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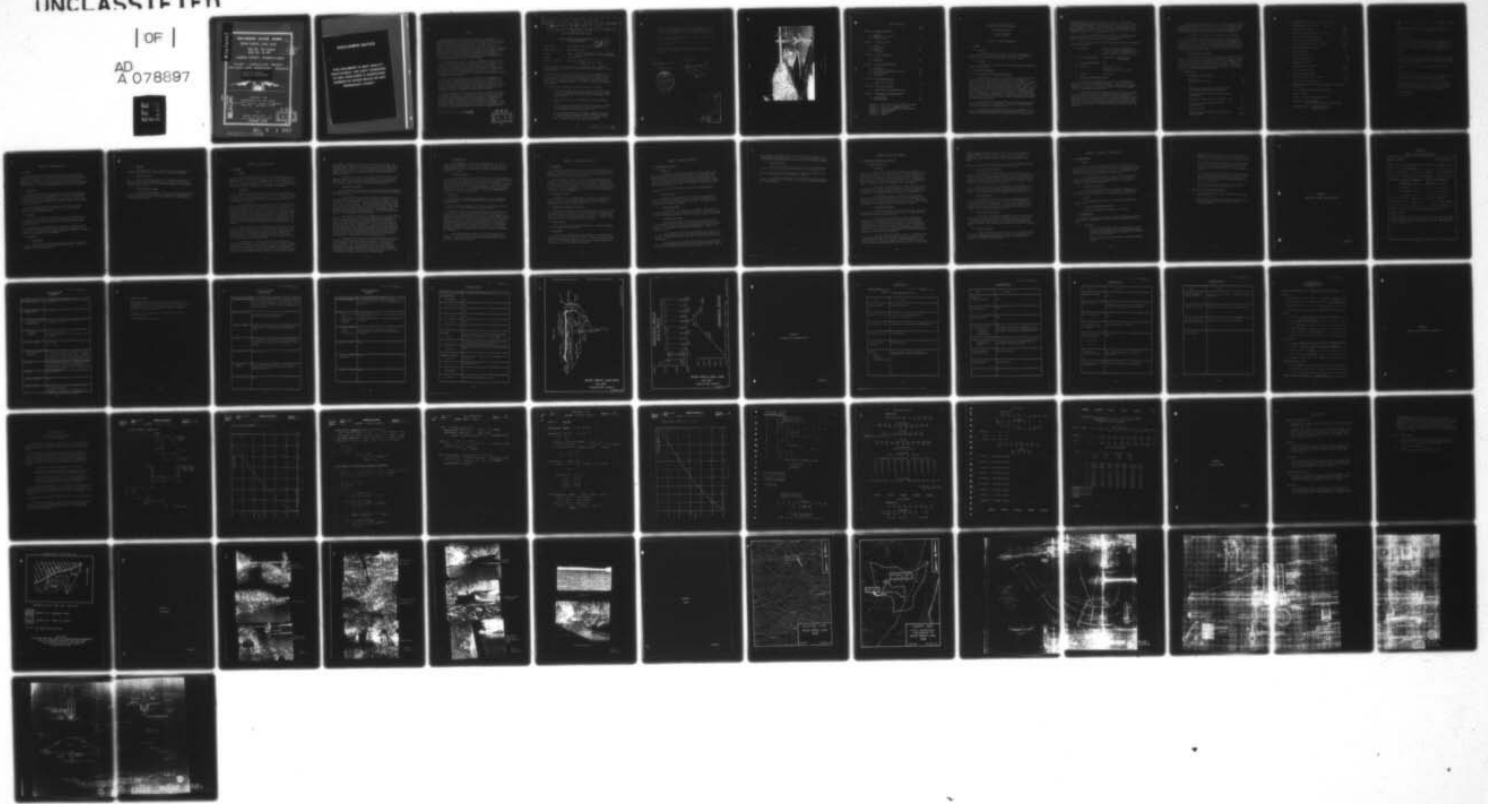
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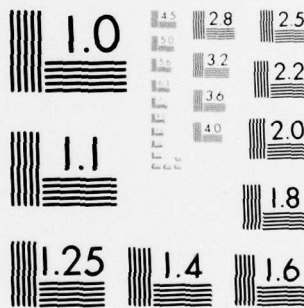
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NDI NO. PA-00610

DER NO. 13-98

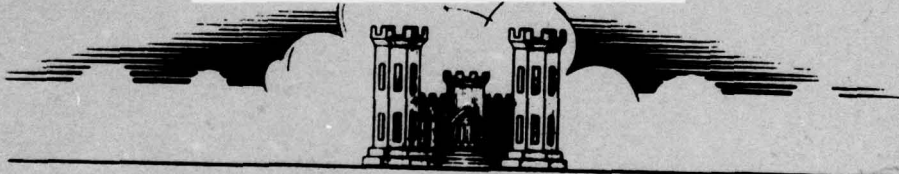
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CARBON COUNTY, PENNSYLVANIA

**PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM**

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DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

BY
Berger Associates, Inc.
Harrisburg, Pennsylvania
AUGUST 1979

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PREFACE

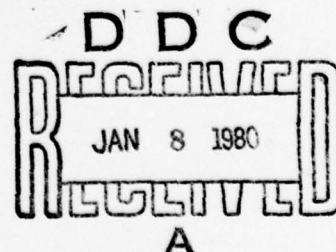
This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify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

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

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

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

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⑥ National Dam Inspection Program.
Bear Creek Lake Dam (NDI Number PA-00610)
DER Number 13-98, Carbon County,
Pennsylvania. Phase I Inspection Report.

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS
AND RECOMMENDATIONS

⑫ 69

Name of Dam: BEAR CREEK LAKE DAM, NDI NO. PA-00610
State & State No: PENNSYLVANIA, 13-98
County: CARBON
Stream: BEAR CREEK
Date of Inspection: June 19, 1979

⑮ DACW31-79-C-0012

⑪ Aug 79

Based upon the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in fair condition.

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is intermediate and the hazard classification is high. The combined spillway discharge and reservoir storage capacities are adequate to pass the PMF (Probable Maximum Flood) peak inflow without overtopping the dam. The spillway capacity is considered to be adequate.

The following recommendations are made for action by the owner:

1. That the weed, brush and small tree growth on the slopes and crest of the embankment be removed and that the slope surfaces be inspected for signs of seepage or other distress after the area is cleared.
2. That the bare areas on the embankment be seeded to prevent erosion.
3. That the removal of growth on the downstream slope be extended to ten feet downstream from the toe of the slope to allow close observation of the seepage in this area.
4. That regular observations of the seepage condition along the toe of the downstream embankment slope be made and recorded. If changes in volume or clarity are noted, immediate action should be taken to assess and remedy the condition.

5. That the control structure be inspected and examined for pipe alignment and settlement and that the control valve in the structure and the sloping gate on the upstream intake structure be operated to assure their use in the case of an emergency.
6. That the hole adjacent to the right spillway outlet channel wall be cleaned and backfilled.
7. That an annual program of slope maintenance be developed and put into effect.
8. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PA

DATE: August 24, 1979



H. Jongema

APPROVED BY:

James W. Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

DATE: 7 Sep 79

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OVERVIEW

BEAR CREEK LAKE DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

BEAR CREEK LAKE DAM

NDI-ID NO. PA-00610
DER-ID NO. 13-98

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

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

B. Purpose

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

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

→ The Bear Creek Lake Dam is a zoned earthfill dam having a clay core and upstream clay blanket at the base of the embankment. The embankment length is 500 feet and its height is 35 feet above the streambed. A concrete cutoff wall was installed over a distance of 200 feet along the centerline of the embankment, refer to Appendix F, Plate V. This wall extends from a minimum of three feet below the rock surface to five feet above the rock surface. The outer shell of the embankment consists of rolled select fill. A rock toe drain is provided at the downstream toe of the embankment. This drain is founded on a 12-inch thick gravel filter. The upstream embankment slope is riprapped to a vertical distance of 10 feet below the crest of the dam. Refer to Appendix F, Plate No.V, for typical plan and section.

→ The spillway is an uncontrolled concrete ogee section located at the left abutment of the embankment. The spillway outlet channel discharges directly to the natural stream. ← ABSTRACT

Although the design drawing indicates a pipe diameter of 30 inches, the blowoff pipe, measured at the outlet structure, is a 24-inch steel pipe encased in concrete. The control structure is a concrete

manhole which houses a 24-inch Darling gate valve. A second control gate was installed several years after the completion of the dam. There are no records or drawings of this modification. The only evidence of its existence is the sloping stem which projects upward from the upstream slope of the dam. Refer to Section 3.1 for additional description and Appendix E, Plate No. E-I for photograph of stem.

The outlet for the blowoff pipe is a concrete endwall section described as a stilling basin. Refer to Appendix F, Plate IV, for details and Appendix E, Plate No. E-II for photographs.

This facility is used for recreational purposes by the surrounding residential development.

- B. Location: Penn Forest Township, Pennsylvania
U.S.G.S. Quadrangle, Christmans, PA.
Latitude: 40°-55.1', Longitude: 75°-40.7'
Refer to Appendix F, Plates I and II
- C. Size Classification: Intermediate - Height 35 feet,
3,483 acre-feet.
- D. Hazard Classification: High.
- E. Ownership: Bear Creek Lake, Inc.
Star Route
Jim Thorpe, Pennsylvania 18229
- F. Purpose: Recreation
- G. Design and Construction History

This project was designed for the owner by the Penn-Jersey Engineering Company of Portland, Pennsylvania. Construction, by J.H. Beers, Inc. was started in June of 1964 and was completed in December of that year. The permit for building the dam was issued by the Commonwealth of Pennsylvania in April, 1964.

The initial plan for the embankment provided for an impervious core with a cutoff trench in the foundation material. Excavation of this area, however, required the removal of considerable amounts of wet, mucky material to the bedrock surface. This condition required a modification to the plans. Instead of a clay filled cutoff trench, a concrete cutoff wall was designed and constructed having its base at least three feet below the rock surface and extending vertically five feet into the clay core.

Reference to settlement of the outlet control structure (manhole) was made in one of the construction reports. The report indicated that there was no deflection in the outlet pipe and that the condition should be observed closely for further movement. Subsequent reports did not refer to this condition indicating that the problem had stabilized.

The remainder of the project was constructed as designed.

Subsequent requests were made in December, 1965, to draw the reservoir water surface down for repairs and in 1969 for dredging to enlarge the lake area. The files do not contain any information as to the details of either operation. The owner did report that the lake was drawn down several years after the completion of construction and at that time, the upstream gate with the sloped stem control was installed on the intake to the blowoff pipe.

H. Normal Operating Procedures

The Bear Creek Lake Dam was designed specifically for recreational purposes to serve the developing residential community. As such, there is no regular operation of the facility except to maintain the lake water surface level as nearly uniform as possible. Controls for operation include the 24-inch gate valve in the manhole type control structure and the upstream slide gate on the inlet pipe. The controls have not been opened or operated since 1967.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	2.0
Computed for this report:	1.9
Use:	1.9

B. Discharge at Dam Site (cubic feet per second) See Appendix C for hydraulic calculations

Maximum known flood for this site (occurred on June 22, 1972)	95
Outlet works low-pool outlet at pool Elev. 1,485	46
Outlet works at pool level Elev. 1,505 (spillway crest)	93
Warm-water outlet	None
Spillway capacity at pool Elev. 1510.8 (top of dam, low point)	2,440

C.	<u>Elevation</u> (feet above mean sea level, U.S.G.S.)	
	Top of dam, design datum = 29 U.S.G.S.	1,511
	Top of dam, low point	1,510.8
	Spillway crest design datum = 23 U.S.G.S.	1,505
	Upstream portal invert (about)	1,476
	Downstream portal invert (about)	1,475.5
	Streambed at downstream toe - estimate	1,475.5
	Maximum tailwater (estimated)	1,485
D.	<u>Reservoir</u> (miles)	
	Length of normal pool	0.85
	Length of maximum pool	0.90
E.	<u>Storage</u> (acre-feet)	
	Spillway crest (Elev. 1505)	2,600
	Top of dam (Elev. 1511)	3,483
F.	<u>Reservoir Surface</u> (acres)	
	Top of dam (Elev. 1511) - estimate	168
	Spillway crest (Elev. 1505)	130
G.	<u>Dam</u> (Refer to Plate III through V, Appendix F for section and plan).	
	Type: Earthfill with upstream rock riprap.	
	Length: 500 feet.	
	Height: 35 feet from streambed at toe.	
	Top Width: 16 feet (design).	
	19 feet (survey, Appendix A, Plate A-II).	
	Design Side Slopes: Upstream 2.5H to 1V	
	Downstream 2H to 1V	

Zoning: Clay core. Upstream - select fill, downstream - random fill.

Cutoff: 8 feet bottom width of trench, 8 feet high concrete core wall 200 feet long. Refer to Appendix F, Plate V.

Grouting: None.

H. Outlet Facilities

One 24-inch blowoff pipe under embankment controlled by a 24-inch gate valve located at bottom of concrete manhole 16 feet upstream of centerline of embankment, and a sloping sluice gate located on upstream end of pipe. Downstream outlets into 20 feet x 6 feet concrete basin then into riprapped stream channel.

I. Spillway

Type: Uncontrolled reinforced concrete modified ogee weir and channel cut into the left bank adjacent to the left end of the embankment. The weir and upstream end of channel are bounded by vertical concrete walls.

Length of weir: 45 feet with vertical reinforced concrete walls.

Crest elevation: 1505.

Downstream channel: Flow over the weir is carried in a rectangular shaped, reinforced concrete channel a distance of about 60 feet. The channel width is a constant 45 feet.

At the end of the concrete chute is a trapezoidal riprapped channel extending to the natural stream channel. The first 100 feet of the riprap was grouted according to the design plan. This was not observed during this inspection.

J. Regulating Outlets

See Section 1.3.H.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The engineering data for this facility includes design drawings, hydrologic and hydraulic calculations, seepage analyses, and structural stability calculations. Test hole information is included on the design drawings and laboratory soil compaction test information is in the PennDER files. The check list of engineering data is included in Appendix B of this report and selected design drawings are presented in Appendix F.

2.2 CONSTRUCTION

Information regarding the construction of the dam is contained in the inspection reports of the Commonwealth. These reports contain the description of progress and conditions at the time of each inspection. Periodic progress reports, indicating percent completion of major items of work were submitted to PennDER by the owner's engineer. These reports are also in the files.

The construction information indicated one modification which included the installation of a concrete core wall in place of the designed clay filled cutoff trench.

2.3 OPERATION

There are no operation or maintenance records in the PennDER files nor with the owner. The dam is used for recreational purposes and is regulated only by the natural inflow to the reservoir and the outflow over the spillway.

The reservoir is the headwaters for Bear Creek. Numerous natural springs in the reservoir area provide the major water supply for the lake. There is no indication of regular operation of the outlet (blowoff) facility or maintenance of the embankment.

2.4 EVALUATION

A. Availability

Sufficient engineering information is available to assess the condition of this dam for the purpose of this inspection. All data is available from the PennDER files.

B. Adequacy

The engineering data is considered sufficiently adequate to evaluate the condition of this dam and its engineering stability.

C. Operating Records

Formal operating records were not found and indications are that an operation plan is nonexistent. The regulation of the outlet controls and the maintenance of the embankment apparently are conducted on an as required basis.

D. Post Construction Changes

The only post construction change of record (oral, not written) is the previously described addition of a slide gate on the upstream entrance to the blowoff pipe. The size, dimensions or other details of this addition are unknown.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of the Bear Creek Lake Dam is fair. This impression is based upon the heavy growth on both the upstream and downstream slopes and the rusty condition of the exposed slide gate control. The concrete spillway and outlet chute are in good condition. The visual inspection check list is in Appendix A of this report. Photographs taken during the inspection are reproduced in Appendix E.

B. Embankment

The visual inspection did not reveal any structural distress of the embankment. There was no evidence of sloughs, slides or excessive settlement. The upstream slope, designed as 2.5H to 1V, was measured by survey as 2.7H to 1V, and the downstream slope, designed as 2H to 1V, was measured as 2.2H to 1V.

The downstream slope was covered with a heavy growth of weeds, brush and some small trees. Close inspection of this slope did not reveal any signs of seepage. The upstream slope is faced with a 2.5 foot layer of riprap. This surface was also covered with a heavy growth of weeds and brush. The surface of the crest of the embankment contains moderate weed growth near the upstream and downstream edges and a bare footpath covering the main portion of the top. A wooden fence section is located at the right end of the dam to prevent vehicular traffic on the dam. A bike trail, which has completely worn away the vegetative cover, traverses the downstream slope from top to bottom near the left abutment.

Seepage was noted at the downstream toe and beyond at several locations. At one location, near the outlet structure, the water was stagnant with no apparent flow. The ground surface, beneath the water, was rust colored. A second location, near the right abutment, was actually flowing. The discharge point was right at the toe and the source appeared to be beneath the embankment. Here, again, the bottom was rust colored, but the water was clear.

Recalling that the cutoff excavation during construction encountered considerable amounts of wet mucky material in the foundation area and that the cutoff feature had to be changed to a concrete cutoff wall in order to control the water from the springs at this location, and that the prime source of water, supplying the reservoir is numerous springs, it is most probable that this water, seeping from below the toe

of the dam, is coming from springs rather than through the dam. The scattered sources of seepage along the toe did not permit an estimate of the volume flow. However, at a point approximately 50 feet downstream from the toe, where much of the flow converged and discharged into the blowoff outlet channel, the combined flow was estimated at about 50 gallons per minute.

One hole was observed in the embankment adjacent to the right spillway channel wall. This hole is about three feet by six feet in area and about three feet deep. Large stones were noted in this hole. This condition should be repaired to prevent further erosion.

C. Appurtenant Structures

The appurtenant structures for this dam include the uncontrolled ogee shaped concrete spillway and spillway channel and the outlet structure for the blowoff pipe.

The uncontrolled ogee spillway section was observed to be in very good condition. The approach to the spillway is directly from the reservoir and is unobstructed. The depth of the water, on the upstream side of the weir, was 2.3 feet. Water was just flowing over the crest at the time of this inspection. The concrete lined outlet channel, from the ogee spillway to its terminus is also in good condition. The slopes and walls did not show any signs of distress. The natural channel, downstream from the slab, is unobstructed with a rocky bottom and short slopes. Trees and brush cover the overbanks.

The control structure for the blowoff pipe is a precast concrete manhole. This structure is situated just upstream from the upstream edge of the embankment crest. The outside appearance of this unit is good. The owner indicated that there was no one available to open or operate the valve at this time; therefore, the inside of the structure and the valve could not be inspected. A sloped stem for the control of an upstream slide gate was observed projecting from the upstream slope at the water's edge. The owner indicated that this gate was installed several years after the completion of the dam when the lake was drawn down for repairs. This control was also not operated at the time of this inspection. The stem is in a very rusted condition.

The blowoff pipe is noted on the design drawings as a 30-inch diameter concrete encased steel pipe with cutoff collars on 20-foot centers along the pipe. This pipe was measured as 24 inches at the outlet structure. The outlet structure is a rectangular concrete stilling basin 20 feet in length and six feet wide. This structure discharges to a narrow shallow channel which is partially filled with weed growth, indicating no recent flow through the channel. There was no flow from the outlet at the time of this inspection.

D. Reservoir Area

The reservoir is used for recreational purposes. The lake shores feature woodlands, sand beaches, boat docks and some lawns and grassed areas with gentle slopes toward the lake. Residents of this development have use of the entire area. Sedimentation has not been reported as a problem.

E. Downstream Channel

As noted earlier, the Bear Creek Lake Dam forms the headwaters for Bear Creek. The discharge from this area flows in a westerly direction in a narrow stream channel with a wide overbank floodplain area. The overbanks are composed chiefly of brush and trees. Several farm buildings and one residence are located in the floodplain of Bear Creek within 2,000 feet of the dam. It is estimated that about five persons would be endangered in the event of a dam failure. The hazard classification, therefore, is "High" for this dam.

3.2 EVALUATION

In the absence of evidence of major distress on the embankment, spillway and outlet control structures the dam is judged to be in a stable condition.

There is need for maintenance work on the embankment and for the operation of the outlet controls on a regular schedule.

Maintenance needs on the embankment include the removal of trees, brush and heavy weed growth from the slopes, the repair of the hole behind the left spillway outlet wall, seeding of the bare spots on the downstream slope and on the crest of the dam. The weed growth should be removed to a distance of ten feet downstream from the toe so that all the seepage from the toe area can be readily observed. The seepage condition should be examined on a regular basis for the appearance of sediment or cloudy water or a change in flow volume. If such changes are noted, immediate action should be taken by the owner, through a professional engineer experienced in dam design, to assess and remedy the condition.

The condition of the control valve and slide gate and the ability to operate these devices was not established during this inspection. A program should be developed for the operation of these controls at least once each year.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The Bear Creek Lake Dam is used as a recreational facility for an adjoining residential development. The source of water for the lake is numerous natural springs on the lake bottom and the normal runoff from the surrounding two square mile drainage area.

Outflow from the reservoir is over the uncontrolled 45-foot long concrete ogee spillway. Emergency drawdown capability is provided for through a 24-inch diameter concrete encased steel pipe. The pipe has one upstream control and a second control in a manhole structure located near the center of the embankment. These controls have not been operated since 1967. Refer to Appendix F, Plate No. IV for drawing and Appendix E, Plate No. E-1 for photographs.

4.2 MAINTENANCE OF DAM

The maintenance of the dam involves the control of growth on the slopes, repairs to the embankment behind the walls and seeding bare spots to control erosion. As described earlier, there is need for maintenance care in each of these areas.

4.3 MAINTENANCE OF OPERATING FACILITIES

The actual condition of the operating facilities of the dam was not observed during this inspection. The owner was unable to have personnel available to open the manhole or operate the controls. He did report that the controls have not been operated since 1967. A regular schedule of operation should be developed for these controls.

4.4 WARNING SYSTEM

There is no formally organized surveillance or downstream warning system in operation at this facility.

4.5 EVALUATION

On the basis of the observations made during this inspection and information obtained in discussions with the owner, there is no planned operational schedule for this dam. There is a need for maintenance and repair of the embankment surfaces and the gates should be operated to assure their use in the event of an emergency.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analysis available from PennDER for Bear Creek Lake Dam was not very extensive. No design storm data, unit hydrograph or frequency curve were contained in the files. The files did contain a partial stage-storage curve, spillway rating curve, a triangular hydrograph for a 100 year storm and a routing of that storm through the reservoir. The designers computations for sizing the spillway were also in the files.

The project was designed to pass a "C" curve discharge of 2,480 cfs.

B. Experience Data

According to representatives of the owners of the dam, the greatest flow since completion of the dam occurred in 1972 when the depth of flow over the spillway weir was 8 inches. The project passed that small rise without any damage.

C. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped.

D. Overtopping Potential

Bear Creek Lake Dam has a total storage capacity of 3,483 acre-feet and an overall height of 35 feet above streambed, both referenced to the top of the dam. These dimensions indicate a size classification of "Intermediate". The hazard classification is "High" (see Section 3.1.E).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is the full Probable Maximum Flood (PMF). For this dam, the PMF peak inflow is 3,563 cfs. See Appendix C for inflow computations.

Comparison of the estimated PMF peak inflow of 3,563 cfs with the estimated spillway discharge capacity of 2,440 cfs indicates that a potential for overtopping of the Bear Creek Lake Dam does exist. However,

an estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam has the necessary storage available to pass the full PMF without overtopping.

E. Spillway Adequacy

Calculations show that the spillway carries the full PMF with about 0.1 foot of freeboard on the basis of the low point on the dam.

Since the spillway and storage is adequate to handle the full PMF without overtopping, it is judged to be adequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observations

1. Embankment

There were no indications of embankment instability or distress as a result of the visual inspection. The surveyed profile and cross sections show the crest elevation above the design elevation of 1511.0 over the length of the dam except just behind the spillway wall where there is a difference of 0.2 foot (1510.8). Refer to Appendix A, Plates A-I and A-II. The eroded surface at the bike trail needs to be seeded. It does not affect the stability of the embankment.

The seepage observed during the visual inspection appears to be coming from springs under the embankment rather than through the embankment. This condition should not cause any stability problems for the structure. It should, however, be observed on a regular basis.

The embankment slopes, as measured in the field, were 2.7H to 1V on the upstream side and 2.2H to 1V on the downstream side. These slopes are slightly flatter than the design slopes. There were no sloughs, slides or cracks observed in these areas. On the basis of these observations, the embankment slopes are judged to be stable.

2. Appurtenant Structures

The appurtenant structures for this facility include the uncontrolled spillway and its outlet channel and the intake structure, slide gate, gate valve and outlet pipe.

The spillway, spillway outlet channel and walls all appear to be in stable condition. There is no indication of major cracking of the concrete and the walls show no evidence of tilting. At one location on the downstream slope, adjacent to the right spillway outlet channel wall, there is a hole in the embankment. This hole is about three feet by six feet in area and approximately three feet in depth. This hole has not caused any distress to the wall, but should be repaired to prevent any future problems.

The operating valve and gate could not be observed due to the upstream slide gate being submerged and the valve being in the manhole structure which was not opened. Regarding stability of the intake structure housing the control valve, the construction inspection report indicated a settlement problem with this structure. Since these

controls have not been operated since 1967, this structure should be examined inside to determine whether or not additional settlement has occurred and if so what effect this may have on the behavior of the outlet pipe. Both controls should be checked for operation at this time.

The outlet structure, at the toe of the downstream embankment slope appeared to be in sound and stable condition.

B. Design and Construction Data

The PennDER files include sketches and calculations for the stability of the spillway and walls including seepage uplift computations. These records also include hydraulic calculations for the design of the spillway and outlet facilities. These data indicate that the structural design of the spillway, walls and outlet facilities is adequate. There was no slope stability analysis in the files.

Inspection reports by PennDER during the construction period are in the file describing progress, problems and modifications made to the dam. The major change made during construction was the use of a concrete cutoff wall instead of the designed soil filled cutoff trench.

C. Operating Records

The PennDER files did not contain any information regarding the operation of this facility. It is used as a recreational lake by the adjacent residential development. The owner did not have any such records on file. It was reported that the 1972 storm caused a flow of between six and eight inches over the spillway; also, that the outlet controls have not been operated since 1967.

D. Post Construction Changes

The only post construction change noted was the installation of a slide gate control on the upstream intake structure. This modification was made when the reservoir was drawn down for repairs several years after the dam was completed. The reason for this added control was not identified. Also, there are no records or plans of this installation.

E. Seismic Stability

The dam is located in Seismic Zone 1 and it is considered that the static stability with normal safety factors is sufficient to withstand minor earthquake induced dynamic forces. No calculations or studies have been made to confirm this.

SECTION 7 - ASSESSMENT & RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection, the review of the design drawings and the historical records of the development of this dam indicates that the dam is in fair condition. This rating is based upon the maintenance and repair needs, the seepage condition at the toe of the embankment, and the absence of regular operation of the outlet controls.

In accordance with the Corps of Engineers evaluation guidelines, the spillway and reservoir storage capacities are capable of passing the full PMF without overtopping the dam. The spillway is, therefore, considered to be adequate.

B. Adequacy of Information

The engineering information, correspondence and records that are available in the PennDER files are considered to be adequate for making a reasonable assessment of the overall condition of the dam.

C. Urgency

The recommendations presented below should be implemented without delay.

D. Necessity for Additional Studies

Additional studies are not required at this time.

7.2 RECOMMENDATIONS

In order to assure the continued satisfactory operation of the dam, the following recommendations are presented for implementation by the owner:

A. Facilities

1. That the weed, brush and small tree growth on the slopes and crest of the embankment be removed and that the slope surface be inspected for signs of seepage or other distress after the area is cleared.
2. That the bare areas on the embankment be seeded to prevent erosion.

3. That the removal of growth on the downstream slope be extended to ten feet downstream from the toe of the slope to allow close observation of the seepage in this area.
4. That regular observations of the seepage condition along the toe of the downstream embankment slope be made and recorded. If changes in volume or clarity are noted, immediate action should be taken to assess and remedy the condition.
5. That the control structure be inspected and examined for pipe alignment and settlement and that the control valve in the structure and the sloping gate on the upstream intake structure be operated to assure their use in the event of an emergency.
6. That the hole adjacent to the right spillway outlet channel wall be cleaned and backfilled.

B. Operation and Maintenance Procedures

1. That an annual program of slope maintenance be developed and put into effect.
2. That a formal surveillance and downstream warning system be developed to be used during periods of heavy or prolonged rainfall.

APPENDIX A
CHECKLIST OF VISUAL INSPECTION REPORT

APPENDIX A

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # <u>13-98</u>	NDI NO. <u>PA-00 610</u>
NAME OF DAM <u>Bear Creek Lake Dam</u>	HAZARD CATEGORY <u>High</u>
TYPE OF DAM <u>Earth Embankment</u>	
LOCATION <u>Penn Forest</u>	TOWNSHIP <u>Carbon</u> COUNTY, PENNSYLVANIA
INSPECTION DATE <u>6/19/75</u>	WEATHER <u>Sunny, Warm</u> TEMPERATURE <u>70's</u>
INSPECTORS: <u>R. Houseal (Recorder)</u>	OWNER'S REPRESENTATIVE(s):
<u>H. Jongsma</u>	<u>John Wargo</u>
<u>J. Watson</u>	
<u>R. Shireman</u>	
NORMAL POOL ELEVATION: <u>1505</u>	AT TIME OF INSPECTION:
BREAST ELEVATION: <u>1511</u>	POOL ELEVATION: <u>1505+</u>
SPELLWAY ELEVATION: <u>1505</u>	TAILWATER ELEVATION: _____
MAXIMUM RECORDED POOL ELEVATION: <u>6" to 8" over spillway - 1972.</u>	
GENERAL COMMENTS:	
160 acres water. Lake drawn down to dredge and enlarge about two years after completion. Bear Creek starts in this area from natural springs. Bear Creek flows to Lehigh River. Indications are there is an upstream valve on the inlet control pipe.	

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None evident.
B. UNUSUAL MOVEMENT BEYOND TOE	None evident.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None evident - weed growth and brush covers downstream slope.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal appears good. See profile Appendix A, Plate A-II for vertical alignment.
E. RIPRAP FAILURES	None evident.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Good at natural ground at right side. One hole 3' x 6' in area 3' deep adjacent to right spillway outlet wall on downstream slope. Embankment 1' to 1-1/2' lower than right approach wall on upstream side. Vertical concrete cutoff of spillway walls exposed on both sides of the spillway.
G. SEEPAGE	Wet area downstream at toe of embankment. Water stagnant and rust colored near left abutment. Running water to right of outlet structure, rust color on bottom, water is clear. (See Page A-2/a for continuation).
H. DRAINS	Refer to plans.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Upstream: Rock slopes with considerable growth of weeds and brush. Downstream: Heavy growth of brush, weeds and small trees - bike trail near spillway. Surface: Dirt path with light weeds.

G. SEEPAGE (Continued)

The source of the water is from beneath the embankment. It is very possible that the flows detected and the wet marshy condition downstream from the toe are coming from springs. While the residual substance on the small channel bottom is reddish or rust color, the water is clear.

The source of the reservoir water is natural springs at the bottom of the lake.

The embankment slopes were dry.

VISUAL INSPECTION
OUTLET WORKS

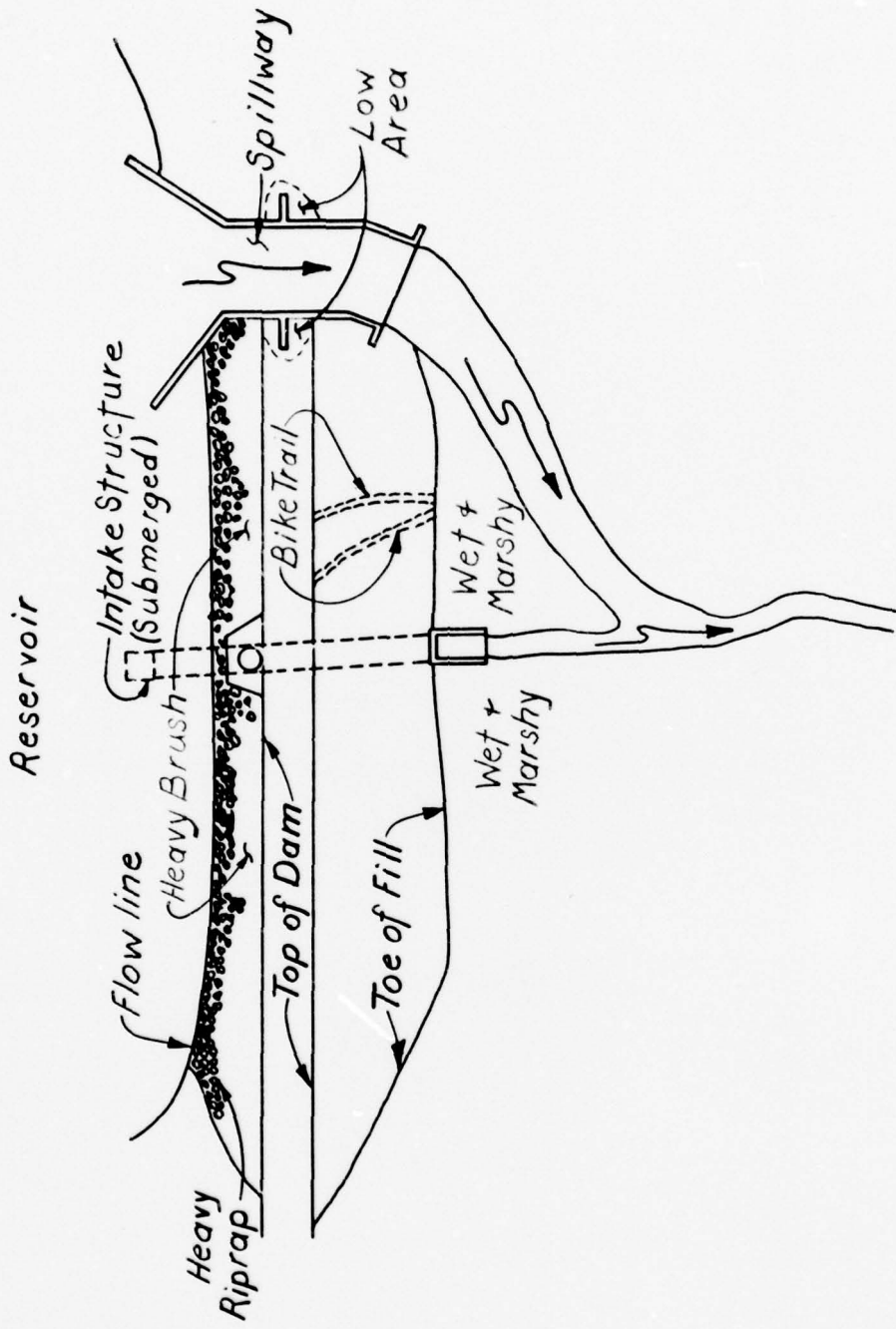
	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Manhole structure with 24" gate valve just upstream from centerline embankment. Concrete encased steel pipe from reservoir through manhole structure to the outlet. Upstream control by means of sloping gate with sloped stem.
B. OUTLET STRUCTURE	Concrete endwall, rectangular walls. No flow from 24-inch outlet pipe.
C. OUTLET CHANNEL	Shallow with weed growth - joins spillway outlet channel about 75 feet downstream from stilling basin.
D. GATES	24" gate valve in manhole plus slide gate upstream of embankment. This second gate was installed at the time of the drawdown to dredge the lake. Size unknown.
E. EMERGENCY GATE	Same as above.
F. OPERATION & CONTROL	None - occasional maintenance - no regular operation of gate valve or slide gate. Gate not operated since 1967.
G. BRIDGE (ACCESS)	None.

VISUAL INSPECTION
SPILLWAY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Directly from Lake Area. Approach channel is 2.3' below top of weir. Water just flowing over weir crest.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Crest Condition - good. No appreciable cracks in concrete nor any serious deterioration. Walls in good condition. Weepholes in walls not flowing.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Concrete apron as extension at end of ogee. Channel formed by concrete walls from upstream approach.
D. BRIDGE & PIERS	None.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	None.

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
<u>INSTRUMENTATION</u>	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
<u>RESERVOIR</u>	
Slopes	Reservoir slopes are relatively flat with woodlands to the waters edge at some locations and grassed areas at others, some sand beaches.
Sedimentation	No serious concern. Lake dredged several years after construction to enlarge area.
Watershed Description	Mostly woodlands near reservoir, some cultivated land.
<u>DOWNSTREAM CHANNEL</u>	
Condition	Natural stream. This area is the headwaters of Bear Creek.
Slopes	Wooded with brush.
Approximate Population	5±
No. Homes	Farm with buildings and one home.



BEAR CREEK LAKE DAM
PA.-610

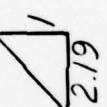
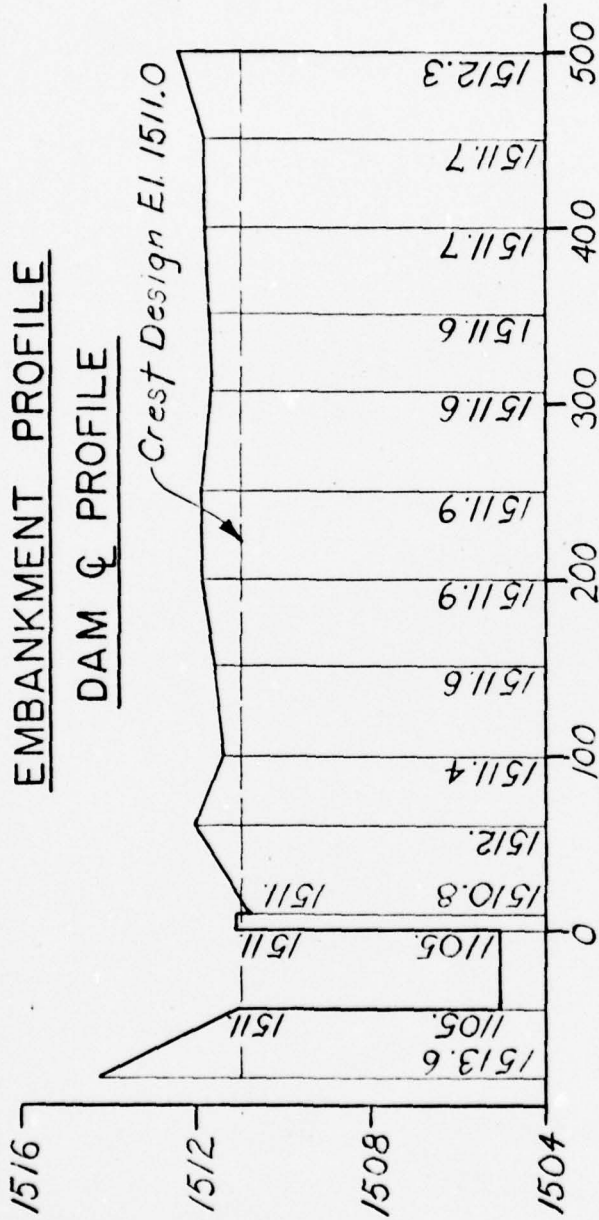
INSPECTION SURVEY

PLATE A-I

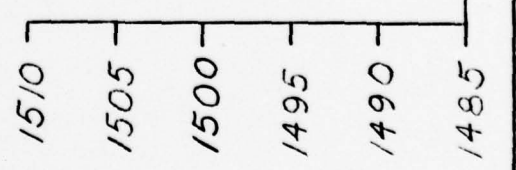
Surveyed 6-20-79

EMBANKMENT PROFILE

DAM & PROFILE



EMBANKMENT SECTION



Surveyed 6-20-70

BEAR CREEK LAKE DAM
PA.-610

INSPECTION SURVEY

PLATE A-II

APPENDIX B
CHECKLIST OF ENGINEERING DATA

APPENDIX B

CHECK LIST
ENGINEERING DATA

PA DER # 13-98

NDI NO. PA-00 610

NAME OF DAM Bear Creek Lake Dam

ITEM	REMARKS
AS-BUILT DRAWINGS	Design Drawings only
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle Christmans, Pa. See Plate II, Appendix F
CONSTRUCTION HISTORY	PennDER Inspection Reports and Correspondence.
GENERAL PLAN OF DAM	Design Drawings.
TYPICAL SECTIONS OF DAM	Design Drawings.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	Plans included in file information. Discharge data included in calculations.

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	None.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrologic and hydraulic computations are in the PennDER files. Also structural stability and uplift calculations and seepage analysis.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	Four test holes - 9'± deep are summarized on the design drawings. Laboratory and field test data. One density curve.
POST CONSTRUCTION SURVEYS OF DAM	Inspection Reports.
BORROW SOURCES	Not identified.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Concrete core wall added as a result of field conditions differing from design concept.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	Inspection Reports by PennDER.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	None - Recreational dam for residential development.
SPILLWAY PLAN, SECTIONS AND DETAILS	Information included in design drawings.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Outlet control gate valve is the only operating equipment.
CONSTRUCTION RECORDS	PennDER inspection reports and correspondence.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	Inspection reports during construction.
MISCELLANEOUS	

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Woodland and cultivated fields

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 1505 2,600 Acre-FeetTOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 1511 3,483 Acre-FeetMAXIMUM DESIGN POOL: Elev. 1511TOP DAM: Elev. 1511

SPILLWAY:

a. Elevation Project Datum = El. 23 : U.S.G.S. 1505.b. Type Concrete ogee section.c. Width 45 feet.d. Length 12 feet.e. Location Spillover Left abutment.f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 24" diameter steel pipe encased in reinforced concrete.b. Location Just left of center of embankment length.c. Entrance inverts 1476±d. Exit inverts 1475.5±e. Emergency drawdown facilities Same.

HYDROMETEOROLOGICAL GAGES:

a. Type None.

b. Location _____

c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE: None reported.

APPENDIX C
HYDROLOGY AND HYDRAULIC CALCULATIONS

APPENDIX C

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge, time of the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California.

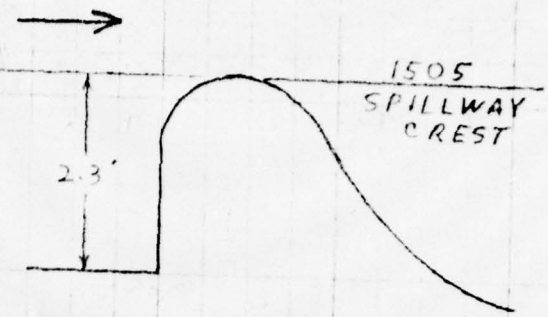
JY. KLS DATE 6/28/29
CHKD. BY DATE
SUBJECT

BERGER ASSOCIATES

SHEET NO. 1 OF
PROJECT 08190

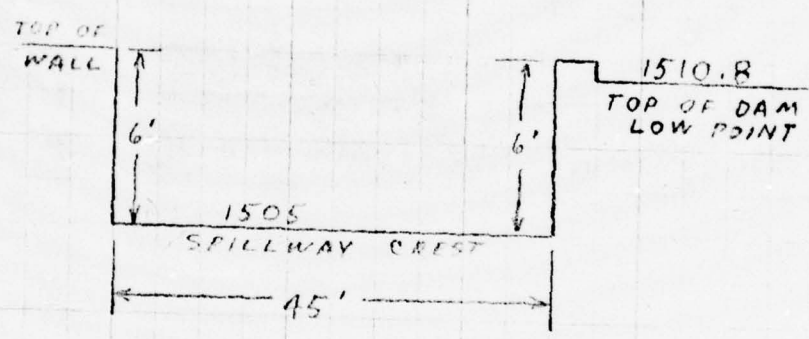
BEAR CREEK DAM

SPILLWAY RATING



OGEE SECTION

$C = 3.88$ (SMALL DAMS FIG. 249)



$H = 1510.8 - 1505 = 5.8'$
 $C = 3.88$
 $L = 45'$

$Q = CLH^{3/2}$
 $= 3.88 \times 45 \times (5.8)^{1.5}$
 $= 2439$

SAY 2440 CFS

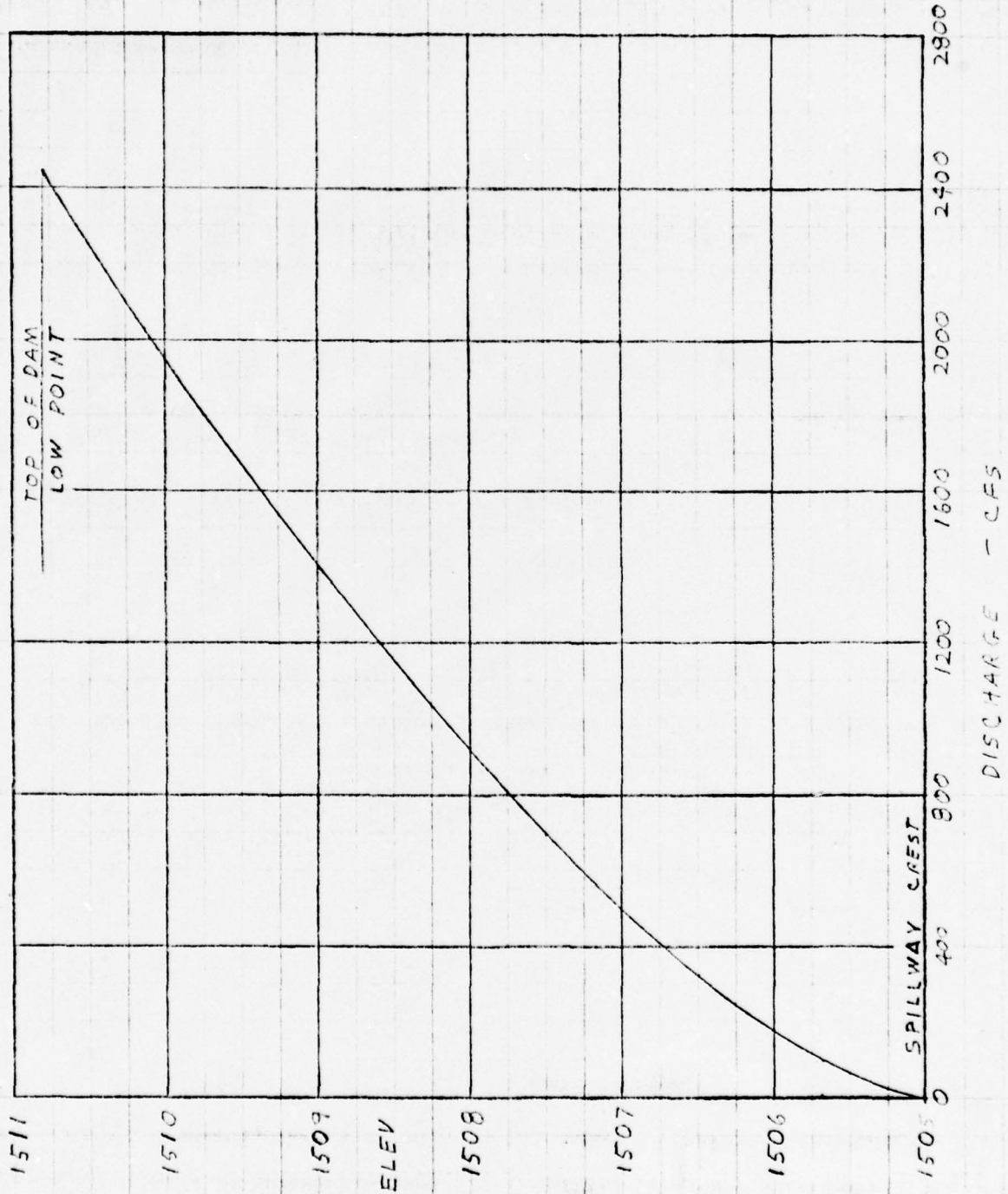
BY RLS DATE 6/28/79
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. 1
PROJECT D849

BEAR CREEK DAM

SPILLWAY RATING CURVE



BY RLS DATE 6/28/79
CHKD. BY DATE
SUBJECT

BERGER ASSOCIATES

SHEET NO. 3
PROJECT 08990

BEAR CREEK DAM

MAXIMUM KNOWN FLOOD AT DAM SITE

THE MAXIMUM KNOWN FLOOD AT BEAR CREEK DAM OCCURRED IN JUNE 1972, WHEN THE WATER LEVEL IN THE RESERVOIR WAS REPORTED TO HAVE BEEN 8 INCHES HIGHER THAN THE SPILLWAY CREST.

$$H = 8''$$

$$C = 3.88$$

$$L = 45'$$

$$\begin{aligned} Q &= CL H^{3/2} \\ &= 3.88 \times 45 \times (8/12)^{1.5} \\ &= 95 \text{ CFS} \end{aligned}$$

DISCHARGE THROUGH OUTLET WORKS

BLOWOFF IS 24" DIAMETER STEEL PIPE EXTENDING ABOUT 157' THROUGH THE EMPANKMENT. DOWNSTREAM INVERT IS ABOUT 1476.5

$$N = .013 \text{ (KING'S HOBBS)}$$

$$A = \pi D^2/4 = 3.14$$

$$R = .5$$

$$L = 157$$

AT NORMAL POOL

$$S = (1505 - 1478.5)/157 = .169$$

$$\begin{aligned} Q &= 1.486 A R^{2/3} S^{1/2} / N \\ &= 1.486 \times 3.14 \times (.5)^{2/3} \times (.169)^{1/2} / .013 \\ &= 93 \text{ CFS} \end{aligned}$$

AT LOW POOL ELEV 1485

$$S = (1485 - 1478.5)/157 = .041$$

$$\begin{aligned} Q &= 1.486 A R^{2/3} S^{1/2} / N \\ &= 1.486 \times 3.14 \times (.5)^{2/3} \times (.041)^{1/2} / .013 \\ &= 46 \text{ CFS} \end{aligned}$$

DATE 12/1/77
DATE

BERGER ASSOCIATES

SHEET NO. 1 OF 1
PROJECT 08490

SUBJECT BEAR CREEK DAM

SIZE CLASSIFICATION:

MAXIMUM STORAGE = 3483 ACRE-FEET

MAXIMUM HEIGHT = 35 FEET

SIZE CLASSIFICATION IS "INTERMEDIATE"

HAZARD CLASSIFICATION:

FARM BUILDINGS AND HOUSES LOCATED ALONG
DOWNSTREAM CHANNEL.

USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE
OF AN SDF EQUAL TO THE PROBABLE
MAXIMUM FLOOD.

HEC-1 DATA

DRAINAGE AREA = 1.9 SQ. MI.

DELAWARE BASIN REGION 2

$C_p = 0.45$

$C_T = 2.1$

LONGEST WATERCOURSE = 2.01 MI.

L TO CENTROID = 0.64 MI. ≤ 0.85 (POOL)

L' FROM RESERVOIR TO BASIN DIVIDE = 1.19 MI

$T_p = C_T (L')^{.6}$

$T_p = 2.33$

RAINFALL (HMR-33)

INDEX (200 SQ. MI. - 24 HR.) = 22.4 HR.

ZONE 6

INCREMENTAL RAINFALL

6 HR = 113 %

12 HR = 123 %

24 HR = 132 %

48 HR = 143 %

PLANIMETERED AREAS (FROM QUAD SHEETS)

ELEV. 1505 = 130 ACRES

ELEV. 1520 = 225 ACRES

ZERO STORAGE ELEVATION

$ELEV. = 1505 - (STORAGE \times 3 / AREA)$
 $= 1445$

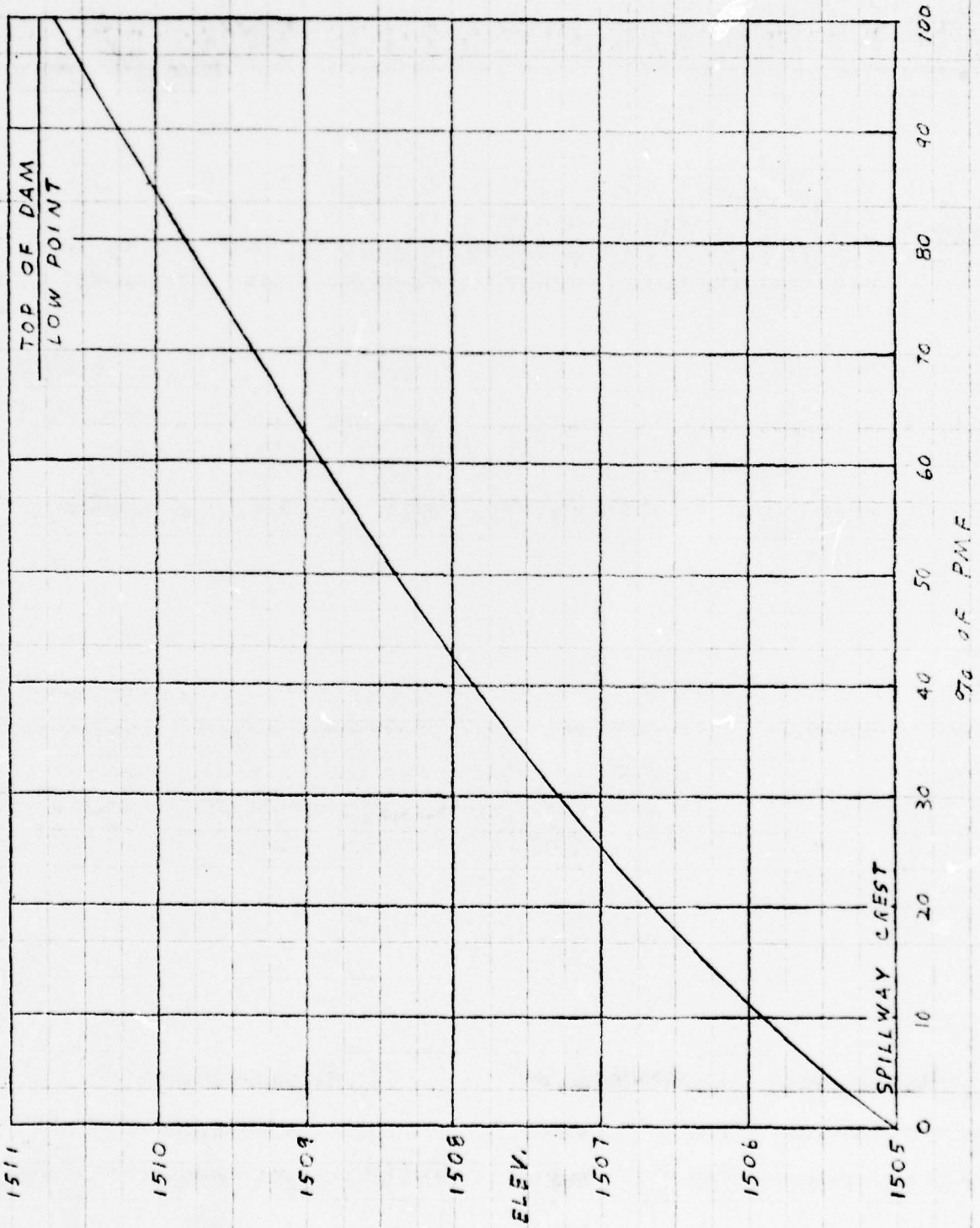
BY RLS DATE 11/1/79
CHKD. BY _____ DATE _____
SUBJECT _____

BERGER ASSOCIATES

SHEET NO. _____ OF _____
PROJECT D8490

BEAR CREEK DAM

SPILLWAY CAPACITY CURVE



DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

01 1/4

1	A1	BEAR CREEK DAM **** BEAR CREEK									
2	A2	PENN FOREST TWP., CARBON COUNTY									
3	A3	NDI # PA-00610 PA DER # 13-98									
4	B	300	0	15	0	0	0	0	0	-4	0
5	B1	5									
6	J	1	9	1							
7	J1	1	.85	.7	.6	.5	.4	.3	.2	.1	
8	K	1	1					1			
9	K1		INFLOW HYDROGRAPH								
10	M	1	1	1.9							
11	F		22.4	113	123	132	143				
12	T							1	.05		
13	U	2.33	.45								
14	X	-1.5	-.05	2							
15	K	1	2					1			
16	K1		RESERVOIR ROUTING								
17	Y			1	0						
18	Y1	1								2600	
19	FA	0	130	225							
20	FE	1445	1505	1520							
21	FF	1505	45	3.88	1.5						
22	FD	1511	2.7	1.5	500						
23	K	99									

1

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
 ROUTE HYDROGRAPH TO 2
 END OF NETWORK

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

RUN DATE# 79/08/15.
 TIME# 11.58.42.

BEAR CREEK DAM **** BEAR CREEK
 PENN FOREST TWP., CARBON COUNTY
 NDI # PA-00610 PA DER # 13-98

JOB SPECIFICATION										
NO	NHR	MHR	IDAY	INR	IMIN	MEIC	IPLT	IPRT	NSTAN	
300	0	15	0	0	0	0	0	-4	0	
			JOPER	HWT	LROPT	TRACE				
			5	0	0	0				

MULTI-FLASH ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 9 LRTIO= 1
 RTIOS= 1.00 .85 .70 .60 .50 .40 .30 .20 .10

SUB-AREA RUMOFF COMPUTATION

01 2/4

INFLOW HYDROGRAPH

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

HYDROGRAPH DATA

IHYDG IUHG TAREA SNAP TRSDA TRSFC RATIO ISNOW ISAME LOCAL
 1 1 1.90 0.00 1.90 0.00 0.000 0 0 0

FRECIP DATA

SPFE FNS R6 R12 R24 R48 R72 R96
 0.00 22.40 113.00 123.00 132.00 143.00 0.00 0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT STRKR DLTNR RTIOL ERAIN STRKS RTIOK STRIL CNSTL ALSMX RTIMP
 0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .05 0.00 0.00

UNIT HYDROGRAPH DATA

TP= 2.33 CP= .45 NTA= 0

RECESSION DATA

STRTO= -1.50 GRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 84 END-OF-PERIOD ORDINATES, LAG= 2.34 HOURS, CP= .45 VOL= 1.00

7.	27.	56.	90.	128.	166.	198.	222.	238.	241.
232.	216.	202.	187.	176.	165.	154.	144.	135.	126.
117.	110.	103.	96.	90.	84.	78.	73.	68.	64.
60.	56.	52.	49.	45.	42.	40.	37.	35.	32.
30.	28.	26.	25.	23.	22.	20.	19.	18.	16.
15.	14.	13.	12.	12.	11.	10.	10.	9.	8.
8.	7.	7.	6.	6.	6.	5.	5.	5.	4.
4.	4.	3.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.						

END-OF-PERIOD FLOW

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

SUM 25.63 23.22 2.41 113756.
 (651.)(590.)(61.)(3221.21)

HYDROGRAPH ROUTING

RESERVOIR ROUTING

ISTAQ ICOMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO
 2 1 0 0 0 0 1 0 0

ROUTING DATA

GLOSS CLOSS AVG IRES ISAME IOPT IPMP LSTR
 0.0 0.000 0.00 1 0 0 0 0

NSIFS NSTDL LAG AMSKK X TSK STORA ISPRAT
 1 0 0 0.000 0.000 0.000 0.000

HYDROGRAPH ROUTING

0.3/4

RESERVOIR ROUTING

ISTAN	ICOMP	IECON	ITAPE	JFLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA							
QLOSS	CLOSS	AVG	IRIS	ISAME	IOFT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTFS	NSTBL	LAG	AMSK	X	TSK	STOR	ISPRAT
1	0	0	0.000	0.000	0.000	2600.	0

SURFACE AREA= 0. 130. 225.
 CAPACITY= 0. 2600. 5230.
 ELEVATION= 1445. 1505. 1520.

CREL	SPWID	COOW	EXPW	ELEV	COOL	CAREA	EXPL
1505.0	45.0	3.9	1.5	0.0	0.0	0.0	0.0

DAM DATA
 TOFEL 1511.0
 COOD 2.7
 EXFD 1.5
 DAMWID 500.

PEAK OUTFLOW IS 2348. AT TIME 44.75 HOURS
 PEAK OUTFLOW IS 1959. AT TIME 44.75 HOURS
 PEAK OUTFLOW IS 1574. AT TIME 45.00 HOURS
 PEAK OUTFLOW IS 1322. AT TIME 45.00 HOURS
 PEAK OUTFLOW IS 1073. AT TIME 45.00 HOURS
 PEAK OUTFLOW IS 829. AT TIME 45.25 HOURS
 PEAK OUTFLOW IS 592. AT TIME 45.50 HOURS
 PEAK OUTFLOW IS 365. AT TIME 45.75 HOURS
 PEAK OUTFLOW IS 157. AT TIME 46.25 HOURS

OT 4/4

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	RATIOS APPLIED TO FLOWS									
			PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				1.00	.85	.70	.60	.50	.40	.30	.20	.10
HYDROGRAPH AT	1	1.90 (4.92)	1	3583. (100.88)	3028. (85.75)	2494. (70.62)	2138. (60.53)	1781. (50.44)	1425. (40.35)	1069. (30.27)	713. (20.18)	356. (10.05)
ROUTED TO	2	1.90 (4.92)	1	2348. (66.50)	1959. (55.48)	1574. (44.57)	1322. (37.43)	1073. (30.38)	829. (23.47)	592. (16.75)	365. (10.34)	157. (4.44)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1505.00	1505.00	1511.00
STORAGE	2600.	2600.	3483.
OUTFLOW	0.	0.	2566.

RATIO OF PWF	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
1.00	1510.66	0.00	3426.	2348.	0.00	44.75	0.00
.85	1510.01	0.00	3323.	1959.	0.00	44.75	0.00
.70	1509.33	0.00	3216.	1574.	0.00	45.00	0.00
.60	1508.86	0.00	3143.	1322.	0.00	45.00	0.00
.50	1508.35	0.00	3068.	1073.	0.00	45.00	0.00
.40	1507.82	0.00	2989.	829.	0.00	45.25	0.00
.30	1507.26	0.00	2907.	592.	0.00	45.50	0.00
.20	1506.64	0.00	2820.	365.	0.00	45.75	0.00
.10	1505.93	0.00	2723.	157.	0.00	46.25	0.00

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

 EOI ENCOUNTERED.
 >

APPENDIX D
GEOLOGIC REPORT

APPENDIX D

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Catskill Formation, Poplar Gap Member and Duncannon Member (reservoir only).

Lithology: The Poplar Gap Member consists of fine to medium grained gray sandstone, massive beds; two to five feet thick, tending to break up into beds of 1/2 to 3 inches thick. Composed of quartz sand, some quartz pebbles, generally cemented with quartz. A few, scarce, red shale interbeds.

Structure

The dam is located on the north flank of the Wild Creek anticline. The beds strike N60°E and dip about 20°NW. No minor folding or faulting is known in the area. Air photo fracture traces trend N20°E and N10°W.

Overburden

Test boring logs indicate the overburden in the area is generally thin. It consists of soil, boulders, gravel, clay and "hard pan". The hard pan is probably till. The test holes were only eight to nine feet deep, and not all of them hit bedrock.

Aquifer Characteristics

The rocks of the Catskill Formation are generally impermeable and ground water movement is on bedding planes and fractures. Where fracturing is intense, considerable movement is possible.

Discussion

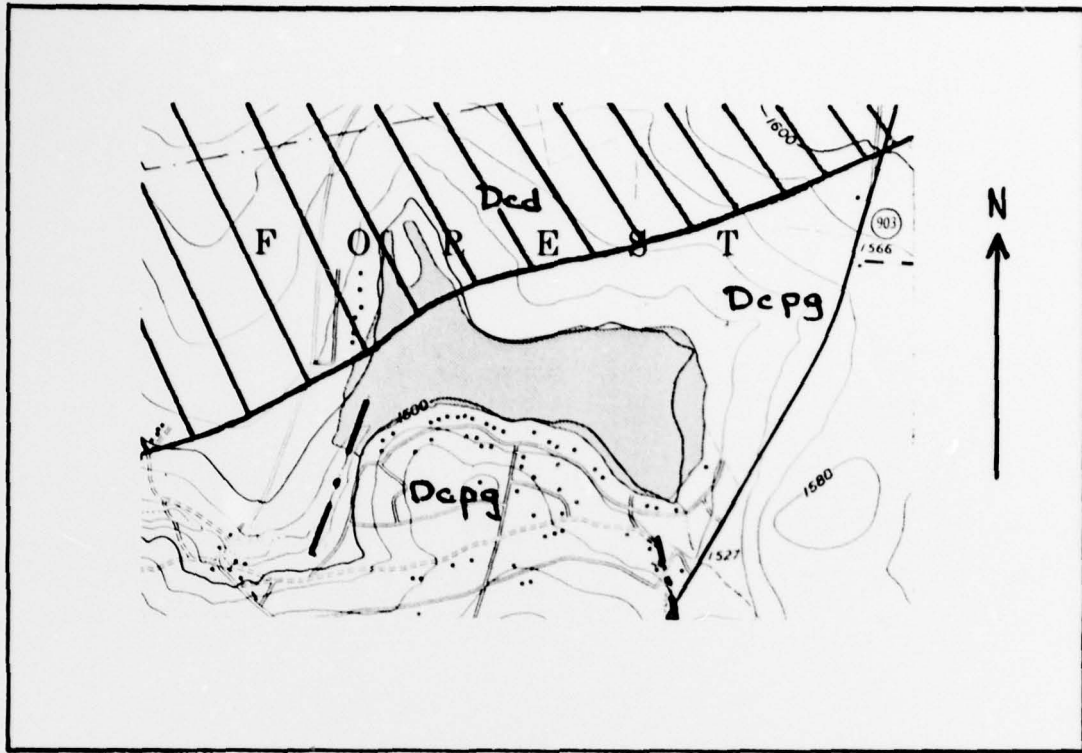
The specifications for this dam call for a cutoff trench filled with compacted clay, which was to be dug not less than ten feet into impervious material. There apparently was no grouting program.

The orientation of the bedding and N20°E fractures in relation to the dam axis make seepage below the cutoff trench a definite possibility. If the cutoff trench were entirely in bedrock, this leakage would not be of any concern. It is possible, however, that the "hardpan" was considered to be impervious and the trench may be in part in this material. Groundwater movement could conceivably weaken this material. Any large flows at the toe of the dam should be monitored carefully.

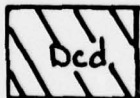
Sources of Information

1. W.D. Sevon (1975). "Geology and Mineral Resources of the Christmans and Pohopoco Mt. Quadrangles, Carbon and Monroe Counties, Pa. Pa. Geol. Survey, Atlas 195ab.
2. Plans and correspondence in file.
3. Air Photographs, scale 1:48,000. Dated 1970.

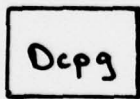
GEOLOGIC MAP - Bear Creek Dam



(geology from Pa. Geol. Surv. Atlas 195)

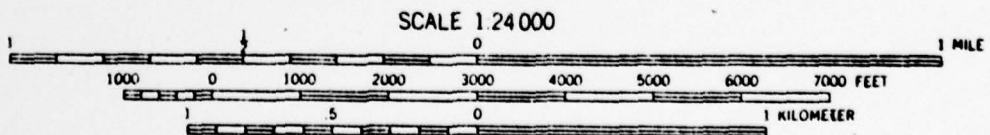


Dcd Catskill Fm.- Duncannon Member



Dcpg Catskill Fm.- Poplar Gap Member

--- air photo fracture trace



CONTOUR INTERVAL 20 FEET

APPENDIX E
PHOTOGRAPHS

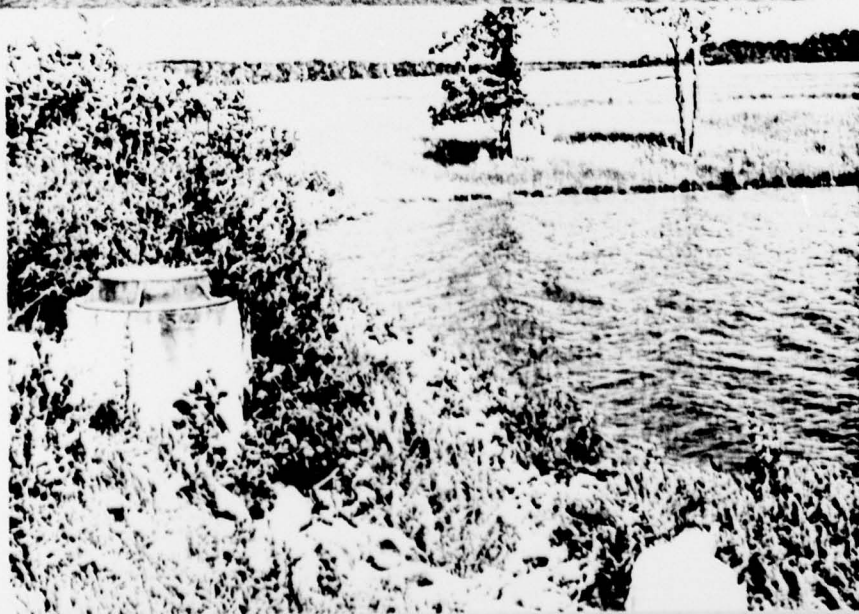
APPENDIX E



Dam Crest
Looking to
Right Abutment



Upstream Slope



Manhole with
Valve Control

PA-610
PLATE E-1



Downstream Slope
with
"Bike" Path

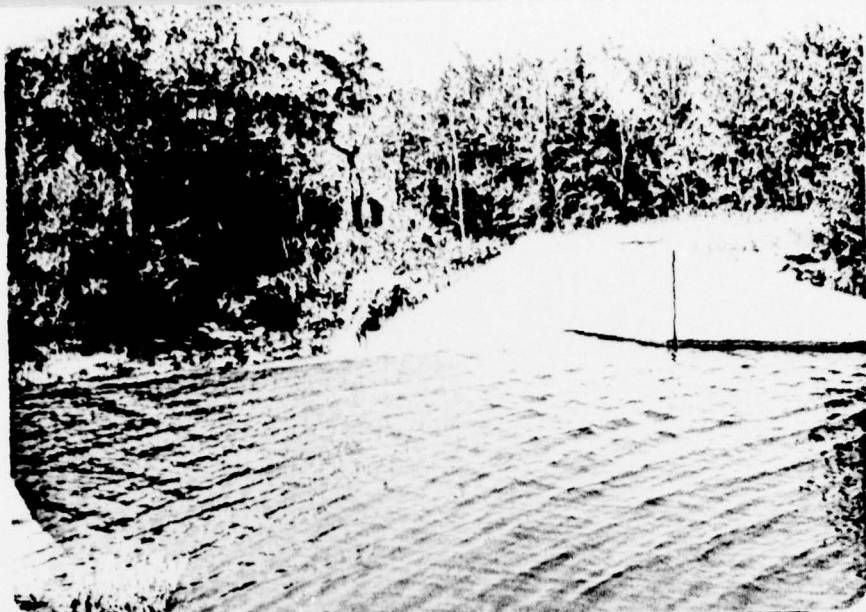


Seepage of Springs
at
Downstream Toe



Conduit Outlet

PA-610
PLATE E-11



Forebay of
Spillway



Spillway Looking
Upstream



Settlement
Adjacent to
Right Spillway
Wall

PA-610
PLATE E-III



Reservoir

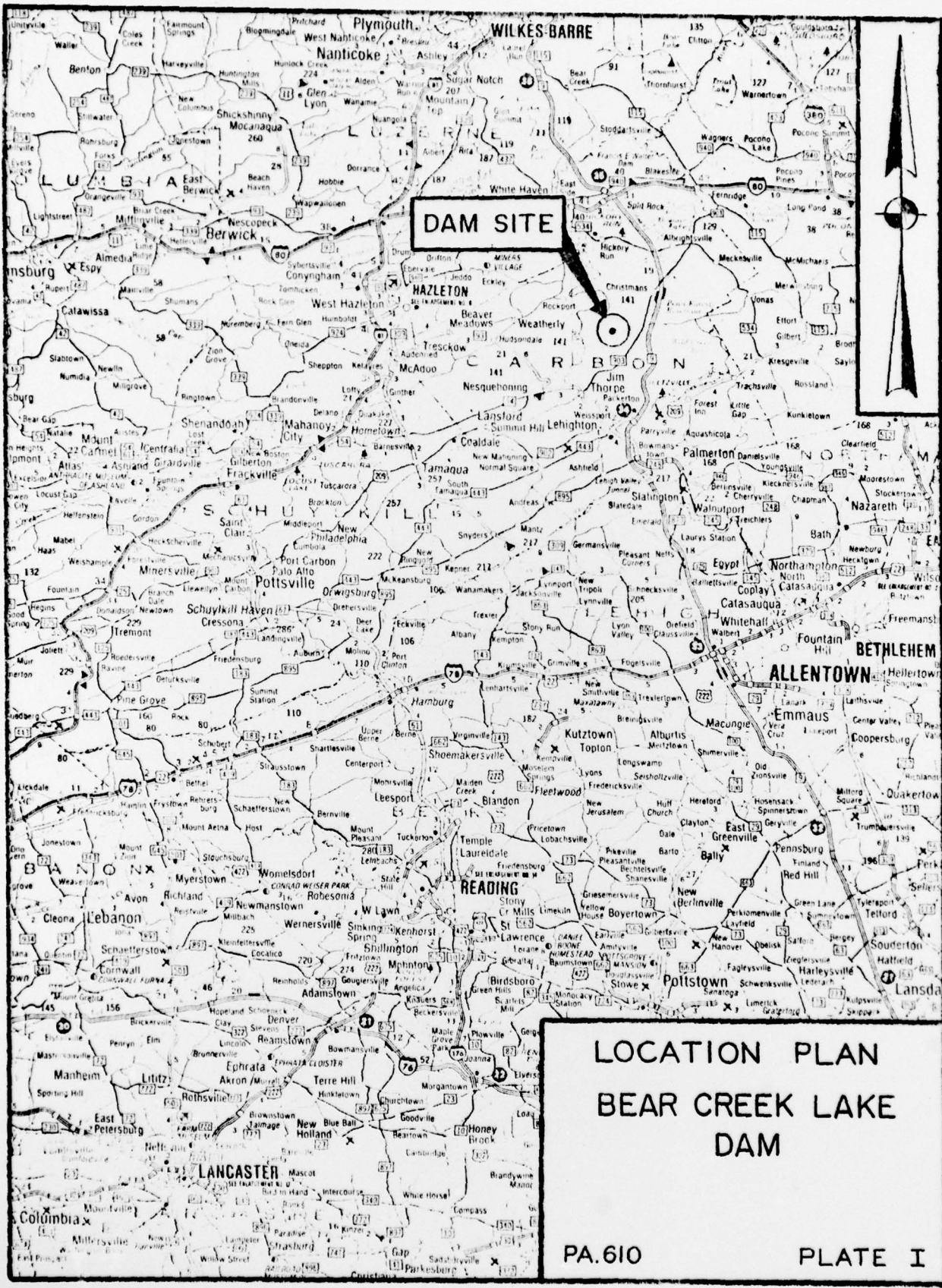


Downstream Channel

PA-610
PLATE E-IV

APPENDIX F
PLATES

APPENDIX F

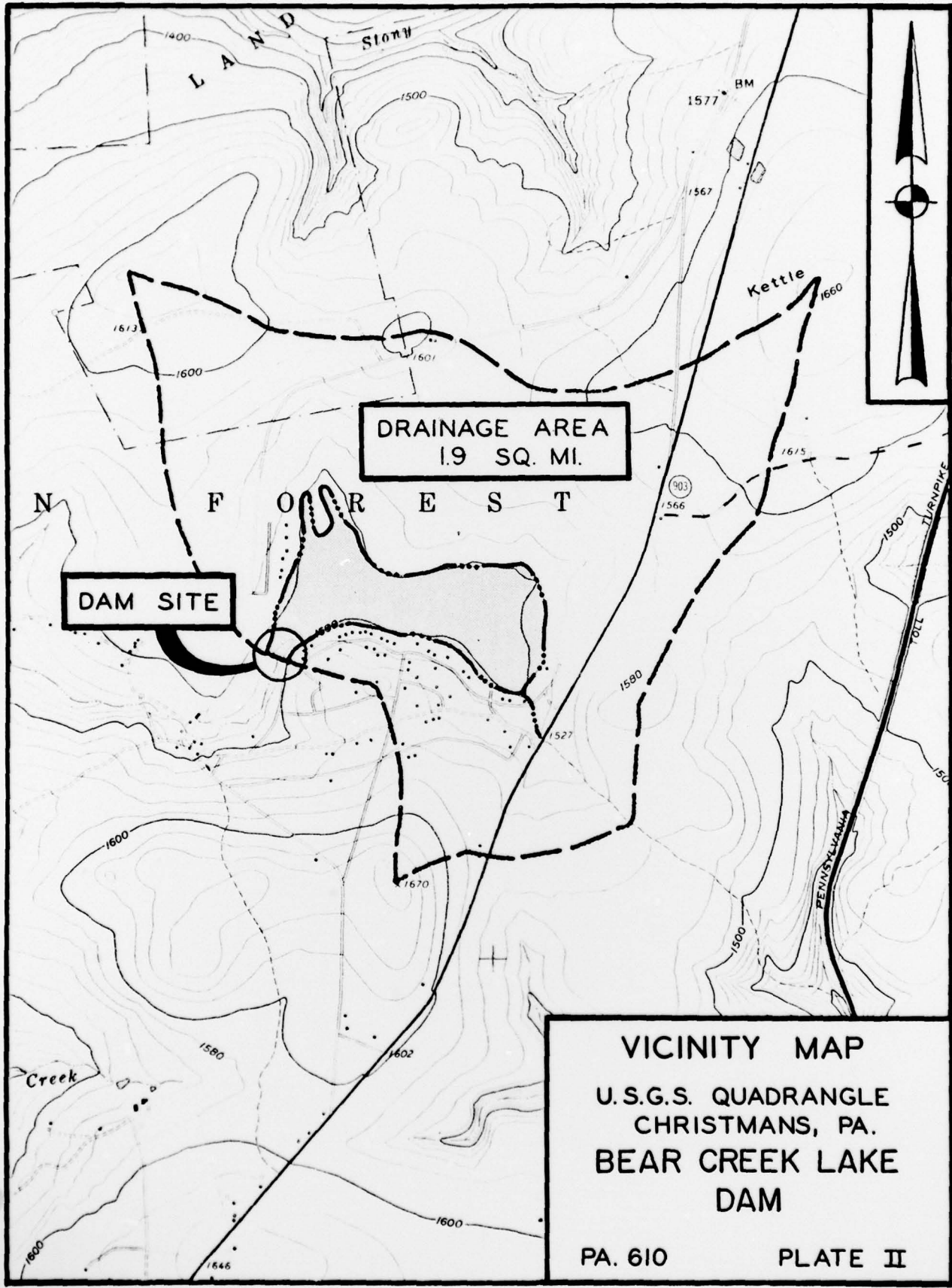


DAM SITE

**LOCATION PLAN
BEAR CREEK LAKE
DAM**

PA. 610

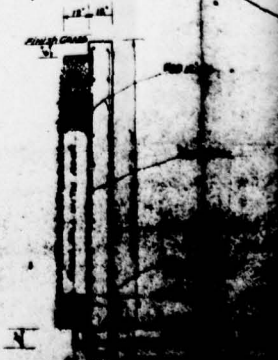
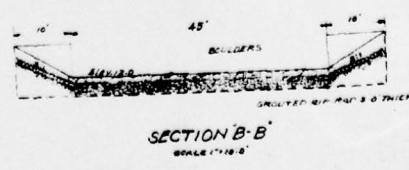
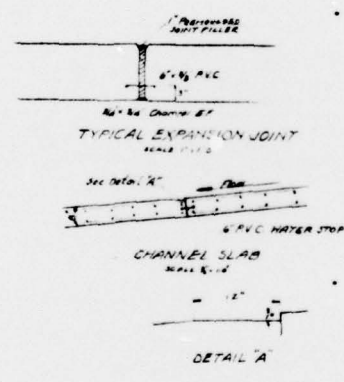
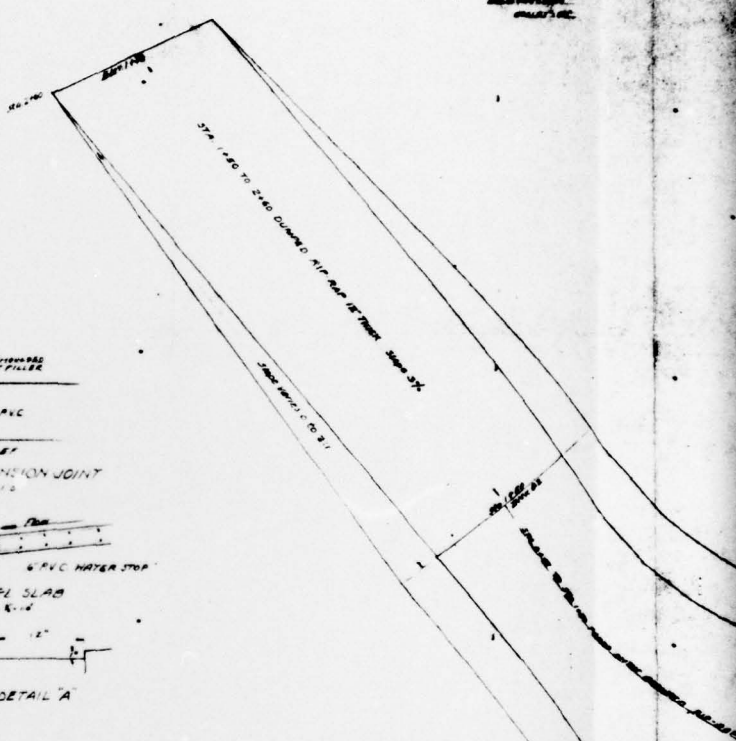
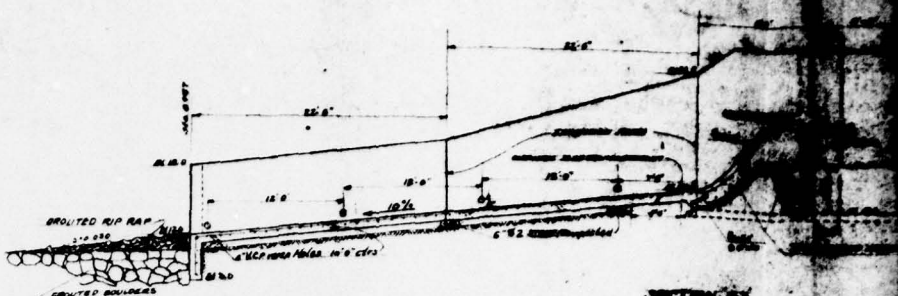
PLATE I

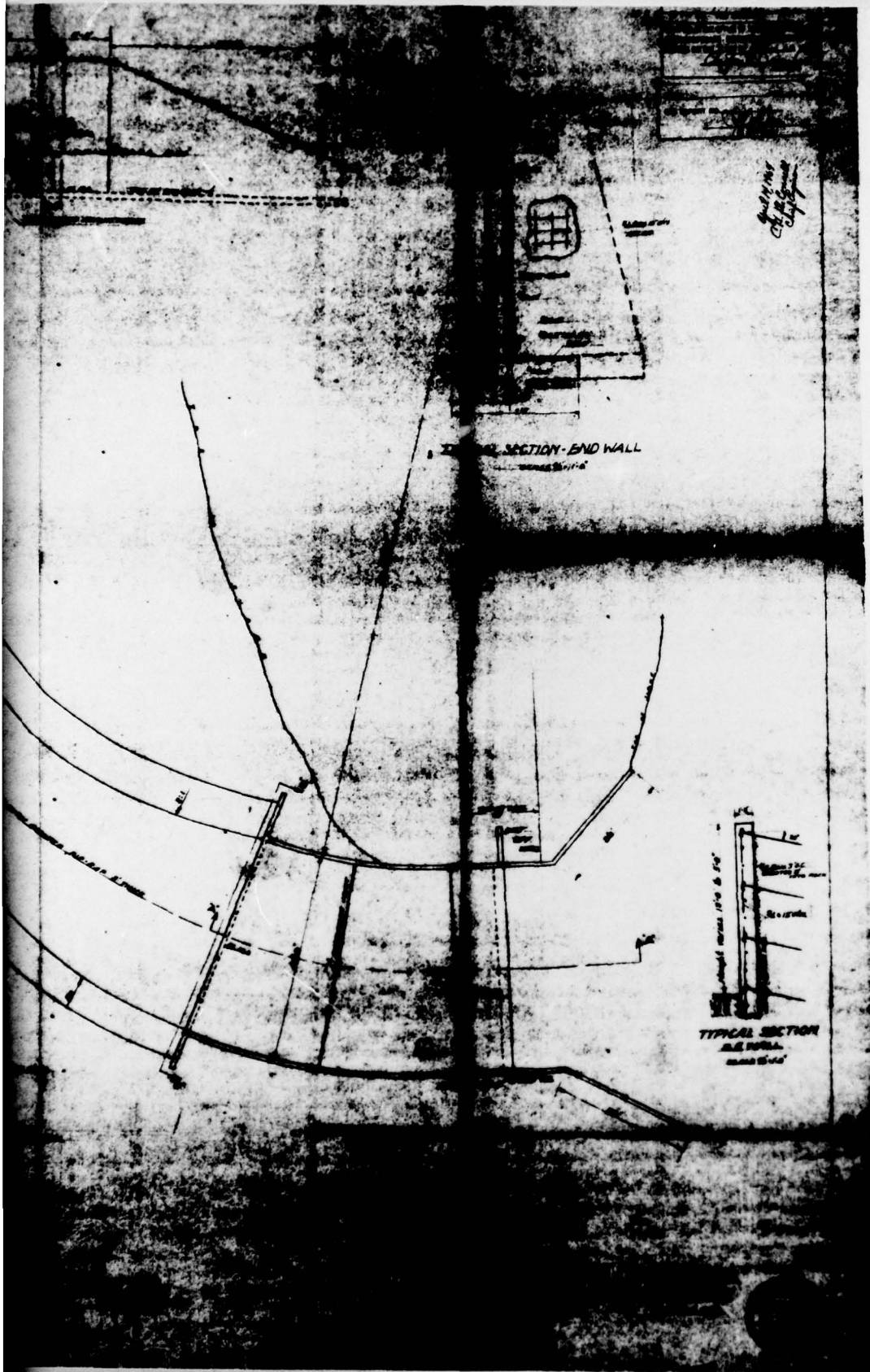


DRAINAGE AREA
1.9 SQ. MI.

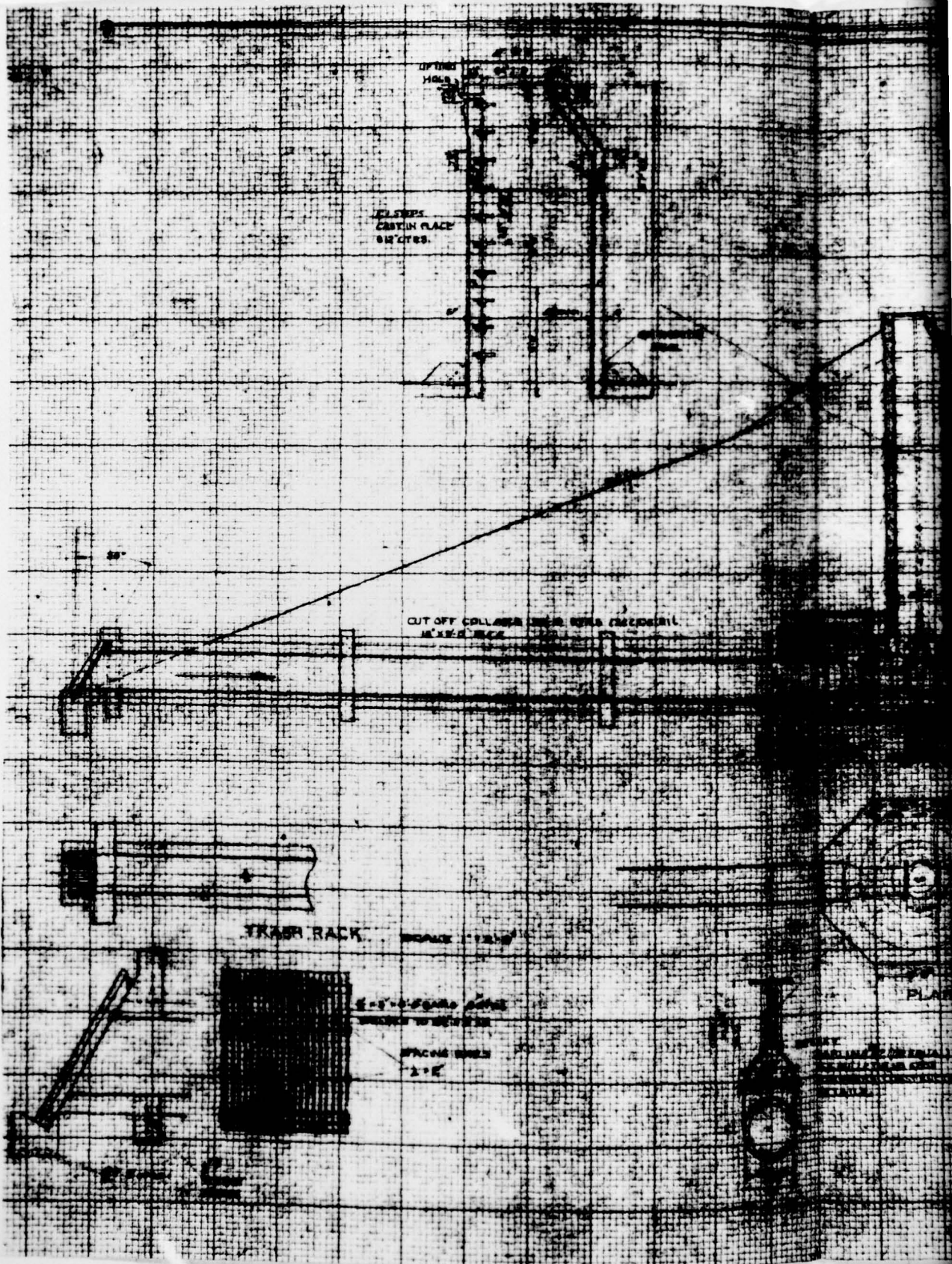
DAM SITE

VICINITY MAP
U.S.G.S. QUADRANGLE
CHRISTMANS, PA.
BEAR CREEK LAKE
DAM
PA. 610 PLATE II





PA.-610
PLATE III



TO 3 ON COMPACTED SAND OR GRAVEL

DESIGNED BY
ARCHITECT
ASST. ENGINEER
APPROVED BY
ENGINEER
(or ARCHITECT)

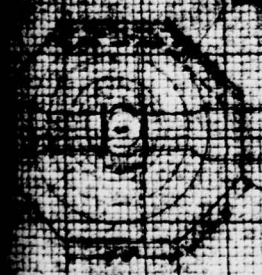
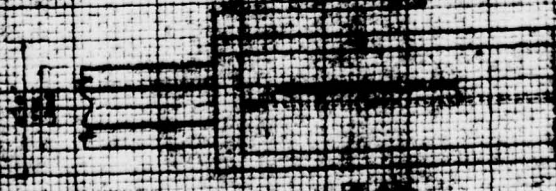
CONCRETE

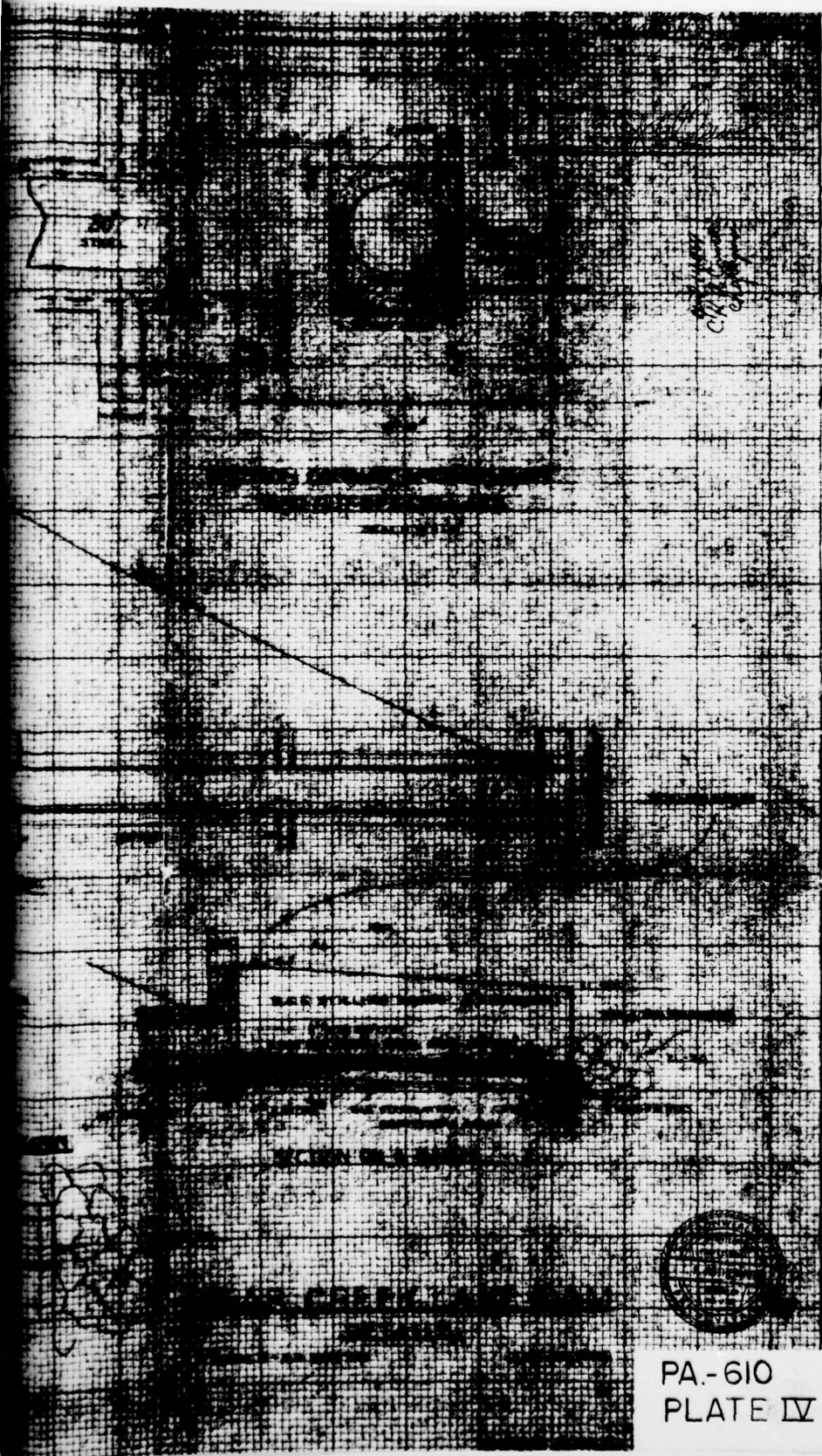
SECTION THROUGH WALL

FOUNDATION

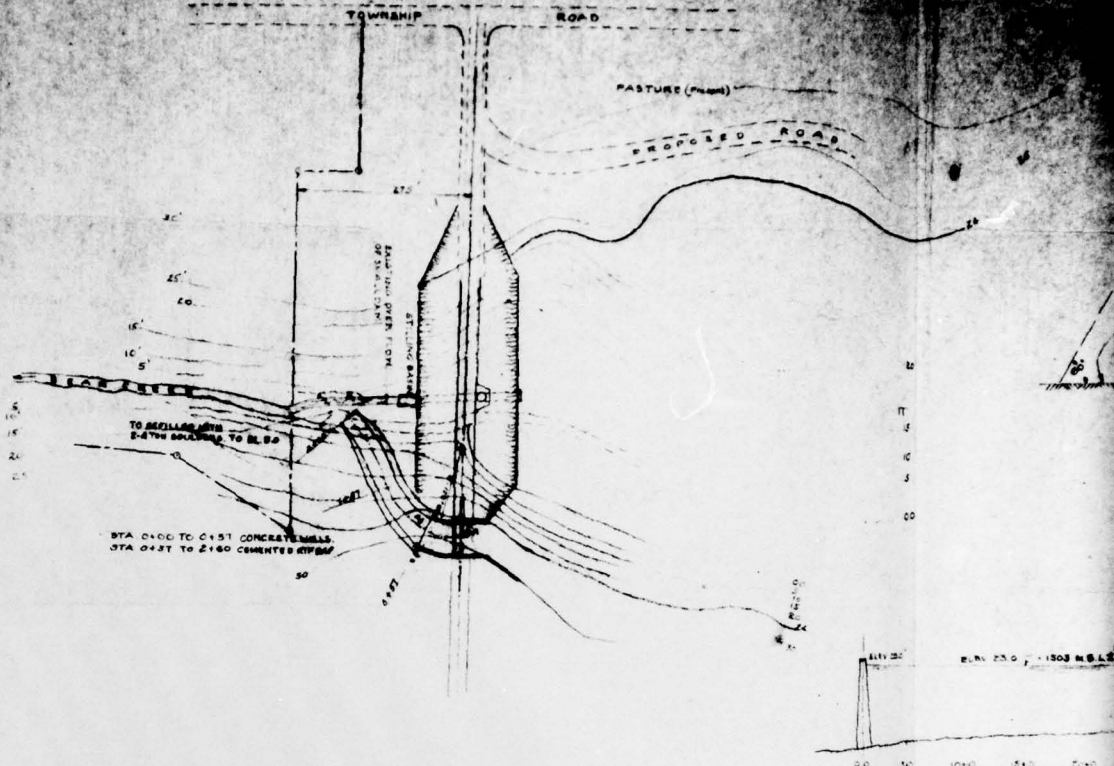
SETTLING BAR

PLAN

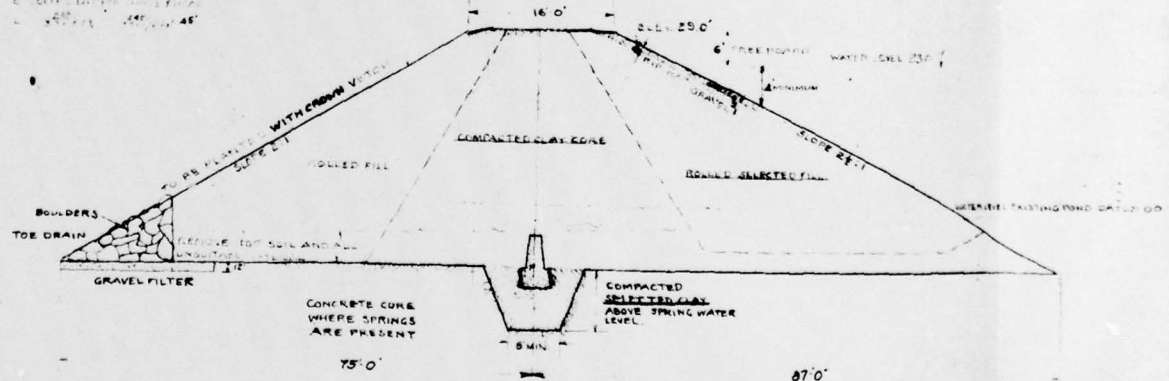


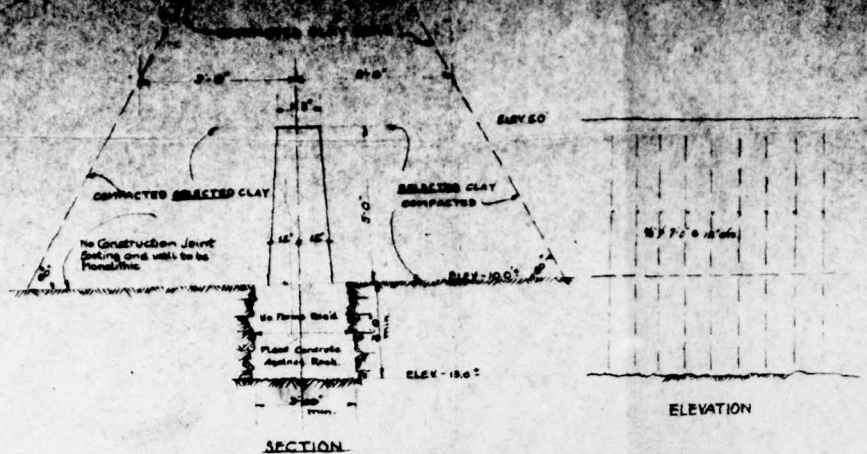


PA.-610
PLATE IV

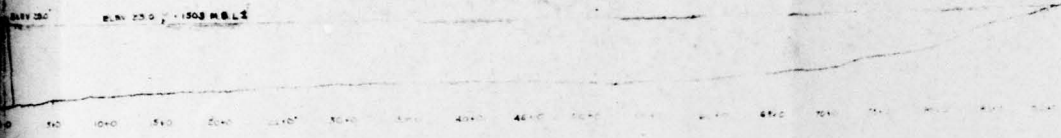


SPILLWAY DESIGN - 100% DESIGN HEAD 25.00 FT
 1. CLIFF
 2. DOWNSTREAM
 3. GRAVEL FILTER
 4. TOE DRAIN
 5. BOULDERS
 6. GRAVEL FILTER
 7. TOE DRAIN
 8. BOULDERS





DETAIL OF CONCRETE CORE WALL
Scale 1" = 2' 0"

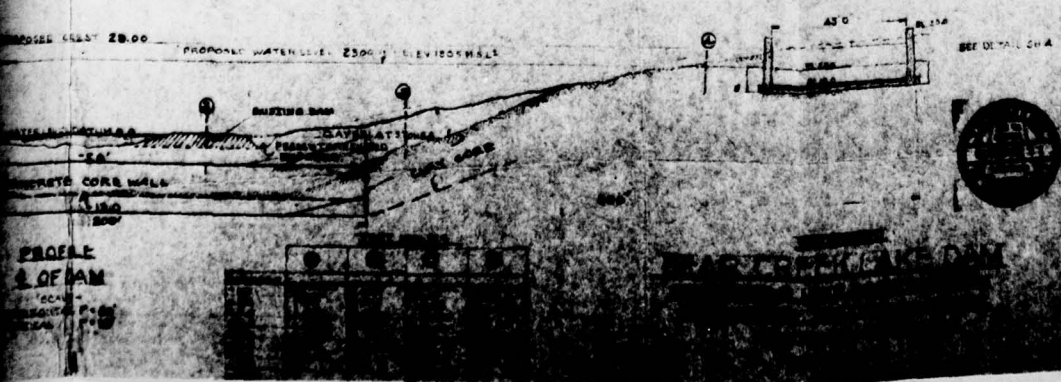


PROFILE OF STREAM
SCALE
HORIZONTAL 1" = 50'
VERTICAL 1" = 10'

NO STRUCTURE IN THIS AREA



SHORE LINE DETAIL



PROFILE OF DAM
SCALE
HORIZONTAL 1" = 50'
VERTICAL 1" = 10'

PA-610
PLATE V