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NATIONAL DAM INSPECTION PROGRAM. HILLS CREEK DAM, NDS ID NUMBER--ETC(U)
JUN 79 R J KIMBALL, K CHUANG DACW31-79-C-0009

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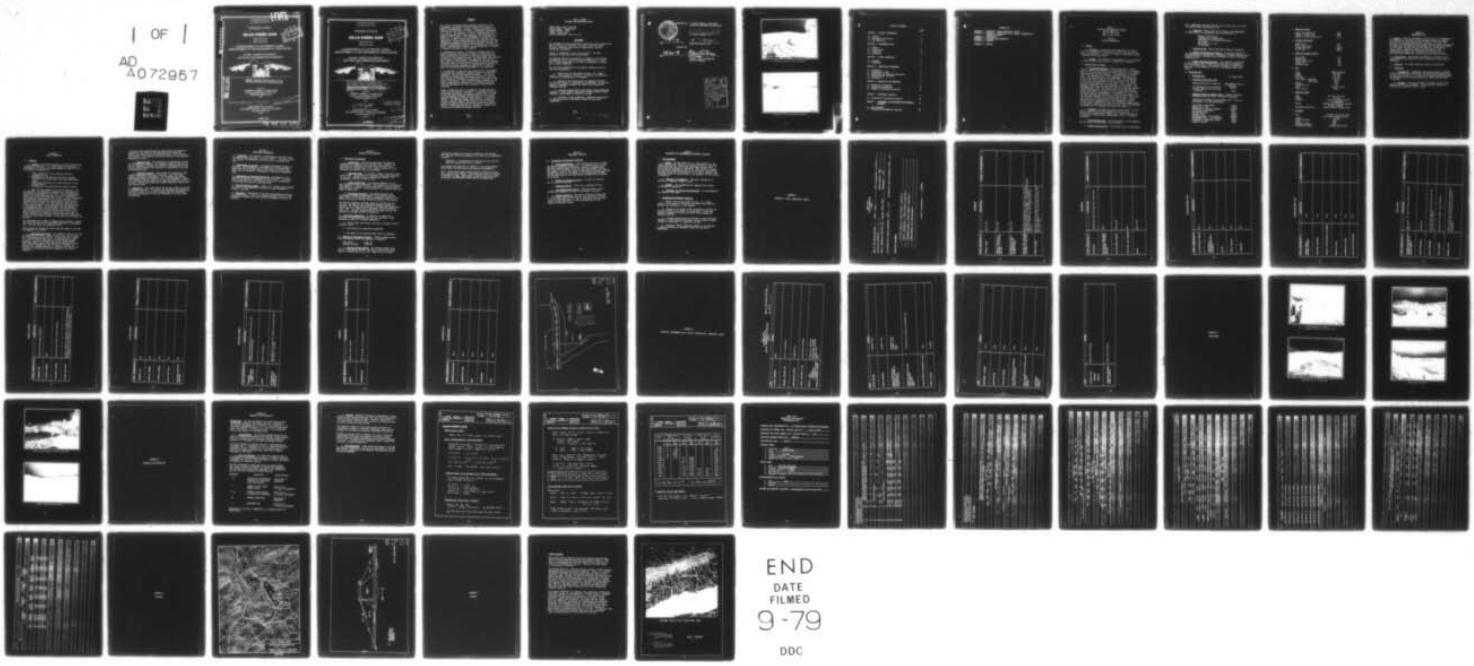

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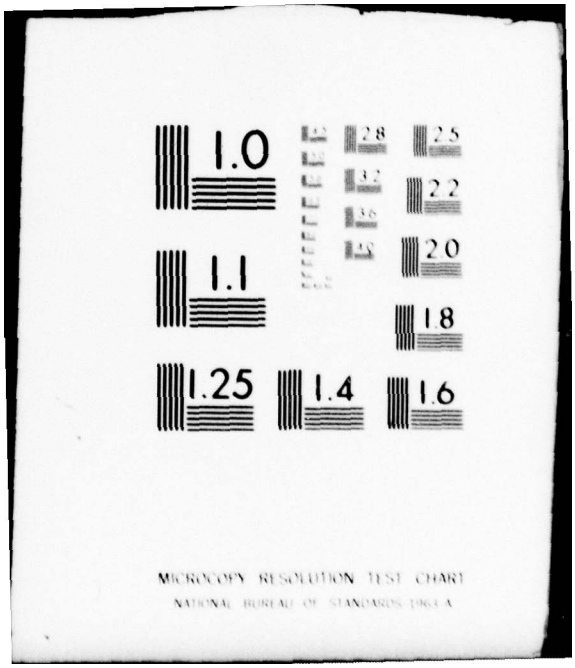
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SUSQUEHANNA RIVER BASIN
HILLS CREEK, TIOGA COUNTY

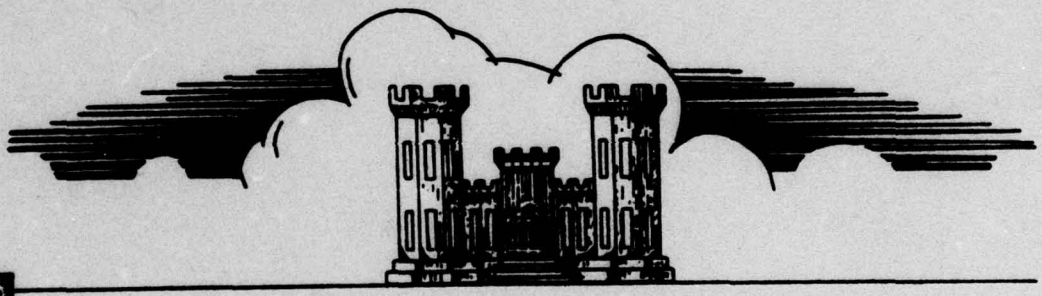
PENNSYLVANIA

HILLS CREEK DAM

NDS ID NO. PA-34
DER ID NO. 59-58

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

Contract # DACW31-79-C-0009
FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

JUNE, 1979

SUSQUEHANNA RIVER BASIN

HILLS CREEK, TIOGA COUNTY

PENNSYLVANIA

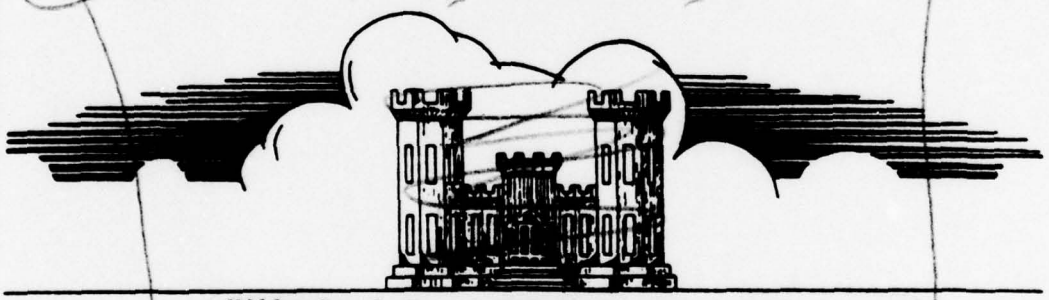
HILLS CREEK DAM

NDS ID NO. PA-34

DER ID NO. 59-58

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM.



Hills Creek Dam. NDS ID Number PA-34. DER ID Number 59-58. Susquehanna River Basin. Hills Creek, Tioga County, Pennsylvania. [redacted] Phase I Inspection Report.

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
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15931

R. Jeffrey /Kimball
Kuang-hwei /Chuang

DACW31-79-C-0009

FOR

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

61 p.

JUNE 1979

PREFACE

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

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

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

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

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM: Hills Creek Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Tioga
STREAM: Hills Creek
DATE OF INSPECTION: April 19, 1979

ASSESSMENT

The assessment of Hills Creek Dam is based upon visual observations made at the time of inspection, review of available records and data, hydrologic and hydraulic computations, and past operational performance.

The dam is considered to be in good condition. No major seepage or erosion was noted on the slopes.

The existing spillway and reservoir are capable of controlling approximately 85% of the PMF (Probable Maximum Flood). Based upon criteria established by the Corps of Engineers, the spillway is termed inadequate.

The following recommendations and remedial measures should be instituted immediately:

1. Monitor the wet area beyond the toe. If a change occurs, a study should be conducted to determine the cause and evaluate the consequences of the seepage.

2. Because of the bridge across the emergency spillway and the pier located in the middle of the spillway, a trash boom should be installed to prevent any debris from blocking the emergency spillway.

3. A warning system should be developed to warn downstream residents of large spillway discharges, during periods of heavy rainfall or high runoff or failure of the dam.

4. Institute a formal inspection program to be conducted at regular intervals by personnel trained for dam safety inspections.

SUBMITTED BY: L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

COMMONWEALTH OF PENNSYLVANIA
Registered PROFESSIONAL
R. JEFFREY KIMBALL
ENGINEER

R Jeffrey Kimball

R. Jeffrey Kimball, P.E.

JUN 12 1979

Date

K. Chuang

Kuang-hwei Chuang, P.E.

APPROVED BY:

28 Jun 79

Date

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

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Overview of dam from left abutment.

Overview of dam from right abutment.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
HILLS CREEK DAM
NDI I.D. NO. PA 34
DER I.D. NO. 59-58

SECTION I
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

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

1.2 Description of Project. ABSTRACT

a. Dam and Appurtenances. Hills Creek Dam is a zoned earthfill dam with a concrete paved upstream slope. The embankment is 587 feet long and has a curved portion in the upstream direction near the left abutment. The embankment is 32 feet high. The upstream slope is 3H:1V and has a concrete paved face on the upper portion of the embankment. The downstream slope is 2H:1V and covered with grass. The crest of the dam is 20.5 feet wide and serves as an access road. The roadway has curbing and guardrails on both sides. Access across the spillway located near the right abutment is by a bridge. The embankment has a central impervious core with pervious upstream and downstream zones. The cutoff trench is 12 feet wide and several feet deep. A 4" drain tile is located below the downstream portion of the embankment. The spillway is located on the right abutment and consists of a concrete lined chute. The spillway weir consists of a concrete ogee section. The drainline consists of a 30" cast iron pipe with a control tower located in the upstream portion of the embankment. Flow in the drainline is regulated at the top of the dam through a stem in the control tower to the valve on the 30" line. The drainline discharges into the emergency spillway exit channel. 4-inch 30-inch 30-inch ABSTRACT

b. Location. The dam is located on Hills Creek, a tributary to Crooked Creek, approximately 2 miles north of Whitneyville, Tioga County, Pennsylvania. Hills Creek Dam can be located on Crooked Creek, Pennsylvania U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Hills Creek Dam is an intermediate size structure (32 feet high, 2623 acre-feet).

d. Hazard Classification. Hills Creek Dam is a high hazard

dam. Downstream conditions indicate loss of more than a few lives is probable should the structure fail.

e. Ownership. Hills Creek Dam is owned by the Commonwealth of Pennsylvania. Correspondence should be addressed to:

Bureau of State Parks
Commonwealth of Pennsylvania
Department of Environmental Resources
3rd & Riley
Harrisburg, PA 17120
717-787-6644

f. Purpose of Dam. Hills Creek Dam is used for recreation.

g. Design and Construction History. The dam was designed by the Commonwealth of Pennsylvania, Department of General Services and by Frederick Dechant. Construction was completed in 1951 by the Osburn Construction Co.

h. Normal Operating Procedures. The reservoir is maintained at the spillway crest elevation with excess inflow discharging over the spillway crest. The reservoir drainline is opened twice each year, in the spring and the fall, for inspection and lubrication.

1.3 Pertinent Data.

a. Drainage Area. 3.7 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Approximately 500 cfs June 1972
30" drainline at pool elevation	Unknown
Spillway capacity at top of dam elevation	6598

c. Elevation (U.S.G.S. Datum) (feet). - Based on spillway elevation noted on U.S.G.S. 7.5 minute quadrangle.

Construction drawings show spillway at 1475. This is a discrepency of 11 feet (vertically).

Top of dam - field survey	1494.9
Design top of dam	1483.0
Maximum pool - design surcharge	Unknown
Full flood control pool	N/A
Recreational pool	1486.0
Spillway crest	1486.0
Upstream portal - 30" drainline	Unknown
Downstream portal - 30" drainline	1462.9
Streambed at centerline of dam	1462.9
Maximum tailwater	None

d. Reservoir (feet).

Length of maximum pool	5200
Length of normal pool	5100
Length of flood control pool	N/A

e. Storage (acre-feet).

Normal pool	1297
Flood control pool	N/A
Design surcharge	Unknown
Top of dam	2623

f. Reservoir Surface (acres).

Top of dam	175
Maximum pool	175
Flood control pool	N/A
Normal pool	128
Spillway crest	128

g. Dam.

Type	Zoned earthfill
Length	587 feet
Height	32 feet
Top width	20.5 feet
Side slopes - Upstream	3H:1V
Downstream	2H:1V
Zoning	Yes
Impervious core	Yes
Cutoff	Partial cutoff
Grout curtain	None

h. Reservoir Drain.

Type	30" cast iron pipe
Length	180 feet
Closure	Valve on upstream portion of embankment
Access	Through exit invert at spillway discharge channel
Regulating facilities	Valve on top of control tower

i. Spillway.

Type	Concrete lined open chute with concrete ogee for weir
Length	59 feet
Crest elevation	1486.0
Gates	None
Upstream channel	Lake
Downstream channel	Concrete lined chute

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) and files of the park superintendent at Hills Creek State Park, indicated that considerable data are available for review. The majority of design data was obtained from PennDER. The information reviewed for this study included construction drawings, correspondence, design reports, inspection reports and dam permits. The construction drawings show a discrepency of approximately 11 feet vertically between the existing conditions and the design.

2.2 Construction. Considerable information is available on the construction of the dam in the form of inspection reports made by inspectors.

2.3 Operation. No formal operating records are maintained.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER Bureau of Dam Safety, Obstructions, and Storm Water Management and by the state park office. The state park superintendent accompanied the inspection team to answer questions on design and operation of the dam.

b. Adequacy. The type and amount of design data and other engineering data is substantial. The information available is sufficient to complete a Phase I report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Hills Creek Dam was conducted by personnel of L. Robert Kimball and Associates accompanied by the state park superintendent on April 19, 1979. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in good condition. The elevations on the construction drawings do not correspond to the elevations determined in the field. The elevations determined in the field were based upon the U.S.G.S. quadrangle which shows the spillway elevation at 1486.0. Both the upstream and downstream slopes appear to be in good condition. The upstream slope was paved from approximately 5 feet below the water to the top of dam. All the joints and cracks in the paved concrete surface on the upstream slope were sealed with a bituminous material. The downstream slope was measured to be approximately 2H:1V and was grassed. The crest was 20.5 feet wide and served as a paved road across the dam. Guardrails and gutters are located on either side of the road. A bridge crosses the spillway near the weir and was in good condition. No trash boom is present to stop debris from blocking the spillway.

The downstream slope showed no seepage zones or erosion. Beyond the toe of the dam is a wet spot which reportedly is constantly wet. This wet area is at elevation 1456.9.

The low point on the dam was located near the center of the dam and measured to be 1494.9.

c. Appurtenant Structures. The reservoir level at the time of inspection was 1486.1. About one tenth of a foot of water was discharging over the spillway. The spillway weir consists of a concrete ogee 69 feet long. The ogee weir was in good condition. Above the concrete ogee is the roadway bridge. The bottom beam of this access road bridge was measured to be 1494.9 which corresponds to the low point on the dam. The spillway exit channel consists of a concrete lined chute. All concrete in the spillway facilities appeared to be in good condition.

A 30" cast iron drainline was not opened during the inspection. Condition of the line was not noted during the inspection. However, the outlet end of the drainline exits in the spillway exit channel. The condition of the exit portion of the drainline appeared to be good.

d. Reservoir Area. The watershed is predominantly covered with woodland and farmland. The reservoir slopes are gentle and are not considered susceptible to massive landslides which would affect storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. Hills Creek has a moderately wide channel downstream of the Hills Creek Dam. The flood plain supports farming and pastureland. Two residences are located approximately 8000 feet beyond the toe of the embankment. These two residences would be affected by large discharges or failure of the dam. Several more houses are located along the stream in the next several miles.

3.2 Evaluation. The visual inspection did not reveal any serious or immediate concerns. In general, the embankment and appurtenant structures appear to be in good condition and well-maintained. The size and condition of wet area downstream of the dam should be monitored.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at as high a level as possible (spillway crest, elevation 1486.0). The valve on the 30" drainline is exercised in the fall and in the spring each year.

4.2 Maintenance of the Dam. No planned maintenance schedule is utilized. All maintenance is performed on an as-needed basis. Minor work such as mowing grass is performed by the park staff. Major work is contracted. Maintenance of the dam is considered good.

4.3 Maintenance of Operating Facilities. Maintenance of the operating facilities is conducted by the park staff. The drainline is exercised and lubricated twice each year. Maintenance of operating facilities is considered good.

4.4 Warning System in Effect. There is no formal warning system in effect to warn downstream residences of high discharges or failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered good. There is no warning system in effect to warn downstream residences of large spillway discharges or failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. Considerable hydrology and hydraulic information is contained in the PennDER files. However, the hydrology and hydraulics were based on an arbitrary datum which does not compare with U.S.G.S. datum. Accuracy of this hydrology and hydraulic data is questionable.

b. Experience Data. No rainfall, runoff or reservoir level data is kept. The spillway has reportedly functioned adequately in the past. Maximum spillway discharge was reported to be approximately 500 cfs in June of 1972.

c. Visual Observations. The spillway appeared to be in good condition and well maintained. The condition of the drainline was unobserved. Upstream of Hills Creek Dam are several shallow ponds formed by beavers. During flooding, it is reported that these dams are washed out.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

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

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this sturcture, it was necessary to make the following assumptions.

1. Initial water level before the flood is elevation 1486.0 (spillway crest).

2. Flow through the drainline is neglected.

3. The effect of the upstream beaver ponds is neglected.

5.3 Summary of Overtopping Analysis. Complete summary sheets from the computer output are presented in Appendix D.

Peak Inflow	11,900 cfs
Spillway capacity	6,598 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for this dam is the PMF. The SDF is based on the hazard and size classification of the dam. Based on the following

definition provided by the Corps of Engineers, the spillway for this dam is rated as inadequate as a result of our hydrologic analysis.

> Inadequate - Intermediate size dams which do not pass the PMF, but which do pass 50% of the PMF.

The spillway and reservoir are capable of controlling approximately 85% of the PMF without overtopping the embankment.

Note: Several small dams located upstream of Hills Creek Dam were constructed by beavers. These dams have failed in the past during heavy storms. These ponds are shallow and in the event of failure, the additional inflow should be insignificant.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations did not reveal any signs of immediate instability. The upstream slope is paved and the downstream slope contains no erosion or seepage zones. The source and the effect of the wet area downstream of the dam are unknown. The wet area should be monitored at periodic intervals. The dam elevations do not conform to the construction drawings. The toe drain shown on the construction drawings was not observed in the field.

b. Design and Construction Data. No stability analyses are on record for this dam.

c. Operating Records. There are no operating records.

d. Post-Construction Changes. There have been no post-construction changes to the dam or appurtenant structures.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analysis has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in good condition. The visual observations, review of available information, hydrologic calculations and past operational performance indicate that Hills Creek Dam spillway is inadequate. The spillway is capable of controlling approximately 85% of the PMF without overtopping. The cause of the wet area downstream of the dam in unknown. The long-term effect of this wet area on the stability of the structure is uncertain.

b. Adequacy of Information. Sufficient information is available to complete a Phase I report.

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

d. Necessity for Further Investigations. No investigations are needed at this time.

7.2 Recommendations/Remedial Measures.

1. Monitor the wet area beyond the toe. If a change occurs, a study should be conducted to determine the cause and evaluate the consequences of the seepage.

2. Because of the bridge across the emergency spillway and the pier located in the middle of the spillway, a trash boom should be installed to prevent any debris from blocking the emergency spillway.

3. A warning system should be developed to warn downstream residents of large spillway discharges, during periods of heavy rainfall or high runoff, or failure of the dam.

4. Institute a formal inspection program to be conducted at regular intervals by personnel trained for dam safety inspections.

APPENDIX A

CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Hills Creek Dam COUNTY Tioga STATE Pennsylvania ID# PA 34

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION April 19, 1979 WEATHER Clear, windy TEMPERATURE 60°F

POOL ELEVATION AT TIME OF INSPECTION 1486.1 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, L. Robert Kimball & Associates

James T. Hockensmith, L. Robert Kimball & Associates

Kuang-hwei Chuang, L. Robert Kimball & Associates

Thomas McGuinn, Park Superintendent

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment has a bend in the upstream direction near the left abutment. This bend was into the structure. A low point at elevation 1494.9 is located near the maximum section of the dam.	designed
RIPRAP FAILURES	No riprap. The upstream face of the dam is paved from approximately 5 feet below water level to the top of dam.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Downstream slope has grass and crown vetch.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good.	
ANY NOTICEABLE SEEPAGE	None noted.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None noted.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	
STAFF GAUGE OR RECORDER	N/A	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Unobserved. 30" cast iron pipe serves as drainline .	
INTAKE STRUCTURE	Unobserved.	
OUTLET STRUCTURE	30" cast iron pipe outlets directly into the spillway exit channel.	
OUTLET CHANNEL	Spillway exit channel - good condition.	
EMERGENCY GATE	Valve on 30" cast iron drainline is operated on the upstream face at the top of the control structure.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete ogee in good condition.	
APPROACH CHANNEL	Lake.	
DISCHARGE CHANNEL	Concrete-lined chute in good condition.	
BRIDGE AND PIERS	Bridge crosses the emergency spillway near the weir. Bottom of beam on bridge is at elevation 1494.9 which corresponds to the low point on the top of dam.	

GATED SPILLWAY

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

DOWNSTREAM CHANNEL

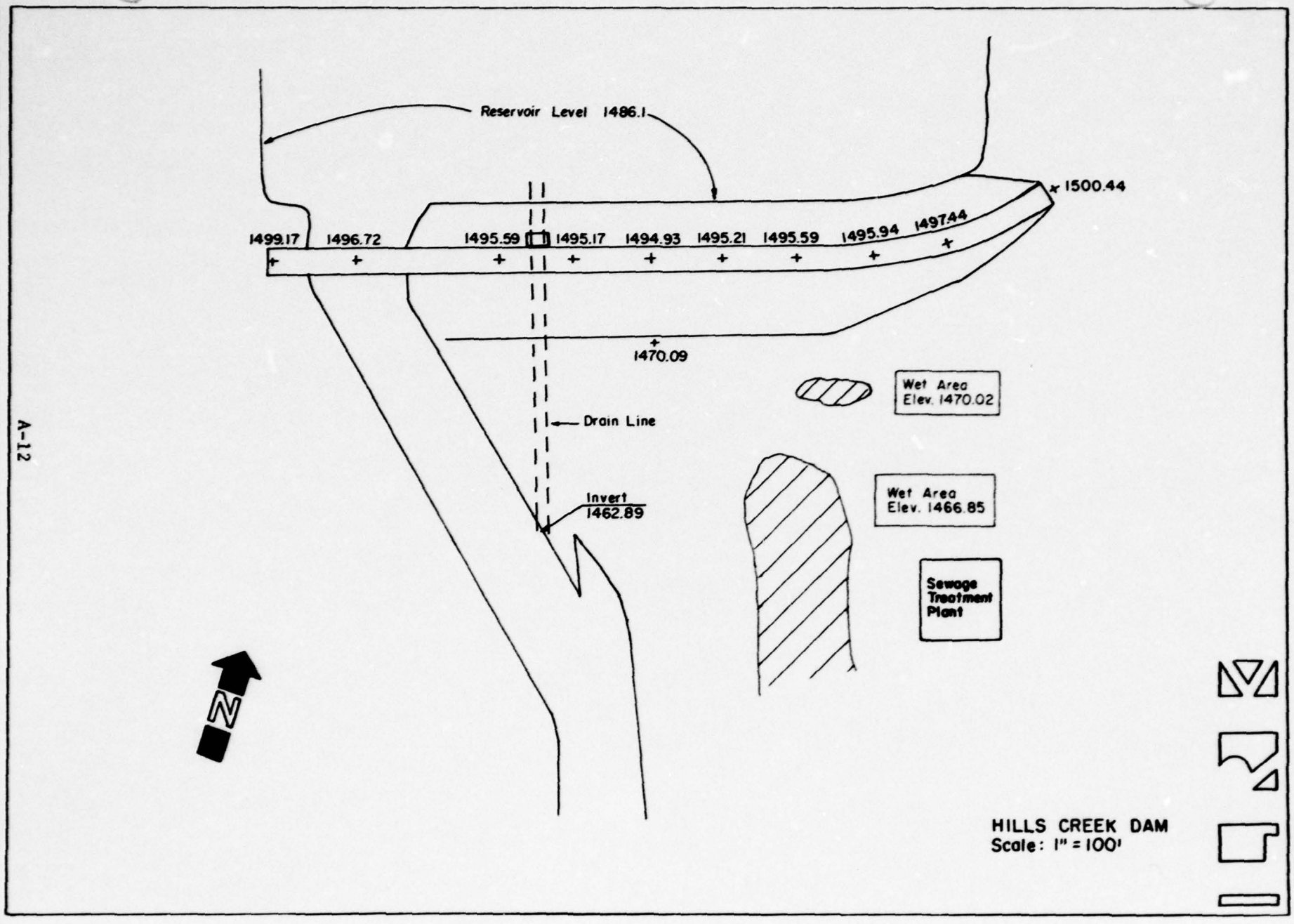
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Natural stream moderately wide flood plain with farming and pastureland.	
SLOPES	Gentle to moderate.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 15 homes (60 people) are located within five miles of the dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle, stable slopes.	
SEDIMENTATION	Did not appear to be excessive.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	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1500.44
1499.17
1496.72
1495.59
1495.17
1494.93
1495.21
1495.59
1495.94
1497.44
1470.09
Wet Area
Elev. 1470.02
Drain Line
Invert
1462.89
Wet Area
Elev. 1466.85
Sewage
Treatment
Plant
N
HILLS CREEK DAM
Scale: 1" = 100'

APPENDIX B

CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Hills Creek Dam

ID# PA 34

ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	PennDER files.
TYPICAL SECTIONS OF DAM	Construction drawings.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	Construction drawings. Construction drawings. Construction drawings. PennDER files. None.

ITEM	REMARKS
DESIGN REPORTS	PennDER files.
GEOLOGY REPORTS	PennDER files.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	PennDER files. PennDER files. None. None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Construction drawings and PennDER files.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

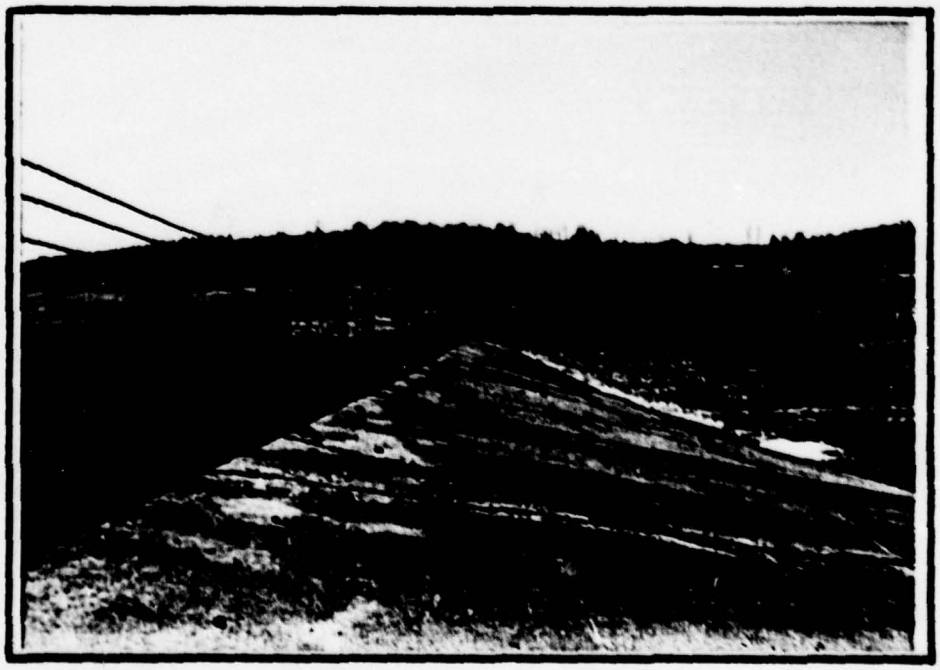
ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Construction drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Construction drawings.

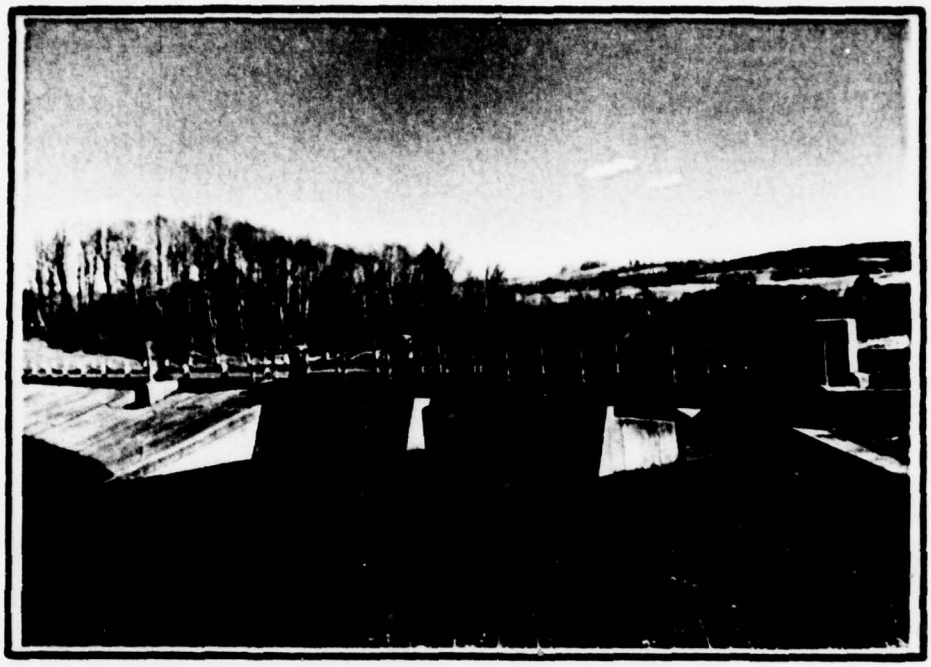
APPENDIX C

PHOTOGRAPHS

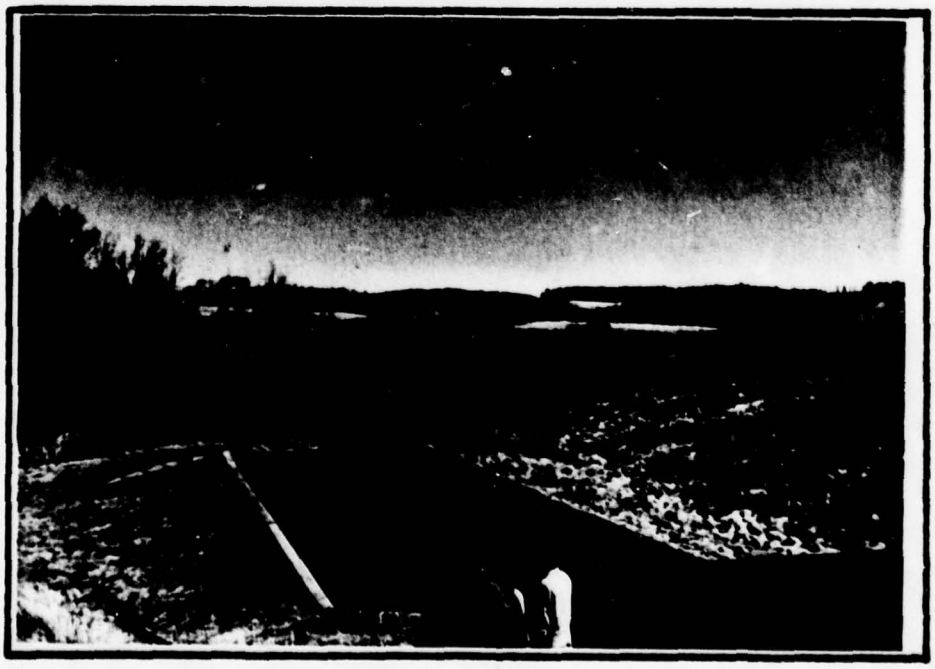
Downstream view of dam.
Note: Sewage treatment plant downstream.



Upstream view of paved slope.

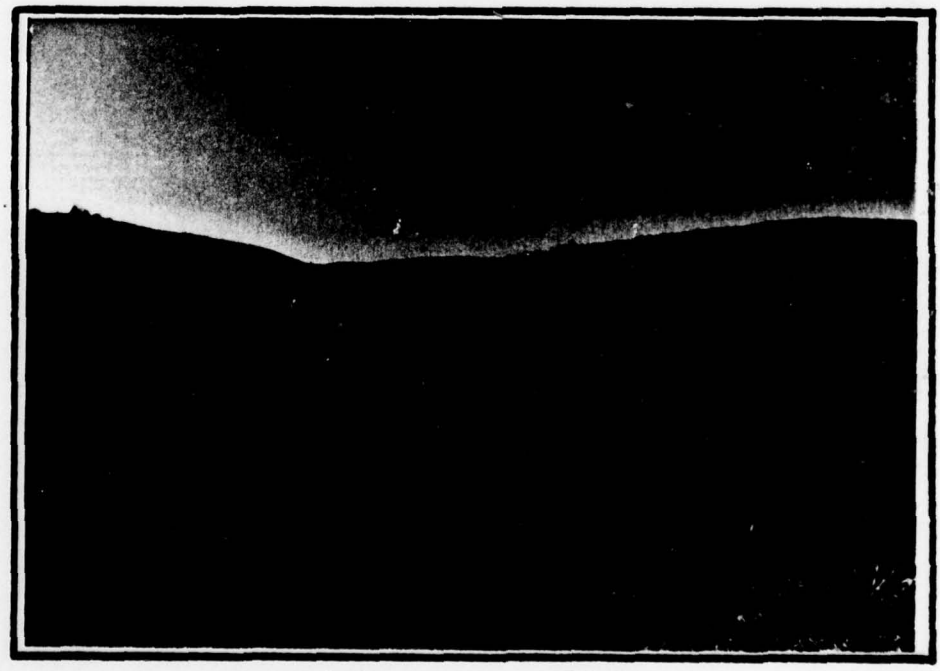


Roadway bridge over spillway.



Spillway exit channel.

Beaver dam upstream of Hills Creek Dam.



Several downstream residences.

APPENDIX D

HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

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

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Reports No. 40 prepared by the National Weather Service.

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

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

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

Parameter	Definition	Where Obtained
C_t	Coefficient representing variations of watershed slope and storage	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
L_{ca}	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
C_p	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

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

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

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

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

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

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HILLS CREEK DAM
I.D. NUMBER PA. 59-58
SHEET NO. 1 OF 3
BY OTM DATE 5-4-79

HILLS CREEK DAM

DRAINAGE AREA

AREA = 3.7 mi^2 (FROM U.S.G.S. 7.5 MINUTE QUAD.)

UNIT HYDROGRAPH PARAMETERS

DAMSITE LOCATED IN ZONE #16, SUSQUEHANNA RIVER BASIN. FROM CORPS OF ENGINEERS, BALTIMORE DISTRICT REGIONAL STUDY.

$C_p = 0.49$, $C_t = 0.80$

$L = 2.6$ mi , $L_{ca} = 0.9$ mi (U.S.G.S. 7.5 MIN. QUAD.)

$t_p = C_t (L \times L_{ca})^{0.3} = 0.8 (2.6 \times 0.9)^{0.3}$

$t_p = 1.0$ HRS (SNYDERS LAG (t_p) IN HRS.)

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR
STRTQ = 1.5 cfs/mi^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.00

PROBABLE MAXIMUM STORM

FROM HR. No. 40
P.M.P., INDEX RAINFALL 22.2(0.99) = 22 IN.

$R_6 = 117\%$, $R_{12} = 127\%$, $R_{24} = 136\%$, $R_{48} = 143$, $R_{72} = 145\%$

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HILLS CREEK DAM
I.D. NUMBER PA. 59-58
SHEET NO. 2 OF 3
BY OTM DATE 5-4-79

ELEVATION - AREA - CAPACITY RELATIONSHIPS

FROM USGS 7.5 MIN. QUAD, FIELD INSPECTION DATA AND DER FILES.

AT SPILLWAY CREST, ELEV. 1486
AREA = 128 ACRES
INITIAL STORAGE = 1298 ACRE·FT

AT 1500', AREA = 220 ACRES
AT 1520', AREA = 288 ACRES

FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A = 3(1298)/128 = 30.4'$
ELEV. AT CAPACITY EQUALS ZERO;
1486' - 30.4' = 1455.6'

ELEVATION (FT.)	1455.6	1486	1491	1495	1500	1504	1520
AREA (AC.)	0	128	150	175	220	245	288

DISCHARGE RATING CURVE

(SPILLWAY)

ELEV. 1486 TO 1495 (OGEE WEIR FLOW), C = 3.6

ELEV. 1495 TO 1496.9 (ORIFICE FLOW), *k = 1.5

ELEV. FROM 1496.9 (ORIFICE AND WEIR FLOW)
*k = 1.5, C = 3.1

* LOSS COEFFICIENT SUGGESTED FOR RELATIVEY SHORT CULVERTS, USE k = 1.5.

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME HILLS CREEK DAM
I.D. NUMBER PA. 59-58
SHEET NO. 3 OF 3
BY OTM DATE 5-29-79

ELEV. (FT.)	OGEE WEIR FLOW c=3.6, l=69'		ORIFICE FLOW (K=1.5)		WEIR FLOW c=3.1 l=69'		DIS-CHARGE
	h_1 (FT)	Q_1 (CFS)	h_2 (FT)	Q_2 (CFS)	h_3 (FT)	Q_3 (CFS)	Q_T (CFS)
1486	0	0					0
1488	2	703					703
1490	4	1987					1987
1492	6	3651					3651
1494	8	5621					5621
1495	9	6707	4.5	8632			6707
1495.5			5	9099			9099
1496			5.5	9543			9543
1496.5			6	9967			9967
1496.7			6.2	10132			10132
1497			6.5	10374	0.3	35	10409
1498			7.5	11144	1.3	317	11461
1499			8.5	11864	2.3	746	12610
1500			9.5	12542	3.3	1282	13824

Q_1 & Q_3 (FROM $Q = CLH^{1.5}$), Q_2 (FROM $Q = A\sqrt{2gh/k}$)

OVERTOP PARAMETERS

TOP OF DAM ELEV. (LOW SPOT) = 1494.9'
LENGTH OF DAM = 518', C = 3.1 (BROAD CREST WEIR)

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.7 square miles, farmland and woodland.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1486.0 (1297)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1494.9

SPILLWAY CREST:

a. Elevation 1486.0
b. Type Concrete ogee
c. Width
d. Length 69 feet
e. Location Spillover Right abutment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 30" cast iron pipe
b. Location Through embankment
c. Entrance inverts None
d. Exit inverts 1462.9
e. Emergency draindown facilities Gate on 30" cast iron pipe.

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: Approximately 500 cfs June 1972

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1          A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2          A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HILLS CREEK DAM  PA.99-98
    3          A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR
    4          B    288       0       15        0        0        0        0        0       -4        0
    5          B1     5
    6          J      1       9        1
    7          J1    .1      .2       .3       .4       .5       .6       .7       .8       1
    8          K      0       1                                                    1
    9          K1       INFLOW TO RESERVOIR
   10          M      1       1      3.7                3.7                                  1
   11          P             22.0     117      127      136      143      145
   12          T                                                          1.0     0.05
   13          W    1.0     0.49
   14          X   -1.9     -.09      2.0
   15          K      1       2                                                    1
   16          K1       ROUTE THROUGH RESERVOIR
   17          Y                                          1        1
   18          Y1                                                          -1486      -1
   19          Y4  1486    1487     1488     1489     1490     1491     1492     1493     1498     1499
   20          Y4 1495.5    1498   1496.5   1496.7     1497     1498     1499     1900
   21          Y5     0     248      703     1291     1987     2777     3651     4600     5621     6707
   22          Y5  9099    9543     9967    10132    10409    11461    12610    13824
   23          SA     0     128      150      175      220      245      288
   24          SE 1495.6    1486     1491     1495     1500     1504     1520
   25          SS  1488
   26          SD 1494.9     3.1      1.5      518
   27          SL     0     210      413      443      456      905      918
   28          SV 1494.9    1495     1496     1497     1498     1499     1500
   29          K     99
```

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

RUN  DATE  79/09/25.
     TIME  19.53.24.

                    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
                    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HILLS CREEK DAM  PA.59-98
                    RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

                                  JOB SPECIFICATION
          NO      NMR     NMIN    IDAY     IHR     IMIN    METRC    IPLT    IPRT   NSTAN
         200        0       15       0       0       0        0       0       5       0
                                  JOPER     NHT    LROPT    ITRACE
                                      5       0       0        0

                          MULTI-PLAN ANALYSES TO BE PERFORMED
                                  NPLAN=  1  NRTIO=  9  LRTIO=  1
                    RTIOS=   .10    .20    .30    .40    .50    .80    .90   1.00   1.20

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

                                SUB-AREA RUNOFF COMPUTATION

                    INFLOW TO RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.70	0.00	3.70	0.00	0.000	0	1	0

PRECIP. DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	117.00	127.00	136.00	143.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	[illegible]	0.00	[illegible]

UNIT HYDROGRAPH DATA
TP= 1.00 CP= .49 NTA= 0

RECESSION DATA
STRTQ= [illegible] QRCSN= [illegible] RTIOR= [illegible]

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG= 1.01 HOURS, CP= .49 VOL= 1.00

120.	440.	835.	1121.	1149.	996.	827.	687.	571.	474.
394.	327.	272.	226.	187.	[illegible]	129.	[illegible]	[illegible]	[illegible]
62.	51.	43.	35.	29.	24.	20.	[illegible]	[illegible]	[illegible]
10.									

0

END-OF-PERIOD FLOW

MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q MO.DA HR.MN PERIOD RAIN EXCS LOSS COMP Q

(640.)(582.)(66.)(6291.38)

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

```
                  ISTAQ   ICOMP   IECON   ITAPE   JPLT   JPRT   INAME   ISTAGE   IAUTO
                      2       1       0       0      0      0       1        0       0
                                       ROUTING DATA
          QLOSS   CLOSS     AVG    IRES   ISAME   IOPT   IPMP                LSTR
            0.0   0.000    0.00       1       1      0      0                   0

                  NSTPS   NSTOL     LAG   AMSKK      X     TSK    STORA   ISPRAT
                      0       0       0   0.000  0.000   0.000   -1456.   [illegible]

STAGE      1486.00    1487.00    1488.00    1489.00    1490.00    1491.00    1492.00    1493.00    1494.00
1495.00
           1495.50    1496.00    1496.50    1496.70    1497.00    1498.00    [illegible]    [illegible]

FLOW          0.00     [illegible]     703.00    1291.00    1947.00    [illegible]    [illegible]    [illegible]    [illegible]
6707.00
           9099.00    9543.00    9987.00   10132.00   10409.00   11461.00   12810.00   13824.00

SURFACE AREA=      0.      128.      150.      175.      220.      [illegible]      [illegible]
    CAPACITY=      0.     1297.    [illegible]    [illegible]    [illegible]    [illegible]    [illegible]
   ELEVATION=   1456.     1486.     1491.     1495.     1500.     1504.     1520.

                CREL   SPWID    COQW    EXPW   ELEVL   COQL   CAREA   [illegible]
              1486.0   [illegible]    [illegible]    [illegible]    [illegible]    [illegible]    [illegible]
                                       DAM DATA
                               TOPEL    COQD    EXPD   DAMWID
                              1494.9     3.1     1.5     310.

CREST LENGTH      [illegible]     310.     [illegible]     [illegible]     [illegible]     305.     [illegible]
```

AT OR BELOW ELEVATION	1494.9	1495.0	1496.0	1497.0	1498.0	1499.0	1500.0

PEAK OUTFLOW IS 576. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 1317. AT TIME 42.79 HOURS

PEAK OUTFLOW IS 2116. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 2936. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 3762. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 4596. AT TIME 42.25 HOURS

PEAK OUTFLOW IS 5444. AT TIME 42.25 HOURS

PEAK OUTFLOW IS 6290. AT TIME 42.25 HOURS

PEAK OUTFLOW IS 9409. AT TIME 41.75 HOURS

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

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS							
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8
RATIO 9				.10	.20	.30	.40	.50	.60	.70	.80
1.00											
HYDROGRAPH AT	1	3.70	1	1190.	2380.	3570.	4760.	5950.	7140.	8330.	9520.
11900.		9.58)		33.70)	67.39)	101.09)	134.79)	168.48)	202.18)	235.88)	269.57)
336.97)											
ROUTED TO	2	3.70	1	576.	1317.	2116.	2936.	3762.	4596.	5444.	6290.
9409.		9.58)		16.32)	37.30)	59.93)	83.14)	106.53)	130.19)	154.14)	178.12)
266.42)											

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1486.00	1486.00	1494.00
STORAGE	1297.	1297.	2628.
OUTFLOW	0.	0.	6998.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	1487.72	0.00	1529.	3788.	0.00	43.00	0.00
.20	1489.04	0.00	1706.	1317.	0.00	42.75	0.00
.30	1490.16	0.00	1867.	2116.	0.00	42.50	0.00
.40	1491.18	0.00	2019.	2936.	0.00	42.50	0.00
.50	1492.12	0.00	2163.	3762.	0.00	42.50	0.00
.60	1493.00	0.00	2303.	4598.	0.00	42.25	0.00
.70	1493.81	0.00	2430.	5446.	0.00	42.25	0.00
.80	1494.62	0.00	2574.	6290.	0.00	42.25	0.00
1.00	1495.50	.60	2730.	9409.	2.25	41.75	0.00

APPENDIX E

DRAWINGS

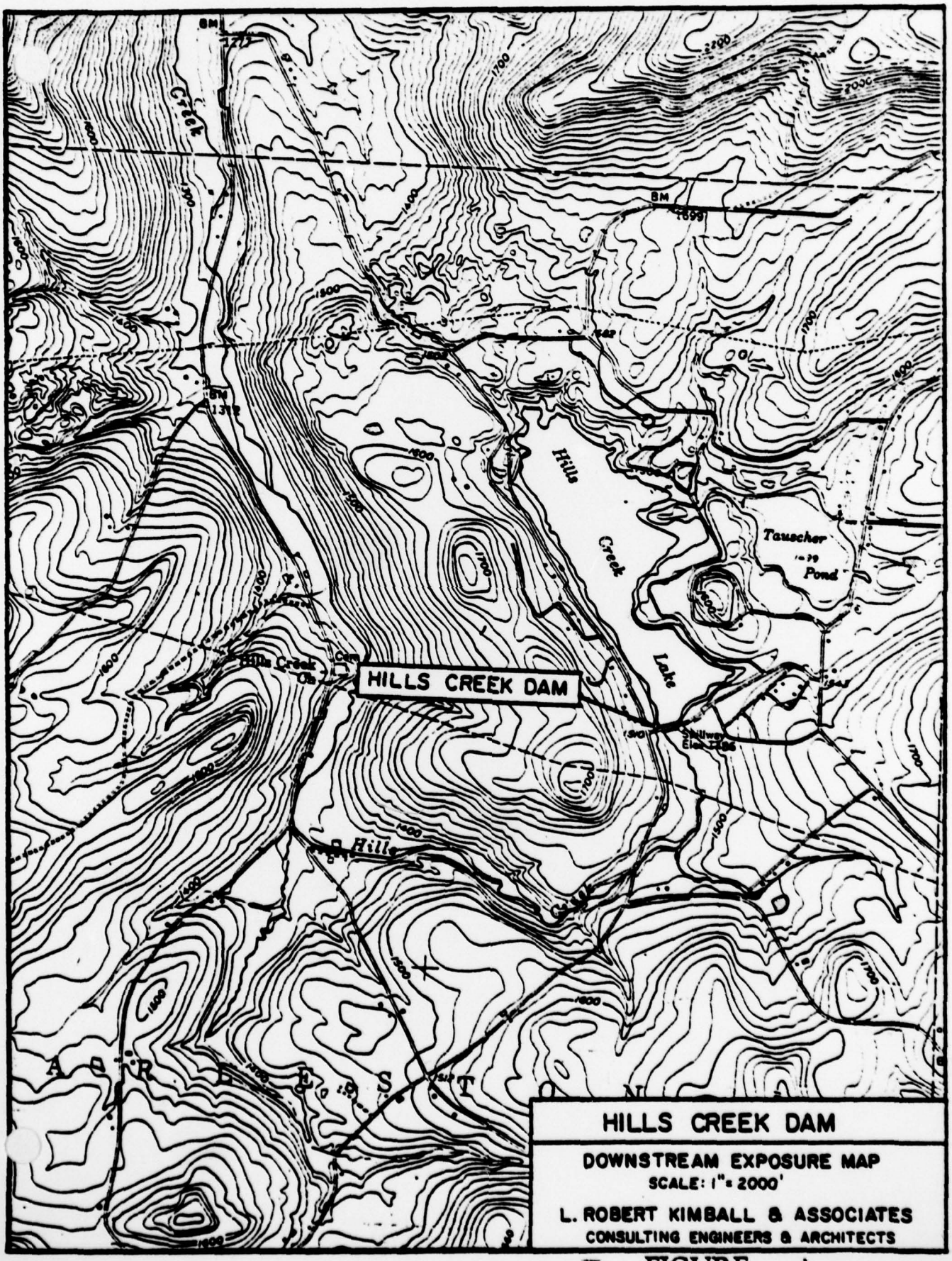
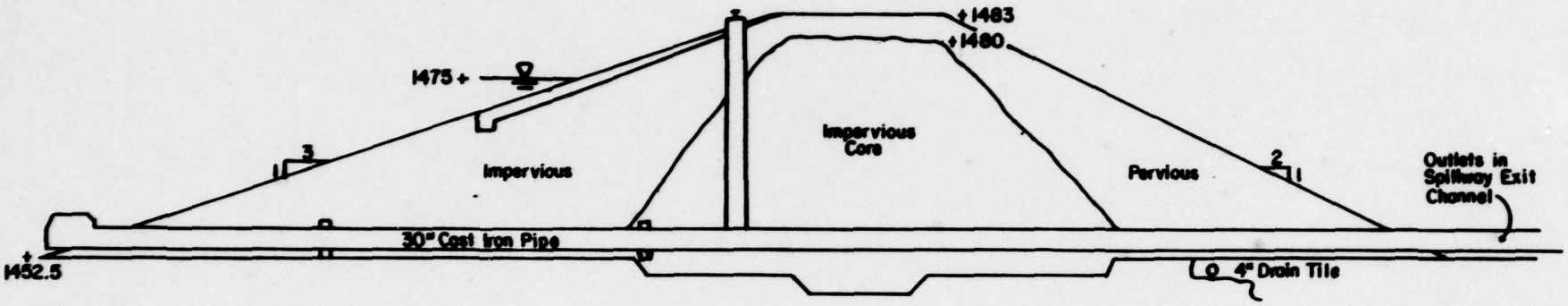

HILLS CREEK DAM
Hills Creek
Lake
Tauscher
Pond
Hills Creek Dam
Spillway
Elev. 1536
Hills
Creek
HILLS CREEK DAM
DOWNSTREAM EXPOSURE MAP
SCALE: 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

FIGURE 1

Plate 2



Scale: 1" = 20'

Note: Sketch Made from Construction Drawings. Discrepancy of 1' Vertically from Field Measurements.

HILLS CREEK DAM

APPENDIX F

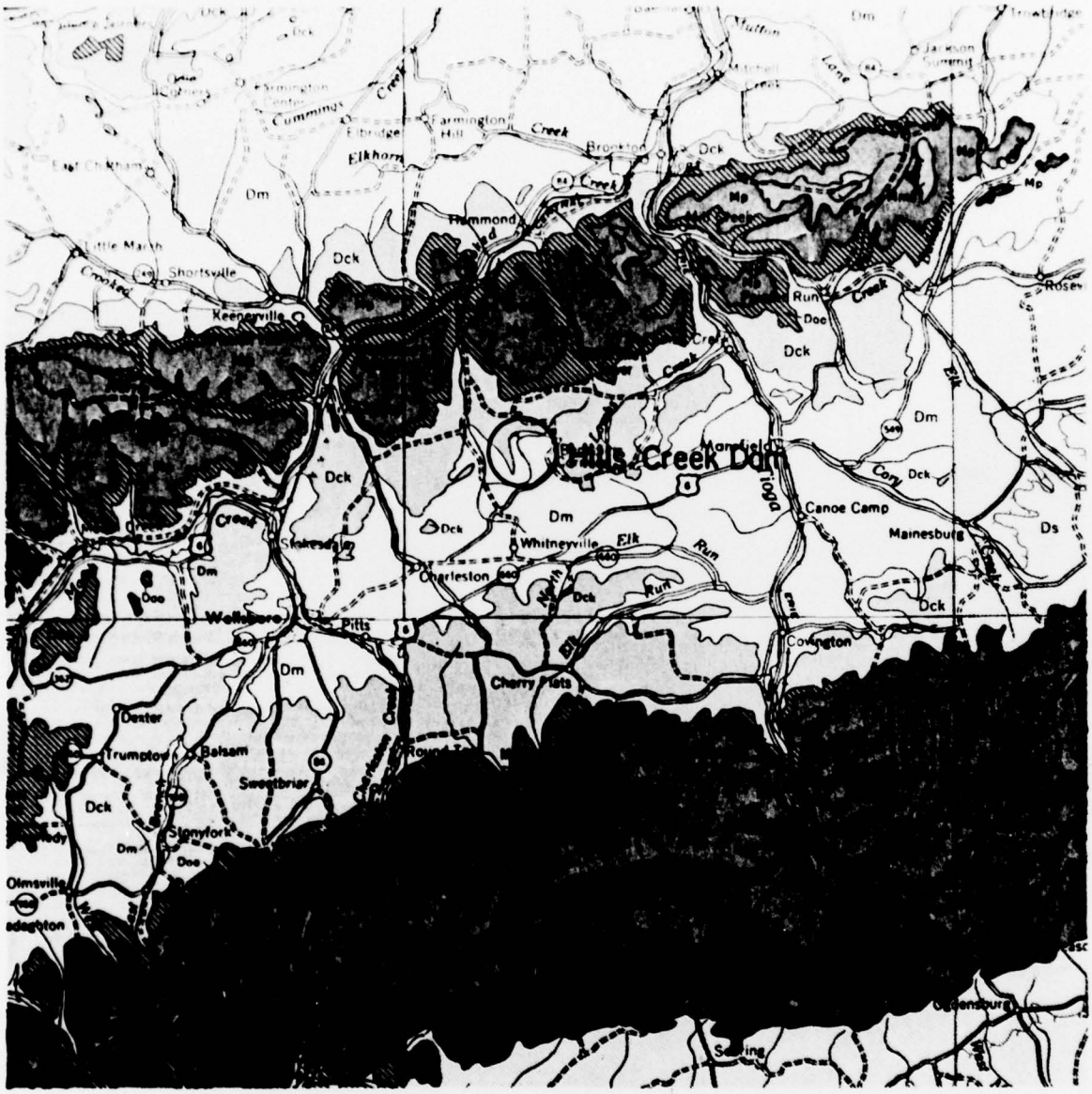
GEOLOGY

General Geology.

Hills Creek Lake and Dam lie within the Allegheny High Plateaus Section of the Applachian Plateaus Physiographic Province. This area is characterized by broad anticlines and synclines with no other major deformational features. There are no known faults in the vicinity of the dam.

The bedrock under the reservoir and dam consists of Upper Devonian aged marine beds and the Catskill Formation. There is no specific information available about the marine beds, but they generally consist of light colored, fine-grained sandstone and siltstone with shale interbeds. The beds are thin, but usually well developed. The joints are also well developed and are moderately to closely spaced in a blocky or platy pattern. The beds are often weathered to a moderate depth which should be excavated to sound material when used as a foundation stone. The surface drainage is good while the joint and bedding planes provide a medium magnitude secondary porosity.

The Catskill Formation is a complex unit consisting of sandstones, siltstones, shales and conglomerates. The beds range in thickness from less than one to over fifteen feet. The joints are well developed, closely spaced and usually form a platy or blocky pattern in shales and siltstones. The shales weather rapidly while the sandstone, siltstones and conglomerates are moderately resistant. This formation may form a good foundation for heavy structures if the weathered portion is excavated and the shales and siltstones are kept water free. The surface drainage is good, except in glaciated areas where it is poor. The coarser rocks have a low interstitial porosity while the joint development causes a medium quantity of total effective porosity.



Geologic Map of Hills Creek Dam Area

Dck — **Catskill Formation**

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

Dm — **Marine beds**

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

Scale: 1:250,000