

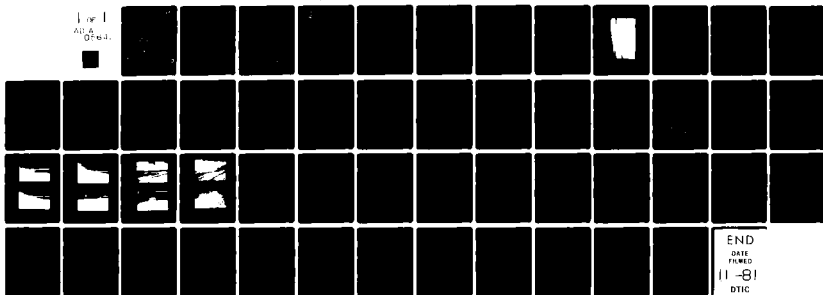
AD-A105 642

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE F/G 13/13
NATIONAL DAM SAFETY PROGRAM, COOL VALLEY LAKE DAM (NO 10934), M--ETC(U)
JUN 79 R S DECKER, G JANISON, G ULMER DACW43-79-C-0046

NL

UNCLASSIFIED

1 of 1
AD-A
0764



END
DATE
FILMED
11-81
DTIC

LEVEL II

1
BS

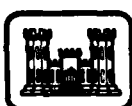
MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

AD A 105642

**COOL VALLEY LAKE DAM
MONTGOMERY COUNTY, MISSOURI
MO. 10934**

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

DTIC FILE COPY



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

St. Louis District

**DTIC
ELECTE
S OCT 16 1981 D**

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

FOR: STATE OF MISSOURI

81 10 15

JUNE, 1979

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105642	3. RECIPIENT'S CATALOG NUMBER 642
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Cool Valley Lake Dam (MO 10934) Montgomery County, Missouri		5. TYPE OF REPORT & PERIOD COVERED (9) Final Report
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) (13) DACW43-79-C-0046
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (10) Rey S. /Decker Gordon /Jamison Garold /Ulmer Harold P. /Hoskins		12. REPORT DATE June 1979 / (12) 53 /
		13. NUMBER OF PAGES Approximately 45
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (6) National Dam Safety Program. Cool Valley Lake Dam (MO 10934), Mississippi - Kaskaskia - St. Louis Basin, Montgomery County, Missouri. Phase I Inspection Report.		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

COOL VALLEY LAKE DAM
MONTGOMERY COUNTY, MISSOURI
MO. 10934

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

JUNE, 1979

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

DTIC
ELECTE
OCT 16 1981
D

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

TABLE OF CONTENTS

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

APPENDIX A - MAPS

Plate A-1	Vicinity Topography
Plate A-2	Location Map

APPENDIX B - PHOTOGRAPHS

Plate B-1	Photo Index
Plate B-2	Photo No. 2 Upstream Slope from Left
	Photo No. 3 Crest of Dam
Plate B-3	Photo No. 4 Downstream Slope from Left
	Photo No. 5 Looking Upstream In Emergency Spillway
Plate B-4	Photo No. 6 Looking Downstream in Emergency Spillway
	Photo No. 7 Principal Spillway Riser
Plate B-5	Photo No. 8 Outlet of Principal Spillway
	Photo No. 9 Outlet of Principal Spillway

APPENDIX C - PROJECT PLATES

Plate C-1	Phase I - Plan and Centerline Profile of Dam
Plate C-2	Phase I - Section of Dam, Profile and Section of Emergency Spillway
Plate C-3	Phase I - Section through Principal Spillway

APPENDIX D - HYDRAULIC AND HYDROLOGIC DATA

Plates D-1 & D-2	Hydrologic Computations
Plate D-3	Emergency Spillway Rating Curve
Plate D-4	Principal Spillway Rating Curve
Plate D-5	Ratio of PMF - Discharge Curve
Plates D-6 to D-17	Computer Input and Output for 1/2 PMF

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Cool Valley Lake Dam
State Located	Missouri
County Located	Montgomery County
Stream	Price's Branch
Date of Inspection	June 28, 1979

Cool Valley Lake Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, 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.

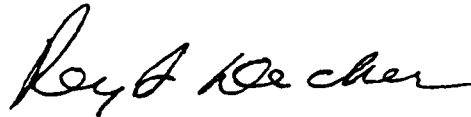
The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten life and property. The estimated damage zone extends approximately two miles downstream of the dam. Within the damage zone are one dwelling, some outbuildings, and 3 county roads.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the volume of water impounded and the downstream hazards, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will 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 30% 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 than a heavy growth of trees and brush in the exit channel, no other deficiencies were found. The dam appears to be in excellent condition.

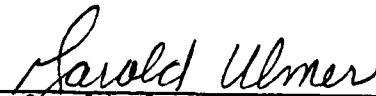
Maintenance of this dam is excellent.



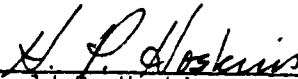
Rey S. Decker
E-3703



Gordon Jamison



Garold Ulmer
E-4777



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



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
COOL VALLEY LAKE DAM - MO 10934
MONTGOMERY 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 Cool Valley 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 earthfill approximately 900 feet in length and about 20 feet in height. It is located in gently rolling hills with loess capping the uplands and glacial till in the valley slopes. The valley slopes and bottoms are mantled by loess-derived colluvium and alluvium. The probable foundation materials are thin alluvial and colluvial silty clays and thick glacial till.
 - (2) The principal spillway consists of a 72-inch diameter riveted steel boiler plate riser connected with a 72-inch diameter boiler plate riveted outlet conduit.
 - (3) A vegetated earth emergency spillway is cut through the left (west) abutment.
 - (4) Pertinent physical data are given in paragraph 1.3 below.

- b. Location. The dam is located in the east central portion of Montgomery County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the NW $\frac{1}{4}$ of Section 2, T47N, R4W and the NE $\frac{1}{4}$ of Section 3, T47N, R4W. The lake formed behind the dam is shown in the NW $\frac{1}{4}$ of Section 2, T47N, R4W, and the NE $\frac{1}{4}$ of Section 3, T47N, R4W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in 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 the hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends for about two miles downstream and includes one dwelling, some outbuildings and 3 county roads.
- e. Ownership. The dam is owned by Ray Oetting, P.O. Box 177, Jonesburg, Missouri 63351.
- f. Purpose of Dam. The dam was constructed for flood retardation and erosion control.
- g. Design and Construction History. It was reported by Mrs. Ray Oetting that the dam was constructed in 1972 or 1973. A core trench was excavated and backfilled during construction. No other information on design and construction was available.
- h. Normal Operating Procedure. It was reported by Mr. Oetting that the reservoir is drawn down occasionally to provide irrigation water for a downstream landowner. The reservoir is drawn down by a 12-inch gate valve located in the principal spillway.

1.3 PERTINENT DATA

- a. Drainage Area. 519 acres (0.811 square miles).
- b. Discharge at Damsite.
 - (1) All discharges at the damsite are through a principal spillway consisting of a 72-inch diameter riveted steel riser connected to a 72-inch diameter riveted steel outlet pipe and through a grassed earth channel ungated emergency spillway. A 12-inch diameter gate valve is located within the 72-inch diameter outlet pipe for a drawdown mechanism. There are no seepage collars located on the outlet pipe.

- (2) Estimated maximum flood at damsite -- unknown.
- (3) The principal spillway capacity varies from 0 c.f.s. at elevation 856.0 to 215 c.f.s. at the crest of the emergency spillway (elevation 858.5) to 272 c.f.s. at the minimum top of dam (elevation 860.0).
- (4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 858.5 to 160 c.f.s. at elevation 860.0 (minimum top of dam).
- (5) Total spillway capacity at the minimum top of dam is 432 c.f.s. ±.

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

- (1) Top of dam - 860 ±
- (2) Principal spillway crest - 856 ±
- (3) Emergency spillway crest - 858.5 ±
- (4) Streambed at centerline - 840 ±
- (5) Maximum tailwater - unknown

d. Reservoir. Length (feet) of maximum pool - 3,300 ±.

e. Storage (Acre-feet).

- (1) Top of dam - 428 ±
- (2) Principal spillway crest - 203 ±

f. Reservoir Surface (Acres).

- (1) Top of dam - 76 ±
- (2) Principal spillway crest - 38 ±

g. Dam.

- (1) Type - Earthfill
- (2) Length - 900 ft. ±
- (3) Height - 20 ft. ±
- (4) Top width - 9 ft. ±
- (5) Side slopes.
 - (a) Downstream - 3.8H on 1V (measured)
 - (b) Upstream - 4.2H on 1V (measured on exposed slope to the top of riprap)
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - Reported by Jeff Oetting, Mr. Oetting's son, that an earth backfilled cutoff trench was constructed.
- (9) Grout curtain - unknown
- (10) Wave protection - limestone riprap
- (11) Internal drainage system - none

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal

(a) Type - Drop inlet with 72-inch steel diameter riser and 72-inch diameter steel outlet conduit.

(b) Crest (invert) elevation - 856.0 ft.
Outlet - 843.8 ft. ±

(c) Length - 80 ft. ±

(2) Emergency

(a) Type - Vegetated earth cut into the left abutment. The spillway is well vegetated with adapted grasses.

(b) Control section - Broad crested weir located about 75 ft. downstream from the reservoir.

(c) Crest elevation - 858.5 ft.

(d) Upstream channel - Vegetated earth, clean, slope = 3.8% ±.

(e) Downstream channel - Exit channel is well vegetated on slope of 3%+.

j. Regulating Outlets. 12-inch gate valve on a 12-inch cast iron drawdown pipe located about 12 feet upstream from the riser within the 72-inch diameter outlet pipe.

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 Mrs. Ray Oetting that the dam was built in 1972 or 1973. The upstream slope was ripped in 1977.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mrs. Oetting that the emergency spillway has never operated. The reservoir can be and has been drawn down to supply irrigation water for a downstream landowner.

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 Cool Valley Lake Dam was made on June 28, 1979. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R.S. Decker, Geotechnical, Gordon Jamison, Hydrology, and Garold Ulmer, Civil Engineer.
- b. Dam.
 - (1) Geology and Soils (abutment and embankment). This dam is located on gently rolling topography with the uplands mantled with CL-silty clay loess overlying a thick sequence of probable Kansan till. Bedrock is not exposed in the region. Loess-derived colluvium and alluvium mantle the valley sides and bottom. No exposures of glacial till were observed on the site.
 - (2) Upstream Slope. The upstream slope is riprapped with durable limestone. The riprap has a nominal size of 6 to 8 inches and extends to about elevation 856.5 to 857 feet. The slope above the riprap is well vegetated. The upstream slope appears to be adequately protected against erosion. No slides, deformations or significant erosion was observed on the upstream slope. Muskrats have been active on the dam but the owner actively traps these rodents and no rodent holes were observed.
 - (3) Crest. The crest is well vegetated with adapted grasses. No cracks, potholes or deformations were noted.
 - (4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. No cracks, seepage or deformations were observed on the downstream slope or along the toe of the dam.
 - (5) Miscellaneous. Materials in the surface 2 feet of the dam and downstream slope consist of plastic silty clay in the CL-CH borderline area between high and medium plasticity. The borrow area was probably located in the alluvium or colluvium within the present reservoir area. Because of the plastic nature of the soil in the embankment it appears this dam could withstand prolonged overtopping without serious damage.

c. Appurtenant Structures.

- (1) The principal spillway consists of a 72-inch diameter riser connected with a 72-inch diameter outlet conduit. The riser and conduit are heavy riveted boiler plate tubing which appeared to be in good condition. The 72-inch diameter conduit is compressed and deformed into an oval shape with a vertical diameter of 5 ft. + under the maximum section of the dam. This is possibly due to settlement of the embankment. However, no leakage was observed around the rivets in the deformed section. The reservoir level was just below the inlet elevation of the riser when inspected.
- (2) The emergency spillway is a well vegetated earth channel cut through the left abutment. It was reported by Mrs. Oetting that the emergency spillway has never operated. The exit channel parallels the toe of the dam. Spillway flows would not endanger the safety of the dam.
- (3) Drawdown Facilities. A 12-inch diameter cast iron drawdown pipe extends about 25 feet from the spillway riser into the reservoir. The facility is controlled by a 12-inch valve located just inside the riser. The drawdown valve is operable and has been used in the past two years.

d. Reservoir Area. The shoreline is surrounded by pasture. Some minor erosion was noted around the shoreline but it did not appear to be significant. A farm pond impounds the drainage from a southeast tributary and releases directly into the reservoirs.

e. Downstream Channel. The channel downstream from the structure is overgrown with trees and brush.

3.2 EVALUATION

This dam appears to be in generally good to excellent condition. Embankment slopes should provide adequate safety against shear failures for a dam of this height. There is no evidence of seepage on the downstream slope or toe nor any evidence of abnormal deformation. Materials in the dam and the excellent vegetative cover indicate that this dam could withstand significant overtopping without potential of failure. The trees and brush should be cleared from the downstream channel. Periodic inspections, coupled with continued proper maintenance, should be made.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There is a 12-inch diameter drawdown pipe with 12-inch valve installed in this dam. The reservoir can be and has been drawn down to supply irrigation water for use downstream and/or for repairs to the dam. The last drawdown occurred about 2 years ago when the riprap was placed on the upstream slope.

4.2 MAINTENANCE OF DAM

Maintenance of the dam and appurtenances appears to be excellent.

4.3 MAINTENANCE OF OPERATING FACILITIES

Drawdown facilities are operable as required and maintenance appears to be excellent.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

Upon checking with the owner, we are not aware of any warning system in effect for this dam.

4.5 EVALUATION

There does not appear to be any 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. Therefore, 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 Jonesburg, Missouri 7 1/2 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) Principal spillway appeared to be in good condition. Some deformation of the outlet pipe was noted and was probably due to the settlement of the embankment.
 - (2) The emergency spillway is located in the left abutment. The spillway releases flow along the downstream toe of dam but will not endanger the integrity of the dam.
 - (3) The downstream channel appeared to be badly choked with trees and brush.
 - (4) A 12-inch gate valve located in the principal spillway is available to evacuate the pool. It was reported by Jeff Oetting to be operable.
- d. Overtopping Potential. The spillways are too small to pass 50% of the probable maximum flood without overtopping. The spillways will pass 30% of the probable maximum flood without overtopping. The 100-year (1 percent) peak outflow discharge is approximately 42% of the spillway capacity. Materials in this dam and the excellent vegetative cover indicate that the dam could withstand significant overtopping without potential of failure. The results of the routings through the dam are tabulated in regards to the following conditions.

<u>Frequency</u>	<u>Inflow Discharge c.f.s.</u>	<u>Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Freeboard Top of Dam Min. Elev. 860.0</u>	<u>Time Dam Overtopping Hr.</u>
100 Yr.	1,500	180	858.2	+1.8	0
1/2 PMF	3,400	2,500	860.8	-0.8	3+
PMF	6,800	5,600	861.5	-1.5	5+
0.3 PMF	1,900	430	860.0	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. Therefore, the 1/2 PMF to the PMF is the test for the adequacy of the dam and its spillway.

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. This dam appears to be structurally stable. Additional studies would be necessary to determine the effect of overtopping on the structural stability, but it would appear that prolonged overtopping would not impair the stability of the dam.
- 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 operating records for this dam. It was reported by Mrs. Oetting that the reservoir was drawn down 6' to 7' in 1977.
- d. Post Construction Changes. It was reported by Mrs. Oetting that the reservoir was drawn down in 1977 and that the upstream slope was riprapped at that time.
- 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.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

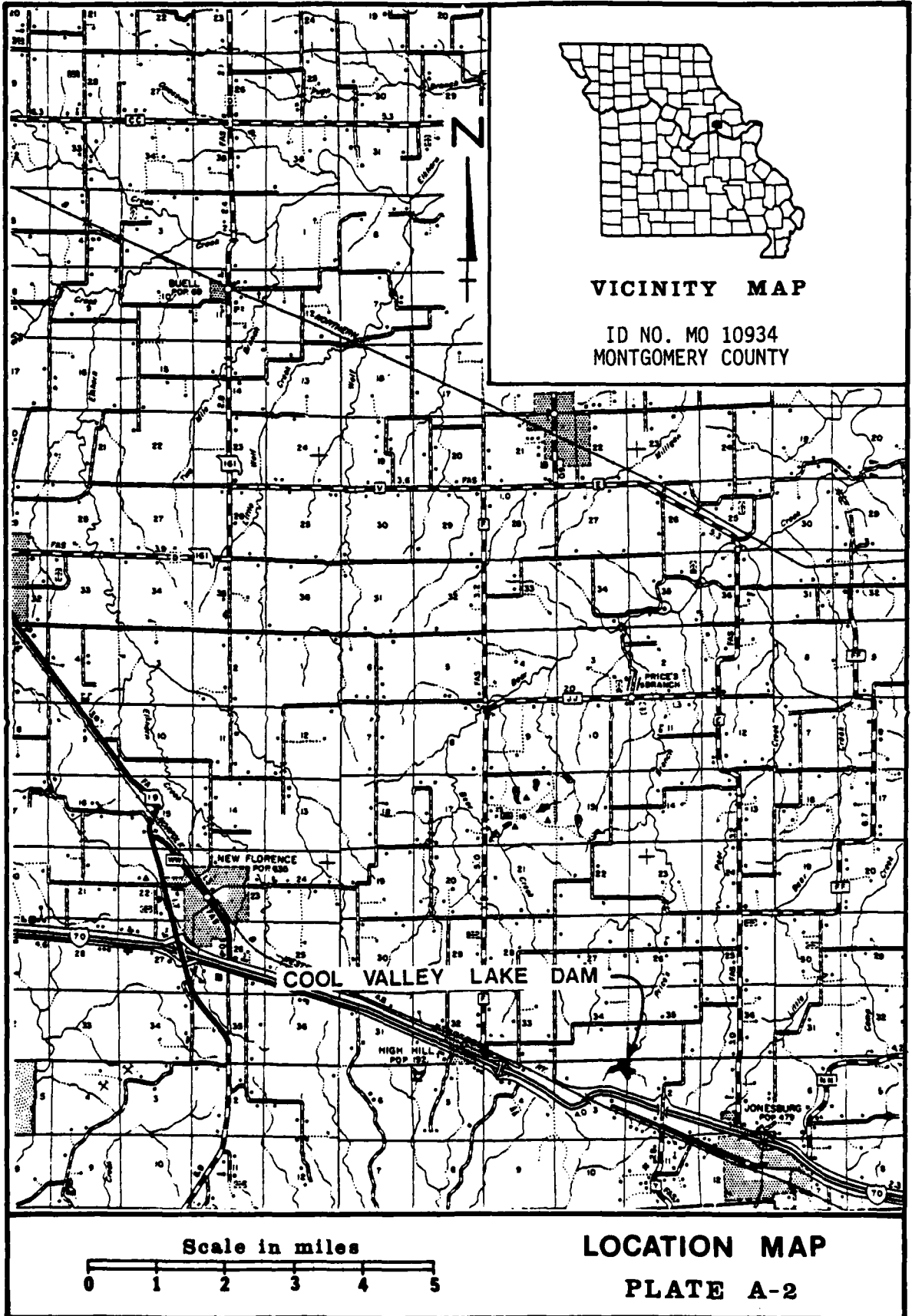
7.1 DAM ASSESSMENT

- a. Safety. There does not appear to be a potential of failure of this dam. The spillways will not pass 50% of the probable maximum flood without overtopping. Additional studies would be required to determine the adverse affects and/or potential of failure from overtopping of this dam.
- 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. The item recommended in paragraph 7.2a 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. An earthquake of this magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

- a. Alternatives. Additional information should be obtained on the topographic characteristics of the reservoir area to determine the increase in the height of dam or the size of the spillway that is necessary to pass one half the Probable Maximum Flood without overtopping the dam. The services of an engineer experienced in the design and construction of dams should be obtained to evaluate the present reservoir storage capacity, to provide seepage and stability and analyses (including earthquake loading) of the present dam, and to design protective measures, if required.
- b. O & M Procedures. Maintenance and operating procedures seem to be adequate for this dam. After cleaning the downstream channel further periodic inspections should be made.

APPENDIX A
MAPS



APPENDIX B
PHOTOGRAPHS

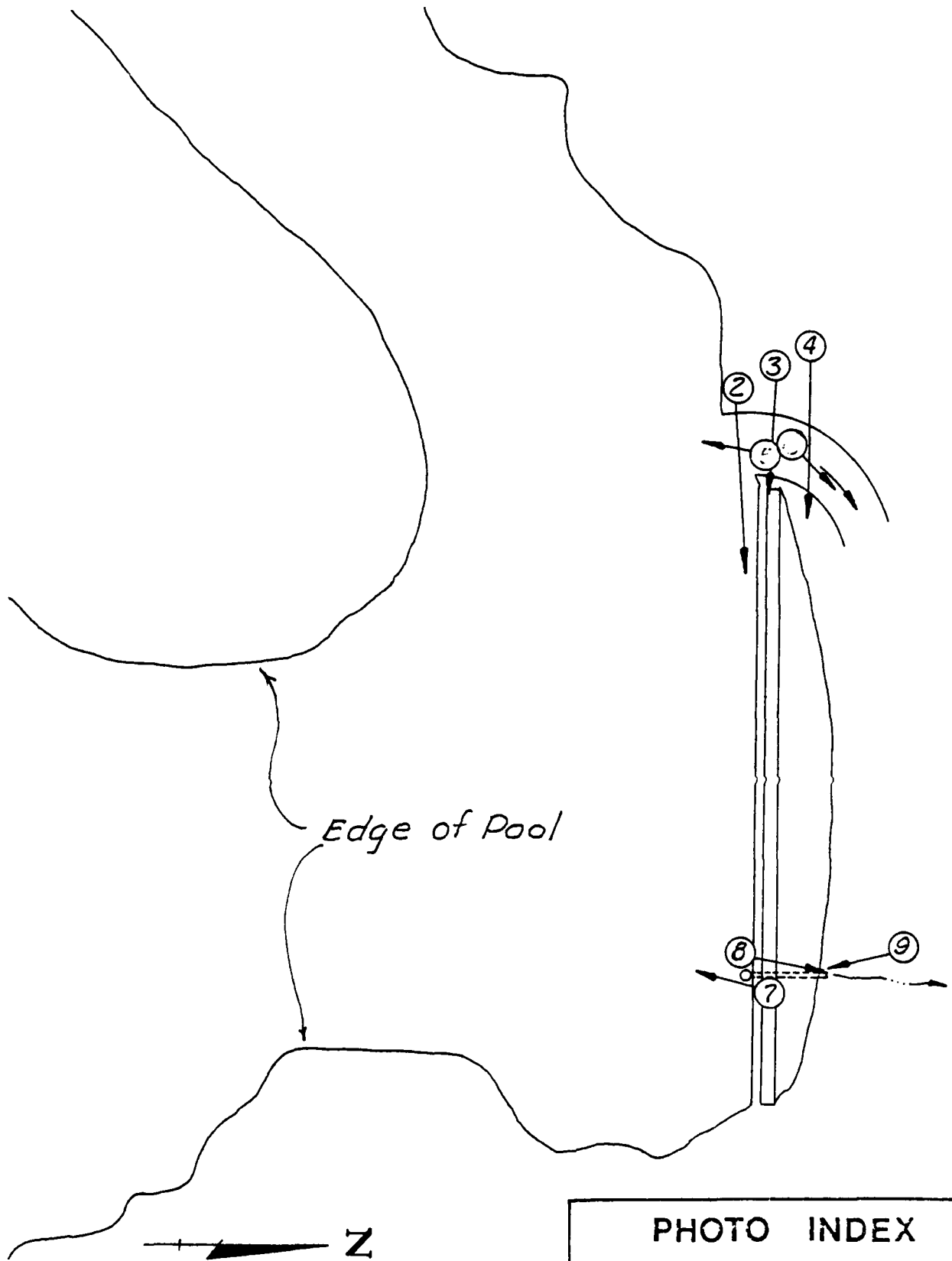


PHOTO INDEX

COOL VALLEY LAKE DAM
 MONTGOMERY COUNTY, MISSOURI

MO. 10934

PLATE B-1



PHOTO NO. 2 - UPSTREAM SLOPE FROM LEFT ABUTMENT

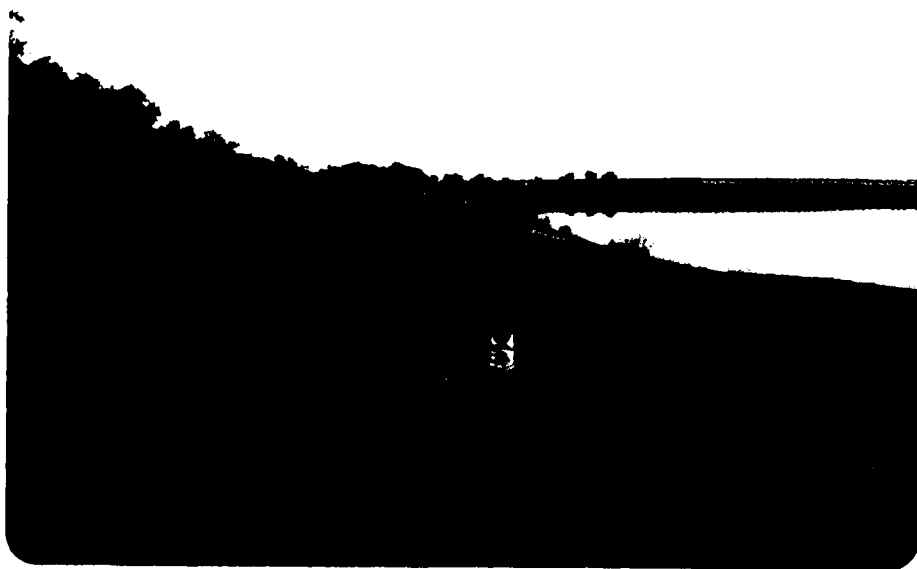


PHOTO NO. 3 - CREST OF DAM



PHOTO NO. 4 - DOWNSTREAM SLOPE FROM LEFT ABUTMENT



PHOTO NO. 5 - LOOKING UPSTREAM IN EMERGENCY SPILLWAY



PHOTO NO. 6 - LOOKING DOWNSTREAM IN EMERGENCY SPILLWAY



PHOTO NO. 7 - PRINCIPAL SPILLWAY RISER

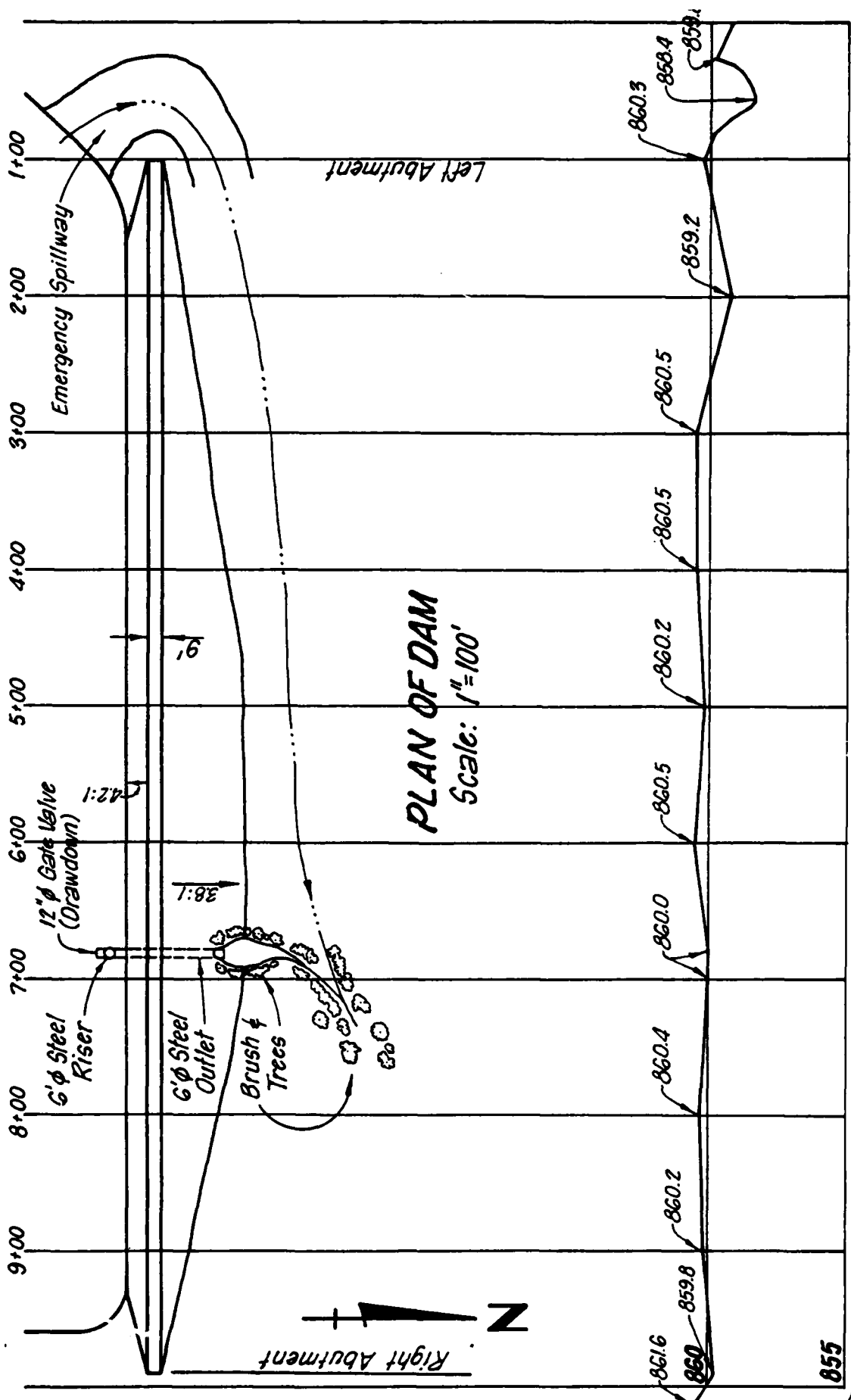


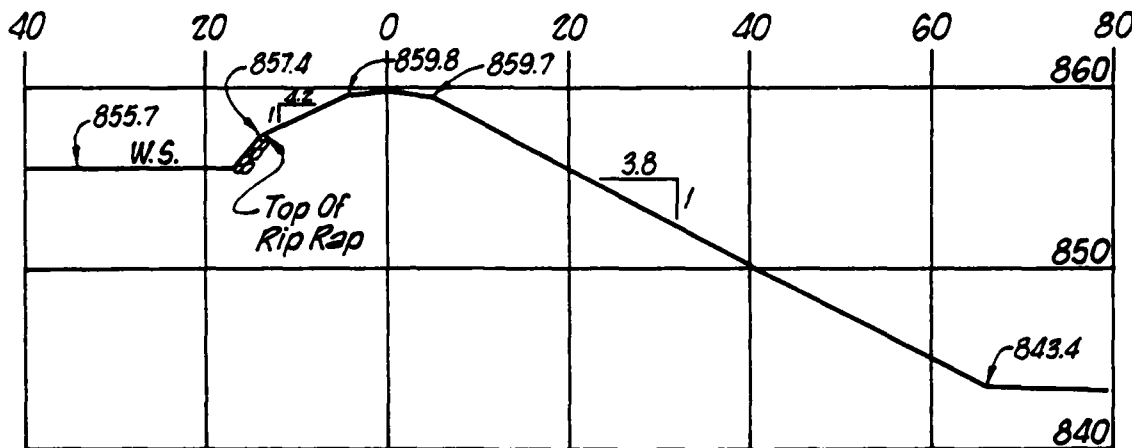
PHOTO NO. 8 - OUTLET OF PRINCIPAL SPILLWAY IN CENTER OF PICTURE



PHOTO NO. 9 - OUTLET END OF PRINCIPAL SPILLWAY

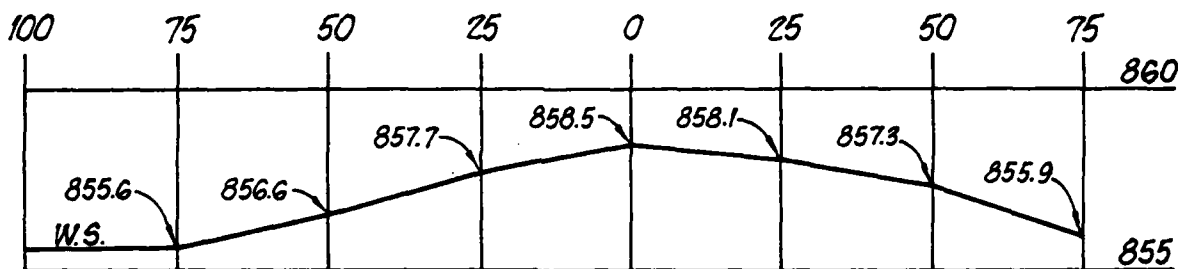
APPENDIX C
PROJECT PLATES





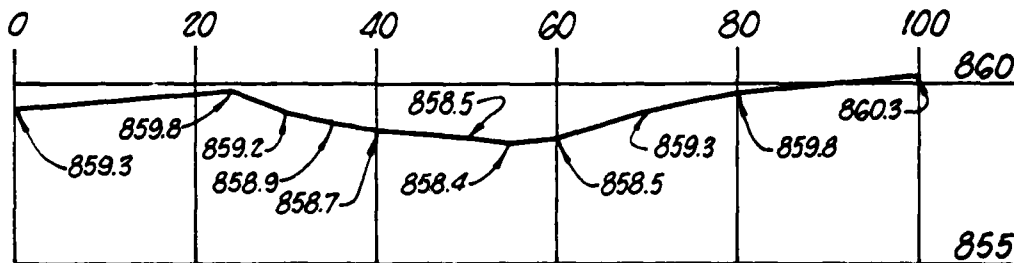
SECTION AT STA. 6+80

Scale: 1" = 20' H.
1" = 10' V.



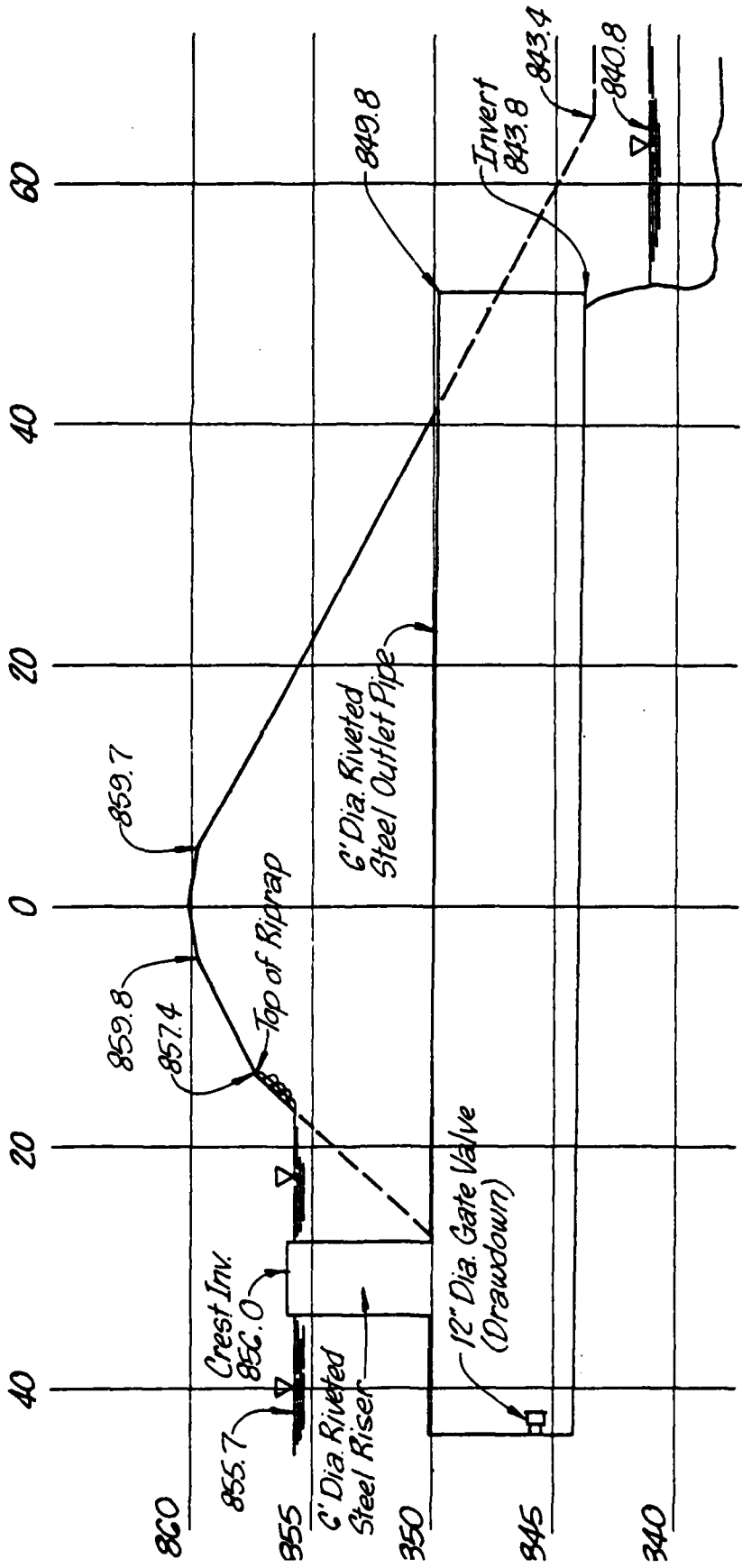
@ PROFILE OF SPILLWAY

Scale: 1" = 30' H.
1" = 5' V.



SPILLWAY SECTION (@ OF DAM)

Scale: 1" = 20' H.
1" = 5' V.



SECTION @ STA. 6+80
SHOWING PRINCIPAL SPILLWAY

Scale: As Shown

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 this section).
 - a. Twenty-four hour, 100-year rainfall for the dam location were taken from the data for the rainfall station at Sullivan, Mo. 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 = 0.811 square miles (519 acres).
 - c. Time of concentration of runoff = 36 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 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 riser.
 - e. The total twenty-four hour storm duration losses for the 100-year storm were 3.09 inches. The total losses for the PMF storm were 1.73 inches. These data are based on SCS runoff curve No. 87 and No. 73 for antecedent moisture conditions, SCS AMC III and AMC II respectively. The watershed is composed of soils from the SCS soil groups C and D (Armster, and Mexico Soils) and consists primarily of pasture with some cropland. The SCS curve numbers were adjusted to reflect the effect of a small dam on the upper portion of the watershed.
 - f. Average soil loss rates = 0.07 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.

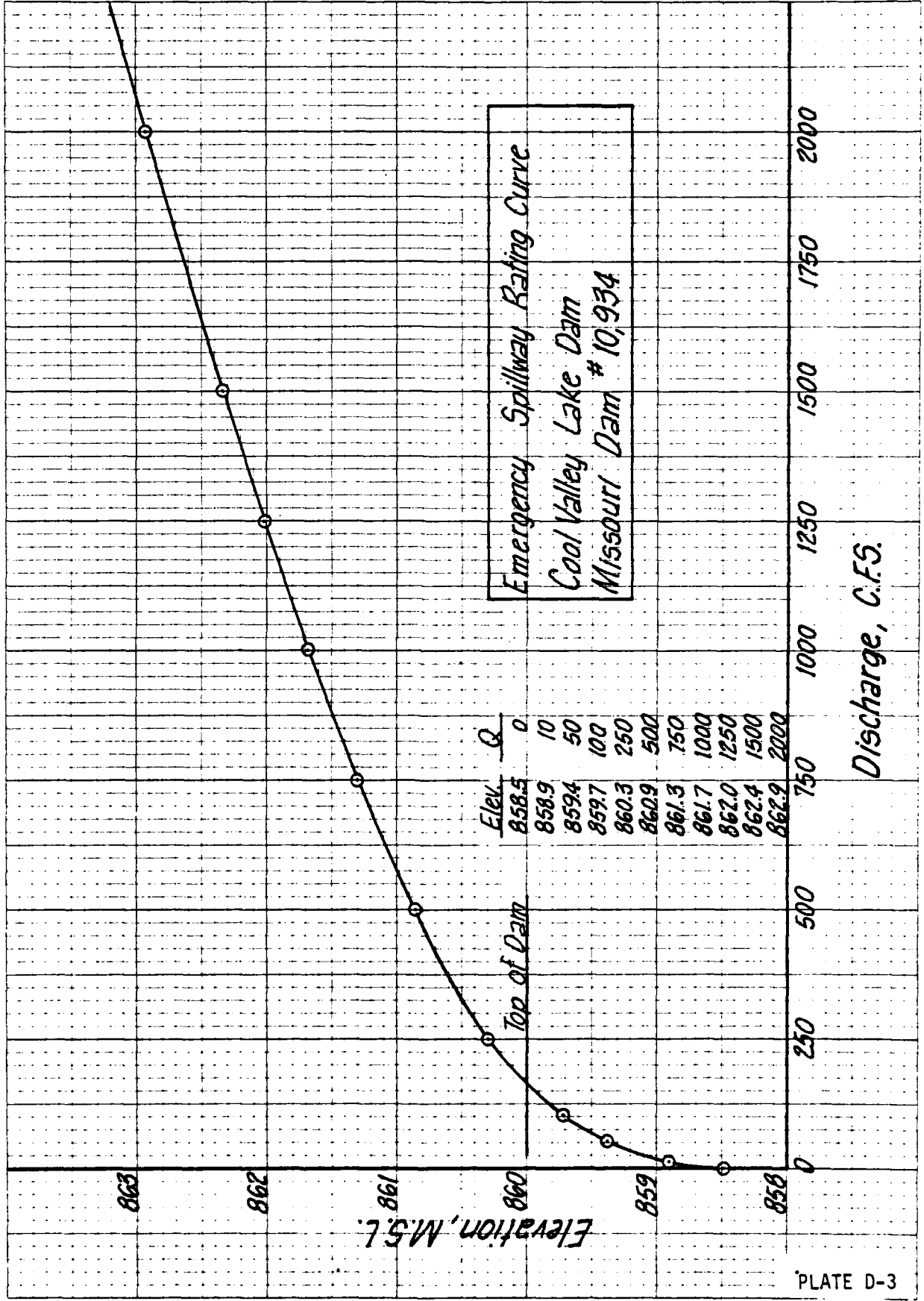
The principal spillway rating was developed using standard weir, orifice, and full conduit flow equations. In determining the rating, it was discovered that the weir and orifice conditions control, whereas the full conduit flow never develops. The weir and orifice equations are as follows:

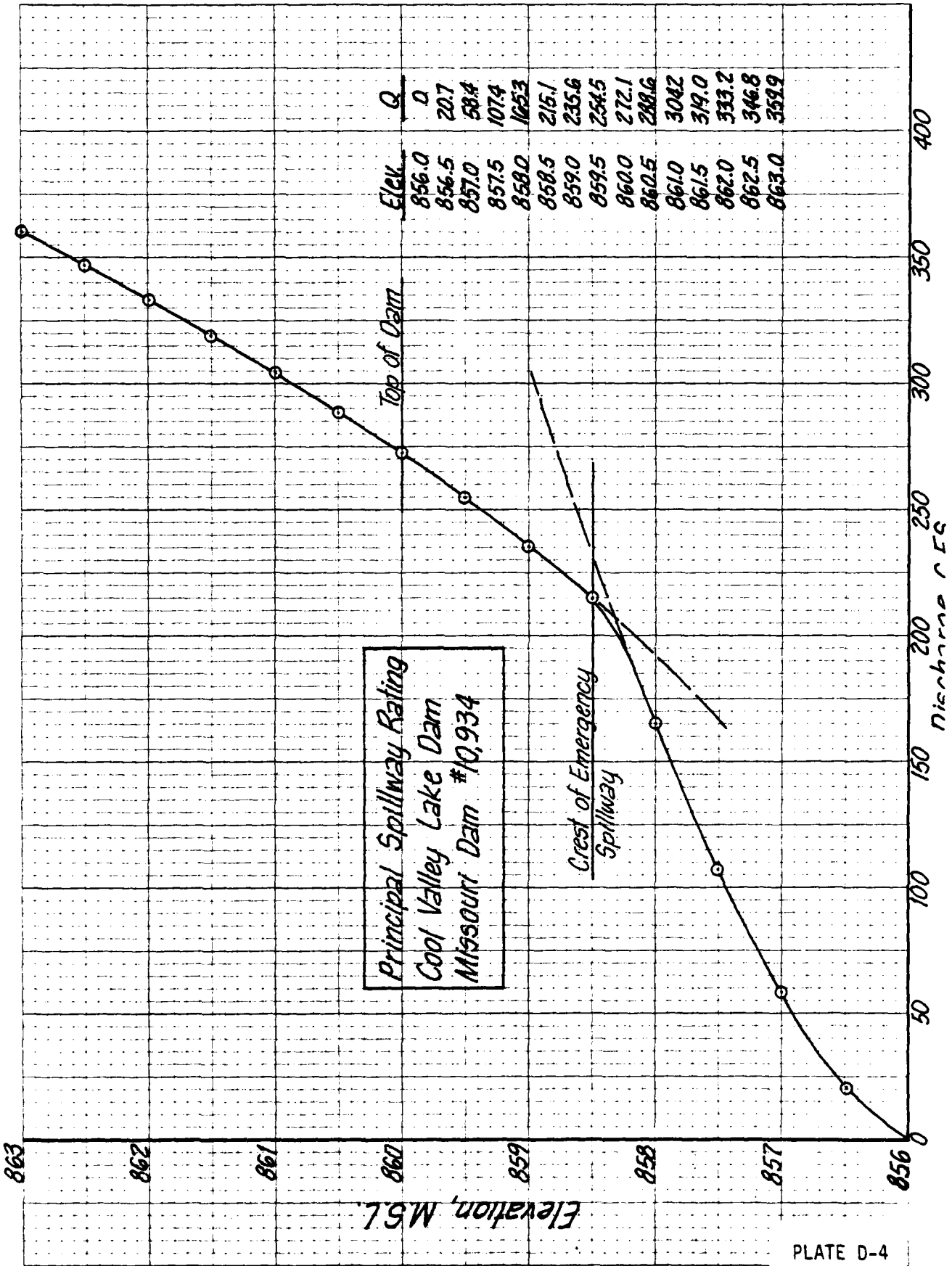
- a. Weir flow equation - $Q = CLH^{3/2}$
where C = weir coefficient = 3.1
L = weir length, ft. = 18.85
H = total head, ft.
- b. Orifice equation - $Q = CA\sqrt{2gh}$
where C = orifice coefficient = 0.6
A = area of riser, sq. ft. = 28.27
h = total head, ft.

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

The flows over the dam were determined by using the dam overtopping analysis within the HEC-1 (Dam Safety Version) program.

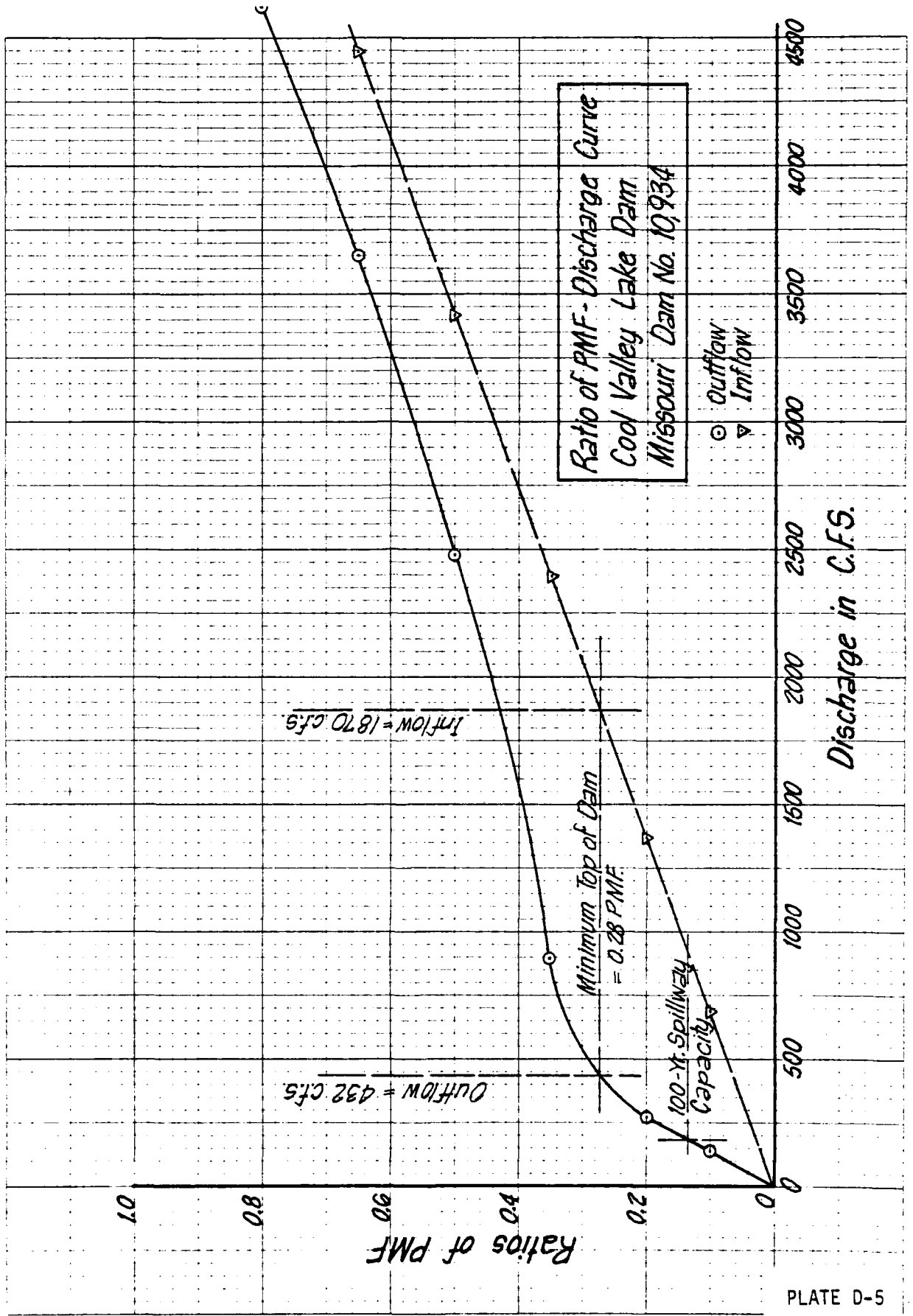
3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The output and plotted hydrographs are attached in this appendix.





Principal Spillway Rating
Cool Valley Lake Dam
Missouri Dam #10,934

Crest of Emergency
Spillway



PMF Output

 FLOOD HYDROGRAPH PACKAGE (HEG-1)
 FOR SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE= 7/27/77
 TIME= 13.26.22

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF COUL VALLEY LAKE DAM-1973/34
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

INQ	NIN	MIN	IOAY	EHK	EMIN	MEIRC	IPRT	IPRT	IPRT	IPRT
208	0	5		0	0	0	0	0	0	0

JOB SPECIFICATION
 JOPER 5
 NWT 0
 LRUPT 0
 TRACE 0

MULTI-PLAN ANALYSIS TO BE PERFORMED
 NPLAN= 1 NRATIO= 7 RATIO= 1

RATIOS= .10 .20 .35 .50 .65 .80 1.00

SUB-AREA RORUFF COMPUTATION

CALCULATION OF TREFLOW HYDROGRAPH TO 16934 RESERVOIR

ESTAG	ICOMP	IFCOPI	IFAPE	JPLT	JPRT	ISAME	ESTAGL	IAUIG
0000.1	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

THYD5	IUNG	TAREA	SWAP	TRSDA	TRSPC	RATIO	ISBOM	ISAME	LOCAL
1	2	.81	0.00	.81	1.00	0.000	0	1	0

PRECIP DATA

SPEE	PHS	R6	R12	R24	R48	R72	R96
0.00	24.89	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LMPT	STKR	DLTKR	RTIOL	FRAIN	SRPK5	PTIOW	SIRL	CRSIL	ALSKR	PLTMP
0	0.00	0.00	1.00	0.00	1.00	-1.00	-07.00	0.00	0.00	0.00

CURVE NO = -87.00 METHOD = -1.00 EFFECT CR = RTAO

UNIT HYDROGRAPH DATA

TC = 0.00 LAG = 0.00

RECESSION DATA

51000 3.00 DRCSPT -0.01 PTYPE 1.00

UNIT HYDROGRAPH 24 HR OF PERIOD OPERATES, TC = 0.00 PTYPE = 1.00

10%	50%	100%	150%	200%
177	84	61	42	23
328	92	67	44	24
105	63	42	23	12

0.5 PMF

STATION 660000, PLAIN 1, RATED 4
END-OF-PERIOD HYDROGRAPH ORDINATES

ORDINATE		STATION 660000, PLAIN 1, RATED 4		END-OF-PERIOD HYDROGRAPH ORDINATES			
Time	Flow	Time	Flow	Time	Flow		
1.	1681.	117.	121.	10.	10.	1.	1.
2.	1489.	130.	130.	11.	11.	2.	2.
3.	933.	147.	147.	12.	12.	3.	3.
4.	68.	16.	16.	13.	13.	4.	4.
5.	60.	20.	20.	14.	14.	5.	5.
6.	57.	27.	27.	15.	15.	6.	6.
7.	77.	45.	45.	16.	16.	7.	7.
8.	92.	60.	60.	17.	17.	8.	8.
9.	117.	77.	77.	18.	18.	9.	9.
10.	130.	92.	92.	19.	19.	10.	10.
11.	187.	117.	117.	20.	20.	11.	11.
12.	236.	147.	147.	21.	21.	12.	12.
13.	315.	177.	177.	22.	22.	13.	13.
14.	406.	217.	217.	23.	23.	14.	14.
15.	347.	241.	241.	24.	24.	15.	15.
16.	295.	260.	260.	25.	25.	16.	16.
17.	261.	274.	274.	26.	26.	17.	17.
18.	245.	282.	282.	27.	27.	18.	18.
19.	231.	291.	291.	28.	28.	19.	19.
20.	203.	306.	306.	29.	29.	20.	20.
21.	203.	318.	318.	30.	30.	21.	21.
22.	203.	326.	326.	31.	31.	22.	22.
23.	203.	336.	336.	32.	32.	23.	23.
24.	203.	346.	346.	33.	33.	24.	24.
25.	203.	356.	356.	34.	34.	25.	25.
26.	203.	366.	366.	35.	35.	26.	26.
27.	203.	376.	376.	36.	36.	27.	27.
28.	203.	386.	386.	37.	37.	28.	28.
29.	203.	396.	396.	38.	38.	29.	29.
30.	203.	406.	406.	39.	39.	30.	30.
31.	203.	416.	416.	40.	40.	31.	31.
32.	203.	426.	426.	41.	41.	32.	32.
33.	203.	436.	436.	42.	42.	33.	33.
34.	203.	446.	446.	43.	43.	34.	34.
35.	203.	456.	456.	44.	44.	35.	35.
36.	203.	466.	466.	45.	45.	36.	36.
37.	203.	476.	476.	46.	46.	37.	37.
38.	203.	486.	486.	47.	47.	38.	38.
39.	203.	496.	496.	48.	48.	39.	39.
40.	203.	506.	506.	49.	49.	40.	40.
41.	203.	516.	516.	50.	50.	41.	41.
42.	203.	526.	526.	51.	51.	42.	42.
43.	203.	536.	536.	52.	52.	43.	43.
44.	203.	546.	546.	53.	53.	44.	44.
45.	203.	556.	556.	54.	54.	45.	45.
46.	203.	566.	566.	55.	55.	46.	46.
47.	203.	576.	576.	56.	56.	47.	47.
48.	203.	586.	586.	57.	57.	48.	48.
49.	203.	596.	596.	58.	58.	49.	49.
50.	203.	606.	606.	59.	59.	50.	50.
51.	203.	616.	616.	60.	60.	51.	51.
52.	203.	626.	626.	61.	61.	52.	52.
53.	203.	636.	636.	62.	62.	53.	53.
54.	203.	646.	646.	63.	63.	54.	54.
55.	203.	656.	656.	64.	64.	55.	55.
56.	203.	666.	666.	65.	65.	56.	56.
57.	203.	676.	676.	66.	66.	57.	57.
58.	203.	686.	686.	67.	67.	58.	58.
59.	203.	696.	696.	68.	68.	59.	59.
60.	203.	706.	706.	69.	69.	60.	60.
61.	203.	716.	716.	70.	70.	61.	61.
62.	203.	726.	726.	71.	71.	62.	62.
63.	203.	736.	736.	72.	72.	63.	63.
64.	203.	746.	746.	73.	73.	64.	64.
65.	203.	756.	756.	74.	74.	65.	65.
66.	203.	766.	766.	75.	75.	66.	66.
67.	203.	776.	776.	76.	76.	67.	67.
68.	203.	786.	786.	77.	77.	68.	68.
69.	203.	796.	796.	78.	78.	69.	69.
70.	203.	806.	806.	79.	79.	70.	70.
71.	203.	816.	816.	80.	80.	71.	71.
72.	203.	826.	826.	81.	81.	72.	72.
73.	203.	836.	836.	82.	82.	73.	73.
74.	203.	846.	846.	83.	83.	74.	74.
75.	203.	856.	856.	84.	84.	75.	75.
76.	203.	866.	866.	85.	85.	76.	76.
77.	203.	876.	876.	86.	86.	77.	77.
78.	203.	886.	886.	87.	87.	78.	78.
79.	203.	896.	896.	88.	88.	79.	79.
80.	203.	906.	906.	89.	89.	80.	80.
81.	203.	916.	916.	90.	90.	81.	81.
82.	203.	926.	926.	91.	91.	82.	82.
83.	203.	936.	936.	92.	92.	83.	83.
84.	203.	946.	946.	93.	93.	84.	84.
85.	203.	956.	956.	94.	94.	85.	85.
86.	203.	966.	966.	95.	95.	86.	86.
87.	203.	976.	976.	96.	96.	87.	87.
88.	203.	986.	986.	97.	97.	88.	88.
89.	203.	996.	996.	98.	98.	89.	89.
90.	203.	1006.	1006.	99.	99.	90.	90.
91.	203.	1016.	1016.	100.	100.	91.	91.
92.	203.	1026.	1026.	101.	101.	92.	92.
93.	203.	1036.	1036.	102.	102.	93.	93.
94.	203.	1046.	1046.	103.	103.	94.	94.
95.	203.	1056.	1056.	104.	104.	95.	95.
96.	203.	1066.	1066.	105.	105.	96.	96.
97.	203.	1076.	1076.	106.	106.	97.	97.
98.	203.	1086.	1086.	107.	107.	98.	98.
99.	203.	1096.	1096.	108.	108.	99.	99.
100.	203.	1106.	1106.	109.	109.	100.	100.
101.	203.	1116.	1116.	110.	110.	101.	101.
102.	203.	1126.	1126.	111.	111.	102.	102.
103.	203.	1136.	1136.	112.	112.	103.	103.
104.	203.	1146.	1146.	113.	113.	104.	104.
105.	203.	1156.	1156.	114.	114.	105.	105.
106.	203.	1166.	1166.	115.	115.	106.	106.
107.	203.	1176.	1176.	116.	116.	107.	107.
108.	203.	1186.	1186.	117.	117.	108.	108.
109.	203.	1196.	1196.	118.	118.	109.	109.
110.	203.	1206.	1206.	119.	119.	110.	110.
111.	203.	1216.	1216.	120.	120.	111.	111.
112.	203.	1226.	1226.	121.	121.	112.	112.
113.	203.	1236.	1236.	122.	122.	113.	113.
114.	203.	1246.	1246.	123.	123.	114.	114.
115.	203.	1256.	1256.	124.	124.	115.	115.
116.	203.	1266.	1266.	125.	125.	116.	116.
117.	203.	1276.	1276.	126.	126.	117.	117.
118.	203.	1286.	1286.	127.	127.	118.	118.
119.	203.	1296.	1296.	128.	128.	119.	119.
120.	203.	1306.	1306.	129.	129.	120.	120.
121.	203.	1316.	1316.	130.	130.	121.	121.
122.	203.	1326.	1326.	131.	131.	122.	122.
123.	203.	1336.	1336.	132.	132.	123.	123.
124.	203.	1346.	1346.	133.	133.	124.	124.
125.	203.	1356.	1356.	134.	134.	125.	125.
126.	203.	1366.	1366.	135.	135.	126.	126.
127.	203.	1376.	1376.	136.	136.	127.	127.
128.	203.	1386.	1386.	137.	137.	128.	128.
129.	203.	1396.	1396.	138.	138.	129.	129.
130.	203.	1406.	1406.	139.	139.	130.	130.
131.	203.	1416.	1416.	140.	140.	131.	131.
132.	203.	1426.	1426.	141.	141.	132.	132.
133.	203.	1436.	1436.	142.	142.	133.	133.
134.	203.	1446.	1446.	143.	143.	134.	134.
135.	203.	1456.	1456.	144.	144.	135.	135.
136.	203.	1466.	1466.	145.	145.	136.	136.
137.	203.	1476.	1476.	146.	146.	137.	137.
138.	203.	1486.	1486.	147.	147.	138.	138.
139.	203.	1496.	1496.	148.	148.	139.	139.
140.	203.	1506.	1506.	149.	149.	140.	140.
141.	203.	1516.	1516.	150.	150.	141.	141.
142.	203.	1526.	1526.	151.	151.	142.	142.
143.	203.	1536.	1536.	152.	152.	143.	143.
144.	203.	1546.	1546.	153.	153.	144.	144.
145.	203.	1556.	1556.	154.	154.	145.	145.
146.	203.	1566.	1566.	155.	155.	146.	146.
147.	203.	1576.	1576.	156.	156.	147.	147.
148.	203.	1586.	1586.	157.	157.	148.	148.
149.	203.	1596.	1596.	158.	158.	149.	149.
150.	203.	1606.	1606.	159.	159.	150.	150.
151.	203.	1616.	1616.	160.	160.	151.	151.
152.	203.	1626.	1626.	161.	161.	152.	152.
153.	203.	1636.	1636.	162.	162.	153.	153.
154.	203.	1646.	1646.	163.	163.	154.	154.
155.	203.	1656.	1656.	164.	164.	155.	155.
156.	203.	1666.	1666.	165.	165.	156.	156.
157.	203.	1676.	1676.	166.	166.	157.	157.
158.	203.	1686.	1686.	167.	167.	158.	158.
159.	203.	1696.	1696.	168.	168.	159.	159.
160.	203.	1706.	1706.	169.	169.	160.	160.
161.	203.	1716.	1716.	170.	170.	161.	161.
162.	203.	1726.	1726.	171.	171.	162.	162.
163.	203.	1736.	1736.	172.	172.	163.	163.
164.	203.	1746.	1746.	173.	173.	164.	164.
165.	203.	1756.	1756.	174.	174.	165.	165.
166.	203.	1766.	1766.	175.	175.	166.	166.
167.	203.	1776.	1776.	176.	176.	167.	167.
168.	203.	1786.	1786.	177.	177.	168.	168.
169.	203.	1796.	1796.	178.	178.	169.	169.
170.	203.	1806.	1806.	179.	179.	170.	170.
171.	203.	1816.	1816.	180.	180.	171.	171.
172.	203.	1826.	1826.	181.	181.	172.	172.
173.	203.	1836.	1836.	182.	182.	173.	173.
174.	203.	1846.	1846.	183.	183.	174.	174.
175.	203.	1856.	1856.	184.	184.	175.	175.
176.	203.	1866.	1866.	185.	185.	176.	176.
177.	203.	1876.	1876.	186.	186.	177.	177.
178.	203.	1886.	1886.	187.	187.	178.	178.
179.	203.	1896.	1896.	188.	188.	179.	179.
180.	203.	1906.	1906.	189.	189.</		

STAT LUNOOGUz

	0.	400.	800.	1200.	1600.	2000.	2400.	2800.	3200.	3600.	4000.
805 11											
810 21											
815 31											
820 41											
825 51											
835 61											
845 71											
850 81											
855 91											
850 101											
855 111											
1800 121											
1805 131											
1810 141											
1815 151											
1820 161											
1825 171											
1830 181											
1835 191											
1840 201											
1845 211											
1850 221											
1855 231											
2800 241											
2805 251											
2810 261											
2815 271											
2820 281											
2825 291											
2830 301											
2835 311											
2840 321											
2845 331											
2850 341											
2855 351											
3800 361											
3805 371											
3810 381											
3815 391											
3820 401											
3825 411											
3830 421											
3835 431											
3840 441											
3845 451											
3850 461											
3855 471											
4800 481											
4805 491											
4810 501											
4815 511											
4820 521											
4825 531											
4830 541											
4835 551											
4840 561											

NOTE*

21.15243.1	U
21.20244.1	U
21.25245.1	U
22.30246.1	U
21.35247.1	U
21.40248.1	U
21.45249.1	U
21.50250.1	U
21.55251.1	U
21.60252.1	U
21.65253.1	U
21.70254.1	U
21.75255.1	U
21.80256.1	U
21.85257.1	U
21.90258.1	U
21.95259.1	U
21.40260.1	U
21.45261.1	U
21.50262.1	U
21.55263.1	U
22.00264.1	U
22.05265.1	U
22.10266.1	U
22.15267.1	U
22.20268.1	U
22.25269.1	U
22.30270.1	U
22.35271.1	U
22.40272.1	U
22.45273.1	U
22.50274.1	U
22.55275.1	U
23.00276.1	U
23.05277.1	U
23.10278.1	U
23.15279.1	U
23.20280.1	U
23.25281.1	U
23.30282.1	U
23.35283.1	U
23.40284.1	U
23.45285.1	U
23.50286.1	U
23.55287.1	U
23.60288.1	U

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS						
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7
				.10	.20	.35	.50	.65	.80	1.00
HYDROGRAPH AT	000001	.81 2.101	1	684. 19.361	1368. 38.731	2393. 67.771	3419. 96.821	4445. 125.861	5471. 154.911	6818. 193.641
MINUTED TO	000002	.81 2.101	1	141. 4.001	268. 7.581	896. 25.371	2474. 70.051	3651. 103.391	4613. 130.631	5055. 165.811

SUMMARY OF DAM SAFETY ANALYSIS

PLAN I
 ELEVATION
 STORAGE
 OUTFLOW
 INITIAL VALUE
 SPILLWAY CREST
 TOP OF DAM
 856.00 860.00
 203. 428.
 0. 432.

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
.10	857.79	0.00	285.	141.	0.00	18.08	0.00
.20	859.12	0.00	365.	268.	0.00	18.17	0.00
.35	860.27	.27	448.	896.	2.52	16.58	0.00
.50	860.75	.75	488.	2414.	3.25	16.17	0.00
.65	861.02	1.02	509.	3671.	4.17	16.08	0.00
.80	861.22	1.22	525.	4613.	4.92	16.08	0.00
1.00	861.46	1.46	545.	5855.	5.58	16.08	0.00

DATE
FILMED
—8