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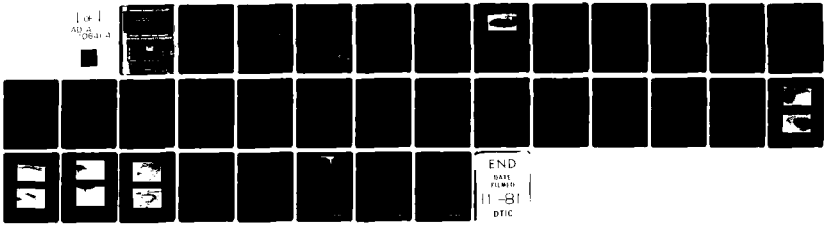

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LEVEL I

SUNNY SHORE DAM
JACKSON COUNTY, MISSOURI
MO 20207

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
FOR STATE OF MISSOURI

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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. A1-A906 / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Phase I Dam Inspection Report National Dam Safety Program Sunny Shores Dam (MO 20237) Jackson County, Missouri	5. TYPE OF REPORT & PERIOD COVERED (9) Final Report / 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Black & Veatch, Consulting Engineers	8. CONTRACT OR GRANT NUMBER(s) (15) DACW43-78-C-0148
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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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MISSOURI-KANSAS CITY BASIN

SUNNY SHORES DAM
JACKSON COUNTY, MISSOURI
MO 20237

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

FOR: STATE OF MISSOURI

SEPTEMBER 1978

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

IN REPLY REFER TO

SUBJECT: Sunny Shores Lake Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Sunny Shores Lake Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 1 MAR 1979 Date

APPROVED BY : SIGNED
Chief, CE, District ENgineer — 1 MAR 1979 Date

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SUNNY SHORES LAKE DAM

JACKSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 20237

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

SEPTEMBER 1978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Sunny Shores Lake Dam
State Located	Missouri
County Located	Jackson County
Stream	Tributary to Little Blue River
Date of Inspection	12 September 1978

Sunny Shores Lake Dam was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. 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 developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers failure would threaten the life and property of approximately three families downstream of the dam and would potentially cause appreciable damage to three improved roads within the estimated damage zone which extends 1 mile downstream of the dam.

Our inspection and evaluation indicates 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 not pass either the probable maximum flood or 50 percent of the probable maximum flood without overtopping but will pass 10 percent of the probable maximum flood, which is less than the estimated 100-year flood. Considering the small volume of water impounded and the large flood plain downstream, one-half the probable maximum flood is the appropriate spillway design flood.

The only deficiency visually observed by the inspection team was the presence of some crayfish holes on the downstream embankment. Seepage and stability analyses were not available which is considered a deficiency.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiency. A detailed report discussing the aforementioned deficiency is attached.

Paul R. Zaman

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OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SUNNY SHORES LAKE DAM

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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 District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Sunny Shores Lake Dam be made.

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 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, in "Recommended Guidelines for Safety Inspection of Dams". 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.

(1) The dam is an earth structure located in the valley of a tributary to the Little Blue River in southwestern Jackson County, Missouri (Plate 1). Topography of the contributing watershed is characterized by rolling hills. The watershed is primarily comprised of residential areas and farmland. Topography in the vicinity of the dam is shown on Plate 2.

(2) A concrete broad-crested weir and spillway was constructed at the right abutment from which the water flows into a limestone and shale discharge channel with steep side slopes.

(3) Pertinent physical data are given in paragraph 1.3.

b. Location. The dam is located in southwestern Jackson County, Missouri, as indicated on Plate 1. The lake formed by the dam is shown on the United States Geological Survey 7.5 minute series quadrangle map for Lee's Summit, Missouri in Section 31 of T48N, R32W.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the small size category.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Sunny Shores Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways or railroads. For the Sunny Shores Lake Dam the flood damage zone extends downstream for one mile. Within the damage zone are three homes and three improved roads.

e. Ownership. The dam is owned by Martha Nemmers; 8800 E. 107th; Kansas City, Missouri 64134.

f. Purpose of Dam. The dam forms a 8-acre recreational lake.

g. Design and Construction History. Data relating to the design and construction were not available.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 120 acres

b. Discharge at Damsite.

(1) Normal discharge at the damsite is through an uncontrolled spillway.

(2) Estimated experienced maximum flood at damsite - unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation - 170 cfs (top of dam).

c. Elevation (Feet Above M.S.L.).

(1) Top of dam - 920.1 ± (see Plate 4)

(2) Spillway crest - 918.6

(3) Streambed at centerline of dam - 900 ±

(4) Maximum tailwater - Unknown.

d. Reservoir. Length of maximum pool - 700 feet ±

e. Storage (Acre-feet)

(1) Top of dam - 84

(2) Design Surcharge - Not available

f. Reservoir Surface (Acres).

(1) Top of dam - 11

(2) Spillway crest - 8

g. Dam.

(1) Type - Earth embankment

(2) Length - 820 feet

(3) Height - 20± feet

(4) Top width - 20 feet

(5) Side slopes - approximate 3H to 1V back slope, approximate 3.5H to 1V front slope (see Plate 4)

(6) Zoning - Unknown

(7) Impervious core - Unknown

(8) Cutoff - Unknown

(9) Grout curtain - Unknown

h. Diversion and Regulating Tunnel - None.

i. Spillway.

(1) Type - Broad crested weir (see paragraph 3.1c)

(2) Length of weir - 33 feet (see paragraph 3.1c)

(3) Crest elevation - 918.6 feet m.s.l.

(4) Gates - None

(5) Upstream channel - None.

(6) Downstream channel - Broken limestone and shale with rock side slope protection.

j. Regulating Outlets - None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data were unavailable.

2.2 CONSTRUCTION

Construction records were unavailable, however the dam was reportedly built circa 1945.

2.3 OPERATION

The maximum recorded loading on the dam is unknown.

2.4 EVALUATION

a. Availability. No engineering data were found.

b. Adequacy. No engineering data were available to make a detailed assessment of design, construction, and operation. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspections 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. No engineering data were available to determine the validity of the design, construction, and operation.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Sunny Shores Lake Dam was made on 12 September 1978. The inspection team included professional engineers with experience in dam design and construction, hydrology - hydraulic engineering, and structural engineering. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following items at the dam. The top of the dam and the downstream embankment were well maintained and protected from erosion by a grass cover. The upstream slope was protected by rip rap which appeared to be in excellent shape. There were some crayfish holes noted on the downstream embankment. In general the dam embankment appeared to be in good condition.

c. Appurtenant Structure. The spillway is a concrete broad-crested weir, 33 feet long which spills into a limestone and shale discharge channel. The spillway appeared to be in good condition.

d. Reservoir Area. No slides or excessive erosion due to wave action were observed along the shore of the reservoir.

e. Downstream Channel. Heavy vegetation and mild channel slopes typical of streams in the area characterize the channel downstream of the spillway.

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action, however, if the crayfish and their resulting holes are allowed to go unchecked, a potential for failure may develop.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

No controlled outlet works exist. The pool is primarily controlled by rainfall, runoff, evaporation, and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

The appearance of the dam indicated that it was well maintained. The grass on the embankment had been mown and no trees had been allowed to grow on the embankment. The owner reported that crayfish holes were filled annually.

4.3 MAINTENANCE OF OPERATING FACILITIES

No controlled outlet works exist.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The presence of crayfish holes on the downstream side of the dam increase the potential for failure and warrant regular monitoring and control.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data pertaining to hydrology and hydraulics were unavailable.

b. Experience Data. The drainage area and lake surface area are developed from the USGS Lees Summit Quadrangle Map. The spillway and dam layouts are from surveys made during the inspection.

c. Visual Observations.

(1) Concrete weir spillway and the spillway discharge channel are in good condition.

(2) No drawdown facilities are available to evacuate the pool.

(3) The spillway and exit channel are located at the right abutment. Spillway releases will not endanger the integrity of the dam.

d. Overtopping Potential. The spillway will not pass 50 to 100 percent of the probable maximum flood, which is the spillway design flood recommended by the guidelines, 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 spillway will pass 10 percent of the probable maximum flood without overtopping. This flood is less than the 100-year estimated according to the methodology outlined by the USGS in "Technique for Estimating the Magnitude and Frequency of Missouri Floods". According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of small size should pass 50 to 100 percent of the probable maximum flood. Considering the small volume of water impounded and the large flood plain downstream from the dam, one-half the probable maximum flood is the appropriate spillway design flood. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 2,100 cfs of the total discharge from the reservoir of 2,300 cfs. The estimated depth over the dam is 1.0 foot and duration of overtopping is 5.1 hours. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 900 cfs of the total discharge of the reservoir of 1,100 cfs. The estimated depth over the dam is 0.75 foot and duration of overtopping is 1.6 hours.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately 1 mile downstream of the dam. There are three inhabited homes and three improved roads downstream of the dam which could be severely damaged and lives could be lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design data relating to the structural stability of the dam were found.

c. Operating Records. No operational records exist.

d. Post Construction Changes. No post construction changes are known to exist.

e. Seismic Stability. This dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during an earthquake in this zone.

The seismic stability of an earth dam is dependent upon a number of factors: The important factors being embankment and foundation materials and shear strengths; abutment material classification, conditions, and strength; embankment zoning; and embankment geometry. Adequate descriptions of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment were not available and therefore no inferences will be made regarding the seismic stability.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The only item of concern that was noted during the visual inspection by the inspection team which should be monitored or controlled was the presence of some crayfish holes on the downstream embankment.

b. Adequacy of Information. Due to the unavailability of engineering design data, the conclusions in this report were based only on performance history and visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. Due to the lack of data, detailed seepage and stability analyses comparable in scope to the requirements of Chapter 4 of the Recommended Guidelines should be performed.

c. Urgency. A program should be developed as soon as possible to correct the deficiency described in this report. The remedial measures recommended in paragraph 7.2 could be accomplished now or delayed until observations and/or the recommendation of a qualified engineer indicate the necessity of action. If the safety deficiency listed in paragraph 7.1a is not corrected, it could lead to a serious potential of failure.

d. Seismic Stability. This dam is located in Seismic Zone 1. Adequate description of embankment design parameters, foundation and abutment conditions, or static stability analyses to assess the seismic stability of this embankment was not available and therefore no inferences will be made regarding the seismic stability. An assessment of the seismic stability should be included as part of the stability analysis required by the guidelines.

7.2 REMEDIAL MEASURES

a. Alternatives. The present spillway has capacity to pass 10 percent of the probable maximum flood without overtopping the dam. In order to pass 50 to 100 percent of the probable maximum flood as required by the Recommended Guidelines, the spillway size and/or height of dam would need to be increased.

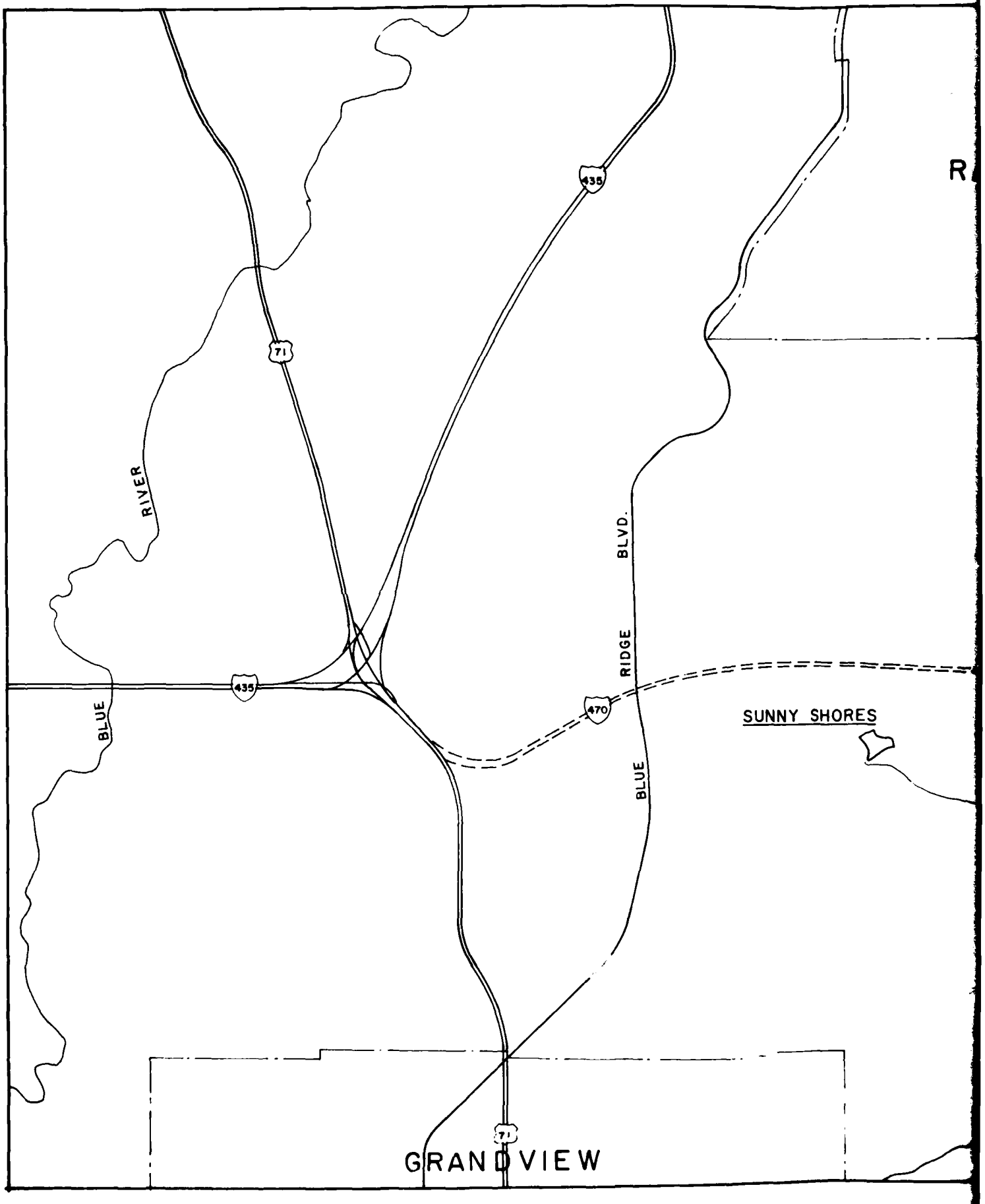
b. O&M Maintenance and Procedures. The following O&M maintenance and procedures are recommended:

(1) Check the downstream face of the dam periodically for further problems with crayfish holes. If the number of crayfish holes is observed to be increasing, the dam should be inspected and the condition evaluated by an engineer experienced in design and construction of earthen dams.

(2) A detailed inspection of the dam should be made at least every year by an engineer experienced in design and construction of dams. More

frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiency increases.

(3) Seepage and stability analyses shall be performed by a professional engineer experienced in the design and construction of earth dams.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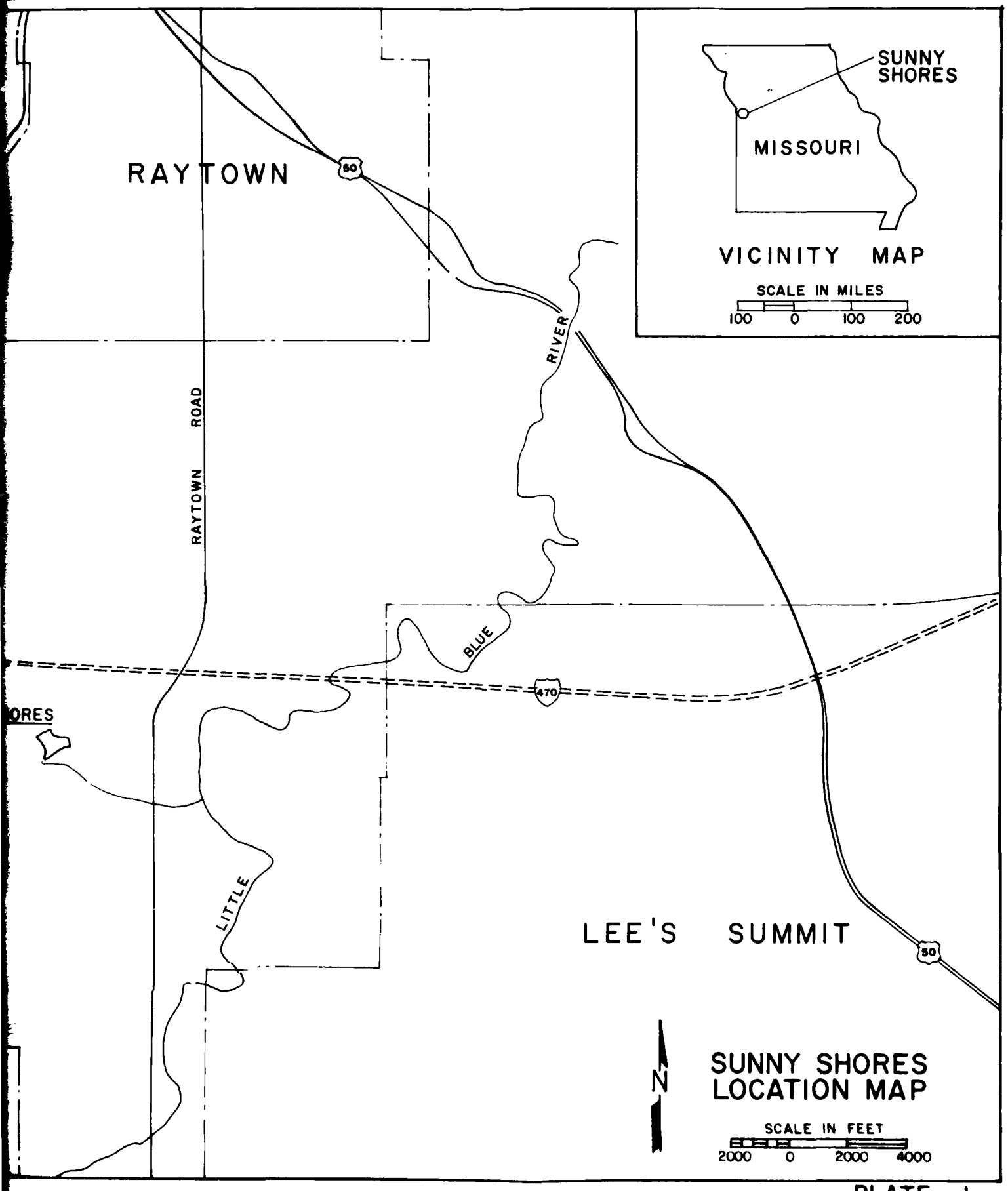
71
RIVER
BLUE
435
BLVD.
RIDGE
470
SUNNY SHORES
BLUE
71
GRANDVIEW


SUNNY SHORES
MISSOURI
VICINITY MAP
SCALE IN MILES
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RAYTOWN
50
RIVER
RAYTOWN ROAD
BLUE
470
ORES
LITTLE
LEE'S SUMMIT
50
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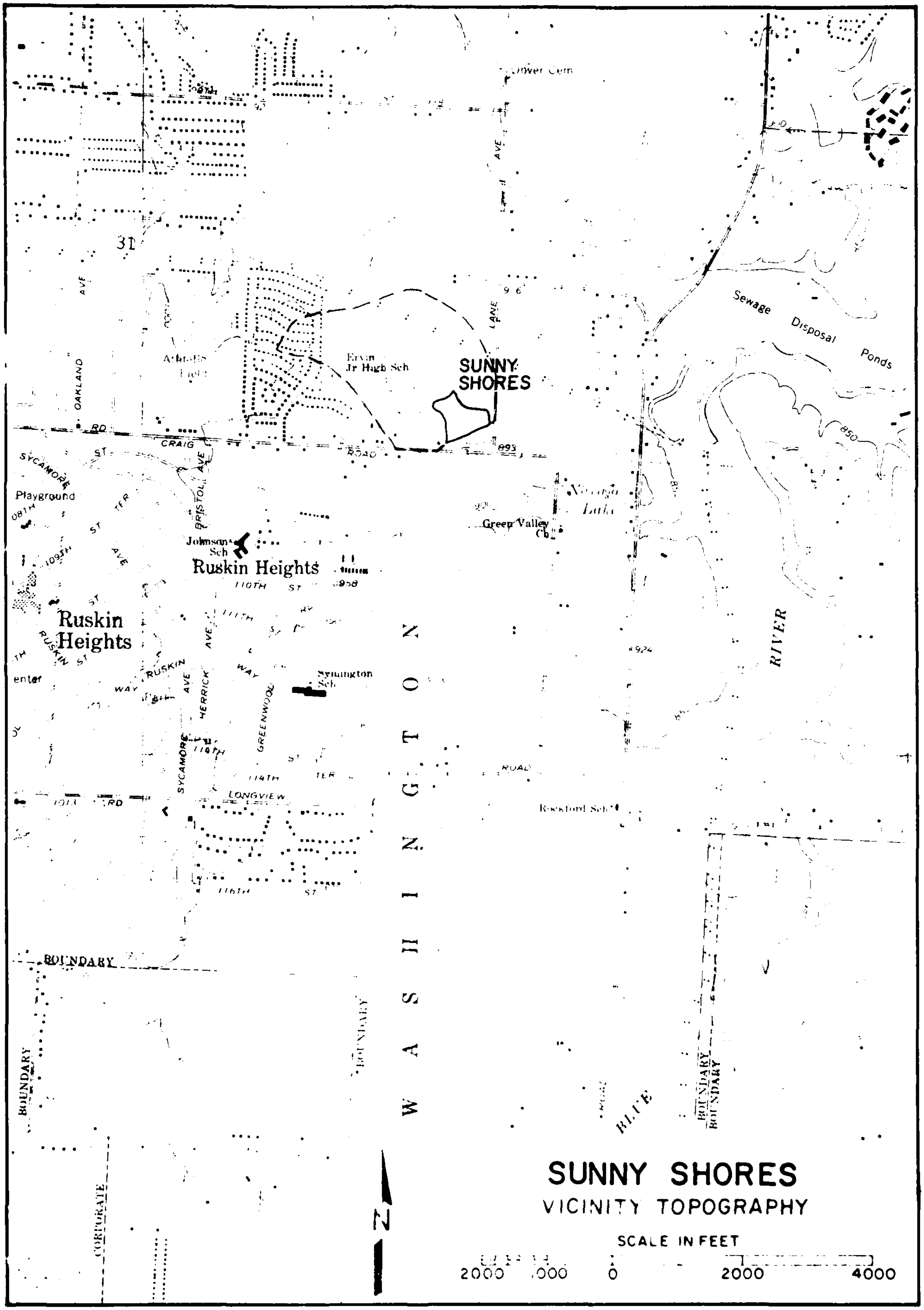
SUNNY SHORES LOCATION MAP
SCALE IN FEET
2000 0 2000 4000

PLATE 1


SUNNY SHORES
VICINITY TOPOGRAPHY
SCALE IN FEET
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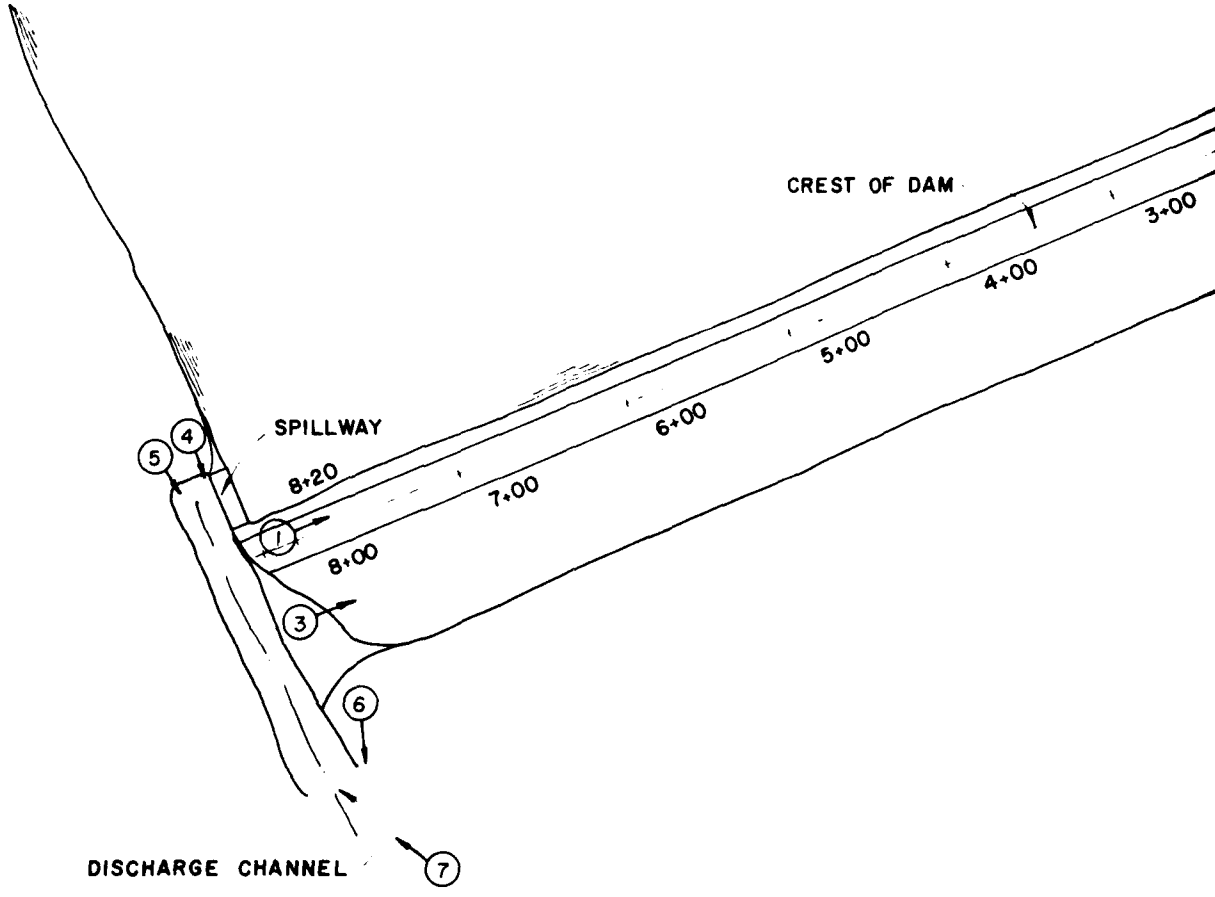
N
SUNNY SHORES
Ervin Jr High Sch
Athletic Field
Sewage Disposal Ponds
RIVER
Ruskin Heights
Ruskin Heights
Johnson Sch
Symington Sch
Green Valley Ch
Rockford Sch
Playground
OAKLAND
AVE
CRAIG
RD
ROAD
LANE
BRISTOL AVE
SYCAMORE
HERRICK
GREENWOOD
LONGVIEW
110TH ST
114TH
116TH ST
RUSKIN
WAY
WASHINGTON
BOUNDARY
CORPORATE
BLUE
850
893
924
958

PLATE 2

SUNNY SHORES



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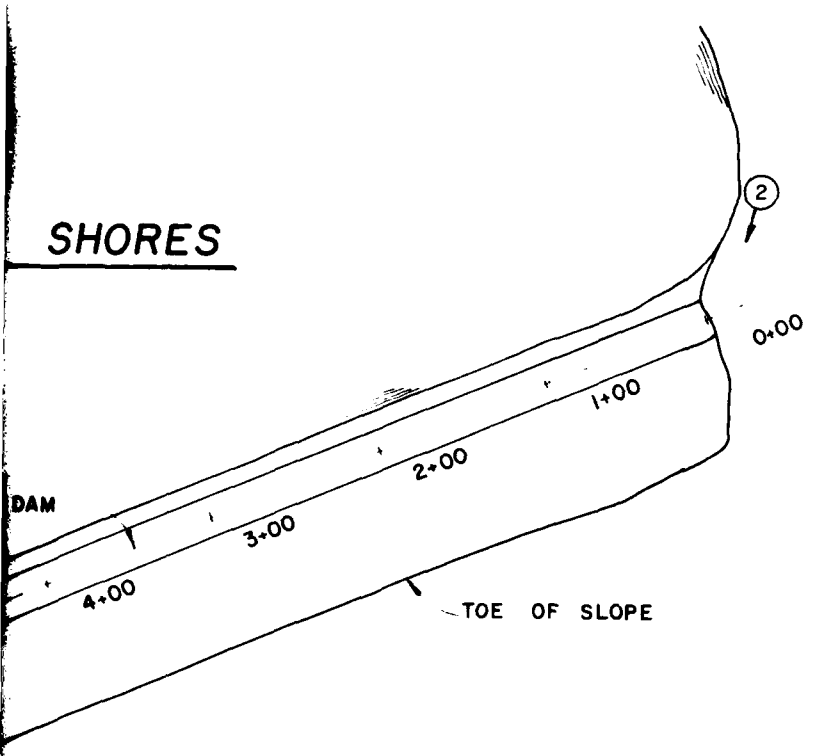

(1)→ PHOTOGRAPH LOCATION AND DIRECTION

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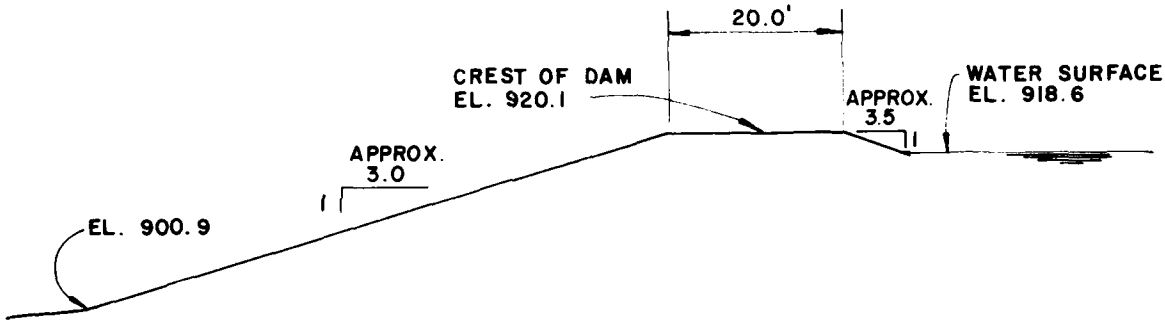
SUNNY SHORES
PLAN

PLATE 3



SUNNY SHORES
SECTION

PLATE 4

PHOTO 1: UPSTREAM FACE (LOOKING EAST)

PHOTO 2: UPSTREAM FACE (LOOKING SOUTH)

PHOTO 3: DOWNSTREAM FACE (LOOKING EAST)

PHOTO 4: BROAD CRESTED WEIR (LOOKING SOUTH)

PHOTO 5: DISCHARGE CHANNEL (LOOKING DOWNSTREAM)

PHOTO 6: DISCHARGE CHANNEL (LOOKING DOWNSTREAM)

PHOTO 7: EROSION THROUGH SHALE OF DISCHARGE CHANNEL

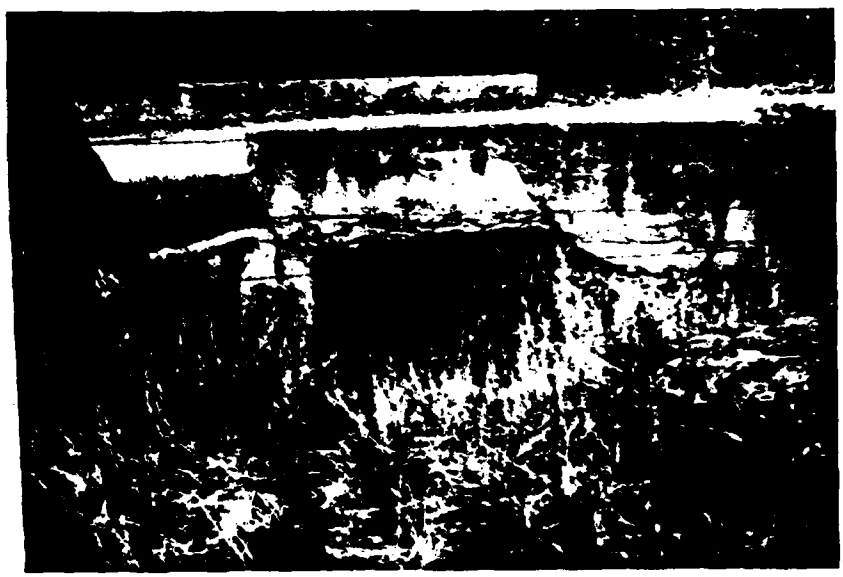


PHOTO 8: BRIDGE AT CRAIG RD. (APPROX. 1/4 MILE DOWNSTREAM OF DAM)

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Soil Conservation Service (SCS) dimensionless unit hydrograph and HEC-1 (1) were used to develop the inflow hydrograph (see Plate A-1). Hydrologic inputs are as follows:

a. Twenty-four hour, probable maximum precipitation determined from U.S. Weather Bureau Hydrometeorological Report No. 33:

200 square mile, 24 hour rainfall	- 24.8 inches
10 square mile, 6 hour percent of 24 hour 200 square mile rainfall	- 106%
10 square mile, 12 hour percent of 24 hour 200 square mile rainfall	- 122%
10 square mile, 24 hour percent of 24 hour 200 square mile rainfall	- 131%

b. Drainage area = 120 acres.

c. Time of concentration: $Tc = (11.9 \times L^3/H)^{0.385} = 0.25$ hours = 15 minutes

d. Losses were determined in accordance with SCS methods for determining runoff using a curve number of 88 and antecedent moisture condition III.

2. Spillway flow rates and dam overflows are based on the broad-crested weir equation.

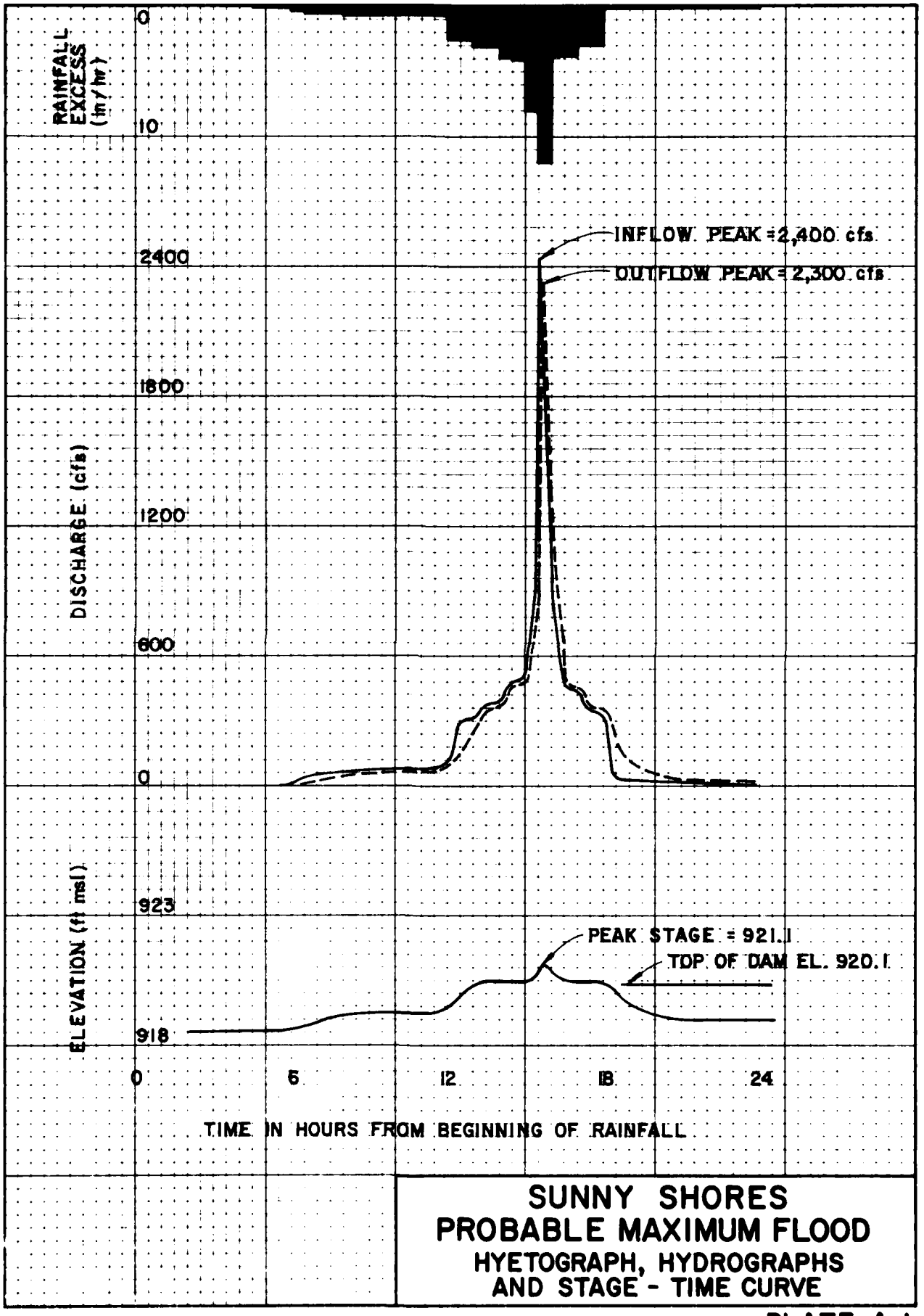
Broad-crested weir equation:

$Q = CLH^{1.5}$ (C = 2.8, L = 33 feet, H is the head on weir).

3. The elevation-storage relationship above normal pool elevation was constructed by planimetering the area enclosed within each contour above normal pool. The storage between two elevations was computed by multiplying the average of the areas at the two elevations by the elevation difference. The summation of these increments below a given elevation is the storage below that level.

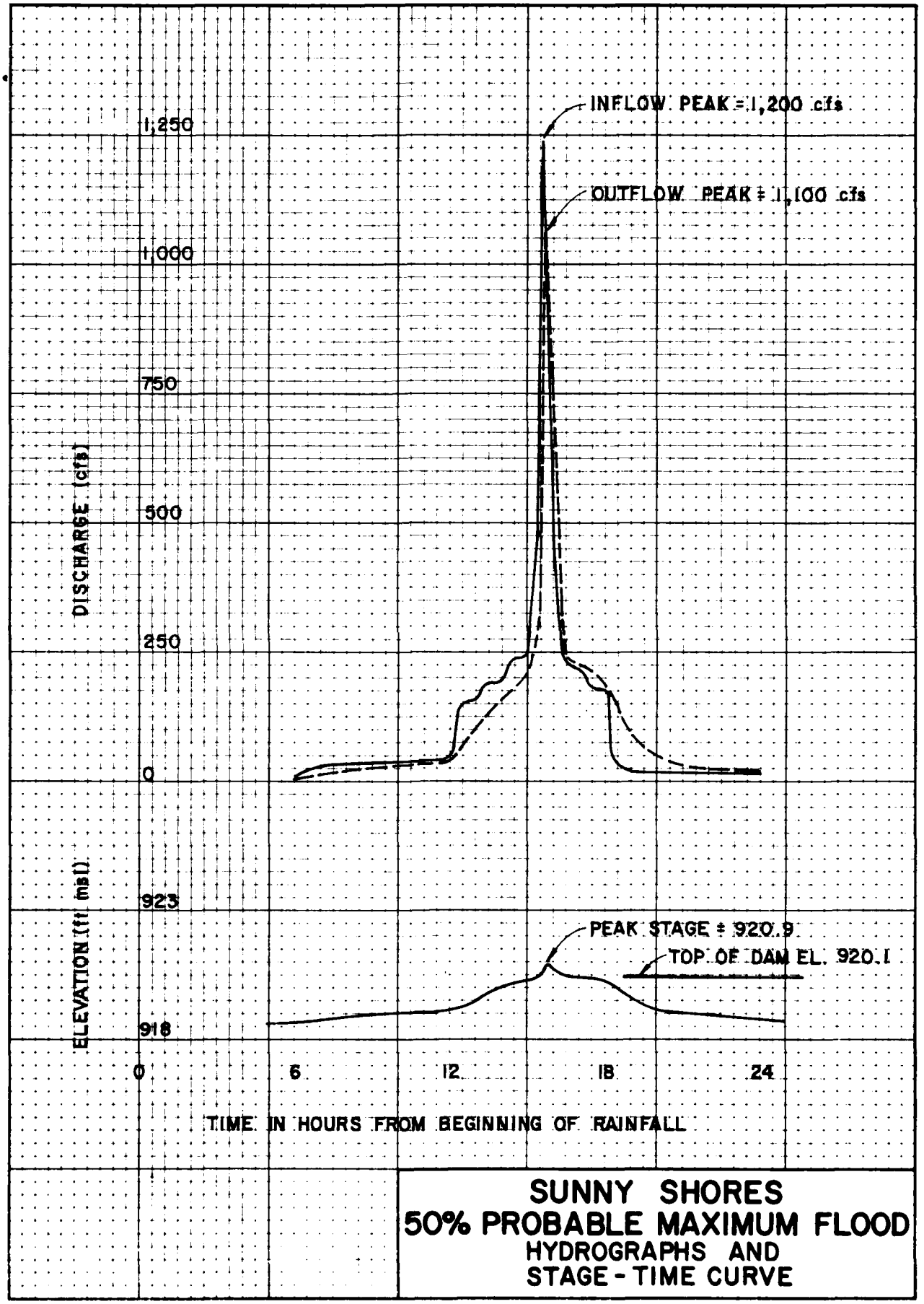
4. Floods are routed through the spillways using HEC-1, with the modified Puls routing method, to determine the capacity of the spillways. Inflow and outflow hydrographs are shown on Plates A-1, A-2, and A-3.

(1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1) Dam Safety Verson, July, 1978, Davis, California



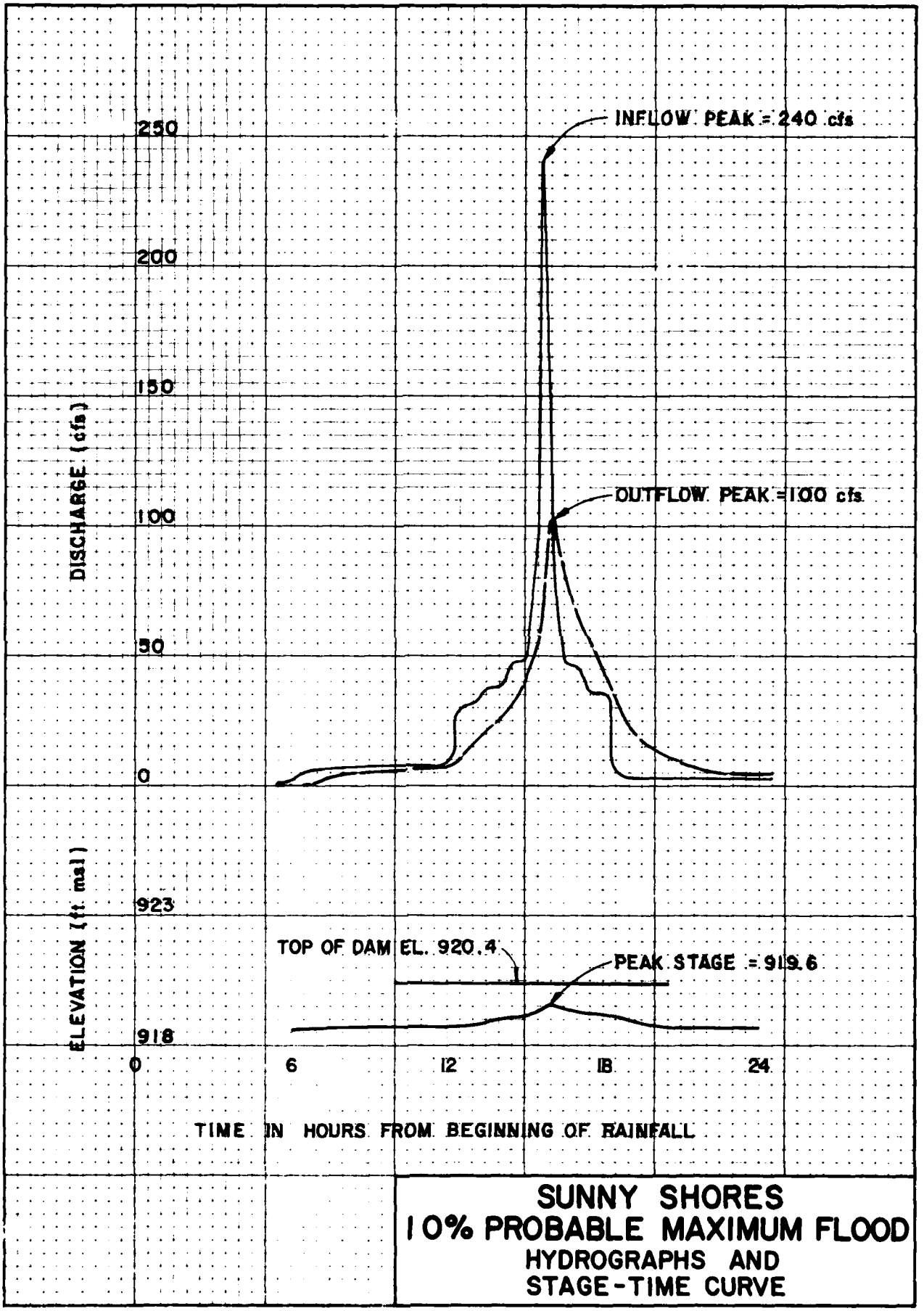
SUNNY SHORES
PROBABLE MAXIMUM FLOOD
HYETOGRAPH, HYDROGRAPHS AND STAGE - TIME CURVE

PLATE A-1



SUNNY SHORES
50% PROBABLE MAXIMUM FLOOD
HYDROGRAPHS AND STAGE - TIME CURVE

PLATE A-2



SUNNY SHORES
10% PROBABLE MAXIMUM FLOOD
HYDROGRAPHS AND STAGE-TIME CURVE

PLATE A-3