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NATIONAL DAM INSPECTION PROGRAM. BEAVER DAM (NDI I.D. NUMBER PA--ETC(U)

JUN 79    DACW31-79-C-0013

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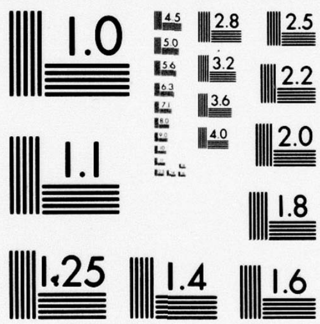


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(15) DACW31-79-C-0013

## PREFACE

(12) 140 (11) Jun 79

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 topograhic 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 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.

(6) National Dam Inspection Program. Beaver Dam (NDI I.D. Number PA-00453, PennDER Number 65-7), Ohio River Basin, Beaver Run, Westmoreland County, Pennsylvania. Phase I Inspection Report.







411002 Gw

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

## ABSTRACT


Beaver Dam: NDI I.D. No. PA-00453

| | |
|---|---|
| Owner: | Municipal Authority of Westmoreland County |
| State Located: | Pennsylvania (PennDER I.D. No. 65-7) |
| County Located: | Westmoreland |
| Stream: | Beaver Run |
| Inspection Date: | 25 May 79 |
| Inspection Team: | GAI Consultants, Inc.<br>570 Beatty Road<br>Monroeville, Pennsylvania 15146 |

[cont'd from p. 1]

Based on a visual inspection, operational history, and available engineering data, the dam is considered to be in poor condition. The defunct facility has been essentially abandoned since 1952 and its reservoir is sediment filled.

The size classification of the facility is small and its hazard classification is considered to be high. In accordance with the recommended guidelines, the spillway design flood (SDF) for the facility is considered to be the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate that the facility is capable of passing and/or storing only 36 percent of the PMF without embankment overtopping. Overtopping and embankment failure is also anticipated under floods of less than 1/2 PMF magnitude which would result in an increase in the potential for loss of life downstream of the dam. Thus, based on screening criteria contained in the recommended guidelines, the spillway is considered seriously inadequate.

Structural deficiencies noted by the inspection team included substantial embankment overgrowth, an access road cut through the embankment near the left abutment, cracking of the masonry spillway wingwalls, and a sediment filled reservoir.

Due to the seriously inadequate spillway and overall poor condition, the facility is considered unsafe but non-emergency as failure is not considered imminent. However, it is

recommended that the owner immediately develop a warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

In addition, as the facility is essentially abandoned and the reservoir is sediment filled, it is recommended that the owner assess the feasibility of dismantling the embankment in accordance with PennDER, Division of Dam Safety, regulations and/or modifying the facility to eliminate the potential hazard due to possible failure from overtopping.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Approved by:

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
BERNARD M. MIHALCIN
ENGINEER
20371-E

Date 19 July 1979

Date 13 August 1979

OVERVIEW PHOTOGRAPH

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
BEAVER DAM
NDI# PA-453, PENNDER# 65-7

SECTION 1
GENERAL INFORMATION

## 1.0 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.

## 1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

## 1.2 Description of Project.

a. Dam and Appurtenances. Beaver Dam is an earth embankment approximately 32 feet high and 385 feet long (including spillway). The defunct facility no longer serves its original purpose as a water supply facility and has been idle since 1952. The dam is constructed with a masonry spillway located about 35 feet left of the right abutment. The crest of the spillway is 100 feet long and about 11 feet below the top of its wingwalls. [Cont'd on p. ii]

Several outlet conduits are associated with the facility; however, only one presently retains a degree of operability. That conduit, a 48-inch diameter blowoff pipe, is reportedly located in a rock tunnel cut through the right abutment which discharges adjacent to the right spillway wingwall.

b. Location. Beaver Dam is located across Beaver Run in Washington Township, Westmoreland County, Pennsylvania, about 1/2-mile upstream of the confluence of Beaver Run and the Kiskiminetas River. The towns of Apollo and Vandergrift, Pennsylvania, are situated downstream about 2 miles north of the facility. The dam and reservoir are located within the Vandergrift, Pennsylvania, U.S.G.S. 7.5 minute topographic quadrangle (see Appendix G). The coordinates of the dam are N40° 34.9' and W79° 34.3'.

c. Size Classification. Small (32 feet high, 148 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Municipal Authority of Westmoreland County
P. O. Box 730
Greensburg, Pennsylvania 15601

f. Purpose of Dam. Formerly water supply; has not been in active operation since 1952.

g. Historical Data. A historical report available from PennDER files (dated May 18, 1915) indicates that Beaver Dam was constructed in 1901-1902 by the Apollo Water Works Company, a wholly owned subsidiary of the Pennsylvania Water Company, to serve the water supply needs of nearby communities. The facility was designed by James H. Harlow and Company of Pittsburgh, Pennsylvania.

Available correspondence from PennDER files indicates that reservoir siltation was a major problem at this facility throughout its history. Modifications to the outlet works were made on two separate occasions for the purpose of aiding in silt removal. Sometime between the years of 1902 and 1915, a hole was cut through the face of the spillway and a 24-inch diameter cast iron pipe (C.I.P.) installed. This conduit was to provide a means of blowing out the silt behind the dam, but its success was limited. In 1919, a tunnel was excavated through rock in the right abutment and a 48-inch diameter blowoff line installed, primarily for the purpose of desilting the reservoir. Correspondence indicates that in 1924, it was proposed that the sediment be removed by hydraulic means; however, it is not known whether or not the plan was executed. In 1941, the reservoir was reported to be totally sediment filled.

A state inspection report dated 1935 indicated that ownership of the facility was transferred to the Vandergrift Water Company sometime after 1932. Maintenance of the facility appears to have steadily declined with maintenance-related deficiencies being addressed in 1948 and 1964 state inspection reports.

Beaver Dam was phased out of active service upon completion of the upstream Beaver Run Dam in the early 1950's. At this time, both facilities were owned and operated by the Municipal Authority of Westmoreland County. Downstream facilities, including filters, pump house, and caretaker's house were subsequently removed and the facility, for all intents and purposes, has been abandoned.

1.3 Pertinent Data.

a. Drainage Area (square miles). 10.9 (local)
54.4 (total)

b. Discharge at Dam Site. Discharge records are not available.

c. Elevation (feet above mean sea level). The following elevations were obtained through field measurements that were based on the elevation of the emergency spillway crest at 843.5 feet.

| | |
|---|---|
| Top of Dam | 850.8 (low spot) |
| Maximum Design High Water | Not known |
| Maximum Pool of Record | Not known |
| Normal Pool | 843.5 |
| Spillway Crest | 843.5 |
| Outlet Upstream Invert | Not known |
| Outlet Downstream Invert | Not known |
| Streambed at Dam Center | Not known |
| Base of Stilling Basin | 818.8 |
| Maximum Tailwater | Not known |

d. Reservoir Length (feet).

| | |
|---|---|
| Top of Dam | 5000 |
| Normal Pool | 4000 |

e. Storage (acre-feet).

| | |
|---|---|
| Top of Dam | 148 |
| Normal Pool | 18 |

f. Reservoir Surface (acres).

| | |
|---|---|
| Top of Dam | 24 |
| Normal Pool | 12 |

g. Dam.

| | |
|---|---|
| Type | Earth |
| Length | 385 feet |
| Height | 32 feet |
| Top Width | 10 feet |
| Upstream Slope | 2H:1V |
| Downstream Slope | 1.5H:1V |
| Zoning | None indicated |
| Impervious Core | None indicated |
| Cutoff | None indicated |
| Grout Curtain | None indicated |

| | | |
|---|---|---|
| h. | Overview and Regulating Tunnels. | None |
| i. | Spillway. | |
| | Type | Concrete overflow section with masonry wingwalls. |
| | Crest Elevation | 843.5 |
| | Crest Length | 100.0 feet |
| j. | Outlet Conduits. | |
| | Type | 48-inch diameter C.I.P. placed in a tunnel cut through rock in the right abutment. |
| | Length | Not known |
| | Closure | Valve with manual control mechanism located in circular, vertical chamber at right abutment. |
| | Access | Access to right abutment area is difficult. Condition of valve chamber renders valve control practically inoperable; however, valve is apparently in open position. |

## SECTION 2
## ENGINEERING DATA

### 2.1 Design.

a. Design Data Availability and Sources.

1. Hydrology and Hydraulics. No design data, calculations, or reports are available.

2. Embankment. No design data, calculations, or reports are available. Limited data pertaining to the design features of Beaver Dam are contained within PennDER files in the form of state inspection reports, dated photographs, and miscellaneous correspondence. No design or construction drawings are available. A brief stability analysis (dated 1915) of the spillway structure, presumably by PennDER personnel, is also available.

3. Appurtenant Structures. See 2 above.

b. Design Features.

1. Embankment. Based on information contained in PennDER files, general statements can be made regarding the embankment design. The facility was constructed in 1901-1902 and consists of three sections, a masonry and concrete spillway flanked by earth embankments. The right embankment is about 35 feet long while the left embankment measures about 250 feet in length. No information is available pertaining to the internal design of the earth section or the foundation. The embankment was constructed with a 2H:1V upstream slope, a 1.5H:1V downstream slope, and a 10-foot top width. The original embankment upstream slope was covered with stone to the flow line while the remainder of the embankment was grass covered.

2. Spillway. The spillway overflow is constructed of rubble masonry covered with a facing of concrete. It is 100 feet long and flanked by rubble masonry wingwalls. The structure is reportedly placed on a shale foundation and is constructed with a corewall that is carried 30 feet into both embankment sections.

3. Outlet Works. The facility was originally constructed with a 24-inch diameter C.I.P. passing under the main embankment and reportedly founded in natural soil. The conduit was separated into three lines downstream of the embankment with a 24-inch diameter by 16-inch diameter cross. One line continued to the filter plant, one reduced to a 12-inch diameter blowoff that discharged into the stream channel,

while the third line served as a reserve supply line. The outlet works were modified twice subsequent to the original construction. The modifications included the installation of a 24-inch diameter C.I.P. through the spillway and a 48-inch diameter conduit placed in a tunnel excavated through rock in the right abutment. Both modifications were presumably undertaken to provide a means of discharging sediment accumulations.

b. Design Data and Procedures.

1. Hydrology and Hydraulics. No design data or information relative to design procedures are available.

2. Embankment. None available.

3. Appurtenant Structures. None available.

## 2.2 Construction Records.

No construction records are available for the facility.

## 2.3 Operational Procedures.

The facility has not been in active operation since 1952 and is now sediment filled and self-regulating. During the visual inspection, discharge was observed from the vicinity of the 48-inch diameter blowoff line reportedly located at the right abutment which remains open year round.

## 2.4 Other Investigations.

There are no available records concerning formal studies or investigations of Beaver Dam other than inspection reports from PennDER files dating to 1915 and a brief set of stability calculations for the spillway structure (dated May 1915).

## 2.5 Evaluation.

Information contained in PennDER files indicates Beaver Dam was constructed in 1901 and 1902. The earliest available records are contained in a historical report dated 1915, approximately 14 years after construction. Little engineering data and no drawings are available relative to the design and construction of the facility; however, sufficient information is available to make a reasonable Phase I evaluation of the dam and its appurtenances.

## SECTION 3
## VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests that it is in poor condition.

b. Embankment. Based on visual observations, the embankment is considered to be in poor condition. The slopes and crest are heavily overgrown with large trees and thick brush (see Photographs 1 and 4). The structure has been partially breached by a temporary construction road cut through the left embankment approximately 40 feet from the left abutment (see Photograph 4). The road has effectively reduced the top of dam elevation by about two feet.

c. Appurtenant Structures.

1. Spillway. The spillway is considered to be in fair condition. Cracking was observed along the wing-walls, primarily at the mortar joints (see Photograph 3). The area behind the weir is heavily sedimented while some debris, including several large logs, were found lodged against the crest and partially obstructing flow (see Photograph 1).

2. Outlet Works. The outlet works are considered to be in poor condition. The original outlet conduit, beneath the main embankment, was presumably disconnected after use of the facility was discontinued. A 24-inch diameter line extending through the face of the spillway is inoperable and has been for many years due to sedimentation behind the spillway weir. The only apparently functional outlet conduit is the 48-inch diameter pipe reportedly in a rock tunnel extending through the right abutment. This line is presumed operable as considerable discharge was observed through the abutment on the day of the inspection (see Photograph 7). The gate control, located in a circular, vertical chamber about 30 feet to the right of the spillway, is practically inaccessible and inoperable (see Photograph 5). A portion of the inlet structure was observed and also found to be in poor condition (see Photograph 6).

d. Reservoir. The reservoir behind Beaver Dam originally contained about 70 million gallons of water (215 acre-feet) and formed a 12-acre lake according to a state inspection report dated 1915. Presently, the reservoir is almost sediment filled and more resembles a marsh (see Photographs 9 and 10).

e. Downstream Channel. The stream immediately below Beaver Dam flows in a northerly direction through a partially developed valley with a broad base and steep confining slopes (see Photograph 8). The first residences are located approximately 1,500 feet downstream of the embankment (see Photographs 11 and 12). At a distance of about 1/2 mile downstream of the embankment, Beaver Run flows into the Kiskiminetas River. Within the next two miles, the banks of the Kiskiminetas are lined with residential and industrial developments as the river flows past the communities of Apollo and Vandergrift.

## 3.2 Evaluation.

The facility is in poor condition, having essentially been abandoned since 1952. The reservoir is sediment filled and offers little storage capacity. In accordance to recently enacted state legislation, the facility should be dismantled.

## SECTION 4
## OPERATIONAL PROCEDURES

### 4.1 Normal Operating Procedure.

There are no formal operating procedures associated with Beaver Dam and the facility is essentially self-regulating. The reservoir is sediment filled and has little remaining storage. Inflows are discharged directly over the spillway and through the blowoff line at the right abutment which remains open continuously.

### 4.2 Maintenance of Dam.

No formal maintenance program exists at this facility. Its overall poor condition suggests that little maintenance has been performed in many years. Essentially, the facility has been abandoned.

### 4.3 Maintenance of Operating Facilities.

See Section 4.2 (above).

### 4.4 Warning Systems.

There are no formal warning systems associated with this facility.

### 4.5 Evaluation.

Beaver Dam has not been in operation since 1952 and has essentially been abandoned. There are no formal manuals or procedures for maintaining or operating the facility. In addition, there is no formal warning system in effect at this site.

## SECTION 5
## HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

No design data, calculations, or reports are available.

5.2 Experience Data.

Actual discharge records are not available for this facility. No data related to the performance of the facility and its appurtenances during major flood events are available.

5.3 Visual Observations.

The visual inspection revealed the facility to be in a deteriorated condition. The embankment is heavily overgrown and partially breached near the left abutment by a temporary construction road. The spillway overflow section is in good condition; however, the masonry wingwalls show considerable cracking. In addition, the reservoir is sediment filled and has very little remaining storage. The above conditions raises doubts as to the facility's reliability during a major flood event.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I investigations, the Spillway Design Flood (SDF) for Beaver Dam ranges between the 1/2 PMF (Probable Maximum Flood) and the PMF. This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (high). Due to the high potential for damage to many residences as well as to the presence of two upstream impoundments, the SDF for this facility is considered to be the PMF.

b. Results of Analysis. Beaver Dam was analyzed under assumed normal operating conditions. That is, the reservoir was initially at its estimated normal pool or spillway elevation of 843.5 feet (MSL), with the low-level outlets assumed to be non-functional. The reservoir area is presently virtually silted in such that only about a 1.5-foot depth of storage exists below normal pool (Appendix C, Sheet 2). The spillway is, by design, a masonry, ogee-like weir structure with concrete facing. However, due to the silt problem, the spillway presently performs like a free overfall, critical flow control structure (Appendix C, Sheet 7). In addition, a small construction area access road was recently cut into a portion of the embankment near the left abutment which resulted in the lowering of the effective low top of dam by about 1.7 feet.

The Beaver Run Dam, located about 5.5 miles upstream from Beaver Dam along Beaver Run, was also evaluated in this analysis to assess its effects on Beaver Dam. It too was investigated under normal operating conditions. That is, the Beaver Run Dam reservoir was initially at its normal pool or spillway elevation of 1050.0 feet (MSL), with its low-level blowoff line closed. Information concerning the reservoir's elevation-storage relationship was available and used in the analysis. The Beaver Run Dam facility is serviced by a concrete shaft spillway. The 215 feet (estimated) of embankment at the left abutment is sloped such that the vertical alignment of the dam drops about 5 feet within this length (Appendix C-1, Sheet 17). Therefore, the low top of dam elevation is that corresponding to the 5-foot drop.

Finally, Gilkerson Dam, located about 0.5 mile upstream from Beaver Dam along a small tributary to Beaver Run, was included in the evaluation so that its effects on Beaver Dam could be assessed. Gilkerson Dam was also analyzed under normal operating conditions, which were assumed to be that the facility's reservoir was initially at its normal pool or spillway elevation of 1,023 feet (MSL), with its low-level outlet closed. The Gilkerson Dam spillway is a combination riprap paved and concrete chute channel, with discharges controlled by a rectangular, critical flow section. All Gilkerson Dam elevations and dimensions are based on design information contained in PennDER files.

Necessary downstream channel routing between dams and beyond Beaver Dam was done under the assumption that the streams were dry prior to the inflow of dam outflows. All pertinent engineering calculations relative to the evaluation of Beaver Dam are provided in Appendix C, while calculations relative to the evaluations of Beaver Run and Gilkerson Dams are provided in Appendix C-1 (Sheets 1 to 20 of 20, and Sheets 1 to 11 of 11, respectively).

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Beaver Dam can accommodate only about 36 percent of the PMF (the SDF) prior to the overtopping of its embankment, while the discharge/storage capacities of both Beaver Run and Gilkerson Dams can accommodate floods in excess of 50 percent of the PMF prior to their respective embankments being overtopped (Appendix C, Summary Input/Output Sheets, Sheets U and V). The low top of embankment of Beaver Dam was inundated by depths of water of about 1.8 feet under 1/2 PMF conditions, and about 4.5 feet under PMF conditions. The low tops of dam of Beaver Run and Gilkerson Dams were inundated by depths of water of about 4.0 and 0.3 feet, respectively, under PMF conditions.

Since the Beaver Dam facility cannot safely handle a flood of at least 1/2 PMF magnitude, the possibility of embankment failure under floods of less than 1/2 PMF intensity was investigated (in accordance with ETL-1110-2-234). Several feasible alternatives were analyzed, since it is difficult, if not impossible, to determine exactly how or if a specific dam will fail. The major concern of the breaching evaluations is with the impact of the various breach discharges on increasing downstream water surface elevations above those to be expected if breaching did not occur.

The Modified HEC-1 Computer Program was used for the breaching analysis with the assumption that the breaching of a dam would begin once its reservoir's water level reached the low top of dam elevation.

Two sets of breach geometry were analyzed for the Beaver Dam for each of two failure times (Appendix C, Sheet 11). The two sets of breach sections chosen were considered to be the minimum and maximum possible sections. The two failure times (total time for each breach section to reach its final dimensions) under which the two breach sections were evaluated were assumed to be a moderate time (1.0 hours) and a prolonged time (4.0 hours) so that the effects of this most sensitive variable might be examined. In addition, an average or more probable set of breach conditions was analyzed, with a failure time of 2.0 hours.

The Beaver Dam peak breach outflows (resulting from a 0.38 PMF overtopping) ranged from about 6480 cfs for the minimum section-prolonged fail time scheme, to about 7560 cfs for the maximum section-minimum fail time scheme (Appendix C, Sheet 13), based on the assumption that the silt volume behind the dam would not flow. The outflow for the average breach conditions was about 6470 cfs, compared to the non-breach 0.38 PMF peak facility outflow of about 6480 cfs (Summary Input/Output Sheets, Sheet V). The water surface elevation corresponding to the non-breach 0.38 PMF peak discharge at a section (Section 7) located about 1,200 feet downstream from the dam (at the first structure) was approximately 812.7 feet (MSL), that at a section (Section 8) located about 1,800 feet downstream from the dam was approximately 809.8 feet (MSL) (Summary Input/Output Sheets, Sheet V). The water surface elevations corresponding to the average condition peak breach outflow at the two above-mentioned downstream sections were about 813.0 feet (MSL) and 810.6 feet (MSL), respectively (Summary Input/Output Sheets, Sheet EE). The approximate elevations of the first three houses located at Section 7 are about 819 feet (MSL), 816 feet (MSL), and 811 feet (MSL); the approximate elevation of the two houses located at Section 8 is about 807 feet (MSL) (field measured). Therefore, the increase in the water surface at Section 7 caused by the failure of Beaver Dam was about 0.3 feet, with the breach water surface above the damage level of only one of the structures. The increase in the water surface at Section 8 caused by the failure of the dam was about 0.8 feet, with the breach water surface above the damage levels of both structures. (Note that those houses affected by the breach outflows would also be flooded by the 0.38 PMF even without embankment failure.)

In addition to the breaching of Beaver Dam under the assumption that the impounded silt would not move, the facility was failed assuming that the silt would indeed flow. This assumption is quite realistic, since it is highly unlikely that a significant portion of the silt volume has consolidated. The peak breach outflow (corresponding to the average breach conditions and under the 0.38 PMF overtopping event) was, then, about 7980 cfs, which resulted in downstream water surface elevations of approximately 813.6 feet (MSL) and 812.0 feet (MSL) at Sections 7 and 8, respectively (Summary Input/Output Sheets, Sheet EE). The increase in the water surface above the base elevations caused by this mode of failure was about 0.9 feet at Section 7, and about 2.2 feet at Section 8. In addition, a significant portion of the 200 or so acre-feet of silt will most probably be deposited on the immediate downstream floodplain.

The consequences of dam failure can be better envisioned if not only the increase in the height of the floodwave is considered, but also the great increase in the momentum that the larger and probably swifter moving volume of water will possess. Therefore, the failure of Beaver Dam under floods of less than 1/2 PMF magnitude is quite possible, and will most probably lead to increased property damage (both water and silt damage) and loss of life in the downstream community.

5.6 Spillway Adequacy.

As presented previously, under existing conditions Beaver Dam can accommodate only about 36 percent of the PMF (the SDF) prior to overtopping of its embankment. Should a 0.38 PMF or larger event occur, the dam will be overtopped and will possibly fail, endangering many residences in the immediate downstream area. Therefore, the spillway of Beaver Dam is considered to be seriously inadequate.

## SECTION 6
## EVALUATION OF STRUCTURAL INTEGRITY

### 6.1 Visual Observations.

a. Embankment. The conditions observed during the field inspection suggest the embankment is in poor condition suffering from a long-term lack of maintenance and care. Such extensive and on-going deterioration is considered serious in light of the age of the facility and its hazard classification.

b. Appurtenant Structures.

1. Spillway. The condition of the spillway is considered fair. No signs of deterioration were observed along the overflow section. Significant cracks were observed along the masonry wingwalls and their integrity under large flows is questionable.

2. Outlet Conduits. The original outlet conduits associated with the facility have been disconnected and presumably plugged. The 24-inch diameter pipe through the face of the spillway has not functioned for many years, due to sedimentation behind the dam. The 48-inch diameter pipe through the right abutment was discharging during the field inspection and reportedly discharges continuously.

### 6.2 Design and Construction Techniques.

No information is available that details the methods of design and/or construction.

### 6.3 Past Performance.

No formal records of past performance are available from the owner; however, historical accounts and inspection reports available from PennDER recount a history of reservoir siltation that could not be controlled. The facility appears to have been well-maintained up until about 1932. A noticeable increase in maintenance related deficiencies is evident in available correspondence for the succeeding years.

### 6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and is, thus, subject to minor earthquake induced dynamic forces. It is thought that the static stability of the structure is sufficient to withstand such forces; however, no calculations or investigations were performed to confirm this opinion.

## SECTION 7
## ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. Visual observations indicate the overall facility to be in poor condition and essentially abandoned. Hydrologic and hydraulic calculations performed during this investigation indicate that the facility will pass only 36 percent of the Probable Maximum Flood (PMF) prior to overtopping of the embankment. Based on screening criteria provided by the Department of the Army, Office of Chief of Engineers, the spillway is deemed to be "seriously inadequate" and the facility is considered to be "unsafe-non-emergency".

Structural deficiencies noted by the inspection team included heavy overgrowth of the embankment, an access road cut through the embankment near the left abutment, cracking of the masonry spillway wingwalls, and a sediment filled reservoir.

b. Adequacy of Information. The available data is considered adequate based on the current disposition of the facility.

c. Urgency. Because of the seriously inadequate spillway, a formal warning system should be immediately implemented. Studies related to the final disposition of the facility, as discussed below, should be initiated immediately.

d. Necessity for Additional Investigations. Due to the fact that the facility has been essentially abandoned and its reservoir filled with sediment, it is recommended that the owner assess the feasibility of dismantling and/or modifying the facility to eliminate its potential hazard due to possible failure from overtopping.

7.2 Recommendations/Remedial Measures.

Due to the seriously inadequate spillway classification, the facility is considered unsafe. Failure is not considered imminent; however, it is recommended that the owner immediately develop a warning system to notify downstream residents should hazardous conditions develop. Included in the plan should be provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

In addition, as the facility is essentially abandoned and the reservoir sediment filled, it is recommended that the owner assess the feasibility of dismantling the embankment in accordance with PennDER, Division of Dam Safety, regulations and/or modifying the facility to eliminate the potential hazard due to possible failure from overtopping.

# APPENDIX A

## CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM: Beaver Dam

NDI#: PA-453 PENNDER#: 65-7

| ITEM | REMARKS NDI# PA - 453 |
|---|---|
| PERSONS INTERVIEWED AND TITLE | Paul Baker (Security - Municipal Authority of Westmoreland County) |
| REGIONAL VICINITY MAP | See Appendix G.<br>(U.S.G.S. 7.5 minute series topographic quadrangle Vandergrift, PA, dated 1953 and photorevised in 1969) |
| CONSTRUCTION HISTORY | Inferred from information contained in PennDER files.<br>Good historical report dated May 18, 1915.<br>Good photographs (4) from 1909 and 1915. |
| AVAILABLE DRAWINGS | No design drawings are available.<br>(See Field Sketch, Figure 1, Appendix F) |
| TYPICAL DAM SECTIONS | No design drawings are available. |
| OUTLETS:<br>PLAN<br>DETAILS<br>DISCHARGE RATINGS | No design drawings are available. Discharge rating curves are not available. |

| ITEM | REMARKS NDI# PA - 453 |
|---|---|
| SPILLWAY:<br>PLAN<br>SECTION<br>DETAILS | No design drawings are available. |
| OPERATING EQUIPMENT<br>PLANS AND DETAILS | No design drawings are available. |
| DESIGN REPORTS | None available |
| GEOLOGY REPORTS | None available |
| DESIGN COMPUTATIONS:<br>HYDROLOGY AND HYDRAULICS<br>STABILITY ANALYSES<br>SEEPAGE ANALYSES | No design data, calculations, or reports are available. |
| MATERIAL INVESTIGATIONS:<br>BORING RECORDS<br>LABORATORY TESTING<br>FIELD TESTING | None available. |

NDI# PA - 453

| ITEM | REMARKS |
|---|---|
| BORROW SOURCES | Not known |
| POST CONSTRUCTION DAM SURVEYS | None |
| POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS | None, other than ten state inspection reports contained in PennDER files. |
| HIGH POOL RECORDS | Not known |
| MONITORING SYSTEMS | None |
| MODIFICATIONS | Sometime between the years 1902 and 1915 a hole was cut through the face of the spillway and a 24-inch diameter C.I.P. installed (currently non-functional). Present blowoff conduit located at right abutment was installed in 1919. Original outlet works and downstream treatment facilities were disconnected and removed sometime after the facility ceased operations in 1952. |

ENGINEERING DATA (CONTINUED)



| ITEM | REMARKS NDI# PA - 453 |
|---|---|
| PRIOR ACCIDENTS OR FAILURES | None recorded. |
| MAINTENANCE: RECORDS MANUAL | Facility has not been in operation since 1952. No maintenance is regularly performed on the facility and no records or formal manual are available. |
| OPERATION: RECORDS MANUAL | No records or formal manual are available. The facility ceased operations in 1952. |
| OPERATIONAL PROCEDURES | Blowoff line at the right abutment discharges continuously and the facility is essentially self-regulating. |
| WARNING SYSTEM AND/OR COMMUNICATION FACILITIES | None. |
| MISCELLANEOUS | |

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-453
PENN DER ID # 65-7


SIZE OF DRAINAGE AREA: 54.4 square miles (total); 10.9 square miles (local)

ELEVATION TOP NORMAL POOL: 843.5 STORAGE CAPACITY: 148

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 850.8 STORAGE CAPACITY: 18

SPILLWAY DATA

CREST ELEVATION: 843.5

TYPE: Uncontrolled masonry spillway with concrete-faced overflow crest

WIDTH: 100 feet

LENGTH: N/A

SPILLOVER LOCATION: 35 feet from right abutment

NUMBER AND TYPE OF GATES: none

OUTLET WORKS

TYPE: 48-inch diameter C.I.P.

LOCATION: Excavated through at base of right abutment

ENTRANCE INVERTS: not known

EXIT INVERTS: not known

EMERGENCY DRAWDOWN FACILITIES: 48-inch diameter gate valve located at base of vault in the embankment adjacent the right abutment.

HYDROMETEOROLOGICAL GAGES

TYPE: none

LOCATION: --

RECORDS: --

MAXIMUM NON-DAMAGING DISCHARGE: not known

# APPENDIX B

# CHECKLIST - VISUAL INSPECTION

# CHECK LIST
# VISUAL INSPECTION
# PHASE 1



NAME OF DAM Beaver Dam STATE Pennsylvania COUNTY Westmoreland

NDI# PA - 453 PENNDER# 65-7

TYPE OF DAM Earth SIZE Small HAZARD CATAGORY High

DATE(S) INSPECTION 25 May 1979 WEATHER clear and sunny TEMPERATURE 70 @ 2:00 PM

POOL ELEVATION AT TIME OF INSPECTION 843.5 M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

| INSPECTION PERSONNEL | OWNER REPRESENTATIVES | OTHERS |
|---|---|---|
| B. M. Mihalcin | Paul Baker (security - | |
| W. J. Veon | Municipal Authority of | |
| D. L. Bonk | Westmoreland Dam) | |
| | | |
| | | |

RECORDED BY D. L. Bonk

EMBANKMENT

| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA - 453 |
| --- | --- |
| SURFACE CRACKS | None observed. |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | The downstream face of the embankment left of the spillway exhibits a change in slope along the toe which may or may not be as constructed. |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | The downstream slope of the embankment right of the spillway is fairly steep and shows signs of erosion behind the wingwalls. Minor erosion is evident across the entire embankment and can generally be attributed to a lack of proper upkeep. |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST | Vertical - good<br>Horizontal - irregular with a temporary construction road cut through the left embankment near the left abutment. |
| RIPRAP FAILURES | No riprap observed. |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | Good |

EMBANKMENT

| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA - 453 |
| --- | --- |
| DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS) | None observed. Reservoir is almost completely silted and stores little water. |
| ANY NOTICEABLE SEEPAGE | None observed. |
| STAFF GAGE AND RECORDER | None observed. |
| DRAINS | None observed. |
| | |
| | |

OUTLET WORKS

| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA -453 |
|---|---|
| INTAKE STRUCTURE | Semi-circular masonry structure located approximately 100 feet upstream of the embankment to the right of the spillway. Heavy quantities of silt, much, and dried leaves have covered most of the structure such that the inlet could not be observed. |
| OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES) | Entire outlet conduit is located underground in rock at the right abutment and was not observable. |
| OUTLET STRUCTURE | None. Flow discharges through 48-inch C.I.P. laid in a tunnel cut through rock within right abutment. |
| OUTLET CHANNEL | The outlet conduit discharges behind the downstream end of the right wingwall of the spillway and into the natural stream below the dam. |
| GATE(S) AND OPERATIONAL EQUIPMENT | A single valve control mechanism is located in a circular masonry vertical vault located in the embankment adjacent the right abutment. The vault contains no cover, ladder, or floor stand making access to and operation of the valve impractical. |
| | |

## EMERGENCY SPILLWAY

| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA - 453 |
|---|---|
| TYPE AND CONDITION | Uncontrolled masonry spillway with a concrete-faced overflow section and masonry wingwalls located about 35 feet from the right abutment. |
| APPROACH CHANNEL | 50- to 100-foot wide channel formed as a result of heavy reservoir siltation. Channel bottom is composed of a deep layer of very soft silt. |
| SPILLWAY CHANNEL AND SIDEWALLS | Concrete-faced overflow section showed no signs of deterioration. Forebay is completely silted. Cracking, particularly along the mortar joints, but, also in the blocks themselves, was evident in both wingwalls. |
| STILLING BASIN PLUNGE POOL | Located immediately below the spillway, the plunge pool was completely submerged and not observed. |
| DISCHARGE CHANNEL | Natural stream (Beaver Run) about 100 feet wide immediately below the spillway and narrowing to about 50 feet wide several hundred feet downstream. |
| BRIDGE AND PIERS | None. |
| EMERGENCY GATES | None. |

SERVICE SPILLWAY

NDI# PA - 453

| ITEM | OBSERVATIONS AND/OR REMARKS |
|---|---|
| TYPE AND CONDITION | N/A |
| APPROACH CHANNEL | N/A |
| OUTLET STRUCTURE | N/A |
| DISCHARGE CHANNEL | N/A |
| | |

INSTRUMENTATION

| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA - 453 |
|---|---|
| MONUMENTATION SURVEYS | None observed. |
| OBSERVATION WELLS | None observed. |
| WEIRS | None observed. |
| PIEZOMETERS | None observed. |
| OTHERS | |

## RESERVOIR AREA AND DOWNSTREAM CHANNEL



| ITEM | OBSERVATIONS AND/OR REMARKS NDI# PA - 453 |
|---|---|
| SLOPES: RESERVOIR | Steep and heavily forested. Recent highway construction along the right hillside has resulted in many falled trees strewn across the slope. |
| SEDIMENTATION | Reservoir is almost completely silted. |
| DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.) | Approximately 2000 feet downstream of the embankment, Beaver Run passes beneath a small concrete bridge for a local road. This is one of three road bridges that serve as potential channel obstructions between the embankment and Kiskiminetas River. |
| SLOPES: CHANNEL VALLEY | Steep and heavily forested valley slopes.<br><br>The channel flows on an approximately nine percent grade. |
| APPROXIMATE NUMBER OF HOMES AND POPULATION | The first downstream residences are located about 1500 feet downstream of the embankment. Five homes are located within a 500-foot stretch in this area. At a distance of about 1-mile downstream of the embankment, Beaver Run flows into the Kiskiminetas River, the banks of which are lined with residential and industrial developments as the river flows past the communitities of Apollo and Vandergrift. |
| | |

# APPENDIX C

# HYDROLOGY AND HYDRAULICS

# PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

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## DAM STATISTICS

HEIGHT OF DAM ≈ 32 FT (FIELD MEASURED)
(FROM SPILLWAY TOE TO LOW TOP OF EMBANKMENT)

MAXIMUM POOL STORAGE CAPACITY ≈ 148 AC-FT (SHEET 4)
@ TOP OF DAM

NORMAL POOL STORAGE CAPACITY ≈ 18 AC-FT (SEE NOTE 1)

DRAINAGE AREA ≈ 54.4 SQ.MI. (TOTAL)*
≈ 10.9 SQ.MI. (LOCAL)

[LOCAL AREA PLANIMETERED OFF USGS 7.5 MINUTE VANDERGRIFT AND SLICKVILLE, PA QUADS]

* SEE APPENDIX C-1, SHEET 1 OF 20, BEAVER RUN DAM CALCULATIONS

NOTE 1: ALTHOUGH THE ORIGINAL NORMAL POOL STORAGE CAPACITY OF THE RESERVOIR WAS ABOUT 70 MILLION GALLONS OR APPROXIMATELY 215 AC-FT ACCORDING TO "REPORT UPON THE BEAVER RUN DAM OF THE APOLLO WATER WORKS COMPANY LOCATED ON BEAVER RUN, WASHINGTON TOWNSHIP, WESTMORELAND COUNTY, PA." AS FOUND IN PENN DER FILES, THE FACILITY IS PRESENTLY VIRTUALLY FILLED WITH SILT. THEREFORE, THE DESIGN CAPACITY IS ERRONEOUS AND CANNOT BE USED IN CALCULATIONS. REFER TO SHEET 2 FOR STORAGE ASSUMPTION.

## DAM CLASSIFICATIONS

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - ½ PMF TO PMF (REF 1, TABLE 3)

SUBJECT DAM SAFFTY INSPECTION
BEAVER DAM

BY WJV DATE 5-25-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 2 OF 14

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## HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 8.0 MI

$L_{CA} \approx 3.8$ MI. (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM TO THE CENTROID OF THE BASIN)

NOTE 2: VALUES OF L AND LCA ARE MEASURED FROM THE USGS 7.5 MINUTE VANDERGRIFT AND SLICKVILLE, PA QUADS. ALL VARIABLES ARE DEFINED IN REF. 2 IN THE SECTION ENTITLED, "SNYDER SYNTHETIC UNIT HYDROGRAPH"

$C_t \approx 1.6$
$C_p \approx 0.45$
[SUPPLIED BY COE; ZONE 24 OHIO RIVER BASIN]

$t_p$ = SNYDER'S STANDARD LAG $\approx 1.6\,(L \times L_{CA})^{0.3}$

$\therefore\ t_p \approx 1.6\,(8.0 \times 3.8)^{0.3} \approx 4.46$ HRS

## RESERVOIR SURFACE AREAS AND STORAGE VOLUMES

SURFACE AREA (SA) @ NORMAL POOL EL 843.5 FT ≈ 12 AC (ORIGINALLY)

NOTE 3: SINCE DESIGN DRAWINGS WERE NOT AVAILABLE FOR THIS FACILITY, THE NORMAL POOL OR SPILLWAY CREST ELEVATION WAS ASSUMED FROM A COMBINATION OF FIELD MEASUREMENTS AND THE VANDERGRIFT, PA QUAD. THE 12 AC SA @ NORMAL POOL WAS OBTAINED FROM THE REFERENCE OF NOTE 1 (SHEET 1). THE PRESENT WATER SA IS SOMEWHAT LESS THAN THIS VALUE DUE TO THE SILTATION PROBLEM OF THE RESERVOIR. SOME

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 5-30-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 3 OF 14

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PORTIONS OF THE RESERVOIR HAVE LANDFORMS ABOVE THE NORMAL POOL WATER SURFACE, WHILE OTHER PORTIONS ARE PROBABLY DEEPER THAN SAY 1.5 FT. HOWEVER, IN ORDER TO ESTABLISH A REPRESENTATIVE STORAGE VALUE BELOW EL 843.5 FT, A CONSTANT DEPTH OF 1.5 FT OF WATER WILL BE ASSUMED TO COVER THE ENTIRE 12 AC AREA @ NORMAL POOL. THEREFORE, THE STORAGE VOLUME @ NORMAL POOL EL 843.5 FT

$\approx$ (1.5 FT)(12 AC) $\approx$ 18 AC-FT

SA @ EL 860 FT $\approx$ 37.6 AC

SA @ EL 880 FT $\approx$ 70.7 AC

[PLANIMETERED FROM THE USGS VANDERGRIFT, PA QUAD]

- ASSUME THE MODIFIED PRISMOIDAL FORMULA (REF 14, PG 15) CAN REPRESENT THE ACTUAL RELATIONSHIP BETWEEN RESERVOIR LEVEL AND VOLUME FOR BEAVER DAM RESERVOIR:

$$\Delta V_{1\to 2} \approx \frac{H}{3} \left( A_1 + A_2 + \sqrt{A_1 \times A_2} \right)$$

WHERE $\Delta V_{1\to 2}$ = INCREMENTAL VOLUME BETWEEN ELEVATIONS 1 AND 2, IN AC-FT;

$H$ = ELEVATION 2 - ELEVATION 1, IN FT;

$A_1$ = SA @ ELEVATION 1, IN AC; AND

$A_2$ = SA @ ELEVATION 2, IN AC.

ALSO, $A_i = A_o + (\Delta A/\Delta H \times H)$

WHERE $A_i$ = SA @ ELEVATION $i$, IN FT;

$A_o$ = 12 AC FOR ELEVATION $i$ < 860 FT, AND 37.6 AC FOR ELEVATION $i$ > 860 FT BUT < 880 FT;

| | |
|---|---|
| SUBJECT | DAM SAFETY INSPECTION<br>BEAVER DAM |
| BY WJV | DATE 5-30-79 |
| PROJ. NO. | 79-617-453 |
| CHKD. BY DLB | DATE 6-18-79 |
| SHEET NO. 4 OF 14 | |

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$\Delta A/\Delta H$ = RATE OF SURFACE AREA CHANGE PER FOOT OF RESERVOIR RISE $\Rightarrow \Delta A/\Delta H \approx \frac{(37.6 - 12.0)\,AC}{(860 - 843.5)\,FT} \approx 1.6 \frac{AC}{FT}$ FOR ELEVATION $i$ < 960 FT, AND $\Delta A/\Delta H \approx \frac{(70.7 - 37.6)}{(880 - 860)\,FT}$ $\approx 1.7 \frac{AC}{FT}$ FOR ELEVATION $i$ > 860 FT BUT < 880 FT, AN[D]

H = ELEVATION $i$ − 843.5 FT FOR ELEVATION $i$ < 860 FT, AND H = ELEVATION $i$ − 860 FT FOR ELEVATION $i$ < 860 FT BUT > 880 FT

- ELEVATION - STORAGE RELATIONSHIP :

| | ELEVATION (FT) | $A_i$ (AC) | $\Delta V_{1\to2}$ (AC-FT) | TOTAL VOLUME MODIFIED PRISMOIDAL (AC-FT) | TOTAL VOLUME ASSUMED * (AC-FT) |
|---|---|---|---|---|---|
| | 842.0 | — | — | — | 0 |
| | 843.0 | — | — | — | 12 |
| NORMAL POOL - | 843.5 | 12.0 | 0 | 18 | 18 |
| | 844.5 | 13.6 | 13 | 31 | |
| | 845.5 | 15.2 | 14 | 45 | |
| | 846.5 | 16.8 | 16 | 61 | |
| | 847.5 | 18.4 | 18 | 79 | |
| | 848.5 | 20.0 | 19 | 98 | |
| | 849.5 | 21.6 | 21 | 119 | |
| LOW TOP OF DAM - | 850.8 | 23.7 | 29 | 148 | |
| | 852.0 | 25.6 | 30 | 178 | |
| | 854.0 | 28.9 | 54 | 232 | |
| | 856.0 | 32.0 | 61 | 293 | |
| | 858.0 | 35.2 | 67 | 360 | |
| | 860.0 | 37.6 | 73 | 433 | |
| | 862.0 | 41.0 | 79 | 512 | |
| | 864.0 | 44.4 | 85 | 597 | |
| | 866.0 | 47.8 | 92 | 689 | |
| | 868.0 | 51.2 | 99 | 788 | |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 5-31-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 5 OF 14

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## PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
(CORRESPONDING TO A DURATION OF 24 HR AND AN AREA OF 200 SQ. MI. LOCATED IN SOUTHWESTERN PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #7 (REF 3, FIG 1)

- LOCAL DRAINAGE AREA ≈ 10.9 SQ. MI. HOWEVER, THE STORM WILL BE CENTERED OVER THE TOTAL DRAINAGE AREA ABOVE BEAVER DAM ≈ 54.4 SQ. MI. ⇒

| DURATION (HR) | PERCENT OF INDEX RAINFALL (%) |
|---|---|
| 6 | 85 |
| 12 | 103 |
| 24 | 113 |
| 48 | 124 |

(FROM REF 3, FIG 2)

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 54.4 SQ MI ⇒ 0.852 (AS COMPUTED BY HEC-1)

| | |
|---|---|
| SUBJECT | DAM SAFETY INSPECTION<br>BEAVER DAM |
| BY WJV | DATE 5-31-79 |
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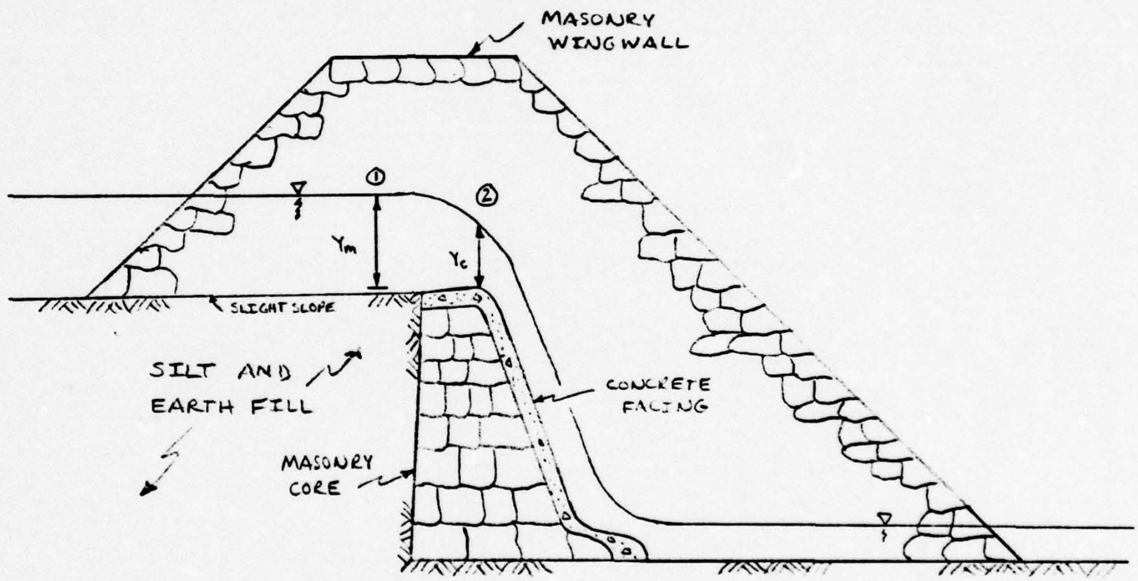
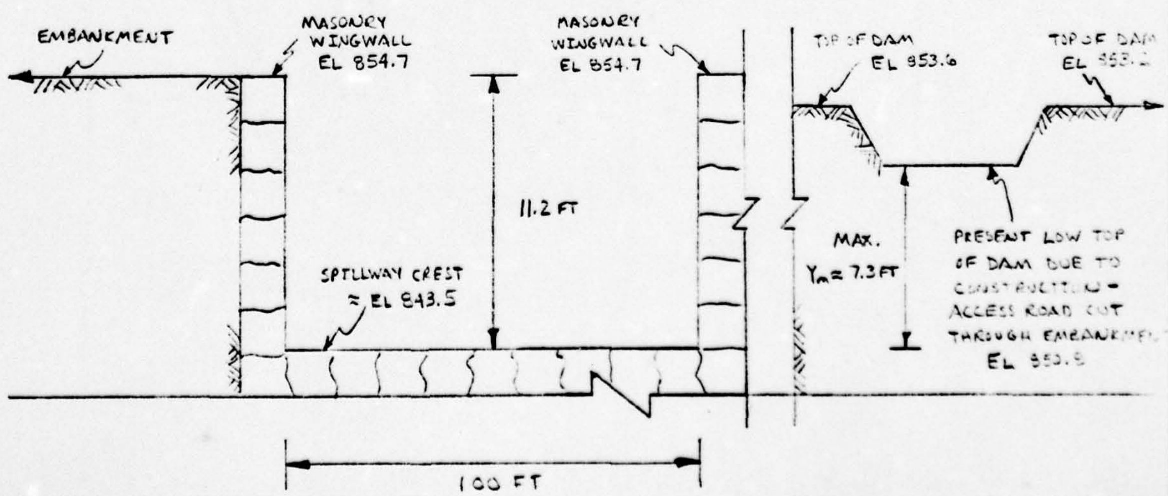
## SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(FROM FIELD MEASUREMENT AND OBSERVATION, AND REF IN NOTE 1)




- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
(FROM FIELD MEASUREMENTS AND OBSERVATION, AND REF IN NOTE 1)




SECTION LOOKING US TOWARD DAM

- THE DISCHARGE OVER THE FREE OVERFALL SPILLWAY HAS BEEN REDUCED TO CRITICAL FLOW CONTROL DUE TO THE SILTATION OF THE FOREBAY OF THE OGEE-LIKE SPILLWAY WEIR.

∴ CRITICAL FLOW WILL OCCUR @ SECTION ② (SEE SKETCH ON SHEET 6) DUE TO THE ABRUPT CHANGE FROM AN US ADVERSE SLOPE TO A DS SUPERCRITICAL SLOPE. THE CRITICAL DEPTH WILL OCCUR @ ②, WHILE THE MAXIMUM RESERVOIR DEPTH (ABOVE THE SPILLWAY CREST) PRIOR TO OVERTOPPING OF THE DAM ($Y_m \approx 7.3$ FT) WILL OCCUR @ SECTION ①

- ENERGY BALANCE BETWEEN ① AND ② :

$$Y_m + v_a^2/2g + z_1 = Y_c + v_c^2/2g + z_2 + H_L \quad \text{(REF 7, PG 40)}$$

WHERE $v_a \approx$ RESERVOIR VELOCITY OF APPROACH $\approx 0$ FPS ;
$z_1 = z_2 =$ ELEVATION DATUM = ELEVATION OF SPILLWAY CREST, IN FT $(z_1 - z_2 = 0)$ ;
$v_c \approx$ CRITICAL VELOCITY, IN FPS ; AND
$H_L \approx$ APPROACH CHANNEL HEAD LOSS $\approx 0$ FT

(ALTHOUGH $v_a$ AND $H_L$ ARE PROBABLY NOT REALLY EQUAL TO 0, IT IS ASSUMED THAT THEIR ACTUAL VALUES WOULD BE SUCH THAT THE $v_a^2/2g$ QUANTITY WOULD CANCEL THE $H_L$ QUANTITY ⇒ SAME RESULT AS THE "0" VALUE ASSUMPTION)

$$\therefore \quad Y_m \approx 7.3 \text{ FT} \approx Y_c + v_c^2/2g$$

- SINCE THE CRITICAL SECTION IS RECTANGULAR IN SHAPE :

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJY DATE 6-1-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 8 OF 14

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$$v_c^2/2g = Y_c/2 \qquad \text{(REF 13, PG 143)}$$

$$\therefore \quad 7.3\text{ FT} \approx Y_c + v_c^2/2g \approx Y_c + Y_c/2 \approx \tfrac{3}{2} Y_c$$

$$Y_c \approx 4.9 \text{ FT}$$

- SINCE $Y_c \approx 4.9$ FT $\Rightarrow A_c \approx (100\text{ FT})(Y_c) \approx (100)(4.9) \approx 490\text{ FT}^2$

$$v_c \approx \sqrt{(Y_c/2)\,2g} \approx \sqrt{g Y_c} \approx \sqrt{g(4.9)} \approx 12.6 \text{ FPS}$$

$\therefore$ CAPACITY OF SPILLWAY $= Q = A_c v_c \approx (490\text{ FT}^2)(12.6\text{ FPS}) \approx 6170$ CFS

## SPILLWAY RATING CURVE

COMPUTED INTERNALLY BY HEC-1 VIA THE TRAPEZOIDAL RATING CURVE ROUTINE, BASED ON THE SPILLWAY GEOMETRY PRESENTED ON SHEET 6. THE TRAPEZOIDAL ROUTINE CALCULATES CRITICAL CONTROL DISCHARGES IN A WAY SIMILAR TO THAT OUTLINED ON SHEETS 7 AND 8. (SEE SUMMARY INPUT / OUTPUT SHEETS)

## DAM EMBANKMENT RATING CURVE

- FLOWS OVER THE EMBANKMENT WILL BE COMPUTED INTERNALLY BY HEC-1 VIA THE ASSUMPTION THAT CRITICAL DEPTH OCCURS ON THE CREST W/ THE CREST PROFILE REPRESENTED BY A SERIES OF TRAPEZOIDS. (SEE SUMMARY INPUT / OUTPUT SHEETS).

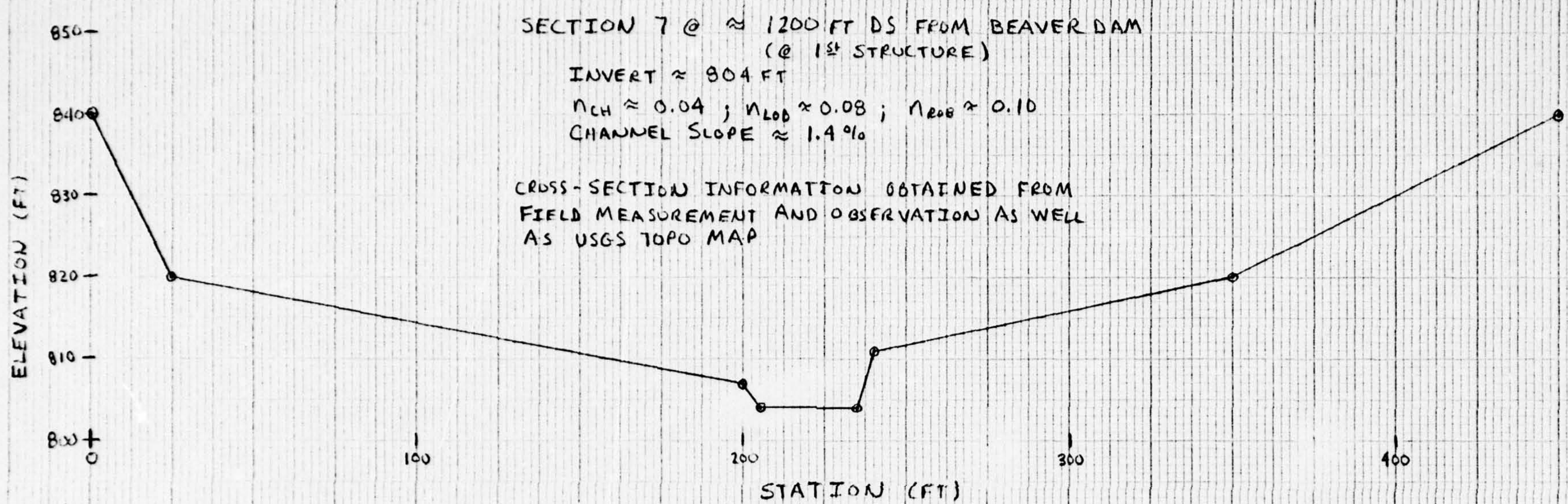
- PRESENTLY A SMALL "DIRT ROAD" IS CUT THROUGH THE EMBANKMENT AT ABOUT 40 FT FROM THE LEFT ABUTMENT. THE PRESENCE OF THIS CUT HAS LOWERED THE PREVIOUS LOW TOP OF DAM BY AN ADDITIONAL 1.7 FT. THIS ROAD CUT WILL BE CONSIDERED IN THIS ANALYSIS.

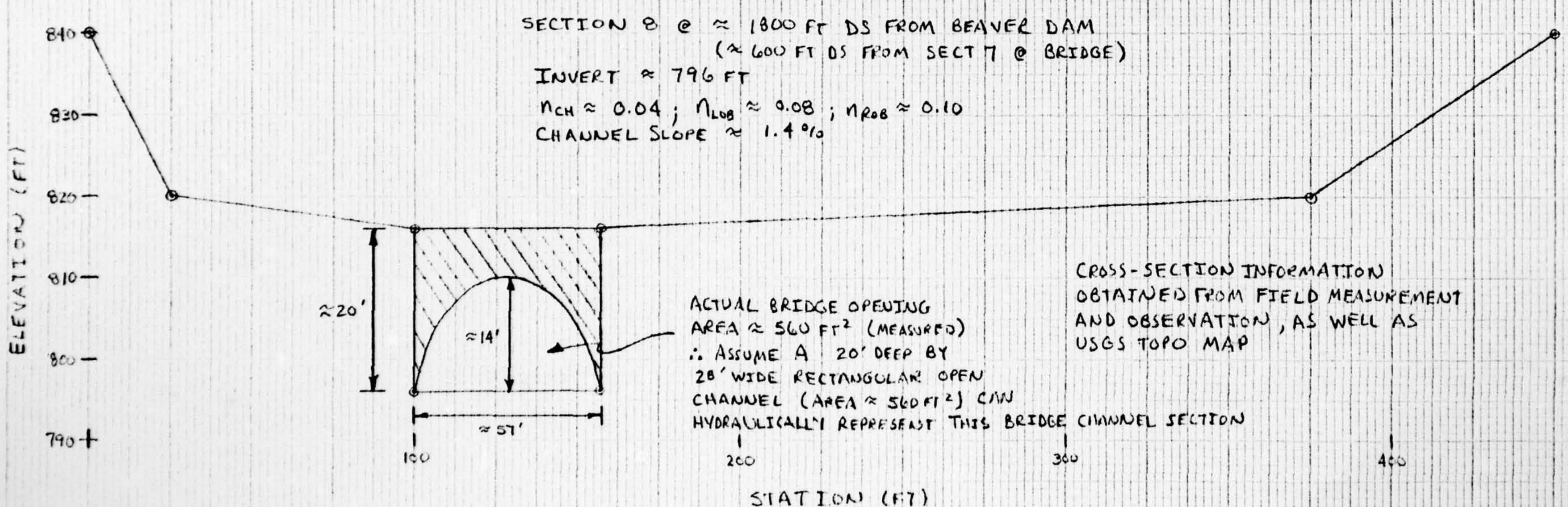
- INPUT INFORMATION : (BASED ON FIELD MEASUREMENTS)

| RESERVOIR ELEVATION (FT) | DEPTH OF WATER ABOVE CREST (FT) | LENGTH OF CREST INUNDATED (FT) | |
|---|---|---|---|
| 850.8 | 0 | 0 | |
| 851.3 | 0.5 | 20 | |
| 852.5 | 1.7 | 20 | |
| 853.0 | 2.2 | 45 | |
| 853.2 | 2.4 | 95 | |
| 853.3 | 2.5 | 150 | |
| 853.5 | 2.7 | 180 | |
| 853.6 | 2.8 | 225 | |
| 854.5 | 3.7 | 250 | |
| 854.7 | 3.9 | 285 | |
| 860.0 | 9.2 | 305 | ASSUMED BASED ON STEEP VALLEY SIDE SLOPES ≈ (2H TO 1V) |
| 868.0 | 17.2 | 340 | |

# DOWNSTREAM ROUTING SECTIONS





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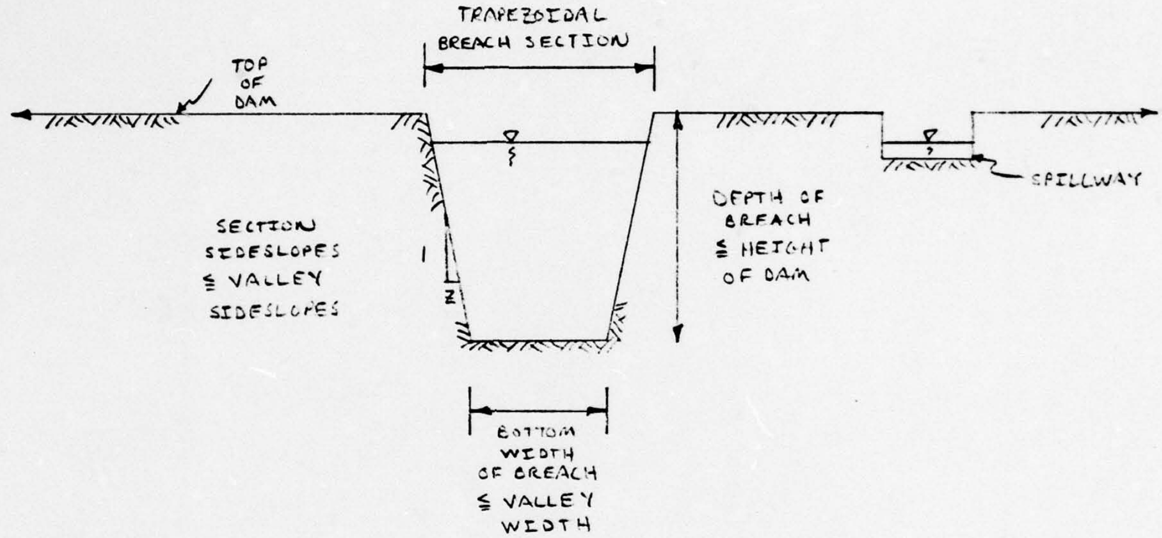
## BREACH ASSUMPTIONS

- TYPICAL BREACH SECTION:




- HEC-1- DAM BREACHING ANALYSIS INPUTS :

(ALL BREACHING WILL BEGIN WHEN THE RESERVOIR LEVEL REACHES THE LOW TOP OF DAM ELEVATION)

| * PLAN NUMBER AND COMMENT | BREACH BOTTOM WIDTH (FT) | MAX BREACH DEPTH (FT) | SECTION SIDESLOPES | * BREACH TIME (HR) | WSEL @ START OF FAILURE (FT) |
|---|---|---|---|---|---|
| ① MIN. BREACH SECT; MIN FAIL TIME | 0 | 8 | ½ to 1 | 1.0 | 850.8 |
| ② MAX. BREACH SECT; MIN FAIL TIME | 200 | 8 | 2 to 1 | 1.0 | 850.8 |
| ③ MIN. BREACH SECT; MAX FAIL TIME | 0 | 8 | ½ to 1 | 4.0 | 850.8 |
| ④ MAX BREACH SECT; MAX FAIL TIME | 200 | 8 | 2 to 1 | 4.0 | 850.8 |
| ⑤ AVERAGE POSSIBLE CONDITIONS | 100 | 8 | 1 to 1 | 2.0 | 850.8 |
| ** ⑥ AVERAGE POSSIBLE CONDITIONS | 100 | 25 | 1 to 1 | 2.0 | 850.8 |

* BREACH TIME = TOTAL TIME NECESSARY TO REACH FINAL BREACH DIMENSIONS

** PLANS ① → ⑤ WILL BE UNDER THE ASSUMPTION THAT THE SILT BEHIND THE DAM DOES NOT MOVE UPON BREACHING, PLAN ⑥ WILL ASSUME THAT THE SILT WILL ALSO FLOW

| | | | |
|---|---|---|---|
| SUBJECT | DAM SAFETY INSPECTION BEAVER DAM | | |
| BY WJV | DATE 6-26-79 | PROJ. NO. 79-617-453 | |
| CHKD. BY DLB | DATE 7-2-79 | SHEET NO. 12 | OF 14 |

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- THE BREACH ASSUMPTIONS LISTED ON SHEET 11 ARE BASED SOMEWHAT ON INFORMATION CONCERNING EARTH DAM BREACHING PROVIDED BY THE COE, BALTIMORE DISTRICT; AND ALSO ON THE PHYSICAL CONSTRAINTS OF THE DAM AND SURROUNDING TERRAIN:

| CONSTRAINT | VALUE | |
|---|---|---|
| - MAXIMUM HEIGHT OF EMBANKMENT | ≈ 32 FT | FIELD MEASURED |
| AVERAGE HEIGHT OF EMBANKMENT | ≈ 25 FT | |
| DEPTH OF EMBANKMENT TO TOP OF DEPOSITED SILT | ≈ 9 FT | |
| - EMBANKMENT CREST LENGTH: | | |
| LENGTH TO LEFT OF SPWY | ≈ 250 FT | FIELD MEASURED |
| LENGTH TO RIGHT OF SPWY | ≈ 35 FT | |
| - VALLEY BOTTOM WIDTH: | | |
| @ DEPOSITED SILT ELEVATION | ≈ 395 FT | (FIELD MEASURED) |
| @ 25 FT BELOW TOP OF DAM | ≈ 200 FT | (FIELD OBSERVATION) |
| - VALLEY SIDESLOPES ADJACENT TO DAM: | | |
| RIGHT WALL | ≈ 2H TO 1V | USGS TOPO MAP |
| LEFT WALL | ≈ 2H TO 1V | |

- IN ORDER TO EVALUATE THE POSSIBILITY (OR PROBABILITY) THAT THE DEPOSITED SILT WILL ALSO FLOW DURING EMBANKMENT BREACHING, THE ESTIMATED VOLUME OF SILT BEHIND THE DAM (≈ 200 AC-FT, FROM REF IN NOTE 1, SHEET 1) MUST BE ADDED TO THE RESERVOIR STORAGE VALUES ON SHEET 4 W/ "0" STORAGE ELEVATION ≈ 515.8 FT

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-29-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. 13 OF 14

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# HEC-1-DAM BREACHING ANALYSIS OUTPUT:

## RESERVOIR DATA

UNDER 0.38 PMF BASE FLOW CONDITIONS (W/ BOTH BEAVER RUN AND GILKERSON DAMS ABLE TO PASS THE ENTIRE FLOOD WITHOUT BREACHING). ASSUME THE SILT BEHIND THE DAM DOES NOT MOVE UPON BREACHING.

| PLAN* NUMBER | VARIABLE BREACH BOTTOM WIDTH (FT) | ACTUAL MAX FLOW DURING FAIL TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | ACTUAL PEAK FLOW THROUGH DAM (CFS) | CORRESPONDING TIME OF PEAK (HR) | TIME OF INITIAL BREACH (HR) |
|---|---|---|---|---|---|---|---|---|
| ① | 0 | 6399 | 45.33 | 6399 | 45.33 | 6471 | 46.67 | 44.33 |
| ② | 200 | 7558 | 45.33 | 7558 | 45.33 | 7558 | 45.33 | 44.33 |
| ③ | 0 | 6493 | 46.50 | 6481 | 46.67 | 6493 | 46.50 | 44.33 |
| ④ | 200 | 6777 | 46.42 | 6774 | 46.33 | 6777 | 46.42 | 44.33 |
| ⑤ | 100 | 6974 | 46.33 | 6974 | 46.33 | 6974 | 46.33 | 44.33 |

UNDER 0.38 PMF BASE FLOW CONDITIONS (W/ BOTH BEAVER RUN AND GILKERSON DAMS ABLE TO PASS THE ENTIRE FLOOD WITHOUT BREACHING). ASSUME THE SILT BEHIND THE DAM FLOWS UPON BREACHING.

| PLAN* NUMBER | VARIABLE BREACH BOTTOM WIDTH (FT) | ACTUAL MAX FLOW DURING FAIL TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | INTERPOLATED OR HEC-1 ROUTED MAX FLOW DURING FAIL TIME (CFS) | CORRESPONDING TIME OF FLOW (HR) | ACTUAL PEAK FLOW THROUGH DAM (CFS) | CORRESPONDING TIME OF PEAK (HR) | TIME OF INITIAL BREACH (HR) |
|---|---|---|---|---|---|---|---|---|
| ⑥ | 100 | 7983 | 45.59 | 7948 | 45.33 | 7983 | 45.58 | 44.33 |

* SEE TABLE ON SHEET 11

SUBJECT: DAM SAFETY INSPECTION — BEAVER DAM

BY: WJV DATE: 6-30-79 PROJ. NO. 73-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. 14 OF 14

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# HEC-1-DAM BREACHING ANALYSIS OUTPUT:

## DOWNSTREAM ROUTING DATA

UNDER 0.38 PMF BASE FLOW CONDITIONS (W/ BOTH BEAVER RUN AND GILKERSON DAMS ABLE TO PASS THE ENTIRE FLOOD WITHOUT BREACHING). ASSUME THE SILT BEHIND THE DAM DOES NOT MOVE UPON BREACHING.

| PLAN NUMBER 1. | VARIABLE BREACH BOTTOM WIDTH (FT) | OUTPUT @ SECTION 7 LOCATED 1200 FT DS OF DAM: PEAK FLOW (CFS) | CORRESPONDING WSEL 2. (FT) | WSEL W/O BREACH 3. (FT) | ΔELEV 4. (FT) | OUTPUT @ SECTION 8 LOCATED 1800 FT DS OF DAM: PEAK FLOW (CFS) | CORRESPONDING WSEL 2. (FT) | WSEL W/O BREACH 3. | ΔELEV 4. |
|---|---|---|---|---|---|---|---|---|---|
| ① | 0 | 6472 | 812.7 | 812.7 | 0.0 | 6473 | 809.8 | 809.8 | 0.0 |
| ② | 200 | 7575 | 813.4 | 812.7 | +0.7 | 7589 | 811.5 | 809.8 | +1.7 |
| ③ | 0 | 6482 | 812.7 | 812.7 | 0.0 | 6482 | 809.8 | 809.8 | 0.0 |
| ④ | 200 | 6776 | 812.9 | 812.7 | +0.2 | 6776 | 810.3 | 809.8 | +0.5 |
| ⑤ | 100 | 6978 | 813.0 | 812.7 | +0.3 | 6978 | 810.6 | 809.8 | +0.8 |

UNDER 0.38 PMF BASE FLOW CONDITIONS (W/ BOTH BEAVER RUN AND GILKERSON DAMS ABLE TO PASS THE ENTIRE FLOOD WITHOUT BREACHING). ASSUME THE SILT BEHIND THE DAM WILL FLOW UPON BREACHING.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ⑥ | 100 | 7412 | 813.6 | 812.7 | +0.9 | 7922 | 812.0 | 809.8 | +2.2 |

1. SEE TABLE ON SHEET 11. 2. WATER SURFACE ELEVATIONS CORRESPONDING TO BREACH FLOWS, FROM SUMMARY INPUT/OUTPUT SHEETS. 3. BASE FLOW ELEVATIONS CORRESPONDING TO THE PEAK 0.38 PMF, F[illegible] ANALYSIS, SUMMARY INPUT/OUTPUT SHEETS. 4. ΔELEV = CORRESPONDING WSEL - WSEL W/O BREACH.

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. A OF EE

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## OVERTOPPING ANALYSIS

## SUMMARY INPUT/OUTPUT SHEETS

```
DAM SAFETY INSPECTION
BEAVER DAM W/ US BEAVER RUN DAM AND GILKERSON DAM *** OVERTOPPING ANALYSIS ***
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

                                  JOB SPECIFICATION
  NO     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
 288       0      20       0       0       0       0       0       0       0
                        JOPER     NWT   LRUPT   TRACE
                           5       0       0       0

                        MULTI-PLAN ANALYSES TO BE PERFORMED
                            NPLAN= 1 NRTIO= 5 LRTIO= 1
   RTIOS=     .20     .30     .40     .50    1.00

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

                              SUB-AREA RUNOFF COMPUTATION

LOCAL INFLOW INTO BEAVER RUN DAM RESERVOIR

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

                                 HYDROGRAPH DATA
   IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       1       1   43.20    0.00   54.40    0.00   0.000       0       1       0

                                   PRECIP DATA
            SPFE     PMS      R6     R12     R24     R48     R72     R96
            0.00   24.00   85.00  103.00  113.00  124.00    0.00    0.00
TRSPC COMPUTED BY THE PROGRAM IS  .852

                                    LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
       0    0.00    0.00    1.00    0.00    0.00    1.00    1.00     .05    0.00    0.00

                              UNIT HYDROGRAPH DATA
                     TP=  6.17     CP= .45      NTA=   0

                                 RECESSION DATA
                  STRTQ=   -1.50    QRCSN=    -.05    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=19.22 AND R=29.45 INTERVALS
```

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

BASE FLOW PARAMETERS AS PER COE

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453
CHKD. BY DLB DATE 7-2-79 SHEET NO. B OF EE

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UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 6.22 HOURS, CP= .45 VOL= .95

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 23. | 89. | 184. | 299. | 429. | 572. | 725. | 886. | 1055. | 1230. |
| 1400. | 1555. | 1691. | 1810. | 1910. | 1990. | 2049. | 2084. | 2090. | 2051. |
| 1985. | 1919. | 1855. | 1793. | 1733. | 1675. | 1619. | 1565. | 1513. | 1463. |
| 1414. | 1366. | 1321. | 1277. | 1234. | 1193. | 1153. | 1115. | 1077. | 1041. |
| 1007. | 973. | 941. | 909. | 879. | 849. | 821. | 794. | 767. | 742. |
| 717. | 693. | 670. | 647. | 626. | 605. | 585. | 565. | 546. | 528. |
| 510. | 493. | 477. | 461. | 446. | 431. | 416. | 402. | 389. | 376. |
| 364. | 351. | 340. | 328. | 317. | 307. | 297. | 287. | 277. | 268. |
| 259. | 250. | 242. | 234. | 226. | 218. | 211. | 204. | 197. | 191. |
| 184. | 178. | 172. | 166. | 161. | 156. | 150. | 145. | 140. | 136. |

0

END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | SUM | 25.35 | 22.87 | 2.48 | 1840953. |
| | | | | | | | | | | ( 644.) | ( 581.) | ( 63.) | (52129.98) |

LOCAL INFLOW HYDROGRAPHS INTO BEAVER RUN DAM RESERVOIR

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 37206. | 34311. | 21164. | 8515. | 1840916. |
| CMS | 1054. | 972. | 599. | 241. | 52129. |
| INCHES | | 7.39 | 18.23 | 22.00 | 22.02 |
| MM | | 187.66 | 463.02 | 558.84 | 559.37 |
| AC-FT | | 17014. | 41978. | 50666. | 50714. |
| THOUS CU M | | 20986. | 51779. | 62495. | 62555. |

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 11162. | 10293. | 6349. | 2554. | 552275. |
| CMS | 316. | 291. | 180. | 72. | 15639. |
| INCHES | | 2.22 | 5.47 | 6.60 | 6.61 |
| MM | | 56.30 | 138.91 | 167.65 | 167.81 |
| AC-FT | | 5104. | 12593. | 15200. | 15214. |
| THOUS CU M | | 6296. | 15534. | 18749. | 18766. |

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 14882. | 13725. | 8466. | 3406. | 736366. |
| CMS | 421. | 389. | 240. | 96. | 20852. |
| INCHES | | 2.96 | 7.29 | 8.80 | 8.81 |
| MM | | 75.07 | 185.21 | 223.54 | 223.75 |
| AC-FT | | 6806. | 16791. | 20266. | 20286. |
| THOUS CU M | | 8395. | 20712. | 24998. | 25022. |

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 18603. | 17156. | 10582. | 4257. | 920458. |
| CMS | 527. | 486. | 300. | 121. | 26064. |
| INCHES | | 3.69 | 9.11 | 11.00 | 11.01 |
| MM | | 93.83 | 231.51 | 279.42 | 279.69 |
| AC-FT | | 8507. | 20989. | 25333. | 25357. |
| THOUS CU M | | 10493. | 25890. | 31248. | 31277. |

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. C OF EE

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```
                              HYDROGRAPH ROUTING

     ROUTE LOCAL INFLOW THROUGH BEAVER RUN DAM RESERVOIR

                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                     101       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  34000.      -1

STAGE      1050.00    1051.00    1052.00    1053.00    1054.00    1054.30    1055.00    1060.00    1065.00
           1071.00    1072.00    1073.00    1074.00    1075.00    1076.00    1077.00    1078.00

FLOW          0.00     310.00     920.00    1760.00    2730.00    3090.00    3100.00    3230.00    3340.00
           3640.00    4120.00    4960.00    6220.00    7930.00   12770.00   20190.00   29420.00

CAPACITY-        0       220      1410.     2830.     4780.     7170.    10400.    13900.    18000.    23000.
            28000.    34000.    41000.    48000.    56000.    64600.    74600.    80000.

ELEVATION=     988.      995.     1005.     1010.     1015.     1020.     1025.     1030.     1035.     1040.
              1045.     1050.     1055.     1060.     1065.     1070.     1075.     1078.

                   CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                 1050.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0

                                         DAM DATA
                                 TOPEL    COQD    EXPD  DAMWID
                                1070.0     0.0     0.0      0.

   PEAK OUTFLOW IS      6281. AT TIME  64.33 HOURS

                                    PEAK  6-HOUR  24-HOUR  72-HOUR  TOTAL VOLUME
                           CFS     6281.   6216.    5507.    3550.       768636.
                           CMS      178.    176.     156.     101.        21765.
                        INCHES              1.34     4.74     9.17          9.20
                            MM             34.00   120.48   232.98        233.56
                         AC-FT             3082.   10923.   21123.        21175.
                     THOUS CU M            3802.   13474.   26054.        26118.

   PEAK OUTFLOW IS      3138. AT TIME  59.67 HOURS

                                    PEAK  6-HOUR  24-HOUR  72-HOUR  TOTAL VOLUME
                           CFS     3138.   3137.    3126.    2003.       433304.
                           CMS       89.     89.      89.      57.        12270.
                        INCHES               .68     2.69     5.18          5.18
                            MM             17.16    68.39   131.49        131.66
                         AC-FT             1555.    6200.   11921.        11937.
                     THOUS CU M            1919.    7648.   14705.        14724.
```

BEAVER RUN DAM OUTFLOW HYDROGRAPHS

PMF

0.3 PMF

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. D OF EE

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BEAVER RUN DAM OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 3213. AT TIME 62.00 HOURS

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3213. | 3212. | 3200. | 2382. | 515215. |
| CMS | 91. | 91. | 91. | 67. | 14589. |
| INCHES | | .69 | 2.76 | 6.15 | 6.16 |
| MM | | 17.57 | 70.02 | 156.32 | 156.55 |
| AC-FT | | 1593. | 6348. | 14173. | 14193. |
| THOUS CU M | | 1965. | 7830. | 17482. | 17507. |

PEAK OUTFLOW IS 3276. AT TIME 64.00 HOURS

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3276. | 3276. | 3267. | 2478. | 536082. |
| CMS | 93. | 93. | 93. | 70. | 15180. |
| INCHES | | .71 | 2.81 | 6.40 | 6.41 |
| MM | | 17.92 | 71.47 | 162.61 | 162.89 |
| AC-FT | | 1624. | 6479. | 14742. | 14768. |
| THOUS CU M | | 2004. | 7992. | 18184. | 18216. |

## HYDROGRAPH ROUTING

ROUTE FROM BEAVER RUN DAM TO SECTION 2 * 7700 FT DS FROM BEAVER RUN DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 102 | 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 | -1. | 0 |

NORMAL DEPTH CHANNEL ROUTING
----------------------------

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .0800 | .0350 | .0900 | 966.0 | 1000.0 | 7700. | .00200 |

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

```
  50.00 1000.00  100.00  980.00  150.00  970.00  155.00  966.00  165.00  966.00
 170.00  970.00  250.00  980.00  500.00 1000.00
```

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453
CHKD. BY: DLB DATE: 7-2-79 SHEET NO. E OF EE

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 3.87 | 9.16 | 17.60 | 33.23 | 56.22 | 86.57 | 124.28 | 169.36 |
| | 284.24 | 354.41 | 433.08 | 520.23 | 615.88 | 720.01 | 832.64 | 953.76 | 1083.37 |
| OUTFLOW | 0.00 | 51.98 | 177.47 | 414.52 | 789.35 | 1328.04 | 2058.93 | 3007.77 | 4194.80 |
| | 7387.23 | 9459.93 | 11879.63 | 14668.32 | 17847.59 | 21438.59 | 25461.98 | 29938.02 | 34886.50 |
| STAGE | 966.00 | 967.79 | 969.58 | 971.37 | 973.16 | 974.95 | 976.74 | 978.53 | 980.32 |
| | 983.89 | 985.68 | 987.47 | 989.26 | 991.05 | 992.84 | 994.63 | 996.42 | 998.21 |
| FLOW | 0.00 | 51.98 | 177.47 | 414.52 | 789.35 | 1328.04 | 2058.93 | 3007.77 | 4194.80 |
| | 7387.23 | 9459.93 | 11879.63 | 14668.32 | 17847.59 | 21438.59 | 25461.98 | 29938.02 | 34886.50 |

FLOW @ 7700 FT DS FROM BEAVER RUN DAM

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6276. | 6212. | 5505. | 3528. | 763509. |
| CMS | 178. | 176. | 156. | 100. | 21620. |
| INCHES | | 1.34 | 4.74 | 9.12 | 9.13 |
| MM | | 33.98 | 120.43 | 231.52 | 232.00 |
| AC-FT | | 3081. | 10919. | 20990. | 21033. |
| THOUS CU M | | 3800. | 13468. | 25891. | 25944. |

MAXIMUM STORAGE = 245.

MAXIMUM STAGE IS 982.8

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3137. | 3137. | 3126. | 1995. | 431402. |
| CMS | 89. | 89. | 89. | 56. | 12216. |
| INCHES | | .68 | 2.69 | 5.16 | 5.16 |
| MM | | 17.16 | 68.39 | 130.95 | 131.08 |
| AC-FT | | 1555. | 6200. | 11872. | 11884. |
| THOUS CU M | | 1919. | 7648. | 14644. | 14659. |

MAXIMUM STAGE IS 978.7 MAXIMUM STORAGE = 129.

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3213. | 3212. | 3200. | 2361. | 510588. |
| CMS | 91. | 91. | 91. | 67. | 14458. |
| INCHES | | .69 | 2.76 | 6.10 | 6.11 |
| MM | | 17.57 | 70.02 | 154.97 | 155.15 |
| AC-FT | | 1593. | 6348. | 14049. | 14066. |
| THOUS CU M | | 1965. | 7830. | 17330. | 17350. |

MAXIMUM STAGE IS 978.8 MAXIMUM STORAGE = 132.

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453
CHKD. BY DLB DATE 7-2-79 SHEET NO. F OF EE

GAI CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

FLOW @ 7700 FT DS FROM BEAVER RUN DAM

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3276. | 3276. | 3267. | 2456. | 531348. |
| CMS | 93. | 93. | 92. | 70. | 15046. |
| INCHES | | .71 | 2.81 | 6.35 | 6.36 |
| MM | | 17.92 | 71.47 | 161.22 | 161.45 |
| AC-FT | | 1624. | 6479. | 14617. | 14638. |
| THOUS CU M | | 2004. | 7992. | 18030. | 18055. |

MAXIMUM STORAGE = 134.

MAXIMUM STAGE IS 978.9

HYDROGRAPH ROUTING

ROUTE FROM SECTION 2 TO SECTION 3 * 27700 FT DS FROM BEAVER RUN DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 203 | 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 | -1. | 0 |

NORMAL DEPTH CHANNEL ROUTING
----------------------------

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1000 | .0350 | .1000 | 846.0 | 880.0 | 20000. | .00900 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
50.00 880.00 200.00 860.00 300.00 850.00 305.00 846.00 315.00 846.00
320.00 850.00 400.00 860.00 420.00 880.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 10.65 | 23.78 | 47.85 | 97.75 | 174.12 | 276.95 | 406.25 | 561.79 |
| | 919.84 | 1117.61 | 1327.88 | 1550.65 | 1785.91 | 2033.67 | 2293.93 | 2566.68 | 2851.93 |
| OUTFLOW | 0.00 | 110.26 | 376.47 | 882.32 | 1702.31 | 2909.40 | 4577.68 | 6774.06 | 9599.50 |
| | 17441.38 | 22269.49 | 27710.49 | 33773.97 | 40471.19 | 47814.52 | 55817.10 | 64492.64 | 73855.23 |
| STAGE | 846.00 | 847.79 | 849.58 | 851.37 | 853.16 | 854.95 | 856.74 | 858.53 | 860.32 |
| | 863.89 | 865.68 | 867.47 | 869.26 | 871.05 | 872.84 | 874.63 | 876.42 | 878.21 |
| FLOW | 0.00 | 110.26 | 376.47 | 882.32 | 1702.31 | 2909.40 | 4577.68 | 6774.06 | 9599.50 |
| | 17441.38 | 22269.49 | 27710.49 | 33773.97 | 40471.19 | 47814.52 | 55817.10 | 64492.64 | 73855.23 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. G OF EE

GAI CONSULTANTS, Engineers • Geologists • Planners • Environmental Specialists

FLOWS @ 27700 FT DS FROM BEAVER RUN DAM

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6264. | 6202. | 5499. | 3494. | 755952. |
| CMS | 177. | 176. | 156. | 99. | 21406. |
| INCHES | | 1.34 | 4.74 | 9.03 | 9.04 |
| MM | | 33.92 | 120.32 | 229.35 | 229.70 |
| AC-FT | | 3076. | 10908. | 20794. | 20825. |
| THOUS CU M | | 3794. | 13455. | 25649. | 25687. |

MAXIMUM STORAGE = 376.

MAXIMUM STAGE IS 858.1

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3137. | 3137. | 3126. | 1984. | 428777. |
| CMS | 89. | 89. | 89. | 56. | 12142. |
| INCHES | | .68 | 2.69 | 5.13 | 5.13 |
| MM | | 17.16 | 68.38 | 130.19 | 130.29 |
| AC-FT | | 1555. | 6200. | 11803. | 11812. |
| THOUS CU M | | 1918. | 7647. | 14559. | 14570. |

MAXIMUM STORAGE = 188.

MAXIMUM STAGE IS 855.2

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3213. | 3212. | 3200. | 2331. | 503855. |
| CMS | 91. | 91. | 91. | 66. | 14268. |
| INCHES | | .69 | 2.76 | 6.02 | 6.03 |
| MM | | 17.57 | 70.01 | 152.97 | 153.10 |
| AC-FT | | 1593. | 6348. | 13869. | 13880. |
| THOUS CU M | | 1964. | 7830. | 17107. | 17121. |

MAXIMUM STORAGE = 193.

MAXIMUM STAGE IS 855.3

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3276. | 3276. | 3266. | 2425. | 524440. |
| CMS | 93. | 93. | 92. | 69. | 14850. |
| INCHES | | .71 | 2.81 | 6.27 | 6.27 |
| MM | | 17.92 | 71.46 | 159.19 | 159.35 |
| AC-FT | | 1624. | 6479. | 14433. | 14447. |
| THOUS CU M | | 2003. | 7992. | 17802. | 17821. |

MAXIMUM STAGE IS 855.3

MAXIMUM STORAGE = 197.

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. H OF EE

GAI CONSULTANTS, Engineers • Geologists • Planner Environmental Specialists

**SUB-AREA RUNOFF COMPUTATION**

LOCAL INFLOW INTO GILKERSON DAM RESERVOIR

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

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | .33 | 0.00 | 54.40 | 0.00 | 0.000 | 0 | 1 | 0 |

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 24.00 | 85.00 | 103.00 | 113.00 | 124.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .852

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA
TP= 1.14 CP= .45 NTA= 0

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.55 AND R= 5.46 INTERVALS

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG= 1.15 HOURS, CP= .45 VOL= 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 11. | 41. | 72. | 82. | 73. | 60. | 50. | 42. | 35. | 29. |
| 24. | 20. | 17. | 14. | 12. | 10. | 8. | 7. | 6. | 5. |
| 4. | 3. | 3. | 2. | 2. | 2. | 1. | 1. | 1. | 1. |
| 1. | | | | | | | | | |

END-OF-PERIOD FLOW

| 0 MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | SUM | 25.35 | 22.87 | 2.48 | 14921. |
| | | | | | | | | | | ( 644.) | ( 581.) | ( 63.) | ( 422.52) |

LOCAL INFLOWS INTO GILKERSON DAM RESERVOIR

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 785. | 517. | 193. | 69. | 14931. |
| CMS | 22. | 15. | 5. | 2. | 423. |
| INCHES | | 14.59 | 21.78 | 23.38 | 23.38 |
| MM | | 370.50 | 553.22 | 593.73 | 593.90 |
| AC-FT | | 257. | 383. | 411. | 411. |
| THOUS CU M | | 317. | 473. | 507. | 507. |

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 236. | 155. | 58. | 21. | 4479. |
| CMS | 7. | 4. | 2. | 1. | 127. |
| INCHES | | 4.38 | 6.53 | 7.01 | 7.01 |
| MM | | 111.15 | 165.97 | 178.12 | 178.17 |
| AC-FT | | 77. | 115. | 123. | 123. |
| THOUS CU M | | 95. | 142. | 152. | 152. |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. I OF EE

CONSULTANTS, Engineers • Geologists • Planner
Environmental Specialists

LOCAL INFLOWS INTO GILKERSON DAM RESERVOIR

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 314. | 207. | 77. | 28. | 5972. |
| CMS | 9. | 6. | 2. | 1. | 169. |
| INCHES | | 5.83 | 8.71 | 9.35 | 9.35 |
| MM | | 148.20 | 221.29 | 237.49 | 237.56 |
| AC-FT | | 103. | 153. | 164. | 165. |
| THOUS CU M | | 127. | 189. | 203. | 203. |

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 393. | 259. | 97. | 35. | 7465. |
| CMS | 11. | 7. | 3. | 1. | 211. |
| INCHES | | 7.29 | 10.89 | 11.69 | 11.69 |
| MM | | 185.25 | 276.61 | 296.86 | 296.95 |
| AC-FT | | 128. | 192. | 206. | 206. |
| THOUS CU M | | 158. | 236. | 254. | 254. |

**HYDROGRAPH ROUTING**

ROUTE LOCAL INFLOW THROUGH GILKERSON DAM RESERVOIR

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 404 | 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 | -1023. | -1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STAGE | 1023.00 | 1023.50 | 1024.00 | 1024.50 | 1025.00 | 1025.50 | 1026.00 | 1026.50 | 1027.00 |
| | 1028.00 | 1028.50 | | | | | | | |
| FLOW | 0.00 | 10.00 | 40.00 | 90.00 | 160.00 | 230.00 | 320.00 | 420.00 | 520.00 |
| | 1620.00 | 2470.00 | | | | | | | |

| | | | | |
|---|---|---|---|---|
| SURFACE AREA= | 0. | 4. | 7. | 16. |
| CAPACITY= | 0. | 30. | 50. | 193. |
| ELEVATION= | 998. | 1023. | 1027. | 1040. |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 1023.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 1027.0 | 0.0 | 0.0 | 0. |

GILKERSON DAM OUTFLOW HYDROGRAPHS

PMF

PEAK OUTFLOW IS 782. AT TIME 40.67 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 782. | 514. | 193. | 69. | 14936. |
| CMS | 22. | 15. | 5. | 2. | 423. |
| INCHES | | 14.50 | 21.77 | 23.38 | 23.39 |
| MM | | 368.25 | 553.06 | 593.87 | 594.11 |
| AC-FT | | 255. | 383. | 411. | 411. |
| THOUS CU M | | 315. | 472. | 507. | 508. |

0.3 PMF

PEAK OUTFLOW IS 220. AT TIME 41.33 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 220. | 154. | 58. | 21. | 4483. |
| CMS | 6. | 4. | 2. | 1. | 127. |
| INCHES | | 4.34 | 6.51 | 7.02 | 7.02 |
| MM | | 110.13 | 165.45 | 178.24 | 178.31 |
| AC-FT | | 76. | 115. | 123. | 123. |
| THOUS CU M | | 94. | 141. | 152. | 152. |

0.4 PMF

PEAK OUTFLOW IS 297. AT TIME 41.00 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 297. | 205. | 77. | 28. | 5976. |
| CMS | 8. | 6. | 2. | 1. | 169. |
| INCHES | | 5.79 | 8.69 | 9.35 | 9.36 |
| MM | | 147.13 | 220.72 | 237.59 | 237.69 |
| AC-FT | | 102. | 153. | 165. | 165. |
| THOUS CU M | | 126. | 189. | 203. | 203. |

0.5 PMF

PEAK OUTFLOW IS 373. AT TIME 41.00 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 373. | 257. | 96. | 35. | 7469. |
| CMS | 11. | 7. | 3. | 1. | 211. |
| INCHES | | 7.24 | 10.87 | 11.69 | 11.70 |
| MM | | 183.94 | 276.06 | 296.97 | 297.10 |
| AC-FT | | 127. | 191. | 206. | 206. |
| THOUS CU M | | 157. | 236. | 254. | 254. |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. K OF EE

GAI CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

## HYDROGRAPH ROUTING

ROUTE FROM GILKERSON DAM TO SECTION 5 * 1400 FT DS FROM GILKERSON DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 405 | 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 | -1. | 0 |

NORMAL DEPTH CHANNEL ROUTING

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .1100 | .0400 | .1100 | 846.0 | 880.0 | 1400. | .12000 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 880.00 50.00 860.00 100.00 850.00 105.00 846.00 110.00 846.00
115.00 850.00 170.00 860.00 200.00 880.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | .42 | 1.09 | 2.26 | 4.49 | 7.80 | 12.19 | 17.66 | 24.20 |
| | 38.98 | 46.98 | 55.39 | 64.22 | 73.46 | 83.11 | 93.17 | 103.64 | 114.53 |
| OUTFLOW | 0.00 | 189.44 | 708.36 | 1801.06 | 3584.48 | 6177.40 | 9715.34 | 14322.18 | 20199.37 |
| | 36306.29 | 46069.29 | 56964.14 | 68994.62 | 82169.10 | 96499.13 | 111998.59 | 128683.00 | 146569.12 |
| STAGE | 846.00 | 847.79 | 849.58 | 851.37 | 853.16 | 854.95 | 856.74 | 858.53 | 860.32 |
| | 863.89 | 865.68 | 867.47 | 869.26 | 871.05 | 872.84 | 874.63 | 876.42 | 878.21 |
| FLOW | 0.00 | 189.44 | 708.36 | 1801.06 | 3584.48 | 6177.40 | 9715.34 | 14322.18 | 20199.37 |
| | 36306.29 | 46069.29 | 56964.14 | 68994.62 | 82169.10 | 96499.13 | 111998.59 | 128683.00 | 146569.12 |

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 788. | 514. | 193. | 69. | 14936. |
| CMS | 22. | 15. | 5. | 2. | 423. |
| INCHES | | 14.50 | 21.77 | 23.38 | 23.39 |
| MM | | 368.31 | 553.06 | 593.87 | 594.11 |
| AC-FT | | 255. | 383. | 411. | 411. |
| THOUS CU M | | 315. | 472. | 507. | 508. |

PMF

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 849.7

FLOW @ 1400 FT DS FROM GILKERSON DAM

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 7-2-79  PROJ. NO. 79-617-453

CHKD. BY: DLB  DATE: 7-2-79  SHEET NO. L OF EE

GAI CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 220. | 154. | 58. | 21. | 4483. |
| CMS | 6. | 4. | 2. | 1. | 127. |
| INCHES | | 4.34 | 6.51 | 7.02 | 7.02 |
| MM | | 110.14 | 165.45 | 178.24 | 178.31 |
| AC-FT | | 76. | 115. | 123. | 123. |
| THOUS CU M | | 94. | 141. | 152. | 152. |

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 847.9

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 298. | 206. | 77. | 28. | 5976. |
| CMS | 8. | 6. | 2. | 1. | 169. |
| INCHES | | 5.79 | 8.69 | 9.35 | 9.36 |
| MM | | 147.15 | 220.71 | 237.59 | 237.69 |
| AC-FT | | 102. | 153. | 165. | 165. |
| THOUS CU M | | 126. | 189. | 203. | 203. |

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 848.2

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 373. | 257. | 96. | 35. | 7469. |
| CMS | 11. | 7. | 3. | 1. | 211. |
| INCHES | | 7.24 | 10.87 | 11.69 | 11.70 |
| MM | | 183.97 | 276.06 | 296.97 | 297.10 |
| AC-FT | | 127. | 191. | 206. | 206. |
| THOUS CU M | | 157. | 236. | 254. | 254. |

MAXIMUM STORAGE = 1.

MAXIMUM STAGE IS 848.4

SUB-AREA RUNOFF COMPUTATION

LOCAL INFLOW INTO BEAVER DAM RESERVOIR

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

HYDROGRAPH DATA

| IHYDG | IUHG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 10.90 | 0.00 | 54.40 | 0.00 | 0.000 | 0 | 1 | 0 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. M OF EE

GAI CONSULTANTS,
Engineers • Geologists • Planner
Environmental Specialists

PRECIP DATA

| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
|---|---|---|---|---|---|---|---|
| 0.00 | 24.00 | 85.00 | 103.00 | 113.00 | 124.00 | 0.00 | 0.00 |

TRSPC COMPUTED BY THE PROGRAM IS .852

LOSS DATA

| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRTL | CNSTL | ALSMX | RTIMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 1.00 | .05 | 0.00 | 0.00 |

UNIT HYDROGRAPH DATA
TP= 4.46 CP= .45 NTA= 0

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

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=14.05 AND R=21.29 INTERVALS

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 4.50 HOURS, CP= .45 VOL= .99

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 13. | 49. | 101. | 164. | 234. | 310. | 392. | 473. | 547. | 610. |
| 660. | 697. | 721. | 726. | 706. | 674. | 643. | 614. | 585. | 559. |
| 533. | 508. | 485. | 463. | 442. | 421. | 402. | 384. | 366. | 349. |
| 333. | 318. | 303. | 289. | 276. | 263. | 251. | 240. | 229. | 218. |
| 208. | 199. | 190. | 181. | 173. | 165. | 157. | 150. | 143. | 136. |
| 130. | 124. | 119. | 113. | 108. | 103. | 98. | 94. | 89. | 85. |
| 81. | 78. | 74. | 71. | 67. | 64. | 61. | 59. | 56. | 53. |
| 51. | 49. | 46. | 44. | 42. | 40. | 38. | 37. | 35. | 33. |
| 32. | 30. | 29. | 28. | 26. | 25. | 24. | 23. | 22. | 21. |
| 20. | 19. | 18. | 17. | 16. | 16. | 15. | 14. | 14. | 13. |

0

END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | SUM | 25.35 | 22.87 | 2.48 | 478576. |
| | | | | | | | | | | ( 644.) | ( 581.) | ( 63.) | (13551.76) |

LOCAL INFLOWS INTO BEAVER DAM RESERVOIR

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 11933. | 10554. | 5745. | 2214. | 478572. |
| CMS | 338. | 299. | 163. | 63. | 13552. |
| INCHES | | 9.01 | 19.61 | 22.67 | 22.69 |
| MM | | 228.77 | 498.15 | 575.94 | 576.33 |
| AC-FT | | 5233. | 11395. | 13175. | 13184. |
| THOUS CU M | | 6455. | 14056. | 16251. | 16262. |

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3580. | 3166. | 1724. | 664. | 143572. |
| CMS | 101. | 90. | 49. | 19. | 4065. |
| INCHES | | 2.70 | 5.88 | 6.80 | 6.81 |
| MM | | 68.63 | 149.45 | 172.78 | 172.90 |
| AC-FT | | 1570. | 3419. | 3952. | 3955. |
| THOUS CU M | | 1937. | 4217. | 4875. | 4879. |

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 7-2-79  PROJ. NO. 79-617-453

CHKD. BY: DLB  DATE: 7-2-79  SHEET NO. N OF EE

GAI CONSULTANTS, Engineers • Geologists • Planners, Environmental Specialists

LOCAL INFLOWS INTO BEAVER DAM RESERVOIR

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 4773. | 4222. | 2298. | 886. | 191429. |
| CMS | 135. | 120. | 65. | 25. | 5421. |
| INCHES | | 3.60 | 7.84 | 9.07 | 9.08 |
| MM | | 91.51 | 199.26 | 230.38 | 230.53 |
| AC-FT | | 2093. | 4558. | 5270. | 5274. |
| THOUS CU M | | 2582. | 5622. | 6500. | 6505. |

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 5966. | 5277. | 2873. | 1107. | 239286. |
| CMS | 169. | 149. | 81. | 31. | 6776. |
| INCHES | | 4.50 | 9.81 | 11.34 | 11.35 |
| MM | | 114.39 | 249.08 | 287.97 | 288.17 |
| AC-FT | | 2617. | 5698. | 6587. | 6592. |
| THOUS CU M | | 3228. | 7028. | 8125. | 8131. |

COMBINE HYDROGRAPHS

COMBINE LOCAL BEAVER DAM INFLOW W/ ROUTED GILKERSON DAM OUTFLOW

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 6 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

COMBINED ROUTED GILKERSON OUTFLOWS + LOCAL BEAVER DAM RESERVOIR INFLOWS

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 12275. | 10884. | 5926. | 2283. | 493508. |
| CMS | 348. | 308. | 168. | 65. | 13975. |
| INCHES | | 9.02 | 19.64 | 22.70 | 22.71 |
| MM | | 228.99 | 498.74 | 576.47 | 576.86 |
| AC-FT | | 5397. | 11754. | 13586. | 13595. |
| THOUS CU M | | 6657. | 14499. | 16758. | 16770. |

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 3686. | 3271. | 1778. | 685. | 148054. |
| CMS | 104. | 93. | 50. | 19. | 4192. |
| INCHES | | 2.71 | 5.89 | 6.81 | 6.81 |
| MM | | 68.82 | 149.68 | 172.94 | 173.06 |
| AC-FT | | 1622. | 3528. | 4076. | 4079. |
| THOUS CU M | | 2001. | 4351. | 5028. | 5031. |

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 4915. | 4360. | 2371. | 913. | 197404. |
| CMS | 139. | 123. | 67. | 26. | 5590. |
| INCHES | | 3.61 | 7.86 | 9.08 | 9.08 |
| MM | | 91.73 | 199.55 | 230.59 | 230.74 |
| AC-FT | | 2162. | 4703. | 5434. | 5438. |
| THOUS CU M | | 2667. | 5801. | 6703. | 6708. |

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6145. | 5449. | 2964. | 1142. | 246755. |
| CMS | 174. | 154. | 84. | 32. | 6987. |
| INCHES | | 4.51 | 9.82 | 11.35 | 11.36 |
| MM | | 114.64 | 249.42 | 288.23 | 288.43 |
| AC-FT | | 2702. | 5878. | 6793. | 6798. |
| THOUS CU M | | 3333. | 7251. | 8379. | 8385. |

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. O OF EE

GAI CONSULTANTS, Engineers • Geologists • Planners, Environmental Specialists

**COMBINE HYDROGRAPHS**

COMBINE ROUTED BEAVER RUN DAM OUTFLOW W/ PREVIOUS COMBINED FLOWS

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 6 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

TOTAL INFLOW HYDROGRAPHS INTO BEAVER DAM RESERVOIR

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 15379. | 13947. | 9518. | 5724. | 1249460. |
| CMS | 435. | 395. | 270. | 162. | 35381. |
| INCHES | | 2.38 | 6.51 | 11.74 | 11.86 |
| MM | | 60.54 | 165.27 | 298.18 | 301.33 |
| AC-FT | | 6916. | 18879. | 34061. | 34420. |
| THOUS CU M | | 8531. | 23286. | 42013. | 42457. |

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 5191. | 5011. | 4194. | 2653. | 576831. |
| CMS | 147. | 142. | 119. | 75. | 16334. |
| INCHES | | .86 | 2.87 | 5.44 | 5.48 |
| MM | | 21.75 | 72.83 | 138.17 | 139.11 |
| AC-FT | | 2485. | 8319. | 15784. | 15891. |
| THOUS CU M | | 3065. | 10262. | 19469. | 19601. |

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6820. | 6473. | 4926. | 3223. | 701260. |
| CMS | 193. | 183. | 139. | 91. | 19857. |
| INCHES | | 1.11 | 3.37 | 6.61 | 6.66 |
| MM | | 28.10 | 85.53 | 167.87 | 169.12 |
| AC-FT | | 3210. | 9771. | 19176. | 19318. |
| THOUS CU M | | 3959. | 12052. | 23653. | 23829. |

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 8455. | 7838. | 5620. | 3540. | 771195. |
| CMS | 239. | 222. | 159. | 100. | 21838. |
| INCHES | | 1.34 | 3.84 | 7.26 | 7.32 |
| MM | | 34.02 | 97.59 | 184.42 | 185.99 |
| AC-FT | | 3887. | 11147. | 21066. | 21245. |
| THOUS CU M | | 4794. | 13750. | 25985. | 26205. |

**HYDROGRAPH ROUTING**

ROUTE TOTAL COMBINED HYDROGRAPH THROUGH BEAVER DAM RESERVOIR

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 606 | 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 | 18. | 1 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. P OF EE

GAI CONSULTANTS, Engineers • Geologists • Planners Environmental Specialists

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CAPACITY= | 0. | 12. | 18. | 31. | 45. | 61. | 79. | 98. | 119. | 148. |
| | 178. | 232. | 293. | 360. | 433. | 512. | 597. | 689. | 788. | |
| ELEVATION= | 842. | 843. | 844. | 845. | 846. | 847. | 848. | 849. | 850. | 851. |
| | 852. | 854. | 856. | 858. | 860. | 862. | 864. | 866. | 868. | |

| CREL | SPWID | COQW | EXPW | ELEVL | COQL | CAREA | EXPL |
|---|---|---|---|---|---|---|---|
| 843.5 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| IABCOA | ISPITW | ISPCTW |
|---|---|---|
| 10 | 0 | 0 |

| SS | NGATES | DESHD | APEL | APWID | APLOSS | PUPTH |
|---|---|---|---|---|---|---|
| 0.00 | 1 | 7.3 | 0.0 | 0.0 | 0.0 | 0.0 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 842.00 | 0. | 0. | 0.0 | 0. | 0. | 0.0 | 0. | 0. | 0. |
| 843.00 | 12. | 0. | 0.0 | 0. | 0. | 0.0 | 0. | 0. | 0. |
| 843.50 | 18. | 0. | 0.0 | 0. | 0. | 0.0 | 0. | 0. | 0. |
| 844.50 | 31. | 309. | .7 | 309. | 0. | 0.0 | 0. | 309. | 309. |
| 845.50 | 45. | 872. | 1.3 | 872. | 0. | 0.0 | 0. | 872. | 872. |
| 846.50 | 61. | 1598. | 2.0 | 1598. | 0. | 0.0 | 0. | 1598. | 1598. |
| 847.50 | 79. | 2454. | 2.7 | 2454. | 0. | 0.0 | 0. | 2454. | 2454. |
| 848.50 | 98. | 3421. | 3.3 | 3421. | 0. | 0.0 | 0. | 3421. | 3421. |
| 849.50 | 119. | 4487. | 4.0 | 4487. | 0. | 0.0 | 0. | 4487. | 4487. |
| 850.80 | 148. | 6003. | 4.9 | 6003. | 0. | 0.0 | 0. | 6003. | 6003. |
| 852.00 | 178. | 7524. | 5.7 | 7524. | 0. | 0.0 | 0. | 7524. | 7524. |
| 854.00 | 232. | 10289. | 7.0 | 10289. | 0. | 0.0 | 0. | 10289. | 10289. |
| 856.00 | 293. | 13309. | 8.3 | 13309. | 0. | 0.0 | 0. | 13309. | 13309. |
| 858.00 | 360. | 16560. | 9.7 | 16560. | 0. | 0.0 | 0. | 16560. | 16560. |
| 860.00 | 433. | 20019. | 11.0 | 20019. | 0. | 0.0 | 0. | 20019. | 20019. |
| 862.00 | 512. | 23669. | 12.3 | 23669. | 0. | 0.0 | 0. | 23669. | 23669. |
| 864.00 | 597. | 27494. | 13.7 | 27494. | 0. | 0.0 | 0. | 27494. | 27494. |
| 866.00 | 689. | 31482. | 15.0 | 31482. | 0. | 0.0 | 0. | 31482. | 31482. |
| 868.00 | 788. | 35622. | 16.3 | 35622. | 0. | 0.0 | 0. | 35622. | 35622. |

DAM DATA

| TOPEL | COQD | EXPD | DAMWID |
|---|---|---|---|
| 850.8 | 0.0 | 0.0 | 0. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CREST LENGTH AT OR BELOW | 0. | 20. | 45. | 95. | 180. | 225. | 250. | 285. | 305. | 340. |
| ELEVATION | 850.8 | 851.3 | 853.0 | 853.2 | 853.5 | 853.6 | 854.5 | 854.7 | 860.0 | 868.0 |

BEAVER DAM OUTFLOW HYDROGRAPH

PEAK OUTFLOW IS 15374. AT TIME 44.00 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 15374. | 13938. | 9514. | 5714. | 1246544. |
| CMS | 435. | 395. | 269. | 162. | 35298. |
| INCHES | | 2.38 | 6.50 | 11.72 | 11.84 |
| MM | | 60.51 | 165.20 | 297.65 | 300.62 |
| AC-FT | | 6912. | 18871. | 34000. | 34340. |
| THOUS CU M | | 8525. | 23277. | 41938. | 42358. |

PMF

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 7-2-79  PROJ. NO. 78-617-453
CHKD. BY: DLB  DATE: 7-2-79  SHEET NO. Q OF EE

gai CONSULTANTS,
Engineers • Geologists • Planne
Environmental Specialists

BEAVER DAM OUTFLOW HYDROGRAPHS

0.3 PMF

PEAK OUTFLOW IS 5183. AT TIME 48.67 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 5183. | 5010. | 4193. | 2648. | 575519. |
| CMS | 147. | 142. | 119. | 75. | 16297. |
| INCHES | | .86 | 2.87 | 5.43 | 5.46 |
| MM | | 21.75 | 72.81 | 137.92 | 138.80 |
| AC-FT | | 2484. | 8317. | 15755. | 15855. |
| THOUS CU M | | 3064. | 10259. | 19433. | 19556. |

0.4 PMF

PEAK OUTFLOW IS 6807. AT TIME 46.33 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6807. | 6469. | 4925. | 3212. | 698596. |
| CMS | 193. | 183. | 139. | 91. | 19782. |
| INCHES | | 1.11 | 3.37 | 6.59 | 6.63 |
| MM | | 28.08 | 85.52 | 167.31 | 168.48 |
| AC-FT | | 3208. | 9769. | 19112. | 19245. |
| THOUS CU M | | 3956. | 12050. | 23574. | 23738. |

OVERTOPPING OCCURS @ ≈ 0.36 PMF

0.5 PMF

PEAK OUTFLOW IS 8435. AT TIME 45.33 HOURS

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 8435. | 7828. | 5618. | 3530. | 768477. |
| CMS | 239. | 222. | 159. | 100. | 21761. |
| INCHES | | 1.34 | 3.84 | 7.24 | 7.30 |
| MM | | 33.98 | 97.55 | 183.87 | 185.33 |
| AC-FT | | 3882. | 11143. | 21004. | 21170. |
| THOUS CU M | | 4788. | 13745. | 25908. | 26113. |

HYDROGRAPH ROUTING

ROUTE FROM BEAVER DAM TO SECTION 7 * 1200 FT DS FROM BEAVER DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 607 | 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 | -1. | 0 |

NORMAL DEPTH CHANNEL ROUTING
---------------------------

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .0800 | .0400 | .1000 | 804.0 | 840.0 | 1200. | .01400 |

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 7-2-79  PROJ. NO. 79-617-453

CHKD. BY: DLB  DATE: 7-2-79  SHEET NO. R OF EE

GAI CONSULTANTS, Engineers • Geologists • Planne Environmental Specialists

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

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 840.00 | 25.00 | 820.00 | 200.00 | 807.00 | 205.00 | 804.00 | 235.00 | 804.00 | | |
| 240.00 | 811.00 | 350.00 | 820.00 | 450.00 | 840.00 | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | 1.68 | 3.70 | 6.93 | 11.61 | 18.55 | 28.04 | 40.06 | 54.63 |
| | 89.05 | 107.29 | 126.14 | 145.61 | 165.70 | 186.40 | 207.73 | 229.67 | 252.23 |
| OUTFLOW | 0.00 | 383.26 | 1256.17 | 2654.61 | 4705.07 | 7655.80 | 11635.48 | 16813.20 | 23341.51 |
| | 42258.31 | 54027.57 | 67136.10 | 81555.97 | 97268.15 | 114259.85 | 132522.83 | 152052.37 | 172846.47 |
| STAGE | 804.00 | 805.89 | 807.79 | 809.68 | 811.58 | 813.47 | 815.37 | 817.26 | 819.16 |
| | 822.95 | 824.84 | 826.74 | 828.63 | 830.53 | 832.42 | 834.32 | 836.21 | 838.11 |
| FLOW | 0.00 | 383.26 | 1256.17 | 2654.61 | 4705.07 | 7655.80 | 11635.48 | 16813.20 | 23341.51 |
| | 42258.11 | 54027.57 | 67136.10 | 81555.97 | 97268.15 | 114259.85 | 132522.83 | 152052.37 | 172846.47 |

FLOWS @ 1200 FT DS FROM BEAVER DAM @ 1st HOUSE

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 15372. | 13936. | 9514. | 5713. | 1246226. |
| CMS | 435. | 395. | 269. | 162. | 35289. |
| INCHES | | 2.38 | 6.50 | 11.72 | 11.83 |
| MM | | 60.50 | 165.21 | 297.59 | 300.55 |
| AC-FT | | 6910. | 18872. | 33993. | 34331. |
| THOUS CU M | | 8524. | 23278. | 41930. | 42347. |

MAXIMUM STORAGE = 37.

MAXIMUM STAGE IS 816.7

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 5184. | 5010. | 4193. | 2647. | 575381. |
| CMS | 147. | 142. | 119. | 75. | 16293. |
| INCHES | | .86 | 2.87 | 5.43 | 5.46 |
| MM | | 21.75 | 72.81 | 137.90 | 138.76 |
| AC-FT | | 2484. | 8317. | 15752. | 15851. |
| THOUS CU M | | 3064. | 10259. | 19429. | 19552. |

MAXIMUM STAGE IS 811.9  MAXIMUM STORAGE = 13.

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6808. | 6468. | 4925. | 3211. | 698309. |
| CMS | 193. | 183. | 139. | 91. | 19774. |
| INCHES | | 1.11 | 3.37 | 6.58 | 6.63 |
| MM | | 28.08 | 85.52 | 167.25 | 168.41 |
| AC-FT | | 3207. | 9769. | 19105. | 19237. |
| THOUS CU M | | 3956. | 12049. | 23566. | 23729. |

MAXIMUM STAGE IS 812.9  MAXIMUM STORAGE = 17.

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. 5 OF EE

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

0.5 PMF

FLOW @ 1200 FT DS FROM BEAVER DAM @ 1st HOUSE

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 8437. | 7829. | 5618. | 3529. | 768103. |
| CMS | 239. | 222. | 159. | 100. | 21753. |
| INCHES | | 1.34 | 3.84 | 7.24 | 7.29 |
| MM | | 33.99 | 97.55 | 183.81 | 185.26 |
| AC-FT | | 3882. | 11143. | 20997. | 21162. |
| THOUS CU M | | 4788. | 13745. | 25899. | 26103. |

MAXIMUM STORAGE = 20.

MAXIMUM STAGE IS 813.8

HYDROGRAPH ROUTING

ROUTE FROM SECTION 7 TO SECTION 8 * 1800 FT DS FROM BEAVER DAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|---|---|---|---|---|---|---|---|---|
| 708 | 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 | -1. | 0 |

NORMAL DEPTH CHANNEL ROUTING
----------------------------

| QN(1) | QN(2) | QN(3) | ELNVT | ELMAX | RLNTH | SEL |
|---|---|---|---|---|---|---|
| .0800 | .0400 | .1000 | 796.0 | 840.0 | 600. | .01400 |

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 840.00 25.00 820.00 100.00 816.00 101.00 796.00 129.00 796.00
130.00 816.00 375.00 820.00 450.00 840.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| STORAGE | 0.00 | .90 | 1.80 | 2.71 | 3.63 | 4.56 | 5.49 | 6.43 | 7.38 |
| | 14.79 | 25.64 | 37.22 | 49.17 | 61.50 | 74.19 | 87.25 | 100.68 | 114.48 |
| OUTFLOW | 0.00 | 454.77 | 1330.52 | 2435.11 | 3692.47 | 5061.47 | 6517.23 | 8043.61 | 9629.67 |
| | 14734.64 | 20876.46 | 29782.64 | 40866.17 | 53948.31 | 68920.38 | 85710.99 | 104271.57 | 124568.71 |
| STAGE | 796.00 | 798.32 | 800.63 | 802.95 | 805.26 | 807.58 | 809.89 | 812.21 | 814.53 |
| | 819.16 | 821.47 | 823.79 | 826.11 | 828.42 | 830.74 | 833.05 | 835.37 | 837.68 |
| FLOW | 0.00 | 454.77 | 1330.52 | 2435.11 | 3692.47 | 5061.47 | 6517.23 | 8043.61 | 9629.67 |
| | 14734.64 | 20876.46 | 29782.64 | 40866.17 | 53948.31 | 68920.38 | 85710.99 | 104271.57 | 124568.71 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. T OF EE

GAI CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

FLOWS @ 1800 FT DS FROM BEAVER DAM

PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 15364. | 13934. | 9515. | 5712. | 1246101. |
| CMS | 435. | 395. | 269. | 162. | 35286. |
| INCHES | | 2.38 | 6.50 | 11.72 | 11.83 |
| MM | | 60.49 | 165.21 | 297.57 | 300.52 |
| AC-FT | | 6909. | 18872. | 33991. | 34328. |
| THOUS CU M | | 8523. | 23278. | 41927. | 42343. |

MAXIMUM STORAGE = 16.

MAXIMUM STAGE IS 819.4

0.3 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 5184. | 5009. | 4193. | 2647. | 575317. |
| CMS | 147. | 142. | 119. | 75. | 16291. |
| INCHES | | .86 | 2.87 | 5.43 | 5.46 |
| MM | | 21.75 | 72.81 | 137.88 | 138.75 |
| AC-FT | | 2484. | 8317. | 15750. | 15849. |
| THOUS CU M | | 3064. | 10259. | 19428. | 19549. |

MAXIMUM STORAGE = 5.

MAXIMUM STAGE IS 807.8

0.4 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 6809. | 6468. | 4925. | 3210. | 698193. |
| CMS | 193. | 183. | 139. | 91. | 19771. |
| INCHES | | 1.11 | 3.37 | 6.58 | 6.63 |
| MM | | 28.08 | 85.52 | 167.23 | 168.38 |
| AC-FT | | 3207. | 9769. | 19102. | 19234. |
| THOUS CU M | | 3956. | 12049. | 23562. | 23725. |

MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 810.3

0.5 PMF

| | PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|---|---|---|---|---|---|
| CFS | 8437. | 7829. | 5618. | 3528. | 768065. |
| CMS | 239. | 222. | 159. | 100. | 21749. |
| INCHES | | 1.34 | 3.84 | 7.24 | 7.29 |
| MM | | 33.99 | 97.55 | 183.79 | 185.23 |
| AC-FT | | 3882. | 11143. | 20994. | 21159. |
| THOUS CU M | | 4789. | 13745. | 25896. | 26099. |

MAXIMUM STAGE IS 812.8

MAXIMUM STORAGE = 7.

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. U OF EE

GAI CONSULTANTS, Engineers • Geologists • Planners • Environmental Specialists

## SUMMARY OF DAM SAFETY ANALYSIS

### BEAVER RUN DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1050.00 | 1050.00 | 1070.00 |
| STORAGE | 34000. | 34000. | 64000. |
| OUTFLOW | 0. | 0. | 3460. |

| 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 |
|---|---|---|---|---|---|---|---|
| .20 | 1054.09 | 0.00 | 39721. | 2834. | 0.00 | 56.67 | 0.00 |
| .30 | 1056.44 | 0.00 | 43020. | 3138. | 0.00 | 59.67 | 0.00 |
| .40 | 1059.34 | 0.00 | 47070. | 3213. | 0.00 | 62.00 | 0.00 |
| .50 | 1062.11 | 0.00 | 51372. | 3276. | 0.00 | 64.00 | 0.00 |
| 1.00 | 1074.04 | 4.04 | 72072. | 6281. | 42.67 | 64.33 | 0.00 |

PLAN 1 STATION 2

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .20 | 2831. | 978.2 | 57.00 |
| .30 | 3137. | 978.7 | 60.00 |
| .40 | 3213. | 978.8 | 62.67 |
| .50 | 3276. | 978.9 | 64.33 |
| 1.00 | 6276. | 982.8 | 64.67 |

PLAN 1 STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .20 | 2825. | 854.8 | 58.00 |
| .30 | 3137. | 855.2 | 60.67 |
| .40 | 3213. | 855.3 | 63.33 |
| .50 | 3276. | 855.3 | 65.33 |
| 1.00 | 6264. | 858.1 | 65.67 |

## SUMMARY OF DAM SAFETY ANALYSIS

### GILKERSON DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1023.00 | 1023.00 | 1027.00 |
| STORAGE | 30. | 30. | 50. |
| OUTFLOW | 0. | 0. | 520. |

| 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 |
|---|---|---|---|---|---|---|---|
| .20 | 1024.91 | 0.00 | 38. | 147. | 0.00 | 41.00 | 0.00 |
| .30 | 1025.43 | 0.00 | 41. | 220. | 0.00 | 41.33 | 0.00 |
| .40 | 1025.87 | 0.00 | 43. | 297. | 0.00 | 41.00 | 0.00 |
| .50 | 1026.27 | 0.00 | 45. | 373. | 0.00 | 41.00 | 0.00 |
| 1.00 | 1027.31 | .31 | 52. | 782. | 2.67 | 40.67 | 0.00 |

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. V OF EE

GAI CONSULTANTS,
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Environmental Specialists

PLAN 1 STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .20 | 147. | 847.4 | 41.33 |
| .30 | 220. | 847.9 | 41.33 |
| .40 | 298. | 848.2 | 41.00 |
| .50 | 373. | 848.4 | 41.00 |
| 1.00 | 788. | 849.7 | 40.67 |

SUMMARY OF DAM SAFETY ANALYSIS

BEAVER DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 843.50 | 843.50 | 850.80 |
| STORAGE | 18. | 18. | 148. |
| OUTFLOW | 0. | 0. | 6003. |

| 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 |
|---|---|---|---|---|---|---|---|
| .20 | 848.47 | 0.00 | 97. | 3396. | 0.00 | 53.00 | 0.00 |
| .30 | 850.10 | 0.00 | 132. | 5183. | 0.00 | 48.67 | 0.00 |
| .40 | 851.42 | .62 | 164. | 6807. | 5.67 | 46.33 | 0.00 |
| .50 | 852.55 | 1.75 | 193. | 8435. | 9.00 | 45.33 | 0.00 |
| 1.00 | 855.43 | 4.63 | 276. | 15374. | 32.00 | 44.00 | 0.00 |

PLAN 1 STATION 7

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .20 | 3396. | 810.4 | 53.00 |
| .30 | 5184. | 811.9 | 48.67 |
| .40 | 6808. | 812.9 | 46.33 |
| .50 | 8437. | 813.8 | 45.33 |
| 1.00 | 15372. | 816.7 | 44.00 |

PLAN 1 STATION 8

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .20 | 3396. | 804.7 | 53.00 |
| .30 | 5184. | 807.8 | 48.67 |
| .40 | 6809. | 810.3 | 46.33 |
| .50 | 8437. | 812.8 | 45.33 |
| 1.00 | 15364. | 819.4 | 44.00 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. W OF EE

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BREACHING ANALYSIS

BREACHING OF BEAVER DAM ONLY, SINCE BOTH BEAVER RUN AND GILKERSON DAMS WILL NOT BE OVERTOPPED BY THE 0.38 PMF EVENT. (SAME INPUT DATA AS FOR THE OVERTOPPING ANALYSIS W/ THE ADDITION OF THE BREACH DATA GIVEN HERE)

```
DAM SAFETY INSPECTION
BEAVER DAM W/ US BEAVER RUN DAM AND GILKERSON DAM *** BREACHING   ANALYSIS ***
20-MINUTE TIME STEP AND 48-HOUR STORM DURATION

                         JOB SPECIFICATION
  NQ    NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT    IPRT   NSTAN
 288      0      20       0      0       0       0       0       0       0
                       JOPER    NWT   LROPT   TRACE
                           5      0       0       0

                  MULTI-PLAN ANALYSES TO BE PERFORMED
                     NPLAN= 5 NRTIO= 1 LRTIO= 1
   RTIOS=     .38

                         HYDROGRAPH ROUTING

   ROUTE TOTAL COMBINED HYDROGRAPH THROUGH BEAVER DAM RESERVOIR
```

PLAN

```
                                                DAM DATA
                                      TOPEL     COQD     EXPD   DAMWID
                                      850.8      0.0      0.0       0.

CREST LENGTH        0.      20.      45.      95.     180.     225.     250.     285.     305.     340.
AT OR BELOW
ELEVATION        850.8    851.3    853.0    853.2    853.5    853.6    854.5    854.7    860.0    868.0
```

(1)

```
                                        DAM BREACH DATA
                         BRWID      Z     ELBM    TFAIL     WSEL   FAILEL
                            0.    .50   842.80     1.00   843.50   850.80

BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS      6471. AT TIME  46.67 HOURS
```

(2)

```
                                        DAM BREACH DATA
                         BRWID      Z     ELBM    TFAIL     WSEL   FAILEL
                          200.   2.00   842.80     1.00   843.50   850.80

BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS      7558. AT TIME  45.33 HOURS
```

(3)

```
                                        DAM BREACH DATA
                         BRWID      Z     ELBM    TFAIL     WSEL   FAILEL
                            0.    .50   842.80     4.00   843.50   850.80

BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS      6483. AT TIME  46.50 HOURS
```

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. X OF EE

GAI CONSULTANTS, Engineers • Geologists • Planne[rs] Environmental Specialists

PLAN

| | | DAM BREACH DATA | | | |
|---|---|---|---|---|---|
| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
| 200. | 2.00 | 842.80 | 4.00 | 843.50 | 850.80 |

④ BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS 6777. AT TIME 46.42 HOURS

| | | DAM BREACH DATA | | | |
|---|---|---|---|---|---|
| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
| 100. | 1.00 | 842.80 | 2.00 | 843.50 | 850.80 |

⑤ BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS 6974. AT TIME 46.33 HOURS

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .333 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

⑤

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | - | COMPUTED BREACH HYDROGRAPH (CFS) | = | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|---|---|---|---|---|---|---|---|---|
| 44.333 | 0.000 | 6065. | | 6065. | | 0. | 0. | 0. |
| 44.375 | .042 | 6110. | | 6105. | | 5. | 5. | 0. |
| 44.417 | .083 | 6156. | | 6154. | | 2. | 7. | 0. |
| 44.458 | .125 | 6201. | | 6204. | | -4. | 4. | 0. |
| 44.500 | .167 | 6246. | | 6254. | | -8. | -5. | -0. |
| 44.542 | .208 | 6291. | | 6302. | | -11. | -16. | -0. |
| 44.583 | .250 | 6336. | | 6347. | | -11. | -27. | -0. |
| 44.625 | .292 | 6381. | | 6389. | | -8. | -35. | -0. |
| 44.667 | .333 | 6427. | | 6427. | | 0. | -35. | -0. |
| 44.708 | .375 | 6453. | | 6461. | | -8. | -43. | -0. |
| 44.750 | .417 | 6479. | | 6492. | | -13. | -56. | -0. |
| 44.792 | .458 | 6505. | | 6521. | | -16. | -72. | -0. |
| 44.833 | .500 | 6531. | | 6547. | | -16. | -89. | -0. |
| 44.875 | .542 | 6557. | | 6572. | | -15. | -103. | -0. |
| 44.917 | .583 | 6583. | | 6594. | | -11. | -114. | -0. |
| 44.958 | .625 | 6609. | | 6615. | | -6. | -120. | -0. |
| 45.000 | .667 | 6635. | | 6635. | | 0. | -120. | -0. |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. Y OF EE

GAI CONSULTANTS,
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| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | - | COMPUTED BREACH HYDROGRAPH (CFS) | = | ERROR - (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|---|---|---|---|---|---|---|---|---|
| 45.042 | .708 | 6651. | | 6654. | | -3. | -123. | -0. |
| 45.083 | .750 | 6668. | | 6672. | | -4. | -127. | -0. |
| 45.125 | .792 | 6684. | | 6689. | | -5. | -132. | -0. |
| 45.167 | .833 | 6700. | | 6705. | | -5. | -137. | -0. |
| 45.208 | .875 | 6716. | | 6721. | | -4. | -142. | -0. |
| 45.250 | .917 | 6732. | | 6736. | | -3. | -145. | -0. |
| 45.292 | .958 | 6749. | | 6751. | | -2. | -147. | -1. |
| 45.333 | 1.000 | 6765. | | 6765. | | 0. | -147. | -1. |
| 45.375 | 1.042 | 6778. | | 6779. | | -1. | -148. | -1. |
| 45.417 | 1.083 | 6791. | | 6792. | | -2. | -150. | -1. |
| 45.458 | 1.125 | 6803. | | 6806. | | -2. | -152. | -1. |
| 45.500 | 1.167 | 6816. | | 6819. | | -2. | -155. | -1. |
| 45.542 | 1.208 | 6829. | | 6831. | | -2. | -157. | -1. |
| 45.583 | 1.250 | 6842. | | 6844. | | -2. | -159. | -1. |
| 45.625 | 1.292 | 6855. | | 6856. | | -1. | -161. | -1. |
| 45.667 | 1.333 | 6868. | | 6868. | | 0. | -161. | -1. |
| 45.708 | 1.375 | 6877. | | 6879. | | -1. | -162. | -1. |
| 45.750 | 1.417 | 6887. | | 6889. | | -2. | -163. | -1. |
| 45.792 | 1.458 | 6897. | | 6899. | | -2. | -165. | -1. |
| 45.833 | 1.500 | 6907. | | 6909. | | -2. | -167. | -1. |
| 45.875 | 1.542 | 6917. | | 6919. | | -2. | -169. | -1. |
| 45.917 | 1.583 | 6927. | | 6928. | | -1. | -170. | -1. |
| 45.958 | 1.625 | 6937. | | 6938. | | -1. | -171. | -1. |
| 46.000 | 1.667 | 6947. | | 6947. | | 0. | -171. | -1. |
| 46.042 | 1.708 | 6950. | | 6955. | | -5. | -176. | -1. |
| 46.083 | 1.750 | 6954. | | 6963. | | -9. | -185. | -1. |
| 46.125 | 1.792 | 6957. | | 6969. | | -12. | -198. | -1. |
| 46.167 | 1.833 | 6960. | | 6973. | | -13. | -210. | -1. |
| 46.208 | 1.875 | 6964. | | 6971. | | -7. | -218. | -1. |
| 46.250 | 1.917 | 6967. | | 6971. | | -4. | -221. | -1. |
| 46.292 | 1.958 | 6971. | | 6972. | | -1. | -222. | -1. |
| 46.333 | 2.000 | 6974. | | 6974. | | 0. | -222. | -1. |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. 2 OF EE

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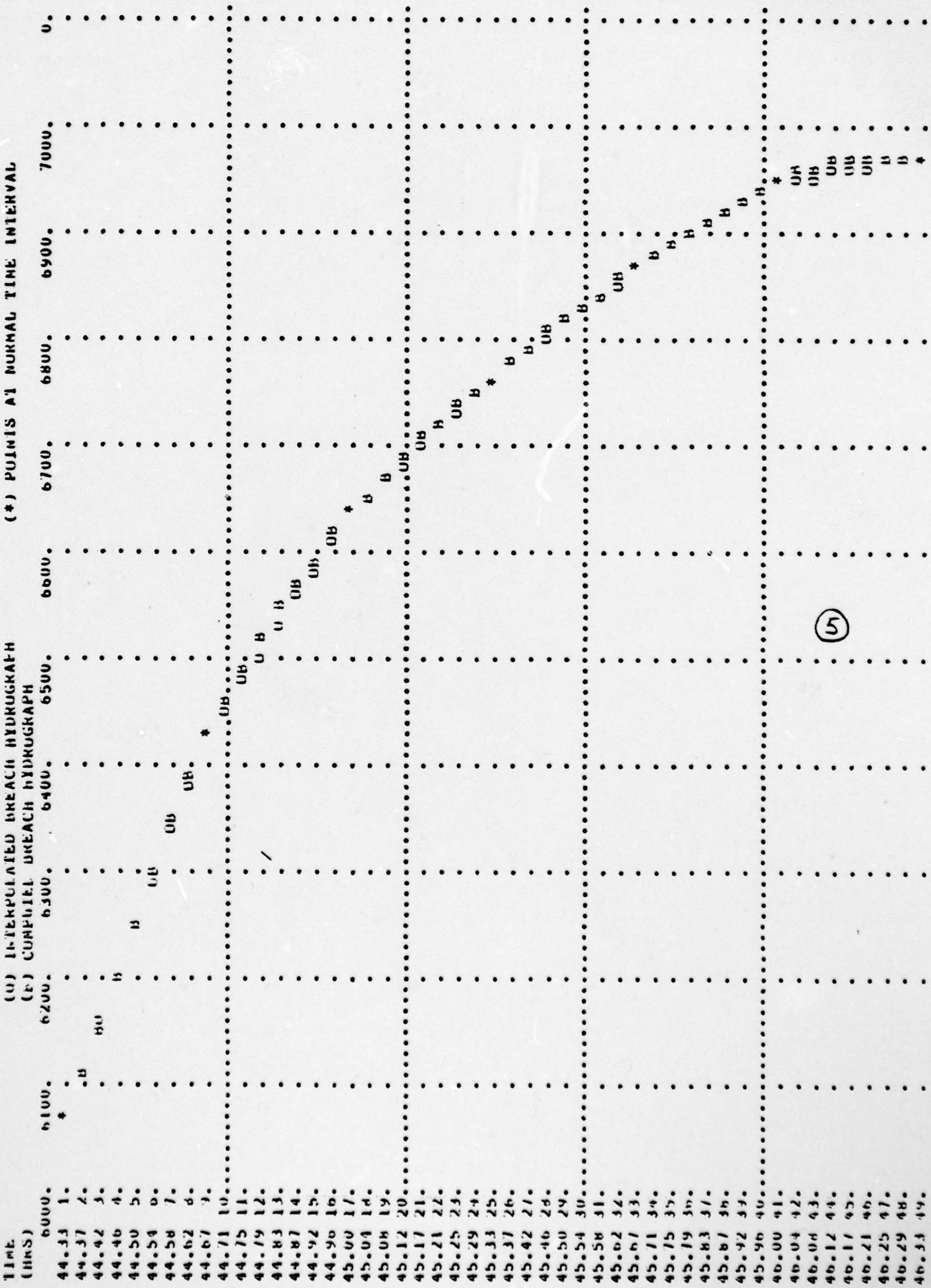

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. AA OF EE

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PLAN (6)

DAM BREACH DATA

| BRWID | Z | ELBM | TFAIL | WSEL | FAILEL |
|---|---|---|---|---|---|
| 100. | 1.00 | 825.80 | 2.00 | 843.50 | 850.80 |

BEGIN DAM FAILURE AT 44.33 HOURS

PEAK OUTFLOW IS 7983. AT TIME 45.58 HOURS

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF .042 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF .333 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

(6)

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) | - | COMPUTED BREACH HYDROGRAPH (CFS) | = | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|---|---|---|---|---|---|---|---|---|
| 44.333 | 0.000 | 6065. | | 6065. | | 0. | 0. | 0. |
| 44.375 | .042 | 6226. | | 6198. | | 28. | 28. | 0. |
| 44.417 | .083 | 6387. | | 6386. | | 1. | 30. | 0. |
| 44.458 | .125 | 6548. | | 6585. | | -37. | -7. | -0. |
| 44.500 | .167 | 6710. | | 6773. | | -64. | -71. | -0. |
| 44.542 | .208 | 6871. | | 6946. | | -75. | -146. | -1. |
| 44.583 | .250 | 7032. | | 7100. | | -68. | -214. | -1. |
| 44.625 | .292 | 7193. | | 7236. | | -43. | -257. | -1. |
| 44.667 | .333 | 7354. | | 7354. | | 0. | -257. | -1. |
| 44.708 | .375 | 7417. | | 7457. | | -40. | -297. | -1. |
| 44.750 | .417 | 7480. | | 7546. | | -66. | -363. | -1. |
| 44.792 | .458 | 7543. | | 7623. | | -80. | -443. | -2. |
| 44.833 | .500 | 7606. | | 7687. | | -81. | -524. | -2. |
| 44.875 | .542 | 7669. | | 7741. | | -73. | -597. | -2. |
| 44.917 | .583 | 7732. | | 7790. | | -58. | -655. | -2. |
| 44.958 | .625 | 7795. | | 7834. | | -39. | -694. | -2. |
| 45.000 | .667 | 7858. | | 7858. | | 0. | -694. | -2. |
| 45.042 | .708 | 7869. | | 7870. | | -1. | -695. | -2. |
| 45.083 | .750 | 7880. | | 7887. | | -6. | -701. | -2. |
| 45.125 | .792 | 7892. | | 7905. | | -14. | -715. | -2. |
| 45.167 | .833 | 7903. | | 7923. | | -20. | -735. | -3. |
| 45.208 | .875 | 7914. | | 7942. | | -28. | -763. | -3. |
| 45.250 | .917 | 7926. | | 7962. | | -36. | -799. | -3. |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. 88 OF EE

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Engineers • Geologists • Planner
Environmental Specialists

| TIME (HOURS) | TIME FROM BEGINNING OF BREACH (HOURS) | INTERPOLATED BREACH HYDROGRAPH (CFS) - | COMPUTED BREACH HYDROGRAPH (CFS) = | ERROR (CFS) | ACCUMULATED ERROR (CFS) | ACCUMULATED ERROR (AC-FT) |
|---|---|---|---|---|---|---|
| 45.292 | .958 | 7937. | 7954. | -17. | -816. | -3. |
| 45.333 | 1.000 | 7948. | 7948. | 0. | -816. | -3. |
| 45.375 | 1.042 | 7933. | 7951. | -18. | -833. | -3. |
| 45.417 | 1.083 | 7918. | 7927. | -10. | -843. | -3. |
| 45.458 | 1.125 | 7903. | 7915. | -12. | -855. | -3. |
| 45.500 | 1.167 | 7887. | 7923. | -35. | -890. | -3. |
| 45.542 | 1.208 | 7872. | 7957. | -85. | -976. | -3. |
| 45.583 | 1.250 | 7857. | 7983. | -126. | -1102. | -4. |
| 45.625 | 1.292 | 7842. | 7890. | -49. | -1150. | -4. |
| 45.667 | 1.333 | 7827. | 7827. | 0. | -1150. | -4. |
| 45.708 | 1.375 | 7822. | 7795. | 28. | -1123. | -4. |
| 45.750 | 1.417 | 7818. | 7780. | 38. | -1084. | -4. |
| 45.792 | 1.458 | 7813. | 7774. | 39. | -1045. | -4. |
| 45.833 | 1.500 | 7809. | 7774. | 35. | -1010. | -3. |
| 45.875 | 1.542 | 7804. | 7776. | 28. | -982. | -3. |
| 45.917 | 1.583 | 7800. | 7781. | 20. | -962. | -3. |
| 45.958 | 1.625 | 7796. | 7786. | 10. | -952. | -3. |
| 46.000 | 1.667 | 7791. | 7791. | 0. | -952. | -3. |
| 46.042 | 1.708 | 7794. | 7796. | -2. | -954. | -3. |
| 46.083 | 1.750 | 7797. | 7800. | -3. | -957. | -3. |
| 46.125 | 1.792 | 7800. | 7803. | -3. | -960. | -3. |
| 46.167 | 1.833 | 7803. | 7805. | -3. | -963. | -3. |
| 46.208 | 1.875 | 7806. | 7808. | -2. | -965. | -3. |
| 46.250 | 1.917 | 7808. | 7810. | -1. | -966. | -3. |
| 46.292 | 1.958 | 7811. | 7812. | -1. | -967. | -3. |
| 46.333 | 2.000 | 7814. | 7814. | 0. | -967. | -3. |

(6)

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 7-2-79 PROJ. NO. 79-617-453

CHKD. BY DLB DATE 7-2-79 SHEET NO. CC OF EE

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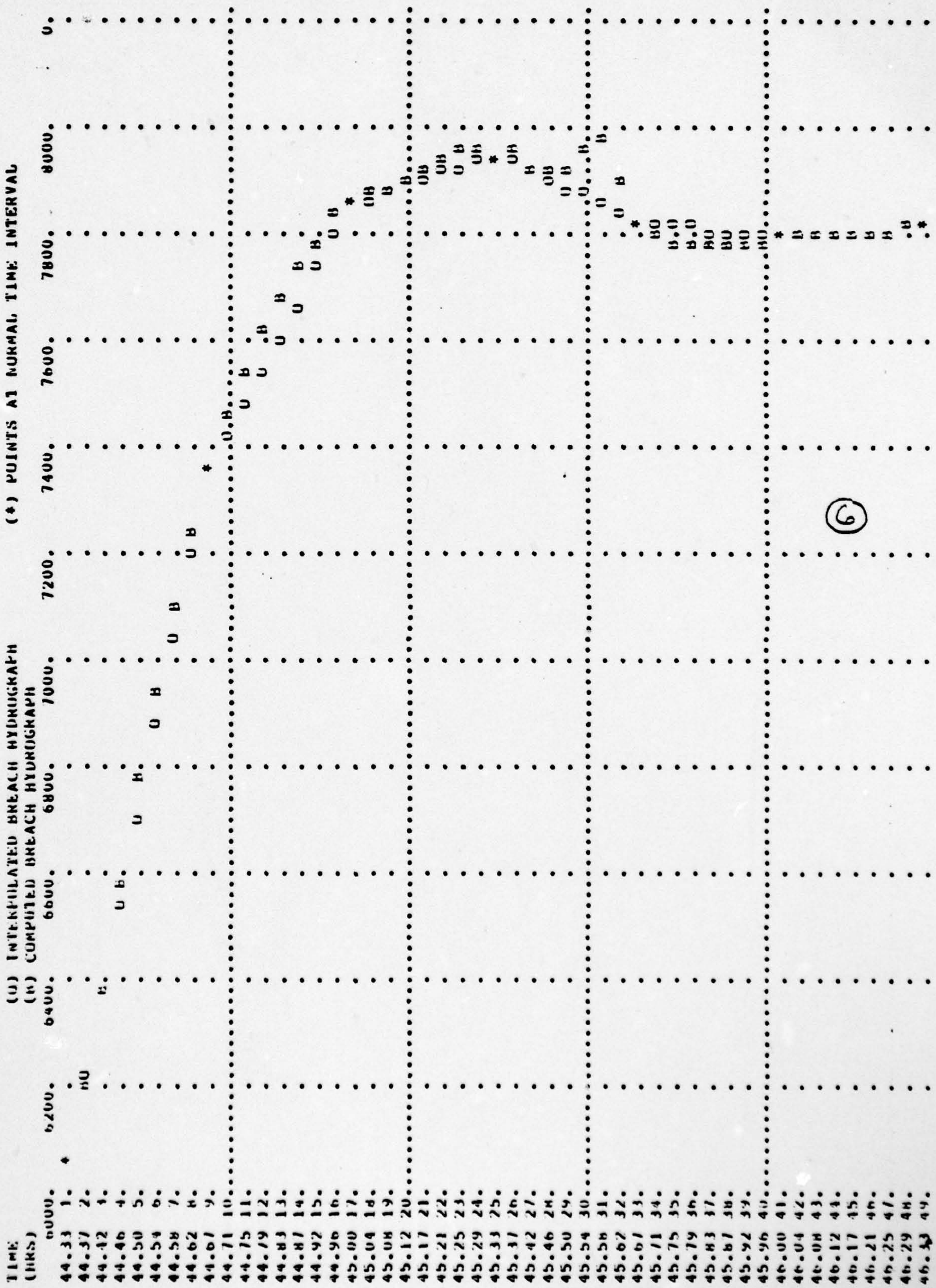


(6)

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453

CHKD. BY: DLB DATE: 7-2-79 SHEET NO. DD OF EE

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## SUMMARY OF DAM SAFETY ANALYSIS

### BEAVER RUN DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1050.00 | 1050.00 | 1070.00 |
| STORAGE | 34000. | 34000. | 64000. |
| OUTFLOW | 0. | 0. | 3460. |

| 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 |
|---|---|---|---|---|---|---|---|
| .38 | 1058.74 | 0.00 | 46236. | 3197. | 0.00 | 61.67 | 0.00 |

} FOR ALL PLANS

ROUTED BEAVER RUN DAM OUTFLOWS

STATION 2

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .38 | 3197. | 978.8 | 62.00 |

STATION 3

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .38 | 3197. | 855.3 | 63.00 |

} FOR ALL PLANS

## SUMMARY OF DAM SAFETY ANALYSIS

### GILKERSON DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 1023.00 | 1023.00 | 1027.00 |
| STORAGE | 30. | 30. | 50. |
| OUTFLOW | 0. | 0. | 520. |

| 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 |
|---|---|---|---|---|---|---|---|
| .38 | 1025.79 | 0.00 | 43. | 282. | 0.00 | 41.00 | 0.00 |

} FOR ALL PLANS

ROUTED GILKERSON DAM OUTFLOW

STATION 5

| RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
|---|---|---|---|
| .38 | 282. | 848.1 | 41.00 |

} FOR ALL PLANS

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV DATE: 7-2-79 PROJ. NO. 79-617-453
CHKD. BY: DLB DATE: 7-2-79 SHEET NO. EE OF EE

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## SUMMARY OF DAM SAFETY ANALYSIS

## BEAVER DAM

| | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM |
|---|---|---|---|
| ELEVATION | 843.50 | 843.50 | 850.80 |
| STORAGE | 18. | 18. | 148. |
| OUTFLOW | 0. | 0. | 6003. |

| PLAN | RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS |
|---|---|---|---|---|---|---|---|---|
| 1 | .38 | 850.98 | .18 | 153. | 6471. | 3.67 | 46.67 | 44.33 |
| 2 | .38 | 850.85 | .05 | 149. | 7558. | .43 | 45.33 | 44.33 |
| 3 | .38 | 851.13 | .33 | 156. | 6483. | 4.08 | 46.50 | 44.33 |
| 4 | .38 | 850.86 | .06 | 149. | 6777. | .67 | 46.42 | 44.33 |
| 5 | .38 | 850.86 | .06 | 149. | 6974. | .58 | 46.33 | 44.33 |
| 6 | .38 | 850.85 | .05 | 349. | 7983. | .42 | 45.58 | 44.33 |

| | STATION 7 | | | | STATION 8 | | | |
|---|---|---|---|---|---|---|---|---|
| PLAN | RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS | RATIO | MAXIMUM FLOW,CFS | MAXIMUM STAGE,FT | TIME HOURS |
| 1 | .38 | 6472. | 812.7 | 46.33 | .38 | 6473. | 809.8 | 46.33 |
| 2 | .38 | 7575. | 813.4 | 45.00 | .38 | 7589. | 811.5 | 45.00 |
| 3 | .38 | 6482. | 812.7 | 46.67 | .38 | 6482. | 809.8 | 46.67 |
| 4 | .38 | 6776. | 812.9 | 46.33 | .38 | 6776. | 810.3 | 46.33 |
| 5 | .38 | 6978. | 813.0 | 46.33 | .38 | 6978. | 810.6 | 46.33 |
| 6 | .38 | 7912. | 813.6 | 45.00 | .38 | 7922. | 812.0 | 45.00 |

## LIST OF REFERENCES


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# APPENDIX C-1

# SUPPLEMENTAL CALCULATIONS

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# BEAVER RUN DAM

## DAM STATISTICS

HEIGHT OF DAM ≈ 91 FT - 5 FT ≈ 86 FT (SEE NOTE 1)
(TO LOW TOP OF DAM)

MAXIMUM POOL STORAGE CAPACITY ≈ 64,000 AC-FT (SEE NOTE 1)
@ LOW TOP OF DAM (EL 1070.0 RATHER THAN EL. 1075.0)

NORMAL POOL STORAGE CAPACITY ≈ 34,000 AC-FT (SEE NOTE 1)
@ TOP OF PRINCIPAL SPILLWAY (EL 1050)

DRAINAGE AREA ≈ 43.2 SQ. MI (SEE NOTE 1)

NOTE 1: INFORMATION CONCERNING BEAVER RUN DAM WAS OBTAINED FROM "BEAVER RUN DAM, PHASE I INSPECTION REPORT, NATIONAL DAM INSPECTION PROGRAM"; PREPARED BY GAI CONSULTANTS, INC, MONROEVILLE, PA FOR THE DEPARTMENT OF ARMY, BALTIMORE DISTRICT CORPS OF ENGINEERS, JULY 1978. APPENDICES C, D, AND F.

## DAM CLASSIFICATION

DAM SIZE - LARGE (REF 1, TABLE 1)
(DUE TO STORAGE VOLUME)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - PMF (REF 1, TABLE 3)

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HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 14.3 MI.

$L_{CA} \approx 6.3$ MI. (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM TO THE CENTROID OF THE BASIN)

NOTE 2: VALUES OF L AND LCA ARE MEASURED FROM THE USGS 15 MINUTE FREEPORT AND GREENSBURG, PA QUADS. ALL VARIABLES ARE DEFINED IN REF. 2 IN THE SECTION ENTITLED, "SNYDER SYNTHETIC UNIT HYDROGRAPH"

$C_t \approx 1.6$
$C_p \approx 0.45$

[SUPPLIED BY COE; ZONE 24 OHIO RIVER BASIN]

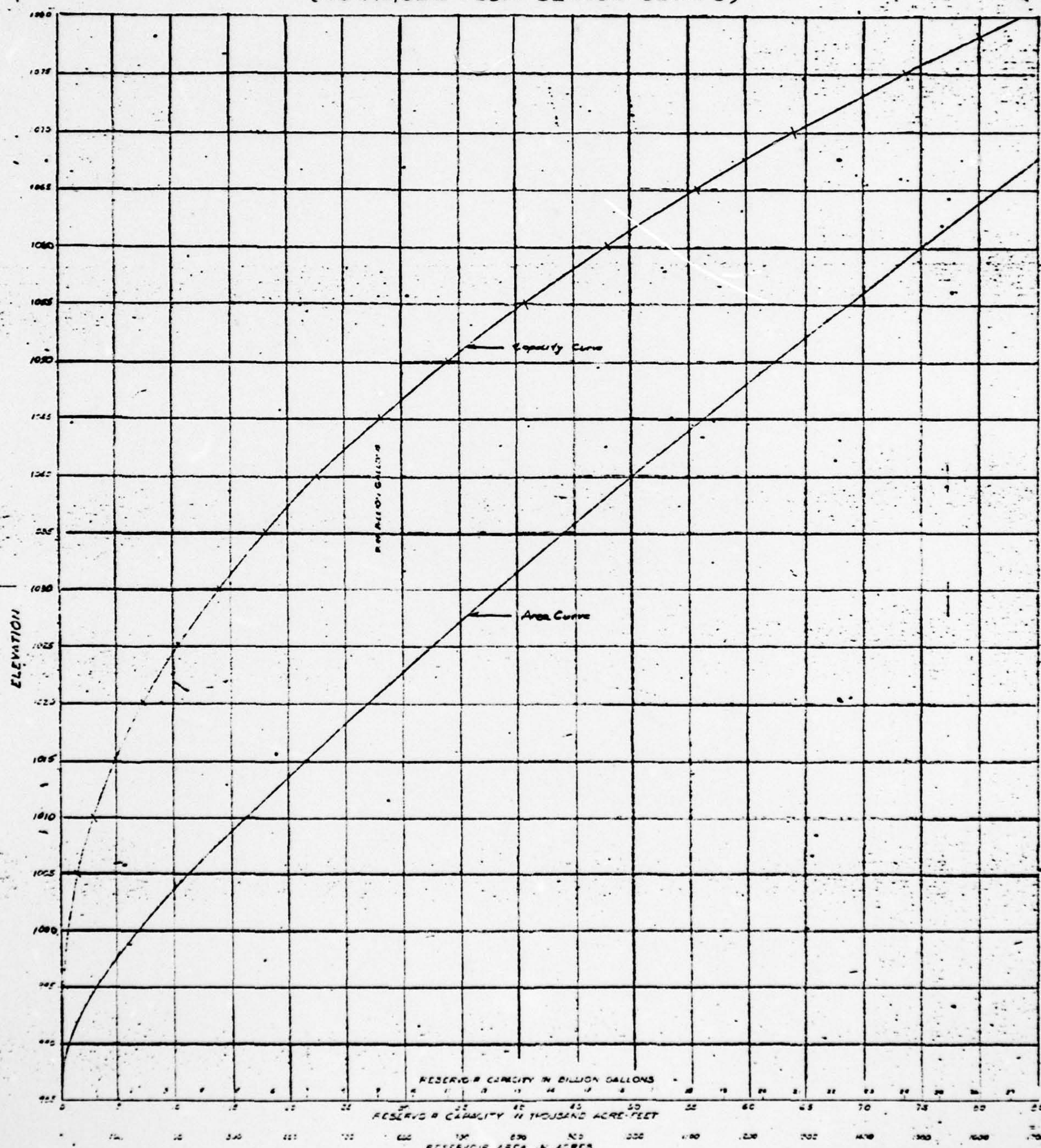
$t_p$ = SNYDER'S STANDARD LAG $\approx 1.6\,(L \times L_{CA})^{0.3}$

$\therefore\ t_p \approx 1.6\,(14.3 \times 6.3)^{0.3} \approx 6.17$ HRS

RESERVOIR ELEVATION - STORAGE RELATIONSHIP

THE DESIGN CAPACITY CURVE AS FOUND IN THE REFERENCE GIVEN IN NOTE 1 (SHEET 1) WILL BE USED TO OBTAIN VALUES OF STORAGE FOR CORRESPONDING ELEVATIONS. THE CURVE IS REPRODUCED ON THE FOLLOWING SHEET.

BEAVER RUN RESERVOIR ELEVATION vs STORAGE DESIGN CURVE
(OBTAINED FROM DESIGN DRWGS)

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MUNICIPAL AUTHORITY OF WESTMORELAND COUNTY
GREENSBURG, PA.

BEAVER RUN DAM

LOCATION MAP AND CAPACITY CURVE

SCALE - AS SHOWN APRIL

GANNETT FLEMING CORDDRY & CARPENTER
ENGINEERS HARRISBURG,

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJY DATE 5-31-79 PROJ. NO. 78-617-453
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## BEAVER RUN DAM

## PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
  (CORRESPONDING TO A DURATION OF 24 HR AND AN AREA OF 200 SQ. MI. LOCATED IN SOUTHWESTERN PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #7 (REF 3, FIG 1)

- LOCAL DRAINAGE AREA ≈ 43.2 SQ. MI. HOWEVER, THE STORM WILL BE CENTERED OVER THE TOTAL DRAINAGE AREA ABOVE BEAVER DAM ≈ 54.4 SQ. MI. ⇒

| DURATION (HR) | PERCENT OF INDEX RAINFALL (%) |
|---|---|
| 6 | 95 |
| 12 | 103 |
| 24 | 113 |
| 48 | 124 |

(FROM REF 3 FIG 2)

- HOLBROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ~ 54.4 SQ MI ⇒ 0.852 (AS COMPUTED BY HEC-1)

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NATIONAL DAM INSPECTION PROGRAM. BEAVER DAM (NDI I.D. NUMBER PA--ETC(U)

JUN 79 DACW31-79-C-0013

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2 OF 2

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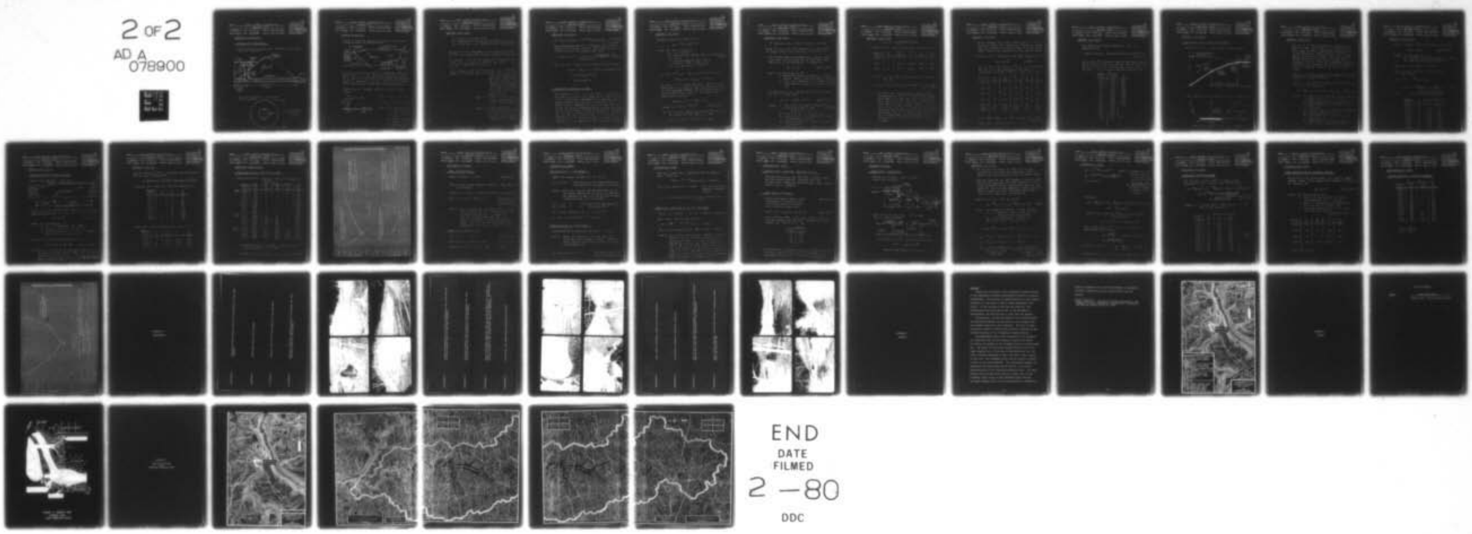

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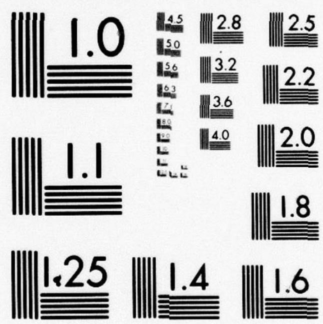


MICROCOPY RESOLUTION TEST CHART

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-4-79 PROJ. NO. 78-617-452
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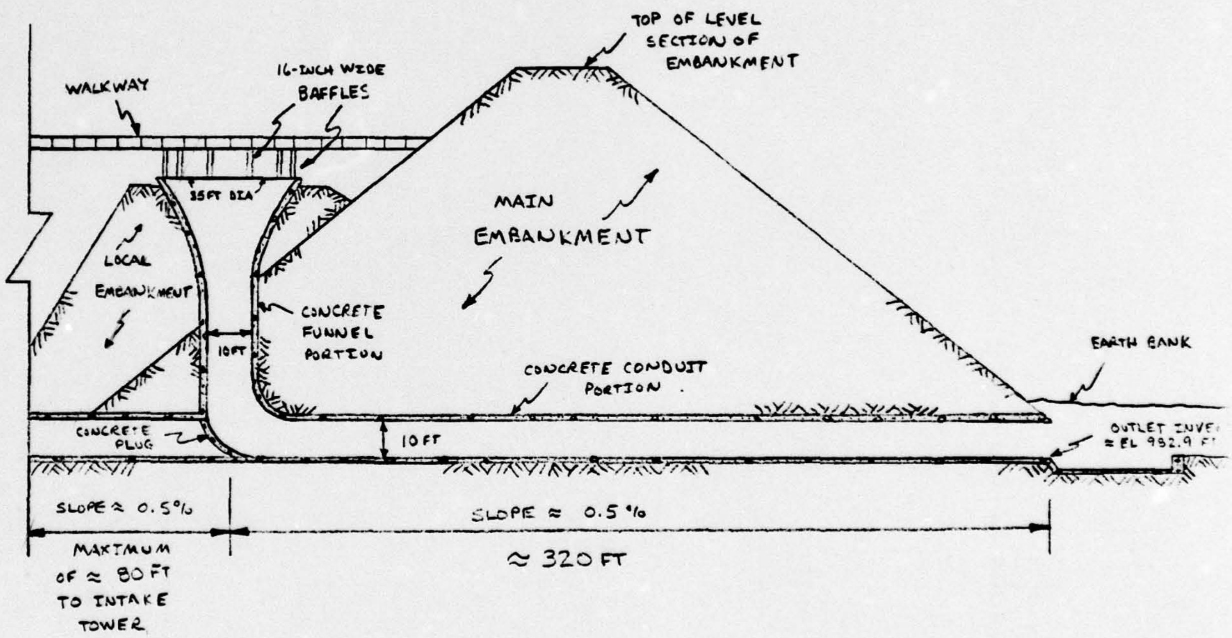
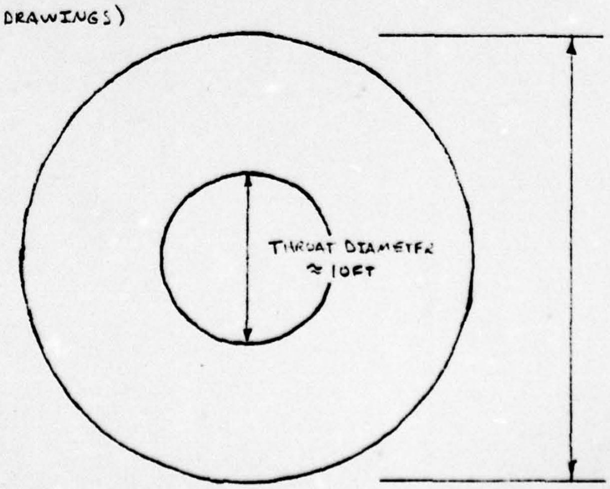
## BEAVER RUN DAM

## SPILLWAY CAPACITY

- SECTION THROUGH MORNING GLORY SPILLWAY: (NOT TO SCALE) (FROM DESIGN DRAWINGS)




- TOP VIEW OF SPILLWAY: (NOT TO SCALE) (FROM DESIGN DRAWINGS)



SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 6-6-79  PROJ. NO. 73-617-453
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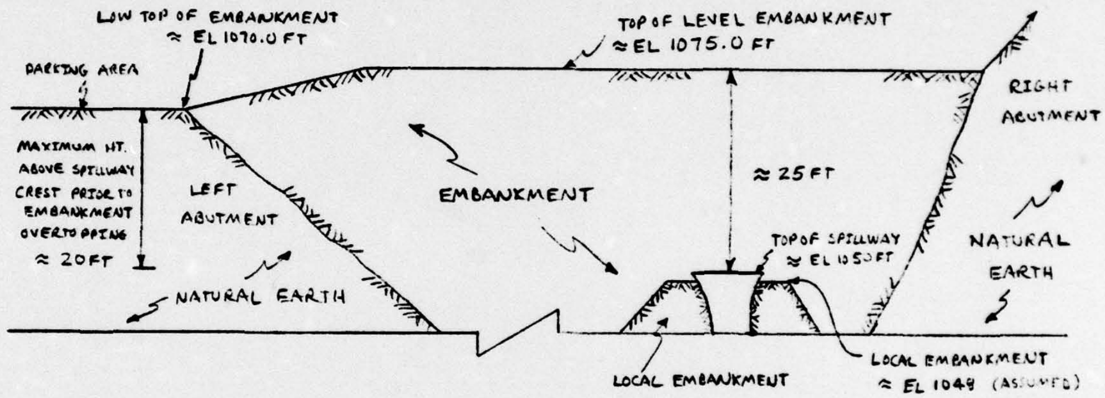
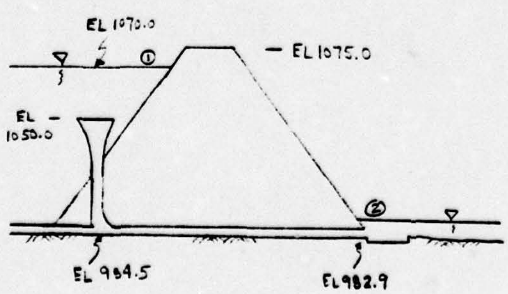
BEAVER RUN DAM

- PROFILE OF EMBANKMENT RELATIVE TO SPILLWAY: (NOT TO SCALE)
  (FROM DESIGN DRAWINGS AND FIELD OBSERVATION)




- SINCE DESIGN CALCULATIONS ARE NOT AVAILABLE, THE ACTUAL DESIGN DISCHARGE AND HEAD ARE UNKNOWN. HOWEVER, IT IS SAFE TO ASSUME THAT BY THE TIME THE RESERVOIR RISES TO ELEVATION 1070.0 FT (20FT ABOVE THE SPILLWAY CREST) THE OUTLET CONDUIT WILL BE FLOWING FULL.

- ENERGY BALANCE BETWEEN SECTIONS ① AND ② SHOWN BELOW:




$$P_1/\gamma + v_1^2/2g + z_1 = P_2/\gamma + v_2^2/2g + z_2 + H_L \quad \text{(REF 13, P}$$

WHERE $P_1/\gamma$ = PRESSURE @ ① = 0 (ATMOSPHERIC PRESSURE)

$v_1$ = VELOCITY OF RESERVOIR ≈ 0 FPS;

$z_1$ = ELEVATION OF RESERVOIR SURFACE ≈ 1070.0 FT

$P_2/\gamma$ = PRESSURE @ ② = 0 (ATMOSPHERIC PRESSURE);

BEAVER RUN DAM

$v_2$ = VELOCITY @ OUTLET IN FPS
$z_2$ = ELEVATION OF TAILWATER ON OUTLET IN FT; AND
$H_L$ = TOTAL HEAD LOSS = ENTRANCE + BEND + FRICTION LOSSES

ASSUME THAT THE TAILWATER IS JUST ABOVE THE CROWN OF THE 10-FT DIAMETER OUTLET CONDUIT $\Rightarrow z_2 \approx$ 992.5 F

THE VELOCITY, $v_2$, OF THE CONDUIT IS A FUNCTION OF FLOW AND CROSS-SECTIONAL AREA $\Rightarrow v_2 \approx Q/A_2$
w/ $A_2 \approx \pi (10\text{FT})^2/4 \approx 78.5 \text{ FT}^2$

TOTAL HEAD LOSS IS A FUNCTION OF CONDUIT VELOCITY HEAD ($v_2^2/2g$) $\Rightarrow$ ENTRANCE $\approx 0.9\, v_2^2/2g$ (ALTHOUGH THE EDGES OF THE SHAFT ENTRANCE ARE ROUNDED, A LARGE COEFFICIENT WAS CHOSEN TO TAKE INTO ACCOUNT THE EFFECTS OF THE 12 BAFFLES, THE WALKWAY, AND THE PROJECTION OF THE SHAFT FROM THE FILL ON THE EFFICIENCY OF ENTRANCE; REF 5, PG 6-19);

BEND $\approx 0.2\, v_2^2/2g$ (90° BEND w/ BEND RADIUS - PIPE DIAMETER RATIO ($R/D$) $\approx 20/10 \approx 2$ ; REF 5 PG ...

FRICTION $\approx [29 n^2 L / R^{1.33}]\, v_2^2/2g$ (WHERE $n$ = MANNINGS ROUGHNESS COEFFICIENT $\approx 0.013$ FOR CONCRETE, $L$ = TOTAL LENGTH OF SHAFT + CONDUIT $\approx$ 65.5 FT + 320 FT $\approx$ 385.5 FT,

BEAVER RUN DAM

R = HYDRAULIC RADIUS = FLOW AREA / WETTED PERIMETER ≈ $78.5\ FT^2/\pi(10\ FT)$
≈ 2.5 FT )

(FRICTION RELATIONSHIP OBTAINED FROM "HYDRAULIC CHARTS FOR THE SELECTION OF HIGHWAY CULVERTS", HEC Nº 3, U.S. DEPT. OF COMMERCE, BUREAU OF PUBLIC ROADS. 1965)

$$\therefore \text{TOTAL HEAD LOSS} \approx \left[0.5 + 0.2 + \frac{29(0.013)^2(385.5)}{(2.5)^{1.33}}\right] \frac{Q^2}{2g(78.5)^2}$$
$$\approx (3.93\times10^{-6})\times Q^2$$

- THUS, DISCHARGE CAPACITY CAN BE FOUND FROM THE RELATIONSHI[P]

$$1070.0\ FT = \frac{Q^2}{2g(78.5)^2} + 992.9\ FT + 0.00000393\ Q^2$$

$$77.1 \approx (6.45\times10^{-6})\times Q^2$$

$$Q \approx 3460\ CFS$$

SPILLWAY RATING CURVE

AN ATTEMPT TO BACK-CALCULATE THE DESIGN DISCHARGE AND HEAD ACCORDING TO THE USBR METHOD (REF 4, PGS 415-4[?]) PROVED TO BE FUTILE. PERTINENT DATA OBTAINED FROM THE DESIGN DRAWINGS DID NOT SEEM TO CONFORM TO THE USBR RELATIONSHIPS. THEREFORE, IN ORDER TO ESTIMATE THE DESIGN PARAMETERS, MANNING'S EQUATION WILL BE APPLIED TO THE 320-FT LENGTH OF CONDUIT IN ORDER TO DETERMINE ITS 75% FULL CAPACITY. (THE CONDUIT SHOULD HAVE BEEN DESIGNED TO PASS THE DESIGN FLOW @ 75% OF ITS CAPACITY SO AS TO HELP AVOID SIPHONIC FLOW CONDITIONS, SINCE IT DOES NOT APPEAR THAT THE CONDUIT IS AERATED.)

BEAVER RUN DAM

MANNING EQUATION (REF 7, PG 129):

$$Q = {}^{1.49}/_{n}\ A\ R^{2/3}\ S^{1/2}$$

WHERE Q = DISCHARGE, IN CFS;
n ≈ 0.013 (SHEET 7);
A ≈ 75% OF TOTAL CONDUIT AREA ≈ 0.75(78.5 FT²) ↳ SHEET 7
≈ 58.9 FT²
R ≈ HYDRAULIC RADIUS @ 75% CAPACITY
≈ 2.97 FT (REF 4, PG 551); AND
S ≈ SLOPE OF CONDUIT ≈ 0.5%

$$\therefore\ Q \approx {}^{1.49}/_{0.013}\ (58.9\ FT^2)(2.97\ FT)^{2/3}(0.005)^{1/2}$$

⟹ ASSUMED $Q_{DESIGN}$ ≈ 990 CFS

- ACCORDING TO THE DESIGN DRAWINGS, THE THROAT OF THE SHAFT IS LOCATED @ ABOUT EL 1009.0 FT AND IS A 10-FT DIAMETER OPENING. IF THE DESIGN DISCHARGE OCCURS DURING "THROAT CONTROL", THE DESIGN HEAD ELEVATION WOULD BE:

$$ELEVATION\ H_o \approx 1009.0 + H_a$$

WHERE $H_a \approx [0.204\ Q^{1/2}/R]^4$ (REF 4, PG 421)

W/ Q = ASSUMED DESIGN DISCHARGE ≈ 990 CFS, AND
R = RADIUS OF THROAT SECTION ≈ 5 FT

$$\therefore\ H_a \approx [0.204\ (990)^{1/2}/5]^4 \approx 2.7\ FT$$

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⇒ ELEVATION $H_o$ = 1009.0 + 2.7 FT ≈ 1011.7 FT

SINCE THE CREST OF THE SPILLWAY IS @ EL 1050 FT
⇒ DESIGN HEAD IS NOT CONTROLLED BY THE THROAT.

- THE ASSUMED DESIGN DISCHARGE MUST OCCUR AS WEIR FLOW OVER THE CIRCULAR LIP OF THE SHAFT. THE WEIR FLOW CAN BE DEFINED BY THE EQUATION:

$$Q = C L H^{3/2}$$ (REF 4, PG 415)

WHERE Q = DISCHARGE IN CFS;
L = EFFECTIVE LENGTH OF WEIR CREST, WHICH EQUALS $2\pi R_s$ − (OBSTRUCTION WIDTHS) IN FT; A
C = DISCHARGE COEFFICIENT = f (DESIGN HEAD, $H_o$ SHAFT ENTRANCE RADIUS, $R_s$, AND FOREBAY DEPTH, P).

THE EFFECTIVE LENGTH OF THE CIRCULAR WEIR CREST CAN BE OBTAINED FROM:

$$L = L' - 2(NK_p + K_a)H_e$$ (REF 4, PG 373)

WHERE $L'$ = NET LENGTH OF CREST = $(2\pi R_s) - (12 \times 16)$ ↳ 12 BAFFLES 16 IN WIDE
$= (2\pi \times 17.5\text{FT}) - (12 \times \frac{16}{12}) \approx 94$ FT;
↳ SEE SKETCH ON SHEET 5
N = NUMBER OF PIERS OR BAFFLES = 12;
$K_p$ = BAFFLE CONTRACTION COEFFICIENT ≈ 0.02 (FOR SQUARE-EDGED BAFFLES);
$K_a$ = ABUTMENT CONTRACTION COEFFICIENT ≈ 0.0 (NO ABUTMENT);
$H_e$ = TOTAL HEAD ON CREST, IN FT.

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$$L \approx 94 - 2\left[(12 \times 0.02) + 0.0\right] H_e$$

- COMPUTATION OF ASSUMED DESIGN HEAD (FOR $Q \approx 990$ CFS):

| ELEVATION (FT) | $H_o$ (FT) | $H_o/R_s$ (FT/FT) | $C_o$* | L (FT) | Q (CFS) |
|---|---|---|---|---|---|
| 1050.0 | 0 | 0 | – | – | 0 |
| 1051.0 | 1 | 0.06 | 4.05 | 94 | 380 |
| 1052.0 | 2 | 0.11 | 4.00 | 93 | 1050 |

* $C_o = f\,(H_o/R_s\,;\ P/R_s\,;$ REF 4, PG 417, FIG 283). ASSUME $P/R_s \geq 2$

∴ ASSUME THAT THE DESIGN HEAD ≈ 1.9 FT (BY INTERPOLATI
SAY 2.0 FT

⇒ THE SHAFT AND THROAT SECTIONS ARE GREATLY OVERDESIGNED W/ RESPECT TO THE OUTLET CONDUIT SINCE THEIR CAPACITIES ARE MUCH GREATER THAN THE CONDUIT CAPACITY. THEORETICALLY, THE CIRCULAR WEIR WILL NOT BE SUBMERGED UNLESS A HEAD OF ABOUT 7.9 FT ($\Rightarrow H_o/R_s \approx 0.45$) WAS USED FOR DESIGN. THEREFORE, THE ABOVE COMPUTED 2.0-FT DESIGN HEAD IS PROBABLY NOT THE CORRECT DESIGN HEAD, BUT IT IS ABOUT THE HIGHEST HEAD OBTAINABLE PRIOR TO THE POSSIBILITY OF SLUG FLOW IN THE OUTLET CONDUIT

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- IT IS EVIDENT THAT THE THROAT WILL NOT CONTROL DISCHARGES FROM THIS SPILLWAY. THEREFORE, OUTFLOWS WILL BE DEFINED BY CIRCULAR WEIR FLOW FOR LOWER HEADS, AND BY FULL BARREL FLOW FOR HIGHER HEADS.

- WEIR CONTROL ELEVATION DISCHARGE RELATIONSHIP:

$$Q = C L H_e^{3/2} \qquad \text{(SHEET 10)}$$

ASSUME THAT THE DESIGN $H_o/R_s \approx 0.3$ ($H_o \approx 5.3$ FT) FOR SIMPLICITY OF CALCULATIONS ⇒ THE "C" COEFFICIENT ≈ 3.75 ($P/R_s \geq 2.0$; REF 4, PG 417, FIG 283)

| ELEVATION (FT) | $H_e$ (FT) | $H_e/R_s$ (FT/FT) | *C | **L (FT) | Q |
|---|---|---|---|---|---|
| 1050.0 | 0 | – | – | – | 0 |
| 1051.0 | 1 | 0.06 | 3.30 | 94 | 310 |
| 1052.0 | 2 | 0.11 | 3.49 | 93 | 920 |
| 1053.0 | 3 | 0.17 | 3.64 | 93 | 1760 |
| 1054.0 | 4 | 0.23 | 3.71 | 92 | 2730 |
| 1054.3+ | 4.3+ | 0.25+ | 3.72 | 92 | 3090 |
| 1055.0 | 5 | 0.29 | 3.75 | 92 | 3860 |

* $C = 3.75 \times C/C_{0.3}$ w/ $C/C_{0.3}$ OBTAINED FROM REF 4, PG 421, FIG 284

** SEE SHEET 10 FOR RELATIONSHIP

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

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BEAVER RUN DAM

- FULL BARREL FLOW CONTROL ELEVATION - DISCHARGE RELATIONSHIP:

ELEVATION RESERVOIR - ELEVATION TAILWATER $\approx (6.45 \times 10^{-6}) \times Q^2$

(SHEETS 6, 7, + 8)

ASSUME THAT THE TAILWATER REMAINS RELATIVELY CONSTANT @ EL 992.9 FT UNTIL THE RESERVOIR REACHES EL 1070.0 FT. ALSO ASSUME THAT THE TAILWATER LEVEL INCREASES BY 1 FT FOR EVERY 1 FT OF RESERVOIR RISE ABOVE EL 1070.0 FT.

| RESERVOIR ELEVATION (FT) | TAILWATER ELEVATION (FT) | Q (CFS) |
|---|---|---|
| 1053.0 | 992.9 | 3050 |
| 1054.0 | 992.9 | 3080 |
| 1054.3⁺ | 992.9 | 3090 |
| 1055.0 | 992.9 | 3100 |
| 1060.0 | 992.9 | 3230 |
| 1065.0 | 992.9 | 3340 |
| 1070.0 | 992.9 | 3460 |
| 1071.0 | 993.9 | 3460 |
| 1072.0 | 994.9 | 3460 |
| 1073.0 | 995.9 | 3460 |
| 1074.0 | 996.9 | ↓ |
| 1075.0 | 997.9 | |
| 1076.0 | 998.9 | |
| 1077.0 | 999.9 | |
| 1078.0 | 1000.9 | |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-7-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 14 OF 20

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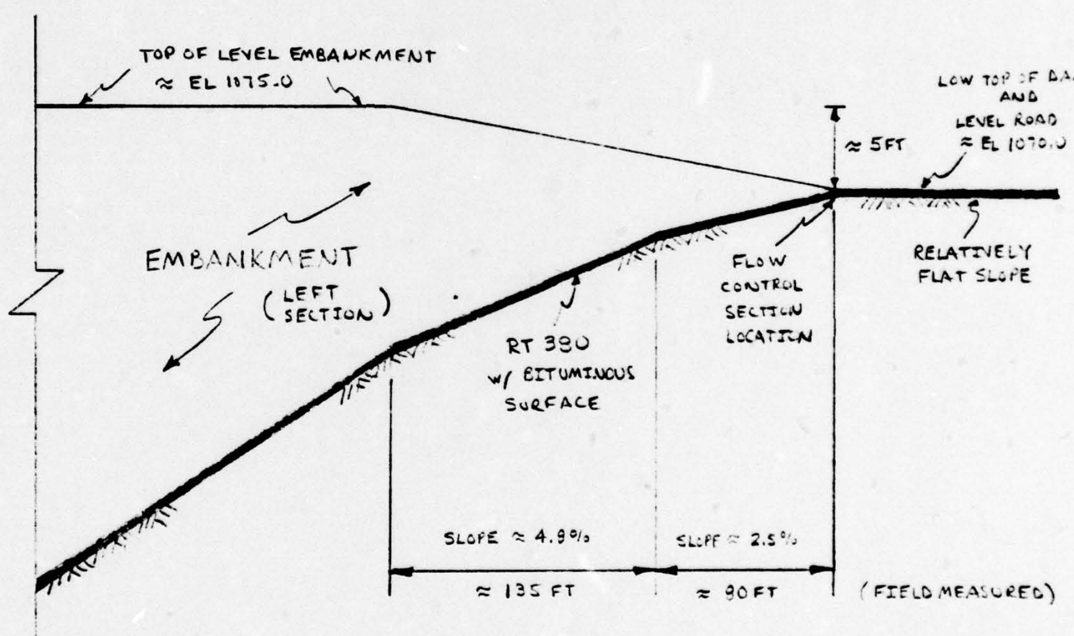
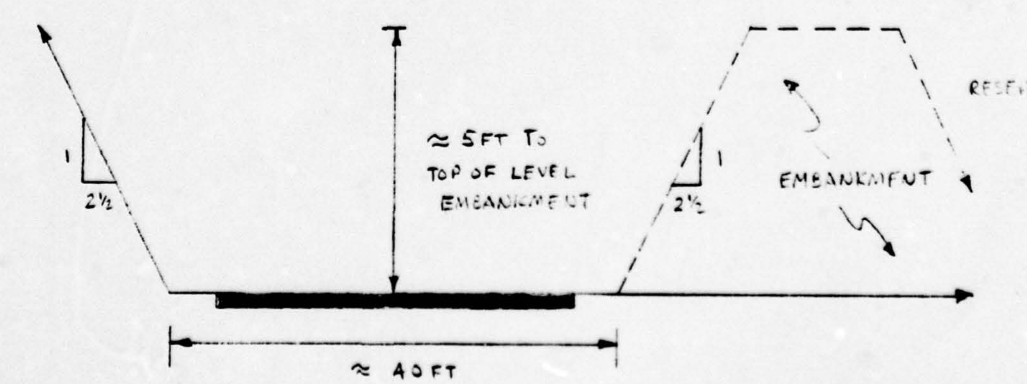
BEAVER RUN DAM

DISCHARGE CAPABILITIES OF RT 380

- PROFILE OF RT 380 "CHUTE CHANNEL": (NOT TO SCALE)




- CROSS-SECTION OF RT 380 CONTROL SECTION: (NOT TO SCALE)




SECTION TAKEN LOOKING DS FROM CONTROL SECTION

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- THE LOW TOP OF DAM ELEVATION IS LOCATED @ THE INVERT OF THE CONTROL SECTION. AS THE RESERVOIR RISES ABOVE EL 1070.0, PROGRESSIVELY LARGER PORTIONS OF THE EMBANKMENT ARE OVERTOPPED. THE MAXIMUM LENGTH OF OVERTOPPING PRIOR TO OVERTOPPING OF THE ENTIRE EMBANKMENT (@ EL 1075.0) IS ABOUT 215 FT OR ABOUT 20% OF OF THE ENTIRE EMBANKMENT LENGTH. THEREFORE, THE DRAINAGE WAY CANNOT BE CONSIDERED TO BE AN EMERGENCY SPILLWAY IN THE STRICTEST SENSE.

- CRITICAL FLOW RELATIONSHIPS WILL GOVERN THE DISCHARGE THROUGH THE CONTROL SECTION:

ENERGY BALANCE BETWEEN THE CONTROL SECTION AND A SECTION JUST UPSTREAM ⇒

$$Y_1 + v_1^2/2g + z_1 = Y_c + v_c^2/2g + z_2 + H_L \quad \text{(REF 7, PG 40)}$$

WHERE $Y_1$ = DEPTH OF WATER IN THE UPSTREAM SECTION ≈ ELEVATION OF RESERVOIR − 1070.0 FT;
$v_1$ = APPROACH VELOCITY OF RESERVOIR ≈ 0 FPS;
$z_1$ = INVERT ELEVATION OF UPSTREAM SECTION ≈ 1070.0 FT;
$Y_c$ = CRITICAL DEPTH @ CONTROL SECTION, IN FT;
$v_c$ = CRITICAL VELOCITY, IN FPS;
$z_2$ = INVERT ELEVATION OF CONTROL SECTION ≈ 1070.0 FT; AND
$H_L$ = TOTAL ENERGY LOSS BETWEEN SECTIONS ≈ 0 (SECTIONS ARE CLOSE TOGETHER).

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ALSO @ CRITICAL FLOW (FOR THE CONTROL SECTION) ⇒

$$Q^2 B_c = g A_c^3 \qquad \text{(REF 13, PG 141)}$$

WHERE $Q$ = DISCHARGE, IN CFS;
$B_c$ = TOPWIDTH OF CRITICAL WATER SURFACE, IN FT; AND
$A_c$ = AREA OF CRITICAL FLOW, IN FT$^2$.

$$B_c \approx 40 + 2.5Y_c + 2.5Y_c \approx 40 + 5Y_c$$

$$A_c \approx (40 \times Y_c) + \tfrac{1}{2}(2.5Y_c \times Y_c) + \tfrac{1}{2}(2.5Y_c \times Y_c)$$
$$\approx 40Y_c + 2.5Y_c^2$$

$$v_c \approx Q/A_c \approx Q/(40Y_c + 2.5Y_c^2)$$

$$\therefore \quad Y_1 = Y_c + Q^2/2g\left[(40Y_c + 2.5Y_c^2)\right]^2 + (1070.0 - 1070.0)$$

AND $$Q = \sqrt{g\,(40Y_c + 2.5Y_c^2)^3/(40 + 5Y_c)}$$

| RESERVOIR ELEVATION (FT) | $Y_1$ (FT) | FINAL ASSUMED $Y_c$ (FT) | FINAL ASSUMED Q (CFS) |
|---|---|---|---|
| 1070.0 | 0 | – | 0 |
| 1071.0 | 1 | 0.67 | 130 |
| 1072.0 | 2 | 1.37 | 390 |
| 1073.0 | 3 | 2.07 | 720 |
| 1074.0 | 4 | 2.79 | 1160 |
| 1075.0 | 5 | 3.51 | 1690 |
| 1076.0 | 6 | 4.25 | 2290 |
| 1077.0 | 7 | 4.99 | 2990 |
| 1078.0 | 8 | 5.73 | 3760 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-9-79 PROJ. NO. 79-617-453

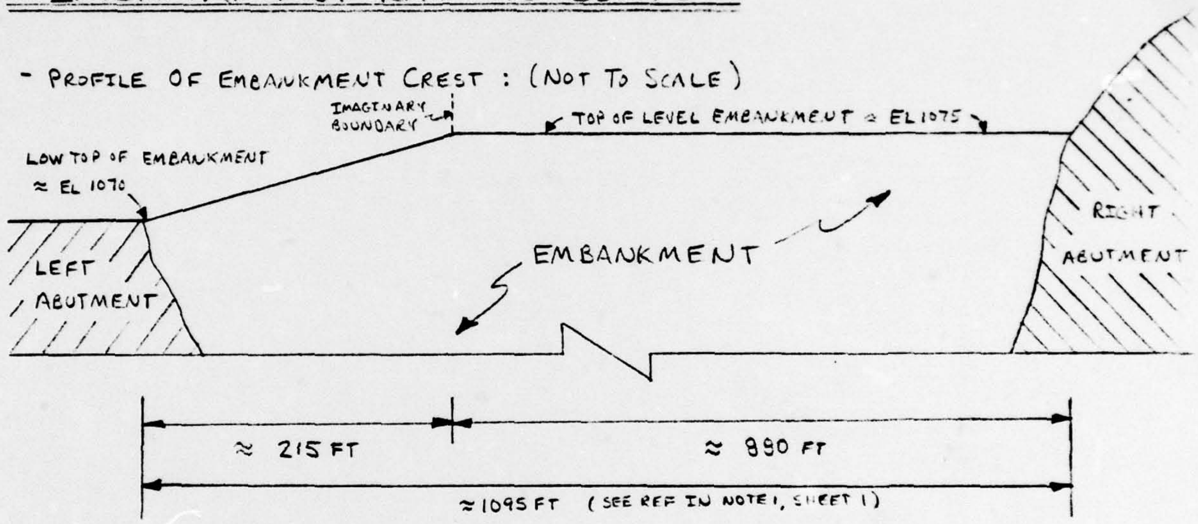
CHKD. BY DLB DATE 6-18-79 SHEET NO. 17 OF 20



BEAVER RUN DAM

EMBANKMENT RATING CURVE

- PROFILE OF EMBANKMENT CREST : (NOT TO SCALE)




- ASSUME THAT THE EMBANKMENT ACTS LIKE A BROAD-CRESTED WEIR WHEN OVERTOPPED W/ DISCHARGES DEFINED BY: (FOR THE LEVEL EMBANKMENT PORTION)

$$Q = C L H_1^{3/2}$$ (REF 5, PG 5-23)

WHERE Q = DISCHARGE, IN CFS;
L = LENGTH OF EMBANKMENT CREST ≈ 880 FT;
$H_1$ = ELEVATION OF RESERVOIR − EL 1075.0 FT;
C = DISCHARGE COEFFICIENT = f ( H/l w/ l = WIDTH OF CREST ≈ 22 FT ; AND REF 12, PG 46).

AND (FOR THE INCLINED EMBANKMENT PORTION), ASSUME

$$Q = [C_1 \tan \theta/2 \; H_2^{2.5}]/2$$ (REF 5, PG 5-4)

WHERE Q = DISCHARGE, IN CFS ; θ/2 = ANGLE WHICH INCLINED CREST MAKES W/ A VERTICAL LINE ≈ 88.7° ⇒ TAN θ/2 ≈ $\frac{215 FT}{5 FT}$ ≈ 43 ; H = RESERVOIR ELEVATION − 1170.0 FT ; AND $C_1$ = DISCHARGE COEFFICIENT, ASSUMED TO BE EQUAL TO : 2.5 (FOR SHARP-CRESTED V-NOTCH, REF 5, PG 5-16) × $\frac{3.09}{3.33}$ ($\frac{\text{BROAD-CRESTED RECTANG.}}{\text{SHARP-CRESTED RECTANG.}}$ REF 5, PGS 5-24 AND 5-7) ≈ 2.32

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-8-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 18 OF 20

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BEAVER RUN DAM

HOWEVER, ABOVE EL 1075.0 FT, DISCHARGE OVER THE INCLINED CREST PORTION IS DEFINED BY:

$$Q = [(2.32 \tan \theta/2 \ H_2^{2.5})/2] - [(2.32 \tan \theta/2 \ H_1^{2.5})/2]$$

- INCLINED CREST ELEVATION - DISCHARGE RELATIONSHIP:

| RESERVOIR ELEVATION (FT) | $H_1$ (FT) | $H_2$ (FT) | Q (CFS) |
|---|---|---|---|
| 1070.0 | - | 0 | 0 |
| 1071.0 | - | 1 | 50 |
| 1072.0 | - | 2 | 280 |
| 1073.0 | - | 3 | 780 |
| 1074.0 | - | 4 | 1600 |
| 1075.0 | - | 5 | 2790 |
| 1076.0 | 1 | 6 | 4350 |
| 1077.0 | 2 | 7 | 6190 |
| 1078.0 | 3 | 8 | 8250 |

- LEVEL CREST ELEVATION - DISCHARGE RELATIONSHIP:

| RESERVOIR ELEVATION (FT) | $H_1$ (FT) | H/ℓ (FT/FT) | C | Q (CFS) |
|---|---|---|---|---|
| 1075.0 | 0 | — | - | 0 |
| 1076.0 | 1 | 0.05 | 3.03 | 2670 |
| 1077.0 | 2 | 0.10 | 3.04 | 7570 |
| 1078.0 | 3 | 0.14 | 3.05 | 13950 |

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-7-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-18-79 SHEET NO. 19 OF 20

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# BEAVER RUN DAM

## TOTAL FACILITY RATING CURVE

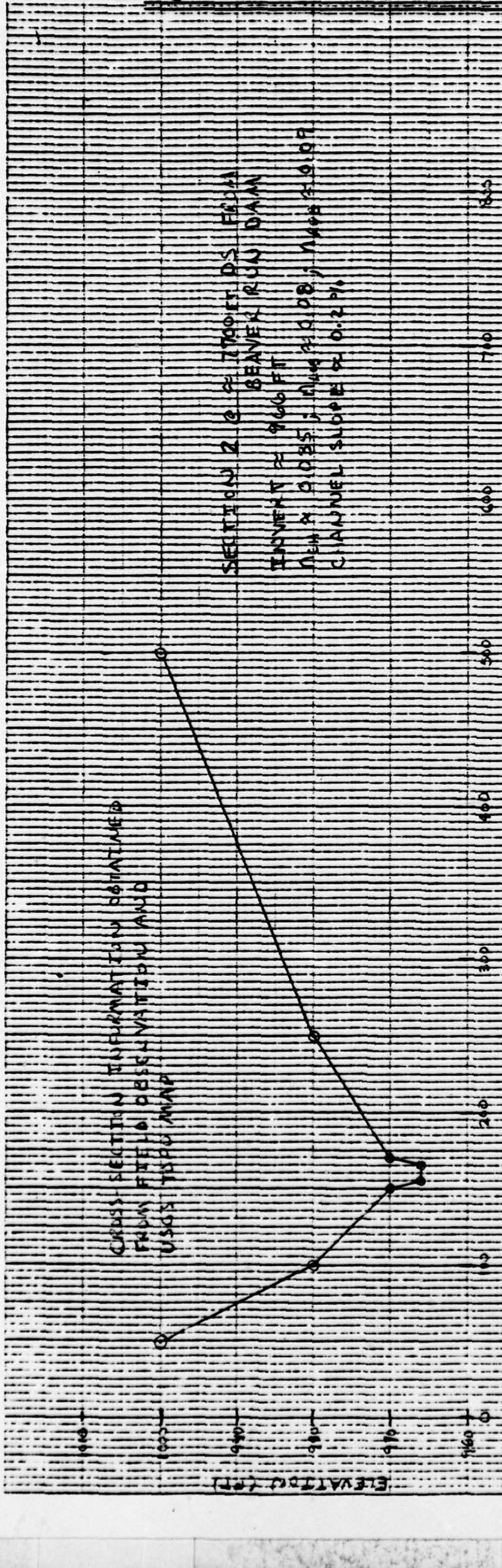
TOTAL DISCHARGE = $Q_{SPILLWAY} + Q_{RT 380} + Q_{INCLINED CREST} + Q_{LEVEL CREST}$

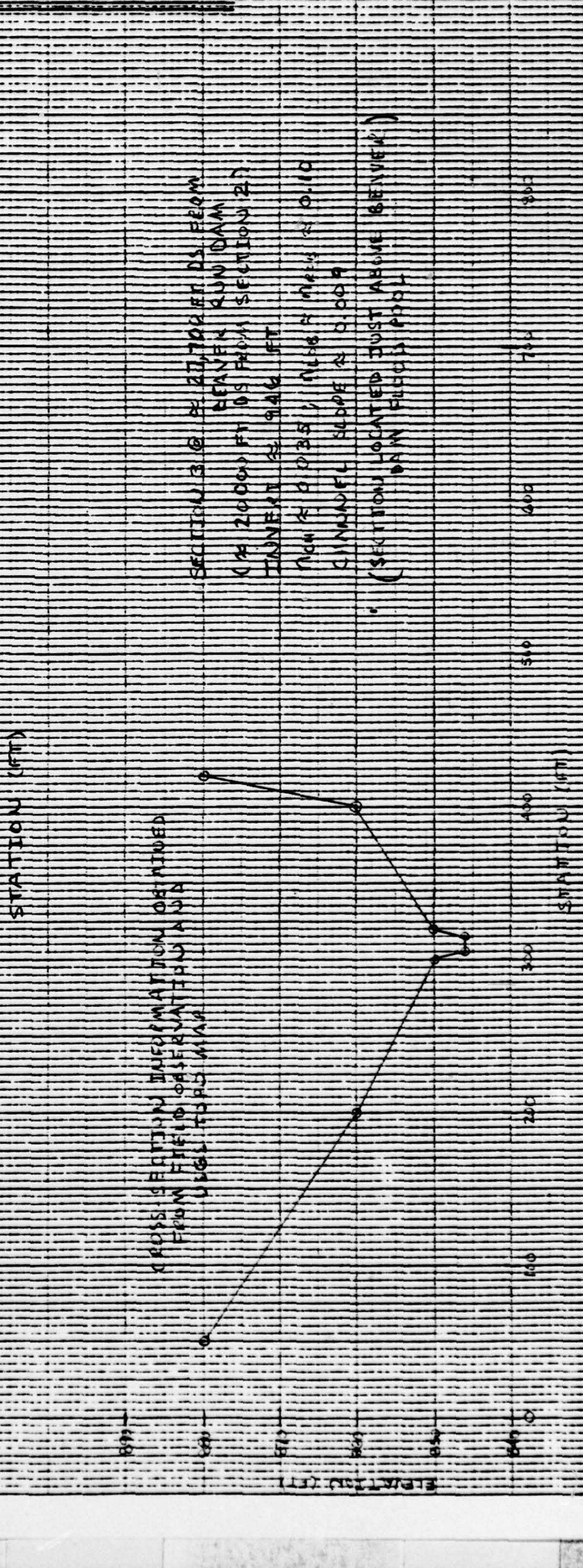
| | RESERVOIR ELEVATION (FT) | ① SPILLWAY Q (CFS) | ② RT 380 Q (CFS) | ③ INCLINED CREST Q (CFS) | ④ LEVEL CREST Q (CFS) | TOTAL Q (CFS) |
|---|---|---|---|---|---|---|
| NORMAL POOL - | 1050.0 | 0 | – | – | – | 0 |
| | 1051.0 | 310 | – | – | – | 310 |
| | 1052.0 | 920 | – | – | – | 920 |
| | 1053.0 | 1760 | – | – | – | 1760 |
| | 1054.0 | 2730 | – | – | – | 2730 |
| | * 1054.3 | 3090 | – | – | – | 3090 |
| | 1055.0 | 3100 | – | – | – | 3100 |
| | 1060.0 | 3230 | – | – | – | 3230 |
| | 1065.0 | 3340 | – | – | – | 3340 |
| LOW TOP OF DAM - | 1070.0 | 3460 | 0 | 0 | – | 3460 |
| | 1071.0 | 3460 | 130 | 50 | – | 3640 |
| | 1072.0 | 3460 | 380 | 280 | – | 4120 |
| | 1073.0 | 3460 | 720 | 780 | – | 4960 |
| | 1074.0 | 3460 | 1160 | 1600 | – | 6220 |
| TOP OF LEVEL CREST - | 1075.0 | 3460 | 1680 | 2790 | 0 | 7930 |
| | 1076.0 | 3460 | 2290 | 4350 | 2670 | 12770 |
| | 1077.0 | 3460 | 2980 | 6180 | 7570 | 20190 |
| | 1078.0 | 3460 | 3760 | 8250 | 13750 | 29420 |

* TRANSITION ELEVATION BETWEEN WEIR FLOW AND FULL BARREL FLOW FOR THE SPILLWAY

① SHEETS 12 & 13, ② SHEET 16, ③ SHEET 18, ④ SHEET 18

# DOWNSTREAM ROUTING SECTIONS



| | | | |
|---|---|---|---|
| SUBJECT | DAM SAFETY INSPECTION | | |
| | BEAVER DAM | | |
| BY WJV | DATE 5-25-79 | PROJ. NO. 79-617-453 | |
| CHKD. BY DLB | DATE 6-12-79 | SHEET NO. 1 | OF 11 |

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GILKERSON DAM

DAM STATISTICS

HEIGHT OF DAM ≈ 19 FT (SEE NOTE 1)

MAXIMUM POOL STORAGE CAPACITY ≈ 50 AC-FT (FROM HEC-1)
@ TOP OF DAM

NORMAL POOL STORAGE CAPACITY ≈ 30 AC-FT (SEE NOTE 1)

DRAINAGE AREA ≈ 0.33 SQ MI. [PLANIMETERED OFF USGS 7.5 MINUTE VANDERGRIFT, PA QUAD]

NOTE 1: STORAGE VALUE OBTAINED FROM "REPORT ON THE APPLICATION OF THE APOLLO WATERWORKS COMPANY FOR PERMISSION TO CONSTRUCT A DAM ON A TRIBUTARY OF BEAVER RUN, NEAR APOLLO, ARMSTRONG COUNTY, PENNSYLVANIA" AS FOUND IN PENN DER FILES. THE ACTUAL REPORTED VALUE WAS 10 MILLION GALLONS. ALSO, HEIGHT OF DAM OBTAINED FROM SAME REFERENCE.

DAM CLASSIFICATION

DAM SIZE - SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATION)

REQUIRED SDF - ½ PMF TO PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 5-30-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-12-79 SHEET NO. 2 OF 11

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## GILKERSON DAM

## HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 0.8 MI

$L_{CA} \approx 0.4$ MI (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM TO THE CENTROID OF THE BASIN)

NOTE 2: VALUES OF L AND $L_{CA}$ ARE MEASURED FROM THE USGS 7.5 MINUTE VANDERGRIFT, PA QUAD. ALL VARIABLES ARE DEFINED IN REF. 2 IN THE SECTION ENTITLED, "SNYDER SYNTHETIC UNIT HYDROGRAPH".

$C_t \approx 1.6$
$C_p \approx 0.45$ } [SUPPLIED BY THE COE; ZONE 24 OHIO RIVER BASIN]

$t_p$ = SNYDER'S STANDARD LAG $\approx 1.6 \, (L \times L_{CA})^{0.3}$

$\therefore \; t_p \approx 1.6 \, (0.8 \times 0.4)^{0.3} \approx 1.14$ HRS

## RESERVOIR SURFACE AREAS

SURFACE AREA (SA) @ NORMAL POOL EL. 1023 FT ≈ 3.6 AC

NOTE 3: NORMAL POOL ELEVATION OBTAINED FROM THE REFERENCE GIVEN IN NOTE 1 (SHEET 1). SURFACE AREA VALUE MEASURED OFF DESIGN DRAWINGS AS FOUND IN PENNDER FILES

SA @ EL 1040 FT ≈ 16.1 AC [PLANIMETERED OFF USGS 7.5 MINUTE VANDERGRIFT, PA QUAD]

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 5-31-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-12-79 SHEET NO. 3 OF 11

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## GILKERSON DAM

RATE OF SURFACE AREA CHANGE PER FOOT OF RESERVOIR RISE ($\Delta A / \Delta H$) ⇒

$$\Delta A / \Delta H \approx (16.1 - 3.6)\,AC / (1040 - 1023)\,FT \approx 0.74\ AC/FT$$

TOP OF DAM ELEVATION ≈ 1027 FT (FROM AVAILABLE DESIGN DRAWINGS IN PENNDER FILES)

$$\therefore\ SA\ @\ TOP\ OF\ DAM\ EL\ 1027\ FT \approx 3.6\,AC + [(0.74\ AC/FT) \times (1027 - 1023)] \approx 6.6\ AC$$

## RESERVOIR ELEVATION @ "0" STORAGE

NORMAL POOL VOLUME ≈ $\frac{1}{3}$ HA ≈ 30 AC-FT (CONIC METHOD)

SA @ NORMAL POOL EL 1023 ≈ 3.6 AC

$$\therefore\ H \approx \frac{3V}{A} \approx (3)(30\,AC\text{-}FT)/(3.6\,AC) \approx 25\ FT$$

ZERO VOLUME ELEVATION ≈ 1023 FT − 25 FT ≈ 998 FT

NOTE 4: ALTHOUGH THE ACTUAL MINIMUM ELEVATION OF THE RESERVOIR IS ABOUT 1009 FT (ACCORDING TO DESIGN DRAWINGS), IN ORDER TO COMPUTE AN ELEVATION-STORAGE RELATIONSHIP AND STILL MAINTAIN A STORAGE OF 30 AC-FT @ EL 1023 FT, THE ABOVE "0" STORAGE ELEVATION MUST BE INPUT INTO THE HEC-1 PROGRAM. (THE ERROR IN POSSIBLE BREACH OUTFLOW CAUSED BY THIS ASSUMPTION WILL HAVE AN INSIGNIFICANT EFFECT ON DOWNSTREAM BEAVER DAM.)

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# GILKERSON DAM

## ELEVATION - STORAGE RELATIONSHIP

COMPUTED INTERNALLY BY THE HEC-1 PROGRAM BASED ON THE GIVEN RESERVOIR SURFACE AREA AND CORRESPONDING ELEVATION INFORMATION. (SEE SUMMARY INPUT / OUTPUT SHEETS)

## PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
  (CORRESPONDING TO A DURATION OF 24 HRS AND AN AREA OF 200 SQ. MI. LOCATED IN SOUTHWESTERN PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #7 (REF 3, FIG 1)

- LOCAL DRAINAGE AREA ≈ 0.33 SQ. MI. HOWEVER, THE STORM WILL BE CENTERED OVER THE TOTAL DRAINAGE AREA ABOVE BEAVER DAM ≈ 54.4 SQ. MI. ⇒

| DURATION (HR) | PERCENT OF INDEX RAINFALL (%) |
|---|---|
| 6 | 95 |
| 12 | 103 |
| 24 | 113 |
| 48 | 124 |

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 54.4 SQ. MI. ⇒ 0.852
  (AS COMPUTED BY HEC-1)

| | | | |
|---|---|---|---|
| SUBJECT | DAM SAFETY INSPECTION BEAVER DAM | | |
| BY WJV | DATE 6-1-79 | PROJ. NO. 78-617-453 | |
| CHKD. BY DLB | DATE 6-12-79 | SHEET NO. 5 | OF 11 |

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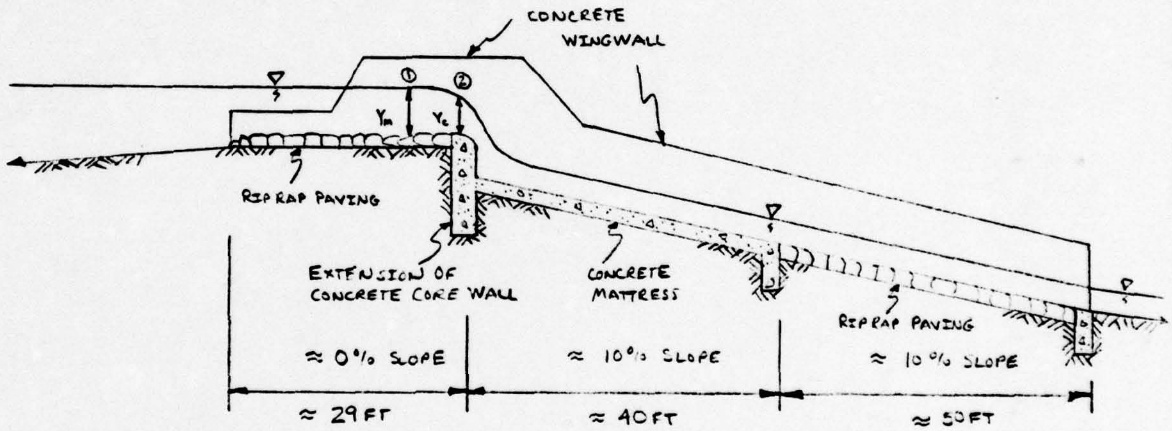
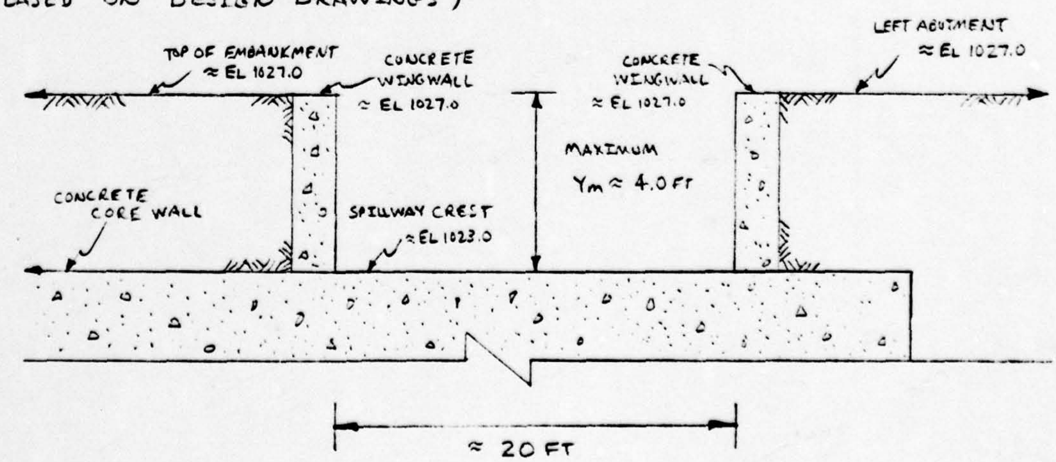
## GILKERSON DAM

## SPILLWAY CAPACITY

- PROFILE OF SPILLWAY : (NOT TO SCALE)
(BASED ON DESIGN DRAWINGS)




- CROSS-SECTION OF SPILLWAY : (NOT TO SCALE)
(BASED ON DESIGN DRAWINGS)




SECTION TAKEN LOOKING US TOWARD DAM

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GILKERSON DAM

- THE SPILLWAY IS ACTUALLY IN POOR SHAPE W/ THE CONCRETE IN A DETERIORATED STATE, AND DEBRIS AND VEGETATION OBSTRUCTING FLOW IN THE FOREBAY AREA.

- THE DISCHARGE OVER THE FREE OVERFALL - CHUTE CHANNEL SPILLWAY IS CONTROLLED BY CRITICAL DEPTH AT THE SLOPE TRANSITION POINT, SECTION ② (SEE SKETCH ON SHEET 5). THE MAXIMUM RESERVOIR DEPTH (ABOVE THE SPILLWAY CREST) PRIOR TO OVERTOPPING OF THE DAM ($Y_m \approx 4.0$ FT) WILL OCCUR @ SECTION ①.

- ENERGY BALANCE BETWEEN ① AND ②:

$$Y_m + v_a^2/2g + Z_1 = Y_c + v_c^2/2g + Z_2 + H_L \quad \text{(REF 7, PG...}$$

WHERE $v_a$ = VELOCITY OF APPROACH CHANNEL, IN FPS;
$Z_1 = Z_2$ = ELEVATION DATUM = ELEVATION OF SPILLWAY CREST ($Z_1 - Z_2 = 0$);
$v_c$ = CRITICAL VELOCITY, IN FPS; AND
$H_L$ = TOTAL APPROACH LOSS, IN FT.

$$\therefore \; Y_m + v_a^2/2g = 4.0 + v_a^2/2g = Y_c + v_c^2/2g + H_L$$

- $v_a = Q/A_a = Q/(20\text{FT})(Y_m) = Q/(20)(4) = Q/80\text{FT}^2$

$v_c = Q/A_c = Q/(20\text{FT})(Y_c) = Q/20Y_c$

$H_L$ = CHANNEL FRICTION LOSS + CHANNEL ENTRANCE LOSS
$= \underbrace{S_f L + 0.1\, v_a^2/2g}_{\text{REF 4, PG 379}}$ (WHERE $S_f$ = FRICTION SLOPE
L = APPROACH CHANNEL LENGTH ≈ 29 FT)

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-?-79 PROJ. NO. 79-617-453

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GILKERSON DAM

$$S_f \approx \left( Qn / 1.49 A_a R_a^{2/3} \right)^2$$

$$S_f \approx \left[ Q(0.06) / 1.49 (90 FT) \left( \frac{90 FT^2}{25.5 FT} \right)^{2/3} \right]^2$$

$$S_f \approx 5.52 \times 10^{-3}$$

WHERE $n$ = CHANNEL ROUGHNESS FACTOR ≈ 0.06, DUE TO DRY RUBBLE MASONRY W/ VEGETATION (REF 7, PGS 111, 112); AND

$$R_a = \frac{\text{APPROACH CHANNEL FLOW AREA}}{\text{APPROACH CHANNEL WETTED PERIMETER}}$$
$$\approx A_a / \left[ 20 FT + 2 \left( \frac{Y_m + 1.5}{2} \right) \right]$$
$$\approx A_a / \left[ 20 + 2 \left( \frac{4 + 1.5}{2} \right) \right]$$
$$\approx A_a / 25.5 FT$$

- THEREFORE,

$$4 FT + Q^2 / 2g (90 FT)^2 = Y_c + Q^2 / 2g (20 Y_c)^2 + \left[ (5.52 \times 10^{-5} Q^2 \times 29) + \left( 0.1 \times Q^2 / 2g [90 FT]^2 \right) \right]$$

$$4 + (2.43 \times 10^{-6} Q^2) = Y_c + Q^2 / 25760 Y_c^2 + (1.60 \times 10^{-6} Q^2) + (2.43 \times 10^{-7} Q^2)$$

$$4 = Y_c + Q^2 / 25760 Y_c^2 - (5.87 \times 10^{-7} Q^2)$$

ALSO, CRITICAL DEPTH IN A RECTANGULAR SECTION IS DEFINED BY (REF 13, PG 143):

$$Y_c = \sqrt[3]{q^2 / g} \quad \text{WHERE } q = Q / 20 FT$$

$$Y_c = \sqrt[3]{(7.76 \times 10^{-5}) \times Q^2}$$

- BY TRIAL AND ERROR: $Q \approx 524$ CFS, SAY 520 CFS
$Y_c \approx 2.77$ FT

(SINCE THE DS SLOPE ≈ 10% ⇒ CRITICAL FLOW WILL CONTROL)

SUBJECT: DAM SAFETY INSPECTION
BEAVER DAM

BY: WJV  DATE: 6-2-79  PROJ. NO. 79-617-453

CHKD. BY: DLB  DATE: 6-12-79  SHEET NO. 8 OF 11



## GILKERSON DAM

## SPILLWAY RATING CURVE

THE SPILLWAY RATING CURVE IS BASED ON THE PROCEDURE OF SHEETS 6 AND 7, AND THE EQUATIONS:

$$Y + Q^2/2g(20Y)^2 = Y_c + Q^2/25760\,Y_c^2 + 29\,S_f + 0.1\left[Q^2/2g(20Y)^2\right]$$

$$S_f = \left[Q(0.06)/1.49(20Y)\left(\frac{20Y}{20 + 2[(Y+1.5)/2]}\right)^{2/3}\right]^2$$

FOR 1.5 < Y < 4, ASSUME. FOR Y ≦ 1.5, USE Y. FOR Y > 4, USE Y = 4.

$$Y_c = \sqrt[3]{(7.76\times10^{-5})\times Q^2}$$

WHERE Y = RESERVOIR DEPTH (ABOVE SPILLWAY CREST) @ THE ASSUMED ELEVATION

| ELEVATION (FT) | Y (FT) | FINAL ASSUMED $Y_c$ (FT) | FINAL ASSUMED Q (CFS) |
|---|---|---|---|
| 1023.0 | 0 | 0 | 0 |
| 1023.5 | 0.5 | 0.22 | 10 |
| 1024.0 | 1.0 | 0.53 | 40 |
| 1024.5 | 1.5 | 0.88 | 90 |
| 1025.0 | 2.0 | 1.24 | 160 |
| 1025.5 | 2.5 | 1.61 | 230 |
| 1026.0 | 3.0 | 2.00 | 320 |
| 1026.5 | 3.5 | 2.38 | 420 |
| 1027.0 | 4.0 | 2.77 | 520 |
| 1027.5 | 4.5 | 3.17 | 640 |
| 1028.0 | 5.0 | 3.58 | 770 |
| 1028.5 | 5.5 | 4.00 | 910 |

ROUNDED FLOW VALUES

| | | | |
|---|---|---|---|
| SUBJECT | DAM SAFETY INSPECTION<br>BEAVER DAM | | |
| BY WJV | DATE 6-4-79 | PROJ. NO. 78-617-453 | |
| CHKD. BY DLB | DATE 6-12-79 | SHEET NO. 9 | OF 11 |

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## GILKERSON DAM

## DAM EMBANKMENT RATING CURVE

ASSUME THAT THE EMBANKMENT ACTS LIKE A BROAD-CRESTED WEIR WHEN OVERTOPPED. THEREFORE, DISCHARGE IS DEFINED BY :

$$Q = CLH^{3/2}$$ (REF 5, PG 5-3)

WHERE Q = DISCHARGE, IN CFS ;
L = LENGTH OF EMBANKMENT ≈ 290 FT (SEE REFERENCE IN NOTE 1, SHEET 1) ;
H = HEIGHT OF RESERVOIR ABOVE EMBANKMENT CREST EL 1027.0 FT, IN FT ; AND
C = DISCHARGE COEFFICIENT ≈ f ( $H/\ell$ , WHERE $\ell$ = CREST WIDTH ≈ 10 FT )
↳ SEE REFERENCE IN NOTE 1, SHEET 1

| ELEVATION (FT) | H (FT) | $H/\ell$ (FT/FT) | C* | Q (CFS) |
|---|---|---|---|---|
| 1027.0 | 0 | – | – | 0 |
| 1027.5 | 0.5 | 0.05 | 3.02 | 300 |
| 1028.0 | 1.0 | 0.10 | 3.03 | 850 |
| 1028.5 | 1.5 | 0.15 | 3.04 | 1560 |

* FROM REF 12, PG 46

SUBJECT DAM SAFETY INSPECTION
BEAVER DAM

BY WJV DATE 6-4-79 PROJ. NO. 78-617-453

CHKD. BY DLB DATE 6-12-79 SHEET NO. 10 OF 11

GAI CONSULTANTS,
Engineers • Geologists • Planner
Environmental Specialists

## GILKERSON DAM

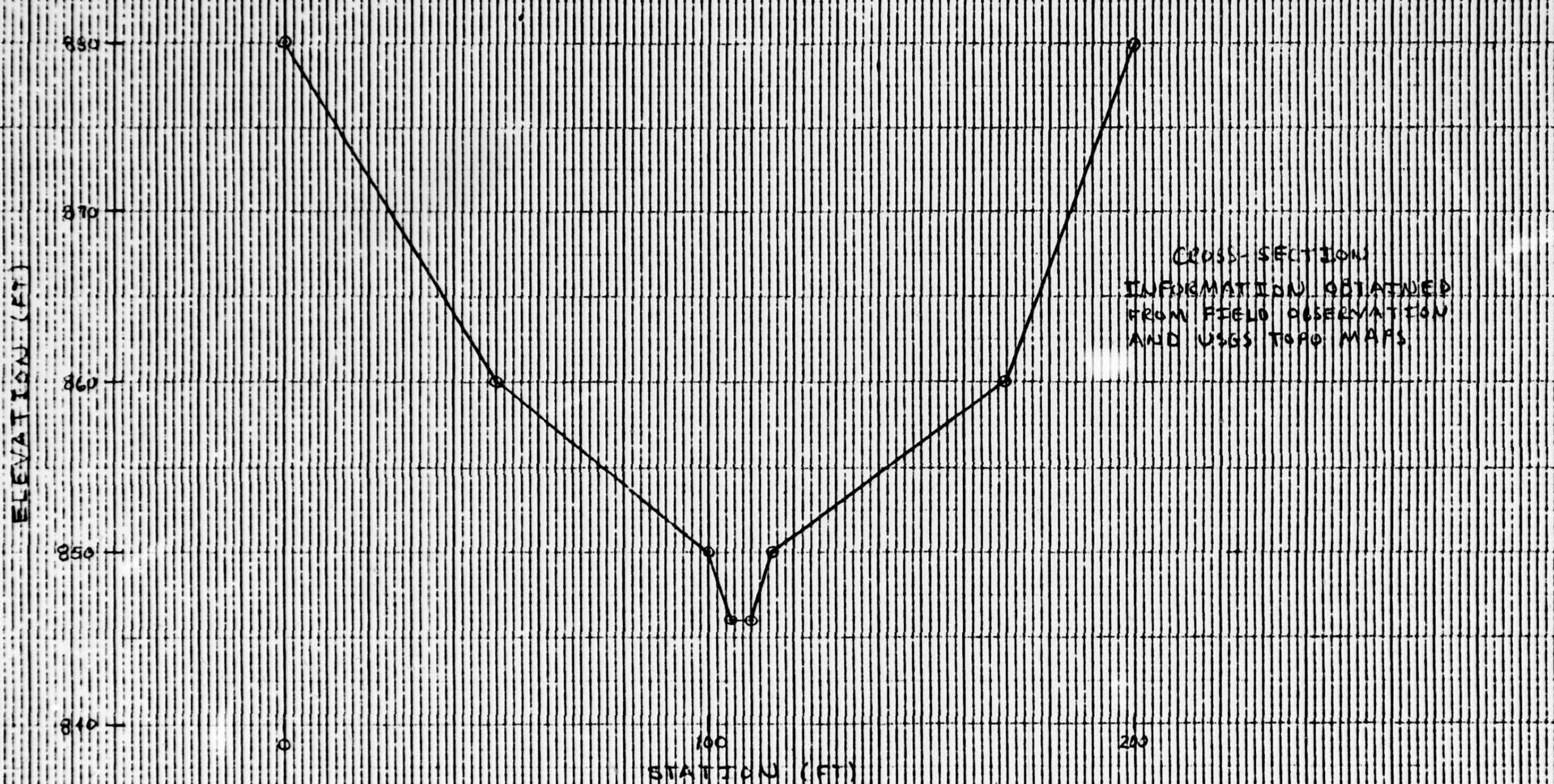
## TOTAL FACILITY RATING CURVE

| ELEVATION (FT) | * SPILLWAY Q (CFS) | ** EMBANKMENT Q (CFS) | TOTAL Q (CFS) |
|---|---|---|---|
| 1023.0 | 0 | – | 0 |
| 1023.5 | 10 | – | 10 |
| 1024.0 | 40 | – | 40 |
| 1024.5 | 90 | – | 90 |
| 1025.0 | 160 | – | 160 |
| 1025.5 | 230 | – | 230 |
| 1026.0 | 320 | – | 320 |
| 1026.5 | 420 | – | 420 |
| 1027.0 | 520 | 0 | 520 |
| 1027.5 | 640 | 300 | 940 |
| 1028.0 | 770 | 850 | 1620 |
| 1028.5 | 910 | 1560 | 2470 |

* FROM SHEET 8
** FROM SHEET 9

# DOWNSTREAM ROUTING SECTION






SECTION 5 @ ≈ 1400 FT DS FROM GILKERSON DAM (JUST ABOVE BEAVER DAM FLOOD POOL)

INVERT ≈ EL 846 FT

$n_{CH} \approx 0.04$ ; $n_{LOB} \approx n_{ROB} \approx 0.11$

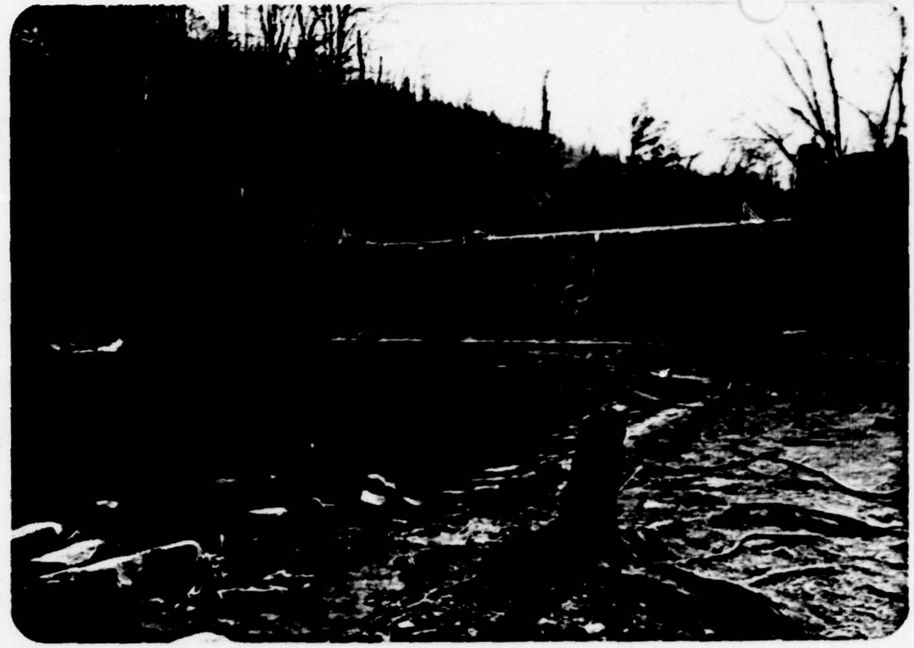
CHANNEL SLOPE ≈ 12%

# APPENDIX D

# PHOTOGRAPHS

| | |
|---|---|
| PHOTOGRAPH 1 | Overview of Beaver Dam as seen from the hillside at the right abutment. |
| PHOTOGRAPH 2 | Downstream view of the spillway. |
| PHOTOGRAPH 3 | Close-up view of the left wingwall of the spillway. |
| PHOTOGRAPH 4 | View of a temporary construction road cut through the left embankment near the left abutment. |

1



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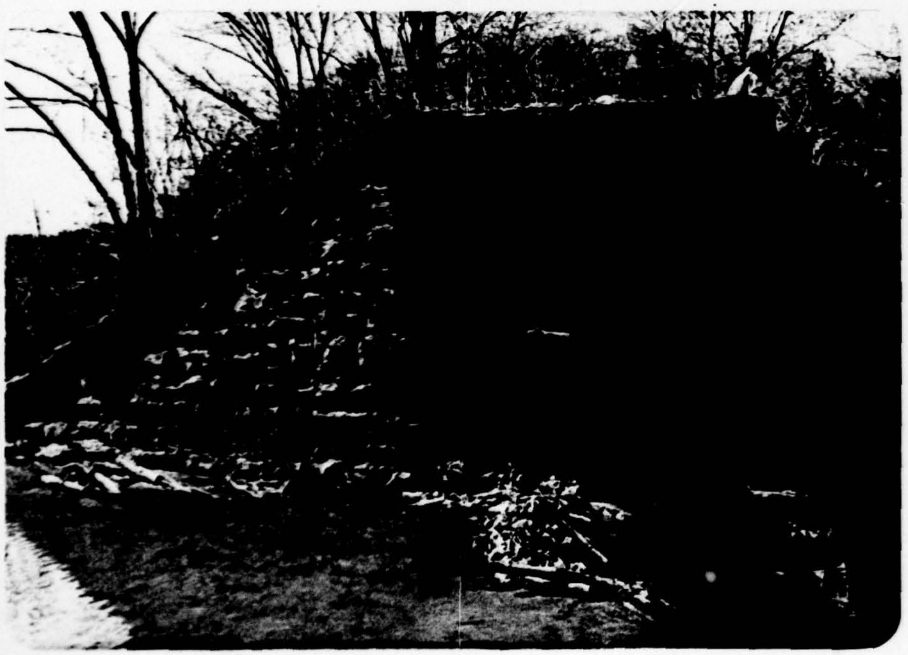


3

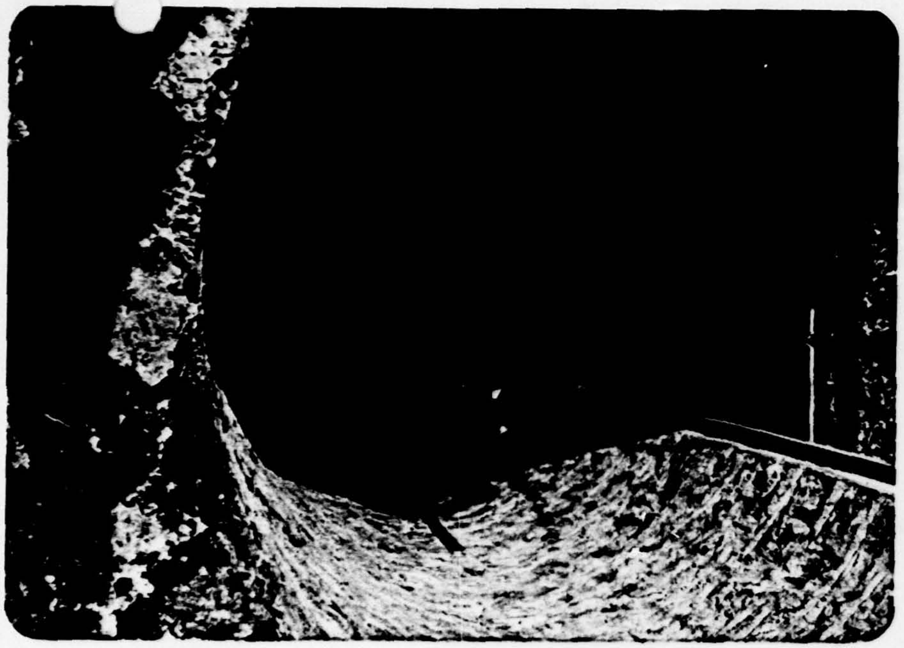
4

PHOTOGRAPH 5 — View of the blowoff valve control mechanism as seen from atop the circular masonry vault at the right abutment.

PHOTOGRAPH 6 — The outlet conduit inlet structure located adjacent the right hillside about 100 feet upstream of the embankment.

PHOTOGRAPH 7 — View of discharge emanating from the outlet conduit (not visible in view) via a rock tunnel cut through the right abutment. The discharge is also visible in the extreme left center of Photograph 2.

PHOTOGRAPH 8 — View of the area immediately downstream of the dam.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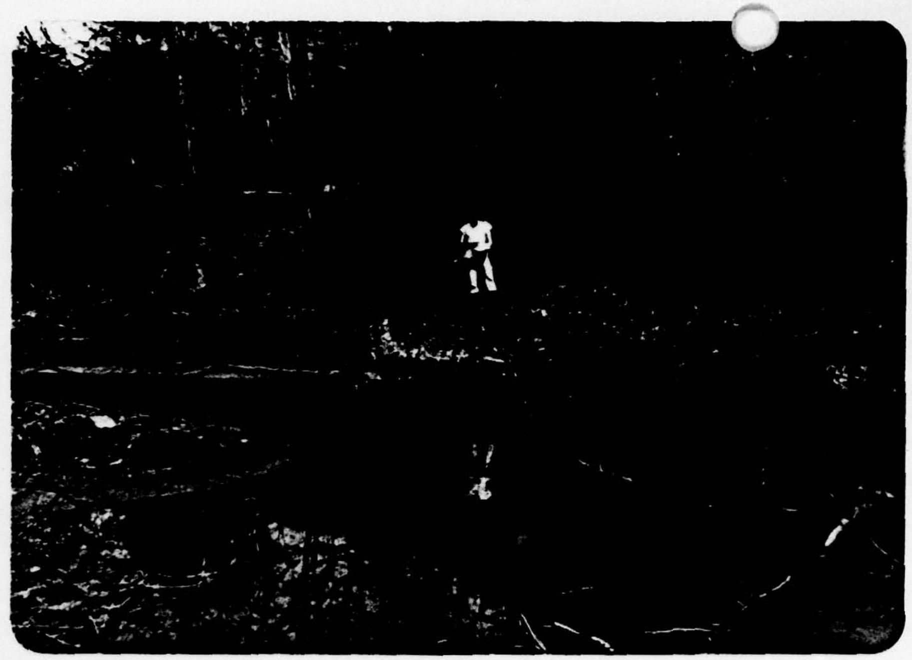
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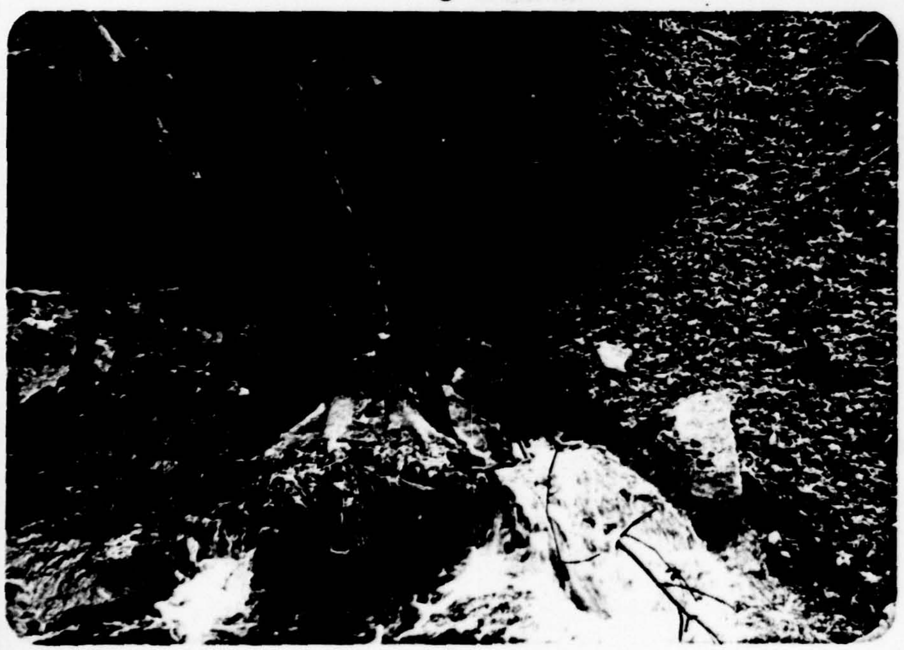
7


8

PHOTOGRAPH 9 View, looking upstream, toward the silted reservoir.

PHOTOGRAPH 10 View showing sedimented reservoir condition.

PHOTOGRAPH 11 View of the first downstream residences located along the floodplain approximately 1500 feet downstream of the embankment.

PHOTOGRAPH 12 View, looking upstream, from bridge located a distance of about 2000 feet from the dam.


9


10


11


12

# APPENDIX E

# GEOLOGY

## Geology[1]

Beaver Dam is located in the Pittsburgh Plateaus Section of the Appalachian Plateaus Physiographic Province of western Pennsylvania. This section is characterized as a high plateau underlain by flat-lying to gently folded sedimentary rock strata. In the vicinity of the dam and reservoir, the Pennsylvanian age rocks gently dip to the northwest at approximately 125 feet per mile or less than two degrees.

Structurally, the dam and reservoir are located between the Murrysville-Roaring Run Anticline to the southeast and the Duquesne Syncline to the northwest. The axes of these structures conform to N30°E trend typically displayed by the folded structures of the Pittsburgh Plateaus Section.

The sedimentary rock strata contained in the abutments and underlying the alluvial deposits flooring the Beaver Run valley are members of the Allegheny Group of Pennsylvanian age. The strata of this group extends from the top of the Upper Freeport Coal to the base of the Brookville Coal and have an average thickness of about 300 feet in the vicinity of the site. The Allegheny Group contains several coalbeds as well as clay and limestone. The intervening measures are sandstones and shales being quite similar to the strata characteristics of the overlying Conemaugh Group. The Upper Freeport Coal horizon which marks the upper limit of the Allegheny Group occurs in both abutments above the dam. The Upper Freeport Coal in the right abutment is completely mined out whereas coal in the left abutment in apparently in-place, although it may be locally mined along the outcrop.

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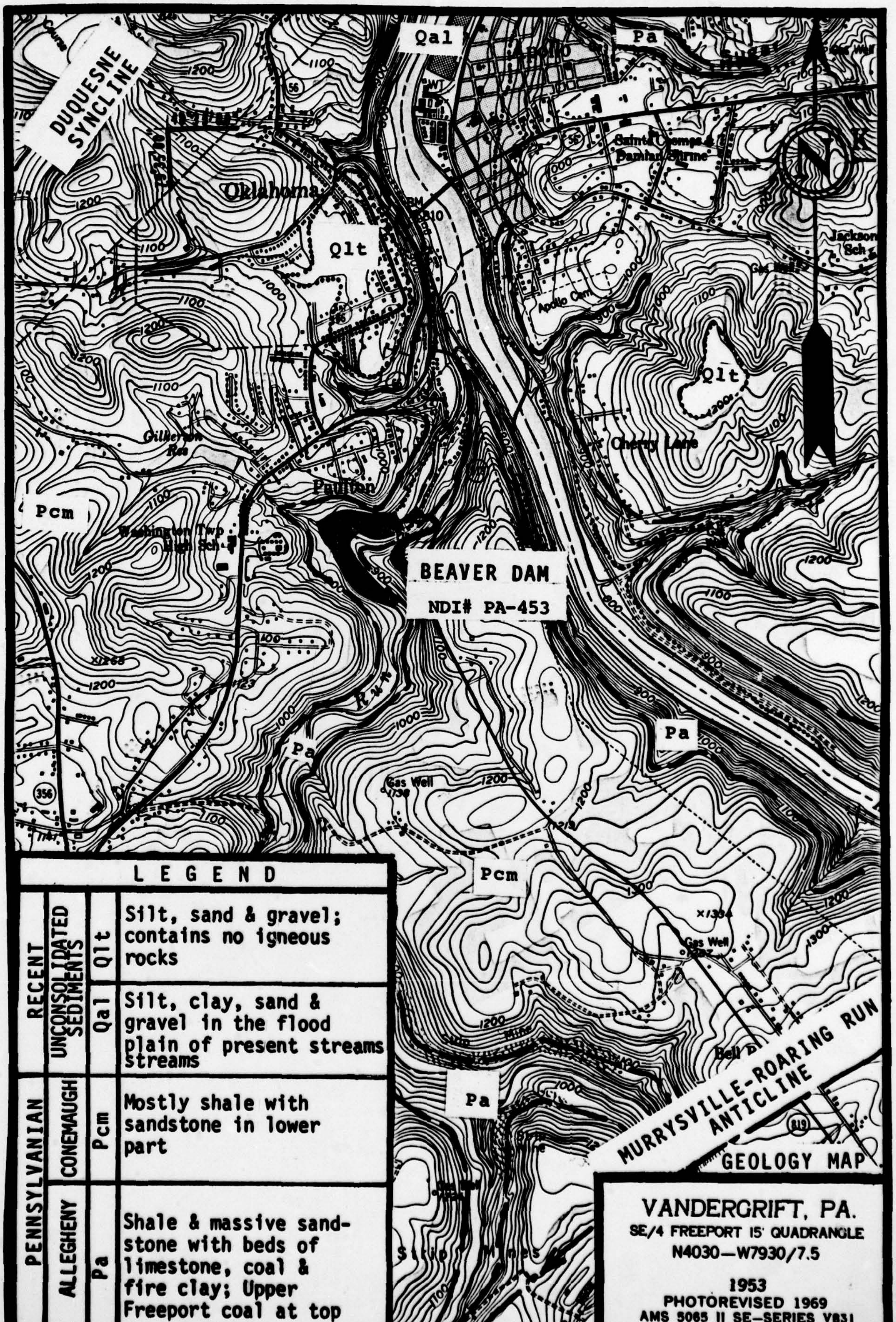
[1]Hughs, Herbert H., "Geology and Mineral Resources of the Freeport 15 Minute Quadrangle, Pennsylvania," Topographic and Geologic Survey, Atlas 36, 1933.


DUQUESNE SYNCLINE
Qal
Pa
Oklahoma
Qlt
Saint Cosmas & Damian Shrine
Apollo Cem
Jackson Sch
Gas Well
Qlt
Cherry Lane
Gilkerson Res
Pullton
Pcm
Washington Twp High Sch
BEAVER DAM
NDI# PA-453
Pa
Pa
Gas Well
Pcm
Gas Well
Pa
Strip Mines
MURRYSVILLE-ROARING RUN ANTICLINE
LEGEND
RECENT
UNCONSOLIDATED SEDIMENTS
Qlt
Silt, sand & gravel; contains no igneous rocks
Qal
Silt, clay, sand & gravel in the flood plain of present streams streams
PENNSYLVANIAN
CONEMAUGH
Pcm
Mostly shale with sandstone in lower part
ALLEGHENY
Pa
Shale & massive sandstone with beds of limestone, coal & fire clay; Upper Freeport coal at top
GEOLOGY MAP
VANDERGRIFT, PA.
SE/4 FREEPORT 15' QUADRANGLE
N4030—W7930/7.5
1953
PHOTOREVISED 1969
AMS 5065 II SE—SERIES V831

APPENDIX F

FIGURES

## LIST OF FIGURES

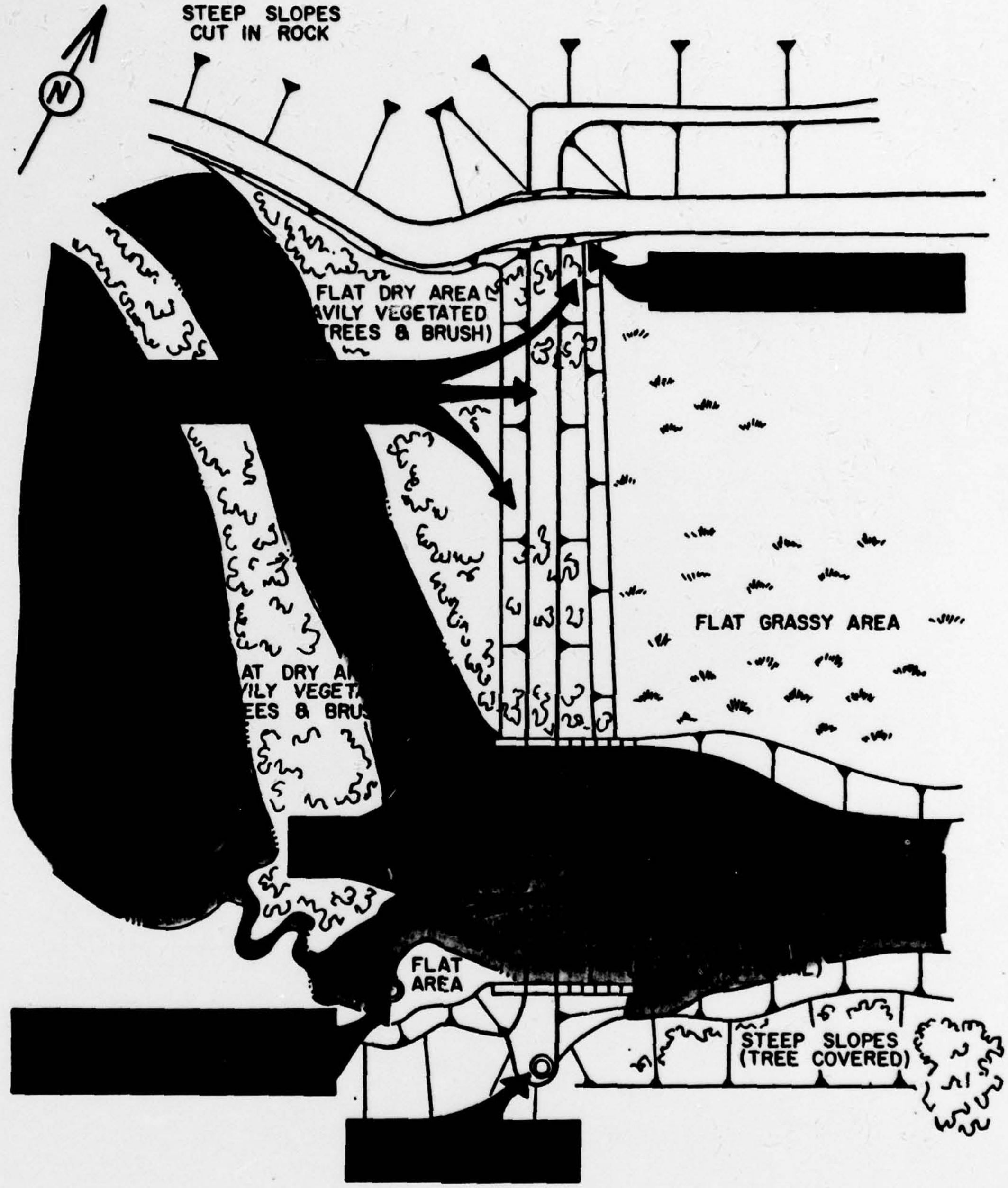
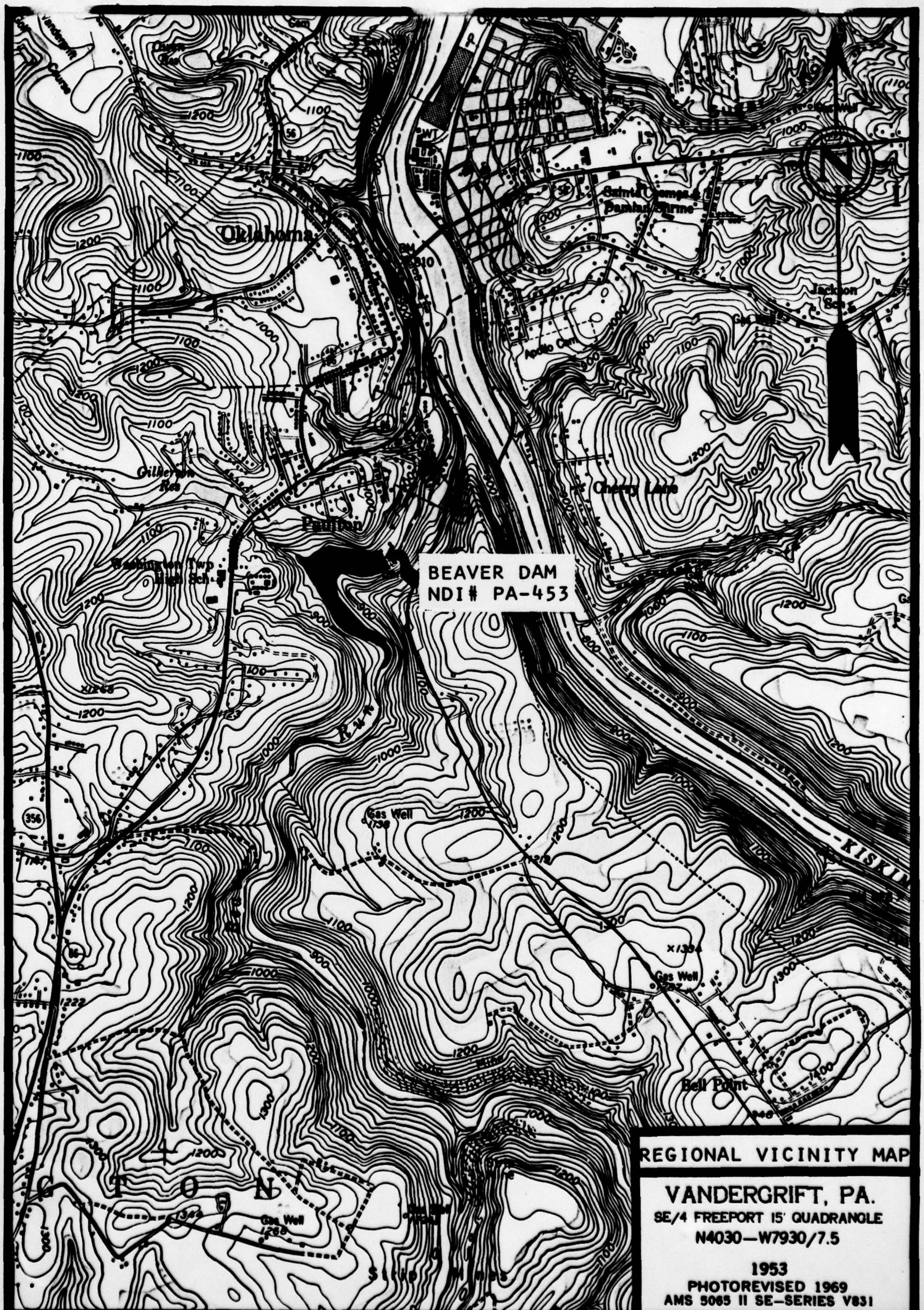
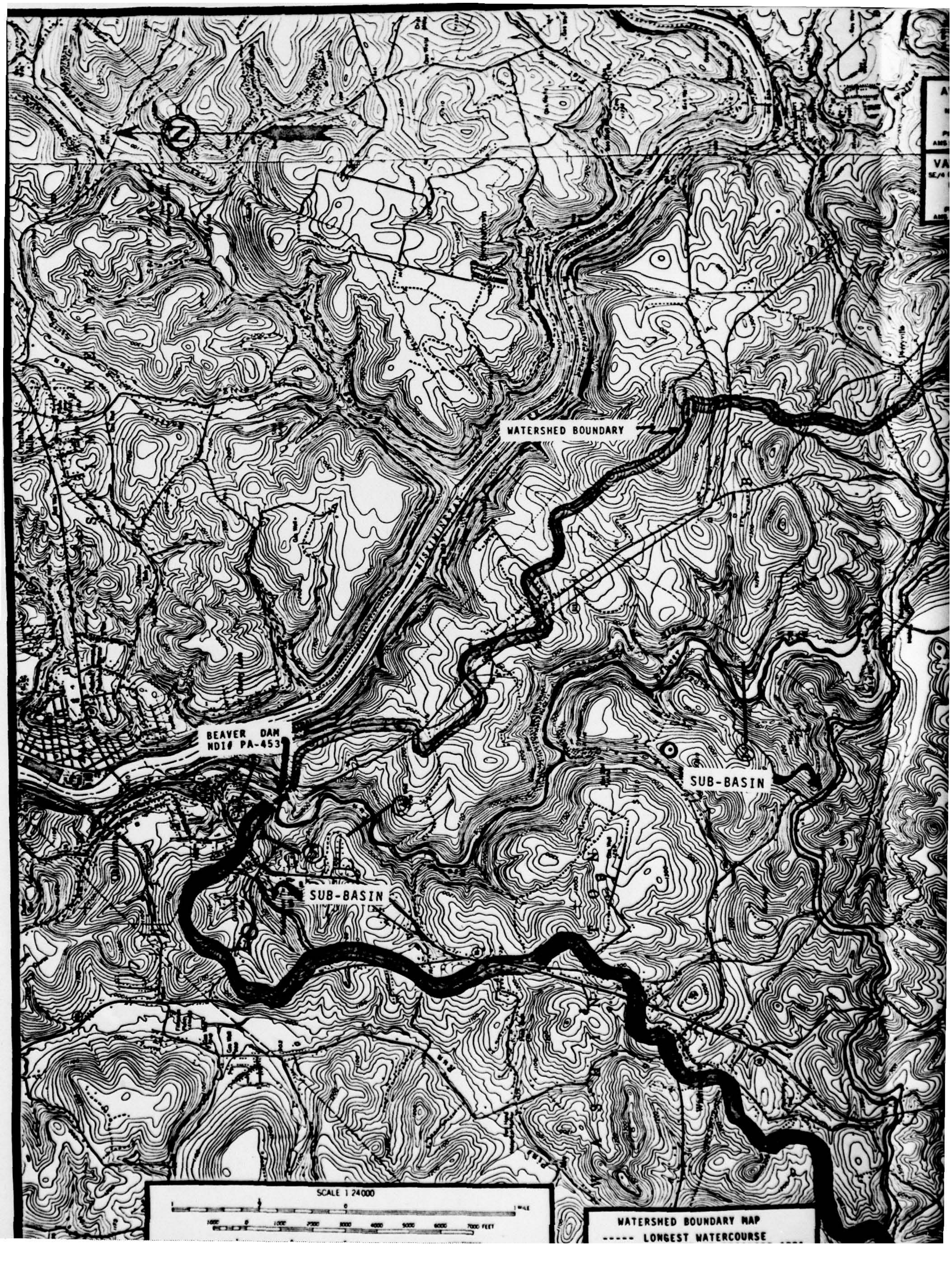


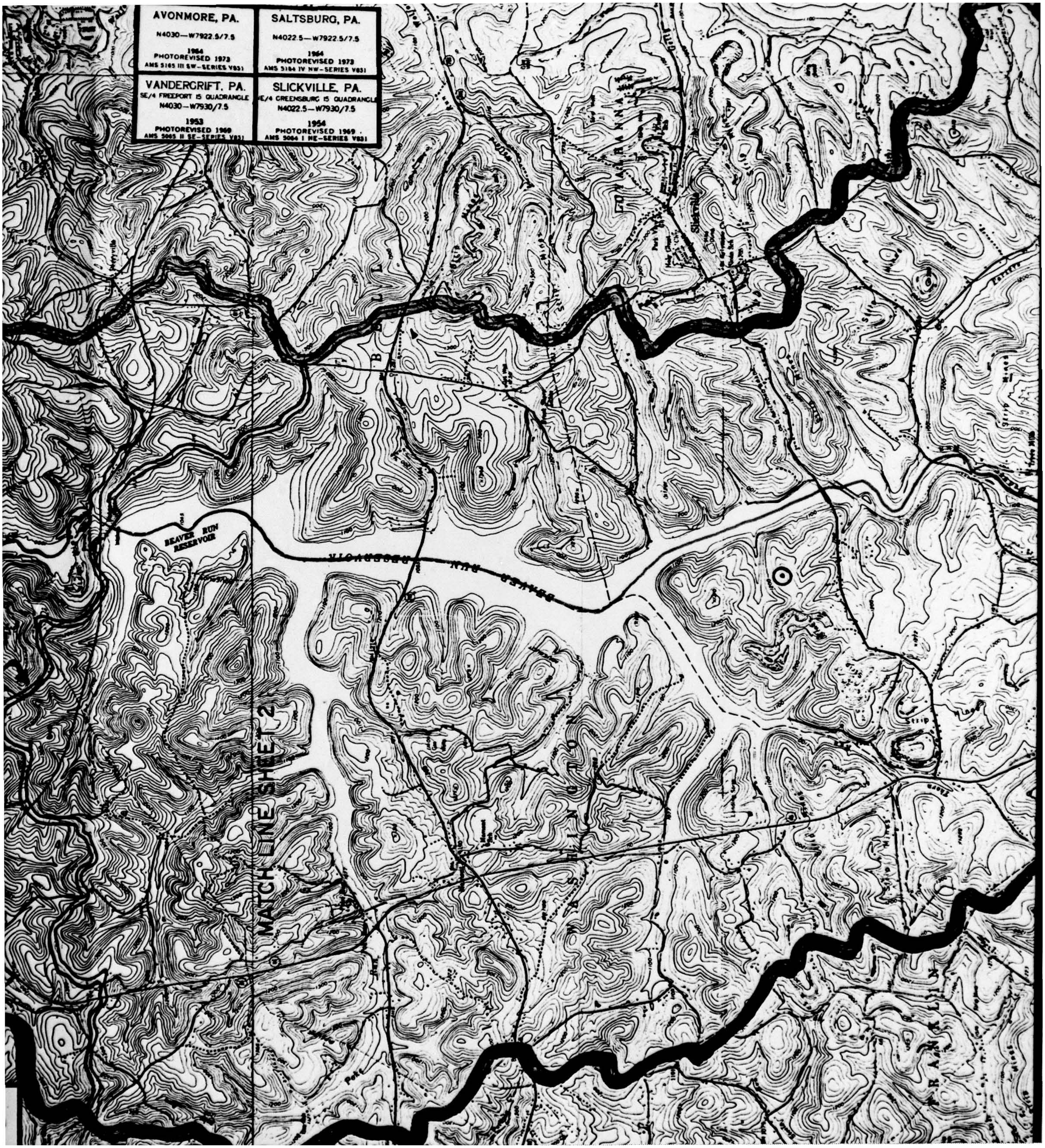

FIGURE 1 - BEAVER DAM
GENERAL PLAN
FIELD INSPECTION NOTES

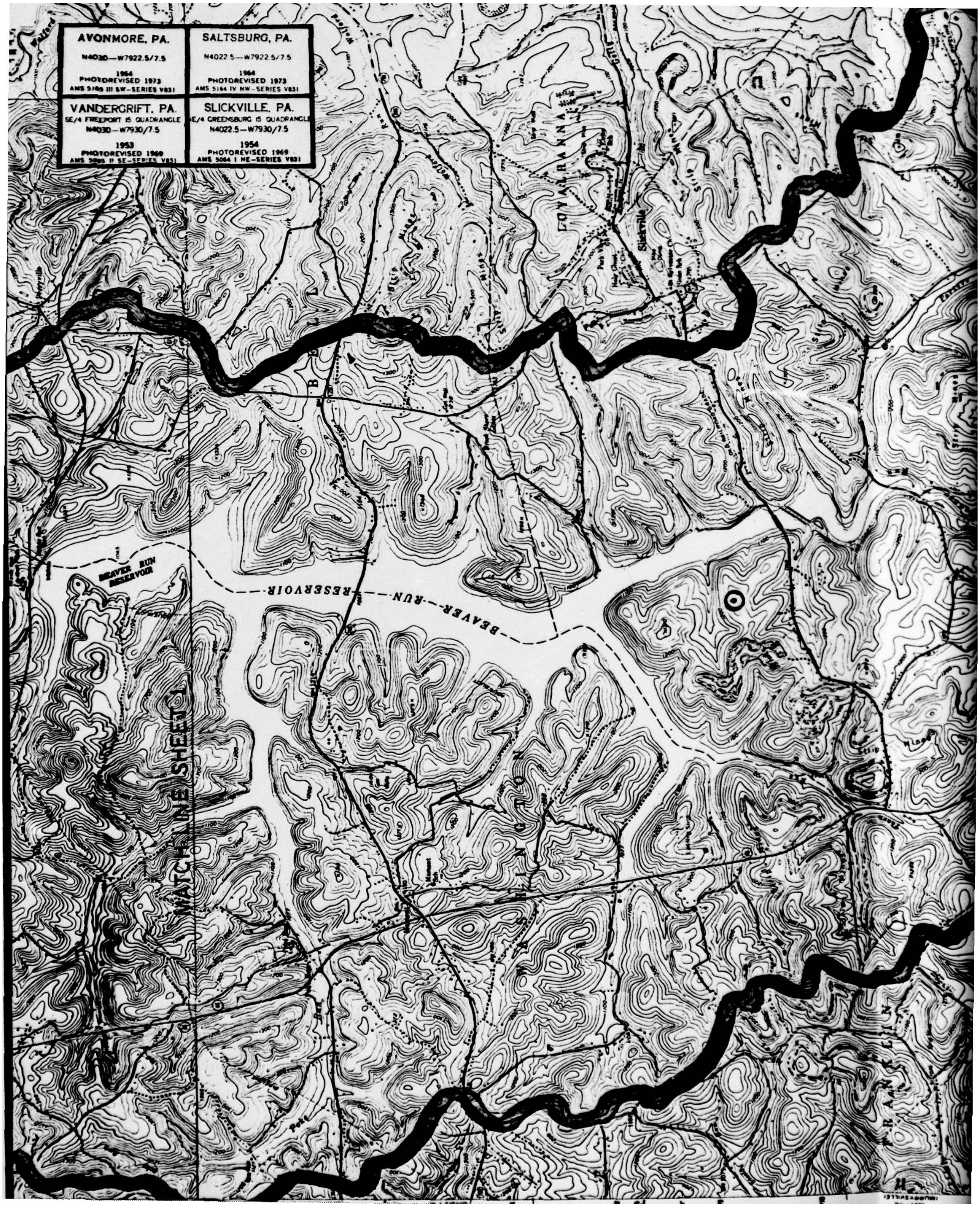
# APPENDIX G

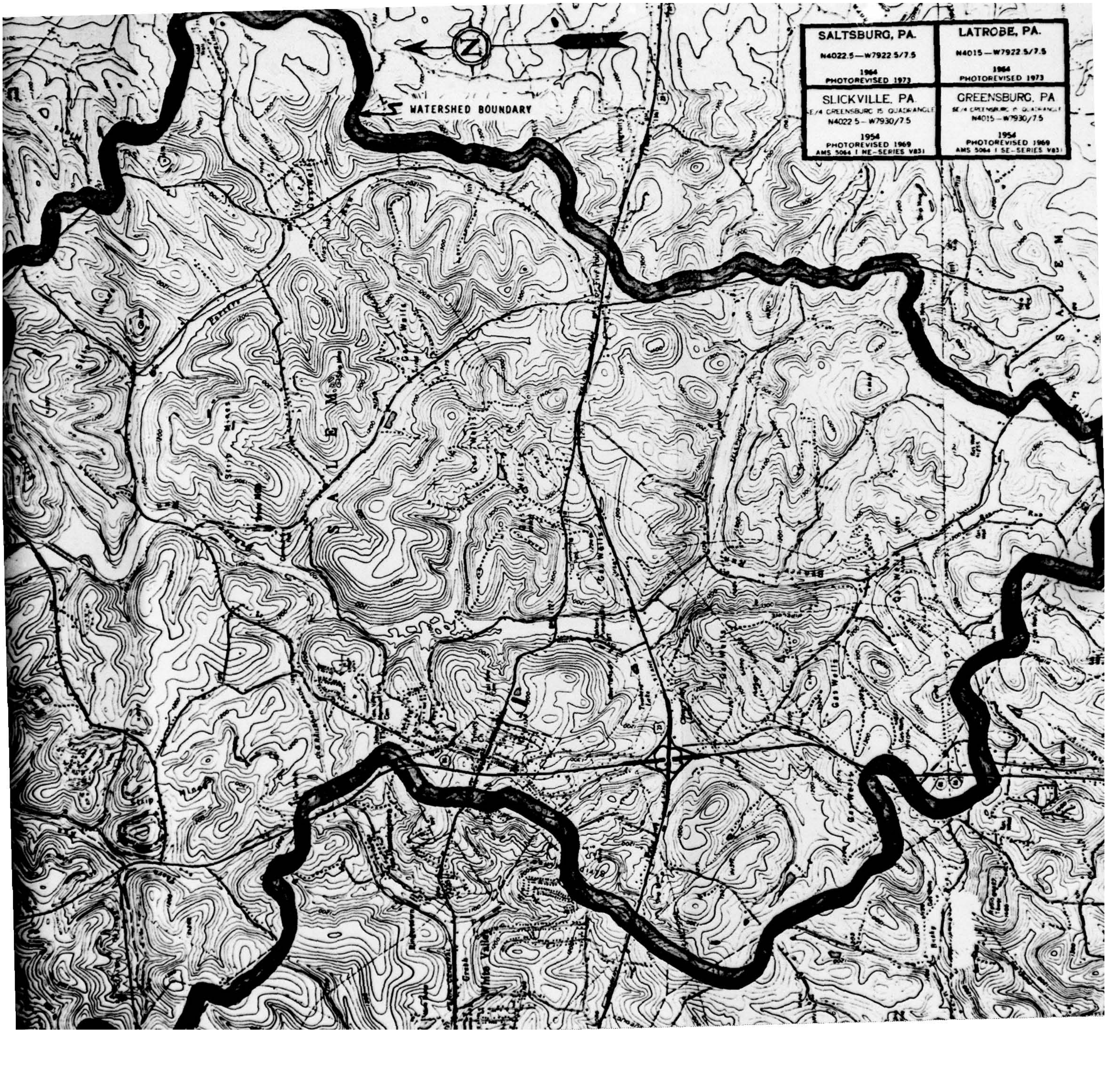
## REGIONAL VICINITY
## AND
## WATERSHED BOUNDARY MAPS


BEAVER DAM
NDI# PA-453
Oklahoma
Paulton
Cherry Lane
Gilbertson Res
Washington Twp High Sch
Apollo Cem
Jackson Sch
Gas Well
Bell Point
REGIONAL VICINITY MAP
VANDERGRIFT, PA.
SE/4 FREEPORT 15' QUADRANGLE
N4030—W7930/7.5
1953
PHOTOREVISED 1969
AMS 5065 II SE-SERIES V831


WATERSHED BOUNDARY
BEAVER DAM
NDI# PA-453
SUB-BASIN
SUB-BASIN
SCALE 1 24000
WATERSHED BOUNDARY MAP
----- LONGEST WATERCOURSE


AVONMORE, PA.
N4030—W7922.5/7.5
1964
PHOTOREVISED 1973
AMS 5165 III SW—SERIES V831
SALTSBURG, PA.
N4022.5—W7922.5/7.5
1964
PHOTOREVISED 1973
AMS 5164 IV NW—SERIES V831
VANDERGRIFT, PA.
SE/4 FREEPORT 15 QUADRANGLE
N4030—W7930/7.5
1953
PHOTOREVISED 1969
AMS 5065 II SE—SERIES V831
SLICKVILLE, PA.
SE/4 GREENSBURG 15 QUADRANGLE
N4022.5—W7930/7.5
1954
PHOTOREVISED 1969
AMS 5064 I NE—SERIES V831
BEAVER RUN RESERVOIR
MATCH LINE SHEET 2


AVONMORE, PA.
N4030—W7922.5/7.5
1964
PHOTOREVISED 1973
SALTSBURG, PA.
N4022.5—W7922.5/7.5
1964
PHOTOREVISED 1973
AMS 5164 IV NW–SERIES V831
VANDERGRIFT, PA.
SE/4 FREEPORT 15 QUADRANGLE
N4030—W7930/7.5
1953
PHOTOREVISED 1969
SLICKVILLE, PA.
SE/4 GREENSBURG 15 QUADRANGLE
N4022.5—W7930/7.5
1954
PHOTOREVISED 1969
AMS 5064 I NE–SERIES V831
BEAVER RUN RESERVOIR
BEAVER–RUN–RESERVOIR
MATCH LINE SHEET 1
Slickville


WATERSHED BOUNDARY
SALTSBURG, PA.
N4022.5—W7922.5/7.5
1964
PHOTOREVISED 1973
LATROBE, PA.
N4015—W7922.5/7.5
1964
PHOTOREVISED 1973
SLICKVILLE, PA.
SE/4 GREENSBURG 15 QUADRANGLE
N4022.5—W7930/7.5
1954
PHOTOREVISED 1969
AMS 5064 I NE—SERIES V831
GREENSBURG, PA
N4015—W7930/7.5
1954
PHOTOREVISED 1969
AMS 5064 I SE—SERIES V831