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NATIONAL DAM SAFETY PROGRAM. LAKE HARMONY DAM (MO 30612), LOWER--ETC(U)
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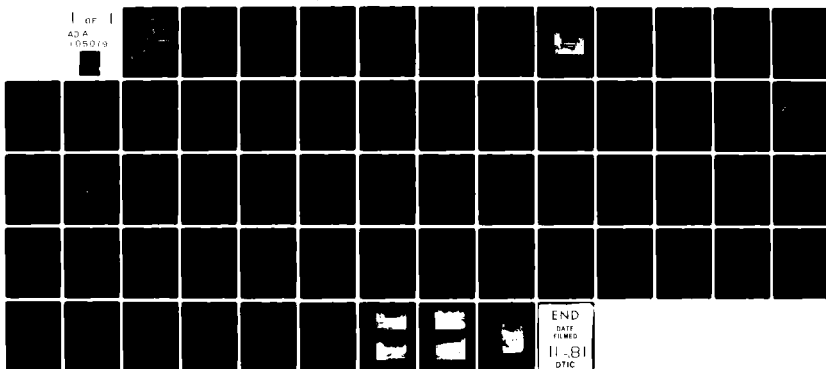
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LAKE HARMONY DAM

MADISON COUNTY, MISSOURI

MO 30612

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PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION.

Lake Harmony Dam (MO 30612),
Lower Mississippi - St. Francis Basin,
Madison County, Missouri. Phase I Inspection
Report.



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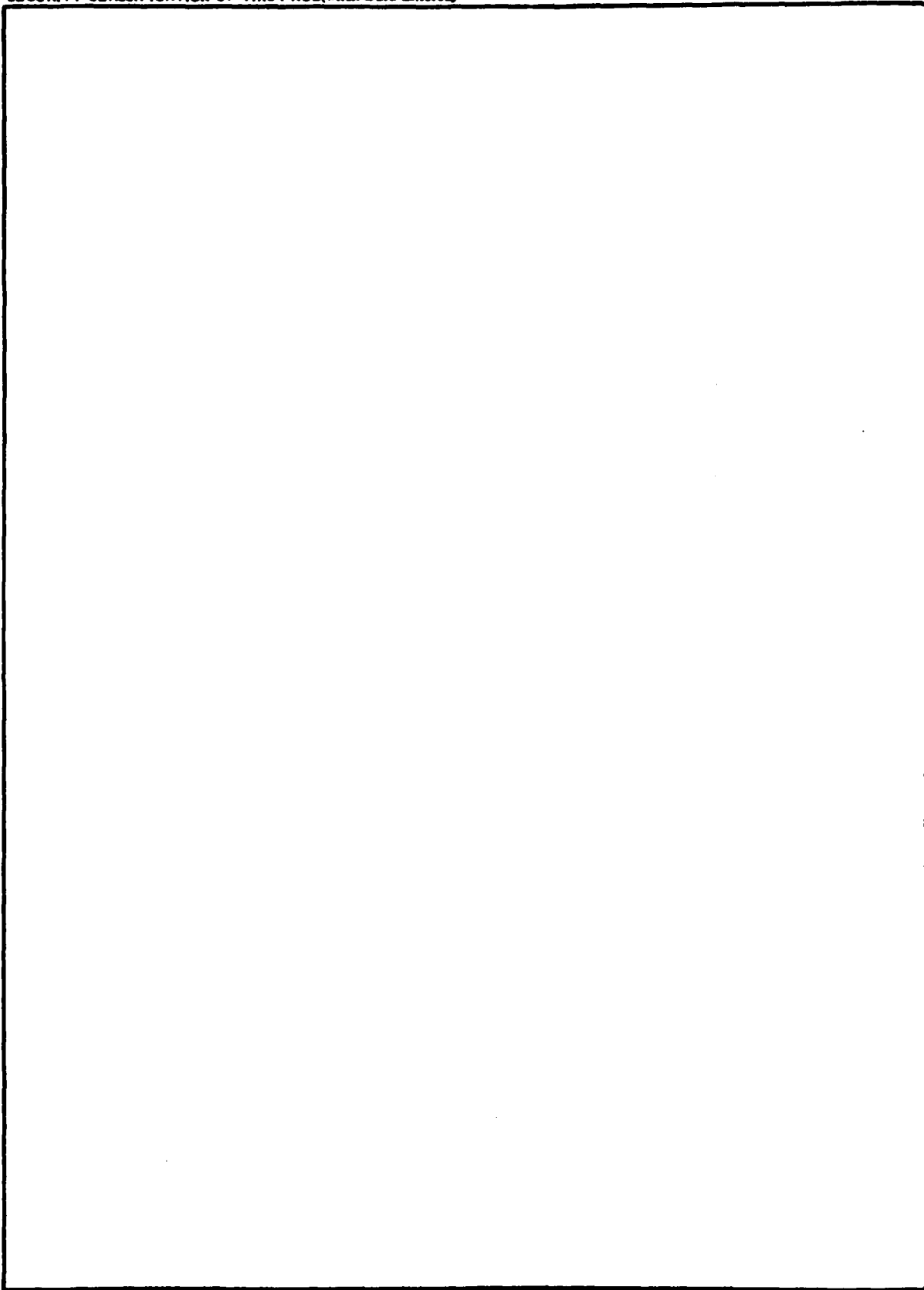
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based 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 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

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SUBJECT: Lake Harmony Dam Phase I Inspection Report

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This report presents the results of field inspection and evaluation of the Lake Harmony Dam (MO. 30612).

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

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

- a. Spillway will not pass 10-year frequency flood without overtopping of the dam. The spillway is, therefore, considered to be unusually small and seriously inadequate.
- b. Overtopping could result in dam failure.
- c. Dam failure significantly increases the hazard to life and property downstream.

Submitted by: SIGNED 14 APR 1980
Chief, Engineering Division Date

Approved by: SIGNED 14 APR 1980
Colonel, CE, District Engineer Date

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM	Lake Harmony Dam
STATE LOCATED	Missouri
COUNTY LOCATED	Madison
STREAM	Unnamed tributary to Little St. Francis River
DATE OF INSPECTION	September 5, 1979

Lake Harmony Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high-hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The dam is in the small size classification since it has a storage capacity greater than 50 acre-feet. The downstream damage zone extends for nine miles downstream of the dam. Within this estimated damage zone is two dwellings and several buildings, a railroad line, several highways and bridges and the Fredericktown City Water Dam.

Based on the downstream affected area the Spillway Design Flood for this dam is the PMF (Probable Maximum Flood). The spillway is capable of controlling approximately 6% of the PMF without overtopping the embankment. In addition, the spillway can not control the 10 year storm or the 100 year storm. The spillway is considered seriously inadequate.

Deficiencies visually observed for Lake Harmony Dam were no riprap on the upstream slope, seepage through the concrete portion of the dam and at the base of the concrete and vegetation (trees) growing on the upstream, downstream and crest of the dam. There is no warning system in effect or a safety inspection program. Stability and seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not available which is considered a deficiency. These deficiencies should be remedied at the direction of a professional engineer knowledgeable in the design and construction of concrete and earthfill dams.

LAKE HARMONY DAM - MO. 30612

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Photograph No. 1

Overview of crest and upstream slope.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE HARMONY DAM - I.D. NO. 30612

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 Lake Harmony Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. Lake Harmony Dam is a combination concrete and earthfill dam. The concrete portion of the dam is approximately 16 feet high and is exposed on the downstream slope of the dam. The upper 5 feet of the dam is formed by an earth embankment, apparently due to raising the dam. The downstream portion of the slope varies from section to section but averages approximately 1H:1V. The upstream slope ranges from 1H:1V to 1.5H:1V. The crest width is approximately 6 feet. The dam is approximately 21 feet high and 524 feet long. The left abutment of the dam is formed by a roadway which is apparently on natural ground. Beyond the road (south) is an open strip mine or gravel pit.

The open cut spillway is located on the right abutment. The spillway exit channel flows along the downstream toe of the dam to the maximum section where it turns downstream (southwest).

A 6" and an 18" siphon are located on the embankment and downstream slope and is used to lower the reservoir.

b. Location. Lake Harmony Dam is located approximately 1 mile southwest of Mine LaMotte, Missouri, on an unnamed tributary to the Little St. Francois River. The dam can be located (Section 30, Township 34 North, Range 7 East) on the Fredericktown, Missouri 15 minute U.S.G.S. quadrangle.

c. Size Classification. Lake Harmony Dam is a small size structure (21 feet high, 343 acre-feet).

d. Hazard Classification. Lake Harmony Dam is a high hazard dam. Downstream conditions indicate that loss of life is probable should failure of the dam occur. The estimated damage zone downstream of the dam is approximately nine miles. Within this damage zone is two dwellings, several buildings, several highways and bridges and the Fredericktown City Water Dam.

e. Ownership. Lake Harmony Dam is owned by the Lake Harmony Property Owners Association, Inc.. Correspondence should be addressed to:

Mr. Darrell Mitchell
113 North Street
Farmington, Missouri 63640
314-756-5202

f. Purpose of Dam. Lake Harmony Dam is used for recreation.

g. Design and Construction History. Based on interviews with the owner Lake Harmony Dam, originally called Mine LaMotte Lake, was reportedly built 100 years ago. The present owner bought the dam in December, 1978. The dam was formerly owned by St. Joe Mineral Company. The present owner and St. Joe Mineral Company were contacted to obtain design information. No design drawings, reports or construction history was available and is assumed not to exist.

h. Normal Operating Procedures. No normal operations are conducted at the dam. However, periodically the siphons are used to lower the lake level. Excess inflow normally discharges over the spillway crest.

1.3 PERTINENT DATA

a. Drainage Area.

Lake Harmony (direct contributing)	3.4 square miles
	U.S.G.S. quadrangle
Lake LaMotte (upstream dam)	0.9 square miles
	U.S.G.S. quadrangle

b. Discharge at Damsite (cfs).

(1) Maximum known flood at dam site	Unknown
(2) Spillway capacity at top of dam	940
(3) Drainlines	None

c. Elevation (feet) - Field survey based on spillway elevation 778 shown on U.S.G.S. quadrangle.

(1) Top of dam	781
(2) Spillway crest	778
(3) Normal pool	778
(4) Maximum pool (PMF)	786.9
(5) Tailwater on day of inspection	None
(6) Streambed at centerline of dam	760.0

d. Reservoir (feet).

(1) Length of maximum pool	4000
(2) Length of normal pool	3000

e. Storage (acre-feet).

(1) Top of dam	343
(2) Spillway crest	185
(3) Normal pool	185
(4) Maximum pool (PMF)	814

f. Reservoir Surface (acres).

(1) Top of dam	65
(2) Spillway crest	37
(3) Normal pool	37
(4) Maximum pool (PMF)	98

g. Dam.

(1) Type	Concrete and earthfill
(2) Length	524 feet
(3) Height	21 feet
(4) Top width	6 feet
(5) Side slopes	Upstream - 1H:1V to 1.5H:1V Downstream - average 1H:1V
(6) Zoning	Unknown
(7) Grout curtain	Unknown
(8) Cutoff	Unknown

h. Spillway.

(1) Type	Earthen-trapezoidal
(2) Length (bottom)	57 feet
(3) Crest elevation	778 feet
(4) Upstream channel	Lake
(5) Downstream channel	narrow confined

i. Siphons.

(1) Size	6" and 18"
(2) Type	Have to be primed
(3) Discharge	at toe of dam

SECTION 2 - ENGINEERING DATA

2.1 DESIGN. No design drawings, reports or data are known to exist.

2.2 CONSTRUCTION. Based on interviews with the owner and the former owner it is reported that the dam was constructed approximately 100 years ago. No information exists on the construction of the dam.

2.3 OPERATION. No operating records exist.

2.4 EVALUATION.

a. Availability. There are no engineering data available.

b. Adequacy. The field surveys and visual inspection presented herein are considered adequate to support the conclusion 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. The onsite inspection of Lake Harmony Dam was conducted by personnel of L. Robert Kimball and Associates on September 5, 1979. The inspection team consisted of a hydrologist, structural/soils engineer and a geologist. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments, and toe.
2. Examination of the spillway facilities, exposed portions of any outlet works, and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.

b. Project Geology. Lake Harmony and its dam are underlain by rocks of the Cambrian aged LaMotte formation. This formation is primarily a quartzose sandstone that may grade laterally into arkose or conglomerate. The sandstone, which may be yellow, gray, brown or red, often attains thicknesses of up to 500 feet and usually overlies the Precambrian basement rocks. The only exposure in the vicinity of the dam was in the spillway itself. This showed a buff colored sandstone with some jointing indicated. The beds were about one foot in thickness.

The area around Lake Harmony has experienced extensive faulting in the past. The lake itself lies on an upthrown block on the west side of the Mine LaMotte faults. These northwest trending faults have a displacement of about 100 feet, causing the LaMotte sandstone to be brought against the Bonnetterre formation. These faults are believed to be part of the Doe Run - Higdon fault system which is, in turn, part of the Simms Mountain fault system.

c. Dam and Spillway. The visual inspection of the dam indicated that the structure was in fair condition. From a brief survey conducted during the inspection, it was determined that a low spot was present on the crest of the dam at the junction of the left abutment where the roadway comes in contact with the embankment. The downstream slope was measured to be approximately 1H:1V. The bottom portion of the downstream slope is formed by a concrete wall or concrete gravity section (extent and configuration unknown). This concrete section is approximately 16 feet high. It appears that the original dam was a concrete dam but has since has been raised 5 feet by placing an earth embankment over the concrete portion. This earth embank-

ment is approximately 5 feet high. The dimensions of the embankment are unknown since no drawings are available and the owner did not provide additional information. Seepage is exiting from the concrete wall and at the base of the wall. The seepage was estimated at approximately 5 gallons per minute. This seepage is exiting from a wide area. Because of the heavy vegetation in this area close examination was not possible. It appears that the seepage is exiting at the concrete/rock contact, through the rock and through the uncracked wall. The upstream slope of the embankment ranged from 1.5H:1V to 1H:1V. The crest width is narrow and averages 6 feet. The upstream slope, the downstream slope and the crest are covered with numerous small and large trees. Visible examination revealed that the embankment consists of a clayey sand with rock fragments.

The spillway is located on the right abutment and is formed by an open cut, trapezoidal shape. The bottom of the spillway is 57 feet long and cut in rock. The spillway exit channel bottom is formed by bedrock and extends along the toe of the dam to the maximum section of the dam where it turns to the southwest and flows into the unnamed tributary of the St. Francois River.

A 6" and an 18" steel siphon has been installed in the dam at the maximum section to lower the reservoir level. These siphons are not automatic and have to be primed.

Beyond the road which is located on the left abutment is a strip mine pit. The bottom of the strip mine pit (lead mine) is lower than the bottom of the reservoir. No seepage from the reservoir into the pit was observed.

d. Drainlines. The siphons are located at the maximum section of the dam. According to the owner the siphons can lower the water level approximately 6 feet.

e. Reservoir Area. No pertinent problems were noted in the reservoir area. The watershed is moderately flat. Approximately 2 miles upstream of Lake Harmony is Mine LaMotte Dam.

f. Downstream Channel. The unnamed tributary to the St. Francois River is narrow and confined.

3.2 EVALUATION. The visual inspection revealed that the dam appears to be in fair condition. The concrete portion appeared to be in fair condition with seepage exiting through portions of the concrete and at the base. No major cracks were noted in the concrete. The earth embankment portions of the dam also appear to be in fair condition.

Complete evaluation of the structure cannot be made without a detailed stability, stress or seepage analysis.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES. The reservoir is maintained at the spillway crest elevation. Excess inflow discharges over the spillway crest. Periodically (once each year) the owner operates the siphon to partially lower the reservoir.

4.2 MAINTENANCE OF DAM. No maintenance of the dam is conducted.

4.3 MAINTENANCE OF OPERATING FACILITIES. The operating facilities are not maintained.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT. Upon checking with the owner, the inspection team is unaware of any warning system in effect.

4.5 EVALUATION. Maintenance of the dam and operating facilities are considered poor. There is no warning system in effect to warn downstream residences of large spillway discharges or failure of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. There are no hydraulic or hydrological design data available as discussed in Section 2.

b. Experience Data. The drainage area was developed using the U.S.G.S. quadrangle sheet. The lake surface area was determined by planimetering the quadrangle sheet. Surface area -elevations were determined by planimetering various contour lines within the drainage area on the U.S.G.S. quadrangle sheets. The spillway and dam layout was made from surveys conducted from the inspection. Despite no record of reservoir water levels, there is no history of the dam being overtopped. However, it is unknown when the dam was raised the additional 5 feet and no information is available on the geometry and condition of the concrete portion of the dam. The dam may have been originally a concrete dam with a full overflow section.

c. Visual Observations. The low point on the dam located at the left abutment was used as the top of dam elevation. Upstream of Lake Harmony Dam is Mine LaMotte Dam which controls part of the contributing drainage area of Lake Harmony Dam.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, St. Louis District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydraulic Engineering Center (HEC) U.S. Army Corp of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed in Appendix B.

To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions:

1. The top of dam was considered to be elevation 781.0.
2. No flow through the siphons was considered.
3. The flood was routed through Mine LaMotte Dam.
4. Failure of Mine LaMotte Dam was not considered.

Complete summary sheets for the computer output are presented in Appendix B. To facilitate review, the major results of the overtopping analysis are presented below:

Peak inflow	31,400 cfs
Spillway capacity	940 cfs

Ratio of PMF	Maximum Reservoir Water Surface	Maximum Depth over Dam (embankment)	Maximum Outflow, of over- cfs	Duration of over- topping, hours
.10	781.91	.91	1557	3.00
.50	785.04	4.04	14466	9.33
1.00	786.91	5.91	30185	14.83

The Corps of Engineers Spillway Design Flood for a high hazard-small dam is 1/2 PMF to the PMF. Based on the downstream hazard exposure, the Spillway Design Flood for this dam has been selected to be the PMF. The spillway is capable of controlling approximately 6% of the PMF without overtopping the embankment. Overtopping of the embankment for an extended period of time will cause failure of the dam. Overtopping of the embankment for an extended period of time will cause failure of the dam.

Because of the low spillway capacity the 10 year storm was routed through the reservoir. The parameters for the 10 year storm were obtained from the St. Louis District Corps of Engineers. Based on parameters provided by the St. Louis District, Corps of Engineers, the spillway cannot control the 10 year storm. Past history may not be applicable since the dam was raised 5 feet and the spillway has been modified. The dam cannot control the 100 year storm.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations did not reveal any signs of immediate instability. The embankment portion of the dam appeared to be in fair condition. No slumps, major erosion areas or seepage was noted on the earth embankment portions of the dam. However, most of the earth embankment portion of the dam is above a normal water level. The concrete portion of the dam appeared to be in fair condition. No major cracks were noted. Seepage was found exiting through the concrete with most of the seepage exiting at the base of the concrete.

b. Design and Construction Data. No design or construction data is available on the dam. The dimensions of the dam cross section in particular the concrete portion of the dam are unknown. No testing of the concrete and earth embankment has been performed. Stability and seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspections of Dams" were not available, which is considered a deficiency.

c. Operating Records. No operating records are kept on the structure.

d. Post Construction Changes. The post construction changes for this structure have not been documented. The dam had been raised approximately 5 feet at an unknown date.

e. Seismic Stability. The dam is located in seismic zone 2 to which the guidelines assign a "moderate" damage potential. No seismic stability analysis has been conducted.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The visual observations, review of available data and hydrologic calculations indicate that Lake Harmony Dam's spillway is seriously inadequate. The spillway is capable of controlling approximately 6% of the PMF without overtopping the embankment. In addition, the spillway can not control the 10 year storm or the 100 year storm.

The earth embankment portion of the dam and the concrete portion of the dam both appeared to be in fair condition. Seepage was exiting through the concrete, through the rock and at the concrete/rock contact. The long term effect of the seepage and the extent of deterioration and weakening of the concrete is unknown. The concrete in the dam will deteriorate with age and should be analyzed in periodic intervals. Because of the lack of design and construction data the dimensions of the dam and concrete are unknown. Stability, stress and seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspections of Dams" were not available, which is considered a deficiency. Operation of the siphons was not conducted during the inspection. Removal of the trees on the slopes and the erosive nature of the clayey sand soils in the embankment requires that riprap should be provided on the upstream slope.

b. Adequacy of Information. Complete assessment of the structural stability of the structure cannot be made because of the limited design data and construction data. Stability and seepage analyses comparable to the requirement of the "Recommended Guidelines for Safety Inspections of Dams" were not available, which is considered a deficiency.

c. Urgency. The deficiencies described herein are serious and corrective actions listed in 7.2.b should be initiated on a high priority basis. Special note should be made of items in paragraph 7.2.a and these recommendations should be pursued immediately.

d. Need for Phase II. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required. However, a Phase II investigation is not required.

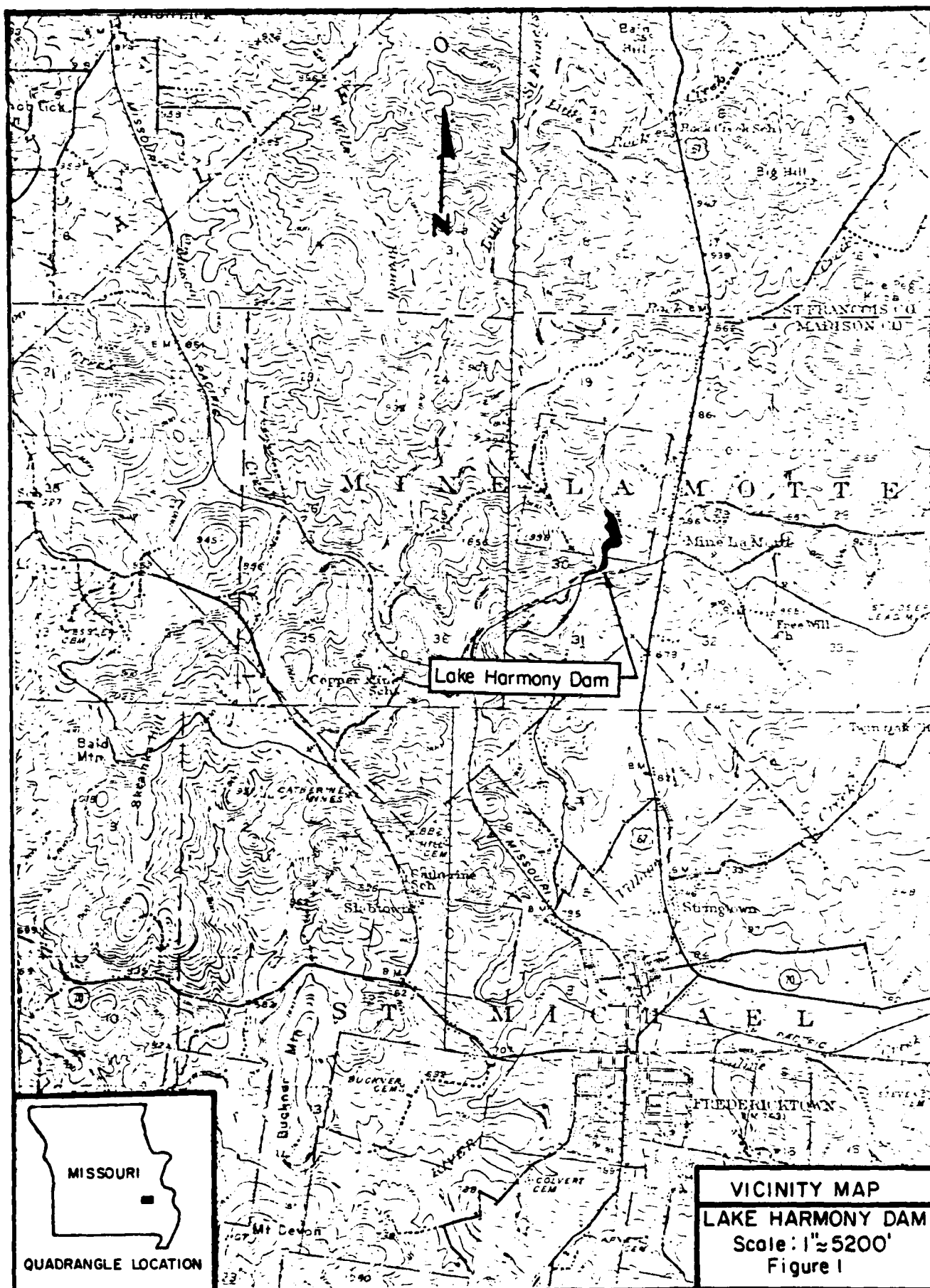
7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives. A detailed hydraulic and hydrology study should be conducted by a registered professional engineer knowledgeable in dam design to increase the spillway capacity. The study should begin immediately and remedial modifications begun immediately after the study is complete.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures and followup actions are recommended:

1. Stability, stress and seepage analyses should be conducted of the earth embankment portion of the dam and the concrete portion of the dam by a registered professional engineer knowledgeable in the design and construction of earth and concrete dams.
2. The extent and location, structural requirements and condition of the concrete should be determined.
3. The seepage through the concrete and at the base of the concrete should be monitored at periodic intervals.
4. Institute a formal inspection program to be conducted at regular intervals.
5. Institute a formal warning system to warn downstream residences of high spillway discharges or failure of the dam.
6. The siphon should be exercised at regular intervals.
7. Riprap should be provided on the upstream slope of the dam.
8. Trees growing on the dam should be removed under the direction of a professional engineer, experienced in the design of earth and concrete dams.

DRAWINGS



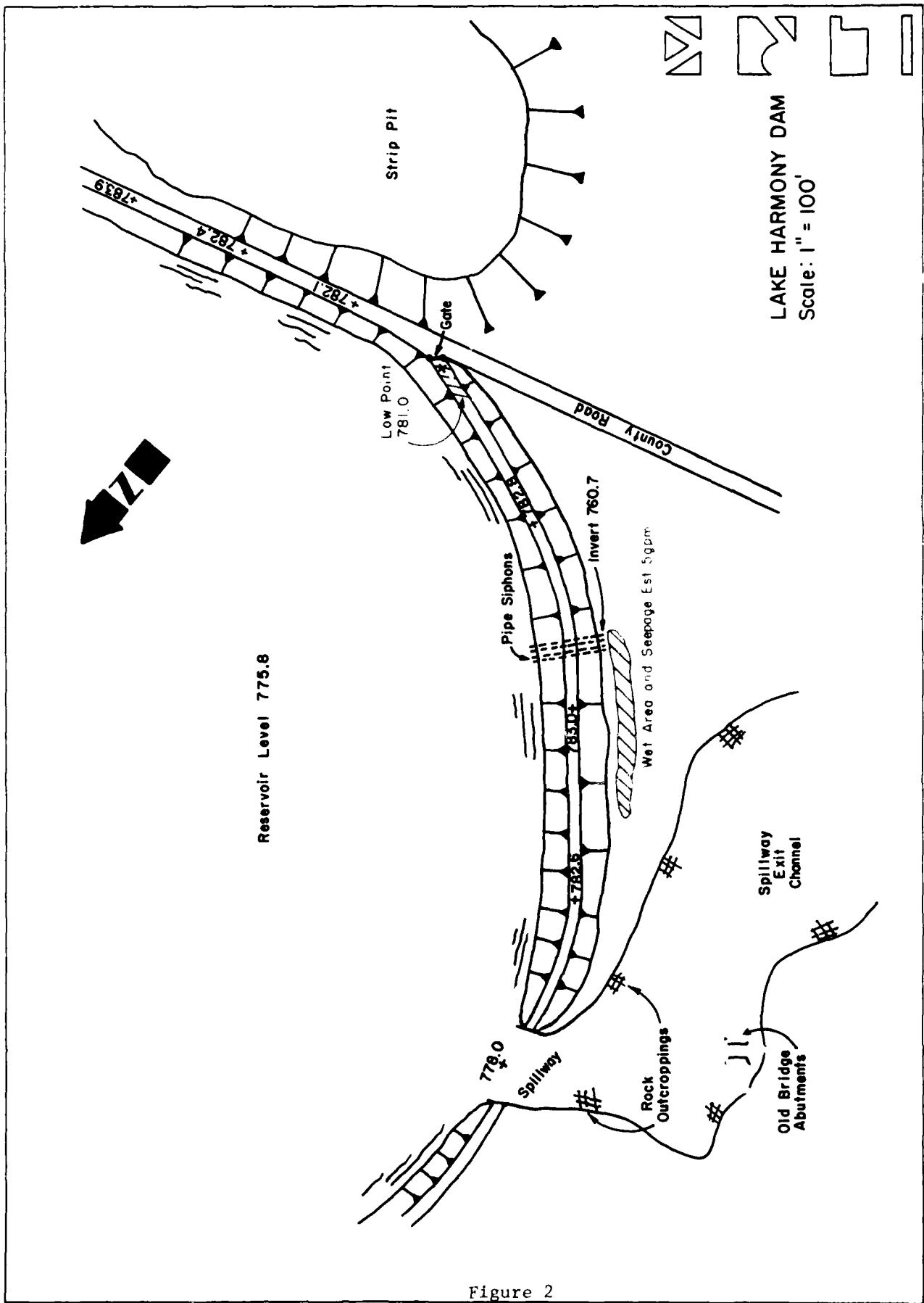


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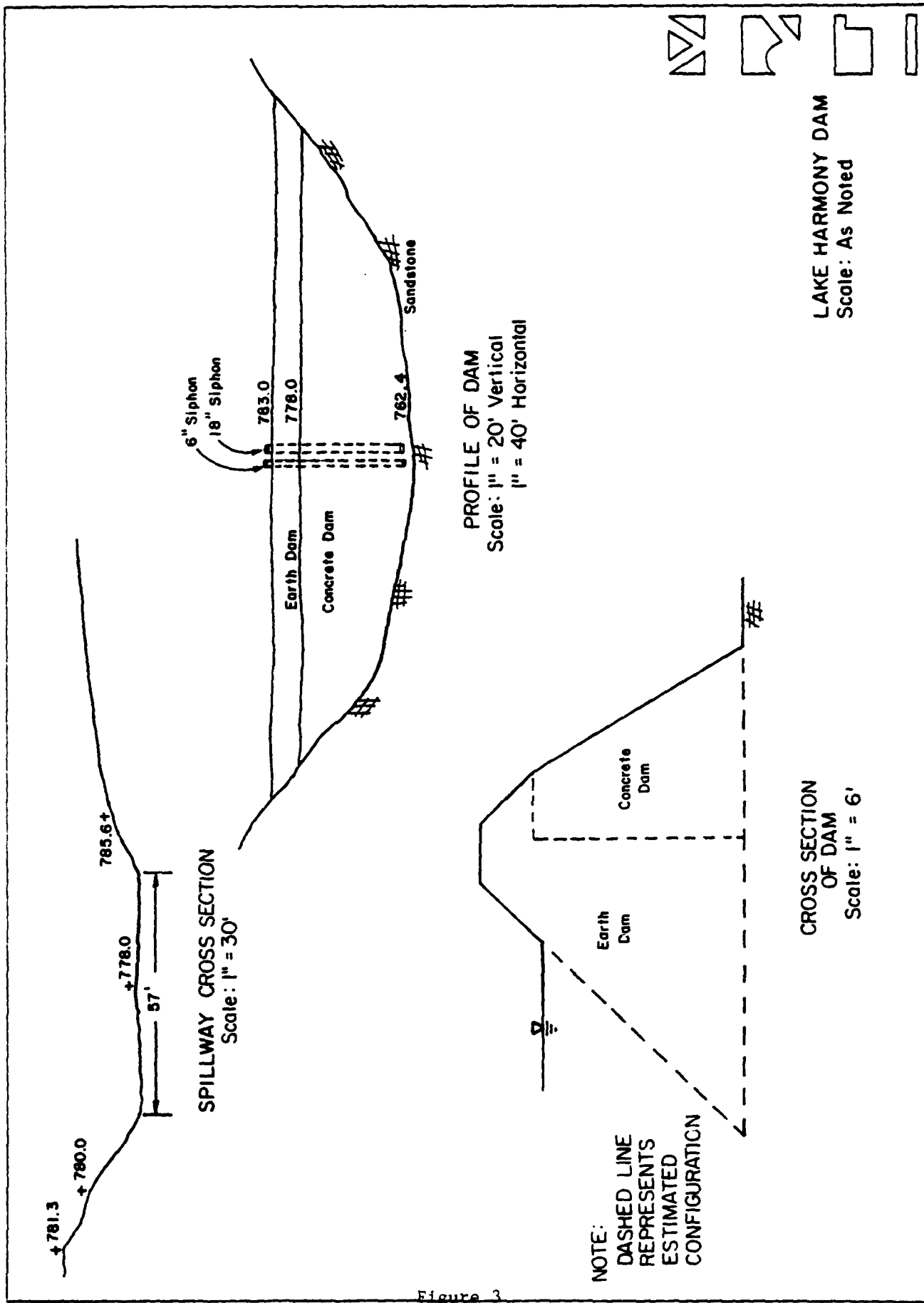
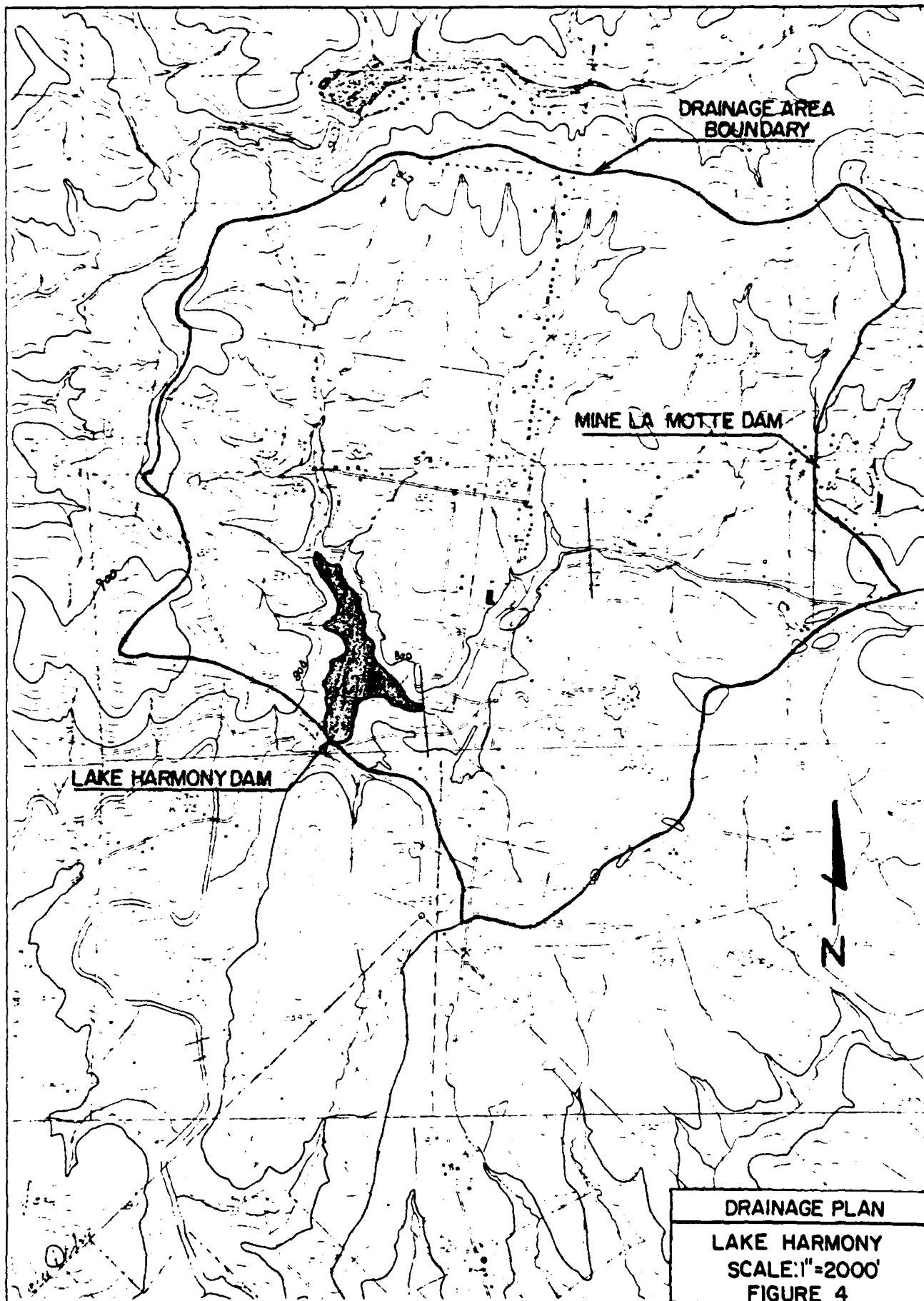


Figure 3



HYDROLOGY AND HYDRAULICS

APPENDIX B

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33." Reduction factors have not been applied. A 48 hour storm duration is assumed with total depth distributed over 6 hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6 hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6 hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use, and antecedent moisture conditions.

The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the outlet works, spillways, and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-storage capacity curve. The hydraulic capacity of the outlet works, spillways, and top of dam are defined by elevation-discharge curves.

Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determines the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

The above analysis has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed in the computer printout. Definitions of these variables are contained in the "User's Manual" for the computer program.

The inflow hydrograph was routed through the reservoir using HEC-1's Modified Puls option.



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DAM NAME LAKE HARMONY

I.D. NUMBER 30612

SHEET NO. 1 OF 4

BY OTM DATE 9-24-79

LAKE HARMONY

DRainage AREA = 4.3 mi² (2755 ACRES)

3.4 mi² DIRECT CONTRIBUTING (2177 ACRES)

0.9 mi² MINE LA MOTTE DAM UPSTREAM (578 ACRES)

FROM U.S.G.S. 7.5-MIN. QUAD.

UNIT HYDROGRAPH PARAMETERS

KIRPICH:

$t_c = 50 \text{ MIN OR } 0.83 \text{ HRS.}$ $LAG = 0.6 t_c = \underline{0.50 \text{ HRS.}}$

WHERE LENGTH (L) = 10,000 FT.

HEIGHT (H) = 122 FT.

FROM TIME OF CONCENTRATION NOMOGRAPH,
KENTUCKY BUREAU OF HIGHWAYS.

CURVE NUMBER METHOD:

$$LAG = \frac{L^{0.8} (S+1)^{0.7}}{1900 Y^{0.5}} = \frac{(10,000)^{0.8} (2.49)^{0.7}}{1900 (3.0)^{0.5}}$$

$$= \frac{(1585)(1.89)}{3291} = \underline{0.91 \text{ HRS.}}$$

WHERE L = GREATEST FLOW LENGTH IN FEET.

$S = \frac{1000}{CN} - 10$ AND CN = S.C.S. CURVE NUMBER
 Y = AVERAGE SLOPE

$CN = 87$, ANTECEDENT MOISTURE CONDITION III
SOIL GROUP "C".

FROM S.C.S.

USED TIME OF CONCENTRATION IN THIS
ANALYSIS = 0.83 HRS, LAG = 0.5 HRS



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DAM NAME LAKE HARMONY

I.D. NUMBER 30612

SHEET NO. 2 OF 4

BY OTM DATE 9-24-79

LOSS RATE AND BASE FLOW

STRTL = 1 INCH
CNSTL = 87 SCS CURVE NO. (AMC III)
STRTQ = 1.5 CFS/MI²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.5

PROBABLE MAXIMUM STORM

FROM H.R. No. 33

P.M.P. INDEX RAINFALL (ZONE 7) = 26.5 INCHES
R₆ = 102% , R₁₂ = 120% , R₂₄ = 130% , R₄₈ = 140%

ELEVATION-AREA-CAPACITY RELATIONSHIP

SPILLWAY CREST ELEV. = 778.0'
INITIAL STORAGE = 184 AC·FT (ST. LOUIS DIST. C.O.E.)

FROM U.S.G.S. 7.5-MIN. QUAD.

AT ELEV. 778 , AREA = 37 AC.
" " 780 , " = 60 AC.
" " 800 , " = 135 AC.

FROM THE CONIC METHOD FOR RESERVOIR VOLUME.
FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM
SAFETY VERSION USERS MANUAL.

$$H = 3V/A = 3(184)/37 \approx 15'$$

ELEV. WHERE AREA EQUALS ZERO:
778' - 15' = 763'

\$A	0	37	60	80	90	100	120	135
\$E	763	778	780	784	786	789	795	800



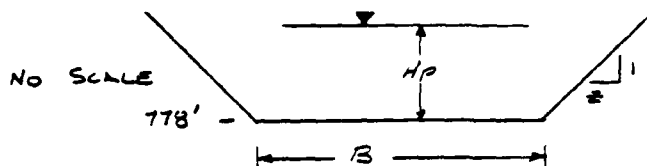
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EDENSBURG PENNSYLVANIA

DAM NAME LAKE HARMONY
I.D. NUMBER 30612

SHEET NO. 3 OF 4
BY OTM DATE 9-24-79

SPILLWAY DISCHARGE

SPILLWAY CREST = 778'



H_p = VARIABLE

$z = 2.25$

$B = 57'$

USE $C' = 0.95$

FROM EQ. FOR TRAPEZOIDAL SPILLWAY FLOW.

$$Q = 8.03 C' h_v^{1/2} (h_p - h_v) [B + z (h_p - h_v)]$$

$$\text{WHERE } h_v = \frac{3(2z h_p + B) - (16z^2 h_p^2 + 16z B h_p + 9B^2)^{1/2}}{10z}$$

LOW DAMS p. 79, NATIONAL RESOURCE COMM.

WATER AND WASTEWATER ENGINEERING p. 11-34,
FAIR, GEYER, AND OKUN

ELEVATION (FT.)	TRAPEZOIDAL FLOW	
	HEIGHT (FT.)	*DISCHARGE (C.F.S.)
778	0	—
779	1	170
780	2	500
781	3	940 (TOP OF DAM)
782	4	1480
783	5	2120
784	6	2860
785	7	3680
790	12	9,240
800	22	27,810

* DISCHARGE ROUNDED TO NEAREST 10 C.F.S.



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DAM NAME LAKE HARMONY
I.D. NUMBER 30612

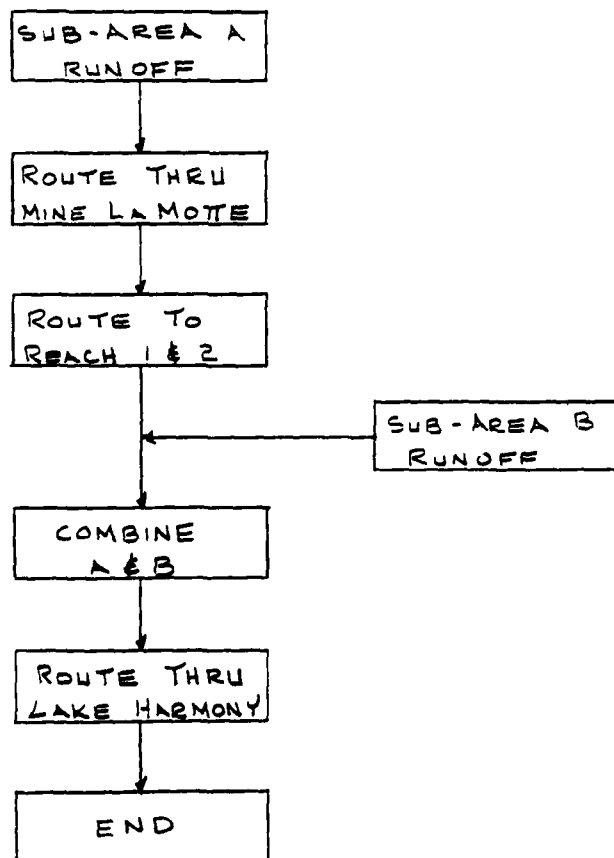
SHEET NO. 4 OF 4
BY OTM DATE 9-25-79

OVER TOP PARAMETERS

DISCHARGE DETERMINED BY (HEC-1)

TOP OF DAM ELEV. (LOW SPOT) = 781'
LENGTH OF DAM (EXCLUDING S.W.) = 524'
COEFFICIENT OF DISCHARGE = 2.9 (BROAD CREST)
#L_{MAX.} = 923' #Y_{MAX.} = 787'

UPSTREAM CONDITIONS (SCHEMATIC NETWORK)



	K1	ROUTE TINKU LAKE HARMONY				
	Y	1	1	1	1	
51						
52	Y1	1	781	782	-118	-1
53	Y4	778	779	780	783	784
54	Y5	0	170	500	2120	785
55	SA	0	37	60	100	786
56	SE	763	778	780	789	790
57	SS	778	282	183	1015	791
58	SO	781	127	750	769	792
59	SL	5	782	783	793	794
60	SV	781	782	783	793	794
61	K	92			795	796
62					795	796

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

RUN DATE= 79/09/28.
 TIME= 07:52:29.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE HARMONY DAM
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (MISSOURI - 30812)

NO	NHR	NMIN	IDAY	JOB SPECIFICATION				METRC	IPLT	IPRT	NSTAN
				IHR	IMIN	LMIN	TRACE				
288	0	10	0	0	0	0	0	0	0	0	0
			JOPER	NMT	LROPT	TRACE					
			5	0	0	0					

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS= .10 .50 1.00 NPLAN= 1 NR10= 1 LR10= 1

SUB-AREA RUNOFF COMPUTATION

INFLOW SUB-AREAL

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

IMYDG	IUMG	TAREA	SNAP	THSDA	TRSPC	RATIO	ISMOW	LSAME	LOCAL
1	2	.90	0.00	4.30	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.50	102.00	120.00	130.00	140.00	0.00	0.00

LOSS DATA

LROPT	STKR	DLTKR	RTIOL	ERAIN	SINKS	RTIOK	STRIL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-87.00	0.00	0.00

CURVE NO = -87.00 WETNESS = -1.00 EFFECT CM = 87.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .30

RECESSION DATA

STRIO= -1.50 ORCSN= -.05 RTIOR= 2.50

TIME INCREMENT 100 LARGE--(INNO IS GT LAG/2)

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

418.	1110.	979.	494.	247.	121.	59.	30.	15.	8.
2.									
END-OF-PERIOD FLOW									
MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HR. MN	PERIOD	MAIN
0									
1.01	1.10	1	.00	0.00	.00	1.02	1.10	145	.03
1.01	2.20	2	.00	0.00	.00	1.02	2.20	146	.03
1.01	3.30	3	.00	0.00	.00	1.02	3.30	147	.03
1.01	4.40	4	.00	0.00	.00	1.02	4.40	148	.03
1.01	5.50	5	.00	0.00	.00	1.02	5.50	149	.03
1.01	6.00	6	.00	0.00	.00	1.02	6.00	150	.03
1.01	7.10	7	.00	0.00	.00	1.02	7.10	151	.03
1.01	8.20	8	.00	0.00	.00	1.02	8.20	152	.03
1.01	9.30	9	.00	0.00	.00	1.02	9.30	153	.03
1.01	1.40	10	.00	0.00	.00	1.02	1.40	154	.03
1.01	2.50	11	.00	0.00	.00	1.02	2.50	155	.03
1.01	3.60	12	.00	0.00	.00	1.02	3.60	156	.03
1.01	4.70	13	.00	0.00	.00	1.02	4.70	157	.03
1.01	5.80	14	.00	0.00	.00	1.02	5.80	158	.03
1.01	6.90	15	.00	0.00	.00	1.02	6.90	159	.03
1.01	8.00	16	.00	0.00	.00	1.02	8.00	160	.03
1.01	9.10	17	.00	0.00	.00	1.02	9.10	161	.03
1.01	1.20	18	.00	0.00	.00	1.02	1.20	162	.03
1.01	2.30	19	.00	0.00	.00	1.02	2.30	163	.03
1.01	3.40	20	.00	0.00	.00	1.02	3.40	164	.03
1.01	4.50	21	.00	0.00	.00	1.02	4.50	165	.03
1.01	5.60	22	.00	0.00	.00	1.02	5.60	166	.03
1.01	6.70	23	.00	0.00	.00	1.02	6.70	167	.03
1.01	7.80	24	.00	0.00	.00	1.02	7.80	168	.03
1.01	8.90	25	.00	0.00	.00	1.02	8.90	169	.03
1.01	1.00	26	.00	0.00	.00	1.02	1.00	170	.03
1.01	2.10	27	.00	0.00	.00	1.02	2.10	171	.03
1.01	3.20	28	.00	0.00	.00	1.02	3.20	172	.03
1.01	4.30	29	.00	0.00	.00	1.02	4.30	173	.03
1.01	5.40	30	.00	0.00	.00	1.02	5.40	174	.03
1.01	6.50	31	.00	0.00	.00	1.02	6.50	175	.03
1.01	7.60	32	.00	0.00	.00	1.02	7.60	176	.03
1.01	8.70	33	.00	0.00	.00	1.02	8.70	177	.03
1.01	9.80	34	.00	0.00	.00	1.02	9.80	178	.03
1.01	1.90	35	.00	0.00	.00	1.02	1.90	179	.03
1.01	3.00	36	.00	0.00	.00	1.02	3.00	180	.03
1.01	4.10	37	.01	0.00	.01	1.02	4.10	181	.13
1.01	5.20	38	.01	0.00	.01	1.02	5.20	182	.13
1.01	6.30	39	.01	0.00	.01	1.02	6.30	183	.13
1.01	7.40	40	.01	0.00	.01	1.02	7.40	184	.13
1.01	8.50	41	.01	0.00	.01	1.02	8.50	185	.13
1.01	9.60	42	.01	0.00	.01	1.02	9.60	186	.13
1.01	1.70	43	.01	0.00	.01	1.02	1.70	187	.13
1.01	2.80	44	.01	0.00	.01	1.02	2.80	188	.13
1.01	3.90	45	.01	0.00	.01	1.02	3.90	189	.13
1.01	5.00	46	.01	0.00	.01	1.02	5.00	190	.13
1.01	6.10	47	.01	0.00	.01	1.02	6.10	191	.13
1.01	7.20	48	.01	0.00	.01	1.02	7.20	192	.13
1.01	8.30	49	.01	0.00	.01	1.02	8.30	193	.13
1.01	9.40	50	.01	0.00	.01	1.02	9.40	194	.13
1.01	1.50	51	.01	0.00	.01	1.02	1.50	195	.13
1.01	2.60	52	.01	0.00	.01	1.02	2.60	196	.13
1.01	3.70	53	.01	0.00	.01	1.02	3.70	197	.13
1.01	4.80	54	.01	0.00	.01	1.02	4.80	198	.13
1.01	5.90	55	.01	0.00	.01	1.02	5.90	199	.13
1.01	7.00	56	.01	0.00	.01	1.02	7.00	200	.13

1.01	9.10	55	.01	0.00	.01	0.	1.02	9.10	194	.13	.13	.01	441.
1.01	9.20	56	.01	0.00	.01	0.	1.02	9.20	200	.13	.13	.01	442.
1.01	9.30	57	.01	0.00	.01	0.	1.02	9.30	201	.13	.13	.01	443.
1.01	9.40	58	.01	0.00	.01	0.	1.02	9.40	202	.13	.13	.00	444.
1.01	9.50	59	.01	0.00	.01	0.	1.02	9.50	203	.13	.13	.00	445.
1.01	10.00	60	.01	0.00	.01	0.	1.02	10.00	204	.13	.13	.00	446.
1.01	10.10	61	.01	0.00	.01	1.	1.02	10.10	205	.13	.13	.00	447.
1.01	10.20	62	.01	0.00	.01	1.	1.02	10.20	206	.13	.13	.00	448.
1.01	10.30	63	.01	0.00	.01	2.	1.02	10.30	207	.13	.13	.00	449.
1.01	10.40	64	.01	0.00	.01	2.	1.02	10.40	208	.13	.13	.00	450.
1.01	10.50	65	.01	0.00	.01	2.	1.02	10.50	209	.13	.13	.00	451.
1.01	11.00	66	.01	0.00	.01	3.	1.02	11.00	210	.13	.13	.00	452.
1.01	11.10	67	.01	0.00	.01	3.	1.02	11.10	211	.13	.13	.00	453.
1.01	11.20	68	.01	0.00	.01	4.	1.02	11.20	212	.13	.13	.00	454.
1.01	11.30	69	.01	0.00	.01	4.	1.02	11.30	213	.13	.13	.00	455.
1.01	11.40	70	.01	0.00	.01	5.	1.02	11.40	214	.13	.13	.00	456.
1.01	11.50	71	.01	0.00	.01	5.	1.02	11.50	215	.13	.13	.00	457.
1.01	12.00	72	.01	0.00	.01	5.	1.02	12.00	216	.13	.13	.00	458.
1.01	12.10	73	.01	0.00	.01	6.	1.02	12.10	217	.13	.13	.00	459.
1.01	12.20	74	.01	0.00	.01	6.	1.02	12.20	218	.13	.13	.00	460.
1.01	12.30	75	.01	0.00	.01	6.	1.02	12.30	219	.13	.13	.00	461.
1.01	12.40	76	.01	0.00	.01	6.	1.02	12.40	220	.13	.13	.00	462.
1.01	12.50	77	.01	0.00	.01	6.	1.02	12.50	221	.13	.13	.00	463.
1.01	13.00	78	.01	0.00	.01	6.	1.02	13.00	222	.13	.13	.00	464.
1.01	13.10	79	.01	0.00	.01	6.	1.02	13.10	223	.13	.13	.00	465.
1.01	13.20	80	.01	0.00	.01	6.	1.02	13.20	224	.13	.13	.00	466.
1.01	13.30	81	.01	0.00	.01	6.	1.02	13.30	225	.13	.13	.00	467.
1.01	13.40	82	.01	0.00	.01	6.	1.02	13.40	226	.13	.13	.00	468.
1.01	13.50	83	.01	0.00	.01	6.	1.02	13.50	227	.13	.13	.00	469.
1.01	14.00	84	.01	0.00	.01	6.	1.02	14.00	228	.13	.13	.00	470.
1.01	14.10	85	.01	0.00	.01	6.	1.02	14.10	229	.13	.13	.00	471.
1.01	14.20	86	.01	0.00	.01	6.	1.02	14.20	230	.13	.13	.00	472.
1.01	14.30	87	.01	0.00	.01	6.	1.02	14.30	231	.13	.13	.00	473.
1.01	14.40	88	.01	0.00	.01	6.	1.02	14.40	232	.13	.13	.00	474.
1.01	14.50	89	.01	0.00	.01	6.	1.02	14.50	233	.13	.13	.00	475.
1.01	15.00	90	.01	0.00	.01	6.	1.02	15.00	234	.13	.13	.00	476.
1.01	15.10	91	.01	0.00	.01	6.	1.02	15.10	235	.13	.13	.00	477.
1.01	15.20	92	.01	0.00	.01	6.	1.02	15.20	236	.13	.13	.00	478.
1.01	15.30	93	.01	0.00	.01	6.	1.02	15.30	237	.13	.13	.00	479.
1.01	15.40	94	.01	0.00	.01	6.	1.02	15.40	238	.13	.13	.00	480.
1.01	15.50	95	.01	0.00	.01	6.	1.02	15.50	239	.13	.13	.00	481.
1.01	16.00	96	.01	0.00	.01	6.	1.02	16.00	240	.13	.13	.00	482.
1.01	16.10	97	.01	0.00	.01	6.	1.02	16.10	241	.13	.13	.00	483.
1.01	16.20	98	.01	0.00	.01	6.	1.02	16.20	242	.13	.13	.00	484.
1.01	16.30	99	.01	0.00	.01	6.	1.02	16.30	243	.13	.13	.00	485.
1.01	16.40	100	.01	0.00	.01	6.	1.02	16.40	244	.13	.13	.00	486.
1.01	16.50	101	.01	0.00	.01	6.	1.02	16.50	245	.13	.13	.00	487.
1.01	17.00	102	.01	0.00	.01	6.	1.02	17.00	246	.13	.13	.00	488.
1.01	17.10	103	.01	0.00	.01	6.	1.02	17.10	247	.13	.13	.00	489.
1.01	17.20	104	.01	0.00	.01	6.	1.02	17.20	248	.13	.13	.00	490.
1.01	17.30	105	.01	0.00	.01	6.	1.02	17.30	249	.13	.13	.00	491.
1.01	17.40	106	.01	0.00	.01	6.	1.02	17.40	250	.13	.13	.00	492.
1.01	17.50	107	.01	0.00	.01	6.	1.02	17.50	251	.13	.13	.00	493.
1.01	18.00	108	.01	0.00	.01	6.	1.02	18.00	252	.13	.13	.00	494.
1.01	18.10	109	.01	0.00	.01	6.	1.02	18.10	253	.13	.13	.00	495.
1.01	18.20	110	.01	0.00	.01	6.	1.02	18.20	254	.13	.13	.00	496.
1.01	18.30	111	.01	0.00	.01	6.	1.02	18.30	255	.13	.13	.00	497.
1.01	18.40	112	.01	0.00	.01	6.	1.02	18.40	256	.13	.13	.00	498.
1.01	18.50	113	.01	0.00	.01	6.	1.02	18.50	257	.13	.13	.00	499.
1.01	19.00	114	.01	0.00	.01	6.	1.02	19.00	258	.13	.13	.00	500.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4143.	1276.	412.	215.	61845.
CMS	117.	36.	6.		1751.
JNCHES		1321	17403	1776	1776
MM		33527	43268	44101	43101
AC-FI		634.	817.	852.	852.
INCHES CU M		7924	10984	10521.	10521.

HYDROGRAPH AT STA 1 FOR PLAN 1, RYIO 3

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
8,886.0	25.56	82.9	4.29	12369.0
235.0	23	12	12	3503
	26.42	34.07	35.51	35.51
	671.14	965.25	902.02	902.02
	1268	1634	1704	1704
	1504	2102	2102	2102

HYDROGRAPH ROUTING

ROUTE THRU LAMUITE

	ISTAU	ICOMP	IECON	ITAPE	JPLI	JPRI	INAME	ISTAGE	IAUTO
	2	1	0	0	0	0	I	U	0
				ROUTING DATA					
				ISAME	IOPT	IPMP		LSTR	
				1	0	0		0	
	CLOSS	AVG	IRES						
	0.0	0.00	1						
	9.000	0.000							

STAGE	881.00	882.00	883.00	884.00	885.00	886.00	887.00	888.00	889.00	890.00	891.00	892.00	893.00	894.00	895.00	896.00	897.00	898.00	899.00	900.00	901.00	902.00	903.00	904.00	905.00	906.00	907.00	908.00	909.00	910.00	911.00	912.00	913.00	914.00	915.00	916.00	917.00	918.00	919.00	920.00	921.00	922.00	923.00	924.00	925.00	926.00	927.00	928.00	929.00	930.00	931.00	932.00	933.00	934.00	935.00	936.00	937.00	938.00	939.00	940.00	941.00	942.00	943.00	944.00	945.00	946.00	947.00	948.00	949.00	950.00	951.00	952.00	953.00	954.00	955.00	956.00	957.00	958.00	959.00	960.00	961.00	962.00	963.00	964.00	965.00	966.00	967.00	968.00	969.00	970.00	971.00	972.00	973.00	974.00	975.00	976.00	977.00	978.00	979.00	980.00	981.00	982.00	983.00	984.00	985.00	986.00	987.00	988.00	989.00	990.00	991.00	992.00	993.00	994.00	995.00	996.00	997.00	998.00	999.00	1000.00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
FLOW	0.00	40.00	140.00	300.00	410.00	510.00	610.00	710.00	810.00	910.00	1010.00	1110.00	1210.00	1310.00	1410.00	1510.00	1610.00	1710.00	1810.00	1910.00	2010.00	2110.00	2210.00	2310.00	2410.00	2510.00	2610.00	2710.00	2810.00	2910.00	3010.00	3110.00	3210.00	3310.00	3410.00	3510.00	3610.00	3710.00	3810.00	3910.00	4010.00	4110.00	4210.00	4310.00	4410.00	4510.00	4610.00	4710.00	4810.00	4910.00	5010.00	5110.00	5210.00	5310.00	5410.00	5510.00	5610.00	5710.00	5810.00	5910.00	6010.00	6110.00	6210.00	6310.00	6410.00	6510.00	6610.00	6710.00	6810.00	6910.00	7010.00	7110.00	7210.00	7310.00	7410.00	7510.00	7610.00	7710.00	7810.00	7910.00	8010.00	8110.00	8210.00	8310.00	8410.00	8510.00	8610.00	8710.00	8810.00	8910.00	9010.00	9110.00	9210.00	9310.00	9410.00	9510.00	9610.00	9710.00	9810.00	9910.00	1000.00																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
SURFACE AREA	0.0	18.0	30.0	41.0	50.0	60.0	70.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0	170.0	180.0	190.0	200.0	210.0	220.0	230.0	240.0	250.0	260.0	270.0	280.0	290.0	300.0	310.0	320.0	330.0	340.0	350.0	360.0	370.0	380.0	390.0	400.0	410.0	420.0	430.0	440.0	450.0	460.0	470.0	480.0	490.0	500.0	510.0	520.0	530.0	540.0	550.0	560.0	570.0	580.0	590.0	600.0	610.0	620.0	630.0	640.0	650.0	660.0	670.0	680.0	690.0	700.0	710.0	720.0	730.0	740.0	750.0	760.0	770.0	780.0	790.0	800.0	810.0	820.0	830.0	840.0	850.0	860.0	870.0	880.0	890.0	900.0	910.0	920.0	930.0	940.0	950.0	960.0	970.0	980.0	990.0	1000.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
CAPACITY	0.0	72.0	191.0	332.0	468.0	604.0	740.0	876.0	1012.0	1148.0	1284.0	1420.0	1556.0	1692.0	1828.0	1964.0	2100.0	2236.0	2372.0	2508.0	2644.0	2780.0	2916.0	3052.0	3188.0	3324.0	3460.0	3596.0	3732.0	3868.0	4004.0	4140.0	4276.0	4412.0	4548.0	4684.0	4820.0	4956.0	5092.0	5228.0	5364.0	5500.0	5636.0	5772.0	5908.0	6044.0	6180.0	6316.0	6452.0	6588.0	6724.0	6860.0	6996.0	7132.0	7268.0	7404.0	7540.0	7676.0	7812.0	7948.0	8084.0	8220.0	8356.0	8492.0	8628.0	8764.0	8900.0	9036.0	9172.0	9308.0	9444.0	9580.0	9716.0	9852.0	9988.0	10124.0	10260.0	10396.0	10532.0	10668.0	10804.0	10940.0	11076.0	11212.0	11348.0	11484.0	11620.0	11756.0	11892.0	12028.0	12164.0	12300.0	12436.0	12572.0	12708.0	12844.0	12980.0	13116.0	13252.0	13388.0	13524.0	13660.0	13796.0	13932.0	14068.0	14204.0	14340.0	14476.0	14612.0	14748.0	14884.0	15020.0	15156.0	15292.0	15428.0	15564.0	15700.0	15836.0	15972.0	16108.0	16244.0	16380.0	16516.0	16652.0	16788.0	16924.0	17060.0	17196.0	17332.0	17468.0	17604.0	17740.0	17876.0	18012.0	18148.0	18284.0	18420.0	18556.0	18692.0	18828.0	18964.0	19100.0	19236.0	19372.0	19508.0	19644.0	19780.0	19916.0	20052.0	20188.0	20324.0	20460.0	20596.0	20732.0	20868.0	21004.0	21140.0	21276.0	21412.0	21548.0	21684.0	21820.0	21956.0	22092.0	22228.0	22364.0	22500.0	22636.0	22772.0	22908.0	23044.0	23180.0	23316.0	23452.0	23588.0	23724.0	23860.0	23996.0	24132.0	24268.0	24404.0	24540.0	24676.0	24812.0	24948.0	25084.0	25220.0	25356.0	25492.0	25628.0	25764.0	25900.0	26036.0	26172.0	26308.0	26444.0	26580.0	26716.0	26852.0	26988.0	27124.0	27260.0	27396.0	27532.0	27668.0	27804.0	27940.0	28076.0	28212.0	28348.0	28484.0	28620.0	28756.0	28892.0	29028.0	29164.0	29300.0	29436.0	29572.0	29708.0	29844.0	29980.0	30116.0	30252.0	30388.0	30524.0	30660.0	30796.0	30932.0	31068.0	31204.0	31340.0	31476.0	31612.0	31748.0	31884.0	32020.0	32156.0	32292.0	32428.0	32564.0	32700.0	32836.0	32972.0	33108.0	33244.0	33380.0	33516.0	33652.0	33788.0	33924.0	34060.0	34196.0	34332.0	34468.0	34604.0	34740.0	34876.0	35012.0	35148.0	35284.0	35420.0	35556.0	35692.0	35828.0	35964.0	36100.0	36236.0	36372.0	36508.0	36644.0	36780.0	36916.0	37052.0	37188.0	37324.0	37460.0	37596.0	37732.0	37868.0	38004.0	38140.0	38276.0	38412.0	38548.0	38684.0	38820.0	38956.0	39092.0	39228.0	39364.0	39500.0	39636.0	39772.0	39908.0	40044.0	40180.0	40316.0	40452.0	40588.0	40724.0	40860.0	40996.0	41132.0	41268.0	41404.0	41540.0	41676.0	41812.0	41948.0	42084.0	42220.0	42356.0	42492.0	42628.0	42764.0	42900.0	43036.0	43172.0	43308.0	43444.0	43580.0	43716.0	43852.0	43988.0	44124.0	44260.0	44396.0	44532.0	44668.0	44804.0	44940.0	45076.0	45212.0	45348.0	45484.0	45620.0	45756.0	45892.0	46028.0	46164.0	46300.0	46436.0	46572.0	46708.0	46844.0	46980.0	47116.0	47252.0	47388.0	47524.0	47660.0	47796.0	47932.0	48068.0	48204.0	48340.0	48476.0	48612.0	48748.0	48884.0	49020.0	49156.0	49292.0	49428.0	49564.0	49700.0	49836.0	49972.0	50108.0	50244.0	50380.0	50516.0	50652.0	50788.0	50924.0	51060.0	51196.0	51332.0	51468.0	51604.0	51740.0	51876.0	52012.0	52148.0	52284.0	52420.0	52556.0	52692.0	52828.0	52964.0	53100.0	53236.0	53372.0	53508.0	53644.0	53780.0	53916.0	54052.0	54188.0	54324.0	54460.0	54596.0	54732.0	54868.0	55004.0	55140.0	55276.0	55412.0	55548.0	55684.0	55820.0	55956.0	56092.0	56228.0	56364.0	56500.0	56636.0	56772.0	56908.0	57044.0	57180.0	57316.0	57452.0	57588.0	57724.0	57860.0	57996.0	58132.0	58268.0	58404.0	58540.0	58676.0	58812.0	58948.0	59084.0	59220.0	59356.0	59492.0	59628.0	59764.0	59900.0	60036.0	60172.0	60308.0	60444.0	60580.0	60716.0	60852.0	60988.0	61124.0	61260.0	61396.0	61532.0	61668.0	61804.0	61940.0	62076.0	62212.0	62348.0	62484.0	62620.0	62756.0	62892.0	63028.0	63164.0	63300.0	63436.0	63572.0	63708.0	63844.0	63980.0	64116.0	64252.0	64388.0	64524.0	64660.0	64796.0	64932.0	65068.0	65204.0	65340.0	65476.0	65612.0	65748.0	65884.0	66020.0	66156.0	66292.0	66428.0	66564.0	66700.0	66836.0	66972.0	67108.0	67244.0	67380.0	67516.0	67652.0	67788.0	67924.0	68060.0	68196.0	68332.0	68468.0	68604.0	68740.0	68876.0	69012.0	69148.0	69284.0	69420.0	69556.0	69692.0	69828.0	69964.0	70100.0	70236.0	70372.0	70508.0	70644.0	70780.0	70916.0	71052.0	71188.0	71324.0	71460.0	71596.0	71732.0	71868.0	72004.0	72140.0	72276.0	72412.0	72548.0	72684.0	72820.0	72956.0	73092.0	73228.0	73364.0	73500.0	73636.0	73772.0	73908.0	74044.0	74180.0	74316.0	74452.0	74588.0	74724.0	74860.0	74996.0	75132.0	75268.0	75404.0	75540.0	75676.0	75812.0	75948.0	76084.0	76220.0	76356.0	76492.0	76628.0	76764.0	76900.0	77036.0	77172.0	77308.0	77444.0	77580.0	77716.0	77852.0	77988.0	78124.0	78260.0	78396.0	78532.0	78668.0	78804.0	78940.0	79076.0	79212.0	79348.0	79484.0	79620.0	79756.0	79892.0	80028.0	80164.0	80300.0	80436.0	80572.0	80708.0	80844.0	80980.0	81116.0	81252.0	81388.0	81524.0	81660.0	81796.0	81932.0	82068.0	82204.0	82340.0	82476.0	82612.0	82748.0	82884.0	83020.0	83156.0	83292.0	83428.0	83564.0	83700.0	83836.0	83972.0	84108.0	84244.0	84380.0	84516.0	84652.0	84788.0	84924.0	85060.0	85196.0	85332.0	85468.0	85604.0	85740.0	85876.0	86012.0	86148.0	86284.0	86420.0	86556.0	86692.0	86828.0	86964.0	87100.0	87236.0	87372.0	87508.0	87644.0	87780.0	87916.0	88052.0	88188.0	88324.0	88460.0	88596.0	88732.0	88868.0	89004.0	89140.0	89276.0	89412.0	89548.0	89684.0	89820.0	89956.0	90092.0	90228.0	90364.0	90500.0	90636.0	90772.0	90908.0	91044.0	91180.0	91316.0	91452.0	91588.0	91724.0	91860.0	91996.0	92132.0	92268.0	92404.0	92540.0	92676.0	92812.0	92948.0	93084.0	93220.0	93356.0	93492.0	93628.0	93764.0	93900.0	94036.0	94172.0	94308.0	94444.0	94580.0	94716.0	94852.0	94988.0	95124.0	95260.0	95396.0	95532.0	95668.0	95804.0	95940.0	96076.0	96212.0	96348.0	96484.0	96620.0	96756.0	96892.0	97028.0	97164.0	97300.0	97436.0	97572.0	97708.0	97844.0	97980.0	98116.0	98252.0	98388.0	98524.0	98660.0	98796.0	98932.0	99068.0	99204.0	99340.0	99476.0	99612.0	99748.0	99884.0	1000.00

STATION 2. PLAN 1.5. RATIO 3

PEAK OUTFLOW IS 8062. AT TIME 40.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8062.	2548.	809.	418.	120456.
INS	228.	72.	23.	12.	3511.
INCHES		26.33	33.44	34.58	34.58
MM		668.87	849.39	878.43	878.43
AC-FI		12634	1604.	1629.	1629.
THOUS CU M		1558.	1979.	2047.	2047.

HYDROGRAPH ROUTING

REACH 2-3

ISTAU	ICOMP	IECON	ITAPE	JPLT	JPRI	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0
ROUTING DATA								
QLOSS	CLOSS	AVG	IRES	ISAME	ISMP	LSTR		
0.0	0.000	0.00	1	1	0	0		
NSIPS	NSIDL	LAG	AMSKR	X	ISK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	0.	0	

10/14

NORMAL DEPTH CHANNEL ROUTING

QM(11) QM(12) QM(13) ELNVT ELMAX RLNTH SCL
 .0600 .0300 798.0 840.0 4000.0 .02000

CROSS SECTION COORDINATES--STATELEVSIALELV--EIC

0.00 840.00 200.00 820.00 550.00 800.00 570.00 798.00 580.00 798.00
 600.00 800.00 700.00 820.00 1200.00 0.00

STORAGE 0.00 17933.49 18048.83 18174.54 18310.62 18457.06 18613.88 18781.07 18958.63
 19344.84 19550.29 19760.22 19974.63 20193.54 20416.93 20644.81 20877.19 21114.03

OUTFLOW 0.00 24074105.28 24064732.24 24064581.69 24073773.58 24092420.57 24120629.42 24158503.00 24206141.79 24
 24341228.83 24628254.74 24919742.79 25215738.52 25516297.55 25821482.31 26131359.87 26446000.56 26765476.91 27

STAGE 798.00 800.21 802.42 804.63 806.84 809.05 811.26 813.47 815.68
 820.11 822.32 824.53 826.74 828.95 831.16 833.37 835.58 837.79

FLOW 0.00 24074105.28 24064732.24 24064581.69 24073773.58 24092420.57 24120629.42 24158503.00 24206141.79 24
 24341228.83 24628254.74 24919742.79 25215738.52 25516297.55 25821482.31 26131359.87 26446000.56 26765476.91 27

STATION 3. PLAN 1. R110 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	382.	210.	74.	38.	11033.
CMS	11.	6.	2.	1.	312.
INCHES	2.17	3.06	3.17	3.17	80.46
MM	55.05	77.76	80.46	80.46	152.
AC-FT	104.	147.	152.	152.	187.
THOUS CU M	128.	181.	187.	187.	

MAXIMUM STORAGE = 0.

MAXIMUM STAGE IS 798.0

STATION 3. PLAN 1. R110 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	400.	145.	401.	207.	59512.
CMS	113.	36.	11.	6.	1685.
INCHES	12.97	16.56	17.09	17.09	434.00
MM	329.32	420.64	434.00	434.00	820.
AC-FT	622.	795.	820.	820.	1011.
THOUS CU M	767.	980.	1011.	1011.	

MAXIMUM STORAGE = 3.

MAXIMUM STAGE IS 798.0

STATION 3. PLAN 1. R110 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8102.	2548.	809.	418.	120447.
CMS	229.	72.	22.	12.	311.
INCHES	26.33	33.44	34.58	34.58	
MM	668.84	849.34	878.37	878.37	
AC-FI	1242.	1604.	1659.	1659.	
THOUS CU M	1558.	1979.	2046.	2046.	

MAXIMUM STORAGE = 6.

MAXIMUM STAGE IS 798.0

HYDROGRAPH ROUTING

REACH 3-4

ISIAQ	ICOMP	IECON	IIAPE	JPLI	JPRI	INAME	ISIAGE	IAUTO
4	1	0	0	0	0	1	0	0
ROUTING DATA								
CLOSS	AVG	IBES	ISAME	IOPI	IPRP	LATR		
0.0	0.00	1	1	0	0	0		
NSIP2	NSID1	LAG	ANSKK	X	ISK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	0.	0.	

QNL11	QNL2	QNL3	ELMY	ELMAX	RLMIN	SEL
0.0600	0.0500	0.0600	776.0	800.0	4000.	0.0550

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

CROSS SECTION COORDINATES--STA., ELEV., STA., ELEV.--ETC												
STORAGE	0.00	2.37	20.35	54.92	105.19	159.13	216.54	277.44	341.82			
	481.01	555.82	634.12	715.89	801.15	889.88	982.09	1073.19	1176.95			
OUTFLOW	0.00	102.67	624.12	2010.78	4737.15	8619.54	13540.28	19465.97	26385.25			
	43212.84	53140.09	64094.81	76093.60	89154.47	103296.44	118539.21	134903.02	152408.46			
SIAGE	176.00	177.26	778.23	779.12	781.05	782.32	783.58	784.84	786.11			
	788.63	789.89	791.16	792.42	793.68	794.95	796.21	797.47	798.74			
FLOW	0.00	102.67	624.12	2010.78	4737.15	8619.54	13540.28	19465.97	26385.25			
	43212.84	53140.09	64094.81	76093.60	89154.47	103296.44	118539.21	134903.02	152408.46			

STATION : 41 PLAN 1, RIQU

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CF5	335	208	73	39	10862
CMS	9	6	2	1	306
INCHES		2.15	3.02	3.12	3.12
MM		54.62	76.65	79.22	79.22
AC-FI		103	145	150	150
CU M		1.79	1.79	1.85	1.85
THOUS CU M					

MAXIMUM STORAGE = 12.

MAXIMUM STAGE IS 177.8

STATION 4, PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3295	1245	398	205	59117
CMS	93	35	11	6	1676
INCHES		12.87	16.47	16.97	16.97
MM		326.78	418.37	431.11	431.11
AC-FT		617	790	815	815
THOUS CU M		761	975	1004	1004

MAXIMUM STORAGE = 79.

MAXIMUM STAGE IS 780.4

STATION 4, PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7000	2526	806	416	119913
CMS	198	72	23	12	3396
INCHES		26.11	33.32	34.43	34.43
MM		663.11	846.37	874.47	874.47
AC-FT		1252	1599	1652	1652
THOUS CU M		1545	1972	2037	2037

MAXIMUM STORAGE = 137.

MAXIMUM STAGE IS 781.8

SUB-AREA RUNOFF COMPUTATION

INFLOW SUB-AREA(1)

ISTAQ ICOMP IECON ITAPE JPLT JPTI INAME ISTAGE IAUTO

JHYDG IUNG TAREA SNAP TRSDA TRSPL RATIO ISNDW ISAME LOCAL

HYDROGRAPH DATA

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96

LOSS DATA

LROPT STRKR DLTR RTIOL ERAIN STKS RTIOK STRTL CNSTL ALSMX RTIMP

CURVE NO = -87.00 WETNESS = -1.00 EFFECT CN = 87.00

UNIT HYDROGRAPH DATA

TC = 0.00 LAG = .50

RECESSION DATA

STRIO = -1.50 ORCSN = -.05 RTIOR = 2.50

UNIT HYDROGRAPH 17 END OF PERIOD ORDINATES, TC = 0.00 HOURS, LAG = .50 VOL = 1.00 199.

499. 1706. 2716. 2116. 1267. 789. 511. 317.

125. 78. 59. 31. 21. 12. 5.

MO.DA HR.MM PERIOD RAIN EXCS LOSS COMP Q MO.DA HR.MM PERIOD RAIN EXCS LOSS COMP Q

1.01 10.00	60	.01	.00	.01	1.	1.02 10.00	204	.13	.13	.00	1675.
1.01 10.10	61	.01	.00	.01	1.	1.02 10.10	205	.13	.13	.00	1677.
1.01 10.20	62	.01	.00	.01	2.	1.02 10.20	206	.13	.13	.00	1679.
1.01 10.30	63	.01	.00	.01	4.	1.02 10.30	207	.13	.13	.00	1682.
1.01 10.40	64	.01	.00	.01	5.	1.02 10.40	208	.13	.13	.00	1684.
1.01 10.50	65	.01	.00	.01	7.	1.02 10.50	209	.13	.13	.00	1687.
1.01 11.00	66	.01	.00	.01	8.	1.02 11.00	210	.13	.13	.00	1689.
1.01 11.10	67	.01	.00	.01	10.	1.02 11.10	211	.13	.13	.00	1691.
1.01 11.20	68	.01	.00	.01	11.	1.02 11.20	212	.13	.13	.00	1692.
1.01 11.30	69	.01	.00	.01	13.	1.02 11.30	213	.13	.13	.00	1694.
1.01 11.40	70	.01	.00	.01	14.	1.02 11.40	214	.13	.13	.00	1695.
1.01 11.50	71	.01	.00	.01	16.	1.02 11.50	215	.13	.13	.00	1697.
1.01 12.00	72	.01	.00	.01	17.	1.02 12.00	216	.13	.13	.00	1699.
1.01 12.10	73	.03	.01	.03	21.	1.02 12.10	217	.45	.44	.01	1853.
1.01 12.20	74	.03	.01	.03	31.	1.02 12.20	218	.45	.44	.01	2382.
1.01 12.30	75	.03	.01	.03	48.	1.02 12.30	219	.45	.44	.01	3232.
1.01 12.40	76	.03	.01	.02	67.	1.02 12.40	220	.45	.44	.01	4081.
1.01 12.50	77	.03	.01	.02	86.	1.02 12.50	221	.52	.44	.01	4758.
1.01 13.00	78	.03	.01	.02	103.	1.02 13.00	222	.45	.44	.01	5177.
1.01 13.10	79	.04	.02	.03	119.	1.02 13.10	223	.54	.53	.01	5444.
1.01 13.20	80	.04	.02	.03	138.	1.02 13.20	224	.54	.53	.01	5762.
1.01 13.30	81	.04	.02	.02	158.	1.02 13.30	225	.54	.53	.01	6109.
1.01 13.40	82	.04	.02	.02	179.	1.02 13.40	226	.54	.53	.01	6420.
1.01 13.50	83	.04	.02	.02	198.	1.02 13.50	227	.54	.54	.01	6654.
1.01 14.00	84	.04	.02	.02	214.	1.02 14.00	228	.54	.54	.01	6798.
1.01 14.10	85	.05	.03	.03	232.	1.02 14.10	229	.68	.67	.01	6956.
1.01 14.20	86	.05	.03	.02	255.	1.02 14.20	230	.68	.67	.01	7299.
1.01 14.30	87	.05	.03	.02	283.	1.02 14.30	231	.68	.67	.01	7650.
1.01 14.40	88	.05	.03	.02	312.	1.02 14.40	232	.68	.67	.00	8041.
1.01 14.50	89	.05	.03	.02	337.	1.02 14.50	233	.68	.67	.00	8323.
1.01 15.00	90	.05	.03	.02	358.	1.02 15.00	234	.68	.67	.00	8525.
1.01 15.10	91	.05	.03	.02	374.	1.02 15.10	235	.62	.61	.00	8610.
1.01 15.20	92	.08	.05	.03	392.	1.02 15.20	236	1.02	1.02	.01	8789.
1.01 15.30	93	.14	.10	.05	458.	1.02 15.30	237	1.65	1.84	.01	9783.
1.01 15.40	94	.36	.26	.10	674.	1.02 15.40	238	4.62	4.61	.02	13540.
1.01 15.50	95	.10	.08	.02	1041.	1.02 15.50	239	1.34	1.33	.02	19822.
1.01 16.00	96	.06	.05	.01	1328.	1.02 16.00	240	.82	.82	.00	24548.
1.01 16.10	97	.05	.04	.01	1348.	1.02 16.10	241	.63	.63	.00	24409.
1.01 16.20	98	.02	.04	.01	1172.	1.02 16.20	242	.63	.63	.00	20289.
1.01 16.30	99	.05	.04	.01	942.	1.02 16.30	243	.63	.63	.00	16494.
1.01 16.40	100	.05	.04	.01	781.	1.02 16.40	244	.63	.63	.00	13462.
1.01 16.50	101	.05	.04	.01	683.	1.02 16.50	245	.63	.63	.00	11574.
1.01 17.00	102	.05	.04	.01	620.	1.02 17.00	246	.63	.63	.00	10345.
1.01 17.10	103	.04	.03	.01	577.	1.02 17.10	247	.50	.49	.00	9510.
1.01 17.20	104	.04	.03	.01	540.	1.02 17.20	248	.50	.49	.00	8796.
1.01 17.30	105	.04	.03	.01	503.	1.02 17.30	249	.50	.49	.00	8128.
1.01 17.40	106	.04	.03	.01	473.	1.02 17.40	250	.50	.49	.00	7514.
1.01 17.50	107	.04	.03	.01	551.	1.02 17.50	251	.50	.49	.00	7170.
1.01 18.00	108	.04	.03	.01	439.	1.02 18.00	252	.50	.49	.00	6929.
1.01 18.10	109	.00	.00	.00	416.	1.02 18.10	253	.04	.04	.00	6539.
1.01 18.20	110	.00	.00	.00	361.	1.02 18.20	254	.04	.04	.00	5877.
1.01 18.30	111	.00	.00	.00	280.	1.02 18.30	255	.04	.04	.00	4367.
1.01 18.40	112	.00	.00	.00	199.	1.02 18.40	256	.04	.04	.00	3112.
1.01 18.50	113	.00	.00	.00	137.	1.02 18.50	257	.04	.04	.00	2141.
1.01 19.00	114	.00	.00	.00	100.	1.02 19.00	258	.04	.04	.00	1559.
1.01 19.10	115	.00	.00	.00	77.	1.02 19.10	259	.04	.04	.00	1218.
1.01 19.20	116	.00	.00	.00	62.	1.02 19.20	260	.04	.04	.00	1112.
1.01 19.30	117	.00	.00	.00	60.	1.02 19.30	261	.04	.04	.00	1014.
1.01 19.40	118	.00	.00	.00	54.	1.02 19.40	262	.04	.04	.00	926.
1.01 19.50	119	.00	.00	.00	50.	1.02 19.50	263	.04	.04	.00	844.

[illegible]

HYDROGRAPH AT STA 3 FOR PLAN 1, RTIO 1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CES	2455A	927A	309A	161A	46410A
CMS	70%	27%	9%	5%	1314%
INCHES		2.62	3.38	3.53	3.53
AC-FT		66450	85422	89459	89459
THOUS CU M		475%	613%	639%	639%
		585%	756%	789%	789%

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 2

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12274.	4785.	1546.	806.	232049.
CMS	348.	132.	44.	23.	6271.
INCHES		13.09	16.92	17.64	17.64
MM		332.51	429.76	447.94	447.94
AC-FT		2373.	3066.	3196.	3196.
THOUS CU M		2927.	3782.	3943.	3943.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24348.	9569.	3092.	1611.	464098.
CMS	695.	271.	88.	46.	13142.
INCHES		26.18	33.84	35.27	35.27
MM		665.02	859.51	895.89	895.89
AC-FT		4745.	6133.	6393.	6393.
THOUS CU M		5853.	7565.	7885.	7885.

COMBINE HYDROGRAPHS

ISTAG	ICOMP	IECON	ITAPE	JPLI	JPRI	INAME	ISTAGE	IAUTO
6	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT	6	PLAN 1	RTIO 1	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.

[illegible]

SUM OF 2 HYDROGRAPHS AT 6 PLAN 1 RTIO 2.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
SES	15492	5015	1942	1011	291156
CMS	430	170	55	25	825
INCHES		13.01	16.83	17.50	
MM		330.25	427.37	442.52	
AC-FT		2983	3857	4011	
THOUS. CU M		3679	4757	4947	

SUM OF 2 HYDROGRAPHS AT 6 PLAN 1 RTIO 3

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31409.	12091.	3898.	2028.	584011.
CMS	889.	342.	110.	51.	1653.
INCHES		26.16	33.73	35.09	35.09
MM		664.37	856.76	891.41	891.41
AC-FT		5995.	7732.	8044.	8044.
THOUS CU M		7399.	9537.	9922.	9922.

HYDROGRAPH ROUTING

ROUTE THRU LAKE HARMONY

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0
ROUTING DATA								
QLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR	
0.0	0.000	0.000	1	1	0	0	0	
DAM DATA								
STPS	NSTD	LAG	AMSK	X	TSK	STORA	ISPRAT	
1	0	0	9.000	0.000	0.000	-778.	-1	
STAGE	778.00	780.00	781.00	782.00	783.00	784.00	785.00	790.00
FLOW	0.00	170.00	500.00	940.00	1480.00	2120.00	2860.00	3680.00
SURFACE AREA	0.	37.	60.	80.	90.	100.	120.	135.
CAPACITY	0.	185.	281.	560.	730.	1015.	1674.	2311.
ELEVATION	763.	778.	780.	784.	786.	789.	793.	800.
DAM DATA								
COREL	SPWID	COQM	EXPM	ELEV	COOL	CAREA	EXPL	
778.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
DAM DATA								
TOPEL	COON	EXPD	DAMWID					
781.0	2.9	1.5	524.					
CREST LENGTH	5.	127.	750.	835.	920.	1015.	1100.	1200.
AT OR BELOW								
ELEVATION	781.0	782.0	783.0	785.0	787.0	789.0	791.0	793.0
								795.0
								800.0

STATION 6. PLAN 1. RATIO 1

PEAK OUTFLOW IS 1557. AT TIME 49.82 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1557.	1003.	361.	188.	54001.
CMS	44.	24.	10.	5.	1529.
INCHES		2.17	3.13	3.25	3.25
MM		55.11	79.41	82.43	82.43
AC-FT		477.	717.	744.	744.
THOUS CU M		613.	884.	917.	917.

STATION 6: PLAN 1: RATIO 2

PEAK OUTFLOW IS 14466. AT TIME 40.33 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
14466.	5827.	1906.	287.	284236.
CFS	167.	94.	28.	8049.
INCHES	12.76	16.49	17.08	17.08
MM	324.06	418.87	433.84	433.84
AC-FT	2924.	3780.	3915.	3915.
THOUS CU M	3607.	4663.	4829.	4829.

STATION 6: PLAN 1: RATIO 3

PEAK OUTFLOW IS 30185. AT TIME 40.17 HOURS

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
30185.	12029.	3842.	1992.	573612.
CFS	341.	109.	56.	18243.
INCHES	26.02	33.25	34.47	34.47
MM	660.98	844.65	875.53	875.53
AC-FT	3265.	1620.	1901.	1901.
THOUS CU M	7358.	9400.	9746.	9746.

PEAK FLOW AND STORAGE TEND 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 JO FLOWS			
				RATIO 1	RATIO 2	RATIO 3	
				.10	.50	1.00	
HYDROGRAPH AT	1	.90	1	829.	4143.	8286.	
	(	2.331	(	23.5611	117.3211	235.6411	
ROUTED TO	2	.90	1	383.	3988.	8062.	
	(	2.331	(	10.8411	112.9411	228.2911	
ROUTED TO	3	.90	1	382.	4000.	8102.	
	(	2.331	(	10.8211	113.2711	229.5511	
ROUTED TO	4	.90	1	335.	3295.	7000.	
	(	2.331	(	9.6811	93.2911	198.2111	
HYDROGRAPH AT	5	3.40	1	2455.	12274.	24548.	
	(	8.811	(	69.2111	347.5611	695.1111	
2 COMBINED	6	4.30	1	2680.	15499.	31409.	
	(	11.114	(	75.8911	438.8811	889.3911	
ROUTED TO	6	4.30	1	1557.	14466.	30185.	
	(	11.114	(	44.0211	409.6411	854.7611	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1				
	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	881.00	881.00	883.90
	OUTFLOW	72.	72.	134.
		0.	0.	284.

RATIO OF PMF	MAXIMUM RESERVOIR STORAGE	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FI	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	884.10	.20	138.	383.	1.17	40.33	0.00
.50	885.52	1.32	174.	388.	6.50	40.00	0.00
1.00	886.23	2.33	198.	8062.	11.83	40.00	0.00

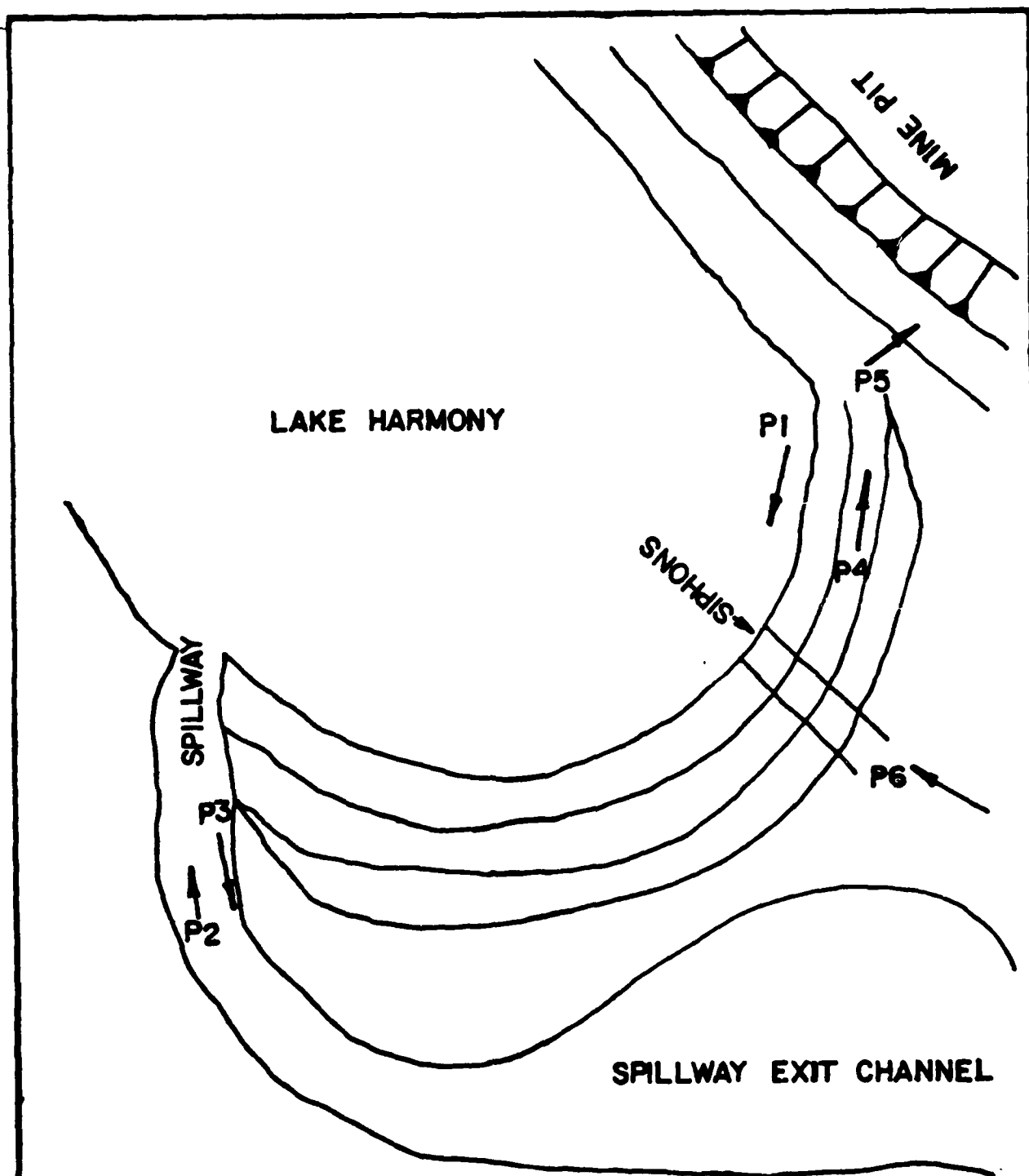
PLAN 1 STATION 3				
RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS	
.10	382.	798.0	40.33	
.50	4000.	798.0	40.00	
1.00	8102.	798.0	40.00	

PLAN 1 STATION 4				
RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS	
.10	335.	777.8	40.67	
.50	3295.	780.4	40.17	
1.00	7000.	781.8	40.17	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1									
ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM			
STORAGE		778.00		778.00		781.00			
OUTFLOW		185.0		185.0		343.0			
		0.		0.		940.			
RATIO OF PHE	MAXIMUM RESERVOIR WATER LEVEL	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FI	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF			
						MAX OUTFLOW		FAILURE	
						HOURS		HOURS	
0.10	781.91	.91	404.	1557.	3.00	40.83	0.00	0.00	0.00
0.50	785.04	5.04	646.	14466.	2.23	50.23	0.00	0.00	0.00
1.00	786.91	5.91	814.	30185.	1.83	40.17	0.00	0.00	0.00

PHOTOGRAPHS



P-INDICATES PHOTO LOCATION

LAKE HARMONY
PHOTO INDEX



Photograph No. 2

Spillway control section.



Photograph No. 3

Spillway exit channel.



Photograph No. 4

Low point on top of dam adjacent to road.



Photograph No. 5

Mine pit adjacent to road.



Photograph No. 6

Downstream slope of dam and siphons.

DATE
TIME