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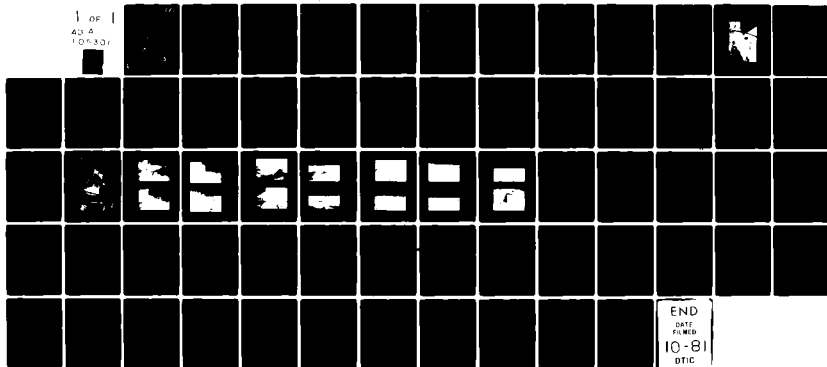
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KELLER LAKE DAM

ANDREW COUNTY, MISSOURI

MO. 11608

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



**United States Army
Corps of Engineers**

*...Serving the Army
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St. Louis District

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

FOR: STATE OF MISSOURI

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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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KELLER LAKE DAM
ANDREW COUNTY, MISSOURI
MISSOURI IDENTIFICATION NO. MO.11608

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, 1980

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ST. LOUIS, MISSOURI 63101

SUBJECT: Keller Lake Dam - MO 11608

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

SUBMITTED BY:

SIGNED

Chief, Engineering Division

25 SEP 1980

Date

APPROVED BY:

SIGNED

Colonel, CE, District Engineer

27 SEP 1980

Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

Name of Dam	Keller Lake Dam
State Located	Missouri
County Located	Andrew County
Stream	Tributary to Dillon Creek
Date of Inspection	June 2, 1980

Keller 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.

Keller Lake Dam has a height of twenty-five (25) feet and a storage capacity at the minimum top elevation of the dam of forty-three (43) acre-feet. In accordance with the guidelines, a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Keller Lake Dam is classified as a small size dam.

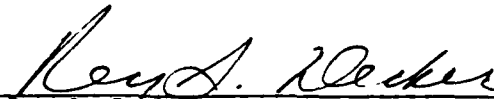
In accordance with the guidelines and based on visual observation, dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends about one mile downstream of the dam. Within the damage zone are two small lakes and dams, eleven trailer homes and Highway I-29.

Our inspection and evaluation indicates that the spillways meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the small volume of water impounded, one-half of the Probable Maximum Flood is the appropriate spillway design flood. The spillways will pass the 100-year flood (1% probability flood, a flood having a one percent chance of being exceeded in any year) without overtopping the dam. The spillways will pass 80% 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. Based on the observation made during the field inspection of the dam. This dam is considered to be structurally and hydrologically adequate and safe.

The following recommendations are made in regard to maintenance of the dam:

- a. The willow trees and brush should be removed from the upstream slope.
- b. Trees and brush up to 12 to 14 inches in diameter should be removed from the downstream slope under the guidance of an engineer experienced in the design and construction of dams and a good vegetative cover reestablished.
- c. A program of regular inspection and maintenance should be initiated with particular emphasis on the removal and/or control of the tree growth on the slopes.



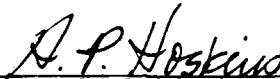
Rey S. Decker
E-3703



Gordon Jamison



Garold Ulmer
E-19246



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



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
KELLER LAKE DAM - MO 11608
ANDREW 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 Keller Lake Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) The dam is an earth fill approximately 425 feet in length and 25 feet in height. The maximum water storage at the minimum top of dam is 43 acre-feet. This site is located in the dissected till plains area of the Central Lowlands Physiographic Region.
 - (2) The spillway is an uncontrolled earth channel cut through the right abutment. A seven-inch diameter cast iron pipe culvert approximately 23 feet in length crosses under the gravelled road control section spanning the spillway.
 - (3) Pertinent physical data are given in paragraph 1.3 below.
- b. Location. The dam is located in the south central portion of Andrew County, Missouri, as shown on Plate A-2. The dam is shown on Plate A-1 in the SE 1/4 of Section 3, T 58 N, R 35 W.
- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Keller Lake Dam has a height of 25 feet and a storage capacity at the minimum top elevation of the dam of 43 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category.

- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines and visual observation, this dam is in the High Hazard Classification. The estimated damage zone extends about one mile downstream of the dam. Within the damage zone are two small lakes and dams, eleven trailer homes and Highway I-29.
- e. Ownership. The dam is owned by Mr. A. J. Keller, Route 3, St. Joseph, Missouri 64505.
- f. Purpose of Dam. The dam was constructed to impound water to be used by a ready-mix concrete plant owned by Mr. A. J. Keller. The concrete plant was sold in 1968, and the reservoir no longer is used for its original purpose.
- g. Design and Construction History. The dam was constructed in 1963 by Mr. A. J. Keller who stated that a core trench was excavated six feet into clay. Materials for the embankment were borrowed from the abutments and were compacted with sheepsfoot rollers. A 2 1/2-inch pipeline was constructed through the left end of the dam to carry water from the reservoir to the concrete plant.
- h. Normal Operating Procedure. There are no controlled outlets for this dam other than the 2 1/2-inch pipeline formerly used to transport water to the concrete plant. The level of the pool is dependent upon precipitation, infiltration, evaporation, and the capacity of the uncontrolled spillway.

1.3 PERTINENT DATA

- a. Drainage Area. 31.3 acres (0.049 acres).
- b. Discharge At Damsite.
 - (1) All discharges at the damsite are through an uncontrolled vegetated earth spillway cut through the right abutment with a gravel covered road normal to the spillway acting as a weir. There is a 7-inch diameter cast iron pipe acting as a culvert under the road that discharges into the spillway channel.
 - (2) Estimated maximum flood at damsite--- It was reported by Mr. A. J. Keller that the maximum discharge through the spillway produced an approximate depth of 1 foot of water in the spillway. It was not reported when that occurred.
 - (3) The spillway capacity varies from 0 c.f.s. at its crest (elevation 1018.0 feet) to 327 c.f.s. at the minimum top of dam (elevation 1019.7 feet).
 - (4) Total spillway capacity at the minimum top of dam is 327 c.f.s. $\pm$

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

- (1) Top of dam - 1019.7 (minimum)
- (2) Spillway crest - 1018.0 (crest of road);
1017.5 (invert of 7-inch diameter culvert)
- (3) Observed pool - 1017.2
- (4) Normal pool - 1017.5
- (5) Maximum experienced pool - 1018.5 $\pm$
- (6) Streambed at centerline - 994.5
- (7) Maximum tailwater - Unknown

d. Reservoir. Length (feet) of pool

- (1) Spillway Crest - 600 $\pm$
- (2) Top of Dam (minimum) - 700 $\pm$

e. Storage (Acre-feet).

- (1) Top of dam - 43 $\pm$
- (2) Spillway crest - 34 $\pm$
- (3) Observed pool - 34 $\pm$
- (4) Normal pool - 34 $\pm$
- (5) Maximum experienced pool - 35 $\pm$

f. Reservoir Surface (Acres).

- (1) Top of dam - 6 $\pm$
- (2) Spillway crest - 4 $\pm$
- (3) Observed pool - 4 $\pm$
- (4) Normal pool - 4 $\pm$
- (5) Maximum experienced pool - 5 $\pm$

g. Dam.

- (1) Type - Earth fill
- (2) Length - 425 ft. $\pm$
- (3) Height - 25 ft. $\pm$
- (4) Top width - 15 ft. $\pm$

(5) Side slopes.

(a) Downstream - 1V on 2.1 H, 1V on 3.3 H, 1V on 1.6 H
(avg. 1V on 2 H)

(b) Upstream - 1V on 1.3 H (exposed)

(6) Zoning - unknown

(7) Impervious core - Core trench excavated 6 feet into clay (reported by Mr. A. J. Keller).

(8) Cutoff - unknown

(9) Grout curtain - unknown

(10) Wave protection - concrete rubble riprap

(11) Drains - none

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

(1) Principal (and only)

(a) Type - Vegetated earth, uncontrolled spillway cut through right abutment with a 7-inch diameter cast iron pipe culvert under the gravel surfaced road that crosses the spillway.

(b) Control section - gravel surfaced road crossing the spillway acting as a weir.

(c) Crest elevation - 1018.0 (minimum road surface elevation)

(d) Upstream Channel - clear of vegetation. Water surface at the upstream end of the 7-inch culvert. Slope of channel unknown.

(e) Downstream Channel - Channel excavated in a hillside in a westerly direction from the right end of the dam approximately 500 feet where it discharges into a small reservoir.

j. Regulating Outlets. None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. Mr. A. J. Keller reported that he had constructed the dam in 1963 and that a core trench had been excavated to a depth of six feet into clay. It was also reported that the embankment materials were borrowed from the abutments and that compaction was done with sheepsfoot rollers.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. A. J. Keller that the maximum discharge in the spillway produced an approximate depth of one foot of water in the spillway.

2.4 EVALUATION

- a. Availability. No data were available
- b. Adequacy. The field surveys and visual observations 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 Keller Lake Dam was made on June 2, 1980. Engineers from Hoskins-Western-Sonderregger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical, Garold Ulmer and Gordon Jamison, Hydrology and Hydraulics. The owner, Mr. A. J. Keller, was interviewed prior to the inspection but was not present during the inspection.

b. Dam.

- (1) Geology and Soils (abutment and embankment). Keller Lake Dam is located in the dissected till plains area within the Central Lowlands Physiographic Region. The dam site is in a region where the stratigraphic sequence consists of loess, 4 to 8 feet thick, overlying Kansan-age glacial drift, of undetermined thickness and character which in turn overlies bedrock. Bedrock beneath the site consists of strata assigned to the Pedee and Lansing Groups, Missourian Series, Pennsylvanian System. Strata of these two groups are comprised of interlayered sequences of shale, sandstone, and limestone.

The upland soils in the dam area consists of soils of the Knox-Marshall soil association. This soil association is common in the dissected areas adjacent to the Missouri River where soils are formed on deep loess deposits. They are positioned on rolling to hilly topography with the Knox soils occupying the steeper slopes and narrow ridgetops. The Marshall soil occupies the more gently sloping areas. Both soils have a moderate infiltration rate.

The abutments consist of loess colluvium overlying glacial till. Till (gravelly CH) is exposed along the shoreline on the right side of the reservoir (See Photo No. 10) Materials in the valley consist of alluvium of unknown depth. Materials in the dam are CL-CH borrowed from the loess-till abutments.

- (2) Upstream Slope. The upstream slope is pretty well covered with concrete rubble riprap. No erosion was noted. A few small trees and brush are growing along the waterline. No bulges or slumps were observed. Some loose dirt had been recently placed along the upstream face in the area of station 2 + 70 to 3 + 00. The reason for this new fill is not known. Photo No. 2 shows the upstream slope and Photo No. 5 the recent repair work on the slope.
- (3) Crest. The crest is well vegetated with adapted grasses and legumes. Measurements indicate that the crest elevation is quite uniform. A section of the upstream crest (and upstream slope) between centerline station 2 + 70 and 3 + 00 had been recently filled with soil as shown in Photo No. 5. No cracks

were observed on the crest. No bulges were observable along the crest, but two utility poles on the crest lean downstream at about 5 to 10 degrees off vertical. The crest and leaning poles are shown in Photo 3, 4 and 5.

- (4) Downstream Slope. The downstream slope is well covered with brush and trees up to 12 to 14 inches in diameter. There is a sparse cover of grass beneath the trees. No significant erosion was noted. The downstream slope is shown in Photos 3, 4 & 7. A berm-like projecting or slump occurs on the downstream slope about 10 feet vertically below the crest, from about centerline station 1 + 75 to 3 + 50. It is not known whether this was a constructed berm or is the result of bulging and/or spreading of the embankment. Although the power poles on the crest are leaning downstream, the trees on the downslope in this area do not appear to be misaligned. At the present time it appears to be stable and is used as a cow path. This area is shown in Photo No. 6.

A small seepage area was observed in the lower end of the right abutment trough. There was no visible discharge from this seep.

c. Appurtenant Structures.

- (1) Spillway- The uncontrolled spillway consists of a cut through the right abutment. It has a bottom width of 35 feet $\pm$ with side slopes of 1V on 12 H or flatter. A roadway, that appeared relatively new, was constructed across the spillway. A 7-inch cast iron pipe passed through the base of the roadway. An old conservation terrace serves as the outlet for the spillway. This terrace goes around the ridge into an adjacent drainage way. The first 80 to 100 feet of outlet channel immediately downstream from the roadway has been recently denuded of vegetation. The terrace channel downstream from this area is well vegetated with adapted grasses. The entrance section is open and clear. Photos 8 & 9 show the spillway.
- (2) Drawdown Facility- Mr. A. J. Keller reported that there is a 2 1/2-inch steel pipeline passing through the left end of the dam that was used as a water supply for the concrete ready-mix plant. The concrete plant is now dismantled, and this pipeline has not been used for several years.

- d. Reservoir Area. The area around the reservoir is well grassed, and there was no erosion apparent along the waterline. Mr. A. J. Keller reported that a permanent spring along the west side feeds into the reservoir. Photo No. 11 shows a portion of the reservoir.

- e. Downstream Channel. The downstream channel from the spillway does

not enter the old channel downstream from the dam. The channel is excavated in a hillside leading to the west approximately 500 feet where it discharges into a small reservoir. Photo No. 1 shows a portion of the small reservoir at the extreme left center. The channel is devoid of vegetative growth for a distance of 80 to 100 feet downstream from the gravelled road that serves as the spillway control section, and the raw appearance would indicate recent construction. The remainder of the channel has good vegetative growth with no trees or brush. Photos 8 and 9 show views of the channel immediately downstream from the control section.

3.2 EVALUATION

This dam is in reasonably good shape with no serious potential of failure. The slight seepage in the right abutment trough has no apparent detrimental effect upon the integrity of the dam. The cause of the irregularities (berm, slump or what) in the downstream slope and the leaning power poles is not known; however, there is no evidence of recent deformation on the slope (trees on the slope, up to 12 inches in diameter, appear to be near vertical). Tree growth on the downstream slope could ultimately impair the integrity of the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The only controlled outlet for this dam is the 2 1/2-inch pipe that formerly carried water from the reservoir to the concrete plant. The pool level is controlled by rainfall, infiltration, evaporation, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

The extensive tree growth on the downstream slope of the dam would indicate some deficiency in maintenance operations.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam other than the 2 1/2-inch pipe that formerly carried water from the reservoir to the concrete plant. The concrete plant is no longer in use.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

The majority of deficiencies observed during the inspection were due to a lack of routine maintenance.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS St. Joseph North, Missouri, 7.5 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.
- c. Visual Observations.
 - (1) The spillway is cut through the right abutment and discharges into a terrace which drains into an adjoining small reservoir (See Photo No. 1). Spillway releases will not endanger the integrity of the dam.
 - (2) A road over the spillway with a 7-inch pipe culvert appeared to have been recently constructed.
 - (3) It is reported by Mr. A. J. Keller that there is a 2 1/2-inch drawdown pipe through the dam which had been used as a water supply for a concrete plant in the past. The pipe was not located during the inspection.
- d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. The spillways will pass the 1% probabilistic flood as well as 80% of the probable maximum flood without overtopping the dam. The overtopping which the embankment would experience during the PMF is such that it should not cause excessive damage. The results of the routings through the dam are tabulated in regards to the following conditions:

Frequency	Inflow Discharge c.f.s.	Outflow Discharge c.f.s.	Maximum Pool Elevation	*Maximum Depth Over Dam, Ft.	Duration Over Top Hr.
1/2 PMF	270	190	1019.3	0	0
PMF	550	430	1019.9	0.2	1-
0.80 PMF	440	320	1019.7	0	0

*Minimum top of dam elevation - 1019.7

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 from the standpoint of strength and excess seepage pressures. Any deformation processes that could have caused the irregularities in the downstream slope have evidently stabilized. The dam has been in place with full reservoir for 17 years, and there is no evidence of recent movements of slides on the downstream slope. Uncontrolled tree growth on the downstream slope might ultimately affect the safety of the structure.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Operating Records. There are no controlled operating facilities for this dam other than the 2 1/2-inch water line which formerly carried water from the reservoir to the concrete plant.
- d. Post Construction Changes. It would appear that the road crossing the spillway has been constructed rather recently.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of 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. This dam is in reasonably good condition except for extensive tree growth on the downstream slope and a few small willows on the upstream slope. It is considered to be structurally stable. It is hydrologically adequate to pass 80% of the probable maximum flood (PMF) without overtopping and the PMF storm will only overtop the dam by 0.2 foot + for about 1 hour which should not cause extensive damage to the embankment.

This dam does not appear to have any serious potential of failure. 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.

- 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 "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.
- c. Urgency. There does not appear to be any urgency to accomplish the remedial measures recommended in paragraph 7.2.
- d. Necessity for Further Investigations. Further investigations are 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

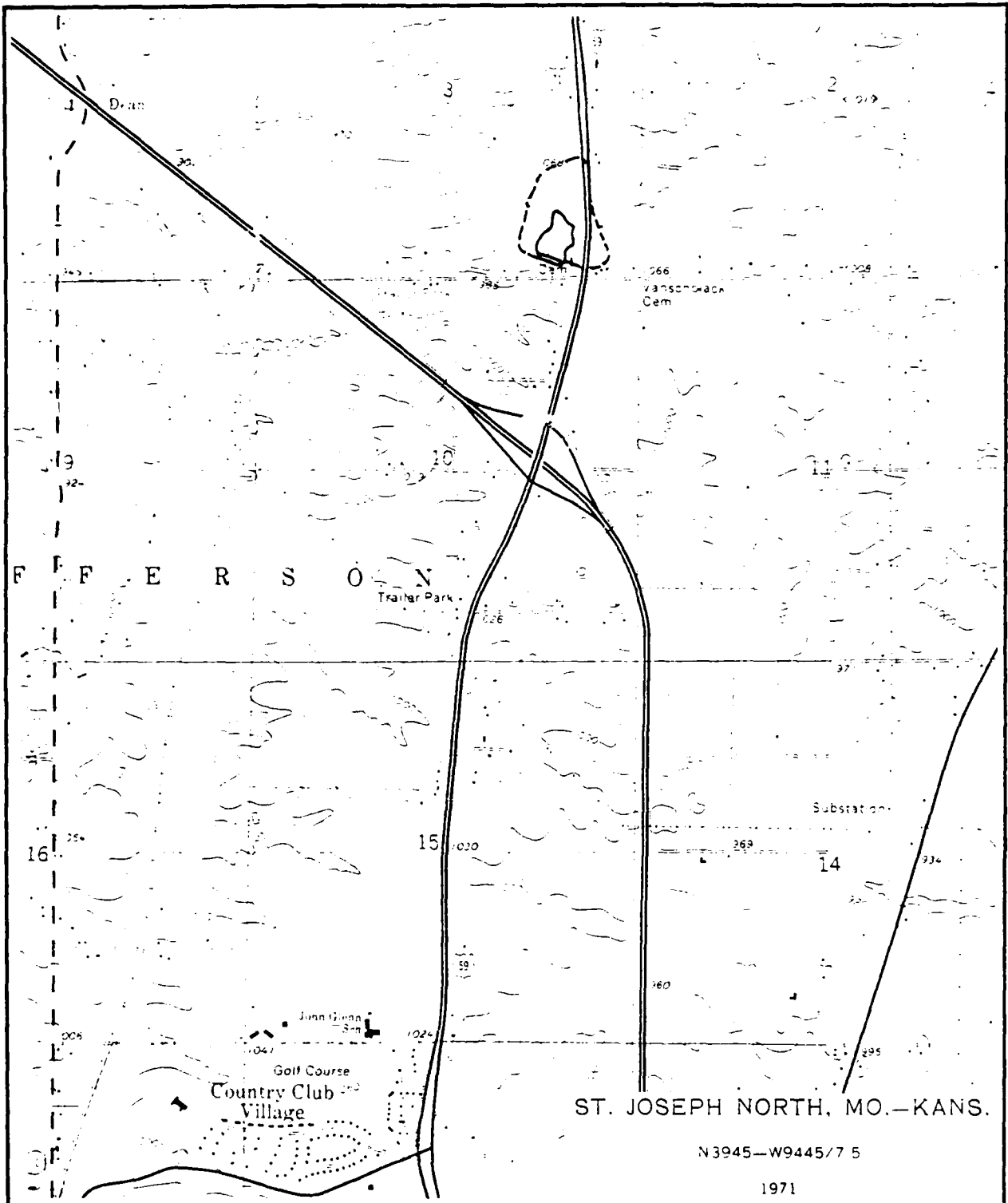
- a. Alternatives.

- (1) Since the dam and spillway pass 80 percent of the PMF and are in relatively good condition, no alternative methods of accommodating the PMF are required.

- b. Operation and Maintenance Procedures.

- (1) The willow trees and brush should be removed from the upstream slope.
- (2) Trees and brush up to 12 to 14 inches in diameter should be removed from the downstream slope under the guidance of an engineer experienced in the design and construction of dams. A good vegetative cover should be reestablished.
- (3) A program of regular inspection and maintenance should be initiated with particular emphasis on the removal and/or control of tree growth on the slopes.

APPENDIX A
MAPS



Scale in feet
2000 1000 0 2000 4000

Contour Interval - 20'



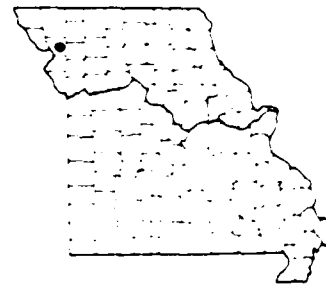
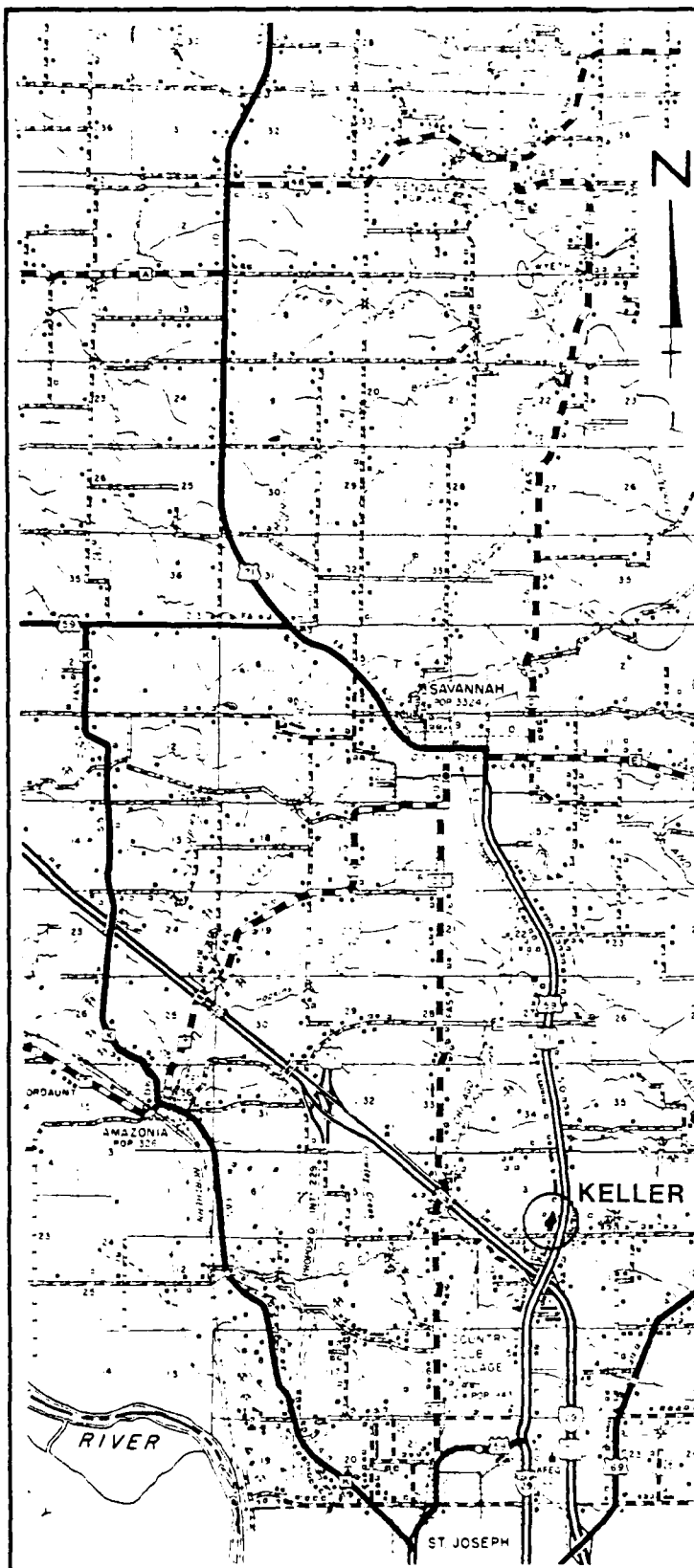
VICINITY TOPOGRAPHY

KELLER LAKE DAM

ANDREW COUNTY, MISSOURI

MO. 11608

PLATE A-1

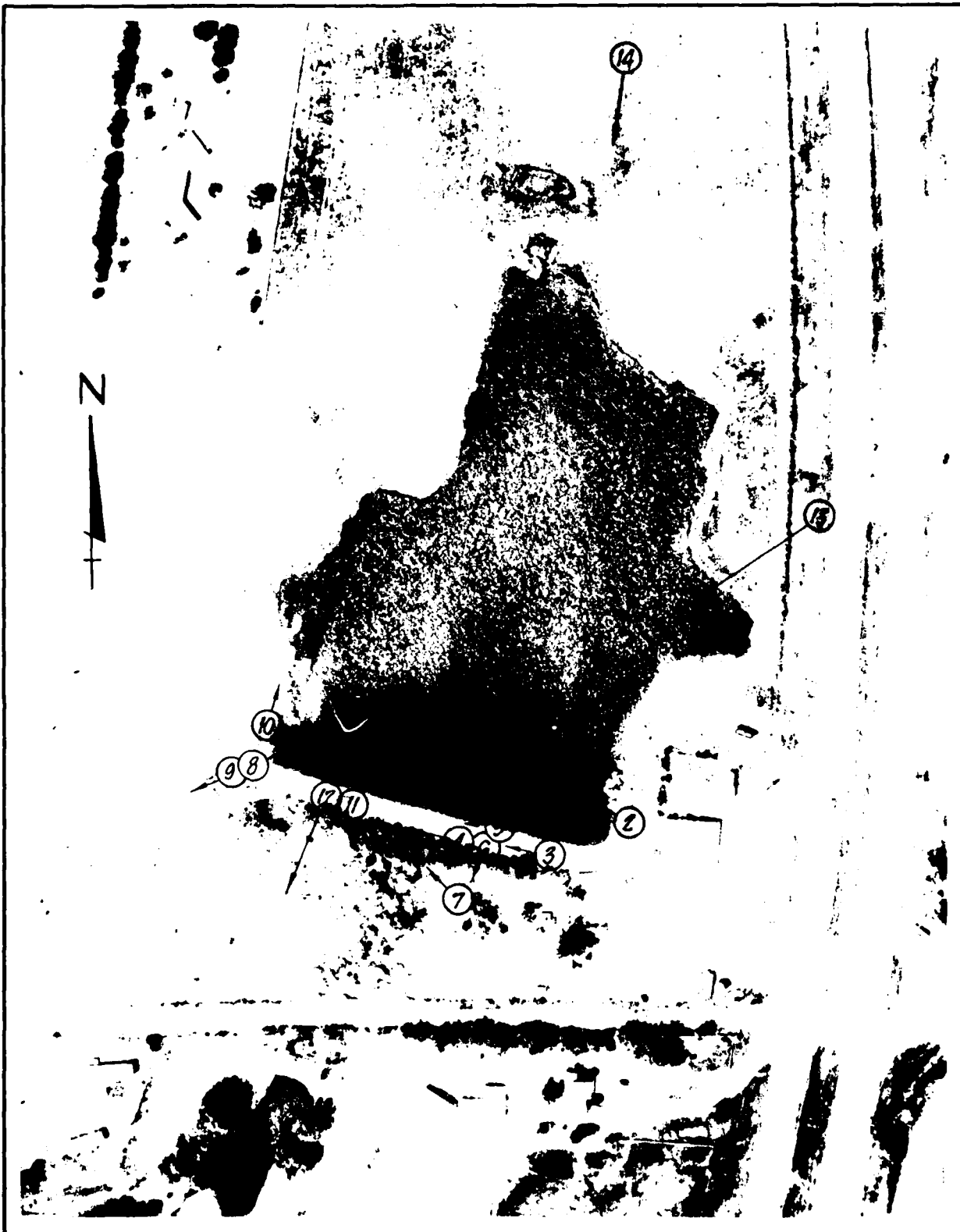


VICINITY MAP
ID NO. MO 11608
ANDREW COUNTY, MISSOURI

Scale in miles
0 1 2 3 4 5

LOCATION MAP
PLATE A-2

APPENDIX B
PHOTOGRAPHS



KELLER LAKE DAM
ANDREW COUNTY, MISSOURI
MO 11608

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - UPSTREAM FACE TAKEN FROM LEFT END. WELL COVERED WITH OLD CONCRETE RUBBLE



PHOTO NO. 3 - CREST TAKEN FROM LEFT END



PHOTO NO. 4 - LOOKING LEFT TO RIGHT ALONG THE DOWNSTREAM CREST AT TWO POWER POLES WHICH ARE OFF VERTICAL ABOUT 5° to 10°



PHOTO NO. 5 - REPAIR WORK ON UPSTREAM FACE AT ABOUT STA. 2+70 to 3+00

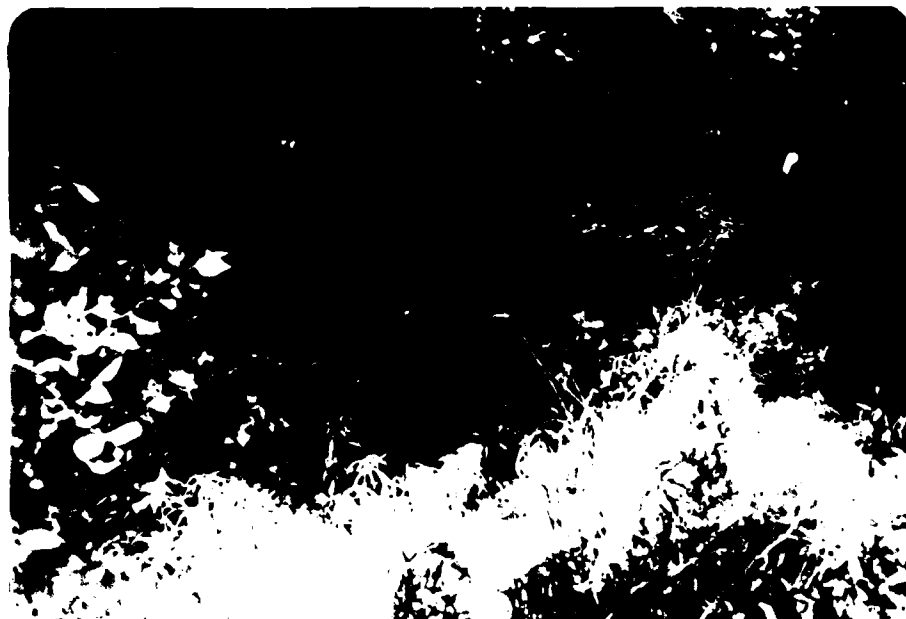


PHOTO NO. 6 - LOOKING DOWNSTREAM ON THE BACKSLOPE SHOWING
THE COW PATH

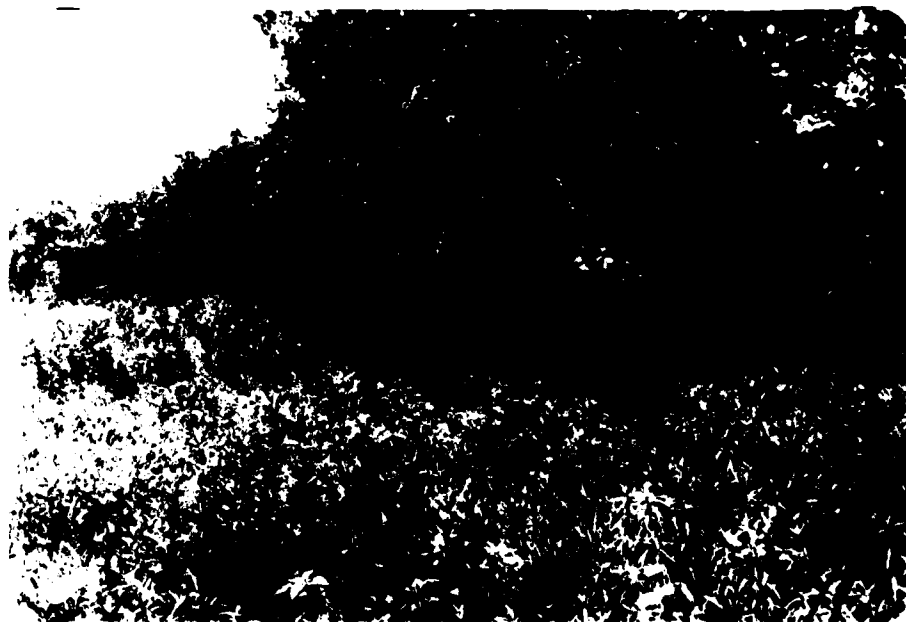


PHOTO NO. 7 - DOWNSTREAM SLOPE TAKEN FROM LEFT END. SLOPE
ALMOST COMPLETELY COVERED WITH TREES & RUBBISH. TREES UP TO
12 TO 15 INCHES IN DIAMETER



PHOTO NO. 8 - LOOKING UPSTREAM IN THE EMERGENCY SPILLWAY



PHOTO NO. 9 - LOOKING DOWNSTREAM THE EMERGENCY SPILLWAY WHICH DRAINS INTO A LOW TERRACE & INTO AN ADJOINING SMALL RESERVOIR



PHOTO NO. 10 - GLACIAL TILL OUTCROPPING ALONG RIGHT SHORELINE JUST UPSTREAM FROM THE RIGHT END OF DAM



PHOTO NO. 11 - LOOKING UPSTREAM AT ABOUT STA. 4+30



PHOTO NO. 12 - LOOKING DOWNSTREAM FROM ABOUT STA. 4+30. NOTE THE OTHER SMALL LAKE JUST DOWNSTREAM OF KELLER LAKE



PHOTO NO. 13 - OVERVIEW FROM LEFT SIDE



PHOTO NO. 14 - OVERVIEW FROM NORTH END

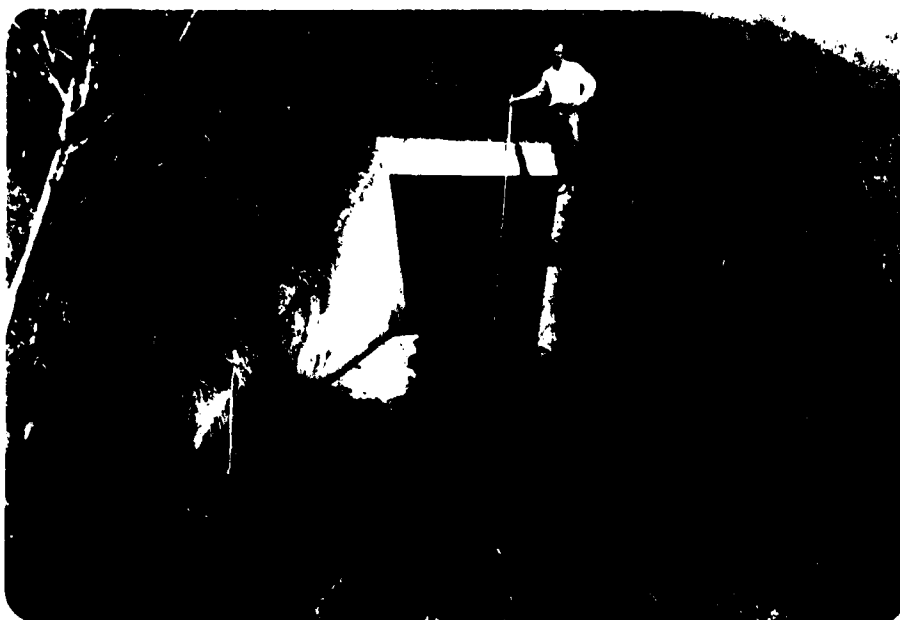
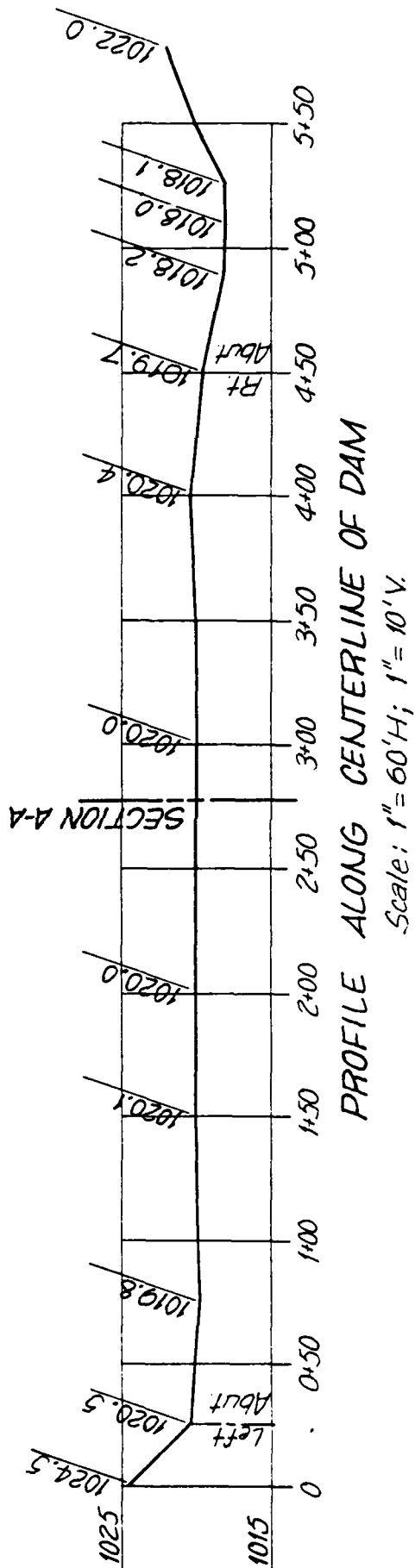
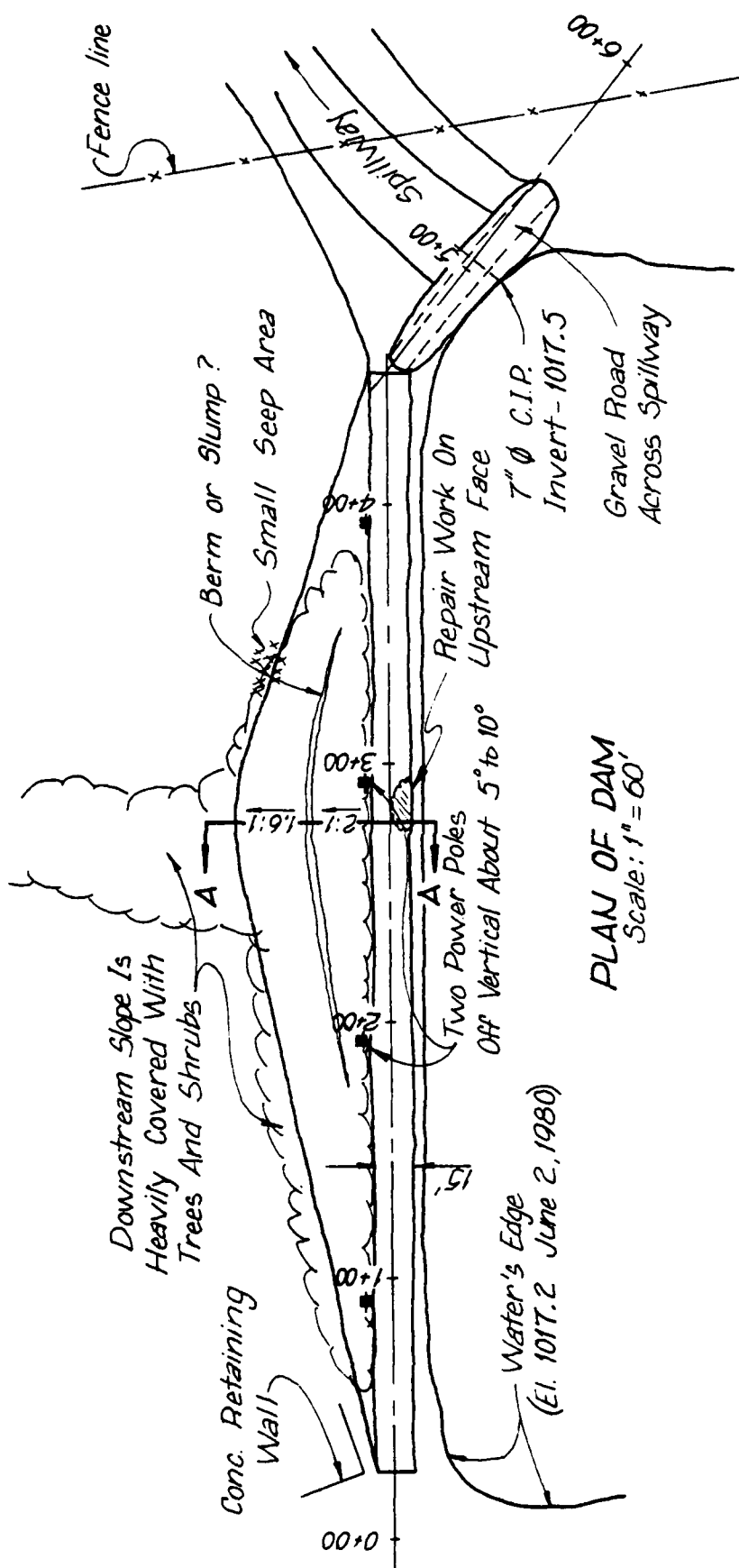
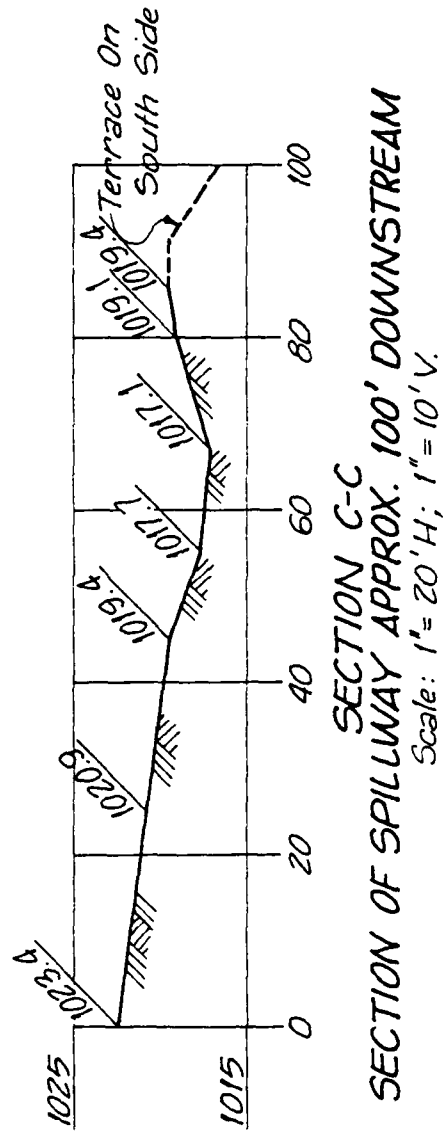
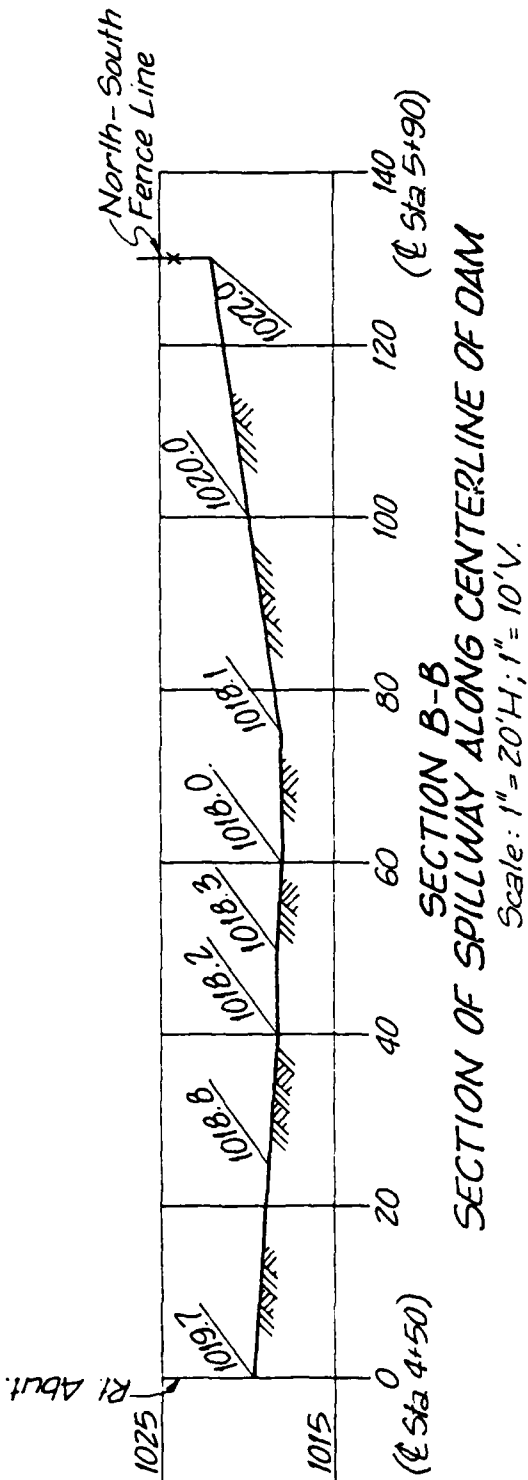


PHOTO NO. 15 - 6' x 6' CULVERT UNDER INTERSTATE 29

APPENDIX C
PROJECT PLATES





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 Appendix).
 - a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Sweet Springs, Mo. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology. The rainfall distribution as described by EM 1110-2-1411 (Standard Project Storm) was used in distributing the rainfall.
 - b. Drainage area = 0.049 square miles (31.3 acres).
 - c. Time of concentration of runoff = 9.6 minutes (computed from SCS "Upland" method). 900 feet of the watershed is in short grass pasture (overland flow) with an average watershed slope of approximately 6%. The overland flow velocity was assumed to be 1.7 ft/sec. Approximately 575 ft of the watershed course was reservoir. Assuming a mean depth of 10 feet, the velocity through the reservoir was assumed to be 16 ft/sec. Travel time was computed using the equation: $T_t = l/3600V$, where l = length, in feet and V = velocity.

The time of concentration was verified using the "Kirpich" method. A value of 7.7 minutes was obtained. The SCS "Upland" method value was used due to the large amount of overland flow in lieu of small gully flow.
 - 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 one percent probabilistic 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 spillway. The 7-inch diameter spillway pipe was assumed negligible in relation to the routings due to the antecedent storm preceding the routings.
 - e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 3.35 inches. The total losses for the PMF storm were 1.87 inches. These data are based on SCS runoff curve No. 86 and No. 71 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily the SCS soil association Marshall-Knox of which both are of hydrologic soil group B. The watershed is mostly in pasture.
 - f. Average soil loss rates = 0.08 inch per hour approximately

- g. The owner stated that the reservoir was spring fed. The spring keeps the lake level about constant; therefore, it replenishes only what the lake loses due to evaporation. With such a small surface area (4-6 acres), evaporation would be minimal. For this reason, the flow into the reservoir from the spring was ignored in the hydrologic routings of the dam.
- 2. The combined discharge rating consisted of two components: the flow through the spillway and the flow over the top of the dam.
 - a. The spillway discharge rating was developed using methods for flow over Highway Embankments in U.S.G.S. TWRI, BK. 3, Ch. A-5 (coefficients based on h/l ratios and a gravel road surface).
 - b. The flows over the dam crest were developed using the HEC-1 (Dam Safety Version) program using the irregular top of dam option.
- 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 input, output, and plotted hydrographs are attached in this Appendix.

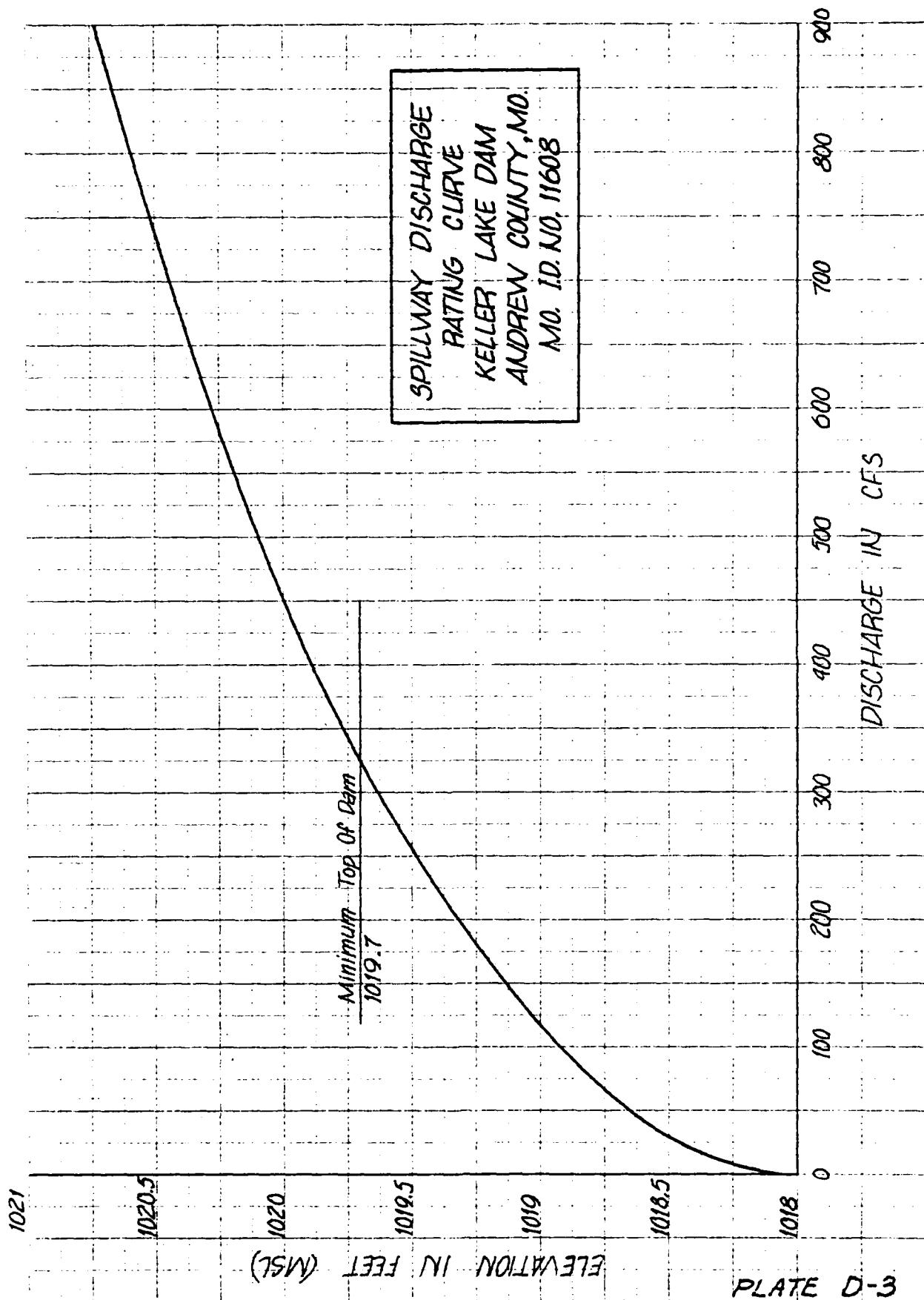


PLATE D-3

A1	ANALYSIS UF DAM OVERTOPPING USING RATIOS OF PMF		
A2	HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KELLER LAKE DAM 11608		
A3	RATIOS UF PMF ROUTED THROUGH THE RESERVOIR		
D	0002880000000000000005		0000000000000000000003
B1	000005		
J	00000100000009000000001		
J1	000.500000.600000.700000.750000.800000.850000.900000.9500001.00		
K	00000000000001		0000000000000000000001
K1	CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 11608		00000001
M	0000010000002000.049		0000.049000001.0
P	000000000024.1000001020000012100000130		
T		-1.0	-86.0
W	200000000000.17		
X	000000 - .0100000001		
K	00000100000002	000000200000000000000001	
K1	ROUTED FLOWS THRU RESERVOIR 11608		
Y	000000010000001		
Y1	0000001	-1018.0	-1
Y4	1018.0001018.5001019.1001019.7001020.5001021.0001022.0001023.0001024.0001025.0		
Y5	0000000000028.9000140.3000327.4000737.80000108400001912000029880000422700005606		
Y6	0000000000004.25000006.0000014.7		
Y7	0995.0001017.5001020.0001040.0		
Y8	1018.0		
Y9	1019.7000002.9000001.50000425.		
Y10	0000000000052000001950000036000000420000000425000000425		
Y11	1019.7001019.9001020.0001020.2001020.4001020.6001021.0001025.0		
K	000099		

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

RUN DATE= 00/07/16.
 TIME= 14.45.24.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF KELLER LAKE DAM 11608
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

JOB SPECIFICATION									
NO	NHR	AMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	INSTAN
28H	0	5	0	0	0	0	0	3	0
JOPER				NMT	LROPT	TRACE			
5				0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIUS= .50 .60 .70 .75 .80 .85 .90 .95 1.00
 NPLAN= 1 NRTIO= 9 LRTIO= 1

SUR-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 11608

ISTAQ	ICUMP	IECON	ITAPE	JPLT	JPRY	INAME	ISTAGE	TAUTO
CCCC01	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INHYG	IWUG	IAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.05	0.00	.05	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PM5	R6	R12	R24	R48	R72	R96
0.00	24.10	102.00	121.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	SIRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRIL	CNSTL	ALSPX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-86.00	0.00	0.00

CURVE NO = -86.00 WEIKNSS = -1.00 EFFECT CN = 86.00

UNIT HYDROGRAPH DATA

IC= 0.00 LAG= .17

RECESSION DATA

STRIC= 0.00 QRESN= -.01 RTICR= 1.00

UNIT HYDROGRAPH 12 ENL OF PERIOD UPDATES, IC= 0.00 HOURS, LAG= .17 VOL= 1.00
 34. 103. 106. 66. 33. 18. 9. 5. 3. 1.
 1. 0.

END-13-PERIOD FLOW

MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO. DA	HR. MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	05	1	.01	0.00	.01	0.	1.01	12.05	145	.20	.19	.01	27.
1.01	10	2	.01	0.00	.01	0.	1.01	12.10	146	.20	.19	.01	41.
1.01	15	3	.01	0.00	.01	0.	1.01	12.15	147	.20	.19	.01	55.
1.01	20	4	.01	0.00	.01	0.	1.01	12.20	148	.20	.20	.01	64.
1.01	25	5	.01	0.00	.01	0.	1.01	12.25	149	.20	.20	.01	69.
1.01	30	6	.01	0.00	.01	0.	1.01	12.30	150	.20	.20	.01	71.
1.01	35	7	.01	0.00	.01	0.	1.01	12.35	151	.20	.20	.01	73.
1.01	40	8	.01	0.00	.01	0.	1.01	12.40	152	.20	.20	.01	74.
1.01	45	9	.01	0.00	.01	0.	1.01	12.45	153	.20	.20	.01	74.
1.01	50	10	.01	0.00	.01	0.	1.01	12.50	154	.20	.20	.01	74.
1.01	55	11	.01	0.00	.01	0.	1.01	12.55	155	.20	.20	.01	75.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.20	.20	.01	75.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.25	.24	.01	76.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.25	.24	.01	81.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.25	.24	.01	85.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.20	160	.25	.24	.01	88.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.25	161	.25	.24	.01	89.
1.01	1.30	18	.01	0.00	.01	0.	1.01	13.30	162	.25	.24	.01	90.
1.01	1.35	19	.01	0.00	.01	0.	1.01	13.35	163	.25	.24	.01	90.
1.01	1.40	20	.01	0.00	.01	0.	1.01	13.40	164	.25	.24	.01	91.
1.01	1.45	21	.01	0.00	.01	0.	1.01	13.45	165	.25	.24	.01	91.
1.01	1.50	22	.01	0.00	.01	0.	1.01	13.50	166	.25	.24	.00	91.
1.01	1.55	23	.01	0.00	.01	0.	1.01	13.55	167	.25	.24	.00	91.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.00	168	.25	.24	.00	91.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.05	169	.31	.30	.01	93.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.10	170	.31	.30	.01	100.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.15	171	.31	.30	.00	106.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.20	172	.31	.30	.00	110.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.25	173	.31	.30	.00	112.
1.01	2.30	30	.01	0.00	.01	0.	1.01	14.30	174	.31	.30	.00	114.
1.01	2.35	31	.01	0.00	.01	0.	1.01	14.35	175	.31	.30	.00	114.
1.01	2.40	32	.01	0.00	.01	0.	1.01	14.40	176	.31	.30	.00	115.
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1.01	2.50	34	.01	0.00	.01	0.	1.01	14.50	178	.31	.30	.00	115.
1.01	2.55	35	.01	0.00	.01	0.	1.01	14.55	179	.31	.30	.00	115.
1.01	3.00	36	.01	0.00	.01	0.	1.01	15.00	180	.31	.30	.00	115.
1.01	3.05	37	.01	0.00	.01	0.	1.01	15.05	181	.19	.18	.00	111.
1.01	3.10	38	.01	0.00	.01	1.	1.01	15.10	182	.37	.37	.00	105.
1.01	3.15	39	.01	0.00	.01	1.	1.01	15.15	183	.37	.37	.00	112.
1.01	3.20	40	.01	0.00	.01	1.	1.01	15.20	184	.56	.56	.01	130.
1.01	3.25	41	.01	0.00	.01	1.	1.01	15.25	185	.65	.65	.01	160.
1.01	3.30	42	.01	0.00	.01	1.	1.01	15.30	186	1.59	1.58	.01	225.
1.01	3.35	43	.01	0.00	.01	1.	1.01	15.35	187	2.62	2.60	.02	374.
1.01	3.40	44	.01	0.00	.01	1.	1.01	15.40	188	1.03	1.02	.01	543.
1.01	3.45	45	.01	0.00	.01	1.	1.01	15.45	189	.65	.65	.00	545.
1.01	3.50	46	.01	0.00	.01	1.	1.01	15.50	190	.56	.56	.00	439.
1.01	3.55	47	.01	0.00	.01	1.	1.01	15.55	191	.37	.37	.00	332.
1.01	4.00	48	.01	0.00	.01	1.	1.01	16.00	192	.37	.37	.00	254.
1.01	4.05	49	.01	0.00	.01	1.	1.01	16.05	193	.29	.29	.00	199.
1.01	4.10	50	.01	0.00	.01	1.	1.01	16.10	194	.29	.29	.00	161.
1.01	4.15	51	.01	0.00	.01	1.	1.01	16.15	195	.29	.29	.00	137.
1.01	4.20	52	.01	0.00	.01	1.	1.01	16.20	196	.29	.29	.00	123.
1.01	4.25	53	.01	0.00	.01	1.	1.01	16.25	197	.29	.29	.00	116.
1.01	4.30	54	.01	0.00	.01	1.	1.01	16.30	198	.29	.29	.00	112.
1.01	4.35	55	.01	0.00	.01	1.	1.01	16.35	199	.29	.29	.00	110.
1.01	4.40	56	.01	0.00	.01	1.	1.01	16.40	200	.29	.29	.00	109.
1.01	4.45	57	.01	0.00	.01	1.	1.01	16.45	201	.29	.29	.00	109.
1.01	4.50	58	.01	0.00	.01	1.	1.01	16.50	202	.29	.29	.00	108.
1.01	4.55	59	.01	0.00	.01	1.	1.01	16.55	203	.29	.29	.00	108.
1.01	5.00	60	.01	0.00	.01	2.	1.01	17.00	204	.29	.29	.00	108.

1.01	5.05	61	-01	-01	-01	2.	1.01	17.05	205	-23	-22	-00	106.
1.01	5.10	62	-01	-01	-01	2.	1.01	17.10	206	-23	-22	-00	100.
1.01	5.15	63	-01	-01	-01	2.	1.01	17.15	207	-23	-22	-00	94.
1.01	5.20	64	-01	-01	-01	2.	1.01	17.20	208	-23	-22	-00	90.
1.01	5.25	65	-01	-01	-01	2.	1.01	17.25	209	-23	-22	-00	87.
1.01	5.30	66	-01	-01	-01	2.	1.01	17.30	210	-23	-22	-00	86.
1.01	5.35	67	-01	-01	-01	2.	1.01	17.35	211	-23	-22	-00	86.
1.01	5.40	68	-01	-01	-01	2.	1.01	17.40	212	-23	-22	-00	86.
1.01	5.45	69	-01	-01	-01	2.	1.01	17.45	213	-23	-22	-00	85.
1.01	5.50	70	-01	-01	-01	2.	1.01	17.50	214	-23	-22	-00	85.
1.01	5.55	71	-01	-01	-01	2.	1.01	17.55	215	-23	-22	-00	85.
1.01	5.60	72	-01	-01	-01	2.	1.01	18.00	216	-23	-22	-00	85.
1.01	5.65	73	-06	-06	-03	3.	1.01	18.05	217	-02	-02	-00	78.
1.01	5.70	74	-06	-06	-03	5.	1.01	18.10	218	-02	-02	-00	57.
1.01	5.75	75	-06	-06	-03	8.	1.01	18.15	219	-02	-02	-00	35.
1.01	5.80	76	-06	-06	-03	10.	1.01	18.20	220	-02	-02	-00	21.
1.01	5.85	77	-06	-06	-03	11.	1.01	18.25	221	-02	-02	-00	15.
1.01	5.90	78	-06	-06	-03	12.	1.01	18.30	222	-02	-02	-00	11.
1.01	5.95	79	-06	-06	-03	13.	1.01	18.35	223	-02	-02	-00	9.
1.01	6.00	80	-06	-06	-03	14.	1.01	18.40	224	-02	-02	-00	8.
1.01	6.05	81	-06	-06	-03	14.	1.01	18.45	225	-02	-02	-00	7.
1.01	6.10	82	-06	-06	-03	15.	1.01	18.50	226	-02	-02	-00	7.
1.01	6.15	83	-06	-06	-03	15.	1.01	18.55	227	-02	-02	-00	7.
1.01	6.20	84	-06	-06	-03	16.	1.01	19.00	228	-02	-02	-00	7.
1.01	6.25	85	-06	-06	-03	16.	1.01	19.05	229	-02	-02	-00	7.
1.01	6.30	86	-06	-06	-03	16.	1.01	19.10	230	-02	-02	-00	7.
1.01	6.35	87	-06	-06	-03	17.	1.01	19.15	231	-02	-02	-00	7.
1.01	6.40	88	-06	-06	-03	17.	1.01	19.20	232	-02	-02	-00	7.
1.01	6.45	89	-06	-06	-03	17.	1.01	19.25	233	-02	-02	-00	7.
1.01	6.50	90	-06	-06	-03	18.	1.01	19.30	234	-02	-02	-00	7.
1.01	6.55	91	-06	-06	-03	18.	1.01	19.35	235	-02	-02	-00	7.
1.01	6.60	92	-06	-06	-03	18.	1.01	19.40	236	-02	-02	-00	7.
1.01	6.65	93	-06	-06	-03	18.	1.01	19.45	237	-02	-02	-00	7.
1.01	6.70	94	-06	-06	-03	19.	1.01	19.50	238	-02	-02	-00	7.
1.01	6.75	95	-06	-06	-03	19.	1.01	19.55	239	-02	-02	-00	7.
1.01	6.80	96	-06	-06	-03	19.	1.01	20.00	240	-02	-02	-00	7.
1.01	6.85	97	-06	-06	-03	19.	1.01	20.05	241	-02	-02	-00	7.
1.01	6.90	98	-06	-06	-03	19.	1.01	20.10	242	-02	-02	-00	7.
1.01	6.95	99	-06	-06	-03	19.	1.01	20.15	243	-02	-02	-00	7.
1.01	7.00	100	-06	-06	-03	20.	1.01	20.20	244	-02	-02	-00	7.
1.01	7.05	101	-06	-06	-03	20.	1.01	20.25	245	-02	-02	-00	7.
1.01	7.10	102	-06	-06	-03	20.	1.01	20.30	246	-02	-02	-00	7.
1.01	7.15	103	-06	-06	-03	20.	1.01	20.35	247	-02	-02	-00	7.
1.01	7.20	104	-06	-06	-03	20.	1.01	20.40	248	-02	-02	-00	7.
1.01	7.25	105	-06	-06	-03	20.	1.01	20.45	249	-02	-02	-00	7.
1.01	7.30	106	-06	-06	-03	20.	1.01	20.50	250	-02	-02	-00	7.
1.01	7.35	107	-06	-06	-03	21.	1.01	20.55	251	-02	-02	-00	7.
1.01	7.40	108	-06	-06	-03	21.	1.01	21.00	252	-02	-02	-00	7.
1.01	7.45	109	-06	-06	-03	21.	1.01	21.05	253	-02	-02	-00	7.
1.01	7.50	110	-06	-06	-03	21.	1.01	21.10	254	-02	-02	-00	7.
1.01	7.55	111	-06	-06	-03	21.	1.01	21.15	255	-02	-02	-00	7.
1.01	7.60	112	-06	-06	-03	21.	1.01	21.20	256	-02	-02	-00	7.
1.01	7.65	113	-06	-06	-03	21.	1.01	21.25	257	-02	-02	-00	7.
1.01	7.70	114	-06	-06	-03	21.	1.01	21.30	258	-02	-02	-00	7.
1.01	7.75	115	-06	-06	-03	21.	1.01	21.35	259	-02	-02	-00	7.
1.01	7.80	116	-06	-06	-03	21.	1.01	21.40	260	-02	-02	-00	7.
1.01	7.85	117	-06	-06	-03	21.	1.01	21.45	261	-02	-02	-00	7.
1.01	7.90	118	-06	-06	-03	21.	1.01	21.50	262	-02	-02	-00	7.
1.01	7.95	119	-06	-06	-03	22.	1.01	21.55	263	-02	-02	-00	7.
1.01	8.00	120	-06	-06	-03	22.	1.01	22.00	264	-02	-02	-00	7.
1.01	8.05	121	-06	-06	-03	22.	1.01	22.05	265	-02	-02	-00	7.
1.01	8.10	122	-06	-06	-03	22.	1.01	22.10	266	-02	-02	-00	7.

1.01	10.15	.06	.06	.01	22.	1.01	22.15	267	.02	.02	.00	7.
1.01	10.20	.06	.06	.01	22.	1.01	22.20	268	.02	.02	.00	7.
1.01	10.25	.06	.06	.01	22.	1.01	22.25	269	.02	.02	.00	7.
1.01	10.30	.06	.06	.01	22.	1.01	22.30	270	.02	.02	.00	7.
1.01	10.35	.06	.06	.01	22.	1.01	22.35	271	.02	.02	.00	7.
1.01	10.40	.06	.06	.01	22.	1.01	22.40	272	.02	.02	.00	7.
1.01	10.45	.06	.06	.01	22.	1.01	22.45	273	.02	.02	.00	7.
1.01	10.50	.06	.06	.00	22.	1.01	22.50	274	.02	.02	.00	7.
1.01	10.55	.06	.06	.00	22.	1.01	22.55	275	.02	.02	.00	7.
1.01	11.00	.06	.06	.00	22.	1.01	23.00	276	.02	.02	.00	7.
1.01	11.05	.06	.06	.00	22.	1.01	23.05	277	.02	.02	.00	7.
1.01	11.10	.06	.06	.00	22.	1.01	23.10	278	.02	.02	.00	7.
1.01	11.15	.06	.06	.00	22.	1.01	23.15	279	.02	.02	.00	7.
1.01	11.20	.06	.06	.00	22.	1.01	23.20	280	.02	.02	.00	7.
1.01	11.25	.06	.06	.00	22.	1.01	23.25	281	.02	.02	.00	7.
1.01	11.30	.06	.06	.00	22.	1.01	23.30	282	.02	.02	.00	7.
1.01	11.35	.06	.06	.00	22.	1.01	23.35	283	.02	.02	.00	7.
1.01	11.40	.06	.06	.00	23.	1.01	23.40	284	.02	.02	.00	7.
1.01	11.45	.06	.06	.00	23.	1.01	23.45	285	.02	.02	.00	7.
1.01	11.50	.06	.06	.00	23.	1.01	23.50	286	.02	.02	.00	7.
1.01	11.55	.06	.06	.00	23.	1.01	23.55	287	.02	.02	.00	7.
1.01	12.00	.06	.06	.00	23.	1.02	0.00	288	.02	.02	.00	7.
SUM 31.33 29.46 1.87 11164.												
(796.31 748.31 48.34 316.13)												

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
545.	127.	39.	39.	11153.
15.	4.	1.	1.	316.
CFS	24.05	29.41	29.41	29.41
CMS	610.89	746.95	746.95	746.95
INCHES	63.	77.	77.	77.
AC-FT	77.	95.	95.	95.
THOUS CU M				

HYDROGRAPH AT STA00001 FOR PLAN 1, RTIO 1

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
272.	63.	19.	19.	5577.
8.	2.	1.	1.	158.
CFS	12.03	14.70	14.70	14.70
CMS	305.45	373.47	373.47	373.47
INCHES	31.	38.	38.	38.
AC-FT	39.	47.	47.	47.
THOUS CU M				

HYDROGRAPH AT STA00001 FOR PLAN 1, RTIO 2

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
327.	76.	23.	23.	6692.
9.	2.	1.	1.	189.
CFS	14.43	17.64	17.64	17.64
CMS	366.54	448.17	448.17	448.17
INCHES	38.	46.	46.	46.
AC-FT	46.	57.	57.	57.
THOUS CU M				

HYDROGRAPH AT STA00001 FOR PLAN 1, RTIO 3

CMS 15. 3. 1. 1. 300.
 INCHES 22.85 27.94 27.94 27.94
 MM 580.35 709.60 709.60 709.60
 AC-FT 60. 73. 73. 73.
 THOUS CU M 74. 90. 90. 90.

HYDROGRAPH AT STAGCC001 FOR PLAN 1, RTIO 9

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME
 CFS 545. 127. 39. 11153.
 CMS 15. 4. 1. 316.
 INCHES 24.05 29.41 29.41 29.41
 MM 610.89 746.95 746.95 746.95
 AC-FT 63. 77. 77. 77.
 THOUS CU M 77. 95. 95. 95.

HYDROGRAPH ROUTING

ROUTED FLOWS THRU RESERVOIR 11608

STAG	ICOMP	IECON	IIAPE	JPLI	JPRF	INAME	ISTAGE	IAUTO
000002	1	0	0	2	0	1	0	0
ROUTING DATA								
QLUSS	CLOSS	AVG	IRFS	ISAME	IOPT	IPPP	ISTR	
0.0	0.000	0.00	1	1	0	0	0	
NSIPS	NSIDL	LAG	AMSK	X	TSK	STORA	ISPRAT	
1	0	0	0.000	0.000	0.000	-1018.	-1	
STAG	1018.00	1019.50	1019.70	1020.50	1021.00	1022.00	1023.00	1024.00
FLOW	0.00	140.30	327.40	737.80	1084.00	1912.00	2988.00	4227.00
SURFACE AREA = 0. 4. 6. 15.								
CAPACITY = 0. 32. 45. 245.								
ELEVATION = 995. 1018. 1020. 1040.								
CREL	SPWID	COOW	EXPM	ELEV	COQL	CAREA	EXPL	
1018.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

SURFACE AREA = 0. 4. 6. 15.
 CAPACITY = 0. 32. 45. 245.
 ELEVATION = 995. 1018. 1020. 1040.

UAM DATA

TINEL	COQD	EXPD	DAMPID
1019.7	2.9	1.5	425.
0.	52.	195.	360.
1019.7	1019.9	1020.0	1020.2
1019.7	1019.9	1020.0	1020.4
1019.7	1019.9	1020.0	1020.6
1019.7	1019.9	1020.0	1021.0
1019.7	1019.9	1020.0	1025.0

STATION 000002, PLAN 1, PATT 1

END-OF-PERIOD HYDROGRAPH ORIGINATES

1. AK 001101 1, 189. AT TIME 15.02 HOURS

PLATE D-11

STATION 000002

0.	40.	80.	120.	160.	200.	240.	280.	C.	0.	0.	0.	0.	0.
0.05													
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6.65 571	
6.60 581	
6.55 591	
6.50 601	
6.45 611	
6.40 621	
6.35 631	
6.30 641	
6.25 651	
6.20 661	
6.15 671	
6.10 681	
6.05 691	
6.00 701	
5.95 711	
5.90 721	
5.85 731	
5.80 741	
5.75 751	
5.70 761	
5.65 771	
5.60 781	
5.55 791	
5.50 801	
5.45 811	
5.40 821	
5.35 831	
5.30 841	
5.25 851	
5.20 861	
5.15 871	
5.10 881	
5.05 891	
5.00 901	
4.95 911	
4.90 921	
4.85 931	
4.80 941	
4.75 951	
4.70 961	
4.65 971	
4.60 981	
4.55 991	
4.50 1001	
4.45 1011	
4.40 1021	
4.35 1031	
4.30 1041	
4.25 1051	
4.20 1061	
4.15 1071	
4.10 1081	
4.05 1091	
4.00 1101	
3.95 1111	
3.90 1121	
3.85 1131	
3.80 1141	
3.75 1151	
3.70 1161	
3.65 1171	
3.60 1181	
3.55 1191	
3.50 1201	

10,00120	0
10,00121	0
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PLATE D-15

20.15263.10
 20.20264.10
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 20.50270.10
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 21.00272.10
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 23.45305.10
 23.50306.10
 23.55307.10
 24.00308.10

STATION 000002, PLAN 1, RAIL 9

FIELD-OF-VIEW-HYDROGRAPH CRILIATES

Year	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	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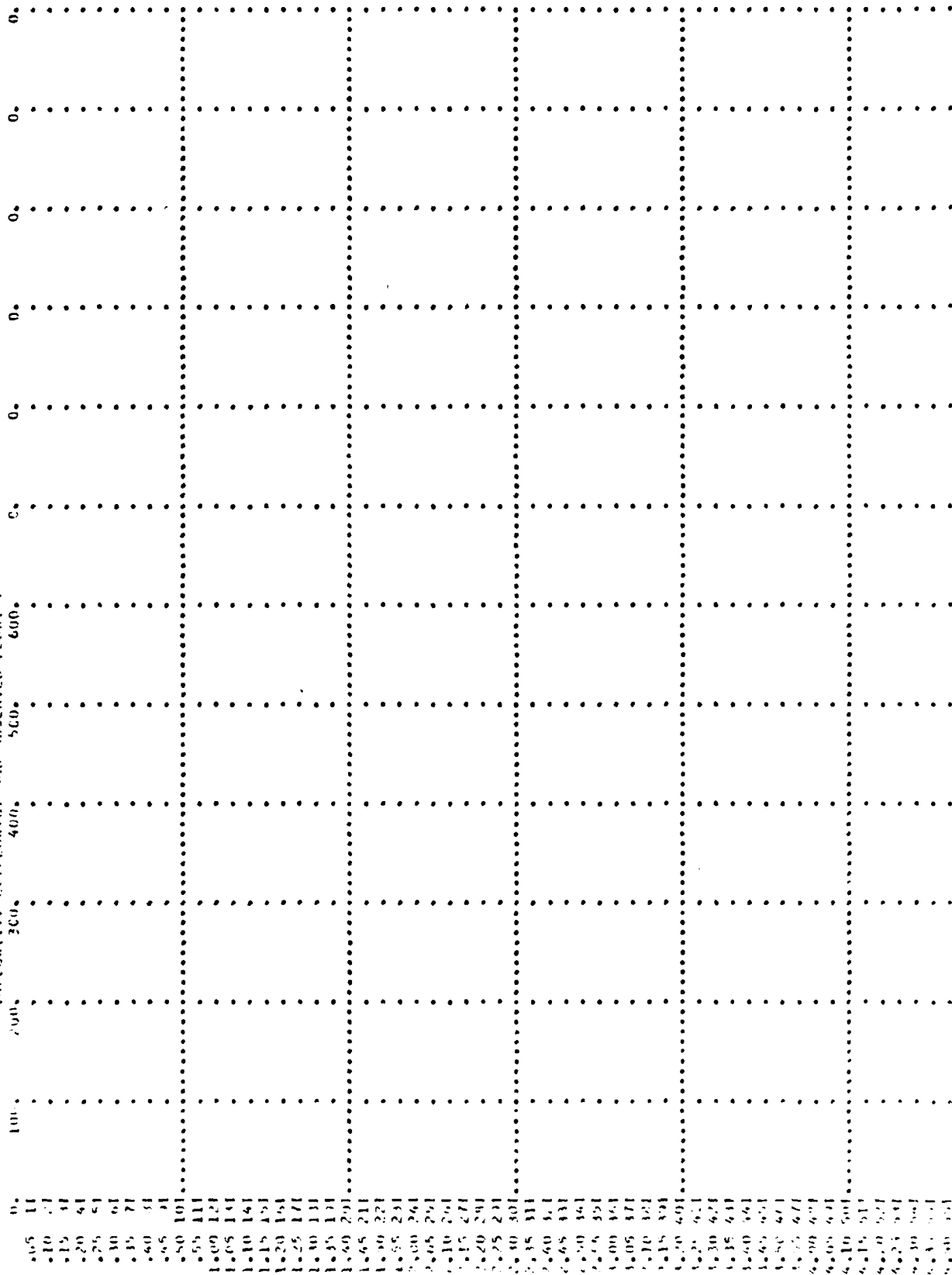
RECEIVED BY THE 456. AT TIME 15.03 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL	VOLUME
CFS	4.34	125	38	38	11076	314
CMS	1.2	4	1	1	29.20	741.76
INCHES		21.67	29.20	29.20	741.76	16
AC-FI		601.21	741.76	76	94	94
UNITS, CU YD		62	76	94		

60.418

STATIONC000002

INFLOW(1), CATHLOW(1) AND OBSERVED FLOW(1)



PLAN 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)

CONFLUENCE	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS									
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	
				.50	.60	.70	.75	.80	.85	.90	.95	1.00	
OVERFLOW AT	000001	.05	1	272.	327.	381.	408.	436.	463.	490.	517.	545.	
	(	.13)	(	7.71)	9.25)	10.79)	11.56)	12.34)	13.11)	13.88)	14.65)	15.42)	
OVERFLOW TO	000002	.05	1	189.	233.	276.	297.	319.	346.	377.	406.	434.	
	(	.13)	(	5.34)	6.59)	7.81)	8.42)	9.03)	9.79)	10.67)	11.49)	12.28)	

SUMMARY OF DAM SAFETY ANALYSIS

PLATE 1	RATIO OF PPE	ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM		TIME OF FAILURE HOURS
		STORAGE OUTFLOW	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	MAX CUTFLOW	TIME OF FAILURE HOURS	
	.50		1019.25	0.00	40.	189.	0.00	15.92	0.00	0.00
	.60		1019.40	0.00	41.	233.	0.00	15.83	0.00	0.00
	.70		1019.53	0.00	42.	276.	0.00	15.83	0.00	0.00
	.75		1019.60	0.00	42.	297.	0.00	15.83	0.00	0.00
	.80		1019.67	0.00	43.	319.	0.00	15.83	0.00	0.00
	.85		1019.74	.04	43.	346.	.17	15.83	0.00	0.00
	.90		1019.79	.09	43.	377.	.17	15.83	0.00	0.00
	.95		1019.85	.15	44.	406.	.33	15.83	0.00	0.00
	1.00		1019.90	.20	44.	434.	.33	15.83	0.00	0.00

DA
FILM
O