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NATIONAL DAM INSPECTION PROGRAM. WILMORE DAM (NDI ID NUMBER 435--ETC(U)
JUL 78 DACW31-78-C-0049
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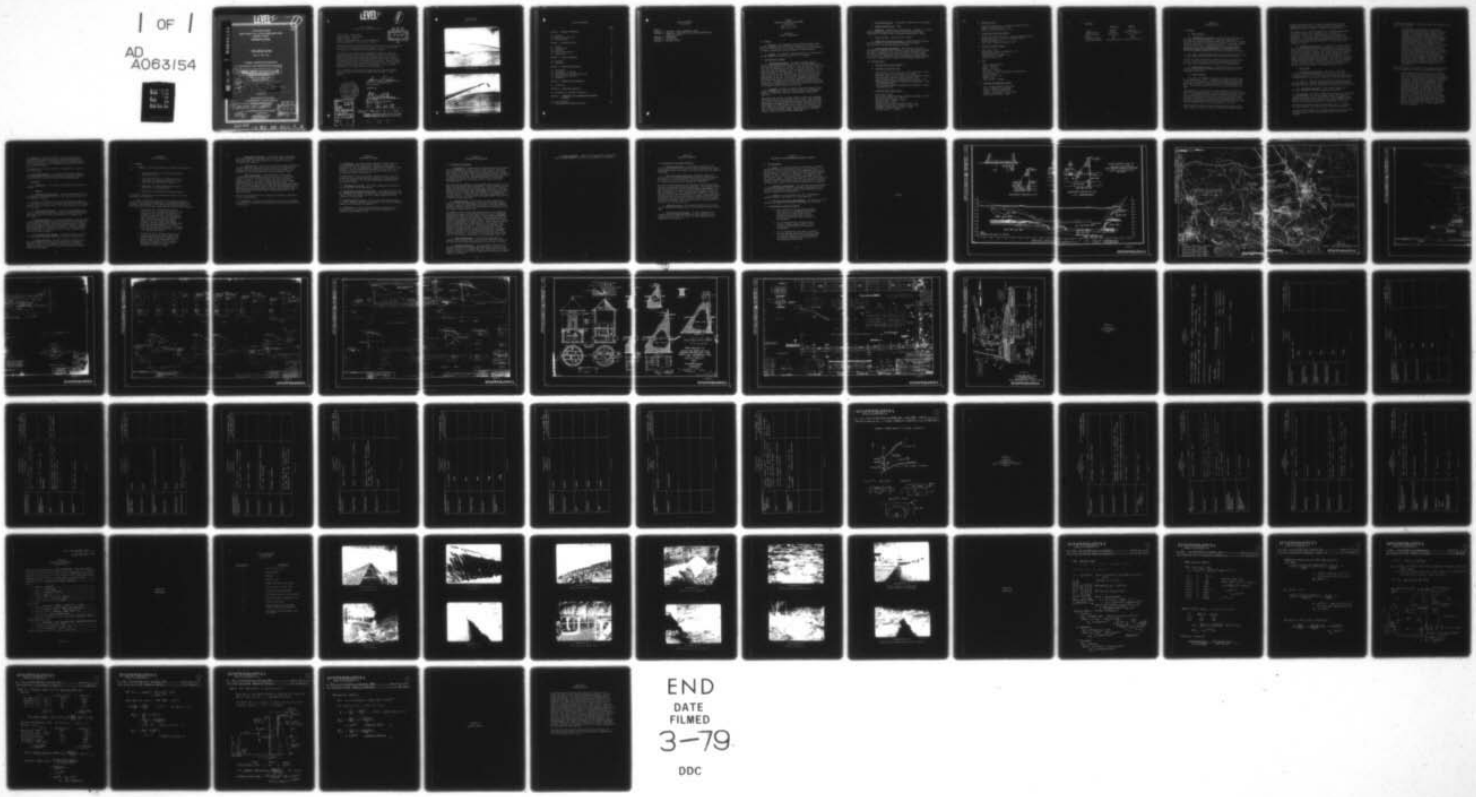

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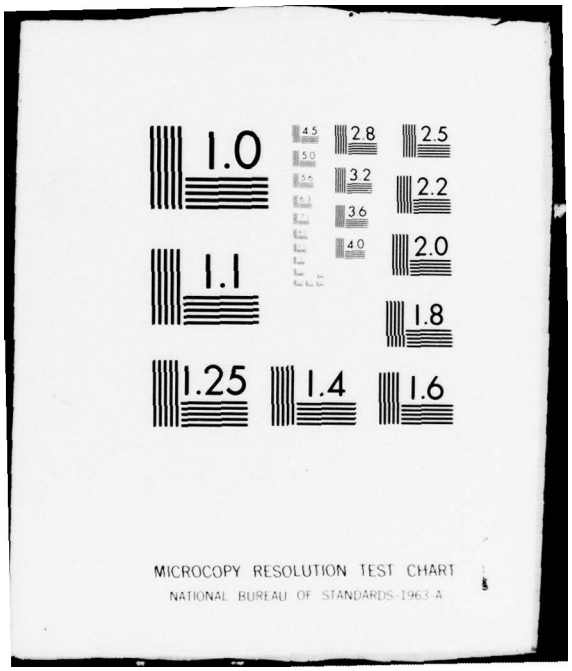
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LEVEL II

3 OHIO RIVER BASIN
NORTH BRANCH OF LITTLE CONEMAUGH RIVER,
CAMBRIA COUNTY
PENNSYLVANIA

2 WILMORE DAM

NDI I.D. NO: 435

4 PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

DISTRIBUTION STATEMENT A
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(6) National Dam Inspection Program. Wilmore Dam (NDI ID Number 435), Ohio River Basin, North Branch of Little Conemaugh River, Cambria County, Pennsylvania. Phase I Inspection Report.

PREPARED FOR

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

(15) DACW31-78-C-0049

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

(12) 74p.

(11) JULY 1978

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LEVEL II

1

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Wilmore Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Cambria
STREAM: North Branch of Little Conemaugh River
DATE OF INSPECTION: June 7 and 12, 1978

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 Wilmore Dam is assessed to be good.

The spillway does not have the recommended capacity to pass the probable maximum flood without overtopping. However, the dam is a masonry structure, and overtopping by the probable maximum flood would not significantly affect the stability of the dam. Therefore, the spillway capacity is considered to be adequate. However, during unusually heavy runoff, when overtopping might occur, an around-the-clock surveillance plan should be implemented to detect possible problems, such as rapid erosion of the abutments.

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

Lawrence D. Andersen

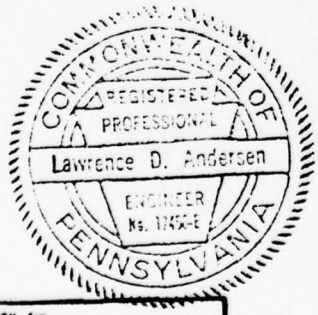
Lawrence D. Andersen, P.E.
Vice President

APPROVED BY:

G. K. Withers

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

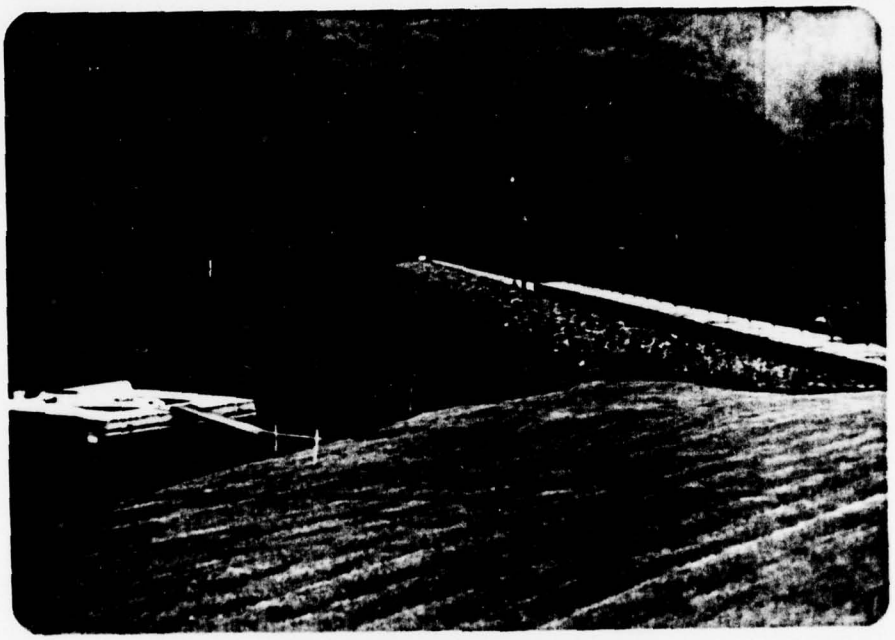
DATE: 31 Jul 78



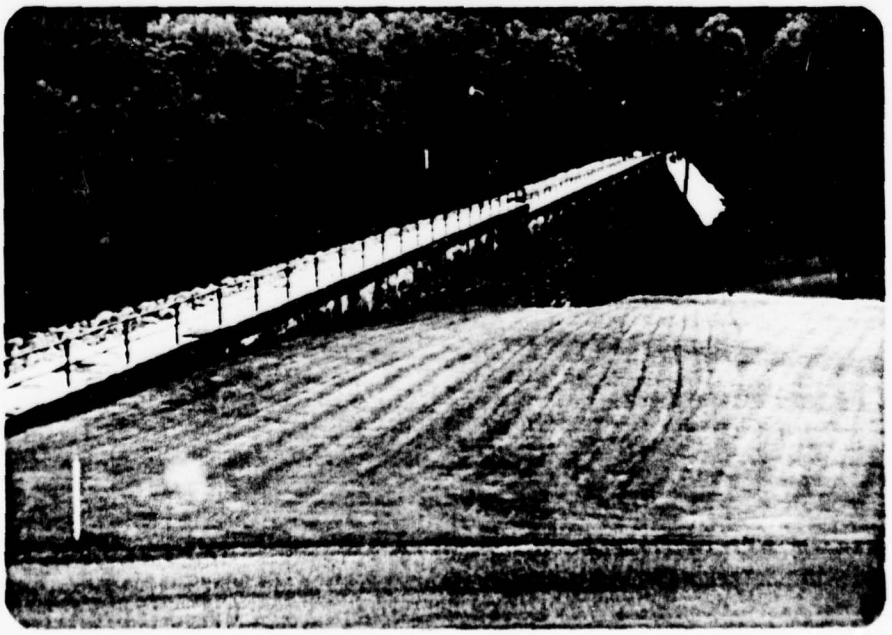
Contract DACW31-78-C-0044

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

WILMORE DAM
JUNE 7, 1978



Upstream Face



Downstream Face

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(Continued)

PHASE I
NATIONAL DAM INSPECTION PROGRAM
WILMORE DAM
NDI I.D. NO. 435
DER I.D. NO. 11-4

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 is a masonry-gravity structure approximately 800 feet long with a maximum height of 40 feet from the downstream toe (Plate 1). The low sections along the crest are the spillways for the dam. A 150-foot section of the crest near the left abutment, four feet below the dam crest, is the primary spillway of the impoundment. A 450-foot section of the crest which lies two feet below the dam crest is the second overflow section of the dam. The flow over the primary spillway discharges down the face of the dam into a riprapped plunge pool. The outlet works consist of a 36-inch blow-off pipe and 36-inch supply line. Discharge through these pipes is controlled by valves located at the intake tower. The 36-inch blow-off pipe constitutes the emergency drawdown facility for the dam.

b. Location. The dam is located on the North Branch of the Little Conemaugh River about two miles upstream of the Borough of Wilmore, in Summerhill Township, Cambria County, Pennsylvania (Plate 2).

Downstream from the dam, the North Branch of the Little Conemaugh River flows for two miles through a valley 1000 to 1500 feet wide and joins the Little Conemaugh River south of the town of Wilmore. Approximately 50 homes in the town of Wilmore would be within the flood plain of the North Branch in the event of a failure of the dam. Therefore, a failure of the dam could result in substantial loss of life and property damage. Additional loss of life and property might also result further downstream.

c. Size Classification. Intermediate (based on 40-foot height).

d. Hazard Classification. High.

e. Ownership. 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. Wilmore Dam was designed and constructed by the American Pipe Manufacturing Company. Construction of the dam was completed in 1908.

h. Normal Operating Procedure. The reservoir is normally maintained at spillway level, Elevation 1619.9 (USGS Datum), leaving four feet of freeboard to the top of the dam at Elevation 1623.9. All inflow occurring when the reservoir level is at the spillway crest or above is discharged over the uncontrolled overflow sections of the dam. Supply water is taken from the 36-inch supply line.

1.3 Pertinent Data

a. Drainage Areas (square miles) - 25

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - 2800 (estimated) in 1936
Warm water outlet at pool elevation - Unknown
Diversion tunnel low pool outlet at pool elevation - Unknown
Gated spillway capacity at pool elevation - N/A
Gated spillway capacity at maximum pool elevation - N/A
Ungated spillway capacity at maximum pool elevation - 7700 at Elevation 1623.9
Total spillway capacity at maximum pool elevation - 7700 at Elevation 1623.9

c. Elevation (USGS Datum) (feet)

Top of dam - 1623.9
Maximum pool-design surcharge (emergency spillway) - 1621.9
Full flood control pond - 1623.9
Recreation pool (normal) - 1619.9
Spillway crest - 1619.9
Upstream portal invert diversion tunnel - N/A
Downstream portal invert diversion tunnel - N/A
Streambed at center line of dam - ~ 1576
Maximum tailwater - Unknown

d. Reservoir (feet)

Length of maximum pool - 13,500± at Elevation 1623.9
Length of recreation pool - N/A
Length of flood control pool - N/A

e. Storage (acre-feet)(estimated)

Recreation pool (normal pool) - 3150± at Elevation 1619.9
Flood control pool - 3570± at Elevation 1621.9
Design surcharge - N/A
Top of dam - 3990± at Elevation 1623.9

f. Reservoir Surface (acres)

Top of dam - 182
Maximum pool (secondary spillway) - 172
Flood control pool - 182
Recreation pool (normal) - 162
Spillway crest - 162

g. Dam

Type - Masonry gravity
Length - 850 feet
Height - 48 feet
Top width - 6.5 feet
Side slopes - 2H:1V (Upstream); Transition zone
Zoning - Unknown
Impervious core - Yes
Cutoff - Yes
Grout curtain - Unknown

h. Diversion and Regulating Tunnel

Type - 36-inch-diameter steel pipe
Length - 200± feet (estimated)
Closure - Valve @ upstream end
Access - Foot bridge to intake tower
Regulating facilities - Valve

i. Spillway

	Emergency	Primary
Type	Masonry	Concrete
Length of Weir	450 feet	150' (2' deep) main
Crest Elevation	1621.9 feet	1619.9 feet
Gates	N/A	N/A
Upstream Channel	Lake	Lake
Downstream Channel	Riprapped Channel	Riprapped Plunge Pool

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. Review of the information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), showed that there are no original hydrologic and hydraulic design data available for the dam. However, a report prepared by E. D'Appolonia Associates, of Pittsburgh, Pennsylvania, entitled, Preliminary Report, Recommendations for Minimizing Leakage through Wilmore Dam, dated September 1960, states the discharge capacity of the overflow sections of the dam.

(2) Dam. Information available on the original design consists of design drawings and geologic cross section of the dam site.

In 1961, an earth buttress was constructed on the upstream side of the dam. This work was designed by E. D'Appolonia Associates, and construction information is available in PennDER's files.

(3) Appurtenant Structures. Available information includes original design drawings and 1961 modification drawing for the appurtenant structures.

(b) Design Features

(1) Dam. As designed, the dam is a "boulder concrete" wall faced with masonry. Plate 1 illustrates the typical cross section of the dam. It consists of an essentially vertical upstream face and a two horizontal to three vertical (2:3) sloping downstream face. The crest is capped with cut stones 6 feet long and 2 feet thick.

The foundation of the dam rests on rock identified as "fire clay rock" in the design drawings. To control seepage through the foundation, a cutoff wall was constructed at the heel of the dam. The cutoff wall extended five to ten feet into the "fire clay rock." The depth to the bottom of the cutoff wall varied between 35 feet below the original ground surface at the creek bed to 50 feet below original ground surface on the right abutment of the dam.

The structure has had a history of leakage from the time of the first filling. From 1912 to 1959, all inspection reports mention

seepage through the dam. In 1960, the dam was bought by the Manufacturers Water Company of Johnstown from the Summit Water Company and steps were taken to correct the seepage problem.

The seepage control scheme, designed by E. D'Appolonia Associates, included placing an earth embankment on the upstream side of the dam. Plates 3, 4, and 5 illustrate the details of the embankment. It included a sand filter against the masonry dam (drained by holes drilled through the dam), a clay core, a transition zone, and riprap erosion protection. This alteration was completed in 1961.

(2) Appurtenant Structures. The spillway of the dam consists of two low sections along the crest of the dam. The crest of the lowest 150-foot-long section is at Elevation 1619.9 and constitutes the primary spillway of the dam. The second 450-foot-long section is north of the primary spillway with a crest elevation of 1621.9 feet, two feet below the crest of the dam. The flow from the primary spillway discharges down the face of the dam to a riprapped plunge pool located within the streambed. Flow over the secondary spillway discharges into a channel at the toe of the dam and along the toe toward the stream at the left side of the valley. The details of the outlet works are included in Plates 6 and 7.

c. Design Data

(1) Hydrology and Hydraulics. The 1960 E. D'Appolonia Associates report states that the spillways of the dam have a discharge capacity of 240 cubic feet per second per square mile of watershed, for a total flow of 8500 cfs at pool Elevation 1623.9.

(2) Dam. No original design or stability analyses for the dam are available. However, the stability of the dam was analyzed in conjunction with the 1961 alterations and found to be satisfactory.

(3) Appurtenant Structures. Only design drawings were available for review. No other design data were found.

2.2 Construction. Available information concerning the construction of the dam includes an as-built drawing showing the sequence of concrete pours and a report dated July 29, 1912, prepared by the General Superintendent of the Summit Water Supply Company (owner of the dam at that time) describing the construction of the dam.

The dam was constructed under the direction of Mr. J. W. Ledoux, the chief engineer of the American Pipe Manufacturing Company.

A drawing in the PennDER files indicates that most of the concrete work was completed in one construction season, from April to December.

The 1912 superintendent's reports described the foundation construction as follows:

> "The geological sections show the formations upon which the dam is located. North of the main spillway, the downstream masonry slope does not continue to the bottom of the foundation, but terminates in a vertical wall which butts against the natural shale rock. On account of the stable character and depth of this shale rock, it was not considered necessary to continue the full masonry section. The first intention was to build the dam on the strata marked "fire clay rock." This was of satisfactory character to carry the weight, but on being tested by a series of holes, drilled about fifteen feet deep along the upstream face; and into which water was pumped under pressure; the rock did not prove entirely satisfactory for water tightness, and it was decided to sink the cut-off trench. The bottom of this cut-off trench was also drilled and tested in the same manner, and the material proved to be satisfactory."

In the same report, the causes of the seepage which developed after the completion of the dam is explained as follows:

> "The foundation was all inspected and passed upon by Mr. Ledoux and the writer before any concrete was laid. The construction work was done throughout in the most careful manner and received continuous inspection of materials and workmanship. After the dam was finished, a few temperature cracks developed, and these were pumped full of grout, under pressure, and the leakage through these practically stopped. Some seepage has developed within a few feet of the flow line; this is confined almost entirely to the north one-half of the dam. It is believed to be due to the fact that this section of the dam was laid in freezing weather and the stone used being green from the quarry. It was afterwards found that these green quarry stones cracked with the frost, and no stone were put in the wall, in the future, which had not been seasoned."

2.3 Operation. Operating records of the dam include daily records of pool level, precipitation, average air temperature, and weather conditions. Operating records are available since 1961. The spillways of the impoundment are uncontrolled and have no operational features.

The blow-off pipe for the reservoir is controlled by a valve at the intake tower.

2.4 Other Investigations. The available information indicated no investigations other than the periodic inspections conducted by the state and the report related to 1961 modifications.

2.5 Evaluation

a. Availability. The available information was provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. Available engineering data are not adequate to assess the structure. Only the design capacity of the spillway is reported.

(2) Dam. The stability of the dam was analyzed in 1960 by E. D'Appolonia Associates in conjunction with the alteration project and was found to be satisfactory. The calculations were not available for review.

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

c. Operating Records. To the best knowledge of the dam tender, no operating difficulties have been encountered in the recent past. To his knowledge, maximum flow through the dam occurred in March 1936, when 8 inches flowed over the secondary spillway. This flow depth corresponds to a discharge of 2800 cfs. The second highest flow through the dam occurred in July 1977, when 5 inches flowed over the secondary spillway.

d. Post-Construction Changes. The dam was modified in 1961. The changes were discussed in previous sections of this report.

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 earthquake.

SECTION 3
VISUAL INSPECTION

3.1 Findings

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

1. Visual inspection of the retaining structure, abutments, and toe.

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

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

4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 8 and in the photographs in Appendix C.

b. Dam. The general inspection of the retaining structure consisted of searching for indications of structural distress, such as cracks, deterioration of rock surfaces and seepage areas, and observing general maintenance conditions and other surficial features.

1. Two sections of the downstream face were found to be wet. One area was located on the right end of the secondary spillway over a distance of about 30 feet. No concentrated seeps appeared to be associated with the wet area. The second wet area was located immediately to the right of the primary spillway. Several concentrated seepage points were observed approximately 10 to 13 feet below the secondary spillway crest. The total flow from this area was estimated to be about 4 to 5 gallons per minute.

2. A section of the stream bank along the left abutment apparently has eroded during high flows through the spillway. However, the present extent is not considered to be a threat to the integrity of the dam, and a substantial increase in erosion is not anticipated in the near future.

c. Appurtenant Structures. The spillway crests and plunge pools were examined for deterioration or other signs of distress and obstructions that would limit flow. No signs of distress or erosion were observed.

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. The North Branch of the Little Conemaugh River flows into the main branch about two miles downstream of the lake. The North Branch flows under two highway bridges upstream of the town of Wilmore and one railroad bridge downstream from the town before joining the main branch. In the event of failure of the dam, it is estimated that the highway embankments would be overtopped; however, the railroad embankment which is approximately 40 feet high would constitute a major constriction to the flow and back water would flood a significant portion of the town of Wilmore.

Sketches and photographs of the bridges are included in Appendices A and C, respectively.

3.2 Evaluation. In general, the condition of the dam is considered to be good. No conditions were observed that would require attention at this time.

SECTION 4
OPERATIONAL FEATURES

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

The maintenance of the 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 was found to be satisfactory.

4.3 Maintenance of Operating Facilities. The operating facilities are adequately maintained. On the date of the field inspection, the blow-off valve was operated by water company personnel and was 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 communication facilities are available.

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. Wilmore Dam has a watershed area of 25 square miles and impounds a reservoir with a surface area of 182 acres. The spillway of the dam consists of two low sections on the crest with a total of 600 feet, which have a discharge capacity of 8500 cfs at pool Elevation 1623.9. The remaining 200 feet of the crest also is capable of passing flow without significantly affecting the performance of the structures when the pool level rises above Elevation 1623.9.

There are four impoundments in the watershed above the dam. Plate 2 shows the locations of these impoundments. Old City Reservoir, Lake Jenks, and Lake Rowena are relatively small reservoirs. Old City Reservoir and Lake Rowena store approximately 60 acre-feet of water. Storage capacity of Lake Jenks is estimated to be in the range of 5 to 10 acre-feet. Howells Run Dam, the major impoundment, has a watershed area of 1.4 square miles and impounds about 1300 acre-feet of water at normal pool level.

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

The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers, conservatively neglecting the effect of the upstream impoundments (Appendix D). Based on this analysis, it was determined that the PMF inflow hydrograph would have a peak of 28,000 cfs and a total volume of approximately 34,600 acre-feet. These values are greater than the spillway capacity (8500 cfs) and the reservoir flood storage volume (840 acre-feet). Therefore, the spillway is not capable of passing the PMF flow without overtopping. Further analysis, according to the procedure, indicated that the spillway can pass a maximum flow of approximately 30 percent of the PMF without overtopping. In the event of full PMF, the depth of flow over the dam crest was determined to be approximately three 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 dam will be overtopped during a flood whose magnitude exceeds 30 percent PMF. However, because it is a masonry dam, the entire crest of the dam is capable of passing flows without significantly affecting the overall stability of the dam.

e. Spillway Adequacy. Based on the observations stated above, flood discharge capacity of the dam is considered to be 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 and Construction Data. Available information indicates that the original design incorporated stability analyses for the dam. The 1961 stability of the dam was reanalyzed by E. D'Appolonia Associates and reported to be adequate.

As a part of this inspection, the stability of the dam was reevaluated by an independent approximate analysis. This stability analysis indicated that the factor of safety against overturning is 2.0 when pool level is at the crest level of the dam and 1.8 when the dam is overtopped by 3 feet. Sliding shear stresses for the two loading conditions were determined to be 17 and 18 psi, respectively. The sliding shear stresses are within the range of allowable shear strength of claystones on which the dam is reported to be founded. This analysis indicates that the dam is stable, concurring with the results of the previous analysis.

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. An earth embankment was constructed on the upstream side of the dam in 1961 to control seepage through the dam. The effect of this modification was considered in the analysis.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Wilmore Dam is in good condition. It appears that the structure was built with reasonable care with the means available at the time of construction and received extensive repairs in 1961 to improve its condition. The capacity of the spillway was found to be inadequate (30 percent PMF) relative to the spillway capacity criteria established by the Corps of Engineers. However, because an overtopping would not cause failure of the dam, flood discharge capacity of the dam was considered to be adequate.

b. Adequacy of Information. The available design information is considered adequate to make a reasonable assessment of the dam based on visual observations, reports of past observations, and previous experience of the inspectors.

c. Urgency. It is considered that the recommendations suggested below be implemented on a continuing basis.

d. Necessity for Further Investigation. The condition of the dam does not require more detailed investigation at this time.

7.2 Recommendations/Remedial Measures

1. Since the dam may overtop during unusually high runoff, it is recommended that during such periods the owner should provide around-the-clock surveillance for early detection of problems, such as erosion of the abutments.

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

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

PLATES

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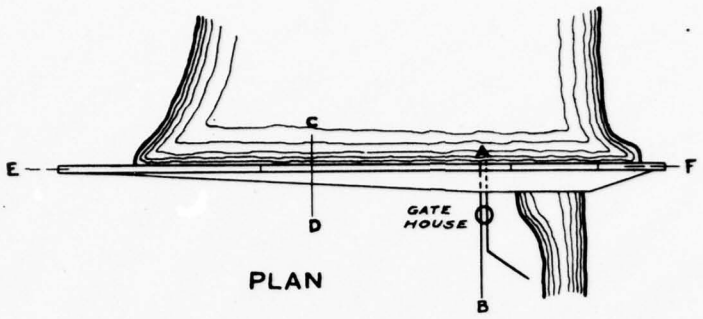
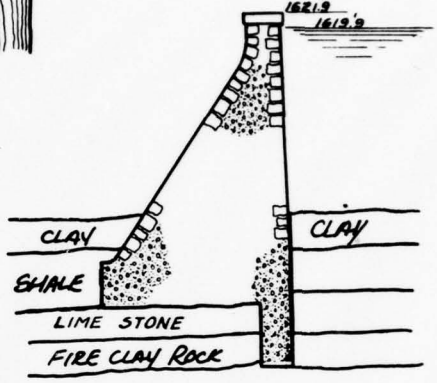


PLAN



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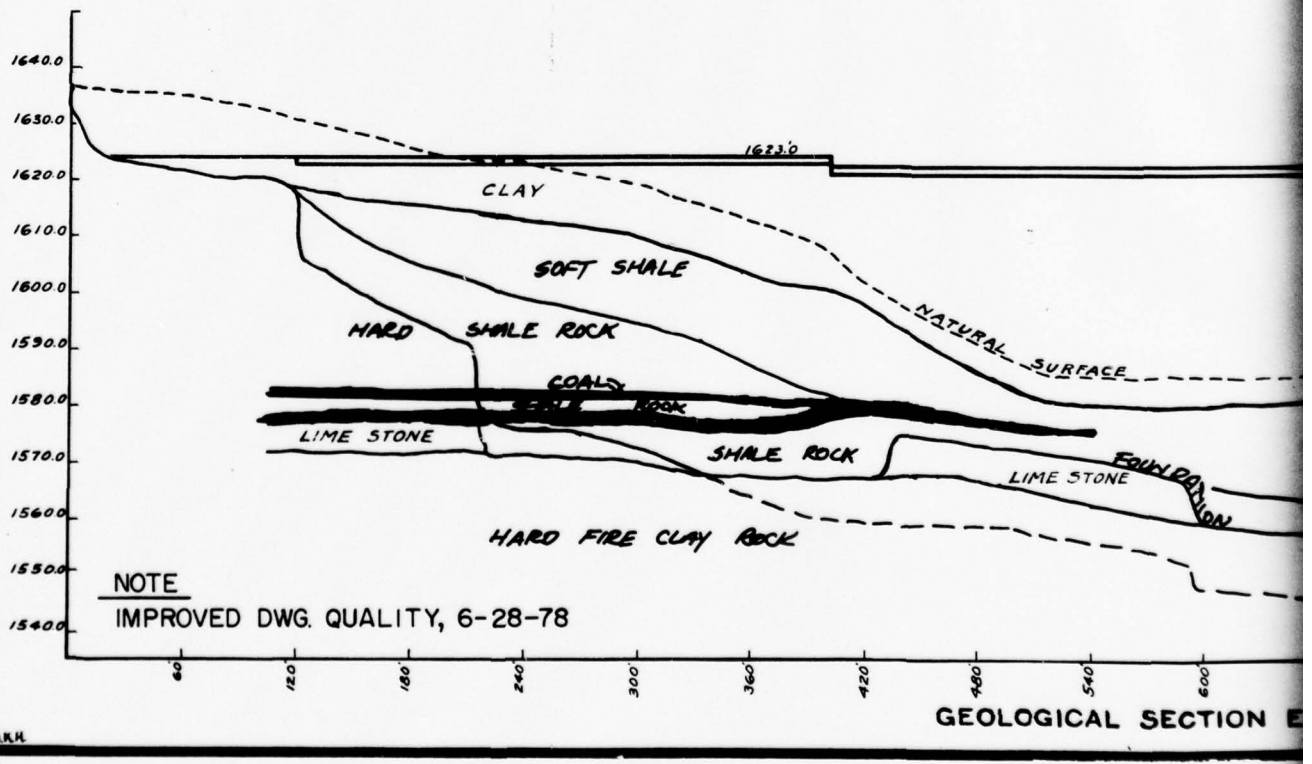
GEO



NOTE
IMPROVED DWG. QUALITY, 6-28-78

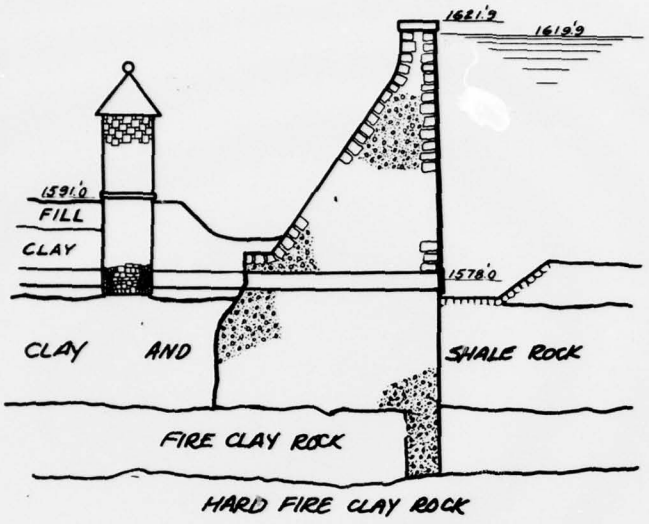
GEOLOGICAL SECTION E

GRH

SUMMIT WATER SUPPLY CO.

GEOLOGICAL SECTIONS OF NORTH BRANCH CONEMAUGH RESERVOIR

GENERAL SUPERINTENDENTS OFFICE
JULY 13, 1912



GEOLOGICAL SECTION A—B

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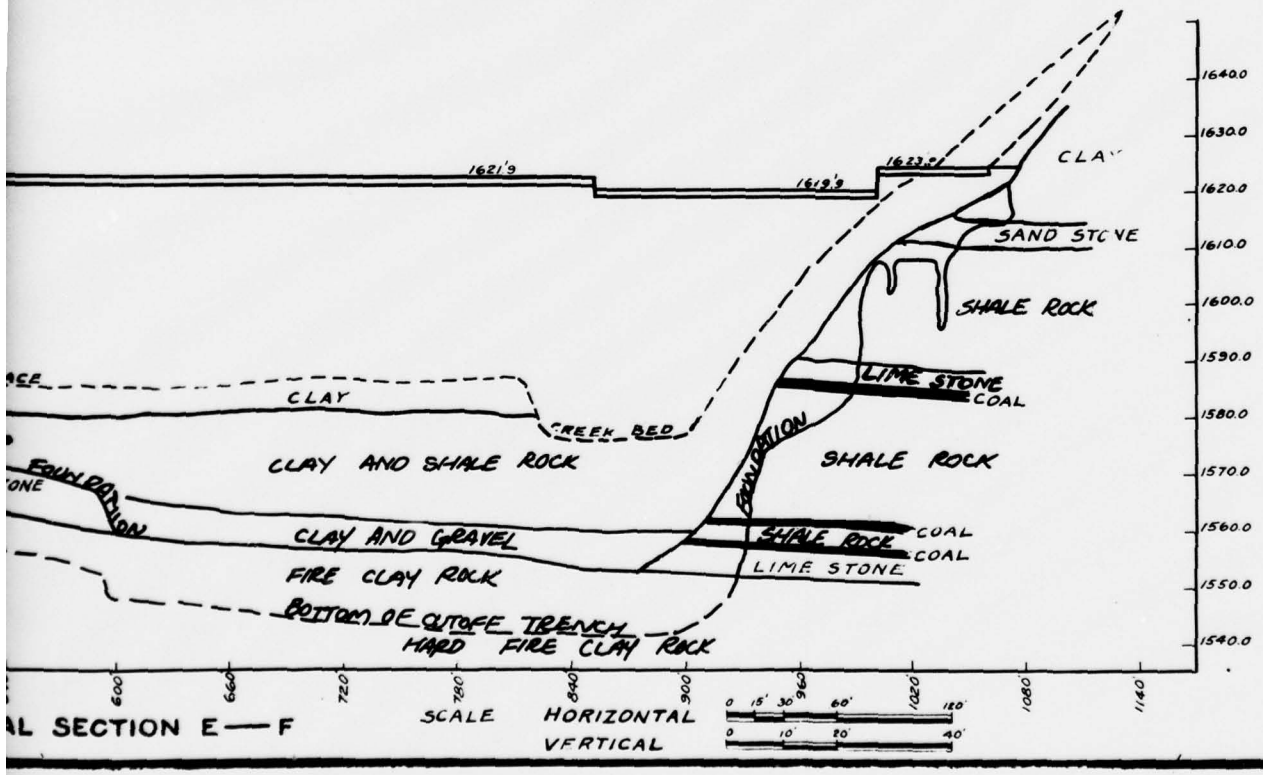


AL SECTION E—F

SCALE HORIZONTAL 0 15' 30' 60' 120'
VERTICAL 0 10' 20' 40'

PLATE I

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY		DRAWING NUMBER	78-4-B56
	6-20-78	APPROVED BY			

REFERENCE:
U.S.G.S. , 7.5', CARROLLTOWN PA. QUADRANGLE PHOTOREVISED 1972 , SCALE-1:2000.
U.S.G.S. , 7.5', COLVER PA. QUADRANGLE PHOTOREVISED 1972 , SCALE-1:2000.
U.S.G.S. , 7.5', EBENSBURG PA. QUADRANGLE PHOTOREVISED 1972 , SCALE-1:2000
U.S.G.S. , 7.5', NANTY GLO PA. QUADRANGLE PHOTOREVISED 1972 , SCALE-1:2000.

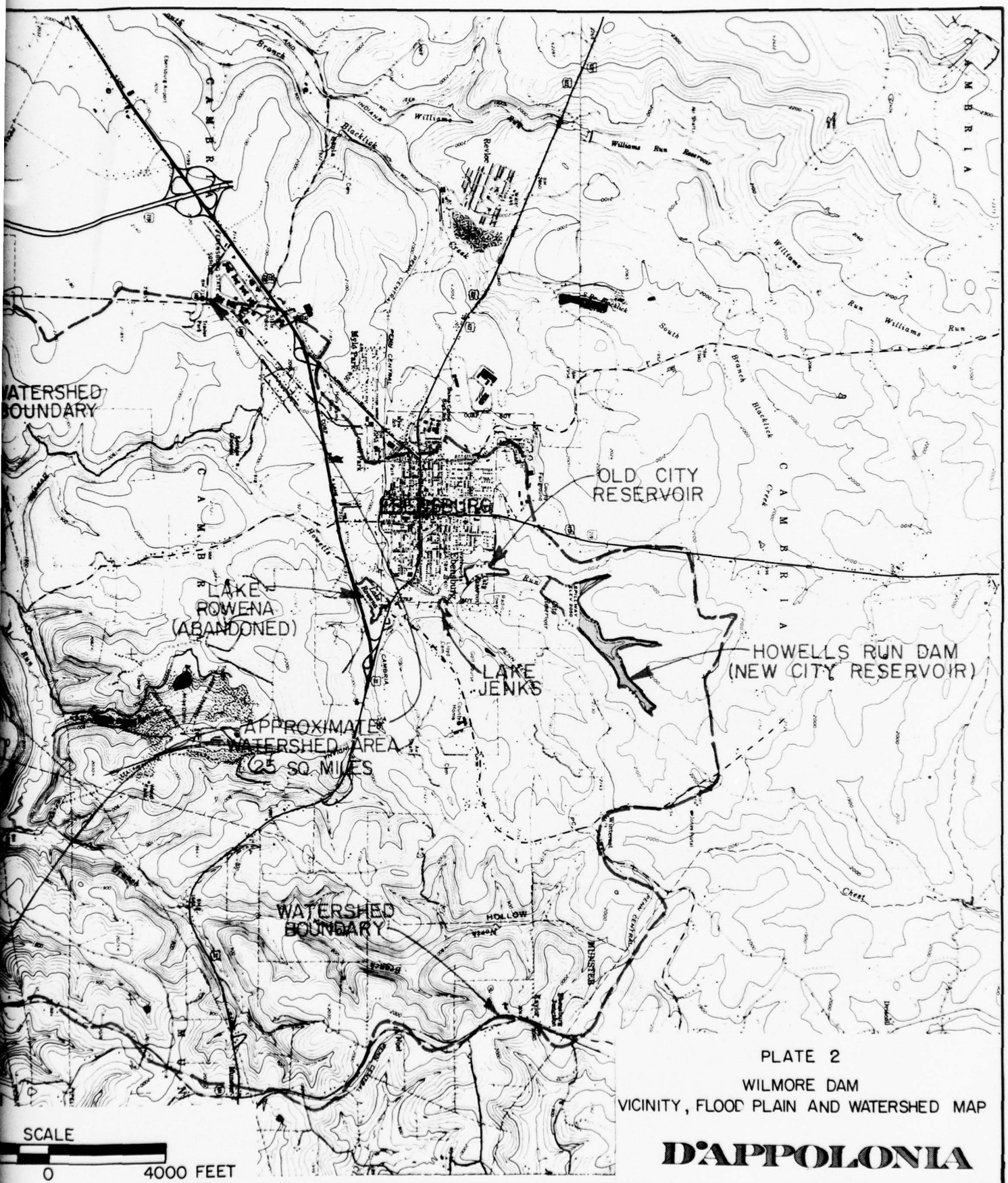


PLATE 2

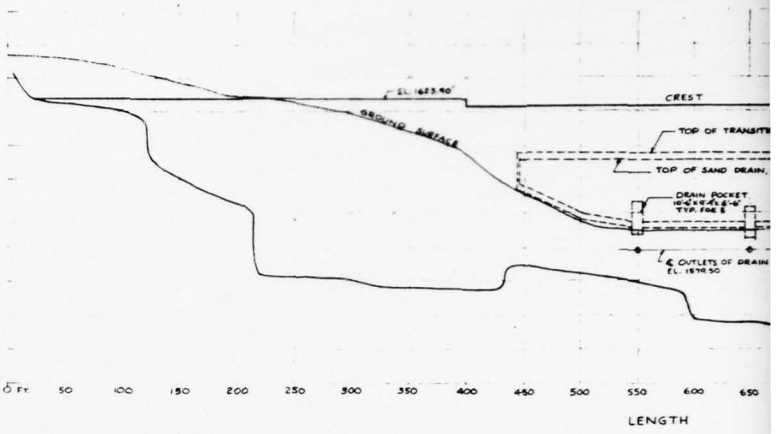
WILMORE DAM

VICINITY, FLOOD PLAIN AND WATERSHED MAP

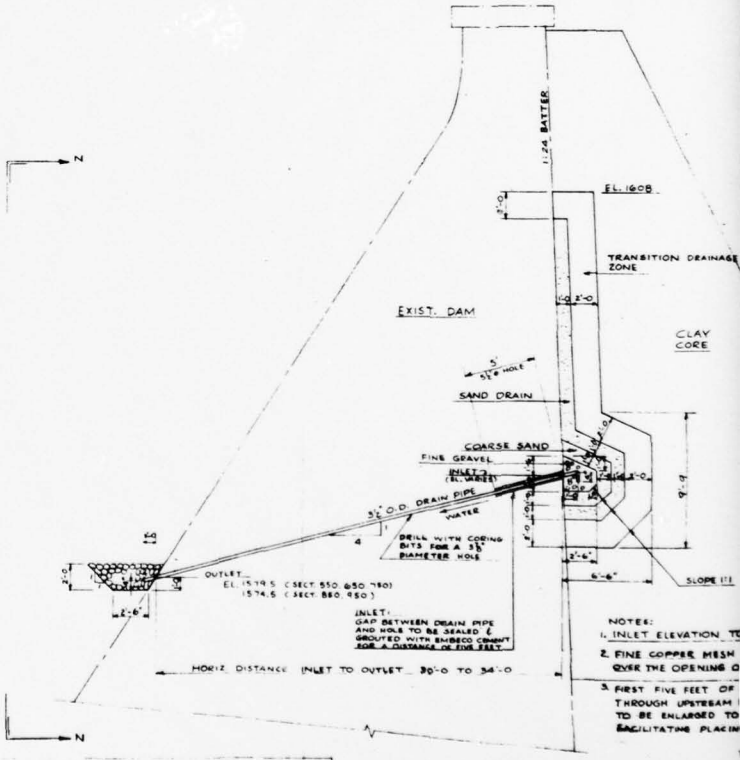
D'APPOLONIA

2

DRAWN BY	G.J.G	CHECKED BY	BE	7-5-78	DRAWING NUMBER	78-4-B57
	6-26-78	APPROVED BY	[illegible]	7.5.78		



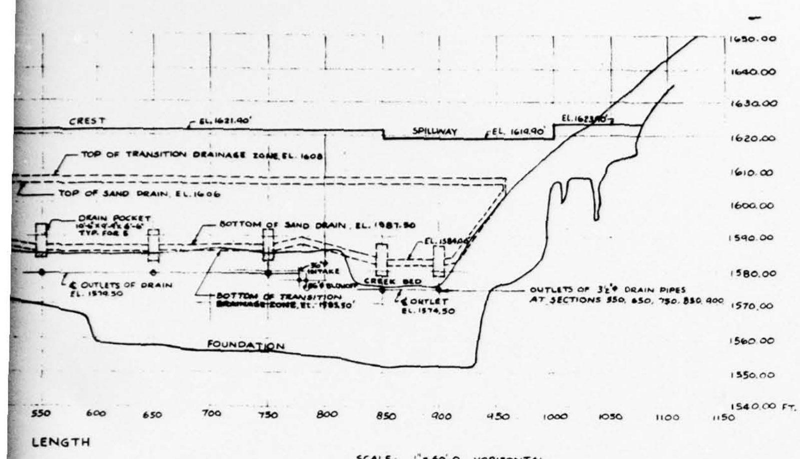
FRONT VIEW OF BACK WALL DRAINA



TYPICAL SECTION OF SAND DRAIN 1"=5

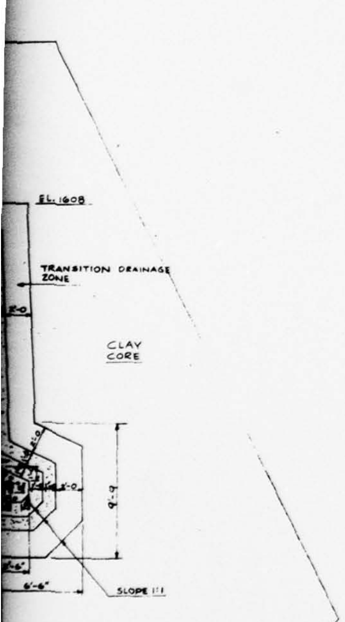
REFERENCE DRAWINGS

REVISION 4 — DATE: 10-31-80
ADDED DWG. GO-185-E6 FOR SAND DRAIN DETAILS
REVISION 5 — DATE: 12-28-81
AS BUILT



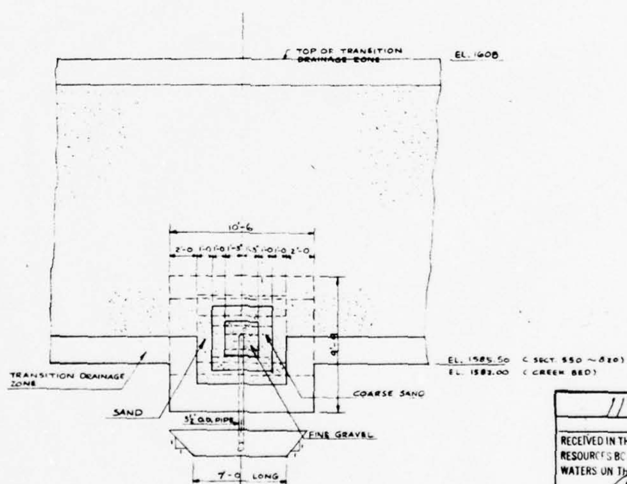
OF BACK WALL DRAINAGE BLANKET

SCALE: 1" = 60'-0 HORIZONTAL
1" = 20'-0 VERTICAL



NOTES:
1. INLET ELEVATION TO BE FOUND IN FIELD
2. FINE COPPER MESH TO BE FASTENED OVER THE OPENING OF PIPE INLET.
3. FIRST FIVE FEET OF DRAIN PIPE DRILL HOLE THROUGH UPSTREAM FACE OF MASONRY DAM TO BE ENLARGED TO 5½" DIAMETER TO FACILITATING PLACING OF GROUT SEAL.

SAND DRAIN. 1" = 5'-0



ELEVATION N-N 1" = 5'-0

11-4-2

RECEIVED IN THE ... R & POWER RESOURCES BO... FORESTS, WATERS ON THE 13 ... Feb ... A.D. 19..
Austin H. Davenport
File Clerk

REC'D As Built 11-4
SEE REPORT NO.
J.J. Ellam
Div. Engr.

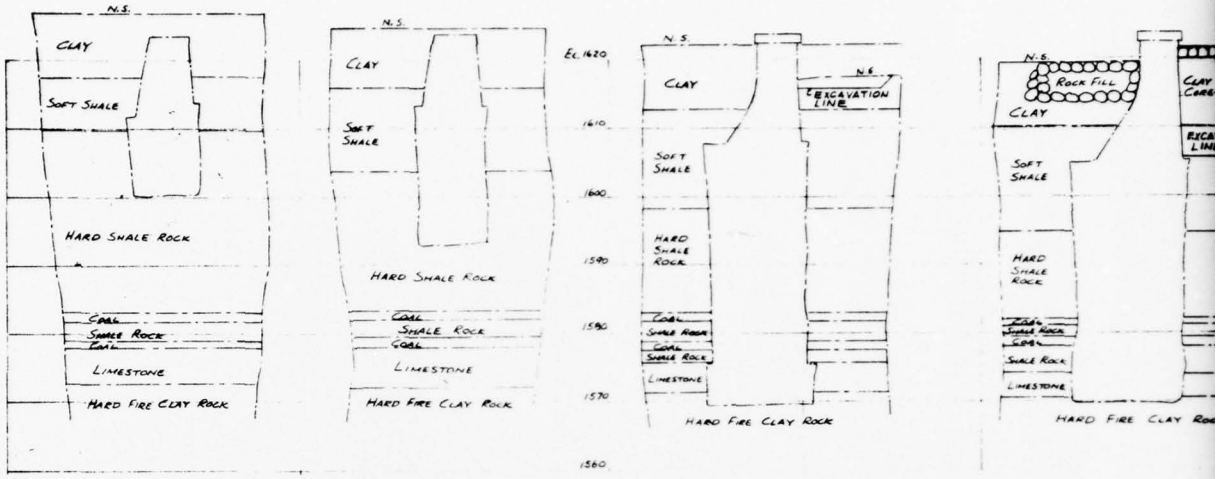
E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	SAND DRAIN WILMORE DAM
JOHNSTOWN WATER COMPANY AND MANUFACTURERS WATER COMPANY JOHNSTOWN, PENNSYLVANIA	DRAWN BY CC CHECKED BY JPS

PLATE 3

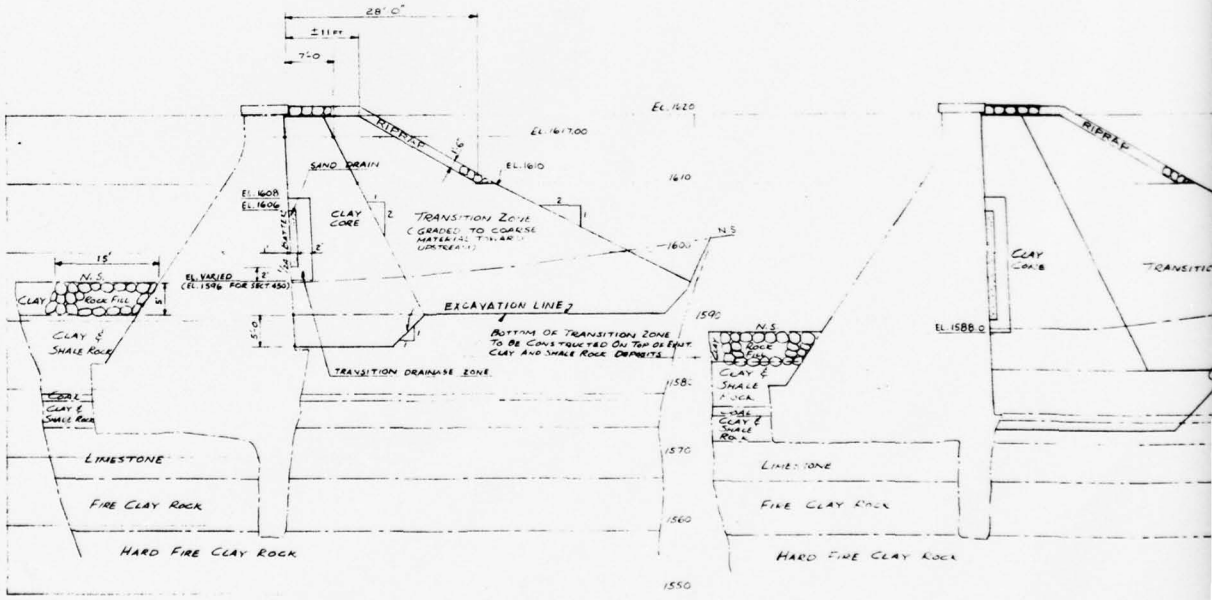
D'APPOLONIA

2

DRAWN BY	D.J.D.	CHECKED BY		7-5-78	DRAWING NUMBER 78-.4-B58
	6-26-78	APPROVED BY		7.5.78	



SECTION AT 150 | SECTION AT 200 | SECTION AT 250 | SECTION AT 300



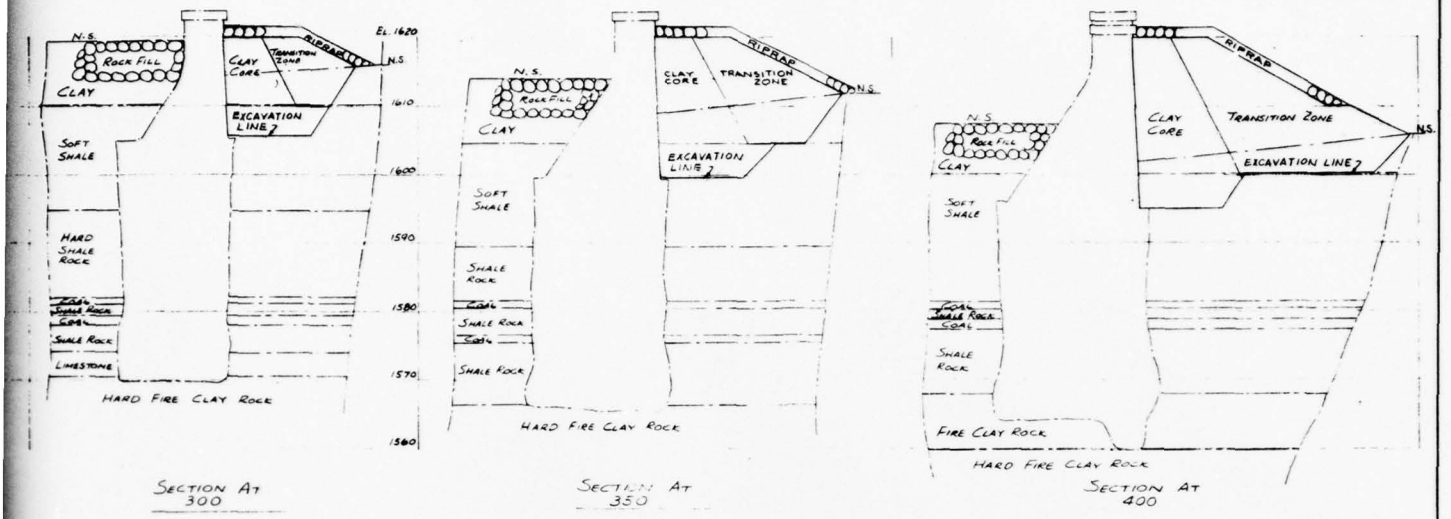
SECTION AT 450 | DIMENSIONS SHOWN IN SECTION 450 ARE TYPICAL FOR ALL EXCEPT SPILLWAY SECTIONS | SECTION AT 500

REFERENCE DRAWINGS

REVISION ⚠ DATE: 10-31-60
1. ADDED TRANSITION DRAINAGE ZONE, SAND DRAIN & GRAVEL DRAIN POCKETS (SECT. 450-550)
2. ADDED DRAIN PIPE ON SECTION 550
3. CHANGED BOTTOM ELEVATION OF HAND PLACED RIPRAP TO EL. 1610

REVISION ⚠ DATE: 12-27-61
1. AS BUILT

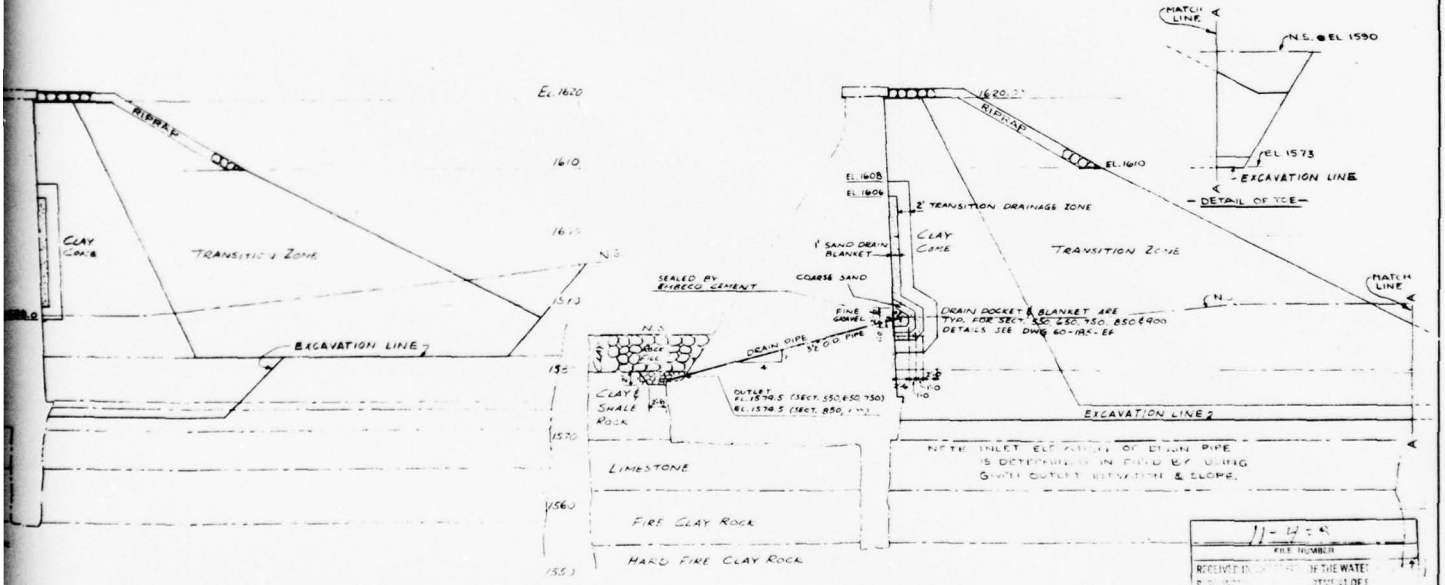
N. S. — NATURAL SURFACE



SECTION AT 300

SECTION AT 350

SECTION AT 400



SECTION AT 500

SECTION AT 550

AL SURFACE

ALL NUMBERS IN PARENTHESES ARE CROSS SECTION AREAS OF CORE, TRANSITION ZONE & LENGTH OF RIPRAP OF EACH CROSS SECTION

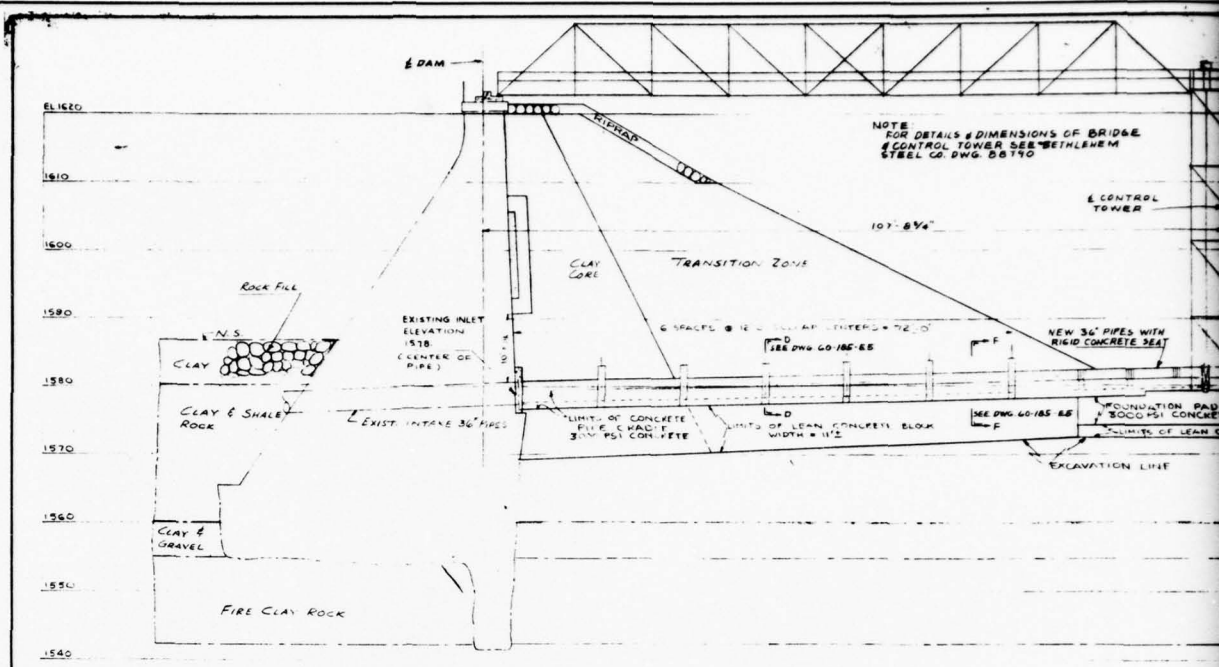
E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	CROSS SECTIONS FROM STATION 1+50 TO STATION 5+50		
JOHNSTOWN WATER COMPANY AND MANUFACTURERS WATER COMPANY JOHNSTOWN, PENNSYLVANIA	DRAWN BY	C.C.	9-14-60
	CHECKED BY	A.M.D.	10-14-60
	APPROVED BY	A.M.D.	10-15-60
	SCALE: 1" = 10'-0		
	DRAWING NO. 60-185-E2		

PLATE 4

D'APPOLONIA

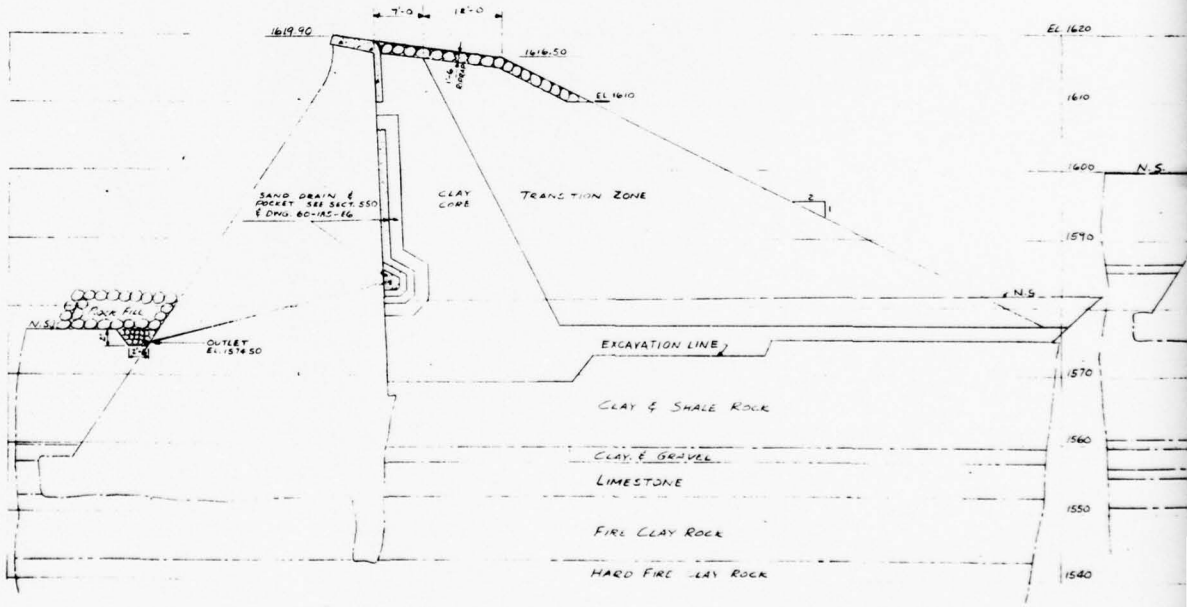
2

DRAWN BY	D.J.D.	CHECKED BY	BE	2-5-78	DRAWING NUMBER 78-4-B59
	6-26-78	APPROVED BY	TOP	7.5.78	



SECTION AT 784

DETAILS OF INTAKE PIPES & TOWER SEE



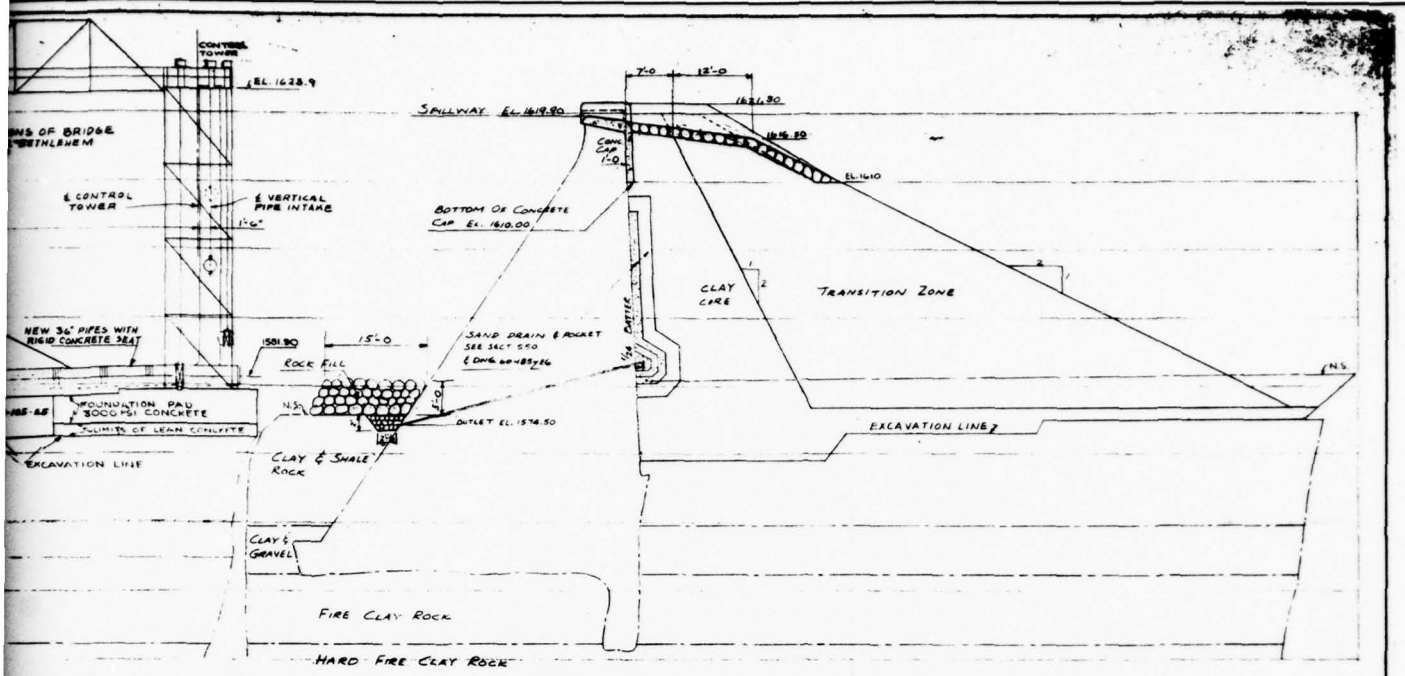
SECTION AT 900

SPILLWAY

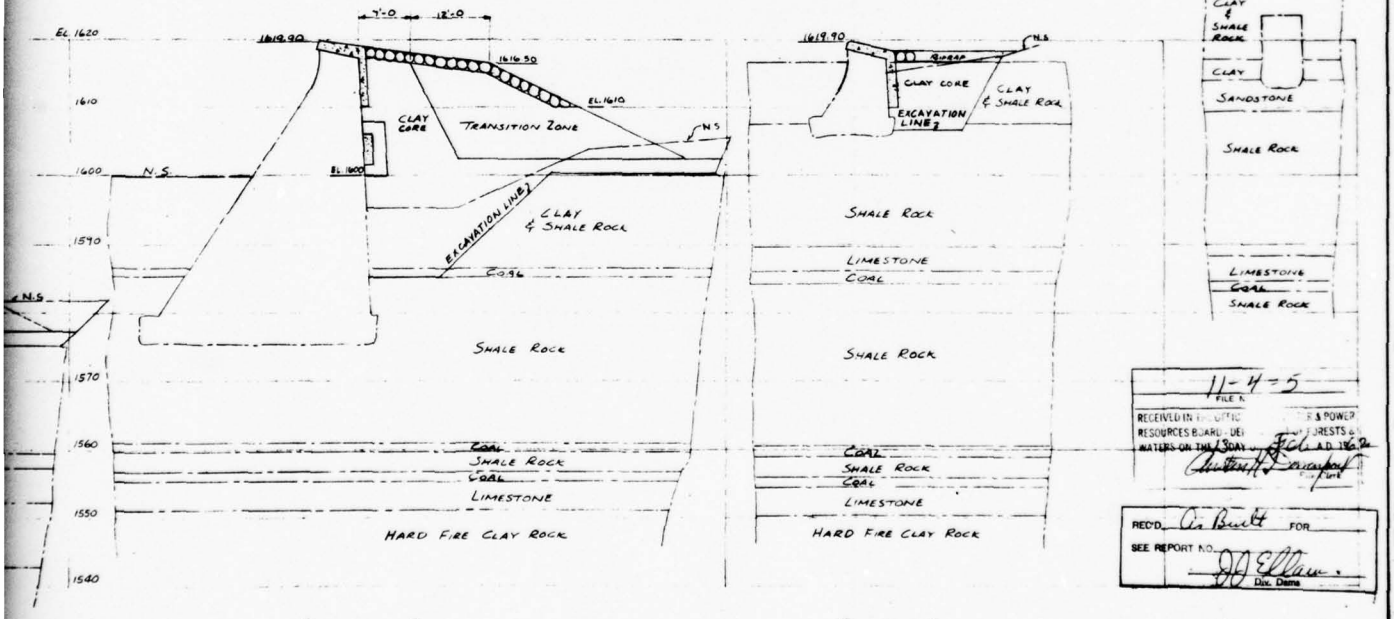
REFERENCE DRAWINGS	REVISION 1 DATE 10-31-60 1. ADDED TRANSITION ZONE SAND DRAIN & GRAVEL DRAIN POCKETS (SECT 800-950) 2. ADDED DRAIN PIPES ON SECTIONS 860 & 900 3. CHANGED BOTTOM OF HAND PLACED RIPRAP TO EL. 1610 REVISION 2 DATE 12-27-60 1. LOWERED NEW INLET 2. ADDED SECT. F-F REVISION 3 DATE 12-29-61

N. S. — NATURAL SURFACE

1



SECTION AT 850 SPILLWAY



SECTION AT 950 SPILLWAY

SECTION AT 1000

SECTION AT 1050

11-4-5
FILE NO.

RECEIVED IN THE OFFICE OF THE DEPARTMENT OF MINERAL & POWER RESOURCES BOARD OF DEPARTMENT OF FORESTS & WATERS ON THIS 7 DAY OF FEB A.D. 1969

REC'D. FOR
SEE REPORT NO.
Dist. Dams

— Natural Surface

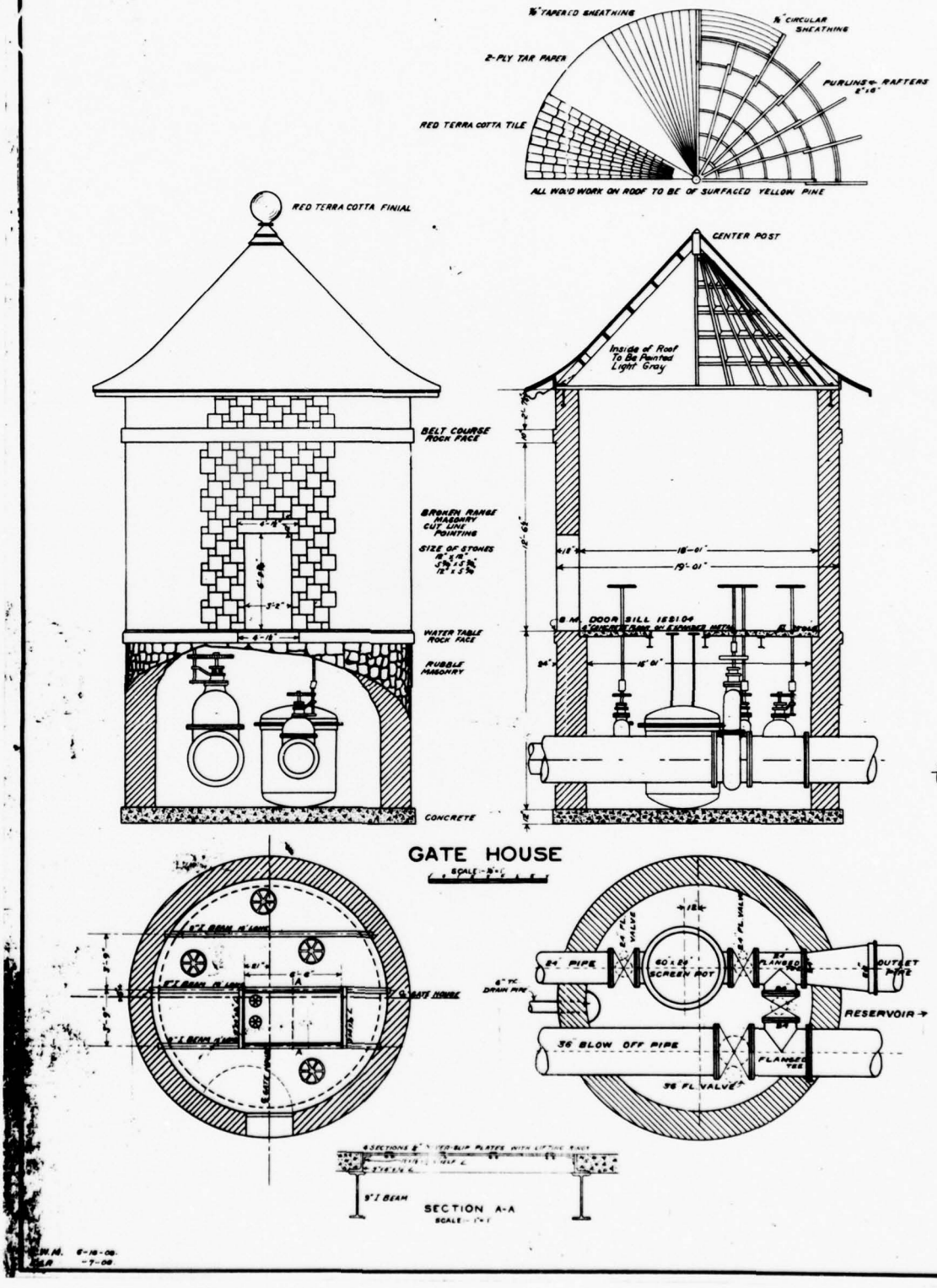
ALL NUMBERS IN PARENTHESES ARE CROSS SECTIONAL AREAS OF CORE, TRANSITION ZONE & LENGTH OF RIPRAP OF EACH CROSS SECTION

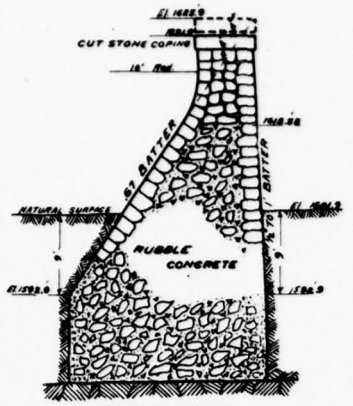
E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	CROSS SECTIONS FROM STATION 8+00 TO STATION 10+50
JOHNSTOWN WATER COMPANY AND MANUFACTURERS WATER COMPANY JOHNSTOWN, PENNSYLVANIA	DRAWN BY CC 9-16-68 SCALE: 1"=50'
	CHECKED BY AMD 9-16-68 DRAWING NO.
	APPROVED BY AMD 9-16-68 60-485

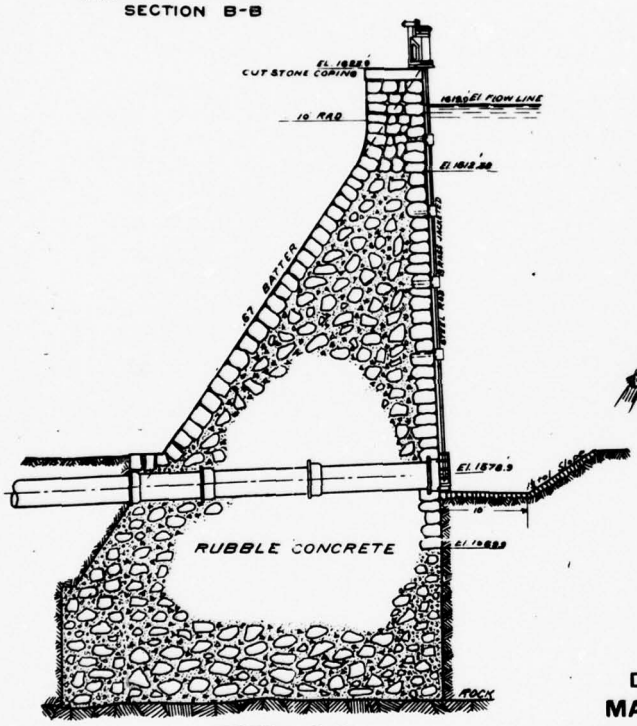
PLATE 5

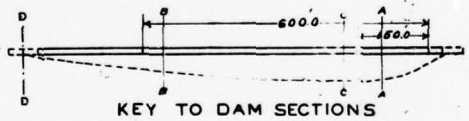
D'APPOLONIA

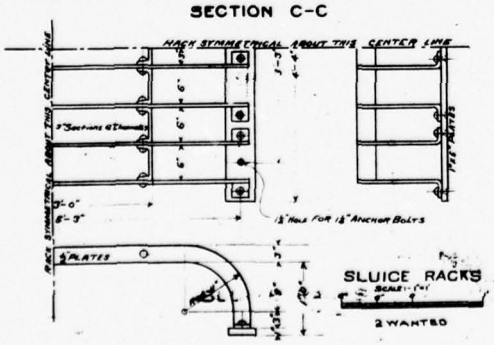
DRAWN BY	D.J.D.	CHECKED BY		7-5-78	DRAWING NUMBER 78 4-B60
	6-26-78	APPROVED BY		7.5.78	











SUMMIT WATER SUPPLY CO.

DETAILS AND CROSS SECTIONS MASONRY DAM AND GATE HOUSE NORTH BR., CONEMAUGH RES.

CAPACITY 1,025,100,000 GAL.

PORTAGE TWP., CAMBRIA CO., PA.

1906.

SCALE: 1" = 10'

THE AMERICAN PIPE MFG. CO
ENGINEERS & CONTRACTORS.
112 N. BROAD ST., PHILA., PA.

APPROVED W. Hedow
Chief Engineer, The American Pipe Mfg. Co.
Aug 27, 1906

APPROVED
Chief Engineer, S. of W. P. Co.

REVISED, 12-19-08

REVISED AS CONSTRUCTED AUG. 18, 1914. W.W.

15
194

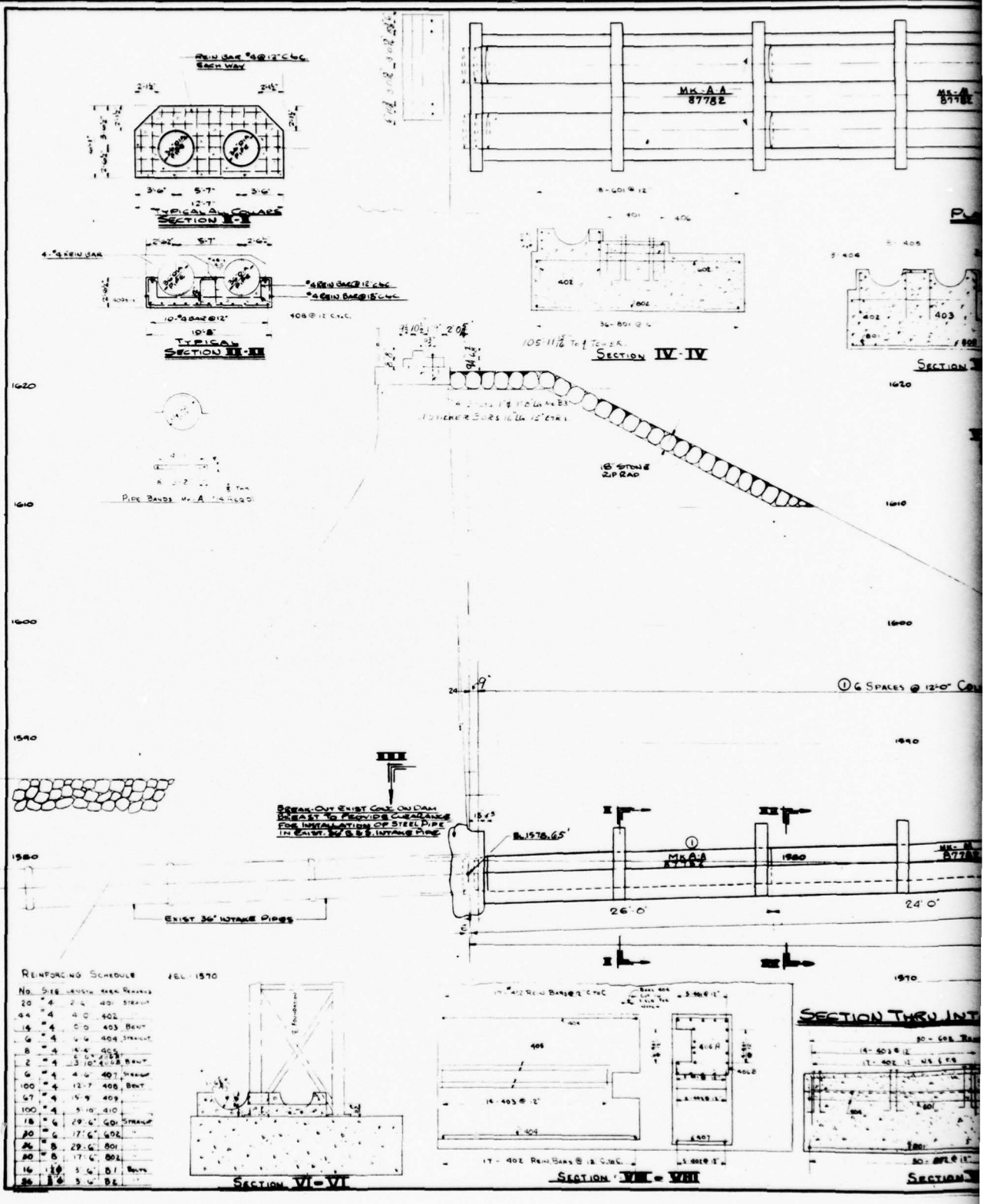
97A
18

PLATE 6

D'APPOLONIA

2

DRAWN BY	D.J.D.	CHECKED BY	RE	7-5-78	DRAWING NUMBER	4-B61
	6-26-78	APPROVED BY	[illegible]	7.5.78		78



No.	Size	Length	Mark	Remarks
20	#4	2'-6"	401	STRAIGHT
44	#4	4'-0"	402	
16	#4	10'-0"	403	BENT
6	#4	4'-6"	404	STRAIGHT
8	#4	6'-6"	405	
2	#4	5'-10" / 3'-10"	406	BENT
6	#4	4'-6"	407	STRAIGHT
100	#4	12'-7"	408	BENT
67	#4	15'-9"	409	
100	#4	5'-10"	410	
18	#6	29'-6"	601	STRAIGHT
30	#6	17'-6"	602	
26	#8	29'-6"	801	
80	#8	17'-6"	802	
16	#10	5'-6"	B1	BENT
26	#10	3'-6"	B2	

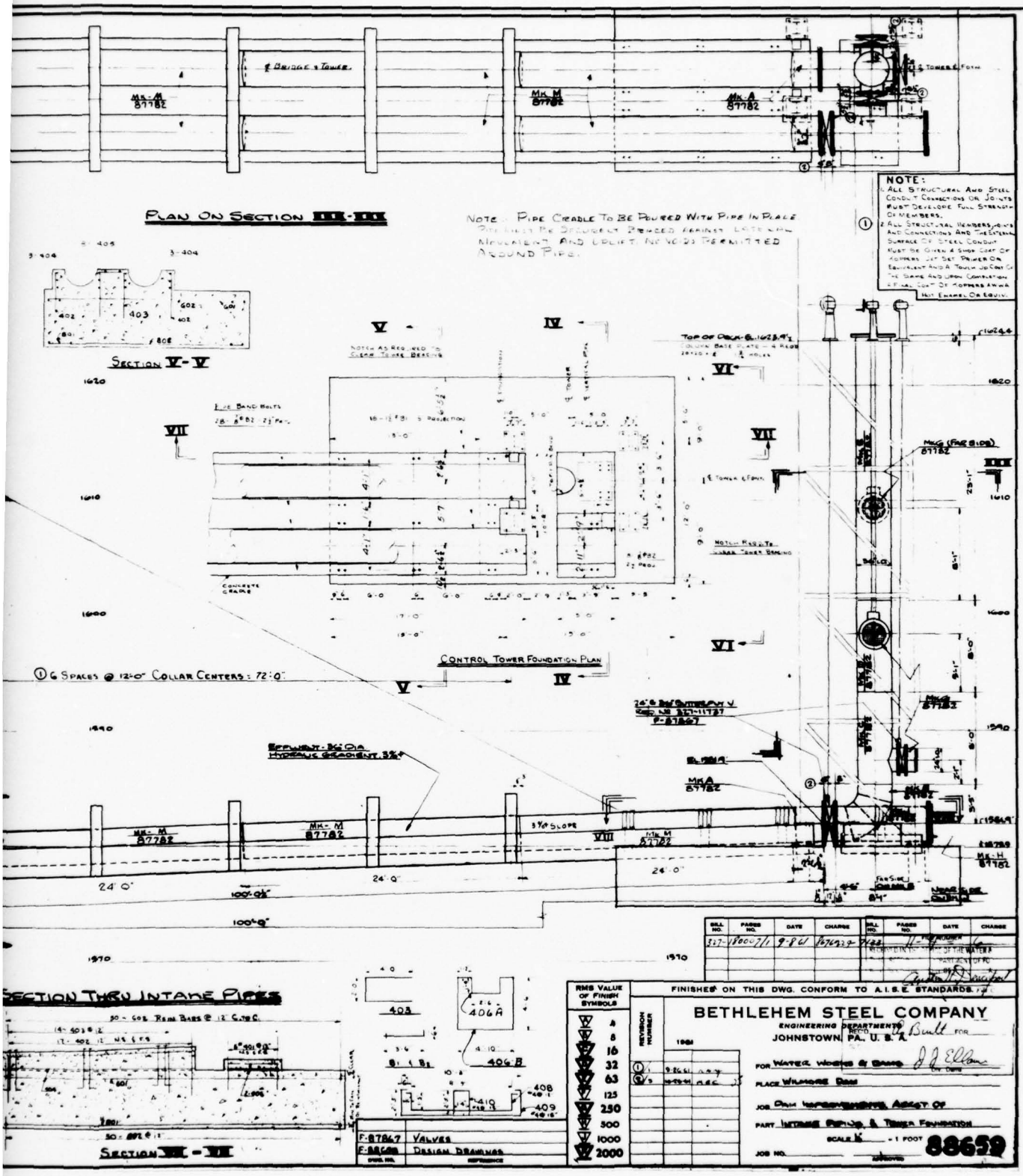
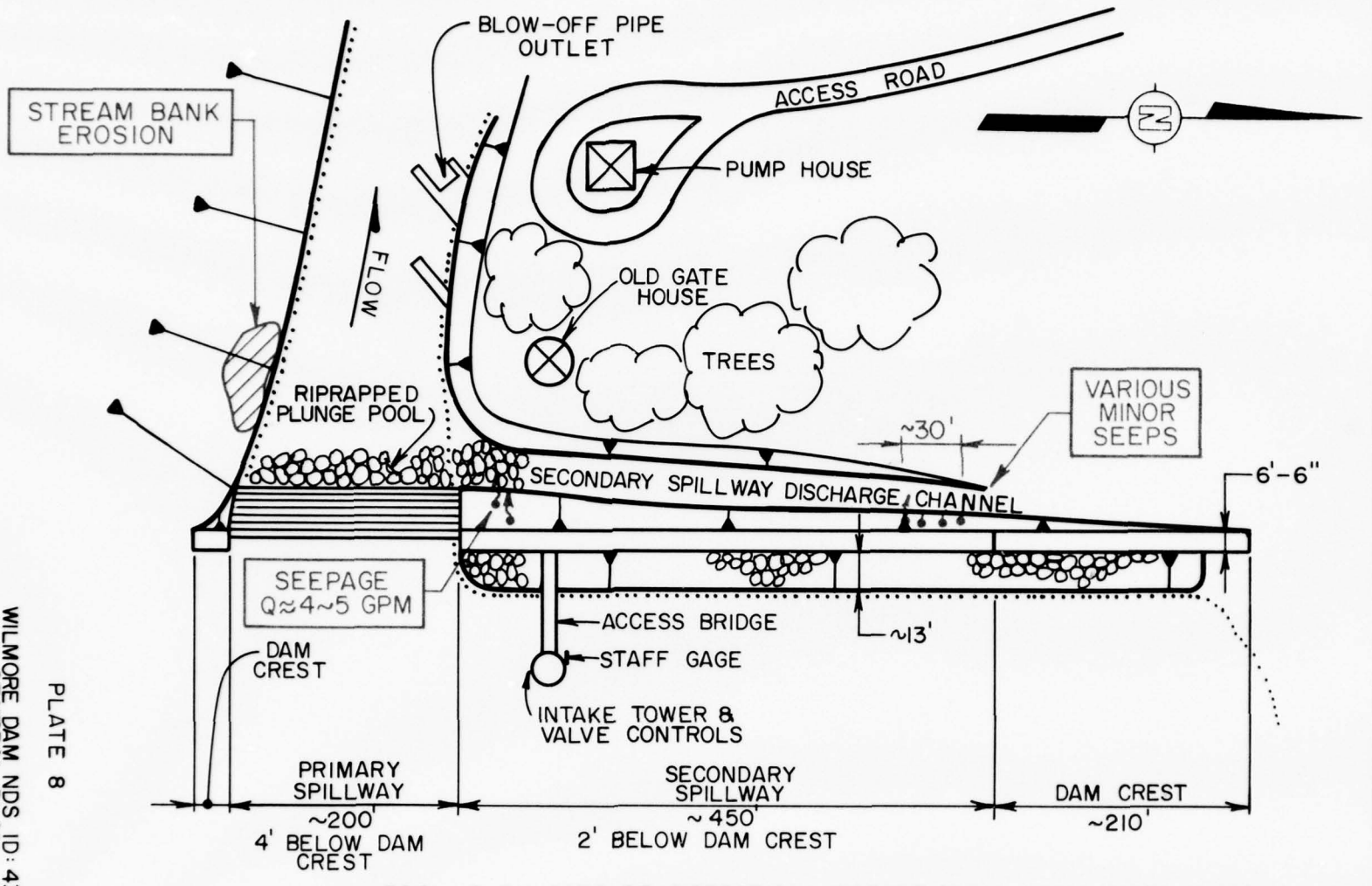


PLATE 7

D'APPOLONIA

2

DRAWN BY	G. J. G. 6-20-78	CHECKED BY	BE	7-5-78	DRAWING NUMBER 78- 1-A12
		APPROVED BY	JHP	7 5 78	



POOL ELEV. DATE OF INSPECTION: 1620.1 FT (READ FROM STAFF GAGE)

N.T.S.

PLATE 8

WILMORE DAM NDS ID: 435
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: JUNE 7, 1978

D'APPOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM WILMORE DAM COUNTY CAMBRIA STATE PENNSYLVANIA ID# NDI: 435
DER: 11-4

TYPE OF DAM MASONRY- GRAVITY HAZARD CATEGORY HIGH.

DATE(S) INSPECTION JUNE 7, 1978 WEATHER SUNNY TEMPERATURE 70's

POOL ELEVATION AT TIME OF INSPECTION 1620.1 M.S.L. TAILWATER AT TIME OF INSPECTION ~1576 M.S.L.

INSPECTION PERSONNEL:

B. 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 WILMORE DAM
ID# NDI:435 DER:11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	MASONRY DAM ∴ N/A.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	N/A	
RIPRAP FAILURES	N/A.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM WILMORE DA

ID# NDI:435 DER:11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	MASONARY DAM N/A	
ANY NOTICEABLE SEEPAGE	N/A	
STAFF GAGE AND RECORDER	N/A	
DRAINS	N/A	

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM WILMORE DAM
ID# NDI:435 DER:11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	AT TWO LOCATIONS THROUGH THE DAM SEE PLATE 8 FOR LOCATION	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	NO SIGNS OF DISTRESS OR SEEPAGE	
DRAINS	DRAINS THROUGH THE DAM DISCHARGE BELON GROUND LEVEL, INTO ROCK TOE DRAIN. (NOT VISIBLE)	SEE PLATE 3 FOR LOCATION OF DRAINS.
WATER PASSAGES		
FOUNDATION	NO SIGNS OF DISTRESS.	

VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM WILMORE D. 1
ID# NDI:435 DER:11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	NONE	
STRUCTURAL CRACKING	NONE	
VERTICAL AND HORIZONTAL ALIGNMENT	NO PERCEIVABLE MISALIGNEMENT	
MONOLITH JOINTS	NONE	
CONSTRUCTION JOINTS	NONE	
STAFF GAGE OR RECORDER:	STAFF GAGE IS ATTACHE TO INTAKE TOWER & RECORDED DAILY.	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

NAME OF DAM WILMORE DAM
ID# NDI : 435 DER 11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OUTLET CONDUIT IS SUBMERGED ONLY OUTLET END IS VISIBLE	
INTAKE STRUCTURE	STEEL INTAKE TOWER	
OUTLET STRUCTURE	OUTLET CONDUIT DIRECTLY DISCHARGES INTO THE STREAM	
OUTLET CHANNEL	NATURAL STREAM	
EMERGENCY GATE	OUTLET PIPE GATE WAS OPERATED ON THE DATE OF INSPECTION OBSERVED TO BE FUNCTIONAL.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

NAME OF DAM WILMORE DAM
ID# NDI:435 DER:11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	GOOD CONDITION	
APPROACH CHANNEL	LAKE (NO APPROACH CHANNEL)	
DISCHARGE CHANNEL	WATER FLOW OVER THE FACE OF THE DAM INTO A RIPRAPPED PLUNGE POOL.	
BRIDGE AND PIERS	NONE	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

NAME OF DAM WILMORE DA

ID# NDI: 435 DER: 11-4

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 WILMORE DAM
ID# NDI: 935 DER: 11-4

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

VISUAL INSPECTION
PHASE I
RESERVOIR

NAME OF DAM WILMORE DAM
ID# NDI: 435 DER: 11-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	WOODED, NO SIGNS OF EROSION.	
SEDIMENTATION	UNKNOWN.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

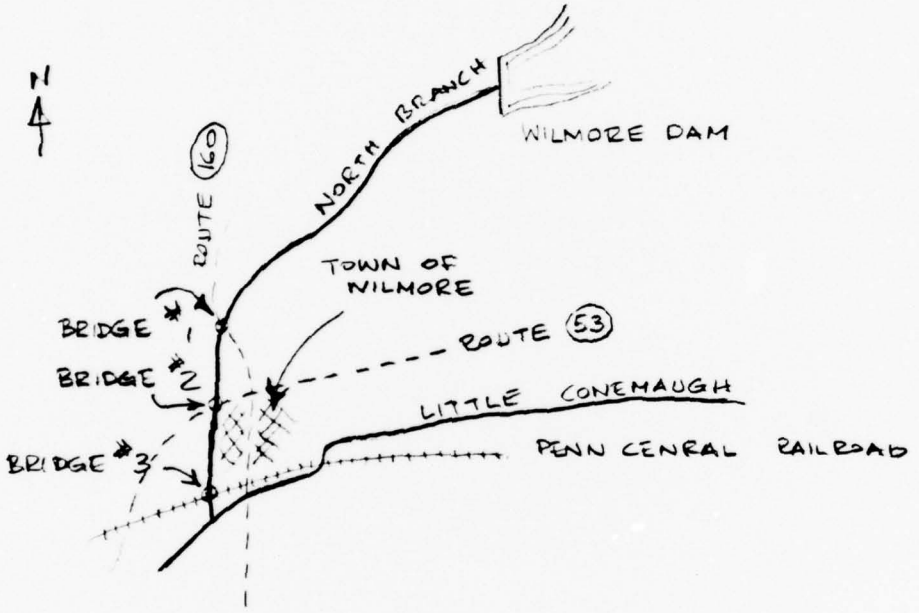
NAME OF DAM WILMORE M
ID# NDI:435 DER: II-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	STREAM FLOWS UNDER TWO HIGHWAY BRIDGES & ONE RAILROAD BRIDGE BEFORE JOINING MAIN BRANCH OF LITTLE CONEMAUGH RIVER	SEE ATTACHED SKETCHES OF BRIDGES.
SLOPES	TYPICAL NATURAL STREAM CHANNEL NO NOTICABLE EROSION.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	50 HOMES IN THE TOWN OF WILMORE POPULATION ≈ 200~300	

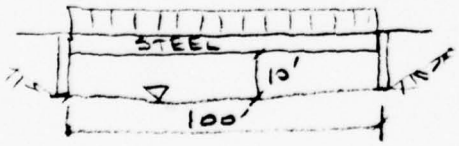
D'APPOLONIA
CONSULTING ENGINEERS, INC

By RE Date 6-7-73 Subject WILMORE DAM NDI: 435 Sheet No. 1 of 1
Chkd. By WTC Date 7-5-73 FIELD INSPECTION SKETCH Proj. No. 78-114-06

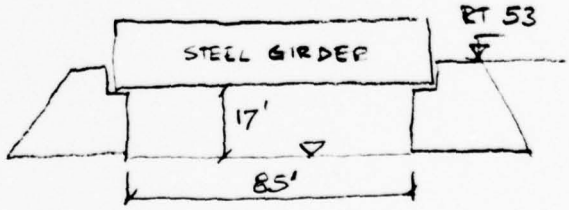
STREAN CROSS-SECTION & BRIDGE LOCATIONS.



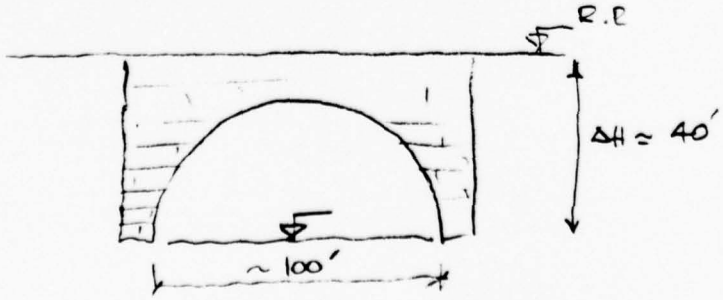
BRIDGE # 1 (ROUTE 160)



BRIDGE # 2



BRIDGE # 3 (R.R)



APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM WILMORE DAM
ID# NDI:435 DER:11-4

ITEM	REMARKS
AS-BUILT DRAWINGS	AVAILABLE IN STATE FILES.
REGIONAL VICINITY MAP	SEE PLATE 2.
CONSTRUCTION HISTORY	DESIGNED AND BUILT BY AMERICAN PIPE MANUFACTURING CO. (COMLETED IN 1908) UPSTREAM EARTH EMBANKMENT WAS CONSTRUCTED 1961
TYPICAL SECTIONS OF DAM	SEE PLATES 1 & 3
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	SEE PLATES 6 & 7

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM WILMORE DAM
ID# NDI:435 DER 11-4

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	RECORDED SINCE 1961
DESIGN REPORTS	DESIGN REPORTS ON 1961 MODIFICATIONS WERE PREPARED BY E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS OF PITTSBURGH.
GEOLOGY REPORTS	NOT AVAILABLE. A GEOLOGIC CROSS SECTION OF THE SITE IS INCLUDED IN ORIGINAL DESIGN DRAWING.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NOT AVAILABLE.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NOT AVAILABLE.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM WILMORE DAM
ID# NDI:435 DER:11-4

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED AFTER 1961 MODIFICATIONS
BORROW SOURCES	UNKNOWN
MONITORING SYSTEMS	NONE
MODIFICATIONS	IN 1961 AN EARTH FILL WAS PLACE ON THE UPSTREAM SIDE OF THE DAM.
HIGH POOL RECORDS	RECORDED SINCE 1961. RECORD HIGH 5 INCHES OVER SECONDARY SPILLWAY.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM WILMORE DAM
ID# NDI:435 DER:11-4

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	1961 MODIFICATIONS WERE DESIGNED BY D'APPOLONIA ASSOCIATES OF PITTSBURGH, PA.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
MAINTENANCE OPERATION RECORDS	RECORDS MAINTAINED SINCE 1961
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATE 1
OPERATING EQUIPMENT PLANS AND DETAILS	SEE PLATES 6 & 7

NAME OF DAM WILMORE DAM

ID# NDI:435 DER: II-4

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOOD & PASTURE 25 SQ. MILES

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 3150 AC-FT @ EL 1619.9

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 3570 @ EL 1621.9

ELEVATION; MAXIMUM DESIGN POOL: 3990 AC-FT @ EL 1623.9

ELEVATION; TOP DAM: 1623.9 FT (USGS DATUM)

CREST:

a. Elevation 1623.9

b. Type CUT STONE

c. Width 6 FT 6 INCHES

d. Length 850 FT

e. Location Spillover ENTIRE CREST

f. Number and Type of Gates NONE

OUTLET WORKS:

a. Type 36-INCH STEEL BLOW-OFF PIPE

b. Location ABOUT 200 FT FROM LEFT ABUTMENT

c. Entrance Inverts 1579.9 (SEE PLATE 7)

d. Exit Inverts 1576 (ESTIMATED)

e. Emergency Draindown Facilities 36-INCH BLOW-OFF PIPE

HYDROMETEOROLOGICAL GAGES:

a. Type RAINFALL, AIR TEMPERATURE, WEATHER CONDITION

b. Location AT THE DAM SITE

c. Records AVAILABLE SINCE 1961

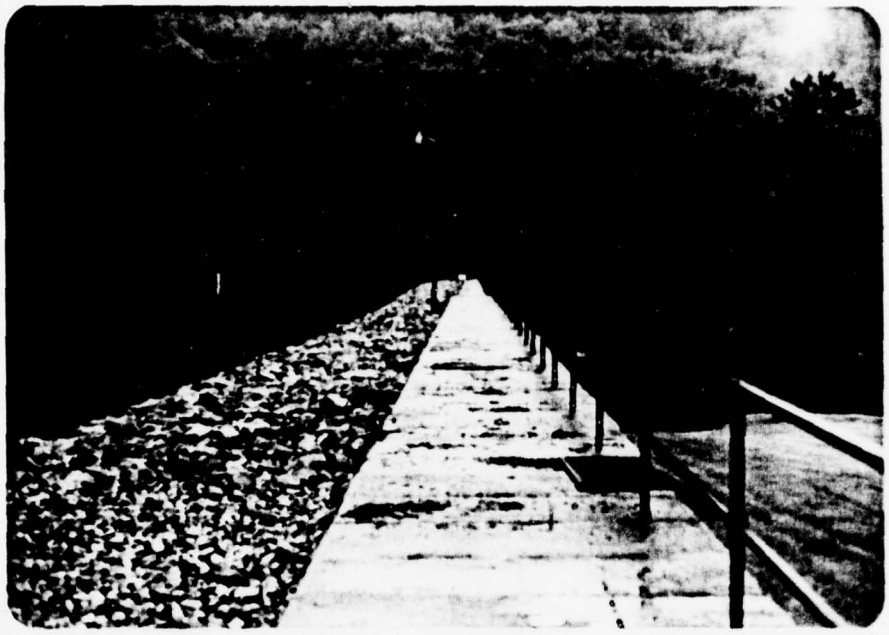
MAXIMUM NONDAMAGING DISCHARGE: ABOUT 2000 CFS

APPENDIX C

PHOTOGRAPHS

LIST OF PHOTOGRAPHS
WILMORE DAM
JUNE 7, 1978

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking south).
2	Right abutment.
3	Spillway.
4	Spillway crest.
5	Intake tower and access bridge.
6	Gate controls at intake tower.
7	"Blow-off" pipe discharging.
8	Stream bank erosion on left abutment.
9	Typical wet area on downstream face.
10	Bridge on Route 160.
11	Bridge on Route 53 (background). (Town of Wilmore in foreground.)
12	Penn Central Railroad bridge (south of Wilmore).

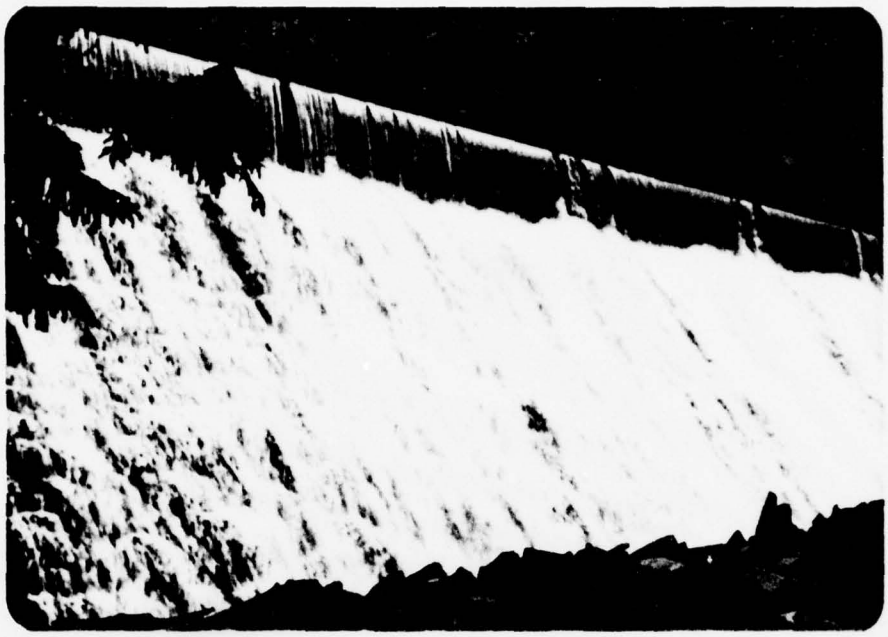


Photograph No. 1

Crest (looking south).

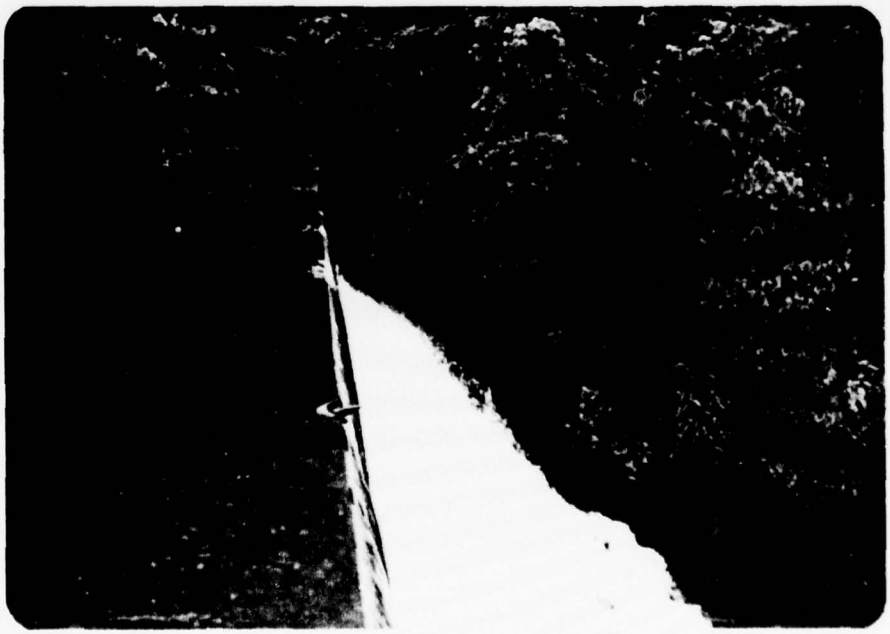
Photograph No. 2

Right abutment.



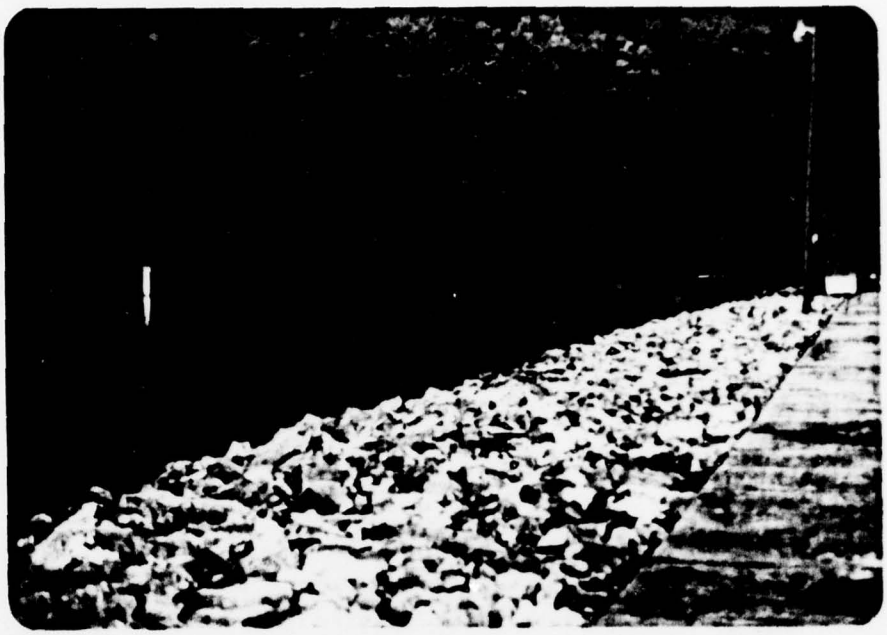
Photograph No. 3

Spillway.



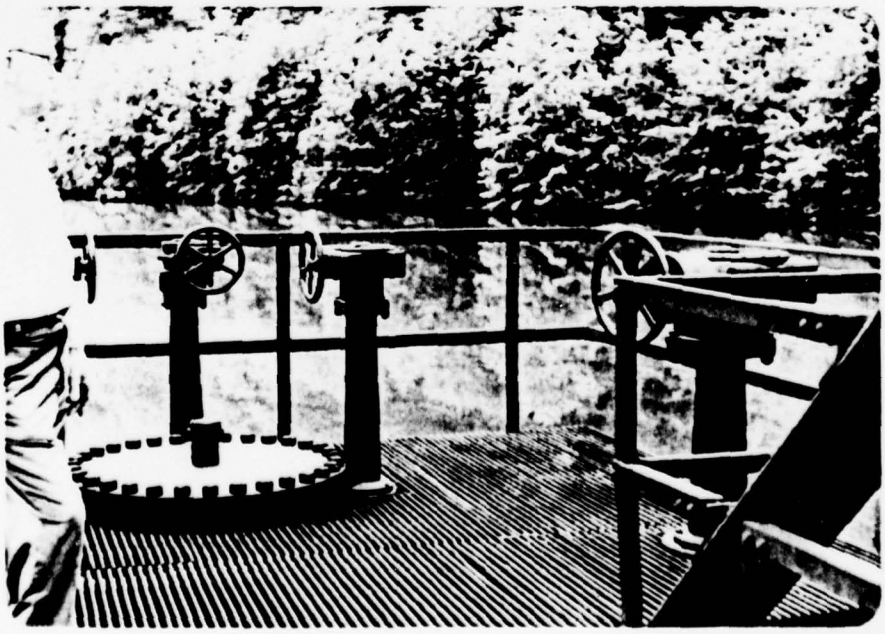
Photograph No. 4

Spillway crest



Photograph No. 5

Intake tower and access bridge.

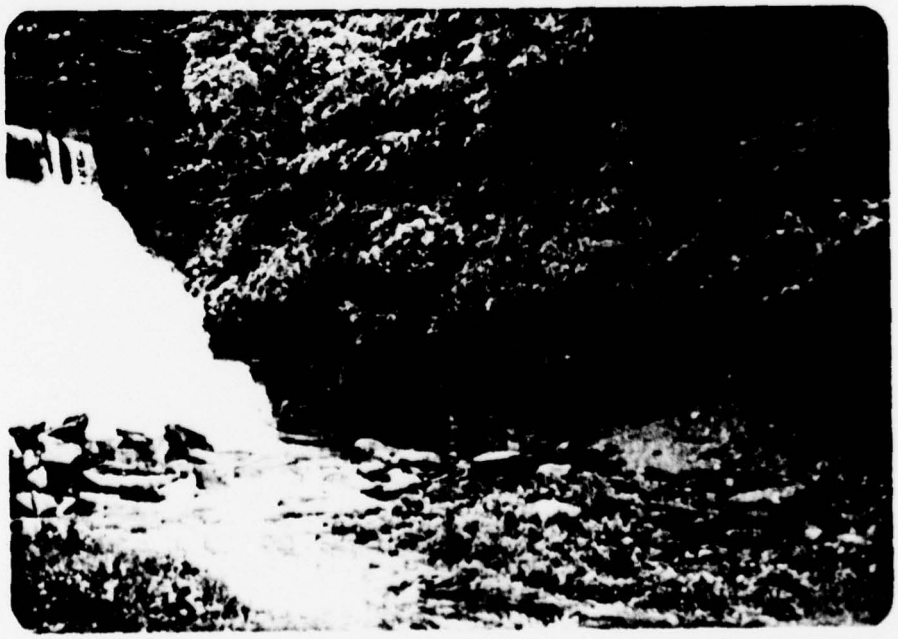


Photograph No. 6

Gate controls at intake tower.

Photograph No. 7

"Blow-off" pipe discharging.



Photograph No. 8

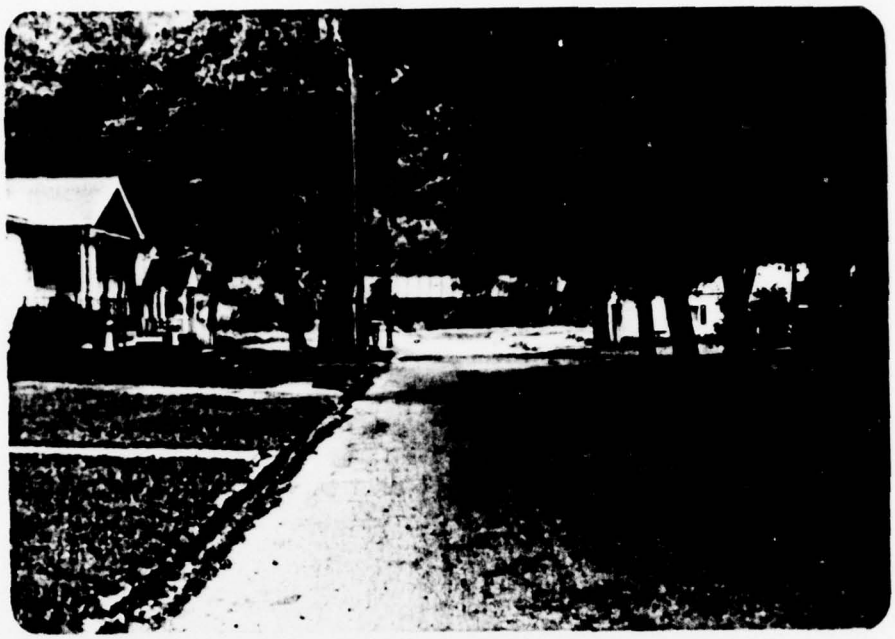
Stream bank erosion on left abutment.

Photograph No. 9

Typical wet area on downstream face.

Photograph No. 10

Bridge on Route 160.



Photograph No. 11

Bridge on Route 53 (background).
(Town of Wilmore in foreground)

Photograph No. 12

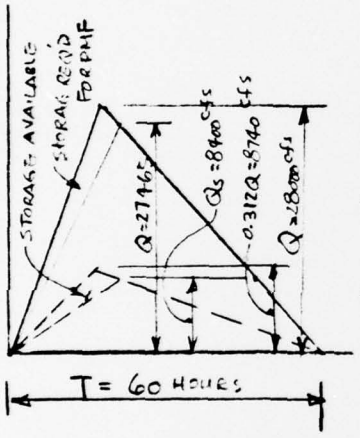
Penn Central Railroad bridge (south of Wilmore).

APPENDIX D
CALCULATIONS

DAM WILMORE DAM
SUMMER HILL TOWNSHIP, CAMBRIA COUNTY

WATERSHED AREA, A, 25 SQ MI

INFLOW HYDROGRAPH BASIN: OHIO RIVER BASIN, NORTH BRANCH OF CONEMAUGH RIVER



TOTAL TIME, T_1 = 60 HOURS

PMF PEAK FLOW, q = 1120 cfs/SQ.MI

PMF PEAK FLOW, $Q = q \cdot A$ = 28000 cfs

VOLUME OF INFLOW HYDROGRAPH

$$V_i = \frac{1}{2}(T \times 3600) \times Q \times \frac{1}{43560} \text{ AC-ft}$$

$$= \frac{1}{2}(60)(3600)(28000)\left(\frac{1}{43560}\right) = 69421 \text{ AC-FT}$$

EQUAL TO 52" RUNOFF/60 hours REVISE V_i to 26" RUNOFF

$$V_i = \frac{26}{12}(25)(640) = 34667 \text{ AC.FT} \text{ & } t_{26} = 30 \text{ hr}$$

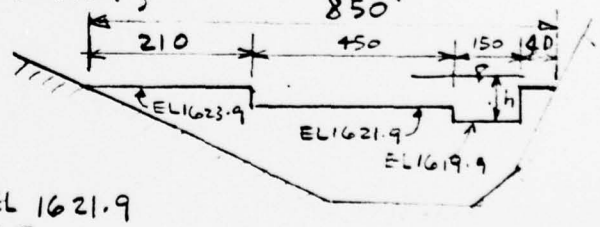
SPILLWAY CAPACITY (PRIMARY & EMERGENCY)

A. PRIMARY

TYPE CONCRETE WEIR; DISCHARGE COEF (AS DESIGNED), C = 3.1

LENGTH L_1 = 150' CREST EL 1619.9,

$$Q_{S1} = (3.1)(150)(h)^{1.5}$$



SPILLWAY SECTION

B EMERGENCY

TYPE MASONARY CREST WEIR

LENGTH L_2 = 450' CREST EL 1621.9

$$Q_{S2} = (3.1)(450)(h-2)^{1.5}$$

C DAM CREST

TYPE: MASONARY

LENGTH L_3 = 250 FT CREST EL 1623.9)

$$Q_{S3} = (3.1)(250)(h-4)^{1.5}$$

TOTAL SPILLWAY CAPACITY

$$Q_s = Q_{s1} + Q_{s2} + Q_{s3}$$
$$= 3.1\left[150\,h^{1.5} + 450\,(h-2)^{1.5} + 250\,(h-4)^{1.5}\right] \text{ cfs}$$

EL	h	Q_s cfs
1619.9	0	0
1620.9	1	465
1621.9	2	1315
1622.9	3	3811
1623.9	4	7666 (MAX)
1624.9	5	13222
1625.9	6	20186
1626.9	7	28236

MAX KNOWN FLOOD in 1936
WATER DEPTH WAS 8' OVER EMERGENCY

$$Q_s = 3.1\left[150(2.67)^{1.5} + 450(.67)^{1.5}\right]$$
$$= 2784 \text{ cfs}$$
$$\text{say } 2800 \text{ cfs}$$

say 7700 cfs MAX

RESERVOIR STORAGE CAPACITY (@ PERIMETER OF USGS)

EL	AREA, IN^2	AREA, ACRE
1620	1.76	162
1640	2.85	262

$$\Delta V = \frac{20}{3}\left[162 + 262 + \sqrt{(162)(262)}\right] = 4200 \text{ ac-ft}/20\text{FT}$$

$$\Delta V/_{FT} = 210 \text{ ac-ft}/_{FT}$$

ROUTING EQUATION

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

DETERMINE WATER DEPTH h above spillway crest FOR PMF

$$\frac{3.1\left[150h^{1.5}+450(h-2)^{1.5}+250(h-4)^{1.5}\right]}{28000}+\frac{210\times h}{34667}=1$$

h = 6.84 FT ABOVE SPILLWAY EL 1619.9
(OR 2.84 FT ABOVE DAM CREST EL 1623.9)
Q_s = 26841 cfs

FOR ½ PMF STORM

$$\frac{3.1\left[150h^{1.5}+450(h-2)^{1.5}+457(h-4)^{1.5}\right]}{\frac{1}{2}(28000)}+\frac{210\times h}{\frac{1}{2}(34667)}=1$$

h = 4.99 FT ABOVE SPILLWAY EL 1619.9
(OR 0.99 FT ABOVE DAM CREST EL 1623.9)
Q_s = 13154 cfs

PERCENTAGE OF PMF WITHOUT OVERTOPPING

$$=\left(\frac{7666}{28000}+\frac{210\times 4}{34667}\right)\times 100\% = 29.8\%\ PMF$$

Say 30% PMF

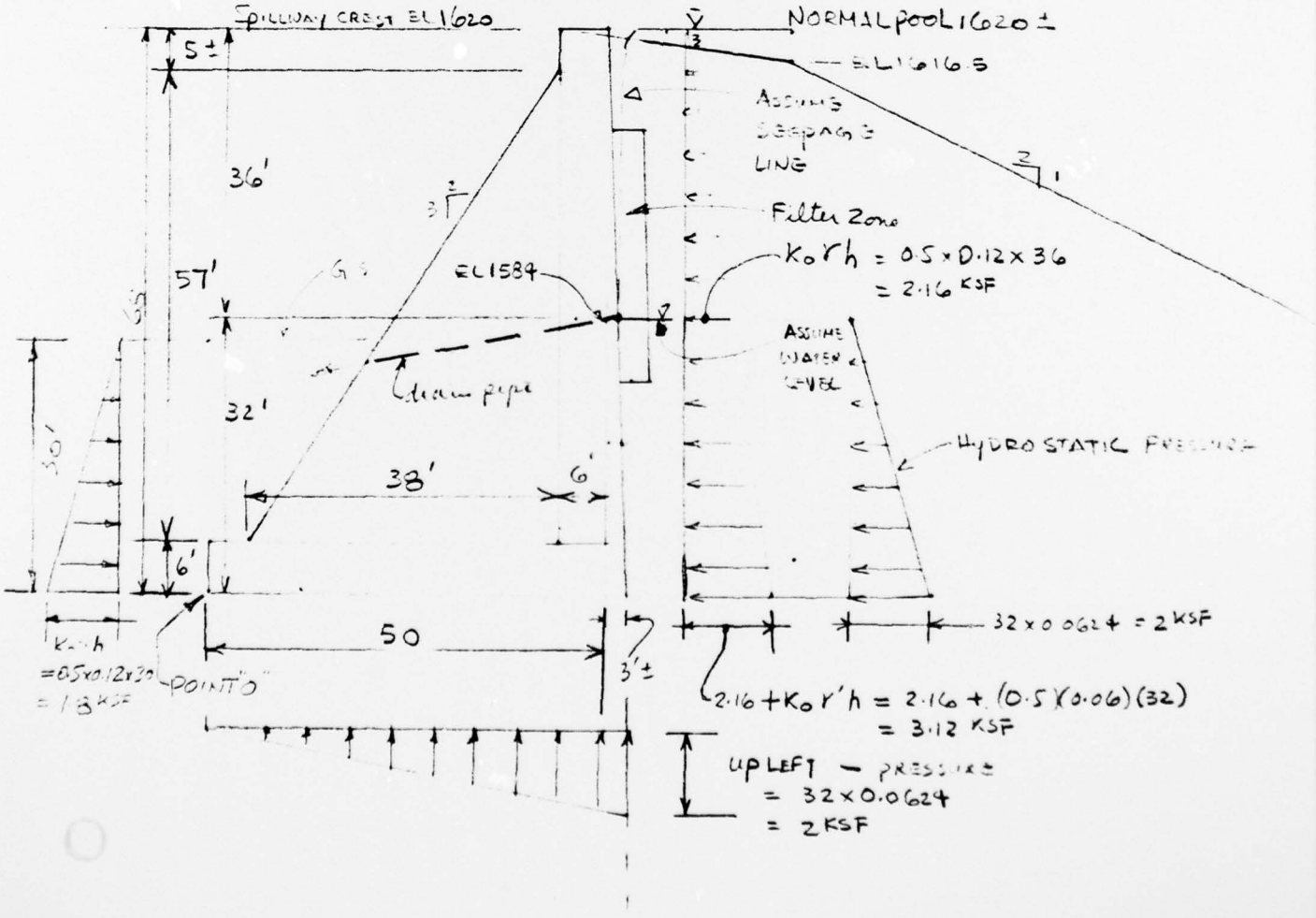
D'APPOLONIA
CONSULTING ENGINEERS, INC.

By JTC Date 6-26-78 Subject WILMORE DAM Sheet No. 1 of 5
Chkd. By BE Date 7-5-78 STABILITY ANALYSIS Proj. No. 78-114-06

WILMORE STABILITY ANALYSIS

Ref (1) DWgs 60-185-E6 "SAND DRAIN, WILMORE DAM" D'APPOLONIA ASSOCIATES dated 11-2-60
(2) DWgs 60-185-E4 "CROSS SECTION FROM STATION 8+00 to Sta 10+50 By D'APPOLONIA ASSOCIATES dated 10-15-60

Primary Spillway @ sta 9+00.



D'APPOLONIA
CONSULTING ENGINEERS, INC

By JTC Date 6-26-78 Subject WILMORE DAM Sheet No. 2 of 5
Chkd. By BE Date 7-5-78 STABILITY ANALYSIS Proj. No. 78-117-06

CASE 1 NORMAL CONDITION FOR SPILLWAY SECTION

WEIGHT

wt		× ARM to POINT "O"	= MOMENT, K-'
6 × 68 × 0.15	= 61.2 K	47 FT	2876
½ × 38 × 57 × 0.15	= 162.5 K	31.3	5086
½ × 68 × 3 × 0.15	= 15.3 K	51	780
50 × 6 × 0.15	= 45 K	25	1125
Σ =	284 K		Σ = 9867 K-'

RESULTANT WEIGHT = 284 acting at $\frac{9867}{284}$ = 34.7 FT FROM TOE

RESISTANCE FORCE ½ × 1.8 × 30 = 27 K ARM TO POINT "O" = 10' MOMENT = 270 K-'

DRIVING FORCES

FORCE		× ARM to POINT O	= MOMENT, K-'	
½(2.16)(36) = 38.9	P_H =	44	1712	
(2.16)(32) = 69.1	155.4 K	16	1106	3035
½(3.12 - 2.16)(32) = 15.4		10.7	165	
½(2)(32) = 32		10.7	342	
½(2)(53) = 53 uplift		35.3	1871	
Σ = 208.4 K			Σ = 5196 K-'	

Factor Safety against overturning = $\frac{9867+270}{5196}$ = 2.0 > 1.5 OK

FOUNDATION SHEAR STRESS = $\frac{\Sigma(\text{HORIZONTAL FORCES})}{\text{FOUNDATION AREA}}$

= $\frac{155.4 - 27}{53 \times 1}$

= 2.42 KSF

= 16.8 PSI Say 17 PSI

OK BY INSPECTION

D'APPOLONIA
CONSULTING ENGINEERS, INC

By NTC Date 6-26-78 Subject WILMORE DAM Sheet No. 3 of 5
Chkd. By GE Date 7-5-78 STABILITY ANALYSIS Proj. No. 78-1[illegible]06

Net Turning Moment = 9867 + 270 − 5196
= 4941 K-1

Net Vertical Load = 284 − 53 = 231 K

$e = \frac{53}{2} - \frac{4941}{231}$ = 5.07 FT LEFT of Centr. of Ftg

$p_{max} = \frac{V}{BL}\left(1 + \frac{6e}{L}\right)$

$= \frac{231}{1 \times 53}\left(1 + \frac{(6)(5.07)}{53}\right)$

= 6.8 KSF Compression @ Toe OK

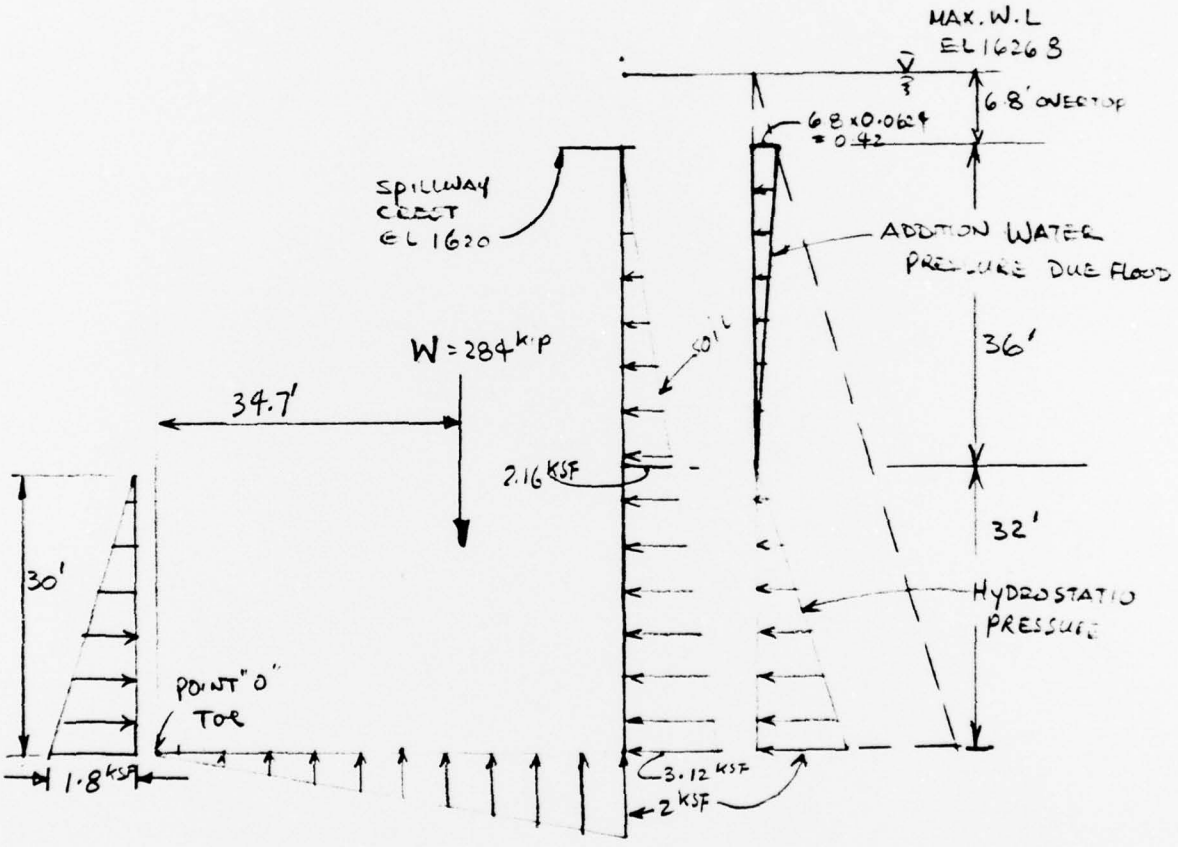
$p_{min} = \frac{231}{53}\left(1 - \frac{(6)(5.07)}{53}\right)$

= 1.9 KSF COMPRESSION @ Heel OK

CASE 2 PMF FLOOD CONDITION IN SPILLWAY SECTION

ACCORDING TO HYDROLOGY & HYDRAULIC CALCULATION THE MAX. WATER LEVEL FOR PMF IS 6.8 ABOVE EL 1620

THE UPLEFT PRESSURE IS ASSUMED UNCHANGE DURING FLOOD & THE HYDROSTATIC PRESSURE IS INCREASED AS FOLLOWS



	FORCE		ARM, FT		MOMENT
$(\frac{1}{2})(0.42)(36)$	$= 7.6^{K}$	x	56	=	426^{k-1}

F.S AGAINST OVERTURNING $= \frac{9867+270}{5196+426} = 1.8 > 1.5$ OK

FOUNDATION SHEAR STRESS $= \frac{155.4 - 27 + 7.6}{53 \times 144} \times 1000 = 17.8^{PSI}$

Say 18^{PSI}

OK BY INSPECTION

D'APPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 6-26-78 Subject WILMORE DAM Sheet No. 5 of 5
Chkd. By BE Date 7-5-78 STABILITY ANALYSIS Proj. No. 78-114-06

FOUNDATION PRESSURE

NET TURNING MOMENT = 4941 − 426 = 4515 K-ft

NET VERTICAL LOAD = 284 − 53 = 231

$$e = \frac{53'}{2} - \frac{4515}{231} = 6.95 \text{ FT LEFT OF CENTER OF FDN}$$

$$p_{max} = \frac{231}{53}\left(1 + \frac{(6)(6.95)}{53}\right)$$

$$= 7.8 \text{ KSF} \quad \text{COMPRESSION @ TOE} \quad \text{OK}$$

$$p_{min} = \frac{231}{53}\left(1 - \frac{(6)(6.95)}{53}\right)$$

$$= 0.9 \text{ KSF} \quad \text{COMPRESSION @ HEEL} \quad \text{OK}$$

APPENDIX E

REGIONAL GEOLOGY

APPENDIX E
REGIONAL GEOLOGY

The Wilmore Dam and reservoir lie just east of the axis of the Wilmore Syncline, a north-northeast trending structure. The rock strata are members of the middle portion of the Conemaugh Group (Pennsylvanian Age). The rock strata consist of shales and sandstones and the bedding dips approximately 300 feet per mile to the northwest. The coal that crops out in the lower portion of the slopes is probably the Harlem coal seam. There are five major coal seams in the Conemaugh Group, none of which are minable. However, information obtained from the Division of Mine Subsidence Regulations, Bureau of Land Protection, Department of Environmental Resources, Commonwealth of Pennsylvania, and a map published by the same agency entitled, "Mine Map of Cambria County," dated January 1975, indicates that three coal seams of the underlying Allegheny Group have been mined up to the safety zone lines of the dam and reservoir. The available information indicates that the dam and reservoir have not been undermined. The mined coal seams are the B (Lower Kittanning), C (Upper Kittanning), and E (Upper Freeport) coal seams. The Upper Freeport coal seam, the highest of the three, is located approximately 400 feet below the ground surface.

The steep slopes in the banks around the reservoir indicate that sandstone beds predominate, precluding large slides, although small rock falls probably could occur.