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NATIONAL DAM INSPECTION PROGRAM. MILBURN SPRING RESERVOIR (NDI --ETC(U)
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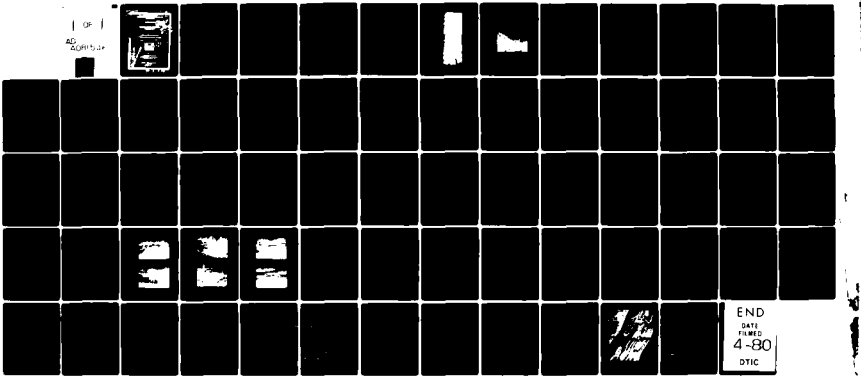

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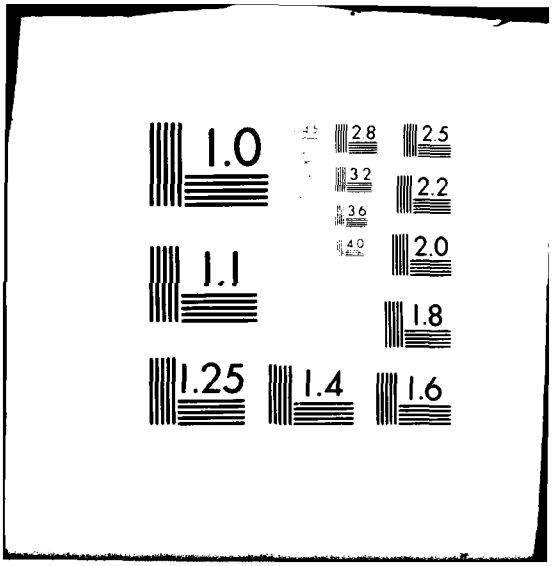
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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the 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.

(12) 66 (10) Lawrence I. [illegible]

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM.

NAME OF DAM: Milburn Spring Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Bedford
STREAM: Unnamed tributary of Cumberland Valley Run
SIZE CLASSIFICATION: Small
HAZARD CLASSIFICATION: High
OWNER: Borough of Bedford
DATE OF INSPECTION: November 19 and December 12, 1979

ASSESSMENT: Based on the evaluation of the existing conditions, the condition of Milburn Spring Dam is considered to be poor. Extensive swampy areas and numerous seepage points were observed along the downstream toe of the dam, which raised concern as to the continued stability of the embankment. Therefore, the dam is classified to be unsafe/nonemergency. In view of the seepage conditions and relatively steep downstream slope of the embankment, reaching almost one horizontal to one vertical at certain locations, it is recommended that the stability of the embankment be further investigated.

The flow through the outlet pipe is controlled by a valve located downstream of the dam which causes the pipe to be under pressure through the embankment. Because no information is available on the manner in which the pipe through the embankment was constructed, concern exists as to the effect of a rupture of this pipe on the embankment stability. Therefore, the owner should provide means for an upstream control.

Milburn Spring Dam is an offstream reservoir which receives flow through pipelines fed from adjacent springs. An 18-inch corrugated metal pipe near the right abutment constitutes the outflow facilities for the dam. Although no perennial stream discharges into the reservoir, it is estimated that during severe storm conditions, the reservoir may receive discharge from a watershed of approximately 14 acres. Based on this potential watershed, the adequacy of the spillway to pass the recommended spillway design flood of full to half probable maximum flood (PMF) was investigated. It was found that the spillway can pass 20 percent of the PMF without overtopping the embankment. Therefore, it is classified to be inadequate according to the recommended criteria. Because the spillway cannot pass 50 percent of the PMF without overtopping the embankment and overtopping of the embankment is considered to introduce a significant breach potential, and further that the pipe primary spillway is

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highly vulnerable to blockage during the passage of severe storms, the spillway capacity is considered to be seriously inadequate.

It is recommended that the following measures be implemented immediately or on a continuing basis:

1. The owner should immediately retain a professional engineer for detailed evaluation of the dam and the spillway facilities to prepare and execute plans for:

   a. Controlling seepage along the downstream toe.

   b. Evaluating the structural integrity of the embankment in view of the observed conditions.

   c. Initiating additional studies to determine the nature and extent of improvements required to provide adequate spillway capacity.

   d. Assess the structural integrity of the outlet pipe and develop means for installing an upstream control on the pipe.

   e. Evaluate the operational condition of the outlet pipe and determine the adequacy of the pipe as an emergency drawdown facility.

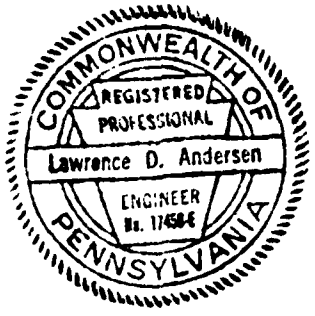
   The detailed evaluation of the dam should include but not be limited to subsurface investigation, materials testing, instrumentation, stability and seepage analyses. In conjunction with the detailed investigation of the dam, the crest of the dam should be surveyed and filling of the low areas along the crest of the dam should be considered.

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 necessary maintenance performed.

Lawrence D. Andersen, P.E.
Vice President

January 28, 1980
Date



Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
25 Feb 1980
Date

MILBURN SPRING DAM
NDI I.D. PA-239
NOVEMBER 19, 1979

Upstream Face

Downstream Face

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(Continued)

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
MILBURN SPRING DAM
NDI I.D. PA-239
DER I.D. 5-7

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. Milburn Spring Dam impounds a hillside offstream reservoir approximately rectangular in plan with a surface area of about one acre. The earth embankments which form three sides of the reservoir have a total crest length of 700 feet and a maximum height of 28 feet from the downstream toe of the embankment near the south corner of the reservoir. The reservoir is reported to be fed by two 6-inch pipelines receiving flow from adjacent springs. There are no perennial water courses discharging into the reservoir. However, the topographic map indicates that the reservoir can receive surface runoff from a watershed of approximately 14 acres during severe storms. The flood discharge facilities for the dam consist of an 18-inch corrugated metal overflow pipe. The overflow pipe is located near the right abutment (looking downstream) providing approximately two feet of freeboard from its invert elevation to the low spot on the embankment crest. The outlet works consist of an 8-inch cast-iron pipe leading from the reservoir through the embankment to a valve house approximately 500 feet downstream from the dam. Flow through the outlet pipe is controlled by manually operated gate valves located at the valve house. An 8-inch blow-off line at the gate house constitutes the emergency drawdown facilities for the reservoir.

b. Location. The dam is located approximately two miles southwest of Bedford in Bedford Township, Bedford County, Pennsylvania. Plate 1 illustrates the location of the reservoir.

c. Size Classification. Small (based on 28-foot height and 28 acre-feet storage capacity).

d. Hazard Classification. The dam is classified to be in the high hazard category. Approximately five homes within a distance of one quarter mile from the reservoir are considered to be within the potential flood plain in the event of a dam failure. It is estimated that failure of the dam would cause significant loss of life and property damage in this area.

e. Ownership. Borough of Bedford (address: Mr. James Montgomery, Borough Manager, Bedford Borough, 244 West Penn Street, Bedford, Pennsylvania 15522).

f. Purpose of Dam. Water supply.

g. Design and Construction History. No information on the design and construction of the dam is available. A state report dated 1916 indicates that the dam was built in about 1885.

h. Normal Operating Procedure. The reservoir is normally maintained at the invert elevation of the pipe primary spillway.

1.3 Pertinent Data. No design drawings are available for this dam, therefore, the elevations referred to in this and subsequent sections of the report were calculated based on approximate field measurements assuming the invert elevation of the pipe primary spillway to be at Elevation 1330 (USGS Datum), which was interpolated from the U.S. Geological Survey Bedford 7-1/2-minute quadrangle, dated 1971.

a. Drainage Area — 14 acres

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	8
Total spillway capacity at maximum pool	8

c. Elevation (USGS Datum) (feet)

Top of dam	1331.9 (measured low spot)
Maximum pool	1331.9
Normal pool	1330
Upstream invert outlet works	1305±
Downstream invert outlet works	1280±

Streambed at center line of dam	1300±
Maximum tailwater	Not applicable
Toe of dam	1304±

d. Reservoir Length (feet)

Normal pool level	200
Maximum pool level	200

e. Storage (acre-feet)

Normal pool level	27
Maximum pool level	29

f. Reservoir Surface (acres)

Normal pool level	1
Maximum pool level	1

g. Dam

Type	Earth
Length	700 feet
Height	28 feet
Top width	17± feet
Side slopes	Downstream: 1.2H:1V; Upstream: 2H:1V(1)
Zoning	Unknown
Impervious core	Unknown
Cutoff	Unknown
Grout curtain	Unknown

h. Regulating Outlet

Type	8-inch cast-iron pipe
Length	500± feet
Closure	Gate valves at gate house
Regulating facilities	Gate valves

i. Spillway

Type	18-inch corrugated metal pipe

(1) Estimated

Length	Not applicable
Crest elevation	1330 (assumed invert elevation)
Upstream channel	Lake
Downstream channel	Corrugated metal half-round pipes

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) and some survey plans obtained from the owner's files. Available information includes state inspection reports and various correspondence. No information on the design and construction of the dam was found.

(1) Hydrology and Hydraulics. No information is available.

(2) Embankment. A 1916 state report indicates that no information on the design and construction of the embankment was available as of that date.

(3) Appurtenant Structures. The available information consists of a drawing illustrating the details of installation of the 18-inch overflow pipe in 1961.

b. Design Features

(1) Embankment. No information is available to ascertain the type of embankment and the manner in which it was constructed.

Based on approximate field measurements, the height of the embankment was found to be approximately 28 feet with the downstream slope varying between 1.5 to 1 (horizontal to vertical) to 1.2 to 1. The crest width of the dam was found to be variable, in the range of 15 to 25 feet, and was measured to be about 17 feet at the cross section of maximum height near the south corner of the reservoir. Plate 2 presents bottom contours of the reservoir based on a 1957 survey.

(2) Appurtenant Structures. Plate 3 illustrates the details of the installation of the corrugated metal pipe overflow structure in 1961. The same drawing also illustrates the location of the 8-inch outlet pipe and the location of inflow pipes from the adjacent springs.

c. Design Data. Available information includes no design data for the embankment or its appurtenant structures.

2.2 Construction. No information is available on the construction of the dam. A 1916 state inspection report indicates that the dam was constructed in about 1885. A state inspection report dated 1922

indicates that the embankment was raised 5 feet during 1921. The same report also indicates that some enlargement work was performed without a permit from the state and includes concern relative to the steep downstream slope of the dam.

2.3 Operation. No formal operating records are maintained for the reservoir. According to the maintenance personnel, maximum pool levels were within 2 to 3 inches of the outflow pipe invert elevation.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. The available information, which mostly consists of correspondence, was provided by PennDER.

b. Adequacy. The available information includes no technical data to assess the adequacy of the design or the construction.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Milburn Spring Dam consisted of:

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

2. Visual examination of the appurtenant structures.

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 poor. Extensive wet and swampy areas and numerous seepage points were located along the toe of the dam. Flow in a drainage ditch along the downstream toe of the dam collecting discharges from the wet areas was estimated to be on the order of 50 gallons per minute (gpm). Several irregularities on the downstream slope suggest possible slumping of the downstream face in the past. However, these irregularities do not appear to be from recent movements. Although the average slope at the maximum cross section near the southern corner of the reservoir was found to be on the order of 2 horizontal to 1 vertical, the slopes on the downstream face in the remaining portions of the embankment are steeper and become almost 1 to 1 near the northern corner of the reservoir.

The crest of the dam was surveyed relative to the intake invert elevation of the outflow pipe. The freeboard was found to range from 1.9 feet near the northern corner of the reservoir to 5.4 feet on the left abutment. The dam crest profile is illustrated in Plate 5.

c. Appurtenant Structures. The appurtenant structures for the dam consist of overflow pipe and outlet works. The overflow pipe was found to be in good condition. No signs of deterioration were noted.

The only visible portion of the outlet pipe was located in the valve house approximately 500 feet from the dam. The regulating equipment in the valve house was found to be poorly maintained.

d. Reservoir Area. Although the reservoir is an offstream impoundment, the topographic map indicates that during severe storm conditions, the reservoir is likely to receive surface runoff from an area of approximately 14 acres. This area is predominantly covered by woodlands.

e. Downstream Channel. Discharge from the dam follows a southeasterly course and joins Cumberland Valley Run approximately 1/2 mile downstream from the dam. Approximately five houses one quarter mile downstream from the dam are considered to be within the potential flood plain in the event of a dam failure. Further description of the downstream conditions is included in Section 1.2(d).

3.2 Evaluation. The overall condition of the dam is considered to be poor. The two most significant conditions noted were swampy areas along the downstream toe of the dam and steep downstream slopes. These two conditions combined with indications of past movement on the downstream slope raise concern as to the continued stability of the dam. In view of these observations and due to lack of any design and construction information, further investigation of the integrity of the embankment is considered advisable. Another point of concern is the vulnerability of the overflow pipe to blockage by debris during severe storms. The overflow pipe is the only discharge facility for the reservoir. Therefore, any blockage in this structure may lead to overtopping of the embankment.

Flow through the outlet pipe is controlled by downstream valves. Therefore, the pipe is always under pressure through the embankment and flow through the outlet pipe cannot be stopped in the event a rupture develops in the portion of the outlet pipe through the embankment, which may cause distress to the embankment. Therefore, a means of providing an upstream control to the outlet pipe should be developed by the owner in conjunction with a detailed evaluation of the embankment. It is also recommended that the operational condition of the outlet pipe blow-off valve be evaluated and the adequacy of the outlet pipe as an emergency drawdown facility assessed.

SECTION 4
OPERATIONAL FEATURES

4.1 Procedure. There are no formal procedures for the operation and maintenance of the dam. The reservoir is normally maintained at the uncontrolled overflow pipe invert elevation with excess inflow discharging through the pipe.

4.2 Maintenance of the Dam. The maintenance of the dam is considered to be fair. It appears that the only maintenance operation at the dam consists of periodic clearing of brush and vegetation from the downstream face of the dam. It was noted that no attempt has been made to observe or monitor seepage conditions along the downstream toe.

4.3 Maintenance of Operating Facilities. The only operable facility of the dam consists of the outlet pipe blow-off valve. The maintenance personnel reported that the operational condition of this valve was questionable. Therefore, operation of the valve was not observed.

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 site.

4.5 Evaluation. While the maintenance condition of the dam is considered to be fair, the maintenance condition of the operating facilities is considered to be poor. The operational condition of the outlet pipe blow-off valve was not observed. It is therefore recommended that the owner operate the blow-off valve and perform necessary maintenance as required.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Milburn Spring Dam is an offstream reservoir and does not receive surface runoff under normal flow conditions. However, a map study indicated that during severe storm conditions, the reservoir might receive runoff from an area of approximately 14 acres. The flood discharge facilities for the dam consist of an 18-inch corrugated metal overflow pipe which is near the right abutment. Under maximum pool, the capacity of the overflow pipe is estimated to be about 22 cfs.

b. Experience Data. As previously stated, Milburn Spring 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.

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 analysis was based on a watershed of 14 acres. Data used for the computer analysis are presented in Appendix D. The PMF inflow hydrograph was found to have a peak flow of 101 cfs. The computer input and summary of computer output are also included in Appendix D.

c. Visual Observations. The overflow pipe, which is the only flood discharge facility for the reservoir, is considered to be vulnerable to blockage by debris during severe storm conditions. However, for the following analysis, the full capacity of the pipe was used.

d. Overtopping Potential. Various percentages of PMF inflow hydrograph were routed through the reservoir and it was found that the overflow pipe can pass 20 percent of the PMF without overtopping the low spot on the crest of the dam. For 50 percent PMF, the low spot on the crest would be overtopped for a duration of four hours with a maximum depth of 0.22 foot. For 100 percent PMF, the dam would be overtopped for a duration of 6.7 hours for a depth of 0.34 foot.

e. Spillway Adequacy. Since the spillway cannot pass the recommended spillway design flood of half to full PMF without overtopping the embankment, the spillway is classified to be inadequate according to the recommended criteria. The overflow pipe,

which is the only discharge facility for the reservoir, is considered to be vulnerable to blockage by debris during severe storms which may lead to overtopping and subsequent failure of the dam. It is estimated that overtopping failure of the embankment would release discharges significantly greater than the discharges (approximately 8 cfs) that would exist just before overtopping, which would significantly increase downstream damage. In view of this condition and the fact that the spillway capacity is less than 50 percent of the PMF, the spillway capacity is rated to be seriously inadequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations revealed various signs of distress consisting of extensive swampy areas along the downstream toe of the dam and indications of past movements on the downstream slope of the embankment. Because no information is available on the design and construction of the embankment and at certain locations the downstream slope is steep, approaching a 1 to 1 slope, and there are indications of past movement on the downstream slope, concern exists as to the effect of the underseepage on the stability of the downstream slope and piping potential through the foundation of the embankment. Therefore, the integrity of the embankment should be investigated in view of the observed conditions.

(2) Appurtenant Structures. From a structural point of view, the concern is relative to the manner in which the outlet pipe through the embankment has been constructed. Because no design and construction information is available, the structural adequacy of the design could not be assessed. Therefore, during the detailed investigation of the dam, the structural details of the outlet pipe, such as presence of concrete encasement or cutoff collars, should be investigated and a means for installing an upstream control on the outlet pipe should be developed.

b. Design and Construction Data

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

(2) Appurtenant Structures. No design information is available for the outlet pipe to assess the adequacy of the design.

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. A state report dated 1922 indicates that the height of the embankment was raised by 5 feet during 1921. However, no information is available on the design and construction of this post-construction change.

e. Seismic Stability. In view of the concerns that exist relative to the static stablity of the dam, the seismic stability of the dam is also considered to be questionable. Therefore, the seismic stability of the dam should be reassessed in conjunction with further investigation and evaluation of the embankment.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. The visual observations indicate that Milburn Spring Dam is in poor condition. In view of the presence of numerous seeps and extensive swampy areas along the downstream toe of the dam and steep downstream slopes on the embankment, concern exists as to the continued stability of the dam. The dam is therefore classified to be unsafe/nonemergency. Based on these visual observations, detailed investigation of the embankment as an impounding structure is recommended. It is also recommended that in conjunction with the detailed investigation of the dam, a means for installing an upstream control in the outlet pipe should also be developed. The flood discharge capacity of the reservoir overflow pipe was found to be less than 50 percent of the PMF and is therefore classified to be seriously inadequate according to the recommended criteria.

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 Data. It is recommended that the dam and appurtenant structures be investigated and evaluated by a professional engineer experienced in design and construction of dams to more accurately ascertain the consequences of the observed conditions and overall integrity of the dam and to develop plans for remedial measures.

7.2 Recommendations/Remedial Measures.

It is recommended that:

1. The owner should immediately retain a professional engineer for detailed evaluation of the dam and the spillway facilities to prepare and execute plans for:

    a. Controlling seepage along the downstream toe.

    b. Evaluating the integrity of the embankment in view of the observed conditions.

c. Initiating additional studies to determine the nature and extent of improvements required to provide adequate spillway capacity.

d. Assess the structural integrity of the outlet pipe and develop means for installing an upstream control on the pipe.

e. Evaluate the operational condition of the outlet pipe and determine the adequacy of the pipe as an emergency drawdown facility.

The detailed evaluation of the dam should include but not be limited to subsurface investigation, materials testing, instrumentation, stability and seepage analyses. In conjunction with the detailed investigation of the dam, the crest of the dam should be surveyed and filling of the low areas along the crest of the dam should be considered.

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 necessary maintenance performed.

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Milburn Spring Dam COUNTY Bedford STATE Pennsylvania ID# NDI I.D. PA-239 DER I.D. 5-7

TYPE OF DAM Earth HAZARD CATEGORY High

DATE(S) INSPECTION November 19, 1979 WEATHER _____ TEMPERATURE _____

POOL ELEVATION AT TIME OF INSPECTION 1330± M.S.L. TAILWATER AT TIME OF INSPECTION 1305± M.S.L.

INSPECTION PERSONNEL:	REVIEW INSPECTION PERSONNEL: (December 12, 1979)
B. Erel	L. D. Andersen
W. T. Chan	J. H. Poellot
	B. Erel

B. Erel RECORDER

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None at the present time, however, certain irregularities suggest past movement on the downstream face of the dam.	
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 5 for the crest profile.	
RIPRAP FAILURES	None	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No visual signs of distress.	
ANY NOTICEABLE SEEPAGE	There are numerous seeps and extensive swampy areas along the downstream toe of the dam. See Plate 4 for the location of wet areas and seepage points.	
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 pipe is an 8-inch cast-iron pipe which is not visible.	
INTAKE STRUCTURE	None	
OUTLET STRUCTURE	None	
OUTLET CHANNEL	None	
EMERGENCY GATE	Outlet pipe blow-off valve is located approximately 500 feet from the dam at a valve house. The operational condition of the blow-off valve was questionable. The operation was not observed.	The operational condition of the blow-off valve should be evaluated and necessary maintenance performed.

VISUAL INSPECTION
PHASE I
UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The only outflow structure of the reservoir consists of an 18-inch corrugated metal overflow pipe near the right abutment.	
APPROACH CHANNEL	Lake. Free of debris.	
DISCHARGE CHANNEL	Corrugated metal half pipes in good condition.	
BRIDGE AND PIERS	Not applicable.	

VISUAL INSPECTION
PHASE I
GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	(The dam has no gated spillway structures). 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	No significant shoreline erosion.	
SEDIMENTATION	Unknown	
UPSTREAM RESERVOIRS	None	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions that would affect the discharge capacity of the overflow pipe.	
SLOPES	No pertinent features that should affect the performance of the dam.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	There are approximately five homes within the potential flood plain of the reservoir in the event of a dam failure. Population: Approximately 20	

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 Milburn Spring
ID# NDI I.D. PA-239
DER I.D. 5-7

ITEM	REMARKS
AS-BUILT DRAWINGS	Not available
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	A state report dated 1916 indicates that the dam was built in about 1885.
TYPICAL SECTIONS OF DAM	Not available
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	Not available

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not recorded
DESIGN REPORTS	Not available
GEOLOGY REPORTS	Not available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Not available

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported
BORROW SOURCES	Unknown
MONITORING SYSTEMS	None
MODIFICATIONS	None
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 recorded
SPILLWAY PLAN SECTIONS DETAILS	Not available
OPERATING EQU r PLANS AND DET/	Not available

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 14 acres (woodlands)

ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1330 (28 acre-feet)

ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 1331.9 (29 acre-feet)

ELEVATION; MAXIMUM DESIGN POOL: Unknown

ELEVATION; TOP DAM: 1331.9 (measured low spot)

SPILLWAY: (18-Inch Corrugated Metal Pipe)

a. Elevation 1330 (pipe invert elevation)

b. Type Pipe

c. Width Not applicable

d. Length Not applicable

e. Location Spillover Near southern corner of the embankment

f. Number and Type of Gates Not applicable

OUTLET WORKS:

a. Type 8-inch cast-iron pipe

b. Location At the center of the embankment

c. Entrance Inverts Unknown

d. Exit Inverts Elevation 1280±

e. Emergency Drawdown Facilities 8-inch cast-iron pipe

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NONDAMAGING DISCHARGE: Approximately 20 cfs

APPENDIX C

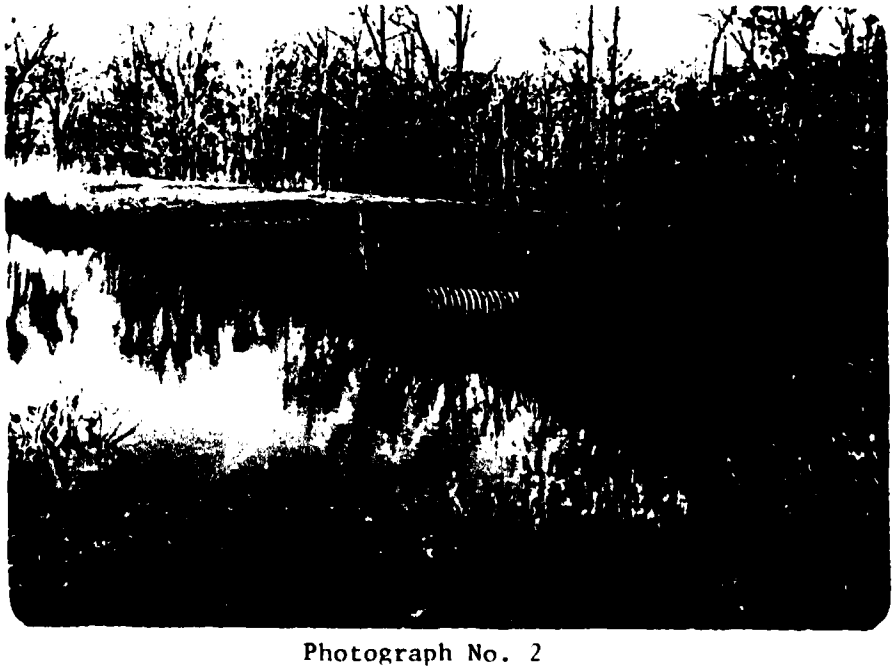
PHOTOGRAPHS

LIST OF PHOTOGRAPHS
MILBURN SPRING DAM
NDI I.D. PA-239
NOVEMBER 19, 1979

PHOTOGRAPH NO.	DESCRIPTION
1	Dam crest.
2	Eighteen-inch-diameter CMP spillway.
3	Spillway discharge channel.
4	Seepage at the toe area.
5	A farm located 1/2 mile downstream from the left abutment.
6	Homes located 1/2 mile downstream from the right abutment.

Photograph No. 1

Dam crest.



Photograph No. 2

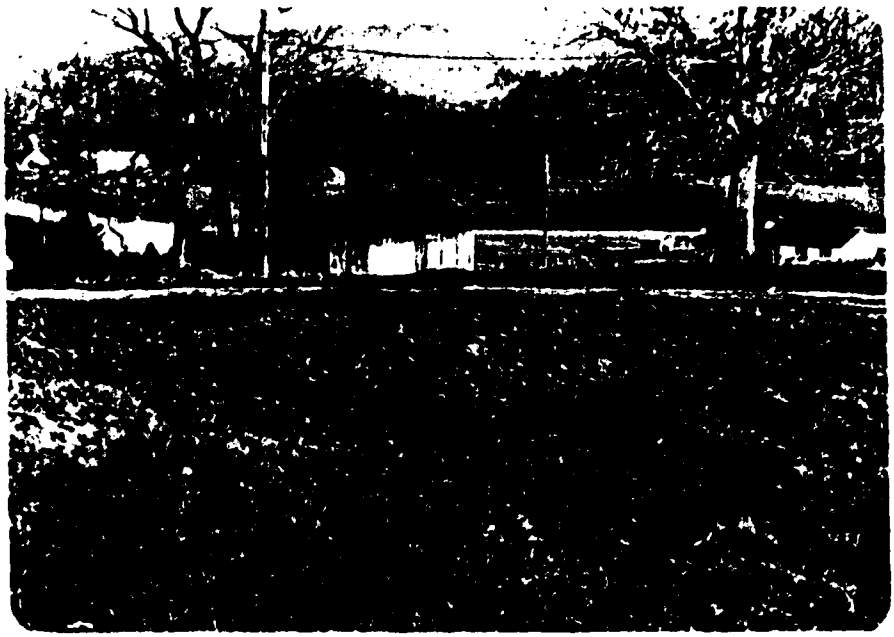
Eighteen-inch-diameter CMP spillway.

Photograph No. 3

Spillway discharge channel.

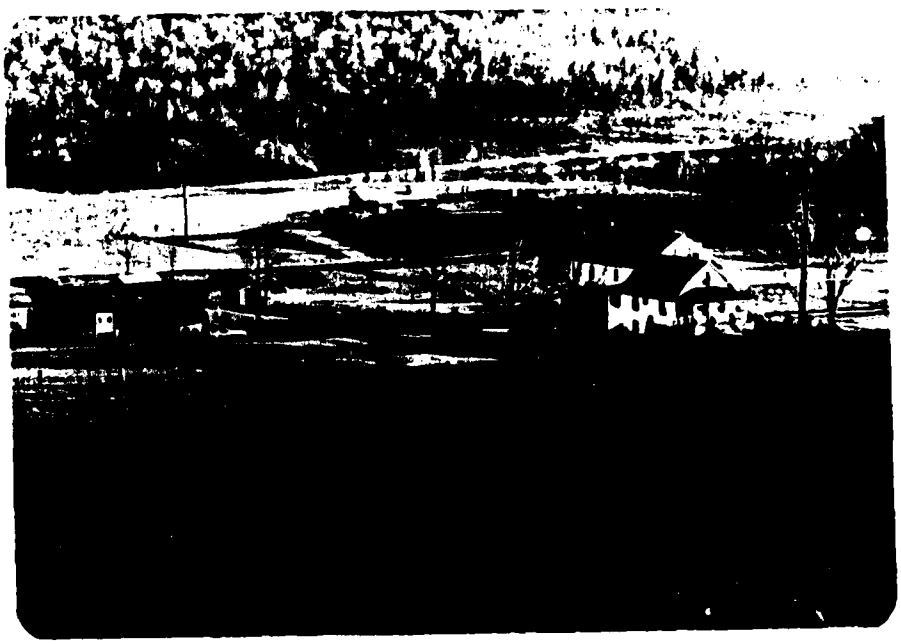
Photograph No. 4

Seepage at the toe area.



Photograph No. 5

A farm located 1/2 mile downstream from the left abutment.



Photograph No. 6

Homes located 1/2 mile downstream from the right abutment.

APPENDIX D

HYDROLOGY AND HYDRAULICS ANALYSES

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Milburn Spring Dam (NDI I.D. PA-239)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.9 INCHES/24 HOURS[1]

STATION	1	2	3	4	5
Station Description	Reservoir	Dam			
Drainage Area (square miles)	0.022	-			
Cumulative Drainage Area (square miles)	0.022	0.022			
Adjustment of PMF for Drainage Area (%)[2]					
6 Hours	102	-			
12 Hours	120	-			
24 Hours	130	-			
48 Hours	140	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone[3]	21	-			
C_p/C_t[4]	0.55/1.50	-			
L (miles)[5]	0.3	-			
L_{ca} (miles)[5]	0.1	-			
$t_p = C_t(L \cdot L_{ca})^{0.3}$ (hours)	0.5	-			
Spillway Data					
Crest Length (ft)	-	18" Diam. CMP			
Freeboard (ft)	-	1.9			
Discharge Coefficient	-	See attached			
Exponent	-	Calculations			

(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.

STORAGE VS. ELEVATION

ELEVATION	ΔH, FEET	AREA (ACRES)[1]	ΔVOLUME (ACRE-FEET)[2]	STORAGE (ACRE-FEET)
1340	10	2.8	18.2	42.8
1330[3]	-	1.0	24.6[4]	24.6
Reservoir Bottom		-		0

(1) Planimetered from USGS maps.

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

(3) Normal pool elevation is interpolated from USGS map.

(4) From PennDER files.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********
    1                 A1       SNYDER UNIT HYDROGRAPH,FLOOD ROUTING AND DAM OVERTOPPING ANALYSES
    2                 A2       MILBURG SPRING DAM,BEDFORD COUNTY,NDI-I.D.PA.239    PROJECT NO.79-543-02
    3                 A3       FOR 20%,30%,40%,50%,60%,70%,80%,90%,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     0.30     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 MILBURG SPRING RESERVOIR
   10                 M       1        1    0.022               0.022                                1
   11                 P                23.9      102      120      130      140
   12                 T                                                    1.0      .05              0.0652
   13                 W    0.52     0.55
   14                 X    -1.0    -0.05      2.0
   15                 K       1        2                                          1
   16                 K1       ROUTING FLOW THROUGH MILBURG SPRING DAM (NDI-I.D.PA.239)
   17                 Y                                 1        1
   18                 Y1      1                                          -1330.0       -1
   19                 Y41330.0  1330.5   1331.0   1331.5   1332.0   1332.5   1333.0   1334.0   1335.0   1336.0
   20                 YS    0.0      1.7      3.1      5.5      8.0      9.6     11.0     13.0     15.0     17.0
   21                 SS    0.0     24.6     42.8
   22                 SE1304.0  1330.0   1340.0
   23                 SS1330.0
   24                 SD1331.9     3.08      1.5    700.0
   25                 SL  100.0    200.0    375.0    425.0    525.0    625.0    650.0    700.0
   26                 SV1331.9  1332.2   1332.4   1333.0   1333.1   1333.2   1334.8   1334.9
   27                 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 .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	.02	1	20.	30.	40.	50.	60.	70.	80.	90.	101.
	(	.06)	(	.57)(	.85)(	1.14)(	1.42)(	1.71)(	1.99)(	2.28)(	2.56)(	2.85)
ROUTED TO	2	.02	1	6.	22.	39.	48.	58.	68.	78.	88.	98.
	(	.06)	(	.18)(	.62)(	1.11)(	1.36)(	1.63)(	1.92)(	2.20)(	2.49)(	2.77)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1330.00	1330.00	1331.90
STORAGE	25.	25.	28.
OUTFLOW	0.	0.	8.

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	1331.68	0.00	28.	6.	0.00	42.17	0.00
.30	1332.02	.12	28.	22.	2.67	40.67	0.00
.40	1332.09	.19	28.	39.	3.33	40.17	0.00
.50	1332.12	.22	28.	48.	4.00	40.33	0.00
.60	1332.15	.25	29.	58.	4.67	40.17	0.00
.70	1332.17	.27	29.	68.	5.17	40.17	0.00
.80	1332.20	.30	29.	78.	5.83	40.17	0.00
.90	1332.22	.32	29.	88.	6.17	40.17	0.00
1.00	1332.24	.34	29.	98.	6.67	40.17	0.00

OVERTOPPING ANALYSIS SUMMARY

D'APPOLONIA
CONSULTING ENGINEERS, INC

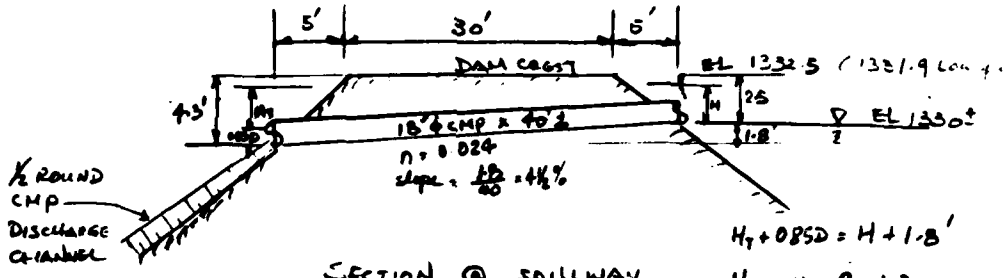
By WJC Date 12/6/79 Subject MILBURG SPRING DAM Sheet No. 1 of 3
Chkd. By MB Date 12/29/79 Proj. No. 79-543-GE

SPILLWAY CAPACITY

REFERENCE · 1) DESIGN OF SMALL DAM, 2nd EDITION P 566

2) DApp FIELD SURVEY, NOV 19 1979

THE SPILLWAY OF THE DAM CONSISTS OF AN 18"ϕ CMP OVERFLOW PIPE AS SHOWN BELOW.



SECTION @ SPILLWAY (NOV 19 1979 SURVEY).

H_T + 0.8SD = H + 1.8'

H_T = H + 1.8 − 1.3

= H + 0.5

from Ref. 1 P 566, P 568 [FOR Projected entrance (3)]

LAKE ELEV.	H FT	H/D	Q_1 cfs (INLET CONTROL) see P 2 of 4	H_T FT	Q_2 (OUTLET CONTROL) see P 3 of 4		SPILLWAY CAPACITY Q, cfs
(Spillway) 1330	0	0	0				0
1330.5	0.5	0.33	1.7				1.7
1331	1	0.67	3.1	1.5	8.3		3.1
1331.5	1.5	1.00	5.5	2.0	9.6		5.5
(Low spot) 1332	2	1.33	8.0	2.5	10.7		8.0
1332.5	2.5	1.67	9.6	3	11.7		9.6
1333	3	2.00	11.0	3.5	12.7		11.0
1334	4	2.67	13	4.5	14.4		13.0
(High Spot) 1335	5	3.33	15	5.5	15.9		15.0
1336	6	4.00	17	6.5	17.3		17.0

NOTE, DISCHARGE CAPACITY IS CONTROLLED BY "INLET" CONDITIONS

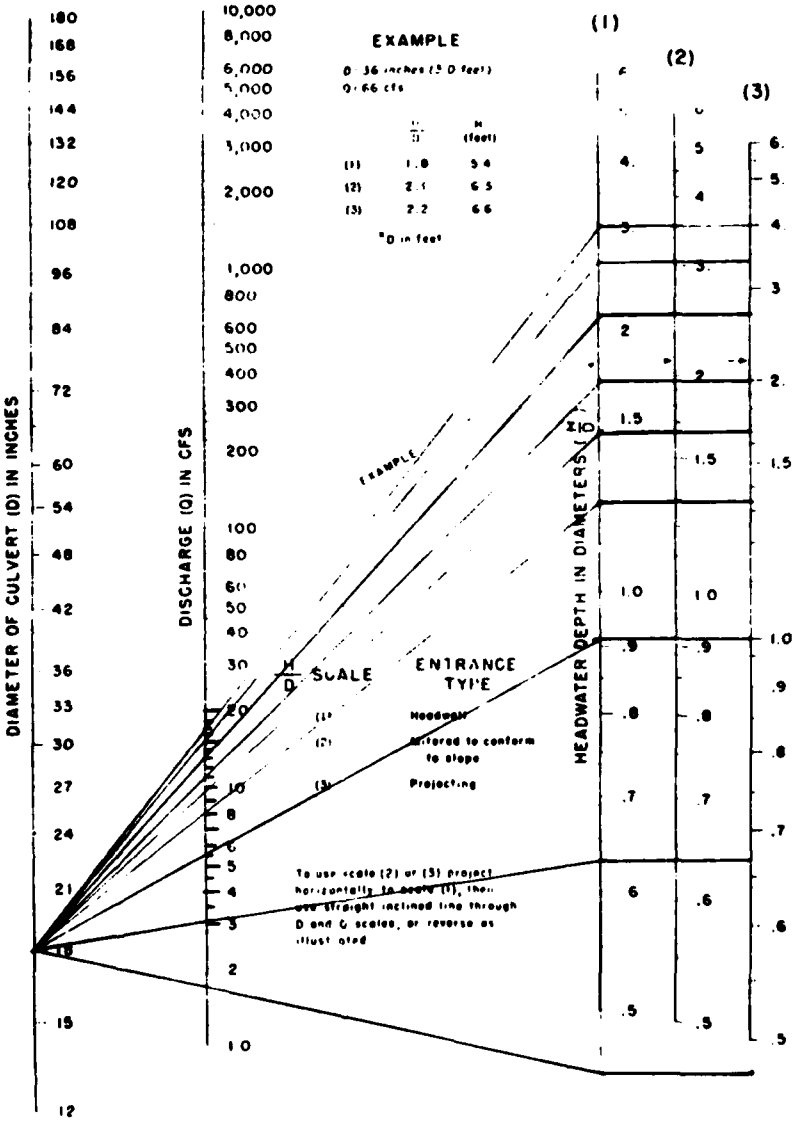


Figure 8.9 Headwater depth for corrugated metal pipe culverts with entrance control. (U.S. Bureau of Public Roads, 288 D 2906)

D'APPOLONIA
CONSULTING ENGINEERS, INC

By WTC Date 12/6/79 Subject MILBURG SPRING DAM Sheet No. 3 of 3
Chkd. By MS Date 12/24/79 Proj. No. 79-563-C

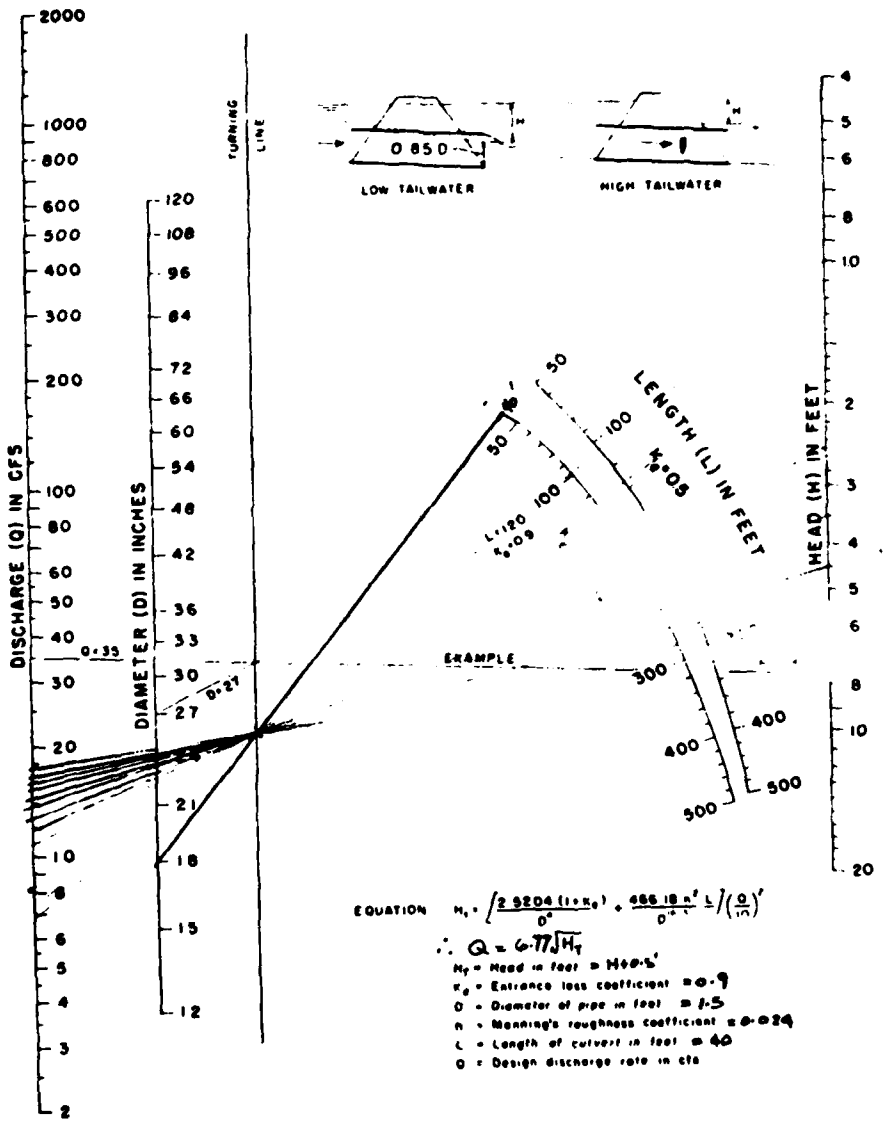
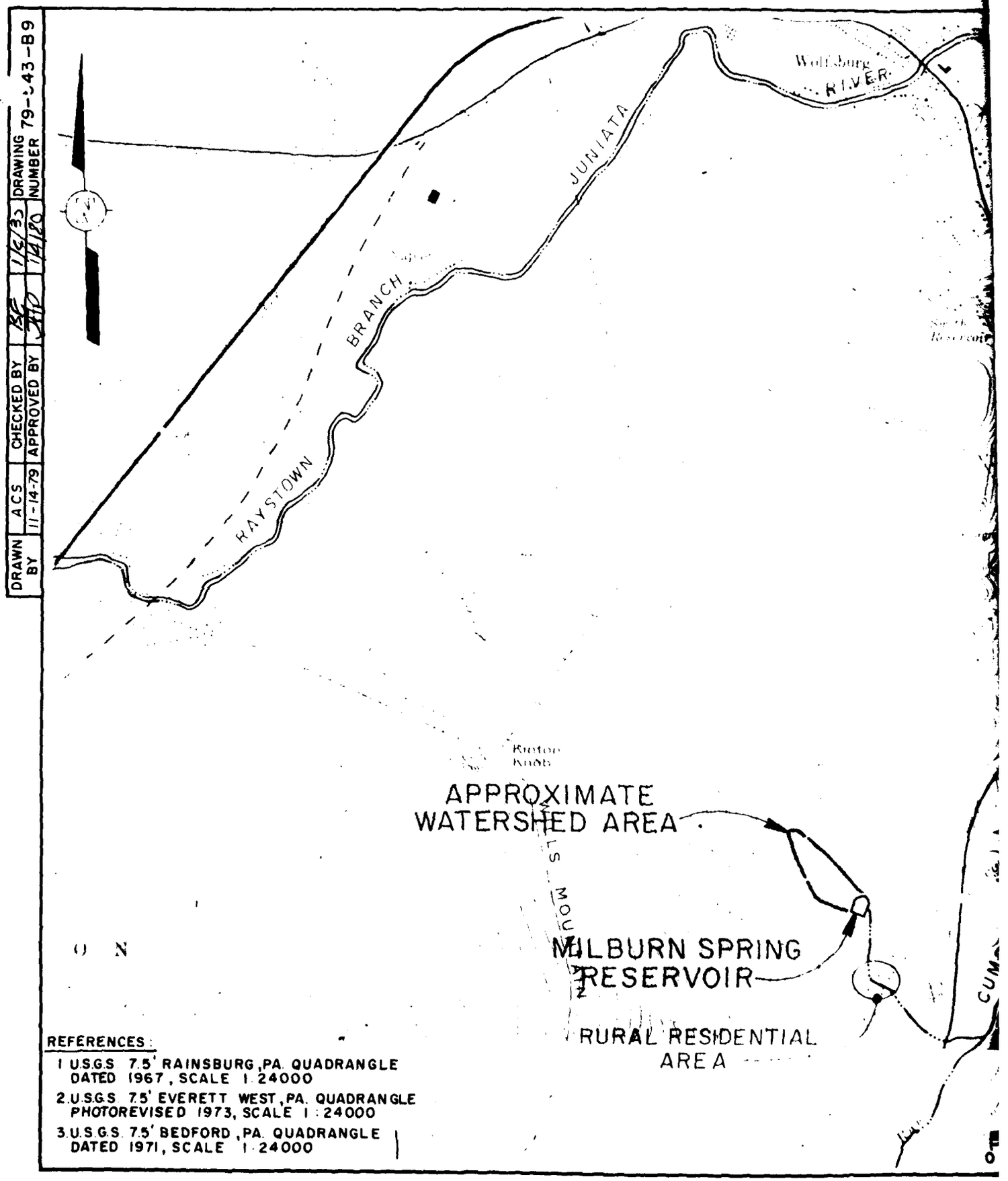


Figure 8-11 Head for corrugated metal pipe culv... flowing full, n = 0.024 (U.S. Bureau of Public Roads) 288 D 7911

APPENDIX E

PLATES


DRAWN BY ACS 11-14-79
CHECKED BY
APPROVED BY
DRAWING NUMBER 79-43-B9
RAYSTOWN BRANCH
JUNIATA
Wolfsburg
RIVER
APPROXIMATE WATERSHED AREA
MILBURN SPRING RESERVOIR
RURAL RESIDENTIAL AREA
REFERENCES:
1 U.S.G.S 7.5' RAINSBURG, PA. QUADRANGLE DATED 1967, SCALE 1:24000
2 U.S.G.S 7.5' EVERETT WEST, PA. QUADRANGLE PHOTOREVISED 1973, SCALE 1:24000
3 U.S.G.S 7.5' BEDFORD, PA. QUADRANGLE DATED 1971, SCALE 1:24000

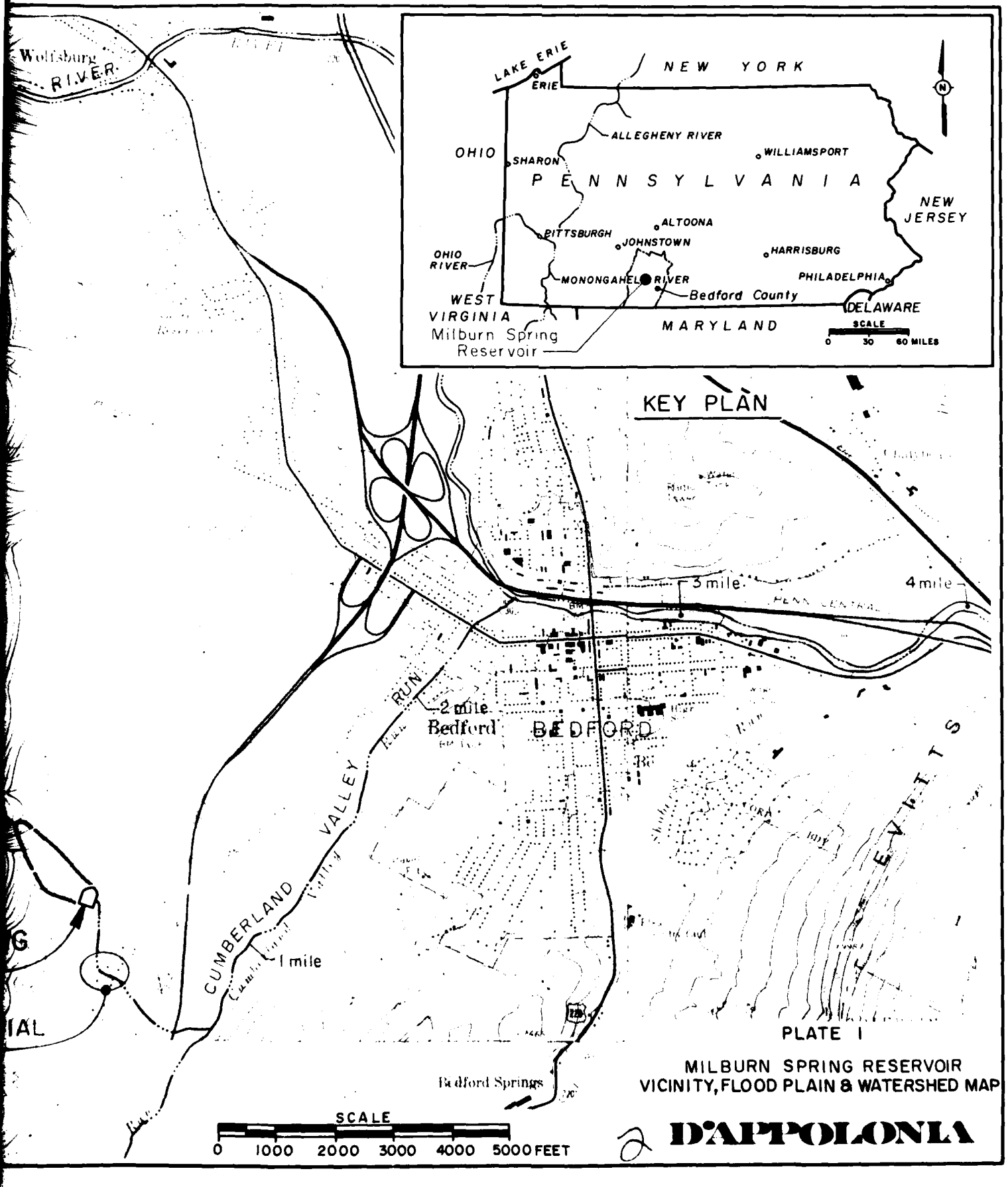


PLATE I

MILBURN SPRING RESERVOIR
VICINITY, FLOOD PLAIN & WATERSHED MAP

D'APPOLONIA

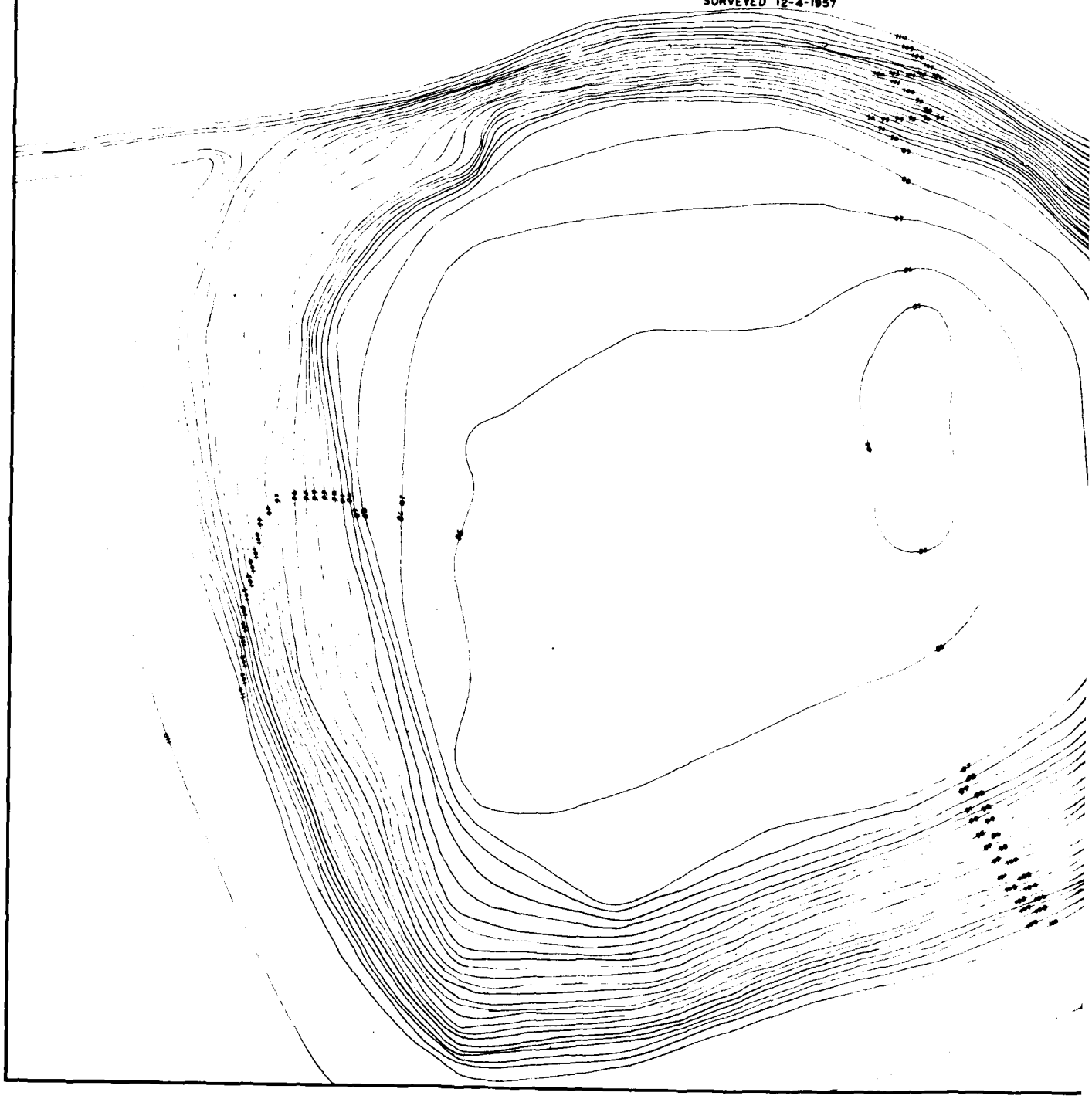
DRAWN BY	ACS	CHECKED BY	BE	DRAWING NUMBER	79-543-B10
	12-31-79	APPROVED BY	[illegible]		1/4/80

BEDFORD BORO. WATER DEPARTMENT

MILBURN RESERVOIR

SCALE 1 INCH = 20 FEET CONTOUR INTERVAL 1 FOOT

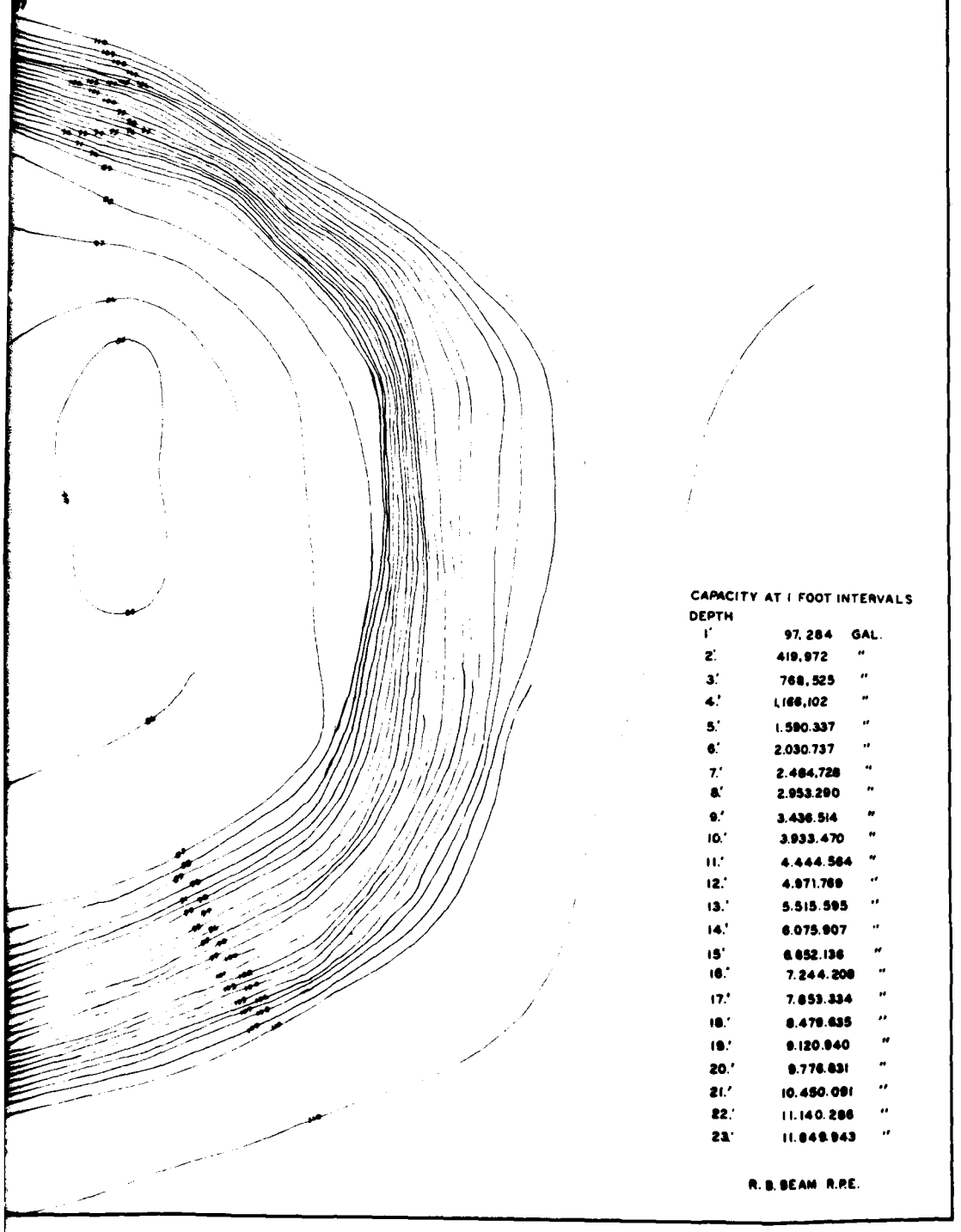
SURVEYED 12-4-1957



ER DEPARTMENT

RVOIR

TOUR INTERVAL 1 FOOT



CAPACITY AT 1 FOOT INTERVALS

DEPTH		
1'	97,284	GAL.
2'	419,972	"
3'	768,525	"
4'	1,166,102	"
5'	1,590,337	"
6'	2,030,737	"
7'	2,484,728	"
8'	2,953,290	"
9'	3,436,514	"
10'	3,933,470	"
11'	4,444,564	"
12'	4,971,769	"
13'	5,515,595	"
14'	6,075,907	"
15'	6,652,136	"
16'	7,244,208	"
17'	7,853,334	"
18'	8,479,635	"
19'	9,120,940	"
20'	9,776,831	"
21'	10,450,091	"
22'	11,140,286	"
23'	11,848,943	"

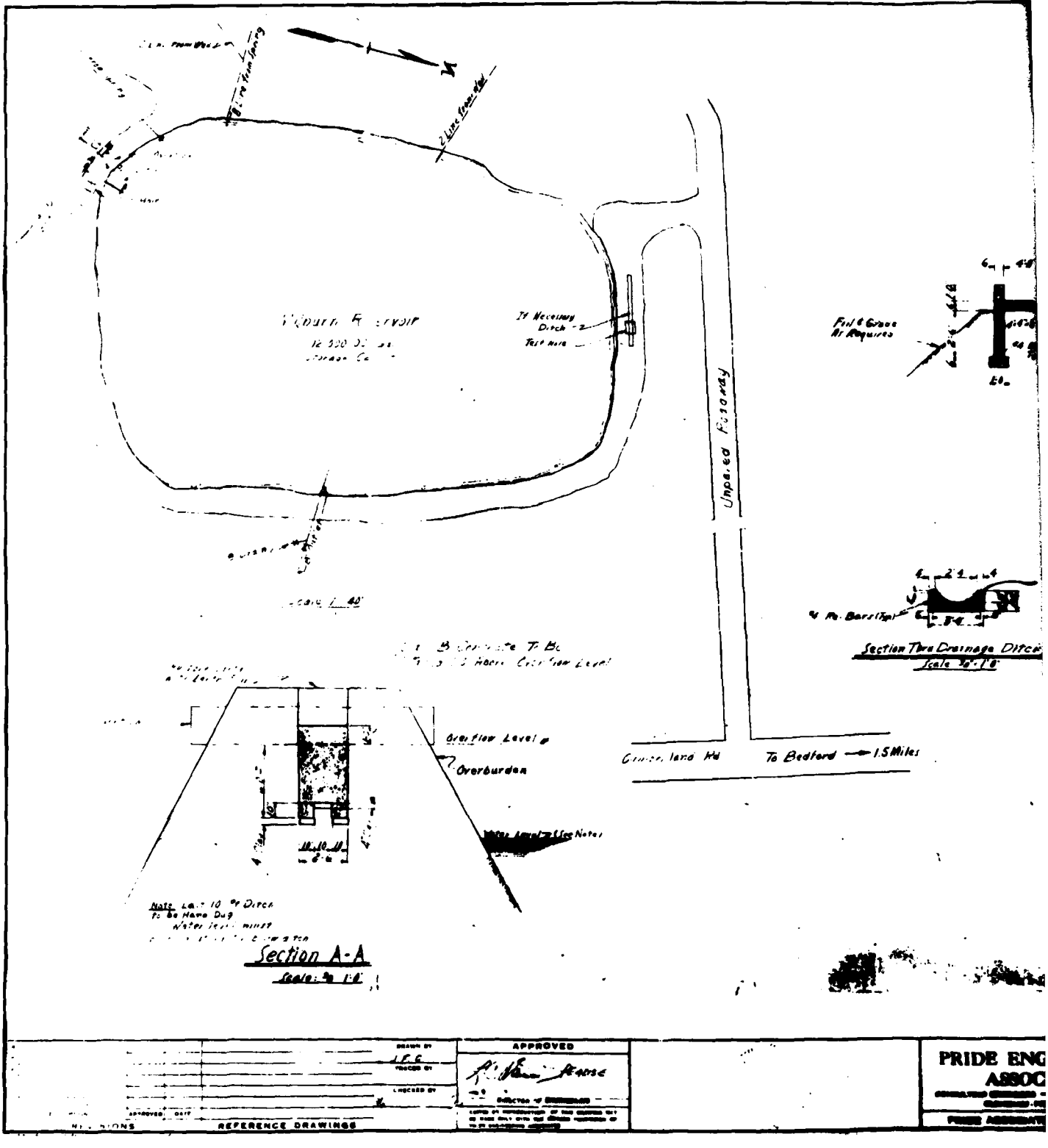
R. B. BEAM R.P.E.

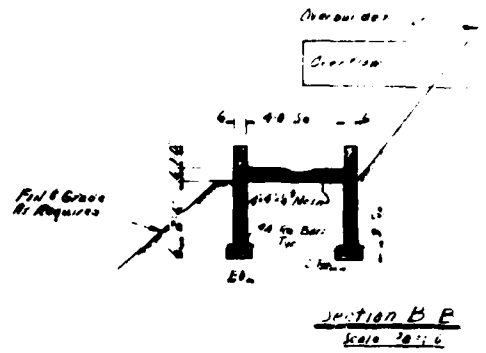
2

PLATE 2

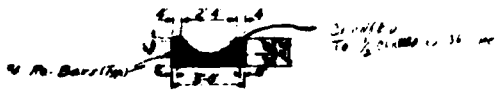
D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	1/4/80	DRAWING NUMBER 79-U-3-B11
	12-31-79	APPROVED BY	[illegible]	1/4/80	





Section B-B
Scale 3/8" = 1'-0"



Section Thru Drainage Ditch
Scale 3/8" = 1'-0"

Bedford — 1.5 Miles

Top View of Engineer Repair
Scale 3/4" = 1'-0"

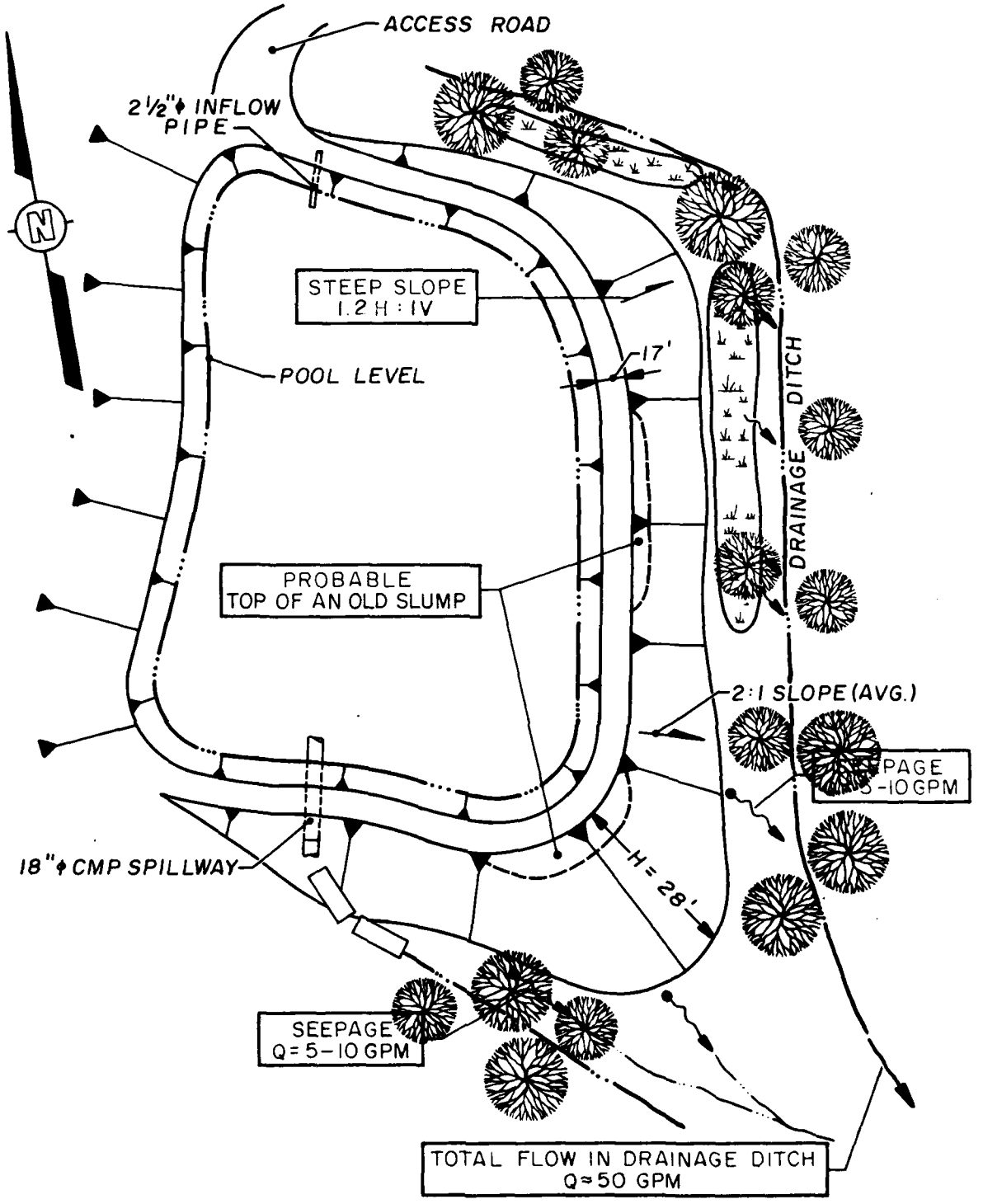
PRIDE ENGINEERING ASSOCIATES	BEDFORD BOROUGH WATER AUTHORITY BEDFORD, PENNSYLVANIA EXPLORATION & REPAIR OF MILBURN RESERVOIR	1-20-64	
		CONTRACT NO. 2	506-S
		DRAWING NO. 45931	
		SHEET NO. 1 OF 1	R

2

PLATE 3

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY		DRAWING NUMBER 79-A5
	12-31-79	APPROVED BY		



NOTE:

1. POOL LEVEL DATE OF INSPECTION: 0.2 FT. ABOVE SPILLWAY PIPE INVERT
2. SEE PLATE 3 FOR INLET AND OUTLET PIPE LOCATIONS.

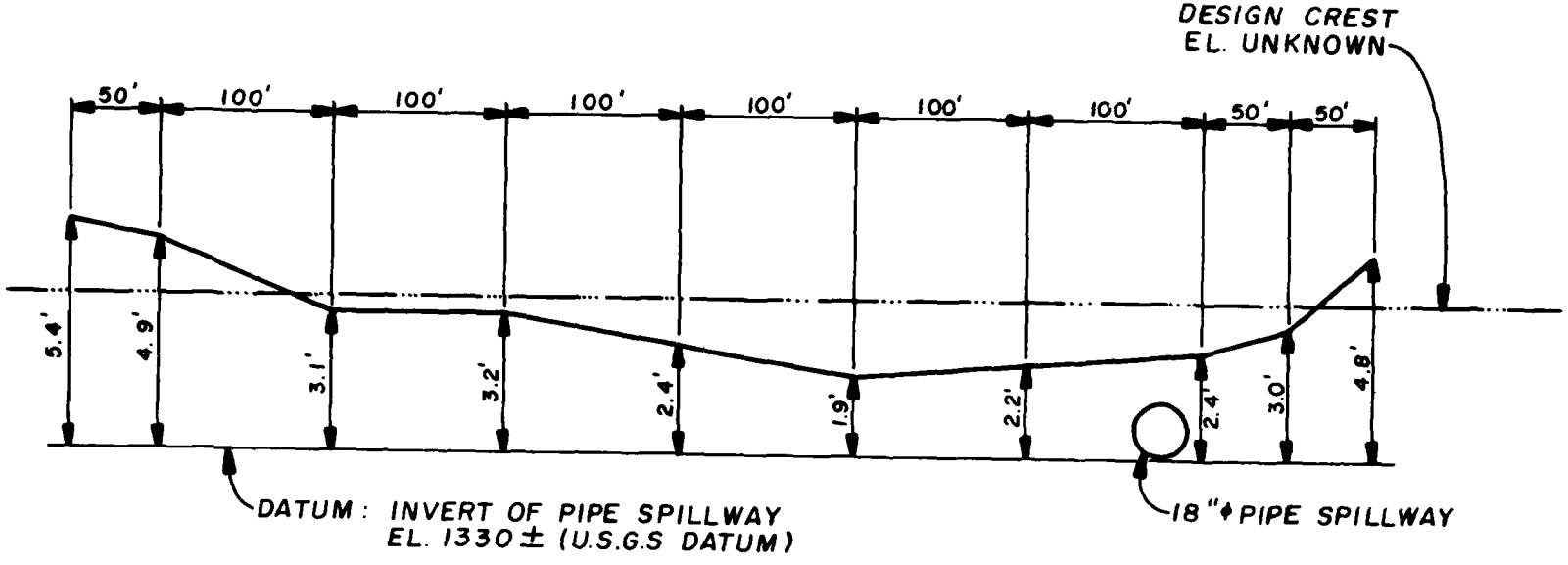
NOT TO SCALE

PLATE 4

MILBURN SPRING RESERVOIR
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: NOV. 19, 1979

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY			DRAWING NUMBER 79-43-A6
	12-31-79	APPROVED BY			



DAM CREST PROFILE
(LOOKING DOWNSTREAM)

NOTES:

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

PLATE 5

MILBURN SPRING RESERVOIR
DAM CREST SURVEY
FIELD INSPECTION DATE: NOV. 19, 1979

DAPPOLONIA

APPENDIX F

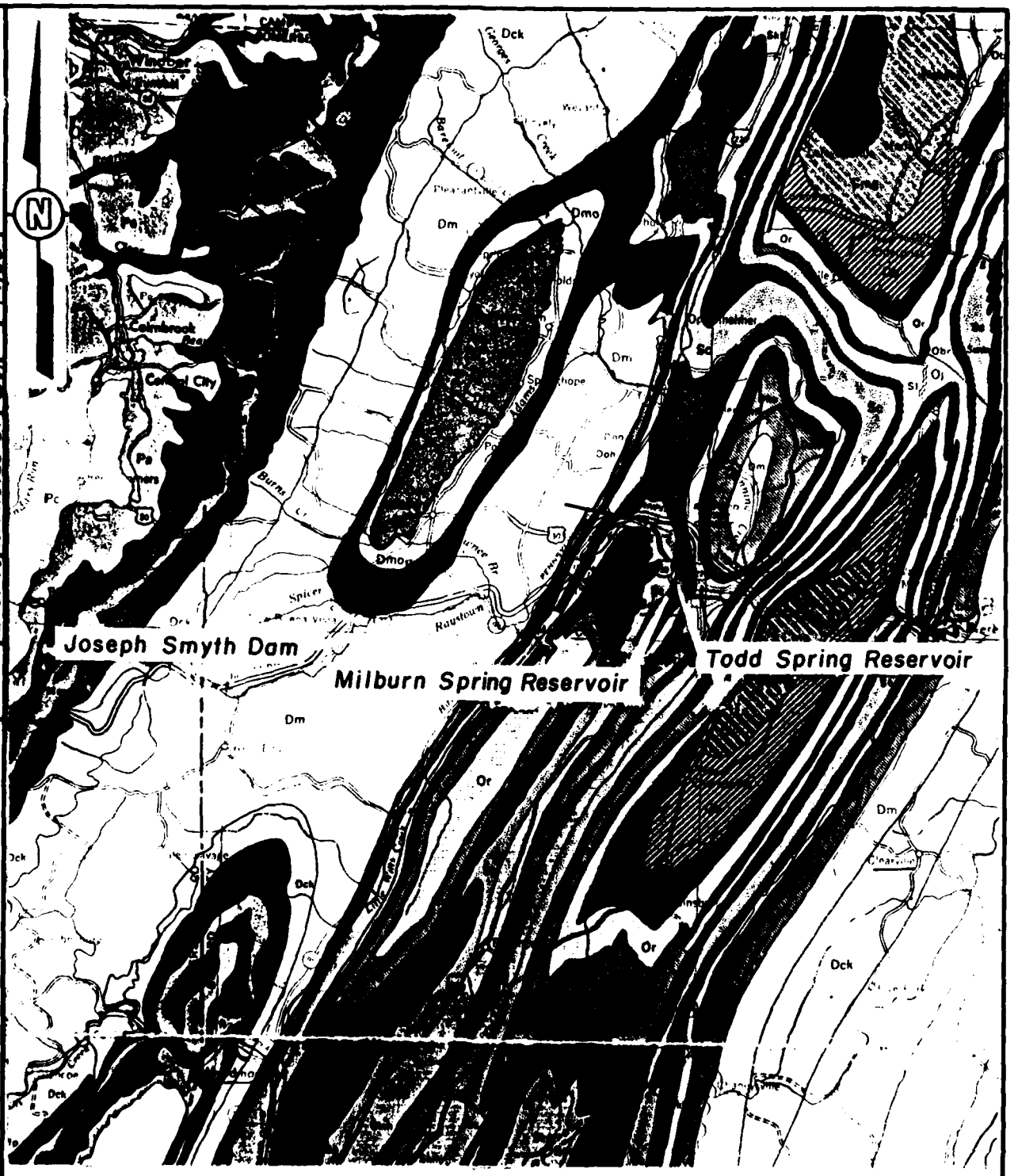
REGIONAL GEOLOGY

APPENDIX F

REGIONAL GEOLOGY
MILBURN SPRING DAM

Milburn Spring Dam is located on rock strata of Silurian Age. the dam and reservoir lie near the boundary of the Rose Hill Formation (Clinton Group) and the overlying Tuscarora Formation. The Rose Hill Formation is a greenish-gray thin to medium bedded shale with interbedded siltstone and sandstone layers. Gray, hard, massive quartzitic sandstone layers compri.e the Tuscarora Formation which is resistant to weathering.

The dam is located on the east flank of the Wills Mountain Anticline, a feature that trends and plunges to the northeast. Rock strata dip approximately 15 degrees to the southeast. Slopes around the reservoir are 15 to 30 degrees and could be susceptible to sliding along bedding planes of the shale.



DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE	DRAWING NUMBER
ACS	12-31-79					3-A11

JOSEPH SMYTH DAM, MILBURN SPRING AND TODD SPRING RESERVOIR

GEOLOGY MAP

REFERENCE:

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

D'APPOLONIA

DRAWING NUMBER	43-AIB
7c	
	1/14/80
	1/14/80
APPROVED BY	
CHECKED BY	
ACS	
12-31-79	
DRAWN BY	

LEGEND

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

Pottsville Group
Light gray to white, coarse grained sandstone and conglomerate with some variable [illegible] 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 Kasaport, Kittanning and Clarion Formations.

Clinton Group
Predominantly Rose Hill Formation - Reddish purple to greenish gray, thin to medium bedded, fossiliferous shale with interfingering iron sandstones and some gray, fossiliferous limestone above the Rose Hill is brown to white quartzite sandstone (Keefer), interbedded upward with dark gray shale (Rochester).

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 to the east.

Sml

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

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.

Marcellus 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
Light to medium gray, hard, massive, crossbedded conglomerate and sandstone with some beds, includes in the Appalachian Plateau, Burgoon, Shenango, Cuyahoga, Corry, and Knapp Formations, includes part of "Oswayo" of M. J. Rowe in Potter and Tioga counties.

Oriskany Formation
White to brown, fine to coarse grained [illegible] locally conglomeratic, [illegible] (Ridgeley) at the base, 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.

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

GEOLOGY MAP LEGEND

D'APPOLONIA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