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NATIONAL DAM INSPECTION PROGRAM. MILL CREEK DAM (NDI ID-PA-0038--ETC(U)
FEB 81 DACW31-81-C-0014

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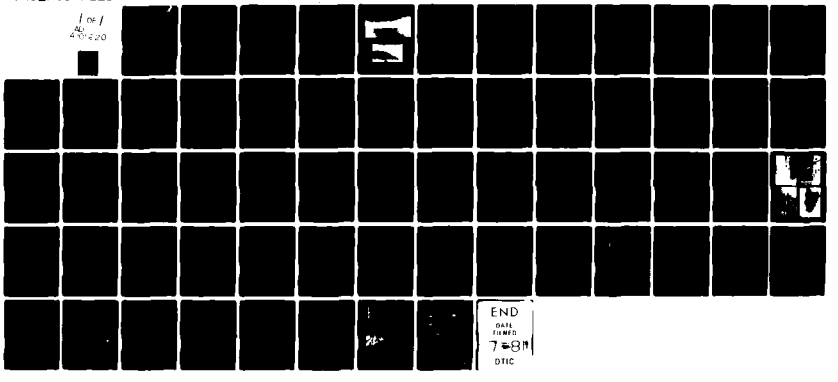


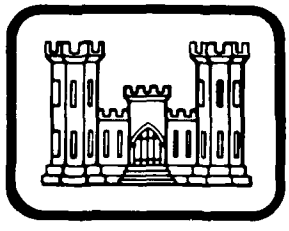
SUSQUEHANNA RIVER BASIN
MILL CREEK, BRADFORD COUNTY

PENNSYLVANIA

MILL CREEK DAM

NDI I.D. PA-0038
DER I.D. 008-051
OWNER: CAMP SPRING HILL,INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



PREPARED FOR

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

BY

D'APPOLONIA CONSULTING ENGINEERS
10 DUFF ROAD
PITTSBURGH, PA. 15235

Contract DACW31-81-C-0014

(6) National Dam Inspection Program.
Mill Creek Dam (NDI ID-PA-0038, DER ID-008-051)
Susquehanna River Basin, Mill Creek,
Bradford County, Pennsylvania. Phase I
Inspection Program.

(12) 61

(11) Feb 81

PREFACE

(15) DACW31-81-C-0014

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 Department of the Army, 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 visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

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 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 the dam depends on numerous and constantly changing internal and external factors which are 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.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

411001

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Mill Creek Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Bradford
STREAM: Mill Creek, a secondary tributary of Susquehanna River
SIZE CLASSIFICATION: Small
HAZARD CLASSIFICATION: Significant
OWNER: Camp Spring Hill, Inc.
DATE OF INSPECTION: November 14, 1980 and February 5, 1981

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Mill Creek Dam is considered to be fair. No conditions were noted that would significantly affect the structural performance of the dam at this time. Ponded water exists along the portion of the downstream toe which precluded inspection of this area for possible seepage. Therefore, this area should be inspected by the owner after the pond below the toe of the dam is drained.

The operational condition of the outlet facilities is unknown. The evaluation of the operational condition of the outlet works by the owner is recommended.

The spillway capacity was evaluated according to the recommended criteria and found to be inadequate. The spillway capacity is less than the 100-year flood peak and the spillway cannot pass the spillway design flood of one-half of the Probable Maximum Flood (PMF) without overtopping the dam. Therefore, the flood discharge capacity of the dam is classified to be inadequate.

The following recommendations should be implemented as soon as possible or on a continuing basis.

1. The owner should determine the nature and extent of improvements required to provide adequate spillway capacity. In the interim, the low areas on the crest of the dam should be scarified and filled with compacted fill.

2. The ponded water at the toe of the dam should be drained and the toe of the dam should be inspected for possible seepage. Necessary measures should be taken to control seepage, if it exists.

3. The operational condition of the low level outlet facilities should be evaluated and necessary maintenance performed. If the low level outlet facilities cannot be rendered functional, other means should be developed to drain the lake in the event of an emergency.

4. Brush on the downstream face of the dam and in the spillway discharge channel should be removed.

5. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of emergencies.

6. The owner should develop a formal operating and maintenance plan and inspect the dam regularly and perform necessary maintenance.

Lawrence D. Andersen, P.E.
Vice President

June 1, 1981
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer

6 JUNE 1981
Date:

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Looking Downstream

Looking Downstream
(From right abutment)

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
MILL CREEK DAM
NDI I.D. PA-0038
DER I.D. 008-051

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct 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 or property.

1.2 Description of Project

a. Dam and Appurtenances. Mill Creek Dam consists of an earth embankment approximately 200 feet long with a maximum height of 12 feet from the downstream toe. The crest width is about 12 feet. The upstream face is partially covered with riprap and has approximately a 2 horizontal to 1 vertical slope. The slope of the downstream face is variable and ranges between 3 horizontal to 1 vertical near the right abutment (looking downstream) to about 2 horizontal to 1 vertical at the middle of the dam. Flood discharge facilities for the reservoir consist of an open channel located near the left abutment. The spillway overflow section discharges into a riprap-lined channel which terminates approximately 50 feet downstream from the control point. This channel, in turn, discharges into an earth channel. According to the design drawings, the outlet works consist of a 16-inch steel pipe through the embankment extending from the upstream to the downstream toe. Flow through the pipe is controlled by a valve located at about the midlength of the pipe, operated by a valve stem extending to the crest level. This outlet system constitutes the emergency drawdown facilities for the dam. No portions of the outlet system could be located during this inspection.

b. Location. The dam is located across Mill Creek, approximately three miles upstream from its confluence with the Tuscarora Creek in Tuscarora Township, Bradford County, Pennsylvania (N41° 43.3', W76° 10.3°). Plate 1 shows the location of the dam.

c. Size Classification. Small (based on 12-foot height and 190 acre-feet maximum storage capacity).

d. Hazard Classification.—The dam is classified to be in the significant hazard category. Approximately 300 to 400 feet below the dam, the stream flows under a highway and then follows a narrow and steep valley for about one-half mile. At the end of this reach, the stream enters a flat marshy area and meanders through this area for another one-half mile. At approximately one mile downstream from the dam, the creek enters a narrow and steep valley for the remainder of its course, until reaching Tuscarora Creek near Silvara. Before joining Tuscarora Creek, the stream flows under State Route 367. The rural residential and commercial areas of Silvara are located in the vicinity of the confluence of Mill Creek and Tuscarora Creek. It is estimated that failure of the dam may cause loss of a few lives and some property damage in these areas.

e. Ownership. Camp Spring Hill, Inc. (address: Mr. Robert Anderson, R.D. #8, Box 569, Flemington, New Jersey 08822).

f. Purpose of Dam. Recreation.

g. Design and Construction History. The dam was designed by Mr. D. C. Meyer, P.E. of Sayre, Pennsylvania, in 1953. The records indicate that the construction of the dam was completed in 1954.

h. Normal Operating Procedure. The reservoir is normally maintained at the crest level of the uncontrolled spillway.

1.3 Pertinent Data. Elevations referred to in this and subsequent sections of the report were calculated based on field measurements assuming the normal pool level to be at Elevation 1155 (USGS Datum) which is interpolated from the USGS 7.5-minute Laceyville and Auburn Center quadrangles.

a. Drainage Area	1.3 square miles[1]
b. Discharge at Dam Site (cfs)	
Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	Unknown
Gated spillway capacity at maximum pool	Not applicable
Ungated spillway capacity at maximum pool	836
Total spillway capacity at maximum pool	836
c. Elevation (USGS Datum) (feet)	
Top of dam	1159 (as designed
Maximum pool	1157.9 (low spot)
Normal pool	1155
Upstream invert outlet works	Unknown

[1] Planimetered from USGS maps.

Downstream invert outlet works	1145± (estimated)
Maximum tailwater	Unknown
Toe of dam	1146

d. Reservoir Length (feet)

Normal pool level	2100
Maximum pool level	2200+

e. Storage (acre-feet)

Normal pool level	120(2)
Maximum pool level	190(2)

f. Reservoir Surface (acres)

Normal pool level	21.1
Maximum pool level	26.6

g. Dam

Type	Earth
Length	200 feet
Height	12 feet
Top width	12 feet
Side slopes	Downstream: Varies 3H:1V to 2H:1V Upstream: 2H:1V
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Regulating Outlet(2)

Type	16-inch-diameter steel(3)
Length	78 feet(3)
Closure	Valve(3)
Access	Unknown(3)
Regulating facilities	Valve(3)

i. Spillway

Type	Earth channel overflow section

(2) Estimated based on the reservoir area and height of the dam.

(3) Reported on design drawings. Outlet works were not observed during this inspection.

Length	46 feet (perpendicular to flow) 62 feet (as designed)
Crest elevation	1155
Upstream channel	Lake
Downstream channel	Earth

SECTION 2
DESIGN DATA

2.1 Design

a. Data Available. The available data consist of files provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER), which contain design drawings, past inspection reports and correspondence.

(1) Hydrology and Hydraulics. No design information is available. A Commonwealth of Pennsylvania report entitled, "Report Upon the Application of Howard T. Karschner," dated September 1955, gives the design capacity of the spillway.

(2) Embankment. Available information consists of design drawings, past inspection reports, and correspondence.

(3) Appurtenant Structures. The available information consists of limited design drawings.

b. Design Features

(1) Embankment. Available records indicate that the dam consists of a compacted homogeneous earth embankment. Plates 2 and 3 show the plan and the typical cross section of the dam, respectively. The dam was designed to have a 2 horizontal to 1 vertical slope both upstream and downstream with a crest width of 12 feet. Riprap was provided on the upstream face extending from about two feet below the normal pool level to about two feet above the normal pool level.

Plate 2 also shows the plan and valley cross section of the dam. As shown in Plate 3, approximately a 60-foot section of the embankment forms the base of the open channel spillway.

(2) Appurtenant Structures. The appurtenant structures consist of a combined emergency and primary spillway located on the left abutment and outlet works. The spillway is comprised of a trapezoidal riprap-lined open channel. The base of the overflow section is approximately 60 feet wide and located about 2.5 feet below the low spot on the crest of the dam.

According to the design drawings, the outlet works for the dam consist of a 16-inch steel pipe located at the center of the dam. No design information is available on the details of the construction of the outlet pipe through the embankment. Flow through the outlet pipe is controlled by a valve at about the midlength of the pipe.

c. Design Data

(1) Hydrology and Hydraulics. No design data are available. The 1953 Commonwealth of Pennsylvania report notes the spillway capacity to be 1325 cfs, based on a 63-foot flow width and a head of 4 feet.

(2) Embankment. No engineering data are available on the design of the embankment.

(3) Appurtenant Structures. No design information is available on the appurtenant structures.

2.2 Construction. Available records indicate that the construction of the dam was completed about 1954. No other information is available on the construction of the dam. Based on field observations, it appears that the spillway was not constructed in accordance with design drawings. While the design drawings show the width of the spillway to be 63 feet, the width of the spillway was measured to be approximately 46 feet during inspection. No information was found to indicate that any major postconstruction changes were undertaken.

2.3 Operation. There are no formal operating records maintained for the dam.

2.4 Other Investigations. None.

2.5 Evaluation

a. Availability. The available information was provided by PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. Available information is not considered to be sufficient to assess the adequacy of the spillway capacity.

(2) Embankment. No design and construction information is available to assess the adequacy of the design of the embankment.

(3) Appurtenant Structures. No design information is available for the appurtenant structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The onsite inspection of Mill Creek Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.

2. Visual examination of the spillway and the visible portions of the outlet works.

3. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 4.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

In general, the condition of the dam is considered to be fair. The downstream face of the dam is covered with grass and brush and revealed no signs of distress. The upstream face of the dam is also covered with grass and partially with riprap and was found to be in good condition with no signs of significant shoreline erosion.

The most significant condition noted was the presence of a pond at the toe of the dam. The pond appeared to be caused by blockage of the outlet pipe discharge channel by debris, approximately 20 feet below the dam. The pond submerges a portion of the downstream slope of the dam, precluding adequate inspection of the toe of the dam for possible seepage.

The crest of the dam was surveyed relative to the spillway crest elevation and it was found that approximately two-thirds of the embankment is approximately 1.0 foot below the design crest level. The dam crest profile is illustrated in Plate 5. The downstream slope of the dam was surveyed and found to be varying between 3 horizontal to 1 vertical and 2 horizontal to 1 vertical.

c. Appurtenant Structures. The spillway structures were examined for deterioration or other signs of distress that would limit flow. In general, the spillway structures, which consist of a riprap-lined overflow section and a discharge channel, were found to be in fair condition. Approximately 300 feet downstream from the dam, the stream flows through an 8-foot-diameter highway culvert. However, it appears that a blockage of the culvert would not affect the discharge capacity of the spillway.

No portions of the outlet facilities were visible to assess their condition.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered by woodlands. A review of the regional geology is included in Appendix F.

e. Downstream Channel. Below the dam, the stream flows through an uninhabited valley for most of its course and joins Tuscarora Creek at Silvara. Further description of the downstream conditions is included in Section 1.2 d.

3.2 Evaluation. In general, the dam was found to be in fair condition. Due to the presence of ponded water along the toe of the dam which precluded inspection of this dam for signs of seepage, concern exists as to the possibility of seepage through the dam which may be feeding this pond below the dam. In view of this condition, the toe of the dam should be inspected after the pond below the dam is drained. Further, no portions of the outlet facilities were visible for inspection. Therefore, the owner is advised to locate the outlet facilities and evaluate their condition.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. The reservoir is normally maintained at the uncontrolled open-channel spillway crest level with excess inflow discharging over the spillway.

4.2 Maintenance of the Dam. The maintenance condition of the dam is considered to be fair. While the grass on the crest of the dam appears to be occasionally mowed, the downstream face is covered with brush, requiring clearing.

4.3 Maintenance of Operating Facilities. No portions of the outlet facilities were visible for inspection.

4.4 Warning System. No formal warning system exists for the dam. Telephone communication facilities are available approximately one-half mile downstream from the dam.

4.5 Evaluation. While the maintenance condition of the dam is considered to be fair, the outlet pipe and operating equipment could not be located. It is recommended that the operational condition of the outlet facilities be evaluated and necessary maintenance performed by the owner.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Mill Creek Dam has a watershed of 1.3 square miles and impounds a reservoir with a surface area of 21.1 acres at normal pool level. The flood discharge facilities consist of an open-channel spillway located near the left abutment. The capacity of the spillway was determined to be 836 cfs, based on the available 2.9-foot freeboard relative to the low spot on the crest of the embankment. Based on the design freeboard of 4 feet, the spillway capacity would be 1340 cfs.

b. Experience Data. As previously stated, Mill Creek Dam is classified as a small dam in the significant hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass from the 100-year flood to one-half of the PMF. In view of the downstream damage potential, one-half PMF was selected as the spillway design flood.

The PMF inflow hydrograph for the reservoir was determined utilizing the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. Data used for the computer analysis are presented in Appendix D. The one-half PMF inflow hydrograph was found to have a peak flow of 1641 cfs. The 100-year flood, calculated according to the recommended procedure, was found to have a peak flow of 1170 cfs. The computer input and a summary of the computer output for the PMF analysis and the 100-year flood calculations are included in Appendix D.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the capacity of the spillway would be significantly reduced in the event of a flood.

d. Overtopping Potential. The existing spillway capacity of 836 cfs is found to be less than the 100-year flood peak flow of 1170 cfs. Further, various percentages of PMF inflow hydrograph were routed through the reservoir, and it was found that the spillway can pass 20 percent of the PMF without overtopping at the low spot on the crest of the dam. For 50 percent of the PMF, the low spot on the crest would be overtopped for a duration of 3.5 hours with a maximum depth of 1 foot.

e. Spillway Adequacy. Since the spillway cannot pass the spillway design flood of one-half PMF without overtopping the embankment, the spillway is classified to be inadequate. Further, the existing spillway capacity is less than the 100-year flood peak flow of 1171 cfs. However, if the low areas on the dam crest were filled to the design elevation, the spillway capacity would be sufficient to pass the 100-year flood.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam at this time. However, ponded water along the toe of the dam precluded adequate inspection of this area and raised concern as to the possibility of seepage through the dam that could affect the performance of the structure. Therefore, inspection of this area is recommended after the pond below the toe of the dam is drained.

(2) Appurtenant Structures. The structural performance of the spillway facilities appears to be satisfactory. Because the outlet pipe was not visible and could not be located, no conclusions were reached as to the structural adequacy of the outlet facility.

b. Design and Construction Data

(1) Embankment. As previously noted, no signs of distress were noted at this time. Therefore, based on visual observations, the static stability of the dam is considered to be adequate.

(2) Appurtenant Structures. No design and construction data are available to assess the structural adequacy of the appurtenant structures.

c. Operating Records. Not maintained.

d. Postconstruction Changes. None reported.

e. Seismic Stability. The dam is located in Seismic Zone 1 and based on visual observations, the static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for the evaluation of seismic stability of dams, the structure is presumed to present no hazard from earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that the Mill Creek Dam embankment is in fair condition. No conditions were observed that would significantly affect the overall performance of the structure at this time. However, the presence of ponded water along the toe of the dam raises concern as to the possibility of seepage through the dam in this area. Therefore, the toe of the dam should be inspected for signs of seepage after the pond is drained and necessary measures taken if seepage conditions exist.

Operating facilities for the outlet pipe could not be located; therefore, the operational condition of these facilities is unknown. It is recommended that the owner evaluate the operational condition of the outlet facilities and perform necessary maintenance.

Spillway capacity was evaluated according to the recommended procedure and was found to pass 20 percent of the PMF without overtopping the embankment, which is less than the required spillway design flood of 50 percent of the PMF. Further, the spillway capacity is also less than the 100-year flood peak. Therefore, the spillway capacity is rated to be inadequate.

b. Adequacy of Information. The available information, in conjunction with the visual observations and the previous experience of the inspectors, is considered to be sufficient to make the following recommendations.

c. Urgency. The following recommendations should be implemented immediately or on a continuing basis.

d. Necessity for Additional Investigations. See Section 7.2 1.

7.2 Recommendations/Remedial Measures

The following recommendations should be implemented as soon as possible or on a continuing basis.

1. The owner should determine the nature and extent of improvements required to provide adequate spillway capacity. In the interim, the low areas on the crest of the dam should be scarified and filled with compacted fill.

2. The ponded water at the toe of the dam should be drained and the toe of the dam should be inspected for possible seepage. Necessary measures should be taken to control seepage, if it exists.

3. The operational condition of the low level outlet facilities should be evaluated and necessary maintenance performed. If the low level outlet facilities cannot be rendered functional, other means should be developed to drain the lake in the event of an emergency.

4. Brush on the downstream face of the dam and in the spillway discharge channel should be removed.

5. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert the downstream residents in the event of emergencies.

6. The owner should develop a formal operating and maintenance plan and inspect the dam regularly and perform necessary maintenance.

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Mill Creek COUNTY Bradford STATE Pennsylvania ID# NDI: PA-0038 DER : 008-051

TYPE OF DAM Earth HAZARD CATEGORY Significant

DATE(S) INSPECTION November 14, 1980 WEATHER Cloudy TEMPERATURE 30's

POOL ELEVATION AT TIME OF INSPECTION 1154.3 M.S.L. TAILWATER AT TIME OF INSPECTION 1146.2 M.S.L.

INSPECTION PERSONNEL:	REVIEW INSPECTION PERSONNEL: (February 5, 1981)
Douglas Cosler	Lawrence D. Andersen
Arthur Smith	James H. Poello
Bilgin Erel	Bilgin Erel

Owner's Representative:
None

Bilgin Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	See Plate 5 for dam crest profile.	
RIPRAP FAILURES	None observed.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No problems observed.	
ANY NOTICEABLE SEEPAGE	None in the visible area of the embankment. A pond submerges a portion of the toe which precludes inspection of this area for signs of seepage.	The pond should be drained and the toe of the dam should be reinspected.
STAFF GAGE AND RECORDER	None	
DRAINS	None	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit shown in design drawings could not be located.	The owner should provide for a functional outlet facility or prepare plans to drain the lake in case of emergency.
INTAKE STRUCTURE	Submerged, not visible.	
OUTLET STRUCTURE	None found.	
OUTLET CHANNEL	N/A	
EMERGENCY GATE	N/A	See above comments.

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Spillway section is a riprap-lined earth channel in fair condition.	
APPROACH CHANNEL	Lake	
DISCHARGE CHANNEL	Earth channel. No significant problems observed.	
BRIDGE AND PIERS	None	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	The dam has no gated spillway.	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

VISUAL INSPECTION
PHASE 1
INSTRUMENTATION

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

VISUAL INSPECTION
PHASE 1
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	No problems observed.	
SEDIMENTATION	Unknown	
UPSTREAM RESERVOIRS	None	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No problems observed.	
SLOPES	No problems observed.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	One mobile home, one house and a general store. Population: Approximately 15.	

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
AND HYDROLOGIC AND HYDRAULIC
PHASE I

APPENDIX B

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Mill Creek

ID# NDI: PA-0038
DER: 008-051

ITEM	REMARKS
AS-BUILT DRAWINGS	None available.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by Mr. D. C. Meyer, a professional engineer from Sayre, Pennsylvania.
TYPICAL SECTIONS OF DAM	See Plate 2.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plate 2.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	None reported.
DESIGN REPORTS	None available.
GEOLOGY REPORTS	No geology information reported.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Some preliminary spillway capacity calculations are contained in state files.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	None
MONITORING SYSTEMS	No existing monitoring systems.
MODIFICATIONS	None reported.
HIGH POOL RECORDS	None available.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None available.
MAINTENANCE OPERATION RECORDS	None available.
SPILLWAY PLAN SECTIONS DETAILS	See Plate 2.
OPERATING EQUIPMENT PLANS AND DETAILS	None available.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 1.3 square miles (wooded)

ELEVATION, TOP OF NORMAL POOL AND STORAGE CAPACITY: 1155 (120 acre-feet)

ELEVATION, TOP OF FLOOD CONTROL POOL AND STORAGE CAPACITY: 1158 (120 acre-feet

ELEVATION, MAXIMUM DESIGN POOL: 1159

ELEVATION, TOP OF DAM: 1158

SPILLWAY:

a. Elevation 1155

b. Type Earth channel

c. Width 46 feet (perpendicular to flow)

d. Length N/A

e. Location Spillover Middle of embankment

f. Number and Type of Gates None

OUTLET WORKS:

a. Type Dam has no outlet facilities.

b. Location N/A

c. Entrance Inverts N/A

d. Exit Inverts N/A

e. Emergency Drawdown Facilities None

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location N/A

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: 836 cfs existing spillway capacity

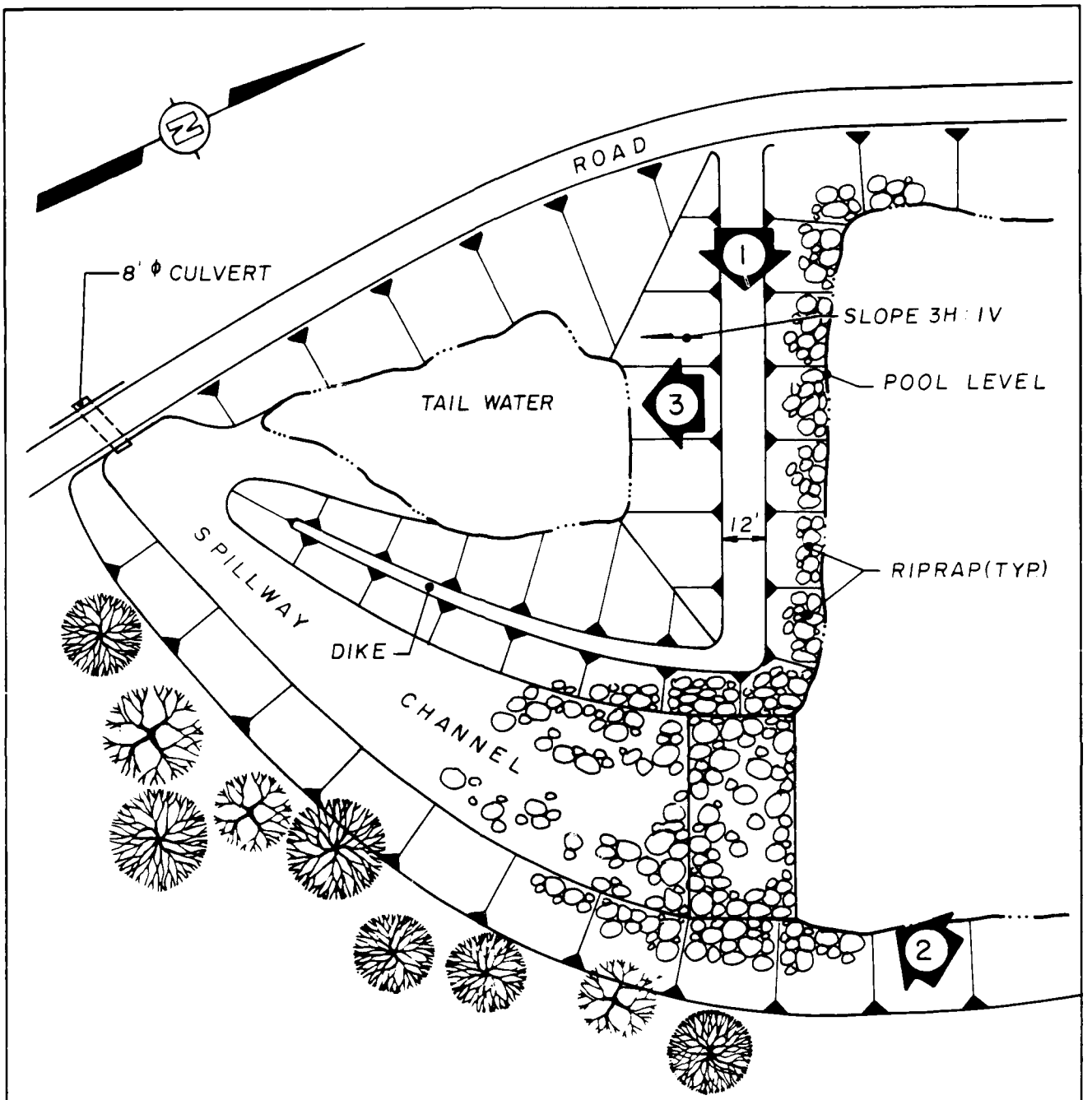
APPENDIX C

PHOTOGRAPHS

LIST OF PHOTOGRAPHS
MILL CREEK DAM
NDI I.D. NO. PA-0038
NOVEMBER 14, 1980

PHOTOGRAPH NO.	DESCRIPTION
1	Crest (looking east).
2	Spillway crest looking downstream.
3	Ponded water along downstream toe of dam.
4	House (3.0 miles).

80-55



LEGEND:

2 INDICATES DIRECTION IN WHICH PHOTOGRAPH WAS TAKEN.

MILL CREEK DAM
KEY PLAN OF PHOTOGRAPHS
FIELD INSPECTION DATE: NOV 14,1980

DAPPOLONIA

NOT TO SCALE

PHOTOGRAPH NO 1

PHOTOGRAPH NO 2

PHOTOGRAPH NO 3

PHOTOGRAPH NO. 4

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM [illegible] Creek Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = [illegible] INCHES/24 HOURS

STATION	1	[illegible]	3	4	5
Station Description	Mill Creek [illegible]	Mill Creek Dam			
Drainage Area (square miles)	1.29	--			
Cumulative Drainage Area (square miles)	1.29	1.29			
Adjustment of PMF for Drainage Area (%)[1]	[illegible]				
6 Hours	[illegible]				
12 Hours	[illegible]	--			
24 Hours	[illegible]				
48 Hours	[illegible]				
72 Hours	[illegible]				
Snyder Hydrograph Parameters					
Zone[2]	[illegible]				
C_p C_t[3]	[illegible]	-			
L (miles)[4]	[illegible]				
L_{ca} (miles)[4]	[illegible]				
t_p = C_t(L · L_{ca})[illegible] (hours)	[illegible]				
Spillway Data					
Crest Length (ft)		46			
Freeboard (ft)	[illegible]	[illegible]			
Discharge Coefficient		[illegible]			
[illegible]		[illegible]			

(1) [illegible] Hydrometeorological Report [illegible], U.S. Weather Bureau, [illegible].
(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients C_p and C_t.
(3) Snyder's [illegible].
(4) L = length of [illegible] watercourse from [illegible].
L_{ca} = length of watercourse from [illegible] point opposite to the centroid of drainage area.

STORAGE VS. ELEVATION

ELEVATION	[illegible] FEET	AREA (acres)[1]	ΔVOLUME (acre-feet)[2]	STORAGE (acre-feet)
[illegible]		[illegible]		
[illegible]		[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]

(1) Planimetered from [illegible].
(2) ΔVolume = [illegible]

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                A1       SNYDER UNIT HYDROGRAPH, SPILLWAY AND DAM OVERTOPING ANALYSES
    2                A2       MILL CREEK DAM,(DER 08-51),BRADFORD COUNTY,PA.       PROJECT NO.8 -55-14
    3                A4       FOR 20%,30%,40%,50%,60%,70%,80%,90%,AND 100% PROBABLE MAXIMUM FLOOD(PMF)
    4                B     300        0       15        0        0        0        0        0       -4        0
    5                B1      5
    6                J       1        9        1
    7                J1   0.20     0.30     0.40     0.50     0.60     0.70     0.80     0.90     1.00
    8                K       0        1                                          1
    9                K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO MILL CREEK DAM,(DER 08-51)
   10                M       1        1     1.29              1.29                                1
   11                P                21.3      117      127      136      142      145
   12                T                                                           1.0      0.5           0.255
   13                W    1.62     0.62
   14                X    -1.5    -0.05      2.0
   15                K       1        2                                          1
   16                K1       ROUTING FLOW THROUGH MILL CREEK DAM,(DER 08-51)
   17                Y                                          1        1
   18                Y1      1                                                -1155.0       -1
   19                Y41155.0  1155.5   1156.0   1156.5   1157.0   1157.5   1158.0   1158.5   1159.0   1159.5
   20                Y41160.0  1160.5   1161.0   1162.0   1163.0   1164.0
   21                Y5    0.0     51.3    148.3    278.2    437.3    623.7    836.4   1074.9   1339.0   1628.6
   22                Y51943.7  2284.3   2650.7   3461.5   4377.9   5402.2
   23                $A   21.1     30.3     53.3
   24                $E1155.0  1160.0   1180.0
   25                $$1155.0
   26                $D1157.9     2.65      1.5    200.0
   27                $L   50.0     75.0    125.0    180.0    200.0
   28                $V1157.9  1158.3   1158.5   1159.5   1160.6
   29                K      99
```

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 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 .60	RATIO 6 .70	RATIO 7 .80	RATIO 8 .90	RATIO 9 1.00
HYDROGRAPH AT	1	1.29	1	656.	985.	1313.	1641.	1969.	2298.	2626.	2954.	3282.
	(	3.34)	(	18.59)(	27.88)(	37.18)(	46.47)(	55.76)(	65.06)(	74.35)(	83.65)(	92.94)
ROUTED TO	2	1.29	1	562.	869.	1218.	1559.	1904.	2237.	2569.	2894.	3224.
	(	3.34)	(	15.92)(	24.60)(	34.50)(	44.16)(	53.93)(	63.35)(	72.76)(	82.02)(	91.29)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1155.00	1155.00	1157.90
STORAGE	0.	0.	68.
OUTFLOW	0.	0.	794.

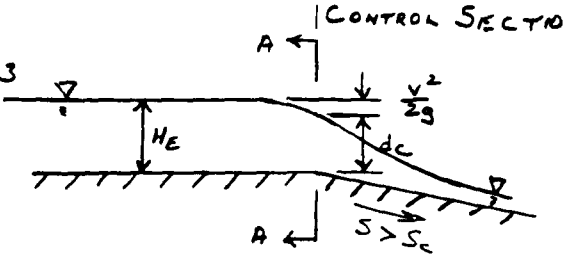
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1157.33	0.00	54.	562.	0.00	42.00	0.00
.30	1158.05	.15	72.	869.	1.25	42.00	0.00
.40	1158.55	.65	86.	1218.	3.00	41.75	0.00
.50	1158.90	1.00	96.	1559.	3.50	41.50	0.00
.60	1159.20	1.30	104.	1904.	4.25	41.50	0.00
.70	1159.45	1.55	111.	2237.	4.75	41.50	0.00
.80	1159.67	1.77	118.	2569.	5.00	41.50	0.00
.90	1159.88	1.98	124.	2896.	5.50	41.50	0.00
1.00	1160.07	2.17	130.	3224.	6.00	41.50	0.00

D'APPOLONIA
CONSULTING ENGINEERS, INC

By MB Date 1/27/81 Subject SPILLWAY RATING CURVE Sheet No. 1 of 1
Chkd. By WTC Date 1/27/81 MILL CREEK DAM Proj. No. 80-556-13

SPILLWAY CAPACITY

REF.: "DESIGN OF SMALL DAMS", 2ND ED., PG 553

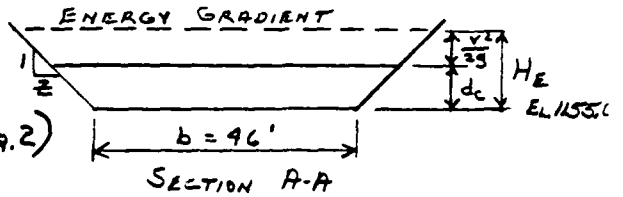


$$V_c = \sqrt{\left(\frac{b + z d_c}{b + 2z d_c}\right) d_c g} \qquad (Eq. 1)$$

$$H_E = d_c + \frac{V_c^2}{2g} = d_c + \left(\frac{b+zd_c}{b+2zd_c}\right)(d_c g)\left(\frac{1}{2g}\right)$$

$$= \left(\frac{3b + 5zd_c}{2b + 4zd_c}\right) d_c$$

$$d_c = \frac{-(3b - 4H_E z) + \sqrt{(3b - 4H_E z)^2 + (4H_E z)(10b)}}{10z} \qquad (Eq. 2)$$



$$A_c = (z d_c + b) d_c \qquad (Eq. 3)$$

$$Q_c = A_c V_c \qquad (Eq. 4)$$

$z_1 = 3.0$, $z_2 = 4.6$.

USE $z = 3.0$

LAKE ELEVATION (FT.)	H_E (FT)	Eq.2 d_c (FT)	Eq.3 A_c (FT^2)	Eq.1 V_c (FPS)	Eq 4 Q_c, SPILLWAY CAPACITY (CFS)	
1155.0	0	0	0	0	0	
1155.5	0.5	0.3	15.8	3.3	51.3	
1156.0	1.0	0.7	32.5	4.6	148.3	
1156.5	1.5	1.0	50.0	5.6	278.2	
1157.0	2.0	1.4	68.5	6.4	437.3	
1157.5	2.5	1.7	87.9	7.1	623.7	
1158.0	3.0	2.1	108.3	7.7	836.9	TOP OF DAM
1158.5	3.5	2.4	129.5	8.3	1079.9	
1159.0	4.0	2.8	151.7	8.8	1339.1	
1159.5	4.5	3.2	174.9	9.3	1628.6	
1160.0	5.0	3.5	198.9	9.8	1943.7	
1160.5	5.5	3.9	223.9	10.2	2284.3	
1161.0	6.0	4.3	249.9	10.6	2650.7	
1162.0	7.0	5.0	304.6	11.4	3461.5	
1163.0	8.0	5.7	363.1	12.1	4377.9	
1164.0	9.0	6.5	425.5	12.7	5402.2	

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CONSULTING ENGINEERS, INC.

By MB Date 4/28/81 Subject MILL CREEK DAM Sheet No. 1 of 2
Chkd. By WJC Date 4/29/81 100 YR FLOOD PEAK Proj. No. 80-556

100 YEAR FLOOD PEAK CALCULATION

REF 1: "HYDROLOGIC STUDY TROPICAL STORM AGNES", ARMY CORPS OF ENGINEERS, DEC., 1975

$$\text{LOG}(P) = \text{LOG}(Q_M) + K(P,G)S$$

WHERE

$\text{LOG}(P)$ = FLOOD PEAK IN CFS FOR A GIVEN EXCERDENCE FREQUENCY P.

$\text{LOG}(Q_M)$ = MEAN LOG OF ANNUAL FLOOD PEAKS

$$\text{LOG}(Q_M) = C_M + 0.75\ \text{LOG}(A)$$

C_M = A MAP COEFFICIENT (FIG. 21, REF. 1)

A = DRAINAGE AREA IN SQ. MILES

$K(P,G)$ = STANDARD DEVIATE FOR A GIVEN P AND SKEW COEFFICIENT G.

S = STANDARD DEVIATION

$$S = C_S - 0.05\ \text{LOG}(A)$$

C_S = A MAP COEFFICIENT (FIG. 22, REF. 1)

G = SKEW COEFFICIENT (FIG. 23, REF. 1)

D'APPOLONIA
CONSULTING ENGINEERS, INC.

C

By WTC Date 1-20-81 Subject MILL CREEK DAM (DER 08-51) Sheet No. 1 of 1
Chkd. By MB Date 1/22/81 FLOOD PEAK DISCHARGE Proj. No. 80-556-13

FLOOD PEAK DISCHARGE BY REGRESSION EQUATIONS

REFERENCE : HERBERT N. FLIPPO, JR. "FLOODS IN PENNSYLVANIA" WATER RESOURCES BULLETIN NO. 13, U.S. DEPT. OF THE INTERIOR, GEOLOGICAL SURVEY, OCTOBER 1977

FROM PLATE 1 OF REFERENCE, MILL CREEK DAM IS LOCATED ON FLOOD - FREQUENCY "2", BASED ON THE RECORDS OF 50 GAGING STATIONS WITH IN THIS REGION, THE FLOOD PEAK DISCHARGES, Q_T, AS SHOWN ON FIG 2 OF REFERENCE, ARE DETERMINED AS FOLLOWS

$$Q_T = C A^X \quad ; \quad \text{where } A = \text{WATERSHED AREA} = 1.29 \text{ SQ. MI.}$$

X, C = REGRESSION COEF.

FREQUENCY T-YEAR	REGRESSION COEFFICIENTS			Q_T
	C	X	Standard Error	cfs
10	240	0.782	26% ±	293
25	349	0.765	27% ±	424
50	448	0.754	29% ±	543
100	564	0.744	31% ±	682

MILL CREEK DAM 100 YEAR FLOOD P=0.01

DRAINAGE AREA = 1.29 SQ MILES
C_M = 2.2
C_S = 0.38
G = 0.28

$$\text{LOG } Q_M = 2.2 + 0.75 \text{ LOG } (1.29) = 2.28$$

$$S = 0.38 - 0.05 \text{ LOG } (1.29) = 0.37$$

FROM REF. 1 ; EXHIBIT 39
$K(P, G) = K(0.01, 0.28) = 2.530$

$$\text{LOG } Q_{0.01} = 2.28 + 2.530 \times 0.37$$

$$= 3.22$$

$$Q_{100\,YR} = 10^{3.22} = 1660 \text{ CFS}$$

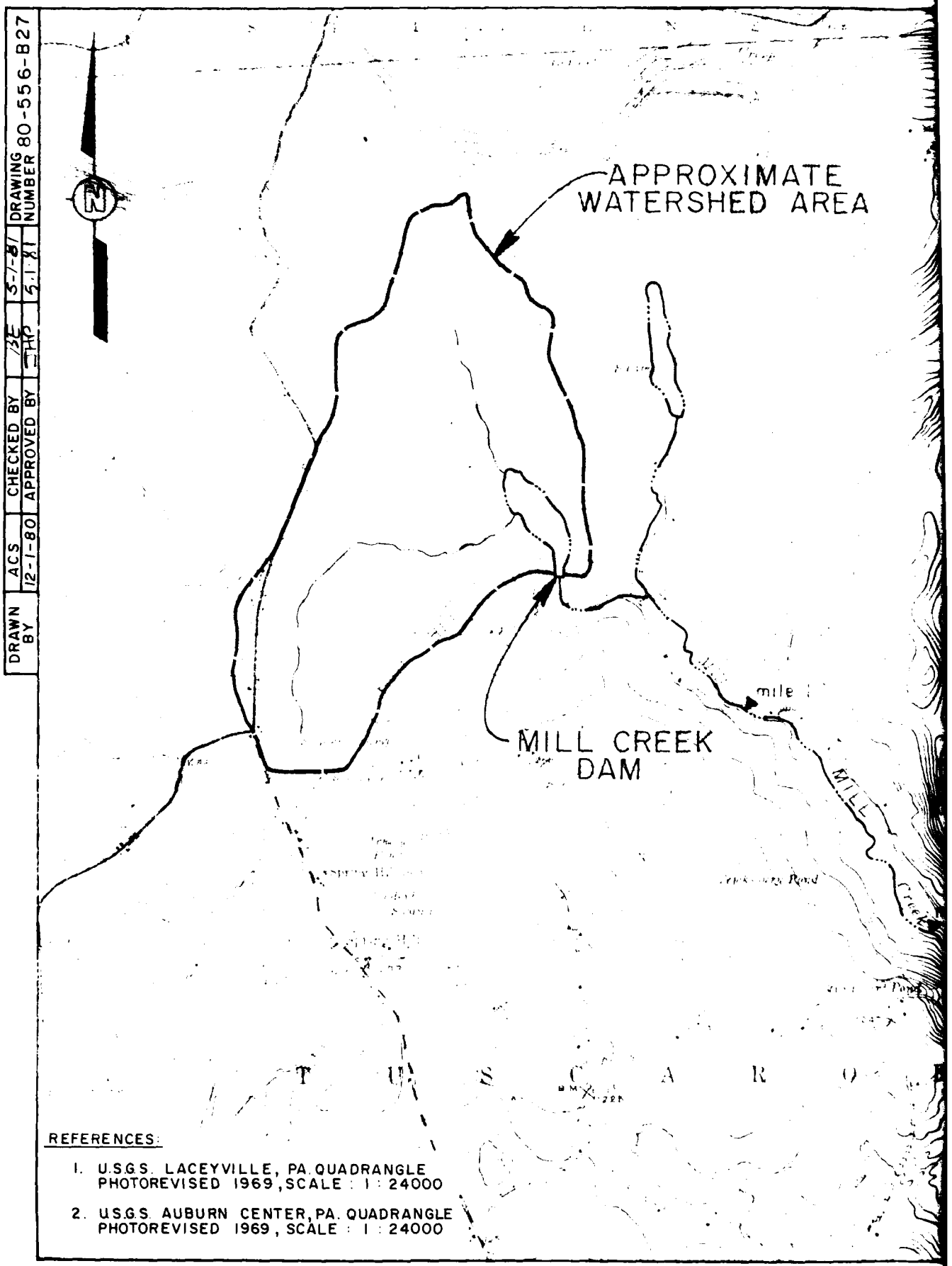
PER CORPS OF ENGINEERS MEMO, DATED 4/22/81, THE ADOPTED 100 YEAR FLOOD PEAK IS THE AVERAGE OF METHODS A AND B.

$$Q_{100} = \frac{1660 + 682}{2}$$
$$= 1171 \text{ CFS}$$

SAY Q_{100} = 1170 CFS

APPENDIX E

PLATES



DRAWN BY	ACS	CHECKED BY	JE	3-1-81	DRAWING NUMBER 80-556-B27
	12-1-80	APPROVED BY	THD	3.1.81	

REFERENCES:

1. U.S.G.S. LACEYVILLE, PA. QUADRANGLE PHOTOREVISED 1969, SCALE : 1 : 24000
2. U.S.G.S. AUBURN CENTER, PA. QUADRANGLE PHOTOREVISED 1969, SCALE : 1 : 24000

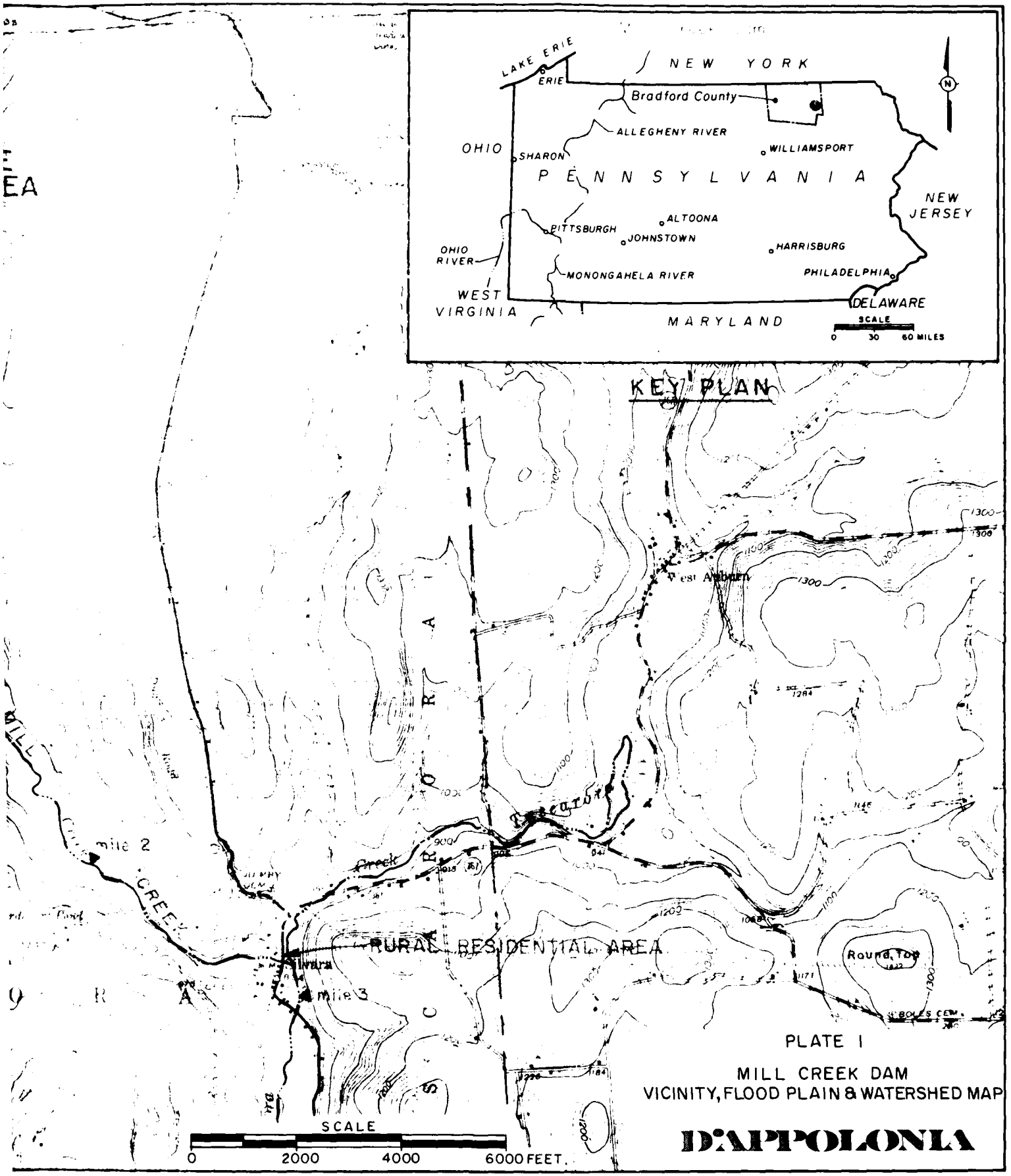
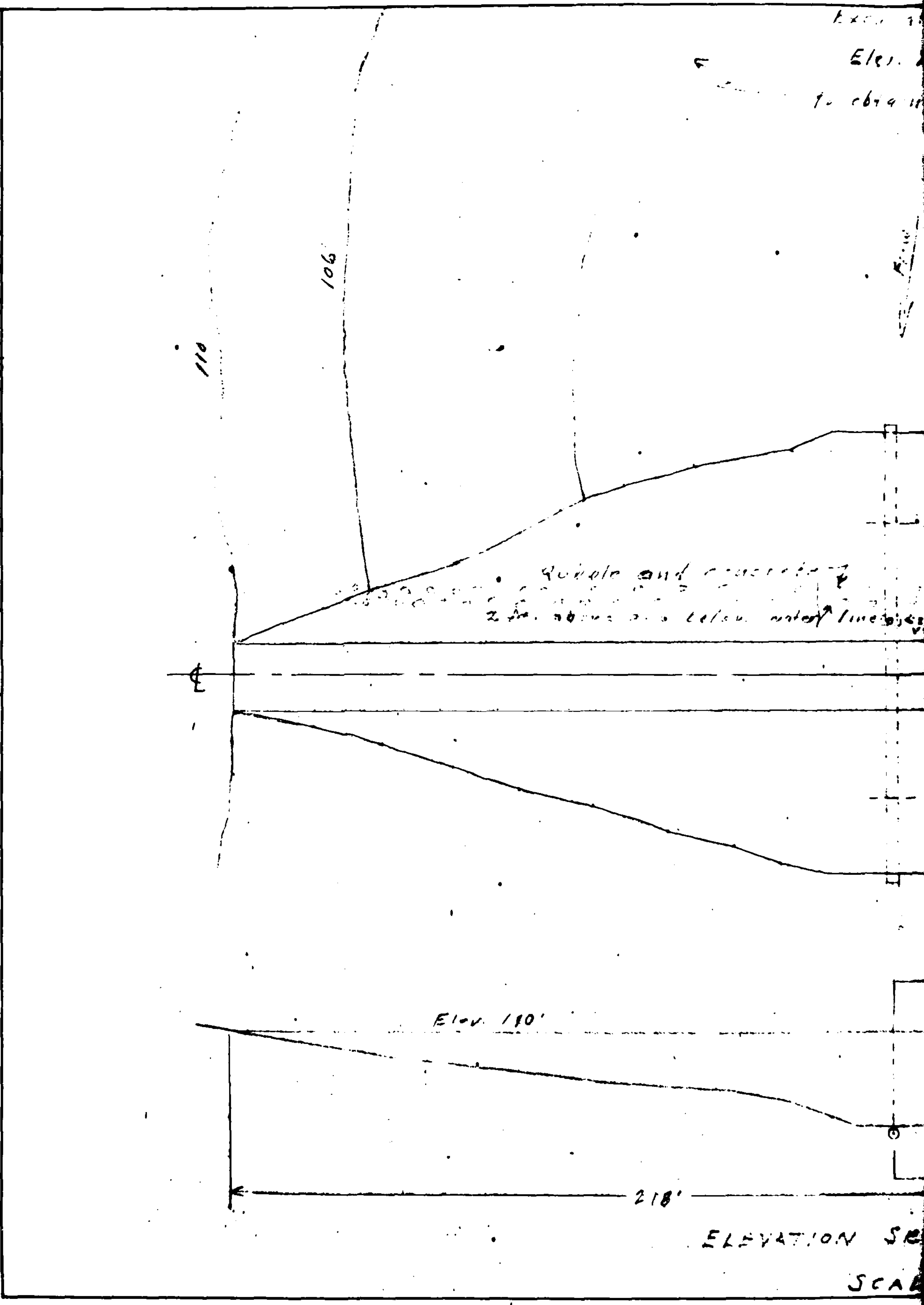


PLATE I

MILL CREEK DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

DAPPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	5-1-81	DRAWING NUMBER	80-556-B28
	4-28-81	APPROVED BY	TMD	5-1-81		



Elev. 94

106'

110'

Present Grd Elev.

63'

Extend rubble and concrete in spillway at least 3ft beyond toe of dam.

A

Elev. 106'

Spillway 63'

A

PLATE 2

ON SECTION AT CENTER LINE

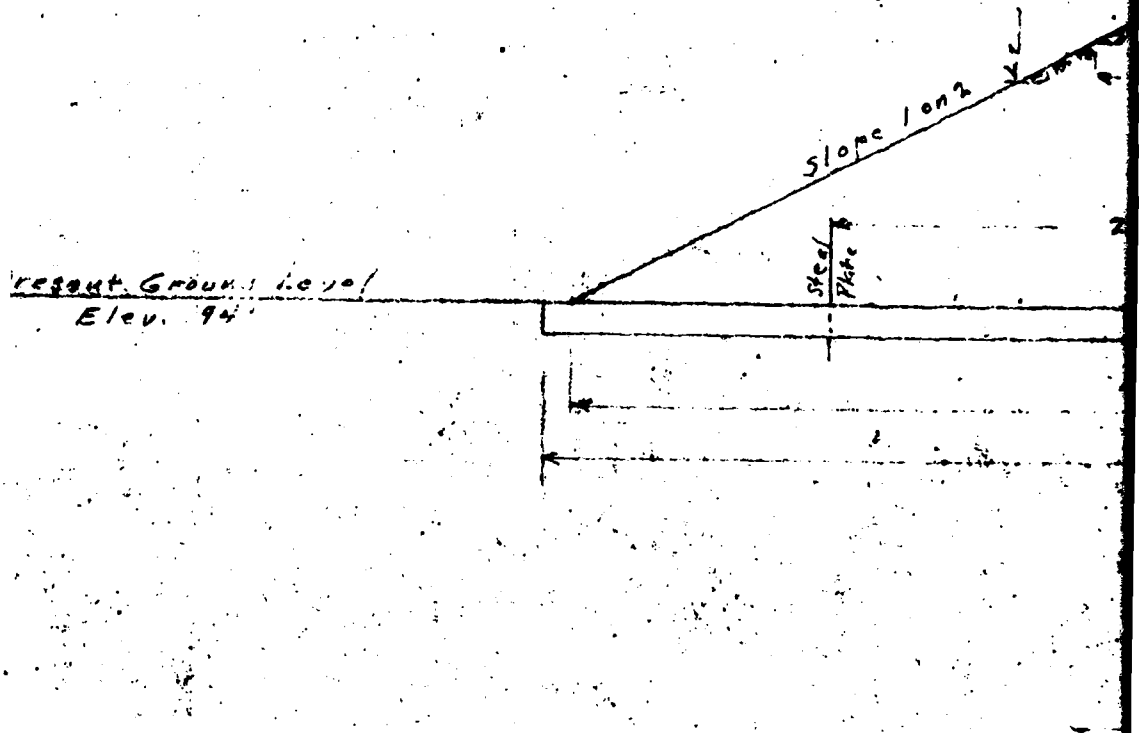
SCALE 1" = 20'

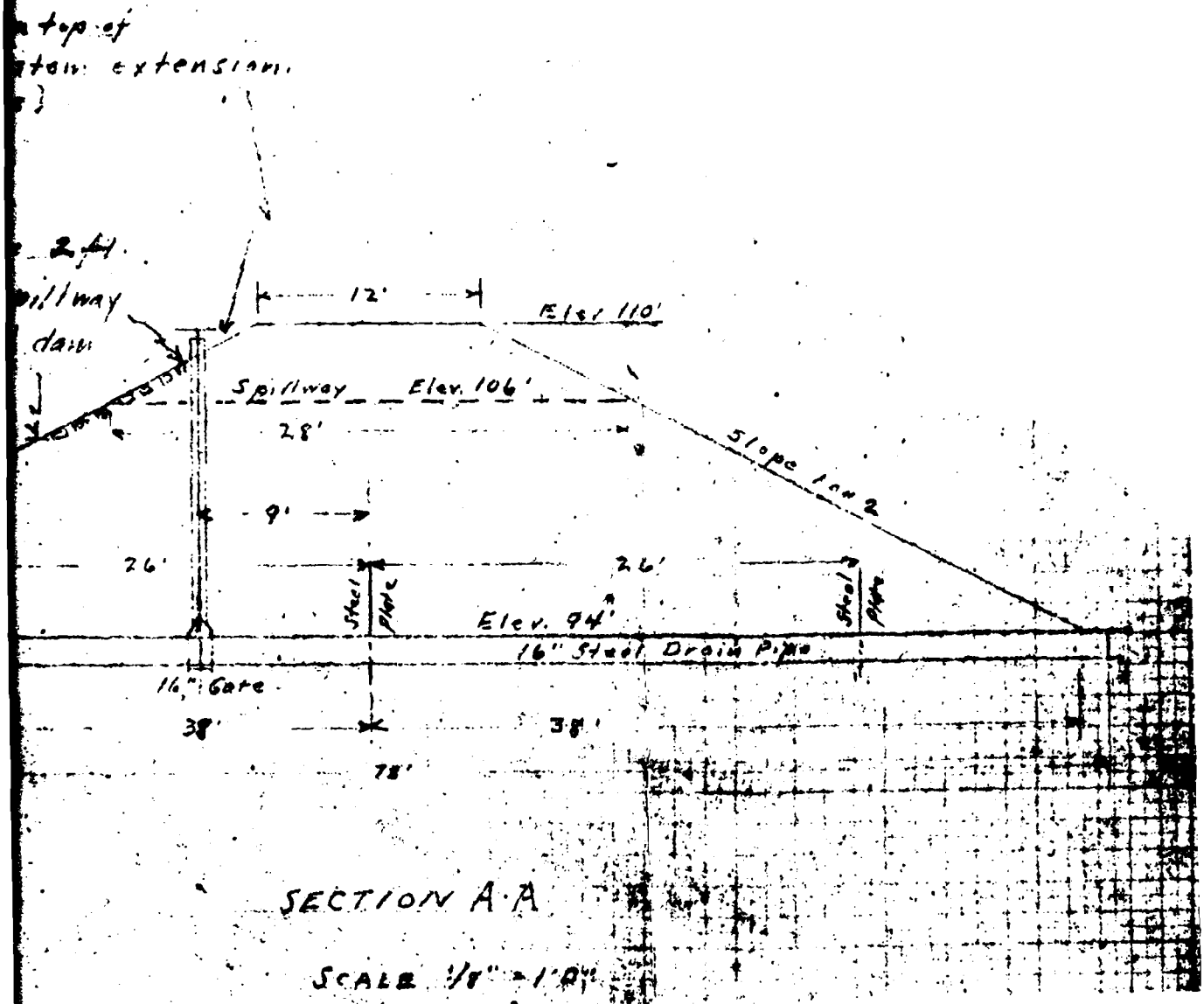
DAPPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	S-1-8	DRAWING NUMBER 80-556-B29
	4-28-81	APPROVED BY	JHD	S-1-1	

Place 4" Steel pipe on top of
16" Gate for valve stem e
(14'6" - 4" Steel pipe)

Rubble and concrete 2 ft.
above and below spillway
level total length of dam





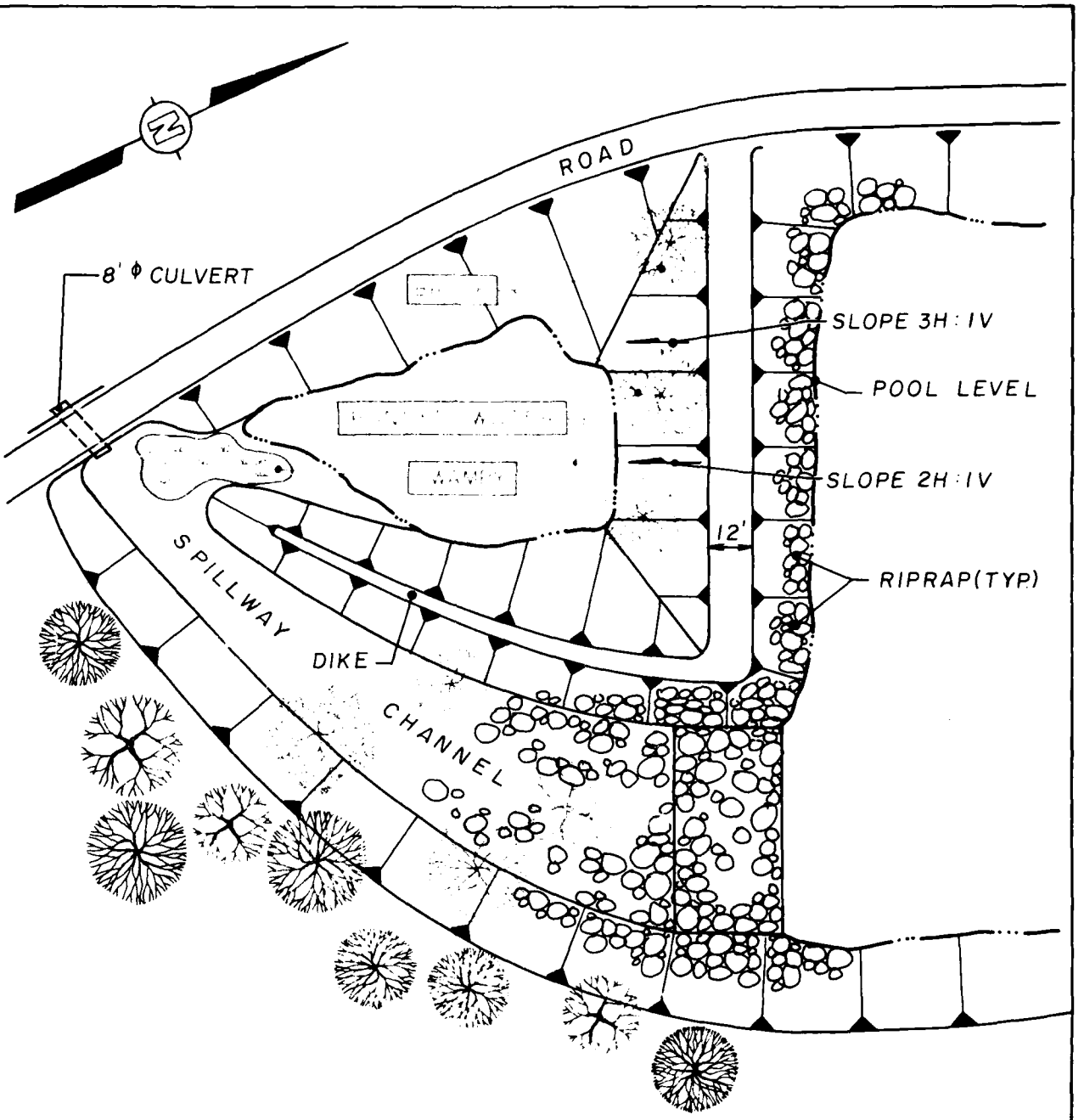
SECTION A-A

SCALE 1/8" = 1'-0"

PLATE 3

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER 80-556-A31
	11-21-80	APPROVED BY		



NOTE:

POOL LEVEL AT DATE OF INSPECTION:
~1 FT. BELOW SPILLWAY CREST

PLATE 4

MILL CREEK DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: NOV. 14, 1980

D'APPOLONIA

NOT TO SCALE

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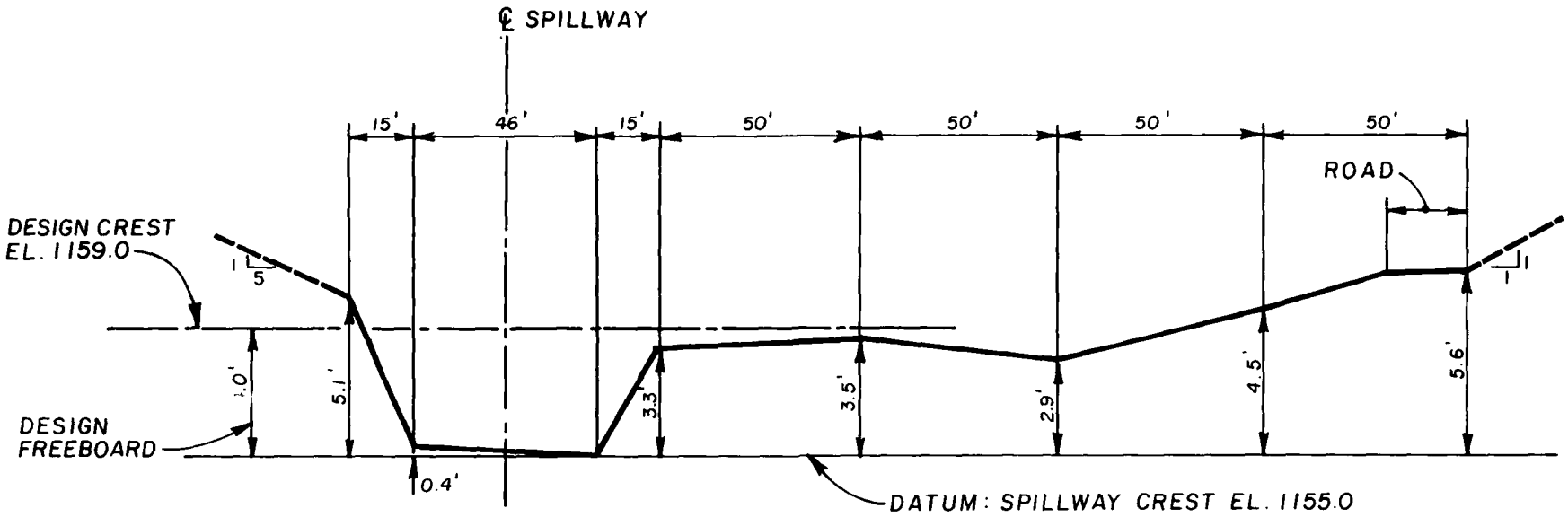
	12 23 80	APPROVED BY	JHP	5 Feb 81		



DAM CREST PROFILE
(LOOKING DOWNSTREAM)

NOTES:

1. DAM CREST WAS SURVEYED RELATIVE TO SPILLWAY CREST LEVEL.
2. DATUM ELEVATION WAS INTERPOLATED FROM U.S.G.S. MAPS, THEREFORE IS APPROXIMATE.

PLATE 5

MILL CREEK DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: NOV. 14, 1980

D'APPOLONIA

APPENDIX F

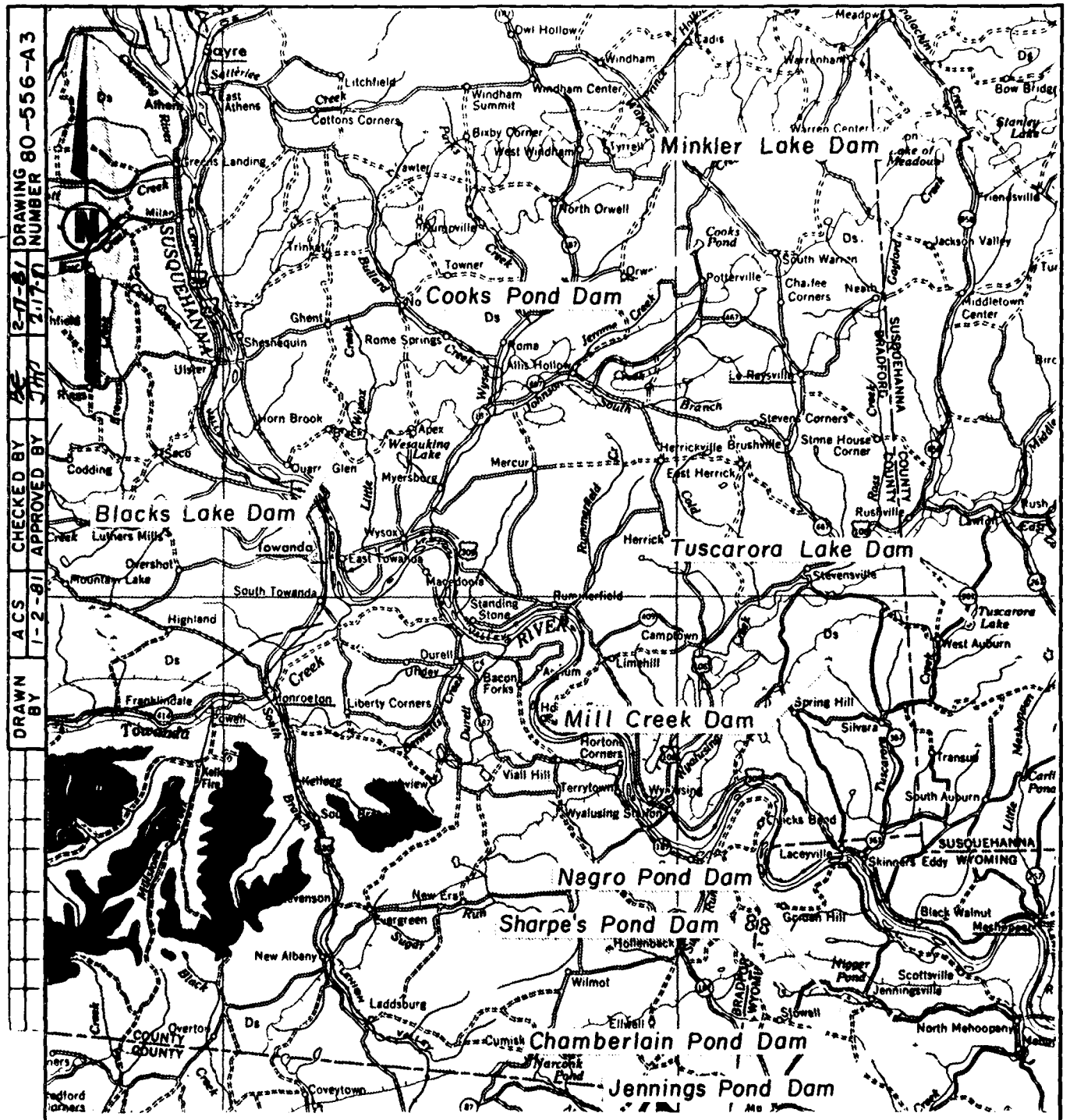
REGIONAL GEOLOGY

REGIONAL GEOLOGY
MILL CREEK DAM

The Mill Creek Dam is located in the glaciated low plateaus section of the Appalachian Plateau physiographic province, characterized as a mature glaciated plateau of moderate relief.

The geologic structure consists of a series of northeast trending folds (approximately N70°E) which plunge gently to the southwest. The dip of the limbs of the folds in the vicinity of the Mill Creek Dam is less than five degrees, with the southeast limb steeper than the northwest limb. The dam is located just north of a small syncline and south of the Towanda Anticline. In general, the discontinuity trends are northeast and northwest.

The stratigraphy consists of glacial till which will range in thickness from very thin to approximately 200 feet. The glacial till is underlain by the Devonian Chemung Formation, which is approximately 475 feet thick in this area. The Chemung Formation is marine in origin, consisting of interbedded green-gray shale, sandy shale, and fine-grained sandstone. The shale strata tend to weather rapidly when exposed.



SCALE

0 2 4 6 8 10 miles

GEOLOGY MAP

REFERENCE

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA, DEPARTMENT OF ENVIRONMENTAL RESOURCES, DATED: 1960 SCALE 1:250,000

D'APPOLONIA

DRAWING NUMBER 80-556-A3

2-17-81

2-17-81

APPROVED BY

CHECKED BY

ACS 1-2-81

DRAWN BY

DRAWN BY	ACS	CHECKED BY		2-17-81	DRAWING NUMBER 80-556-A4
	1-2-81	APPROVED BY		2-17-81	

PENNSYLVANIAN

APPALACHIAN PLATEAU

Pa — **Allegheny Group**
Cyclic sequences of sandstone, shale, limestone and coal, numerous commercial coals, limestones thicken westward; Vanport Limestone in lower part of section, includes Freeport, Kittanning, and Clarion Formations.

Pottsville Group
Predominantly sandstones and conglomerates with thin shales and coals, some coals mineable locally.

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.

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

MISSISSIPPIAN

Mauch Chunk Formation
Red shales with brown to greenish gray flaggy sandstones, includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties, Loyalhanna Limestone at the base in southwestern Pennsylvania.

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

DEVONIAN

UPPER

CENTRAL AND EASTERN PENNSYLVANIA

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

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

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

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

GEOLOGY MAP LEGEND

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA., DEPARTMENT OF ENVIRONMENTAL RESOURCES, DATED: 1960
SCALE 1:250,000

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