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BERGER ASSOCIATES INC HARRISBURG PA
NATIONAL DAM INSPECTION PROGRAM. MARKUNAS DAM.
APR 81

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SUSQUEHANNA RIVER BASIN

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River Basin

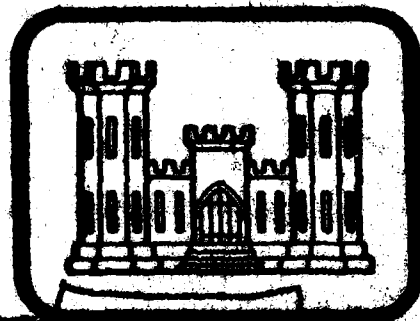
Dam Inspection
MARKUNAS DAM

NDI PA-0114
DER 50-063

PERRY COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



DTIC
ELECTE
MAY 19 1981

DACW 31-RIC-0013
PREPARED FOR

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

BY
Berger Associates
Harrisburg, Pennsylvania 17105

APR 1981

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PREFACE

This report has been 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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Distribution Unlimited

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS
AND RECOMMENDATIONS

Name of Dam: MARKUNAS
State & State No.: PENNSYLVANIA, 50-063
County: PERRY
Stream: UNNAMED TRIBUTARY TO SUSQUEHANNA RIVER
Date of Inspection: November 11, 1980

↓
Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small and the hazard classification is significant. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of the 100 year flood to one-half the Probable Maximum Flood (PMF). The recommended SDF for this structure is the 100 year flood. The spillway capacity is sufficient for passing the SDF peak inflow without overtopping the dam. The spillway, therefore, is considered to be adequate.

↓
The following recommendations are presented for immediate action by the owner. ←

1. That all weeds, brush and trees be removed from the entire embankment including an area 20 feet in width beyond the downstream toe of the dam.
2. That the embankment be maintained on a regular basis to prevent future heavy growth on the slopes.
3. That provisions be made for removal of the stoplogs in the outlet conduit in case of an emergency.
4. That the seepage be observed on a regular basis. If turbidity or an increase in quantity is detected, immediate steps should be taken to correct this condition.
5. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

MARKUNAS DAM NDI NO. PA-01114 DER NO. 50-063

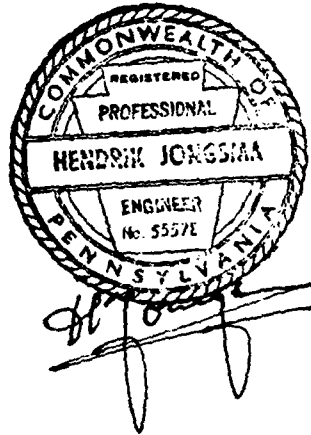
MAUD L. MARKUNAS PERRY COUNTY

6. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: April 3, 1981



APPROVED BY:

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE: 22 APR 81

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OVERVIEW

MARKUNAS DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

MARKUNAS DAM

NDI NO. PA-01114
DER NO. 50-063

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 inspections of dams throughout the United States.

B. Purpose

The purpose of this inspection is to determine if the dam constitutes a hazard to human life and property.

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Note: Normal pool elevation was estimated from the U.S.G.S. Quadrangle sheet at elevation 695.0. This elevation is used in this report as the top of the principal spillway (Photograph No. 4).

Markunas Dam is an earthfill structure with a maximum embankment height of about 25 feet. The reservoir is used for recreation. The length of the embankment is about 310 feet, and the low point of the dam is about 3.7 feet above the principal spillway elevation.

The principal spillway is a 42-inch vertical drop inlet pipe with a 24-inch outlet pipe (Photographs No. 4 and No. 5). It appears that stoplogs close off an opening at the upstream side of the drop inlet. This opening was presumably used during construction as a bypass.

An emergency spillway is located near the right abutment. This grass lined channel has a bottom width of 50 feet and a crest elevation 1.1 feet above the principal spillway. The emergency spillway was apparently excavated in the abutment.

B. Location:

Liverpool Township, Perry County
U.S.G.S. Quadrangle - Millersburg, Pa.
Latitude 40°-36.8', Longitude 76°-58.4'
Appendix E, Plates I & II

- C. Size Classification: Small: Height - 25 feet
Storage - 133 acre-feet
- D. Hazard Classification: Significant (refer to Section 3.1.E.)
- E. Ownership: Mrs. Maud L. Markunas
P.O. Box 88
Dauphin, PA 17018
- F. Purpose: Recreation
- G. Design and Construction History

The present owner stated that the Perry County Soil Conservation Service assisted with the design and construction of the dam. Records of construction are not available. The dam was constructed during the 1960's.

H. Normal Operating Procedures

The dam and reservoir are located on private property. All inflow is discharged through the principal spillway. There are no records indicating that the emergency spillway was ever used.

1.3 PERTINENT DATA

- A. Drainage Area (square miles)
Computed for this report: 0.40
- B. Discharge at Dam Site (cubic feet per second)
See Appendix D for hydraulic calculations.

Maximum known flood (estimated from U.S.G.S. gage data for Bixler Run at nearby Loysville, Pennsylvania) 369

Outlet works at pool Elev. 695 66
Outlet works at low pool Elev. 680 30

Principal spillway capacity at pool Elev. 698.7 (low point of dam) 73

Emergency spillway capacity at pool Elev. 698.7 602
- C. Elevation (feet above mean sea level)
Top of dam (low point) 698.7
Top of dam (design crest) Unknown

Principal spillway crest	695									
Emergency spillway crest	696.1									
Upstream portal invert (estimated)	675									
Downstream portal invert (approximate)	674									
Streambed at downstream toe of dam (estimate)	674									
D. <u>Reservoir</u> (miles)										
Length of normal pool (Elev. 695)	0.3									
Length of maximum pool (Elev. 698.7)	0.5									
E. <u>Storage</u> (acre-feet)										
Principal spillway crest (Elev. 695)	66									
Top of dam (Elev. 698.7)	133									
F. <u>Reservoir Surface</u> (acres)										
Spillway crest (Elev. 695)	9.9									
Top of dam (Elev. 698.7)	29									
G. <u>Dam</u>										
Refer to Plates A-I and A-II in Appendix A for schematic plan and section.										
Type:	Earthfill.									
Length:	310 feet.									
Height:	25 feet.									
Top Width:	Design - Unknown; Survey - 10 feet.									
Side Slopes:	<table border="0"> <thead> <tr> <th></th> <th><u>Design</u></th> <th><u>Surveyed</u></th> </tr> </thead> <tbody> <tr> <td>Upstream</td> <td>Unknown</td> <td>2.7H to 1V</td> </tr> <tr> <td>Downstream</td> <td>Unknown</td> <td>3.4H to 1V</td> </tr> </tbody> </table>		<u>Design</u>	<u>Surveyed</u>	Upstream	Unknown	2.7H to 1V	Downstream	Unknown	3.4H to 1V
	<u>Design</u>	<u>Surveyed</u>								
Upstream	Unknown	2.7H to 1V								
Downstream	Unknown	3.4H to 1V								
Zoning:	Unknown.									
Cutoff:	Unknown.									
Grouting:	Unknown.									

H. Outlet Facilities

Type: 24-inch diameter pipe discharging into the drop inlet structure of the principal spillway.

Closure: Stoplogs in drop inlet structure.

Inlet Elev.: 675 (estimated).

Location: At drop inlet structure near center of dam.

I. Spillway

Principal:

Type: Uncontrolled 42-inch diameter vertical pipe (depth - 20.3 feet) drop inlet with 24-inch diameter outlet pipe.

Location: Near center of dam.

Crest
Elevation: 695

Emergency:

Type: Uncontrolled, sod lined, broad crested weir.

Location: Right abutment.

Crest
Elevation: 696.1

Width: 50 feet on bottom with side slope of 3.2H to 1V on right and irregular slope on left.

J. Regulating Outlets

See Section 1.3.H. above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Engineering design data for Markunas Dam does not exist. Mrs. Markunas, the owner, stated that the general plan for the dam and its appurtenant structures were laid out with the assistance of the local office of the Soil Conservation Service. Drawings were not prepared for the facilities. The original design dam crest elevation is unknown.

2.2 CONSTRUCTION

The dam was constructed in the 1960's. The contractor is unknown. Construction records do not exist. The original construction did not include the screen over the principal spillway.

2.3 OPERATION

Records of operation are not maintained by the owner. Access to the dam is over seldom used dirt trails. Records of maximum pool level are unknown. All inflow is discharged through the principal spillway until the pool level reaches the crest elevation of the emergency spillway.

2.4 EVALUATION

A. Availability

Engineering design and construction data do not exist.

B. Adequacy

Because of the lack of engineering data, the assessment of the dam is based on visual inspection only.

C. Operating Records

Operating records have not been maintained.

D. Post Construction Changes

There are no indications that post construction changes have occurred at these facilities, with the possible exception of placing a screen over the principal spillway. It is unknown whether or not the emergency spillway was included with the original design.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Markunas Dam is fair. The embankment has not been maintained and is overgrown with weeds, brush and small trees. Some seepage is apparent near the right end of the downstream embankment slope. An irregular mound of dirt is located in this area, covering part of the downstream slope.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Photographs of the facilities taken during the inspection are reproduced in Appendix C.

Mrs. Maud Markunas, the owner, accompanied the inspectors on the day of inspection.

B. Embankment

The embankment was constructed on a slightly curved horizontal alignment and butts into natural ground at the left end. The right abutment ends at the emergency spillway, which was excavated into natural ground.

The upstream slope above the normal pool elevation is covered with high weeds, some trees and brush. There were no indications of wave damage or erosion on the slope. The pool level was 2.7 feet below its normal elevation at the time of inspection.

The crest of the dam is about 10 feet wide and is occasionally used by vehicles (Photographs No. 1 and No. 3). There is adequate vegetative cover to prevent erosion.

The downstream slope is overgrown with weeds, brush and small trees, preventing close observation of possible sloughing or unusual movements at the toe of the embankment. An irregular mound of earth was observed near the emergency spillway. This mound had the appearance of a possible slough. However, closer observation and discussion with the owner indicates that this mound was probably created by the excavation of the emergency spillway after the embankment was completed. The excavated material was wasted over the downstream slope. Seepage was detected in this area and also near the outlet pipe (Plate A-I, Appendix A). The amount of seepage was not considered to be serious at the time of inspection.

C. Appurtenant Structures

The principal spillway consists of a 42-inch vertical drop inlet corrugated metal pipe (Photograph No. 4). To prevent clogging of the intake, a metal screen has been placed over the top of the pipe. The clearance of the screen over and around the inlet appears to be adequate to prevent a serious restriction of the opening. The vertical pipe is about 20.5 feet in height and is located about 16 feet upstream from the centerline of the dam. A 24-inch corrugate pipe extending through the embankment provides the outlet of the principal spillway (Photograph No. 5). Water discharges into a small pool at the end of this pipe. It appeared that at the upstream side of the 42-inch vertical pipe, stoplogs closed an opening at the bottom of the inlet. Some water was seeping through these logs. It is assumed that an upstream horizontal pipe was used during construction as a temporary outlet.

An emergency spillway is located in the right abutment. It appears that this spillway was created by excavating natural ground. The approach channel is directly from the reservoir, and the spillway has a wide, flat, sparsely sodded channel which discharges into a downstream wooded area away from the embankment.

D. Reservoir Area

The reservoir area has moderate slopes on the left side consisting of abandoned farm land. The right side of the reservoir consists of steeper wooded slopes. The banks are stable and sedimentation is not expected to be a serious problem.

E. Downstream Channel

The immediate downstream emergency spillway channel is a wooded slope leading to a natural stream channel. The principal spillway discharges directly in the natural, narrow streambed (Photograph No. 6). The stream meanders through woodlands and drops about 400 feet over a length of about 6000 feet before it joins the Susquehanna River. The stream crosses under Route 15 three hundred feet upstream from the river. One house is located close to the stream along Route 15. A potential hazard to life exists downstream if the dam fails; however, possible loss of lives would be less than a few. The hazard category for the Markunas Dam is considered to be "Significant."

3.2 EVALUATION

The overall visual evaluation of the facilities indicates that Markunas Dam is in fair condition. The entire embankment, including slopes, should be cleared of weeds, brush and trees on a regular basis. After clearing of the brush, the seepage should be observed regularly for turbidity and/or increase of flow.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Markunas Dam was constructed for recreational purposes for the private use by the owner. The property has poor access and is used only occasionally. There are no operational procedures. All inflow is discharged through the principal spillway until the pool level reaches the crest of the emergency spillway.

4.2 MAINTENANCE OF DAM

Maintenance of the embankment has not been performed over recent years, resulting in heavy brush and tree growth on the slopes.

4.3 MAINTENANCE OF OPERATING FACILITIES

Operating facilities for this dam are limited to the stoplogs in the bottom of the drop inlet pipe. It would be difficult or nearly impossible to remove these logs in case of an emergency.

4.4 WARNING SYSTEM

There is no formally organized surveillance and downstream warning system in existence at the present time.

4.5 EVALUATION

The operational procedures for Markunas Dam are minimal. It is recommended that the maintenance of the dam should include the removal of weeds, brush and trees on the embankment and in an area 20 feet beyond the downstream toe of the embankment. This maintenance should be provided on a regular basis.

Provisions should be made for removal of the stoplogs in the outlet conduit in the event of an emergency.

A formal surveillance plan and downstream warning system should be developed for implementation during periods of heavy or prolonged precipitation.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

Hydrologic and hydraulic analyses for Markunas Dam do not exist.

B. Experience Data

There are no records of flood levels at Markunas Dam. Based on records of the U.S.G.S. stream gage on Bixler Run at nearby Loysville, Pennsylvania, the maximum inflow to Markunas Dam is estimated to be 369 cfs (June, 1972). This flood was passed without reported difficulties.

C. Visual Observations

No conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event until the dam is overtopped.

D. Overtopping Potential

Markunas Dam has a total storage capacity of 133 acre-feet, and the overall height is 25 feet above the streambed. These dimensions indicate a size classification of "Small." The hazard classification for this dam is "Significant" (see Section 3.1.E.).

The Spillway Design Flood (SDF) for a dam having the above classifications should be in the range of the 100 year flood to one-half the Probable Maximum Flood (PMF). Because of the small size of the dam and the small population downstream, the recommended SDF for this dam is the 100 year flood. For this dam the SDF peak inflow is 436 cfs (see Appendix D for hydraulic calculations).

Comparison of the estimated SDF peak inflow of 436 cfs with the estimated total discharge capacity of 675 cfs indicates that a potential for overtopping of the Markunas Dam does not exist.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam has the necessary storage capacity available to pass the SDF without overtopping. The spillway-reservoir system passes the SDF with about 1.6 feet of freeboard.

E. Spillway Adequacy

Calculations show that the total spillway discharge capacity and reservoir storage capacity, based on the present low point of the

dam profile, can pass the SDF without overtopping the dam (refer to Appendix D).

Since the total spillway discharge and reservoir storage capacity can pass the SDF without overtopping, the spillway is considered to be adequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

The visual inspection of Markunas Dam did not detect any signs of embankment instability. However, the brush and trees on the downstream slope prevented close observation. Some seepage was apparent between the outlet pipe and right abutment. The present overgrown condition and the distribution of the seepage prevented an estimate of quantity and origin. It appeared that the amount was not sufficient to be considered serious. The embankment slopes are considered to be adequate for the height of dam under consideration.

2. Appurtenant Structures

The visual observation of the principal and emergency spillway did not disclose any signs of instability. The exposed outlet pipe is not encased.

B. Design and Construction Data

Design and construction data for this dam do not exist.

C. Operating Records

Operating records for this dam have not been maintained by the owner.

D. Post Construction Changes

Records of post construction changes do not exist. Visual inspection indicates that the screen over the principal spillway was installed after completion of the dam. It appears that excavation of the emergency spillway also occurred after the embankment was completed.

E. Seismic Stability

This dam is located in Seismic Zone 1, and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM SAFETY

A. Safety

The visual inspection indicates that Markunas Dam is in fair condition. The embankment appears to be stable, although the slopes require improved maintenance procedures. The seepage near the right abutment is not considered serious at the present time. This condition should, however, be observed on a regular basis.

The hydrologic and hydraulic computations indicate that the combination of storage capacity and the discharge capacity of the spillway is sufficient to pass the recommended SDF (100 year flood) without overtopping. The spillway is considered to be adequate.

B. Adequacy of Information

The visual inspection is considered to be sufficiently adequate for making a reasonable assessment of this dam.

C. Urgency

The recommendations presented below should be implemented immediately.

D. Additional Studies

Additional studies are not required at this time.

7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of this dam, the following recommendations are presented for implementation by the owner:

1. That all weeds, brush and trees be removed from the entire embankment including an area 20 feet in width beyond the downstream toe of the dam.
2. That the embankment be maintained on a regular basis to prevent future heavy growth on the slopes.
3. That provisions be made for removal of the stoplogs in the outlet conduit in case of an emergency.
4. That the seepage be observed on a regular basis. If turbidity or an increase in quantity is detected, immediate steps should be taken to correct this condition.

5. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.
6. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

APPENDIX A

CHECK LIST OF VISUAL INSPECTION REPORT

APPENDIX A

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 50-063

NDI NO. PA-01114

NAME OF DAM Markunas Dam HAZARD CATEGORY Significant

TYPE OF DAM Earthfill

LOCATION Liverpool TOWNSHIP Perry COUNTY, PENNSYLVANIA

INSPECTION DATE 11/4/80 WEATHER Overcast TEMPERATURE 50's

INSPECTORS: R. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

H. Jongsma

Mrs. Markunas

R. Shireman

A. Bartlett

(Estimated

NORMAL POOL ELEVATION: 695 U.S.G.S.) AT TIME OF INSPECTION: _____

BREAST ELEVATION: 699+ POOL ELEVATION: 692.3

(Principal

SPILLWAY ELEVATION: 695 Spillway) TAILWATER ELEVATION: _____

MAXIMUM RECORDED POOL ELEVATION: Unknown

GENERAL COMMENTS:

The embankment is not maintained and is overgrown with weeds, brush and trees. Present owner is intending to sell property.

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None observed.
B. UNUSUAL MOVEMENT BEYOND TOE	On right side of embankment is a mound of earth which appears to be waste material from excavation of emergency spillway.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	Heavy growth of small trees and brush prevented close inspection. No evidence of distress except as noted above.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal alignment slightly curved. Refer to profile for vertical alignment.
E. RIPRAP FAILURES	No riprap.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Embankment junctions with natural ground appear to be sound.
G. SEEPAGE	Seepage to the right of the 24-inch outlet pipe at several locations around the mound described above.
H. DRAINS	None.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Upstream: some small trees and brush. Crest: cartway - some weeds. Downstream: heavy growth of small trees and brush.

VISUAL INSPECTION
OUTLET WORKS

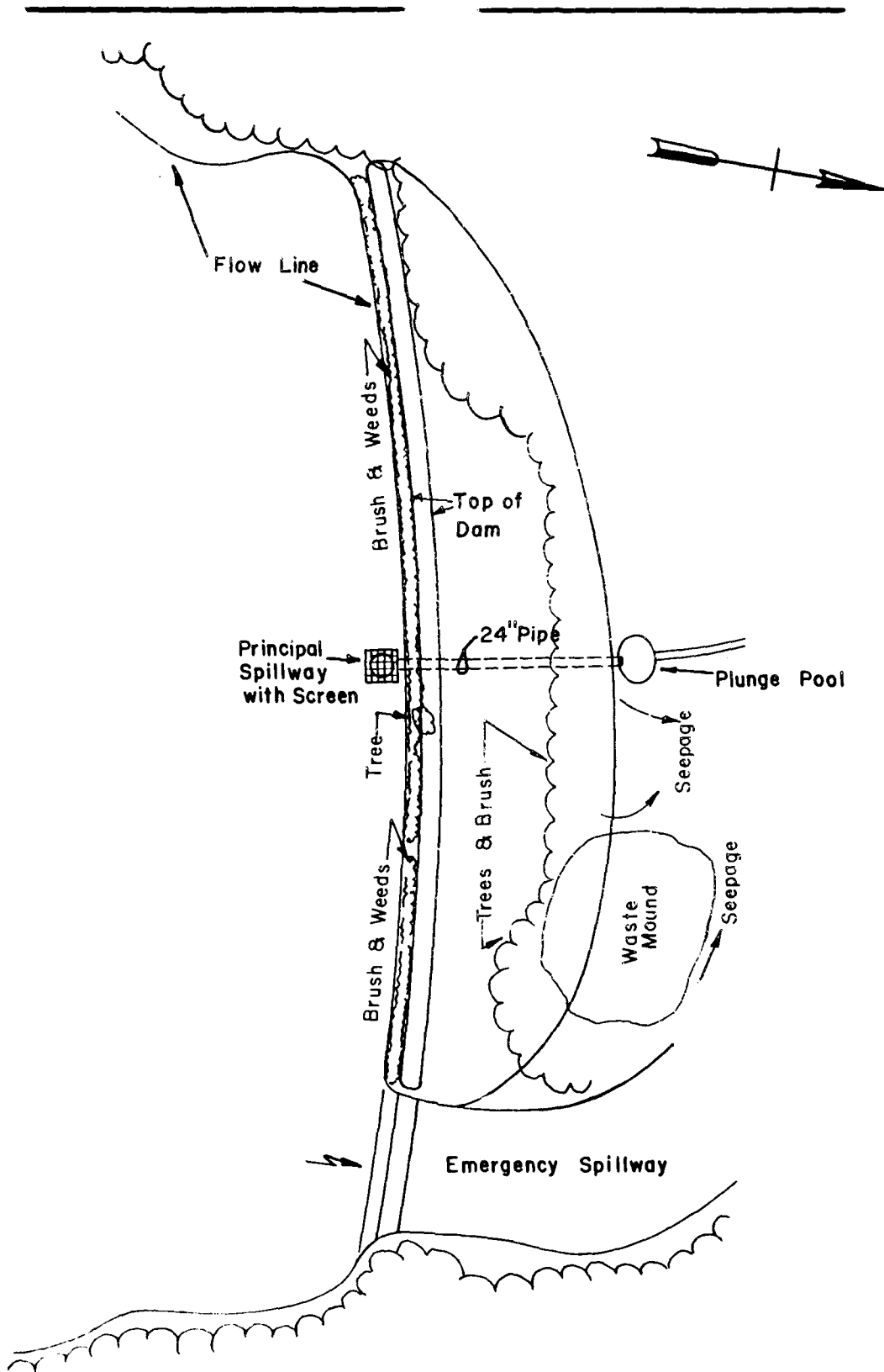
	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Vertical corrugated metal standpipe, 42" dia., 20.3 feet deep. Water seeping in at bottom through stoplogs.
B. OUTLET STRUCTURE	Horizontal CMP 24" dia. discharging into a small excavated plunge pool.
C. OUTLET CHANNEL	Natural mountain stream.
D. GATES	None.
E. EMERGENCY GATE	None, except apparent stoplogs at upstream side of standpipe.
F. OPERATION & CONTROL	None. Direct overflow from reservoir into vertical standpipe.
G. BRIDGE (ACCESS)	None.

VISUAL INSPECTION
SPILLWAY
EMERGENCY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Directly from reservoir.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Excavated earth swale.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Discharges into woodlands toward outlet discharge channel (natural stream).
D. BRIDGE & PIERS	None.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	None.

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
<u>INSTRUMENTATION</u>	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
<u>RESERVOIR</u>	
Slopes	Flat and overgrown cultivated land on left side. Woodlands on slightly steeper slopes (15°-20°) on right side.
Sedimentation	None reported.
Watershed Description	Woodlands and abandoned cultivated land.
<u>DOWNSTREAM CHANNEL</u>	
Condition	Natural mountain stream.
Slopes	15°-20°
Approximate Population	Four.
No. Homes	House at Route 15.



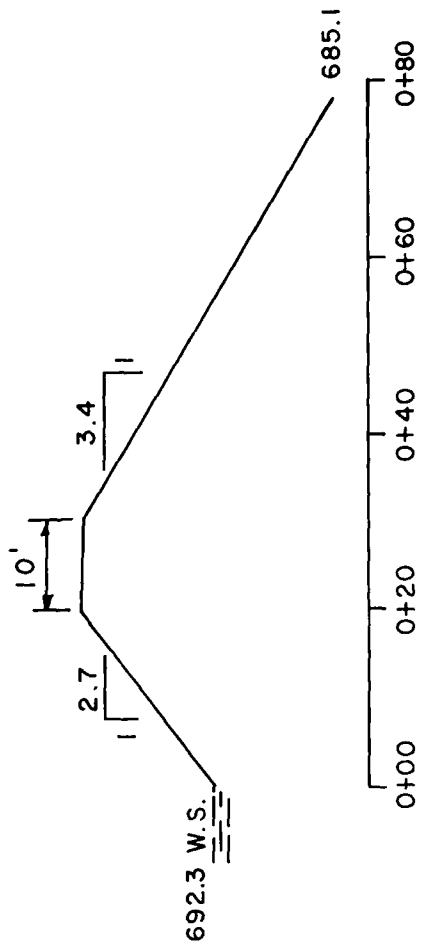
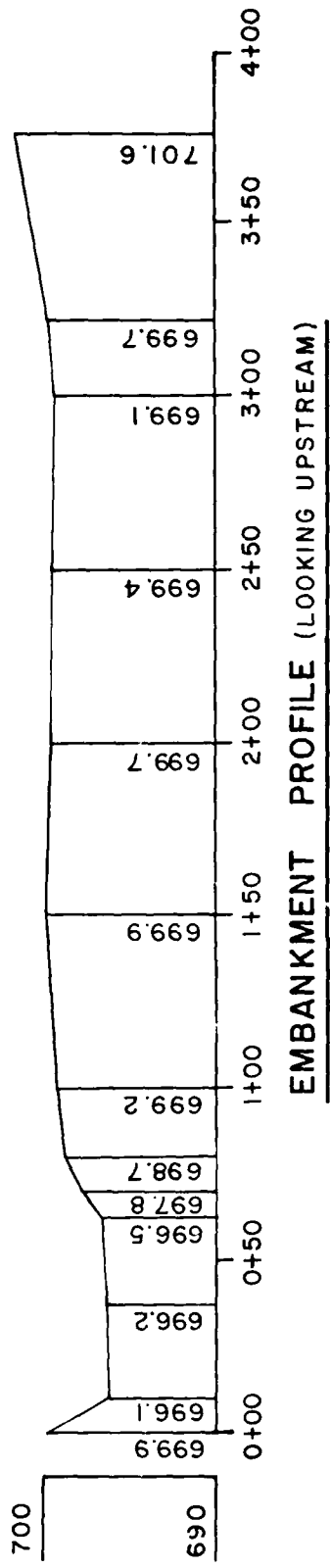
MARKUNAS DAM

PA-01114

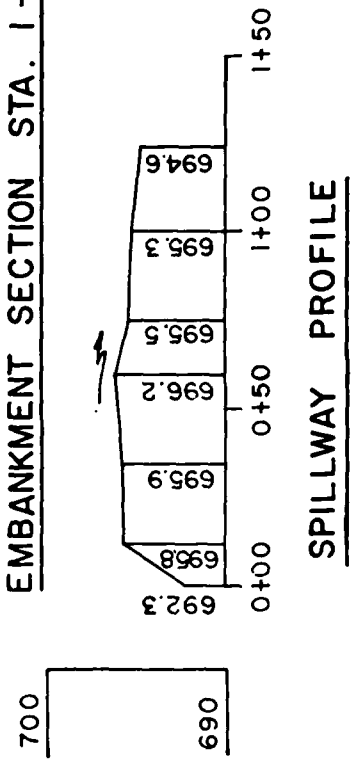
INSPECTION SURVEY

PLATE A-I

SURVEYED 11-4-80



EMBANKMENT SECTION STA. 1+80



SURVEYED 11-4-80

MARKUNAS DAM
PA-01114
INSPECTION SURVEY

PLATE A-II

APPENDIX B
CHECK LIST OF ENGINEERING DATA

APPENDIX B

CHECK LIST
ENGINEERING DATA

PA DER # 50-063

NDI NO. PA-01114

NAME OF DAM Markunas Dam

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Millersburg, Pa. See Plate II, Appendix E
CONSTRUCTION HISTORY	No records.
GENERAL PLAN OF DAM	Not available.
TYPICAL SECTIONS OF DAM	None.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	None.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	No records.
POST CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None recorded.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	No records.
SPILLWAY PLAN, SECTIONS AND DETAILS	None.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	No operating equipment.
CONSTRUCTION RECORDS	No records.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	No records.
MISCELLANEOUS	

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Forest land

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 695 Acre-Feet 66

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 698.7 Acre-Feet 133

MAXIMUM DESIGN POOL: Elev. 698.7 (estimated)

TOP DAM: Elev. 698.7

SPILLWAY:	<u>PRINCIPAL</u>	<u>EMERGENCY</u>
a. Elevation	<u>695</u>	<u>Uncontrolled, sod lined, broad crested weir</u>
b. Type	<u>Drop inlet</u>	
c. Width	<u>42" dia.</u>	<u>50'</u>
d. Length	<u>--</u>	<u>--</u>
e. Location Spillover	<u>Near center of dam</u>	<u>Right abutment</u>
f. Number and Type of Gates	<u>None</u>	<u>None</u>

OUTLET WORKS:

a. Type 24" dia. pipe

b. Location At drop inlet

c. Entrance inverts 675±

d. Exit inverts 674.7

e. Emergency drawdown facilities Stoplogs in drop inlet

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location _____

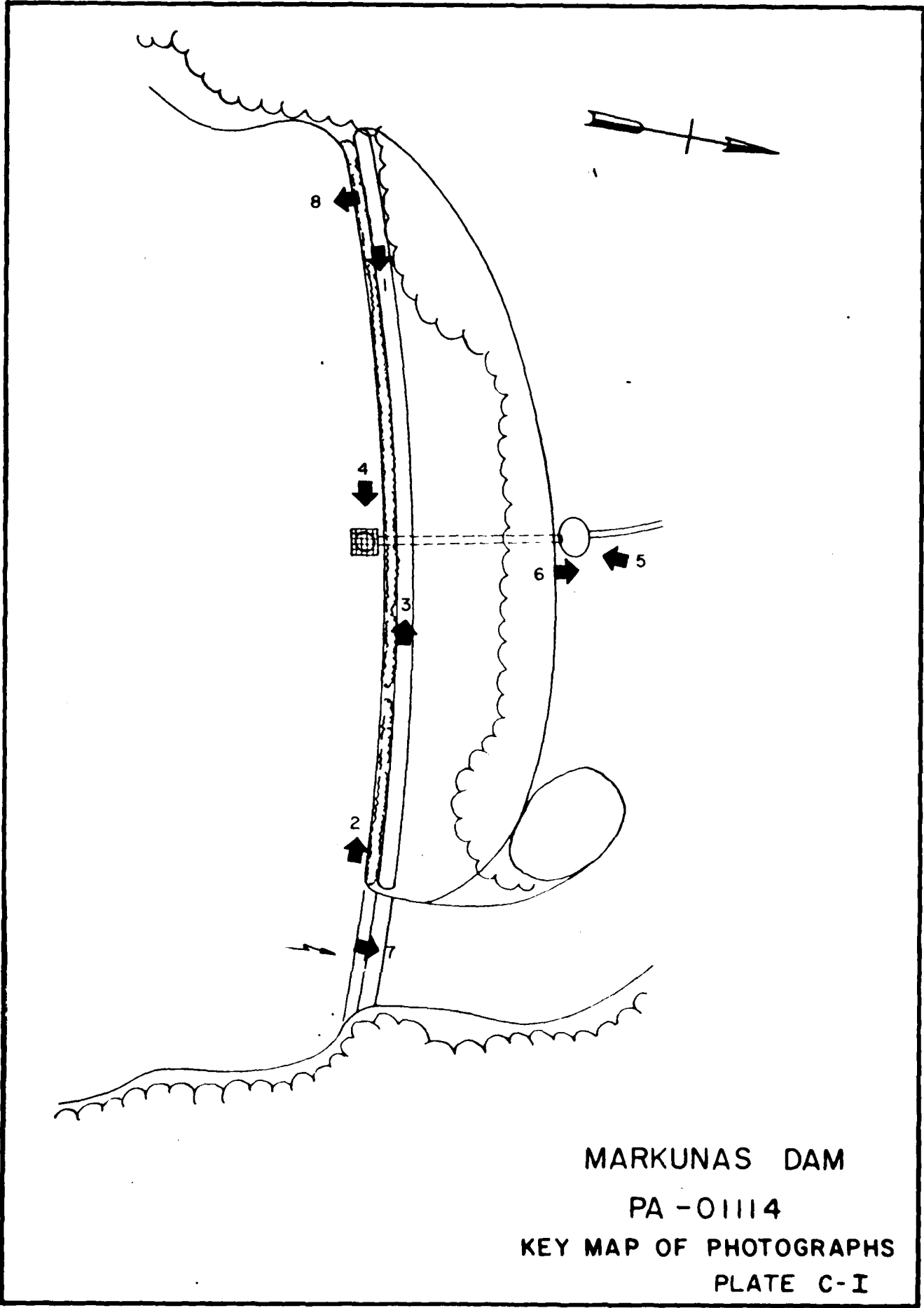
c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: 675 cfs

APPENDIX C

PHOTOGRAPHS

APPENDIX C



MARKUNAS DAM

PA - 01114

KEY MAP OF PHOTOGRAPHS

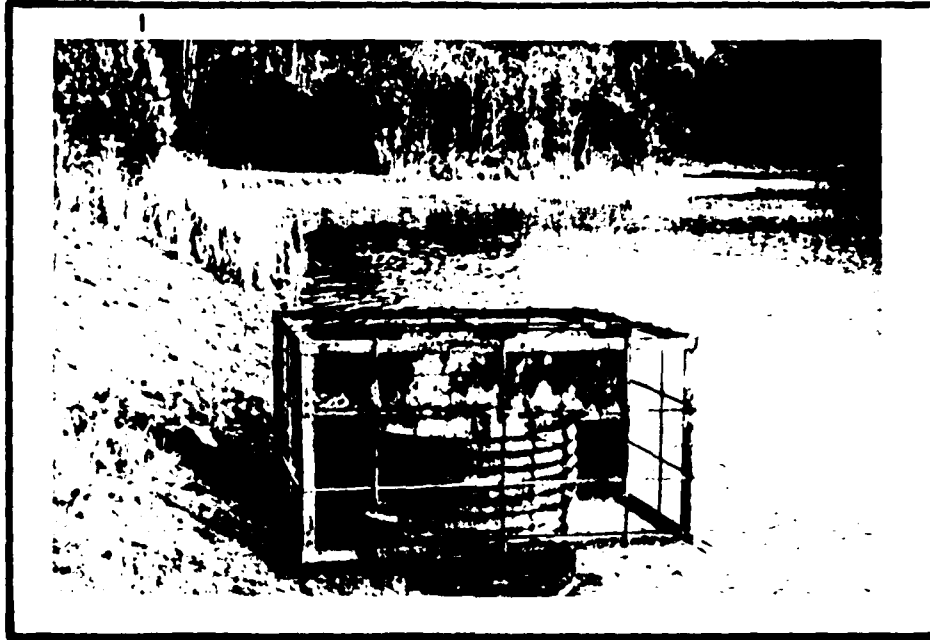
PLATE C-I



UPSTREAM SLOPE AND DROP INLET - NO. 2

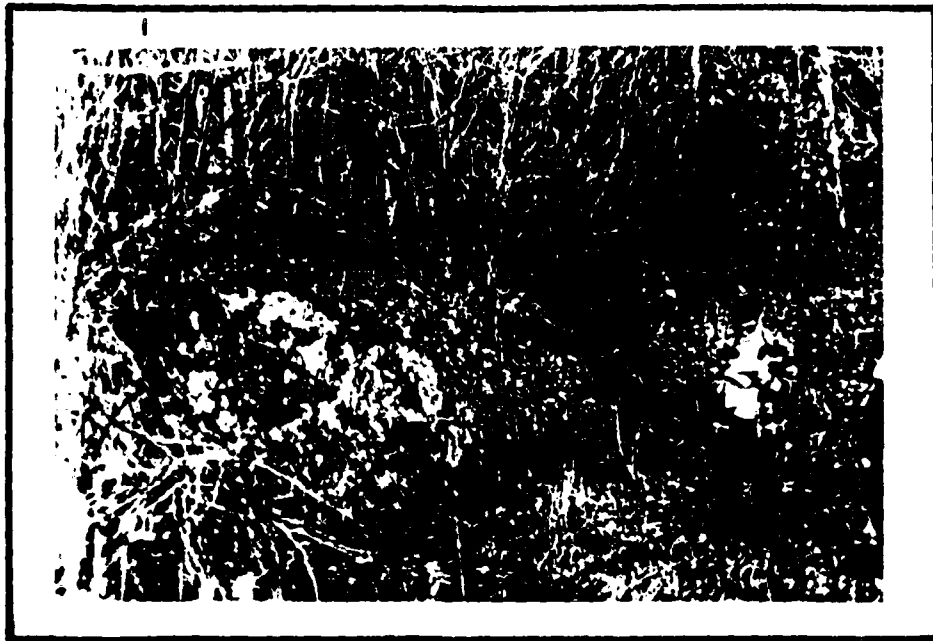


DAM AND DOWNSTREAM SLOPE - NO. 3



DETAIL OF DROP WELL - NO. 4

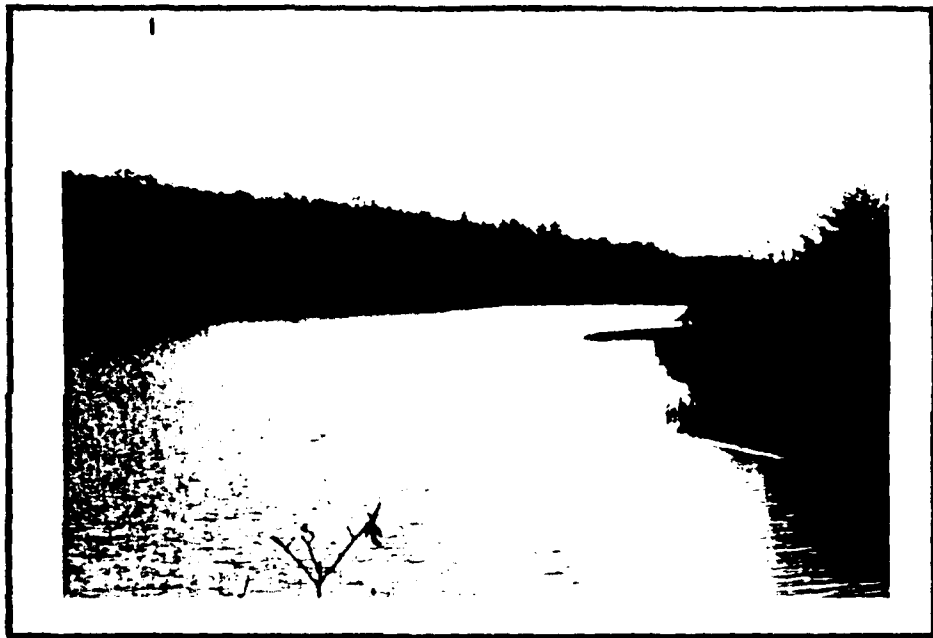




DOWNSTREAM CHANNEL OF OUTLET - NO. 6



EMERGENCY SPILLWAY LOOKING DOWNSTREAM - NO. 7



RESERVOIR - NO. 8

PA-01114
Plate C-V

APPENDIX D
HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

BY RLS DATE 2/5/91
CHKD. BY DATE
SUBJECT

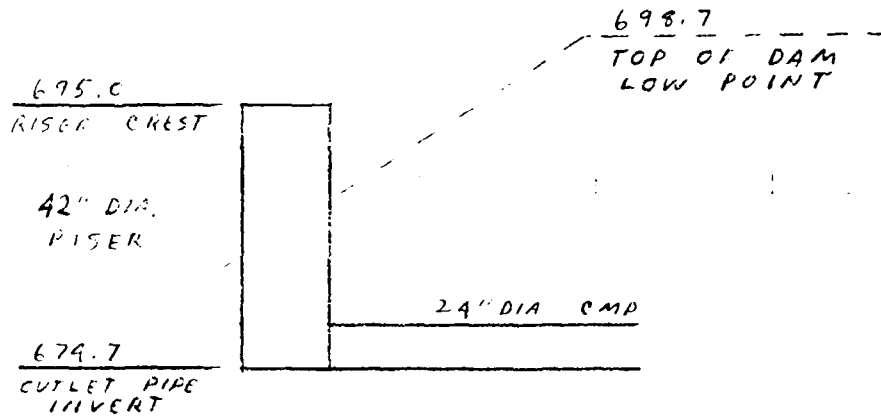
BERGER ASSOCIATES

SHEET NO. 1 OF 1
PROJECT D0590

MARKUNAS DAM

SPILLWAY RATING

PRINCIPAL SPILLWAY



C = 0.6 (KINGS HDBK)

$$Q = CA \sqrt{2gH}$$

$$H = 698.7 - 675.7 = 23'$$

$$Q = 0.6 \times \pi \times \left(\frac{21}{4}\right)^2 \times (2 \times 32.2 \times 23)^{0.5}$$

$$= 73 \text{ CFS}$$

BY RLS DATE 2/5/81
 CHKD. BY _____ DATE _____
 SUBJECT _____

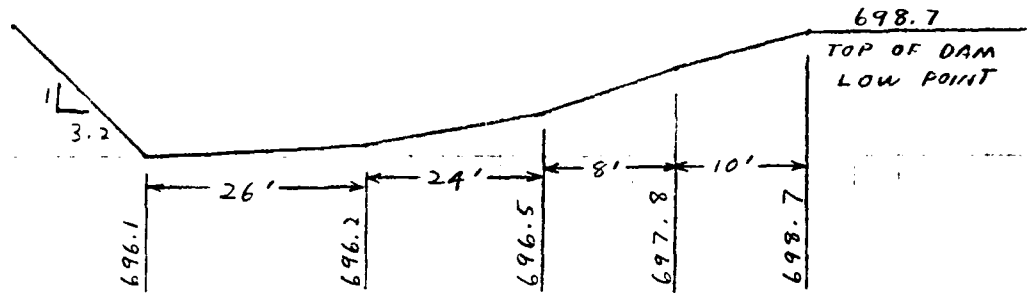
BERGER ASSOCIATES

SHEET NO. 2 OF 10
 PROJECT DO 590

MARKUNAS DAM

SPILLWAY RATING

EMERGENCY SPILLWAY



BROADCRESTED WEIR
 $C = 2.7$ (KINGS HDBK)

$$Q = C L_1 H_1^{3/2} + C L_2 H_2^{3/2} + C L_3 H_3^{3/2} + C L_4 H_4^{3/2} + C L_5 H_5^{3/2}$$

$$L_1 = (698.7 - 696.1) \times 3.2 = 8.3'$$

$$H_1 = (698.7 - 696.1) / 2 = 1.3'$$

$$L_2 = 26'$$

$$H_2 = 698.7 - (696.1 + 696.2) / 2 = 2.55'$$

$$L_3 = 24'$$

$$H_3 = 698.7 - (696.2 + 696.5) / 2 = 2.35'$$

$$L_4 = 8'$$

$$H_4 = 698.7 - (696.5 + 697.8) / 2 = 1.55'$$

$$L_5 = 10'$$

$$H_5 = (698.7 - 697.8) / 2 = .45'$$

$$Q = 2.7 \times ((8.3 \times (1.3)^{1.5}) + (26 \times (2.55)^{1.5}) + (24 \times (2.35)^{1.5}) + (8 \times (1.55)^{1.5}) + (10 \times (.45)^{1.5}))$$

$$= 602 \text{ CFS}$$

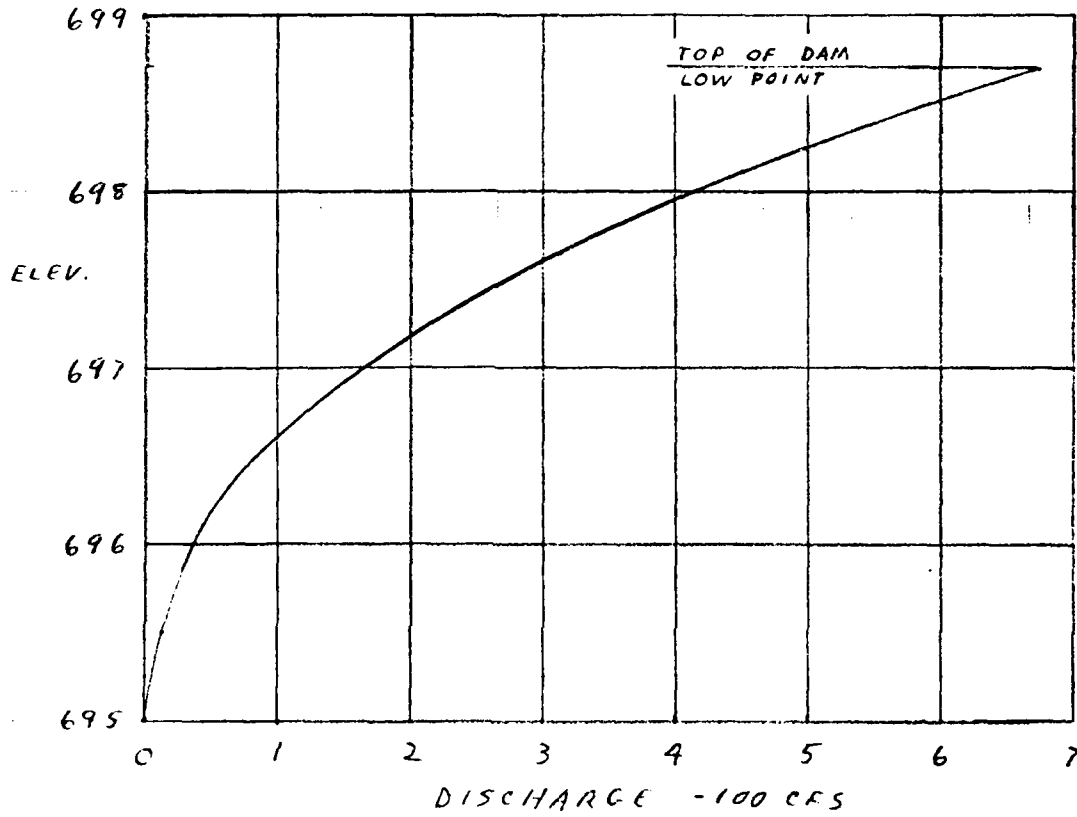
BY RLS DATE 2/5/81
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. 3 OF 10
PROJECT D0590

MARK UNAS DAM

DISCHARGE RATING CURVE



BY RLS DATE 2/5/81

BERGER ASSOCIATES

SHEET NO. A OF 10

CHKD. BY _____ DATE _____

PROJECT 00590

SUBJECT MARKUNAS DAM

DISCHARGE THROUGH OUTLET WORKS

24" DIA. BLOWOFF PIPE

APPROX INVERT ELEV. = 675

C = 0.6 (KINGS HDBK)

$$Q = CA\sqrt{2gH}$$

AT NORMAL POOL LEVEL 695

$$H = 695 - 676 = 19'$$

$$Q = 0.6 \times \pi \times \left(\frac{24}{4}\right)^2 \times (2 \times 32.2 \times 19)^{0.5}$$

$$= 66 \text{ CFS}$$

AT LOW POOL LEVEL 680

$$H = 680 - 676 = 4'$$

$$Q = 0.6 \times \pi \times \left(\frac{24}{4}\right)^2 \times (2 \times 32.2 \times 4)^{0.5}$$

$$= 30 \text{ CFS}$$

BY RLS DATE 2/9/81
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. 5 OF 10
PROJECT D0590

MARKUNAS DAM

EMBANKMENT RATING

$$Q = C L H^{3/2}$$

$$C = 2.7 \text{ (KING'S HOOK)}$$

AT ELEV 699.2

$$2.7 \times 20 \times (.25)^{1.5} = 7$$

$$2.7 \times 20 \times (.05)^{1.5} = 1$$

$$\Sigma = 8 \text{ CFS}$$

AT ELEV 699.5

$$2.7 \times 20 \times (.55)^{1.5} = 22$$

$$2.7 \times 21 \times (.15)^{1.5} = 3$$

$$2.7 \times 17 \times (.05)^{1.5} = 1$$

$$2.7 \times 50 \times (.25)^{1.5} = 17$$

$$2.7 \times 7 \times (.2)^{1.5} = 2$$

$$\Sigma = 45 \text{ CFS}$$

AT ELEV 700

$$2.7 \times 20 \times (1.05)^{1.5} = 58$$

$$2.7 \times 50 \times (.45)^{1.5} = 41$$

$$2.7 \times 50 \times (.2)^{1.5} = 12$$

$$2.7 \times 50 \times (.45)^{1.5} = 41$$

$$2.7 \times 50 \times (.75)^{1.5} = 89$$

$$2.7 \times 20 \times (.6)^{1.5} = 25$$

$$2.7 \times 9 \times (.15)^{1.5} = 1$$

$$\Sigma = 266 \text{ CFS}$$

AT ELEV 700.5

$$2.7 \times 20 \times (1.55)^{1.5} = 104$$

$$2.7 \times 50 \times (.95)^{1.5} = 125$$

$$2.7 \times 50 \times (.7)^{1.5} = 79$$

$$2.7 \times 50 \times (.95)^{1.5} = 125$$

$$2.7 \times 50 \times (1.25)^{1.5} = 189$$

$$2.7 \times 20 \times (1.1)^{1.5} = 62$$

$$2.7 \times 24 \times (.9)^{1.5} = 16$$

$$\Sigma = 700 \text{ CFS}$$

BY RLS DATE 2/6/81
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. 7 OF 10
PROJECT 00590

MARKUNAS DAM

100 YR FLOOD

REF.: "HYDROLOGIC STUDY, TROPICAL STORM AGNES"
NORTH ATLANTIC DIVISION, U.S. ARMY, CORPS OF ENGINEERS.

DRAINAGE AREA = .40 SQ. MI.

$$(FIG. 21) \quad C_m = 1.91$$

$$\begin{aligned} \text{LOG}(Q_m) &= C_m + 0.75 \text{ LOG}(DA) \\ &= 1.91 + 0.75 \text{ LOG}(.4) = 1.612 \end{aligned}$$

$$(FIG. 22) \quad C_s = .362$$

$$\begin{aligned} S &= C_s - 0.05 \text{ LOG}(DA) \\ &= .362 - 0.05 \text{ LOG}(.4) = .382 \end{aligned}$$

$$(FIG. 23) \quad \text{SKEW} = .45$$

$$\text{STANDARD DEVIATE} = K(P, g) = 2.6506$$

$$\text{LOG}(Q(P)) = \text{LOG}(Q_m) + K(P, g) S$$

$$\begin{aligned} \text{LOG}(Q_1) &= 1.612 + (2.6506 \times .382) \\ &= 2.6245 \end{aligned}$$

$$Q_1 = 421 \text{ CFS}$$

BY RLS DATE 2/5/81

BERGER ASSOCIATES

SHEET NO. 6 OF 10

CHKD. BY _____ DATE _____

PROJECT 00590

SUBJECT MARKUNAS DAM

MAXIMUM KNOWN FLOOD AT DAMSITE

THERE ARE NO RECORDS OF FLOOD LEVELS AT THIS DAM. BASED ON RECORDS OF THE STREAM GAGING STATION ON BIXLER RUN AT NEARBY LOYSVILLE PA. (D.A. = 15.0 SQ. MI.) THE MAXIMUM DISCHARGE AT THE GAGE, SINCE CONSTRUCTION OF THE DAM, OCCURRED IN JUNE 1978 WHEN A DISCHARGE OF 6700 CFS WAS RECORDED. THE MAXIMUM INFLOW TO MARKUNAS DAM IS ESTIMATED TO BE:

$$Q = \left(\frac{.40}{15.0} \right)^{0.8} \times 6700$$
$$= 369 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 133 ACRE-FEET

MAXIMUM HEIGHT = 25 FEET

SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

ONE HOUSE LOCATED NEAR THE CHANNEL ABOUT ONE MILE DOWNSTREAM.

USE "SIGNIFICANT"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF IN THE RANGE OF THE 100 YEAR FLOOD TO ONE-HALF THE PROBABLE MAXIMUM FLOOD.

BY RLS DATE 2/6/51
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. 8 OF 10
PROJECT DC590

MARKUNAS DAM

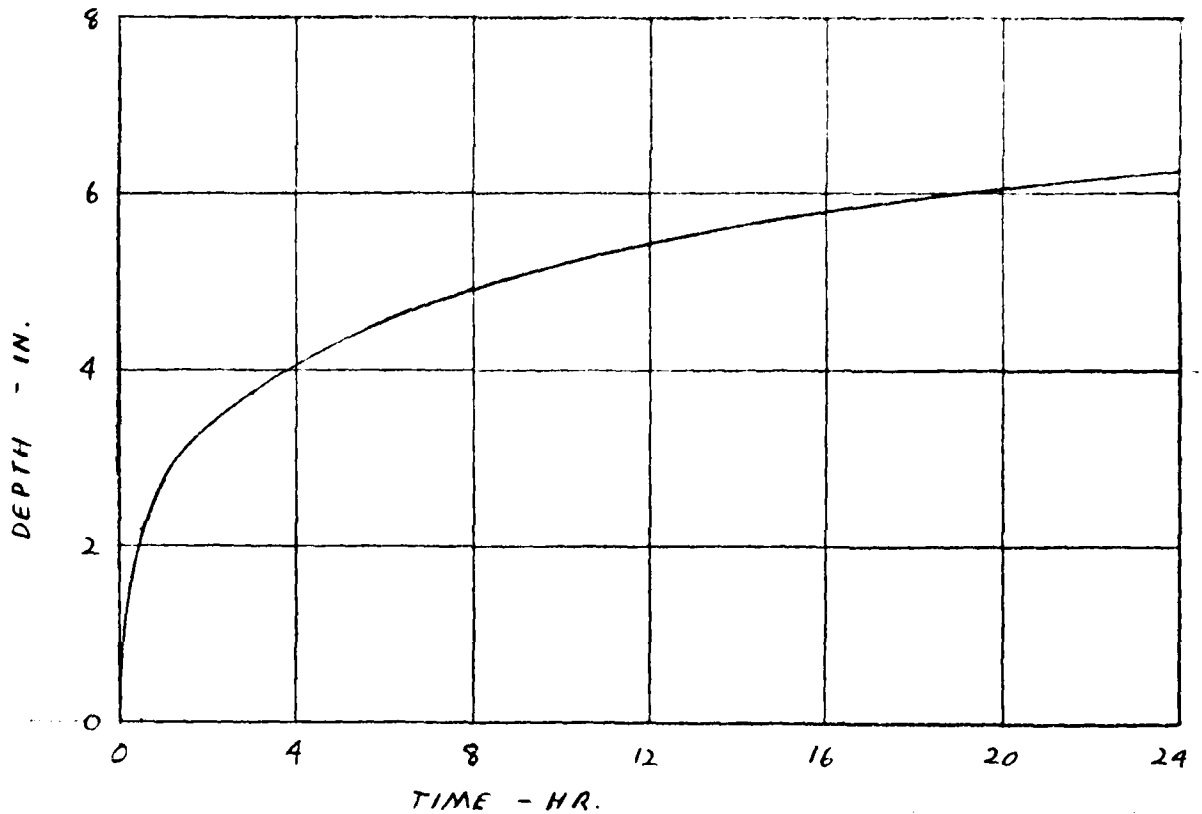
100 YR FLOOD

(CONT)

TOTAL RAINFALL

(FROM 11-40)

DURATION (HR)	DEPTH (IN)
.5	2.19
1	2.73
2	3.39
3	3.71
6	4.55
12	5.41
24	6.29



BY RLS
CHKD BY
SUBJECT

DATE 2/19/51
DATE

BERGER ASSOCIATES
MARKUNAS DAM

SHEET NO. 9 OF 10
PROJECT D0590

SO S PARAMETERS

SOIL TYPE	CLASS
BUTTERNUT	C
MERTZ	B
DEKALB	C
DECATUR	C
ADLER	D

USE: CLASS C

COVER: WOODLAND SOME FARMLAND

CN = 17

LAG:

$$L = 6400'$$

$$Y = 267/6400 \times 100\% = 4.17\%$$

$$S = (1000/CN) - 10$$

$$LAG = \frac{(L)^{0.8} \times (S+1)^{0.7}}{1900 \times (Y)^{0.5}}$$

$$= .75 \text{ HR.}$$

$$Q_{100} = 404 \text{ CFS} \approx 421 \text{ CFS}$$

BY
CMD BY
SUBJECT

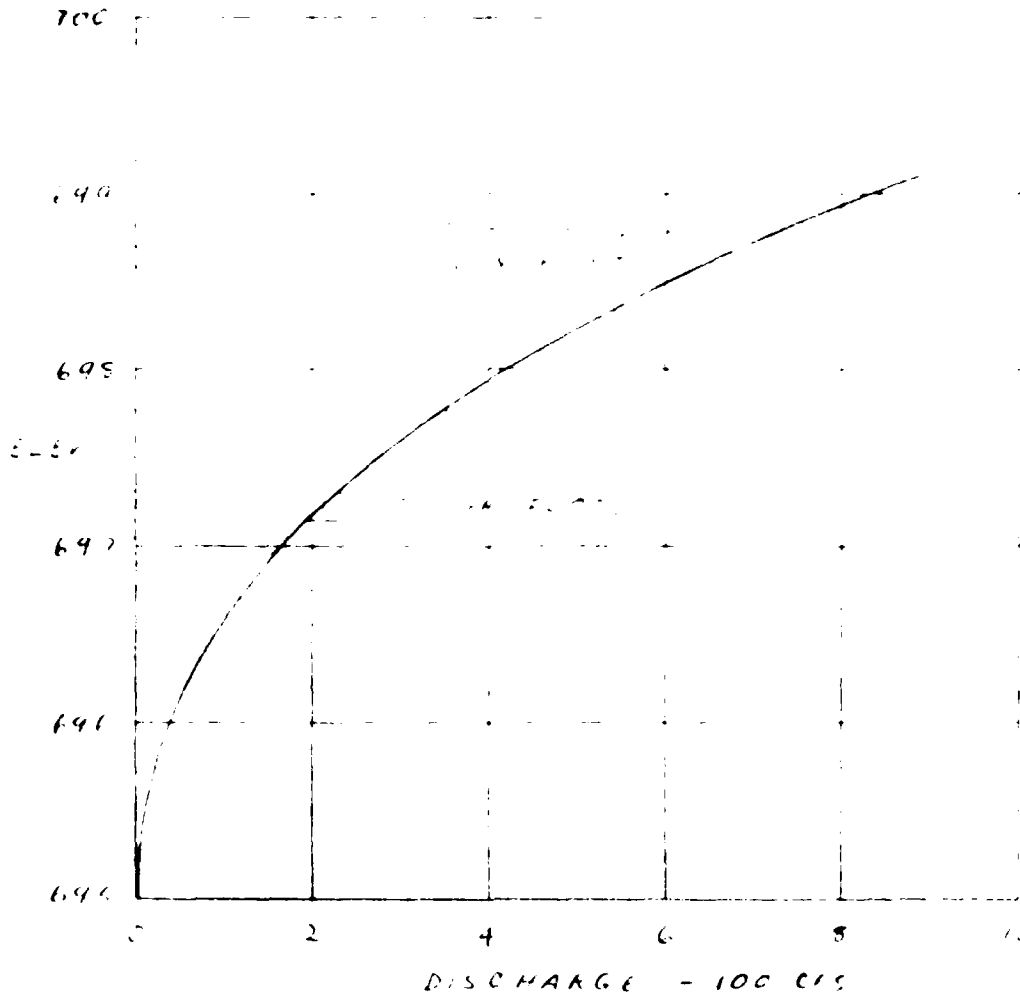
DATE
DATE

BERGER ASSOCIATES

SHEET NO OF 10
PROJECT

WARRIOR IAN

SHILLMAN CAPACITANCE CURVE



- (1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.
- (2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.
- (3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).
- (4) Snyder's Coefficients.
- (5) 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.
- (6) Planimetered area encompassed by contour upstream of dam.
- (7) PennDER files.
- (8) Computed by conic method.
- (9) Hydrometeorological Report No. 40, U.S. Army Corps of Engineers, 1965.

FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 AFR 80

1	A1	MARKUNAS DAM *** TRIBUTARY TO SUSQUEHANNA RIVER										
2	A2	LIVERPOOL TWP., PERRY COUNTY, PA.										
3	A3	NDI # PA-01114					PA DER # 50-63					
4	B	300	0	15	0	0	0	0	0	-4	0	
5	B1	5										
6	J	1	1	1								
7	J1	1										
8	K									1		
9	K1	INFLOW HYDROGRAPH										
10	M	2	.40									
11	D	96										
12	O1	.01	.01	.01	.01	.01	.02	.02	.02	.02	.02	
13	O1	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	
14	O1	.02	.02	.02	.02	.02	.03	.03	.03	.03	.03	
15	O1	.03	.04	.04	.05	.05	.06	.06	.06	.07	.07	
16	O1	.08	.09	.09	.11	.13	.21	.29	1.68	.51	.25	
17	O1	.15	.12	.09	.09	.08	.07	.07	.06	.06	.06	
18	O1	.06	.05	.05	.04	.04	.03	.03	.03	.03	.03	
19	O1	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	
20	O1	.02	.02	.02	.02	.02	.02	.02	.02	.02	.02	
21	O1	.02	.01	.01	.01	.01	.01	.01				
22	T									-1	-77	
23	W1	.75										
24	X	-1.5	-0.05	2								
25	K	1	2									
26	K1	RESERVOIR ROUTING										
27	Y	1										
28	Y1	1									66	-1
29	Y4	695	695.5	696	696.5	697	697.5	698	698.7	699.5	700	
30	Y4	700.5										
31	Y5	0	12	36	85	162	274	417	675	1092	1582	
32	Y5	2301										
33	\$A	0	9.9	35.8								
34	\$E	675	695	700								
35	\$S	695										
36	\$D	698.7										
37	K	99										

1

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
 ROUTE HYDROGRAPH TO 2
 END OF NETWORK

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 AFR 80

RUN DATE# 81/02/20.
 TIME# 05.11.57.

MARKUNAS DAM *** TRIBUTARY TO SUSQUEHANNA RIVER
 LIVERPOOL TWP., PERRY COUNTY, PA.
 NDI # PA-01114 PA DER # 50-63

2

JOB SPECIFICATION										
NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IFRT	NSTAN	
300	0	15	0	0	0	0	0	-4	0	
			JOPER	NWT	LROFT	TRACE				
			5	0	0	0				

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

RTIOS= 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JFLT	JFRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSFC	RATIO	ISHOW	ISAME	LOCAL
0	2	.40	0.00	.40	0.00	0.000	0	0	0

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRNS	RTIOK	STRTL	CNSTL	ALSHX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-77.00	0.00	0.00

CURVE NO = -77.00 WETNESS = -1.00 EFFECT CN = 77.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .75

RECESSION DATA

STRTO= -1.50 QRCSN= -.05 RTIOR= 2.00

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM 6.23 3.72 2.56 4000.
 (160.)(95.)(65.)(113.27)

HYDROGRAPH ROUTING

RESERVOIR ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JFLT	JFRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IDPT	IFHP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	66.	-1

STAGE	695.00 700.50	695.50	696.00	696.50	697.00	697.50	698.00	698.70	699.50	700.00
-------	------------------	--------	--------	--------	--------	--------	--------	--------	--------	--------

FLOW	0.00 2301.00	12.00	36.00	85.00	162.00	274.00	417.00	675.00	1092.00	1582.00
------	-----------------	-------	-------	-------	--------	--------	--------	--------	---------	---------

SURFACE AREA= 0. 10. 36.
 CAPACITY= 0. 66. 174.
 ELEVATION= 675. 695. 700.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
695.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA
 TOPEL COOD EXPD DAMWID
 698.7 0.0 0.0 0.

PEAK OUTFLOW IS 193. AT TIME 13.50 HOURS

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

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN	RATIO	1
					1.00
HYDROGRAPH AT	1	.40	1	404.	
	(1.04)	(11.43)	(
ROUTED TO	2		1	193.	
	((5.46)	(

SUMMARY OF DAM SAFETY ANALYSIS

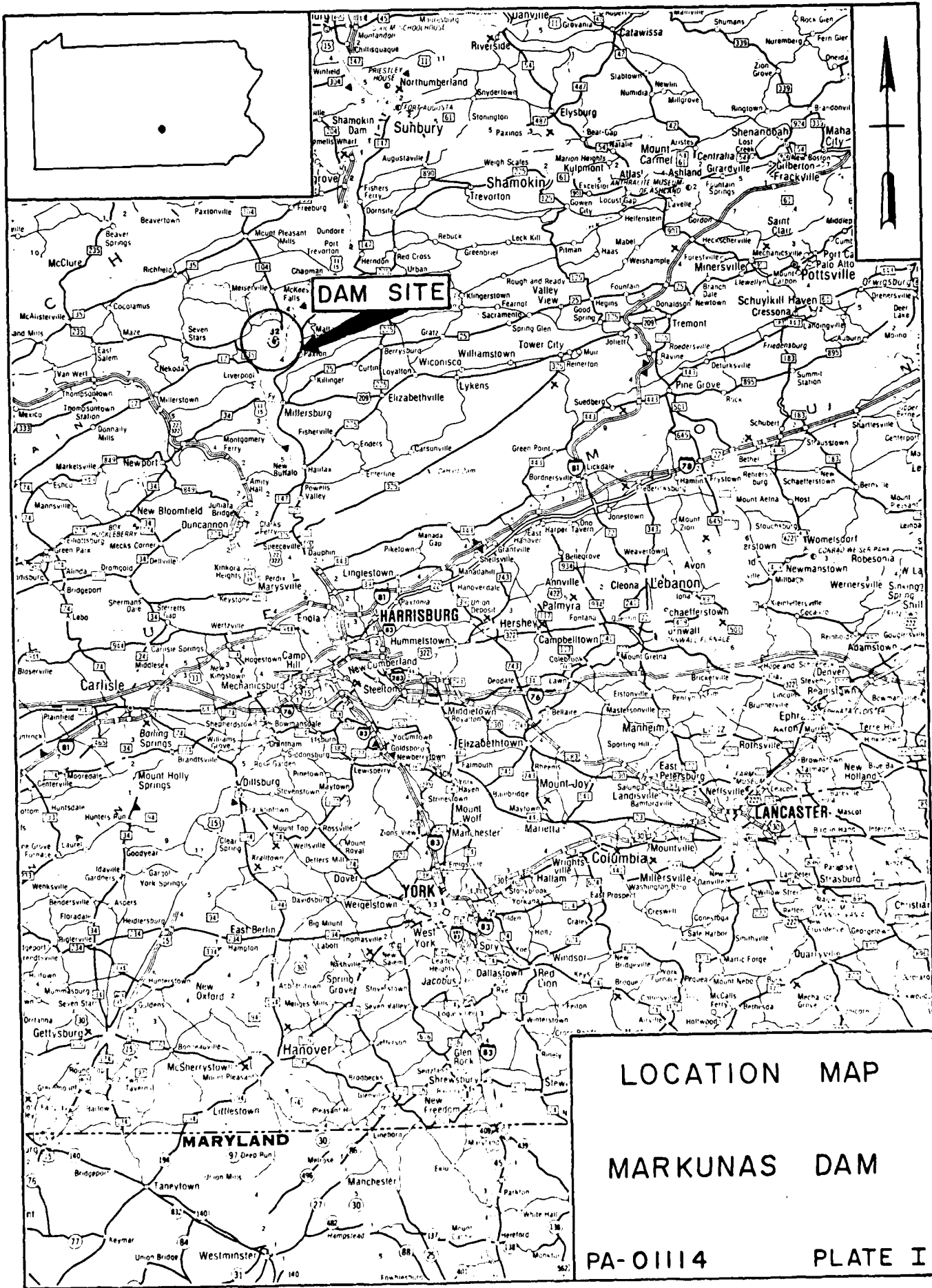
PLAN 1	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	695.00	698.70
	STORAGE	66.	133.
	OUTFLOW	0.	675.

RATIO OF SDF	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	697.14	0.00	96.	193.	0.00	13.50	0.00

APPENDIX E

PLATES

APPENDIX E



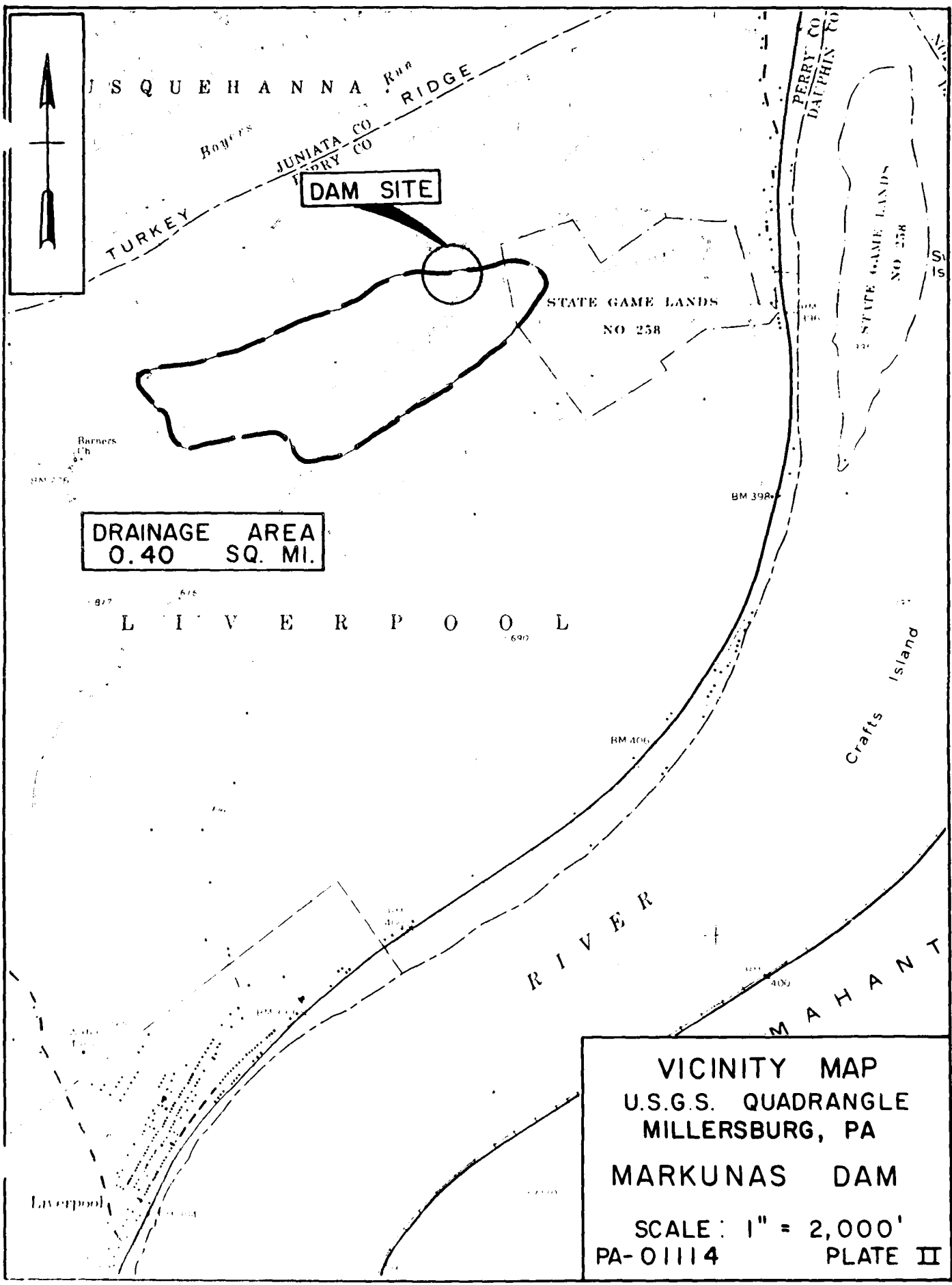
DAM SITE

LOCATION MAP

MARKUNAS DAM

PA-01114

PLATE I



DRAINAGE AREA
0.40 SQ. MI.

DAM SITE

VICINITY MAP
U.S.G.S. QUADRANGLE
MILLERSBURG, PA
MARKUNAS DAM
SCALE: 1" = 2,000'
PA-01114 PLATE II

JUNIATA CO RIDGE
TURKEY RIVER
BARNERS CH

STATE GAME LANDS
NO 258

LIVERPOOL

RIVER

MAHANANT

Crafts Island

STATE GAME LANDS
NO 258

Liverpool

Barners Ch
BM 276

BM 398

BM 406

400

690

SI

APPENDIX F
GEOLOGIC REPORT

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GEOLOGIC REPORT

BEDROCK - DAM AND RESERVOIR

This area overlies the Fisher Ridge member of the Mahantango Formation which consists of medium olive-gray, laminated siltstones, silty claystones and very fine grained sandstones. The lower part has calcareous lenses.

STRUCTURE

Joints are well developed in a blocky pattern. There are two main sets of joints, one perpendicular and one parallel to the bedding. Most joints strike from 350° to 320° and 030° to 080°. The regional bedrock strike is from 065° to 090° and the dip ranges from 45-85°.

OVERBURDEN

The overburden in this area most probably consists of residual soils originating from the parent bedrock.

AQUIFER CHARACTERISTICS

The Mahantango Formation has a secondary porosity of low to medium magnitude and subsurface seepage should be of little concern.

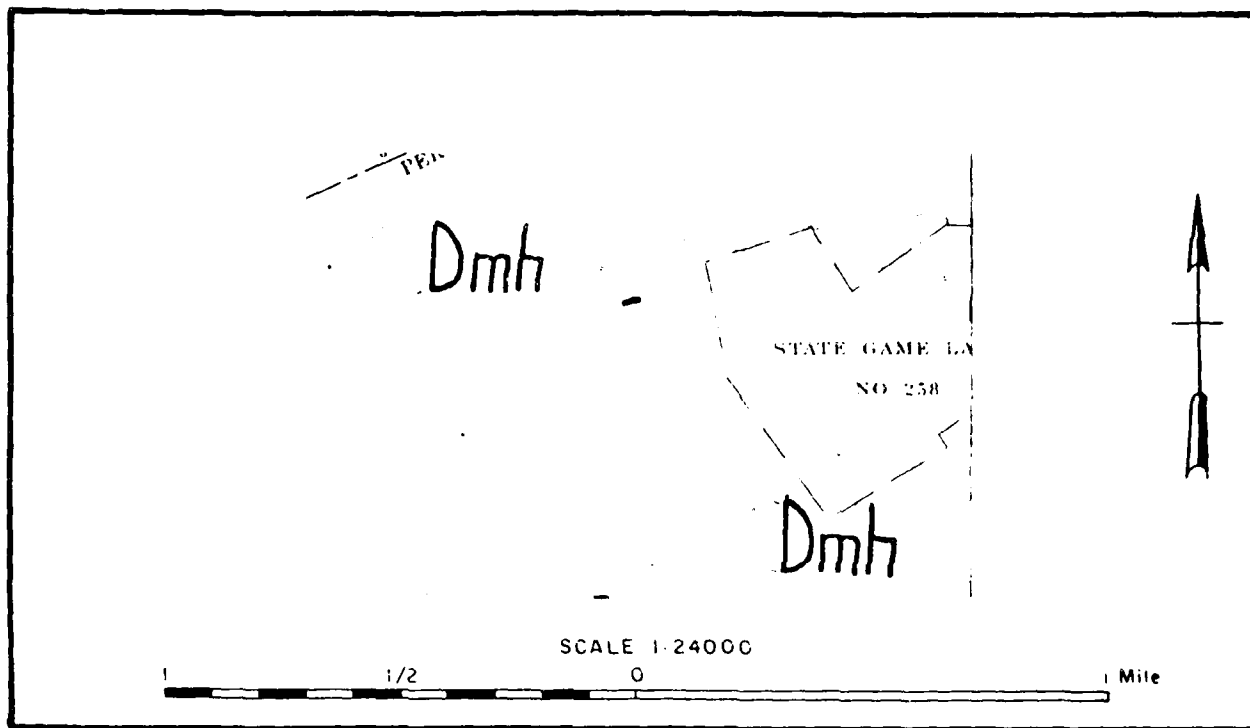
DISCUSSION

There are no construction plans available to determine if the dam rests on bedrock. However, the Mahantango Formation provides for a good quality foundation for heavy structures.

SOURCES OF INFORMATION

1. Hoskins, D.M., 1976. Geology and Mineral Resources of the Millersburg 15-Minute Quadrangle, Dauphin, Juniata, Northumberland, Perry, and Snyder Counties, Pennsylvania: Pennsylvania Geological Survey A-146.
2. McClade, W.C., 1972. Engineering Characteristics of the Rocks of Pennsylvania: Pennsylvania Geological Survey EG-1.

GEOLOGIC MAP - MARKUNAS DAM



LEGEND



Mahantango Formation

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