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NATIONAL DAM INSPECTION PROGRAM. PENELEC RETENTION DAM. (NDI I.--ETC(U)
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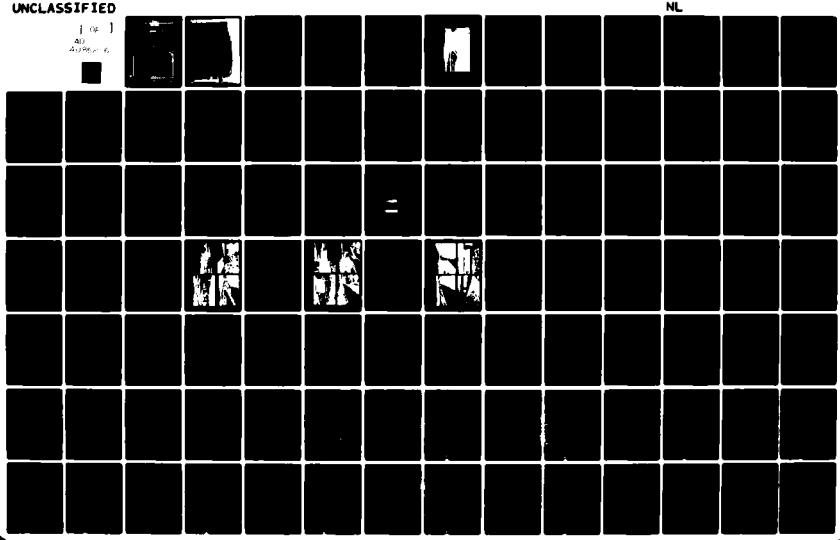

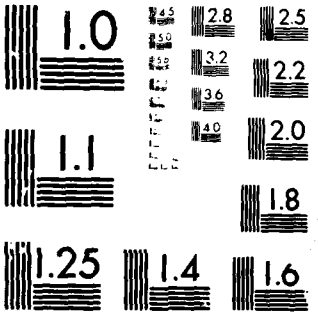

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PHASE I INSPECTION REPORT

[illegible] PROGRAM

(10) Bernard M. Mihalaini

PREPARED FOR

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland [illegible]

PREPARED BY

GAI CONSULTANTS, INC.

570 BEATTY ROAD

MONROEVILLE, PENNSYLVANIA [illegible]

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 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 investigation and analyses involving topograhic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of 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.

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Penelec Retention Dam: NDI I.D. No. PA-00809

Owner:	Conemaugh Station Owners Group Pennsylvania Electric Company (operator)
State Located:	Pennsylvania (PennDER I.D. No. 32-78)
County Located:	Indiana
Stream:	Unnamed Tributary to the Conemaugh River
Inspection Date:	4 and 21 February 1980
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and available engineering data, the dam is considered to be in good condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and loss of life, the SDF for the facility is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store a flood of PMF magnitude. Consequently, the spillway is considered adequate.

It is recommended that the owner:

a. Regrade the embankment crest to restore local low spots to design elevation.

b. Visually assess cracking noted in the spillway structure in future inspections and make remedial repairs if necessary.

c. Clean excess debris from the concrete gutter along the toe of the dam.

d. Develop a formal warning system for the notification of downstream inhabitants should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

e. Develop formal manuals of maintenance and operation to ensure continued proper care and maintenance of the facility.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Date 26 MAR 1980

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date 3 May 1980

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E

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OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
PENELEC RETENTION DAM
NDI# PA-00809, PENNDER# 32-78

SECTION 1
GENERAL INFORMATION

1.0 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.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Penelec Retention Dam is an earth embankment approximately 590 feet long, including spillway, with a curved crest and a height of about 27 feet. Its appurtenances consist of a 56-foot long concrete side channel spillway, a concrete and gabion-lined spillway channel, a grass-lined trapezoidal-shaped diversion canal, a small gabion-lined diversion dike, and 2 gated 24-inch diameter reinforced concrete outlet pipes. One of the outlet conduits can be utilized to drain the reservoir.

b. Location. Penelec Retention Dam is located on an unnamed tributary to the Conemaugh River in West Wheatfield Township, Indiana County, Pennsylvania. The embankment is situated approximately 1.3 miles north of New Florence, Pennsylvania, just upstream of the Conemaugh Generating Station. The dam, reservoir, and watershed are contained within the New Florence, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N40° 23.8' and W79° 4.0'.

c. Size Classification. Small (27 feet high, 57 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Conemaugh Station Owners Group operated by:

Pennsylvania Electric Company
1001 Broad Street
Johnstown, Pennsylvania 15907
Attention: Mr. R. T. Gallus
Supervisor, Generating
Plant Civil Engineering

f. Purpose. The purpose of the retention embankment is to collect and contain storm runoff which comes in contact with leachate from the upstream solid waste disposal area so that it may be treated prior to being discharged downstream.

g. Historical Data. Penelec Retention Dam was designed by E. D'Appolonia Consulting Engineers, Inc., of Pittsburgh, Pennsylvania. Construction of the facility began in September 1973, by R and L Construction of New Alexandria, Pennsylvania, and was completed on October 25, 1974. The facility has operated virtually problem-free since its completion and no subsequent major modifications have been made.

1.3 Pertinent Data.

a. Drainage Area (square miles). 1.24

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge rating curves are not available.

Discharge Capacity of Spillway at Maximum Pool ≈ 2430 cfs (see Appendix D, Sheet 9).

c. Elevation (feet above mean sea level). The following elevations were obtained from available drawings and through field measurements based on the elevation of the spillway crest at 1150 feet. (Note: There is no defined design normal pool associated with this facility. The treatment plant operates on a continuous basis, causing a constant pool level fluctuation).

Top of Dam	1156.0 (design).
	1154.9 (field).
Maximum Design Pool	1153.1
Maximum Pool of Record	Not known.
Spillway Crest	1150.0
Upstream Outlet Invert	1133.0
Downstream Outlet Invert	1128.2 (field).
Streambed at Dam Centerline	1130.0
Maximum Tailwater	Not known

d. Reservoir Length (feet).

Top of Dam	1600
Spillway Crest	1200

e. Storage (acre-feet).

Top of Dam	57
Spillway Crest	30
Design Pool	46
Design Surcharge	11

f. Reservoir Surface (acres).

Top of Dam	4.9
Spillway Crest	3.7
Maximum Design Pool	4.5

g. Dam.

Type	Homogeneous earth.
Length	534 feet (excluding spillway).
Height	27 feet (field measured; crest to downstream blowoff outlet invert).
Top Width	15 feet (field). 12 feet (design).
Upstream Slope	2.5H:1V
Downstream Slope	2.5H:1V
Zoning	Homogeneous earth with downstream drainage blanket and toe drain.
Impervious Core	None indicated.
Cutoff	Cutoff trench reportedly excavated to a depth of 5 feet along the embankment centerline and backfilled with impervious material. The trench is 15 feet

	Grout Curtain	None indicated.
h.	Diversion Canal and Regulating Tunnels.	Trapezoidal-shaped, grass-lined diversion canal located along left side of reservoir.
i.	Spillway.	
	Type	Uncontrolled, reinforced concrete, side channel spillway with ogee-shaped crest.
	Crest Elevation	1150 feet.
	Crest Length	56 feet.
j.	Outlet Conduit.	
	Type	24-inch diameter reinforced concrete pipe.
	Length	165 feet.
	Closure and Regulating Facilities	Flow through the blowoff can be regulated by a 24-inch diameter sluice gate at the inlet and a 24-inch diameter gate valve near the outlet at the downstream toe.
	Access	The outlet conduit control mechanisms are both accessible by foot at the crest and downstream embankment toe.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. Formal design data is contained in a report dated August 1972, by E. D'Appolonia Consulting Engineers, Inc., entitled "Engineer's Report, Retention Pond Embankment, Conemaugh Station Ash and Mine Refuse Disposal Area." This report is available from both the owner and the PennDER. A brief report by PennDER, dated December 22, 1972, summarizes the various design aspects of the facility and is contained in PennDER files.

b. Design Features.

1. Embankment. The embankment is a homogeneous earthfill structure. The top width is 15 feet while the slopes of both the upstream and downstream faces are 2.5H:1V. The crest is covered with a layer of crushed stone. Other major design considerations include: 1) a cutoff trench along the longitudinal axis; 2) a drainage blanket, toe drain, and paved gutter along the downstream toe; and 3) riprap protection for the upstream embankment face (see Figures 3 and 4).

2. Appurtenant Structures.

a) Spillway. The spillway is an uncontrolled, reinforced concrete, rectangular side-channel type overflow with an ogee-shaped crest located at the left abutment. The weir discharges into a concrete, rectangular spillway channel that provides positive protection for the eastern downstream slope of the embankment. Beyond the concrete channel, the spillway discharge channel is trapezoidal in cross section and lined with gabions. The trapezoidal section has a base width of 20 feet and side slopes of 2H:1V (see Figures 3, 6, and 7).

b) Outlet Works. Two 24-inch diameter reinforced concrete pipes, gated at the upstream end and valved at the downstream embankment toe, comprise the outlet works. The gates are heavy duty sluice gates with stainless steel riser stems and corrosion resistant seating faces. Both pipes direct flow into the treatment facilities, but, the left pipe can be utilized as a blowoff (see Figures 3, 4, and 5).

c) Diversion Canal System. The facility is provided with a diversion canal system consisting of a

trapezoidal-shaped earth channel that traverses the eastern slope of the ponding area and a small gabion-lined dike approximately 1,000 feet upstream of the embankment. The canal system is designed to discharge flows of up to 250 cfs from the east basin. The base width of the ditch is 10 feet with 2H:1V side slopes. The canal is designed to flow about 5 feet deep on a slope of .0001 feet per foot (see Figures 2, 3, and 7). Flows in excess of the canal capacity overtop the gabion-lined dike and enter the retention pond.

c. Specific Design Data and Criteria.

1. Hydrology and Hydraulics. Utilizing 6-hour precipitation data from U. S. Weather Bureau and Soil Conservation Service (SCS) rainfall and runoff distributions, the design storm was developed from the 100-year recurrence storm. Peak discharges of 840 and 559 cfs resulted for the main basin and east basin, respectively. These values are slightly in excess of the Pennsylvania "C" Curve criterion. In addition, a freeboard hydrograph was constructed from the SCS Class "A" freeboard storm. The freeboard storm gives peak discharges of 1090 and 775 cfs for the main basin and east basin, respectively. The design and freeboard hydrographics and area-volume curves for the pond are shown on Figure 8.

Flow attenuation due to storage is minimal; consequently, the design assumed outflow to equal inflow. Considering the diversion canal, the peak outflows over the spillway were 1149 and 1615 cfs for the design storm and freeboard storm, respectively.

2. Embankment. The consultant performed a detailed stability analysis of the embankment for the conditions at the end of construction, steady-state seepage at normal pool, and rapid drawdown from normal pool (see Figure 8). Soil parameters utilized in the analysis are presented in Figure 10.

3. Appurtenant Structures. Design aspects of the appurtenances reportedly conform, in general, to the criteria and procedures contained in "Construction or Repair of Dams" by the Water and Power Resources Board of the Pennsylvania Department of Forests and Waters, 1964. Specific design data is contained within the engineer's report available from the owner and the PennDER.

2.2 Construction Records.

Design drawings, contract specifications, several

construction photographs, and construction progress reports are contained in PennDER files.

2.3 Operational Records.

No records of the day-to-day operation of the facility are maintained.

2.4 Other Investigations.

No formal investigations have been performed on the facility subsequent to its completion. The owner has recently surveyed the facility and is currently preparing plan drawings.

2.5 Evaluation.

The data available are considered adequate to make a reasonable Phase I assessment of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests it to be adequately maintained and in good condition.

b. Embankment. Observations made during the visual inspection indicate the embankment is in good condition. No evidence of sloughing, seepage through the downstream embankment face, animal burrows, or signs of serious maintenance neglect were observed (see Photographs 3 and 4). Local settlements slightly in excess of 1-foot were field measured adjacent the right wingwall of the spillway and excess debris has accumulated in the concrete gutter along the downstream embankment toe to the right of the outlet.

c. Appurtenant Structures.

1. Spillway. The visual inspection revealed the spillway is in good condition. Some minor cracking was observed along the channel sidewalls, particularly at the weepholes.

2. Outlet Works. Both 24-inch diameter conduits that comprise the outlet works are reportedly functional; however, neither was operated in the presence of the inspection team. All exposed valve mechanisms appear to be well maintained and in good condition as does the outlet headwall (see Photographs 1, 3, 5 and 6).

3. Diversion Canal System. The diversion canal and upstream diversion dike are considered to be in excellent condition. No conditions were observed that would be expected to significantly hinder the proper functioning of the system (see Photographs 8, 9, 10).

d. Reservoir Area. The topography of the general area surrounding the reservoir gently rises in elevation to the east and more steeply to the west. The adjacent slopes are, for the most part, brush covered or lightly wooded. No evidence of slope distress was observed.

e. Downstream Channel. The embankment is situated in a north-south trending stream valley. The stream flows to the south and is a tributary to the Conemaugh River. Approximately 1/2-mile below the embankment the stream passes

within several hundred feet of the facilities comprising the Conemaugh Generating Station. The community of Centerville, Pennsylvania is located about 1-mile downstream of the embankment along a low area adjacent the Conemaugh River. A breach of the embankment would likely result in significant economic damage at the generating station and possibly the loss of many lives in Centerville. Consequently, the hazard classification of this facility is considered to be high.

3.2 Evaluation.

The overall condition of the facility is considered to be good. Deficiencies noted by the inspection team included minor cracking along the spillway channel sidewalls, particularly at the weepholes, local embankment settlement slightly in excess of 1-foot adjacent the right wingwall of the spillway, and excess debris in the paved gutter along the downstream embankment toe to the right of the outlet.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

The facility is essentially self-regulating. Normal leachate flow from the ash disposal site is designed to pass unattenuated through the impoundment to the treatment plant. Runoff from storms of 3-year return or less are entirely retained by the impoundment. Additional runoff from storms in excess of this is discharged through the spillway system. The treatment plant, located immediately below the embankment, operates on a continuous basis acting to drawdown any ponded storm water. Consequently, normal pool is undefined at this facility. The diversion canal routes low flow runoff (up to 250 cfs) from the east basin around the impoundment.

4.2 Maintenance of Dam.

The dam is maintained on an informal as-needed basis. No formal operations or maintenance manuals are available.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

No formal warning system is in effect.

4.5 Evaluation.

The facility is designed to be essentially self-regulating and to require minimal maintenance. Formal operations and maintenance manuals need to be developed and a formal warning system put in effect.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

The hydraulic structures, as provided in the design, include a single concrete side channel spillway, a diversion canal system, and outlet works. The design aspects reportedly conform, in general, to the procedures and criteria contained in the reference, "Construction or Repair of Dams," by the Water and Power Resources Board of the Pennsylvania Department of Forests and Waters, 1964. Specific design data are contained in the engineer's report available from the owner and the PennDER.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharge are not available.

5.3 Visual Observations.

On the date of the inspection, no conditions were observed that would indicate the spillway could not perform satisfactorily during a flood event, within the limits of its design capacity.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Penelec Retention Dam ranges between the 1/2 PMF (Probable Maximum Flood) and

the PMF. This classification is based on the relative size of the dam (small) and the potential hazard of dam failure to downstream developments (high). Due to the high potential for damage to downstream structures and possibly loss of life, the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Penelec Retention Dam was evaluated under near normal design operating conditions. That is, the reservoir was initially drawn down to the zero storage elevation of approximately 1133.0 feet. The outlet conduits were assumed to be non-functional for the purpose of analysis, since the flow capacities of these conduits are not such that they would significantly increase the total discharge capabilities of the facility. The spillway consists of a concrete side-channel ogee-type weir, which discharges freely into a rectangular concrete channel. The diversion canal, which by-passes the spillway, was assumed to be capable of conveying up to 250 cfs of runoff from the east basin, as designed. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix D.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Penelec Retention Dam can accommodate storms in excess of the PMF. The maximum spillway capacity of 2430 cfs (Appendix d, Sheet D) was found to be in excess of the peak PMF inflow of approximately 2425 cfs (Appendix D, Summary Input/Output Sheets, Sheet G). The peak PMF inflow was essentially not attenuated by the discharge/storage capabilities of the dam, as the resulting PMF peak outflow was about 2422 cfs (Appendix D, Summary Input/Output Sheets, Sheet F).

5.6 Spillway Adequacy.

Penelec Retention Dam was found to be capable of accommodating its SDF (the PMF), and therefore, its spillway is considered to be adequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment is in good condition. Local low spots along the crest should be graded and restored to design elevation.

b. Appurtenant Structures.

1. Spillway. Visual observations indicate the spillway is in good condition. Cracks noted in the spillway sidewalls do not appear significant, presently, but should be specifically addressed in future inspections.

2. Outlet Works. The outlet works are reportedly functional and appear to be well maintained and in good condition.

3. Diversion Canal System. The diversion canal system was observed in excellent condition. No adverse conditions were noted by the inspection team.

6.2 Design and Construction Techniques.

Correspondence, specifications, contract drawings, and construction progress reports indicate that the facility was designed and constructed in accordance with generally accepted modern practices.

6.3 Past Performance.

According to available correspondence and discussions with the owner's representative, the facility has performed satisfactorily since its completion.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. As the facility appears well constructed and sufficiently stable, it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this belief.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual inspection suggests the facility is adequately designed and in good condition.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. Due to the high potential for damage to downstream structures and loss of life, the SDF for the facility is considered to be the PMF. Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store a flood of PMF magnitude. Consequently, the spillway is considered adequate.

Deficiencies noted by the inspection team included local settlement slightly in excess of 1-foot along the embankment crest adjacent to the right spillway wingwall, minor cracking of the spillway channel walls, and excess debris in the paved gutter along the toe of the embankment to the right of the outlet.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. No additional investigations are currently deemed necessary.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

a. Regrade the embankment crest and restore local low spots to design elevation.

b. Visually assess cracking noted in the spillway structure in future inspections and make remedial repairs if necessary.

c. Clean excess debris from the concrete gutter along the toe of the dam.

d. Develop a formal warning system for the notification of downstream inhabitants should hazardous embankment conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

e. Develop formal manuals of maintenance and operation to ensure continued proper care and maintenance of the facility.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Penelec Retention Dam STATE Pennsylvania COUNTY Indiana

NDI # PA — 00809 PENNDER # 32-78

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY High

DATE(S) INSPECTION 4 February 1980 WEATHER Cold, clear TEMPERATURE 20° @ 2:00 p.m.

POOL ELEVATION AT TIME OF INSPECTION 1141.4 M.S.L.

TAILWATER AT TIME OF INSPECTION - M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B. M. Mihalcin	Penelec Personnel	
D. J. Spaeder	R. T. Gallus	
D. L. Bonk		
Site Revisited and Rephotographed		
by B. M. Mahalcin 21 February 1980		

RECORDED BY B. M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA-00809
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Local low area slightly in excess of 1-foot adjacent to spillway right wingwall. Curved centerline.
RIPRAP FAILURES	None observed. Riprap is durable, well-graded Loyalhanna Limestone.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Embankment to abutments, good. Concrete-lined gutter along entire downstream toe. Excess debris in gutter along downstream embankment toe to right of outlet.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00809
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	None observed.
ANY NOTICEABLE SEEPAGE	None observed.
STAFF GAGE AND RECORDER	None.
DRAINS	None.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00809
INTAKE STRUCTURE	Submerged, not observed.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Headwall in excellent condition.
OUTLET STRUCTURE	See above.
OUTLET CHANNEL	Gabion-lined trapezoidal channel. Excellent condition.
GATE(S) AND OPERATIONAL EQUIPMENT	Two gate operators on upstream face of dam in excellent condition. Two valve operators near downstream toe in excellent condition.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 00809
TYPE AND CONDITION	Ogee-type concrete side channel spillway discharges into rectangular concrete channel. Good conditions.
APPROACH CHANNEL	Rock-lined, unobstructed.
SPILLWAY CHANNEL AND SIDEWALLS	Generally in good condition. Sidewalls well-aligned but exhibiting several vertical cracks at weephole locations, particularly in upstream diversion canal. Should be observed in future inspections and sealed as required.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Gabion-lined trapezoidal channel. Excellent condition.
BRIDGE AND PIERS EMERGENCY GATES	None.

SERVICE SPILLWAY

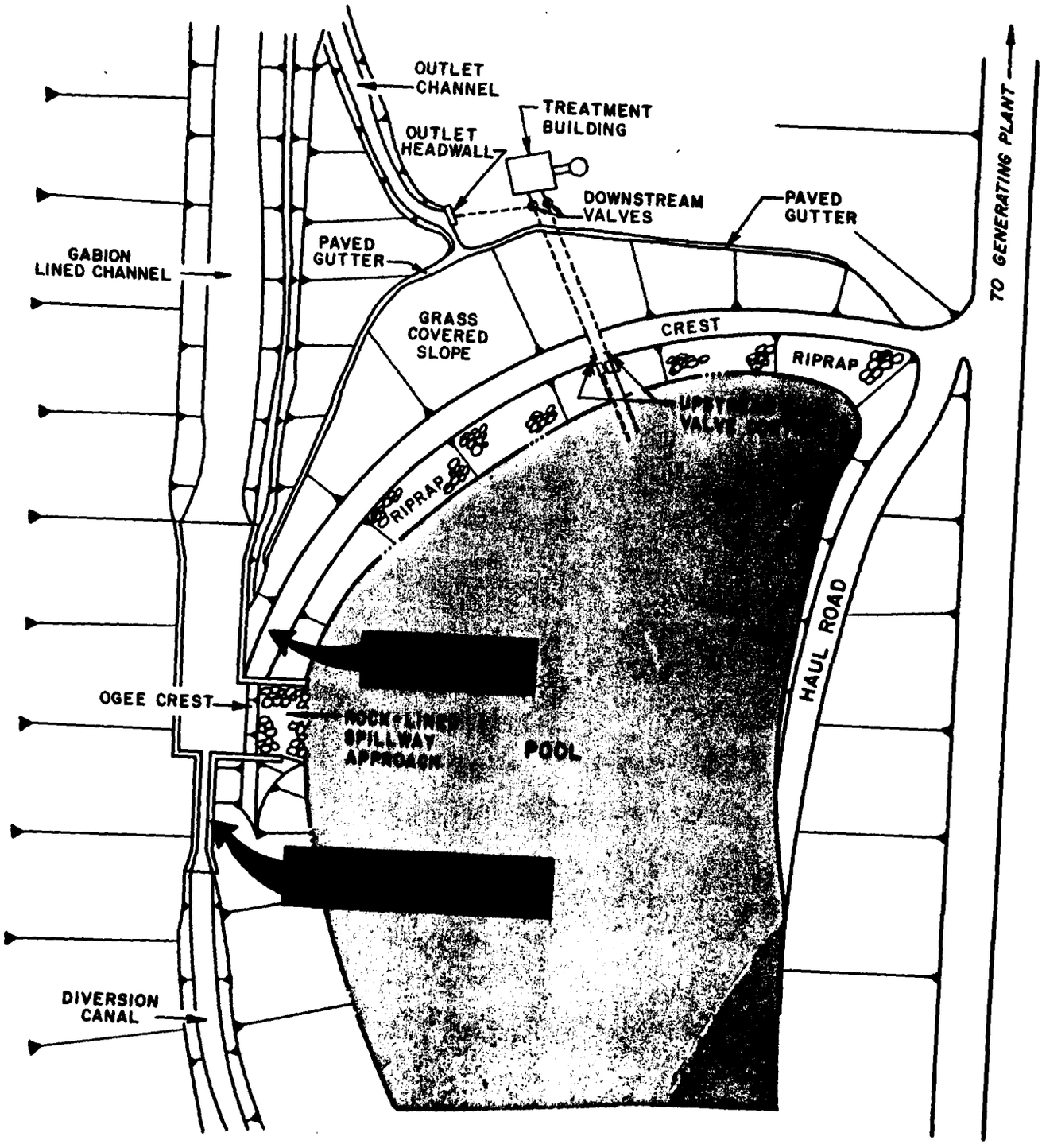
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00809
TYPE AND CONDITION	N/A.
APPROACH CHANNEL	N/A.
OUTLET STRUCTURE	N/A.
DISCHARGE CHANNEL	N/A.

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00809
MONUMENTATION SURVEYS	Owner has recently surveyed entire dam and reservoir area. Detailed drawings are being prepared.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

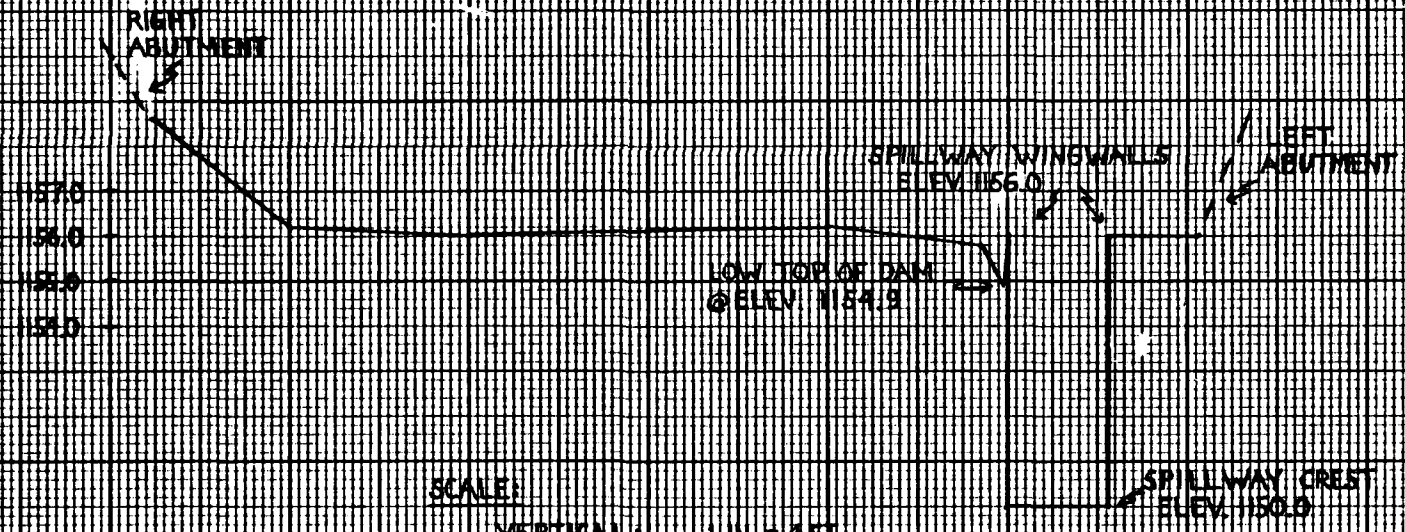
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 00809
SLOPES: RESERVOIR	Slopes are moderate to steep, and are grass-covered to lightly wooded.
SEDIMENTATION	No significant sedimentation. Owner dredges reservoir area to control sedimentation.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Road bridges are located about 1/2-mile and 1-mile downstream from the dam. The stream runs adjacent to the community of Centerville, about 1-mile downstream from the dam, and discharges into the Conemaugh River.
SLOPES: CHANNEL VALLEY	The channel slope is generally mild (on the order of 1 percent) within the downstream reach. The stream valley is broad in sections, with mild to steep side slopes.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Effluent treatment plant near toe of dam. About 1/2-mile below the embankment the stream passes within several hundred feet of the facilities comprising the Conemaugh Generating Station. The community of Centerville, Pennsylvania is about 1-mile downstream of the embankment. An embankment breach would likely result in significant economic damage and possibly the loss of many lives in Centerville.



PENELEC RETENTION DAM
GENERAL PLAN - FIELD INSPECTION NOTES

PENELEC RETENTION DAM

PROFILE OF DAM CREST
FROM FIELD SURVEY



SCALE:
VERTICAL: 1 IN. = 4 FT
HORIZONTAL: 1 IN. = 100 FT

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Penelec Retention Dam

ITEM	REMARKS NDI# PA- 00809
PERSONS INTERVIEWED AND TITLE	Pennsylvania Electric Company. R. T. Gallus (Supervisor, Generating Plant Civil Engineering).
REGIONAL VICINITY MAP	See Appendix E, Figure 1.
CONSTRUCTION HISTORY	Designed by E. D'Appolonia Consulting Engineers, Inc., of Pittsburgh, Pennsylvania. Constructed in 1973-1974 by R and L Construction of New Alexandria, Pennsylvania.
AVAILABLE DRAWINGS	Complete set of design drawings dated 1972 by D'Appolonia available from the owner and the PennDER (see Appendix E, Figures 2 through 10).
TYPICAL DAM SECTIONS	See Appendix E, Figures 4 and 5.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	See Appendix E, Figure 5. Discharge curves are not available.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00809
SPILLWAY: PLAN SECTION DETAILS	See Appendix E, Figures 6 and 7.
OPERATING EQUIPMENT PLANS AND DETAILS	See Appendix E, Figure 5.
DESIGN REPORTS	Report by E. D'Appolonia Consulting Engineers, Inc., dated August 1972, entitled "Engineer's Report, Retention Pond Embankment, Conemaugh Station Ash and Mine Refuse Disposal Area" available from the owner and the PennDER.
GEOLOGY REPORTS	See design report. See Appendix E, Figure 9.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	See design report. See Appendix E, Figure 8.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	See Appendix E, Figures 9 and 10.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 00809
BORROW SOURCES	See Appendix E, Figure 2.
POST CONSTRUCTION DAM SURVEYS	Recently completed survey. Drawings are currently being prepared.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
HIGH POOL RECORDS	None available.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA - 00809
PRIOR ACCIDENTS OR FAILURES	None.
MAINTENANCE: RECORDS MANUAL	Maintenance performed as-needed. No formal records or manual are available.
OPERATION: RECORDS MANUAL	No formal records or manual are available.
OPERATIONAL PROCEDURES	Essentially self-regulating. Water is drawn through the outlets on continuous basis to be treated and released.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None presently in effect.
MISCELLANEOUS	

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00809
PENNDER ID # 32-78

SIZE OF DRAINAGE AREA: 1.24 square miles.

ELEVATION TOP NORMAL POOL: 1150.0 STORAGE CAPACITY: 30 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: _____ STORAGE CAPACITY: _____

ELEVATION TOP DAM: 1154.9 STORAGE CAPACITY: 57 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 1150.0 feet.

TYPE: Ogee-crested side channel.

CREST LENGTH: 56 feet.

CHANNEL LENGTH: 151 feet.

SPILLOVER LOCATION: Left abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: Two 24-inch diameter reinforced concrete pipes.

LOCATION: Near center of embankment.

ENTRANCE INVERTS: 1133.0 feet.

EXIT INVERTS: 1128.2 feet (blowoff).

EMERGENCY DRAWDOWN FACILITIES: Blowoff gated at inlet and valved at outlet.

HYDROMETEOROLOGICAL GAGES

TYPE: None.

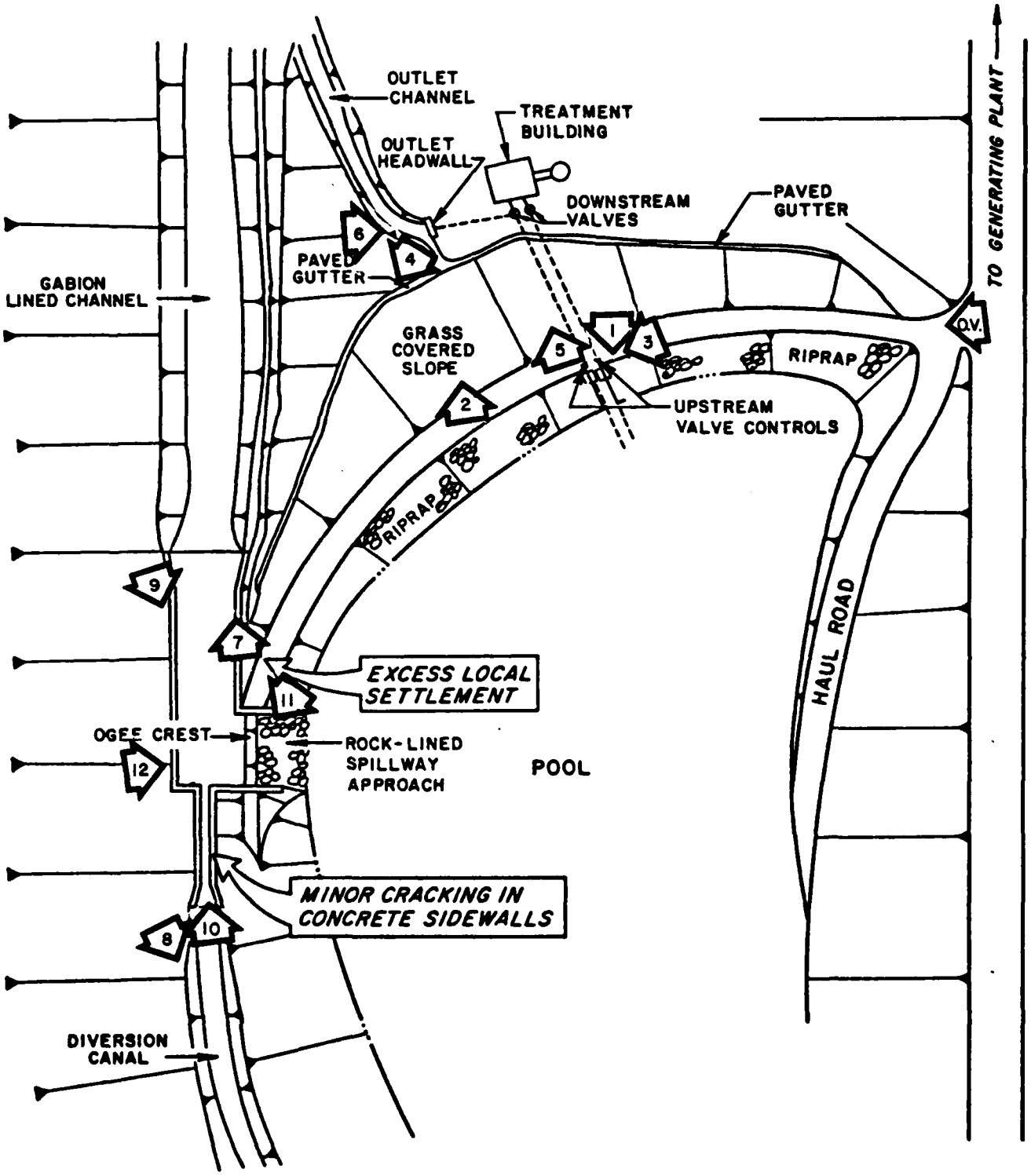
LOCATION: -

RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS



PENELEC RETENTION DAM
PHOTOGRAPH KEY MAP

PHOTOGRAPH 1 View of the reservoir and upstream gate operators as seen from embankment crest.

PHOTOGRAPH 2 View of the area immediately downstream of the embankment. The outlet discharge channel is in the center of the view.

PHOTOGRAPH 3 View of the upstream embankment slope and gate operators as seen from the right abutment.

PHOTOGRAPH 4 View of the downstream embankment slope to the left of the outlet. Paved gutter runs along the entire downstream toe.

1

2

3

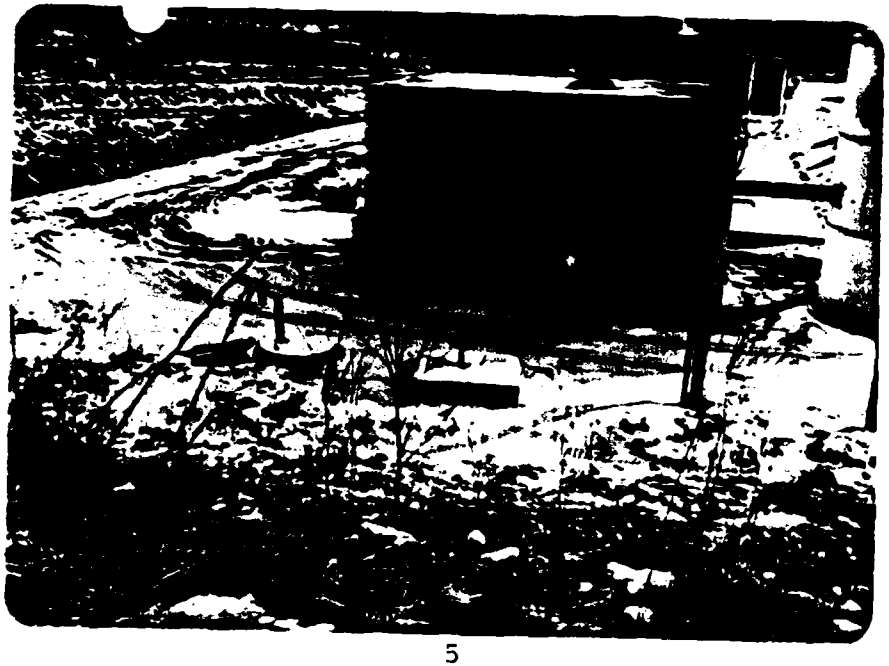
4

PHOTOGRAPH 5 View of the treatment building and gate valve control mechanisms located immediately below the embankment.

PHOTOGRAPH 6 View of the discharge end of the blowoff outlet located at the downstream embankment toe.

PHOTOGRAPH 7 View of the rectangular, concrete spillway channel and trapezoidal-shaped, gabion-lined discharge channel.

PHOTOGRAPH 8 View of the trapezoidal-shaped, grass-lined diversion canal.



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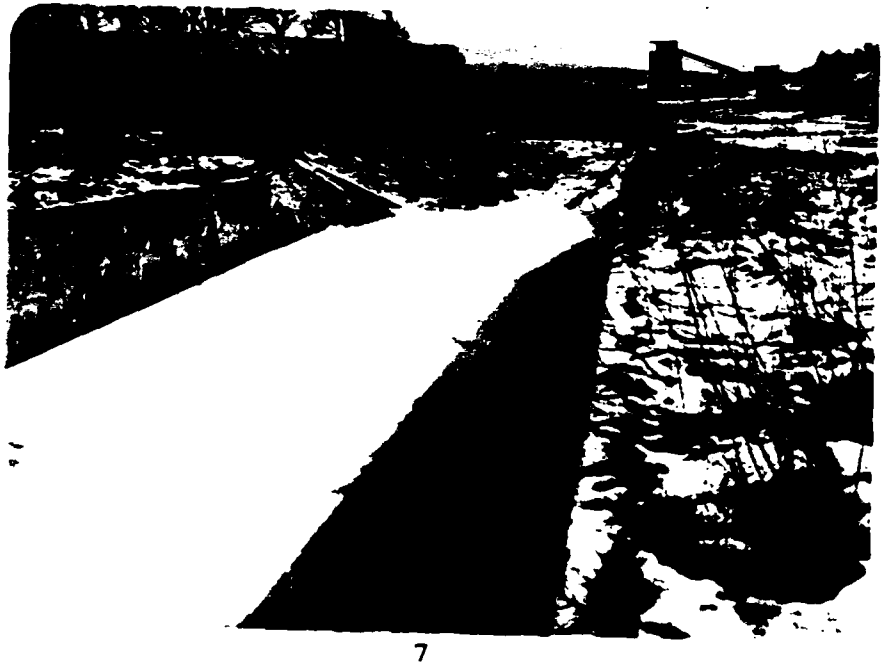

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PHOTOGRAPH 9 View, looking upstream, of the spillway channel as seen from the left abutment.

PHOTOGRAPH 10 View, looking downstream, of the spillway channel as seen from the concrete-lined portion of the diversion canal.

PHOTOGRAPH 11 View of the spillway forebay area.

PHOTOGRAPH 12 Front view of the ogee-crested spillway weir.

9

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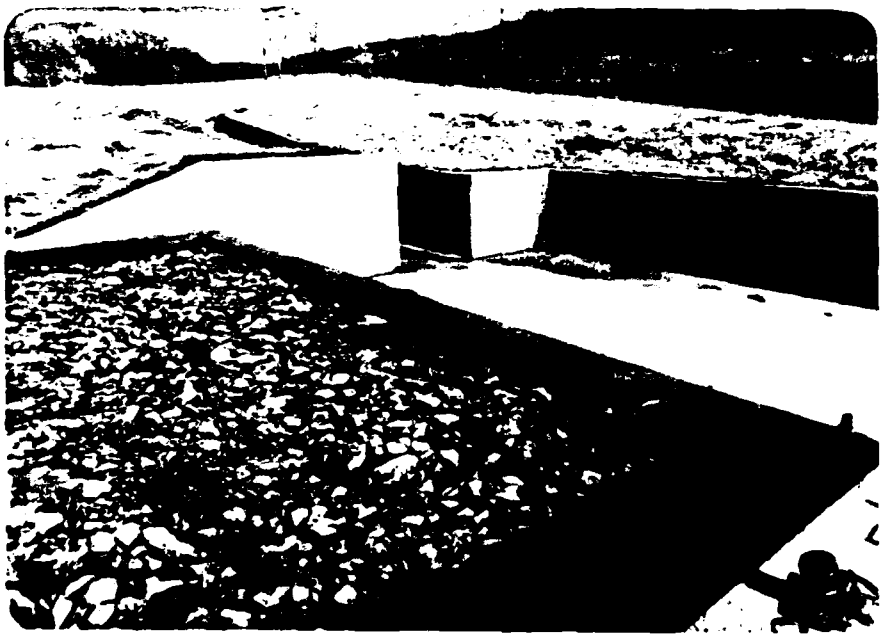

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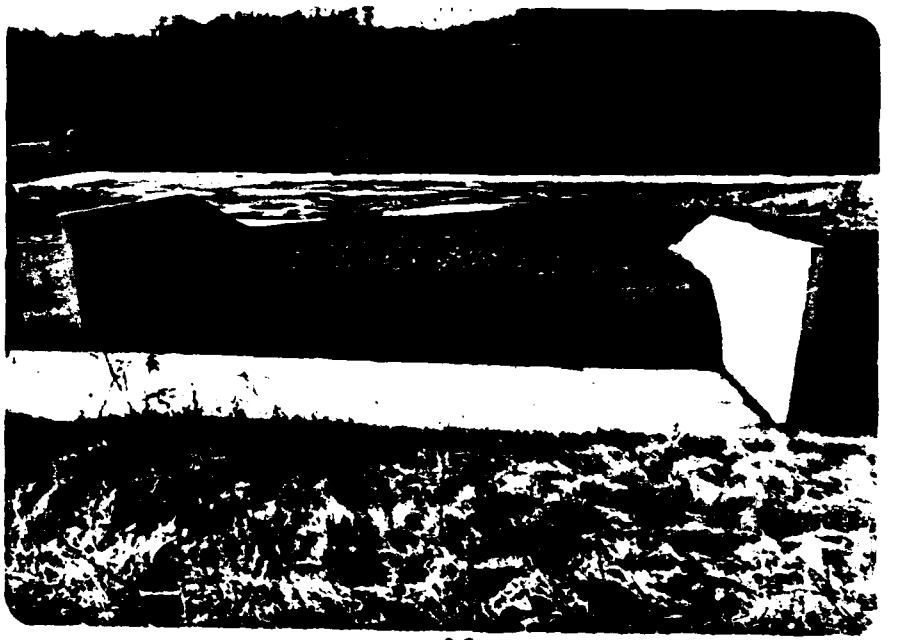

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APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: PENELEC RETENTION DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 24 INCHES/24 HOURS (1)

STATION	1		2	3
STATION DESCRIPTION	PENELEC RETENTION DAM			
DRAINAGE AREA (SQUARE MILES)	0.91	0.33 (5)		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	1.24			
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) (1)				
6 HOURS	102			
12 HOURS	120			
24 HOURS	130			
48 HOURS	140			
72 HOURS	-			
SNYDER HYDROGRAPH PARAMETERS				
ZONE (2)	24			
C_p (3)	0.45			
C_t (3)	1.6			
L (MILES) (4)	1.85	0.82 (5)		
L_{ca} (MILES) (4)	1.00	0.38		
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (HOURS)	1.92	1.13		
SPILLWAY DATA				
CREST LENGTH (FEET)	56			
FREEBOARD (FEET)	4.9			

(1) HYDROMETEOROLOGICAL REPORT 33, U.S. ARMY CORPS OF ENGINEERS, 1956.

(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).

(3) SNYDER COEFFICIENTS

(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE.
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

(5) MAIN BASIN/EAST BASIN

SUBJECT: DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY: DJS DATE: 2-25-80 PROJ. NO. 79-203-809
CHKD. BY: DLB DATE: 2-28-80 SHEET NO. 1 OF 13

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DAM STATISTICS

- HEIGHT OF DAM ≈ 27 FT (FIELD MEASURED)
- NORMAL POOL STORAGE CAPACITY ≈ 1.3×10^6 CUBIC FEET ≈ 29.8 ACRE-FEET (SEE NOTE 1)
- MAXIMUM POOL STORAGE CAPACITY ≈ 57 ACRE-FT (SEE NOTE 1)
  (AT LOW TOP OF DAM)
- DRAINAGE AREA:

  MAIN BASIN: 0.91 SQ MI.
  EAST BASIN: 0.33 SQ. MI.
  TOTAL: 1.24 SQ. MI (PLANIMETERED ON USGS 7.5' TOPO QUAD: NEW FLORENCE, PA)

- ELEVATION OF TOP OF DAM (FIELD) ≈ 1154.9
- ELEVATION OF TOP OF DAM (DESIGN) ≈ 1156.0 (FIGURE 4)
- NORMAL POOL ELEVATION ≈ 1150.0 (FIGURE 4)
- UPSTREAM INLET INVERT ELEVATION ≈ 1133.0 (FIGURE 5)
- DOWNSTREAM OUTLET INVERT ≈ 1128.2 (FIELD MEASURED)
- STREAMBED AT DAM CENTERLINE ≈ 1130.0 (FIGURE 3)

PROJECT: DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY: DTS DATE: 2-25-80 PROJ. NO. 79-203-809
CHKD. BY: DLB DATE: 2-28-80 SHEET NO. 2 OF 13

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NOTE 1: VALUES OBTAINED FROM "ENGINEER'S REPORT – RETENTION POND EMBANKMENT, CONEMAUGH STATION, ASH AND MINE REFUSE DISPOSAL AREA," FOR PENNSYLVANIA ELECTRIC COMPANY, JOHNSTOWN, PA, BY E. D'APPOLONIA CONSULTING ENGINEERS, INC., PITTSBURGH, PA, 1972.

DAM CLASSIFICATION

DAM SIZE: SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION: HIGH (FIELD OBSERVATION)

REQUIRED SDF: ½ PMF TO PMF (REF 1, TABLE 3)

HYDROGRAPH PARAMETERS

	MAIN BASIN	EAST BASIN	
– LENGTH OF LONGEST WATERCOURSE (L):	1.85 MI.	0.82 MI.	(PLANIMETERED ON USGS TOPO QUAD: NEW FLORENCE, PA)
– LENGTH OF LONGEST WATERCOURSE FROM DAM TO A POINT OPPOSITE BASIN CENTROID (L_{CA}):	1.00 MI.	0.38 MI.	
C_t:	1.6	1.6	(SNYDER COEFFICIENTS: C.O.E. ZONE 24, ALLEGHENY RIVER BASIN)
C_p:	0.45	0.45	
– SNYDER'S STANDARD LAG: $t_p = C_t (L \cdot L_{CA})^{0.3}$:	1.92 HRS	1.13 HRS	

(NOTE: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REF. 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH")

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RESERVOIR STORAGE CAPACITY

STORAGE VOLUMES BELOW ELEVATION 1155.0*:

RESERVOIR ELEVATION (FT)	STORAGE (AC-FT)
1133.0	0
1135.0	1.4
1140.0	4.8
1145.0	14.0
(NORMAL POOL) 1150.0	29.8
1152.0	39.0
1154.0	50.5
(LOW TOP OF DAM) 1154.9	56.9
1155.0	57.4

* VALUES TAKEN FROM STORAGE-ELEVATION CURVE; SEE FIGURE 8.

STORAGE VOLUMES ABOVE ELEVATION 1155.0:

- BETWEEN ELEVATIONS 1155.0 AND 1160.0, IT IS ASSUMED THAT THE MODIFIED PRISMOIDAL RELATIONSHIP ADEQUATELY MODELS THE RESERVOIR SURFACE AREA – STORAGE RELATIONSHIP. (REF 14, p. 15)

$$\Delta V_{1-2} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 \cdot A_2}\right)$$

WHERE ΔV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 & 2, IN ACRE-FT,
h = ELEVATION 1 – ELEVATION 2, IN FEET,
A_1 = SURFACE AREA AT ELEVATION 1, IN ACRES, AND
A_2 = SURFACE AREA AT ELEVATION 2, IN ACRES.

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ALSO, S.A. @ ELEV 1155.0 ≈ 4.9 ACRES (FIGURE 8)

S.A. @ ELEV 1160.0 = 9.1 ACRES (PLANIMETERED ON FIG. 2)

- ASSUME SURFACE AREAS AT ELEVATIONS BETWEEN 1155.0 AND 1160.0 VARY LINEARLY.

ELEVATION - STORAGE RELATIONSHIP ABOVE ELEV. 1155.0 :

ELEVATION (FT)	SURFACE AREA (AC.)	ΔV_{1-2} (AC-FT)	TOTAL VOLUME (AC-FT)
1155.0	4.9	—	57.4 *
1156.0	5.7	5.3	62.7
1157.0	6.6	6.1	68.8
1158.0	7.4	7.0	75.8
1159.0	8.3	7.8	83.6
1160.0	9.1	8.7	92.3

*- SEE SHEET 3.

PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 INCHES (REF. 3, FIG. 1)
  (CORRESPONDING TO A DURATION OF 24 HOURS AND AN AREA OF 200 SQUARE MILES IN SOUTHWESTERN PENNSYLVANIA.)

- DEPTH-AREA-DURATION ZONE # 7. (REF 3, FIG. 1)

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- DRAINAGE AREA OF MAIN BASIN = 0.91 SQUARE MILES; DRAINAGE AREA OF EAST BASIN = 0.33 SQUARE MILES; ASSUME THAT DATA CORRESPONDING TO A 10-SQUARE MILE AREA IS REPRESENTATIVE OF TOTAL BASIN AREA, 1.24 SQ MI:

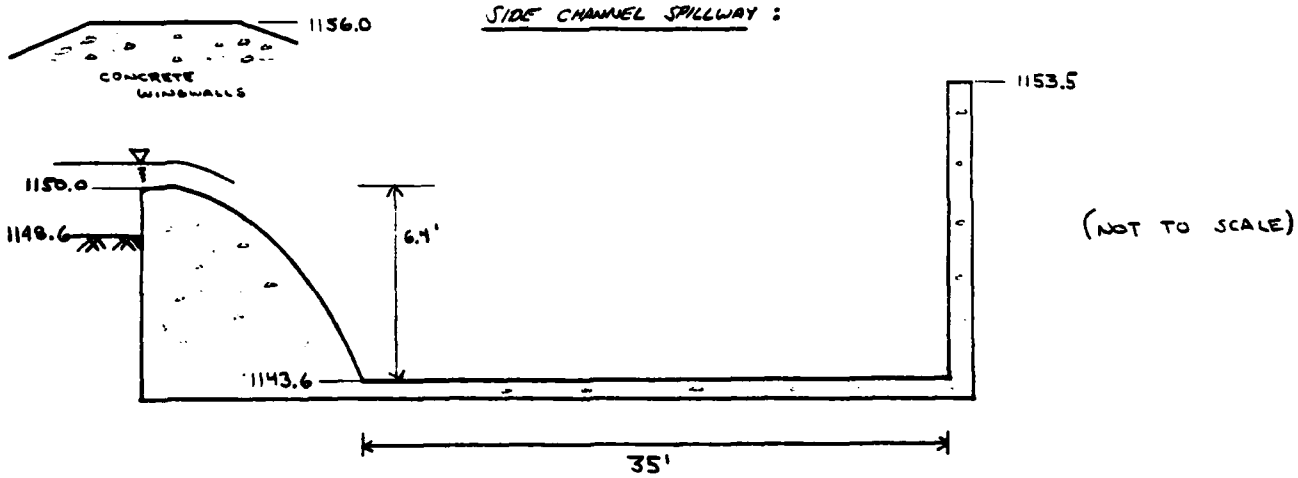
DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	102
12	120
24	130
48	140

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR DRAINAGE AREA OF 1.24 SQUARE MILES IS 0.80

(REF 4, p. 48)

SPILLWAY CAPACITY

SIDE CHANNEL SPILLWAY:



(NOT TO SCALE)

- BASED ON FIELD MEASUREMENTS AND FIG. 6

ECT DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY DJS DATE 2-21-80 PROJ. NO. 79-203-809
CHKD. BY DLB DATE 2-28-80 SHEET NO. 6 OF 13

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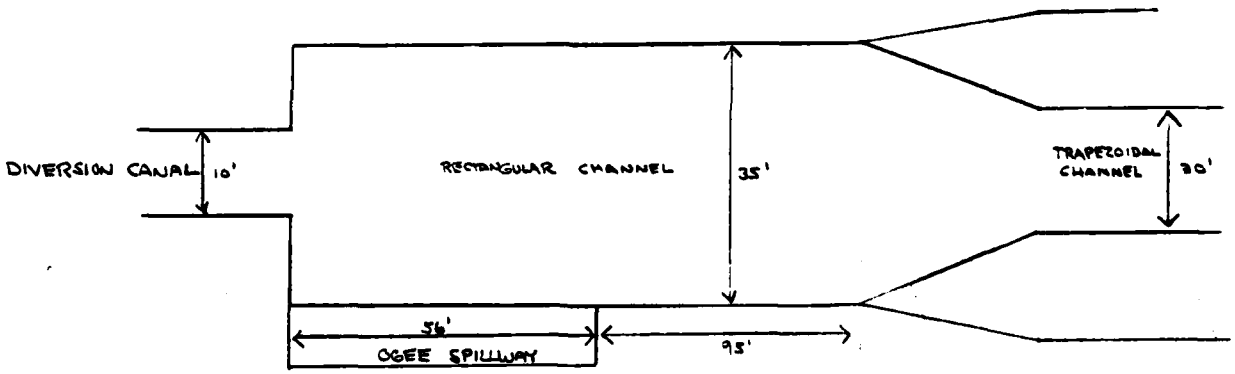
THE SPILLWAY CONSISTS OF 56-FOOT OGEE-TYPE SIDE-CHANNEL SPILLWAY, WHICH DISCHARGES INTO A 35-FT. WIDE RECTANGULAR CHANNEL. THIS CONCRETE RECTANGULAR CHANNEL EXTENDS 95 FEET BEYOND THE DOWNSTREAM END OF THE SIDE-CHANNEL SPILLWAY. A CONCRETE TRANSITION SECTION IS THEN PROVIDED, AS THE CHANNEL SECTION BECOMES TRAPEZOIDAL AND GABION-LINED, EXTENDING ABOUT 420 FEET BEFORE DISCHARGING INTO THE NATURAL CHANNEL.

ALSO, THE DIVERSION CANAL, WHICH CONVEYS UP TO 250 CFS OF RUNOFF FROM THE EAST BASIN, DISCHARGES INTO THE RECTANGULAR CHANNEL AT A POINT JUST UPSTREAM OF THE SIDE-CHANNEL WEIR.



- NOT TO SCALE -

(FROM FIG. 7)

IN THE HEC-1 COMPUTER PROGRAM OVERTOPPING ANALYSIS, UP TO 250 CFS IS SUBTRACTED FROM ALL ORDINATES OF THE EAST BASIN OUTFLOW HYDROGRAPH, IN ORDER TO ACCOUNT FOR THE DISCHARGE CONVEYED BY THE DIVERSION CANAL, BYPASSING THE OGEE SPILLWAY.

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SPILLWAY CAPACITY:

- DISCHARGE OVER THE OGEE-TYPE WEIR CAN BE ESTIMATED BY THE RELATION

$$Q = CLH^{3/2} \qquad \text{(REF 4, p. 373)},$$

WHERE Q = WEIR DISCHARGE, IN CFS,
C = DISCHARGE COEFFICIENT,
L = LENGTH OF WEIR CREST = 56 FT, AND
H = EFFECTIVE HEAD ON WEIR CREST, IN FEET.

THE DESIGN HEAD IS 3.1 FEET, AS REPORTED IN THE "ENGINEER'S REPORT" (SEE NOTE 1), AND THE CORRESPONDING COEFFICIENT OF DISCHARGE IS 3.8. AS THE HEAD ON THE WEIR BECOMES SMALL, DISCHARGE IS REDUCED DISPROPORTIONATELY, DUE TO THE ROUGHNESS AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE WEIR SURFACE. THUS, THE DISCHARGE COEFFICIENT (C) TAKES ON A LOWER VALUE THAN THAT AT DESIGN HEAD. THE OPPOSITE TREND OCCURS FOR HEADS GREATER THAN THAT OF DESIGN. THEREFORE, THE DISCHARGE COEFFICIENT MUST BE MODIFIED APPROPRIATELY, ACCORDING TO FIGURE 250, REFERENCE 4.

DISCHARGE OVER THE OGEE WILL BE AFFECTED BY TAILWATER CONDITIONS AT THE HIGHER FLOWS. THEREFORE, THE DISCHARGE COEFFICIENT MUST ALSO BE MODIFIED TO ACCOUNT FOR SUBMERGENCE EFFECTS. IN ORDER TO ESTIMATE TAILWATER LEVELS CORRESPONDING TO VARIOUS OUTFLOWS, A BACKWATER CURVE WAS COMPUTED, BY USE OF THE HEC-2 WATER SURFACE PROFILES COMPUTER PROGRAM (HEC-2 WATER SURFACE PROFILES, USERS MANUAL, HYDROLOGIC ENGINEERING CENTER, U.S. ARMY CORPS OF ENGINEERS, DAVIS, CA, NOV., 1976). HEC-2 COMPUTES BACKWATER BY THE STANDARD STEP METHOD (REF 7, p. 274-280), BASED ON CHANNEL CROSS-SECTION INFORMATION. SPECIFIC CROSS-SECTION DATA

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USED HERE IS GIVEN ON SHEET 13 (SEE FIG. 3). COMPUTATIONS WERE INITIATED AT A SECTION (SECTION 1, SHEET 13) LOCATED ABOUT 135 FEET DOWNSTREAM OF THE OGEE STRUCTURE, AT THE CHANNEL TRANSITION. CRITICAL DEPTH WAS ASSUMED HERE, DUE TO THE TRANSITION AND THE BREAK IN CHANNEL SLOPE (0.1 % TO 7.0 % SLOPE). CALCULATIONS PROCEEDED UPSTREAM, TO A SECTION LOCATED JUST DOWNSTREAM OF THE OGEE. WATER SURFACE ELEVATIONS AT THIS SECTION (SECTION 3) WERE ASSUMED TO BE APPLICABLE FOR THE ENTIRE LENGTH OF THE OGEE.

TAILWATER RATING CURVE:

ELEVATION * (FT)	DISCHARGE (CFS)
1146.8	500
1148.3	1000
1149.4	1500
1150.2	2000
1150.7	2500
1151.1	3000
1151.4	3500
1152.1	4000
1153.1	5000
1153.7	6000
1154.5	7000

* WATER SURFACE ELEVATION AT SECTION 3; SEE SUMMARY INPUT/OUTPUT SHEETS, SHEET B. CHANNEL INVERT = 1143.6 FT.

'ECT DAM SAFETY INSPECTION

PENELEC RETENTION DAM

BY DJS DATE 2-25-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 2-28-80 SHEET NO. 9 OF 13

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ALSO TAKEN INTO ACCOUNT WITH THE TAILWATER IS THE OUTFLOW OF UP TO 250 CFS FROM THE EAST VALLEY DIVERSION CANAL. A DISCHARGE OF 250 CFS IS ASSUMED TO OCCUR IN THE DIVERSION CANAL AT ALL RESERVOIR ELEVATIONS, TO BE CONSERVATIVE. APPROACH LOSSES AT THE OGEE WERE ASSUMED TO BE INSIGNIFICANT.

SPILLWAY RATING TABLE:

RESERVOIR ELEVATION (FT)	H (FT)	H/H_o ①	C/C_o ②	C ③	INITIAL OUTFLOW ESTIMATE (CFS) ④	POTENTIAL CHANNEL DISCHARGE (CFS) ⑤	ESTIMATED TW DEPTH (FT) ⑥	h_d (FT) ⑦	$\frac{h_d}{H}$	$\frac{C_s}{C}$ ⑧	C_s ⑨	Q (CFS) ⑩
1150.0	—	—	—	—	—	—	—	—	—	—	—	0
1151.0	1.0	0.32	0.88	3.34	190	440	2.8	4.6	4.60	1.0	3.34	190
1152.0	2.0	0.65	0.95	3.61	570	820	4.2	4.2	2.10	1.0	3.61	570
1153.0	3.0	0.97	0.99	3.76	1090	1340	5.4	4.0	1.33	1.0	3.76	1090
1154.0	4.0	1.29	1.04	3.95	1770	2020	6.6	3.8	0.95	1.0	3.95	1770
(LOW TOP OF DAM) 1154.9	4.9	1.58	1.07	4.00	2430	2680	7.2	4.1	0.84	1.0	4.00	2430
1155.0	5.0	1.61	1.07	4.00	2500	2750	7.3	4.1	0.82	1.0	4.00	2500
1156.0	6.0	1.94	1.07	4.00	3290	3540	7.9	4.5	0.75	1.0	4.00	3290
1157.0	7.0	2.26	1.07	4.00	4150	4400	8.9	4.5	0.64	0.99	3.96	4110
1158.0	8.0	2.58	1.07	4.00	5070	5320	9.7	4.7	0.59	0.98	3.92	4970
1159.0	9.0	2.90	1.07	4.00	6050	6300	10.3	5.1	0.57	0.98	3.92	5930
1160.0	10.0	3.23	1.07	4.00	7080	7330	11.2	5.2	0.52	0.98	3.92	6940

① $H_o = 3.1$ FT (DESIGN HEAD)

② C/C_o : FROM REF 4, FIG 250, P. 378

③ $C_o = 3.8$; $C = C_o \times C/C_o$

④ $Q = CLH^{3/2}$, $L = 56$ FT

⑤ POTENTIAL CHANNEL DISCHARGE = INITIAL OUTFLOW ESTIMATE + 250 CFS (E. VALLEY BY-PASS)

⑥ INTERPOLATED/EXTRAPOLATED FROM TAILWATER RATING TABLE, CHANNEL INVERT = 1143.6 FT.

⑦ h_d = RESERVOIR ELEV − TW DEPTH − 1143.6 (SEE REF 4, FIG 254)

⑧ FROM REF 4, FIG. 254, P. 382

⑨ $C_s = C \times C_s/C$

⑩ $Q = C_s L H^{3/2}$, $L = 56$ FT

PROJECT: DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY: DJS DATE: 2-21-80 PROJ. NO. 79-203-809
CHKD. BY: DLB DATE: 2-28-80 SHEET NO. 10 OF 13

GAI CONSULTANTS, INC.
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EMBANKMENT RATING CURVE

– ASSUME THAT THE EMBANKMENT BEHAVES ESSENTIALLY AS A BROAD-CRESTED WEIR WHEN OVERTOPPING OCCURS. THUS, DISCHARGE CAN BE ESTIMATED BY THE RELATIONSHIP

$$Q = CLH^{3/2}$$ (REF 5, p. 5-23)

WHERE Q = DISCHARGE OVER THE EMBANKMENT, IN CFS,
L = LENGTH OF EMBANKMENT OVERTOPPED, IN FEET,
H = HEAD, IN FEET; IN THIS CASE IT IS THE AVERAGE "FLOW-AREA" WEIGHTED HEAD ABOVE THE CREST, WITH THE LOW TOP OF DAM AS THE DATUM;
C = COEFFICIENT OF DISCHARGE, DEPENDENT ON THE HEAD AND THE WEIR BREADTH.

LENGTH OF EMBANKMENT INUNDATED VS RESERVOIR ELEVATION:

RESERVOIR ELEVATION (FT)	EMBANKMENT LENGTH (FT)
(LOW TOP OF DAM) 1154.9	0
1155.8	15
1156.0	100
1156.1	280
1156.2	450
1156.5	465
1157.0	485
1158.0	530
1158.6	550 (BASED ON FIELD MEASUREMENTS)
1159.0	560
1160.0	575

SUBJECT: DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY: DJS DATE: 2-21-80 PROJ. NO. 79-203-809

CHKD. BY: DLB DATE: 2-28-80 SHEET NO. 11 OF 13

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ASSUME THAT INCREMENTAL DISCHARGES (FOR SUCCESSIVE RESERVOIR ELEVATIONS) OVER THE EMBANKMENT ARE APPROXIMATELY TRAPEZOIDAL IN CROSS-SECTIONAL FLOW AREA. THEN ANY INCREMENTAL AREA OF FLOW, A_i, CAN BE ESTIMATED AS $H_i \times [(L_1+L_2)/2]$, WHERE L_1 = LENGTH OF EMBANKMENT AT HIGHER ELEVATION, L_2 = LENGTH OF EMBANKMENT AT LOWER ELEVATION, AND H_i = DIFFERENCE IN ELEVATIONS. THE AVERAGE FLOW-AREA WEIGHTED HEAD WILL THUS BE

$$H_w \simeq (A_T/L_1), \text{ WHERE } A_T = \text{TOTAL FLOW AREA.}$$

EMBAKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	L_1 (FT)	L_2 (FT)	INCREMENTAL HEAD, H_i (FT)	① INCREMENTAL FLOW AREA, A_i (FT^2)	TOTAL FLOW AREA, A_T (FT^2)	② WEIGHTED HEAD, H_w (FT)	③ H_w/ℓ	④ C	⑤ Q (CFS)
1154.9	0	—	0	0	0	0	—	—	0
1155.8	15	0	0.9	7	7	0.5	0.03	3.02	20
1156.0	100	15	0.2	12	19	0.2	0.01	2.97	30
1156.1	280	100	0.1	19	38	0.1	0.01	2.93	30
1156.2	450	280	0.1	37	75	0.2	0.01	2.97	120
1156.5	465	450	0.3	137	212	0.5	0.03	3.02	500
1157.0	485	465	0.5	238	450	0.9	0.06	3.03	1250
1158.0	530	485	1.0	508	958	1.8	0.12	3.04	3890
1159.0	560	530	1.0	545	1503	2.7	0.18	3.07	7630
1160.0	575	560	1.0	568	2071	3.6	0.24	3.08	12,100

① $A_i = H_i \left[\frac{L_1+L_2}{2}\right]$

② $H_w = A_T / L_1$

③ ℓ = BREADTH OF CREST = 15' (FIELD MEASURED)

④ $C = f(H_w, \ell)$; FROM REF 12, FIG. 24.

⑤ $Q = C L_1 H_w^{3/2}$

PROJECT DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY JJS DATE 2-25-80 PROJ. NO. 79-303-809

CHKD. BY DLB DATE 2-28-80 SHEET NO. 12 OF 13

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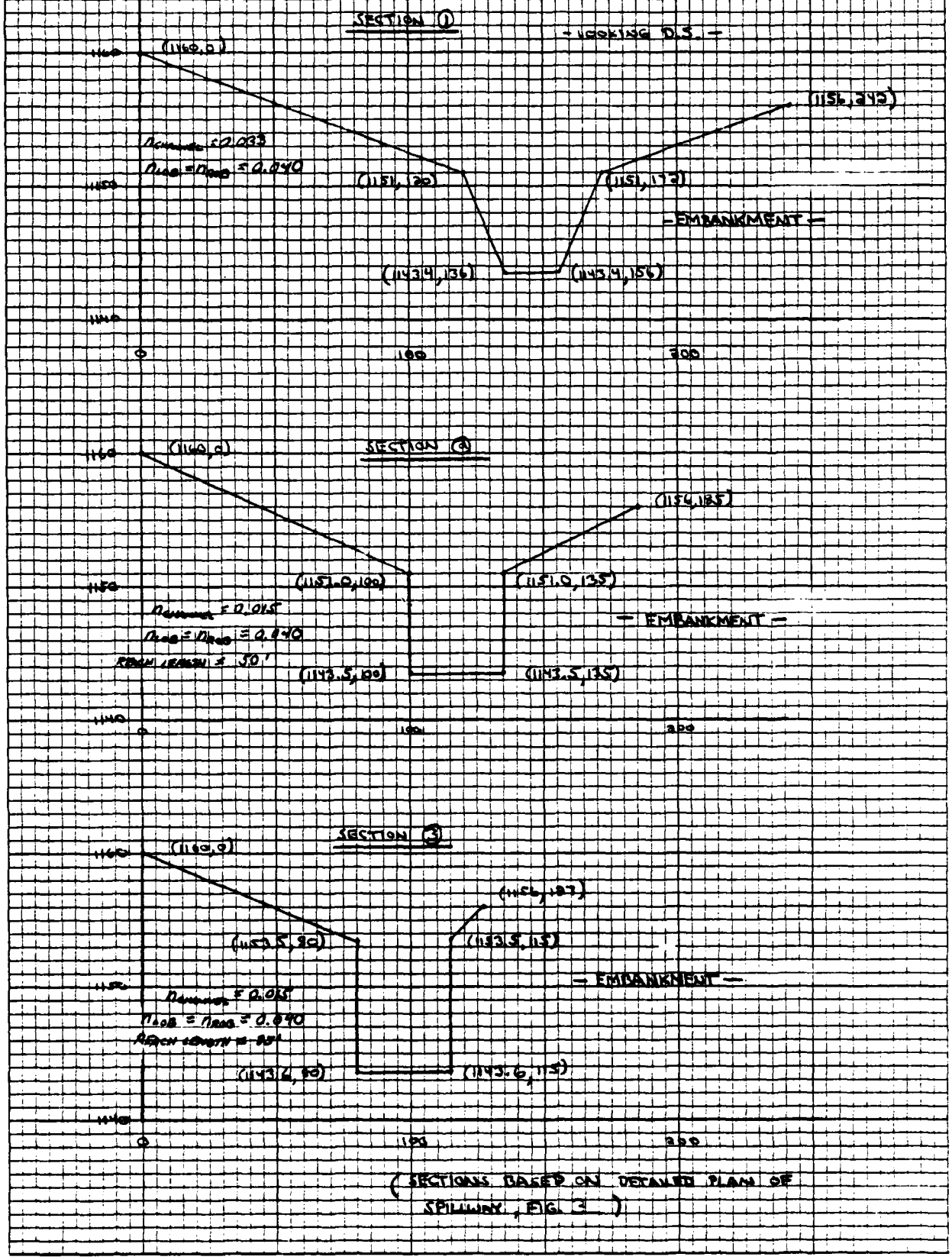
TOTAL FACILITY RATING TABLE

	RESERVOIR ELEVATION	$Q_{SPILLWAY}$	$Q_{EMBANKMENT}$	Q_{TOTAL}
	1150.0	0	–	0
	1151.0	190	–	190
	1152.0	570	–	570
	1153.0	1090	–	1090
	1154.0	1770	–	1770
(LOW TOP OF DAM)	1154.9	2430	0	2430
	1155.0	2500	0	2500
	1155.8	3130 *	20	3150
	1156.0	3290	30	3320
	1156.2	3450 *	120	3570
	1156.5	3700 *	500	4200
	1157.0	4110	1250	5360
	1158.0	4970	3890	8860
	1159.0	5930	7630	13,560
	1160.0	6940	12,100	19,040

*- BY LINEAR INTERPOLATION

CROSS SECTIONS FOR HEC-2 BACKWATER COMPUTATION:



(SECTIONS BASED ON DETAILED PLANS OF SPILLWAY, FIG. 3)

ECT DAM SAFETY INSPECTION

PENELEC RETENTION DAM

BY DBS DATE 2-4-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 3-4-80 SHEET NO. A OF G

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HEC-2 TAILWATER COMPUTATION

SUMMARY INPUT/OUTPUT SHEETS

```
T1   DAM SAFETY INSPECTION
T2   PENELEC RETENTION DAM
T3   TAILWATER COMPUTATION

J1   ICHECK    INQ       NINV      IDIM      SIRT      METRIC    HVINS     Q         WSEL      FQ

       0.        2.        0.        0.  -1.000000     0.0       0.0       0.   1164.400     0.0

J2   NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     1.000     0.0      -1.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0

J5   LPRNT     NUMSEC                        ********REQUESTED SECTION NUMBERS********

    -10.000   -10.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
NC     0.040     0.040     0.033     0.200     0.400     0.0       0.0       0.0       0.0       0.0
QT    11.000   500.000  1000.000  1500.000  2000.000  2500.000  3000.000  3500.000  4000.000  5000.000
QT  6000.000  7000.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0

X1     1.000     6.000   120.000   172.000     0.0       0.0       0.0       0.0       0.0       0.0
GR  1160.000     0.0     1151.000  120.000  1143.400   136.000  1143.400   156.000  1151.000   172.000
GR  1156.000   242.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
NC     0.0       0.0       0.015     0.0       0.0       0.0       0.0       0.0       0.0       0.0

X1     2.000     6.000   100.000   135.000    50.000    50.000    50.000     0.0       0.0       0.0
GR  1160.000     0.0     1151.000  100.000  1143.500   100.000  1143.500   135.000  1151.000   135.000
GR  1156.000   165.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0

X1     3.000     6.000    80.000   115.000    85.000    85.000    85.000     0.0       0.0       0.0
GR  1160.000     0.0     1153.500   80.000  1143.600    80.000  1143.600   115.000  1153.500   115.000
GR  1160.000   127.000     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
EJ     0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
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SUBJECT DAM SAFETY INSPECTION

PENELEC RETENTION DAM

BY DJS DATE 3-4-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 3-4-80 SHEET NO. 8 OF G

GAI CONSULTANTS, INC.
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DISCHARGE ELEVATION

	SECNO	XLCH	ELTHO	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	TOKPS	VCH	AREA
*	1.000	0.0	0.0	0.0	1143.40	500.00	1145.84	1145.84	1146.87	133.23	8.13	61.
*	1.000	0.0	0.0	0.0	1143.40	1000.00	1147.10	1147.10	1148.57	120.14	9.72	102.
*	1.000	0.0	0.0	0.0	1143.40	1500.00	1148.10	1148.10	1149.87	111.66	10.66	140.
*	1.000	0.0	0.0	0.0	1143.40	2000.00	1148.90	1148.90	1150.96	110.40	11.53	173.
*	1.000	0.0	0.0	0.0	1143.40	2500.00	1149.64	1149.64	1151.91	105.83	12.09	206.
*	1.000	0.0	0.0	0.0	1143.40	3000.00	1150.32	1150.32	1152.76	102.17	12.55	239.
*	1.000	0.0	0.0	0.0	1143.40	3500.00	1150.83	1150.83	1153.54	104.73	13.20	265.
*	1.000	0.0	0.0	0.0	1143.40	4000.00	1151.49	1151.49	1154.26	92.87	13.35	302.
*	1.000	0.0	0.0	0.0	1143.40	5000.00	1152.79	1152.79	1155.47	70.04	13.29	410.
*	1.000	0.0	0.0	0.0	1143.40	6000.00	1153.82	1153.82	1156.42	59.07	13.36	528.
*	1.000	0.0	0.0	0.0	1143.40	7000.00	1154.60	1154.60	1157.22	54.52	13.64	637.
	2.000	50.00	0.0	0.0	1143.50	500.00	1146.80	0.0	1147.09	4.89	4.33	115.
	2.000	50.00	0.0	0.0	1143.50	1000.00	1148.28	0.0	1148.83	6.25	5.98	167.
	2.000	50.00	0.0	0.0	1143.50	1500.00	1149.30	0.0	1150.15	7.81	7.39	203.
	2.000	50.00	0.0	0.0	1143.50	2000.00	1150.08	0.0	1151.25	9.56	8.69	230.
	2.000	50.00	0.0	0.0	1143.50	2500.00	1150.62	0.0	1152.18	11.81	10.04	249.
	2.000	50.00	0.0	0.0	1143.50	3000.00	1150.93	0.0	1152.99	15.01	11.54	259.
	2.000	50.00	0.0	0.0	1143.50	3500.00	1150.99	0.0	1153.76	19.92	13.35	262.
	2.000	50.00	0.0	0.0	1143.50	4000.00	1151.40	1150.85	1154.65	21.77	14.46	278.
*	2.000	50.00	0.0	0.0	1143.50	5000.00	1152.39	1152.39	1156.33	22.70	15.97	331.
*	2.000	50.00	0.0	0.0	1143.50	6000.00	1153.89	1153.89	1157.75	18.52	16.00	451.
*	2.000	50.00	0.0	0.0	1143.50	7000.00	1155.06	1155.06	1158.92	16.60	16.27	578.
SECTION IMMEDIATELY DOWNSTREAM OF OGEE WEIR	3.000	85.00	0.0	0.0	1143.60	500.00	1146.83	0.0	1147.14	5.20	4.41	113.
	3.000	85.00	0.0	0.0	1143.60	1000.00	1148.32	0.0	1148.89	6.45	6.04	165.
	3.000	85.00	0.0	0.0	1143.60	1500.00	1149.36	0.0	1150.22	7.95	7.43	201.
	3.000	85.00	0.0	0.0	1143.60	2000.00	1150.16	0.0	1151.33	9.60	8.70	229.
	3.000	85.00	0.0	0.0	1143.60	2500.00	1150.72	0.0	1152.28	11.79	10.03	249.
	3.000	85.00	0.0	0.0	1143.60	3000.00	1151.11	0.0	1153.13	14.48	11.40	263.
	3.000	85.00	0.0	0.0	1143.60	3500.00	1151.43	0.0	1153.96	17.47	12.76	274.
	3.000	85.00	0.0	0.0	1143.60	4000.00	1152.10	0.0	1154.90	17.96	13.43	297.
	3.000	85.00	0.0	0.0	1143.60	5000.00	1153.06	0.0	1156.60	20.63	15.09	331.
	3.000	85.00	0.0	0.0	1143.60	6000.00	1153.71	1153.23	1158.17	24.32	16.95	354.
*	3.000	85.00	0.0	0.0	1143.60	7000.00	1154.51	1154.51	1159.71	25.68	18.31	388.

* CRITICAL DEPTH ASSUMED.

SUBJECT DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY DJS DATE 3-4-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 3-4-80 SHEET NO. C OF G

GAI CONSULTANTS, INC.
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OVERTOPPING ANALYSIS:

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DAM SAFETY INSPECTION
PENELEC RETENTION DAM *** OVERTOPPING ANALYSIS ***
10-MINUTE TIME STEP AND 48-HOUR DURATION

                              JOB SPECIFICATION
  NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
 288       0      10       0       0       0       0       0       0       0
                       JOPER     NWT   LROPT   TRACE
                           5       0       0       0

                    MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 5 LRTIO= 1
  RTIOS=    .50    .60    .70    .80   1.00

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

                        SUB-AREA RUNOFF COMPUTATION

EAST BASIN RUNOFF HYDROGRAPH

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

                              HYDROGRAPH DATA
  IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
      1       1     .33    0.00    1.24    0.00   0.000       0       1       0

                              PRECIP DATA
          SPFE     PMS      R6     R12     R24     R48     R72     R96
          0.00   24.00  102.00  120.00  130.00  140.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                                  INITIAL AND CONSTANT RAINFALL LOSSES : COE
                                 LOSS DATA
 LROPT   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=  1.13    CP= .45    NTA=  0
                                                  BASE FLOW PARAMETERS : COE
                              RECESSION DATA
                  STRTQ=   -1.50    QRCSN=    -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.09 AND R=10.92 INTERVALS

     UNIT HYDROGRAPH 62 END-OF-PERIOD ORDINATES, LAG=   1.14 HOURS, CP=  .45  VOL= 1.00
   4.      16.      32.      50.      68.      80.      85.      82.      75.      69.
  63.      57.      52.      48.      43.      40.      36.      33.      30.      27.
  25.      23.      21.      19.      17.      16.      14.      13.      12.      11.
  10.       9.       8.       8.       7.       6.       6.       5.       5.       4.
   4.       4.       3.       3.       3.       3.       2.       2.       2.       2.
   2.       1.       1.       1.       1.       1.       1.       1.       1.       1.
   1.       1.
```

SUBJECT DAM SAFETY INSPECTION

PENELEC RETENTION DAM

BY DTS DATE 3-4-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 3-4-80 SHEET NO. D OF G

GAI CONSULTANTS, INC.

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END-OF-PERIOD FLOW

0 HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.88	24.46	2.42	30454.
										(683.)(	621.)(	61.)(	862.36)

EAST BASIN RUNOFF HYDROGRAPH:

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	898.	580.	205.	106.	30432.
CMS	25.	16.	6.	3.	862.
INCHES		16.36	23.14	23.83	23.83
MM		415.45	587.69	605.25	605.25
AC-FT		288.	407.	419.	419.
THOUS CU M		355.	502.	517.	517.

(PMF)

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

HYDROGRAPH ROUTING

REDUCE EAST BASIN OUTFLOW BY UP TO 250 CFS

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
250.0	0.000	0.00	0	1	0	0	0

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

EAST BASIN OUTFLOW HYDROGRAPH;

DISCHARGE REDUCED TO ACCOUNT FOR DIVERSION CANAL:

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	648.	330.	83.	42.	12000.
CMS	18.	9.	2.	1.	340.
INCHES		9.31	9.40	9.40	9.40
MM		236.45	238.67	238.67	238.67
AC-FT		164.	165.	165.	165.
THOUS CU M		202.	204.	204.	204.

(PMF)

SUBJECT DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY DJS DATE 7-4-80 PROJ. NO. 79-203-809
CHKD. BY DLB DATE 3-4-80 SHEET NO. E OF G

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

                         SUB-AREA RUNOFF COMPUTATION

      MAIN BASIN RESERVOIR INFLOW HYDROGRAPH

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

                                HYDROGRAPH DATA
      IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
          1       1     .91    0.00    1.24    0.00   0.000       0       1       0

                                 PRECIP DATA
              SPFE     PMS      R6     R12     R24     R48     R72     R96
              0.00   24.00  102.00  120.00  130.00  140.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .800

                                  LOSS DATA
     LROPT   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=  1.92    CP= .45    NTA=  0

                                RECESSION DATA
                     STRTQ=   -1.50    QRCSN=    -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=12.12 AND R=18.18 INTERVALS

          UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=  1.93 HOURS, CP=  .45  VOL=  .99
        3.      12.      25.      40.      56.      74.      93.     109.     123.     133.
      139.     141.     138.     130.     123.     117.     111.     105.      99.      94.
       89.      84.      79.      75.      71.      67.      64.      60.      57.      54.
       51.      48.      46.      43.      41.      39.      37.      35.      33.      31.
       30.      28.      26.      25.      24.      22.      21.      20.      19.      18.
       17.      16.      15.      14.      14.      13.      12.      12.      11.      10.
       10.       9.       9.       8.       8.       7.       7.       7.       6.       6.
        6.       5.       5.       5.       5.       4.       4.       4.       4.       3.
        3.       3.       3.       3.       3.       2.       2.       2.       2.       2.
        2.       2.       2.       2.       2.       1.       1.       1.       1.       1.

     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

                                                                  SUM  26.88  24.46   2.42   78640.
                                                                       ( 683.)( 621.)(  61.)( 2226.84)
```

MAIN BASIN RESERVOIR INFLOW HYDROGRAPH:

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1881.	1414.	529.	272.	78450.
CMS	53.	40.	15.	8.	2221.
INCHES		14.46	21.65	22.28	22.28
MM		367.16	549.83	565.82	565.82
AC-FT		701.	1050.	1081.	1081.
THOUS CU M		865.	1295.	1333.	1333.

(PMF)

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

COMBINE HYDROGRAPHS

COMBINE EAST BASIN OUTFLOW HYDROGRAPH WITH MAIN BASIN INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	2	0	0	0	0	1	0	0

SUM OF EAST BASIN OUTFLOW HYDROGRAPH AND MAIN BASIN INFLOW HYDROGRAPH:

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2425.	1727.	613.	314.	90451.
CMS	69.	49.	17.	9.	2561.
INCHES		12.96	18.39	18.85	18.85
MM		329.16	467.02	478.75	478.75
AC-FT		857.	1215.	1246.	1246.
THOUS CU M		1057.	1499.	1537.	1537.

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

HYDROGRAPH ROUTING

ROUTE TOTAL HYDROGRAPH THROUGH MAIN RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	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	0.	-1

STAGE	1150.00	1151.00	1152.00	1153.00	1154.00	1154.90	1155.00	1155.80	1156.00	1156.20
	1156.50	1157.00	1158.00	1159.00	1160.00					
FLOW	0.00	190.00	570.00	1090.00	1770.00	2430.00	2500.00	3150.00	3320.00	3570.00
	4200.00	5360.00	8860.00	13560.00	19040.00					
CAPACITY=	0.	1.	5.	14.	30.	39.	51.	57.	57.	63.
	69.	76.	84.	92.						
ELEVATION=	1133.	1135.	1140.	1145.	1150.	1152.	1154.	1155.	1155.	1156.
	1157.	1158.	1159.	1160.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1154.9	0.0	0.0	0.

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

SUBJECT DAM SAFETY INSPECTION
PENELEC RETENTION DAM

BY DTS DATE 3-4-80 PROJ. NO. 79-203-809

CHKD. BY DLB DATE 3-4-80 SHEET NO. G OF G

Engineers • Geologists • Planners
Environmental Specialists

GAI CONSULTANTS, INC.

RESERVOIR OUTFLOW HYDROGRAPH:

PEAK OUTFLOW IS 2422. AT TIME 41.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2422.	1727.	609.	305.	87760.
CMS	69.	49.	17.	9.	2485.
INCHES		12.95	18.28	18.29	18.29
MM		328.99	464.35	464.52	464.52
AC-FT		856.	1208.	1209.	1209.
THOUS CU M		1056.	1491.	1491.	1491.

(PMF)

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

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1133.00	1150.00	1154.90
STORAGE	0.	30.	57.
OUTFLOW	0.	0.	2430.

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
.50	1152.99	0.00	45.	1085.	0.00	41.50	0.00
.60	1153.39	0.00	47.	1354.	0.00	41.50	0.00
.70	1153.78	0.00	49.	1621.	0.00	41.50	0.00
.80	1154.16	0.00	52.	1887.	0.00	41.50	0.00
1.00	1154.89	0.00	57.	2422.	0.00	41.50	0.00

APPENDIX E

FIGURES

LIST OF FIGURES

Figure	Description/Title
1	Regional Vicinity and Watershed Boundary Map
2	General Plan
3	Detailed Plan
4	Typical Sections
5	Plan and Section Through Outlet Works
6	Concrete Channel Details
7	Plan, Profile and Sections, Spillway Channel and Diversion Canal
8	Hydrology and Slope Stability
9	Subsurface Investigation Sections
10	Lab Data Sheet

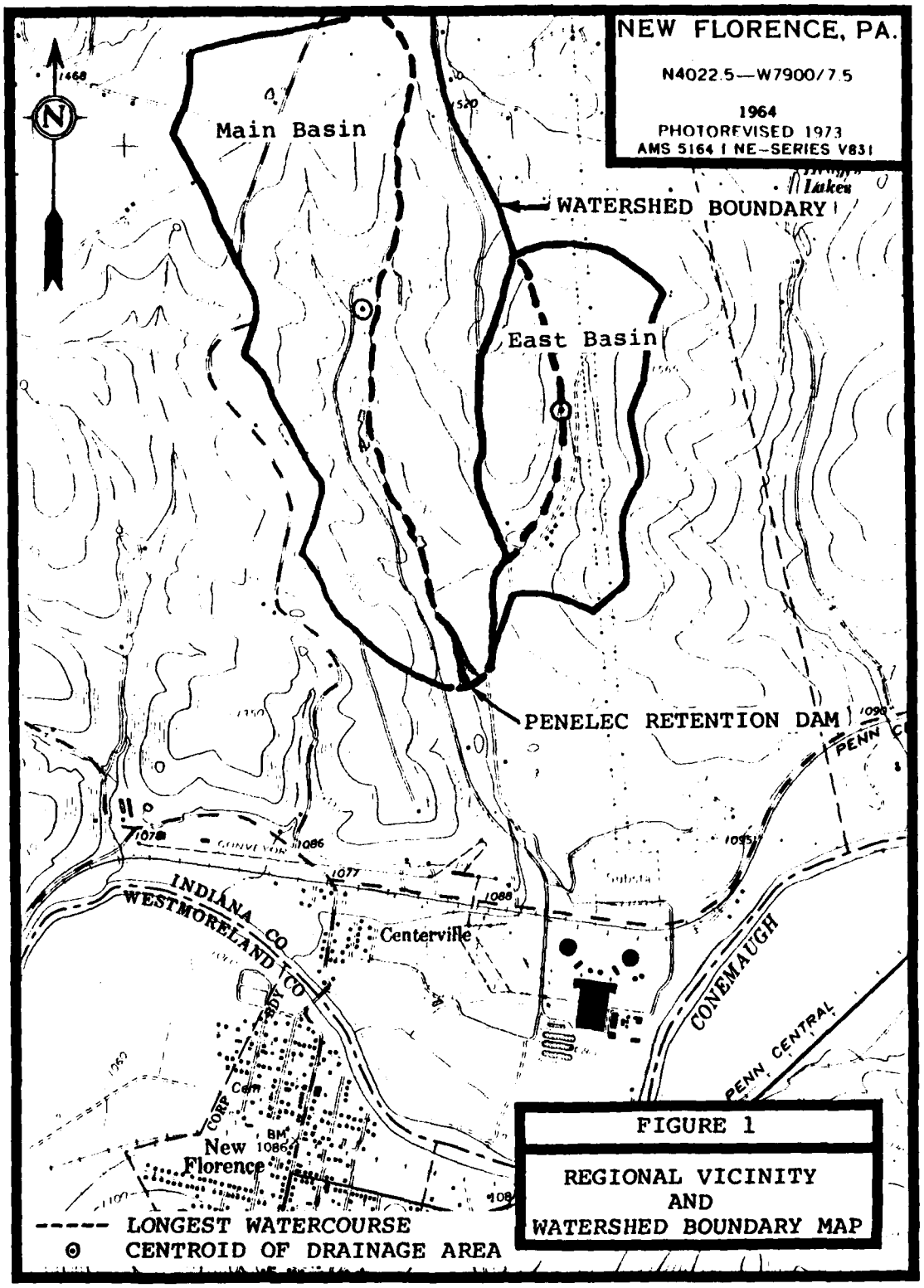
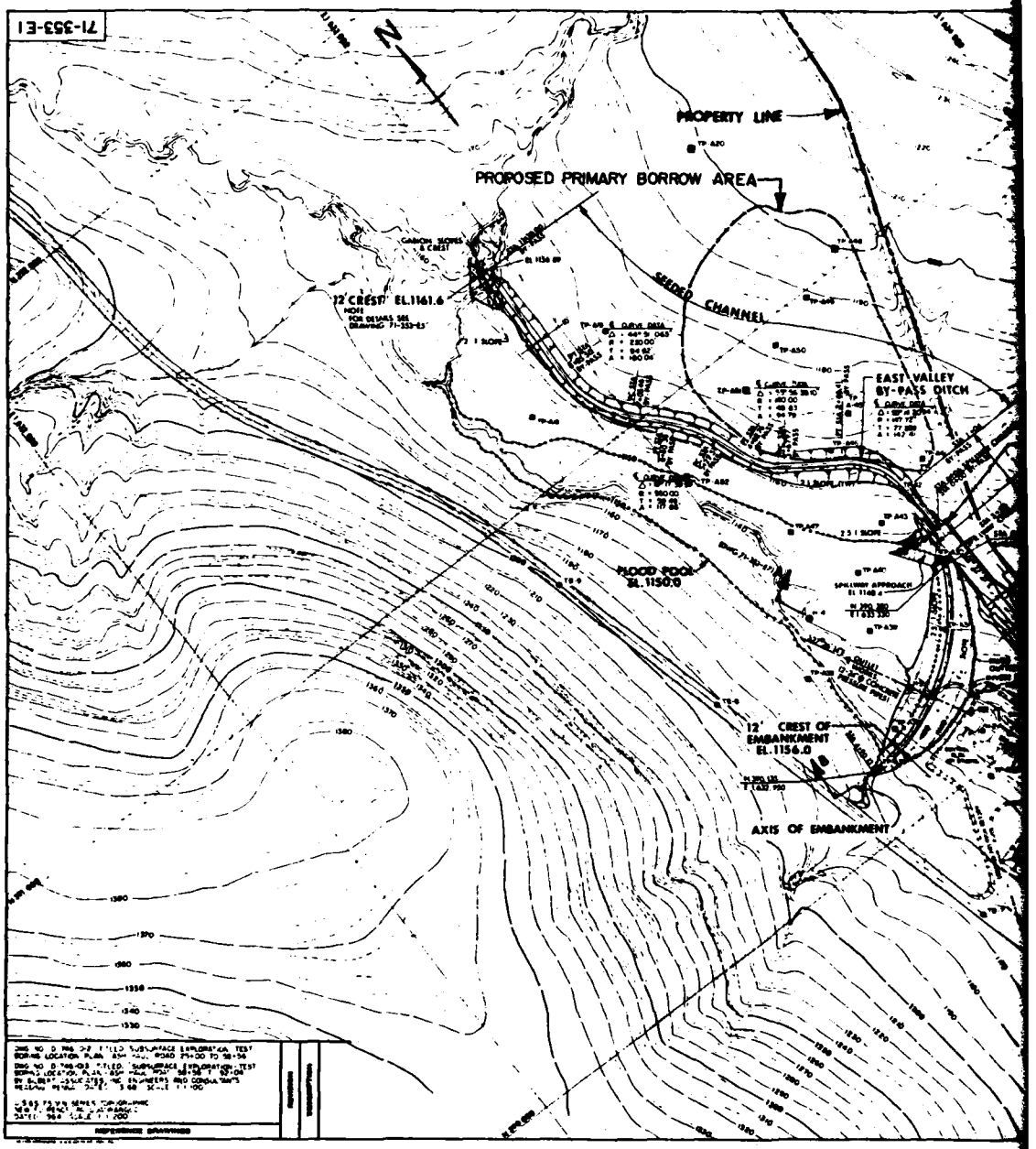


FIGURE 1

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP


71-353-E1
PROPERTY LINE
PROPOSED PRIMARY BORROW AREA
SEEPED CHANNEL
12' CREST EL.1161.6
EAST VALLEY BY-PASS DITCH
FLOOD POOL EL.1150.0
12' CREST OF EMBANKMENT EL.1156.0
AXIS OF EMBANKMENT

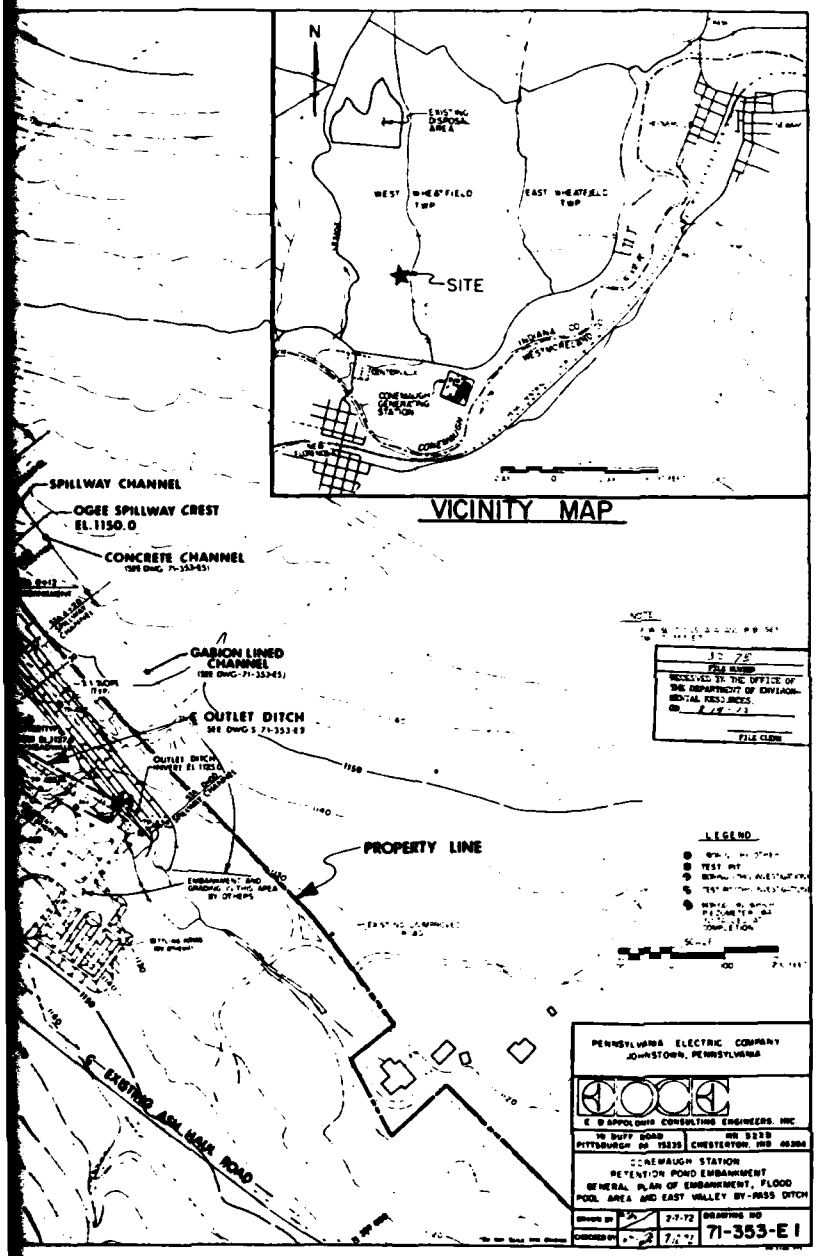


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FIGURE 2

71-353-E2
EAST VALLEY
BY-PASS DITCH
FLOOD POOL
EL. 1150.0
SPILLWAY APPROACH
EL. 1148.4
OUTLET WORKS
OUTLET WORKS INTAKE
2-24" ϕ CONC. PRESSURE PIPES
AXIS OF
EMBANKMENT
12' CREST OF
EMBANKMENT
EL. 1156.0
AXIS CURVE DATA

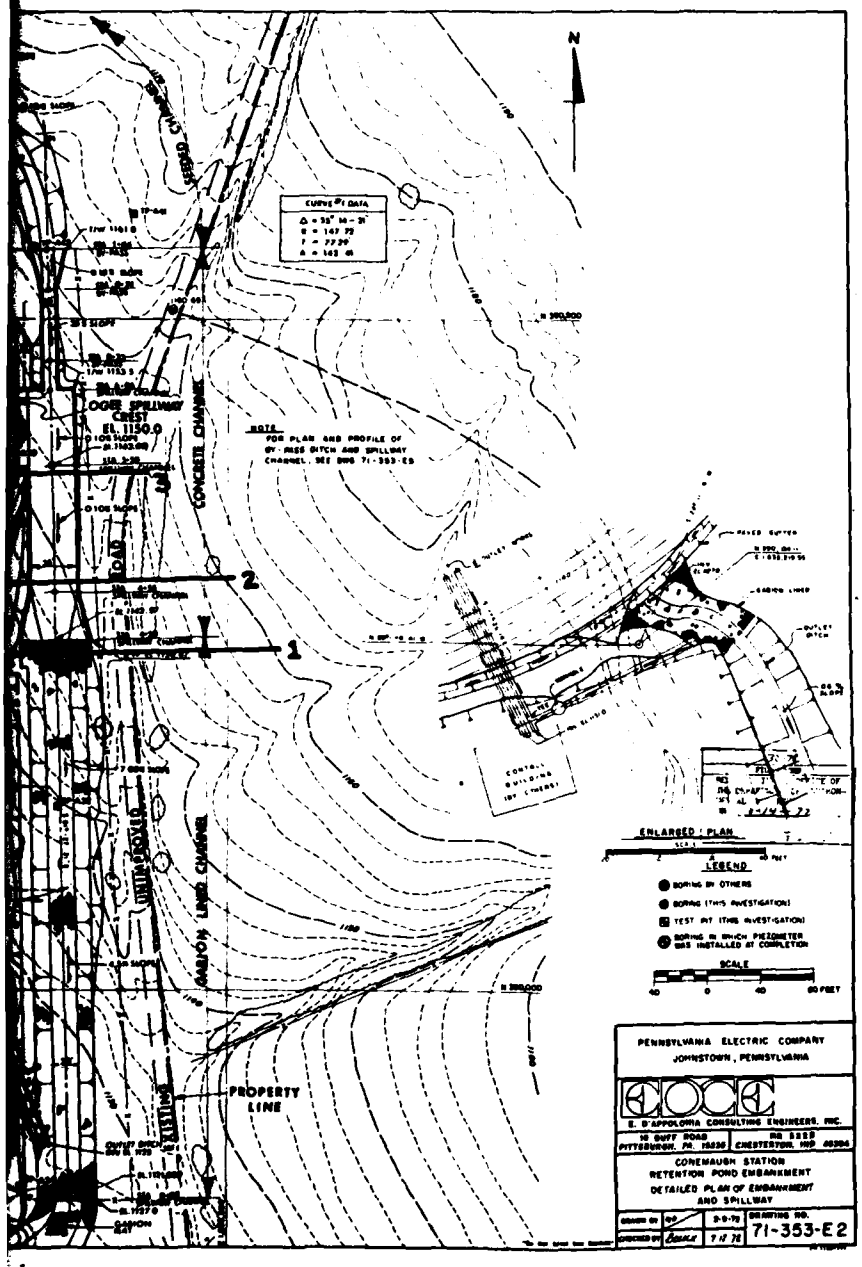

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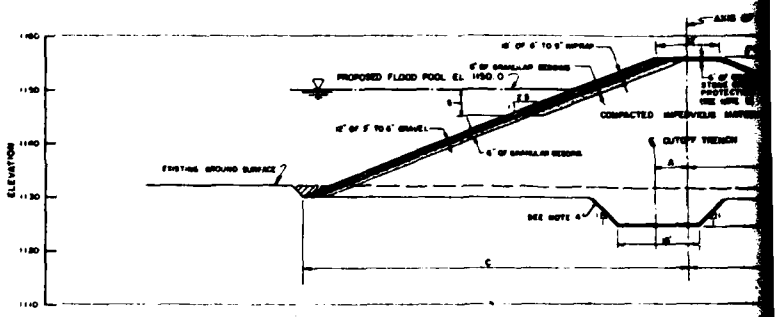
FIGURE 3

71-353-E3

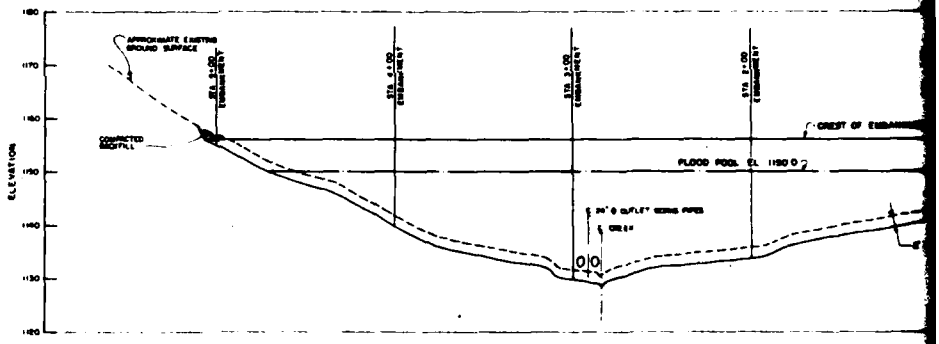


TYPICAL TRANSVERSE

SCALE: 1" = 10

NOTES

1. FOR DIMENSIONS A, B, C AND D SEE TABLE I
2. THE DESIGN STRIPPING DEPTH UNDER THE EMBANKMENT IS 2 FEET. ADDITIONAL UNSUITABLE MATERIAL WILL BE REMOVED AS DIRECTED BY THE FIELD ENGINEER
3. THE CREST PROTECTION SHALL BE PLACED IN 2 STAGES. FIRST STAGE SHALL BE 3", DISC PLOWED INTO THE CREST OF THE DAM. SECOND STAGE SHALL BE 3" PLACED ON THE PRIOR DISCED MATERIAL
4. CUTOFF TRENCH: EXCAVATED ROCK SURFACE TREATMENT AS DIRECTED BY FIELD ENGINEER TO BE A MINIMUM OF 2" THICK GUNITE LAYER



LONGITUDINAL SECTION AT ℄ OF E

HORIZONTAL SCALE 1" = 30'
VERTICAL SCALE 1" = 10

TABLE I

STATION	A	B	C	D
0+00	4	13	0	[illegible]
0+50	6	17	41	[illegible]
1+00	8	20	48	41
1+50	9	23	56	[illegible]
2+00	11	27	61	[illegible]
2+50	12	29	71	[illegible]
3+00	12	31	[illegible]	[illegible]
3+50	11	27	61	[illegible]
4+00	7	22	48	[illegible]
4+50	4	14	26	[illegible]
4+90		0		
5+00	0			

REFERENCE DRAWINGS

REVISION

DESCRIPTION

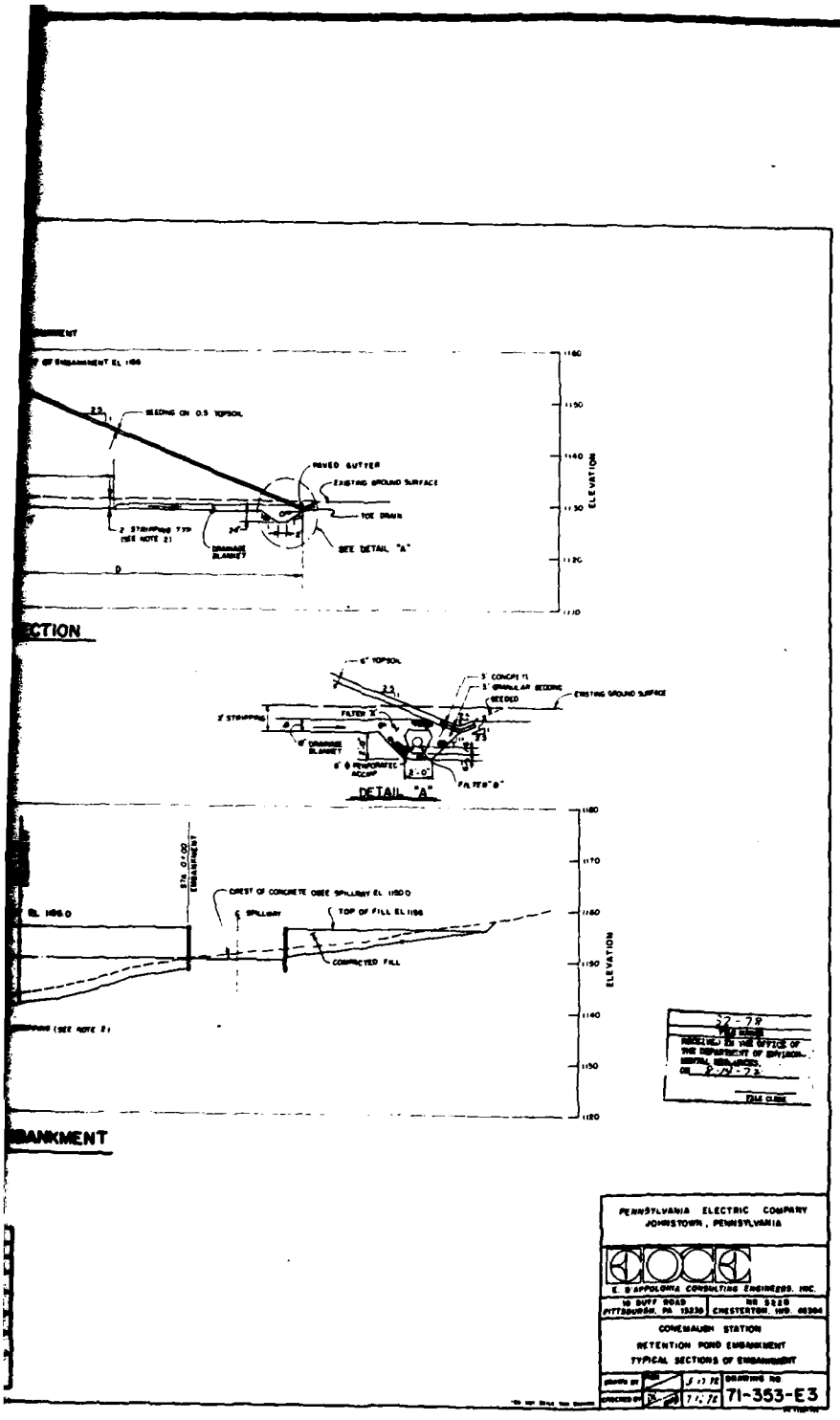


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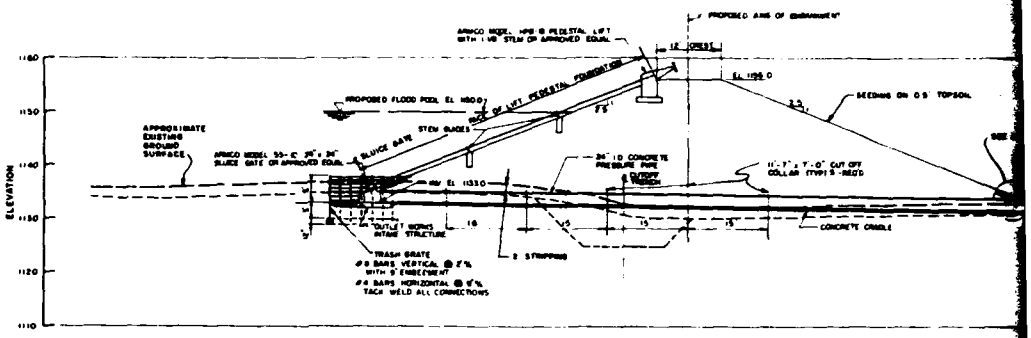
FIGURE 4

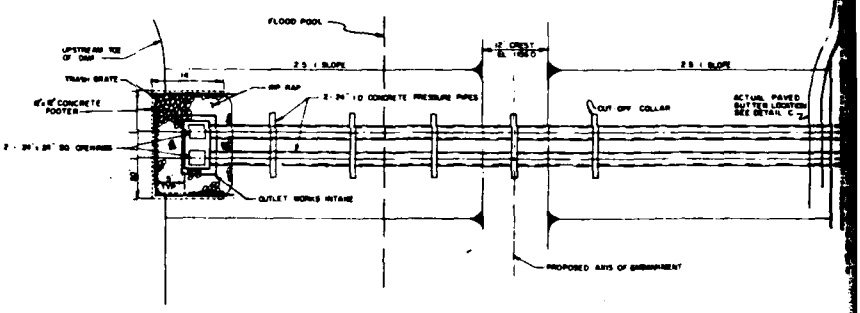
71-353-E3A



SECTION THROUGH OUTLET WORKS

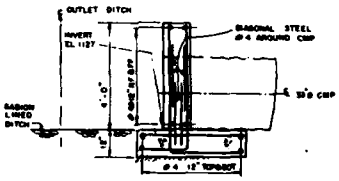
SCALE 1" = 10'

NOTE FOR ADDITIONAL DETAILS SEE DWG 71-353 E-11

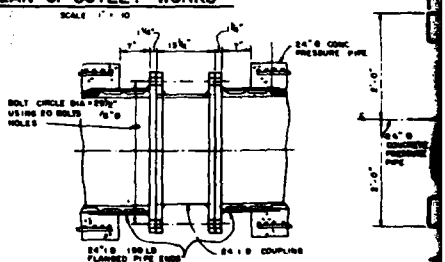


PLAN OF OUTLET WORKS

SCALE 1" = 10'



SECTION A-A



SECTION C-C

SCALE 1" = 1'-0"

REFERENCE DRAWINGS

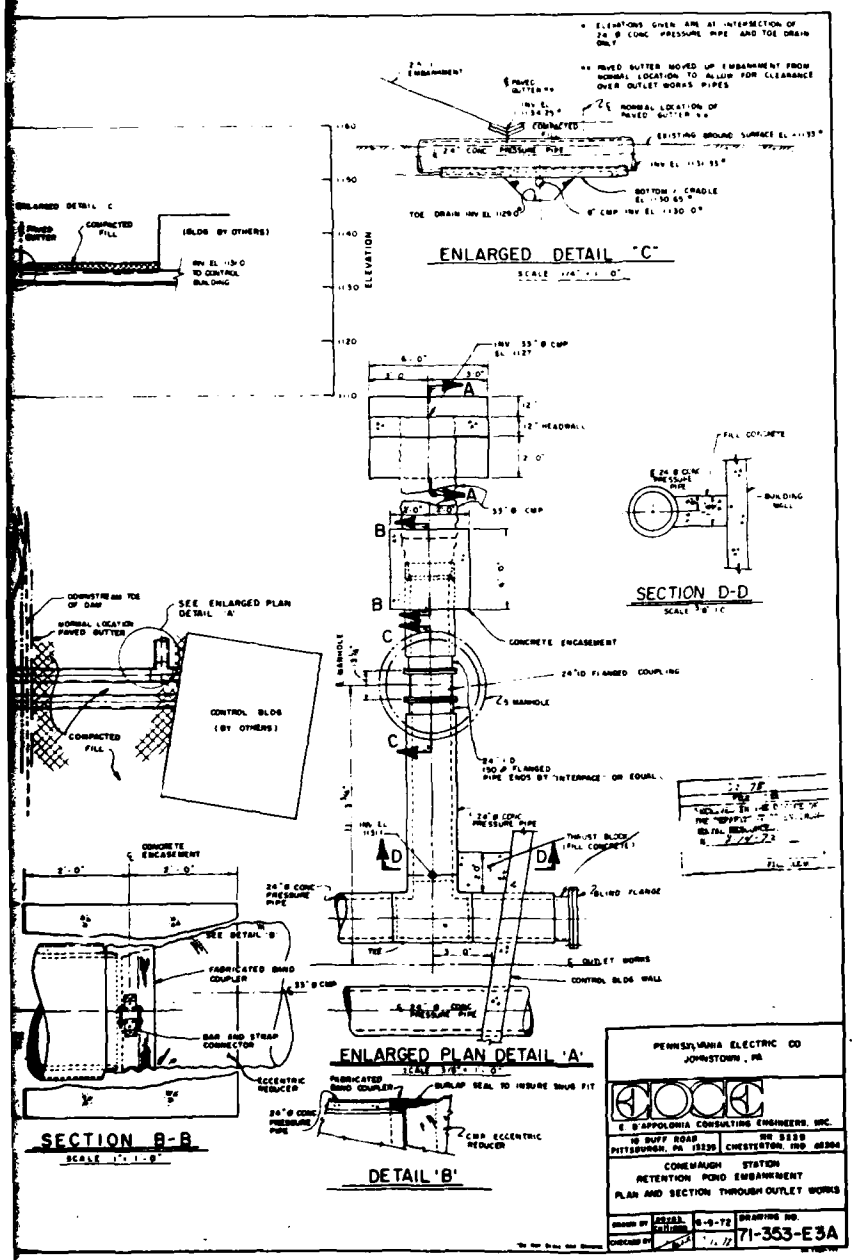


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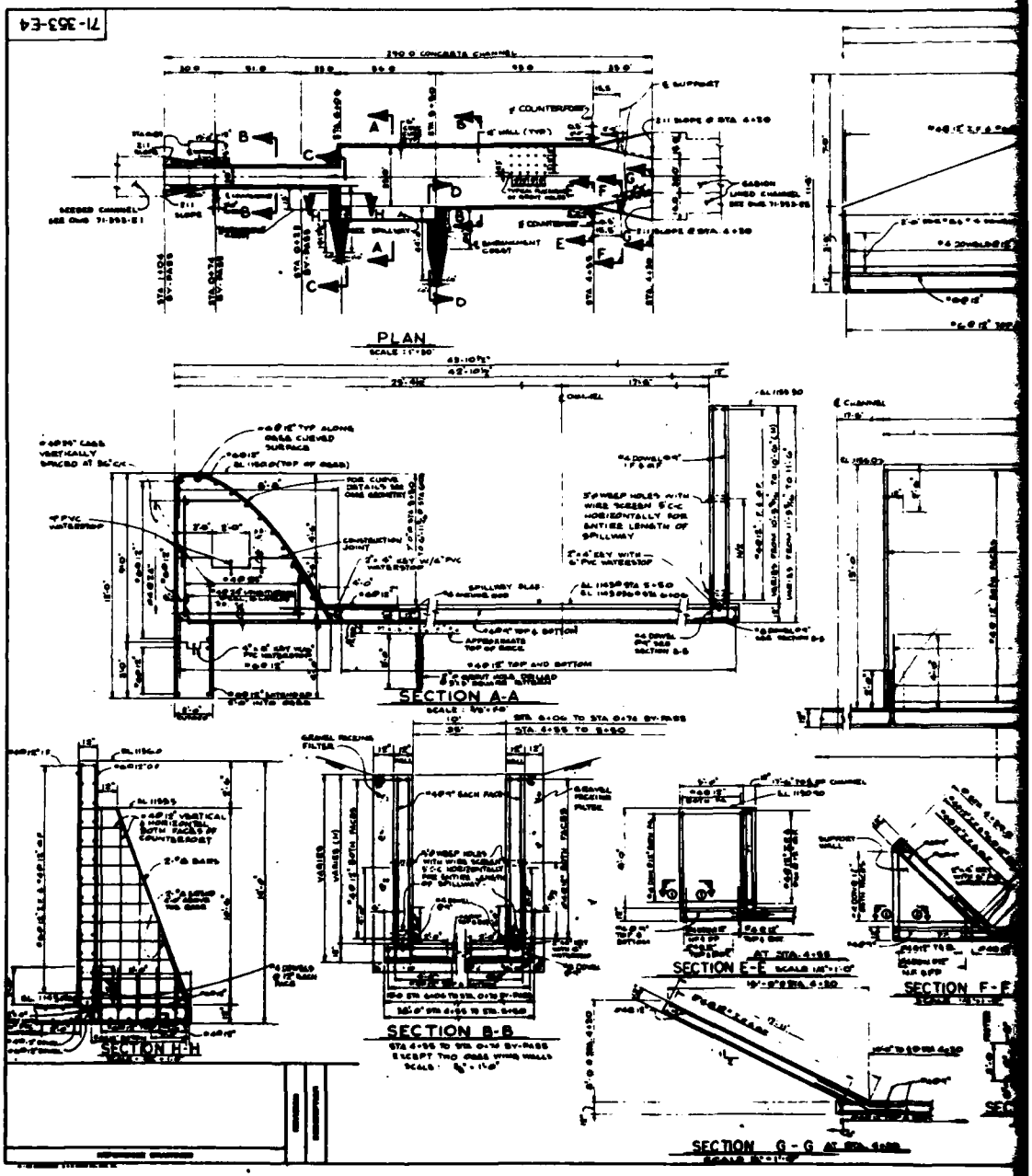
FIGURE 5

71-353-E4


PLAN
SECTION A-A
SECTION B-B
SECTION H-H
SECTION E-E
SECTION F-F
SECTION G-G

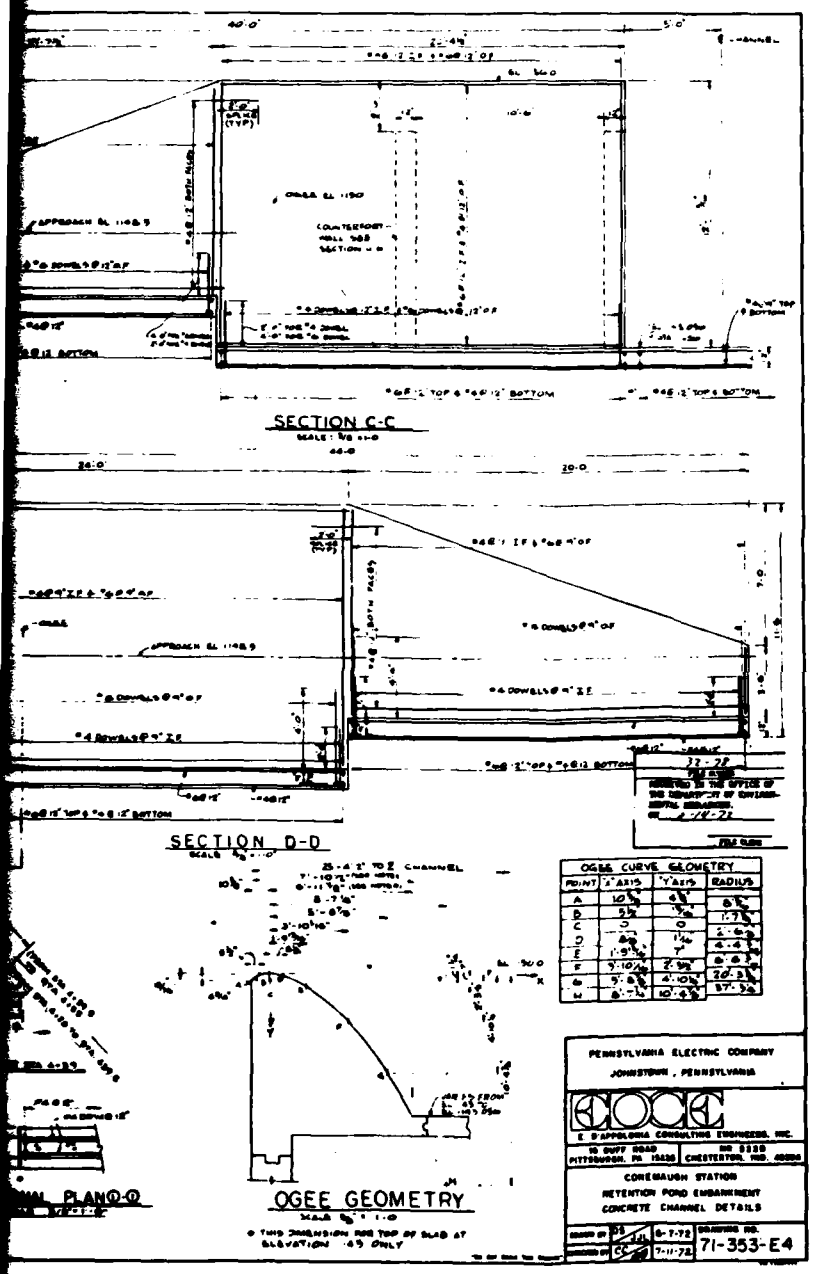


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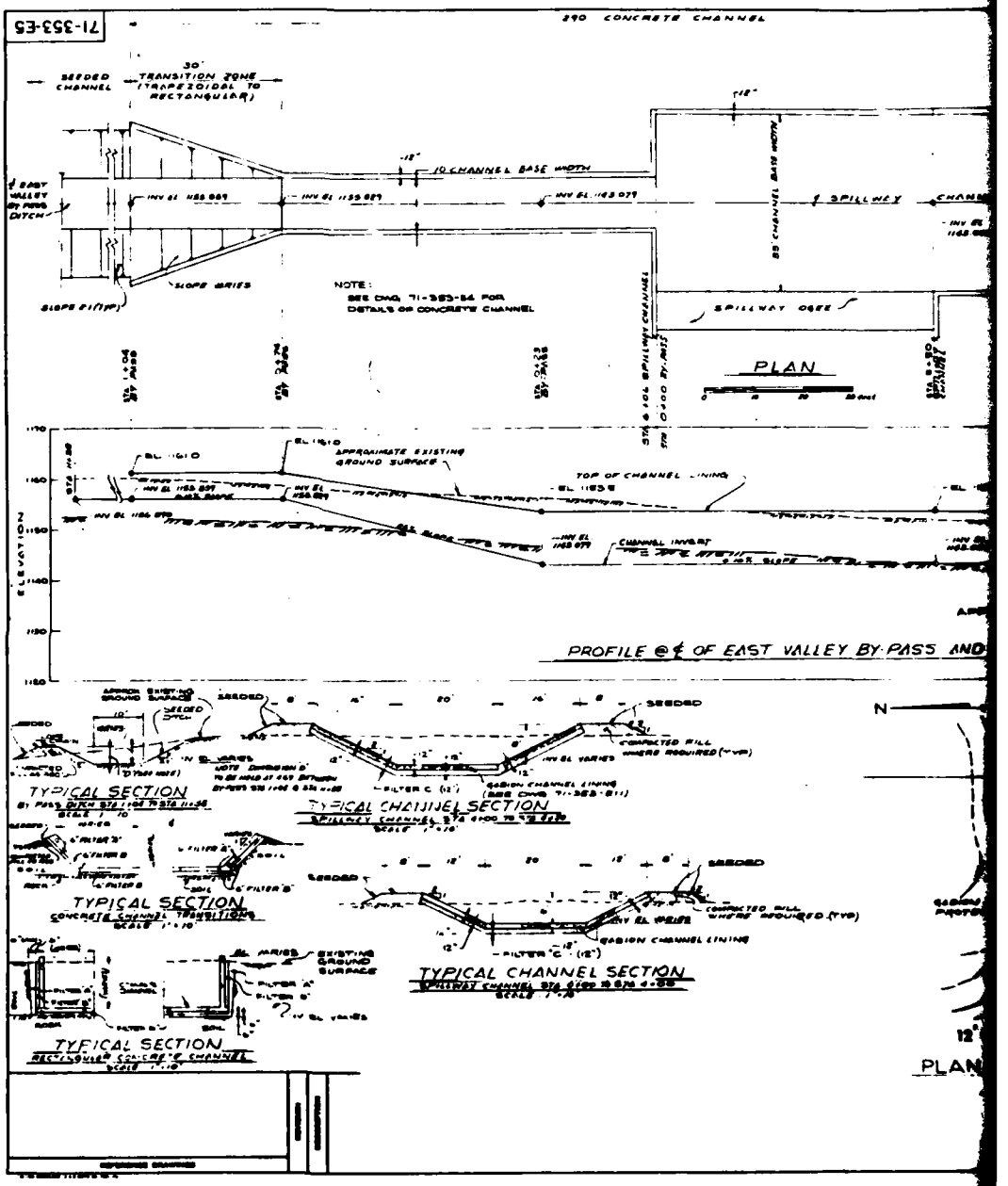
FIGURE 6


71-353-E3
290 CONCRETE CHANNEL
SEEDED CHANNEL
30' TRANSITION ZONE (TRAPEZOIDAL TO RECTANGULAR)
10 CHANNEL BASE WIDTH
SPILLWAY
SLOPE SERIES
NOTE:
SEE DWG. 71-353-E4 FOR DETAILS OF CONCRETE CHANNEL
SPILLWAY OGEE
PLAN
ELEVATION
APPROXIMATE EXISTING GROUND SURFACE
TOP OF CHANNEL LINING
CHANNEL INVERT
PROFILE @ ℄ OF EAST VALLEY BY-PASS AND
SEEDED
COMPACTED FILL WHERE REQUIRED (TYP)
GABION CHANNEL LINING
FILTER C (12")
TYPICAL SECTION
TYPICAL CHANNEL SECTION
TYPICAL SECTION
TYPICAL CHANNEL SECTION
EXISTING GROUND SURFACE
TYPICAL SECTION
N
PLAN

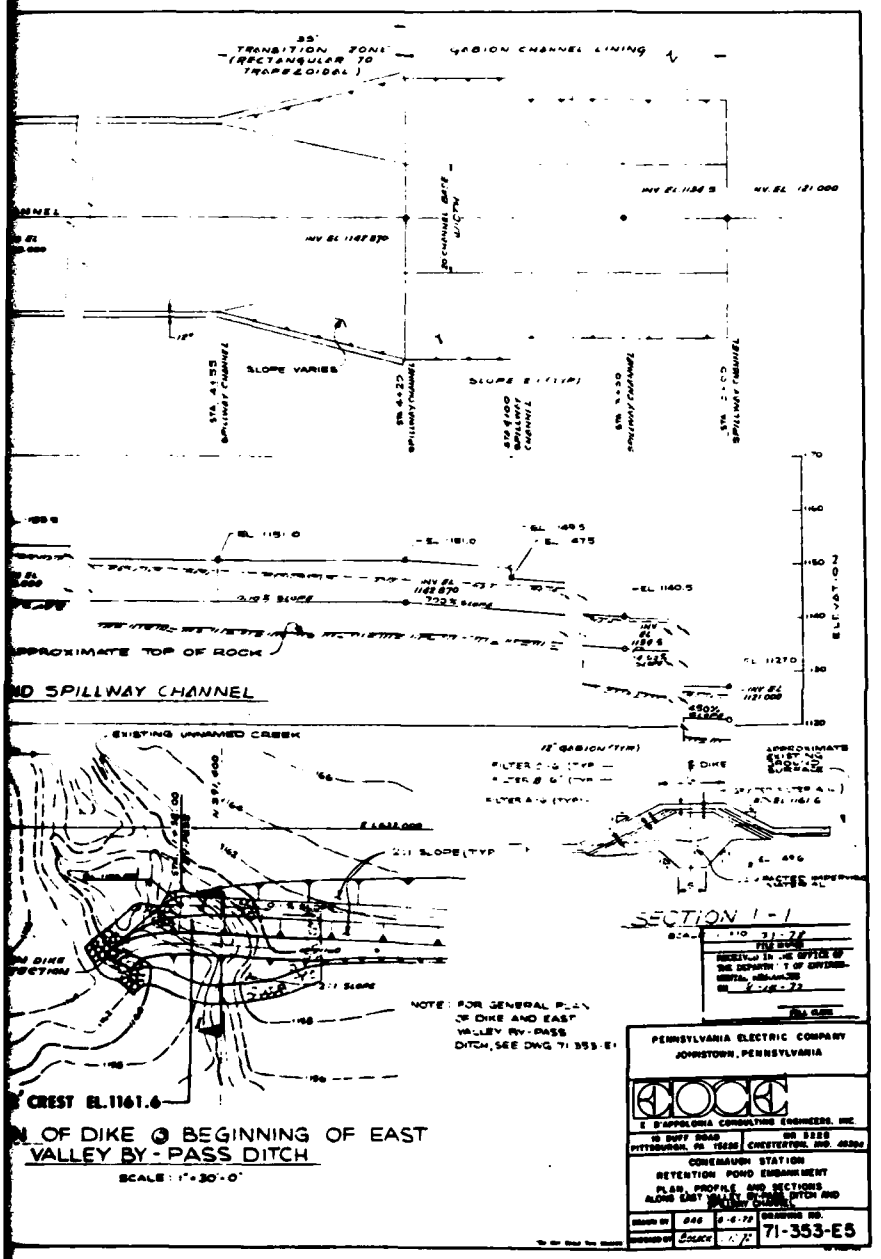


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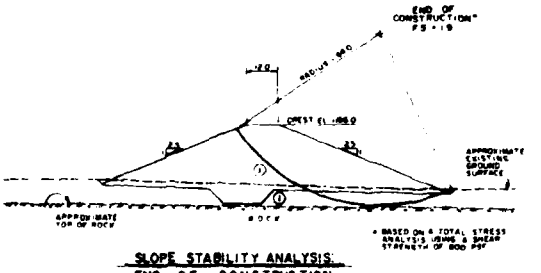
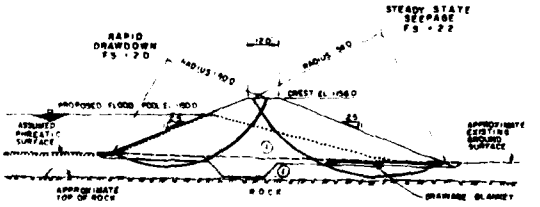
FIGURE 7

71-353-E6



SLOPE STABILITY ANALYSIS: END OF CONSTRUCTION



SLOPE STABILITY ANALYSIS: RAPID DRAWDOWN & STEADY STATE SEEPAGE

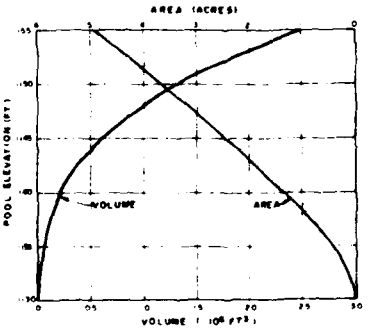
SOIL PROPERTIES

NO	DESCRIPTION	UNIT WEIGHT (PCF)	EFFECTIVE STRESS PARAMETERS	
			C (PSF)	φ (°)
1	[illegible] CLAY LOAM	132	100	27.5

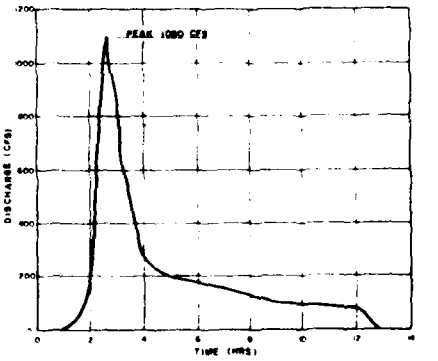
SCALE

NOTE

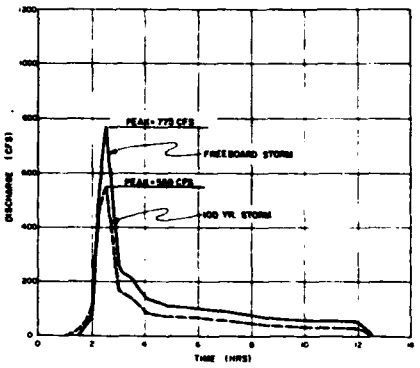
STABILITY ANALYSES PERFORMED USING A COMPUTERIZED VERSION OF BISHOPS METHOD OF SLICES



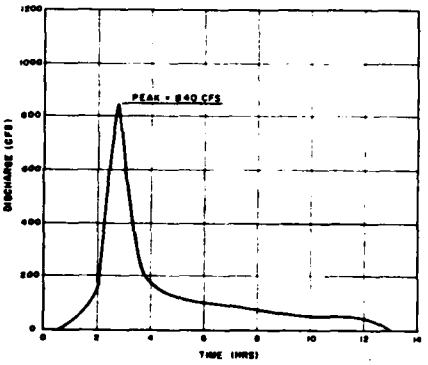
POOL ELEVATION vs AREA & VOLUME OF RETENTION POND



MAIN BASIN HYDROGRAPH FREEBOARD STORM



EAST BASIN HYDROGRAPHS



MAIN BASIN HYDROGRAPH
100 YR. STORM

NOTE:

DESIGN PEAK OUTFLOWS FROM POND:

1149 CFS, 100 YR STORM;
1615 CFS, FREEBOARD STORM

PENNSYLVANIA ELECTRIC COMPANY
JOHNSTOWN, PENNSYLVANIA

E. D'APPOLONIA CONSULTING ENGINEERS, INC.

10 DUFF ROAD
PITTSBURGH, PA. 15235

NR 5220
CHESTERTON, IND. 46304

CONEMAUGH STATION
RETENTION POND EMBANKMENT

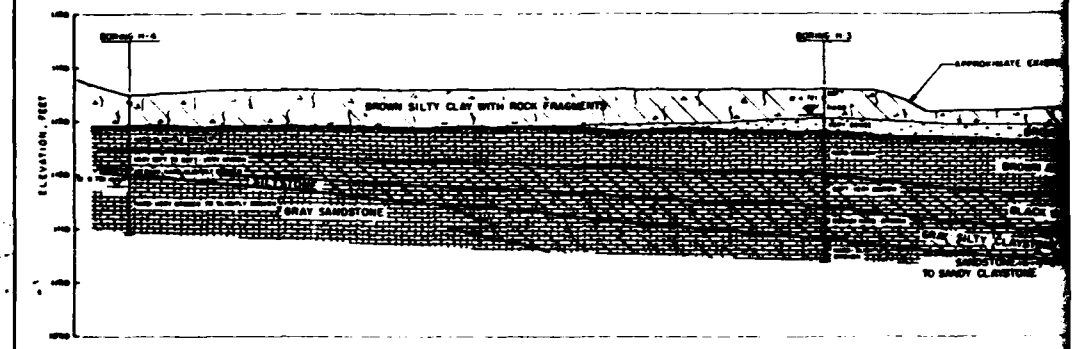
HYDROLOGY AND SLOPE STABILITY

DRAWING NO.
71-353-E6

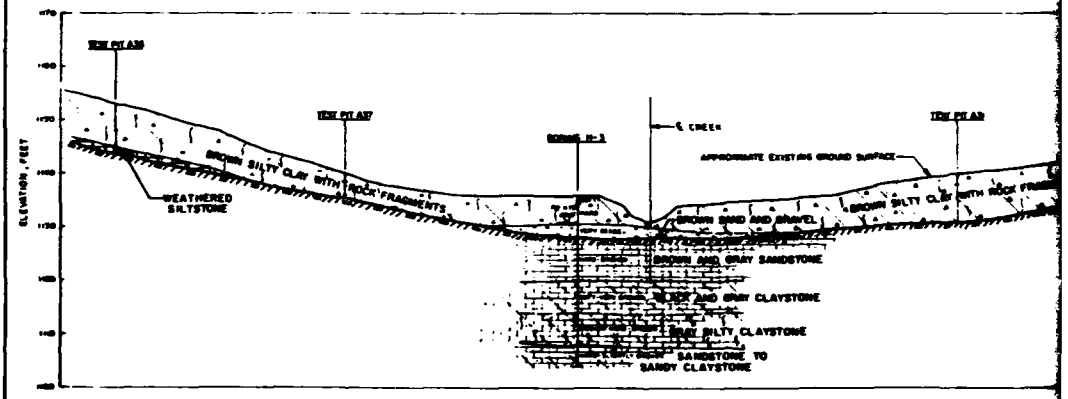
CONSULTANTS, INC.

FIGURE 8

71-353-E7



SECTION A-A



THE DEPTH AND THICKNESS OF THE SUBSURFACE STRATA INDICATED ON THE SECTIONS WERE GENERALIZED FROM AND INTERPOLATED BETWEEN THE TEST BORINGS. INFORMATION ON ACTUAL SUBSURFACE CONDITIONS EXISTS ONLY AT THE LOCATION OF THE TEST BORINGS AND IT IS POSSIBLE THAT SUBSURFACE CONDITIONS BETWEEN THE TEST BORINGS MAY VARY FROM THOSE INDICATED

SECTION B-B

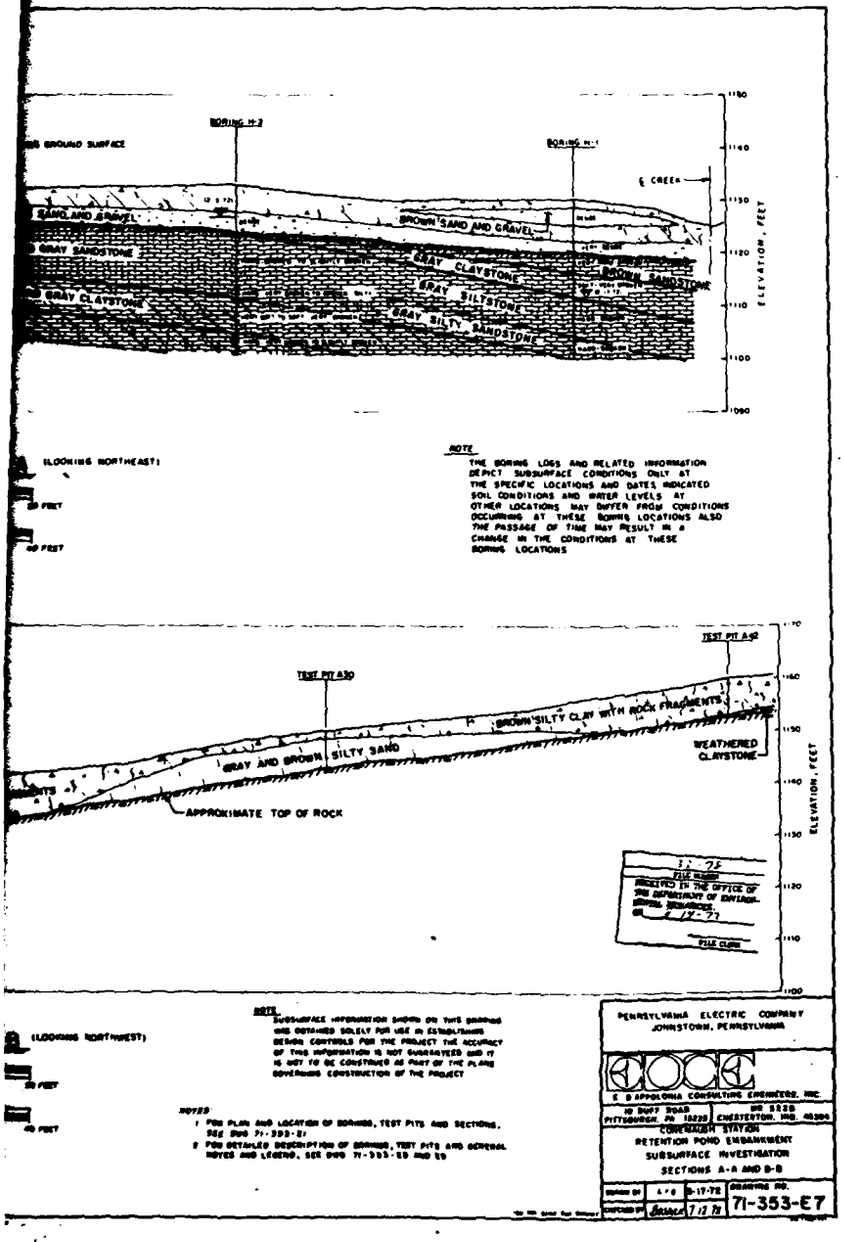


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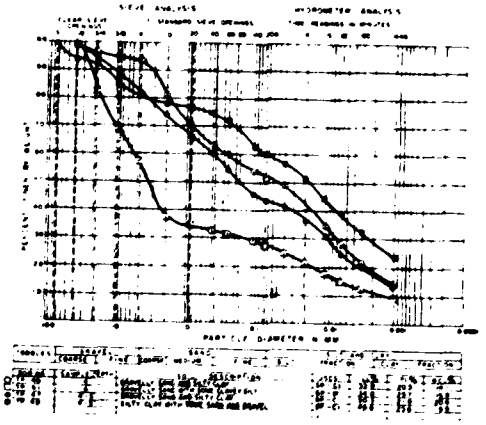
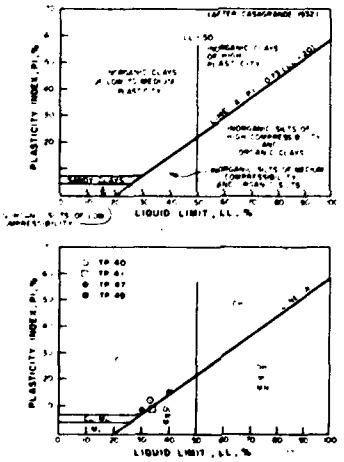
FIGURE 9

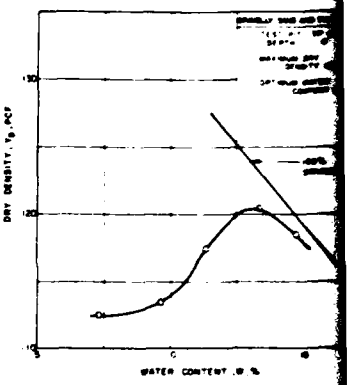
71-353-E10

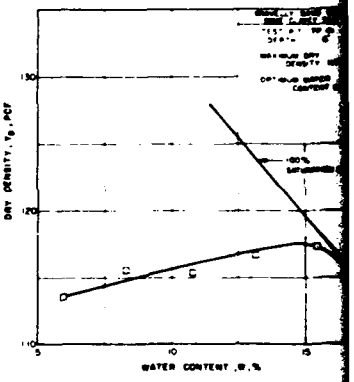


GRAIN SIZE ANALYSIS

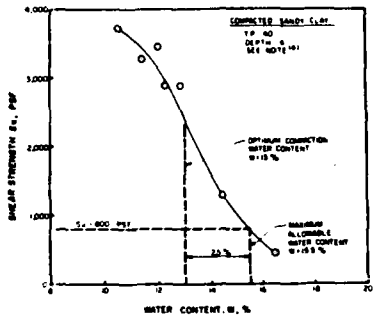


PLASTICITY CHART



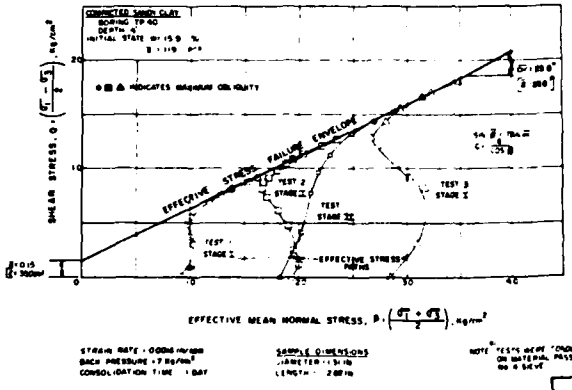


MOISTURE-DENSITY RELATIONS FROM STANDARD COMPACTION TEST



NOTE TOTAL STRESS SHEAR STRENGTH AS A FUNCTION OF WATER CONTENT OBTAINED FROM UNCONFINED COMPRESSION TESTS ON HANDMOLD MOISTURE SAMPLES

MOISTURE - SHEAR STRENGTH RELATION OF COMPACTED SANDY CLAY



STRAIN RATE
BACK PRESSURE
CONSOLIDATION TIME

SAMPLE DIMENSIONS
DIAMETER
LENGTH

NOTE TESTS WERE CONDUCTED ON MATERIAL PASSING NO 4 SIEVE

CONSOLIDATED UNDRAINED TRIAXIAL TEST

7-1-72
FILE COPY
RECEIVED IN THE OFFICE OF THE DEPARTMENT OF ENVIRONMENTAL RESOURCES
ON 7-17-72
FILE COPY

PENNSYLVANIA ELECTRIC COMPANY
JOHNSTOWN, PENNSYLVANIA

E. D. APPOLONIA CONSULTING ENGINEERS, INC.

CONEMAUGH STATION
RETENTION POND ENBANKMENT
LAB DATA SHEET

DRAWING NO. 71-353-E10

GAI CONSULTANTS, INC.

FIGURE 10

APPENDIX F

GEOLOGY

Geology.

Penelec Retention Dam is located in the Allegheny Mountain section of the Appalachian Plateau province of west central Pennsylvania. In this area, the Allegheny Mountain section is characterized by gently folded sedimentary rock strata of Middle Pennsylvanian age. Major structural axes strike from southwest to northeast with flanking strata dipping northwest and southeast.

Structurally, the dam and reservoir lie about 1-mile northwest of the Ligonier syncline and about 5 miles northwest of the Laurel Hill anticline, both of which strike in the regional southwest to northeast trend.

The sedimentary rock sequence contained in the abutments and immediately underlying the embankment are members of the Conemaugh Group of Pennsylvanian age. The rocks of this group typically exhibit the rapid vertical and lateral lithologic changes characteristic of cyclic sedimentation. In this area, the Conemaugh Formation consists of a variable sequence of sandstone, shale, clay, thin coals, and thin beds of limestone.

A subsurface investigation of the site was conducted in 1972 with the results presented in the "Engineer's Report". The soil and rock conditions underlying the proposed embankment were explored with 23 test pits and borings. The Engineer's Report disclosed the following subsurface conditions:

> "8-11 feet of hard, broken brown and gray sandstone; overlying 5-6 feet of soft, very broken black and gray claystone; overlying greater than 5 feet of hard slightly broken sandstone to sandy claystone."

Soils were discribed as:

> "residual, derived from siltstone, claystone, sandstone, and shale lithologic units. The soils vary in depth from thin veneers to deeply weathered zones, and their permeable nature ranges from poorly drained to well drained."

Mining conditions were described as:

> "Mining of one coal seam (known locally as the "B" seam) by the North American Coal Company has extended to just within the vicinity of the proposed embankment.

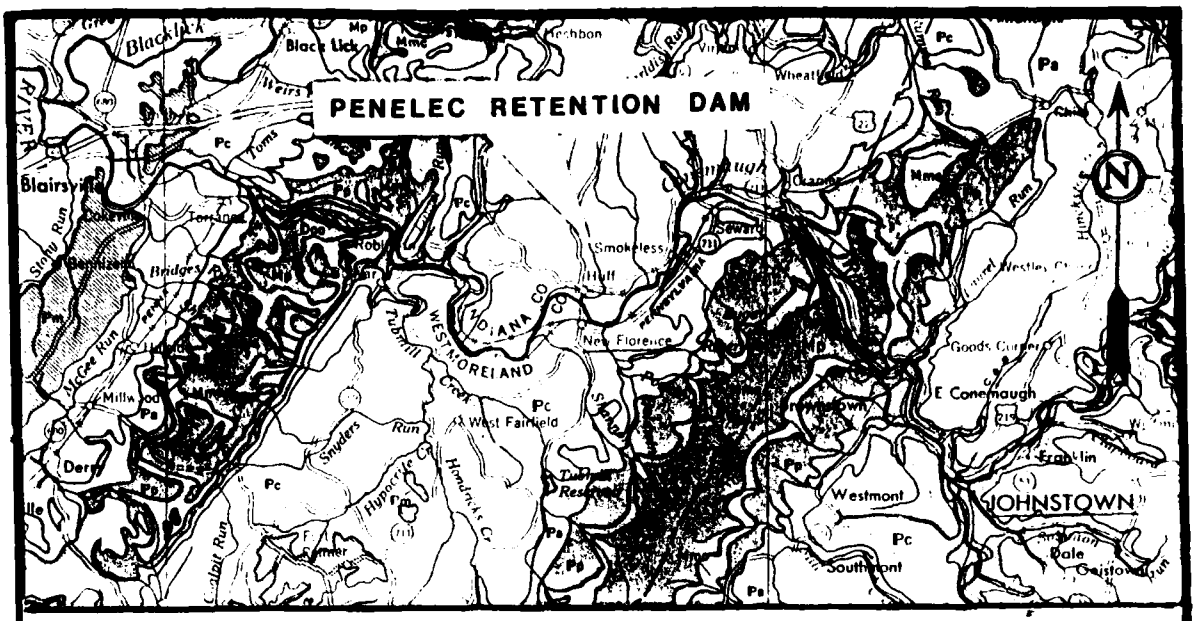
The coal was mined in the period 1953 to 1954, initially by the room and pillar method, and subsequently by retreat mining. The mine was nominally 300 feet below the surface in the vicinity of the proposed embankment. Discussions with cognizant mining personnel indicate that controlled subsidence has occurred within the vicinity of the retention pond embankment. A detailed surficial study of this area showed no evidence of subsidence at the surface."

References

[1] Lohman, Stanley W., "Groundwater in South-Central Pennsylvania," Water Resource Report No. 5, Pennsylvania Geological Survey, Fourth Series, Harrisburg, 1938.

[2] Shaffner, M. N., "Preliminary Map of Geologic Structure on Base of Lower Kittanning Coal in New Florence Quadrangle, Pennsylvania," Pennsylvania Geological Survey, Fourth Series, Progress Report No. 137, 1951.

[3] Engineer's Report, Retention Pond Embankment, Conemaugh Station Ash and Mine Refuse Disposal Area, Pennsylvania Electric Company, Johnstown, Pennsylvania, E. D'Appolonia Consulting Engineers, Inc., 1972.



LEGEND

PENNSYLVANIAN

APPALACHIAN PLATEAU

Pm — **Monongahela Formation**
Cyclic sequences of sandstone, shale, limestone and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at the bottom of the Pittsburgh Coal.

Pc — **Conemaugh Formation**
Cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of sections; Brush Creek Limestone in lower part of section.

Pa — **Allegheny Group**
Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals; limestones thicken westward; Vanport Limestone in lower part of section; includes Freeport, Kittanning, and Clarion Formations.

Pp — **Pottsville Group**
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**
Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties; Loyalhanna Limestone at the base in southwestern Pennsylvania.

Mp — **Pocono Group**
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.

DEVONIAN

Dos — **Oswayo Formation**
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved

Dck — **Catskill Formation**
Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Scale

0 2 4 6 8 10 MILES

GEOLOGY MAP

GAI CONSULTANTS, INC.

REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES