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NATIONAL DAM SAFETY PROGRAM. GLEN ROSE LAKE DAM (MO 10700), MIS--ETC(U)
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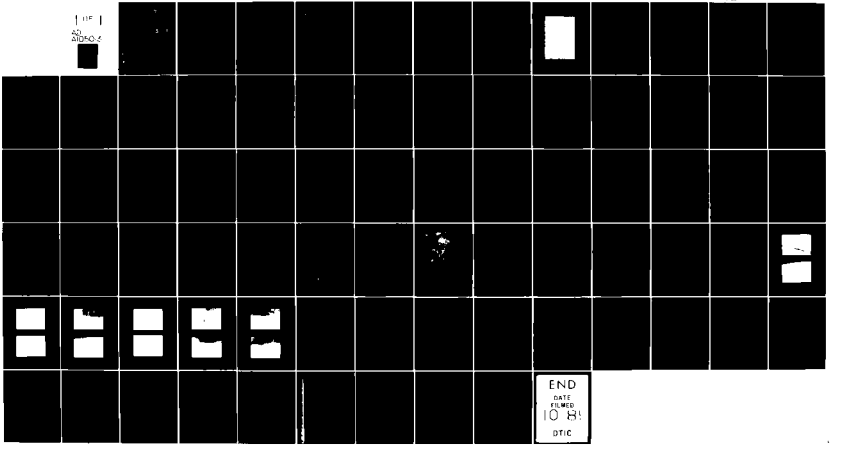

LEVEL II

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MISSISSIPPI·KASKASKIA·ST. LOUIS BASIN

GLEN ROSE LAKE DAM
JEFFERSON COUNTY, MISSOURI
MO. 10700

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Glen Rose Lake Dam (MO 10700),
Mississippi - Kaskaskia - St. Louis Basin,
Jefferson County, Missouri. Phase I
Inspection Report.

(9) Final rept.,

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

St. Louis District

(12) 76

(11) May 81

(15) DACW43-80-C-0094

(10) Walter G. Shifrin

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

FOR: STATE OF MISSOURI

MAY 1981

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Glen Rose Lake Dam (MO 10700) Jefferson County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report
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7. AUTHOR(s) Consoer, Townsend and Associates, Ltd.	8. CONTRACT OR GRANT NUMBER(s) DACW43-80-C-0094
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 May 1981
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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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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Glen Rose Lake Dam (Mo. 10700) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Glen Rose Lake Dam (Mo. 10700).

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:

1) The spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

2) Overtopping of the dam could result in failure of the dam.

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

SUBMITTED BY: SIGNED
Chief, Engineering Division
11 JUN 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
12 JUN 1981
Date

GLEN ROSE LAKE DAM
JEFFERSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10700

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
PRC CONSOER TOWNSEND, INC.
ST. LOUIS, MISSOURI
AND
PRC ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

MAY 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Glen Rose Lake Dam,
Missouri Inventory No. 10700
State Located: Missouri
County Located: Jefferson
Stream: Unnamed tributary of Rock Creek
Date of Inspection: March 3, 1981

Assessment of General Condition

Glen Rose Lake Dam was inspected by the engineering firms of PRC Consoer Townsend, Inc. of St. Louis, Missouri, and PRC Engineering Consultants, Inc. of Englewood, Colorado, (A Joint Venture) in accordance with the U. S. Army Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams" and additional guidelines furnished by the St. Louis District of the Corps of Engineers. Based upon the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. Located within the estimated damage zone of two miles downstream of the dam are eight dwellings, one commercial building, one bridge, and a rodeo ring, which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Glen Rose Lake Dam is in the small size classification since it is 30.2 feet high and has a maximum reservior impoundment of 61 acre-feet.

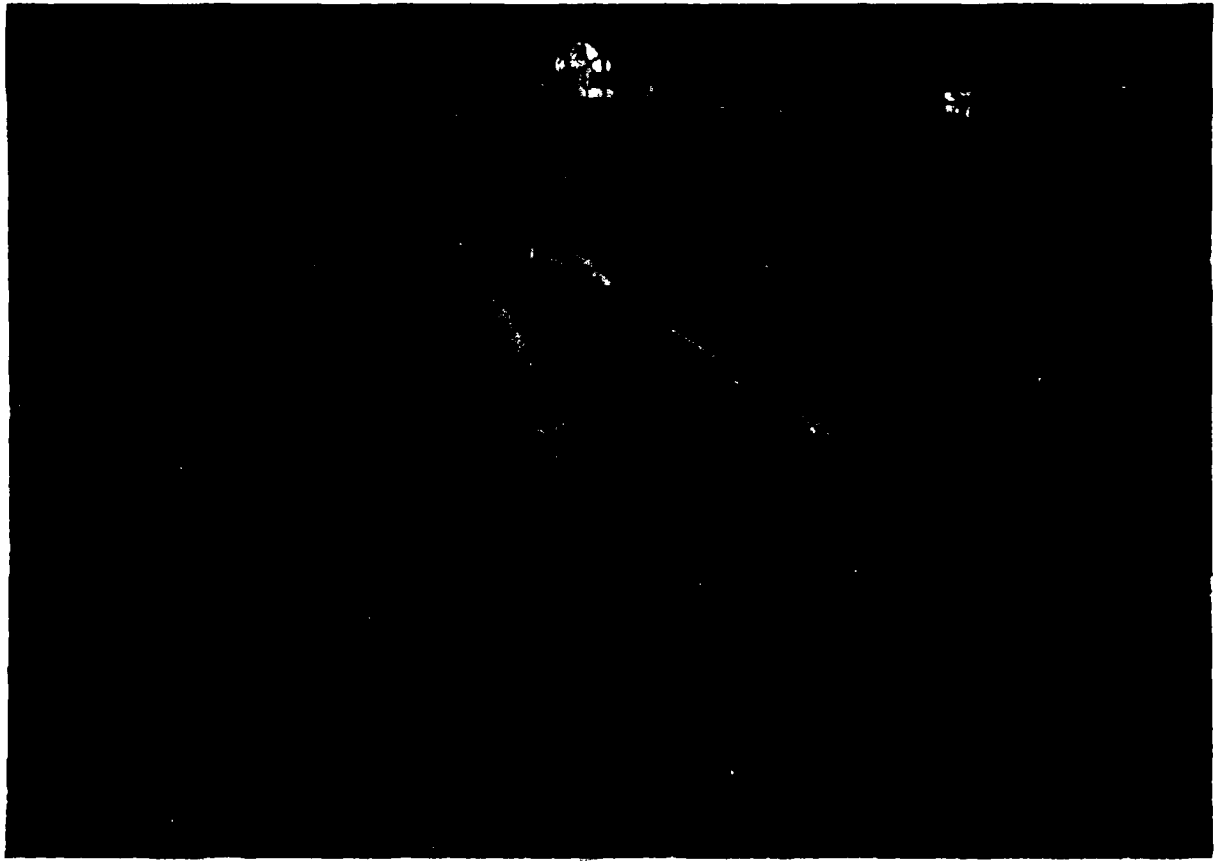
The inspection and evaluation of the consultant's inspection team indicate that the spillway of Glen Rose Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and

hazard potential. Glen Rose Lake Dam being a small size dam with a high hazard potential is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping the dam. Considering the possibility of loss of life and the destruction of property downstream of the dam, the PMF is considered the appropriate spillway design flood for Glen Rose Lake Dam. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. It was determined that the reservoir/spillway system can accommodate approximately 35 percent of the Probable Maximum Flood without overtopping the dam. The evaluation also indicates that the reservoir/spillway system can accommodate the one-percent chance flood without overtopping the dam.

The overall condition of the dam and the spillway appears to be fair; however, several deficiencies were noted by the inspection team. The deficiencies included: an area of boggy ground observed on the downstream slope indicating possible seepage through the embankment; the erosion gullies observed in the spillway channel; the erosion of the upstream slope due to wave action and the lack of proper protection; the saplings and the large bushes growing on the downstream slope; the possibility of debris collection against the fish screen and foot bridge, which could increase the potential of spillway erosion and reduce spillway flows; potential problems associated with the livestock watering system; a need for periodical maintenance of the grass cover on the embankment and in the spillway channel and a lack of a maintenance schedule. There also exists a need for periodic inspection by a qualified engineer. The lack of seepage and stability analyses on record is another deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.



Overview of Glen Rose Lake Dam

NATIONAL DAM SAFETY PROGRAM

GLEN ROSE LAKE DAM, I.D. No. 10700

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

GLEN ROSE LAKE DAM, Missouri Inv. No. 10700

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Glen Rose Lake Dam was carried out under Contract DACW 43-80-C-0094 between the Department of the Army, St. Louis District, Corps of Engineers, and the engineering firms of PRC Consoer Townsend, Inc. of St. Louis, Missouri, and PRC Engineering Consultants, Inc. of Englewood, Colorado, (A Joint Venture).

b. Purpose of Inspection

The visual inspection of Glen Rose Lake Dam was made on March 3, 1981. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project, presents a summary of visual observations made during the field inspection, presents an assessment of hydrologic and hydraulic conditions at the site and of the structural adequacy

of the various project features, and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing and detailed analyses were not within the scope of this study. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that in this report reference to left or right abutments is viewed as looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to the southeast abutment or side, and right to the northwest abutment or side.

d. Evaluation Criteria

The inspection and evaluation of the dam is performed in accordance with the U.S. Army Corps of Engineers "Recommended Guidelines for Safety Inspection of Dams" and additional guidelines furnished by the St. Louis District office of the Corps of Engineers for Phase 1 Dam Inspection.

1.2 Description of the Project

a. Description of Dam and Appurtenances

The following description is based upon observations and measurements made during the visual inspection and conversations with Mrs. Rose Binning, the previous owner of the dam. No design or "as-built" drawings for the dam or appurtenant structures were available.

The dam is a homogeneous, rolled, earthfill structure, according to Mrs. Binning. The alignment of the dam is straight between earth abutments. A plan and elevation of the dam are shown on Plate 3 and Photos 1 through 3 show views of the dam. The top of

the dam has a length of 315 feet between the right abutment and the spillway, and an assumed minimum elevation of 605 feet above mean sea level (M.S.L.) at the spillway. From the spillway, the top of dam slopes upward to a point 115 feet to the left of the right abutment with a rise in elevation of 1.1 feet. For the next 100 feet of the dam to a point 15 feet to the left of the right abutment, the top of dam was surveyed to be level. For the last 15 feet of the dam, the top of dam rose another 1.3 feet in elevation. The embankment has a top width of 13 feet and a maximum structural height of 30.2 feet. The downstream slope was measured to be 1 vertical to 2 horizontal (1V to 2H). The upstream slope varied from 1V to 2.5H from the top of the dam to the normal water surface level to 1V to 3.5H from the normal water surface level to the water surface level on the day of the inspection.

The only spillway at this damsite is a grass lined channel cut into the left abutment. At the control section of the spillway, the channel has a trapezoidal shape with a 24-foot bottom width, a 40-foot top width and side slopes of 1V to 2H and 1V to 3H on the left and right sides, respectively, and is 3.2 feet deep. The crest elevation of the spillway is 601.8 feet above M.S.L. The bottom of the spillway channel is level for 30 feet immediately downstream of the control section. A two-foot high chicken wire screen crosses the spillway at the control section (see Photo 5). Mrs. Binning described this screen as a fish screen. A metal foot bridge crosses over the spillway about two feet above the level section (see Photo 5). The bridge is founded at both ends on the base of concrete steps, and in the center on a piece of native rock acting as a pier in the spillway channel. Downstream of the level section, the channel begins to curve towards the embankment. A training berm on the right side of the channel directs flow away from the embankment and towards the downstream channel (see Photos 6 and 8). Discharge from the spillway enters the original stream channel slightly downstream of the embankment.

No low level outlet or outlet works were provided for this dam; however, according to Mrs. Binning, a one-inch diameter pipe was provided through the embankment for use as a livestock watering system. The system is controled by a globe valve located on the downstream slope about one third of the way up the slope from the toe of the dam and approximately 100 feet from the right abutment. The valve is housed in a square clay pipe. According to Mrs. Binning, the system is operable, but has not been used for several years.

b. Location

Glen Rose Lake Dam is located in Jefferson County in the State of Missouri on an unnamed tributary of Rock Creek. The location of the dam on the 7.5 minute series of the U.S. Geological Survey maps is found in the northwest quadrant of Section 34 of Township 43 North, Range 5 East, of the Maxville, Missouri Quadrangle Sheet (see Plate 2).

c. Size Classification

The reservoir impoundment of Glen Rose Lake Dam is less than 1,000 acre-feet but more than 50 acre-feet, which would classify it as a "small" size dam. The maximum height of the dam is less than 40 feet and greater than 25 feet, which also classifies it as a "small" size dam. The size classification is determined by either the storage or height, whichever gives the larger size category. Therefore, the size classification is determined to fall within the "small" category, according to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineer.

d. Hazard Classification

The dam has been classified as having a "high" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. From a visual inspection of the downstream area, our findings concur with this classification. Located within the estimated damage zone, which extends approximately two miles downstream of the dam, are eight dwellings, one commercial building, one bridge, and a rodeo ring (see Photos 11 and 12).

e. Ownership

Glen Rose Lake Dam is privately owned by Mr. Richard N. Williams. The mailing address is: 4167 S. Lindbergh, St. Louis, Missouri, 63127. Mr. Williams recently purchased the dam and lake property from Mrs. Rose Binning.

f. Purpose of Dam

The dam was constructed to impound water for a commercial, recreational, fishing lake.

g. Design and Construction History

According to Mrs. Rose Binning, Glen Rose Lake Dam was built in 1962 by Mr. Glen Leonard of Hillsboro, Missouri. No formal engineering design was performed for this dam, therefore, no drawings or specifications were used to construct the dam.

h. Normal Operational Procedures

Normal operational procedure is to allow the reservoir to remain as full as possible. The water level is controlled by rainfall, runoff, evaporation, and the elevation of the spillway crest.

1.3 Pertinent Data

a. Drainage Area (square miles):. 0.15

b. Discharge at Damsite

Estimated experienced maximum flood (cfs): 50

Estimated ungated spillway capacity with reservoir at top of dam elevation (cfs): 465

c. Elevation (Feet above MSL)

Top of dam (minimum):.	605.0	(assumed)*
Spillway crest:	601.8	
Normal Pool:	601.8	
Maximum Experienced Pool:.	602.8	
Observed Pool:	597.5	

d. Reservoir

Length of pool with water surface at top of dam elevation (feet):.	800

e. Storage (Acre-Feet)

Top of dam (minimum):.	61
Spillway crest:.	46
Normal Pool:	46
Maximum Experienced Pool:.	51
Observed Pool:	33

f. Reservoir Surfaces (Acres)

Top of dam (minimum):.	5.0
Spillway crest:.	4.0
Normal Pool:	4.0
Maximum Experienced Pool:.	4.5
Observed Pool:	3.0

g. Dam

Type:	Rolled, Earthfill
Length:	315 feet
Structural Height:	30.2 feet
Hydraulic Height**:	30.2 feet
Top width:	13 feet
Side slopes:	
Downstream.	1V to 2H (measured)
Upstream.	Varied from 1V to 2.5H (from the top of dam to the normal water surface elevation) to 1V to 3.5H (below the normal water surface elevation to the elevation of the water surface on the day of the inspection)
Zoning:	N.A., Homogeneous
Impervious core:	N.A.
Cutoff:	A cutoff trench excavated to bedrock, according Mrs. Binning
Grout curtain:	None
Volume:	23,100 cu. yds. (Estimated)

h. Diversion and Regulating Tunnel. . . . . None

i. Spillway

Type:	Earthcut channel, uncontrolled
Location.	Left abutment
Length of crest:	24 feet
Crest Elevation (feet above MSL):	601.8

j. Regulating Outlets. . . None, however,a one-inch diameter livestock watering system was provided

Location.	Approximately 100 feet to the left of the right abutment
Length.	Unknown
Closure	Globe Valve, housed in a clay pipe
Maximum Capacity.	Unknown

* No exact elevation is known for the top of dam, therefore, an elevation was estimated from the Maxville, Missouri, U.S.G.S. Quadrangle sheet. This estimated elevation is referred to as assumed elevation. All other elevations were determined from the assumed top of dam elevation and field measurements.

** The hydraulic height of the dam is the vertical distance from the lowest point on the downstream toe to the top of dam or the maximum water surface, if below the top of dam.

SECTION 2: ENGINEERING DATA

2.1 Design

No design drawings, design calculations, or specifications were available for this dam.

2.2 Construction

No documented data concerning the construction of the dam was available for use in this report; however, information was obtained from Mrs. Binning about the construction of the dam. Mrs. Binning stated that the compaction of the embankment was achieved by the activity of the earthmoving equipment across the fill; no compaction control was employed. A cutoff trench was excavated to solid bedrock at the base of the dam.

2.3 Operation

No operational records are available for Glen Rose Lake Dam.

2.4 Evaluation

a. Availability

The availability of engineering data is poor and consists only of a general soils map of the State of Missouri published by the Soil Conservation Service, State Geological Maps and U.S.G.S. Quadrangle Sheets. No design drawings, design computations, construction data, or operation data are available.

b. Adequacy

The available engineering data was not sufficient for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation, and construction data, but is based primarily on visual inspection and past performance. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity

No valid engineering data pertaining to the design or construction of the dam and the spillway were available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Glen Rose Lake Dam was made on March 3, 1981. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Mark Haynes, P.E.	PRC Engineering Consultants, Inc.	Soils
Jerry Kenny	PRC Engineering Consultants, Inc.	Hydraulics and Hydrology
James Nettum, P.E.	PRC Engineering Consultants, Inc.	Civil-Structural and Mechanical
Razi Quraishi, R.P.G.	PRC Engineering Consultants, Inc.	Geology
John Lauth, P.E.	PRC Consoer Townsend, Inc.	Civil and Structural
Rose Binning	Previous Owner	
Richard Williams	New Owner	

Specific observations are discussed below.

b. Dam

The overall condition of the dam appears to be fair, however, some items of concern were observed and are described below.

The top of dam appears to be adequately protected against surface erosion by a well maintained grass cover (see Photo 2). Vehicular traffic across the dam is prevented by a series of gates on the right abutment and the terrain on the left abutment. No depressions or cracks indicating a settlement of the embankment were observed. The variation in elevation across the top of dam did not appear to be due to an instability of the embankment. No significant deviation in the horizontal alignment was apparent. According to Mrs. Binning, the dam has never been overtopped and no evidence indicating the contrary was observed.

The upstream slope is not adequately protected by riprap; however, a surficial layer of rock fragments up to three inches in diameter was observed on the slope below the normal water surface level (see Photo 1). Some minor erosion and undercutting of the slope due to wave action was observed at the normal water surface level. The undercutting of the slope indicates that future sloughing of the slope is possible. The upper portion of the slope above the normal water surface level was adequately protected against surface runoff by a well maintained grass cover and no erosion due to runoff was present. No bulges, depressions or cracks indicating an instability of the embankment or foundation were observed on the slope.

The downstream slope is adequately protected against surface runoff by an unmaintained grass cover. Several small saplings and large bushes were observed on the slope (see Photo 3). An area of moist boggy ground was seen on the slope just above the toe of the dam and approximately 100 feet from the right abutment. The area was about 50 feet long and 15 feet wide. No measurable

flow of water was apparent; however, cattails were observed in the area, which would indicate that moisture is generally present in the area (see Photo 4). The source of the moisture was apparently due to seepage through the embankment. No other areas of possible seepage were apparent on the slope or downstream of the dam. Some small circular depressions and shallow surface sloughs, which were apparently due to livestock grazing on the slope, were observed. No bulges, depressions or cracks indicative of a slope movement were apparent on the slope.

Both abutments slope gently upward from the dam. No instabilities, seepage or erosion were observed on either abutment. A barn with a concrete foundation was built on the right abutment near the embankment. The foundation of the barn appeared to be acting as a retaining wall, thus apparently adding additional strength to the embankment in this area.

No evidence of burrowing animals was apparent on either the embankment or the abutments.

c. Project Geology and Soils

(1) Project Geology

The damsite is located on an unnamed tributary of Rock Creek in the Springfield Plateau section of the Ozark Plateaus Physiographic Province. The Springfield Plateau includes that part of the Ozarks which is underlain mainly by rocks of Mississippian age. Most of the Springfield Plateau are prairies, which are separated by valleys cut 200 to 300 feet below the upland surface. Most of the area of the Springfield Plateau is overlain by a mantle of chert derived by weathering of the Mississippian Limestone. Widespread distribution of dolomite and limestone bedrock with deep dissection is responsible for the development of many springs in the vicinity of the damsite. A major component of the surface discharge into the reservoir is contributed by these springs.

Topography in the damsite vicinity is hilly with V-shaped valleys. Elevations of the ground surface range from 916 feet M.S.L. nearly 2.5 miles southwest of the damsite to 600 feet M.S.L. at the damsite. The reservoir slopes are generally from 15 degrees to 25 degrees from horizontal. The reservoir slopes are stable and the reservoir appears to be watertight. The area near the damsite is covered with residual soil mixed with loess deposits consisting of reddish brown mottled, stiff, medium plastic, silty clay with occasional rocks and chert fragments.

The regional bedrock geology beneath the loess and residual soil deposits in the damsite area as shown on the Geologic Map of Missouri (1979) (see Plate 5) consist of Mississippian age rocks which consist of the St. Louis Formation, Salem Formation and Keokuk-Burlington Formation, and Ordovician age rocks consisting of Maquoketa Shale, Kimmswick Limestone and St. Peter Sandstone. The predominent bedrock underlying the surficial soil cover in the vicinity of the damsite is the Mississippian Keokuk-Burlington Formation.

Outcrops of Mississippian Keokuk-Burlington Formation (brownish gray to whitish pink, fine to medium grained, hard unweathered cherty limestone) are exposed on the rim of the reservoir (see Photo 9).

No faults have been identified at the damsite. The closest trace of a fault to the damsite is a normal fault cutting the Mississippian rocks. The fault is located nearly one mile east of the damsite. The Geologic Map of Missouri indicates that the overlying Quaternary deposits are not displaced by this fault. Thus, the fault has no effect on the damsite.

No boring logs or construction reports were available that would indicate foundation conditions encountered during construction. Based on the visual inspection, the embankment probably rests on the bedrock of the Keokuk-Burlington Formation and the spillway was cut into the residual soils.

(2) Project Soils

According to the "Missouri General Soil Map and Soil Association Description" published by the Soil Conservation Service, the materials in the general area of the dam belong to the soil series of Union-Goss-Gasconade-Peridge in the Ozark Border Association. The soils are basically formed from loess deposits and weathered cherty limestone. These soils vary from a slowly permeable silty clay to moderately permeable silt loam.

Materials removed from the embankment slopes varied from a light-brown, slightly plastic, silty clay with traces of fine sand and cobbles on the upstream slope to a medium brown, moderately plastic, silty clay with traces of fine to medium sand and some cobbles on the downstream slope. Based upon the Unified Soil Classification System, these soils would probably be classified as a CL. This is an impervious soil type, which generally has the following characteristics: a coefficient of permeability less than 1.0 foot per year, medium shear strength, and a high resistance to piping.

d. Appurtenant Structures

(1) Spillway

The spillway for the most part has a dense grass covering showing no sign of recent mowing (see Photo 6). There are some erosion gullies in the discharge channel beginning just downstream from the end of the training berm (see Photos 7 and 8). Evidence of grazing livestock activity can be seen in this area and may have provided the cause and/or aggravation of the erosion. Presently this erosion is not a safety hazard to the dam. But if allowed to continue, the erosion will progress up the channel to where it could affect the safe operation of the spillway. No instabilities of the side slopes of the spillway channel were observed.

The spillway appears to be able to function as originally intended. However, the spillway is partially obstructed by the fish screen and the foot bridge supports. There was no noticeable erosion around either the fish screen or the foot bridge supports on the day of inspection. Presently the fish screen has a high clear area to total area ratio, but it provides an excellent facility for trapping whatever debris flood waters may be carrying. When the spillway operates, the screen could become clogged. This would increase the head loss across the screen and would generally increase the turbulence and the erosive capability of the flow through the spillway. The center pier and end supports of the foot bridge could also create flow irregularities raising the potential for erosion.

(2) Outlet Works

No low level outlet or outlet works were provided for this dam. Nevertheless, a one-inch diameter pipe used as a livestock watering system was provided for the dam. According to Mrs. Binning, the system was operable but had not been used for several years. The only portion of the system located was the globe valve which controls the system. Clear standing water was observed in the clay pipe housing. It was undetermined whether the source of the water was due to seepage along the pipe or leakage through the fittings for the valve.

e. Reservoir Area

The reservoir water surface elevation at the time of the inspection was 597.5 feet above M.S.L. The reservoir has a normal water surface elevation of 601.8 feet above M.S.L. and a surface area of four acres at the normal water surface level.

The rim appeared to be stable with no erosional or stability problems observed (see Photo 10). The land around the reservoir slopes gently to moderately upward from the reservoir rim and is mostly wooded. No houses are built near the reservoir shoreline. No evidence of excessive siltation was observed in the reservoir on the day of the inspection.

f. Downstream Channel

The downstream channel near the dam is a triangularly shaped streambed with approximate dimensions of two to three feet deep and six feet wide. Outside of the streambed, the downstream channel widens into a narrow flood plain (see Photo 11).

3.2 Evaluation

The visual inspection did not reveal any items that are sufficiently significant to indicate a need for immediate remedial action. However, the following conditions were observed which could adversely affect the dam in the future.

1. The moist boggy area observed on the downstream slope of the dam could affect the structural stability of the dam; however, it does not constitute an unsafe condition at the present time. If the moisture in this area is due to seepage through the embankment, with time, it is possible the rate of seepage could increase and transport soil particles. This could cause piping of embankment material which could lead to the eventual failure of the embankment.

2. The erosion in the lower portion of spillway discharge channel does not currently pose a safety hazard to the dam but will worsen with future flows through the spillway.

3. The wave erosion on the upstream slope does not appear to affect the stability of the dam in its present condition. However, continual erosion of the slope can only be detrimental to the structural integrity of the dam.

4. The small saplings and the large bushes on the downstream slope pose a potential danger to the safety of the dam if allowed to grow. A tall, dense growth of vegetation on the embankment hinders a comprehensive inspection of the dam and potential problems could go undetected. And, the root system of large trees present possible paths for piping through the embankment and can also do damage to the embankment by being uprooted during a storm.

5. The fish screen and foot bridge supports in the control section area of the spillway have not resulted in any apparent damage at the time of inspection. But, by the very nature of allowing obstructions in an earthcut channel, which can increase the potential of turbulence and erosion provides cause for concern.

6. The livestock watering system could be a source of serious problems as indicated already by the standing water observed in the clay pipe housing. If the source of the water is due to seepage along the pipe, it is possible that the piping of the embankment material could occur and lead to the eventual failure of the dam.

7. The damage to the embankment and the spillway channel due to the grazing livestock is not serious enough to warrent repair in its present conditon. However, further damage to these areas caused by the grazing livestock can only have an adverse effect on the dam and the spillway.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Glen Rose Lake Dam was built for commercial, recreational fishing purposes, and there are no specific procedures that are followed for the operation of the dam or reservoir. The water level below the spillway crest is controlled by rainfall, runoff and evaporation.

4.2 Maintenance of Dam

The dam was maintained by the previous owner, Mrs. Rose Binning. Mrs. Binning periodically mowed the crest and upstream slope of the dam. Brush and saplings had recently been removed from part of the downstream slope by Mr. Richard Williams, the new owner of the dam. Nevertheless, saplings, large bushes, and an unmaintained grass cover still remain on the downstream slope. Mr. Williams indicated he planned to remove the remaining saplings and brush from the downstream slope in the near future.

4.3 Maintenance of Operating Facilities

The livestock watering system is the only operating device at the dam. Mrs. Binning indicated that she has not operated the system for several years. The system was not operated on the day of the inspection.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any warning system in use at the damsite, such as an electrical warning system or a manual notification plan.

4.5 Evaluation

Glen Rose Lake Dam does not appear to be neglected. The maintenance is fair for this dam; however, the remedial measures described in Section 7 should be undertaken to improve the condition of the dam.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

No hydrologic and hydraulic design data are available for Glen Rose Lake Dam. The sizes of physical features utilized to develop the stage-outflow relation for the spillway and overtopping of the dam were prepared from field notes and sketches prepared during the field inspection. The reservoir elevation-area data were based on the U.S.G.S. Maxville, Missouri Quadrangle topographic map (7.5 minute series). The spillway and overtop release rates and the reservoir elevation-area data are presented in Appendix B.

The hydrologic soil group of the watershed was determined from information available in the U.S.D.A. Soil Conservation Service publication "Missouri General Soil Map and Soil Association Descriptions", 1979. The Probable Maximum Precipitation (PMP) used to determine the Probable Maximum Flood (PMF) was determined by using the U.S. Weather Bureau publication "Hydrometeorological Report No. 33" (April 1956). The 100-year and the 10-year floods were derived from the 100-year rainfall and the 10-year rainfall, respectively, of St. Louis, Missouri.

b. Experience Data

Records of reservoir stage or spillway discharge are not maintained for this site. However, according to Mrs. Binning, the maximum reservoir level was approximately 12 inches above the crest of the spillway.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1d and evaluated in Section 3.2.

d. Overtopping Potential

Both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak inflows of the PMF and one-half of the PMF are 2,480 cfs and 1,240 cfs, respectively. The peak outflow discharges for the PMF and one-half of the PMF are 2,197 cfs and 932 cfs, respectively. The maximum capacity of the spillway just before overtopping the dam is 465 cfs. The PMF overtopped the dam by 1.56 feet and one-half of the PMF overtopped the dam by 0.64 feet. The total duration of flow over the dam is 45 minutes during the occurrence of the PMF and 25 minutes during one-half of the PMF. The spillway/reservoir system of Glen Rose Lake Dam is capable of accommodating a flood equal to approximately 35 percent of the PMF just before overtopping the dam. The reservoir/spillway system of Glen Rose Lake Dam will accommodate the one-percent chance flood without overtopping the dam.

The surface soils on the embankment and in the spillway appear to be a silty clay. The spillway and the top of dam have a good cover of grass. The dam will be overtopped by approximately 1.5 feet during the occurrence of the PMF which can cause severe erosion to the embankment due to the high velocity of flow on its downstream slope and could lead to the eventual failure of the dam. The maximum velocity of flow in the spillway during the PMF will be about 9.5 ft/sec, which could also cause excessive erosion in the spillway channel due to the high velocity of flow.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. The estimated damage zone extends approximately two miles downstream of the dam. Located within the damage zone are eight dwellings, a commercial building, one bridge, and a rodeo ring.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no major signs of settlement or distress observed on the embankment or foundation during the visual inspection. The area of possible seepage on the downstream slope could be detrimental to the stability of the embankment, but it does not appear to constitute an unsafe condition at this time. The apparent problems associated with the livestock watering system do not appear to endanger the stability of the dam at the present time. Nevertheless, the condition can only worsen with time. The minor wave erosion on the upstream slope does not appear to endanger the structural stability of the embankment in its present condition; however, continual erosion of the slope could be detrimental to the embankment. In the absence of seepage and stability analyses, no quantitative evaluation of the structural stability can be made.

The structural stability of spillway at the present time is good. Nevertheless, if the erosion in the discharge channel should worsen and progress upstream, the stability of the spillway could be in jeopardy. The foundations of the foot bridge supports appear sound and there is no apparent erosion around either the fish screen or the foot bridge supports.

b. Design and Construction Data

No design computations pertaining to the embankment were uncovered during the report preparation phase. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. No

embankment or foundation soil parameters were available for carrying out a conventional stability analysis on the embankment. No construction data or specifications relating to the degree of embankment compaction were available for use in a stability analysis.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. The water level on the day of inspection was 4.3 feet below the crest of the spillway; however, the reservoir remains close to full most of the time.

d. Post Construction Changes

No post construction changes to the embankent are known to exist that will affect the structural stability of the dam.

e. Seismic Stability

The dam is located in Seismic Zone 2, as defined in the "Recommended Guidelines for Safety Inspection of Dams" prepared by the Corps of Engineers (see Plate 8). Seismic Zone 2 is characterized by a moderate earthquake hazard. An earthquake of the magnitude that would be expected in Seismic Zone 2 should not cause significant distress to a well designed and constructed earth dam. Available literature indicates that no active faults exist near the vicinity of the damsite. The maximum recorded historic magnitude earthquake in the immediate vicinity of the damsite was the January 24, 1902 event of magnitude 5 located at a distance of 15 miles northeast of the damsite. This event cannot be correlated with known tectonic structure and is considered to probably be related to the release of accummulated residual strain along a buried pre-Quaternary fault. The attenuation of this event to the damsite would produce a peak ground acceleration of less than 0.05g which would not produce a significant seismic impact on the dam.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and the visual inspection. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based upon observations of field conditions at the time of the inspection along with data available to the inspection team.

It is also important to realize that the condition of a dam depends upon numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be assurance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Glen Rose Lake Dam is found to be "Seriously Inadequate". The spillway/reservoir system will accommodate about 35 percent of the PMF without overtopping the dam. If the dam is overtopped, the safety of the embankment would be in jeopardy due to the susceptibility of the embankment materials to erosion. High velocity of flow on the downstream slope of the dam could cause excessive erosion and eventually lead to a failure of the dam. The spillway system would also receive considerable damage during the occurrence of a PMF.

The overall condition of the dam and appurtenant structures appears to be fair; however, some items of concern were noted which will require attention. A quantitative evaluation of the safety of the embankment could not be made in view of the absence of seepage and stability analyses. The present embankment and appurtenant structures, however, appear to have performed satisfactorily since their construction without failure or evidence of instability. The dam has never been overtopped, according to Mrs. Binning, and no evidence indicating the contrary was observed. The safety of the dam can only be improved if the deficiencies described in Sections 3.2 and 6.1a are properly corrected as described in Section 7.2b.

b. Adequacy of Information

The conclusions presented in this report are based upon field measurement, past performance and the present condition of the dam. Information on the design hydrology, hydraulic design, operation, and maintenance of the dam was not available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency

The items recommended in paragraph 7.2a should be pursued on a high priority basis. The remedial measures recommended in Paragraph 7.2b should be accomplished within a reasonable period of time.

d. Necessity for Phase II Inspection

Based upon results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

There are several options that 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. Increase the spillway capacity to pass the PMF, without overtopping the dam. The spillway should also be protected to prevent excessive erosion during the occurrence of the PMF.

2. Increase the height of the dam in order to pass the PMF without overtopping the dam; an investigation should also include studying the effects that increasing the height of the dam would have on the structural stability of the present embankment. The overtopping depth during the occurrence of the PMF, stated in Section 5.1d, is not the required or recommended increase in the height of the dam.

3. A combination of 1 and 2 above.

b. O & M Procedures

1. The moist, boggy area on the downstream slope should be monitored to detect any flow of water or changes in location of the area. Any changes of the condition of the area should be investigated further by a qualified professional engineer and proper repairs made as required.

2. The erosion gullies in the spillway discharge channel should be repaired and stabilized to prevent further damage.

3. The minor wave erosion on the upstream slope should be monitored, and, if the erosion continues, protective measures should be employed to protect the slope from further damage.

4. The saplings and large bushes on the downstream slope should be removed from the embankment and prevented from growing back. An adequate well maintained grass cover should be retained on the downstream slope and in the spillway channel to protect them from erosion and to prevent excessive erosion in the event the dam is overtopped or during high flows through the spillway.

5. The supports of the foot bridge and the area around the fish screen should be inspected frequently for erosion and any erosion found should be repaired immediately. The fish screen should also be either continuously cleared of all debris or removed altogether.

6. The livestock watering system should be monitored to detect any leakage along the pipe which can be detrimental to the dam. Any problems with the pipe should be investigated further by a qualified professional engineer and repairs made as required.

7. Grazing livestock should be prevented access to the embankment and the spillway channel area.

8. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of earth dams.

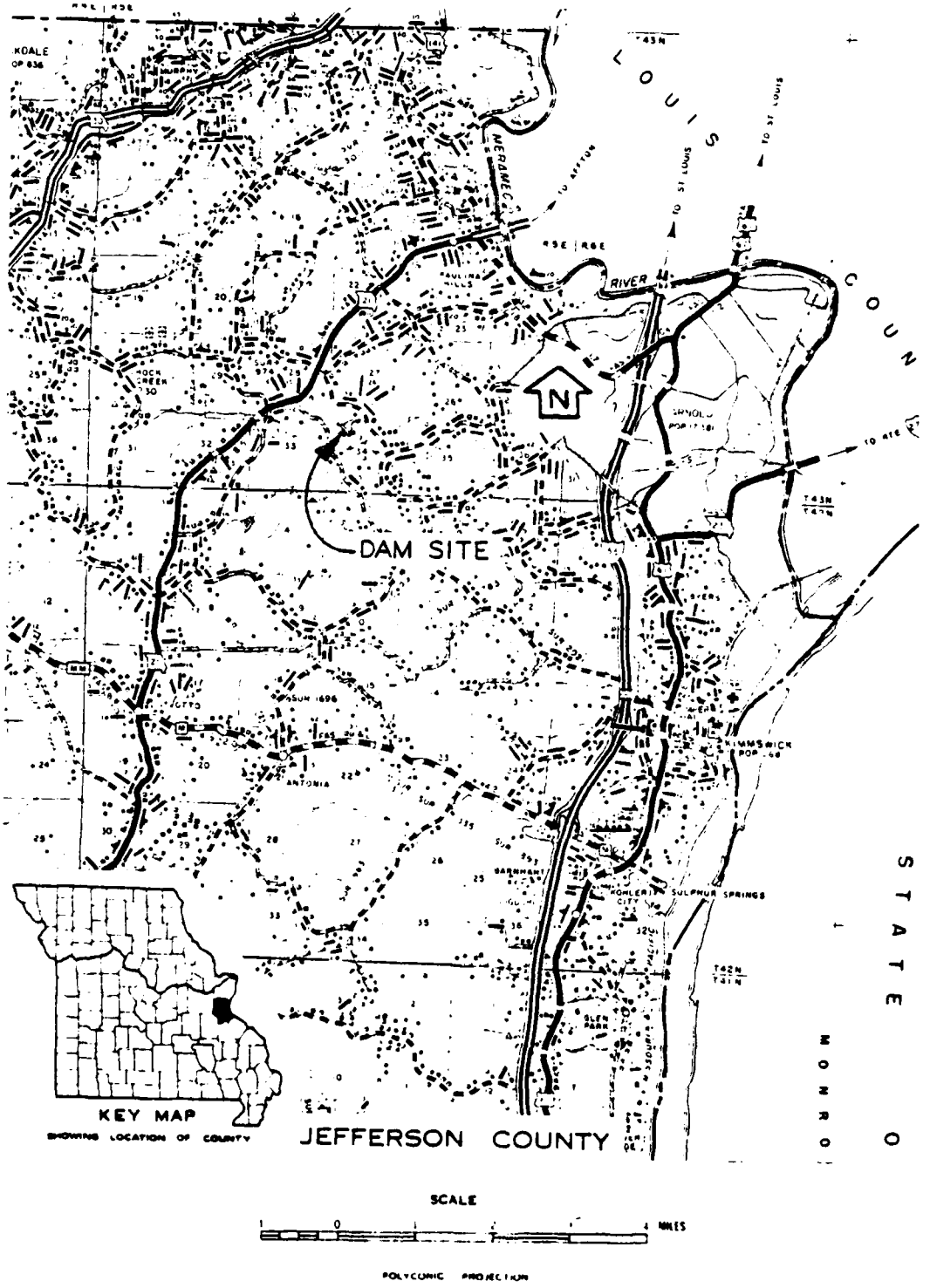
9. The owner should initiate the following programs:

   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all repairs, and maintenance.

PLATES

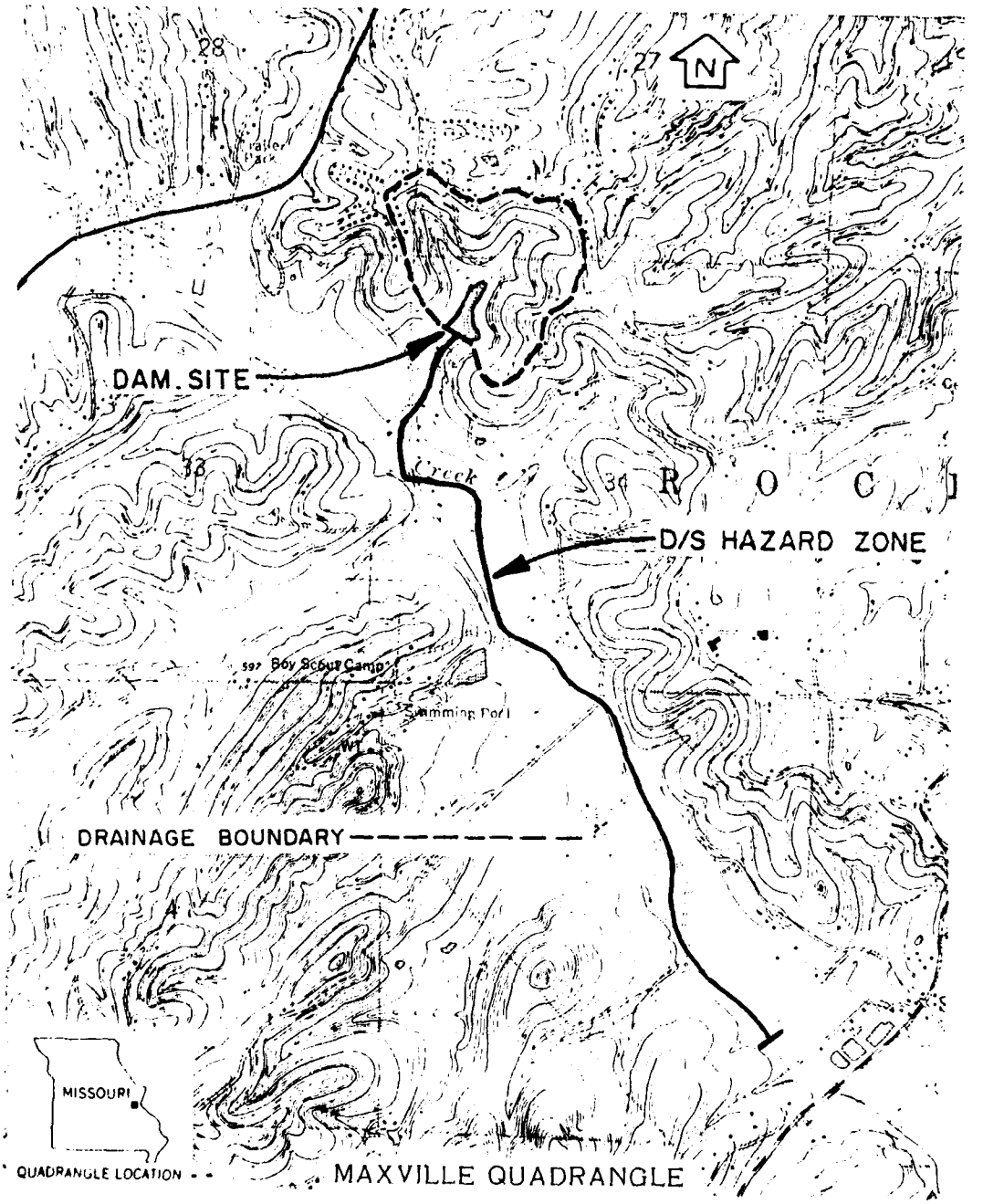
PLATE 1



LOCATION MAP - GLEN ROSE LAKE DAM

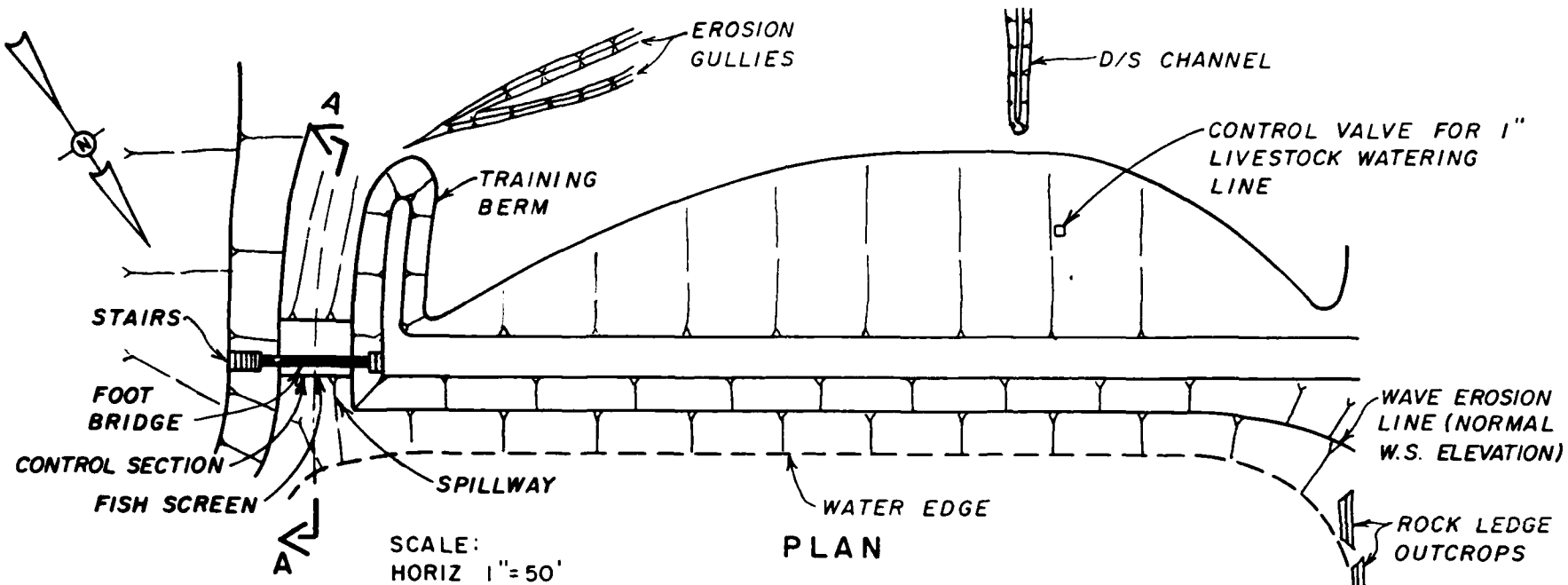
MO. - 10700

PLATE 2

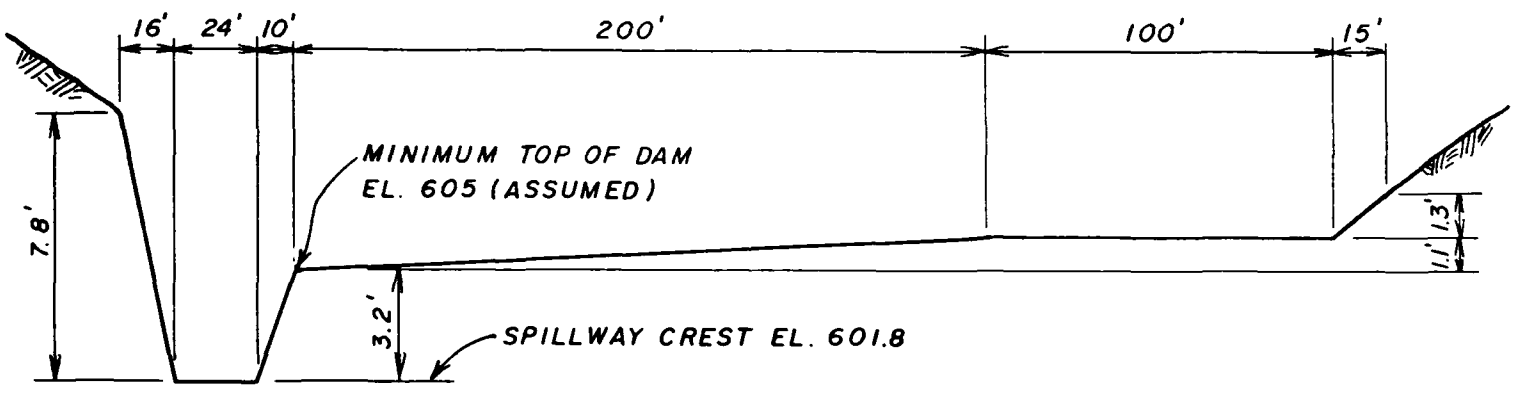


GLEN ROSE LAKE DAM (MO.-10700)

DRAINAGE BASIN AND
DOWNSTREAM HAZARD ZONE



PLAN



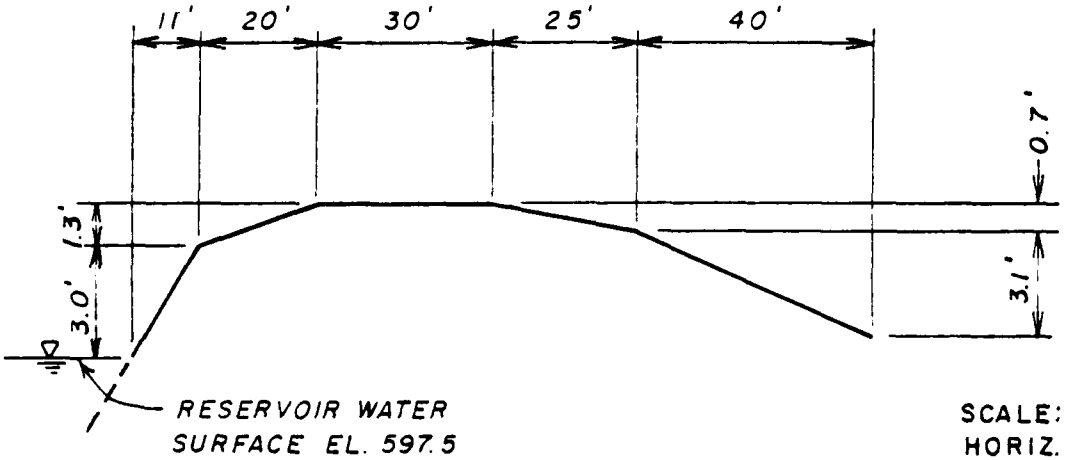
SCALE:
HORIZ. 1"= 50'
VERT. 1"= 5'

ELEVATION

GLEN ROSE DAM (MO. 10700)
PLAN AND ELEVATION
(SHEET 1 OF 2)

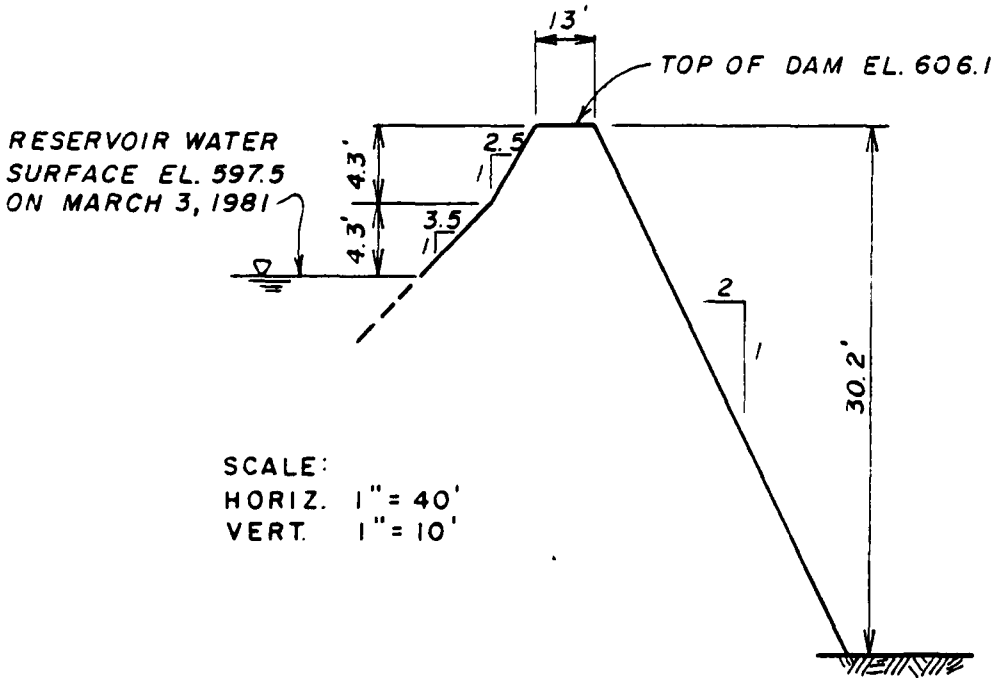
PLATE 3

PLATE 4



SCALE:
HORIZ. 1" = 30'
VERT. 1" = 5'

SECTION A-A
(SPILLWAY PROFILE)

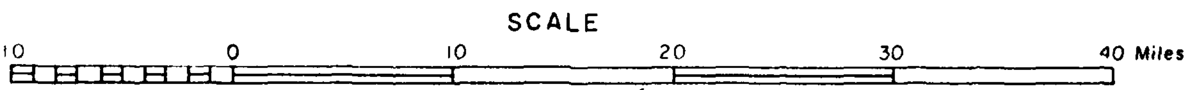


SCALE:
HORIZ. 1" = 40'
VERT. 1" = 10'

MAXIMUM SECTION

GLEN ROSE DAM (MO. 10700)
SPILLWAY PROFILE AND MAXIMUM SECTION
(SHEET 2 OF 2)

PLATE 5



⊕ LOCATION OF DAM

NOTE: LEGEND FOR THIS MAP IS ON PLATES 6 AND 7.

REFERENCE:

GEOLOGIC MAP OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
MISSOURI GEOLOGICAL SURVEY
KENNETH H. ANDERSON, 1979

REGIONAL GEOLOGICAL MAP OF GLEN ROSE LAKE DAM

GLEN ROSE LAKE DAM
PLATE 6
SHEET 1 OF 2

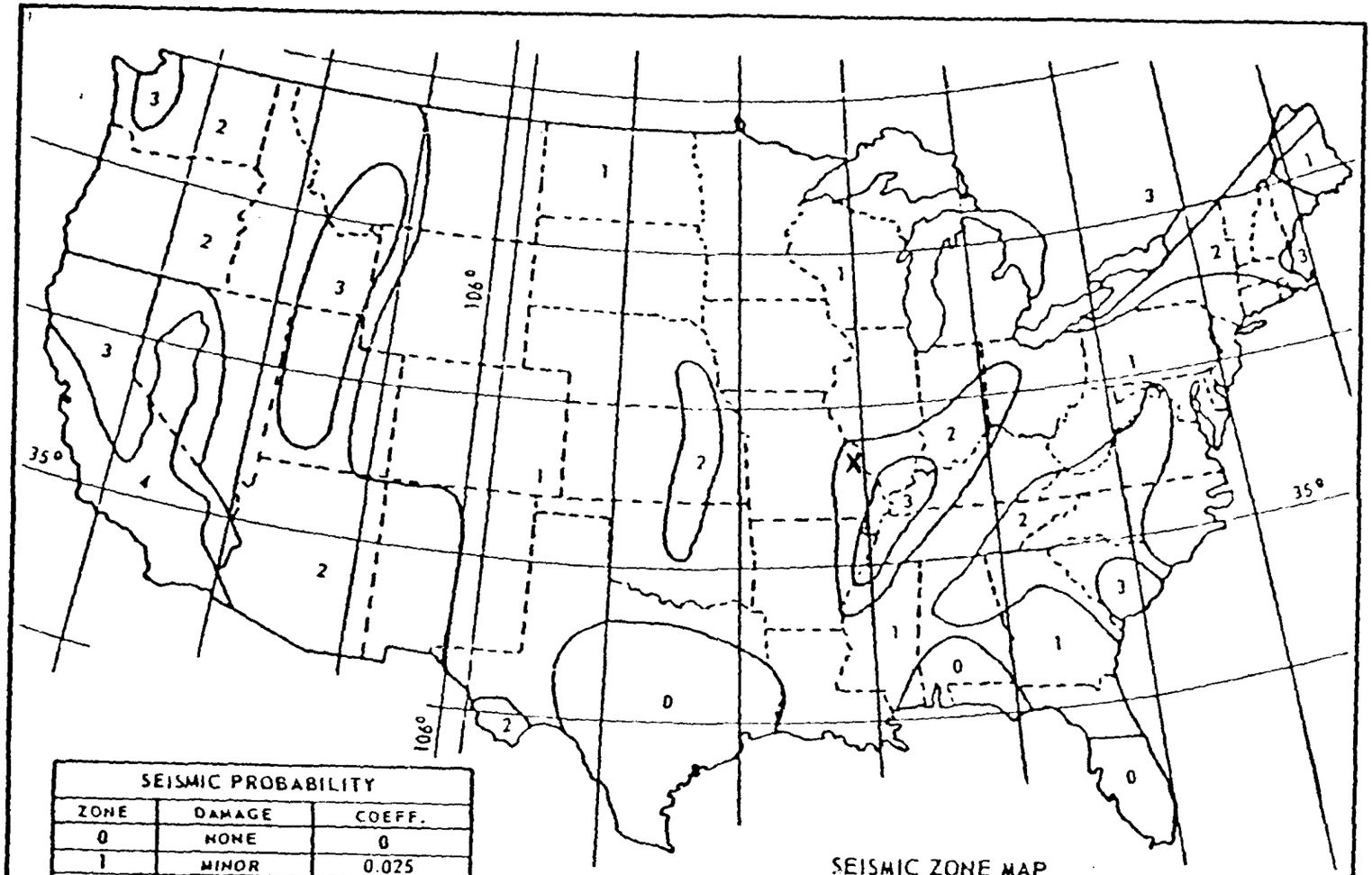
LEGEND

PERIOD	SYMBOL	DESCRIPTION
QUATERNARY	Qal	ALLUVIUM: SAND, SILT, GRAVEL
PENNSYLVANIAN	Pp	PLEASANTON GROUP: CYCLIC DEPOSITS OF SANDSTONE, SHALE AND LIMESTONE
	Pm	MARMATON GROUP: CYCLIC DEPOSITS OF SHALE, LIMESTONE AND SANDSTONE
	Pcc	CHEROKEE GROUP: CYCLIC DEPOSITS OF SHALE, LIMESTONE AND SANDSTONE
MISSISSIPPIAN	Mm	ST. LOUIS FORMATION: LIMESTONE INTERBEDDED WITH SHALE
	Mm	SALEM FORMATION: LIMESTONE INTERBEDDED WITH SHALE AND SILTSTONE
	Mo	KEOKUK– BURLINGTON FORMATION: CHERTY GRAYISH BROWN SANDY LIMESTONE
	Mk	UNDIFFERENTIATED CHOUTEAU GROUP: LIMESTONE
	Mk	HANNIBAL FORMATION: SHALE AND SILTSTONE

GLEN ROSE LAKE DAM
PLATE 7
SHEET 2 OF 2

LEGEND

PERIOD	SYMBOL	DESCRIPTION
ORDOVICIAN	Ou	NOIX LIMESTONE
	Omk	MAQUOKETA SHALE, KIMMSWICK LIMESTONE
	Odp	DECORAH FORMATION: GREEN TO GRAY CALCAREOUS SHALE WITH THIN FOSSILIFEROUS LIMESTONE
	Osp	ST. PETER SANDSTONE
	Ospe	ST. PETER SANDSTONE, EVERTON FORMATION
	Ojd	JOACHIM DOLOMITE
	Ojc	JEFFERSON CITY DOLOMITE
	Or	ROUBIDOUX FORMATION: INTERBEDS OF CHERTY LIMESTONE AND SANDSTONE
	Og	GASCONADE DOLOMITE
CAMBRIAN	€ep	EMINENCE DOLOMITE, POTOSI DOLOMITE
	€eb	FRANCONIA AND BONNETERRE FORMATION: INTERBEDED LIMESTONE, CHERTY LIMESTONE, DOLOMITE AND SILTSTONE
	U / D	NORMAL FAULT
	U / D	INFERRED FAULT
	U =	UPTHROWN SIDE; D = DOWNTHROWN SIDE



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

X APPROXIMATE LOCATION OF GLEN ROSE LAKE DAM

SEISMIC ZONE MAP
of
CONTIGUOUS STATES

PLATE 8

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

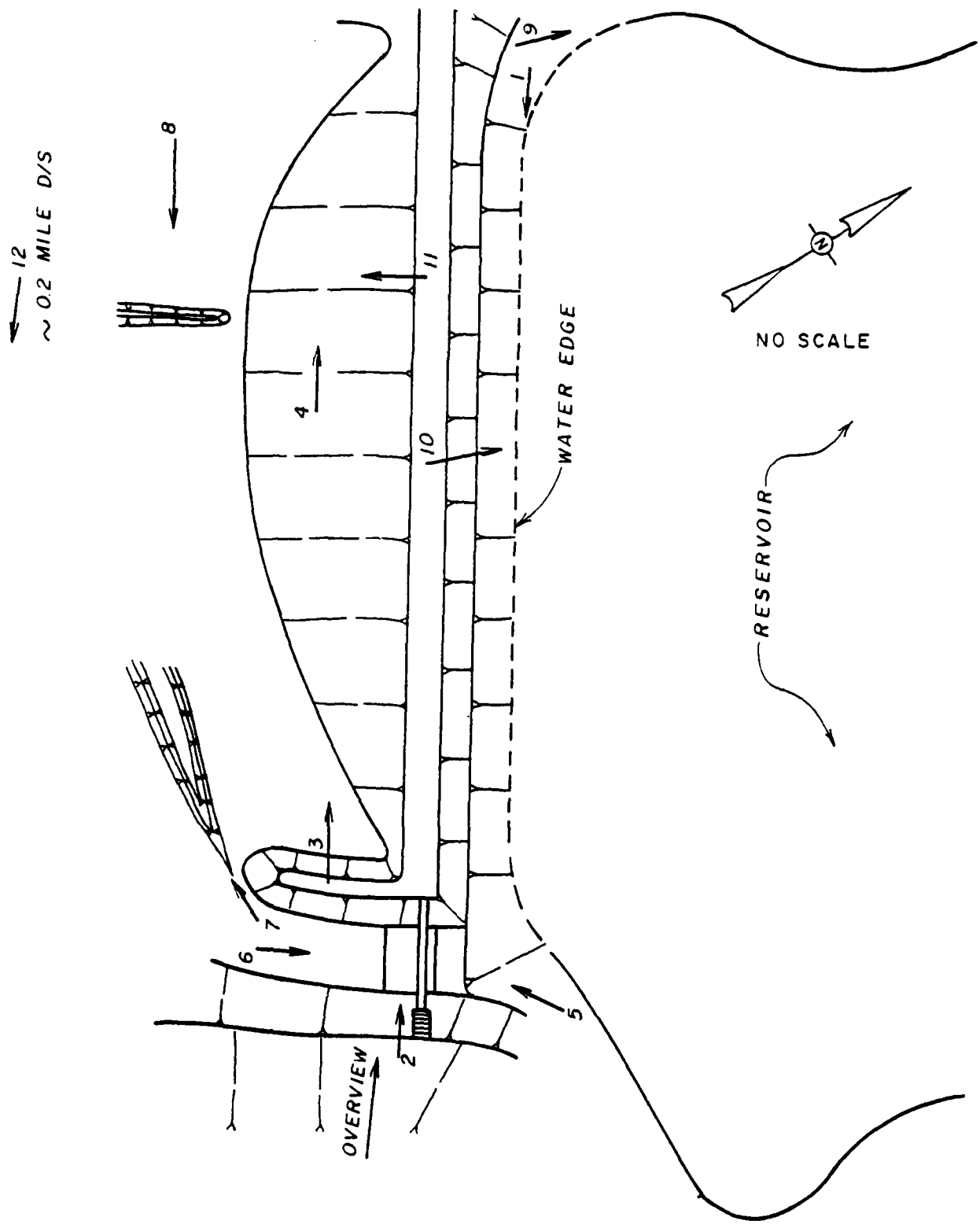


PHOTO INDEX
FOR
GLEN ROSE LAKE DAM

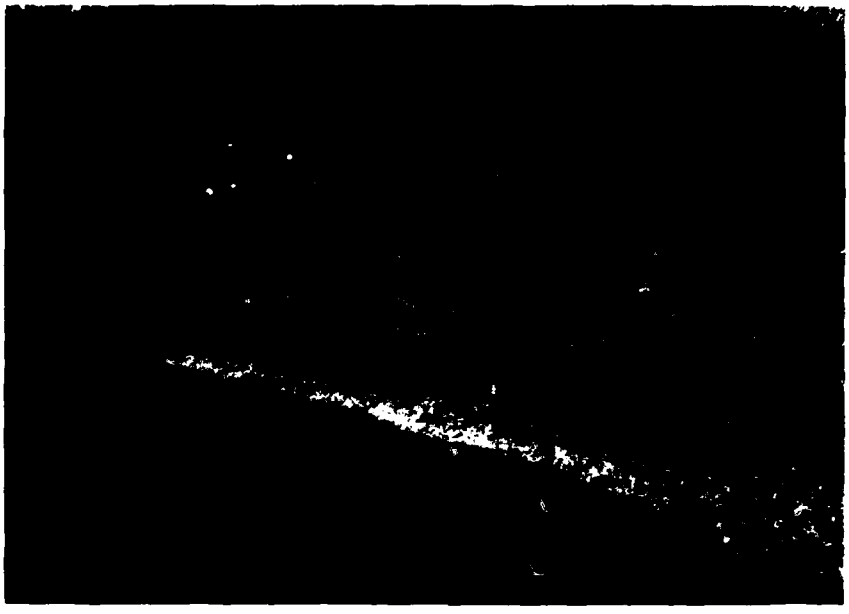


Photo 1 - View of the upstream slope from the right abutment.

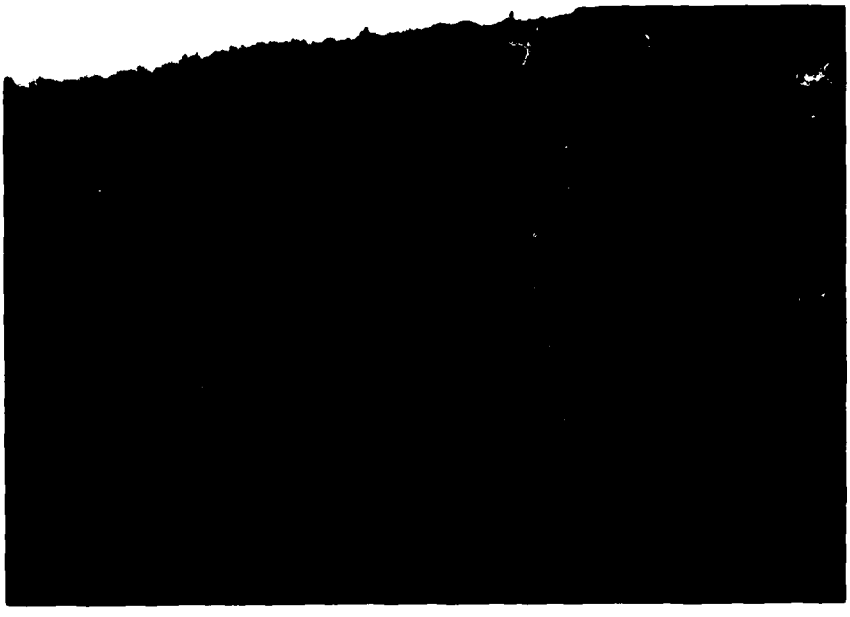


Photo 2 - View of the top of dam from the left abutment with the spillway in the foreground.

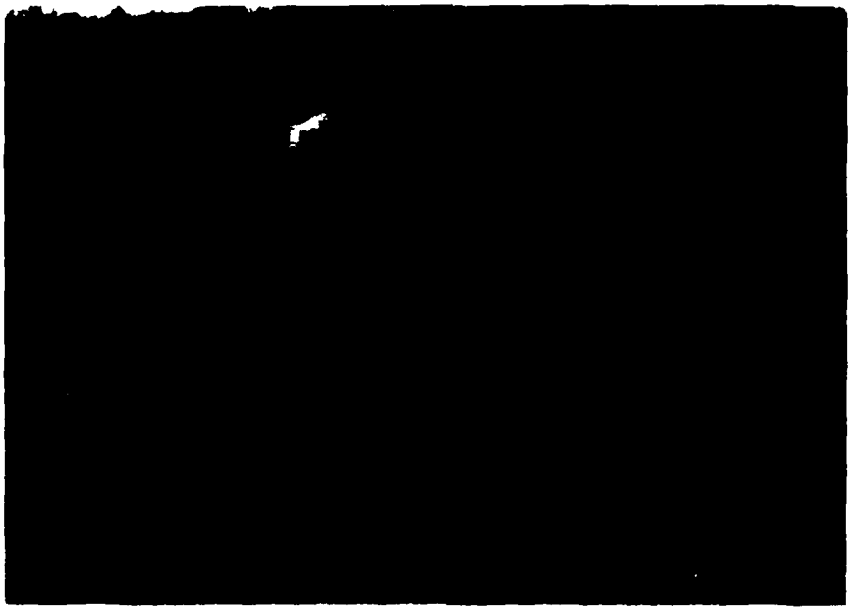


Photo 3 - View of the downstream slope from the left abutment.

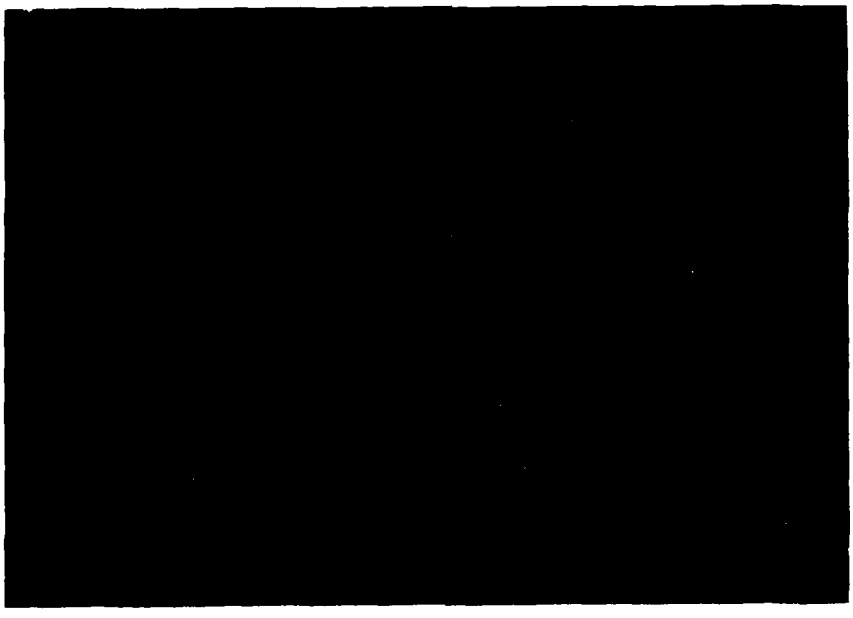


Photo 4 - Close-up view of the area of cattails and boggy ground on the downstream slope.

Photo 5 - View of the control section of the spillway from the reservoir showing foot bridge across the spillway.

Photo 6 - View of the discharge channel of the spillway looking upstream.

Photo 7 - Close-up view of the erosion gully in the discharge channel of the spillway.

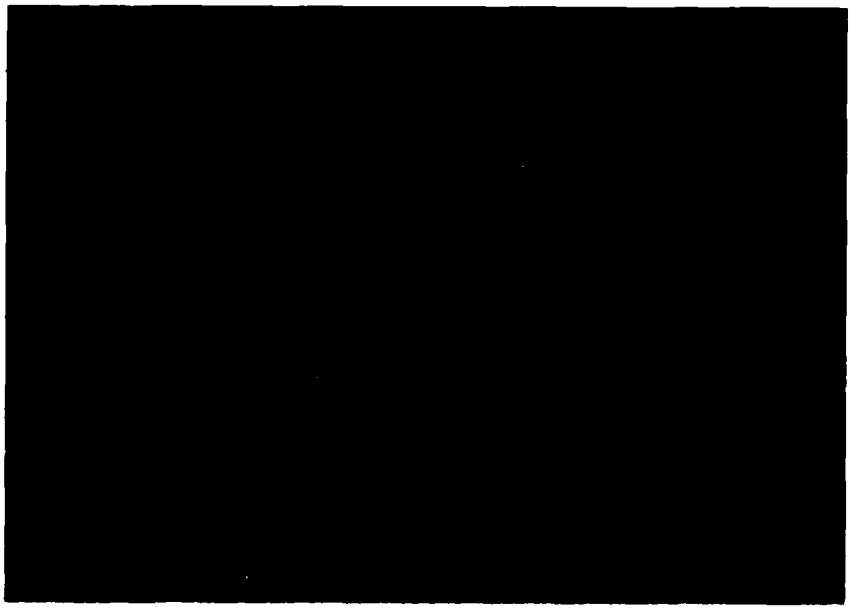


Photo 8 - View from the right abutment showing the location of the erosion gully in the discharge channel and the training berm along the left side of the discharge channel.

Photo 9 - View of outcropping of unweathered cherty limestone on the right side of the reservoir near the dam.

Photo 10 - View of the reservoir and rim.

Photo 11 - View of dwellings in the downstream hazard zone and the downstream channel taken from the dam.

Photo 12 - View of dwellings in the downstream hazard zone looking across the downstream channel.

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

GLEN ROSE LAKE DAM

HYDROLOGIC AND HYDRAULIC DATA, ASSUMPTIONS AND METHODOLOGY

1. SCS Unit Hydrograph procedures and the HEC-1DB computer program are used to develop the inflow hydrographs. The hydrologic inputs are as follows:

   (a) Twenty-four hour probable maximum precipitation from Hydrometeorological Report No. 33, 24-hour 100-year rainfall and 24-hour 10-year rainfall of St. Louis, Missouri.

   (b) Drainage area = 0.15 square miles.

   (c) Lag time = 0.06 hours.

   (d) Hydrologic Soil Group:
   Soil Group "C".

   (e) Runoff curve number:
   CN = 73 for AMC II and CN = 87 for AMC III.

2. Flow rates through the spillway are based on HEC-2 generated profiles assuming critical depth at the downstream edge of the control section and a Manning's n = 0.035. Flow rates over the dam are based on the broad crested weir equation $Q = CLH^{3/2}$ and critical depth assumption.

3. Floods are routed through Glen Rose Lake to determine the capability of its spillway.

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. ___ OF ___

DAM NAME: GLEN ROSE DAM (MO. 10700) — JOB NO. 1263

UNIT HYDROGRAPH PARAMETERS — BY _____ DATE _____

1) DRAINAGE AREA, $A = .15$ sq. mi = (93.0 acres)

2) LENGTH OF STREAM, $L = (0.9" \times 2000' = 1800') = .34$ mi.

3) ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM,

$H_1 = 795'$

4) ELEVATION OF RESERVOIR AT SPILLWAY CREST, $H_2 = 601.8'$

5) ELEVATION OF CHANNEL BED AT 0.85L, $E_{85} = 715'$

6) ELEVATION OF CHANNEL BED AT 0.10L, $E_{10} = 610'$

7) AVERAGE SLOPE OF THE CHANNEL, $S_{AVG} = (E_{85} - E_{10})/0.75L = 7.8\%$

8) TIME OF CONCENTRATION:

A) BY KIRPICH'S EQUATION,

$t_c = [(11.9 \times L^3)/(H_1 - H_2)]^{0.385} = 0.10$ hrs

B) BY VELOCITY ESTIMATE,

SLOPE = 7.8% $\Rightarrow$ AVG. VELOCITY = 5 fps

$t_c = L/V = 1800$ ft $/(5$ fps $\times 3600$ s/hr$) = 0.10$ hrs

USE $t_c = 0.10$

9) LAG TIME, $t_l = 0.6\, t_c = 0.06$ hr.

10) UNIT DURATION, $D \leq t_l/3 = 0.02$ hrs. < 0.083 hr.

USE $D = .083$ hrs.

11) TIME TO PEAK, $T_p = D/2 + t_l = 0.10$ hrs

12) PEAK DISCHARGE,

$q_p = (484 \times A)/T_p = (484 \times 0.15\,mi^2)/.10$ hr $= 720$ cfs

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Dam Safety Inspection / Missouri SHEET NO. ___ OF ___

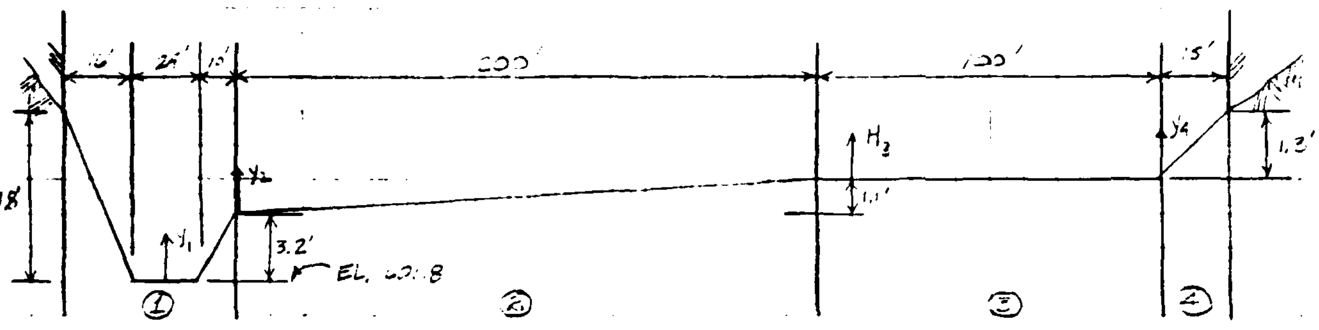
Glen Rose Lake Dam (MO 10702) JOB NO 1283

Reservoir Elevation - Area Data BY JFC DATE 3/18/81

Elevation (M.S.L.) feet	Reservoir Surface Area acres	Remarks
575	0	Estimated streambed elevation U/S @ dam
580	0.5	Measured on U.S.G.S 7.5' Quad (Maxville)
590	2.0	" " " " "
600	3.5	" " " " "
601.8	4.0	Spillway Crest
605	5.0	Minimum Top of Dam (Assumed)
610	5.5	Measured on U.S.G.S. 7.5' Quad (Maxville)
620	7.5	" " " "

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Dam Safety Inspection – [illegible] | SHEET NO ____ OF ____
Spillway and Overtop Rating [illegible] | JOB NO. 1283
[illegible] Rose Lake Dam (MO [illegible]) | BY SFK | DATE [illegible]



for Section 1*: $0 < y_c < 3.2$; $3.2 \le y_c < 7.8$; $7.8 \le y_c$, $Q_1 = \sqrt{A^3 g / T}$
(at critical depth)

$T = 24 + 9.8\, y_c$; $A = 24 y_c + 2.53\, y_c^2$

$T = 34 - 2.05\, y_c$; $A = 34 y_c - 1.03\, y_c^2 - 1.5$

$T = 40$; $A = 40 y_c - 78.4$

for Section 2: $0 < y_2 < 1.1$; $1.1 \le y_2$, $H_2 =$ W.S.EL $- 605$, $Q_2 = \sqrt{A^3 g / T}$

$y_2 = 4.5\, H_2$; $T = 181.82\, y_2$; $A = 90.91\, y_2^2$

$y_2 = 2/3 (H_2 + 0.275)$; $T = 200$; $A = 200\, y_2 - 110$

for Section 3: $Q_3 = C L H_3^{1.5}$, $H_3 =$ W.S.EL. $- 606.1$

$Q_3 = C (100) H_3^{1.5}$

for Section 4: $0 < y_4 < 1.3$; $1.3 \le y_4$, $H_4 =$ W.S.EL. $- 606.1$, $Q_4 = \sqrt{A^3 g / T}$

$y_4 = 4.5\, H_4$; $T = 11.54\, y_4$; $A = 5.77\, y_4^2$

$y_4 = 2/3 (H_4 + 0.325)$; $T = 15$; $A = 15\, y_4 - 9.75$

* For Section 1, HEC-2 was used to calculate the backwater profile in the spillway from the D/S end of the control section [illegible]

ECI-4 **PRC ENGINEERING CONSULTANTS, INC.**

Dam Safety Inspection – [illegible] SHEET NO ___ OF ___

[illegible] and Discharge Rating [illegible] JOB NO 1283

[illegible] Rose Lake [illegible] BY JFL DATE 3/18/[illegible]

From to HEC-2 Printout

Section #2					Section #3												
y_c	T_c	A_c	V_c	Q	y_1	V_1	h_v	W.S. EL.	H_2	y_2	A_2	T_2	V_2	Q_2	H_3	C	Q_3
0	0	0	0	0	0	0	0	601.8									
.22	25.2	5.6	2.5	14	.46	1.2	.02	602.3									
.32	25.7	7.9	3.2	25	.62	1.6	.04	602.5									
.50	26.6	12.7	4.0	50	.88	2.2	.07	602.8									
.79	28.1	20.6	5.0	100	1.25	3.0	.14	603.2									
1.24	30.4	33.6	6	200	1.80	4.0	.24	603.5									
1.60	32.3	45.0	6.9	300	2.22	4.7	.33	604.4									
1.92	33.9	55.5	7.5	400	2.59	5.3	.41	604.8	0	0	0	0	0	0	0	0	0
2.20	35.4	[illegible]	8.0	500	2.90	5.8	.48	605.2	0.2	.16	2.3	29.1	1.6	3.7	0.2	2.97	26.[illegible]
2.82	38.6	83.3	8.9	750	3.59	6.6	.64	606.0	1.0	.80	58.2	145.5	3.6	208.8	1.0	3.03	303.0
3.37	40.9	100.2	9.6	1000	4.15	7.4	.79	606.7	1.7	1.32	153.3	200.	5.0	761.9	1.7	3.04	673.9
4.21	42.6	145.5	10.8	1500	5.10	8.5	1.06	608.0	3.0	2.18	326.7	200.	7.3	2369.0	3.0	3.08	1605.6
4.96	44.2	172.8	11.8	2000	5.93	9.6	1.29	609.0	4.0	2.85	460.	200.	8.6	3958.7	4.0	3.09	2472.
5.63	45.6	207.9	12.6	2500	6.67	10.2	1.51	610.0	5.0	3.52	593.3	200.	9.8	5799.1	5.0	3.09	3454.7
6.26	46.8	226.8	13.2	3000	7.35	10.9	1.71	610.9	5.9	4.12	713.3	200.	10.7	7644.6	5.9	3.09	4428.3

H_4	y_4	A_4	T_4	V_4	Q_4	Q_{total}
						0
						14
						25
						50
						100
						200
						300
						400
						530
0	0	0	0	0	0	262
.2	.45	1.3	5.5	2.3	3.7	2439
1.9	1.42	12.5	15.	5.2	64.8	5539
2.9	2.15	22.5	15.	7.0	156.4	8587
[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]	[illegible]

HEC-2 INPUT AND SUMMARY TABLE

```
**************************************************
  HEC, RELEASE DATED NOV 76 UPDATED APR 1980
  ERROR CORR - 
  MODIFICATIONS - 
**************************************************

T1       MISSOURI DAM SAFETY
T2       SPILLWAY RATING CURVE
T3       LEES ROST DAM

J1  ICHECK     INQ       NINV      IDIF      SKPJ      METRIC    HVINS     Q         WSEL      FQ

       -1.        1.        0.        0. -1.000000      0.00      0.0       0.   597.500     0.000

J2  NEROF      IEIOT     IPRVS     XSECV     XSECH     FN        ALLOC     IBW       CUNIM     ITRACE

       1.00      1.000    -1.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

      50.000     0.010    25.000     4.000    26.000    10.000    43.000     3.000     5.000    17.000

J4  ELMNT     NUMSEC                        ********REQUESTED SECTION NUMBERS********

     -10.000   -10.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
NC       .035      .035      .035     0.000     0.000     0.000     0.000     0.000     0.000     0.000
SF     10.000    25.000    50.000   100.000   200.000   300.000   400.000   500.000   750.000  1000.000
SI   1500.000  2000.000  2500.000  3000.000  4000.000     0.000     0.000     0.000     0.000     0.000

XI       1.000     6.000     0.000    40.000     0.000     0.000     0.000     0.000     -.700     0.000
GR     620.000     0.000   609.600     0.000   601.400    16.000   601.400    40.000   605.000    50.000
GR     620.000    50.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000

XI       2.000     0.000     0.000     0.000    25.000    25.000    25.000     0.000      .700     0.000

XI       3.000     0.000     0.000     0.000    50.000    50.000    50.000     0.000     0.000     0.000
GR       3.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000     0.000
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B-7

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HEC-2 RELEASE DATED NOV 7 UPDATED FEB 1979

ERROR CODE - 1.00

MODIFICATION - **********

****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

DELTA ROSE DAM

SUMMARY PRINTOUT

	SECNO	DEPTH	AREA	TOPWID	VCH	QV	Q	EG	10K*S	KXNCH
*	1.[illegible]	.2	5.45	25.13	2.65	.11	14.00	601.43	302.09	35.00
*	1.[illegible]	.32	7.91	25.65	3.19	.16	25.00	601.57	264.48	35.00
*	1.[illegible]	.5[illegible]	12.71	26.60	3.98	.24	50.00	601.85	227.48	35.00
*	1.[illegible]	.79	20.58	28.09	4.85	.37	100.00	602.26	195.87	35.00
*	1.[illegible]	1.24	33.60	30.20	6.11	.56	200.00	602.90	169.19	35.00
*	1.[illegible]	1.79	44.98	32.27	6.89	.71	300.00	603.41	155.77	35.00
*	1.[illegible]	1.[illegible]	55.46	33.91	7.49	.84	400.00	603.85	147.11	35.00
*	1.[illegible]	2.21	65.60	35.43	7.94	.94	500.00	604.24	139.15	35.00
*	1.[illegible]	2.45	88.67	38.65	8.88	1.16	750.00	605.09	128.95	35.00
*	1.[illegible]	3.46	109.97	40.50	9.58	1.34	1000.00	605.80	122.17	35.00
*	1.[illegible]	4.21	145.23	43.63	10.83	1.71	1500.00	607.01	120.33	35.00
*	1.[illegible]	4.95	177.45	44.15	11.79	2.02	2000.00	608.07	118.40	35.00
*	1.[illegible]	5.64	208.39	45.57	12.54	2.29	2500.00	609.03	115.45	35.00
*	1.[illegible]	6.25	236.41	46.81	13.26	2.56	3000.00	609.91	115.13	35.00
	2.[illegible]	.22	5.63	25.19	2.52	.10	14.00	602.12	255.55	35.00
*	2.[illegible]	.32	7.91	25.65	3.18	.16	25.00	602.27	263.77	35.00
*	2.[illegible]	.5[illegible]	12.73	26.60	3.97	.24	50.00	602.55	226.62	35.00
*	2.[illegible]	.79	20.60	28.09	4.84	.37	100.00	602.96	195.12	35.00
*	2.[illegible]	1.24	33.64	30.40	6.10	.56	200.00	603.60	168.59	35.00
*	2.[illegible]	1.[illegible]	45.04	32.[illegible]	6.[illegible]	.71	300.00	604.11	155.15	35.00
*	2.[illegible]	1.[illegible]	55.53	33.93	7.48	.83	400.00	604.55	146.50	35.00
*	2.[illegible]	2.[illegible]	64.37	35.[illegible]	7.97	.94	500.00	604.94	140.65	35.00
*	2.[illegible]	2.[illegible]	88.33	39.61	9.31	1.17	750.00	605.79	133.40	35.00
*	2.[illegible]	3.27	110.29	42.[illegible]	9.[illegible]	1.35	1000.00	606.50	121.43	35.00
*	2.[illegible]	4.31	145.50	43.69	10.81	1.70	1500.56	607.71	119.68	35.00
*	2.[illegible]	4.96	177.75	44.17	11.77	2.02	2000.00	608.77	117.77	35.00
*	2.[illegible]	5.[illegible]	207.85	45.[illegible]	12.57	2.59	2500.00	609.73	116.35	35.00
*	2.[illegible]	[illegible]	[illegible]	46.[illegible]	13.[illegible]	2.[illegible]	3000.00	610.61	114.[illegible]	35.00

SECNO	DEPTH	AREA	TOPWID	VEL	DV	Q	FG	TOPAS	K-ANCH
3.000	.97	11.75	2[illegible].41	1.28	.02	15.00	602.28	22.99	35.00
3.000	.[illegible]	15.09	27.25	1.[illegible]	.04	2[illegible].00	602.46	27.27	35.00
3.000	.[illegible]	2[illegible].20	28.57	2.[illegible]	.07	50.00	602.76	33.54	35.00
3.000	1.[illegible]	36.16	30.49	3.01	.14	100.00	603.19	40.19	35.00
3.000	1.[illegible]	51.44	33.[illegible]	4.03	.24	200.00	603.84	46.12	35.00
3.000	2.[illegible]	66.69	35.50	4.73	.33	300.00	604.35	48.03	35.00
3.000	2.58	78.43	37.39	5.27	.41	400.00	604.79	50.62	35.00
3.000	2.[illegible]	91.40	39.02	5.75	.48	500.00	605.19	52.47	35.00
3.000	3.59	119.20	41.36	6.62	.64	750.00	606.03	54.09	35.00
3.000	4.15	142.79	42.51	7.35	.79	1000.00	606.79	56.24	35.00
3.000	5.10	183.74	44.45	8.59	1.06	1500.00	607.96	60.10	35.00
3.000	6.43	221.61	46.16	9.65	1.29	2001.00	609.02	61.76	35.00
3.000	6.67	256.28	47.68	10.19	1.51	2500.00	609.98	63.24	35.00
3.000	7.55	289.00	49.06	10.85	1.71	3000.00	610.86	64.45	35.00

SUMMARY OF ERRORS

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 5 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 6 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 7 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 8 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 9 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE=10 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE=11 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE=12 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE=13 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE=14 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 2.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 2 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 3 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 4 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 4 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 5 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 5 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 5 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 6 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 6 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 6 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 7 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 7 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 7 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 8 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 8 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 8 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 9 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 9 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 9 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE=10 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE=10 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE=10 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE=11 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE=11 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE=11 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE=12 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE=12 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE=12 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE=13 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE=13 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE=13 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE=14 CRITICAL DEPTH ASSUMED

B-10

CAUTION SECTION= 2.000 PROFILE=14 PROPANE MINIMUM SPECIFIC ENERGY
CAUTION SECTION= 2.000 PROFILE=14 20 TRIALS ATTEMPTED TO BALANCE WEL

SUMMARY OF PMF AND ONE-HALF PMF ROUTING

```
**********  **********
DROGRAPH PACKAGE (HEC-1)
TY VERSION      JULY 1978
ODIFICATION  81 APR 83
**********  **********
```

```
A1                    MISSOURI DAM SAFETY
A2                     GLEN ROSE LAKE DAM (MO.10700)
A3                      PMF AND 50 PERCENT PMF
B     300       0       5       0       0       0       0       0       0       0
H1      5
J       1       2       1
J1      1      .5
K                DA GR                                          1
K1               RUNOFF CALCULATION FOR GLEN ROSE LAKE DRAINAGE AREA
M       1       2      .15              .15       1                               1
P              25.5     100      120     130
T                                                      -1      -87
M2              .06
X                       1
K       1        GR DM                                         1
K1               ROUTE HYDROGRAPH THROUGH GLEN ROSE LAKE
Y                                       1       1
Y1      1                                                  -601.8      -1
Y4  601.8    602.3   602.5   602.8   603.2   603.8   604.4   604.8   605.2   606.0
Y4  606.7    608.0   609.0   610.0   610.9
Y5      0       14      25      50     100     200     300     400     530    1262
Y5   2439     5539    8587   12025   15465
$A      0       .5       2     3.5       4       5     5.5     7.5
$E    575      580     590     600   601.8     605     610     620
$S  601.8
$D    605
K      59
```

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	601.80	601.80	605.30
STORAGE	46.	46.	51.
OUTFLOW	0.	0.	465.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	606.56	1.56	69.	2197.	.75	15.67	0.00
.50	605.64	.64	64.	932.	.42	15.67	0.00

PERCENT OF PMF ROUTING
EQUAL TO SPILLWAY CAPACITY

```
***********  *******
APH PACKAGE (HEC-1)
RSION      JULY 1978
CATION   01 APR 80
*********************
      A1                       MISSOURI DAM SAFFTY
      A2                        GLEN ROSE LAKE DAM (MO.10700)
      A3                        PERCENT PMF
      B    300       0       5       0       0       0       0       0      -4       0
      B1     5
      J      1       4       1
      J1   .30     .32     .33     .35
      K          DA GR                                   1
      K1         RUNOFF CALCULATION FOR GLEN ROSE LAKE DRAINAGE AREA
      M      1       2     .15             .15       1                       1
      P           25.5     100     120     130
      T                                                 -1     -87
      W2           .06
      X                      1
      K      1    GR DM                                  1
      K1         ROUTE HYDROGRAPH THROUGH GLEN ROSE LAKE
      Y                              1       1
      Y1     1                                      -601.8      -1
      Y4 601.8   602.3   602.5   602.8   603.2   603.8   604.4   604.8   605.2   606.0
      Y4 606.7   608.0   609.0   610.0   610.9
      Y5     0      14      25      50     100     200     300     400     530    1262
      Y5  2439    5539    8587   12025   15465
      $A     0      .5       2     3.5       4       5     5.5     7.5
      $E   575     580     590     600   601.8     605     610     620
      $$ 601.8
      $D   605
      K     99
```

B-16

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	601.00	601.00	605.00
STORAGE	46.	46.	61.
OUTFLOW	0.	0.	465.

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
.30	604.77	0.00	60.	393.	0.00	15.75	0.00
.32	604.89	0.00	60.	430.	0.00	15.75	0.00
.33	604.95	0.00	61.	448.	0.00	15.75	0.00
.35	605.05	.05	61.	483.	.08	15.75	0.00

END

DATE
FILMED
10-81

DTIC