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NATIONAL DAM SAFETY PROGRAM, HIGH BRIDGE DAM, SUSQUEHANNA RIVER--ETC(U)
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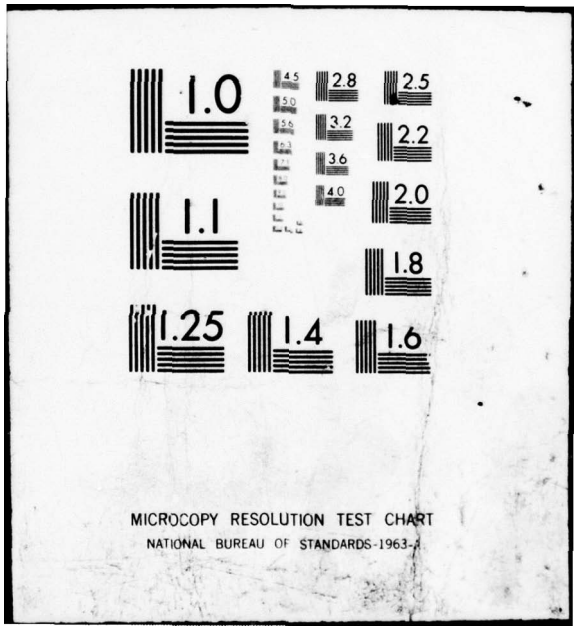
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(6) National Dam Safety Program.
High Bridge Dam, Susquehanna River Basin,
Commonwealth of Pennsylvania,
Schuylkill County (NDS-PA-679).
Phase I Inspection Report.

LEVEL II (1)

SUSQUEHANNA RIVER BASIN

HIGH BRIDGE DAM

COMMONWEALTH OF PENNSYLVANIA

SCHUYLKILL COUNTY

INVENTORY NUMBER NDS PA-679

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

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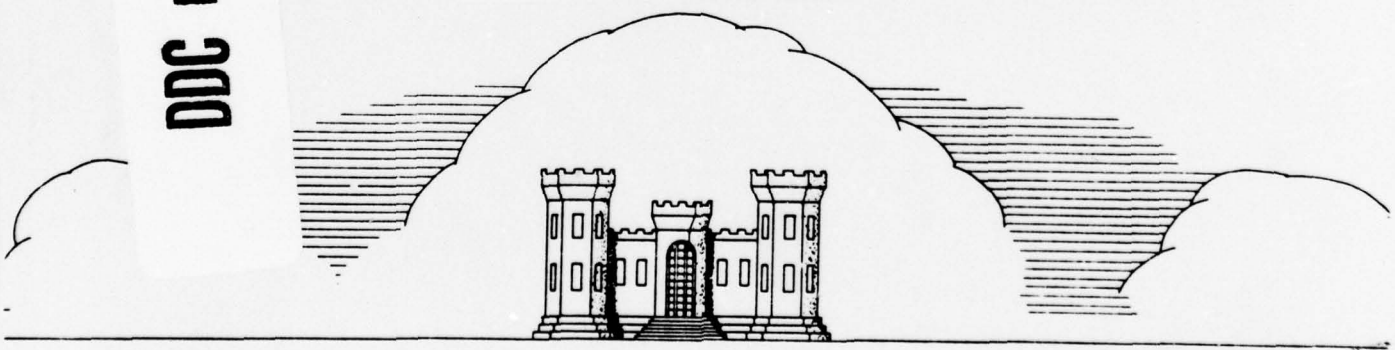


Prepared For
DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland
by
BERGER ASSOCIATES, INC
CONSULTING ENGINEERS
HARRISBURG, PA

(12) 66p.

(11) SEPTEMBER 1978

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam: HIGH BRIDGE

State & State Number: PENNSYLVANIA - 54-157A

County Located: SCHUYLKILL

Stream: FISHING CREEK

Date of Inspection: August 7, 1978

Based on a visual inspection, past performance and available engineering data, the dam and its appurtenances appear to be in good condition.

The spillway capacity plus the available reservoir storage is sufficient to pass only 45 percent of the PMF without overtopping the dam. The spillway is, therefore, considered to be seriously inadequate in accordance with the Corps of Engineers criteria and guidelines.

The following recommendations are presented for implementation by the owner:

1. Conduct a detailed hydrologic and hydraulic study to investigate means for improving the seriously inadequate capacity of the spillway.

2. Inspect the downstream slope of the embankment at the time of the annual maintenance and during periods of high pool levels to detect any signs of seepage or slope distress. If such signs occur, conduct a detailed evaluation of the embankment seepage control.

3. Repair cracks and deteriorated areas of the spillway outlet channel walls.

4. Develop a formal surveillance and downstream warning system to be used during periods of high or prolonged preceipitation.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: September 22, 1978

COMMONWEALTH OF PENNSYLVANIA
REGISTERED
PROFESSIONAL
HENDRIK JONGSMA
ENGINEER
No. 5557E

APPROVED BY:

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

DATE: 23 Sep 78

Under the recently revised spillway evaluation guidelines, this dam is considered unsafe, non-emergency.

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 1715
BALTIMORE, MARYLAND 21203

NABEN-R

Honorable Milton J. Shapp
Governor of Pennsylvania
Harrisburg, Pennsylvania 17120

Dear Governor Shapp:

In accordance with President Carter's directive under Public Law 92-367 (National Dam Inspection Program), the Baltimore District, Corps of Engineers, is continuing to carry out Phase I inspections of non-Federal dams in Pennsylvania. Inspection reports have been completed for the following five dams:

a. Lake Meade Dam - NDI No. PA 331

b. Antietam Dam - NDI No. PA 332

c. Ringtown No. 5 Dam - NDI No. PA 659

d. Ringtown No. 6 Dam - NDI No. PA 660

e. High Bridge Dam - NDI No. PA 679

One copy of each report is inclosed.

As stated in our letter to you of 27 March 1978, two copies of each report are being furnished to Dr. Maurice K. Goddard's office, Pennsylvania Department of Environmental Resources (PennDER), for distribution to respective dam owners. Under the provisions of the Freedom of Information Act, these inspection reports will be subject to release by this office, upon request after 25 October 1978.

Each report has received thorough consideration by a Board of Review consisting of senior engineers and staff members from this office, and a designated representative from PennDER. The recommendations of each report have received concurrence by the Board. As stated in our letter to you of 20 September 1978, the capacity of the spillways for Ringtown No. 5 and Ringtown No. 6 Dams is judged to be seriously inadequate. In addition, the spillway capacity for High Bridge Dam has recently been determined to be seriously inadequate. For this reason, these dams are considered to be unsafe, and require immediate attention.

NABEN-R
Honorable Milton J. Shapp

SEP 2 6 1978

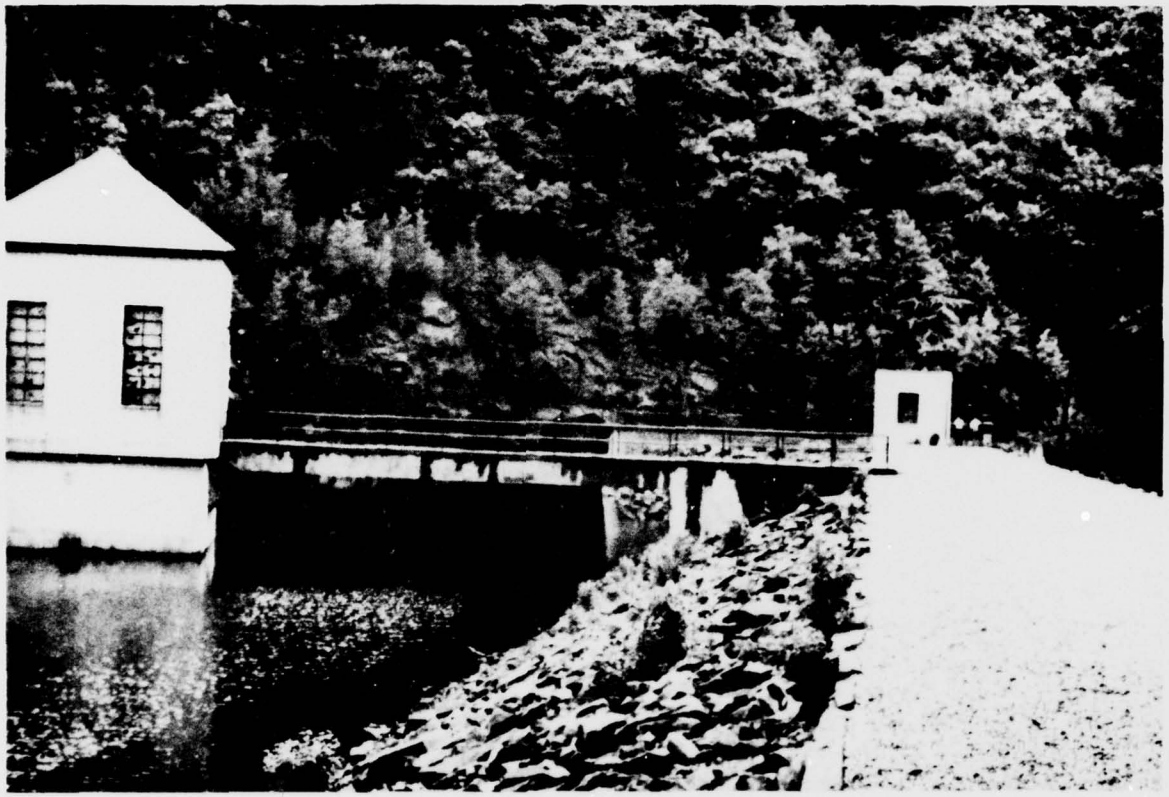
An important facet of the ongoing program for inspection of non-Federal dams will be the implementation of the recommendations made in the reports. Emphasis is placed on the Commonwealth providing the impetus for the fulfillment of the recommendations and keeping the Baltimore District informed of the proposed actions to be taken.

Additional copies of the reports will be made available to you upon request.

Sincerely yours,

5 Incl
As stated

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



OVERVIEW

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. The Phase I Inspection and Report are limited to a review of available data, a visual inspection of the dam site and basic calculations to determine the hydraulic adequacy of the spillway.

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 High Bridge dam is an earth embankment structure 414 feet long and 66 feet high. Water is conveyed from the reservoir through two pipe lines, each 5 feet in diameter, over a distance of 375 feet underneath the dam. These lines lead to the control and treatment house some 1150 feet downstream.

The spillway is located in rock excavation at the left end of the dam, and has a length of 70 feet.

The concrete weir is an ogee section. An automatically controlled bascule gate with a maximum crest at elevation 674.5 is located on the crest of the ogee section. A control building, containing the control equipment and appurtenances for the gate is situated adjacent to the right spillway wall on the top of the embankment.

The forebay section has a maximum width of 87 feet that gradually converges to 70 feet at the weir.

The intake tower, which is located upstream of the centerline of the dam, is a concrete structure 24 feet 5 inches by 25 feet at the base and is divided into 6 compartments. There are three inlets to the control tower at elevations 624, 650 and 660. These inlets are equipped with sluice gates. Two other sluice gates control the discharge leading from the tower to the downstream control building. Water is carried to Lebanon through a 30-inch supply main from the control building.

B.	Location	Pine Grove Township Schuylkill County, Pennsylvania U.S. Quadrangle, Pine Grove, Pa. Latitude 40°-32.7', Longitude 76°-29.8' (Appendix D, Plates I and II)
C.	Size Classification:	Intermediate (Height 66 feet)
D.	Hazard Classification	High (See Section 3.1.E)
E.	Ownership:	City of Lebanon Water Authority 400 South Eighth Street Lebanon, Pennsylvania 17042
F.	Purpose:	Water Supply

G. Design and Construction History

The City of Lebanon, Pennsylvania, engaged Gannett, Eastman and Fleming, Inc., consulting engineers, to design this dam as a water supply reservoir for the City. Plans were prepared and a permit application was submitted to the Commonwealth of Pennsylvania. The application was approved and a permit was issued on October 24, 1945, and construction began in the spring of 1946.

During the construction period modifications to the location of the dam axis were made as a result of unstable foundations at the initial right abutment location (Appendix D, Plate VII). An additional construction change involved the foundation for the inlet control tower and the outlet pipe support foundations. Depth to the designed rock foundation level was considered excessive and the foundations were modified to rest on the overburden soils. Other design features were constructed according to the plans. The project was completed on September 15, 1948.

In 1961, the owners desired to increase the storage capacity of the reservoir. At that time, they engaged Morris Knowles, Inc., Consulting Engineers to prepare designs for accomplishing this desire. Plans and specifications were prepared and application was made for a permit to modify the facility. The Commonwealth approved the plan and a permit was issued on February 16, 1961.

The modification included the installation of a Bascule gate on the crest of the existing spillway (Appendix D, Plates X and XI). This gate raised the spillway crest elevation 4.5 feet and increased the reservoir storage from 310 million gallons to 380 million gallons. The modification included the construction of a control structure which

houses all controls for this system. This construction was completed on March 1, 1962. No further modifications have been made.

H. Normal Operating Procedures

This dam and reservoir are operated for domestic water supply to the City of Lebanon, Pennsylvania. The initial operation involved the intake of water from the reservoir at the intake tower through one or several of openings in the tower at different levels. The outlet pipes from the control tower lead to a control and treatment plant located approximately 1150 feet downstream. This plant is still in the system but is no longer used for treatment.

The plans show the intake tower of a cell type construction. Intake from the reservoir is controlled by sluice gates: 24-inch at elevation 660, 24-inch at elevation 650, and two 60-inch at elevation 624. The discharge from the control tower to the outlet control building is regulated by one or both of two 60-inch diameter gates at elevation 624. The flow is conveyed to the outlet control through two 60-inch diameter pipes. The water is delivered to the City of Lebanon through a 30-inch main. The 60-inch diameter inlet pipes can be used for emergency drawdown. A blowoff pipe discharges through an 18-inch pipe from the control building to the creek.

The bascule gate on the spillway crest is controlled automatically. A control house is located adjacent to the spillway and contains the sensing devices. The system is designed to operate the gate when the depth of flow over the crest of the gate reaches six inches. The gate can be operated manually by releasing the holding pressure by means of a control valve. When operated manually, the gate will open fully within two to three minutes.

In the event of a power failure, the gate will begin to open in approximately 12 hours as a result of slow loss of holding pressure. In this case, a hand pump, which is designed into the system, is used within the 12-hour period to restore the pressure and thus keep the gate in the desired position.

The operating procedure is to lower the gate in November and have it remain down until April of the next year. The blowoff valve is operated twice each year for sediment control.

The weed growth on the embankment slopes is cut every October.

1.3 PERTINENT DATA

A. Drainage Area (square miles)	14.2

B. Discharge at Dam Site (cubic feet per second)
For hydraulic calculations see Appendix B.

Maximum known flood at dam site	6,230
Outlet conduit at low pool (Elev. 630)	38
Outlet conduit at pool (Elev. 671.86)	53
Spillway capacity at pool (Elev. 686 top of dam) and Bascule gate down	12,280
Spillway capacity at pool (Elev. 686 top of dam) with Bascule gate up	10,230

C. Elevation (feet above mean sea level)

Top of earth embankment	686
Spillway crest (Bascule gate lowered)	671.86
Spillway crest (Bascule gate raised)	674.5
Upstream invert of conduit	624
Downstream invert of conduit	584
Streambed elevation at dam	620
Maximum tailwater (estimated)	635
Normal pool (gate raised)	674.5
Normal pool (gate lowered)	671.86

D. Reservoir (miles)

Length of maximum pool (Elev. 686.0)	0.4
Length of normal pool (Elev. 674.5)	0.3

E. Storage (acre-feet)

Spillway crest (Elev. 671.86, Bascule gate down)	1,043
Normal pool (Elev. 674.5, Bascule gate up)	1,182
Top of dam (Elev. 686)	1,887

F. Reservoir Surface (acres)

Spillway crest (Elev. 671.86)	56
Top of dam (Elev. 686)	62

G. Dam (Refer to Appendix D, Plates VII & VIII)

Type: Rolled earthfill embankment of impervious fill.

Length: 414 feet.

Height: 66 feet.

Top Width: 20 feet.

Breast Elevation: 686.0

Sideslopes: Upstream 3H to 1V, 2.5H to 1V and 2H to 1V
Downstream 2.5H to 1V and 2H to 1V
Stone facing on both slopes.

Cutoff Trench: Bottom width of 20 feet excavated to top rock surface. Sideslopes 1H to 1V.

Core Wall: At bottom of cutoff trench. Extends 6 feet up into the cutoff trench and is seated in rock.

Filters: None.

Grouting: None.

H. Outlet Conduit

Type: Two 60-inch diameter steel pipes reducing to a 30-inch steel pipe and a 24-inch steel pipe reducing to two 18-inch diameter steel pipes reducing to one 18-inch diameter steel pipe. Parallel pipes are used for both water supply and discharge.

Total Length: 2085 feet.

Closure: Two 60-inch diameter sluice gates on upstream end.

Access: Footbridge to intake tower.

Regulating Facilities: Three gate valves in 18-inch pipes.

I. Spillway (See Appendix D, Plate XII)

Type: concrete weir with bascule gate. Upstream face is vertical, downstream ogee shaped. Remainder of chute is concrete channel.

Length: 70 feet.

Crest Elevation: 671.86 feet, mean sea level.

Upstream Channel: Rectangular, unlined channel excavated in rock.

Downstream channel: Rectangular, concrete channel. It is 320 feet long and has a concrete stilling basin at the downstream end. The elevation at the downstream end of the stilling basin is 616.

J. Regulating Outlets

Water is admitted to control tower by four inlets.

Inlet No.	Size (Ft.)	Invert Elev.	Sluice Gate Size (Ft.)
1	2	660	2 x 2
2	2	650	2 x 2
3 & 4	5	624	5 Dia.

Water is discharged from control tower as follows: Two 5-feet pipes which reduce to a 30-inch pipe and a 24-inch pipe. In the control building the 24-inch and 30-inch pipes reduce to two 18-inch pipes, which in turn reduce to one 18-inch pipe.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Data Available

1. Hydrology and Hydraulics

The hydrology and hydraulic information available in the PennDER files is very limited. No design flood hydrograph, flood routing, or stage-discharge curves were submitted by the designer to PennDER. The files did contain a stage-storage curve for the reservoir.

2. Embankment

The design information available for the embankment is limited to the construction drawings and the specifications. Both are included in the PennDER files. There were no calculations or test data available.

3. Appurtenant Structures

Calculations or criteria for design of the appurtenant structures are not available in the PennDER files. The design drawings provide the data for evaluating these structures. Appurtenant structures include the spillway with bascule gate and controls, the intake structure and the outlet control building.

B. Design Features

1. Embankment

The embankment is an earthfill structure constructed with homogeneous impervious fill. The downstream slope is variable being 2.5H to 1V from the toe up to elevation 656 and 2H to 1V from elevation 656 to the crest of the dam at elevation 686. The upstream slope is also variable: 3H to 1V from toe to elevation 646; 2.5H to 1V from elevation 646 to elevation 676; and 2H to 1V from elevation 676 to the crest of the dam at elevation 686. A small rock toe is provided in the valley section with no filter between it and the adjacent impervious material.

The slope cover is a dumped stone facing on both the upstream and downstream sides.

A cutoff trench is provided on the axis of the dam. It was also constructed with rolled impervious fill and is underlain along

its axis by a concrete core wall. The concrete core wall was designed to be founded at 3.5 to 4 feet below the rock surface.

2. Appurtenant Structures

a. Spillway

The spillway was originally designed and constructed as an uncontrolled concrete ogee structure at elevation 670.0. In order to increase the capacity of the reservoir, the spillway was modified in 1961 with the installation of a bascule gate on the crest of the original ogee section. The spillway is 70 feet from abutment to abutment and has a crest elevation at the top of the bascule gate of 674.5. The crest elevation with the gate in the down position is 671.86.

Automatic controls provide the operation of the gate. The gate begins to open when the head on the gate reaches six inches. A standby generator can provide emergency operation in the event of loss of power. The gate can also be operated manually.

The spillway outlet channel is composed of concrete slabs and walls and directs the spillway discharge to a concrete stilling basin 300 feet downstream from the spillway. The invert of the stilling basin is at elevation 602 or 72.5 feet lower than the spillway crest.

b. Intake Tower

The intake tower is situated 90 feet upstream from the centerline of the dam axis. The tower is a concrete structure with a brick housing in which there are six sluice gates and two screens for controlling the discharge to the downstream control house. The inlet elevations are located at elevation 660, 650 and 624. The gates are operated from the controls mounted on the deck of the tower. The tower contains three chambers which, along with the internal gates, provide the control of the discharge to the two 60-inch diameter steel pipe leading to the downstream control building.

c. Outlet Control Building

This structure is located 1153 feet downstream from the dam. The discharge from the intake tower is finally controlled here with a series of pipes of various sizes and valves. The blowoff and drawdown capability of this facility is controlled in this building. The structure originally included treatment of the water prior to distribution to the City of Lebanon. It is no longer used for that purpose.

C. Design Data

As indicated in Section 2.A, there is no design criteria or calculations available in the PennDER files for review. The engineering information is limited to the details of the design drawings.

2.2 CONSTRUCTION

The original project was constructed by the Kingston Construction Company, address unknown. There is no record of the modifications to the spillway in 1961 when the bascule gate was installed. Allis Chalmers, manufacturer of this equipment, do supervise their installations and it is assumed that they were the installers for this project addition.

There are a number of periodic inspection reports by PennDER personnel during the initial construction of the dam. The major change in the design was the realignment of the dam axis as a result of the discovery of unsuitable embankment foundations. Refer to Appendix D, Plate VII for plan view showing original axis and changed axis.

The original design provided for four-foot high flashboards on the spillway crest. This feature was never constructed.

2.3 OPERATION

There are no formal records of the operation of the dam being a water supply facility. The prime records deal with volume and quality of the water used.

There are unrecorded procedures for the operation of the dam including the lowering of the bascule gate between the months of November and April each year, the semi-annual operation of the blowoff and the annual removal of weeds and brush from the embankment slopes.

There is no formal surveillance or downstream warning system for this facility.

2.4 EVALUATION

A. Availability

A full set of design drawings are available in the PennDER files. These data include a stage-storage curve for the reservoir. Calculations for the embankment or appurtenant structures were not in the files.

B. Adequacy

Although there were no detailed engineering calculations in the files, the design drawing details and the visual inspection obser-

vations were sufficient for making a reasonable evaluation of this facility.

C. Operating Records

The procedures employed by the owner for operation of the facility are considered to be satisfactory. The gates and controls are operated regularly and the maintenance of the embankment slopes is good.

D. Post Construction Changes

The only modification to the original 1948 construction was the addition of the bascule gate to the spillway crest along with its controls in 1961. This change was made to increase the storage capacity of the reservoir.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it 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 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of the dam and appurtenant structures is good. The facility is well maintained and the gates are operated on a regular schedule. The visual inspection checkoff list is contained in Appendix A. Photographs taken during the August 7, 1978 inspection are presented in Appendix D.

B. Dam

The dam embankment is in good condition. The downstream slope cover is dumped rock with some sparce weed growth. This vegetation is removed each October at the end of the normal weed growing season. The upstream slope cover is also dumped rock. Neither of the slopes showed any signs of distress. The top of the embankment has a 3/4 inch size stone surface. This area is also in good condition.

The owners representative reported that there has been no seepage problems at the dam. Inspection of the downstream slope, along and below the toe of the embankment did not observe any evidence of seepage.

The embankment abutments with the original ground on the right and with the spillway wall on the left appear to be sound.

C. Appurtenant Structures

1. Spillway

The approach channel to the spillway abuts and is excavated into the natural rock formation. It appears to be in sound condition. The right side of the channel is formed by the concrete spillway wall and also is in good condition. The forebay is a curved approach to the spillway. Refer to Appendix D, Plate VII.

The spillway itself is a former concrete ogee section upon which a bascule gate was installed in 1961. This gate operates automatically through a hydraulic pressure system. The controls for the operation of the gate are housed in a concrete-brick structure located on top of the embankment and adjacent to the right spillway wall. Inspection of the gate and its controls showed all to be in good condition and well maintained. The spillway abuts with the concrete wall on the right and with a concrete wall poured against the exposed rock on the left.

The spillway outlet chute is a concrete channel with vertical walls. Considerable cracking and deterioration of the walls was noted. The channel leads to the stilling basin downstream beyond which the discharge returns to the natural stream channel. Refer to Appendix D, Plate VII.

A footbridge crosses the spillway outlet channel at the head of the stilling basin. It is in good condition.

Normal operation of this facility provides for the bascule gate to be opened from November to April each year as part of the water management program.

2. Intake Tower

The intake tower is located upstream from the dam embankment in the reservoir areas. Refer to Appendix D, Plates VII and VIII. This structure is a brick building on a concrete tower and houses all intake controls for the operation of the facility. Refer to Section 1.3.G and H. for details of controls. All equipment contained in this structure appeared to be in good condition and showed evidence of good maintenance.

3. Outlet Control Structure

The structure containing the controls for water supply to the City of Lebanon and the controls for emergency drawdown is located 1153 feet downstream from the dam. The structure is no longer used for treatment purposes, but it is well maintained. The blowoff valve was operated at the time of this inspection. All controls appear to be in good condition.

D. Reservoir Area

This reservoir is used solely for water supply. The area surrounding the reservoir is wooded in the natural form of typical forest lands. Sedimentation is not a problem in this area.

E. Downstream Channel

The downstream channel is a natural stream with trees and underbrush forming the overbank areas. The slopes are described as woody and rocky. Approximately nine permanent residences are located between the dam and Swatara Creek about two miles downstream. Approximately 30 to 40 persons live in this area. The hazard category, on the basis of these facts is "High".

3.2 EVALUATION

The observed condition of this dam and all its appurtenant facilities is good. With the exception of some maintenance of the spillway outlet channel walls, there are no special conditions of note which would adversely influence the continued satisfactory operation of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The purpose of this facility is to provide for the storage of water as a supply for the City of Lebanon. The intake of the water is controlled at the intake structure and can be selected from three different levels; elevation 660, elevation 650 or elevation 624. The water is conveyed to the downstream outlet control building where the discharge, through a system of control valves, can be regulated and delivered to the City system or to the nearby stream.

The water storage capacity of the reservoir varies over the year, as the controlled spillway crest is lowered from November until April annually.

The operational features have the capability to draw the reservoir down through the blowoff valve to the natural stream.

4.2 MAINTENANCE OF DAM

The maintenance of the embankment is on an annual basis. All vegetative growth on the slopes is cleared during the month of October.

4.3 MAINTENANCE OF OPERATING FACILITIES

The operation of the gates and valves is regular and involves all of the controls. The blowoff to the natural stream is operated twice each year.

4.4 WARNING SYSTEM

There is no formal warning system in effect and there are no procedures for surveillance during periods of intense or prolonged rainfall.

4.5 EVALUATION

The operational procedures for this dam appear to be satisfactory. Maintenance of the dam is on a regular basis and is reflected in the good appearance.

In view of the minimal provisions for internal drainage, the dam should be inspected for signs of seepage and embankment slope distress at the time of the annual slope maintenance and especially during periods of high pool levels.

A formal downstream warning system should be developed and a procedure for surveillance should be planned to be used during periods of prolonged or intense rainfall.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analysis available from PennDER for High Bridge Dam was not very extensive. No design flood hydrograph, flood routing, or stage-discharge curves were submitted by the designer to PennDER. The files did contain a stage-storage curve for the reservoir.

B. Experience Data

No records are kept of the water level in the reservoir; however, the water plant superintendent recalled that the June 1972 flood was the greatest flood experienced at High Bridge Dam. This flood caused the water level to rise almost 9 feet above the spillway crest with the Bascule gate in the down position. This storm was passed without difficulty.

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

High Bridge Dam has a total storage capacity of 1887 acre-feet and the overall height is 66 feet above the streambed. These dimensions indicate a size classification of "Intermediate". The hazard classification for this dam is "High" (see Section 3.1.E).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is the PMF (Probable Maximum Flood). For this dam the PMF peak inflow is 29,820 cfs. Refer to Appendix B for hydraulic calculations.

Comparison of the estimated PMF peak inflow of 29,820 with the estimated maximum spillway capacity of 12,280 cfs indicates that a potential for overtopping of the High Bridge Dam exists.

An estimate of the storage effect of the reservoir shows that this dam does not have the necessary storage available to pass the PMF

without overtopping. The spillway-reservoir system can pass a flood event equal to 45% of a PMF if the Bascule gate is lowered. If the gate remains in the up position, the spillway-reservoir system can pass a flood event equal to 34% of a PMF.

E. Spillway Adequacy

On the basis of the Corps of Engineers' criteria and guidelines, and the following information, the spillway for this dam is considered to be seriously inadequate.

1. The dam has a "High" hazard potential (See Section 3.1.E).

2. The combined effect of spillway capacity and the reservoir storage is sufficient to pass only 45% of the PMF without overtopping the dam. Refer to Sheet 7 of Appendix B (criteria requires a full PMF).

3. Since this dam is an earthfill structure, failure of the dam is expected if the dam is overtopped.

4. In the event of dam failure, it is expected that the surge of suddenly released water will increase the loss-of-life hazard downstream over that anticipated just prior to failure.

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

The visual inspection of the embankment did not detect any signs of distress that would indicate an unstable condition. Settlement, sloughage or misalignment were not observed at any location.

2. Appurtenant Structures

There were no visual signs of structural instability in the spillway area, the intake tower or the spillway outlet channel. Although some deterioration and slight cracking of the channel walls were noticed, they will not have an influence on the stability of the units at the present time. Regular maintenance can take care of these conditions.

B. Design and Construction

There was no design criteria or calculations in the PennDER files for the embankment or the appurtenant structures. The design drawings and specifications provide the information for assessing the stability of each unit.

1. Embankment

The embankment is an earth structure composed of rolled impervious fill and is provided with a cutoff trench and a concrete core wall. Refer to Appendix D, Plate VIII. The upstream slope varies from 2H to 1V to 3H to 1V and the downstream slope varies from 2H to 1V to 2.5H to 1V. Both are typical of embankment slopes for dams and appear to be satisfactory. Embankment drainage is not indicated on the plans except for a small rock toe with no filter. The stone facing on the slopes provide some protection against seepage erosion.

2. Appurtenant Structures

On the basis of the details shown on the design drawings, the appurtenant structures including the spillway, spillway channel and stilling basin, intake tower and outlet controls, appear to be sufficient from a structural point of view. Other than the slight deterioration of the spillway outlet channel slabs and walls, there were no visual observation that would suggest an unstable condition of any of the structures.

C. Operating Records

This facility has withstood the two tropical storms of record; Agnes in June of 1972 and Eloise in September of 1975. The maximum observed water level over the spillway during a storm event was in 1972 when the elevation was estimated at 680.5. The crest of the dam embankment is 686.0. Other operating records deal with volume of water supply to the City of Lebanon.

D. Post Construction Changes

The original dam was built in 1946 with an uncontrolled concrete ogee section. In order to increase the storage capacity of the reservoir, a modification was made to the spillway in 1961 by constructing a Bascule gate on the original spillway crest. Appurtenant controls were included in this modification.

The control building was originally designed and used for treatment as well as control. The treatment of the water at this location has been discontinued.

E. Seismic Stability

This dam is located in Seismic Zone No.1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. However, no calculations, studies, etc., were made to confirm this conclusion.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection, the review of the design drawings and specifications and the operational history indicate that this dam is in good condition. The evaluation of the capacity of the spillway in accordance with the U.S. Army Corps of Engineers' guidelines indicates that the spillway together with the available storage can pass only 45 percent of the PMF, on the condition that the bascule gate is fully open. In the unlikely event that the gate would not be open, the combined capacity would be 34 percent of the PMF. The spillway capacity is considered to be seriously inadequate.

B. Adequacy of Information

The information available for review, along with the observed conditions are considered adequate for making a reasonable assessment of this facility.

C. Urgency

The recommendations for action by the owner involving maintenance measures can be treated in the normal maintenance program without urgency.

The inadequacy of the spillway capacity should be studied by the owner at the earliest possible time. Results of the study should provide means for improving the capacity and the recommendation for carrying out the measures.

D. Necessity for Additional Studies

A need for additional hydrologic and hydraulic investigations is indicated on the basis of the seriously inadequate capacity of the spillway. Refer to Section 5.1.E.

7.2 RECOMMENDATIONS

A. Facilities

A detailed hydrologic and hydraulic study should be undertaken by the owner's engineering consultant to determine means for improving the capacity of the spillway.

B. Operation and Maintenance Procedures

Although the facilities are maintained in good condition, it is recommended that the following actions be taken by the owner to insure the satisfactory performance of the dam.

1. That careful inspection of the downstream embankment slope be made at the time of the annual slope maintenance and during periods of high pool levels to detect any signs of seepage or slope distress. If such signs are observed, a detailed evaluation of the embankment seepage control should be made.

2. That the cracks and deteriorated areas of the spillway outlet channel walls be repaired in the next maintenance period.

3. That a formal surveillance and downstream warning system be developed to be used during periods of intense or prolonged rainfall.

APPENDIX A

VISUAL INSPECTION

CHECK LIST - DAM INSPECTION PROGRAM

PHASE I - VISUAL INSPECTION REPORT

NAD NO. 679

PA. ID # 54-157 NAME OF DAM High Bridge Reservoir HAZARD CATEGORY High

TYPE OF DAM: Earthfill

LOCATION: Pine Grove TOWNSHIP Schuylkill COUNTY, PENNSYLVANIA

INSPECTION DATE 8/7/78 WEATHER Cloudy-Humid TEMPERATURE 70's - 80's

INSPECTORS: H. Jongsma, R. Houseal City of Lebanon
Christ Siegrist
R. Shireman, A. Bartlett

NORMAL POOL ELEVATION: 674.50 AT TIME OF INSPECTION:

BREAST ELEVATION: 686.0
670 (Original) POOL ELEVATION: 675.0±

SPILLWAY ELEVATION: 671.86
674.50 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: 1972 Agnes - 680.50

GENERAL COMMENTS:

Automatic gate operation.
One single gate.
The general appearance of this facility is good.
The maintenance of the downstream slope is good. It is cut every October.
Blowoff was operated at the time of this inspection.

DAM NO. NAD 679

VISUAL INSPECTION

EMBANKMENT	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. SURFACE CRACKS	None observed.	
B. UNUSUAL MOVEMENT BEYOND TOE	None evident.	
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None observed	
D. VERTICAL & HORIZONTAL ALIGNMENT OF CREST	Horizontal - good. Vertical - good.	
E. RIPRAP FAILURES	None	
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Right side with original ground - good.	
G. SEEPAGE	None reported by owners representative nor none observed.	
H. DRAINS	Two outlets each side of spillway near footbridge.	
J. GAGES & RECORDER	None	
K. COVER(GROWTH)	Downstream - dumped rock with sparse weed growth, good condition. Top 3/4" stone surface - good condition. Upstream - dumped rock - good condition.	

DAM NO. NAD 679

VISUAL INSPECTION

OUTLET WORKS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. INTAKE STRUCTURE	Intake tower - brick building on concrete.	
B. OUTLET STRUCTURE	Downstream - not in the vicinity of the dam 1500 to 2000 feet downstream	
C. OUTLET CHANNEL	Natural stream beyond stilling basin	
D. GATES	15' - 24" gate 20' - 24" gate 30' - 2 - 5' fates 6 controls + 2 hoists.	
E. EMERGENCY GATE	Gates controlled downstream and can be operated in case of emergency. Gates partial open in intake tower.	
F. OPERATION & CONTROL	Water taken into tower from one or several depths. Then downstream through outlet pipes from the channel.	
G. BRIDGE (ACCESS)	Concrete bridge from embankment to tower.	

DAM NO. NAD 679

VISUAL INSPECTION

SPILLWAY	OBSERVATIONS	REMARKS & RECOMMENDATIONS
A. APPROACH CHANNEL	Left side excavated rock - good condition Right side - concrete wall at left abutment of embankment. Approach is side approach through a curved forebay area - good condition.	
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Ogee weir with top gate (automatic) Spillway walls concrete both sides. Bascule by Allis Chalmers	
C. DISCHARGE CHANNEL Lining Cracks Stilling Basin	Concrete channel with vertical walls Considerable cracking and deterioration of walls. Stilling basin curved at downstream end.	
D. BRIDGE & PIERS	Bridge (foot) across channel at end of chute at the start of the stilling basin.	
E. GATES & OPERATION EQUIPMENT	Automatic gate control - set to operate when head on gate reaches 6" Standpipe - float control Gates down (November - April)	
F. CONTROL & HISTORY	Automatic gate control. Can be operated manually. Gates down in wintertime. Standby generator available. In case of power loss gates will go down after 12 hours (±) due to pressure loss.	

DAM NO. NAD 679

VISUAL INSPECTION

MISCELLANEOUS	OBSERVATIONS	REMARKS & RECOMMENDATIONS
INSTRUMENTATION		
Monumentation	None	
Observation Wells	None	
Weirs	None	
Piezometers	None	
Other	None	
RESERVOIR		
Slopes	Wooded	
Sedimentation	No problem - blowoff twice each year - spring and fall - clears sediment.	
DOWNSTREAM CHANNEL		
Condition	Natural	
Slopes	Wooded and rocky natural stream	
Approximate Population	30 to 40	
No. Homes	9 homes ± per residences.	

No downstream warning plan in case of emergency.

APPENDIX B

HYDROLOGY/HYDRAULICS

CHKD. BY ____ DATE ____ PROJECT ____

SUBJECT HIGH BRIDGE DAM 1 OF 8

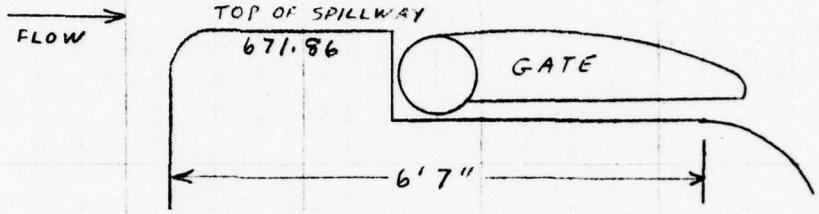
MAXIMUM KNOWN FLOOD AT DAMSITE

THE WATER PLANT SUPERINTENDENT RECALLED THAT THE MAXIMUM FLOOD AT THE DAMSITE OCCURRED IN JUNE 1972 WHEN THE HEAD ON THE SPILLWAY CREST WAS ALMOST 9 FEET. THE BASCULE GATES AUTOMATICALLY WENT TO THE LOWEST POSITION DURING THIS FLOOD

$L = 70'$

$H = 9'$

$C = 3.3$



$Q = C L H^{3/2}$

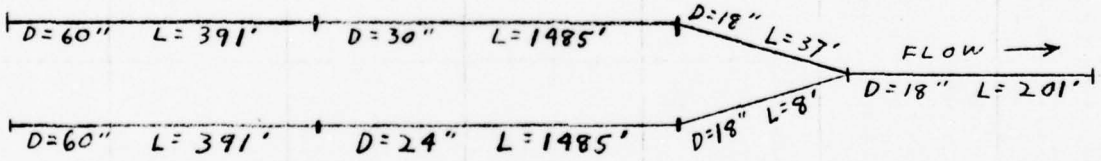
$= 3.3 \times 70 \times 9^{3/2}$

$= 6237$ SAY 6230 CFS

$C = 3.3$ (KINGS HDBK.)

DISCHARGE THROUGH OUTLET WORKS

DISCHARGE PIPE NETWORK



EQUIVALENT PIPE LENGTHS

$$L_A = \frac{A_A^2 \times R_A^{4/3} \times L_B}{A_B^2 \times R_B^{4/3}}$$

CONVENT TO EQUIVALENT 18" PIPE

OUTLET WORKS DISCHARGE (CONT.)

$$L_{18\ 60''} = \frac{\left(\pi \frac{1.5^2}{4}\right)^2 \times \left(\frac{1.5}{4}\right)^{4/3} \times 391}{\left(\pi \frac{5^2}{4}\right)^2 \times \left(\frac{5}{4}\right)^{4/3}} = \frac{330.19}{519.13} = .64'$$

$$L_{18\ 30''} = \frac{\left(\pi \frac{1.5^2}{4}\right)^2 \times \left(\frac{1.5}{4}\right)^{4/3} \times 1485}{\left(\pi \frac{2.5^2}{4}\right)^2 \times \left(\frac{2.5}{4}\right)^{4/3}} = \frac{1254.04}{12.88} = 97.39'$$

$$L_{18\ 24''} = \frac{\left(\pi \frac{1.5^2}{4}\right)^2 \times \left(\frac{1.5}{4}\right)^{4/3} \times 1485}{\left(\pi \frac{2^2}{4}\right)^2 \times \left(\frac{2}{4}\right)^{4/3}} = \frac{1254.04}{3.92} = 320.17'$$

$L_{T_1} = .64 + 97.39 + 37 = 135'$

$L_{T_2} = .64 + 320.17 + 8 = 328.8'$

FOR PARALLEL PIPES

$$\frac{N^2 Q_1^2 L_1}{R_1^{4/3} A_1^2} = \frac{N^2 Q_2^2 L_2}{R_2^{4/3} A_2^2}$$

IF SAME SIZE $\therefore Q_1^2 L_1 = Q_2^2 L_2$

$$Q_1 = Q_2 \sqrt{L_2/L_1} = Q_2 \left(\frac{328.8}{135}\right)^{.5}$$

$$Q_1 = 1.561\, Q_2$$

$$Q_T = Q_1 + Q_2 = 2.561\, Q_2$$

$$H_L = \frac{N^2 Q_2^2 L}{2.208\, A^2 R^{4/3}} = \frac{.015^2 \times Q_2^2 \times 328.8}{2.208 \times \left(\pi \frac{1.5^2}{4}\right)^2 \times \left(\frac{1.5}{4}\right)^{4/3}} = .039676\, Q_2^2$$

$$Q_T^2 = 6.559\, Q_2^2$$

$$H_L = .006049\, Q_T^2$$

DISCHARGE (CONT.)

$$H_{L_2} = \frac{N^2 Q_1^2 L}{2.208 A^2 R^{4/3}} = \frac{.015^2 \times Q_T^2 \times 201}{2.209 \times \left(\pi \frac{1.5^2}{4}\right)^2 \times \left(\frac{1.5}{4}\right)^{4/3}} = .024255\ Q_T^2$$

$$H_{L_T} = H_L + H_{L_2} = .006049\ Q_T^2 + .024255\ Q_T^2$$
$$= .030304\ Q_T^2$$

DISCHARGE AT NORMAL POOL LEVEL (671.86)

ASSUME TAILWATER = 586

$H = 671.86 - 586$
$= 85.86$

$= .030304\ Q_T^2$

$Q_T = 53$ CFS

DISCHARGE AT LOW POOL LEVEL (630)

$H = 630 - 586$
$= 44$

$= .030304\ Q_T^2$

$Q_T = 38$ CFS

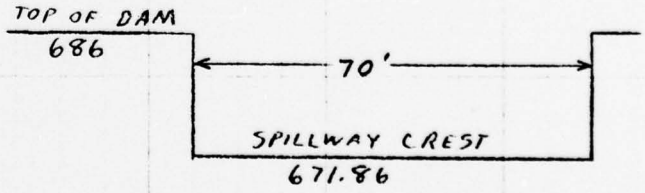
SPILLWAY DISCHARGE

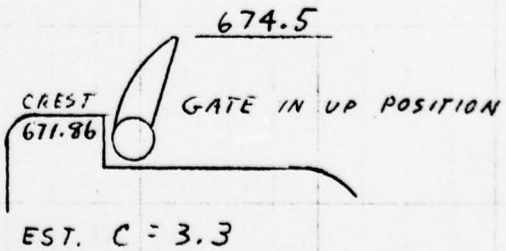
$L = 70'$

$H = 686 - 671.86$ (GATE DOWN)
$= 14.14'$

$C = 3.3$ (GATE DOWN)

$Q = C L H^{3/2}$
$= 3.3 \times 70 \times (14.14)^{3/2}$
$= 12282$
SAY 12280 CFS





EST. C = 3.3

SPILLWAY DISCHARGE (CONT.)

$L = 70'$

$H = 686 - 674.5$ (GATE UP)

$= 11.5'$

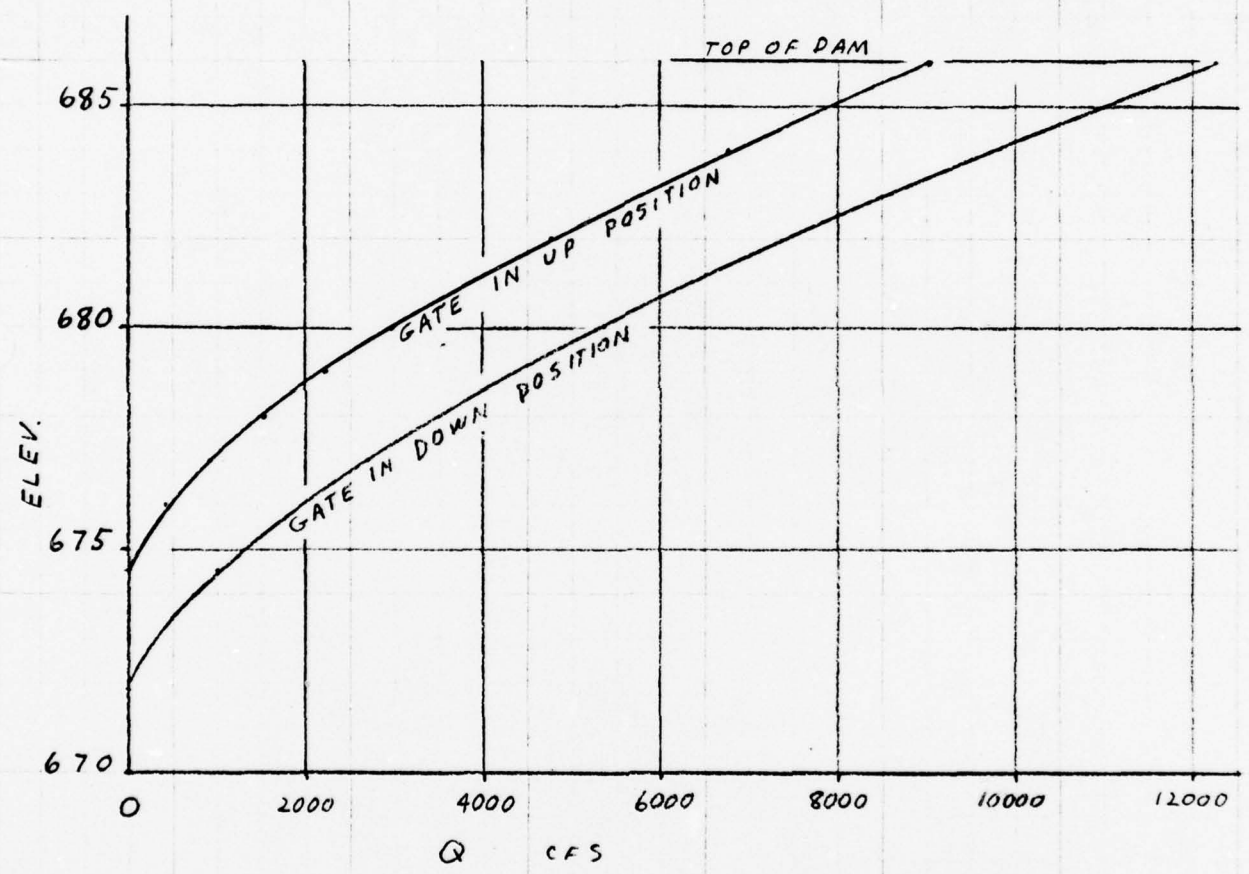
$C = 3.3$

$Q = CLH^{3/2}$

$= 3.3 \times 70 \times (11.5)^{3/2}$

$= 9009$

SAY 9010 CFS



GATE NORMALLY IN UP POSITION. GATE LOWERS AUTOMATICALLY AS HEAD ON WEIR INCREASES.

SIZE CLASSIFICATION

MAXIMUM STORAGE = 1887 AC-FT
MAXIMUM HEIGHT = 66 FT
SIZE CLASSIFICATION IS "INTERMEDIATE"

HAZARD CLASSIFICATION

STREAM FLOWS THROUGH THE VILLAGE OF SUEDBERG ABOUT 2 MILES DOWNSTREAM.
USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

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

PMF

D.A. = 14.2 SQ. MI.
PMF = 2100 CSM } FROM CORPS OF ENG. CURVES
T = 31 HRS

PMF = 2100 × 14.2 = 29820 CFS PEAK INFLOW

$$\frac{\text{MAXIMUM SPILLWAY DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{12280}{29820} = .412 \quad \text{SAY } 41\%$$

$$\text{VOL. OF INFLOW} = \frac{29820 \times \frac{31}{24}}{2} = 19259 \text{ CFS-DAYS}$$
$$= 38160 \text{ AC-FT}$$
$$= 50.4 \text{ IN. (TOO HIGH! USE 26")}$$
$$26 \text{ IN.} = 19678 \text{ AC-FT}$$

$$\frac{\text{REQ'D. RES. STORAGE}}{\text{VOL. OF INFLOW}} = .588 \quad \text{FROM SHORT CUT METHOD}$$

REQ'D. RES. STORAGE = .588 × VOL. OF INFLOW
= .588 × 19678
= 11571 AC-FT

AVAILABLE STORAGE BETWEEN TOP OF DAM AND TOP OF BASCULE GATE =

$1887 - 1182 = 705$ AC-FT

$11571 > 705$ ∴ DAM WILL BE OVERTOPPED BY PMF

FOR ONE HALF PMF

PEAK INFLOW = $29820/2 = 14910$ CFS

VOL. OF INFLOW = $19678/2 = 9839$ AC-FT

$$\frac{\text{MAX. SPILLWAY DISCHARGE}}{\frac{1}{2}\text{ PMF PEAK INFLOW}} = \frac{12280}{14910} = .824 \quad \text{SAY } 82\%$$

$$\frac{\text{REQD. RES. STORAGE}}{\text{VOL OF INFLOW}} = .176 \quad \text{FROM SHORTCUT METHOD}$$

REQD. RES. STORAGE = $.176 \times$ VOL. OF INFLOW
$= .176 \times 9839$
$= 1732$ AC-FT

$1732 > 705$ ∴ DAM WILL BE OVERTOPPED BY $\frac{1}{2}$PMF

FOR 45% PMF

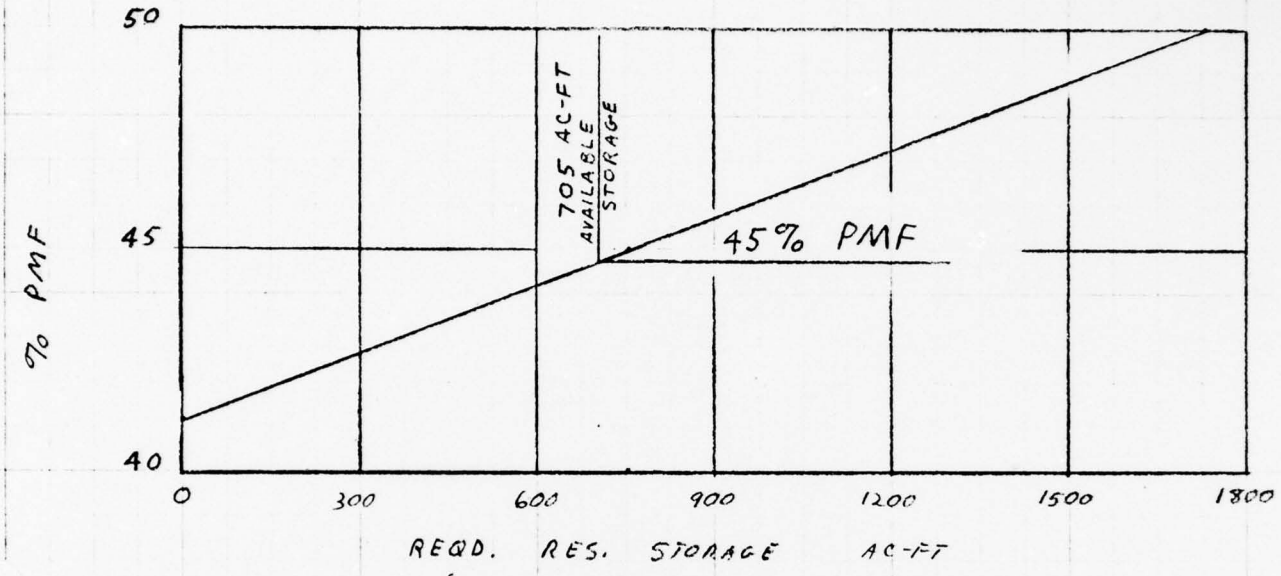
PEAK INFLOW = $.45 \times 29820 = 13419$ CFS

VOL OF INFLOW = $.45 \times 19678 = 8855$ AC-FT

$$\frac{\text{MAX. SPILLWAY DISCHARGE}}{45\%\text{ PMF PEAK INFLOW}} = \frac{12280}{13419} = .915$$

$$\frac{\text{REQD RES STORAGE}}{\text{VOL OF INFLOW}} = .085 \quad \text{FROM SHORTCUT METHOD}$$

REQD. RES. STORAGE = .085 × VOL OF INFLOW
= .085 × 8855
= 753 AC-FT



SPILLWAY AND RESERVOIR CAN PASS A STORM EQUAL TO 45% OF A PMF WITHOUT OVERTOPPING.

IF BASCULE GATE REMAINS IN UP POSITION

$$\frac{\text{MAXIMUM SPILLWAY DISCHARGE}}{\text{PMF PEAK INFLOW}} = \frac{9010}{29820} = .302$$

SAY 30%

FOR 40% PMF

PEAK INFLOW = .4 × 29820 = 11928

VOL OF INFLOW = .4 × 19678 = 7871

$$\frac{\text{MAX. SPILLWAY DISCHARGE}}{\text{40\% PMF PEAK INFLOW}} = \frac{9010}{11928} = .755$$

$\frac{\text{REQD. RES. STORAGE}}{\text{VOL OF INFLOW}} = .245$

REQD. RES. STORAGE = .245 × VOL OF INFLOW
= .245 × 7871 = 1928 AC-FT

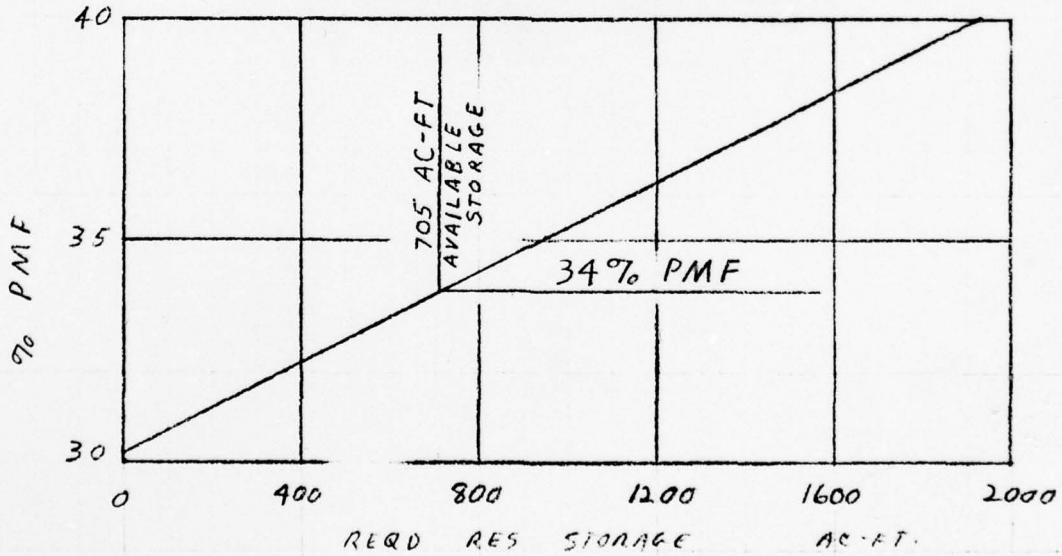
FOR 35% PMF

PEAK INFLOW = .35 × 29820 = 10437 CFS
VOL. OF INFLOW = .35 × 19678 = 6887 AC-FT

$\frac{\text{MAX. SPILLWAY DISCHARGE}}{\text{35\% PMF PEAK INFLOW}} = \frac{9010}{10437} = .863$

$\frac{\text{REQD. RES. STORAGE}}{\text{VOL OF INFLOW}} = .137$

REQD RES STORAGE = .137 × VOL OF INFLOW
= .137 × 6887 = 944 AC-FT



WITH BASCULE GATE IN UP POSITION SPILLWAY AND RESERVOIR CAN PASS A STORM EQUAL TO 34% OF A PMF WITHOUT OVERTOPPING.

APPENDIX C

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam

Formation Name: Pocono Formation (Mt. Carbon Member).

Lithology: The Mt. Carbon Member of the Pocono Formation consists of thick bedded, gray to brownish gray sandstone and conglomeratic sandstone with some interbedded siltstone and shale. A bed of conglomerate is present at the base of the member.

Bedrock - Reservoir

Formation Names: Mauch Chunk Formation (lower member) and Pocono Formation (Mt. Carbon).

Lithology: The lower member of the Mauch Chunk Formation consists of red to brownish-red interbedded siltstones, shales, and sandstones. In the reservoir area it is generally concealed by talus blocks of sandstone and conglomerate, derived from the Pottsville Formation on the north, and the Pocono Formation on the south side.

Structure

The dam is located on the Dauphin syncline, a tight, overturned, much faulted, fold. The beds strike N40° to 50°E and dip 75°S. About one-half a mile east of the dam, the crest of Second Mountain is offset by a major cross fault. However, there is apparently no faulting where Mill Creek passes through the ridge. Air photo fracture traces strike N10°W and N20°W, and one of these sets of fractures probably control the course of the stream at the dam.

Overburden

Inspection reports made during dam construction indicate that the overburden was 14 to 17 feet thick. The upper few feet of bedrock was weathered, but the cutoff trench was dug three to four feet into fresh gray sandstone.

Aquifer Characteristics

The Pocono is composed of essentially impermeable rocks of very low porosity. Ground water movement is limited to bedding planes and fractures.

Discussion

The bedrock at the dam site is very strong and stable. The bedding is nearly vertical and strikes parallel to the dam axis. Ground water movement below the cutoff wall would be only on cross cutting fractures. Unless fracturing was intense, such movement would be limited. The minerals of the rock are not soluble, and continued ground water seepage would not alter the rock or enlarge the openings appreciably.

Sources of Information

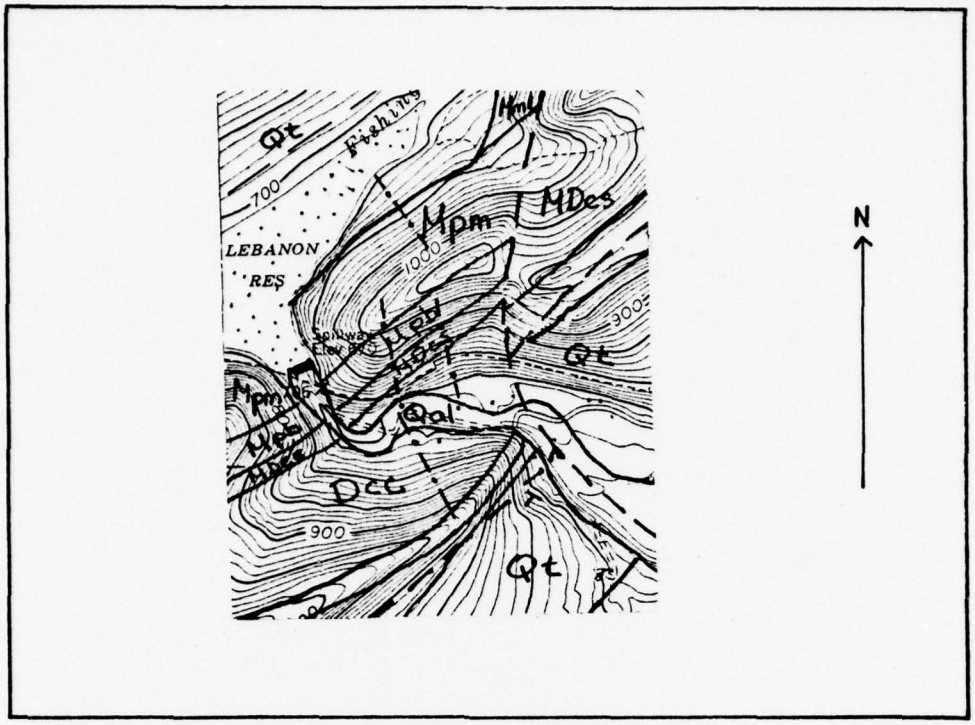
1. Wood, G.H. and Kehn, T.M. 1968, "Geologic Map of the Pine Grove Quadrangle". U.S. Geological Survey Map GQ 691.

2. Wood, G.H. and others, (1969) "Geology of the West-Central Part of the Southern Anthracite Field and Adjoining Areas, Pennsylvania". U.S. Geological Survey Prof. Paper 602.

3. Air photos, scale 1:24,000, dated 1969.

4. Inspection reports in file.

GEOLOGIC MAP - HIGH BRIDGE DAM



(geology from U.S.G.S. Map GQ-691)

KEY

Qal — Alluvium	Mpb — Pocono Fm., Beckville member
Qt — Talus	MDcs — Catskill Fm., Spechty Kopf member
Mml — Mauch Chunk Fm., lower member	Dcc — Catskill Fm., Cherry Ridge member
Mpm — Pocono Fm., Mount Carbon member	-- -- high angle fault
	— —┤— — thrust fault

-·-·-· air photo fracture trace

SCALE 1:24000

1 0 1 MILE

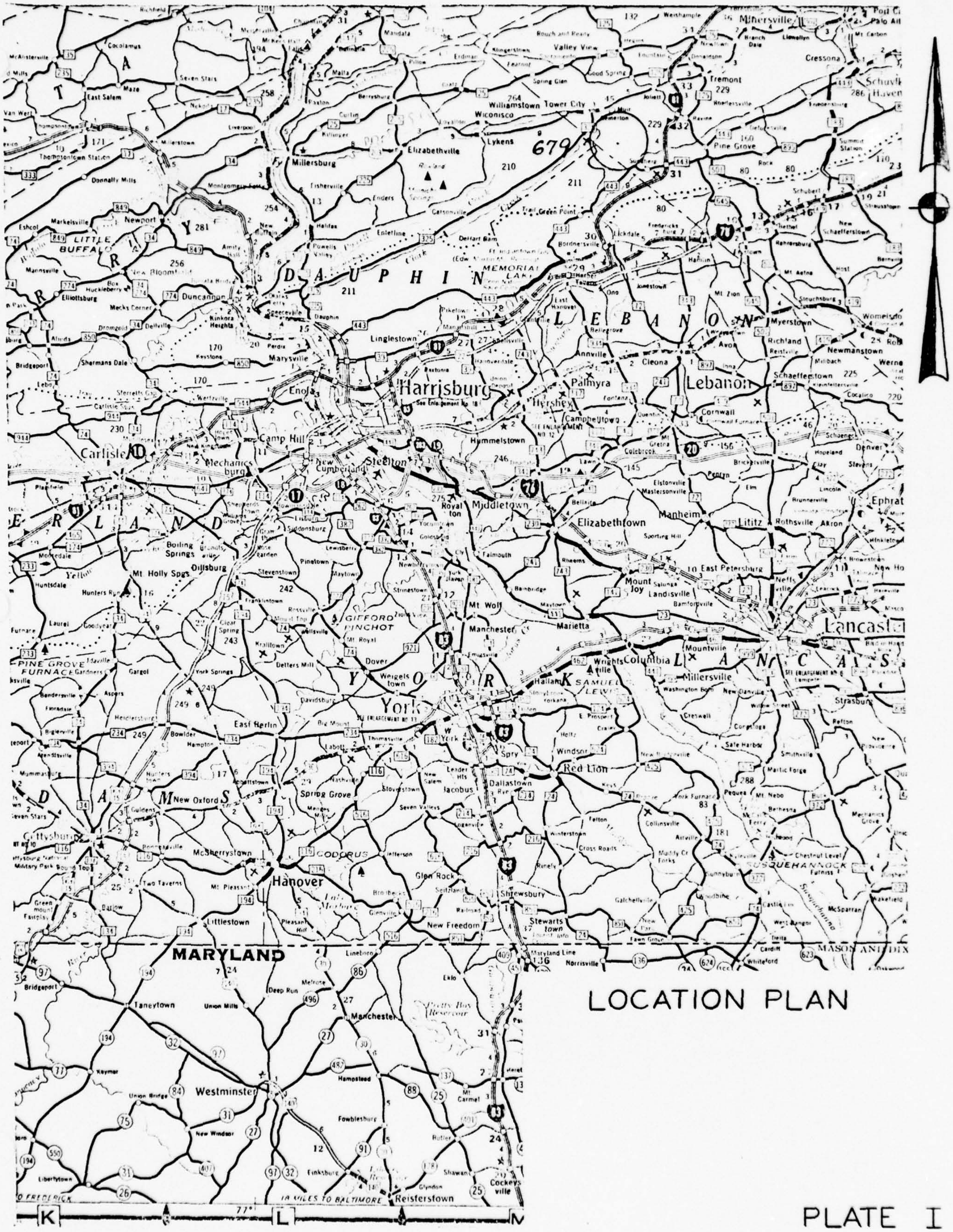
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

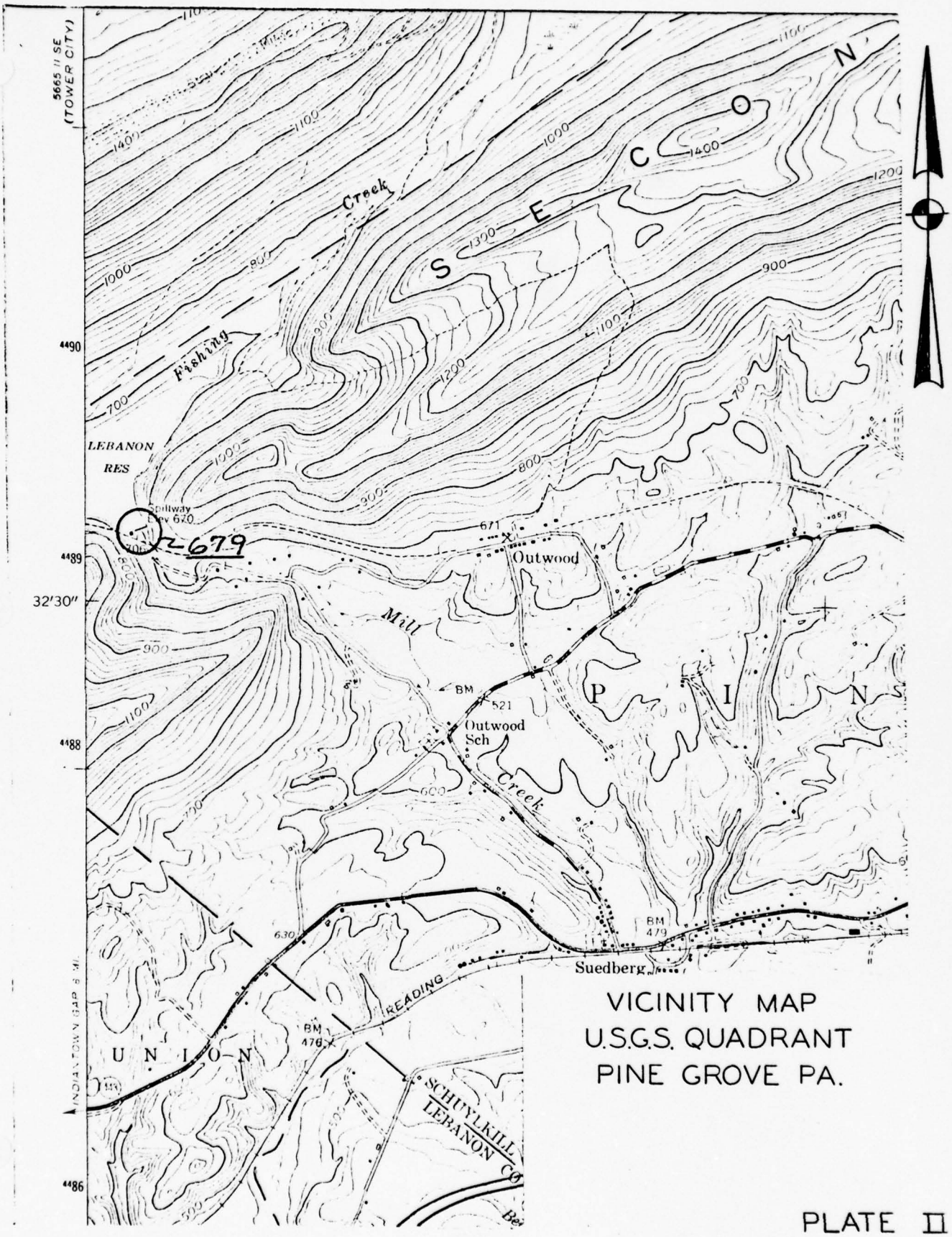
APPENDIX D

LOCATION, PHOTOGRAPHS & DESIGN DRAWINGS



LOCATION PLAN

PLATE I



VICINITY MAP
U.S.G.S. QUADRANT
PINE GROVE PA.

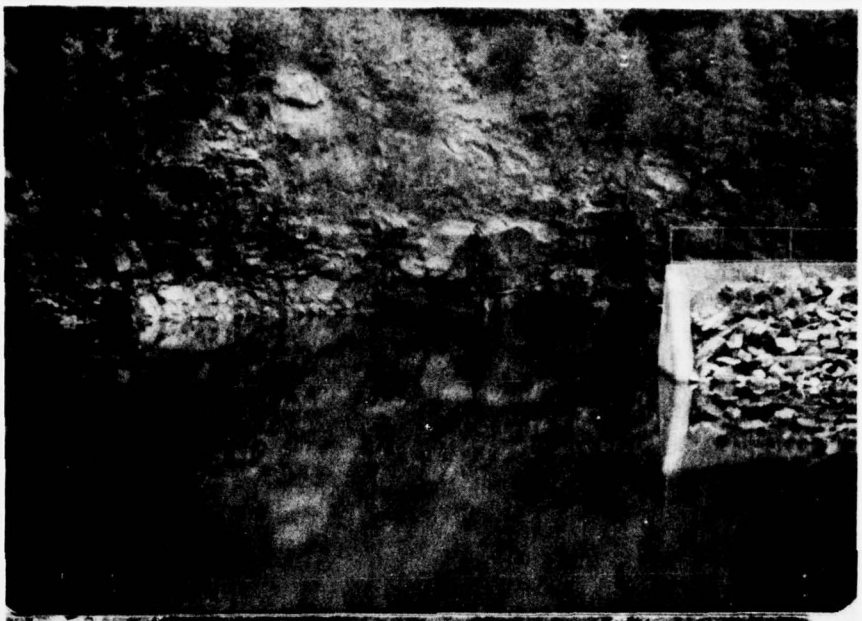
PLATE II

Dam Crest

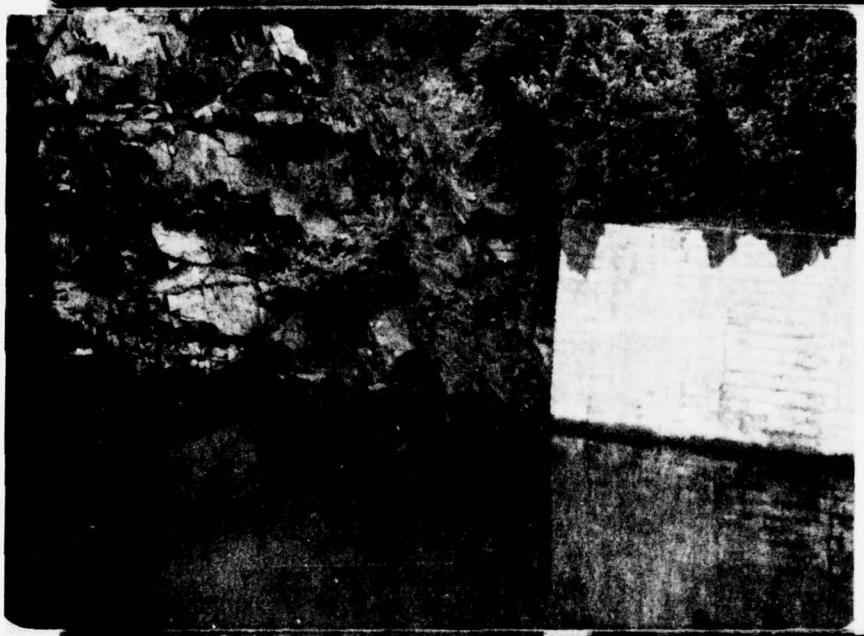
Downstream
Slope

Reservoir

PLATE III



Forebay

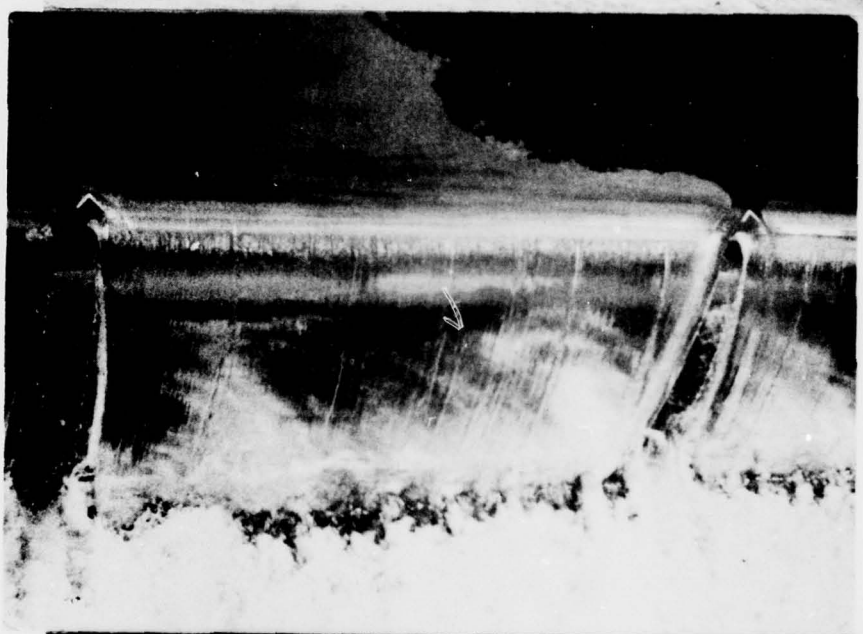


Left Forebay
Wall

Left Section
Of Spillway
Wall

PLATE IV

Spillway
Chute

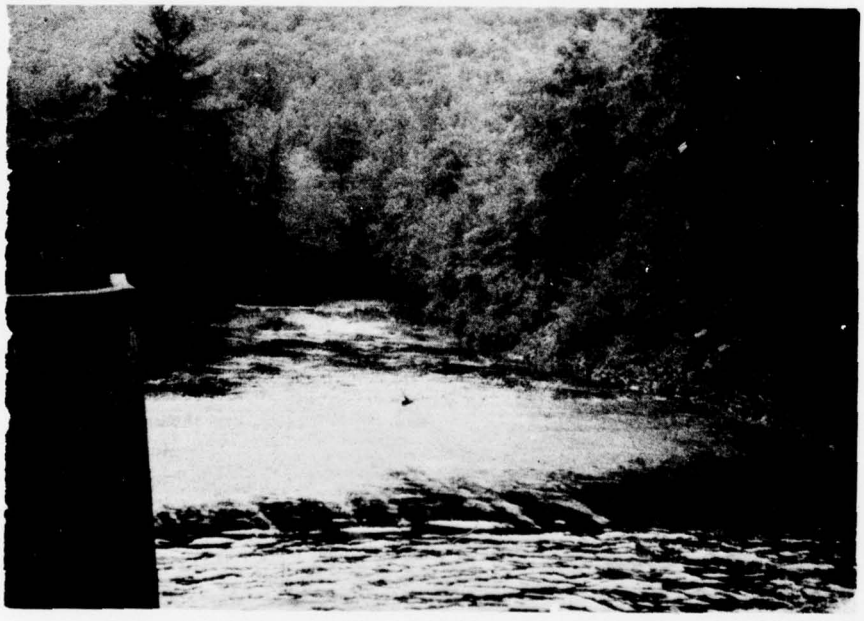


Closeup of
Gate

Walls of
Spillway

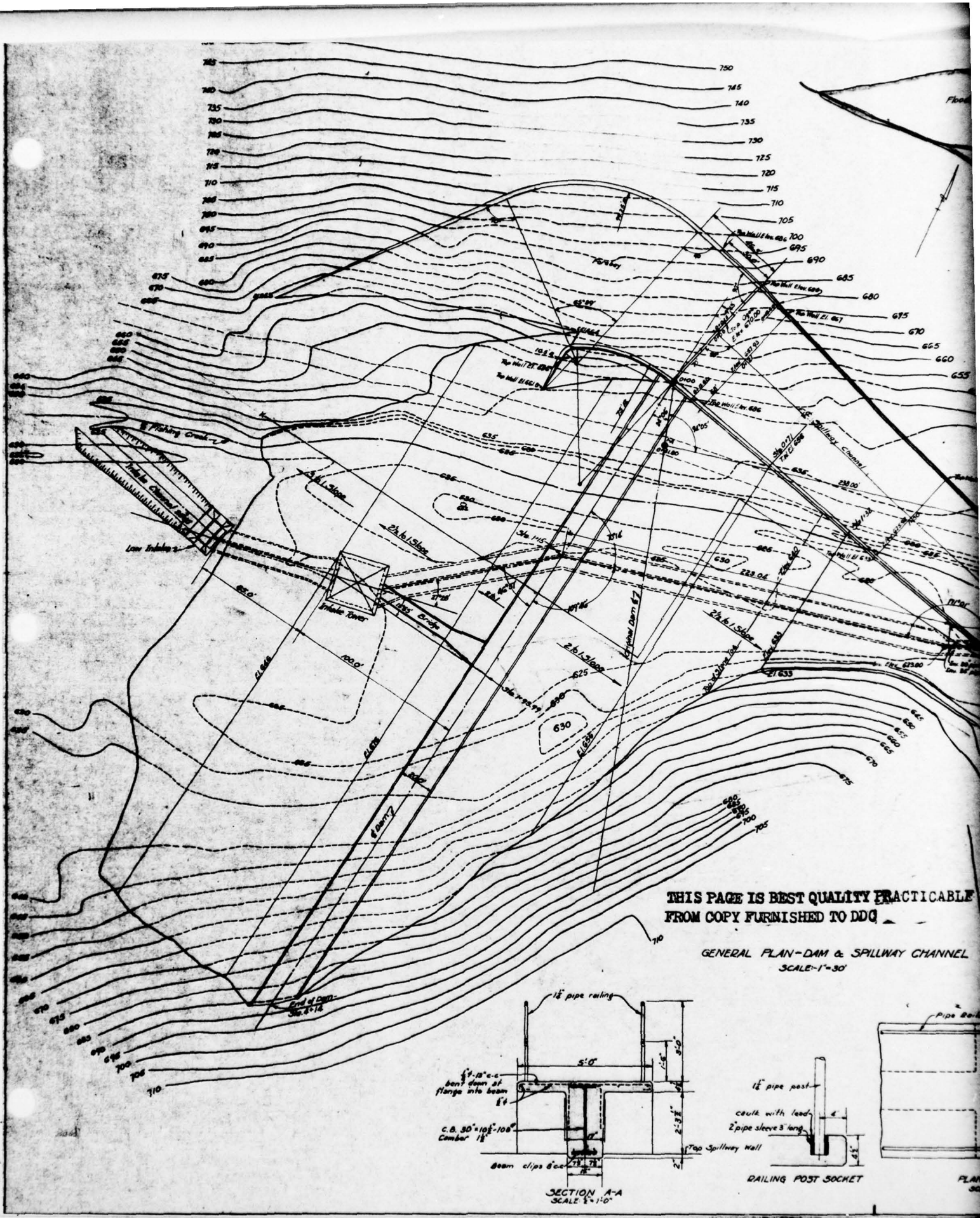
PLATE V

Stilling Basin



Downstream Channel

PLATE VI



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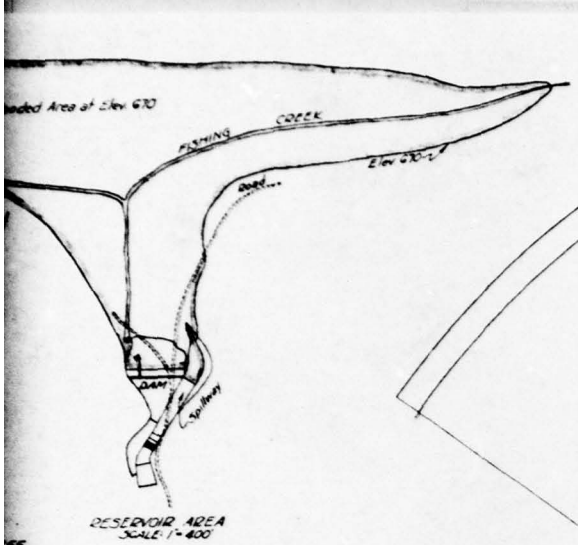
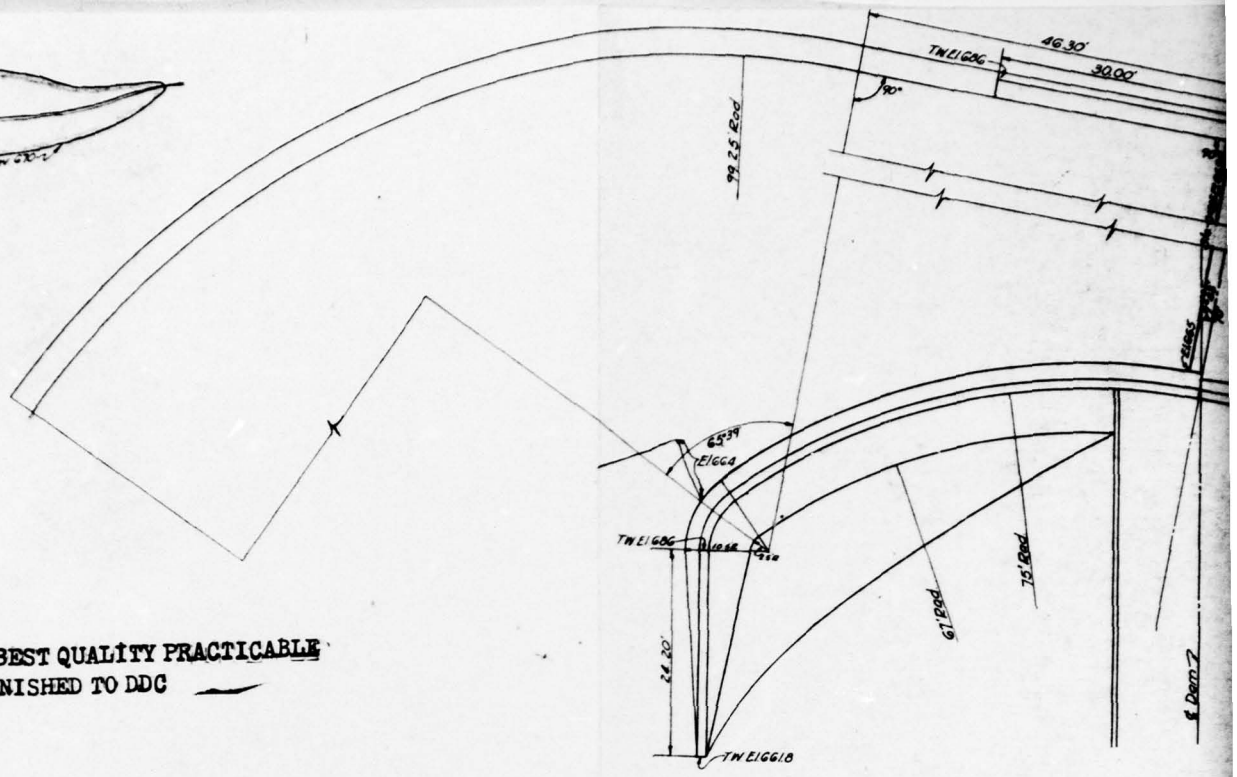
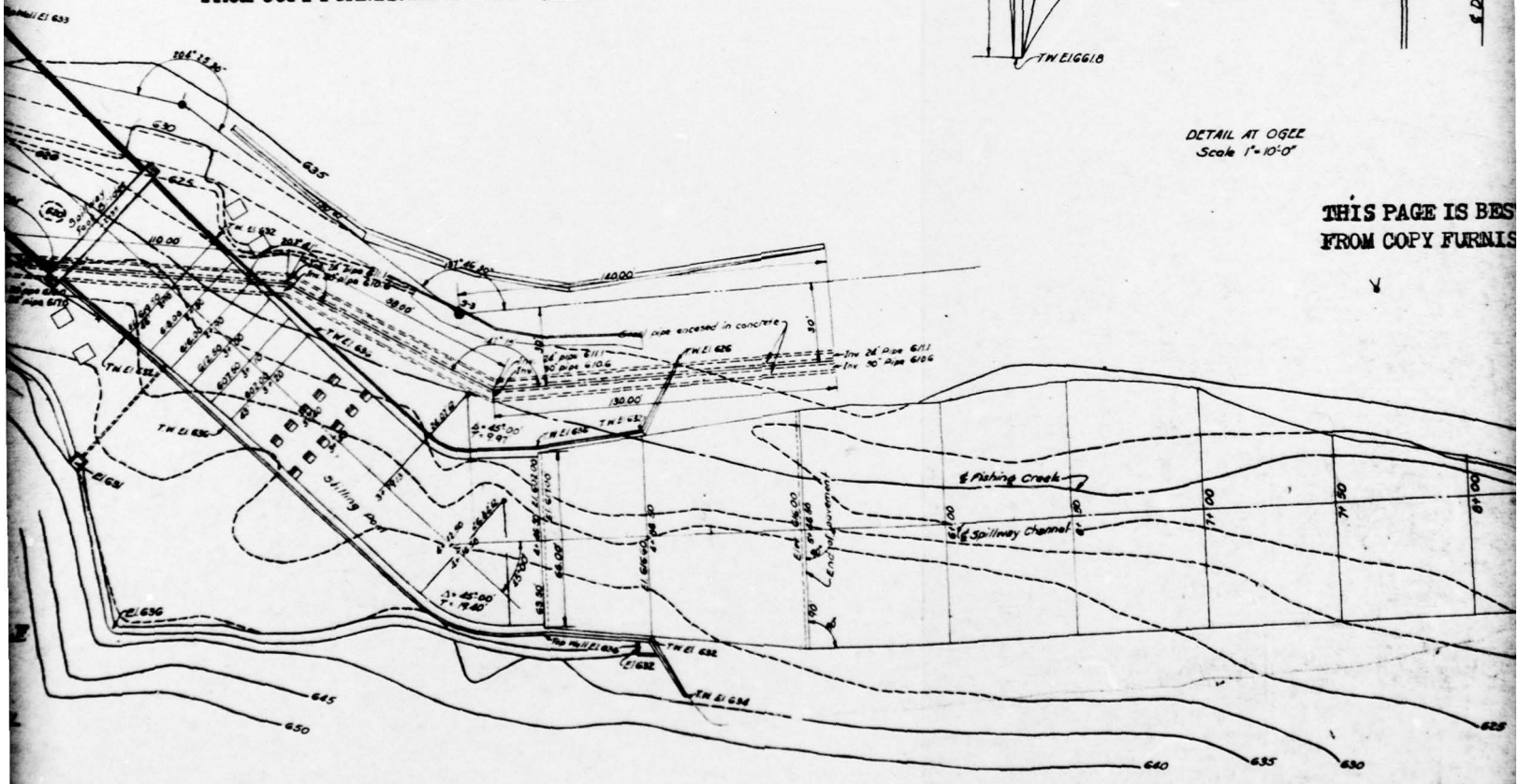
GENERAL PLAN - DAM & SPILLWAY CHANNEL
SCALE: 1"=30'

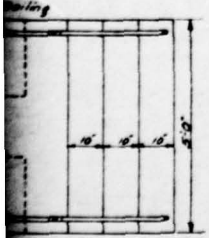


RESERVOIR AREA
SCALE 1"=400'

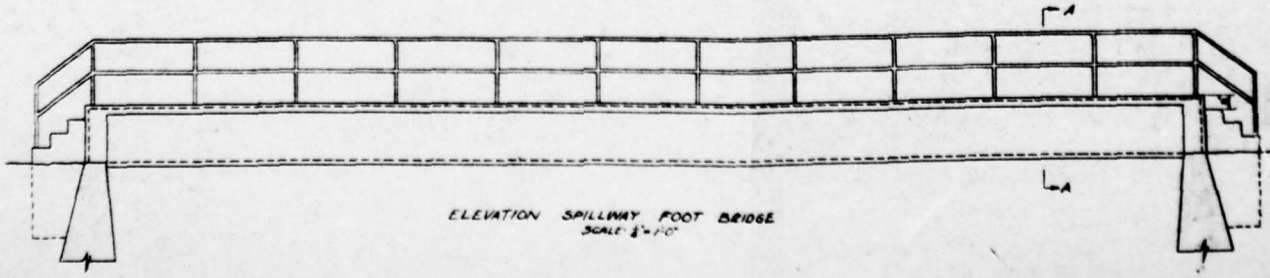


DETAIL AT OGEE
Scale 1"=10'-0"





AN STEPS
SCALE 1/4"=1'-0"



ELEVATION SPILLWAY FOOT BRIDGE
SCALE 1/4"=1'-0"

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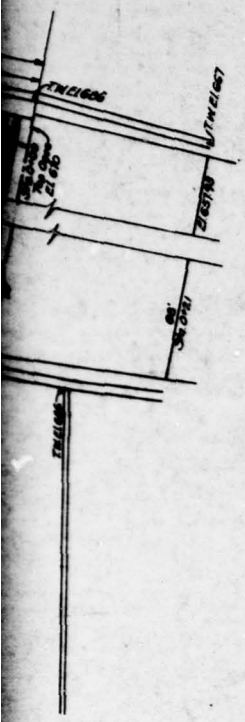


ST QUALITY PRACTICABLE
SHED TO DDC

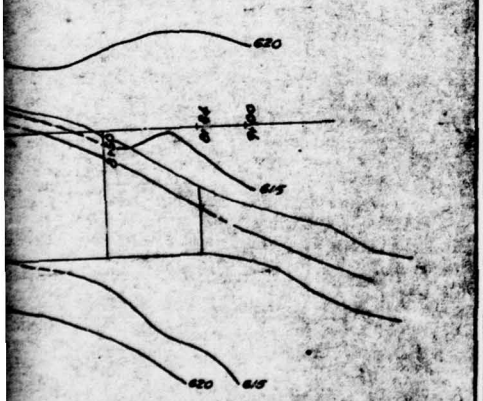


PLATE VII

CITY OF LEBANON
LEBANON COUNTY, PA.

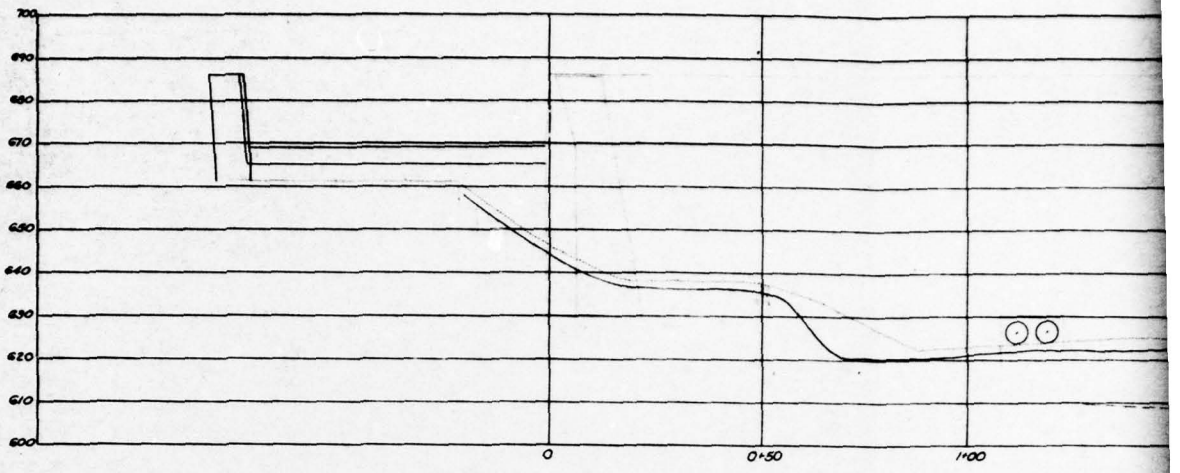
WATER SUPPLY PROJECT
DAM AND RESERVOIR
HIGH BRIDGE
SCHUYLKILL CO.

PLAN OF DAM

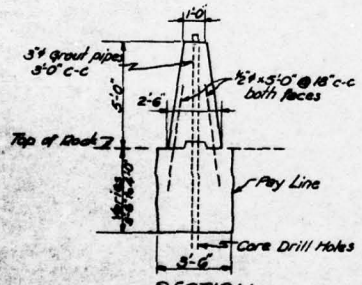
LE- AS SHOWN DATE- JULY 3, 1963

T-FLEMING-CORDLEY & CARPENTER, INC.
HARRISBURG, PA.

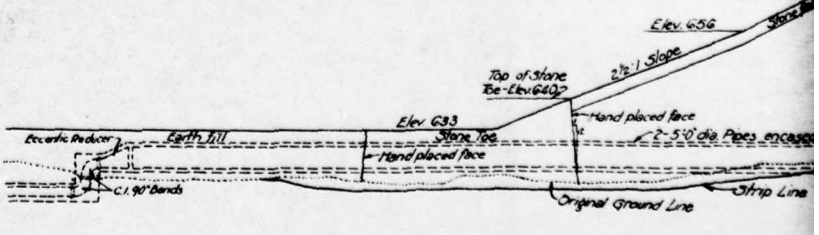
3

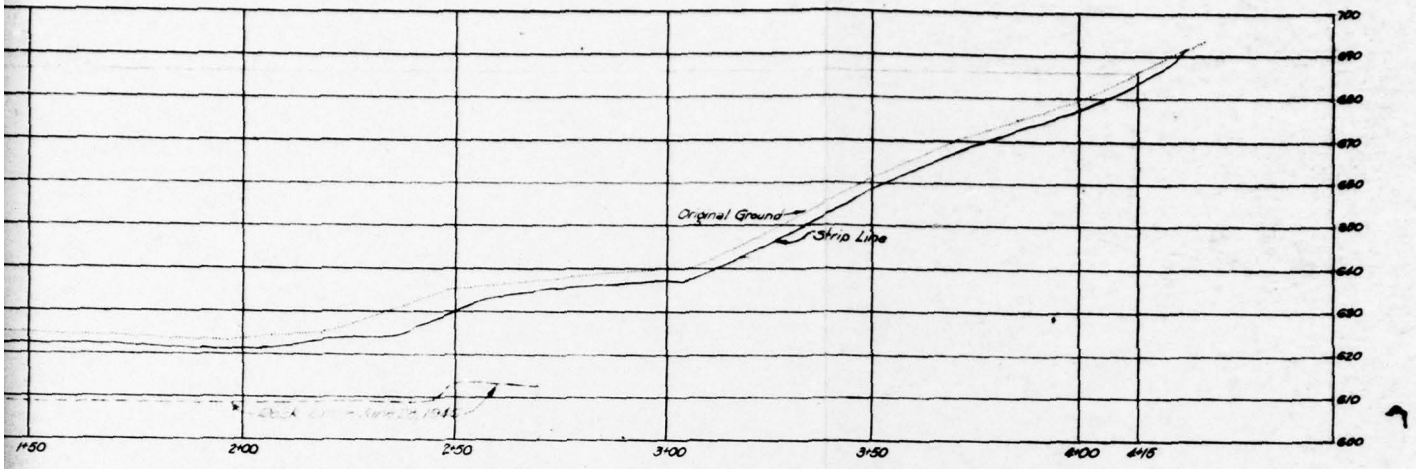


LONGITUDINA

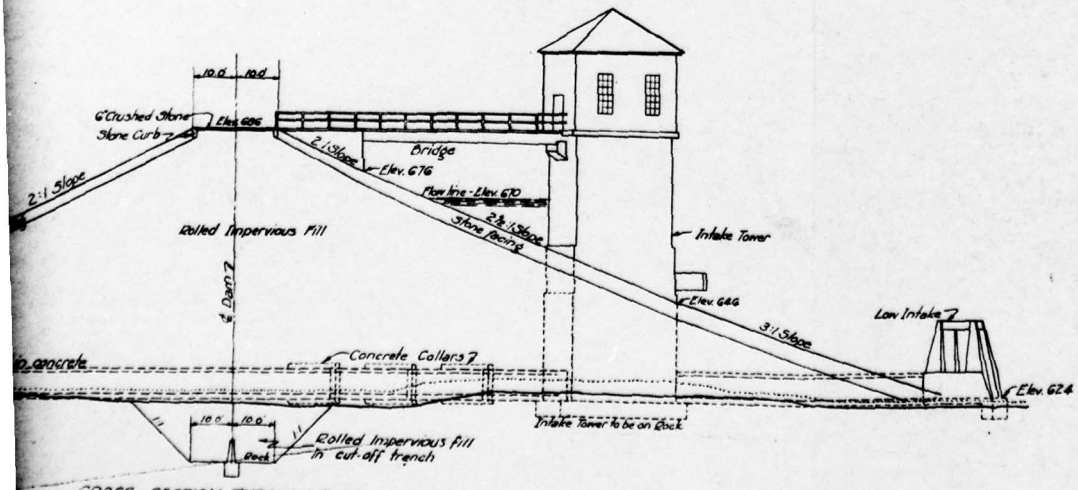


SECTION
CONCRETE CUT-OFF WALL
Scale: ¼"=1'-0"





AL SECTION THROUGH CENTER LINE OF DAM
Scale: 1" = 20'



CROSS SECTION THROUGH DAM
See Section Line X-X on Sheet No. 1-5282-1
Scale: 1" = 20'

CITY OF
LEBANON
WATER SUP
DAM AND
HIGH
SECT O
DATE - 7/2/46
GANNETT FLEMING CO
ENG
HARR

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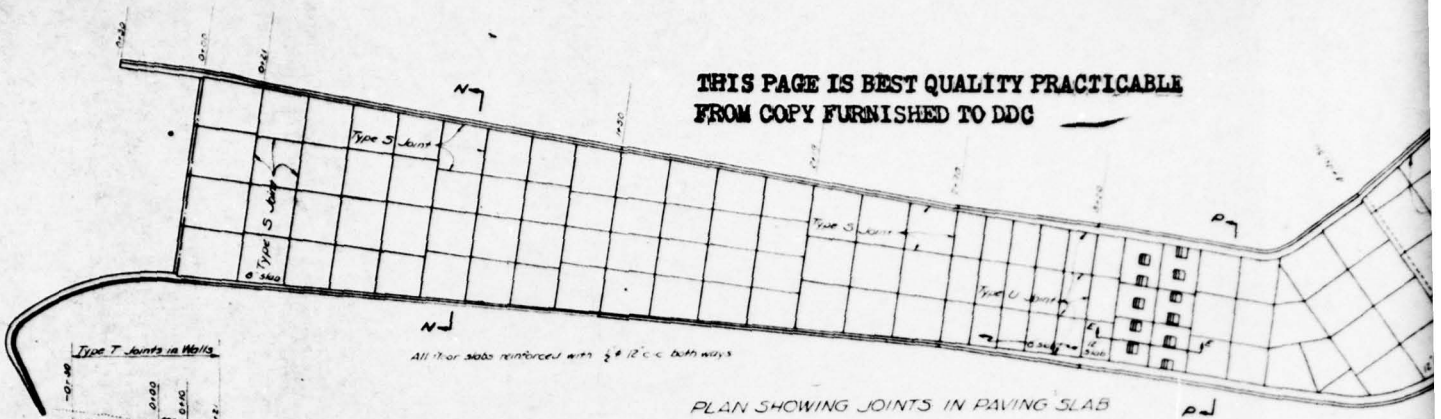
ACTICABLE

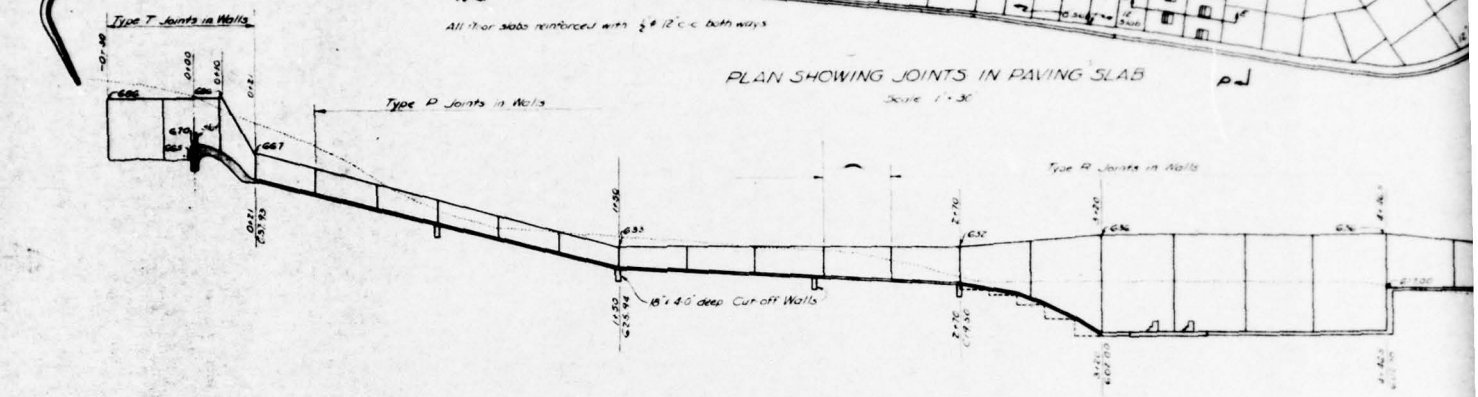
PLATE VIII

OF LEBANON
ON COUNTY PA.
UPPLY PROJECT
D RESERVOIR
GH BRIDGE
NUXHALL RD
& THRU DAM
SCALE - AS SHOWN
CORDER & CARPENTER INC.
ENGINEERS
PHILADELPHIA

3

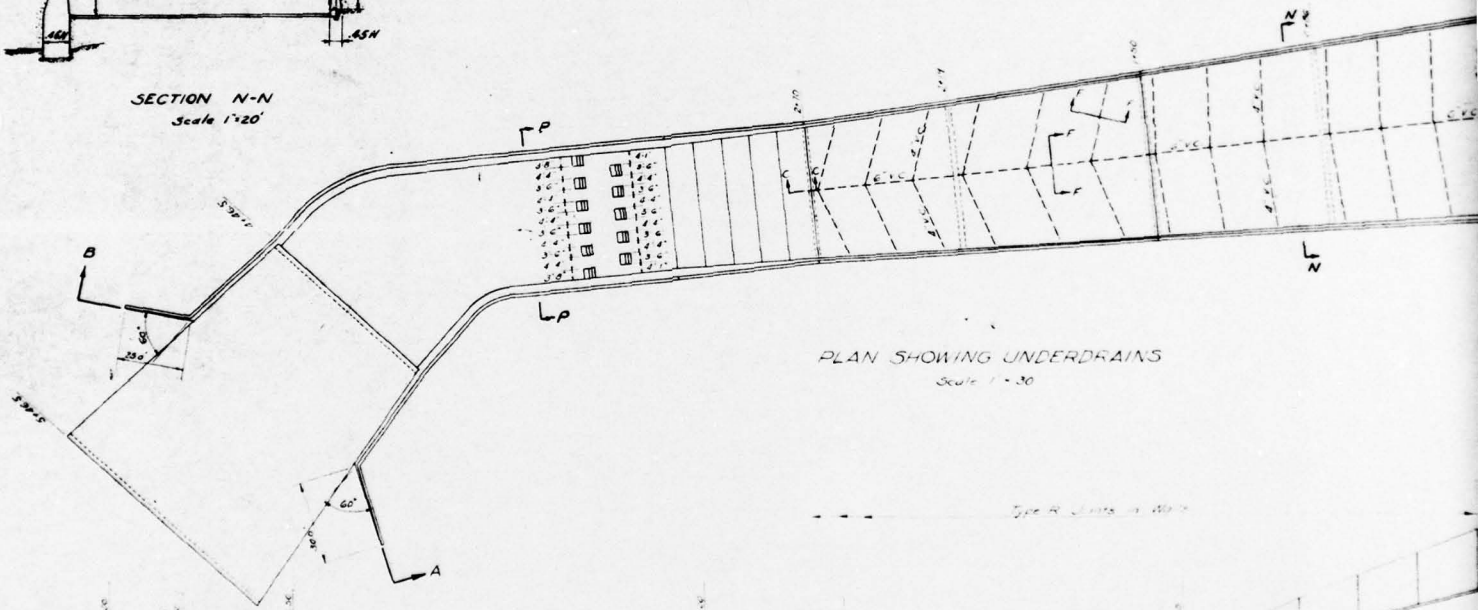


PLAN SHOWING JOINTS IN PAVING SLAB
Scale 1" = 30'

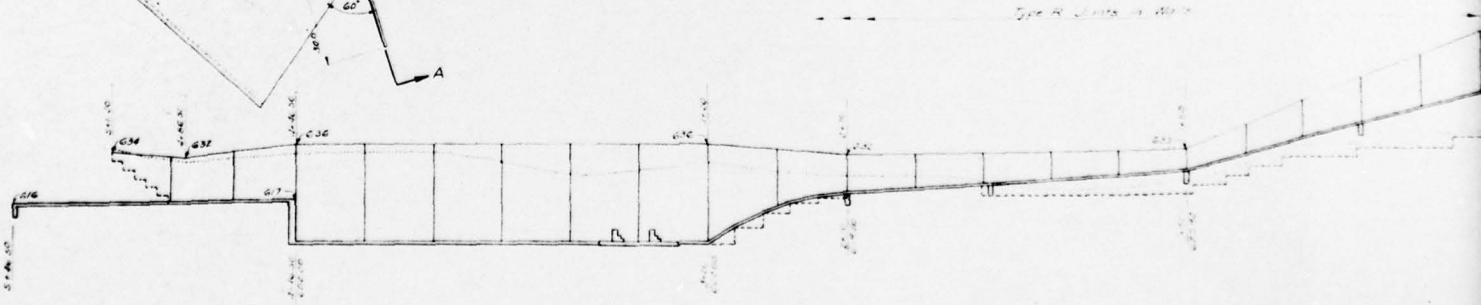


SECTION A-A SHOWING ELEVATION EAST WALL SPILLWAY
Scale 1" = 30'

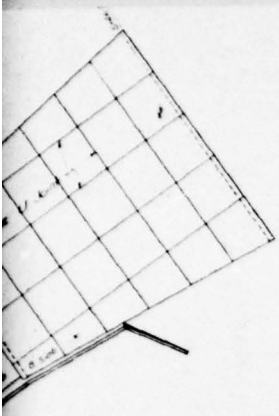
SECTION N-N
Scale 1" = 20'



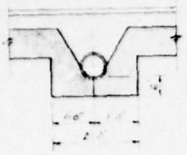
PLAN SHOWING UNDERDRAINS
Scale 1" = 30'



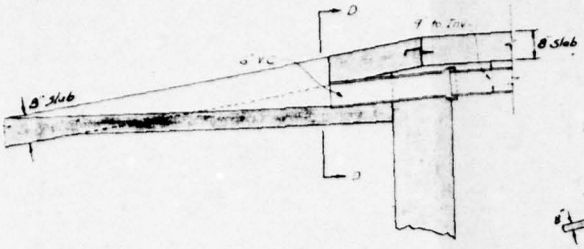
SECTION B B SHOWING ELEVATION WEST WALL SPILLWAY
Scale 1" = 30'



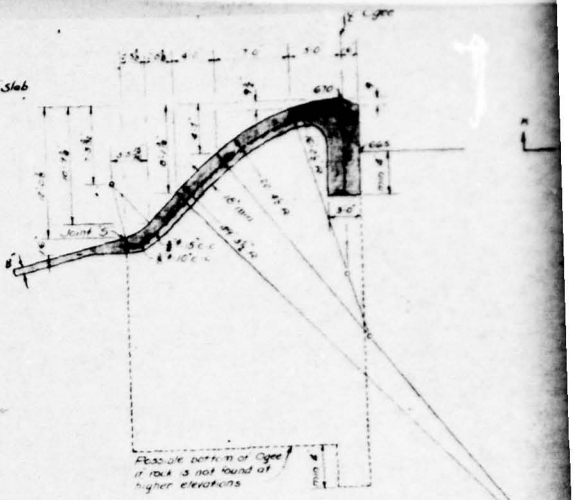
UNDERDRAIN THROUGH SLAB



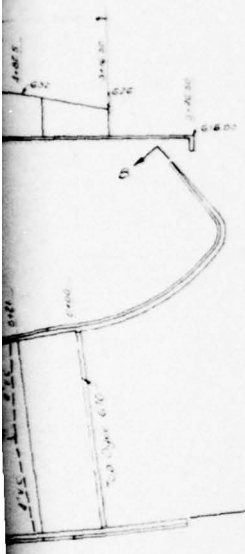
SECTION D-D
Scale ½"=1'0"

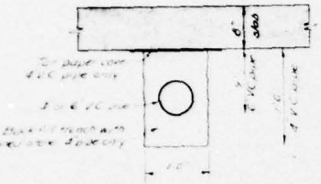


SECTION C-C
Scale ½"=1'0"

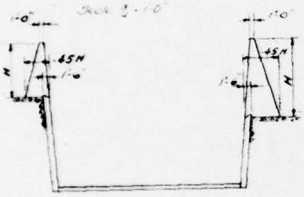


SECTION THROUGH OGEE
Scale ½"=1'0"

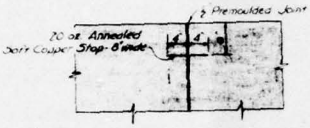




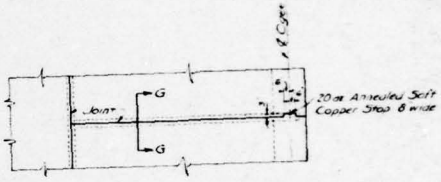
SECTION E-E
Scale ½"=1'0"



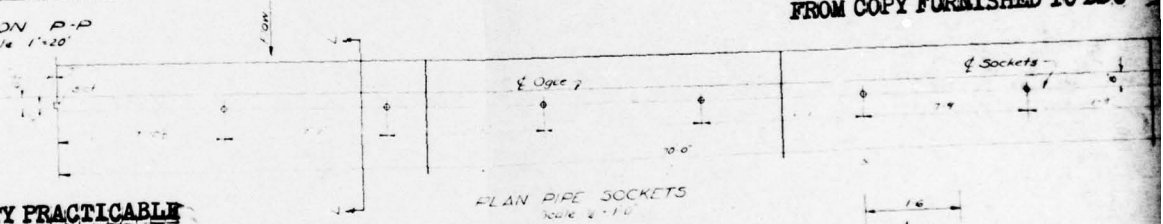
SECTION F-F
Scale ½"=1'0"



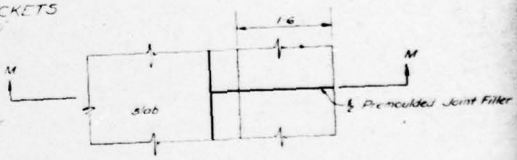
SECTION G-G SHOWING JOINT
Scale ½"=1'0"



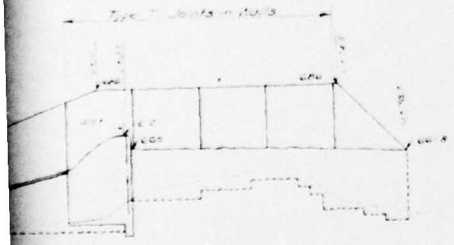
PLAN OGEE SHOWING JOINTS & KEY
Similar Joint between Ogee and Walls
Scale ⅛"=1'0"

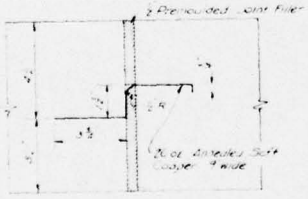


PLAN PIPE SOCKETS
Scale ⅛"=1'0"



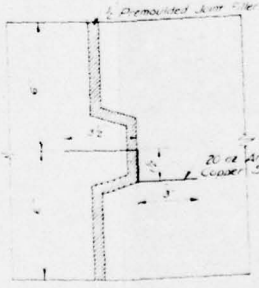
PLAN TYPICAL JOINT D



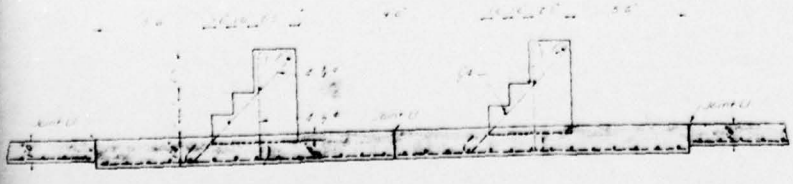


SECTION SHOWING TYPICAL JOINT S
Scale 3"=1'0"

OMIT COPPER STOP FOR JOINT J



PLAN TYPICAL JOINT T
Scale 3"=1'0"



SECTION E-E AT BUFFER BLOCKS
Scale ½"=1'0"

TYPICAL SECTION OF RETAINING AND FACING WALLS IN EARTH AND ROCK CUTS

SECTION M-M
Scale ½"=1'0"

DATE -

GANNETT

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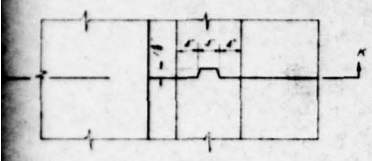
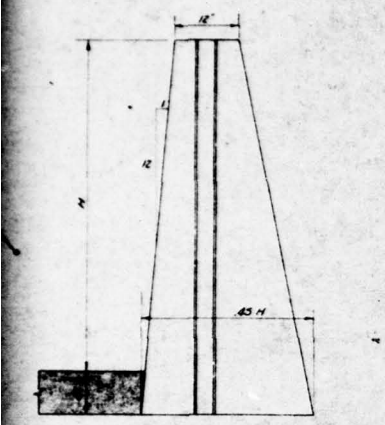
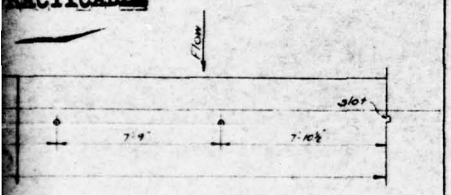


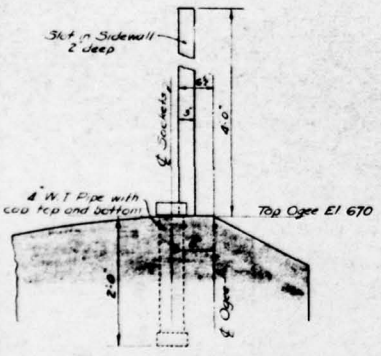
PLAN TYPICAL JOINT R
Scale $\frac{1}{4}$"-1'0"



ECTION K-K SHOWING TYPICAL WALL & JOINT R
Scale $\frac{1}{4}$"-1'0"

RACTICABLE





SECTION L L

PLATE IX

CITY OF LEBANON
LEBANON COUNTY, PA.

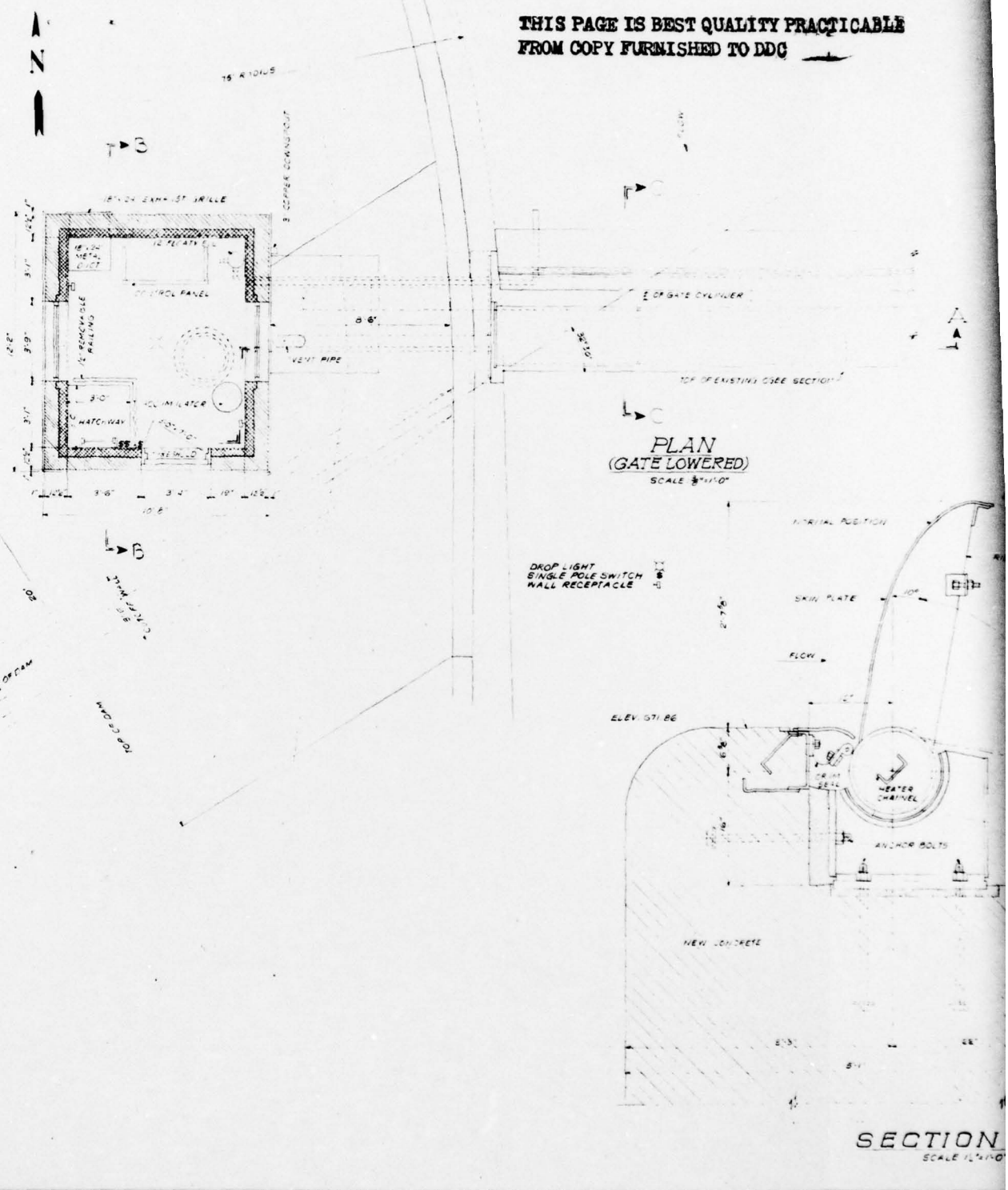
ATER SUPPLY PROJECT
DAM AND RESERVOIR
HIGH BRIDGE
SCHUYLKILL CO.

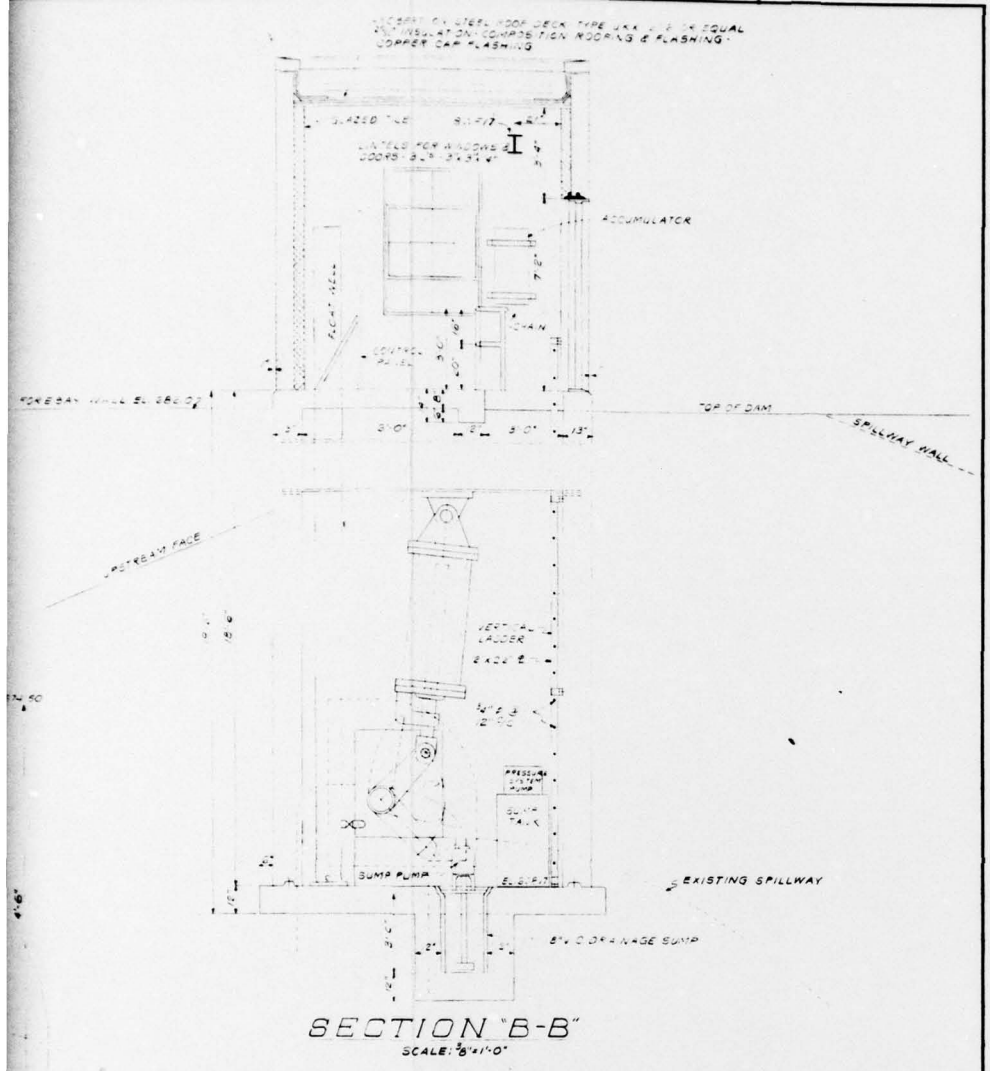
SPILLWAY DETAILS

W 1945 SCALES - AS SHOWN

FLEMING CORDDRY & CARPENTER INC.
ENGINEERS
HARRISBURG, PA.

3





SECTION "B-B"
SCALE: 3/8"=1'-0"

LOWERED POSITION

CUT 3'X18" STOP IN EXISTING SPILLWAY

ELEV 877.0

EXISTING SPILLWAY

THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

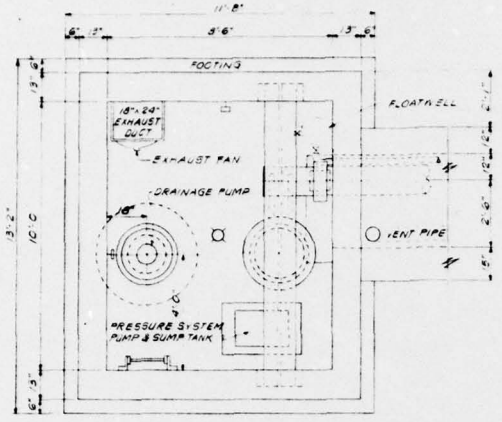
MORRIS KNOWLES INC.
ENGINEERS
PER: [signature]
REG. PROF. ENGINEER - PA. NO. 5157

CITY OF LEBANON AUTHORITY
WATER WORKS IMPROVEMENTS
HIGH BRIDGE DAM
PLAN & SECTIONS

MORRIS KNOWLES INC.
ENGINEERS
PITTSBURGH, PA.

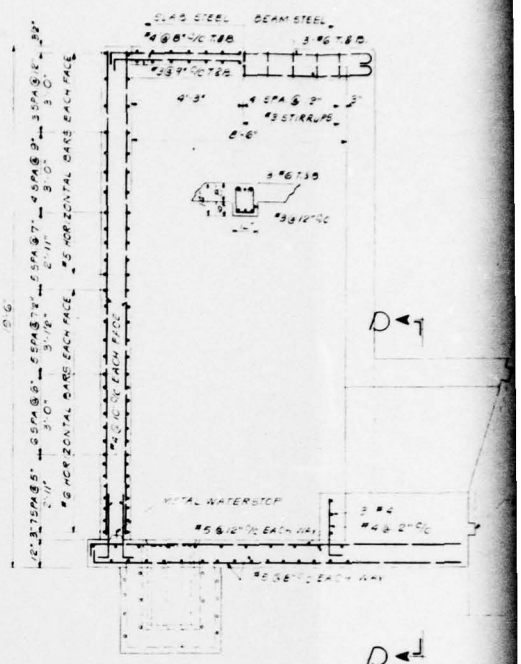
SCALE: AS SHOWN		DATE: NOV. 1960
DR. D.B.	REV. FEB. 2, 1961	REV.
TR. W.B.	REV.	REV.
CH. D.B.	REV.	REV.
SHEET 1 OF 2		C-18561

PLATE X



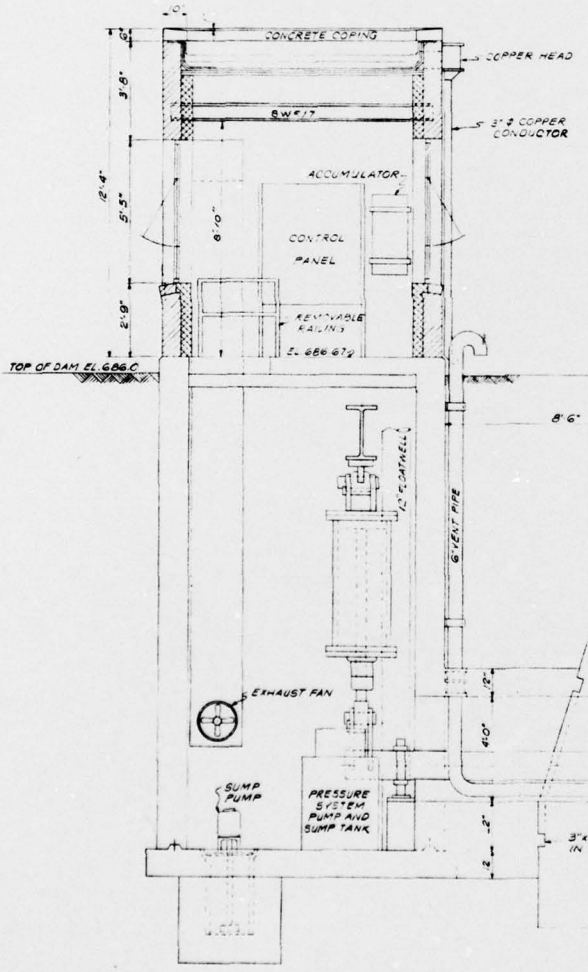
SUBSTRUCTURE PLAN

SCALE: 3/8"=1'-0"



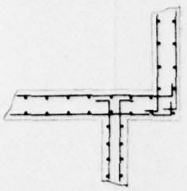
REINFORCING STEEL DETAIL

SCALE: 3/8"=1'-0"

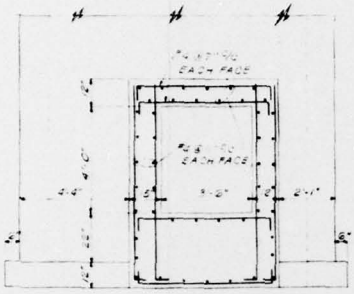


SECTION A-A

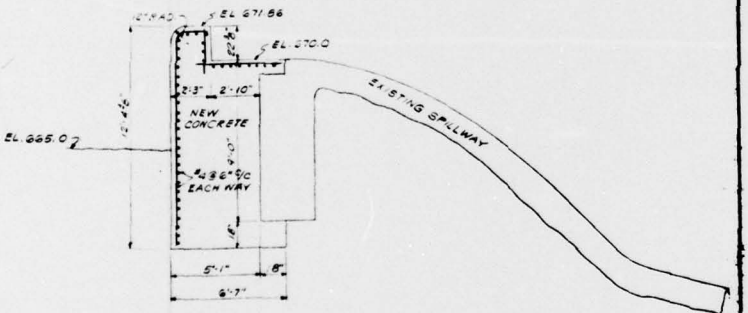
SCALE: 3/8"=1'-0"



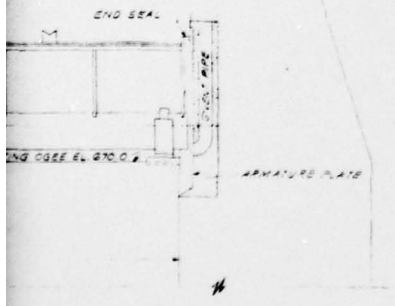
TYPICAL REINFORCEMENT
AT WALL INTERSECTIONS



SECTION "D-D"
SCALE: 3/8"=1'-0"



SECTION THRU SPILLWAY
SCALE: 1/4"=1'-0"



MORRIS KNOWLES INC.
ENGINEERS

CITY OF LEBANON AUTHORITY		
WATER WORKS IMPROVEMENTS		
HIGH BRIDGE DAM		
SECTIONS & DETAILS		
MORRIS KNOWLES INC. ENGINEERS PITTSBURGH, PA.		
SCALE: AS SHOWN		DATE: NOV. 1960
DR. D.B.	REV. FEB. 2, 1961	REV.
TR. J.B.	REV.	REV.
CH. D.B.	REV.	REV.
SHEET 2 OF 2		C-18562

PLATE XI 2