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NATIONAL DAM INSPECTION PROGRAM. TYRONE RESERVOIR 1 (NDI ID 536--ETC(U)
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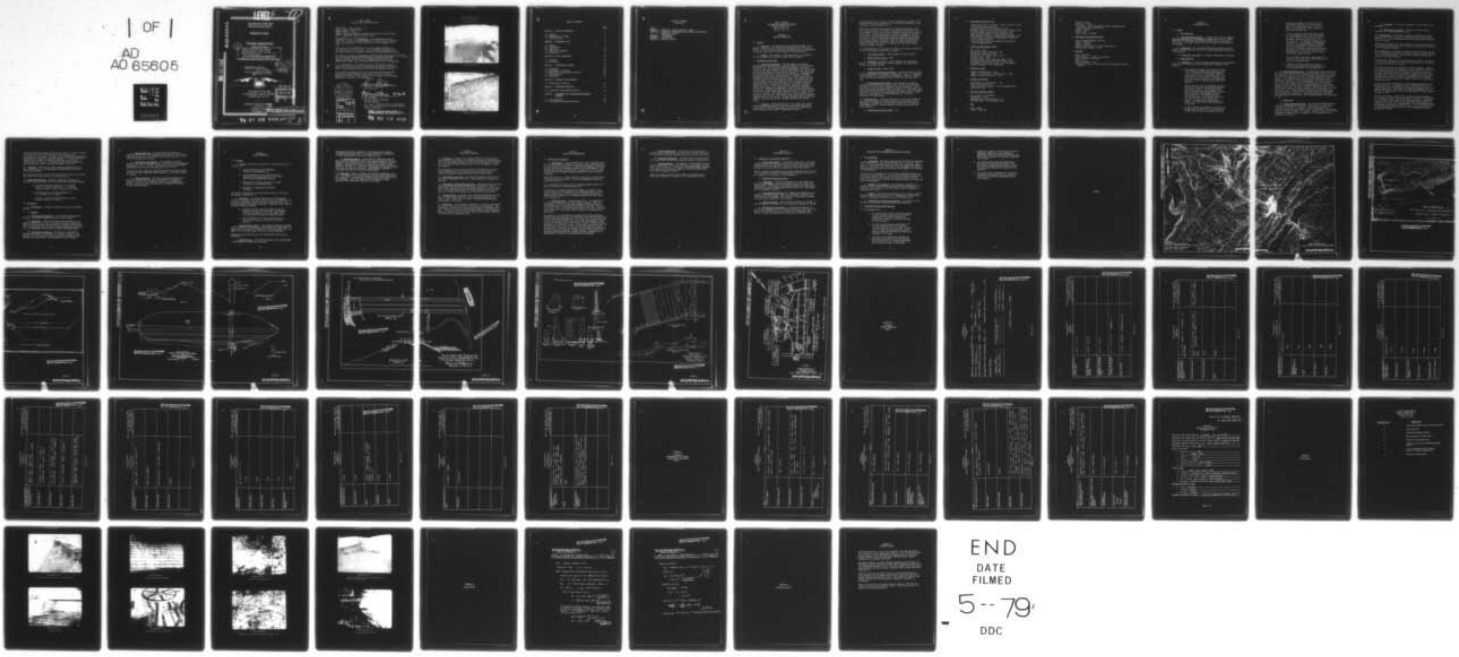

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SUSQUEHANNA RIVER BASIN
SINK RUN, BLAIR COUNTY

PENNSYLVANIA

TYRONE RESERVOIR 1

NDI I.D. NO. 536

National Dam Inspection Program.
Tyrone Reservoir 1 (NDI ID 536),
Susquehanna River Basin, Sink Run, Blair
County, Pennsylvania.

PHASE I INSPECTION REPORT.

NATIONAL DAM INSPECTION PROGRAM

(11) Sep 78

(12) 63p.

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Contract No. (15) DACW31-78-C-0049

PREPARED FOR

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

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D'APPOLONIA CONSULTING ENGINEERS
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PITTSBURGH, PA. 15235

SEPTEMBER 1978

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PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM: Tyrone Reservoir No. 1
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Blair
STREAM: Sink Run, secondary tributary of the Little Juniata River
DATE OF INSPECTION: July 11 and 18, 1978

ASSESSMENT: Based on the evaluation of the conditions as they existed on the date of inspection and as revealed by visual observations, the condition of Tyrone Reservoir No. 1 is assessed to be fair. It is

Tyrone Borough personnel reported that the drawdown facility for the reservoir is not functional. It is therefore recommended that the owner assess the functional condition of the operating facilities.

The spillway capacity is classified to be "seriously inadequate" (27% PMF), (27 percent PMF), because it is estimated that overtopping would result in failure of the dam and the damage potential would be significantly higher than that which would exist prior to overtopping.

It is recommended that the owner reevaluate the spillway capacity using more accurate analysis techniques and determine the nature and extent of improvements required to increase the spillway capacity.

It is further recommended that the owner provide around-the-clock surveillance during unusually heavy runoff to detect possible problems and develop a formal warning system to alert the downstream residents in the event of an emergency.

Lawrence D. Andersen, P.E.
Vice President

23 Sep 78

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

This dam is considered unsafe, non-emergency, under the recently furnished revised spillway capacity guidelines.

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
Lawrence D. Andersen
ENGINEER
No. 17459-E

ACCESSION NO.
NTIS White Section X
DDC Buff Section ☐
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TYRONE RESERVOIR NO. 1
NDI I.D. NO. 536
JULY 11, 1978

Upstream Face

Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
TYRONE RESERVOIR NO. 1
NDI I.D. NO. 536
DER I.D. NO. 7-1

SECTION 1
PROJECT INFORMATION

1.1 General

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

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

1.2 Description of Project

a. Dam and Appurtenances. The dam consists of an earth embankment 600 feet long, with a maximum height of 36 feet from the downstream toe. The combined primary and emergency spillway is located on the right abutment (looking downstream). The flow through the chute spillway is controlled by an ogee weir 70 feet wide at an elevation approximately 5 feet below the dam crest. Discharge over the spillway flows into a 70-foot-wide, 60-foot-long, concrete, rectangular channel and then passes over a series of steps in the discharge channel and flows into the stream. The outlet works for the dam consist of a 20-inch-diameter cast-iron blow-off pipe and a 16-inch-diameter cast-iron supply line, both located through the embankment left of the center of the dam. According to a state report dated June 7, 1915, these pipes are encased in concrete through the embankment and supported on masonry walls extending to firm ground. Discharge through these pipes is controlled by valves located in an intake tower and by valves located in a valve house at the toe of the dam. The intake tower has no direct access; it is accessible only by boat. The blow-off pipe constitutes the emergency drawdown facility for the dam. Borough personnel reported that the blow-off valve for the dam has not been functional for several years.

b. Location. Tyrone Reservoir No. 1 is located on Sink Run about two miles upstream of its confluence with Bald Eagle Creek, a tributary of Little Juniata River, two miles west of Tyrone in Snyder Township, Blair County, Pennsylvania (Plate 1).

Tyrone Reservoir No. 2, which is located immediately upstream of the backwater from Tyrone Reservoir No. 1, is the only reservoir in the watershed of Tyrone Reservoir No. 1.

Downstream from Tyrone Reservoir No. 1, Sink Run flows about 3000 feet southeast where it is diverted into Schell Run valley to the south through the U.S. Army Corps of Engineers' flood control project on Sink Run. The Baltimore District, Corps of Engineers, reports that the flood control embankment would be overtopped in the event of failure of one of the upstream reservoirs and flow would follow the original course of Sink Run. Below the flood control project, Sink Run goes through residential areas of Tyrone, restricted by numerous bridges. The stream is confined to a small box culvert through the town of Tyrone.

It is estimated that in the event of failure of the dam, a large loss of life and property would result in Tyrone.

c. Size Classification. Small (based on 36-foot height).

d. Hazard Classification. High.

e. Ownership: Borough of Tyrone (Address: Mr. Raymond B. Ervin, Jr., Borough Secretary, Tyrone Borough, 1100 Logan Avenue, Tyrone, Pennsylvania 16686).

f. Purpose of Dam. Water supply.

g. Design and Construction History. The dam was built in 1896 by Hite and Company of Clearfield, Pennsylvania. Mr. T. J. Humphries of Philadelphia was the designer and engineer in charge of construction. The dam was enlarged in 1910 by raising of the crest nine feet.

h. Normal Operating Procedure. The reservoir is normally maintained at spillway crest level, which is about five feet below the crest level of the dam as measured in this inspection. Elevations shown on the design drawings are relative to an arbitrary site datum of Elevation 100 taken at the spillway crest. The U.S. Geological Survey 7.5-minute Tipton quandrangle map (photorevised in 1972) shows the pool elevation of Tyrone Reservoir No. 1 to be at Elevation 1178 (USGS Datum).

1.3 Pertinent Data. Elevations referred to in this and subsequent sections of the report are calculated based on approximate field measurements assuming the spillway crest elevation to be 1178 feet (USGS Datum) which is the pool elevation shown in the above-referenced USGS map.

a. Drainage Area (square miles) - 6.0

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site - 1000 in 1936 (3.5 feet over 50-foot-wide spillway)
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 - 2500 at Elevation 1183
Total spillway capacity at maximum pool elevation - 2500 at Elevation 1183

c. Elevation (USGS Datum) (feet)

Top of dam - 1183
Maximum pool-design surcharge - N/A
Full flood control pool - N/A
Recreation pool (normal pool) - 1178
Spillway crest - 1178
Upstream portal invert diversion tunnel - N/A
Downstream portal invert diversion tunnel - N/A
Streambed at center line of dam - 1147 (estimated)
Maximum tailwater - 1147 (estimated)

d. Reservoir (feet)

Length of maximum pool - 1300
Length of recreation pool (normal pool) - 1100
Length of flood control pool - N/A

e. Storage (acre-feet)

Recreation pool (normal pool) - 184
Flood control pool - N/A
Design surcharge (maximum) - 259 at Elevation 1183
Top of dam - 259

f. Reservoir Surface (acres)

Top of dam - 20 (estimated)
Maximum pool - N/A
Recreation pool (normal pool) - 15
Spillway crest - 15 at Elevation 1178

g. Dam

Type - Earth
Length - 600 feet

Height - 36 feet
Top width - 10 feet
Side slopes - 2H:1V (upstream); 1.5H:1V (downstream) to Elevation 1169 and 2H:1B below
Zoning - Unknown
Cutoff - Yes
Grout curtain - Unknown

h. Diversion and Regulating Tunnel

Type - 20-inch-diameter cast iron
Length - 120± feet
Closure - Valves
Access - Valve house at toe and intake tower
Regulating facilities - Valves

i. Spillway

Type - Ogee weir
Length of weir - 70 feet (as measured)
Crest elevation - 1178 feet
Gates - N/A
Upstream channel - Lake
Downstream channel - 6-foot by 70-foot rectangular concrete channel

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available

(1) Hydrology and Hydraulics. A state report entitled, Report Upon the Application of the Borough of Tyrone, dated July 7, 1936, summarizes the hydrologic and hydraulic data which are available for the project. The report states the criteria used for the design of the spillway.

(2) Embankment. The available information includes a limited number of design drawings, various past state inspection reports, and correspondence.

(3) Appurtenant Structures. No design information is available.

b. Design Features

(1) Embankment. A review of design drawings and the correspondence files for the dam show the following main features of the project:

a. As originally designed, the dam was a 27-foot-high, essentially homogeneous embankment with a 2 to 1 (horizontal to vertical) upstream slope and a 1-1/2 to 1 downstream slope. The crest width of the dam was 23 feet and a 24-foot-wide bench was located on the downstream slope at a level 15 feet below the dam crest (Plate 2).

   Reports indicate that the embankment material was placed in one-foot layers and compacted with wooden rollers. The embankment was built by placing less porous material in the upstream half of the embankment and more porous material in the downstream half. The upstream face of the dam was lined with two feet of puddle clay, protected by riprap. The puddle clay lining joined a puddle clay cutoff wall at the upstream toe of the dam.

b. In 1910, the dam was enlarged to increase the storage capacity (Plate 2). Fill was placed on the crest and on the downstream slope to

increase the height of the dam by 9 feet. The enlarged dam had a 2:1 upstream slope and a 1.5:1 downstream slope. A 5-foot bench was located about 15 feet above the toe of the enlarged dam.

c. In 1919, additional porous fill was placed on the downstream face of the dam starting at a level about 14 feet below the crest of the dam to reduce the slope from 1.5:1 to 2:1 (Plate 3). The purpose of this fill was reported to be to strengthen the embankment in view of the seepage problems encountered after the enlargement of the dam in 1910. The source of seepage through the embankment was attributed to the water entering into the embankment at the interface of the old dam and the fill placed in 1910.

   The 1919 repairs included reconstruction of a portion of the puddle clay cutoff trench at the toe of the upstream slope.

d. Available information indicates that no subsurface investigation was conducted prior to the construction of the original dam.

(2) Appurtenant Structures. The appurtenant structures for the dam consist of an uncontrolled spillway and outlet works. The spillway structures consist of a 70-foot-long ogee weir located at a level five feet below the dam crest and a concrete rectangular discharge channel. The plans and details of the spillway structures are illustrated in Plates 4 and 5, respectively. The outlet works consist of an intake tower, a 20-inch blow-off pipe, and a 16-inch supply line, all located through the embankment and a valve house located at the toe of the dam. Discharge through the pipes can be controlled by either the valves located at the intake tower or at the valve house. No design drawings are available for the details of the outlet works. A state report indicates that the pipes through the embankment were encased in concrete and supported on masonry walls extending to firm ground. The existing spillway was constructed in 1936.

c. Design Data

(1) Hydrology and Hydraulics. The 1936 report stated that the spillway was designed for an inflow of 665 cubic feet per second (cfs) per square mile of watershed. The spillway capacity as designed was reported to be 4000 cfs with no freeboard. No calculations were found to support this number. However, present calculations (Appendix D) indicate that the capacity of the spillway with no freeboard is 2500 cfs.

(2) Embankment. No data are available on the design of the embankment.

(3) Appurtenant Structures. There are no design values available for the appurtenant structures.

2.2 Construction. There were no original construction drawings available for review. Two state inspection reports dated March 9, 1914 and June 7, 1915 summarize the available construction information for the dam.

These reports indicate that the foundation for the dam was prepared by removing the stumps and large rocks and by excavating the topsoil down to impermeable hardpan.

The embankment was constructed from material excavated near the dam site. The material was placed in one-foot layers, watered, and compacted with wooden rollers. The dam had a 30-foot-wide spillway located on the right abutment.

As previously described, the dam was enlarged in 1910. The height of the dam was increased by 9 feet and the spillway crest width was increased from 30 feet to 34 feet.

On filling the lake after completion of the enlargement, seepages were observed through the embankment. Records indicate that due to the seepage condition, the state ordered the owner of the dam at the time, Tyrone Gas and Water Company, to immediately lower the spillway level to the level prior to enlargement until the seepage condition was corrected. Further reports indicate that seepage through the dam was significantly reduced when the pool level was lowered five feet.

In 1911, the dam was inspected by three engineers appointed by the Borough of Tyrone. The inspection was in conjunction with the investigation of the breaching of the upstream reservoir by a flood during construction. The inspection report recommended that the spillway of Tyrone Reservoir No. 1 be increased to 55 feet, and this was done in 1915.

In 1916, the dam was inspected by a private consulting engineer, Mr. Frederic R. Sterns, who was retained by the state. This inspection concluded that in view of the continuing seepage conditions below the toe of the dam and steep downstream slope (1.5H:1V) the condition of the dam was "unsatisfactory." The recommendations were to decrease the downstream slope from 1.5:1 to 2:1 by placing fill on the downstream slope of the dam. These recommendations were implemented in 1919.

After the 1936 flood, which raised the pool level to within 18 inches of the dam crest, the spillway capacity was assessed to be insufficient by the state. The owner, Tyrone Borough Water Department, was advised to increase the spillway capacity. In 1936, plans were submitted by the owner to increase the spillway crest to its present length of 70 feet. In conjunction with the enlargement of the spillway, the crest of the dam was raised by one foot.

2.3 Operation. There are no formal operating procedures for the dam. The spillway of the impoundment is uncontrolled and has no operational features.

The blow-off pipes for the dam are controlled by valves at the intake tower and at the valve house at the toe of the dam.

2.4 Other Investigations. Available information includes the following reports in addition to state inspection and review reports:

a. An inspection report signed by J. N. Chester, ASCE, W. C. Howley, ASCE, and W. G. Williams, ASCE (not dated - assumed to be March 31, 1911).

b. An inspection report dated September 10, 1911, signed by C. W. Knight.

c. An inspection report dated November 24, 1916, signed by Frederic R. Sterns.

2.5 Evaluation

a. Availability. Available engineering data were provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. The available information is limited to providing the design capacity of the spillway.

(2) Embankment. Review of the geotechnical aspects of the design indicates that in view of the age of the dam, completed in 1896, the design approach and construction techniques are not likely to be in conformance with currently accepted engineering practice, e.g., the embankment does not have an internal drainage system.

(3) Appurtenant Structures. No drawings are available to evaluate the design of outlet works for the dam. Review of the drawings for the spillway indicates no apparent significant deficiencies that should affect the performance of the structure.

c. Operating Records. No formal operating records are available for the dam. Correspondence dated April 29, 1936, indicates that during the flood in March 1936 the maximum depth of flow over the spillway was 42 inches.

d. Post-Construction Changes. As discussed in previous sections, the dam was enlarged in 1910. The height of the embankment was raised by 9 feet. In 1919, additional fill was placed on the downstream slope to reduce the slope from 1.5:1 to 2:1.

The spillway crest length was increased from 30 to 34 feet in 1919. In 1936, the crest length was again increased to its present length of 70 feet.

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 Tyrone Reservoir No. 1 consisted of:

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

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

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

4. Evaluation of downstream area hazard potential.

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

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

1. Numerous wet areas and three seepage areas were observed below the toe of the dam. The seepage flows were estimated to be in the range of one to four gallons per minute as shown in Plate 6.

2. The downstream face of the dam was found to be covered with high grass which sould be mowed annually.

c. Appurtenant Structures. The spillway structures, spillway crests, channels, and plunge pool were examined for deterioration or other signs of distress and obstructions that would limit flow. In general, the structures were found to be in fair condition.

Borough personnel reported that the lake blow-off valve was not functional.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered with woodlands.

The shorelines are not considered to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

3. Downstream Channel. About 3000 feet downstream from the dam, Sink Run is diverted to Schell Run valley through the Corps of Engineers flood control project. The Baltimore District, Corps of Engineers, reported that the flood control project would be overtopped in the event of a failure of the dam and the flow would follow the course of Sink Run into Tyrone. Photographs in Appendix C illustrate the course of Sink Run through Tyrone.

3.2 Evaluation. General condition of the dam is considered to be fair. The extent of the wet areas below the dam raises some concern as to the effect of the seepage through the dam on the stability of the embankment. The owner should monitor and record seepage quantities and observe the turbidity of the seeps.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedures. Review of the design drawings and field observations indicate that there are no formal procedures for operating the dam. The operational feature of the dam which may affect the safety of the dam is the blow-off pipe valve, if it is required to lower the reservoir.

The clearing of debris from the spillway as required and the 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 conditions of the dam are considered to be fair. Annual mowing of the grass is required.

4.3 Maintenance of Operating Facilities. Borough personnel reported that the blow-off valve for the dam is not functional. Visual observations indicate that the operating equipment is in poor condition. The intake tower where the upstream valves for the blow-off pipe are located has no bridge; it is only accessible by boat.

4.4 Warning System. No formal flood warning system exists for the dam. The dam is maintained by borough personnel operating from Tyrone, about 2 miles from the site. No communication facilities are available at the site.

4.5 Evaluation. The operational condition of the dam is considered to be poor. The blow-off valve is reported to be inoperable. The maintenance condition of the operating equipment is considered to be poor. The dam is accessible only through a narrow road; therefore, access to the site may be difficult during severe weather conditions for inspection and emergency action.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Tyrone Reservoir No. 1 has a watershed area of 6.0 square miles and impounds a reservoir with a surface area of 15 acres at normal pool level. A 70-foot-wide spillway constitutes both the primary and emergency spillway for the impoundment. Flow through the spillway is controlled by an ogee weir. As it exists, the spillway has a maximum discharge capacity of 2500 cfs with no freeboard.

Tyrone Reservoir No. 2, which impounds a lake with a surface area of 23 acres at normal pool level, is located immediately upstream of Tyrone Reservoir No. 1.

It is estimated that failure of the upstream reservoir would also result in failure of Tyrone Reservoir No. 1.

In the event of probable maximum flood (PMF), the effect of the upstream reservoir is considered to be negligible because the surcharge storage volume of this reservoir (115 acre-feet) is much smaller than the volume of the probable maximum flood (8300 acre-feet) (Appendix C).

b. Experience Data. Tyrone Reservoir No. 1 is classified to be a "small" size dam in the "high" hazard category. Under the recommended criteria for evaluating emergency spillway capacity, such impoundments are required to pass half to full PMF. In view of the high loss of life and damage potential that exists downstream from the dam, the upper limit of the criteria is considered to be applicable.

The adequacy of the spillway was analyzed based on the simplified procedure and the hydrologic data provided by the Baltimore District, Corps of Engineers (Appendix D). They report that the PMF would have a peak flow of 1639 cfs per square mile, which corresponds to 9800 cfs for the drainage area of the dam and a volume of 8300 acre-feet, equivalent to 26 inches of runoff. These values are greater than the spillway capacity of 2500 cfs and the surcharge storage volume of 85 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 27 percent of the PMF without overtopping.

c. Visual Observations. On the dates of inspections, no conditions were observed that 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 27 percent PMF.

e. Spillway Adequacy. The capacity of the spillway is less than 50 percent PMF. It is estimated that overtopping of the dam would result in failure of the dam and downstream damage potential would significantly increase compared to that which would exist just before overtopping failure.

Based on the above results, the spillway is classified to be "seriously inadequate" according to the recommended criteria.

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 at this time and none were reported in the past after the completion of the 1919 repairs.

However, because of the extent of wet areas below the toe of the dam, it is considered advisable to quantitatively evaluate the effect of the seepage on the stability of the embankment.

b. Design and Construction Data

(1) Embankment. The dam was designed at a time (1896) when limited understanding of the geotechnical behavior of earth structures existed. Consequently, the available design and construction information includes limited quantitative data to aid in the assessment of embankment stability.

(2) Appurtenant Structures. No drawings are available on the design of the outlet works. Available information indicates that pipes through the embankment were encased in concrete and supported on masonry walls extending to firm ground.

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

d. Post-Construction Changes. As discussed in Section 2.2, the dam was enlarged in 1910 by raising the crest by about nine feet, and in 1919 additional fill was placed on the downstream slope. Details of these enlargements are illustrated in Plates 2 and 3.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations and review of available information indicate that Tyrone Reservoir No. 1 is in fair condition. Although observations did not reveal any significant signs of distress, the extent of wet areas below the dam suggest the need to quantitatively investigate the effect of the seepage on the stability of the embankment.

The spillway is considered to be "seriously inadequate" because its capacity (27 percent PMF) is less than 50 percent PMF and because it is estimated that overtopping of the dam would result in failure which would significantly increase the damage potential existing just prior to overtopping.

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. More detailed evaluation of the spillway capacity should be made immediately and other recommendations listed below should be implemented immediately or on a continuing basis.

d. Necessity for Further Investigation. The capacity of the spillway is considered to require further investigation.

7.2 Recommendations/Remedial Measures

It is recommended that:

1. The owner should initiate additional studies to more accurately ascertain the spillway capacity and the nature and extent of improvements required to provide sufficient spillway capacity.

2. The owner should evaluate the stability of the dam considering the wet conditions existing below the toe of the dam. In addition, the owner should monitor and record seepage quantities regularly and observe the turbidity of the seeps.

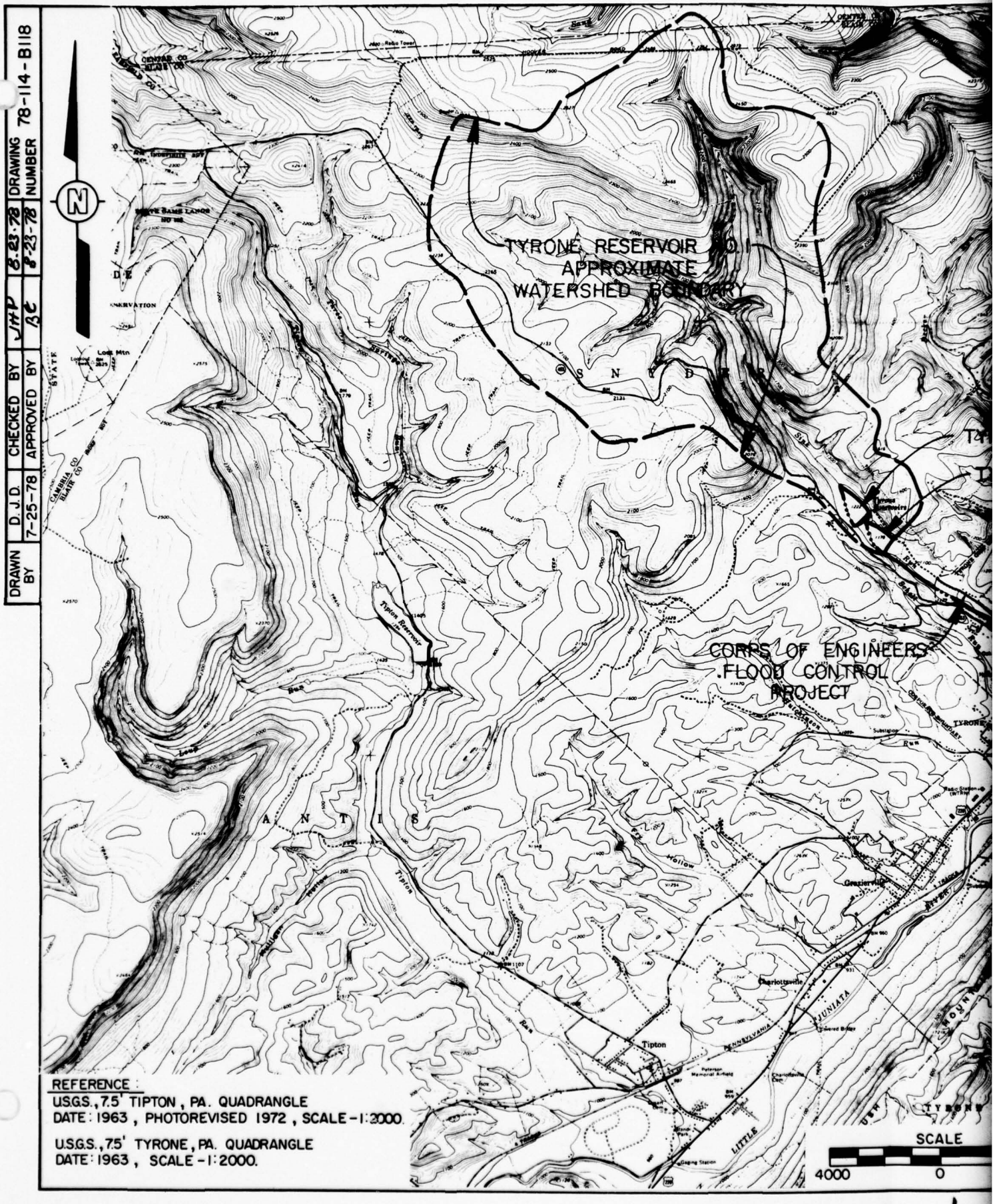
3. The owner should immediately evaluate the operational condition of the lake blow-off valve and perform any necessary maintenance and/or repairs to make it functional.

4. Because the adequacy of the reported concrete encasement around the pipes through the embankment could not be reliably assessed, the owner should evaluate the structural integrity of the pipes.

5. The owner should provide around-the-clock surveillance during unusually heavy runoff and develop a formal warning system to alert the downstream residents in the event of an emergency.

6. The owner should be advised that the dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

PLATES



REFERENCE:

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DATE: 1963, PHOTOREVISED 1972, SCALE - 1:2000.

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DATE: 1963, SCALE - 1:2000.

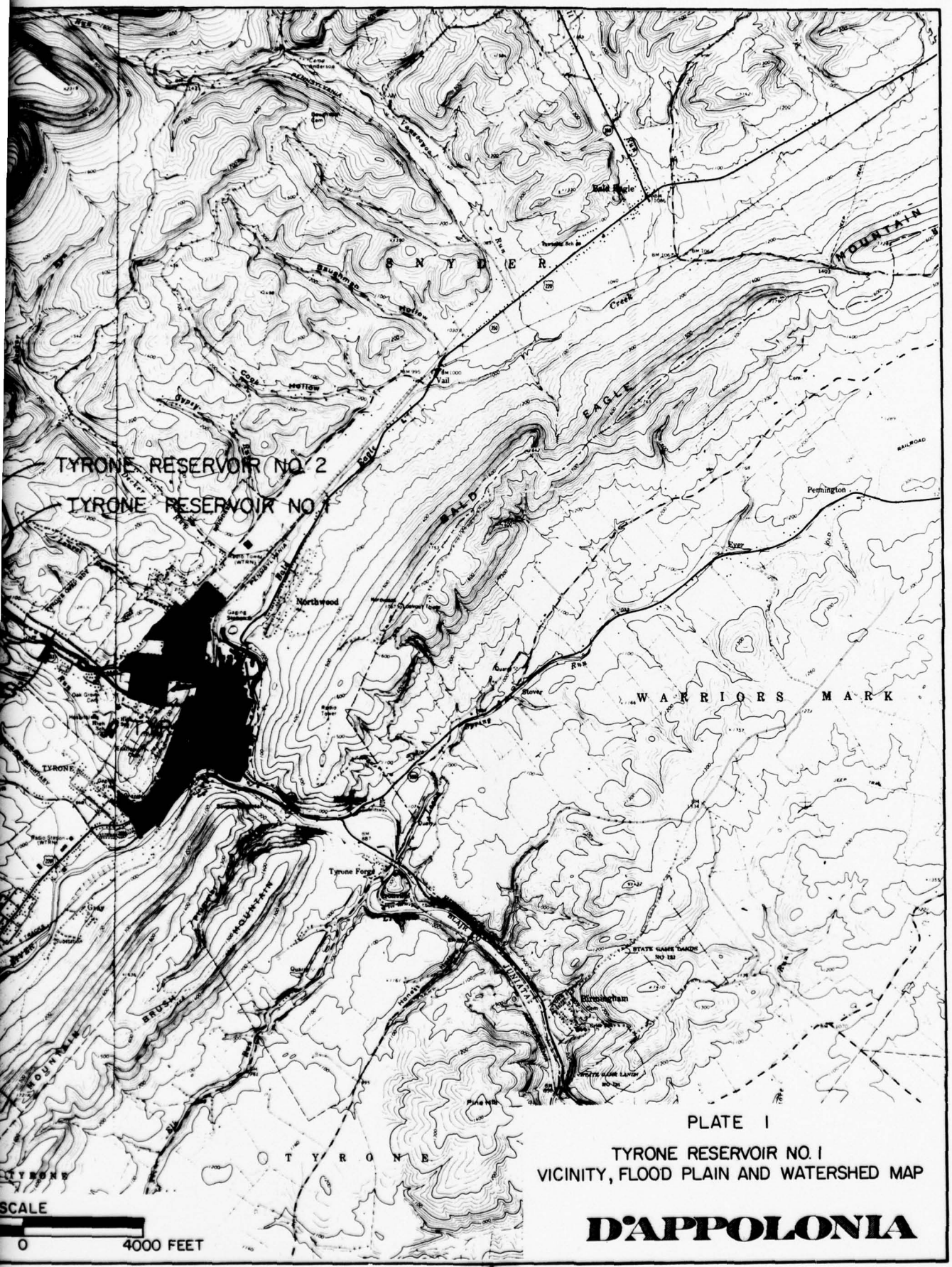

PLATE 1

TYRONE RESERVOIR NO. 1
VICINITY, FLOOD PLAIN AND WATERSHED MAP

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	JAP	8-23-78	DRAWING NUMBER	78-114-B105
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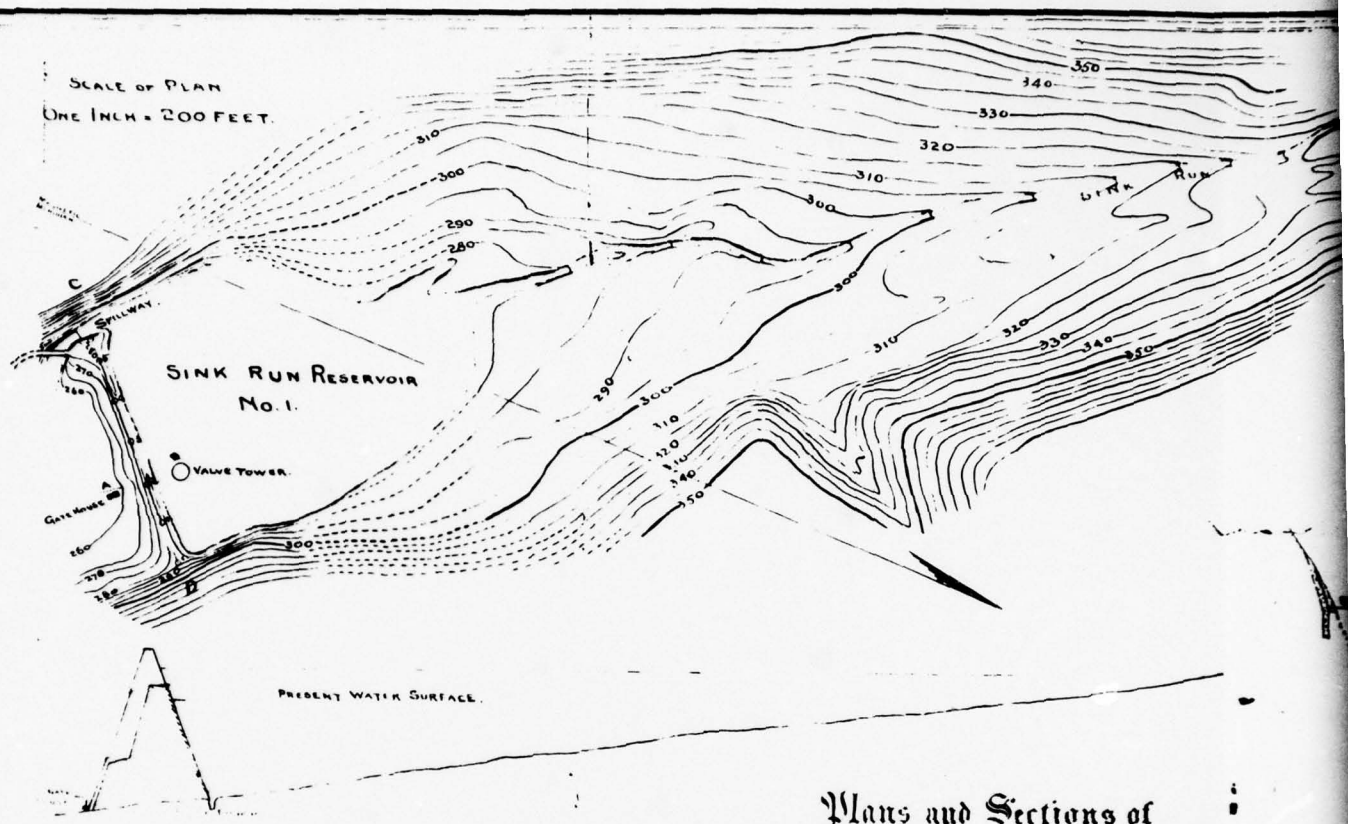

SECTION.
THROUGH CENTER OF RESERVOIR.

SCALE. { HOR. ONE INCH = 100 FEET.
VERT. ONE INCH = 20 "

Plans and Sections of
SINK RUN DAM AND RESERVOIR No. 1, AS ENLARGED FOR
TYRONE GAS AND WATER COMPANY.

ALTOONA, PA., MAY 27, 1910.

Lowry Linton

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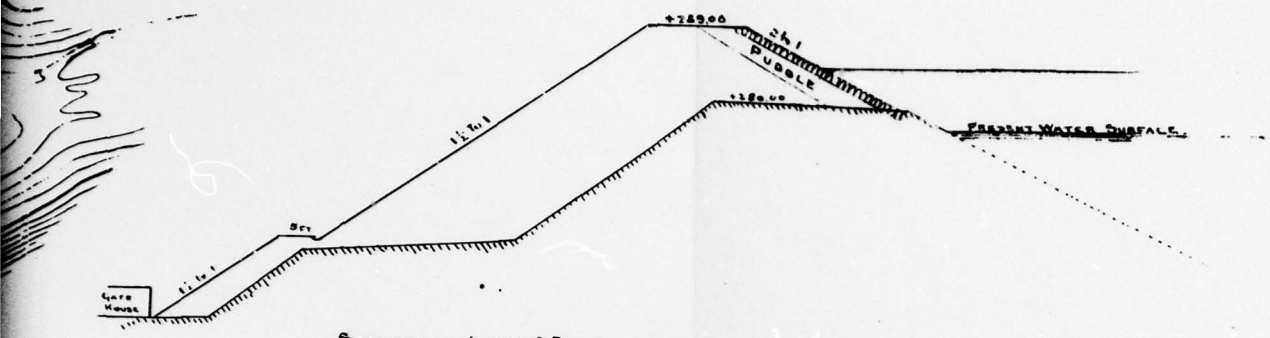
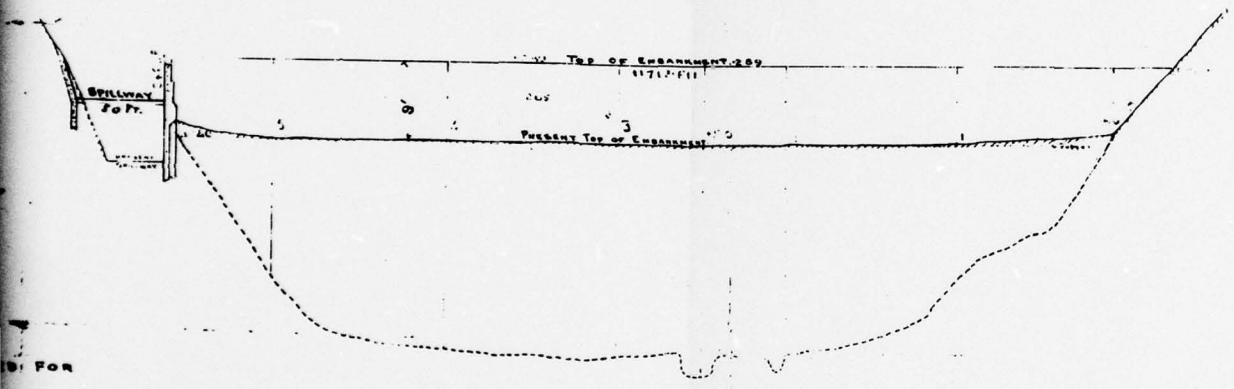


SECTION ON LINE AB. SCALE, ONE INCH = 10 FEET.



SECTION ON LINE CD. SCALE HOR. ONE INCH = 50 FEET
VERT. ONE INCH = 10 FEET.

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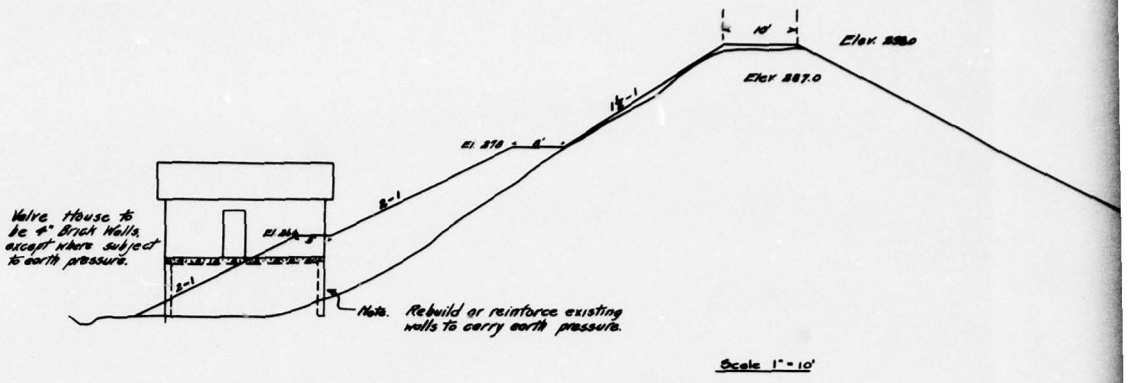
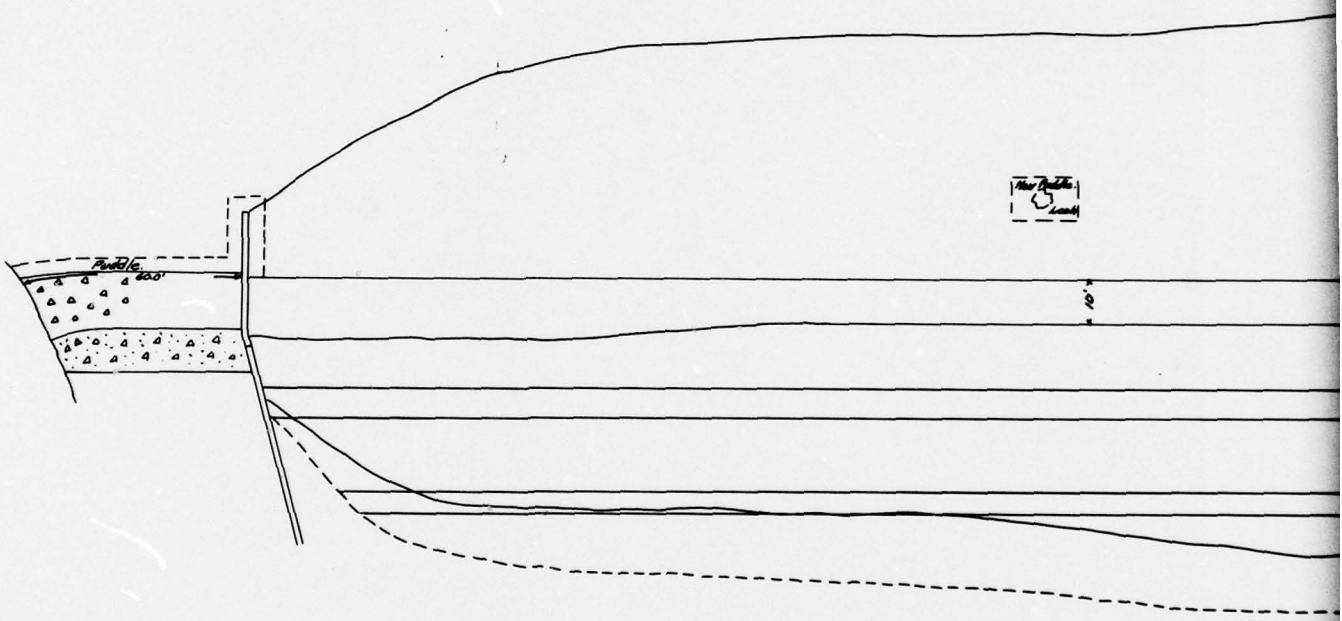
PLATE 2

D'APPOLONIA

DRAWN BY	D. J. D.	CHECKED BY	VHP	8-23-78	DRAWING NUMBER	78-114-B103
	7-21-78	APPROVED BY	BE	8-23-78		





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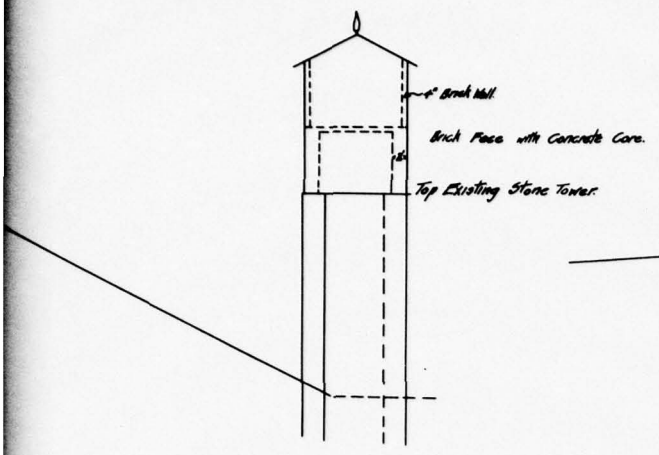
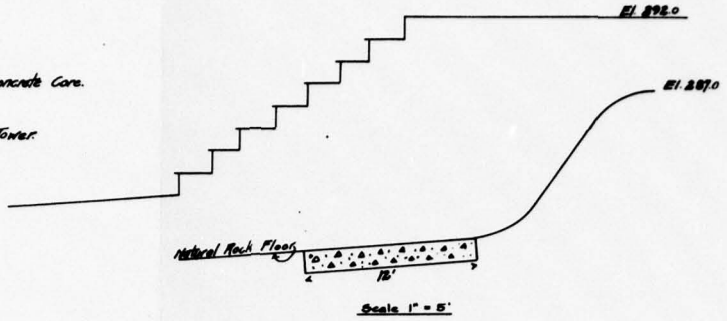
PLAN SHOWING
PROPOSED ADDITIONS AND BETTERMENTS
TO
No. 1 DAM ON SINK RUN OF
TYRONE GAS & WATER COMPANY
TYRONE, PA.

Scales as Shown. May 19, 1919.





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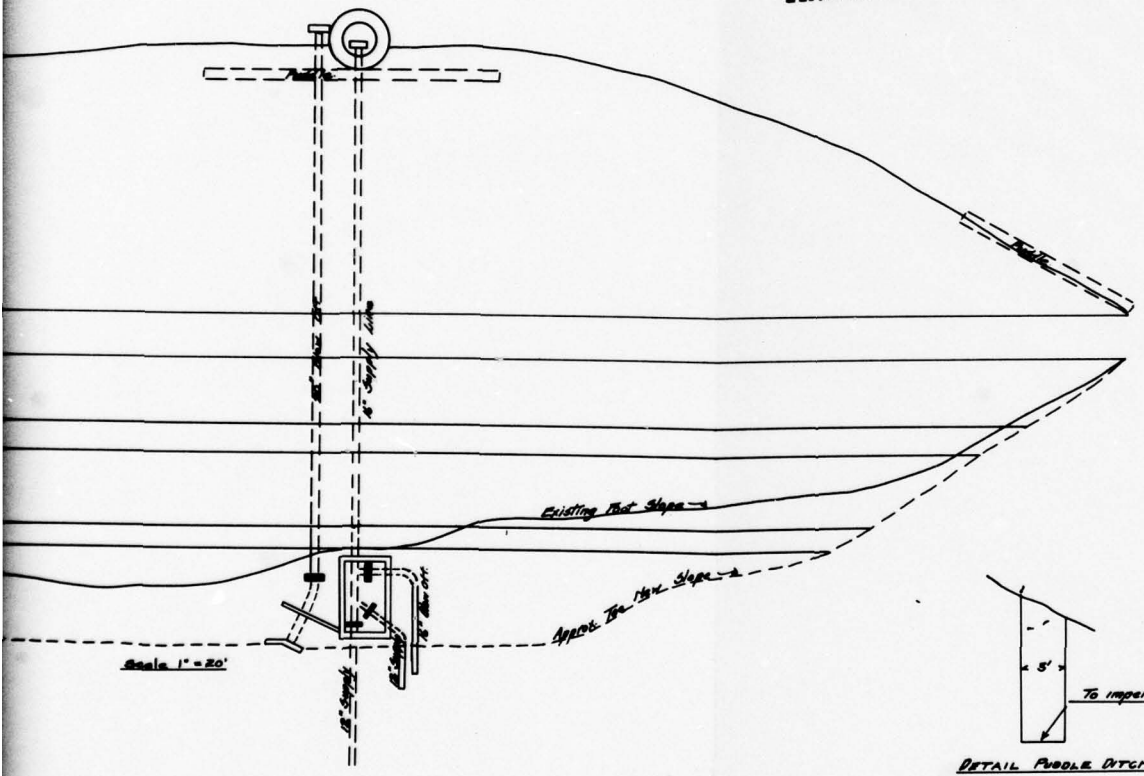


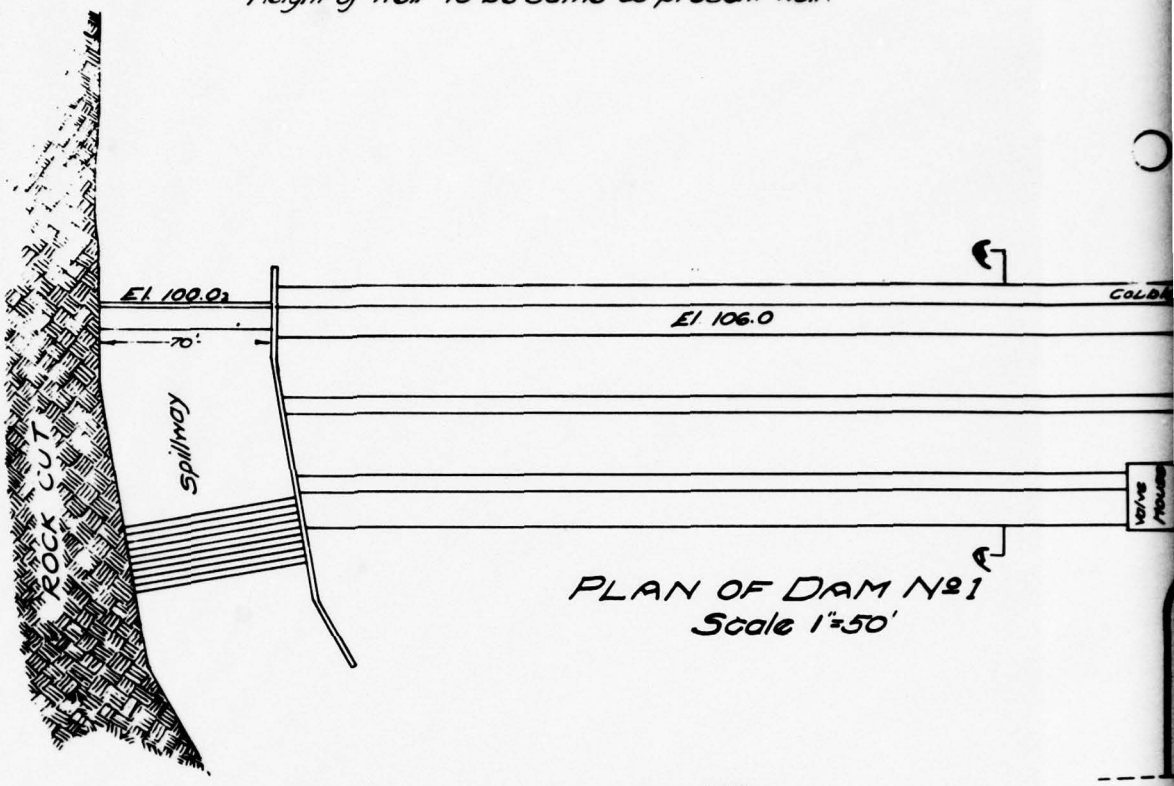
DETAIL PUDDLE DITCHES.

PLATE 3

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	VHP	8-23-78	DRAWING NUMBER	78-114-B106
	7-21-78	APPROVED BY	BE	8-23-78		

Note - Brest of Dam to be raised 1'.
Height of Weir to be same as present weir.



PLAN OF DAM No 1
Scale 1"=50'

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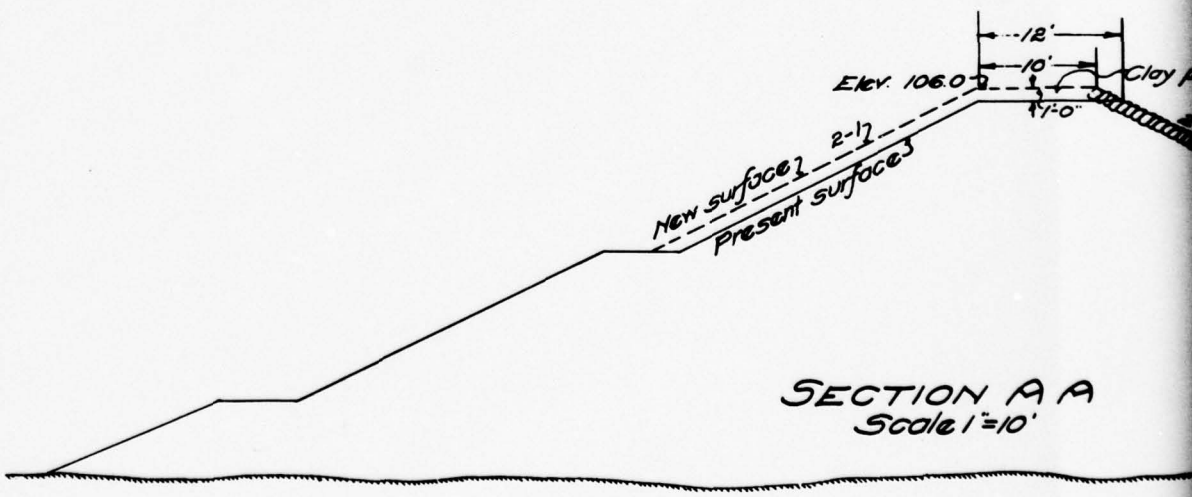
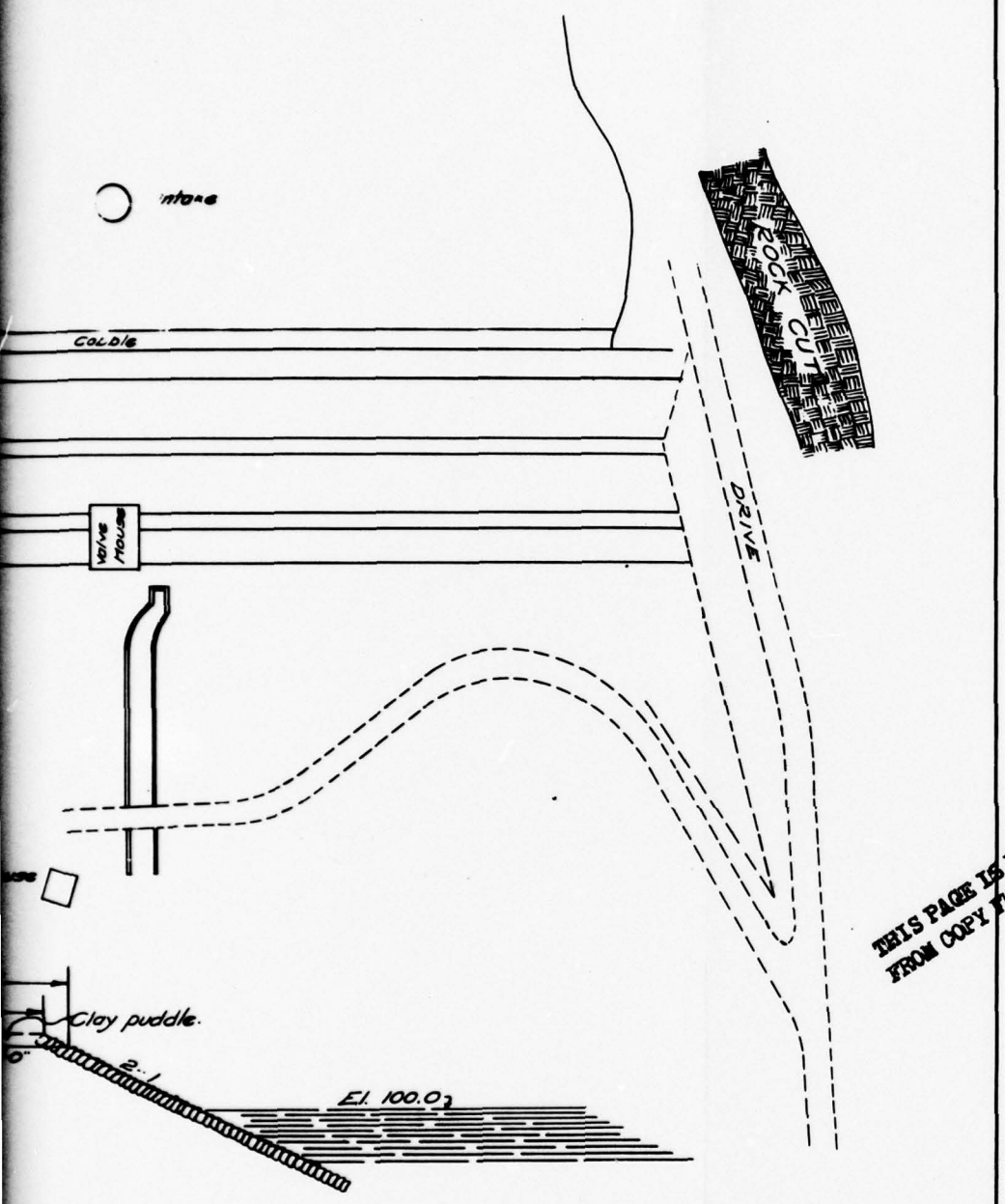


SECTION A A
Scale 1"=10'



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PLAN DAM No 1. TYRONE PA.
SHOWING NEW CONSTRUCTION
June 30-1936 Scales as shown

Raymond A. Hagerman
Registered C.E. Tyrone Pa.

PLATE 4

D'APPOLONIA

DRAWN BY	D.J.D	CHECKED BY	J.H.P	8-23-78	DRAWING
	7-21-78	APPROVED BY	[illegible]	8-23-78	NUMBER 78-114-B104

Note:
All concrete to be 1-2-4 Mix.

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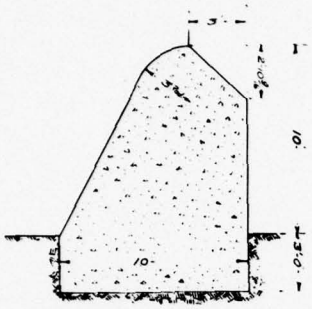
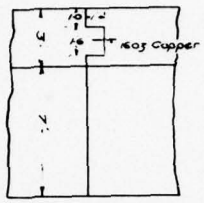
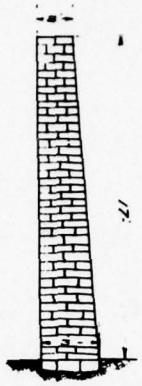


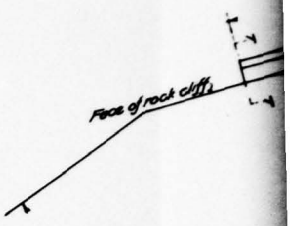
SECTION A.A.
Scale 1/4"=1'

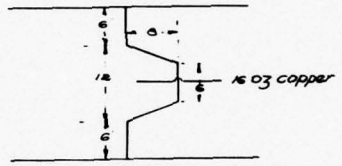


DETAIL OF WEIR JOINT.
Scale 1/4"=1'

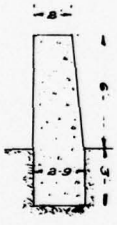


SECTION L.L. & R.R.
Scale 1/4"=1'

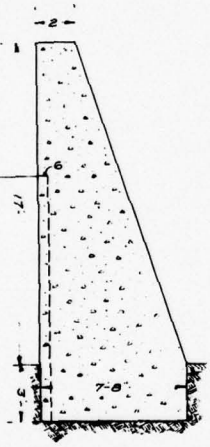




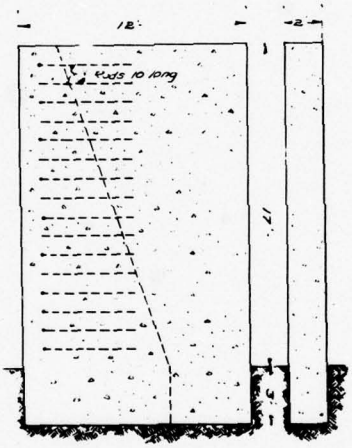
DETAIL OF WALL JOINT
Scale 1"=1'



SECTION B.B.
Scale 1/4"=1'



SECTION C.C. & E.E.
Scale 1/4"=1'

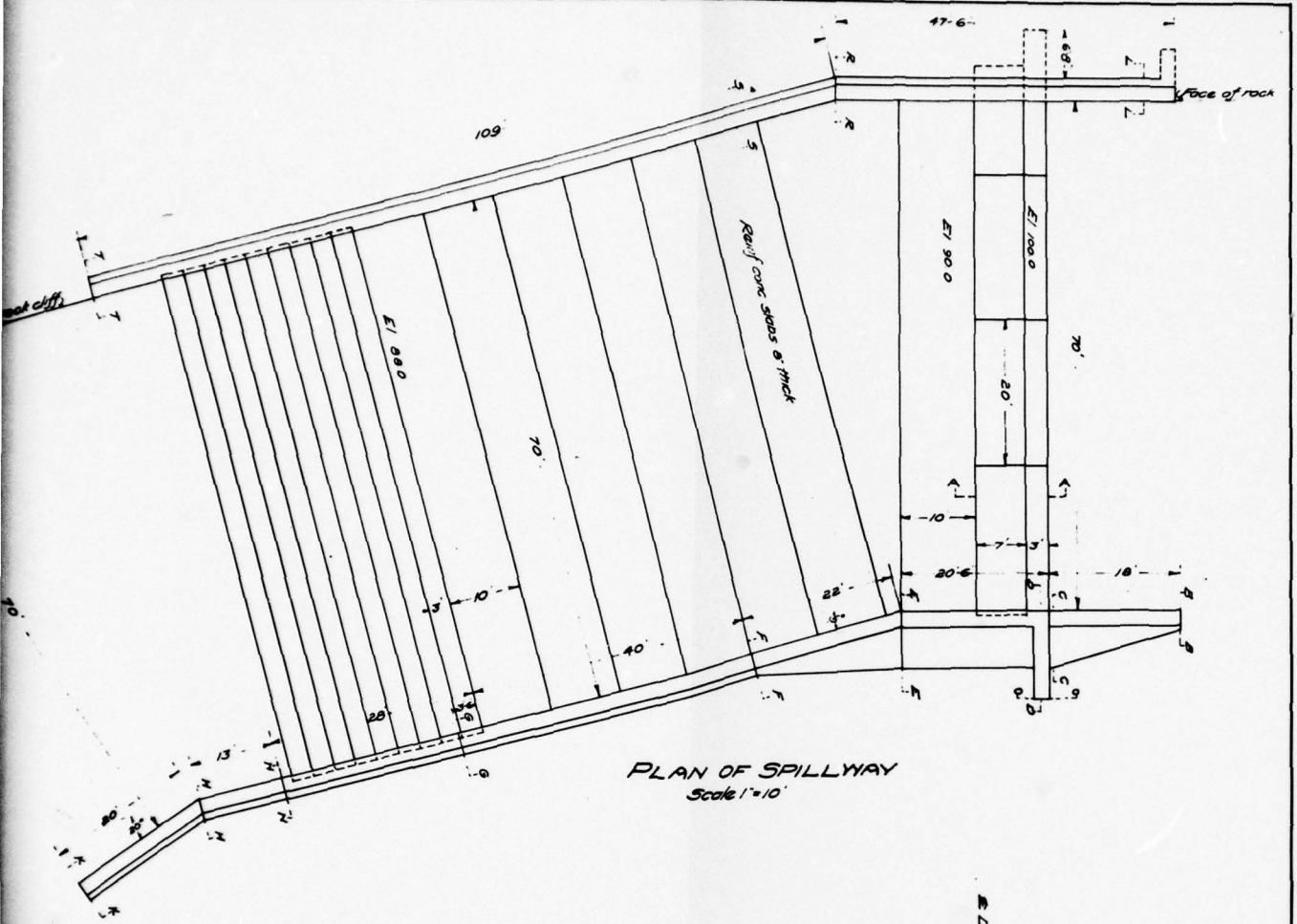


SECTION D.D.
Scale 1/4"=1'

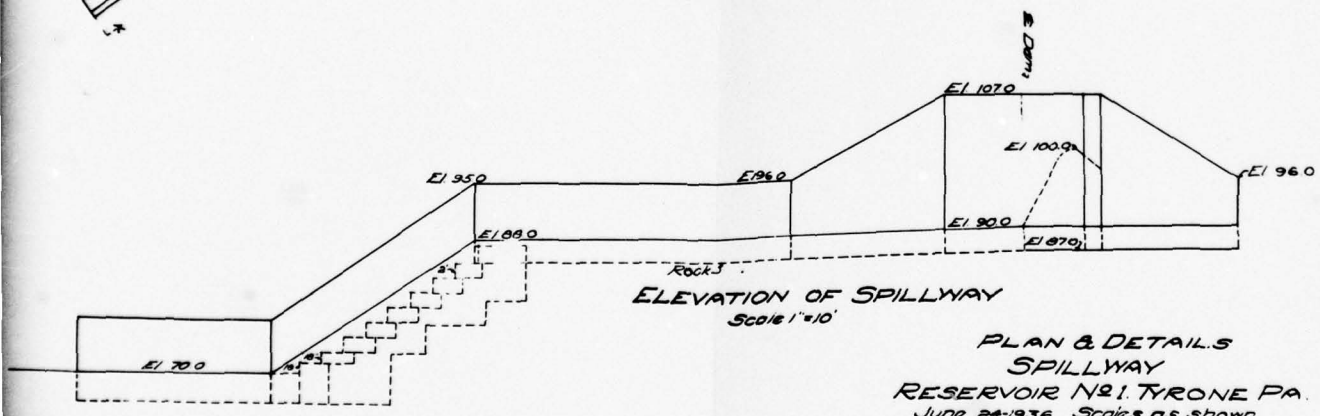
SECTION O.O.
Scale 1/4"=1'

SECTION F.F. G.G. N.N. H.H. & K.K.
Scale 1/4"=1'

SECTION S.S. & T.T.



PLAN OF SPILLWAY
Scale 1"=10'



ELEVATION OF SPILLWAY
Scale 1"=10'

PLAN & DETAILS
SPILLWAY
RESERVOIR No 1. TYRONE PA.
June 24-1936 Scales as shown.
Raymond A Hagerman
Registered C.E. Tyrone Pa.

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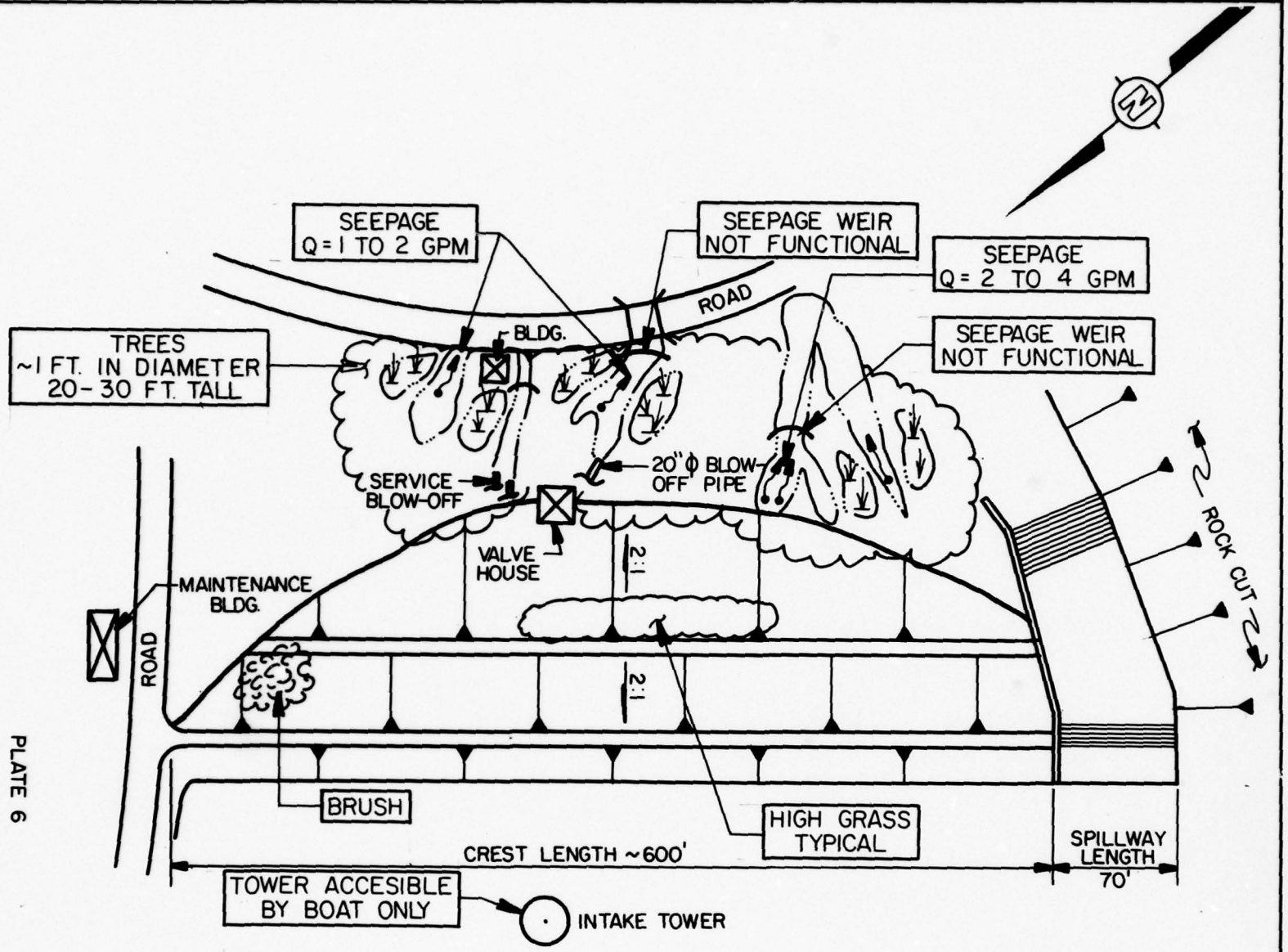
PLATE 5

D'APPOLONIA

DRAWN BY	D.J.D.	CHECKED BY	J.H.D.	8-23-78	DRAWING NUMBER 78-[illegible]-A18
	7-17-78	APPROVED BY	B.E.	8-23-78	



POOL LEVEL DATE OF INSPECTION = 5 FT. BELOW CREST

D'APPOLONIA

PLATE 6

TYRONE RESORVOIR #1
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: JULY 11, 1978

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM TYRONE RESERVOIR #1 COUNTY BLAIR STATE PA ID# NDI-536
DER: 7-1

TYPE OF DAM EARTHFILL HAZARD CATEGORY

DATE(S) INSPECTION JULY 11, 1978 WEATHER SUNNY TEMPERATURE 80's

POOL ELEVATION AT TIME OF INSPECTION 1178 M.S.L. TAILWATER AT TIME OF INSPECTION M.S.L.

INSPECTION PERSONNEL:

BILGIN EREL
WAH-TAK CHAN

REVIEW INSPECTION BY: (JULY 18, 1978)

ELIO D'APPOLONIA
L.A. ANDERSEN
JAMES POELLOT

BILGIN EREL RECORDER

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VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM TYRONE RES. #1
ID# NDI :536 DER: 7-1

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	MINOR RIPRAP IRREGULARITIES.	

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VISUAL INSPECTION
PHASE I
EMBANKMENT

NAME OF DAM TYRONE RES. # 1
ID# NDI:536 DER: 7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	NO VISUAL SIGNS OF DISTRESS, NO SEEPAGE	
ANY NOTICEABLE SEEPAGE	SOME WET & SWAMPY AREAS BELOW TOE. SEEPAGE MINOR Q ≈ 1 TO 4 GPM	SEE PLATE 6 FOR LOCATION OF SEEPS.
STAFF GAGE AND RECORDER	NONE	
DRAINS	NONE	

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VISUAL INSPECTION
PHASE I
CONCRETE/MASONRY DAMS

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DER: 7-1

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	

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VISUAL INSPECTION
PHASE 1
CONCRETE/MASONRY DAMS

NAME OF DAM TYRONE RES * 1
ID# NDI: 536 DER: 7-1

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 STAFF GAGE OF RECORDER:	N/A.	

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VISUAL INSPECTION
PHASE I
OUTLET WORKS

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DER: 7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	ϕ20" CAST IRON PIPE ONLY DOWNSTREAM END VISIBLE.	
INTAKE STRUCTURE	INTAKE TOWER. (TOWER IS ACCESSIBLE BY BOAT ONLY)	
OUTLET STRUCTURE	NO OUTLET STRUCTURE. PIPE WOULD DISCHARGE INTO OUTLET CHANNEL.	
OUTLET CHANNEL	POORLY DEFINED EARTH CHANNEL.	
EMERGENCY GATE	BOROUGH PERSONNEL INDICATED THAT BLOW-OFF PIPE GATE IS NOT FUNCTIONAL	

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VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

NAME OF DAM TYRONE RES. #1

ID# NDI: 536 DER: 7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	OGEE WEIR, IN FAIR CONDITION	
APPROACH CHANNEL	FREE OF DEPRIS.	
DISCHARGE CHANNEL	RECTANGULAR CONCRETE CHANNEL.	
BRIDGE AND PIERS	NONE.	

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VISUAL INSPECTION
PHASE I
GATED SPILLWAY

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DEC: 7-1

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	

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VISUAL INSPECTION
PHASE I
INSTRUMENTATION

NAME OF DAM TYRONE RES. #1

ID# NDI: 536 DER: 7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE	
OBSERVATION WELLS	NONE	
WEIRS	THREE ABANDONED SEEPAGE WEIRS. SEE PLATE 6 FOR LOCATION.	
PIEZOMETERS	NONE	
OTHER	NONE	

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VISUAL INSPECTION
PHASE I
RESERVOIR

NAME OF DAM TYRONE RES. #1

ID# NDI:536 DER:7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	WOODED, STEEP.	
SEDIMENTATION	UNKNOWN.	

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VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

NAME OF DAM TYRONE RES. #1

ID# NDI: 536 DER: 7-1

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	NORMAL FLOW IN SINK RUN IS DIVERTED TO SCHELL RUN BY U.S ARMY CORPS OF ENGINEER FLOOD CONTROL PROJECT.	
SLOPES	N/A.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	IT IS ESTIMATED THAT IN THE EVENT OF DAM FAILURE, FLOOD CONTROL PROJECT DIKE WOULD BE OVERTOPPED AND FLOOD WOULD FLOW THROUGH TYRONE HOMES: 100 ~ 200 POPULATION ≈ 500 ~ 1000	

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APPENDIX B

CHECKLIST
ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION
PHASE I

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM TYRONE RES. #1
ID# NDI : 536 DER : 7-1

ITEM	REMARKS
AS-BUILT DRAWINGS	LIMITED NUMBER OF DRAWINGS ARE AVAILABLE FROM STATE FILES.
REGIONAL VICINITY MAP	SEE PLATE 1
CONSTRUCTION HISTORY	BUILT IN 1896 BY HITE AND COMPANY OF CLEARFIELD PA. THE DAM WAS ENLARGED IN 1910.
TYPICAL SECTIONS OF DAM	SEE PLATES 2 & 3
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	SEE PLATE 3.

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CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DER: 7-1

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	NOT RECORDED.
DESIGN REPORTS	NOT AVAILABLE (SEVERAL STATE INSPECTION REPORTS DESCRIBE THE DESIGN OF THE DAM)
GEOLOGY REPORTS	NOT AVAILABLE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NOT AVAILABLE
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NOT AVAILABLE.

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CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DER: 7-1

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED (RECORDS INCLUDE VISUAL INSPECTION REPORTS)
BORROW SOURCES	UNKNOWN.
MONITORING SYSTEMS	NONE.
MODIFICATIONS	THE DAM WAS ENLARGED IN 1910. THE HEIGHT WAS INCREASED BY 9 FEET. IN 1919 FILL WAS PLACED ON DOWNSTREAM TOE, TO REDUCE THE SLOPE FROM 1½ H : 1V TO 2H : 1V.
HIGH POOL RECORDS	ACCORDING TO A TYRONE BOROUGH WATER DEPARTMENT LETTER DATED APRIL 29, 1936 MAX FLOW OVER THE SPILLWAY (50 FT WIDE AT THE TIME) DURING MARCH-1936 FLOOD WAS 42-INCHES.

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CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM TYRONE RES. #1
ID# NDI: 536 DER: 7-1

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	VARIOUS REPORTS ON POST CONSTRUCTION CHANGES AND REPAIRS ARE AVAILABLE IN STATE FILES.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
MAINTENANCE OPERATION RECORDS	NOT AVAILABLE.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATE 5
OPERATING EQUIPMENT PLANS AND DETAILS	NOT AVAILABLE.

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NAME OF DAM TYRONE RES. #1

ID# NDI: 536 DER: 7-1

CHECKLIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOODED 6.0 SQ. MILES.

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 184 AC-FT @ EL 1178

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: SAME AS ABOVE

ELEVATION; MAXIMUM DESIGN POOL: EL. 1183 (USGS DATUM)

ELEVATION; TOP DAM: EL 1183

CREST: (SPILLWAY)

a. Elevation EL. 1178
b. Type OGEE WEIR
c. Width 70 FT
d. Length N/A
e. Location Spillover DAM CREST.
f. Number and Type of Gates NONE

OUTLET WORKS:

a. Type ϕ20" CAST IRON PIPE
b. Location MIDDLE OF DAM THROUGH EMBANKMENT
c. Entrance Inverts EL 1150 ± (ESTIMATED)
d. Exit Inverts EL 1147 ± (ESTIMATED)
e. Emergency Draindown Facilities ϕ20" BLOW-OFF PIPE

HYDROMETEOROLOGICAL GAGES:

a. Type NONE
b. Location NONE
c. Records NONE

MAXIMUM NONDAMAGING DISCHARGE: SPILLWAY CAPACITY ≈ 2500 CFS.

APPENDIX C

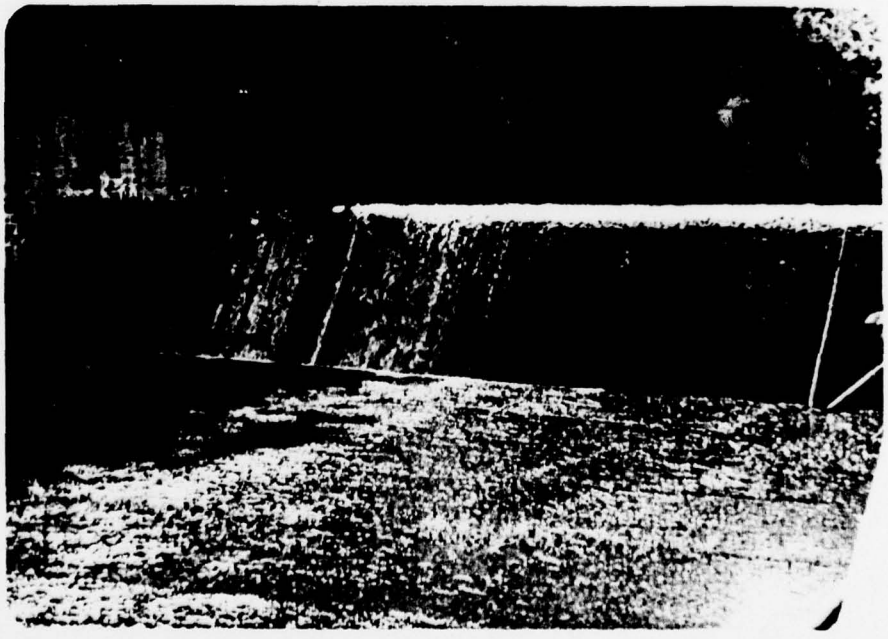
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
TYRONE RESERVOIR NO. 1
NDI I.D. NO. 536
JULY 11, 1978

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (note intake tower is inaccessible).
2	Spillway crest.
3	Spillway discharge channel.
4	Gate control at intake tower.
5	Blow-off pipe plunge pool.
6	Seepage at toe (note abandoned seepage weir).
7	Corps of Engineers flood control project (1/2 mile downstream).
8	Sink Run through Tyrone.

Photograph No. 1

Crest (note intake tower is inaccessible).

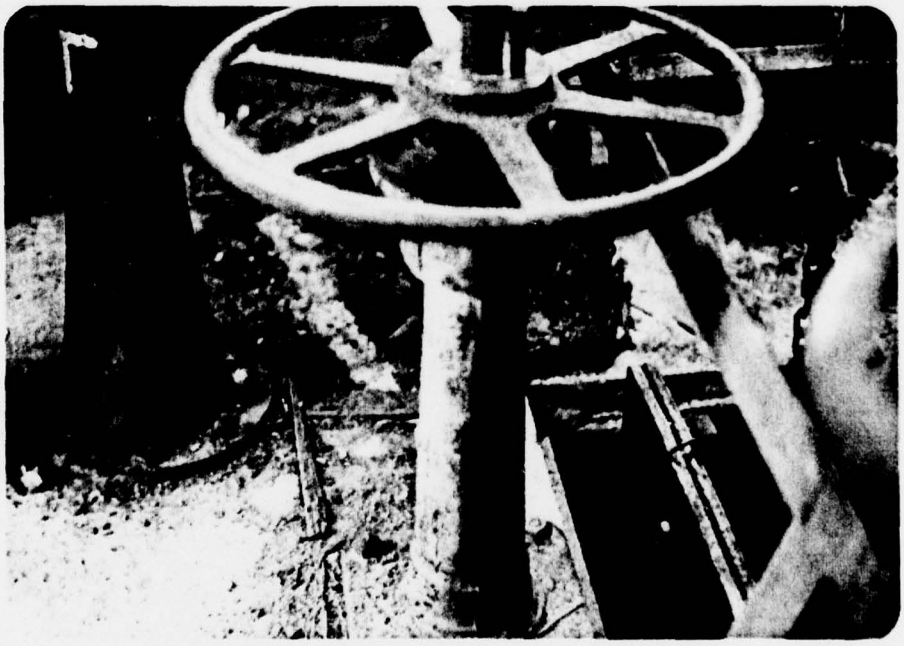


Photograph No. 2

Spillway crest.

Photograph No. 3

Spillway discharge channel.



Photograph No. 4

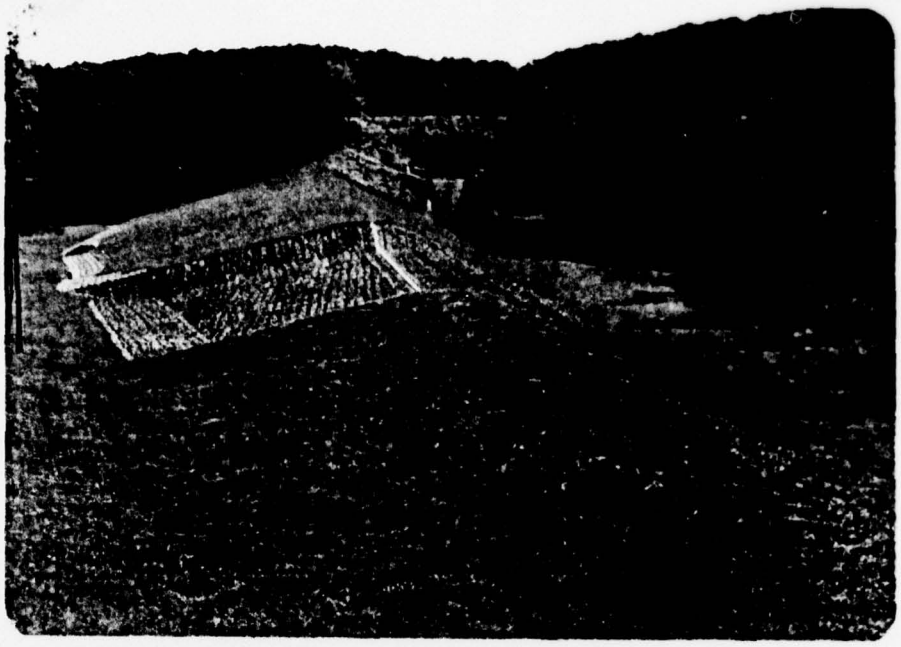
Gate control at intake tower.

Photograph No. 5

Blow-off pipe plunge pool.

Photograph No. 6

Seepage at toe (note abandoned seepage weir).



Photograph No. 7

Corps of Engineers flood control project (1/2 mile downstream).

Photograph No. 8

Sink Run through Tyrone.

APPENDIX D

CALCULATIONS

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D'APPOLONIA
CONSULTING ENGINEERS, INC

By LJTC Date 8-11-78 Subject TYRONE NO 1 Sheet No. 1 of 2
Chkd. By MG Date 8/23/78 HYDROLOGY & HYDRAULICS Proj. No. 78114-19

DAM: TYRONE RESERVOIR NO 1

WATERSHED AREA $A = 6.0$ SQ. MILE

BASIN: SUSQUEHANNA RIVER BASIN, REGION NO 1 SINK RUN

ACCORDING TO THE SINK RUN PROJECT DATA OBTAINED FROM COE BALTIMORE DIST. THE PEAK DISCHARGE OF PMF $Q_p = 10{,}000$ cfs for WATERSHED AREA OF 6.1 SQ. MILE or $q_p = 1639$ cfs/SQ MILE

THEN THE PEAK DISCHARGE FOR SITE

$Q_p = 6.0 \times 1639 = 9836$ cfs **say 9800 cfs**

$V_i = \frac{26''}{12} \times 60 \times 640 = 8320$ ac-ft

say 8300 ac ft

THE UPSTREAM RESERVOIR CAPACITY CAN ONLY HOLD 32% OF PMP WITH FLASH BOARD, or 43% PMF IF NO FLASH BOARD THEREFORE THE OVERTOPPING OF TYRONE #2 IS LIKELY TO OCCUR DURING PMF

$Q_p \simeq 9700$ cfs (EQUAL TO #2)

$V_i = 8300 - 115 = 8805$ ac-ft ← stored in #2

Say 8200 ac ft

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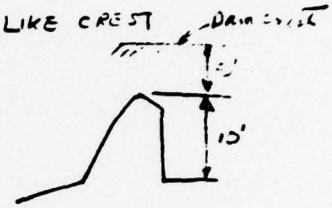
SPILLWAY CAPACITY

TYPE OVERFLOW WEIR WITH OGEE LIKE CREST



LENGTH = 70'

$Q_s = (3.2)(70)(5)^{1.5}$

$= 2504$ cfs say 2500 cfs

STORAGE VOLUME

LAKE AREA = 15 acres

Vol, $V_s = 15 \times 5$

$= 75$ ac-ft

PERCENT of PMF WITHOUT OVERTOPPING

$\left(\frac{2500}{9700} + \frac{75}{8200}\right) 100\% = 26.7\%$

say 27% PMF

CONCLUSION: THE SPILLWAY IS SERIOUSLY INADEQUATE FOR PMF

APPENDIX E

REGIONAL GEOLOGY

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REGIONAL GEOLOGY

Tyrone Reservoirs Nos. 1 and 2 are located on the northwest edge of the folded belt of the Appalachian Mountains. The two reservoirs are on the boundary between the Catskill Formation and the underlying Chemung Formation (both Devonian Age), with the strata dipping moderately in a northwest direction.

The upper reservoir is on the Catskill Formation which consists of thin-bedded, highly fractured reddish-brown claystone and shale with some interbedded sandstone beds. The finer grained strata are easily weathered while the more resistant sandstone forms stable, moderately steep slopes.

The lower reservoir is located on rock of the Chemung Formation which consists of thin-bedded greenish-gray shales with some interbedded fine-grained sandstone layers. The shales are fractured and weather easily, while the sandstone is moderately resistant to weathering.

Small rock falls may occur where the less resistant claystone and shales are eroded below sandstone layers. This occurs in both the Catskill and Chemung Formations.