AD A109216

DELAWARE RIVER BASIN
RED SHALE BROOK, WAYNE COUNTY

PENNSYLVANIA

UNGER DAM

NDI I.D. NO. PA-01090
PENNDER I.D. NO. 64-208

LEVEL II

CHRISTINA UNGER

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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PREPARED FOR
DACW31-81-C-0015
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

PREPARED BY

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GAI CONSULTANTS, INC.
570 BEATTY ROAD
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SEPTEMBER 1981

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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.

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 (greatest reasonably possible storm runoff) for the region, 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.

Breach analyses are performed, when necessary, to provide data to assess the potential for downstream damage and possible loss of life. The results are based on specific theoretical scenarios peculiar to the analysis of a particular dam and are not applicable to other related studies such as those conducted under the Federal Flood Insurance Program.

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Unger Dam: NDI I.D. No. PA-01090

Owner:	Christina Unger
State Located:	Pennsylvania (PennDER I.D. No. 64-208)
County Located:	Wayne
Stream:	Red Shale Brook
Inspection Date:	20 May 1981
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and hydrologic and hydraulic analysis, the dam is considered to be in good condition.

The size classification of the facility is small and its hazard classification is considered to be significant. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). Since the facility is classified near the lower bounds of the small category, the SDF is considered to be the 100-year frequency flood. Results of the hydrologic and hydraulic analysis indicate the facility is not capable of passing the inflow resulting from a 100-year frequency flood without overtopping the embankment. Consequently, the spillway at Unger Dam is considered to be inadequate.

It is recommended that the owner immediately:

a. Develop a formal warning system to minimize the potential for loss of life and economic damage downstream of the facility in the event of a dam failure. The system should include provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

b. Retain the services of a registered professional engineer experienced in the hydrology and hydraulics of dams to make recommendations for remedial measures to provide adequate spillway capacity.

c. Provide a means or develop a plan for draining the reservoir in the event emergency conditions develop.

Unger Dam: NDI I.D. No. PA-01090

d. Remove all excess debris from the spillway channel and continue to maintain a clear channel through regular maintenance.

e. Clear all excess overgrowth from the embankment adjacent the right abutment and provide positive drainage for ponded water along the downstream embankment toe in this area.

f. Develop formal manuals of operations and maintenance to ensure the continued proper care of the facility.

GAI Consultants, Inc.

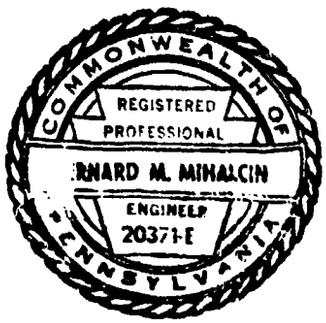
Bernard M. Mihalcin, P.E.

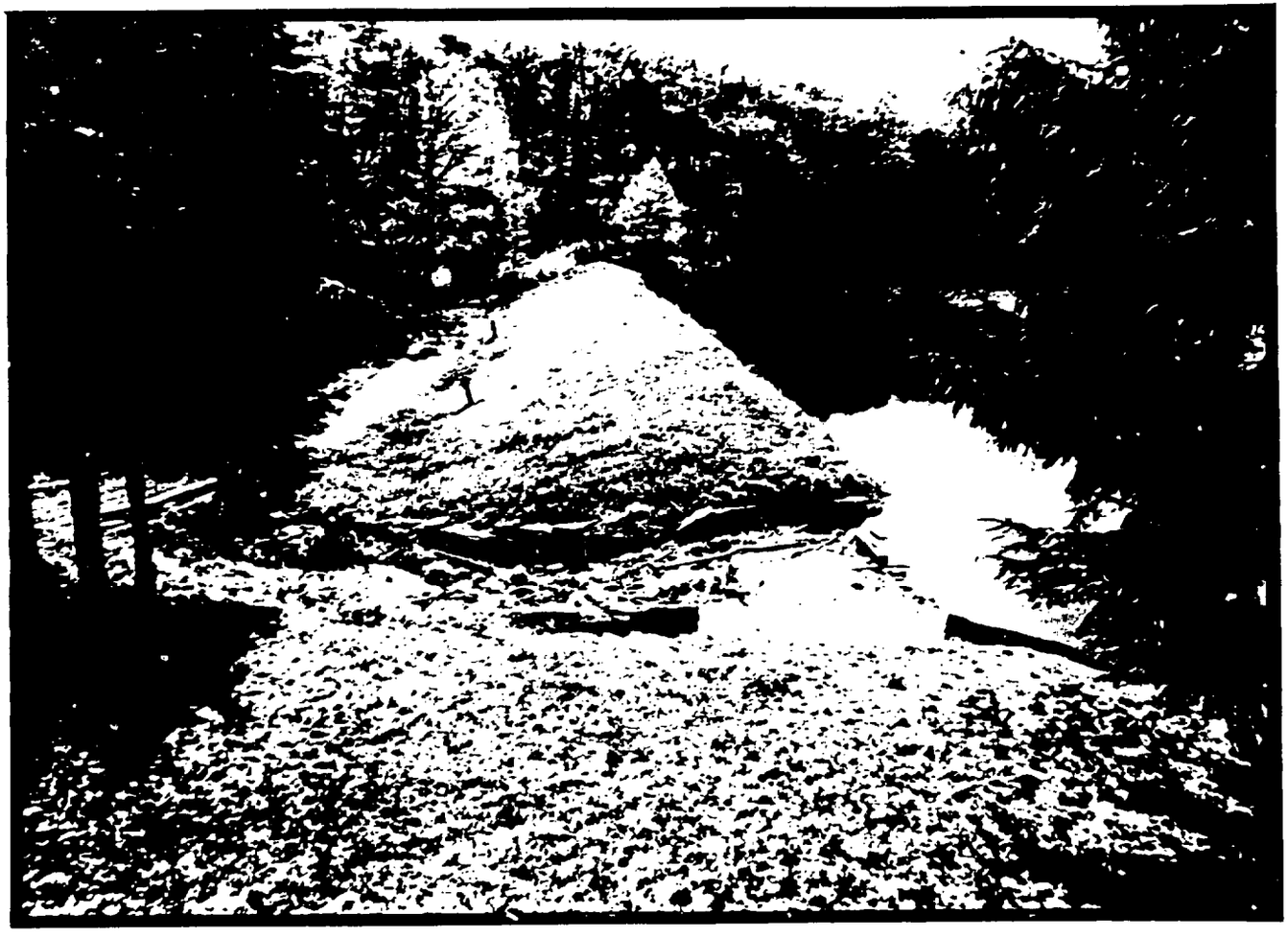
Date 10 Sept 1981

Approved by:

James W. Peck
Colonel, Corps of Engineers
Commander and District Engineer

Date 18 Sep 1981





OVERVIEW PHOTOGRAPH

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NATIONAL DAM INSPECTION PROGRAM
UNGER DAM
NDI NO. PA-01090, PENNDER NO. 64-208

SECTION 1
GENERAL INFORMATION

1.0 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.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Unger Dam is an earth embankment approximately 9 feet high and 260 feet long, including spillway. The spillway is an uncontrolled, rectangular shaped, concrete and masonry chute channel located at the left abutment. The width of the spillway channel at its control section is 19.4 feet. No means of drawing down the reservoir is available.

b. Location. Unger Dam is located on Red Shale Brook in Paupack Township, Wayne County, Pennsylvania. The facility is situated off Pennsylvania Route 590, less than three miles southwest of Hawley, Pennsylvania, and immediately upstream of Lake Florence. The dam, reservoir and watershed are contained within the Hawley, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N 41° 27.9' and W 75° 13.8'.

c. Size Classification. Small (9 feet high, 70 acre-feet storage capacity at top of dam).

d. Hazard Classification. Significant (see Section 3.1.e).

e. Ownership. Christina Unger
Star Route 1
Hawley, Pennsylvania 18428

f. Purpose. Recreation.

g. Historical Data. Information provided by the owner indicates that Unger Dam was originally constructed around 1947. The project was conceived and financed by Casper Unger, the

deceased brother of the present owner, Christina Unger. In 1954, heavy rains resulted in the overtopping and failure of Unger Dam, and subsequently, the failure of the downstream Lake Florence Dam. No loss of life or other significant downstream damage was incurred as a result of these events. Both facilities were reconstructed soon thereafter and provided with larger spillways.

No information is available from PennDER relative to the history of Unger Dam.

1.3 Pertinent Data.

a. Drainage Area (square miles). 0.37

b. Discharge at Dam Site.

Discharge Capacity of Spillway at Maximum Pool ≅ 80 cfs (see Appendix D, Sheet 5).

c. Elevations (feet above mean sea level). The following elevations were obtained from field measurements based on the elevation of normal pool at 1292.0 feet as indicated on the U.S.G.S. 7.5 minute topographic quadrangle, Hawley, Pennsylvania (see Appendix D, Sheet 1 and Appendix E, Figure 1).

Top of Dam	1293.2 (field).
Top of Spillway Sidewalls	1293.2
Maximum Design Pool	Not known.
Maximum Pool of Record	Not known.
Normal Pool	1292.0 (assumed datum).
Spillway Crest	1292.0
Upstream Inlet Invert	N/A.
Downstream Outlet Invert	N/A.
Downstream Embankment Toe	1284.7 (field).

d. Reservoir Length (feet).

Top of Dam	1900
Normal Pool	1850

e. Storage (acre-feet).

Top of Dam	70
Normal Pool	47

f. Reservoir Surface (acres).

Top of Dam	18
Normal Pool	17

g.	Dam.	
	Type	Earth.
	Length	236 feet (excluding spillway).
	Height	9 feet (field measured; embankment crest adjacent top of spillway right sidewall to downstream embankment toe).
	Top Width	9 feet.
	Upstream Slope	2.25H:1V
	Downstream Slope	2.5H:1V
	Zoning	Homogeneous earth.
	Impervious Core	None.
	Cutoff	Core trench reportedly cut to a sound foundation along the embankment centerline. Dimensions not known.
	Grout Curtain	None.
h.	Diversion Canal and Regulating Tunnels.	None.
i.	Spillway.	
	Type	Uncontrolled, rectangular shaped, concrete and masonry chute channel located at the left abutment. No regulating weir.
	Crest Elevation	1292.0 feet.
	Crest Length	19.4 feet (at control situated 11 feet downstream of spillway entrance).
j.	Outlet Conduit.	None.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No design reports, calculations, miscellaneous design data, state inspection reports, design or construction drawings are available from either the owner or PennDER. General information regarding the history and construction of the facility was obtained during the inspection interview.

b. Design Features.

1. Embankment. Based primarily on visual observations and field measurements, as well as information obtained during the inspection interview, general statements can be made regarding the embankment design. The dam is a 9-foot high, 260-foot long earth embankment, including spillway. It has grass covered slopes and a 9-foot wide, grass covered crest (see Photographs 1, 2 and 4). The upstream embankment face is protected with a riprap layer consisting of hard, well graded sandstone boulders and rock fragments. The upstream and downstream embankment faces are sloped at 2.25H:1V and 2.5H:1V, respectively. Internally, the structure was reportedly constructed as a homogeneous embankment without any specific impervious zone or core. The embankment is reportedly keyed into sound foundation material with a cutoff trench (dimensions not known) located along the embankment centerline. No formal information is available relative to the internal or foundation design of this structure.

2. Appurtenant Structures.

a) Spillway. The spillway is an uncontrolled, rectangular shaped, concrete and masonry chute channel located at the left abutment (see Photograph 1). The spillway has no regulating weir or well defined control section; therefore, discharges are regulated strictly by the channel slope. The structure has a concrete channel floor and concrete sidewalls at its entrance, but a rubble masonry right sidewall and a partially rock lined channel floor beyond the embankment crest. The left sidewall of the discharge channel abuts the adjoining hillside and is virtually unlined (see Photograph 7). The present channel was constructed subsequent to the overtopping and failure of the structure that occurred in 1954 and reportedly represents a substantial increase in capacity relative to its predecessor.

b) Outlet Conduit. Unger Dam was constructed without an outlet conduit or any means for drawing down the reservoir.

c. Specific Design Data and Criteria. No design data or information relative to design procedures are available.

2.2 Construction Records.

The owner's personal file contains miscellaneous information relative to the construction of the facility including various bills of sale and handwritten notes. Mr. Ernie Unger stated to the inspection team that the dam was constructed with high lifts and compacted with rubber tired trucks. No engineering supervision was employed to oversee the construction.

2.3 Operational Records.

No records of the day-to-day operation of the facility are maintained.

2.4 Other Investigations.

There are no available records concerning other formal studies or investigations of Unger Dam.

2.5 Evaluation.

There is no formal data available relative to the design and construction of this facility. The structural design, based primarily on external appearances and on information obtained during the inspection interview, generally conforms to modern engineering practices. The only specific design deficiency noted is the lack of a means for drawing down the reservoir.

SECTION 3

VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the dam and its appurtenances are in good condition.

b. Embankment. Observations made during the visual inspection reveal the embankment is generally well maintained and presently in good condition (see Photographs 1 and 4). No evidence of seepage through the downstream embankment face, sloughing, erosion, animal burrows, or excess embankment settlement was noted. The extreme right end of the embankment, adjacent to the right abutament, is presently overgrown with briars and high brush, which is uncharacteristic relative to the rest of the embankment (see Photographs 2 and 5). In addition, some ponding is evident along the downstream embankment toe in this area. The ponding appears to be the result of poor drainage, however, and not seepage. The condition is not considered significant at present.

c. Appurtenant Structures.

1. Spillway. The spillway is considered to be in good condition. Small debris, such as concrete blocks and driftwood, was observed in the channel and should be removed (see Photographs 1, 6 and 7). No other deficiencies were noted.

d. Reservoir Area. The general area surrounding the reservoir is composed of steep and heavily forested slopes. No signs of slope distress were observed.

e. Downstream Channel. Discharges from Unger Dam flow directly into Lake Florence, located immediately downstream. Lake Florence Dam (Phase I Inspection Report, National Dam Inspection Program, NDI I.D. No. PA-01092, prepared by GAI Consultants, Inc., dated September 1981) is an earth embankment about 21 feet high and 268 feet long, including spillways. The facility is constructed with two small, uncontrolled, rectangular shaped, concrete spillways, one at each abutment. The total combined discharge capacity of the spillways is about 97 cfs. Flow from Lake Florence Dam is discharged into a narrow, steep and heavily forested valley that is presently uninhabited. A small reservoir for supplying water to the community of Hawley, Pennsylvania, is located about 7,000 feet downstream of Unger Dam. Approximately 2,300 feet further downstream are the remnants of a small ski lodge and resort which was apparently destroyed by fire within the last several years. Due to the presence of the downstream dams, the possibility exists for appreciable economic loss due to embankment failure. Thus, the hazard classification for this facility is considered to be significant.

3.2 Evaluation.

The overall appearance of the facility suggests it to be in good condition. Remedial measures are necessary to remove excess debris from the spillway channel and to clear overgrowth from the embankment adjacent the right abutment.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Unger Dam is essentially a self-regulating facility. Excess inflows are automatically discharged through the uncontrolled spillway and channeled into Lake Florence downstream. The facility was constructed without an outlet conduit and, thus, no operable devices are associated with the facility. No formal operations manual is available.

4.2 Maintenance of Dam.

The owner maintains the dam on an unscheduled, as-needed basis. No formal maintenance manual is available.

4.3 Maintenance of Operating Facilities.

No operable devices are associated with this facility.

4.4 Warning System.

No formal warning system is presently in effect.

4.5 Evaluation.

The general appearance of the facility indicates it to be well maintained with the exception of the extreme right portion of the embankment adjacent the right abutment. No formal program of regular routine maintenance has been established; however, formal manuals of maintenance and operations are recommended to ensure continued proper care of the facility. Included in these manuals should be a formal plan to effect drawdown along with a formal emergency warning system for the protection of downstream inhabitants that provides for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

SECTION 5

HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No formal design reports, calculations, or miscellaneous design data are available for the facility.

5.2 Experience Data.

Records of reservoir levels and/or spillway discharges are not available.

5.3 Visual Observations.

On the date of the inspection, no conditions were observed that would indicate the spillway could not function satisfactorily during a flood event, within the limits of its design capacity.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Unger Dam ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (significant). Since the facility is classified near the lower bounds of the small category, the SDF is considered to be the 100-year frequency flood.

b. Results of Analysis. Unger Dam was evaluated in order to determine if it could accommodate the 100-year frequency flood without overtopping of its embankment. The 100-year peak inflow was determined according to methods provided in the Pennsylvania Department of Environmental Resources, Water Resources Bulletin No. 13, "Floods in Pennsylvania" (see Appendix D, Sheet 3). The peak inflow under this 100-year event was determined to be about 270 cfs, while the maximum spillway capacity (at the minimum

embankment crest elevation) was found to be approximately 80 cfs. Therefore, it can be concluded that the embankment would be overtopped under the 100-year flood event, based on the assumption of little or no attenuation of the peak inflow (Note: no hydrograph routing was performed in this analysis; see Appendix D, Sheet 5).

5.6 Spillway Adequacy.

As presented previously, Unger Dam cannot accommodate the 100-year frequency flood (the SDF) without overtopping of its embankment. However, since its hazard category is considered to be significant, no breaching analysis was performed, in accordance with Corps directive ETL-1110-2-234. Thus, as Unger Dam cannot accommodate its SDF, its spillway is considered to be inadequate.

SECTION 6

EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on visual observations, the embankment is considered to be in good structural condition. The overgrowth and ponding observed at the extreme right portion of the embankment is considered to be a minor deficiency which can be remedied through regular maintenance. No other deficiencies were observed.

b. Appurtenant Structures.

1. Spillway. The spillway is considered to be in good structural condition. Excess debris noted in the spillway channel could potentially obstruct discharge and effectively reduce spillway capacity. Thus, any excess debris should be removed immediately and a clear channel maintained through regular maintenance.

6.2 Design and Construction Techniques.

Information collected by the inspection team indicates that the embankment was not formally designed. No formal data is available that documents the actual applied construction techniques.

6.3 Past Performance.

The present facility is the result of reconstruction performed subsequent to the overtopping and failure of the original facility in 1954. The present facility has reportedly functioned adequately since its completion and has never been overtopped.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. As the facility appears to be well constructed and sufficiently stable, it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this belief.

SECTION 7

ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The results of this investigation indicate the facility is in good condition.

The size classification of the facility is small and its hazard classification is considered to be significant. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). Since the facility is classified near the lower bounds of the small category, the SDF is considered to be the 100-year frequency flood. Results of the hydrologic and hydraulic analysis indicate the facility is not capable of passing the inflow resulting from a 100-year frequency flood without overtopping the embankment. Consequently, the spillway at Unger Dam is considered to be inadequate.

b. Adequacy of Information. The available data is considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. No additional investigations are deemed necessary at this time.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner immediately:

a. Develop a formal warning system to minimize the potential for loss of life and economic damage downstream of the facility in the event of a dam failure. The system should include provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

b. Retain the services of a registered professional engineer experienced in the hydrology and hydraulics of dams to make recommendations for remedial measures to provide adequate spillway capacity.

c. Provide a means or develop a plan for draining the reservoir in the event emergency conditions develop.

d. Remove all excess debris from the spillway channel and continue to maintain a clear channel through regular maintenance.

e. Clear all excess overgrowth from the embankment adjacent the right abutment and provide positive drainage for ponded water along the downstream embankment toe in this area.

f. Develop formal manuals of operations and maintenance to ensure the continued proper care of the facility.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Unger Dam STATE Pennsylvania COUNTY Wayne

NDI # PA — 01090 PENNDER # 64-208

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY Significant

DATE(S) INSPECTION 20 May 1981 WEATHER Clear TEMPERATURE 60° @ 10:00 a.m.

POOL ELEVATION AT TIME OF INSPECTION 1292.2 feet M.S.L.

TAILWATER AT TIME OF INSPECTION 1284.1 feet M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B. M. Mihalcin	None Present	
D. J. Spaeder		
D. L. Bonk		

RECORDED BY B. M. Mihalcin

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01090
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None associated with embankment.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - Good. Vertical - see "Profile of Dam Crest from Field Survey", Appendix A.
RIPRAP FAILURES	Riprap consists of hard, well-graded sandstone boulders and rock fragments. Some of the rocks are partially covered by sod near the embankment crest. Good condition.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition. Right end of embankment is overgrown with thick brush and small trees. Minor erosion observed along the left spillway sidewall at the left abutment.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01090
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	Minor ponding observed along the overgrown portion of the downstream embankment toe near the right abutment. Appears to be a poor drainage condition. Not significant.
ANY NOTICEABLE SEEPAGE	None observed.
STAFF GAGE AND RECORDER	None.
DRAINS	None observed.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01090
INTAKE STRUCTURE	No outlet conduit.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	N/A.
OUTLET STRUCTURE	N/A.
OUTLET CHANNEL	N/A.
GATE(S) AND OPERATIONAL EQUIPMENT	N/A.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01090
TYPE AND CONDITION	Uncontrolled, rectangular shaped, concrete and masonry chute channel. Good condition, but, debris cluttered.
APPROACH CHANNEL	Rock lined, unobstructed.
SPILLWAY CHANNEL AND SIDEWALLS	Channel floor is concrete in good condition at the control section. Left sidewall is concrete at control section and unlined downstream. Concrete is in good condition. *Minor erosion observed* along the unlined section. Right sidewall is masonry in good condition.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Lower portion of spillway channel is rock lined. Spillway flows discharge into Lake Florence through a 15-inch diameter CMP beneath an access road located at the downstream embankment toe.
BRIDGE AND PIERS EMERGENCY GATES	Gravel covered access road extends from abutment to abutment along the downstream toe of Unger Dam and crosses the discharge end of the spillway channel.

SERVICE SPILLWAY

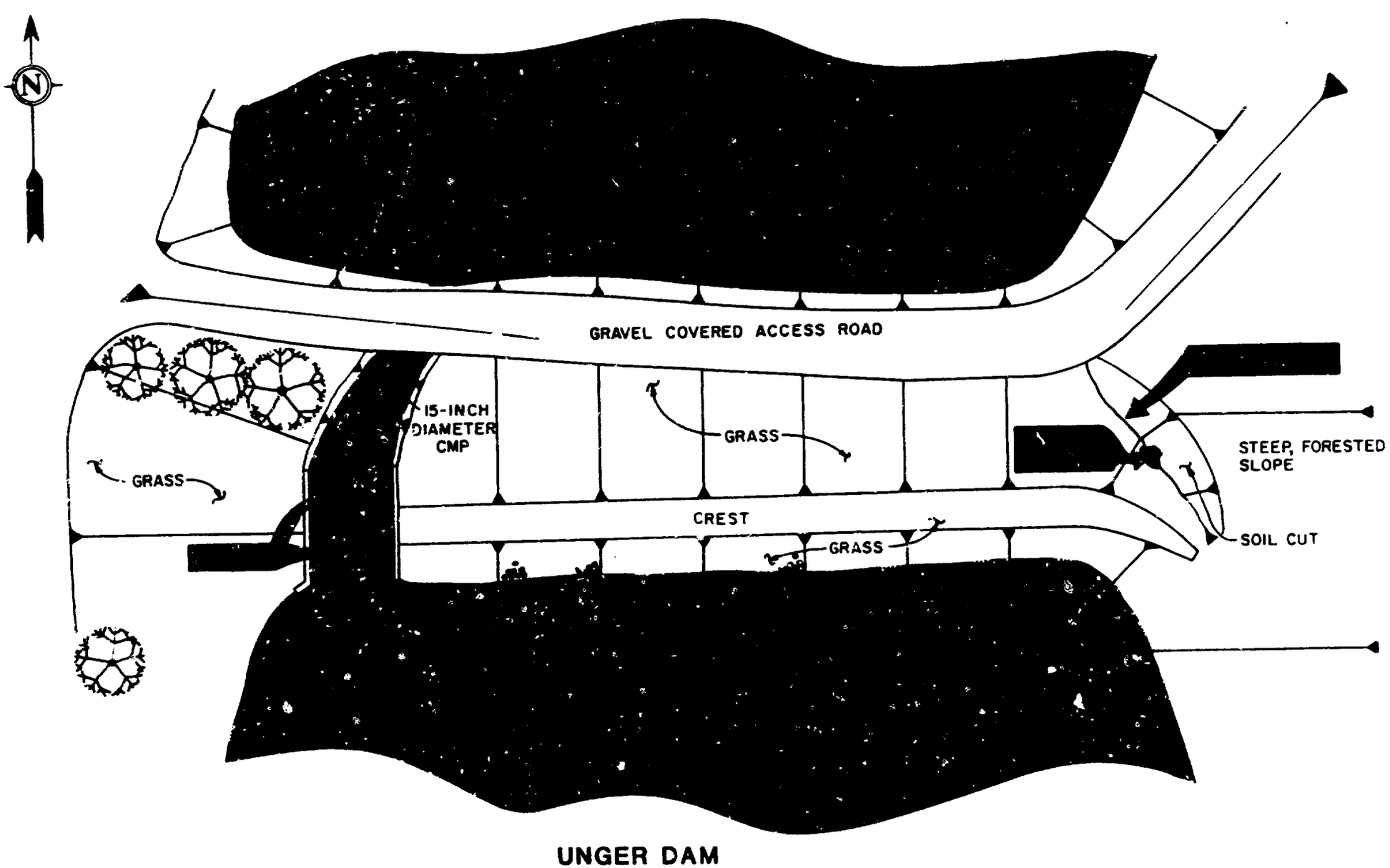
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01090
TYPE AND CONDITION	N/A.
APPROACH CHANNEL	N/A.
OUTLET STRUCTURE	N/A.
DISCHARGE CHANNEL	N/A.

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01090
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01090
SLOPES: RESERVOIR	Steep and heavily forested.
SEDIMENTATION	None evident.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Discharges directly into Lake Florence.
SLOPES: CHANNEL VALLEY	Narrow, steep and heavily forested valley that gradually broadens as Red Shale Brook approaches its confluence with Middle Creek about 10,000 feet downstream of Unger Dam.
APPROXIMATE NUMBER OF HOMES AND POPULATION	The valley beneath Unger Dam and Middle Creek is presently uninhabited. A small water supply reservoir for the community of Hawley, Pennsylvania, is located about 6,000 feet downstream of Lake Florence Dam, which is situated about 1,100 feet downstream of Unger Dam. A small ski resort occupied a portion of the valley several years ago, but, has since been destroyed by fire.



UNGER DAM

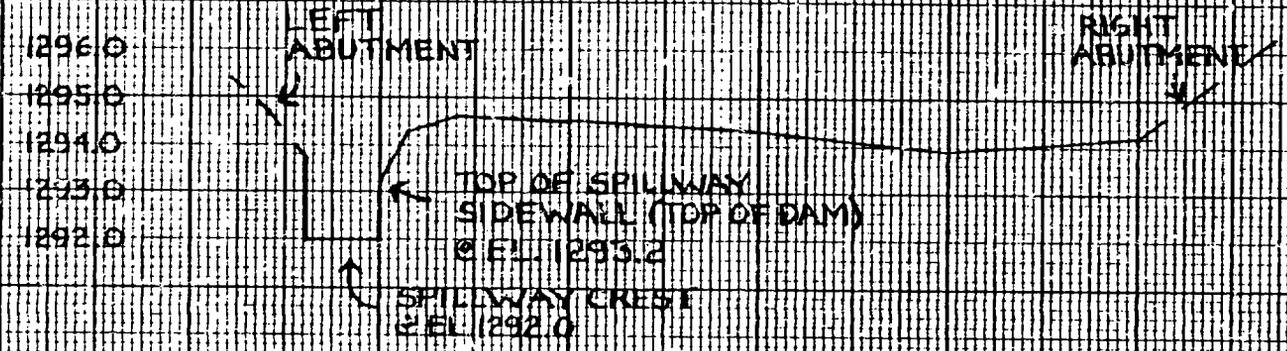
GENERAL PLAN - FIELD INSPECTION NOTES

K•E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

NDI # PA-01090

UNGER DAM

PROFILE OF EMBANKMENT CREST
FROM FIELD SURVEY



SCALE:
VERTICAL: 1 IN. = 1 FT.
HORIZONTAL: 1 IN. = 50 FT.

SUBJECT	UNGER DAM		
BY DTS	DATE 6-21-81	SHEET NO.	OF
CHKD BY [illegible]	DATE 7-27-81	PROJECT NO 80-259-090	

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM Unger Dam

ITEM	REMARKS NDI# PA- 01090
PERSONS INTERVIEWED AND TITLE	Christina Unger - Owner. Ernie Unger (Brother)
REGIONAL VICINITY MAP	See Figure 1, Appendix E.
CONSTRUCTION HISTORY	No information available from PennDER. Owner has a small personal file containing miscellaneous receipts and correspondence. Constructed around 1947. Compacted by trucks. Reportedly cut core trench to sound foundation.
AVAILABLE DRAWINGS	None.
TYPICAL DAM SECTIONS	None.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	No outlet conduit.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA - 01090
SPILLWAY: PLAN SECTION DETAILS	None.	
OPERATING EQUIP- MENT PLANS AND DETAILS	N/A.	
DESIGN REPORTS	None.	
GEOLOGY REPORTS	None.	
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	None.	
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	None.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS	NDI# PA - 01090
BORROW SOURCES	Left abutment hillside above the reservoir.	
POST CONSTRUCTION DAM SURVEYS	None.	
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.	
HIGH POOL RECORDS	None recorded. Original facility overtopped and breached in 1954. Present structure is reported to be several feet higher than the original facility and equipped with a larger spillway.	
MONITORING SYSTEMS	None.	
MODIFICATIONS	Rehabilitated in 1954 after an overtopping incident caused the embankment to breach. Embankment was reportedly raised and constructed with a larger spillway. Owner reportedly consulted an engineer to aid in spillway sizing.	

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 01090
PRIOR ACCIDENTS OR FAILURES	Overtopped in 1954 and breached, resulting in the overtopping and breaching of the downstream Lake Florence Dam. No injuries or significant damage were reported.
MAINTENANCE: RECORDS MANUAL	No formal records or manual are available.
OPERATION: RECORDS MANUAL	No formal records or manual are avilable.
OPERATIONAL PROCEDURES	Self-regulating.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	None.
MISCELLANEOUS	

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CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-01090
PENNDER ID # 64-208

SIZE OF DRAINAGE AREA: 0.37 square mile.

ELEVATION TOP NORMAL POOL: 1292.0 STORAGE CAPACITY: 47 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1293.2 STORAGE CAPACITY: 70 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 1292.0 feet.

TYPE: Uncontrolled, rectangular, concrete and masonry chute channel.

CREST LENGTH: 19.4 feet (at control).

CHANNEL LENGTH: 53 feet.

SPILLOVER LOCATION: Left abutment.

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: None.

LOCATION: -

ENTRANCE INVERTS: -

EXIT INVERTS. -

EMERGENCY DRAWDOWN FACILITIES: -

HYDROMETEOROLOGICAL GAGES

TYPE: None.

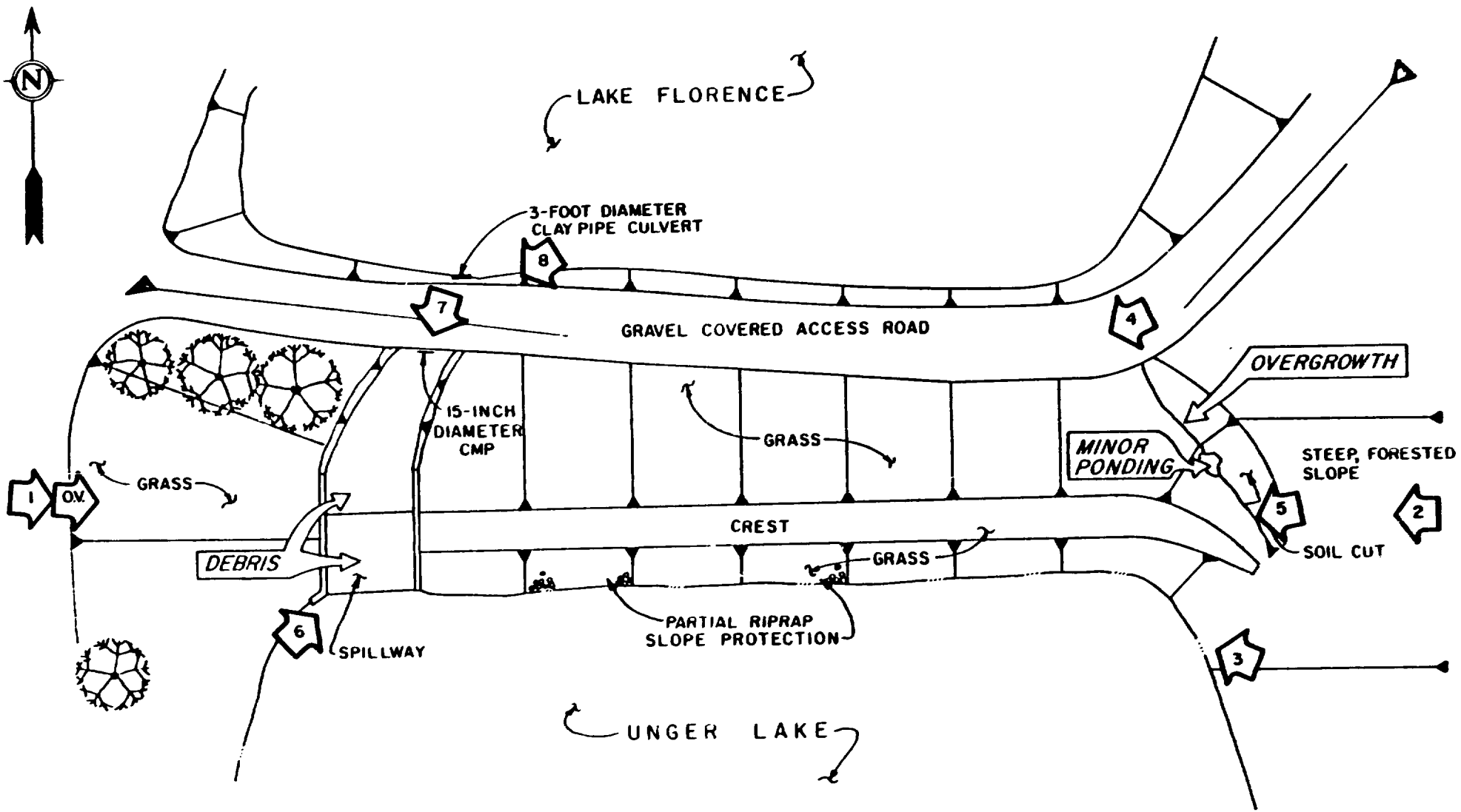
LOCATION: -

RECORDS: -

MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS



UNGER DAM
PHOTOGRAPH KEY MAP

PHOTOGRAPH 1 Overview of Unger Dam as seen from the left abutment.

PHOTOGRAPH 2 Overview of Unger Dam as seen from the right abutment.

PHOTOGRAPH 3 View of the upstream embankment face looking toward the left abutment.

PHOTOGRAPH 4 View of the downstream embankment face looking toward the left abutment.

1

2

3

4

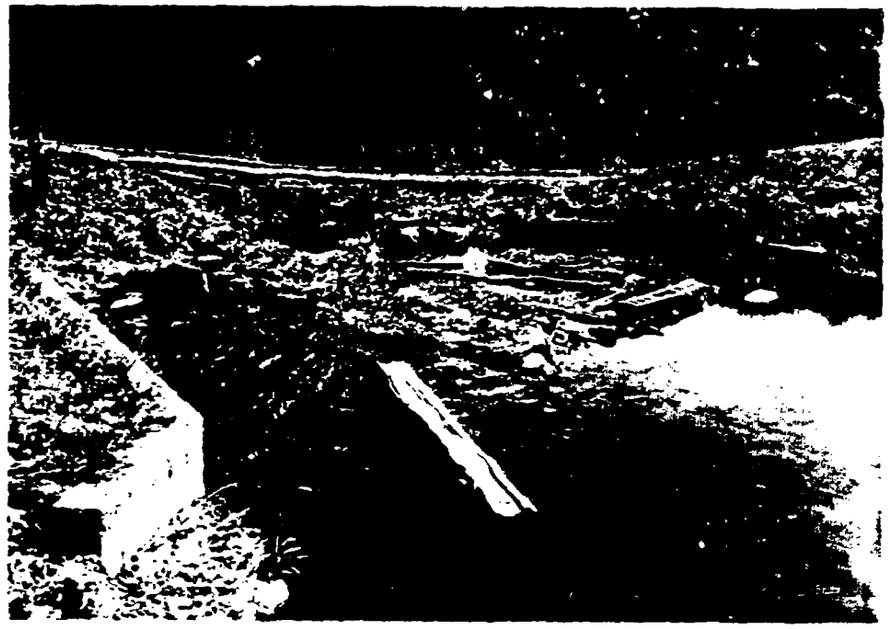
PHOTOGRAPH 5 View of the overgrown portion of the embankment adjacent the right abutment.

PHOTOGRAPH 6 View of the control section of the spillway located at the left abutment.

PHOTOGRAPH 7 View, looking upstream, of the spillway channel as seen from the road located along the downstream embankment toe.

PHOTOGRAPH 8 View, looking upstream, of the culvert beneath the road that crosses the spillway channel.

5



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APPENDIX D

HYDROLOGIC AND HYDRAULIC ANALYSES

SUBJECT DAM SAFETY INSPECTION
UNGER DAM

BY DCS DATE 6-8-81 PROJ. NO. 81-302-090

CHKD. BY DLB DATE 6-24-81 SHEET NO. 1 OF 5

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DAM STATISTICS

HEIGHT OF DAM = 9 FT (FIELD MEASURED: TOP OF DAM TO DOWNSTREAM EMBANKMENT TOE; "TOP OF DAM" HERE AND ON ALL SUBSEQUENT CALCULATION SHEETS REFERS TO THE LOW AREA ON THE EMBANKMENT CREST.)

NORMAL POOL STORAGE CAPACITY = 47 AC-FT (SHEET 3)

MAXIMUM POOL STORAGE CAPACITY = 72 AC-FT (SHEET 3)
(@ TOP OF DAM)

DRAINAGE AREA = 0.37 SQ. MI. (PLANIMETERED ON USGS TOPO QUAD - HAWLEY, PA)

ELEVATIONS:

TOP OF DAM (DESIGN)	=	NOT KNOWN
TOP OF DAM (FIELD)	=	1293.2
NORMAL POOL	=	1292.3 (USGS TOPO QUAD - HAWLEY, PA)
SPILLWAY CREST	=	1292.0
UPSTREAM INLET INVERT	=	N/A
DOWNSTREAM OUTLET INVERT	=	N/A
DOWNSTREAM EMBANKMENT TOE (FIELD)	=	1284.7
STREAMBED @ DAM CENTERLINE	=	NOT KNOWN

SUBJECT DAM SAFETY INSPECTION
UNGER DAM

BY JJS DATE 6-8-81 PROJ. NO. 80-238-090

CHKD. BY DLG DATE 6-24-81 SHEET NO. 2 OF 5

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DAM CLASSIFICATION

DAM SIZE: SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION: SIGNIFICANT (FIELD OBSERVATION)

REQUIRED SDF: 100-YEAR FLOOD TO ½ PMF (REF 1, TABLE 3)

SELECTED SDF = 100-YEAR FLOOD

RESERVOIR CAPACITY

SURFACE AREA (S.A.) @ NORMAL POOL (EL. 1292.3) = 17 ACRES

S.A. @ EL. 1300.0 = 24 ACRES

(PLANIMETERED ON USGS TOPO QUAD - HANLEY, MT.)

S.A. @ TOP OF DAM (EL. 1293.3) = 18.1 ACRES

(BY LINEAR INTERPOLATION)

DETERMINE RESERVOIR STORAGE CAPACITY USING MODIFIED PRISMOIDAL RELATIONSHIP:

$$\Delta V_{1-2} = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 \cdot A_2}\right) \qquad \text{(REF 14, P. 15)}$$

WHERE ΔV_{1-2} = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 & 2, IN ACRE-FT,
h = ELEVATION 1 – ELEVATION 2, IN FEET,
A_1 = S.A. @ ELEVATION 1, IN ACRES,
A_2 = S.A. @ ELEVATION 2, IN ACRES.

SUBJECT DAM SAFETY INSPECTION
UNGER DAM

BY DJS DATE 6-8-81 PROJ. NO. 80-238-090

CHKD. BY DLB DATE 6-24-81 SHEET NO. 3 OF 5

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- ASSUMING THAT THE MINIMUM RESERVOIR ELEVATION = 1285 (WHICH IS APPROXIMATELY THE ELEVATION OF THE DOWNSTREAM TOE OF THE EMBANKMENT),

STORAGE CAPACITY @ NORMAL POOL = $\left(\frac{8.3}{3}\right)(17)$
= 47.0 AC-FT

STORAGE CAPACITY @ TOP OF DAM (EL 1293.2) =

$47.0 + \left(\frac{1.3}{3}\right)\left(17.0 + 18.1 + \sqrt{17.0 \times 18.1}\right)$
= 69.8 AC-FT

100-YEAR FLOOD COMPUTATION

THE DETERMINATION OF THE 100-YEAR FREQUENCY FLOOD PEAK WAS BASED ON PENNDER WATER RESOURCES BULLETIN NO. 13, "FLOODS IN PENNSYLVANIA," SNYDER, 1977:

ON PLATE 1, BULLETIN NO. 13, IT CAN BE SEEN THAT THE UNGER DAM WATERSHED IS ESSENTIALLY ON THE BOUNDARY BETWEEN FLOOD FREQUENCY REGIONS 2 AND 3. HOWEVER, SINCE THE DAM ULTIMATELY DISCHARGES INTO MIDDLE CREEK, AND SINCE THE MIDDLE CREEK BASIN IS LOCATED IN REGION 2, THE UNGER DAM WATERSHED IS CONSIDERED TO BE ENTIRELY IN REGION 2.

THE REGRESSION EQUATION FOR REGION 2 IS

$$Q_{100} = cA^x ,$$

WHERE Q_{100} = 100-YEAR FREQUENCY PEAK FLOW, IN CFS,
A = DRAINAGE AREA, IN SQ. MI.,
c, x = REGRESSION COEFFICIENTS.

SUBJECT DAM SAFETY INSPECTION
UNGER DAM

BY JJS DATE 6-9-81 PROJ. NO. 80-238-090
CHKD. BY DLB DATE 6-24-81 SHEET NO. 4 OF 5

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FROM TABLE 2, BULLETIN No. 13,

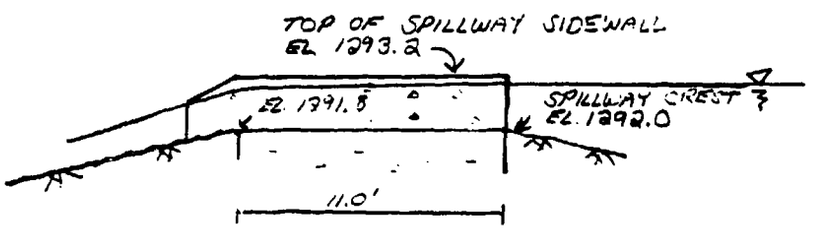
$C = 564$
$x = 0.744$

$\therefore \quad Q_{100} = 564\,(0.37)^{0.744} = 269 \text{ cfs} = \underline{270} \text{ cfs.}$

THIS REGRESSION EQUATION IS BASED ON RECORDS FOR 50 GAGING STATIONS IN REGION 2, WITH DRAINAGE AREAS OF 2.0 SQUARE MILES OR GREATER. IT IS ASSUMED HERE THAT THE EQUATION MAY BE APPLIED TO THIS 0.37-SQUARE MILE BASIN.

SPILLWAY CAPACITY

PROFILE:



(NOT TO SCALE)
-BASED ON FIELD SURVEY.

THE SPILLWAY CONSISTS OF AN UNCONTROLLED, RECTANGULAR SHAPED, CONCRETE CHANNEL. IT DISCHARGES INTO A ROCK LINED CHANNEL, AND EVENTUALLY INTO LAKE FLORENCE IMMEDIATELY DOWNSTREAM.

SUBJECT DAM SAFETY INSPECTION
UNGER DAM

BY DJS DATE 6-9-81 PROJ. NO. 80-328-330

CHKD. BY DLG DATE 6-24-81 SHEET NO. 5 OF 5

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DISCHARGE OVER THE WEIR CAN BE ESTIMATED BY THE RELATIONSHIP

$$Q = CLH^{3/2}$$ (REF 5, p. 5-23)

WHERE Q = DISCHARGE, IN CFS,
C = COEFFICIENT OF DISCHARGE,
L = WEIR LENGTH, IN FT,
H = HEAD, IN FT.

IT IS ASSUMED THAT C = 3.087, THE DISCHARGE COEFFICIENT FOR CRITICAL FLOW IN A RECTANGULAR SECTION (REF 5, p. 5-24). ALSO, THE EFFECTIVE WEIR LENGTH WAS FIELD MEASURED TO BE 19.4 FT.

$$\therefore Q = (3087)(19.4)H^{3/2}$$
$$= 59.9\,H^{3/2}$$

AT EL. 1293.2 (TOP OF DAM),

$$Q = (59.9)(1.2)^{3/2} = 80 \text{ CFS} \longrightarrow \text{MAX. SPILLWAY CAPACITY}$$

IN COMPARING THE 100-YEAR FREQUENCY FLOOD PEAK (270 CFS) WITH THE MAXIMUM SPILLWAY CAPACITY (80 CFS), IT IS SEEN THAT THE DAM WILL BE OVERTOPPED UNDER THE 100-YEAR EVENT. IT WAS NOTED HERE THAT THERE WOULD BE NO SIGNIFICANT ATTENUATION OF THE PEAK INFLOW. THEREFORE, THE SPILLWAY IS CONSIDERED TO BE INADEQUATE.

LIST OF REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams," prepared by Department of the Army, Office of the Chief of Engineers, Washington, D. C. (Appendix D).

2. "Unit Hydrograph Concepts and Calculations," by the U. S. Army, Corps of Engineers, Baltimore District (L-519).

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5. Handbook of Hydraulics, H. W King, and E. F. Brater, McGraw-Hill, Inc., New York, 1963.

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11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army, Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, H. M. Morris and J. N. Wiggert, Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

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18. Roughness Characteristics of Natural Channels, H. H. Barnes, Jr., Geological Survey Water-Supply Paper 1849, Department of the Interior, United States Geological Survey, Arlington, Virginia, 1967.

19. "Hydraulic Charts for the Selection of Highway Culverts," Hydraulic Engineering Circular No. 5, Bureau of Public Roads, Washington, D. C., 1965.

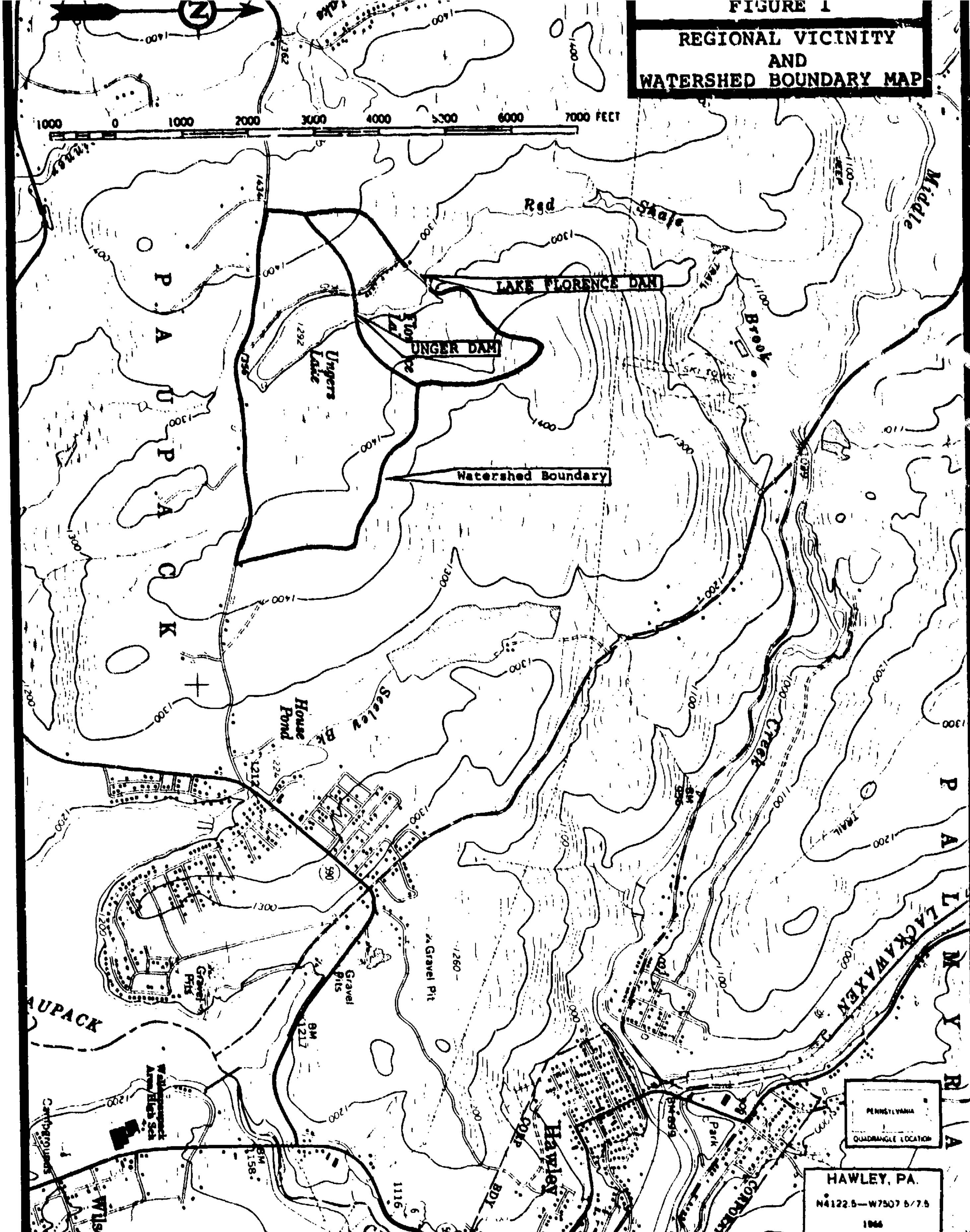
APPENDIX E

FIGURES

LIST OF FIGURES

FIGURE 1

REGIONAL VICINITY AND WATERSHED BOUNDARY MAP



APPENDIX F

GEOLOGY

Geology

Unger Dam is located in the glaciated Low Plateaus section of the Appalachian Plateaus physiographic province of northeastern Pennsylvania. In this area, the Appalachian Plateaus province is characterized topographically by flat-topped, hummocky hills formed as a result of glaciation and subsequent stream dissection of nearly flat-lying strata. The Devonian age sedimentary rock strata in Wayne County regionally strike N35°E and dip gently to the northwest. The Delaware River is the major drainage basin in the area. Major tributary streams intersect the Delaware River at right angles; whereas, smaller streams display a slightly more random tributary pattern. Both major and minor tributary stream systems are joint controlled and exhibit modified rectangular and trellis-type drainage patterns.

Structurally, the area containing the dam site lies on the south flank of a broad, asymmetrical synclinorium that plunges to the southwest. Superimposed on this broad structural basin are numerous anticlinal and synclinal folds characterized by planar limbs and narrow hinges. Due to prior glaciation, low relief and surficial soil cover, fold axes are difficult to trace.

The sedimentary rock sequences in the vicinity of the dam and reservoir are probably of Upper Devonian age (see Geology Map). The sedimentological changes observed in the Catskill Formation (Upper Devonian age) indicate that the rate of sedimentation exceeded the rate of basin subsidence resulting in a facies change from marine to non-marine strata.

Approximately half of Wayne County, including the dam site, is covered by a blanket of Wisconsin age (most recent) glacial drift which, based on the degree of weathering, was probably deposited during the Woodfordian stage. Valley bottoms are typically covered by recent alluvium and Woodfordian outwash of variable thickness, but typically less than 10 feet. These deposits are characteristically unconsolidated stratified sand and gravel, usually with more gravel than sand and some small boulders. The direction of the Wisconsin ice advance was from the northeast over the Catskill Mountains and from the north over the Appalachian Plateau. The terminal moraine resulting from the southern most advance of the Wisconsin ice sheet in this area is located in the southern portion of Monroe County which partially borders Wayne County to the South.

References:

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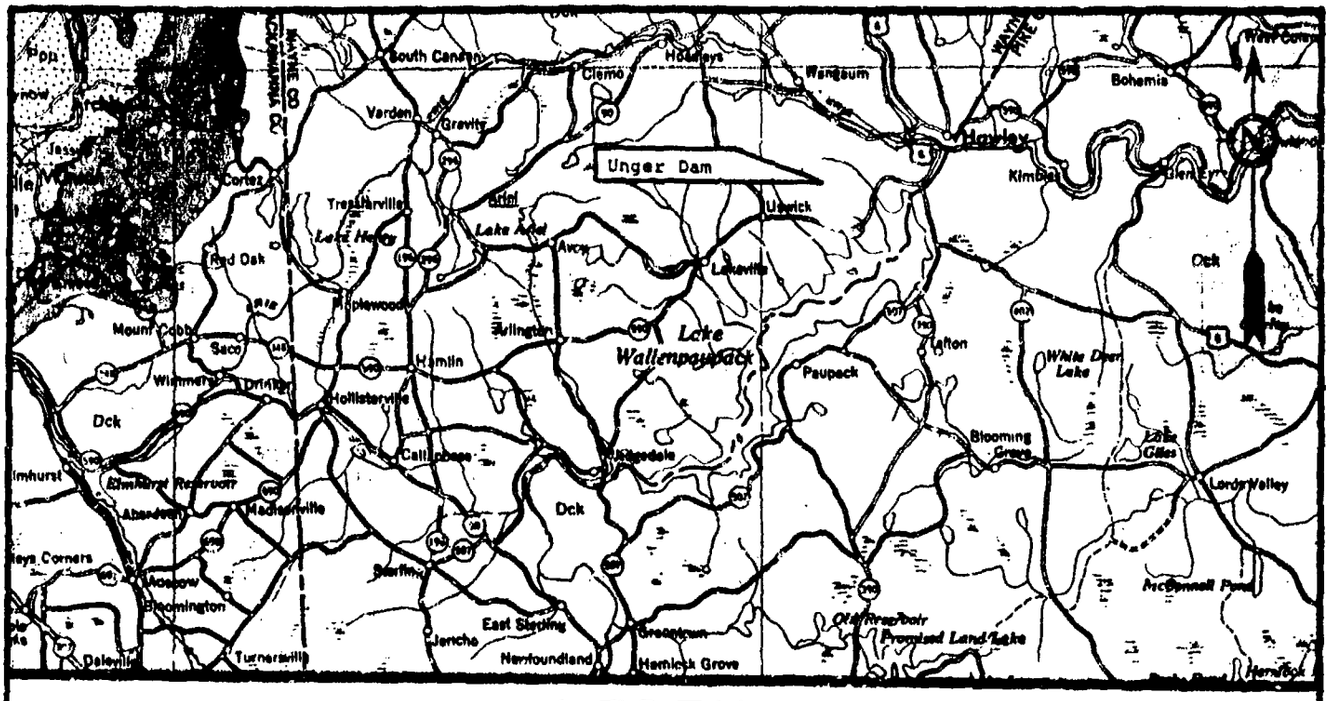

LEGEND

PENNSYLVANIAN

ANTHRACITE REGION

Post-Pottsville Formations
Brown or gray sandstones and shales with some conglomerate and numerous minable coals.

Pottsville Group
Light gray to white, coarse grained sandstones and conglomerates with some minable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN

Pocono Group
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; exclusive of the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Cussewago" of M. L. Fuller in Potter and Tioga counties.

UPPER DEVONIAN

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

Scale

0 2 4 6 8 10 MILES

REFERENCE:
GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

GEOLOGY MAP

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