake to control seepage.

e. Seismic Stability. The dam is located in Seismic Zone 1. Because adequate assessment of the static stability of the dam requires further investigation, evaluation of the seismic stability cannot be made at this time.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Indian Lake Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.
2. Visual examination of the spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.
3. Observation of factors affecting the runoff potential of the drainage basin.
4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 6 and in the photographs in Appendix C.

b. Dam. The general inspection of the dam consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

1. Numerous wet areas were observed on the downstream slope at a level approximately 20 feet below the crest of the dam.
2. The middle one-third of the downstream slope in the vicinity of the toe appeared to have slumped in the past. However, no surficial cracks were observed.
3. Numerous concentrated seeps and wet areas were observed on the left abutment through the natural ground. The estimated quantity of seepage is shown in Plate 6. Seeps were clear and no indication of internal erosion was observed.
4. Several wet and swampy areas were also observed on the right abutment in the vicinity of the toe of the dam.

5. The total seepage discharging on each side of the drainpipe headwall at the toe of the dam was estimated to be in the range of 15 to 20 gallons per minute (gpm). This seepage was also clear.
6. The outlet pipe gate hydraulic controls located on the crest of the dam were abandoned and not functional.
7. Riprap on the upstream face of the dam does not extend to the crest of the dam.

c. Appurtenant Structures. The spillway structures were examined for deterioration of the concrete or other signs of distress and obstructions that would limit flow. These structures were found to be in good condition and performing satisfactorily.

d. Reservoir Area. The watershed is predominantly woodlands, pasturelands, and low density residential development. A small portion of the watershed has been strip mined. Infiltration capacity is estimated to be good.

A review of the regional geology (Appendix E) indicates that shorelines are not likely to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

e. Downstream Channel. The spillway of Indian Lake Dam discharges directly into Lake Stoneycreek. It is estimated that failure of Indian Lake Dam would cause the failure of Lake Stoneycreek Dam, and the combined discharge would cause loss of life and extensive property damage in Shanksville and further downstream. Further description of downstream conditions is included in Section 1.2.b.

3.2 Evaluation. In general, the condition of the dam is considered to be poor.

The most significant condition at the dam appears to be the wet areas noted on the downstream face and associated surface irregularities. These conditions suggest possible high phreatic surface (probably perched) through the embankment and consequent instability.

Seeps on both abutments and in the vicinity of the outlet end of the drainpipe may also affect the overall performance of the embankment.

The drainpipe, which is the only low-level drain system for the lake, is not operational.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedures. Review of the design drawings and field observations indicates that there are no formal procedures for operating the dam. The only operational feature of the dam which may affect the safety of the dam is the outlet pipe sluice gate, in case it is required to lower the reservoir.

The clearing of debris from the spillway as required and continued inspection of the facilities are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The maintenance conditions of the dam are poor. There is no formal dam tender responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities. The only operational feature of the dam, the drainpipe gate, was abandoned and not functional.

4.4 Warning System in Effect. There is no formal warning system in effect. Telephone communication is available via residences in the vicinity of the dam.

4.5 Evaluation. The dam is not adequately maintained. It is considered to be accessible under all weather conditions for inspection and emergency action.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Indian Lake Dam has a watershed area of 13.7 square miles and impounds a reservoir with a surface area of 541 acres. A 150-foot-wide spillway constitutes the flood discharge system for the impoundment. The flow through the spillway is controlled by an ogee weir at Elevation 2280, eleven feet below the dam crest at Elevation 2291. The spillway has a maximum discharge capacity of 13,000 cfs with no freeboard.

b. Experience Data. As previously stated, Indian Lake Dam is classified to be an "intermediate" size dam in the "high" hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass the probable maximum flood (PMF).

The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers (Appendix D). Based on this analysis procedure, it was determined that the PMF inflow hydrograph would have a peak flow of 19,200 cfs and a total volume of approximately 19,000 acre-feet. Further analysis based on the procedure indicates that the dam can pass the recommended PMF design inflow without overtopping, using the design crest elevation for the dam.

c. Visual Observations. On the date of inspection, no conditions were observed which would indicate that the spillway of the dam could not operate satisfactorily in the event of flood.

d. Overtopping Potential. As stated above, the spillway can pass the PMF without the dam being overtopped. However, the riprap on the upstream slope does not extend to the crest level of the dam and the crest level is not uniform. Therefore, the crest of the dam should be regraded and riprap should be extended to the design crest level for adequate performance of the embankment.

e. Spillway Adequacy. The spillway can pass the PMF, therefore, it is classified as adequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations revealed various signs of distress that may affect the stability of the dam.

The presence of wet areas on the downstream face of the dam and surface irregularities associated with these areas raise concern about the stability of the dam. Further investigation is required to evaluate the stability of the embankment. The affect of various seeps located on both abutments and at the outlet end of the drainpipe should also be evaluated because they affect the overall performance of the embankment.

(2) Appurtenant Structures. The structural condition of spillway components are considered to be satisfactory. The structural condition of the 36-inch drainpipe could not be assessed.

b. Design and Construction Data

(1) Dam. The soils investigation report prepared by E. D'Appolonia Associates, Inc., includes description of subsurface conditions (Plate 7), the results of laboratory tests, and stability and seepage analyses. Pertinent data were included in Section 2.1.c(2). The stability calculations are included in the design drawings. The report also includes recommendations for installation of piezometers within the embankment and foundation to measure pore pressures or phreatic levels within these zones.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of appurtenant structures.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. As reported by PennDER, the embankment and abutments were grouted shortly after filling of the lake to control seepage through these sections.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations indicate that Indian Lake Dam requires further investigation. The field observations revealed various conditions, such as wet areas on the embankment and embankment slope irregularities, which suggest potential slope instability.

The capacity of the spillway was found to be adequate relative to the recommended spillway capacity criteria.

b. Adequacy of Information. The available information in conjunction with visual observations and the previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the condition of the dam.

c. Urgency. Further investigation of the dam and repairs to the outlet pipe sluice gate should be implemented immediately. The other recommendations should be considered as soon as practicable or on a continuing basis.

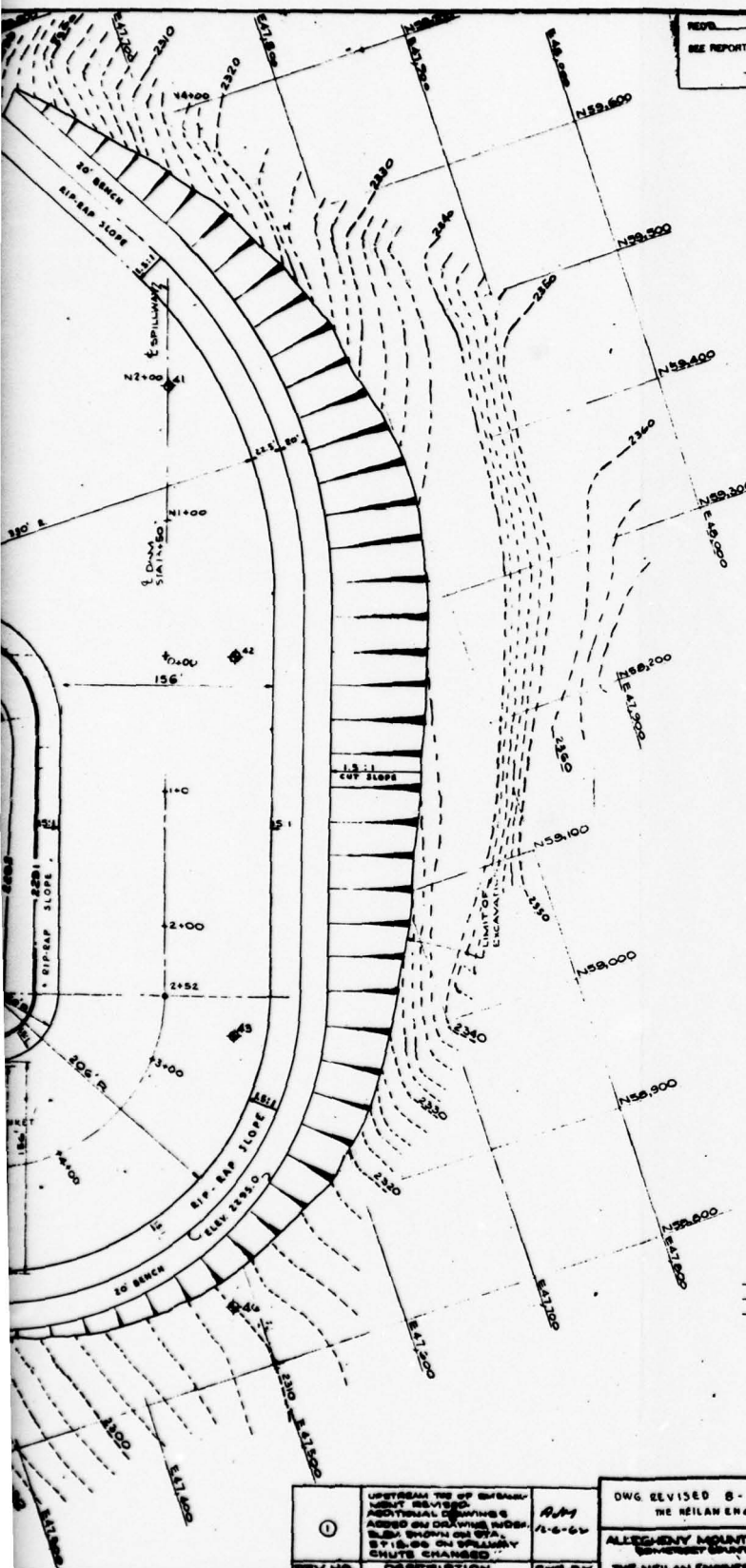
d. Necessity for Further Investigation. The condition of the dam is considered to require further investigation.

7.2 Recommendations/Remedial Measures

1. The stability of the dam and methods for controlling existing seepages should be further evaluated in view of the following conditions: (a) the presence of slope irregularities and wet areas on the downstream slope, and (b) numerous seeps on each abutment.
2. Outlet pipe sluice gate controls should be repaired immediately.
3. The crest of the dam should be regraded and the upstream riprap should be extended to the design crest level.
4. The dam and appurtenant structures should be inspected regularly and any unusual conditions should be reported to the appropriate authorities.
5. The owner should develop a formal warning system to alert the downstream residents in the event of emergencies.

PLATES

20



RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FOREST & WATERS ON THE 17th DAY OF July, A.D. 1965
Clayton H. ...

- GENERAL NOTES**
- CONCRETE STRENGTH:**
 ALL STRUCTURAL CONCRETE TO DEVELOP 3000 PSI AT 28 DAYS.
 ALL FILL CONCRETE TO DEVELOP 2000 PSI AT 28 DAYS.
 - PROTECTION FOR REINFORCEMENT:**
 CONCRETE PLACED AGAINST ROCK - 2" CLEAR
 CONCRETE EXPOSED TO WEATHER - 2" CLEAR
 - CONCRETE PLACED ON GRANULAR UNDERDRAIN MATERIAL:**
 THE COARSE GRANULAR UNDERDRAIN MATERIAL SHOULD BE SURFACE CHECKED WITH DAMP SAND IMMEDIATELY PRIOR TO PLACING.
 - PLACEMENT OF SPILLWAY SLABS & WALL PANELS:**
 ALL UNITS SHOULD BE PLACED ALTERNATELY TO MINIMIZE CONTRACTION OPENINGS AT CONSTRUCTION JOINTS.
 - CONSTRUCTION JOINTS:**
 ALL CONSTRUCTION JOINTS SHALL CONTAIN A SIX INCH (6") POLYVINYL CHLORIDE WATER STOP.
 - REINFORCEMENT:**
 ALL REINFORCEMENT SHALL MEET THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS FOR BILLET STEEL REINFORCEMENT BARS, INTERMEDIATE GRADE (A.S.T.M. DESIGNATION A15-58). ALL REINFORCING RODS SHALL BE DEFORMED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR THE MINIMUM REQUIREMENTS FOR DEFORMATION OF DEFORMED STEEL BARS FOR CONCRETE REINFORCEMENT (A.S.T.M. DESIGNATION A305-56T). ALL REINFORCING BAR BENDS SHALL CONFORM TO THE DIMENSIONS SHOWN IN "THE MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES" (ACI-315-57).
 - SPILLWAY AREA DRAWING INDEX:**

DWG. NO.	TITLE
G2-143-E25	SPILLWAY AREA - PLAN AND LOCATION OF BORINGS
G2-143-E26	BORING LOGS - BORINGS 41, 42, 43, & 44
G2-143-E27	BORING LOGS - BORINGS 45, 46, 47 & 48
G2-143-E28	SPILLWAY AREA - SECTION A-A & SECTION B-B
G2-143-E29	SPILLWAY AREA - SECTION C-C & SECTION D-D
G2-143-E30	SPILLWAY AREA - SECTION E-E & SECTION F-F
G2-143-E31	GENERAL PLAN OF SPILLWAY AREA
G2-143-E32	CONCRETE SPILLWAY GEOMETRY & SPILLWAY CENTERLINE PROFILE
G2-143-E33	SPILLWAY PAVING SLABS AND WALL GEOMETRY
G2-143-E34	SPILLWAY PAVING AND DRAINS: GENERAL ARRANGEMENT & DETAILS - SHEET 2
G2-143-E35	SPILLWAY CONCRETE DETAILS

THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDG

- LEGEND**
- EXISTING GROUND SURFACE CONTOURS
 - NEW WORK AND NEW GROUND LINES & CONTOURS
 - DAM WORK LINES AND CONTOURS
 - TEST BORINGS

revised 8/27/65

© 41%

①	UPSTREAM END OF SPILLWAY	REVISED	8-15-65	THE NEILAN ENGINEERS, INC.	INDIAN LAKE PROJECT
	ADDITIONAL DRAWINGS & NOTES				
REV. NO.	DESCRIPTION	DATE	BY	THE NEILAN ENGINEERS, INC.	5

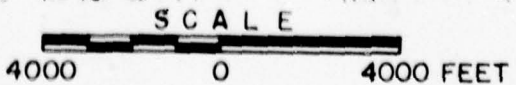
PLATE I

D'APPOLONIA

DRAWN S/S CHECKED BY S/S DRAWING 78-1-544
BY S-3-78 APPROVED BY



REFERENCES:
USGS 7.5' STOYSTOWN, PA. QUADRANGLE
1971, SCALE - 1:2000
USGS 7.5' CENTRAL CITY, PA. QUADRANGLE
1971, SCALE - 1:2000
USGS 7.5' BERLIN, PA. QUADRANGLE
PHOTOREVISED 1973, SCALE - 1:2000
USGS 7.5' NEW BALTIMORE QUADRANGLE
PHOTOREVISED 1973, SCALE - 1:2000



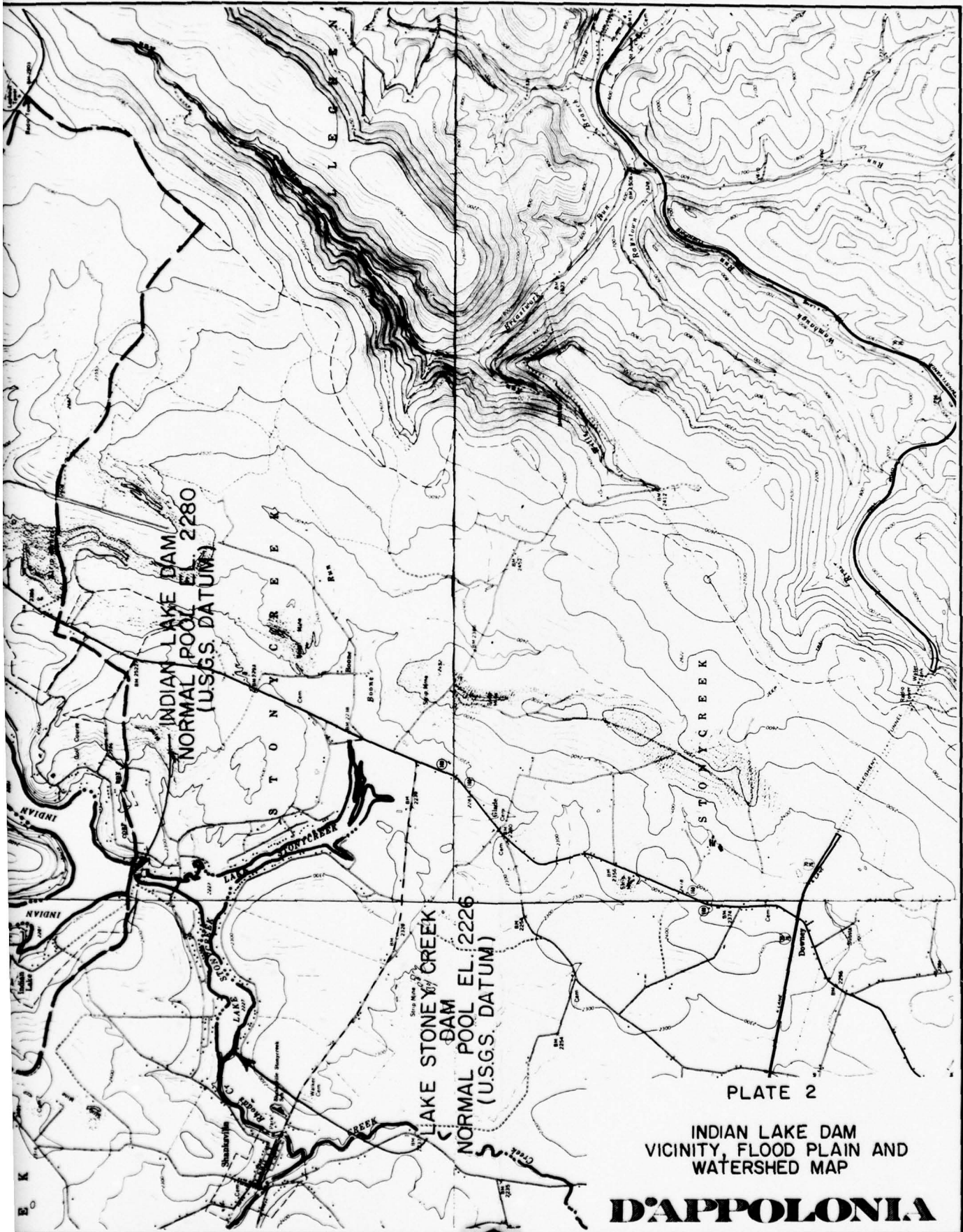


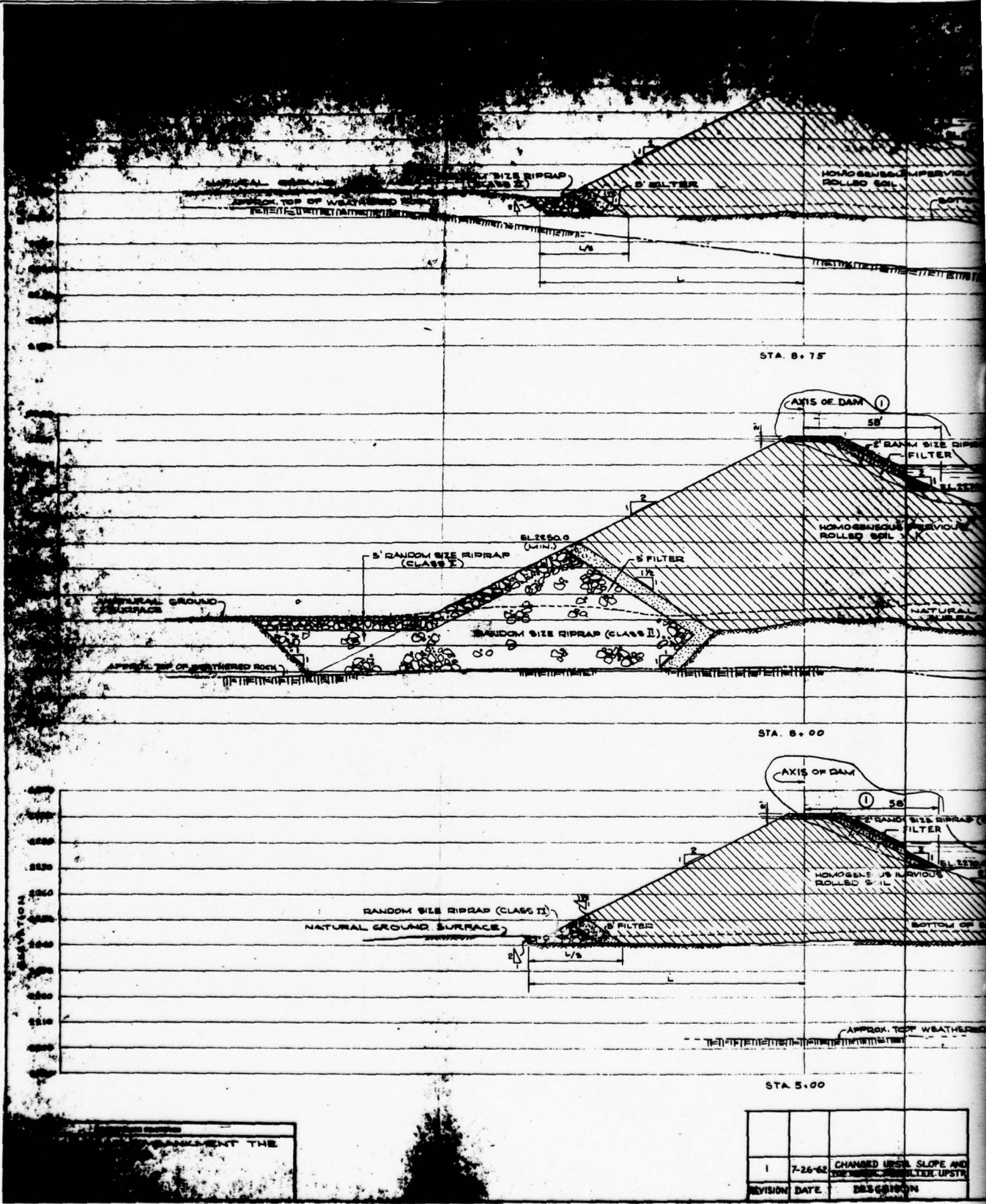
PLATE 2

INDIAN LAKE DAM
VICINITY, FLOOD PLAIN AND
WATERSHED MAP

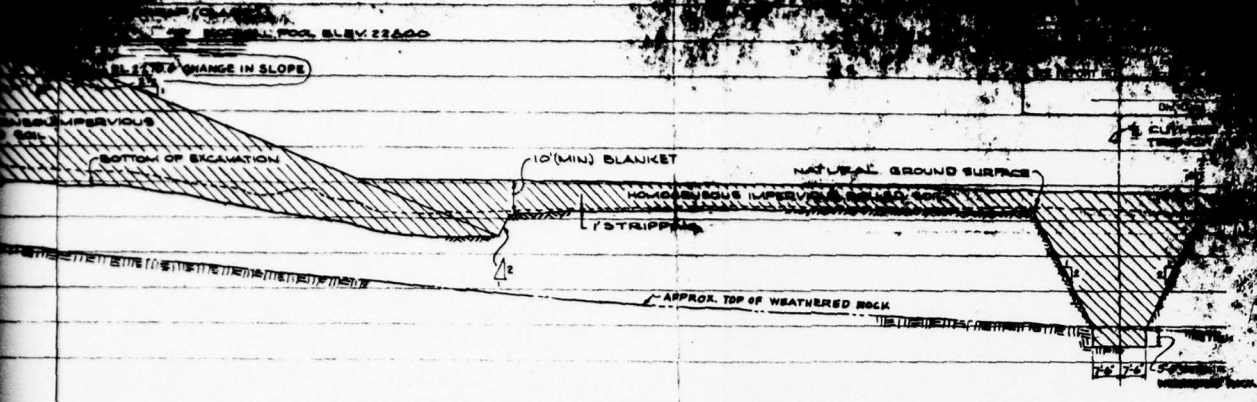
D'APPOLONIA

2

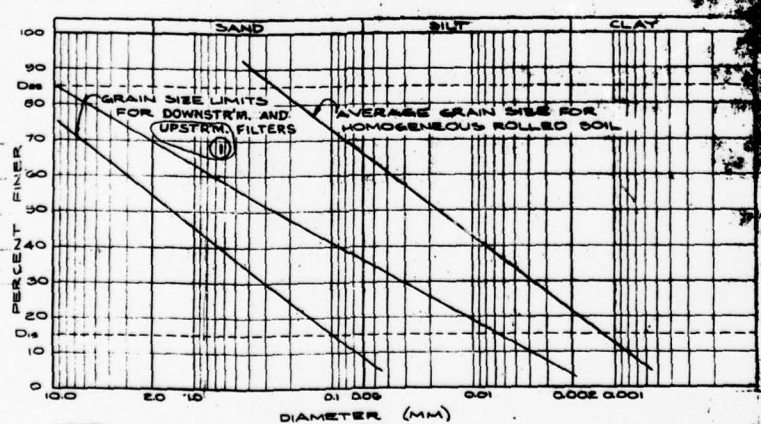
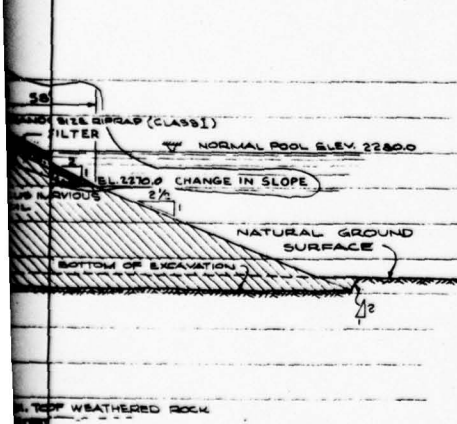
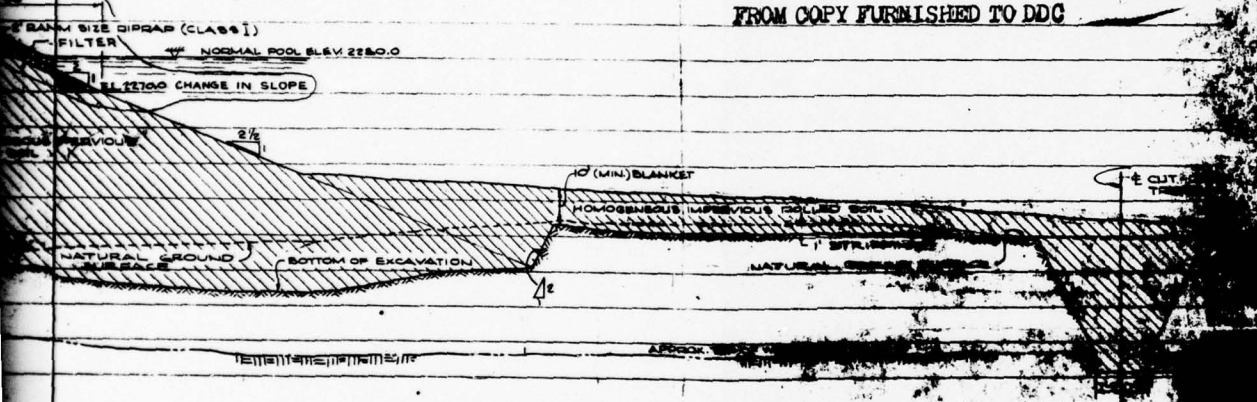
DRAWN BY: RGN 5-25-78
 CHECKED BY: EF 7-5-78
 APPROVED BY: SHP 7-5-78
 DRAWING NUMBER: 7 4-B-36



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NOTE:
THE PERCENTAGES ABOVE ARE BY WEIGHT AS DETERMINED
BY MECHANICAL ANALYSIS (ASTM DESIGNATION D 422)

NOTES:
1. FOR GENERAL PLAN-EMBANKMENT SEE
DWG. GE-145-E2
2. GROUND SURFACE CONTOURS FROM NEILAN
ENGINEERS GENERAL PLAN-EMBANKMENT.

REVISED - DESTROY
ALL PREVIOUS PRINTS

350
AUG - 3 1962
E. D'APPOLONIA

E. D'APPOLONIA ASSOCIATES
INCORPORATED
PHILADELPHIA, PENNSYLVANIA

TRUMAN VALENTI
CORPORATION
PHILADELPHIA, PENNSYLVANIA

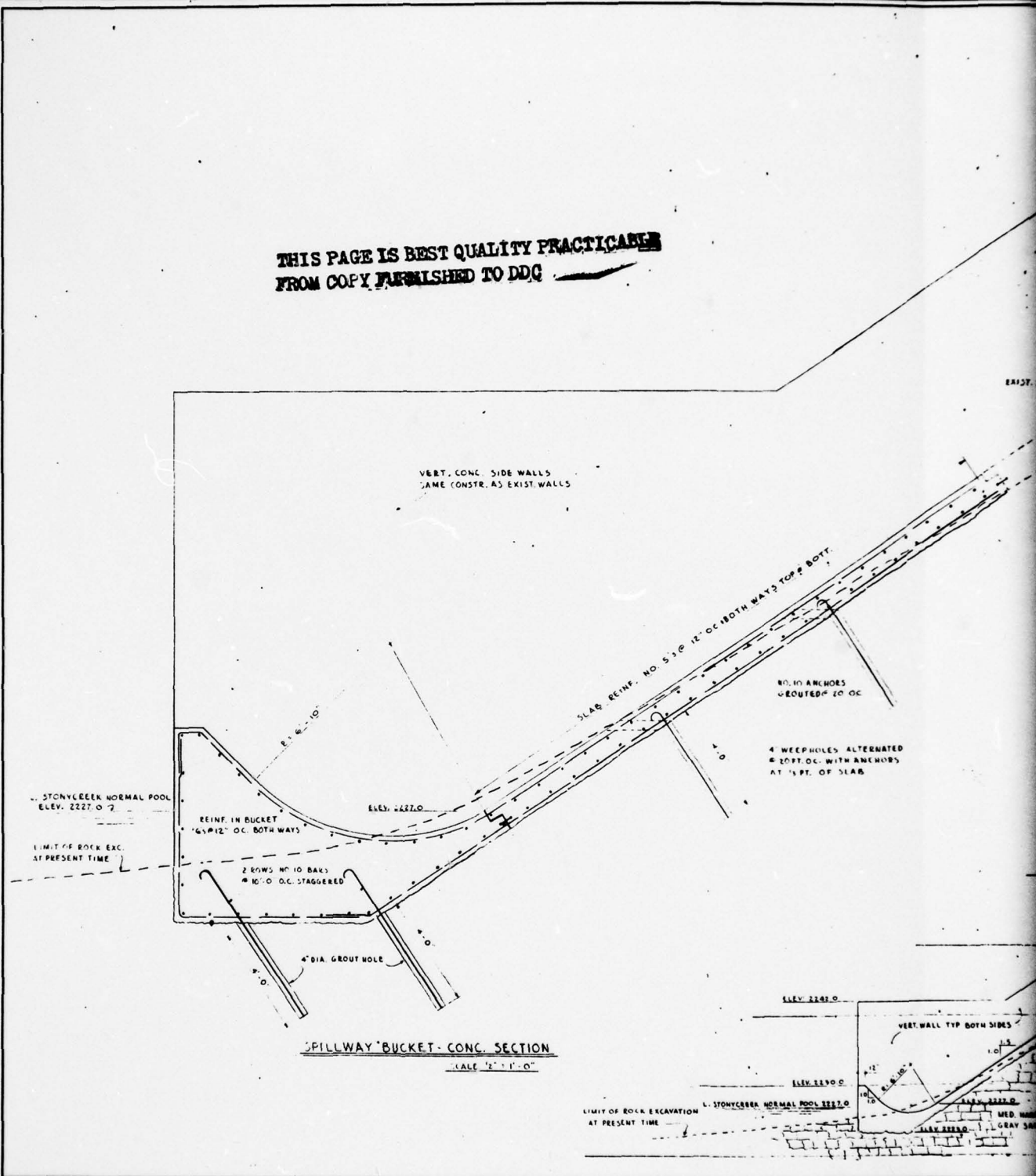
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PLATE 3

D'APPOLONIA

DRAWN BY G J G
 CHECKED BY BE
 6-20-78 APPROVED BY SMD
 DRAWING NUMBER 78 14-B53
 7-5-78

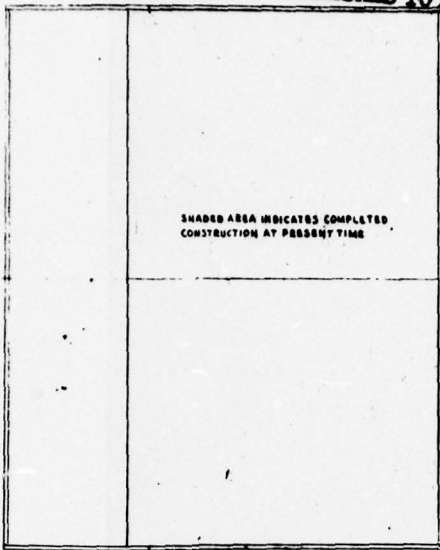
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SPILLWAY BUCKET - CONC. SECTION
 SCALE 1/2" = 1'-0"

FIELD NOTES:	REFERENCE DRAWINGS

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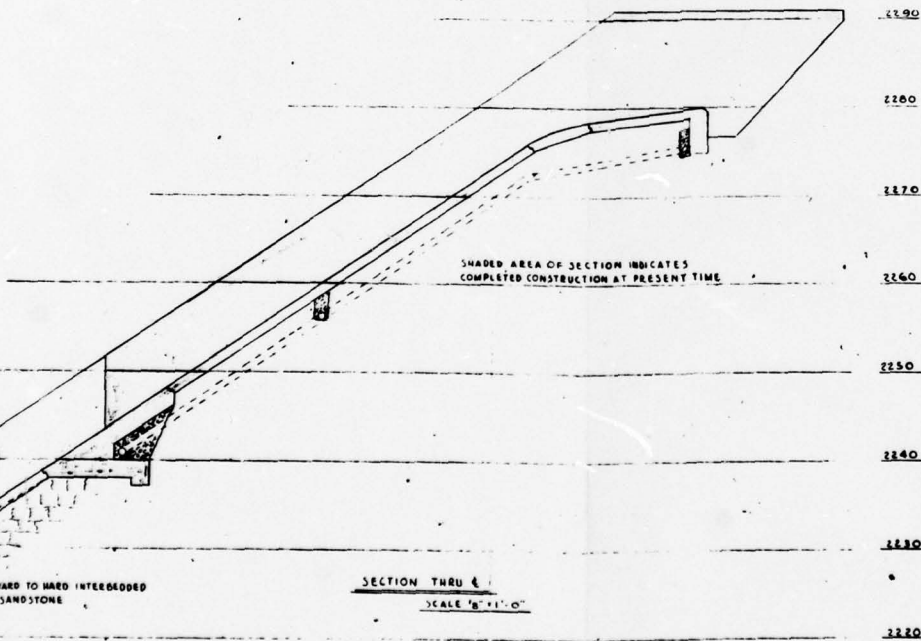


SHADED AREA INDICATES COMPLETED
CONSTRUCTION AT PRESENT TIME

EXIST WALL

EXIST SLAB

PLAN
SCALE 1"=20'



SECTION THRU E
SCALE 1/8"=1'-0"

REVISIONS

NO.	DATE	REMARKS	BY

ALLEGHENY MOUNTAIN LAKES INC.
SOMERSET, PA.

INDIAN LAKE PROJECT
SPILLWAY REVISION

THE NEILAN ENGINEERS, INC.
SOMERSET, PENNSYLVANIA

DESIGNED	ART	4-64	SCALE: NOTED
DRAWN	"	5-64	DRAWING NO.
CHECKED	JHN	5-64	R-5
APPROVED			

PLATE 4

D'APPOLONIA

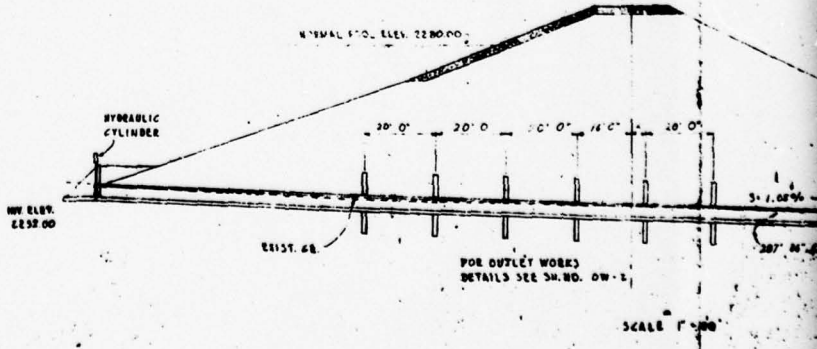
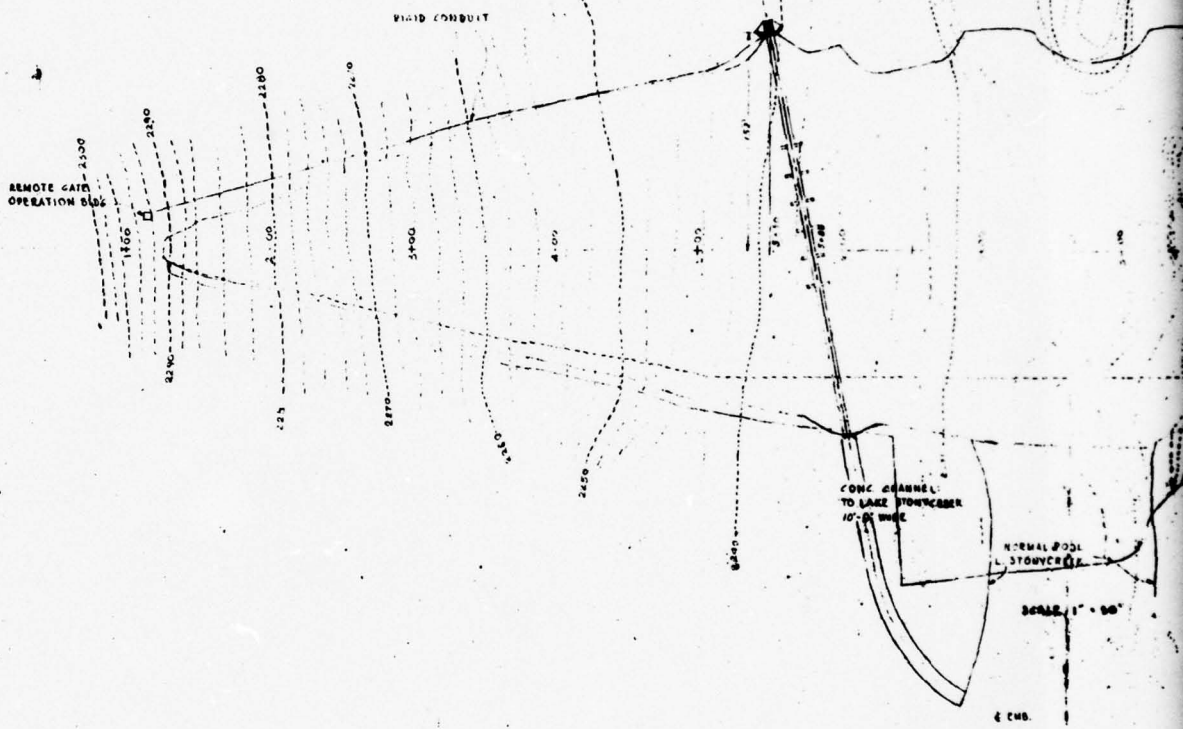
2

DRAWN BY G. J. G. CHECKED BY G. J. G. APPROVED BY G. J. G. DRAWING NUMBER 7E 4-B54

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NOTE: THE SLUICE GATE SHALL BE OPERATED BY A HYDRAULIC CYLINDER MOUNTED ON THE GATE & REMOTELY CONTROLLED AT THE CONTROL BLDG. CONSTRUCTED ABOVE MAX. FLOOD ELEV.

EXTEND THIS SIDE OF BLANKET TO IMPERVIOUS CLAYEY SILT AS DETERMINED IN THE FIELD

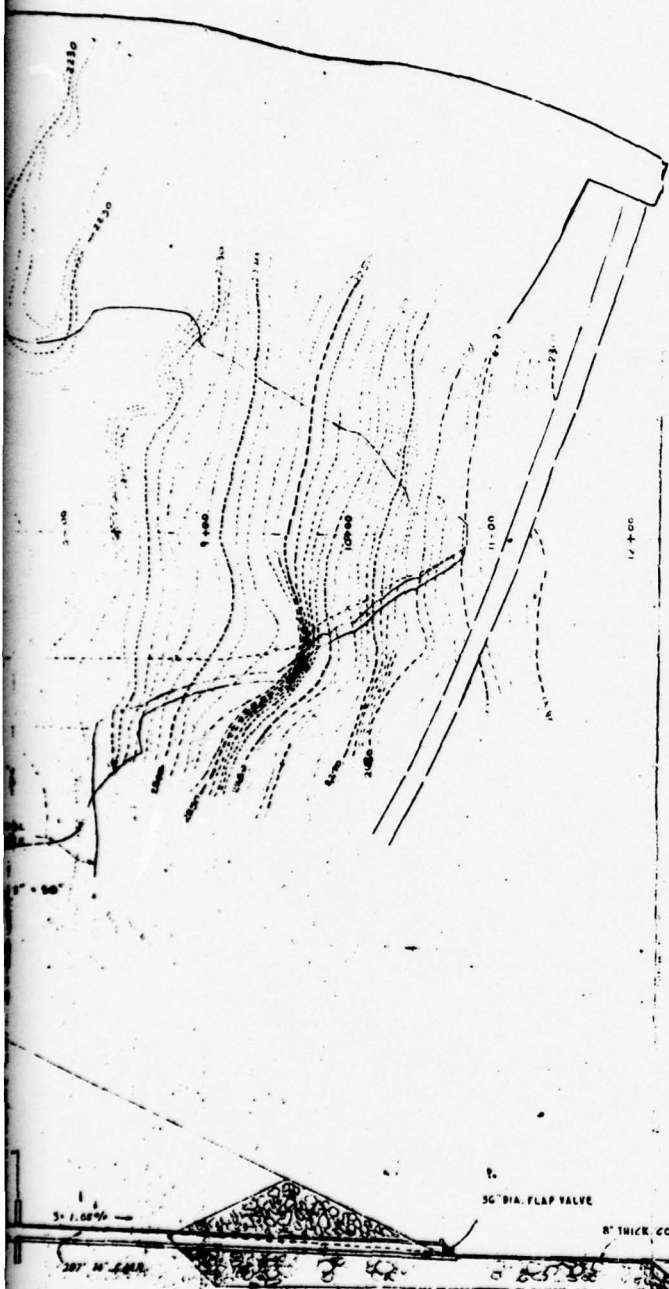


FOR OUTLET WORKS DETAILS SEE SH. NO. DW-1

58-103-#37
 FILE NUMBER

RECEIVED IN THE OFFICE OF THE WATER & POWER
 RESOURCES DIVISION DEPARTMENT OF FORESTS &
 WATERS ON THE 30 DAY OF *April* A.D. 19*52*
Austin H. Dyer
 Chief

REC'D _____ FOR _____
 SEE REPORT NO. _____
 Div. Dam



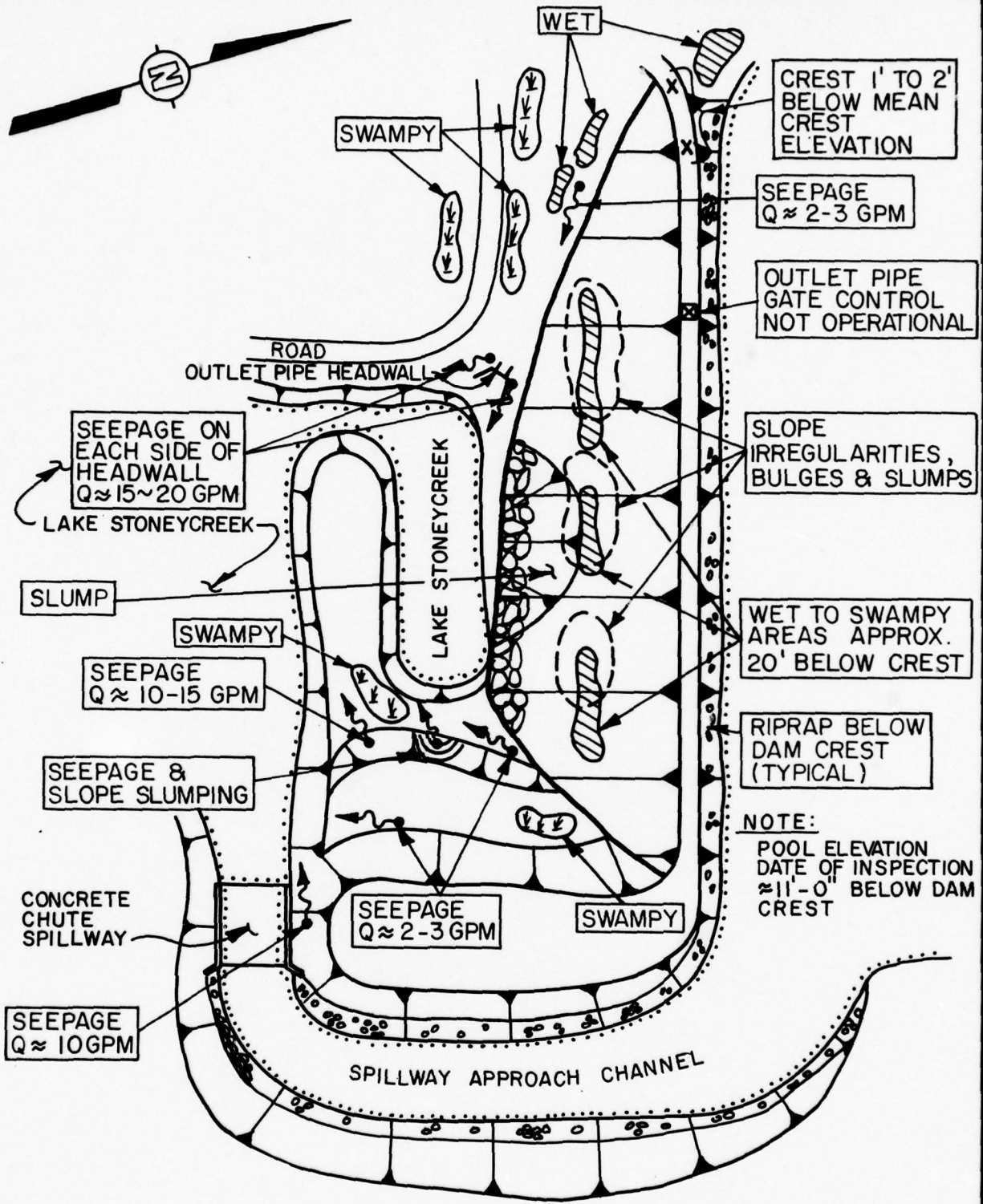
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OUTLET WORKS - PLAN & PROFILE		INDIAN LAKE PROJECT	
DESIGNED BY	E.J.	SCALE	AS SHOWN
CHECKED BY	AST	DATE	1952
APPROVED BY	JNR		

PLATE 5
D'APPOLONIA

DRAWING NUMBER 78 4-A6
 7-5-78
 1-5-78
 BE
 5-24-78
 1-5-78
 RGN
 5-24-78
 DRAWN BY
 CHECKED BY
 APPROVED BY



CREST 1' TO 2'
BELOW MEAN
CREST
ELEVATION

SEEPAGE
Q ≈ 2-3 GPM

OUTLET PIPE
GATE CONTROL
NOT OPERATIONAL

SLOPE
IRREGULARITIES,
BULGES & SLUMPS

WET TO SWAMPY
AREAS APPROX.
20' BELOW CREST

RIPRAP BELOW
DAM CREST
(TYPICAL)

NOTE:
POOL ELEVATION
DATE OF INSPECTION
≈ 11'-0" BELOW DAM
CREST

SEEPAGE ON
EACH SIDE OF
HEADWALL
Q ≈ 15~20 GPM

SEEPAGE
Q ≈ 10-15 GPM

SEEPAGE &
SLOPE SLUMPING

SEEPAGE
Q ≈ 2-3 GPM

SEEPAGE
Q ≈ 10GPM

PLATE 6

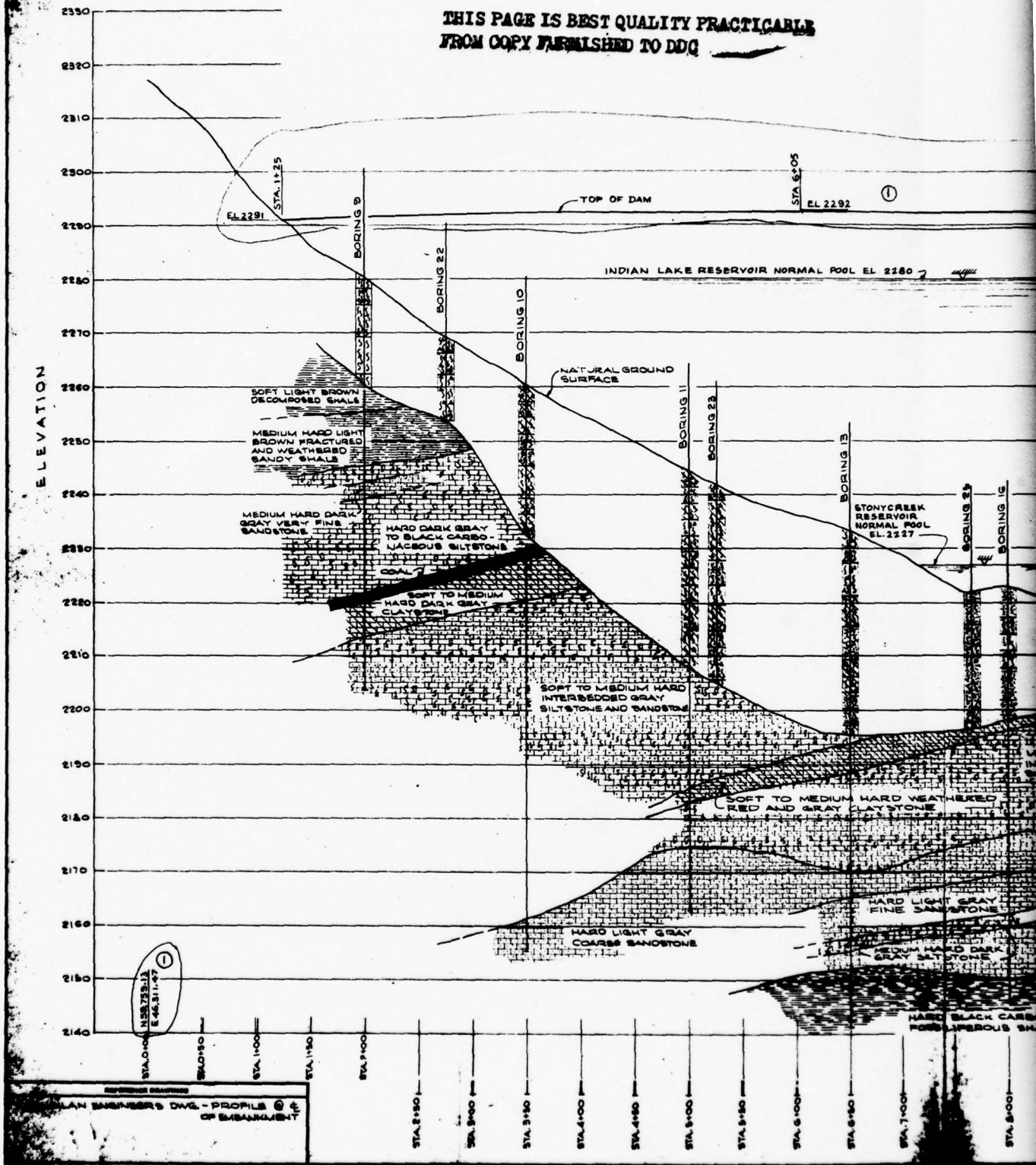
INDIAN LAKE DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: MAY 17, 1978

D'APPOLONIA

NOT TO SCALE

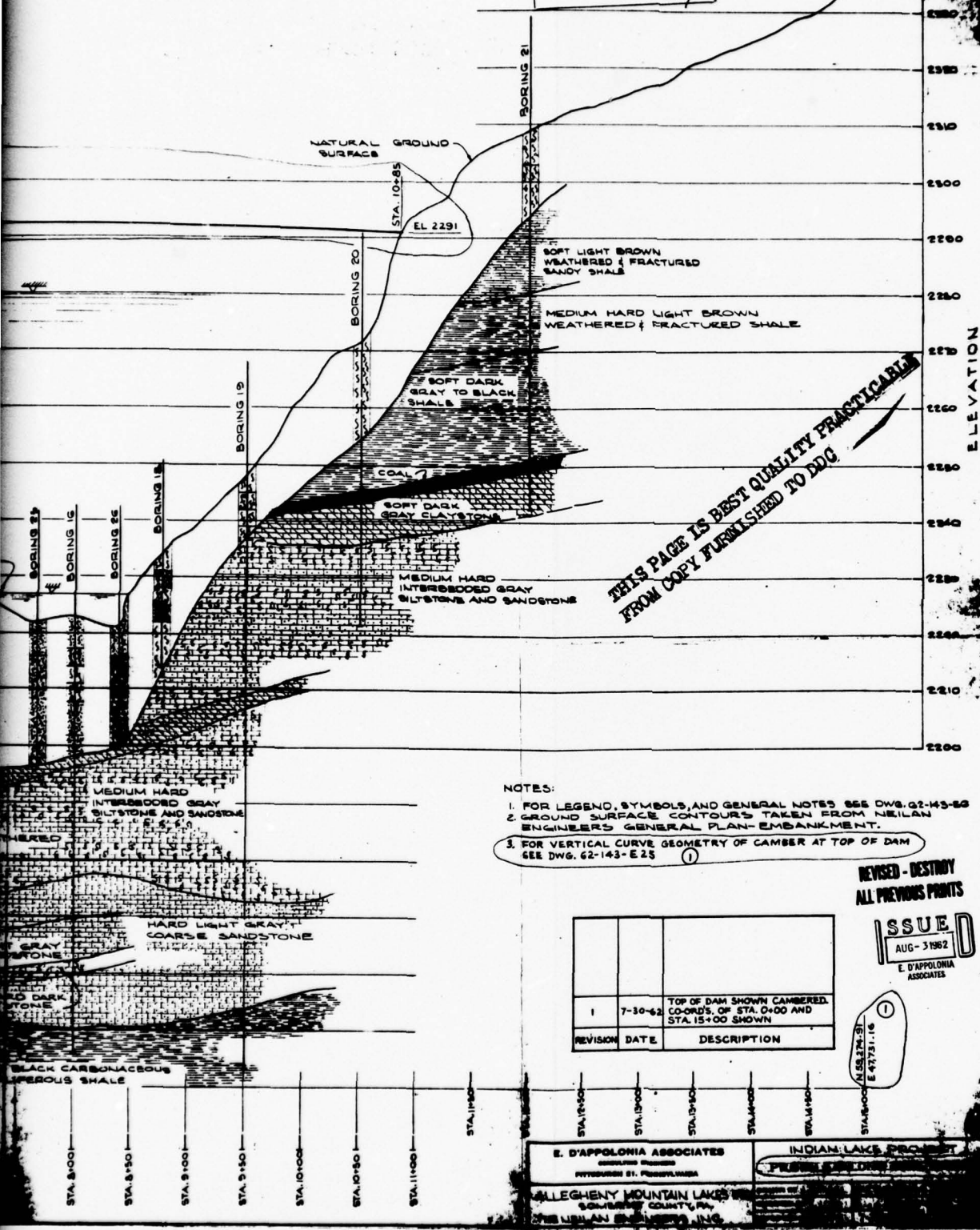
DRAWN BY RGN 5-25-78 CHECKED BY BE 2-5-78 DRAWING NUMBER 71 '4-B-37 APPROVED BY JAP 7.5.78

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PLAN ENGINEER'S DWG - PROFILE OF EMBANKMENT

RECORDED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTRY & WATERS ON THIS DAY OF *Aug* A.D. 1962
Christina
Per Copy



- NOTES:
1. FOR LEGEND, SYMBOLS, AND GENERAL NOTES SEE DWG. 62-143-56
 2. GROUND SURFACE CONTOURS TAKEN FROM NEILAN ENGINEERS GENERAL PLAN-EMBANKMENT.
 3. FOR VERTICAL CURVE GEOMETRY OF CAMBER AT TOP OF DAM SEE DWG. 62-143-E25

REVISED - DESTROY ALL PREVIOUS PRINTS

ISSUED
 AUG-3-1962
 E. D'APPOLONIA ASSOCIATES

REVISION	DATE	DESCRIPTION
1	7-30-62	TOP OF DAM SHOWN CAMBERED. CO-ORD'S. OF STA. 0+00 AND STA. 15+00 SHOWN

E. D'APPOLONIA ASSOCIATES
 CONSULTING ENGINEERS
 PITTSBURGH 21, PENNSYLVANIA

INDIAN LAKE PROJECT
 FEDERAL POWER COMMISSION

ALLEGHENY MOUNTAIN LAKES
 SCHENCK COUNTY, PA.

2

APPENDIX A
CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM INDIAN LAKE DAM COUNTY SOMERSET STATE PENNSYLVANIA ID# NDI: 228
TYPE OF DAM EARTH FILL HAZARD CATEGORY HIGH DER: 56-103
DATE(S) INSPECTION MAY 17, 1978 WEATHER RAINY TEMPERATURE 60's
POOL ELEVATION AT TIME OF INSPECTION 2280 M.S.L. TAILWATER AT TIME OF INSPECTION 2227 ± M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL REVIEW INSPECTION: ELJO D'APPOLONIA
WAH-TAK CHAN (MAY 30, 1978) LARRY ANDERSEN
JAMES POELLOT.

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BILGIN EREL RECORDER

VISUAL INSPECTION
 PHASE I
 EMBANKMENT

NAME OF DAM INDIAN LAKE DA
 ID# NDI: 228 DER: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE FOUND	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	TOE AREA IS SUBMERGED (LAKE STONEY CREEK) NOT VISIBLE.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	SOME SLOUGHING ON DOWNSTREAM SLOPE ABOUT 20 FT BELOW CREST LEVEL. (SEE PLATE 6)	SLOPE IRREGULARITIES ARE ASSOCIATED WITH WET AREAS.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	CREST ELEVATION VARIES ± 1.0 FEET RIGHT ABUTMENT SIDE APPROXIMATELY 1 ~ 2 FT BELOW MEAN CREST LEVEL.	
RIPRAP FAILURES	NONE. HOWEVER RIPRAP IS NOT EXTENDING TO CREST LEVEL.	

VISUAL INSPECTION
 PHASE I
 EMBANKMENT

NAME OF DAM INDIAN LAKE M

ID# NDI: 228 DER: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO IDENTIFYABLE SIGNS OF DISTRESS.	
ANY NOTICEABLE SEEPAGE	NUMEROUS WET AREAS ON EMBANKMENT. SEEPAGES ON RIGHT TOE AREA AND LEFT ABUTMENT	SEE PLATE G FOR APPROXIMATE LOCATION OF WET AREAS & SEEPS.
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	

VISUAL INSPECTION
 PHASE I
 CONCRETE/MASONRY DAMS

NAME OF DAM INDIAN LAKE DAM
 ID# NDI: 228 DER: 56-103

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

VISUAL INSPECTION
 PHASE I
 CONCRETE/MASONRY DAMS

NAME OF DAM INDIAN LAKE D.A.
 ID# NDI: 228 DEC: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	EARTH FILL DAM ∴ N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A.	
STAFF GAGE OF RECORDER:		

VISUAL INSPECTION
 PHASE I
 OUTLET WORKS

NAME OF DAM INDIAN LAKE D
 ID# NDI 228 DER: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OUTLET PIPE IS CORRUGATED METAL (ONLY OUTLET END IS VISIBLE)	
INTAKE STRUCTURE	SUBMERGED NOT VISIBLE.	
OUTLET STRUCTURE	THERE IS NO DEFINED OUTLET STRUCTURE. PIPE WOULD DIRECTLY DISCHARGE INTO LAKE STONEY CREEK.	
OUTLET CHANNEL	NONE.	
EMERGENCY GATE	THERE IS ONLY ONE GATE ON THE PIPE (UPSTREAM) AND IT IS NOT FUNCTIONAL.	

VISUAL INSPECTION
 PHASE I
 UNGATED SPILLWAY

NAME OF DAM INDIAN LAKE L M
 ID# NDI: 228 DER: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	NO SIGNS OF DISTRESS OR EROSION	
APPROACH CHANNEL	TRAPEZOIDAL CHANNEL	
DISCHARGE CHANNEL	SPILLWAY DIRECTLY DISCHARGES INTO LAKE STONEY CREEK.	
BRIDGE AND PIERS	NONE.	

VISUAL INSPECTION
 PHASE I
 GATED SPILLWAY

NAME OF DAM INDIAN LAKE D

ID# NDI: 228 DEP: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	NO GATED SPILLWAY	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

VISUAL INSPECTION
 PHASE I
 INSTRUMENTATION

NAME OF DAM INDIAN LAKE D 1

ID# NDI: 228 DEP: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	NONE	
PIEZOMETERS	NONE	
OTHER	NONE	

VISUAL INSPECTION
 PHASE I
 RESERVOIR

NAME OF DAM INDIAN LAKE DA

ID# NEI: 228 VER: 56-103

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	GENTLE, SUMMER HOME & COTTAGES.	
SEDIMENTATION	UNKNOWN	

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VISUAL INSPECTION
 PHASE I
 DOWNSTREAM CHANNEL

NAME OF DAM INDIAN LAKE DAM

ID# NDI: 228 DER: 56-103

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VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	(INDIAN LAKE DIRECTLY DISCHARGES INTO LAKE STONEY CREEK) N/A	
SLOPES	N/A	
APPROXIMATE NUMBER OF HOMES AND POPULATION	1) APPROXIMATELY 50 HOME ALONG THE SHORES OF LAKE STONEY CREEK. 2) APPROXIMATELY 50 HOMES IN SHANKSVILLE POPULATION ~ 400	

APPENDIX B
CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM INDIAN LAKE DAM

ID# NDI: 22B DER: S6-103

ITEM	REMARKS
AS-BUILT DRAWINGS	AVAILABLE IN STATE FILES.
REGIONAL VICINITY MAP	SEE PLATE 2
CONSTRUCTION HISTORY	DAM WAS BUILT BY THE FORCES OF THE OWNER. CONSTRUCTION WAS COMPLETED IN 1964
TYPICAL SECTIONS OF DAM	HOMOGENEOUS EMBANKMENT WITH ROCK TOE FILTER AND UPSTREAM CLAY BLANKET. SEE PLATE 3
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	SEE PLATE 5

CHECKLIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION
 PHASE I

NAME OF DAM INDIAN LAKE DAM

ID# NDI:228 DER:56-103

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ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NOT RECORDED.
DESIGN REPORTS	DESIGN DATA FOR INDIAN LAKE DAM, 1962 PREPARED BY E. D'APOLONIA ASSOCIATES INC. OF RGH, PA.
GEOLOGY REPORTS	SAME AS ABOVE.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	STABILITY AND SEEPAGE ANALYSIS ARE INCLUDED IN DESIGN DRAWINGS.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	REFERRED IN DESIGN REPORT.

CHECKLIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION
 PHASE I

NAME OF DAM INDIAN LAKE DAM

ID# NDI: 228 DER: 56-103

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ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NO REPORTS OTHER THAN TWO INSPECTION REPORTS BY THE STATE.
BORROW SOURCES	SPILLWAY APPROACH CHANNEL EXCAVATION
MONITORING SYSTEMS	NONE
MODIFICATIONS	NONE
HIGH POOL RECORDS	NOT RECORDED.

CHECKLIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION
 PHASE I

NAME OF DAM INDIAN LAKE DAM
 ID# NDI : 228 DER : 56-103

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ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NONE FOUND
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REFERRED.
MAINTENANCE OPERATION RECORDS	NOT AVAILABLE
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATES 1 AND 4
OPERATING EQUIPMENT PLANS AND DETAILS	SEE PLATE 5

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NAME OF DAM INDIAN LAKE DAM

ID# NDI:228 DER:56-103

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOOD & PASTURE LAND (13.7 SQ. MILES)
ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 19,200 AC-FT @ EL 2280
ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 26,040 AC-FT @ EL 2291
ELEVATION; MAXIMUM DESIGN POOL: EL. 2291 (USGS DATUM)
ELEVATION; TOP DAM: 2291 FT

CREST:

- Elevation 2291 FT
- Type EARTH.
- Width 20 FT.
- Length 960 FT
- Location Spillover RIGHT ABUTMENT 12 FT BELOW CREST LEVEL
- Number and Type of Gates NONE.

OUTLET WORKS:

- Type 36-INCH CMP.
- Location THROUGH MIDDLE OF EMBANKMENT.
- Entrance Inverts EL 2235 (ESTIMATED)
- Exit Inverts EL 2232
- Emergency Draindown Facilities _____

HYDROMETEOROLOGICAL GAGES:

- Type NONE
- Location NONE
- Records NONE

MAXIMUM NONDAMAGING DISCHARGE: ABOUT 10,000 CFS.

APPENDIX C
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
INDIAN LAKE DAM
MAY 16, 1978

<u>PHOTOGRAPH NO.</u>	<u>DESCRIPTION</u>
1	Dam crest.
2	Dam toe.
3	Right abutment.
4	Left abutment.
5	Spillway and plunge pool.
6	Spillway approach channel.
7	Outlet pipe valve hydraulic control (nonfunctional).
8	Outlet pipe.
9	Right abutment toe drain.
10	Dam downstream slope irregularity near center.
11	Dam downstream slope irregularity near right of center.
12	Seepage at left abutment.
13	Seepage near spillway right wing wall.
14	Seepage around outlet pipe headwall.



Photograph No. 1
Dam crest.



Photograph No. 2
Dam toe.



Photograph No. 3
Right abutment.



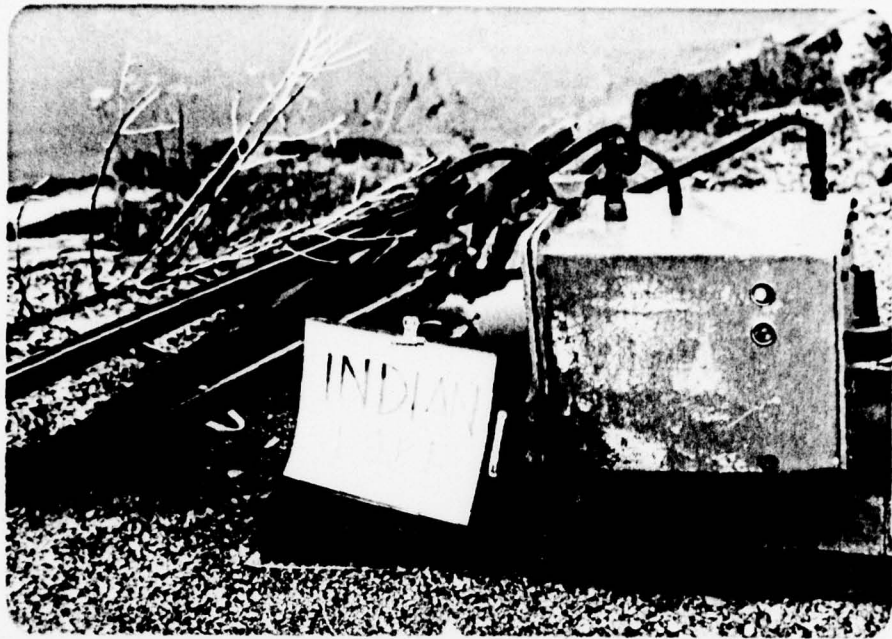
Photograph No. 4
Left abutment.



Photograph No. 5
Spillway and plunge pool.



Photograph No. 5
Spillway approach channel.



Photograph No. 7

Outlet pipe valve hydraulic control (nonfunctional).



Photograph No. 8

Outlet pipe.



Photograph No. 9
Right abutment toe drain.



Photograph No. 10
Dam downstream slope irregularity near center.



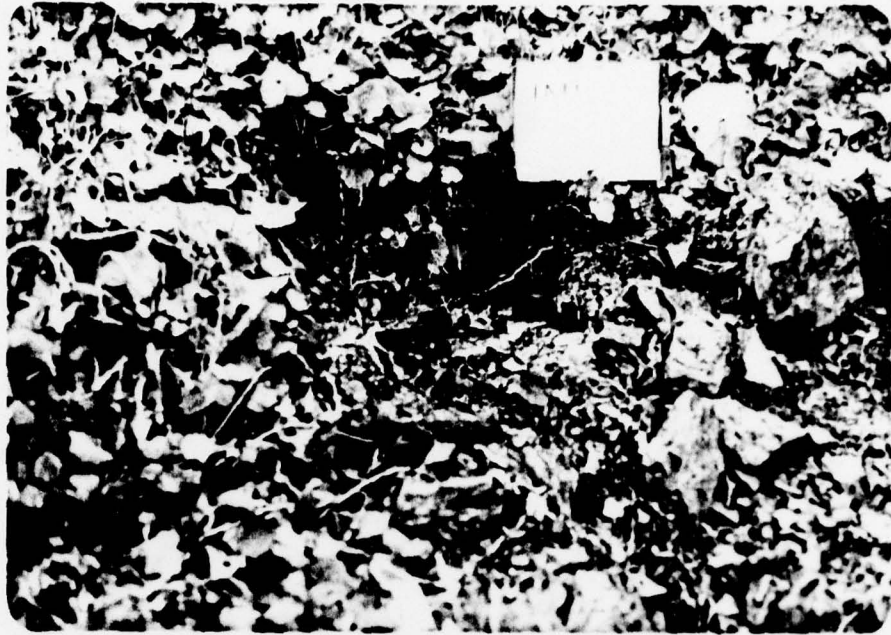
Photograph No. 11

Dam downstream slope irregularity near right of center.

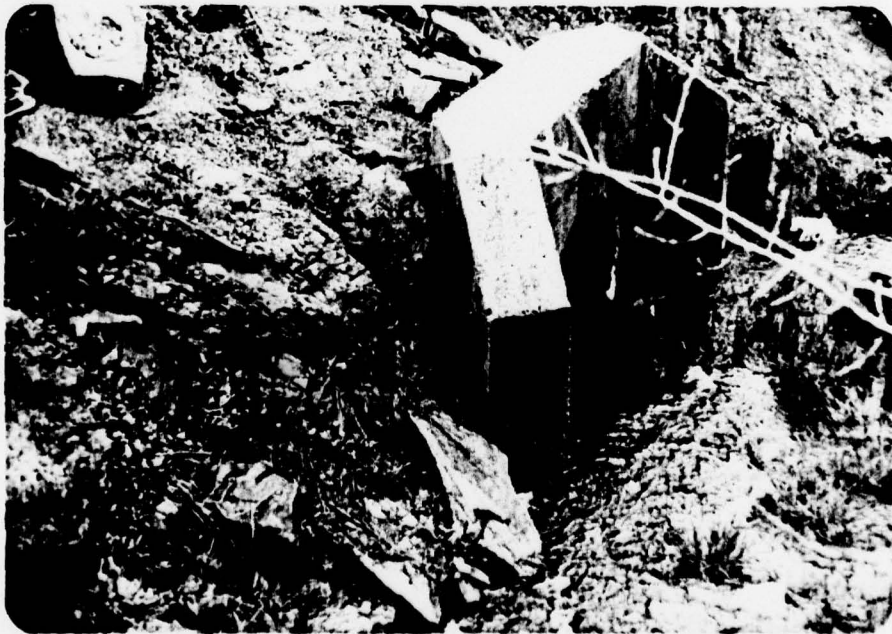


Photograph No. 12

Seepage at left abutment.



Photograph No. 13
Seepage near spillway right wing wall.



Photograph No. 14
Seepage around outlet pipe headwall.

APPENDIX D
CALCULATIONS



By TC Date 5-23-78 Subject INDIAN LAKE DAM NDS 22B Sheet No. 1 of 2
Chkd. By BE Date 6-30-78 HYDROLOGY & HYDRAULIC Proj. No. 78114-03

DAM : INDIAN LAKE DAM, NDS - 22B

WATERSHED AREA, $A = 13.7$ SQ. MILES

INFLOW HYDROGRAPH BASIN : OHIO RIVER BASIN, CALENDAR'S RUN
OF STONY CREEK

TOTAL TIME, $T = 52$ hr

PMF Peak Flow $q = 1400$ cfs/sq miles

PMF Peak inflow, $Q = q \cdot A = 19180$ cfs
say 19200 cfs

VOLUME OF INFLOW HYDROGRAPH

$$\begin{aligned} V_i &= \frac{1}{2} T \times 3600 \times Q \\ &= \frac{1}{2} (52 \times 3600) (19200) \times \frac{1}{43560} \\ &= 41256 \text{ AC-FT} \end{aligned}$$

SPILLWAY CAPACITY

↳ EQUAL TO $56.5''/52$ hr
REVISED TO $26''/24$ hr say $V_i = 19000$ AC-FT
 $V_i = 18997$ AC-FT

TYPE : BOARD CREST WEIR

DISCHARGE COEF (AS USED IN DESIGN) = 2.6

LENGTH = 150 FT

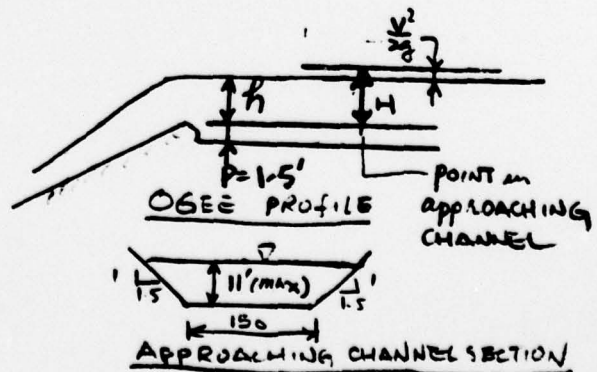
TOTAL AVAILABLE HEAD = 11'

$$H = \text{TOTAL HEAD} = h + \frac{V^2}{2g}$$

$$Q = (2.6)(150)(h)^{1.5}$$

$$A = [150 + (1.5)(h+11)](h+11)$$

$$V = \frac{Q}{A}$$





By WIC Date 5-23-78 Subject INDIAN LAKE DAM NDS 228 Sheet No. 2 of 2
 Chkd. By BE Date 6-30-78 HYDROLOGY & HYDRAULIC Proj. No. 78-114-03

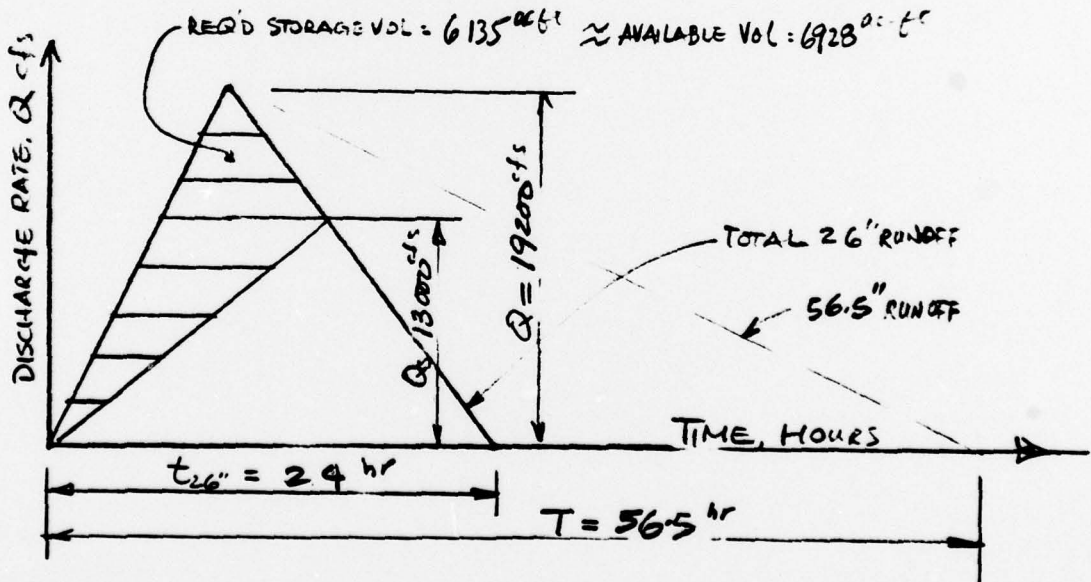
R	Q _s	V	$\frac{V^2}{2g}$	H = h + $\frac{V^2}{2g}$	
ft	cfs	ft ³	ft	ft	
10	12332	64	0.7	10.7	} H _{AVG} = 11.0 ft h = 10.34 ft Q = 12967 cfs
11	14228	67	0.7	11.7	

Say MAX. SPILLWAY DISCHARGE, Q_s = 13000 cfs

RESERVOIR CAPACITY

LAKE AREA EL 2280
 T/DAM EL 2291
 Surcharge Volume

MEASURED FROM USGS
 541
 723
 6928 ac-ft



REQ'D RESERVOIR STORAGE Volume for PMF (26" runoff)

$$= \left(1 - \frac{\text{MAX. SPILLWAY CAPACITY, } Q_s}{\text{PMF PEAK INFLOW, } Q}\right) (\text{VOLUME OF INFLOW, } V_i)$$

$$= \left(1 - \frac{13000}{19200}\right) (19000 \text{ ac-ft}) = 6135 \text{ ac-ft} < 6928 \text{ ac-ft}$$

CONCLUSION: THE DAM & SPILLWAY ARE ADEQUATE FOR PMF
 STORM, MAX. SPILLWAY DISCHARGE IS APPROXIMATELY 13000 cfs

APPENDIX E
REGIONAL GEOLOGY

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Indian Lake Dam is located in the Berlin-Salisbury Syncline and between the Negro Anticline on the west and Savage Anticline on the east. These anticlines trend north-northwest. The rock strata underlying the dam and reservoir are members of the Conemaugh Group (Pennsylvanian Age). The rock at the surface is approximately 250 feet above the Conemaugh-Allegheny Group contact. The rock strata primarily consist of gray to brown shaly siltstone and sandstone. The review of the boring logs for the dam indicates that the Lower Bakerstown coal seam was encountered at Elevation 2250 which is about 40 feet below the crest level of the dam. The Conemaugh Group contains four other minable coal seams which outcrop above the reservoir level. There are active strip mines within the watershed area. The rock strata in the region generally dip northwest approximately 700 feet per mile. Relatively gentle slopes surrounding the lake appear to preclude large landslides.