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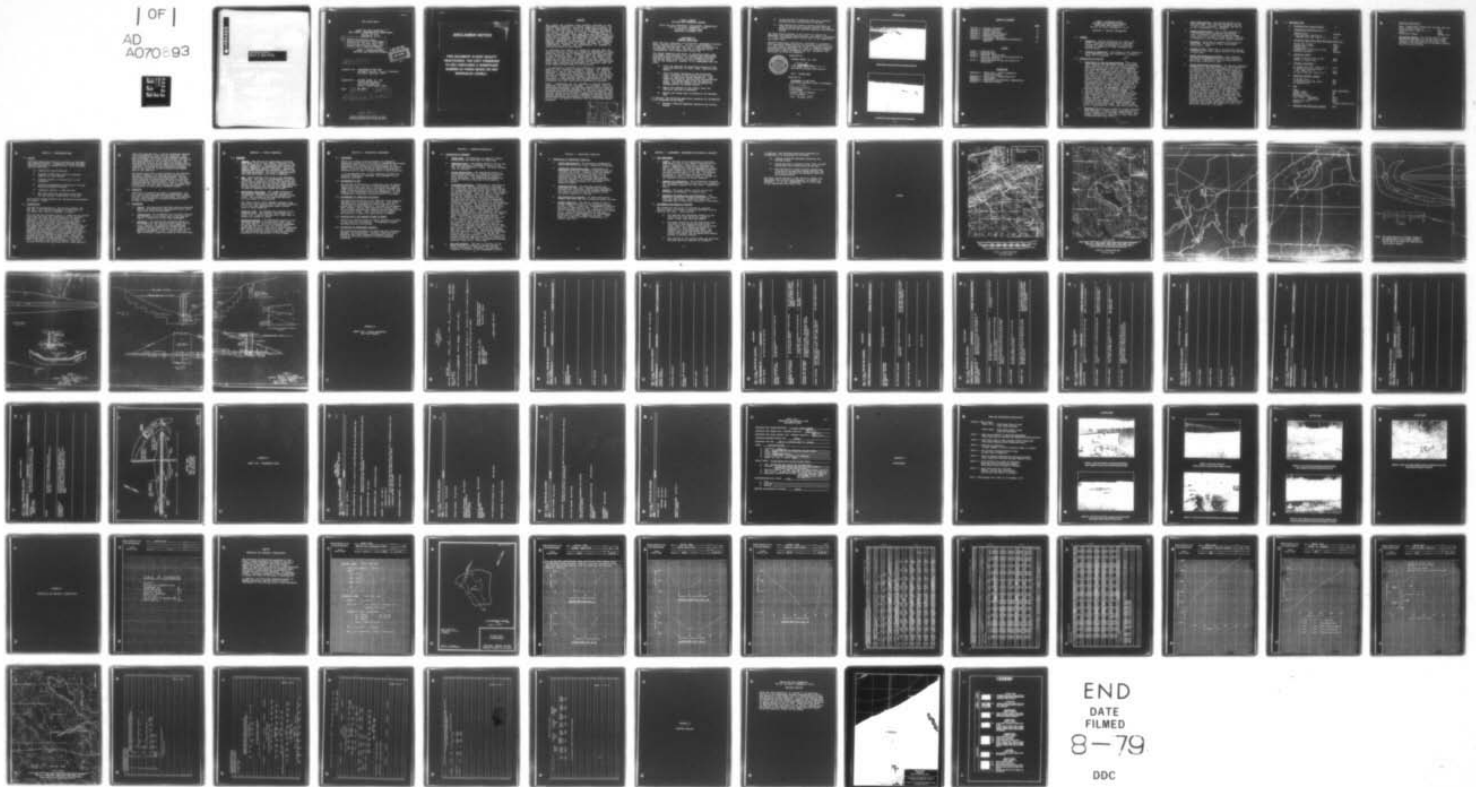
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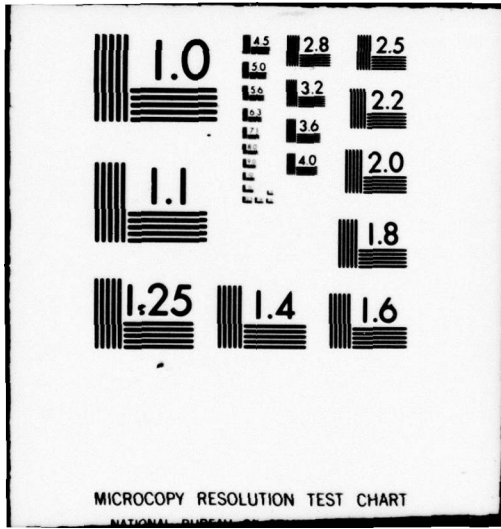
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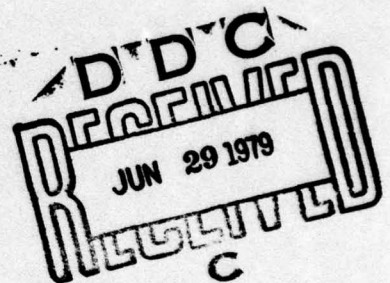
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OHIO RIVER BASIN

EATON DAM (BULL RESERVOIR)  
ERIE COUNTY, COMMONWEALTH OF PENNSYLVANIA  
NDI No. PA 00016  
PennDER No. 25-34

(6) National Dam Inspection Program.  
Eaton Dam (Bull Reservoir) (NDI-PA-00016,  
PennDer-25-34), Ohio River Basin, Tribu-  
tary to French Creek, Erie County, Penn-  
sylvania. Phase I Inspection Report.

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM



(10) C. Y. / Chen

Prepared for: DEPARTMENT OF THE ARMY  
Baltimore District, Corps of Engineers  
Baltimore, Maryland 21203

Prepared by: MICHAEL BAKER, JR., INC.  
Consulting Engineers  
4301 Dutch Ridge Road  
Beaver, Pennsylvania 15009

Date:

(11) May 30 1979

(12) 77p.

(45) DACW 31-79-C-0011

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PREFACE

This report was prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. 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 a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

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

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**PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM**

Eaton Dam (Bull Reservoir), Erie County, Pennsylvania  
NDI No. PA 00016, PennDER No. 25-34  
Tributary to French Creek  
Inspected 16 November 1978

**ASSESSMENT OF  
GENERAL CONDITIONS**

Eaton Dam (Bull Reservoir) is an earthfill embankment structure with a concrete cutoff wall. The dam is approximately 22 feet high and 840 feet long, and is owned and operated by the Borough of North East. The dam is classified as an "Intermediate" size-"Significant" hazard dam.

The visual inspection and review of engineering data, made in November 1978 and March 1979, indicate some deficiencies requiring remedial treatment, but not emergency attention. The dam was found to be in good overall condition at the time of the inspection. However, it is recommended that the owner:

- 1) Clear the approach and downstream channels of the auxiliary spillway of trees, rocks, logs and other debris.
- 2) Clear the dense vegetation on the downstream slope, including 10 feet beyond the toe of the slope, to facilitate future inspections. This vegetation should be replaced with well-maintained grass. All eroded areas on the dam should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.
- 3) Repair the concrete of the control tower and auxiliary spillway as necessary.
- 4) Replace the riprap that is missing on the upstream face.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.

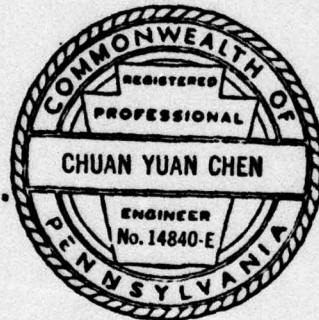
- 2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

The owner should continue in the future to inspect the embankment and concrete appurtenances, and repair as necessary. It is also recommended that a log be kept of the inspections and repair work.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District of the U.S. Army Corps of Engineers for Phase I Inspection Reports, revealed that the spillways will pass the Probable Maximum Flood (PMF) without overtopping the dam. Therefore, the spillways are rated as "adequate."

Submitted by:

MICHAEL BAKER, JR., INC.



*C. Y. Chen*  
C. Y. Chen, Ph.D., P.E.  
Engineering Manager-Geotechnical

Date: 25 May 1979

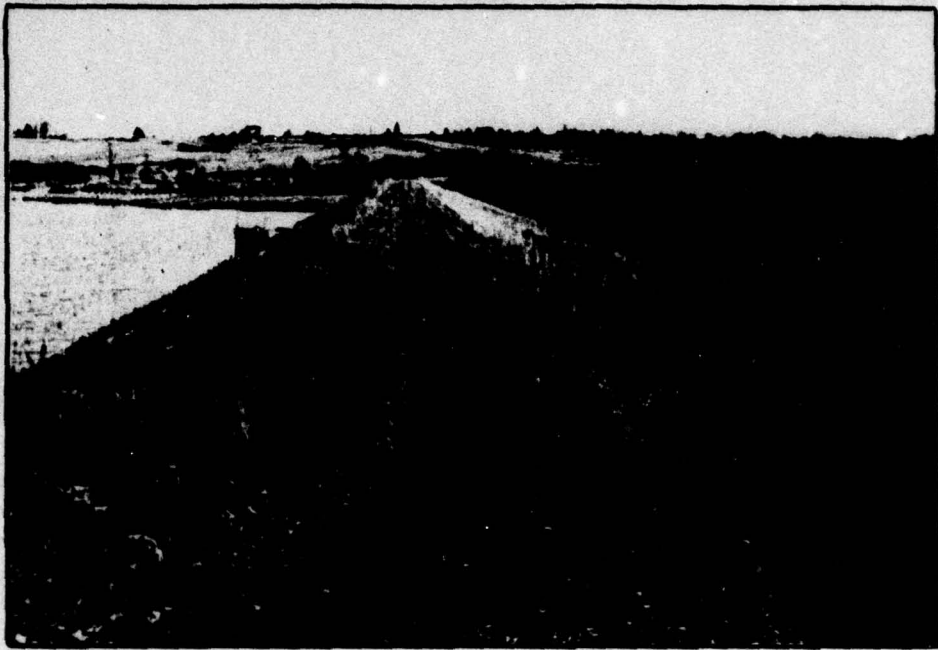
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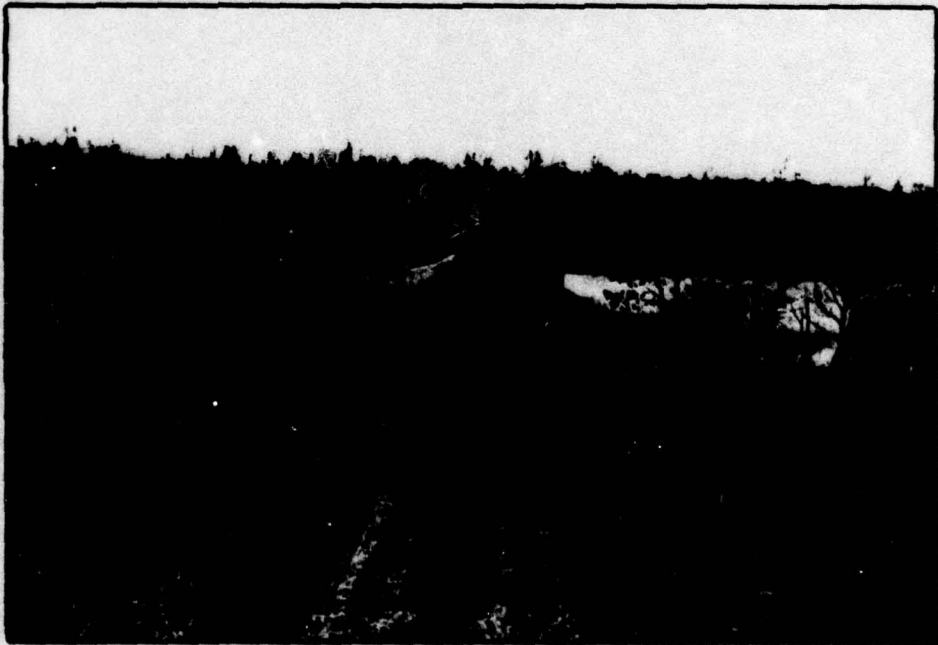
*G. R. Withers*  
G. R. WITHERS  
Colonel, Corps of Engineers  
District Engineer

Date: 16 June 1979

**EATON DAM**



**Overall View of Dam along Crest from Right Abutment**



**Overall View of Dam along Crest from Left Abutment**

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PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM  
EATON DAM (BULL RESERVOIR)  
NDI No. PA 00016, PennDER No. 25-34

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.
- b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances - Eaton Dam (also known as Bull Reservoir) is an earth embankment, straight in plan, with a spillway channel in excavation around its right end. The embankment has a maximum height of 22 feet and a length of 840 feet. The upstream slope is 3H:1V (Horizontal to Vertical), the downstream slope is 2H:1V, and the crest is 20 feet wide. The 14-inch cast-iron pipe outlet was laid in an excavation on a concrete cradle provided with concrete cutoffs. The control valve is located in a tower in the upstream slope. The upstream slope is provided with riprap and the downstream slope is grass covered. The 20-foot wide clay core of the dam extends throughout the entire length of the embankment. The auxiliary spillway consists of an approach channel, a concrete ogee weir and an outlet channel. The approach channel to the weir is 20 feet wide with side slopes of 2H:1V and approximately 265 feet long. The channel is protected with 12-inch asphalt paving. Four 22-foot by 4-foot by 1-foot cutoff walls are spaced 10 feet apart at the entrance of the channel; the spaces between the walls are filled with stone. The concrete ogee weir is approximately 8 feet high and 20 feet wide.
- b. Location → Eaton Dam is located in a small drainage area tributary to French Creek, approximately 4.5 miles southeast of the Borough of North East, Erie County, Pennsylvania, less than 0.5 mile from the Pennsylvania-New York border.

- c. Size Classification - The maximum height of the dam is 22 feet. The reservoir volume to the top of dam is 4650 acre-feet. Therefore, the dam is in the "Intermediate" size category.
- d. Hazard Classification - Due to the existence of a chlorination plant downstream and several acres of farmland, significant property damage could occur as a result of a dam failure. The dam is therefore in the "Significant" hazard category.
- e. Ownership - Eaton Dam is owned by the Borough of North East, 58 East Main Street, North East, Pennsylvania 16428.
- f. Purpose of Dam - Eaton Dam is an auxiliary storage reservoir in the water supply system of the Borough of North East.
- f. Design and Construction History - The existing structure was designed by Hill and Hill Engineers, North East, Pennsylvania and was constructed as a WPA project from 1936 to 1939.
- h. Normal Operational Procedures - The dam was originally designed as an auxiliary storage or surge reservoir in conjunction with the Smith Reservoir which is located about 3 miles northwest of Bull Reservoir. The outlet pipe for Bull Reservoir is connected to the control tower at Eaton Dam and to a pump house located on French Creek to the south of Eaton Dam. The pump house, which is approximately 1 mile from the dam, was installed to pump water from French Creek into the reservoir through the control tower for storage during periods of high water demand. At the opposite end of the reservoir two 24-inch corrugated steel pipes are used to supply water to the Smith Reservoir. The flow through these two pipes is adjusted to maintain the normal pool elevation of Smith Reservoir. Mr. Herb Mallick, Borough Engineer, stated that the pump house on French Creek and sluice gate at the control tower were operated periodically several years ago; however, in the past few years this operating procedure had not been performed. Mr. Mallick did state that the system could possibly be put into operation within 24 to 48 hours.

1.3 PERTINENT DATA

a.	<u>Drainage Area (square miles) -</u>	1.1
b.	<u>Discharge at Dam Site (c.f.s.) -</u>	
	Maximum Flow -	Unknown
	Total Spillway Capacity at Maximum Pool (El. 1428.3 ft.) -	1080
c.	<u>Elevation [feet above Mean Sea Level (M.S.L.)] -</u>	
	Design Top of Dam -	1429
	Minimum Top of Dam -	1428.3
	Normal Pool -	1422
	Streambed at Centerline of Dam -	1407
	Maximum Tailwater -	Unknown
d.	<u>Reservoir (feet) -</u>	
	Length of Pool at Top of Dam -	6600
	Length of Normal Pool -	6500
e.	<u>Storage (acre-feet) -</u>	
	At Normal Pool (El. 1422.0 ft.) -	2760
	At Auxiliary Spillway Crest (El. 1422.0 ft.) -	2760
	At Top of Dam (El. 1429.0 ft.) -	4650
f.	<u>Reservoir Surface (acres) -</u>	
	At Normal Pool -	246
	At Auxiliary Spillway Crest -	246
	At Maximum Pool -	332
g.	<u>Dam -</u>	
	Type -	Earth embankment
	Length (feet) -	840
	Height (feet) -	22
	Top Width (feet) -	20
	Side Slopes - Upstream -	3H:1V
	Downstream -	3H:1V
	Impervious Core -	Clay
	Cutoff -	12-inch concrete wall
h.	<u>Diversion and Regulating Tunnel -</u>	None

i. Spillway (Auxiliary) -

Type - Trapezoidal channel and concrete ogee weir  
Width of Weir (feet) - 20  
Crest Elevation (feet M.S.L.) - 1422  
Gates - None  
Downstream Channel - Marshy area

j. Regulating Outlets - Two valves used to control the two 24-inch pipes on the west end of the reservoir, and one valve in the control tower located at the upstream toe of the dam to control the 14-inch outlet pipe.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

Pertinent design data were not available for the Eaton Dam Inspection Report. Information reviewed included material contained in PennDER File No. 25-34 including the following data:

- 1) Construction specifications.
- 2) Borough of North East report on proposed addition to water supply.
- 3) Progress reports of construction of the structure.
- 4) Various correspondence pertaining to the dam during preliminary planning.
- 5) Inspection reports -- 1948 and 1967.
- 6) The Water and Power Resources Board permit for the original construction of the dam.

The original design drawings are reproduced and presented as Plates 3, 4 and 5.

### 2.2 CONSTRUCTION

The dam was constructed as a WPA project between 1936 and 1939. Hill and Hill Engineers of North East was the design and consulting engineer in charge.

When the dam was originally built, a tunnel and an 18-inch vitrified clay pipe were constructed at the northwest end to deliver water from Bull Reservoir to Smith Reservoir. The up-gradient ends of both the tunnel and pipe were placed in a tower located approximately 350 feet from the northwest shore of Bull Reservoir. The tunnel went through a series of manholes and finally outletted into an open channel approximately 4000 feet northwest of Bull Reservoir. The tile pipe followed another route which took it through a gate valve control tower and then underground for an estimated 550 feet, at which point it entered an open ditch. This ditch eventually joined the open channel from the tunnel and carried the water to Smith Reservoir. In the fall of 1973, a portion of the tunnel collapsed. Since the 18-inch vitrified clay tile pipe was not large enough to

carry the required flow, a 24-inch reinforced concrete and corrugated metal pipe line was installed. This pipe intercepted the tunnel at the uppermost manhole and ran through a gate valve control tower, and then to the ditch adjacent to the 18-inch tile outlet. The down-gradient section of the tunnel was blocked with a concrete plug in the manhole where the 24-inch pipe was connected. According to the information available, this is the extent of the post-construction changes made to the reservoir.

The design plans show a chute channel as the auxiliary spillway. However, the auxiliary spillway was not constructed according to the design plans. The auxiliary spillway as constructed consists of a 265-foot long trapezoidal approach channel and an 8-foot high concrete ogee weir (see Photos 5, 6 and 7). The outlet channel below the weir then carries the discharge from the reservoir to the natural streambed channel.

### 2.3 OPERATION

Operational procedures discussed in paragraphs 1.2.h., 4.2, and 4.3 were obtained from interviewing Mr. Herb Mallick, Borough Engineer for North East. No operation or pool level records are currently recorded by the Borough of North East.

### 2.4 EVALUATION

- a. Design - The structural stability could be evaluated only on an observational and empirical basis since design data were not available.
- b. Construction - No information was available describing the depth of the cutoff wall or the type and degree of compaction of the earth embankment.
- c. Operation - The operational procedures appear to be adequate for the auxiliary water supply facilities. However, the operation and maintenance program should be expanded to include periodic operation of the gates located in the tower in the upstream embankment. Also, a record should be kept of periodic inspections made by local personnel.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

- a. General - The dam and its appurtenant structures were found to be in good overall condition at the time of inspection. The problems noted during the visual inspection are considered minor and do not require immediate remedial treatment. Noteworthy deficiencies observed are described briefly in the following paragraphs. The visual inspection check list and field sketch are given in Appendix A.
- b. Dam - Three problems were noted on the embankment structure: the crest of the embankment is heavily rutted due to vehicular traffic, the upstream face has a 6-foot-square area of missing riprap approximately 200 feet to the right of the intake structure, and the downstream area including the embankment is heavily vegetated with weeds and brush.
- c. Appurtenant Structures - The intake structure in the upstream embankment is cracked and spalled; consequently, reinforcing bars are exposed in some areas. The concrete in the auxiliary spillway also has signs of deterioration.

The intake control valve chambers located at the west end of the reservoir are in very good condition as are the other appurtenances used to outlet water to Smith Reservoir.

- d. Reservoir Area - No problems were observed in the reservoir area. The reservoir side slopes are nearly flat to gently sloping with a good cover of grasses and stands of forest.
- e. Downstream Channel - The downstream channel of the auxiliary spillway is covered with rocks, trees and other debris. Below the downstream embankment of the dam the entire area is a natural marsh. Approximately 0.6 to 1 mile below, several dwellings and a water treatment plant are located. However, all the buildings are located above the elevation considered to be susceptible to flood damage.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

There is no formal written procedure for emergency downstream evacuation in the event of impending catastrophe. The sluice gate located at the upstream face of the embankment is closed and has not been opened for several years. The water is removed by gravity flow from the northwest end in order to supply water to Smith Reservoir.

It is recommended that a formal emergency procedure be prepared, prominently displayed, and furnished to all operating personnel.

### 4.2 MAINTENANCE OF DAM

The Borough of North East is responsible for the maintenance of the dam. The area is visited weekly; however, inspection is difficult due to the growth of bushes and trees along the auxiliary spillway channel and the high weeds on the downstream face of the embankment. A more comprehensive maintenance program should be initiated.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

The operating facilities at the west end of the reservoir appeared to be in satisfactory condition. The valves are operated as necessary in order to maintain the normal pool at Smith Reservoir. The gate at the embankment, however, has not been operated in several years, nor was there evidence that repairs had been made to the valve control tower. This valve should be operated periodically to ensure its availability if needed.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or formal emergency procedure in the event of a dam failure. An emergency warning procedure should be developed.

### 4.5 EVALUATION OF OPERATIONAL ADEQUACY

The maintenance procedures for Eaton Dam are considered marginal, as stated above. Periodic inspection documentation and a more adequate maintenance routine should be initiated along with a formal emergency procedure.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

- a. Design Data - No hydrologic or hydraulic design calculations were available for Eaton Dam.
- b. Experience Data - The maximum depth of flow in the auxiliary spillway, according to owners of the dam, was approximately 6 inches. No other information is available.
- c. Visual Observations - The downstream section of the auxiliary spillway is covered with brush and small trees that could significantly restrict flood discharges. The downstream discharge area below the auxiliary spillway is also heavily wooded.
- d. Overtopping Potential - Eaton Dam is classified as a "Significant" hazard-"Intermediate" size dam. For a dam with this hazard and size classification, the recommended spillway design flood (SDF) is the 1/2 Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). Since the dam is on the low end of the "Intermediate" size category, the 1/2 PMF was chosen as the spillway design flood. The auxiliary spillway is a concrete trapezoidal channel with its control section at El. 1422 feet. A concrete ogee spillway is located at the downstream end of this channel. The discharge rating curve for this spillway was established with the aid of the U.S. Army Corps of Engineer's Water Surface Profiles Package, HEC-2. The hydrologic and hydraulic capabilities of the reservoir and spillway were then evaluated with the aid of the U.S. Army Corps of Engineer's Flood Hydrograph Package, HEC-1. The 1/2 PMF hydrograph developed as a part of this analysis had a peak discharge of 2935 c.f.s. using a total storm runoff of 12.6 inches. The results of this routing indicate that the reservoir and spillway are capable of passing the 1/2 PMF with a maximum reservoir level of El. 1424.1 feet, which is about 4.2 feet below the minimum dam crest El. 1428.3 feet. The maximum discharge from the reservoir during a storm of this magnitude would be 144 c.f.s. In addition, the PMF was routed through the reservoir. The results of this analysis indicate that the reservoir is capable of safely passing the PMF with a corresponding maximum reservoir level of El. 1426.0 feet.
- e. Spillway Adequacy - The dam, as outlined in the above analysis is capable of passing the PMF without overtopping. Therefore, the spillway is "adequate" according to the recommended criteria.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations - No structural inadequacies were noted during the visual inspection of the dam.
- b. Design and Construction Data - Calculations of embankment slope and foundation stability were not available for review. Because of the low height of the earthfill section of the dam, and its substantial width and moderate slopes; it is inferred that the dam could meet the required stability criteria. No further stability assessments are deemed necessary for this Phase I Inspection Report.
- c. Operating Records - No operating records were available for Eaton Dam. Operational procedures obtained from interviewing the borough engineer do not indicate cause for concern relative to the structural stability of the dam.
- d. Post-Construction Changes - No post-construction changes were made that would adversely affect the dam.
- e. Seismic Stability - The dam is located in Zone 2 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of moderate seismic activity. As indicated in paragraph 6.1.b., Eaton Dam could be shown to meet the static stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." Thus, there is no need for further consideration of seismic stability.

## SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

- a. Safety - The dam and its appurtenant structures were found to be in good overall condition at the time of inspection. Eaton Dam is evaluated as being a "Significant" hazard-"Intermediate" size dam in accordance with the "Recommended Guidelines for Safety Inspection of Dams" and should have a spillway capacity equal to 1/2 PMF. As presented in Section 5, the spillway and reservoir were determined to have a capacity equal to the PMF and are therefore assessed as being "adequate."
- b. Adequacy of Information - The information available and the observations made during the field inspection are considered adequate for this Phase I Inspection Report.
- c. Urgency - The owner should initiate the action discussed in paragraph 7.2 without delay.
- d. Necessity for Additional Data/Evaluation - The hydraulic/ hydrologic analysis performed in connection with this Phase I Inspection Report has indicated that no additional evaluation is necessary.

### 7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be performed without delay by the owner. These include:

- 1) The approach and downstream channels of the auxiliary spillway should be cleared of trees, rocks, logs and other debris.
- 2) The dense vegetation on the downstream slope, including 10 feet beyond the toe of the slope, should be cleared to facilitate future inspections. This vegetation should be replaced with well-maintained grass. All eroded areas on the dam should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.
- 3) The concrete in the control tower and auxiliary spillway should be repaired as necessary.

In addition, the following operational measures are recommended to be undertaken by the owner:

- 1) Develop a detailed emergency operation and warning system.
- 2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.
- 3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

The owner should continue in the future to inspect the embankment and concrete appurtenances, and repair as necessary. It is also recommended that a log be kept of the inspections and repair work.

PLATES

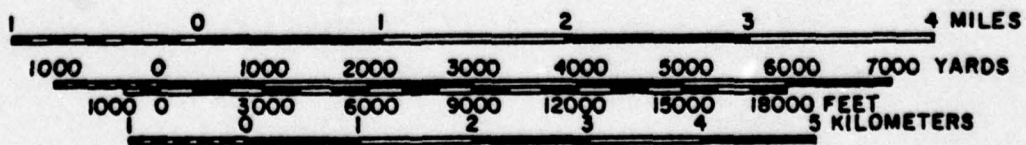
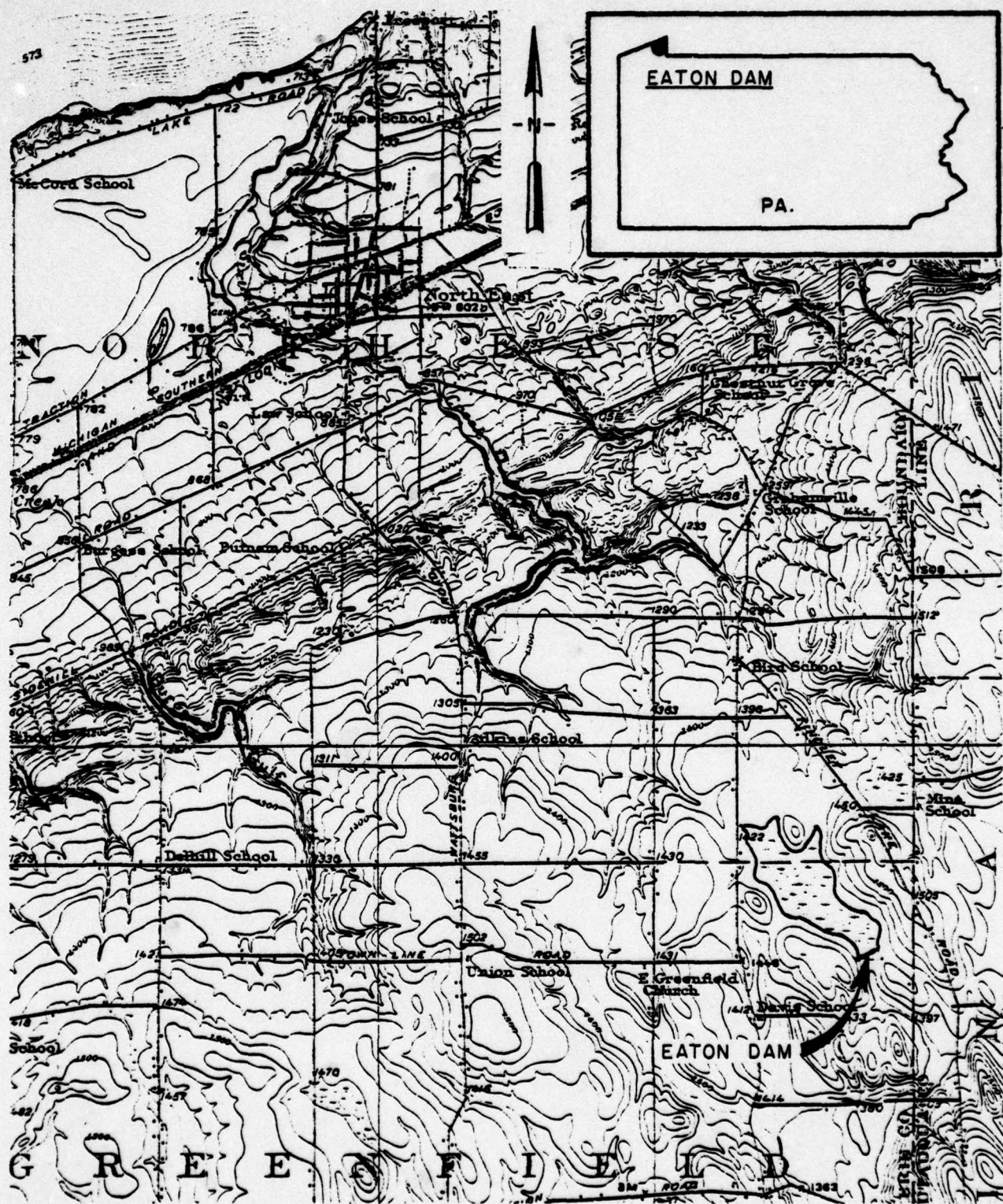
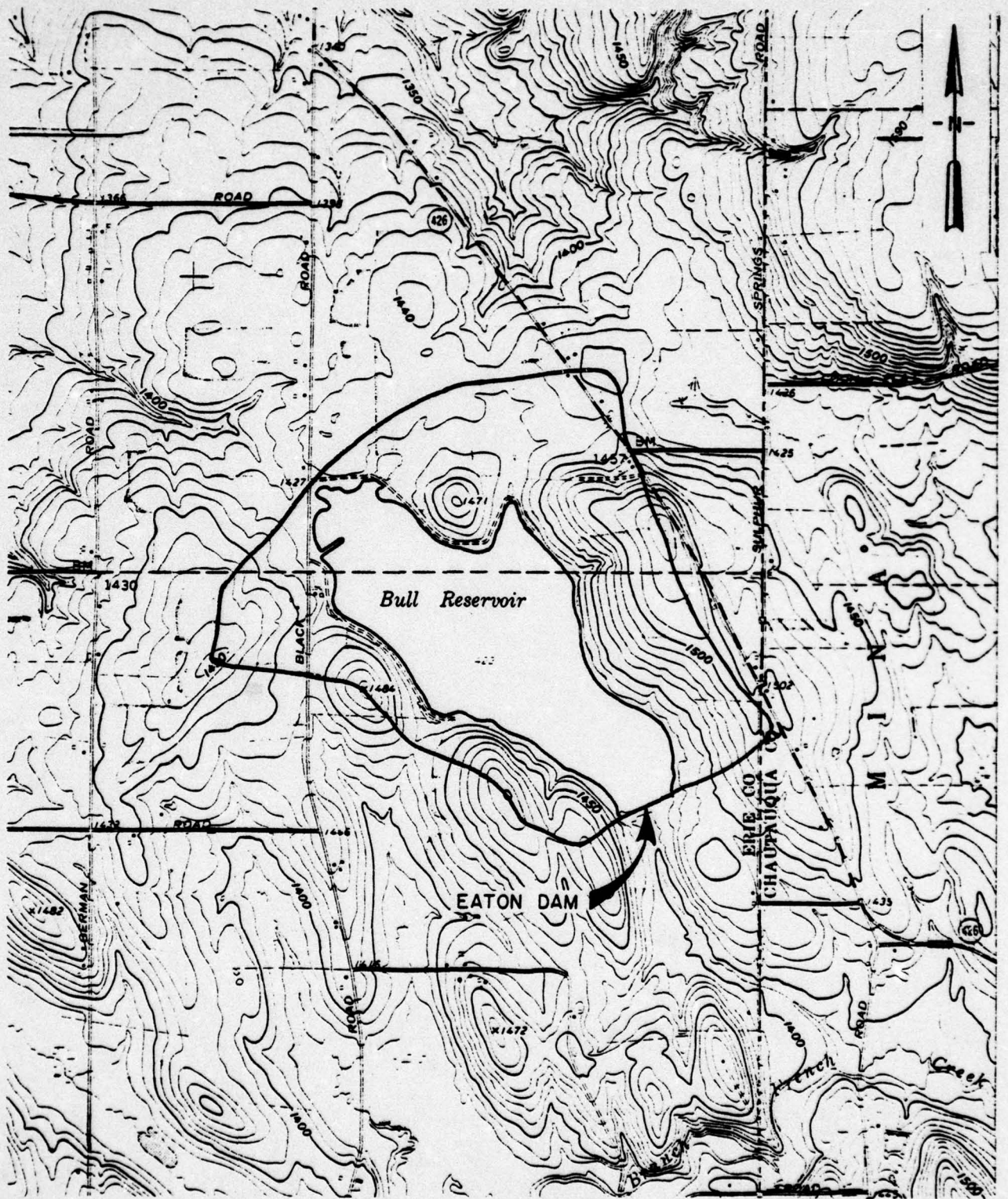


PLATE I LOCATION PLAN  
EATON DAM



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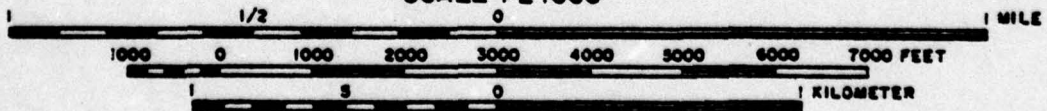


PLATE 2 WATERSHED MAP  
EATON DAM



YORK  
PENNSYLVANIA

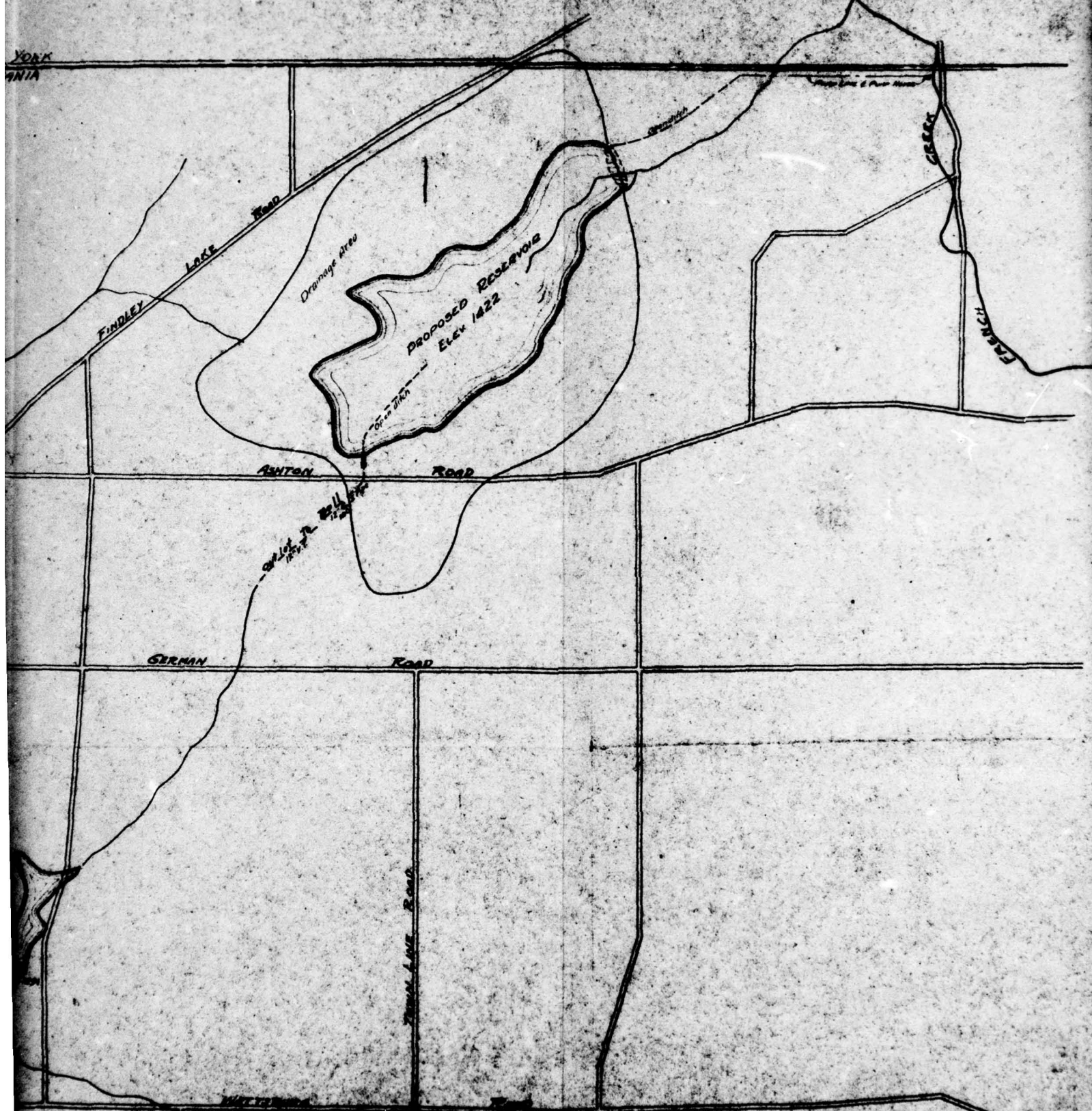
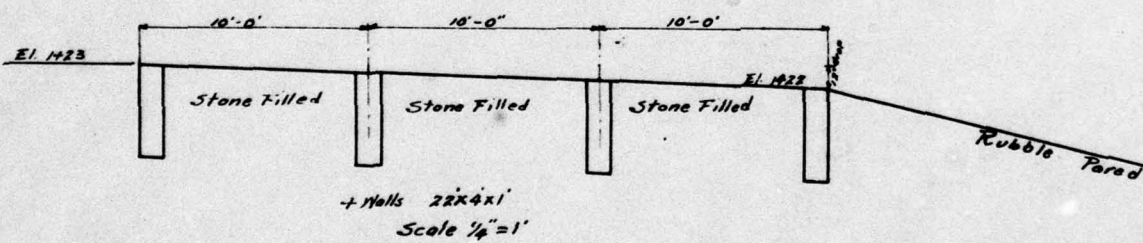
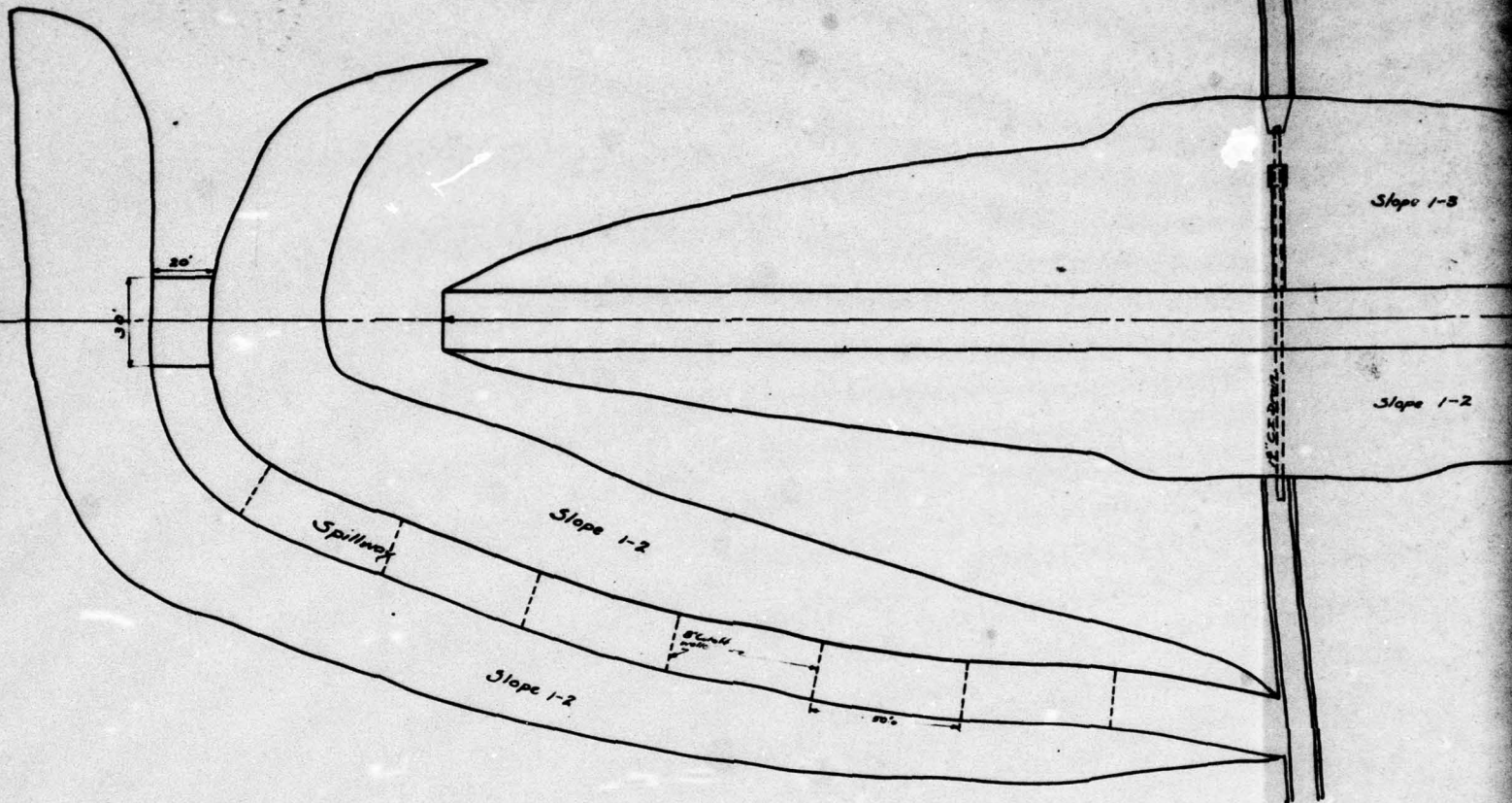


PLATE 3  
NORTH EAST BORO  
WATER WORKS IMPROVEMENT



**NOTE:** This Design Drawing of the Auxiliary Spillway Is Not Representative of the "As Built" Conditions. See the Text of This Report and Photos 5, 6, and 7 For "As Built" Condition.

Slope 1-3

Slope 1-2

TOP VIEW OF DAM  
Scale 1" = 30'

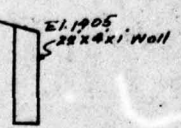
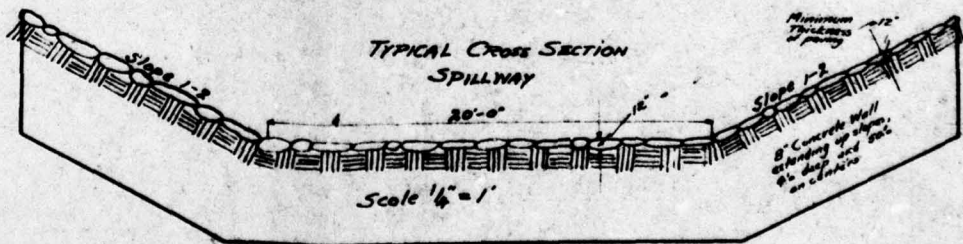
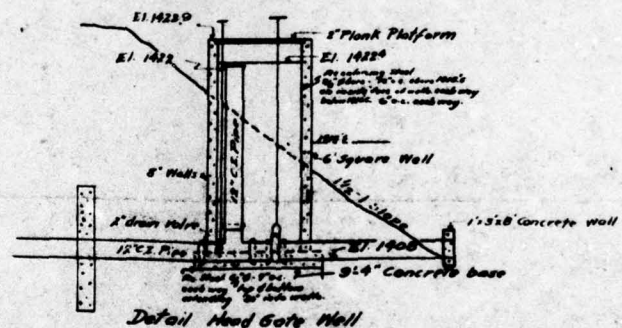


PLATE 4

NORTH EAST BORO  
 WATER WORKS IMPROVEMENT  
 HILL & HILL ENGINEERS  
 NORTH EAST PENNA  
 Scales as noted Jan 7 1935  
 Approx. Half Scale

Top of Dam El. 1427.7

Proposed Water level El. 1422.7

El. 1423.9

Present Ground

Scales - Vert 1"=5'  
Hor. 1"=50'

Clay Puddle Trench

14" C.I. Drain Line

12" Support Wall  
(Sub. of Wall)

Thin Puddle

El. 1427 Top of Dam

20'-0"

CLAY CORE  
ENTIRE LENGTH = DAM

Slope 1:2

El. 1405

Clay Puddle

Present ground level or Top of 14" C.I. Drain Pipe

12" cd of Wall

1'-8" x 2'-6" CORNER

El. 1396.2

Cross SECTION  
Scale 1"=6'

14830

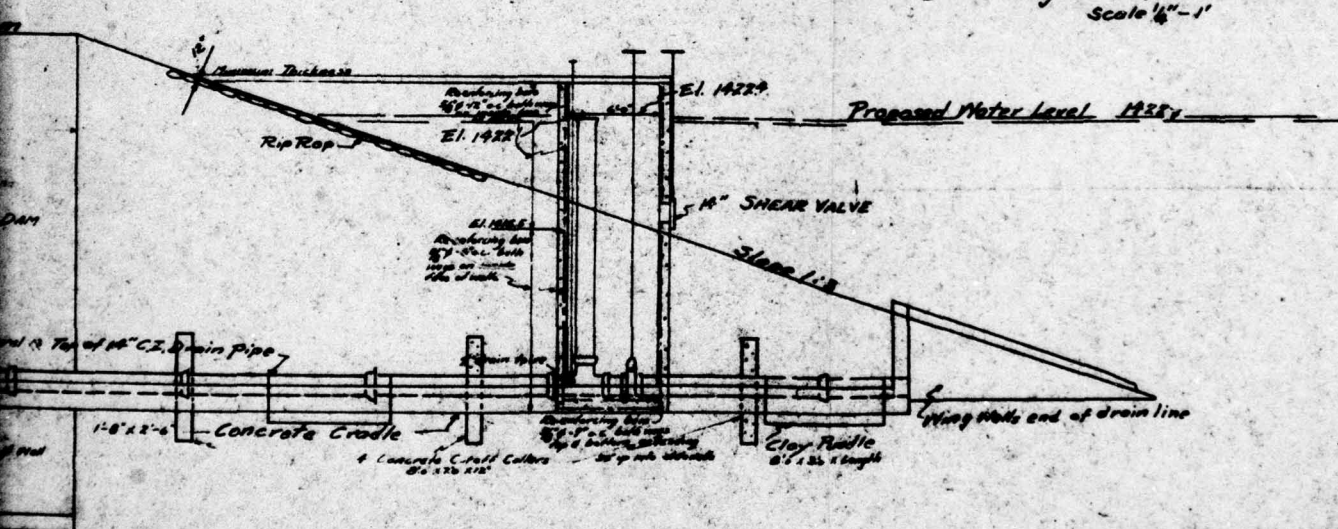
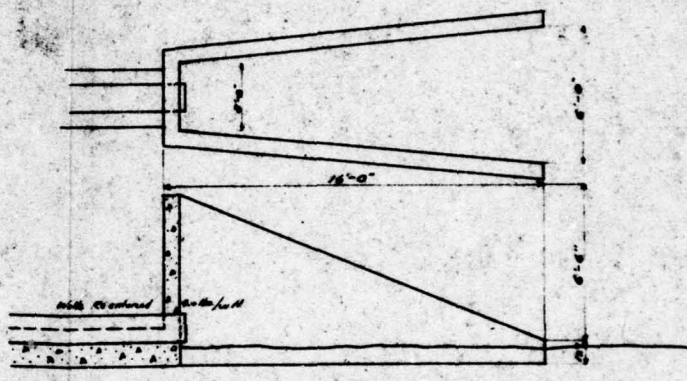
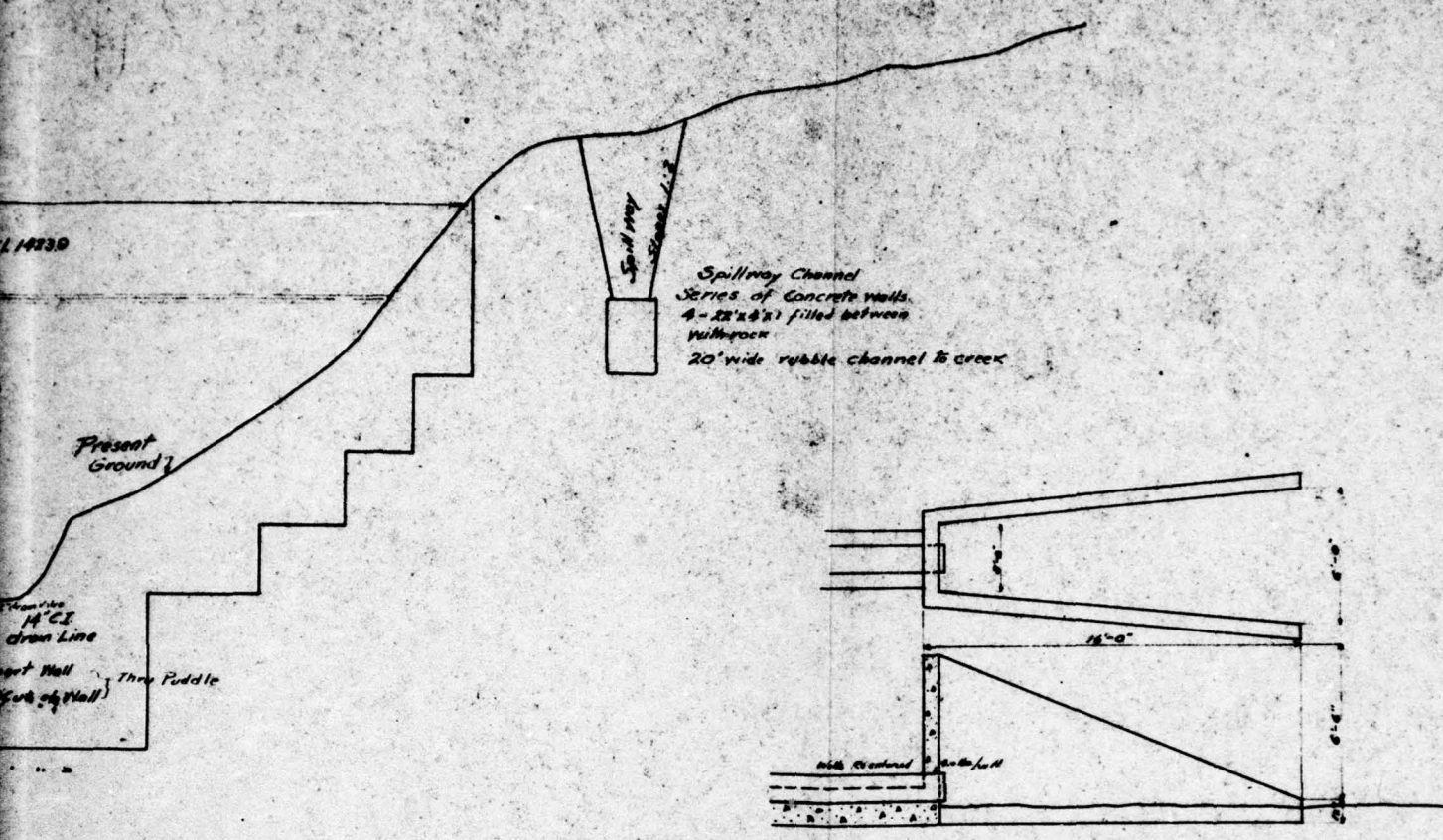


PLATE 5  
 NORTH EAST BORO  
 WATER WORKS IMPROVEMENT  
 HILL & HILL ENGINEERS  
 NORTH EAST PENNA.  
 Scale as noted Jan 6 1935  
 Approx. Half Scale

APPENDIX A

CHECK LIST - VISUAL INSPECTION  
AND FIELD SKETCH

Check List  
Visual Inspection  
Phase 1

Name Dam Eaton Dam County Erle State PA Coordinates Lat. N 42° 08.8'  
(Bull Reservoir)  
NDI # PA 00016  
PENNER # 25-34 Long. W 79° 46.0'

Date Inspection 16 November 1978 Weather Overcast Temperature 55°F.

Pool Elevation at Time of Inspection 1417.5 ft. M.S.L. Tailwater at Time of Inspection 1406.0 ft. M.S.L.

Elevations are based on plan datum, top of concrete gate valve chamber.

Inspection Personnel:

Michael Baker, Jr., Inc.:  
Rodney E. Holderbaum  
James G. Ulinski  
David F. Johns

Owner's Representatives  
Borough of North East:  
Herb Mallick - Engineer

David F. Johns Recorder

**CONCRETE/MASONRY DAMS - Not Applicable**

A-2

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION OF**

**OBSERVATIONS**

**REMARKS OR RECOMMENDATIONS**

**LEAKAGE**

**STRUCTURE TO  
ABUTMENT/EMBANKMENT  
JUNCTIONS**

**DRAINS**

**WATER PASSAGES**

**FOUNDATION**

CONCRETE/MASONRY DAMS - Not Applicable

A-3

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

**EMBANKMENT**

A-4

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS**

**SURFACE CRACKS** No surface cracks were observed.

**UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE** No unusual movement or cracking at or beyond the toe was noted.

**SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES**

1. The crest of the embankment is heavily rutted due to vehicular traffic.
1. The crest should be regraded, treated, and seeded with an appropriate mixture to prevent erosion.
2. A few bushes are growing on the upstream face through the riprap.
2. The riprap should be cleared of vegetation.

**VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST**

No problems were noted. (Rutting and surface irregularities were observed; however, they did not appear to present a problem.)

**RIPRAP FAILURES**

Approximately 200 ft. to the right of the intake and 10 ft. down from the crest, a 6-ft.-square area of riprap is missing. The riprap should be replaced.

**EMBANKMENT**

A-5

Name of Dam: EATON DAM (BULL RESERVOIR)  
NOI # PA 00016

**VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS**

**JUNCTION OF EMBANKMENT  
AND ABUTMENT, SPILLWAY  
AND DAM**

No problems were noted.

**ANY NOTICEABLE SEEPAGE**

No noticeable seepage was noted during the inspection.

The downstream face should be cleared of high, dense vegetation to facilitate the visual inspection.

**STAFF GAGE AND RECORDER**

None installed

**DRAINS**

None installed

**OUTLET WORKS**

A-6

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION OF**

**OBSERVATIONS**

**REMARKS OR RECOMMENDATIONS**

**CRACKING AND SPALLING OF  
CONCRETE SURFACES IN  
OUTLET CONDUIT**

The outlet for the 14-in. cast-iron pipe on the downstream side is piped several hundred ft. down to French Creek.

**INTAKE STRUCTURE**

1. Reinforcing bars are exposed along the walkway to the intake structure.
2. The concrete is cracked and spalled on the walkway and the intake structure.

1. The concrete should be repaired as necessary.

**OUTLET STRUCTURE**

The outlet structure at the west end of the reservoir (toward Smith Reservoir) was noted as being in good condition.

**OUTLET CHANNEL**

The outlet channel to Smith Reservoir is rock-lined. No erosion problems were noted.

**EMERGENCY GATE**

The sluice gate located on the upstream side of the embankment has been closed for several years and has not been operated.

The sluice gate should be operated periodically to insure its availability if future conditions would require its operation.

UNGATED SPILLWAY  
(AUXILIARY)

A-7

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

**CONCRETE WEIR**

The concrete is cracked and spalled along the ogee weir.

Repair concrete as necessary.

**APPROACH CHANNEL**

The approach channel is covered with high weeds and trees.

The approach channel should be cleared of all obstructions.

**DISCHARGE CHANNEL**

The discharge channel is covered with trees, bushes, rocks, logs, and other debris.

The channel should be cleared of all obstructions.

**BRIDGE AND PIERS**

A small, abandoned, wooden bridge is located approximately 300 ft. down the channel; however, it does not appear to present any resistance to flow.

GATED SPILLWAY - Not Applicable

A-8

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

CONCRETE SILL

APPROACH CHANNEL

DISCHARGE CHANNEL

BRIDGE AND PIERS

GATES AND OPERATION  
EQUIPMENT

A-9

INSTRUMENTATION - None

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION**

**OBSERVATIONS**

**REMARKS OR RECOMMENDATIONS**

MONUMENTATION/SURVEYS

OBSERVATION WELLS

WEIRS

PIEZOMETERS

OTHER

**RESERVOIR**

A-10

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION OF**

**OBSERVATIONS**

**REMARKS OR RECOMMENDATIONS**

**SLOPES**

The slopes are mild to gently sloping, and covered with heavy woods and bush-like vegetation.

**SEDIMENTATION**

No excessive sedimentation was noted.

**DOWNSTREAM CHANNEL**

A-11

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

**VISUAL EXAMINATION OF**

**OBSERVATIONS**

**REMARKS OR RECOMMENDATIONS**

**CONDITION**  
(**OBSTRUCTIONS,**  
**DEBRIS, ETC.)**

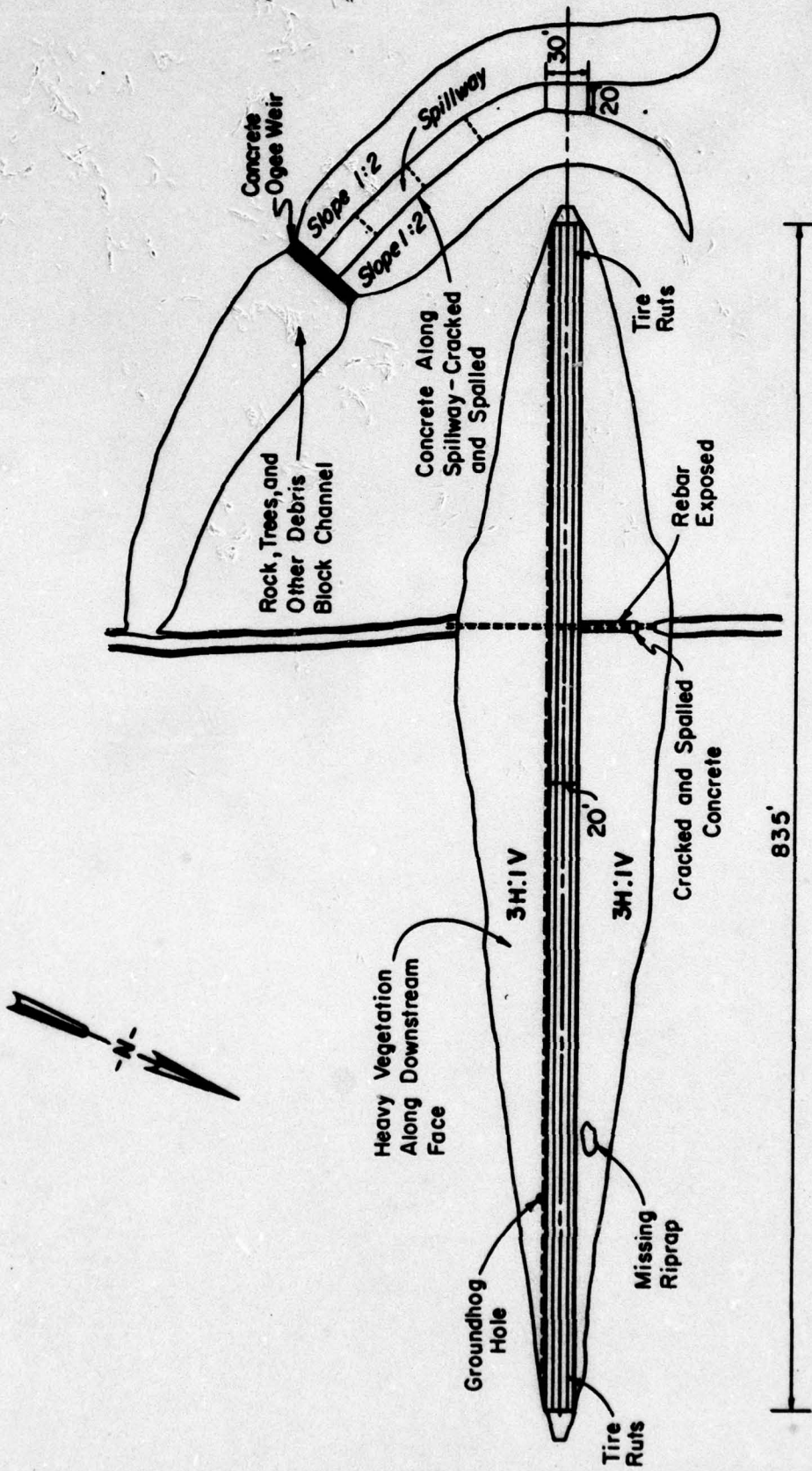
The downstream channel is entirely silted in. The exact cause of the condition could not be determined.

**SLOPES**

The slope of the downstream channel from the reservoir is relatively mild, averaging approximately 1% or less.

**APPROXIMATE NO.**  
**OF HOMES AND**  
**POPULATION**

A chlorination plant is located approximately 1 mile below the structure with a few small farm houses located between. The buildings, however, are located above the elevation that is susceptible to flood damage.



EATON DAM  
 (BULL RESERVOIR)  
 NDI No. PA.00016  
 Penn DER No. 25-34

**APPENDIX B**

**CHECK LIST - ENGINEERING DATA**

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

ITEM	REMARKS
------	---------

PLAN OF DAM See Plate 3.

REGIONAL VICINITY MAP See Plate 1, a portion of 7.5 minute USGS quadrangle map with state location inset.

CONSTRUCTION HISTORY Eaton Dam was built as a MPA project from 1936-1939 under the direction of Hill and Hill Engineers of North East, Pennsylvania.

TYPICAL SECTIONS OF DAM See Plate 5.

HYDROLOGIC/HYDRAULIC DATA No information available

OUTLETS - PLAN See Plate 5.

- DETAILS See Plate 5.

- CONSTRAINTS 14-in. cast-iron pipe from control vault at dam; 2-24 in. corrugated metal pipes at west end of reservoir, each with separate control vaults.

- DISCHARGE RATINGS None available

RAINFALL/RESERVOIR RECORDS None available

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

B-2

ITEM REMARKS

DESIGN REPORTS None available

GEOLOGY REPORTS None available

DESIGN COMPUTATIONS None available  
HYDROLOGY & HYDRAULICS  
DAM STABILITY  
SEEPAGE STUDIES

MATERIALS INVESTIGATIONS None available  
BORING RECORDS  
LABORATORY  
FIELD

POST-CONSTRUCTION SURVEYS OF DAM None available

BORROW SOURCES No information available

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

B-3

ITEM REMARKS

MONITORING SYSTEMS None installed

MODIFICATIONS Following the collapse of a portion of the tunnel at the west end, a new set of water lines were installed to carry flow to Smith Reservoir.

HIGH POOL RECORDS None available

POST CONSTRUCTION ENGINEERING None available  
STUDIES AND REPORTS

PRIOR ACCIDENTS OR FAILURE OF DAM None available  
DESCRIPTION

MAINTENANCE None available  
OPERATION RECORDS

Name of Dam: EATON DAM (BULL RESERVOIR)  
NDI # PA 00016

B-4

**ITEM**

**REMARKS**

**SPILLWAY PLAN** See Plate 4.

**SECTIONS** See Plate 4.

**DETAILS** See Plate 4.

**OPERATING EQUIPMENT  
PLANS & DETAILS** See Plate 4.

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

B-5

DRAINAGE AREA CHARACTERISTICS: 1.1 sq.mi. (heavily wooded)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1422.0 ft.  
(2760 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1429.0 ft.  
(4650 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1428.3 ft. (minimum), 1428.7 ft. (average)

CREST: Auxiliary Spillway

- a. Elevation 1422.0 ft.
- b. Type Concrete ogee weir and trapezoidal approach channel
- c. Width 20 ft.
- d. Length Approximately 500 ft.
- e. Location Spillover At right end of embankment
- f. Number and Type of Gates None

OUTLET WORKS: 14-inch Outlet Pipe, Two 24-inch Water Supply

- a. Type 14-inch cast-iron, Two 24-inch corrugated metal
- b. Location 14-inch approximately 285 feet from right abutment,  
Two 24 inch - at west end of reservoir
- c. Entrance inverts 14 inch - El. 1408.0 ft., Two-24 inch - El. 1411.8 ft.
- d. Exit inverts 14 inch - El. 1405.0 ft., Two-24 inch - El. 1405.8 ft.
- e. Emergency draindown facilities 12-inch cast-iron pipe located in  
valve chamber at dam. Invert  
El. 1422.0 ft.

HYDROMETEOROLOGICAL GAGES: None

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE Unknown

**APPENDIX C**

**PHOTOGRAPHS**

## DETAILED PHOTOGRAPH DESCRIPTIONS

### Overall View of Dam -

Upper Photo - View along Crest of Dam  
from Right Abutment

Lower Photo - View along Crest of Dam  
from Left Abutment

Photo 1 - Gate Valve Chamber in Upstream Embankment  
(Note Spalling of Concrete and Exposed Reinforcing Bar)

Photo 2 - View from Crest at Dam Looking toward Downstream  
(Note High Grasses along Downstream Face)

Photo 3 - West End of Reservoir  
(Intake Chamber is Block Structure Right of Center)

Photo 4 - Two 24-inch Corrugated Metal Pipes  
at West End of Reservoir

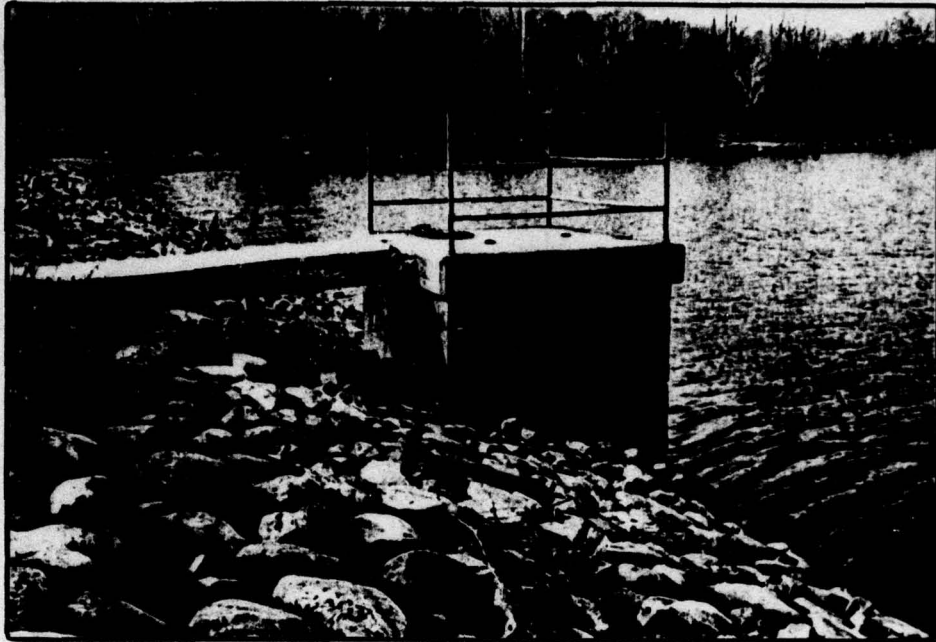
Photo 5 - View of Channel Approaching Auxiliary Spillway  
(Note Vegetation Growing through Channel Floor)

Photo 6 - View Looking over Crest of Auxiliary  
Spillway toward Downstream Channel  
(Note Dense Brush Growing in Channel)

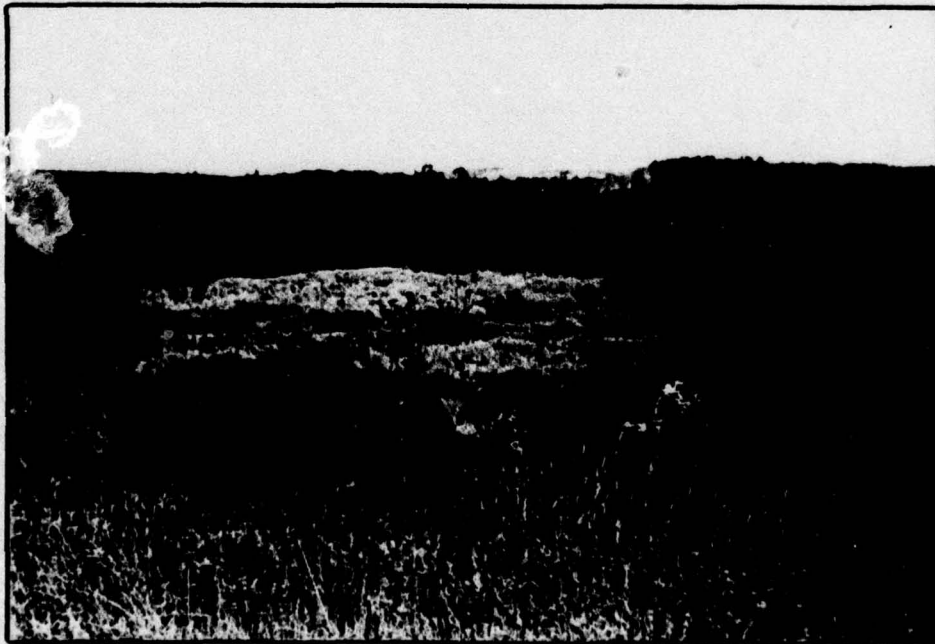
Photo 7 - View from Auxiliary Spillway  
Channel Looking Back toward Weir  
(Note Brush and Debris in Channel)

Note: Photographs were taken on 16 November 1978.

## EATON DAM

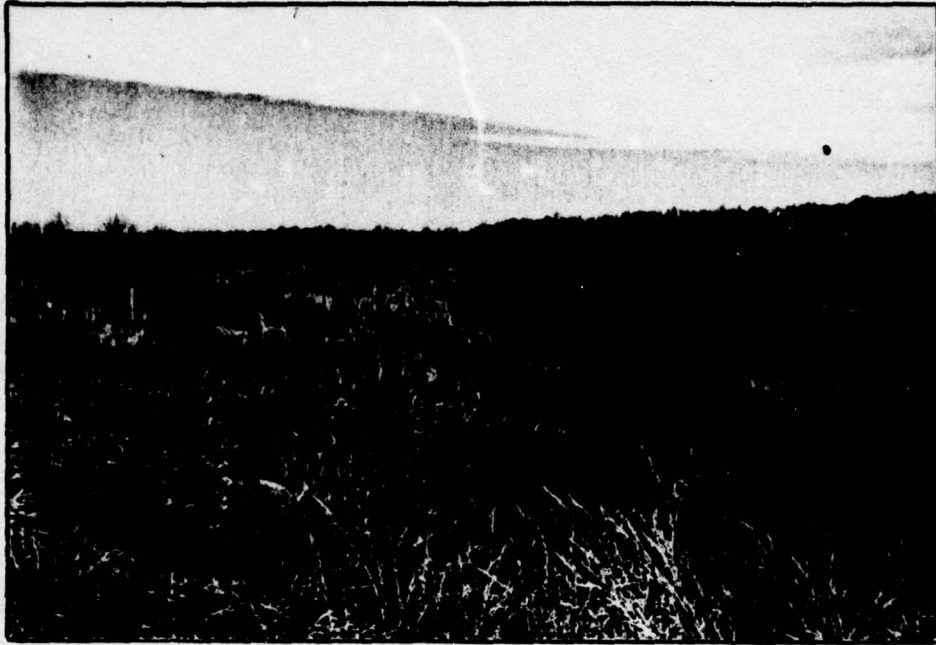


**PHOTO 1. Gate Valve Chamber in Upstream Embankment  
(Note Spalling of Concrete and Exposed Reinforcing Bar)**

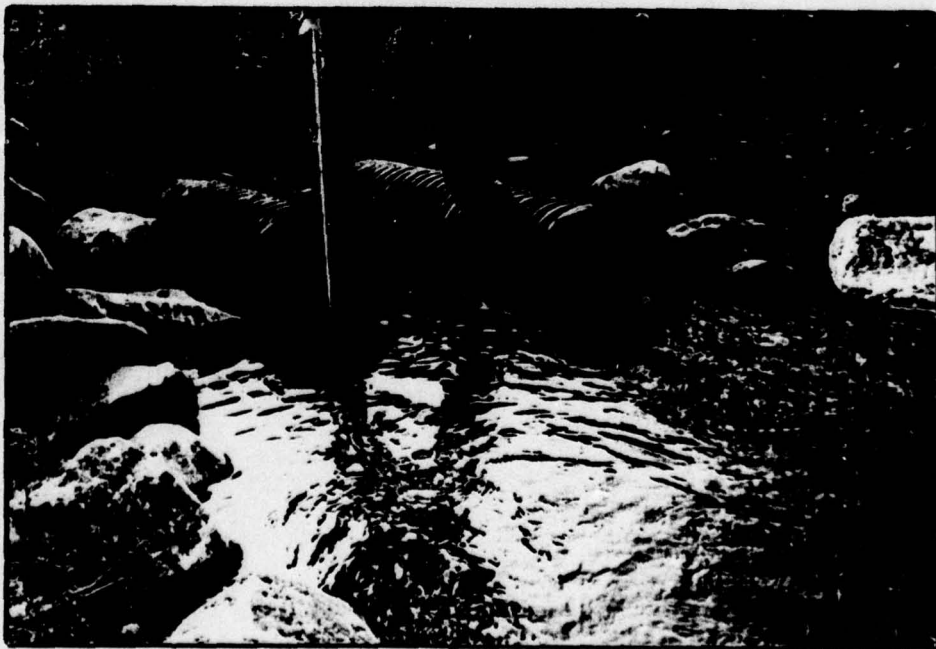


**PHOTO 2. View from Crest at Dam Looking toward Downstream  
(Note High Grasses along Downstream Face)**

**EATON DAM**

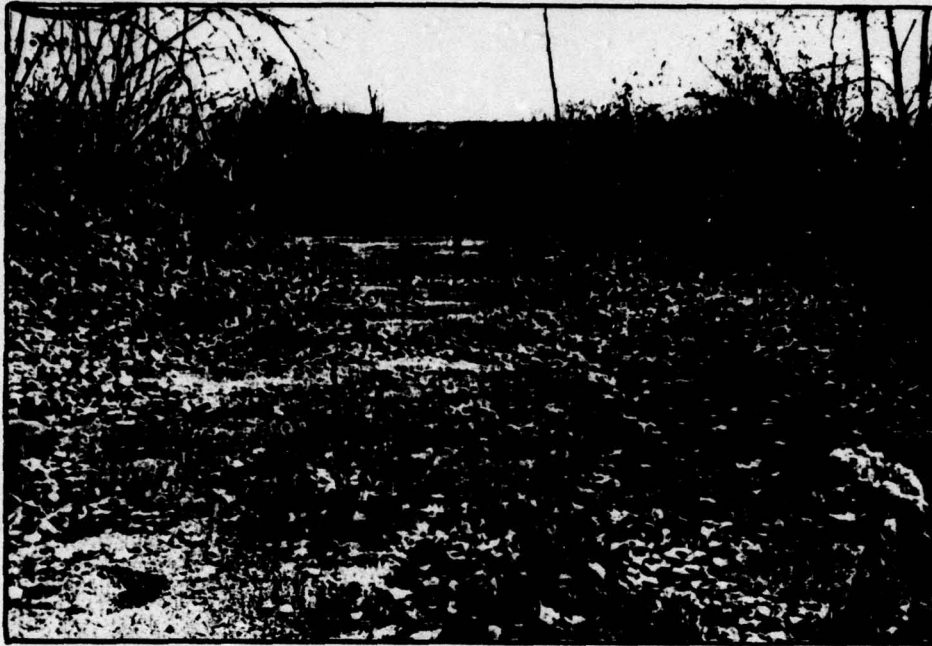


**PHOTO 3. West End of Reservoir  
(Intake Chamber is Block Structure Right of Center)**



**PHOTO 4. Two 24-inch Corrugated Metal Pipes at West End of Reservoir**

**EATON DAM**



**PHOTO 5. View of Channel Approaching Auxillary Spillway  
(Note Vegetation Growing through Channel Floor)**



**PHOTO 6. View Looking over Crest of Auxillary Spillway toward  
Downstream Channel (Note Dense Brush Growing in Channel)**

**EATON DAM**



**PHOTO 7. View from Auxillary Spillway Channel Looking Back toward Weir  
(Note Brush and Debris in Channel)**

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject EATON DAM S.O. No. \_\_\_\_\_

Sheet No. \_\_\_\_\_ of \_\_\_\_\_

Drawing No. \_\_\_\_\_

Computed by \_\_\_\_\_ Checked by \_\_\_\_\_ Date \_\_\_\_\_

## TABLE OF CONTENTS

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WATERSHED MAP	2
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SPILLWAY RATING	6-9
STAGE VS. STORAGE	10
TOP OF DAM	11
MAP OF LAKE & D.S. DAMAGE AREA	12
FLOOD ROUTING	13-17

PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variation of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.

MICHAEL BAKER, JR., INC.

THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject EATON DAM

S.O. No. \_\_\_\_\_

Rainfall and Hydrograph Data

Sheet No. 1 of 17

Drawing No. \_\_\_\_\_

Computed by g.a.s.

Checked by REN

Date 3-1-79

Rainfall Data: (From HMR 33)

RMR (24 hr = 100 mi<sup>2</sup>) = 21.9 in.

Ratios:

$P_1 = 11.1\%$

$P_2 = 11.1\%$

$P_3 = 18.1\%$

$P_4 = 15.1\%$

Hydrograph Data: (From C&E Data)

Time  $L = 3$   $C_p = 0.55$

$C_p = 3.3 L^{0.6}$  since centroid of drainage area is located within lake.

Length of major watercourses:

A = 1000 ft

D = 1500 ft

B = 1500 ft

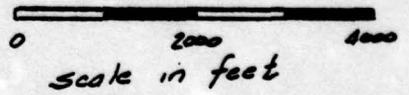
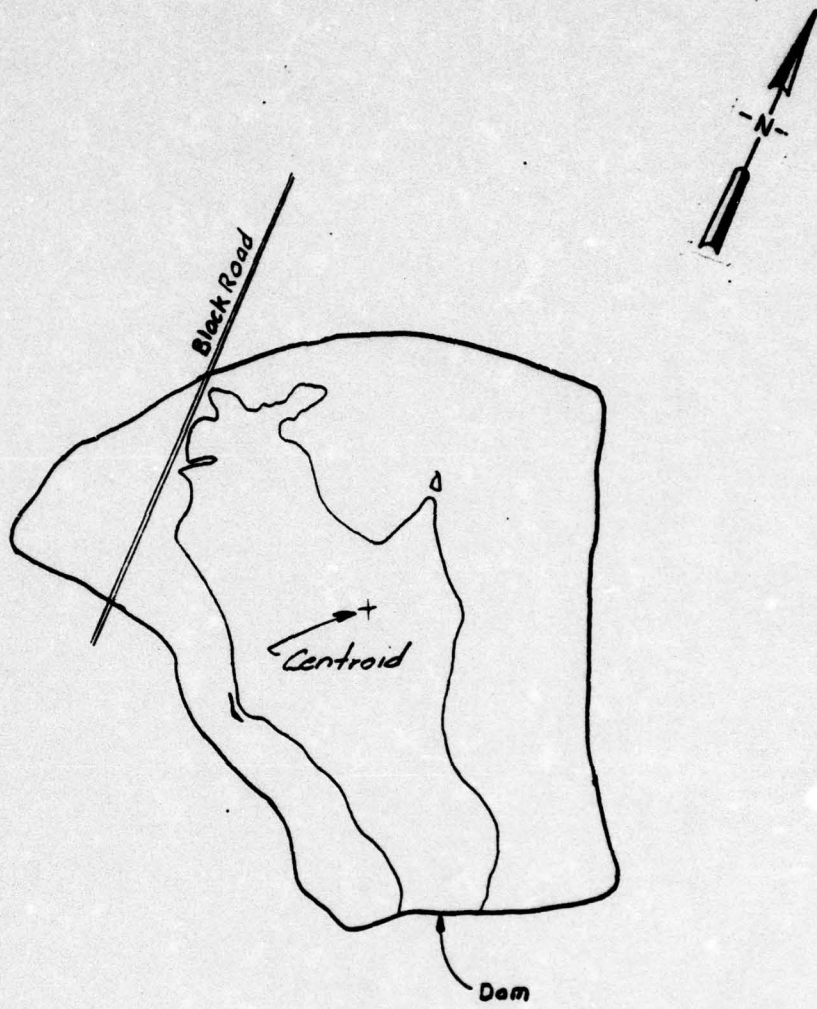
E = 1000 ft

C = 500 ft

Lake = 1600 ft = 0.30 mi.

$T_p = 3.3 (0.3)^{0.6} = 1.61$  hours

$T_p = 1.61 + 0.25 (0.3)^{1.6/3.5} = 1.66$  hours



Quad: North East  
Drainage Area = 1.07 mi.<sup>2</sup>  
L = 0.30 mi.

EATON DAM  
WATERSHED

MICHAEL BAKER JR. INC.  
Consulting Engineers & Surveyors

DATE: 3-29-79 gss

MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject EATON DAM  
CROSS-SECTIONS

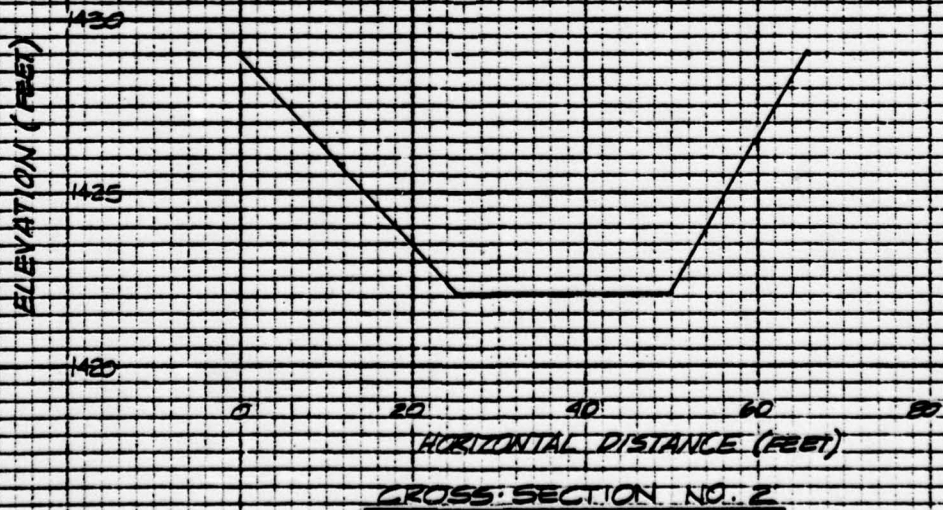
S.O. No. \_\_\_\_\_

Sheet No. 3 of 17

Drawing No. \_\_\_\_\_

Computed by SCB Checked by \_\_\_\_\_ Date 5-22-79

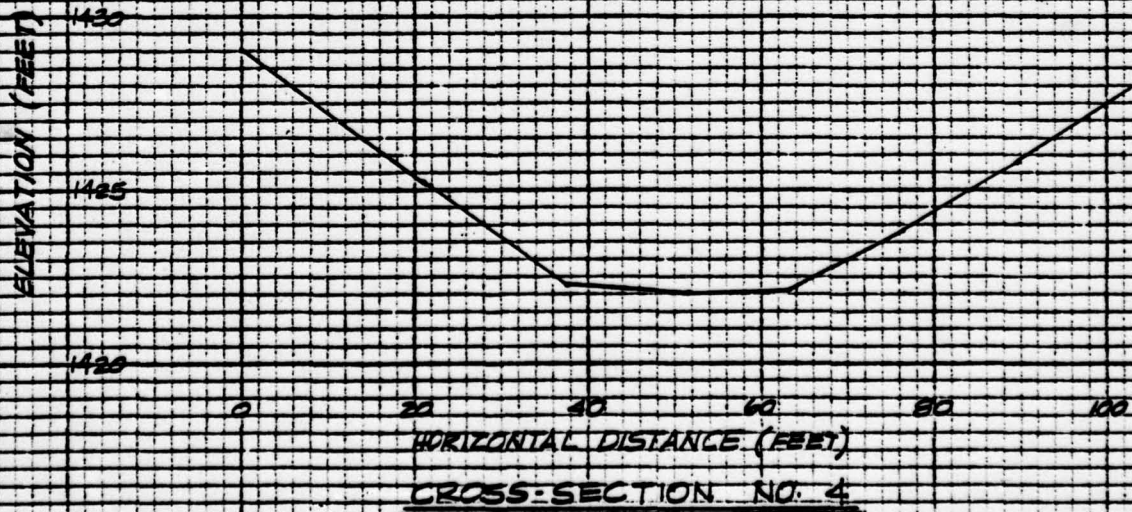
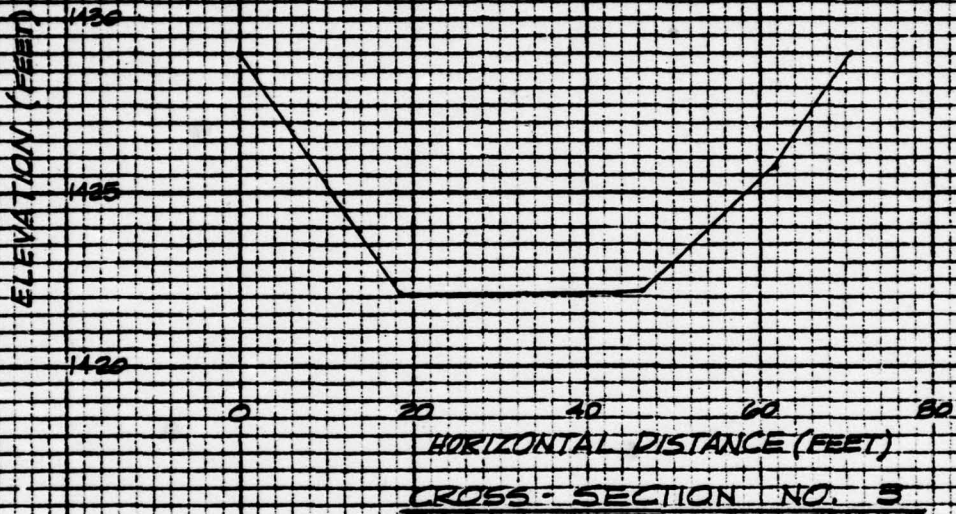
NOTE: THE FOLLOWING CROSS-SECTIONS WERE DETERMINED FROM DESIGN PLANS AND DATA TAKEN DURING THE FIELD INSPECTION. THEY ARE INCLUDED IN THE INPUT DATA FOR THE HEC-2 PROGRAM USED TO DETERMINE THE AUXILIARY SPILLWAY CAPACITY.



MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

Subject EATON DAM S.O. No. \_\_\_\_\_  
CROSS-SECTIONS Sheet No. 4 of 17  
Drawing No. \_\_\_\_\_  
Computed by SCB Checked by \_\_\_\_\_ Date 5-22-79



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Subject EATON DAM  
CROSS-SECTIONS

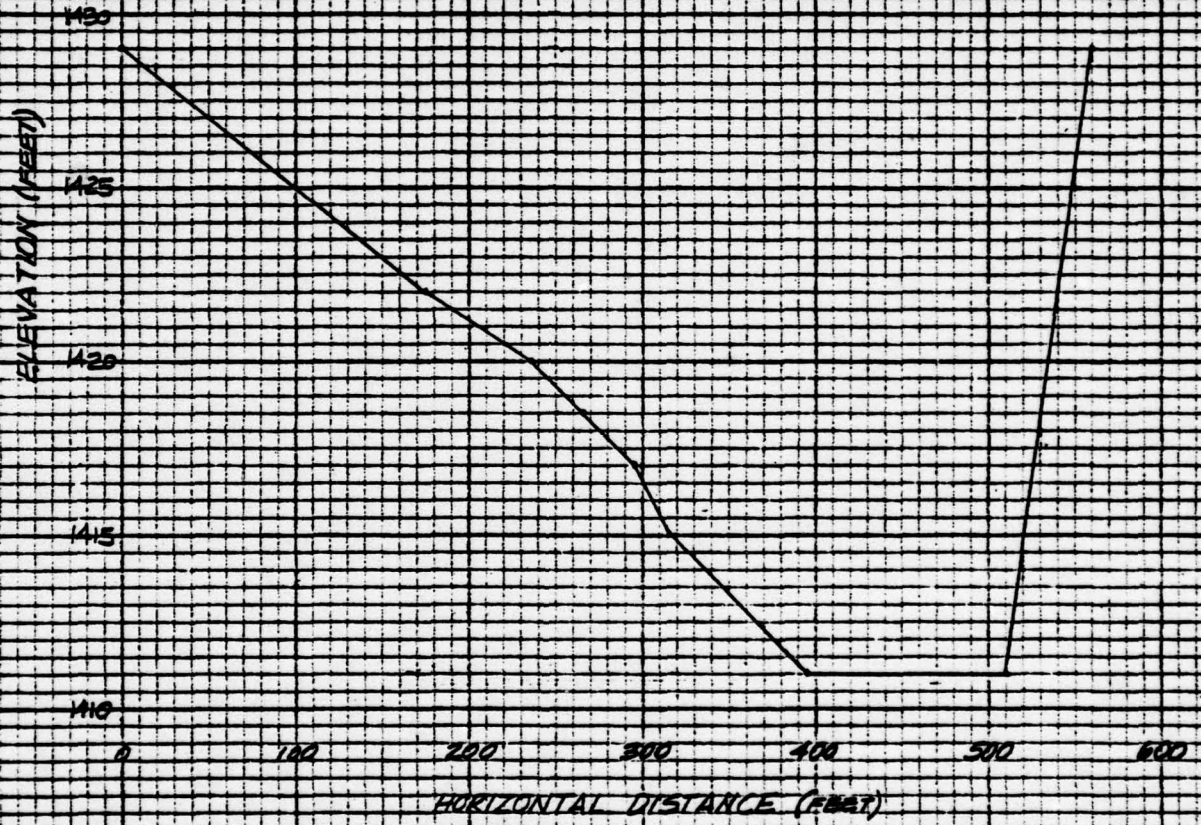
S.O. No. A

Sheet No. 5 of 17

Drawing No. \_\_\_\_\_

Computed by SCB Checked by \_\_\_\_\_

Date 5-22-79



CROSS-SECTION NO. 5



THIS RUN EXECUTED 03/10/79 15.54

\*\*\*\*\*  
 MPCZ RELEASED MAY 19 09:07:00 AUG1977  
 ERROR CORR - 01.02  
 MODIFICATION - 50.51.52.53; M&J UPDATE MADE 16 JAN 5 PM  
 \*\*\*\*\*

NOTE - ASTERISK (\*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SPELLWAY RATING (output)

SUMMARY PRINTOUT

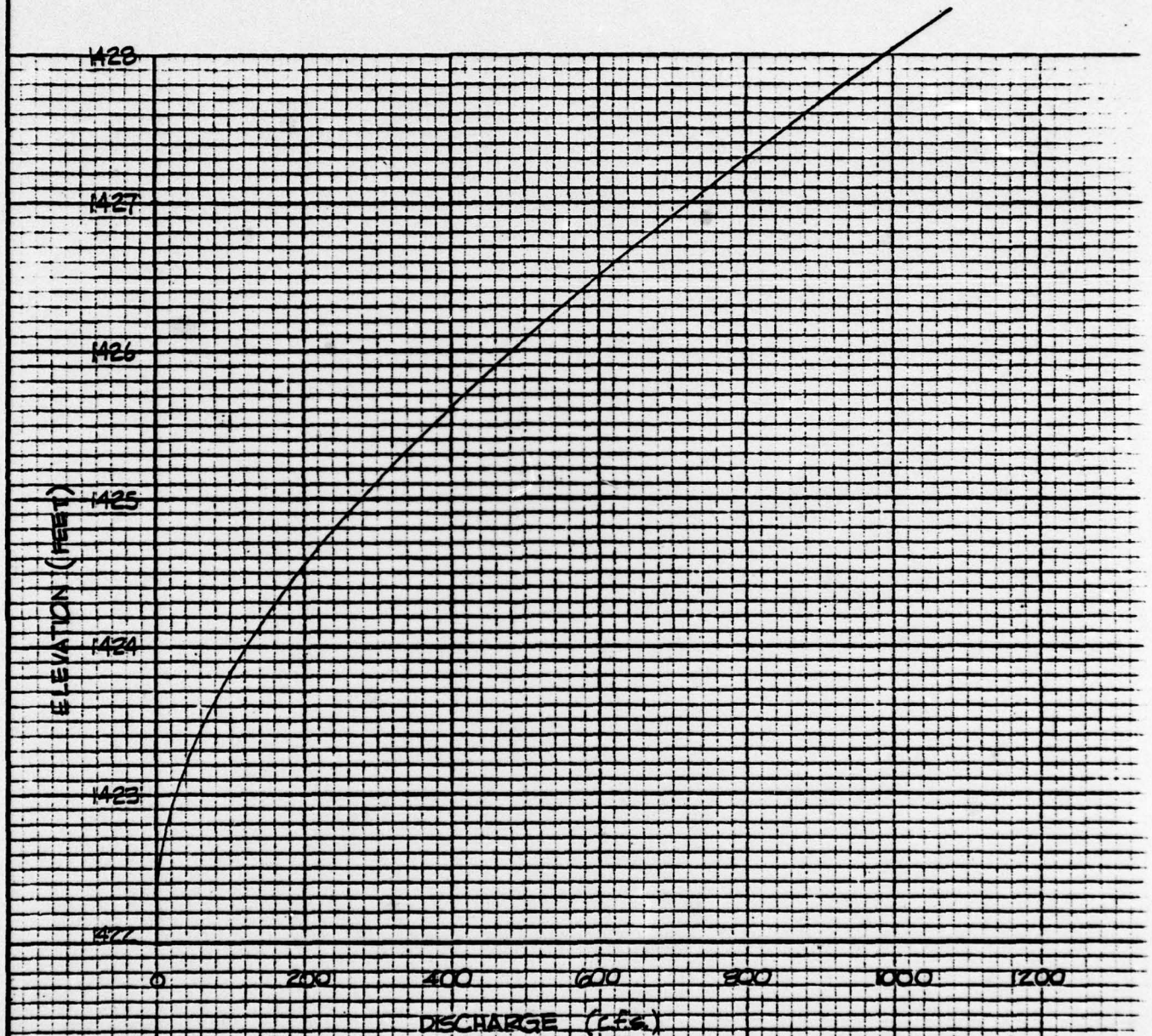
SECNO	Q	CMSBL	DEPTH	XLCH	CUM OIS	\$STA	STEMCL	STCHL	STCHR	STEMCR	ENDST	TOPMID
*	1.000	100.00	1421.48	0.0	0.0	9.00	0.0	9.00	29.00	0.0	29.00	20.00
*	1.000	200.00	1422.02	0.0	0.0	9.00	0.0	9.00	29.00	0.0	29.00	20.00
*	1.000	400.00	1422.58	0.0	0.0	9.00	0.0	9.00	29.00	0.0	29.00	20.00
*	1.000	800.00	1423.14	0.0	0.0	9.00	0.0	9.00	29.00	0.0	29.00	20.00
*	1.000	1000.00	1423.70	0.0	0.0	9.30	0.0	9.00	29.00	0.0	30.00	21.79
*	1.000	1200.00	1424.26	0.0	0.0	7.00	0.0	9.00	29.00	0.0	31.52	24.32
2.000	100.00	1423.17	1.12	100.00	100.00	20.95	0.0	0.0	65.50	0.0	52.29	31.34
2.000	200.00	1423.71	1.12	100.00	100.00	18.70	0.0	0.0	65.50	0.0	53.65	34.93
2.000	400.00	1424.25	2.74	100.00	100.00	16.86	0.0	0.0	65.50	0.0	55.90	41.04
2.000	800.00	1424.79	4.94	100.00	100.00	8.36	0.0	0.0	65.50	0.0	59.93	51.57
2.000	1000.00	1425.33	5.34	100.00	100.00	5.57	0.0	0.0	65.50	0.0	61.79	56.22
2.000	1200.00	1425.87	6.08	100.00	100.00	3.04	0.0	0.0	65.50	0.0	63.47	60.44
3.000	100.00	1423.72	1.92	100.00	200.00	14.03	0.0	0.0	75.50	0.0	52.91	38.98
3.000	200.00	1424.26	2.28	100.00	200.00	12.20	0.0	0.0	75.50	0.0	55.87	43.67
3.000	400.00	1424.80	3.28	100.00	200.00	9.52	0.0	0.0	75.50	0.0	60.10	50.59
3.000	800.00	1425.34	5.93	100.00	200.00	3.16	0.0	0.0	75.50	0.0	67.17	62.81
3.000	1000.00	1425.88	5.69	100.00	200.00	3.17	0.0	0.0	75.50	0.0	70.37	67.20
3.000	1200.00	1426.42	6.36	100.00	200.00	1.34	0.0	0.0	75.50	0.0	73.33	71.99
4.000	100.00	1423.78	1.78	20.50	220.50	19.07	0.0	0.0	109.50	0.0	76.36	47.29
4.000	200.00	1424.32	2.47	20.50	220.50	25.16	0.0	0.0	109.50	0.0	80.84	55.68
4.000	400.00	1424.86	3.50	20.50	220.50	19.33	0.0	0.0	109.50	0.0	87.54	68.19
4.000	800.00	1425.40	5.17	20.50	220.50	10.12	0.0	0.0	109.50	0.0	98.06	87.95
4.000	1000.00	1425.94	5.93	20.50	220.50	5.92	0.0	0.0	109.50	0.0	102.80	96.88
4.000	1200.00	1426.48	6.63	20.50	220.50	2.03	0.0	0.0	109.50	0.0	107.16	105.23
5.000	100.00	1423.83	12.83	44.50	265.00	139.29	0.0	0.0	560.00	0.0	265.63	416.34
5.000	200.00	1424.37	13.34	44.50	265.00	111.45	0.0	0.0	560.00	0.0	247.62	436.17
5.000	400.00	1424.91	14.61	44.50	265.00	84.65	0.0	0.0	560.00	0.0	250.59	465.94
5.000	800.00	1425.45	16.30	44.50	265.00	42.52	0.0	0.0	560.00	0.0	255.28	512.75
5.000	1000.00	1426.00	17.08	44.50	265.00	23.31	0.0	0.0	560.00	0.0	257.39	539.00
5.000	1200.00	1426.54	17.76	44.50	265.00	5.98	0.0	0.0	560.00	0.0	259.34	553.36



MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

Box 280  
Beaver, Pa. 15009

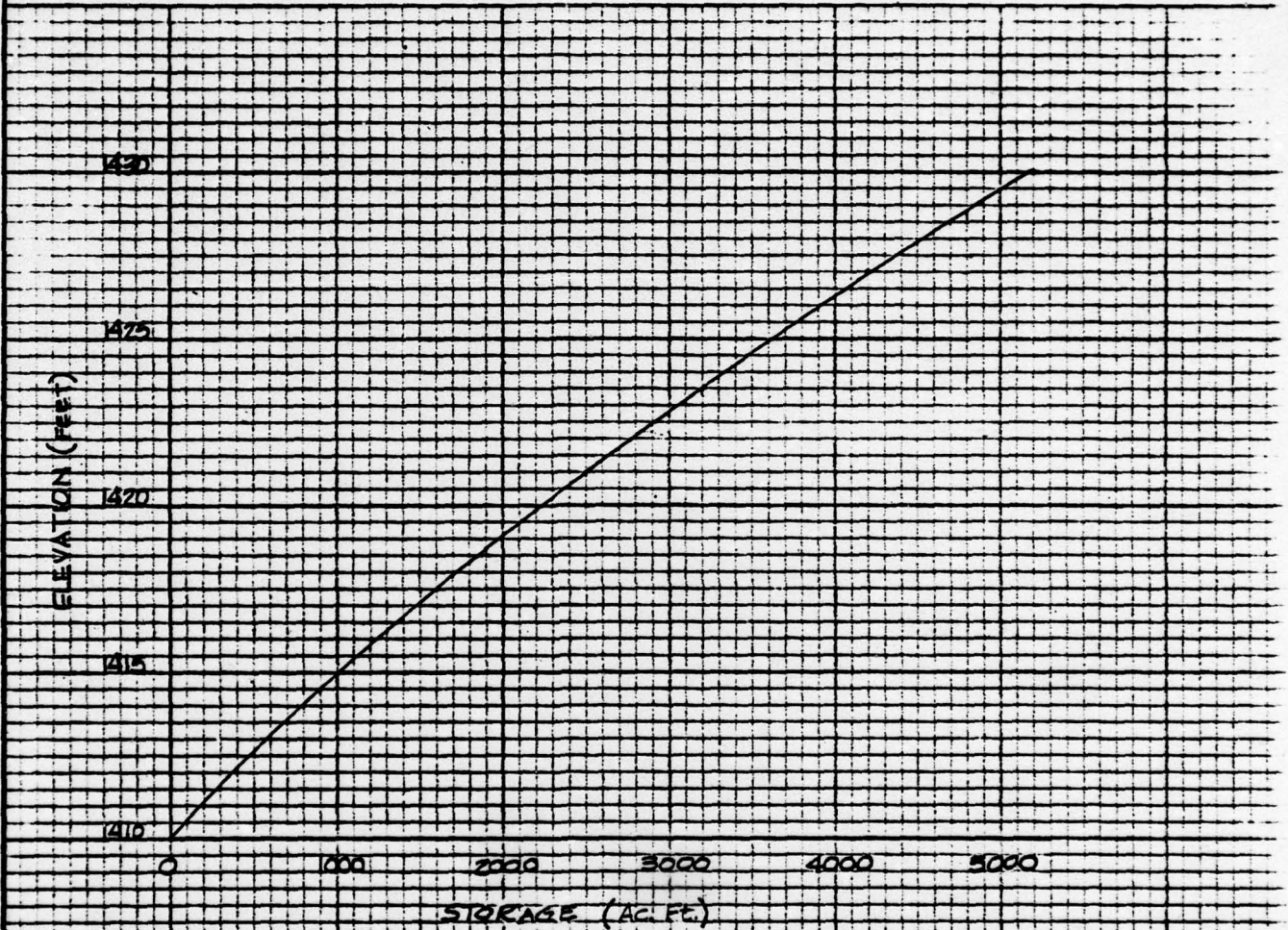
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EMERGENCY SPILLWAY RATING Sheet No. 9 of 17  
Drawing No. \_\_\_\_\_  
Computed by REH Checked by \_\_\_\_\_ Date \_\_\_\_\_



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Subject EATON DAM S.O. No. \_\_\_\_\_  
STAGE VS. STORAGE Sheet No. 10 of 17  
Drawing No. \_\_\_\_\_  
Computed by REH Checked by \_\_\_\_\_ Date \_\_\_\_\_

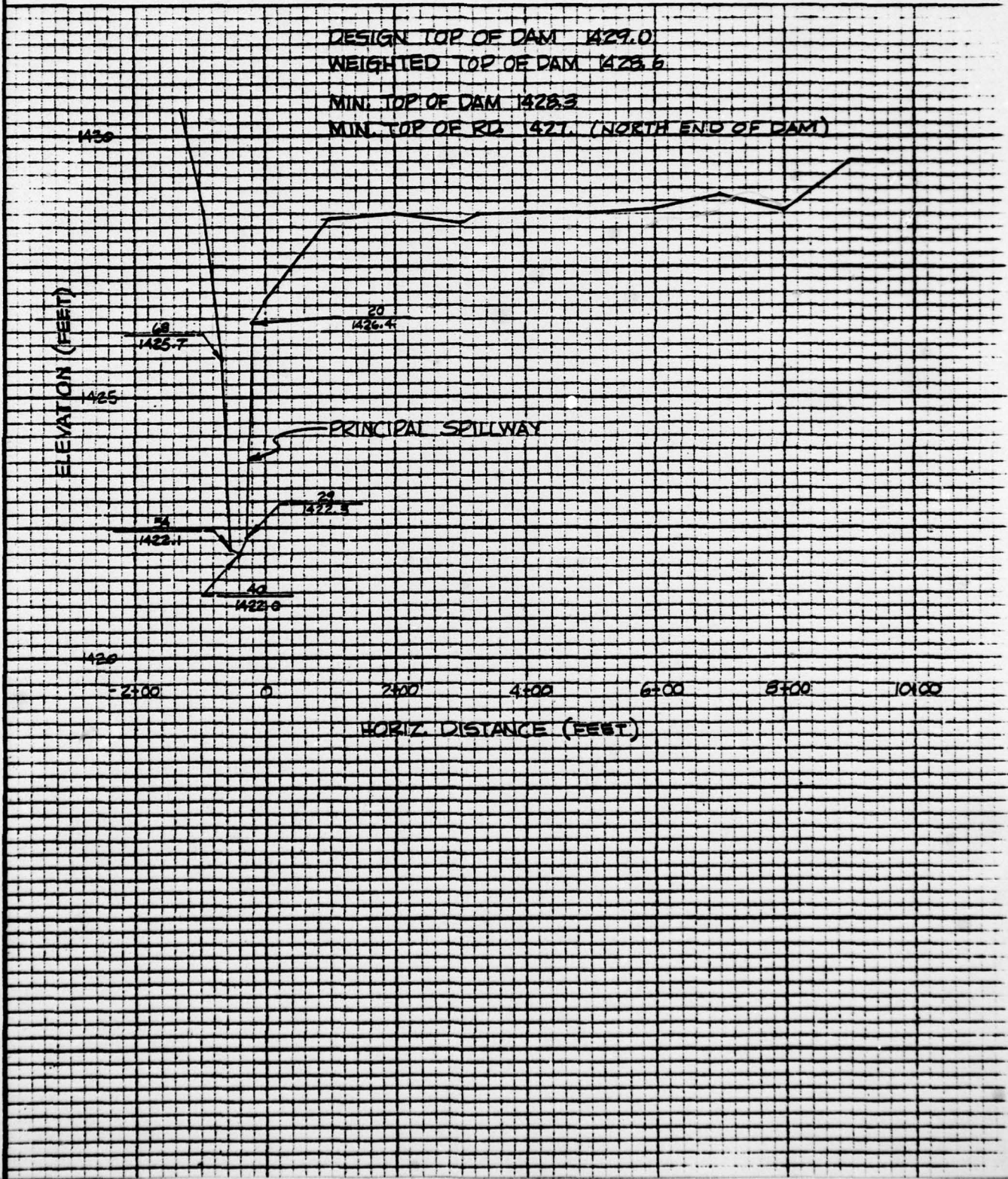


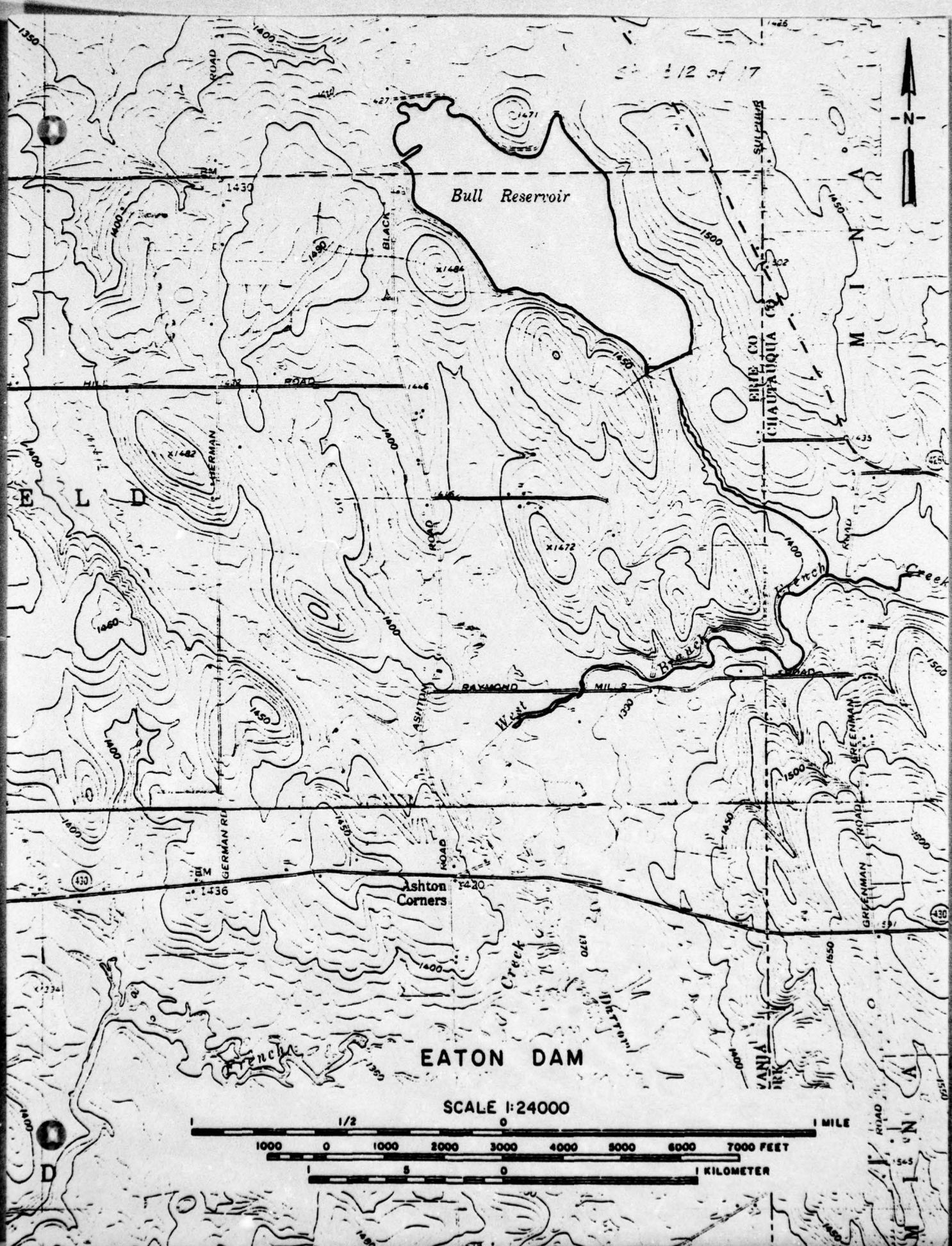
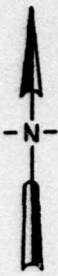
ELEV.	A. F.	REMARKS
1410	0	FROM DESIGN PLANS
1422	2160	(900' x 10" GALS.) FROM DESIGNING
1427	4200	CALCULATED STORAGE
1430	5200	AREA FROM QUAD. (CALC. SURV.)

MICHAEL BAKER, JR., INC.  
THE BAKER ENGINEERS

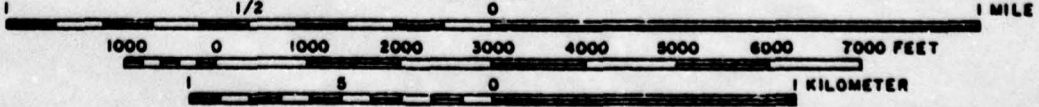
Box 280  
Beaver, Pa. 15009

Subject EATON DAM S.O. No. \_\_\_\_\_  
TOP OF DAM PROFILE Sheet No. 11 of 17  
Drawing No. \_\_\_\_\_  
Computed by GAS Checked by \_\_\_\_\_ Date 3-1-79





SCALE 1:24000



\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE LHEC-11  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 25 SEP 78  
 \*\*\*\*\*

1 A1 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS  
 2 A2 HYDROLOGIC AND HYDRAULIC ANALYSIS OF BULL RESERVOIR M8J 05  
 3 A3 PROBABLE MAXIMUM FLOOD PHE/UNIT GRAPH BY SNYDERS METHOD  
 4 B 200 0 30 0 0 0 0 0 0 0  
 5 B1 5 2 1  
 6 J 1 1.0  
 7 J1 0.5 1  
 8 K 0 1  
 9 K1 MODIFIED SNYDER HYDROGRAPH BY COE METHOD 1  
 10 M 1 1 1.07 127 141 151 1  
 11 P 22.9 117 127 141 151 1.0 0.05  
 12 T  
 13 W 1.66 0.55  
 14 X -1.5 -0.05 2.0  
 15 K 1 DAM  
 16 K1 THIS IS A ROUTING FOR BULL RESERVOIR  
 17 Y 1 1  
 18 Y1 -1422.0 -1  
 19 V61422.0 1423.8 1426.5 1425.6 1427.3 1428.1 1428.8  
 20 Y5 0 100 200 400 800 1000 1200  
 21 S5 0 2760 5200  
 22 SE 1410 1422 1427 1430  
 23 S1422.0  
 24 S01427.0 2.65 1.5 950  
 25 K 99

Low point on roadway at north  
 end of reservoir.

\*\*\*\*\*  
 FLOOD HYDROGRAPH PACKAGE (HEC-1)  
 DAM SAFETY VERSION JULY 1978  
 LAST MODIFICATION 25 SEP 78  
 \*\*\*\*\*

RUN DATE 05/17/79  
 TIME 18.11

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS  
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF BULL RESERVOIR MBJ 05  
 PROBABLE MAXIMUM FLOOD PHE/UNIT GRAPH BY SNYDER'S METHOD

JOB SPECIFICATION  
 #IG NHR NMIN IDAY IGR IMIN METRC IPLT IPRT NSTAN  
 200 0 30 0 0 0 0 0 0 0 0 0 0  
 JOPER NHT LROPT TRACE  
 5 0 0 0 0 0 0 0 0 0 0 0 0

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= 0.50 1.00

SUB-AREA RUNOFF COMPUTATION

MODIFIED SNYDER HYDROGRAPH BY COE METHOD

1STAQ ICOMP IECON ITAPE JPLI JPRT INAME ISTAGE IAUTO  
 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0

HYDROGRAPH DATA

1HYDG IUHG TAREA SNAP TRSDA TRSPC NATIO ISNOW ISAME LOCAL  
 1 1 1.07 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96  
 0.0 22.90 117.00 127.00 141.00 151.00 0.0 0.0 0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

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

UNIT HYDROGRAPH DATA

TP= 1.66 CP=0.55 NTA= 0

RECESSION DATA

STRATQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 23 END-OF-PERIOD ORIGINATES, LAG= 1.66 HOURS, CP= 0.55 VOL= 1.00  
 31. 112. 195. 222. 190. 146. 112. 86. 66. 51.  
 39. 30. 23. 18. 14. 10. 8. 6. 5.  
 3. 2. 2.

NO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q  
 MD.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q  
 SUM 27.66 25.23 2.43 3030.6  
 ( 703.31 641.11 62.11 1029.77)

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HYDROGRAPH ROUTING

THIS IS A ROUTING FOR BULL RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPR1	INAME	ISTAGE	IAUTD
DAM	1	0	0	0	0	1	070000000	
ROUTING DATA								
QLOSS	CLOSS	AVG	IRCS	ISAME	IUPI	IPMP	ISIR	
0.0	0.0	0.0	1	1	0	0	0	
NSTPS NSTDL LAG ANSKK X ISK SIORA ISPRAT								
	0	0	0	0.0	0.0	0.0	-1422.	-1
STAGE	1422.00	1423.80	1424.50	1425.60	1427.30	1428.10	1428.80	
FLOW	0.0	100.00	200.00	400.00	800.00	1000.00	1200.00	
CAPACITY=	0.	2760.	4200.	5200.				
ELEVATION=	1410.	1422.	1427.	1430.				

CREL	SPWID	COQM	EXPW	ELEVL	CONL	CAREA	EXPL
1422.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA  
 TOPEL 1427.0  
 COQU 2.6  
 EXPD 1.5  
 DAMNID 950.

PEAK OUTFLOW IS 144. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 481. AT TIME 46.50 HOURS

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 \*\*\*\*\*  
 \*\*\*\*\*  
 \*\*\*\*\*  
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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)

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN RATIO	RATIO 1	RATIO 2
			0.50		1.00
HYDROGRAPH AT	1	1.07	1	1467.	2935.
	(	2.77)	(	41.55)(	83.10)(
ROUTED TO	DAM	1.07	1	146.	481.
	(	2.77)	(	4.09)(	13.63)(



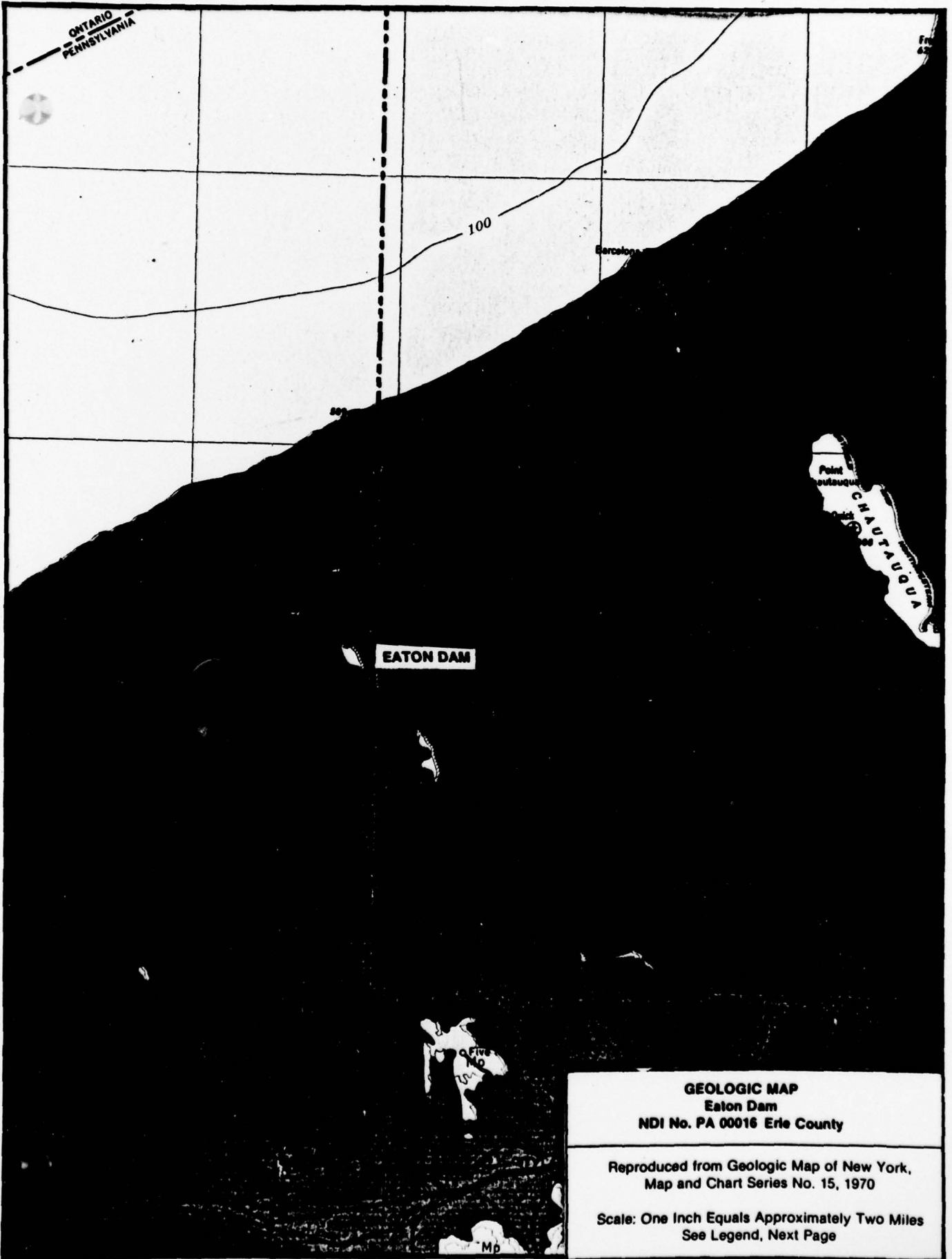
**APPENDIX E**

**REGIONAL GEOLOGY**

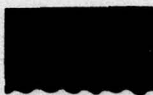






EATON DAM (BULL RESERVOIR)  
NDI No. PA 00016, PennDER No. 25-34

REGIONAL GEOLOGY

Eaton Dam (Bull Reservoir) is located in the glaciated section of the Appalachian Plateaus physiographic province. The reservoir is the former site of a marsh located on Kent ground moraine glacial deposits. Logs of test borings made for design of the dam describe foundation soils as deposits of yellow and blue clay with beds containing sand and gravel at depths between 20 and 25 feet. These soils are about 38 feet thick near the center of the valley. Bedrock units are members of the Conneaut Group, Upper Devonian system which are typically shales and siltstones.



# LEGEND

Lower Pennsylvanian		Pp	<b>POTTSVILLE GROUP</b> Connoquenessing Formation—sandstone, shale; Sheron Formation—shale, sandstone, conglomerate; Olean Conglomerate 50-100 ft. (15-30 m.)
		Mp	<b>POCONO GROUP</b> Cuyahoga Formation—shale, sandstone; Corry Sandstone; Knapp Formation 60-100 ft. (20-30 m.)—shale, conglomerate.
Lower Mississippian		Dco	<b>CONEWANGO GROUP</b> 450-650 ft. (140-200 m.) Oswayo and Venango Formations—shale, siltstone, sandstone; replaced eastwardly by Cattaraugus Formation—shale, sandstone, conglomerate.
		Dct	<b>CONNEAUT GROUP</b> 250-600 ft. (75-200 m.) In west: Ellicott and Dexterville Formations—shale, siltstone. In east: Germania Formation—shale, sandstone; Whitesville Formation—shale, sandstone; Hinsdale Sandstone; Wellsville Formation—shale, sandstone; Cuba Sandstone.
Upper Devonian		Dcys Dcyl Dcyd Dcy	<b>CANADAWAY GROUP</b> 700-1200 ft. (210-370 m.) Northeast Shale; Shumie Siltstone. Westfield Shale; Leona Siltstone. Gowanda, South Wales, and Dunkirk Shales. Machias Formation—shale, siltstone; Rushford Sandstone; Canesdale, Canisota, and Hume Shales; Canesota Sandstone; South Wales and Dunkirk Shales.
		Dj	<b>JAVA GROUP</b> 100-200 ft. (30-60 m.) Hanover Shale; Wiscoy Formation—sandstone, shale; Pipe Creek Shale.
		Dwf Dwn Dwg Dwr	<b>WEST FALLS GROUP</b> 400-950 ft. (120-290 m.) Angola and Rhinestreet Shales. Nunda Formation—sandstone, shale. West Hill and Gardeau Formations—shale, siltstone; Roricks Glen Shale; upper Beers Hill Shale; Grimes Siltstone. Lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales.