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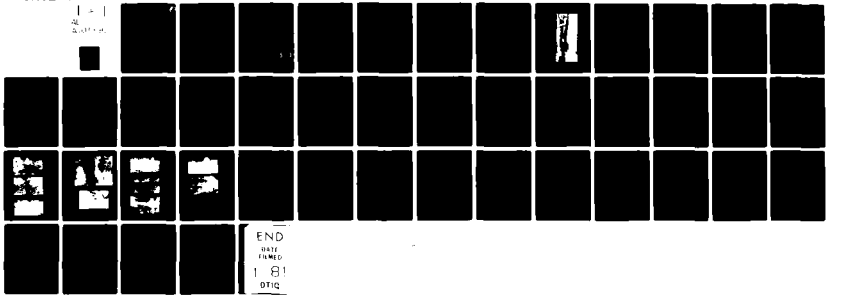

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MO NONAME 163 DAM

CLAY COUNTY, MISSOURI

MO 10583

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.

FOR: STATE OF MISSOURI

SEPTEMBER, 1978

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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. AD-A105582	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Mo Noname 168 Dam (MO 10583) Clay County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report
	6. PERFORMING ORG. REPORT NUMBER
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9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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18. SUPPLEMENTARY

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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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

IN REPLY REFER TO

SUBJECT: Mo Noname 168 Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of Mo Noname 168 Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

1 MAR 1978
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

1 MAR 1978
Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MO NONAME 168 DAM
MO 10583

TABLE OF CONTENTS

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Mo Noname 168 Dam
State Located	Missouri
County Located	Clay County
Stream	Tributary to Missouri River
Date of Inspection	September 21, 1978

Mo Noname 168 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 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. Failure would threaten life and property. The estimated damage zone extends three miles downstream of the dam. Within the first 3/4 mile downstream of the dam are three to four houses and associated buildings, three improved road crossings, two railroad tracks and two power lines. The floodplain is farmed. Located just upstream of the dam is a small reservoir.

Our inspection and evaluation indicates that in consideration of the small volume of water impounded, 50% of the Probable Maximum Flood is the appropriate design flood. The spillway of this dam meets this criteria. The spillway will pass the 100-year event as well as 77% of the Probable Maximum Flood (PMF) 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.

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.

Deficiences visually observed by the inspection team were several trees (up to 12" diameter) growing on the upstream slope, dense growth of trees, brush and weeds covering the downstream slope, a 6' x 6' erosion channel descends the right abutment in the vicinity of the principal spillway riser, and the 36" diameter corrugated metal spillway riser is in an extremely deteriorated condition.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report.

H. P. Hoskins

Harold P. Hoskins, P.E.
Hoskins-Western-Sonderegger, Inc.
Lincoln, Nebraska

OP-1

PHOTO NO. 1
OVERVIEW
LOOKING SOUTHEAST
TO DAM

PHASE I INSPECTION REPORT
NATION DAM SAFETY PROGRAM
MO NONAME DAM 168-MO 10583
CLAY 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 Mo Noname Dam 168 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) This dam is an earth embankment about 500 feet in length and 30 feet in height. Topography around the dam is moderately steep. Materials on the slopes surrounding the dam consist of loess or reworked loess soils underlain by shales and limestones. Materials on the slopes of the dam consist of variably sized rock. The materials on the crest of the dam consist of silty clay and gravel.

(2) The spillway consists of a 36-inch diameter corrugated metal pipe riser and a 30-inch diameter concrete pipe passing through the dam near the right abutment and extending approximately 275 feet downstream from the dam.

(3) An emergency spillway approximately 50 feet wide has been cut through the left abutment.

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

b. Location. The dam is located in the southwestern portion of Clay County, Missouri, as shown on Plate A-2. The dam and the lake formed by the dam is shown on Plate A-1 in the SW 1/4 of Section 2, T50N, 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, 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 c, above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends three miles downstream from the dam. Within the first mile downstream of the dam are three to four houses and associated buildings, three improved road crossings, two railroad tracks, and two power lines.

e. Ownership. This dam is owned by the Great Midwest Corporation, 8330 Northeast Underground Drive, Kansas City, Missouri 64161, Attention: Donald Woodard.

f. Purpose of Dam. The dam forms a 3.5 acre ± impoundment. The current use of the dam appears to be exclusively for flood control.

g. Design and Construction History. No design or construction data were available.

h. Normal Operating Procedure. There are no controlled outlet works for this dam. No information was available on fluctuation of the lake level.

1.3 PERTINENT DATA

a. Drainage Area - 193 acres (determined by consultant).

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled corrugated metal riser pipe and reinforced concrete conduit principal spillway and/or a grassed earth channel ungated emergency spillway. The principal spillway intake riser has been modified considerably from its original configuration to facilitate lowering of the normal reservoir water level. The information obtained by the inspection are given in the appended photos and in Section 1.3 i (1) below.

(2) Estimated maximum flood at damsite - unknown.

(3) The principal spillway capacity varies from 0 c.f.s. at its present crest (elevation 797.3 M.S.L.) to 15.7 c.f.s. at the crest of the emergency spillway (elevation 820.4).

(4) The principal spillway capacity at maximum pool (elevation 822.2) is 16.2 c.f.s. Maximum pool elevation is the minimum dam crest elevation at the left abutment.

(5) The emergency spillway capacity at maximum pool elevation is 177 c.f.s.

(6) The total spillway capacity at maximum pool elevation is 193 c.f.s.

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

(1) Top of dam - 823.2 (average from survey 21 September 1978).

(2) Principal spillway crest (present) - 797.3.

(3) Emergency spillway crest - 820.4.

(4) Streambed at center line dam - 790 ±.

(5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 3000 feet ±.

e. Storage (Acre-feet). Top of dam - 363.
Principal Spillway Crest - 13

f. Reservoir Surface (Acres).

(1) Top of dam - 26 ±.

(2) Spillway crest (principal) - 3.5 ±.
(emergency)- 22 ±.

g. Dam.

(1) Type - Earth or earth-rock embankment.

(2) Length - 500 feet ±.

(3) Height - 30 feet ±.

(4) Top width - 24 feet ±.

(5) Side slopes.

(a) Downstream - 1.95H on 1V (measured).

(b) Upstream - Exposed section - 2.4H on 1V (measured).

(6) Zoning - unknown, although silty clay and gravel appeared on crest of the dam and the upstream and downstream slopes have only rock exposed.

(7) Impervious core - unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

(10) Wave protection - Riprap, limestone rock.

h. Diversion Channel and Regulating Tunnel - none.

i. Spillway.

(1) Principal.

(a) Type - Uncontrolled drop inlet (36" diameter) corrugated metal pipe with screen on top and (estimated) depth of 13 feet to invert; a crude orifice weir slot has been cut into the side to form the present crest. The conduit through the dam is a 30-inch diameter concrete pressure pipe (see photo 7). The spillway riser has been much higher in the past - perhaps 8-10 feet from evidence found at the site (see photos 3, 5, and 6).

(b) Size of weir orifice - 1 foot wide by 4 feet high. Top riser weir - 9 feet (not controlling).

(c) Crest elevations - 802 (top present riser).
797.3 (crest weir orifice).

(d) Downstream channel - low brush and a few trees in channel 75 feet wide.

(2) Emergency.

(a) Type - grassed earth channel.

(b) Control section - 20 foot bottom width 10(h):1(v) left bank and 5:1 right bank at emergency spillway station 1+50.

(c) Crest elevation - 820.4 feet M.S.L.

(d) Upstream channel - very poor grass and bare ground.

(e) Downstream channel - very poor grass.

j. Regulating Outlet.

(1) Principal spillway and dam.

(a) Apparently 2" hose is used at times to pump or siphon down the lake level.

(b) No other regulating devices.

(2) Emergency spillway - none.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available.

2.2 CONSTRUCTION

No construction data were available.

2.3 OPERATION

There are no control discharge structures for this dam. No data on operation of the spillway were available.

2.4 EVALUATION

a. Availability. There were no engineering data available for this dam.

b. Adequacy. 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 Mo Noname Dam 168 was made on September 21, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: Stephen Nickel, Geology and Soil Mechanics; Gordon Jamison, Hydraulics and Hydrology; Garold Ulmer, Civil Engineer; and Richard Walker, Hydrology. Specific observations are discussed below.

b. Dam. The upstream slope from the waterline to the crest of the dam was found to be covered with riprap of semi-durable limestone. The riprap appears to be in good condition and to be quite thick. There is some possibility that the embankment is zoned, and consists of upstream and downstream rock zones and a silty clay core. There are several trees,up to 12 inches in diameter, growing out of the limestone rock.

The downstream slope was also covered by limestone riprap. The entire face was overgrown with trees, brush and weeds. The density of the growth on the downstream slope made it difficult to determine the condition of this section. No slides or seepage were noted on the downstream slope.

There is an erosion channel up to 6 feet deep and 6 feet wide which descends the right abutment in the vicinity of the principal spillway inlet riser. The soil exposed in this erosion channel is a plastic silty clay, similar to that found on the crest of the embankment. This appears to be a loessial soil, which probably overlies shales and limestones. No limestone outcrops were observed in the abutments. Neither slides nor seepage were noted in the abutments.

c. Appurtenant Structures. The principal spillway consists of a 36-inch corrugated metal pipe riser connected to a 30-inch diameter concrete outlet pipe passing through the dam at about center line station 6+00. The riser is in an extremely deteriorated condition. At one time the riser appears to have been as much as 10 feet taller than it is currently. A broken piece of riser pipe is lying near the riser and the structure which probably held it is still partially in place around the riser. The upper portion of the riser which is still in place has been punctured along most of its visible length. Water is entering 6 to 8 feet below the top. In this manner the pool elevation is maintained at its present level.

d. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shoreline.

e. Downstream Channel. The spillway outlets approximately 275 feet below the toe of the dam into a small plunge pool and a well defined channel. No excessive erosion was noted.

f. Downstream Hazards. Downstream hazards are described in Section 5.

3.2 EVALUATION

The general condition of this dam, including the vegetation on the upstream and downstream slopes, the deep erosion channel in the right abutment and the deteriorated condition of the inlet riser for the principal spillway, indicates lack of any maintenance. The pool level that is currently maintained is lower than the level of ground at the downstream toe of the dam. The heavy vegetation on the downstream slope made it impossible to fully observe the structural conditions on the slope. The trees now growing on the upstream and downstream slopes, if allowed to continue to grow, would have the potential of causing failure of the dam during times of high runoff. The erosion in the right abutment is a cause for alarm. If this erosion is left unchecked, it could lead to failure of the dam during periods of high runoff. The emergency spillway appeared to be in good condition.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam and no regulating procedures exist.

4.2 MAINTENANCE

The general condition of this dam, including the vegetation on the upstream and downstream faces, the erosion in the right abutment, and the deteriorated condition of the principal spillway inlet riser, indicates that it has been several years since any maintenance measures have been performed.

4.3 MAINTENANCE AND OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

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

4.5 EVALUATION

The trees growing on the upstream and downstream slopes and the erosion in the right abutment both could lead to the potential of failure during high runoffs if not controlled.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic or hydrologic data were available from the owner. All computations are based on the survey made at inspection or are taken from the 7 1/2' quadrangle. These are summarized and attached in Appendix D.

b. Experience Data. The drainage area and elevation-area-storage curves were developed from the USGS Liberty, Missouri 7 1/2' quadrangle. The hydraulic computations for spillways and dam overtopping discharge ratings were based on data taken in the inspection field survey.

c. Visual Observations.

(1) The principal spillway is in very poor condition as the photos indicate. It is only a makeshift in its present condition to crudely maintain lower reservoir stages.

(2) The emergency spillway channel is in good condition and could function.

(3) The emergency spillway channel is in the left abutment. Spillway releases will not endanger the integrity of the dam.

(4) There is a small dam upstream of the structure which would affect PMF flows. It is located in the north extremity of the watershed and can be seen on Plate 1.

(5) The inspection of the smaller dam showed it to have an effective spillway which diverts its outflow out of the watershed of Mononame Dam 168 (see map Plate 1). The possibility of this small dam being overtopped and contributing flood flows directly to dam Mononame 168 is considered in the routing analysis for overtopping potential given in Paragraph 5.1d.

d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. The spillways will pass the 1/2 PMF without overtopping, and they will also pass the 100-year frequency flood without overtopping. The spillways will just pass the 0.77 PMF without overtopping. The 100-year flood outflow requires 6% overtopping spillway capacity. The 0.77 PMF has a frequency less than (return period greater than) the 100-year flood. The results of the

routings through the dam are tabulated in regards to the following conditions. The inflow from the drainage area above the upstream dam mentioned in Paragraph 1 c. (5) was routed through that dam for the PMF which did not overtop and contribute to dam 10583 inflows. Therefore the flood flows from this upper area do not contribute to the inflow to the subject dam 10583 and are not reflected in the following routings.

Frequency	Peak Inflow Discharge c.f.s.	Peak Outflow Discharge c.f.s.	Maximum Pool Elevation M.S.L.	Freeboard Top of Dam Min. Elev. 822.2	Time Dam Overtopping Hrs.
100-Year	420	12	808.2	+14.0	-
1/2 PMF	960	15	817.3	+ 4.9	-
PMF	1950	740	823.3	- 1.1	3.3
0.77 PMF	1500	190	822.20	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 high hazard rating and a small size. In consideration of the small amount of water impounded, 50% of the PMF is the test for the adequacy of the dam and its spillways.

The St. Louis District, Corps of Engineers in a letter dated 11 August, 1978 has estimated the damage zone extending three miles downstream of the dam. Within the first 3/4 mile downstream of the dam are three to four houses and associated buildings, three improved road crossings, two railroad tracks and two power lines. The floodplain is farmed. Located just upstream of the dam is a smaller dam and reservoir whose effect was considered in the hydrologic analysis.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of items which adversely affect the structural stability of this dam are discussed in Section 3. These include the following features: the trees and other vegetation on both slopes and the erosion in the right abutment.

b. Design and Construction Data. No data were available.

c. Operating Records. There are no controlled outlets for this dam.

d. Post-Construction Changes. The only post-construction change that is apparent is the removal or destruction of the upper portion of the inlet riser and the subsequent lowering of the normal pool level.

e. Seismic Stability. This dam is in Seismic Zone 1. An earthquake of the magnitude used for design in this seismic zone is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Two items were noted during the visual inspection which could seriously threaten the safety of the dam if not corrected or controlled. These items are the uncontrolled vegetation on both slopes of the dam and the erosion in the right abutment. The presence of riprap on both slopes of the embankment, to the crest of the embankment, would provide some protection against erosion of the embankment during overtopping.

b. Adequacy of Information. Due to the lack of engineering data, conclusions in this report are based upon performance history and visual observations. These data are considered sufficient to support these conclusions. Neither seepage nor stability analysis were found, which is a deficiency that should be corrected in the future.

c. Urgency. The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. A Phase II investigation is not called for. However, additional engineering data and analyses should be obtained by the owner, at the owner's expense, to evaluate and design the recommended remedial measures.

e. Seismic Stability. This dam is in Seismic Zone 1. An earthquake of the magnitude used for design in this seismic zone is not expected to cause structural failure of this dam.

7.2 REMEDIAL MEASURES

a. Alternatives. The present elevation of the permanent pool appears to be almost a matter of chance. A permanent pool elevation should be chosen, such that at least one-half of the PMF can be passed without overtopping of the dam. The inlet riser should be repaired so as to maintain the permanent pool at its selected elevation. Additional investigations and analyses should be conducted to determine the structural characteristics and stability of the present embankment. These analyses should include a seepage analysis if it is warranted by the chosen elevation of the permanent pool. The services of an engineer experienced in the design of dams should be obtained to perform the investigations and analyses of the present dam and to design the appropriate modifications and remedial measures.

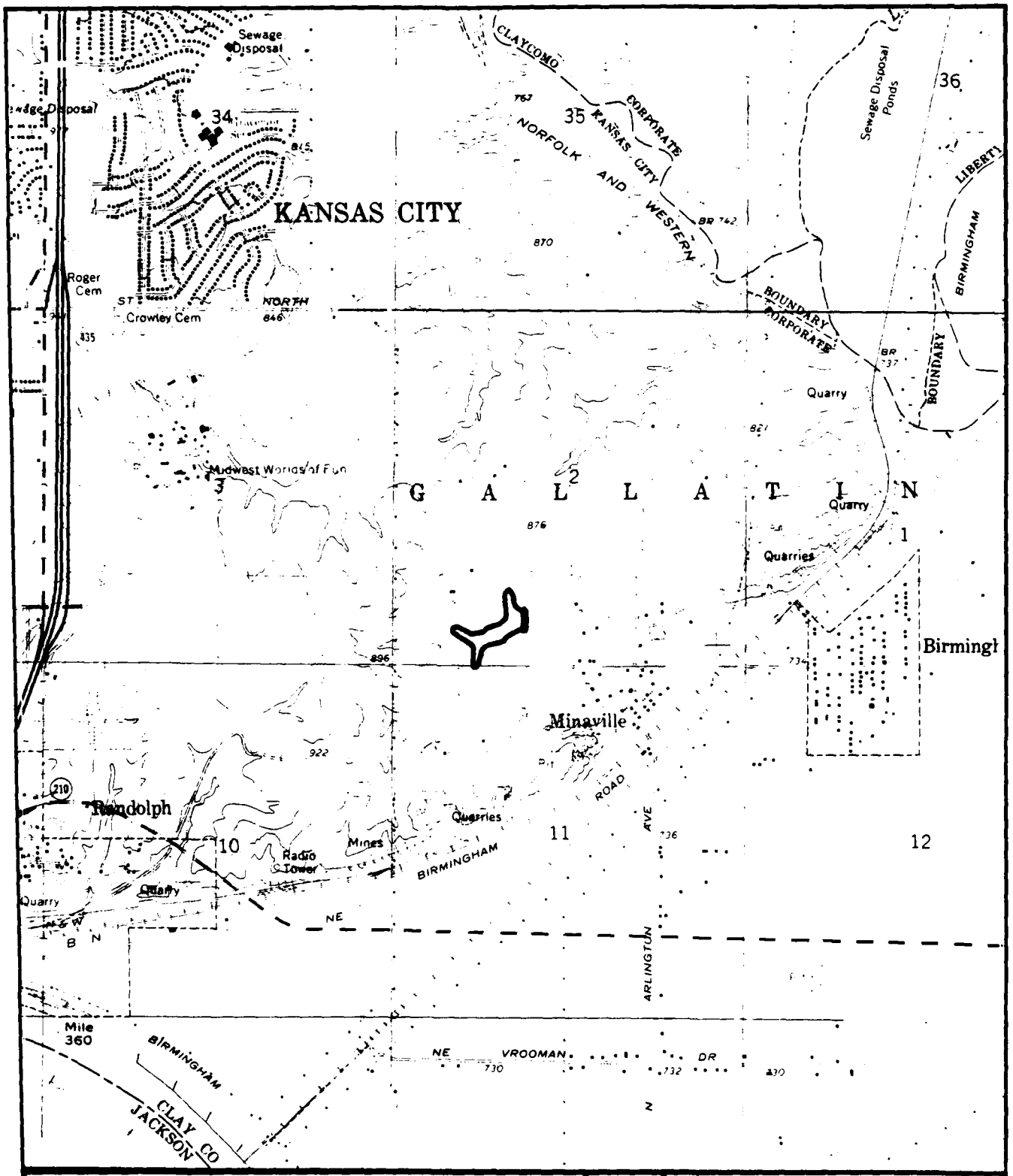
b. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended.

(1) A program should be developed and put into action to remove trees and brush from the dam and to keep trees and brush permanently off the dam and to control other vegetation. Mowing is not possible due to the riprap entirely covering both the upstream and downstream slopes.

(2) The erosion in the right abutment should be repaired and controlled.

(3) If the dam is to remain functional even as a dry dam, the inlet riser should be repaired to preclude the possibility of its structural collapse and the potential for the inlet to become permanently blocked.

APPENDIX A
MAPS



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1000 500 0 1000
SCALE IN METERS

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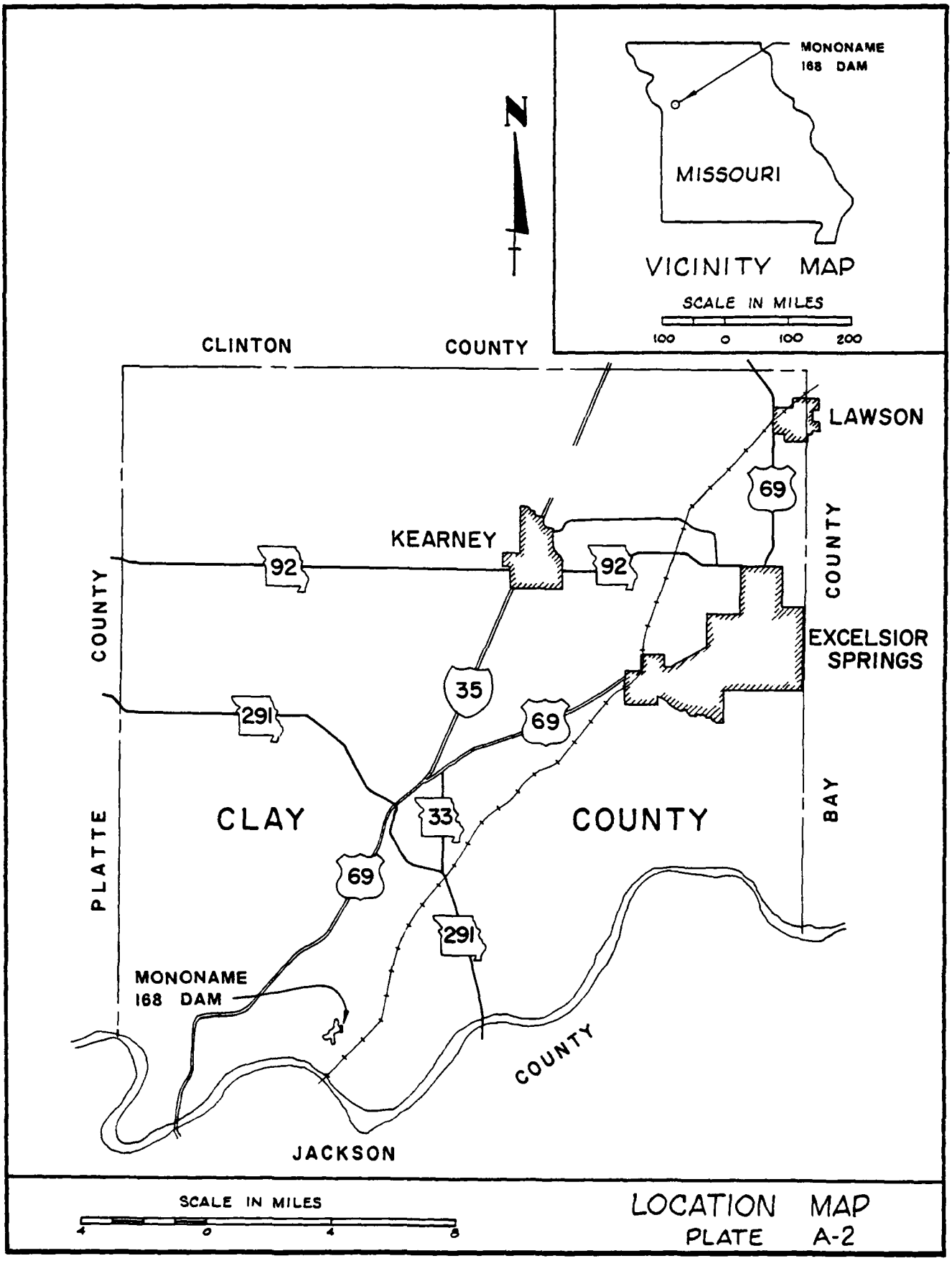
MO NONAME 168 DAM

VICINITY TOPOGRAPHY

PLATE A-1


MONONAME
168 DAM
MISSOURI
VICINITY MAP
SCALE IN MILES
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N
CLINTON COUNTY
LAWSON
69
KEARNEY
92
92
COUNTY
COUNTY
EXCELSIOR
SPRINGS
35
291
69
CLAY
33
COUNTY
BAY
PLATTE
69
291
MONONAME
168 DAM
COUNTY
JACKSON
SCALE IN MILES
4 0 4 8
LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS

PHOTO NO. 2
UPSTREAM FACE
FROM LEFT ABUTMENT

PHOTO NO. 3
UPSTREAM FACE
BROKEN SECTION OF
RISER IN FOREGROUND

PHOTO NO. 4
CREST FROM
RIGHT ABUTMENT

PHOTO NO. 5
EROSION CHANNEL
IN RIGHT ABUTMENT

PHOTO NO. 6
PRINCIPAL SPILLWAY
INLET RISER

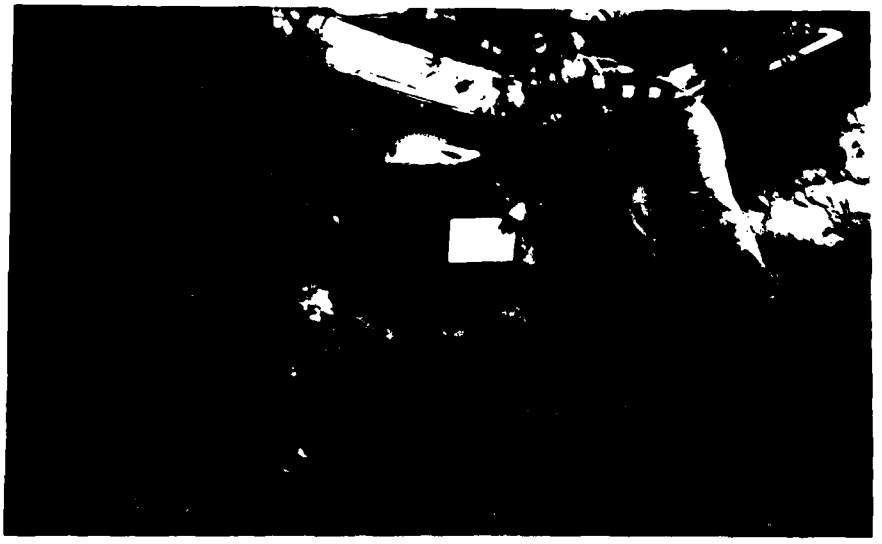


PHOTO NO. 7
PRINCIPAL
SPILLWAY
OUTLET

PHOTO NO. 8
DOWNSTREAM FACE
FROM RIGHT ABUTMENT

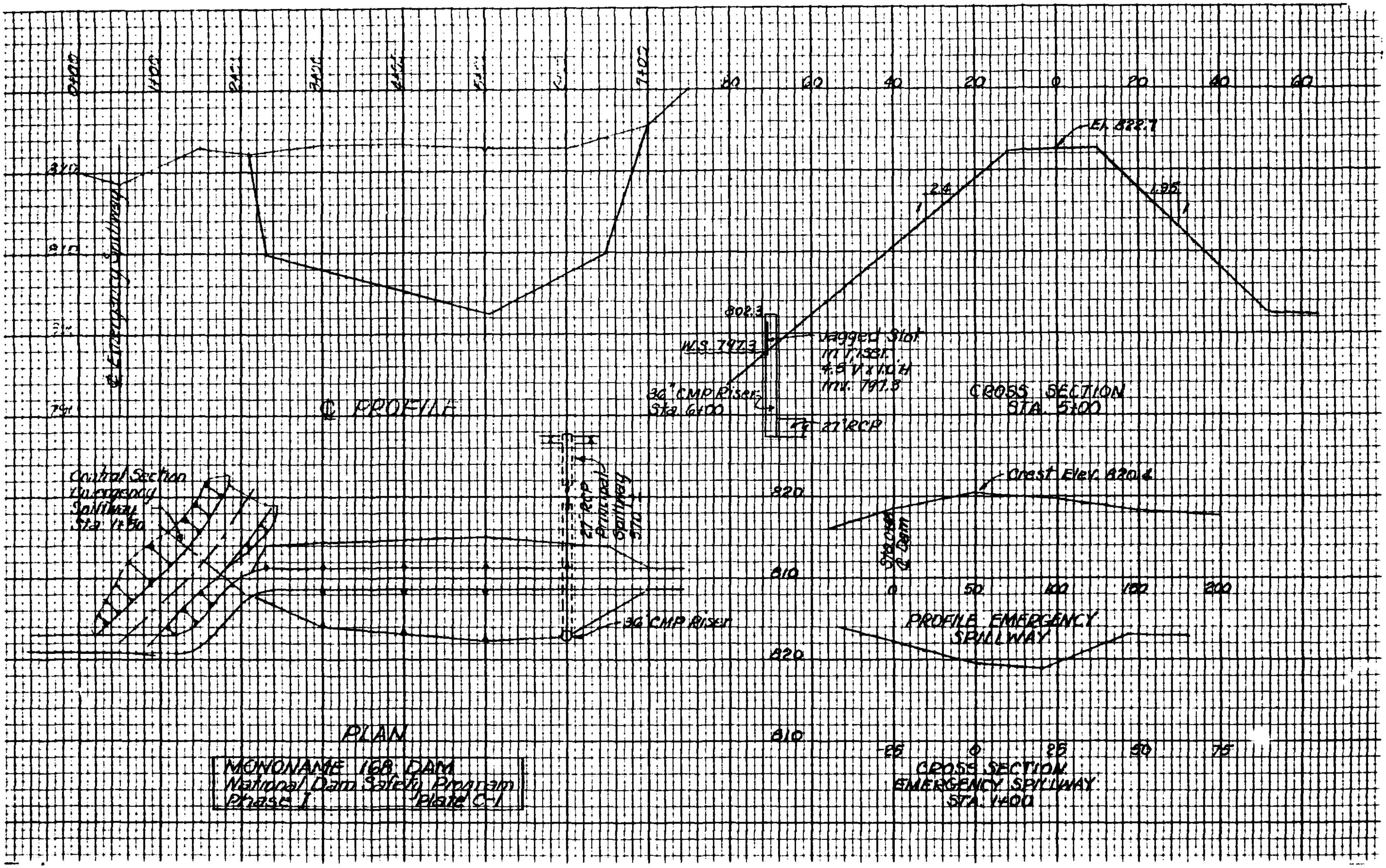
PHOTO NO. 9
LOOKING DOWNSTREAM
IN EMERGENCY SPILLWAY
FROM DAM CENTER LINE

PHOTO NO. 10
LOOKING DOWNSTREAM
IN EMERGENCY SPILLWAY
FROM CONTROL SECTION

PHOTO NO. 11
LOOKING DOWNSTREAM
IN EMERGENCY SPILLWAY
EXIT CHANNEL

PHOTO NO. 12
LOOKING DOWNSTREAM
FROM DAM

APPENDIX C
PLAN, PROFILES AND SECTION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℄ PROFILE
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36" CMP Riser
Sta. 6+00
27" RCP
Central Section
Emergency
Spillway
Sta. 1+50
27" RCP
Principal
Spillway
36" CMP Riser
Crest Elev. 820.4
Station
℄ Dam
PROFILE EMERGENCY
SPILLWAY
PLAN
CROSS SECTION
EMERGENCY SPILLWAY
STA. 1+00
MONONAME 168 DAM
National Dam Safety Program
Phase I
Plate C-1

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvilinear unit hydrograph and SCS TR-20 computer program were used to develop the inflow hydrograph (see Plate D1). The inflow hydrograph for the 100-year flood was also generated by the consultant using the TR-20 program.

   a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 24-hour probable maximum precipitation was taken from curves of Hydrometeorological Report No. 33 and current Corps of Engineers, St. Louis District, policy and guidance for hydraulics and hydrology.

   b. Drainage area = 0.30 square mile contributing to the dam inflow and 0.04 square mile noncontributing because of small dam.

   c. Time of concentration of runoff - 0.29 hour which was derived by the Kirpich Formula. The unit hydrograph duration was 0.171 time of concentration.

   d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMCIII). The initial pool elevation was assumed at the crest of the principal spillway (797.3 M.S.L.).

   e. The total 24-hour storm duration losses for the 100-year storm were 1.37 inches. The total losses for the 1/2 PMF storm were 1.45 inches. The total losses for the PMF storm were 1.54 inches. These data are based on SCS runoff curve number 76 and antecedent moisture conditions from SCS AMCIII. The hydrologic soil groups of the watershed are B and the land usage is mixed pasture and woods.

      An SCS runoff curve number of 82 was used on the small noncontributing area. The land usage contained more impervious surfaces.

   f. Average soil loss rates = 0.08 inch per hour approximately.

2. The principal spillway weir/full pipeflow discharge ratings were developed using standard formulas and criteria from the SCS publication "Design Manual EWP-5". The emergency spillway rating was developed as follows. Hydraulic analysis showed the control section in the emergency spillway to exist at spillway station 1+50 because of the mild channel slope from station 0+50 to 1+50. Critical depths were computed at the control section (station 1+50). Then corresponding depths of flow were established at the spillway crest (station 0+50), and the reservoir water surface corresponding to a given discharge was established by correcting for velocity head and entrance losses. See sketches, Appendix C for spillway channel geometry. The rating curves for each component spillway flow, the dam overtopping flows, and the combined rating is given on Plate D-4.

The flows over the dam crest were based on the broad-crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; the coefficient C which varies with head was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods".

3. Floods were routed through the reservoir using the TR-20 program which was the "Modified Puls" method to determine the capabilities of the spillways and dam embankment crest. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D1. The pertinent portions of the TR-20 computer runs are attached for the PMF, 1/2 PMF and 100 year flood.

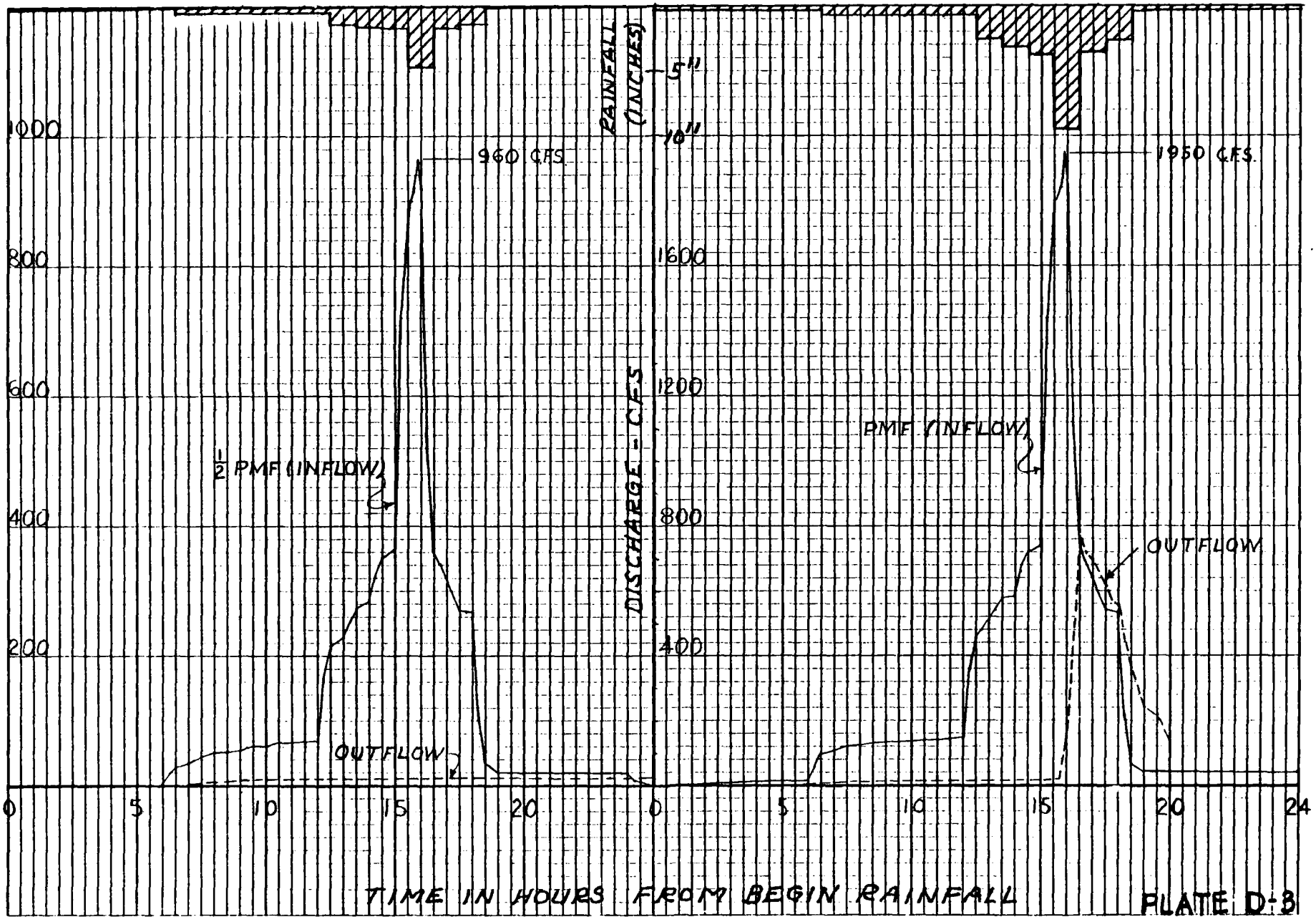

PLATE D-3

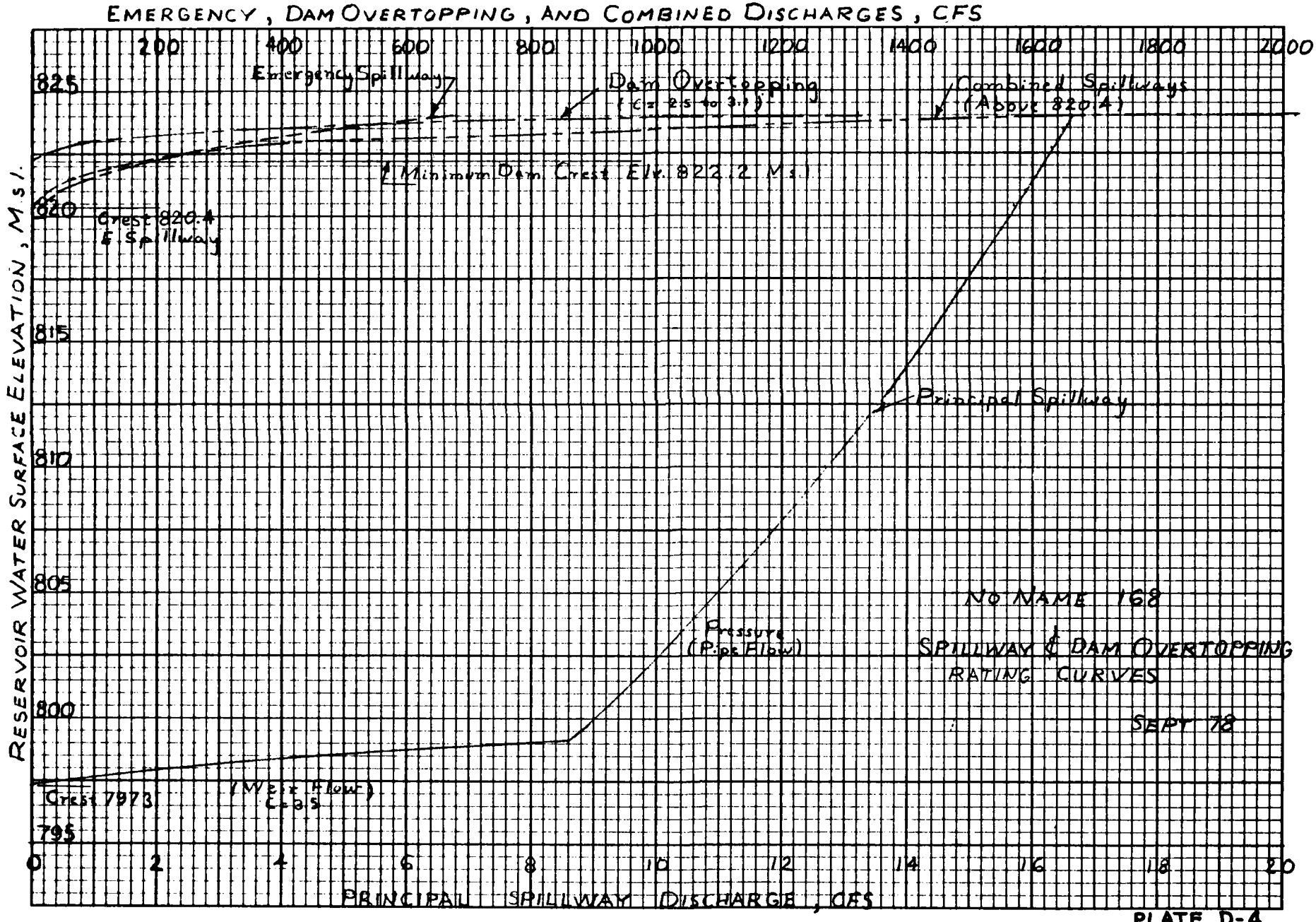
EMERGENCY, DAM OVERTOPPING, AND COMBINED DISCHARGES, CFS
200
400
600
800
1000
1200
1400
1600
1800
2000
825
820
815
810
805
800
795
Emergency Spillway
Dam Overtopping
(C = 2.5 to 3.1)
Combined Spillways
(Above 820.4)
Minimum Dam Crest Elv. 822.2 M.S.L.
Crest 820.4
E Spillway
Principal Spillway
Pressure
(Pipe Flow)
(Weir Flow)
C=3.5
Crest 797.3
RESERVOIR WATER SURFACE ELEVATION, M.S.L.
0
2
4
6
8
10
12
14
16
18
20
PRINCIPAL SPILLWAY DISCHARGE, CFS
NO NAME 168
SPILLWAY & DAM OVERTOPPING
RATING CURVES
SEPT 78

PLATE D-4

PMF & 1/2 PMF

HYDROLOGY PROGRAM FOR IBM 1130 - DATED JULY, 1968

EXECUTIVE CONTROL CARD NO NAME 168, NO MO 10583 OPERATION LIST

TR-20 ROUTING.

NO NAME 168, NO MO 10583

C TABLE VELOCITY INCREMENT = 0.200

8	0.0000	0.0800	0.1800	0.2500	0.3200
8	0.3700	0.4100	0.4500	0.4900	0.5100
8	0.5400	0.5700	0.5900	0.6100	0.6300
8	0.6500	0.6600	0.6700	0.6900	0.7000
8	0.7100	0.7200	0.7300	0.7400	0.7500
8	0.7600	0.7700	0.7700	0.7800	0.7900
8	0.7900	0.8000	0.8100	0.8100	0.8200
8	0.8200	0.8300	0.8300	0.8400	0.8400
8	0.8400	0.8500	0.8500	0.8500	0.8600
8	0.8600	0.8600	0.8700	0.8700	0.8700
8	0.8800	0.8800	0.8800	0.8900	0.8900
8	0.8900	0.8900	0.8900	0.8900	0.9000
8	0.9000	0.9000	0.9000	0.9000	0.9100
8	0.9100	0.9100	0.9100	0.9100	0.9100
8	0.9200	0.9200	0.9200	0.9200	0.9200
8	0.9200	0.9200	0.9200	0.9300	0.9300
9 ENDTBL					

STRUCTURE NO. 1

	ELEVATION	DISCHARGE	STORAGE
8	797.3000	0.0000	0.0000
8	798.0001	2.0000	4.0000
8	798.5001	4.6000	8.0000
8	799.0001	7.8000	12.0000
8	799.5001	8.8000	15.0000
8	800.0001	9.0000	19.0000
8	803.0001	10.4000	43.0000
8	806.0001	11.4000	67.0000
8	810.0001	12.7000	105.9999
8	813.0001	13.7000	143.0000
8	817.0001	14.9000	211.9999
8	819.5001	15.5000	265.0000
8	820.4000	15.7000	285.0000
8	821.0001	39.2000	298.0000
8	821.5001	83.0000	315.0000
8	822.0001	155.0000	325.0000
8	822.7000	287.0000	340.0000
8	823.0001	440.0000	350.0000
8	823.5001	1046.0002	365.0000
8	824.0001	2020.0002	380.0000
9 ENDTBL			

← NOTE: STORAGE VOLUMES GIVEN RELATIVE TO CREST PRINCIPAL SPILLWAY

DIMENSIONLESS HYDROGRAPH - DELTA T =484.00

8	0.0000	0.0300	0.1000	0.1900	0.3100
8	0.4700	0.6600	0.8200	0.9300	0.9900
8	1.0000	0.9900	0.9300	0.8600	0.7800
8	0.6800	0.5600	0.4600	0.3900	0.3300
8	0.2800	0.2410	0.2070	0.1740	0.1470
8	0.1260	0.1070	0.0910	0.0770	0.0660
8	0.0550	0.0470	0.0400	0.0340	0.0290
8	0.0250	0.0210	0.0180	0.0150	0.0130
8	0.0110	0.0090	0.0080	0.0070	0.0060
8	0.0050	0.0040	0.0030	0.0020	0.0010
8	0.0000	0.0000	0.0000	0.0000	0.0000
9 ENDTBL					

RAINFALL TABLE NO. 1 TIME INCREMENT = 0.50

8	0.0000	0.0080	0.0170	0.0260	0.0350
8	0.0450	0.0550	0.0650	0.0760	0.0870
8	0.0990	0.1120	0.1250	0.1400	0.1560
8	0.1740	0.1940	0.2190	0.2540	0.3030
8	0.5150	0.5830	0.6240	0.6540	0.6820
8	0.7050	0.7270	0.7480	0.7670	0.7840
8	0.8000	0.8160	0.8300	0.8440	0.8570
8	0.8700	0.8820	0.8930	0.9050	0.9160
8	0.9260	0.9360	0.9460	0.9550	0.9650
8	0.9740	0.9830	0.9920	1.0000	1.0000
9 ENDTBL					

PLATE D-5

RAINFALL TABLE NO. 3 TIME INCREMENT = 0.50

8	0.0000	0.0700	0.1400	0.2200	0.2900
8	0.3700	0.4400	0.5200	0.5900	0.6700
8	0.7400	0.8200	0.8900	1.2600	1.6700
8	2.0600	2.4500	2.8400	3.2300	3.6300
8	4.0200	4.4200	4.8100	5.2100	5.6000
8	6.8700	8.1300	9.6500	11.1700	13.0700
8	14.9700	19.7800	24.5800	26.3500	28.1200
8	29.5100	30.9000	31.0200	31.1300	31.2500
8	31.3600	31.4700	31.5900	31.6900	31.8000
8	31.9100	32.0200	32.1300	32.2400	32.2400
9 ENDTBL					

PLATE D-9

PMF

EXECUTIVE CONTROL CARD OPERATION INCREM. MAIN TIME INCREMENT= 0.25
EXECUTIVE CONTROL CARD OPERATION COMPUT. FROM XSECTN/STRUCT 01 1 TO XSECTN/STRUCT 01 1
STARTING TIME= 0.00 RAIN DEPTH= 1.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 3 SOIL CONDITION= 3
ALTERNATE NO.= 1 STORM NO.= 1

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.30 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.20
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
4.59	12.482	(RUNOFF)
5.54	15.336	(RUNOFF)
9.54	142.299	(RUNOFF)
10.51	145.797	(RUNOFF)
11.49	148.091	(RUNOFF)
15.87	1946.515	(RUNOFF)
19.46	46.390	(RUNOFF)
23.62	42.669	(RUNOFF)

32.20
30.70
1.64

HYDROGRAPH, TZERO= 2.00 DELTA T= 0.25 DRAINAGE AREA= 0.30

TIME											
2.00	DISCHG	0.00	1.66	3.32	4.42	5.39	7.04	8.51	8.87	9.36	11.02
4.50	DISCHG	12.36	12.20	12.34	14.04	15.30	14.75	15.82	61.20	92.77	104.34
7.00	DISCHG	111.66	117.20	121.65	125.29	128.29	130.81	133.95	134.75	136.31	137.36
9.50	DISCHG	142.26	141.19	140.99	143.94	145.82	144.32	143.76	146.44	140.06	140.34
12.00	DISCHG	147.66	353.51	462.44	476.05	478.95	541.99	575.65	581.11	585.63	675.59
14.50	DISCHG	723.87	730.82	738.35	1442.54	1806.73	1852.43	1853.80	1114.28	738.85	691.25
17.00	DISCHG	685.60	591.85	545.24	539.38	537.81	225.64	68.79	46.39	42.83	43.11
19.50	DISCHG	46.31	44.04	42.81	42.65	42.63	42.64	42.63	42.63	42.64	42.63
22.00	DISCHG	42.63	42.64	42.64	42.64	42.63	42.64	42.63	42.64	42.43	15.67
24.50	DISCHG	1.95	0.20	0.00							

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 30.7036 CFS-HRS= 5964.38 ACRE-FT= 492.89

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 797.30

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
16.62	750.371	823.25

HYDROGRAPH, TZERO= 2.00 DELTA T= 0.25 DRAINAGE AREA= 0.30

TIME											
2.00	DISCHG	0.00	0.00	0.03	0.07	0.12	0.18	0.26	0.35	0.44	0.54
2.00	ELEV	797.30	797.30	797.31	797.32	797.34	797.36	797.39	797.42	797.45	797.48
4.50	DISCHG	0.65	0.77	0.89	1.01	1.16	1.30	1.44	1.81	2.76	4.04
4.50	ELEV	797.52	797.57	797.61	797.65	797.70	797.75	797.80	797.93	798.14	798.39
7.00	DISCHG	5.62	7.40	8.40	8.85	8.98	9.12	9.27	9.42	9.57	9.72
7.00	ELEV	798.66	798.93	799.30	799.64	799.95	800.26	800.58	800.90	801.22	801.55
9.50	DISCHG	9.88	10.04	10.20	10.36	10.48	10.60	10.71	10.85	10.95	11.06
9.50	ELEV	801.89	802.23	802.57	802.91	803.26	803.61	803.95	804.30	804.65	805.00
12.00	DISCHG	11.18	11.39	11.66	11.98	12.30	12.64	12.96	13.27	13.59	13.85
12.00	ELEV	805.35	805.97	806.82	807.79	808.77	809.83	810.78	811.72	812.68	813.51
14.50	DISCHG	14.09	14.35	14.61	14.96	15.34	21.99	134.60	452.92	715.45	715.21
14.50	ELEV	814.33	815.18	816.04	817.27	818.84	820.56	821.99	822.98	823.22	823.22
17.00	DISCHG	699.43	663.68	607.65	569.17	551.16	451.38	362.24	282.16	242.57	201.47
17.00	ELEV	823.21	823.18	823.13	823.10	823.09	823.00	822.84	822.67	822.46	822.28
19.50	DISCHG	182.17	159.34	142.56	128.73	116.81	106.54	97.69	90.07	83.50	81.07
19.50	ELEV	822.14	822.02	821.91	821.81	821.73	821.66	821.60	821.54	821.50	821.47
22.00	DISCHG	79.07	77.18	75.39	73.69	72.08	70.56	69.11	67.74	66.43	64.49
22.00	ELEV	821.45	821.43	821.41	821.39	821.37	821.35	821.34	821.32	821.31	821.28
24.50	DISCHG	61.60	58.46	55.44	52.56	49.84	47.25	44.80	42.48	40.28	38.46
24.50	ELEV	821.25	821.22	821.18	821.15	821.12	821.09	821.06	821.03	821.01	820.96

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 12.1345 CFS-HRS= 2356.19 ACRE-FT= 194.36

ENDCMP 1

PLATE D-7

½ PMF

EXECUTIVE CONTROL CARD OPERATION COMPUT. FROM XSECTN/STRUCT 0/ 1 TO XSECTN/STRUCT 0/ 1
STARTING TIME= 0.00 RAIN DEPTH= 0.50 RAIN DURATION= 1.00 RAIN TABLE NO.= 3 SOIL CONDITION= 3
ALTERNATE NO.= 2 STORM NO.= 1

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.30 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.20
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
10.59	64.685	(RUNOFF)
11.55	67.330	(RUNOFF)
15.87	964.402	(RUNOFF)
19.46	23.095	(RUNOFF)
23.62	21.234	(RUNOFF)

TIME		HYDROGRAPH, TZERO= 4.25				DELTA T= 0.25				DRAINAGE AREA= 0.30		
4.25	DISCHG	0.00	1.32	1.58	1.83	2.33	2.77	2.87	3.10	14.52	20.72	
6.75	DISCHG	30.90	35.76	39.82	43.30	46.29	48.80	51.15	53.14	54.90	56.46	
9.25	DISCHG	58.81	60.57	60.61	61.35	63.21	64.57	64.32	64.57	66.18	67.50	
11.75	DISCHG	66.86	67.78	163.57	215.96	224.23	227.36	259.01	276.67	280.65	285.01	
14.25	DISCHG	328.82	353.46	357.06	362.40	710.20	892.10	915.92	919.51	953.15	967.04	
16.75	DISCHG	345.55	340.87	294.34	271.23	268.38	267.65	142.50	54.24	33.09	21.32	
19.25	DISCHG	22.45	23.05	21.92	21.31	21.23	21.22	21.22	21.22	21.22	21.22	
21.75	DISCHG	21.22	21.22	21.23	21.22	21.23	21.22	21.23	21.23	21.24	21.12	
24.25	DISCHG	7.80	0.37	0.10	0.00							

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 14.6655 CFS-HRS= 2046.68 ACRE-FT= 235.45

1.45

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 797.30

PEAK TIMES PEAK DISCHARGES PEAK ELEVATIONS
NO PEAK FOUND, MAXIMUM DISCHARGE.= 14.976 CFS.

TIME		HYDROGRAPH, TZERO= 4.25				DELTA T= 0.25				DRAINAGE AREA= 0.30		
4.25	DISCHG	0.00	0.00	0.02	0.03	0.06	0.08	0.11	0.14	0.23	0.42	
4.25	ELEV	797.30	797.30	797.30	797.31	797.32	797.32	797.33	797.35	797.38	797.45	
6.75	DISCHG	0.71	1.04	1.42	1.83	2.36	2.96	3.59	4.24	4.97	5.80	
6.75	ELEV	797.54	797.66	797.79	797.94	798.06	798.18	798.30	798.43	798.55	798.68	
9.25	DISCHG	6.65	7.52	8.04	8.41	8.78	8.85	9.11	8.96	9.03	9.10	
9.25	ELEV	798.82	798.95	799.12	799.30	799.49	799.63	799.77	799.92	800.06	800.21	
11.75	DISCHG	9.17	9.24	9.36	9.58	9.84	10.10	10.38	10.60	10.83	11.07	
11.75	ELEV	800.36	800.51	800.79	801.25	801.80	802.35	802.96	803.62	804.31	805.01	
14.25	DISCHG	11.32	11.56	11.80	12.04	12.40	12.90	13.39	13.83	14.09	14.25	
14.25	ELEV	805.77	806.51	807.24	807.98	809.09	810.60	812.09	813.43	814.30	814.35	
16.75	DISCHG	14.37	14.49	14.60	14.69	14.78	14.87	14.92	14.94	14.94	14.94	
16.75	ELEV	815.24	815.63	816.00	816.32	816.62	816.93	817.11	817.17	817.19	817.19	
19.25	DISCHG	14.94	14.94	14.95	14.95	14.95	14.95	14.95	14.95	14.96	14.96	
19.25	ELEV	817.19	817.20	817.21	817.22	817.22	817.23	817.23	817.24	817.25	817.25	
21.75	DISCHG	14.96	14.96	14.96	14.96	14.96	14.97	14.97	14.97	14.97	14.97	
21.75	ELEV	817.26	817.26	817.27	817.28	817.28	817.29	817.29	817.30	817.31	817.31	
24.25	DISCHG	14.97	14.97	14.97	14.96	14.96	14.95	14.95	14.95	14.94	14.94	
24.25	ELEV	817.31	817.30	817.29	817.27	817.26	817.24	817.23	817.22	817.20	817.19	
26.75	DISCHG	14.94	14.93	14.93	14.93	14.92	14.92	14.92	14.91	14.91	14.91	
26.75	ELEV	817.17	817.16	817.14	817.13	817.11	817.10	817.08	817.07	817.06	817.04	

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.3905 CFS-HRS= 270.11 ACRE-FT= 22.32

ENDCMP 1

END OF JOB TR20 RHW
BATCH JOB
JOB NUMBER 78/3095 PHASE 0
DATE RAN 10/10/78 QUEUE 256

PLATE D-8

100 YR FLOOD

HYDROLOGY PROGRAM FOR IBM 1130 - DATED JULY, 1968

TR-20 ROUTING.

NO NAME 168, NO MO 10583
EXECUTIVE CONTROL CARD OPERATION LIST

NO NAME 168, NO MO 10583

C TABLE VELOCITY INCREMENT = 0.200

8	0.0000	0.0800	0.1800	0.2500	0.3200
8	0.3700	0.4100	0.4500	0.4900	0.5100
8	0.5400	0.5700	0.5900	0.6100	0.6300
8	0.6500	0.6600	0.6700	0.6900	0.7000
8	0.7100	0.7200	0.7300	0.7400	0.7500
8	0.7600	0.7700	0.7700	0.7800	0.7900
8	0.7900	0.8000	0.8100	0.8100	0.8200
8	0.8200	0.8300	0.8300	0.8400	0.8400
8	0.8400	0.8500	0.8500	0.8600	0.8600
8	0.8600	0.8600	0.8700	0.8700	0.8700
8	0.8800	0.8800	0.8800	0.8900	0.8900
8	0.8900	0.8900	0.8900	0.8900	0.9000
8	0.9000	0.9000	0.9000	0.9000	0.9100
8	0.9100	0.9100	0.9100	0.9100	0.9100
8	0.9200	0.9200	0.9200	0.9200	0.9200
8	0.9200	0.9200	0.9200	0.9300	0.9300
9 ENDTBL					

STRUCTURE NO. 1

	ELEVATION	DISCHARGE	STORAGE
8	797.3000	0.0000	0.0000 *
8	798.0001	2.0000	4.0000
8	798.5001	4.6000	8.0000
8	799.0001	7.8000	12.0000
8	799.5001	8.8000	15.0000
8	800.0001	9.0000	19.0000
8	803.0001	10.4000	43.0000
8	806.0001	11.4000	67.0000
8	810.0001	12.7000	105.9999
8	813.0001	13.7000	143.0000
8	817.0001	14.9000	211.9999
8	819.5001	15.5000	265.0000
8	820.4000	15.7000	285.0000
8	821.0001	39.2000	298.0000
8	821.5001	83.0000	315.0000
8	822.0001	155.0000	325.0000
8	822.7000	287.0000	340.0000
8	823.0001	440.0000	350.0000
8	823.5001	1046.0002	365.0000
8	824.0001	2020.0002	380.0000
9 ENDTBL			

* Note Storage Given Relative to Crest of Spillway

DIMENSIONLESS HYDROGRAPH - DELTA T =484.00

8	0.0000	0.0300	0.1000	0.1300	0.3100
8	0.4700	0.6600	0.8200	0.9300	0.9900
8	1.0000	0.9900	0.9300	0.8600	0.7800
8	0.6800	0.5600	0.4600	0.3900	0.3300
8	0.2800	0.2410	0.2070	0.1740	0.1470
8	0.1260	0.1070	0.0910	0.0770	0.0660
8	0.0550	0.0470	0.0400	0.0340	0.0290
8	0.0250	0.0210	0.0180	0.0150	0.0130
8	0.0110	0.0090	0.0080	0.0070	0.0060
8	0.0050	0.0040	0.0030	0.0020	0.0010
8	0.0000	0.0000	0.0000	0.0000	0.0000
9 ENDTBL					

RAINFALL TABLE NO. 1 TIME INCREMENT = 0.50

8	0.0000	0.0080	0.0170	0.0260	0.0350
8	0.0450	0.0550	0.0650	0.0760	0.0870
8	0.0990	0.1120	0.1250	0.1400	0.1560
8	0.1740	0.1940	0.2190	0.2540	0.3030
8	0.5150	0.5830	0.6240	0.6540	0.6820
8	0.7050	0.7270	0.7480	0.7670	0.7840
8	0.8000	0.8160	0.8300	0.8440	0.8570
8	0.8700	0.8820	0.8930	0.9050	0.9160
8	0.9260	0.9360	0.9460	0.9550	0.9650
8	0.9740	0.9830	0.9920	1.0000	1.0000
9 ENDTBL					

PLATE D-

RAINFALL TABLE NO. 5 TIME INCREMENT = 0.50

8	0.0000	0.0300	0.0600	0.0900	0.1200
8	0.1500	0.1800	0.2100	0.2400	0.2700
8	0.3000	0.3300	0.3600	0.4400	0.5200
8	0.6000	0.6800	0.7700	0.8500	0.9400
8	1.0200	1.1100	1.1900	1.2300	1.3600
8	1.6500	1.9300	2.2700	2.6100	3.0400
8	3.4600	4.5500	5.6300	6.0300	6.4300
8	6.7500	7.0600	7.1100	7.1500	7.2000
8	7.2400	7.2900	7.3300	7.3800	7.4200
8	7.4700	7.5100	7.5600	7.6000	7.6000

- 6.23

1.37

9 ENDTBL

PLATE D-10

EXECUTIVE CONTROL CARD OPERATION INCRLM, MAIN TIME INCREMENT= 0.25
EXECUTIVE CONTROL CARD OPERATION COMPUT, FROM XSECTN/STRUCT 0/ 1 TO XSECTN/STRUCT 0/ 1
STARTING TIME= 0.00 RAIN DEPTH= 1.00 RAIN DURATION= 1.00 RAIN TABLE NO.= 3 SOIL CONDITION= 3
ALTERNATE NO.= 3 STORM NO.= 2

SUBROUTINE RUNOFF STRUCTURE 1
AREA= 0.30 INPUT RUNOFF CURVE= 76.0 TIME OF CONCENTRATION= 0.29
COMPUTED CURVE NO. = 88.6

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
8.58	16.239	(RUNOFF)
9.54	19.302	(RUNOFF)
10.51	21.680	(RUNOFF)
11.50	23.553	(RUNOFF)
15.87	418.966	(RUNOFF)
19.46	18.788	(RUNOFF)
20.46	18.784	(RUNOFF)
21.46	18.785	(RUNOFF)
22.46	18.796	(RUNOFF)
23.46	18.626	(RUNOFF)

HYDROGRAPH, TZERO= 5.50 DELTA T= 0.25 DRAINAGE AREA= 0.30

TIME											
5.50	DISCHG	0.00	1.22	1.46	3.73	5.87	7.30	8.55	9.70	10.76	11.74
8.00	DISCHG	12.66	14.63	16.13	15.86	15.98	17.90	19.27	18.60	18.46	20.37
10.50	DISCHG	21.67	20.73	20.38	22.30	23.55	22.39	22.25	59.39	81.08	84.55
13.00	DISCHG	86.43	100.36	108.93	111.93	114.12	135.05	147.01	147.96	149.83	302.14
15.50	DISCHG	384.82	397.29	400.10	242.01	161.34	151.35	150.39	131.43	122.04	118.57
18.00	DISCHG	117.18	54.72	23.36	16.99	15.33	17.55	18.74	16.52	15.34	17.56
20.50	DISCHG	18.74	16.54	15.36	17.56	18.75	16.55	15.36	17.57	18.76	16.55
23.00	DISCHG	15.37	17.58	18.77	16.56	15.28	5.59	0.69	0.07	0.00	

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 6.2318 CFS-HRS= 1210.58 ACRE-FT= 100.04

SUBROUTINE RESVOR STRUCTURE 1
SURFACE ELEVATION= 797.30

PEAK TIMES	PEAK DISCHARGES	PEAK ELEVATIONS
24.06	12.108	808.18

HYDROGRAPH, TZERO= 5.50 DELTA T= 0.25 DRAINAGE AREA= 0.30

TIME											
5.50	DISCHG	0.00	0.00	0.02	0.04	0.09	0.16	0.24	0.33	0.43	0.54
5.50	ELEV	797.30	797.30	797.30	797.31	797.33	797.35	797.38	797.41	797.45	797.49
8.00	DISCHG	0.66	0.79	0.94	1.10	1.25	1.41	1.59	1.77	1.94	2.16
8.00	ELEV	797.53	797.57	797.63	797.68	797.73	797.79	797.85	797.92	797.98	798.03
10.50	DISCHG	2.41	2.66	2.90	3.14	3.41	3.67	3.92	4.41	5.45	6.71
10.50	ELEV	798.07	798.12	798.17	798.22	798.27	798.32	798.36	798.46	798.63	798.83
13.00	DISCHG	7.88	8.47	8.85	8.95	9.07	9.21	9.37	9.54	9.70	9.86
13.00	ELEV	799.04	799.33	799.62	799.88	800.15	800.45	800.79	801.15	801.51	802.06
15.50	DISCHG	10.36	10.70	11.03	11.30	11.45	11.55	11.65	11.75	11.81	11.89
15.50	ELEV	802.93	803.91	804.91	805.71	806.16	806.47	806.77	807.04	807.28	807.51
18.00	DISCHG	11.96	12.01	12.03	12.04	12.04	12.04	12.05	12.05	12.05	12.06
18.00	ELEV	807.74	807.90	807.95	807.97	807.98	807.99	808.00	808.01	808.02	808.03
20.50	DISCHG	12.06	12.06	12.07	12.07	12.07	12.08	12.08	12.08	12.09	12.09
20.50	ELEV	808.04	808.05	808.06	808.07	808.09	808.10	808.11	808.11	808.13	808.14
23.00	DISCHG	12.09	12.10	12.10	12.11	12.11	12.11	12.10	12.09	12.08	12.08
23.00	ELEV	808.15	808.16	808.17	808.18	808.19	808.19	808.17	808.14	808.12	808.09
25.50	DISCHG	12.07	12.06	12.05	12.04	12.03	12.03	12.02	12.01	12.00	11.99
25.50	ELEV	808.07	808.04	808.01	807.99	807.96	807.94	807.91	807.89	807.86	807.84
28.00	DISCHG	11.98	11.98	11.97	11.96	11.95	11.94	11.94	11.93	11.92	11.91
28.00	ELEV	807.81	807.79	807.76	807.73	807.71	807.68	807.66	807.63	807.61	807.58

TOTAL WATER, IN INCHES ON DRAINAGE AREA= 1.1002 CFS-HRS= 213.71 ACRE-FT= 17.66

ENDCMP 1

END OF JOB TR20 RHS

PLATE D-11