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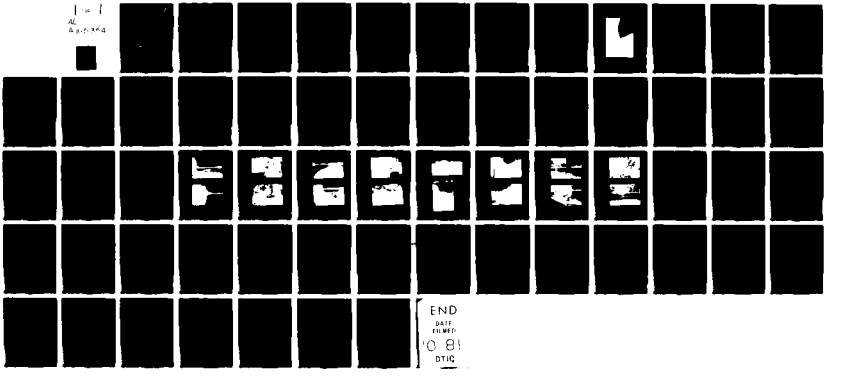

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MISSOURI - KANSAS CITY BASIN

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ONLY WAY LAKE DAM

SALINE COUNTY, MISSOURI

MO. 10111

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

St. Louis District

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

FOR: STATE OF MISSOURI

JUNE, 1979

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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

REPLY TO ATTENTION OF

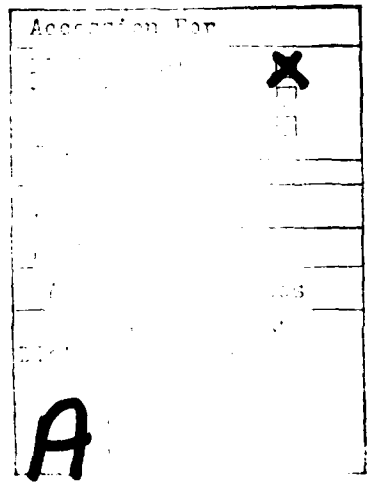
LMSED-P

SUBJECT: Only Way Lake Dam (MO 10111), Phase I Inspection Report

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

SUBMITTED BY: SIGNED
Chief, Engineering Division — 15 APR 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer — 15 APR 1980
Date



ONLY WAY LAKE DAM
SALINE COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. 10111

9 Final rept.,

DACW43-79-C-0046

10 Rey S. /Decker Gordon /Jamison
Garold /Ulmer Harold P. /Hoskins

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

Only Way Lake Dam (MO 10111),
Missouri - Kansas City Basin,
Saline County, Missouri. Phase I Inspection
Report.

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF

ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

11 JUN[redacted]1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Only Way Lake Dam
State Located	Missouri
County Located	Saline County
Stream	Tributary of Bear Creek
Date of Inspection	June 25, 1979

Only Way Lake Dam was inspected by an interdisciplinary team of engineers ~~from Hoskins-Western-Sonderegger, Inc~~. The purpose of the inspection was to make an assessment of the general conditions 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 significant downstream hazard potential. Failure may damage isolated homes, secondary highways or minor railroads or cause interruption of use or service of relatively important public utilities. The estimated damage zone extends approximately one and one-half miles downstream of the dam. Within the damage zone are the Illinois Central Gulf Railroad and two light duty roads.

Our inspection and evaluation indicates that the spillways do not meet the criteria set forth in the recommended guidelines for a small dam having a significant hazard potential. Considering the volume of water impounded and the downstream hazards, the 100-year flood is the appropriate spillway design flood. The spillways will not pass the 100-year flood (flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 11% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

No design data were available for this dam. 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 analyses should be obtained in the future.

Other deficiencies observed during the inspection are good sized trees growing on the crest and upstream slope, downstream slope overgrown with trees and brush, seepage along the toe of the dam from Station 3+00 to Station 7+50, concrete headwall of principal spillway inlet structure cracked in several places, undermining and poor condition of the concrete in the emergency spillway, steel mesh fence across the inlet to the emergency spillway, erosion of earth channel downstream from concrete spillway channel, and downstream channels from spillways overgrown with trees and shrubs.

A program of regular inspection and maintenance needs to be initiated. Preventative maintenance items are described in greater detail in the body of the report.

Rey S. Decker
E-3703

Gordon Jamison

Garold Ulmer
E-4777

H. P. Hoskins
Harold P. Hoskins
Chairman of Board
Hoskins-Western-Sonderegger, Inc.
E-8696

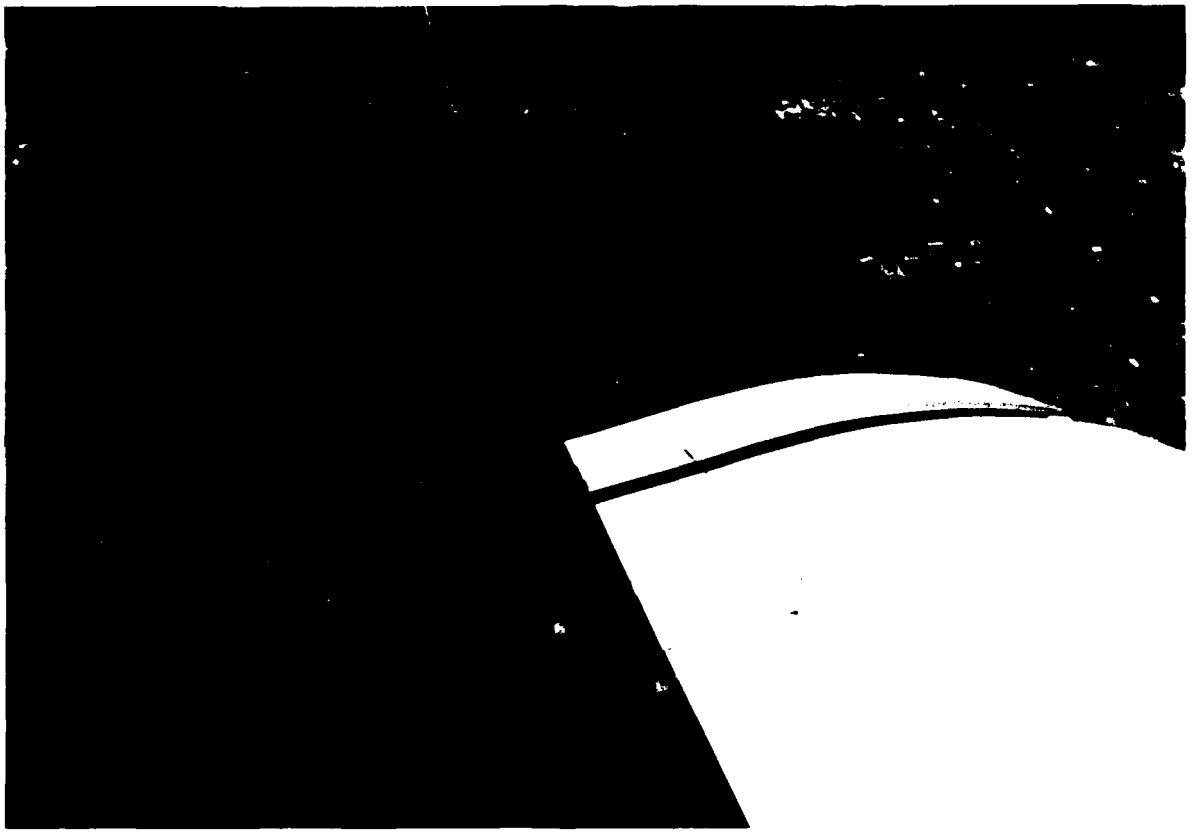


PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
ONLY WAY LAKE DAM - MO 10111
SALINE COUNTY, MISSOURI

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 of Only Way 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," Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth fill about 930 feet in length and 21 feet in height. The dam is located in the gently rolling loess covered hills south of the Missouri River.

(2) The principal spillway consists of a shallow weir box inlet, and conduit constructed of old oil barrels with the ends removed and concreted in place. This conduit exits into an old gully filled with rock and concrete rubble.

(3) A small emergency spillway is cut through the right end of the dam. This spillway is plated, or lined, with unreinforced, hand placed concrete.

(4) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the northeastern portion of Saline County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the NW¼ of Section 12, T51N, R20W. The lake formed behind the dam is shown in the NW¼ of Section 12, T51N, R20W and the NE¼ of Section 12, T51N, R20W.

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, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the Significant Hazard Classification. The estimated damage zone extends for about one and one-half miles downstream of the dam where the impounded drainage way enters the much larger Bear Creek drainage way. Dwellings located along the subject drainage way appear to be 20 to 30 feet above the Creek bottom. A railroad bridge is situated about 0.4 miles downstream of the dam and two light duty road crossings are located 0.6 and one and one-half miles downstream.

e. Ownership. The dam is owned by the Illinois Central Gulf Railroad, 233 North Michigan Ave., Chicago, Illinois, and is leased to the Only Way Fishing and Golf Club, Slater, Missouri.

f. Purpose of Dam. The dam impounds a recreational lake covering about 31 acres.

g. Design and Construction History. The following information was supplied by Mr. Davis, caretaker for the fishing club that leases the reservoir. The dam was constructed in the early 1900's to form a water supply lake for the railroad. The original dam extended south-westward from present dam Station 2+00±. In 1929 or 1930 this southwest leg of the dam was lowered about 5 feet to extend the lake westward to the railroad right-of-way. At this same time the present dam was raised, the crest was widened, and the emergency spillway was installed. The emergency spillway was widened and modified in 1975.

h. Normal Operating Procedure. There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, and the capacity of the uncontrolled spillways.

1.3 PERTINENT DATA

a. Drainage Area. 435 acres (0.68 square miles).

b. Discharge at Damsite.

(1) All discharges at the damsite are through a principal spillway consisting of a series of oil barrels, ends cut out, concreted in place with a French drain type outlet, and an ungated emergency spillway plated with concrete grout.

(2) Estimated maximum flood at damsite -- 100 c.f.s. maximum outflow (approximate).

(3) The principal spillway capacity varies from 0 c.f.s. at elevation 816.0 feet to 4 c.f.s. at the crest of the emergency spillway (elevation 816.4 feet) to 16 c.f.s. at the minimun top of dam (elevation 818.5 feet).

(4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 816.4 feet to 90 c.f.s. at elevation 818.5 feet (minimum top of dam).

(5) Total spillway capacity at the minimum top of dam is 106 c.f.s.±

c. Elevations (feet above M.S.L.).

(1) Top of dam - varies from 818.5 (minimum) to 820± (maximum)
(2) Principal spillway crest - 816.0±
(3) Emergency spillway crest - 816.4±
(4) Streambed at center line - 798±
(5) Maximum tail water - unknown

d. Reservoir. Length (feet) of maximum pool - 1600±.

e. Storage (Acre-feet)

(1) Top of dam - 256±
(2) Principal spillway crest - 165±

f. Reservoir Surface (Acres).

(1) Top of dam - 42±
(2) Principal spillway crest - 31±

g. Dam.

(1) Type - earth fill
(2) Length - 930 feet ±
(3) Height - 21 feet ±
(4) Top width - 11 feet ±
(5) Side slopes

(a) Downstream - variable 1.8 to 3.4H on 1V (measured)
(b) Upstream - Exposed = 1.4H on 1V (measured) to near vertical

(6) Zoning - unknown
(7) Impervious core - unknown
(8) Cutoff - unknown
(9) Grout curtain - unknown
(10) Wave protection - Partial plating with concrete slabs and rubble
(11) Internal Drainage System - unknown

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - Uncontrolled weir box inlet with steel barrel conduit. According to Mr. Davis the conduit was constructed of 2.2 feet diameter steel oil barrels, ends removed and concreted into place. The barrel conduit is covered and outlets into an old gully which has been filled with rock and concrete rubble to the present ground surface which is about elevation 822 feet.

(b) Crest (invert) elevation - 814.7 feet± (Pipe)
816.0 feet± (Weir)
Outlet - Covered, unknown, outlet of rock drain in gully bottom - elevation 806 feet±.

(c) Length - Pipe (barrel) section estimated at 350 feet ±.

(2) Emergency

(a) Type - uncontrolled, excavated earth channel partially lined or plated with concrete.

(b) Control section - 10 feet long nearly level section, with concrete lining across the bottom.

(c) Crest elevation - 816.4 feet ±

(d) Upstream Channel - concrete lined, about 5 feet in length.

(e) Downstream Channel - Earth channel partially lined with rough concrete grout.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Howard Davis that the dam was built in the early 1900's and modified in 1929 or 1930.

2.3 OPERATION

No data were available on spillway operation. It was reported that the emergency spillway operates 2-3 times each year. Maximum flow through the emergency spillway was reported to be about 2 feet in 1976 following a 15 inch rain.

2.4 EVALUATION

a. Availability. No data were available.

b. Adequacy. The field surveys and visual observation presented herein are considered adequate to support the conclusions of this report. 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. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Only Way Lake Dam was made on June 25, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison, Hydrology; Garold Ulmer, Civil Engineer. Howard Davis, Caretaker for the fishing and golf club that leases the lake accompanied the inspection team.

b. Dam.

(1) Geology and Soils (abutment and embankment). Soils in the area consist of the Sharpsburg, Higginsville, Macksburg Association which consist of moderately deep ML-CL loess over shale or sandstone. No bedrock formations were exposed at the site or in the area. They probably consist of shales of the Cherokee group of lower Pennsylvanian age. The bedrock at this site would not control foundation characteristics for this structure. Borings on the dam showed brown clayey silts (ML) to depths of 3 feet. No slumps or slides were evident in the abutments.

(2) Upstream Slope. The upstream face is nearly vertical from the crest to the waterline and is plated with concrete slabs, rubble and limestone cobbles. Very little erosion was noted along the face. Several good sized trees are growing on the upstream crest and slope. No slides or abnormal deformations were noted on the slope.

(3) Crest. The crest is partially vegetated with grass with several bare spots caused by fishing activity. Several large trees are growing along the up and down crest lines. No cracks, rodent holes or lateral deformations were noted along the crest. The profile of the crest is somewhat irregular with about 1 foot of variation in elevation across the main section of the dam.

(4) Downstream Slope. The downstream slope is heavily overgrown with trees up to 24 inches in diameter. Grass cover amid the trees is fairly good. There is an apparent bulge or hump in the slope about one-half way down from the crest to toe. This deformation

appears to be the result of construction operations in raising and widening the dam. No seepage was observed on the slope of the dam, but seepage outcrops and accumulates along the entire toe of the dam from about station 3+00 to 7+50. The seep and marsh area extends 50 to 100 feet below the toe of the dam with as much as 6 inches of water standing in some places. No flow was observed in the seepage area, and it was not possible to estimate total seepage effluent. A small pond (probably part of the old channel) is located downstream from about station 2+50. The pond area is partially filled with concrete rubble, bricks and other refuse. No rodent holes or slides were observed on the slope, however, the dense cover of trees and brush made observation very difficult.

(5) Miscellaneous. Materials in the dam, the steep downstream slope and the type of vegetative cover would indicate that overtopping of this dam could result in serious damage.

c. Appurtenant Structures.

(1) Principal Spillway. The principal spillway is located in natural ground northwest of the dam. It consists of a concrete weir inlet and 2.2 ft. diameter steel oil barrels concreted in place outletting into a French drain. It was not possible to observe any of the steel barrel conduit. The conduit outlets into a gulley which has been filled with rock and concrete rubble up to about elevation 822. The rock filled gulley serves as a French drain exit for flows through the principal spillway. The inlet is protected with a mesh screen. The concrete head walls of the inlet structure are cracked in several places but the integrity of the structure does not appear to be endangered. Water was barely flowing over the inlet sill. The outlet end of the rock filled exit channel (French drain type) was observed to be stable with a trickle of discharge. No slumps or depressions were noted on the ground surface covering the pipe conduit.

(2) Emergency Spillway. The emergency spillway was modified in 1975±. It now has a thin concrete plating covering the bottom and extending up the side slopes about one foot above the bottom elevation. This plating extends from the water surface inlet for about 25 or 30 feet downstream where the spillway discharges into an eroded earth

channel. The right side of the concrete section of the spillway is badly undermined by erosion from the center line of dam downstream for several feet (see photos 8 and 9). A trickle of water (<0.1 gal/min) was flowing in the erosion channel(s) under the concrete section of the spillway. None of the concrete in the spillway looked too good. A steel mesh fence has been constructed across the entrance to the spillway.

(3) Drawdown Facilities. There are no drawdown facilities for this dam.

d. Reservoir Area. No slides or significant erosion was noted around the shore line of the reservoir.

e. Downstream Channel. The channels downstream from the spillway outlets are overgrown with trees and shrubs.

3.2 EVALUATION

This dam appears to have a serious potential of failure. The effects of seepage pressures under full loading conditions are not known but it appears that they could be critical at, and/or above, the downstream toe. Tree growth on the slopes could adversely affect the structural stability of the dam. Maximum flows in the emergency spillway could cause severe erosion and breaching of the dam. It would appear that overtopping of the dam would cause severe damage to the structure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, and the capacity of the uncontrolled spillways.

4.2 MAINTENANCE OF DAM

Maintenance is generally poor and there does not appear to be any regular program in effect.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There appears to be a serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data were found for this dam. All computations are based on field inspection and surveys performed by the consultant. The plan, profiles, and cross sections from the survey are attached in Appendix C.

b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Slater, Missouri, 7½ minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.

c. Visual Observations.

(1) The principal spillway inlet was free of debris. A screen was located over the entrance to the spillway conduit.

(2) The principal spillway outlet consists of a gully filled with concrete rubble and slabs (French drain). The downstream channel was badly choked with trees and brush.

(3) The emergency spillway is located in the dam embankment near the right end of the dam. A woven-wire fence was across the entrance of the spillway. The spillway was badly undercut with flow coming through the undercut at the time of inspection. Spillway releases could possibly endanger the integrity of the dam.

(4) The exit channel of the emergency spillway was badly choked with brush and vegetation.

(5) There are no drawdown facilities available to evacuate the pool.

d. Overtopping Potential. The spillways are too small to pass 50% of the probable maximum flood and the 100-year (1 percent) flood without overtopping. The spillways will pass 11% of the probable maximum flood without overtopping. The 10-year (10 percent) peak outflow discharge is approximately 57% of the spillway capacity. It would appear that over-

topping of the dam would cause severe damage to the structure. The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	Freeboard Top of Dam Min. Elev. 818.5	Time Dam Overtopping Hr.
10 yr.	900	60	818.0	+0.5	0
100 yr.	1600	200	818.9	-0.4	5±
1/2 PMF	3100	2600	820.1	-1.6	9±
PMF	6200	5500	820.8	-2.3	14±
0.11 PMF	680	100	818.5	0	0

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a significant hazard rating and a small size. Therefore, the 100-year flood to one-half the Probable Maximum Flood is the test for the adequacy of the dam and its spillways.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. It appears that this dam could be structurally unstable, due to excess pore pressure, under maximum loading conditions. Additional studies would be required to determine whether or not the hump or deformation on the downstream slope resulted from shear failure. Analyses presented in Section 5 of this report indicate that the dam would be overtopped with 1.6 feet of water for a period of about 9 hours by one half the Probable Maximum Flood. It would appear that such overtopping could impair the integrity of the dam through erosional damage. These analyses also indicate that the 10-year flood will cause the emergency spillway to flow at a level above the present concrete plating. This could result in severe erosion of the spillway and possible breaching of the dam in that area.

b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Operating Records. There are no controlled operating facilities for this dam.

d. Post Construction Changes. The dam was raised and the crest widened in 1929 or 1930. The emergency spillway was modified in about 1975 as described in Section 3 of this report.

e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam. However, the silty characteristics of materials observed in the dam and the potential for development of excess pore pressures are features that could adversely affect structural stability under dynamic stresses.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. This structure has many deficiencies and appears to have a serious potential of failure. The spillways will not pass the 100 year flood without overtopping the dam. Erosion under the concrete lining and in the outlet channel of the emergency spillway could result in breaching the reservoir with any significant flow (10 year flood) through the spillway. Excessive seepage pressures along the toe of the dam could result in structural failure of the dam under maximum reservoir head. Seepage and slope stability analyses were not available. Uncontrolled tree growth on the slopes could ultimately impair the integrity of the dam. Flow through the emergency spillway could be obstructed by the fence across the entrance. Additional studies would be required to assess the stability of this structure under earthquake stresses predicted for this area.

b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the guidelines were not available which is considered a deficiency.

c. Urgency. A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2.a (1) should be pursued on a high priority basis.

d. Necessity for Phase II. Phase II investigation is not considered necessary.

e. Seismic Stability. This dam is located in Seismic Zone 1. Even though an earthquake of this magnitude is not expected to be hazardous to a dam of this size, the nature of materials in the dam and the seepage conditions observed would appear to warrant additional studies.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) Additional information should be obtained on the topographic characteristics of the reservoir area in order to determine the increase in the height of dam or the size of the spillway that is necessary to pass the 100-year flood without overtopping the dam.

(2) Studies and analyses should be made to determine the source of seepage along the downstream toe and the effects of seepage upon the stability of the structure from the standpoint of uplift and piping potential.

(3) Analyses should be performed to determine the stability of the dam under earthquake stresses predicted for this area with present seepage and pore pressure conditions.

(4) The services of an engineer experienced in the design and construction of dams should be obtained to perform the above studies and analyses and to design protective measures as required.

b. O & M Maintenance and Procedures.

(1) Trees should be removed from the dam under the guidance of an engineer experienced in the design and construction of earthen dams and measures taken to prevent their recurrence.

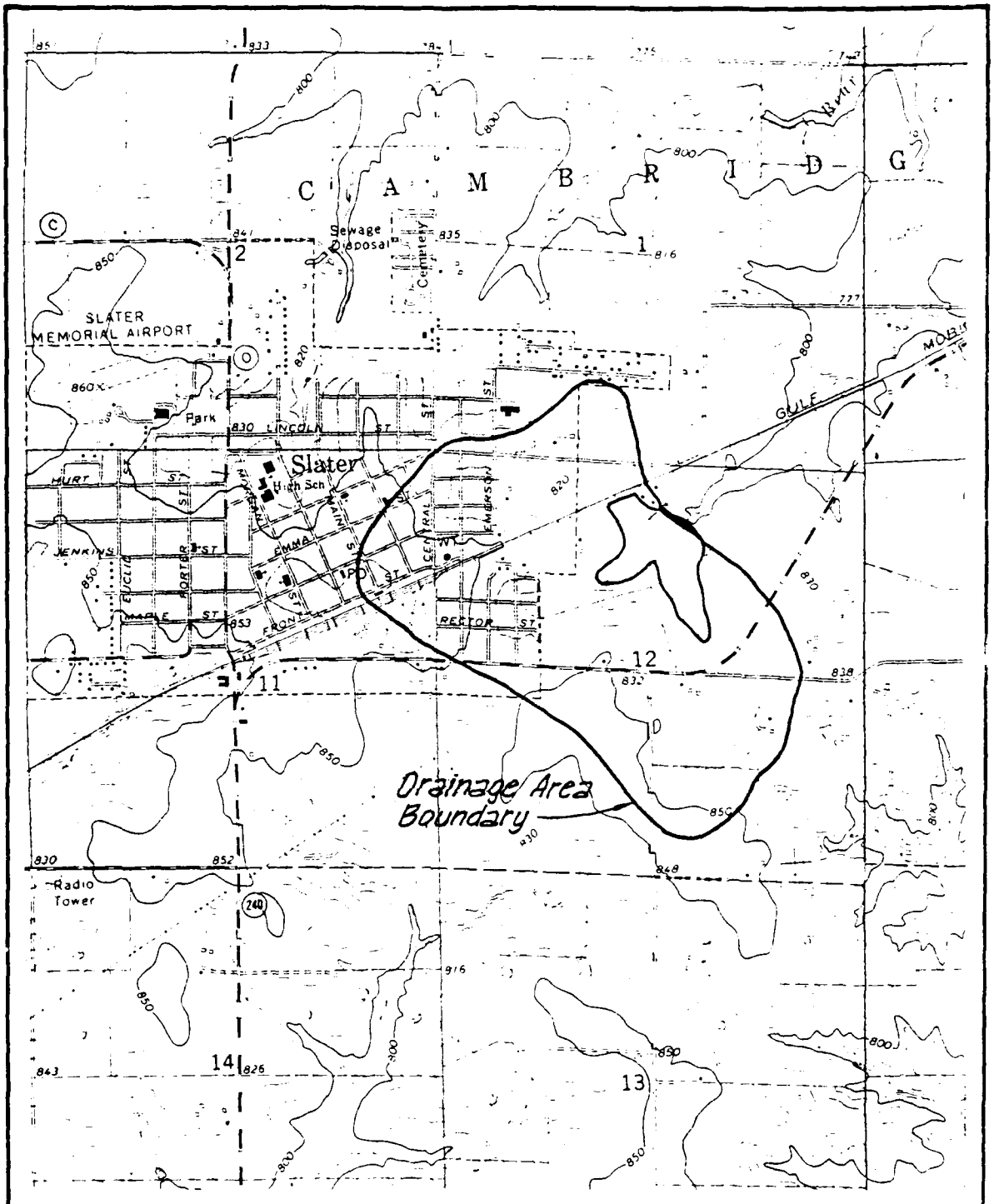
(2) The emergency spillway should be repaired under the guidance of an engineer experienced in the design and construction of earthen dams so that it will at least handle the 10-year flood event without the potential of breaching the dam, regardless of the results of studies recommended in paragraph 7.2(a) above. The mesh fence should be removed from the spillway.

(3) The outlet channel for the emergency spillway should be cleared and stabilized for a distance downstream from the dam that will prevent encroachment of spillway flows on the toe of the dam.

(4) The headwall of the principal spillway should be repaired to prevent further deterioration.

(5) A program of regular inspection and maintenance should be initiated.

APPENDIX A
MAPS



Scale in feet

2000 1000 0 2000 4000

Contour Interval 10 Feet

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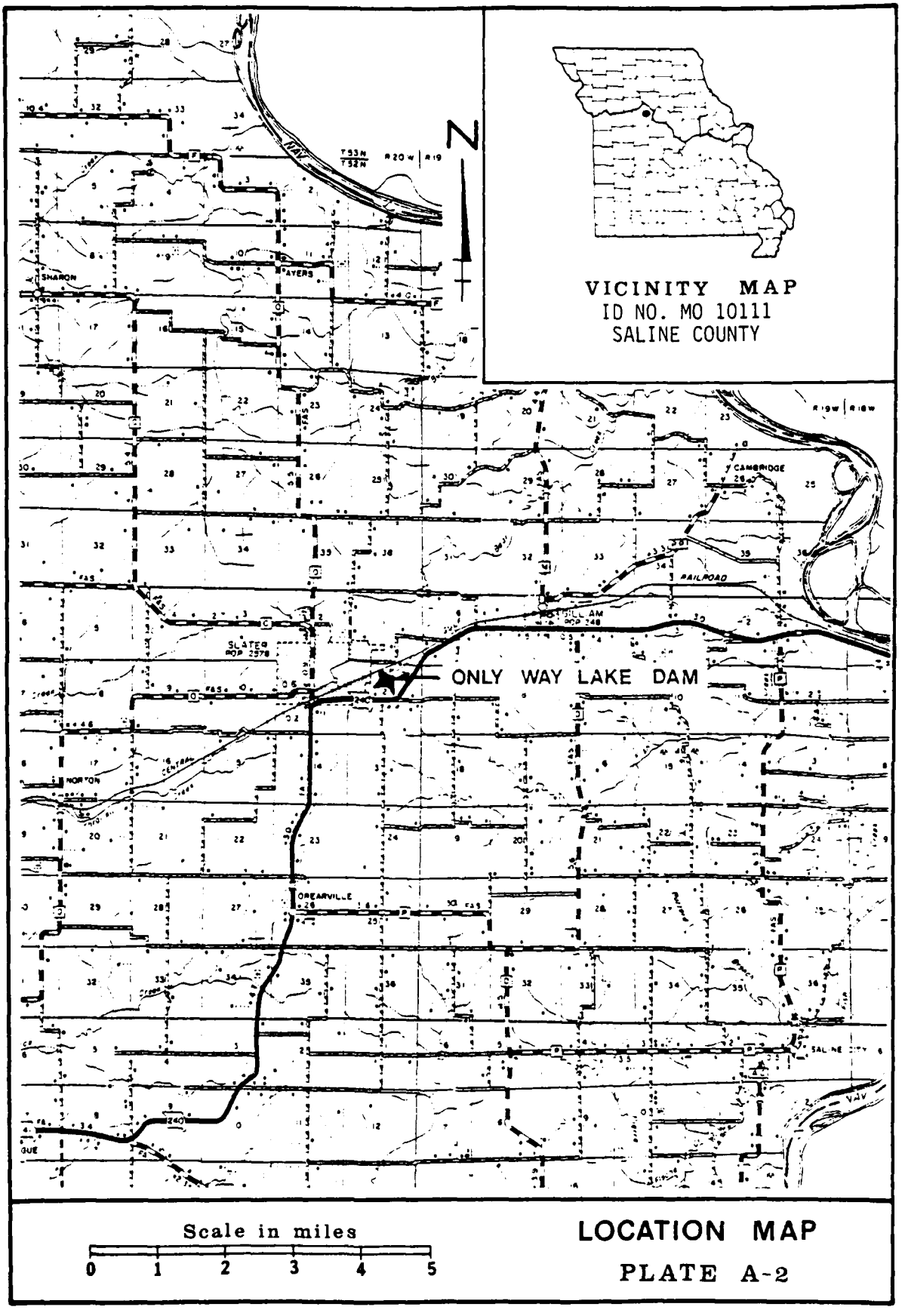
VICINITY TOPOGRAPHY

ONLY WAY LAKE DAM

SALINE COUNTY, MISSOURI

MO. 10111

PLATE A-1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VICINITY MAP
ID NO. MO 10111
SALINE COUNTY
ONLY WAY LAKE DAM
SHARON
AYERS
SLATER
POP 2578
NORTON
OREARVILLE
CAMBRIDGE
RAILROAD
SALINE CITY
T53N
T52N
R20W
R19
R19W
R18W
Scale in miles
0 1 2 3 4 5
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

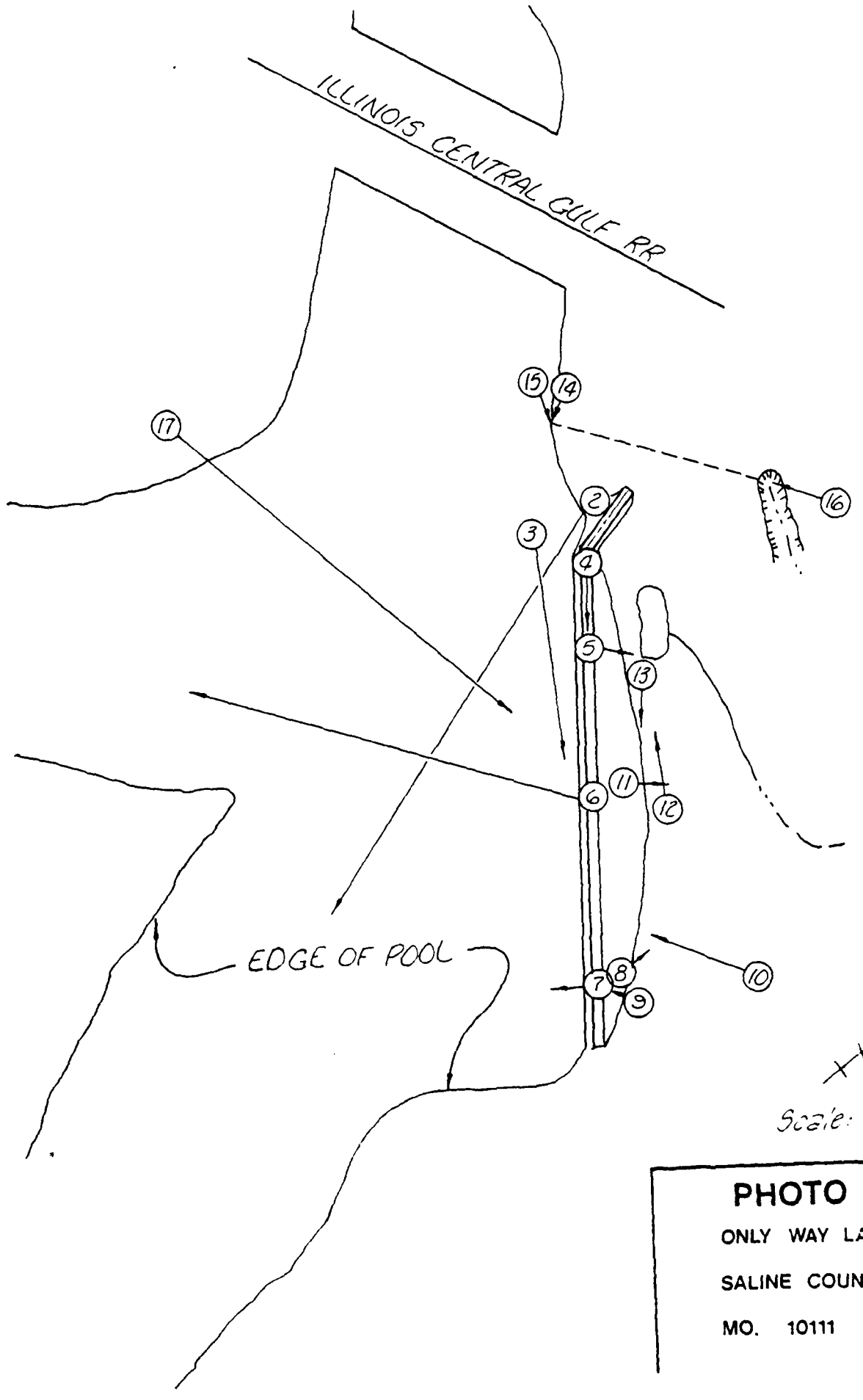


PHOTO INDEX

ONLY WAY LAKE DAM

SALINE COUNTY, MISSOURI

MO. 10111

PLATE B-1

PHOTO NO. 2 - LOOKING INTO RIGHT ARM OF LAKE

PHOTO NO. 3 - UPSTREAM FACE OF DAM TAKEN FROM DIVING PLATFORM LOOKING TO RIGHT

PHOTO NO. 4 - CREST OF DAM TAKEN FROM LEFT END

PHOTO NO. 5 - DOWNSTREAM SLOPE FROM LEFT END

PHOTO NO. 6 - UPSTREAM FROM STA. 6 + 00

PHOTO NO. 7 - LOOKING UPSTREAM AT ENTRANCE TO EMERGENCY SPILLWAY

PHOTO NO. 8 - LOOKING DOWNSTREAM IN CONCRETE LINED EMERGENCY SPILLWAY

PHOTO NO. 9 - UNDERCUT OF CONCRETE LINING IN EMERGENCY SPILLWAY

PHOTO NO. 10 - DOWNSTREAM SLOPE FROM RIGHT. DENSE TREE COVER

PHOTO NO. 11 -

LOOKING AT WET AREA DOWNSTREAM FROM STA. 6 + 00±

PHOTO NO. 12 - LOOKING ALONG TOE TO LEFT FROM STA. 6 + 00.
SEEPAGE ALL ALONG TOE

PHOTO NO. 13 - LOOKING ALONG TOE TO RIGHT FROM STA. 3 + 00±

PHOTO NO. 14 - PRINCIPAL SPILLWAY HEADWALL. AUGER SET IN CRACK IN CONCRETE

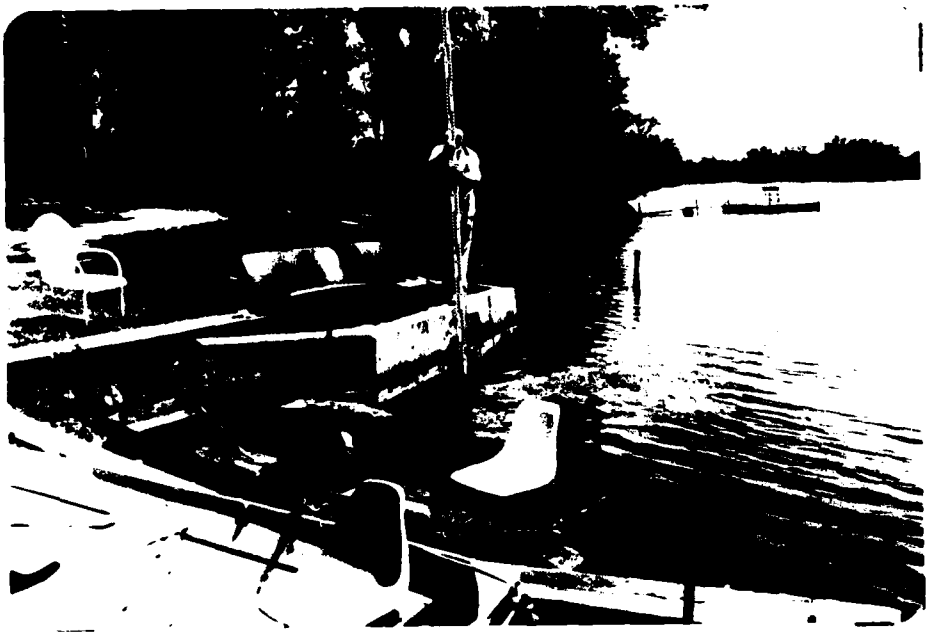


PHOTO NO. 15 - PRINCIPAL SPILLWAY INLET

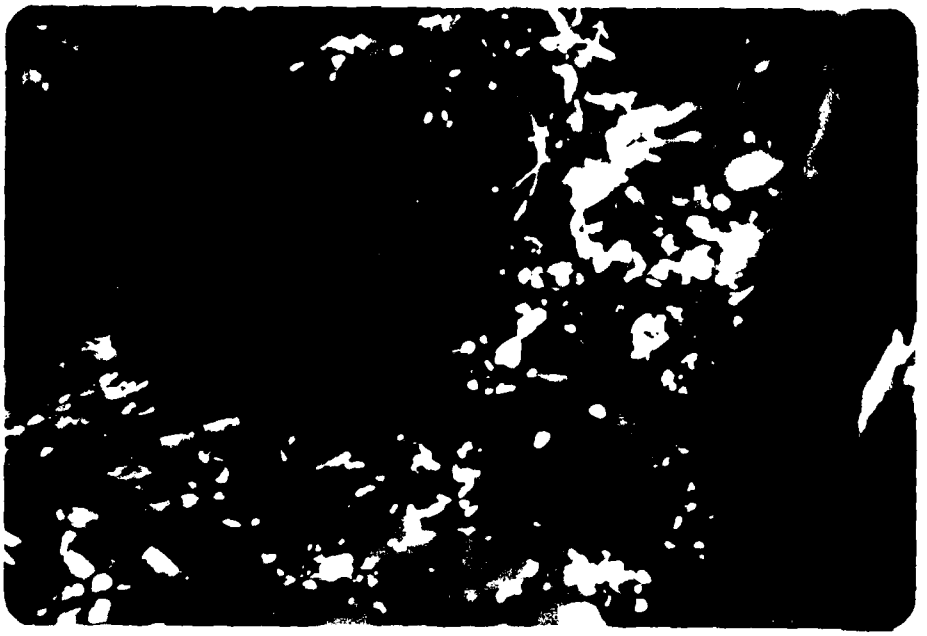
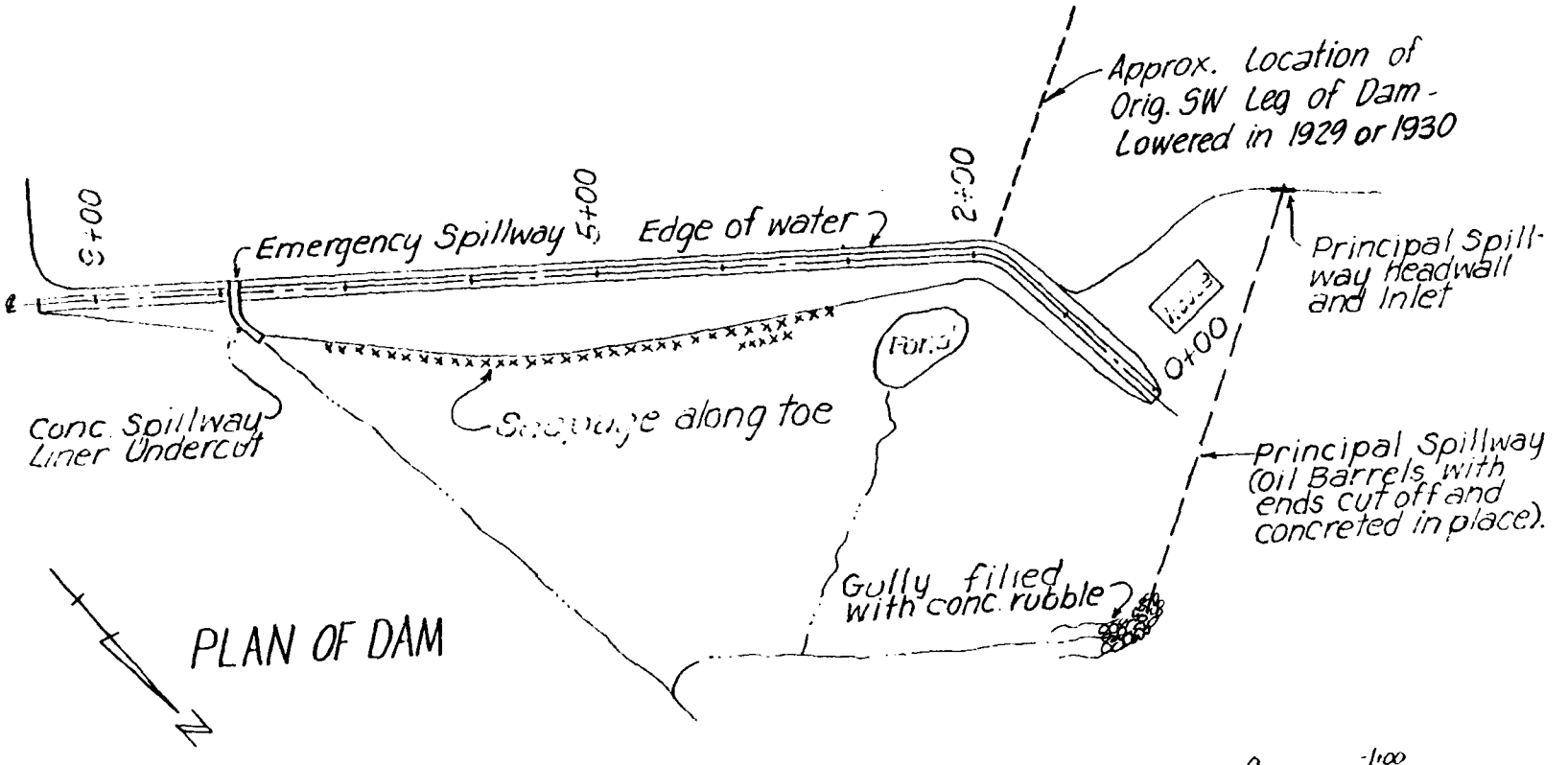
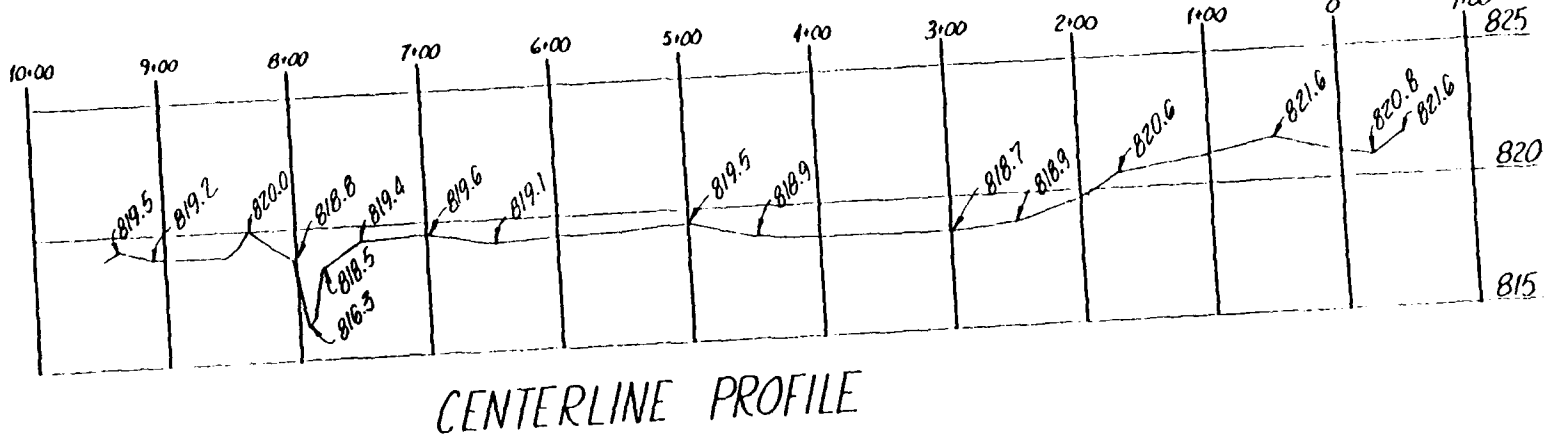


PHOTO NO. 16 - PRINCIPAL SPILLWAY OUTLET

PHOTO NO. 17 - OVERVIEW TAKEN FROM UPSTREAM ON LEFT SIDE

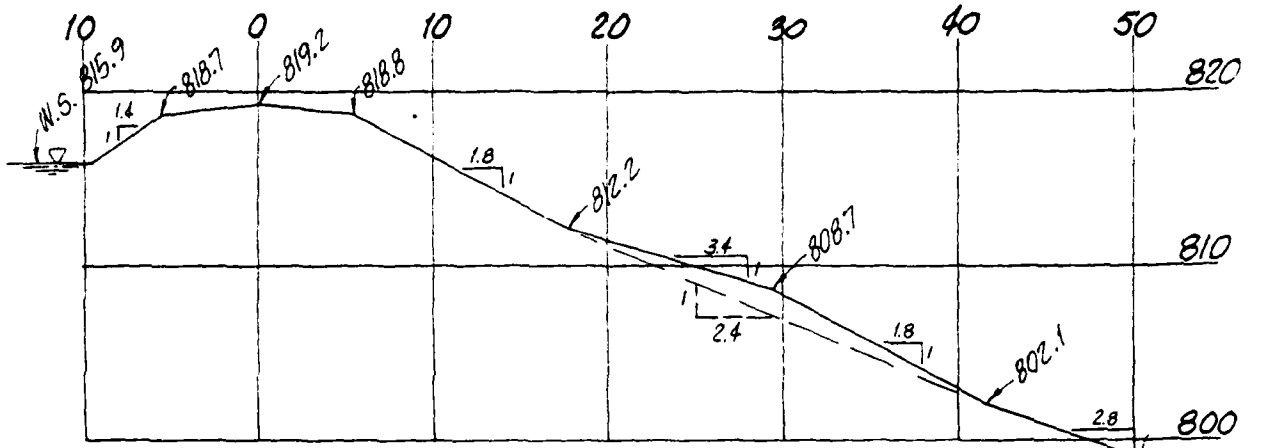
APPENDIX C
PROJECT PLATES



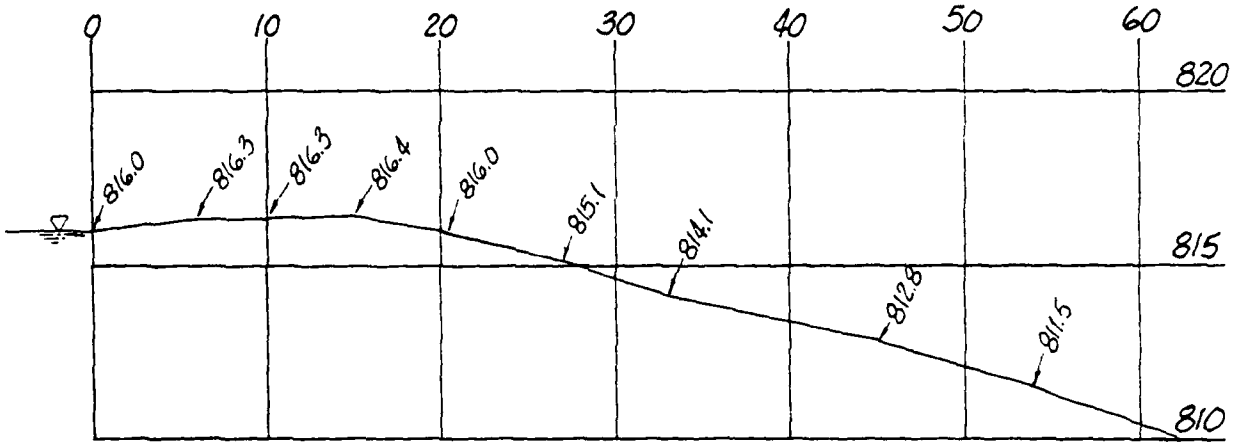


CENTERLINE PROFILE

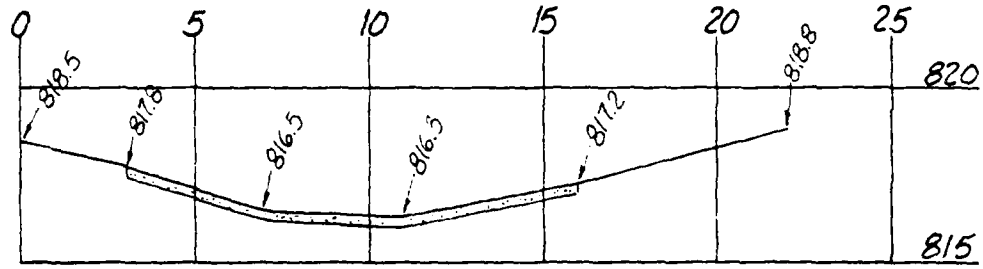
PLATE C-1



DAM SECTION AT STA. 5+88
Scale: 1"=10'



℄ PROFILE OF SPILLWAY
Scale: 1"= 10' H.
1"= 5' V.



SPILLWAY SECTION ON DAM ℄
Scale: 1"= 5' H.
1"= 5' V.

PLATE C-2

APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (see Appendix D).

   a. Twenty-four hour, 100-year and 10-year rainfall for the dam location were taken from the data for the rainfall station at Jefferson City, Missouri, as supplied by the St. Louis District, Corps of Engineers per their letter dated 6 March 1979. The twenty-four hour probable maximum precipitation was taken from the curves of the Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.68 square miles (435 acres).

   c. Time of concentration of runoff = 30 minutes. (Computed from Kirpich formula.)

   d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the 100-year and 10-year precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the principal spillway.

   e. The total twenty-four hour storm duration losses for the 100-year storm were 2.56 inches. The total losses for the PMF storm were 1.30 inches. These data are based on SCS runoff curve No. 90 and No. 78 for antecedent moisture conditions SCS AMC III and AMC II, respectively. The watershed is composed of soils from primarily the SCS soil Group B(Sharpsburg, Higginsville, and Macksburg Soil Association) and consists of part of the City of Slater, Missouri, as well as some pasture and cropland.

   f. Average soil loss rates = 0.05 inch per hour approximately (for PMF storm, AMC III).

2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow going over the top of the dam.

a. The principal spillway rating was developed by using the weir and full conduit flow equations.

1. Weir Flow equation ($Q = CLH^{1.5}$)
   where C = weir coefficient = 3.1
   L = effective weir length, ft. = 5.08
   H = total head, ft.

2. Full conduit flow equation

$$Q = a \sqrt{\frac{2gH}{1 + K_e + K_b + K_pL}}$$

where a = cross-sectional area of pipe, ft^2 = 3.80
H = total head, ft.
K_e = coefficient for entrance loss = 0.5
K_b = coefficient for bend loss = 0
K_p = coefficient for pipe friction loss = 0.0584
L = length of pipe, ft. = 350

b. The emergency spillway rating curve was developed using the Corps of Engineers Surface Water Profile HEC-2 computer program.

c. The flows over the dam were determined by using the dam overtopping analyses (irregular top of dam) within the HEC-1 (Dam Safety Version) program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The output and plotted hydrographs are attached as Appendix D.

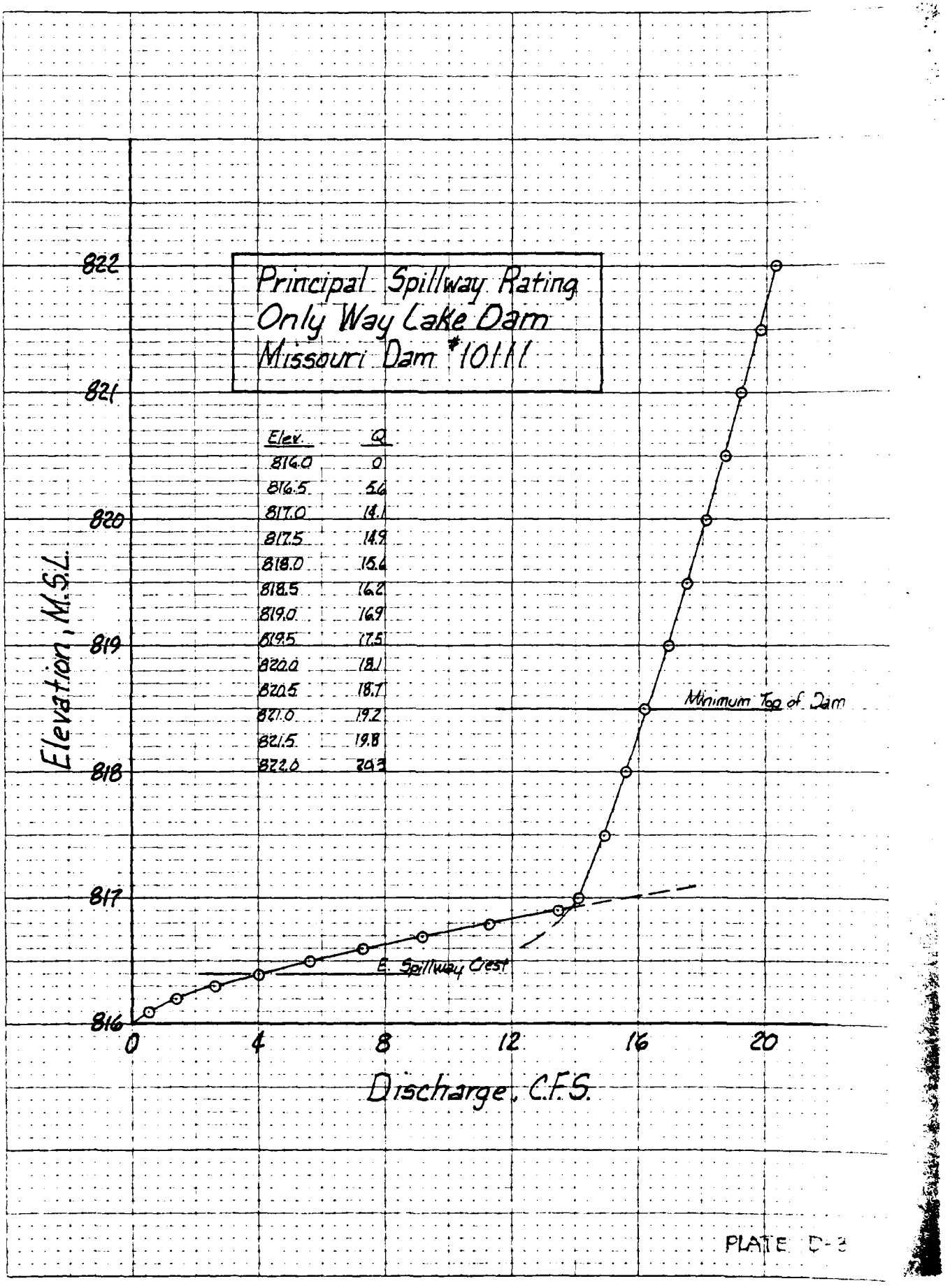
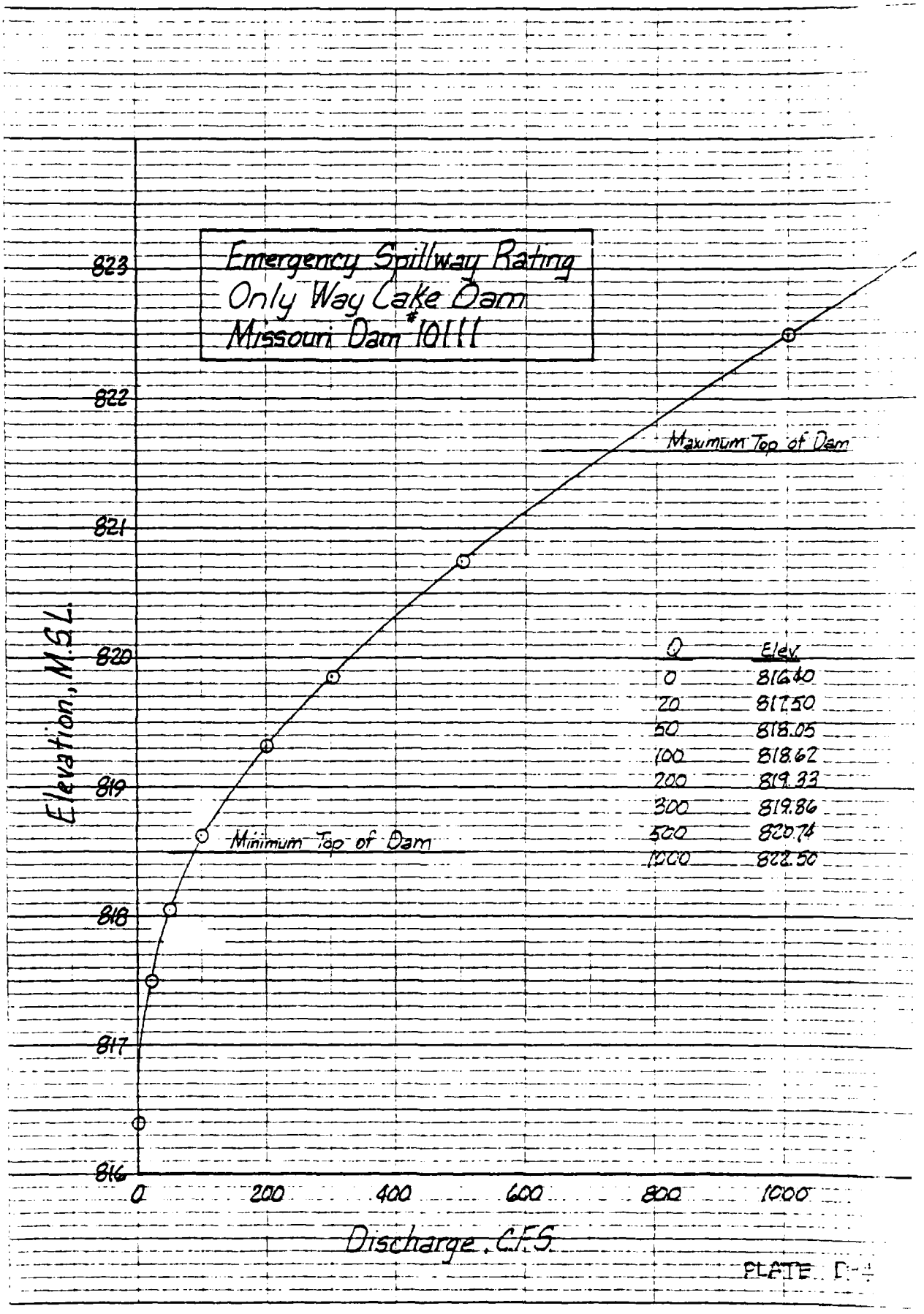


PLATE D-3



Q	Elev.
0	816.40
20	817.50
50	818.05
100	818.62
200	819.33
300	819.86
500	820.74
1000	822.50

PLATE D-4

```
A1       ANALYSIS OF DAM OVERTOPPING USING 100-YEAR
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF SLATER DAM 10111   ONLY WAY LAKE DAM
A1       100-YEAR ROUTED THRU THE RESERVOIR
B 000288000000000000C035                           0000000000000000000000003
B1000005
J 000001000000010000001
J10001.0
K 00000000000001                    00000002         00000001
K1       CALCULATION OF INFLOW HYDROGRAPH TO 10111 RESERVOIR
M 0000000000000020000.68           0C000.68000001.0                       00000001
O 000288
0100.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.007
0100.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.007
0100.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.007
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0100.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.0070000.007
0100.0070000.0070000.0070000.0070000.0670000.0070000.0070000.007
T                                                           -1.0     -78.
W2       00000.10
X 000000     -.0100000001
K 00000100000002                    0C000002         00000001
K1       ROUTED FLOWS THRU 10111 RESERVOIR
Y                          000000010000001
Y1000001                                                   -816.0      -1
Y4C0816.000816.5000817.0000817.5000818.0000818.5000819.0000819.5000820.0000820.5
Y40821.0000821.5000822.0
Y500000000000006010000319000000350000006100000106000001670000024000003480000459
Y5000570000007200000865
$A000000000000310000004900000770000113
$F000800000308160000082000000825000000830
$10816.0
$DC818.500000.0000001.500000925
$1 0000000000000700000107000003216000003800000056600000706000007370000075500000925
$V0818.5000818.7000818.7000818.9000819.2000819.4000819.6000820.0000820.6000821.6
K 99000
A
A
A
A
```

PLATE D-5

```
*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
*********************************

RUN  DATE= 79/08/08.
     TIME= 18.11.20.
```

ANALYSIS OF DAM OVERTOPPING USING 100-YEAR
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF ~~SLATER DAM~~ 10111 ONLY WAY LAKE DAM
100-YEAR ROUTED THRU THE RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	0	0	0	3	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 1 LRTIO= 1

RTIOS= 1.00

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

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO 10111 RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
G00001	0	0	0	2	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	.68	0.00	.68	1.00	0.000	0	1	0

PRECIP DATA

NP	STORM	DAJ	DAK
288	0.00	0.00	0.00

PRECIP PATTERN

.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.08	.08	.08	.08	.08	.08	.12	.12
.12	.24	.24	.55	.84	.38	.24	.12	.12	.12
.08	.08	.08	.08	.08	.08	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03

PLATE D-6

.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01		

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-78.00	0.00	0.00

CURVE NO = -78.00 WETNESS = -1.00 EFFECT CN = 78.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .30

RECESSION DATA

STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 20 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .30 VOL= 1.00

134.	434.	824.	961.	883.	690.	438.	293.	201.	134.
91.	61.	41.	27.	19.	12.	9.	6.	4.	1.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.84	.66	.18	738.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.38	.31	.07	1088.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.24	.20	.04	1433.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.12	.11	.02	1588.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.12	.11	.02	1543.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.12	.11	.02	1353.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.08	.07	.01	1115.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.08	.07	.01	919.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.08	.07	.01	764.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.08	.07	.01	646.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.08	.07	.01	559.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.08	.07	.01	496.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.03	.03	.00	449.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.03	.03	.00	403.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.03	.03	.00	347.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.03	.03	.00	292.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.03	.03	.00	243.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.03	.03	.00	206.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.03	.02	.00	182.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.03	.02	.00	164.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.03	.02	.00	151.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.03	.02	.00	141.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.03	.02	.00	135.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.03	.02	.00	130.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.03	.02	.00	127.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.03	.02	.00	125.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	.03	.02	.00	124.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.03	.02	.00	123.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.03	.02	.00	122.
1.01	2.30	30	.01	0.00	.01	0.	1.01	14.30	174	.03	.02	.00	122.

PLATE D-7

DVN

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1588.	290.	88.	88.	25375.
CMS	45.	8.	2.	2.	719.
INCHES		3.97	4.82	4.82	4.82
MM		100.90	122.46	122.46	122.46
AC-FT		144.	175.	175.	175.
THOUS CU M		178.	216.	216.	216.

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

HYDROGRAPH ROUTING

ROUTED FLOWS THRU 10111 RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-816.	-1

STAGE	816.00	816.50	817.00	817.50	818.00	818.50	819.00	819.50	820.00	820.50
	821.00	821.50	822.00							
FLOW	0.00	6.00	19.00	35.00	61.00	106.00	167.00	248.00	340.00	459.00
	579.00	720.00	865.00							
SURFACE AREA=	0.	31.	49.	77.	113.					
CAPACITY=	0.	165.	324.	636.	1108.					
ELEVATION=	800.	816.	820.	825.	830.					

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
816.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
818.5	3.0	1.5	925.

CREST LENGTH AT OR BELOW ELEVATION	0.	7.	107.	216.	380.	566.	706.	737.	755. /	925.
	818.5	818.7	818.7	818.9	819.2	819.4	819.6	820.0	820.6	821.6

STATION 000002, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.05	1	.08	0.	0.	165.	816.0
1.01	.10	2	.17	0.	0.	165.	816.0
1.01	.15	3	.25	0.	0.	165.	816.0

1.01	.20	4	.33	0.	0.	165.	816.0
1.01	.25	5	.42	0.	0.	165.	816.0
1.01	.30	6	.50	0.	0.	165.	816.0
1.01	.35	7	.58	0.	0.	165.	816.0
1.01	.40	8	.67	0.	0.	165.	816.0
1.01	.45	9	.75	0.	0.	165.	816.0
1.01	.50	10	.83	0.	0.	165.	816.0
1.01	.55	11	.92	0.	0.	165.	816.0
1.01	1.00	12	1.00	0.	0.	165.	816.0
1.01	1.05	13	1.08	0.	0.	165.	816.0
1.01	1.10	14	1.17	0.	0.	165.	816.0
1.01	1.15	15	1.25	0.	0.	165.	816.0
1.01	1.20	16	1.33	0.	0.	165.	816.0
1.01	1.25	17	1.42	0.	0.	165.	816.0
1.01	1.30	18	1.50	0.	0.	165.	816.0
1.01	1.35	19	1.58	0.	0.	165.	816.0
1.01	1.40	20	1.67	0.	0.	165.	816.0
1.01	1.45	21	1.75	0.	0.	165.	816.0
1.01	1.50	22	1.83	0.	0.	165.	816.0
1.01	1.55	23	1.92	0.	0.	165.	816.0
1.01	2.00	24	2.00	0.	0.	165.	816.0
1.01	2.05	25	2.08	0.	0.	165.	816.0
1.01	2.10	26	2.17	0.	0.	165.	816.0
1.01	2.15	27	2.25	0.	0.	165.	816.0
1.01	2.20	28	2.33	0.	0.	165.	816.0
1.01	2.25	29	2.42	0.	0.	165.	816.0
1.01	2.30	30	2.50	0.	0.	165.	816.0
1.01	2.35	31	2.58	0.	0.	165.	816.0
1.01	2.40	32	2.67	0.	0.	165.	816.0
1.01	2.45	33	2.75	0.	0.	165.	816.0
1.01	2.50	34	2.83	0.	0.	165.	816.0
1.01	2.55	35	2.92	0.	0.	165.	816.0
1.01	3.00	36	3.00	0.	0.	165.	816.0
1.01	3.05	37	3.08	0.	0.	165.	816.0
1.01	3.10	38	3.17	0.	0.	165.	816.0
1.01	3.15	39	3.25	0.	0.	165.	816.0
1.01	3.20	40	3.33	0.	0.	165.	816.0
1.01	3.25	41	3.42	0.	0.	165.	816.0
1.01	3.30	42	3.50	0.	0.	165.	816.0
1.01	3.35	43	3.58	0.	0.	165.	816.0
1.01	3.40	44	3.67	0.	0.	165.	816.0
1.01	3.45	45	3.75	0.	0.	165.	816.0
1.01	3.50	46	3.83	0.	0.	165.	816.0
1.01	3.55	47	3.92	0.	0.	165.	816.0
1.01	4.00	48	4.00	0.	0.	165.	816.0
1.01	4.05	49	4.08	0.	0.	165.	816.0
1.01	4.10	50	4.17	0.	0.	165.	816.0
1.01	4.15	51	4.25	0.	0.	165.	816.0
1.01	4.20	52	4.33	0.	0.	165.	816.0
1.01	4.25	53	4.42	0.	0.	165.	816.0
1.01	4.30	54	4.50	0.	0.	165.	816.0
1.01	4.35	55	4.58	0.	0.	165.	816.0
1.01	4.40	56	4.67	0.	0.	165.	816.0
1.01	4.45	57	4.75	0.	0.	165.	816.0
1.01	4.50	58	4.83	0.	0.	165.	816.0
1.01	4.55	59	4.92	0.	0.	165.	816.0
1.01	5.00	60	5.00	0.	0.	165.	816.0
1.01	5.05	61	5.08	0.	0.	165.	816.0
1.01	5.10	62	5.17	0.	0.	165.	816.0
1.01	5.15	63	5.25	0.	0.	165.	816.0
1.01	5.20	64	5.33	0.	0.	165.	816.0
1.01	5.25	65	5.42	0.	0.	165.	816.0

PLATE D-9

1.01	5.30	66	5.50	0.	0.	165.	816.0
1.01	5.35	67	5.58	0.	0.	165.	816.0
1.01	5.40	68	5.67	0.	0.	165.	816.0
1.01	5.45	69	5.75	0.	0.	165.	816.0
1.01	5.50	70	5.83	0.	0.	165.	816.0
1.01	5.55	71	5.92	0.	0.	165.	816.0
1.01	6.00	72	6.00	0.	0.	165.	816.0
1.01	6.05	73	6.08	0.	0.	165.	816.0
1.01	6.10	74	6.17	0.	0.	165.	816.0
1.01	6.15	75	6.25	0.	0.	165.	816.0
1.01	6.20	76	6.33	0.	0.	165.	816.0
1.01	6.25	77	6.42	0.	0.	165.	816.0
1.01	6.30	78	6.50	0.	0.	165.	816.0
1.01	6.35	79	6.58	0.	0.	165.	816.0
1.01	6.40	80	6.67	0.	0.	165.	816.0
1.01	6.45	81	6.75	0.	0.	165.	816.0
1.01	6.50	82	6.83	1.	0.	165.	816.0
1.01	6.55	83	6.92	1.	0.	165.	816.0
1.01	7.00	84	7.00	2.	0.	165.	816.0
1.01	7.05	85	7.08	2.	0.	165.	816.0
1.01	7.10	86	7.17	3.	0.	165.	816.0
1.01	7.15	87	7.25	3.	0.	165.	816.0
1.01	7.20	88	7.33	4.	0.	165.	816.0
1.01	7.25	89	7.42	5.	0.	165.	816.0
1.01	7.30	90	7.50	5.	0.	165.	816.0
1.01	7.35	91	7.58	6.	0.	166.	816.0
1.01	7.40	92	7.67	6.	0.	166.	816.0
1.01	7.45	93	7.75	7.	0.	166.	816.0
1.01	7.50	94	7.83	7.	0.	166.	816.0
1.01	7.55	95	7.92	8.	0.	166.	816.0
1.01	8.00	96	8.00	8.	0.	166.	816.0
1.01	8.05	97	8.08	9.	0.	166.	816.0
1.01	8.10	98	8.17	9.	0.	166.	816.0
1.01	8.15	99	8.25	10.	0.	166.	816.0
1.01	8.20	100	8.33	10.	0.	166.	816.0
1.01	8.25	101	8.42	11.	0.	166.	816.0
1.01	8.30	102	8.50	11.	0.	166.	816.0
1.01	8.35	103	8.58	12.	0.	166.	816.0
1.01	8.40	104	8.67	12.	0.	166.	816.0
1.01	8.45	105	8.75	13.	0.	166.	816.0
1.01	8.50	106	8.83	13.	0.	166.	816.0
1.01	8.55	107	8.92	14.	0.	167.	816.0
1.01	9.00	108	9.00	14.	1.	167.	816.0
1.01	9.05	109	9.08	15.	1.	167.	816.0
1.01	9.10	110	9.17	17.	1.	167.	816.0
1.01	9.15	111	9.25	20.	1.	167.	816.1
1.01	9.20	112	9.33	24.	1.	167.	816.1
1.01	9.25	113	9.42	28.	1.	167.	816.1
1.01	9.30	114	9.50	31.	1.	168.	816.1
1.01	9.35	115	9.58	34.	1.	168.	816.1
1.01	9.40	116	9.67	36.	1.	168.	816.1
1.01	9.45	117	9.75	38.	1.	168.	816.1
1.01	9.50	118	9.83	40.	1.	168.	816.1
1.01	9.55	119	9.92	42.	1.	169.	816.1
1.01	10.00	120	10.00	43.	1.	169.	816.1
1.01	10.05	121	10.08	45.	2.	169.	816.1
1.01	10.10	122	10.17	46.	2.	170.	816.1
1.01	10.15	123	10.25	47.	2.	170.	816.1
1.01	10.20	124	10.33	49.	2.	170.	816.2
1.01	10.25	125	10.42	50.	2.	171.	816.2
1.01	10.30	126	10.50	51.	2.	171.	816.2
1.01	10.35	127	10.58	53.	2.	171.	816.2

1.01	10.40	128	10.67	55.	2.	172.	816.2
1.01	10.45	129	10.75	57.	3.	172.	816.2
1.01	10.50	130	10.83	59.	3.	172.	816.2
1.01	10.55	131	10.92	62.	3.	173.	816.2
1.01	11.00	132	11.00	64.	3.	173.	816.2
1.01	11.05	133	11.08	69.	3.	174.	816.3
1.01	11.10	134	11.17	82.	3.	174.	816.3
1.01	11.15	135	11.25	105.	4.	175.	816.3
1.01	11.20	136	11.33	132.	4.	175.	816.3
1.01	11.25	137	11.42	159.	4.	176.	816.4
1.01	11.30	138	11.50	182.	5.	178.	816.4
1.01	11.35	139	11.58	203.	5.	179.	816.4
1.01	11.40	140	11.67	228.	6.	180.	816.5
1.01	11.45	141	11.75	262.	6.	182.	816.5
1.01	11.50	142	11.83	309.	8.	184.	816.6
1.01	11.55	143	11.92	376.	10.	186.	816.6
1.01	12.00	144	12.00	502.	12.	189.	816.7
1.01	12.05	145	12.08	738.	15.	193.	816.9
1.01	12.10	146	12.17	1080.	20.	199.	817.0
1.01	12.15	147	12.25	1433.	28.	208.	817.3
1.01	12.20	148	12.33	1588.	37.	218.	817.5
1.01	12.25	149	12.42	1543.	52.	229.	817.8
1.01	12.30	150	12.50	1353.	67.	238.	818.1
1.01	12.35	151	12.58	1115.	85.	246.	818.3
1.01	12.40	152	12.67	919.	99.	253.	818.4
1.01	12.45	153	12.75	784.	111.	258.	818.5
1.01	12.50	154	12.83	646.	123.	262.	818.6
1.01	12.55	155	12.92	559.	133.	265.	818.7
1.01	13.00	156	13.00	496.	148.	268.	818.8
1.01	13.05	157	13.08	449.	165.	270.	818.8
1.01	13.10	158	13.17	404.	181.	271.	818.9
1.01	13.15	159	13.25	347.	194.	273.	818.9
1.01	13.20	160	13.33	292.	203.	274.	818.9
1.01	13.25	161	13.42	243.	208.	274.	818.9
1.01	13.30	162	13.50	206.	209.	274.	818.9
1.01	13.35	163	13.58	182.	208.	274.	818.9
1.01	13.40	164	13.67	164.	206.	274.	818.9
1.01	13.45	165	13.75	151.	202.	273.	818.9
1.01	13.50	166	13.83	141.	198.	273.	818.9
1.01	13.55	167	13.92	135.	193.	273.	818.9
1.01	14.00	168	14.00	130.	189.	272.	818.9
1.01	14.05	169	14.08	127.	185.	272.	818.9
1.01	14.10	170	14.17	125.	181.	272.	818.9
1.01	14.15	171	14.25	124.	177.	271.	818.9
1.01	14.20	172	14.33	123.	174.	271.	818.8
1.01	14.25	173	14.42	122.	171.	270.	818.8
1.01	14.30	174	14.50	122.	168.	270.	818.8
1.01	14.35	175	14.58	122.	165.	270.	818.8
1.01	14.40	176	14.67	122.	163.	270.	818.8
1.01	14.45	177	14.75	122.	161.	269.	818.8
1.01	14.50	178	14.83	122.	159.	269.	818.8
1.01	14.55	179	14.92	122.	157.	269.	818.8
1.01	15.00	180	15.00	122.	155.	269.	818.8
1.01	15.05	181	15.08	121.	153.	268.	818.8
1.01	15.10	182	15.17	116.	152.	268.	818.8
1.01	15.15	183	15.25	108.	150.	268.	818.8
1.01	15.20	184	15.33	99.	148.	267.	818.8
1.01	15.25	185	15.42	85.	145.	267.	818.8
1.01	15.30	186	15.50	77.	142.	267.	818.8
1.01	15.35	187	15.58	72.	140.	266.	818.7
1.01	15.40	188	15.67	68.	137.	266.	818.7
1.01	15.45	189	15.75	66.	135.	265.	818.7

1.01	15.50	190	15.83	64.	133.	265.	818.7
1.01	15.55	191	15.92	63.	131.	264.	818.7
1.01	16.00	192	16.00	63.	130.	264.	818.7
1.01	16.05	193	16.08	62.	128.	263.	818.7
1.01	16.10	194	16.17	62.	127.	263.	818.7
1.01	16.15	195	16.25	62.	126.	263.	818.7
1.01	16.20	196	16.33	62.	124.	262.	818.6
1.01	16.25	197	16.42	62.	123.	262.	818.6
1.01	16.30	198	16.50	62.	122.	261.	818.6
1.01	16.35	199	16.58	62.	121.	261.	818.6
1.01	16.40	200	16.67	62.	119.	261.	818.6
1.01	16.45	201	16.75	62.	118.	260.	818.6
1.01	16.50	202	16.83	62.	117.	260.	818.6
1.01	16.55	203	16.92	62.	116.	259.	818.6
1.01	17.00	204	17.00	62.	115.	259.	818.6
1.01	17.05	205	17.08	62.	114.	259.	818.6
1.01	17.10	206	17.17	62.	113.	258.	818.6
1.01	17.15	207	17.25	62.	112.	258.	818.5
1.01	17.20	208	17.33	62.	111.	258.	818.5
1.01	17.25	209	17.42	62.	110.	257.	818.5
1.01	17.30	210	17.50	62.	109.	257.	818.5
1.01	17.35	211	17.58	62.	108.	257.	818.5
1.01	17.40	212	17.67	62.	107.	256.	818.5
1.01	17.45	213	17.75	62.	106.	256.	818.5
1.01	17.50	214	17.83	62.	105.	256.	818.5
1.01	17.55	215	17.92	62.	105.	255.	818.5
1.01	18.00	216	18.00	62.	104.	255.	818.5
1.01	18.05	217	18.08	61.	104.	255.	818.5
1.01	18.10	218	18.17	59.	103.	255.	818.5
1.01	18.15	219	18.25	54.	102.	254.	818.5
1.01	18.20	220	18.33	49.	102.	254.	818.5
1.01	18.25	221	18.42	44.	101.	254.	818.4
1.01	18.30	222	18.50	41.	100.	253.	818.4
1.01	18.35	223	18.58	38.	99.	253.	818.4
1.01	18.40	224	18.67	37.	98.	252.	818.4
1.01	18.45	225	18.75	36.	97.	252.	818.4
1.01	18.50	226	18.83	35.	96.	251.	818.4
1.01	18.55	227	18.92	34.	95.	251.	818.4
1.01	19.00	228	19.00	34.	94.	251.	818.4
1.01	19.05	229	19.08	34.	94.	250.	818.4
1.01	19.10	230	19.17	34.	93.	250.	818.4
1.01	19.15	231	19.25	34.	92.	249.	818.3
1.01	19.20	232	19.33	34.	91.	249.	818.3
1.01	19.25	233	19.42	33.	90.	249.	818.3
1.01	19.30	234	19.50	33.	89.	248.	818.3
1.01	19.35	235	19.58	33.	88.	248.	818.3
1.01	19.40	236	19.67	33.	88.	247.	818.3
1.01	19.45	237	19.75	33.	87.	247.	818.3
1.01	19.50	238	19.83	33.	86.	247.	818.3
1.01	19.55	239	19.92	33.	85.	246.	818.3
1.01	20.00	240	20.00	33.	84.	246.	818.3
1.01	20.05	241	20.08	33.	84.	246.	818.3
1.01	20.10	242	20.17	33.	83.	245.	818.2
1.01	20.15	243	20.25	33.	82.	245.	818.2
1.01	20.20	244	20.33	33.	81.	245.	818.2
1.01	20.25	245	20.42	33.	81.	244.	818.2
1.01	20.30	246	20.50	33.	80.	244.	818.2
1.01	20.35	247	20.58	33.	79.	244.	818.2
1.01	20.40	248	20.67	33.	79.	243.	818.2
1.01	20.45	249	20.75	33.	78.	243.	818.2
1.01	20.50	250	20.83	34.	77.	243.	818.2
1.01	20.55	251	20.92	34.	77.	243.	818.2

1.01	21.00	252	21.00	34.	76.	242.	818.2
1.01	21.05	253	21.08	34.	75.	242.	818.2
1.01	21.10	254	21.17	34.	75.	242.	818.2
1.01	21.15	255	21.25	34.	74.	241.	818.1
1.01	21.20	256	21.33	34.	73.	241.	818.1
1.01	21.25	257	21.42	34.	73.	241.	818.1
1.01	21.30	258	21.50	34.	72.	241.	818.1
1.01	21.35	259	21.58	34.	72.	240.	818.1
1.01	21.40	260	21.67	34.	71.	240.	818.1
1.01	21.45	261	21.75	34.	70.	240.	818.1
1.01	21.50	262	21.83	34.	70.	240.	818.1
1.01	21.55	263	21.92	34.	69.	239.	818.1
1.01	22.00	264	22.00	34.	69.	239.	818.1
1.01	22.05	265	22.08	34.	68.	239.	818.1
1.01	22.10	266	22.17	34.	68.	239.	818.1
1.01	22.15	267	22.25	34.	67.	238.	818.1
1.01	22.20	268	22.33	34.	67.	238.	818.1
1.01	22.25	269	22.42	34.	66.	238.	818.1
1.01	22.30	270	22.50	34.	66.	238.	818.1
1.01	22.35	271	22.58	34.	65.	237.	818.0
1.01	22.40	272	22.67	34.	65.	237.	818.0
1.01	22.45	273	22.75	34.	64.	237.	818.0
1.01	22.50	274	22.83	34.	64.	237.	818.0
1.01	22.55	275	22.92	34.	63.	237.	818.0
1.01	23.00	276	23.00	34.	63.	236.	818.0
1.01	23.05	277	23.08	34.	62.	236.	818.0
1.01	23.10	278	23.17	34.	62.	236.	818.0
1.01	23.15	279	23.25	34.	61.	236.	818.0
1.01	23.20	280	23.33	34.	61.	236.	818.0
1.01	23.25	281	23.42	34.	61.	235.	818.0
1.01	23.30	282	23.50	34.	61.	235.	818.0
1.01	23.35	283	23.58	34.	60.	235.	818.0
1.01	23.40	284	23.67	34.	60.	235.	818.0
1.01	23.45	285	23.75	34.	60.	235.	818.0
1.01	23.50	286	23.83	34.	60.	235.	818.0
1.01	23.55	287	23.92	34.	59.	234.	818.0
1.02	0.00	288	24.00	34.	59.	234.	818.0

PEAK OUTFLOW IS 209. AT TIME 13.50 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	209.	141.	54.	54.	15414.
CMS	6.	4.	2.	2.	436.
INCHES		1.93	2.93	2.93	2.93
MM		48.99	74.39	74.39	74.39
AC-FT		70.	106.	106.	106.
THOUS CU M		86.	131.	131.	131.

OVF

STATION000002

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)

	0.	200.	400.	600.	800.	1000.	1200.	1400.	1600.	0.	0.	0.	0.
.05	11												
.10	21												
.15	31												
.20	41												
.25	51												
.30	61												
.35	71												
.40	81												
.45	91												
.50	101												
.55	111												
1.00	121												
1.05	131												
1.10	141												
1.15	151												
1.20	161												
1.25	171												
1.30	181												
1.35	191												
1.40	201												
1.45	211												
1.50	221												
1.55	231												
2.00	241												
2.05	251												
2.10	261												
2.15	271												
2.20	281												
2.25	291												
2.30	301												
2.35	311												
2.40	321												
2.45	331												
2.50	341												
2.55	351												
3.00	361												
3.05	371												
3.10	381												
3.15	391												
3.20	401												
3.25	411												
3.30	421												
3.35	431												
3.40	441												
3.45	451												
3.50	461												
3.55	471												
4.00	481												
4.05	491												
4.10	501												
4.15	511												
4.20	521												
4.25	531												
4.30	541												
4.35	551												
4.40	561												

PLATE O-14

PLATE D-15

PLATE D-16

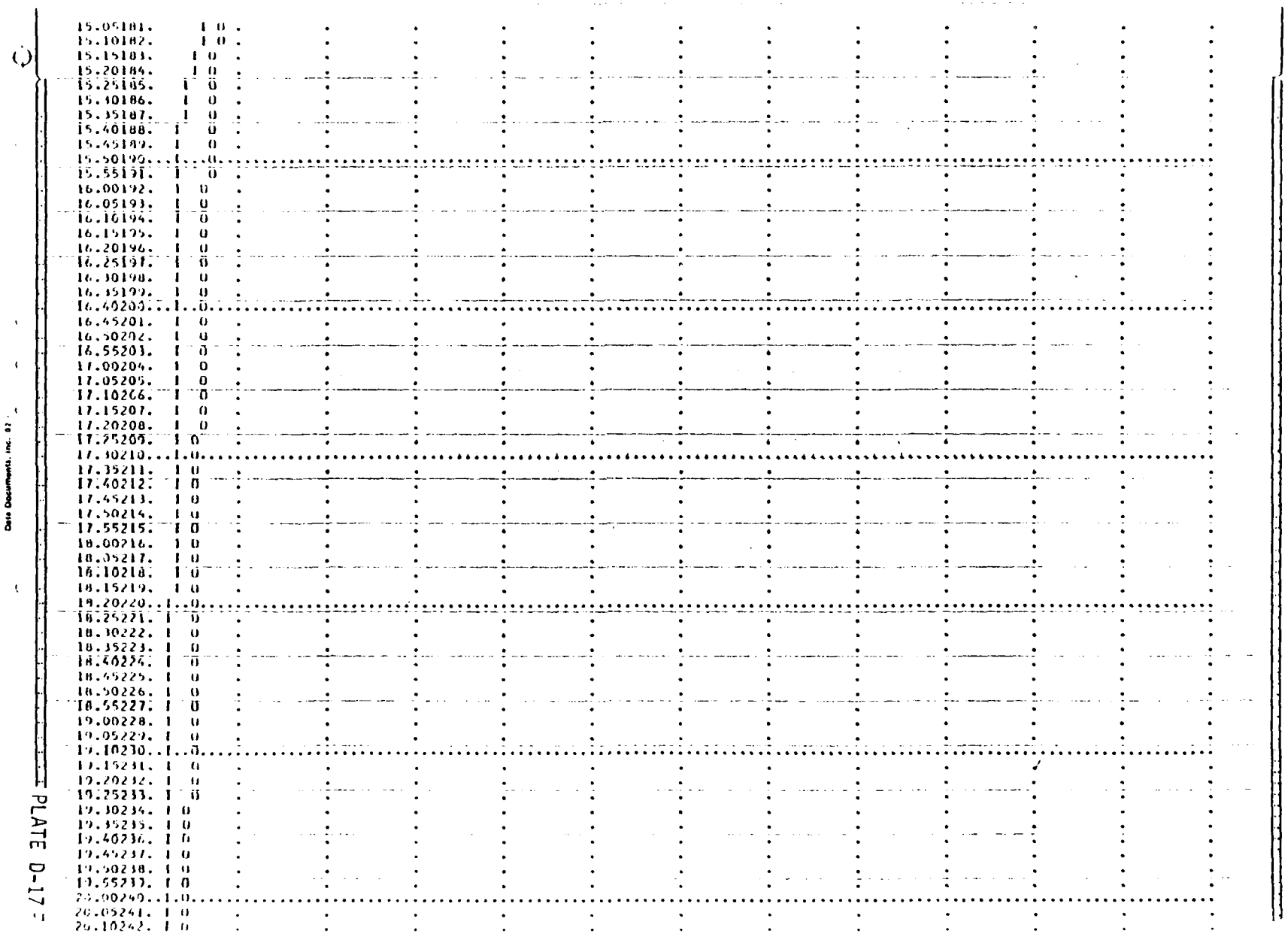

PLATE D-17

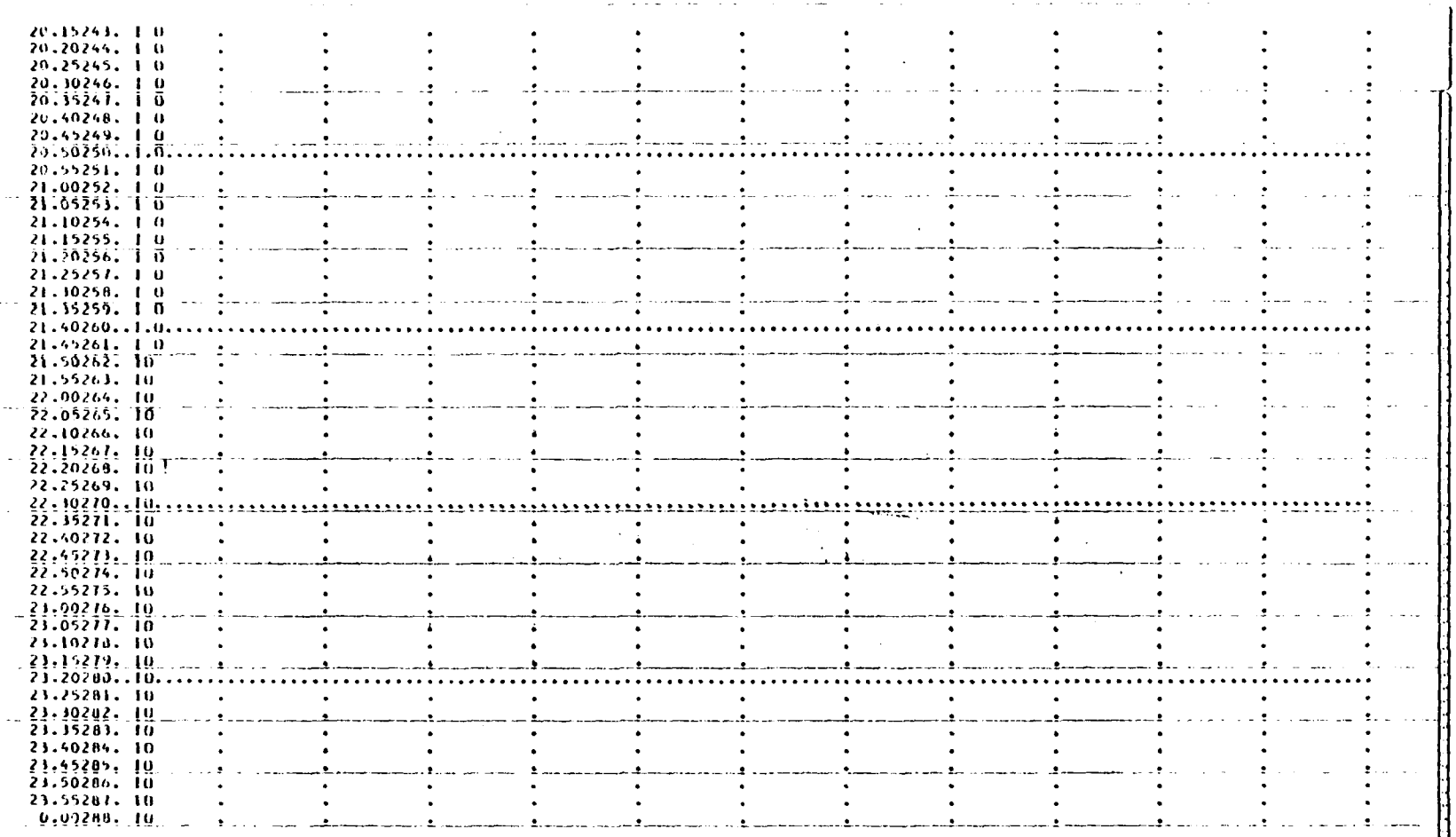

PLATE D-18

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 1.00
HYDROGRAPH AT	000001	.68	1	1588.
		(1.76)		(44.98)(
ROUTED TO	000002	.68	1	209.
		(1.76)		(5.93)(

PLATE D-19

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	816.00	816.00	818.50
	STORAGE	165.	165.	256.
	OUTFLOW	0.	0.	106.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	818.92	.42	274.	209.	5.08	13.50	0.00

PLATE D-20