OHIO RIVER BASIN

EATON DAM (BULL RESERVOIR)
ERIE COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI No. PA 00016
PennDER No. 25-34

National Dam Inspection Program,
Eaton Dam (Bull Reservoir) (NDI-PA-00016, PennDER-25-34), Ohio River Basin, Tributary to French Creek, Erie County, Pennsylvania. Phase I Inspection Report.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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

Prepared by: MICHAEL BAKER, JR., INC.
Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

Date: 11 May 1979

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THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.
This report was prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

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

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.
PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
Eaton Dam (Bull Reservoir), Erie County, Pennsylvania
NDI No. PA 00016, PennDER No. 25-34
Tributary to French Creek
Inspected 16 November 1978

ASSESSMENT OF
GENERAL CONDITIONS

Eaton Dam (Bull Reservoir) is an earthfill embankment structure with a concrete cutoff wall. The dam is approximately 22 feet high and 840 feet long, and is owned and operated by the Borough of North East. The dam is classified as an "Intermediate" size-"Significant" hazard dam.

The visual inspection and review of engineering data, made in November 1978 and March 1979, indicate some deficiencies requiring remedial treatment, but not emergency attention. The dam was found to be in good overall condition at the time of the inspection. However, it is recommended that the owner:

1) Clear the approach and downstream channels of the auxiliary spillway of trees, rocks, logs and other debris.

2) Clear the dense vegetation on the downstream slope, including 10 feet beyond the toe of the slope, to facilitate future inspections. This vegetation should be replaced with well-maintained grass. All eroded areas on the dam should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.

3) Repair the concrete of the control tower and auxiliary spillway as necessary.

4) Replace the riprap that is missing on the upstream face.

In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.
2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

The owner should continue in the future to inspect the embankment and concrete appurtenances, and repair as necessary. It is also recommended that a log be kept of the inspections and repair work.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District of the U.S. Army Corps of Engineers for Phase I Inspection Reports, revealed that the spillways will pass the Probable Maximum Flood (PMF) without overtopping the dam. Therefore, the spillways are rated as "adequate."

Submitted by:

MICHAEL BAKER, JR., INC.

C. Y. Chen, Ph.D., P.E.
Engineering Manager-Geotechnical

Date: 25 May 1979

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

C. F. WITHERS
Colonel, Corps of Engineers
District Engineer

Date: 10 June 1979
EATON DAM

Overall View of Dam along Crest from Right Abutment

Overall View of Dam along Crest from Left Abutment
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1.1 GENERAL

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

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances - Eaton Dam (also known as Bull Reservoir) is an earth embankment, straight in plan, with a spillway channel in excavation around its right end. The embankment has a maximum height of 22 feet and a length of 840 feet. The upstream slope is 3H:1V (Horizontal to Vertical), the downstream slope is 2H:1V, and the crest is 20 feet wide. The 14-inch cast-iron pipe outlet was laid in an excavation on a concrete cradle provided with concrete cutoffs. The control valve is located in a tower in the upstream slope. The upstream slope is provided with riprap and the downstream slope is grass covered. The 20-foot wide clay core of the dam extends throughout the entire length of the embankment. The auxiliary spillway consists of an approach channel, a concrete ogee weir and an outlet channel. The approach channel to the weir is 20 feet wide with side slopes of 2H:1V and approximately 265 feet long. The channel is protected with 12-inch asphalt paving. Four 22-foot by 4-foot by 1-foot cutoff walls are spaced 10 feet apart at the entrance of the channel; the spaces between the walls are filled with stone. The concrete ogee weir is approximately 8 feet high and 20 feet wide.

b. Location - Eaton Dam is located in a small drainage area tributary to French Creek, approximately 4.5 miles southeast of the Borough of North East, Erie County, Pennsylvania, less than 0.5 mile from the Pennsylvania-New York border.
Size Classification - The maximum height of the dam is 22 feet. The reservoir volume to the top of dam is 4650 acre-feet. Therefore, the dam is in the "Intermediate" size category.

Hazard Classification - Due to the existence of a chlorination plant downstream and several acres of farmland, significant property damage could occur as a result of a dam failure. The dam is therefore in the "Significant" hazard category.

Ownership - Eaton Dam is owned by the Borough of North East, 58 East Main Street, North East, Pennsylvania 16428.

Purpose of Dam - Eaton Dam is an auxiliary storage reservoir in the water supply system of the Borough of North East.

Design and Construction History - The existing structure was designed by Hill and Hill Engineers, North East, Pennsylvania and was constructed as a WPA project from 1936 to 1939.

Normal Operational Procedures - The dam was originally designed as an auxiliary storage or surge reservoir in conjunction with the Smith Reservoir which is located about 3 miles northwest of Bull Reservoir. The outlet pipe for Bull Reservoir is connected to the control tower at Eaton Dam and to a pump house located on French Creek to the south of Eaton Dam. The pump house, which is approximately 1 mile from the dam, was installed to pump water from French Creek into the reservoir through the control tower for storage during periods of high water demand. At the opposite end of the reservoir two 24-inch corrugated steel pipes are used to supply water to the Smith Reservoir. The flow through these two pipes is adjusted to maintain the normal pool elevation of Smith Reservoir. Mr. Herb Mallick, Borough Engineer, stated that the pump house on French Creek and sluice gate at the control tower were operated periodically several years ago; however, in the past few years this operating procedure had not been performed. Mr. Mallick did state that the system could possibly be put into operation within 24 to 48 hours.
1.3 PERTINENT DATA

a. Drainage Area (square miles) - 1.1

b. Discharge at Dam Site (c.f.s.) -
   Maximum Flow - Unknown
   Total Spillway Capacity at
   Maximum Pool (El. 1428.3 ft.) - 1080

c. Elevation [feet above Mean Sea Level (M.S.L.)] -
   Design Top of Dam - 1429
   Minimum Top of Dam - 1428.3
   Normal Pool - 1422
   Streambed at Centerline of Dam - 1407
   Maximum Tailwater - Unknown

d. Reservoir (feet) -
   Length of Pool at Top of Dam - 6600
   Length of Normal Pool - 6500

e. Storage (acre-feet) -
   At Normal Pool (El. 1422.0 ft.) - 2760
   At Auxiliary Spillway Crest
   (El. 1422.0 ft.) - 2760
   At Top of Dam (El. 1429.0 ft.) - 4650

f. Reservoir Surface (acres) -
   At Normal Pool - 246
   At Auxiliary Spillway Crest - 246
   At Maximum Pool - 332

g. Dam -
   Type - Earth embankment
   Length (feet) - 840
   Height (feet) - 22
   Top Width (feet) - 20
   Side Slopes - Upstream - 3H:1V
   Downstream - 3H:1V
   Impervious Core - Clay
   Cutoff - 12-inch concrete wall

h. Diversion and Regulating Tunnel - None
i. **Spillway (Auxiliary)**

- **Type** - Trapezoidal channel and concrete ogee weir
- **Width of Weir (feet)** - 20
- **Crest Elevation (feet M.S.L.)** - 1422
- **Gates** - None
- **Downstream Channel** - Marshy area

j. **Regulating Outlets** - Two valves used to control the two 24-inch pipes on the west end of the reservoir, and one valve in the control tower located at the upstream toe of the dam to control the 14-inch outlet pipe.
2.1 DESIGN

Pertinent design data were not available for the Eaton Dam Inspection Report. Information reviewed included material contained in PennDER File No. 25-34 including the following data:

1) Construction specifications.
2) Borough of North East report on proposed addition to water supply.
3) Progress reports of construction of the structure.
4) Various correspondence pertaining to the dam during preliminary planning.
5) Inspection reports -- 1948 and 1967.
6) The Water and Power Resources Board permit for the original construction of the dam.

The original design drawings are reproduced and presented as Plates 3, 4 and 5.

2.2 CONSTRUCTION

The dam was constructed as a WPA project between 1936 and 1939. Hill and Hill Engineers of North East was the design and consulting engineer in charge.

When the dam was originally built, a tunnel and an 18-inch vitrified clay pipe were constructed at the northwest end to deliver water from Bull Reservoir to Smith Reservoir. The up-gradient ends of both the tunnel and pipe were placed in a tower located approximately 350 feet from the northwest shore of Bull Reservoir. The tunnel went through a series of manholes and finally outletted into an open channel approximately 4000 feet northwest of Bull Reservoir. The tile pipe followed another route which took it through a gate valve control tower and then underground for an estimated 550 feet, at which point it entered an open ditch. This ditch eventually joined the open channel from the tunnel and carried the water to Smith Reservoir. In the fall of 1973, a portion of the tunnel collapsed. Since the 18-inch vitrified clay tile pipe was not large enough to
carry the required flow, a 24-inch reinforced concrete and corrugated metal pipe line was installed. This pipe intercepted the tunnel at the uppermost manhole and ran through a gate valve control tower, and then to the ditch adjacent to the 18-inch tile outlet. The down-gradient section of the tunnel was blocked with a concrete plug in the manhole where the 24-inch pipe was connected. According to the information available, this is the extent of the post-construction changes made to the reservoir.

The design plans show a chute channel as the auxiliary spillway. However, the auxiliary spillway was not constructed according to the design plans. The auxiliary spillway as constructed consists of a 265-foot long trapezoidal approach channel and an 8-foot high concrete ogee weir (see Photos 5, 6 and 7). The outlet channel below the weir then carries the discharge from the reservoir to the natural streambed channel.

2.3 OPERATION

Operational procedures discussed in paragraphs 1.2.1., 4.2, and 4.3 were obtained from interviewing Mr. Herb Mallick, Borough Engineer for North East. No operation or pool level records are currently recorded by the Borough of North East.

2.4 EVALUATION

a. Design - The structural stability could be evaluated only on an observational and empirical basis since design data were not available.

b. Construction - No information was available describing the depth of the cutoff wall or the type and degree of compaction of the earth embankment.

c. Operation - The operational procedures appear to be adequate for the auxiliary water supply facilities. However, the operation and maintenance program should be expanded to include periodic operation of the gates located in the tower in the upstream embankment. Also, a record should be kept of periodic inspections made by local personnel.
SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam and its appurtenant structures were found to be in good overall condition at the time of inspection. The problems noted during the visual inspection are considered minor and do not require immediate remedial treatment. Noteworthy deficiencies observed are described briefly in the following paragraphs. The visual inspection check list and field sketch are given in Appendix A.

b. Dam - Three problems were noted on the embankment structure: the crest of the embankment is heavily rutted due to vehicular traffic, the upstream face has a 6-foot-square area of missing riprap approximately 200 feet to the right of the intake structure, and the downstream area including the embankment is heavily vegetated with weeds and brush.

c. Appurtenant Structures - The intake structure in the upstream embankment is cracked and spalled; consequently, reinforcing bars are exposed in some areas. The concrete in the auxiliary spillway also has signs of deterioration.

The intake control valve chambers located at the west end of the reservoir are in very good condition as are the other appurtenances used to outlet water to Smith Reservoir.

d. Reservoir Area - No problems were observed in the reservoir area. The reservoir side slopes are nearly flat to gently sloping with a good cover of grasses and stands of forest.

e. Downstream Channel - The downstream channel of the auxiliary spillway is covered with rocks, trees and other debris. Below the downstream embankment of the dam the entire area is a natural marsh. Approximately 0.6 to 1 mile below, several dwellings and a water treatment plant are located. However, all the buildings are located above the elevation considered to be susceptible to flood damage.
SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There is no formal written procedure for emergency downstream evacuation in the event of impending catastrophe. The sluice gate located at the upstream face of the embankment is closed and has not been opened for several years. The water is removed by gravity flow from the northwest end in order to supply water to Smith Reservoir.

It is recommended that a formal emergency procedure be prepared, prominently displayed, and furnished to all operating personnel.

4.2 MAINTENANCE OF DAM

The Borough of North East is responsible for the maintenance of the dam. The area is visited weekly; however, inspection is difficult due to the growth of bushes and trees along the auxiliary spillway channel and the high weeds on the downstream face of the embankment. A more comprehensive maintenance program should be initiated.

4.3 MAINTENANCE OF OPERATING FACILITIES

The operating facilities at the west end of the reservoir appeared to be in satisfactory condition. The valves are operated as necessary in order to maintain the normal pool at Smith Reservoir. The gate at the embankment, however, has not been operated in several years, nor was there evidence that repairs had been made to the valve control tower. This valve should be operated periodically to ensure its availability if needed.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or formal emergency procedure in the event of a dam failure. An emergency warning procedure should be developed.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The maintenance procedures for Eaton Dam are considered marginal, as stated above. Periodic inspection documentation and a more adequate maintenance routine should be initiated along with a formal emergency procedure.
SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design calculations were available for Eaton Dam.

b. Experience Data - The maximum depth of flow in the auxiliary spillway, according to owners of the dam, was approximately 6 inches. No other information is available.

c. Visual Observations - The downstream section of the auxiliary spillway is covered with brush and small trees that could significantly restrict flood discharges. The downstream discharge area below the auxiliary spillway is also heavily wooded.

d. Overtopping Potential - Eaton Dam is classified as a "Significant" hazard-"Intermediate" size dam. For a dam with this hazard and size classification, the recommended spillway design flood (SDF) is the 1/2 Probable Maximum Flood (1/2 PMF) to the Probable Maximum Flood (PMF). Since the dam is on the low end of the "Intermediate" size category, the 1/2 PMF was chosen as the spillway design flood. The auxiliary spillway is a concrete trapezoidal channel with its control section at El. 1422 feet. A concrete ogee spillway is located at the downstream end of this channel. The discharge rating curve for this spillway was established with the aid of the U.S. Army Corps of Engineer's Water Surface Profiles Package, HEC-2. The hydrologic and hydraulic capabilities of the reservoir and spillway were then evaluated with the aid of the U.S. Army Corps of Engineer's Flood Hydrograph Package, HEC-1. The 1/2 PMF hydrograph developed as a part of this analysis had a peak discharge of 2935 c.f.s. using a total storm runoff of 12.6 inches. The results of this routing indicate that the reservoir and spillway are capable of passing the 1/2 PMF with a maximum reservoir level of El. 1424.1 feet, which is about 4.2 feet below the minimum dam crest El. 1428.3 feet. The maximum discharge from the reservoir during a storm of this magnitude would be 144 c.f.s. In addition, the PMF was routed through the reservoir. The results of this analysis indicate that the reservoir is capable of safely passing the PMF with a corresponding maximum reservoir level of El. 1426.0 feet.

e. Spillway Adequacy - The dam, as outlined in the above analysis is capable of passing the PMF without overtopping. Therefore, the spillway is "adequate" according to the recommended criteria.
SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - No structural inadequacies were noted during the visual inspection of the dam.

b. Design and Construction Data - Calculations of embankment slope and foundation stability were not available for review. Because of the low height of the earthfill section of the dam, and its substantial width and moderate slopes; it is inferred that the dam could meet the required stability criteria. No further stability assessments are deemed necessary for this Phase I Inspection Report.

c. Operating Records - No operating records were available for Eaton Dam. Operational procedures obtained from interviewing the borough engineer do not indicate cause for concern relative to the structural stability of the dam.

d. Post-Construction Changes - No post-construction changes were made that would adversely affect the dam.

e. Seismic Stability - The dam is located in Zone 2 of the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of moderate seismic activity. As indicated in paragraph 6.1.b., Eaton Dam could be shown to meet the static stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." Thus, there is no need for further consideration of seismic stability.
SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. **Safety** - The dam and its appurtenant structures were found to be in good overall condition at the time of inspection. Eaton Dam is evaluated as being a "Significant" hazard-"Intermediate" size dam in accordance with the "Recommended Guidelines for Safety Inspection of Dams" and should have a spillway capacity equal to 1/2 PMF. As presented in Section 5, the spillway and reservoir were determined to have a capacity equal to the PMF and are therefore assessed as being "adequate."

b. **Adequacy of Information** - The information available and the observations made during the field inspection are considered adequate for this Phase I Inspection Report.

c. **Urgency** - The owner should initiate the action discussed in paragraph 7.2 without delay.

d. **Necessity for Additional Data/Evaluation** - The hydraulic/ hydrologic analysis performed in connection with this Phase I Inspection Report has indicated that no additional evaluation is necessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be performed without delay by the owner. These include:

1) The approach and downstream channels of the auxiliary spillway should be cleared of trees, rocks, logs and other debris.

2) The dense vegetation on the downstream slope, including 10 feet beyond the toe of the slope, should be cleared to facilitate future inspections. This vegetation should be replaced with well-maintained grass. All eroded areas on the dam should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.

3) The concrete in the control tower and auxiliary spillway should be repaired as necessary.
In addition, the following operational measures are recommended to be undertaken by the owner:

1) Develop a detailed emergency operation and warning system.

2) During periods of unusually heavy rain, provide around-the-clock surveillance of the dam.

3) When warning of a storm of major proportions is given by the National Weather Service, the owner should activate the emergency operation and warning system.

The owner should continue in the future to inspect the embankment and concrete appurtenances, and repair as necessary. It is also recommended that a log be kept of the inspections and repair work.
PLATES
NOTE: This Design Drawing of the Auxiliary Spillway is Not Representative of the "As Built" Conditions. See the Text of This Report and Photos 5, 6, and 7 For "As Built" Condition.
PLATE 4

NORTH EAST BORO
WATER WORKS IMPROVEMENT
HILL & HILL ENGINEERS
NORTH EAST PENNIA
Scales-2"=1'-0"
Jan 7, 1935
Approx. Half Scale
PLATE 8

NORTH EAST Boro
WATER WORKS IMPROVEMENT
HILL & HILL ENGINEERS
North East Purmore
Scale as noted  Jan 6 1936
Approx. Half Scale
APPENDIX A

CHECK LIST - VISUAL INSPECTION AND FIELD SKETCH
Check List
Visual Inspection
Phase 1

Name Dam Eaton Dam (Bull Reservoir)
County Erie
State PA
Coordinates Lat. N 42° 08.8'
Long. W 79° 46.0'
NDI # PA 00016
PennDER # 25-34

Date Inspection 16 November 1978
Weather Overcast
Temperature 55°F.

Pool Elevation at Time of Inspection 1417.5 ft. M.S.L.
Tailwater at Time of Inspection 1406.0 ft. M.S.L.

Elevations are based on plan datum, top of concrete gate valve chamber.

Inspection Personnel:

Michael Baker, Jr., Inc.:
Rodney E. Holderbaum
James G. Ullinski
David F. Johns

Owner's Representatives
Borough of North East:

Herb Mallick - Engineer

David F. Johns Recorder
**CONCRETE/MASONRY DAMS - Not Applicable**

**Name of Dam:** EATON DAM (BULL RESERVOIR)  
**NDI #: PA 00016**

<table>
<thead>
<tr>
<th><strong>VISUAL EXAMINATION OF</strong></th>
<th><strong>OBSERVATIONS</strong></th>
<th><strong>REMARKS OR RECOMMENDATIONS</strong></th>
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<tr>
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<tr>
<td>CONCRETE SURFACES</td>
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<td></td>
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<tr>
<td>ALIGNMENT</td>
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<td>MONOLITH JOINTS</td>
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<td>CONSTRUCTION JOINTS</td>
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<td>VISUAL EXAMINATION OF</td>
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<td>REMARKS OR RECOMMENDATIONS</td>
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<tr>
<td>-----------------------</td>
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<td>--------------------------</td>
</tr>
<tr>
<td>SURFACE CRACKS</td>
<td>No surface cracks were observed.</td>
<td></td>
</tr>
<tr>
<td>UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE</td>
<td>No unusual movement or cracking at or beyond the toe was noted.</td>
<td></td>
</tr>
<tr>
<td>SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES</td>
<td>1. The crest of the embankment is heavily rutted due to vehicular traffic.</td>
<td>1. The crest should be regraded, treated, and seeded with an appropriate mixture to prevent erosion.</td>
</tr>
<tr>
<td></td>
<td>2. A few bushes are growing on the upstream face through the riprap.</td>
<td>2. The riprap should be cleared of vegetation.</td>
</tr>
<tr>
<td>VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST</td>
<td>No problems were noted. (Rutting and surface irregularities were observed; however, they did not appear to present a problem.)</td>
<td></td>
</tr>
<tr>
<td>RIPRAP FAILURES</td>
<td>Approximately 200 ft. to the right of the intake and 10 ft. down from the crest, a 6-ft.-square area of riprap is missing.</td>
<td>The riprap should be replaced.</td>
</tr>
</tbody>
</table>
**Name of Dam:** EATON DAM (BULL RESERVOIR)  
**NDI #:** PA 00016

<table>
<thead>
<tr>
<th>VISUAL EXAMINATION OF EMBANKMENT</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
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<tbody>
<tr>
<td>JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM</td>
<td>No problems were noted.</td>
<td></td>
</tr>
<tr>
<td>ANY NOTICEABLE SEEPAGE</td>
<td>No noticeable seepage was noted during the inspection.</td>
<td>The downstream face should be cleared of high, dense vegetation to facilitate the visual inspection.</td>
</tr>
<tr>
<td>STAFF GAGE AND RECORDER</td>
<td>None installed</td>
<td></td>
</tr>
<tr>
<td>DRAINS</td>
<td>None installed</td>
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</table>
### Visual Examination of Outlet Conduit

<table>
<thead>
<tr>
<th>Cracking and Spalling of Concrete Surfaces in Outlet Conduit</th>
<th>Observations</th>
<th>Remarks or Recommendations</th>
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<tbody>
<tr>
<td>The outlet for the 14-in. cast-iron pipe on the downstream side is piped several hundred ft. down to French Creek.</td>
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</tbody>
</table>

### Intake Structure

1. Reinforcing bars are exposed along the walkway to the intake structure.
   1. The concrete should be repaired as necessary.
2. The concrete is cracked and spalled on the walkway and the intake structure.

### Outlet Structure

The outlet structure at the west end of the reservoir (toward Smith Reservoir) was noted as being in good condition.

### Outlet Channel

The outlet channel to Smith Reservoir is rock-lined. No erosion problems were noted.

### Emergency Gate

The sluice gate located on the upstream side of the embankment has been closed for several years and has not been operated.

The sluice gate should be operated periodically to insure its availability if future conditions would require its operation.
<table>
<thead>
<tr>
<th>VISUAL EXAMINATION OF</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
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<tbody>
<tr>
<td>CONCRETE WEIR</td>
<td>The concrete is cracked and spalled along the ogee weir.</td>
<td>Repair concrete as necessary.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPROACH CHANNEL</td>
<td>The approach channel is covered with high weeds and trees.</td>
<td>The approach channel should be cleared of all obstructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DISCHARGE CHANNEL</td>
<td>The discharge channel is covered with trees, bushes, rocks, logs, and other debris.</td>
<td>The channel should be cleared of all obstructions.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIDGE AND PIERS</td>
<td>A small, abandoned, wooden bridge is located approximately 300 ft. down the channel; however, it does not appear to present any resistance to flow.</td>
<td></td>
</tr>
</tbody>
</table>
**GATED SPILLWAY - Not Applicable**

<table>
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<tr>
<th>Name of Dam: EATON DAM (BULL RESERVOIR)</th>
<th>NDI #: PA 00016</th>
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<table>
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<th>GATES AND OPERATION EQUIPMENT</th>
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### INSTRUMENTATION - None

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</table>

<table>
<thead>
<tr>
<th>WEIRS</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>PIEZOMETERS</th>
</tr>
</thead>
</table>

<table>
<thead>
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<th>OTHER</th>
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</table>
**Name of Dam:** EATON DAM (BULL RESERVOIR)  
**NDI #:** PA 00016

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<th>VISUAL EXAMINATION OF</th>
<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOPES</td>
<td>The slopes are mild to gently sloping, and covered with heavy woods and bush-like vegetation.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEDIMENTATION</th>
<th>No excessive sedimentation was noted.</th>
<th></th>
</tr>
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</table>
### DOWNSTREAM CHANNEL

**Name of Dam:** Eaton Dam (Bull Reservoir)  
**NDI #:** PA 00016

<table>
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<th>OBSERVATIONS</th>
<th>REMARKS OR RECOMMENDATIONS</th>
</tr>
</thead>
</table>
| **CONDITION**  
(OBSTRACTIONS,  
DEBRIS, ETC.) | The downstream channel is entirely silted in. The exact cause of the condition could not be determined. | |

| SLOPES | The slope of the downstream channel from the reservoir is relatively mild, averaging approximately 1% or less. | |

| APPROXIMATE NO. OF HOMES AND POPULATION | A chlorination plant is located approximately 1 mile below the structure with a few small farm houses located between. The buildings, however, are located above the elevation that is susceptible to flood damage. | |
APPENDIX B

CHECK LIST - ENGINEERING DATA
**CHECK LIST**

**ENGINEERING DATA**

**DESIGN, CONSTRUCTION, OPERATION**

**Name of Dam:** EATON DAM (BULL RESERVOIR)

**NDI #:** PA 00016

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<th>REMARKS</th>
</tr>
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<tbody>
<tr>
<td><strong>PLAN OF DAM</strong></td>
<td>See Plate 3.</td>
</tr>
<tr>
<td><strong>REGIONAL VICINITY MAP</strong></td>
<td>See Plate 1, a portion of 7.5 minute USGS quadrangle map with state location inset.</td>
</tr>
<tr>
<td><strong>CONSTRUCTION HISTORY</strong></td>
<td>Eaton Dam was built as a WPA project from 1936-1939 under the direction of Hill and Hill Engineers of North East, Pennsylvania.</td>
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<tr>
<td><strong>TYPICAL SECTIONS OF DAM</strong></td>
<td>See Plate 5.</td>
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<tr>
<td><strong>HYDROLOGIC/HYDRAULIC DATA</strong></td>
<td>No information available</td>
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<tr>
<td><strong>OUTLETS - PLAN</strong></td>
<td>See Plate 5.</td>
</tr>
<tr>
<td></td>
<td>- DETAILS See Plate 5.</td>
</tr>
<tr>
<td></td>
<td>- CONSTRAINTS 14-in. cast-iron pipe from control vault at dam; 2-24 in. corrugated metal pipes at west end of reservoir, each with separate control vaults.</td>
</tr>
<tr>
<td></td>
<td>- DISCHARGE RATINGS None available</td>
</tr>
<tr>
<td><strong>RAINFALL/RESERVOIR RECORDS</strong></td>
<td>None available</td>
</tr>
</tbody>
</table>
**Name of Dam:** EATON DAM (BULL RESERVOIR)  
**NDI #** PA 00016

<table>
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<tr>
<th>ITEM</th>
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</thead>
<tbody>
<tr>
<td>MONITORING SYSTEMS</td>
<td>None installed</td>
</tr>
<tr>
<td>MODIFICATIONS</td>
<td>Following the collapse of a portion of the tunnel at the west end, a new set of water lines were installed to carry flow to Smith Reservoir.</td>
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<tr>
<td>HIGH POOL RECORDS</td>
<td>None available</td>
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<tr>
<td>POST CONSTRUCTION ENGINEERING</td>
<td>None available</td>
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<td>STUDIES AND REPORTS</td>
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<td>PRIOR ACCIDENTS OR FAILURE OF DAM</td>
<td>None available</td>
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<tr>
<td>DESCRIPTION</td>
<td></td>
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<tr>
<td>REPORTS</td>
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<tr>
<td>MAINTENANCE OPERATION RECORDS</td>
<td>None available</td>
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<tr>
<td>Name of Dam: Eaton Dam (Bull Reservoir)</td>
<td>REMARKS</td>
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<tr>
<td>----------------------------------------</td>
<td>---------</td>
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<tr>
<td>IND 1 PA 00016</td>
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<tr>
<td>SPILLWAY PLAN</td>
<td>See Plate 4.</td>
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<tr>
<td>SECTIONS</td>
<td>See Plate 4.</td>
</tr>
<tr>
<td>DETAILS</td>
<td>See Plate 4.</td>
</tr>
<tr>
<td>OPERATING EQUIPMENT</td>
<td>See Plate 4.</td>
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<tr>
<td>PLANS &amp; DETAILS</td>
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</table>
DRAINAGE AREA CHARACTERISTICS: 1.1 sq.mi. (heavily wooded)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1422.0 ft. (2760 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1429.0 ft. (4650 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1428.3 ft. (minimum), 1428.7 ft. (average)

CREST: Auxiliary Spillway

a. Elevation 1422.0 ft.
b. Type Concrete ogee weir and trapezoidal approach channel
c. Width 20 ft.
d. Length Approximately 500 ft.
e. Location Spillway at right end of embankment
f. Number and Type of Gates None

OUTLET WORKS: 14-Inch Outlet Pipe, Two 24-Inch Water Supply

a. Type 14-Inch cast-iron, Two 24-Inch corrugated metal
b. Location 14-Inch approximately 285 feet from right abutment,
   Two 24 Inch - at west end of reservoir
c. Entrance inverts 14 inch - El. 1408.0 ft., Two-24 inch-El. 1411.8 ft.
d. Exit inverts 14 inch - El. 1405.0 ft., Two-24 inch - El. 1405.8 ft.
e. Emergency draindown facilities 12-Inch cast-iron pipe located in valve chamber at dam. Invert El. 1422.0 ft.

HYDROMETEOROLOGICAL GAGES: None

a. Type ____________________________
b. Location ____________________________
c. Records ____________________________

MAXIMUM NON-DAMAGING DISCHARGE Unknown
APPENDIX C

PHOTOGRAPHS
DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam -
Upper Photo - View along Crest of Dam from Right Abutment
Lower Photo - View along Crest of Dam from Left Abutment

Photo 1 - Gate Valve Chamber in Upstream Embankment
(Note Spalling of Concrete and Exposed Reinforcing Bar)

Photo 2 - View from Crest at Dam Looking toward Downstream
(Note High Grasses along Downstream Face)

Photo 3 - West End of Reservoir
(Intake Chamber is Block Structure Right of Center)

Photo 4 - Two 24-inch Corrugated Metal Pipes
at West End of Reservoir

Photo 5 - View of Channel Approaching Auxiliary Spillway
(Note Vegetation Growing through Channel Floor)

Photo 6 - View Looking over Crest of Auxiliary Spillway
Spillway toward Downstream Channel
(Note Dense Brush Growing in Channel)

Photo 7 - View from Auxiliary Spillway
Channel Looking Back toward Weir
(Note Brush and Debris in Channel)

Note: Photographs were taken on 16 November 1978.
PHOTO 1. Gate Valve Chamber in Upstream Embankment
(Note Spalling of Concrete and Exposed Reinforcing Bar)

PHOTO 2. View from Crest at Dam Looking toward Downstream
(Note High Grasses along Downstream Face)
PHOTO 3. West End of Reservoir
(Intake Chamber is Block Structure Right of Center)

PHOTO 4. Two 24-inch Corrugated Metal Pipes at West End of Reservoir
PHOTO 5. View of Channel Approaching Auxiliary Spillway  
(Note Vegetation Growing through Channel Floor)

PHOTO 6. View Looking over Crest of Auxiliary Spillway toward  
Downstream Channel (Note Dense Brush Growing in Channel)
PHOTO 7. View from Auxiliary Spillway Channel Looking Back toward Weir (Note Brush and Debris in Channel)
APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS
# TABLE OF CONTENTS

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<thead>
<tr>
<th>Section</th>
<th>Page</th>
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<tbody>
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<td>PREFACE</td>
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<tr>
<td>RAINFALL AND HYDROGRAPH DATA</td>
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<tr>
<td>WATERSHED MAP</td>
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<td>CROSS-SECTIONS</td>
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<td>SPILLWAY RATING</td>
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<td>STAGE VS. STORAGE</td>
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<td>TOP OF DAM</td>
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<td>MAP OF LAKE &amp; D.S. DAMAGE AREA</td>
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<td>FLOOD ROUTING</td>
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PREFACE

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic determinations presented in this Phase I Inspection Report are based on the use of a Snyder's unit hydrograph developed by the U.S. Army Corps of Engineers. Due to the limited number of gaging stations available in this hydrologic region and the wide variation of watershed slopes, the Snyder's coefficients may yield results of limited accuracy for this watershed. As directed however, a further refinement of these coefficients is beyond the scope of this Phase I Investigation.

In addition, the conclusions presented pertain to present conditions, and the effect of future development on the hydrology has not been considered.
### Rainfall Data (from June 30)

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<th>Time (June 30th)</th>
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<td>Rainfall Depth</td>
<td>0.15 in</td>
</tr>
<tr>
<td>G</td>
<td>2.5 in</td>
</tr>
<tr>
<td>R</td>
<td>3.0 in</td>
</tr>
<tr>
<td>R</td>
<td>2.3 in</td>
</tr>
<tr>
<td>R</td>
<td>3.0 in</td>
</tr>
</tbody>
</table>

### Hydrograph Data (from June 30)

<table>
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<tr>
<th>Time</th>
<th>Flow</th>
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<tbody>
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<td>10 A.M.</td>
<td>1250 cfs</td>
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</tbody>
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**Gross Area:**

\[ A = \frac{1}{2} \times \text{length} \times \text{width} \]

**Length of Major Watercourses:**

- **B:** 1200 ft
- **C:** 1500 ft
- **D:** 2000 ft
- **E:** 1800 ft

**Perimeter:**

\[ P = 2 \times (A + B + C + D + E) = 161 \text{ ft} \]

**Area:**

\[ A = \frac{1}{2} \times \text{length} \times \text{width} = 0.30 \text{ mi}^2 \]

**Flow:**

\[ F = 1250 \text{ cfs} \]
• Quad: North East
  Drainage Area = 1.07 mi.²
  L = 0.30 mi.

EATON DAM
WATERSHED

DATE: 3-29-79

MICHAEL BAKER JR. INC.
Consulting Engineers & Surveyors
NOTE: THE FOLLOWING CROSS-SECTIONS WERE DETERMINED FROM DESIGN PLANS AND DATA TAKEN DURING THE FIELD INSPECTION. THEY ARE INCLUDED IN THE INPUT DATA FOR THE HEC2 PROGRAM USED TO DETERMINE THE AUXILIARY SPILLWAY CAPACITY.

CROSS-SECTION NO. 1

CROSS-SECTION NO. 2
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**Notes:**
- This table represents data collected over various columns and rows.
- The values are numeric, indicating measurements or counts.
- The table is part of a larger data set, possibly from a scientific or engineering study.
Subject: Eaton Dam

Top of Dam Profile

S.O. No. [blank]

Sheet No.: II of 17

Drawing No. [blank]

Computed by: GAS
Checked by [blank]
Date: 3-1-79

Design Top of Dam: 1429.0
Weighted Top of Dam: 1428.8
Min. Top of Dam: 1428.3
Min. Top of Block 1421.7 (North End of Dam)

Elevation (Feet)

Principal Spillway

Horizontal Distance (Feet)

0 1000 2000 3000 4000 5000 6000 7000 8000 9000
**FLOOD HYDROGRAPH PACKAGE (HEC-11)**

**DAM SAFETY VERSION** JULY 1978

**LAST MODIFICATION** 25 SEP 78

**NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS**

**HYDROLOGIC AND HYDRAULIC ANALYSIS OF BULL RESERVOIR MRJ 05**

**PROBABLE MAXIMUM FLOOD PEE/UNIT GRAPH BY NYDERS METHOD**

### JOB SPECIFICATION

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<th>NHR</th>
<th>NMIN</th>
<th>IDAY</th>
<th>INR</th>
<th>ININ</th>
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**MULTI-PLAN ANALYSES TO BE PERFORMED**

- NPLAN = 1
- NRIO = 2
- LRIO = 1

**RTIOS = 0.50  1.00**

### SUB-AREA RUNOFF COMPUTATION

**MODIFIED NYDERS HYDROGRAPH BY CYE METHOD**

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<th>ICOPC</th>
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**HYDROGRAPH DATA**

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**TRSPC COMPUTED BY THE PROGRAM IS 0.900**

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**UNIT HYDROGRAPH DATA**

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**UNIT HYDROGRAPH 23 END-OF-PERIOD ORDINATES, LAG = 1.66 HOURS, CP = 0.55 VOL = 1.00**

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**HYDROGRAPH ROUTING**

**THIS IS A ROUTING FOR ROLL RESERVOIR**

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<thead>
<tr>
<th>ISTAQ</th>
<th>ICOMP</th>
<th>IECON</th>
<th>ITAPE</th>
<th>JPLT</th>
<th>JPRRT</th>
<th>INAME</th>
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**ROUTING DATA**

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**NSTPS**

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**STAGE**

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<th>ELEVATION</th>
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<tr>
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**DAM DATA**

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**PEAK OUTFLOW IS 144, AT TIME 48.00 HOURS**

**PEAK OUTFLOW IS 481, AT TIME 46.50 HOURS**
<table>
<thead>
<tr>
<th>Operation</th>
<th>Area</th>
<th>Station</th>
<th>Plan Ratio 1</th>
<th>Ratio 2</th>
<th>Rivals Applied to Flow</th>
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PEAK FLOW AND STORAGE END OF PERIOD SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS.

一线 FEET PER SECOND (Cubic Meters Per Second)

AREA IN SQUARE MILES (Square Kilometers)

HYDROGRAPH AT

RECEIVED TO

DAM (ft)

Routed To

Sheet 10 of 17
### SUMMARY OF DAM SAFETY ANALYSIS

<table>
<thead>
<tr>
<th>PLAN</th>
<th>ELEVATION STORAGE</th>
<th>INITIAL VALUE</th>
<th>SPILLWAY CREST</th>
<th>TOP OF DAM</th>
<th>AVERAGE</th>
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<table>
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<tr>
<th>RATIO</th>
<th>MAXIMUM RESERVOIR W.S.ELEV</th>
<th>AVERAGE MAXIMUM DEPTH OVER DAM</th>
<th>MAXIMUM STORAGE AC-FT</th>
<th>MAXIMUM OUTFLOW CFS</th>
<th>DURATION OVER TOP HOURS</th>
<th>TIME OF MAX OUTFLOW HOURS</th>
<th>TIME OF FAILURE HOURS</th>
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*Low point on road at north end of reservoir.*
EATON DAM (BULL RESERVOIR)
NDI No. PA 00016, PennDER No. 25-34

REGIONAL GEOLOGY

Eaton Dam (Bull Reservoir) is located in the glaciated section of the Appalachian Plateaus physiographic province. The reservoir is the former site of a marsh located on Kent ground moraine glacial deposits. Logs of test borings made for design of the dam describe foundation soils as deposits of yellow and blue clay with beds containing sand and gravel at depths between 20 and 25 feet. These soils are about 38 feet thick near the center of the valley. Bedrock units are members of the Conneaut Group, Upper Devonian system which are typically shales and siltstones.
LEGEND

POTTsville GROUP
Conococheague Formation—sandstone, shale; Sher- 
on Formation—shale, sandstone, conglomerate; Clean 
Conglomerate 50-100 ft. (15-30 m.)

POcono GROUP
Cayohega Formation— shale, sandstone; Corry Sand-
stone; Knapp Formation 60-100 ft. (20-30 m.) — 
shale, conglomerate.

ConeWang Group
450-650 ft. (140-200 m.)
Oswego and Venango Formations— shale, siltstone, 
sandstone; replaced eastward by Cattaraugus For-
mati on— shale, sandstone, conglomerate.

Conneaut Group
250-600 ft. (75-200 m.)
In west: Elicott and Dextrorville Formations— shale, 
siltstone.
In east: Germania Formation— shale, sandstone; 
Whiteville Formation— shale, sandstone; Hinsdale 
Sandstone; Wellsburg Formation— shale, sandstone; 
Coke Sandstone.

Canadaway Group
700-1200 ft. (210-370 m.)
Northeast Shale; Shumla Siltstone.
Westfield Shale; Leona Siltstone.
Gowanda, South Wales, and Dunkirk Shales.
Machias Formation— shale, siltstone; Rushford 
Sandstone; Canandaigua, Canisteo, and Rame Shales; 
Canaseraga Sandstone; South Wales and Dunkirk 
Shales.

Java Group
100-200 ft. (30-60 m.)
Hanover Shale; Wiscey Formation— sandstone, shale; 
Pike Creek Shale.

West Falls Group
400-850 ft. (120-250 m.)
Angola and Rhinestreet Shales.
Nunda Formation— sandstone, shale.
West Hill and Gardoau Formations— shale, siltstone; 
Roderick Glen Shale; upper Bears Hill Shale; Grimes 
Siltstone.
lower Bears Hill Shale; Dunn Hill, Millport, and 
Moreland Shales.