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MISSISSIPPI-ST. FRANCIS RIVER BASIN

POTASHNICK LAKE DAM

WAYNE COUNTY, MISSOURI

MO 30565

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



United States Army
Corps of Engineers

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St. Louis District

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

FOR: STATE OF MISSOURI

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

SUBJECT: Potashnick Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Potashnick Lake Dam (MO No. 30565).

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

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

- a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- b. Overtopping of the dam could result in failure of the dam.
- c. Dam failure significantly increases the hazard to loss of life downstream.

SIGNED

SUBMITTED BY: _____
Chief, Engineering Division

13 FEB 1981

Date

APPROVED BY: _____
Colonel, District Engineer

SIGNED

16 MAR 1981

Date

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MISSISSIPPI-ST. FRANCIS RIVER BASIN

POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MISSOURI INVENTORY NO. 30565

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

DECEMBER, 1980

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
SUMMARY

Name of Dam: Potashnick Lake Dam
State Located: Missouri
County Located: Wayne
Stream: Tributary of St. Francis River (Lake Wappapello)
Date of Inspection: October 7, 1980

Potashnick Lake 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 this 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 one mile downstream of the dam. Located within this zone are two dwellings and a trailer.

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 1,000 ac-ft.

Our inspection and evaluation indicates that the combined spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The combined spillways will pass 25 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

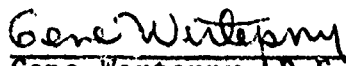
the low height of dam (26 ft) and the small storage capacity (64 acre-ft) 50 percent of the PMF has been determined to be the appropriate spillway design flood. The 100-year flood (1 percent probability flood) will not overtop the dam. The 1 percent probability flood is one that has a 1 percent chance of being exceeded in any given year.

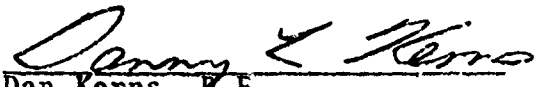
The embankment was in good condition. Deficiencies visually observed by the inspection team were: (1) Scattered brush and tree growth on upstream and downstream faces of embankment; (2) No wave protection for upstream face; (3) Animal burrows in upstream and downstream faces; (4) Trash screen in need of repair; (5) Apparent seepage at principal spillway outlet; and (6) Downstream channel lined with trees and brush.

Another deficiency was the lack of seepage and stability analysis records.

It is recommended that the owners take the necessary action without undue delay to correct the deficiencies reported herein. A detailed discussion of these deficiencies is included in the following report.

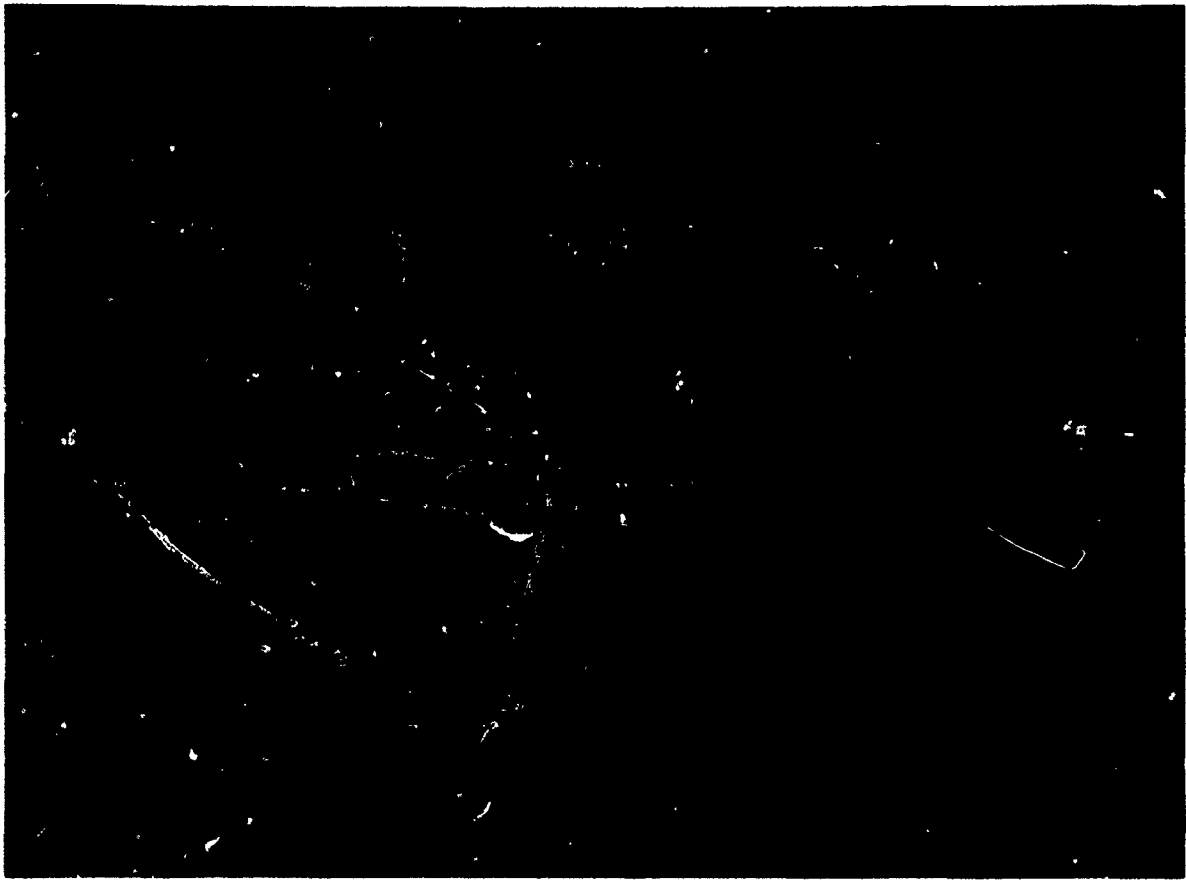

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AERIAL VIEW OF LAKE AND DAM

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
POTASHNICK LAKE DAM
MISSOURI INVENTORY NO. 30565

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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 Potashnick Lake Dam in Wayne 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:

Potashnick Lake Dam is an earth fill structure approximately 26 ft high and 650 ft long at the crest. The appurtenant work consists of a 15 in. principal spillway corrugated metal pipe with 18 in. CMP riser and an earthcut emergency spillway channel.

Sheet 3 of Appendix A shows a plan, profile, and typical section of the embankment. Sheets 4 and 5 of Appendix A shows a cross-section and profile of the emergency spillway.

B. Location:

The dam is located in the north central part of Wayne County, Missouri on a tributary of St. Francis River (Lake Wappapello). The dam and lake are within the Greenville, Missouri 7.5 minute quadrangle sheet (Survey Number 2211, T30N, R5E - latitude 37°13.8'; longitude 90°28.6'). Sheet 2 of Appendix A shows the general vicinity.

C. Size Classification:

With an embankment height of 26 ft and a maximum storage capacity of approximately 64 acre-ft, the dam is in the small size category.

D. Hazard Classification:

The St. Louis District, Corps of Engineers has determined that this dam is in the high hazard potential classification. The estimated damage zone extends approximately one mile downstream of the dam. Located within this zone are two dwellings and a trailer. The affected features located within the damage zone were field verified by the inspection team.

E. Ownership:

The dam is owned by Boy Scouts of America, Attention Mr. Jerry Beckner. The owner's address is P. O. Box 637, Cape Girardeau, Missouri 63701.

F. Purpose of Dam:

The dam was constructed primarily for recreation.

G. Design and Construction History:

The dam was constructed in 1966 by the R. B. Potashnick Construction Company, Cape Girardeau, Missouri. The dam was built as a volunteer project by Mr. Potashnick from plans and survey provided by the Soil Conservation Service. All of the construction history as stated below was obtained from Mr. L. U. Spell.

Mr. L. U. Spell, construction foreman for Mr. Potashnick, stated that a core trench approximately 12 ft wide and 4 ft deep was excavated. The floor of the excavation, according to Mr. Spell, consisted of a gravelly, cherty stone layer.

All the material for the embankment was obtained from the lake bed area. Select material was used as fill for the core trench and the central core of the embankment. Compaction of the embankment was acquired by use of a sheeps-foot roller.

Two anti-seep collars were installed on the 15 in. diameter CMP principal spillway pipe. The collars were constructed of 16 gauge material.

No unusual conditions were encountered during construction of the dam. The only modification to the dam was the construction of the sidewalk, in 1975, at the emergency spillway. The sidewalk which provides access to a nearby bleacher area also serves as a non-erodible emergency spillway section.

II. Normal Operating Procedures:

All flows will be passed by the uncontrolled principal spillway pipe and riser and the earthcut emergency spillway channel. Mr. Beckner indicated that, to his knowledge, the dam had never been overtopped.

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 90 acres. Information obtained from the Soil Conservation Service indicated the drainage area to be 100 acres.

B. Discharge at Dam Site:

- (1) All discharge at the dam site is through uncontrolled spillways.
- (2) Estimated Total Spillway Capacity at Maximum Pool (Top of Dam - El. 491.9): 287 cfs
- (3) Estimated Capacity of Principal Spillway: 17 cfs
- (4) Estimated Capacity of Emergency Spillway: 270 cfs
- (5) Estimated Experience Maximum Flood at Dam Site:
Unknown
- (6) Diversion Tunnel Low Pool Outlet at Pool Elevation:
Not Applicable
- (7) Diversion Tunnel Outlet at Pool Elevation: Not Applicable

- (8) Gated Spillway Capacity at Pool Elevation: Not Applicable
- (9) Gated Spillway Capacity at Maximum Pool Elevation: Not Applicable

C. Elevations:

All elevations are consistent with an assumed mean sea level elevation of 494.0 for the top of the plaque and monument (estimated from quadrangle map).

- (1) Top of Dam: 491.9 ft, MSL
- (2) Principal Spillway Crest: 487.9 ft, MSL
- (3) Emergency Spillway Crest: 490.0 ft, MSL
- (4) Principal Spillway Pipe Invert at Outlet: 467.8 ft, MSL
- (5) Streambed at Centerline of Dam: 466.0 ft, MSL
- (6) Pool on Date of Inspection: 485.4 ft, MSL
- (7) Apparent High Water Mark: 488.7 ft, MSL
- (8) Maximum Tailwater: Not Applicable
- (9) Upstream Portal Invert Diversion Tunnel: Not Applicable
- (10) Downstream Portal Invert Diversion Tunnel: Not Applicable

D. Reservoir Lengths:

- (1) At Top of Dam: 670 ft
- (2) At Emergency Spillway Crest: 620 ft
- (3) At Principal Spillway Crest: 570 ft

E. Storage Capacities:

- (1) At Top of Dam: 64 acre-ft
- (2) At Emergency Spillway Crest: 51 acre-ft
- (3) At Principal Spillway Crest: 40 acre-ft

F. Reservoir Surface Areas:

- (1) At Top of Dam: 7.0 Acres
- (2) At Emergency Spillway Crest: 6.1 Acres
- (3) At Principal Spillway Crest: 4.6 Acres

G. Dam:

- (1) Type: Rolled Earth
- (2) Length at Crest: 650 ft
- (3) Height: 26 ft
- (4) Top Width: 14 ft
- (5) Side Slopes: Upstream varies from 1V on 3H to 1V on 5.1H;
Downstream varies from 1V on 2.1 H to 1V on 2.4H
- (6) Zoning: Apparently Homogeneous
- (7) Impervious Core: None
- (8) Cutoff: Key trench, 4 ft deep
- (9) Grout Curtain: None

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: Station 4 + 67
- (2) Type: Corrugated metal pipe with riser

- (3) Upstream Channel: Not Applicable
- (4) Downstream Channel: Well defined Earth channel, brush and tree lined with mild slopes

I.2 Emergency Spillway:

- (1) Location: West Abutment
- (2) Type: Earthcut Channel
- (3) Upstream Channel: Grass lined Earthcut channel
- (4) Downstream Channel: Heavily wooded Earth channel with mild slopes

J. Regulating Outlets:

There are no regulating outlets associated with this dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN:

The dam was designed by the Soil Conservation Service. Copies of a portion of the design are included as Sheets 7 through 10 of Appendix A. No documentation of construction inspection records was available. There are no documented maintenance data.

Preliminary geology reports prepared by SCS are included as Sheets 4 through 6 of Appendix B.

A. Surveys:

A pre-construction survey was conducted by the Soil Conservation Service in 1963. This survey consisted of a profile along the centerline axis of the dam and a profile along the channel of the existing streambed. An assumed local datum was used for the survey. Sheet 3 of Appendix A presents a plan, profile, and cross-section of the dam from survey data obtained during the site inspection. The top of the plaque monument at Station 0 + 00 was used as a site datum of elevation 494.0. The mean sea level elevation of 494.0 was estimated from the Greenville, Missouri 7.5 minute quadrangle sheet.

B. Geology and Subsurface Materials:

The site is located at the southwestern limits of the St. Francois Mountains geologic region of Missouri. The St. Francois Mountains are described as an island of crystalline rocks entirely surrounded by the Salem Plateau. The area is characterized topographically by steep mountains of Precambrian age. These mountains are highly resistant to erosion as compared with the once-overlying Paleozoic formations. These igneous mountains are encircled by dolomite, sandstone and chert of the Cambrian system.

Information from the Missouri Department of Natural Resources indicates that the bedrock in the area is the Gasconade Dolomite, which is predominately a light brownish-gray, cherty dolomite. The formation contains a persistent sandstone unit in its lowermost part that is designated the Gunter member. The lower part of the dolomite which overlies the Gunter member is coarsely crystalline and characterized by large amounts of chert. The upper part of the dolomite is predominately finely crystalline and contains smaller amounts of chert. Caves and springs are common in the Gasconade formation.

The publication "Caves of Missouri" lists three caves known to exist in Wayne County, the closest being about two miles southwest of the site. Of two caves listed in adjacent Reynolds County, the closest is about twenty miles northwest of the site. No caves are listed in adjacent Iron and Madison Counties.

Information from the United States Department of Agriculture Soil Conservation Service indicates that the soils in the immediate area of the dam and lake consist primarily of Clarksville Stony Silt Loam. The Clarksville series subsoil is a reddish-brown to red silty clay to heavy, stiff, tenacious, compact clay. These residual soils are derived from cherty and dolomitic limestones. Chert fragments are very common in the Clarksville soils. The loessial thickness map indicates that upland areas may have about 2.5 ft of loess cover.

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 Corps of Engineers guidelines. The contractor indicated that a core trench approximately 12 ft wide and 4 ft deep was excavated to cherty rock. The embankment fill was obtained from the lake bed area.

D. Hydrology and Hydraulics:

The available hydrologic and hydraulic design computations are included as Sheets 7 through 9 of Appendix A. Based on the available design information and field measurements of spillway dimensions and embankment elevations, and the watershed area, lake area and storage data from 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 through 10.

E. Structure:

The only structure associated with this dam is the 15 in. CMP with 18 in. CMP riser. (See Sheet 3 and 10 of Appendix A).

2.2 CONSTRUCTION:

No construction inspection data have been obtained.

2.3 OPERATION:

Normal flows would be passed by the uncontrolled principal spillway pipe and emergency spillway channel.

2.4 EVALUATION:

A. Availability:

2.1. The engineering data available are as listed in Section

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 and made a matter of record.

C. Validity:

The available engineering design data obtained from the Soil Conservation Service are considered valid. No valid engineering data on the construction of the embankment are available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS:

A. General:

The field inspection was made on October 7, 1980. The inspection team consisted of personnel from Anderson Engineering, Inc. of Springfield, Missouri and Hanson Engineers, Inc. of Springfield, Illinois. The team members were:

Steven L. Brady - Anderson Engineering, Inc. (Civil Engineer)
Tom R. Beckley - Anderson Engineering, Inc. (Civil Engineer)
Gene Wertepny - Hanson Engineers, Inc. (Hydraulic Engineer)
Dan Kerns - Hanson Engineers, Inc. (Geotechnical Engineer)

Mr. James Gray, caretaker of the Boy Scout facility, was present during part of the inspection.

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

B. Dam:

The embankment appears to be in good condition. The horizontal and vertical alignment of the dam was good. The crest of the dam was 14 ft wide with a good grass cover. A small depression was observed at the centerline of the dam near station 1 + 10. Minor surface cracking was noted along the crest of the dam.

Small trees and brush were noted along the upstream face of the embankment near the normal pool level. On the date of inspection the lake level was about 2.5 ft below normal pool elevation. No rip rap or other form of wave protection was noted along the upstream slope. No significant erosion of the upstream slope was noted. Numerous animal burrows were noted along the upstream face of the embankment, at and slightly below normal pool elevation. The slope of the upstream face varied from 1V on 3.0H from the crest to normal pool elevation to 1V on 5.1H from normal pool to water elevation.

The slope of the downstream face varied from 1V on 2.4H to 1V on 2.1H. Brush and small tree growth were noted on the downstream slope. A few small animal burrows were observed. The downstream slope had a good grass cover with no noticeable significant erosion. No unusual movements or sloughing of the embankment were observed.

The junctions of the embankment and the abutments were adequate with no observed erosion.

Seepage, with no measurable flow, was observed at the downstream toe of the embankment near the outlet of the principal spillway pipe. Iron oxide staining of the standing water was noted, although no flow or soil particle suspension was observed.

Shallow auger probes of the embankment indicated the embankment soil to consist of a reddish-brown sandy silty clay with rock fragments (Unified Soil Classification of CL).

C. Appurtenant Structures:

C.1 Principal Spillway:

The principal spillway consisted of an 18 in. diameter corrugated metal riser pipe and a 15 in. diameter CMP discharge pipe. Flow through the principal spillway is uncontrolled. An anti-vortex corrugated metal shield was installed on the riser pipe. The approach to the riser pipe was clear. No trash accumulation was noted. The wire mesh trash screen was in need of repair. The outlet of the discharge pipe was partially submerged with a dense growth of cattails and weeds around the plunge pool.

C.2 Emergency Spillway:

The emergency spillway is an earthcut channel located at the west abutment. The approach to the spillway is clear. Minor surface erosion was observed in the spillway channel. A concrete sidewalk, 4 ft wide, was constructed across the spillway channel. The sidewalk provides a non-erodible section for the emergency spillway. The grass cover within the channel was light to moderate. The emergency spillway channel appears not to have recently carried any flows. The owner did not recall if the spillway had ever carried any water flow. The triangular shaped spillway is approximately 63 ft wide.

D. Reservoir:

The watershed is primarily wooded with gentle rolling slopes. No significant erosion or sloughing was noted. Siltation appears to be minor and is not considered to be a problem.

E. Downstream Channel:

The downstream channel is generally brush covered and wooded. The principal spillway channel and the emergency spillway channel merge approximately 800 ft downstream of the embankment toe. The slopes of the channel are gentle to rolling.

3.2 EVALUATION:

The embankment is in good structural condition. Trees and brush on the dam constitute a potential seepage hazard and encourage animal burrowing. The wave erosion, seepage, and animal burrows could worsen and adversely affect the embankment stability. The discharge of the emergency spillway channel outlet is reduced due to the brush and tree growth.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES:

There are no operating facilities associated with the dam. The pool level is normally controlled by rainfall, runoff, evaporation, the capacity of the uncontrolled spillways and apparent seepage from the reservoir.

4.2 MAINTENANCE OF DAM:

The crest of the dam is kept mowed. No additional maintenance of dam is known to be provided.

4.3 MAINTENANCE OF OPERATING FACILITIES:

There are no operating facilities associated with this dam.

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 tree and brush growth on the dam and outlet channels, animal burrows, seepage, and lack of wave protection are deficiencies which should be corrected. Remedial measures should be investigated by an engineer experienced in the design and construction of dams. Subsequently, the areas should be inspected periodically to detect any further seepage.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES:

A. Design Data:

The hydrologic and hydraulic design calculations obtained from SCS are included as Sheets 7 through 10 of Appendix A.

B. Experience Data:

No recorded rainfall, runoff, discharge, or reservoir stage data were available for this lake and watershed. The owner indicated that the dam has never been overtopped. The apparent high water line was at elevation 488.7 (top of dam elevation is 491.9). Our hydrologic and hydraulic analyses using U. S. Army Corps of Engineers guidelines appear in Appendix C.

C. Visual Observations:

The approaches to the spillways are clear. The trash screen of the principal spillway is in need of repair. The principal spillway outlet is at the toe of the embankment. An area of apparent seepage was observed at this location. The emergency spillway channel is well separated from the embankment, and spillway releases would not be expected to endanger the dam. The downstream channel is densely overgrown with trees and brush.

D. Overtopping Potential:

The hydraulic and hydrologic analyses (using the U. S. Army Corps of Engineers guidelines and the HEC-1 computer program) were based on: (1) A review of the design data obtained from SCS; (2) A field survey of spillway dimensions and embankment elevations; and (3) An estimate of the reservoir storage and the pool and drainage areas from the Greenville, Missouri 7.5 Minute U.S.G.S. quad sheet.

Based on the hydrologic and hydraulic analysis presented in Appendix C, the combined spillways will pass 25 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 low height of the dam (26 ft) and the small storage capacity (64 acre-ft) 50 percent of the PMF has been determined to be the

appropriate spillway design flood. The spillways will pass a 1 percent probability flood without overtopping the dam.

Application of the probable maximum precipitation (PMP), minus losses, resulted in a flood hydrograph peak inflow of 2,329 cfs. For 50 percent of the PMF, the peak inflow was 1,165 cfs.

The routing of 50 percent of the PMF through the spillways and dam indicates that the dam will be overtopped by 0.6 ft at elevation 492.5. The duration of the overtopping will be 0.6 hours, and the maximum outflow will be 1,031 cfs. The maximum discharge capacity of the spillways is 287 cfs. The routing of the PMF indicates that the dam will be overtopped by 1.1 ft at elevation 493.0. The maximum outflow will be 2,217 cfs, and the duration of overtopping will be 3.4 hours. Overtopping of an earthen embankment could cause serious erosion and could possibly lead to failure of the structure.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY:

A. Visual Observations:

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

B. Design and Construction Data:

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:

No operating records have been obtained.

D. Post-Construction Changes:

The only reported post-construction change to the dam is the construction of the sidewalk through the emergency spillway channel.

E. Seismic Stability:

The structure is located in seismic zone 2. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT:

C 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 in good structural condition. Several items were noted during the visual inspection which should be investigated further, corrected or controlled. These items are: (1) Scattered brush and tree growth on upstream and downstream faces of embankment; (2) Lack of wave protection for upstream face; (3) Animal burrows in upstream and downstream faces; (4) Trash screen in need of repair; (5) Apparent seepage at principal spillway outlet; and (6) Downstream channel lined with trees and brush.

Another deficiency was the lack of seepage and stability analyses records.

The dam will be overtopped by flows in excess of 25 percent of the Probable Maximum Flood. 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:

O 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 continue to deteriorate and possibly could become serious in the future. The items recommended in paragraph 7.2A should be pursued without undue delay.

D. Necessity for Additional Inspection:

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. An earthquake of this magnitude would not generally be expected to cause severe structural damage to a well constructed earth dam of this size.

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.

A. Alternatives:

- (1) Spillway size and/or height of dam should be increased to pass 50 percent of the PMF. In either case, the spillway should be protected to prevent erosion.

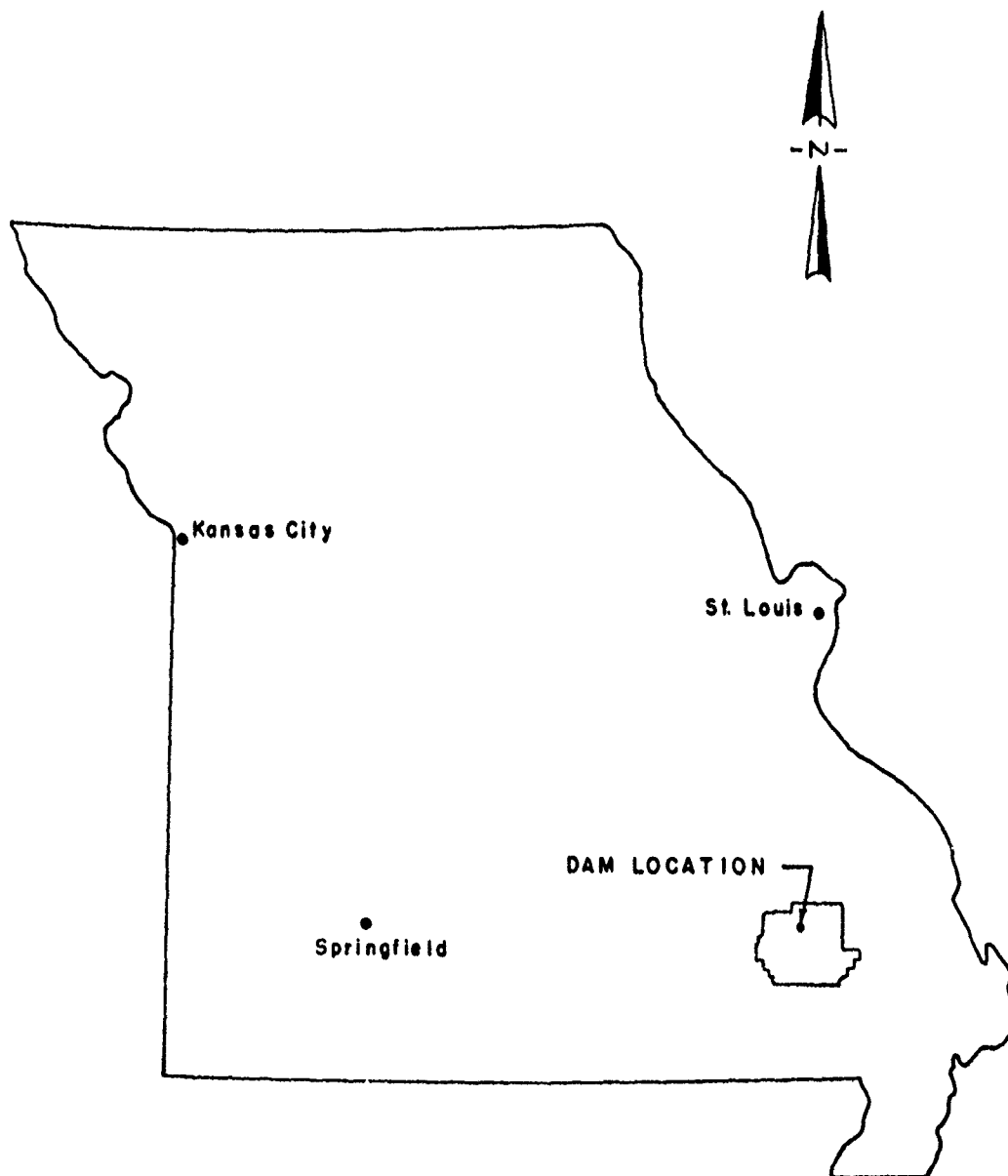
B. O & M Procedures:

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by an engineer experienced in the construction of dams.
- (2) Brush and tree growth should be removed from the embankment and the spillway channels. 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.
- (3) The seepage area at the principal spillway outlet should be investigated by a professional engineer experienced in the design and construction of dams. Remedial measures may be required.
- (4) The animal burrows should be repaired and maintained.

- (5) Wave protection, such as rip rap, should be provided for the upstream face of the embankment.
- (6) The trash screen should be repaired and maintained.
- (7) A detailed inspection of the dam should be made periodically by an engineer experienced in the design and construction of dams.

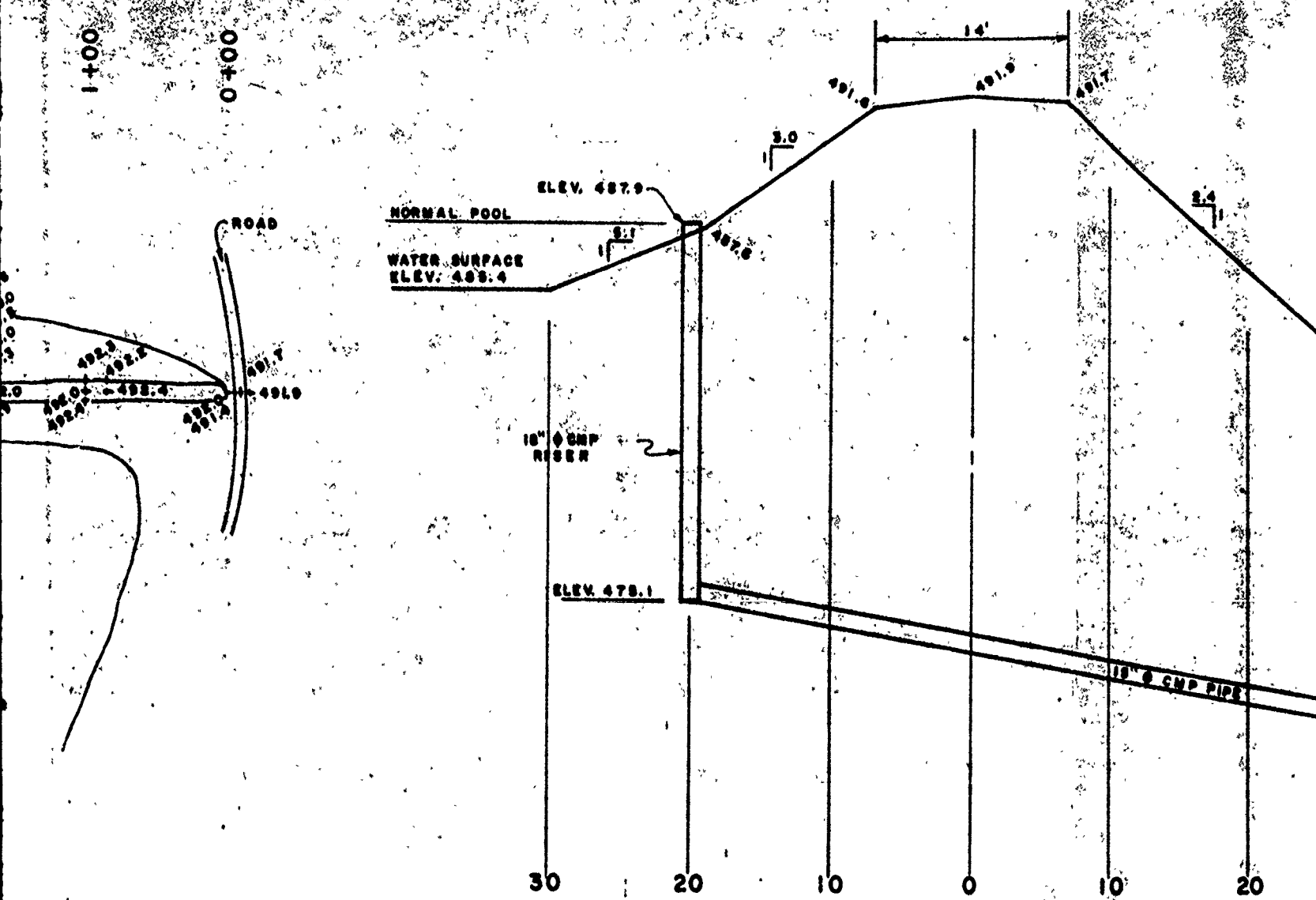
APPENDIX A

Dam Location and Plans

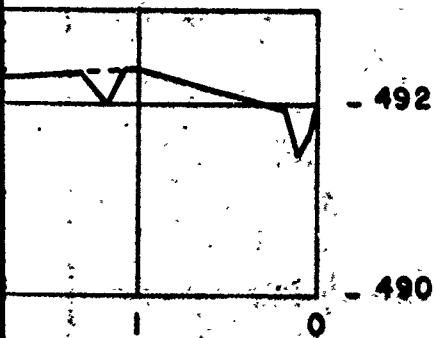


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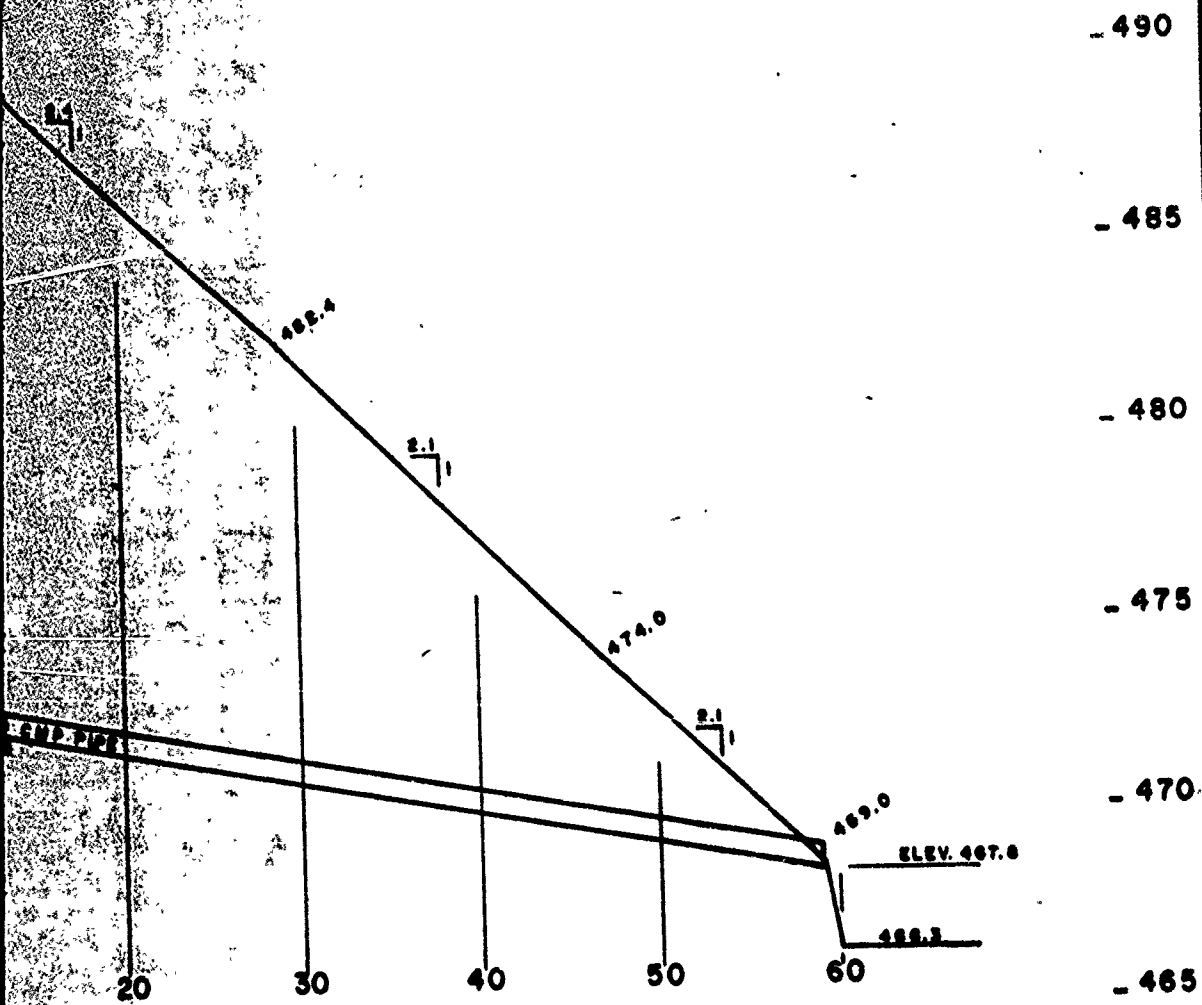
LOCATION MAP
POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30565



SECTION A-A STA 4+67



2



STA 4+67

3

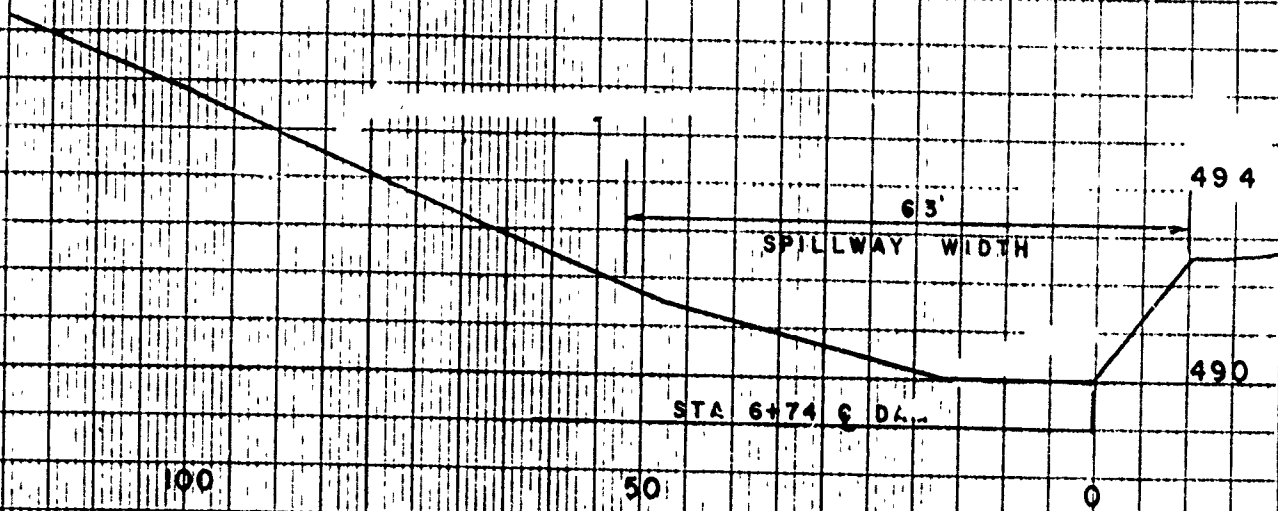
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POTASHNICK LAKE DAM

MO. No 30565

PLAN & PROFILE
WAYNE COUNTY, MO.

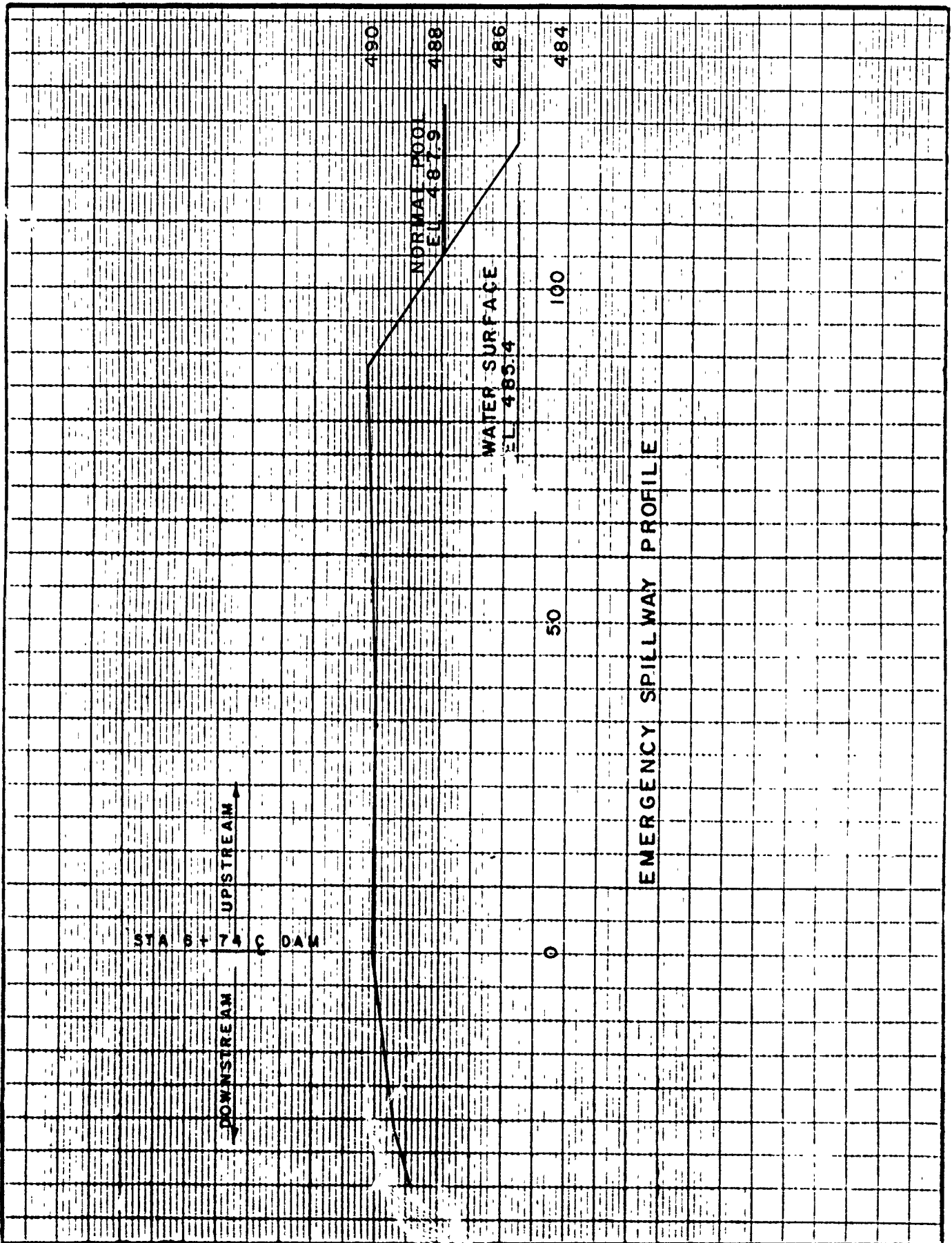
SHEET 3, APPENDIX A



EMERGENCY SPILLWAY CROSS-SECTION
ALONG & DAM

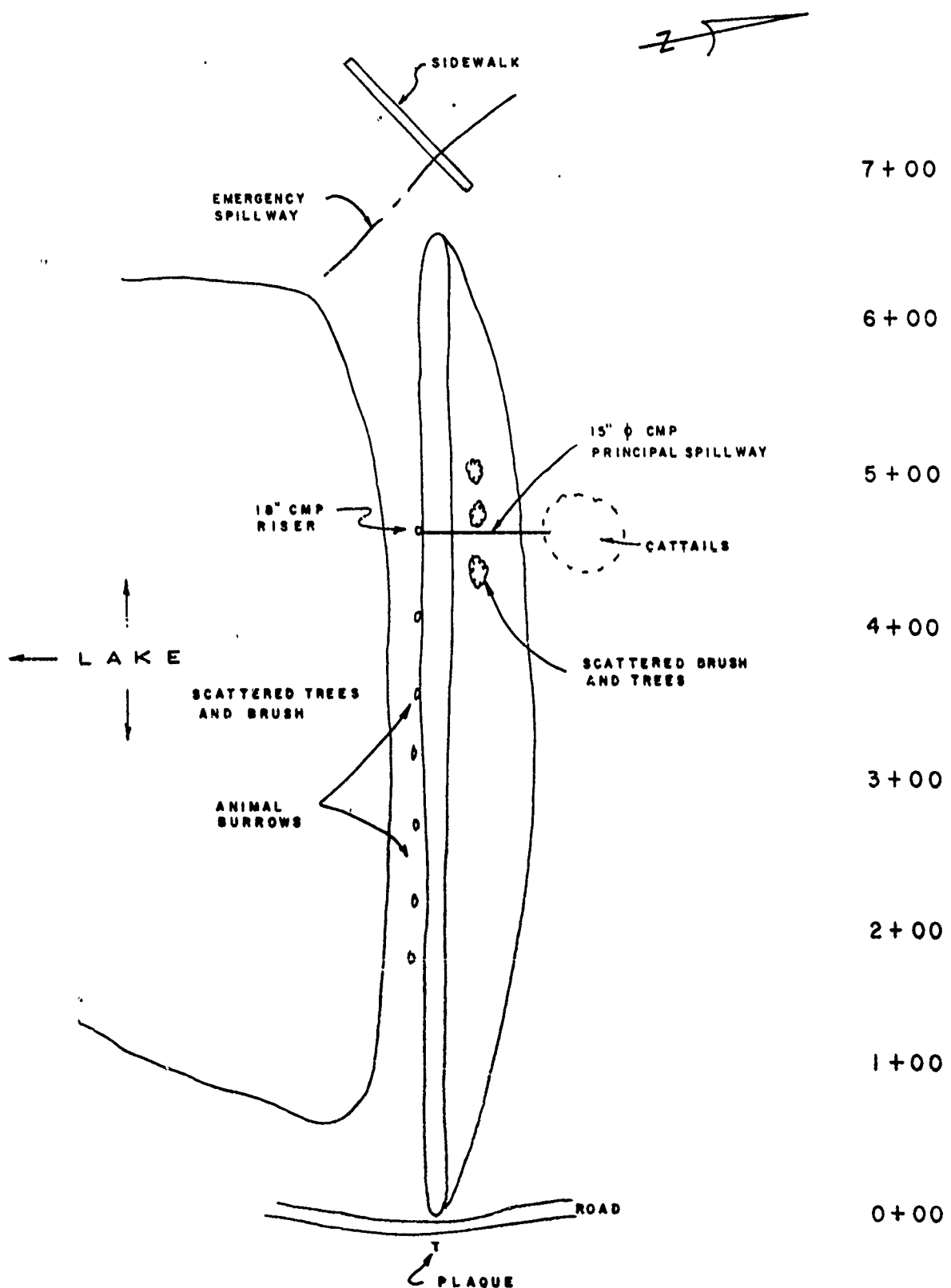
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POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I.D. No. 30565
SPILLWAY SECTION



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POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. E.D. No. 30565
PROFILE



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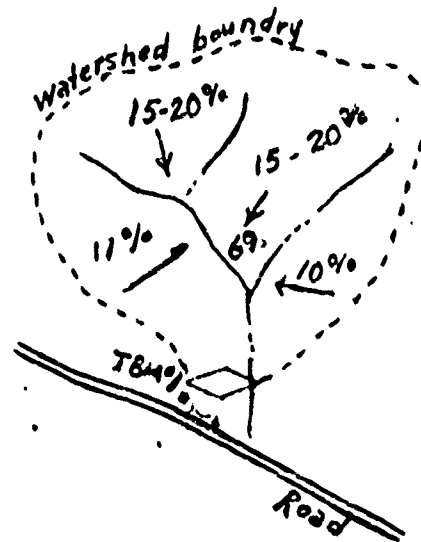
PLAN SKETCH

**POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30565**

SHEET 6, APPENDIX A

WATERSHED MAP

DA 100 acres



N

0 1320 2640 3960
Scale in feet

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HYDROLOGIC DATA Drainage area 100 acres

Relief	(Av. slopes 10%)	20
Infiltration	(Soil type 3)	7
Vegetative cover	(Woodland,	5
Storage	(Normal)	3
Σ W		40

$Q_i(50)$ Peak = PPF = $122 \times 10 \times 1.5 = 122$ cfs

Surface area permanent pool = 4.6 acres

6-hour rainfall = 4.5 inches - runoff coeff. 70

Design runoff 1.67 inches

Volume flood runoff (cu) = $\frac{122}{12} \times 1.67 = 13.4$ ac ft

Flood volume depth = $\frac{13.4}{100} = 0.134$ ft = 1.61 in

Tank No 1 top of vitrified clay tile
of spring located on south side
gravel road and 500 feet down-
stream from fill site, elev 109.50

HYDRAULIC DATA

PIPE FLOW:

$$Q_c = A \sqrt{\frac{2gH}{2.0 + K_f L}} = 1.33 \times 8.02 \sqrt{\frac{21.1}{2.0 + 76 \times 0.36}} = 9.85 \times \sqrt{\frac{21.1}{28.4}} = 17 \text{ cfs}$$

WEIR FLOW for CIRCULAR RISER:

$$Q = 9.4 D H^{3/2} \quad H = \left(\frac{17}{9.4 \times 1.5} \right)^{2/3} = \left(\frac{17}{14.1} \right)^{2/3} = \sqrt[3]{1.2^2} = 1.1 \text{ ft.}$$

2.0' available

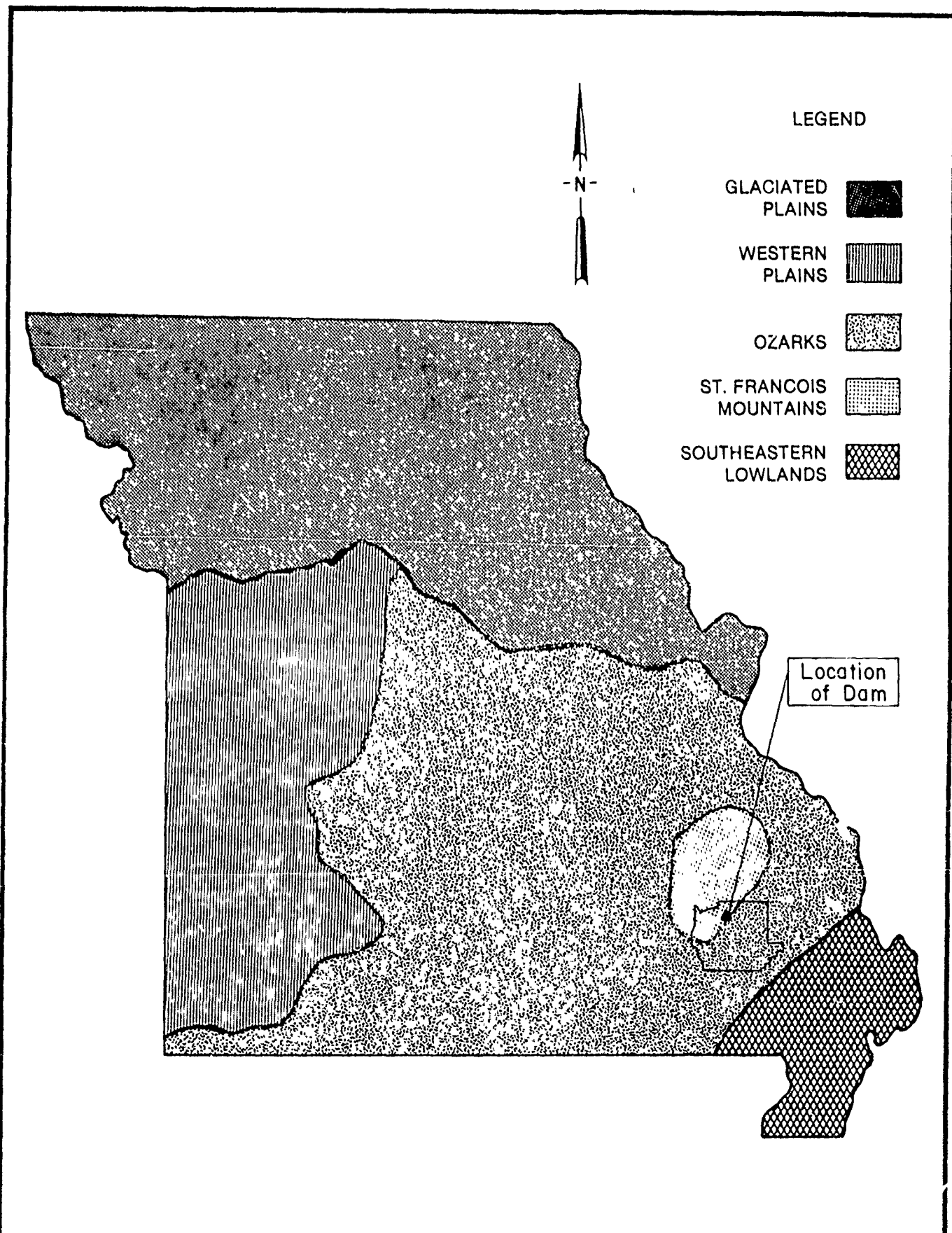
EMERGENCY SPILLWAY: (Q = 2.75 L H^{3/2}) H = 0.5 ft.

Design Q = 40% of $Q_c = 28 \text{ cfs}$

$$L = \left(\frac{28}{2.75 \times 0.5} \right)^{2/3} = \left(\frac{28}{1.375} \right)^{2/3} = 41^{2/3} = 25 \text{ ft.}$$

APPENDIX B

Geology and Soils



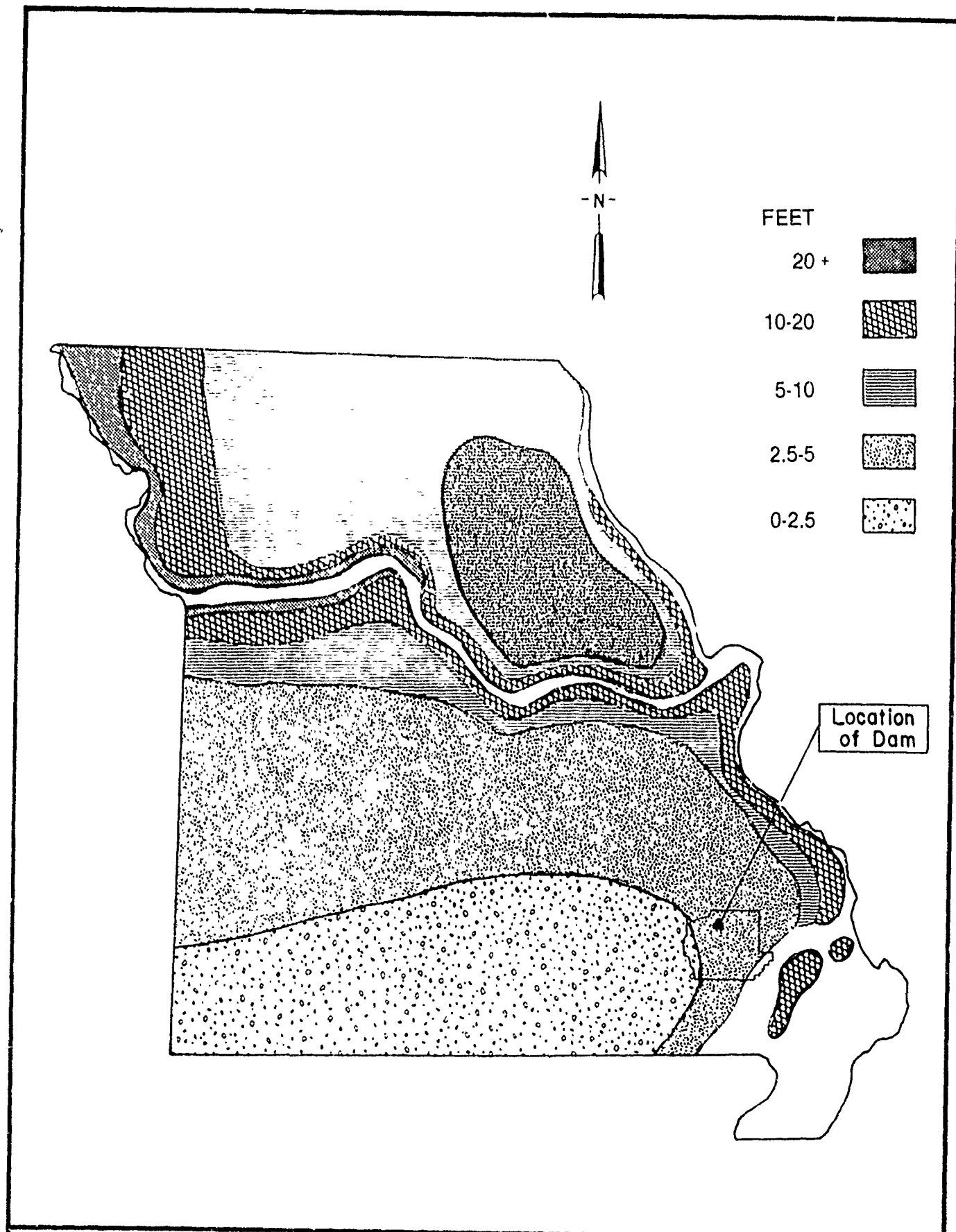
MAJOR GEOLOGIC REGIONS OF MISSOURI



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Lake R.B. Potashnick Dam
Wayne County, Missouri
Mo. I.D. No. 30565

SHEET 1, APPENDIX B



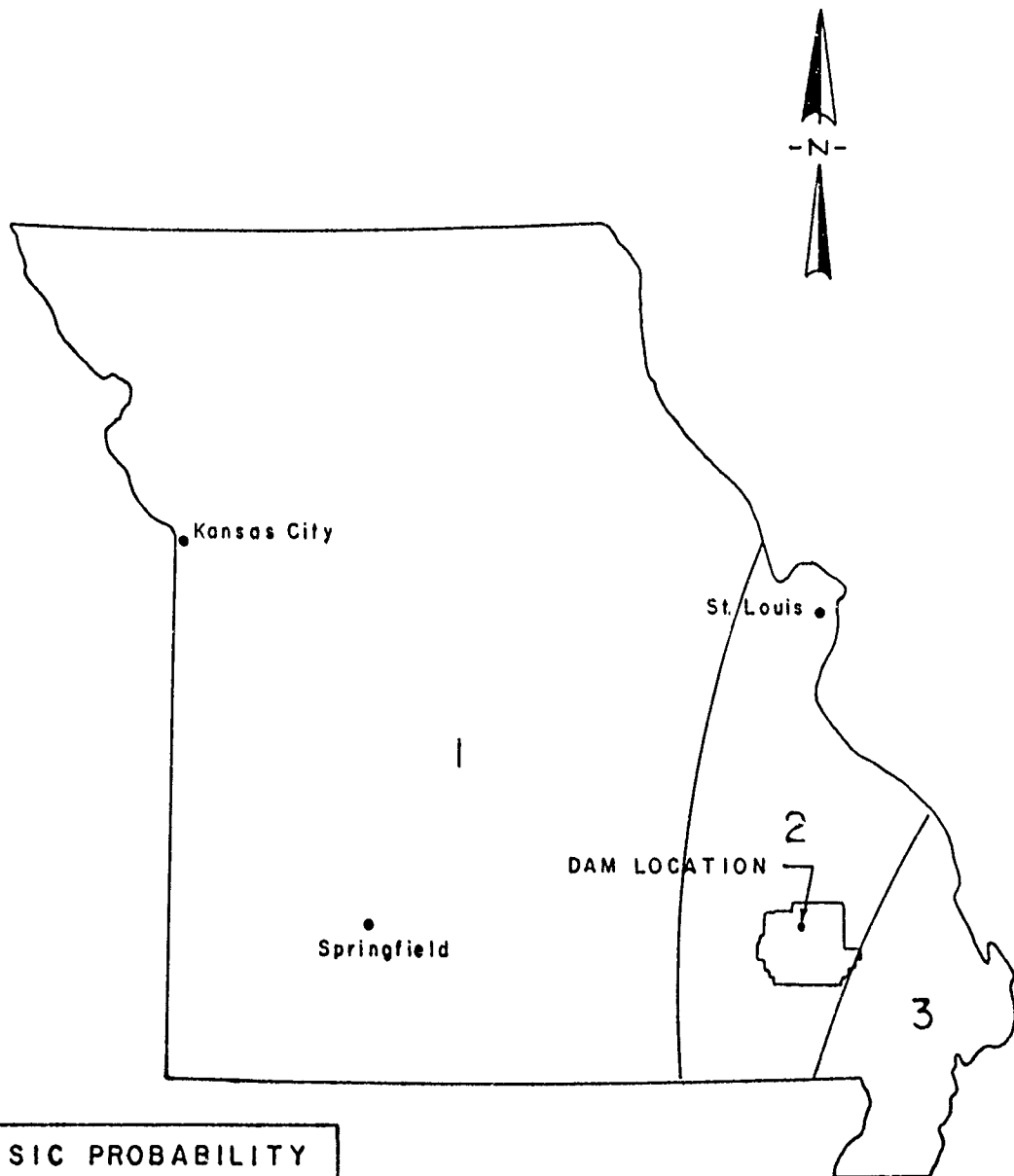
THICKNESS OF LOESSIAL DEPOSITS



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Lake R.B. Potashnick Dam
Wayne County, Missouri
Mo. I.D. No. 30565

SHEET 2, APPENDIX B



SEISMIC PROBABILITY	
ZONE	DAMAGE
1	MINOR
2	MODERATE
3	MAJOR

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SEISMIC ZONE MAP

POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30565

SHEET 3, APPENDIX B

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

June 25, 1963

June 25, 1963

Mr. Jim Martin
District Geologist Survey and Water Resources
Post Office Box 100
Jella, Missouri

Dear Sir:

Sorry I did not call on Tuesday the eleventh. I was in a bit of a hurry to get off on my vacation and should have caught the train yesterday, June 12 in your letter. I am sure you and Albert Howard are out o.k. without me as I was running on a pretty tight schedule the balance of the week.

We certainly attach to your help and report on the day report on the site you gave the L. L. Preister job.

We made a trip on the day report, I saw a site last week and the information was a little disappointing. Also, M. C. Hillier, our District Scientist made about the same report on the soil's part of the site as you made.

We are therefore, rejecting the site and writing Mr. Richard Hillier, Executive Director, a copy of which is attached. We are sorry to hear of their loss.

Sincerely yours,

Bob -
Bob Landers
Area Engineer

511 H & H Building
Cape Girardeau, Missouri

June 25, 1963

Mr. Richard Ray
Executive Director
Boy Scout Camp Lewallen
Chamber of Commerce Bldg.
Cape Girardeau, Missouri

Dear Mr. Ray:

Shortly after Bob Landers, our Area Engineer, met with you on June 11 relative to the construction of a proposed lake at Camp Lewallen, we had our Soil Scientist, M. G. Wilbur, to make some soil borings on the lake site. Wilbur's findings on the foundation materials are not too encouraging. Following this, Landers sent a survey crew over the 16th and 19th. They found the topography rather steep. In fact, so steep that a 30' fill would only back the water up the valley about 550'. The watershed area above the lake site was computed at 100 acres.

Mr. Jim Martin from the State Geologist's office in Rolla, while in Wayne County recently, was requested to check this site also. His findings are, and we quote:

"In general, things do not look too favorable at the Boy Scout Camp site with one spring at the dam site and another immediately below it.

They are also losing water from their swimming pool, whether into very porous hillslope colluvium or bedrock. Bedrock within the proposed lake area is restricted to a single, small outcrop on the creek bank by the house. However, the area is underlain by probably cavernous upper cambian dolomite (Rebel Cave to the south, springs, open joints, etc., bear this out).

I feel that a great part of the ability, or lack of it, of the lake site to retain water rests on the porosity of the soils. Your soil scientist could best answer this.

The bottom soil (area near spring in field) had heavy clay content and appeared tight, but the field on the west side and the west slope is a very cherty (Clarksville) and porous soil. Some of the east slopes are also high in silt content.

The erosion factors on the soil map are 1 and 2 which, I assume, indicate pretty good porosity. Also, the surface erosion factors in the vaelley look rather subdued.

From surface indications, I don't feel the site to be too favorable with the large area of absorptive stoney soils to be inundated along the west side. If possible, I feel that they might put a few deep, large diameter auger holes through the soil to explore their subsurface conditions."

Mr. Martin goes on to say that he and Mr. Jim Williams, senior geologist for the State Geologists department, would be happy to revisit the site with us if we decide to pursue the project further.

For your information, the Soil Scientist borrowed a large mechanical auger from REA and several deep borings were made, I believe, to about 7', and they were unable to go through the cherty, stoney layer.

In view of these findings by the Soil Scientist and our survey crew, we would seriously question this project being economically justified. In fact, it would cost a lot of money, as you will agree, to take the necessary precautions for even a probable seal and, at best, after you had spent your money there would still be a big questionmark as to whether or not it would eventually hold water.

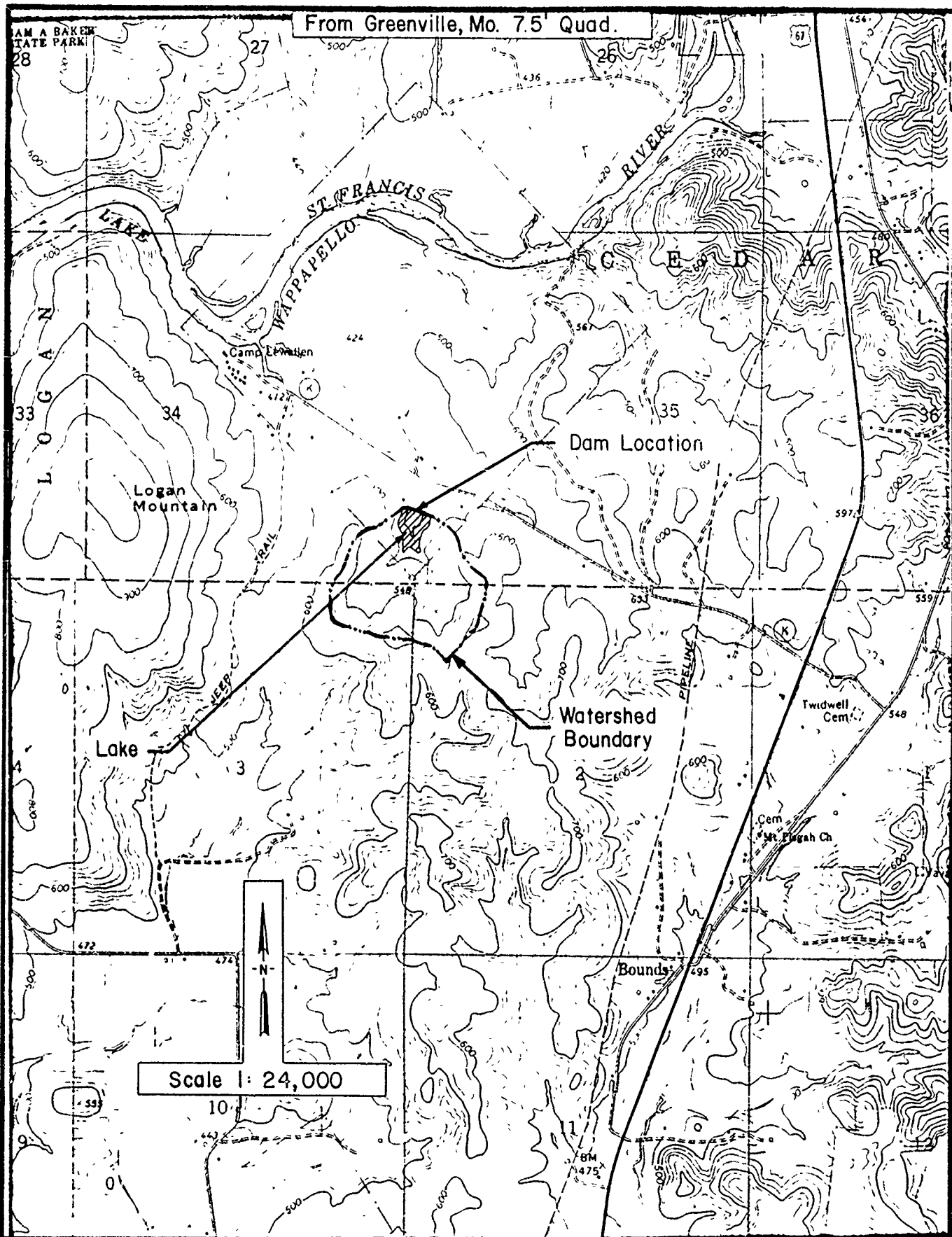
Very truly yours,

W. H. Colman
Area Conservationist

WHC/jlb

APPENDIX C

Overtopping Analysis



LAKE AND WATERSHED MAP



SPRINGFIELD, IL • PEORIA, IL • ROCKFORD, IL

Lake R.B. Potashnick Dam
Wayne County, Missouri
Mo. I.D. No. 30565

Sheet I, Appendix C

APPENDIX C

HYDROLOGIC AND HYDRAULIC ANALYSIS

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrograph. The inflow hydrograph was then routed through the reservoir and spillway. The overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California.

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm duration was assumed according to the procedures outlined in EM 1110-2-1411 (SPD Determination). Also, the 1 percent chance probability flood was routed through the reservoir and spillway. Doniphan, Missouri rainfall distribution (5 min. interval - 24 hours duration), as provided by the St. Louis District, Corps of Engineers, was used in this case.

The synthetic unit hydrograph for the watershed was developed by the computer program using the SCS method. The time of concentration was estimated using the Kirpich formula. This formula and the parameters for the unit hydrograph are shown in Table 1 (Sheet 4, Appendix C). The time of concentration was also verified from velocity estimates for the average slopes of the watershed and the main channel (Design of Small Dams, page 70, 1974 Edition).

The SCS curve number (CN) method was used in computing the infiltration losses for rainfall-runoff relationship. The CN values used for the antecedent moisture conditions (AMC), and the result from the computer output, are shown in Table 2 (Sheet 5, Appendix C).

The reservoir routing was accomplished by using the Modified Puls Method assuming the starting lake elevation at normal pool. No antecedent storm was routed in order to determine the starting elevation. It was assumed that the mean annual high water elevation corresponds with the normal pool elevation. The hydraulic capacity of the spillway was used as an outlet control in the routing. The hydraulic capacity of the spillway and the storage capacity of the reservoir were defined by the elevation-surface area-storage-discharge relationships shown in Table 3 (Sheet 5, Appendix C).

The rating curve for the spillway (see Table 4 Sheet 6, Appendix C) was determined assuming weir control, and inlet and outlet pipe control for the principal spillway. Critical flow condition at the control section was assumed for the emergency spillway.

The flow over the crest of the dam during overtopping was determined using the non-level dam option (\$L and \$V cards) of the HEC-1 program. The program assumes critical flow over a broad-crested weir. The lowest elevation of the crest of the dam, obtained from survey measurements, was assumed as top of dam elevation.

A summary of the routing analysis for different ratios of the PMF is shown in Table 5 (Sheet 7, Appendix C). The result of the routings indicates that the spillway will pass the 1 percent probability flood without overtopping the dam.

The computer input data, a summary of the output data, and a plot of the inflow-outflow hydrograph for the PMF are presented on Sheets 8, 9, and 10 of Appendix C.

TABLE 1
SYNTHETIC UNIT HYDROGRAPH

Parameters:

Drainage Area (A)	0.14 sq miles
Length of Watercourse (L)	0.38 miles
Difference in elevation (H)	212 ft
Time of concentration (Tc)	0.11 hrs
Lag Time (Lg)	0.07 hrs
Time to peak (Tp)	0.11 hrs
Peak Discharge (Qp)	620 cfs
Duration (D)	5 min.

<u>Time (Min.)(*)</u>	<u>Discharge (cfs)(*)</u>
0	0
5	515
10	406
15	116
20	33
25	10
30	3

(*) From the computer output

FORMULA USED:

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{0.385}$$

Kirpich Formula.
From California Culverts Practice, California
Highways and Public Works, September, 1942.

$$L_g = 0.6 T_c$$

$$T_p = \frac{T_c}{2} + L_g$$

$$Q_p = \frac{484 A Q}{T_p}$$

Q = Excess Runoff = 1 inch

TABLE 2
RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP	24	35.1	33.17	1.93
1% Prob. Flood	24	7.55	4.25	3.30

Additional Data:

- 1) Soil Conservation Service Soil Group B
- 2) Soil Conservation Service Runoff Curve CN = 85 (AMC III) for the PMP
- 3) Soil Conservation Service Runoff Curve CN = 70 (AMC II) for the
1 percent probability flood
- 4) Percentage of Drainage Basin Impervious 5 percent

TABLE 3
ELEVATION, SURFACE AREA, STORAGE AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
466.0	0	0	-
480.0	2.0	14	-
*487.9	4.6	40	0
**490.0	6.1	51	16
***491.9	7.0	64	287
494.0	8.0	80	1,207
500.0	11.0	137	-

*Principal spillway crest elevation

**Emergency spillway crest elevation

***Top of dam elevation

The above relationships were developed using data from the USGS Greenville, Missouri 7.5 minute quadrangle map and the field measurements.

TABLE 4

SPILLWAYS RATING CURVE

<u>Reservoir Elevation (MSL)</u>	<u>Principal Spillway (cfs)</u>	<u>Emergency Spillway (cfs)</u>	<u>Total Discharge (cfs)</u>
*487.9	0	-	0
488.5	6	-	6
489.0	15	-	15
**490.0	16	0	16
490.5	16	30	46
491.0	16	90	106
491.4	16	160	176
***491.9	17	270	287
492.5	17	460	477
493.0	17	650	667
493.5	17	890	907
494.0	17	1,190	1,207
494.4	17	1,470	1,487

*Principal spillway crest elevation

**Emergency spillway crest elevation

*** Top of dam elevation

Method Used:

- 1) Principal Spillway: Using charts for corrugated-metal pipes with inlet and outlet control from the U.S. Bureau of Public Roads.
- 2) Emergency Spillway: Assuming critical flow condition at the control section and approach channel losses equal to 50 percent of the velocity head at the control section.

FORMULA:

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

Design of Small Dams, Water and Power Resources
Service (Former USBR), page 553, 1974 Edition.

Q = Discharge in cubic feet per second

A = Cross sectional area in square feet

T = Water surface width in feet

g = Acceleration of gravity in ft/sec²

TABLE 5

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (cfs)	Peak Lake Elevation (ft, MSL)	Total Storage (acre-ft)	Peak Outflow (cfs)	Depth (ft) Over Top of Dam
-	0	*487.9	40	0	-
0.10	233	490.3	53	34	-
0.20	466	491.5	61	195	-
0.25	582	**491.9	64	287	0
0.30	699	492.1	65	391	0.2
0.35	815	492.2	67	534	0.3
0.40	932	492.3	67	659	0.4
0.50	1,165	492.5	69	1,031	0.6
0.75	1,747	492.8	71	1,657	0.9
1.00	2,329	493.0	72	2,217	1.1

The percentage of the PMF that will reach the top of the dam is 25 percent.

*Principal spillway crest elevation

**Top of dam elevation

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

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
HYDROGRAPH AT	1	0.14	1	233.	466.	582.	699.	815.	932.	1165.	1747.	2329.
	(	0.36)	(	6.60)	(	13.19)	(	16.49)	(	19.79)	(	26.38)
ROUTED TO	2	0.14	1	34.	195.	272.	391.	534.	659.	1031.	1657.	2217.
	(	0.36)	(	0.96)	(	5.52)	(	7.70)	(	11.08)	(	18.65)

SUMMARY OF DAM SAFETY ANALYSIS

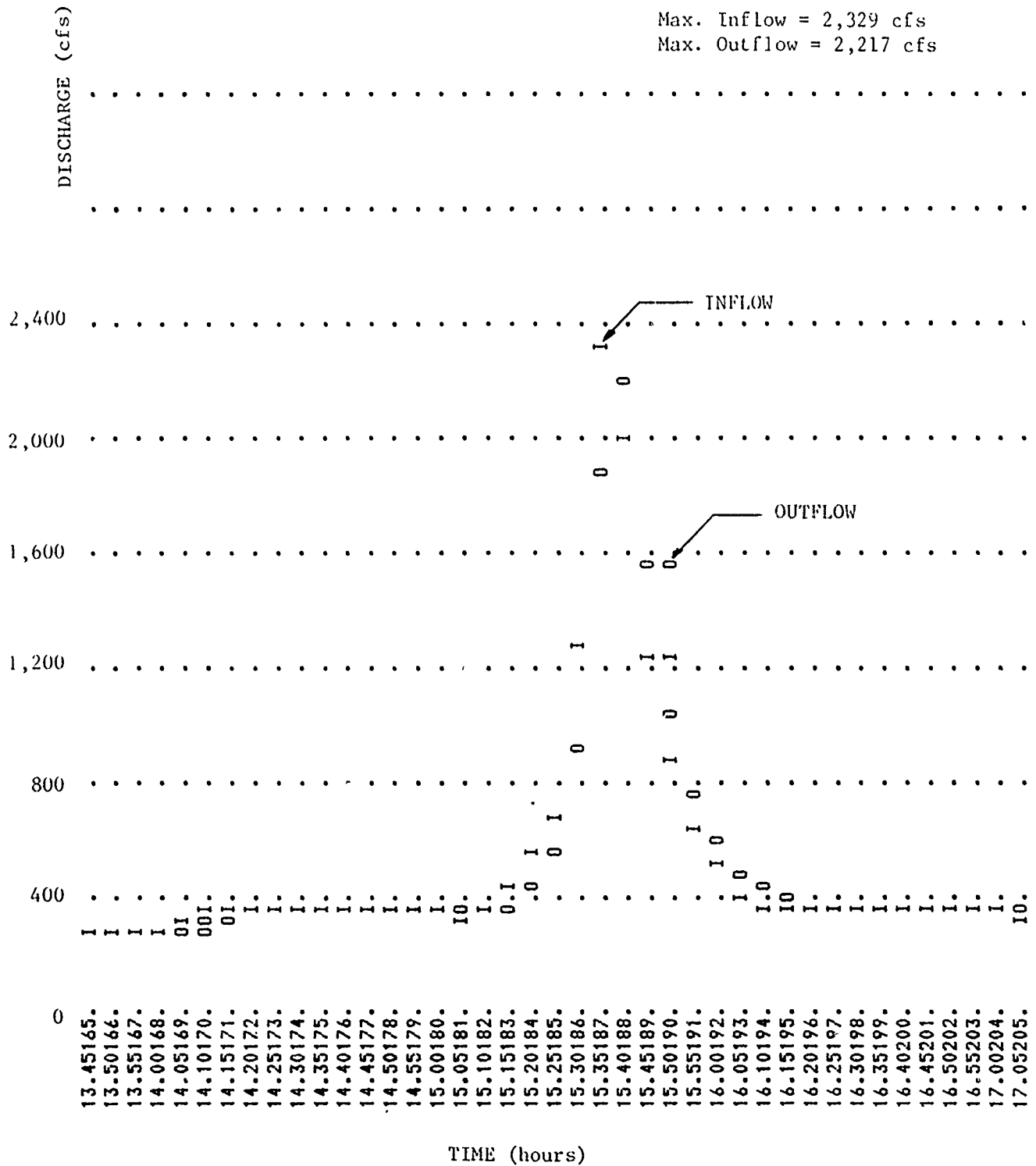
PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	487.90	487.90	491.90
	OUTFLOW	40.	40.	64.
		0.	0.	287.

RATIO OF PMF	MAXIMUM RESERVOIR U.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	490.30	0.00	53.	34.	0.00	17.00	0.00
0.20	491.49	0.00	61.	195.	0.00	15.83	0.00
0.25	491.83	0.00	64.	272.	0.00	15.75	0.00
0.30	492.09	0.19	65.	391.	0.33	15.75	0.00
0.35	492.24	0.34	67.	534.	0.42	15.75	0.00
0.40	492.33	0.43	67.	659.	0.50	15.67	0.00
0.50	492.53	0.63	69.	1031.	0.58	15.67	0.00
0.75	492.77	0.87	71.	1657.	1.17	15.67	0.00
1.00	492.96	1.06	72.	2217.	3.42	15.67	0.00

PMF RATIOS
OUTPUT DATA

INFLOW-OUTFLOW
HYDROGRAPH
FOR THE PMF

Max. Inflow = 2,329 cfs
Max. Outflow = 2,217 cfs

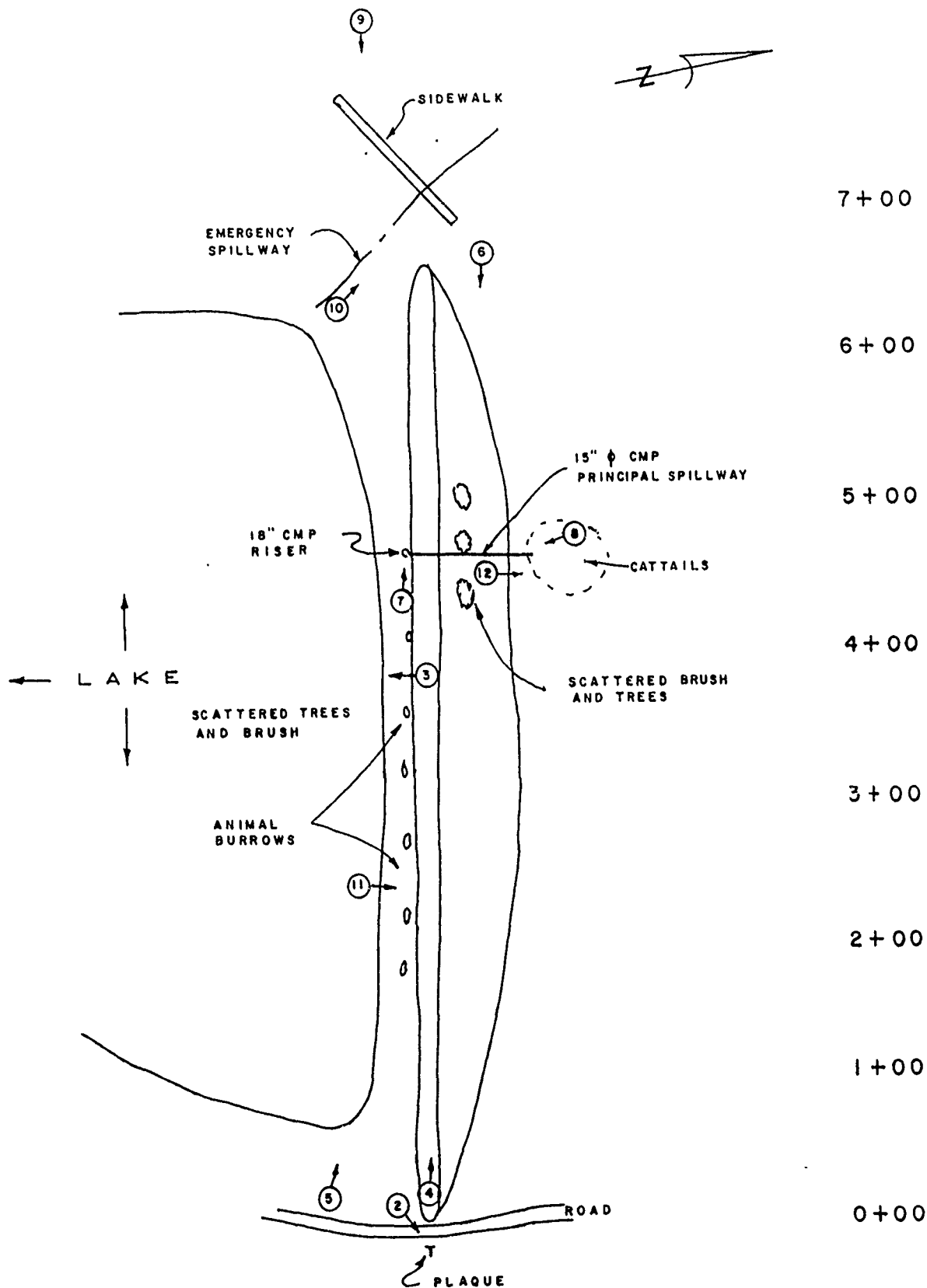


APPENDIX D

Photographs

LIST OF PHOTOGRAPHS

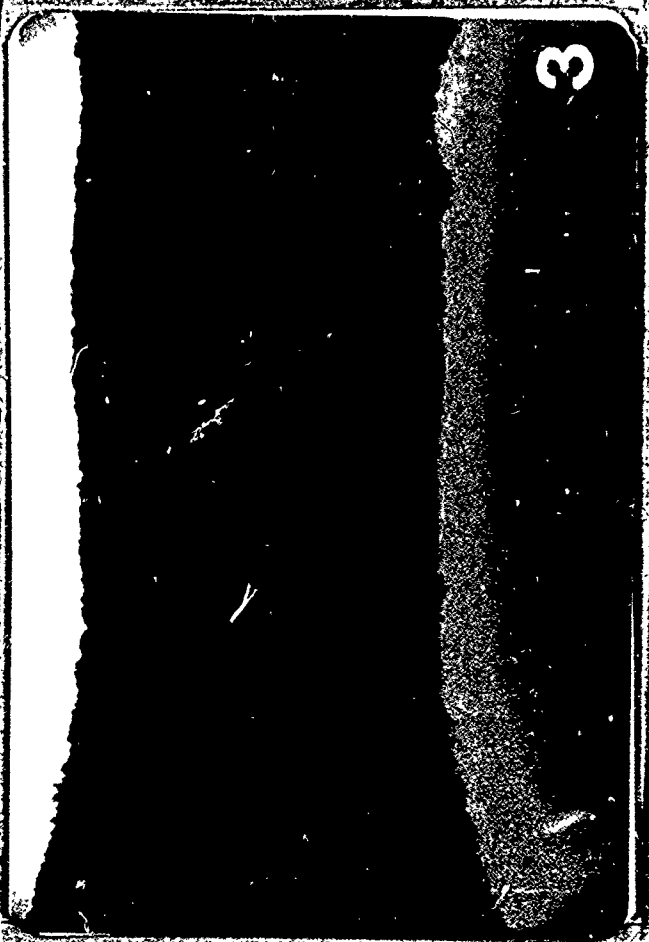
<u>PHOTO NO.</u>	<u>DESCRIPTION</u>
1	Aerial View (Looking Northwest)
2	View of Plaque
3	Reservoir and Watershed (Looking South)
4	Crest of Dam (Looking West)
5	Upstream Face of Dam (Looking West)
6	Downstream Face of Dam (Looking East)
7	Principal Spillway Pipe Inlet (Looking West)
8	Principal Spillway Pipe Outlet (Looking South)
9	Emergency Spillway Channel (Looking East)
10	Emergency Spillway Outlet Channel (Looking Northwest)
11	Animal Burrow on Upstream Face
12	Principal Spillway Downstream Channel (Looking North)



**A/E ANDERSON
ENGINEERING, INC.**
730 N. BENTON AVE. • SPRINGFIELD, MO. 65802

PHOTO INDEX

POTASHNICK LAKE DAM
WAYNE COUNTY, MISSOURI
MO. I. D. No. 30565



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