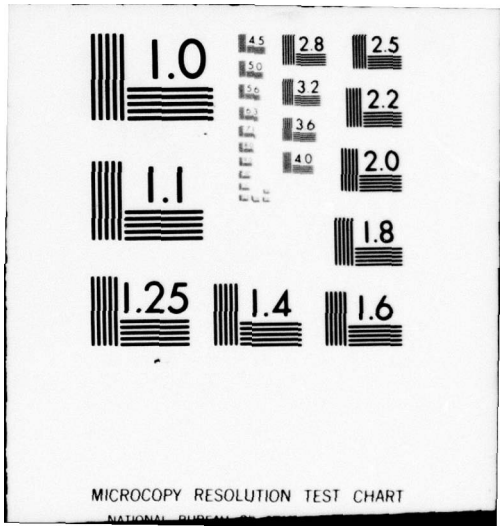
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LEVEL I

DELAWARE RIVER BASIN
WEST BRANCH MIDDLE BROOK
SOMERSET COUNTY
NEW JERSEY

WEST BRANCH RESERVOIR
NJ 00372

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

AD A069204

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DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Inspection Act Report
Spillway	Safety
Embankments	Visual Inspection
Structural Analysis	West Branch Reservoir

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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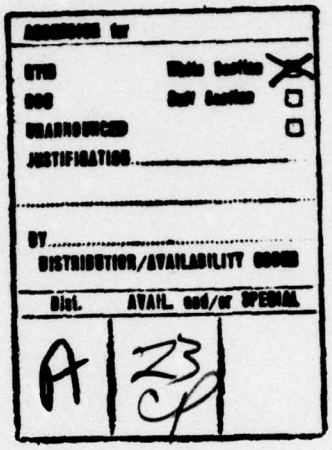
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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D



15 MAY 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for West Branch Reservoir Dam in Somerset County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, West Branch Reservoir Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate since 26 percent of the Spillway Design Flood - SDF - would overtop the dam. (The SDF, in this instance, is the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the fact that failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from that which would exist just prior to overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Operation of the reservoir at lower levels should be considered. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report,

engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980. The dam should be surveyed and survey markers should be installed for future monitoring.

c. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Repair the cracked and eroded areas of the spillway channel training wall.

(2) Check the emergency outlet valves to see that they are functioning properly. Regularly operate the outlet in the future to check its performance.

(3) Remove all shrubs and trees from the embankment and clean floating debris from the spillway area.

(4) Inspect the dam annually, using the criteria set forth in the Corps of Engineers Guidelines.

(5) Keep records of all maintenance work.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congresswoman Millicent Fenwick of the Fifth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-D
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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WEST BRANCH RESERVOIR DAM (NJ00372)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 5 and 21 December 1978 by Jenny-Leedshill Engineers under contract to the State of New Jersey. The State, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

West Branch Reservoir Dam, a high hazard potential structure, is judged to be in good overall condition. The dam's spillway is considered inadequate since 26 percent of the Spillway Design Flood - SDF - would overtop the dam. (The SDF, in this instance, is the Probable Maximum Flood). The decision to consider the spillway "inadequate" instead of "seriously inadequate" is based on the fact that failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from that which would exist just prior to overtopping failure. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Operation of the reservoir at lower levels should be considered. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the dam's embankment and foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980. The dam should be surveyed and survey markers should be installed for future monitoring.

c. The following remedial actions should be completed within six months from the date of approval of this report:

(1) Repair the cracked and eroded areas of the spillway channel training wall.

(2) Check the emergency outlet valves to see that they are functioning properly. Regularly operate the outlet in the future to check its performance.

(3) Remove all shrubs and trees from the embankment and clean floating debris from the spillway area.

(4) Inspect the dam annually, using the criteria set forth in the Corps of Engineers Guidelines.

(5) Keep records of all maintenance work.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 11 May 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	West Branch Reservoir Federal I.D. No. NJ 00372
State Located:	New Jersey
County Located:	Somerset
Stream:	West Branch Middle Brook
Dates of Inspection:	December 5 and 21, 1978

Brief Assessment of General Condition of Dam

Structurally the dam appears to be in good overall condition, without any major discontinuities or evidence of distress. Certain repairs are needed, however, to assure the long-term integrity of the project.

The spillway of the dam is inadequate and can pass only about 25 percent of the Probable Maximum Flood. The dam has been overtopped once, causing considerable damage to the downstream embankment.

Information is generally lacking on the as-built physical properties and configuration of the dam. It is recommended that in the near future a program of soil borings and tests be initiated so that seepage and stability analyses can be performed. A survey of the dam and installation of survey markers on the dam for future monitoring are also recommended in the near future.

Because the dam and reservoir are no longer used for water supply, it is recommended that alternative methods of operating the reservoir at lower levels

be investigated as soon as possible. A downstream warning system should also be implemented soon. Other recommendations for operation and maintenance should be implemented in the near future. These include repair of the spillway training wall, operation of the outlet valves, installation and monitoring of instrumentation devices, removal of vegetation and debris, maintenance of repair records, and annual inspection of the dam along with timely repairs.

More detailed and sophisticated hydraulic and hydrologic studies to more accurately determine the spillway capacity should be undertaken by the owner within six months. Remedial action, as a result of these studies, should be initiated within one year. In the interim a warning and evacuation plan should be implemented to provide adequate warning to downstream residents. Also, surveillance of the dam should be provided during periods of heavy precipitation.

Frank L. Panuzio

Frank L. Panuzio, P.E.
Project Engineer

Robert J. Jenny, P.E.
Project Director
New Jersey License No. 9878

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Check List - Engineering, Construction Maintenance Data

APPENDIX B - Photographs

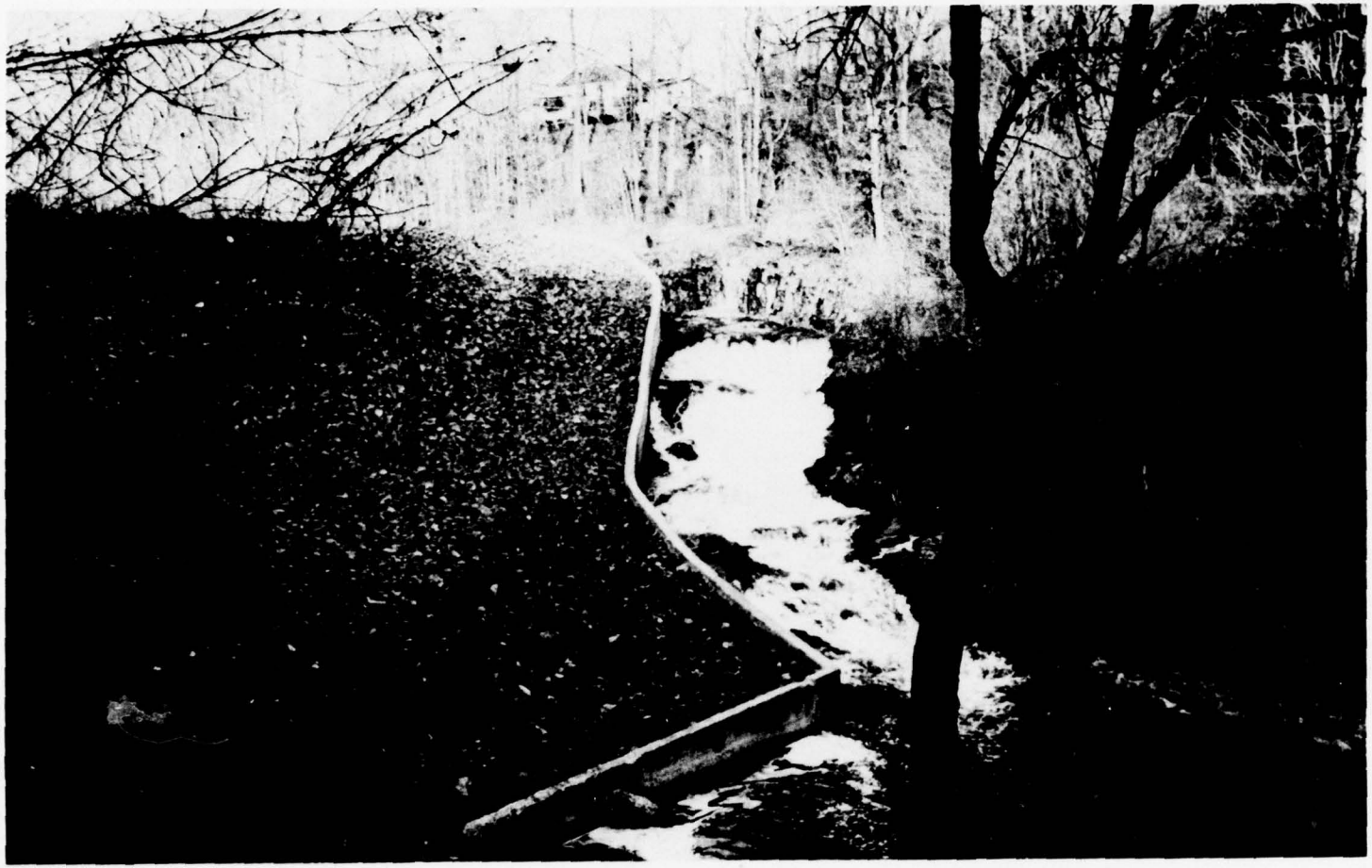
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2. Crest of dam
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5. Spillway and left wingwall
6. Broken right wingwall
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WEST BRANCH RESERVOIR DAM

View of downstream embankment and spillway, looking northeast. (December 21, 1978)

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the 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. 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 continued care and inspection can there be any chance that unsafe conditions be detected.

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

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

WEST BRANCH RESERVOIR DAM
Federal I.D. No. NJ 00372
New Jersey I.D. No. 118

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act, Public Law 92-367, 1972, provides for the National Inventory and Inspection Program by the U. S. Army Corps of Engineers. This report has been prepared in accordance with this authority, through contract between the State of New Jersey and Jenny-Leedshill Engineers. The State of New Jersey has also entered into an agreement with the U. S. Army Engineer District, Philadelphia, to have this work performed.

b. Purpose of Inspection

The purpose of this inspection was to evaluate the general structural integrity and hydraulic adequacy of the dam, and to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Description of Dam and Appurtenances

West Branch Reservoir Dam (variously called Bound Brook Reservoir Dam and Washington Valley Reservoir Dam) is an earthfill structure with a concrete core wall

which impounds a reservoir of 805 acre feet maximum capacity on West Branch Middle Brook. The dam is 330 feet long, 39 feet high and has an upstream slope of 3H:1V and a downstream slope of 2H:1V. Both sides of the embankment are faced with riprap. The spillway is a concrete ogee structure at the left abutment and there is a downstream channel cut into natural bedrock. A 24-inch diameter emergency outlet is operated from a control tower in the reservoir. The water supply outlet has been abandoned.

b. Location

The dam is located in north central New Jersey, near Martinsville, in Somerset County. The location of the dam is shown on Plate 1.

c. Size Classification

The size classification of the dam, based on its 39-foot height and 805 acre-feet maximum storage capacity, is small. The criteria for size classification of dams are set forth in the Corps' Guidelines. A small size dam is defined as one in which the reservoir capacity is equal to or greater than 50 acre-feet and less than 1,000 acre-feet, and/or the maximum height of the dam is equal to or greater than 25 feet and less than 40 feet.

d. Hazard Classification

A highway bridge is 500 feet downstream of the dam, and the stream parallels Chimney Rock Road for about a mile through a narrow, steep sided valley. Within the valley are a large rock quarry plant and a filtration plant. Further downstream is the Borough of Bound Brook (population 10,500) where failure of the dam could result in extensive property damage and the loss of more than a few lives in the western portion of the borough where it appears that several

dozen houses and a public institution are in the flood plain. For this reason West Branch Reservoir Dam merits a high hazard classification.

e. Ownership

The dam is owned by Elizabethtown Water Company, Box 111, 1341 North Avenue, Plainfield, New Jersey 07062.

f. Purpose of Dam

The dam presently has no purpose. It was formerly used for municipal water supply.

g. Design and Construction History

The dam was constructed during the period October, 1928 to July, 1930. Clyde Potts of New York was the engineer for the Bound Brook Water Company, the builder of the dam. The dam was overtopped by floodwaters in the storm of August 1971, resulting in considerable erosion of the downstream embankment. The embankment was restored to the original design under the direction of John V. Dinan Company, Inc. Ownership of the dam apparently passed to the present owners in 1971 or 1972.

h. Normal Operating Procedures

There is little regulation of the reservoir, but the owner reports that the reservoir is lowered in anticipation of large storms. No other releases are made. The dam is periodically checked by the owner's supervisory personnel.

1.3 Pertinent Data

a. Drainage Area - 6.3 square miles

b. Discharge at Damsite

- Ungated spillway capacity at top of dam - 5360 cfs.

c. Elevation (ft. above MSL)

. Top dam	194.5
. Spillway crest	187
. Top core wall	193
. Streambed at centerline of dam	155
. Upstream invert emergency outlet	161

d. Reservoir Length (feet)

. Maximum Pool	4400
. Spillway crest	3700

e. Storage (acre-feet)

. Spillway crest	465
. Top of dam	805

f. Reservoir Surface (acres)

. Top dam	46
. Spillway crest	33

g. Dam

. Type	Earthfill with concrete core wall
. Length	330 ft. (approx.)
. Height	39 ft.
. Top Width	15 ft.
. Side Slopes - upstream	3H:1V
- downstream	2H:1V
. Zoning	Selected material puddled on upstream side of core wall
. Impervious Core	Concrete core wall

h. Spillway

. Type	Concrete ogee
. Length of weir	72.5 ft.
. Crest elevation	187 ft.
. U/S Channel	Reservoir
. D/S Channel	Excavated rock channel with concrete training wall on right side

i. Regulating Outlets

. 24-inch diameter C.I. pipe and gate valves (emergency outlet)

. Abandoned 20-inch diameter water supply outlet with sluice gate inlets in control tower

SECTION 2: ENGINEERING DATA

2.1 Design

a. Geological Conditions

West Branch Reservoir Dam is situated near the head of a narrow gorge cut through the First Watchung Mountain near Bound Brook, New Jersey in the central portion of the Piedmont Lowlands Physiographic Province. The regional geology of this province is discussed in Appendix C to this report.

The dam is located totally on dark, hard, competent columar "Newark" basalt. The same rock has been used for the dumped rock facing on the dam. A 2-foot wide fault was reported during excavation of the right side of the dam. The spillway has been blasted out of the bedrock on the left abutment and a concrete channel wall constructed on the rock. The bare rock is exposed in the channel floor and left wall. It is highly jointed but appears to be competent.

Overburden in the immediate area of the dam site is shallow (less than 10 feet thick) and composed primarily of recent sandy alluvium in the streambed and what appears to be an old, weathered, bouldery till on the adjacent side slopes. This site is well south of the Wisconsin age glacial terminal moraine but it was covered by pre-Wisconsin glaciation.

The dam is located in Seismic Zone 1. This classification indicates that the dam would be subject to shaking from distant earthquakes.

b. Design Data

Correspondence indicates that the dam was originally

designed to carry a roadway over the crest, and early plans show two spillways, one at each abutment. The design was changed sometime prior to or during construction to exclude the roadway, to raise the dam 3 feet and to construct only one spillway at the left abutment.

Specifications and most plans that are available pertain to earlier designs. Based on available data, the dam is thought to be approximately as represented in plan on Plate 2. The site topography and an earlier design of the dam are shown on Plate 3.

Typical sections of the dam are illustrated on Plate 4, and with the exceptions of the two spillways and the crest elevations, they are believed to represent the as-built design. Specifications indicate that the embankment material was to be compacted in horizontal layers of 6 inches or less thickness. Two classes of concrete were specified. The core wall was specified to be Class B concrete, consisting of 1 part Portland cement, 2-1/2 parts sand and 5 parts broken stone and gravel.

2.2 Construction

Inspections were made periodically during construction by the State, and reports on these inspections are available. They indicate that the foundation trench for the core wall was excavated an average of 1 to 3 feet depth to reach sound rock. No grouting was done, as the foundation rock was considered to be good quality with only hairline cracks.

Material for the embankment was excavated from the reservoir area and spread and compacted with a 5-ton bulldozer. Apparently no roller was used. The material was described as "a clayey earth carrying about 30 percent of broken and weathered trap fragments averaging

two inches in size". Selected material was puddled adjacent to the core wall on the upstream side.

The core wall was poured in a continuous operation over a period of 6 days. A vertical crack developed in the wall from the top to within 6 feet of ground level. The crack was treated with bitumen and muslin.

While excavating for the west spillway, a 2-3 feet wide fault was encountered in the bedrock. It was cleaned out and filled to a depth of 12 feet with concrete. Because of the presence of the fault, the plans were changed to eliminate the west spillway, to extend the core wall into this area, and to construct a larger spillway at the east end of the dam. The downstream spillway channel was to have been lined with concrete, but the quality of the bedrock was sufficiently good that lining was not required.

The spillway is shown in plan on Plate 5. The stone paving indicated on the downstream side of the weir was eliminated during construction because of the good quality bedrock. The spillway was constructed with a groove in the crest designed to accommodate flashboards. The flashboards were attached to the crest by steel ties and were designed to break away under high water level conditions. A request by the engineer to raise the spillway crest a foot higher than shown on the plans was denied by the State.

The dam was accepted by the State on June 2, 1930.

2.3 Operation

The reservoir is no longer used for water supply and is essentially unregulated. Periodic inspections are made by the owner's personnel.

2.4 Evaluation

a. Availability

Design drawings are available for an earlier design of the dam. Inspection reports made during construction are available, and there is correspondence in the State files regarding certain design and construction considerations. Most of the available data are listed in Appendix A.

b. Adequacy

Available data are insufficient to adequately evaluate the structural stability of the dam. Calculations relating to the structural design of the dam or the stability of the as-built structure are not available. Little is known of construction methods and nothing is known of materials testing or as-built material properties. There are no drawings representing the present geometry of the dam.

c. Validity

The available drawings of the embankment (Plates 3 and 4) represent an earlier design in which two spillways were proposed. Crest elevations on these drawings are incorrect. Drawings of the spillway (Plate 5) are substantially correct with regard to the geometry of the structure.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of the dam was made on December 5, 1978, and a subsequent inspection was made on December 21, 1978. At the time of the first inspection the reservoir level was 1.7 feet below the spillway crest. No water discharges were being made.

The visual inspection did not reveal any critical signs of distress in the dam. The remedial work to repair damage to the embankment following the 1971 storm appears to have been done in a satisfactory manner. The spillway channel training wall is cracked in places and eroded at the base, and there are certain maintenance matters that need to be attended to.

Detailed inspection was made of the dam, appurtenant structures, reservoir area, and the downstream channel. Descriptions of the findings of these inspections are summarized in the paragraphs which follow. The checklist of visual inspection items is included in Appendix A. Geologic and foundation conditions observed at the time of inspection are noted in greater detail in Section 2.1-a.

b. Dam

The dam was inspected for signs of settlement, seepage, erosion, cracking and any other evidence of undesirable behavior which might affect the stability of the structure.

The embankment appears to be in reasonably good

condition. It is completely covered with dumped rock riprap, and, possibly because of variations in thickness of the riprap, the slopes and crest are slightly uneven (Photo 1). The horizontal alignment of the crest is good. Riprap is missing from a small area near the spillway (Photo 2). There are no signs of erosion, and no seepage could be detected. The junctions of the embankment with the spillway and the right abutment appear to be tight, with no evidence of separation or movement.

A heavy growth of shrubs and small trees covers the upstream embankment (Photo 3).

c. Appurtenant Structures

Spillway

The spillway weir appears to be basically sound, but with indications of minor cracking, spalling and erosion (Photo 4). The weir has provisions for attaching flashboards but the boards have been removed (Photo 5). There has been minor erosion and slight undercutting of the channel at the base of the weir. The top of the right wingwall has broken off at the upstream end (Photo 6). The concrete at the downstream end of the left wingwall is spalled and there is evidence of leaching (Photo 7). There is some minor seepage through the abutment rock adjacent to this area.

Spillway Channel

The spillway channel is cut into natural bedrock and is unlined except for a concrete training wall between the channel and the embankment of the dam (Photo 8). The basalt bedrock is strongly jointed and the finished

surfaces are uneven. The concrete training wall has several vertical cracks extending from the base to the top (Photo 9). Some of the cracks show evidence of leaching. The base of the training wall is eroded at a number of places. At the bottom of the spillway channel the training wall is attached to a toe wall which separates the embankment from the stilling basin.

Outlet Works

The only working reservoir outlet is the 24-inch diameter blowoff. It is operated from a control tower in the reservoir with access from a bridge on the right bank (Photo 10). Windows in the control tower or gatehouse are broken out and concrete has spalled from posts supporting the bridge railing.

The water supply outlet has been abandoned and is capped with a steel plate (Photo 11). The 24-inch emergency outlet empties into a stilling basin at the base of the dam. There was some minor leakage from the outlet pipe, indicating that the 2 gate valves were not seated properly.

d. Reservoir Area

The reservoir is surrounded by tree-covered, moderate slopes. There is a bridge opening at the upper end of the reservoir, and the reservoir in this area is shallow and partly covered by aquatic vegetation. There is considerable debris in the reservoir near the dam and at the spillway (Photos 3 and 5).

e. Downstream Channel

There is a stilling basin at the base of the dam. The downstream channel has steep tree-covered slopes. There is a bridge over the channel about 500 feet down-

stream of the dam (Photo 12). Downstream of the bridge the channel follows a steep ravine with a roadway on the right bank above the stream channel. There is a small concrete arch dam on the stream about 1500 feet downstream of the dam. The reservoir of the small dam was dry at the time of the inspection.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

The water supply line downstream of the dam was removed following damage during the 1971 flood. Since the reservoir is no longer used for water supply, there is little regulation. The owner's representatives reported that they sometimes operate the emergency outlet to lower the reservoir in anticipation of high runoff.

4.2 Maintenance of Dam

There has apparently been little maintenance work done on the dam, other than the major repair of the downstream embankment following the overtopping in 1971. Normal maintenance work is done by the owner. No records of maintenance work were found. Several inspection reports are available.

4.3 Maintenance of Operating Facilities

It was reported that the emergency outlet is occasionally operated. The former water supply line has been sealed with a steel cap where it exits from the downstream toe of the dam.

4.4 Description of Warning System

There is no warning system and no coordination with local authorities. The dam is checked periodically by the owner's personnel.

4.5 Evaluation of Operational Adequacy

Maintenance of the dam appears to be generally adequate, although certain repairs are needed.

The present operation of the reservoir should be reviewed, since it is no longer used for water supply. Alternative operation as a flood control facility or for downstream water quality control should be considered.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The capacity of West Branch Reservoir is 465 acre feet at the spillway crest and 805 acre feet at the dam crest. The embankment height is 39 feet. In accordance with Corps guidelines, the dam is classified as small in size. Failure or misoperation of the dam would result in overbank flow that would pose a hazard to more than a few lives and could cause excessive property damage downstream. Thus, the dam is classified as high hazard and the Spillway Design Flood (SDF) is the Probable Maximum Flood (PMF).

Data obtained from State files indicate the drainage basin area of the dam is 6.3 square miles. Elevations range from a maximum of 600 feet above mean sea level along the perimeter of the drainage basin to about 180 feet in the valley floor. About 23 percent of the land within the watershed is occupied by commercial, industrial and residential developments. About 1.0 percent of the watershed area is the reservoir of the dam. The drainage basin is delineated on a U.S.G.S. topographic map and is presented on Plate D-1, Appendix D.

The hydraulic and hydrologic features of the dam were evaluated using criteria set forth in the Corps of Engineers, "Recommended Guidelines for Safety Inspection of Dams", and additional guidance and criteria provided by the Philadelphia District, Corps of Engineers. The Probable Maximum Precipitation (PMP) was calculated using Hydrometeorological Report No. 33 and the Hop

Brook reduction factor of 0.80 for misalignment of the storm.

The PMF was calculated using the Corps' computer program HEC-1, Dam Break Version. In computing the PMF the Corps requested that the SCS triangular unit hydrograph with curvilinear transformation be used. The computer program was used to calculate this unit hydrograph from the basin lag. A lag time of 0.9 hours was calculated for the basin and used in the program.

An initial infiltration loss of 0.5 inch and a final infiltration loss rate of 0.05 inch per hour were used in the HEC-1 program to give the rainfall excess. These values were selected because a relatively large percentage of the basin area is developed and the basin slopes are fairly steep. Using the excess rainfall and the unit hydrograph, the program computed the peak inflows of the 25 percent, 50 percent, 75 percent and 100 percent PMF. These inflows are approximately 6,630 cfs, 13,260 cfs, 19,880 cfs, and 26,510 cfs, respectively.

The various percentages of the PMF inflow hydrograph were routed through the reservoir using the Modified Puls Method by the HEC-1 DB program. The peak outflow of the 25 percent, 50 percent, 75 percent and 100 percent PMF were calculated to be approximately 5580 cfs, 12,580 cfs, 19,180 cfs and 25,760 cfs, respectively. The flood routings indicate that all floods greater than about 25 percent of the PMF will overtop the dam. A plot of percent PMF versus peak outflow discharge is presented as Plate D-2 in Appendix D.

The spillway and overtop stage-discharge rating curve used in the flood routings was calculated using the weir equation and assuming free overflow across the entire

length of the dam and spillway. The spillway is a modified ogee crest weir with a reported discharge coefficient of 3.6. The main embankment is a round-crested weir with an estimated discharge coefficient of 3.1. The reservoir stage-storage curve was determined from U.S.G.S. 7.5 - minute topographic maps and data obtained from State files. This stage-storage curve was extended above the dam crest to include surcharge storage during peak flood discharges. In the reservoir routing computations possible discharges through the outlet works were excluded because their capacity is small compared to the PMF and because of the possibility that the outlet valves may be closed. The stage-storage and the spillway and overtop stage-discharge curves are presented in Appendix D as Plates D-3 and D-4, respectively.

The various percentages of the PMF were routed 0.7 miles downstream to a point where the stream channel crosses under Chimney Rock Road. At this location is a filtration plant and associated structures, and just downstream of the plant is the very small community of Chimney Rock. These routings were made to determine downstream flooding characteristics without dam failure. The flooding characteristics, assuming no breach of the dam, were compared to those that would result assuming the dam fails because of the inadequate capacity of its spillway. From this comparison the seriousness of the spillway's inadequacy was assessed.

The hydraulic parameters used in the HEC-1 program for the downstream routing calculations were estimated based on observations made in the field and information obtained from U.S.G.S. topographic maps. The locations of the cross-sections used in the routing calculations are shown

on page D-6, Appendix D.

The breach parameters used in the HEC-1 analysis are: the breach is trapezoidal in shape with 45-degree side slopes, is 190 feet wide at the base, will extend to the approximate original reservoir floor elevation (160'), will begin breaching when the dam is first overtopped, and will develop to its maximum size in 6.0 hours.

The flooding characteristic at the filtration plant and the nearby rock quarry are summarized for the various floods in the following tabulation. At this location there would be a high hazard to personnel and property.

	25% PMF	50% PMF	75% PMF	100% PMF
No Breaching				
Peak Discharge, cfs	5540	12,500	18,960	25,530
Peak Flow Depth, ft	7.9	11.1	13.0	14.6
Peak Flow Width, ft	190	275	320	355
Peak Flow Velocity, fps	8.2	8.8	9.5	10.1
Breaching				
Peak Discharge, cfs	6320	14,670	21,830	28,360
Peak Flow Depth, ft	8.4	11.8	13.8	15.2
Peak Flow Width, ft	200	295	340	370
Peak Flow Velocity, fps	8.2	9.1	9.7	10.3

Information obtained from the State's files indicate that the drain for the reservoir is a 24-inch diameter pipe. Using the orifice flow equation and assuming no tailwater at the outlet or inflows into the reservoir, the time required to drain the reservoir from the spillway crest full condition was calculated to be about 3.5 days.

b. Experience Data

Records of lake levels are not maintained for this site. The reservoir is unregulated and unused. The reservoir is generally at or near its maximum storage level. It is known that the dam was overtopped in 1971.

c. Visual Observations

There is a well defined channel downstream of the embankment. No dwellings were observed on the banks of the immediate downstream channel. About 500 feet downstream of the dam is a bridge that, during high flows, would constrict flows if the dam does not fail. The constriction would tend to attenuate the downstream flood.

d. Overtopping Potential

As indicated in Section 5.1-a, West Branch Reservoir Dam spillway can pass only 25 percent of the PMF. During the PMF the embankment would be overtopped for about 5.7 hours and would have a maximum overtopping stage about 6.2 feet above the dam crest. These overtopping heights assume the dam remains in its current condition. This amount of overtopping would probably result in a dam breach.

The data tabulated in Section 5.1-a were used to assess the degree of significance that overtopping failure would increase the downstream hazard. As shown in the tabulation, for all the floods that were studied the flooding characteristics assuming the dam fails are not significantly different from those that would exist if the dam does not fail. Thus, failure caused by inadequate spillway capacity does not significantly increase the downstream hazard and the spillway should be classified as Inadequate.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The visual inspection did not indicate any signs of structural instability of the embankment. The crest alignment is good, the downstream slope is reasonably even, and no indications of seepage through the embankment were observed.

The concrete spillway appears to be in fairly good condition, although there is some erosion at the base of the weir and the right wingwall has been damaged. The natural rock spillway channel may be subject to some erosion and frost action along the joints, but basically the rock appears to be competent. The concrete training wall on the right side of the spillway channel is cracked in several places and the concrete is badly eroded from the base of the wall at several locations.

b. Design and Construction Data

The design of the dam was changed during construction, so that most of the available design drawings do not show the present configuration of the dam. The designs of the embankment slopes and core wall appear to be adequate, and construction reports indicate that the core wall was founded well into bedrock. Very little is known about the placement of embankment materials and nothing is known of the as-built properties of the materials.

c. Operating Records

There are no records of reservoir operation. There is

no instrumentation to detect seepage or measure pore pressures or phreatic levels in the embankment. No recent survey of the dam is known to exist.

d. Post-Construction Changes

No records are available of the work done to repair the embankment following the 1971 overtopping, and the condition of the core wall following the flood is not known. Visually, the workmanship seems to have been of good quality.

e. Seismic Stability

The dam is located in Seismic Zone 1 in which it may be generally assumed that there is no hazard from earthquake, provided static stability conditions are satisfactory and conventional safety margins exist. Although the dam appears to have adquate static stability, a stability analysis would be needed to verify this.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The spillway of the dam is inadequate and can pass only 25 percent of the Probable Maximum Flood. The dam was overtopped in 1971, causing considerable damage to the downstream embankment.

Structurally, the dam appears to be adequate. The slopes and crest are without any major discontinuities or evidence of distress. Although nothing is known of the embankment materials, it is known that the dam has a concrete core wall that extends into bedrock. However, the core wall should not be expected to provide structural stability if overtopping should again result in removal of embankment materials.

The spillway channel training wall is cracked, eroded and in need of repair.

b. Adequacy of Information

Data are insufficient to evaluate the stability of the dam, since little is known of the design or construction of the dam, and nothing is known of the as-built properties of the embankment materials. The present condition of the core wall is not known. Insofar as is known, the dam has not been surveyed in recent years.

c. Urgency

The operation of the reservoir should be reviewed as soon as possible, as should implementation of a down-

stream warning system. Other measures as itemized below are of a less urgent nature and should be implemented in the near future.

d. Necessity for Additional Data/Evaluation

Corps of Engineers Guidelines require that, in general, seepage and stability analyses should be on record for all dams in the high hazard category. In view of the fact that West Branch Reservoir Dam is a high hazard dam which has an inadquate spillway and which has been overtopped, it is recommended that a program of soil borings and laboratory tests be performed by the owners to determine the physical properties of the dam and foundation materials so that seepage and stability analyses can be performed. Such a program should also include the installation of piezometers on the crest and downstream slope to establish the internal water levels of the dam. Evaluation of all data should be made by experienced geotechnical and soils engineers.

It is also recommended that the dam be surveyed to verify the existing crest elevation and side slopes. This could become the basis for periodic monitoring surveys in the future.

More detailed and sophisticated hydraulic and hydrologic studies to more accurately determine the spillway capacity should be undertaken by the owner within six months. Remedial action, as a result of these studies, should be initiated within one year.

7.2 Remedial Measures

a. Alternatives

It is recommended that as soon as possible the owner investigate alternative methods of operation of the reservoir, since it is no longer used for water supply. Such alternatives could influence the means of obtaining adequate spillway capacity and eliminating future overtopping of the dam. The alternatives might include its conversion to a flood control facility by construction of a new low-level spillway to supplement the existing spillway. Another alternative is to maintain a lower operating level by installing a low-level standpipe downstream of the emergency outlet valve. Other alternatives might suggest themselves, including, of course, abandonment and breaching of the dam.

b. Operation and Maintenance Procedures

The following operation and maintenance procedures are recommended:

1. Repair the cracked and eroded areas of the spillway channel training wall.
2. Check the emergency outlet valves to see that they are functioning properly. Regularly operate the outlet in the future to check its performance.
3. Install and periodically monitor the piezometers and survey markers as recommended above in Section 7.1-d.
4. Remove all shrubs and trees from the embankment and clean floating debris from the spillway area.

5. Inspect the dam annually, using the criteria set forth in the Corps of Engineers Guidelines.

7. Keep records of all maintenance work.

8. Establish and implement an emergency warning plan to provide adequate warning to downstream residents. Also, surveillance of the dam should be provided during periods of heavy precipitation.

PLATE 1



000 0 1000 2000 3000 4000 5000 6000 7000

SCALE IN FEET

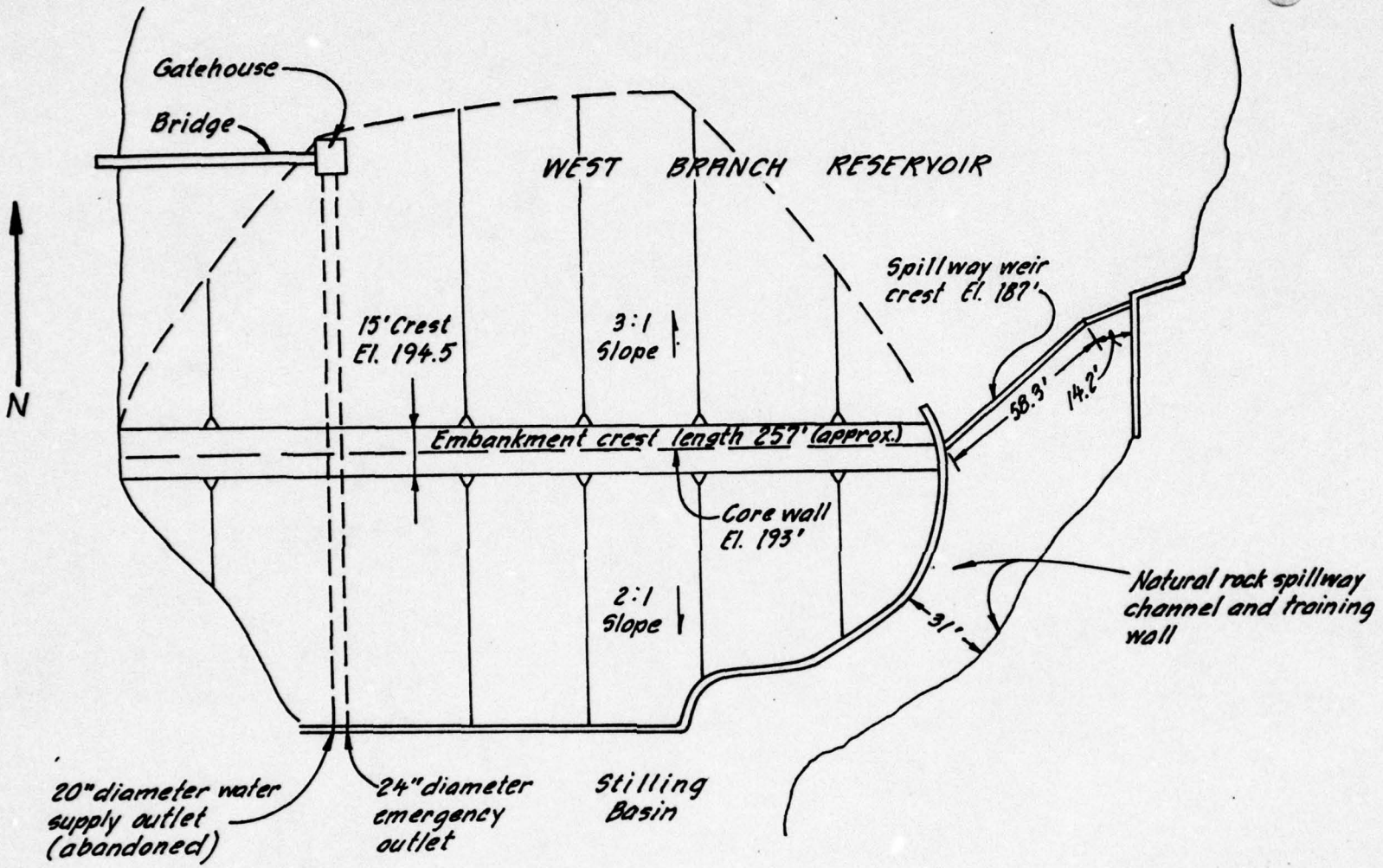


AREA LOCATION

VICINITY MAP

JENNY-LEEDSHILL

JANUARY 1979



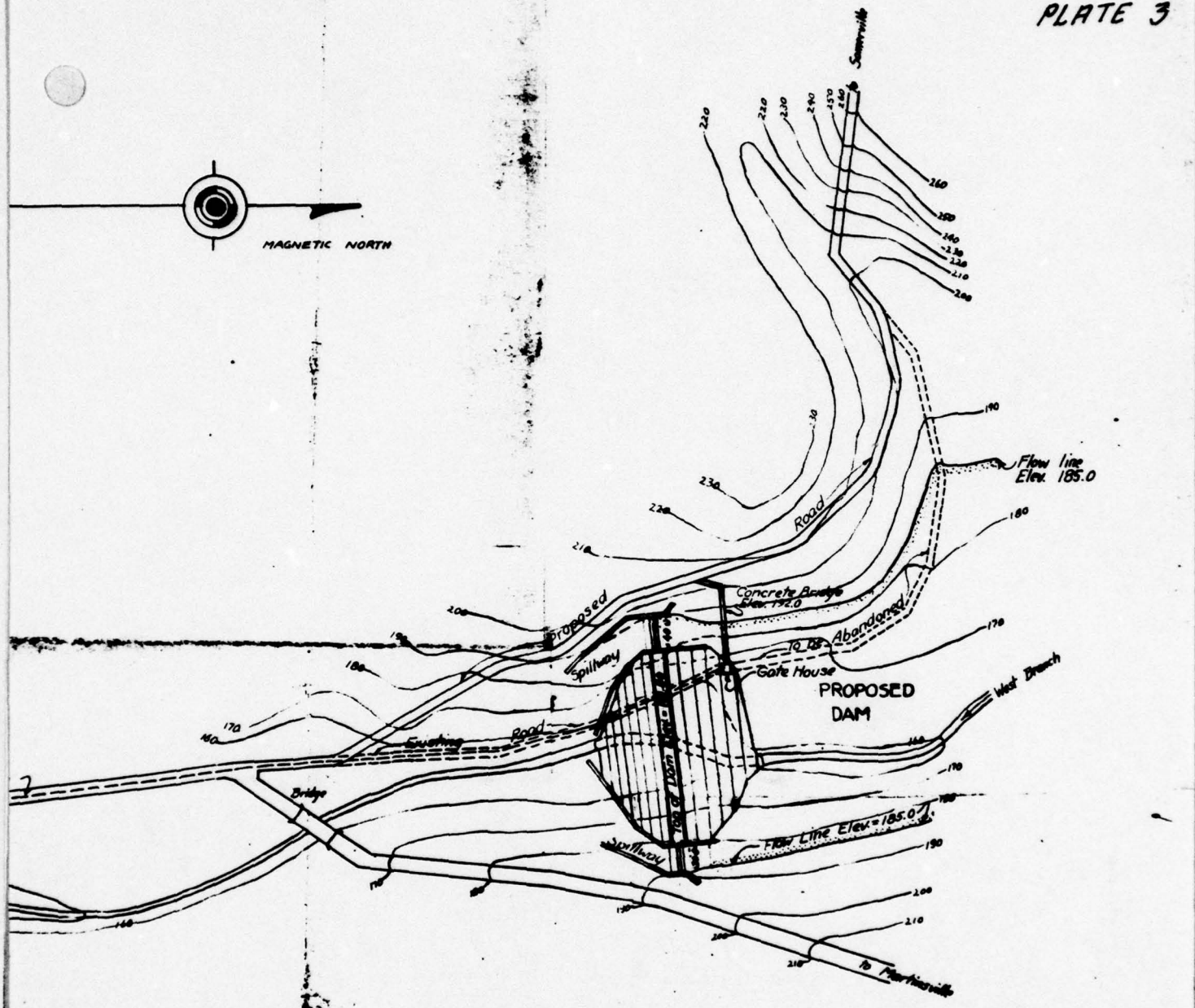
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WEST BRANCH RESERVOIR DAM
GENERAL VIEW

JENNY-LEEDSHILL FEBRUARY 1979

PLATE 2

PLATE 3



MAP OF

WEST BRANCH – MIDDLE BROOK

SHOWING

PROPOSED WEST BRANCH RESERVOIR

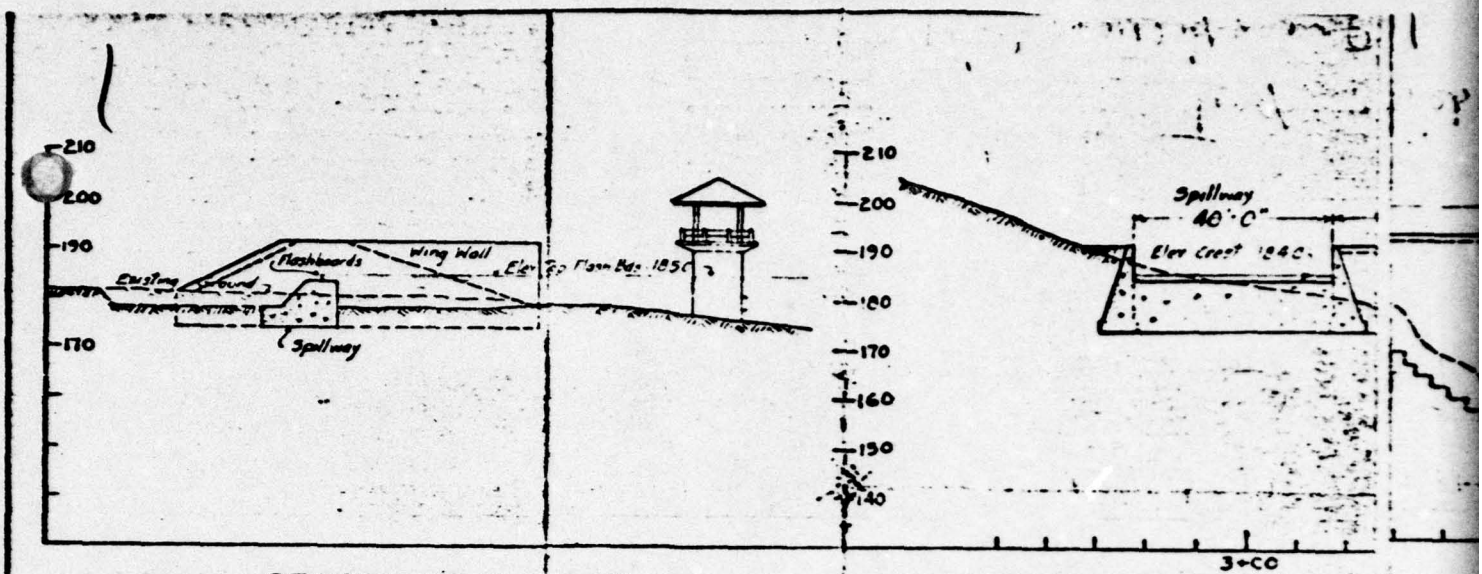
FOR

BOUND BROOK WATER CO. N.J.

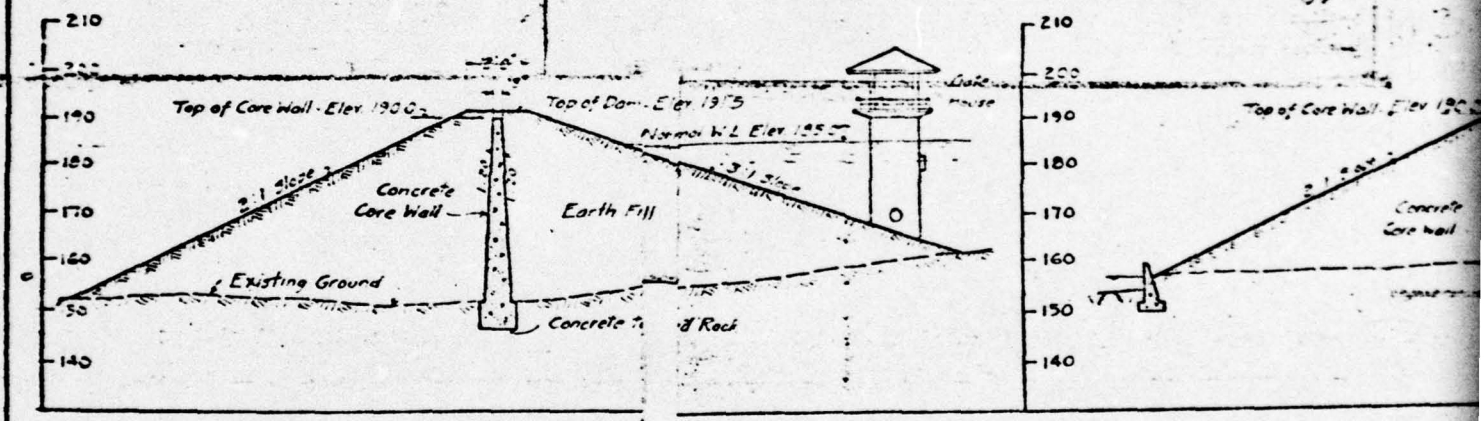
SEPT. 1928

CONSULTING ENGINEER
30 CHURCH ST. N.Y.C.

Scale: 1" = 100'-0"

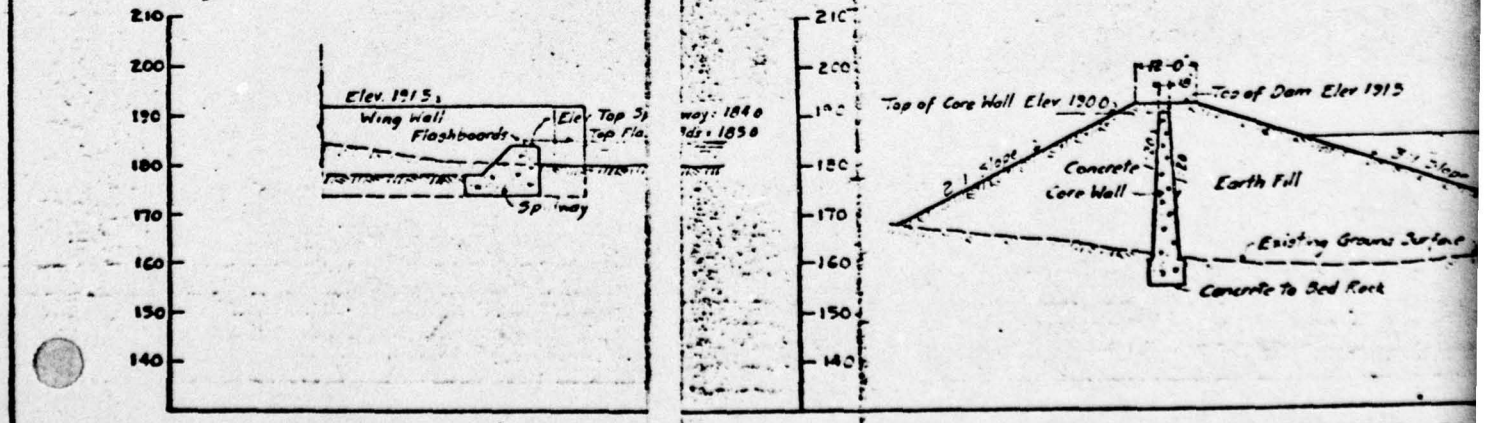


SECTION AT STA 2+90



SECTION AT STA 1+

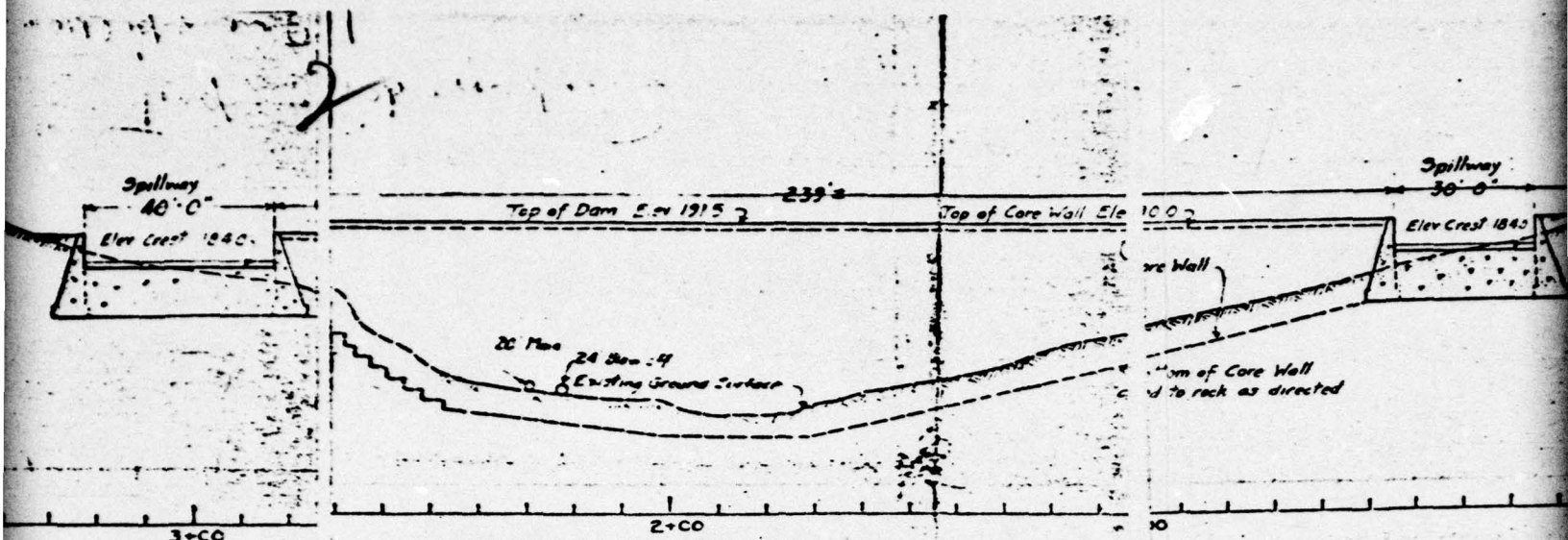
SECT



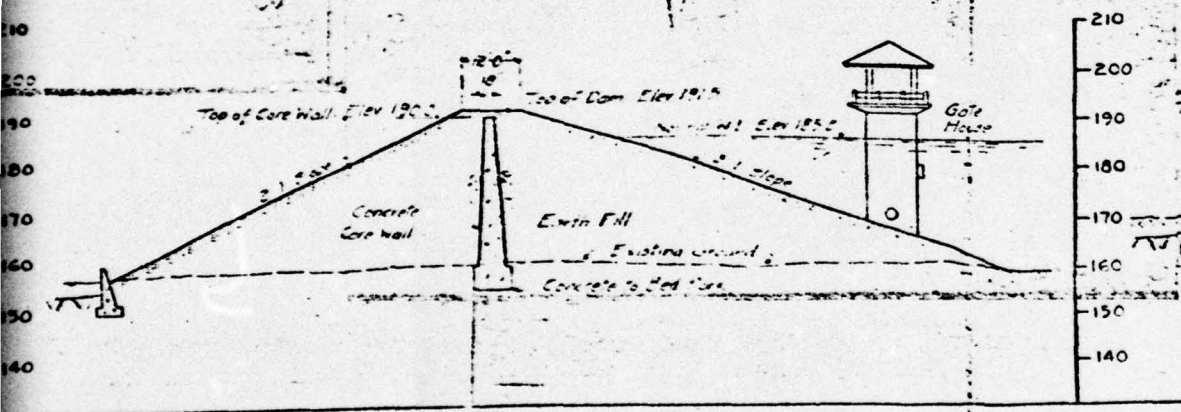
SECTION AT STA 0+4

SECTION AT STA 0+90

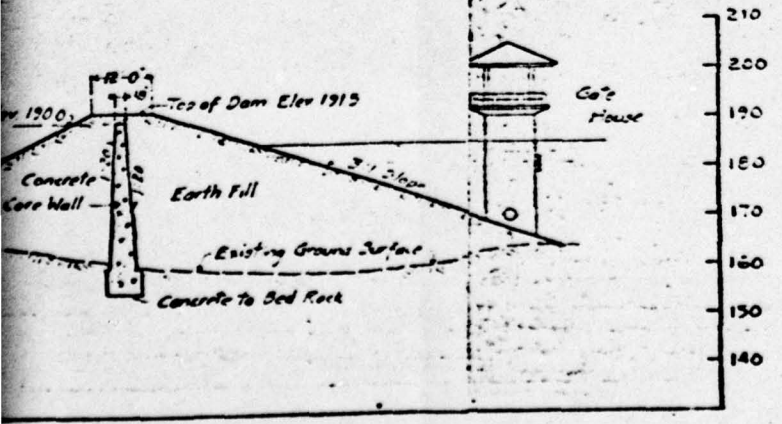
DES. BY— W.G.
DRD. BY—
TRC. BY— W.G.



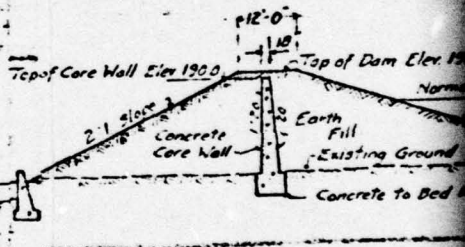
LONGITUDINAL SECTION FACING NORTH



SECTION AT STA. 1+90



SECTION AT STA. 0+90



SECTION AT STA. 2

SECTIONS

AT

PROPOSED WEST B

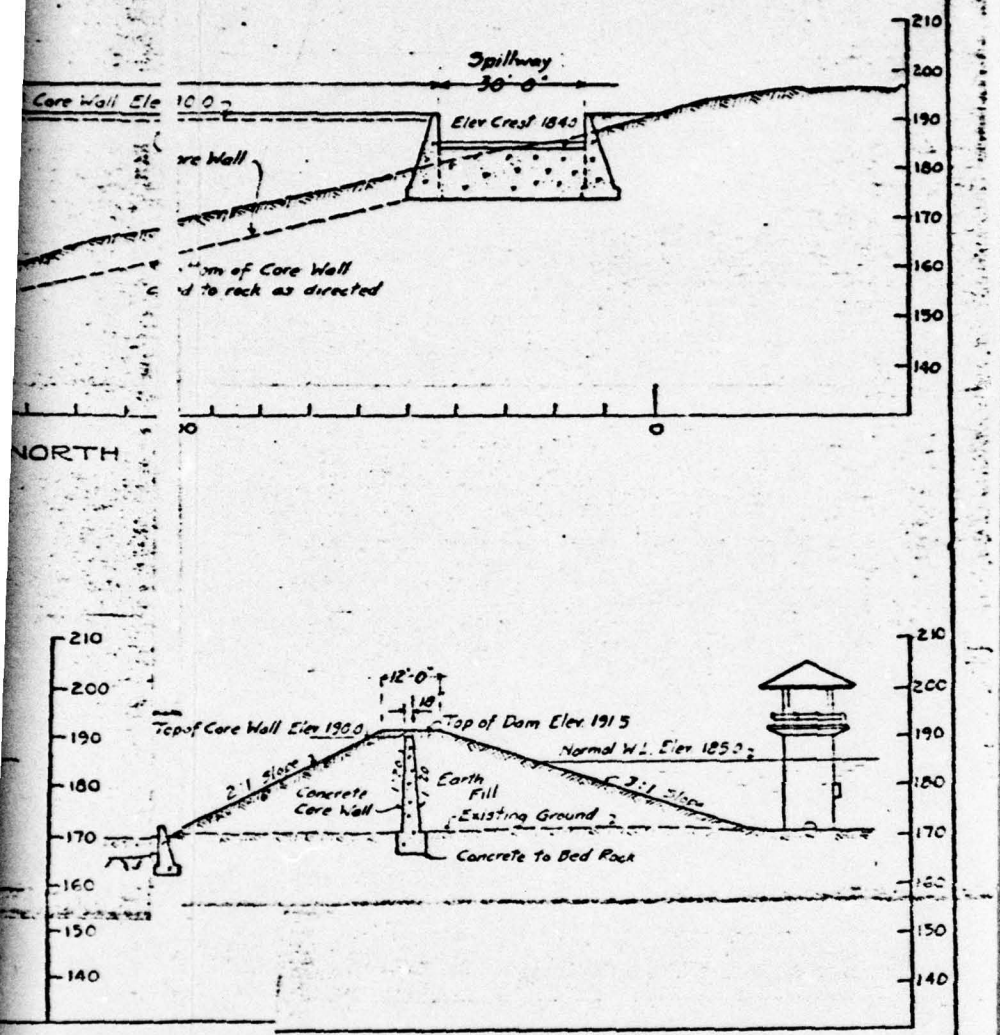
PO

BOUND BROOK

OCT.

Scales:-Hor

PLATE 4



SECTION AT STA. 2+40

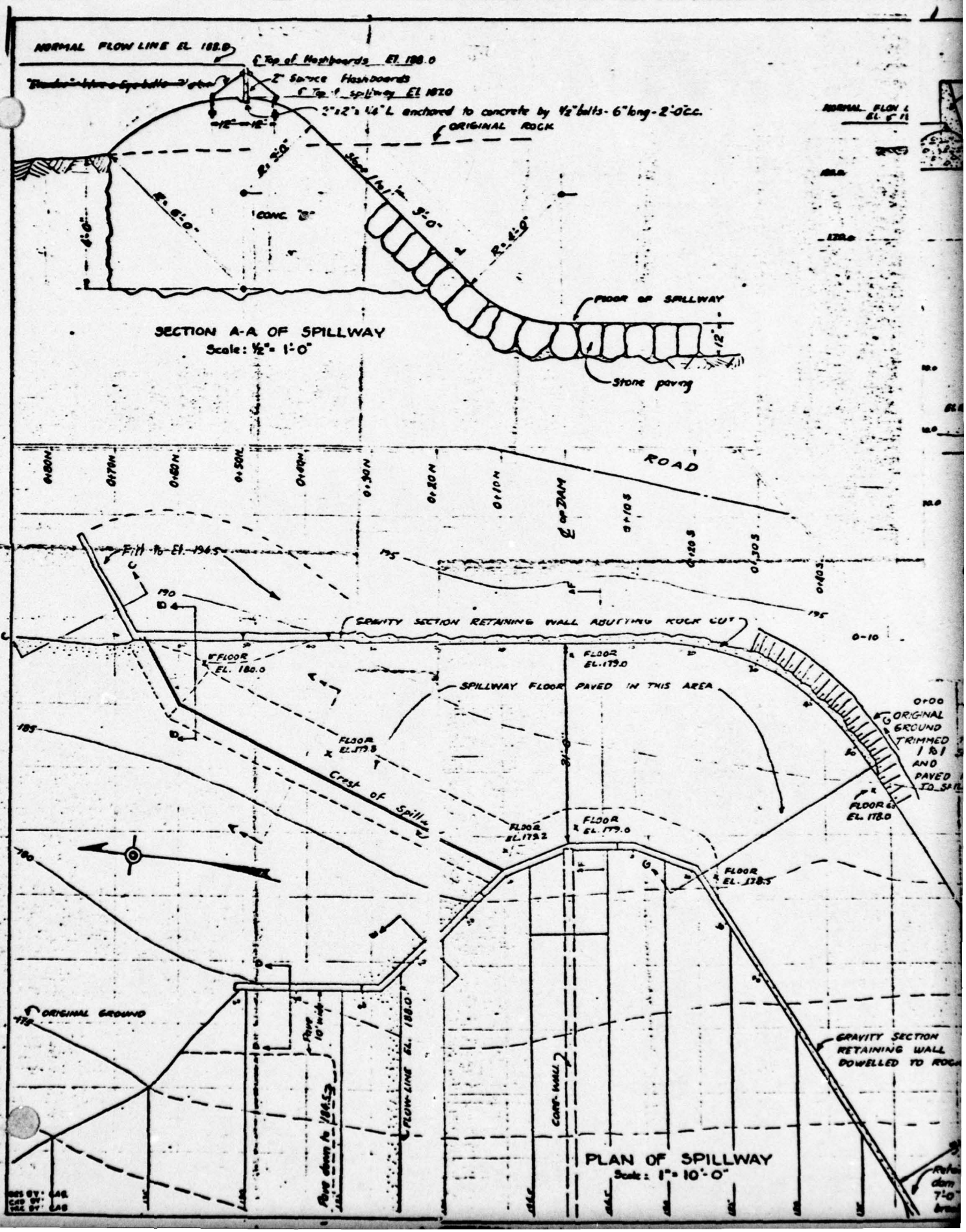
SECTIONS OF DAM
AT
PROPOSED WEST BRANCH RESERVOIR
FOR
BOUND BROOK WATER CO. N.J.

OCT. 1928.

CONSULTING ENGINEER
30 CHURCH ST N.Y.C.

Scales:-Hor 1"=20'-Vert 1"=20'

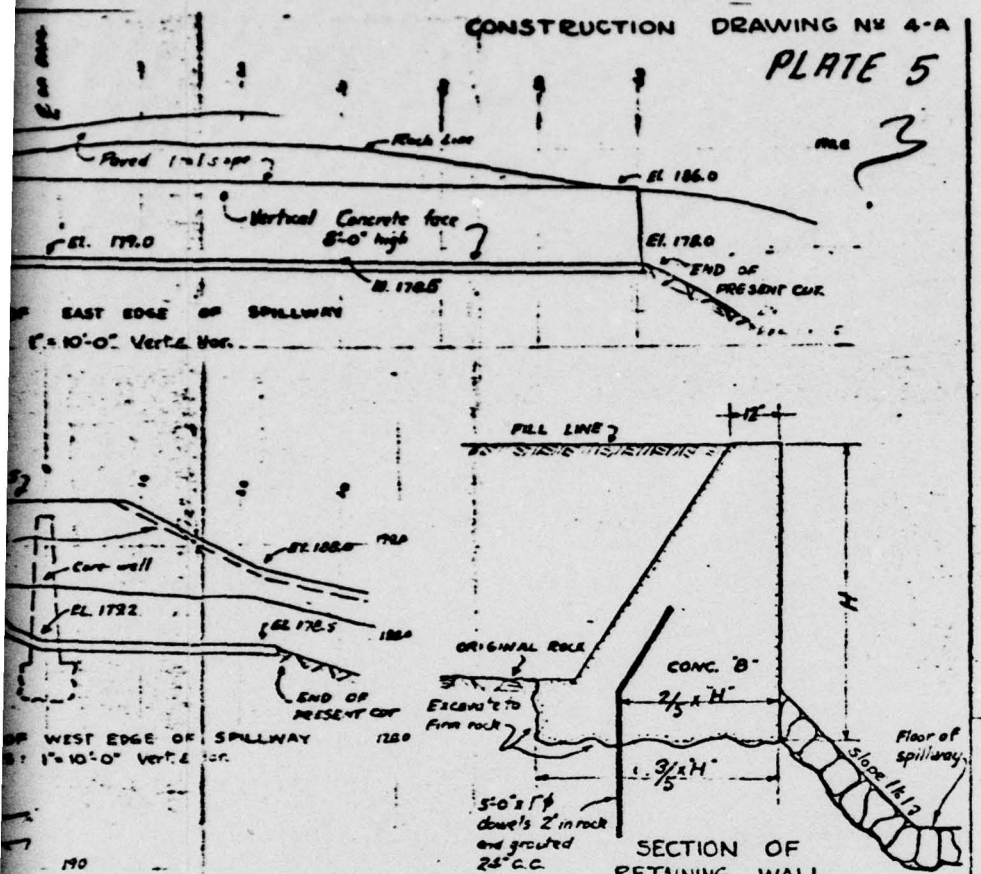
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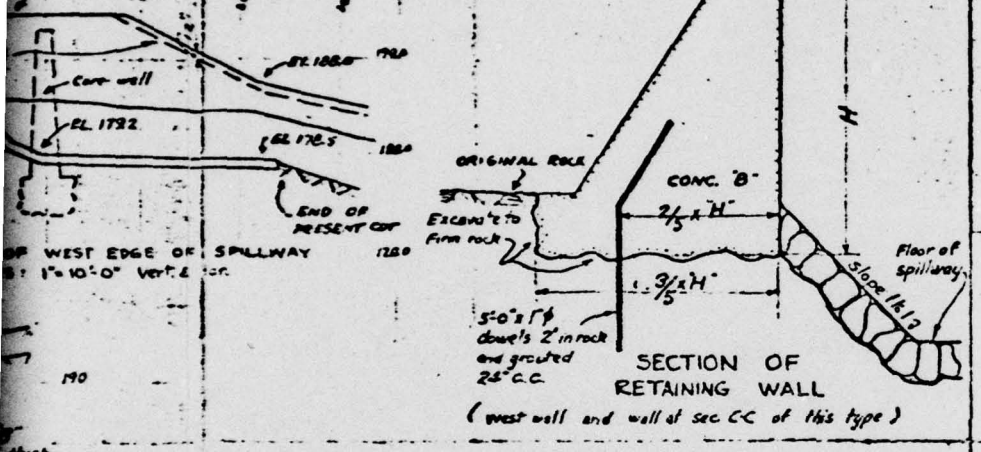


CONSTRUC
El. 194.5
Wing wall
2 to 1
Ground Line
El. 187.5
Paved 1 to 1 slope
Rock Line
Floor El. 180.0
El. 179.5
El. 179.0
Vertical Concrete face 8'-0" high
Stone paving 12" thick
El. 178.5
PROFILE OF EAST EDGE OF SPILLWAY
SCALES: 1" = 10'-0" Vert. & Hor.
FILL LINE
El. 194.5
Wing Wall
El. 189.0
NORMAL FLOW LINE
El. 188.0
Line of fill
El. 188.0
Core wall
El. 185.5
Ground Line
Strip to rock
El. 179.2
El. 178.5
Rock Line
END OF PRESENT CUT
PROFILE OF WEST EDGE OF SPILLWAY
SCALES: 1" = 10'-0" Vert. & Hor.
ORIGINAL ROCK
Excavate to firm rock
Top of dam El. 194.5
El. 194.5
Stone Paving
Top of Core wall El. 193
1 to 1
31'-0"
8'-0"
Conc. 8" 2'-0" thick
Dowels
Floor El. 179.0
Stone Paving
SECTION F-F
Scales: 1" = 10'-0" V.C.H.
SEC. GG SIMILIAR
ROCK CUT
0+00
ORIGINAL GROUND TRIMMED TO 1 to 1 SLOPE AND PAVED HERE TO SPILLWAY
0+10
0+20
0+30
0+40
0+50
0+60
FLOOR El. 178.0
FLOOR El. 178.5
GRAVITY SECTION RETAINING WALL DOWELLED TO ROCK
Retaining wall 12" higher than dam fill to toe of fill, then starting 7'-0" high, drop to 5'-0" high at brook and continue level across brook
SPILLWAY
= 10'-0"
Fill line
Ground
Rock
Dowels
SECTION E-E
Scale 1" = 10'-0"
Flow Line 180.0
Strip to rock
SPILLWAY
PROPOSED WEST
BOUND BROOK

CONSTRUCTION DRAWING Nº 4-A

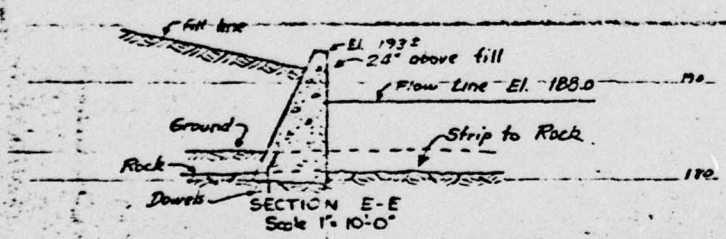
PLATE 5



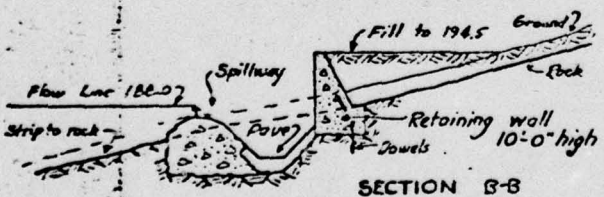


SECTION OF RETAINING WALL

(west wall and wall of sec. C-C of this type)



SECTION E-E
Scale 1" = 10'-0"



SECTION B-B
SCALE 1" = 10'-0"

SPILLWAY DETAILS

PROPOSED WEST BRANCH RESERVOIR

FOR

BOUND BROOK WATER CO. N.J.

SEPT. 1929

CONSULTING ENGINEER
30 CHURCH ST. N.Y.C.

Scales as Shown

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APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

Check List
Visual Inspection
Phase 1

Name Dam West Branch Reservoir County Somerset State New Jersey Coordinator NJDEP

Coordinates: Lat. 40° 35' 25"N
Long. 74° 33' 51"W

Date(s) Inspection 12-5-78
12-21-78 Weather Partly Cloudy Temperature 45°F

Pool Elevation at Time of Inspection 185.3' M.S.L. Tailwater at Time of Inspection ±155' M.S.L.

Inspection Personnel:

(December 5, 1978)

R. C. Gaffin

A. R. Slaughter

P. L. Wagner

(December 21, 1978)

R. J. Jenny
D. J. Lachel
F. L. Panuzio
A. R. Slaughter

P. L. Wagner Recorder

Owner Representative:
(December 5, 1978)

Donald M. Robertson, Manager
Engineering and Planning
Elizabethtown Water Company

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Not Applicable	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not Applicable	
DRAINS	Not Applicable	
WATER PASSAGES	Not Applicable	
FOUNDATION	Not Applicable	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not Applicable	
STRUCTURAL CRACKING	Not Applicable	
VERTICAL AND HORIZONTAL ALIGNMENT	Not Applicable	
MONOLITH JOINTS	Not Applicable	
CONSTRUCTION JOINTS	Not Applicable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Not observable because of thick rock riprap cover.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No movement or cracking could be detected. An extension of the spillway channel training wall protects the toe of the embankment from the stilling basin.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None visible. Slightly undulating surface.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Vertical alignment slightly uneven, probably due to variations in thick riprap cover. Horizontal alignment good.	
RIPRAP FAILURES	Small area of riprap missing from crest near spillway. Riprap is quarried basalt.	Missing riprap should be replaced.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy growth of shrubs on upstream side, also considerable debris.	Shrubs should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Abutments are bedrock. Junctions appear to be tight.	
ANY NOTICEABLE SEEPAGE	None observed through embankment. Some minor seepage through bedrock at left abutment in spillway channel.	
STAFF GAGE AND RECORDER	Staff gage painted on intake tower, water level of reservoir indicated to be 197.3 feet.	Gage elevations apparently are a local datum, since reservoir was about 1.7 ft. below spillway crest which is Elev. 187 ft.
DRAINS	None observed.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Concrete wall at downstream toe of dam housing outlets is spalled and cracked. Training wall adjacent to 24-inch outlet is broken off at top.	Toe wall should be repaired.
INTAKE STRUCTURE	Tree branches protruding from top inlet of diversion intake. Other inlets not visible. Windows broken out of gate house. Concrete spalled from railing posts, exposing re-bar.	Maintenance work is required.
OUTLET STRUCTURE	Old outlet pipe capped with steel plate at downstream toe of dam. Other outlet conduit removed downstream.	
OUTLET CHANNEL	Natural stream channel with 70-ft. long by 40 ft. wide stilling pool. Steep natural channel below, with bridge about 500 ft. downstream.	
EMERGENCY GATE	24-inch steel pipe blowoff operated at gate house. Minor flow at outlet.	Seating of gate valves should be checked.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Minor erosion and slight undercutting of base of ogee concrete on right side.	Eroded areas should be repaired.
APPROACH CHANNEL	Trees and debris in reservoir approach. Top right inlet wall broken.	Debris should be removed regularly.
DISCHARGE CHANNEL	Natural rock channel and left wall, with uneven surfaces, Minor seepage near spillway. Right wall of concrete has several vertical cracks with leaching deposits on surface. Considerable spalling at base of wall up to 6 in. or more in depth. Also spalling at base of joints.	Cracks and eroded areas of concrete training wall should be repaired. Stability of rock channel could be improved by grouting.
BRIDGE AND PIERS	Left wingwall spalled at downstream end, with some indication of leaching.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not Applicable	
APPROACH CHANNEL	Not Applicable	
DISCHARGE CHANNEL	Not Applicable	
BRIDGE AND PIERS	Not Applicable	
GATES AND OPERATION EQUIPMENT	Not Applicable	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate slopes. Heavily wooded.	
SEDIMENTATION	Upstream end of reservoir appears to have a siltation problem. Numerous aquatic plants at upstream end.	
DEBRIS	Considerable debris on spillway weir and upstream side of dam.	Floating debris should be regularly removed.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Bridge and roadway (Chimney Rock Road) about 500 feet downstream of dam. Small concrete arch dam further downstream.	
SLOPES	Steep ravine downstream of bridge with roadway on right bank above it.	
APPROXIMATE NO. OF HOMES AND POPULATION	Large stone quarry and a filtration plant about 1/2 mile downstream. Borough of Bound Brook further downstream. Several dozen houses in western part of borough could be floded.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Plan prepared from field measurements made during inspection (See Plate 2). Site topography shown on Plate 3.
REGIONAL VICINITY MAP	U. S. Geological Survey Map (See Plate 1).
CONSTRUCTION HISTORY	Periodic inspection reports made by the State during construction are available.
TYPICAL SECTIONS OF DAM	"Sections of Dam at Proposed West Branch Reservoir for Bound Brook Water Company", October 1928, Scale 1"=20' (See Plate 4)
HYDROLOGIC/HYDRAULIC DATA	Computations of spillway capacity available in State files.
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	"Gatehouse Details of Proposed West Branch Reservoir for Bound Brook Water Company", October 1928
RAINFALL/RESERVOIR RECORDS	Not Available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
DESIGN REPORTS	Not available. Some correspondence regarding design considerations is available in State files.
GEOLOGY REPORTS	Not available. Construction reports in State files provide some information. Reconnaissance geology made during this inspection.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Not available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	It is reported that field and laboratory tests were made in connection with the repair of the downstream embankment following the 1971 overtopping.
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Borrow source is reported to be from the reservoir area

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
SPILLWAY-PLAN -SECTIONS -DETAILS	"Spillway Details, Proposed West Branch Reservoir for Bound Brook Water Company", September 1929 (See Plate 5)
OPERATING EQUIPMENT PLANS & DETAILS	Not available
MONITORING SYSTEMS	None
MODIFICATIONS	None made, other than repair of the embankment
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Not available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	The dam was overtopped in 1971 and much of the downstream embankment washed away. Apparently, there are no reports concerning this, other than a hydrologic report prepared for the owner. The latter report was not made available for this inspection report.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
MAINTENANCE OPERATION RECORDS	Not available

APPENDIX B

PHOTOGRAPHS



Photo 1 - Rock facing on downstream embankment, looking toward right (west) abutment. (December 5, 1978)



Photo 2 - Crest of dam, looking toward right abutment (December 5, 1978)



Photo 3 - Shrubs and small trees on upstream embankment. Spillway at left. (December 5, 1978)



Photo 4 - Spillway weir and right wingwall. (December 5, 1978)



Photo 5 - Spillway weir and left wingwall
(December 5, 1978)



Photo 6 - Broken top of right wingwall of
spillway. (December 5, 1978)

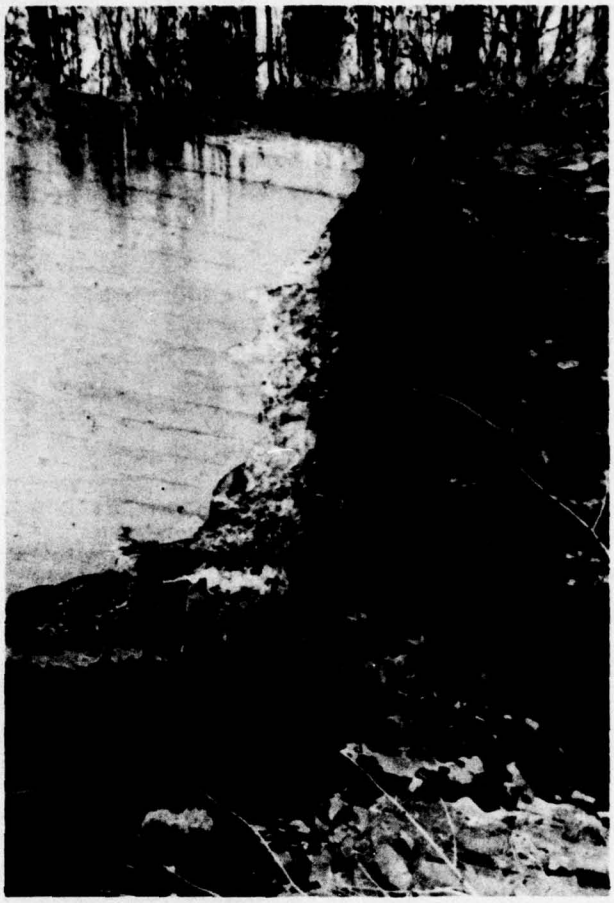


Photo 7 - Leaching and spalling of concrete at downstream end of left wingwall. Minor seepage through abutment rock. (Dec. 5, 1978)



Photo 8 - Spillway channel cut in bedrock (December 5, 1978)

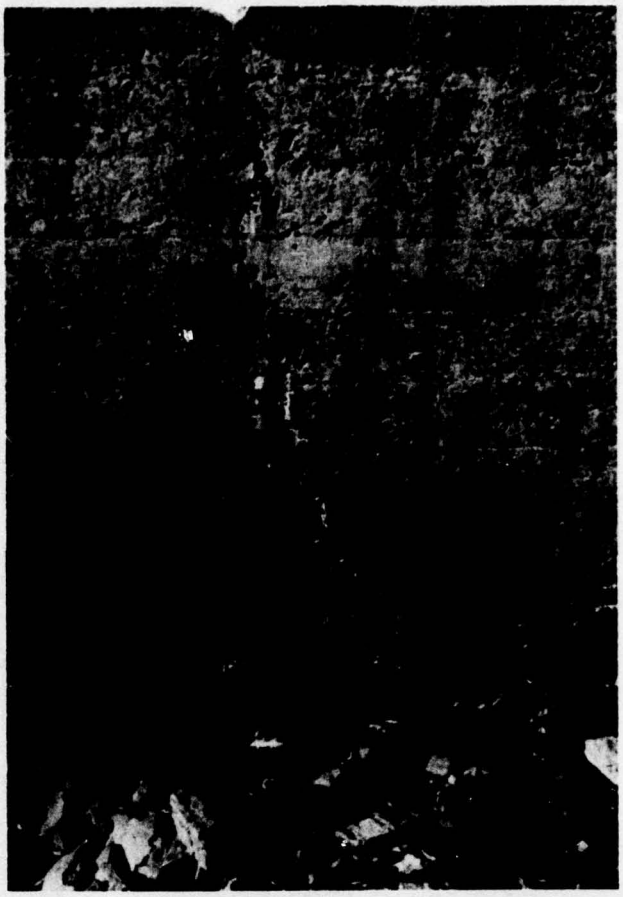


Photo 9 - Cracked and eroded area of spillway channel training wall. (December 5, 1978)

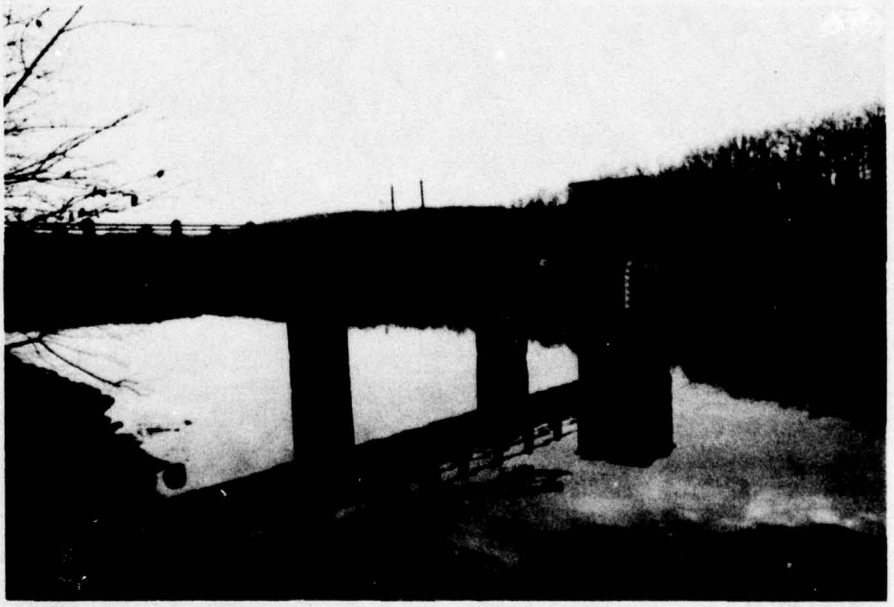


Photo 10 - Gatehouse and staff gage near right bank of reservoir. (December 5, 1978)

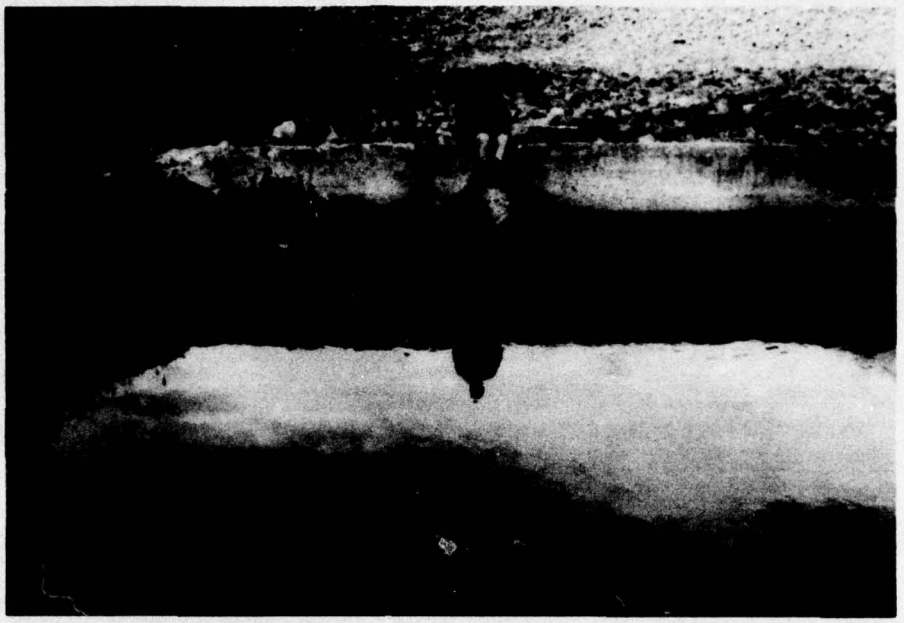


Photo 11 - Abandoned 20-inch diameter outlet (left) and 24-inch emergency outlet (right). (December 5, 1978)

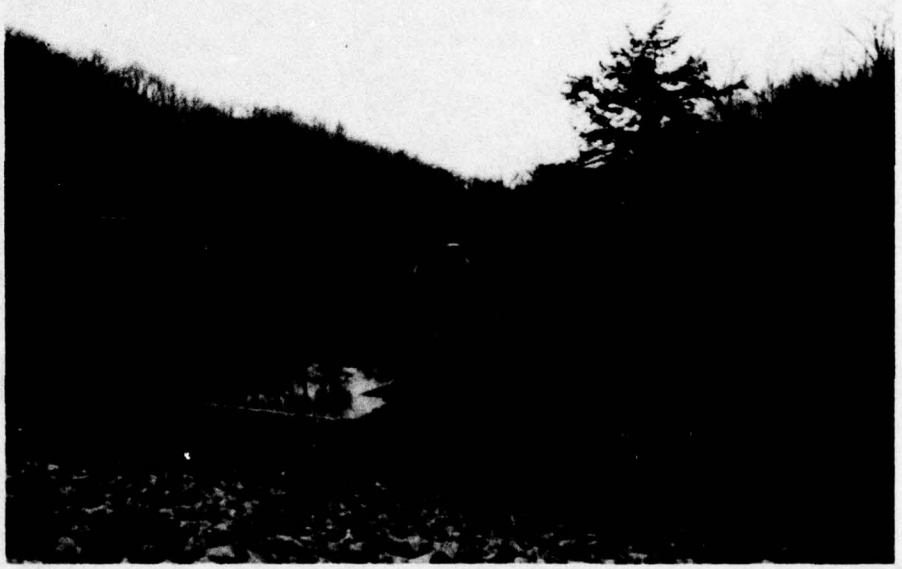


Photo 12 - Downstream channel and bridge on Chimney Rock Road. (December 5, 1978)

APPENDIX C

REGIONAL GEOLOGY - PIEDMONT LOWLANDS

REGIONAL GEOLOGY - PIEDMONT LOWLANDS

Physiography

The Piedmont Lowlands Province of New Jersey lies northwest of a line approximately between Trenton and Perth Amboy and southeast of an approximate line between Milford on the Delaware River and Mahwah near the New York State border. Physiographically, the province is situated between the predominantly Precambrian age New Jersey Highlands Province to the northwest and the typically unconsolidated Creataceous age and younger sediments of the Coastal Plain Province to the southeast. (See Figure C-1).

Bedrock

The Piedmont Lowlands, encompassing about one-fifth of the state, is characterized by northwestward dipping bedrock composed of interbedded red shales, siltstones and sandstones of Triassic and Jurassic age and igneous basalt extrusions (lava flows) and diabase intrusions of Jurassic age. The sedimentary rocks have been eroded to a broad southeastward sloping piedmont plain. The northwest border of the province is a northeast-southwest trending fault zone (Ramapo Fault) which truncates the sedimentary beds. Total vertical displacement on the fault may reach 10,000 feet.

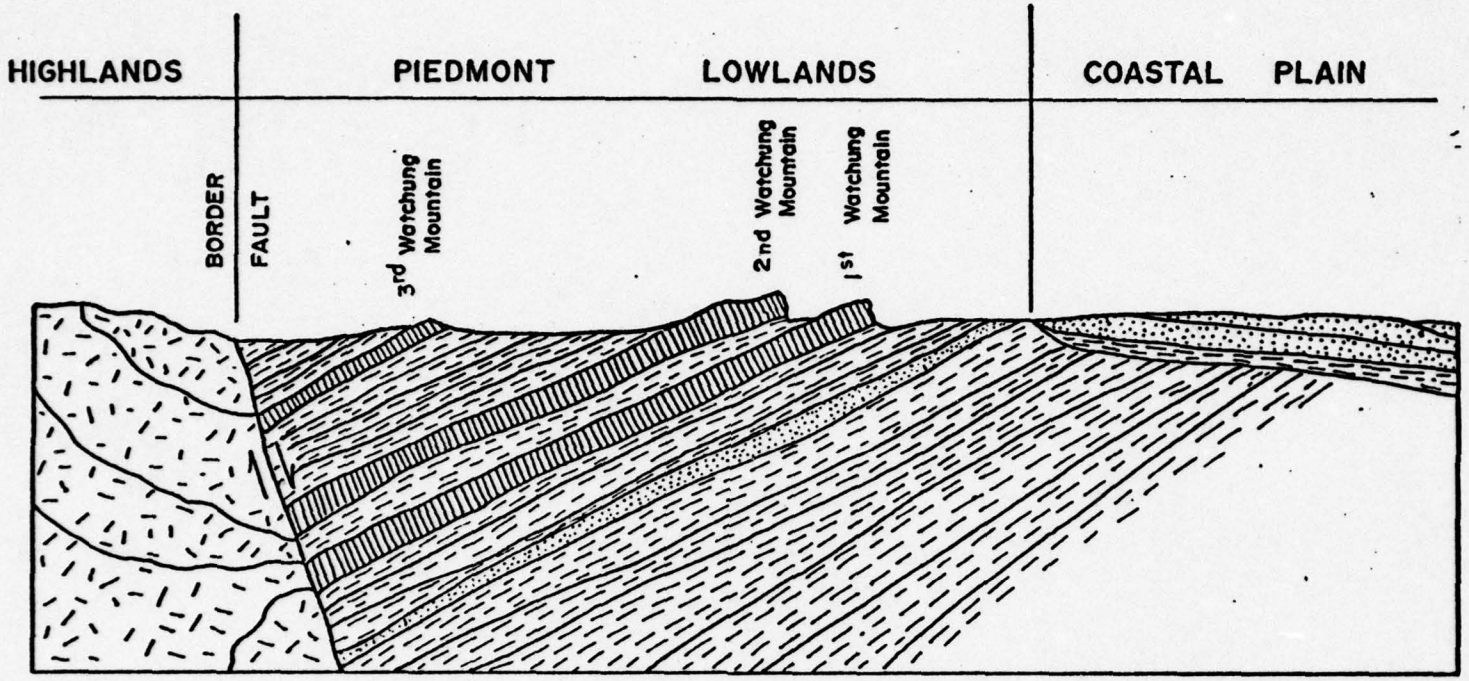
The gently rolling lowland topography of the piedmont lowlands is pierced by long asymetric ridges of hard

and resistant igneous rocks which were intruded into or on top of the sedimentary sequences. With the subsequent erosion of the softer sedimentary rocks, these igneous formations have been left standing, often in bold relief, up to 400 ft. above the surrounding plains. The igneous bodies composed of diabase and basalt form the Palisades along the Hudson River and the three Watchung Mountain ridges of the central Piedmont. The ridges are all steeper on the southeast with gentle dip slopes to the northwest.

Overburden

The Pleistocene Age Wisconsin continental glacier has smoothed and filled approximately the northern half of the province. The terminal moraine of the glacier extends from Perth Amboy to Summit then northwestward to Morris Plains. North of the morainal line the soils characteristically consist of glacial tills overlying the bedrock with scattered overlying stratified outwash deposits. At least three large glacial lakes occupied portions of the area north of the moraine at different periods, resulting in a relatively flat topography composed predominantly of silts and clays.

South of the terminal moraine, most of the overburden consists of alluvial deposits overlying a more highly developed weathered transition zone on top of the bedrock. Some highly weathered tills of pre-Wisconsin glaciation can be found on the top of intervalley ridges. Much of the alluvium is glacial outwash.



SCHEMATIC CROSS-SECTION OF
NEW JERSEY PIEDMONT LOWLANDS
PHYSIOGRAPHIC PROVINCE

JENNY / LEEDSHILL
JANUARY 1979

FIGURE C-1

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

W. BRANCH RES.

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 6.3 SQ. MI.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 187 FT (465 AF)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 194.5 (805 AF)

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: 194.5 FT.

CREST: SPILLWAY

a. Elevation 187 FT
b. Type CONCRETE OGEE
c. Width —
d. Length 22.5
e. Location Spillover LEFT ABUTMENT (LOOKING DOWNSTREAM)
f. Number and Type of Gates CAN PUT UP FLASHBOARDS

OUTLET WORKS:

a. Type 1-24" PIPE & GATE VALVE
b. Location
c. Entrance inverts 162
d. Exit inverts
e. Emergency draindown facilities

HYDROMETEOROLOGICAL GAGES:
a. Type STAGE
b. Location PAINTED ON INTAKE TOWER
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 5360 CFS

FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

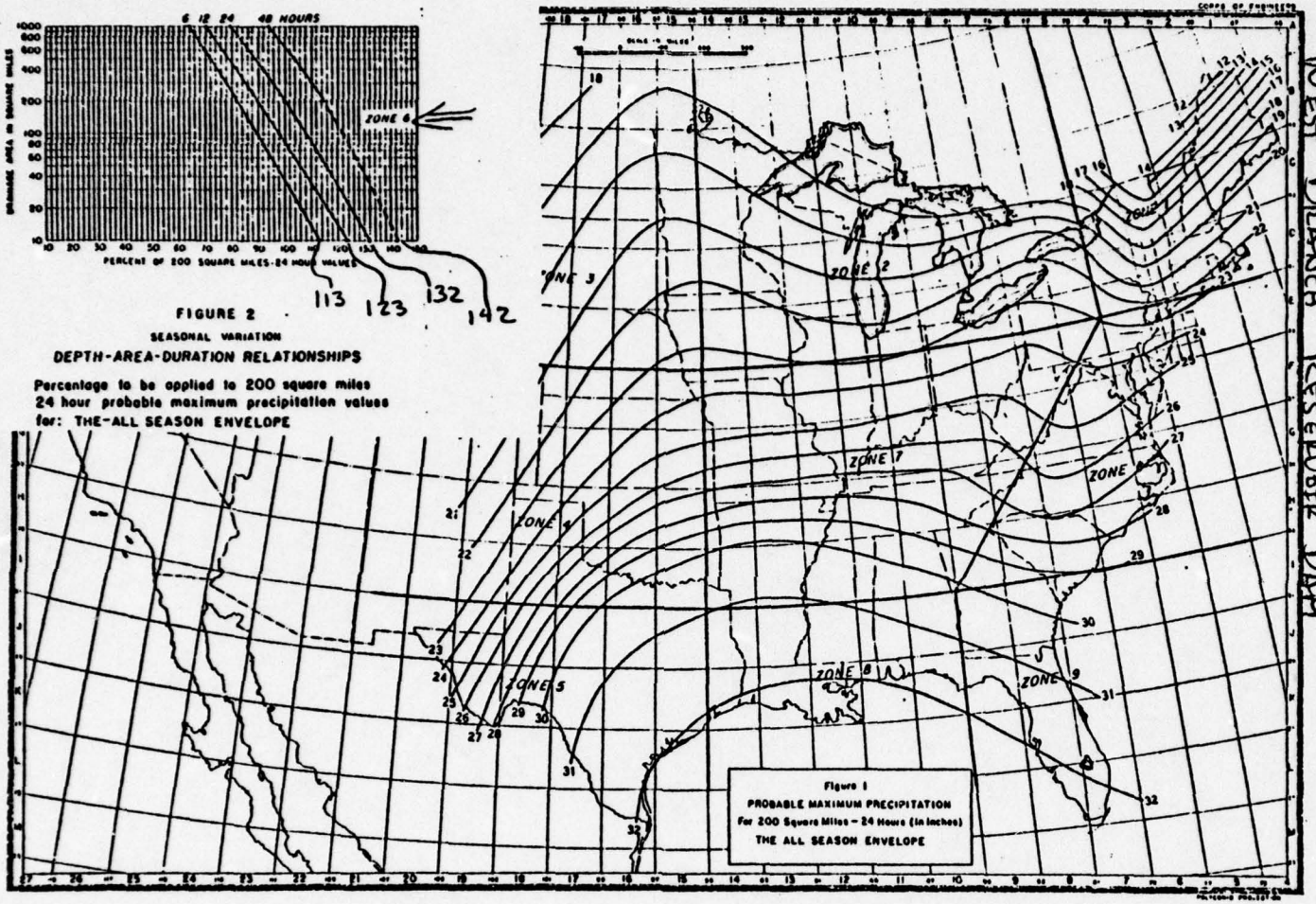


Figure 1

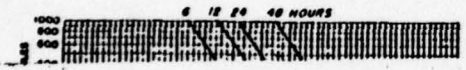
PROBABLE MAXIMUM PRECIPITATION

For 200 Square Miles – 24 Hours (in inches)

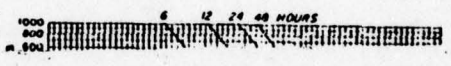
THE ALL SEASON ENVELOPE

WEST BRANCH RESERVOIR DAM

D-2







CHAMPION LINE NO. 636-P LEEDS, HILL AND JEWETT, INC.

BY RBE DATE 781220 CLIENT N.J. SHEET NO. 1 OF 2

CHKD DATE JOB TIME OF CONCENTRATION JOB NO. 302

DATA

L = STREAM LENGTH FROM WATERSHED OUTLET TO THE MOST DISTANT RIDGE = 4.05 mi

L_{CA} = STREAM LENGTH FROM BASIN CENTROID = 1.97 mi

H = DIFF BETWEEN ELEV AT OUTLET AND ELEV AT MOST DISTANT POINT = 240.1

T_C = TIME OF CONCENTRATION OR TIME FOR WATER TO FLOW FROM THE MOST DISTANT POINT IN THE WATERSHED TO THE WATERSHED OUTLET

T_L = LAG TIME FROM CENTER OF EXCESS RAINFALL TO TIME OF PEAK. $= 0.6\,T_C$

METHOD 1

$$T_C = \frac{L^{1.15}}{7700\,H^{0.38}}$$

L IN FT
H IN FT

$$T_L = \frac{0.6\,L^{1.15}}{7700\,H^{0.38}}$$

METHOD 2

$$T_C = \left(\frac{11.9\,L^3}{H}\right)^{0.385}$$

L IN MILES
H IN FT.

$$T_L = 0.6\left(\frac{11.9\,L^3}{H}\right)^{0.385}$$

METHOD 3

$$T_L = C_T\left(\frac{L\,L_C}{S^{1/2}}\right)^{0.38}$$

S IN FT/MI $S = H/L = 1.1\%$

$$T_L = C_T\left(\frac{L\,L_C}{(H/L)^{1/2}}\right)^{0.38}$$

C_T = 1.2 = (0.72) = 0.35 MOUNTAIN FOOTHILL VALLEY DRAINAGE AREA

METHOD 4

$T_C = L/V$

$T_L = 0.6\,L/V$

V = AVG VELOCITY FROM CURVE OF V VS. AVG SLOPE

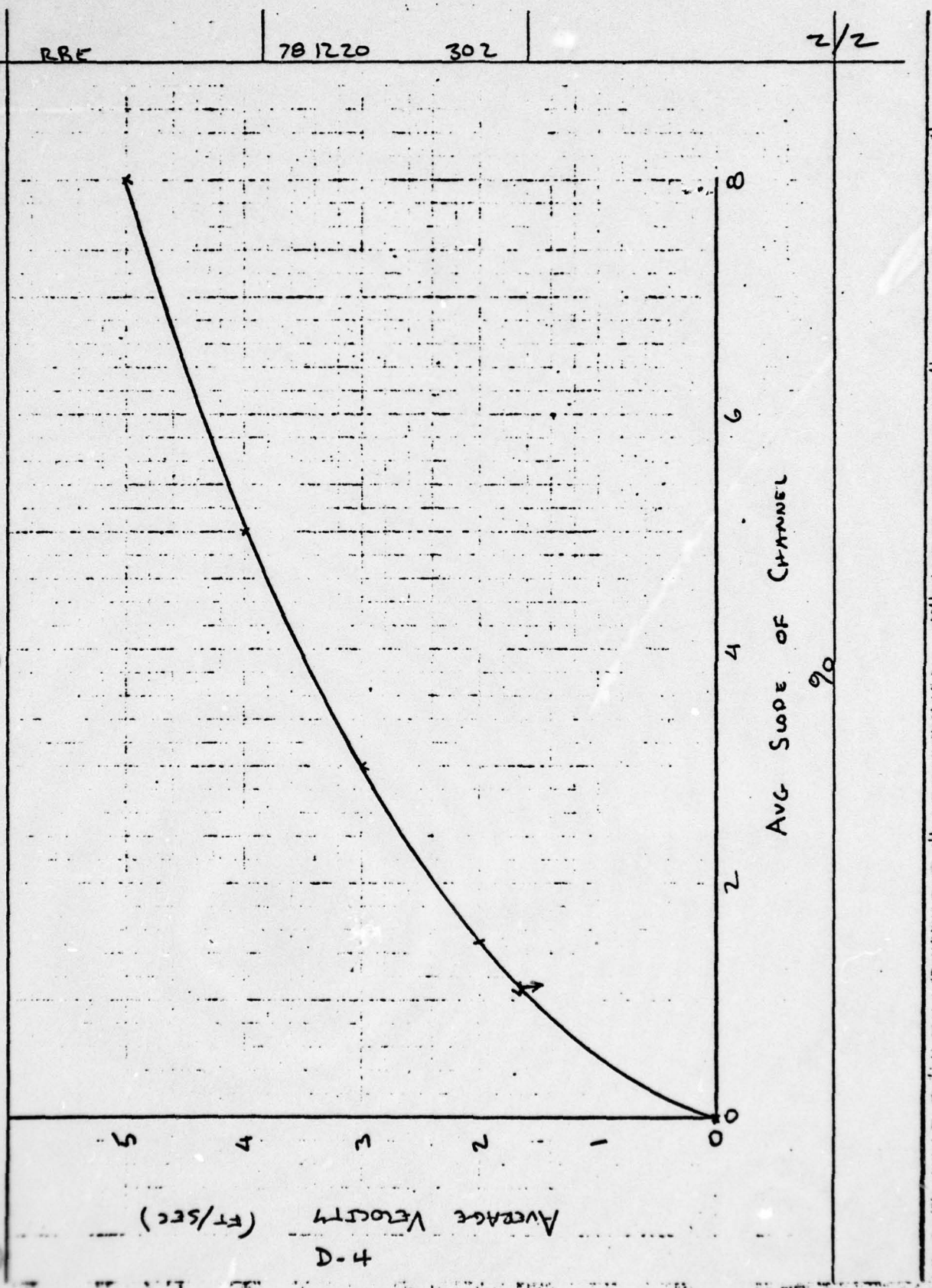
V = 1.65 fps

DAM

LAG IN HOURS

	METHODS 1	2	3	4	USE
WEST BRANCH	0.9	0.9	0.7	2.2	0.9

D-3


Average Velocity (Ft/sec)
5
4
3
2
1
0
0
2
4
6
8
Avg Slope of Channel
%

LEEDS, HILL AND JEWETT, INC.

BY RBE DATE CLIENT N.J. Dam Safety SHEET NO. OF

CHKD DATE JOB JOB NO. 302-03

REFERENCES

METHOD 1 - FROM "HANDBOOK OF APPLIED HYDROLOGY"
BY CHOW
McGRAW HILL PP 21-10, 11

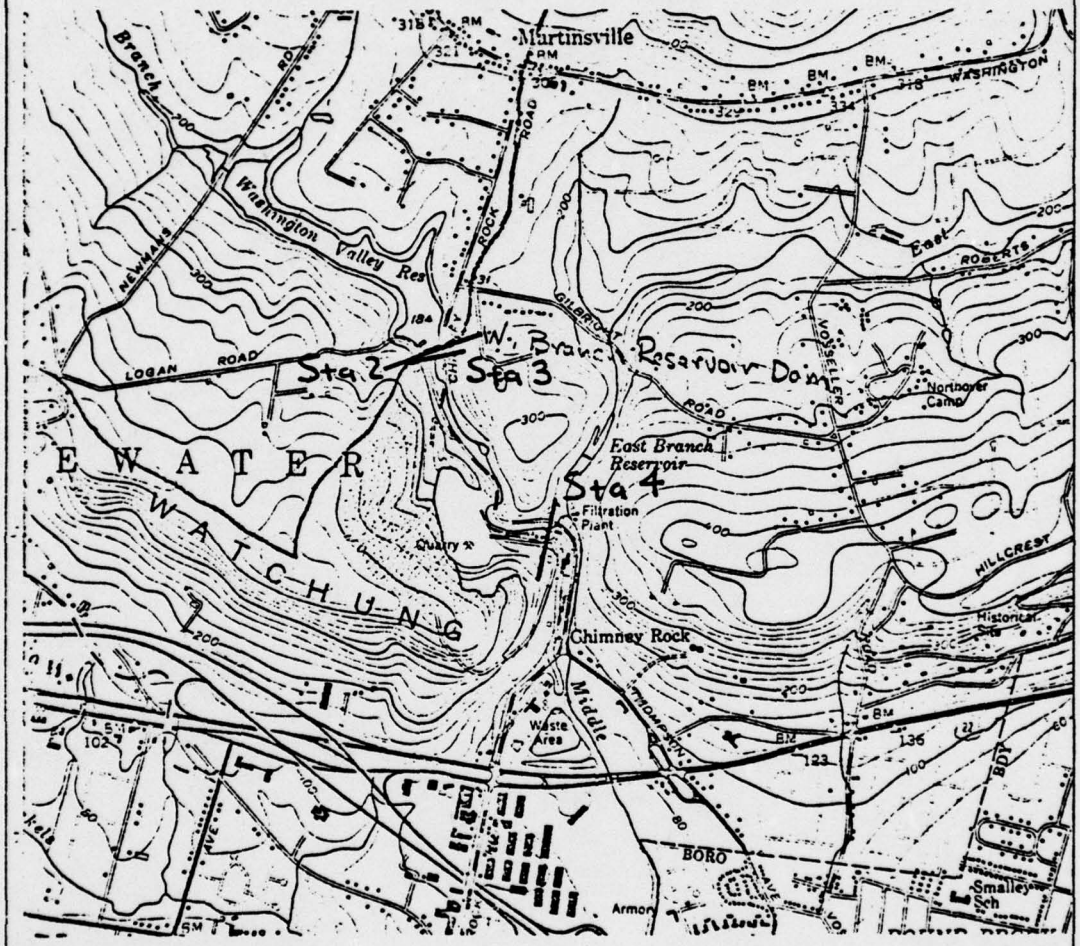
METHOD 2 - FROM CALIFORNIA CULVERTS PRACTICE, CALIF HIGHWAYS AND PUBLIC WORKS, SEPT 1942
SEE USBR DESIGN OF SMALL DAMS
PG. 71

METHOD 3 - FROM HYDROLOGY FOR ENGINEERS
LINSLEY / KOHLER / PAULUS 1975
PP 247-248

METHOD 4 - FROM U.S. NAVY - TECHNICAL PUBLICATION
NAVDOCKS TP-PW-5 TABLE 8B, MARCH 1953
SEE USBR DESIGN OF SMALL DAMS PG. 70

RBE 750207 WEST BRANCH RESERVOIR 30203

LOCATION MAP OF CROSS-SECTIONS USED IN ROUTING CALCULATIONS



LEEDS, HILL AND JEWETT, INC.

BY RBF DATE 7/9/18 CLIENT New Jersey SHEET NO. OF

CHKD DATE JOB JOB NO. 202-01

W. Branch

Channel Cross-Sections

Station	Distance Downstream of Dam (ft)	Mannings n° Left Over-Bank	Mannings n° Main Channel	Mannings n° Right Over-Bank	Channel Invert (ft)	Max Elev. (ft)	Reach Length (ft)	Energy Grade Line Slope	X or Y	X or Y (ft) 1	2	3	4	5	6	7	8
3 - Below Dam	100	0.10	0.045	0.10	180	220	100	0.02	X	0	100	300	300	325	325	475	600
									Y	240	200	181	180	180	181	200	220
4	3500	0.10	0.045	0.10	108	140	3400	0.017	X	0	400	500	500	525	525	700	725
									Y	140	120	110	108	108	110	120	140

4 Looking Upstream

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
C. EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.028	0.030	0.035
5. Stony bottom and weedy banks	0.025	0.035	0.040
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline-excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
D. NATURAL STREAMS			
D-1. *Minor streams (top width at flood stage <100 ft)*			
a. Streams on plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones and weeds	0.030	0.035	0.040
3. Clean, winding, some pools and shoals	0.033	0.040	0.045
4. Same as above, but some weeds and stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150

STATIONS 3 & 4

TABLE 5-6. VALUES OF THE ROUGHNESS COEFFICIENT n (*continued*)

Type of channel and description	Minimum	Normal	Maximum
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070
D-2. Flood plains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
D-3. Major streams (top width at flood stage >100 ft). The n value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	.....	0.060
b. Irregular and rough section	0.035	.....	0.100

D-8

OPEN-CHANNEL HYDRAULICS

STATIONS 3 & 4

VEN TE CHOW, Ph.D.

Professor of Hydraulic Engineering
University of Illinois

ASSUMED BREACH PARAMETERS

WIDTH OF BREACH BOTTOM: 190 FT

SIDE SLOPES: 45°

BREACH BOTTOM ELEV.: 160 FT

TIME TO FAIL: 6 hrs

ELEV. @ WHICH FAILURE OCCURS: 194.5 -

INITIAL WATER SURFACE ELEV.: 187 FT

(1) BASED ON PREVIOUS STUDIES OF ACTUAL DAM FAILURES.

790213	W. BRANCH RES	302-03

DRAWDOWN CALCULATIONS

PIPE DIAMETER = 24"

USE ORIFICE EQN.

ASSUME: ORIFICE COEFF OF 0.6
NO TAILWATER EFFECT
NO INFLOWS INTO RESERVOIR

$Q = C A \sqrt{2gH}$ H = MEAN DEPTH

$Q = 0.6 (\pi (1)^2) \sqrt{2gH}$

$\Delta S/\Delta t = 15.13 H^{1/2}$

$\Delta t = \left(\frac{1}{15.13 H^{1/2}}\right) \Delta S \, (43560 \text{ FT}^3/\text{AF}) (1/3600 \text{ SEC/HR})$

$\Delta t = 0.80 H^{-1/2} \Delta S$

ELEV. (FT)	STO (AF)	ΔSTO (AF)	AVG. H (FT)	Δt (HRS)	Σ HRS
184	360				
		120	20	21.5	
180	240				21.5
		115	15.5	23.4	
175	125				44.9
		75	10.5	18.5	
170	50				63.4
		40	5.5	13.6	
165	10				77.0
		10	1.5	6.5	
162	0				83.5 hrs

TOTAL DRAWDOWN TIME = 83.5 HRS/24 = 3.5 DAYS

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1979
  LAST MODIFICATION  25 SEP 78
**********

    1              A1       NEW JERSEY DAM SAFETY - WEST BRANCH RESERVOIR DAM I.D. NO. 00372
    2              A2       HYDRAULIC-HYDROLOGIC ANALYSIS   302-03
    3              A3       PROBABLE MAXIMUM FLOOD                                        -RBE-
    4              R   144      0      10       0       0       0       0       0       0       0
    5              R1    5
    6              J     1      4      1
    7              J1  0.25    0.5    0.75    1.0
    8              K     0      1                                                    1
    9              K1                        INFLOW HYDROGRAPH TO RESERVOIR
   10              M     1      2     5.3      6.3                                           1
   11              P           22.9    113      123     132
   12              T                                                    0.50    0.05
   13              W2          0.9
   14              X    -1     -.05    2.0
   15              K     1      2                                                    1
   16              K1                        ROUTED FLOWS THROUGH RESERVOIR
   17              Y                               1       1
   18              Y1    1                                                    465
   19              RS    0     40      240     360     465     565     680     805     880    1120
   20              RE  160     170     180     164     187     188     192   194.5     196     200
   21              RI  187    72.5     3.6     1.5
   22              RD 294.5    3.2     1.9     260
   23              K     1      3                                                    1
   24              K1       CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
   25              Y                               1       1
   26              Y1    1
   27              Y6  0.10   0.045    0.10     180     240     160    0.02
   28              Y7    0      240     100     200     300     181     300     180     325     180
   29              Y7  325      141     475     260     600     240
   30              K     1      4                                                    1
   31              K1       CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
   32              Y                               1       1
   33              Y1    1
   34              Y6  0.10   0.045    0.10     108     140    3400    0.02
   35              Y7    0      140     400     120     503     110     500     108     525     108
   36              Y7  525      110     700     120     725     140
   37              K    99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
ROUTE HYDROGRAPH TO	3
ROUTE HYDROGRAPH TO	4
END OF NETWORK	

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  25 SEP 78
**********

RUN  DATED 01/24/79
     TIME 0 22.36.18.
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NEW JERSEY DAM SAFETY - WEST BRANCH RESERVOIR DAM I.D. NO. 00372
HYDRAULIC-HYDROLOGIC ANALYSIS 302-03
PROBABLE MAXIMUM FLOOD -RBE-

JOB SPECIFICATION

NQ	NMO	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPPT	MSTAN
144	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .25 .50 .75 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH TO RESERVOIR

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

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	6.30	0.00	6.30	0.00	0.600	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	P96
0.00	22.90	113.60	123.00	132.00	0.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .600

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	.50	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .00

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 29 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .00 VOL= 1.00

244.	733.	1505.	2436.	2968.	3092.	2905.	2525.	2011.	1440.
1088.	829.	636.	486.	367.	279.	211.	159.	120.	92.
70.	54.	40.	32.	25.	19.	13.	8.	3.	

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERI... COMP Q	LOW MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.02	0.00	.02	6.	1.01	12.10	73	.35	.34	.01	1109.
1.01	.20	2	.02	0.00	.02	5.	1.01	12.20	74	.35	.34	.01	1329.
1.01	.30	3	.02	0.00	.02	5.	1.01	12.30	75	.35	.34	.01	1768.
1.01	.40	4	.02	0.00	.02	5.	1.01	12.40	76	.35	.34	.01	2483.
1.01	.50	5	.02	0.00	.02	4.	1.01	12.50	77	.35	.34	.01	3356.
1.01	1.00	6	.02	0.00	.02	4.	1.01	13.00	78	.35	.34	.01	4265.
1.01	1.10	7	.02	0.00	.02	4.	1.01	13.10	79	.41	.41	.01	5137.
1.01	1.20	8	.02	0.00	.02	4.	1.01	13.20	80	.41	.41	.01	5930.
1.01	1.30	9	.02	0.00	.02	3.	1.01	13.30	81	.41	.41	.01	6625.
1.01	1.40	10	.02	0.00	.02	3.	1.01	13.40	82	.41	.41	.01	7217.
1.01	1.50	11	.02	0.00	.02	3.	1.01	13.50	83	.41	.41	.01	7742.
1.01	2.00	12	.02	0.00	.02	3.	1.01	14.00	84	.41	.41	.01	8199.
1.01	2.10	13	.02	0.00	.02	3.	1.01	14.10	85	.52	.51	.01	8612.
1.01	2.20	14	.02	0.00	.02	2.	1.01	14.20	86	.52	.51	.01	9004.
1.01	2.30	15	.02	0.00	.02	2.	1.01	14.30	87	.52	.51	.01	9406.
1.01	2.40	16	.02	0.00	.02	2.	1.01	14.40	88	.52	.51	.01	9839.
1.01	2.50	17	.02	0.00	.02	2.	1.01	14.50	89	.52	.51	.01	10284.
1.01	3.00	18	.02	0.00	.02	2.	1.01	15.00	90	.52	.51	.01	10707.
1.01	3.10	19	.02	0.00	.02	2.	1.01	15.10	91	.47	.46	.01	11077.
1.01	3.20	20	.02	0.00	.02	2.	1.01	15.20	92	.79	.78	.01	11441.
1.01	3.30	21	.02	0.00	.02	1.	1.01	15.30	93	1.42	1.41	.01	12011.
1.01	3.40	22	.02	0.00	.02	1.	1.01	15.40	94	3.54	3.53	.01	13537.
1.01	3.50	23	.02	0.00	.02	1.	1.01	15.50	95	1.02	1.01	.01	14197.
1.01	4.00	24	.02	0.00	.02	1.	1.01	16.00	96	.63	.62	.01	14942.
1.01	4.10	25	.02	0.00	.02	1.	1.01	16.10	97	.49	.47	.01	23720.
1.01	4.20	26	.02	0.00	.02	1.	1.01	16.20	98	.49	.47	.01	26014.
1.01	4.30	27	.02	0.00	.02	1.	1.01	16.30	99	.48	.47	.01	26511.
1.01	4.40	28	.02	.01	.01	3.	1.01	16.40	100	.48	.47	.01	25567.
1.01	4.50	29	.02	.01	.01	8.	1.01	16.50	101	.48	.47	.01	23660.
1.01	5.00	30	.02	.01	.01	21.	1.01	17.00	102	.48	.47	.01	21211.
1.01	5.10	31	.02	.01	.01	43.	1.01	17.10	103	.38	.37	.01	18695.
1.01	5.20	32	.02	.01	.01	71.	1.01	17.20	104	.38	.37	.01	16455.
1.01	5.30	33	.02	.01	.01	101.	1.01	17.30	105	.38	.37	.01	15404.
1.01	5.40	34	.02	.01	.01	131.	1.01	17.40	106	.38	.37	.01	14193.
1.01	5.50	35	.02	.01	.01	157.	1.01	17.50	107	.38	.37	.01	13129.
1.01	6.00	36	.02	.01	.01	179.	1.01	18.00	108	.38	.37	.01	12245.
1.01	6.10	37	.05	.04	.01	202.	1.01	18.10	109	.03	.02	.01	11425.
1.01	6.20	38	.05	.04	.01	230.	1.01	18.20	110	.03	.02	.01	10571.
1.01	6.30	39	.05	.04	.01	296.	1.01	18.30	111	.03	.02	.01	9578.
1.01	6.40	40	.05	.04	.01	382.	1.01	18.40	112	.03	.02	.01	8384.
1.01	6.50	41	.05	.04	.01	484.	1.01	18.50	113	.03	.02	.01	7084.
1.01	7.00	42	.05	.04	.01	589.	1.01	19.00	114	.03	.02	.01	5902.
1.01	7.10	43	.05	.04	.01	687.	1.01	19.10	115	.03	.02	.01	4830.
1.01	7.20	44	.05	.04	.01	771.	1.01	19.20	116	.03	.02	.01	3833.
1.01	7.30	45	.05	.04	.01	838.	1.01	19.30	117	.03	.02	.01	2839.
1.01	7.40	46	.05	.04	.01	887.	1.01	19.40	118	.03	.02	.01	2269.
1.01	7.50	47	.05	.04	.01	923.	1.01	19.50	119	.03	.02	.01	1833.
1.01	8.00	48	.05	.04	.01	951.	1.01	20.00	120	.03	.02	.01	1497.
1.01	8.10	49	.05	.04	.01	972.	1.01	20.10	121	.03	.02	.01	1295.
1.01	8.20	50	.05	.04	.01	988.	1.01	20.20	122	.03	.02	.01	1204.
1.01	8.30	51	.05	.04	.01	1000.	1.01	20.30	123	.03	.02	.01	1127.
1.01	8.40	52	.05	.04	.01	1010.	1.01	20.40	124	.03	.02	.01	1052.
1.01	8.50	53	.05	.04	.01	1017.	1.01	20.50	125	.03	.02	.01	981.
1.01	9.00	54	.05	.04	.01	1022.	1.01	21.00	126	.03	.02	.01	915.
1.01	9.10	55	.05	.04	.01	1026.	1.01	21.10	127	.03	.02	.01	854.
1.01	9.20	56	.05	.04	.01	1029.	1.01	21.20	128	.03	.02	.01	797.
1.01	9.30	57	.05	.04	.01	1031.	1.01	21.30	129	.03	.02	.01	744.
1.01	9.40	58	.05	.04	.01	1033.	1.01	21.40	130	.03	.02	.01	694.
1.01	9.50	59	.05	.04	.01	1034.	1.01	21.50	131	.03	.02	.01	647.
1.01	10.00	60	.05	.04	.01	1035.	1.01	22.00	132	.03	.02	.01	604.
1.01	10.10	61	.05	.04	.01	1036.	1.01	22.10	133	.03	.02	.01	563.
1.01	10.20	62	.05	.04	.01	1037.	1.01	22.20	134	.03	.02	.01	526.
1.01	10.30	63	.05	.04	.01	1037.	1.01	22.30	135	.03	.02	.01	491.
1.01	10.40	64	.05	.04	.01	1038.	1.01	22.40	136	.03	.02	.01	464.
1.01	10.50	65	.05	.04	.01	1038.	1.01	22.50	137	.03	.02	.01	467.
1.01	11.00	66	.05	.04	.01	1038.	1.01	23.00	138	.03	.02	.01	467.
1.01	11.10	67	.05	.04	.01	1038.	1.01	23.10	139	.03	.02	.01	467.
1.01	11.20	68	.05	.04	.01	1038.	1.01	23.20	140	.03	.02	.01	467.
1.01	11.30	69	.05	.04	.01	1038.	1.01	23.30	141	.03	.02	.01	467.
1.01	11.40	70	.05	.04	.01	1038.	1.01	23.40	142	.03	.02	.01	467.
1.01	11.50	71	.05	.04	.01	1038.	1.01	23.50	143	.03	.02	.01	467.
1.01	12.00	72	.05	.04	.01	1038.	1.02	0.00	144	.03	.02	.01	467.
									SUM	24.18	22.71	1.47	553285.
										(614.1(	577.1(	37.3(	15667.29)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	26511.	13129.	3841.	3841.	553042.
CMS	751.	372.	109.	109.	15660.
INCHES		19.39	22.68	22.68	22.68
MM		492.39	576.16	576.16	576.16
AC-FT		6510.	7618.	7618.	7618.
THOUS CU M		8030.	9396.	9396.	9396.

HYDROGRAPH AT STA 1 FOR PLAN 1, RATIO 4

6.	5.	5.	5.	4.	4.	4.	4.	3.	3.
3.	3.	3.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	3.	8.	21.
43.	71.	101.	131.	157.	179.	202.	238.	296.	382.
484.	589.	697.	771.	838.	887.	923.	951.	972.	988.
1000.	1010.	1017.	1022.	1026.	1029.	1031.	1033.	1034.	1035.
1036.	1037.	1037.	1038.	1038.	1038.	1038.	1038.	1039.	1038.
1038.	1038.	5104.	1325.	1768.	2483.	3356.	4265.	5137.	5930.
6625.	7217.	7702.	8199.	8612.	9004.	9446.	9839.	10284.	10767.
11277.	11441.	12011.	13537.	16197.	19882.	23720.	26014.	26511.	25567.
23660.	21711.	19693.	18055.	15404.	14198.	13129.	12245.	11625.	10571.
9578.	8394.	7084.	5402.	4636.	3630.	2839.	2269.	1833.	1497.
1295.	1208.	1127.	1052.	981.	915.	854.	797.	744.	694.
647.	604.	563.	526.	491.	468.	467.	467.	467.	467.
467.	467.	467.	467.						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	26511.	13129.	3841.	3841.	553042.
CMS	751.	372.	109.	109.	15660.
INCHES		19.39	22.68	22.68	22.68
MM		492.39	576.16	576.16	576.16
AC-FT		6510.	7618.	7618.	7618.
THOUS CU M		8030.	9396.	9396.	9396.

D-14

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

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

ROUTING DATA

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

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	465.	0

CAPACITY=	0.	40.	240.	360.	465.	505.	640.	805.	880.	1120.
ELEVATION=	160.	170.	180.	184.	187.	188.	192.	195.	196.	200.

CREL	SPVID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
147.0	72.9	3.6	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
194.9	3.1	1.5	260.

STATION 2, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	4.	6.	11.	18.	26.	37.	50.	67.	90.
123.	166.	220.	282.	346.	414.	481.	546.	618.	665.
717.	743.	864.	846.	871.	897.	920.	939.	956.	969.
981.	991.	999.	1006.	1011.	1016.	1020.	1023.	1026.	1028.
1429.	1831.	1839.	1870.	1157.	1339.	1693.	2111.	2703.	3343.
4019.	4779.	5429.	6426.	7359.	8092.	8663.	9121.	9586.	10037.
10472.	10879.	11323.	12100.	13632.	16194.	19037.	23610.	25177.	25759.
24986.	23296.	21113.	18995.	17228.	15771.	14538.	13483.	12566.	11715.
10849.	9859.	8834.	7825.	6878.	5531.	4914.	4332.	3791.	3307.
2886.	2498.	2196.	1954.	1755.	1589.	1449.	1328.	1222.	1129.
1046.	972.	905.	844.	789.	739.	695.	660.	633.	605.
585.	567.	552.	540.						

STORAGE

465.	465.	465.	465.	465.	465.	465.	466.	466.	466.
466.	466.	466.	466.	466.	466.	466.	466.	465.	466.
466.	466.	466.	466.	466.	466.	465.	466.	466.	466.
467.	467.	468.	470.	472.	474.	476.	478.	481.	485.
489.	495.	501.	507.	514.	521.	527.	533.	538.	543.
547.	551.	554.	557.	559.	561.	563.	564.	565.	566.
567.	568.	568.	569.	569.	570.	570.	570.	572.	570.
570.	571.	571.	573.	579.	591.	611.	638.	669.	704.
739.	775.	808.	838.	857.	872.	883.	893.	903.	912.
921.	929.	938.	952.	980.	1023.	1077.	1125.	1155.	1163.
1153.	1129.	1098.	1067.	1040.	1016.	996.	977.	961.	945.
929.	909.	887.	862.	837.	811.	746.	759.	728.	702.
678.	658.	642.	629.	617.	607.	598.	591.	584.	577.
572.	566.	561.	557.	553.	549.	545.	542.	540.	538.
536.	535.	533.	532.						

STAGE

187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0
187.0	187.0	187.0	187.0	187.0	187.3	187.0	187.0	187.0	187.0
187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0
187.0	187.1	187.1	187.1	187.2	187.2	187.3	187.3	187.4	187.5
187.6	187.7	187.9	188.1	188.2	188.4	188.5	188.6	188.8	188.9
189.0	189.0	189.1	189.2	189.2	189.3	189.3	189.3	189.4	189.4
189.4	189.4	189.4	189.5	189.5	189.5	189.5	189.5	189.5	189.5
189.5	189.5	189.5	189.6	190.7	190.0	190.4	191.0	191.8	192.5
193.2	193.9	194.6	195.1	195.5	195.8	196.1	196.2	196.4	196.5
196.7	196.8	197.0	197.2	197.7	198.4	199.3	200.1	200.6	200.7
200.5	200.2	199.6	199.1	198.7	198.3	197.9	197.6	197.3	197.1
196.8	196.5	196.1	195.6	195.1	194.6	194.1	193.5	193.0	192.4
192.0	191.5	191.1	190.8	190.6	190.3	190.1	190.0	189.8	189.7
189.5	189.4	189.3	189.2	189.1	189.0	188.9	188.9	188.8	188.8
188.7	188.7	188.6	188.6						

PEAK OUTFLOW IS 25759. AT TIME 16.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25759.	12923.	3807.	3807.	548159.
CMS	729.	366.	108.	108.	15522.
INCHES		19.08	22.48	22.48	22.48
MM		484.66	571.07	571.07	571.07
AC-FT		6408.	7550.	7550.	7550.
THOUS CU M		7904.	9313.	9313.	9313.

D-15

D-16

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 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)	ELMAY	ELMAX	ALNTH	SEL
.100C	.0450	.1000	1PC.0	240.0	100.	.02000

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

0.00	243.00	100.00	200.00	300.00	181.00	300.00	180.00	325.00	180.00	
325.00	181.00	475.00	200.00	800.00	240.00					

STORAGE	0.00	.28	.96	2.06	3.59	5.53	7.90	10.62	13.49	16.49
	19.61	22.97	26.25	29.77	33.41	37.18	41.08	45.10	49.26	53.55
OUTFLOW	0.00	850.61	3449.03	8351.49	16077.27	27100.41	41864.70	62271.24	87403.63	116353.90
	149060.68	185499.98	225652.32	269540.07	317179.22	368598.44	423832.74	482921.94	545909.63	612842.37
STAGE	180.00	183.14	186.32	189.47	192.63	195.79	198.95	202.11	205.26	208.42
	211.58	214.74	217.89	221.05	224.21	227.37	230.53	233.68	236.84	240.00
FLOW	0.00	850.61	3448.03	8351.49	16077.27	27160.41	41864.70	62271.24	87403.63	116353.90
	149060.69	185499.98	225652.32	269540.07	317179.22	368598.44	423832.74	482921.94	545909.63	612842.37

STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	4.	6.	11.	18.	24.	37.	50.	66.	90.
122.	169.	219.	281.	345.	412.	480.	545.	607.	664.
716.	762.	803.	839.	870.	897.	920.	939.	955.	969.
981.	991.	999.	1005.	1011.	1016.	1020.	1023.	1025.	1028.
1129.	1831.	1038.	1049.	1155.	1334.	1645.	2161.	2891.	3331.
4608.	4716.	5416.	6405.	7345.	8078.	8660.	9111.	9576.	10628.
11468.	10870.	11319.	12063.	13606.	16147.	19595.	22966.	25164.	25756.
25008.	23308.	21147.	19616.	17253.	15785.	14559.	13492.	12583.	11723.
10965.	9905.	8838.	7843.	6495.	5543.	4922.	4343.	3798.	3316.
2891.	2506.	2200.	1959.	1757.	1593.	1450.	1331.	1223.	1132.
1047.	974.	906.	846.	796.	740.	696.	661.	631.	606.
585.	568.	552.	540.						

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	4.	4.	5.	5.	5.
5.	5.	4.	4.	4.	4.	3.	3.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						

STAGE

190.0	190.0	180.0	190.0	190.0	180.0	190.0	180.0	180.0	180.0
180.0	190.0	180.0	180.0	180.0	180.0	180.0	190.0	180.0	180.0
190.0	190.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0
180.0	190.0	180.0	180.0	180.1	180.1	180.1	180.2	180.2	180.3
180.5	190.6	180.8	181.0	181.3	181.5	181.8	182.0	182.3	182.5
182.7	182.8	183.0	183.1	183.2	183.2	183.2	183.3	183.3	183.3
183.3	183.3	183.3	183.3	183.4	183.4	183.4	183.4	183.4	183.4
183.4	183.4	183.4	183.4	183.5	183.7	184.1	184.7	185.4	186.2
186.7	187.1	187.6	188.2	188.8	189.3	189.6	189.8	190.0	190.2
190.3	190.5	190.7	191.0	191.6	192.7	193.6	194.6	195.2	195.4
195.2	194.7	194.1	193.5	193.0	192.5	192.0	191.6	191.2	190.9
190.5	190.1	189.7	189.0	188.3	187.7	187.3	186.9	186.5	186.2
185.6	185.2	184.8	184.5	184.3	184.1	183.9	183.7	183.6	183.5
183.4	183.3	183.2	183.1	182.9	182.7	182.6	182.5	182.3	182.2
182.2	182.1	182.1	182.0						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25756.	12923.	3807.	3807.	548147.
CMS	729.	366.	108.	108.	15522.
INCHES		19.08	22.48	22.48	22.48
MM		484.67	571.06	571.06	571.06
AC-FT		6408.	7550.	7550.	7550.
THOUS CU M		7904.	9313.	9313.	9313.

MAXIMUM STORAGE = 5.

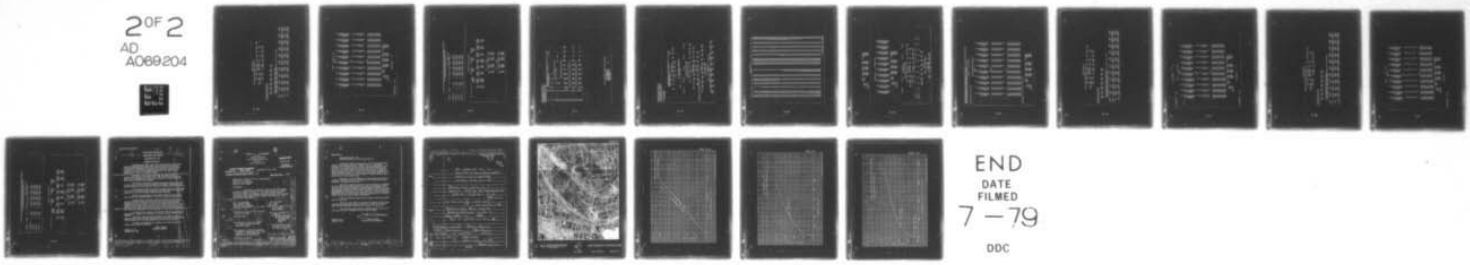
MAXIMUM STAGE IS 195.4

D-17

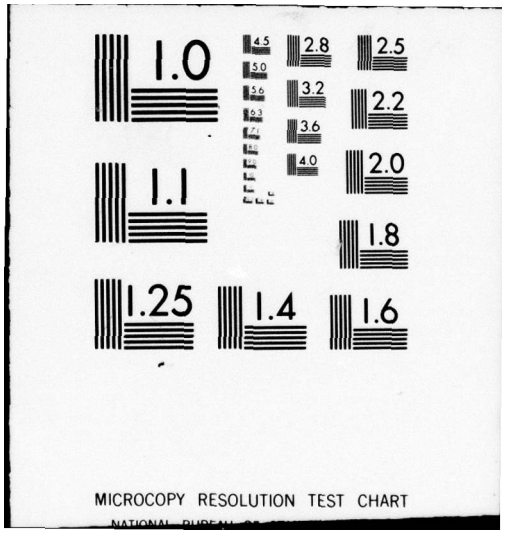
AD-A069 204 NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. WEST BRANCH RESERVOIR (NJ 00372) D--ETC(U)
MAY 79 R J JENNY DACW61-78-C-0124

UNCLASSIFIED NL

2 OF 2
AD
A069204



END
DATE
FILMED
7-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
MICROCOPY RESOLUTION TEST CHART

D-18

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

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

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.50	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	.0450	.1000	100.0	140.0	3400.	.62000

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

0.00 140.00 400.00 120.00 500.00 110.00 500.00 108.00 525.00 108.00
525.00 110.00 700.00 120.00 725.00 140.00

STORAGE	0.00	3.29	9.58	19.86	37.23	60.68	90.23	125.86	167.65	212.93
	263.57	319.48	373.90	443.63	513.04	587.20	666.04	744.58	837.83	930.79
OUTFLOW	0.00	236.34	644.65	1934.80	3701.02	6290.65	9837.61	14465.09	20518.23	27957.81
	36780.89	47031.02	58760.20	72024.68	86879.91	103385.56	121599.01	141578.03	163380.08	187062.19
STAGE	108.00	109.59	111.37	113.05	114.74	116.42	118.11	119.79	121.47	123.16
	124.84	126.53	128.21	129.89	131.58	133.26	134.95	136.63	138.32	140.00
FLOW	0.00	236.34	644.65	1934.80	3701.02	6290.65	9837.61	14465.09	20518.23	27957.81
	36780.89	47031.02	58760.20	72024.68	86879.91	103385.56	121599.01	141578.03	163380.08	187062.19

STATION 4, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	4.	7.	12.	19.	28.	38.	52.	70.
95.	129.	173.	227.	294.	367.	435.	502.	566.	626.
681.	731.	776.	815.	849.	876.	902.	924.	942.	958.
972.	983.	992.	1000.	1007.	1012.	1017.	1021.	1023.	1026.
1028.	1030.	1034.	1050.	1099.	1219.	1435.	1765.	2264.	2883.
3531.	4238.	4952.	5721.	6747.	7820.	8293.	8836.	9295.	9754.
10217.	10644.	11069.	11666.	12779.	14779.	17890.	21339.	24215.	25529.
25374.	24091.	22125.	19995.	18123.	16509.	15164.	14146.	13094.	12265.
11345.	10439.	9457.	8365.	7192.	6137.	5336.	4731.	4161.	3642.
3198.	2787.	2429.	2141.	1909.	1722.	1562.	1425.	1307.	1203.
1112.	1031.	958.	892.	832.	774.	725.	685.	651.	623.
599.	579.	563.	549.						

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	2.	2.	3.	4.	4.	5.	5.	6.	7.
7.	8.	8.	8.	9.	9.	9.	9.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	11.	11.	11.	12.	15.	18.	23.	29.
36.	47.	49.	56.	64.	72.	77.	82.	86.	90.
93.	94.	106.	104.	113.	128.	140.	172.	193.	198.
197.	189.	177.	163.	151.	140.	131.	123.	115.	108.
102.	95.	87.	78.	68.	59.	52.	47.	41.	37.
32.	28.	25.	22.	20.	18.	16.	15.	13.	12.
11.	11.	10.	9.	8.	8.	8.	7.	7.	7.
6.	6.	6.	6.						

STAGE

108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.1	108.1	108.2	108.3	108.3	108.5
108.6	108.9	109.1	109.5	109.8	110.3	110.2	110.4	110.6	110.7
110.9	111.0	111.2	111.3	111.4	111.4	111.5	111.5	111.5	111.5
111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6
111.7	111.7	111.7	111.7	111.8	111.9	112.3	112.8	113.4	114.0
114.6	115.1	115.6	116.1	116.6	117.1	117.4	117.6	117.8	118.1
118.2	118.4	118.6	118.8	119.2	119.9	120.7	121.7	122.3	122.6
122.6	122.3	121.8	121.3	120.8	120.4	120.0	119.6	119.3	119.0
118.7	118.4	117.9	117.4	116.8	116.3	115.8	115.4	115.0	114.7
114.3	113.9	113.5	113.2	113.0	112.7	112.5	112.3	112.1	111.9
111.8	111.7	111.5	111.4	111.3	111.2	111.0	110.9	110.8	110.7
110.7	110.6	110.6	110.5						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25529.	12914.	3804.	3804.	547717.
CMS	723.	366.	108.	108.	15510.
INCHES		19.07	22.46	22.46	22.46
MM		484.33	570.61	570.61	570.61
AC-FT		6464.	7594.	7594.	7594.
THOUS CU M		7899.	9306.	9306.	9306.

MAXIMUM STORAGE = 198.

MAXIMUM STAGE IS 122.6

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 .25	RATIO 2 .50	RATIO 3 .75	RATIO 4 1.00
HYDROGRAPH AT	1	6.30	1	6628.	13255.	19883.	26511.
		(16.32)		(187.67)(	375.35)(	563.02)(	750.70)(
ROUTED TO	2	6.30	1	5579.	12582.	19184.	25759.
		(16.32)		(157.98)(	356.29)(	543.23)(	729.42)(
ROUTED TO	3	6.30	1	5582.	12581.	19184.	25756.
		(16.32)		(158.07)(	356.27)(	543.23)(	729.33)(
ROUTED TO	4	6.30	1	5544.	12495.	18964.	25529.
		(16.32)		(156.99)(	353.82)(	537.00)(	722.89)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	187.60	187.00	196.50
STORAGE	465.	465.	805.
OUTFLOW	0.	0.	5361.

RATIO OF PMP	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
.25	194.66	.16	813.	5579.	.50	17.00	0.00
.50	197.35	2.85	961.	12582.	3.00	16.67	0.00
.75	199.16	4.66	1670.	19184.	4.67	16.67	0.00
1.00	200.72	6.22	1163.	25759.	5.67	16.67	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	5582.	187.7	17.00
.50	12581.	191.2	16.67
.75	19184.	193.5	16.67
1.00	25756.	195.4	16.67

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	5544.	115.9	17.00
.50	12495.	119.1	16.83
.75	18964.	121.0	16.83
1.00	25529.	122.6	16.67

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1979
  LAST MODIFICATION  23 SEP 78
**********
    1              A1       NEW JERSEY DAM SAFETY - WEST BRANCH RESERVOIR DAM I.D. NO. 00372
    2              A2       HYDRAULIC-HYDROLOGIC ANALYSIS   302-83
    3              A3       PROBABLE MAXIMUM FLOOD                                    -RDE-
    4              B   144       0      10       0       0       0       0       0       0       0
    5              B1    9
    6              J     1       4       1
    7              J1 0.25     0.5    0.75     1.0
    8              K     0       1                                              1
    9              K1                        INFLOW HYDROGRAPH TO RESERVOIR
   10              M     1       2     6.3               6.3                                   1
   11              P            22.9     113     123     132
   12              T                                                        0.30    0.03
   13              W2           0.9
   14              K    -1    -.05     2.0
   15              K     1       2                                              1
   16              K1                        ROUTED FLOWS THROUGH RESERVOIR
   17              V                                 1       1
   18              V1    1                                                  465
   19              S5    0      40     240     360     465     505     600     805     880    1120
   20              S6  160     170     180     194     187     188     192   194.5     196     200
   21              S5  187    72.5     3.6     1.5
   22              S5 194.5     3.1     1.5     260
   23              S4  190       1     160       6     187   194.5
   24              K     3       3                                              1
   25              K1       CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3
   26              V                                 1       1
   27              V1    1
   28              V6 0.10   0.045    0.10     140     240     100    0.02
   29              V7    0     240     100     260     300     181     300     160     325     160
   30              V7  325     181     475     260     600     240
   31              K     1       4                                              1
   32              K1       CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4
   33              V                                 1       1
   34              V1    1
   35              V6 0.10   0.045    0.10     108     140    3400    0.02
   36              V7    0     140     400     120     900     110     900     108     525     108
   37              V7  525     110     700     120     725     140
   38              K    99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          1
ROUTE HYDROGRAPH TO           2
ROUTE HYDROGRAPH TO           3
ROUTE HYDROGRAPH TO           4
END OF NETWORK
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  23 SEP 78
**********

RUN  DATE= 01/25/79
     TIME= 20.50.38.

                    NEW JERSEY DAM SAFETY - WEST BRANCH RESERVOIR DAM I.D. NO. 00372
                    HYDRAULIC-HYDROLOGIC ANALYSIS   SOZ-03
                    PROBABLE MAXIMUM FLOOD                                  -RPE-

                                    JOB SPECIFICATION
                      NO     NMIN    MINUT    IDAY     IHR    IMIN   METRC    IPLT   IPRT   NSTAN
                     144        0       10       0       0       0       0       0      0       0
                                                JOPER     NWT   LROPT   TRACE
                                                    5       0       0       0

                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1  NRTIO= 4  LRTIO= 1
                          RTIOS=     .25     .50     .75    1.00

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

                                SUB-AREA RUNOFF COMPUTATION

                                INFLOW HYDROGRAPH TO RESERVOIR

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

                                        HYDROGRAPH DATA
                          IHYDG    IUNG    TAREA    SNAP    TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                              1       2     6.30     0.00     6.30    0.00   0.000       0       1       0

                                        PRECIP DATA
                                SPFE     PMS      R6      R12     R24     R48     R72     R96
                                0.00   22.90  113.00  123.00  132.00    0.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .000

                                        LOSS DATA
                          LROPT   STRTL   OLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRIL   CNSTL   ALSMX   RTIMP
                              0    0.00    0.00    1.00    0.00    0.30    1.00     .50     .05    0.00    0.00

                                        UNIT HYDROGRAPH DATA
                                    TC=  0.00    LAG=   .00

                                        RECESSION DATA
                                  STRTQ=   -1.00    QRCSN=   -.05    RTIOR= 2.00

                UNIT HYDROGRAPH 20 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=    .00  VOL= 1.00
              244.     733.    1505.    2430.    2968.    3092.    2903.    2525.    2011.    1440.
             1000.     829.     638.     440.     307.     279.     211.     159.     120.      92.
               70.      51.      40.      32.      25.      19.      13.       8.       3.
```

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END-OF-PERIOD SUMMARY

HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	1	.02	0.00	.02	0.	1.01	12.10	73	.35	.34	.01	1100.
1.01	2	.02	0.00	.02	0.	1.01	12.20	74	.35	.34	.01	1325.
1.01	3	.02	0.00	.02	0.	1.01	12.30	75	.35	.34	.01	1766.
1.01	4	.02	0.00	.02	0.	1.01	12.40	76	.35	.34	.01	2483.
1.01	5	.02	0.00	.02	0.	1.01	12.50	77	.35	.34	.01	3559.
1.01	6	.02	0.00	.02	0.	1.01	13.00	78	.35	.34	.01	4269.
1.01	7	.02	0.00	.02	0.	1.01	13.10	79	.41	.41	.01	5137.
1.01	8	.02	0.00	.02	0.	1.01	13.20	80	.41	.41	.01	5930.
1.01	9	.02	0.00	.02	0.	1.01	13.30	81	.41	.41	.01	6825.
1.01	10	.02	0.00	.02	0.	1.01	13.40	82	.41	.41	.01	7217.
1.01	11	.02	0.00	.02	0.	1.01	13.50	83	.41	.41	.01	7762.
1.01	12	.02	0.00	.02	0.	1.01	14.00	84	.41	.41	.01	8199.
1.01	13	.02	0.00	.02	0.	1.01	14.10	85	.52	.51	.01	8612.
1.01	14	.02	0.00	.02	0.	1.01	14.20	86	.52	.51	.01	9104.
1.01	15	.02	0.00	.02	0.	1.01	14.30	87	.52	.51	.01	9466.
1.01	16	.02	0.00	.02	0.	1.01	14.40	88	.52	.51	.01	9839.
1.01	17	.02	0.00	.02	0.	1.01	14.50	89	.52	.51	.01	10284.
1.01	18	.02	0.00	.02	0.	1.01	15.00	90	.52	.51	.01	10707.
1.01	19	.02	0.00	.02	0.	1.01	15.10	91	.47	.46	.01	11077.
1.01	20	.02	0.00	.02	0.	1.01	15.20	92	.79	.78	.01	11441.
1.01	21	.02	0.00	.02	0.	1.01	15.30	93	1.42	1.41	.01	12011.
1.01	22	.02	0.00	.02	0.	1.01	15.40	94	3.54	3.53	.01	13937.
1.01	23	.02	0.00	.02	0.	1.01	15.50	95	1.02	1.01	.01	16107.
1.01	24	.02	0.00	.02	0.	1.01	16.00	96	.03	.02	.01	19842.
1.01	25	.02	0.00	.02	0.	1.01	16.10	97	.48	.47	.01	23720.
1.01	26	.02	0.00	.02	0.	1.01	16.20	98	.48	.47	.01	26014.
1.01	27	.02	0.00	.02	0.	1.01	16.30	99	.48	.47	.01	26911.
1.01	28	.02	.01	.01	3.	1.01	16.40	100	.48	.47	.01	25587.
1.01	29	.02	.01	.01	8.	1.01	16.50	101	.48	.47	.01	23660.
1.01	30	.02	.01	.01	21.	1.01	17.00	102	.48	.47	.01	21211.
1.01	31	.02	.01	.01	43.	1.01	17.10	103	.38	.37	.01	18695.
1.01	32	.02	.01	.01	71.	1.01	17.20	104	.38	.37	.01	16855.
1.01	33	.02	.01	.01	101.	1.01	17.30	105	.38	.37	.01	15404.
1.01	34	.02	.01	.01	131.	1.01	17.40	106	.38	.37	.01	14143.
1.01	35	.02	.01	.01	157.	1.01	17.50	107	.38	.37	.01	13129.
1.01	36	.02	.01	.01	179.	1.01	18.00	108	.38	.37	.01	12245.
1.01	37	.03	.04	.01	202.	1.01	18.10	109	.03	.02	.01	11425.
1.01	38	.03	.04	.01	230.	1.01	18.20	110	.03	.02	.01	10571.
1.01	39	.03	.04	.02	296.	1.01	18.30	111	.03	.02	.01	9578.
1.01	40	.03	.04	.01	382.	1.01	18.40	112	.03	.02	.01	8384.
1.01	41	.03	.04	.01	484.	1.01	18.50	113	.03	.02	.01	7084.
1.01	42	.03	.04	.01	589.	1.01	19.00	114	.03	.02	.01	5902.
1.01	43	.03	.04	.01	687.	1.01	19.10	115	.03	.02	.01	4830.
1.01	44	.03	.04	.01	771.	1.01	19.20	116	.03	.02	.01	3830.
1.01	45	.03	.04	.01	838.	1.01	19.30	117	.03	.02	.01	2839.
1.01	46	.03	.04	.01	897.	1.01	19.40	118	.03	.02	.01	2209.
1.01	47	.03	.04	.01	923.	1.01	19.50	119	.03	.02	.01	1833.
1.01	48	.03	.04	.01	951.	1.01	20.00	120	.03	.02	.01	1497.
1.01	49	.03	.04	.01	972.	1.01	20.10	121	.03	.02	.01	1293.
1.01	50	.03	.04	.01	988.	1.01	20.20	122	.03	.02	.01	1209.
1.01	51	.03	.04	.01	1000.	1.01	20.30	123	.03	.02	.01	1127.
1.01	52	.03	.04	.01	1010.	1.01	20.40	124	.03	.02	.01	1052.
1.01	53	.03	.04	.01	1017.	1.01	20.50	125	.03	.02	.01	981.
1.01	54	.03	.04	.01	1022.	1.01	21.00	126	.03	.02	.01	915.
1.01	55	.03	.04	.01	1026.	1.01	21.10	127	.03	.02	.01	854.
1.01	56	.03	.04	.01	1029.	1.01	21.20	128	.03	.02	.01	797.
1.01	57	.03	.04	.01	1031.	1.01	21.30	129	.03	.02	.01	744.
1.01	58	.03	.04	.01	1033.	1.01	21.40	130	.03	.02	.01	694.
1.01	59	.03	.04	.01	1034.	1.01	21.50	131	.03	.02	.01	647.
1.01	60	.03	.04	.01	1035.	1.01	22.00	132	.03	.02	.01	604.
1.01	61	.03	.04	.01	1036.	1.01	22.10	133	.03	.02	.01	563.
1.01	62	.03	.04	.01	1037.	1.01	22.20	134	.03	.02	.01	526.
1.01	63	.03	.04	.01	1037.	1.01	22.30	135	.03	.02	.01	491.
1.01	64	.03	.04	.01	1038.	1.01	22.40	136	.03	.02	.01	464.
1.01	65	.03	.04	.01	1038.	1.01	22.50	137	.03	.02	.01	457.
1.01	66	.03	.04	.01	1038.	1.01	23.00	138	.03	.02	.01	467.
1.01	67	.03	.04	.01	1038.	1.01	23.10	139	.03	.02	.01	467.
1.01	68	.03	.04	.01	1038.	1.01	23.20	140	.03	.02	.01	467.
1.01	69	.03	.04	.01	1038.	1.01	23.30	141	.03	.02	.01	467.
1.01	70	.03	.04	.01	1038.	1.01	23.40	142	.03	.02	.01	467.
1.01	71	.03	.04	.01	1038.	1.01	23.50	143	.03	.02	.01	467.
1.01	72	.03	.04	.01	1038.	1.02	0.00	144	.03	.02	.01	467.
								SUM	24.19	22.71	1.47	553285.
									(614.3	(577.1	37.1	(15667.2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	26511.	13179.	3841.	3841.	953642.
CMS	751.	372.	109.	109.	15010.
INCHES		19.39	22.68	22.68	22.68
MM		492.39	576.16	576.16	576.16
AC-FT		6510.	7618.	7618.	7618.
THOUS CU M		8030.	9396.	9396.	9396.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

6.	5.	5.	5.	4.	4.	4.	4.	3.	3.
3.	3.	3.	2.	2.	2.	2.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	3.	8.	21.
43.	71.	101.	131.	157.	179.	202.	238.	295.	382.
484.	589.	687.	771.	838.	887.	923.	951.	972.	988.
1000.	1010.	1017.	1022.	1026.	1029.	1031.	1033.	1034.	1035.
1036.	1037.	1037.	1038.	1038.	1038.	1038.	1038.	1038.	1038.
1038.	1038.	1109.	1325.	1768.	2483.	3356.	4265.	5137.	5930.
6625.	7217.	7742.	8199.	8612.	9006.	9406.	9839.	10294.	10707.
11077.	11441.	12011.	13537.	16197.	19682.	23726.	28014.	28911.	25567.
23666.	21211.	19095.	16855.	15404.	14103.	13129.	12245.	11423.	10571.
9578.	8886.	7986.	5902.	4430.	3630.	2830.	2269.	1833.	1497.
1295.	1208.	1127.	1052.	981.	915.	854.	797.	744.	694.
647.	604.	563.	526.	491.	488.	467.	467.	467.	467.
467.	467.	467.	467.						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	26511.	13129.	3841.	3841.	953642.
CMS	751.	372.	109.	109.	15010.
INCHES		19.39	22.68	22.68	22.68
MM		492.39	576.16	576.16	576.16
AC-FT		6510.	7618.	7618.	7618.
THOUS CU M		8030.	9396.	9396.	9396.

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	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	465.	0

CAPACITY=	0.	40.	240.	360.	465.	505.	680.	865.	880.	1120.
ELEVATION=	160.	170.	180.	184.	187.	188.	192.	195.	196.	200.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
187.0	72.5	3.6	1.5	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
194.5	3.1	1.5	260.

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
190.	1.00	160.00	6.00	187.00	194.50

D-24

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .167 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .167 HOURS.
THE TIME INTERVAL FOR BREACH DEVELOPMENT AND DOWNSTREAM ROUTING ARE THE SAME.

STATION 2, PLAN 1, RATIO 4

BEGIN DAM FAILURE AT 13.83 HOURS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	4.	6.	11.	18.	26.	37.	50.	67.	86.
123.	166.	220.	282.	346.	414.	481.	546.	608.	665.
717.	763.	804.	840.	871.	897.	920.	939.	955.	969.
981.	991.	999.	1006.	1011.	1016.	1020.	1023.	1026.	1028.
1029.	1031.	1038.	1070.	1157.	1339.	1653.	2111.	2703.	3343.
4019.	4722.	5433.	7238.	8796.	9791.	10523.	11228.	11895.	12472.
12984.	13448.	13925.	14643.	16436.	19272.	22918.	26255.	28162.	28434.
27653.	25644.	23287.	20965.	18992.	17307.	16043.	14415.	13285.	12449.
11536.	10478.	9274.	8229.	4863.	4183.	3199.	2668.	2187.	1667.
1371.	1219.	1154.	1059.	1041.	933.	871.	813.	754.	709.
662.	618.	577.	539.	503.	475.	466.	467.	467.	467.
467.	467.	467.	467.						

STORAGE

465.	465.	465.	465.	465.	465.	465.	466.	466.	466.
466.	466.	466.	466.	466.	466.	466.	466.	466.	466.
466.	466.	466.	466.	466.	466.	466.	466.	466.	466.
467.	467.	468.	470.	472.	474.	476.	478.	481.	485.
489.	495.	501.	507.	514.	521.	527.	533.	538.	543.
547.	551.	554.	557.	559.	561.	563.	564.	565.	566.
567.	568.	568.	569.	569.	570.	570.	571.	572.	570.
570.	571.	571.	573.	579.	591.	611.	638.	669.	764.
739.	779.	809.	830.	836.	829.	816.	799.	778.	755.
729.	702.	675.	654.	645.	647.	657.	661.	648.	617.
571.	514.	452.	392.	346.	293.	252.	216.	189.	163.
136.	109.	79.	49.	32.	26.	20.	15.	10.	7.
7.	6.	6.	6.	6.	5.	5.	5.	5.	5.
4.	4.	4.	4.	4.	3.	3.	3.	3.	3.
3.	3.	3.	3.						

STAGE

187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0
187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0
187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0	187.0
187.0	187.1	187.1	187.1	187.2	187.2	187.3	187.3	187.4	187.5
187.6	187.7	187.9	188.1	188.2	188.4	188.5	188.6	188.8	188.9
189.0	189.0	189.1	189.2	189.2	189.3	189.3	189.3	189.4	189.4
189.4	189.4	189.4	189.5	189.5	189.5	189.5	189.5	189.5	189.5
189.5	189.5	189.5	189.6	189.7	190.0	190.4	191.0	191.8	192.5
193.2	193.9	194.6	195.3	195.1	195.0	194.7	194.4	194.0	193.5
193.0	192.4	191.9	191.4	191.2	191.3	191.5	191.6	191.3	190.6
189.5	188.2	186.6	184.9	183.3	181.8	180.4	179.8	177.4	176.1
174.8	173.4	172.0	170.6	167.9	166.5	165.0	163.7	162.4	161.8
161.8	161.8	161.8	161.5	161.4	161.4	161.3	161.2	161.2	161.1
161.1	161.0	161.0	160.9	160.9	160.9	160.9	160.9	160.9	160.9
160.9	160.9	160.9	160.9						

PEAK OUTFLOW IS 28434. AT TIME 16.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	28434.	14456.	4073.	4073.	986554.
CMS	805.	409.	115.	115.	27959.
INCHES		21.35	24.06	24.06	24.06
MM		542.18	611.07	611.07	611.07
AC-FT		7168.	8079.	8079.	8079.
THOUS CU M		8842.	9966.	9966.	9966.

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 2 TO 3

ISTAO	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	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QM(1)	QM(2)	QM(3)	FLMVT	ELMAX	RLNTH	SEL
.1006	.0453	.1009	180.0	240.0	100.	.02000

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

0.00 240.00 100.00 200.00 300.00 180.00 300.00 140.00 325.00 180.00
325.00 180.00 475.00 200.00 600.00 240.00

STORAGE	0.00	.29	.96	2.06	3.59	5.53	7.90	10.62	13.69	16.49
	19.61	22.97	26.25	29.77	33.41	37.18	41.08	45.10	49.26	53.55
OUTFLOW	0.00	850.61	3448.03	8351.49	16077.27	27100.41	41864.70	62271.24	87403.63	116353.90
	149060.69	185499.59	225692.32	269540.07	317179.22	368598.44	423832.74	482921.94	545909.63	612842.37
STAGE	180.00	183.16	186.32	189.47	192.63	195.79	198.95	202.11	205.26	208.42
	211.58	214.74	217.89	221.05	224.21	227.37	230.53	233.68	236.84	240.00
FLOW	0.00	850.61	3448.03	8351.49	16077.27	27100.41	41864.70	62271.24	87403.63	116353.90
	149060.69	185499.59	225692.32	269540.07	317179.22	368598.44	423832.74	482921.94	545909.63	612842.37

MAXIMUM STORAGE = 179.

MAXIMUM STAGE IS 121.8

STATION 4, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	2.	4.	7.	12.	19.	25.	38.	52.	70.
95.	129.	173.	227.	294.	367.	435.	502.	566.	626.
691.	731.	776.	815.	849.	876.	902.	924.	942.	958.
972.	989.	992.	1000.	1007.	1012.	1017.	1020.	1023.	1026.
1028.	1030.	1034.	1056.	1099.	1215.	1435.	1765.	2284.	2883.
3531.	4238.	4954.	6124.	7404.	9137.	11659.	14821.	17511.	12138.
12088.	13181.	13652.	14262.	15531.	17028.	21094.	24733.	27319.	24362.
27908.	24487.	24386.	22023.	19911.	18161.	16702.	15264.	13696.	12934.
12057.	11041.	9959.	8785.	6721.	4816.	3850.	3098.	2591.	1967.
1928.	1342.	1219.	1134.	1055.	986.	920.	859.	799.	744.
694.	648.	605.	565.	527.	495.	474.	468.	467.	467.
467.	467.	467.	467.						

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	2.	2.	3.	4.	4.	5.	5.	6.	7.
7.	8.	8.	8.	9.	9.	9.	9.	10.	10.
10.	10.	10.	10.	10.	10.	10.	10.	10.	10.
10.	10.	11.	11.	11.	12.	15.	18.	23.	29.
36.	42.	49.	59.	73.	84.	92.	98.	103.	108.
112.	116.	120.	124.	133.	149.	171.	193.	209.	215.
213.	206.	191.	176.	163.	151.	141.	131.	121.	114.
107.	100.	91.	81.	64.	47.	39.	31.	26.	20.
16.	14.	12.	12.	11.	10.	9.	9.	8.	8.
7.	7.	6.	6.	6.	5.	5.	5.	5.	5.
5.	5.	5.	5.						

STAGE

108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0
108.0	108.0	108.0	108.0	108.1	108.1	108.2	108.3	108.3	108.5
108.6	108.8	109.1	109.5	109.8	110.0	110.2	110.4	110.6	110.7
110.9	111.0	111.2	111.3	111.4	111.4	111.5	111.5	111.5	111.5
111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6	111.6
111.7	111.7	111.7	111.7	111.8	111.9	112.3	112.8	113.4	114.0
114.6	115.1	115.6	116.3	117.1	117.8	118.2	118.5	118.7	118.9
119.1	119.3	119.5	119.7	120.1	120.7	121.6	122.4	123.0	123.2
123.1	122.8	122.3	121.8	121.3	120.8	120.4	120.0	119.6	119.2
118.9	118.6	118.1	117.6	116.6	115.5	114.8	114.2	113.6	113.1
112.6	112.1	111.9	111.8	111.7	111.6	111.5	111.4	111.2	111.1
110.9	110.8	110.7	110.6	110.5	110.4	110.3	110.3	110.3	110.3
110.3	110.3	110.3	110.3						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	28362.	14491.	4071.	4071.	586167.
CMS	803.	409.	115.	115.	16598.
INCHES		21.34	24.04	24.04	24.04
MM		541.96	610.67	610.67	610.67
AC-FT		7166.	8074.	8074.	8074.
THOUS CU M		8838.	9959.	9959.	9959.

MAXIMUM STORAGE = 215.

MAXIMUM STAGE IS 123.2

D-27

HYDROGRAPH ROUTING

CHANNEL ROUTING -MODIFIED PULS- STATION 3 TO 4

ISTAO	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	NSTOL	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)	ELMVT	ELMAX	ELMTH	SEL
.1000	.0450	.1000	100.0	140.0	3400.	.02000

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

0.00	140.00	420.00	120.00	510.00	110.00	900.00	100.00	925.00	100.00
925.00	110.00	700.00	120.00	725.00	140.00				

STORAGE	0.00	3.29	9.58	19.84	37.23	60.68	90.23	125.86	167.05	212.95
	263.57	314.44	374.90	443.63	513.04	587.20	666.04	749.58	837.83	930.79
OUTFLOW	0.00	256.94	844.65	1934.80	3701.02	6290.85	9837.61	14465.09	20310.25	27957.81
	36780.69	47031.32	58760.20	72024.08	86879.91	103345.56	121599.01	141578.03	163380.08	187062.19
STAGE	108.60	109.48	111.37	113.05	114.74	116.42	118.11	119.79	121.47	123.16
	124.84	126.53	128.21	129.89	131.58	133.26	134.95	136.63	138.32	140.00
FLOW	0.00	256.94	844.65	1934.80	3701.02	6290.85	9837.61	14465.09	20310.25	27957.81
	36780.69	47031.32	58760.20	72024.08	86879.91	103345.56	121599.01	141578.03	163380.08	187062.19

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STATION 3, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	4.	6.	11.	18.	26.	37.	50.	66.	90.
122.	165.	219.	281.	345.	412.	480.	545.	607.	664.
714.	767.	803.	839.	870.	897.	920.	939.	955.	969.
981.	991.	999.	1005.	1011.	1016.	1020.	1023.	1025.	1028.
1029.	1031.	1032.	1049.	1155.	1334.	1645.	2111.	2691.	3331.
4004.	4710.	5424.	7191.	8784.	9760.	10525.	11260.	11897.	12494.
12987.	13433.	13926.	14670.	16404.	19225.	22671.	26217.	28153.	28436.
27454.	25868.	23323.	20969.	19017.	17324.	16097.	14448.	13285.	12469.
11543.	10504.	9282.	8053.	6956.	6122.	5273.	4618.	3950.	1434.
1665.	1196.	1180.	1049.	1022.	916.	893.	799.	775.	647.
675.	608.	588.	531.	512.	468.	473.	401.	472.	402.
471.	463.	471.	463.						

STOR

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	3.	3.	3.
3.	3.	3.	3.	4.	4.	5.	5.	6.	6.
6.	5.	5.	4.	4.	4.	4.	3.	3.	3.
3.	2.	2.	2.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						

STAGE

180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0
180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0
180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0	180.0
180.0	180.0	180.0	180.0	180.1	180.1	180.1	180.2	180.2	180.3
180.5	180.6	180.8	181.0	181.3	181.5	181.8	182.0	182.3	182.5
182.7	182.8	183.0	183.1	183.2	183.2	183.2	183.3	183.3	183.3
183.3	183.3	183.3	183.3	183.4	183.4	183.4	183.4	183.4	183.4
183.4	183.4	183.4	183.4	183.5	183.7	184.1	184.7	185.4	186.2
186.7	187.1	187.4	188.7	189.7	190.1	190.4	190.6	190.9	191.2
191.4	191.6	191.8	192.1	192.7	193.5	194.6	195.5	196.0	196.1
195.9	195.4	194.7	194.0	193.5	193.0	192.6	192.0	191.5	191.2
190.8	190.4	189.9	189.3	187.3	186.7	186.1	185.3	184.9	183.9
183.8	183.6	183.4	183.4	183.4	183.2	183.2	183.0	182.9	182.6
182.5	182.3	182.2	182.0	181.9	181.7	181.8	181.7	181.8	181.7
181.8	181.7	181.7	181.7						

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	28436.	14457.	4073.	4073.	386543.
CMS	805.	409.	115.	115.	10809.
INCHES		21.35	24.06	24.06	24.06
MM		542.19	611.06	611.06	611.06
AC-FT		7169.	8079.	8079.	8079.
THOUS CU M		8842.	9965.	9965.	9965.

MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 196.1

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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 .25	RATIO 2 .50	RATIO 3 .75	RATIO 4 1.00
HYDROGRAPH AT	1	6.30	1	6528.	13255.	19883.	26511.
	(	16.32)	(	184.87)(	375.35)(	563.02)(	750.70)(
ROUTED TO	2	6.30	1	6345.	14734.	21994.	28434.
	(	16.32)	(	179.66)(	417.21)(	622.79)(	805.16)(
ROUTED TO	3	6.30	1	6347.	14739.	21993.	28436.
	(	16.32)	(	179.74)(	417.35)(	622.76)(	805.21)(
ROUTED TO	4	6.30	1	6316.	14673.	21834.	28362.
	(	16.32)	(	178.84)(	415.50)(	618.28)(	803.11)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	ELEVATION	STORAGE	OUTFLOW
INITIAL VALUE	187.00	465.	0.
SPILLWAY CREST	187.00	465.	0.
TOP OF DAM	194.50	803.	9361.

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
.25	194.64	.14	812.	6345.	.33	17.17	16.83
.50	195.42	.92	851.	14734.	1.17	16.67	15.67
.75	194.99	.49	830.	21994.	.67	16.67	14.50
1.00	195.11	.61	836.	28434.	.83	16.67	13.83

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	6347.	188.2	17.17
.50	14739.	192.1	16.67
.75	21993.	194.3	16.67
1.00	28436.	196.1	16.67

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.25	6316.	116.4	17.33
.50	14673.	119.8	16.83
.75	21834.	121.8	16.67
1.00	28362.	123.2	16.67

Report on Dam Inspection.

WEST BRANCH RESERVOIR DAM

BOUND BROOK WATER COMPANY

APPLICATION No. 118

LOCATION 25.33.4.4.1.

On September 20, 1929 a letter was received from Mr. Clyde Potts, Consulting Engineer, stating that since a fault and a seam has been discovered in the foundation for the proposed west spillway of the above dam, it is desired to omit the west spillway and to construct a single larger spillway at the site of the proposed east spillway. The letter was accompanied by a copy of the attached drawing.

Examination of the drawing shows that the single spillway as designed will discharge 2,435 second feet or 386 cubic feet per second per square mile of drainage area with the flash boards on, as compared with 373 by the two spillways formerly proposed.

The spillway channel will discharge 2,435 second feet with a depth of flow of 4.1 feet and a velocity of 22 feet per second. Training walls are provided adequate to protect the east bank and the downstream fill from erosion.

On September 24, 1929 the site for the single spillway was inspected by the writer in company with Mr. Badeau of Mr. Potts's office, Mr. Edgar, the Contractor, and Mr. M. E. Johnson, Assistant State Geologist.

Rock has been uncovered in the spillway channel and at the downstream side of the spillway structure. The rock is sound and satisfactory.

At the west end of the dam trench for core wall has been carried back into the bank 10 feet beyond the flow line and into solid ledge rock to depths of from 4 to 12 feet. The fault crossing this trench has been cleansed out to its full width of 2 feet and to a depth of 12 feet for a distance of 15 feet above the core wall and will be filled with concrete. The horizontal joint which appears in the rock below the core wall was examined by Mr. Johnson and pronounced to be an insignificant cooling crack in the gneiss.

Core wall is 100% complete. Upstream fill 80% and downstream fill 90% complete. Compacting is satisfactory. Spillway channel excavation 40% complete.

The writer recommends the acceptance of the attached drawing as a change in detail under the plans approved November 9th, 1927, and the approval of the foundation for the single spillway at the east end of the dam.

If these recommendations are accepted by the Chief Engineer, Mr. Potts's office should be notified.

John W. Brooks,
Hydraulic Engineer.

Trenton, N. J.,
September 24, 1929.

OFFICE OF

CLYDE POTTS

CIVIL AND SANITARY ENGINEER

30 CHURCH ST.

NEW YORK CITY

RECEIVED

SEP 30 1927

Department of
Conservation & Development

DEPARTMENT OF CONSERVATION AND DEVELOPMENT
RECEIVED AND FILED SEP 30 1927
TO ACCOMPANY APPLICATION FILED SEP 30 1927

September 27th, 1927.

DAM APPLICATION No. 118

Department of Conservation & Development,
Division of Waters,
State Office Building,
Trenton, New Jersey.

Gebtlemen:

Desiring to construct a dam on the West Branch of Middle Brook, tributary to the Raritan River, at Bound Broon, in Somerset County, in the State of New Jersey, the Bound Brook Water Company submits herewith the following information and respectfully requests the issue of a permit by your Department:

Area of watershed	= 6.3 sq. miles.
Max. depth of pond	= 28 feet.
Area of water surface	= 42 acres.
Capacity of spillway at 6 ft. head	=2650 c.f.s. computed by the formula $Q=3,0\ LH\ 3/2$
Capacity of blow-off pipe and gate at 28 feet head	= 80 c.f.s. computed by formulae.
Entrance loss	= 0.5 $\frac{v^2}{2g}$ and pipe friction by Hazen-Williams formula with c=100
The capacity of 20" line (2500 ft. long) to aerators with reservoir empty	= 4 million gallons per day with 16 ft. head on aerator nozzles.
With reservoir full and aerators bypassed to dicharge 20 in. pipe directly to lower dam, the capacity of 20 inch pipe =	= 13 m.g.d. or 20.11 c.f.s
Elevation of outlet	= Approx. Elev. 134. Computed by formulae used for blow-off computation.

The character of the foundation is bed rock as deter-

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Memorandum re.

Dam Application No. 118,
West Branch Reservoir, Bound Brook Water Co.

On March 21, 1930 Mr. Weston Gavett of Mr. Clyde Potts' office called at the Trenton office and on behalf of Mr. E. D. LaTourette, President of the Bound Brook Water Company, requested permission to raise the crest of the concrete spillway and the crest of the flashboards one foot above the elevation shown on the drawing approved by our Chief Engineer on September 25, 1929. The purpose of the increase in height is to obtain additional storage. The concrete weir forming the spillway crest has not yet been poured and Mr. Gavett asked for a prompt ruling on the request so that it can be poured soon.

Inspection of the dam on March 14, 1930 showed all of the work practically completed except the spillway weir and the gate house superstructure. The pond was half filled.

The spillway details approved by the Chief Engineer on September 25, 1929 show an O.G. section concrete weir with a crest length of 66.0 feet at Elevation 187.0 surmounted by wood flashboards designed to go out in high water, having their crest at Elevation 188.0; the top of the earth dam at Elevation 194.5 and the top of the concrete core wall at Elevation 193.0. With water at top of core wall this gives 5.0 ft. head over the flashboards with 1.5 ft. freeboard and a discharge of 2435 sec. ft. or 386 sec. ft. per sq. mile from 6.3 sq. miles of watershed.

With the flashboards washed out the capacity would be about 500 sec. ft. per sq. mi.

With the crests raised as requested the discharge capacity with flashboards in place would be but 1740 sec. ft. or 276 sec. ft. per sq. mile, and with flashboards washed out about 386 sec. ft. per sq. mi.

Our flood flow studies indicate a maximum flood of 470 sec. ft. per square mile and I recommend that the request be denied.

John N. Brooks.

Trenton, N. J.
March 21, 1930.

John N. Brooks,
Assistant Division Engineer.

DMB 10/3/27

Dam Application No. 118

Clyde Potts for Round Brook Water Co.

West Branch of Middle Brook

Location 25.33.4.4.1 [1]

Drainage area 6.3 sq mi ✓

Spillway Crest Elev. 184' Flood level Elev. 190

Head 6.0' Length 60.0 C = 3.6

Potts uses 3.0'

$Q = 3.0 \times 60. \times 6^{\frac{3}{2}} = 2650$ cu ft ✓

$(14.697) = 420$ cu ft / sq mi OK.

Spillway section OK by inspection

Slope of earth banks upstream 3:1

downstream 2:1 OK.

Spec. for earth fill and core. OK.

Revised design submitted 12/11/25 — Design Approved.

Two skimmers — DMB Brooks 10/3/27

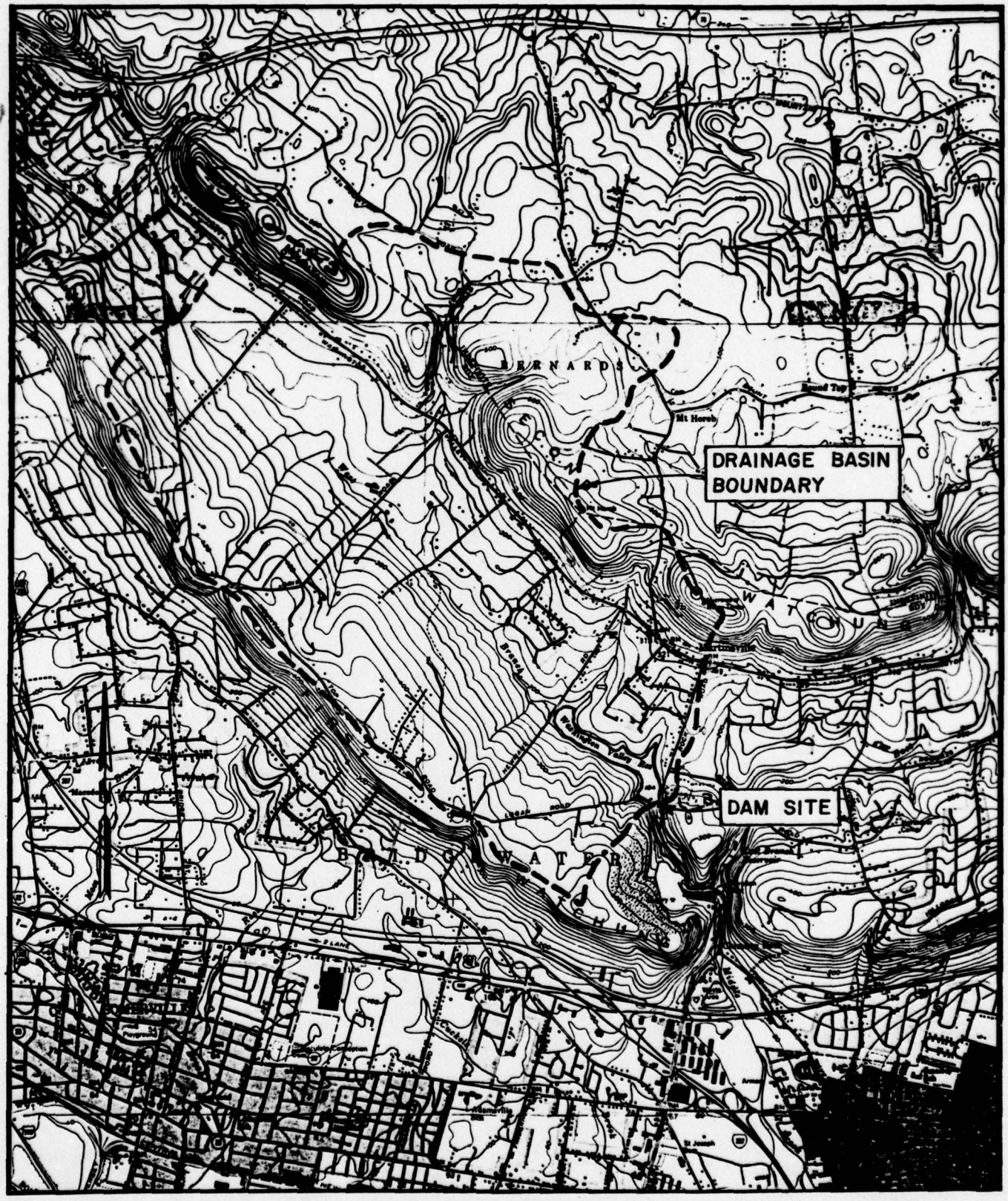
20' + 40' - 10' Crest 184

$Q = 3 \times 70 \times 6^{\frac{3}{2}} = 3090$ cu ft

$(14.7) = 490$ cu ft / sq mi OK

DMB 12/11/25

PLATE D-1



1000 0 1000 2000 3000 4000 5000 6000 7000

SCALE IN FEET



AREA LOCATION

WEST BRANCH RESERVOIR DAM

JENNY - LEEDSHILL

JANUARY 1979

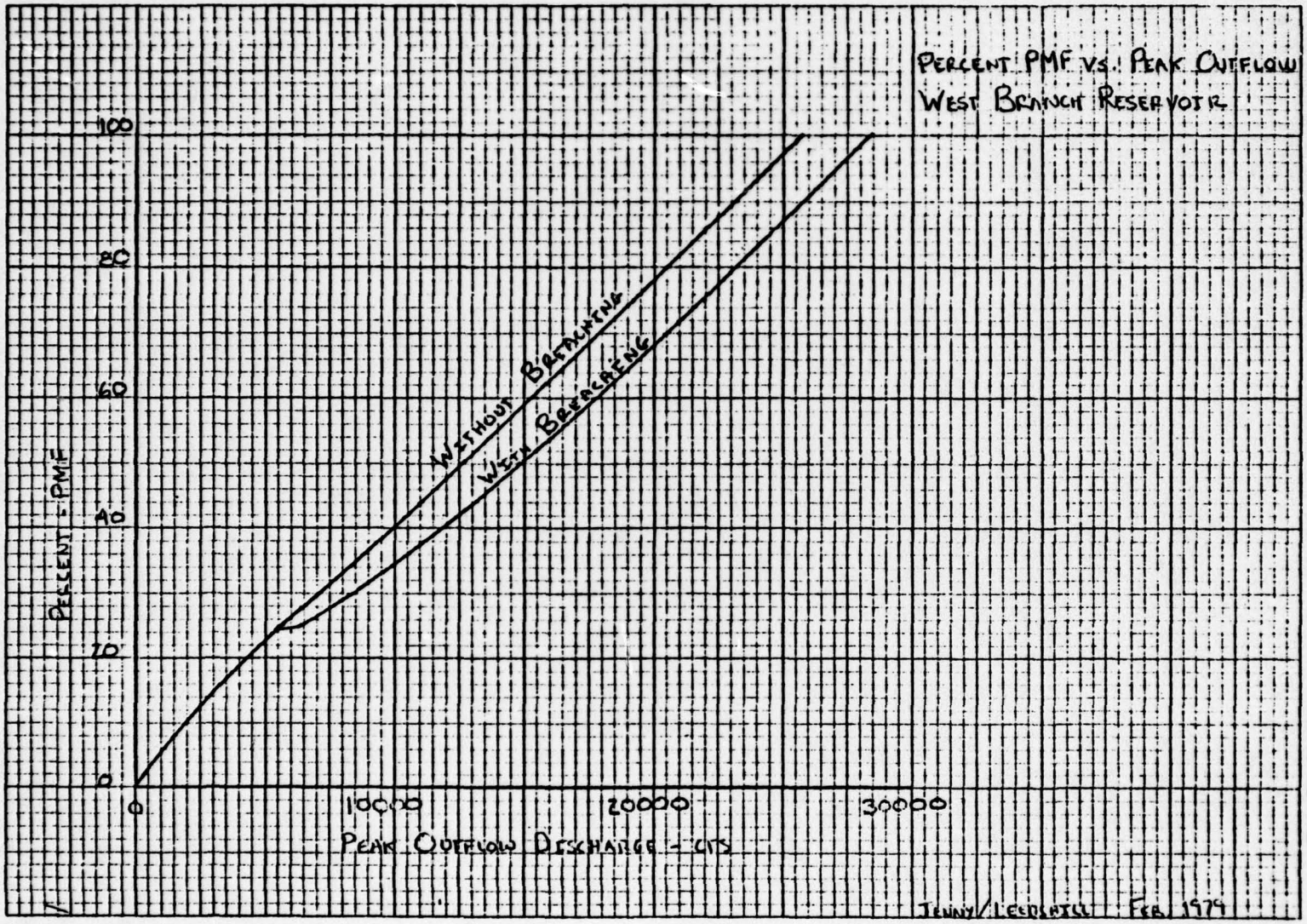

PERCENT PMF VS. PEAK OUTFLOW
WEST BRANCH RESERVOIR
WITHOUT BREACHING
WITH BREACHING
PERCENT PMF
100
80
60
40
20
0
0
10000
20000
30000
PEAK OUTFLOW DISCHARGE - CFS
JENNY/LEDERLE FEB. 1979

Plate D-2

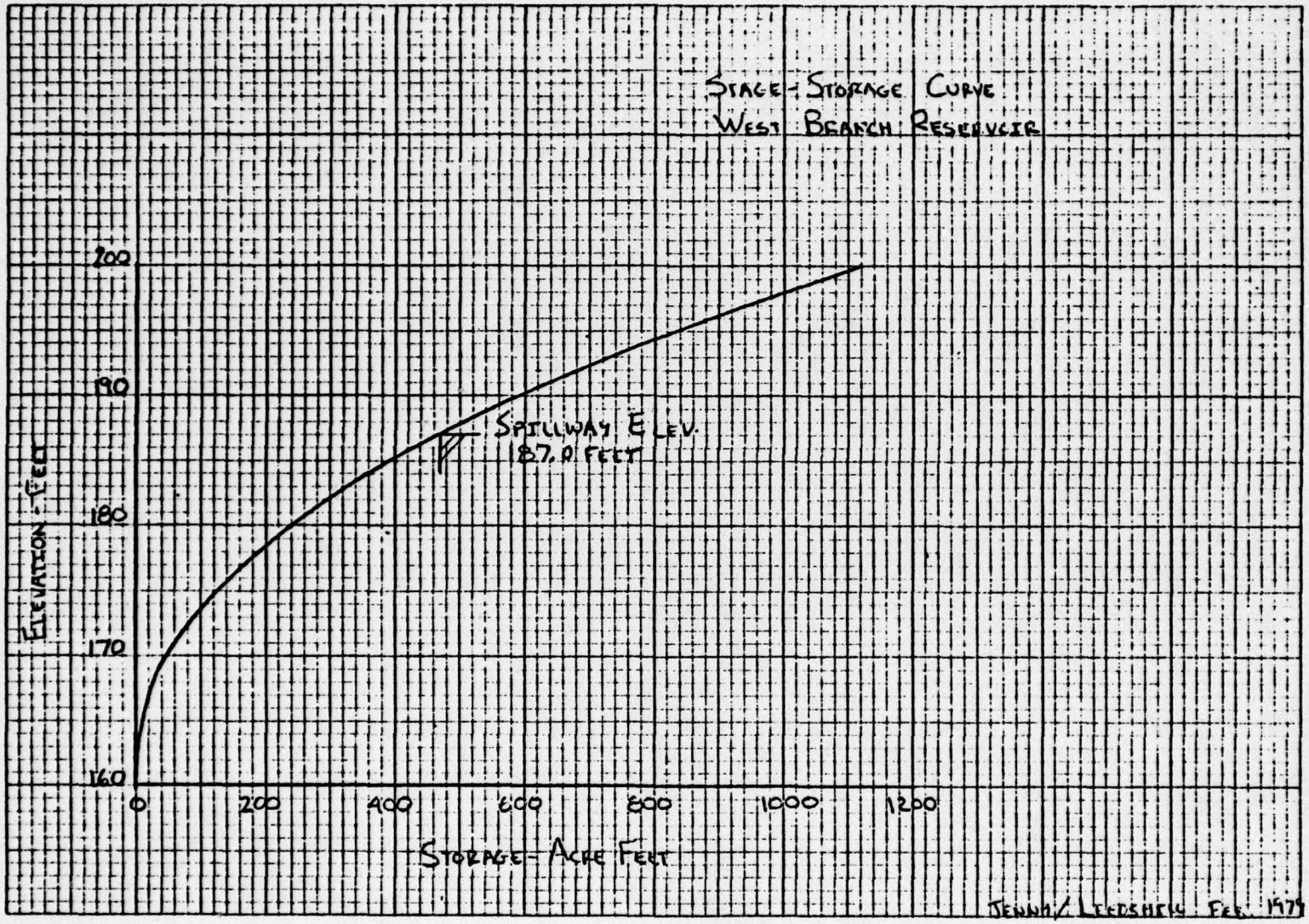

STAGE - STORAGE CURVE
WEST BRANCH RESERVOIR
SPILLWAY ELEV.
187.0 FEET
ELEVATION - FEET
200
190
180
170
160
0
200
400
600
800
1000
1200
STORAGE - ACRE FEET
JENNA / LEEDSHEIM FEB. 1979

Plate D-3

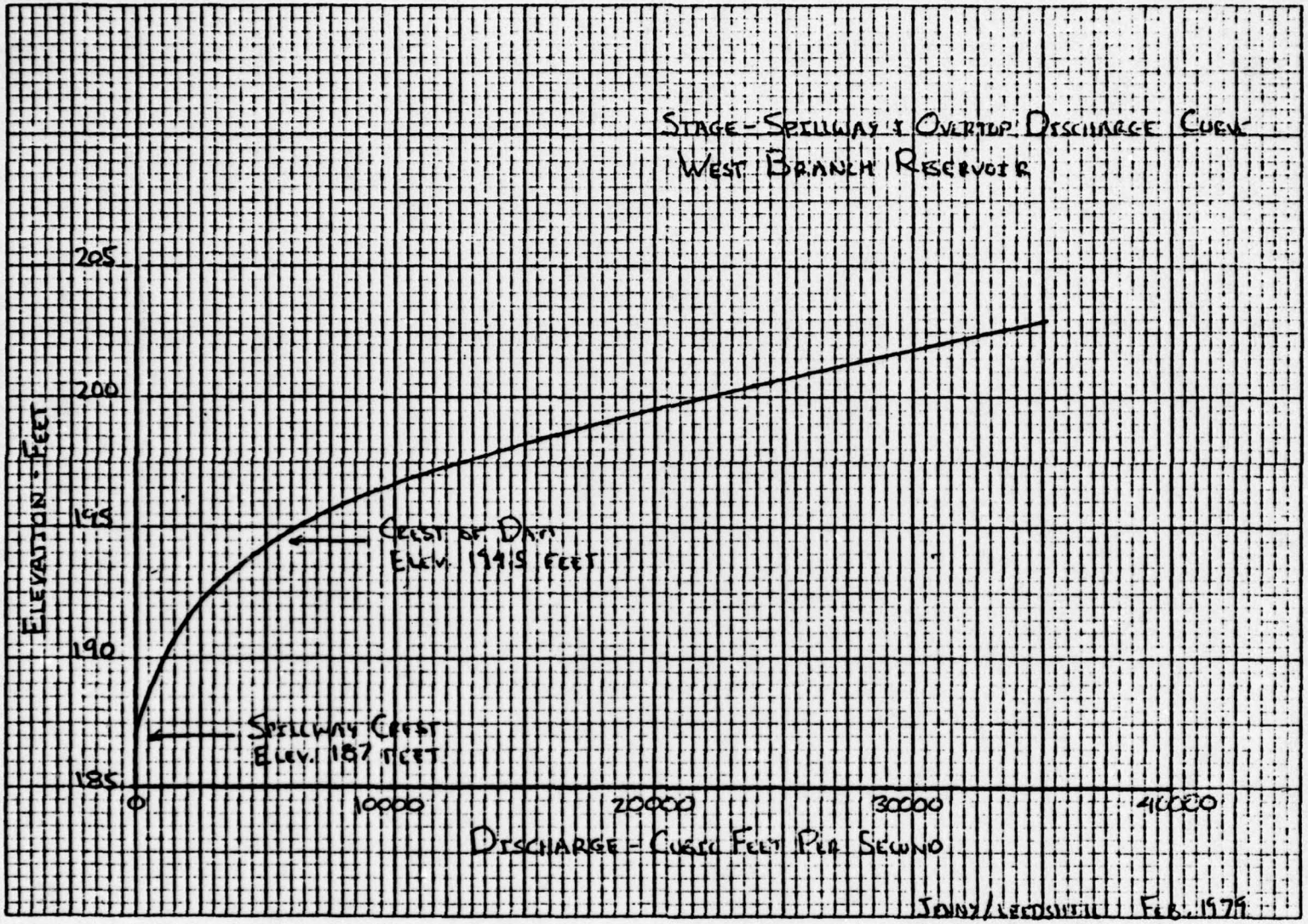

STAGE - SPILLWAY & OVERTOP DISCHARGE CURVE
WEST BRANCH RESERVOIR
205
200
195
190
185
ELEVATION - FEET
CREST OF DAM
ELEV. 194.5 FEET
SPILLWAY CREST
ELEV. 187 FEET
0
10000
20000
30000
40000
DISCHARGE - CUBIC FEET PER SECOND
JOHN J. LEEDS WELL
FEB. 1979

Plate D-4