OHIO RIVER BASIN
CRABTREE CREEK
WESTMORELAND COUNTY

PENNSYLVANIA

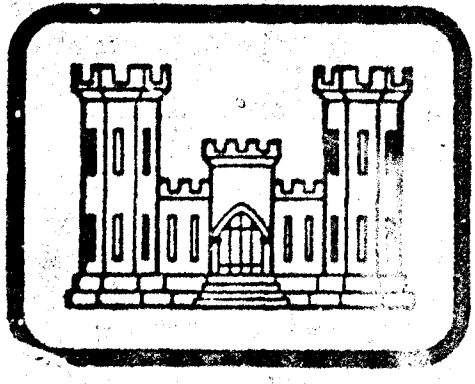
NDI No. PA 00476
PENN DER No. 65-52

GREENWALT DAM

PENNSYLVANIA FISH COMMISSION

DACW 31-80-C-0026

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

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

BY

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JULY 1980

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National Dam Inspection Program.

OHIO RIVER BASIN

GREENWALT DAM
WESTMORELAND COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA-00476
PennDER NO. 65-52
Number

Ohio River Tributary, Crabtree Creek, Westmoreland County, Pennsylvania

PENNSYLVANIA FISH COMMISSION

(11) Jul 80

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

(12) 85

(15) DACW31-80-C-0026

(10) James P. Hannan James Ellsworth Barrick, II

Prepared for: DEPARTMENT OF THE ARMY
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Pittsburgh, Pennsylvania 15216

Date: July 1980

KL1785

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Greenwalt Dam
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Westmoreland
STREAM:	Crabtree Creek, a tributary of the Loyalhanna Creek.
DATES OF INSPECTION:	27 November 1979 3 April 1980
COORDINATES:	Lat. 40°21'49", Long. 79°27'05"

ASSESSMENT

Based on a review of available design information and visual observations of conditions as they existed on the date of the field inspection, the general condition of the Greenwalt Dam is considered to be in an unsafe, non-emergency condition.

This assessment is based on visual observations and hydrology calculations that indicate:

1. A possible inadequate margin of safety against slope failure as indicated by embankment slope and groundwater conditions.

2. Advanced deterioration and possible structural instabilities of the principal (and emergency) spillway.

3. "Inadequate" discharge capacity of the principal (and emergency) spillway.

The structure is classified as a "small" size, "significant" hazard dam. Corps of Engineers guidelines recommend the 100 year flood to 1/2 times the Probable Maximum Flood (PMF) for a "small" size, "significant" hazard dam. Greenwalt Dam's Spillway Design Flood is 1/2 the Probable Maximum Flood. Spillway capacity is "inadequate" because the non-overtopping flood discharge capacity, as estimated using the HEC-1 computer program, was found to be twenty seven percent of the PMF.

The visual inspection indicated deficiencies which are considered correctable. The deficiencies can be corrected or improved through implementation of the following recommended remedial, monitoring and/or maintenance efforts.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Greenwalt Dam

RECOMMENDATIONS

1. Additional Investigations: It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams and masonry spillways to provide a detailed engineering investigation of Greenwalt Dam. This investigation should include but not be limited to the following:

(a) Investigate the stability of the embankment and, if required, make recommendations for achieving a satisfactory margin of safety.

(b) Investigate the stability, hydraulic capacity, and structural integrity of the principal spillway facility, and make recommendations as required to bring the structure to an acceptable condition.

(c) Investigate the physical condition and operation characteristics of the outlet works facility. The engineer should prepare sketches and/or drawings to show the relationships and configurations of the outlet works components, as well as make recommendations for remedial work, if required.

2. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(a) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(b) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(c) Procedures for drawdown of the reservoir under emergency conditions.

(d) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Greenwalt Dam

c. Remedial Work: The Phase I Inspection of Greenwalt Dam also disclosed several deficiencies which should be corrected immediately.

(1) Raise the embankment crest to design elevation.

(2) Replace the rotted outlet works trap door.

(3) Closely mow the embankment slopes, crest, groins, abutments and immediate adjacent areas.

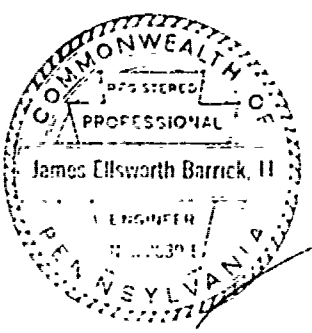
(4) Locate and backfill completely, all animal burrows on the embankment, groins and adjacent abutment areas.

(5) Replace lost riprap along the upstream slope of the embankment.

(6) Fill wheel ruts and minor erosion gullies on the embankment and adjacent areas.

(7) Develop and implement formal maintenance and inspection procedures.

d. Orderly Breaching: In lieu of performing the above recommendations, the owner may choose to engage the services of a professional engineer, knowledgeable in dam design and performance, to prepare specifications for breaching the structure, to make it incapable of impounding water. The structure should then be breached under the direction of the professional engineer and in accordance with applicable state and local regulations.



James P. Hannan
Project Engineer
Date

James E. Barrick, P.E.
PA Registration No. 022639-E
24 July 1980
Date

Approved by:
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
21 Aug 80
Date

GREENWALT DAM

OVERVIEW

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
GREENWALT DAM
NATIONAL I. D. NO. PA 00476
PennDER No. 65-52

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) 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 the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: Greenwalt Dam was designed and constructed as a homogeneous earthfill structure. The embankment is 785 feet long, with a maximum toe to crest height of 27 feet and a crest width of 13 feet. The embankment's upstream slope was observed to be 2.2H:1V above the water line; the downstream slope was observed to be 2.1H:1V near the crest, and to 1H:1V near the toe.

(2) Outlet Works: The dam was constructed with two outlet pipes through the embankment. These pipes were a six inch water supply line and a ten inch pond drain. When the spillway abutment was repaired after a piping failure in 1938, the pipes were blocked and a new outlet works was installed in the embankment adjacent to the principal spillway's right training wall. The locations of control valves for the original outlet works pipes are not known.

(3) Principal (and Emergency) Spillway: An uncontrolled, open channel spillway with overfall weir was constructed in the embankment near the left abutment. The weir maintains the reservoir pool level and passes normal and storm flows. The weir's control section is a 20 foot high concrete capped, masonry wall across the spillway channel at the embankment crest centerline.

Freeboard at the spillway is seven feet, but minimum dam freeboard is 5.0 feet. The discharge channel below the weir is a masonry lined open channel which flows under a township road bridge.

(4) Downstream Conditions: Discharge from the Greenwalt Dam spillway is to an unnamed tributary which flows into Crabtree Creek about 250 feet below the dam. The confluence lies within the Loyalhanna Creek Flood Protection Control Reservation. Crabtree Creek enters Loyalhanna Creek about two miles below the dam. Several roads and bridges, and a Conrail railroad track lie on the floodplains of Crabtree and Loyalhanna Creeks.

The normal pool level at Loyalhanna Dam is 913 and the maximum pool level is 975.

There is one inhabited dwelling on the floodplain in the eleven mile reach between Greenwalt Dam and Loyalhanna Dam. That dwelling is about 1 mile from Greenwalt Dam.

(5) Reservoir: Greenwalt Dam's reservoir, which is also known as Lake Dom, is 1930 feet long at normal pool elevation and has a normal surface area of 15 acres. When the pool is at the crest of the dam, the reservoir length increases to 2430 feet and the surface area is 17.2 acres.

(6) Watershed: The watershed above Greenwalt Dam is mostly pasture with some woods containing a few roads and a few inhabited dwellings.

b. Location: Greenwalt Dam is located in Unity Township, Westmoreland County, Pennsylvania, approximately one mile east of Crabtree.

c. Size Classification: The dam has a maximum storage capacity of 171 acre-feet and a maximum toe to crest height of 27 feet. Based on the Corps of Engineers guidelines, this dam is classified as a "small" size structure.

d. Hazard Classification: Greenwalt Dam is classified as a "significant" hazard dam. In the event of a dam failure, the road to Crabtree, a major township road, may be damaged. If Greenwalt Dam failed when the Loyalhanna Creek Flood Protection Control Reservation was at maximum pool level (Elevation 975), possible damage to the U. S. Routes 22 and 119 bridge, four miles downstream, could cause considerable economic damage.

e. Ownership: Greenwalt Dam is owned by the Fish Commission of the Commonwealth of Pennsylvania. Correspondence should be addressed to:

Pennsylvania Fish Commission
P. O. Box 1673
Harrisburg, PA 17120
Attn: Mr. Ralph Abele, Executive Director
(717) 787-6376

f. Purpose of Dam: Greenwalt Dam was constructed to provide an industrial water supply for Donohoe Coke Company. The dam is currently used for recreational purposes.

g. Design and Construction History: The dam was designed by Mr. A. P. Knight of Rome, New York and was constructed in 1900 for the Donohoe Coke Company under the supervision of Mr. J. Hughes. Major repairs were performed in 1938 which included filling in a breach along the right spillway training wall, raising the crest, construction of a new outlet works, installation of cutoff provisions at the spillway walls, and plugging of the two original outlet pipes.

h. Normal Operating Procedure: Greenwalt Dam was designed to operate as an uncontrolled structure. Under normal operating conditions, the pool level is maintained at Elevation 991 by the crest of the principal spillway. The configuration and operating characteristics of the existing outlet works are unknown.

1.3 PERTINENT DATA

a. Drainage Area:	2.2 sq. mi.
b. Discharge at Dam Facility:	
Maximum Flood at Dam Facility	1067 cfs
Principal Spillway Capacity at Top of Dam	1148 cfs
c. Elevation (feet above MSL)	
Design Top of Dam	998.0*
Current Top of Dam (low point)	995.9
Normal Pool	991.0
Principal Spillway Overflow Crest	991.0

c. Elevation (feet above MSL)

Maximum Tailwater	Unknown
Inlet Invert of Pond Drain (Abandoned)	Unknown
Outlet Invert of Pond Drain	Unknown
Inlet Invert of Water Supply Pipeline (Abandoned)	Unknown
Inlet Invert of Outlet Works	Unknown
Base of Principal Spillway	969±

d. Reservoir Length

Length of Maximum Pool	2430 feet
Length of Normal Pool	1930 feet

e. Reservoir Storage

Current Top of Dam	171 acre-feet
Principal Spillway Weir Crest	92 acre-feet*
Normal Pool	92 acre-feet*

f. Reservoir Surface

Current Top of Dam	17.2 acres
Principal Spillway Crest	15 acres*
Normal Pool	15 acres*
Sediment Pool	15 acres*

g. Embankment

Type	Earth
Length	785 feet
Height	27 feet
Crest Width	13 feet
Slopes	
Upstream	2.2H:1V
Downstream	Varies from 2.1H:1V to 1H:1V
Impervious Core	450 foot long puddle wall in central portion of dam*
Cutoff Provisions	See Impervious Core*
Grout Curtain	None reported*

h. Principal Spillway
(Regulating And Emergency Oulet)

Type	Masonry Weir Wall with Concrete Cap
Length of Weir	34.25 feet
Weir Crest Elevation	991 feet*

i. Outlet Works (Pond Drain)

Type	12 inch diameter cast iron pipe
Inlet	Concrete Box with Stop Log Level Control
Upstream Flow Control	Unknown
Conduit length	Unknown
Gate Valve	Unknown
Anti-seep Collars	Unknown

*Taken or derived from original specifications and/or drawings.

SECTION 2
ENGINEERING DATA

2.1 DESIGN

The files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) were reviewed but no engineering data related to the original design of the embankment and spillway was found. The dam was reportedly built in 1900 and the first correspondence with the state was made in 1915.

2.2 CONSTRUCTION

No information was found related to the original construction of this dam.

2.3 MODIFICATION/REPAIR

PennDER files indicated that modifications were made to this dam in 1938. These included raising the crest, filling in a breach that extended from the foundation to the crest at the right spillway training wall and adding riprap to the upstream slope.

2.4 OPERATION

The dam was designed to operate without a dam tender and no operational data is available. The principal and emergency spillway is uncontrolled and performance and operating records are not maintained.

2.5 EVALUATION

a. Availability: Engineering data was provided by PennDER, Bureau of Dams and Waterway Management.

b. Adequacy: The available engineering information, though greatly limited, was supplemented by field inspections and supporting engineering analyses and is considered adequate for the purpose of this Phase I inspection report.

c. Validity: Based on the review of the available information, there appears to be no reason to question the validity of the limited engineering data.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The initial visual observations of Greenwalt Dam and reservoir were performed on 27 November 1979, and consisted of:

(1) Visual observations of the embankment crest and slopes, groins and abutments;

(2) Visual observations of the spillway including overflow weir wall, training walls and approach and discharge channels.

(3) Visual observations of downstream conditions and evaluation of the downstream hazard potential.

(4) Visual observations of the reservoir shoreline and inlet stream channel.

(5) Transit stadia survey of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

A second inspection was performed on 3 April 1980 to supplement the earlier inspection and to obtain additional photographic documentation.

The visual observations were made during periods when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field plan, profile and section containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the visual inspection are presented in the following sections.

b. Embankment

(1) Crest: The embankment's crest was generally straight throughout the central portion of the dam but curved upstream at both ends. The curvature in horizontal alignment appeared to be the result of design and construction procedures.

The vertical aligment of the embankment crest was observed to be irregular. In particular, a depression was noted in the embankment crest adjacent to and immediately to the right of the principal spillway right training wall. The depression was approximatley 1 foot deep, 10 feet long and extended across the embankment crest.

A second depression, of 1/2 foot, was observed about 200 feet to the right of the principal spillway right training wall. This depression occurred at approximately the same location along the embankment as a downstream slope slough zone noted and discussed below.

A third depression was observed near the right end of the embankment. At this location, erosion or excavation has created an approximate two foot drop in the embankment crest, where an access road enters a parking area adjacent to the reservoir shoreline behind the embankment.

In general, the embankment crest was heavily vegetated except for a foot path along the entire length of the crest. Some minor wheel rutting was noted on the embankment left of the principal spillway.

(2) Upstream Slope: The upstream slope was generally covered with brush, weeds and small woody vegetation. The slope appeared to have been covered with hand placed riprap at one time, but coverage on the date of inspection was generally discontinuous and disturbed. Several foot paths crossed the upstream slope and some minor erosion has occurred as a result.

Some erosion of the upstream slope has occurred at and just above the water line apparently as the result of lake wave action.

An erosional gully was noted on the upstream slope just left of the principal spillway left training wall. The erosion appeared to be the result of surface runoff from the embankment crest.

(3) Downstream Slope: The embankment's downstream slope was heavily covered with brush, weeds, and small woody vegetation. Several foot paths crossed the downstream slope and some minor erosion has resulted.

Because of the dense vegetal growth on the downstream slope, no significant cracking was observed. However, finger penetration of surface soils indicated soil consistencies ranging from soft to stiff. The softer consistencies were observed in the topsoil layer.

A slough zone was observed on the downstream slope near the central portion of the right part of the embankment. The top of the slough appeared to be approximatley 1/2 way up the embankment slope and did not show a well defined scarp. Below the top of the slough there appeared to be a depression on the embankment slope. This depression was noted initially because of the lack of heavy or dense brush in the immediate vicinity. Below this, there appeared to be a slight bulge as though the toe was pushing out. A hole was hand excavated near the top of the slough and the upper 6 to 8 inches was found to be very soft and wet. A small cavity was encountered which, when penetrated, yielded a viscous, silt laden liquid. Below however, according to finger penetration, the soil material firmed up considerably to a medium stiff consistency. A second hole was excavated by shovel immediately below the first hole and similar conditions were observed. The material observed in the excavated hole appeared to be generally saturated and quite plastic.

Immediately to the left of the slough zone, a second area of changed vegetal conditions was observed. Close inspection did not reveal any significant indication of slope instability or slope failure.

(4) Groins (Junction of Embankment and Abutment): The embankment's right groin consists of the road side drainage ditch running along the toe of the embankment. In general, the ditch was dry and in good condition. No significant erosion or seeping water was observed. A small amount of standing water was noted in the ditch immediately below the previously described slough zone on the downstream slope.

Two catch basins have been constructed in the right groin, one near the right end of the embankment and the other near the center of the embankment. The basins are constructed of masonry and range from 12 to 18 inches deep. A 15 inch bituminous coated corrugated metal pipe (BCCMP) exits each catch basin, passes beneath the roadway and discharges to the roadway slope below. Both catch basins and pipe drains were operative on the date of inspection.

The left groin was generally brush and weed covered and in reasonably good condition in the reach between the left abutment and the left principal spillway training wall. No significant erosion or seepage was observed.

A wet zone was noted immediately beyond the toe of the left embankment approximately 100 feet from the left end of the embankment. Water was standing in wheel ruts but appeared to be the result of surface runoff from recent heavy rains. There was no strong indication that this standing water was the result of seepage.

c. Abutments:

(1) Left: The left abutment beyond the end of the embankment is generally flat and partially grass covered. Numerous vehicle trails and barren parking areas were observed.

The lower left abutment, below the left portion of the embankment, contains a vehicle trail and numerous foot paths. The previously described wet zone also lies on this portion of the left abutment.

Well below the embankment the township road crosses the left abutment, approaching the bridge over the discharge channel. The road side ditch carries a significant flow of 'black water' apparently draining from an adjacent coal refuse embankment.

(2) Right: The right abutment is also generally flat and partially vegetated. It contains vehicle roads and parking areas in the immediate vicinity of the dam.

The lower right abutment contains the township road as well as the highway slope below. This slope is heavily wooded and brush covered and abuts a swamp that lies on the floodplain of Crabtree Creek below. The denseness of the vegetal growth on this slope made careful examination impossible. However, an animal burrow was noted approximately 1 foot below road level near the right end of the embankment. An erosional ditch was observed at and below the outfall from the previously described upper road side culvert. In general, there were no indications of slope instability on this portion of the right abutment and existing seepage conditions could not be ascertained.

d. Outlet Works:

(1) Inlet: The outlet works intake structure consists of a concrete box constructed into the right training wall of the principal spillway, upstream of the dam crest centerline. The conditon of the concrete was observed to be fair with some minor cracking and spalling.

The structure is a wet well, split by stop logs which control the level of water to be released. The inlet to the box from the lake was not observed, apparently because of an elevated pool level. Within the box, the upstream chamber is approximately at lake level. Water was leaking around the stop logs, into the lower portion of the wet well which submerged the inlet end of the outlet works conduit. The difference in water level in the intake structure was approximately five feet on the date of observation.

The intake structure is covered by a wooden plank trap door which was rotted and deteriorated. Ladder rungs embedded in the concrete within the intake structure were observed to be in a deteriorated (rusted) condition.

(2) Outlet Works Conduit: The outlet works conduit is 12 inch diameter cast iron pipe.

(3) Outlet Conditions: The outlet works conduit leaves the intake structure box and travels along the principal spillway right training wall and discharges through the training wall by free fall to the principal spillway discharge channel below.

(4) Reported Outlet Pipes: The visual inspection revealed no indication of the existence of two reported outlet pipes beneath the central portion of the embankment.

e. Principal (and Emergency) Spillway:

(1) General Configuration: The principal (and emergency) spillway for Greenwalt Dam is a masonry structure constructed into the embankment near the left end of the dam. The structure consists of two training walls, an overflow weir wall and base slab.

The overflow weir is 5.3 feet wide, 20 feet high and 34 feet in length. The freeboard between the crest of the weir and the top of the training wall was seven feet.

The training walls are slightly skewed to the centerline of the crest of the embankment. Below the weir, they turn 30° to the right and proceed approximately 100 feet downstream where they turn 30° to the left and pass beneath the township road bridge.

(2) Approach Channel: The approach channel to the overflow weir lies between the two training walls that contain the upstream slope of the embankment. The approach channel is quite short and on the date of inspection was unobstructed.

(3) Weir Wall: On the date of inspection, a considerable flow was passing over the weir wall. The flow was generally uniform indicating the wall to be approximately level.

Because of the considerable flow, the condition of the downstream face of the weir wall could not be observed.

(4) Discharge Channel: The discharge channel consists of a masonry slab between the two training walls immediately below the overfall weir. Because of the depth of the water and the height of the walls, a close inspection of this slab could not be made. However, observations from the top of the training walls indicated that the lower portion of the slab has broken and settled away from the portion of the slab immediately below the overflow weir wall.

The right training wall that contains the embankment is seriously deteriorated and contains numerous cracks and evidences of displacement.

Two masonry pilasters buttress the right training wall. Both pilasters were observed to be in an advanced state of deterioration, being severely cracked and collapsed in several places.

When observed from below (highway bridge), the right training wall appeared to be tilting toward the discharge channel.

The left training wall did not contain any major cracking although numerous wet spots and small seeps were observed.

f. Instrumentation: No instrumentation was observed during the inspection.

g. Downstream Conditions:

(1) Downstream Channel: The downstream channel lies between extensions of the masonry training walls and passes beneath the highway bridge. The bridge opening is 15 feet wide and 8 feet high. Beyond the bridge, discharge is to a ponded area on the floodplain of Crabtree Creek. Discharge from the ponded area is via a natural creek channel, which is winding and clogged with trees and brush. Approximately 100 feet below the bridge, the creek joins Crabtree Creek within the boundary of Loyalhanna Reservoir.

(2) Floodplain Development: No inhabited dwellings were observed on the floodplain of Crabtree Creek or Loyalhanna Creek within the first five miles below Greenwalt Dam. The area lies within the reservation of the Loyalhanna Reservoir. However, several roads and bridges and a Conrail track may be damaged or destroyed by failure of the dam.

h. Reservoir:

(1) Shoreline and Slopes: The reservoir slopes are generally flat to very flat except for a steep portion along the left shoreline approximately midway up the reservoir. In this area, the slope is quite steep and trees are tilted toward the water and some sloughing of shoreline slopes was observed. Some downtimber and brush were also noted. The remainder of the slopes are quite flat and wooded for the entire perimeter of the reservoir except at the dam and inlet stream areas.

(2) Sedimentation: Some minor sedimentation was observed at the upper end of the reservoir. A significant amount of sediment was observed in a small channel that connnects an upstream pond with the reservoir. The channel also contained considerable vegetation and cattails.

(3) Inlet Stream: The inlet stream to the reservoir is generally winding and traverses a very flat, swampy zone that lies at the head of the reservoir. The inlet stream passes to the right and bypasses the previously mentioned pond at the upper end of the reservoir.

(4) Watershed: The watershed appeared to be as indicated by the U.S.G.S. topographic map. Several new homes were noted in the watershed but no new strip

mining or major construction was observed. The surface mines indicated on the most recent topographic map (revised 1973) were 10 to 15 years old and did not appear to significantly affect the drainage patterns of the watershed.

3.2 EVALUATION

a. Embankment: The general, overall condition of the embankment is considered to be poor. This evaluation is based on the following conditions.

(1) Observed erosion of the upstream slope and deterioration of the upstream slope riprap protection.

(2) Observed unevenness and wheel rutting of the embankment crest.

(3) Observed sloughing of the downstream slope.

(4) Observed high groundwater level in the embankment.

(5) Observed erosion of foot paths on the downstream slope.

(6) Observed lack of maintenance of the upstream slope, downstream slope and crest of the embankment as evidenced by excessive vegetal cover and the above noted conditions.

b. Outlet Works: The condition of the outlet works facility is considered to be fair. This evaluation is based on the observed, apparent proper functioning of the facility. However, failure to closely examine the inlet to the intake structure and the inlet to the discharge pipe is considered to be a deficiency. Also, the condition of the wooden trap door of the intake structure is considered to be a deficiency.

c. Principal (and Emergency) Spillway: The condition of the principal spillway is considered to be poor. This is based on observations of structural instability of the spillway's right training wall and discharge channel floor slab. In particular, significant cracks and associated deterioration, bulging and tilting of spillway components is considered to represent a hazardous condition.

Leaks and seepage through the left training wall are also considered to be a deficiency.

d. Hazard Category: Based on observations of downstream conditions the hazard category for Greenwalt Dam is "significant".

SECTION 4
OPERATIONAL FEATURES

4.1 PROCEDURE

Resevoir pool level is maintained by the uncontrolled weir crest of the principal spillway. Normal operating procedure does not require a dam tender. The reservoir pool level can apparently be controlled at a lower elevation by the outlet works. However, no records were found indicating either normal or emergency use of the outlet works facility.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are maintained by the Unity Township Road Supervisors who leased the dam from the Pennsylvania Fish Commission on 24 August 1978.

4.3 INSPECTION OF DAM

The Pennsylvania Fish Commission is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

4.4 WARNING SYSTEM

There is no warning system and no formal emergency procedure to alert or evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

The inability to observe the operation of the outlet works is considered to be a deficiency. The lack of a written maintenance program is considered to be a deficiency. The lack of a downstream monitoring system to alert civil defense authorities in the event of dam failure is considered to be a deficiency.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Greenwalt Dam has a watershed of 1408 acres which is vegetated primarily by pastur The watershed is about two and one-half miles long and one mile wide and has a maximum elevation of 1380 feet (MSL). At normal pool the dam impounds a reservoir with a surface area of 15 acres and a storage volume of 92 acre-feet. Normal pool level is maintained at Elev. 991 by the overflow weir wall of the principal (and emergency) spillway.

Spillway capacity and embankment freeboard where made sufficient to accomodate 1685 cubic feet per second which was considered sufficient for this structure and watershed at the time of design. The current embankment freeboard and spillway capacity is 1148 cfs before the embankment is overtopped. No additional hydrologic calculations were found relating reservoir/ spillway performance to the Probable Maximum Flood or fractions thereof.

b. Experience Data: Records are not kept of reservoir level or rainfall amounts. In 1935 a seepage condition developed in the embankment at the right spillway wall after the storm of 3 August 1935. In the winter of 1935-1936, a breach developed in this area and the dam failed. There was a reported water depth of 65 inches over the spillway crest during the storm of 3 August 1935.

c. Visual Observations: On the date of the field reconnaissance, severe deterioration of the pilasters of the principal spillway was noted. Also, severe cracking, horizontally, vertically and diagonally, was observed in the principal spillway right training wall. The structural stability of the spillway is of some concern.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend the 100 year flood to 0.5 times the

Probable Maximum Flood (PMF) for "small" size, "significant" hazard dams. Based on observed downstream conditions, Greenwalt Dam has a Spillway Design Flood (SDF) of 0.5 PMF.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.2 inches. No calculations are available to indicate whether the reservoir and spillway are sized to pass a flood corresponding to one half of the runoff from 19.2 inches of rainfall in 24 hours. Consequently, an evaluation of the reservoir/spillway system was performed to determine whether the dam's spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Greenwalt Dam was determined by HEC-1 to be 4293 cfs for a full PMF. The peak inflow for the SDF was determined to be 2150 cfs.

An initial pool elevation of 991 was assumed prior to commencement of the storm.

According to the HEC-1 analysis, at 0.50 PMF, Greenwalt Dam is overtopped by a maximum of 1.88 feet of water for a duration of 5 hours and 15 minutes. The analysis is included in Appendix D.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 0.27 PMF by HEC-1. According to Corps of Engineers' guidelines, Greenwalt Dam spillway is "inadequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed. This data is discussed in Section 2 and a detailed listing is included in Appendix B. Selected items are presented in Appendix E.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Visual Observations:

(1) Embankment: The field inspection, though hindered by dense weeds and brush, revealed a slough zone on the embankment's downstream slope and gave indication of the location of the embankment's line of seepage (at the top of the slough zone).

The field stadia survey showed segments of the embankment's downstream slope to be as steep as 1H:1V.

The floodplain of Crabtree Creek, below the dam, is generally swampy, but gave no strong indication of unstable or detrimental seepage conditions.

(2) Abutments: The abutments of the dam are generally flat and gave no indication of instability.

(3) Principal Spillway: The principal spillway structure was observed to be badly deteriorated, particularly the right training wall. Major structural cracks, evidences of movement, and significant tilting were noted during both field inspections. Pilaster disintegration appeared to worsen over the interval between inspections.

d. Performance: Greenwalt Dam was breached by a piping failure in the fall of 1935. The failure was apparently initiated by seepage conditions that developed during the storm of 3 August 1935, when the reservoir pool level rose more than five feet above the spillway crest. The breach occurred along the principal spillway's right training wall and was sufficient to completely dewater the reservoir. No records exist indicating the performance of the embankment's upstream slope during and after this rapid drawdown condition.

Greenwalt Dam has been periodically inspected over the eighty year life of the structure by Water and Power Resources Board personnel and later PennDER personnel. Twelve inspection reports from 9 June 1917 to 11 June 1971 are on file. Several of the reports note the existence of seepage and wet zones but there was no indication of distress of the embankment due to this seepage condition.

The inspection reports do not cite any references to embankment slope instability.

6.2 EVALUATION

a. Design Documents: The design documentation was, by itself, considered inadequate to evaluate the structure. There were no stability calculations for the embankment or of appurtenant structures.

b. Embankment: Based on visual observations of an embankment slough zone, seepage conditions, embankment slopes and materials, the margin of safety against slope failure of Greenwalt Dam may be less than required by current Corps of Engineers guidelines.

Additional investigations should be performed to evaluate whether or not an adequate margin of safety exists.

c. Principal Spillway: Based on visual observations, the structural stability of the principal spillway right training wall is questionable. Observed progressive cracking and tilting suggest that an adequate margin of safety against failure does not exist. Additional investigations should be performed.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Greenwalt Dam is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. Since there is concern regarding the static stability of the embankment, the seismic stability is questionable and should be assessed as part of the investigations recommended in Section 7.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) General: Greenwalt Dam is considered to be unsafe, non-emergency. This assessment is based primarily on the observed conditions of the embankment and principal spillway as described below.

(2) Embankment: Greenwalt Dam's embankment is considered to be in poor condition. This is based on visual observations of:

i. A slough zone on the downstream slope;

ii. Evidence of a high ground water level in the embankment;

iii. Observed steep downstream slope conditions;

iv. Observed irregularities of the embankment crest;

v. Erosion of the embankment slopes and crest;

vi. Deterioration of the riprap wave erosion protection on the upstream slope; and

vii. Lack of an effective maintenance program.

(3) Outlet Works: The outlet works is considered to be in a functional condition but in need of maintenance. The lack of knowledge related to facility operating features is considered to be a deficiency.

(4) Principal (and Emergency) Spillway: The principal (and emergency) spillway is considered to be in very poor condition. This assessment is based on an observed, progressive disintegration of the structure's right training wall.

(5) Flood Discharge Capacity: The principal spillway flood discharge capacity is "inadequate" based

on current Corps of Engineers guidelines. This is based on hydrologic/hydraulic computations using the HEC-1 Dam Safety Version computer program, that indicated the existing reservoir/spillway system is capable of passing 0.27 PMF. At 0.5 PMF, the embankment is overtopped by a maximum 1.88 feet for a duration of 5 hours and 15 minutes. The Spillway Design Flood is 0.5 PMF because of the dam's size and hazard classification.

(6) Downstream Conditions: Based on the results of the visual observations and the hydrologic/hydraulic computations, the lack of an emergency warning and operation plan is considered to be a deficiency.

b. Adequacy of Information: The available information and the observations made during field inspections of the dam are considered sufficient for purposes of the Phase I inspection report.

c. Urgency: The recommendations presented in Sections 7.2a through 7.2c should be implemented immediately.

d. Necessity for Additional Data/Evaluation: Additional engineering information is required to adequately evaluate and improve the structural stability and hydraulic capacity of the facilities.

7.2 RECOMMENDATIONS

a. Additional Investigations: It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams and masonry spillways to provide a detailed engineering investigation of Greenwalt Dam. This investigation should include but not be limited to the following:

(1) Investigate the stability of the embankment and, if required, make recommendations for achieving a satisfactory margin of safety.

(2) Investigate the stability, hydraulic capacity, and structural integrity of the principal spillway facility, and make recommendations as required to bring the structure to an acceptable condition.

(3) Investigate the physical condition and operation characteristics of the outlet works facility. The engineer should prepare sketches and/or drawings to show the relationships and configurations of the outlet works components, as well as make recommendations for remedial work, if required.

b. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Pr dures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

c. Remedial Work. The Phase I Inspection of Greenwalt Dam also disclosed several deficiencies which should be corrected immediately.

(1) Raise the embankment crest to design elevation.

(2) Replace the rotted outlet works trap door.

(3) Closely mow the embankment slopes, crest, groins, abutments and immediate adjacent areas.

(4) Locate and backfill completely, all animal burrows on the embankment, groins and adjacent abutment areas.

(5) Replace lost riprap along the upstream slope of the embankment.

(6) Fill wheel ruts and minor erosion gullies on the embankment and adjacent areas.

(7) Develop and implement formal maintenance and inspection procedures.

d. Orderly Breaching: In lieu of performing the above recommendations, the owner may choose to engage the services of a professional engineer, knowledgeable in dam design and performance, to prepare specifications for breaching the structure, to make it incapable of impounding water. The structure should then be breached under the direction of the professional engineer and in accordance with applicable state and local regulations.

APPENDIX A

VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name Dam Greenwalt County Westmoreland State Pennsylvania National ID # PA 00476

Type of Dam Earthfill Hazard Category Significant

Date (s) Inspection 27 November 1979 Weather clear, cold Temperature 40°F
3 April 1980 Weather clear, mild Temperature 50°F

Pool Elevation at Time of Inspection 991+ (MSL)
Tailwater at Time of Inspection 971+

Inspection Personnel: 28 November 1979

J. P. Hannan	Ackenheil & Associates,	Geotechnical Engineer
S. G. Mazzella	Ackenheil & Associates,	Civil Engineer
J. B. Zeppieri	Ackenheil & Associates,	Geologist

3 April 1980

J. E. Barrick, P.E.	Ackenheil & Associates,	Hydrologist and Project Manager
S. G. Mazzella	Ackenheil & Associates,	Civil Engineer

Recorder J. E. Barrick

GEO Project G79153-Q
PennDER I.D. No. 65-52

A1

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surace cracks observed. Embankment crest, upstream and downstream slopes heavily covered with grass, brush, small, woody vegetation, some small trees growing on both upstream and downstream slopes. Wheel ruts noted on embankment crest to the left of the spillway.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	The toe of the embankment over the right portion of the dam consists of a two lane, asphalt paved township road. A small drainage ditch comprises the groin between the roadway and the embankment toe. A portion of this ditch contains standing water. No seeping water was observed anywhere along the ditch. The roadway shows no unusual or abnormal cracking or evidences of movement. Below the roadway, a second slope exists down to the floodplain of Crabtree Creek below. This slope is heavily wooded and very densely covered with brush and woody vegetation. Observation of this slope was impossible. One animal burrow was noted, as shown on the field plan, approximately 1 foot below the elevation of the roadway. The area below the toe of this slope is generally swampy.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The right abutment beyond the end of the embankment is slightly eroded where an access road and parking area has developed. The upstream slope of the embankment is traversed by several paths which apparently permit access to the shoreline for fisherman. These paths are generally eroded and causing deterioration of the embankment.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (continued)	An access path on the downstream slope approximately 50 feet to the right of the spillway is also eroded, causing general deterioration of the embankment in the immediate area. Minor erosion has occurred on the left abutment, behind the embankment, apparently as the result of vehicle and pedestrian traffic to and from the lake. The area is generally barren. Two eroded access paths traverse the upstream slope on the left portion of the embankment beyond the spillway. A possible slough zone was observed on the embankment's downstream slope at approximately the central portion of the dam. The top of the slough appeared to be approximately one half way up the embankment slope. The upper portion of the slough appeared to be an apparent depression in the embankment slope. The depression was noted initially because of the lack of heavy and dense brush in the immediately vicinity. Below this, there appeared to be a slight bulge as though the toe were pushing out. The slough appeared to be about twenty feet in length along the embankment. A hand dug hole was excavated near the top of the apparent slough. The top six to eight inches of soil was, very soft and found to be moist to wet. A small cavity was encountered which, when penetrated, yielded a viscous, silt laiden liquid. Below this however, as estimated by finger penetration, the soil material firmed considerably. A second hole was excavated by shovel imemdiately below the first hole. Again the surficial soft material was penetrated and below, the soil firmed to a considerably stiffer consistency. The material appeared to be generally saturated and quite plastic.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The embankment crest is straight through the central portion of the embankment and curves upstream at both ends of the dam. The crest width varies between 10 and 14 feet. The embankment crest is somewhat uneven in the vertical plane. At the far right end of the embankment, there is a sharp drop where an access road passes around the end of the embankment. Immediately to the right of the right spillway training wall, there is a depression approximately 1 foot deep extending for a distance of 10 feet to the right of the spillway training wall. The embankment crest to the left of the spillway is slightly uneven in the vertical plane.	
RIPRAP FAILURES	The upstream slope of the embankment appears to have been covered at one time with handplaced sandstone riprap. Remnants of this riprap covering exist, but considerable material has disappeared. In particular, there is very little riprap at or immediately above the waterline. The riprap that does exist on the upstream slope lies from the crest down approximately halfway to the waterline. Below this, erosion of the upstream slope has occurred. An access path traverses the upstream slope at approximately the water line and appears to have been heavily traveled by fisherman.	
SETTLEMENT	The depression noted earlier near the right training wall of the spillway may be the result of settlement. Also, the slightly uneven vertical condition of the crest of the embankment may also be the result of settlement.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No evidence of seepage or erosion was observed along any groin. Standing water in the ditch along the road noted above appears to be surface runoff contained by a topographic low at the ditch. No significant erosion of groins was noted except for the previously described access roads and parking areas on both abutments.	
ANY NOTICEABLE SEEPAGE	One wet zone (see the Field Plan) was observed below the toe of the left portion of the embankment. Water was standing in wheel ruts and appeared to be the result of surface runoff from recent heavy rains. There was no strong indication that this standing water was the result of seepage. Seepage was also noted in excavations described above under the heading "Sloughing or Erosion of Embankment and Abutment Slopes".	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed on the embankment. Two catch basins have been constructed in the ditch between the embankment and the roadway at the locations noted on the Field Plan. The basins are constructed of stone and mortar and range from 12 to 18 inches deep. A fifteen inch bituminous coated corrugated metal pipe exits each catch basin, passes beneath the roadway and discharges onto the slope below the roadway. Both catch basins and pipe drains are operative. At the discharge point of the upper drain, considerable erosion of the slope has occurred.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet conduit is 12 inch diameter cast iron pipe.	
INTAKE STRUCTURE	The intake structure is a concrete box constructed into the right spillway training wall upstream of the weir crest. The condition of the concrete is fair, some minor cracking and spalling observed. No significant deterioration of the structure was noted however. The structure is a wet well split by stop logs. The upstream chamber is approximately at lake level, but the inlet from the lake was not observed. Water is leaking around the stop logs into the lower portion of the wet well, which apparently submerges the inlet end of the outlet conduit. The intake structure is covered by a wooden plank trap door. The trap door is rotted and deteriorated. Deteriorated ladder rungs embedded in the concrete wall were observed inside the intake structure, descending into the lower portion of the wet well. The wall thickness of the intake structure is 1 foot.	
OUTLET STRUCTURE AND CHANNEL	The 12 inch cast iron outlet works pipe passes through the right spillway training wall, and discharges by free fall, to the principal spillway discharge channel below.	
EMERGENCY GATE	None observed.	
REPORTED OUTLET PIPES	Two reported outlet pipes, referred to in project correspondence, were not observed during the inspection.	

PRINCIPAL (AND EMERGENCY) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
WEIR	The Greenwalt Dam spillway weir consists of a masonry wall, 5.3 feet wide and approximately 20 feet high. The overflow crest length is 34 feet. On both observation dates considerable water was flowing over the weir and the condition of the downstream face of the wall could not be determined. The crest of the weir appears to be in good condition. The flow over the wall is generally uniform indicating that the weir is level. The weir lies between two masonry training walls that are slightly skewed to the embankment crest centerline. Freeboard between the crest of the weir and the top of the training walls is 7 feet. Below the overfall, the training walls turn approximately 30° forming the discharge channel. The training walls are 3 feet thick.	
APPROACH CHANNEL	The approach channel is contained between the two training walls and was clear of debris that might obstruct flow.	
DISCHARGE CHANNEL	The discharge channel consists of a masonry slab between the two training walls. Because of the depth of water and the height of the walls, a close inspection of the slab could not be made. However, observations from the top of the training walls indicated that the lower portion of the slab has broken and settled away from the portion of the slab immediately below the weir wall. The right training wall is seriously deteriorated. A large crack begins at the top of the wall at the downstream edge of the weir wall and travels down the wall, touches the weir wall and then turns diagonally and runs down the wall to the first masonry pilaster. The crack is two inches wide and considerable deterioration of wall materials has occurred along the crack.	

PRINCIPAL (AND EMERGENCY) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DISCHARGE CHANNEL (continued)	The first pilaster is badly cracked vertically at the base. Chunks of rock have fallen off and lie in the discharge channel. There are evidences of past patching of cracks in this area. The base of the first pilaster is deflected slightly downstream. Movement appears to have occurred at the base. The previously mentioned crack in the base slab approaches the upstream edge of the pilaster. A second pilaster is located downstream of the first and is also badly deteriorated. It has collapsed into the channel below the end of the base slab. A large diagonal crack with two inch opening exists in the training wall from the top of the second pilaster to the top of the training wall. An additional diagonal crack exists in the training wall running approximately from the base of the pilaster. The 12 inch diameter outlet works pipe exits the training wall just below the second pilaster and additional cracking was observed in this area. When viewed from below the right training wall is bowed and tilted towards the spillway. The left training wall appeared to be in generally good condition with no major cracking apparent, although numerous wet spots and small seeps were observed. Two inch steel pipe handrails traverse both training walls from lake level to the toe of the training walls. The handrails are in good condition.	

INSTRUMENTATION

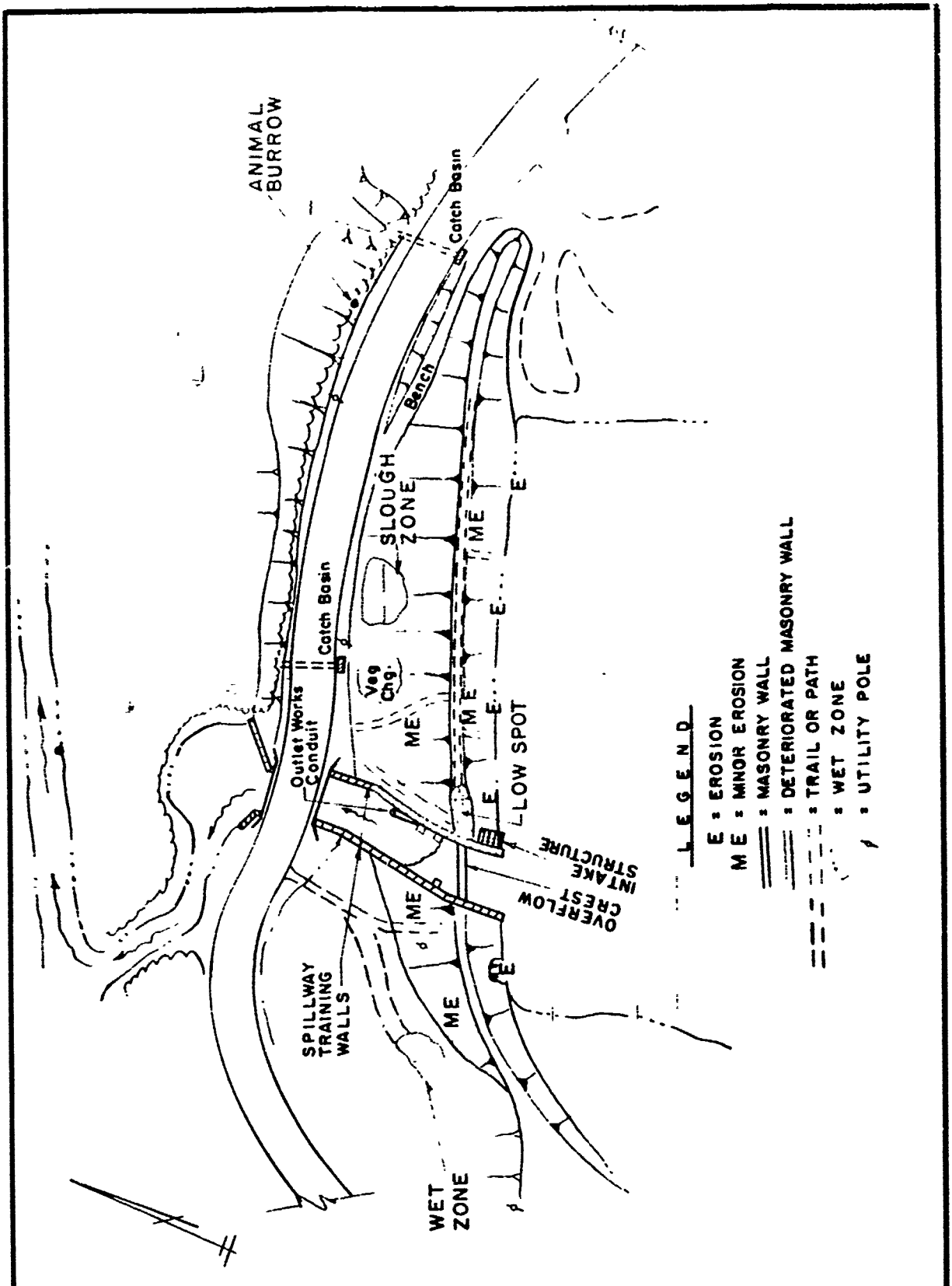
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER		

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The upper reach of the downstream channel lies between extensions of the two masonry training walls. The channel passes beneath the township road bridge. The opening at the bridge is 15 feet wide and 8 feet high and discharges to a ponded area immediately below the bridge. Discharge from the ponded area is via a natural creek channel which is winding and clogged with trees and brush. Approximately 100 feet below the bridge, the creek joins Crabtree Creek, within the boundary of the Loyalhanna Reservoir.	
SLOPES	Above the bridge, the channel is contained between vertical masonry walls. Below the bridge, the creek slopes are densely wooded with trees and underbrush. They are quite flat and lie on the floodplain of Crabtree Creek.	
APPROXIMATE NO. OF HOMES AND POPULATION	There appeared to be no inhabited dwellings on the floodplain in the first 5 miles below Greenwalt Dam. However, there are at least four bridge crossings in this reach that could sustain damage in the evant of failure of Greenwalt Dam. Also, several roads and a Conrail track lie on the Crabtree Creek and Loyalhanna Creek floodplains below the dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Reservoir slopes are generally flat to very flat except for a portion of the left bank approximately midway up the reservoir, where the slope is quite steep. Trees are tilted toward the water in this area and some down timber and brush were noted in the reservoir at the shoreline. The remainder of the slopes are quite flat. The reservoir is wooded for its entire perimeter with the exception of the immediate dam vicinity and the inlet stream area.	
SEDIMENTATION	Minor sedimentation was observed at the upper end of the reservoir. The channel connecting a small upstream pond with the reservoir was silted and contained considerable vegetation and cattails.	
INLET STREAM	The inflow stream is generally winding and traverses a very flat swampy zone above the reservoir. A significant flow was noted in the channel on the day of observation. The channel was approximately 6 feet wide, 8 inches deep and was flowing at approximately 2 feet per second. The inlet channel bypasses the previously mentioned pond and enters the lake to the right of the pond.	
WATERSHED	The watershed appeared to be pretty much as indicated by U.S.G.S. (revised 1973) topographic map. Surface mines indicated on topographic map are 10 to 15 years, and do not materially effect the drainage patterns of the watershed. No new strip mining or major construction apparent in the watershed although several new houses were noted.	



DATE: JULY 1980		GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM	FIELD PLAN
SCALE: NONE			
DR: PT	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

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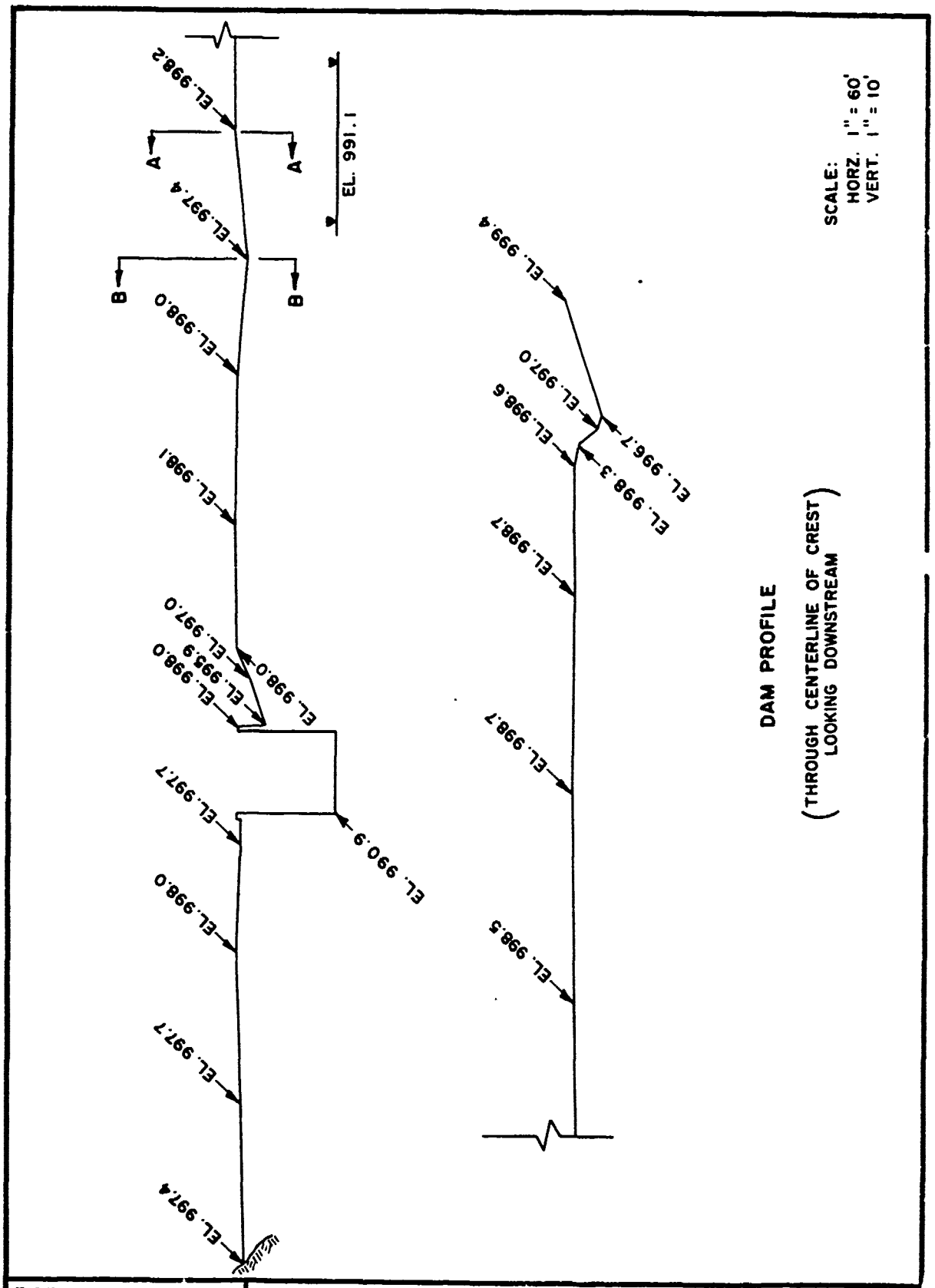

DATE: JULY 1980		GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM	FIELD PROFILE
SCALE: AS SHOWN			
DR: JF	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

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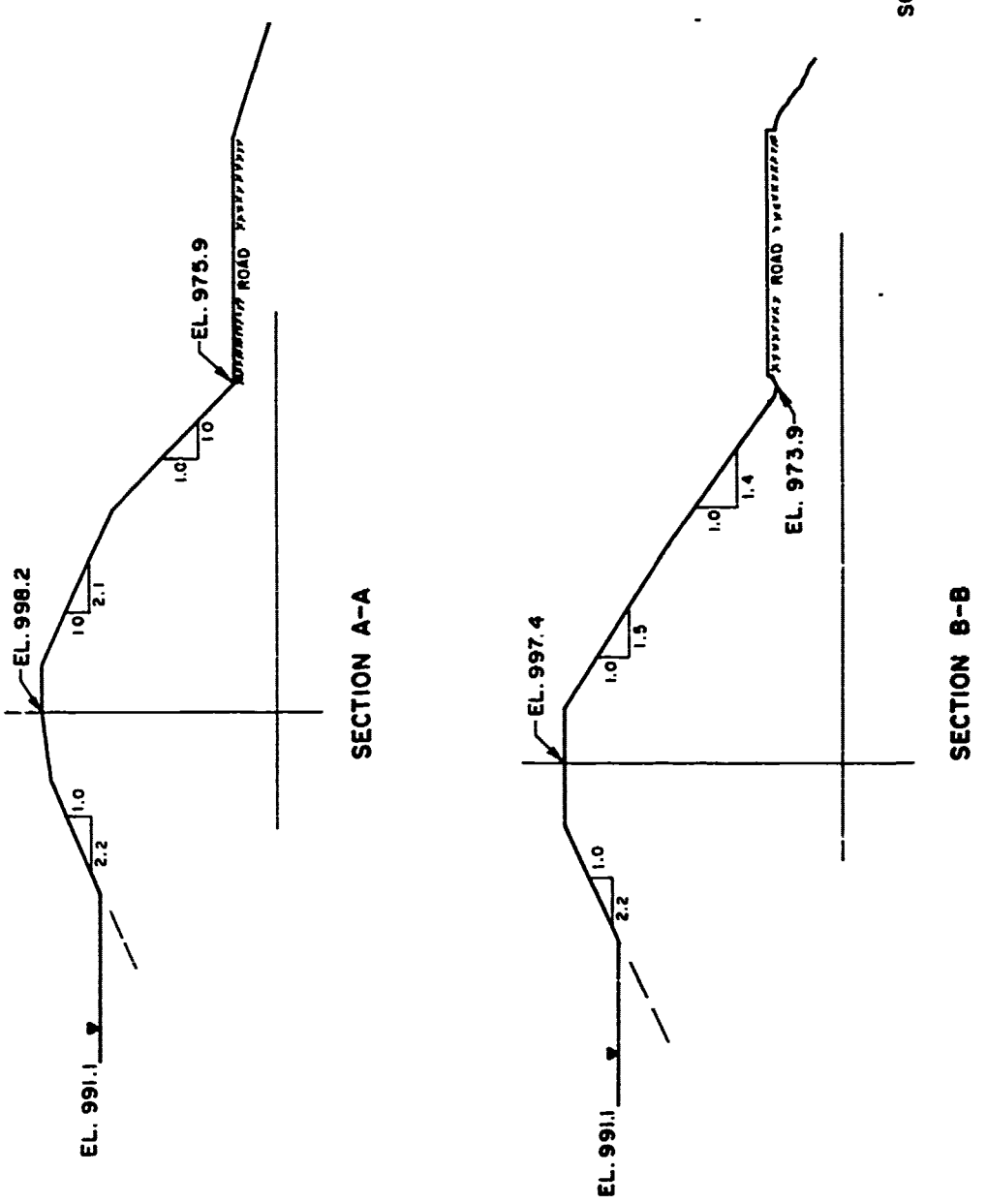

DATE: JULY 1980	GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM	FIELD SECTIONS
SCALE: AS SHOWN		
DR: JF CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

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APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Greenwalt Dam
I.D. No. PA 00476

ITEM	REMARKS
*Design Drawings	Topography of Donohoe Water Company Reservoir, untitled, undated.** "Commonwealth of Pennsylvania, Rebuilding of Greenwalt Dam" April 20, 1938, Plan and Profile.** "Commonwealth of Pennsylvania, Department of Forest and Waters, Details of Blowoff Control Tower for Greenwalt Dam", dated 30 June 1938.**
As-Built Drawings	None available.
Regional Vicinity Map	U.S.G.S. 7-1/2 Minute Latrobe, Pennsylvania Quadrangle Map.
*Construction History	Constructed in 1900 by Donohoe Water Company. Designed by A.P. Knight of Rome, New York. Constructor - unknown. Extensive modifications and repairs done in 1938.
Typical Sections of Dam	None available.
*Outlets-Plan Details Constraints Discharge Ratings	See Design Drawings.

ITEM	REMARKS
*Rainfall/Reservoir Records	Depth of 56 inches over the spillway crest during storm of 3 August 1935. See Post-Contruction Engineering Studys and Reports below.
*Design Reports	See "Report Upon the Dam of Donohoe Water Company" by Water Supply Commission of Pennsylvania, dated 9 August 1915.
Geology Reports	None available.
Design Computations	None available.
*Hydrology and Hydraulics	Spillway capacity calculation, dated 9 August 1915.
Dam Stability	None available.
Seepage Studies	None available.
*Materials Investigations, Boring Records, Laboratory, Field	None available.
Post-Construction Surveys of Dam	None recorded.
Borrow Sources	Data not available.
Monitoring Systems	None reported.

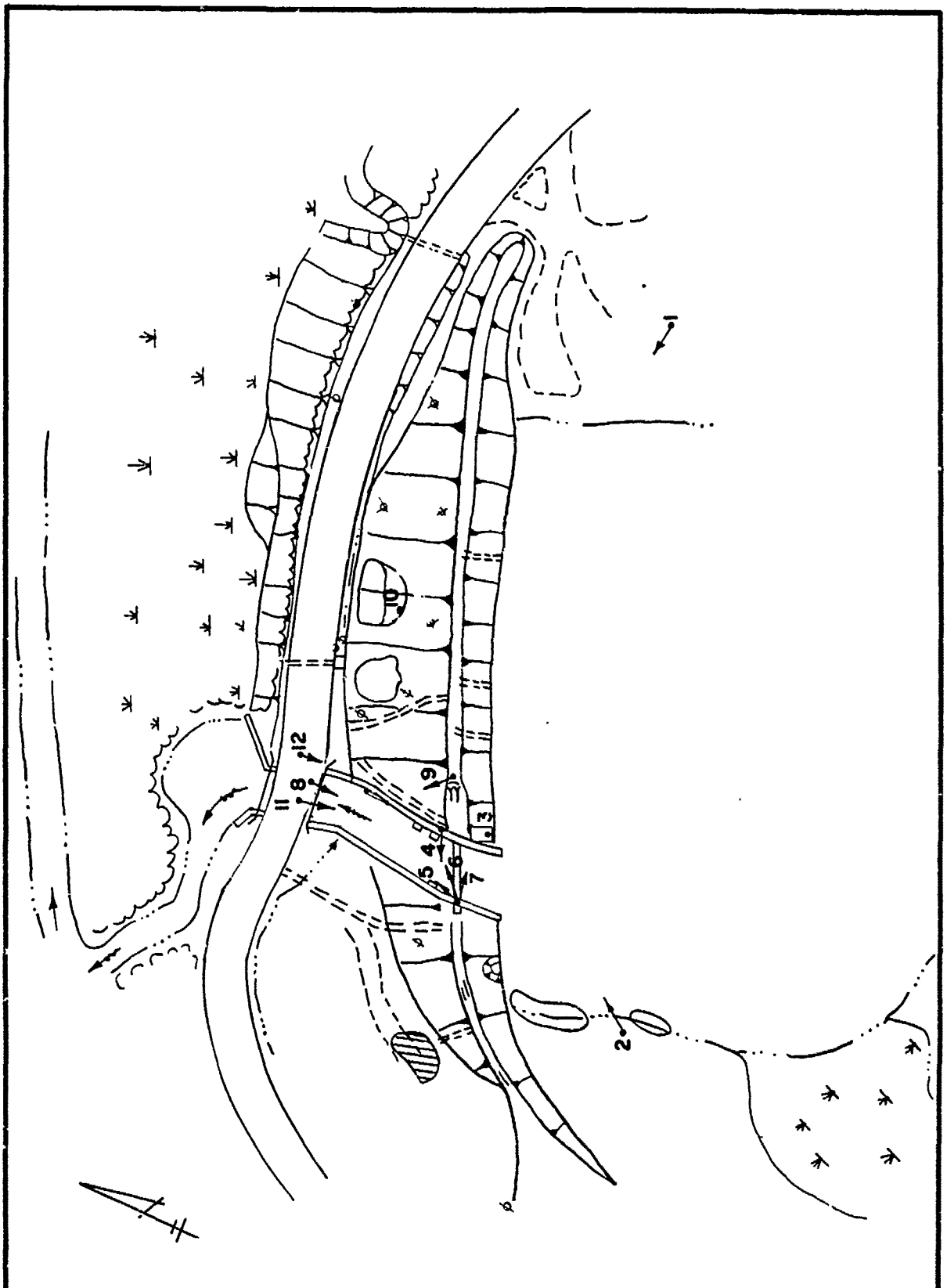
ITEM	REMARKS
*Modifications	In 1938, the following modifications were performed: 1. Filled in breach and repaired spillway walls. 2. Installed new outlet works. 3. Plugged old water supply and drain lines. 4. Leveled crest to spillway wall elevations. 5. Installed upstream slope riprap. 6. Repaired weir and masonry walls.
*High Pool Records	See Rainfall/Reservoir Records above.
*Post-Construction Engineering Studies and Reports	See "Report Upon the Dam of the Commissioners of Westmoreland County (Donohoe Water Company)" prepared by the Chief of Dams, Department of Forests and Waters, dated 20 September 1935.
Maintenance, Operation, Records	None available.
*Spillway Plan Sections Details	See Design Drawings above.
Operating Equipment	None available.

ITEM	REMARKS
*Specfications	See specifications for "Rebuilding of Greenwalt Dam on Branch of Crabtree Creek".
*Miscellaneous	Miscellaneous correspondence involving the ownership of Greenwalt Dam after it was sold to Westmoreland County for taxes. Twelve inspection reports from 9 June 1919 through 11 June 1971 by Department of Forests and Water Personnel. One inspection report on dam by owner dated 1 June 1924.
*Prior Accidents or Failure of Dam Description Reports	Memorandum on leakage at right abutment of spillway after storm of 2 August 1935. Failure of embankment to the right of the right spillway wall, fall 1935-36.

*Information and data may be obtained from the PennDER, Harrisburg, Pennsylvania.
**Reduced size reproductions contained in Appendix E.

APPENDIX C

PHOTOGRAPHS



DATE: JULY 1980	GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM		PHOTO KEY MAP
SCALE: NONE			
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

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PR

GREENWALT DAM

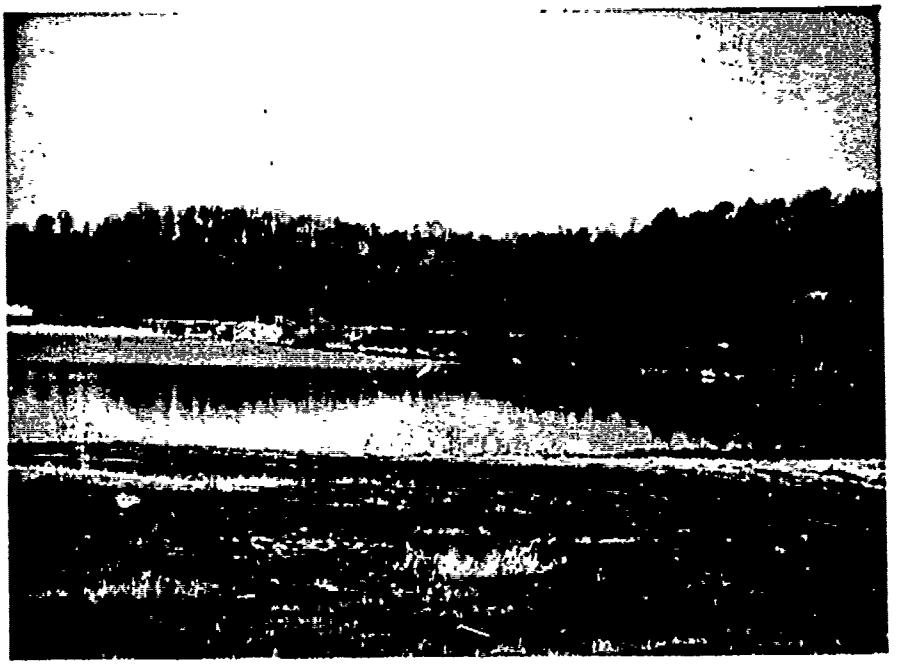

PHOTO I. UPSTREAM SLOPE

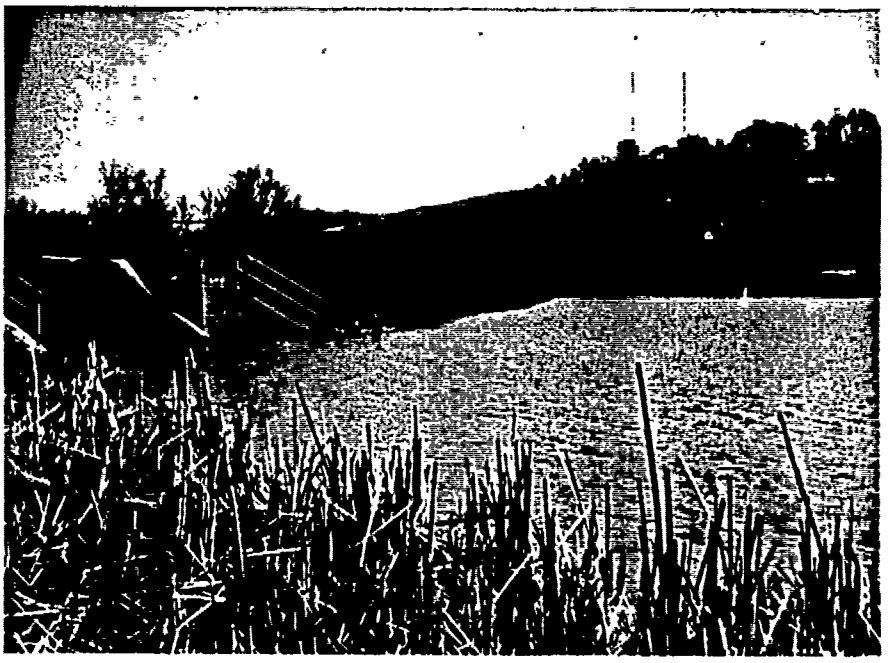

PHOTO 2. UPSTREAM SLOPE

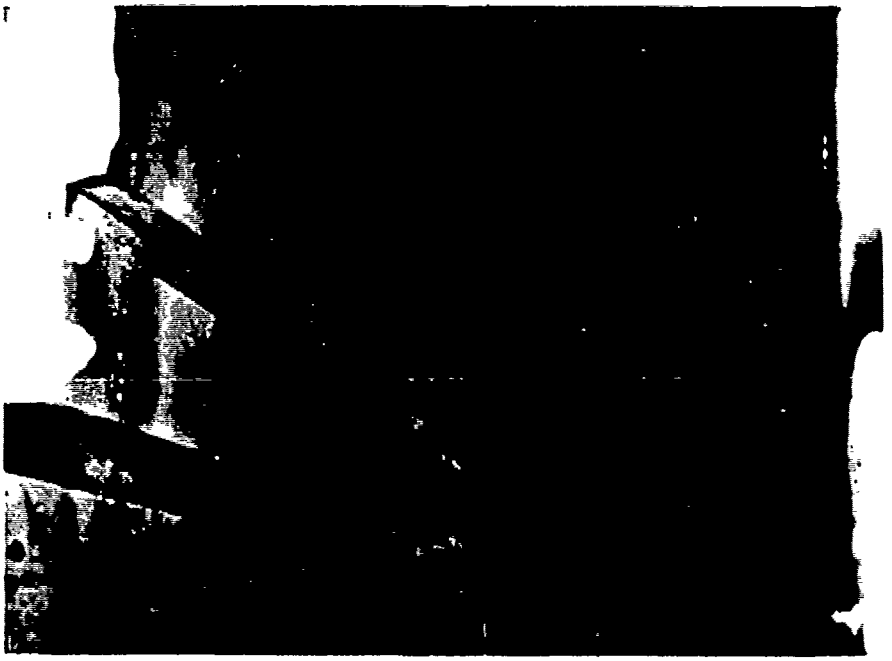

PHOTO 3. OUTLET WORKS

PHOTO 4. LEFT SPILLWAY WALL

PHOTO 6. RIGHT SPILLWAY WALL

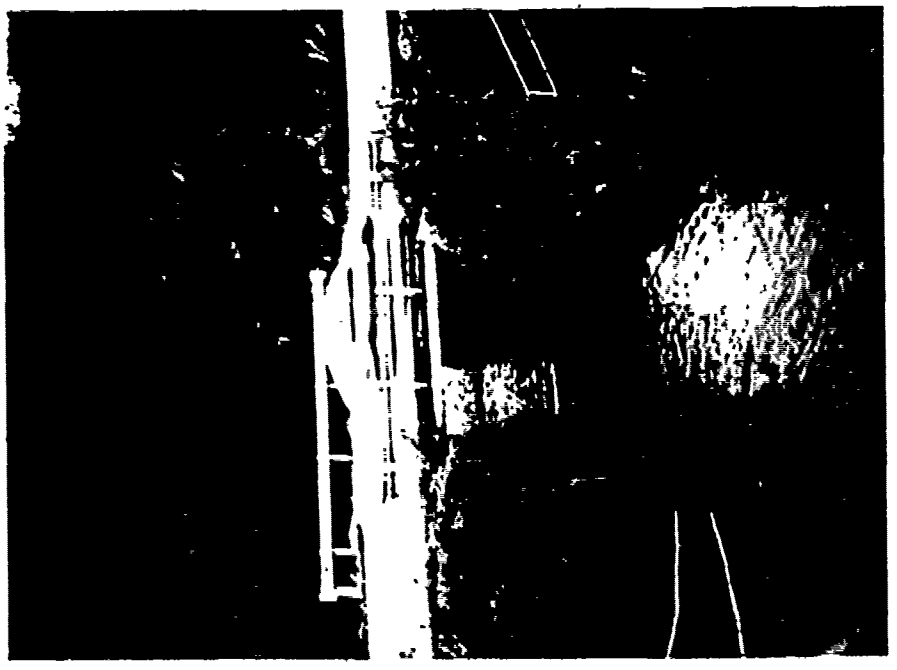

PHOTO 5. DISCHARGE CHANNEL

GREENWALT DAM

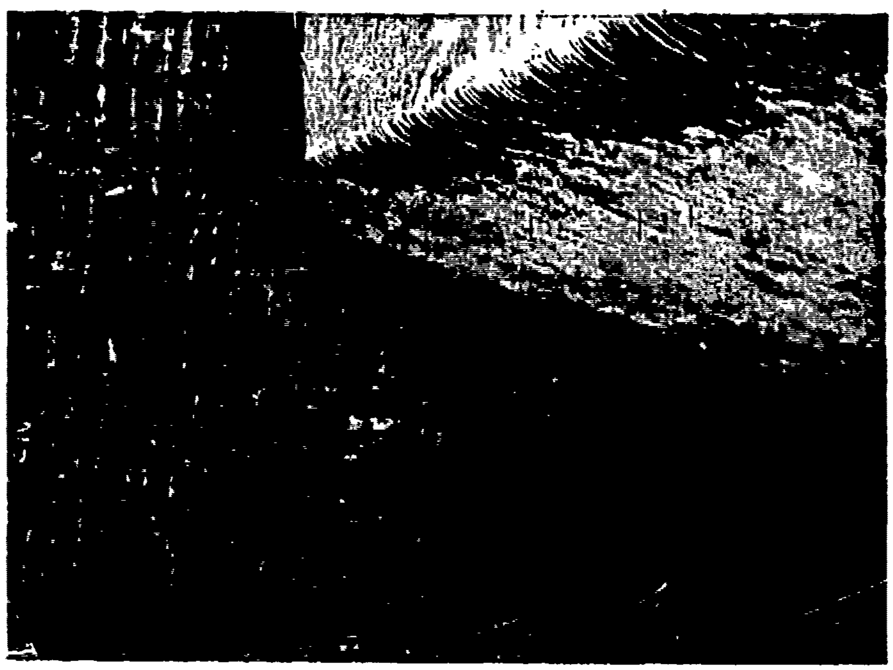

PHOTO 7. RIGHT SPILLWAY WALL

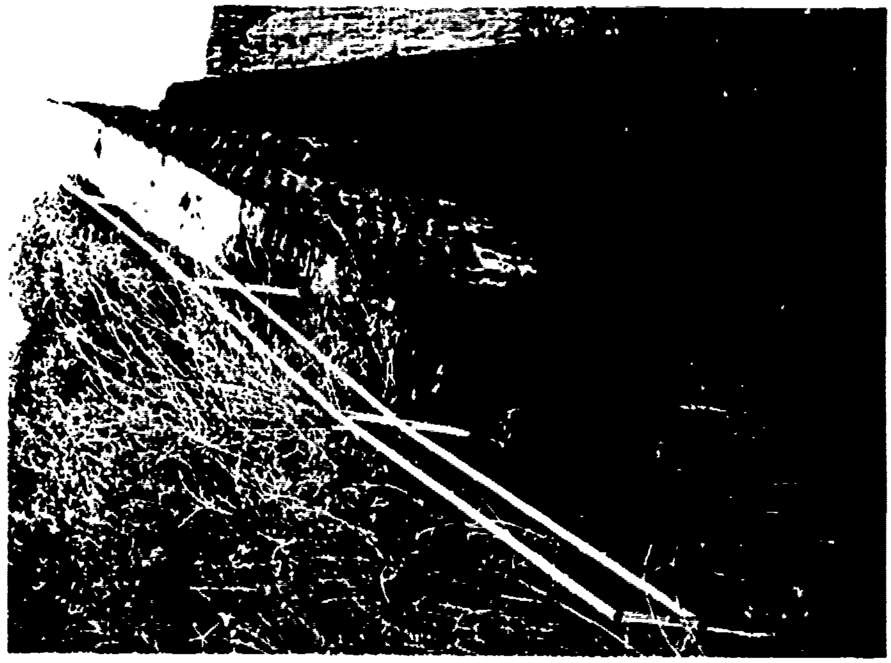

PHOTO 8. RIGHT SPILLWAY WALL

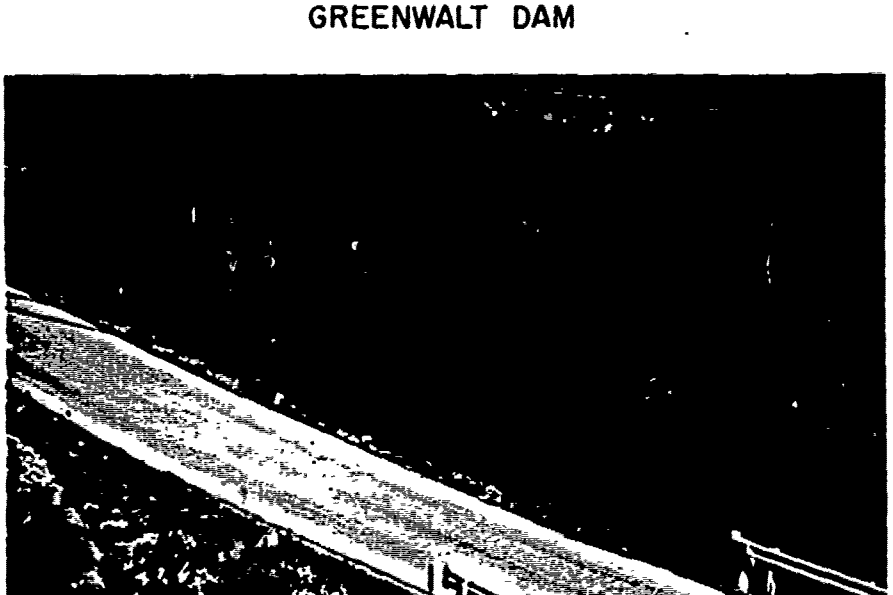

PHOTO 9. DOWNSTREAM CONDITIONS

PHOTO 10. SILT FLOW

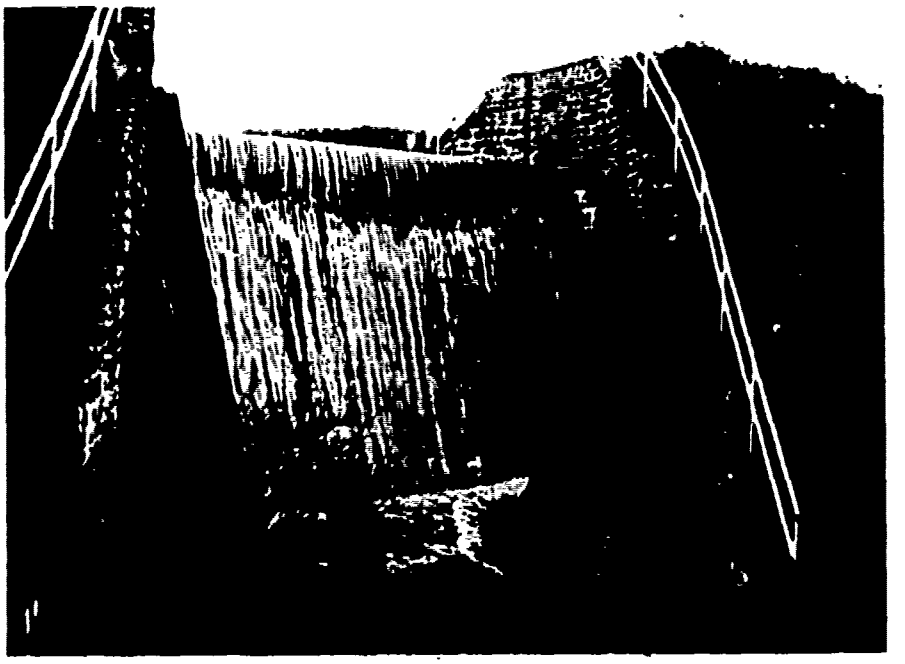

PHOTO 11. PRINCIPAL SPILLWAY

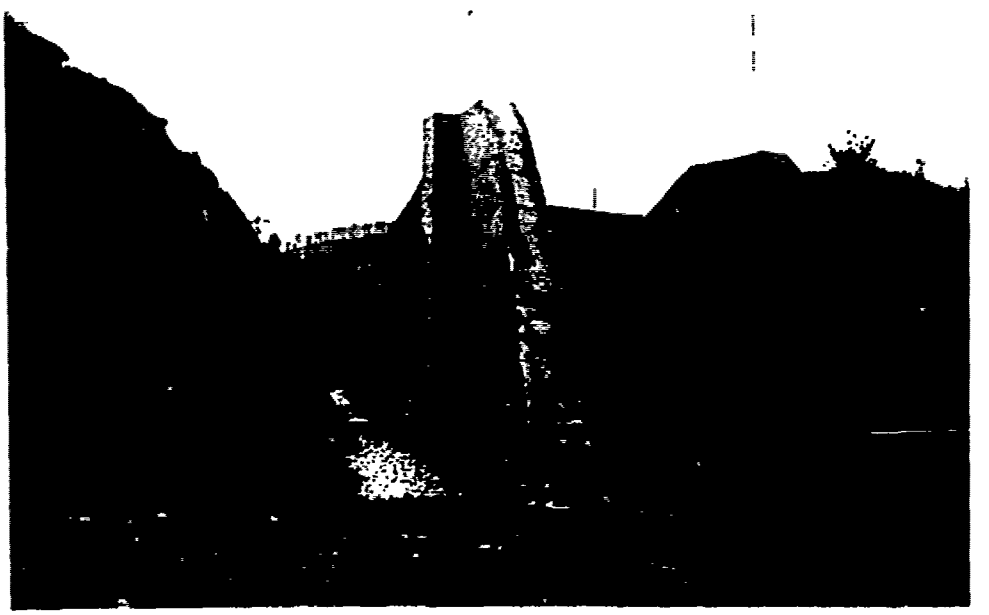

PHOTO 12. BREACH

DETAILED PHOTO DESCRIPTIONS

Photo 1 Upstream Slope showing spillway inlet as seen from right abutment.

Photo 2 Upstream Slope showing spillway inlet as seen from left abutment.

Photo 3 Outlet Works showing stoplog controls.

Photo 4 Left Spillway Wall showing seepage conditions.

Photo 5 Discharge Channel and township road bridge.

Photo 6 Right Spillway Wall showing deteriorated pilasters and cracking.

Photo 7 Right Spillway Wall showing major structural crack.

Photo 8 Right Spillway Wall showing tilted condition and outlet works discharge pipe.

Photo 9 Downstream Conditions.

Photo 10 Silt Flow observed in hand dug excavation on downstream slope.

Photo 11 Principal Spillway as seen from highway bridge downstream.

Photo 12 Breach resulting from piping failure during winter of 1935-1936 (photo taken 21 October 1937).

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel	From U.S.G.S. 7.5 minute topographic map
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic map

Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately pasture, some dwellings and local roads.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 991.0 (92 acre-feet.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 995.9 (171 acre-feet.)

ELEVATION MAXIMUM DESIGN POOL: 998

ELEVATION TOP DAM: 995.9 (minimum)

OVERFLOW SECTION

a. Elevation 991.0
b. Type Masonry weir wall
c. Width 5.3 feet
d. Length 34.25 feet
e. Location Spillover Left of centerline
f. Number and Type of Gates None

OUTLET WORKS

a. Type None known
b. Location
c. Entrance Inverts Unknown
d. Exit Inverts Unknown
e. Emergency Drawdown Facilities 12 inch diameter cast iron pipe

HYDROMETEOROLOGICAL GAGES

a. Type None
b. Location N/A
c. Records None

MAXIMUM REPORTED NON-DAMAGING DISCHARGE Pool level at Elev. 996.4 during storm of 2 August 1935

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Greenwalt Dam	NDI ID NO. PA 00476
Probable Maximum Precipitation (PMP)	24*
Drainage Area	2.2 sq. mi.
Reduction of PMP Rainfall for Data Fit	0.8 (24)
Reduce by 20%, therefore PMP rainfall =	=19.2 in.
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102%
12 hrs.	120%
24 hrs.	130%
Snyder Unit Hydrograph Parameters	
Zone	24**
C_p	0.45
C_t	1.6
L	2.5 mile
L_{ca}	1.0 mile
$t_p = C_t (L \cdot L_{ca})^{0.3}$ =	2.11 hours
Loss Rates	
Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq.mi=3.30 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Overflow Section Data	
Crest Length	34.25 feet
Freeboard	4.9 feet
Discharge Coefficient	3.09
Exponent	1.5
Discharge Capacity	1148 cfs

---

* Hydrometerological Report 33
** Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

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(412) 531-7111

Sheet _____ of _____

Job GREENWALT DAM Job No. 79153Q

Subject DATA Input

Made By JPH Date _____ Checked JEB Date 6/17/81

Loss Rates and Base Flow Parameters

As Recommended by Corps of Engineers, Baltimore District

STRTL = 1 INCH
CNSTL = 0.05"/hour
STRTQ = 1.5 cfs/mi^2
QRCSN = 0.05 (5% of Peak Flow)
RTIOR = 2.0

Elevation - Area - Capacity Relationships

From U.S.G.S. 7.5 min Quad, Penn Dep Files, and Field Inspection Data.

At Spillway Crest Elevation 991

Initial Storage 92 Acre feet

Pond Surface Area 15 Acres

At elevation 1000 Area = 19 Acres

From conic method of Reservoir Volume
Flood Hydrograph Package (Hec-1)
Dam Safety Version (Users Manual)

$H = 3V/A$

$= 3(92)/15 = 18.4$

Elevation where Area Equals Zero

$991 - 18.4 = 972.6$

AREA	$DA	0.0	15.0	19.0
Elevation	$E	972.6	991.0	1000.

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Sheet _____ of _____

Job GREENWALT DAM Job No. 79153.Q

Subject DATA Input

Made By JDH Date _____ Checked EB Date 6/17/80

SPILLWAY PARAMETERS

Crest elevation	991.0
Length of Crest	84.25 feet
Coefficient of Discharge	3.09 (Free overfall)
Width of Crest	5.3 feet

DAM OVERTOP PARAMETERS

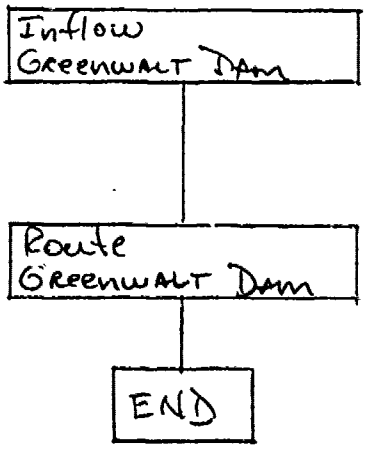
Top of Dam ELEVATION (Minimum) = 995.9

Length of Dam (Excluding Spillway) = 940.0

Coefficient of Discharge = 3.09

$LMAX = 950.0 $UMAX = 1000.

PROGRAM SCHEDULE



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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1             A1       NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
    2             A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF GREENWALT DAM
    3             A3       PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD
    4             B    100      0      15       0       0       0       0       0      -4       0
    5             B1     5
    6             J      1      3       1
    7             J1    1.     .5      .2
    8             K      0      1                                       1
    9             K1       INFLOW HYDROGRAPH FOR GREENWALT DAM
   10             M      1      1     2.2              2.2                                      1
   11             P             24     102     120     130
   12             T                                                   1.0 *  0.05
   13             W   2.11   0.45
   14             X   -1.5  -0.05     2.0
   15             K      1      2                                       1
   16             K1       ROUTING AT GREENWALT DAM
   17             Y                                     1       1
   18             Y1     1                                          92.
   19             $A    0.     15.     19.
   20             $E 972.6    991.   1000.
   21             $$  991.   34.25    3.09     1.5
   22             $D 995.9    3.09     1.5    940.
   23             $L    3.     30.    200.    935.    950.
   24             $V 995.9    997.    998.    999.   1000.
   25             K     99
   26             A
   27             A
   28             A
   29             A
   30             A

                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT          1
                                ROUTE HYDROGRAPH TO           2
                                END OF NETWORK

**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

RUN  DATE:  5 JUN 80
RUN  TIME: 13. 2.29


                        NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
                        HYDROLOGIC AND HYDRAULIC ANALYSIS OF GREENWALT DAM
                        PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

                                        JOB SPECIFICATION
          NQ      NHR     NMIN    IDAY     IHR     IMIN    METRC     IPLT    IPRT    NSTAN
         100        0       15       0       0       0       0        0      -4        0
                                   JOPER     NWT   LROPT   TRACE
                                       5       0       0       0


                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1 NRTIO= 3 LRTIO= 1
                        RTIOS=    1.00    0.50    0.20
**********      **********      **********      **********      **********
```

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR GREENWALT DAM

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.20	0.0	2.20	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	24.00	102.00	120.00	130.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 2.11 CP=0.45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 76 END-OF-PERIOD ORDINATES, LAG= 2.11 HOURS, CP= 0.45 VOL= 1.00

11.	41.	83.	133.	187.	237.	275.	300.	307.	295.
274.	254.	236.	219.	203.	189.	175.	162.	151.	140.
130.	120.	112.	104.	96.	89.	83.	77.	71.	66.
62.	57.	53.	49.	46.	42.	39.	36.	34.	31.
29.	27.	25.	23.	22.	20.	19.	17.	16.	15.
14.	13.	12.	11.	10.	10.	9.	8.	8.	7.
7.	6.	6.	5.	5.	5.	4.	4.	4.	3.
3.	3.	3.	2.	2.	2.				

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	24.96	23.08	1.88	119846.
										(634.)	(586.)	(48.)	(3393.67)

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

HYDROGRAPH ROUTING

ROUTING AT GREENWALT DAM

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	92.	0

SURFACE AREA=	0.	15.	19.
CAPACITY=	0.	92.	245.
ELEVATION=	973.	991.	1000.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
991.0	34.3	3.1	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
995.9	3.1	1.5	940.

CREST LENGTH AT OR BELOW	3.	30.	200.	935.	950.

CREST LENGTH	3.	30.	200.	935.	950.
AT OR BELOW ELEVATION	995.9	997.0	998.0	999.0	1000.0

PEAK OUTFLOW IS 4290. AT TIME 18.00 HOURS

PEAK OUTFLOW IS 2120. AT TIME 18.25 HOURS

PEAK OUTFLOW IS 814. AT TIME 18.75 HOURS

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

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.20
HYDROGRAPH AT	1	2.20	1	4293.	2147.	859.
	(	5.70)	(	121.57)(	60.79)(	24.31)(
ROUTED TO	2	2.20	1	4290.	2120.	814.
	(	5.70)	(	121.49)(	60.04)(	23.04)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	991.00	991.00	995.90
STORAGE	92.	92.	171.
OUTFLOW	0.	0.	1148.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	998.92	3.02	224.	4290.	9.75	18.00	0.0
0.50	997.77	1.88	204.	2120.	5.25	18.25	0.0
0.20	994.90	0.0	154.	814.	0.0	18.75	0.0

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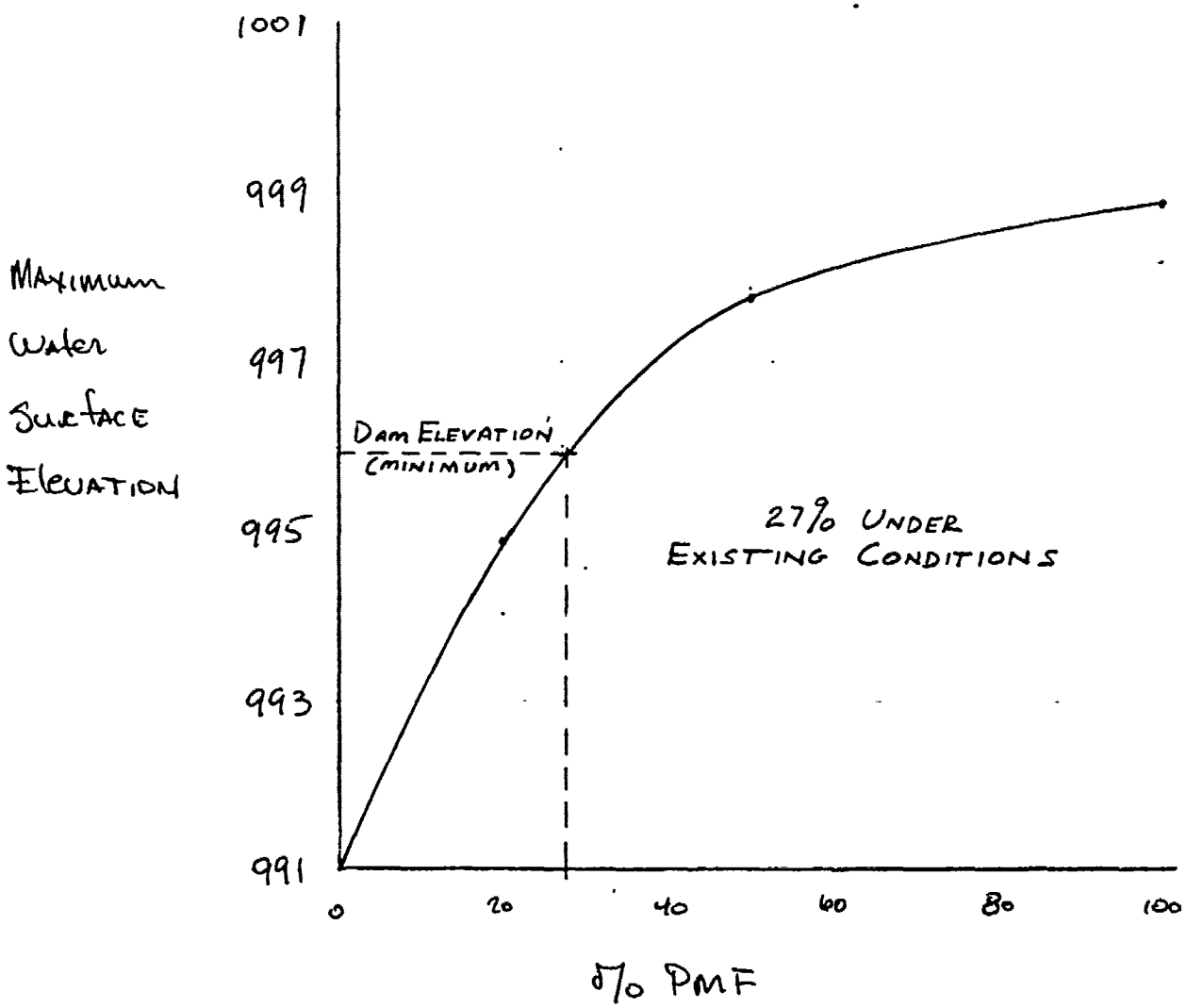
Sheet _____ of _____

Job GREENWALT DAM Job No. 191530

Subject HYDROLOGY - PERFORMANCE PLOT

Made By JPH Date 6/16/80 Checked JFB Date 6/17/80

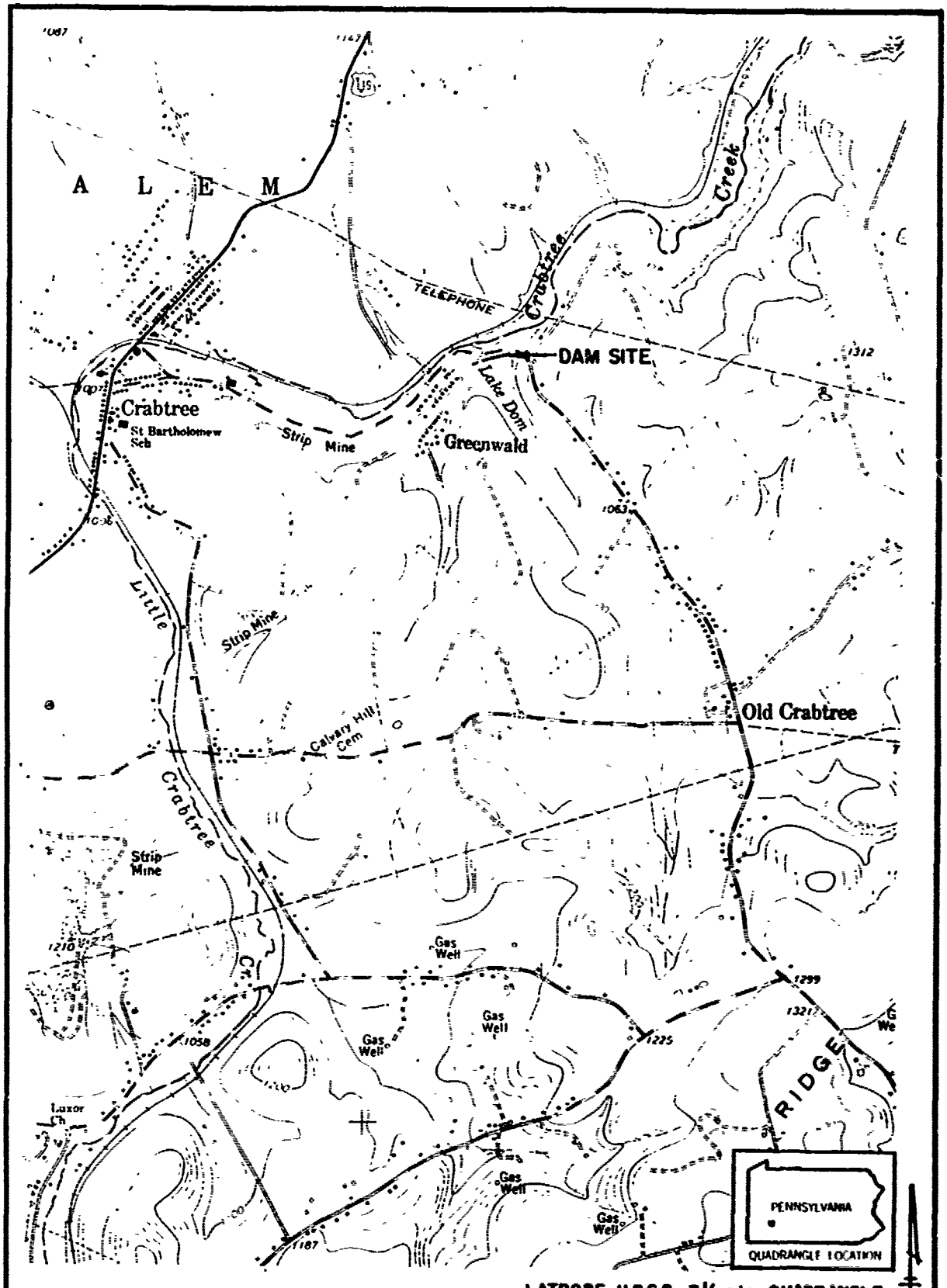


APPENDIX E

PLATES

LIST OF PLATES

Plate I	Regional Vicinity Map.
Plate II	Topography of Donohoe Water Company Reservoir
Plate III	Commonwealth of Pennsylvania, Rebuilding of Greenwalt Dam, Plan and Profile
Plate IV	Commonwealth of Pennslvania, Department of Forest and Waters, Details of Blowoff Control Tower for Greenwalt Dam

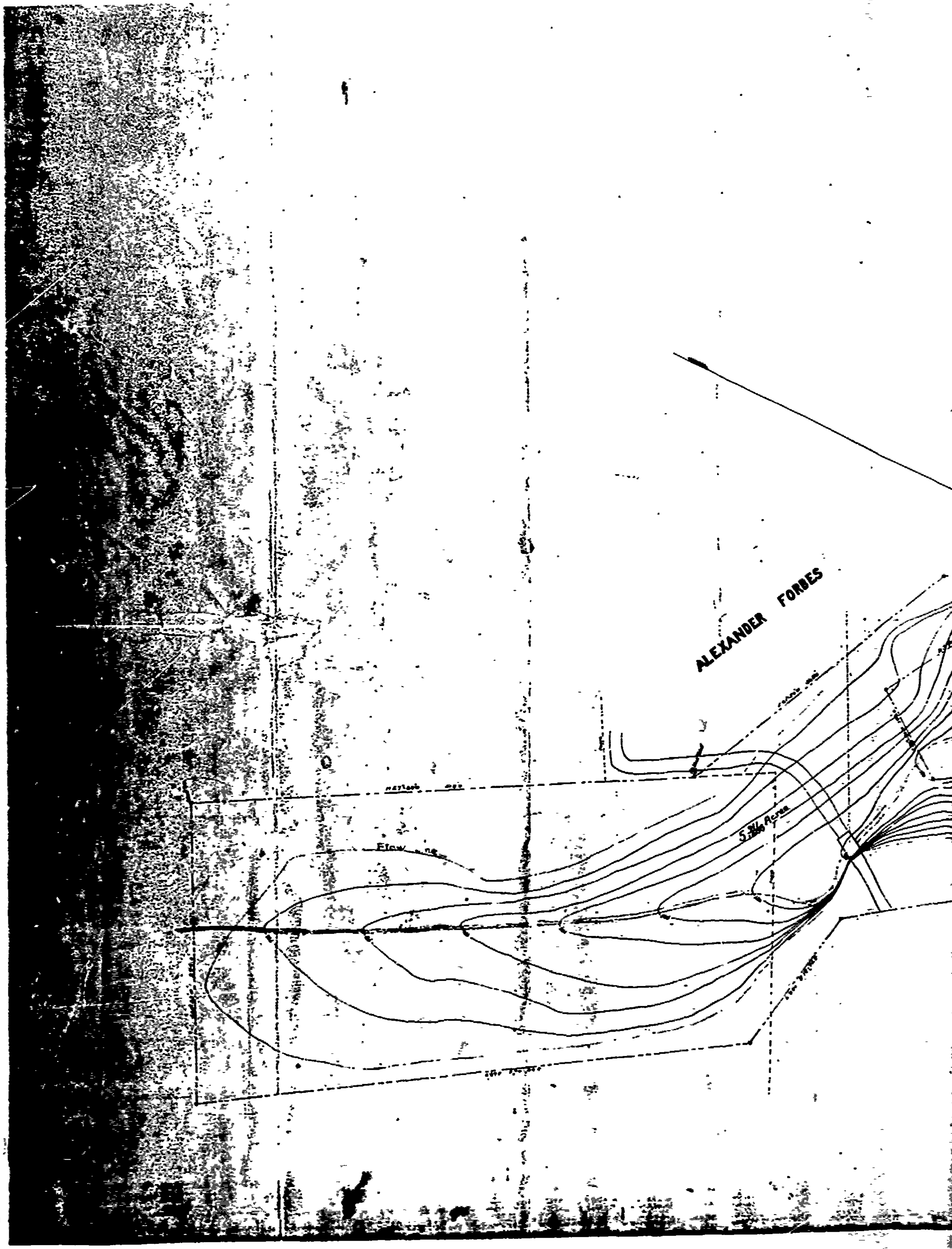


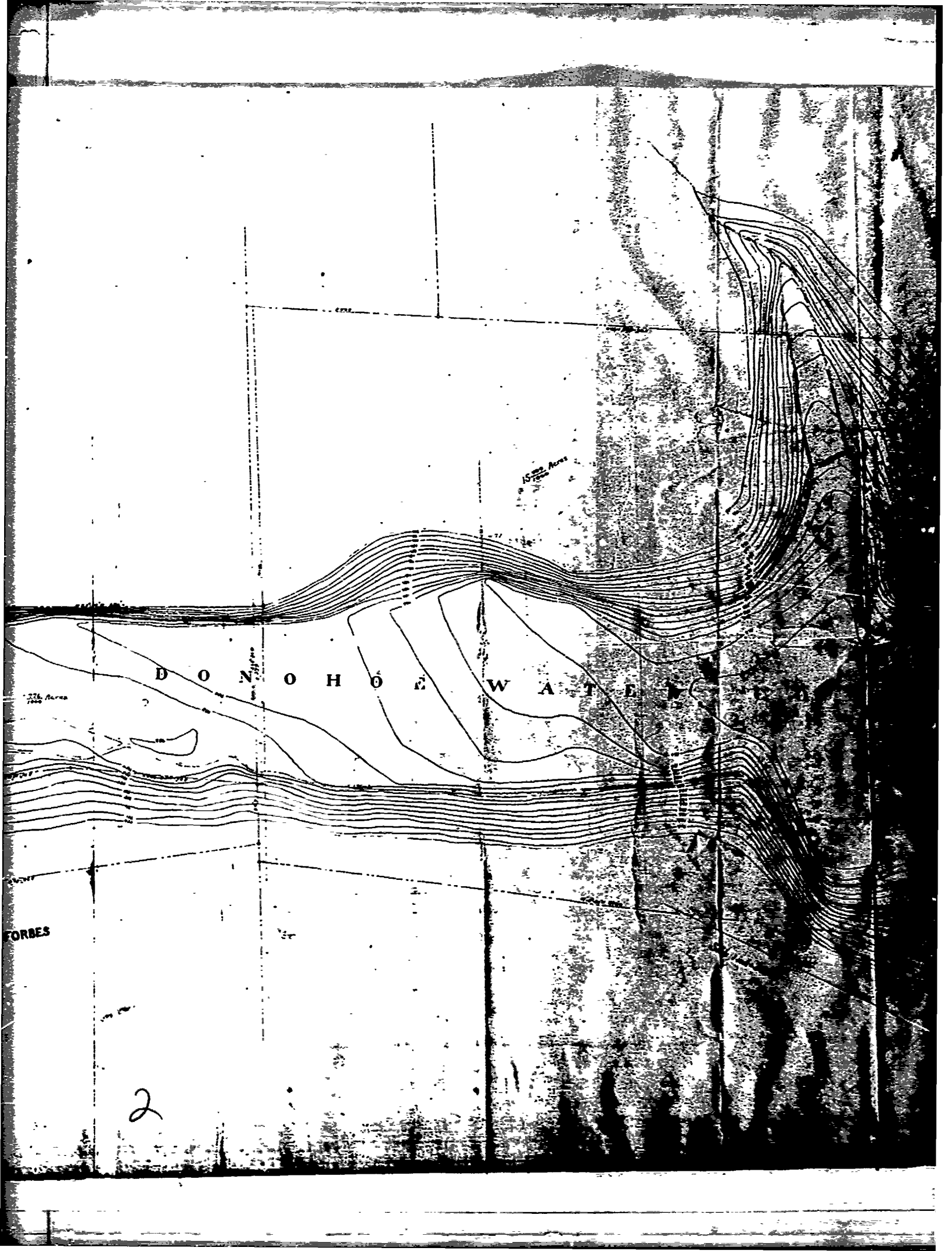
LATROBE U.S.G.S. 7½ min. QUADRANGLE

DATE: JULY 1980	GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM		REGIONAL VICINITY MAP
SCALE: 1" = 2000'			
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	
DWG. NO. PLATE I			

10 7100 ALBANENE A. & B. SMITH CO., PGH., PA.

PR


ALEXANDER FORBES


D O N O H O E W A T E R
FORBES
2

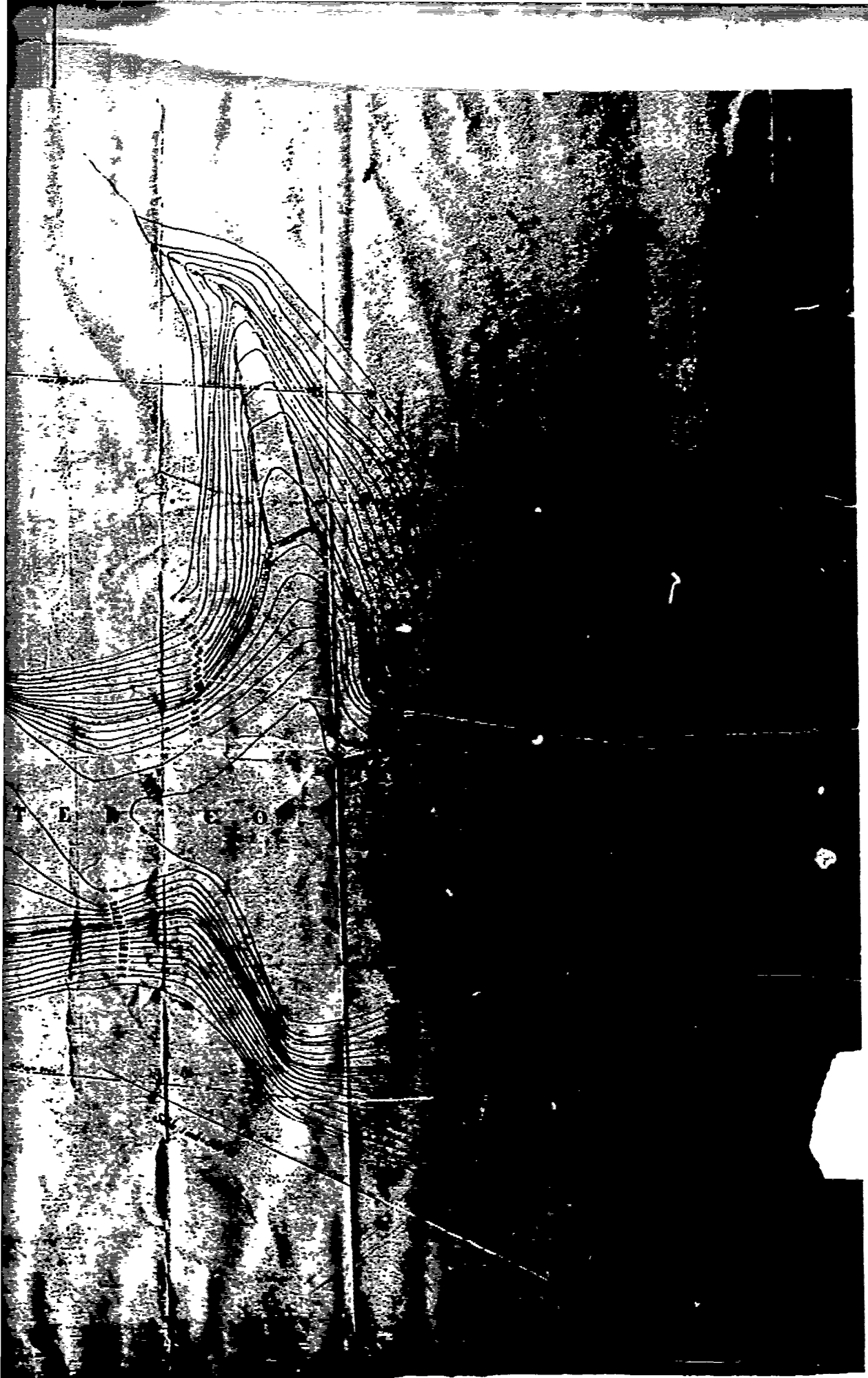
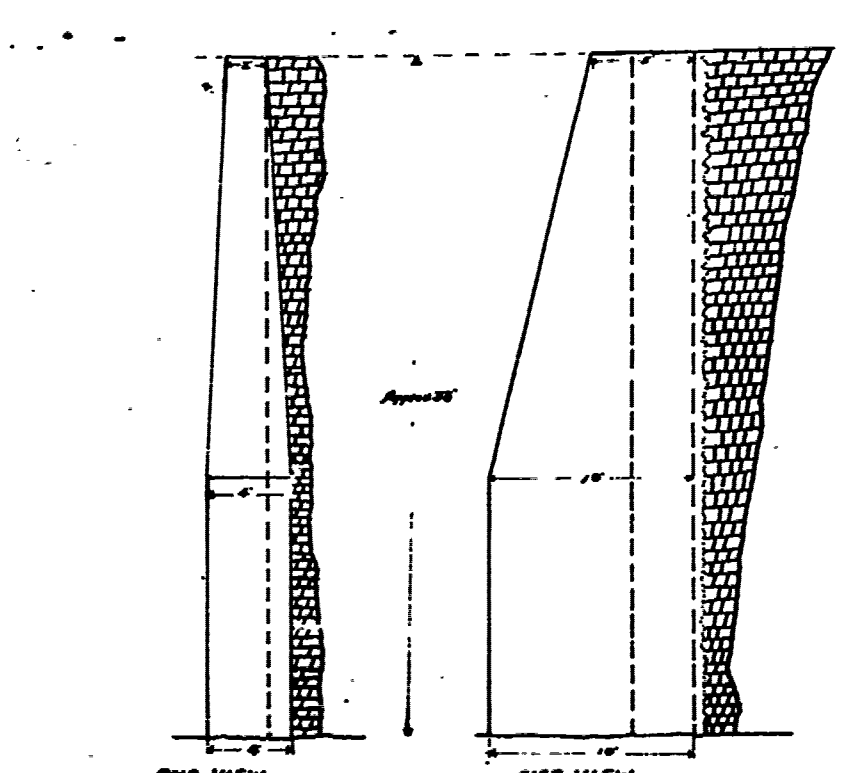


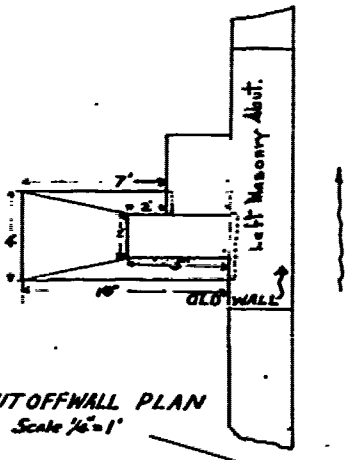
PLATE II



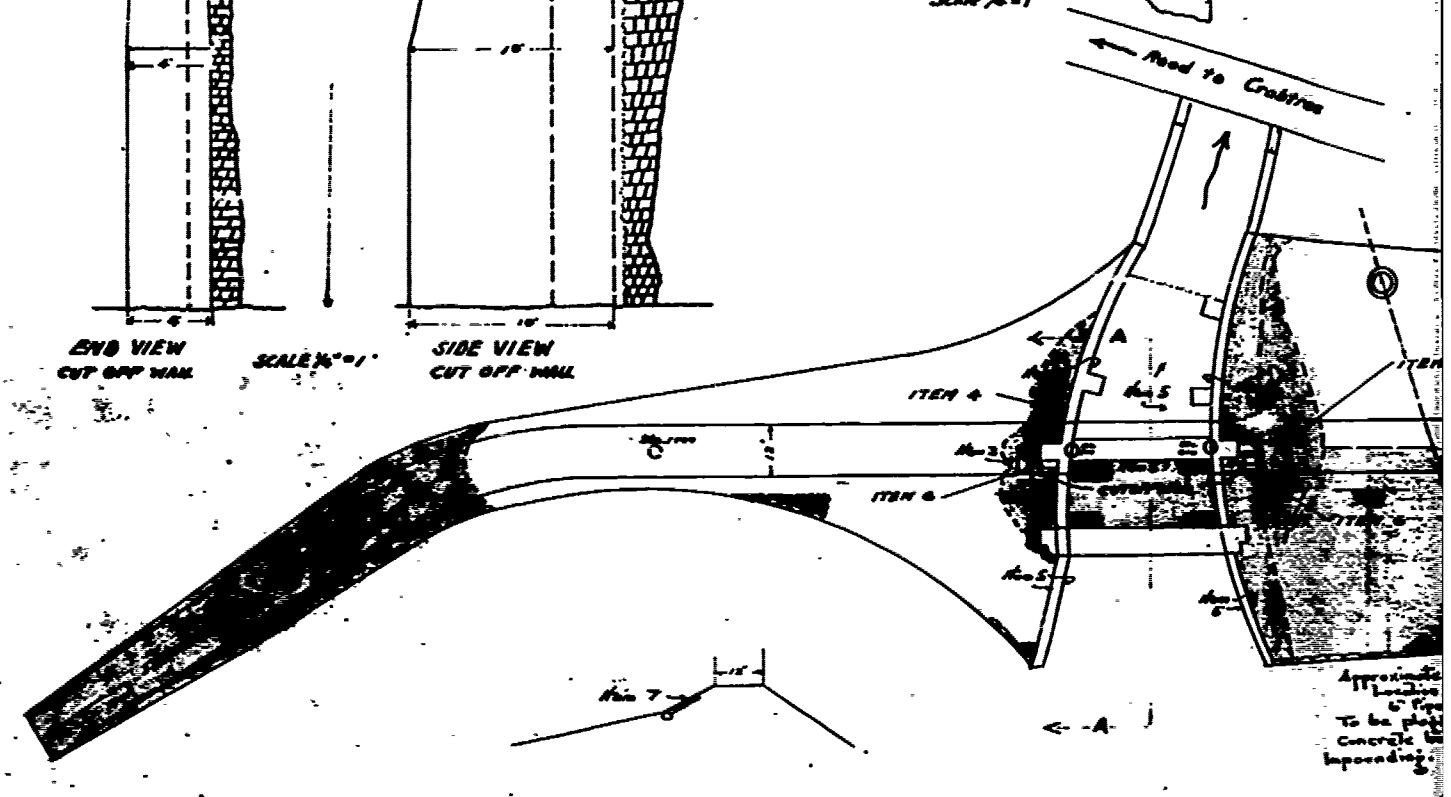
END VIEW
CUT OFF WALL

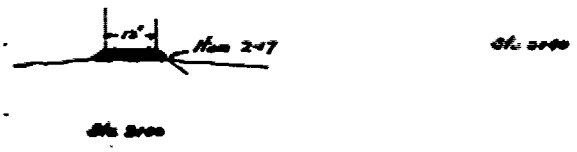
SCALE 1/16" = 1'

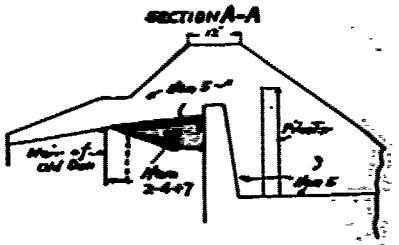
SIDE VIEW
CUT OFF WALL

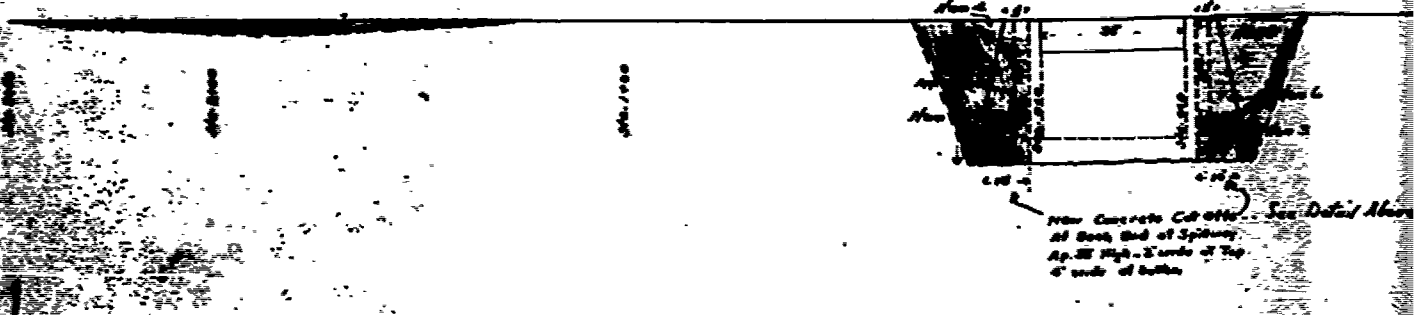


CUT OFFWALL PLAN
Scale 1/16" = 1'









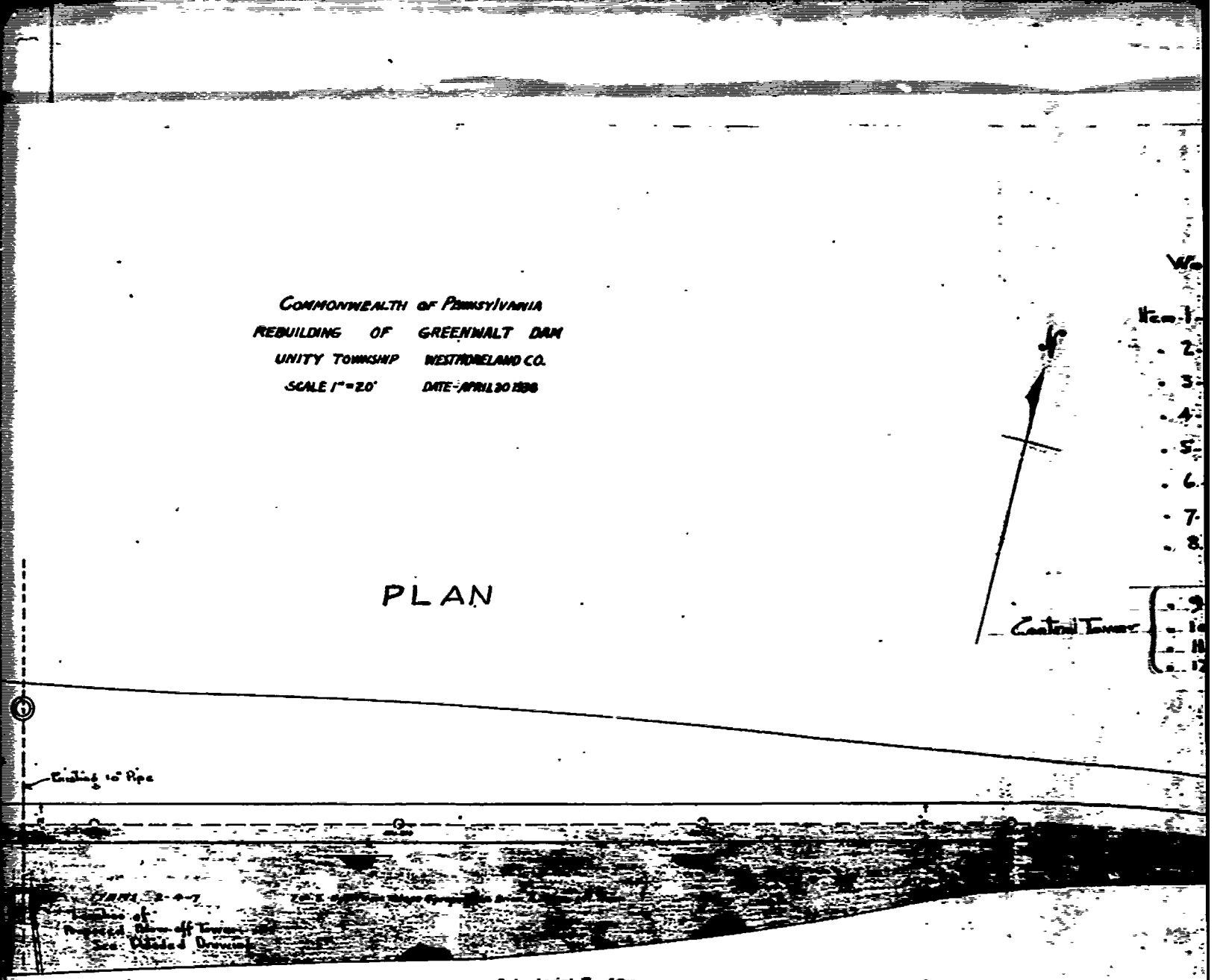
COMMONWEALTH OF PENNSYLVANIA

REBUILDING OF GREENWALT DAM

UNITY TOWNSHIP WESTMORELAND CO.

SCALE 1"=20' DATE-APRIL 30 1938

PLAN



PROFILE

2

Work Items and Approximate Quantities

Item 1	Clearing	12 Acres
" 2	Soil Stripping	950 Cu. Yds.
" 3	Excavation	275 " "
" 4	Embankment	3250 " "
" 5	Masonry Repairs	690 Sq. Yds.
" 6	Concrete	42 Cu. Yds.
" 7	Slope Protection-Riprap	750 Cu. Yds.
" 8	Cofferdam	
Control Tower " 9	Concrete	34 Cu. Yds.
" " 10	Masonry	30 " "
" " 11	Steel	663 lbs.
" " 12	Gate Valve	

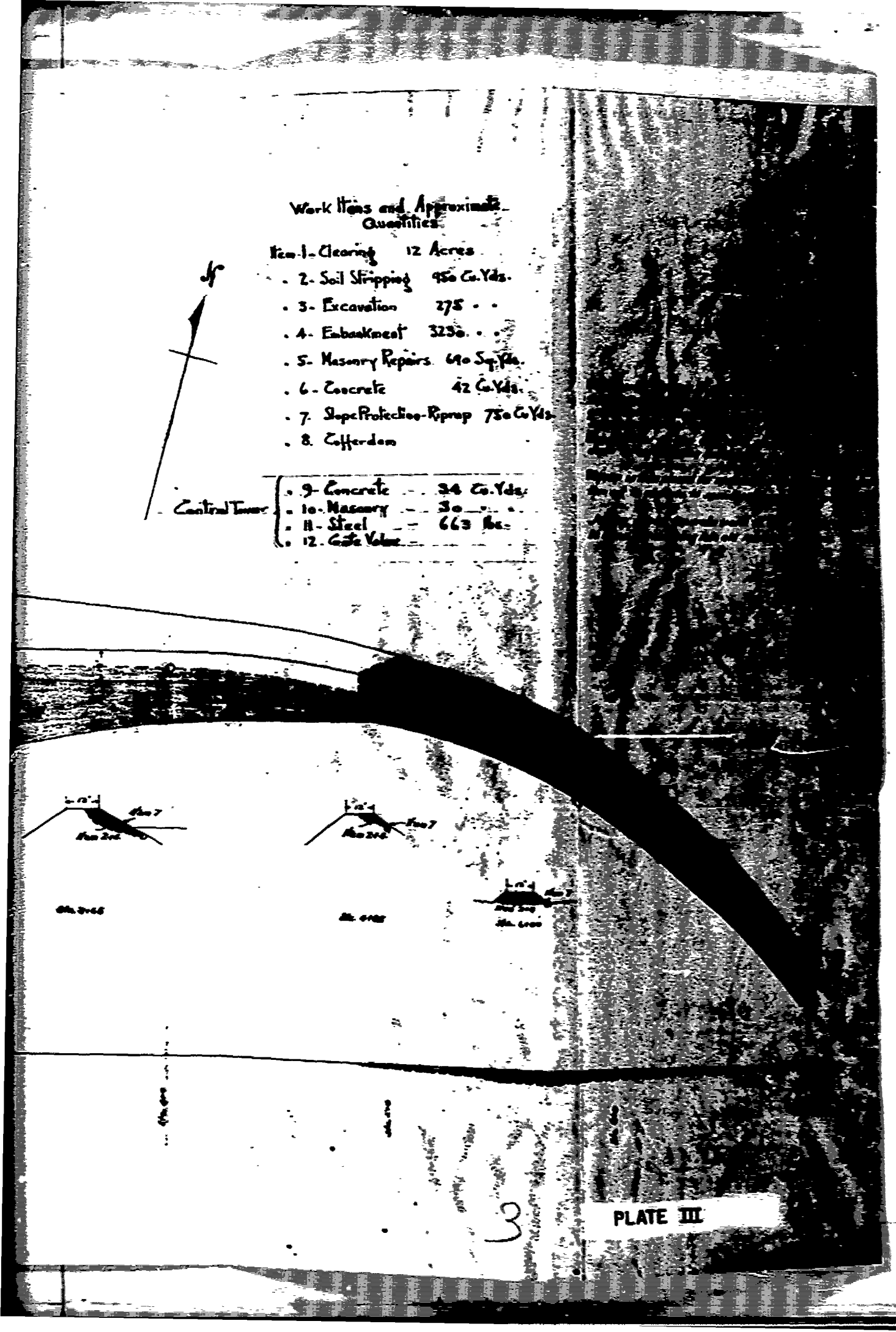
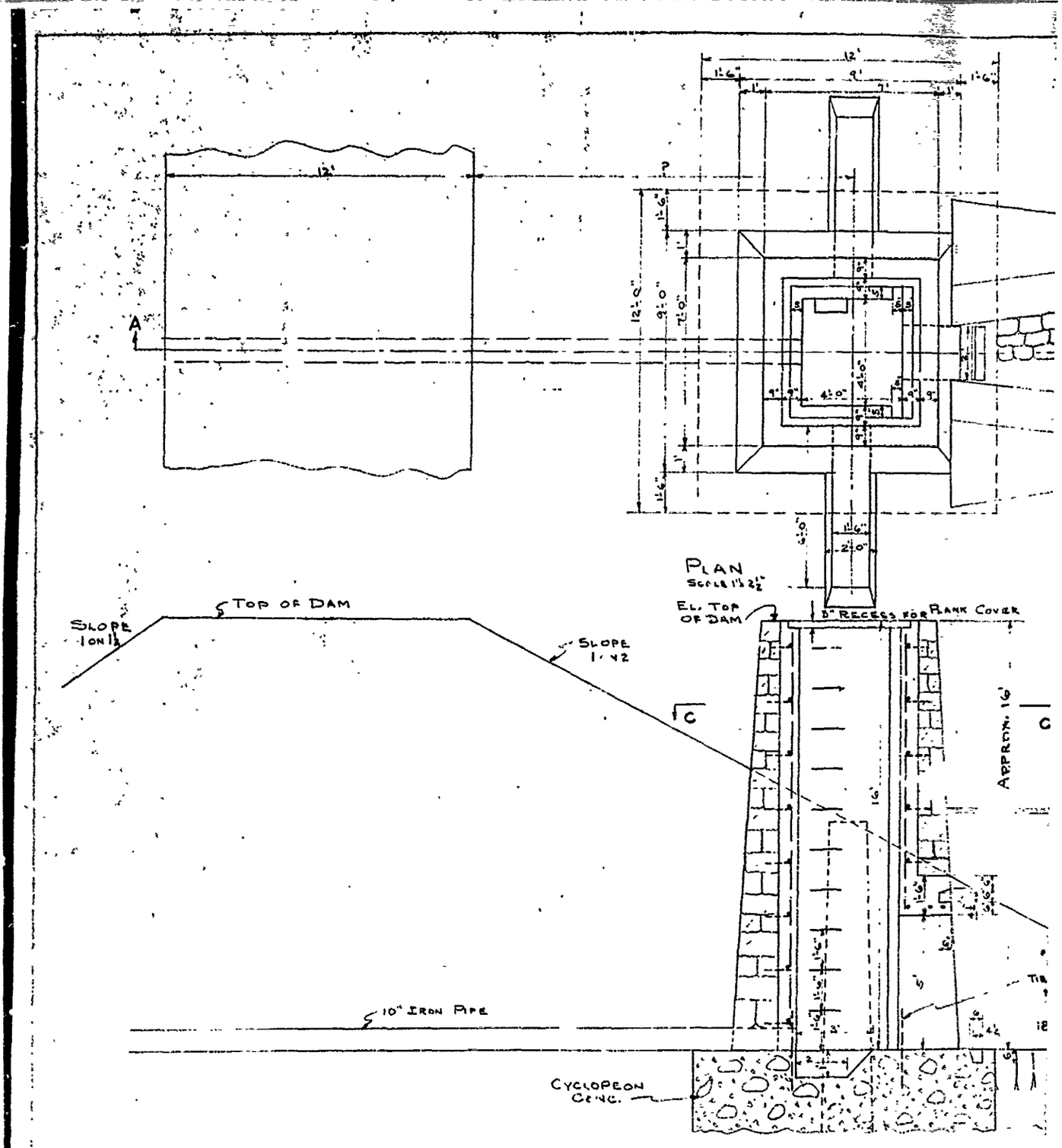
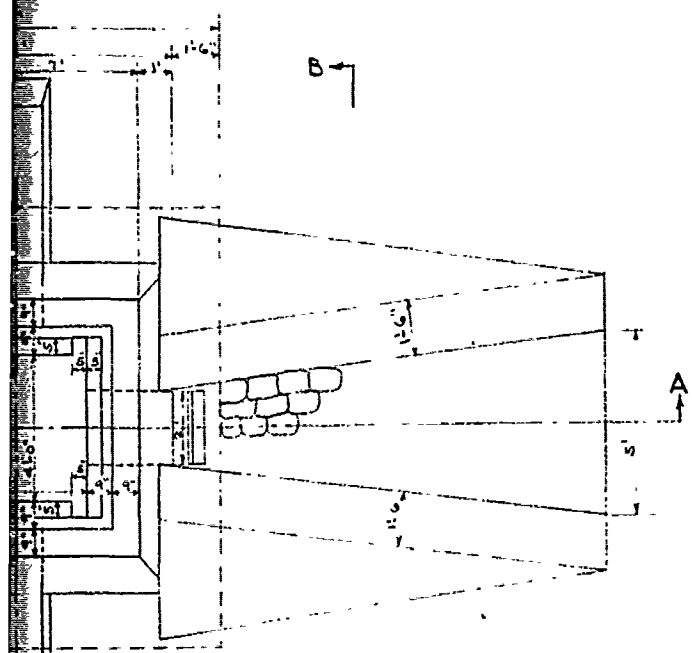
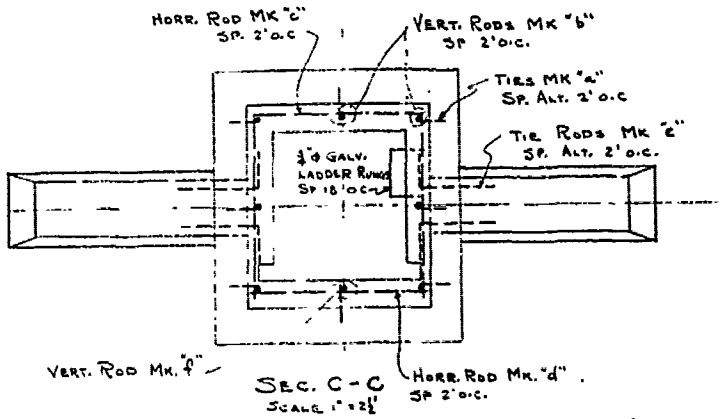


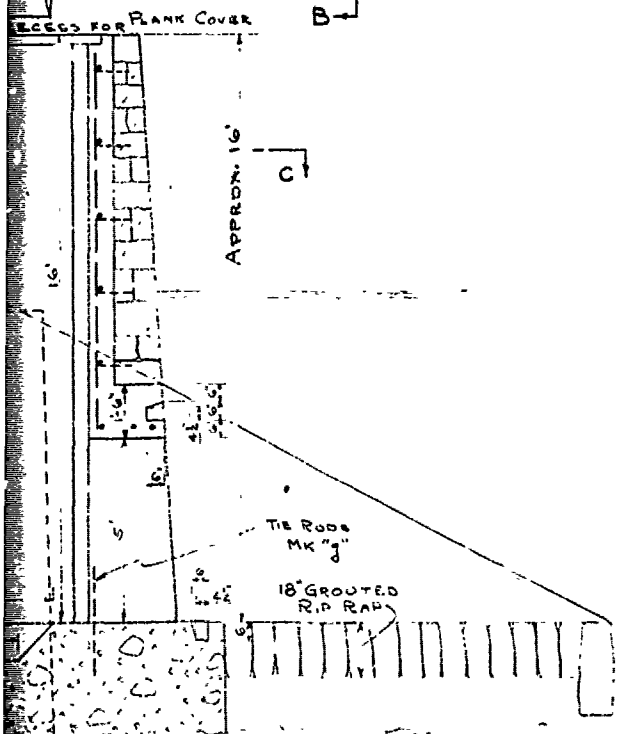
PLATE III


12'
9'
A
12'-0"
9'-0"
7'-0"
4'-0"
2'-0"
PLAN
SCALE 1"=2½'
TOP OF DAM
SLOPE 1 ON 1½
SLOPE 1:42
EL. TOP OF DAM
9" RECESS FOR PLANK COVER
APPROX. 16'
C
10" IRON PIPE
CYCLOPEON CONC.
SEC. A-A
SCALE 1"=2½'

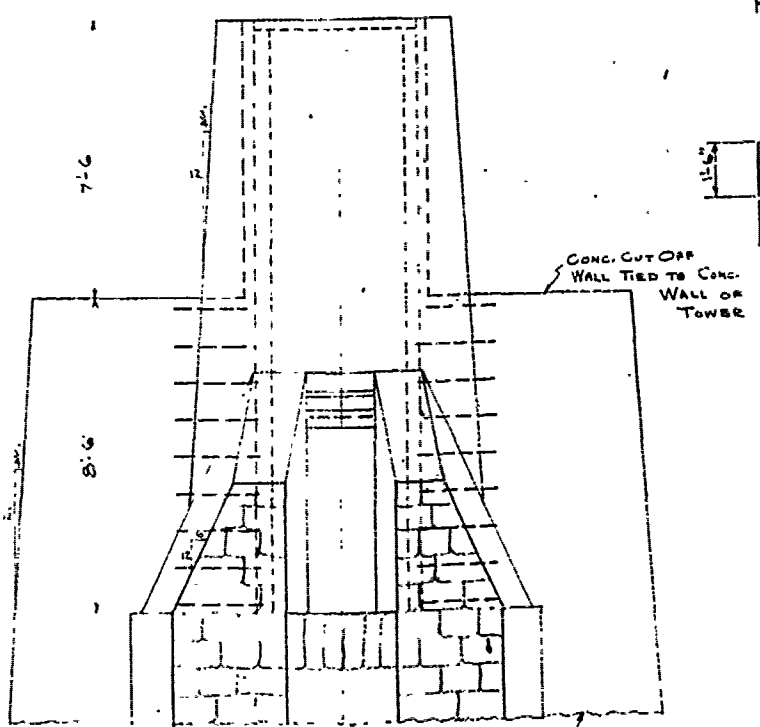




SEC. C-C
SCALE 1"=2½'

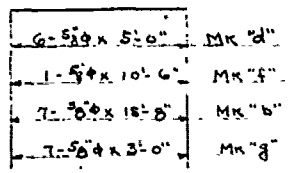


EC. A-A
SCALE 1"= 2½'

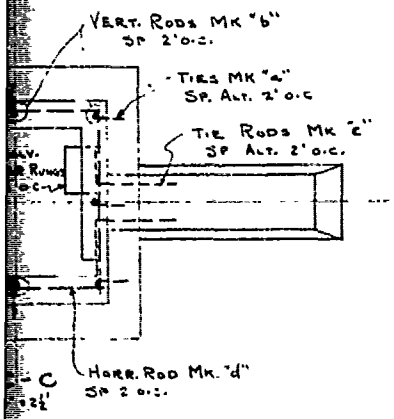


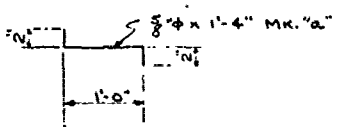
SEC. B-B
SCALE 1"=2½'

2

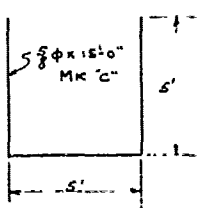


STR. RODS REQD.

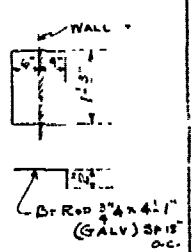




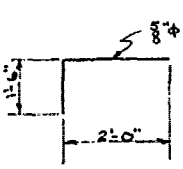
32 WALL TIES REQD.



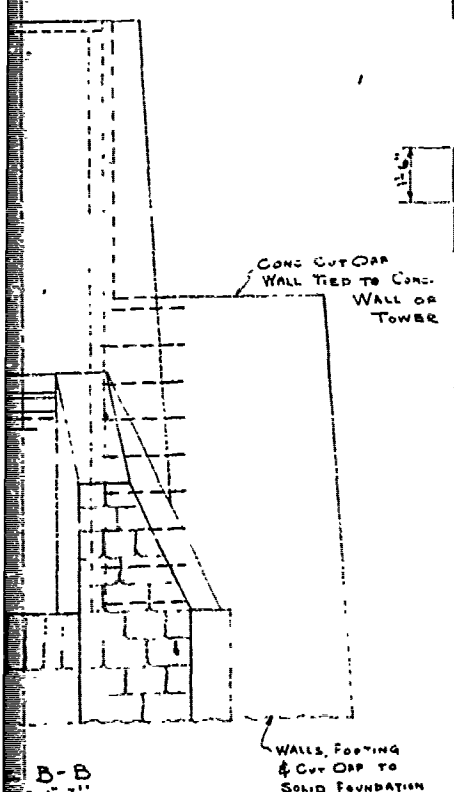
8 RODS REQD.

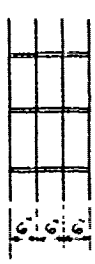


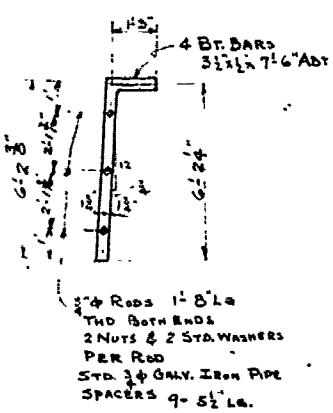
10 LADDER RUNGS REQD.



18 RODS REQD.







ONE TRASH RACK REQD.

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF FORESTS AND WATERS

DETAILS
BLOW OFF CONTROL TOWER
FOR
GREENWALT DAM 3

CO. WESTMORELAND FILE 65-52 DATE 6-30-38

APPROVED [redacted]

PLATE IV

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

The bedrock in the area of Greenwalt Dam is part of the Pittsburgh Plateau section of the Appalachian Plateau Physiographic Province. This area is characterized by essentially flat lying sedimentary rocks which have been cut deeply by streams in many places to form steep sided valleys. Greenwalt Dam is located along an unnamed tributary to Crabtree Creek. The rounded hilltops near the dam are commonly at Elev. 1200 to 1300 feet and in a regional sense are part of a broad undulating plateau. The valley bottom along the unnamed tributary is at about Elev. 1000 feet.

Structure

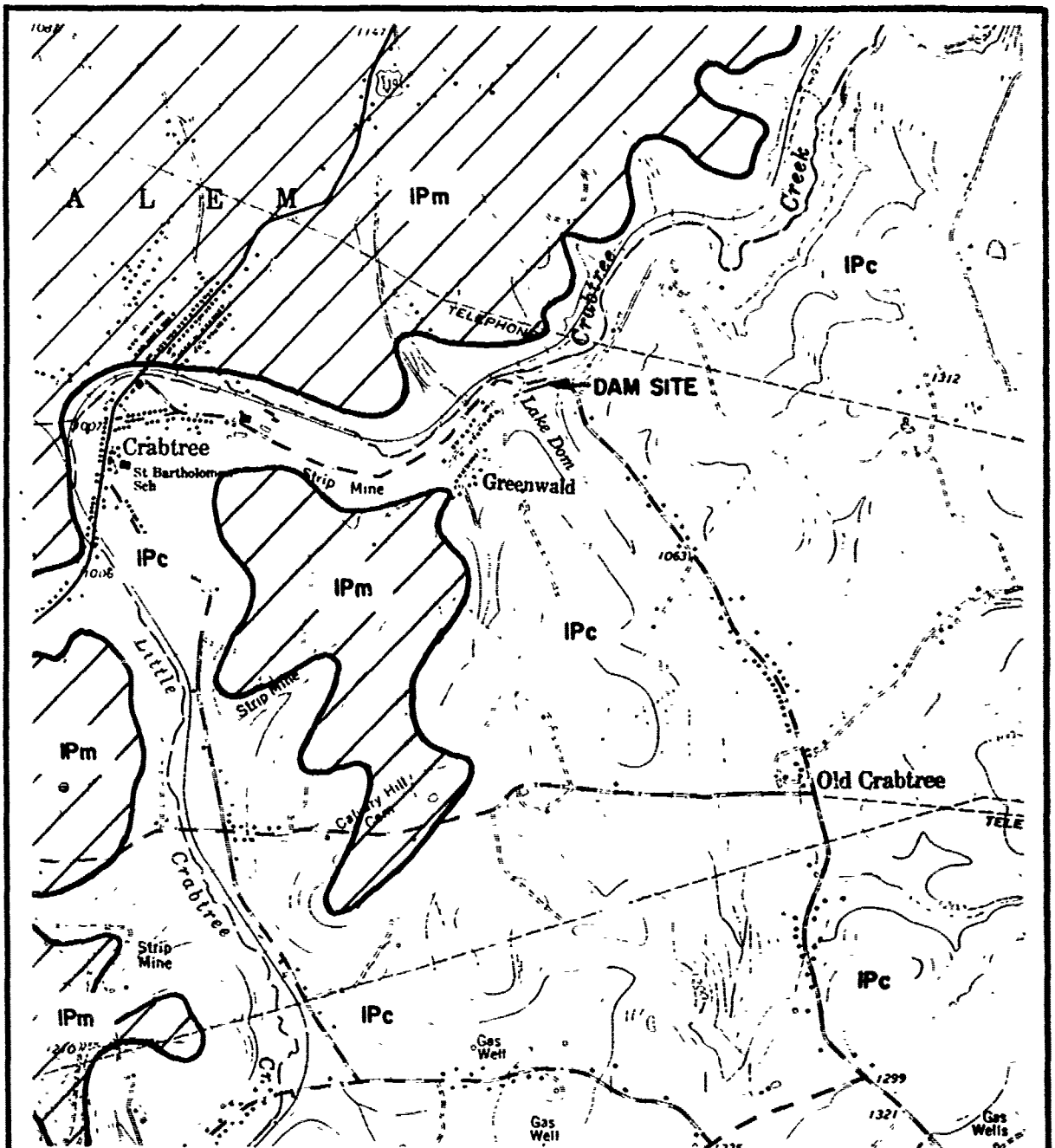
General: Regionally the dam on the east flank of the Greensburg syncline about 1 mile east of its axis. The dip of the bedrock strata is 300 feet/mile (3.3°) to the northwest.

Faults: No observations were made that would indicate faulting in the rocks outcropping around the dam site. In general, only a few evidences of faulting have been observed in all of Westmoreland County.

Stratigraphy

General: The rocks exposed in the immediate area of Greenwalt Dam are part of the Conemaugh Group of Pennsylvania Age, and include primarily the uppermost members of the Casselman Formation. The Pittsburgh Coal Seam, which stratigraphically marks the top of the Conemaugh Group and the base of the Monongahela Group, outcrops at elevations between 1000 and 1100 feet on the Crabtree Creek valley wall.

Rock Types: Bedrock in the immediate vicinity of the dam site is composed primarily of cyclic sequences of sandstone, siltstone shale and thin limestone.



LATROBE QUADRANGLE, WESTMORELAND COUNTY, PENNSYLVANIA

SCALE: 0 1/2 MILE 1:24000

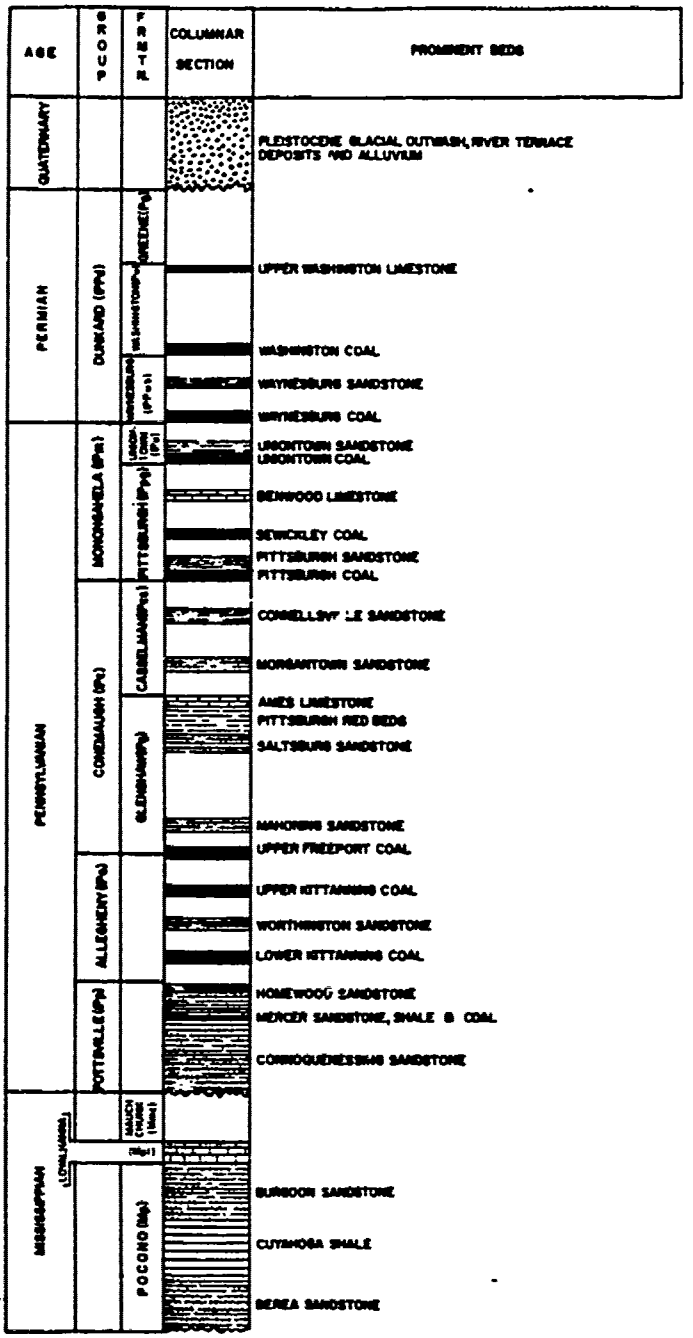
CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION GEOLOGIC MAP AND CROSS SECTIONS, 1975 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

DATE: JULY 1980		GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC MAP
SCALE: 1" = 2000'			
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

10 7189 ALBANENE A. & B. SMITH CO., PGH., PA.



DATE: JULY 1980		GREENWALT DAM NATIONAL DAM INSPECTION PROGRAM	GEOLOGIC COLUMN
SCALE: 1" = 360'			
DR: JF	CK:	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	

19 7199 ALBANENE A. & B. SMITH CO., PGH., PA.

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