

AD-A105 352

ANDERSON ENGINEERING INC SPRINGFIELD MO

F/8 13/13

NATIONAL DAM SAFETY PROGRAM, LAKE SERENE DAM (MO 30542), MISSIS-ETC(U)

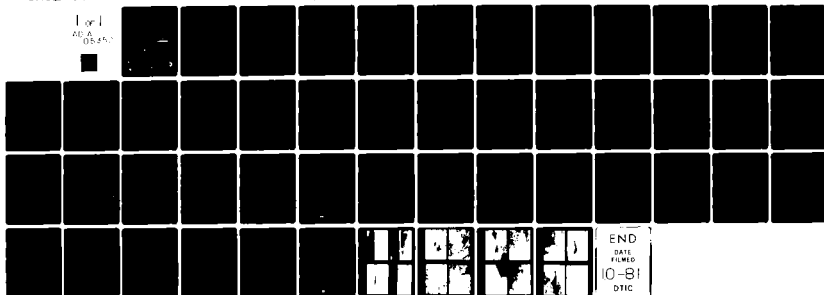
AUG 79 S BRADY, G WERTEPNY, D DANIELS

DACW43-79-C-0070

NL

UNCLASSIFIED

For
AD-A
05450



LEVEL

BS

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AD A105352

LAKE SERENE

FRANKLIN COUNTY, MISSOURI

MO 30542

PHASE 1 INSPECTION REPORT

6 NATIONAL DAM SAFETY INSPECTION

Lake Serene Dam (MO 30542),
Mississippi - Kaskaskia - St. Louis Basin,
Franklin County, Missouri. Phase I
Inspection Report.

Program



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

St. Louis District

9 Final rept.,

15 DACW43-79-C-0070

10 Steve /Brady Gene /Wertepny /
Dave /Daniels Tom /Beckley

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

FOR: STATE OF MISSOURI

DTIC FILE COPY

1259

11 AUG 1979

**DTIC
ELECTE**
OCT 13 1981

A

This document has been approved
for public release and sale; its
distribution is unlimited.

81 10 9 072

4/2554

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105 352	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Lake Serene Dam (MO 30542) Franklin County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
7. AUTHOR(s) Anderson Engineering, Inc.		6. PERFORMING ORG. REPORT NUMBER
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		8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0070
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		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1979
		13. NUMBER OF PAGES Approximately 45
		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.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Lake Serene Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lake Serene Dam:

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) Spillway will not pass 50 percent of the Probable Maximum Flood
- 2) Overtopping could result in dam failure
- 3) Dam failure significantly increases the hazard to loss of life downstream

SIGNED

SUBMITTED BY: _____

Chief, Engineering Division

14 SEP 1979

Date

SIGNED

APPROVED BY: _____

Colonel, CE, District Engineer

14 SEP 1979

Date

LAKE SERENE DAM
FRANKLIN COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30542

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Prepared By

Anderson Engineering, Inc., Springfield, Missouri
Hanson Engineers, Inc., Springfield, Illinois

Under Direction Of
St. Louis District, Corps of Engineers

For
Governor of Missouri

August 1979

Accession No. ☒
 Date Recd. ☐
 From ☐
 To ☐
 Subject ☐
 Remarks ☐
 File No. ☐
 Date ☐
 Initials ☐
 Signature ☐

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Lake Serene Dam
State Located:	Missouri
County Located:	Franklin
Stream:	Tributary of Calvey Creek
Date of Inspection:	May 8, 1979

Lake Serene Dam was inspected by an interdisciplinary team of engineers from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

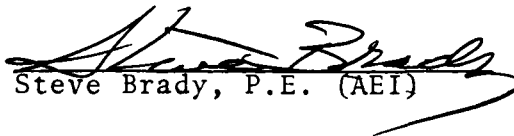
The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers, and they have been developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, the St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur if the dam fails. The estimated damage zone extends approximately 4 miles downstream of the dam. Located within this zone are a factory, two buildings, one railroad and 42 dwellings. The dam is in the small size classification, since it is greater than 25 ft high but less than 40 ft high, and the maximum storage capacity is greater than 50 ac-ft but less than 1000 ac-ft.

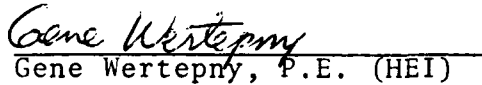
Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillway will pass 27 percent of the Probable Maximum Flood without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the PMF. Considering the large volume of water impounded and the magnitude of the downstream hazard potential, 100 percent of the PMF has been determined to be the appropriate

spillway design flood. The 100-year frequency flood will not overtop the dam. The 100-year flood is one that has a 1 percent chance of being exceeded or equaled in any given year.

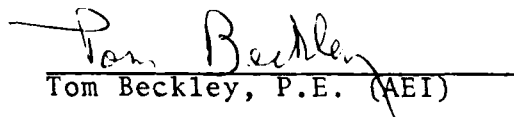
Deficiencies visually observed by the inspection team were: (1) erosion at the contacts of the dam with the north and south abutments; (2) tree and brush growth on downstream face of dam; (3) animal burrows on face of dam; (4) concrete debris on dam face near spillway; and (5) debris in spillway outlet channel. Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action in the near future to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.


Steve Brady, P.E. (AEI)


Gene Wertepny, P.E. (HEI)


Dave Daniels, P.E. (HEI)


Tom Beckley, P.E. (AEI)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SERENE DAM - ID No. 30542

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
	SECTION 1 - PROJECT INFORMATION	
1.1	General	1
1.2	Description of the Project	1
1.3	Pertinent Data	3
	SECTION 2 - ENGINEERING DATA	
2.1	Design	6
2.2	Construction	7
2.3	Operation and Maintenance	7
2.4	Evaluation	8
	SECTION 3 - VISUAL INSPECTION	
3.1	Findings	9
3.2	Evaluation	10
	SECTION 4 - OPERATIONAL PROCEDURES	
4.1	Procedures	11
4.2	Maintenance of Dam	11
4.3	Maintenance of Operating Facilities	11
4.4	Description of Any Warning System in Effect	11
4.5	Evaluation	11
	SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1	Evaluation of Features	12
	SECTION 6 - STRUCTURAL STABILITY	
6.1	Evaluation of Structural Stability	14
	SECTION 7 - ASSESSMENT/REMEDIAL MEASURES	
7.1	Dam Assessment	15
7.2	Remedial Measures	16

APPENDICES

	<u>Sheet</u>
APPENDIX A	
Location Map	1
Vicinity Map	2
Plan, Profile and Section of Dam	3
Plan Sketch of Dam	4
APPENDIX B	
Geologic Regions of Missouri	1
Thickness of Loessial Deposits	2
APPENDIX C	
Overtopping Analysis - PMF	1-7
APPENDIX D	
Photographs of Dam and Lake	1-4

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL:

A. Authority:

The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection be made of Lake Serene Dam in Franklin County, Missouri.

B. Purpose of Inspection:

The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and a visual inspection in order to determine if the dam poses hazards to human life or property.

C. Evaluation Criteria:

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, "Recommended Guidelines for Safety Inspection of Dams, Appendix D." 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:

Lake Serene Dam is an earth fill structure approximately 37 ft high and 1200 ft long at the crest. The appurtenant works consist of a rock cut spillway with a concrete weir control structure located at the south abutment, and a 12 in. diameter siphon pipe located near the north end of the dam. Sheet 3 of Appendix A shows a plan, profile and typical section of the embankment.

B. Location:

The dam is located in the eastern part of Franklin County, Missouri on a tributary of Calvey Creek. The dam and lake are within the Gray Summit, Missouri 7.5 minute quadrangle sheet (Section 03, T42N, R2E - latitude 38° 24.8'; longitude 90° 47.1'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 37 ft and a maximum storage capacity of approximately 913 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has classified this dam as a high hazard dam. The estimated damage zone extends approximately 4 miles downstream of the dam. Located within this zone are a factory, two buildings, one railroad, and 42 dwellings.

E. Ownership:

The dam is owned by The Lake Serene Trustees (in care of Mr. Raymond D. Breeden). The owner's address is 15 Cedar Street, Catawissa, Missouri 63015.

F. Purpose of Dam:

The dam was constructed primarily for recreational purposes, although some flood protection is also provided.

G. Design and Construction History:

No design information is available. According to Mr. Joe Dailey, a member of the development corporation, the dam was built in 1957 with a core trench about 10 ft wide and 5 ft deep. Material for construction of the dam was taken from the north abutment area downstream of the dam and from the lake area. The spillway was blasted into rock at the south abutment, and a concrete control structure was constructed to raise the level of the lake to design elevation. Joe Dailey, indicated that at one time (date unknown) lumber was placed on the control structure to raise the lake level about 6 in. in anticipation of a dry spell. The siphon was installed in the dam in 1965 and has been used only twice (both times in 1965 or 1966). First, the lake was drawn down to construct a peninsula into the lake; then, the lake was drawn down to treat vegetative growth.

H. Normal Operating Procedures:

All flows will be passed by an uncontrolled rock cut spillway with a concrete weir control structure. Information indicates that water passed over the swale at the

north end of the dam (see Sheet 3, Appendix A) during a storm in 1958 or 1959. The highest water in recent memory (Ray Breeden - Trustee) occurred in April 1979. The high water mark as observed in the field is estimated to be at approximate elevation 521.8.

1.3 PERTINENT DATA:

Pertinent data about the dam, appurtenant works, and reservoir are presented in the following paragraphs. Sheet 3 of Appendix A presents a plan, profile and typical section of the embankment.

A. Drainage Area:

The drainage area for this dam, as obtained from the U.S.G.S. quad sheet, is approximately 939 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through an uncontrolled spillway.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 524): 1118 cfs (Calculated using the formula $Q = CLH^{3/2}$)
- (3) Estimated Capacity of Spillway: 1118 cfs
- (4) Estimated Experienced Maximum Flood at Dam Site: 1118 cfs (Elev. 524.0)
- (5) Diversion Tunnel Low Pool Outlet at Pool Elevation: Not Applicable
- (6) Diversion Tunnel Outlet at Pool Elevation: Not Applicable
- (7) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (8) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed elevation of 519.0 for the spillway crest as shown on the Gray Summit, Missouri 7.5 minute quadrangle.

- (1) Top of Dam: 524
- (2) Principal Spillway Crest: 519.0
- (3) Emergency Spillway Crest: None
- (4) Principal Outlet Pipe Invert: Not Applicable
- (5) Streambed at Centerline of Dam: 487.4
- (6) Pool on Date of Inspection: 519.1
- (7) Apparent Recent High Water Mark: 521.8 (Measured on Day of Inspection)
- (8) Maximum Tailwater: Unknown
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Spillway Crest: 2250 ft
- (2) At Top of Dam: 2670 ft

E. Storage Capacities:

- (1) At Spillway Crest: 608 acre-ft
- (2) At Top of Dam: 913 acre-ft

F. Reservoir Surface Areas:

- (1) At Spillway Crest: 57 acres
- (2) At Top of Dam: 65 acres

G. Dam:

- (1) Type: Rolled earth
- (2) Length at Crest: 1200 ft

- (3) Height: 37 ft
- (4) Top Width: 16 ft
- (5) Side Slopes: Upstream irregular; Downstream irregular
(See Sheet 3, Appendix A)
- (6) Zoning: Unknown
- (7) Impervious Core: Unknown
- (8) Cutoff: Shallow core trench (depth of about 5 ft and
about 10 ft wide - information from Joe Dailey).
- (9) Grout Curtain: Unknown

H. Diversion and Regulating Tunnel:

- (1) Type: Not Applicable
- (2) Length: Not Applicable
- (3) Closure: Not Applicable
- (4) Access: Not Applicable
- (5) Regulating Facilities: Not Applicable

I. Spillway:

I.1 Principal Spillway:

- (1) Location: South Abutment
- (2) Type: Rock cut with concrete weir control structure.

I.2 Emergency Spillway:

- (1) Location: Not Applicable
- (2) Type: Not Applicable

J. Regulating Outlets:

The dewatering facility for the dam consists of a 12 in. diameter siphon which is located in the northern portion of the dam (approximate station 3+00).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

No design computations or reports for Lake Serene Dam are available. No documentations of construction inspection records have been obtained. There are no documented maintenance data to our knowledge.

A. Surveys:

No information regarding pre-construction surveys was obtained. Sheet 3 of Appendix A presents a plan, profile and cross section of the dam from survey data obtained during the site inspection. The crest of the spillway was used as datum (Elev. 519.0 as indicated by the U.S.G.S. quad sheet).

B. Geology and Subsurface Materials:

The site is located near the northeastern limit of the Ozarks geologic region of Missouri. The Ozarks are characterized topographically by hills, plateaus and deep valleys. The most common bedrock types are dolomite, sandstone and chert. The "Geologic Map of Missouri" indicates that the bedrock in the site area consists primarily of the Jefferson City formation of the Canadian Series in the Ordovician System. The Jefferson City formation is composed principally of light brown to brown medium to finely crystalline dolomite and argillaceous dolomite. The publication "Caves of Missouri" indicates that while numerous caves are known to exist in Franklin County, they are densely clustered in the south-central part of the county, at least 15 miles from the site.

The Jefferson City formation in the area of Lake Serene Dam is overlain by a relatively thin (5 to 10 ft) mantle of soils. The soils, belonging to the Union Fullerton-McGirk Soil Association, consist of a veneer of clayey residual material overlain by a cover of loess. Information supplied by the Missouri Geological Survey indicates that alluvial deposits in broad valleys have a top few feet of silt loam, becoming more clay-rich for several more feet. Permeable gravels and sand may not be encountered for 15 to 20 ft in deeper valleys.

C. Foundation and Embankment Design:

No foundation and embankment design information was available. Seepage and stability analyses apparently were not performed as required in the guidelines. Information from Joe Daily indicates that a core trench was constructed at the base of the dam. The depth of the core trench is reported to be 5 ft, and it is about 10 ft wide. There is apparently no particular zoning of the embankment, and no internal drainage features are known to exist. No construction inspection test results have been obtained.

D. Hydrology and Hydraulics:

No hydrologic or hydraulic design computations for Lake Serene Dam were available. Based on a field check of spillway dimensions and embankment elevations, and a check of the drainage area on U.S.G.S. quad sheets, hydrologic analyses using U.S. Army Corps of Engineers guidelines were performed and appear in Appendix C, Sheets 1 to 7. It was concluded that the structure will pass 27 percent of the Probable Maximum Flood without overtopping. The 100-year frequency flood will not overtop the dam.

E. Structure:

The only appurtenant structures are the 12 in. diameter siphon pipe and the concrete control section for the spillway. No design information concerning these structures is available.

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION AND MAINTENANCE:

Normal flows are passed by the uncontrolled spillway. The siphon is reported to have been used twice during or about 1966: once to treat vegetative growth, and once to facilitate construction within the lake area. Each time, the lake was drawn down approximately 10 ft. No actual operating records are known to exist.

It is reported that trees and brush on the dam are removed approximately every three years. Erosion damage in the spillway approach area was repaired last fall with several loads of dirt covered with 2 in. to 4 in. of limestone rock, (see Photo No. 9).

2.4 EVALUATION:

A. Availability:

No engineering data, seepage or stability analyses, or construction test data were available.

B. Adequacy:

The engineering data available were inadequate to make a detailed assessment of the design, construction, and operation of this structure. 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:

To our knowledge, no valid engineering data on the design or construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on May 8, 1979. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steve Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dave Daniels - Hanson Engineers, Inc. (Geotechnical Engineer)

B. Dam:

The dam appears to be generally in good condition. No sloughing or obvious seepage through the embankment was noted. The horizontal alignment of the embankment is good. The dam is fairly level across the crest, and no surface cracking or unusual movement was obvious. Shallow auger probes into the embankment indicated the dam to consist of a brown and gray silty clay which appeared to be of loessial origin. Information from local residents indicated that borrow material for construction of the embankment was obtained from the north abutment area and lake area.

Small erosion channels are located on the front face of the dam near the contacts with the north and south abutments. Also, several large animal holes were present on the face of the dam near the north end of the dam (see Photo No. 7). Light brush is present along the downstream face of the dam; a heavy growth of small trees and brush exists along the southern one-third of the downstream face. A considerable amount of concrete debris is present at the south abutment-dam contact (see Photo No. 6). This debris is used as a shelter by small animals, and numerous burrows exist at this location. Wave protection for the upstream face of the dam consists of a fairly intact layer of large gravel (maximum 2 in. size). No instrumentation (monuments, piezometers, etc.) was observed.

C. Appurtenant Structures:

C.1 Primary Spillway:

The approach to the spillway is riprapped on each side, and the approach has a few small trees on the north side.

The concrete control section appears to be in good condition. The spillway channel downstream of the control section is well separated from the embankment, and its base is cut into bedrock. A plunge pool has been eroded into the bedrock at valley floor level well downstream of the concrete control section. Spillway releases then filter through a pile of dumped rock and then into the outlet channel (see Photo No. 13).

C.2. Emergency Spillway:

There is no emergency spillway associated with Lake Serene Dam.

D. Reservoir:

The watershed is generally wooded, with a residential subdivision located immediately around the lake. The slopes adjacent to the lake are moderate, and no sloughing or serious erosion was noted.

E. Downstream Channel:

The downstream channel has some wood debris near its confluence with the old stream channel (see Photo No. 14). The channel is fairly heavily wooded.

3.2 EVALUATION:

Trees and brush on the dam constitute a potential seepage hazard and encourage animal burrowing. Trees in the approach to the spillway can restrict flood flows. The erosional area and animal holes at the north end of the embankment could worsen and adversely affect the stability of the dam. The concrete debris at the south end of the embankment face has served to promote animal burrows in this area. The wood debris in the outlet channel can restrict spillway flows.

All of the above are deficiencies which should be corrected under the direction of an engineer experienced in the design and construction of dams.

Photographs of the dam, appurtenant structures, and the reservoir are presented in Appendix D.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no controlled outlet works for this dam except for the 12 in. diameter drawdown pipe (siphon) which is apparently used very infrequently. The spillway is uncontrolled, so that the pool is normally controlled by rainfall, runoff and evaporation.

4.2 MAINTENANCE OF DAM:

Mr. Ray Breeden, a member of the Lake Serene Trustees, indicated that brush and trees on the dam are cut about every three years.

4.3 MAINTENANCE OF OPERATING FACILITIES:

Although the drawdown facilities (siphon) appear to be in good condition, it is not known whether they are regularly maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT:

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION:

The concrete debris at the south dam-abutment contact, vegetation on the embankment face, erosional areas, and animal burrows are serious deficiencies which should be corrected, under the direction of an experienced engineer, to avoid creating an unsafe condition.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. & B. Design and Experience Data:

The hydraulic and hydrologic analyses were based on: (1) a field survey of spillway dimensions and embankment elevations, and (2) an estimate of the pool and drainage areas from the U.S.G.S. quad sheet; Joe Dailey reported that the north end of the dam was overtopped in 1958 or 1959. A local resident indicated that the lake level this spring was the highest it had been in recent years. The high water mark was visible at elevation 521.8 (2.8 ft above normal pool). Our hydrologic and hydraulic analyses using U. S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approach to the spillway contains small trees and brush. Wood debris exists in the outlet channel near its confluence with the old stream channel. The concrete control section appears to be in good condition. The spillway channel is well separated from the embankment, and spillway releases would not be expected to endanger the dam.

D. Overtopping Potential:

Based on the hydrologic and hydraulic analysis presented in Appendix C, the spillway will pass 27 percent of the Probable Maximum Flood. The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The recommended guidelines from the Department of the Army, Office of the Chief of Engineers, require that this structure (small size with high downstream hazard potential) pass 50 percent to 100 percent of the PMF, without overtopping. Considering the large volume of water impounded, and the magnitude of the downstream hazard potential, 100 percent of the PMF has been determined to be the appropriate spillway design flood. The structure will pass a 100-year frequency flood without overtopping.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 2.06 ft at elevation 526.06. The duration of the overtopping will be 5.92 hours, and the maximum outflow will be 12,437 cfs. The maximum discharge capacity of the spillways is 1118 cfs. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure. Considering the height and duration of overtopping and the silty nature of the embankment materials, the design flood would be expected to cause considerable damage to the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

Features observed which could adversely affect the structural stability of this dam are discussed in Sections 3.1B and 3.2.

B. Design and Construction Data:

No design and construction data for the foundation and embankment were available. Seepage and stability analyses comparable to the requirements of the guidelines were not available, which constitutes a deficiency which should be rectified.

C. Operating Records:

To our knowledge, no operating records exist.

D. Post-Construction Changes:

The embankment was constructed in 1957. The only apparent post-construction change was the installation of the siphon pipe in 1965.

E. Seismic Stability:

The structure is located in seismic zone 2, immediately adjacent to zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

This Phase I inspection and evaluation should not be considered as being comprehensive since the scope of work contracted for is far less detailed than would be required for an in-depth evaluation of dams. Latent deficiencies, which might be detected by a totally comprehensive investigation, could exist.

A. Safety:

The embankment is generally in good condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) brush and tree growth on the dam; (2) minor erosion at the dam-abutment contacts; (3) concrete debris on the face of the dam; (4) animal burrows in the embankment; (5) small tree growth in the approach to the spillway; and (6) wood debris in the outlet channel. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is also considered a deficiency.

The dam will be overtopped by flows in excess of 27 percent of the Probable Maximum Flood. Calculations indicate that the dam would be overtopped by 2.06 ft for a duration of 5.92 hours. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

B. Adequacy of Information:

The conclusions in this report were based on review of the information listed in Section 2.1, the performance history as related by others, and visual observation of external conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

C. Urgency:

The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. If the deficiencies listed in paragraph A are not corrected, and if

good maintenance is not provided, the embankment condition will deteriorate and possibly could become serious in the future. Priority should be given to remedial measures described in Section 7.2(1).

D. Necessity for Phase II:

Based on the result of the Phase I inspection, no Phase II inspection is recommended.

E. Seismic Stability:

The structure is located in seismic zone 2, immediately adjacent to zone 1. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

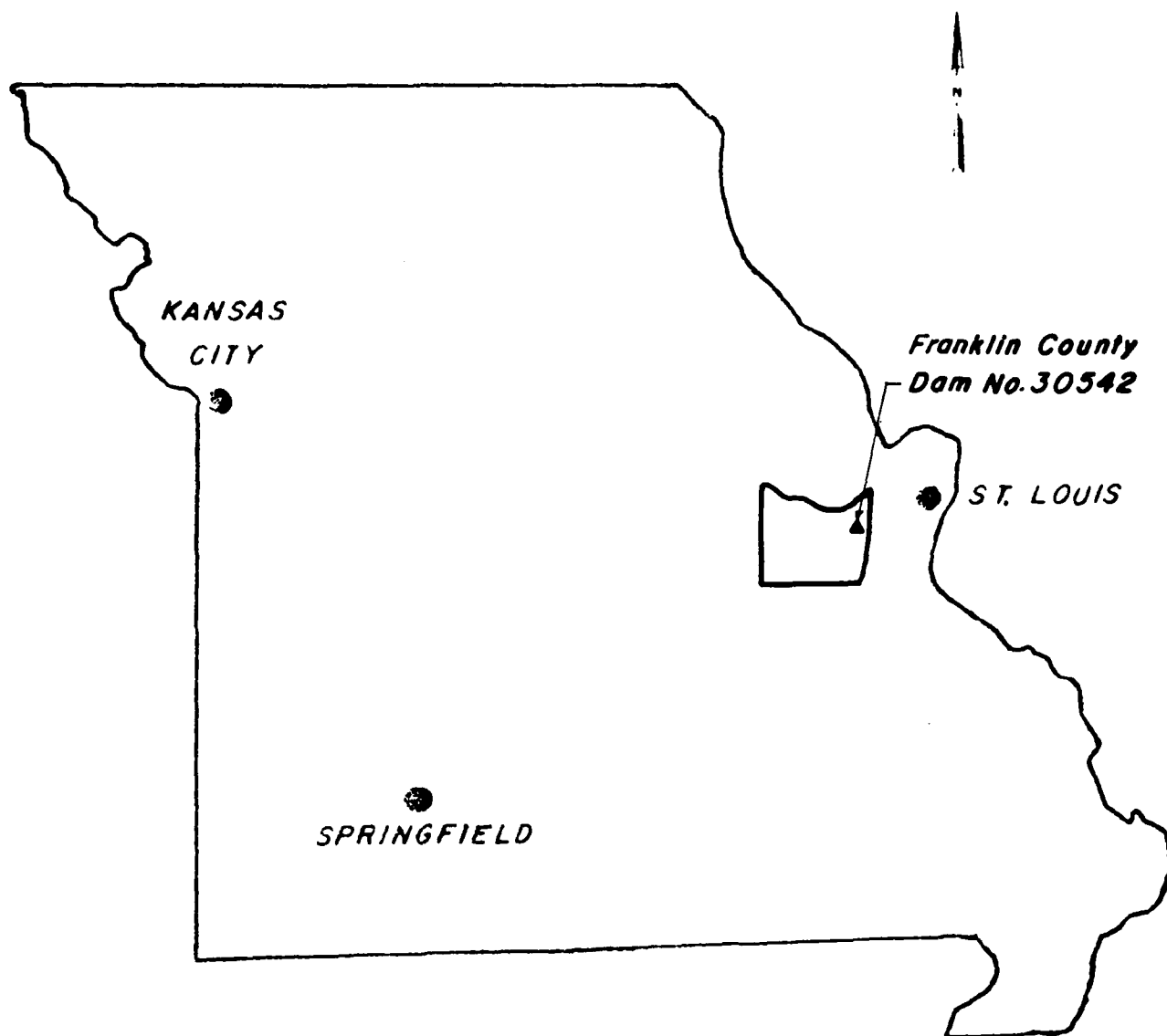
7.2 REMEDIAL MEASURES:

The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

- (1) Spillway size and/or height of dam should be increased to pass the PMF. In either case, the spillway should be protected to prevent erosion.
- (2) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (3) Brush and tree growth should be removed from the dam and from the approach to the spillway. This should be done under the guidance of a professional engineer experienced in the design and construction of dams. Indiscriminate clearing methods could jeopardize the safety of the dam.
- (4) Erosional areas at dam-abutment contacts should be repaired and maintained.
- (5) The concrete debris on the face of the dam near the spillway should be removed and the animal burrows filled.

- (6) Animal burrows on the rest of the dam should be repaired.
- (7) The wood debris in the outlet channel should be removed.
- (8) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

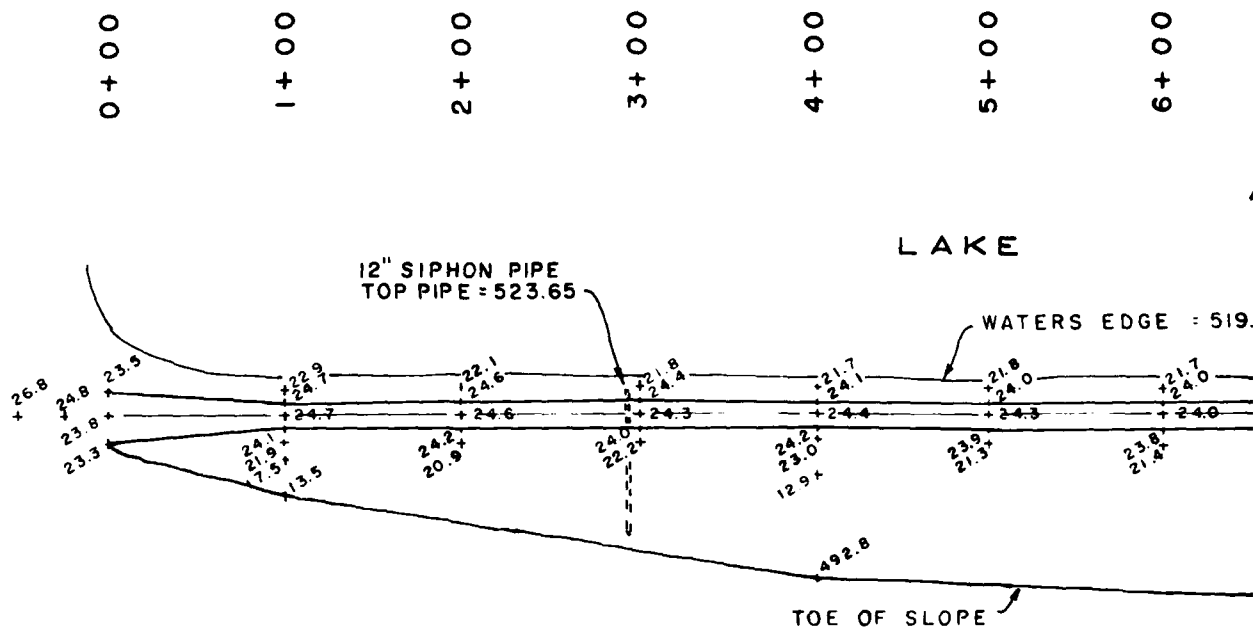
APPENDIX A



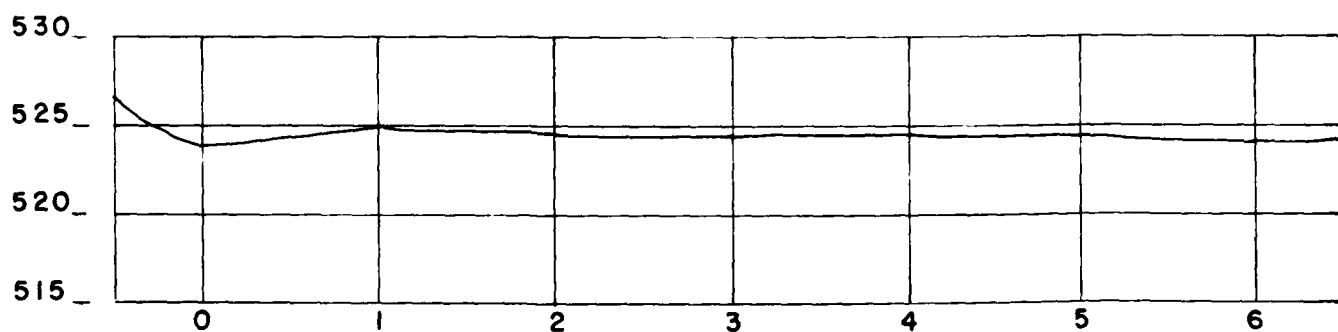
LOCATION MAP



SITE VICINITY MAP

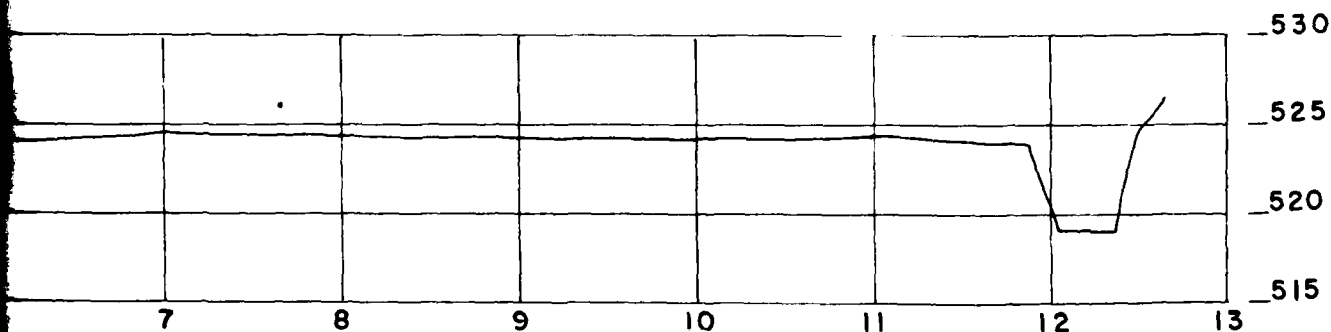


PLAN VI
SCALE: 1"=10'



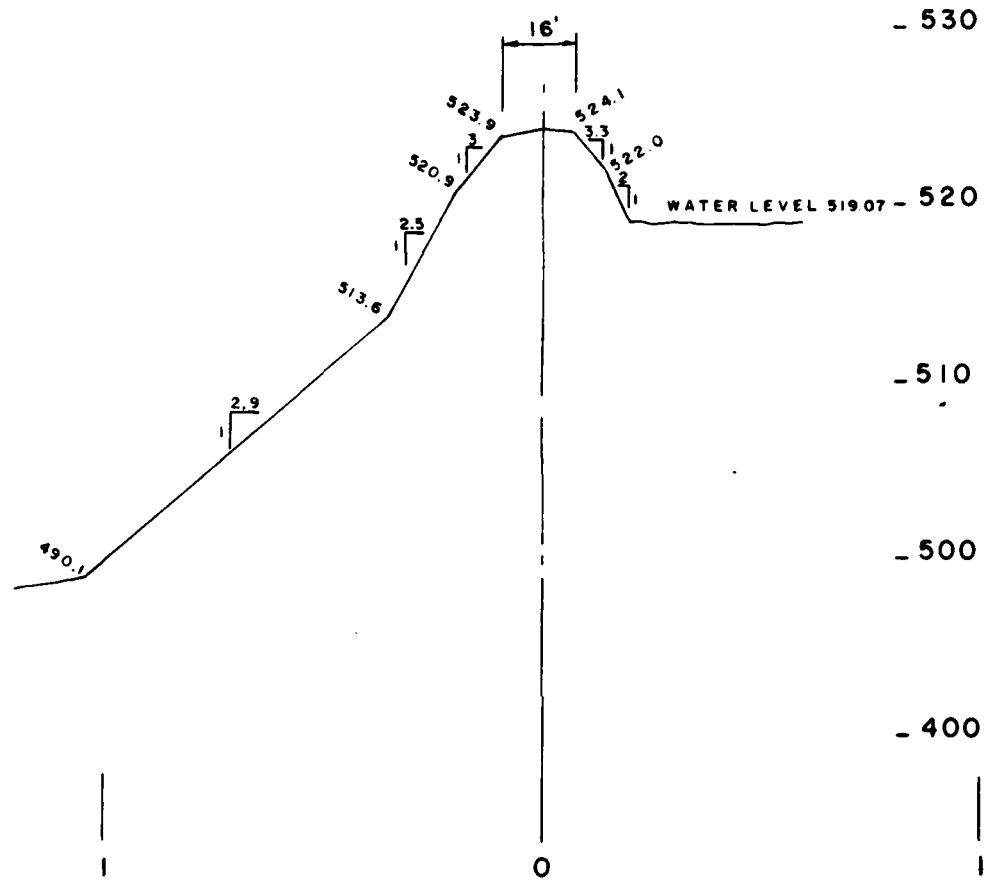
PROF

2+00

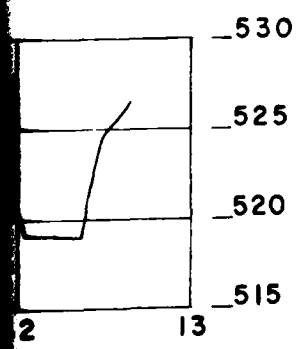
 $1'' = 100'$ 

PROFILE

12+00



SECTION A-A STA 7+00



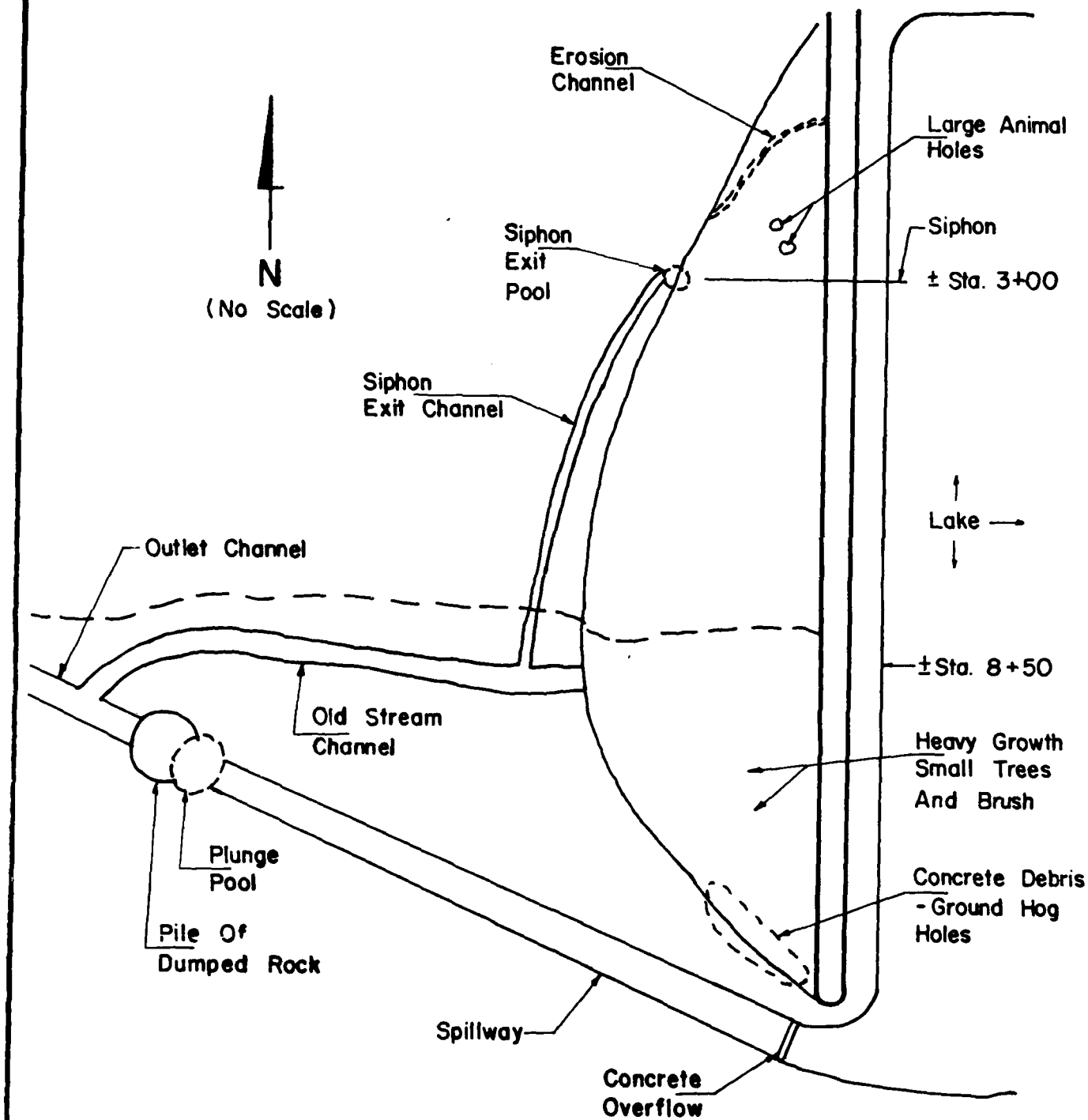
ANDERSON ENGINEERING, INC.
730 NORTH BENTON AVENUE
SPRINGFIELD, MISSOURI 65802

LAKE SERENE DAM
MO. No. 30542

PLAN & PROFILE

Sheet 3 Appendix A

FRANKLIN COUNTY, MO.



Plan Sketch of Major Features

DRAWN JAR
 CHECKED DED
 DATE 5-30-79
 JOB NO 79511



SPRINGFIELD ILL

PEORIA ILL

Lake Serene Dam
 Catowissa, Missouri

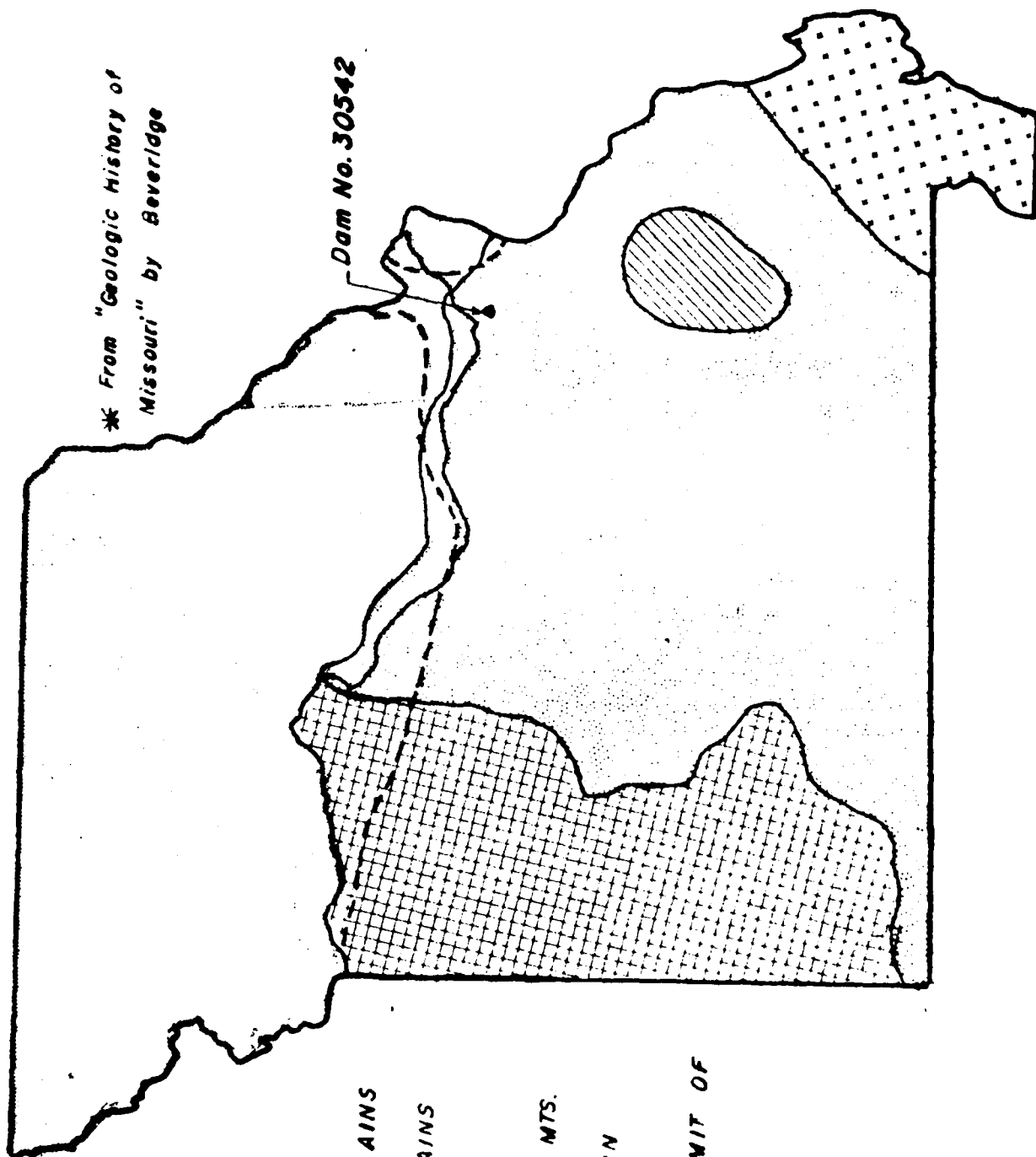
Sheet 4 Appendix A

APPENDIX B

MAJOR GEOLOGIC REGIONS OF MISSOURI

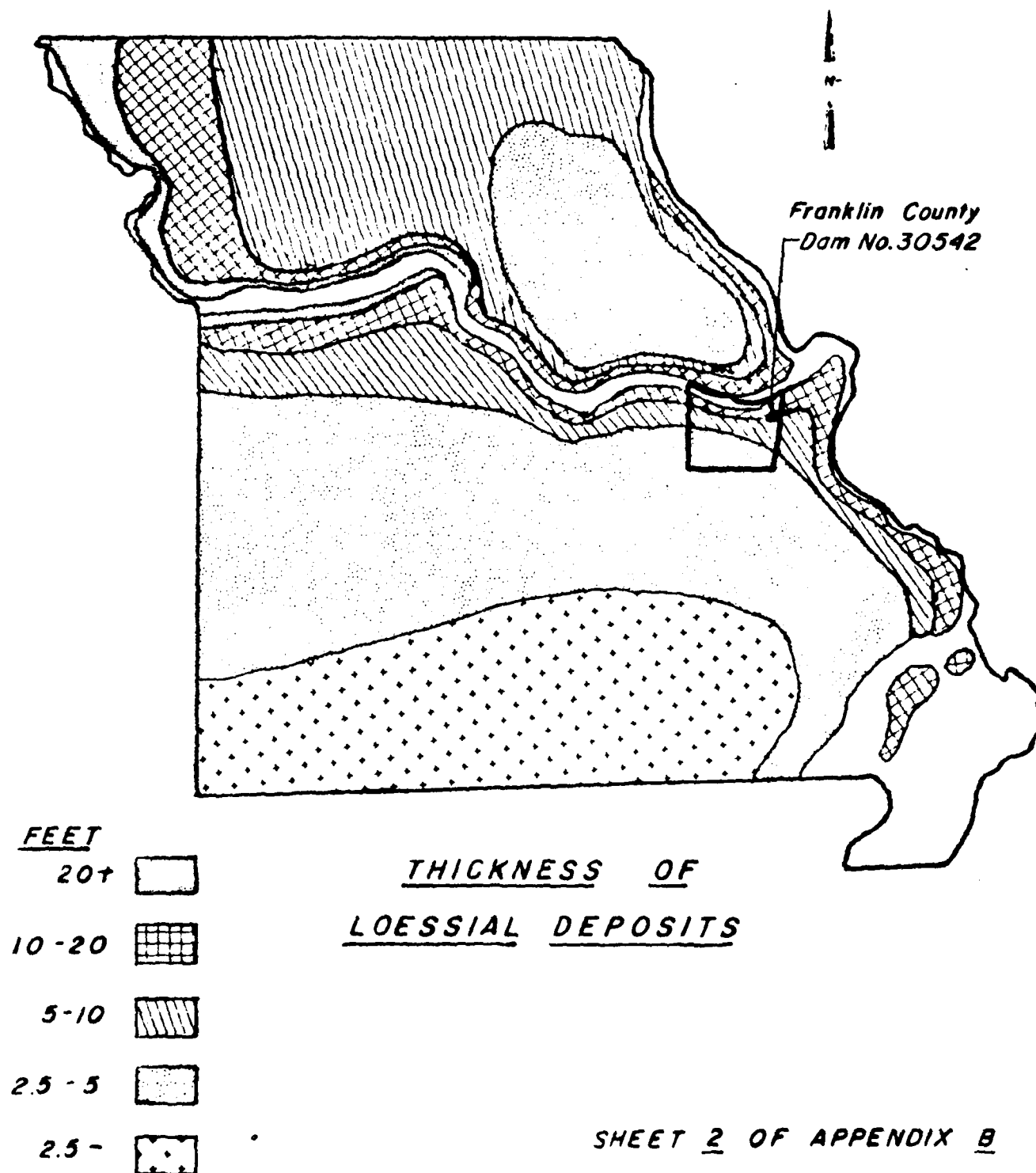
* From "Geologic History of Missouri" by Beverage

Dam No. 30542



- GLACIATED PLAINS
- WESTERN PLAINS
- OZARKS
- ST. FRANCOIS MTS.
- SOUTHEASTERN LOWLANDS
- SOUTHERN LIMIT OF GLACIATION

* From "Soils of Missouri"



APPENDIX C



HYDRAULIC AND HYDROLOGIC DATA

Design Data: From Field Measurements and Computations

Experience Data: No records are available. A trustee indicated that the range in water levels has been between 8 ft below and 2.8 ft above the normal pool level. He also indicated that the dam has never been overtopped.

Visual Inspection: At the time of the inspection the pool level was approximately 0.1 ft above below normal pool.

Overtopping Potential: Flood routing studies were performed to determine the overtopping potential of the dam. The guidelines require that a dam of small size with a high downstream hazard potential pass 50 to 100 percent of the Probable Maximum Flood. Considering the large volume of water impounded and the magnitude of the downstream hazard potential, 100 percent of the PMF has been determined to be the appropriate spillway design flood. The PMF is defined by the guidelines as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The watershed drainage and the reservoir surface areas were obtained by planimeter from the U.S.G.S. 7.5 min. Gray Summit, Mo. quadrangle map. The reservoir area elevation relationship was developed from these data.

A 5 minute interval unit graph was developed for this watershed which resulted in a peak inflow of 1946 c.f.s. and a time to peak of 20 minutes. Application of the probable maximum precipitation, minus losses resulted in a flood hydrograph peak inflow of 13,399 c.f.s. Rainfall distribution for the 24 hour storm was according to EM 1110-2-1411.

The routing of the PMF through the spillway and dam indicates that the dam will be overtopped by 2.06 ft at elevation 526.06. The duration of the overtopping will be 5.92 hours, and the maximum outflow will be 12,437 cfs. The maximum discharge capacity of the spillway is 1,942 cfs. Analysis of the routing results indicates that the structure will pass the 100-year frequency flood and 27 percent of the PMF without overtopping.

OVERTOPPING ANALYSIS FOR LAKE SERENE DAM

INPUT PARAMETERS

1. Unit Hydrograph - SCS Dimensionless - Flood Hydrograph Package (HEC-1); Dam Safety Version Was Used.

Hydraulic Inputs Are As Follows:

- a. Twenty-four Hour Rainfall of 25.4 Inches
For 200 Square Miles - All Season Envelope
 - b. Drainage Area = 939 Acres; = 1.47 Sq. Miles
 - c. Travel Time of Runoff 0.53 Hrs.; Lag Time 0.32 Hrs.
 - d. Soil Conservation Service Soil Group C
 - e. Soil Conservation Service Runoff Curve No. 94
(AMC III)
 - f. Proportion of Drainage Basin Impervious 0.08
2. Spillways
- a. Primary Spillway: Concrete Weir
 - b. Emergency Spillway None
Length Ft.; Side Slopes ; C =
 - c. Dam Overflow
Length 1200 Ft.; Side Slopes ; C = 3.0

Note: Spillway and Dam Rating Curve Prepared by Hanson Engineers. Data Provided To Computer on Y4 and Y5 Cards.

SUMMARY OF DAM SAFETY ANALYSIS

1. Unit Hydrograph

- a. Peak - 1946 c.f.s.
- b. Time to Peak 20 Min.

2. Flood Routings Were Computed by the Modified Puls Method

a. Peak Inflow

50% PMF 6699 c.f.s.; 100% PMF 13,399 c.f.s.

b. Peak Elevation

50% PMF 525.16 100% PMF 526.06

c. Portion of PMF That Will Reach Top of Dam

27 %; Top of Dam Elev. 524 Ft.

Note: Time of Concentration From Equation $T_c = \left(\frac{11.9 L^3}{H} \right)^{.385}$
California Culvert Practice, California Highways and
Public Works, Sept. 1942.

A	OVERTOPPING ANALYSIS FOR LAKE SERENE DAM (#25)									
A	CO CODE 071 CO NAME FRANKLIN STATE ID MO 30542 OWNER TRUSTEES									
A	HANSON ENGINEERS INC DAM SAFETY INSPECTION JOB #79511									
B	300			5						
B1	5									
J	1		7	1						
J1	0.2		0.3	0.4	0.5	0.6	0.8	1.0		
K	0		1				3	1		
K1	INFLOW HYDROGRAPH COMPUTATION									
M	1		2	1.47		1.47	1			1
P	0		25.4	102	120	130				
T									-1	-94
W2	0.53		0.32							0.08
X	0		-0.1	2						
K	1		2			2	4	1		
K1	RESERVOIR ROUTING BY MODIFIED PULS AT LAKE SERENE DAM									
Y					1	1				
Y1	1							608	-1	
Y4	519		520	521	522	523	524			
Y5	0		75	230	443	750	1118			
\$A	0		57	65						
\$E	487		519	524						
\$S	519									
\$D	524		3.0	1.5	1200					
K	99									

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS						
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
HYDROGRAPH AT	1	1.47	1	2680.	4020.	5359.	6699.	8039.	10719.	13399.
	(3.81)	(75.88)	(113.82)	(151.76)	(189.70)	(227.65)	(303.53)	(379.41)	(486.81)	(614.41)
ROUTED TO	2	1.47	1	847.	2199.	4328.	5979.	7291.	9867.	12437.
	(3.81)	(75.88)	(113.82)	(151.76)	(189.70)	(227.65)	(303.53)	(379.41)	(486.81)	(614.41)

SUMMARY OF DAM SAFETY ANALYSIS

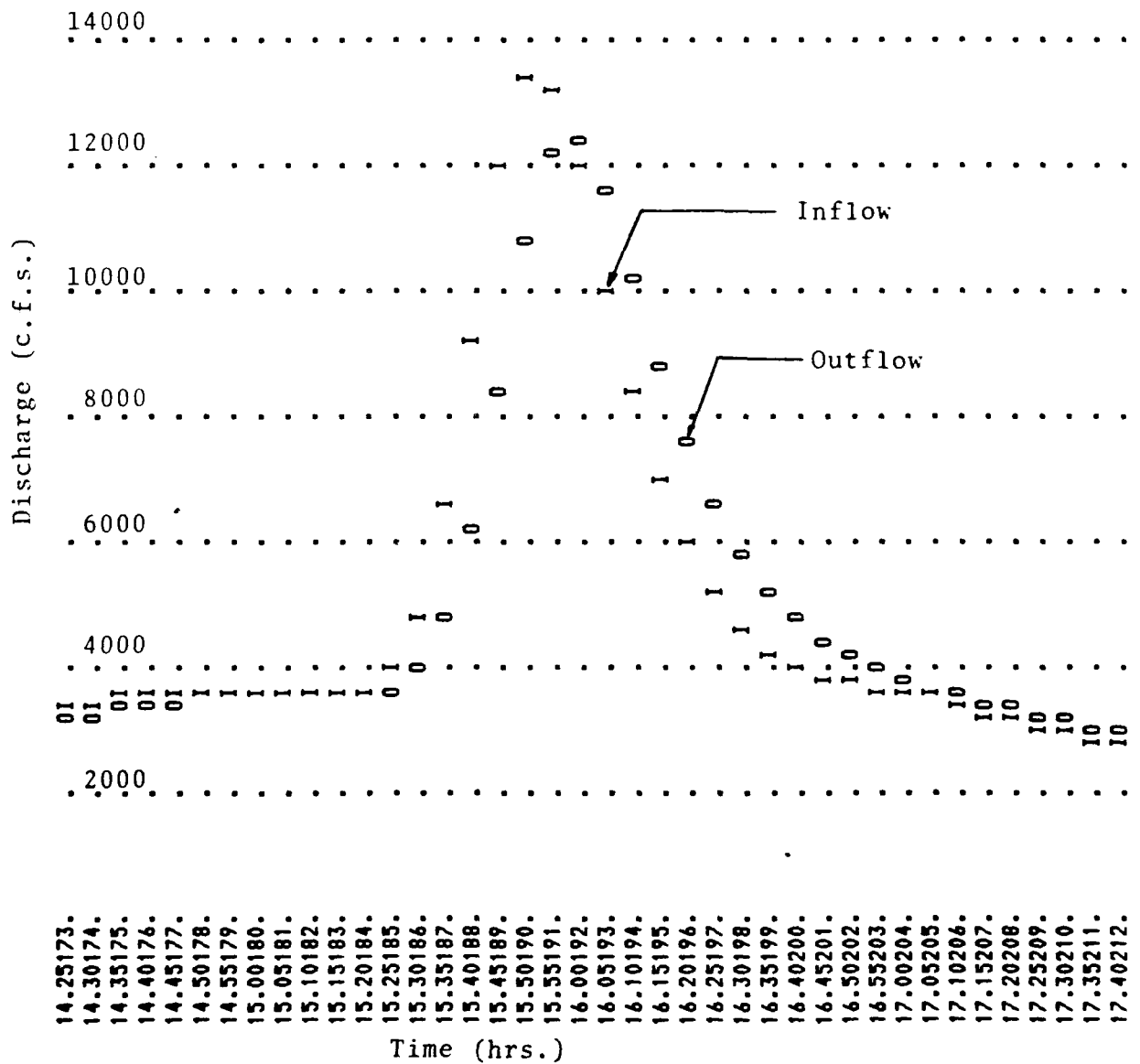
PLAN 1	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	DURATION OVER TOP HOURS	MAXIMUM OUTFLOW CFS	MAXIMUM STORAGE AC-FT	MAXIMUM DEPTH OVER DAM	MAXIMUM RESERVOIR U.S.ELEV	RATIO OF PMF	TIME OF FAILURE HOURS
	519.00	519.00	524.00	524.00	0.00	847.	861.	0.00	523.20	0.20	0.00
	608.	608.	913.	913.	1.50	2199.	940.	0.41	524.41	0.30	0.00
	0.	0.	1118.	1118.	2.58	4328.	970.	0.87	524.87	0.40	0.00
					3.33	5979.	989.	1.16	525.16	0.50	0.00
					4.08	7291.	1003.	1.36	525.36	0.60	0.00
					5.17	9867.	1027.	1.73	525.73	0.80	0.00
					5.92	12437.	1050.	2.06	526.06	1.00	0.00

INFLOW OUTFLOW

HYDROGRAPH
FOR P.M.F.

Max. Inflow = 13,399 c.f.s.

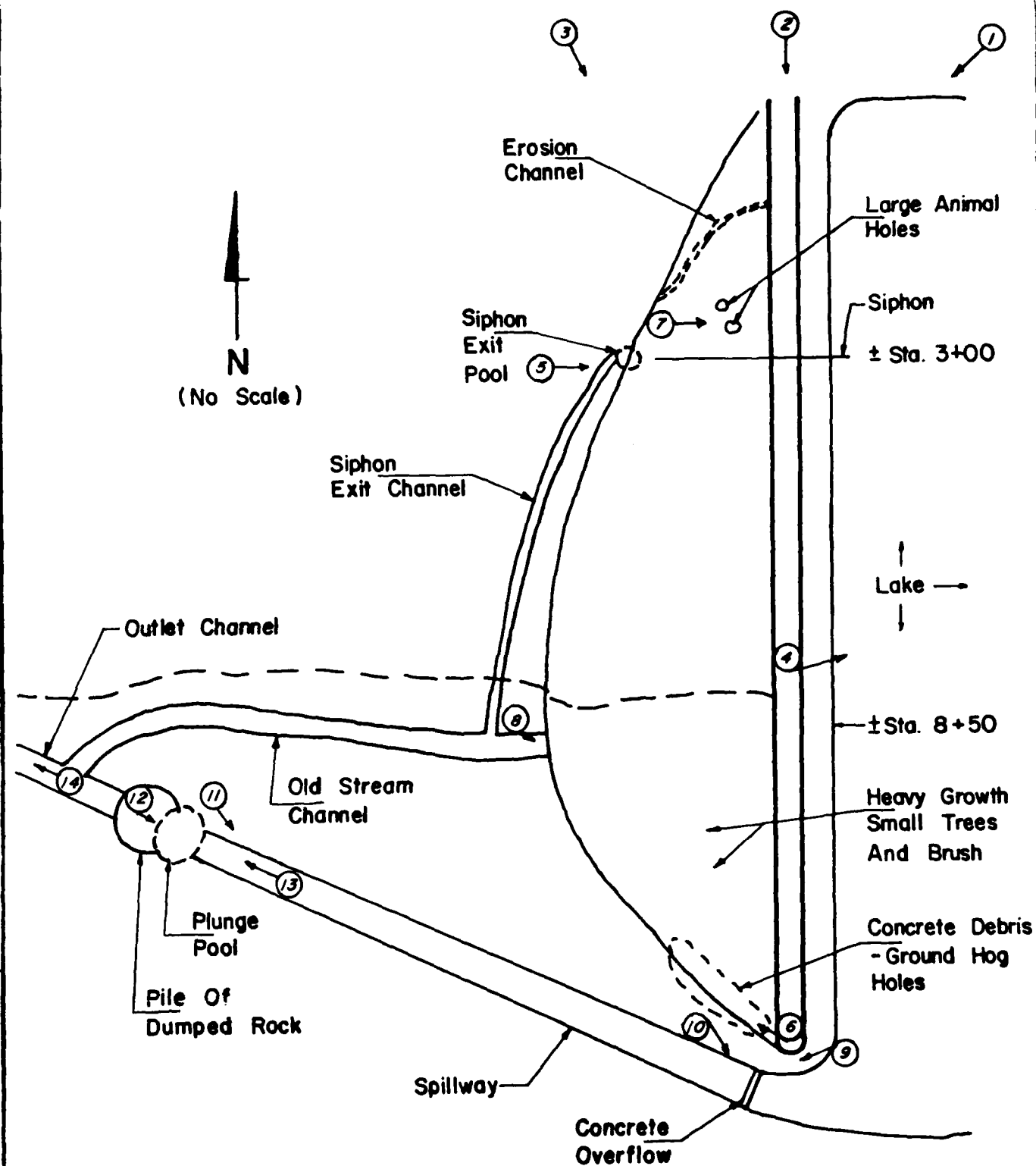
Max. Outflow = 12,437 c.f.s.



APPENDIX D

LIST OF PHOTOGRAPHS

<u>Photo No.</u>	<u>Description</u>
1.	Upstream Face of Embankment
2.	Crest of Embankment (Looking South)
3.	Downstream Face of Embankment
4.	Reservoir Area
5.	Exit of Siphon Pipe
6.	Concrete Debris at South End of Dam
7.	Animal Burrow
8.	Contact of Dam with Old Stream Channel
9.	Spillway Approach Channel
10.	Control Section of Spillway
11.	View of Rock Cut Spillway (Looking Upstream)
12.	Plunge Pool
13.	Plunge Pool (Looking Downstream)
14.	Outlet Channel (Note Wood Debris)
15.	Aerial - Looking North Across Dam
16.	Aerial - Lake and Watershed Looking Southeast



Plan of Photograph Locations			Lake Serene Dam Catawissa, Missouri	
DRAWN	JAR	 HANSON ENGINEERS SPRINGFIELD ILL. PEORIA ILL.	Sheet 2 Appendix D	
CHECKED	DED			
DATE	5-30-79			
JOB NO.	79511			

