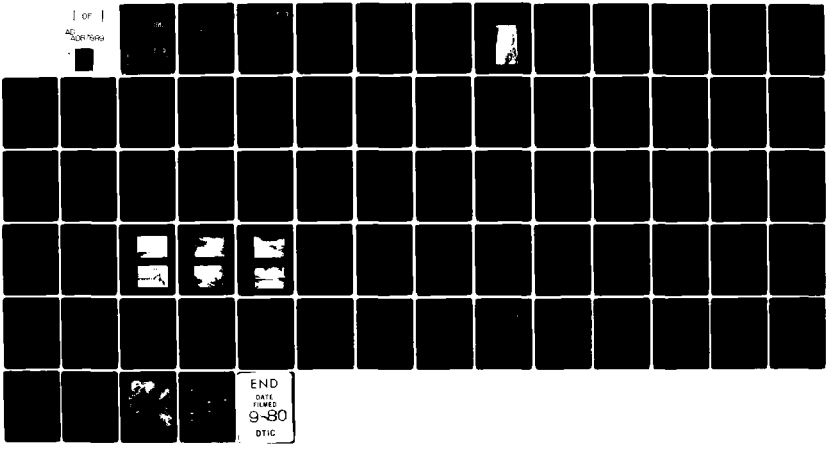
AD-A087 889 D'APPOLONIA CONSULTING ENGINEERS INC PITTSBURGH PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. REYNOLDSVILLE STORAGE DAM (NDI--ETC(U)
1980 DACW31-80-C-0022
UNCLASSIFIED NL



END
DATE FILMED
9-80
DTIC

OHIO RIVER BASIN
PITCHPINE RUN, JEFFERSON COUNTY

PENNSYLVANIA

LEVEL II

REYNOLDSVILLE STORAGE DAM

NDI I.D. PA-01130
DER I.D. 33-5

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

D'APPOLONIA CONSULTING ENGINEERS
DACW31-80-C-0022

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

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

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 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.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Reynoldsville Storage Dam (Upper Dam)
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Jefferson
STREAM: Pitchpine Run, a Tributary of Sandy Creek
SIZE CLASSIFICATION: Small
HAZARD CLASSIFICATION: High
OWNER: Borough of Reynoldsville
DATE OF INSPECTION: April 23, 1980 and April 30, 1980

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Reynoldsville Storage Dam is considered to be unsafe/nonemergency due to seriously inadequate spillway capacity. The condition of the embankment is considered to be poor. The spillway structures were found to be significantly deteriorated. Extensive seepage on the order of 100 to 200 gallons per minute was observed seeping through the spillway structures. The abutment walls of the spillway were constructed about 2 feet below the mean dam crest elevation, posing a potential for erosion of the embankment and the abutment in the event of large flows through the spillway. The downstream face of the dam was found to be on a steep slope (approximately 1.5H to 1V) with swampy areas at the downstream toe level of the dam. The downstream end of the outlet pipe was found to be blocked by debris and siltation, indicating that it has not been functional for some time. In view of the above deficiencies and lack of any design information, it is considered advisable that the dam be evaluated in detail by a professional engineer to assess the structural integrity of the embankment and prepare and execute plans for the rehabilitation of the spillway structures and outlet facilities.

According to the recommended criteria, small dams in the high hazard category are required to pass from 50 percent to full probable maximum flood (PMF). In view of the downstream damage potential, the upper limit of the recommended range is considered to be applicable to this dam. The flood discharge capacity was evaluated according to the recommended criteria and was found to pass 20 percent of the PMF without overtopping the abutment walls of the spillway. Because the spillway capacity is less than 50 percent of the PMF and it is estimated that an overtopping failure of the dam would significantly increase the downstream hazard of loss of life compared to that which would exist just before failure, the spillway is considered to be seriously inadequate.

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

1. The owner should immediately retain an experienced professional engineer to conduct additional studies and to prepare and execute plans for the repair and restoration of the spillway structures and to evaluate the integrity of the embankment as a water retention structure. Repairs and restoration and additional studies should include, but not be limited to, the following work:

   a. Conduct additional detailed hydrologic and hydraulic studies to determine the nature and extent of improvements required to provide adequate spillway capacity.

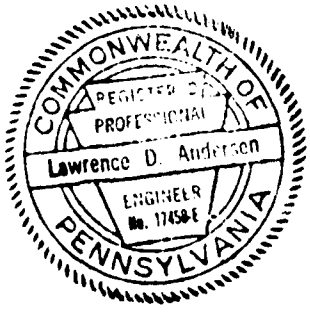
   b. Evaluate the structural integrity of the embankment in view of the steep downstream slope and swampy areas at the toe level of the embankment.

   c. Evaluate the operational condition of the outlet pipe and conduct necessary maintenance. Also, a means should be developed to provide upstream control to all pipes through the embankment.

   d. Evaluate the need to provide erosion protection such as riprap on the upstream face of the dam.

2. 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.

3. The dam and appurtenant structures should be inspected regularly and a formal maintenance manual should be developed for future maintenance of the dam.



Lawrence D. Andersen, P.E.
Vice President

June 18, 1980
Date

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

11 Sep 1980
Date

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
REYNOLDSVILLE STORAGE DAM
(UPPER DAM)
NDI I.D. PA-1130
DER I.D. 33-5

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. Reynoldsville Storage Dam consists of an earth embankment approximately 240 feet long with a maximum height of approximately 24 feet from the downstream toe. The crest width is in the range of 6 to 8 feet. The downstream slope of the dam is irregular and covered with thick brush. The downstream slope varies between 1.5H to 1V to 2H to 1V. The crest and the upstream face are covered with grass. There is no shoreline protection on the upstream side of the dam.

The flood discharge facilities for the reservoir consist of a concrete overflow structure located on the left abutment (looking downstream). The overflow section is approximately 25 feet wide and 2 feet deep. A cutoff wall extends in both directions from the overflow section, the top of which is about 2 feet below the mean dam crest elevation. The crest of the overflow section (parallel to flow) is about 30 inches wide (in two steps with about 5 inches vertical separation) dropping about five feet to a 30-foot-long concrete slab, which terminates at a 5- to 6-foot vertical drop to an earth channel.

According to the previous inspection reports, the outlet facilities consist of a 24-inch cast-iron blow-off pipe and a 6-inch cast-iron

supply line. The field observations indicate that the flow through these pipes is controlled by valves located in a valve chamber at the downstream toe of the dam. The 24-inch blow-off pipe constitutes the emergency drawdown facility for the reservoir.

b. Location. Reynoldsville Storage Dam is located near the headwaters of Pitchpine Run, a tributary of Sandy Lick Creek, approximately one mile northeast of Reynoldsville in Winslow Township, Jefferson County, Pennsylvania. Plate 1 illustrates the location of the dam.

c. Size Classification. Small (based on 24-foot height and 68 acre-feet maximum storage capacity).

d. Hazard Classification. The dam is classified to be in the high hazard category. Discharge from this dam flows into the reservoir of a dam located 1000 feet downstream. Below the second dam, Pitchpine Run flows through a small streambed approximately 3 to 4 feet wide and 1 to 2 feet deep through residential areas of Reynoldsville. It then discharges into a sewer system near the center of the town. It is estimated that failure of the upstream dam may in turn cause the failure of the downstream dam and the combined discharge would cause loss of lives and large property damage in Reynoldsville.

e. Ownership. Reynoldsville Water Authority (address: Mrs. Lesley, Secretary, Municipal Building, Reynoldsville, Pennsylvania 15851).

f. Purpose of Dam. Water supply.

g. Design and Construction History. The dam was designed by a local engineer, Mr. G. Mellinger, a surveyor from Reynoldsville, Pennsylvania, and constructed by the original owner, Reynoldsville Water Company, with completion in 1901.

h. Normal Operating Procedure. The reservoir is normally maintained at the crest level of the uncontrolled spillway. When the lake is at or above the spillway crest level, inflow is discharged through 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 spillway crest level (normal pool level) to be at Elevation 1452, which was interpolated from the USGS 7.5-minute DuBois quadrangle map.

a. Drainage Area 0.62 square mile

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	20±
Gated spillway capacity at maximum pool	Not applicable
Ungated spillway capacity at maximum pool	236(1)
Total spillway capacity at maximum pool	236(1)

c. Elevation (USGS Datum) (feet)

Top of Dam	1454.1 (top of spillway walls, design elevation unknown)
Maximum pool	1455.8
Normal pool	1452
Upstream invert outlet works	Unknown
Downstream invert outlet works	1430±
Maximum tailwater	Unknown
Toe of Dam	1430±

d. Reservoir Length (feet)

Normal pool level	1200
Maximum pool level	1300±

e. Storage (acre-feet)

Normal pool level	21
Maximum pool level	27

f. Reservoir Surface (acres)

Normal pool level	2.8
Maximum pool level	4±

g. Dam

Type	Earth
Length	240 feet
Height	24 feet
Top width	6 to 8 feet

(1) The capacity of the spillway relative to the top of the spillway abutment walls.

Side slopes	Downstream: 1.5H:1V to 2.5H:1V Upstream: 2H:1V
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	None

h. Regulating Outlet

Type	24-inch cast-iron pipe
Length	Unknown
Closure	Downstream valve
Access	Valve chamber
Regulating facilities	Downstream valve

i. Spillway

Type	Rectangular open channel
Length	25 feet
Crest elevation	1452
Upstream channel	Lake
Downstream channel	Earth channel

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 limited design drawings and correspondence and several past inspection reports.

(1) Hydrology and Hydraulics. The available information includes the design capacity of the spillway.

(2) Embankment. The available information consists of a description of the embankment included in the past inspection reports.

(3) Appurtenant Structures. The available information consists of design drawings and a description of the facilities included in the previous inspection reports.

b. Design Features

(1) Embankment. As illustrated in Plates 2 and 3, the dam appears to be a homogeneous embankment. A Commonwealth report dated September 3, 1915, indicates that the dam was constructed of sands, stones, and gravel obtained from the reservoir area. No other information was found relative to the design and construction of the embankment.

(2) Appurtenant Structures. The appurtenant structures consist of an open channel spillway located on the left abutment and outlet works. Plate 4 shows the details of the spillway structures. Field observations indicate that the existing spillway is not fully in conformance with the design drawings. The spillway consists of a rectangular overflow section approximately 25 feet wide and about 2 feet deep, discharging onto a concrete apron which in turn discharges into an earth channel approximately 30 feet downstream from the overflow section. Further description of the spillway structures is included in Section 1.2a. According to the available information, this spillway was constructed in 1941. The original spillway for the reservoir consisted of an earth channel located on the right abutment which was abandoned at the time of construction of the present spillway. With respect to the outlet facilities, only the size of the outlet pipes was reported. The outlet pipes through the dam consist of a 24-inch cast-iron blow-off pipe and a 6-inch supply line, through which flow is controlled by valves located at the downstream end. No other information was found relative to the details of the outlet facilities.

c. Design Data

(1) Hydrology and Hydraulics. The existing spillway was constructed in 1941 under a Commonwealth permit which required the spillway capacity to be 1050 cfs. However, subsequent correspondence indicates that the as-built capacity of the spillway was 230 cfs relative to the freeboard available to the top of the spillway abutment walls.

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

(3) Appurtenant Structures. No design data are available on the appurtenant structures.

2.2 Construction. Available records indicate the dam was constructed in 1901 by the original owner, Reynoldsville Water Company. No information was found relative to the manner in which the embankment was constructed.

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

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. The available information was provided by PennDER. A design drawing provided by the owner was reviewed to obtain additional information.

b. Adequacy

(1) Hydrology and Hydraulics. The available information consists of the design capacity of the spillway. This information is not considered to be sufficient to assess the adequacy of the spillway.

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

(3) Appurtenant Structures. No information is available to assess the structural adequacy of the appurtenant structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Reynoldsville Storage Dam consisted of:

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

2. Visual examination of the spillway structures and the downstream end of the outlet facilities.

3. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 5.

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 embankment is considered to be poor. The downstream face of the dam was found to be irregular with slopes ranging between 1.5H to 1V to 2.5H to 1V. The downstream face of the dam is covered with thick brush. Swampy areas and perched water were found below the toe of the dam, suggesting the presence of underseepage through the embankment. These soft toe conditions combined with the relatively steep downstream slope of the embankment and the fact that no engineering data are available on the design of the embankment to assess its structural adequacy raise concern as to the continued integrity of the embankment as an impounding structure. Further investigation of the embankment to evaluate its integrity is considered advisable.

The crest of the dam was surveyed relative to the spillway crest elevation and it was found to be on the order of 4 feet above the spillway crest level. The embankment crest profile is illustrated in Plate 6. The downstream slopes were surveyed and were found to range between 1.5H to 1V to 2.5H to 1V.

c. Appurtenant Structures. The spillway structures were examined for deterioration and other signs of distress and obstructions that would limit flow. The spillway structures were found to be in poor condition. The concrete spillway abutment walls were found to be seriously deteriorated. Large seeps were observed along

the interface of the abutment walls and the slab forming an apron downstream from the overflow section. Seeps were also observed discharging through the cracks of the apron slab. As previously noted, the tops of the spillway abutment walls were constructed approximately two feet below the mean dam crest elevation, leaving a portion of the abutment and the embankment unprotected if the lake level were to rise to the dam crest level. Repair and restoration of the spillway structures with provisions to provide adequate erosion protection on the embankment and abutment sides of the spillway above the spillway wall level are required.

The downstream end of the outlet pipe was observed and was found to be partially covered with silt and debris, indicating that the outlet pipe has not been operated for some time. The operation of the outlet pipe valve was not observed.

d. Reservoir Area. A map review and visual observations indicate that the watershed is predominantly covered by woodlands and pasturelands. No signs of landslide activity in the vicinity of the reservoir were found. A review of the regional geology is included in Appendix F.

e. Downstream Channel. Below the dam, the stream flows into the reservoir of a downstream dam. The downstream dam consists of an earth embankment approximately 20 feet high and impounding a reservoir with a surface area of about 2 acres at normal pool level. Further downstream, Pitchpine Run flows through residential areas of Reynoldsville, discharging into the city sewer system. A further description of the downstream conditions is included in Section 1.2d.

3.2 Evaluation. The overall condition of the dam is considered to be poor. Further investigation of the integrity of the embankment and implementation of necessary measures to repair and restore the spillway facilities is recommended.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. As it presently exists, the reservoir is normally maintained at the crest level of the uncontrolled spillway.

4.2 Maintenance of the Dam. The visual observations indicate that the only maintenance operation consists of occasional mowing of the grass on the crest of the dam. The downstream face of the dam is covered with thick brush.

4.3 Maintenance of Operating Facilities. According to the dam tender, the outlet facilities have not been operated in the past five to six years. Since the operational condition of the outlet pipe valve was questionable, no attempt to operate the valve was made by the owner.

4.4 Warning System. No formal warning system exists for the dam. Telephone communication facilities are available via residences in the vicinity of the dam.

4.5 Evaluation. The visual observations indicate that the dam has not been adequately maintained. After the restoration of the dam, development of a formal maintenance plan is recommended.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Reynoldsville Storage Dam has a watershed of 0.62 square mile and impounds a reservoir with a surface area of 2.8 acres at normal pool level. The flood discharge facilities consist of an open channel spillway located near the left abutment. The overflow section of the spillway is approximately 25 feet wide and has an available freeboard of about 2.3 feet deep relative to the top of the spillway abutment walls and about 4 feet relative to the top of the embankment. In line with the overflow section, a concrete wall extends approximately 10 feet from each side of the spillway into the embankment and the abutment. Based on the available freeboard to the top of the spillway abutment walls, the spillway capacity was estimated to be 236 cfs. The capacity calculation is included in the computer output in Appendix D.

b. Experience Data. As previously stated, Reynoldsville Storage Dam is classified as a small dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass half to full PMF. Considering the high downstream hazard potential, the upper limit of the recommended range is considered to be applicable to this dam.

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. The data used for the computer analysis are presented in Appendix D. The one-half PMF and full PMF inflow hydrographs were found to have peak flows of 449 and 899 cfs, respectively. Computer input and summary of computer output for the PMF analysis are included in Appendix D.

c. Visual Observations. No conditions were observed that would indicate the capacity of the spillway would be significantly reduced in the event of a flood.

d. Overtopping Potential. Various percentages of the PMF inflow hydrograph were routed through the reservoir, and it was found that the spillway can pass 20 percent of the PMF without overtopping the spillway abutment walls. For 50 percent of the PMF, it was found that the spillway abutment walls would be overtopped for a duration of 8.3 hours with a maximum depth of about 0.9 foot. For full PMF, the overtopping duration would be 10.5 hours and the depth 1.9 foot.

e. Spillway Adequacy. The spillway was found to pass 20 percent of the PMF, which is significantly less than the required spillway capacity of full PMF. Further, based on visual observations and a dam breach analysis, it was estimated that overtopping failure of the dam would significantly increase the downstream hazard to loss of life and property damage from that which would exist just before overtopping failure. The results of the dam breach analysis are included in Apppendix D. The results indicate that flood stages in the potential damage area would be raised by about 2 feet due to a dam failure which is considered to be a significant increase in damage potential. Therefore, the spillway is classified to be seriously inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, concern exists as to the continued integrity of the embankment in view of the steep downstream slopes and swampy areas below the toe of the dam which may affect the stability of the embankment. Further investigation of the stability of the embankment is recommended.

(2) Appurtenant Structures. The spillway structures were found to be in poor condition with extensive concrete deterioration and underseepage. Repair and restoration of the spillway structures and implementation of necessary measures to control the underseepage are considered to be advisable.

b. Design and Construction Data

(1) Embankment. The available information includes no design data to aid in the assessment of the structural stability of the embankment. It appears that the dam was designed as a homogeneous embankment. In the available information, no reference was found to indicate the manner in which the dam was constructed. In view of the concerns stated above, further investigation of the stability of the embankment is considered advisable.

(2) Appurtenant Structures. No information is available to assess the structural adequacy of the appurtenant structures.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. The existing spillway was constructed in 1941. The available information indicates no other post-construction changes.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations, further investigations are considered required to evaluate the static stability of the dam. Therefore, the seismic stability of the dam should be evaluated in conjunction with this further study.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. Based on the evaluation of the existing conditions, the condition of Reynoldsville Storage Dam is considered to be unsafe/nonemergency due to seriously inadequate spillway capacity. The condition of the dam is considered to be poor.

The spillway structures were found to be significantly deteriorated. Extensive seepage on the order of 100 to 200 gallons per minute was observed seeping through the spillway structures. The abutment walls of the spillway were constructed about 2 feet below the mean dam crest elevation, posing a potential for erosion of the embankment and the abutment in the event of large flows through the spillway. The downstream face of the dam was found to be on a steep slope (approximately 1.5H to 1V) with swampy areas at the downstream toe level of the dam. The downstream end of the outlet pipe was found to be blocked by debris and siltation, indicating that it has not been functional for some time. In view of the above deficiencies and lack of any design information, it is considered advisable that the dam be evaluated by a professional engineer to assess the structural integrity of the embankment and prepare and execute plans for the rehabilitation of the spillway structures and outlet facilities.

According to the recommended criteria, small dams in the high hazard category are required to pass from 50 percent to full probable maximum flood (PMF). In view of the downstream damage potential, the upper limit of the recommended range is considered to be applicable to this dam. The flood discharge capacity was evaluated according to the recommended criteria and was found to pass 20 percent of the PMF without overtopping the abutment walls of the spillway. Because the spillway capacity is less than 50 percent of the PMF and it is estimated that an overtopping failure of the dam would significantly increase the downstream hazard of loss of life compared to that which would exist just before failure, the spillway is considered to be seriously inadequate.

b. Adequacy of Information. Available information, in conjunction with 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 Data. In view of the conditions described above, the owner should retain a professional engineer to conduct additional studies to investigation the stability of the dam and prepare and implement plans to provide adequate spillway capacity.

7.2 Recommendations/Remedial Measures. It is recommended that the following recommendations be implemented immediately or on a continuing basis:

1. The owner should immediately retain an experienced professional engineer to conduct additional studies and to prepare and execute plans for the repair and restoration of the spillway structures and to evaluate the integrity of the embankment as a water retention structure. Repairs and restoration and additional studies should include, but not be limited to, the following work:

   a. Conduct additional detailed hydrologic and hydraulic studies to determine the nature and extent of improvements required to provide adequate spillway capacity.

   b. Evaluate the structural integrity of the embankment in view of the steep downstream slope and swampy areas at the toe level of the embankment.

   c. Evaluate the operational condition of the outlet pipe and conduct necessary maintenance. Also, a means should be developed to provide upstream control to all pipes through the embankment.

   d. Evaluate the need to provide erosion protection such as riprap on the upstream face of the dam.

2. 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.

3. The dam and appurtenant structures should be inspected regularly and a formal maintenance manual should be developed for future maintenance of the dam.

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Reynoldsville Storage Dam COUNTY Jefferson STATE Pennsylvania ID# NDI I.D. PA-1130
DER I.D. 33-5

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION April 23, 1980 WEATHER _____ TEMPERATURE _____

POOL ELEVATION AT TIME OF INSPECTION 1451.6 M.S.L. TAILWATER AT TIME OF INSPECTION 1340± M.S.L.

INSPECTION PERSONNEL:

B. Erel

W. T. Chan

_____

B. Erel

OWNER'S REPRESENTATIVE:

Foreman of the Water Authority.

REVIEW INSPECTION PERSONNEL:
(April 30, 1980)

E. D'Appolonia

L. D. Andersen

J. H. Poellot

B. Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	See Plate 6 for dam crest profile.	
RIPRAP FAILURES	The upstream slope has no erosion protection.	The upstream slope of the dam should be provided with adequate erosion protection.

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No signs of distress.	
ANY NOTICEABLE SEEPAGE	There are swampy areas and ponded water below the toe of the dam. However, no isolated point of seepage was located.	
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	Only the downstream end of the 24-inch cast-iron blow-off pipe was visible.	
INTAKE STRUCTURE	Submerged (unknown).	
OUTLET STRUCTURE	The outlet pipe directly discharges into an earth channel	
OUTLET CHANNEL	There is no defined outlet channel. The downstream end of the outlet pipe is partially blocked by debris and siltation.	
EMERGENCY GATE	Flow through the outlet pipe is controlled by a valve located in a valve chamber at the downstream toe of the dam. The operation of the outlet pipe was not observed.	

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete weir is in poor condition. There is significant underseepage through the overflow section.	Further investigation of the seepage condition and implementation of necessary corrective measures are recommended.
APPROACH CHANNEL	Lake	
DISCHARGE CHANNEL	Earth channel. In fair condition.	
BRIDGE AND PIERS	None	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable	
APPROACH CHANNEL	Not applicable	
DISCHARGE CHANNEL	Not applicable	
BRIDGE PIERS	Not applicable	
GATES AND OPERATION EQUIPMENT	Not applicable	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

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

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderately steep. No significant shoreline erosion was noted.	
SEDIMENTATION	The reservoir appears to be significantly silted.	
UPSTREAM RESERVOIRS	None	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Downstream channel is in fair condition.	
SLOPES	No features pertinent to the safety of the dam.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Below the dam, Pitchpine Run flows through residential areas of Reynoldsville. The business district of the town is also within the potential flood plain. Number of houses: more than 20. Population: approximately 100 to 200.	

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 Reynoldsville Storage
ID# NDI I.D. PA-1130
DER I.D. 33-5

ITEM	REMARKS
AS-BUILT DRAWINGS	No as-built drawings are available. Drawings showing the 1941 construction of the spillway are included in Commonwealth files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by a local engineer, Mr. G. Mellinger, a surveyor from Reynoldsville, Pennsylvania, and constructed by the original owner, the Reynoldsville Water Company, with completion in 1901.
TYPICAL SECTIONS OF DAM	See Plate 2.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	None available.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not maintained
DESIGN REPORTS	None prepared
GEOLOGY REPORTS	None prepared
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None reported

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported
BORROW SOURCES	Unknown
MONITORING SYSTEMS	None
MODIFICATIONS	The existing spillway was constructed in 1941.
HIGH POOL RECORDS	Not recorded

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 reported
MAINTENANCE OPERATION RECORDS	Not maintained
SPILLWAY PLAN SECTIONS DETAILS	See Plate 4.
OPERATING EQUIPMENT PLANS AND DETAILS	Not available

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 0.62 square mile (woodlands)

ELEVATION, TOP OF NORMAL POOL AND STORAGE CAPACITY: 1452 (61 acre-feet)

ELEVATION, TOP OF FLOOD CONTROL POOL AND STORAGE CAPACITY: 1455.8 (67 acre-feet)

ELEVATION, MAXIMUM DESIGN POOL: 1455.8

ELEVATION, TOP OF DAM: 1445.8 (measured low spot; design elevation unknown)

SPILLWAY:

a. Elevation 1452

b. Type Concrete overflow section

c. Width 25 feet (perpendicular to flow)

d. Length Not applicable

e. Location Spillover Adjacent to spillway

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 24-inch cast-iron blow-off pipe

b. Location Center of embankment

c. Entrance Inverts Unknown

d. Exit Inverts 1340±

e. Emergency Drawdown Facilities 24-inch blow-off pipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

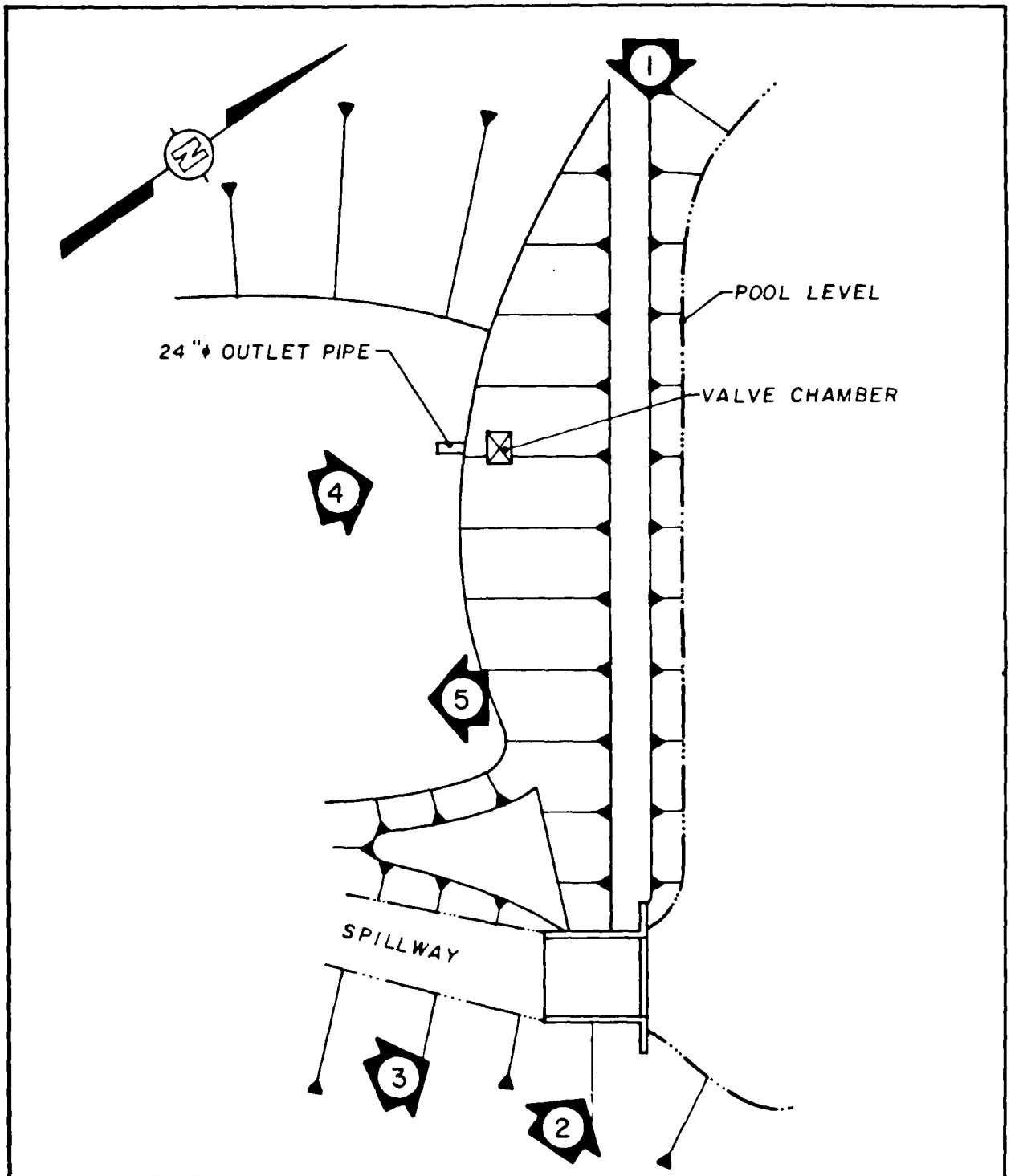
MAXIMUM NONDAMAGING DISCHARGE: 230± cfs existing spillway capacity

APPENDIX C

PHOTOGRAPHS

LIST OF PHOTOGRAPHS
REYNOLDSVILLE STORAGE DAM
NDI I.D. PA-1130
DER I.D. 33-5
APRIL 23, 1980

PHOTOGRAPH NO.	DESCRIPTION
1	Upstream face (looking east).
2	Spillway and dam crest (looking west).
3	Spillway (note deteriorating concrete).
4	Outlet (partially blocked).
5	Downstream reservoir (looking downstream from the crest of Storage Dam).
6	Pitchpine Run at Reynoldsville (approximately 3/4 mile downstream).



LEGEND:

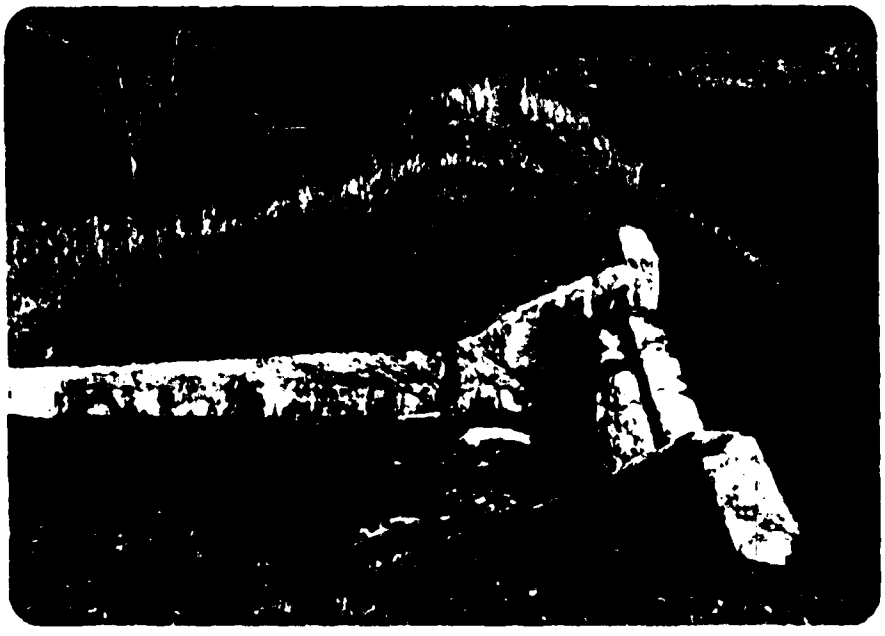
4 INDICATES DIRECTION IN WHICH PHOTOGRAPH WAS TAKEN.

REYNOLDSVILLE STORAGE DAM
KEY PLAN OF PHOTOGRAPHS
FIELD INSPECTION DATE APR 23,1980

DAMPDLONLA

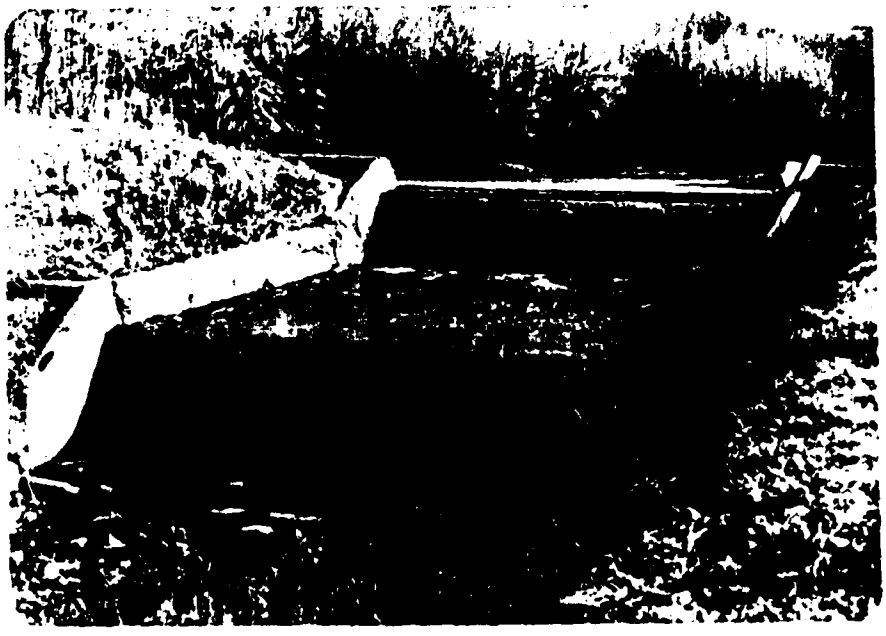
Photograph No. 1

Upstream face (looking east).



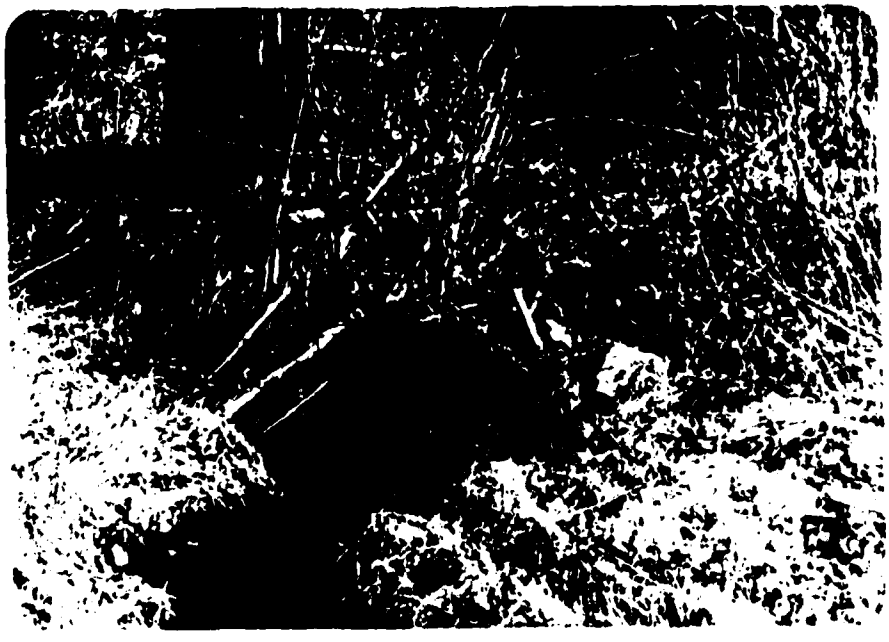
Photograph No. 2

Spillway and dam crest (looking west).



Photograph No. 3

Spillway (note deteriorating concrete).

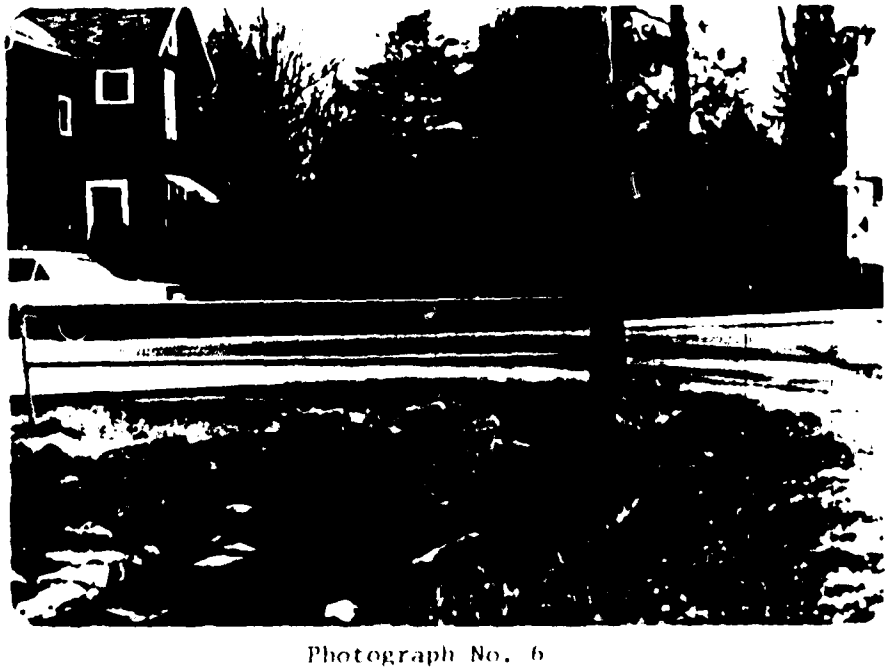


Photograph No. 4

Outlet (partially blocked).

Photograph No. 5

Downstream reservoir (looking downstream from the crest of Storage Dam).



Photograph No. 6

Pit Horse Run at Reynoldsville (approximately [illegible] downstream).

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Reynoldsville Storage Dam
(NDI I.D. PA-1130)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.4 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	Lake	Dam			
Drainage Area (square miles)	0.62	-			
Cumulative Drainage Area (square miles)	0.62	0.62			
Adjustment of PMF for Drainage Area (%)[2]					
6 Hours	116	-			
12 Hours	126	-			
24 Hours	141	-			
48 Hours	151	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone[3]	24A	-			
C_p/C_t[4]	0.45/4.2	-			
L (miles)[5]	1.3	-			
L_{ca} (miles)[5]	0.6	-			
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	3.9	-			
Spillway Data					
Crest Length (ft)	-	25			
Freeboard (ft)	-	2.1			
Discharge Coefficient	-	3.1[6]			
Exponent	-	1.5			

[1] Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

[2] Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

[3] Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

[4] Snyder's Coefficients.

[5] L = Length of longest water course from outlet to basin divide.
L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

[6] Assumed based on field observations.

STORAGE VS. ELEVATION

ELEVATION	ΔH, FEET	AREA (ACRES)[1]	ΔVOLUME (ACRE-FEET)[2]	STORAGE (ACRE-FEET)
1452[3]	8	2.8	35.8	0
1460		6.4		35.8

[1] Planimetered from USGS maps.

[2] $\Delta Volume = \Delta H/3\ (A_1 + A_2 + \sqrt{A_1 A_2})$.

[3] Normal pool elevation.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                 A1       SNYDER UNIT HYDROGRAPH, OVERTOPPING AND DOWNSTREAM ROUTING ANALYSES
    2                 A2       REYNOLDSVILLE DAM, JEFFERSON COUNTY PA DER 33-5      PROJECT NO. 79-543-20
    3                 A3       FOR 20%, 25%, 30%, 50%, 55%, 60%, 70%, 80%, AND 100% PMF
    4                 B    300        0       10        0        0        0        0        0       -4        0
    5                 B1     5
    6                 J      1        9        1
    7                 J1  0.20     0.25     0.30     0.50     0.55     0.60     0.70     0.80     1.00
    8                 K      0        1                                          1
    9                 K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO REYNOLDSVILLE DAM
   10                 M      1        1    0.62                0.62                                  1
   11                 P              23.5      116      126      141      151
   12                 T                                                        1.0      .08             0.0070
   13                 M   3.90     0.45
   14                 I   -1.0    -0.05      2.0
   15                 K      1        2                                          1
   16                 K1       ROUTING FLOW THROUGH REYNOLDSVILLE DAM (UPPER DAM)
   17                 Y                                 1        1
   18                 Y1     1                                                -1452.0
   19                 QA   0.1      2.8      6.4
   20                 QE1434.0   1452.0   1460.0
   21                 QQ1432.0     25.00     3.10      1.5
   22                 QQ1434.1      2.70      1.5     215.0
   23                 QL   9.0     20.0      34.0      84.0     150.0     195.0     215.0
   24                 QV1434.1   1454.3   1459.4   1459.8   1459.9   1456.0   1457.1
   25                 K      1        3                                          1
   26                 K1       ROUTING FLOW THROUGH REYNOLDSVILLE DAM (LOWER DAM)
   27                 Y                                 1        1
   28                 Y1     1                                                -1434.0
   29                 QA   1.8      5.51
   30                 QE1434.0   1460.0
   31                 QQ1436.0      30.0     3.10      1.5
   32                 QQ1437.4      2.80      1.5     255.0
   33                 QL  18.0      90.0     140.0     190.0     245.0     255.0
   34                 QV1437.4   1437.5   1437.7   1437.8   1438.2   1439.7
   35                 K      1        4                                          1
   36                 K1       CHANNEL ROUTING USING MODIFIED PULS
   37                 Y                                 1        1
   38                 Y1     1
   39                 Y6 0.045    0.045    0.045   1420.0   1480.0   1056.0  .001894
   40                 Y7   0.0   1480.0    110.0   1460.0    220.0   1440.0    500.0   1420.0    920.0   1480.0
   41                 Y7 720.0   1440.0    850.0   1460.0    950.0   1480.0
   42                 K      1        5                                          1
   43                 K1       CHANNEL ROUTING USING MODIFIED PULS
   44                 Y                                 1        1
   45                 Y1     1
   46                 Y6 0.045    0.045    0.045   1392.0   1440.0   2640.0  .010606
   47                 Y7   0.0   1440.0    100.0   1420.0    250.0   1400.0    500.0   1392.0    920.0   1392.0
   48                 Y7 700.0   1400.0    900.0   1420.0   1200.0   1440.0
   49                 K     99
```

COMPUTER INPUT: OVERTOPPING ANALYSIS

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 .25	RATIO 3 .30	RATIO 4 .50	RATIO 5 .55	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT	1	62	1	180.	225.	270.	449.	494.	539.	629.	719.	899.
		(1.61)		(5.09)(	6.36)(	7.63)(	12.72)(	13.99)(	15.27)(	17.81)(	20.36)(	25.44)
ROUTED TO	2	62	1	179.	223.	268.	448.	493.	538.	628.	718.	897.
		(1.61)		(5.05)(	6.32)(	7.59)(	12.69)(	13.96)(	15.23)(	17.78)(	20.32)(	25.41)
ROUTED TO	3	62	1	178.	223.	268.	447.	492.	537.	627.	717.	897.
		(1.61)		(5.04)(	6.31)(	7.58)(	12.67)(	13.94)(	15.21)(	17.77)(	20.31)(	25.41)
ROUTED TO	4	62	1	178.	223.	268.	447.	492.	537.	627.	717.	897.
		(1.61)		(5.04)(	6.30)(	7.57)(	12.67)(	13.94)(	15.21)(	17.76)(	20.30)(	25.41)
ROUTED TO	5	62	1	177.	222.	267.	446.	491.	536.	626.	715.	893.
		(1.61)		(5.03)(	6.29)(	7.56)(	12.64)(	13.91)(	15.18)(	17.72)(	20.28)(	25.38)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1452.00	1452.00	1454.10
STORAGE	21	21.	27.
OUTFLOW	0.	0.	236.

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	1453.74	0.00	26.	178.	0.00	43.83	0.00
.25	1454.02	0.00	27.	223.	0.00	43.83	0.00
.30	1454.27	.17	28.	268.	3.00	43.67	0.00
.50	1454.97	.87	31.	448.	8.33	43.67	0.00
.55	1455.11	1.01	31.	493.	9.17	43.67	0.00
.60	1455.25	1.15	32.	538.	9.50	43.67	0.00
.70	1455.50	1.40	33.	628.	9.83	43.67	0.00
.80	1455.71	1.61	34.	718.	10.17	43.67	0.00
1.00	1456.02	1.92	35.	897.	10.50	43.50	0.00

OVERTOPPING ANALYSIS
(REYNOLDSVILLE STORAGE DAM - UPPER DAM)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1434.00	1434.00	1437.40
STORAGE	0	0	7
OUTFLOW	0	0	383

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	1435.54	0.00	3	178	0.00	44.00	0.00
.25	1435.79	0.00	3	223	0.00	43.83	0.00
.30	1436.02	0.00	4	268	0.00	43.83	0.00
.50	1436.85	0.00	6	447	0.00	43.83	0.00
.55	1437.04	0.00	6	492	0.00	43.83	0.00
.60	1437.22	0.00	6	537	0.00	43.83	0.00
.70	1437.54	.14	7	627	2.17	43.67	0.00
.80	1437.72	.32	7	717	4.00	43.67	0.00
1.00	1437.97	.57	8	897	6.17	43.67	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.20	178	1421.4	44.00
.25	223	1421.7	44.00
.30	268	1422.1	44.00
.50	447	1423.2	43.83
.55	492	1423.3	43.83
.60	537	1423.4	43.83
.70	627	1423.6	43.83
.80	717	1423.8	43.67
1.00	897	1424.1	43.67

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.20	177	1392.5	44.33
.25	222	1392.6	44.17
.30	267	1392.7	44.17
.50	446	1393.2	44.00
.55	491	1393.3	44.00
.60	536	1393.4	44.00
.70	626	1393.6	44.00
.80	715	1393.9	44.00
1.00	895	1394.4	43.83

DOWNSTREAM CHANNEL ROUTING
(WITHOUT DAM BREACH)

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1                A1       SNYDER HYDROGRAPH,OVERTOPPING,DAM BREACH,DOWNSTREAM ROUTING ANALYSES
    2                A2       REYNOLDSVILLE DAM,JEFFERSON COUNTY,PA.DER.33-5      PROJECT NO.79-563-20
    3                A3       FOR 20%,25%,30%,50%,55%,60%,70%,80%,AND 100% PMF
    4                B    300        0       10        0        0        0        0        0       -4        0
    5                B1     5
    6                J      1        9        1
    7                J1  0.20     0.25     0.30     0.50     0.55     0.60     0.70     0.80     1.00
    8                K      0        1                                          1
    9                K1       CALCULATION OF SNYDER INFLOW HYDROGRAPH TO REYNOLDSVILLE DAM
   10                A      1        1     0.62              0.62                                       1
   11                P             23.5      116      126      141      151
   12                T                                                          1.0      .05             0.0070
   13                J   3.90     0.45
   14                K   -1.0    -0.05      2.0
   15                K      1        2                                          1
   16                K1       ROUTING FLOW THROUGH REYNOLDSVILLE DAM(UPPER DAM)
   17                Y                                  1        1
   18                Y1     1                                                -1452.0
   19                SA    0.1      2.8      6.4
   20                SE1456.0   1452.0   1460.3
   21                SS1452.0     25.0      3.10      1.5
   22                SD1454.1      2.7       1.5    215.0
   23                SL     9.0     20.3     36.0     84.0    150.0    195.0    215.0
   24                SV1454.1   1454.3   1455.4   1455.8   1455.9   1456.0   1457.1
   25                SQ 150.0      0.5   1434.0    0.333   1452.0   1454.8
   26                K      1        3                                          1
   27                K1       ROUTING FLOW THROUGH REYNOLDSVILLE DAM (LOWER DAM)
   28                Y                                  1        1
   29                Y1     1                                                -1434.0
   30                SA    1.8     5.51
   31                SE1434.0   1460.0
   32                SS1434.0     30.0      3.10      1.5
   33                SD1437.4      2.8       1.5    255.0
   34                SL    95.0     90.0    140.0    190.0    245.0    255.0
   35                SV1437.4   1437.5   1437.7   1437.8   1438.2   1439.7
   36                K      1        4                                          1
   37                K1       CHANNEL ROUTING USING MODIFIED PULS
   38                Y                                  1        1
   39                Y1     1
   40                Y6 0.045    0.045    0.045   1420.0   1480.0   1056.0  .001894
   41                Y7    0.0   1480.0    110.0   1460.0    220.0   1440.0    500.0   1420.0    520.0   1420.0
   42                Y7  720.0   1440.0    850.0   1460.0    950.0   1480.0
   43                K      1        5                                          1
   44                K1       CHANNEL ROUTING USING MODIFIED PULS
   45                Y                                  1        1
   46                Y1     1
   47                Y6 0.045    0.045    0.045   1392.0   1440.0   2640.0  .010606
   48                Y7    0.0   1440.0    100.0   1420.0    250.0   1400.0    500.0   1392.0    520.0   1392.0
   49                Y7  700.0   1400.0    900.0   1420.0   1200.0   1440.0
   50                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 .25	RATIO 3 .33	RATIO 4 .50	RATIO 5 .55	RATIO 6 .60	RATIO 7 .70	RATIO 8 .80	RATIO 9 1.00
HYDROGRAPH AT	1	.62	1	150.	225.	270.	449.	496.	539.	629.	719.	899.
	(	1.61)	(	5.09)(	6.36)(	7.63)(	12.72)(	13.99)(	15.27)(	17.81)(	20.36)(	25.44)
ROUTED TO	2	.62	1	178.	223.	268.	2747.	2775.	2784.	2788.	2800.	2812.
	(	1.61)	(	5.05)(	6.32)(	7.59)(	77.79)(	78.59)(	78.83)(	78.96)(	79.28)(	79.66)
ROUTED TO	3	.62	1	178.	223.	268.	2029.	2066.	2071.	2067.	2077.	2087.
	(	1.61)	(	5.04)(	6.31)(	7.58)(	57.45)(	58.49)(	58.64)(	58.52)(	58.82)(	59.09)
ROUTED TO	4	.62	1	178.	223.	268.	1743.	1771.	1781.	1788.	1801.	1815.
	(	1.61)	(	5.04)(	6.30)(	7.57)(	49.36)(	50.16)(	50.44)(	50.64)(	50.99)(	51.40)
ROUTED TO	5	.62	1	177.	222.	267.	1303.	1333.	1334.	1327.	1336.	1339.
	(	1.61)	(	5.03)(	6.29)(	7.56)(	36.90)(	37.74)(	37.78)(	37.57)(	37.77)(	37.91)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1452.00	1452.00	1456.10
STORAGE	21.	21.	27.
OUTFLOW	0.	0.	236.

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	1453.76	0.00	26.	178.	0.00	43.85	0.00
.25	1454.02	0.00	27.	223.	0.00	43.83	0.00
.30	1454.27	.17	28.	268.	3.00	43.67	0.00
.50	1454.82	.72	30.	2800.	1.75	42.65	42.50
.55	1454.85	.75	30.	2827.	1.58	42.32	42.17
.60	1454.85	.75	30.	2835.	1.41	41.99	41.83
.70	1454.83	.73	30.	2838.	1.25	41.49	41.33
.80	1454.84	.74	30.	2848.	1.25	41.15	41.00
1.00	1454.84	.74	30.	2860.	1.08	40.65	40.50

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1434.00	1434.00	1437.40
STORAGE	0.	0.	7.
OUTFLOW	0.	0.	583.

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	1435.54	0.00	3.	178.	0.00	44.00	0.00
.25	1435.79	0.00	3.	223.	0.00	43.83	0.00
.30	1436.02	0.00	4.	268.	0.00	43.83	0.00
.50	1436.88	1.48	10.	2029.	.33	42.67	0.00
.55	1438.90	1.50	10.	2056.	.33	42.33	0.00
.60	1438.90	1.50	10.	2071.	.33	42.00	0.00
.70	1438.90	1.50	10.	2067.	2.33	41.50	0.00
.80	1438.91	1.51	10.	2077.	4.17	41.17	0.00
1.00	1438.91	1.51	10.	2087.	6.50	40.67	0.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	178.	1421.4	44.00
.25	223.	1421.7	44.00
.30	268.	1422.1	44.00
.50	1743.	1425.8	42.83
.55	1771.	1425.8	42.50
.60	1781.	1425.9	42.17
.70	1788.	1425.9	41.67
.80	1801.	1425.9	41.33
1.00	1815.	1425.9	40.83

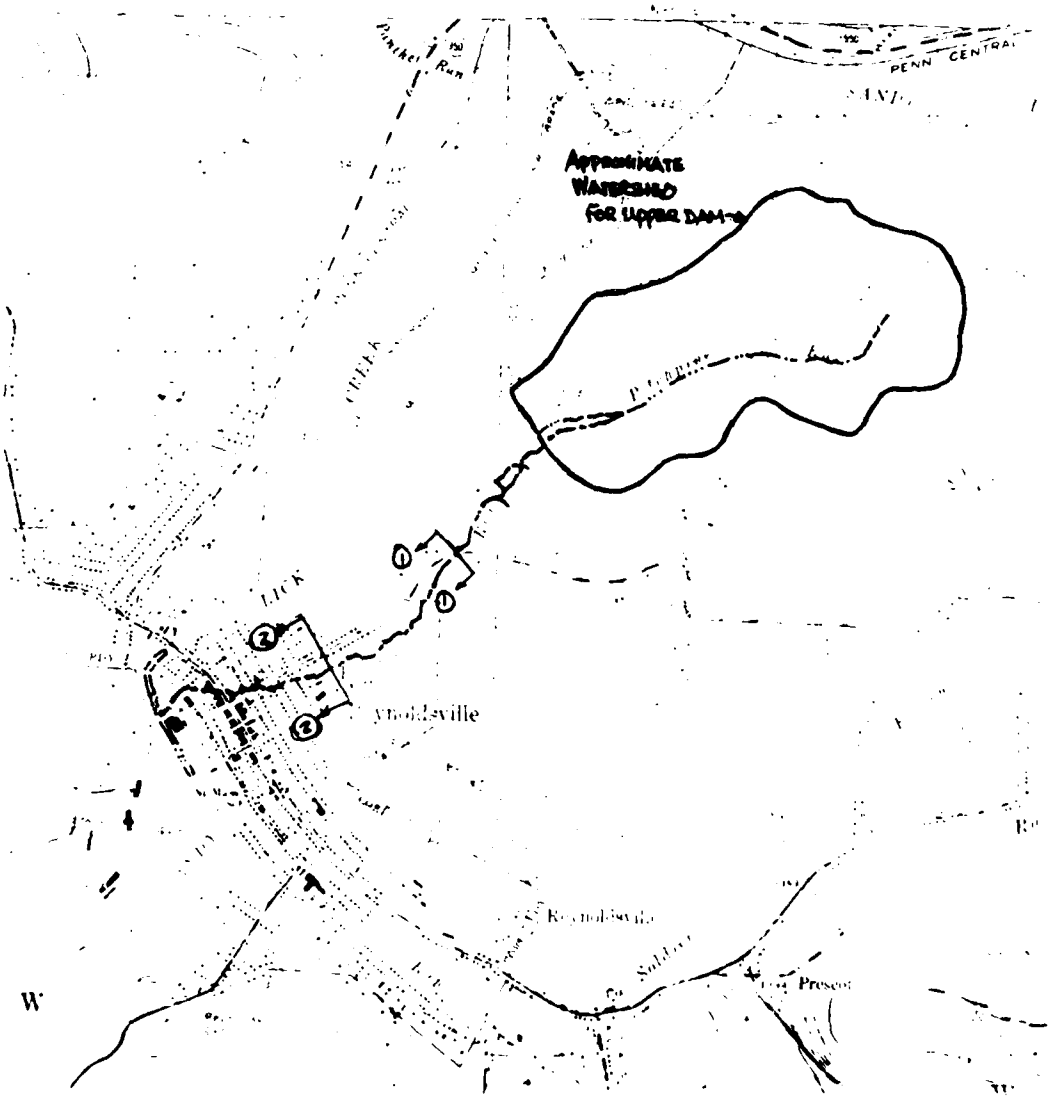
PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	177.	1392.5	44.33
.25	222.	1392.6	44.17
.30	267.	1392.7	44.17
.50	1305.	1394.7	42.83
.55	1333.	1394.7	42.50
.60	1334.	1394.8	42.17
.70	1327.	1394.7	41.67
.80	1334.	1394.7	41.33
1.00	1339.	1394.8	41.00

DOWNSTREAM CHANNEL ROUTING
(WITH DAM BREACH)

DAPPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 6/17/80 Subject REYNOLDSVILLE DAM (UPPER) Sheet No 1 of 3
Chkd. By BE Date 6/19/80 D/S ROUTING Proj. No 79-543-20



D'APPOLONIA
CONSULTING ENGINEERS, INC

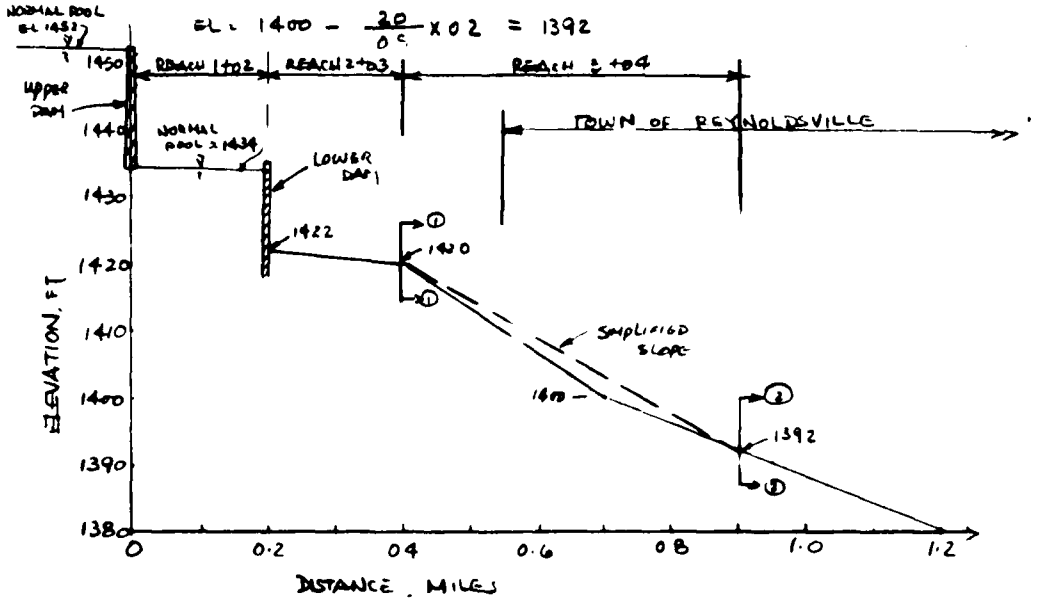
By WTC Date 6/17/80 Subject REYNOLDSVILLE DAM (UPPER) Sheet No. 2 of 3
Chkd. By PE Date 6/19/80 D/S ROUTING Proj. No. 79-543-2

CHANNEL PROFILE AND CROSS-SECTION OF REYNOLDSVILLE DAM

REACH	LOCATION OF	ELEVATION (USGS)	DISTANCE FROM UPPER DAM	SIMPLIFIED	REMARKS
		FT	MILES	%	
1-to-2	REYNOLDSVILLE UPPER DAM TOE	≈ 1434	0	LOWER LAKE	
	LOWER DAM	Spillway 1434 TAILWATER 1422	0.2	$\frac{1422-1420}{0.2\times5280} = 0.184\%$	
2-to-3	SECTION ①	1420	0.4		
3-to-4		1400	0.7	$\frac{1420-1392}{0.5\times5280} = 1.061\%$	TOWN OF REYNOLDSVILLE P.A.
	SECTION ②	1392*	0.9		

* INTERPOLATED EL = 1380 @ 1.2 mile.

$EL = 1400 - \frac{20}{0.5} \times 0.2 = 1392$



CHANNEL PROFILE

D'APPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 6/17/80 Subject REYNOLDSVILLE DAM (UPPER) Sheet No. 3 of 3
Chkd. By RS Date 6/19/80 D/S ROUTING Proj. No. 79-543-20

SUMMARY OF CHANNEL CROSS-SECTION DATA

REACH 2 to 3		REACH 3 to 4	
L = 1056		L = 2640	
S = 0.00189		S = 0.01064	
SECTION ①		SECTION ②	
DISTANCE	ELEVATION	DISTANCE	ELEVATION
0	1480	0	1440
115	1460	100	1420
220	1440	250	1400
500	1420	500	1392
520	1420	520	1392
720	1440	700	1400
850	1460	900	1420
950	1480	1200	1440

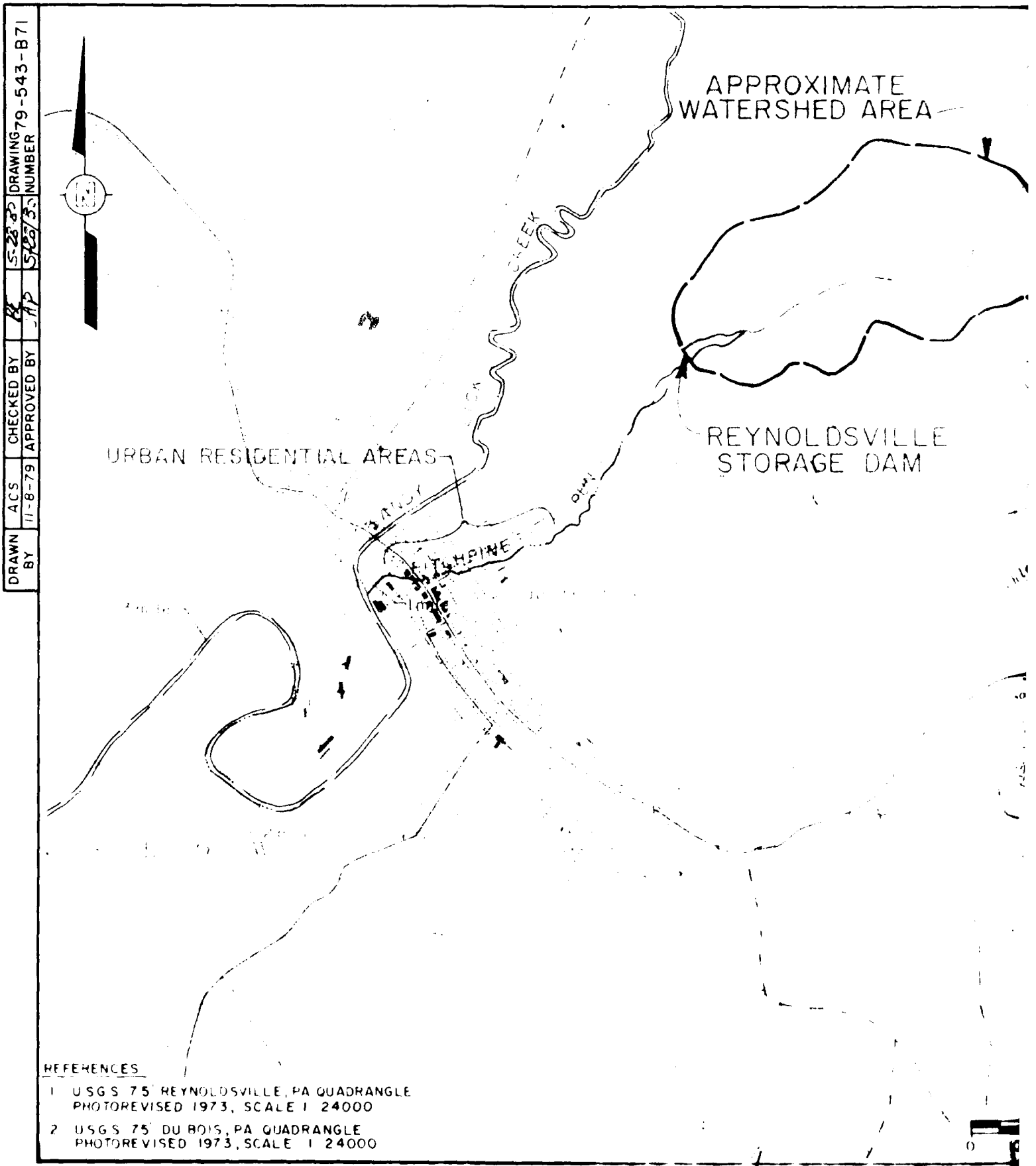
NOTES (1) L = REACH LENGTH IN FEET S = SLOPE OF REACH FT/FT
(2) DISTANCES FOR EACH CROSS SECTION ARE MEASURED FROM USGS 7.5' MAPS (FROM LEFT TO RIGHT, LOOKING D/S)
(3) ASSUMED CHANNEL BOTTOM WIDTH = 10'
(4) ASSUMED CHANNEL ROUGHNESS COEF n = 0.0045

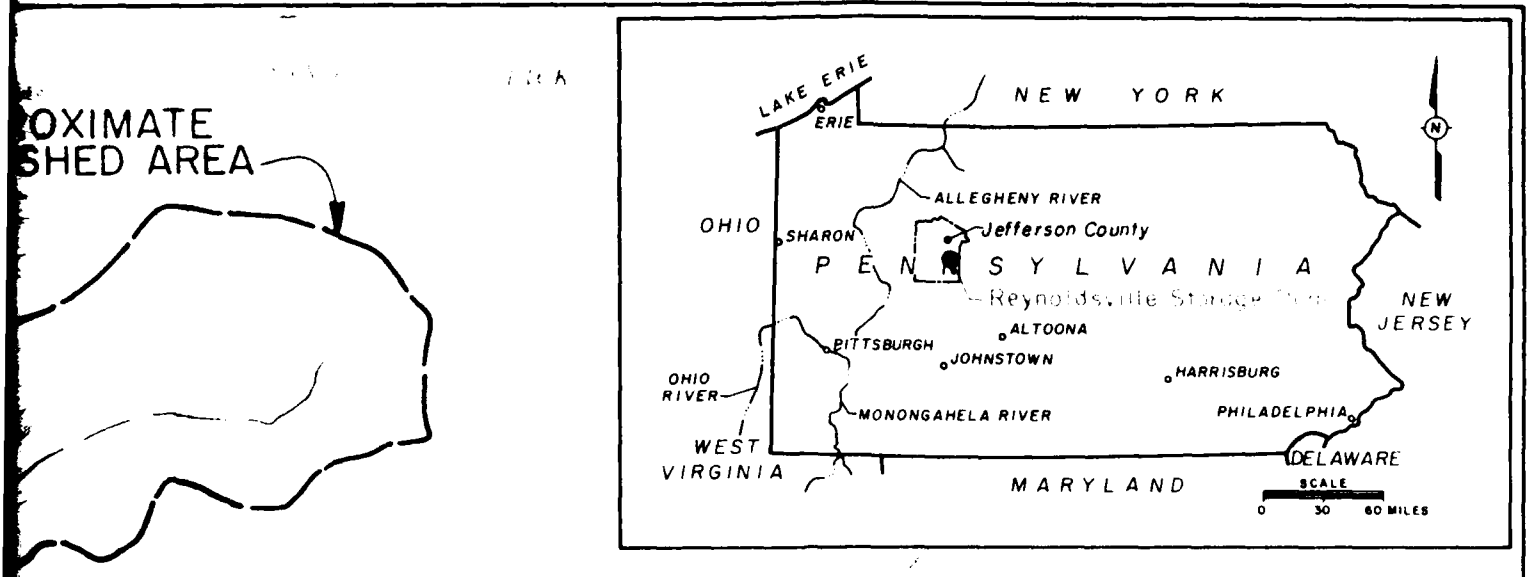
SUMMARY OF AREA & SURCHARGE STORAGE VOL. ABOVE SPILLWAY LOWER DAM.

ELEVATION	PLANIMETER AREA		SURCHARGE STORAGE VOLUME
FT	IN^2	ACRES	AC-FT
1434	002	1.8	0 (SPILLWAY)
1460	006	5.51	90.6

APPENDIX E

PLATES


APPROXIMATE
WATERSHED AREA
REYNOLDSVILLE
STORAGE DAM
URBAN RESIDENTIAL AREAS
SANDY
CREEK
PINE
RUN
DRAWN BY
ACS
11-8-79
CHECKED BY
APPROVED BY
DRAWING NUMBER
79-543-B71
REFERENCES
1 USGS 7.5' REYNOLDSVILLE, PA QUADRANGLE
PHOTOREVISED 1973, SCALE 1 24000
2 USGS 7.5' DU BOIS, PA QUADRANGLE
PHOTOREVISED 1973, SCALE 1 24000



KEY PLAN

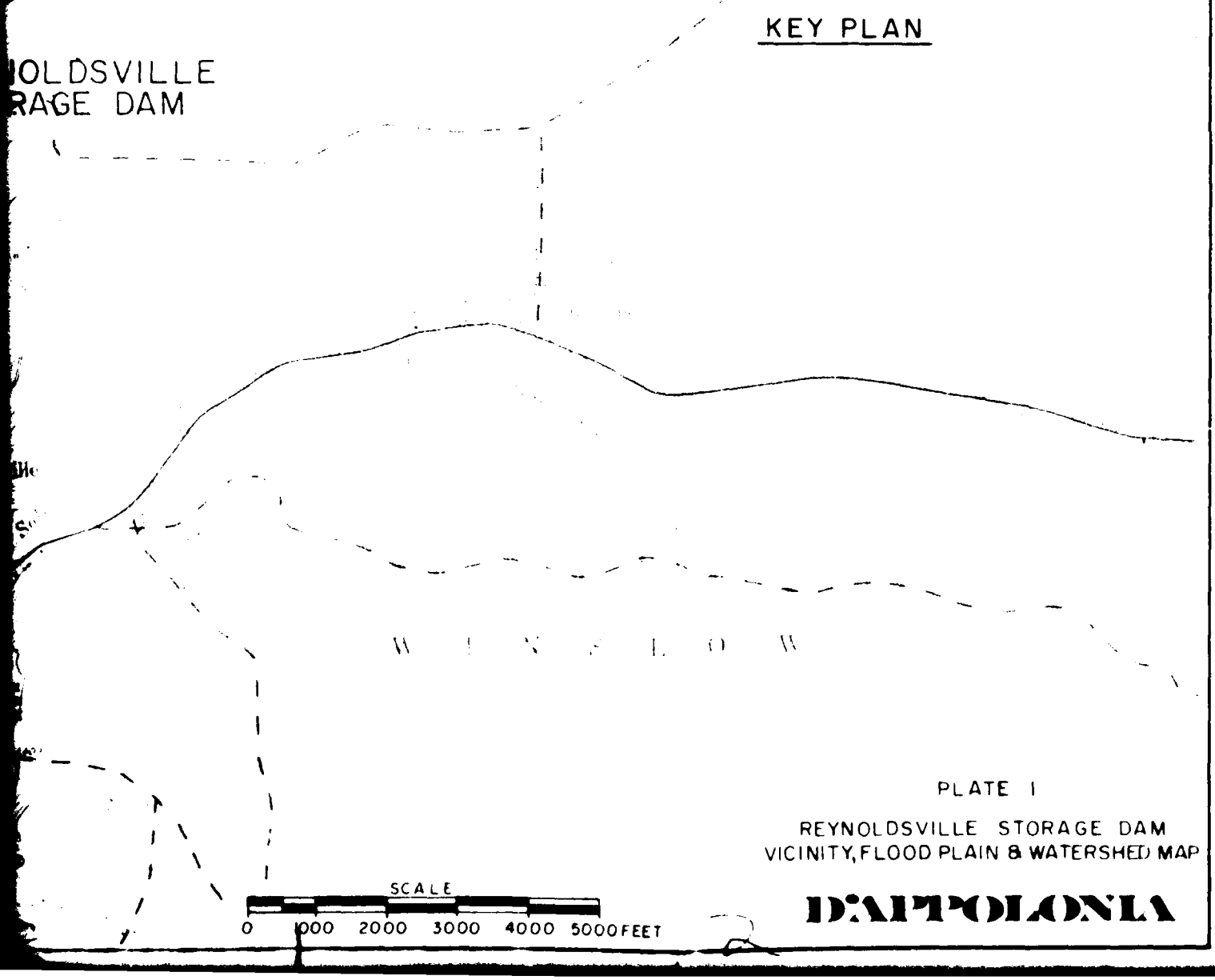


PLATE 1

REYNOLDSVILLE STORAGE DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP

DAIDOLONIA

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER	79-543-B72
	5 27 80	APPROVED BY			

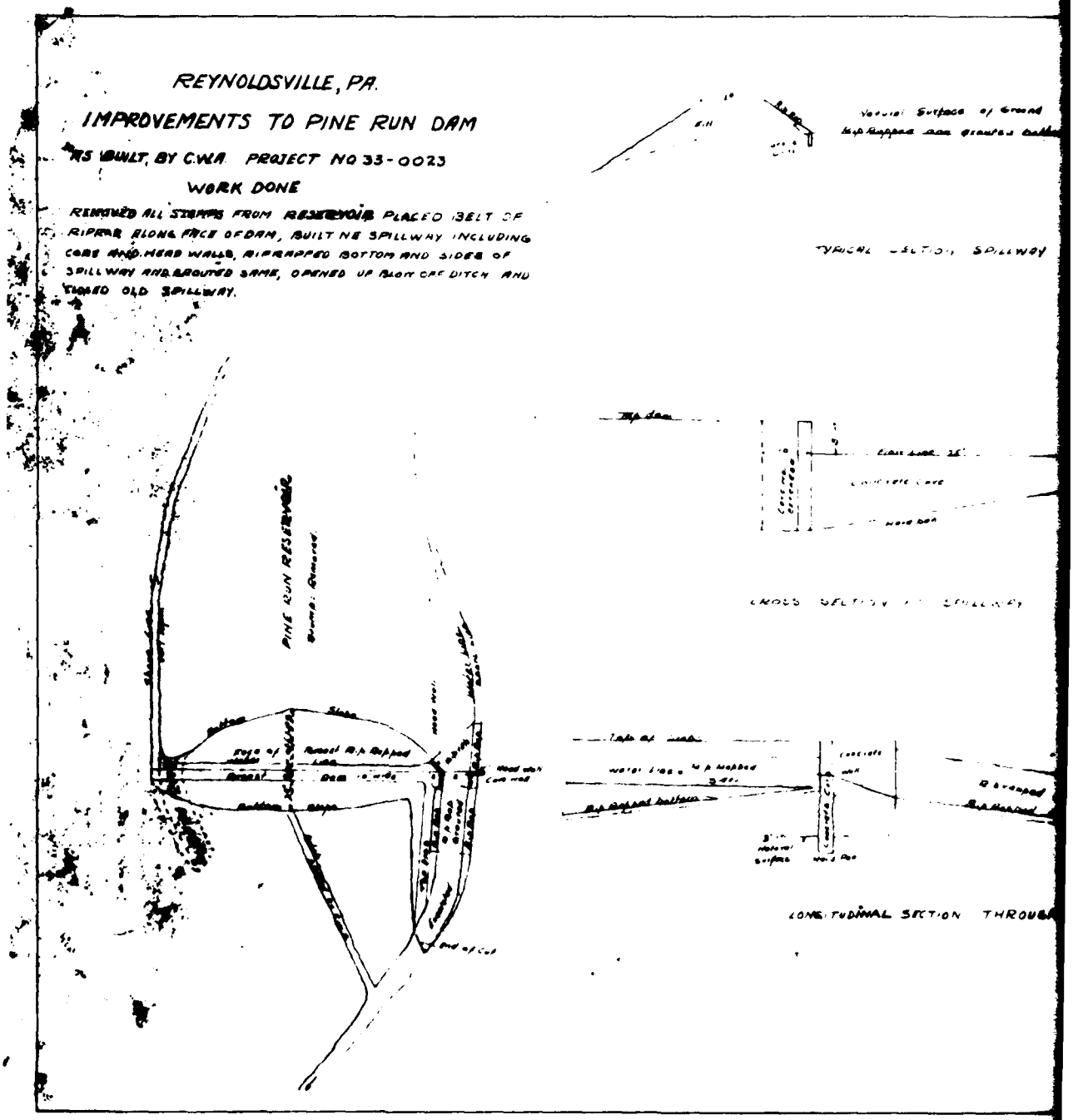
REYNOLDSVILLE, PA.

IMPROVEMENTS TO PINE RUN DAM

AS BUILT, BY C.W.A. PROJECT NO 33-0023

WORK DONE

REMOVED ALL SLIDES FROM RESERVOIR PLACED BELT OF RIPRAP ALONG FACE OF DAM, BUILT NE SPILLWAY INCLUDING CORE AND HEAD WALLS, RIPRAPPED BOTTOM AND SIDES OF SPILLWAY AND GROUTED SAME, OPENED UP FLOW CAR DITCH AND CLOSED OLD SPILLWAY.



TYPICAL SECTION SPILLWAY

CROSS SECTION OF SPILLWAY

LONGITUDINAL SECTION THROUGH

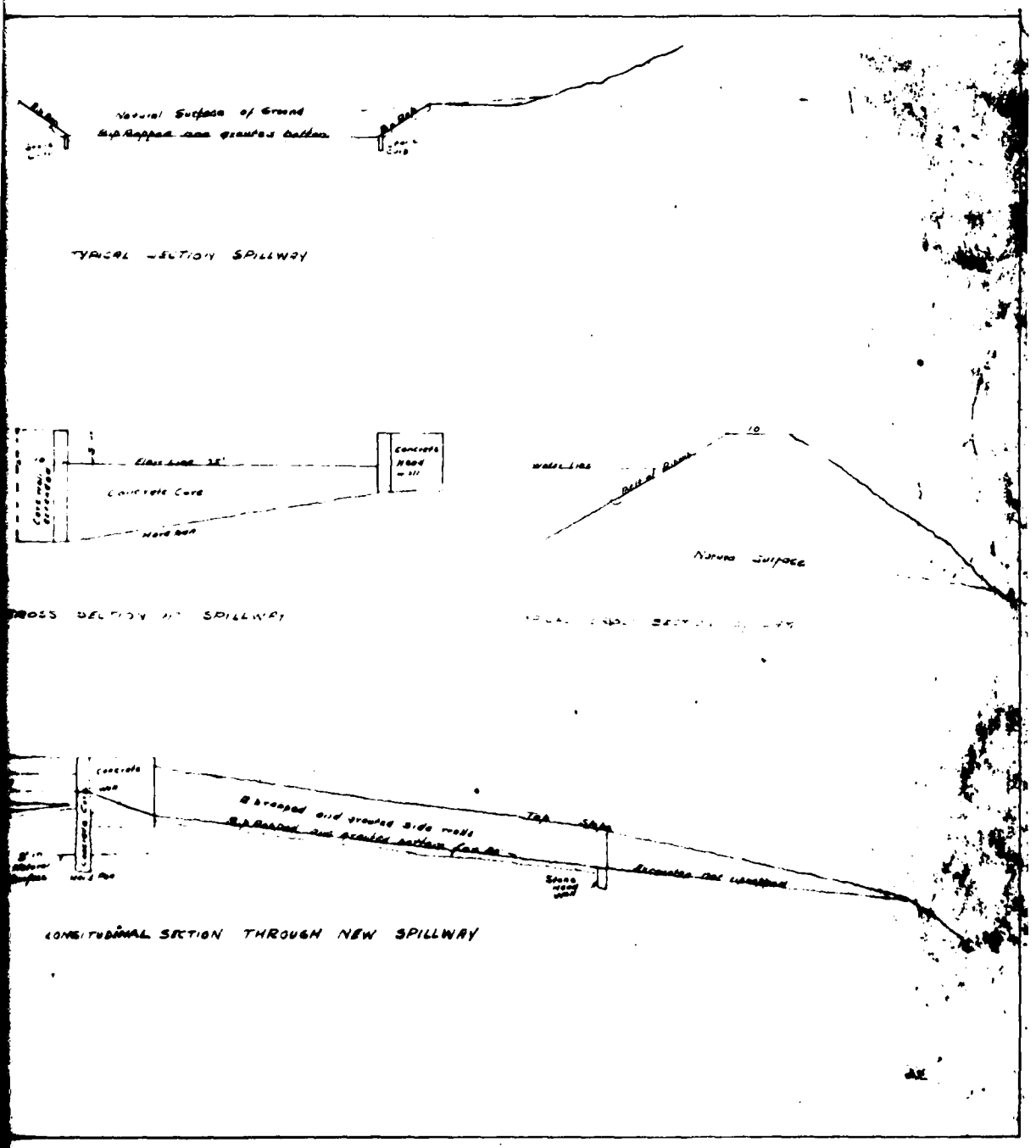
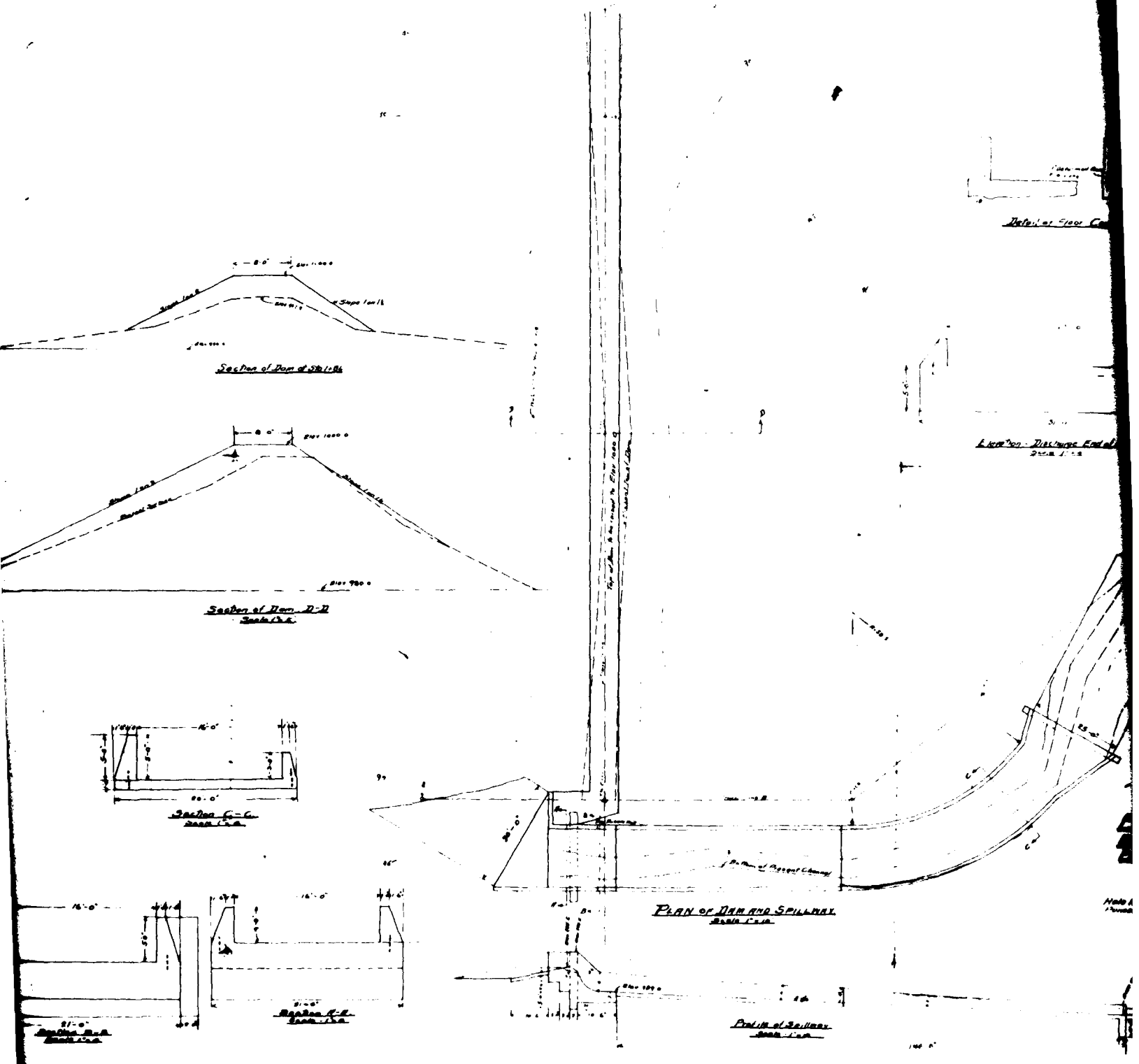


PLATE 2

DAPTOLONIA



ROPOSED SPILLWAY NOT CONSTRUCTED

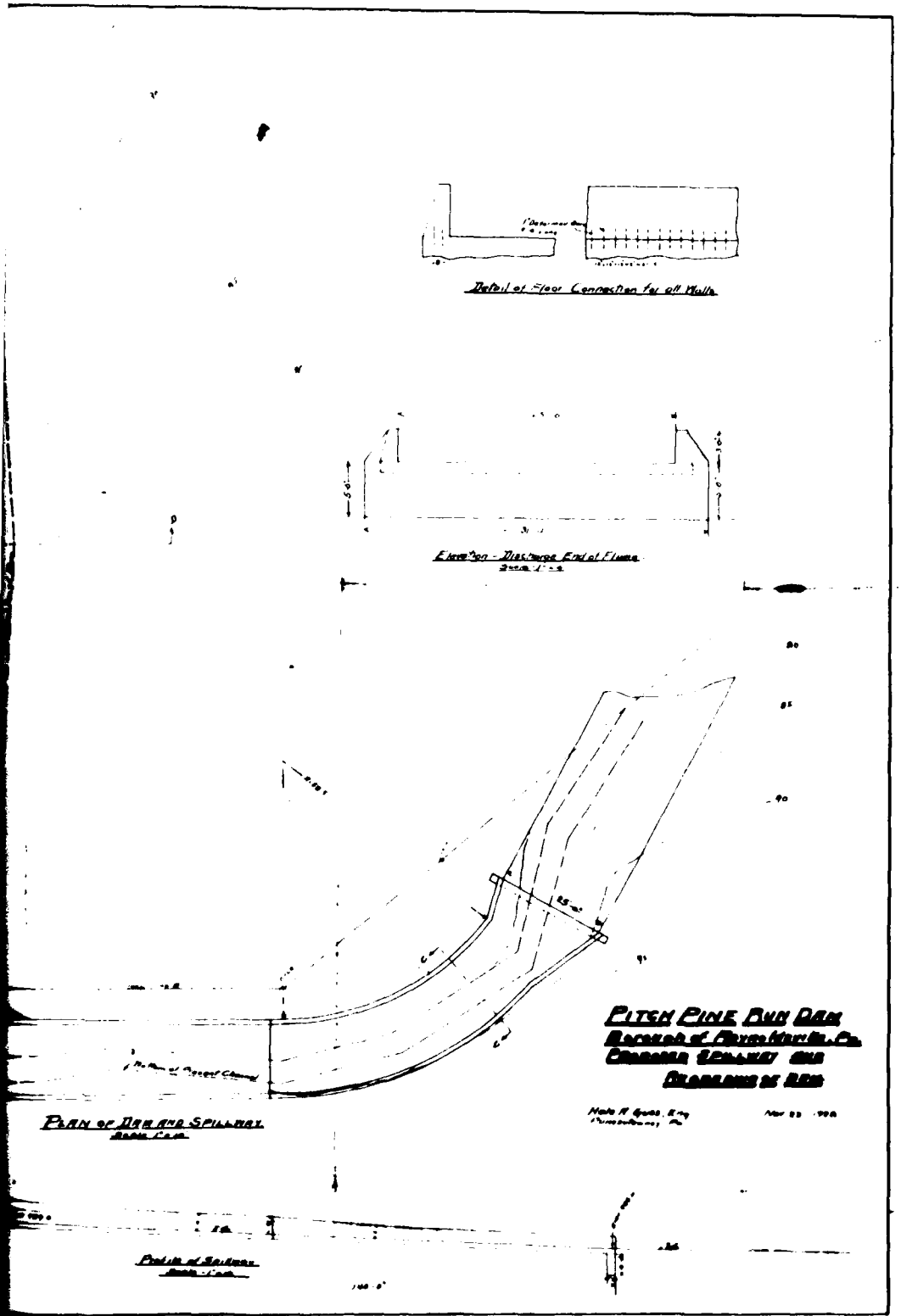
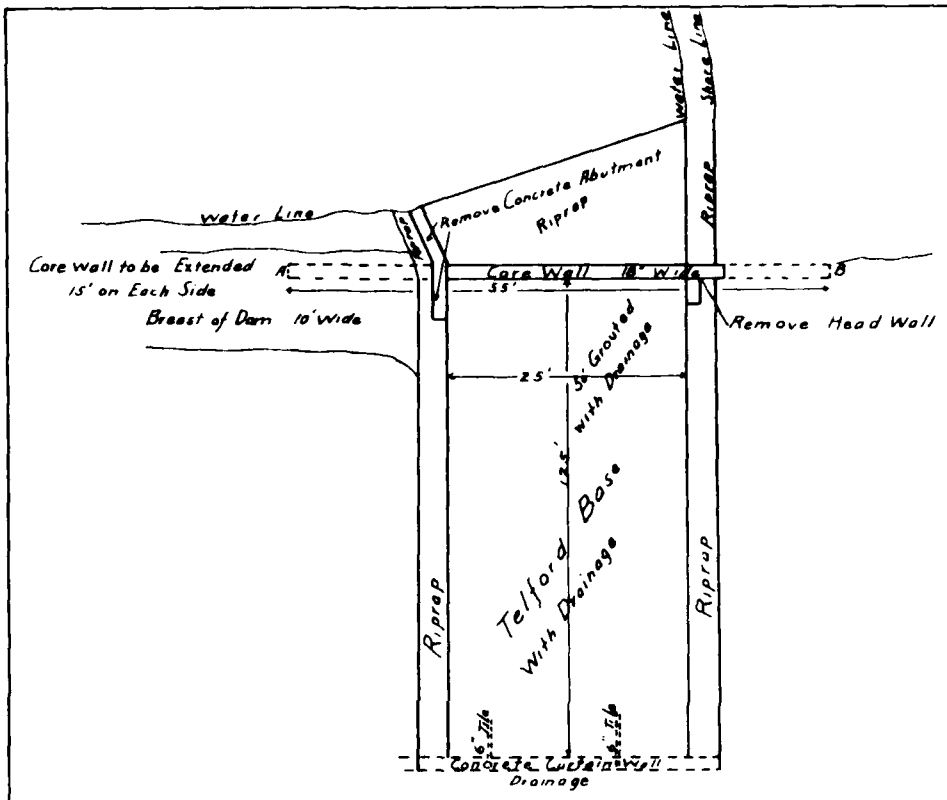
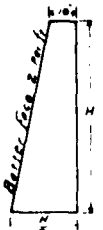


PLATE 3

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER 79-543-B74
	5-22-80	APPROVED BY		



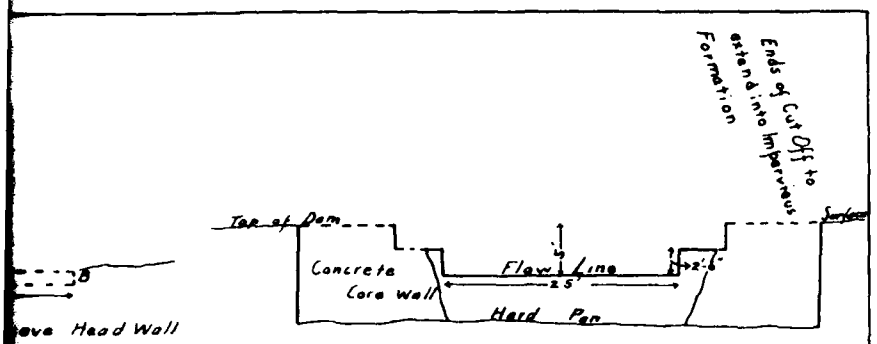
PLAN of SPILLWAY



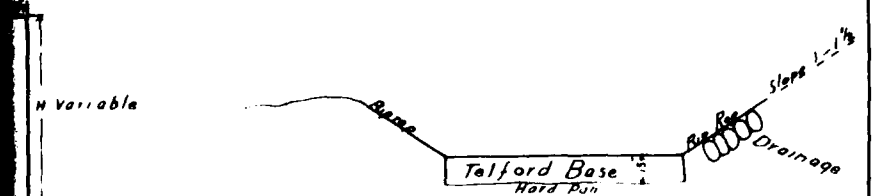
Typical Cross Section of Concrete Walls

BOROUGH OF REYNOLDSVILLE WA
REYNOLDSVILLE, PA
Improvement to Spillway at Dam on West B

Scale: 1" = 10'



Cross Section through A B



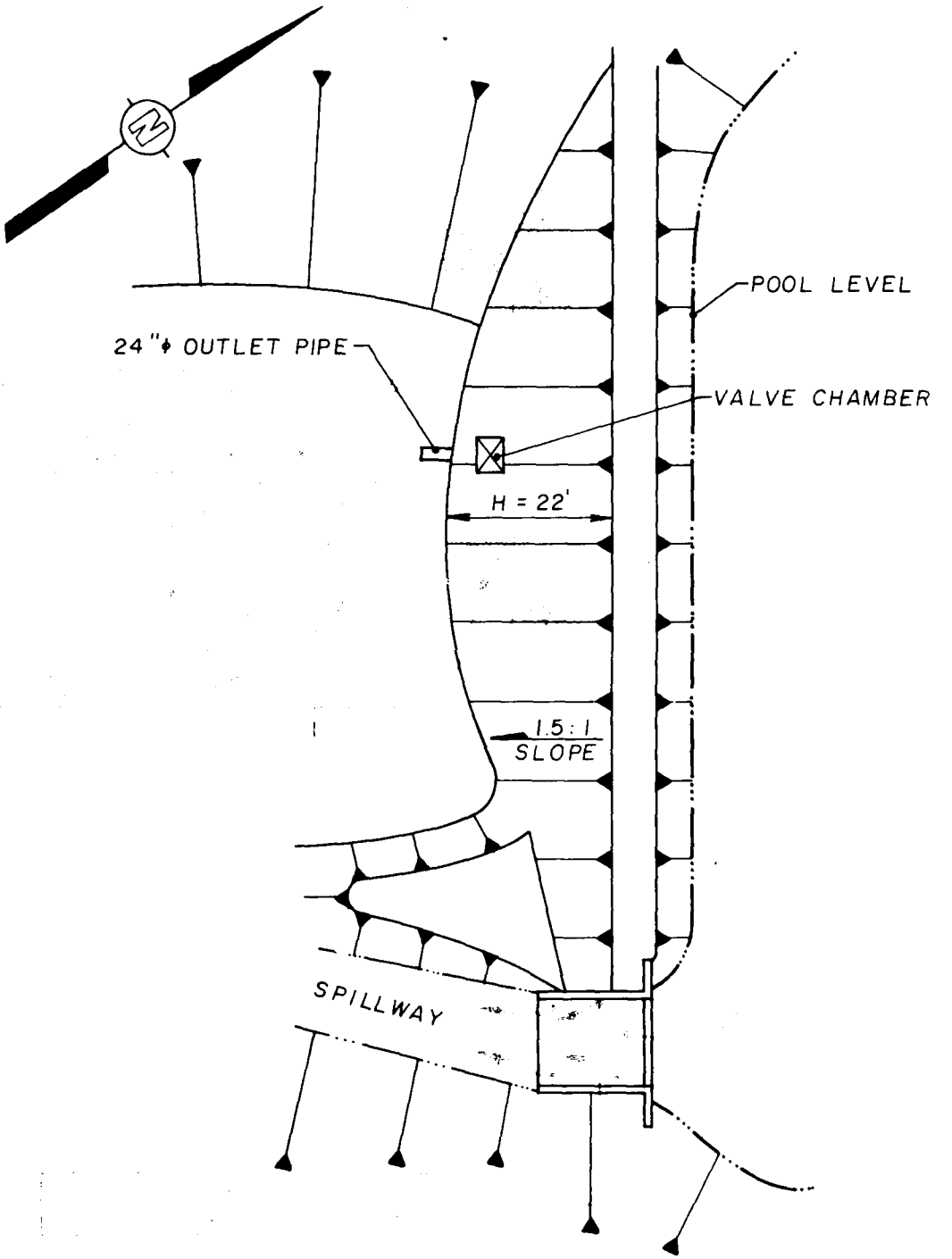
Cross Section through Spillway

OF REYNOLDSVILLE WATER PLANT
REYNOLDSVILLE, PA
illway at Dam on West Branch Pitch Pine Run

C.S. Davis

PLATE 4

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER
	5-21-80	APPROVED BY		79-543-A47



NOTES:

1. POOL LEVEL DATE OF INSPECTION 0.6 FT. BELOW SPILLWAY CREST

PLATE 5

REYNOLDSVILLE STORAGE DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: APR 23, 1980

DAPPOLONIA

APPENDIX F

REGIONAL GEOLOGY

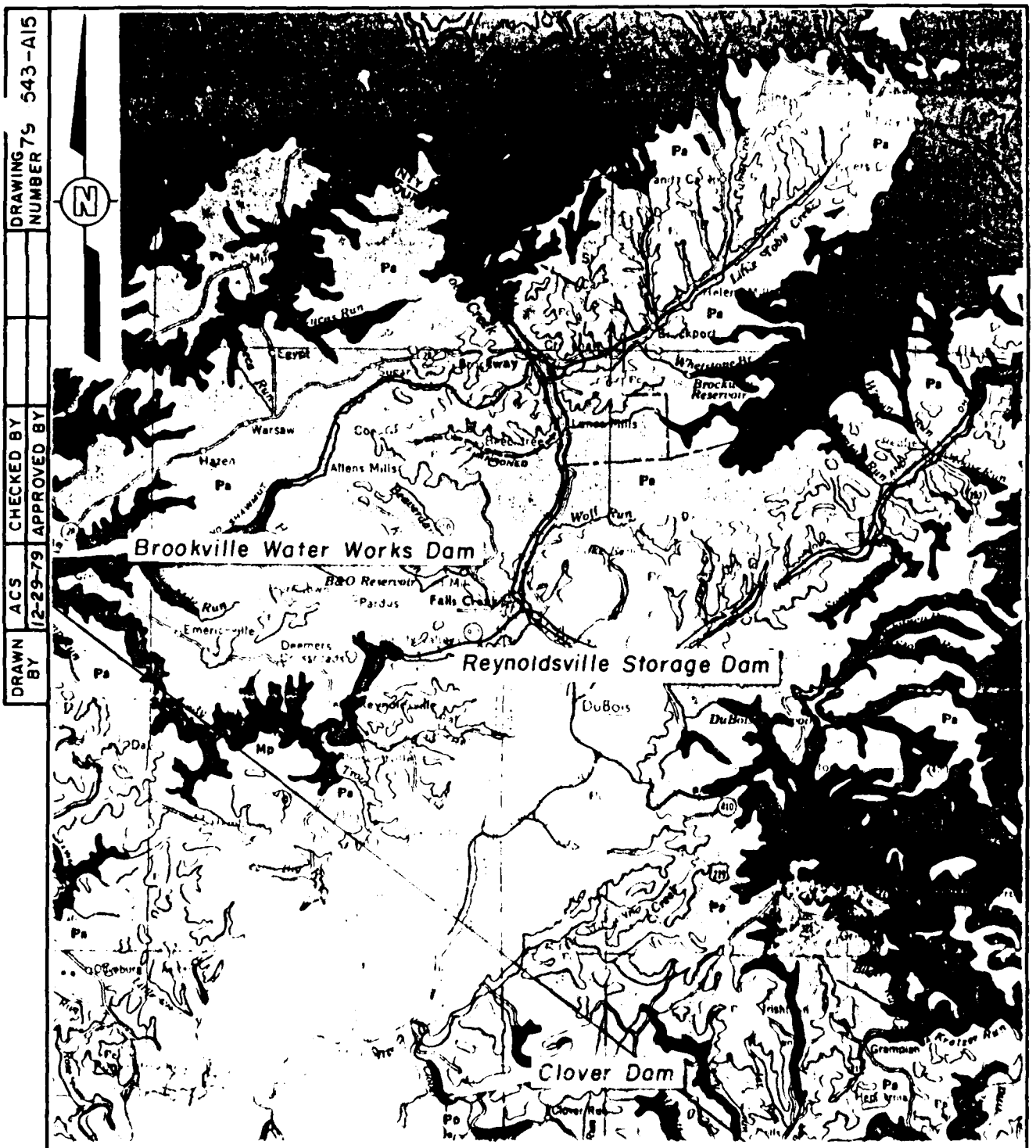
APPENDIX F

REGIONAL GEOLOGY
REYNOLDSVILLE STORAGE DAM

Reynoldsville Storage Dam is located in the central area of the Appalachian Plateau Province which is characterized by broad, nearly level ridges and deep steep valleys. Strata in the vicinity have been gently folded to form the Roaring Run Anticline which trends to the northeast.

The dam lies on strata belonging to the Allegheny Group of Pennsylvanian Age. The Allegheny is characterized by shales, sandstones, and several minable coals. The Vanport Limestone occurs in this formation and outcrops in the Reynoldsville area.

The Lower Freeport Coal has been mined extensively for many years in the Reynoldsville area. No deep mines are known to exist in the area.



BROOKVILLE WATER WORKS, REYNOLDSVILLE STORAGE AND CLOVER DAMS

GEOLOGY MAP

REFERENCE

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

DAPTOLONIA

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER 79-543-A18
	12-31-79	APPROVED BY		

LEGEND

Pc

Conemaugh Formation

Cyclic sequences of red and gray shales and siltstones with thin limestones and coals, massive Mahoning Sandstone commonly present at base; Amos Limestone present in middle of sections, Brush Creek Limestone in lower part of section.

Pottsville Group

Light gray to white, coarse grained sand stone and conglomerate with some mineable coal; includes Sharp Mountain, Schuylkill and Tumbling Run Formations

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

Clinton Group

Predominantly Rose Hill Formation - Reddish purple to greenish gray, thin to medium bedded, fossiliferous shale with interbedding iron sandstones and local gray, fossiliferous limestone above the Eyer Ho[illegible] to white quartzite sandstone (Keefer) - fines upward with dark gray shale (Rochester)

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

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

Oriskany Formation

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

Tuscarora Formation

White to gray, medium to thick bedded, fine grained, quartzitic sandstone, conglomeratic in part

Marcellus Formation

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

Onondaga Formation

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

Dmo

Wills Creek Formation

Greenish gray, thin bedded, fissile shale with local limestone and sandstone zones; contains red shale and siltstone in the lower part

Bloomsburg Formation

Red, thin and thick bedded shale and siltstone with local units of sandstone and thin impure limestone, some green shale in places

McKenzie Formation

Greenish gray, thin bedded shale interbedded with gray, thin bedded, fossiliferous limestone; shale predominant at the base, intraformational breccia in the lower part. Absent in Harrisburg quadrangle and to the east

Keyser Formation

Dark gray, highly fossiliferous, thick bedded, crystalline to nodular limestone; passes into Manlius, Rondout, and Decker Formations in the east

Tonoloway Formation

Gray, highly laminated, thin bedded, argillaceous limestone; passes into Bossardville and Poxono Island beds in the east

Catskill Formation

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

GEOLOGY MAP LEGEND

REFERENCE:

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

D'APPOLONIA