LEVEL II

(1)

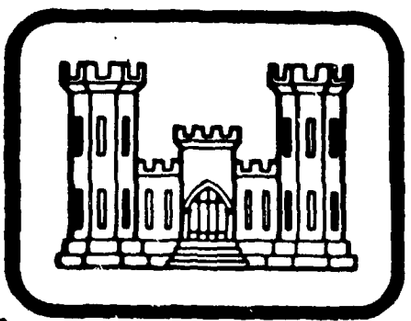
AD A109108

DELAWARE RIVER BASIN
MILLTOWN DAM
WEST CHESTER AREA MUNICIPAL AUTHORITY

NDI NO. PA-00218
DER NO. 15-146

CHESTER COUNTY, PENNSYLVANIA

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



DACW31-81-C-0013
PREPARED FOR

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

BY
Berger Associates
Harrisburg, Pennsylvania 17105

JULY 1981

81 12 28 161

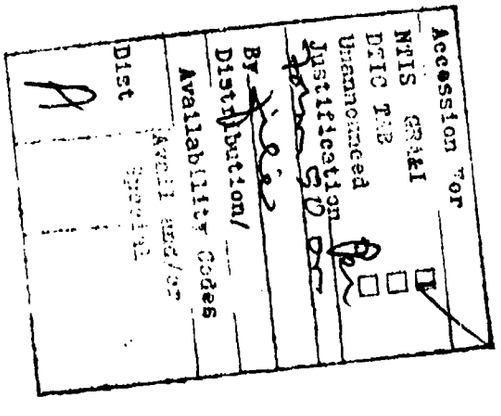
PREFACE

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

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

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

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



PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam:	MILLTOWN DAM
State & State No.:	PENNSYLVANIA, 15-146
County:	CHESTER
Stream:	EAST BRANCH CHESTER CREEK
Date of Inspection:	APRIL 9, 1981

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

In accordance with the Corps of Engineers' evaluation guidelines, the size classification of this dam is small, and the hazard classification is high. These classifications indicate that the Spillway Design Flood (SDF) should be in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. The recommended SDF for this structure is one-half the PMF. The spillway capacity is adequate for passing only 18 percent of the PMF peak inflow without overtopping the dam. Hazard to life is significantly increased downstream if the dam fails. The spillway, therefore, is considered to be seriously inadequate, and the facility is classified as unsafe, non-emergency.

The following recommendations are presented for immediate action by the owner:

1) That, in lieu of improving the facilities, the embankment be breached after obtaining a permit from the Bureau of Dam Safety, Obstruction and Storm Water Management, Pennsylvania Department of Environmental Resources.

2) That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for providing adequate spillway capacity.

3) That the upstream and downstream slopes and the crest be cleared of all trees, brush and debris under the supervision of a professional engineer experienced in the design and construction of dams. The embankment shall be provided with an adequate protective cover and be maintained on a regular basis.

4. That, after clearing, the right abutment be inspected for signs of seepage, sloughs and other indications of instability.

5. That the crest of the left embankment be widened and raised.

6. That the eroded stone section of the spillway discharge channel be filled with rocks of appropriate size.

7. That the drawdown valve be maintained and operated on an annual basis.

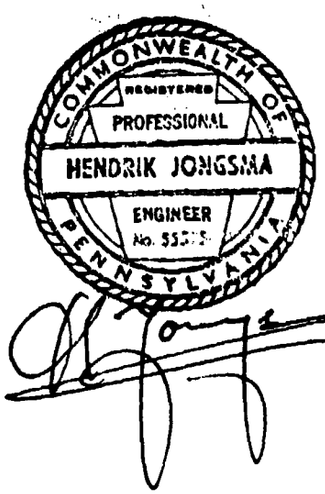
8. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

9. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

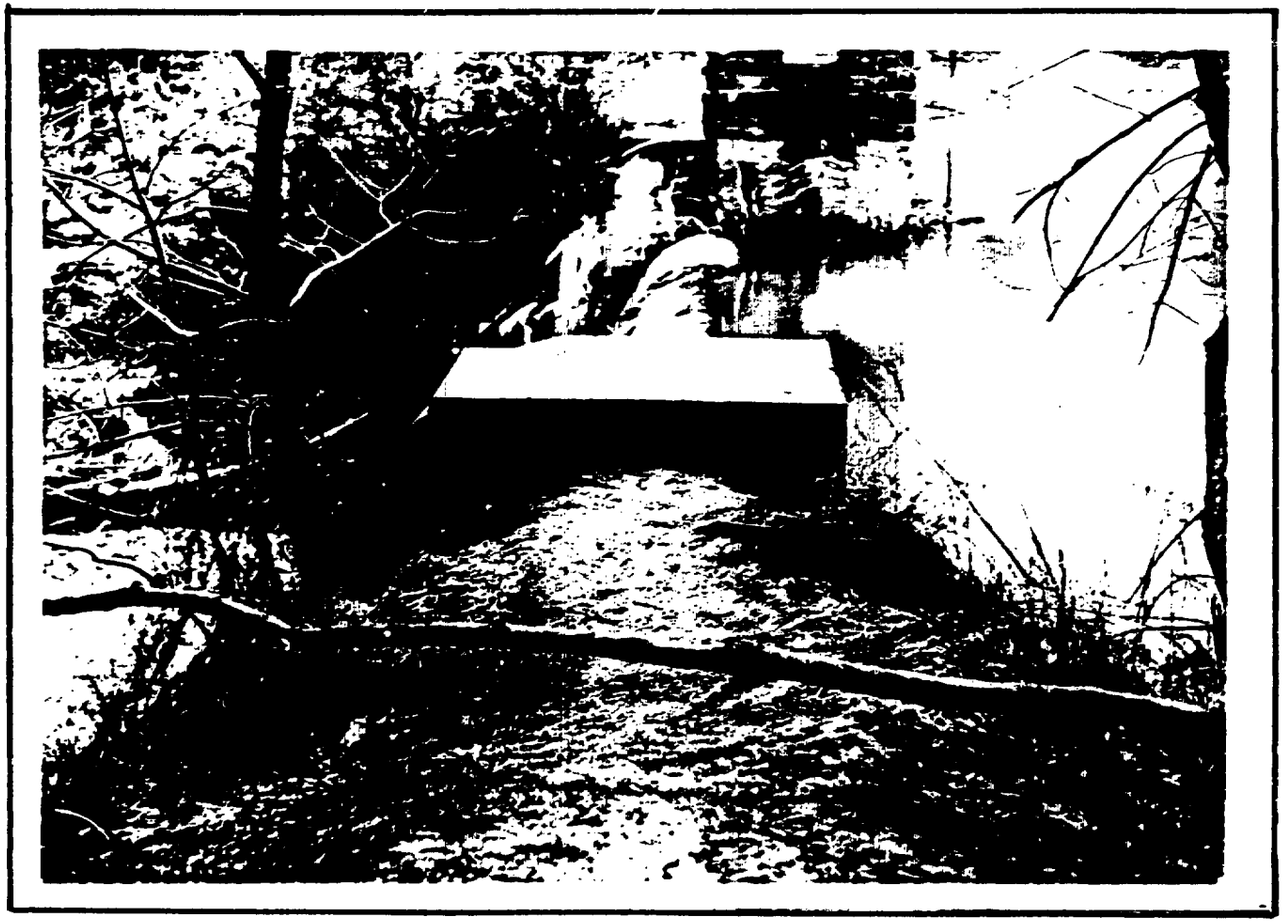
DATE: July 31, 1981



APPROVED BY:

James W. Peck
Colonel, Corps of Engineers
Commander and District Engineer

DATE: 7 Aug 81



OVERVIEW

MILLTOWN DAM

Photograph No. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

MILLTOWN DAM

NDI NO. PA-00218
DER NO. 15-146

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 of this inspection 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

Note: Design drawings for this dam (Plate III, Appendix E) indicate a spillway elevation of 104.0 (normal pool). It was estimated from the U.S.G.S. Quadrangle sheet that the normal pool elevation is 345.0. Elevation 345.0 was used as the elevation of the low flow notch in the spillway for this report.

Milltown Dam is an earthfill structure with an embankment length of 250 feet on the right of the spillway and 30 feet on the left of the spillway. The maximum embankment height is about 20 feet. The ogee spillway is located near the left abutment. Its crest is 69 feet long at an elevation 5.5 feet below the abutment walls.

The intake control structure is a wet well located on the upstream side of the crest adjacent to the right spillway wall. Two 16-inch pipes discharge from the reservoir into the wet well. A 16-inch pipe leading from the wet well is used as the supply line. A 16-inch Y-section, with a control valve at the downstream toe, can be used for drawdown.

B. Location:

East Goshen Township, Chester County
U.S.G.S. Quadrangle - West Chester, PA
Latitude 39°-58.1', Longitude 75°-32.7'
Appendix E, Plates I & II

C. Size Classification: Small: Height - 20 feet
Storage - 114 acre-feet

D. Hazard Classification: High (Refer to Section 3.1.E.)

E. Ownership: West Chester Area Municipal Authority
Mr. David M. Hughes, Manager
205 Lacey Street
West Chester, Pennsylvania 19380

F. Purpose: Water supply (abandoned)

G. Design and Construction History

The facilities were designed in 1921 by Franklin and Company, Philadelphia. A permit for construction was issued on February 22, 1921. H.W. Fitzgerald, Binghamton, New York, the contractor, started construction in the spring of 1923 and completed the facilities on August 15, 1924.

H. Normal Operating Procedures

The dam and reservoir were constructed for use as a domestic water supply. An abandoned filtration plant is located about 250 feet downstream. Heavy siltation of the reservoir has occurred over the years and the reservoir is no longer used for domestic water supply storage.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files:	6.6
Computed for this report:	6.3
Use:	6.3

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

Maximum known flood (estimated from gage records for East Branch Chester Creek)	633
Outlet works at pool Elev. 345	58
Outlet works at low pool Elev. 335	33
Spillway capacity at pool Elev. 349.1 (low point of dam)	2063

C. Elevation (feet above mean sea level)

Top of dam (low point as surveyed)	349.1
Top of dam (design crest)	350.3
Spillway crest (low flow notch)	345.0
Upstream portal invert (approx.)	329.2
Downstream portal invert (approx.)	329
Streambed at downstream toe of dam (estimate)	329

D. Reservoir (miles)

Length of normal pool (Elev. 345.0)	0.4
Length of maximum pool (Elev. 349.1)	0.7

E. Storage (acre-feet)

Spillway crest (Elev. 345.0)	18.5
Top of dam (Elev. 349.1)	114

F. Reservoir Surface (acres)

Spillway crest (Elev. 345.0)	9.2
Top of dam (Elev. 349.1)	43

G. Dam

Refer to Plates III and IV in Appendix E for plan and section.

Type: Earthfill.

Length: 280 feet not including the spillway.

Height: 20 feet.

Top Width: Design - 8 feet; Survey - varies.

Side Slopes:

	Design	Surveyed
Upstream:		
Below elev. 345	2.5H to 1V	Unknown
Above elev. 345	2.0H to 1V	2.1H to 1V
Downstream:	2.0H to 1V	2.1H to 1V

Zoning: Concrete core wall on centerline of the dam.

Cutoff: Trench excavated into rock for placing of concrete core wall.

Grouting: None.

H. Outlet Facilities

Type: 24" diameter concrete outlet pipe, blowoff from 16-inch water supply line.

Inlet Elevation: (Approx.) 329.2

Location: Right side of spillway.

I. Spillway

Type: Concrete ogee section with low flow notch.

Length of Weir: 69 feet including 41 foot low flow notch.

Crest Elevation: 345 (low flow notch); 345.5 (remainder).

Location: Left end of dam.

J. Regulating Outlets

See Section 1.3.H. above.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The available engineering data for Milltown Dam are limited to a set of three construction drawings. One drawing is a general plan of the reservoir. The other two drawings have been reproduced in Appendix E of this report. The files also contained a report prepared by the Pennsylvania Department of Environmental Resources (PennDER) upon the application for a permit. This report states that PennDER calculated the capacity of the spillway at 2940 cfs and had reviewed the stability of the spillway section. This review indicates that the resultant would fall within the middle third of the base. Designer's calculation for stability, seepage, and spillway capacity are not available.

2.2 CONSTRUCTION

The available construction data are limited to a copy of the construction specifications, a progress report by PennDER dated July 17, 1923, and a few construction photographs. The report was based on a field inspection of the foundation on July 16, 1923, and states that excavation for the core wall had been completed. The trench was 15 feet deep at the spillway section and had reached a very hard gneissic rock with tight seams. The overburden consisted of large boulders and loose seamy stone. No seepage was noticed on the upstream side of the excavation. The concrete of the core wall was of good quality.

The construction specifications indicates that material with up to 3 inches of stone was to be placed on the upstream side of the core wall, and that less impervious material was to be placed on the downstream side. Fill, placed in layers of 6 to 12 inches, was to be compacted.

2.3 OPERATION

Formal records of operation are not maintained by the owner. Maximum discharges over the spillway crest are unknown. The reservoir is no longer used for water supply storage. All inflow above normal pool is discharged over the spillway. The valves on the drawdown line and supply lines have not been operated for many years. Inspection reports by PennDER indicate that maintenance of the embankment has been neglected.

2.4 EVALUATION

A. Availability

The available engineering data are contained in the files of PennDER, Harrisburg, Pennsylvania.

B. Adequacy

The available engineering and construction data, combined with the field inspection, are considered to be adequate for making a reasonable assessment of the dam.

C. Operating Records

Operating records, including maximum pool levels, have not been maintained.

D. Post Construction Changes

The visual inspection did not reveal that post construction changes were made at these facilities.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Milltown Dam is poor, due to lack of maintenance. Brush and trees are growing on the upstream and downstream slopes (Photograph No. 4), and the immediate downstream area has been used as a dump area. The crest of the left section of the embankment is low and narrow. There were no signs of seepage or slope stability problems.

The visual inspection check list and sketches of the general plan and profile of the dam, as surveyed during the inspection, are presented in Appendix A of this report. Photographs of the facilities taken during the inspection are reproduced in Appendix C. The inspectors discussed the use and condition of the facilities with the manager of the authority in his office.

B. Embankment

The embankment on the left side of the spillway has a low and narrow crest (Photographs No. 1 and No. 6). Several large trees are growing on both the upstream and downstream slopes. The embankment to the right of the spillway has a poor appearance. The crest is below the design elevation and has very little protective cover. The upstream slope is covered with dumped rock with a considerable growth of brush near the normal flow line (Photograph No. 3). The downstream slope has very dense brush over most of its surface, which prevented close observation of the condition of this slope. Rubbish and fill have been dumped on this slope. A steep, bare footpath is located adjacent to the spillway on the downstream slope. A concrete slab has been placed on the crest adjacent to the control structure (Photograph No. 5). A sewer line and several man holes are located immediately downstream of the dam (Plate A-I). Piles of rock, brush, tires, and other debris were dumped in this area.

C. Appurtenant Structures

The ogee concrete spillway has a 41 foot wide low flow notch in its center. (See Photographs No. 7, 8 and 10.) The concrete in this area has deteriorated. A large piece of concrete has spalled off adjacent to the low flow notch (Photograph No. 10) at the top of the weir. The spillway abutment walls have many small cracks, but appeared to be stable. At the downstream end of the concrete ogee section there is a two foot deep basin with an endsill (Photograph No. 9). It appears that the original riprap in this area has eroded. Further investigation is required to determine the depth of erosion and the condition of the bottom of the basin. Placing additional heavy stone in this basin is recommended.

The intake control structure is located in the right spillway wall and is in fair condition. The downstream valve on the drawdown line has not been operated in many years.

D. Reservoir

The reservoir area is surrounded by flat to moderate slopes. A sewer line has been recently installed in the right bank of the reservoir. The bank is at the present unprotected against erosion. A roadway parallels the bank on this side. An undetermined but considerable amount of siltation has occurred in the reservoir. The drainage area is mostly cultivated land with many residential developments. Township Line Dam, another reservoir for the West Chester Area Municipal Authority, is located two miles upstream from Milltown Dam. This dam (DER No. 15-046) has been previously inspected for a Phase I report.

E. Downstream Channel

The immediate downstream channel is a natural creek with a rock-lined bottom. The slopes are moderate to nearly level. An abandoned municipal water treatment plant and Pennsylvania Route 3 are located within 600 feet downstream of the dam. There are four houses located about one-half mile farther downstream. Based on the field observation, the potential hazard for loss of more than a few lives exists downstream of the dam. The hazard category is therefore considered to be "High."

3.2 EVALUATION

The overall visual evaluation of Milltown Dam indicates that the dam is in poor condition due to poor maintenance practices. It is recommended that the embankment and the area immediately downstream of the embankment be cleared of all trees, brush and debris. The crest of the embankment and the slopes should be restored to their original design dimensions and be provided with a protective vegetative cover.

The eroded spillway discharge channel should be backfilled with appropriate sized stone.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The dam and reservoir were constructed to provide water supply storage for the West Chester area. Due to siltation, this facility is no longer used. At the present time, all inflow is discharged over the spillway.

4.2 MAINTENANCE OF EMBANKMENT

The owners of the reservoir and embankment have not performed any maintenance of the embankment in the recent years.

4.3 MAINTENANCE OF OPERATING FACILITIES

The reservoir is no longer used for its original purpose and the gates and valves have not been maintained or operated in recent years.

4.4 WARNING SYSTEM

There is no formally organized surveillance and downstream warning system in existence at the present time.

4.5 EVALUATION

The operational procedures for Milltown Dam are inadequate. It is recommended that a program be developed for regular maintenance of the dam, which shall include the removal of all trees, brush, and debris, the mowing of the embankment on a regular basis after reseeding, and the annual maintenance and operation of the drawdown valve.

A formal surveillance plan and downstream warning system should be developed for implementation during periods of heavy or prolonged rainfall.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic analyses available from PennDER for Milltown Dam were not very extensive. No stage-discharge curve, stage-storage curve, unit hydrograph, or flood routings were contained in the PennDER files.

B. Experience Data

There are no records of flood levels at Milltown Dam. Based on records of the U.S.G.S. stream gage on East Branch Chester Creek located about 2.6 miles downstream of the dam, the maximum inflow to Milltown Dam is estimated to be 633 cfs. This flood was passed without reported difficulties.

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. It was noted that riprap at the downstream end of the spillway chute had been dislodged. Upstream of Milltown Dam is one manmade dam. This impoundment was included in the hydrologic evaluation in Appendix D.

D. Overtopping Potential

Milltown has a total storage capacity of 114 acre-feet and an overall height of 20 feet, both referenced to the top of the dam. These dimensions indicate a size classification of "Small"; the hazard classification is "High" (see Section 3.1.E.).

The recommended Spillway Design Flood (SDF) for a dam having the above classification is in the range of one-half the Probable Maximum Flood (PMF) to the full PMF. Because of the small storage capacity, the recommended SDF is one-half the PMF. For this dam, the SDF peak inflow is 6531 cfs (see Appendix D for HEC-1 inflow computations).

Comparison of the estimated SDF peak inflow of 6531 cfs with the estimated spillway discharge capacity of 2063 cfs indicates that a potential for overtopping of Milltown Dam 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 SDF without overtopping. The spillway-reservoir system can pass a flood event equal

to 18% of a PMF, based on the present low point of the embankment. If the top of dam would be made uniform at the design elevation, the spillway-reservoir system would be able to pass a flood event equal to 26% of a PMF without overtopping.

E. Dam Break Evaluation

The calculations to determine the behavior of the dam in the event of an overtopping and a resulting breaching of the embankment indicates that there will be a substantial increase in water levels downstream from the dam.

Several houses are located about 3200 feet downstream from the dam. On the basis of the results of the dam break analysis, using the U.S. Army Corps of Engineers HEC-1 program, the water surface elevations in the vicinity of the houses have been compared for several conditions prior to and after a dam break. (Refer to Table 1, Appendix D.) For an earth embankment with a concrete core wall, it is estimated that one foot of overtopping would result in a breach. It is estimated that the core wall will fail along with the earth embankment. Calculations indicate that 27 percent of the PMF inflow would cause an overtopping of 1.0 foot, based on the present low point of the crest. The increase in water levels downstream due to overtopping of 1.0 foot with no failure as compared to no overtopping would be 1.0 foot. While more property would be exposed to flooding, the increase in the hazard to loss of life is not considered significant. With failure, however, the breaching analysis indicates a rise of 2.1 feet above the flow level just prior to breach when considering a 15 minute time to complete the breach and a 0.6 foot rise above flow level just prior to breach when considering a two hour time to complete the breach. The increase in hazard to loss of life and property damage is reflected not only in the increase in depth of water of 2.1 feet in the 15 minute breach and 0.6 foot in the two hour breach, but more significantly in the shorter time to reach the peak. Less time would be available to respond to the flooding under the breach conditions.

Being an earth embankment with a core wall, it is judged that the breach would be completed between the 15 minute and the two hour period. The numerical difference of water levels is 1.5 feet. The property damage would be similar with either time of failure. Again, however, the time factor is most significant regarding loss of life. Calculations indicate that the water depth will increase at a rate of 2.1 feet in 15 minutes under the 15 minute breach condition.

One manmade dam is located upstream of Milltown Dam. For this evaluation, this impoundment was not considered to have breached (see Appendix D).

On the basis of these calculations, it is concluded that the hazard to loss of life and property damage is significantly increased when the dam is overtopped and failed as compared to the condition just prior to failure.

Refer to Table 1, Appendix D, for comparison of flood water levels.

F. Spillway Adequacy

Calculations show that the spillway discharge capacity and reservoir storage capacity combine to handle 18% of the PMF (refer to Appendix D).

Since the spillway discharge and reservoir storage capacity cannot pass one-half of the PMF and because the downstream hazard to loss of life is high and this hazard is significantly increased when the dam fails as compared to just prior to failure, the spillway is judged to be 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 Observations

1. Embankment

The visual inspection of Milltown Dam did not detect any signs of embankment instability. However, the downstream slope was covered with dense brush and trash, preventing close observation. At its lowest point, the crest of the dam is 1.2 feet below its design elevation and is narrow and unprotected near the left abutment. A footpath adjacent to the right spillway wall has caused a steep, eroded condition. Seepage was not detected. The upstream slope is protected with dumped rock.

2. Appurtenant Structures

Although the spillway has deteriorated, the present condition does not endanger the safety of the structure. The spillway walls have numerous small cracks but are apparently stable. No movement or tilting was detected. The erosion beyond the concrete spillway slab is of concern. To prevent possible undermining of the concrete slab, heavy stone should be placed in this area.

B. Design and Construction Data

1. Embankment

The typical embankment section (Plate III, Appendix E) indicates an earthfill embankment with a concrete core wall along the centerline of the dam. The core wall has a bottom width of three feet and was founded on rock. A trench up to 15 feet deep was excavated through the overburden. The top of the core was 1.8 feet below the design crest elevation. The upstream slope was protected with riprap.

An inspection report in 1927, prepared by PennDER, indicates that the embankment had settled one foot over a length of ten feet on each side of the spillway. The narrow crest in the left embankment has been reported since 1941.

2. Appurtenant Structures

The typical section of the spillway (Plate IV, Appendix E) indicates only a token amount of reinforcement in the concrete section. Fifteen tension bars, spaced at about 5 feet, are located on the upstream side. A cutoff wall is placed on the upstream side. The spillway is founded on gravel and sand. At the downstream side, there is a 30-inch deep cutoff wall with weepholes. Beyond this cutoff wall is a grouted stone slab about 25 feet long with another three foot deep cutoff wall.

The intake control structure is an integral part of the right spillway wall.

C. Operating Records

Operating records for this dam have not been maintained by the owner.

D. Post Construction Changes

There are no indications that post construction modifications have been made to the dam or its appurtenant structures.

E. Seismic Stability

This dam is located in Seismic Zone 1, and it is considered that the static stability is sufficient to withstand minor earthquake-induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection and the review of the construction drawings indicates that Milltown Dam is in poor condition due to poor maintenance procedures. There were no signs of structural instability, seepage, or sloughage. Dense brush growth on the downstream slope prevented close observation. The embankment profile is below its design crest elevation over most of its length. Erosion beyond the spillway could undermine the concrete slab.

The hydrologic and hydraulic computations indicate that the combination of the storage capacity and the discharge capacity of the spillway are sufficient to pass only 18 percent of the PMF without overtopping the embankment. The recommended SDF is 50 percent of the PMF. Failure of the dam could occur with 27 percent of the PMF. The hazard to loss of life is significantly increased when the dam fails. The spillway is therefore considered to be seriously inadequate and the facility is classified as unsafe, non-emergency.

B. Adequacy of Information

The visual inspection is considered to be sufficiently adequate for making a reasonable assessment of this dam.

C. Urgency

The recommendations presented below should be implemented immediately.

D. Additional Studies

A detailed hydrologic and hydraulic study is recommended to determine methods of improving the spillway capacity.

7.2 RECOMMENDATIONS

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

1. That, in lieu of improving the facilities, the embankment be breached after obtaining a permit from the Bureau of Dam Safety, Obstruction and Storm Water Management, Pennsylvania Department of Environmental Resources.

2. That a detailed hydrologic and hydraulic engineering analysis be made by a professional engineer with experience in the design and construction of dams to determine means for providing adequate spillway capacity.

3. That the upstream and downstream slopes and the crest be cleared of all trees, brush and debris under the supervision of a professional engineer experienced in the design and construction of dams. The embankment shall be provided with an adequate protective cover and be maintained on a regular basis.

4. That, after clearing, the right embankment be inspected for signs of seepage, sloughs and other indications of instability.

5. That the crest of the left embankment be widened.

6. That the eroded stone section of the spillway discharge channel be filled with rocks of appropriate size.

7. That the drawdown valve be maintained and operated on an annual basis.

8. That a formal surveillance and downstream warning system be developed for use during periods of high or prolonged rainfall.

9. That an operation and maintenance manual be prepared for guidance in the operation of the dam during normal and emergency conditions, and that a schedule be developed for the annual inspection of the dam and its appurtenant structures.

APPENDIX A

CHECK LIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 15-146 NDI NO. PA-00 218

NAME OF DAM Milltown Dam HAZARD CATEGORY High

TYPE OF DAM Earthfill

LOCATION East Goshen TOWNSHIP Chester COUNTY, PENNSYLVANIA

INSPECTION DATE 4/9/81 WEATHER Showers TEMPERATURE 40-50°

INSPECTORS: R. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

H. Jongsma

R. Shireman

A. Bartlett

NORMAL POOL ELEVATION: 345 (U.S.G.S.) AT TIME OF INSPECTION:

BREAST ELEVATION: 350.3 (Design) POOL ELEVATION: 345.1

SPILLWAY ELEVATION: 345.0 (Low flow) TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: Unknown

GENERAL COMMENTS:

The general visual appearance of this dam is poor due to the lack of maintenance. The downstream slope and beyond is used by locals for disposal of miscellaneous items. Fill from sewer installation along the right shore of the reservoir encroaches into the pool.

NDI NO. PA-00 218

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	None observed.
B. UNUSUAL MOVEMENT BEYOND TOE	None observed. Dirt road at toe plus waste area for timber, boulders, stone, misc. fill, tires and other non organic rubbish. Sanitary sewer manhole about 50' downstream from toe near spillway outlet channel.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	Downstream slope covered with heavy brush, brambles, small trees and rubbish. Could not detect any sloughs or slope distress.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal - straight line--no movement visible. Vertical - refer to Profile, Plate A-II.
E. RIPRAP FAILURES	None observed. Weed and brush cover to water's edge on upstream slope.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	Appear to be sound structurally. Eroded foot path down slope at junction with right spillway wall. Recent fill from sewer installation at right end of embankment near roadway.
G. SEEPAGE	None observed on slope or along downstream toe.
H. DRAINS	Refer to plans.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Crest - bare earth--some grass--tire tracks. Upstream slope - dumped rock with weeds, grass and brush. Downstream slope - heavy brush--some small trees and rubbish and fill.

NDI NO. PA-00 218

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	Stone masonry structure adjacent to the right spillway structure.
B. OUTLET STRUCTURE	None.
C. OUTLET CHANNEL	Directly from spillway to creek.
D. GATES	None. Valve in downstream manhole for a reported 24" blowoff. Has not been operated in many years.
E. EMERGENCY GATE	See D. above.
F. OPERATION & CONTROL	No records.
G. BRIDGE (ACCESS)	None.

NDI NO. PA-00 218

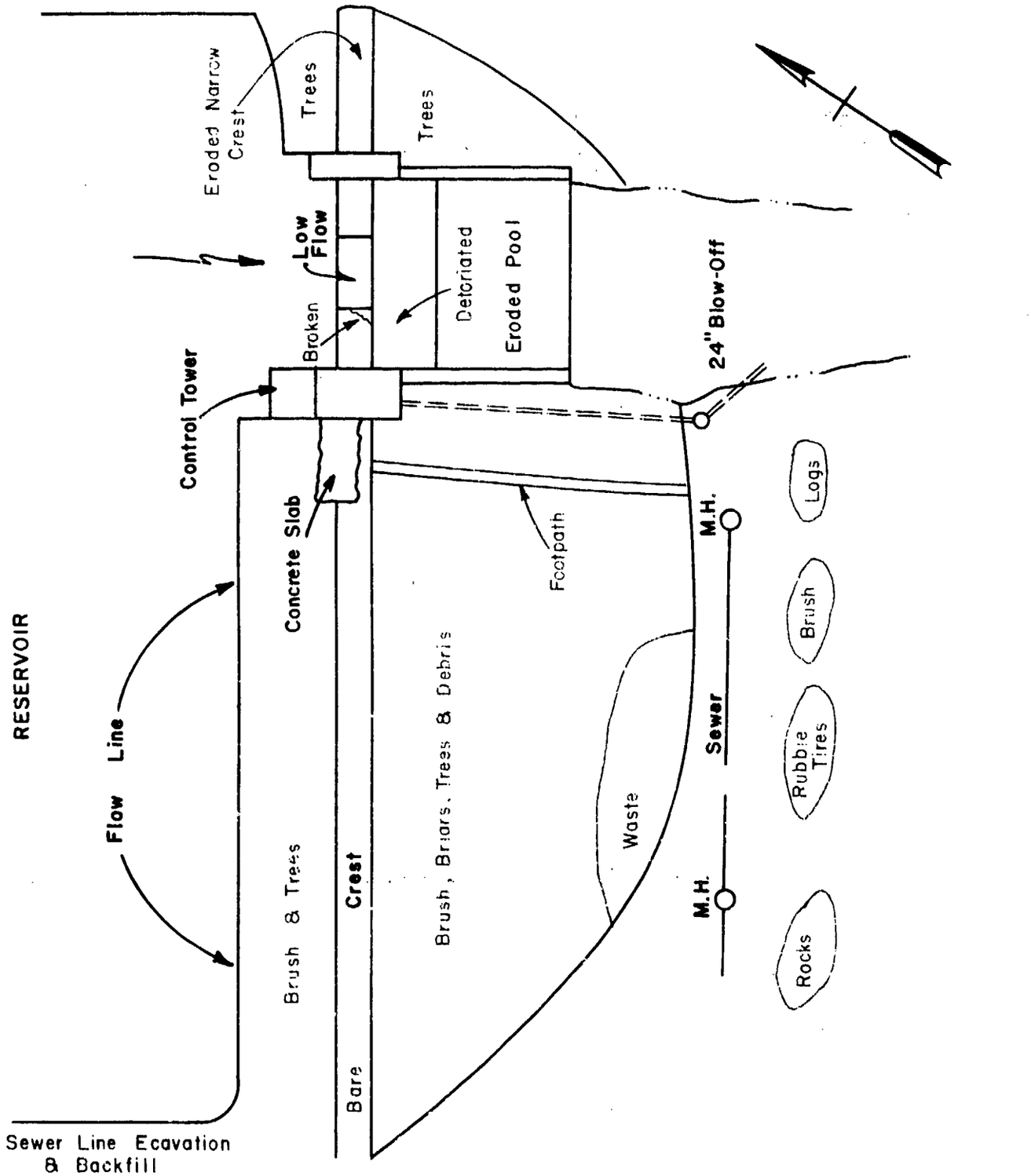
VISUAL INSPECTION
SPILLWAY

	OBSERVATIONS AND REMARKS
A APPROACH CHANNEL	Directly from reservoir.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	Ogee spillway section. Concrete spalled and in a slightly deteriorated condition. Overflow section is fair. Spillway walls have many cracks. It appears that the embankment to the right of the control structure has been repaired by placing a mass of concrete.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Natural stone and rock channel. Should be drained to inspect condition.
D. BRIDGE & PIER	None.
E. GATES & OPERATION EQUIPMENT	None.
F. CONTROL & HISTORY	No records.

NDI NO. PA-00 218

VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION	
Monumentation	None.
Observation Wells	None.
Weirs	None.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR	
Slopes	Moderate - 3:1 and flatter.
Sedimentation	Reported as a serious problem. The reservoir is no longer used in the water supply system.
Watershed Description	Grassed lawns and roadway on right. Lawns and woods on left.
DOWNSTREAM CHANNEL	
Condition	Natural creek--rock bottom.
Slopes	Moderate to near level.
Approximate Population	More than a few.
No. Homes	Abandoned water treatment plant. Route 3. Four homes.



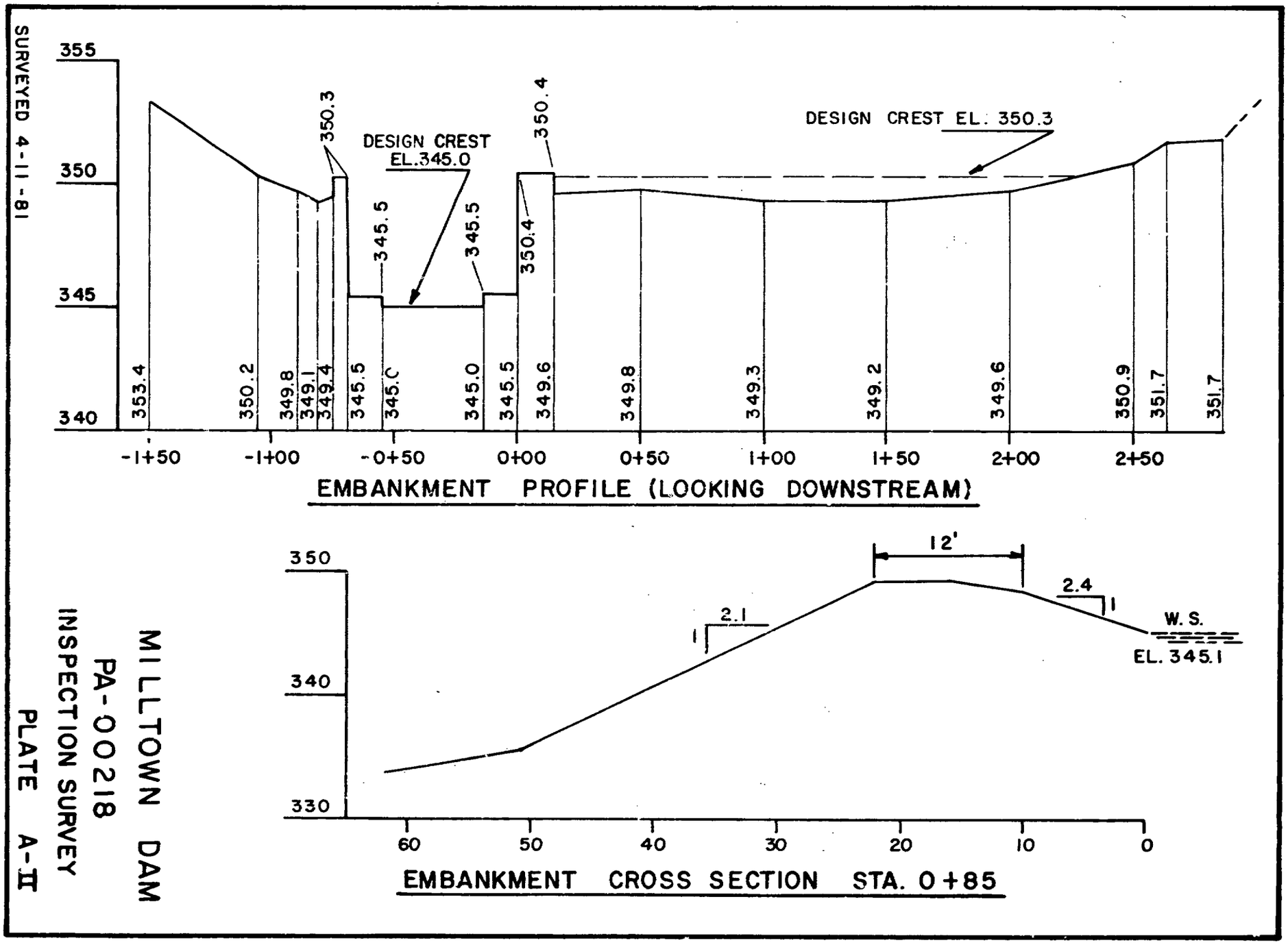
MILLTOWN DAM

PA-00218

INSPECTION SURVEY

PLATE A-I

SURVEYED 4-11-81


SURVEYED 4-11-81
355
350
345
340
353.4
350.2
349.8
349.1
349.4
350.3
345.5
345.0
345.5
345.5
350.4
350.4
349.6
349.8
349.3
349.2
349.6
350.9
351.7
351.7
DESIGN CREST EL.345.0
DESIGN CREST EL. 350.3
-1+50
-1+00
-0+50
0+00
0+50
1+00
1+50
2+00
2+50
EMBANKMENT PROFILE (LOOKING DOWNSTREAM)
350
340
330
12'
2.4
1
2.1
1
W. S.
EL. 345.1
60
50
40
30
20
10
0
EMBANKMENT CROSS SECTION STA. 0+85
MILLTOWN DAM
PA-00218
INSPECTION SURVEY
PLATE A-II

APPENDIX B

CHECK LIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 15-146 NDI NO. PA-00218

NAME OF DAM MILLTOWN DAM

ITEM	REMARKS
AS-BUILT DRAWINGS	Not available.
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle - West Chester, PA See Plate II, Appendix E
CONSTRUCTION HISTORY	Construction started in Spring 1923. Contractor: H.W. Fitzgerald, Binghamton, NY. Completion date: August 15, 1924.
GENERAL PLAN OF DAM	Plate III, Appendix E.
TYPICAL SECTIONS OF DAM	Plate III, Appendix E.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	Plates III and IV, Appendix E. Not available.

NDI NO. PA-00218

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	No records.
DESIGN REPORTS	Not available.
GEOLOGY REPORTS	Not available.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	Borings were made. Results are unknown.
POST CONSTRUCTION SURVEYS OF DAM	None reported.
BORROW SOURCES	From reservoir area.

NDI NO. PA-00218

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	No records.
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	No records.
SPILLWAY PLAN, SECTIONS AND DETAILS	Plates III and IV, Appendix E.

NDI NO. PA-00218

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	See plans.
CONSTRUCTION RECORDS	Limited to one inspection report for foundation of core wall.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	PennDER inspection reports dated 1923, 1927, 1932, 1934, 1937, 1941, 1944, 1948, 1952, 1962, 1970, and 1972. Narrow crest, low crest, brush, and trees have been reported.
MISCELLANEOUS	

NDI NO. PA-00 218

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: suburban housing developments

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 345 Acre-Feet 18.5

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 349.1 Acre-Feet 114

MAXIMUM DESIGN POOL: Elev. 350.3

TOP DAM: Elev. 349.1

SPILLWAY:

a. Elevation 345

b. Type concrete ogee section with low flow notch

c. Width 69 feet including 41 foot low flow notch

d. Length --

e. Location Spillover near left abutment

f. Number and Type of Gates none

OUTLET WORKS:

a. Type 24 inch pipe with valves

b. Location right side of spillway

c. Entrance inverts 329.2

d. Exit inverts 329.0

e. Emergency drawdown facilities pipe with valves

HYDROMETEOROLOGICAL GAGES:

a. Type none

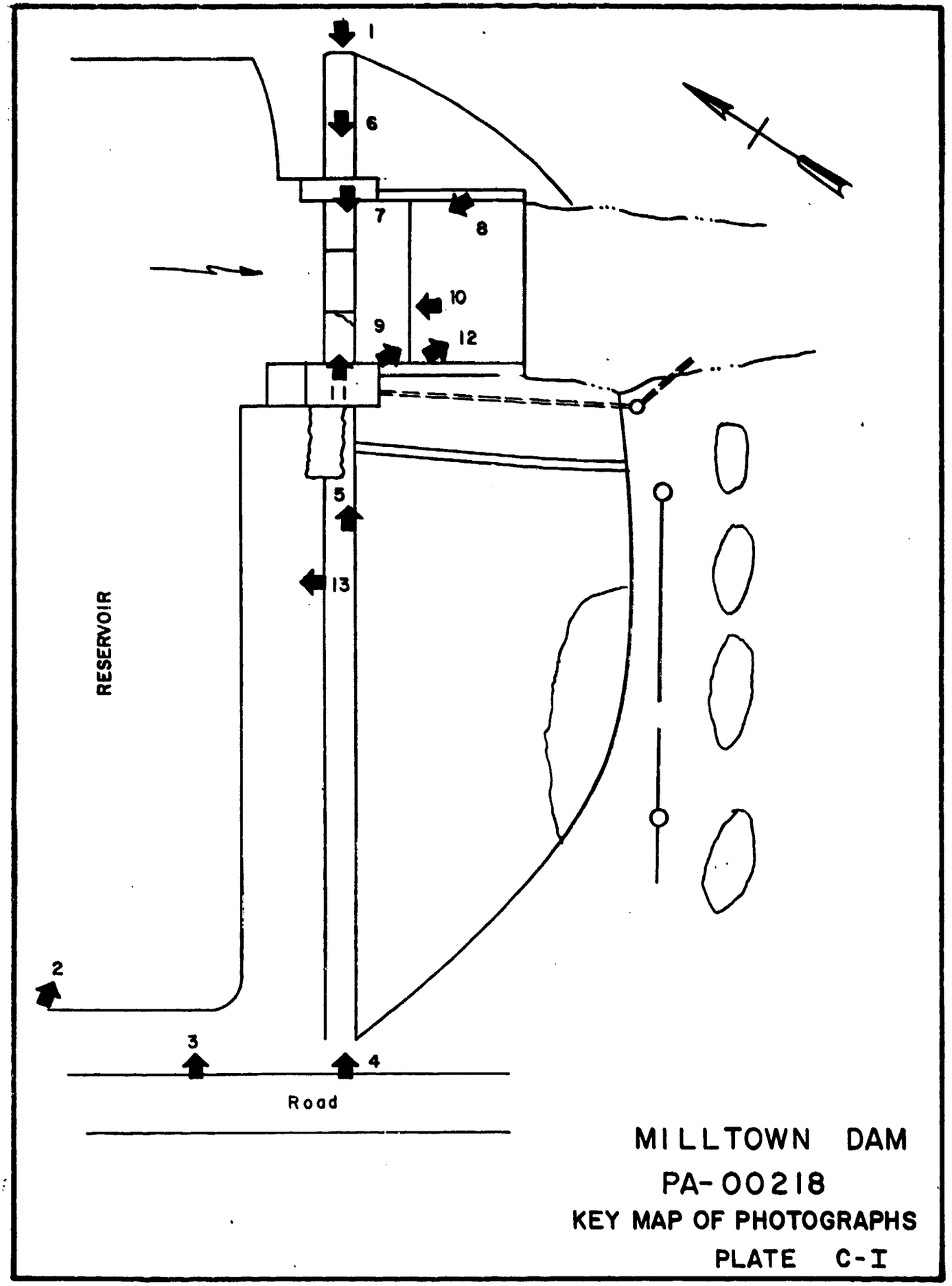
b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 2063 cfs

APPENDIX C

PHOTOGRAPHS



MILLTOWN DAM

PA-00218

KEY MAP OF PHOTOGRAPHS

PLATE C-I

OVERVIEW OF SPILLWAY AND RIGHT EMBANKMENT - NO. 2

UPSTREAM SLOPE - NO. 3

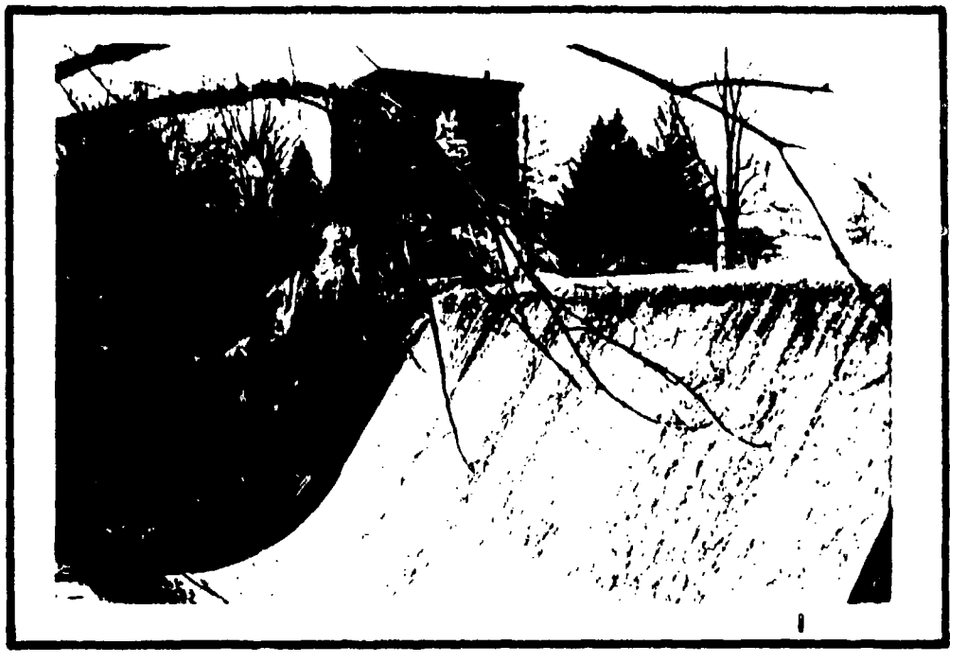
RIGHT EMBANKMENT - NO. 4
NOTE: BRUSH AND TREES ON SLOPE

CONTROL TOWER - NO. 5
NOTE: CONCRETE SLABS

PA-00218
Plate C-III

LEFT EMBANKMENT - NO. 6
NOTE: TREES AND NARROW CREST

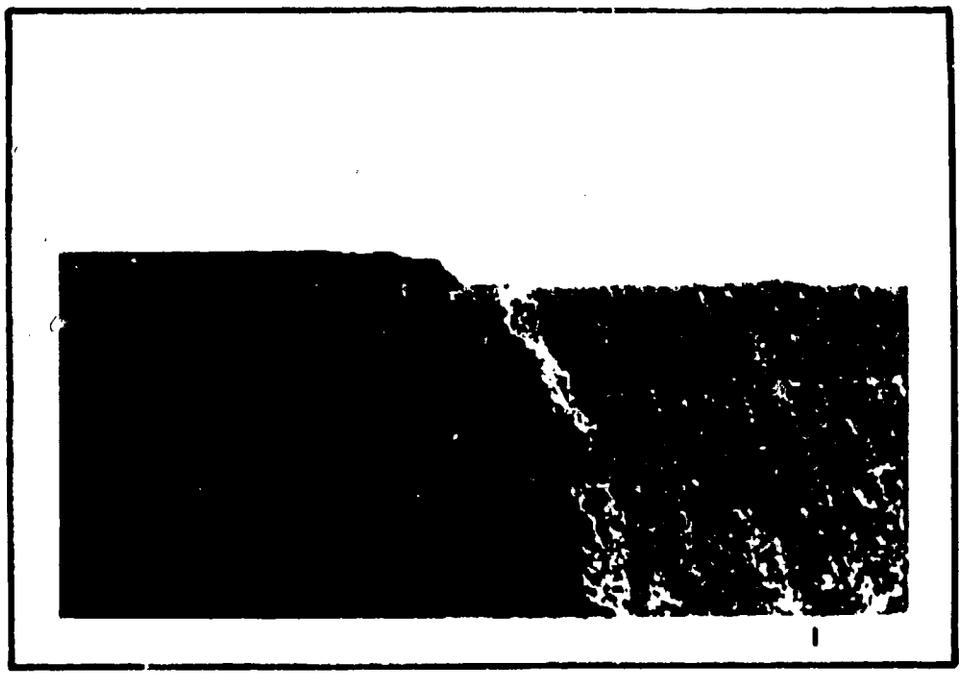
LOW FLOW NOTCH IN SPILLWAY - NO. 7



OVERVIEW OF SPILLWAY - NO. 8

ERODED DOWNSTREAM SLAB - NO. 9

PA-00218
Plate C-V

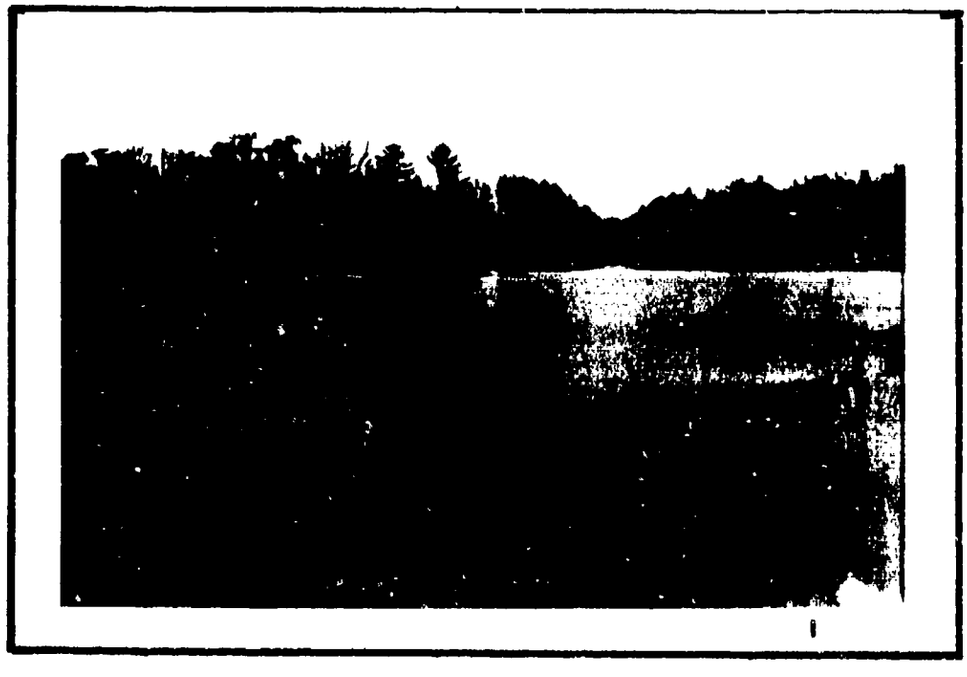


ERODED SPILLWAY CREST - NO. 10

SPILLWAY SECTION FROM RIGHT ABUTMENT - NO. 11

PA-00218
Plate C-VI

DOWNSTREAM CHANNEL - NO. 12



OVERVIEW OF RESERVOIR - NO. 13

APPENDIX D

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 and maximum stage of each routed hydrograph at the outlet of the reach.

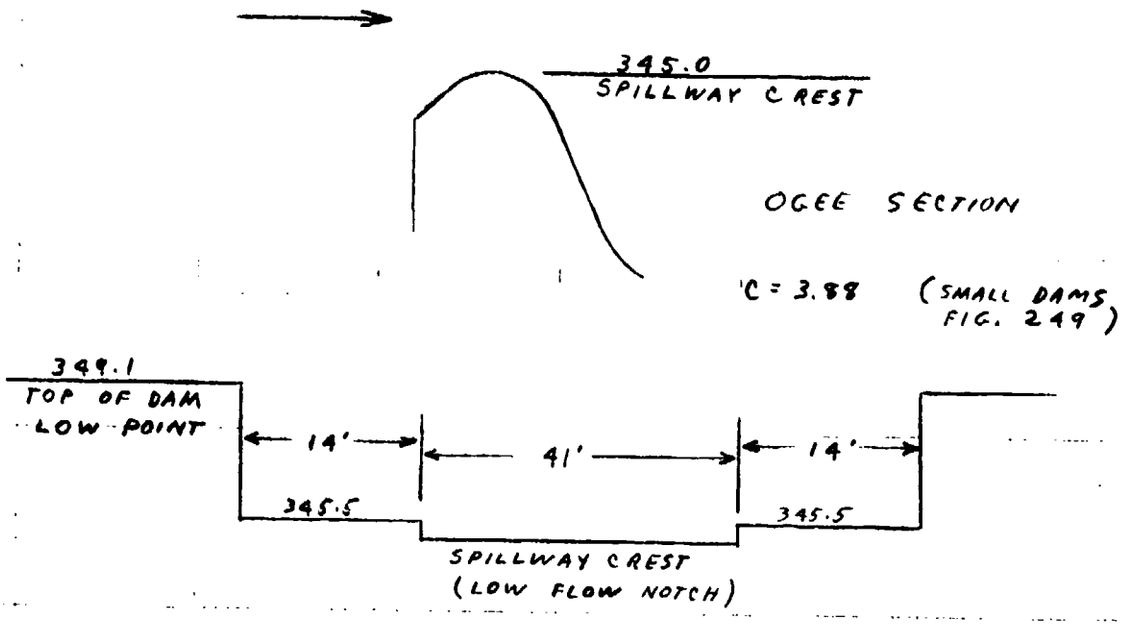
The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

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.

BY RLS DATE 1/22/81 **BERGER ASSOCIATES** SHEET NO. 1 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

SPILLWAY RATING



$$Q = C L_1 H_1^{3/2} + C L_2 H_2^{3/2}$$

$L_1 = 14+14 = 28'$

$L_2 = 41'$

$H_1 = 349.1 - 345.5 = 3.6$

$H_2 = 349.1 - 345.0 = 4.1$

$$Q = 3.88 \times 28 \times (3.6)^{1.5} + 3.88 \times 41 \times (4.1)^{1.5}$$

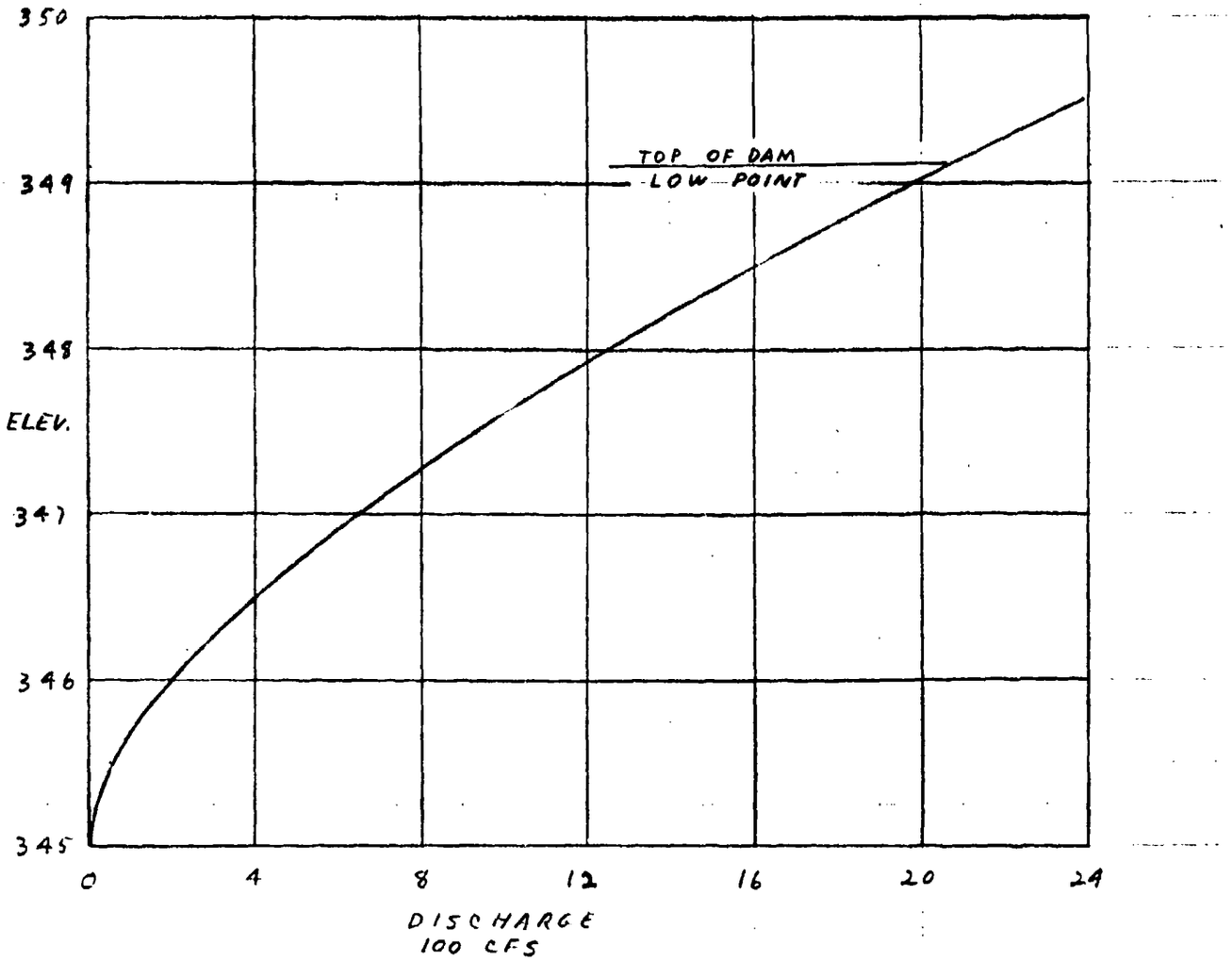
$$= 2063 \text{ CFS}$$

BY RLS DATE 9/22/81 **BERGER ASSOCIATES** SHEET NO. 2 OF 9

CHKD. BY DATE PROJECT

SUBJECT MILLTOWN DAM

SPILLWAY RATING CURVE



BY RLS DATE 4/22/81 **BERGER ASSOCIATES** SHEET NO. 3 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

DISCHARGE THROUGH OUTLET WORKS

24" DIA PIPE C = 0.6 (KINGS HDBK)

UPSTREAM INVERT = 329.2

$Q = C A \sqrt{2gH}$

AT POOL ELEV. 345

$H = 345 - 330.2 = 14.8'$

$Q = 0.6 \times \pi \times 2^2/4 \times (2 \times 32.2 \times 14.8)^{0.5}$

$= 58$ CFS

AT LOW POOL ELEV 335

$H = 335 - 330.2 = 4.8'$

$Q = 0.6 \times \pi \times 2^2/4 \times (2 \times 32.2 \times 4.8)^{0.5}$

$= 33$ CFS

BY RLS DATE 9/22/81 **BERGER ASSOCIATES** SHEET NO. 4 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

EMBANKMENT RATING

$Q = C L H^{3/2}$ $C = 2.7$ (KINGS HDBK.)

AT ELEV 349.5

$2.7 \times 7 \times (.25)^{1.5} = 2$
$2.7 \times 4 \times (.2)^{1.5} = 1$
$2.7 \times 20 \times (.1)^{1.5} = 2$
$2.7 \times 50 \times (.25)^{1.5} = 17$
$2.7 \times 36 \times (.15)^{1.5} = 6$ $\Sigma = 28$ CFS

AT ELEV 350

$2.7 \times 7 \times (.75)^{1.5} = 12$
$2.7 \times 7 \times (.55)^{1.5} = 8$
$2.7 \times 9 \times (.1)^{1.5} = 1$
$2.7 \times 36 \times (.3)^{1.5} = 16$
$2.7 \times 50 \times (.45)^{1.5} = 41$
$2.7 \times 50 \times (.75)^{1.5} = 88$
$2.7 \times 50 \times (.6)^{1.5} = 63$
$2.7 \times 15 \times (.2)^{1.5} = 4$ $\Sigma = 233$ CFS

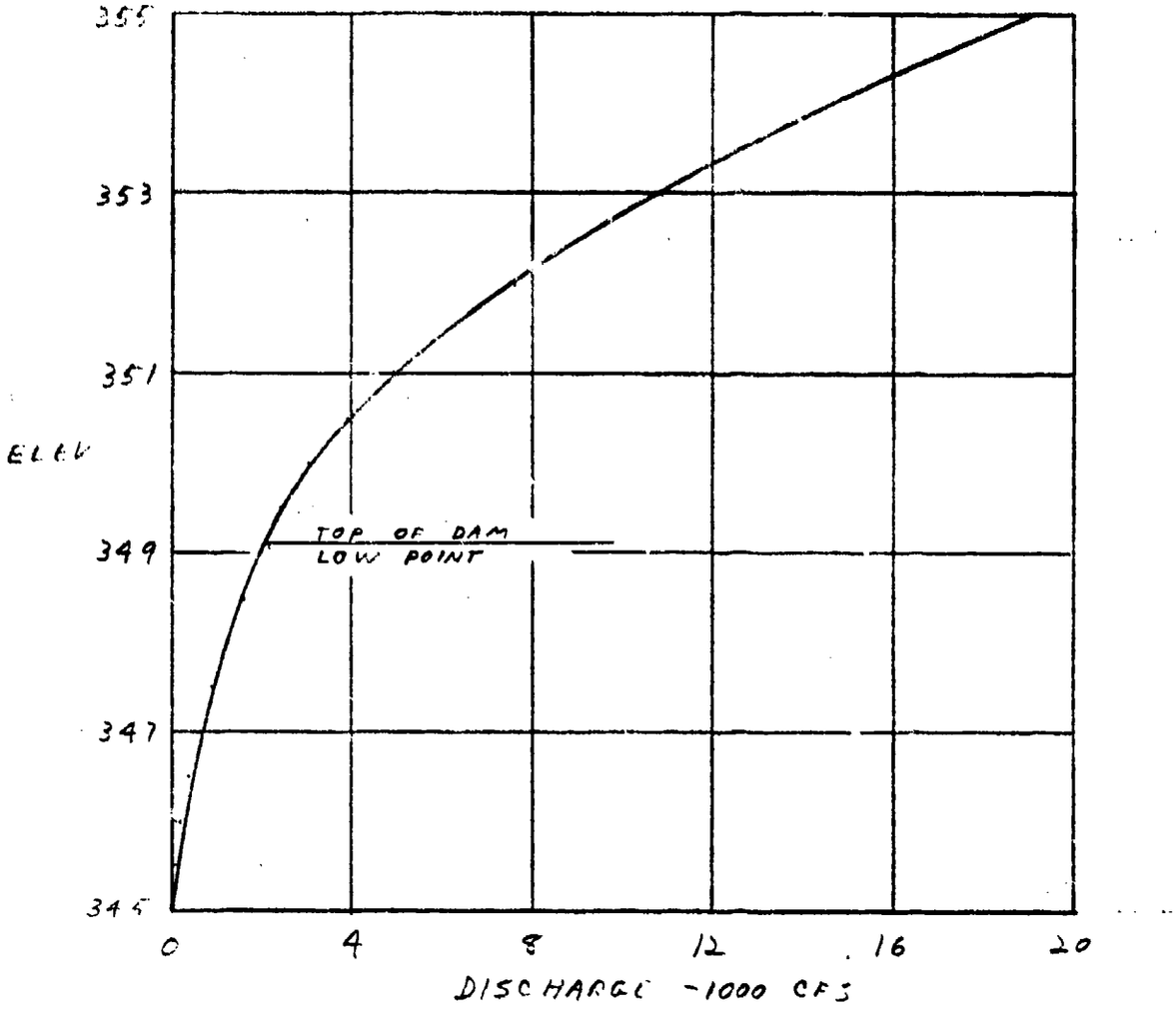
AT ELEV 350.5

$2.7 \times 6 \times (.2)^{1.5} = 1$
$2.7 \times 7 \times (1.25)^{1.5} = 26$
$2.7 \times 7 \times (1.05)^{1.5} = 20$
$2.7 \times 18 \times (.5)^{1.5} = 17$
$2.7 \times 4 \times (.15)^{1.5} = 1$
$2.7 \times 14 \times (.1)^{1.5} = 1$
$2.7 \times 36 \times (.8)^{1.5} = 70$
$2.7 \times 50 \times (.95)^{1.5} = 125$
$2.7 \times 50 \times (1.25)^{1.5} = 189$
$2.7 \times 50 \times (1.1)^{1.5} = 156$
$2.7 \times 35 \times (.45)^{1.5} = 29$ $\Sigma = 635$ CFS

AT ELEV 351 $\Sigma = 1217$ CFS
AT ELEV 352 $\Sigma = 2846$ CFS
AT ELEV 353 $\Sigma = 5041$ CFS
AT ELEV 355 $\Sigma = 10800$ CFS

BY RLS DATE 7/22/71 **BERGER ASSOCIATES** SHEET NO. 14 OF 9
CHKD. BY DATE PROJECT D-0590
SUBJECT MILLTOWN DAM

TOTAL DISCHARGE CURVE



MAXIMUM KNOWN FLOOD AT DAMSITE

THERE ARE NO RECORDS OF POOL LEVELS AT THIS DAM. BASED ON RECORDS OF THE STREAM GAGING STATION ON EAST BRANCH CHESTER CREEK LOCATED ABOUT 2.6 MILES DOWNSTREAM OF THE DAM (D.A. = 10.8 SQ. MI.) THE MAXIMUM DISCHARGE AT THE GAGE OCCURRED IN JANUARY 1978 WHEN A FLOW OF 971 CFS WAS OBSERVED. THE MAXIMUM INFLOW TO MILLTOWN DAM IS ESTIMATED TO BE:

$$\left(\frac{6.33}{10.8}\right)^{0.8} \times 971 = 633 \text{ CFS}$$

DESIGN FLOOD

SIZE CLASSIFICATION

MAXIMUM STORAGE = 114 ACRE-FEET
MAXIMUM HEIGHT = 20 FEET
SIZE CLASSIFICATION IS "SMALL"

HAZARD CLASSIFICATION

SEVERAL HOMES LOCATED NEAR THE DOWNSTREAM CHANNEL.
USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

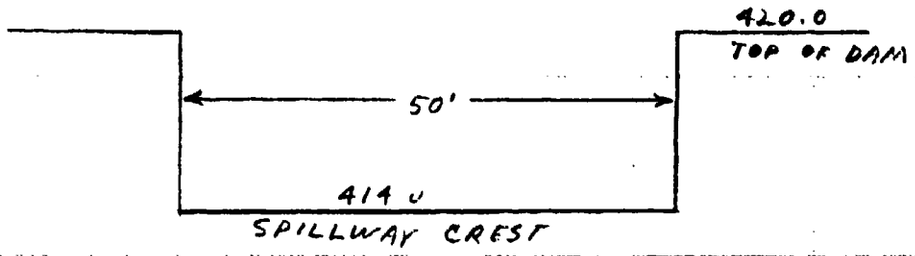
THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO ONE-HALF PMF TO THE PROBABLE MAXIMUM FLOOD.

BY RLS DATE 9/23/81 BERGER ASSOCIATES SHEET NO. 6 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

UPSTREAM RESERVOIR

TOWNSHIP LINE DAM

EARTHFILL DAM WITH CONCRETE CORE WALL
34' HIGH
530' LONG



OGEE SECTION
C = 3.8 (PENNDER FILES)

EMBANKMENT C = 2.7 (KINGS HDBK)

DATA OBTAINED FROM PENNDER FILES AND SITE VISIT.

BY RLS DATE 9/23/81 **BERGER ASSOCIATES** SHEET NO. 7 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

BREACH ASSUMPTIONS

BREACH WIDTH = 50'

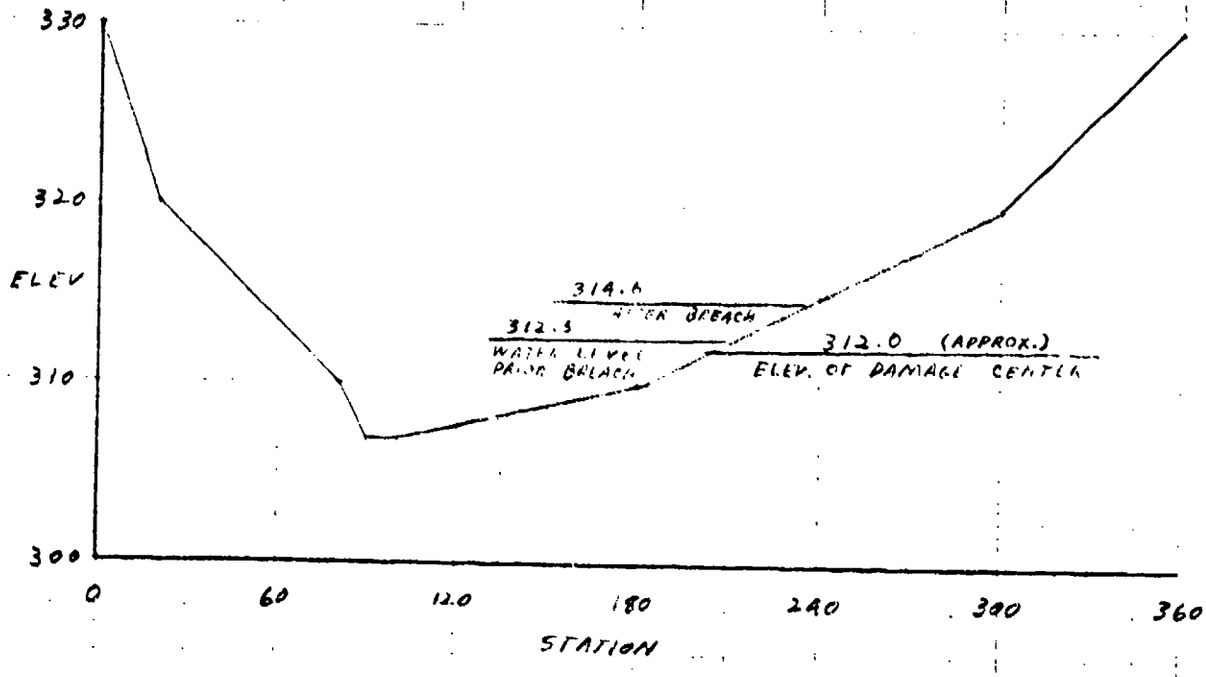
SIDE SLOPES (EARTH EMBANKMENT WITH CORE WALL) = 1:1

FAILURE TIME (EARTH EMBANKMENT WITH CORE WALL) =
BETWEEN 15 MIN. AND 2 HR.
USE: .25 HR, .5 HR., 1 HR., 2 HR.

POOL LEVEL AT FAILURE: EARTH EMBANKMENT WITH CORE WALL
SAY 1.0 FT. OVER TOP OF DAM

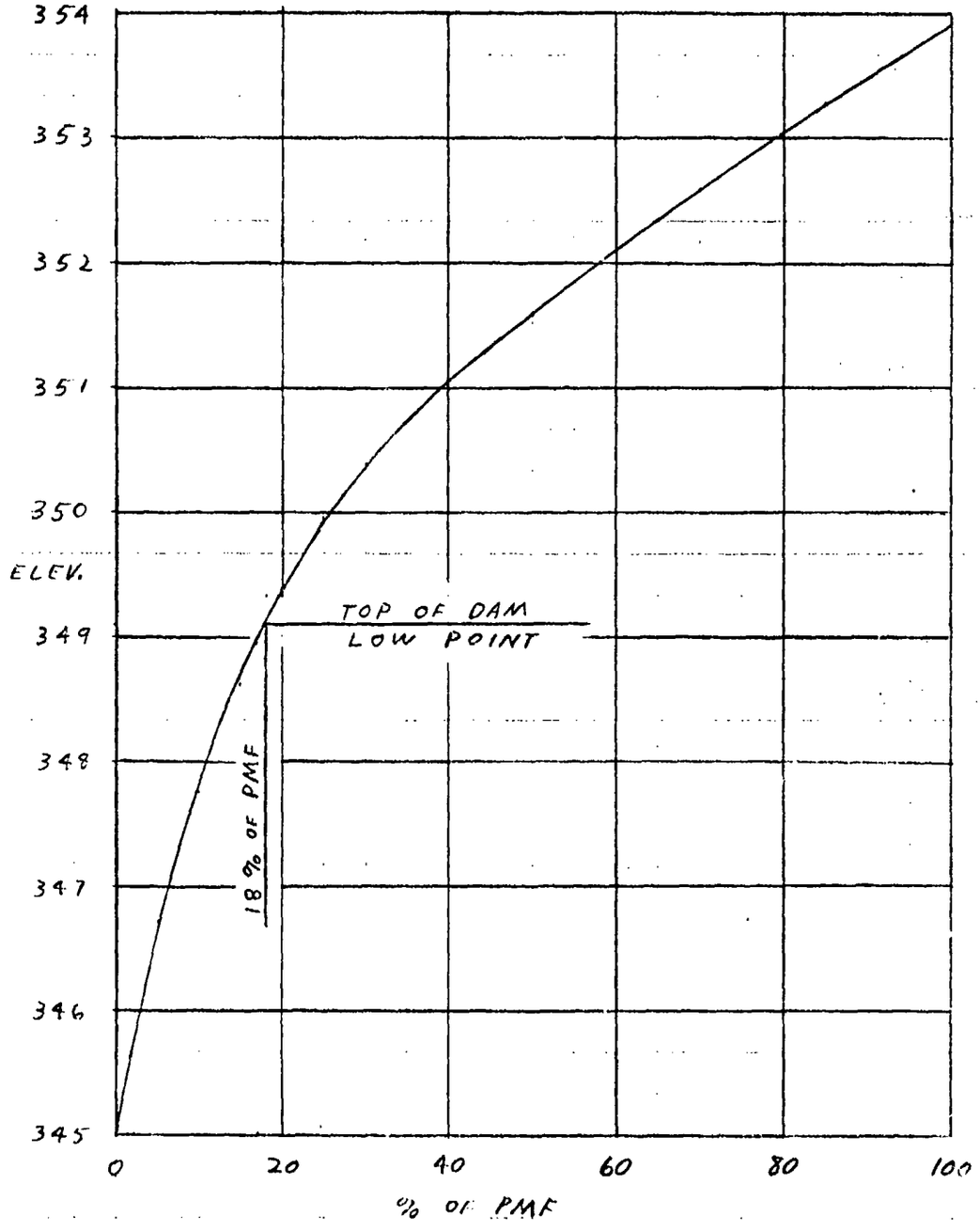
UPSTREAM RESERVOIR:
TWP. LINE DAM = NOT OVERTOPPED BY 27% PMF
WILL NOT BREACH.

DAMAGE CENTER - 3200 FT DOWNSTREAM



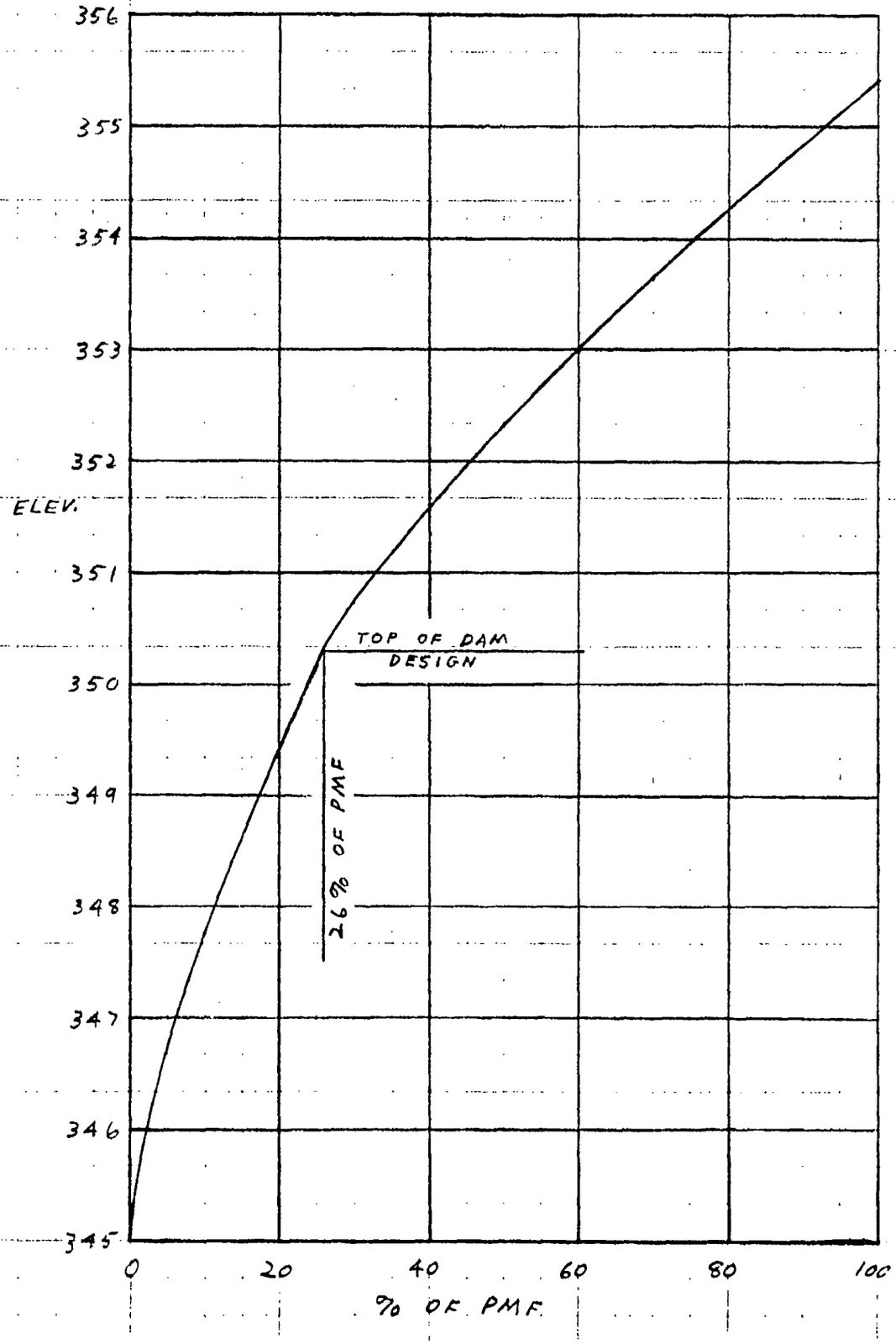
BY RLS DATE 4/23/81 **BERGER ASSOCIATES** SHEET NO. 8 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

SPILLWAY CAPACITY CURVE



BY RLS DATE 6/22/81 **BERGER ASSOCIATES** SHEET NO. 9 OF 9
CHKD. BY DATE PROJECT D0590
SUBJECT MILLTOWN DAM

SPILLWAY CAPACITY CURVE (DESIGN)



HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: MILLTOWN DAM RIVER BASIN: Delaware

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.5 INCHES/24 HOURS[1]

(FOR FOOTNOTES SEE NEXT PAGE)

STATION		1	2	3	4
STATION DESCRIPTION		TOWNSHIP LINE DAM	MILLTOWN DAM		
DRAINAGE AREA (SQUARE MILES)		2.6	3.7		
CUMULATIVE DRAINAGE AREA (SQUARE MILE)		2.6	6.3		
ADJUSTMENT OF PMP FOR DRAINAGE AREA (%)[2]	6 HOURS	113	113		
	12 HOURS	123	123		
	24 HOURS	132	132		
	48 HOURS	143	143		
	72 HOURS	--	--		
	Zone 6				
SNYDER HYDROGRAPH PARAMETERS	ZONE[3]	10	10		
	C_p / C_t[4]	.60/1.25	.60/1.25		
	L (MILES)[5]	3.30	3.73		
	L_{ca} (MILES)[5]	1.59	1.65		
	$T_p = C_t (L \cdot L_{ca})^{0.3}$ (Hours)	2.06	2.16		
SPILLWAY DATA	CREST LENGTH (FT.)	50	69		
	FREEBOARD (FT.)	5.7	4.1		
	DISCHARGE COEFFICIENT	3.8	3.88		
	EXPONENT	1.5	1.5		
	ELEVATION	414	345		
AREA[6] (ACRES)	NORMAL POOL	414 = 65	345 = 9.2		
	ELEV. _____	420 = 124	350 = 51		
	ELEV. _____		360 = 77		
STORAGE (ACRE-FEET)	NORMAL POOL[7]	414 = 597	345 = 13.5		
	ELEV. _____ [8]	390 = 0	339 = 0		
	ELEV. _____ [8]	405 = 174			
	ELEV. _____ [8]	420 = 1150			
		425 = 2000			

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

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

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

(4) Snyder's Coefficients.

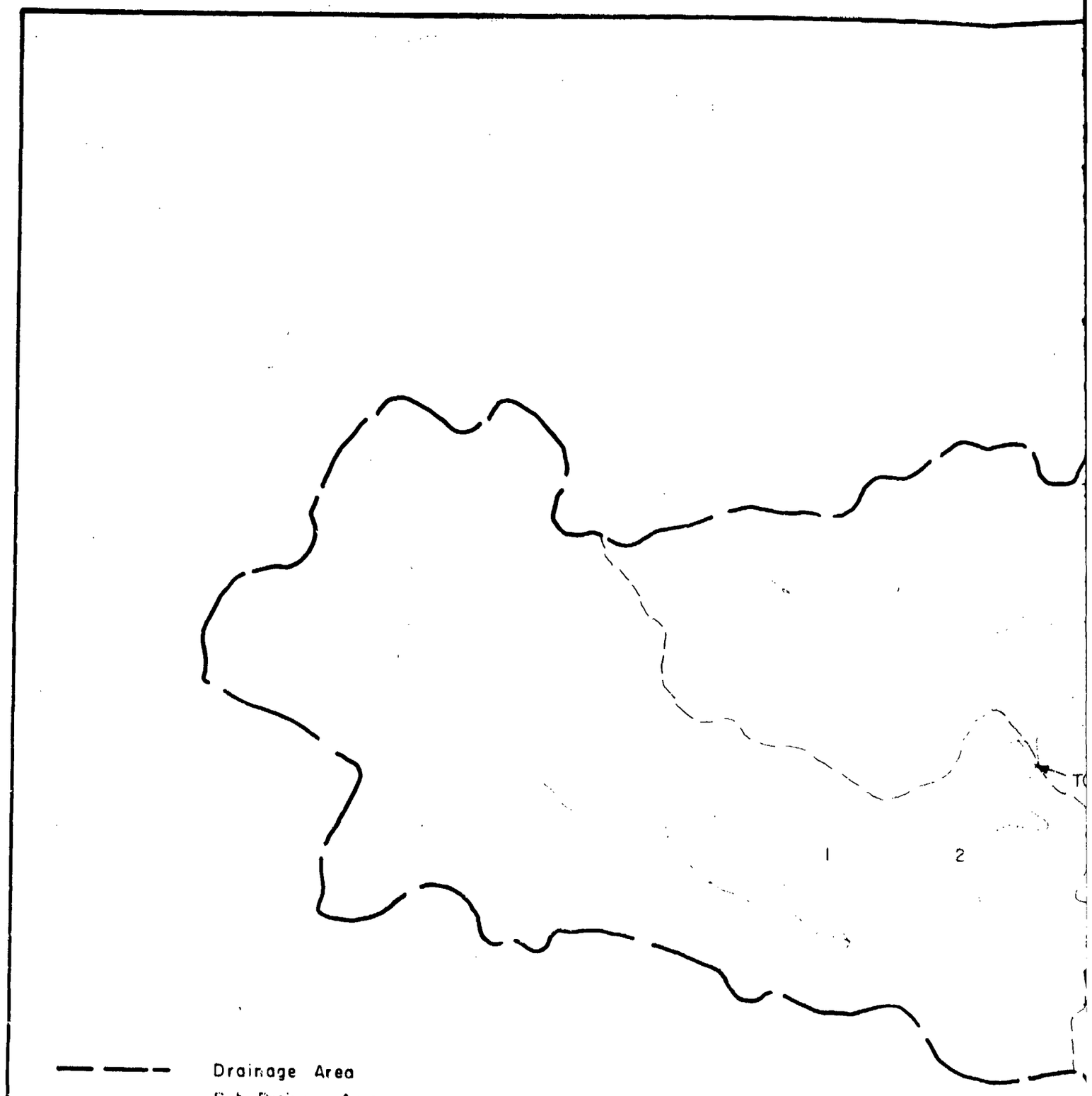
(5) L = Length of longest water course from outlet to basin divide.

L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Planimetered area encompased by contour upstream of dam.

(7) PennDER files.

(8) Computed by conic method.



— — — Drainage Area

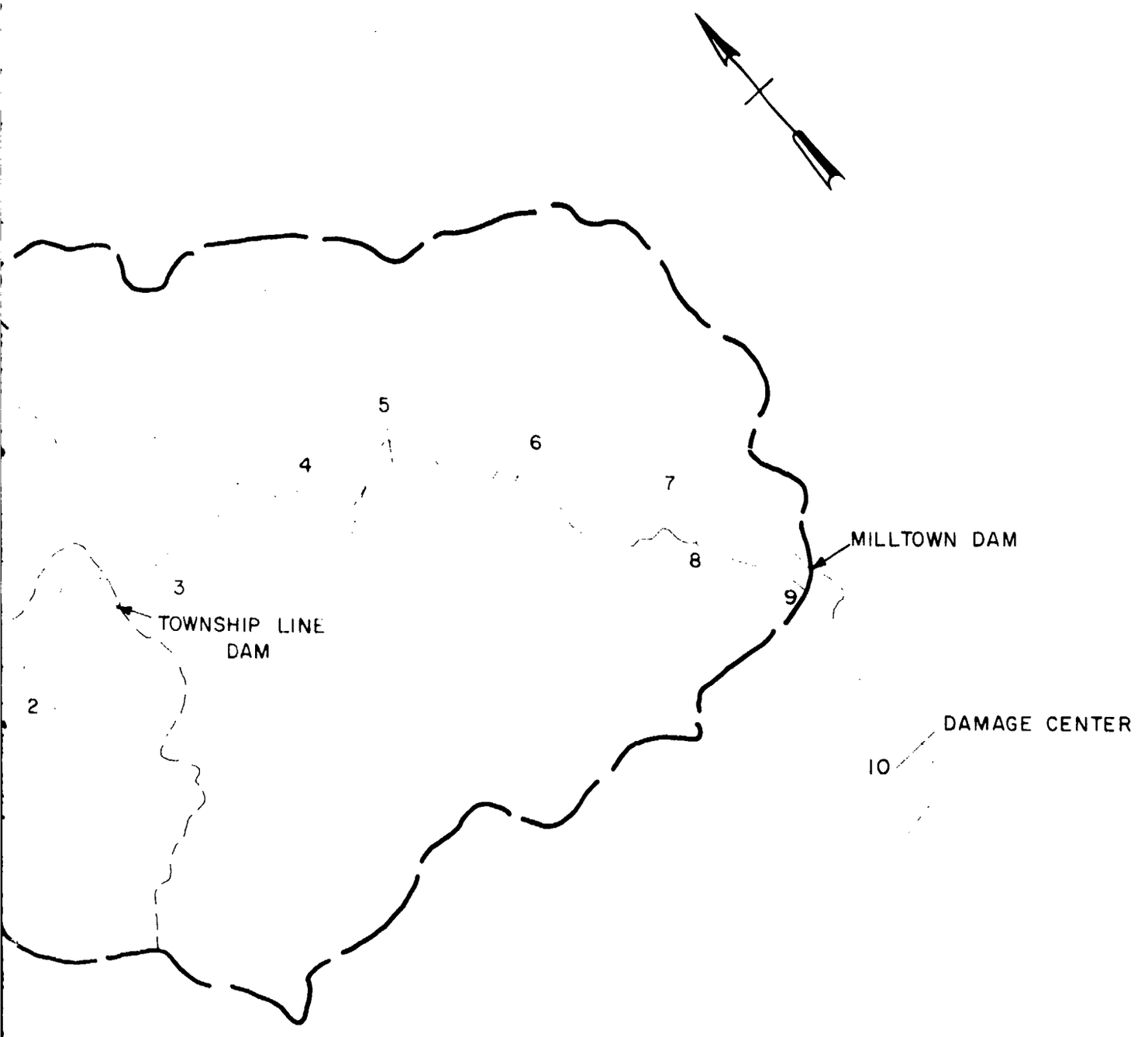
Sub-Drainage Area

Stream

9 Stream Station Identification

DRAINAGE AREA MAP

SCALE: 1" = 1 MILE



MAP

2

MILLTOWN DAM
PA-00218
PLATE D-I

TABLE NO. 1

COMPARISON OF WATER SURFACE ELEVATIONS

MILLTOWN DAM

SDF = 6531 cfs

Crest Elevation (Low Point) - 349.1 Spillway Elevation - 345.0

	STAGE	CREST OF DAM ELEVATION	DEPTH	3200' D/S OF DAM* ELEVATION
A.	At Low Point in Embankment Crest	349.1	0	311.5
B.	27% PMF Overtopping No Breach	350.14	1.04	312.5
C.	27% PMF Overtopping (15 Min. Breach)	350.11	1.01	314.6
D.	27% PMF Overtopping (2 Hour Breach)	350.13	1.03	313.1

*Several houses located about 3200 feet downstream of Milltown Dam. Considered to be damage center.

Condition C: (Time refers to elapsed time after start of storm). Time to reach breach elevation 350.1 at dam = 42.50 Hours. Water level 3200' downstream prior to breach = 312.5'. Duration of breach = 15 Minutes. Time for breach to peak 3200' downstream = .5 Hours. Peak elevation 3200' downstream due to breach = 314.6. Rate of increase in water level = 2.1' in 30 Minutes.

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
```

```
    1          A1                    MILLTOWN DAM    ****    EAST BRANCH CHESTER CREEK
    2          A2                    EAST GOSHEN TWP., CHESTER COUNTY, PA.
    3          A3                    NDI # PA-00218        PA DER # 15-146
    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 - TWP. LINE DAM SUBAREA
   10          M      1       1     2.6             6.3                               1
   11          P             23.5     113     123     132     143
   12          T                                                       1     .05
   13          W   2.06     .60
   14          X   -1.5    -.05       2
   15          K      1       2                                       1
   16          K1                    RESERVOIR ROUTING - TWP. LINE DAM
   17          Y                             1       1
   18          Y1     1                                               597
   19          $S     0      12      61     174     361     597    1150    2000
   20          $E   390     395     400     405     410     414     420     425
   21          $$   414      50     3.8     1.5
   22          $D   420     2.7     1.5     530
   23          K      1       3                                       1
   24          K1                    ROUTING THRU REACH 2 - 3
   25          Y                             1       1
   26          Y1     1
   27          Y6    .1     .07      .1     384     410    1100    .0063
   28          Y7     0     410      80     400     180     390     510     384     520     384
   29          Y7   620     390     790     400    1000     410
   30          K      1       4                                       1
   31          K1                    ROUTING THRU REACH 3 - 4
   32          Y                             1       1
   33          Y1     1
   34          Y6   .07     .05     .07     369     390    2350    .0028
   35          Y7     0     380     500     380     700     370     740     369     750     369
   36          Y7   870     370     990     380    1010     390
   37          K      1       5                                       1
   38          K1                    ROUTING THRU REACH 4 - 5
   39          Y                             1       1
   40          Y1     1
   41          Y6    .1     .05      .1     363     390    2050    .0028
   42          Y7     0     390     150     380     260     370     450     363     460     363
   43          Y7   890     370    1010     380    1120     390
   44          K      1       6                                       1
   45          K1                    ROUTING THRU REACH 5 - 6
   46          Y                             1       1
   47          Y1     1
   48          Y6    .1     .07      .1     354     380    2100    .0069
   49          Y7     0     380      50     370     150     360     240     354     250     354
   50          Y7   370     360     450     370     510     380
1  51          K              7                                               1
   52          K1                    INFLOW HYDROGRAPH - MILLTOWN DAM SUBAREA
   53          M      1       1     3.7             6.3
   54          P             23.5     113     123     132     143
   55          T                                                       1     .05
   56          W   2.18     .60
   57          X   -1.5    -.05       2
   58          K      2       8                                       1
   59          K1                    COMBINE HYDROGRAPHS AT MILLTOWN DAM
   60          K      1       9                                       1
   61          K1                    RESERVOIR ROUTING - THRU MILLTOWN DAM
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 62        Y                                1
 63        Y1     1                                                18.5      -1
 64        Y4   345    345.5     346    346.5     347    347.5     348    348.5    349.1    349.5
 65        Y4   350    350.5     351     352      353     355
 66        Y5     0      56      197     401      650     936     1256     1606     2063     2416
 67        Y5  3049    3901     4956    7593    10872   19012
 68        $A     0     9.2       51      77
 69        $E   339     345      350     360
 70        $$   345
 71        $D 349.1
 72        K     99
1                         PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                   RUNOFF HYDROGRAPH AT           1
                                   ROUTE HYDROGRAPH TO            2
                                   ROUTE HYDROGRAPH TO            3
                                   ROUTE HYDROGRAPH TO            4
                                   ROUTE HYDROGRAPH TO            5
                                   ROUTE HYDROGRAPH TO            6
                                   RUNOFF HYDROGRAPH AT           7
                                   COMBINE  2 HYDROGRAPHS AT      8
                                   ROUTE HYDROGRAPH TO            9
                                   END OF NETWORK


1********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  01 APR 80
 ********************************

 RUN  DATE* 81/07/23.
      TIME* 10.06.31.


                                  MILLTOWN DAM     ****    EAST BRANCH CHESTER CREEK
                                  EAST GOSHEN TWP., CHESTER COUNTY, PA.
                                  NDI # PA-00218        PA DER # 15-146

                                               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


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3/29

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - TWP. LINE DAM SUBAREA

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	2.60	0.00	6.30	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	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= 2.06 CP= .60 NTA= 0

RECESSION DATA

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

UNIT HYDROGRAPH 48 END-OF-PERIOD ORDINATES, LAG= 2.05 HOURS, CP= .60 VOL= 1.00

20.	74.	149.	234.	325.	406.	465.	498.	502.	469.
416.	348.	325.	287.	253.	224.	198.	175.	154.	136.
120.	106.	94.	83.	73.	65.	57.	51.	45.	39.
35.	31.	27.	24.	21.	19.	17.	15.	13.	11.
10.	9.	8.	7.	6.	5.	5.	4.		

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	26.88	24.47	2.42	166100.
										(683.)(621.)(61.)(4703.43)			

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4/28

HYDROGRAPH ROUTING

RESERVOIR ROUTING - TWP. LINE DAM

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	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	597.	0

CAPACITY=	0.	12.	61.	174.	361.	597.	1150.	2000.
ELEVATION=	390.	395.	400.	405.	410.	414.	420.	425.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
414.0	50.0	3.8	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
420.0	2.7	1.5	530.

PEAK OUTFLOW IS 6150. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 5051. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 3946. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 3209. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 2589. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 2016. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 1452. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 911. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 402. AT TIME 43.75 HOURS

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5/28

HYDROGRAPH ROUTING

ROUTING THRU REACH 2 - 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	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	1	0	0	0

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0700	.1000	384.0	410.0	1100.	.00630

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 410.00 80.00 400.00 180.00 390.00 510.00 384.00 520.00 384.00
620.00 390.00 790.00 400.00 1000.00 410.00

STORAGE	0.00	2.04	7.47	16.29	28.49	43.69	60.32	78.22	97.41	117.86
	139.60	162.61	186.91	212.55	239.56	267.95	297.70	328.83	361.33	395.20
OUTFLOW	0.00	112.38	635.47	1797.67	3790.15	7218.61	11975.64	17763.64	24570.20	32392.40
	41233.41	51100.50	61994.52	73924.41	86930.36	101029.42	116239.63	132579.68	150068.75	168726.29
STAGE	384.00	385.37	386.74	388.11	389.47	390.84	392.21	393.58	394.95	396.32
	397.68	399.05	400.42	401.79	403.16	404.53	405.89	407.26	408.63	410.00
FLOW	0.00	112.38	635.47	1797.67	3790.15	7218.61	11975.64	17763.64	24570.20	32392.40
	41233.41	51100.50	61994.52	73924.41	86930.36	101029.42	116239.63	132579.68	150068.75	168726.29

MAXIMUM STAGE IS 390.4

MAXIMUM STAGE IS 390.0

MAXIMUM STAGE IS 389.5

MAXIMUM STAGE IS 389.1

MAXIMUM STAGE IS 388.6

MAXIMUM STAGE IS 388.3

MAXIMUM STAGE IS 387.7

MAXIMUM STAGE IS 387.1

MAXIMUM STAGE IS 386.1

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6/18

HYDROGRAPH ROUTING

ROUTING THRU REACH 3 - 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0700	.0500	.0700	369.0	390.0	2350.	.00280

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 380.00 500.00 380.00 700.00 370.00 740.00 369.00 750.00 369.00
870.00 370.00 990.00 380.00 1010.00 390.00

STORAGE	0.00	5.83	17.22	30.72	46.33	64.05	83.88	105.82	129.86	156.02
	185.70	244.80	304.04	363.40	422.90	482.53	542.29	602.19	662.21	722.37
OUTFLOW	0.00	125.67	693.56	1637.76	2947.49	4627.54	6688.19	9142.24	12003.75	15287.44
	17194.03	22734.27	29316.12	36840.62	45241.60	54470.04	64487.44	75262.33	86768.30	98982.71
STAGE	369.00	370.11	371.21	372.32	373.42	374.53	375.63	376.74	377.84	378.95
	380.05	381.16	382.26	383.37	384.47	385.58	386.68	387.79	388.89	390.00
FLOW	0.00	125.67	693.56	1637.76	2947.49	4627.54	6688.19	9142.24	12003.75	15287.44
	17194.03	22734.27	29316.12	36840.62	45241.60	54470.04	64487.44	75262.33	86768.30	98982.71

MAXIMUM STAGE IS 375.3

MAXIMUM STAGE IS 374.8

MAXIMUM STAGE IS 374.1

MAXIMUM STAGE IS 373.6

MAXIMUM STAGE IS 373.1

MAXIMUM STAGE IS 372.6

MAXIMUM STAGE IS 372.1

MAXIMUM STAGE IS 371.5

MAXIMUM STAGE IS 370.6

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7/28

HYDROGRAPH ROUTING

ROUTING THRU REACH 4 - 5

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	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	1	0	0	0

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0500	.1000	363.0	390.0	2050.	.00280

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 390.00 150.00 380.00 260.00 370.00 450.00 363.00 460.00 363.00
890.00 370.00 1010.00 380.00 1120.00 390.00

STORAGE	0.00	4.88	18.17	39.88	70.01	108.54	151.93	197.31	245.26	295.1
	347.34	401.66	458.16	517.00	578.31	642.09	708.35	777.07	848.27	921.9
OUTFLOW	0.00	136.41	788.96	2250.93	4766.99	8636.71	14937.17	22604.28	31572.15	41795.5
	53242.66	65890.37	79720.85	94698.72	110854.18	128184.34	146686.63	166368.27	187225.82	209264.9
STAGE	363.00	364.42	365.84	367.26	368.68	370.11	371.53	372.95	374.37	375.7
	377.21	378.63	380.05	381.47	382.89	384.32	385.74	387.16	388.58	390.0
FLOW	0.00	136.41	788.96	2250.93	4766.99	8636.71	14937.17	22604.28	31572.15	41795.5
	53242.66	65890.37	79720.85	94698.72	110854.18	128184.34	146686.63	166368.27	187225.82	209264.9

MAXIMUM STAGE IS 369.2

MAXIMUM STAGE IS 368.8

MAXIMUM STAGE IS 368.2

MAXIMUM STAGE IS 367.8

MAXIMUM STAGE IS 367.4

MAXIMUM STAGE IS 367.0

MAXIMUM STAGE IS 366.5

MAXIMUM STAGE IS 366.0

MAXIMUM STAGE IS 365.0

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HYDROGRAPH ROUTING

8/28

ROUTING THRU REACH 5 - 6

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	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	1	0	0	0

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.1000	.0700	.1000	354.0	380.0	2100.	.00690

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

1.00 390.00 50.00 370.00 150.00 360.00 240.00 354.00 250.00 354.00
370.00 380.00 450.00 370.00 510.00 380.00

STORAGE	0.00	2.24	7.64	16.20	27.92	42.50	58.83	76.78	96.36	117.56
	140.38	164.83	190.88	218.07	246.25	275.43	305.60	336.76	368.92	402.07
OUTFLOW	0.00	70.86	366.38	999.63	2066.78	3885.94	6410.93	9497.37	13148.72	17371.96
	22176.43	27573.00	33607.55	40318.42	47620.96	55514.22	63998.94	73077.09	82751.53	93025.83
STAGE	354.00	355.37	356.74	358.11	359.47	360.84	362.21	363.58	364.95	366.32
	367.68	369.05	370.42	371.79	373.16	374.53	375.89	377.26	378.63	380.00
FLOW	0.00	70.86	366.38	999.63	2066.78	3885.94	6410.93	9497.37	13148.72	17371.96
	22176.43	27573.00	33607.55	40318.42	47620.96	55514.22	63998.94	73077.09	82751.53	93025.83

MAXIMUM STAGE IS 362.0

MAXIMUM STAGE IS 361.5

MAXIMUM STAGE IS 360.9

MAXIMUM STAGE IS 360.3

MAXIMUM STAGE IS 359.9

MAXIMUM STAGE IS 359.4

MAXIMUM STAGE IS 358.7

MAXIMUM STAGE IS 357.9

MAXIMUM STAGE IS 356.8

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9/28

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH - MILLTOWN DAM SUBAREA

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.70	0.00	6.30	0.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.50	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= 2.16 CP= .60 NTA= 0

RECESSION DATA

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

UNIT HYDROGRAPH 52 END-OF-PERIOD ORDINATES, LAG= 2.15 HOURS, CP= .60 VOL= 1.00

25.	92.	185.	292.	407.	516.	600.	653.	674.	651.
592.	528.	470.	419.	374.	333.	297.	265.	236.	210.
189.	167.	149.	133.	118.	106.	94.	84.	75.	67.
59.	53.	47.	42.	38.	33.	30.	27.	24.	21.
19.	17.	15.	13.	12.	11.	9.	8.	8.	7.
6.	5.								

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	26.88	24.47	2.42	236071.
										(683.)(	621.)(	61.)(	6684.79)

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COMBINE HYDROGRAPHS

COMBINE HYDROGRAPHS AT MILLTOWN DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	2	0	0	0	0	1	0	0

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10/28

HYDROGRAPH ROUTING

RESERVOIR ROUTING - THRU MILLTOWN DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	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	19.	-1

STAGE	345.00	345.50	346.00	346.50	347.00	347.50	348.00	348.50	349.10	349.50
	350.00	350.50	351.00	352.00	353.00	355.00				
FLOW	0.00	56.00	197.00	401.00	650.00	936.00	1256.00	1606.00	2063.00	2416.00
	3049.00	3901.00	4936.00	7593.00	10872.00	19012.00				
SURFACE AREA=	0.	9.	51.	77.						
CAPACITY=	0.	18.	155.	790.						
ELEVATION=	339.	345.	350.	360.						

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
345.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
349.1	0.0	0.0	0.

PEAK OUTFLOW IS 14587. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 12017. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 9478. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 7938. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 6496. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 5082. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 3697. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 2320. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 1096. AT TIME 43.00 HOURS

11/28

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)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	2.60	1	6804.	5783.	4762.	4082.	3402.	2721.	2041.	1361.	680.
		(6.73)		(192.65)(	163.76)(	134.86)(	115.59)(	96.33)(	77.06)(	57.80)(	38.55)(	19.27)
ROUTED TO	2	2.60	1	6150.	5051.	3946.	3209.	2589.	2016.	1452.	911.	402.
		(6.73)		(174.14)(	143.02)(	111.72)(	90.87)(	73.32)(	57.08)(	41.11)(	25.79)(	11.38)
ROUTED TO	3	2.60	1	6148.	5057.	3944.	3202.	2590.	2014.	1452.	91^.	402.
		(6.73)		(174.09)(	143.20)(	111.69)(	90.68)(	73.33)(	57.02)(	41.13)(	25.76)(	11.38)
ROUTED TO	4	2.60	1	6126.	5048.	3941.	3201.	2582.	2011.	1447.	908.	400.
		(6.73)		(173.46)(	142.95)(	111.60)(	90.65)(	73.10)(	56.94)(	40.99)(	25.71)(	11.33)
ROUTED TO	5	2.60	1	6120.	5035.	3927.	3190.	2579.	2004.	1444.	906.	399.
		(6.73)		(173.29)(	142.58)(	111.20)(	90.33)(	73.04)(	56.74)(	40.89)(	25.65)(	11.29)
ROUTED TO	6	2.60	1	6103.	5037.	3925.	3189.	2574.	2002.	1443.	904.	398.
		(6.73)		(172.80)(	142.62)(	111.15)(	90.31)(	72.89)(	56.68)(	40.85)(	25.59)(	11.26)
HYDROGRAPH AT	7	3.70	1	9339.	7938.	6537.	5603.	4669.	3736.	2802.	1868.	934.
		(9.58)		(264.44)(	224.78)(	185.11)(	158.67)(	132.22)(	105.78)(	79.33)(	52.89)(	26.44)
2 COMBINED	8	6.30	1	14653.	12080.	9513.	7977.	6531.	5111.	3748.	2383.	1126.
		(16.32)		(414.94)(	342.07)(	269.38)(	225.89)(	184.93)(	144.71)(	106.13)(	67.48)(	31.88)
ROUTED TO	9	6.39	1	14587.	12017.	9478.	7938.	6496.	5082.	3697.	2320.	1096.
		(16.32)		(413.06)(	340.27)(	268.40)(	224.78)(	183.94)(	143.89)(	104.69)(	65.70)(	31.04)

1

SUMMARY OF DAM SAFETY ANALYSIS

TWP. LINE DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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	421.39	1.39	1386.	6150.	5.25	42.50	0.00
.85	421.03	1.03	1326.	5051.	4.25	42.75	0.00
.70	420.62	.62	1256.	3946.	3.50	42.75	0.00
.60	420.28	.28	1198.	3209.	2.25	43.00	0.00
.50	419.71	0.00	1123.	2589.	0.00	43.25	0.00
.40	418.83	0.00	1042.	2016.	0.00	43.25	0.00
.30	417.83	0.00	955.	1452.	0.00	43.25	0.00
.20	416.84	0.00	869.	911.	0.00	43.50	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6148.	390.4	42.50
.85	5057.	390.0	42.75
.70	3944.	389.5	43.00
.60	3202.	389.1	43.25
.50	2590.	388.6	43.25
.40	2014.	388.3	43.25
.30	1452.	387.7	43.50
.20	910.	387.1	43.75
.10	402.	386.1	44.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6126.	375.3	42.75
.85	5048.	374.8	42.75
.70	3941.	374.1	43.00
.60	3201.	373.6	43.25
.50	2582.	373.1	43.50
.40	2011.	372.6	43.50
.30	1447.	372.1	43.75
.20	908.	371.5	43.75
.10	400.	370.6	44.25

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6120.	369.2	42.75
.85	5035.	368.8	43.00
.70	3927.	368.2	43.25
.60	3190.	367.8	43.50
.50	2579.	367.4	43.50
.40	2004.	367.0	43.75
.30	1444.	366.5	43.75
.20	906.	366.0	44.00
.10	399.	365.0	44.50

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6103.	362.0	42.75
.85	5037.	361.5	43.00
.70	3925.	360.9	43.25
.60	3189.	360.3	43.50
.50	2574.	359.9	43.75
.40	2002.	359.4	43.75
.30	1443.	358.7	44.00
.20	904.	357.9	44.25
.10	398.	356.8	44.75

1

SUMMARY OF DAM SAFETY ANALYSIS

MILLTOWN DAM

13/28

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	18.	18.	114.
OUTFLOW	0.	0.	2063.

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	353.91	4.81	373.	14587.	11.25	42.50	0.00
.85	353.28	4.18	335.	12017.	10.75	42.75	0.00
.70	352.58	3.48	294.	9478.	10.00	42.75	0.00
.60	352.11	3.01	267.	7938.	9.00	42.50	0.00
.50	351.58	2.48	239.	6496.	8.25	42.75	0.00
.40	351.05	1.95	210.	5082.	7.00	42.75	0.00
.30	350.38	1.28	174.	3697.	5.25	42.75	0.00
.20	349.39	.29	126.	2320.	2.50	43.00	0.00
.10	347.75	0.00	67.	1096.	0.00	43.00	0.00

EOI ENCOUNTERED.
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
 LAST MODIFICATION  01 APR 80
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(BREACH) 14/25

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 1          A1          MILLTOWN DAM    ****    EAST BRANCH CHESTER CREEK
 2          A2          EAST GOSHEN TWP., CHESTER COUNTY, PA.
 3          A3          NDI # PA-00218        PA DER # 15-146
 4          B   300      0      15      0       0       0       0       0      -4      0
 5          B1    5
 6          J     5      1       1
 7          J1  .27
 8          K             1                                              1
 9          K1          INFLOW HYDROGRAPH - TWP. LINE DAM SUBAREA
10          M     1       1     2.6             6.3                                    1
11          P           23.5     113     123     132     143
12          T                                                          1     .05
13          W   2.06     .60
14          X   -1.5    -.05       2
15          K     1       2                                            1
16          K1          RESERVOIR ROUTING - TWP. LINE DAM
17          Y                            1       1
18          Y1    1                                                  597
19          $S    0      12      61     174     361     597    1150    2000
20          $E  390     395     400     405     410     414     420     425
21          $$  414      50     3.8     1.5
22          $D  420     2.7     1.5     530
23          K     1       3                                            1
24          K1          ROUTING THRU REACH 2 - 3
25          Y                            1       1
26          Y1    1
27          Y6   .1     .07      .1     384     410    1100   .0063
28          Y7    0     410      80     400     180     390     510     384     520     384
29          Y7  620     390     790     400    1000     410
30          K     1       4                                            1
31          K1          ROUTING THRU REACH 3 - 4
32          Y                            1       1
33          Y1    1
34          Y6  .07     .05     .07     369     390    2330   .0028
35          Y7    0     380     500     380     700     370     740     369     750     369
36          Y7  970     370     990     380    1010     390
37          K     1       5                                            1
38          K1          ROUTING THRU REACH 4 - 5
39          Y                            1       1
40          Y1    1
41          Y6   .1     .05      .1     363     390    2050   .0028
42          Y7    0     390     150     380     260     370     450     363     460     363
43          Y7  890     370    1010     380    1120     390
44          K     1       6                                            1
45          K1          ROUTING THRU REACH 5 - 6
46          Y                            1       1
47          Y1    1
48          Y6   .1     .07      .1     354     380    2100   .0069
49          Y7    0     380      50     370     150     360     210     354     250     354
50          Y7  370     360     450     370     510     380
51          K             7                                              1
52          K1          INFLOW HYDROGRAPH - MILLTOWN DAM SUBAREA
53          M     1       1     3.7             6.3                                    1
54          P           23.5     113     123     132     143
55          T                                                          1     .05
56          W   2.16     .60
57          X   -1.5    -.05       2
58          K     2       8                                            1
59          K1          COMBINE HYDROGRAPHS AT MILLTOWN DAM
60          K     1       9                                            1
61          K1          RESERVOIR ROUTING - THRU MILLTOWN DAM
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Y				1	1					
Y1	1						18.5	-1		
Y4	345	345.5	346	346.5	347	347.5	348	348.5	349.1	349.5
Y4	350	350.5	351	352	353	355				
Y5	0	56	197	401	650	936	1256	1606	2063	2416
Y5	3049	3901	4956	7593	10872	19012				
$A	0	9.2	51	77						
$E	339	345	350	360						
$$	345									
$D	349.1									
$B	50	1	339	.25	345	400				
$B	50	1	339	.25	345	350.1				
$B	50	1	339	.5	345	350.1				
$B	50	1	339	1	345	350.1				
$B	50	1	339	2	345	350.1				
K	1	10					1			
K1			ROUTING THRU REACH 9 - 10							
Y				1	i					
Y1	1									
Y6	.08	.06	.08	307	330	3200	.014			
Y7	0	330	20	320	80	310	90	307	100	307
Y7	180	310	300	320	360	330				
K	99									

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
ROUTE HYDROGRAPH TO	4
ROUTE HYDROGRAPH TO	5
ROUTE HYDROGRAPH TO	6
RUNOFF HYDROGRAPH AT	7
COMBINE 2 HYDROGRAPHS AT	8
ROUTE HYDROGRAPH TO	9
ROUTE HYDROGRAPH TO	10
END OF NETWORK	

1*******************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE* 81/07/23.
TIME* 10.07.54.

MILLTOWN DAM **** EAST BRANCH CHESTER CREEK
EAST GOSHEN TWP., CHESTER COUNTY, PA.
NDI # PA-00218 PA DER # 15-146

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= 5 NRTIO= 1 LRTIO= 1

RTIOS= .27

16/28

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .27
HYDROGRAPH AT	1	2.60	1	1837.
	(	6.73)	(	52.02)(
			2	1837.
			(	52.02)(
			3	1837.
			(	52.02)(
			4	1837.
			(	52.02)(
			5	1837.
			(	52.02)(
ROUTED TO	2	2.60	1	1288.
	(	6.73)	(	36.46)(
			2	1288.
			(	36.46)(
			3	1288.
			(	36.46)(
			4	1288.
			(	36.46)(
			5	1288.
			(	36.46)(
ROUTED TO	3	2.60	1	1288.
	(	6.73)	(	36.46)(
			2	1288.
			(	36.46)(
			3	1288.
			(	36.46)(
			4	1288.
			(	36.46)(
			5	1288.
			(	36.46)(
ROUTED TO	4	2.60	1	1284.
	(	6.73)	(	36.35)(
			2	1284.
			(	36.35)(
			3	1284.
			(	36.35)(
			4	1284.
			(	36.35)(
			5	1284.
			(	36.35)(

ROUTED TO	5	2.60	1 1279.
		(6.73)	(36.22)(
			2 1279.
			(36.22)(
			3 1279.
			(36.22)(
			4 1279.
			(36.22)(
			5 1279.
			(36.22)(
ROUTED TO	6	2.60	1 1279.
		(6.73)	(36.21)(
			2 1279.
			(36.21)(
			3 1279.
			(36.21)(
			4 1279.
			(36.21)(
			5 1279.
			(36.21)(
HYDROGRAPH AT	7	3.70	1 2521.
		(9.58)	(71.40)(
			2 2521.
			(71.40)(
			3 2521.
			(71.40)(
			4 2521.
			(71.40)(
			5 2521.
			(71.40)(
2 COMBINED	8	6.30	1 3334.
		(16.32)	(94.40)(
			2 3334.
			(94.40)(
			3 3334.
			(94.40)(
			4 3334.
			(94.40)(
			5 3334.
			(94.40)(
ROUTED TO	9	6.30	1 3286.
		(16.32)	(93.04)(
			2 8382.
			(237.36)(
			3 7360.
			(208.42)(
			4 5812.
			(164.57)(
			5 4167.
			(118.01)(
ROUTED TO	10	6.30	1 3286.
		(16.32)	(93.06)(
			2 6890.
			(195.12)(
			3 6247.
			(176.89)(
			4 5586.
			(158.19)(
			5 4134.

17/28

SUMMARY OF DAM SAFETY ANALYSIS

TWP. LINE DAM

18/26

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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
.27	417.58	0.00	927.	1288.	0.00	43.50	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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
.27	417.58	0.00	927.	1288.	0.00	43.50	0.00

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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
.27	417.58	0.00	927.	1288.	0.00	43.50	0.00

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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
.27	417.58	0.00	927.	1288.	0.00	43.50	0.00

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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
.27	417.58	0.00	927.	1288.	0.00	43.50	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1288.	387.5	43.50

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1288.	387.5	43.50

PLAN 3 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1288.	387.5	43.50

PLAN 4 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1288.	387.5	43.50

PLAN 5 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1288.	387.5	43.50

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1284.	371.9	43.75

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1284.	371.9	43.75

PLAN 3 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1284.	371.9	43.75

PLAN 4 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1284.	371.9	43.75

PLAN 5 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1284.	371.9	43.75

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	366.3	43.75

PLAN 2 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	366.3	43.75

PLAN 3 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	366.3	43.75

PLAN 4 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	366.3	43.75

PLAN 5 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	366.3	43.75

2/28

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	358.5	44.00

PLAN 2 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	358.5	44.00

PLAN 3 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	358.5	44.00

PLAN 4 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	358.5	44.00

PLAN 5 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	1279.	358.5	44.00

1

SUMMARY OF DAM SAFETY ANALYSIS

MILLTOWN DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	18.	18.	114.
OUTFLOW	0.	0.	2063.

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
.27	350.14	1.04	162.	3386.	5.00	43.00	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	18.	18.	114.
OUTFLOW	0.	0.	2063.

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
.27	350.11	1.01	161.	8382.	2.03	42.75	42.50

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	8.	16.	114.
OUTFLOW	0.	0.	2063.

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
.27	350.12	1.02	161.	7360.	2.21	43.00	42.50

PLAN 4 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	18.	18.	114.
OUTFLOW	0.	0.	2063.

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
.27	350.12	1.02	161.	5812.	2.54	43.50	42.50

PLAN 5 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	349.10
STORAGE	18.	18.	114.
OUTFLOW	0.	0.	2063.

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
.27	350.13	1.03	161.	4172.	3.04	44.08	42.50

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	3286.	312.5	43.00

PLAN 2 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	6990.	314.6	43.00

23/29

PLAN 3 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	6247.	314.3	43.00

PLAN 4 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	5586.	313.9	43.50

PLAN 5 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.27	4134.	313.1	44.25

EOI ENCOUNTERED.
N>

```
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
*********************************
```

(DESIGN)   2 4/28

```
A1              MILLTOWN DAM    ****    EAST BRANCH CHESTER CREEK
A2              EAST GOSHEN TWP., CHESTER COUNTY, PA.
A3              NDI # PA-00218          PA DER # 15-146
B     300     0     15     0     0     0     0     0    -4     0
B1      5
J       1     9      1
J1      1   .85     .7    .6    .5    .4    .3    .2    .1
K             1
K1              INFLOW HYDROGRAPH - TWP. LINE DAM SUBAREA        1
M       1     1    2.6         6.3
P          23.5    113   123   132   143                      1
T                                             1    .05
W    2.06   .60
X    -1.5  -.05      2
K       1     2
K1              RESERVOIR ROUTING - TWP. LINE DAM                1
Y                        1     1
Y1      1
$S      0    12     61   174   361   597   597
$E    390   395    400   405   410   414  1150  2000
$$    414    50    3.8   1.5               420   425
$D    420   2.7    1.5   530
K       1    .3
K1              ROUTING THRU REACH 2 - 3                         1
Y                        1     1
Y1      1
Y6     .1   .07     .1   384   410  1100 .0063
Y7      0   410     80   400   180   390   510   384   520   384
Y7    620   390    790   400  1000   410
K       1     4
K1              ROUTING THRU REACH 3 - 4                         1
Y                        1     1
Y1      1
Y6    .07   .05    .07   369   390  2350 .0028
Y7      0   380    500   380   700   370   740   369   750   369
Y7    870   370    990   380  1010   390
K       1     5
K1              ROUTING THRU REACH 4 - 5                         1
Y                        1     1
Y1      1
Y6     .1   .05     .1   363   390  2050 .0028
Y7      0   390    150   380   260   370   450   363   460   363
Y7    890   370   1010   380  1120   390
K       1     6
K1              ROUTING THRU REACH 5 - 6                         1
Y                        1     1
Y1      1
Y6     .1   .07     .1   354   380  2100 .0069
Y7      0   380     50   370   150   360   240   354   250   354
Y7    370   360    450   370   510   380
K             7
K1              INFLOW HYDROGRAPH - MILLTOWN DAM SUBAREA         1
M       1     1    3.7         6.3
P          23.5    113   123   132   143
T                                             1    .05
W    2.16   .60
X    -1.5  -.05      2
K       2     8
K1              COMBINE HYDROGRAPHS AT MILLTOWN DAM              1
K       1     9
K1              RESERVOIR ROUTING - THRU MILLTOWN DAM            1
```

```
   62          Y                          1
   63          Y1    1                                                    18.5     -1
   64          Y4  345   345.5    346   346.5    347   347.5    348    348.5   349.1   350.3
   65          Y4  351   351.5    352    353     354    355
   66          Y5    0     56     197    401     650    936    1256    1604    2063    3084
   67          Y5 4182   5227    6422   9185   12368  15916
   68          $A    0    9.2      51     77
   69          $E  339    345     350    360
   70          $$  345
   71          $D 350.3
   72          K    99
1                        PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                              RUNOFF HYDROGRAPH AT          1
                              ROUTE HYDROGRAPH TO           2
                              ROUTE HYDROGRAPH TO           3
                              ROUTE HYDROGRAPH TO           4
                              ROUTE HYDROGRAPH TO           5
                              ROUTE HYDROGRAPH TO           6
                              RUNOFF HYDROGRAPH AT          7
                              COMBINE  2 HYDROGRAPHS AT     8
                              ROUTE HYDROGRAPH TO           9
                              END OF NETWORK

1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  01 APR 80
 **********************************

 RUN  DATE= 81/07/23.
      TIME= 10.09.11.
```

MILLTOWN DAM **** EAST BRANCH CHESTER CREEK
EAST GOSHEN TWP., CHESTER COUNTY, PA.
NDI # PA-00218 PA DER # 15-146

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

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

1 ********** ********** ********** ********** ********** 26/27

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .85	RATIO 3 .70	RATIO 4 .60	RATIO 5 .50	RATIO 6 .40	RATIO 7 .30	RATIO 8 .20	RATIO 9 .10
HYDROGRAPH AT	1	2.60	1	6804.	5783.	4762.	4082.	3402.	2721.	2041.	1361.	680.
	(	6.73)	(	192.65)(	163.76)(	134.86)(	115.59)(	96.33)(	77.06)(	57.80)(	38.53)(	19.27)
ROUTED TO	2	2.60	1	6150.	5051.	3946.	3209.	2589.	2016.	1452.	911.	402.
	(	6.73)	(	174.14)(	143.02)(	111.72)(	90.87)(	73.32)(	57.08)(	41.11)(	25.79)(	11.38)
ROUTED TO	3	2.60	1	6148.	5057.	3944.	3202.	2590.	2014.	1452.	910.	402.
	(	6.73)	(	174.09)(	143.20)(	111.69)(	90.68)(	73.33)(	57.02)(	41.13)(	25.76)(	11.38)
ROUTED TO	4	2.60	1	6126.	5048.	3941.	3201.	2582.	2011.	1447.	908.	400.
	(	6.73)	(	173.46)(	142.95)(	111.60)(	90.65)(	73.10)(	56.94)(	40.99)(	25.71)(	11.33)
ROUTED TO	5	2.60	1	6120.	5035.	3927.	3190.	2579.	2004.	1444.	906.	399.
	(	6.73)	(	173.29)(	142.58)(	111.20)(	90.33)(	73.04)(	56.74)(	40.89)(	25.65)(	11.29)
ROUTED TO	6	2.60	1	6103.	5037.	3925.	3189.	2574.	2002.	1443.	904.	398.
	(	6.73)	(	172.80)(	142.62)(	111.15)(	90.31)(	72.87)(	56.68)(	40.85)(	25.59)(	11.26)
HYDROGRAPH AT	7	3.70	1	9339.	7938.	6537.	5603.	4669.	3736.	2802.	1868.	934.
	(	9.58)	(	264.44)(	224.78)(	185.11)(	158.67)(	132.2)(	105.78)(	79.33)(	52.89)(	26.44)
2 COMBINED	8	6.30	1	14653.	12080.	9513.	7977.	6531.	5111.	3748.	2383.	1126.
	(	15.32)	(	414.94)(	342.07)(	269.38)(	225.89)(	184.93)(	144.71)(	106.13)(	67.48)(	31.88)
ROUTED TO	9	6.30	1	14551.	11999.	9472.	7920.	6491.	5068.	3673.	2317.	1096.
	(	16.32)	(	412.04)(	339.76)(	268.22)(	224.27)(	183.80)(	143.51)(	104.02)(	65.61)(	31.04)

1 SUMMARY OF DAM SAFETY ANALYSIS

TWP. LINE DAM

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	414.00	414.00	420.00
STORAGE	597.	597.	1150.
OUTFLOW	0.	0.	2792.

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	421.39	1.39	1386.	6150.	5.25	42.50	0.00
.85	421.03	1.03	1326.	5051.	4.25	42.75	0.00
.70	420.62	.62	1256.	3946.	3.50	42.75	0.00
.60	420.28	.28	1198.	3209.	2.25	43.00	0.00
.50	419.71	0.00	1123.	2589.	0.00	43.25	0.00
.40	418.83	0.00	1042.	2016.	0.00	43.25	0.00
.30	417.88	0.00	955.	1452.	0.00	43.25	0.00
.20	416.94	0.00	859.	911.	0.00	43.50	0.00
.10	415.65	0.00	749.	402.	0.00	43.75	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6148.	390.4	42.50
.85	5057.	390.0	42.75
.70	3944.	389.5	43.00
.60	3202.	389.1	43.25
.50	2590.	388.6	43.25
.40	2014.	388.3	43.25
.30	1452.	387.7	43.50
.20	910.	387.1	43.75
.10	402.	386.1	44.00

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6126.	375.3	42.75
.85	5048.	374.8	42.75
.70	3941.	374.1	43.00
.60	3201.	373.6	43.25
.50	2582.	373.1	43.50
.40	2011.	372.6	43.50
.30	1447.	372.1	43.75
.20	908.	371.5	43.75
.10	400.	370.6	44.25

PLAN 1 STATION 5

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6120.	369.2	42.75
.85	5035.	368.8	43.00
.70	3927.	368.2	43.25
.60	3190.	367.8	43.50
.50	2579.	367.4	43.50
.40	2004.	367.0	43.75
.30	1444.	366.5	43.75
.20	906.	366.0	44.00
.10	399.	365.0	44.50

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	6103.	362.0	42.75
.85	5037.	361.5	43.00
.70	3925.	360.9	43.25
.60	3189.	360.3	43.50
.50	2574.	359.9	43.75
.40	2002.	359.4	43.75
.30	1443.	358.7	44.00
.20	904.	357.9	44.25
.10	398.	356.8	44.75

1

SUMMARY OF DAM SAFETY ANALYSIS

MILLTOWN DAM

28/28

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	345.00	345.00	350.30
STORAGE	18.	18.	170.
OUTFLOW	0.	0.	3084.

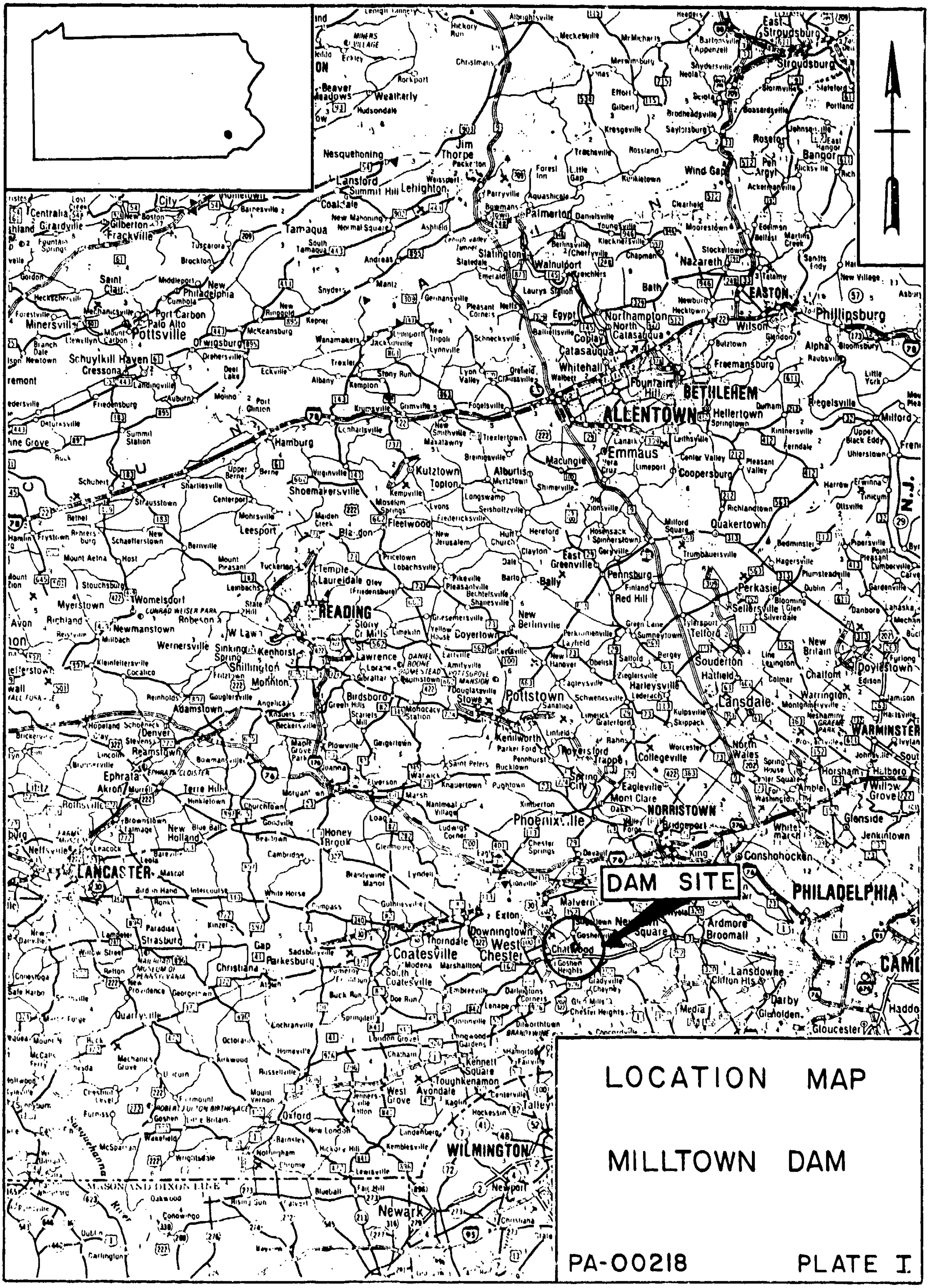
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	354.62	4.32	416.	14551.	9.00	42.50	0.00
.85	353.88	3.58	371.	11999.	8.50	42.75	0.00
.70	353.09	2.79	324.	9472.	7.50	42.75	0.00
.60	352.54	2.24	292.	7920.	6.75	42.75	0.00
.50	352.02	1.72	263.	6491.	5.75	42.75	0.00
.40	351.42	1.12	230.	5068.	4.50	42.75	0.00
.30	350.68	.38	190.	3673.	2.50	43.00	0.00
.20	349.40	0.00	126.	2317.	0.00	43.00	0.00
.10	347.75	0.00	67.	1096.	0.00	43.00	0.00

EOI ENCOUNTERED.

N>

APPENDIX E

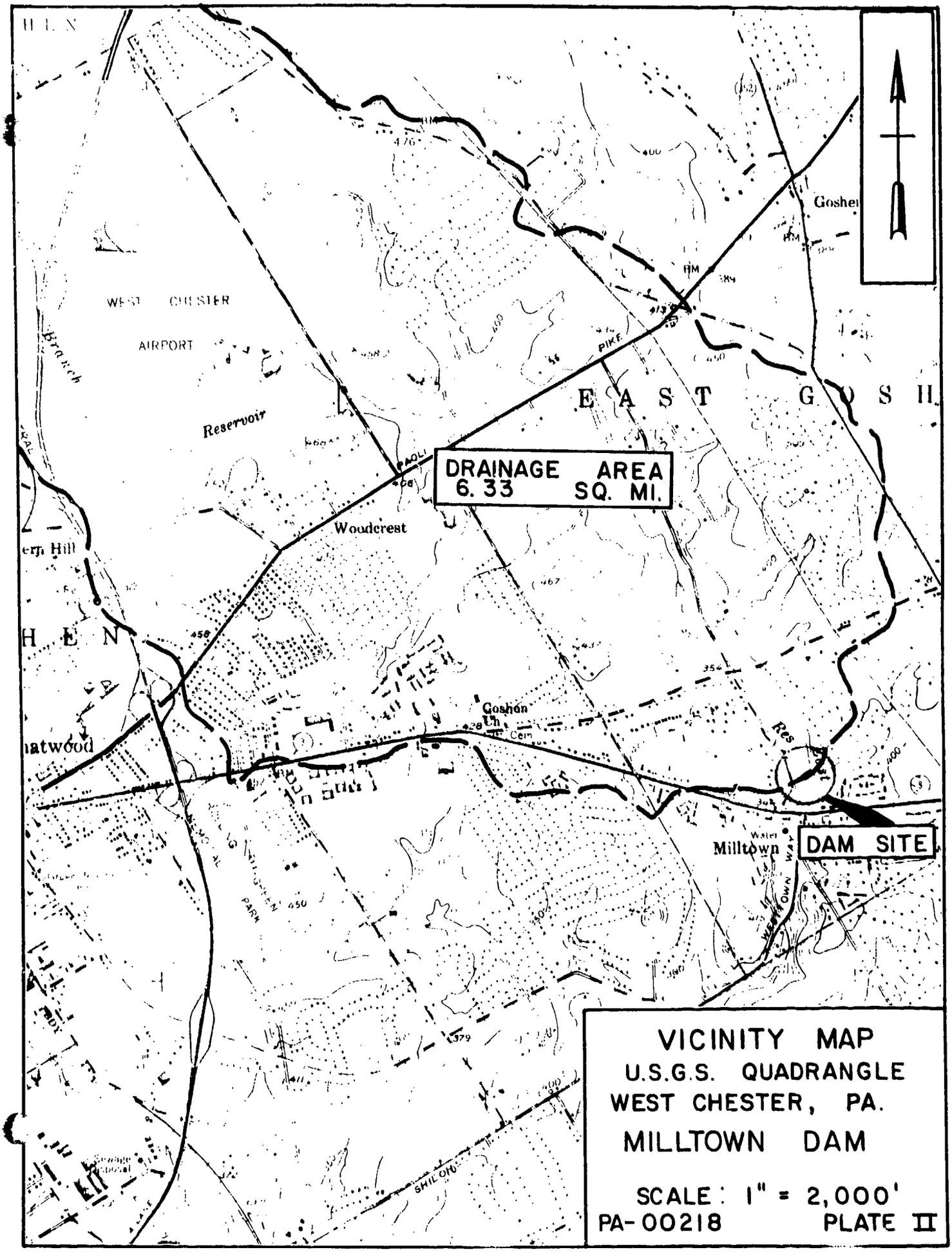
PLATES

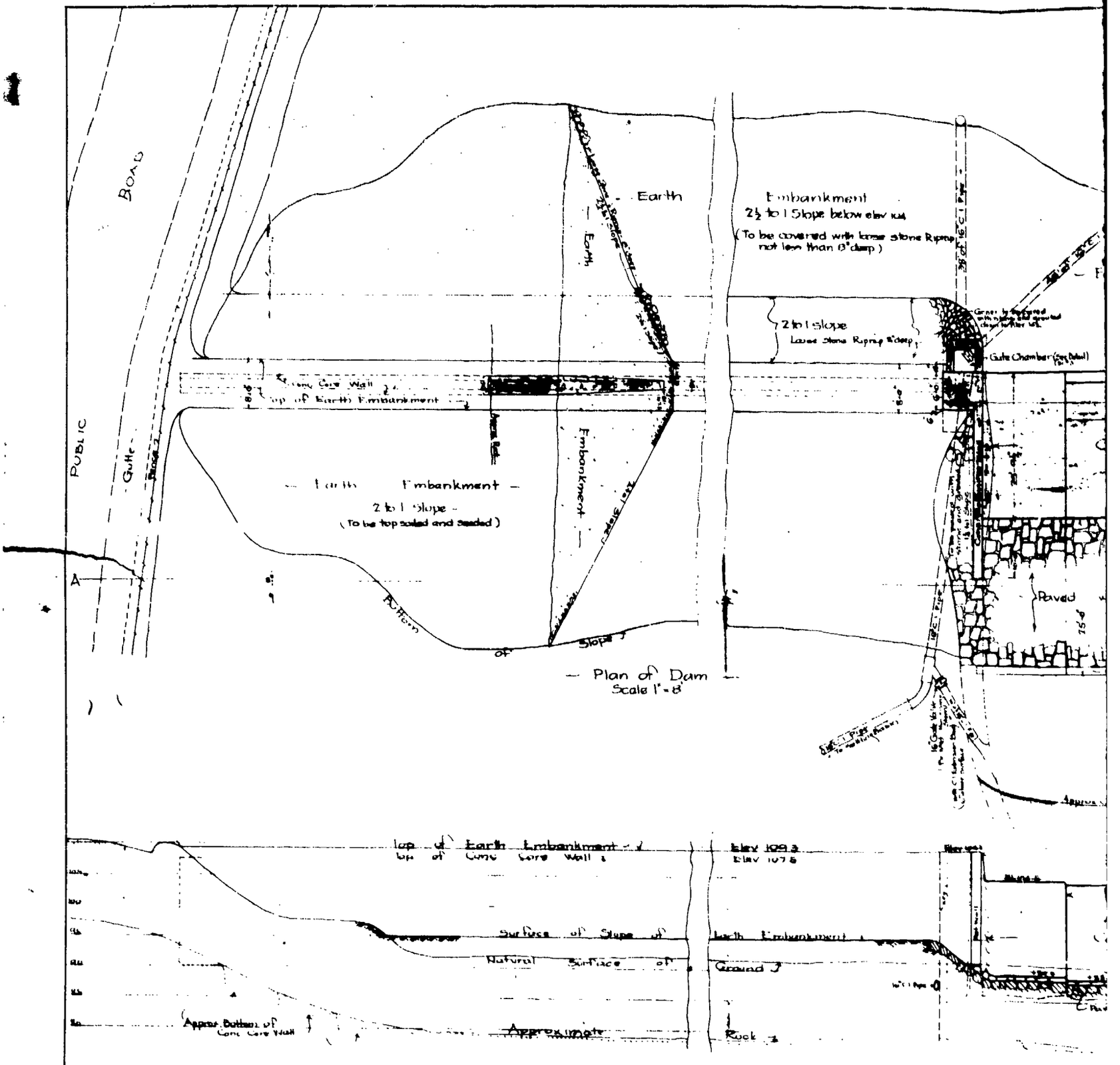


LOCATION MAP

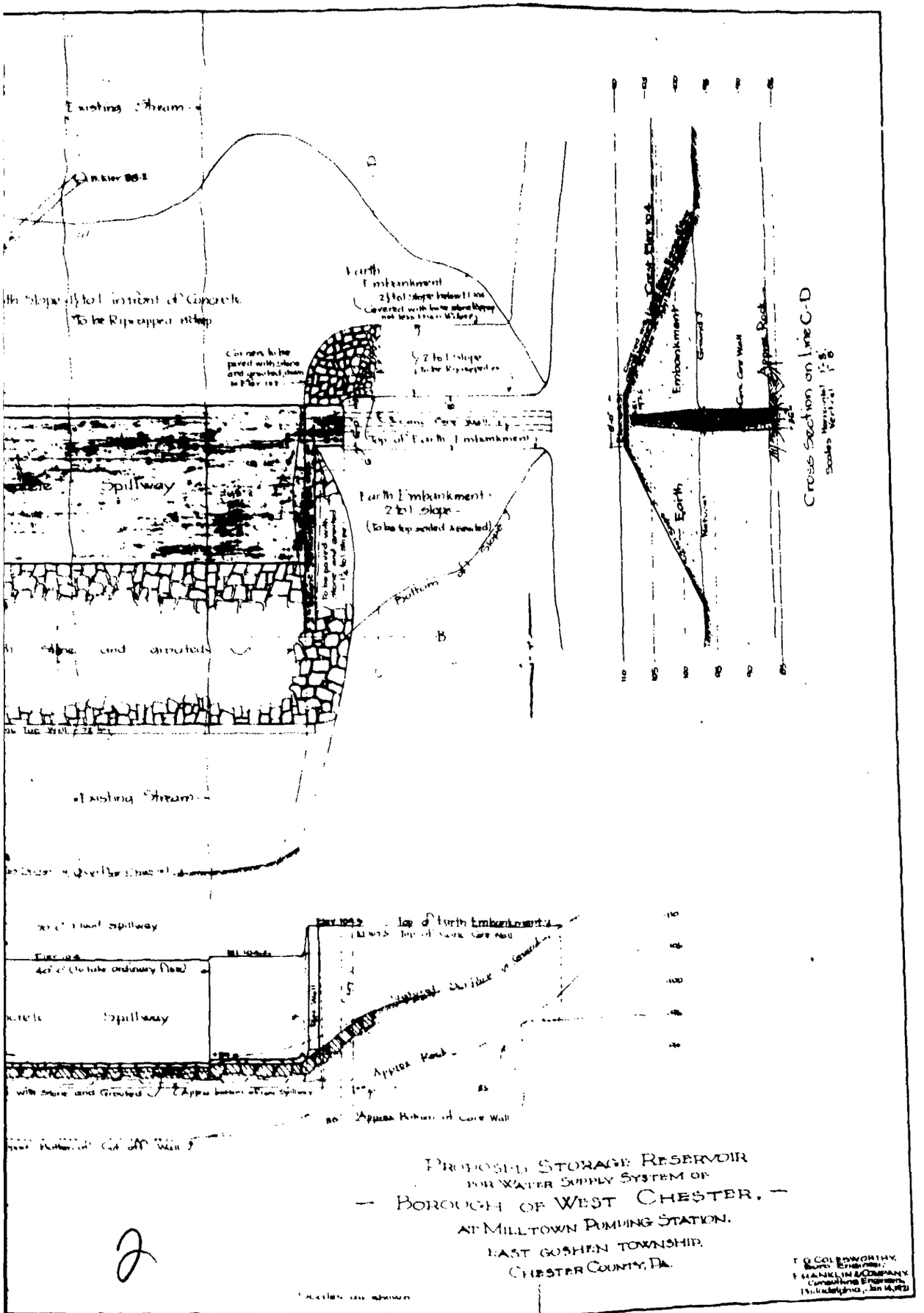
MILLTOWN DAM

PA-00218 PLATE I


DRAINAGE AREA
6.33 SQ. MI.
DAM SITE
WEST CHESTER
AIRPORT
Reservoir
Woodcrest
Goshen
Milltown
PIKE
PAOLI
Res
VICINITY MAP
U.S.G.S. QUADRANGLE
WEST CHESTER, PA.
MILLTOWN DAM
SCALE: 1" = 2,000'
PA-00218
PLATE II



DRAWING No 2 - Plan and Sections of Dam

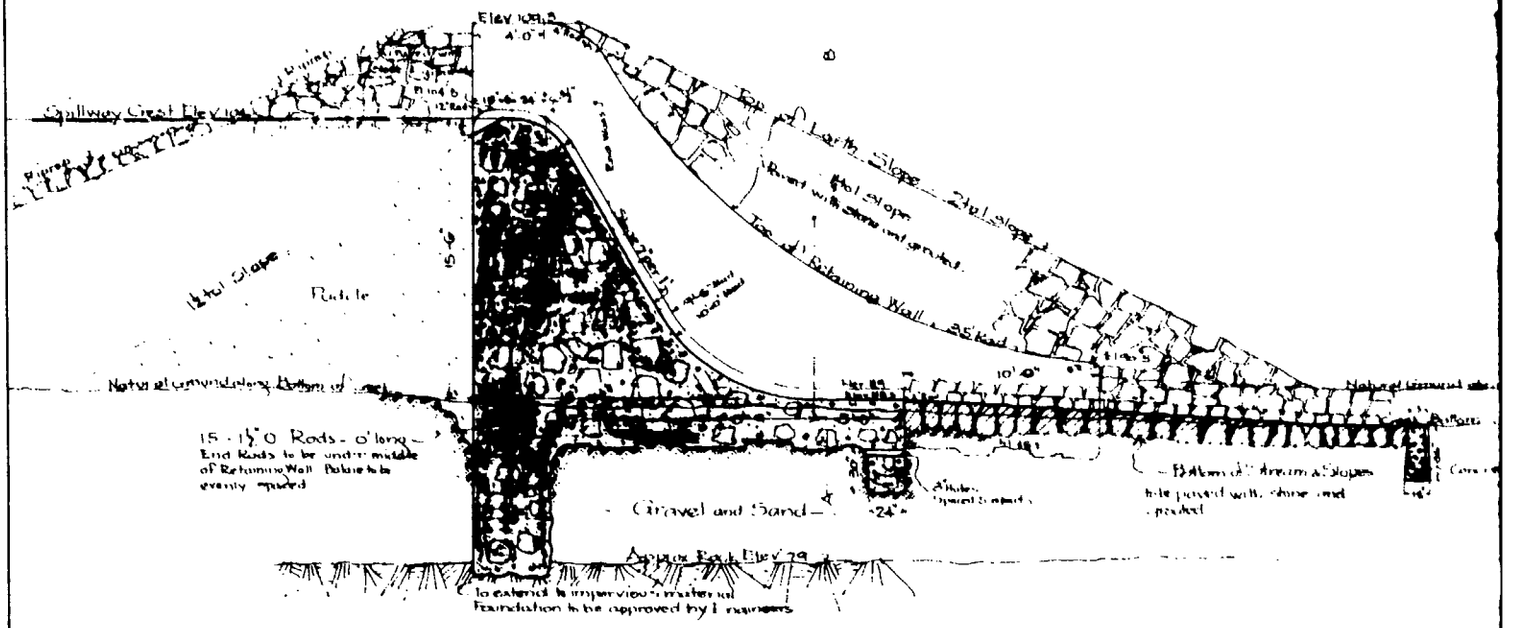


PROPOSED STORAGE RESERVOIR
FOR WATER SUPPLY SYSTEM OF
— BOROUGH OF WEST CHESTER, —
AT MILLTOWN PUMPING STATION.
EAST GOSHEN TOWNSHIP,
CHESTER COUNTY, PA.

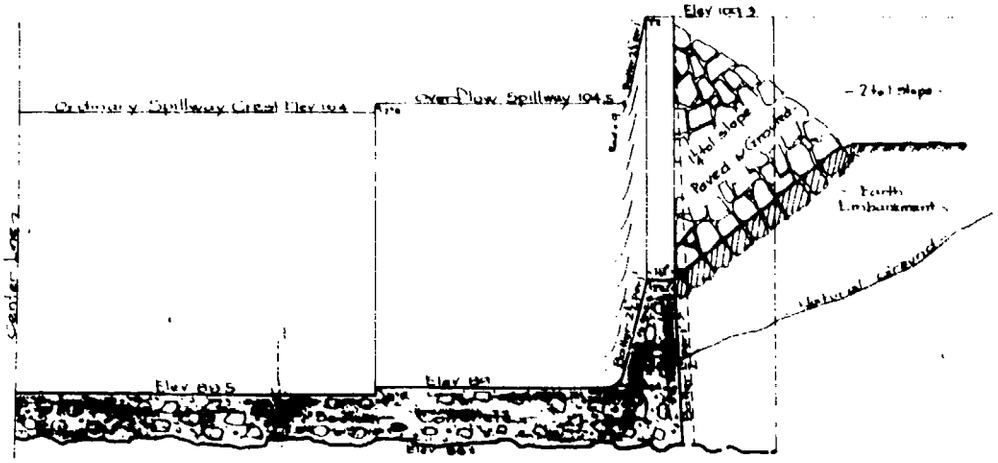
T. G. COLESWORTHY,
Borough Engineer.
FRANKLIN & COMPANY,
Consulting Engineers,
Philadelphia, Jan. 14, 1930.

2

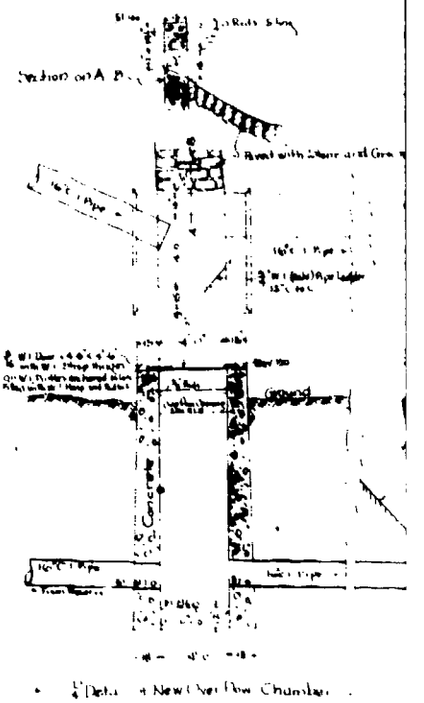
PLATE III
PA-00218



— Cross Section of Concrete Spillway —
(Looking under Line looking east)
Scale: 1"

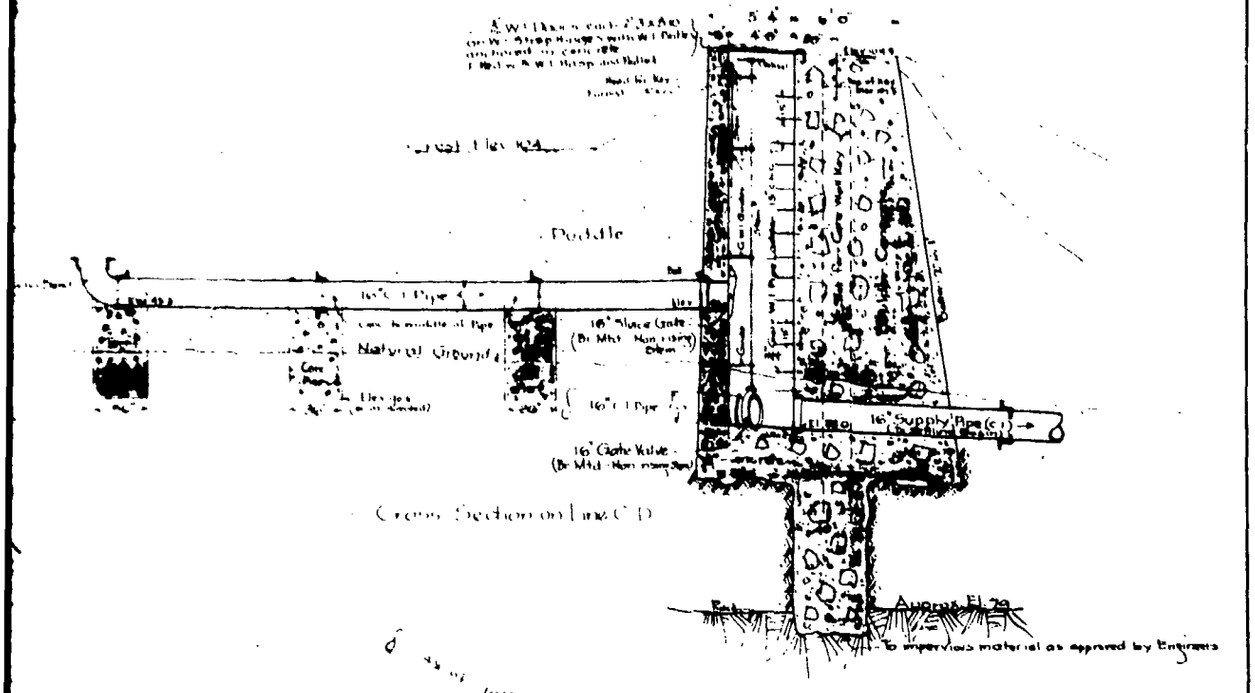


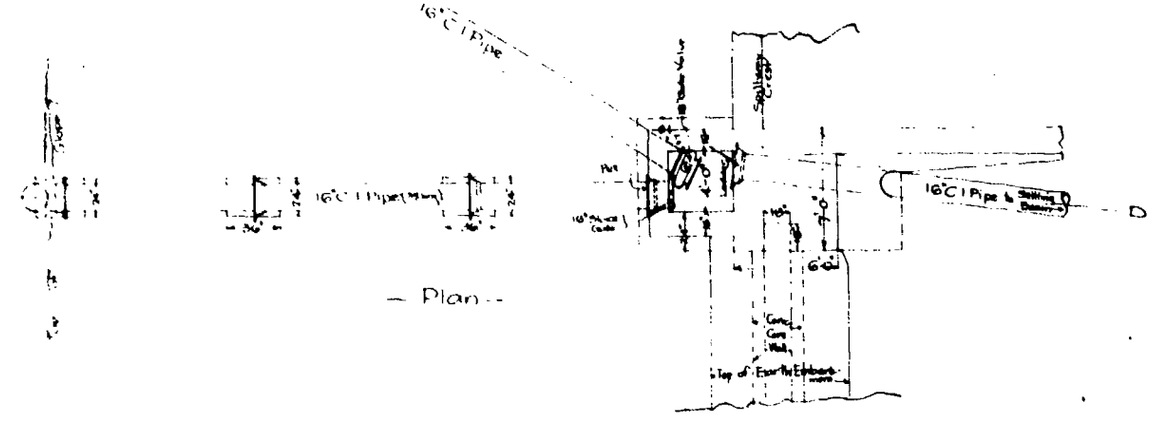
— Cross Section through Retaining Wall —
½ Section on Line A-B
Scale 1"



1" Data - New Overflow Chamber

DRAWING No 3.
DETAILS.





— Plan —

— Detail of Gate Chamber —
Scale: 1"

PROPOSED STORAGE RESERVOIR
FOR WATER SUPPLY SYSTEM OF
BOROUGH OF WEST CHESTER,
AT MILLTOWN PUMPING STATION,
EAST GOSHEN TOWNSHIP,
CHESTER COUNTY, PA

T.G. COLESMORTHY,
Asst. Engineer;
FRANKLIN & COMPANY,
Consulting Engineers,
Philadelphia, Jan 16, 1931

PLATE IV
PA-00218

APPENDIX F

GEOLOGIC REPORT

GEOLOGIC REPOPT

BEDROCK - DAM AND RESERVOIR

This area overlies the Baltimore Gneiss, which is a recrystallized sediment consisting of biotite and hornblende gneiss, heavily injected with gabbro.

STRUCTURE

The joints are moderately to poorly formed in a platy or blocky pattern.

OVERBURDEN

The overburden in this area most probably consists of residual soils originating from the parent bedrock.

AQUIFER CHARACTERISTICS

This formation has an extremely low primary porosity and the jointing provides a very low secondary porosity. Subsurface seepage in this area should be of little concern.

DISCUSSION

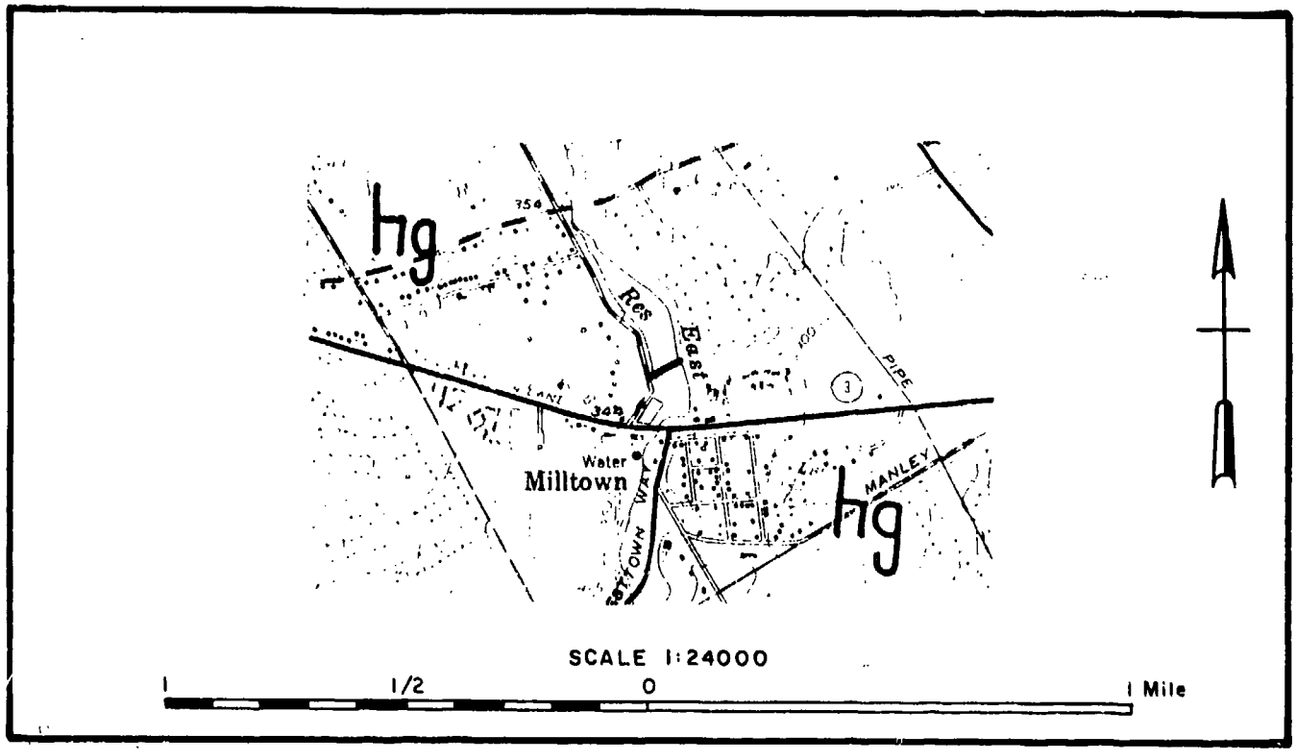
From the available construction plans, it appears that the cutoff trench of the dam was excavated to bedrock. If such is the case, the Baltimore Gneiss provides a good quality foundation for heavy structures.

SOURCES OF INFORMATION

1. Bascom, F., et al., 1932. Coatesville - West Chester, Pennsylvania - Delaware Folio: U.S. Geological Survey F-233.

2. McGlade, W.G., 1972. Engineering Characteristics of the Rocks of Pennsylvania: Pennsylvania Geological Survey EG-1.

GEOLOGIC MAP - MILLTOWN DAM



LEGEND

hg	Baltimore Gneiss