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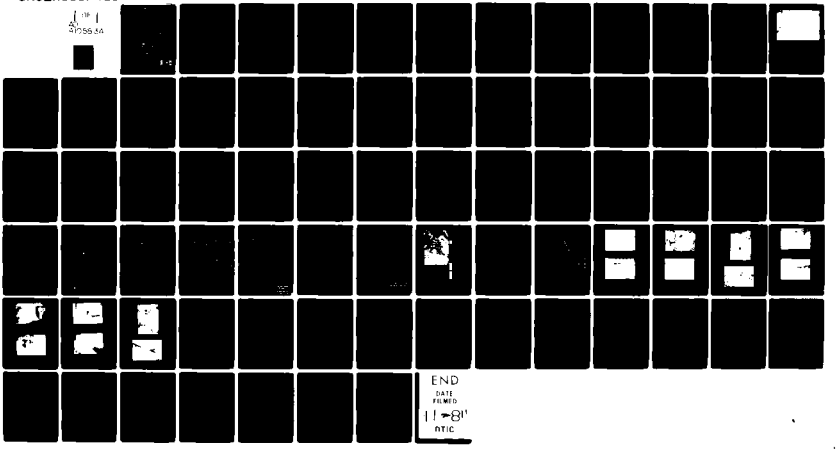

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PJ'S BASS LAKE DAM
ST FRANCOIS COUNTY, MISSOURI
MO 31189

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

JUNE 1981

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1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 834
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program PJ's Bass Lake Dam (MO 31189) St. Francois County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report.
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Woodward-Clyde Consultants	8. CONTRACT OR GRANT NUMBER(s) DACW43-81-C-0039
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE June 1981
	13. NUMBER OF PAGES Approximately 70
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) National Dam Safety Program. PJ's Bass Lake Dam (MO 31189), Mississippi - Kaskaskia - St. Louis Basin, St. Francois County, Missouri. Phase I Inspection Report.	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	
18. SUPPLEMENTARY NOTES	
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams	
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	

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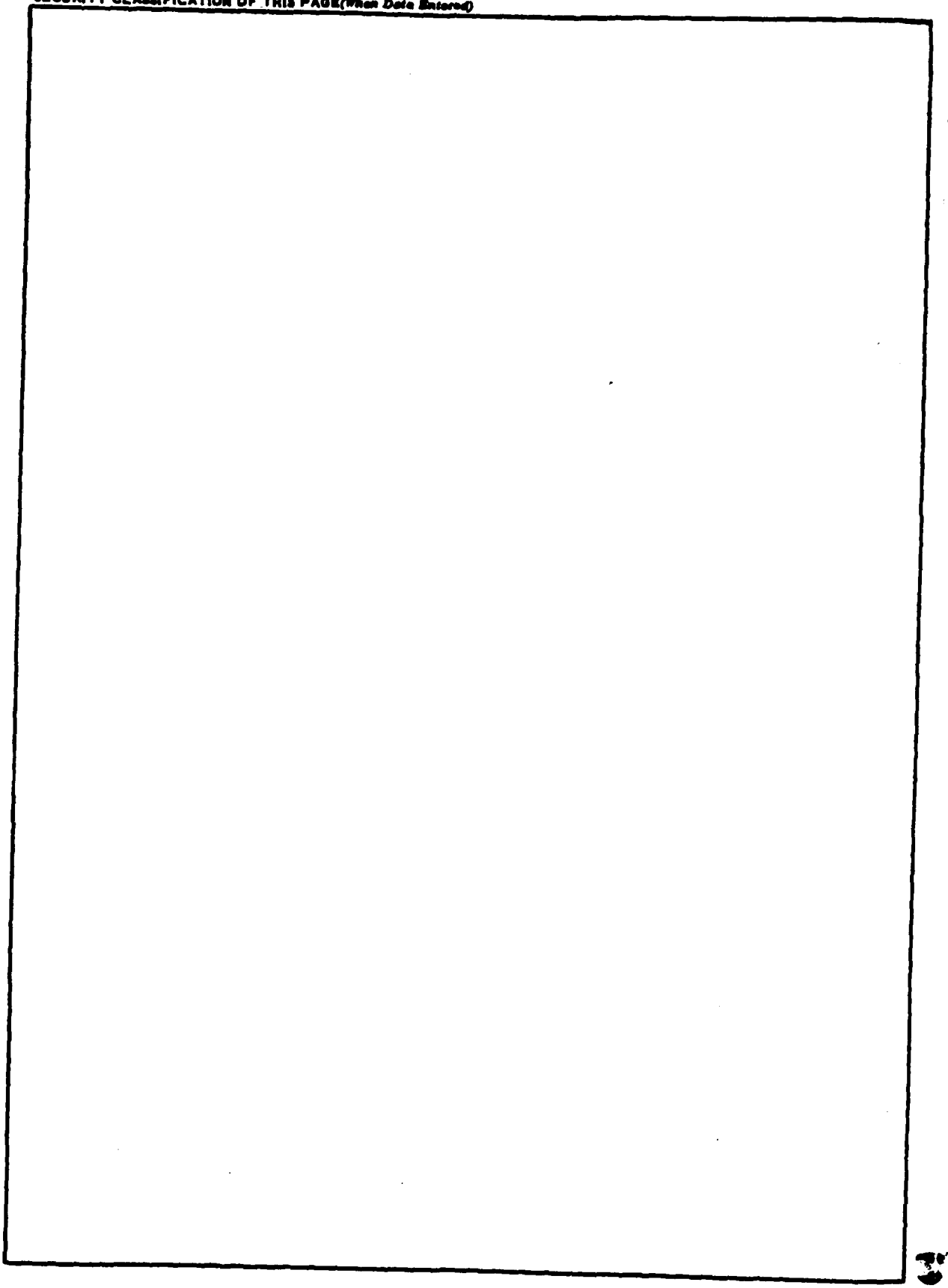

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: PJ's Bass Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the PJ's Bass Lake Dam (MO 31189).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam,

b. Overtopping of the dam could result in failure of the dam,

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

20 JUL 1981
Date

APPROVED BY: SIGNED
Colonel, CE, Commanding

20 JUL 1981
Date

PJs BASS LAKE DAM

St Francois County, Missouri

Missouri Inventory No. 31189

Phase I Inspection Report

National Dam Safety Program

Prepared by

Woodward-Clyde Consultants

Chicago, Illinois

Under Direction of

St Louis District, Corps of Engineers

for

Governor of Missouri

June 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is not to provide a complete evaluation of the safety of the structure nor to provide a guarantee on its future integrity. Rather the purpose of the program is to identify potentially hazardous conditions to the extent they can be identified by a visual examination. The assessment of the general condition of the dam is based upon available data (if any) and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies. In view of the limited nature of the Phase I studies no assurance can be given that all deficiencies have been identified.

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 any data which may be available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action removes the normal load on the structure, as well as the reservoir head along with seepage pressures, and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, so that corrective action can be taken. Likewise continued care and maintenance are necessary to minimize the possibility of development of unsafe conditions.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	PJ's Bass Lake Dam
State Located	Missouri
County Located	St Francois
Stream	Unnamed Tributary of the Big River
Date of Inspection	28 April 1981

PJ's Bass Lake Dam, Missouri Inventory Number 31189, was inspected by Richard Berggreen (engineering geologist), Craig Fulthorpe (geotechnical engineer), Jean-Yves Perez (geotechnical engineer), and Maryann Rivera (hydrologist). The dam impounds a lake used for recreational purposes.

The dam inspection was made following the guidelines presented in the "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines represent a consensus of the engineering profession. These guidelines are intended to provide for an expeditious identification of those dams which may pose hazards to human life or property, based on available data and a visual inspection. In view of the limited scope of the study, no assurance can be given that all deficiencies have been identified.

The St Louis District (SLD), Corps of Engineers, has classified this dam as having a high hazard potential. The SLD estimated damage zone length extends approximately one mile downstream of the dam to the flood plain of the Big River. Within this damage zone are Missouri State Highway E, several occupied dwellings and assorted farm buildings.

The dam is classified small size based on its height of approximately 37 ft and storage capacity of 108 ac-ft. The small size classification criteria are: height between 25 and 40 ft, or storage capacity between 50 and 1000 ac-ft.

On the basis of the findings of the visual inspection, the dam is judged to be in fair to poor condition. The principal deficiencies contributing to this judgement are buried debris and resulting voids in the embankment at the downstream toe of the left half of the dam, the potential for erosion of the embankment along the discharge channels of both the main and emergency spillways, the lack of seepage or stability analyses as per the "Recommended Guidelines for Safety Inspection of Dams," and the inadequate spillway capacity.

Hydraulic/hydrologic analyses indicate the dam will be overtopped by a flood greater than 20 percent of the Probable Maximum Flood (PMF). The PMF is defined as the flood event that may be expected to occur from a combination of the most severe meteorologic and hydrologic conditions that are reasonably possible in the region. These analyses also indicate the 1 percent probability-of-occurrence flood (100 year flood) will be stored in the reservoir and passed through the spillways, without overtopping the dam. The 1 percent probability-of-occurrence flood is the storm that has 1 percent probability of occurring any one year, or occurs on the average once every 100 years.

On the basis of the small drainage basin (0.14 mi^2), relatively small storage capacity (108 ac-ft) and sparse downstream population, 50 percent of the PMF is recommended as the spillway design flood for this dam.

Based on our visual inspection the following recommendations are made for remedial work and additional study of PJ's Bass Lake Dam. All remedial measures should be performed by or under the direction of an engineer experienced in the design, construction and maintenance of earth dams.

1. Prepare a detailed hydraulic/hydrologic analysis and design a spillway system capable of passing the spillway design flood (50 percent of PMF) without overtopping the dam. The spillway should be protected from erosion.

2. Remove the debris buried at the toe of the embankment and replace the excavated material with compacted fill. Safety considerations may require the lake level to be lowered significantly during these repairs.

3. Install erosion control measures or reroute the spillway discharge channels away from the toe of the embankment slopes.

4. Repair the arc-shaped swale at the toe of the maximum section to conform with the general downstream slope configuration.

5. Prepare seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams," and make them a matter of record.

6. Remove the small trees from the embankment before they become large enough to pose a hazard to the embankment. The grass and weed vegetation on the dam should be maintained to the extent that it will not hamper the recommended inspection of the dam.

7. Evaluate the feasibility of a practical and effective warning system to alert downstream residents and traffic in the event unsafe conditions develop at this dam.

It is also recommended that a program of periodic inspections and maintenance be developed and implemented as soon as practical. Records of the inspections and any necessary maintenance should be kept. This program should include, as a minimum, the following items.

1. Inspect the embankment for evidence of cracking, slumping, or other slope instability features.

2. Monitor the area of seepage at the toe of the dam to identify changes in the amount of seepage or turbidity (soil) in the seepage water.

3. Inspect the discharge channels below both spillways for evidence of erosion of the toe of the embankment slope.

4. Maintain the spillways, trash rack and discharge channels free of obstructions to flow. It is also recommended that an alternate trash rack, less susceptible to blockage than the existing rack, be installed in the main spillway.

5. Inspect, operate, and maintain the low-level outlet valve.

6. Inspect the main spillway pipe for evidence of corrosion or separation of joints. Consideration should also be given to paving the invert of this pipe to reduce erosion and corrosion of the pipe.

All inspections and maintenance should be evaluated by or performed under the direction of an engineer experienced in the design, construction, and maintenance of earth dams.

WOODWARD-CLYDE CONSULTANTS

Richard G. Berggreen
Registered Geologist, No. 3572, CA

Jean-Yves Perez, PE No. 62-34675, IL
Vice President

OVERVIEW

PJ'S BASS LAKE DAM

MISSOURI INVENTORY NUMBER MO 31189

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
PJs BASS LAKE DAM - MISSOURI INVENTORY NO. 31189
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
PJ's BASS LAKE DAM, MISSOURI INVENTORY NO. 31189

SECTION 1
PROJECT INFORMATION

1.1 General

a. **Authority.** The National Dam Inspection Act, Public Law 92-367, provides for a national inventory and inspection of dams throughout the United States. Pursuant to the above, an inspection was conducted of PJ's Bass Lake Dam, Missouri Inventory Number 31189.

b. **Purpose of inspection.** "The primary purpose of the Phase I investigation program is to identify expeditiously those dams which may pose hazards to human life or property... The Phase I investigation will develop an assessment of the general condition with respect to safety of the project based upon available data and a visual inspection, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted" (Chapter 3, "Recommended Guidelines for Safety Inspection of Dams").

c. **Evaluation criteria.** The criteria used to evaluate the dam were established in the "Recommended Guidelines for Safety Inspection of Dams," and Engineering Regulation No. 1110-2-106 and Engineering Circular No. 1110-2-188, "Engineering and Design National Program for Inspection of Non-Federal Dams," prepared by the Office of the Chief of Engineers, Department of the Army; and "Hydrologic/Hydraulic Standards, Phase I Safety Inspecton of Non-Federal Dams," prepared by the St Louis District (SLD), Corps of Engineers. These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. **Description of dam and appurtenances.** PJ's Bass Lake Dam is a curved earth embankment, convex downstream, approximately 325 ft along the crest and 37 ft high at the maximum section. The crest of the dam is approximately 18 ft wide. The downstream slope is grass-covered, the crest has a gravel road, and the upstream slope is nearly barren of vegetation. The upstream slope from the dam crest to the waterline varies from 2.0 to 2.4(H) to 1(V). The downstream slope for the most part is approximately 1.5 - 1.7(H) to 1(V), but is locally steeper, approaching 1(H) to 1(V) near the toe at the maximum section.

A 4-in. diameter low-level outlet is located at the toe of the maximum section. It is controlled by a hand-operated butterfly valve located at the downstream end of the outlet pipe.

The main spillway is a 48-in. diameter corrugated metal pipe at the left abutment. Concrete-lined approach and discharge channels have also been constructed at this spillway. The main spillway pipe is equipped with a wire mesh trash rack.

The emergency spillway consists of a low swale in the right abutment. The emergency spillway is crossed by the gravel road which runs along the dam crest but is otherwise unlined. There are no control structures in either spillway.

b. **Location.** The dam is located on an unnamed tributary of the Big River, just east of Missouri State Highway E, in Section 27, T38N, R4E, on the USGS Bonne Terre, Missouri 7.5-minute quadrangle map. The dam is approximately 4 mi north of the town of Bonne Terre in St Francois County, Missouri.

c. **Size classification.** The dam is classified as a small size dam based on its height of 37 ft and storage capacity of 108 ac-ft. The small size classification criteria are: height between 25 and 40 ft or storage capacity between 50 and 1000 ac-ft.

d. **Hazard classification.** The St Louis District (SLD), Corps of Engineers, has classified this dam as having a high hazard potential; we concur with this classification. The SLD estimated damage zone length extends approximately 1 mile downstream to the flood plain of the Big River. Within this estimated damage zone are Missouri State Highway E, several occupied dwellings and assorted farm buildings. The contents of the damage zone were verified by aerial reconnaissance (Photo 1).

e. **Ownership.** The dam is reportedly owned by Mr Paul J. Hunt, Route 2, Box 624, Bonne Terre, Missouri, 63628. Correspondence should be sent to his attention. At the time of the inspection Mr Hunt maintained a residence immediately adjacent to the lake.

f. **Purpose of dam.** The reservoir impounded by the dam is used as a recreational and commercial fishing pond.

g. **Design and construction history.** Information on the design and construction of the dam was obtained through phone interviews with Mr Hunt and a written note from him. No design plans or construction reports were available.

The dam was not designed by an engineer. No design plans were available.

The dam was constructed in 1976 by C.E. Patt and Raymond Patt (relatives of Mr Hunt) of C. E. Patt Excavating Company, Bonne Terre, Missouri.

h. **Normal operating procedures.** The only operating procedure described for this dam consists of opening the low-level discharge pipe to increase discharge from the lake during periods of heavy runoff.

1.3 Pertinent Data

a. **Drainage area.** 0.14 mi^2

b. **Discharge at dam site.**

Maximum known flood at damsite	Described by owner as approximately 3 ft deep flow through main spillway pipe.
Warm water outlet at pool elevation	N/A (not applicable)
Diversion tunnel low pool outlet at pool elevation	N/A
Diversion tunnel outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	N/A
Gated spillway capacity at maximum pool elevation	N/A
Ungated spillway capacity at maximum pool elevation	79 ft^3/sec (72 ft^3/sec through main spillway, 7 ft^3/sec through emergency spillway
Total spillway capacity at maximum pool elevation	79 ft^3/sec (72 ft^3/sec through main spillway, 7 ft^3/sec through emergency spillway

c. **Elevations (ft above MSL).**

Top of dam	Varies from 801.2 to 803.3
Maximum pool-design surcharge	N/A
Full flood control pool	N/A
Recreation pool (main spillway crest)	797.1
Spillway crest (gated)	N/A
Upstream portal invert diversion tunnel	N/A
Downstream portal invert diversion tunnel	N/A
Streambed at centerline of dam	Unknown
Maximum tailwater	Unknown
Toe of dam at maximum section	763.9

d. **Reservoir.**

Length of maximum pool	1300 ft
Length of recreation pool	1100 ft
Length of flood control pool	N/A

e. **Storage (acre-feet).**

Recreation pool	83
Flood control pool	N/A
Design surcharge	N/A
Top of dam	108

f. **Reservoir surface (acres).**

Top of dam	7.9
Maximum pool	7.0
Flood control pool	N/A
Recreation pool	5.4
Spillway crest	5.4

g. **Dam.**

Type	Convex downstream, curved earth embankment
Length	325
Height	37 ft
Top width	18 ft
Side slopes	Upstream reported 3(H) to 1(V); measured at 2.0 - 2.4(H) to 1(V) from crest to waterline. Downstream typically 1.5 - 1.7(H) to 1(V); toe of slope locally 1(H) to 1(V).
Zoning	None
Impervious core	Homogeneous impervious embankment
Cutoff	Trenched to bedrock (reported by owner)
Grout curtain	None

h. **Diversion and regulating tunnel.**

Type	None
Length	N/A
Closure	N/A

Access	N/A
Regulating facilities	N/A

i. **Spillway.**

	Main	Emergency
Type	27 ft long 48-in. diameter corrugated metal pipe at left end of dam.	Broad triangular swale in right abutment.
Length of weir	N/A	35 ft at minimum top of dam elevation.
Crest elevation	797.1 ft	800.7 ft
Gates	None	None
Downstream channel	Upper 22 ft concrete-lined flume; remainder unlined. Downstream portion flows along toe of embankment, may be subject to erosion of toe of slope.	Unlined. Flows along junction of embankment and abutment. Erosion could lead to slumping of embankment.

j. **Regulating outlets.** 4-in. diameter low-level outlet. Hand-operated butterfly valve at downstream end. Outlet invert elevation 760.2 ft.

SECTION 2
ENGINEERING DATA

2.1 Design

Mr Hunt reported that no engineering design was prepared for this dam. No as-built plans were available.

2.2 Construction

No construction records were available for this dam. The following information on the dam construction was obtained from Mr Paul Hunt, owner of the dam, who was reportedly present when the dam was built.

The dam was constructed in 1976 by C. E. Patt and Raymond Patt (relatives of Mr Hunt) of C. E. Patt Excavating Company, Bonne Terre, Missouri.

According to Mr Hunt, a keyway of unknown dimensions was cut to bedrock. The embankment was constructed of gravelly residual clay soil excavated from the dam foundation and a borrow site at the left abutment. Compaction was limited to construction traffic. No compaction testing was performed. The upstream slope was reported to be constructed at 3(H) to 1(V).

A 4-in. diameter low-level outlet was built at the base of the dam. The control is at the downstream end. No anti-seep collars were installed along the pipe. The upstream end of the pipe is covered by two 55-gal barrels with a mesh screen. Rock was piled around the barrels to anchor them and act as a filter.

No other information was available on design or construction of this dam.

2.3 Operation

The only facility requiring operation at this dam is the low-level outlet located at the toe of the maximum section. Mr Hunt reported that this outlet is opened to increase discharge during periods of heavy runoff. There are no regulating outlets at either the main or emergency spillway.

2.4 Evaluation

a. **Availability.** The only information available on the design and construction of this dam was obtained from interviews with the owner, Mr Hunt.

b. **Adequacy.** The available information is insufficient to evaluate the design of PJ's Bass Lake Dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not on record. This is considered a deficiency which should be rectified. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record. These analyses should be performed by an engineer experienced in the design and construction of earth dams.

c. **Validity.** There is no reason to question the validity of the information obtained from Mr Hunt. However, the information is incomplete.

2.5 Project Geology

The dam site is located on the northern flank of the Ozark structural dome. Bedrock in the area is mapped on the Geologic Map of Missouri (1979) as Cambrian age Potosi Dolomite and Eminence Dolomite. The Potosi Dolomite, a light gray medium- to fine-grained dolomite, typically contains an abundance of quartz druse associated with chert deposits within the formation. The Eminence Dolomite, which conformably overlies the Potosi Dolomite, is similar in appearance but contains less chert and quartz. The Cambrian age Bonneterre Formation and Elvins Group are mapped a short distance south of the dam site.

The soil at the dam site is a dark red residual clay (CL or CH) containing abundant quartz druse gravel, probably developed on the Potosi Dolomite. This is apparently the soil used to construct the embankment. The soil was sampled and classified in the field. Two soils are mapped and described in the area of the dam site in the Missouri General Soils Map and Soil Association Descriptions (1979). The Peridge-Cantwell-Gasconade Soil Association is mapped to the south of the site; the Union-Goss-Gasconade-Peridge Soil Association is mapped at the site and to the north, and probably underlies most of the drainage basin.

There are several faults mapped in the general area of the dam site. The Big River Fault System, a NE-SW to E-W trending network of faults approximately 20 miles long, is located south of the dam site. The main fault in this system passes the dam site approximately 2 miles to the southeast. The E-W trending Cabanne Fault is mapped approximately 3.5 miles southwest of the dam site. Displacement on these two faults is mapped as north side down. A branch fault of the Ditch Creek Fault System is mapped approximately 5 miles northeast of the dam site. This fault system is generally NW-SE trending and is approximately 5 miles long.

Other faults in the area include the Tiff Fault Zone, two small (approximately 1 mile in length) NW-SE trending faults which are mapped on the Structural Features Map of Missouri (1971) about 4.5 and 5 miles northwest of the dam site. The NW-SE trending Cruise Mill-Fertile Fault Zone is approximately 7 miles northwest of the dam site. These faults, like most others in the Ozark region, are within Precambrian and Paleozoic formations, and are likely Paleozoic in age. They are not considered seismically active.

The dam is located approximately 85 miles northwest of the line of epicenters for the very large New Madrid earthquakes of 1811 and 1812. A recurrence of an earthquake of the magnitude of the New Madrid events could cause damage to this dam, but an assessment of this risk is beyond the scope of this Phase I investigation.

SECTION 3
VISUAL INSPECTION

3.1 *Findings*

a. **General.** A visual inspection was conducted of PJ's Bass Lake Dam on 28 April 1981. Mrs Hunt, wife of the owner of the dam, met with the inspection team but did not accompany them during the inspection. Mrs Hunt provided the inspection team with notes prepared by her husband concerning construction of the dam.

On the basis of the findings of the inspection, the dam is judged to be in fair to poor condition.

b. **Dam.** The dam is a curved earth embankment, convex downstream, approximately 325 ft along the crest and 37 ft high at the maximum section (Photo 2). The crest of the dam is approximately 18 ft wide with a gravel road along the crest.

The embankment was constructed of gravelly clay soil (Photo 3) excavated from the dam foundation and left abutment. The gravel fraction is predominantly chert and quartz druse characteristic of soils developed on the chert-bearing bedrock in the area. Some portions of the fill also contain boulders of unweathered bedrock to several feet in diameter. The fine fraction of the embankment material is a red-brown, plastic residual clay soil (CL or CH) also typical of the weathering of the local bedrock formations.

The upstream slope is nearly barren of vegetation with only scattered weeds. The slope from the crest of the dam to the waterline is 2.0 - 2.4(H) to 1(V). No erosion protection was installed on the upstream slope. No significant wave erosion is anticipated due to the short fetch of the reservoir. Gradual erosion of the fine fraction will likely leave a lag gravel and provide some erosion protection.

The downstream slope has a relatively well developed cover of grass (Photo 4). This grass likely provides moderate erosion protection. No significant slope erosion was noted during the visual inspection. The slope for the most part is approximately 1.5 - 1.7(H) to 1(V), but is locally steeper, approaching 1(H) to 1(V) near the toe.

Along the immediate toe of the slope, specifically from the maximum section up along the junction with the left abutment, large boulders, stumps, trees, and other debris, apparently from past clearing of the dam site, have been buried in the toe of the embankment (Photo 5). Voids several feet in diameter resulting from fill bridging over this debris can be seen extending at least 5 ft under the toe of the slope (Photo 6). These voids indicate compaction of the outer portion of the downstream slope was either not attempted or was inadequate.

An arc-shaped, steeply sloping area was noted at the toe of the maximum section (Photo 7). This area could either be the scarp of a slump at the toe of the slope or the result of poor construction. A large bush near the center of the arc suggests the slope may have been constructed in this configuration. In either case, the steep slope will likely be subject to slumping or sloughing.

Several areas of seepage were noted at the toe of the dam (Photo 8). These were described by Mrs Hunt as springs and not leaks through the dam. The entire area was described by Mr Hunt as having numerous springs; 17 were reported in the area occupied by the reservoir. Total flow from the seepage at the toe of the dam was estimated at approximately 5 gal/min. The seepage was stained red-brown, but appeared to be stained by algae rather than transported soil.

No evidence of animal burrows or sinkhole development was noted on the embankment. No cracking was noted of the embankment, but the downstream slope was hummocky, possibly the result of construction rather than distress to the slope.

The visual inspection indicated some settlement may have occurred leaving the center of the dam crest lower than the ends. The field survey (Fig. 3A) shows the center to be approximately 0.6 ft lower than the right end and more than 2 ft lower than the left end of the dam. The horizontal alignment of the crest does not appear disturbed, although this is difficult to assess due to the curving downstream configuration.

Several small trees were noted on the right toe of the slope. These should be removed before they become large enough to pose a hazard to the dam, either from piping along decayed root channels or being blown over in a storm and uprooting a portion of the embankment.

c. **Appurtenant structures.**

1. Main spillway. The main spillway is located at the left end of the dam. It consists of a 12-ft long concrete-lined approach channel approximately 5-ft wide, a 48-in diameter, 27-ft long corrugated metal culvert beneath the dam (Photo 9), and a 22-ft long concrete-lined discharge channel (Photo 10). A wire mesh trash rack has been placed across the upstream end of the culvert. Some trash has already collected against the wire mesh indicating a potential exists for obstructing passage of flood flows. As the spillway is concrete or metal, erosion is not likely to be significant in this area. However, downstream of the concrete-lined portion of the discharge channel, erosion may occur along the toe of the embankment (Section 3.1e).

2. Emergency spillway. The emergency spillway consists of a broad swale in the right abutment (Photo 11). It is crossed by the gravel road which runs along the crest of the dam, but is otherwise unlined. Some erosion can be anticipated in this spillway in the event of heavy flood flows. There did not appear to be a significant potential for obstruction of this emergency spillway.

3. Low-level outlet. A low-level outlet pipe was noted at this dam, located at the toe of the maximum section. The outlet consists of a 4-in. diameter pipe with a hand-operated butterfly valve at the downstream end. The upstream end was described as being covered by two 55-gallon barrels with a fish control screen over the top. Rock has been piled around the barrels to

anchor the barrels and to act as a filter for the intake. The valve was operated during the inspection visit and was in working condition at that time (Photo 12).

It should be noted that, generally, it is not good engineering practice to locate the control valve at the downstream end of the pipe. This allows the pipe beneath the dam to be under full reservoir pressure, and if a leak were to develop, internal erosion of the embankment could occur.

d. **Reservoir area.** The area surrounding the reservoir consists of pasture and forest with several scattered dwellings. The slopes surrounding the reservoir are relatively flat, 4(H) to 1(V), except near the left abutment, which was used as a borrow site. Slopes at the waterline in this area approach a slope of 2(H) to 1(V) and are not vegetated. No evidence of unstable slopes surrounding the reservoir was noted during the visual inspection. No evidence or record of sedimentation was found for this reservoir.

e. **Downstream channel.** The downstream channel below the main spillway is concrete-lined for 22 ft downstream of the end of the spillway culvert. From there it flows through an ill-defined swale cut into the abutment (Photo 13) to a point where it flows along the toe of the slope of the embankment. There is considerable potential for obstruction and diversion of flow in this unlined portion of the main spillway discharge channel. The potential for erosion in the area along the toe of the dam could affect the stability of the embankment.

The downstream channel for the emergency spillway is unlined for its entire length and flows in a swale at the junction of the embankment and right abutment (Photo 14). Erosion in this swale could affect the stability of the embankment. The lower reaches of this swale are densely overgrown and could obstruct flood flows.

3.2 Evaluation

Based on the findings of the visual inspection, the dam is judged to be in fair to poor condition. The principal deficiencies leading to this judgement are the presence of boulders, tree debris and voids within the toe of the embankment, the potential for erosion of the toe of the slope, and the irregular configuration of the toe of the slope, possibly as a result of slumping. No cracks were noted in the embankment but the survey elevations indicate some settlement has occurred at the maximum section. No animal burrows or sinkholes were noted on the embankment.

The main spillway is concrete-lined and not subject to significant erosion, but may be obstructed at the wire mesh trash rack. The emergency spillway is unlined and may be eroded during heavy flood flows. Portions of the downstream channels for both the main and emergency spillways flow along the junction of the embankment and abutment. Erosion could occur in these areas, and may be sufficient to pose a hazard to the stability of the dam.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

The 4-in. diameter low-level outlet is the only facility requiring operation identified at this dam. No formal operating procedures have been prepared, but Mr Hunt reported the hand-operated valve is opened during periods of heavy rain to increase discharge from the reservir. Normal operating procedure is to allow natural runoff to flow through the main spillway.

4.2 Maintenance of Dam

No reports or records of maintenance were available for this dam.

4.3 Maintenance of Operating Facilities

Mr Hunt reported there is no maintenance program for the low-level outlet.

4.4 Description of Any Warning System in Effect

No warning system was identified at this facility during the visual inspection.

4.5 Evaluation

No formal inspection and maintenance program exists for this dam. The owner's residence is immediately adjacent to the dam and allows for periodic informal inspections to be made. However, a formal program of inspections and maintenance and records of these inspections and any necessary maintenance is recommended for this facility.

Mr Hunt reported the low-level outlet valve was brass and required no maintenance. However, to assure continued operation, the valve should be inspected and operated periodically. Records should be kept of the operating condition of the valve and outlet, and maintenance should be performed as necessary.

The feasibility of a warning system should be evaluated to alert downstream residents and traffic in the event hazardous conditions develop at this dam.

SECTION 5
HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. **Design data.** No hydraulic or hydrologic design data were available for evaluation of this dam or reservoir; however, dimensions of the dam were surveyed by James F. McCaul III and Associates, Potosi, Missouri. Other relevant data were measured during the field inspection or estimated from topographic mapping. The map used in the analyses was the USGS Bonne Terre, Missouri 7.5-minute quadrangle map (1958).

b. **Experience data.** No recorded rainfall, runoff, discharge, or pool stage historical data were found for this reservoir. Mr Hunt estimated the maximum known flood produced a flow about 3 ft deep through the main spillway culvert. No flow was reported to have passed through the emergency spillway.

c. **Visual observations.**

1. Watershed. The watershed consists of pasture and natural woodlands. A few houses are located around the lake. The area of the reservoir at the top of the dam elevation is approximately 8 percent of the total drainage area of 0.14 mi^2.

2. Reservoir. The reservoir, dam and spillway are best described by the maps and photographs enclosed herewith. The purpose of the reservoir is recreational.

3. Spillway. The main spillway consists of a 27 ft long, 48-in. diameter corrugated metal pipe located at the east end of the dam. The emergency spillway, located at the west end of the embankment, consists of a broad swale in the natural ground. The outflow will pass over the emergency spillway into

a steep discharge channel. A 4-in. diameter low-level outlet is located at the toe of the dam. However, discharge through this small diameter outlet was not considered in the overtopping analysis since significant discharge through the main spillway will likely carry enough water to cover the valve and outlet. Also the capacity is small relative to the main and emergency spillways.

4. Seepage. Potential seepage through this dam was considered insignificant in the hydrologic analysis of overtopping potential.

d. **Overtopping potential.** One of the primary considerations in the evaluation of this dam is the assessment of the potential for overtopping and possible consequent failure by erosion of the embankment. The lowest portion of the dam, which is near the middle portion of the embankment was considered the top of the dam for the purpose of determining overtopping potential. Since the emergency spillway of this dam consists of natural earth, erosion may occur at the control section of this spillway due to high velocity discharge.

Hydrologic analyses of this dam for the 1 and 10 percent probability-of-occurrence and Probable Maximum Floods (PMF) were all based on initial water surface elevations equal to the invert elevation of the 48-in. diameter main spillway pipe. The results of the analyses indicate that a flood greater than 20 percent of the PMF will overtop the dam. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The analyses also indicate that the main and emergency spillways will pass the 1 percent probability of occurrence (100 year) flood without overtopping the dam. The 1 percent probability-of-occurrence flood is the flood event that has 1 percent chance of occurring in any year, or occurs on the average once every 100 years. The total spillway capacity at maximum pool elevation is approximately 80 ft^3/sec.

The following overtopping data for various flood events were computed for the dam, assuming no erosion of the dam or spillways.

Precipitation Event	Max. Reservoir WS Elev., ft, MSL	Max. Depth Over Dam, ft	Max. Outflow, ft^3/sec	Duration of Overtopping, hrs
1% Prob	800.3	0	50	0
20% PMF	801.1	0	80	0
50% PMF	802.2	1.0	550	4.3
100% PMF	802.7	1.5	1150	6.2

Based on the relatively small drainage basin (0.14 mi^2), the small storage capacity (108 ac-ft), and the sparse downstream population, 50 percent of the PMF is the recommended spillway design flood for this dam.

It should be noted that at 100 percent of the PMF the depth of overtopping may reach 1.5 feet and the dam may be overtopped for 6.2 hours. In view of the relatively steep downstream slope, this depth and duration of overtopping could lead to sufficient erosion to cause failure of this dam.

Input data and output summaries for the hydrologic and hydraulic analyses are presented in the attached Appendix B.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. **Visual inspection.** The visual inspection identified no signs of cracking, sinkhole development, or animal burrows on the embankment. The field survey noted minor settlement had occurred near the center of the embankment (Fig. 3A). Seepage was noted at the toe of the dam. This was reported by Mr Hunt as a spring which existed prior to the building of the dam. If this is the case, it does not appear that any special precaution was taken during construction to install a filter over the spring. Total seepage flow was estimated at 5 gal/min. The seepage water did not appear to be transporting any soil, and was not considered to pose a hazard to the stability of the dam at the time of the inspection.

Near the toe of the maximum section, an arc-shaped, steeply sloping area was noted. This area could be either a slump scarp or the result of the original configuration of the dam. A large bush near the center of the arc suggests the dam may have been built in this configuration. This area is likely to be subject to slumping in the future due to the steep slopes. Other parts of the toe of the dam are also quite steep, locally approaching 1(H) to 1(V), and are judged only marginally stable.

The discharge channels for both the main and emergency spillways flow along the junction of the embankment and abutments. During flood flows through these spillways erosion of the toe of the embankment could occur, reducing the slope stability of these areas. Erosion control measures may be required to prevent undercutting and slumping of the embankment slopes.

An item of significant concern regarding the embankment stability is the debris buried within the toe of the embankment, specifically from the maximum section up along the junction of the embankment with the left abutment (Photos 5 and 6). This debris consists of boulders and trees

apparently cleared from the vicinity of the dam foundation. Fill has been placed over much of this debris, and in places bridges over voids several feet in diameter and extending at least several feet into the embankment. These voids suggest compaction of the outer portion of the downstream slope was inadequate or not attempted. The downstream slope appears hummocky indicating compaction may not have been attempted. Decay of the buried vegetation may also reduce the embankment stability and provide potential piping paths.

Seepage and stability analyses as required by the "Recommended Guidelines for Safety Inspection of Dams" were not available. As a result the stability of the dam cannot be evaluated.

b. **Design and construction data.** No design drawings or construction reports were available for this dam. All information on the construction of this dam was provided through interviews with Mr Hunt, the dam owner, and is presented in Sections 1.2g, 2.1 and 2.2. Seepage and stability analysis as per the guidelines were not available, which is considered a deficiency.

c. **Operating records.** No operating records or water level records are maintained for this facility.

d. **Post construction changes.** No post construction changes were reported or identified for this dam, other than the growth of vegetation on the embankment.

e. **Seismic stability.** The dam is located in Seismic Zone 2 to which the guidelines assign a moderate damage potential. During a seismic event, liquefaction of the rocky clay soil used to construct the dam is unlikely. However, without knowledge of the soil properties of the embankment materials, the seismic stability cannot be evaluated.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. **Safety.** Based on the results of the visual inspection and evaluation of other available data, the dam is judged to be in fair to poor condition. The principal deficiencies identified were the buried debris and resulting voids at the downstream toe of the left half of the dam, the potential for erosion of the embankment along the discharge channels of both the main or emergency spillways, and the lack of seepage or stability analyses as per the "Recommended Guidelines for Safety Inspection of Dams," and the inadequate spillway capacity. Hydraulic/hydrologic analyses indicate the dam will be overtopped by a flood greater than 20 percent of the PMF. The 1 percent probability-of-occurrence flood will be stored and passed by the two spillways without overtopping the embankment. Based on the small drainage basin and storage capacity, and the sparse downstream population, 50 percent of the PMF should be the recommended spillway design flood for this dam.

b. **Adequacy of information.** The visual inspection and other data supplied to the inspection team provided sufficient information to support the conclusions and recommendations presented in this Phase I report. The lack of design documents such as static and seismic stability analyses or seepage analysis precludes an assessment of the stability of the dam. This is a deficiency which should be rectified.

c. **Urgency.** The deficiencies described in this report could affect the safety of the dam. Remedial measures regarding the debris buried in the toe of the slope, erosion along the discharge channels below the spillways and inadequate spillway capacities should be addressed immediately. Other recommendations should be addressed without undue delay.

d. **Necessity for Phase II.** In accordance with the Recommended Guidelines for Safety Inspection of Dams, the subject investigation was a minimum study. This study revealed that additional in-depth investigations are needed to complete the assessment of the safety of the dam. Those investigations which should be performed immediately are described in Section 7.2b. It is our understanding from discussions with the SLD that any additional investigations are the responsibility of the owner.

7.2 Remedial Measures

a. **Alternatives.** There are several general options which may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these options are:

1. Remove the dam, or breach it to prevent storage of water.

2. Increase the height of dam and/or spillway size to pass the spillway design flood without overtopping the dam.

3. Purchase downstream land that would be adversely impacted by dam failure, and restrict human occupancy.

4. Provide a highly reliable flood warning system (generally does not prevent damage but diminishes chances for loss of life).

b. **Recommendations.** Based on our inspection of PJ's Bass Lake Dam, the following recommendations should be addressed immediately. All remedial measures should be performed by or under the direction of an engineer experienced in the design, construction and maintenance of earth dams.

1. Prepare a detailed hydraulic/hydrologic analysis and design a spillway system capable of passing the spillway design flood (50 percent of PMF) without overtopping the dam. The spillway should be protected from erosion.

2. Remove the debris buried at the toe of the embankment and replace the excavated material with compacted fill. Safety considerations may require the lake level to be lowered significantly during these repairs.

3. Install erosion control measures or re-route the spillway discharge channels away from the toe of the embankment slopes.

4. Repair the arc-shaped swale near the toe of the maximum section to conform with the rest of the downstream slope.

The following measures should be addressed without undue delay.

5. Prepare seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams," and make them a matter of record.

6. Remove the small trees growing on the embankment before they become large enough to pose a hazard to the embankment. The grass vegetation should be maintained to the extent that it will not hamper the recommended inspection of the dam.

7. Evaluate the feasibility of a practical and effective warning system to alert downstream residents and traffic in the event unsafe conditions develop at this dam.

c. **O & M procedures.** It is recommended that a program of periodic inspections and maintenance be developed and implemented as soon as practical. Records of inspections and necessary maintenance should be kept. This program should include, as a minimum, the following items:

1. Inspect the embankment for evidence of cracking, slumping or other slope instability features.

2. Monitor seepage at the toe of the dam to identify changes in the amount of seepage or turbidity (soil) in the seepage water.

3. Inspect the discharge channels below both spillways for evidence of erosion of the toe of the embankment slope.

4. Maintain the spillways, trash rack and discharge channels free of obstructions to flow. It is also recommended that an alternate trash rack, less susceptible to blockage than the existing rack, be installed in the main spillway.

5. Inspect, operate and maintain the low-level outlet valve.

6. Inspect the main spillway pipe for evidence of corrosion or separation along joints. Consideration should be given to paving the invert of this pipe to reduce erosion and corrosion of the pipe.

All inspections and maintenance should be evaluated by or performed under the direction of an engineer experienced in the design, construction, and maintenance of earth dams.

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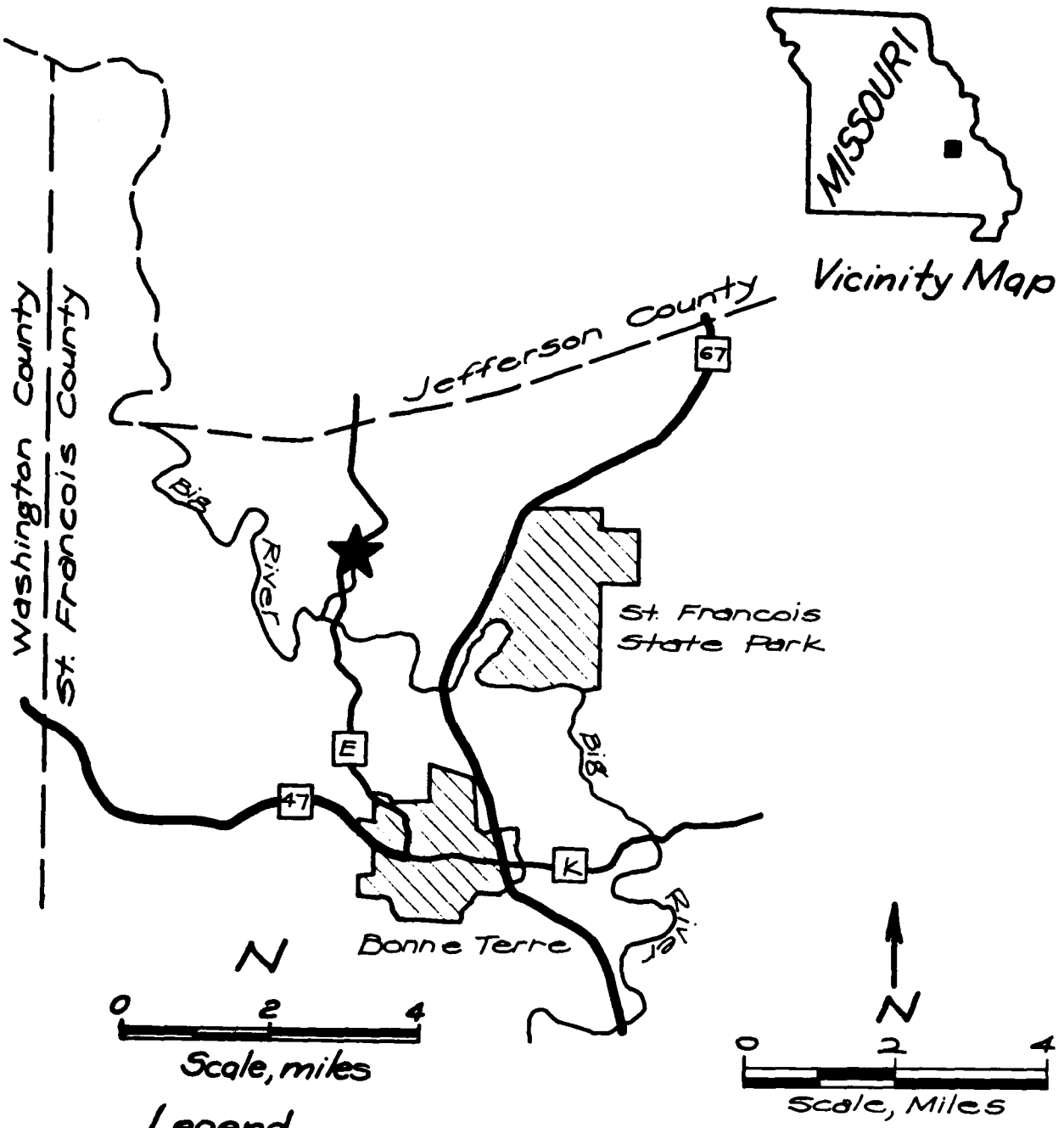
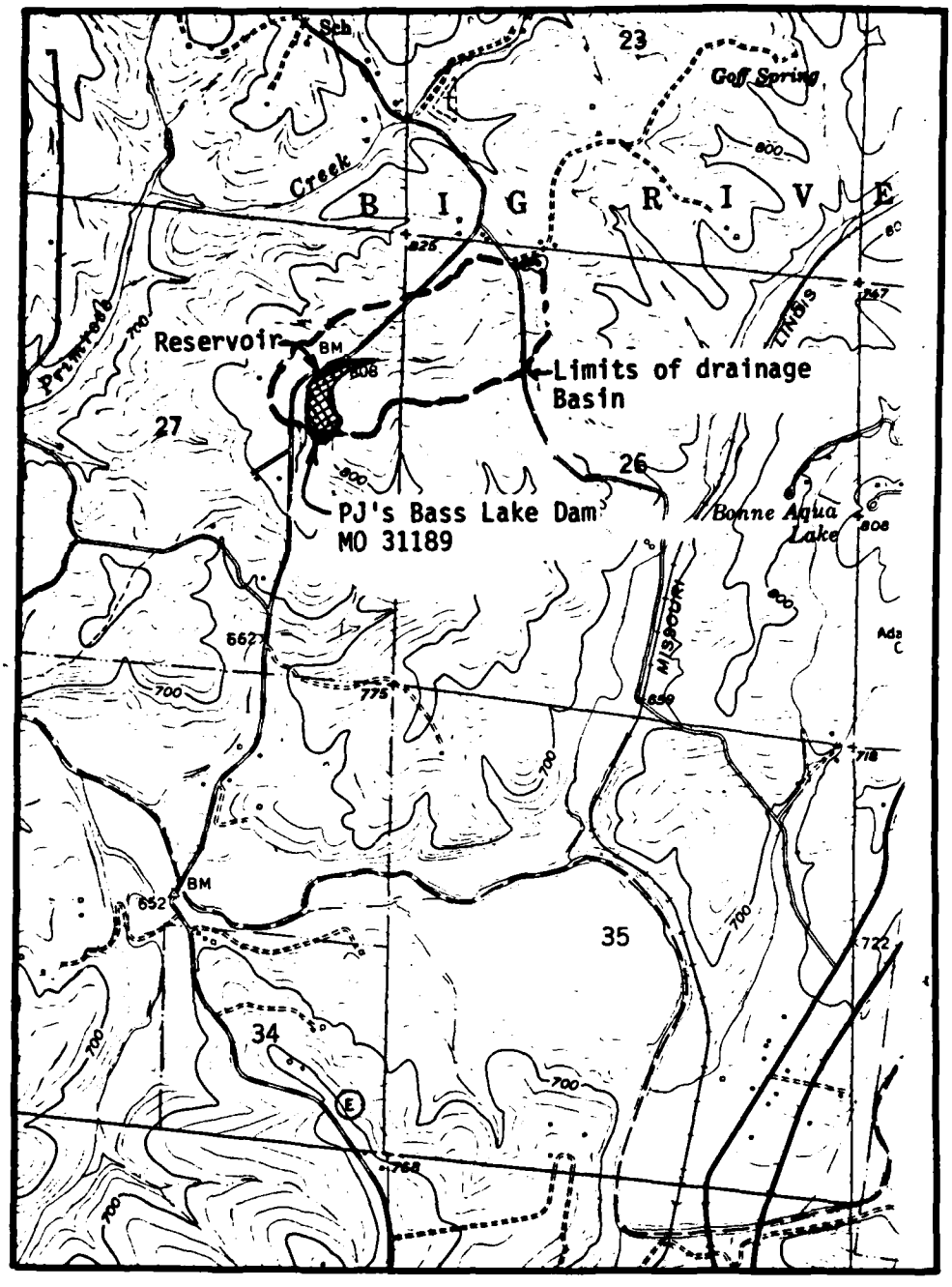


SITE LOCATION MAP

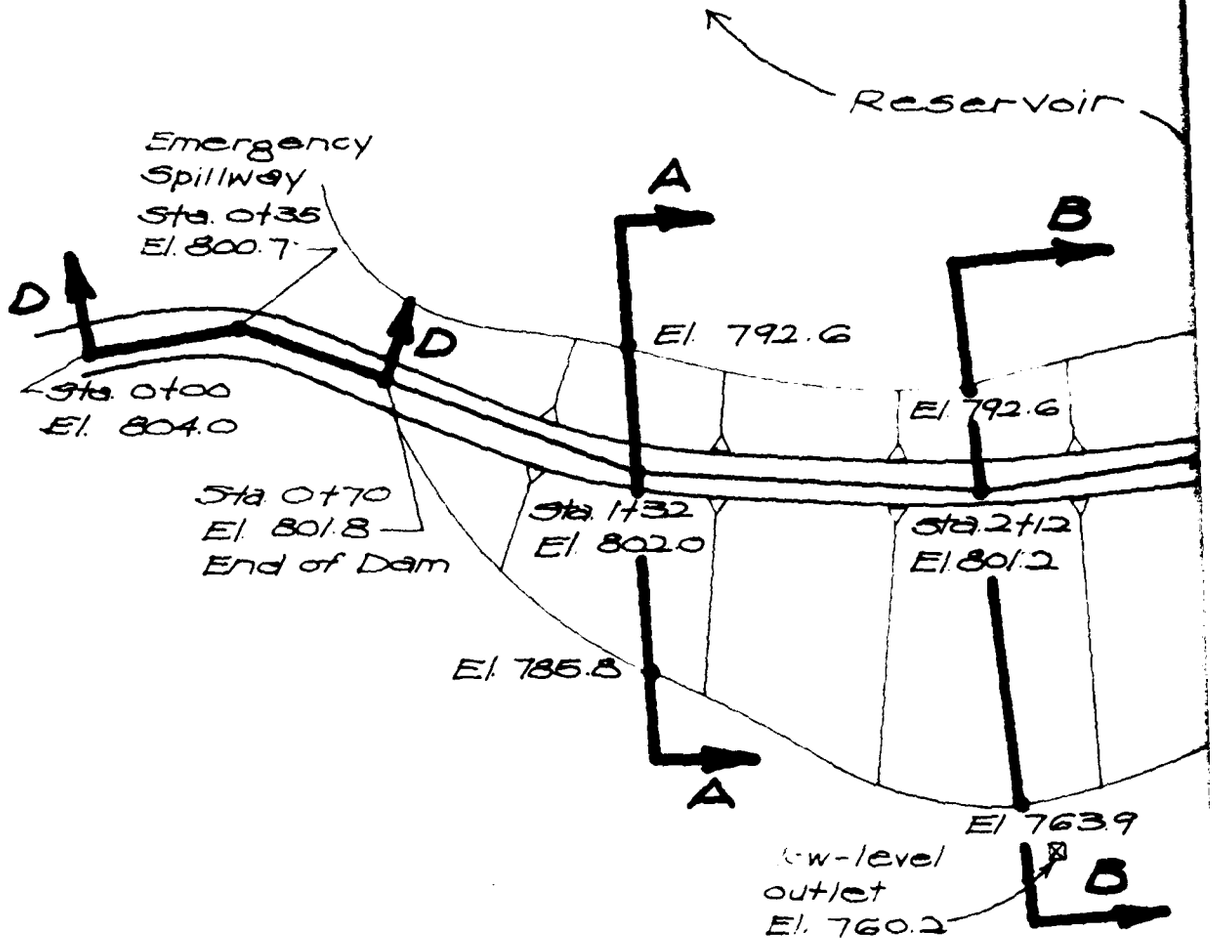
PJ'S BASS LAKE DAM

MO 31189 | **Fig. 1**

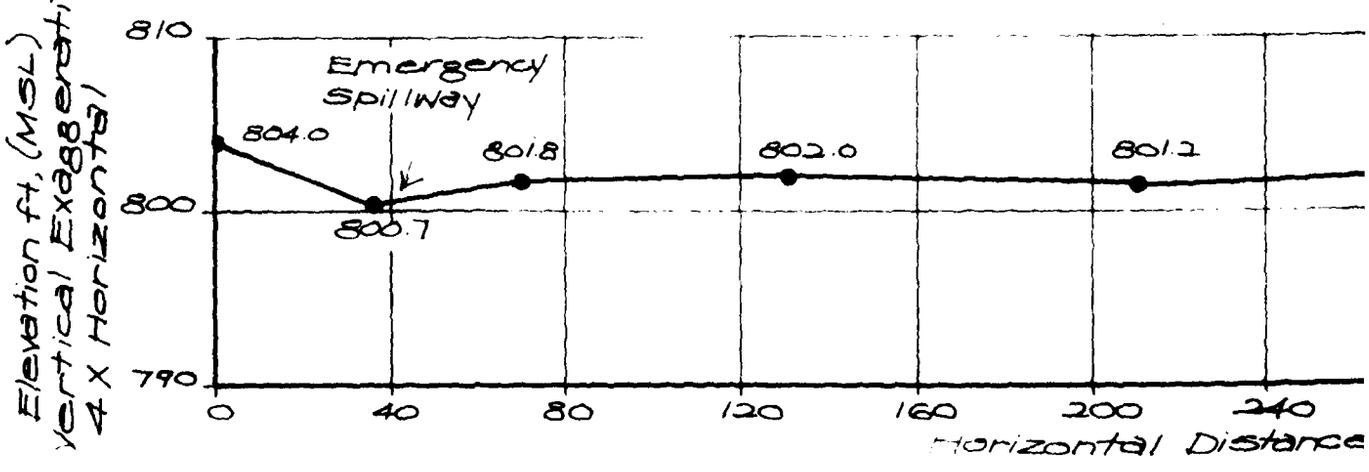


Note:
Topography from USGS Bonne Terre
7.5-minute quadrangle map (1958)

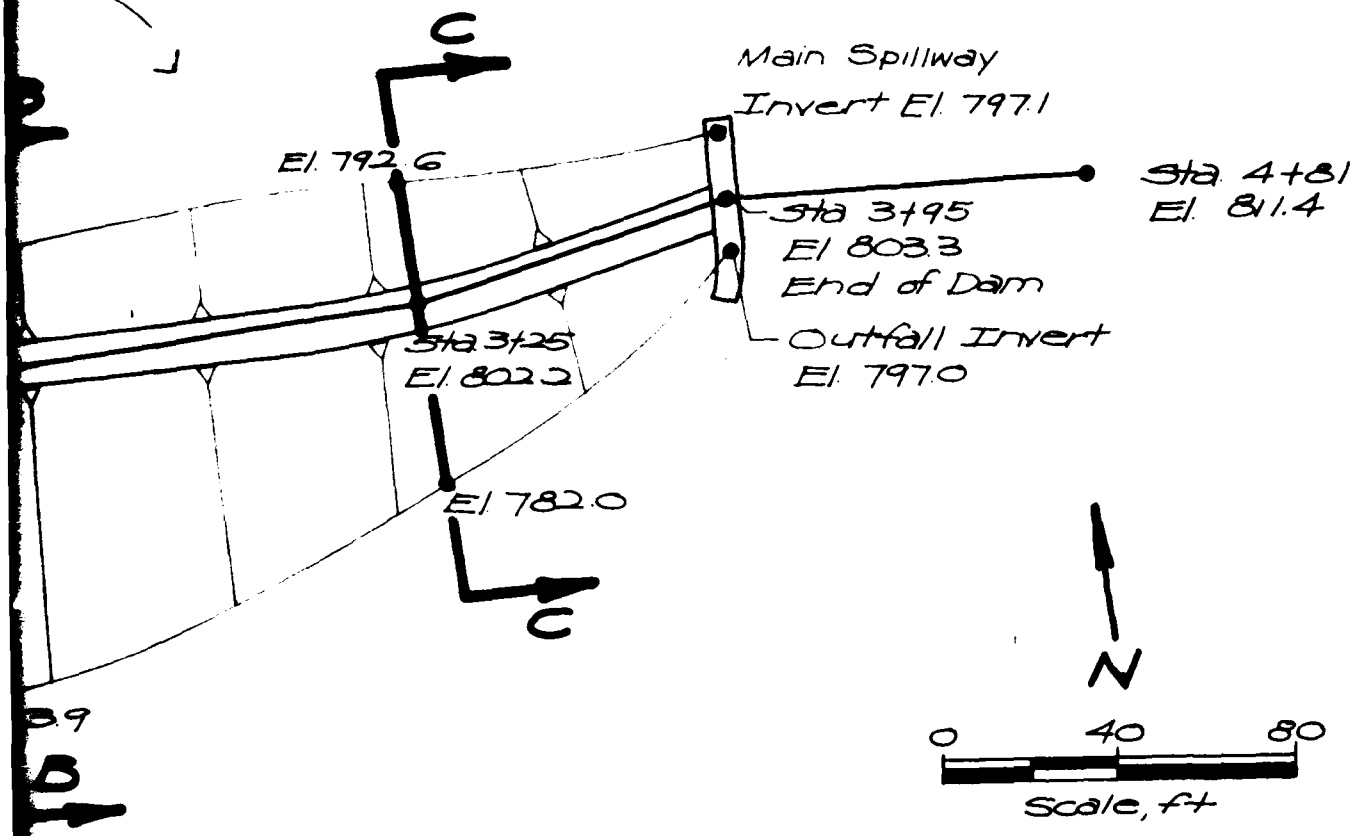
DRAINAGE BASIN AND SITE TOPOGRAPHY	
PJ'S BASS LAKE DAM	
MO.31189	Fig. 2

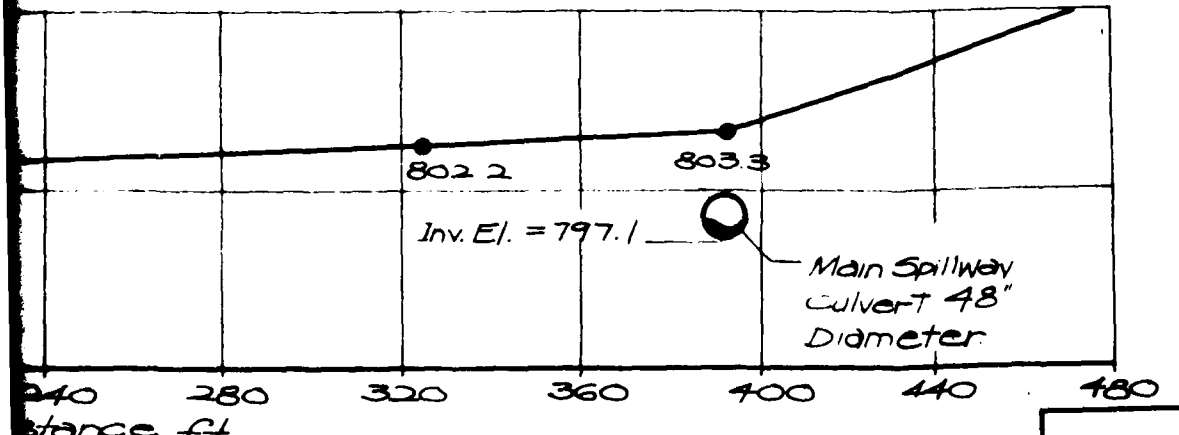


PLAN OF DAM



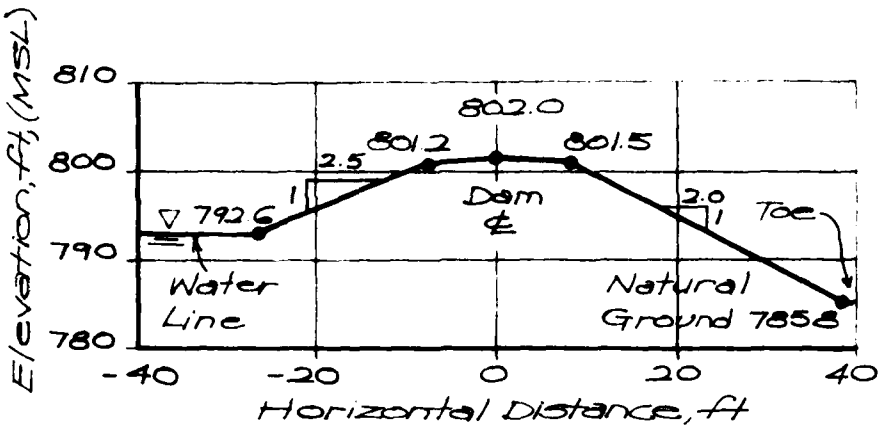
PROFILE OF DAM





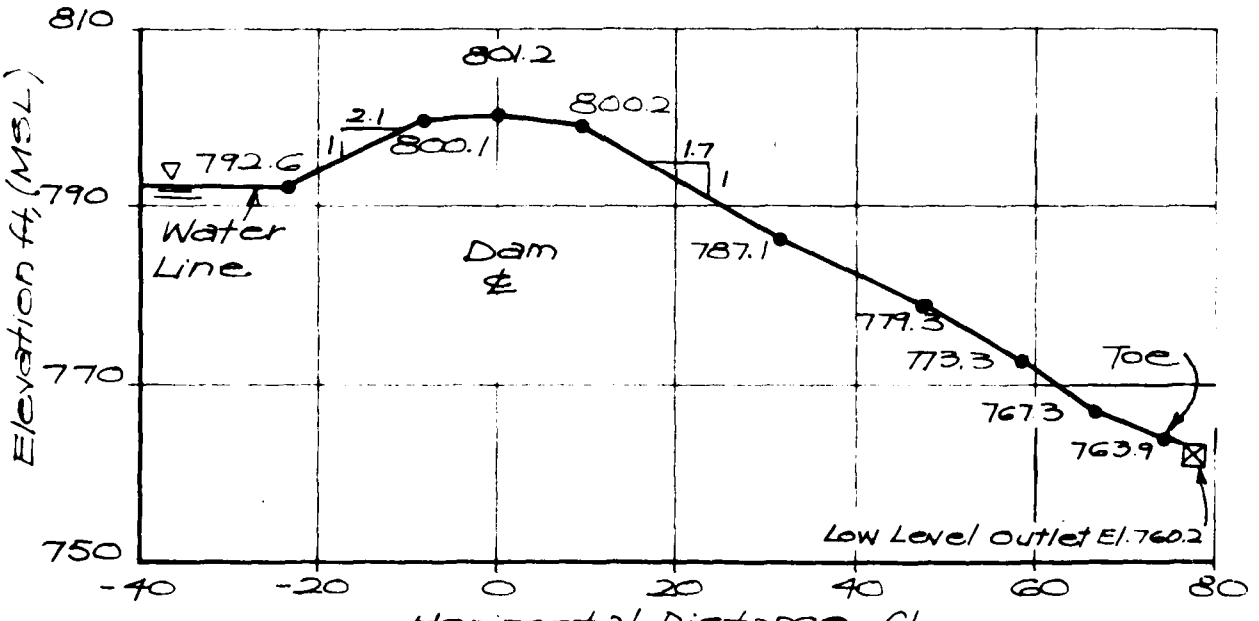
Note:
Survey data supplied by James F. McCaul, III and Associates; Consulting Engineers/Land Surveyors Potosi, Mo. 63664

PLAN AND PROFILE OF DAM	
[illegible] DAM	
[illegible]	Fig. 3-A



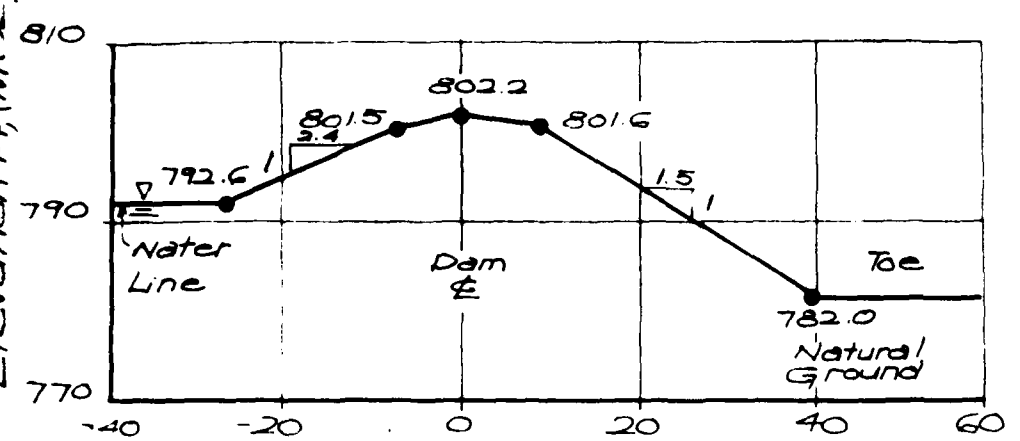
SECTION A-A

Dam crest section

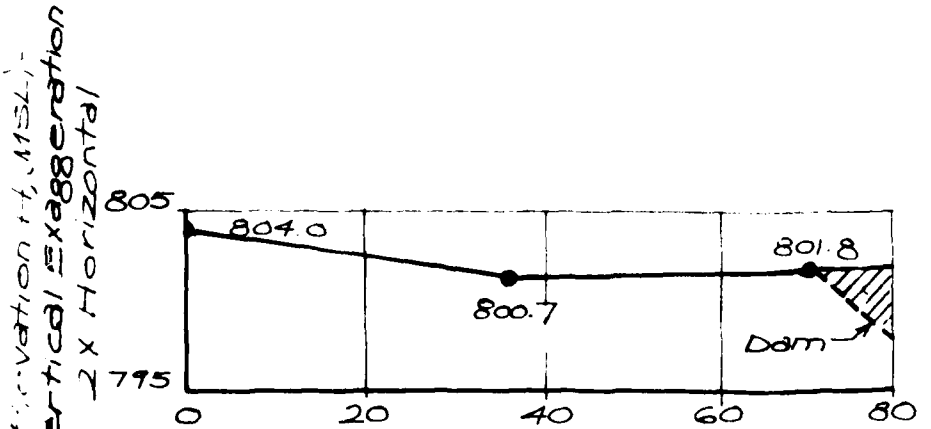


SECTION B-B

Maximum Dam Section



SECTION C-C
Dam Crest Section



SECTION D-D
Emergency Spillway Section

Note:
Survey data supplied by Jame F McCaul, III and Associates; Consulting Engineers, Land Surveyors.
Potosi, MO 63664

SECTIONS OF DAM AND EMERGENCY SPILLWAY	
PJ'S BASS LAKE DAM	
MO 31100	Fig. 3-B

2

1

Legend

- Oic — Smithville Formation; Powell Dolomite; Cotter Dolomite; Jefferson City Dolomite
- Or — Roubidoux Formation
- Gasconade Dolomite; Gunter Sandstone Member
- Cep — Eminence Dolomite; Potosi Dolomite
- Ceb — Derby-Doerun Dolomite; Davis Formation; Bonneterre Formation; Whetstone Creek Member; Sullivan Siltstone Member
- Reagan Sandstone
- Lamotte Sandstone
- Diabase (dikes and sills)
- St. Francois Mountains Intrusive Suite
- St. Francois Mountains Volcanic Supergroup

REGIONAL GEOLOGIC MAP

PJ'S BASS LAKE DAM

MO 31189 | **Fig. 4**

APPENDIX A

Photographs

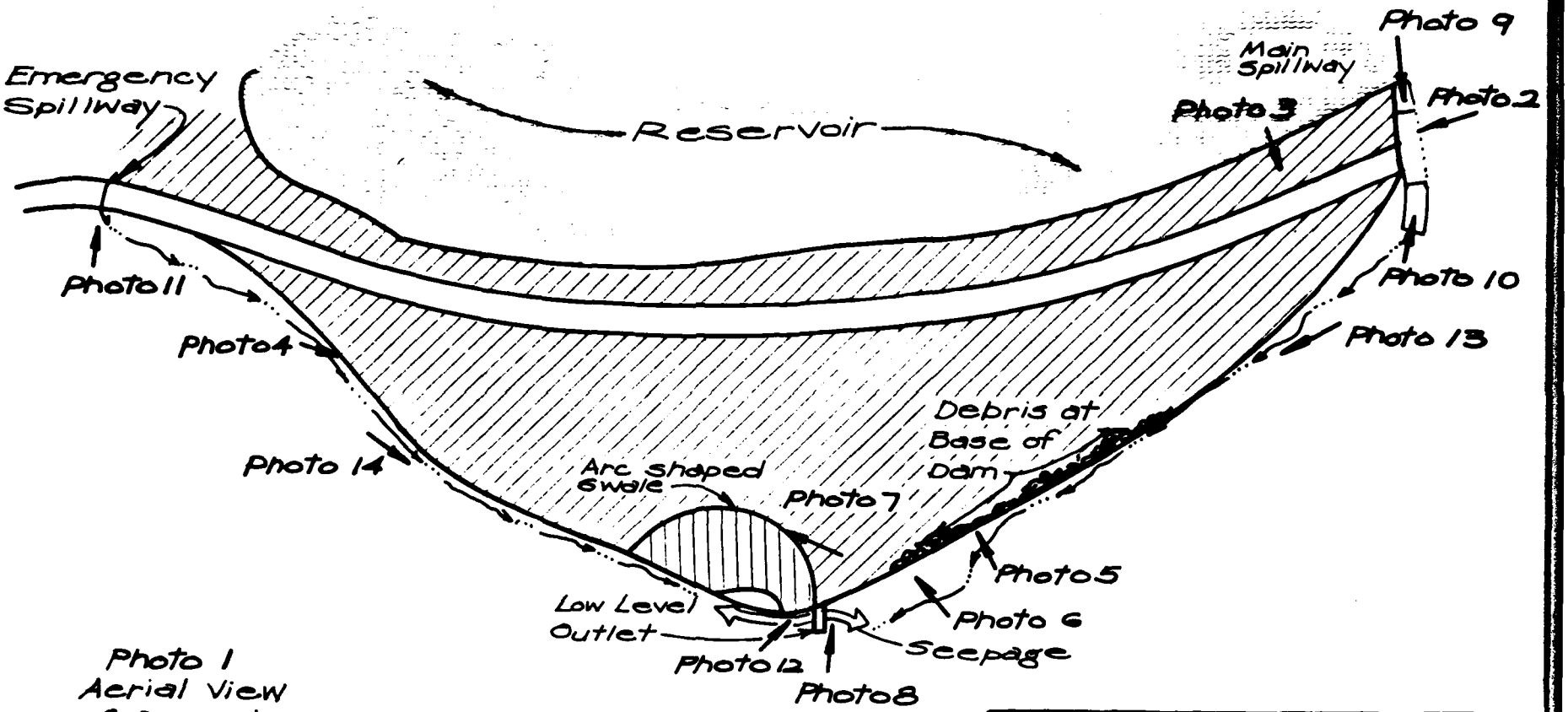


Photo 1
Aerial View
of Downstream
Hazard Zone

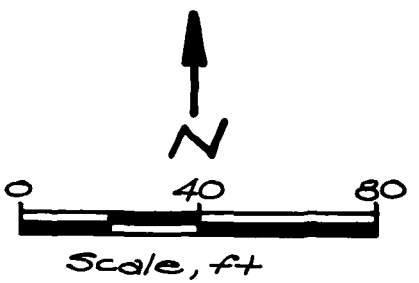
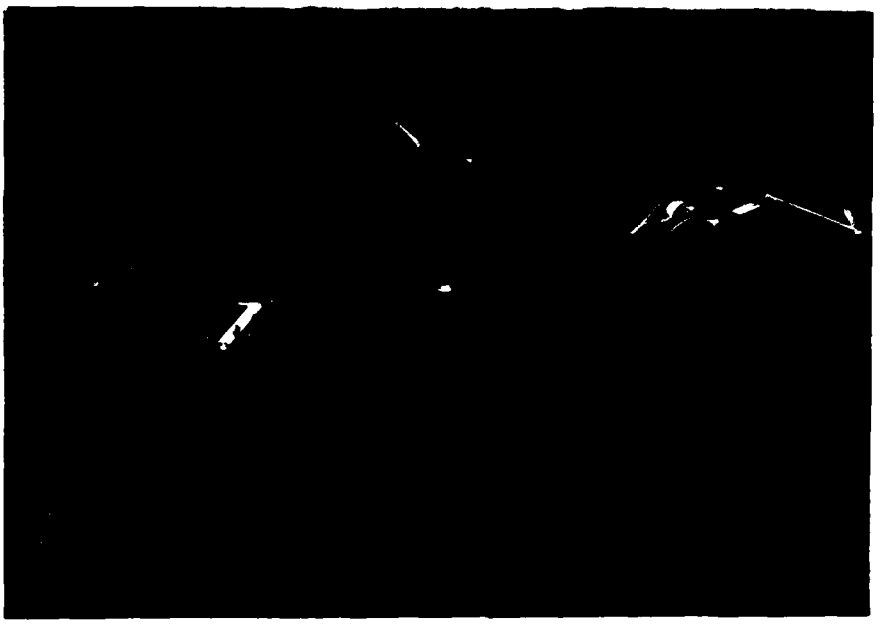
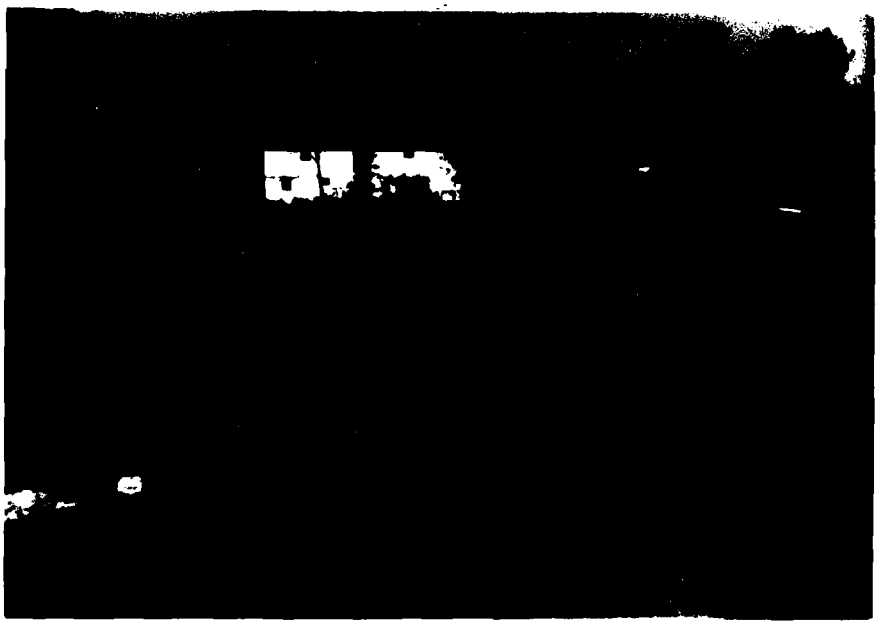


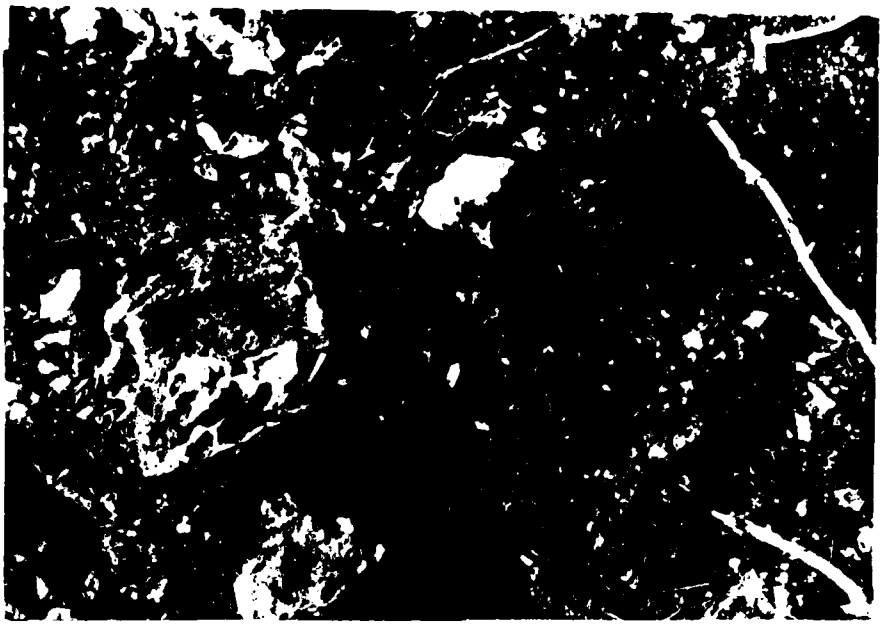
PHOTO LOCATION SKETCH	
PJ'S BASS LAKE DAM	
MO 31189	Fig. A-1



1. Typical contents of downstream damage zone. Dam is out of picture to the right.



2. View along crest of dam from left abutment. Note barren upstream slope, gravel road along crest, and slight dip in crest near center of dam. Part of concrete spillway visible in lower left corner. Emergency spillway located at far end of dam. Looking west.



3. Gravelly clay soil used in construction of dam. Exposed on upstream slope of dam.

4. Downstream slope of dam from right abutment, showing grass cover. Looking southeast.

5. Boulders and trees buried at toe of downstream slope. Clipboard is 12-in. tall. Looking north from toe of dam.

6. Void, visible behind tree debris, extending beneath embankment at toe of dam. Looking north from toe of dam.

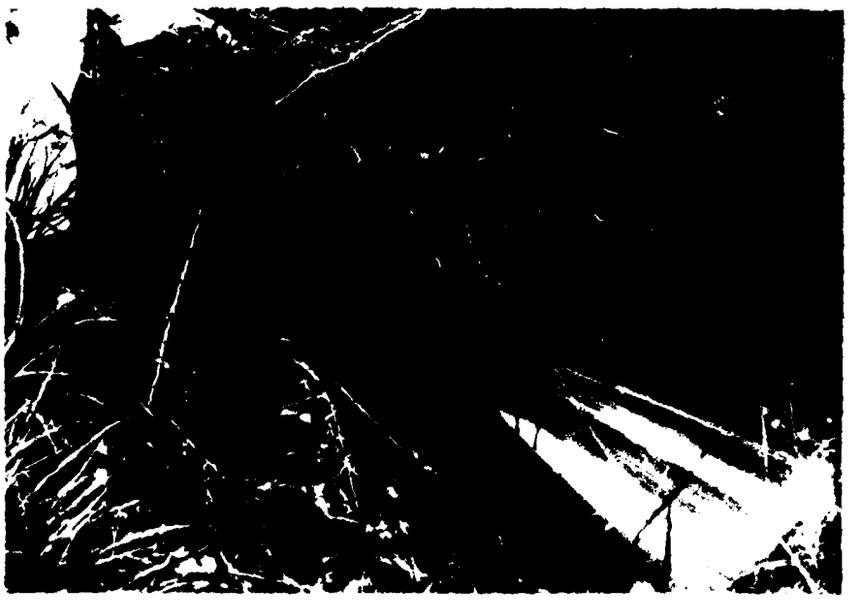
7. Observers standing along top of arc-shaped scarp(?) at toe of maximum section. May be result of slump or poor construction control. Looking west along downstream slope of dam.

8. Typical seepage at toe of dam. Red-brown color appears to be algae rather than transported soil.

9. Approach channel, trash rack, and spillway culvert for main spillway. Note trash rack has already accumulated some debris. Looking south, downstream.

10. Lined portion of discharge channel for main spillway. Looking north, upstream.

11. Emergency spillway at right abutment. Looking north, upstream.



12. Low-level outlet partially opened. Valve and outlet pipe appear to be in operating condition.

13. Unlined portion of downstream channel below main spillway. Dam is through the trees at the right side of the photo. Looking west.

14. Discharge channel for emergency spillway flows along junction of embankment, to the left, and right abutment, to the right. Looking southeast from emergency spillway.

APPENDIX B

Hydraulic/Hydrologic Data and Analyses

APPENDIX B
Hydraulic/Hydrologic Data and Analyses

B.1 Procedures

a. General. The hydraulic/hydrologic analyses were performed using the "HEC-1, Dam Safety Version (1 Apr 80)" computer program. The inflow hydrographs were developed for various precipitation events by applying them to a synthetic unit hydrograph. The inflow hydrographs were subsequently routed through the reservoir and appurtenant structures by the modified Puls reservoir routing option.

b. Precipitation events. The Probable Maximum Precipitation (PMP) and the 1 and 10 percent probability-of-occurrence events were used in the analyses. The total rainfall and corresponding distributions for the 1 and 10 percent probability events were provided by the St. Louis District, Corps of Engineers. The Probable Maximum Precipitation was determined from regional curves prepared by the US Weather Bureau (Hydrometeorological Report Number 33, 1956). The probable maximum precipitation distribution was computed by the HEC-1 program internally using standard EM-1110-1411 method.

c. Unit hydrograph. The Soil Conservation Services (SCS) Dimensionless Unit Hydrograph method (SCS, 1971, Hydrology: National Engineering Handbook, Section 4) was used in the analysis. This method was selected because of its simplicity, applicability to drainage areas less than 10 mi^2, and its easy availability within the HEC-1 computer program.

The watershed lag time was computed using the SCS "curve number method" by an empirical relationship as follows:

$$L = \frac{\ell^{0.8}\,(s+1)^{0.7}}{1900\,Y^{0.5}} \qquad \text{(Equation 15-4)}$$

where: L = lag in hours
ℓ = hydraulic length of the watershed in feet = 3500
$s = \frac{1000}{CN} - 10 = 3.3$
CN = AMC II hydrologic soil curve number as indicated in Section B.2e.
Y = average watershed land slope in percent = 7.7.

This empirical relationship accounts for the soil cover, average watershed slope and hydraulic length.

With the lag time thus computed, another empirical relationship is used to compute the time of concentration as follows:

$$T_c = \frac{L}{0.6} \qquad \text{(Equation 15-3)}$$

where: T_c = time of concentration in hours

L = lag in hours.

Subsequent to the computation of the time of concentration, the unit hydrograph duration was approximated utilizing the following relationship:

$$\Delta D = 0.133 T_C \qquad \text{(Equation 16-12)}$$

where: ΔD = duration of unit excess rainfall
T_C = time of concentration in hours.

The final duration was selected to provide at least three discharge ordinates prior to the peak discharge ordinate of the unit hydrograph. For this dam, the unit hydrograph duration of 5 minutes was used.

d. Infiltration losses. The infiltration losses were computed by the HEC-1 computer program internally using the SCS loss function. The curve number of SCS loss rate procedure was established taking into consideration the variables of: (a) antecedent moisture condition, (b) hydrologic soil group classification, (c) vegetative cover and (d) present land usage in the watershed. In addition, the computed basin loss was reduced proportional to the impervious area in the drainage basin.

Antecedent moisture condition III (AMC III) was used for the PMF events and AMC II was used for the 1 and 10 percent probability events, in accordance with the guidelines. The remaining variables are defined in the SCS procedure and judgements in their selection were made on the basis of visual field inspection.

e. Starting elevations. Reservoir starting water surface elevations for this dam were set as follows:

(1) 1 and 10 percent probability events - main spillway crest elevation 797.1 ft

(2) Probable Maximum Storm - main spillway crest elevation 797.1 ft.

Because the low level outlet pipe is of small diameter, and likely to be covered by water from the main spillway, it was assumed it was inoperable and did not pass any amount of the flood.

f. Spillway Rating Curve.

Flow through the 48-in. diameter main spillway pipe was computed using the culvert capacity chart prepared by the Bureau of Public Roads. In addition, the HEC-2 computer program was used to compute the emergency spillway rating curve using spillway cross section characteristics and assuming critical depth over the spillway.

B.2 Pertinent Data

a. Drainage area. 0.14 mi^2

b. Storm duration. A unit hydrograph was developed by the SCS method option of HEC-1 program. The design storm of 24 hours duration was divided into equal intervals equal to the unit hydrograph duration of 5 minutes in order to develop the inflow hydrograph.

c. Lag time. 0.4 hr

d. Hydrologic soil group. C

e. SCS curve numbers.

1. For PMF- AMC III - Curve Number 88
2. For 1 and 10 percent probability-of-occurrence events - AMC II - Curve Number 75

f. Storage. Elevation-area data were developed by planimetering areas at various elevation contours on the USGS Bonne Terre (1958) 7.5 minute quadrangle map. The data were entered on the $A and $E cards so that the HEC-1 program could compute storage volumes.

g. Outflow over dam crest. As the profile of the dam crest is irregular, flow over the crest was computed according to the "Flow Over Non-Level Dam Crest" supplement to the HEC-1 User's Manual. The crest length-elevation data and hydraulic constants were entered on the $D, $L, and $V cards.

h. Outflow capacity. The combined outflow rating curve was computed by combining the flow through the 48-in. diameter main spillway pipe and flow over the emergency spillway. Capacity of the 48-in. culvert was calculated using the Bureau of Public Roads culvert capacity chart. The emergency spillway rating curve was developed from the cross section data of the spillway using the HEC-2 backwater program. The rating curve data were entered on the Y4 and Y5 cards of the HEC-1 program.

i. Reservoir elevations. For the 50 and 100 percent of the PMF events, the starting reservoir elevation was 797.1 ft, the main spillway crest elevation. For the 1 and 10 percent probability-of-occurrence events, the starting reservoir elevation was also 797.1 ft, the main spillway crest elevation.

B.3 Results

The results of the analyses as well as the input values to the HEC-1 program follow in this Appendix. Only the results summaries are included, not the intermediate output. Complete copies of the HEC-1 output are available in the project files.

```
*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
LAST MODIFICATION  01 APR 80
*************************************
    1          A1    P.J.'S BASS LAKE DAM NO. 31189, FRANCOIS COUNTY , MISSOURI
    2          A2    WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 89C2247100.
    3          A3    PROBABLE MAXIMUM FLOOD (PMF) ANALYSIS
    4          B   288       0       5       0       0       0       0       0       0       0
    5          B1      5
    6          J       1       2       1
    7          J1  0.50     1.0
    8          K       0  INFLOW                                               1
    9          K1    P.J.'S BASS LAKE INFLOW COMPUTATIONS, PROBABLE MAXIMUM FLOOD
   10          M       1       2     .14                       1.0
   11          P       0      26     102.     120.     130.
   12          T                                                -1     -.88              .08
   13          W2              .4
   14          K      -1    -.05       5
   15          K       1     DAM                                1
   16          K1      FLOOD ROUTING AND OVERTOPPING ANALYSIS
   17          V                              1
   18          Y1      1                                      -797.1      -1
   19          Y4  797.1   798.0   799.0   800.0   800.7   801.2   801.7   802.5   803.7
   20          Y5     0.      8.0    20.0    43.0    60.0    82.0   134.0   302.0   723.0
   21          SA     0.      1.      2.3     4.1     5.4     6.1     7.0    12.6
   22          SE   764.    770.    780.0   790.3   797.1   800.0   801.2   810.0
   23          SS  797.1
   24          SD  801.2     2.5     1.5
   25          SL     0.    57.0   132.0   235.0   257.0   325.0
   26          SV  801.2   801.5   801.8   802.0   802.2   803.2
   27          K      99
```

Input Data
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B4

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**********.  **********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
LAST MODIFICATION  01 APR 80
**********
RUN DATE= 81/05/18.
    TIME= 17.06.00.

P.J.'S BASS LAKE DAM NO. 31189, FRANCOIS COUNTY , MISSOURI
WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 80C2247100.
PROBABLE MAXIMUM FLOOD (PMF) ANALYSIS

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

                    MULTI-PLAN ANALYSES TO BE PERFORMED
                        NPLAN= 1 NRTIO= 2 LRTIO=10
                RTIOS=     .50    1.00

**********      **********      **********      **********      **********
                            SUB-AREA RUNOFF COMPUTATION

          P.J.'S BASS LAKE INFLOW COMPUTATIONS, PROBABLE MAXIMUM FLOOD

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

                                HYDROGRAPH DATA
          IHYDG    IUNG    TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1       2      .14    0.00     .14    1.00   0.000       0       0       0

                                PRECIP DATA
              SPFE     PMS      R6     R12     R24     R48     R72     R96
              0.00   24.00  102.00  120.00  130.00    0.00    0.00    0.00

                                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  -88.00    0.00     .00

     CURVE NO =  -88.00  WETNESS =   -1.00  EFFECT CN =   88.00

                            UNIT HYDROGRAPH DATA
                        TC=  0.00    LAG=   .40

                                RECESSION DATA
                    STRTQ=   -1.00    QRCSN=   -.05    RTIOR= 5.00

 UNIT HYDROGRAPH 26 END-OF-PERIOD ORDINATES, TC=    0.00 HOURS, LAG=    .40  VOL= 1.00
    14.     43.     91.    135.    152.    149.    129.    102.     71.     92.
    39.     29.     21.     15.     11.      8.      6.      4.      3.      2.
     2.      1.      1.      1.      0.      0.

                            END-OF-PERIOD FLOW
```

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B5

	14.	43.	91.	135.	152.	149.	129.	102.	71.	52.				
	39.	29.	21.	15.	11.	8.	6.	4.	3.	2.				
	2.	1.	1.	1.	0.	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
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.22	.21	.01	76.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.22	.21	.01	78.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.22	.21	.01	80.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.22	.21	.01	82.
1.01	.25	5	.01	.00	.01	1.	1.01	12.25	149	.22	.21	.01	84.
1.01	.30	6	.01	.00	.01	1.	1.01	12.30	150	.22	.22	.01	86.
1.01	.35	7	.01	.00	.01	1.	1.01	12.35	151	.22	.22	.01	88.
1.01	.40	8	.01	.00	.01	1.	1.01	12.40	152	.22	.22	.01	90.
1.01	.45	9	.01	.00	.01	1.	1.01	12.45	153	.22	.22	.01	92.
1.01	.50	10	.01	.00	.01	1.	1.01	12.50	154	.22	.22	.00	94.
1.01	.55	11	.01	.00	.01	1.	1.01	12.55	155	.22	.22	.00	96.
1.01	1.00	12	.01	.00	.01	1.	1.01	13.00	156	.22	.22	.00	98.
1.01	1.05	13	.01	.00	.01	1.	1.01	13.05	157	.27	.26	.00	100.
1.01	1.10	14	.01	.00	.01	1.	1.01	13.10	158	.27	.26	.00	102.
1.01	1.15	15	.01	.00	.01	1.	1.01	13.15	159	.27	.26	.00	104.
1.01	1.20	16	.01	.00	.01	1.	1.01	13.20	160	.27	.26	.00	106.
1.01	1.25	17	.01	.00	.01	1.	1.01	13.25	161	.27	.26	.00	108.
1.01	1.30	18	.01	.00	.01	1.	1.01	13.30	162	.27	.26	.00	110.
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.27	.26	.00	112.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.27	.26	.00	114.
1.01	1.45	21	.01	.00	.01	1.	1.01	13.45	165	.27	.26	.00	116.
1.01	1.50	22	.01	.00	.01	1.	1.01	13.50	166	.27	.26	.00	118.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.27	.26	.00	120.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.27	.26	.00	122.
1.01	2.05	25	.01	.00	.01	2.	1.01	14.05	169	.33	.33	.00	124.
1.01	2.10	26	.01	.00	.01	2.	1.01	14.10	170	.33	.33	.00	126.
1.01	2.15	27	.01	.00	.01	2.	1.01	14.15	171	.33	.33	.00	128.
1.01	2.20	28	.01	.00	.01	2.	1.01	14.20	172	.33	.33	.00	130.
1.01	2.25	29	.01	.00	.01	2.	1.01	14.25	173	.33	.33	.00	132.
1.01	2.30	30	.01	.00	.01	3.	1.01	14.30	174	.33	.33	.00	134.
1.01	2.35	31	.01	.00	.01	3.	1.01	14.35	175	.33	.33	.00	136.
1.01	2.40	32	.01	.00	.01	3.	1.01	14.40	176	.33	.33	.00	138.
1.01	2.45	33	.01	.00	.01	3.	1.01	14.45	177	.33	.33	.00	140.
1.01	2.50	34	.01	.00	.01	4.	1.01	14.50	178	.33	.33	.00	142.
1.01	2.55	35	.01	.00	.01	4.	1.01	14.55	179	.33	.33	.00	144.
1.01	3.00	36	.01	.00	.01	4.	1.01	15.00	180	.33	.33	.00	146.
1.01	3.05	37	.01	.01	.01	4.	1.01	15.05	181	.20	.20	.00	147.
1.01	3.10	38	.01	.01	.01	4.	1.01	15.10	182	.40	.40	.00	149.
1.01	3.15	39	.01	.01	.01	5.	1.01	15.15	183	.40	.40	.00	151.
1.01	3.20	40	.01	.01	.01	5.	1.01	15.20	184	.60	.60	.00	153.
1.01	3.25	41	.01	.01	.01	5.	1.01	15.25	185	.70	.70	.00	154.
1.01	3.30	42	.01	.01	.01	5.	1.01	15.30	186	1.71	1.71	.01	418.
1.01	3.35	43	.01	.01	.01	5.	1.01	15.35	187	2.82	2.81	.01	928.
1.01	3.40	44	.01	.01	.01	6.	1.01	15.40	188	1.11	1.11	.00	655.
1.01	3.45	45	.01	.01	.01	6.	1.01	15.45	189	.71	.70	.00	512.
1.01	3.50	46	.01	.01	.01	6.	1.01	15.50	190	.60	.60	.00	1099.
1.01	3.55	47	.01	.01	.01	6.	1.01	15.55	191	.40	.40	.00	1078.
1.01	4.00	48	.01	.01	.01	6.	1.01	16.00	192	.40	.40	.00	1062.
1.01	4.05	49	.01	.01	.01	6.	1.01	16.05	193	.31	.31	.00	1099.
1.01	4.10	50	.01	.01	.01	7.	1.01	16.10	194	.31	.31	.00	993.
1.01	4.15	51	.01	.01	.01	7.	1.01	16.15	195	.31	.31	.00	919.
1.01	4.20	52	.01	.01	.01	7.	1.01	16.20	196	.31	.31	.00	866.
1.01	4.25	53	.01	.01	.01	7.	1.01	16.25	197	.31	.31	.00	827.
1.01	4.30	54	.01	.01	.01	7.	1.01	16.30	198	.31	.31	.00	797.
1.01	4.35	55	.01	.01	.01	7.	1.01	16.35	199	.31	.31	.00	773.
1.01	4.40	56	.01	.01	.01	7.	1.01	16.40	200	.31	.31	.00	753.
1.01	4.45	57	.01	.01	.01	8.	1.01	16.45	201	.31	.31	.00	736.

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B6

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B7

1.01	8.05	97	.06	.06	.01	59.	1.01	20.05	241	.02	.02	.00	23.
1.01	8.10	98	.06	.06	.01	60.	1.01	20.10	242	.02	.02	.00	23.
1.01	8.15	99	.06	.06	.01	60.	1.01	20.15	243	.02	.02	.00	23.
1.01	8.20	100	.06	.06	.01	61.	1.01	20.20	244	.02	.02	.00	23.
1.01	8.25	101	.06	.06	.01	61.	1.01	20.25	245	.02	.02	.00	23.
1.01	8.30	102	.06	.06	.01	61.	1.01	20.30	246	.02	.02	.00	23.
1.01	8.35	103	.06	.06	.01	62.	1.01	20.35	247	.02	.02	.00	23.
1.01	8.40	104	.06	.06	.01	62.	1.01	20.40	248	.02	.02	.00	23.
1.01	8.45	105	.06	.06	.01	62.	1.01	20.45	249	.02	.02	.00	23.
1.01	8.50	106	.06	.06	.01	63.	1.01	20.50	250	.02	.02	.00	23.
1.01	8.55	107	.06	.06	.01	63.	1.01	20.55	251	.02	.02	.00	23.
1.01	9.00	108	.06	.06	.01	63.	1.01	21.00	252	.02	.02	.00	23.
1.01	9.05	109	.06	.06	.01	63.	1.01	21.05	253	.02	.02	.00	23.
1.01	9.10	110	.06	.06	.01	63.	1.01	21.10	254	.02	.02	.00	23.
1.01	9.15	111	.06	.06	.01	64.	1.01	21.15	255	.02	.02	.00	23.
1.01	9.20	112	.06	.06	.01	64.	1.01	21.20	256	.02	.02	.00	23.
1.01	9.25	113	.06	.06	.00	64.	1.01	21.25	257	.02	.02	.00	23.
1.01	9.30	114	.06	.06	.00	64.	1.01	21.30	258	.02	.02	.00	23.
1.01	9.35	115	.06	.06	.00	64.	1.01	21.35	259	.02	.02	.00	23.
1.01	9.40	116	.06	.06	.00	65.	1.01	21.40	260	.02	.02	.00	23.
1.01	9.45	117	.06	.06	.00	65.	1.01	21.45	261	.02	.02	.00	23.
1.01	9.50	118	.06	.06	.00	65.	1.01	21.50	262	.02	.02	.00	23.
1.01	9.55	119	.06	.06	.00	65.	1.01	21.55	263	.02	.02	.00	23.
1.01	10.00	120	.06	.06	.00	65.	1.01	22.00	264	.02	.02	.00	23.
1.01	10.05	121	.06	.06	.00	65.	1.01	22.05	265	.02	.02	.00	23.
1.01	10.10	122	.06	.06	.00	66.	1.01	22.10	266	.02	.02	.00	23.
1.01	10.15	123	.06	.06	.00	66.	1.01	22.15	267	.02	.02	.00	23.
1.01	10.20	124	.06	.06	.00	66.	1.01	22.20	268	.02	.02	.00	23.
1.01	10.25	125	.06	.06	.00	66.	1.01	22.25	269	.02	.02	.00	23.
1.01	10.30	126	.06	.06	.00	66.	1.01	22.30	270	.02	.02	.00	23.
1.01	10.35	127	.06	.06	.00	66.	1.01	22.35	271	.02	.02	.00	23.
1.01	10.40	128	.06	.06	.00	66.	1.01	22.40	272	.02	.02	.00	23.
1.01	10.45	129	.06	.06	.00	66.	1.01	22.45	273	.02	.02	.00	23.
1.01	10.50	130	.06	.06	.00	66.	1.01	22.50	274	.02	.02	.00	23.
1.01	10.55	131	.06	.06	.00	67.	1.01	22.55	275	.02	.02	.00	23.
1.01	11.00	132	.06	.06	.00	67.	1.01	23.00	276	.02	.02	.00	23.
1.01	11.05	133	.06	.06	.00	67.	1.01	23.05	277	.02	.02	.00	23.
1.01	11.10	134	.06	.06	.00	67.	1.01	23.10	278	.02	.02	.00	23.
1.01	11.15	135	.06	.06	.00	67.	1.01	23.15	279	.02	.02	.00	23.
1.01	11.20	136	.06	.06	.00	67.	1.01	23.20	280	.02	.02	.00	23.
1.01	11.25	137	.06	.06	.00	67.	1.01	23.25	281	.02	.02	.00	23.
1.01	11.30	138	.06	.06	.00	67.	1.01	23.30	282	.02	.02	.00	23.
1.01	11.35	139	.06	.06	.00	67.	1.01	23.35	283	.02	.02	.00	23.
1.01	11.40	140	.06	.06	.00	67.	1.01	23.40	284	.02	.02	.00	23.
1.01	11.45	141	.06	.06	.00	67.	1.01	23.45	285	.02	.02	.00	23.
1.01	11.50	142	.06	.06	.00	67.	1.01	23.50	286	.02	.02	.00	23.
1.01	11.55	143	.06	.06	.00	67.	1.01	23.55	287	.02	.02	.00	23.
1.01	12.00	144	.06	.06	.00	67.	1.02	0.00	288	.02	.02	.00	23.
									SUM	33.60	32.34	1.44	34852.
										(859.1(	822.1(	37.1(	988.039

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1171.	389.	121.	121.	34901.
CMS	33.	11.	3.	3.	988.
INCHES		25.83	32.21	32.21	32.21
MM		656.14	818.10	818.10	818.10
AC-FT		193.	240.	240.	240.
THOUS CU M		238.	296.	296.	296.

HYDROGRAPH AT STAINFLOW FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.

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

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2
				.50	1.00
HYDROGRAPH AT	INFLOW	.14	1	585.	1171.
		(.36)		(16.58)	(33.15)
ROUTED TO	DAM	.14	1	557.	1151.
		(.36)		(15.79)	(32.60)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	797.10	797.10	801.20
STORAGE	83.	83.	108.
OUTFLOW	0.	0.	82.

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
.50	802.22	1.02	115.	557.	4.33	16.08	0.00
1.00	802.68	1.48	119.	1151.	6.25	16.00	0.00

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B9

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

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6
				.20	.21	.22	.23	.24	.25
HYDROGRAPH AT	INFLOW	.14	1	234.	246.	258.	269.	281.	293.
		(.361)		(6.631)	(6.961)	(7.291)	(7.631)	(7.961)	(8.291)
ROUTED TO	DAM	.14	1	79.	88.	101.	116.	132.	150.
		(.361)		(2.241)	(2.501)	(2.861)	(3.271)	(3.741)	(4.251)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	797.10	797.10	801.20
STORAGE	83.	83.	108.
OUTFLOW	0.	0.	82.

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	801.13	0.00	107.	79.	0.00	16.83	0.00
.21	801.26	.06	108.	88.	.83	16.75	0.00
.22	801.36	.16	109.	101.	1.33	16.67	0.00
.23	801.45	.25	110.	116.	1.67	16.58	0.00
.24	801.53	.33	110.	132.	1.83	16.50	0.00
.25	801.60	.40	111.	150.	2.00	16.42	0.00

Output Summary
Various PMF Events
P.J.'s Bass Lake Dam
MO 31189
B10

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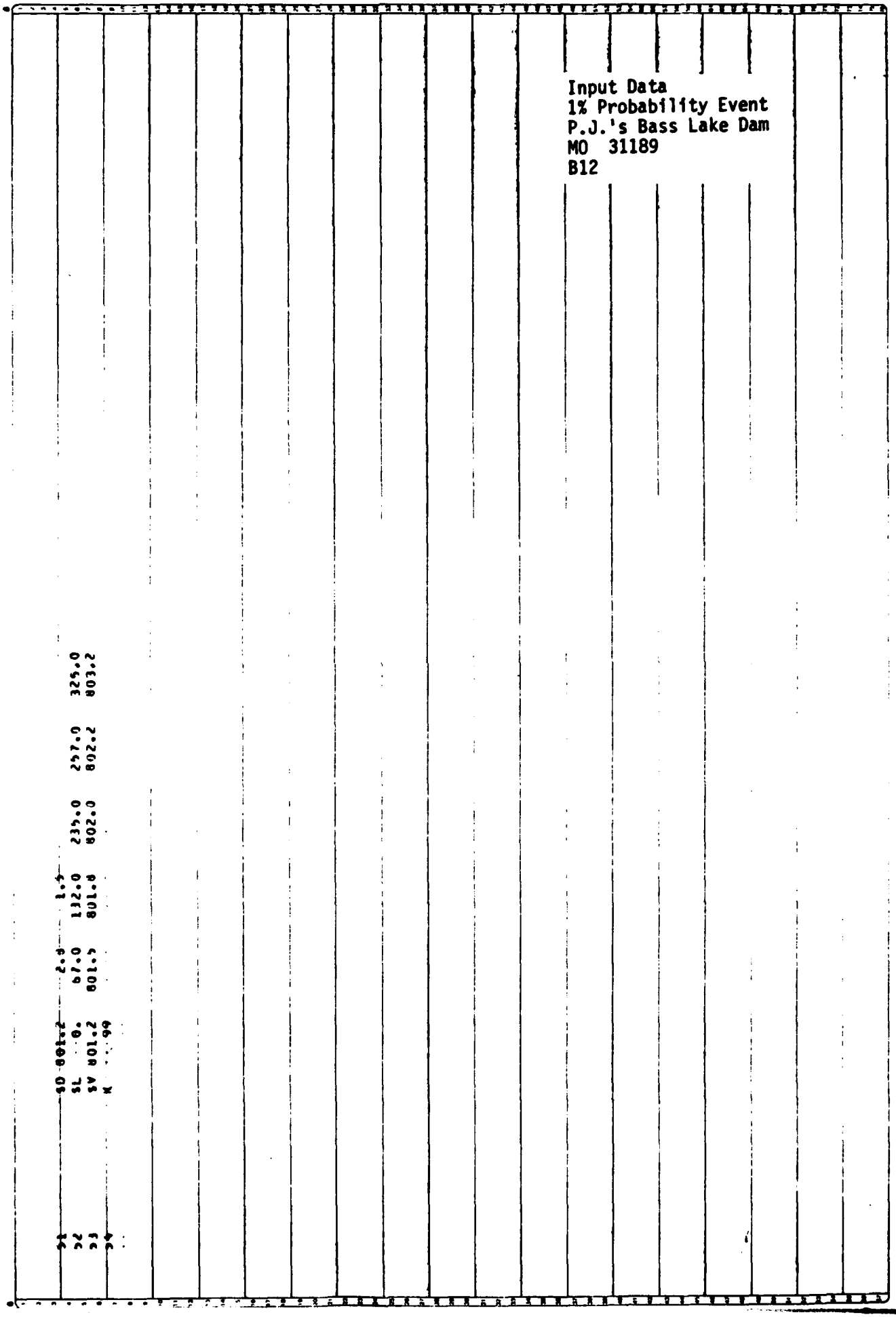
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION  JULY 1978
LAST MODIFICATION  01 APR 90
**********
     1     A1   P.J.'S BASS LAKE DAM NO. 31189, FRANCOIS COUNTY , MISSOURI
     2     A2       WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 80C2247100.
     3     A3       PROBABILISTIC FLOOD 100-YEAR
     4     B     298       3       5       0       0       0       0       0       0       0
     5     B1      3
     6     K       0  INFLOW                                                  1
     7     K1   RAIN STATION SULLIVAN, FREQ.=  1.0, INTERVAL= 5.0 MIN., DURATION= 24 HOURS
     8     M       0       2     .14                       1.0
     9     O     288   7.224                    DA =    .50
    10     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    11     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    12     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    13     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    14     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    15     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    16     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    17     O1  .007    .007    .014    .014    .014    .014    .014    .014    .014    .014
    18     O1  .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
    19     O1  .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
    20     O1  .014    .014    .014    .014    .014    .014    .014    .014    .022    .022
    21     O1  .022    .022    .022    .022    .022    .022    .022    .022    .022    .022
    22     O1  .022    .022    .022    .022    .022    .022    .031    .031    .031    .031
    23     O1  .031    .031    .061    .061    .061    .061    .061    .061    .132    .132
    24     O1  .132    .252    .252    .552    .826    .384    .252    .132    .132    .132
    25     O1  .061    .061    .061    .061    .061    .061    .031    .031    .031    .031
    26     O1  .031    .031    .022    .022    .022    .022    .022    .022    .022    .022
    27     O1  .022    .022    .022    .022    .022    .022    .022    .022    .022    .022
    28     O1  .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
    29     O1  .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
    30     O1  .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
    31     O1  .014    .014    .014    .014    .014    .014    .007    .007    .007    .007
    32     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    33     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    34     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    35     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    36     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    37     O1  .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
    38     O1  .007    .007    .007    .007    .007    .007    .007    .007
    39     T                                                   -1     -75             .04
    40     M2          .4
    41     K     -1    .05       5
    42     K      1     BAM                                            1
    43     K1       FLOOD ROUTING AND OVERTOPPING ANALYSIS
    44     Y                                  1
    45     Y1     1                                                -797.1     -1
    46     Y4 797.1   798.0   799.0   800.0   800.7   801.2   801.7   802.5   803.7
    47     Y5    0.     9.9    29.9    43.3    60.0    82.0   134.0   302.0   723.0
    48     SA    0.     1.     2.3     4.1     5.4     6.1     7.0    12.6
    49     SE  764.    770.    780.0   790.3   797.1   800.0   801.2   810.0
    50     SS 797.1
```

Input Data
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B11


Input Data
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B12
SD 801.2 2.0 1.5
SL 0. 67.0 132.0 235.0 257.0 325.0
SV 801.2 801.5 801.8 802.0 802.2 803.2
K .99

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

RUN DATE? 81/05/18.
    TIME? 17.05.59.

P.J.'S BASS LAKE DAM NO. 31189, FRANCOIS COUNTY , MISSOURI
HOBDNARD-CLYDE CONSULTANTS, HOUSTON JOB 80C2241100.
PROBABILISTIC FLOOD 100-YEAR

                    JOB SPECIFICATION
   NO     NHR    NMIN    IDAY     IHR    ININ   METRC    IPLT    IPRT   NSTAN
  288       0       5       0       0       0       0       0       0       0
                JOPER     NMT   LROPT   TRACE
                    3       0       0       0

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

                SUB-AREA RUNOFF COMPUTATION

RAIN STATION SULLIVAN, FREQ.= 1.0, INTERVAL= 5.0 MIN., DURATION= 24 HOURS

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

                    HYDROGRAPH DATA
   IHYDG    IUNG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
       0       2     .14    0.00     .14    1.00   0.000       0       0       0

                    PRECIP DATA
                      NP   STORM     DAJ     DAK
                     288    7.22    0.00    0.00
                    PRECIP PATTERN
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .02     .02
   .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
   .02     .02     .02     .02     .02     .02     .03     .03     .03     .03
   .03     .03     .06     .06     .06     .06     .06     .06     .13     .13
   .13     .25     .25     .55     .83     .38     .25     .13     .13     .13
   .06     .06     .06     .06     .06     .06     .03     .03     .03     .03
   .03     .03     .02     .02     .02     .02     .02     .02     .02     .02
   .02     .02     .02     .02     .02     .02     .02     .02     .02     .02
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01
   .01     .01     .01     .01     .01     .01     .01     .01     .01     .01

Output Summary
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B13
```

.03	.03	.02	.02	[illegible]	[illegible]	[illegible]			
.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01		

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	-75.00	0.00	.00

CURVE NO = -75.00 WETNESS = -1.00 EFFECT CN = 75.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .40

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

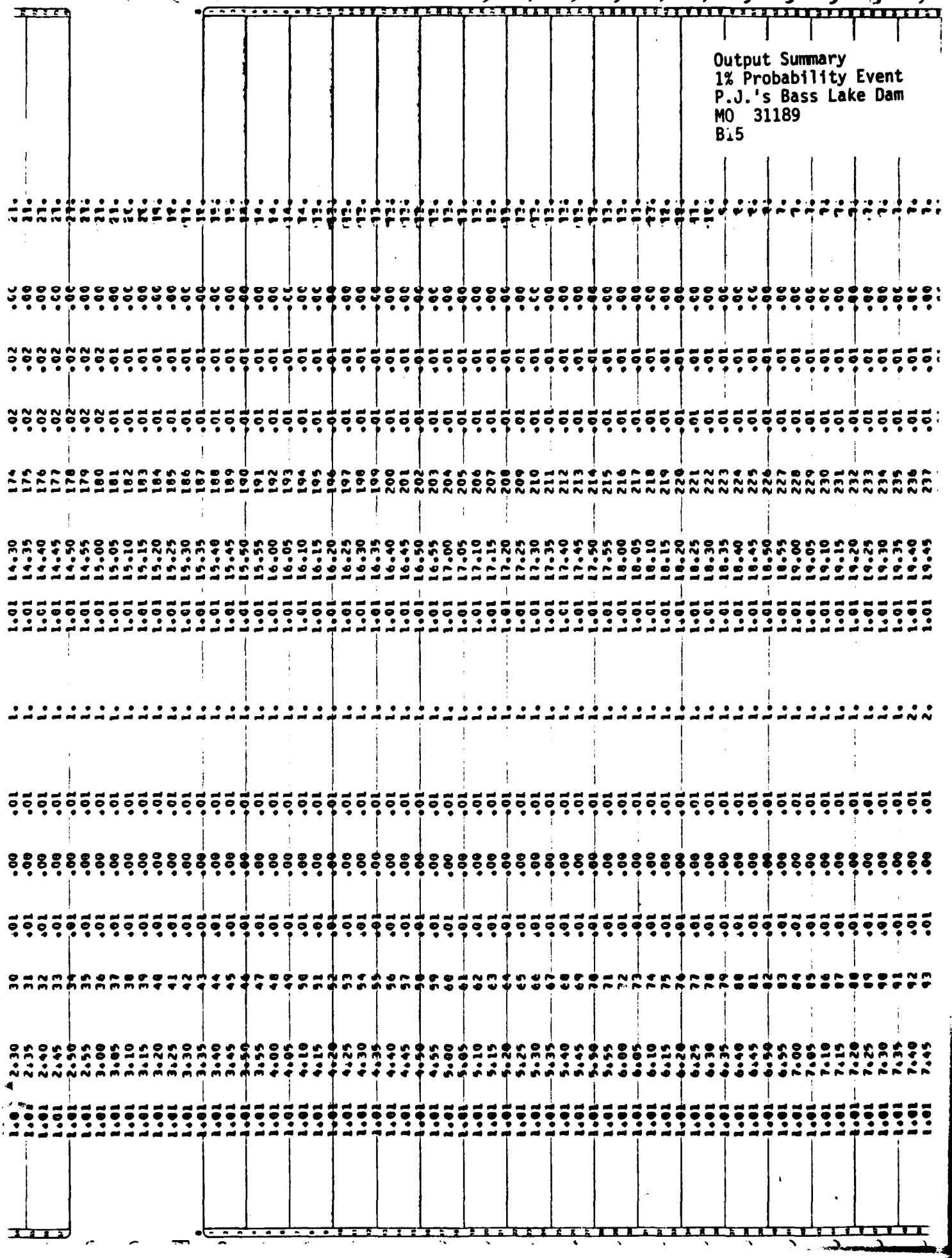
UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .40 VOL= 1.00

14.	43.	91.	135.	152.	149.	129.	102.	71.	52.
39.	29.	21.	15.	11.	8.	6.	4.	3.	2.
2.	1.	1.	1.	0.	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
1.01	.05	1	.01	.00	.01	0.	1.01	12.05	145	.83	.62	.20	[illegible]
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.38	.31	.08	[illegible]
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.25	.21	.05	[illegible]
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.13	.11	.02	[illegible]
1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.13	.11	.02	[illegible]
1.01	.30	6	.01	.00	.01	0.	1.01	12.30	150	.13	.11	.02	232.
1.01	.35	7	.01	.00	.01	0.	1.01	12.35	151	.06	.05	.01	[illegible]
1.01	.40	8	.01	.00	.01	0.	1.01	12.40	152	.06	.05	.01	[illegible]
1.01	.45	9	.01	.00	.01	1.	1.01	12.45	153	.06	.05	.01	192.
1.01	.50	10	.01	.00	.01	1.	1.01	12.50	154	.06	.05	.01	[illegible]
1.01	.55	11	.01	.00	.01	1.	1.01	12.55	155	.06	.05	.01	[illegible]
1.01	1.00	12	.01	.00	.01	1.	1.01	13.00	156	.06	.05	.01	118.
1.01	1.05	13	.01	.00	.01	1.	1.01	13.05	157	.03	.03	.00	[illegible]
1.01	1.10	14	.01	.00	.01	1.	1.01	13.10	158	.03	.03	.00	[illegible]
1.01	1.15	15	.01	.00	.01	1.	1.01	13.15	159	.03	.03	.00	77.
1.01	1.20	16	.01	.00	.01	1.	1.01	13.20	160	.03	.03	.00	[illegible]
1.01	1.25	17	.01	.00	.01	1.	1.01	13.25	161	.03	.03	.00	[illegible]
1.01	1.30	18	.01	.00	.01	1.	1.01	13.30	162	.03	.03	.00	[illegible]
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.02	.02	.00	[illegible]
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.02	.02	.00	40.
1.01	1.45	21	.01	.00	.01	1.	1.01	13.45	165	.02	.02	.00	36.
1.01	1.50	22	.01	.00	.01	1.	1.01	13.50	166	.02	.02	.00	[illegible]
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.02	.02	.00	[illegible]
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.02	.02	.00	[illegible]
1.01	2.05	25	.01	.00	.01	1.	1.01	14.05	169	.02	.02	.00	28.
1.01	2.10	26	.01	.00	.01	1.	1.01	14.10	170	.02	.02	.00	24.
1.01	2.15	27	.01	.00	.01	1.	1.01	14.15	171	.02	.02	.00	23.
1.01	2.20	28	.01	.00	.01	1.	1.01	14.20	172	.02	.02	.00	[illegible]
1.01	2.25	29	.01	.00	.01	1.	1.01	14.25	173	.02	.02	.00	22.
1.01	2.30	30	.01	.00	.01	1.	1.01	14.30	174	.02	.02	.00	21.
						1.	1.01	14.35	175	.02	.02	.00	21.

Output Summary
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B14


Output Summary
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
Bi5

1.01	.50	94	.01	.00	.01	2.	1.01	19.50	238	.01	.01	.00	0.
1.01	7.55	95	.01	.00	.01	2.	1.01	19.55	239	.01	.01	.00	0.
1.01	8.00	96	.01	.00	.01	2.	1.01	20.00	240	.01	.01	.00	0.
1.01	8.05	97	.01	.00	.01	2.	1.01	20.05	241	.01	.01	.00	0.
1.01	8.10	98	.01	.00	.01	2.	1.01	20.10	242	.01	.01	.00	0.
1.01	8.15	99	.01	.00	.01	2.	1.01	20.15	243	.01	.01	.00	0.
1.01	8.20	100	.01	.00	.01	2.	1.01	20.20	244	.01	.01	.00	0.
1.01	8.25	101	.01	.00	.01	2.	1.01	20.25	245	.01	.01	.00	0.
1.01	8.30	102	.01	.00	.01	3.	1.01	20.30	246	.01	.01	.00	0.
1.01	8.35	103	.01	.00	.01	3.	1.01	20.35	247	.01	.01	.00	0.
1.01	8.40	104	.01	.00	.01	3.	1.01	20.40	248	.01	.01	.00	0.
1.01	8.45	105	.01	.00	.01	3.	1.01	20.45	249	.01	.01	.00	0.
1.01	8.50	106	.01	.00	.01	3.	1.01	20.50	250	.01	.01	.00	0.
1.01	8.55	107	.01	.00	.01	3.	1.01	20.55	251	.01	.01	.00	0.
1.01	9.00	108	.01	.00	.01	3.	1.01	21.00	252	.01	.01	.00	0.
1.01	9.05	109	.02	.01	.02	3.	1.01	21.05	253	.01	.01	.00	0.
1.01	9.10	110	.02	.01	.02	3.	1.01	21.10	254	.01	.01	.00	0.
1.01	9.15	111	.02	.01	.02	4.	1.01	21.15	255	.01	.01	.00	0.
1.01	9.20	112	.02	.01	.02	4.	1.01	21.20	256	.01	.01	.00	0.
1.01	9.25	113	.02	.01	.02	4.	1.01	21.25	257	.01	.01	.00	0.
1.01	9.30	114	.02	.01	.02	5.	1.01	21.30	258	.01	.01	.00	0.
1.01	9.35	115	.02	.01	.02	5.	1.01	21.35	259	.01	.01	.00	0.
1.01	9.40	116	.02	.01	.02	6.	1.01	21.40	260	.01	.01	.00	0.
1.01	9.45	117	.02	.01	.02	6.	1.01	21.45	261	.01	.01	.00	0.
1.01	9.50	118	.02	.01	.01	6.	1.01	21.50	262	.01	.01	.00	0.
1.01	9.55	119	.02	.01	.01	7.	1.01	21.55	263	.01	.01	.00	0.
1.01	10.00	120	.02	.01	.01	7.	1.01	22.00	264	.01	.01	.00	0.
1.01	10.05	121	.02	.01	.01	7.	1.01	22.05	265	.01	.01	.00	0.
1.01	10.10	122	.02	.01	.01	7.	1.01	22.10	266	.01	.01	.00	0.
1.01	10.15	123	.02	.01	.01	7.	1.01	22.15	267	.01	.01	.00	0.
1.01	10.20	124	.02	.01	.01	8.	1.01	22.20	268	.01	.01	.00	0.
1.01	10.25	125	.02	.01	.01	8.	1.01	22.25	269	.01	.01	.00	0.
1.01	10.30	126	.02	.01	.01	8.	1.01	22.30	270	.01	.01	.00	0.
1.01	10.35	127	.03	.01	.02	8.	1.01	22.35	271	.01	.01	.00	0.
1.01	10.40	128	.03	.01	.02	9.	1.01	22.40	272	.01	.01	.00	0.
1.01	10.45	129	.03	.01	.02	9.	1.01	22.45	273	.01	.01	.00	0.
1.01	10.50	130	.03	.01	.02	10.	1.01	22.50	274	.01	.01	.00	0.
1.01	10.55	131	.03	.01	.02	11.	1.01	22.55	275	.01	.01	.00	0.
1.01	11.00	132	.03	.01	.02	11.	1.01	23.00	276	.01	.01	.00	0.
1.01	11.05	133	.06	.03	.03	12.	1.01	23.05	277	.01	.01	.00	0.
1.01	11.10	134	.06	.03	.03	13.	1.01	23.10	278	.01	.01	.00	0.
1.01	11.15	135	.06	.03	.03	15.	1.01	23.15	279	.01	.01	.00	0.
1.01	11.20	136	.06	.03	.03	17.	1.01	23.20	280	.01	.01	.00	0.
1.01	11.25	137	.06	.03	.03	20.	1.01	23.25	281	.01	.01	.00	0.
1.01	11.30	138	.06	.03	.03	23.	1.01	23.30	282	.01	.01	.00	0.
1.01	11.35	139	.13	.07	.06	26.	1.01	23.35	283	.01	.01	.00	0.
1.01	11.40	140	.13	.07	.06	30.	1.01	23.40	284	.01	.01	.00	0.
1.01	11.45	141	.13	.08	.06	35.	1.01	23.45	285	.01	.01	.00	0.
1.01	11.50	142	.25	.19	.10	43.	1.01	23.50	286	.01	.01	.00	0.
1.01	11.55	143	.25	.16	.09	54.	1.01	23.55	287	.01	.01	.00	0.
1.01	12.00	144	.55	.38	.17	72.	1.02	0.00	288	.01	.01	.00	0.
									SUM	7.22	4.59	2.65	4992.
										(183.99	116.99	67.99	140.23)

Output Summary
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B16

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	272.	55.	17.	17.	4918.
CMS	8.	2.	0.	0.	139.
INCHES		3.67	4.54	4.54	4.54
MM		93.14	115.28	115.28	115.28
AC-FT		27.	34.	34.	34.
THOUS CU M		34.	42.	42.	42.

THOUS CU M	22.	33.	33.	33.

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RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	INFLOW	272.	55.	17.	17.	.14
	(	7.59)(	1.56)(	.48)(	.48)(	.36)
ROUTED TO	DAM	50.	37.	14.	14.	.14
	(	1.43)(	1.04)(	.38)(	.38)(	.36)

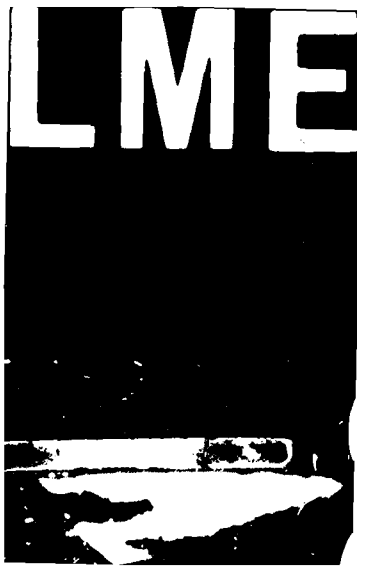
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	797.10	797.10	801.20
STORAGE	83.	83.	109.
OUTFLOW	0.	0.	92.

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
0.00	800.30	0.00	102.	50.	0.00	13.50	0.00

Output Summary
1% Probability Event
P.J.'s Bass Lake Dam
MO 31189
B17


LME