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NATIONAL DAM INSPECTION PROGRAM. REXMONT NUMBER 2 DAM (NDI NUMB--ETC(U)
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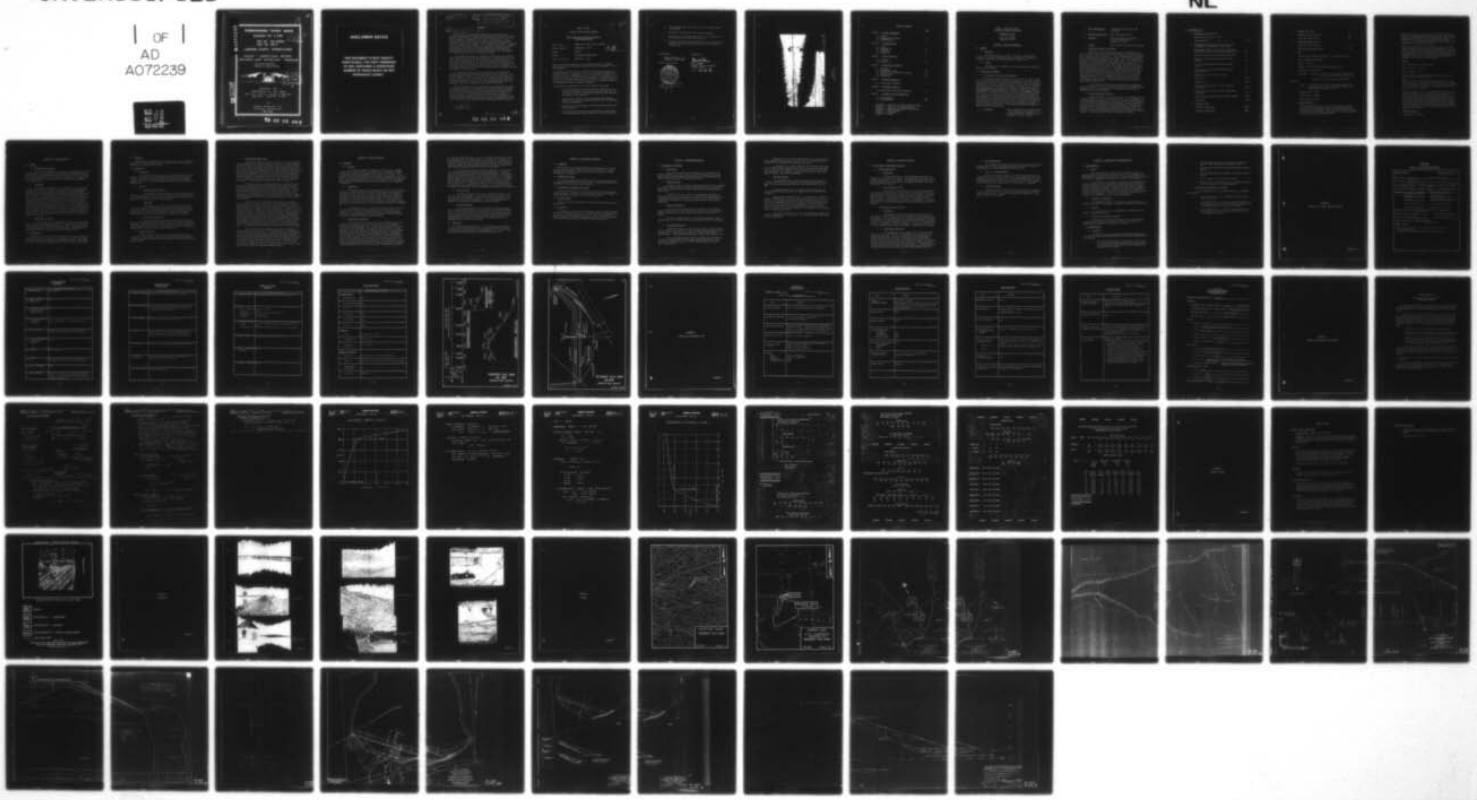

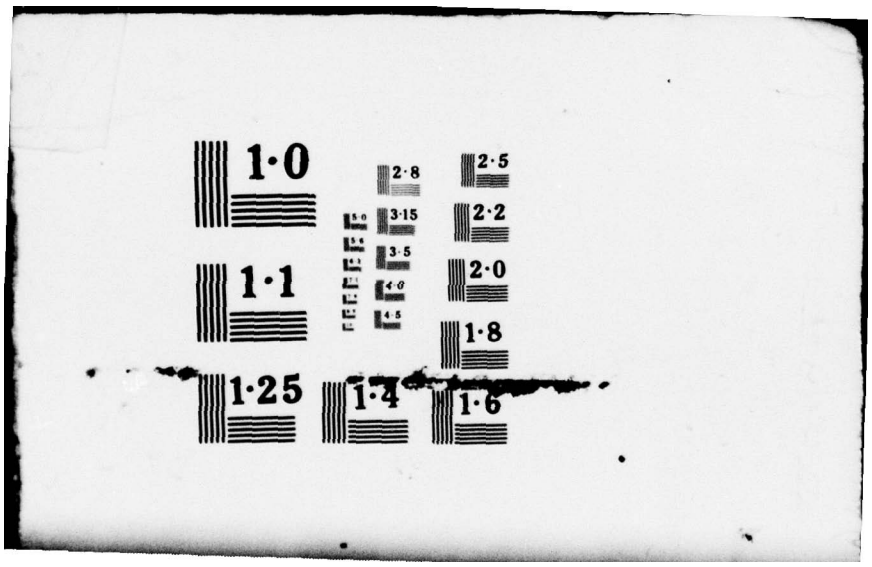
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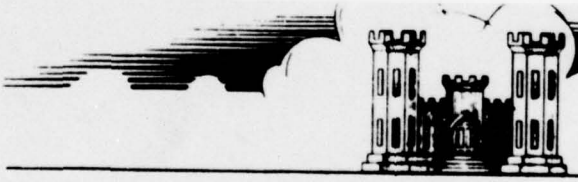
SUSQUEHANNA RIVER BASIN

REXMONT NO. 2 DAM

NDI NO. PA-00594
DER NO. 38-2

LEBANON COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

BY

Berger Associates, Inc.
Harrisburg, Pennsylvania
MAY 1979

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(11) May 79

(6) National Dam Inspection Program. Rexmont Number 2 Dam (NDI Number PA-00594, DER Number 38-2), Susquehanna River Basin, Lebanon County, Pennsylvania. Phase I Inspection Report.

PREFACE

(15) DACW31-79-C-0012

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 evoluntionary 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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PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS
AND RECOMMENDATIONS

Name of Dam: REXMONT NO.2 DAM, NDI NO. PA-00594

State & State No: PENNSYLVANIA, 38-2

County: LEBANON

Stream: WEST BRANCH HAMMER CREEK

Date of Inspection: November 15, 1978

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

In accordance with the Corps of Engineers' evaluation guidelines, the spillway capacity is inadequate to pass the PMF (Probable Maximum Flood) peak inflow without overtopping the dam. The project is capable of passing 23 percent of the PMF without overtopping. Although the 1/2 PMF will cause overtopping, the depth of overflow is not considered sufficient to cause failure. The spillway capacity is, therefore, considered to be inadequate, but not seriously inadequate.

The following recommendations are made for action by the owner:

1. A detailed hydrologic and hydraulic study should be made by a professional engineer with experience in the design and construction of dams to determine the requirements for improving the capacity of the spillway.

2. Brush and tree cuttings on the downstream slope should be removed and a regular maintenance procedure for the embankment should be established.

3. The downstream slope should be protected against erosion where bare spots exist.

4. The drawdown facilities should be operated on a semi-annual basis and personnel should be familiar with these procedures.

5. The footbridge over the spillway should be provided with a safe walkway.

6. The debris in the spillway area should be removed.

7. The walls of the spillway chute should be closely inspected after removal of all brush and overgrowth.

8. A formal surveillance and downstream warning system should be developed to be used during periods of high or prolonged precipitation.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

DATE: May 29, 1979

APPROVED BY:

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

DATE 27 Jun 79

OVERVIEW
REXMONT NO.2 DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

REXMONT NO.2 DAM

NDI-ID NO. PA-00594
DER-ID NO. 38-2

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

Rexmont No.2 Dam, formerly known as Lebanon No.2 Dam, is owned by the City of Lebanon and was originally constructed as a water supply reservoir for the City. At present, the reservoir is used for recreation (fishing) and is only a standby water supply for the City. The Rexmont No.1 Dam, also owned by the City of Lebanon, is located about 1,000 feet further downstream. A state highway is located between the two dams ~~(see Appendix F, Plates II and III)~~. The dam is a homogeneous earthfill structure with a maximum fill height of 42 feet and an embankment length of 690 feet. A 14.5 foot wide spillway (field measured) is located in the left abutment and has a weir elevation 4 feet below the top of the dam embankment. An intake control tower, located at the upstream toe of the dam, has three intake sluice gates and is connected to a downstream valve house by a 16-inch and a 20-inch pipe. The flow in these pipes is controlled by valves in the valve house. The embankment had slope failures in 1910, 1912 and 1925. The downstream slope was stabilized in 1933 by adding fill and a berm.

B. Location:

South Lebanon Township, Lebanon County
U.S.G.S. Quadrangle, Richland, PA
Latitude 40°-16.6', Longitude 76°-21.5'
(Appendix F, Plates I and II)

C. Size Classification: Intermediate (42 feet high, 189 acre-feet)

D. Hazard Classification: High (See Section 3.1.E).

E. Ownership: City of Lebanon Water Authority
400 South Eighth Street
Lebanon, PA 17042

F. Purpose: Water supply (not active) and fishing.

G. Design and Construction History

The dam was first constructed on this site in 1884 for the City of Lebanon. No records are available for the initial dam, except what is shown on Plate V, Appendix F. This drawing indicates the raising of the original dam by about 16 feet in 1909. The design was probably made by the City as the drawings were signed by Mr. T. R. Crowell, City Engineer. These plans included a new intake tower, a 20-inch pipe from the tower to a new valve pit, the removal of the old valve pit, a bridge from the breast of the dam to the intake tower and a new spillway. The spillway crest was only 1.7 feet below the top of the dam and the downstream slope was 1.5H to 1V. A slide occurred on April 24, 1910. A Mr. Fuertes advised the City in 1910 how to repair the slides and recommended changing the downstream slope to 2H to 1V. This was done in 1911, but instead of using stone for the fill, the City used embankment material. The recommendations of Mr. Fuertes were oral suggestions on the site. The spillway was lowered 2.5 feet in 1912 after another slide occurred. This slide was backfilled; however, a third slide occurred in 1925.

In 1932/1933 the valve house was raised and the downstream slope was changed to 3H to 1V. Most of the design for the new slope was prepared by the City and approved by the Pennsylvania Department of Environmental Resources (PennDER).

H. Normal Operating Procedures

Rexmont No.2 Dam is at present used only for fishing and is on a standby basis as a water supply reservoir for the City of Lebanon. No formal procedures for operating the dam are in existence and all inflow is either stored or discharged over the spillway. When the reservoir was used by the City of Lebanon, water could either be piped directly to Lebanon through a 20-inch pipe or through a 16-inch pipe (Plate III, Appendix F). If the reservoir would drop below a desired level, the reservoir could be filled through a 20-inch line from Poplar Run pumping station. This water would be aerated at the time of release.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

Computed for this report - 0.60

From 1938 Report - 0.5 Use 0.60

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

Maximum known flood, June 22, 1972. Estimated peak inflow on basis of downstream gaging station.	580
Warm water outlet at pool elevation 676.0 feet	11
Blowoff at pool elevation 676.0 feet (total 3 pipes)	18
Blowoff at pool elevation 642.0 feet (total 3 pipes)	4
Spillway capacity at pool elevation 680 feet (top of dam)	370

C. Elevation (feet above mean sea level)

Top of dam	680.0
Spillway crest	676.0
Blowoff and outlet pipes (3) invert upstream ends about	639.6
Blowoff and outlet pipes (3) invert downstream ends about	639
Stream bottom at downstream toe of dam, estimate	638
Normal pool	676.0

D. Reservoir (feet)

Length of maximum pool	1,100
Length of normal pool	1,000

E. Storage (acre-feet)

Spillway crest (Elev. 676.0)	150
Top of dam (Elev. 680.0)	189

F. Reservoir Surface (acres)

Top of dam (Elev. 680.0)	10.3
Spillway crest (Elev. 676.0)	9.2

G. Dam

See Plate III through X, Appendix F for plan and sections.

Type: Homogeneous earthfill.

Length: 690 feet.

Height: 42 feet above streambed at downstream toe.

Top Width: 12 to 15 feet.

Side Slopes: Upstream 2.5H to 1V. Old dam to Elevation 664.
2H to 1V from Elev. 664 to top of dam.

Downstream - 3H to 1V after reconstruction in 1933.

Zoning: 18 inch rockfill placed on downstream slope before flattening slope in 1933. Horizontal rockfill drain under downstream slope extension.

Impervious Core: None.

Cutoff Trench: Unknown.

Grout Curtain: Inknown.

H. Outlet Facilities

An intake tower located 62 feet upstream from the centerline of the dam, is reached from the top of the dam by means of a two-span steel-truss bridge. Water is admitted into the tower well through three 2-foot by 2-foot gates. The invert elevations of the gates are 665.9, 652.8 and 639.6.

Water leaves the well through two cast iron pipes which pass through the embankment and continue on as water supply mains. These pipes have diameters of 16 inches and 20 inches. At the downstream toe of the dam, these two pipes pass through a valve pit. In the valve pit each pipe is provided with a main valve and with a 6-inch blowoff valve.

The dam is also provided with a separate 12-inch, cast-iron blowoff pipe which passes through the embankment on a line 85 feet to the right of the two mains mentioned above. This pipe is uncontrolled at its upstream end, has a 12-inch valve at its downstream end, which at present is buried under the slope extension. This pipe is not functional and it is unknown whether or not this pipe is under pressure.

I. Spillway

Type: Uncontrolled broadcrested weir.

Length of weir: 14.5 feet.

Crest Elevation: 676.0.

Upstream Channel: Rectangular channel with concrete paved invert. 0.044 slope up to crest.

Bridge: A steel I beam bridge spans the spillway. Its upstream edge is a few inches upstream from the weir crest (see sketch on Sheet 1 of Appendix C). The underside of the bridge is 3.5 feet above the spillway crest and 0.5 feet below the level of the top of the dam.

Downstream Channel: After a 1.5-foot drop at the weir crest, the chute continues as a rectangular channel with concrete-lined invert and a slope of about 0.05 for twenty feet. It then makes a sharp 90° turn to the right and follows the toe of the embankment down to the original stream level. After the 90° turn, the chute has a downward slope of 0.10 and has a U-shaped concrete invert. After the slip of July 25, 1925, new fill was added to the downstream slope of the embankment and it was necessary to add a 5-foot-high masonry wall to the right side of the chute.

J. Regulating Outlets

See Section 1.3.H above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Hydrology and Hydraulics

The files of Pennsylvania Department of Environmental Resources (PennDER) did not contain hydraulic information for this dam, except a report filed by PennDER upon inspection of the dam in 1914. This report states that the capacity of the spillway is 450 cfs for a drainage area of .5 square miles. The capacity prior to enlarging the spillway in 1912 was only 90 cfs.

B. Embankment

The available design data was limited to the design drawings contained in Appendix F. There were no stability or seepage analysis performed and the soil parameters are unknown. Reports by PennDER indicate that the dam constructed in 1884 was about 22 feet high and 380 feet in length. It had a top width of 13 feet, an upstream slope of 2.5H to 1V and a downstream slope of 1.5H to 1V. The dam was raised in 1909. In constructing the new embankment, an 8 foot berm was made in the upstream slope at the elevation of the old dam crest and the new embankment had an upstream slope of 2H to 1V. The width on top was 15 feet and the downstream slope was made 1.5H to 1V. The embankment was constructed of material found near the dam and consisted of a mixture of clay, sand and shale. The heavy line on Plate V typical section indicates a downstream slope of 2H to 1V, but it was constructed 1.5H to 1V (dashed lines). This Plate and Plate IV indicates also a toe drain along the toe of the old dam with laterals. Records do not report that these were installed.

C. Appurtenant Structures

The design data for the appurtenant structures are limited to design drawings, reproduced in Appendix F. The drawings indicate that the intake tower was constructed of concrete with 1.5 feet thick walls. Steel reinforcement is not indicated on the plans. The spillway was widened and deepened in 1911, according to written reports.

2.2 CONSTRUCTION

The data search did not locate any records of the construction of the dam in 1884 or the raising of the embankment in 1909. The PennDER file reports describe the repairs made after the slides in 1910, 1912 and 1925. These repairs are discussed in Section 2.4.D of this report.

2.3 OPERATION

Formal records of operation for this dam do not exist. The only report of nearly overtopping occurred in April, 1910, at which time the spillway had a depth of only 1.7 feet.

2.4 EVALUATION

A. Availability

The available engineering data was obtained from the files of PennDER. These files also contained the reports written by representatives of PennDER. The City of Lebanon made a full set of drawings available for review. These drawings were duplicates of the drawings in PennDER files.

B. Adequacy

1. Hydrology and Hydraulics

The available engineering data are not sufficient to make a detailed evaluation of the design of these facilities. A review of the hydraulic adequacy of the spillway based on field inspection information is presented in Section 5 of this report.

2. Embankment

The available engineering data did not include design criteria or design analysis for the embankment. Soil parameters and construction data of the embankment fill were not available for review. The recurrence of slides on the embankment slope indicate that the design and construction of the embankment in 1909 was not adequate.

3. Appurtenant Structures

The construction drawings of the intake tower and valve house are adequate to review the design of these structures. Plate VII, Appendix F, indicates that the spillway constructed in 1909 had cutoff walls and curtain walls. There are no records to review the construction changes made in 1912, when the spillway was altered.

C. Operating Records

Formal records of operation are not maintained for these facilities. Correspondence and inspection reports indicate that this dam had embankment slides and that the downstream slope has been changed several times.

D. Post Construction Changes

On April 24, 1910, three slides occurred. One small slide was directly above the valve pit and another small one was located slightly east of the valve pit. Farther east was a slide about 80 feet wide and 3 to 4 feet deep at the top of the slide. This slide slipped further on April 25 to twice this depth and left a dam breast width of only four feet. These slides were filled with select material and not with pervious material as recommended by Mr. Fuertes. In May, 1911, the downstream slope was made 2H to 1V, again using select material and the slope was entirely riprapped. Soundings at the toe of the embankment made prior to this change indicate that the lower part of the fill was saturated with water to a vertical depth of three feet below the surface.

On April 4, 1912, a crack appeared at the downstream edge of the top of the embankment and the embankment settled some and bulged below this settlement about 70 feet west of the gate house. A large slide occurred on April 8, 1912 Plate VI and VIII, Appendix F). This slide was about 120 feet from the east end of the dam and was about 65 feet long. The riprap and concrete cover and vitrified brick on the upstream slope was supposed to form a membrane against seepage. Numerous cracks and imperfections in this membrane allows water to freely enter the embankment.

The slide area was backfilled with stone and the spillway crest was lowered 2.5 feet. Although it was recommended to flatten the downstream slope, no changes were made. On July 25, 1925, a serious slide occurred over a length of 110 feet (Plate VIII, Appendix F) at the top of the dam. The width of the slide narrows down to about 70 feet at the toe of the dam. The material flowed beyond the toe over a length of 150 feet, pushing over a wire fence along the highway. Maximum depth of the slide was about 10 feet with a nearly vertical upstream edge and showing distinctly the horizontal layers in the embankment. Considerable seepage appeared to be coming from the embankment with the water in the reservoir at normal pool level. The material of the slide was soft and saturated and could not bear the weight of a person on July 27, 1925. The estimated maximum reservoir level was 2 feet above spillway crest. The slide area was backfilled in the summer of 1925 with stone.

During 1932 and 1933 the downstream slope was changed to a slope of 3H to 1V starting from a 10 foot wide berm at an elevation of 10 feet below the top of the dam. A stone drain along the old slope and under the new fill with a minimum thickness of 18 inches (including existing riprap) was installed before new embankment material was placed. The berm was sloped outward rather than level as is shown on Plate IX. A few inches of fill were also placed on the crest of the dam. Four tile drains converging at a low point in the center of the dam were combined in a manhole in 1938. To facilitate the flatter slope, a stone wall was built along the spillway discharge channel.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Rexmont No.2 Dam is good, although considerable cleaning up of the downstream slope is required. Seepage was not detected and the embankment slopes appear to be stable. The facilities are not being used and little control is exercised. Mr. Chris Siegrist of the City of Lebanon Water Authority accompanied the inspection team. The visual inspection check list is in Appendix A of this report. Reproductions of photographs taken during the inspection are contained in Appendix E.

B. Embankment

The upstream slope is brick paved and appears to be in excellent condition. Above the normal pool level, grass and some weed growth is covering the brick. The top of the dam has high grass and a footpath. The edges are somewhat rounded off and a slight variation in width was noticeable, but this was not considered serious. The horizontal alignment of the dam was good, with a sharp turn near the left end of the embankment. A survey of the dam profile indicates a fairly level embankment with only one point below the design elevation of 680.0 (see Appendix A).

The downstream slope is covered with weeds and brush. Most of the heavy brush had been cut recently, but the slope has yet to be cleaned off. No seepage or erosion was noticed. A footpath leading from the top of the embankment to the valve chamber is bare and should be seeded or otherwise protected against erosion.

C. Appurtenant Structures

The intake structure is located on the upstream side of the embankment and consists of a concrete tower with a stone building enclosing the operators platform. Access from the breast of the dam is by a steel truss footbridge. The structure and bridge were in good condition. There are three gate operator stands inside of the building. The lower sluice gate, installed for drawdown purposes, was partially opened during the inspection. Drawings indicate that a 16-inch and a 20-inch pipe lead to the downstream Rexmont No.1 reservoir or directly to the City of Lebanon. The reservoir was drawn down in 1970, but the owner's representative did not recall how this was accomplished. The valve pit is located on the downstream slope. This structure was raised when the downstream slope was flattened; however, no ladder is available to descend inside and no inspection was made. Drawings indicate that

the two pipes have valves here, but it is not known if these are in open or closed position. A shallow manhole is located close to the toe of the dam with four pipes entering and one pipe leaving. Presumably these pipes are connected to the toe drain of the old and new rock toe drains. A small discharge was noticed coming from the four pipes. There are no open downstream channels beyond the valve pit and manhole.

The spillway is located in the left abutment. The approach to the spillway weir is shallow and has stone training walls. The weir crest is in good condition with only minor deterioration. The abutments consist of cemented stone walls. The discharge channel of the spillway makes an abrupt 90° turn about thirty feet beyond the weir. The channel narrows down to a rock protected ditch, paralleling the toe of the dam over a length of about 200 feet, at which point the embankment turns away from the ditch. A footbridge provides access over the spillway to the dam breast. The planking on this bridge is in very poor condition. No records of maximum flow over the spillway were available or recollected.

D. Reservoir Area

The reservoir banks are all wooded and appear stable. One of the purposes of the drawdown in 1970 was to clean out siltation. However, the muck was too deep (estimated at 8 feet) and too soft for the equipment and the effort was abandoned. All of the drainage area is wooded and any additional sedimentation should be minimal.

E. Downstream Channel

Under normal conditions, the spillway discharges through a small ditch and pipe underneath a road into the next reservoir (Rexmont No.1). If the dam of Rexmont No.2 would fail due to overtopping, the released water would cross the road, destroy the downstream dam and hit several farms and houses located within 4,000 feet of the dam. The hazard category of the dam is considered to be "High", due to the additional loss of life to be expected.

3.2 EVALUATION

The dam embankment appears to be in good condition, except that cuttings should be removed and better maintenance procedures should be established to control growth of the downstream slope. The bare spots on the downstream slope should be protected against erosion.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURE

The reservoir is at present used for recreation only and is not a part of the water supply system of the City of Lebanon. No specific procedures exist and all inflow above the normal pool level is discharged over the spillway.

4.2 MAINTENANCE OF DAM

The cuttings laying on the downstream slope indicate that little or no maintenance had been done in recent years. The upstream slope and the breast of the dam were in good condition.

4.3 MAINTENANCE OF OPERATING FACILITIES

Because the reservoir is at present not used for the water supply system, the gates and valves are not operated on a regular schedule. No formal maintenance procedures exist for the facilities.

4.4 WARNING SYSTEM

There is no formal surveillance or warning system in effect at the present time.

4.5 EVALUATION

A maintenance procedure for the embankment and operating facilities should be established. Maintenance personnel should be acquainted with the procedure to draw down the reservoir in time of an emergency. A formal surveillance and downstream warning system should be established to be used during periods of prolonged or heavy precipitation.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

Very little information was available on the hydrologic and hydraulic design of the dam. There were no area-capacity curves, frequency curves, unit hydrographs, design storm data, design flood hydrographs, flood routings nor spillway rating curves.

B. Experience Data

The dam has had its present configuration since its top elevation was raised in 1933. During the period between 1909 and 1978 the dam has never been overtopped and the spillway chute has never been damaged by flood flows.

Comparison with the record for the downstream USGS gaging station Conestoga River at Lancaster (324 square miles), indicates that the greatest flood may have been that of June 22, 1972, when the indicated inflow to Rexmont No.2 Dam would have been 580 cfs (see Sheet of Appendix C).

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.

The steel I-beam bridge over the spillway weir might reduce the capacity of the spillway at high pool stages (see Sheet 1 of Appendix C).

D. Overtopping Potential

Rexmont No.2 Dam has a total storage capacity of 189 acre-feet and an overall height of 42 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 Probable Maximum Flood (PMF). For this dam, the PMF peak inflow is 1,780 cfs (see Appendix C for HEC-1 inflow computations).

Comparison of the estimated PMF peak inflow fo 1,780 cfs with the estimated spillway discharge capacity of 370 cfs indicates that a potential for overtopping the Rexmont Dam No.2 exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through 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 23% of a PMF without overtopping.

E. Spillway Adequacy

The intermediate size category and high hazard category, in accordance with the Corps of Engineers criteria and guidelines, indicates that the spillway design flood for this dam should be the full PMF.

Calculations show that the spillway discharge capacity and reservoir storage capacity combine to handle 23% of the PMF (refer to Appendix C).

Being an earth embankment dam, it is judged that a breach is likely to develop when the depth of flow over the crest is 0.5 foot or greater. These studies also indicate that the depth of flow over the crest of the embankment due to one-half PMF is less than 0.5 foot. On the basis of this information, it is judged that a one-half PMF will cause some overtopping of the embankment but not enough to cause a breach. Therefore, the spillway capacity is considered to be inadequate, but not seriously inadequate.

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 Observation

1. Embankment

No visual indications of undue embankment stresses or sloughage of the slopes were noticed. The embankment slopes were found to be dry and appeared to be stable. The amount of seepage water in the manhole collecting water through four tile drains from the toe of the dam appeared to be minimal.

2. Appurtenant Structures

There were no visual indications of unstable conditions of the appurtenant facilities for this dam. The intake tower is in good condition and the spillway and abutment walls will be able to withstand high discharges. The spillway bridge is in poor condition, but this will not affect the safety of the facilities. The spillway chute is overgrown and is located close to the toe of the embankment. A thorough inspection of the stone walls should be made after all brush has been removed.

B. Design and Construction Data

1. Embankment

The available data has been discussed in Section 2 of this report. Although several slides occurred on the downstream slope, the stability of the embankment has been considerably increased with the installation of a rock drain under the additional downstream fill placed in 1932. The original embankment slopes of 1.5H to 1V is considered too steep for a homogeneous earthfill embankment. The present slope of 3H to 1V with the indicated internal drainage is considered to be adequate.

2. Appurtenant Structures

The information on the construction of the intake tower and valve box is very limited. Reinforcement of the concrete is not shown on the drawings. It can be assumed that some reinforcement is present and that these structures are adequate for their function. Although the pipes from the tower to the valve box appear to be placed without concrete or masonry protection and seepage collars, there are no records of any excessive seepage along these pipes. It appears that the spillway chute is small and not sufficiently protected with concrete lining or heavy riprap to prevent washouts during large discharges.

C. Operating Records

The available information indicates that stability and seepage problems existed before the downstream slope was changed to 3H to 1V. This information has been discussed in Section 2.4.D.

D. Post Construction Changes

Reference is made to Section 2.4.D for changes made to these facilities since the dam was raised to its present height in 1909. The downstream slope was changed to 2H to 1V and embankment slides in 1912 and 1925 show that this slope was not stable. Since 1933 the embankment has been stable and the present slope is considered to be adequate.

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 claculations, studies, etc., were made to confirm this conclusion.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection indicates that Rexmont No.2 Dam is in good condition. While serious slides did occur on the embankment, the flattening of the downstream slope appear to have stabilized the condition. No seepage or sloughage was detected at the time of this inspection.

The results of the hydrologic and hydraulic investigations, in accordance with the Corps of Engineers' evaluation guidelines indicate that the combination of spillway discharge and the reservoir storage have the capacity for passing 23 percent of the PMF without overtopping the dam. Calculations, however, show that the depth of overtopping caused by an inflow of one-half of PMF is less than that judged to cause failure of the embankment. Therefore, the spillway capacity is considered to be inadequate, but not seriously inadequate.

B. Adequacy of Information

The information available for review is considered to be sufficiently adequate for making a reasonable assessment of this project.

C. Urgency

It is suggested that the recommendations presented in this report be implemented at once.

D. Necessity for Additional Studies

The results of this inspection indicate the need for additional detailed hydrologic and hydraulic studies to determine the requirements for improving the capacity of the dam.

7.2 RECOMMENDATIONS

A. Facilities

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

1. That a detailed hydrologic and hydraulic study be made by a professional engineer with experience in dam design and construction to determine means for improving the capacity of the spillway.

2. That the footbridge across the spillway be repaired to provide a safe walking path for emergency access.

3. That all brush cuttings on the downstream slope should be removed.

4. That the downstream slope footpath be reseeded to prevent erosion.

5. That the debris in the spillway be removed.

6. That the walls of the spillway chute be closely inspected after the removal of the brush overgrowth.

B. Operation and Maintenance Procedures

It is recommended that the following procedures be scheduled by the owner:

1. Regular maintenance of the embankment including removal of brush and trees.

2. The drawdown facilities should be greased and operated on a semi-annual basis and personnel should be familiar with the drawdown procedures in case of an emergency.

3. Develop and implement a formal surveillance and downstream warning system to be used during periods of high or prolonged precipitation.

APPENDIX A

CHECKLIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 38-2 NDI NO. PA-00 594

NAME OF DAM Rexmont No.2 HAZARD CATEGORY High

TYPE OF DAM Earthfill

LOCATION South Lebanon TOWNSHIP Lebanon COUNTY, PENNSYLVANIA

INSPECTION DATE 11-15-78 WEATHER Cloudy TEMPERATURE 50's

INSPECTORS: H. Jongsma (Recorder) OWNER'S REPRESENTATIVE(s):

A. Bartlett Christ Siegrist

R. Steacy City of Lebanon Water Authority

NORMAL POOL ELEVATION: 676.00 (U.S.G.S.) AT TIME OF INSPECTION:

BREAST ELEVATION: 680.00 POOL ELEVATION: 676.00

SPILLWAY ELEVATION: 676.00 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: Unknown

GENERAL COMMENTS:

Dam not used for domestic water supply since 1954, only for recreation (fishing).
No surveillance and downstream warning system in effect.

NDI NO. PA-00 594

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None detected.
B. UNUSUAL MOVEMENT BEYOND TOE	None.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	None.
D. ALIGNMENT OF CREST: HOPIZONTAL: VERTICAL:	 Good. Sharp angle to spillway at left end. Good.
E. RIPRAP FAILURES	Upstream slope brick paved. Good condition. Downstream slope earthfill with rock toe.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Good.
G. SEEPAGE	None detected.
H. DRAINS	Manhole at toe with 4 pipes. All active. Two from old toe of dam. Two from blowoff.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Upstream - brick paving and grass with weeds. Breast - footpath and grass, edges irregular. Downstream - weeds, brush, tree trunks and cut brush. Riprap bed.

NDI NO. PA-00 594

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Concrete tower, enclosed with stone building.
B. OUTLET STRUCTURE	Valve chamber on downstream slope. Raised when slope was flattened. Manhole cover unlocked, but no ladder to go down.
C. OUTLET CHANNEL	None, except 8-inch pipe in manhole.
D. GATES	Three gates in tower. Operated drawdown gate. Outlet unknown, probably only filled chamber. Drawings indicate pipe runs to downstream lake.
E. EMERGENCY GATE	24" gate to 16" pipe into downstream reservoir.
F. OPERATION & CONTROL	Lake drawn down about 1970. for desiltation. Not desilted due to heavy muck.
G. BRIDGE (ACCESS)	footbridge (trusses).

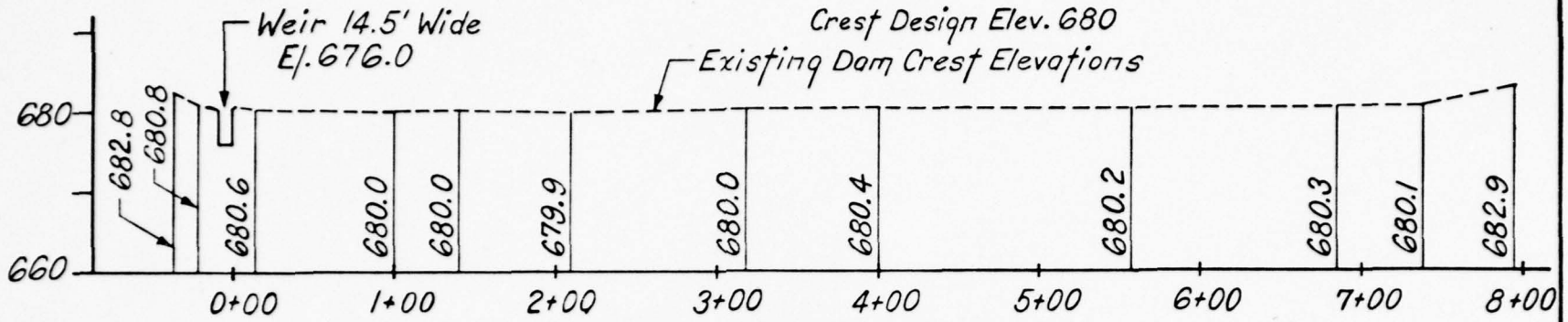
NDI NO. PA-00 594

VISUAL INSPECTION
SPILLWAY

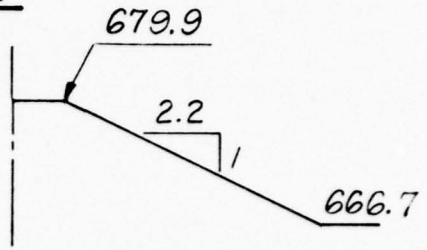
	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	Shallow with stone walls in left abutment.
B. WEIR:	
Crest Condition	Good. Small drop.
Cracks	None.
Deterioration	Some deterioration, not serious.
Foundation	Not visible.
Abutments	Cemented stone.
C. DISCHARGE CHANNEL:	Over 15' the same with walls, then 90° curve into a narrow channel with riprap with stone walls.
Lining	
Cracks	None.
Stilling Basin	Discharge channel follows toe of left embankment.
D. BRIDGE & PIERS	Footbridge with most planks missing.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	None.

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR	
Slopes	Wooded hills, stable.
Sedimentation	About 8 feet.
Watershed Description	All forested.
DOWNSTREAM CHANNEL	
Condition	Rexmont Dam No.1 directly downstream.
Slopes	Narrow dry masonry ditch, parallel to toe of dam.
Approximate Population	20.
No. Homes	4 farms.

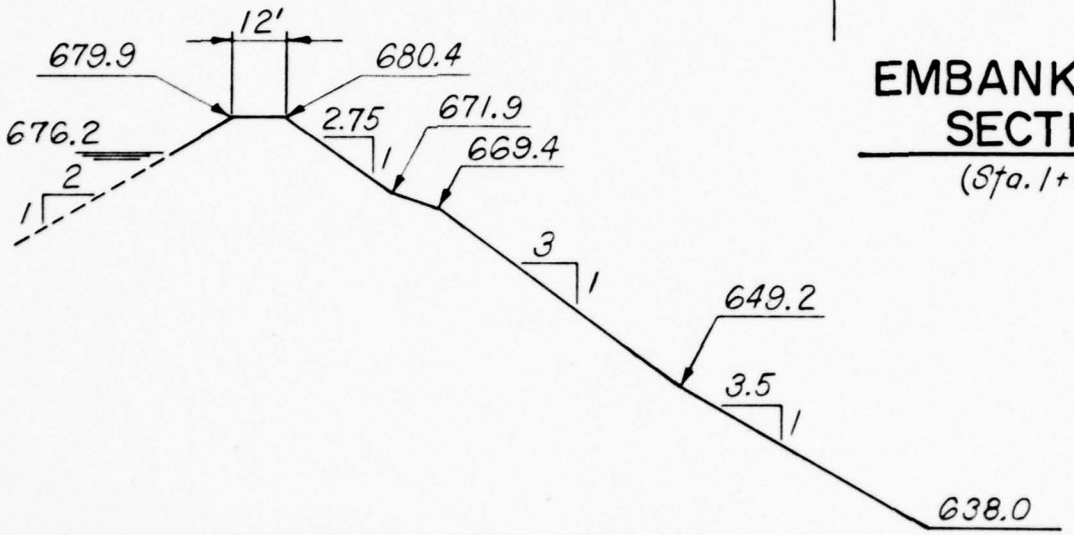


EMBANKMENT PROFILE



EMBANKMENT SECTION

(Sta. 1+60)

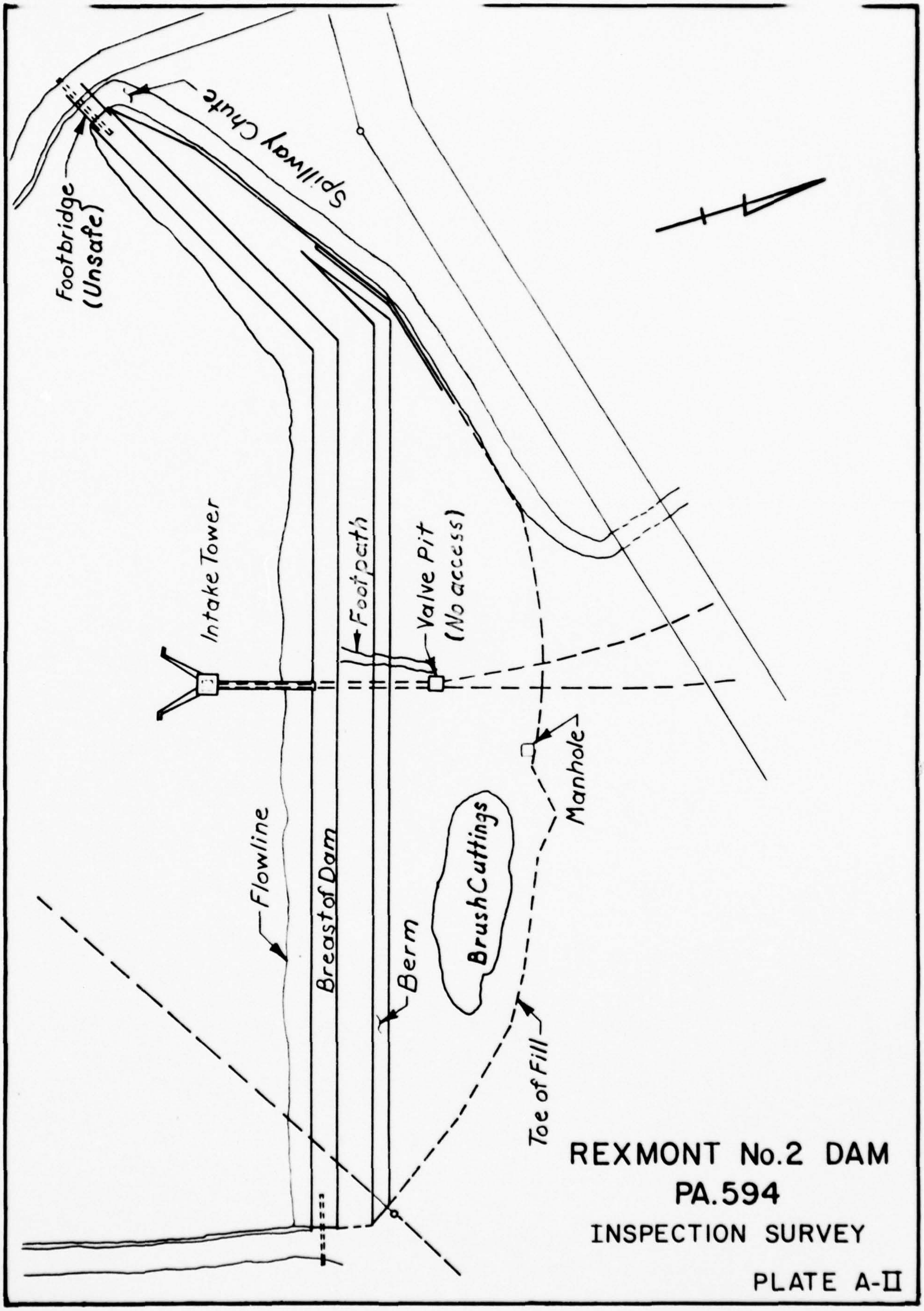


EMBANKMENT SECTION

Surveyed 11/15/78

REXMONT No.2 DAM
PA. 594
INSPECTION SURVEY

PLATE A-I



REXMONT No.2 DAM
PA.594
INSPECTION SURVEY

PLATE A-II

APPENDIX B

CHECKLIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 38-2 NDI NO. PA-00 594

NAME OF DAM REXMONT NO.2

ITEM	REMARKS
AS-BUILT DRAWINGS	None - construction drawings in Appendix F.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - Richland, PA See Plate II, Appendix F
CONSTRUCTION HISTORY	Dam constructed in 1884, raised in 1909. Slides occurred in 1910. Downstream slope changed to 2H to 1V. Slide occurred in 1912 and 1925. Downstream slope changed to 3H to 1V in 1932/1933.
GENERAL PLAN OF DAM	Plate III and IV, Appendix F.
TYPICAL SECTIONS OF DAM	Raising of dam in 1909 - Plate V, Appendix F Slide of 1912 on Plate VI Slide of 1925 on Plate X Present Section, Plate IX
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	 Plate V, Appendix F Plate III, Appendix F None None

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No rainfall records. During heavy rains in 1910 pool level was within a few inches of the top of the dam. This was before spillway weir was lowered from 1.7 feet below top of dam.
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	 None. None. None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	None.
POST CONSTRUCTION SURVEYS OF DAM	See sections after slides occurred. Appendix F, Plate VI.
BORROW SOURCES	Unknown.

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Raising in 1909. Changes of downstream slope in 1911 and 1932. Lowered spillway in 1912.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	Reports by PennDER in 1912, 1914 and 1926.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	Three slides occurred in 1910. Backfilled with embankment material. Report by City Engineer to Council. Another slide occurred in 1912 and 1925. Photographs of slides and repairs in PennDER files.
MAINTENANCE & OPERATION RECORDS	None.
SPILLWAY PLAN, SECTIONS AND DETAILS	None, except Plate VII, Appendix F, which shows spillway before lowering.

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Details of tower in PennDER Files. Valve house see Plate III, Appendix F. This valve house was raised when additional embankment was placed.
CONSTRUCTION RECORDS	None.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	Regular inspection reports by PennDER. Masonry wall along spillway was in need of repairs several times. Brush and tree growth has been a maintenance problem. Embankment slides: 1910, 1912 and 1925.
MISCELLANEOUS	Reports by PennDER 1. Report on the No.2 Dam of the City of Lebanon dated April 23, 1912 by Charles E. Ryder. 2. Supplementary Report on Dam No.2, dated April 29, 1912 by Charles E. Ryder. 3. Supplementary Report on No.2 Dam, dated December 17, 1914 by F.B. McDowell. 4. Report on the slide on the downstream side of Dam No.2, dated July 20, 1925 by Mr. Beal. 5. Report on the application for repairing No.2 Dam, dated January 8, 1926 by Mr. Beal. 6. Supplementary Report dated April 3, 1930. 7. Report on application for revised plan of improvements dated June 10, 1932.

NDI NO. PA-00 594

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Wooded.

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 676 150 Acre-Feet

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 680 189 Acre-Feet

MAXIMUM DESIGN POOL: Elev. Unknown

TOP DAM: Elev. 680

SPILLWAY:

a. Elevation 676

b. Type Uncontrolled broad crested weir.

c. Width 14.5 feet.

d. Length

e. Location Spillover Left abutment.

f. Number and Type of Gates None.

OUTLET WORKS:

a. Type 16-inch and 20-inch pipes.

b. Location Under embankment.

c. Entrance inverts 639.6

d. Exit inverts Connected to City water supply except 6-inch blowoff pipe.

e. Emergency drawdown facilities Probably a 20-inch valve at the headwater of the next reservoir.

HYDROMETEOROLOGICAL GAGES:

a. Type None.

b. Location None.

c. Records None.

MAXIMUM NON-DAMAGING DISCHARGE: 890 cfs.

APPENDIX C

HYDROLOGY AND HYDRAULIC CALCULATIONS

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.

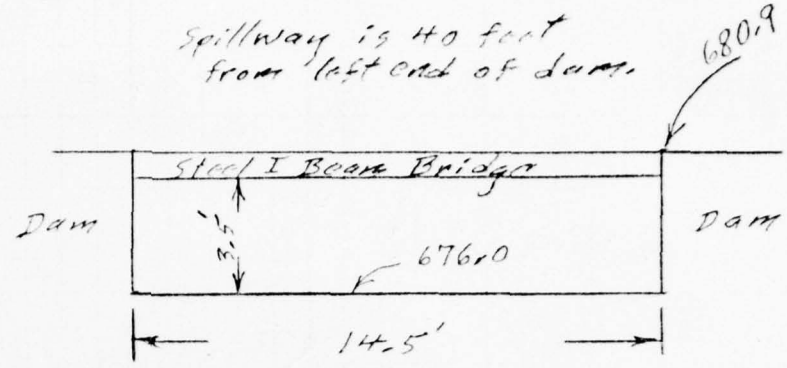
For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California.

SUBJECT Lebanon No. 2 – Pool No. 5 Dam

COMPUTED BY RES DATE 11-21-78 CHECKED BY JJP 11-30-78

Spillway Rating

Spillway is 40 feet from left end of dam.



Pool at 679.5

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

$= 3.2 \times 14.5 \times (3.5)^{3/2}$

$= 304$ cfs

Pool at 680.0

As Orifice

$Q = C a \sqrt{2gh}$

$C = 0.6$

$a = 14.5 \times 3.5$

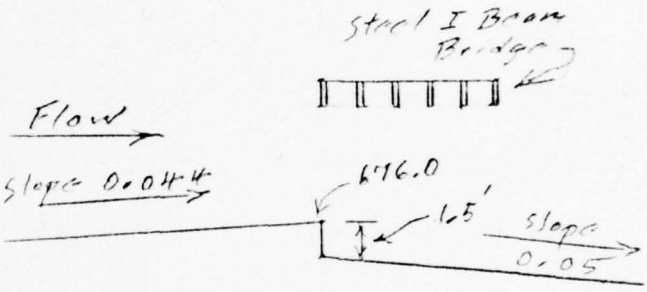
$= 50.75$

$h = 680 - \left(676 + \frac{3.5}{2}\right)$

$= 2.25$ ft.

$Q = 0.6 \times 50.75 \times \sqrt{64.3 \times 2.25}$

$= 366$ cfs



$C = 3.20$

Bratter & King Fig. 5-22

Pool at 680

As Weir

$Q = 3.2 \times 14.5 \times (4)^{3/2} = 370$ cfs

Maximum Known Flood

For USGS gaging station on Conestoga River at Lancaster, maximum flood for period 1933 to 1978 was 88,300 cfs on 6-23-72. The drainage area is 324 sq. mi. Transposed to Lebanon No. 2 Dam —

$\left(\frac{0.60}{324}\right)^{.8} \times 88{,}300 = 576$ cfs

Use 580 cfs (INflow)

SUBJECT Lebanon No. 2 Dam - ID No. 194

COMPUTED BY RES DATE 11-22-78 CHECKED BY JJP 11-30-78

Blowoff Discharge

Intake tower is 62 feet upstream from centerline of dam.
It has 2-ft by 2 ft gates with invert elevations of 665.9, 652.8 and 639.6.
Ungated cast-iron outflow pipes are 20 inch and 16 inch in diameter and have invert elevations of 639.0. These pipes were formerly used to deliver water to Lebanon, but they have 6-inch blowoff taps at a point 120 feet from intake tower. In addition, a 12-inch CIP, 170 feet long passes through the embankment on a line 85 feet to the right of the above pipes. Elevation of latter pipe is about 640 feet. It has a 12-inch valve at downstream end.

Pool at elev. 676

12-inch blowoff $h = 676 - 640 = 36$ ft. $n = 0.03$

$$Q = \frac{0.463}{n} \times d^{8/3} \times S^{1/2}$$

$S = \frac{36}{170} = 0.212$

$$= \frac{0.463}{0.03} \times (1)^{8/3} \times (0.212)^{1/2}$$

$= 7.1$ cfs

6-inch blowoff $c = 0.6$, $a = \pi r^2 = \pi (.25)^2 = 0.196$ ft^2

$$Q = c a \sqrt{2gh}$$

$$= 0.6 \times 0.196 \times (64.3 \times 36)^{1/2}$$

$= 5.7$

Total Blowoff $= 7.1 + 5.7 + 5.7 = 18.5$ cfs

Pool at elev. 642

12-inch blowoff $h = 642 - 640 = 2$ ft, $S = \frac{2}{170} = 0.0118$

$$Q = \frac{0.463}{0.03} \times (0.0118)^{1/2}$$

$= 1.7$ cfs

6-inch blowoff $Q = 0.6 \times 0.196 \times (64.3 \times 2)^{1/2}$

$= 1.3$

Total blowoff $= 1.7 + 1.3 + 1.3 = 4.3$ cfs.

PROJECT

SUBJECT Lebanon No. 2 Dam - ID No. PA 5944

COMPUTED BY RCS DATE 11-22-78 CHECKED BY JJP 11-30-78

Blowoff Discharge (Cont.)

Warm-water outlet

Assume high level gate and the two 6-inch blow off valves. Pool at 676.0

$Q = 5.7 + 5.7 = 11.4$ cfs

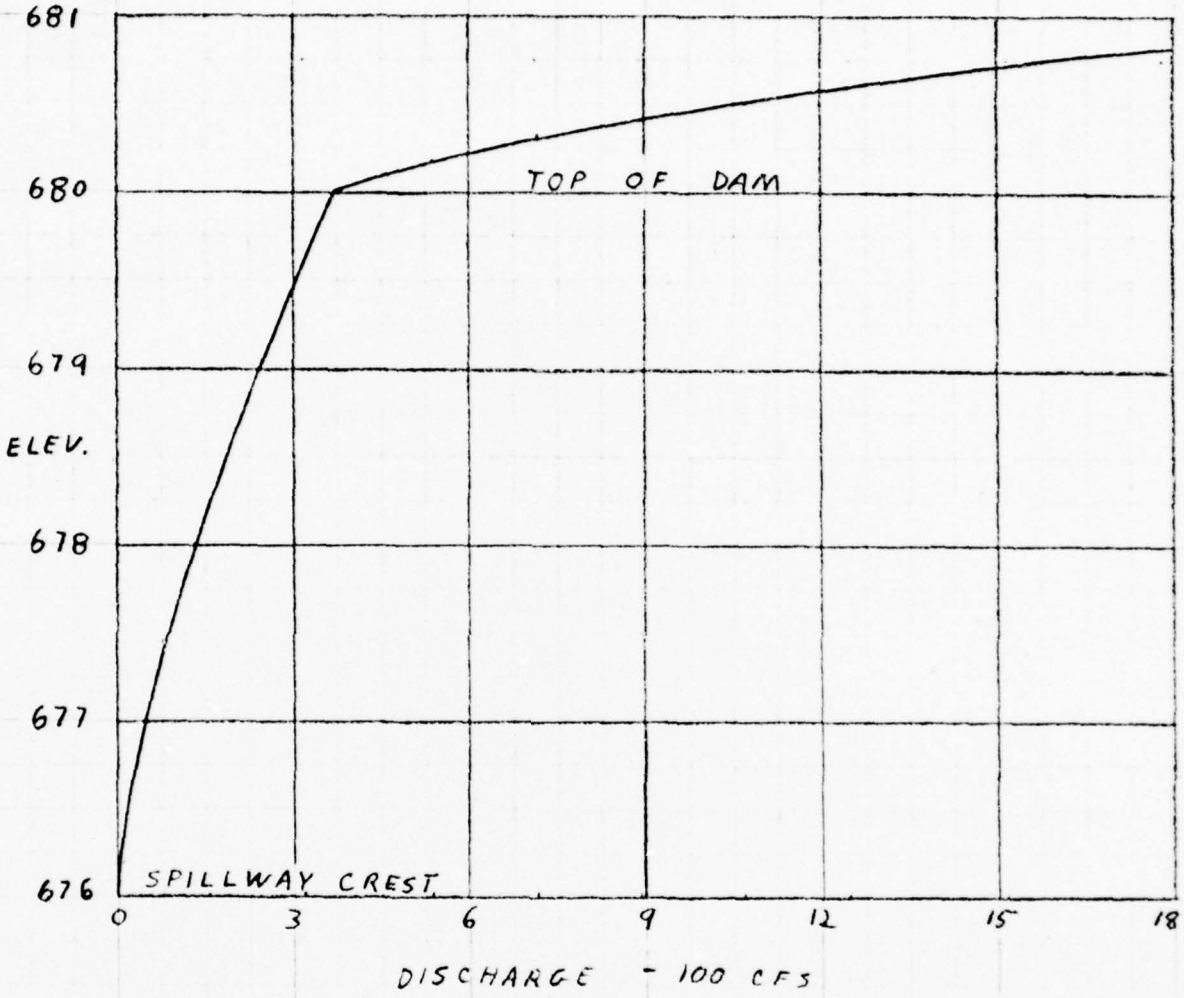
See computations above

BY RLS DATE 1/16/79 **BERGER ASSOCIATES** SHEET NO. 4

CHKD. BY ____ DATE ____ PROJECT D8490

SUBJECT REXMONT NO. 2

DISCHARGE RATING CURVE



BY RLS DATE 11/6/78 BERGER ASSOCIATES SHEET NO. 5 OF 7
CHKD. BY DATE PROJECT D8490
SUBJECT REXMONT NO. 2

SIZE CLASSIFICATION

MAXIMUM STORAGE = 189 ACRE-FEET
MAXIMUM HEIGHT = 42 FEET

SIZE CLASSIFICATION IS INTERMEDIATE

HAZARD CLASSIFICATION

REXMONT DAM NO. 1 LIES DOWNSTREAM OF THIS DAM.

USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

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

BY RLS DATE 1/16/79 **BERGER ASSOCIATES** SHEET NO. 6 of 7
CHKD. BY DATE PROJECT D8490
SUBJECT REXMONT NO. 2

HEC -1 DATA

DRAINAGE AREA = 0.6 SQ. MI.

SUSQUEHANNA BASIN REGION 15C

$C_P = .82$

$C_T = 2.78$

LONGEST WATER COURSE = 1.10 MI.

L TO CENTROID = .51 MI.

$$T_P = C_T (L \times L_{CA})^{.3}$$

$TP = 2.34$

RAINFALL (HMR -33)

INDEX (200 SQ.MI. - 24 HR.) = 23.2"

ZONE 6

INCREMENTAL RAINFALL

6 HR = 113 %

12 HR = 123 %

24 HR = 132 %

48 HR = 143 %

PLANIMETERED AREAS (FROM QUAD SHEETS)

ELEV. 676 = 9.2 ACRES

700 = 16.07 ACRES

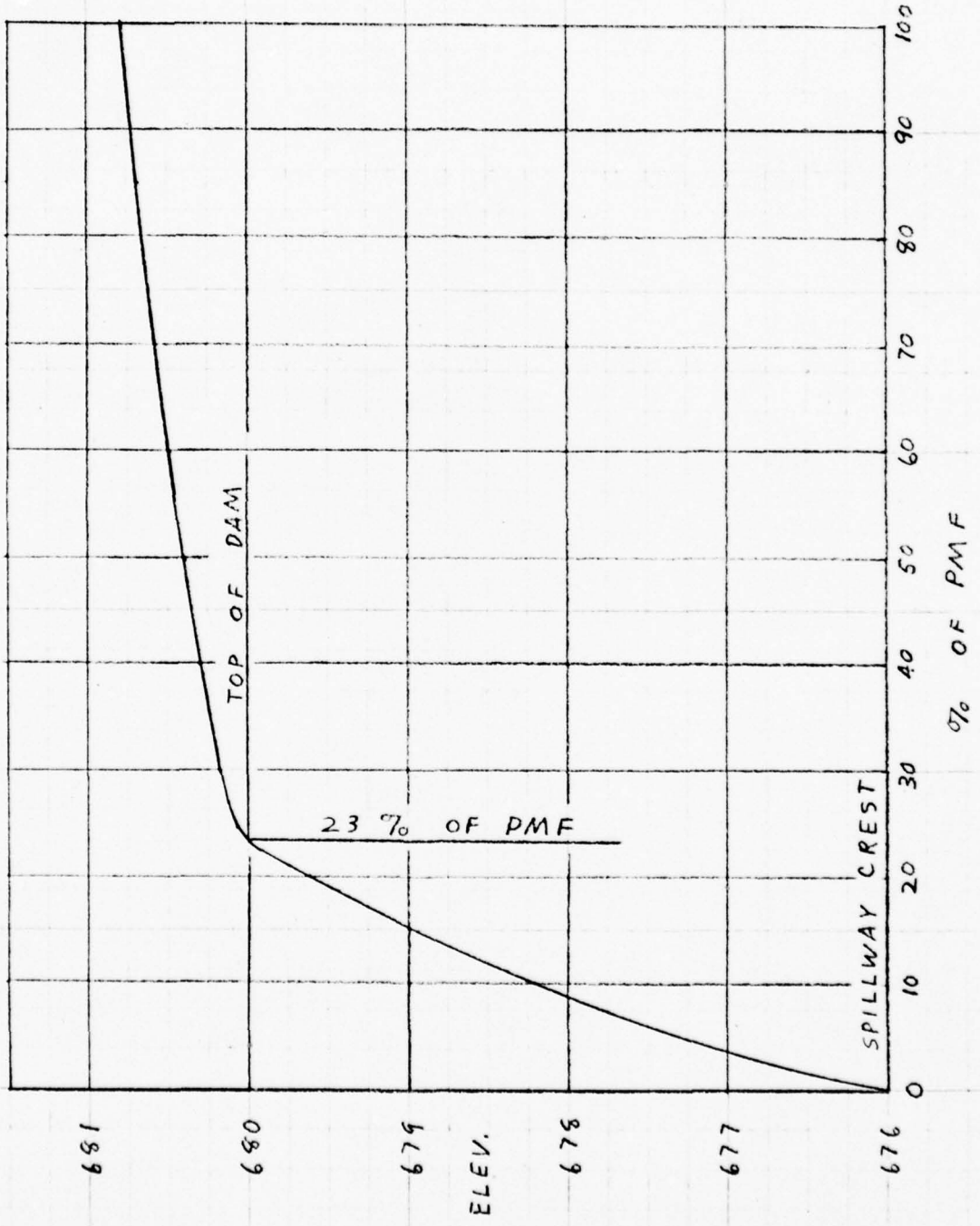
ZERO STORAGE ELEVATION

ELEV. = 676 - (STORAGE x 3/AREA)

= 627.09

BY R.L.S. DATE 11/16/79 **BERGER ASSOCIATES** SHEET NO. 7 OF 7
CHKD. BY ..... DATE ..... PROJECT D8490
SUBJECT REXMONT NO. 2

SPILLWAY CAPACITY CURVE



ANALYSIS

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************
    1             A1      REXMONT NO. 2 DAM  ****  WEST BRANCH HAMMER CREEK
    2             A2      SOUTH LEBANON TWP., LEBANON COUNTY
    3             A3      NDI # PA-00594   PA DER # 38-2
    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
    9             K1             INFLOW HYDROGRAPH
   10             M     1      1     .6
   11             P           23.2    113    123    132    143
   12             T                                           1    .05
   13             W  2.34    .82
   14             X -1.5    -.05     2
   15             K     1      2                                   1
   16             K1             RESERVOIR ROUTING
   17             Y                           1      0
   18             Y1    1                                      150
   19             $A    0    9.2   16.07
   20             $E627.09    676    700
   21             $$  676   14.5    3.2    1.5
   22             $D  680    2.7    1.5    690
   23             K    99
1                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                             RUNOFF HYDROGRAPH AT          1
                             ROUTE HYDROGRAPH TO           2
                             END OF NETWORK


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

 RUN  DATE* 79/05/21.
      TIME* 05.03.51.


                        REXMONT NO. 2 DAM  ****  WEST BRANCH HAMMER CREEK
                        SOUTH LEBANON TWP., LEBANON COUNTY
                        NDI # PA-00594   PA DER # 38-2

                                      JOB SPECIFICATION
                    NQ     NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT    IPRT   NSTAN
                   300       0      15       0      0       0       0       0      -4       0
                                   JOPER     NWT   LROPT   TRACE
                                       5       0       0       0

                                  MULTI-PLAN ANALYSES TO BE PERFORMED
                                      NPLAN= 1 NRTIO= 9 LRTIO= 1
                RTIOS=   1.00    .85    .70    .60    .50    .40    .30    .20    .10
```

REXMONT NO. 2 DAM **** WEST BRANCH HAMMER CREEK
SOUTH LEBANON TWP., LEBANON COUNTY
NDI # PA-00594 PA DER # 38-2

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 1.00 .85 .70 .60 .50 .40 .30 .20 .10

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

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	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.60	0.00	.60	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.20	113.00	123.00	132.00	143.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	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= 2.34 CP= .82 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 26 END-OF-PERIOD ORDINATES, LAG= 2.32 HOURS, CP= .61 VOL= 1.00

6.	21.	41.	61.	80.	99.	116.	130.	137.	137.
134.	125.	112.	91.	68.	50.	37.	27.	20.	15.
11.	8.	6.	4.	3.	2.				

0 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	26.54	24.13	2.41	37466.
										(674.)(613.)(61.)(1066.58)			

********** ********** ********** ********** **********

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING

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

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	150.	0

SURFACE AREA=	0.	9.	16.
CAPACITY=	0.	150.	449.
ELEVATION=	627.	676.	700.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
676.0	14.5	3.2	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
680.0	2.7	1.5	690.

PEAK OUTFLOW IS 1779. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1512. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1245. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 1068. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 890. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 712. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 533. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 319. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 153. AT TIME 42.75 HOURS

********** ********** ********** ********** **********

1 ********** ********** ********** ********** **********

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)

				RATIOS APPLIED TO FLOWS								
OPERATION	STATION	AREA	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	.60	1	1779.	1512.	1245.	1067.	889.	712.	534.	356.	178.
	(	1.55)	(	50.38)(	42.82)(	35.26)(	30.23)(	25.19)(	20.15)(	15.11)(	10.08)(	5.04)
ROUTED TO	2	.60	1	1779.	1512.	1245.	1068.	890.	712.	533.	319.	153.
	(	1.55)	(	50.37)(	42.82)(	35.27)(	30.23)(	25.19)(	20.15)(	15.10)(	9.03)(	4.32)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	676.00	676.00	680.00
STORAGE	150.	150.	189.
OUTFLOW	0.	0.	371.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	680.78	.78	197.	1779.	6.25	42.00	0.00
.85	680.68	.68	196.	1512.	5.75	42.00	0.00
.70	680.57	.57	195.	1245.	5.25	42.00	0.00
.60	680.48	.48	194.	1068.	4.50	42.00	0.00
.50	680.39	.39	193.	890.	4.25	42.00	0.00
.40	680.30	.30	192.	712.	3.25	42.00	0.00
.30	680.18	.18	191.	533.	2.00	42.00	0.00
.20	679.61	0.00	185.	319.	0.00	42.75	0.00
.10	678.21	0.00	171.	153.	0.00	42.75	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****
EOI ENCOUNTERED.
N>

APPENDIX D

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dan and Reservoir

Formation Name: Diabase (Triassic age).

Lithology: Diabase is a dark gray, crystalline igneous rock composed of plagioclase feldspar and pyroxene, with minor amounts of magnetite, ilmenite and quartz. A small part of the reservoir is underlain by red sandstone.

Structure

The diabase was intruded as a dike cutting the sandstone and conglomerate beds of the Gettysburg Formation. The attitude of the dike here is not known, but it may dip steeply to the north. The beds in the Gettysburg Formation dip N55°E and dip 28°NW. There is faulting in the area, the dike may have been intruded along a fault, but no faults have been mapped at the dam.

Air Photo fracture traces strike N10-15°E in the sandstone.

Overburden

No boring data are available at the dam. Overburden on diabase is usually very thin, three to five feet at most.

Aquifer Characteristics

Diabase generally acts as a barrier to ground water movement. Jointing is generally prismatic and does not provide open channels for ground water movement. It is possible that the valley of Hammer Creek here is controlled by the N10°E fracture set and there could be some ground water movement in this direction.

Discussion

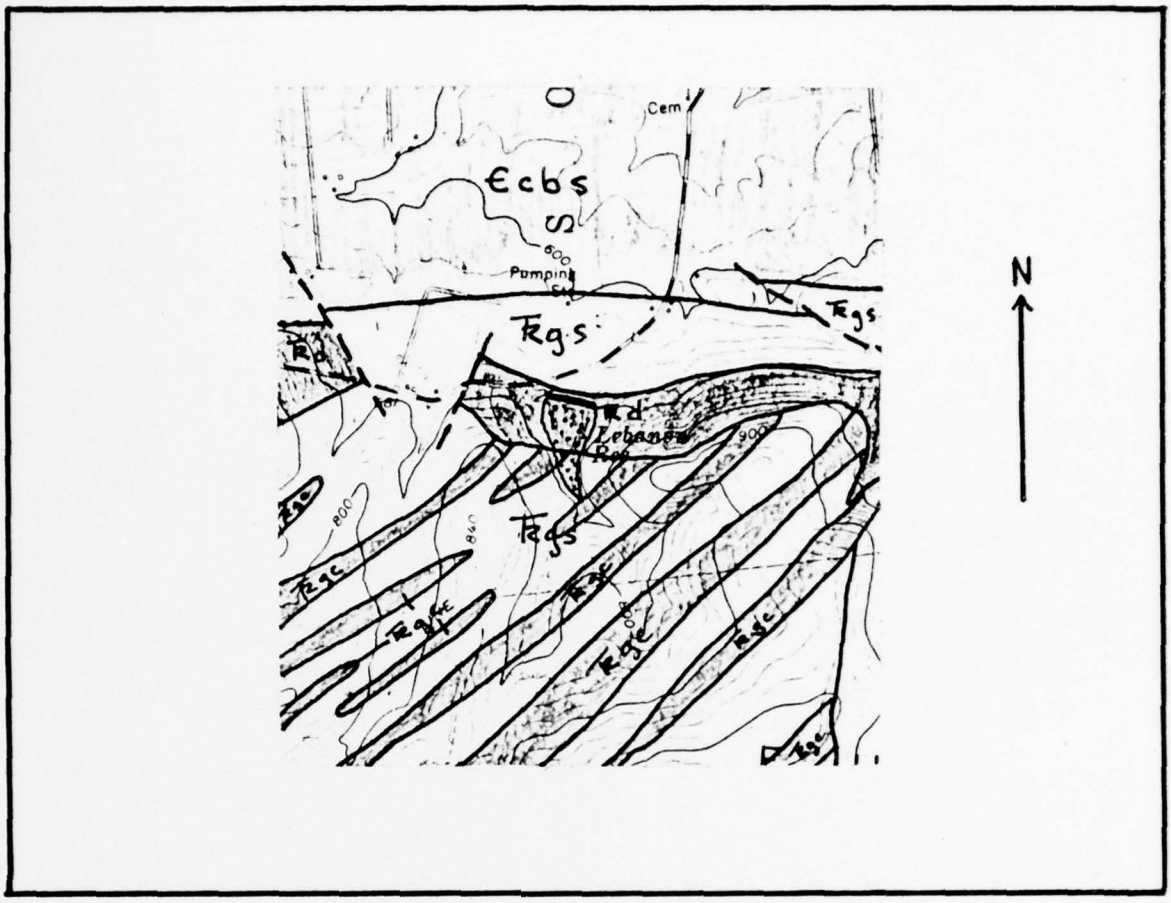
This dam was built in 1884 and no plans of its foundation are in the file. Inspection reports have noted leakage at the toe of the dam. If there is no cutoff wall this may be along the top of the rock surface, or in weathered bedrock if this was not removed. Diabase is a strong sound rock. Continued seepage should not cause any deterioration of the rock.

Sources of Information

1. Gray, C., Geyer, A.R. and McLaughlin, D.B. (1958), "Geology of the Richland Quadrangle", Pa. Geological Survey Bulletin A167D.

2. Inspection reports in file.

GEOLOGIC MAP - Lebanon Reservoir #2 Dam



(geology from Pa. Geol. Surv. Atlas 167D)

Rd — diabase

Rgc — Gettysburg Fm. - conglomerate

Rgs — Gettysburg Fm. - sandstone

Ecbs — Conococheague Fm. - Buffalo Springs Member

— — — high angle fault

SCALE 1:24000

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

CONTOUR INTERVAL 20 FEET

APPENDIX E

PHOTOGRAPHS

Upstream Slope
and Forebay

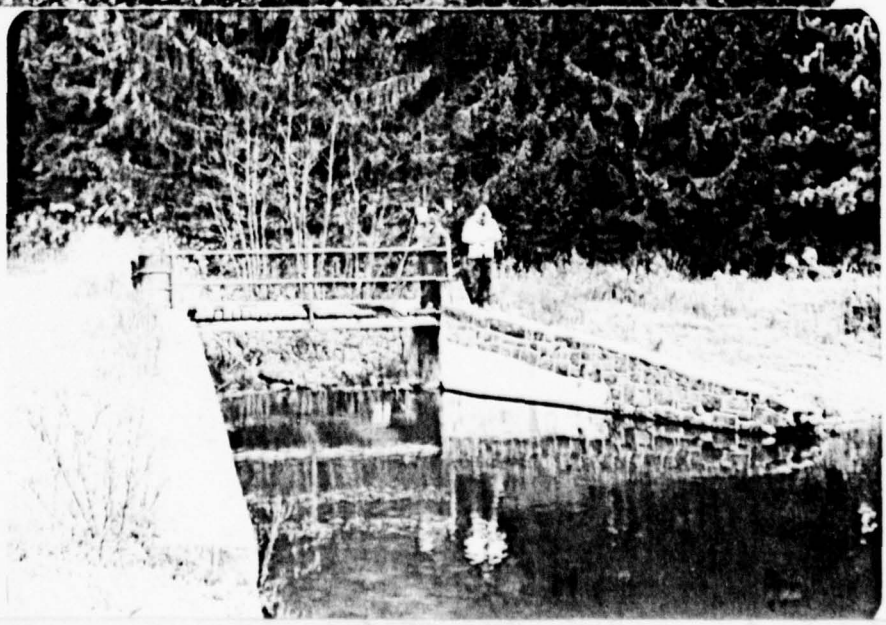
Top of Dam

Reservoir and
Control Tower

PA-594
PLATE E-1

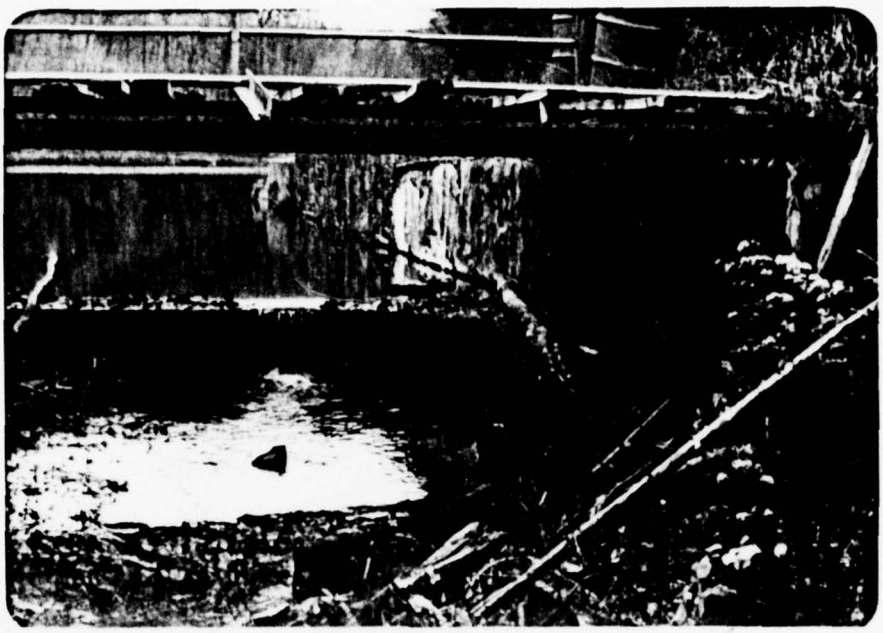
Downstream Slope
With Cut Brush

Downstream Berm



Spillway Entrance
& Bridge

PA-594
PLATE E-II



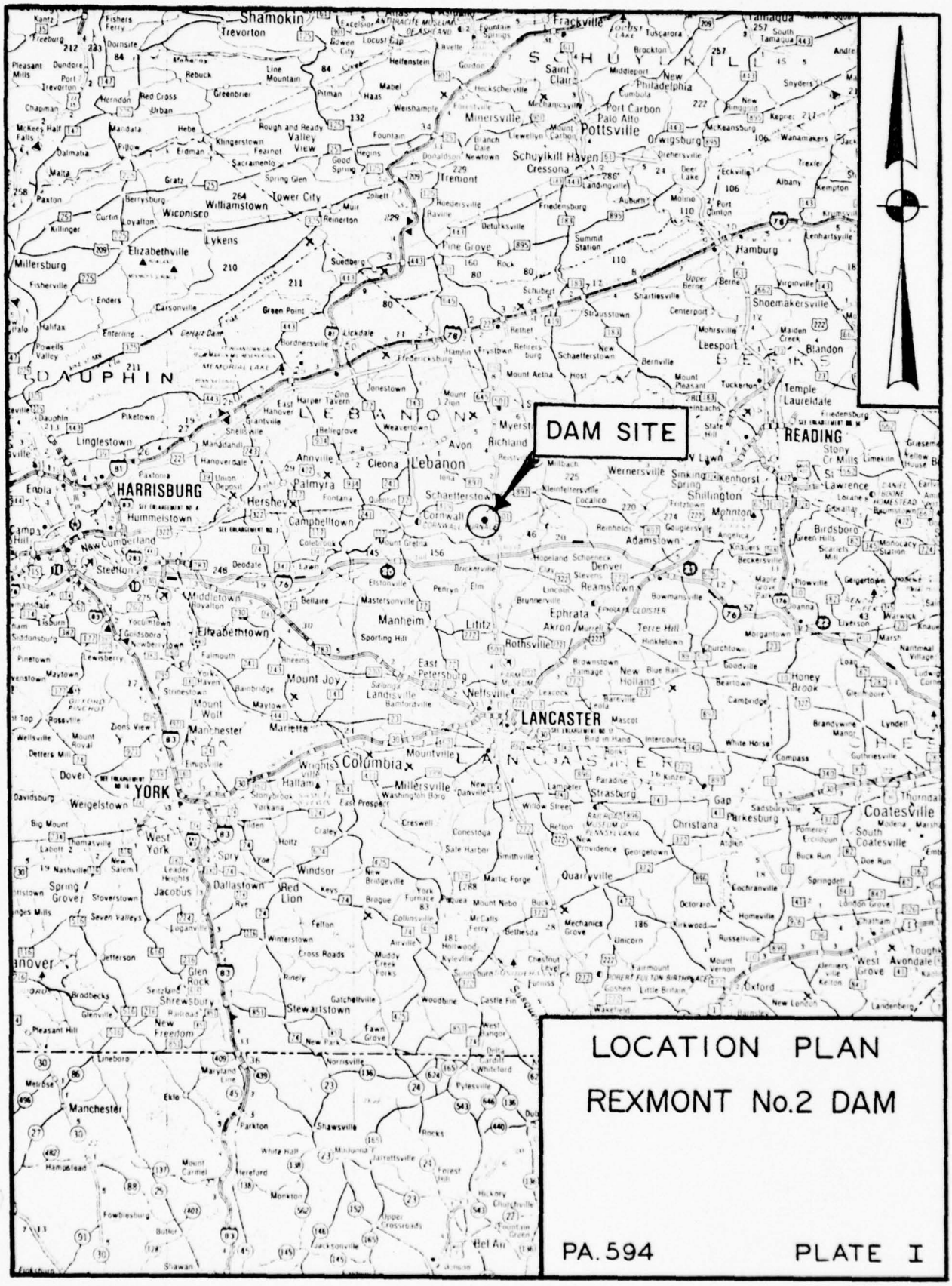
Spillway Looking Upstream Under Bridge

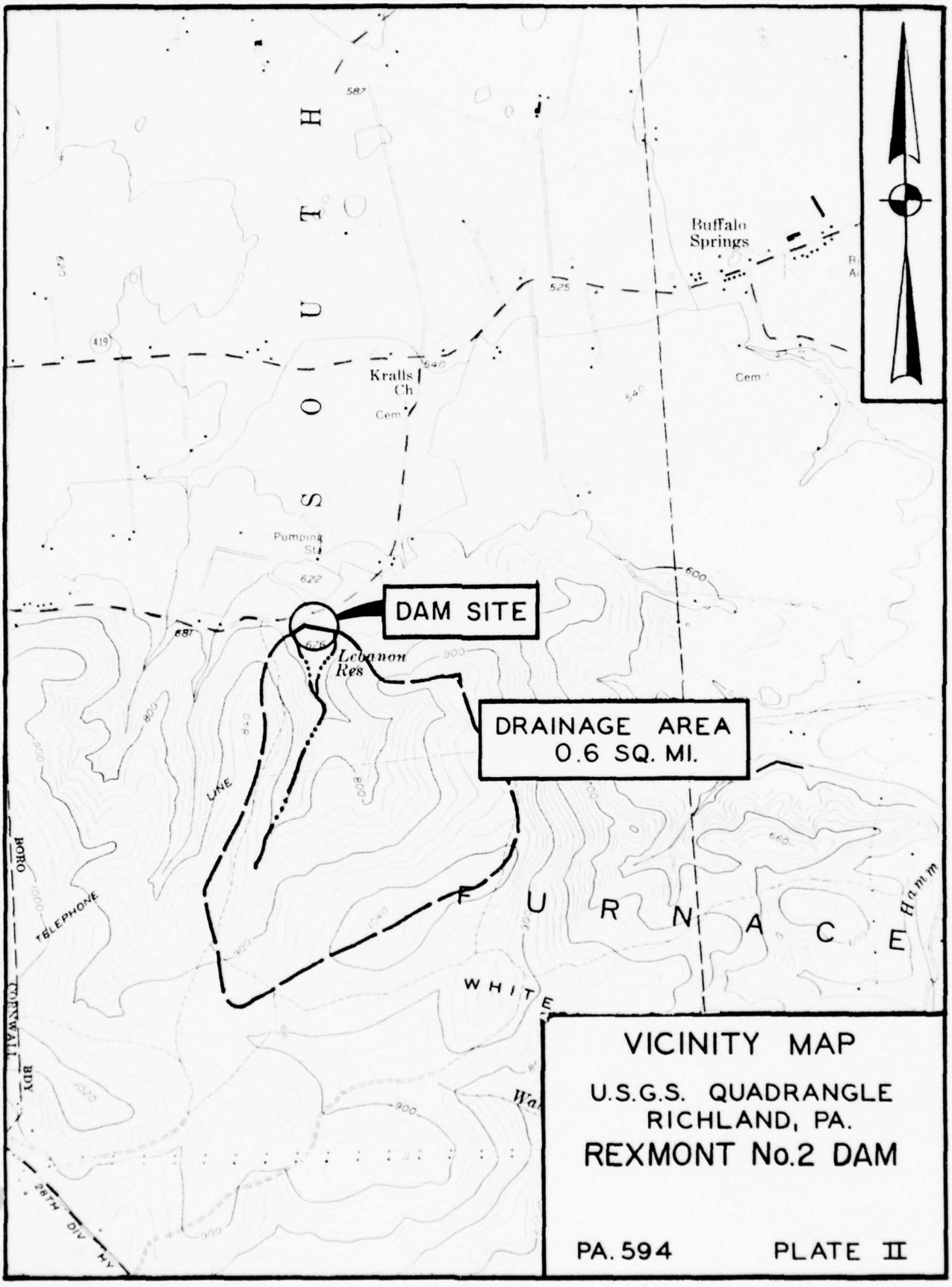
Looking From Dam To Downstream Reservoir

PA-594
PLATE E-111

APPENDIX F

PLATES


DAM SITE
LOCATION PLAN
REXMONT No.2 DAM
PA. 594
PLATE I

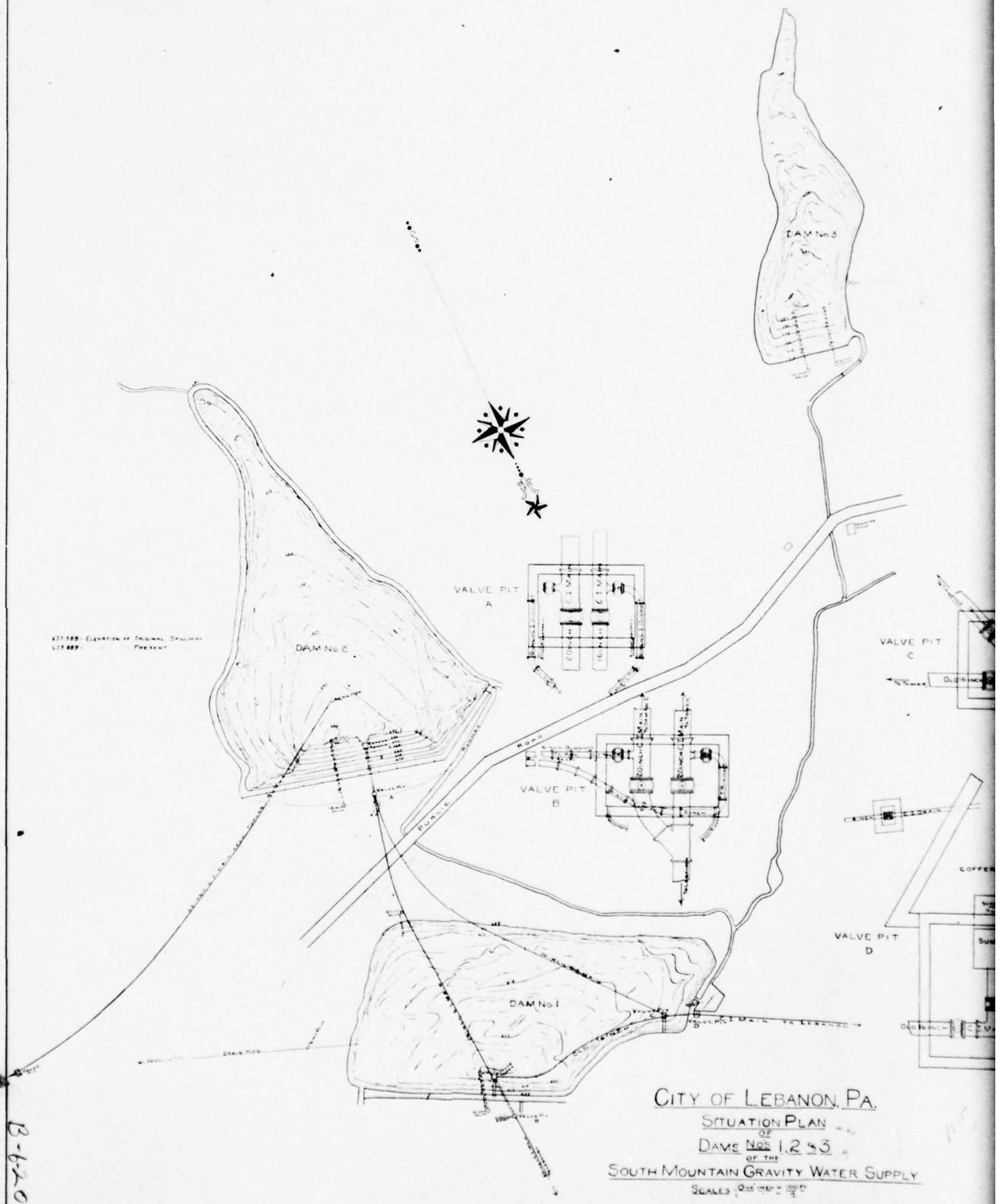


VICINITY MAP

U.S.G.S. QUADRANGLE
RICHLAND, PA.

REXMONT No.2 DAM

PA. 594 PLATE II



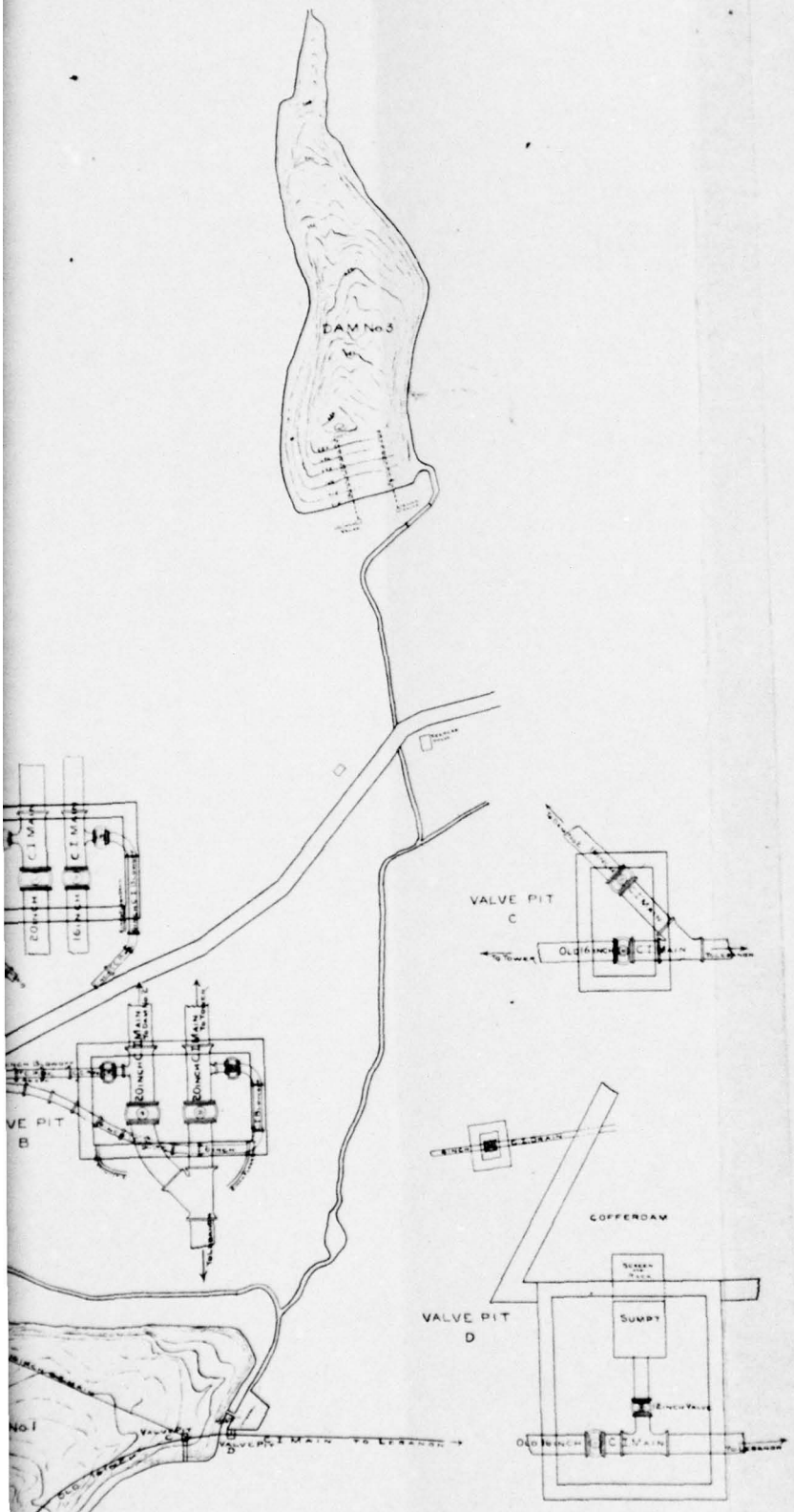
CITY OF LEBANON, PA.

SITUATION PLAN OF DAMS NOS 1, 2 & 3 OF THE SOUTH MOUNTAIN GRAVITY WATER SUPPLY

SCALE: One inch = 100 ft.

B-620

1

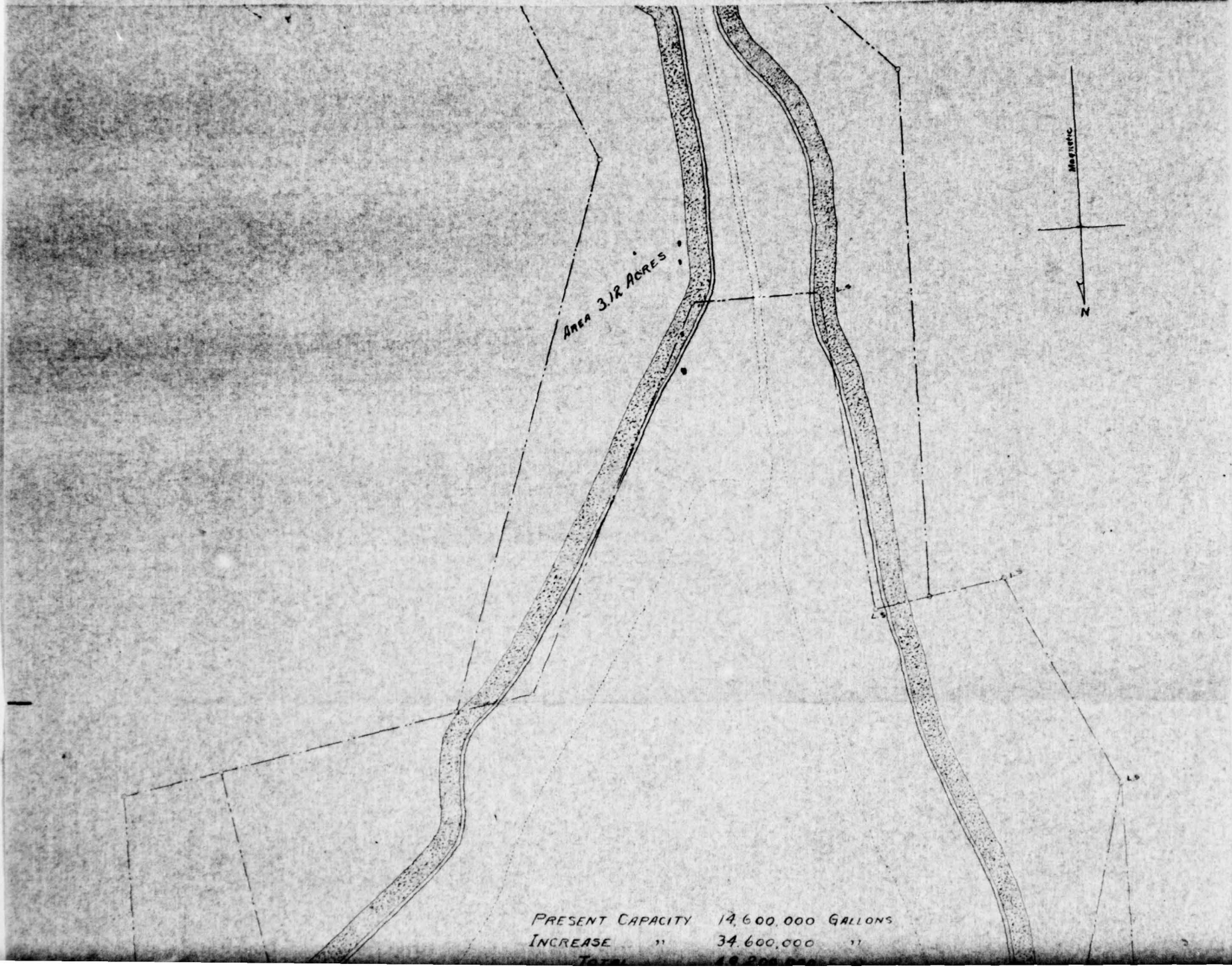


CITY OF LEBANON, PA.

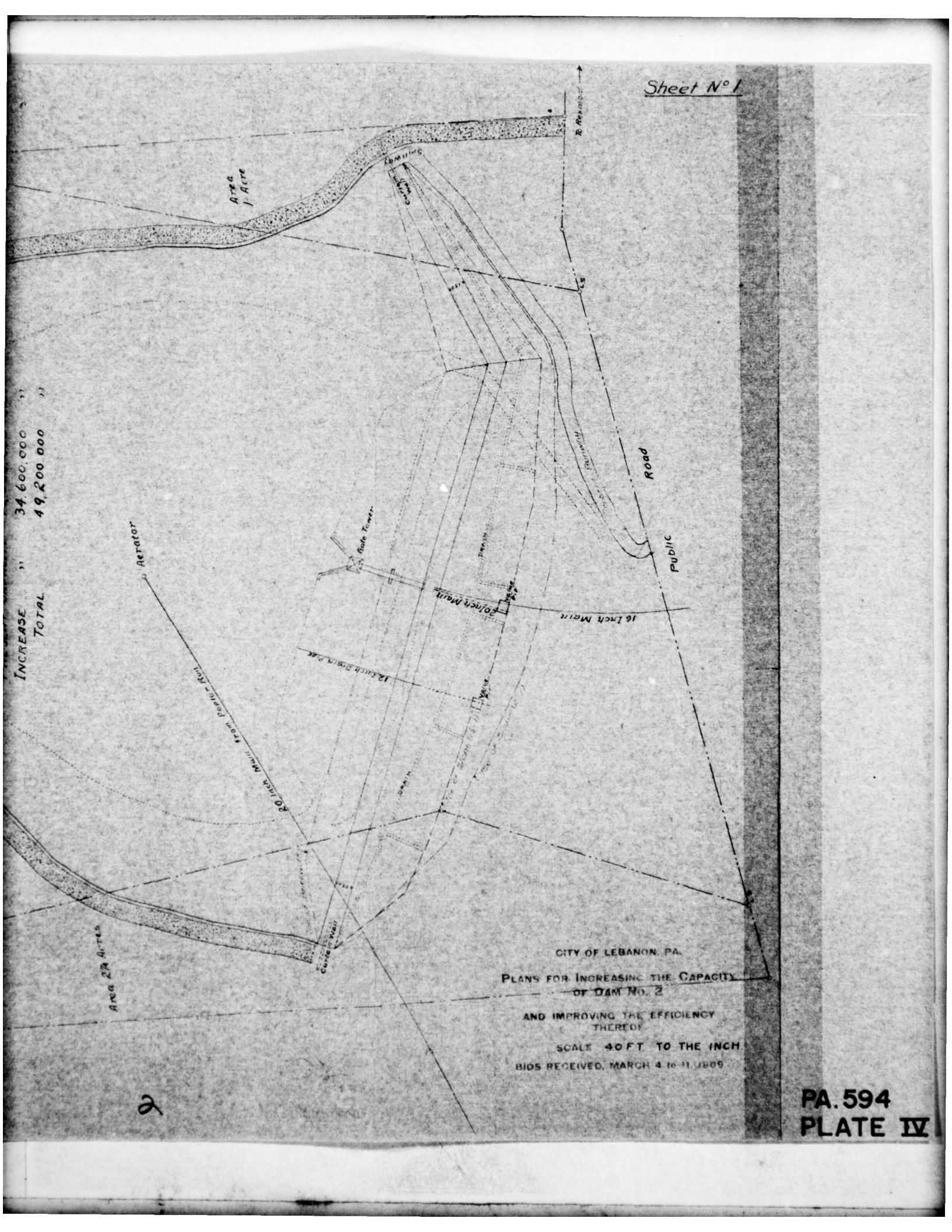
SITUATION PLAN OF DAMS NOS 1, 2 & 3 OF THE SOUTH MOUNTAIN GRAVITY WATER SUPPLY

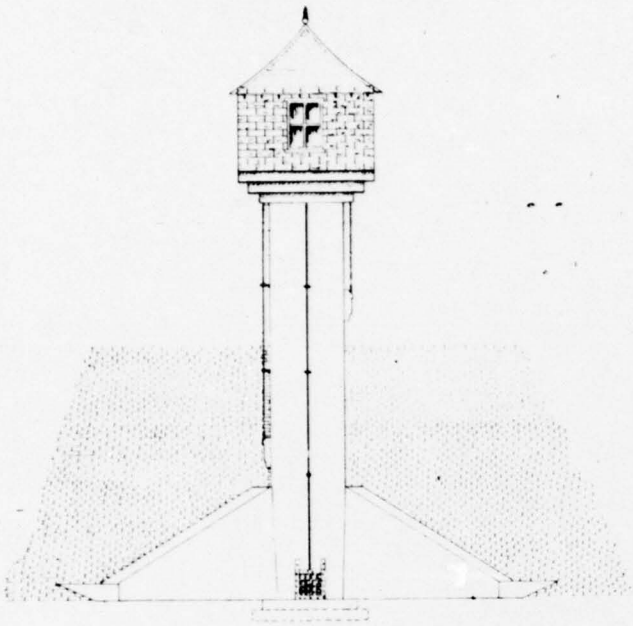
SCALES: ONE INCH = 100 FT

PA. 594
PLATE III

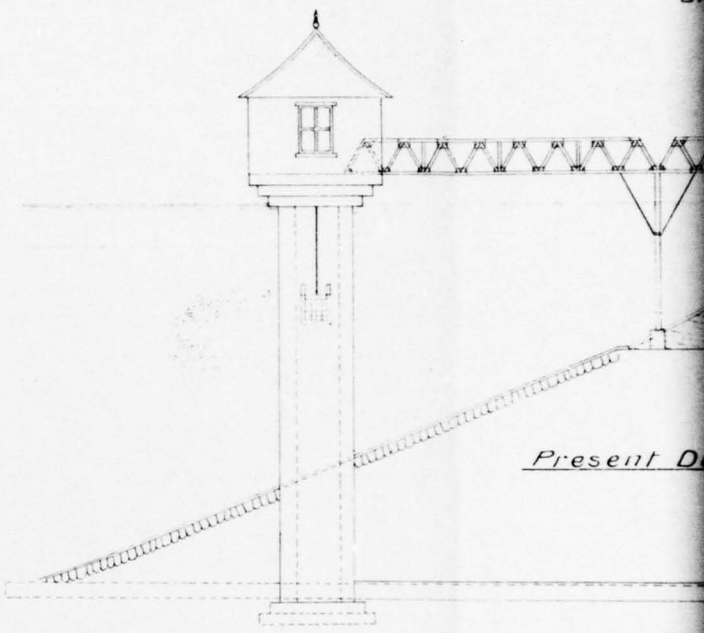


PRESENT CAPACITY 14,600,000 GALLONS
INCREASE " 34,600,000 "


Sheet No 1
Area 1 Acre
Aerator
Gate Tower
Road
Public
16 Inch Main
20 Inch Main
12 Inch Main
Area 2½ Acres
INCREASE 34,600,000 "
TOTAL 49,200,000 "
CITY OF LEBANON, PA.
PLANS FOR INCREASING THE CAPACITY OF DAM NO. 2
AND IMPROVING THE EFFICIENCY THEREOF
SCALE 40 FT TO THE INCH
BIDS RECEIVED, MARCH 4 to 11, 1909
2
PA. 594
PLATE IV



Front Elevation.

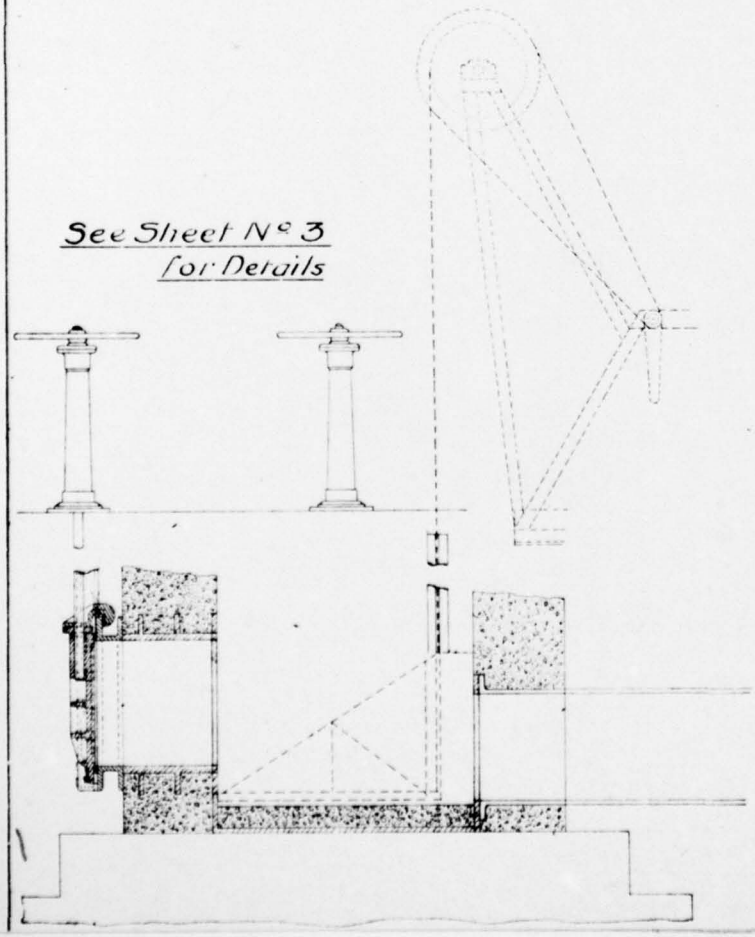


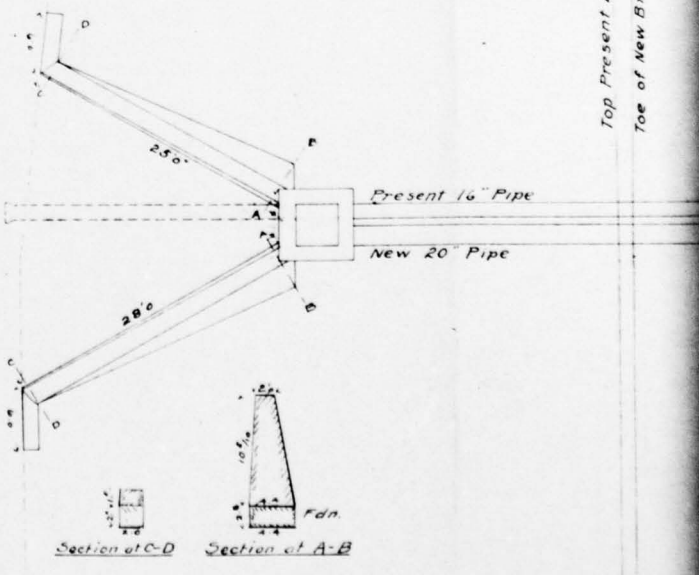
Intake Tower

Present D

Profile of

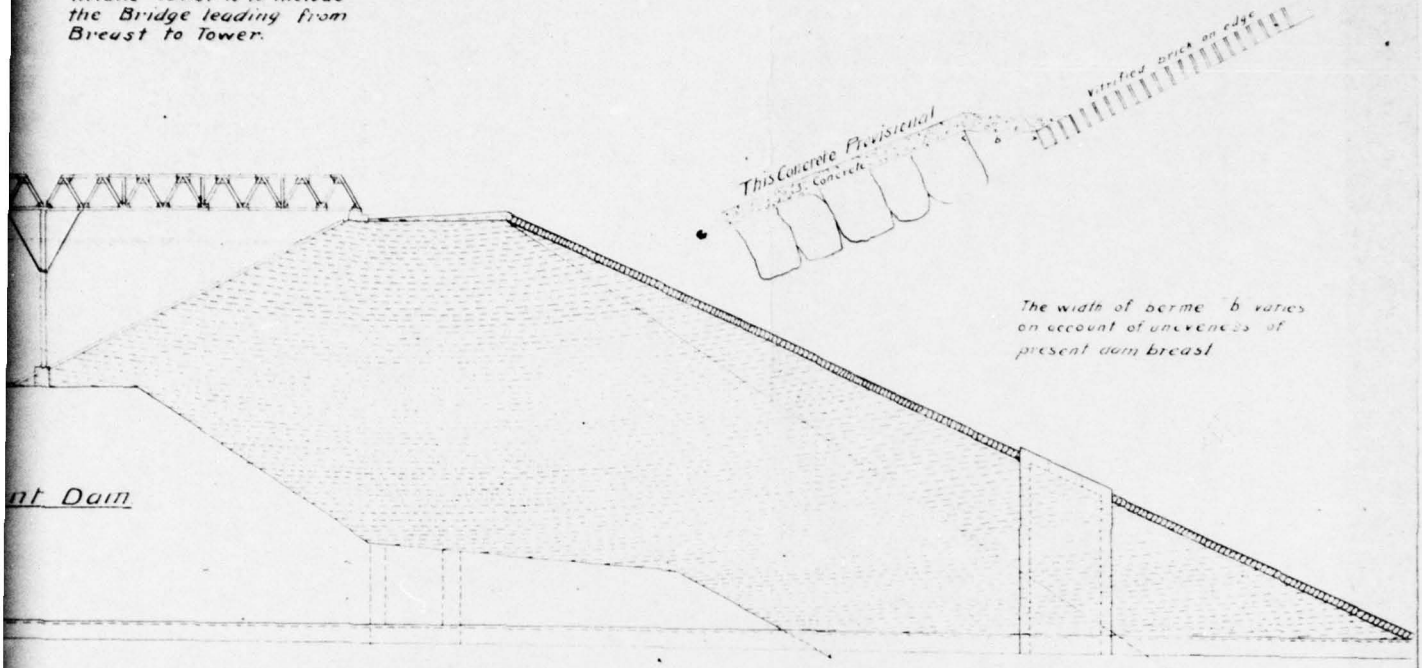
See Sheet No 3
for Details



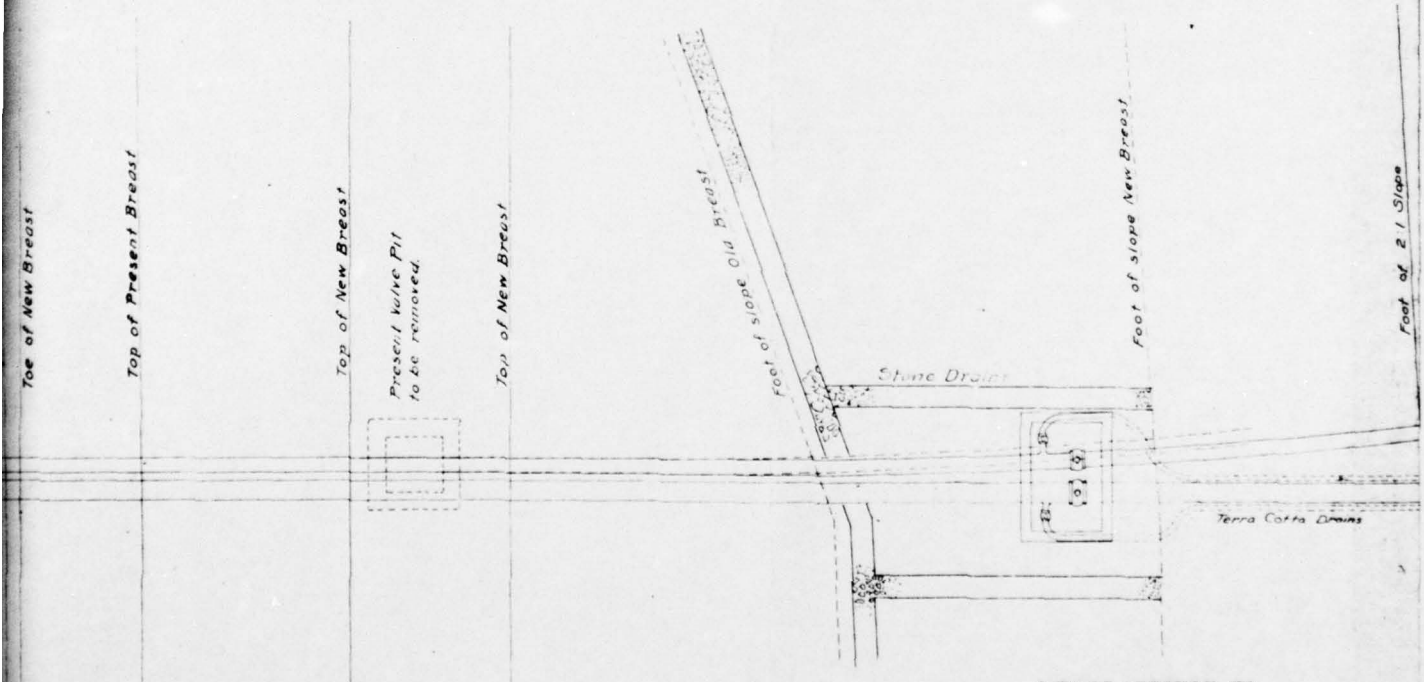


Sheet No 2.

The "Lump Sum" Price for Intake Tower is to include the Bridge leading from Breast to Tower.



ile of Dam at Intake Tower



CITY OF LEBANON, PA.

PLANS FOR INCREASING THE CAPACITY OF DAM NO. 2

AND IMPROVING THE EFFICIENCY THEREOF

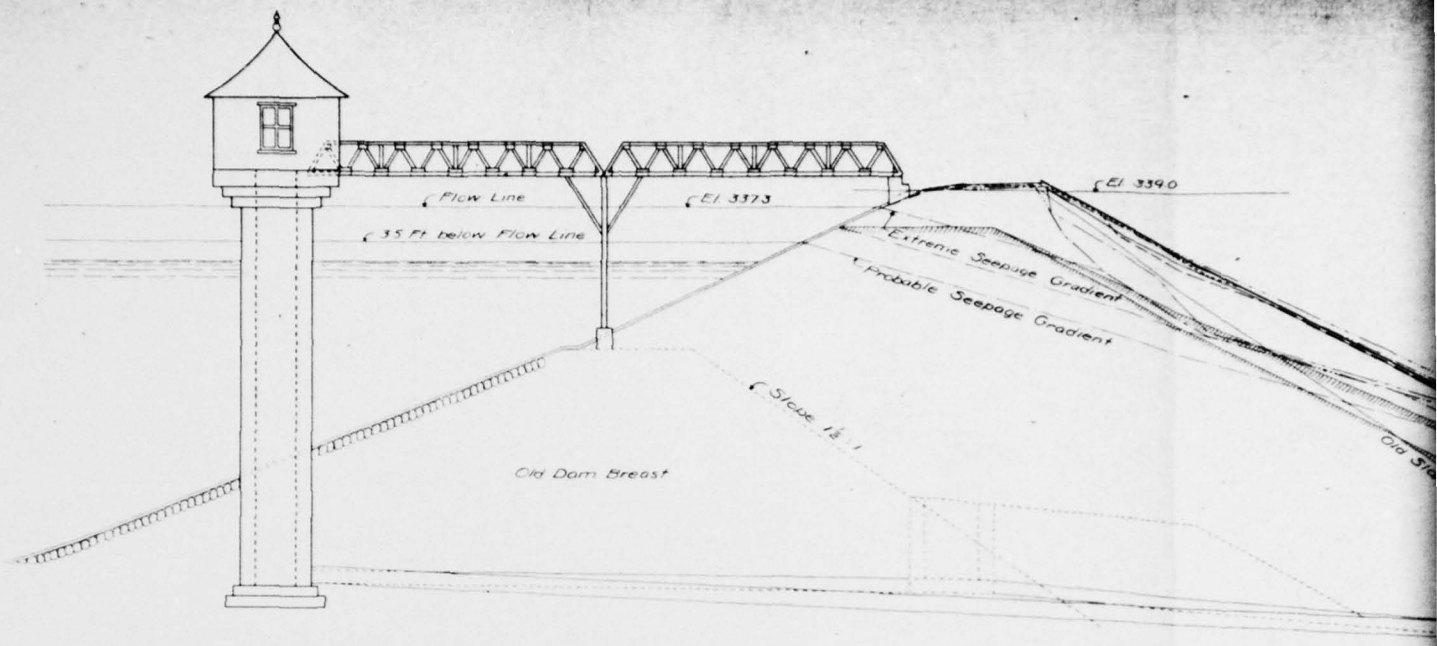
SCALE 1/8 IN. TO THE FT.

BIDS RECEIVED, MARCH 4 to 11, 1909

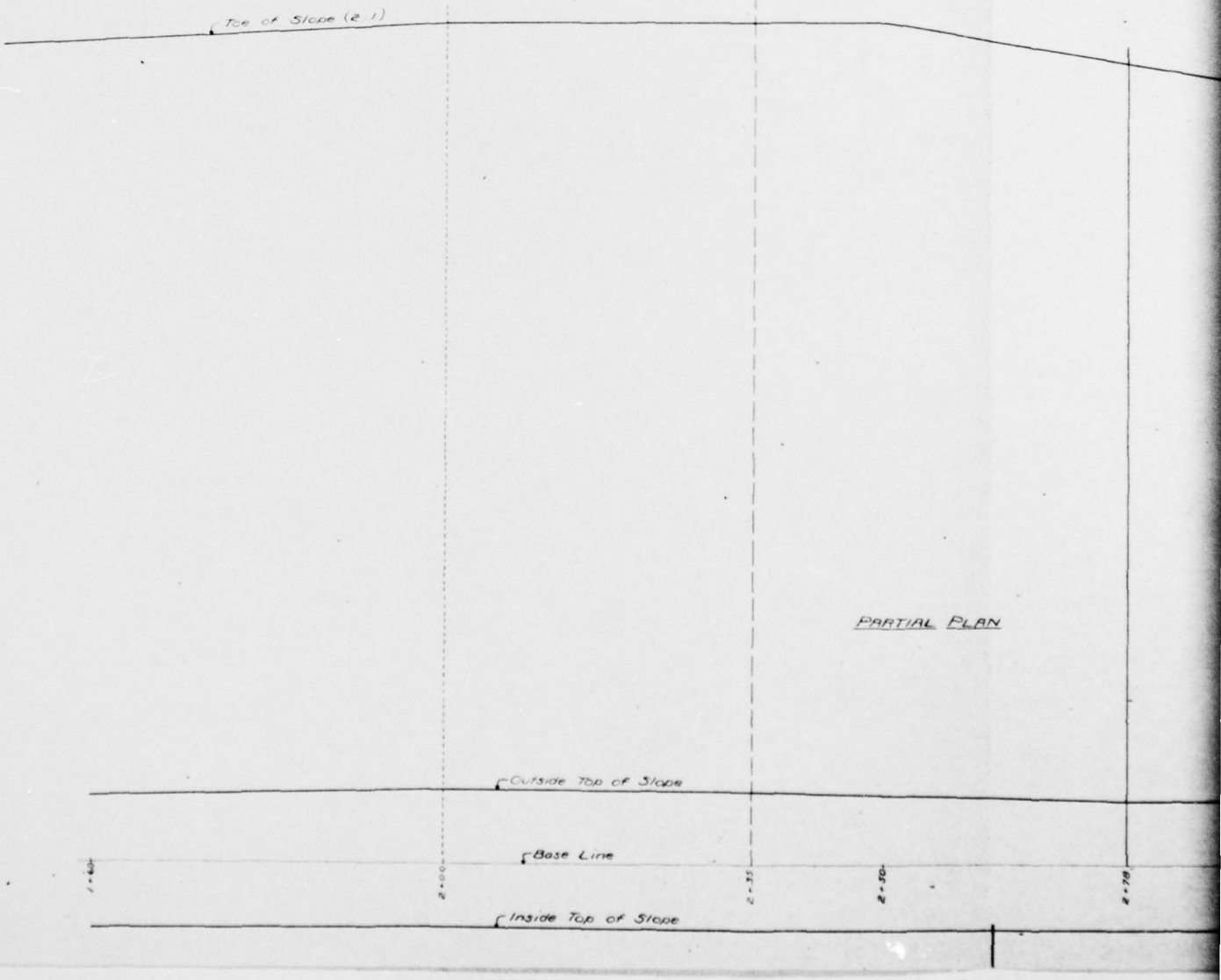
H. Worrall
CITY ENGINEER

2
Partial Plan

PA.594
PLATE



SECTION

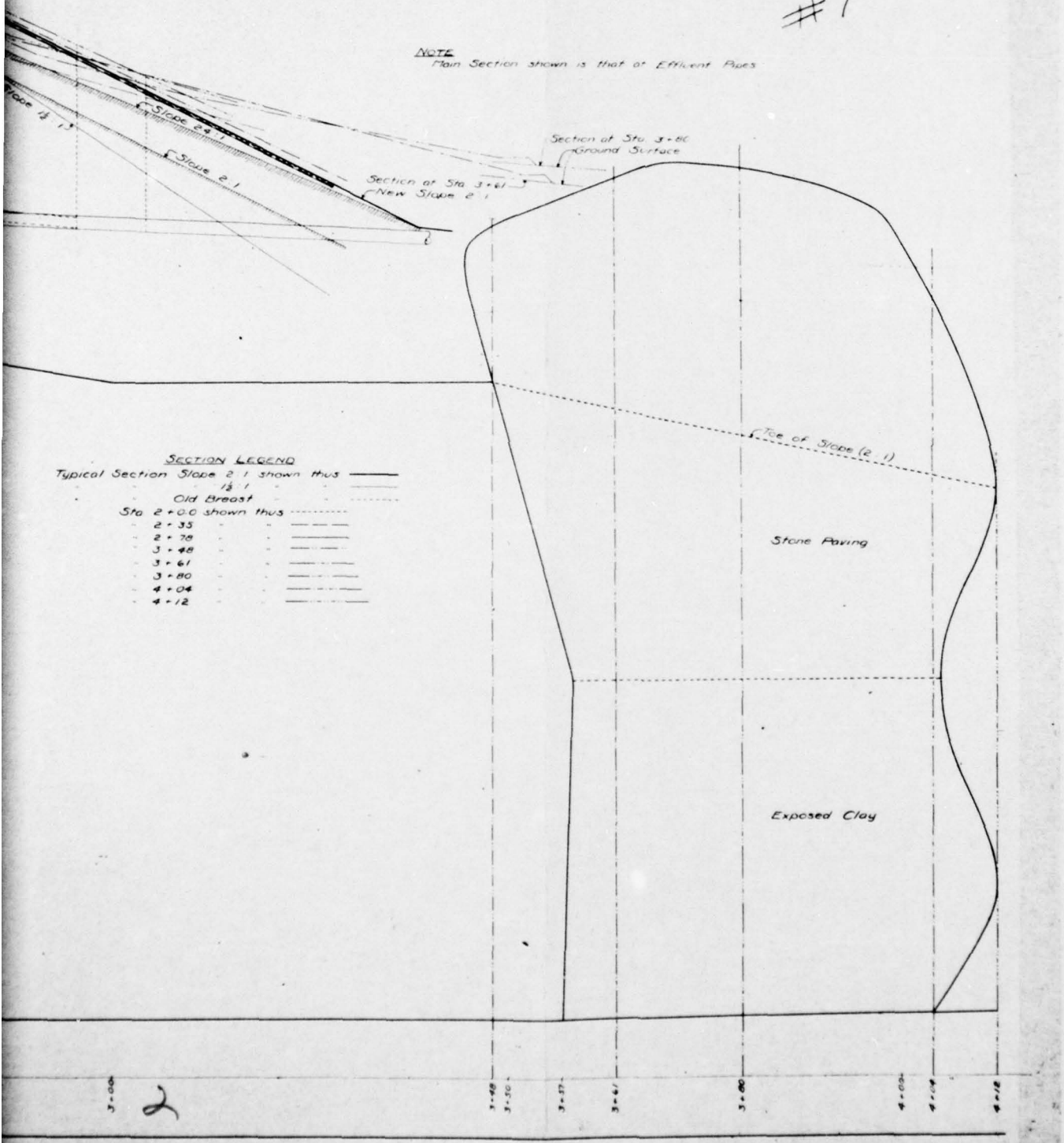


PARTIAL PLAN

CITY OF LEBANON, PA
SECTION THROUGH DAM NO. 2 AND PARTIAL PLAN
SHOWING
SLIP OF APRIL 8, 1912 ON OUTER SLOPE, ETC.
APRIL 16, 1912 SCALE 1/8" = 1'-0"
Approved: [illegible]
City Engineer
S.H. Smith, Del.

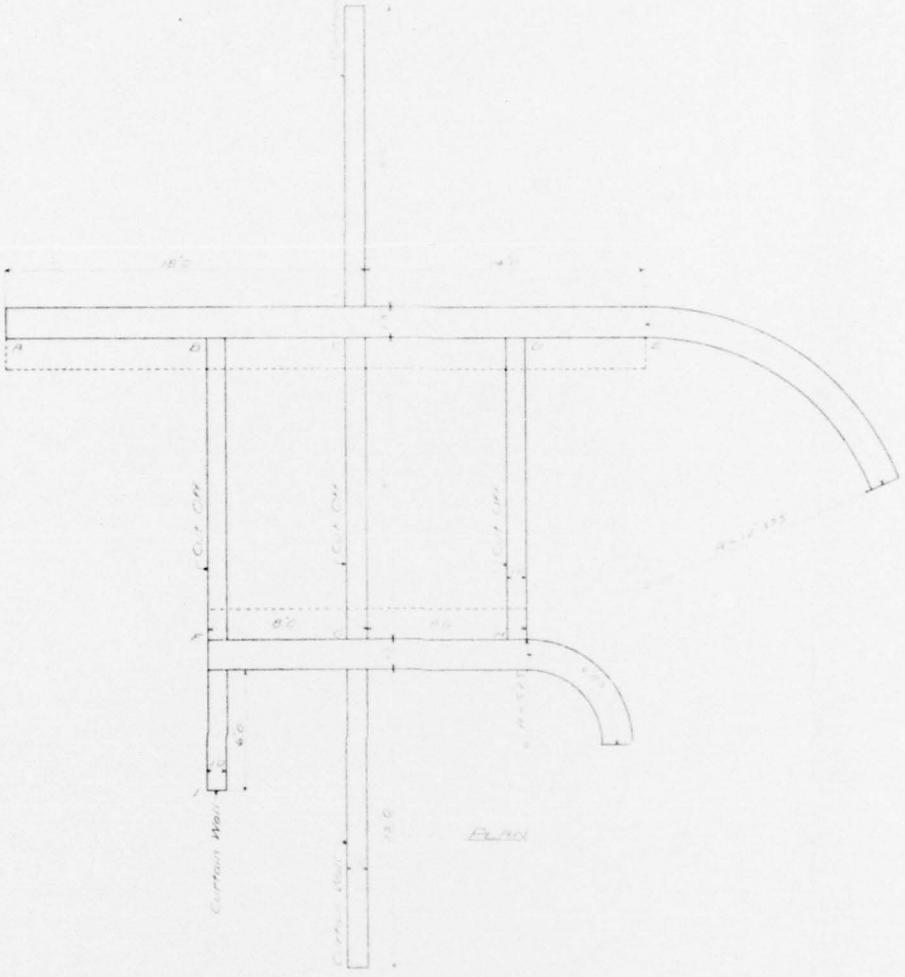
#1

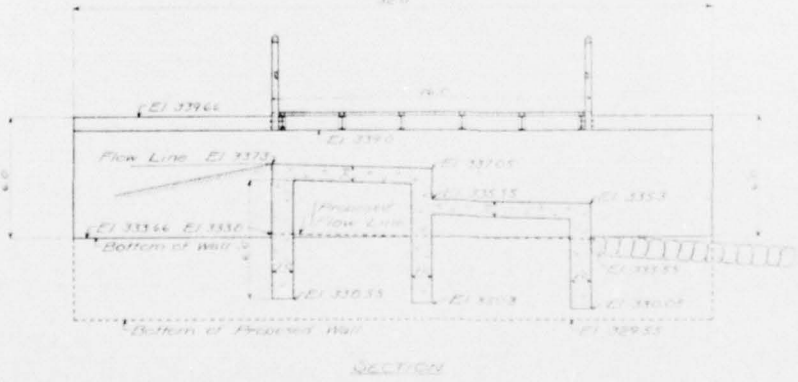
NOTE
Plain Section shown is that of Efficient Pipes



2

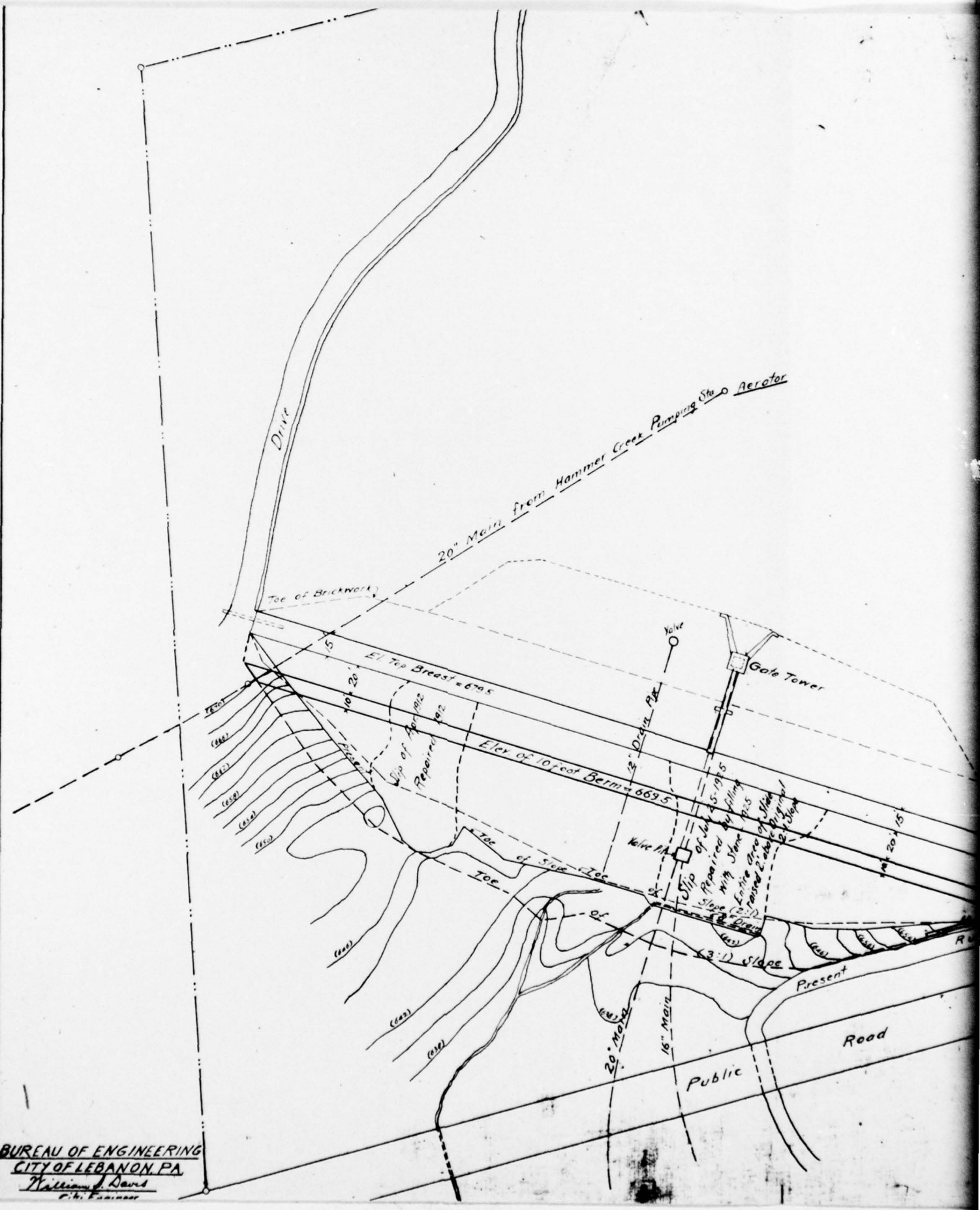
PA. 594
PLATE VI

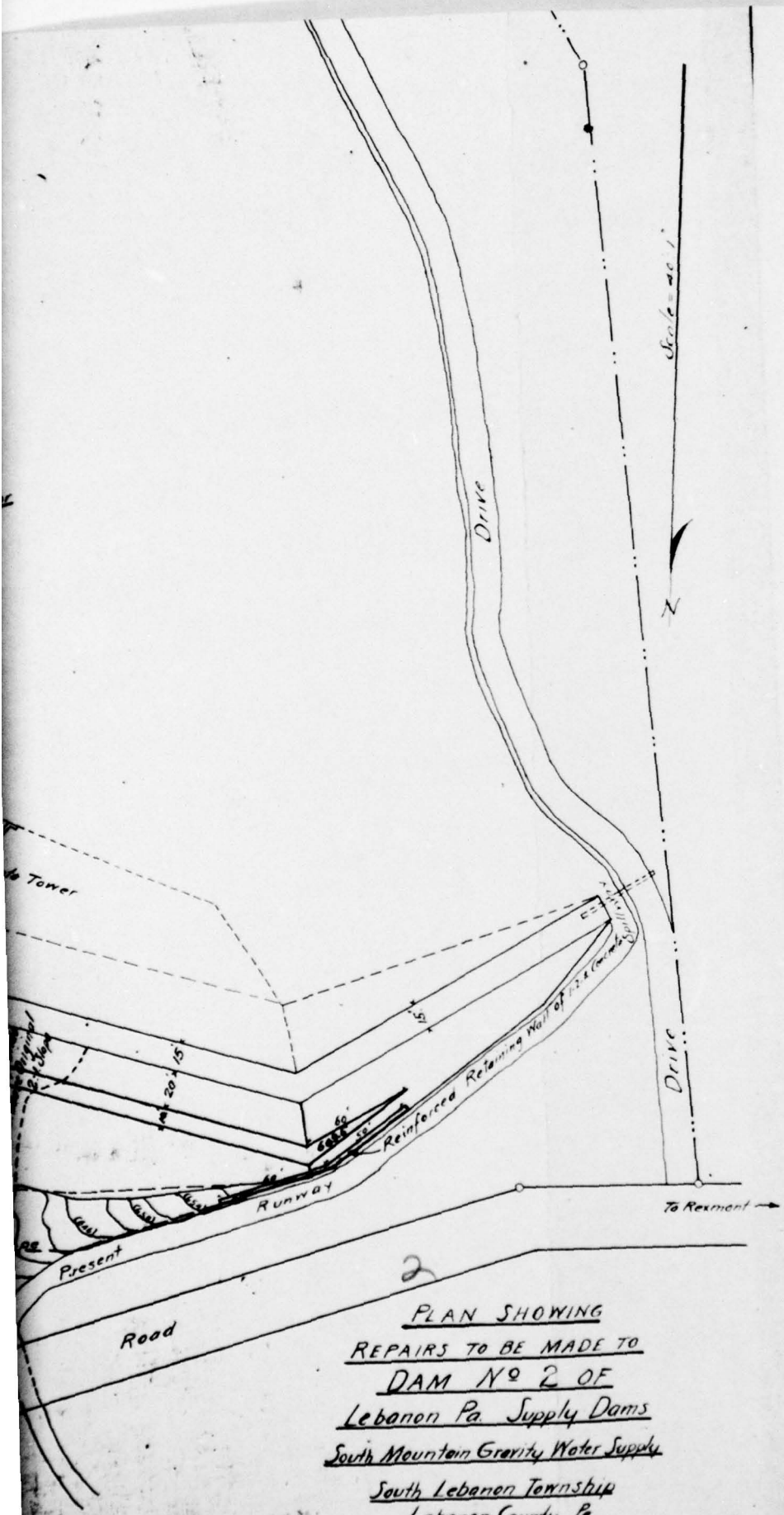




CITY OF LEBANON, PA.
DETAIL OF SPILLWAY
DAM NO. 2
SHOWING PROPOSED CHANGE
MAY 9, 1940 SCALE 1/4" = 1'-0"
APPROVED _____
CITY ENGINEER

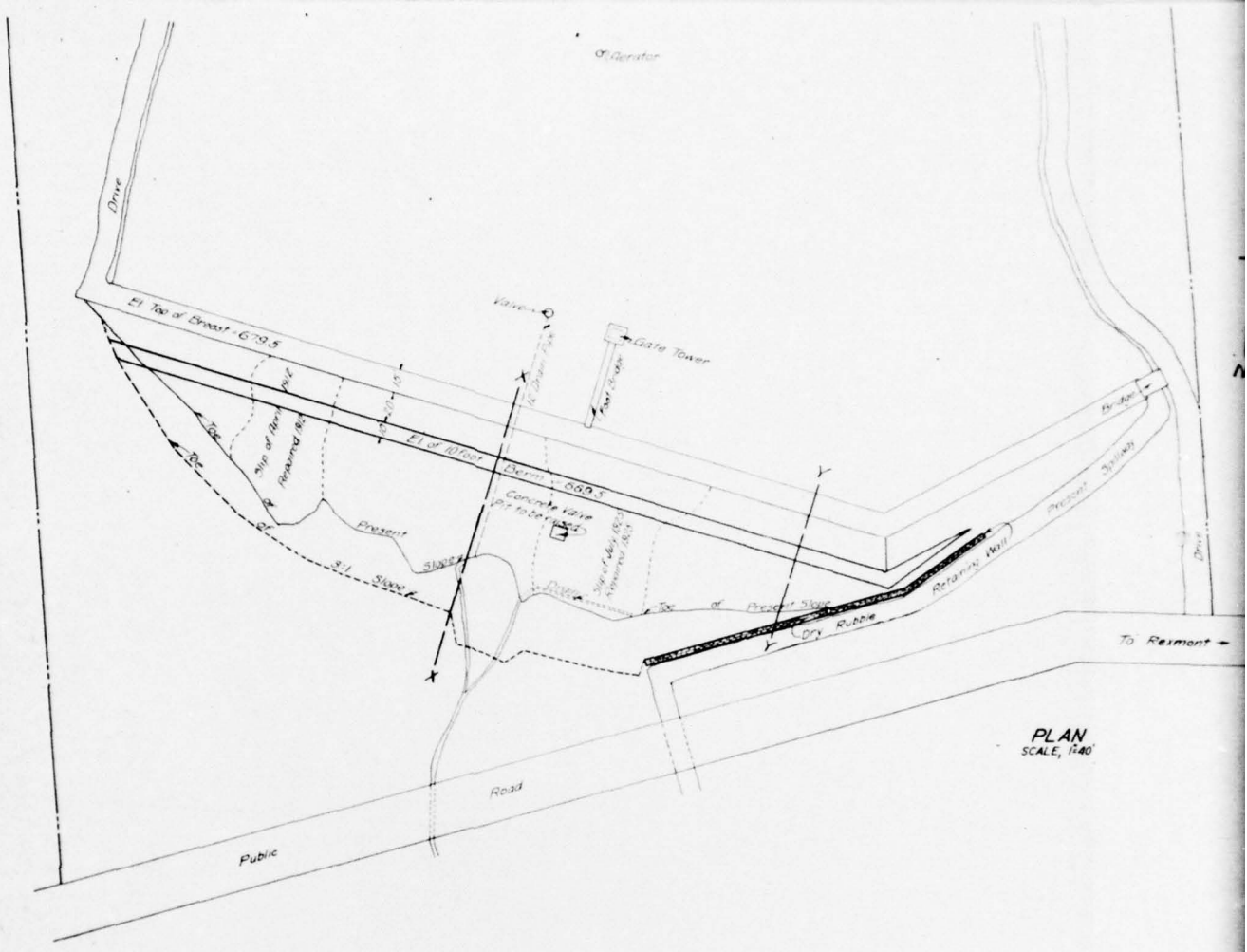
PA. 594
PLATE


Drive
20" Main from Hammer Creek Pumping Sta
Aerator
Toe of Brickwork
15'
El Top Breast = 679.5
10'
20'
Valve
Gate Tower
Elev of 10 foot Berm = 669.5
13" Drain P&L
Slip of April 1935 Repaired
Slip of Jul 25 1935 Repaired by filling with Stone 1935 Entire area of Slide retained 2 to 1 Slope
Valve Pit
Toe of Slope
Toe
3:1 Slope
Present
Road
20" Main
16" Main
Public
BUREAU OF ENGINEERING
CITY OF LEBANON, PA.
William J. Davis
City Engineer

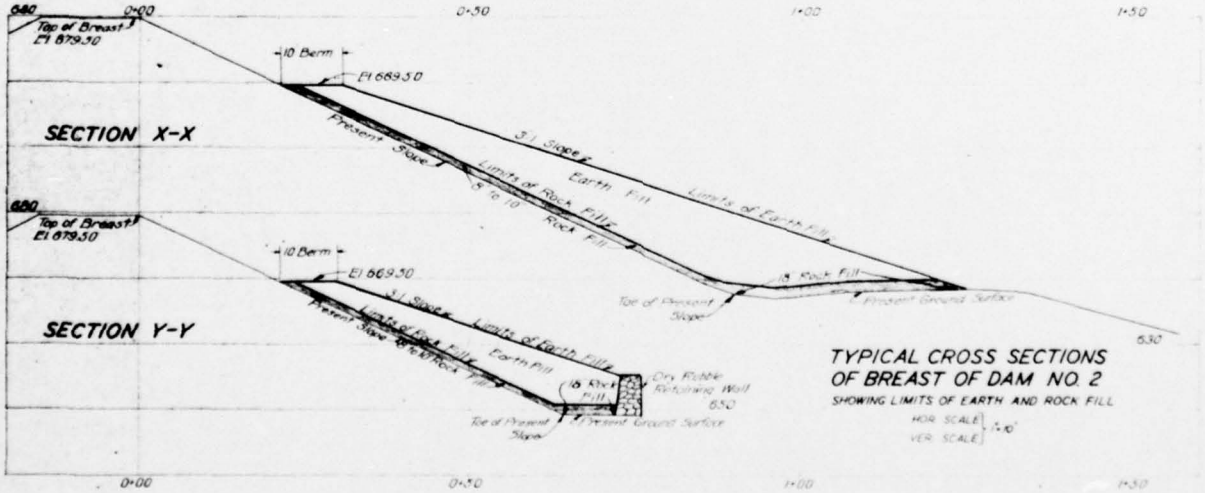


PLAN SHOWING
REPAIRS TO BE MADE TO
DAM Nº 2 OF
Lebanon Pa. Supply Dams
South Mountain Gravity Water Supply
South Lebanon Township
Lebanon County Pa.
December 1925

PA. 594
PLATE VIII



PLAN
SCALE, 1:40'

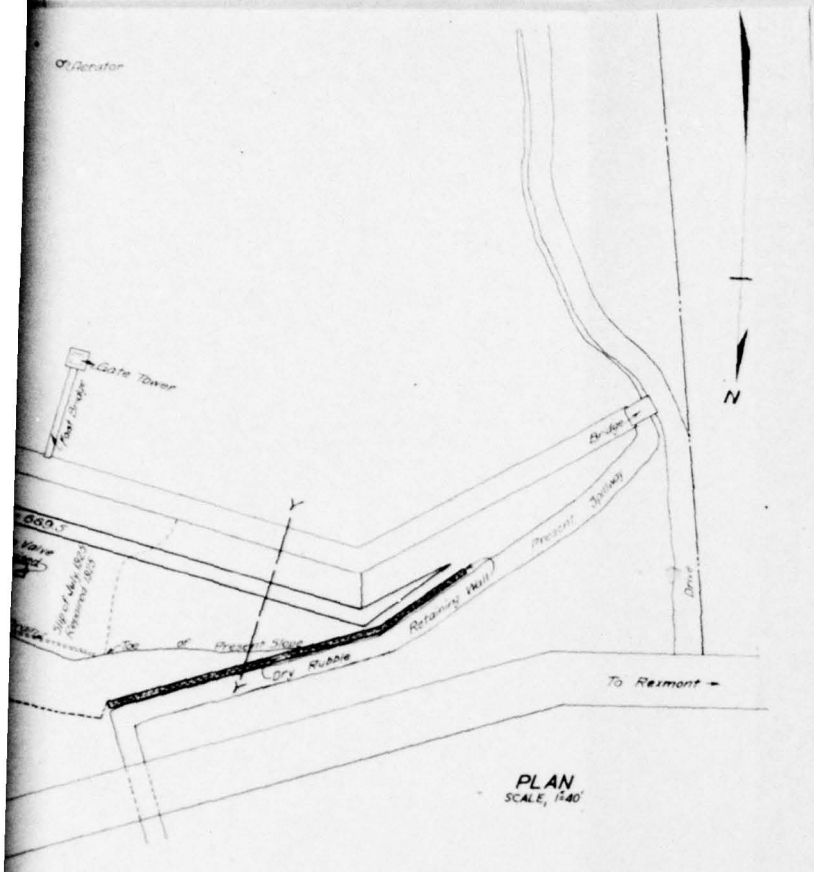


TYPICAL CROSS SECTIONS
OF BREAST OF DAM NO. 2
SHOWING LIMITS OF EARTH AND ROCK FILL
HOR. SCALE } 1:40'
VER. SCALE }

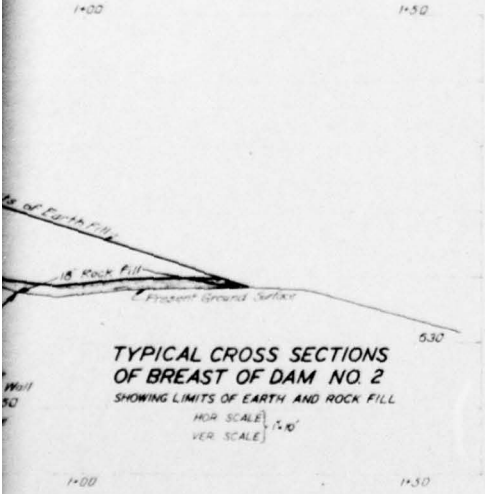
PLAN OF DAM NO.
LEBANON PA WATER SU
SHOWING TENTATIVE MANNE
OF TREATING OUTER SLOPE.

SOUTH LEBANON TOWNSHIP LEBANON

BUREAU OF ENGINEERING CITY OF L
S. ALLEN McADAM, CITY ENGINEER
DATE - JUNE 7, 1930
SCALE AS SHOWN



PLAN
SCALE, 1:40'



TYPICAL CROSS SECTIONS
OF BREAST OF DAM NO. 2
SHOWING LIMITS OF EARTH AND ROCK FILL
HOR. SCALE } 1"=10'
VER. SCALE }

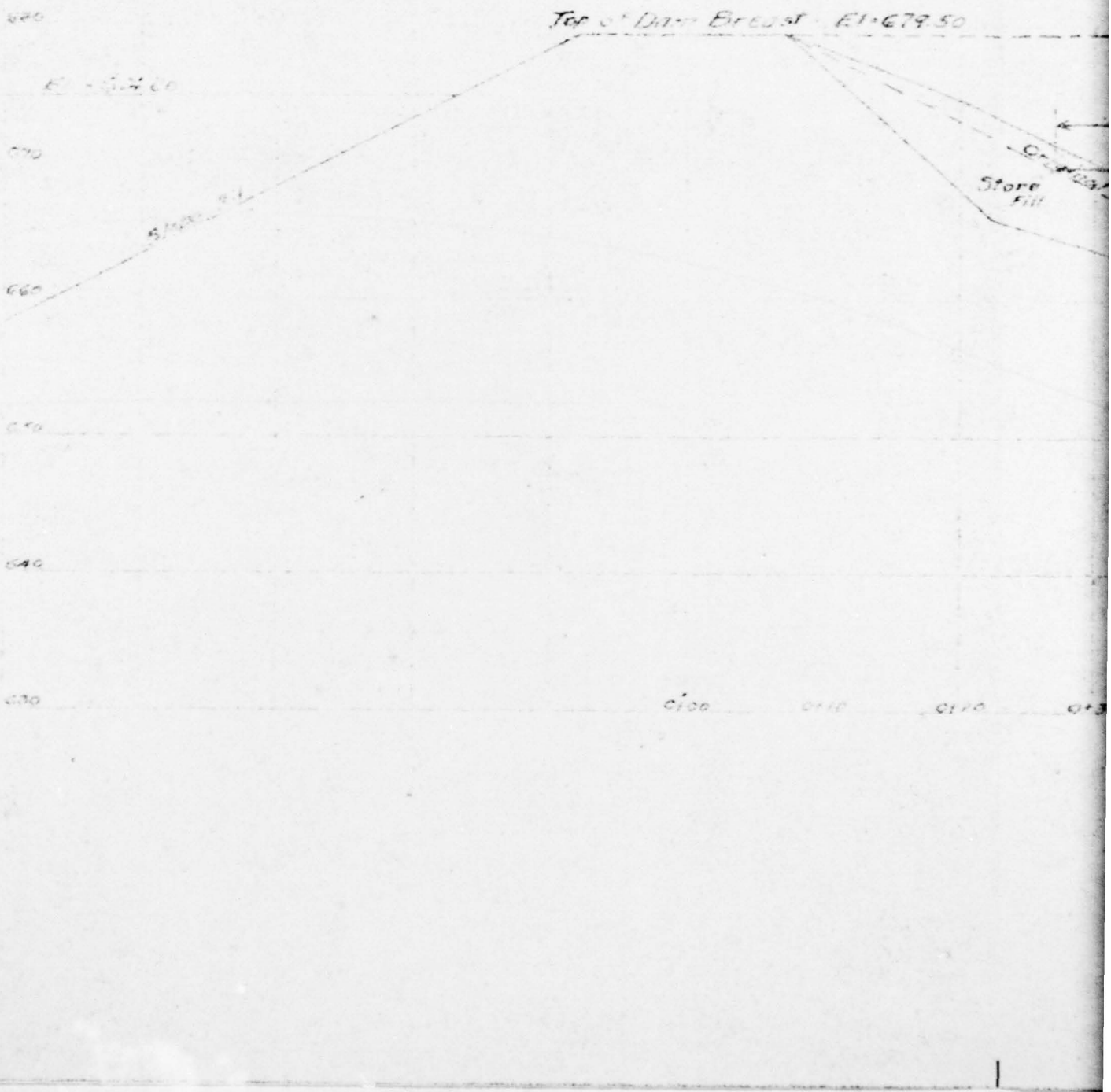
2

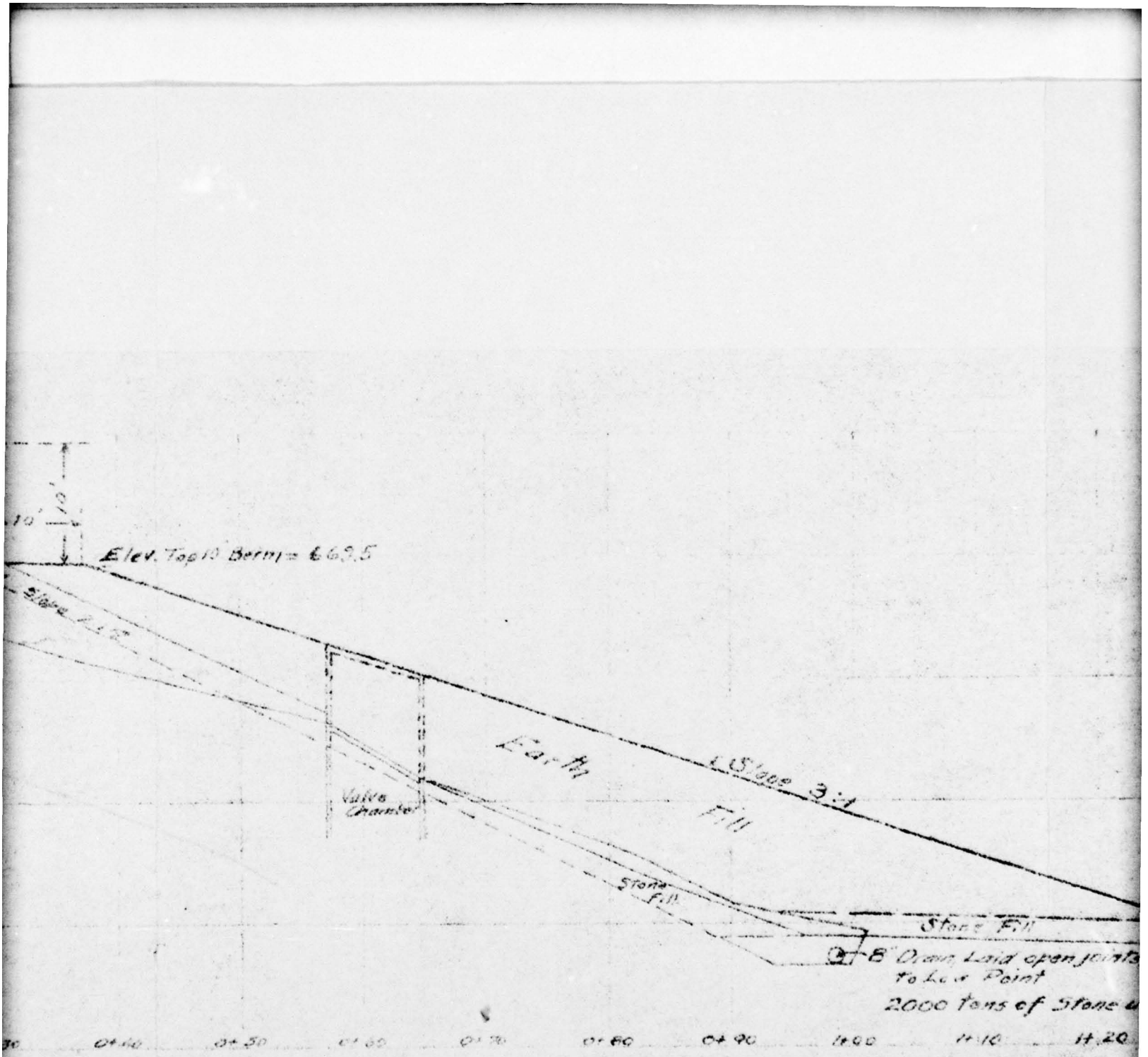
PLAN OF DAM NO. 2
LEBANON PA WATER SUPPLY
SHOWING TENTATIVE MANNER
OF TREATING OUTER SLOPE.
SOUTH LEBANON TOWNSHIP, LEBANON COUNTY, PA.

BUREAU OF ENGINEERING
S. ALLEN McADAM, CITY ENGINEER.
DATE - JUNE 7, 1932.
SCALE AS SHOWN

CITY OF LEBANON, PA.
DRAWN BY
APPROVED BY

PA. 594
PLATE IX

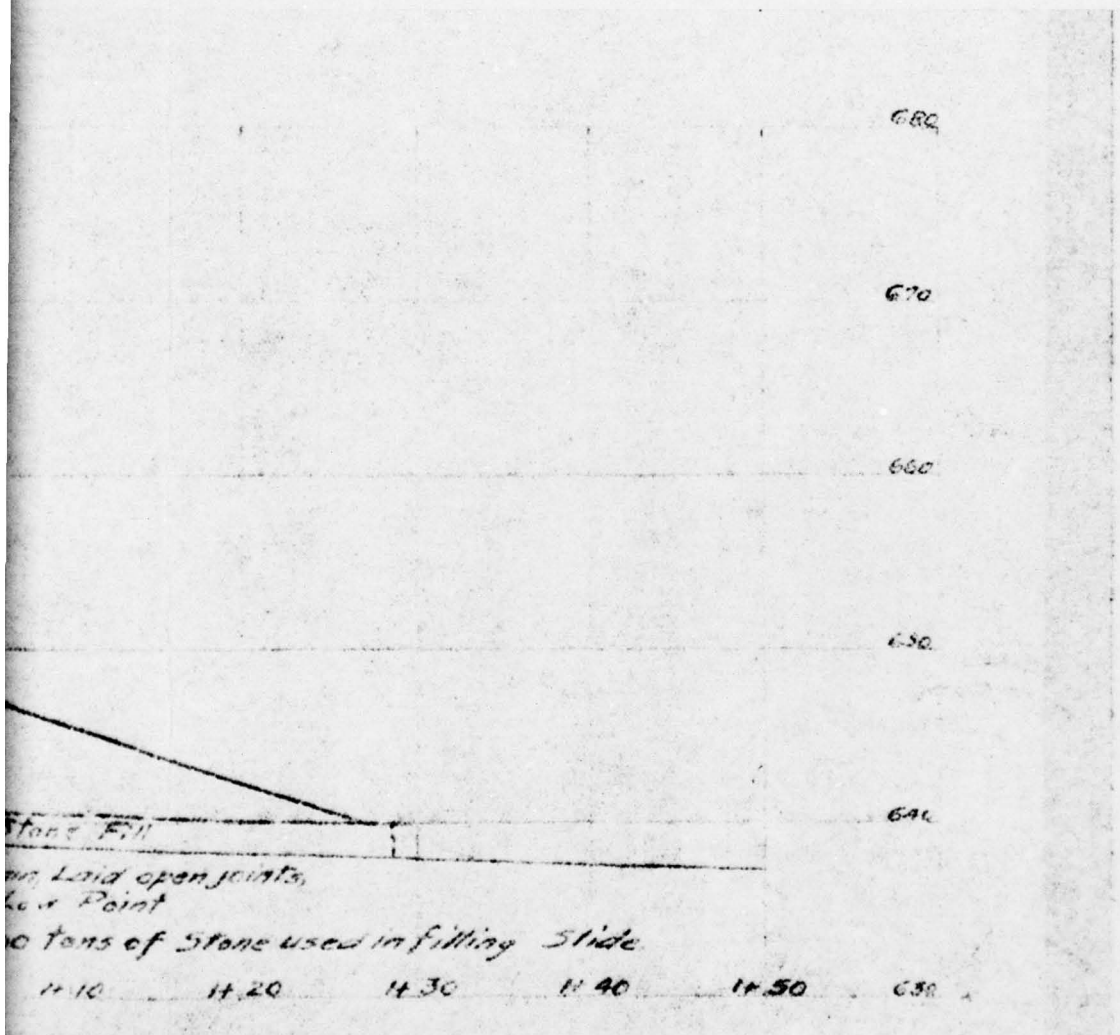

Top of Dam Breast El=679.50
680
670
660
650
640
630
Store Fill



Section of #2 Dam Breast

Scale 1" = 10'

2



BUREAU OF ENGINEERING.
CITY OF LEBANON, PA
Section of Slide of Dam # 2
of City Supply Dams.
Drawn by - J.E.
Check by - R.S.D.
Traced by - J.B.
Approved by William J. Davis
City Engineer
Scale 1" = 10' Date Oct 14, 1925

3

PA. 594
PLATE X