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NATIONAL DAM INSPECTION PROGRAM. BEAVER POND DAM (NDI NUMBER PA--ETC(U)
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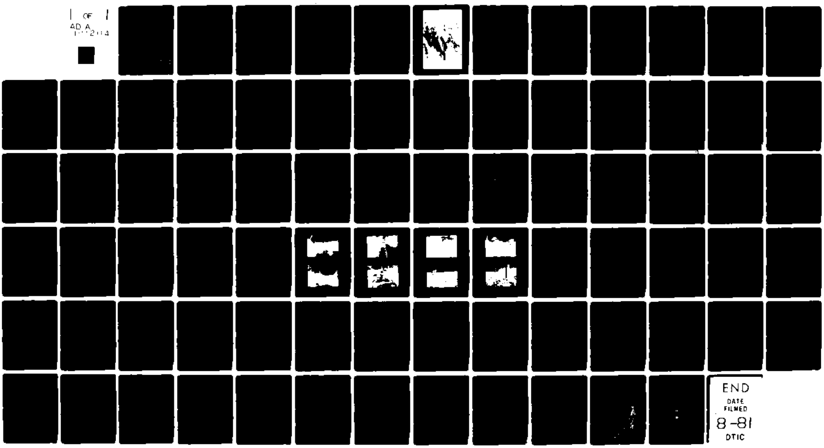

LEVEL II

SUSQUEHANNA RIVER BASIN

UNNAMED TRIBUTARY OF SHADIGEE CREEK, WAYNE COUNTY

PENNSYLVANIA

AD A101204

BEAVER POND DAM

NDI No. PA 00133

PennDER No. 64-19

Dam Owner: Marguerite Card

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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

April 1981

SUSQUEHANNA RIVER BASIN

BEAVER POND DAM
WAYNE COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI No. PA 00133
PennDER No. 64-19

(6) National Dam Inspection Program. Beaver Pond Dam (NDI Number PA-00133, PennDER Number 64-19), Susquehanna River Basin, Unnamed Tributary of Shadigee Creek, Wayne County, Pennsylvania.

PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM

(12) 80 (11) Apr 81

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(15) Contract DACW31-81-C-0011

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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 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.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Beaver Pond Dam, Wayne County, Pennsylvania
NDI No. PA 00133, PennDER No. 64-19
Unnamed Tributary of Shadigee Creek
Inspected 28 October 1980

ASSESSMENT OF GENERAL CONDITIONS

Beaver Pond Dam is ~~owned by Marguerite Card and is~~ classified as a "Significant" hazard - "Small" size dam. The dam was found to be in poor overall condition at the time of inspection.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District, Corps of Engineers, for Phase I Inspection Reports, revealed that the spillway will not pass the 100-year flood without overtopping the dam. A spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF) is required for Beaver Pond Dam. Because the dam is on the low end of the "Small" size category in terms of storage capacity and height, the 100-year flood was chosen as the SDF. During the 100-year flood, the dam is overtopped by a maximum depth of 3.27 feet for a total duration of 8.67 hours. The spillway is therefore considered "Inadequate." It is recommended that the owner immediately develop recommendations for remedial measures to reduce the overtopping potential of the dam.

Several items of remedial work should be immediately initiated by the owner. Item 1 below should be completed under the guidance of a qualified professional engineer experienced in the design of hydraulic structures for dams. These include:

1) Develop remedial measures to ensure that the dam will not be overtopped by the 100-year flood.

2) Repair the timber cribbing on the right side of the dam.

3) Remove the debris and brush on the spillway.

4) Fill the rodent holes on the right side of the dam.

BEAVER POND DAM

5) Cut the brush on the dam and for 10 feet below the toe of the dam.

6) Provide means to draw down reservoir during an emergency.

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, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented. An emergency drawdown plan should be developed in case an emergency drawdown of the reservoir should become necessary. These should be included in a formal maintenance and operations manual for the dam.

Submitted by:

MICHAEL BAKER, JR., INC.

John A. Dziubek, P.E.
Engineering Manager-Geotechnical

Date: 24 April 1981

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 11 May 81

BEAVER POND DAM

Overall View of Dam from Downstream Right Abutment

TABLE OF CONTENTS

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BEAVER POND DAM
NDI No. PA 00133, PennDER No. 64-19

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 - Beaver Pond Dam is a dry masonry dam with earthfill. It has a height of 15 feet and a crest length of 110 feet. The embankment has a crest width of approximately 5 feet and an upstream side slope of 5H:1V (Horizontal to Vertical). The downstream face of the embankment is "stepped" down in two relatively large steps. The top step drops down about 2.5 feet from the dam crest, followed by a fairly level area for 6 feet, then a step of about 5 feet drops down to the toe of the dam. The embankment consists of a large amount of rock rubble and slate with earthfill placed on the crest.

The spillway, located in the center section of the embankment, has a slate broad-crested weir. The spillway crest is 2.9 feet below the minimum crest of the dam and has drylaid stone training walls extending to the crest of the dam. The spillway has a length of 49.5 feet perpendicular to the direction of flow and a width of 10 feet. The discharge channel for the spillway steps down to the toe of the dam in three slate and rock rubble covered steps.

There are no outlet works in the dam.

b. Location - Beaver Pond Dam is located on an unnamed tributary of the Shadigee Creek in Preston Township, Wayne County, Pennsylvania. It is approximately 3 miles east-southeast of Starrucca. The coordinates of the dam are N 41° 53.3' and W 75° 25.1'. The dam can be found on the USGS 7.5 minute topographic quadrangle, Starrucca, Pennsylvania.

c. Size Classification - The height of the dam is 15 feet. Storage at the top of the dam at Elevation 1620.9 feet Mean Sea Level (ft. M.S.L.) is 274 acre-feet. The dam is therefore in the "Small" size category.

d. Hazard Classification - If the dam should fail, economic damage is likely to result to two township road crossings located 4000 and 5000 feet downstream. A residential structure, which is approximately 5 to 10 feet above the streambed and is located 7000 feet downstream from the dam, may also suffer economic damage but loss of life is believed to be unlikely. Therefore, the dam is considered to be in the "Significant" hazard classification.

e. Ownership - The dam is owned by Marguerite Card, Banta Road, P.O. Box 49, Corbettsville, NY 13749.

f. Purpose of the Dam - The reservoir is used for recreational purposes.

g. Design and Construction History - A 1917 report by the Water Supply Commission (one of PennDER's predecessors) reported that the dam was breached down to the original natural lake level by the owner 8 years earlier (1909). In 1930 a permit was granted to Leo L. Card to reconstruct the dam. Extensions of time were granted for reconstruction through 1935. No notice of completion was in the PennDER file; therefore, the date of completion is unknown. The dam was not reconstructed according to the sketches provided by Mr. Card to the Water and Power Resources Board (one of PennDER's predecessors).

h. Normal Operational Procedures - The spillway is uncontrolled and the pool is normally at the spillway crest, Elevation 1618.0 ft. M.S.L.

1.3 PERTINENT DATA

a.	Drainage Area (square miles) -	5.4
b.	Discharge at Dam Site (c.f.s.) -	
	Maximum Flood -	Unknown
	Spillway Capacity at Maximum Pool (El. 1620.9 ft. M.S.L.) -	585
c.	Elevation* (feet above Mean Sea Level [ft. M.S.L.]) -	
	Design Top of Dam -	Unknown
	Minimum Top of Dam -	1620.9
	Maximum Design Pool -	Unknown
	Spillway Crest -	1618.0
	Streambed at Toe of Dam -	1605.8
	Maximum Tailwater of Record -	Unknown
d.	Reservoir (feet) -	
	Length of Maximum Pool (El. 1620.9 ft. M.S.L.) -	2900
	Length of Normal Pool (El. 1618.0 ft. M.S.L.) -	2700
e.	Storage (acre-feet) -	
	Top of Dam (El. 1620.9 ft. M.S.L.) -	274
	Normal Pool (El. 1618.0 ft. M.S.L.) -	176
f.	Reservoir Surface (acres) -	
	Top of Dam (El. 1620.9 ft. M.S.L.) -	38
	Normal Pool (El. 1618.0 ft. M.S.L.) -	28

*All elevations referenced to the spillway crest, Elevation 1618.0 ft. M.S.L., estimated from the USGS 7.5 minute topographic quadrangle, Starrucca, Pennsylvania.

g. Dam -

Type - Dry masonry dam with earthfill	
Total Length including spillway (feet) -	110
Maximum Height (feet) - Design -	Unknown
Field -	15
Top Width (feet) -	5
Side Slopes - Upstream -	5H:1V
Downstream -	Stepped Vertical Face
Zoning -	None
Impervious Core -	None
Cutoff -	None
Drains -	None

h. Diversion and Regulating Tunnel - None

i. Spillway -

Type - Slate broad-crested weir	
Location - Center of dam	
Width of Crest Parallel to Flow (feet) -	10
Length of Crest Perpendicular to Flow (feet) -	49.5
Crest Elevation (ft. M.S.L.) -	1618.0
Gates -	None

Downstream Channel - Moderately sloping, natural rock-lined streambed; an abandoned rock foundation is located 200 feet downstream on the right side of the channel.

j. Outlet Works - None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Information reviewed for preparation of this report consisted of File No. 64-19 of the Pennsylvania Department of Environmental Resources (PennDER). This included:

1) An information sheet on the dam, dated 1914.

2) An application to the Commonwealth of Pennsylvania, Water and Power Resources Board, from Leo L. Card, owner of the dam, dated 10 February 1930, to repair the stone dam.

3) Various correspondence between Leo Card and the Water and Power Resources Board regarding clarifications and revisions to the original permit application.

4) The permit issued by the Water and Power Resources Board allowing the reconstruction of the dam (dated 9 June 1930).

5) The requests for an extension of the expiration date of the building permit and the granting of those extensions by the Water and Power Resources Board.

6) Inspection reports, photographs and correspondence by PennDER personnel, including the last recorded inspection on 8 November 1978.

2.2 CONSTRUCTION

A 1917 report by the Water Supply Commission (one of PennDER's predecessors) reported that the dam was breached down to the original natural lake level by the owner 8 years earlier (1909). In 1930 a permit was granted to Leo L. Card to reconstruct the dam. Extensions of time were granted for reconstruction through 1935. No notice of completion was in the PennDER file; therefore, the date of completion is unknown. The dam was not reconstructed according to the sketches provided by Mr. Card to the Water and Power Resources Board (one of PennDER's predecessors).

2.3 OPERATION

No formal records are available for operation of the dam and reservoir. The spillway is uncontrolled and the owner reported that the reservoir does not fluctuate very much from the spillway crest level.

2.4 EVALUATION

a. Availability - The information reviewed is readily available from PennDER's File No. 64-19.

b. Adequacy - The information available combined with the visual inspection measurements and observations is adequate for a Phase I Inspection of this dam.

c. Validity - There is no reason at the present time to doubt the validity of the available engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam was found to be in poor overall condition at the time of inspection on 28 October 1980. No unusual weather conditions were experienced during the visual inspection. Noteworthy deficiencies observed during the visual inspection of the dam are described briefly in the following paragraphs. The complete visual inspection check list, field sketch, top of dam profile, and typical cross-section are presented in Appendix A.

b. Dam - The timber cribbing on the left half of the dam has rotted considerably. It is recommended that this cribbing be repaired. Rodent holes were observed on the right half of the dam where the dam is covered with a thin layer of soil. Thick brush is growing on the left side of the dam and below the downstream toe of both sides of the dam.

c. Appurtenant Structures - The spillway consists of pieces of slate laid horizontally to form a cap. There was debris and brush partially blocking the right side of the spillway.

d. Reservoir Area - The reservoir slopes are moderate to fairly steep with a good cover of vegetation. Some localized quarrying for slate is being conducted along the left hillside of the reservoir. There are 5 ponds upstream from Beaver Pond Dam on three tributary streams. The northern stream contains Island Lake (PennDER ID No. 64-NL 20), a natural lake, which empties into an unnamed pond 6700 feet to the north-northeast of Beaver Pond Dam. The eastern branch contains another unnamed pond 5600 feet due east of Beaver Pond Dam. This pond was dry at the time of inspection. These three ponds can be found on the USGS 7.5 minute topographic quadrangle, Starrucca, Pennsylvania. Two additional unnamed ponds are shown on the USGS 7.5 minute topographic quadrangle, Orson, Pennsylvania, approximately 8500 feet southeast of Beaver Pond Dam. The lower of these two could not be located in the field and the upper one is considered insignificant to Beaver Pond Dam.

e. <u>Downstream Channel</u> - Two township road crossings are located 4000 and 5000 feet downstream. A residential structure is located 7000 feet downstream. These could suffer economic damage in the event of a dam failure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no formal written instructions for lowering the reservoir or evacuating the downstream area in case of an impending emergency. It is recommended that formal emergency procedures be adopted.

4.2 MAINTENANCE OF DAM

There are no formal records of maintenance or formal procedures for evaluating the necessity of maintenance for the structure. It is recommended that formal inspection procedures be developed.

4.3 MAINTENANCE OF OPERATING FACILITIES

There are no operating facilities installed at the dam. An emergency drawdown plan should be developed.

4.4 DESCRIPTION OF ANY WARNING SYSTEM

There is no warning system in the event of dam failure. It is recommended that an emergency warning system be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The current operational features are adequate for the purpose they serve. However, it is recommended that a formal maintenance and operations manual be prepared for the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations are available for Beaver Pond Dam.

b. Experience Data - No information concerning the effects of significant floods on the dam is available.

c. Visual Observations - During the visual inspection, no problems were observed which would indicate that the dam and appurtenant facilities could not perform satisfactorily during a flood event.

There are five ponds upstream from Beaver Pond Dam on three tributary streams. The northern stream contains Island Lake (PennDER ID No. 64-NL 20), a natural lake with an outlet channel which is 5 feet wide and 3 feet deep. Island Lake empties into an unnamed pond 900 feet downstream. This pond is approximately 6700 feet to the north-northeast of Beaver Pond Dam. The pond is formed by an earth and rockfill dam 60 feet long and 4 feet high. The spillway for this dam consists of a small rock channel 4 feet wide and 0.5 foot deep.

The eastern branch contains another unnamed pond 5600 feet due east of Beaver Pond Dam. This pond was dry at the time of the inspection.

Two additional unnamed ponds are shown on the USGS 7.5 minute topographic quadrangle, Orson, PA. These are located approximately 8500 feet southeast of Beaver Pond Dam. The lower of these two could not be located in the field and the upper one is considered to be insignificant to Beaver Pond Dam.

d. Overtopping Potential - Beaver Pond Dam is a "Small" size - "Significant" hazard dam requiring evaluation for a spillway design flood (SDF) in the range of the 100-year flood to the 1/2 Probable Maximum Flood (1/2 PMF). Because the dam is on the low end of the "Small" size category in terms of storage capacity and height, the 100-year flood was chosen as the SDF.

The hydrologic characteristics of the watershed, specifically, the Snyder's unit hydrograph parameters, were obtained from a regionalized analysis conducted by the Baltimore District of the U.S. Army Corps of Engineers. The hydraulic capacity of the dam, reservoir, and spillway was assessed by utilizing the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 DB.

In the hydrologic and hydraulic analysis performed for this inspection report, the total drainage area tributary to Beaver Pond Dam was divided into two parts. The first part is the area north of Beaver Pond Dam which is controlled by the small dam located 6700 feet upstream from Beaver Pond Dam. The second part is the area which is directly tributary to Beaver Pond Dam. A runoff hydrograph was developed for the drainage area to the dam north of Beaver Pond Dam, routed through this dam, and down to Beaver Pond. This hydrograph was then combined with the runoff hydrograph developed for the area surrounding Beaver Pond and routed through Beaver Pond Dam.

Material from "The Hydrologic Study - Tropical Storm Agnes" prepared by the Corps of Engineers in New York City, was used to calculate the peak flows for the 100-year flood. A detailed description of how these flows were calculated is presented in Appendix D.

Analysis of Beaver Pond Dam shows that the dam will be overtopped during the 100-year flood by a maximum depth of 3.27 feet for a total duration of 8.67 hours.

e. Spillway Adequacy - As outlined in the above analysis, the spillway will not pass the SDF without overtopping the dam; therefore, the spillway is considered "Inadequate."

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - There were no structural inadequacies noted during the visual inspection that cause concern for the structural stability of the dam.

b. Design and Construction Data - No design or construction data were available for review. Generally, for this type of dam, if the ratio of the width of the stonewall portion of the dam is greater than 0.5 times the height of the dam (0.5 w/h), then stability of the dam due to overturning or sliding is not a problem. (Reference: "Evaluation and Repair of Stonewall-earth Dams," by Kent A. Healy, Proceedings of "Safety of Small Dams" conference, New England College, Henniker, New Hampshire, August 4-9, 1974, pp. 149-178). The w/h ratio for this dam is estimated at 0.75 and the downstream face is stepped. Because the w/h ratio is greater than 0.5 and because no signs of instability were observed during the visual inspection, further assessments of the structural stability are not considered necessary.

c. Operating Records - No operating records are available. Nothing in the procedures described by the owner's representative indicates concern for the structural stability of the dam.

d. Post-Construction Changes - No changes adversely affecting the structural stability of the dam have been performed.

e. Seismic Stability - The dam is located in Seismic Zone 1 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 minor seismic activity. Therefore, further consideration of the seismic stability is not warranted.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Beaver Pond Dam was found to be in poor overall condition at the time of inspection. Beaver Pond Dam is a "Significant" hazard - "Small" size dam requiring a spillway capacity in the range of the 100-year flood to the 1/2 PMF. Because the dam is on the low end of the "Small" size category in terms of height and storage, the 100-year flood was chosen as the SDF. As presented in Section 5, the spillway and reservoir are not capable of passing the 100-year flood without overtopping the dam. During the 100-year flood, the dam is overtopped by a maximum depth of 3.27 feet for a total duration of 8.67 hours. Therefore, the spillway is considered "Inadequate."

b. Adequacy of Information - The information available and the observations made during the visual inspection are considered sufficient for a Phase I Inspection Report.

c. Urgency - The owner should immediately initiate the further evaluation discussed in paragraph 7.1.d.

d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner, under the guidance of a professional engineer, develop remedial measures to ensure that the dam will not be overtopped by the 100-year flood.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection revealed certain items of remedial work which should be performed by the owner without delay. Item 1 below should be completed under the guidance of a qualified professional engineer experienced in the design of hydraulic structures for dams. These include:

1) Develop remedial measures to ensure that the dam will not be overtopped by the 100-year flood.

2) Repair the timber cribbing on the left side of the dam.

3) Remove the debris and brush on the spillway.

4) Fill the rodent holes on the right side of the dam.

5) Cut the brush on the dam and for 10 feet below the toe of the dam.

6) Provide means to draw down reservoir during an emergency.

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, activate the emergency operation and warning system.

It is further recommended that formal inspection, maintenance, and operation procedures and records be developed and implemented. An emergency drawdown plan should be developed in case an emergency drawdown of the reservoir should become necessary. These should be included in a formal maintenance and operations manual for the dam.

APPENDIX A

VISUAL INSPECTION CHECK LIST, FIELD SKETCH, TOP OF DAM PROFILE, ANᴰ TYPICAL CROSS-SECTION

Check List
Visual Inspection
Phase 1

Name of Dam Beaver Pond Dam **County** Wayne **State** PA **Coordinates** **Lat.** N 41°53.3'

NDI # PA 00133 **Long.**W 75°25.1'
PennDER # 64-19

Date of Inspection 28 October 1980 **Weather** Overcast **Temperature** 40° F.

Pool Elevation at Time of Inspection 1618.24 ft. M.S.L.* **Tailwater at Time of Inspection** 1608.80 ft. M.S.L.

*All elevations referenced to spillway crest elevation 1618.0 ft. M.S.L. assumed from USGS 7.5 minute topographic quadrangle, Starrucca, Pennsylvania.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Wayne D. Lasch
Jeffrey S. Maze

Owner's Representatives:

Marguerite Card

James G. Ulinski **Recorder**

MASONRY DAMS

Name of Dam: BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE	Small amount of leakage is entering the rockfill in the openings between pieces of slate in the spillway and exiting at the toe of the dam. This is not considered to represent a serious problem for the dam.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Good condition	
VEGETATION	There is brush growing on the dam and below the toe.	Cut the brush on the dam and for 10 ft. below the toe of the dam.
DRAINS	None observed	
WATER PASSAGES	Not Applicable	
FOUNDATION	No problems observed.	
RODENT HOLES	Several rodent holes were observed on the right side of the dam.	Fill the rodent holes.

MASONRY DAMS

Name of Dam: BEAVER POND DAM
NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	The timber cribbing for the left side of the dam is deteriorating.	Repair this portion of the dam.
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Good condition	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT - Not Applicable

Name of Dam BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS		
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE		
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES		

EMBANKMENT - Not Applicable

Name of Dam BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST		
RIPRAP FAILURES		

EMBANKMENT - Not Applicable

Name of Dam BEAVER POND DAM

NDI # PA 00133

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

OUTLET WORKS - Not Applicable

Name of Dam: BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE		
OUTLET STRUCTURE		
OUTLET CHANNEL		
EMERGENCY GATE		

UNGATED SPILLWAY

Name of Dam: BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The spillway crest consists of horizontally laid pieces of slate approximately 1 to 2 in. thick and variable in size in plan view. No problem observed.	
APPROACH CHANNEL	Small amount of debris and brush is partially blocking the spillway.	Remove debris and brush.
DISCHARGE CHANNEL	Good condition	
BRIDGE AND PIERS	None observed	

GATED SPILLWAY - Not Applicable

Name of Dam: BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION

Name of Dam: BEAVER POND DAM

NDI # PA 00133

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

RESERVOIR

Name of Dam: BEAVER POND DAM

NDI # PA 00133

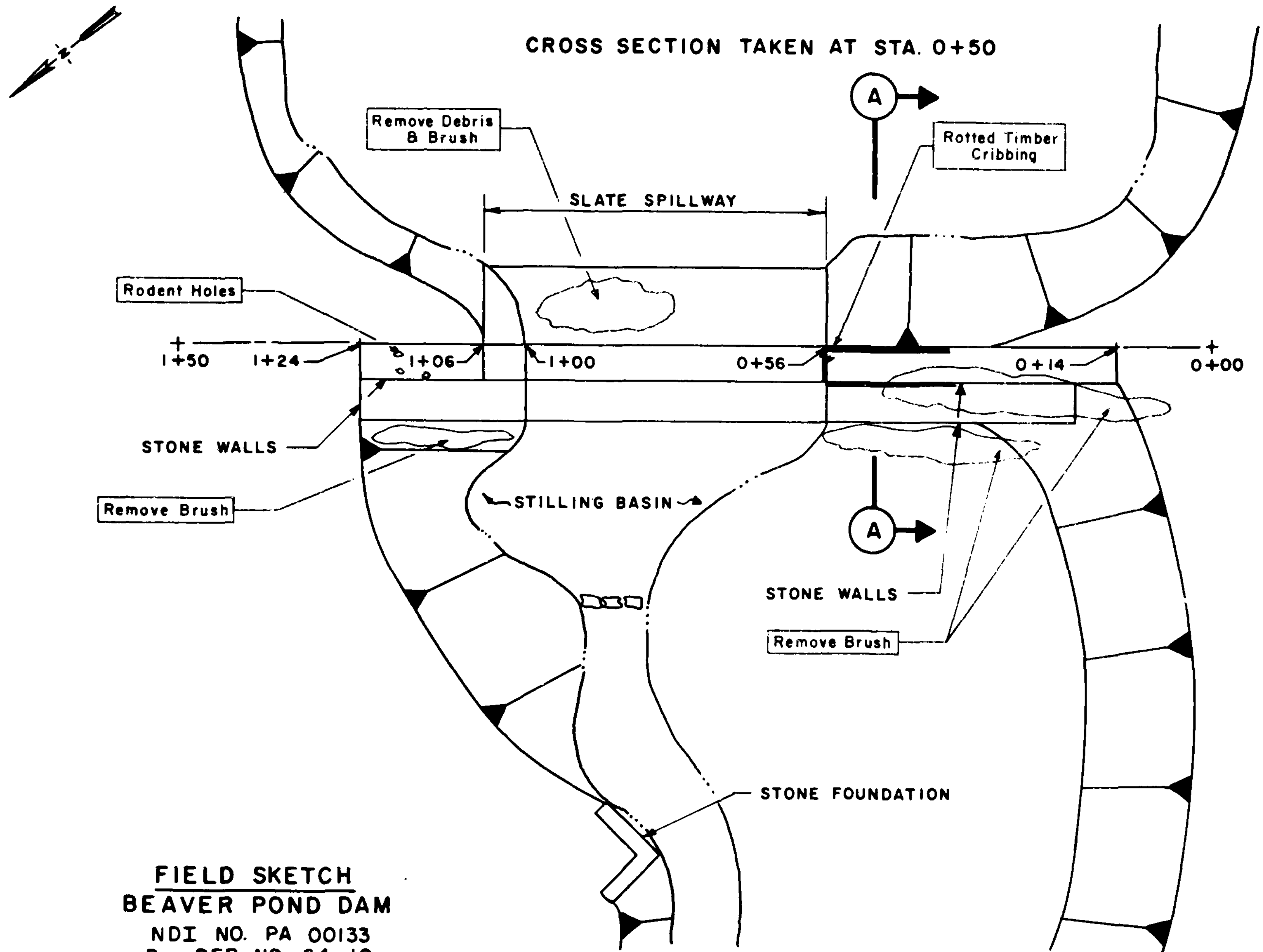
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate (5°-15°) to fairly steep (15°-45°) slopes with good growth of ground cover and woods. Some localized quarrying for slate is occurring along the left hillside of the reservoir.	
SEDIMENTATION	Small amount of sediment in upstream reservoir area.	
UPSTREAM DAMS	A natural lake, Island Lake (PennDER ID No. 64-NL 20) is located upstream (in series) of an unnamed reservoir. This unnamed reservoir is located 6700 ft. upstream of Beaver Pond Dam to the north and slightly east. Another unnamed pond is located 5600 ft. due east of Beaver Pond but was dry at the time of inspection. Two additional ponds (in series) are located south of Beaver Pond. The downstream pond appears on the quadrangle map but could not be located in the field. The upper pond was observed, but is not considered to have an effect on Beaver Pond Dam.	

DOWNSTREAM CHANNEL

Name of Dam: BEAVER POND DAM

NDI # PA 00133

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Two small bridges over township roads 4000 and 5000 ft. downstream of dam.	
SLOPES	Mild to moderately sloping with good growth of ground cover and woods.	
APPROXIMATE NO. OF HOMES AND POPULATION	Two township road crossings are located 4000 and 5000 ft. downstream. A residential structure is located 7000 ft. downstream of the dam.	



FIELD SKETCH
BEAVER POND DAM
NDI NO. PA 00133
PennDER NO. 64-19
SCHEMATIC - NOT TO SCALE

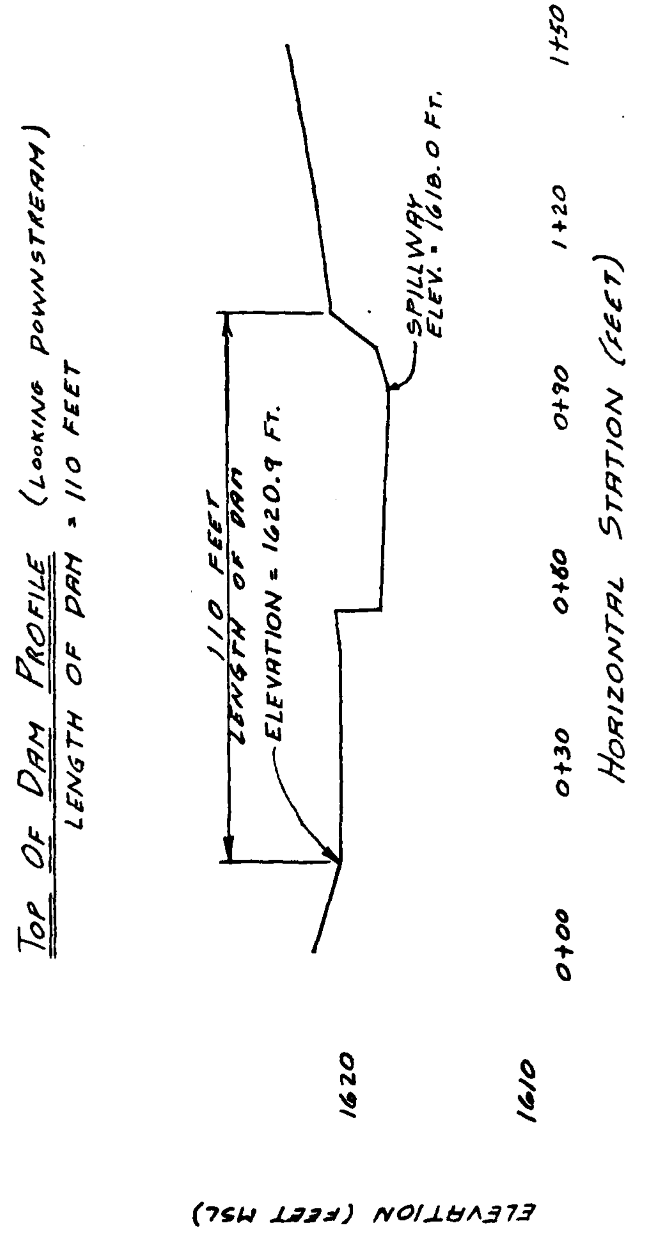
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

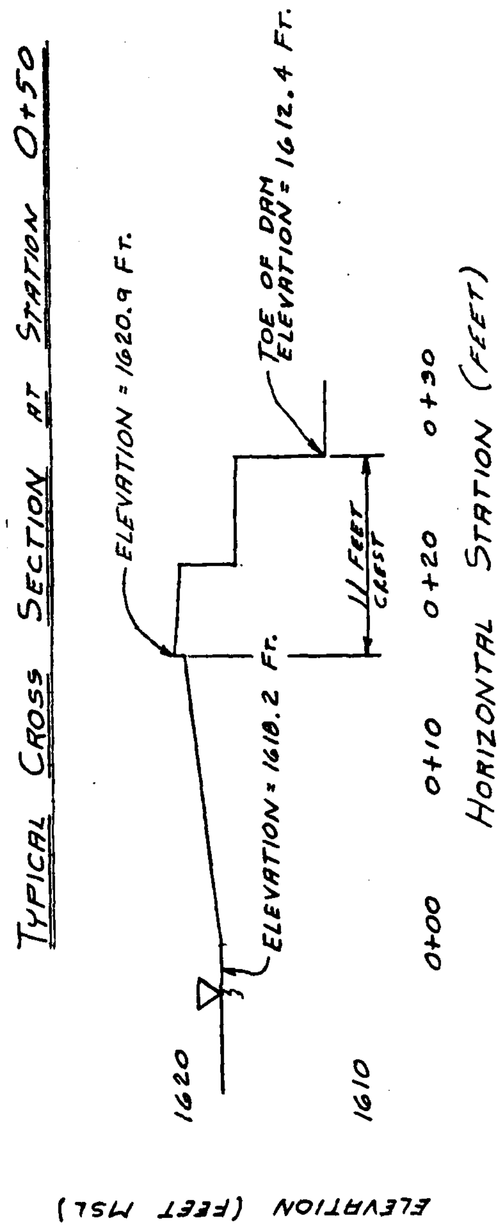
Box 280
Beaver, Pa. 15009

BEAVER POND DAM

TOP OF DAM PROFILE
TYPICAL CROSS-SECTION

DATE OF INSPECTION: 28 October 1980





APPENDIX B

ENGINEERING DATA CHECK LIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: BEAVER POND DAM
NDI # PA 00133

ITEM	REMARKS
PLAN OF DAM	No information available. See the Field Sketch included as Plate 3 of this report.
REGIONAL VICINITY MAP	A USGS 7.5 minute topographic quadrangle of Starrucca, Pennsylvania, was used to prepare the vicinity map which is enclosed in this report as the Location Plan (Plate 1).
CONSTRUCTION HISTORY	A 1917 report by the Water Supply Commission (one of PennDER's predecessors) reported that the dam was breached down to the original natural lake level by the owner 8 years (1909) earlier. In 1930 a permit was granted to Leo L. Card to reconstruct the dam. Extensions of time were granted for reconstruction through 1935. No notice of completion was in the PennDER file, therefore, the date of completion is unknown. The dam was not reconstructed according to the sketches provided by Mr. Card to the Water and Power Resources Board (one of PennDER's predecessors).
TYPICAL SECTIONS OF DAM	No information available. See typical cross section of the dam from the field inspection given as Plate 4 of this report.
HYDROLOGIC/ HYDRAULIC DATA	No information available.
OUTLETS - PLAN	There are no outlets in the dam.
- DETAILS	
- CONSTRAINTS	
- DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	No records are kept.

Name of Dam: BEAVER POND DAM
NDI # PA 00133

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	No geology reports are available. See Appendix F for the Regional Geology.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not performed
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not performed
POST-CONSTRUCTION SURVEYS OF DAM	Not performed
BORROW SOURCES	No information available.

Name of Dam: BEAVER POND DAM
NDI # PA 00133

ITEM	REMARKS
MONITORING SYSTEMS	None observed
MODIFICATIONS	Plans were submitted and a permit was granted for Leo L. Card to reconstruct and make alterations to the dam in 1930. However, these plans were never fully implemented.
HIGH POOL RECORDS	No information available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Inspections were *performed* by PennDER personnel and its predecessors on 8 November 1978, 20 April 1965, 15 May 1917 and in 1914. These reports are available in the PennDER file.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported in the information available.
MAINTENANCE OPERATION RECORDS	No formal records of maintenance are kept.

Name of Dam: BEAVER POND DAM

NDI # PA 00133

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS, and DETAILS	No information available.
OPERATING EQUIPMENT PLANS & DETAILS	None

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.4 sq. mi., moderate to steep slopes, mostly wooded

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1618.0 ft. M.S.L. (176.0 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1620.9 ft. M.S.L. (274 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1620.9 ft. M.S.L. (minimum top of dam elevation)

SPILLWAY: Rectangular channel with slate cap

a. Crest Elevation 1618.0 ft. M.S.L.
b. Type Slate broad crested weir
c. Width of Crest Parallel to Flow 10 ft.
d. Length of Crest Perpendicular to Flow 49.5 ft.
e. Location Spillover Center of dam
f. Number and Type of Gates None

OUTLET WORKS: None

a. Type
b. Location
c. Entrance Inverts
d. Exit Inverts
e. Emergency Drawdown Facilities

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPH LOCATION PLAN AND PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam - Overall View of Dam from Downstream Right Abutment

Photograph Location Plan

Photo 1 - View of Dam from Upstream Shoreline

Photo 2 - View of Dam from Downstream Channel

Photo 3 - View Across Dam Towards Right Abutment

Photo 4 - View Across Dam Towards Left Abutment

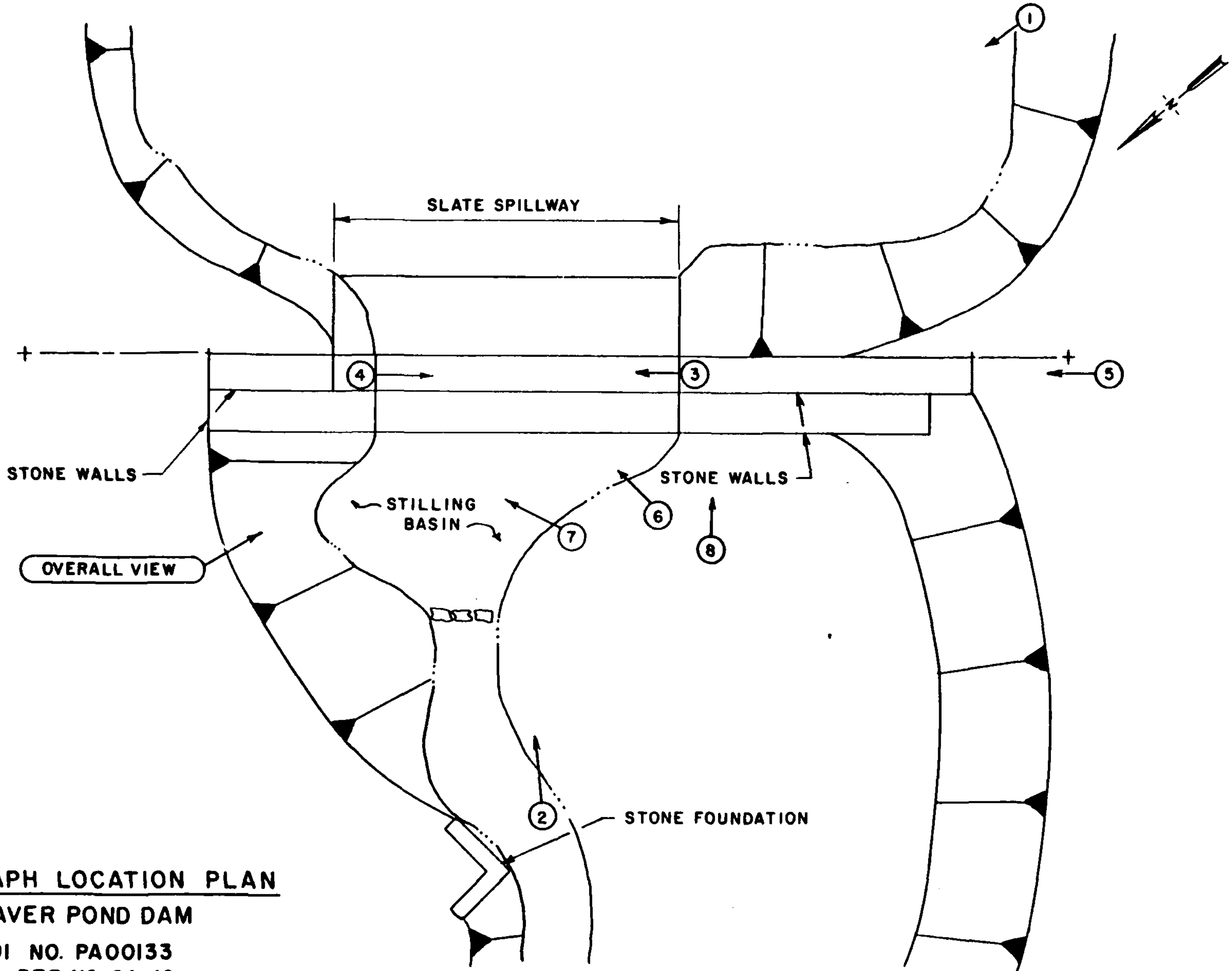
Photo 5 - View of Crest of Dam from Left Abutment

Photo 6 - Downstream View of Spillway

Photo 7 - Downstream View of Right Half of Dam

Photo 8 - Downstream View of Left Half of Dam

Note: Photographs were taken on 28 October 1980.



PHOTOGRAPH LOCATION PLAN

BEAVER POND DAM

NDI NO. PA00133
PennDER NO. 64-19
Photographs Taken 28 October 1980

BEAVER POND DAM

PHOTO 1. View of Dam from Upstream Shoreline

PHOTO 2. View of Dam from Downstream Channel

BEAVER POND DAM

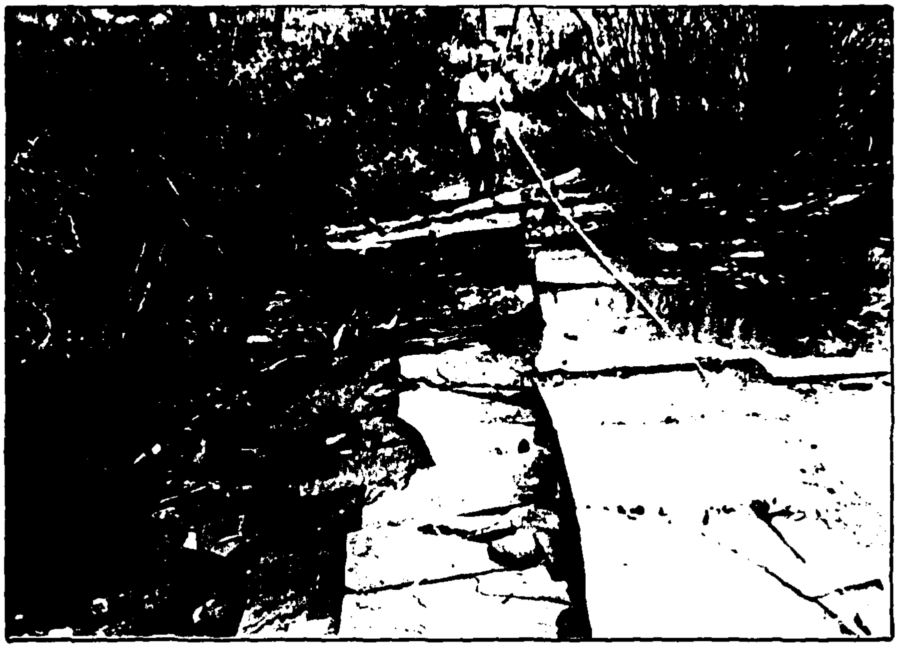


PHOTO 3. View Across Dam Towards Right Abutment

PHOTO 4. View Across Dam Towards Left Abutment

BEAVER POND DAM

PHOTO 5. View of Crest of Dam from Left Abutment

PHOTO 6. Downstream View of Spillway

BEAVER POND DAM

PHOTO 7. Downstream View of Right Half of Dam

PHOTO 8. Downstream View of Left Half of Dam

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject BEAVER POND DAM S.O. No. ____
APPENDIX D - HYDROLOGIC AND HYDRAULIC CALCULATIONS Sheet No. ____ of ____
Drawing No. ____
Computed by ____ Checked by ____ Date ____

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 variations 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.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: BEAVER POND DAM

100-YEAR STORM = 6.4 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	UNNAMED DAM LOCATED 900 ft. DOWNSTREAM FROM ISLAND LAKE	BEAVER POND DAM			
Drainage Area (square miles)	1.64	3.75			
Cumulative Drainage Area (square miles)	1.64	5.39			
Adjustment of PMF for Drainage Area (%)[1] 6 Hours 12 Hours 24 Hours 48 Hours 72 Hours	100-YEAR STORM DISTRIBUTION ON SHEET 6	100-YEAR STORM DISTRIBUTION ON SHEET 6			
Snyder Hydrograph Parameters					
Zone [2]	11 A	11 A			
C_p/C_t [3]	0.62/1.50	0.62/1.50			
L (miles) [4]	1.00	3.37			
L_{ca} (miles) [4]	.62	1.17			
$t_p = C_t\ (L \cdot L_{ca})^{0.3}$ (hours)	1.30	2.26			
Spillway Data					
Crest Length (ft)	56	42			
Freeboard (ft)	0	3.1			
Discharge Coefficient	3.08	SPILLWAY DISCHARGE RATING DEVELOPED ON SHEET 5			
Exponent	1.5				

(1) Technical Paper No. 40, Cooperative Studies Section, U.S. Weather Bureau, Washington, D.C., 1961.

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

(3) Snyder's Coefficients.

(4) L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

STORAGE CALCULATIONS

AREA VS. ELEVATION DATA (MEASURED FROM QUAD.)

ELEVATION (FT.)	SURFACE AREA (ACRES)
1618.2	28.47
1620	36.73
1640	58.77

NORMAL POOL STORAGE

STORAGE VOLUME = $V_{NP} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$

h = ESTIMATED AVERAGE DEPTH 6.8 FT.
A_1 = SURFACE AREA OF NORMAL POOL = 28.47 AC.
A_2 = SURFACE AREA OF RESERVOIR BOTTOM = 23.62 AC.
(ESTIMATED FROM AVERAGE DEPTH AND RESERVOIR SIDE SLOPES)

NORMAL POOL STORAGE = $V_{NP} = \frac{6.8}{3}\left(28.47 + 23.62 + \sqrt{(28.47)(23.62)}\right)$

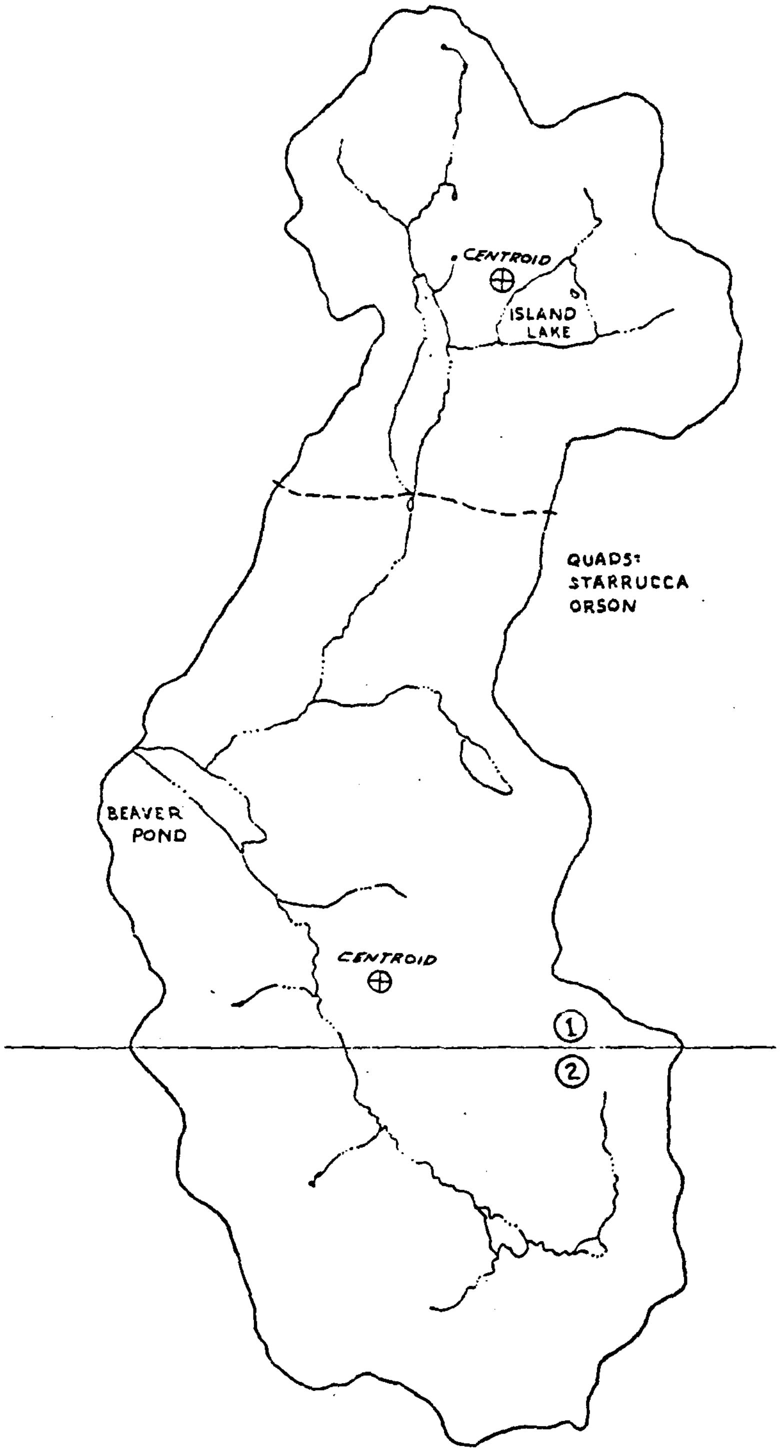
V_{NP} = 176.85 AC.-FT.

TOP OF DAM STORAGE

274 AC.-FT. (FROM HEC-1 ANALYSIS)

DRAINAGE AREA

UPSTREAM DAM	1.64 SQ. MI.
BEAVER POND	3.75 SQ. MI.
TOTAL DRAINAGE AREA	5.39 SQ. MI.



BEAVER POND:
DRAINAGE AREA AND
CENTROID MAP

0 2000 4000 6000

SCALE: 1" APP 3000'

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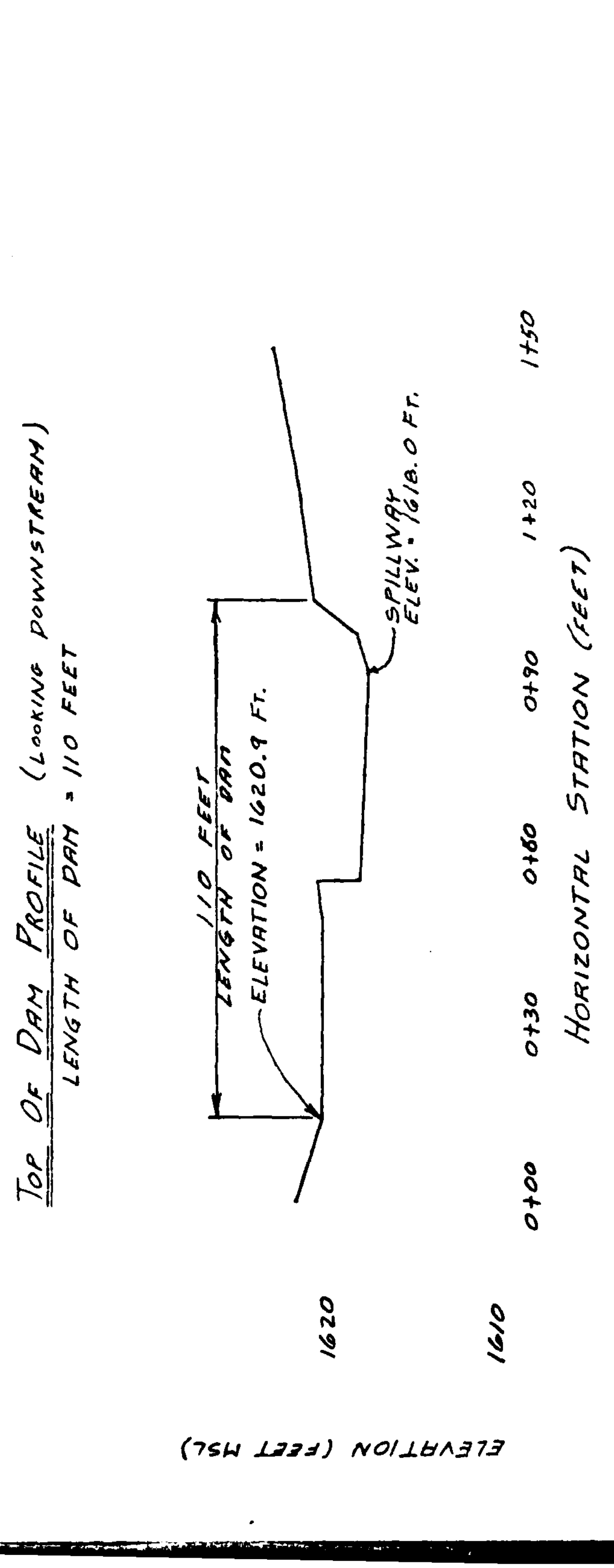
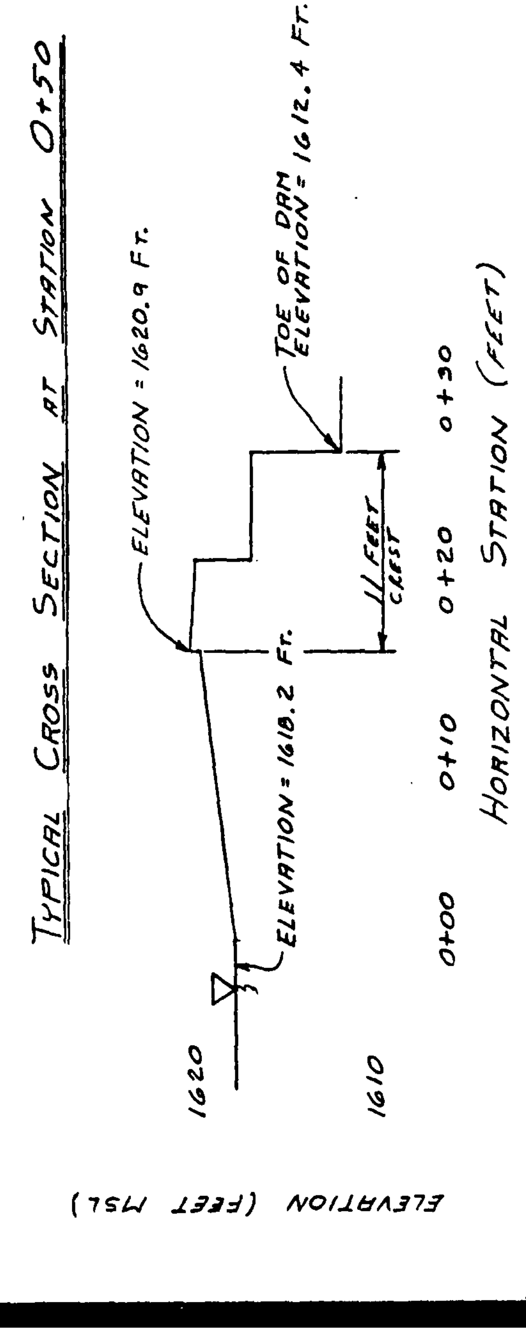
Beaver, Pa. 15009

Subject BEAVER POND DAM S.O. No. 13837-00-ACA-17
TOP OF DAM PROFILE Sheet No. 4 of 18
TYPICAL CROSS SECTION Drawing No.
Computed by GWT Checked by Date 11-18-80





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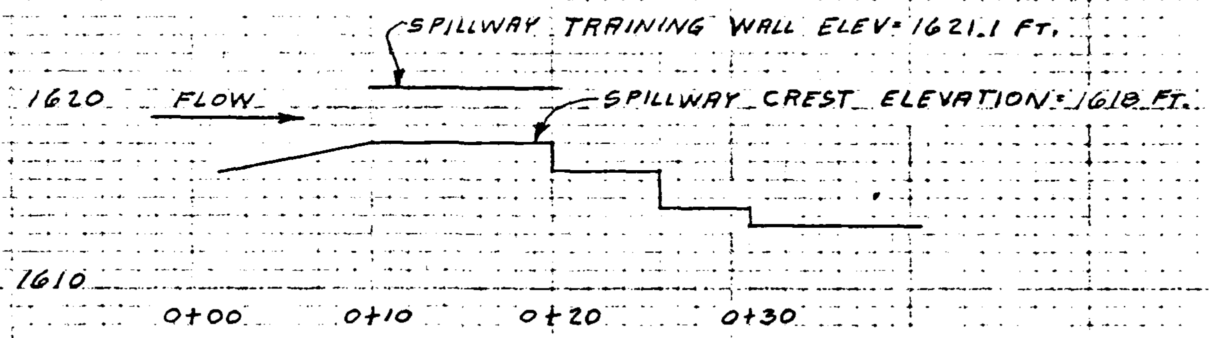
Subject: BEAVER POND DAM
SPILLWAY DISCHARGE RATING

S.O. No. 13837-00-[illegible]-17
Sheet No. 5 of 18
Drawing No.

Computed by: GWT   Checked by: WDC   Date: 11-21-80

SPILLWAY PROFILE



DEVELOP RATING CURVE BASED UPON CRITICAL FLOW OVER SPILLWAY:

$V = \sqrt{gD}$ (CHOW, OPEN CHANNEL HYDRAULICS, P. 43)

D = MEAN HYDRAULIC DEPTH = $\frac{\text{FLOW AREA}}{\text{FREE SURFACE TOP WIDTH}} = \frac{A}{T}$

$g = 32.2$ FT/SEC^2

V = MEAN FLOW VELOCITY

$Q = VA$

SPILLWAY ELEV. FT.	FLOW DEPTH, FT.	AREA FT.^{2}	TOP WIDTH, FT.	A/T	V, FT/SEC	Q, CFS	$V^2/2g$	RESERVOIR SURFACE, FT.
1618.0	0	0	0	0	0	0	0	1618.0
1618.5	0.5	10.5	42.0	0.25	2.84	29.79	0.13	1618.63
1618.8	0.8	23.7	44.0	0.54	4.17	98.83	0.27	1619.07
1619.0	1.0	32.6	44.5	0.73	4.85	158.05	0.37	1619.37
1619.5	1.5	55.85	46.5	1.20	6.22	347.17	0.60	1620.10
1620.0	2.0	79.35	47.0	1.69	7.38	585.35	0.85	1620.85
1620.5	2.5	103.35	48.0	2.15	8.32	859.92	1.07	1621.57
1621.0	3.0	128.10	49.5	2.59	9.13	1,169.84	1.29	1622.29
1621.1	3.1	133.05	49.5	2.69	9.31	1,238.28	1.35	1622.45
1621.5	3.5	157.80	49.5	3.19	10.13	1,599.30	1.59	1623.09
1622.0	4.0	182.55	49.5	3.69	10.90	1,989.86	1.84	1623.84
1622.5	4.5	207.30	49.5	4.19	11.62	2,407.88	2.10	1624.60
1623.0	5.0	232.05	49.5	4.69	12.29	2,851.65	2.35	1625.35

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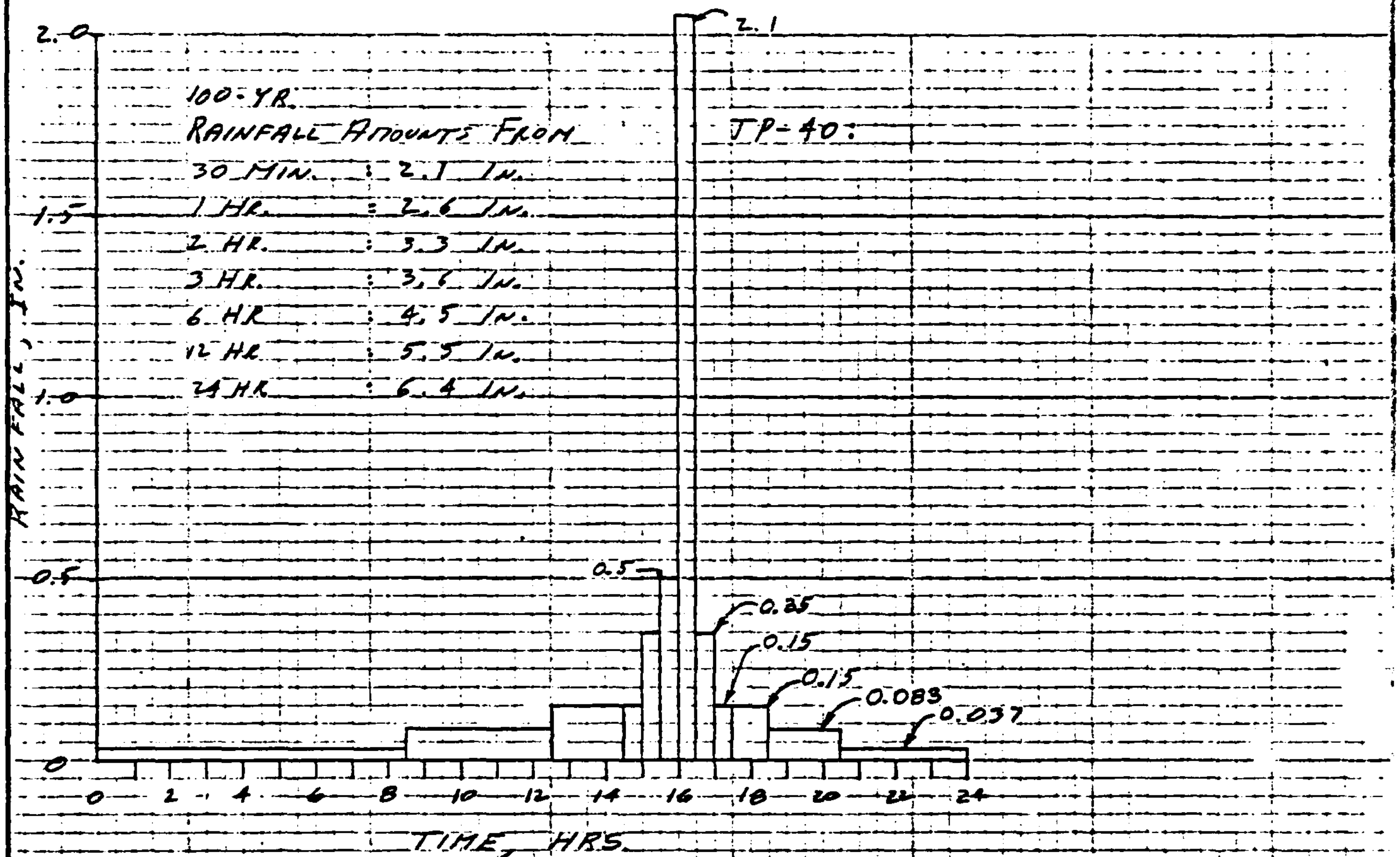
Subject: BEAVER POND DAM
100-YEAR STORM DISTRIBUTION

S.O. No.

Drawing No.

Computed by GWT Checked by WDC Date 11-25-80



RAINFALL DISTRIBUTION:
(30 MINUTE INTERVALS)

INTERVAL NUMBERS	% TOTAL RF OCCURING IN EACH INTERVAL
1-17	0.6
18-25	1.3
26-29	2.3
30	2.3
31	5.4
32	7.8
33	32.8
34	5.4
35	2.3
36-37	2.4
38-41	1.3
42-48	0.6

TOTAL = 100 %

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Subject BEAVER POND DAM S.O. No. ____
100-YEAR DISCHARGE CALCULATION Sheet No. 7 of 18
Drawing No. ____
Computed by GWT Checked by WDL Date 11-25-80

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 3.75 SQ. MI.

① COMPUTE THE MEAN LOGARITHM.

$LOG(Q_m) = C_m + 0.75\ LOG\ A$

$LOG(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS
A = DRAINAGE AREA, SQ. MI. = 3.75 SQ. MI.
C_m = MAP COEFFICIENT FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 = 2.18

$LOG(Q_m) = 2.18 + 0.75(LOG\ 3.75)$
$= 2.6105$

② COMPUTE STANDARD DEVIATION

$S = C_s - 0.05(LOG\ A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.
C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.347
A = DRAINAGE AREA, SQ. MI. = 3.75 SQ. MI.

$S = 0.347 - 0.05(LOG\ 3.75)$
$= 0.3183$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.20

④ $LOG(Q_{100}) = LOG(Q_m) + K(P,g)\ S$

K(P,g) = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$LOG(Q_{100}) = 2.6105 + 2.480(0.3183)$
$\underline{Q_{100} = 2,511.\ CFS}$

USING ZERO LOSS RATES, A PEAK FLOW OF 2717. C.F.S. WAS OBTAINED IN THE HEC-1 ANALYSIS IF THE SNYDER'S UNIT HYDROGRAPH PARAMETERS ORIGINALLY DERIVED FOR THIS BASIN WERE USED. THIS VALUE IS WITHIN 8 PERCENT OF THE PREVIOUSLY COMPUTED VALUE OF 2511. C.F.S. AND IS WITHIN THE 10 PERCENT LIMIT SUGGESTED BY CORPS GUIDELINES.

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 1.64 SQ. MI.

① COMPUTE THE MEAN LOGARITHM.

$LOG(Q_m) = C_m + 0.75\ LOG\ A$

$LOG(Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS

A = DRAINAGE AREA, SQ. MI. = 1.64 SQ. MI.

C_m = MAP COEFFICIENT FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21 = 2.18

$LOG(Q_m) = 2.18 + 0.75\,(LOG\ 1.64)$

$= 2.3411$

② COMPUTE STANDARD DEVIATION

$S = C_S - 0.05\,(LOG\ A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS

C_S = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.347

A = DRAINAGE AREA, SQ. MI. = 1.64 SQ. MI.

$S = 0.347 - 0.05\,(LOG\ 1.64)$

$= 0.3363$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.20

④ $LOG(Q_{100}) = LOG(Q_m) + K(P,g)\,S$

$K(P,g)$ = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$LOG(Q_{100}) = 2.3411 + 2.48\,(0.3363)$

$Q_{100} = 1500$ CFS.

USING AN INITIAL LOSS OF 1.0 INCH AND A CONSTANT LOSS RATE OF 0.05 INCH/HR., A PEAK FLOW OF 1605 CFS. WAS OBTAINED IN THE HEC-1 ANALYSIS IF THE SNYDER'S UNIT HYDROGRAPH PARAMETERS ORIGINALLY DERIVED FOR THIS BASIN WERE USED. THIS VALUE IS WITHIN 7 PERCENT OF THE PREVIOUSLY COMPUTED VALUE OF 1500 CFS. AND IS WITHIN THE 10 PERCENT LIMIT SUGGESTED BY CORPS GUIDELINES.

THE INFLOW TO THE IMPOUNDMENT FOR THE 100-YEAR FLOOD WAS CALCULATED USING MATERIAL FROM "THE HYDROLOGIC STUDY - TROPICAL STORM AGNES" PREPARED BY THE SPECIAL STUDIES BRANCH, PLANNING DIVISION, NORTH ATLANTIC DIVISION, CORPS OF ENGINEERS, IN NEW YORK CITY.

DRAINAGE AREA - 5.39 SQ. MI.

① COMPUTE THE MEAN LOGARITHM

$LOG\ (Q_m) = C_m + 0.75\ LOG A$

$LOG\ (Q_m)$ = MEAN LOGARITHM OF ANNUAL FLOOD PEAKS
A = DRAINAGE AREA, SQ. MI.
C_m = MAP COEFFICIENTS FOR MEAN LOG OF ANNUAL PEAKS FROM FIG. 21

$LOG\ (Q_m) = 2.18 + 0.75\ (LOG\ 5.39)$
$= 2.7287$

② COMPUTE STANDARD DEVIATION

$S = C_s - 0.05\ (LOG\ A)$

S = STANDARD DEVIATION OF THE LOGARITHMS OF THE ANNUAL PEAKS.
C_s = MAP COEFFICIENT FOR STANDARD DEVIATION FROM FIG. 22 = 0.347
A = DRAINAGE AREA, SQ. MI., = 5.39

$S = 0.347 - 0.05\ (LOG\ 5.39)$
$= 0.3104$

③ SELECT SKEW COEFFICIENT FROM FIG. 23 = 0.20

④ $LOG\ (Q_{100}) = LOG\ (Q_m) + K\ (P,g)\ S$

K (P,g) = STANDARD DEVIATE FOR A GIVEN EXCEEDENCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g) FROM EXHIBIT 39 OF BEARD'S "STATISTICAL METHODS IN HYDROLOGY"

$LOG\ (Q_{100}) = 2.7287 + 2.48\ (.3104)$
$Q_{100} = 3150$ CFS

A PEAK INFLOW TO BEAVER POND DAM OF 3699 cfs WAS OBTAINED IN THE HEC-1 DB ANALYSIS. THIS IS WITHIN 15% OF THE CALCULATED 100-YEAR FLOW OF 3150 cfs. THIS LEVEL OF ACCURACY HAS BEEN JUDGED TO BE ACCEPTABLE BY THE BALTIMORE DISTRICT, CORPS OF ENGINEERS, FOR THIS PHASE I INSPECTION REPORT ANALYSIS.

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***********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  MBJ UPDATE         04 JUN 79     100-YEAR  FLOOD  ROUTING
***********************************
      1     A1      NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
      2     A2      HYDROLOGIC AND HYDRAULIC ANALYSIS OF BEAVER POND DAM
      3     A3      UNIT HYDROGRAPH BY SNYDERS METHOD
      4     B     300       0      20       0       0       0       0       0      -4       0
      5     B1      5
      6     J       1       1       1
      7     J1      1
      8     K       0       1                                       1
      9     K1      RUNOFF HYDROGRAPH TO DAM
     10     M       0       1    1.64
     11     O      48     6.4
     12     O1  0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006
     13     O1  0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.013   0.013   0.013
     14     O1  0.013   0.013   0.013   0.013   0.013   0.023   0.023   0.023   0.023   0.023
     15     O1  0.054   0.078   0.328   0.054   0.023   0.024   0.024   0.013   0.013   0.013
     16     O1  0.013   0.006   0.006   0.006   0.006   0.006   0.006   0.006
     17     T                                                     1.0    0.05
     18     W    1.30    0.62
     19     X    -1.5   -0.05     2.0
     20     K       1       2                                       1
     21     K1      ROUTING FOR UPSTREAM DAM
     22     Y                               1       1
     23     Y1      1                                           -1794       0
     24     $A     35      42      70     101
     25     $E   1733    1794    1800    1820
     26     $$   1794     4.0    2.70     1.5
     27     $D1794.5     3.08     1.5      56
     28     $L      0      56      56
     29     $V1794.5  1794.6    1795
     30     K       1       3                                       1
     31     K1      ROUTING THRU CHANNEL TO BEAVER POND
     32     Y                               1       1
     33     Y1      1                                               0
     34     Y6   0.06    0.04    0.06    1735    1760    6700   0.026
     35     Y7      0    1760     100    1740     180    1735     200    1730     205    1730
     36     Y7    225    1735     375    1740     475    1760
     37     K       0       4                                       1
     38     K1      RUNOFF HYDROGRAPH TO BEAVER POND
     39     M       0       1    3.75
     40     O      43     6.4
     41     O1  0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.006
     42     O1  0.006   0.006   0.006   0.006   0.006   0.006   0.006   0.013   0.013   0.013
     43     O1  0.013   0.013   0.013   0.013   0.013   0.023   0.023   0.023   0.023   0.023
     44     O1  0.054   0.078   0.328   0.054   0.023   0.024   0.024   0.013   0.013   0.013
     45     O1  0.013   0.006   0.006   0.006   0.006   0.006   0.006   0.006
     46     T
     47     W    2.26    0.62
     48     X    -1.5   -0.05     2.0
     49     K       2       5                                       1
     50     K1      COMBINE HYDROGRAPHS FROM STATIONS 4 AND 5
```

SHEET 10 OF 18

```
51  K       1       6
52  K1      ROJJING FOR BEAVER POND DAM
53  Y                               1       1
54  Y1      1                                               -1618.0      -1
55  Y4   1618  1618.6  1619.1  1619.4  1620.1  1620.8  1621.6  1622.3  1622.5  1623.1
56  Y41623.8  1624.6  1625.4
57  Y5      0    29.8    98.8   158.0   347.2   585.4   859.9  1169.8  1238.3  1599.3
58  Y51999.9  2407.9  2851.6
59  $A 23.62   28.47   36.73   58.77
60  $E1611.2  1618.2    1620    1640
61  $$  1618
62  $D1620.9    3.08     1.5     110
63  $L      0      40      54      73      83      96     111     118     124     129
64  $V1620.9    1621  1621.5    1622  1622.5    1623  1623.5    1624  1624.5    1625
65  K      99
```

SHEET 11 OF 18

SHEET 12 OF 18

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
   MOJ UPDATE          04 JUN 79
**********************************

RUN  DATE 04/17/81
     TIME    09.59


                              NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                              HYDROLOGIC AND HYDRAULIC ANALYSIS OF BEAVER POND DAM
                              UNIT HYDROGRAPH BY SNYDERS METHOD

                                              JOB SPECIFICATION
                         NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
                        300       0      20       0       0       0       0       0      -4       0
                                                JOPER     NWT   LROPT   TRACE
                                                    5       0       0       0       0

                                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                             NPLAN= 1 NRTIO= 1 LRTIO= 1
                          RTIOS=    1.00


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

                                              SUB-AREA RUNOFF COMPUTATION

                         RUNOFF HYDROGRAPH TO 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
                             0       1     1.64      0.0    1.64     0.0      0.0       0       0       0
                                                          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=  1.30    CP=0.62    NTA=  0

                                                        RECESSION DATA
                                       STRTQ=    -1.50    QRCSN=    -0.05    RTIOR= 2.00

                      UNIT HYDROGRAPH 21 END-OF-PERIOD ORDINATES, LAG=   1.29 HOURS, CP= 0.62  VOL= 1.00
                      57.      205.      380.      494.      483.      387.      291.      218.      164.      123.
                      92.       69.       52.       39.       29.       22.       17.       12.        9.        7.
                       5.

                 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   6.40   4.95   1.45   16644.
```

(163.)(126.)(37.)(471.3))

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

HYDROGRAPH ROUTING

ROUTING FOR UPSTREAM 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	-1794.	0

SURFACE AREA=	35.	42.	70.	101.
CAPACITY=	0.	154.	486.	2187.
ELEVATION=	1790.	1794.	1800.	1820.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1794.0	4.0	2.7	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1794.5	3.1	1.5	56.

CREST LENGTH	0.	56.	56.
AT OR BELOW ELEVATION	1794.5	1794.6	1795.0

PEAK OUTFLOW IS 1015. AT TIME 13.33 HOURS

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

HYDROGRAPH ROUTING

ROUTING THRU CHANNEL TO BEAVER POND

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	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	0.	0

SHEET 13 OF 18

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
0.0600	0.0400	0.0600	1735.0	1760.0	6700.	0.02600

```
CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
    0.0  1760.00   100.00 1740.00   180.00 1735.00   200.00 1730.00   205.00 1739.00
  225.00 1735.00   375.00 1740.00   475.00 1760.00

  STORAGE        0.0       34.66       61.93      101.66      153.44      210.95      271.13      333.97      399.47      467.63
               538.46     611.94      688.09      766.91      848.38      932.52     1019.32     1108.78     1200.91     1295.70

  OUTFLOW        0.0     2931.24     5189.89     8616.15    13538.92    20392.62    28628.56    38194.05    49060.52    61213.56
             74647.63    89363.56   105366.38   122664.19   141267.75   161189.44   182443.00   205043.56   229006.88   254349.50

    STAGE     1735.00     1736.32     1737.63     1738.95     1740.26     1741.58     1742.89     1744.21     1745.53     1746.84
              1748.16     1749.47     1750.79     1752.10     1753.42     1754.74     1756.05     1757.37     1758.68     1760.00

     FLOW        0.0     2931.24     5189.89     8616.15    13538.92    20392.62    28628.56    38194.05    49060.52    61213.56
             74647.63    89363.56   105366.38   122664.19   141267.75   161189.44   182443.00   205043.56   229006.88   254349.50

MAXIMUM STAGE IS    1735.5


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

                                        SUB-AREA RUNOFF COMPUTATION

                      RUNOFF HYDROGRAPH TO BEAVER POND

                              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                  4       0       0       0       0       0       1       0       0

                                                HYDROGRAPH DATA
                      IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                          0       1    3.75     0.0    3.75     0.0     0.0       0       0       0

                                                   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     0.0     0.0     0.0     0.0

                                           UNIT HYDROGRAPH DATA
                                       TP=  2.26     CP=0.62     NTA=  0

                                             RECESSION DATA
                              STRTQ=   -1.50    QRCSN=   -0.05    RTIOR= 2.00

                   UNIT HYDROGRAPH 39 END-OF-PERIOD ORDINATES, LAG=   2.26 HOURS, CP= 0.62  VOL= 1.00
                 35.       133.       259.       403.       536.       629.       671.       647.       571.       489.
                418.       357.       306.       261.       224.       191.       164.       140.       123.       102.
                 88.        75.        64.        55.        47.        40.        34.        29.        25.        21.
                 18.        15.        13.        11.        10.         8.         7.         6.         5.

        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    6.40    6.40    0.0    47571.
                                                                                   ( 163.)( 163.)(   0.)( 1347.06)


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

                                             COMBINE HYDROGRAPHS

                      COMBINE HYDROGRAPHS FROM STATIONS 4 AND 5

                              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
```

SHEET 14 of 18

5 2 0 0 0 0 1 0 0

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

HYDROGRAPH ROUTING

ROUTING FOR BEAVER POND DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	0	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	-1618.	-1

STAGE	1618.00	1618.60	1619.10	1619.40	1620.10	1620.80	1621.60	1622.30	1622.50	1623.10
	1623.80	1624.60	1625.40							
FLOW	0.0	23.80	98.80	158.00	347.20	585.40	859.90	1169.80	1238.30	1599.30
	1989.90	2407.90	2851.60							

SURFACE AREA=	24.	28.	37.	59.
CAPACITY=	0.	182.	241.	1187.
ELEVATION=	1611.	1618.	1620.	1640.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1618.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1620.9	3.1	1.5	110.

CREST LENGTH	0.	43.	54.	73.	83.	96.	111.	118.	124.	129.
AT OR BELOW ELEVATION	1620.9	1621.0	1621.5	1622.0	1622.5	1623.0	1623.5	1624.0	1624.5	1625.0

PEAK OUTFLOW IS 3537. AT TIME 13.67 HOURS

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

SHEET 15 OF 18

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
HYDROGRAPH AT	1	1.64	1	1678.
	(	4.25)	(	47.51)(
ROUTED TO	2	1.64	1	1015.
	(	4.25)	(	28.76)(
ROUTED TO	3	1.64	1	1014.
	(	4.25)	(	28.72)(
HYDROGRAPH AT	4	3.75	1	2717.
	(	9.71)	(	76.94)(
2 COMBINED	5	5.39	1	3699.
	(	13.96)	(	104.73)(
ROUTED TO	6	5.39	1	3537.
	(	13.96)	(	100.16)(

SHEET 16 OF 18

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 *Kestrerm. Dam*

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1794.00	1794.00	1794.50
STORAGE	154.	154.	175.
OUTFLOW	0.	0.	4.

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	1797.64	3.14	335.	1015.	39.33	13.33	0.0

100-YEAR FLOOD ROUTING PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	1014.	1735.5	13.33

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 BEAVER POND DAM

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1618.00	1618.00	1620.90
STORAGE	176.	176.	274.
OUTFLOW	0.	0.	620.

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	1624.17	3.27	403.	3537.	8.67	13.67	0.0

100-YEAR FLOOD ROUTING

APPENDIX E

PLATES

CONTENTS

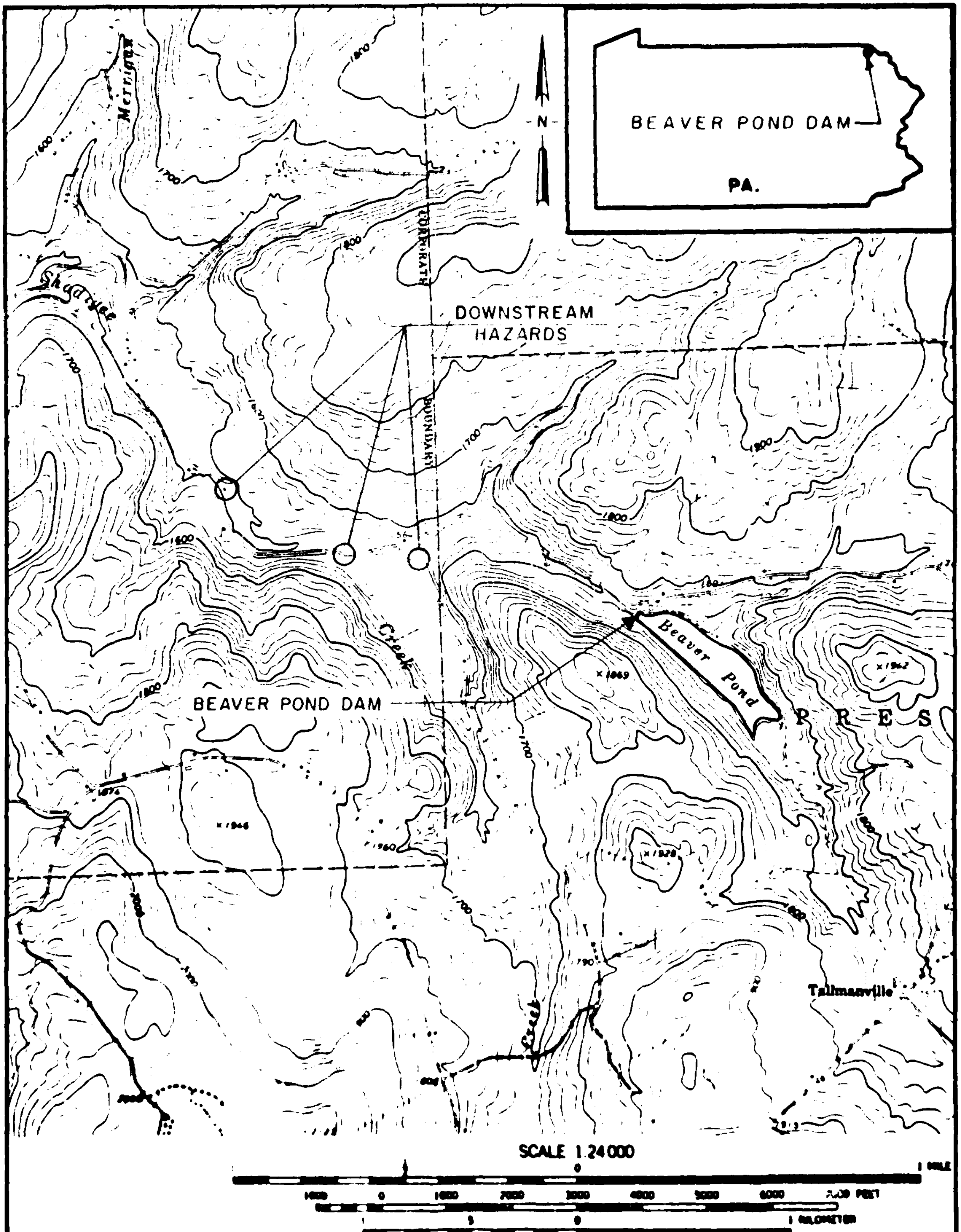
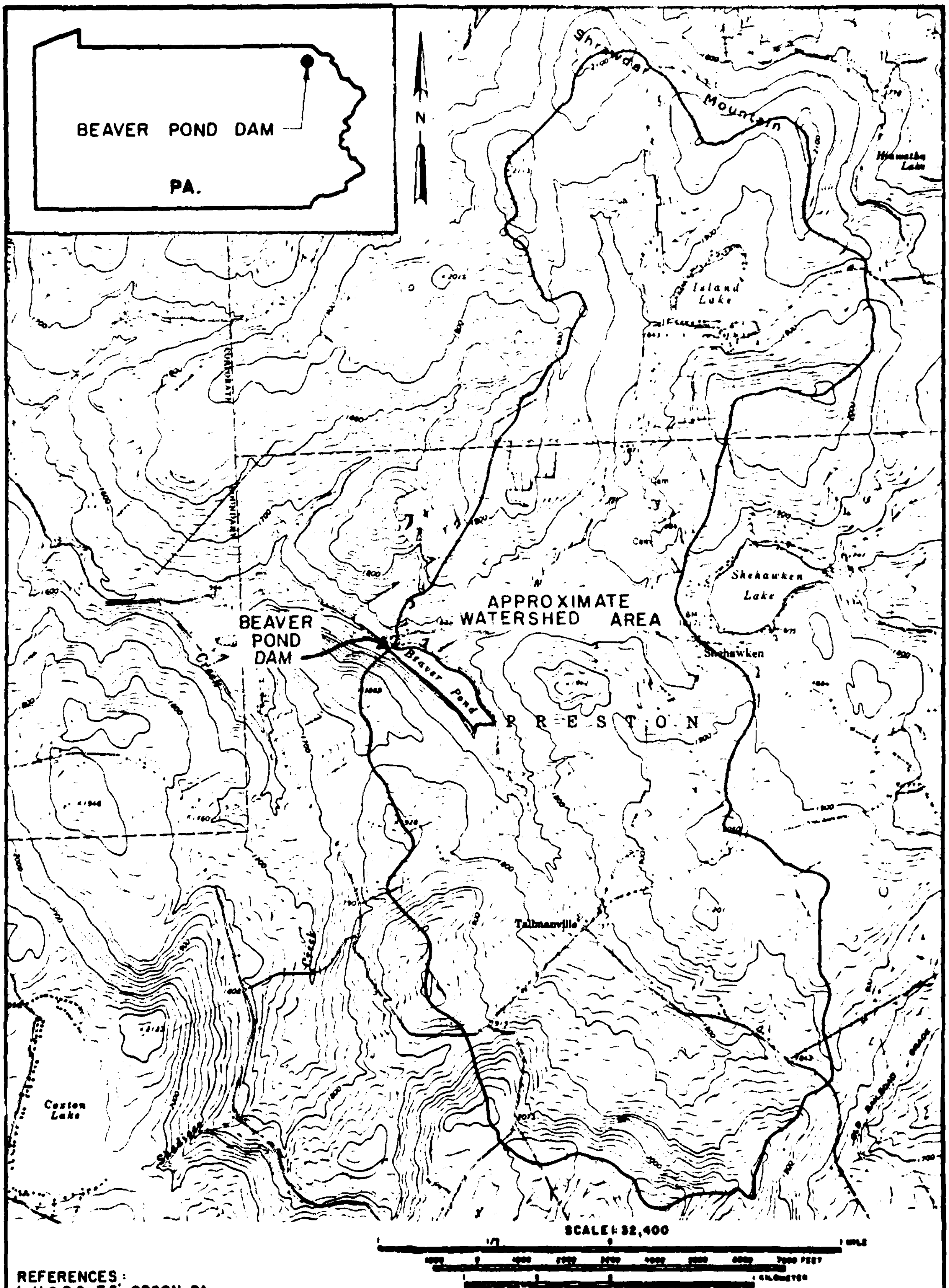


PLATE I LOCATION PLAN

BEAVER POND DAM

REFERENCES

1. U.S.G.S. 7.5' STARRUCCA, PA QUADRANGLE PHOTOREVISED 1978



REFERENCES:
1. U.S.G.S. 7.5' ORSON, PA. QUADRANGLE. PHOTOREVISED 1978
2. U.S.G.S. 7.5' STARRUCCA, PA.-N.Y. QUADRANGLE. PHOTOREVISED 1978

PLATE 2 WATERSHED MAP

BEAVER POND DAM

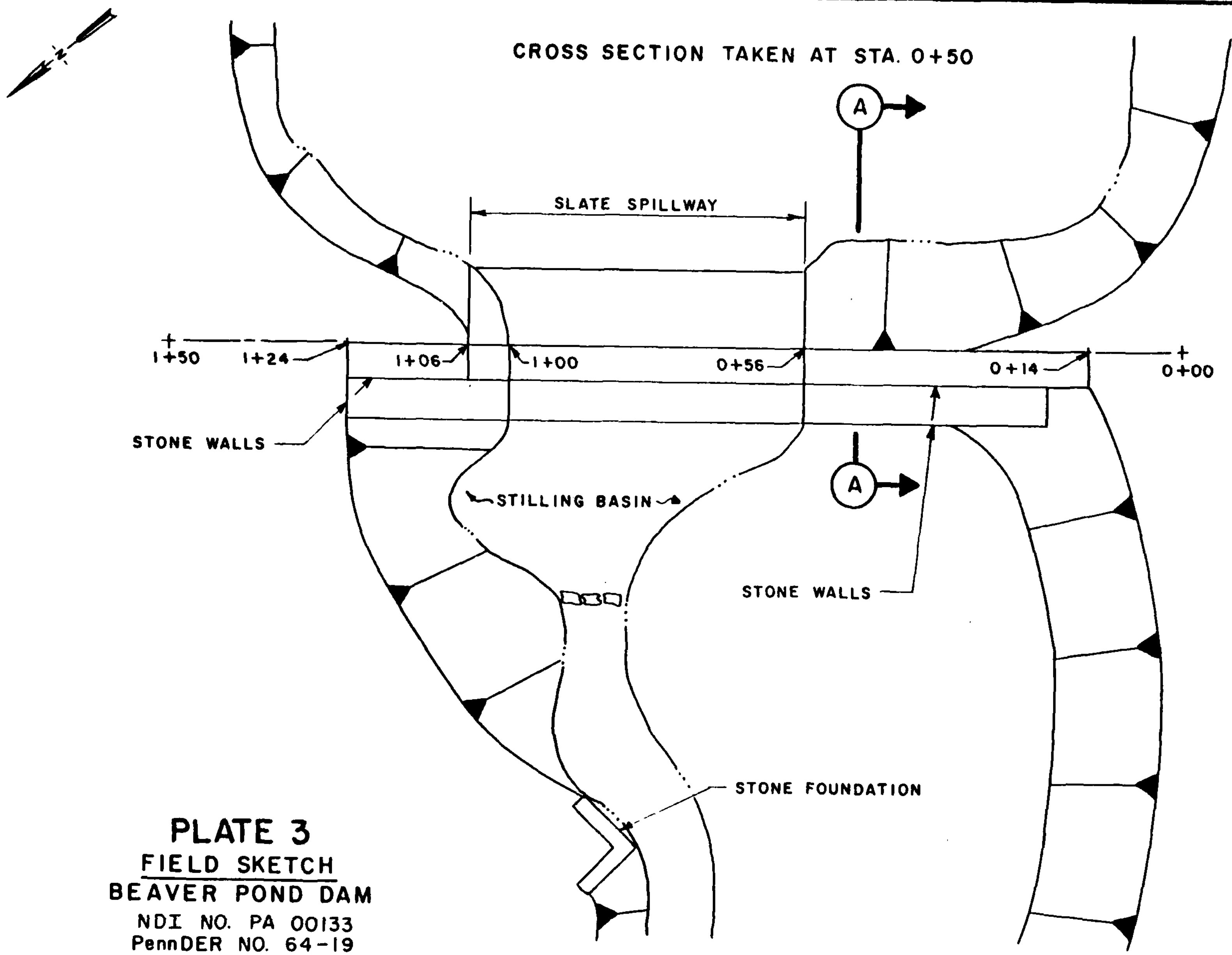


PLATE 3

FIELD SKETCH

BEAVER POND DAM

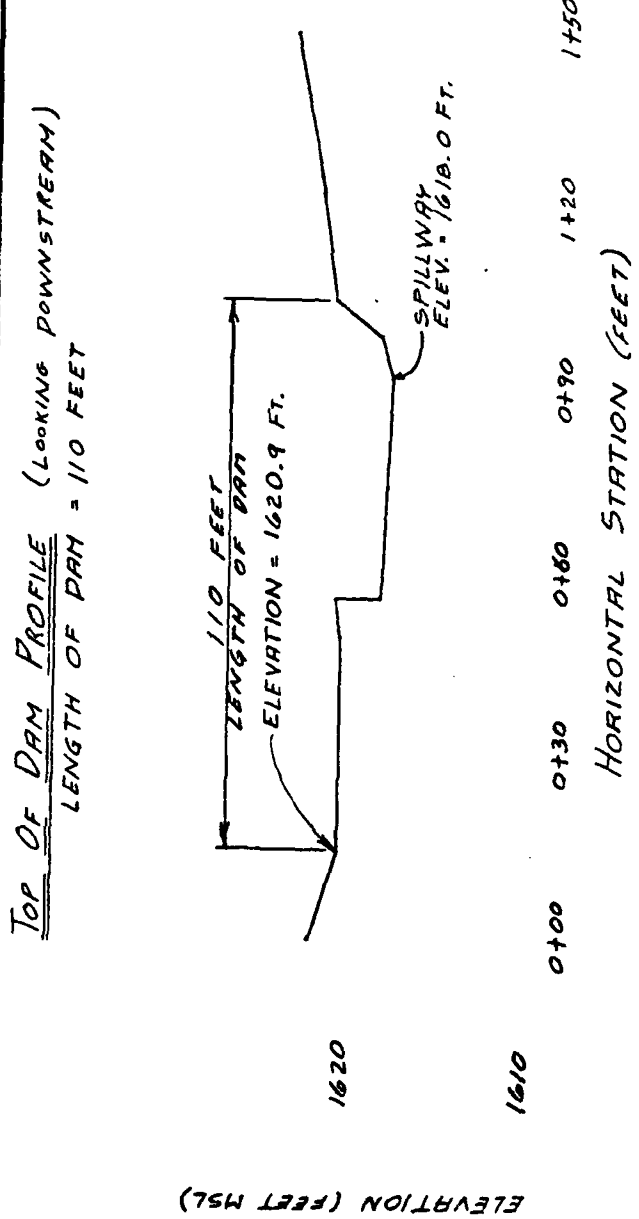
NDI NO. PA 00133

PennDER NO. 64-19

SCHEMATIC - NOT TO SCALE

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009



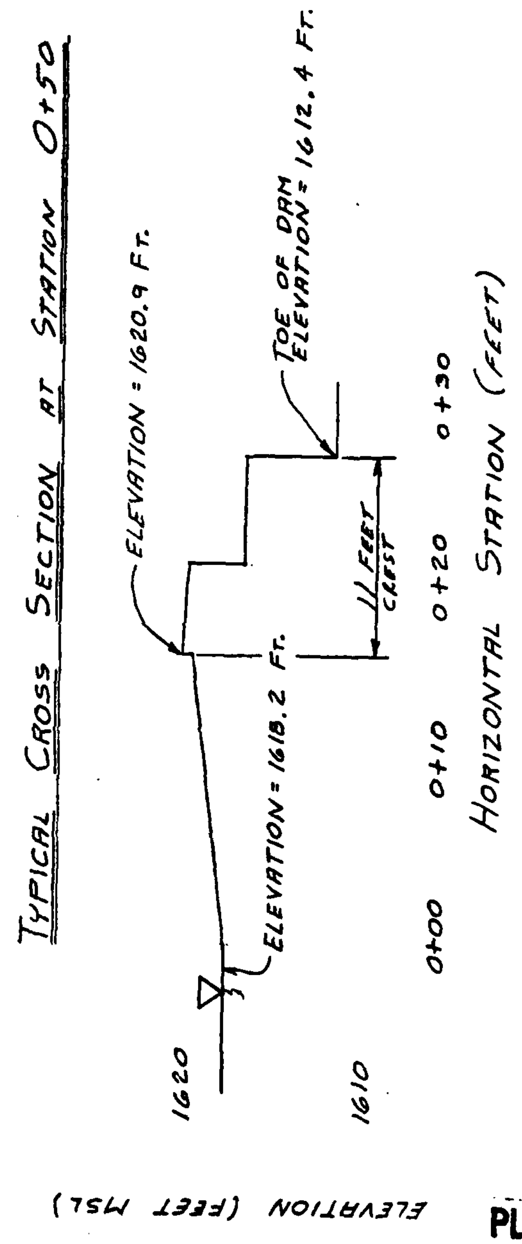


PLATE 4

APPENDIX F

REGIONAL GEOLOGY

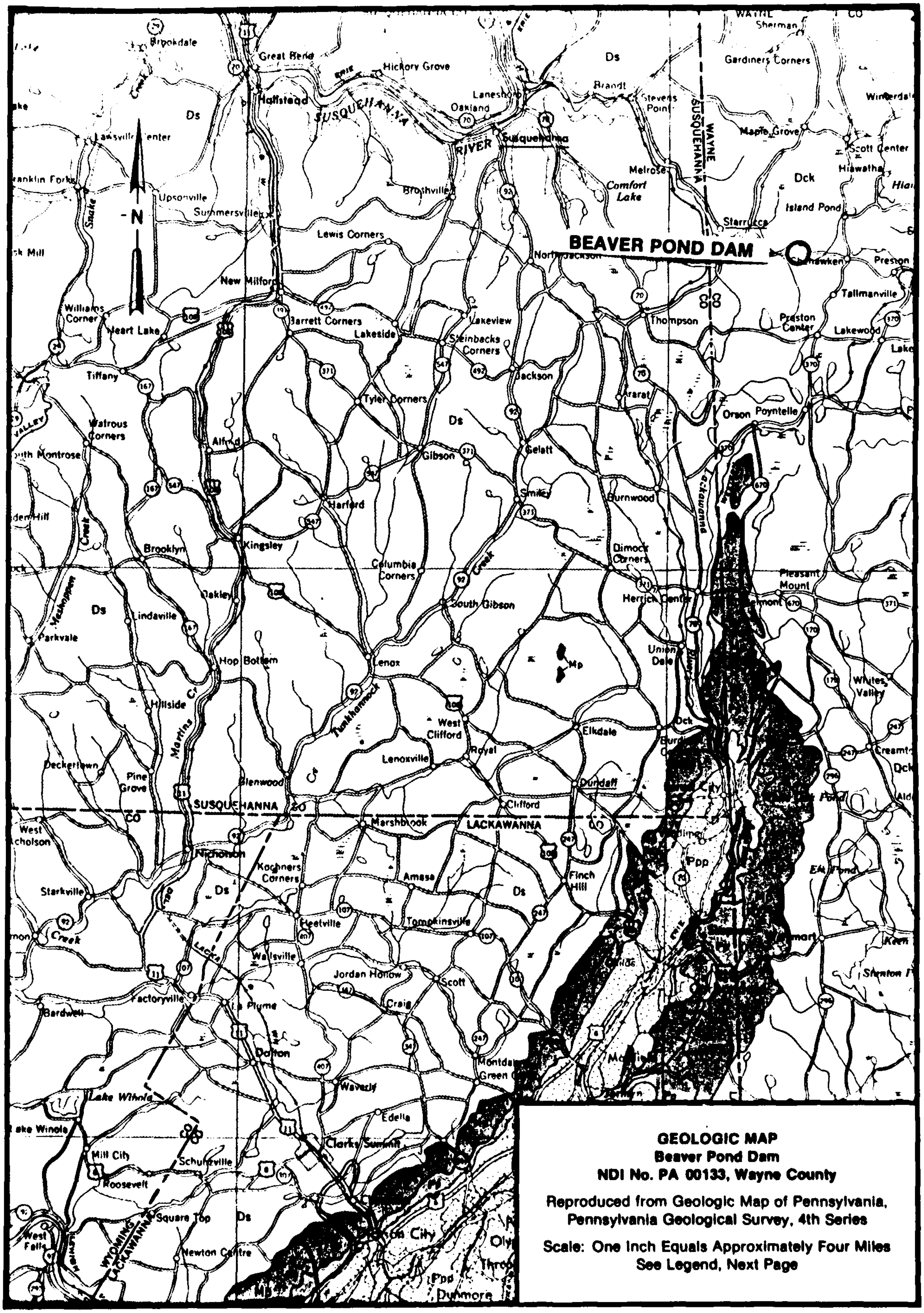
Beaver Pond Dam
NDI No. PA 00133, PennDER No. 64-19

REGIONAL GEOLOGY

Beaver Pond Dam is located in the Glaciated Low Plateaus section of the Appalachian Plateaus physiographic province. Drainage is to the west via Starrucca Creek and average relief in the area is 300 feet. The area has been glaciated at least three times and is presently covered with Wisconsin Stage glacial deposits. According to the Soil Conservation Service's Soil Survey for Wayne County, the surface soils in the vicinity of the dam consist primarily of silt loams on the valley floor and very stoney, silt loams on the valley walls. All soils are of the Volusia series and Oquaga-Lordstown association, respectively. No test borings were available for review, thus, the thickness of the overburden is difficult to ascertain.

Geologic references indicate that the bedrock in the vicinity of the dam consists of members of the Catskill Formation in the Susquehanna Group. The Catskill is composed of bay and delta front, red and gray shales and sandstones of Upper Devonian age. The Formation may also include widely scattered, thin coal seams and scattered fish remains. The strata in the vicinity of the dam remain essentially horizontal after the Appalachian uplift.

C



GEOLOGIC MAP
Beaver Pond Dam
NDI No. PA 00133, Wayne County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania Geological Survey, 4th Series

Scale: One Inch Equals Approximately Four Miles
See Legend, Next Page

GEOLOGY MAP LEGEND

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Oswayo Formation
Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward; considered equivalent to type Oswayo. Riceville Formation Dr in Erie and Crawford Counties; probably not distinguishable north of Corry.

Dcr

Cattaraugus Formation
Red, gray and brown shale and sandstone with the proportion of red decreasing westward, includes Venango sands of drillers and Salamanca sandstone and conglomerate; some limestone in Crawford and Erie counties.

Dct

Conneaut Group
Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" Formations of northwestern Pennsylvania.

Dca

Canadaway Formation
Alternating brown shales and sandstones; includes "Portage" Formation of northwestern Pennsylvania.

CENTRAL AND EASTERN PENNSYLVANIA

Oswayo Formation
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved.

Dck

Catskill Formation
Chiefly red to brownish shales and sandstones, includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

?

Dm

Marine beds
Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.

Ds

Susquehanna Group
Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports; barbs on "Chemung" side of line.

MIDDLE AND LOWER

Dh

Hamilton Group

Mahantango Formation
Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part; contains "Centerfield coral bed" in eastern Pennsylvania.

Marcellus Formation
Black, fissile, carbonaceous shale with thick, brown sandstone (Turkey Ridge) in parts of central Pennsylvania.

Onondaga Formation
Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places; includes Selinsgrove Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Esopus Shale in easternmost Pennsylvania; in Lehigh Gap area includes Palmerton Sandstone and Bowmanstown Chert.

Dmo

Do

Oriskany Formation
White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Ridgeley) at the top; dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver).

Helderberg Formation
Dark gray, calcareous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Becraft Limestone in the east; dark gray, cherty, thin bedded, fossiliferous limestone (New Scotland) with some local sandstones in the middle; and, at the base dark gray, medium to thick bedded, crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules.

DATE

ILME