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NATIONAL DAM INSPECTION PROGRAM. QUEMAHONING DAM (NDI ID NUMBER--ETC(U)
JUL 78 DACW31-78-C-0049
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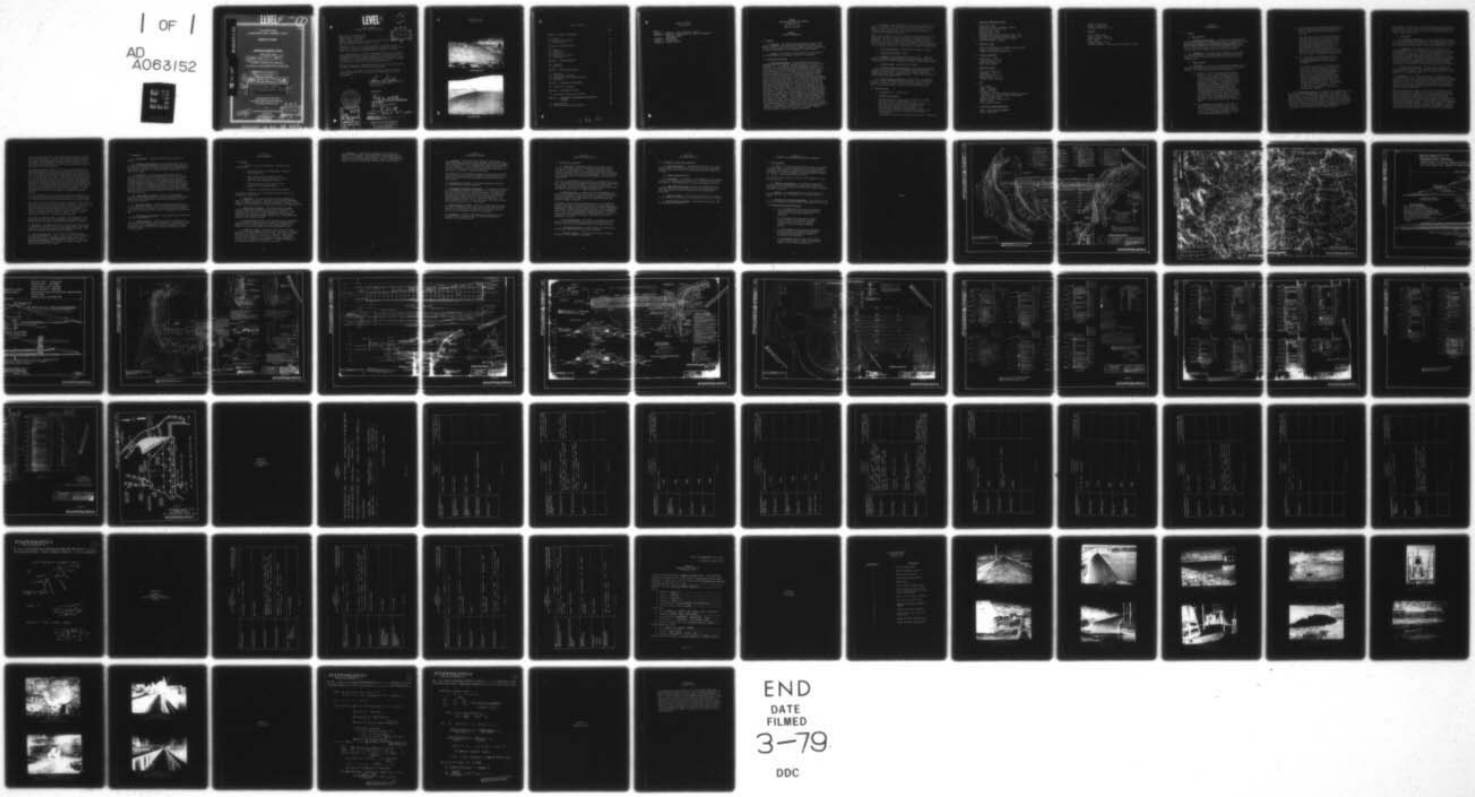

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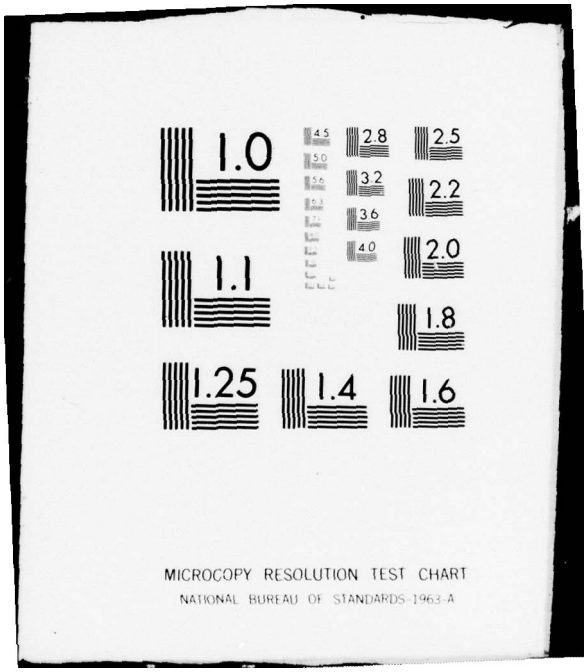
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LEVEL II

OHIO RIVER BASIN
QUEMAHONING CREEK, SOMERSET COUNTY

PENNSYLVANIA

QUEMAHONING DAM

NDI I.D.NO: 740

DACW31-78-C-0049

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ORIGINAL CONTAINS COLOR PLATES: ALL DDC REPRODUCTIONS WILL BE IN BLACK AND WHITE.

National Dam Inspection Program. Quemahoning Dam (NDI ID Number 740), Ohio River Basin, Quemahoning Creek, Somerset County, Pennsylvania. Phase I Inspection Report.

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

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

JULY 1978

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LEVEL II

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Quemahoning Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Somerset
STREAM: Quemahoning Creek, tributary of Stoney Creek
DATE OF INSPECTION: (June 8 and 12, 1978)

(cont'd p. 2)

ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of Quemahoning Dam is assessed to be good.

It is recommended that the owner periodically monitor and record the piezometers installed in 1961 to measure the pore pressures within the embankment to aid in future evaluation of the performance of the embankment. It is also recommended that appropriate repairs be made to stop concrete spalling on the spillway channel walls.

The spillway has the recommended capacity to pass the probable maximum flood. Therefore, the spillway is adequate.

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

A

Lawrence D. Andersen, P.E.
Vice President

APPROVED BY:

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

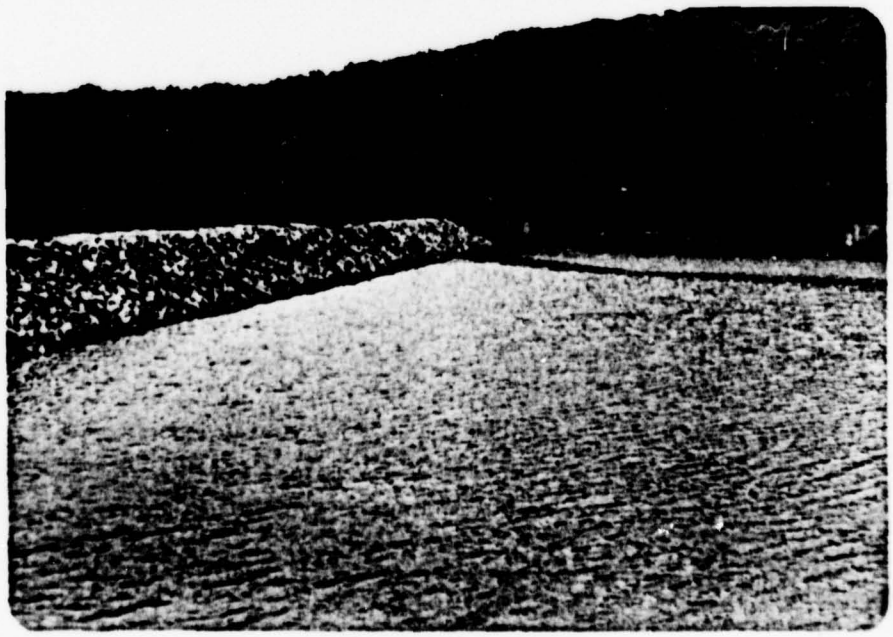
DATE: 31 Jul 78

Contract DACW31-78-C-0044

A

QUEMAHONING DAM
JUNE 9, 1978

Downstream Face



Upstream Face

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(Continuted)

PHASE I
NATIONAL DAM INSPECTION PROGRAM
QUEMAHONING DAM
NDI I.D. NO. 740
DER I.D. NO. 56-4

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 a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. The dam consists of an earth embankment 955 feet long with a maximum height of 100 feet from the downstream toe. The combined primary and emergency spillway is located on the right abutment (looking downstream), (Plate 1). The flow through the spillway discharges over two ogee weir sections. A 185-foot-long section of the ogee weir in line with the axis of the dam discharges directly into the spillway discharge channel. A second 210-foot-long section is oriented perpendicular to the axis of the dam and constitutes a side channel spillway discharging into the same downstream channel. Flow through the discharge channel passes over two ogee weirs and a series of steps to control flow velocity and dissipate energy and then into a pool about 200 feet downstream of the embankment toe. A rock dike along the left side of the discharge channel (Plate 1) protects the embankment during high flows. The outlet works for the dam consist of lake and supply line blow-off facilities. The lake blow-off is controlled by gates located at the intake tower and discharges into a 21-foot-high and 30-foot-wide semicircular diversion tunnel located below the embankment near the left abutment. This diversion tunnel discharges into a concrete stilling basin. A 60-inch supply line located along the left abutment is also controlled by valves at the intake tower. The supply line blow-off is controlled by valves located in a valve house approximately 300 feet downstream from the end of the diversion tunnel. In an emergency, the lake can be drawn down through either the lake or supply line blow-off facilities. The dam impounds 37,000 acre-feet of water at normal pool elevation.

b. Location. Quemahoning Dam is located on Quemahoning Creek (Plate 2), about one mile upstream from its confluence with Stoney Creek, two miles south of the towns of Hollsopple and Benson in Somerset County, Pennsylvania. The dam lies on the boundary of Quemahoning and Conemaugh townships.

Stoney Creek, downstream from its confluence with Quemahoning Creek, flows north for about 10 miles and joins the Conemaugh River at Johnstown. The towns of Benson and Hollsopple would be the first impact area of a flood in the event of a failure of Quemahoning Dam. It is estimated that a failure of the dam would also cause significant loss of life and property as far downstream as the City of Johnstown.

c. Size Classification. Large (based on 100-foot height).

d. Hazard Classification. High.

e. Ownership. The Manufacturers Water Company. (Address: Mr. Bruce Barger, Manager, Manufacturers Water Company, Bethlehem Steel Corporation, 119 Walnut Street, Johnstown, Pennsylvania 15901).

f. Purpose of Dam. Industrial water supply.

g. Design and Construction History. The dam was designed and constructed by the engineers of the Manufacturers Water Company of Johnstown, Pennsylvania. Mr. Frederic D. Stearns of Boston, Massachusetts, was the consulting engineer. The dam was constructed in the period from 1909 to 1912.

h. Normal Operating Procedure. The reservoir is maintained at spillway level, Elevation 1627 (USGS Datum). Flow in excess of demand is discharged through the uncontrolled spillways. The dam has no operational feature to affect the flood flow discharge.

1.3 Pertinent Data

a. Drainage Area - 94 square miles

b. Discharge at Dam Site

Maximum known flood at dam site - 10,200 cfs (in 1936)
Warm water outlet at pool elevation - N/A
Diversion tunnel low pool outlet at pool elevation - N/A
Diversion tunnel outlet at pool elevation - N/A
Gated spillway capacity at pool elevation - N/A
Gated spillway capacity at maximum pool elevation - N/A
Ungated spillway capacity at maximum pool elevation - 91,000 cfs
Total spillway capacity at maximum pool elevation - 91,000 cfs

c. Elevation (USGS Datum) (feet)

Top of dam - 1642
Maximum pool-design surcharge - Unknown
Full flood control pool - N/A
Recreation pool - N/A
Spillway crest - 1627
Upstream portal invert diversion tunnel - N/A
Downstream portal invert diversion tunnel - N/A
Streambed at center line of dam - 1542±
Maximum tailwater - Unknown

d. Reservoir (feet)

Length of maximum pool - 21,000± at Elevation 1642
Length of recreation pool - N/A
Length of flood control pool - N/A

e. Storage (acre-feet)

Normal pool - 37,000
Flood control pool - N/A
Design surcharge - N/A
Top of dam - 52,700

f. Reservoir Surface

Top of dam - 1065 acres
Maximum pool - N/A
Flood control pool - N/A
Recreation pool - N/A
Spillway crest - 845 acres

g. Dam

Type - Earth
Length - 955± feet
Height - 100 feet
Top width - 20 feet
Side slopes - 3:1 above Elevation 1615 and 4:1 below Elevation 1615, both upstream and downstream
Zoning - Hydraulic fill
Impervious core - Hydraulic fill
Cutoff - Partial
Grout curtain - Partial

h. Diversion and Regulating Tunnel

Type - Tunnel through embankment
Length - 400± feet

Closure - Sluice gate
Access - Intake tower
Regulating facilities - Yes

i. Spillway

Type - Concrete ogee
Length of weir - 385 feet
Crest elevation - 1627 feet
Gates - None
Upstream channel - lake
Downstream channel - Variable width rectangular channel

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. A report by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) entitled, Report Upon the Application of Manufacturers Water Company, dated July 17, 1961, summarizes the most recent hydrologic and hydraulic data available for the dam. The report includes the capacity criteria used for the modification of the spillway in 1961.

(2) Embankment. No original design information is available. The available information includes design drawings, boring logs, engineer's report, and construction specifications for the 1961 modifications.

b. Design Features

(1) Embankment. A review of the available information for the dam shows the following main features of the project as originally designed. The modifications are discussed in Section 2.2.

(a) As built, the dam is an hydraulically-filled embankment with a partial concrete cutoff wall (Plate 3). The upstream and downstream toes of the embankment were built of material excavated from the center of the dam site by usual construction techniques. The remainder of the embankment was hydraulically filled with the material sluiced from the abutments. The sluiced material was discharged along the upstream and downstream sides of the center of the embankment toward a pond maintained along the center line of the dam. This construction technique allowed the finest material to settle at the center of the embankment and coarser material to each side of the center line of the dam.

(b) The embankment was designed to have three to one (horizontal to vertical) slopes from crest level (Elevation 1642) down to a point 27 feet below the crest (Elevation 1615) and four to one slopes below this point, on both the upstream and downstream faces.

(c) A Cambria Steel Company report dated February 20, 1913, includes the following description of the extent of concrete cutoff wall and foundation grouting:

> "A concrete cut-off wall was then constructed along the center line of the dam and carried well into the underlying rock, except at the east end, where a good clay deposit of considerable thickness overlies the rock. The rock immediately beneath the core wall is grouted with Portland cement grout for a depth of 10 feet through drill holes on 10 foot centers, the grout being forced into the rock under a pressure of 20 pounds per square inch."

(d) In a 1918 report, Mr. Frederic P. Stearns, the consulting engineer, described the foundation treatment on the east abutment as follows:

> "At the site of the dam on the easterly hillside, there was above the rock a deposit of clayey earth having a maximum thickness of more than 40 feet and an average thickness of about 30 feet. This earth was proved by tests to be substantially water-tight, and hence the only part removed before building the dam and embankment was that near the surface, which contained more or less roots and had been affected by frost. The building of this portion of the dam on an earth instead of a rock foundation did not cause any important leakage."

(2) Appurtenant Structures. The appurtenant structures for the dam consist of the spillway and outlet works. The spillway structures consist of an L-shaped ogee overflow section (Plates 4 and 5), a side channel spillway, spillway discharge channel, and a plunge pool at the end of the discharge channel. The ogee weir, which has a total crest length of 395 feet, consists of a 185-foot section along the axis of the dam and a 210-foot section perpendicular to the axis of the dam. The crest of the spillway is at Elevation 1627. The long weir section constitutes a side channel spillway.

As described in Section 1.2, a diversion tunnel used during construction serves as a lake blow-off facility through the gates controlled from the intake tower. The lake can also be discharged through the 48-inch supply line blow-off.

c. Design Data

(1) Hydrology and Hydraulics. The 1961 PennDER report states that before enlargement of the spillway, the spillway design discharge was 29,800 cubic feet per second (cfs). After enlargement, the spillway is capable of passing 45,000 cfs with a freeboard of 5.6 feet.

(2) Embankment. No engineering data are available on the original design of the dam. However, as part of the design to raise the embankment in 1961, the stability of the embankment was studied by E. D'Appolonia Associates, of Pittsburgh, Pennsylvania. The investigation included subsurface investigation, laboratory testing, and stability analyses. The stability of the embankment was analyzed for rapid drawdown and steady-state conditions, and the minimum factor of safety was reported to be 1.58 for the higher embankment cross section. The extent of modifications is discussed in Section 2.2.

(3) Appurtenant Structures. The 1961 design calculations were available for review. They indicate that the redesign of the spillway was in conformance with the state spillway capacity criteria applicable at the time of design.

2.2 Construction. Very limited information is available on the construction of the dam. It includes various photographs taken during construction and a brief description of the construction in the post-construction report. A state report dated January 31, 1918, notes, "This is a most excellent example of good design and construction." Other accounts from post-construction reports also indicate that the dam was constructed with care.

Available information indicates that the dam has undergone several modifications after its completion. The most recent and most extensive modification was undertaken in 1961 and included raising the crest of the dam with additional earth fill and enlarging and raising the spillway to increase storage capacity. The modifications prior to 1961 were mainly related to erosion problems encountered in the spillway discharge channel. In 1920, eight years after completion, the spillway discharge channel was rebuilt and extended. In 1933, a state construction permit was issued for rebuilding and repairing the spillway discharge channel and for constructing a new retaining

wall along the right side of the channel and new paving at the end of the existing channel. However, following the flood in 1936, the 1933 repairs were damaged and additional channel construction was undertaken. The 1936 repairs included the construction of a 220-foot concrete-paved extension to the discharge channel and repairing the paving in the upper portions.

Available information indicates that the only modification made on the embankment prior to 1961 was the construction of a cutoff wall on the left side of the spillway and grouting the left abutment in 1933. The cutoff wall was built to stop seepage observed on the left side of the spillway. The work included driving two parallel rows of sheet piling along the center of the crest extending 18 feet from the left side of the spillway towards the middle of the embankment, excavating the material between the sheet piles and backfilling with concrete. It was reported that the concrete wall was keyed 18 inches into the rock, which was about 20 feet below the crest of the dam. In 1933, the left abutment was grouted to stop seepage. The holes were drilled to a depth of over 100 feet, pressure tested, and grouted.

The 1961 enlargement of the dam and the spillway was undertaken for the purpose of increasing the storage capacity from 31,800 acre-feet at Elevation 1620 to the present 37,000 acre-feet at Elevation 1627.

The crest of the dam was raised by 9 feet to Elevation 1642. Plate 6 illustrates the details of the embankment enlargement. The crest of the existing spillway was raised from Elevation 1620 to Elevation 1627, and the 210-foot-long side channel spillway was constructed to increase the flood discharge capacity of the reservoir to a design value of 45,000 cfs with 5.6 feet of freeboard. Plates 4 and 5 illustrate the extent of the spillway modifications.

In conjunction with this work, a subsurface investigation was conducted and the stability of the embankment was reevaluated. The boring locations and boring logs are shown in Plates 7 through 10.

2.3 Operation. Operating records of the dam include daily records of pool level, water depth over the four seepage weirs, daily precipitation, average air temperature, and weather conditions. Operating records for the dam are available from 1915.

2.4 Other Investigations. The available information includes numerous state inspection reports. The most recent state inspection was conducted in 1976. Feasibility Study, January 1961, and Stability Investigation, May 1961, were prepared by E. D'Appolonia Associates for Bethlehem Steel Company, the parent company of the owner, Manufacturers Water Company.

2.5 Evaluation

a. Availability. Available information was provided by PennDER.

(1) Hydrology and Hydraulics. The reported results of the hydrology and hydraulic analysis indicate that the 1961 redesign of the spillway followed the criteria set forth by the Commonwealth of Pennsylvania, Department of Forests and Waters, applicable at the time of the design.

(2) Embankment. No quantitative geotechnical data are available on the design of the embankment. In view of the age of the dam, completed in 1912, the design approach and construction techniques are not likely to be in conformance with currently accepted engineering practice. The dam was reinvestigated in 1961 in conjunction with an enlargement project and this investigation included subsurface exploration, laboratory testing, and stability analysis. Review of the geotechnical aspects of the 1961 investigation indicates that this work generally followed currently accepted engineering practice.

(3) Appurtenant Structures. Review of design drawings indicates that as modified in 1961, there are no significant design deficiencies that should affect the overall performance of the appurtenant structures.

c. Operating Records. Operating records are maintained by the dam tender and copies of the records are available at the office of the owner and at the dam site. In the 1936 flood, the maximum pool level was Elevation 1625.4, which is considered to be the record high.

d. Post-Construction Changes. Various modifications made were discussed in Section 2.2.

e. Seismic Stability. The dam is located in Seismic Zone 1 and static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is assumed to present no hazard from earthquakes.

SECTION 3
VISUAL INSPECTION

3.1 Findings

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

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.

3. Observation factors affecting the runoff potential of the drainage basin.

4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 11 and in the photographs in Appendix C.

b. Embankment. The overall condition of the embankment is good. No signs of significant distress, such as cracks, subsidence bulging, uncontrolled seeps, or boils were observed. However, it was observed that the piezometers installed in 1961 were not being monitored.

c. Appurtenant Structures. The spillway crest, discharge channel, plunge pool, and diversion tunnel were examined for deterioration of the concrete and other signs of distress. These structures were found to be in good condition, except concrete spalling in the spillway discharge channel walls. Minor seeps were observed in the diversion tunnel.

d. Reservoir Area. Review of the regional geology (Appendix E) indicates that the 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. Quemahoning Creek flows into Stoney Creek about one mile downstream from the dam. The towns of Holsopple and Benson, two miles north of the dam along Stoney Creek, would be the first impact areas of a flood in the event of a dam failure. Sketches of two bridges in this reach are included in Appendix A and are shown in photographs in Appendix C. Further description of the downstream condition is included in Section 1.

3.2 Evaluation. In general, the condition of the dam is considered to be very good. Some significant concrete spalling was observed in the spillway discharge channel. The spalling does not appear to have caused structural damage. However, repair measures should be taken to avoid further deterioration of the concrete.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedures. The water company personnel reported that the operational procedures include daily readings of pool level, seepage weirs, precipitation, and air temperature. Supply water discharge is also recorded. The only operational procedures of the dam which may affect the safety of the dam are the blow-off facilities, in case they are required to lower the reservoir.

The maintenance of outlet works, clearing of debris from the spillway as required, and continued inspection of the facilities by the dam tender are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The overall maintenance condition of the dam is found to be satisfactory.

4.3 Maintenance of Operating Facilities. The maintenance condition of the operating facilities is satisfactory. All the flow control gates can be mechanically or manually operated. The operation of the lake blow-off gate was not observed. However, the dam tender explained the procedure required to open this gate and all the related equipment appeared to be in functional condition. The other drawdown facility of the dam, the supply line blow-off valve, was operated and observed to be functional.

4.4 Warning System in Effect. There is no formal warning system in effect. However, the dam tender resides at the site and telephone and radio communication facilities are available with the company office and security personnel in Johnstown.

4.5 Evaluation. The dam is satisfactorily maintained and 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. Quemahoning Dam has a watershed area of 94 square miles and impounds a reservoir with a surface area of 845 acres at normal pool level. A 395-foot-long ogee overflow section at Elevation 1627, 15 feet below the dam crest, constitutes the flood discharge facility for the impoundment. The full capacity of the spillway (with no freeboard) was computed to be 91,000 cfs (Appendix D).

There are six impoundments located within the drainage basin of the dam. Lake Gloria and Lake Stoughton are the two largest impoundments, with storage capacities reported to be 264 and 233 acre-feet, respectively. These are very small compared to the 15,700 acre-feet surcharge storage capacity of Quemahoning Reservoir.

b. Experience Data. As previously stated, Quemahoning Dam is classified to be a "large" 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 conservatively neglecting the storage effect of upstream impoundments (Appendix D). Based on this analysis procedure, it was determined that the PMF inflow hydrograph would have a peak flow of 64,000 cfs, and a total volume of approximately 130,000 acre-feet. It was calculated that the spillway can pass the peak PMF inflow with a freeboard of 4.0 feet.

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 a flood.

d. Overtopping Potential. As stated above, the spillway can pass the peak PMF without the dam being overtopped.

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

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam and none were reported in the past.

b. Design Construction Data

(1) Embankment. The stability of the embankment was reanalyzed in 1961 by E. D'Appolonia Associates, Inc., and was reported to be satisfactory. The minimum factor of safety was stated to be 1.58.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the 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. The modifications made in 1961 are performing satisfactorily.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Quemahoning Dam is in good condition. It appears that the dam was constructed with reasonable care and the design of the 1961 enlargement of the dam generally followed the currently accepted engineering practices.

The capacity of the spillway was found to be "adequate" to pass the peak PMF flow.

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

c. Urgency. The recommendations listed below should be implemented as soon as practicable or on a continued basis, as noted.

d. Necessity for Further Investigation. The condition of the dam is not considered to require further investigation at this time.

7.2 Recommendations/Remedial Measures

1. It is recommended that the owner should locate the piezometers installed in 1961 and monitor and record the water levels within the embankment.

2. It is recommended that appropriate repairs should be made to stop concrete spalling at various locations along the spillway discharge channel to prevent structural damage.

3. It is recommended that the dam and appurtenant structures should be inspected regularly and any unusual condition should be reported to the appropriate authorities.

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

PLATES

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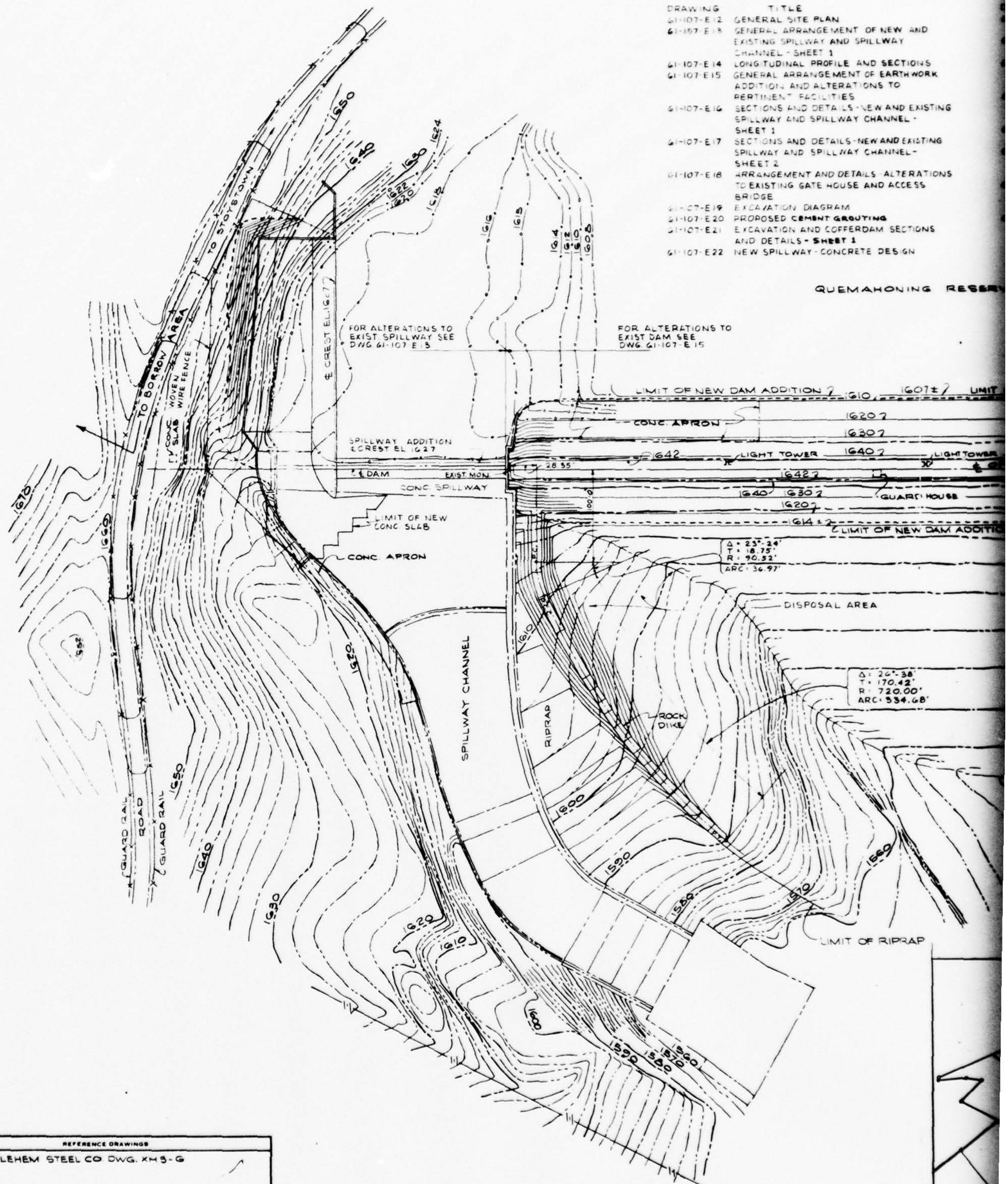
DRAWING	TITLE
61-107-E12	GENERAL SITE PLAN
61-107-E13	GENERAL ARRANGEMENT OF NEW AND EXISTING SPILLWAY AND SPILLWAY CHANNEL - SHEET 1
61-107-E14	LONGITUDINAL PROFILE AND SECTIONS
61-107-E15	GENERAL ARRANGEMENT OF EARTHWORK ADDITION AND ALTERATIONS TO PERTINENT FACILITIES
61-107-E16	SECTIONS AND DETAILS - NEW AND EXISTING SPILLWAY AND SPILLWAY CHANNEL - SHEET 1
61-107-E17	SECTIONS AND DETAILS - NEW AND EXISTING SPILLWAY AND SPILLWAY CHANNEL - SHEET 2
61-107-E18	ARRANGEMENT AND DETAILS - ALTERATIONS TO EXISTING GATE HOUSE AND ACCESS BRIDGE
61-107-E19	EXCAVATION DIAGRAM
61-107-E20	PROPOSED CEMENT GROUTING
61-107-E21	EXCAVATION AND COFFERDAM SECTIONS AND DETAILS - SHEET 1
61-107-E22	NEW SPILLWAY - CONCRETE DESIGN

QUEMAHONING RESERV



REFERENCE DRAWINGS
BETHLEHEM STEEL CO DWG. XH3-G

DRAWING INDEX

DRAWING	TITLE
61-107-E23	NEW SIDE CHANNEL PAVING AND DRAINS SHEET 1
61-107-E24	NEW SIDE CHANNEL PAVING AND DRAINS SHEET 2
61-107-E25	NEW RETAINING WALL-EAST SIDE OF SIDE CHANNEL SPILLWAY-SHEET 1 CONCRETE DESIGN
61-107-E26	NEW RETAINING WALL-EAST SIDE OF SIDE CHANNEL SPILLWAY-SHEET 2 CONCRETE DESIGN
61-107-E27	TRANSITION PYL[illegible]RANGEMENT AND DETAILS-CONCRETE [illegible]IGN-SHEET 1
61-107-E28	ALTERATIONS AND ADDITIONS TO EXISTING SPILLWAY AND WEST SPILLWAY ABUTMENT-CONCRETE DESIGN
61-107-E29	ALTERATIONS TO EXISTING GATE HOUSE ACCESS BRIDGE, ABUTMENT AND LIME INTAKE PIPING
61-107-E30	PREVIOUS DIAMOND DRILLING AND PRESSURE GROUTING DATA AT WEST DAM ABUTMENT-SHEET 1
61-107-E31	PREVIOUS DIAMOND DRILLING AND PRESSURE GROUTING DATA AT WEST DAM ABUTMENT-SHEET 2
61-107-E32	PREVIOUS DIAMOND DRILLING AND PRESSURE GROUTING DATA AT WEST DAM ABUTMENT-SHEET 3
61-107-E33	PREVIOUS DIAMOND DRILLING AND PRESSURE GROUTING DATA AT WEST DAM ABUTMENT-SHEET 4
61-107-E4	PLAN AND LOCATION OF BORINGS AT EXISTING DAM AND SPILLWAY
61-107-E5	BORING LOGS-BORINGS 9,13,17-SHEET 2
61-107-E6	BORING LOGS-BORINGS 7,8,11,12,15,16,18,19 SHEET 3
61-107-E7	BORING LOGS-BORINGS 1,2,3,4,5,6-SHEET 1
61-107-E34	TRANSITION PYLON-ARRANGEMENT AND DETAILS-CONCRETE DESIGN-SHEET 2
61-107-E35	EXCAVATION AND COFFERDAM SECTIONS AND DETAILS-SHEET 2

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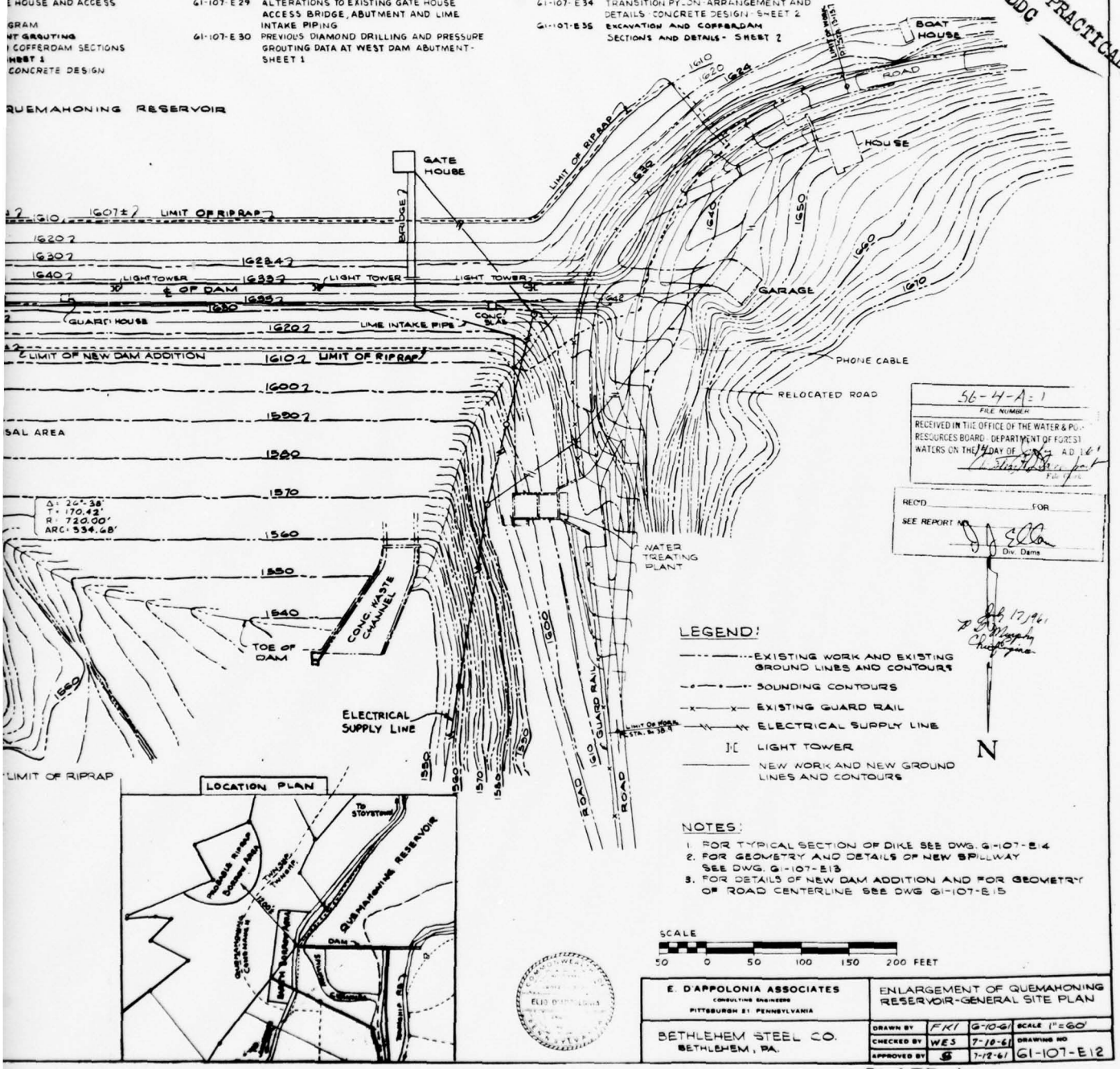
QUEMAHONING RESERVOIR



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FILE NUMBER

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RECD _____ FOR _____
SEE REPORT NO. _____
Div. Dams

Feb 17, 1961
P. J. Murphy
Chief Engineer

LEGEND:

- EXISTING WORK AND EXISTING GROUND LINES AND CONTOURS
- SOUNDING CONTOURS
- EXISTING GUARD RAIL
- ELECTRICAL SUPPLY LINE
- LIGHT TOWER
- NEW WORK AND NEW GROUND LINES AND CONTOURS

N

NOTES:

1. FOR TYPICAL SECTION OF DIKE SEE DWG. G-107-E14
2. FOR GEOMETRY AND DETAILS OF NEW SPILLWAY SEE DWG. G-107-E13
3. FOR DETAILS OF NEW DAM ADDITION AND FOR GEOMETRY OF ROAD CENTERLINE SEE DWG G-107-E15

SCALE
50 0 50 100 150 200 FEET

LOCATION PLAN

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

BETHLEHEM STEEL CO.
BETHLEHEM, PA.

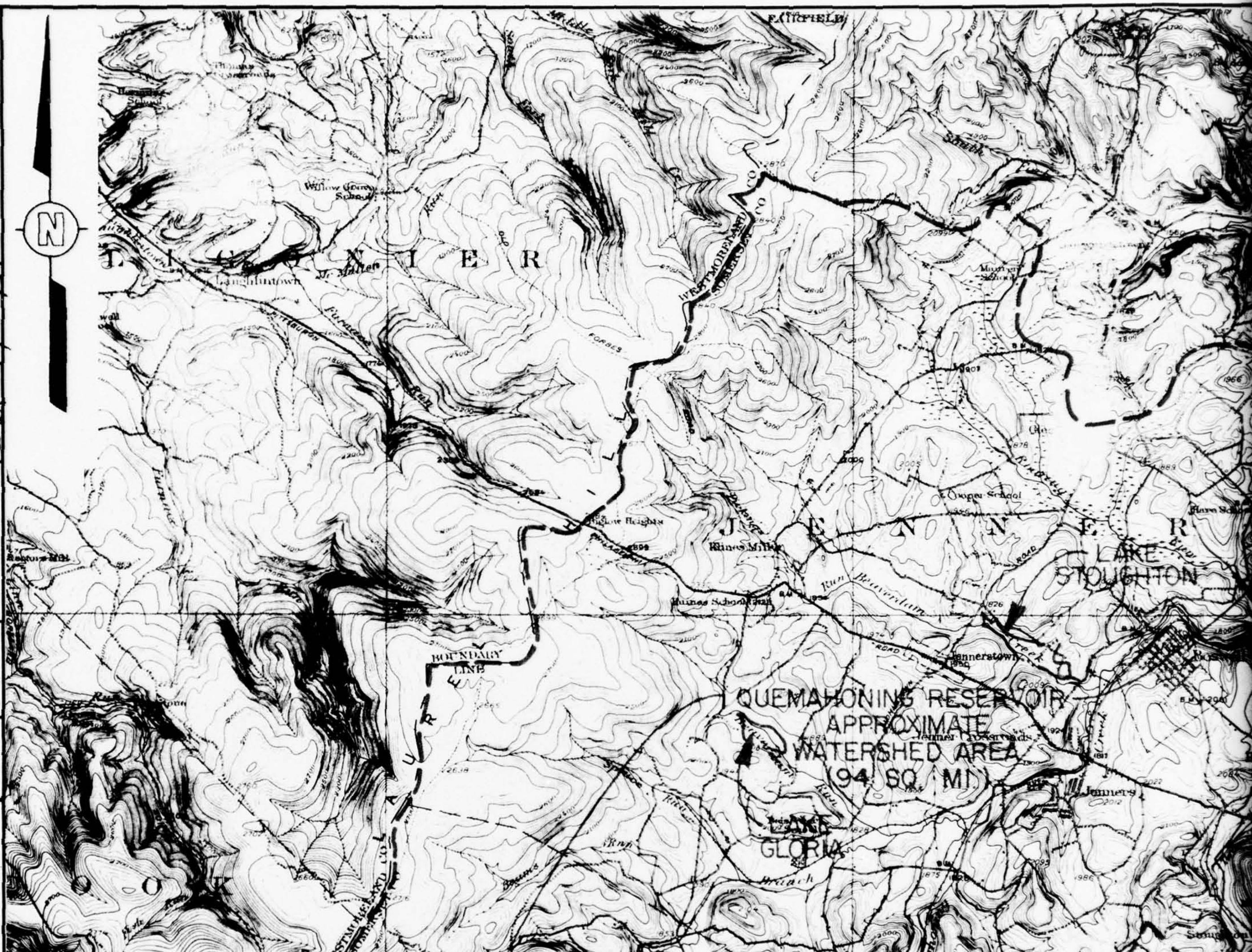
ENLARGEMENT OF QUEMAHONING RESERVOIR-GENERAL SITE PLAN

DRAWN BY	FKI	6-10-61	SCALE 1"=60'
CHECKED BY	WES	7-10-61	DRAWING NO
APPROVED BY	[illegible]	7-12-61	G1-107-E12

PLATE 1

D'APPOLONIA

DRAWN BY	D.J.D. 6-24-78	CHECKED BY	BE 7-5-78	DRAWING NUMBER	78 1-B63
		APPROVED BY	JMP 7-5-78		



REFERENCE:

U.S.G.S., 15', WINDBER PA. QUADRANGLE
DATED: 1914 SCALE - 1:5280

U.S.G.S., 15', SOMERSET PA. QUADRANGLE
DATED: 1913 SCALE - 1:5280

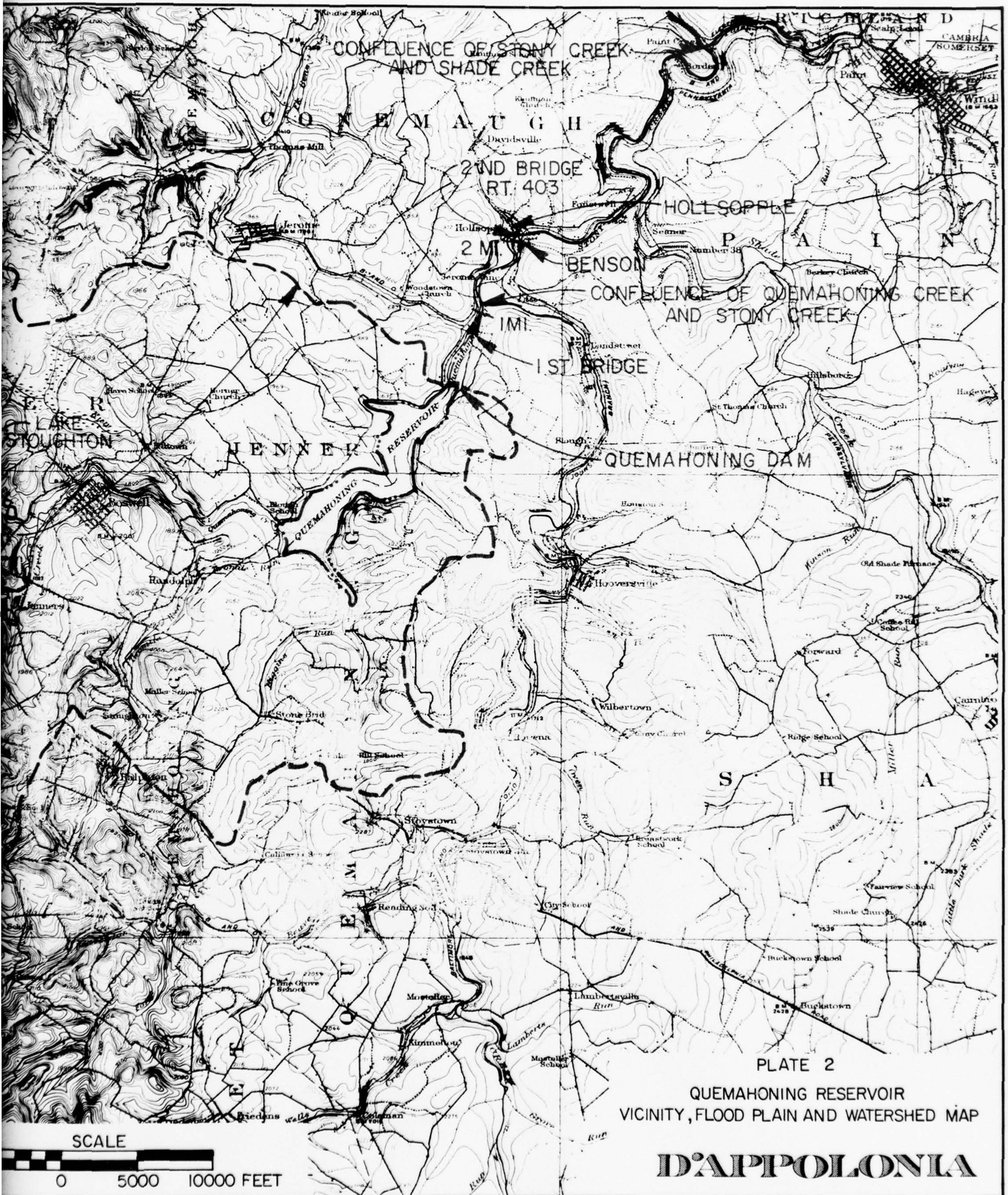


PLATE 2

QUEMAHONING RESERVOIR

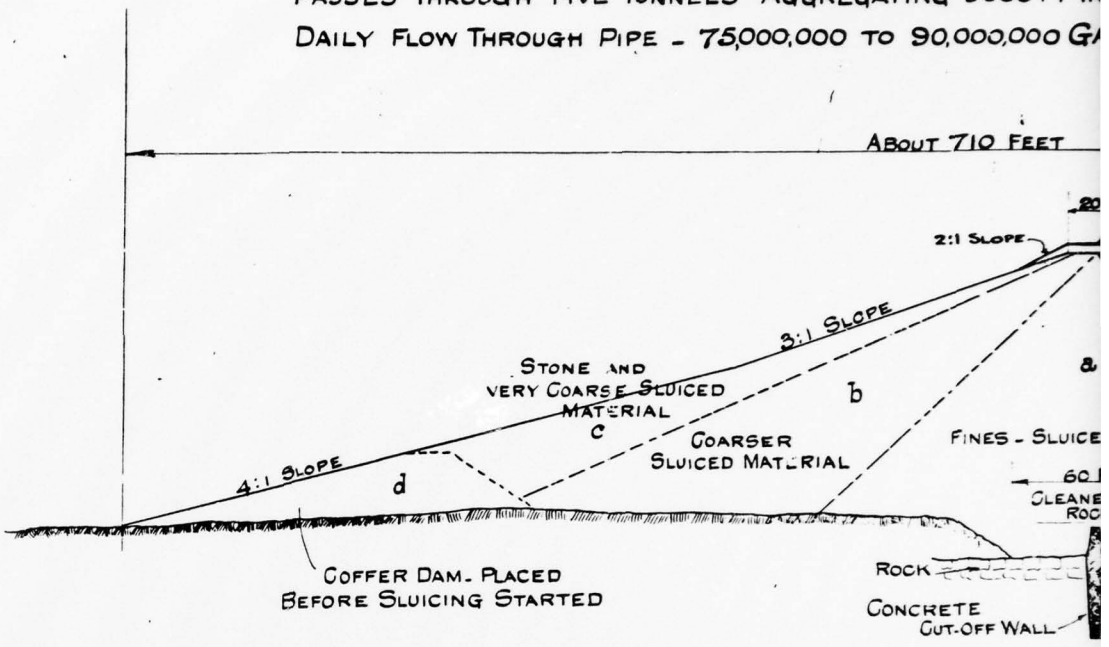
VICINITY, FLOOD PLAIN AND WATERSHED MAP

D'APPOLONIA

DRAWN BY	CJB	CHECKED BY		DRAWING NUMBER	78-, -B 71
	7-5-78	APPROVED BY			7-5-78

8.20655

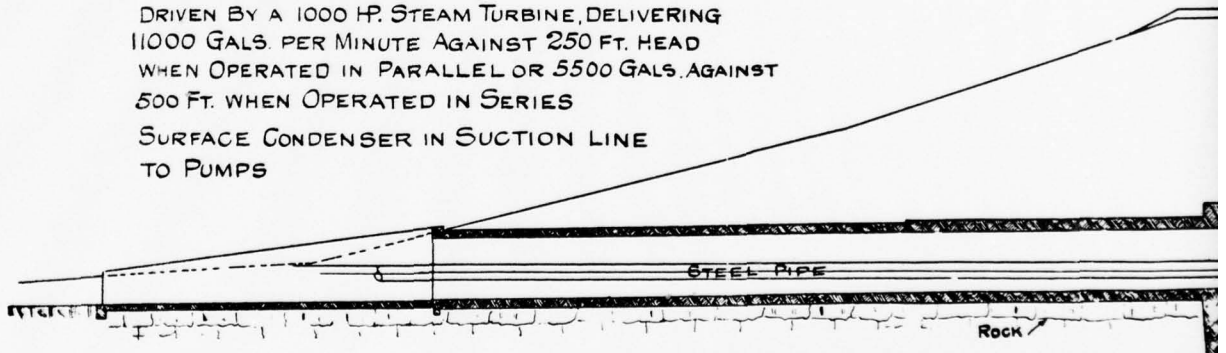
PIPE LINE TO WORKS - 14 MILES LONG
STEEL PIPE - 5'-6" DIAM.
TOTAL WEIGHT OF PIPE - 13000 TONS
CROSSES STONYCREEK RIVER 13 TIMES
PASSES THROUGH FIVE TUNNELS AGGREGATING 9000 FT IN
DAILY FLOW THROUGH PIPE - 75,000,000 TO 90,000,000 GA



SLUICING PLANT

1350 HP. WATER TUBE BOILERS
TWO 14" TWO-STAGE CENTRIFUGAL PUMPS
DRIVEN BY A 1000 HP. STEAM TURBINE, DELIVERING
11000 GALS. PER MINUTE AGAINST 250 FT. HEAD
WHEN OPERATED IN PARALLEL OR 5500 GALS. AGAINST
500 FT. WHEN OPERATED IN SERIES
SURFACE CONDENSER IN SUCTION LINE
TO PUMPS

ALL SEAMS IN
GROUTED TO
50 TO 70



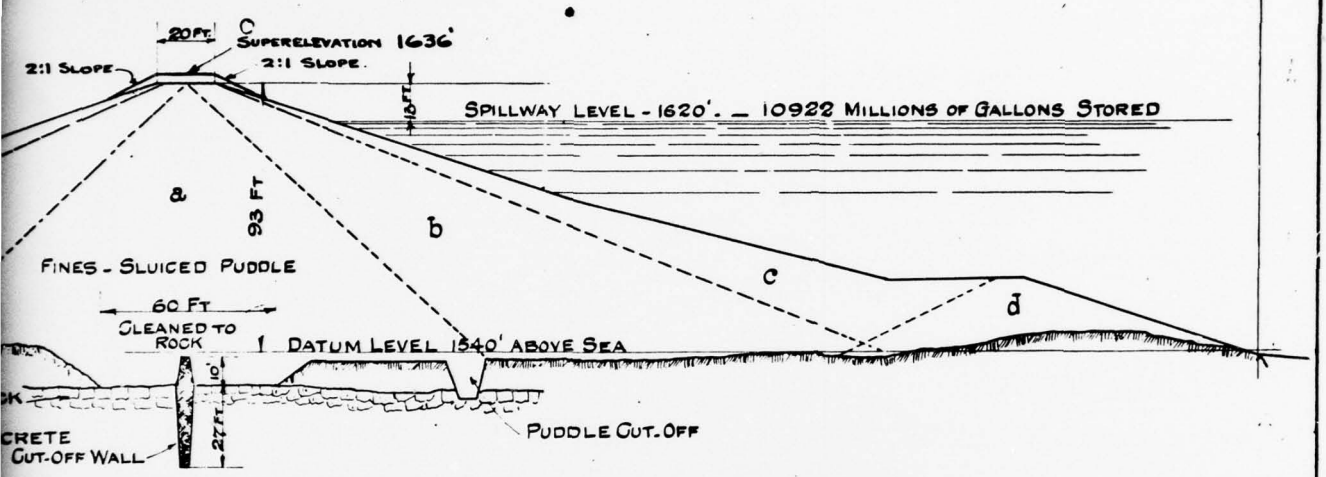
CONCRETE CONDUIT 30 FT WIDE 20 FT HIGH, FOR P
UPPER END AFTERWARD CLOSED BY
13250 CU. YDS

— CAMBRIA S
QUEMAHONING
S

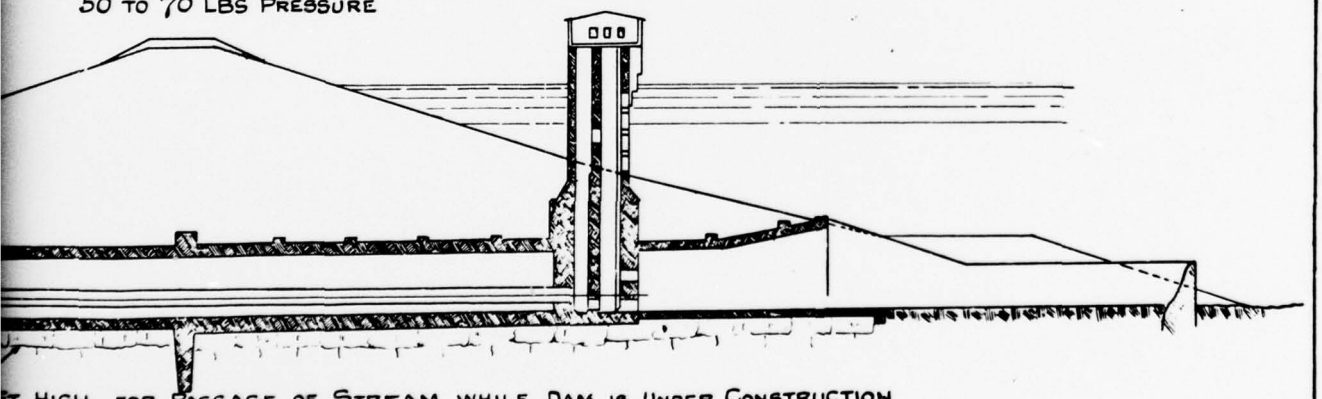
NG 9000 FT IN LENGTH
90,000,000 GALS.

CATCHMENT AREA - 92 SQ. MILES
FLOODED AREA - 900 ACRES
LENGTH OF DAM AT TOP. 950 FEET
WIDTH OF SPILLWAY - 250 FEET
MAXIMUM CALCULATED FLOW OVER SPILLWAY - 11800,000,000 GALS. PER 24 HOURS
MATERIAL IN DAM - 600,000 CU. YDS.

UT 710 FEET



ALL SEAMS IN CUT-OFF TRENCH GROUTED TO REFUSAL UNDER 50 TO 70 LBS PRESSURE



T HIGH, FOR PASSAGE OF STREAM WHILE DAM IS UNDER CONSTRUCTION
ARD CLOSED BY GATE HOUSE AND PIPE LAID THROUGH IT.
13250 CU. YDS CONCRETE IN CONDUCT.

CAMBRIA STEEL Co —
EMAHONING RESERVOIR
SCALE 1" = 40 FT.

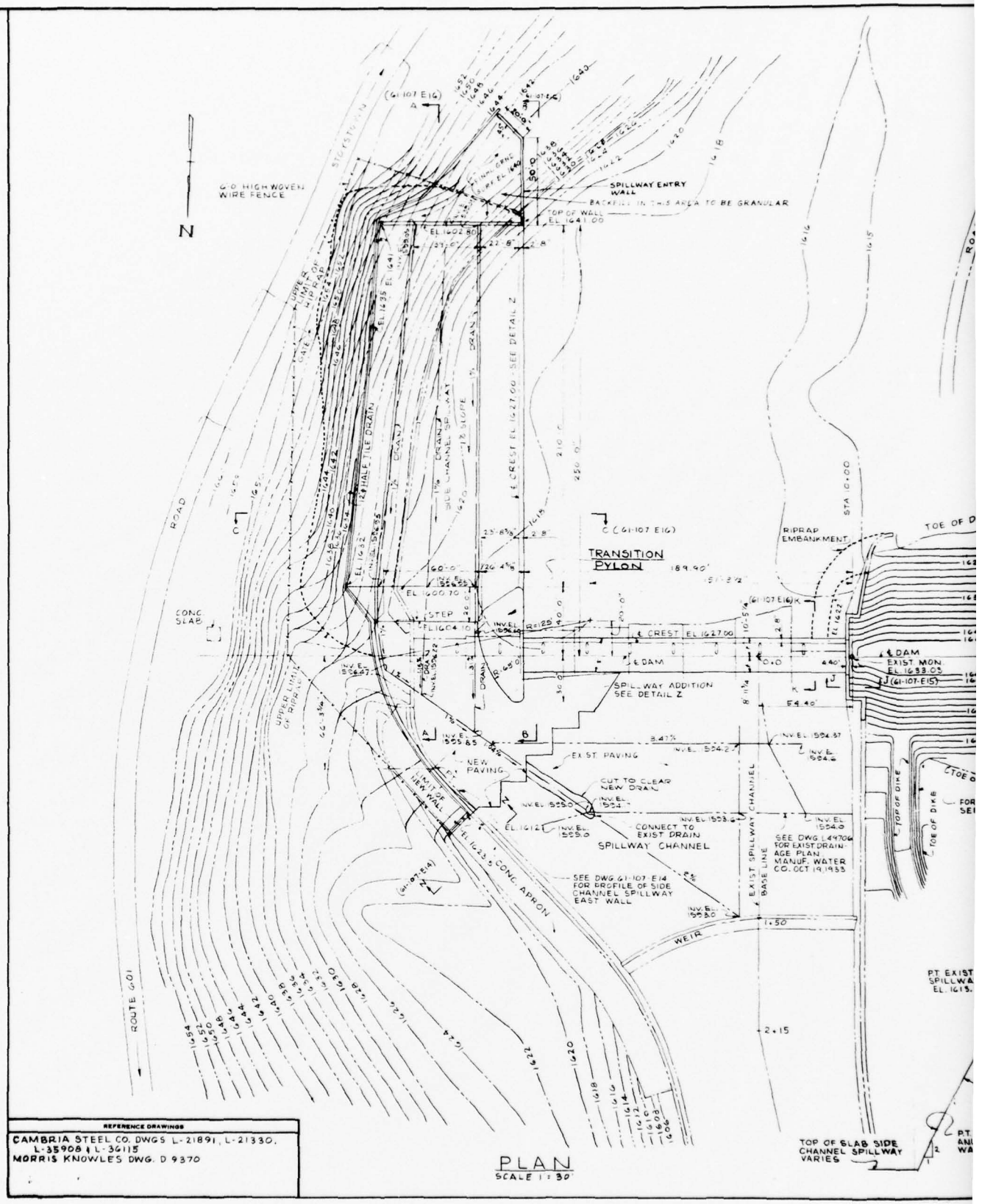
S-20655
MO.-11-DAY-1911

PLATE 3

D'APPOLONIA

2

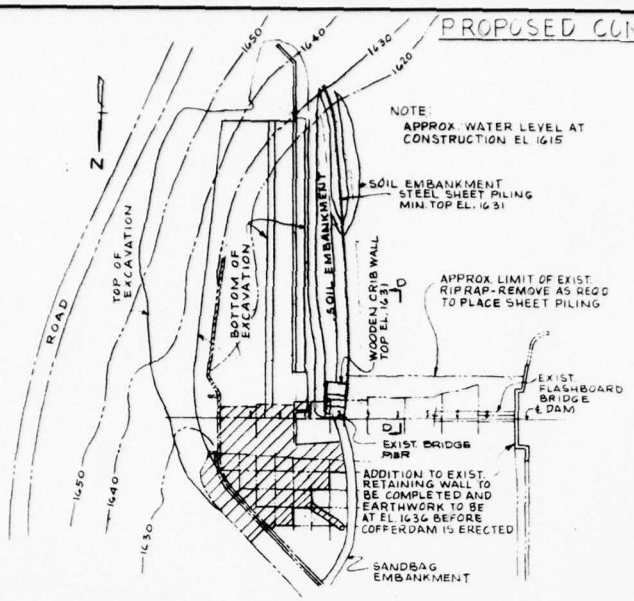
DRAWN BY	G.J.G.	CHECKED BY	7-5-78	DRAWING NUMBER	4-B64
	6-26-78	APPROVED BY	7-5-78		



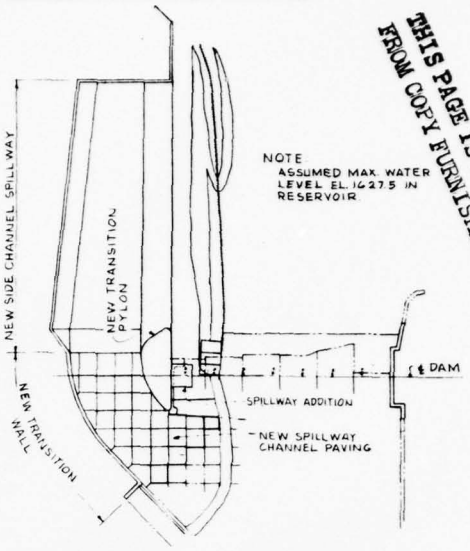
REFERENCE DRAWINGS

CAMBRIA STEEL CO. DWGS L-21891, L-21330, L-35908 & L-36115
MORRIS KNOWLES DWG. D 9370

PROPOSED CONSTRUCTION SEQUENCE

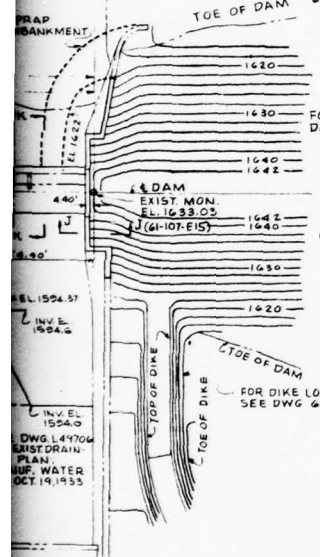


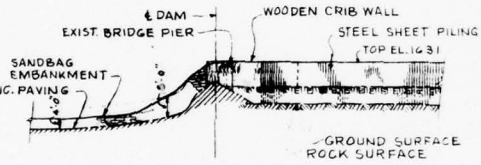
1. REMOVE EXIST. FLASHBOARD BRIDGE - EXIST ELECTRICAL WIRING ON BRIDGE TO BE REMOVED BY CONTRACTOR
2. ERECT WOODEN CRIB WALL } FOR DETAILS SEE
3. DRIVE SHEET PILING } DWG 61-107-E21
4. PLACE SANDBAG EMBANKMENT
5. REMOVE EXIST. SPILLWAY CONCRETE SHOWN
6. EXCAVATE FOR NEW SPILLWAY AND PLACE EXCAVATED SOIL AND ROCK IN TEMPORARY EMBANKMENTS SURROUNDING SHEET PILING AS SHOWN. ROCK GROUTING (DWG. 61-107-E20) WITHIN 50' OF EXCAVATED AREA MUST BE COMPLETED BEFORE ROCK EXCAVATION IS BEGUN.



1. DEWATER AS REQUIRED
2. ERECT TRANSITION PYLON & PORTION OF SPILLWAY ADDITION
3. ERECT NEW SIDE CHANNEL SPILLWAY, NEW TRANSITION WALL, SPILLWAY PAVING AND DRAINS.
4. PLACE HALF TILE DRAIN AND RIPRAP ABOVE EAST WALL OF NEW SIDE CHANNEL SPILLWAY.
5. ERECT WIRE FENCE AROUND SIDE CHANNEL SPILLWAY.
6. SEED REGRADED AREA BEHIND NEW TRANSITION WALL.

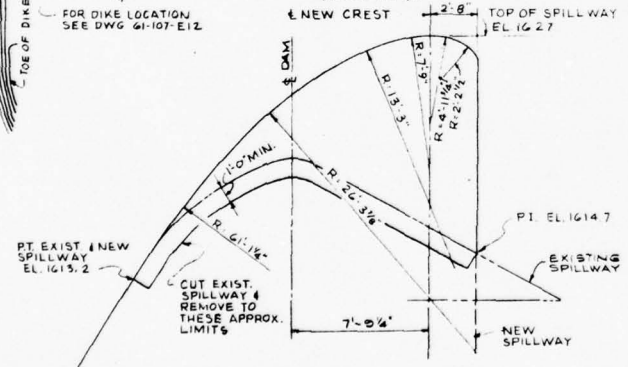
PHASE 1





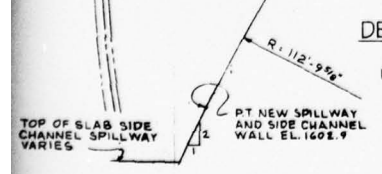
SECTION D-D

SCALE 1" = 30'



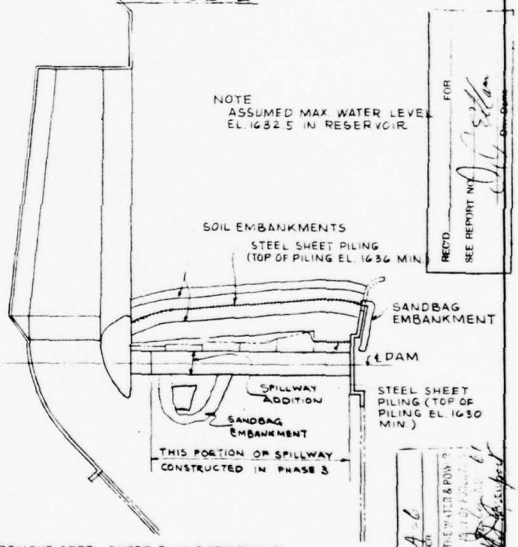
DETAIL Z - SPILLWAY CROSS SECTION

SCALE 1/4" = 1'-0"



NOTE:
GEOMETRY - USE FOR ADDITION TO EXISTING SPILLWAY AND NEW SPILLWAY

PHASE 2



1. REMOVE STEEL SHEET PILING, TEMPORARY EMBANKMENTS, WOODEN CRIB WALL AND SANDBAG EMBANKMENT FROM POSITION SHOWN IN PHASE 1.
2. REPLACE PILING AND TEMPORARY EMBANKMENTS AS SHOWN. REUSE EXISTING PILING AND TEMPORARY EMBANKMENT MATERIAL FROM PHASE 1.
3. DEWATER AROUND EXISTING SPILLWAY.
4. REMOVE EXISTING BRIDGE PIERS AND ADD NEW SPILLWAY CREST.
5. REMOVE SHEET PILING AND TEMPORARY EMBANKMENTS.
6. PLACE RIPRAP EMBANKMENT AT WEST END OF EXIST. SPILLWAY.

PHASE 3

July 17, 1961

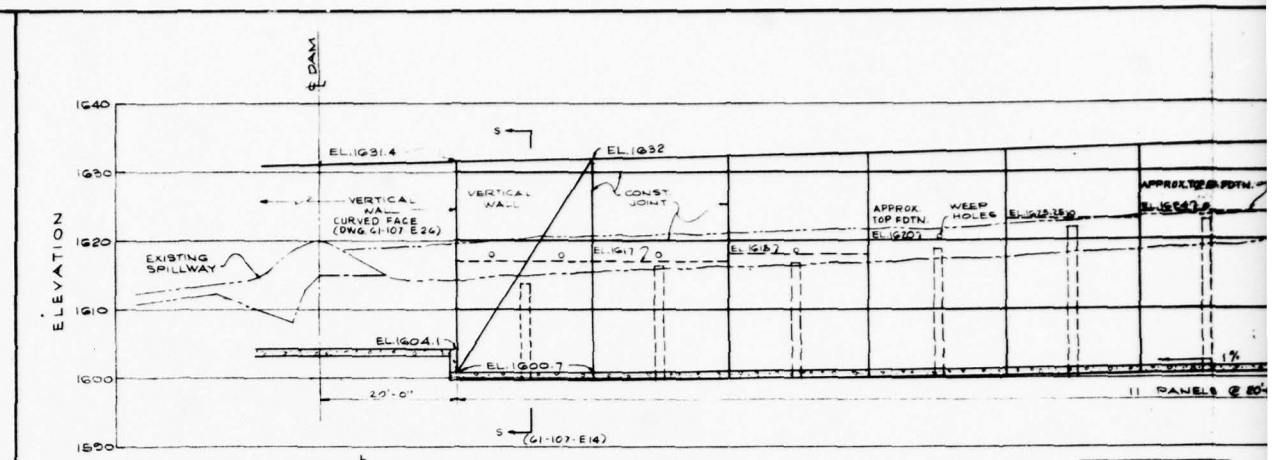
E. D'APPOLONIA ASSOCIATES, CONSULTING ENGINEERS, PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF QUEMAHONING RESERVOIR - GENERAL ARRANGEMENT OF NEW AND EXISTING SPILLWAY AND SPILLWAY CHANNEL - SHEET 3		
BETHLEHEM STEEL CO. BETHLEHEM, PA.	DRAWN BY: S.L.	5-25-61	SCALE: 1" = 30'
	CHECKED BY: W.E.S.	7-10-61	DRAWING NO. 61-107-E3
	APPROVED BY: [illegible]		

PLATE 4

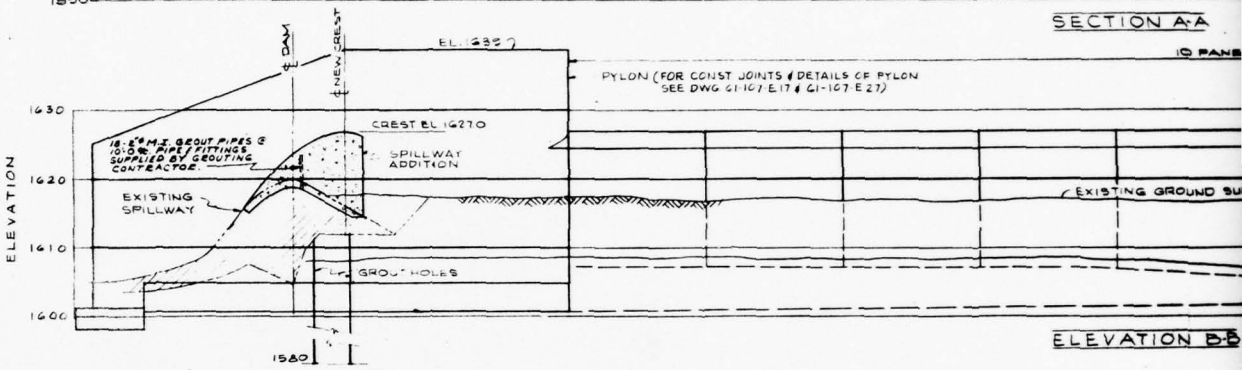
D'APPOLONIA

2

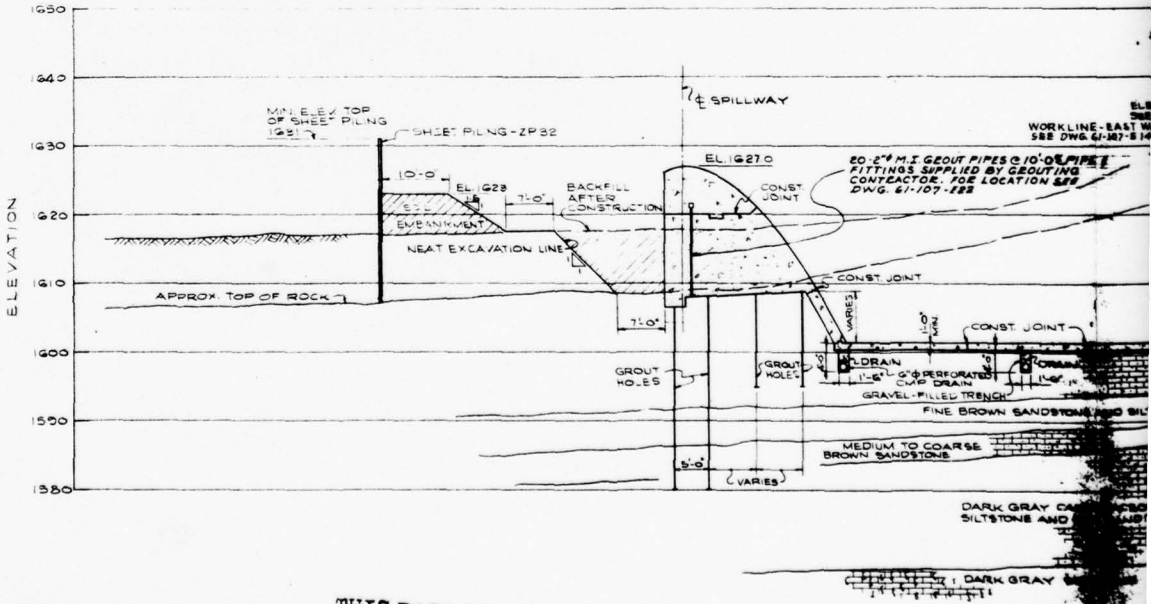
DRAWN BY	G.J.G.	CHECKED BY	BE	7-5-78	DRAWING NUMBER	1-B65
	6-23-78	APPROVED BY	[illegible]	7.5.78		



SECTION A-A



ELEVATION B-B



SECTION C

REFERENCE DRAWINGS

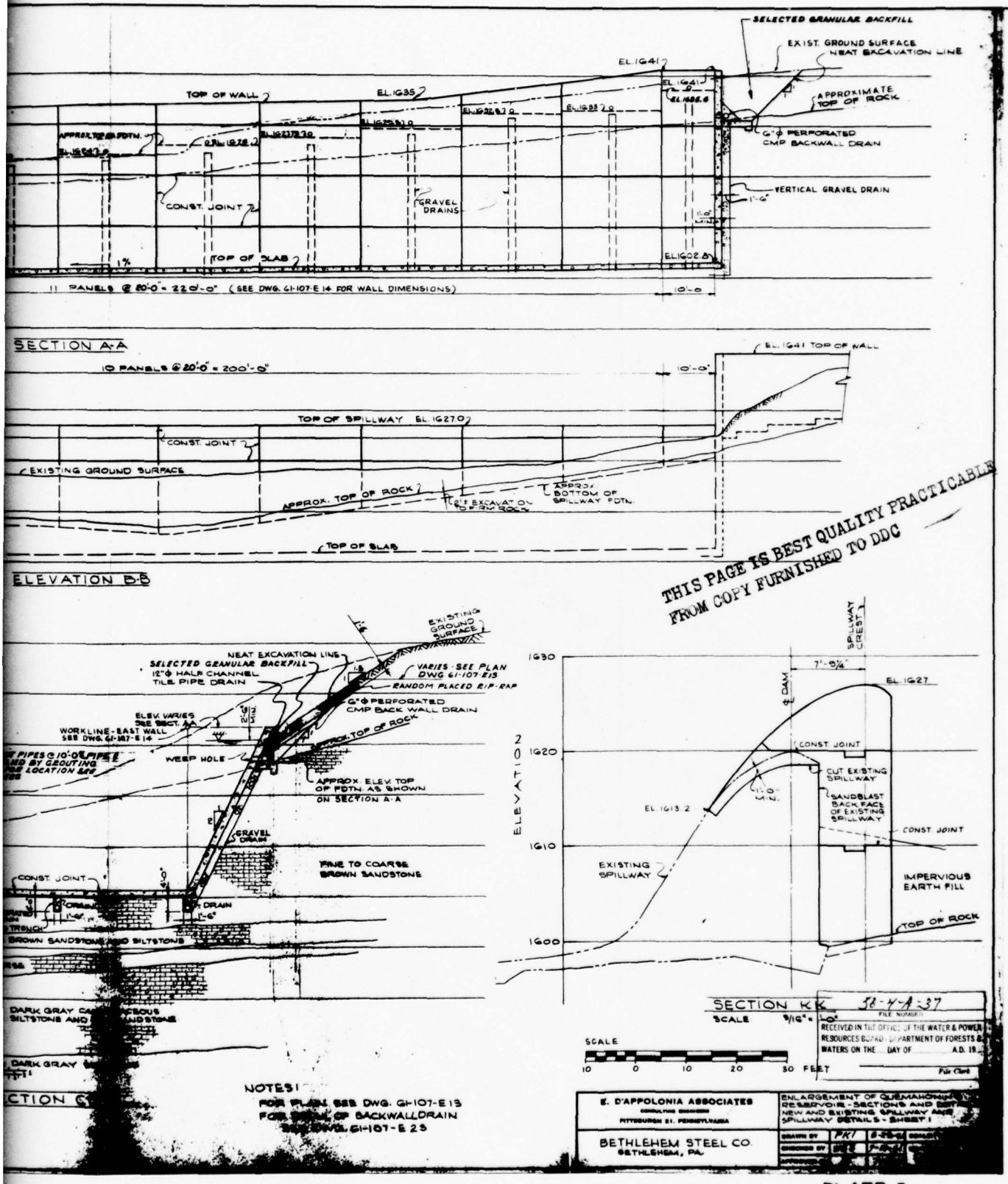
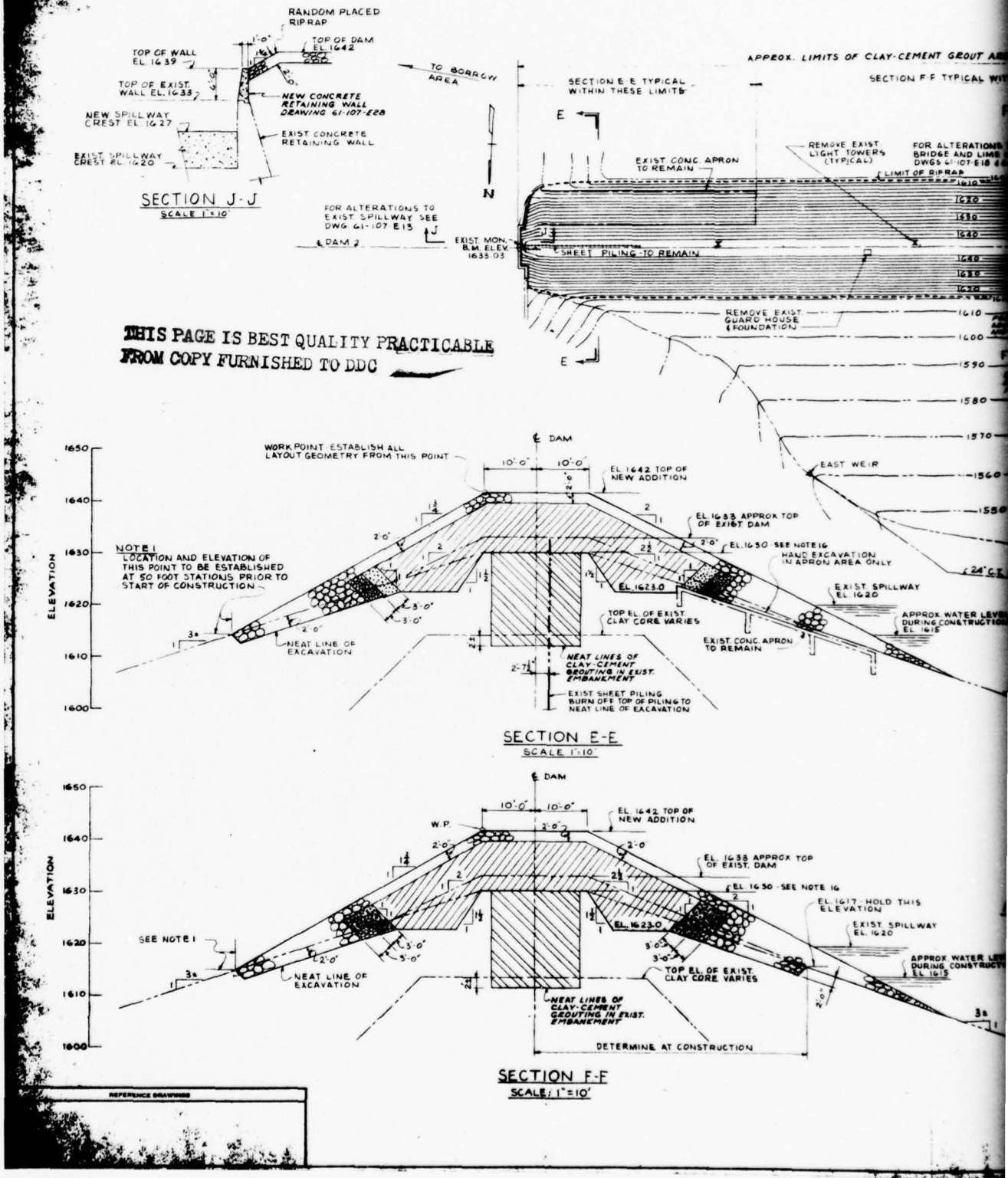
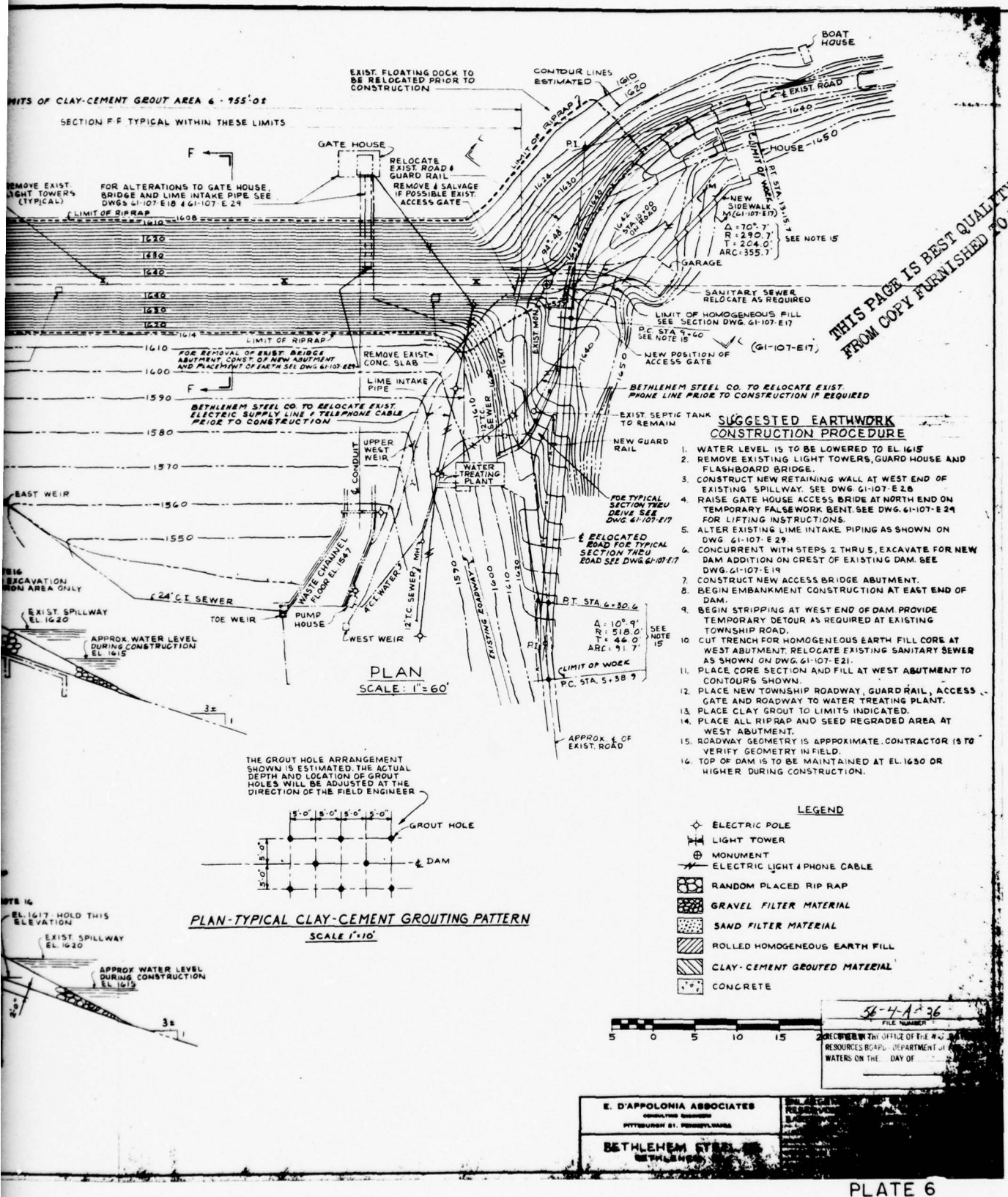


PLATE 5

D'APPOLONIA

DRAWN BY	G.J.G.	CHECKED BY		7-5-78	DRAWING NUMBER 78-1-B66
	6-23-78	APPROVED BY		7-5-78	





PLAN

SCALE: 1" = 60'

THE GROUT HOLE ARRANGEMENT SHOWN IS ESTIMATED. THE ACTUAL DEPTH AND LOCATION OF GROUT HOLES WILL BE ADJUSTED AT THE DIRECTION OF THE FIELD ENGINEER

PLAN-TYPICAL CLAY-CEMENT GROUTING PATTERN

SCALE 1" = 10'

SUGGESTED EARTHWORK CONSTRUCTION PROCEDURE

1. WATER LEVEL IS TO BE LOWERED TO EL. 1615
2. REMOVE EXISTING LIGHT TOWERS, GUARD HOUSE AND FLASHBOARD BRIDGE.
3. CONSTRUCT NEW RETAINING WALL AT WEST END OF EXISTING SPILLWAY. SEE DWG. 61-107-E 28
4. RAISE GATE HOUSE ACCESS BRIDGE AT NORTH END ON TEMPORARY FALSEWORK BENT. SEE DWG. 61-107-E 29 FOR LIFTING INSTRUCTIONS.
5. ALTER EXISTING LIME INTAKE PIPING AS SHOWN ON DWG. 61-107-E 29
6. CONCURRENT WITH STEPS 2 THRU 5, EXCAVATE FOR NEW DAM ADDITION ON CREST OF EXISTING DAM. SEE DWG. 61-107-E 19
7. CONSTRUCT NEW ACCESS BRIDGE ABUTMENT.
8. BEGIN EMBANKMENT CONSTRUCTION AT EAST END OF DAM.
9. BEGIN STRIPPING AT WEST END OF DAM. PROVIDE TEMPORARY DETOUR AS REQUIRED AT EXISTING TOWNSHIP ROAD.
10. CUT TRENCH FOR HOMOGENEOUS EARTH FILL CORE AT WEST ABUTMENT. RELOCATE EXISTING SANITARY SEWER AS SHOWN ON DWG. 61-107-E21.
11. PLACE CORE SECTION AND FILL AT WEST ABUTMENT TO CONTOURS SHOWN.
12. PLACE NEW TOWNSHIP ROADWAY, GUARD RAIL, ACCESS GATE AND ROADWAY TO WATER TREATING PLANT.
13. PLACE CLAY GROUT TO LIMITS INDICATED.
14. PLACE ALL RIPRAP AND SEED REGRADED AREA AT WEST ABUTMENT.
15. ROADWAY GEOMETRY IS APPROXIMATE. CONTRACTOR IS TO VERIFY GEOMETRY IN FIELD.
16. TOP OF DAM IS TO BE MAINTAINED AT EL. 1630 OR HIGHER DURING CONSTRUCTION.

LEGEND

- ELECTRIC POLE
- LIGHT TOWER
- MONUMENT
- ELECTRIC LIGHT & PHONE CABLE
- RANDOM PLACED RIP RAP
- GRAVEL FILTER MATERIAL
- SAND FILTER MATERIAL
- ROLLED HOMOGENEOUS EARTH FILL
- CLAY-CEMENT GROUTED MATERIAL
- CONCRETE

5 0 5 10 15 20

56-4-A-36
FILE NUMBER

RECORDED IN THE OFFICE OF THE [illegible] RESOURCES BOARD, DEPARTMENT OF [illegible] WATERS ON THE DAY OF

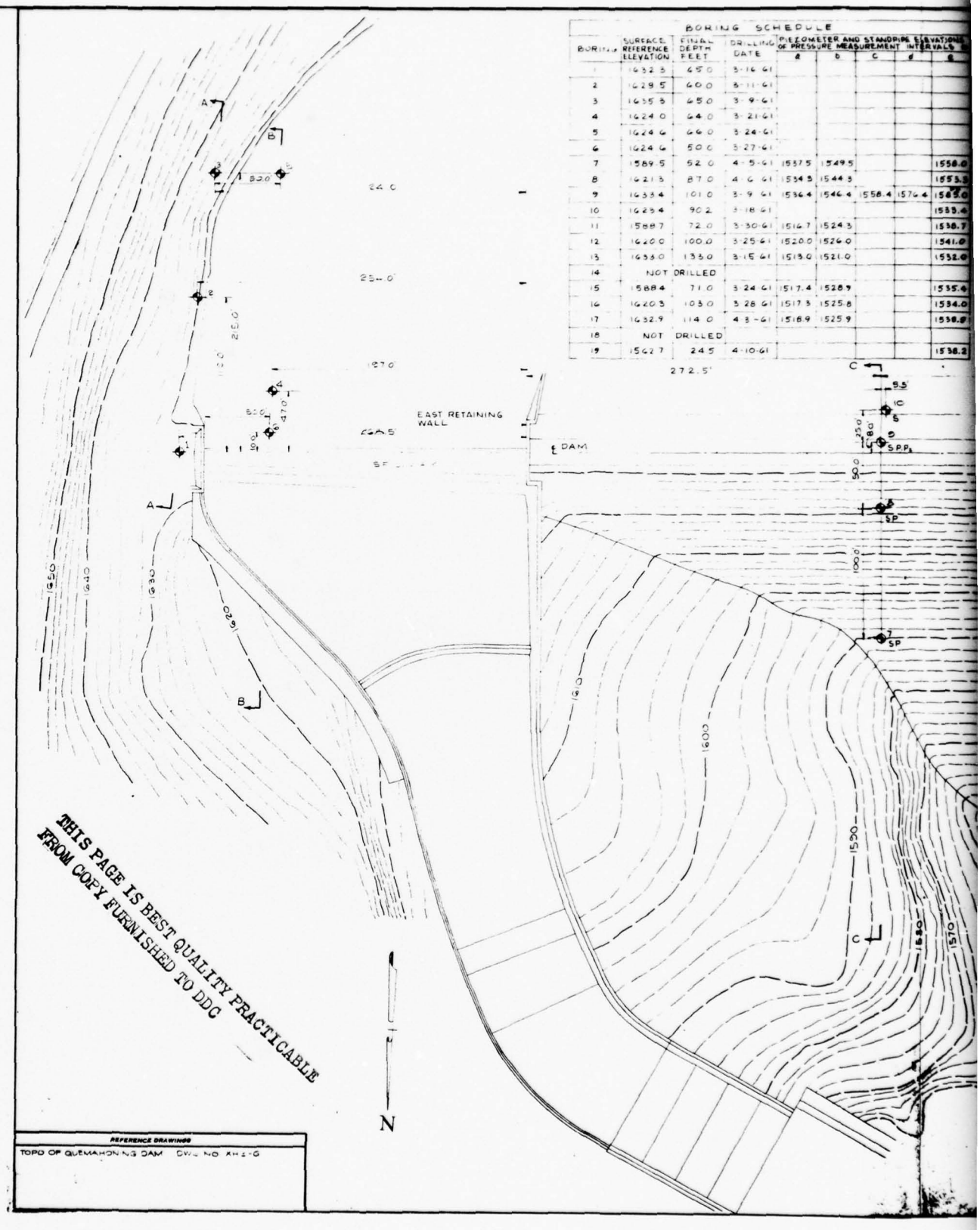
E. D'APPOLONIA ASSOCIATES
CONSULTING ENGINEERS
PITTSBURGH 61, PENNSYLVANIA

BETHLEHEM STEEL CO.
BETHLEHEM, PA.

PLATE 6

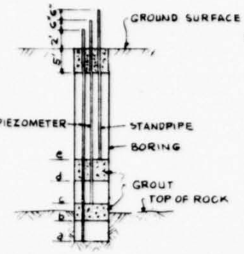
D'APPOLONIA

DRAWN BY	G J G	CHECKED BY	BE	7-5-78	DRAWING 78-	1-B67
	6-23-78	APPROVED BY	SMP	7-5-78	NUMBER	



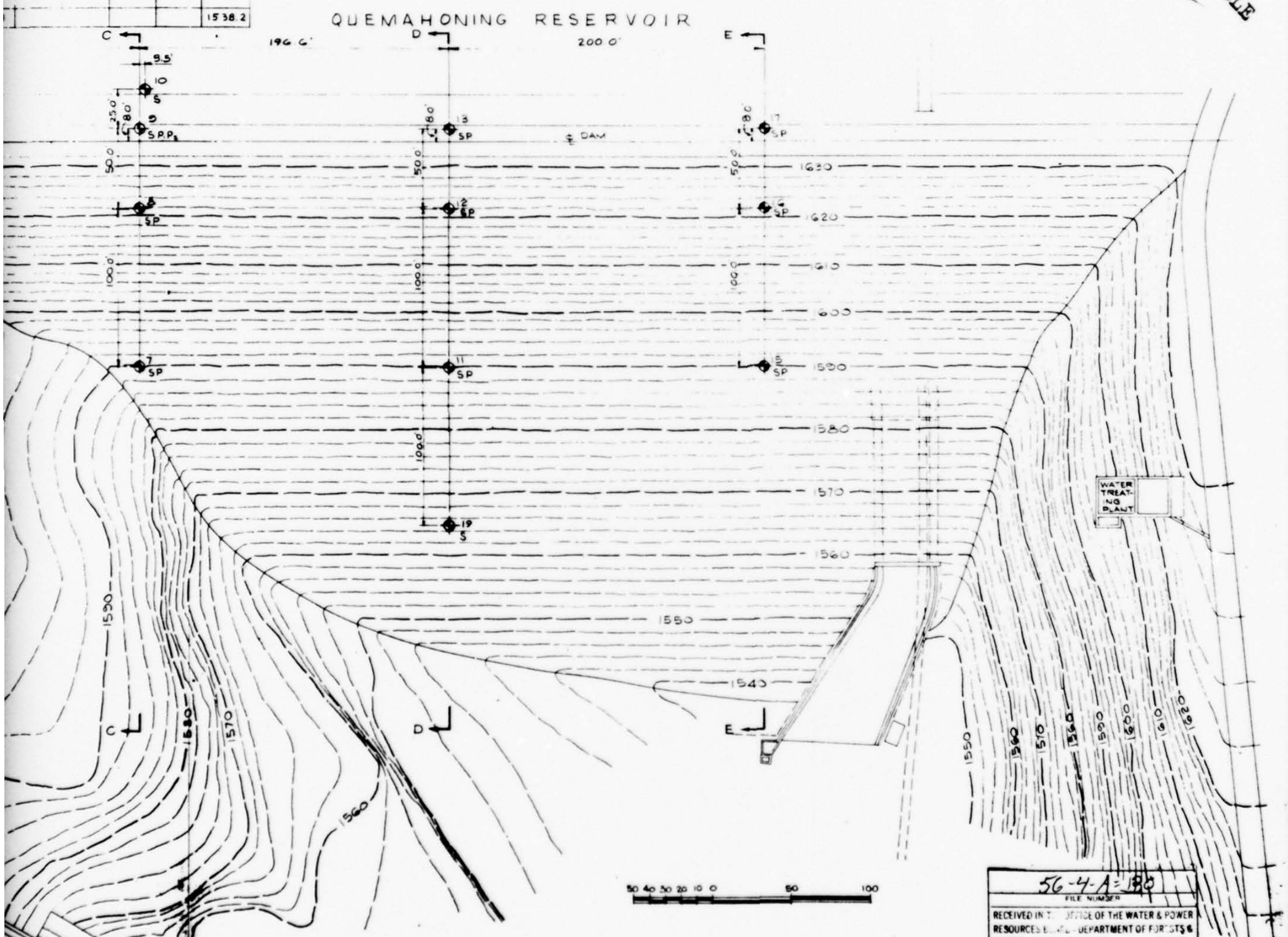
…HEDULE

	PIEZOMETER AND STANDPIPE ELEVATIONS OF PRESSURE MEASUREMENT INTERVALS **				
	a	b	c	d	e
I					
I					
I					
I					
I					
I					
I	1537.5	1549.5			1558.0
I	1534.3	1544.3			1553.3
I	1536.4	1546.4	1558.4	1576.4	1585.0
I					1533.4
I	1516.7	1524.3			1538.7
I	1520.0	1526.0			1541.0
I	1513.0	1521.0			1532.0
I	1517.4	1528.9			1535.4
I	1517.3	1525.8			1534.0
I	1518.9	1525.9			1538.9
I					1538.2



NOTE:
DEEPEST PIPE HAS LEAST STICKUP ABOVE GROUND SURFACE AND SHALLOWER PIPES ARE APPROXIMATELY 6 INCHES HIGHER SUCCESSIVELY

NOTES:
1. FOR BORING LOGS SEE DWGS. 61-107-E5, 61-107-E6 AND 61-107-E7
2. FOR CROSS SECTIONS SEE DWGS. 61-107-E2 AND 61-107-E3
3. ** TWO PIEZOMETERS PLACED IN BORING 9
4. CONTOURS OF EXISTING DAM SURFACE OBTAINED FROM PROPOSED ORIGINAL DESIGN DRAWINGS. TOP OF BORING ELEVATIONS OBTAINED FROM FIELD SURVEY MARCH 22, 1961



LEGEND:
BORING LOCATION
GROUND SURFACE CONTOURS (2 FT. [illegible])
SP [illegible] STANDPIPE-PIEZOMETER UNIT
[illegible]

56-4-A-130
FILE NUMBER
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTS & WATERS ON THE ___ DAY OF ___ A.D. 19__

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

BETHLEHEM STEEL CO.
BETHLEHEM, PA.

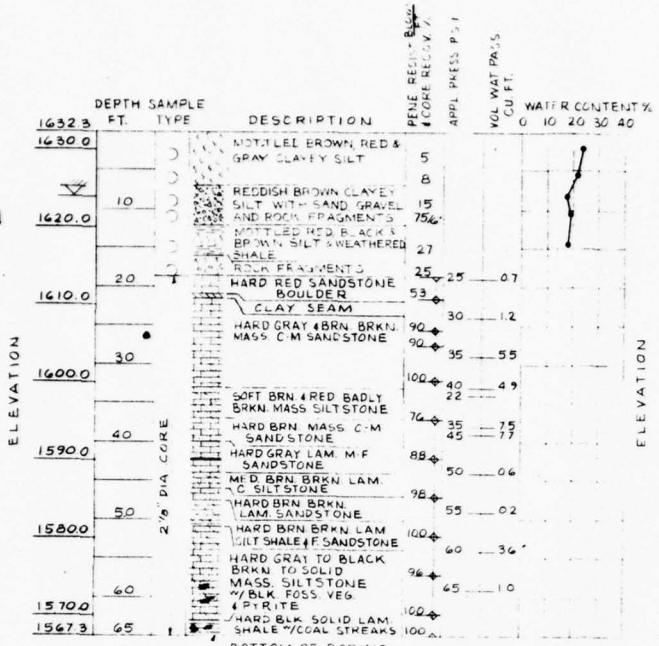
ENLARGEMENT OF QUEMAHONING RESERVOIR - PLAN AND LOCATION OF BORINGS AT EXISTING DAM AND SPILLWAY

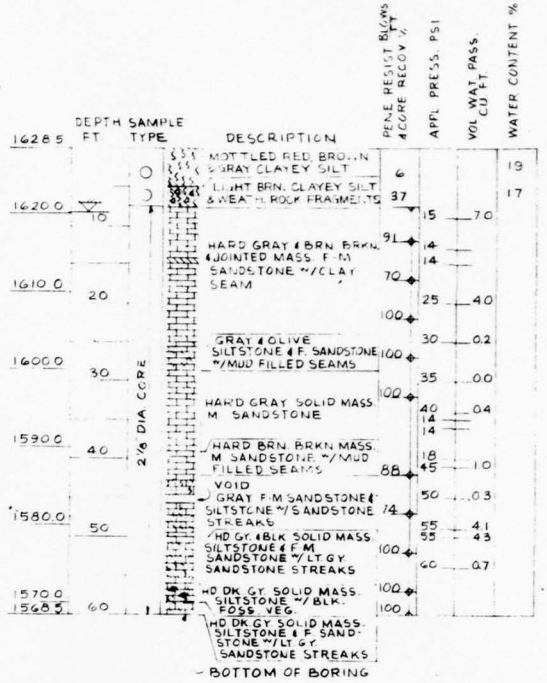
PLATE 7

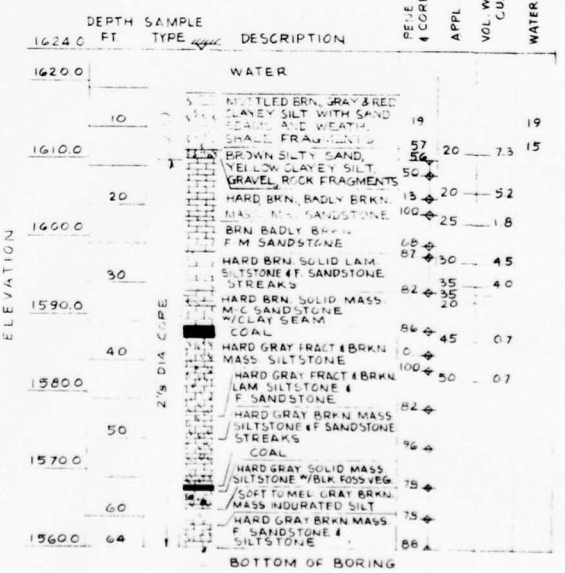
D'APPOLONIA

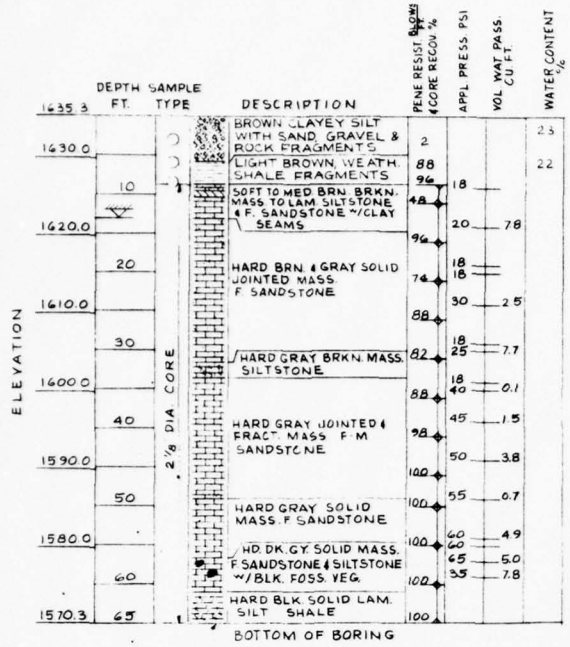
2

DRAWN BY	G.J.G.	CHECKED BY		DRAWING 78- 1-B68
	6-22-78	APPROVED BY	[illegible] 7.5.78	NUMBER 7.5.18

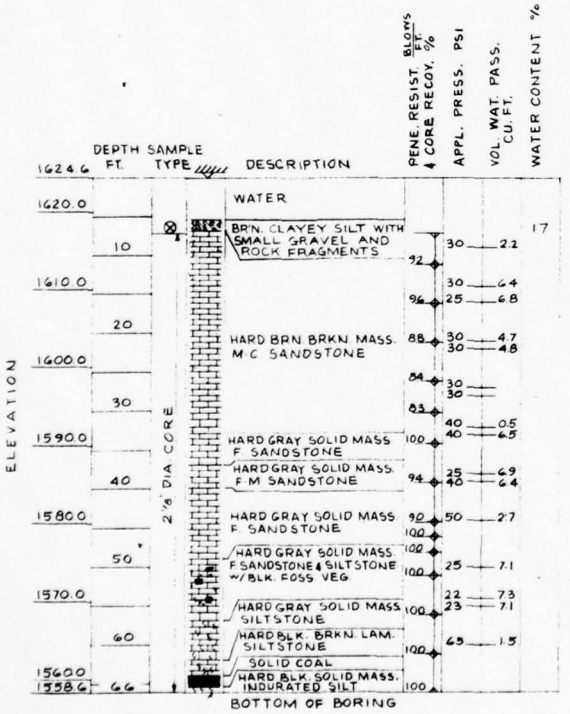








BORING 3



BORING 5

LEGEND

- RESIDUAL SOIL
- GRAVEL
- SAND
- SILT
- CLAY
- SANDSTONE
- SHALE
- SILTSTONE
- ROCK FRAGMENTS
- COAL
- COAL FRAGMENTS
- VOID
- 2" O.D SPLIT SPOON SAMPLE
- 3" SHELBY TUBE SAMPLE
- VANE SHEAR TEST
- CASING SAMPLE
- WATER LEVEL
- LENGTH OF BORING BEING WATER PRESSURE TESTED
- % — LENGTH OF DRILL RUN AND PERCENT OF RECOVERY
- 2⅛" DIA CORE — APPEARS IN SAMPLE TYPE COLUMN WHERE ROCK CORE SAMPLES HAVE BEEN TAKEN
- PL LL — PLASTIC AND LIQUID LIMITS EXPRESSED AS WATER CONTENT

ABBREVIATIONS

PENE. RESIST.	PENETRATION RESISTANCE	
APPL. PRESS.	APPLIED PRESSURE	
VOL. WAT. PASS.	VOLUME WATER PASSED	
MASS.	MASSIVE	STRUCTURE
LAM.	LAMINATED	STRUCTURE
BRKN.	BROKEN	CONDITION
FRACT.	FRACTURED	CONDITION
CARBO.	CARBONACEOUS	
FOSS. VEG.	FOSSILIZED VEGETATION	
WEATH.	WEATHERED	
F-M	FINE TO MEDIUM	GRAIN SIZE
C-M	COARSE TO MEDIUM	GRAIN SIZE
F.	FINE	GRAIN SIZE
M.	MEDIUM	GRAIN SIZE
C.	COARSE	GRAIN SIZE
BRN.	BROWN	COLOR
BLK.	BLACK	COLOR
GY.	GRAY	COLOR
LT.	LIGHT	COLOR
DK.	DARK	COLOR
STRKS.	STREAKS	COLOR
HD.	HARD	HARDNESS
MED.	MEDIUM	HARDNESS
SOFT	SOFT	HARDNESS

NOTE: COMBINATIONS OF SYMBOLS ARE USED WHERE NECESSARY

GENERAL NOTES

1. ALL VALUES SHOWN IN COLUMNS HEADED "APPLIED PRESSURE" AND "VOLUME OF WATER PASSED" ARE FOR WATER PRESSURE TESTS RUN FOR A PERIOD OF 5 MINUTES.
2. ALL PRESSURE TESTS WERE MADE IN 5 FOOT INCREMENTS BEGINNING AT THE BOTTOM OF THE PRE-DRILLED HOLE.
3. WATER LEVEL SHOWN IN BORING LOG DENOTES DEPTH TO WATER SURFACE MEASURED FROM TOP OF BORING UPON COMPLETION OF DRILLING.
4. PENETRATION RESISTANCE IN BLOWS PER FOOT IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2 INCH O.D SPLIT SPOON SAMPLER 12 INCHES USING A 140 POUND HAMMER FALLING 30 INCHES.
5. FOR PLAN AND LOCATION OF BORINGS SEE DWG. NO. 61-107-E1

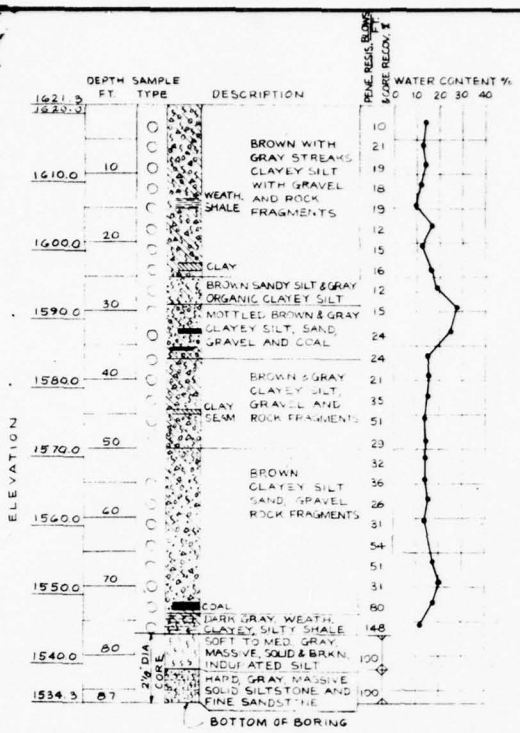
E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF QUEMAHONING RESERVOIR — BORING LOGS BORINGS 1, 2, 3, 4, 5 & 6 SHEET 1			
BETHLEHEM STEEL CO. BETHLEHEM, PA.	DRAWN BY	S.L.	4-11-61	SCALE: 1" = 10' VERT.
	CHECKED BY	D.L.M.	5-2-61	DRAWING NO.
	APPROVED BY	[signature]	7-12-61	61-107-E 7

PLATE 8

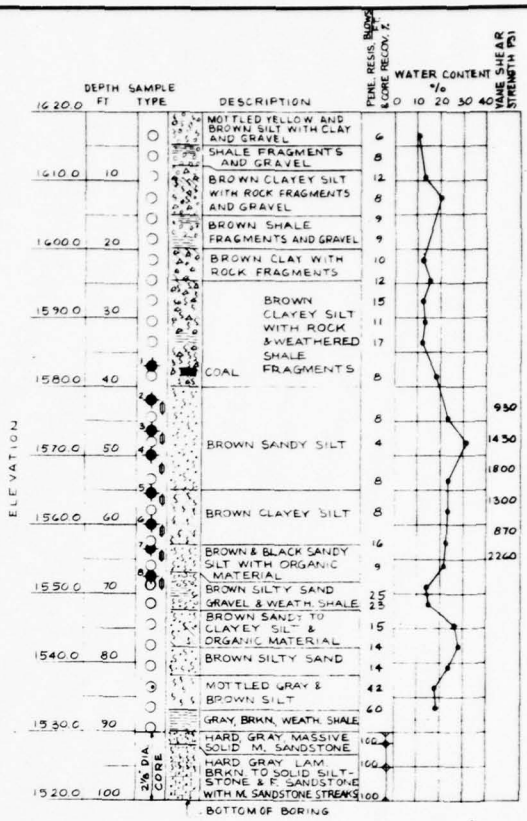
D'APPOLONIA

DRAWN BY	G.J.G.	CHECKED BY	BE
	6-23-78	APPROVED BY	[illegible]
		DRAWING NUMBER	7-5-78 / 75-78

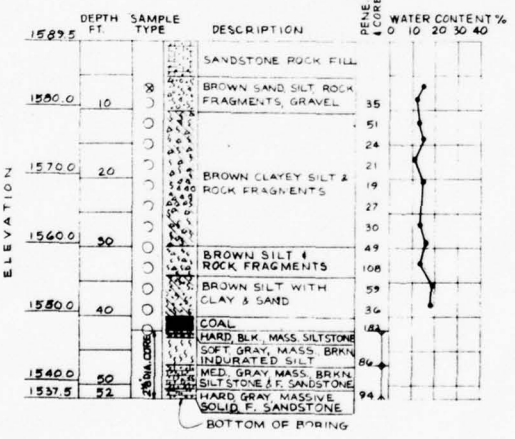
1-B69



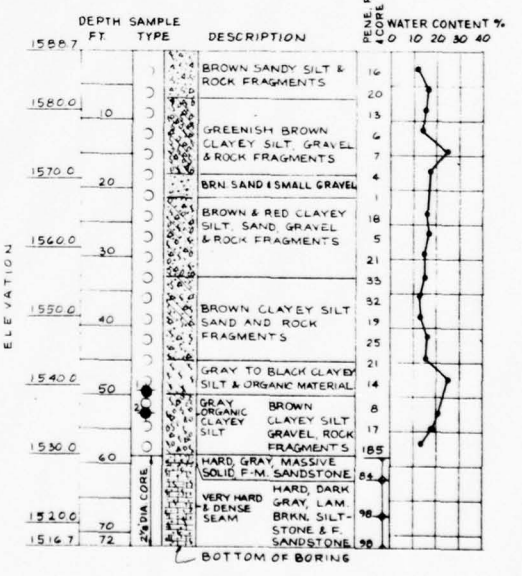
BORING 8



BORING 12

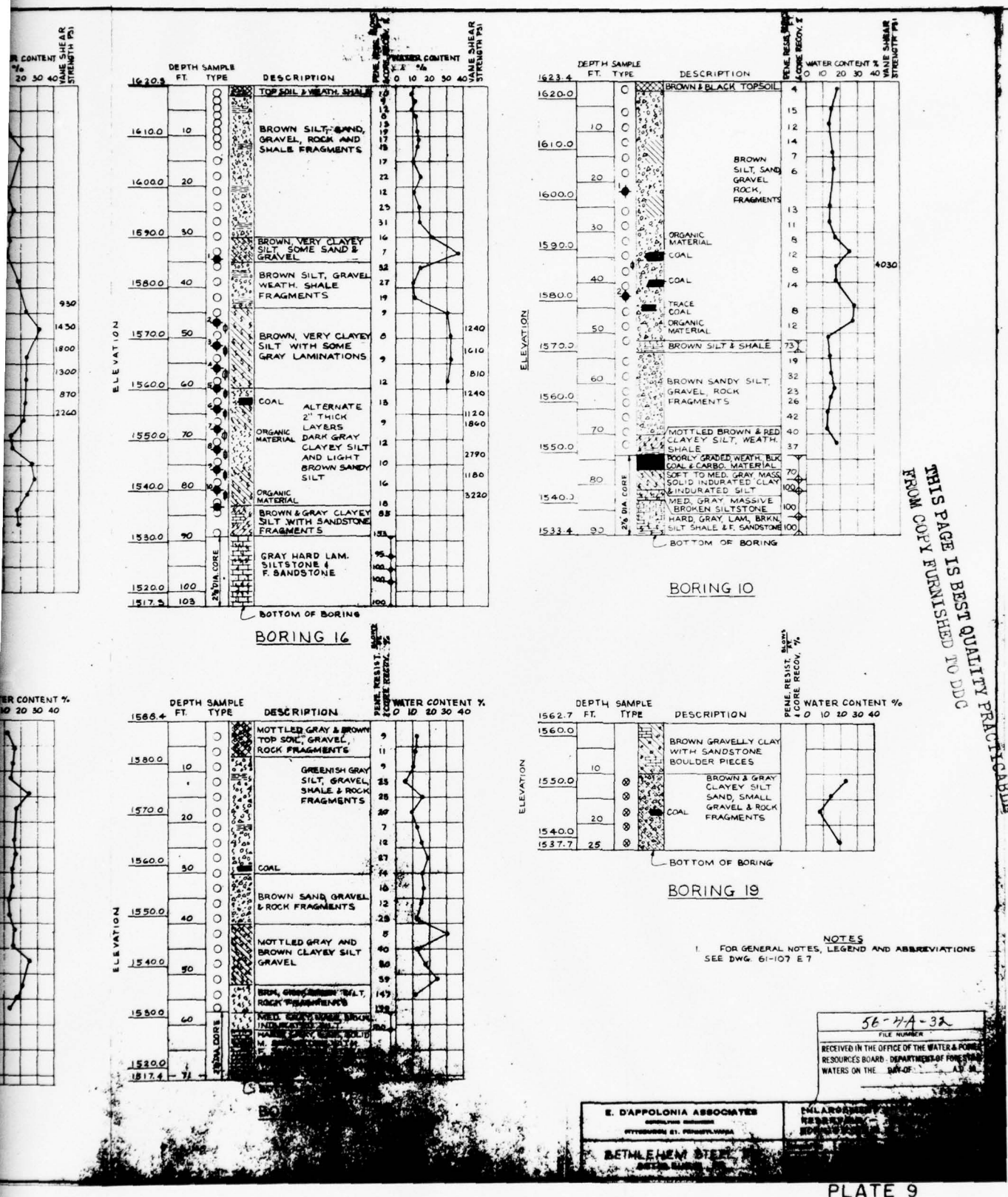


BORING 7



BORING 11

REFERENCE DRAWINGS



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NOTES

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG. 61-107 E 7

56-44-32
FILE NUMBER

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTRY AND WATERS ON THE DAY OF A.D. 19

E. D'APPOLONIA ASSOCIATES
PITTSBURGH 21, PENNSYLVANIA

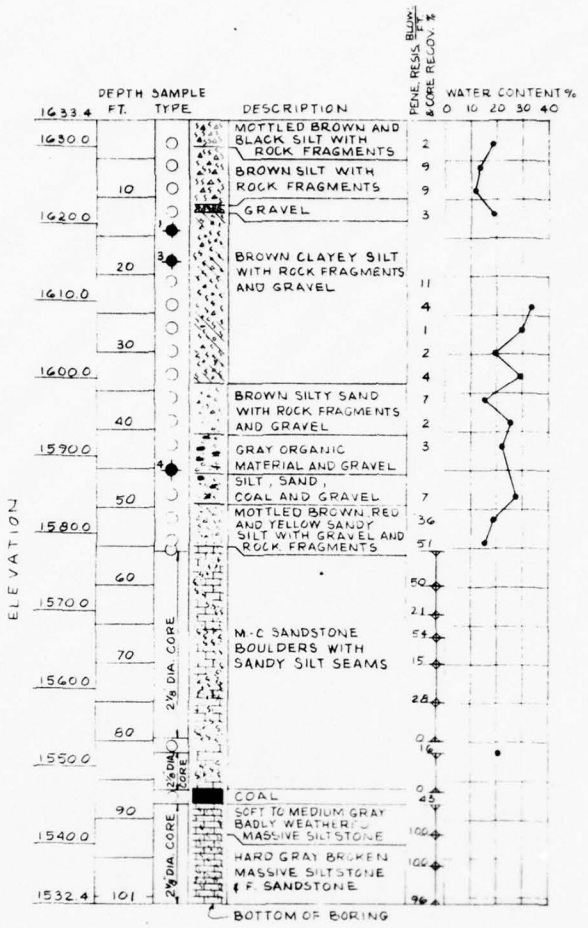
BETHLEHEM STEEL

PLATE 9

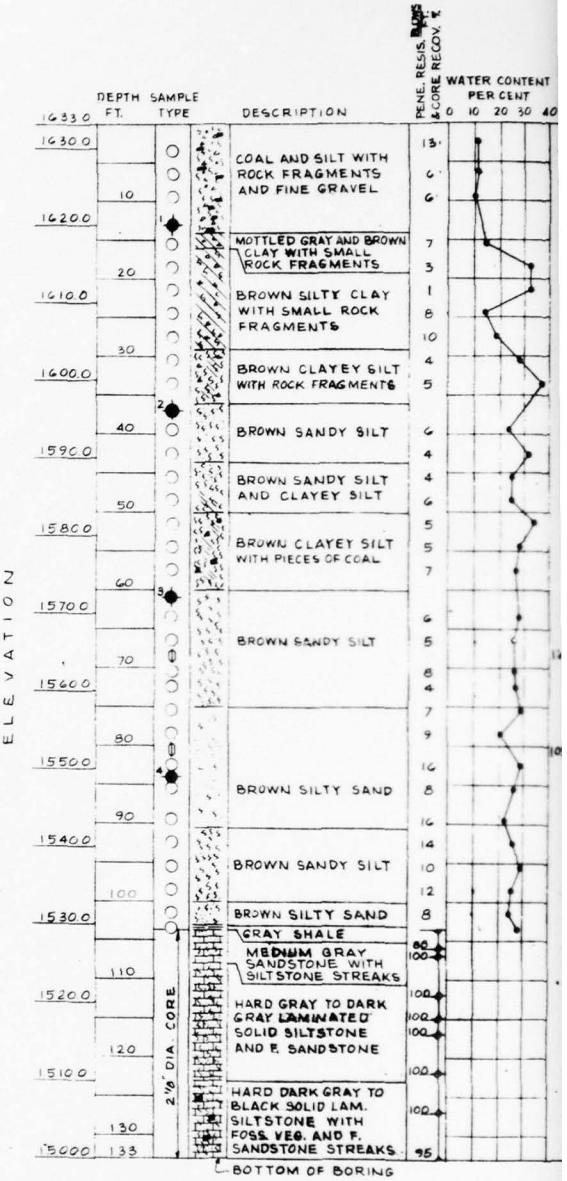
D'APPOLONIA

2

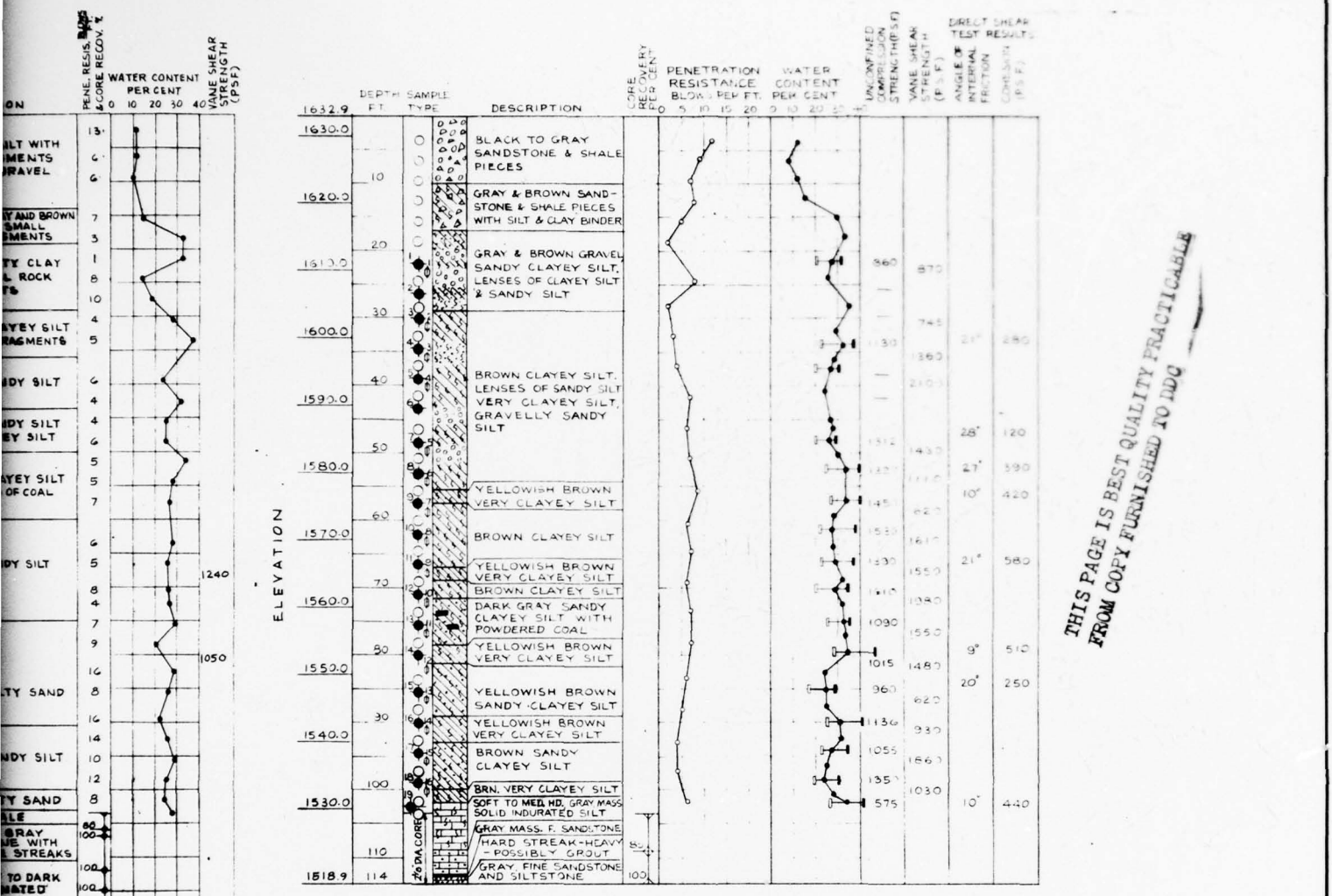
DRAWN BY	G. J. G.	CHECKED BY	BE	DRAWING NUMBER	4-B70
	6-22-78	APPROVED BY	[illegible]		78 75.28



BORING 9



BORING 13



BORING 17

NOTES

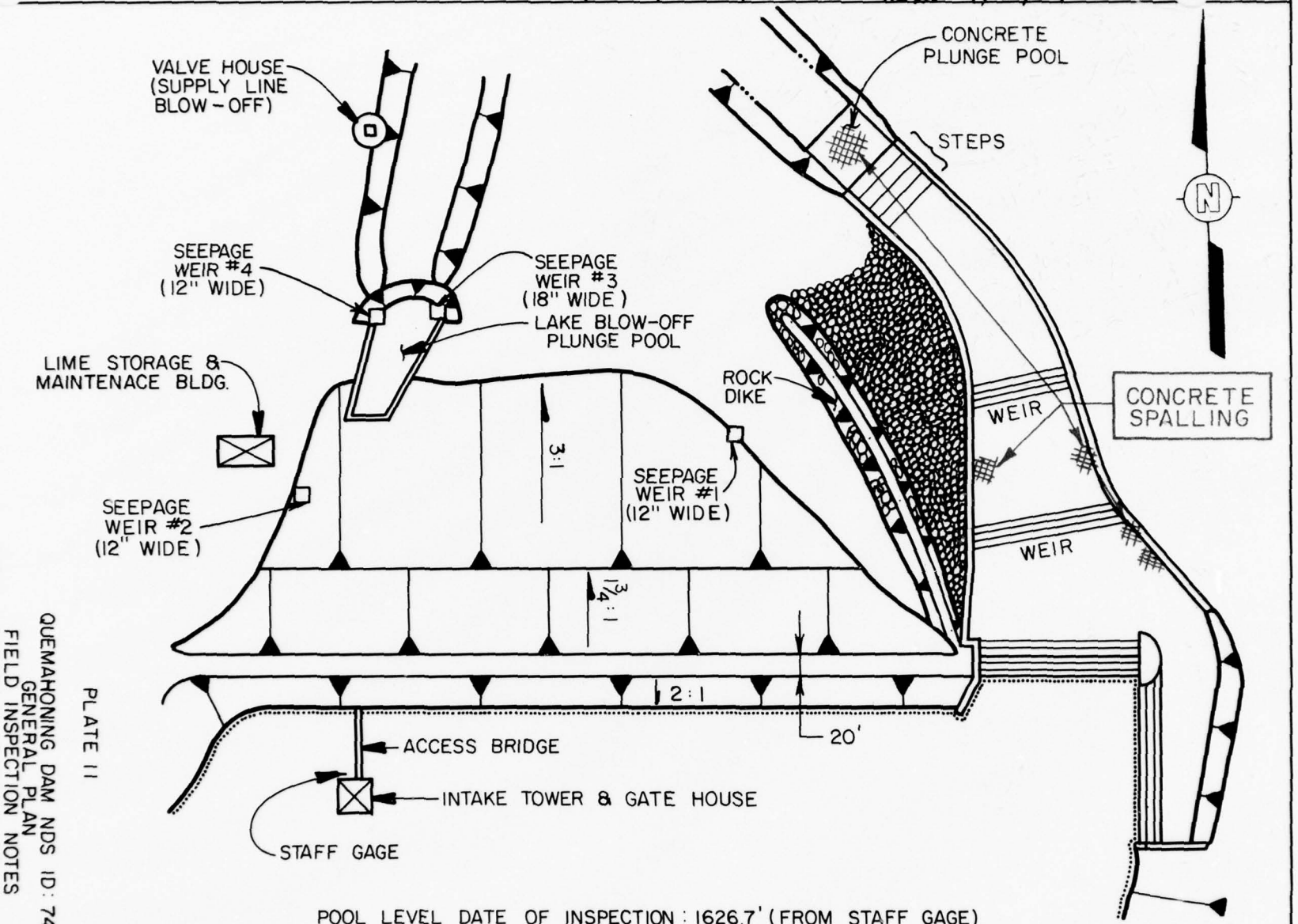
1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG. 61-107 E-7

E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF QUEMAHONING RESERVOIR - BORING LOGS BORINGS 9, 13, 17 SHEET 2			
BETHLEHEM STEEL CO. BETHLEHEM, PA.	DRAWN BY	SL	4-7-61	SCALE: 1"=10'
	CHECKED BY	DGH	5-2-61	DRAWING NO.
	APPROVED BY	[illegible]	7-12-61	61-107

PLATE 10

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	BE	7-5-78	DRAWING NUMBER 78- 1-A13
	6-20-78	APPROVED BY		7.5.78	



POOL LEVEL DATE OF INSPECTION : 1626.7' (FROM STAFF GAGE)

PLATE 11

QUEMAHONING DAM NDS ID: 740
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE : JUNE 9 , 1978

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM QUEMAHONING DAM COUNTY SOMERSET STATE PENNSYLVANIA ID# NDI:710 DER:56-4

TYPE OF DAM EARTH FILL HAZARD CATEGORY HIGH.

DATE(S) INSPECTION JUNE 9, 1978 WEATHER RAINY TEMPERATURE 70's

POOL ELEVATION AT TIME OF INSPECTION 1627 M.S.L. TAILWATER AT TIME OF INSPECTION 1542± M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL
WAH-TAK CHAN

REVIEW INSPECTION BY: (JUNE 12, 1978)

ELIO D'APPOLONIA.
LARRY ANDERSEN
JAMES POELLOT.

BILGIN EREL. RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM RIDGE MAHONING M
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE FOUND.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE FOUND	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NONE FOUND	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	NO PERCEIVABLE MISALIGNMENT	
RIPRAP FAILURES	NONE.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO SIGNS OF DISTRESS.	
ANY NOTICEABLE SEEPAGE	NO UNCONTROLLED SEEPAGE. THERE ARE FOUR WEIRS AT THE SITE FOR MEASURING SEEPAGE THROUGH THE DAM.	SEEPAGE FLOWS ARE DAILY RECORDED BY THE DAM TENDER
STAFF GAGE AND RECORDER	STAFF GAGE IS LOCATED ON INTAKE TOWER. DAILY READINGS ARE TAKEN BY THE DAM TENDER.	
DRAINS	NONE	

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	EARTHFILL 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 QUEMAHONING DAM
ID# NDI:740 DER:56-4

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 QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OUTLET CONDUIT IS A 20 FT HIGH 30 FT WIDE TUNNEL. THE WALLS AND THE ROOF WAS WET, NUMEROUS MINOR CRACKS. TOTAL FLOW SEEPAGE FROM THE TUNNEL ABOUT 5 GPM.	
INTAKE STRUCTURE	CONCRETE INTAKE TOWER. NO SIGNS OF DISTRESS ON VISIBLE PORTIONS.	
OUTLET STRUCTURE	CONCRETE PLUNGE POOL. GOOD CONDITION.	
OUTLET CHANNEL	TRAPEZOIDAL EARTH CHANNEL (BANKS RIPRAPPED)	
EMERGENCY GATE	A SLUICE GATE DISCHARGING INTO DIVERSION TUNNEL. OPERATION NOT OBSERVED. HOWEVER OPERATING EQUIPMENT APPEARS TO BE ADEQUATELY MAINTAINED.	LAKE CAN ALSO BE DRAINED THROUGH SERVICE LINE BLOW-OFF. THE VALVE OPERATED AND OBSERVED TO BE FUNCTIONAL

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

NAME OF DAM QUEMAHONING DAM
ID# NDI:720 DER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	GOOD CONDITION.	
APPROACH CHANNEL	LAKE	
DISCHARGE CHANNEL	CONCRETE SPALLING AT VARIOUS LOCATIONS.	
BRIDGE AND PIERS	NONE	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

NAME OF DAM QUEMAHONING AM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	(NO GATED SPILLWAY) N/A	
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 QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE FOUND	
OBSERVATION WELLS	NONE FOUND.	
WEIRS	THERE ARE FOUR WEIRS TO MONITOR SEEPAGE.	
PIEZOMETERS	1961 DRAWINGS SHOW 10 PIEZOMETERS WERE INSTALLED. THREE WERE LOCATED AT THE SITE. DAM TENDER REPORTED THAT THEY ARE NOT BEING MONITORED.	
OTHER	NONE	

VISUAL INSPECTION
PHASE I
RESERVOIR

NAME OF DAM QUEMAHONING DAM
ID# NDI:740 DER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	NO SIGNS OF UNUSUAL EROSION SLOPES GENTLE.	
SEDIMENTATION	UNKOWN.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

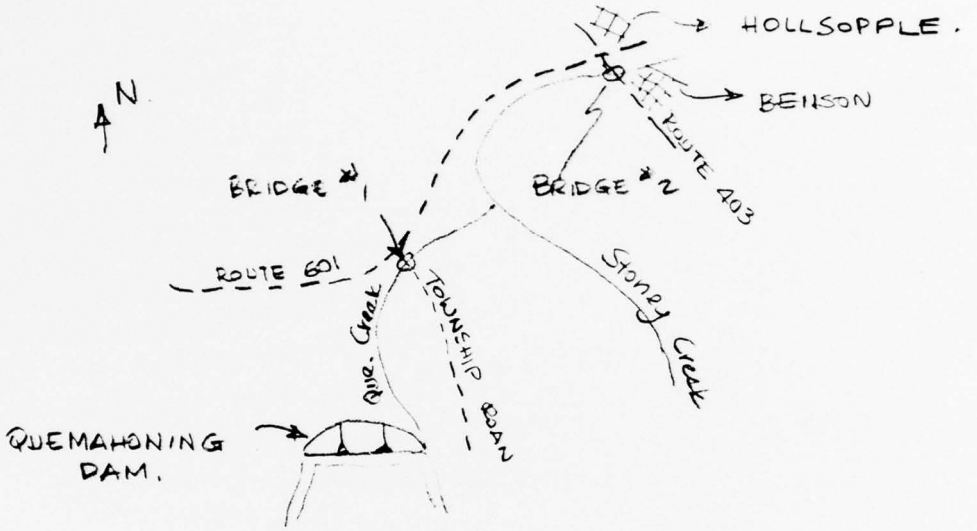
NAME OF DAM QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	NO SIGNFICANT OBSTRUCTIONS,	
SLOPES		
APPROXIMATE NUMBER OF HOMES AND POPULATION	TOWNS OF HOLLSOPPLE AND BENSON. OVER 100 HOMES IN POTENTIAL FLOOD PLAIN IN THE EVEN OF DAM FAILURE POPULATION: ~500	

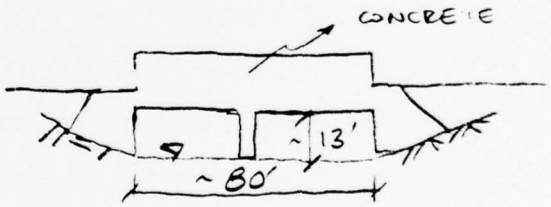
D'APPOLONIA
CONSULTING ENGINEERS, INC.

By E Date 6-8-78 Subject QUEMAHONING DAM NDI: 745 Sheet No. 1 of 1
Chkd. By WTC Date 6-8-78 FIELD INSPECTION SKETCH Proj. No. 73-114-07

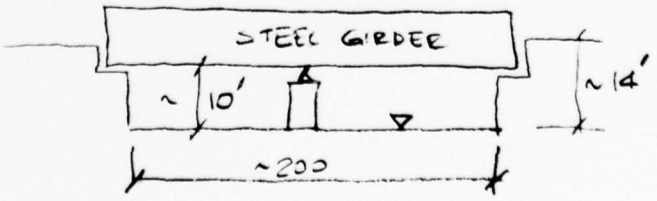
STREAM CROSS-SECTION & BRIDGE LOCATIONS



BRIDGE # 1



BRIDGE # 2 (OVER STONEY CREEK)



APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM QUEMAHONING DAM
ID# NDI : 740 DER: 56-4

ITEM	REMARKS
AS-BUILT DRAWINGS	AVAILABLE IN STATE FILES.
REGIONAL VICINITY MAP	SEE PLATE 2
CONSTRUCTION HISTORY	DESIGNED & BUILT BY THE ENGINEERS OF MANUFACTURERS WATER COMPANY, DURING 1909 & 1912. DAM WAS ENLARGED IN 1961.
TYPICAL SECTIONS OF DAM	HYDRAULIC FILL DAM ∴ GRADUALLY ZONED. FINEST MATERIAL AT THE CORE
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	NOT AVAILABLE

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM QUEMAHONING DAM
ID# NDI: 740 DER: 56-4

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	RECORDED SINCE 1915.
DESIGN REPORTS	NO ORIGINAL DESIGN REPORT IS AVAILABLE. 1961 DESIGN REPORT WAS PREPARED BY D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS.
GEOLOGY REPORTS	SAME AS ABOVE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	AVAILABLE
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	AVAILABLE

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM QUEMAHONING DAM
ID# NDI:700 DER:56-4

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED AFTER 1961.
BORROW SOURCES	RIGHT & LEFT ABUTMENTS (SHOWN IN CONSTRUCTION PHOTOGRAPHS)
MONITORING SYSTEMS	NONE
MODIFICATIONS	IN 1961 THE DAM AND THE SPILLWAY WAS ENLARGED.
HIGH POOL RECORDS	RECORDED SINCE 1915. 1936 FLOOD STAGE 5.4 FT OVER 250 FT WIDE SPILLWAY.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM MUSKINGUM DAM
ID# NDI: 740 DER: 56-4

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	STATE FILES INCLUDE NUMEROUS INPECTION REPORTS. MOST RECENT INSPECTION WAS CONDUCTED IN 1976.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
MAINTENANCE OPERATION RECORDS	RECORDS ARE MAINTAINED BY THE DAM TENDER.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATES
OPERATING EQUIPMENT PLANS AND DETAILS	GATE OPERATING PLANS ARE POSTED AT THE INTAKE TOWER.

NAME OF DAM QUEMAHONING DAM

ID# NDI: 740 DER: 56-4

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOOD & PASTURE LANDS 94 SQ. MILES.

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 37,000 AC-FT @ EL 1627

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 52,700 AC-FT @EL 1642

ELEVATION; MAXIMUM DESIGN POOL: EL

ELEVATION; TOP DAM: 1642 FT (USGS DATUM)

CREST:

a. Elevation 1642 FT

b. Type EARTH

c. Width 20 FT

d. Length 955 FT

e. Location Spillover NO NOTICABLE LOW SECTION

f. Number and Type of Gates NONE

OUTLET WORKS:

a. Type DIVERSION TUNNEL & SUPPLY LINE BLOW-OFF

b. Location NEAR LEFT ABUTMENT

c. Entrance Inverts UNKNOWN ESTIMATED 1550

d. Exit Inverts UNKNOWN ESTIMATED 1540

e. Emergency Draindown Facilities SAME AS OUTLET WORKS.

HYDROMETEOROLOGICAL GAGES:

a. Type RAIN & STAFF GAGE

b. Location DAM SITE

c. Records AVAILABLE SINCE 1915

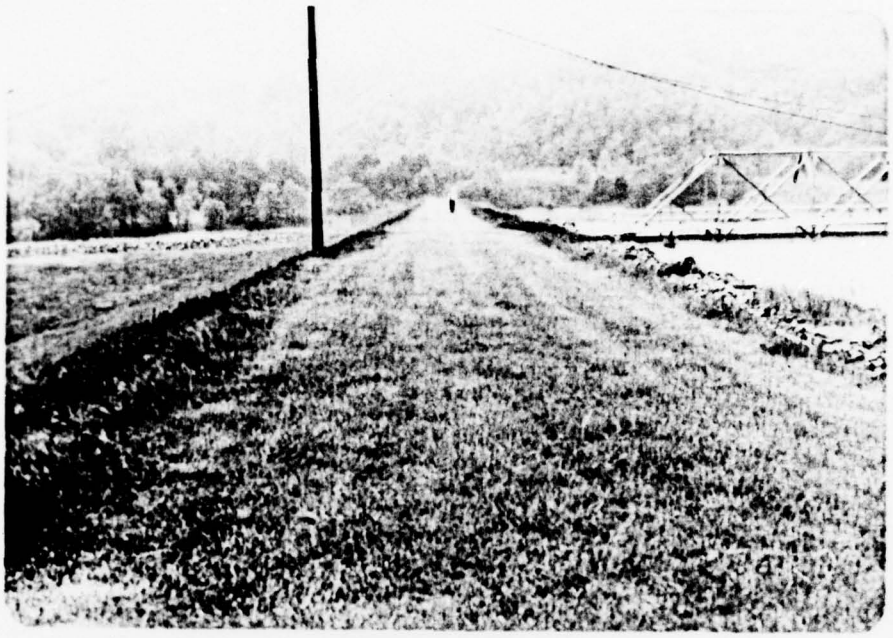
MAXIMUM NONDAMAGING DISCHARGE: SPILLWAY CAPACITY ≈ 90,000 CFS.

APPENDIX C

PHOTOGRAPHS

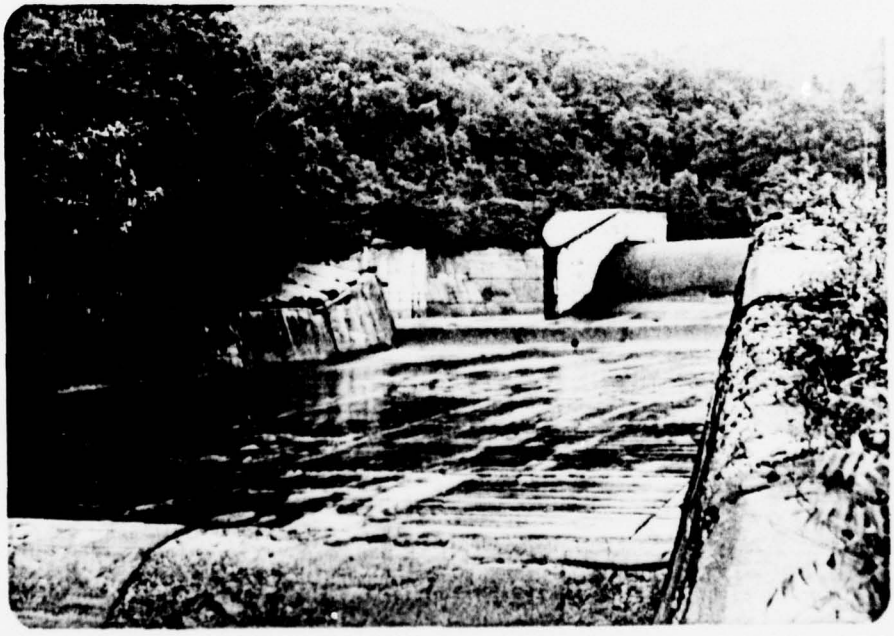
LIST OF PHOTOGRAPHS
QUEMAHONING DAM
JUNE 9, 1978

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking east).
2	Spillway discharge channel.
3	Primary spillway crest.
4	Side channel spillway crest.
5	Intake tower.
6	Valve controls in intake tower.
7	Toe area (lake "blow-off" plunge pool; supply line "blow-off" valve house in background).
8	Supply line "blow-off" operating.
9	Supply line "blow-off" valve.
10	Spalling in spillway discharge channel.
11	Seepage weir on left abutment.
12	Seepage weir in lake "blow-off" plunge pool.
13	Bridge at Benson (looking east).
14	Bridge at Benson (looking west).



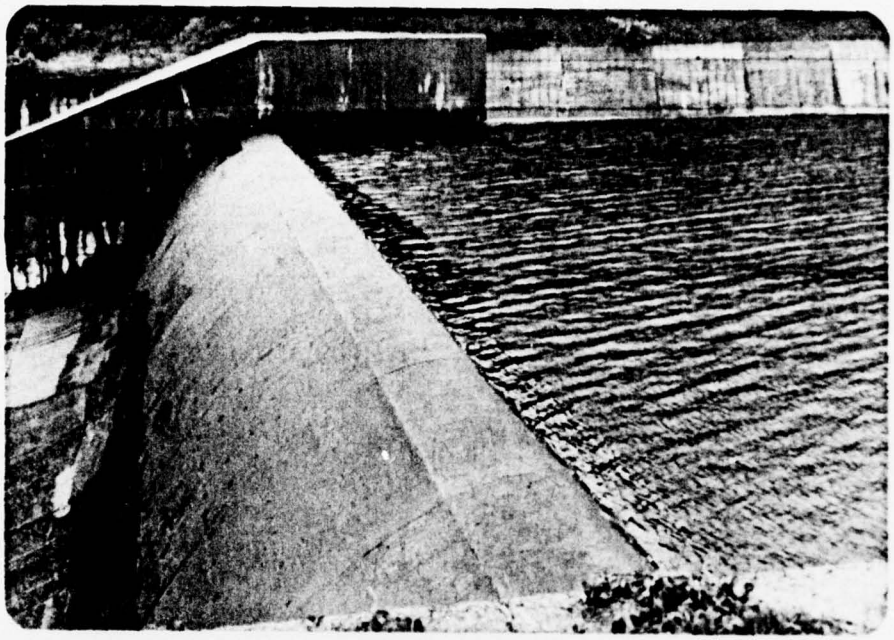
Photograph No. 1

Crest (looking east).



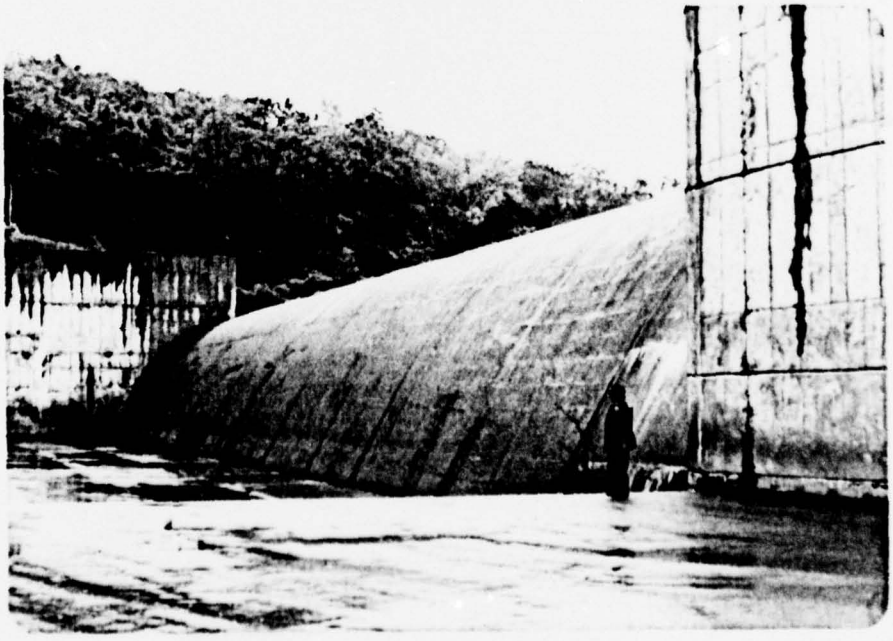
Photograph No. 2

Spillway discharge channel.



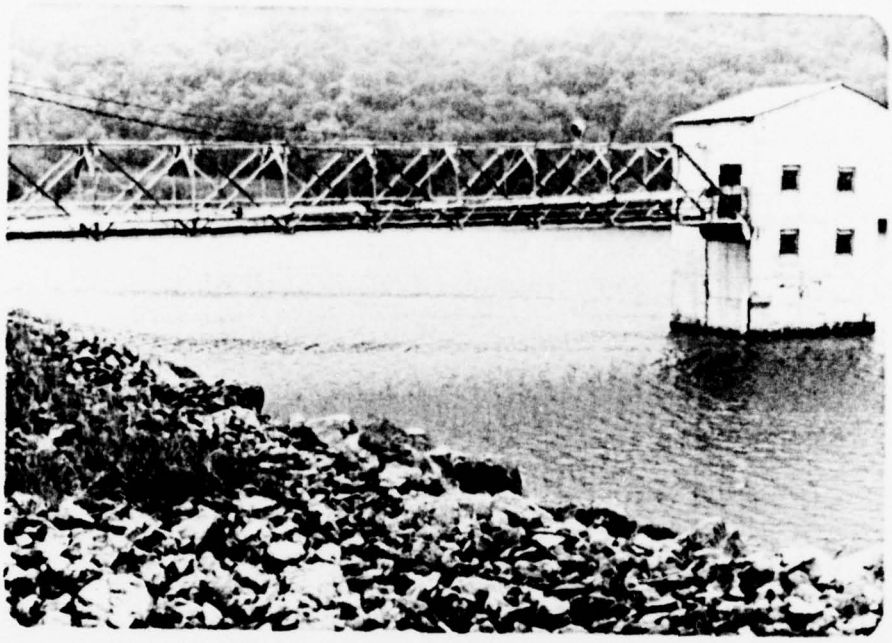
Photograph No. 3

Primary spillway crest.



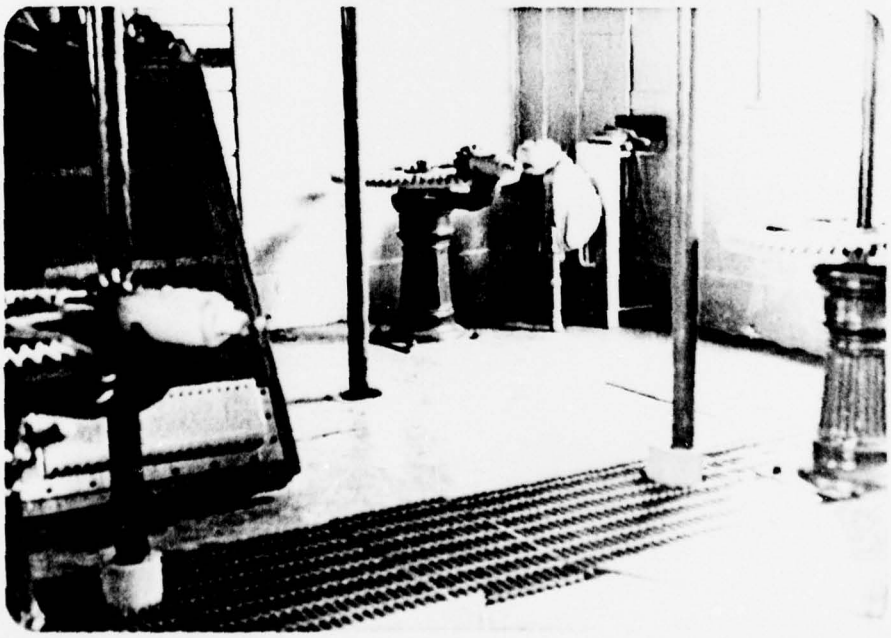
Photograph No. 4

Side channel spillway crest.



Photograph No. 5

Intake tower.

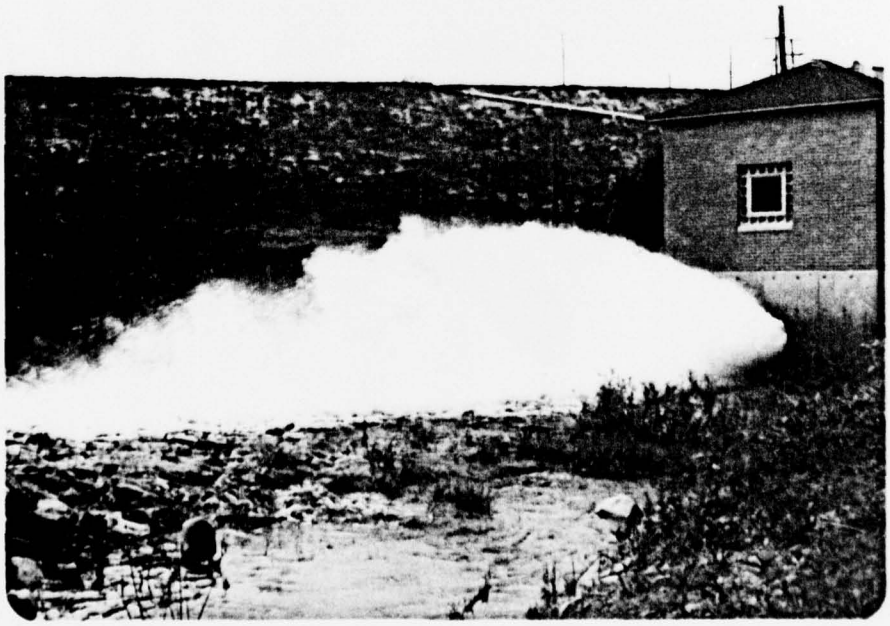


Photograph No. 6

Valve controls in intake tower.

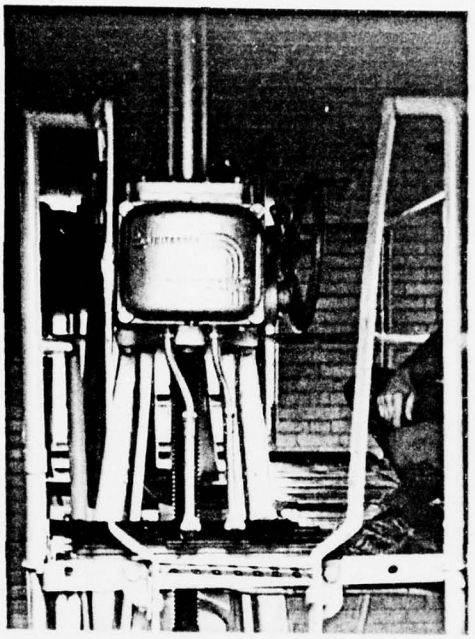
Photograph No. 7

Toe area (lake "blow-off" plunge pool; supply line "blow-off" valve house in background).



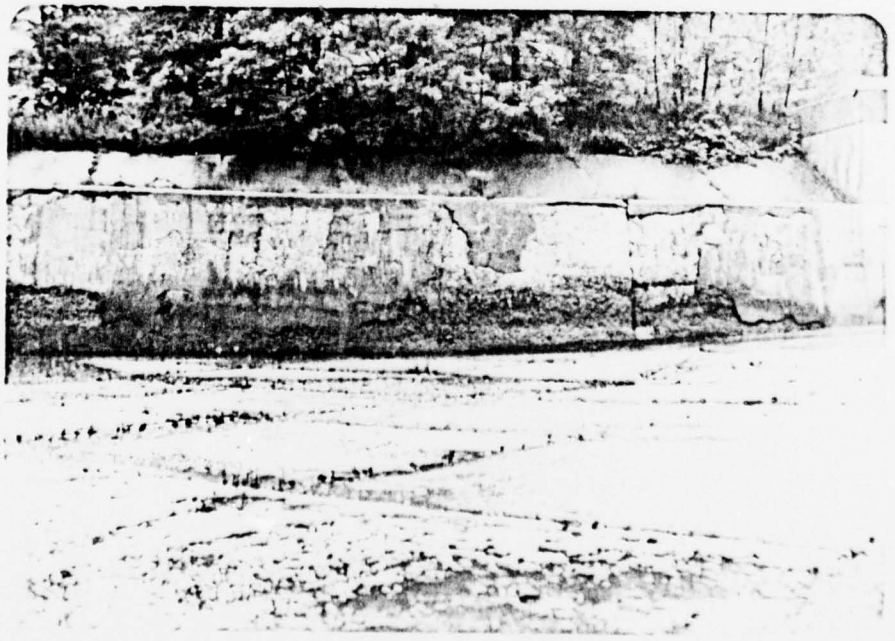
Photograph No. 8

Supply line "blow-off" operating.



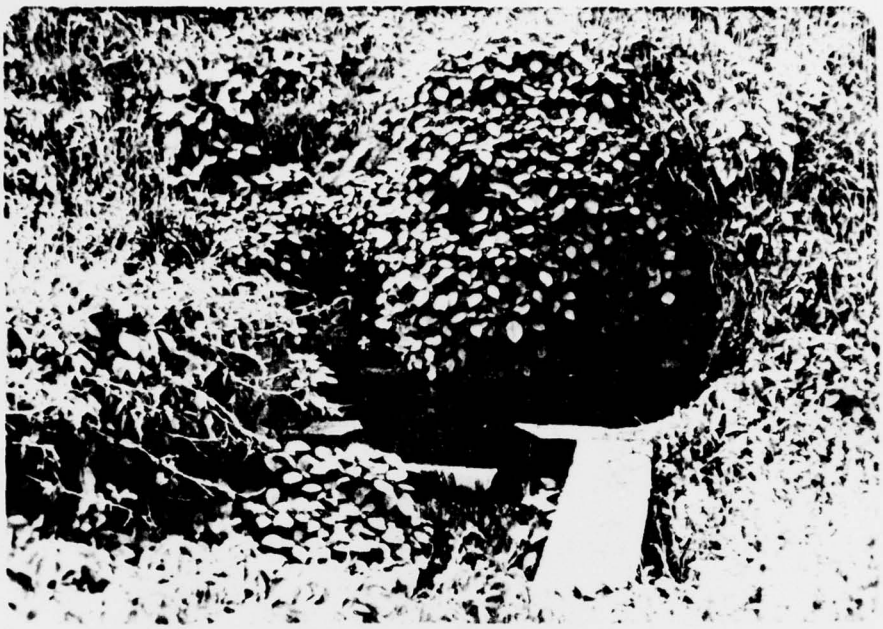
Photograph No. 9

Supply line "blow-off" valve.



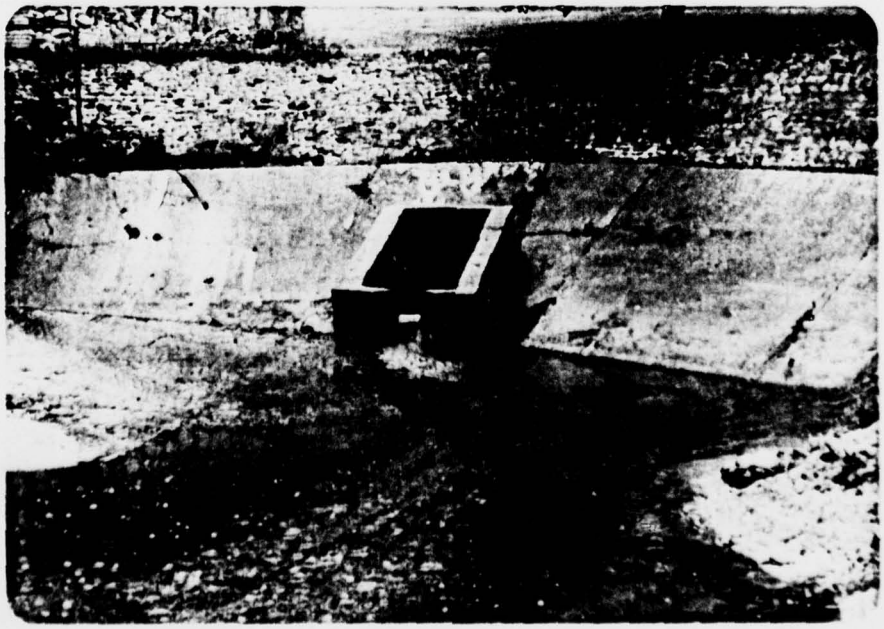
Photograph No. 10

Spalling in spillway discharge channel.



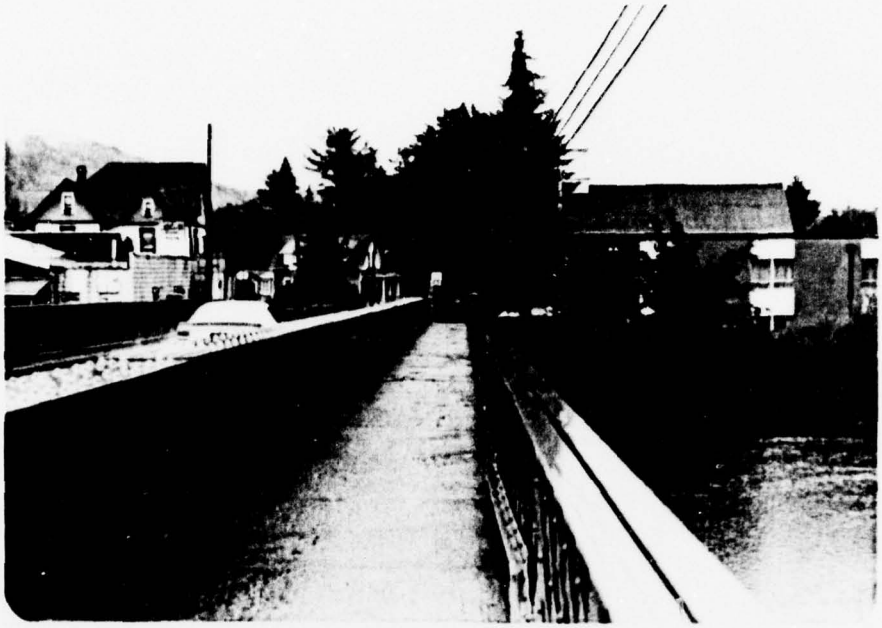
Photograph No. 11

Seepage weir on left abutment.



Photograph No. 12

Seepage weir in lake "blow-off" plunge pool.



Photograph No. 13

Bridge at Benson (looking east).

Photograph No. 14

Bridge at Benson (looking west).

APPENDIX D
CALCULATIONS

D'APPOLONIA
CONSULTING ENGINEERS, INC

By [illegible] Date 6/4/76 Subject QUEMAHONING RESERVOIR Sheet No. 1 of 2
Chkd. By MC Date 6/15/76 HYDROLOGY & HYDRAULICS Proj. No. 73-14-27

DAM: QUEMAHONING DAM, NDS ID #
QUEMAHONING AND CONEMAUGH TOWNSHIPS, SOMERSET CO.,

WATERSHED AREA, A_1 = 94 SQ.MI

INFLOW HYDROGRAPH, BASIN OHIO RIVER BASIN, QUEMAHONING CREEK OF STONY CREEK.

TOTAL TIME, T, = 86 HOURS

PMF PEAK FLOW, q = 680 cfs/SQ MILE

PMF PEAK FLOW, $Q = qA = 680 \times 94 =$ **63920 cfs**

VOLUME OF INFLOW HYDROGRAPH

$V_i = \frac{1}{2} T \times 3600 \times Q \times \frac{1}{43560}$ AC-FT

$= \frac{1}{2}(86)(3600)(63920)\left(\frac{1}{43560}\right)$

= 227,154 AC-FT EQUAL TO 45.3" RUNOFF

∴ REDUCED TO 26 IN RUNOFF in 49.3 hour

Spillway capacity $V_i = \frac{26}{12} \times 94 \times 640 = 130347$ ac-ft

Say 130400 ac-ft

TYPE: OGEE SPILLWAY; L-SHAPED W/SIDE DELIVERY CHANNEL

LENGTH 210 (NEW) + 185 (EXISTING) = 395 FT

DESIGN DISCHARGE RATE: 23600 cfs (NEW) + 21400 cfs (EXIST)

= 45000 cfs

Design max. level 1636.4 ΔH = 1636.4 − 1627

= 9.4 FT

discharge coef = $C = \frac{45000}{(395)(9.4)^{1.5}} = 3.35$ OK

MAX DISCHARGE = $(395)(395)(15)^{1.5} \cong 91000$ cfs

FOR PMF DISCHARGE, Head Reqd h, (WITHOUT CONSIDER SURCHARGE)

$h = \left[\frac{63920}{(395)(395)}\right]^{\frac{1}{1.5}} = 11.88 \text{ FT} < 15 \text{ FT}$

OK.

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By TC Date 6-14 78 Subject QUEMAHONING RESERVOIR Sheet No. 2 of 2
Chkd. By MC Date 6/15/78 HYDROLOGY & HYDRAULICS Proj. No. 73-14-07

RESERVOIR STORAGE CAPACITY
BY PERIMETER & USGS MAP

EL	AREA IN²	AREA AC
1625	9.2	845
1640	13.8	1267

$\Delta V = \frac{15}{3}(845 + 1267 + \sqrt{1267 \times 845})$

$= 15734$ ac-ft / ft of 15'

ASSUME UNIFORM BETWEEN ELEVATIONS

$\Delta V = \frac{15734}{15} = 1049$ ac-ft / ft

FOR PMF MAX WATER LEVEL (CONSIDER STORAGE)

$$\frac{\text{MAX SPILLWAY CAPACITY}}{\text{PEAK INFLOW}} + \frac{\text{STORAGE CAPACITY}}{\text{INFLOW VOLUME}} = 1$$

$$\frac{(3.95)(395)(h)^{1.5}}{63920} + \frac{1049 \times h}{130400} = 1$$

SOLVE FOR h $h = 11.16$ FT Say $h = 11.2$

OR MAX WATER LEVEL EL 1638.2

IT HAS A WAVE FREEBOARD OF 3.8 FT (DAM CREST EL 1642)

SPILLWAY DISCHARGE RATE @ PMF

$Q = (3.95)(395)(11.16)^{1.5} = 58185$ cfs

$V_c = \frac{58185}{(395)(11.16)} \approx 13.2$ fps @ OGEE SECTION

APPENDIX E

REGIONAL GEOLOGY

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REGIONAL GEOLOGY

The Quemahoning Dam and reservoir lie in the Boswell Anticline, a north-northeast trending structure. The rock strata underlying the dam and reservoir consist of the Allegheny Group (Pennsylvanian Age). The rock consists of gray sandstones and shales with at least seven minable coal seams, many of which are being strip mined in the watershed of the dam. The dam and reservoir may be underlain by minable coal seams; however, there is no evidence that these seams have been mined. The underlying Pottsville Group, which is composed primarily of massive sandstones, is exposed just west of the reservoir along Quemahoning Creek. The rock type and steepness in the slopes surrounding the reservoir appear to preclude massive slides from occurring.