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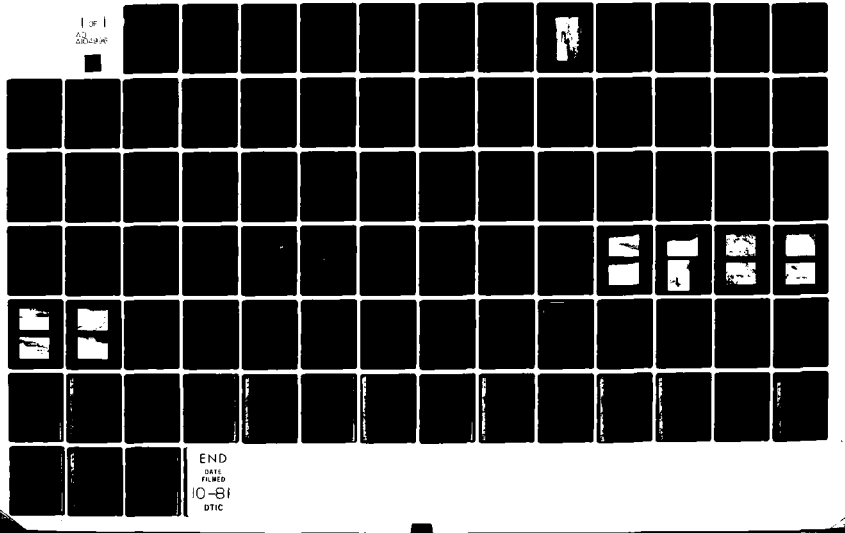

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KRUEGER LAKE DAM

WARREN COUNTY, MISSOURI

MO 11007

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

St. Louis District

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

FOR: STATE OF MISSOURI

SEPTEMBER, 1979

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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

IN REPLY REFER TO

SUBJECT: Krueger Lake Dam (Mo. 11007) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Krueger Lake Dam (Mo. 11007).

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

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

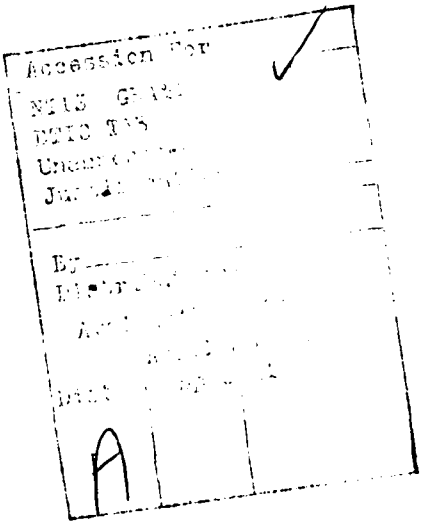
1) Spillway will not pass 50 percent of the Probable Maximum Flood
2) Overtopping could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED
Chief, Engineering Division

18 SEP 1979
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

18 SEP 1979
Date



KRUEGER LAKE DAM
WARREN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 11007

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES LTD.
ST. LOUIS, MISSOURI
AND
ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

SEPTEMBER 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Krueger Lake Dam, Missouri Inv. No. 11007
State Located: Missouri
County Located: Warren
Stream: An intermittent stream tributary to an unnamed tributary of Smith Creek
Date of Inspection: May 16, 1979

Assessment of General Condition

Krueger Lake Dam was inspected by the engineering firms of Consoer, Townsend, and Associates, LTD., and Engineering Consultants, Inc. (A Joint Venture) of St. Louis, Missouri 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 estimated damage zone extends about one mile downstream of the dam. Within the damage zone are four

houses, one road crossing and one State Highway which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Krueger Lake Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

Our inspection and evaluation indicates that the spillway of Krueger Lake Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Krueger Lake Dam being a small size dam with a high hazard potential, is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Since there is high hazard potential downstream of the dam, the appropriate spillway design flood for this dam is the Probable Maximum Flood. Based on available data it was determined that the reservoir/spillway system can accommodate ten percent of the Probable Maximum Flood without overtopping the dam. Our evaluation also indicates that the dam will be overtopped by the 100-year flood. However, the reservoir/spillway system can accommodate the 10-year flood without overtopping.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region. The 10- and 100-year floods are defined as floods having ten percent and one percent chance, respectively, of being equalled or exceeded during any given year.

Another major deficiency with Krueger Lake Dam is the longitudinal cracks, some with vertical offset, and the embankment sloughing on the crest and upstream slope of the embankment. These observations indicate instability in the embankment section of the dam.

Other deficiencies noted by the inspection team were, wave erosion on the upstream embankment, rodent activities on the embankment, the erosion and unstable right bank of the spillway channel, seepage occuring in the left bank of the spillway discharge channel, trees and large brush on spillway discharge channel, and a lack of periodic inspection by a qualified engineer. The lack of stability and seepage analysis on record is also a deficiency that should be corrected.

It is recommended that the owner take immediate action to study the embankment stability, and correct or control the several deficiencies described above in the near future.

Walter G. Shifrin, P.E.

Overview of Krueger Lake Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

KRUEGER LAKE DAM I.D. No. 11007

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

KRUEGER LAKE DAM, Missouri Inv. No. 11007

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Krueger Lake Dam was carried out under Contract DACW 43-79-C-0075 to the Department of the Army, St. Louis District, Corps of Engineers, by the engineering firms of Consoer, Townsend & Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Krueger Lake Dam was made on May 16, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. The conclusions drawn herein, therefore, are based on the presence of or absence of, obvious signs of distress. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to south abutment or side, and right to the north abutment or side.

d. 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. 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 the Project

a. Description of Dam and Appurtenances

It should be noted that design drawings are not available for the dam or appurtenant structures. The following description is based exclusively on observations and measurements made during the visual inspection.

The dam embankment is a compacted earthfill structure, concave upstream, which was likely constructed from residual soils obtained at and near the damsite. The crest width measurements were as follows starting from the left abutment; eight feet wide at 100 feet and 200 feet, ten feet wide at 300 feet, nine feet wide at 400 feet and ten feet wide at 500 feet from left abutment. The crest length is 595 feet. The crest elevation ranges from 609.0 to 611.0 feet above MSL and the maximum height of the embankment was measured to be 34.0 feet.

The downstream slope of the embankment was measured as 1V to 3H. It was not possible to measure the upstream slope because of high reservoir level. No riprap was placed on the upstream slope. The entire exposed embankment had a grass cover.

Krueger Lake Dam is situated on the border between the Dissected Till Plain Section of Central Lowlands Physiographic Province which extends to the north and the Ozark Plateau Province to the south. Although the area in which the dam and reservoir are located was glaciated during Pleistocene time, the till and loess which characterize the uplands of the Till Plains have been largely removed by erosion since the end of the Pleistocene. The area is characterized by wooded hills

which have gentle to steep slopes.

The bedrock geology of the area, as shown on the Geologic Map of Missouri (1977), typically consists of gently northeastwardly dipping (ca. 30-50 feet/mile) sediments of Paleozoic age. To north of Warren County these beds are often capped by young (Pleistocene) deposits of glacial drift and wind blown loess. In southern areas of the county the bedrocks are generally covered by residual soil, colluvium, or alluvium. The rocks underlying the area are predominately carbonates (limestones and dolomites), although beds of sandstone and shale are not infrequent.

Structurally, as stated earlier, the rocks are dipping gently northeastward off the Ozark uplift to the south of the area of interest.

The bedrock of Warren County contains some minor folding. The largest known geologic structure in the area is a gentle anticline centered about 2 1/2 miles northwesterly of the town of Warrenton. This fold does not appear to affect the bed at the damsite.

The spillway for Krueger Lake Dam is an open channel depression in the right abutment just beyond the end of the dam embankment. The spillway was cut into bedrock, and the discharge channel lies mostly in bedrock downstream of the toe of the embankment. The cross-section of the spillway is trapezoidal in shape, with a bottom width of 25 feet, side slopes of 1V to 4H, and a maximum elevation below the crest of the adjacent embankment of 3 feet, 0 inches.

No outlet pipe or low level drain was found at the dam.

b. Location

The dam is located near the head of an unnamed westerly flowing intermittant stream. Approximately 1800 feet downstream, the stream is joined by a minor intermittant creek from slightly south of east. A second tributary feeds the unnamed creek from the north about 4000 feet downstream of the dam. The creek joins south flowing Smith Creek, a perennial stream, just over a mile downstream from the dam. Smith Creek flows into the Missouri near Mile 85 about 6500 feet below its confluence with unnamed creek. The main access to the dam from Warrenton, Missouri, is south on County Road U approximately 11 miles to a small gravel road to the east. The dam and lake are located one mile east on the gravel road. The damsite is shown on the Treloar Quadrangle Sheet (7.5 minute series) in Section 2, Township 45 North, Range 3 West.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam height category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur with the classification. Within one mile downstream from the dam are four houses, one gravel road crossing and State Highway 94 crossing.

e. Ownership

Krueger Lake Dam is owned by a private owner, Larry Bade. His mailing address is Route 3, Box 206A, Warrenton, Missouri, 63383.

f. Purpose of Dam

The purpose of the dam is to impound water for recreational use as a private lake.

g. Design and Construction History

Krueger Lake Dam was built in 1974 by Hutchison & Schafer of Wright City, Missouri. Conversation with Mr. Hutchison determined that no formal engineering design or analysis was followed during construction.

h. Normal Operational Procedures

Based on conversations with the owner, and the findings of our field visit, it appears that Krueger Lake Dam has no operating facilities or operational procedures. Water level in the reservoir below the spillway is controlled by rainfall, runoff and evaporation.

1.3 Pertinent Data

a. Drainage Area (square miles):	0.18
b. Discharge at Damsite	
Estimated experienced maximum flood (cfs):	NA
Estimated ungated spillway capacity at maximum pool, El. 609 Feet above MSL (cfs):	90
c. Elevation (Feet above MSL)	
Top of dam:	609.0
Spillway crest:	
Service Spillway	608.0
Emergency Spillway	NA
Normal Pool:	608.0
Maximum Pool (PMF):	610.55
d. Reservoir	
Length of maximum pool (feet):	1,320
e. Storage (Acre-Feet)	
Top of dam:	112
Spillway crest:	103
Normal Pool:	103
Maximum Pool(PMF):	130
f. Reservoir Surface (Acres)	
Top of dam:	9.0
Spillway crest:	8.4
Normal Pool:	8.4
Maximum Pool (PMF):	10±

g. Dam

Type:	Rolled Earthfill
Length:	595 feet
Structural Height:	34.0 feet
Hydraulic Height:	34.0 feet
Top width:	8.0 feet typical
Side slopes:	
Downstream	1V to 3H
Upstream	Unknown
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel — None

i. Spillway

Type: Overflow

Length of weir: 25 feet (bottom width of the spillway channel)

Crest Elevation (feet above MSL): 608 (assumed)

j. Regulating Outlets — None

SECTION 2 : ENGINEERING DATA

2.1 Design

No design drawings or related data are available for Krueger Lake Dam. All information was gathered through phone conversations with the owner and construction contractor by the inspection team on the day of the field visit.

2.2 Construction

As mentioned above, no construction data is available on this dam for use in this report.

2.3 Operation

The lake receives a very limited amount of use at this time. Normal operation is to allow the lake to be controlled by rainfall, evaporation, runoff and the spillway.

2.4 Evaluation

a. Availability

No design drawings, design computations, construction data, or operation data is available.

In addition, no pertinent data was available for review of hydrology, spillway capacity, flood routing through the reservoir, outlet capacity, slope stability, seepage analysis, or foundation conditions.

b. Adequacy

The lack of engineering data did not allow for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation and construction data, but is based primarily on visual inspection, past performance history, and sound engineering judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were also 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

No valid engineering data is available.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Krueger Lake Dam was made on May 16, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M. A. Samad	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Jon Diebel	Engineering Consultants, Inc.	Structural and Mechanical
Peter Strauss	Engineering Consultants, Inc.	Soils
Peter Howard	Engineering Consultants, Inc.	Geology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural

Specific observations are discussed below.

b. Dam

The downstream face of the dam has a somewhat hummocky feel but no evidence of erosion or gulleying was seen on the embankment. Several natural drainage gulleys run down the left abutment just about at the dam contact. Numerous rodent holes exist in the embankment.

The lack of riprap on the upstream face has resulted in minor erosion by wave action.

A few samples of the embankment indicates that the dam is composed of residual soils. Numerous gravel size pieces of rock were seen on the slopes.

A number of longitudinal cracks were noted on the crest and on the embankment slope near the crest. The following longitudinal cracks were measured from the left abutment: A vertical crack starting at 94 feet and continuing to 305 feet. This crack is just below the crest on the upstream embankment slope and ranges from 1 inch to 6 inches wide, from 3 inches to eighteen inches deep and has a vertical offset of from 1 inch to 9 inches. Some sloughing of the offset material into the reservoir was noted between 155 feet and 182 feet. This crack stops in the reverse curve of the dam. A vertical crack on the crest runs from 180 feet to 231 feet. This crack is from 1/4 inch to 9 inches wide, has a depth of 1/2 inch to 12 inches and a vertical offset of 1 to 2 inches. A vertical crack on the downstream slope very near the crest runs from 158 feet to 200 feet. This crack ranges form 1-3 inches wide, is about 7 inches deep and has a

vertical offset of from 0-2 inches. A vertical crack in the crest runs from 391 feet to 430 feet. This crack is sinuous and ranges from 1/2 inch to 5 inches wide, from 1-6 inches deep and has an offset of 1 to 2 inches. A vertical crack from 481 feet to 505 feet ranges from 1 to 3 inches wide, from 1-12 inches deep and has no offset. Some sloughing of the upstream slope was seen between 300 and 400 feet from the left abutment.

No seepage was observed on the embankment slope or below the downstream toe of the embankment, however, some seepage was observed in the spillway discharge channel downstream of the embankment beginning at approximately 100 feet from the right abutment of the dam. This seepage emerged from the left bank of the spillway discharge channel beginning at the location described above and extending in a length of 200 feet. The seepage was oozing from the bank, with the cummulative seepage forming a small flow at the downstream end of the spillway channel.

The spillway crest and channel is founded on a weathered fine-grained sandstone and dolomite. Dolomite is exposed above the right abutment and most certainly underlies the dam and reservoir. The dolomite is the Jefferson City Dolomite (Ordovician). The Jefferson City Dolomite is about 400 feet thick in the area of the damsite but the base is not exposed in the area. About 90 feet above the dam the St. Peter sandstone (Ordovician) unconformably overlies the Jefferson City Dolomite.

The bedrock under the dam, the Jefferson City Dolomite, is suitable for a small dam foundation if potential solution channels such as joints are blanketed off under and upstream of the dam and abutments. It could not be ascer-

tained if this had been done.

The slope above the left abutment of the dam is creeping downhill. This is exhibited by the angle at which the trees are leaning. It does not appear, however, that a slide will occur in the forseeable future, but the condition should be monitored.

As reported by the Soil Conservation Service (Soil Survey of Montgomery and Warren counties, Missouri, 1979), the soil in the bottom land consists of a thin (12 inches) upper layer of silt (ML) with considerable clayey gravel (GC) below. On the slope are residual soils consisting of clay (CL) and silty clay (CL, CL-ML). The residual soils of the area are probably comparable to the "Clarksville" soils of the Ozark region. These soils generally are fairly high in clay content and are not easily erodable. The dam is located in an area of "Union Silt Loams" which are mixed loessial and residual soils.

c. Appurtenant Structures

(1) Spillway

The spillway section is founded on bedrock, described in the previous section. Discharges through the spillway will flow on bedrock to and beyond the toe of the embankment. Embankment materials will not be substantially eroded by flows through the spillway. The spillway channel downstream of the crest is overgrown with trees and brush. Some dead trees are also lying in the spillway channel.

The right bank of the spillway at the crest is composed of residual soils constructed on a steep slope. This causes the material to slough into the channel section, decreasing the capacity of the spillway. The spillway section is currently partially filled with eroded materials from this bank.

(2) Outlet Works

No outlet works or low level drain are provided for the dam and lake.

d. Reservoir Area

The water surface elevation was 605.0 feet above MSL on the day of the inspection.

The reservoir rim is gently sloping with trees and woods near the shore. There was no evidence of any large scale instability in the reservoir. Some trees around the left abutment of the embankment appeared to be leaning downslope indicating the possibility of creep in the residual soils.

e. Downstream Channel

The discharge channel immediately downstream from the spillway is about 25 feet wide. However, the channel is overgrown with brush and trees. Some debris is also lying on the channel, which may reduce the hydraulic efficiency of the channel.

3.2 Evaluation

The following problems were observed which could affect the safety of the dam or which require immediate remedial action.

1. Series of longitudinal cracks on and near the crest of the dam.

2. Some sloughing of the upstream slope into the reservoir.

3. Rodent activity on the embankment.

4. Erosion and sloughing of the soils from the right bank of the spillway on the spillway channel.

5. Vegetative growth in the spillway discharge channel.

6. Seepage observed in the left bank of the spillway discharge channel.

7. Erosion gullies at the left abutment contact.

8. Wave erosion on the upstream embankment slope.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Krueger Lake is used only for recreational purposes at this time. At the time of its construction, the dam was not provided with a means of lowering the reservoir level. The lake receives a very limited amount of use. The reservoir level is controlled by rainfall, runoff, evaporation and the spillway.

4.2 Maintenance of Dam

The dam is maintained by the owner, Mr. Larry Bade of Warrenton, Missouri, as it is needed and as time permits. The upstream and downstream slopes are clear of trees and brush.

On the day of the inspection, long transverse cracks were noticed on the crest near the upstream slope beginning near the left abutment. The cracks are described in Section 3 of this report.

The owner has stated to the inspection team that he believes the cracks appeared more pronounced after the heavy rains of April 1979.

On the right slope of the spillway there is an area approximately 50 feet by 100 feet of erosion and wash. The materials from this area are slowly sloughing into the spillway channel.

4.3 Maintenance of Operating Facilities

There are no operating facilities for Krueger Lake Dam.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any existing warning system in effect.

4.5 Evaluation

Kreuger Lake is fairly isolated and receives a limited amount of use and maintenance. The remedial measures listed in this report should be initiated within a time period as specified in Section 7.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of the Krueger Lake Dam upstream from the dam axis consists of approximately 116 acres. Most of the watershed area is wooded and covered with grass. Land gradients in the higher regions of the watershed average roughly 25 percent, and in the lower areas surrounding the reservoir average about 12 percent. The Krueger Lake Reservoir is located on an intermittent stream which joins an unnamed tributary of Smith Creek. The reservoir is about one mile upstream to the east from the confluence of the unnamed tributary and Smith Creek. At its longest arm the watershed is approximately 0.6 mile long. A drainage map showing the watershed area is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Krueger Lake Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in EM 1110-2-1411 (Standard Project Storm). The SCS method was adopted for deriving the unit hydrograph, utilizing the Corps of Engineers' computer program HEC-1 (Dam Safety Version).

The unit hydrograph parameters are presented in Appendix B. The SCS method was also used for determining loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, the unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak discharge of the PMF and one-half of the PMF are 2,777 cfs and 1,388 cfs respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir was assumed at the spillway crest level at the start of routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 2,204 and 1,090 cfs respectively. Both the PMF and one-half of the PMF when routed through the reservoir result in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes, and sketches, prepared during the field inspection. The reservoir stage-capacity data were based on the U.S.G.S. Treloar Quadrangle topographic map (7.5 minute series). The spillway and overtop rating curve and the reservoir capacity curve are presented in Plates 2 & 3 respectively in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam aims at avoiding overtopping. Overtopping is especially dangerous for an earth dam because the downrush of waters over the crest will erode the dam embankment and

release all the stored water suddenly into the downstream floodplain. The safe hydrologic design of a dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineer designs its dams to safely pass the Probable Maximum Flood that is estimated could be generated from the upstream watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. According to the Corps criteria, the hydrologic requirement for safety for this dam is the capability to pass the Probable Maximum Flood without overtopping.

b. Experience Data

It is believed that records of reservoir stage or spillway discharge are not maintained for this site.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1.c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1-a, both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 2,204 and 1,090 cfs respectively. The PMF overtopped the dam crest by 1.55 feet and one-half of the PMF overtopped the dam crest by 0.88 feet, respectively. The total duration of embankment overflow is 6.42 hours during the PMF, and 5.42 hours during one-half of the PMF. The spillway and the reservoir systems of Krueger Lake Dam is capable of accommodating a flood equal to approximately 10 percent of the PMF just before overtopping the dam.

The computed one percent and ten percent chance floods using 100- and 10-year, 24 hour rainfall data were routed through the reservoir. The routing results indicate that the 100-year flood will overtop the dam by 0.07 feet and the reservoir/spillway system can accommodate the 10-year flood with a freeboard of 0.49 feet.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. There are four dwellings, one gravel road crossing, an one state highway crossing within about a mile downstream from the dam.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There was definite distress on the crest and slopes as was evidenced by longitudinal cracks showing vertical offsets and sloughing of part of the upstream slope into the reservoir. The extent and degree of this instability could not be determined from the visual inspection, but the observations indicate a condition which is sufficiently serious to warrant further study in the near future.

The upstream slope of the embankment did not contain riprap protection, and has undergone some wave erosion. This condition is not serious at this time, but should be watched and repairs made as required. The rodents on the embankment slope should be eliminated.

The right bank of the spillway channel at the crest should be stabilized to prevent soil from eroding and/or sloughing into the channel. If not repaired the channel will eventually be filled with debris.

The hillside to the left of the dam embankment, although indicating some instability, is not felt to present a hazard to the dam at this time.

b. Design and Construction Data

No design or construction data relating to the structural stability of the dam or appurtenant structures were found.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. Water levels have not been recorded. The reservoir was 3 feet below spillway crest on the day of inspection.

d. Post Construction Changes

No post construction changes exist which will effect the structural stability of the dam.

e. *Seismic Stability*

According to the Seismic Zone Map of Contiguous States, From TM 5-809-10/NAVFAC P.355/AFM 88-3, Chapter 13; April 1977, the portion of Missouri in which Krueger Lake Dam is located is in Seismic Zone 2. This means there is only moderate damage probability. A detailed seismic analysis is not felt to be necessary for this embankment under present conditions. If a stability analysis is to be performed, the seismic coefficient recommended is 0.05.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed 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.

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.

It is also 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 continued care and inspection can there be any chance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Krueger Lake Dam was found to be "Seriously Indadequate". The spillway/reservoir system will accommodate only 10 percent of the PMF without overtopping the dam. The spillway/reservoir system can not accommodate the 100-year flood without overtopping the dam.

The extent and implications of the longitudinal cracks showing vertical offset and the sloughing of portions of the upstream slope must be determined. The observations made indicate a potentially hazardous condition which should be studied in further detail. The study on the embankment should include gathering data on the embankment material and foundation conditions, and monitoring the embankment section for future movement.

The wave erosion on the upstream embankment slope has not progressed to a significant degree at this time, but the condition should be monitored and repairs made as required. The rodent activity is significant at this time, and all rodents should be eliminated from the embankment as soon as possible.

The seepage occurring in the spillway discharge channel does not appear to be serious at this time. However, the condition should be monitored, and any changes in the quantity, location or color of the seepage flow reported to the appropriate authority.

The right bank of the spillway channel at the crest should be stabilized to prevent further erosion of soils into the spillway channel. In addition, all trees and brush should be cleared from the spillway discharge channel, and future growth prevented.

The erosion gullies at the left abutment contact should be filled with compacted material, and repairs made to future erosion as required.

b. Adequacy of Information

Information concerning the dam and appurtenant structures is not available. It is recommended that the following programs be initiated to help alleviate this problem:

1. Periodic inspection of the dam by an engineer experienced in the design and construction of earth dams should be made and this inspection report made a matter of record.

2. Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

3. Perform seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams".

c. Urgency

The study of the embankment stability should begin immediately. The remainder of the remedial measures should be accomplished in the near future.

d. Necessity for Phase II Inspection

The embankment stability study is felt to be necessary to determine the safety of the embankment. This study will include many of the items called for in a Phase II study.

7.2 Remedial Measures

a. Alternatives:

Spillway capacity and/or height of dam should be increased to accommodate the PMF without overtopping the dam.

b. O & M Procedures

1. Perform an investigation of the stability and safety of the embankment due to the distress signs observed during the visual inspection.

2. Eliminate all rodents from the embankment.

3. Stabilize the right bank of the spillway channel at the crest.

4. Repair the erosion gullies at the left abutment contact.

5. Clear the spillway discharge channel of all trees and large brush.

6. Monitor the seepage occuring in the left bank of the spillway discharge channel, and report any changes in quantity, location or color of flow.

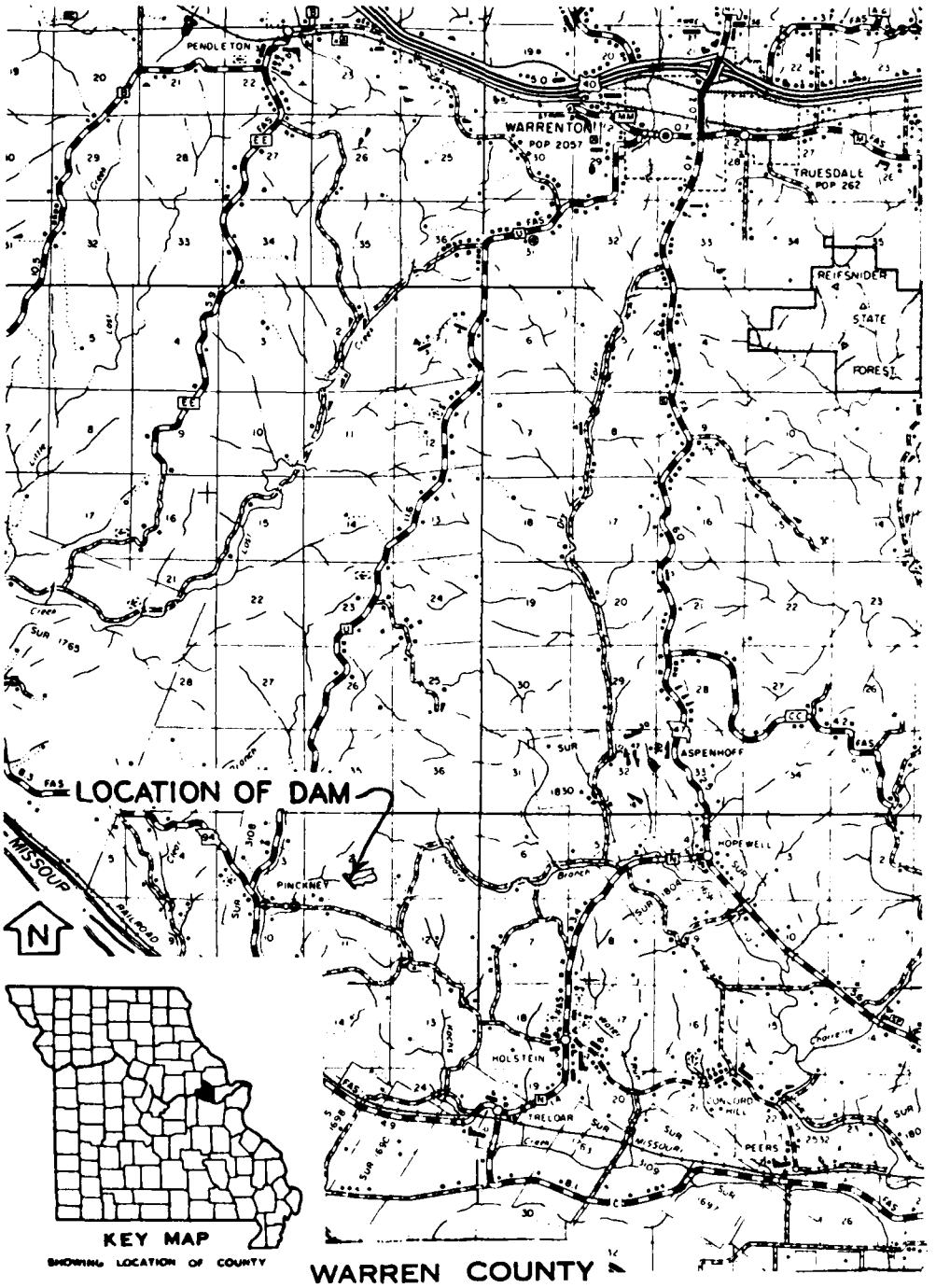
7. Monitor the wave erosion on the upstream embankment slope, and make repairs as required.

8. The owner shall initiate the following programs:

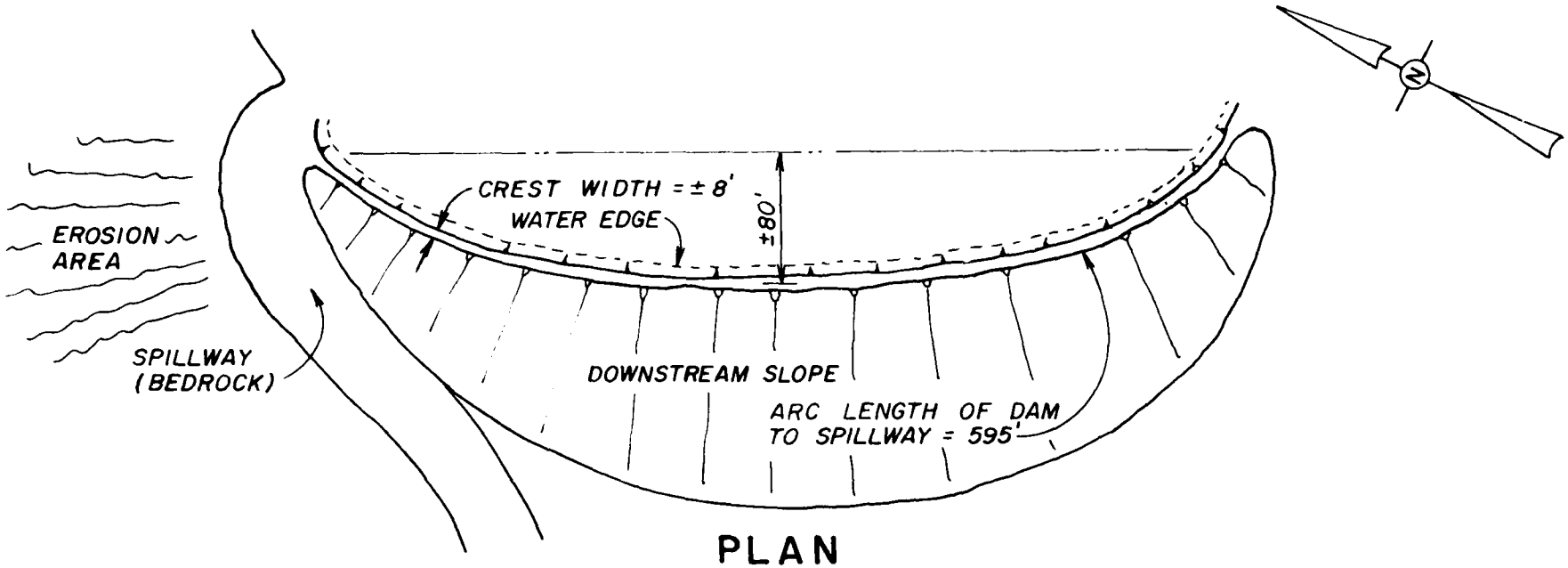
   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

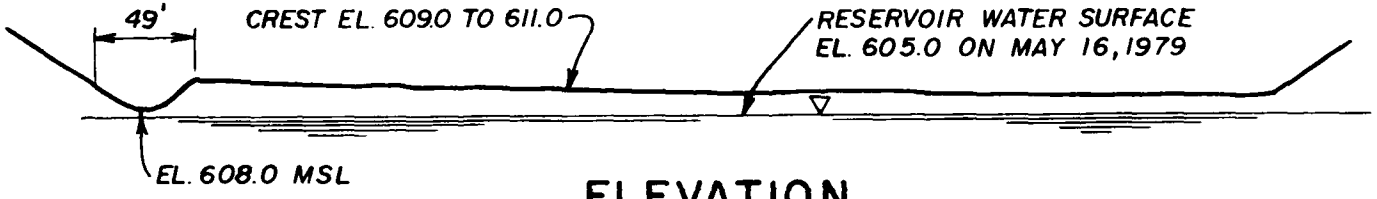
PLATES



LOCATION MAP - KRUEGER LAKE DAM



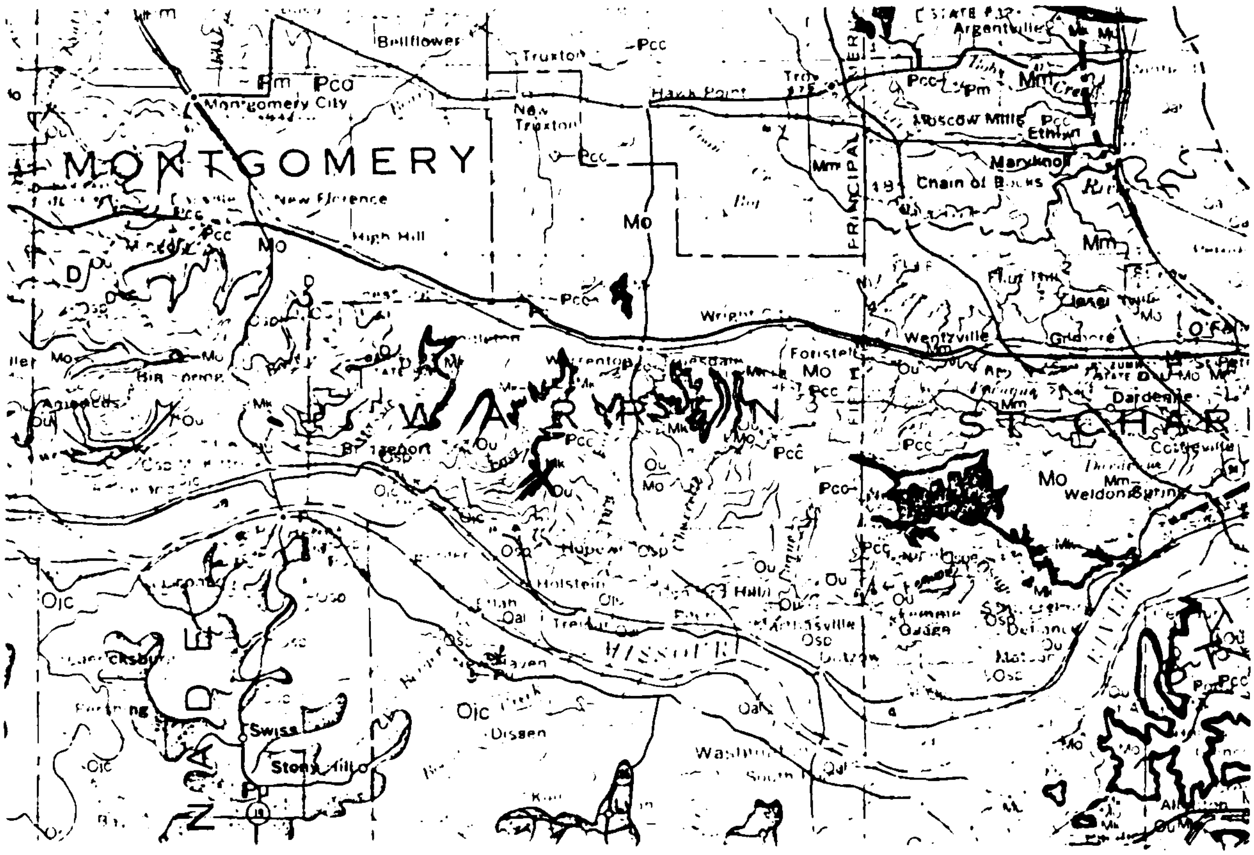
PLAN



ELEVATION

KRUEGER LAKE DAM
PLAN AND ELEVATION

SCALE :
1" = 100' (HORIZONTAL)
VERTICAL NOT TO SCALE



QUARTERNARY	Qal -	ALLUVIUM
PENNSYLVANIAN	Pm -	MARMATON GROUP
	Pcc -	CHEROKEE GROUP
MISSISSIPPIAN	Mm -	ST. LOUIS LIMESTONE SALEM FORMATION WARSAW FORMATION
	Mo -	BURLINGTON-KEOKUK FORMATION
	Mk -	CHOTEAU GROUP
ORDOVICIAN	Ou -	NOIX LIMESTONE MAQUOKETA SHALE CAPE LIMESTONE KIMMSWICK FORMATION DECORAH FORMATION PLATTIN FORMATION JOACHIM DOLOMITE
	Osp -	ST. PETER SANDSTONE
	Ojc -	COTTER-POWELL FORMATION JEFFERSON CITY DOLOMITE

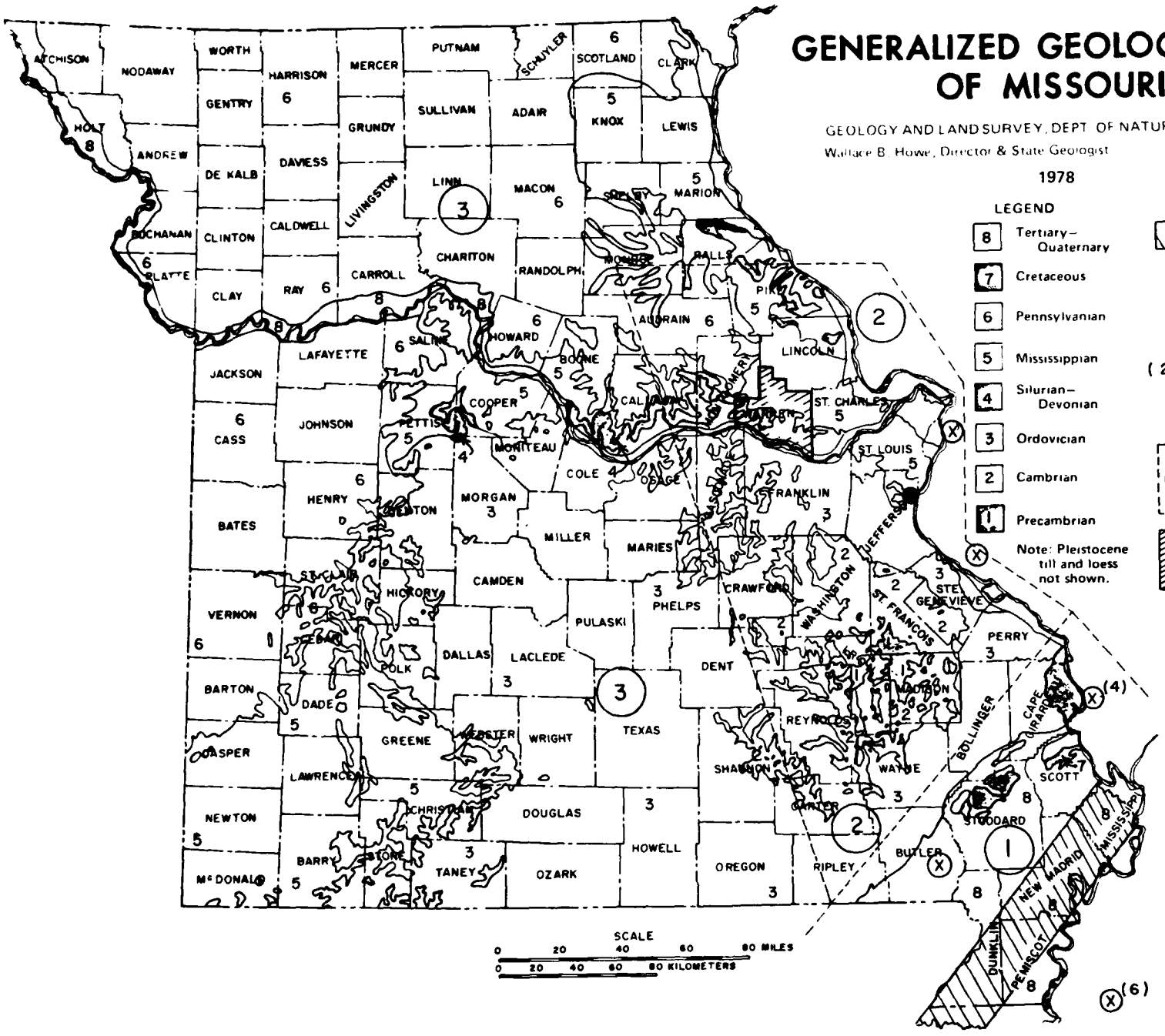
X LOCATION OF DAM MO. 11007

REFERENCE:
GEOLOGIC MAP OF MISSOURI,
MISSOURI GEOLOGIC SURVEY,
1979.

10 0 10

SCALE OF MILES

GEOLOGIC MAP OF WARREN COUNTY AND ADJACENT AREA



GENERALIZED GEOLOGIC MAP OF MISSOURI

GEOLOGY AND LAND SURVEY, DEPT. OF NATURAL RESOURCES
Wallace B. Howe, Director & State Geologist Rolla, MO 65401

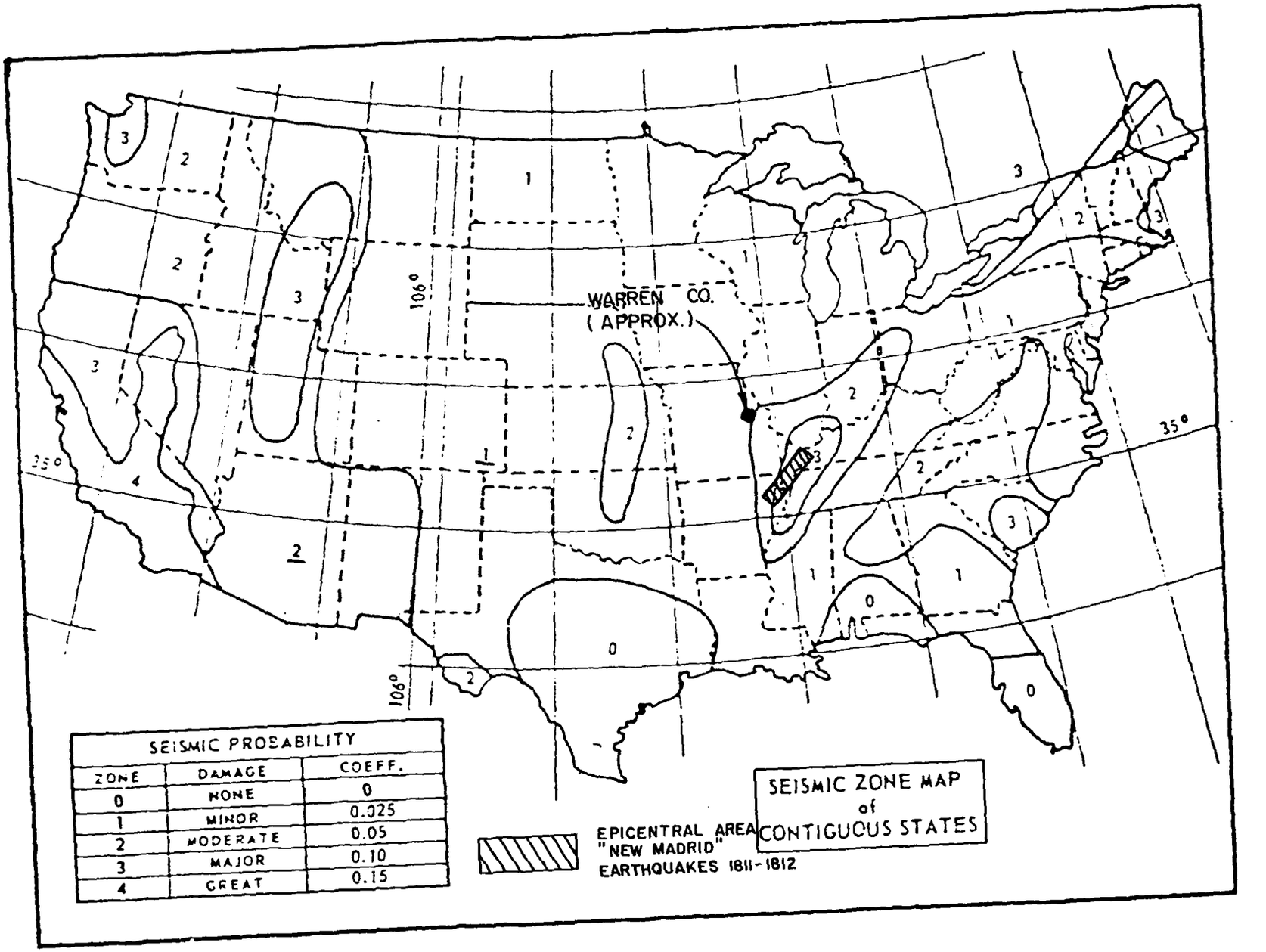
1978

LEGEND

- 8 Tertiary–Quaternary
- 7 Cretaceous
- 6 Pennsylvanian
- 5 Mississippian
- 4 Silurian–Devonian
- 3 Ordovician
- 2 Cambrian
- 1 Precambrian

Note: Pleistocene till and loess not shown.

- Epicentral Area, New Madrid Earthquakes at 1811 - 1812
- ● Other Selected Epicenters ≥ MM VI Since 1843
- (2) ⊗ Other Selected Epicenters ≥ MM V 1950 - 1970 (Number of Events)
- (2) Seismic Region (After Nuttli)
- Border of Warren County


WARREN CO.
(APPROX.)
106°
35°
SEISMIC PROBABILITY
ZONE | DAMAGE | COEFF.
0 | NONE | 0
1 | MINOR | 0.025
2 | MODERATE | 0.05
3 | MAJOR | 0.10
4 | GREAT | 0.15
EPICENTRAL AREA "NEW MADRID" EARTHQUAKES 1811-1812
SEISMIC ZONE MAP of CONTIGUOUS STATES

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

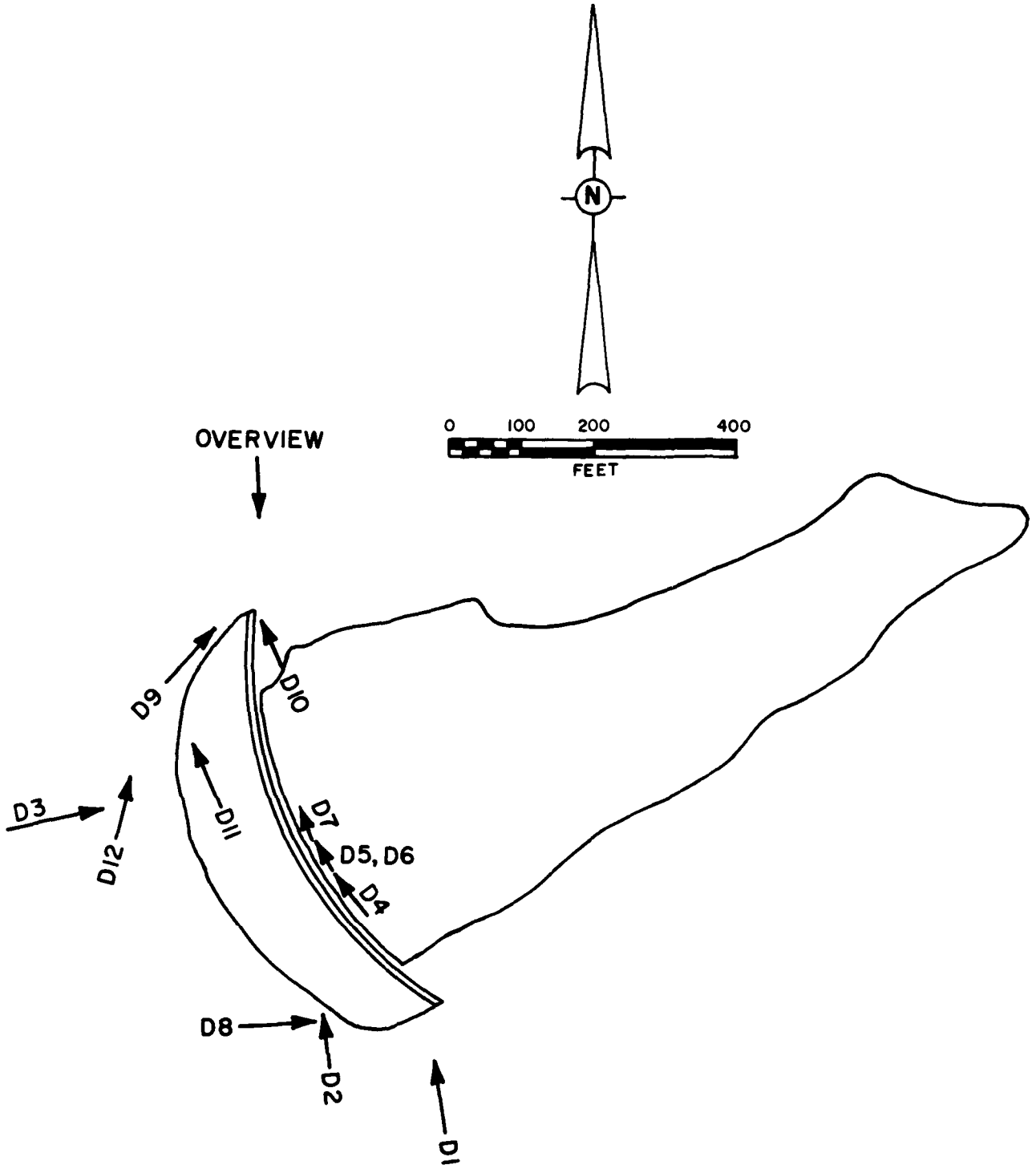


PHOTO INDEX
FOR
KRUEGER LAKE DAM

KRUEGER LAKE DAM

D1 - Upstream Embankment Slope

D2 - Downstream Embankment Slope

D3 - Downstream Embankment Slope

D4 - Sloughing on Upstream Embankment Slope

D5 - Cracking on Upstream Embankment Slope

D6 - Cracking on Upstream Embankment Slope

D7 - Sloughing on Upstream Embankment Slope

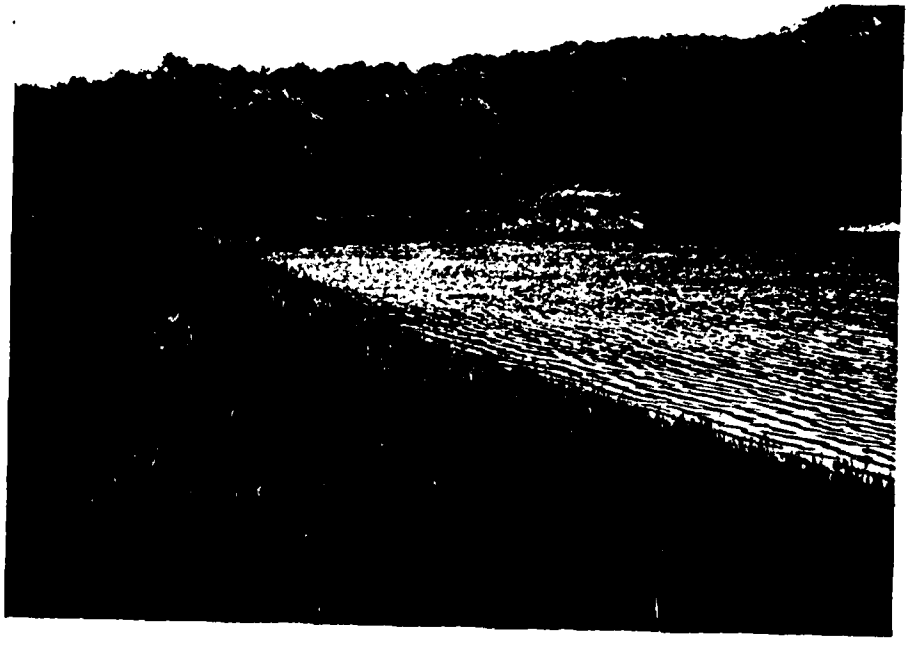
D8 - Erosion Gullies at Right Abutment Contact

D9 - Spillway Approach and Crest

D10 - Right Bank of Spillway

D11 - Spillway Discharge Channel

D12 - Spillway Discharge Channel



D1

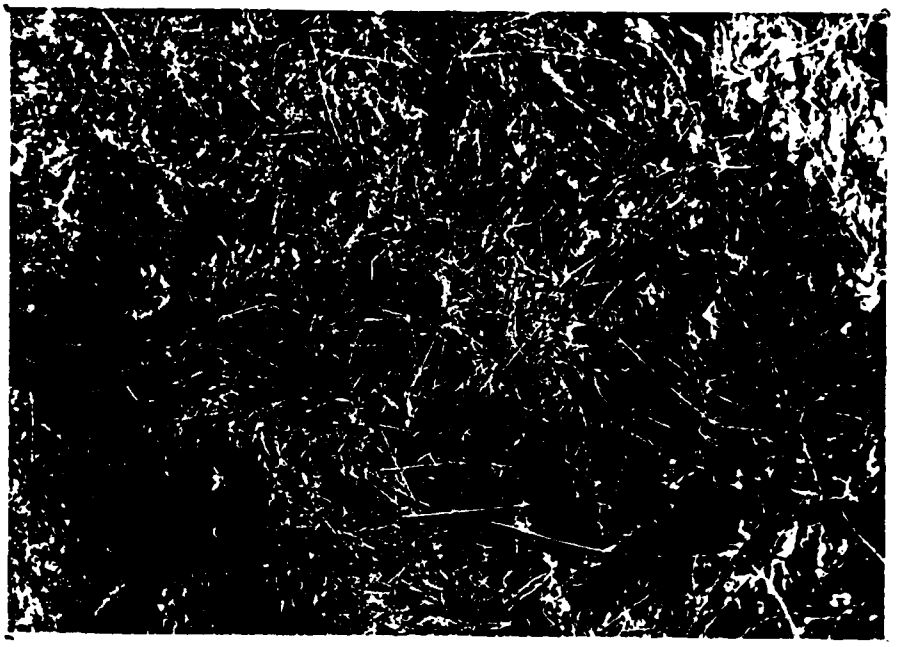
D2

D3

D4

D6

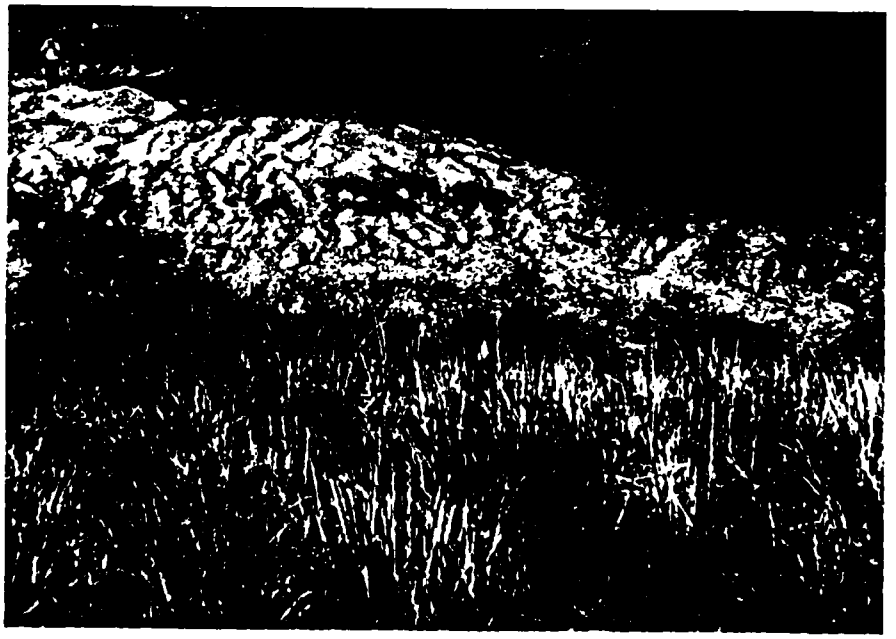
D5



D8

D7

D9



D10

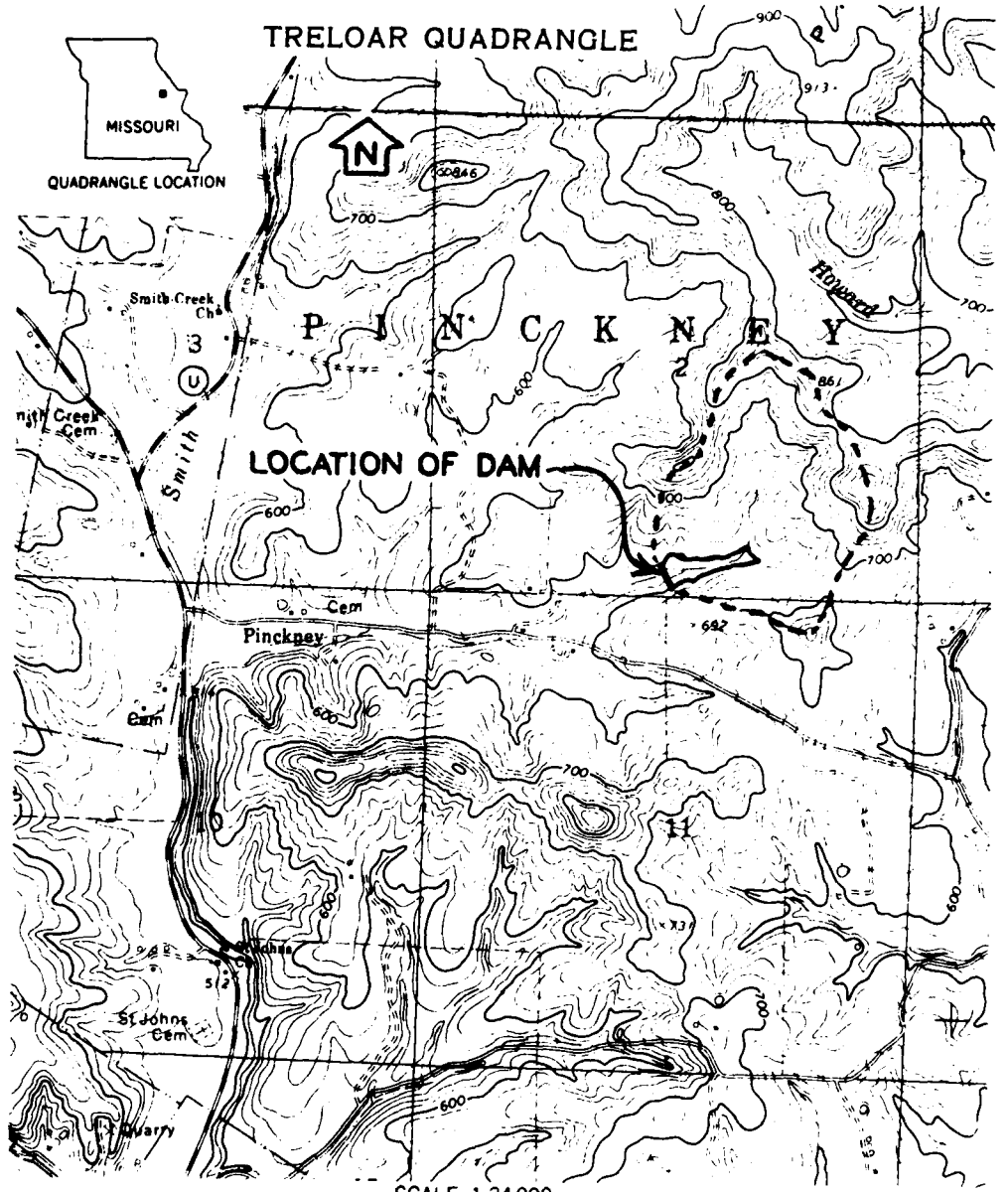
D11

D12

APPENDIX B

HYDROLOGIC COMPUTATIONS

PLATE 1, APPENDIX-B

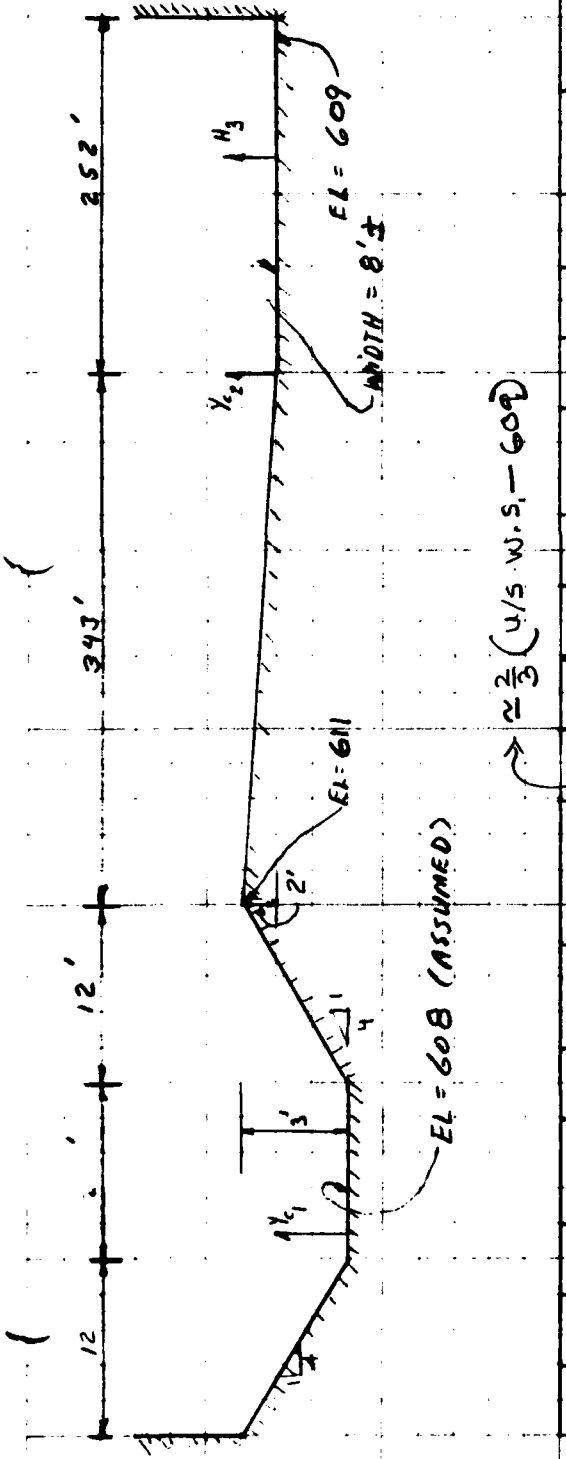


KRUEGER LAKE DAM (MO. 11007)
DRAINAGE BASIN

EC1-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI
KRUEGER LAKE DAM (MO. 11007)
SPILLWAY AND OVERTOP RATING CURVE

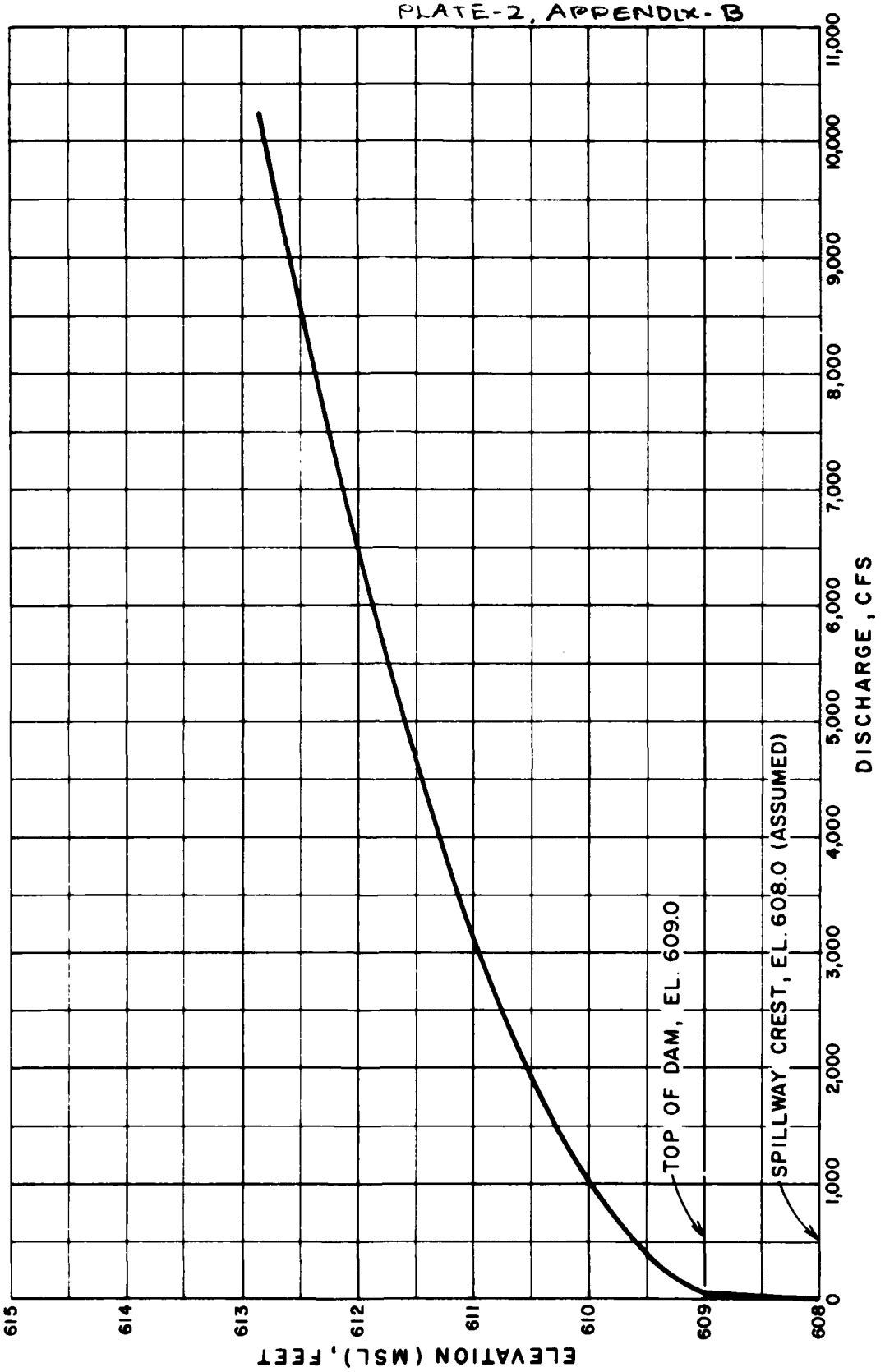
SHEET NO. 1 OF
JOB NO. 1240-001-1
BY DNZ ✓MAS DATE 5-24-7



$\approx \frac{2}{3}$ (U/S W.S. − 609)

Y_{c_1}	T_{c_1}	A_{c_1}	$V_{c_1} = \frac{1.49}{n} R^{2/3} S^{1/2}$	$\frac{V_{c_1}^2}{2g}$	$Q_{c_1} = V_{c_1} \cdot A_{c_1}$	U/S W.S. $= Y_{c_1} + \frac{V_{c_1}^2}{2g} + 608$	Y_{c_2}	T_{c_2}	A_{c_2}	V_{c_2}	$Q_{c_2} = V_{c_2} A_{c_2}$	H_3	L_3	C_3	$Q_3 = C_3 L_3 H_3^{3/2}$	$Q_T = Q_{c_1} + Q_{c_2} + Q_3$
0	0	0	0	0	0	608	–	–	–	–	–	–	–	–	–	0
.5	29	13.5	3.87	0.23	52.23	608.73	–	–	–	–	–	0.09	252	2.40	16.33	52.
0.75	31	21.0	4.67	0.34	98.07	609.09	0.06	10.29	0.31	0.98	0.30	0.44	252	2.54	18.82	117
1	33	29	5.32	0.44	154.14	609.44	.29	30.31	7.29	2.16	15.74	1.8	252	2.64	160.6	357
2	41	66	7.19	0.80	474.8	610.80	1.20	205.9	123.5	4.39	542.32	3.13	252	2.64	368.10	2624
3	49	111	8.53	1.13	947.26	612.13	2.09	343	373.8	5.92	2212.0	3.88	252	2.64	508.45	6843.
3.5	49	136.5	9.43	1.38	1258.7	612.98	2.59	343	548.6	7.15	3899.5					10,243.

PLATE-2, APPENDIX-B



KRUEGER LAKE DAM (MO. 11007)
SPILLWAY & OVERTOP RATING CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

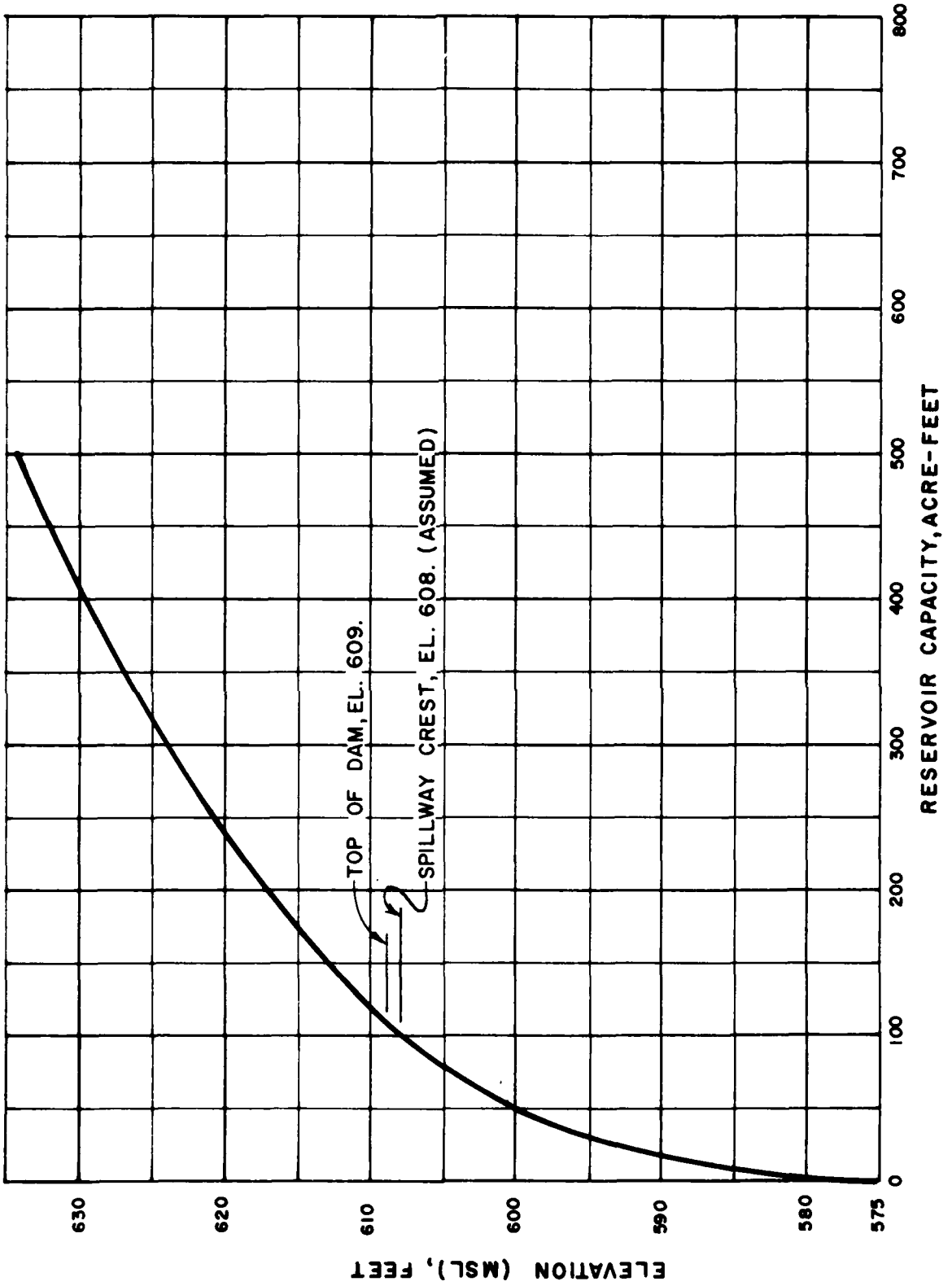
Dam Safety Inspection - Missouri SHEET NO. 1 OF 2
Krueger Lake Dam (MO. 11007) JOB NO. 1240
Reservoir Area Capacity BY M.R.H. DATE 5-22-79
MAB

KRUEGER LAKE DAM

Reservoir Area Capacity

Elev. M.S.L. (Ft.)	Reservoir Surface Area (Acres)	Incremental Volume (Ac.-Ft.)	Total Volume (Ac.-Ft.)	Remarks
575.0	0	0	0	Est. Streambed upstream of Dam.
580.0	0.9	1.5	1.5	Area measured on U.S.G.S. map.
600.0	4.6	50.2	51.7	Area measured on U.S.G.S. map
608.0	8.4	51.2	102.9	Spillway Crest (Assumed)
609.0	9.0	8.7	111.6	Top of Dam
620.0	15	130.6	242.2	Area measured on U.S.G.S. map.
640.0	25	395.8	638.0	Area measured on U.S.G.S. map.

PLATE-3, APPENDIX-B



KRUEGER LAKE DAM (MO. 11007)
RESERVOIR CAPACITY CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION/MISSOURI — SHEET NO. 1 OF
DAM # MO. 11007 — JOB NO. 1240-001
PROBABLE MAXIMUM PRECIPITATION — BY MAS DATE 5/22/

DAM # MO. 11007

DETERMINATION OF PMP

1. Determine drainage area of the basin

   D.A. = 116 ACRES

2. Determine PMP Index Rainfall (200 sq.mi & 24 hrs duration)

   Location of centroid of basin

   Long. = 91°12'57" Lat. = 38°40'59" ⇒ PMP = 24.1"

3. Determine basin rainfall in terms of percentage of PMP Index Rainfall for various durations:

   Location: Long. = 91°12'57", Lat. = 38°40'59"

   ⇒ Zone 7

Duration	Percent of Index Rainfall	Total Rainfall	Rainfall Increments	Duration of Increment
6	100	24.1	24.1	6
12	120	28.9	4.8	6
24	130	31.3	2.4	12

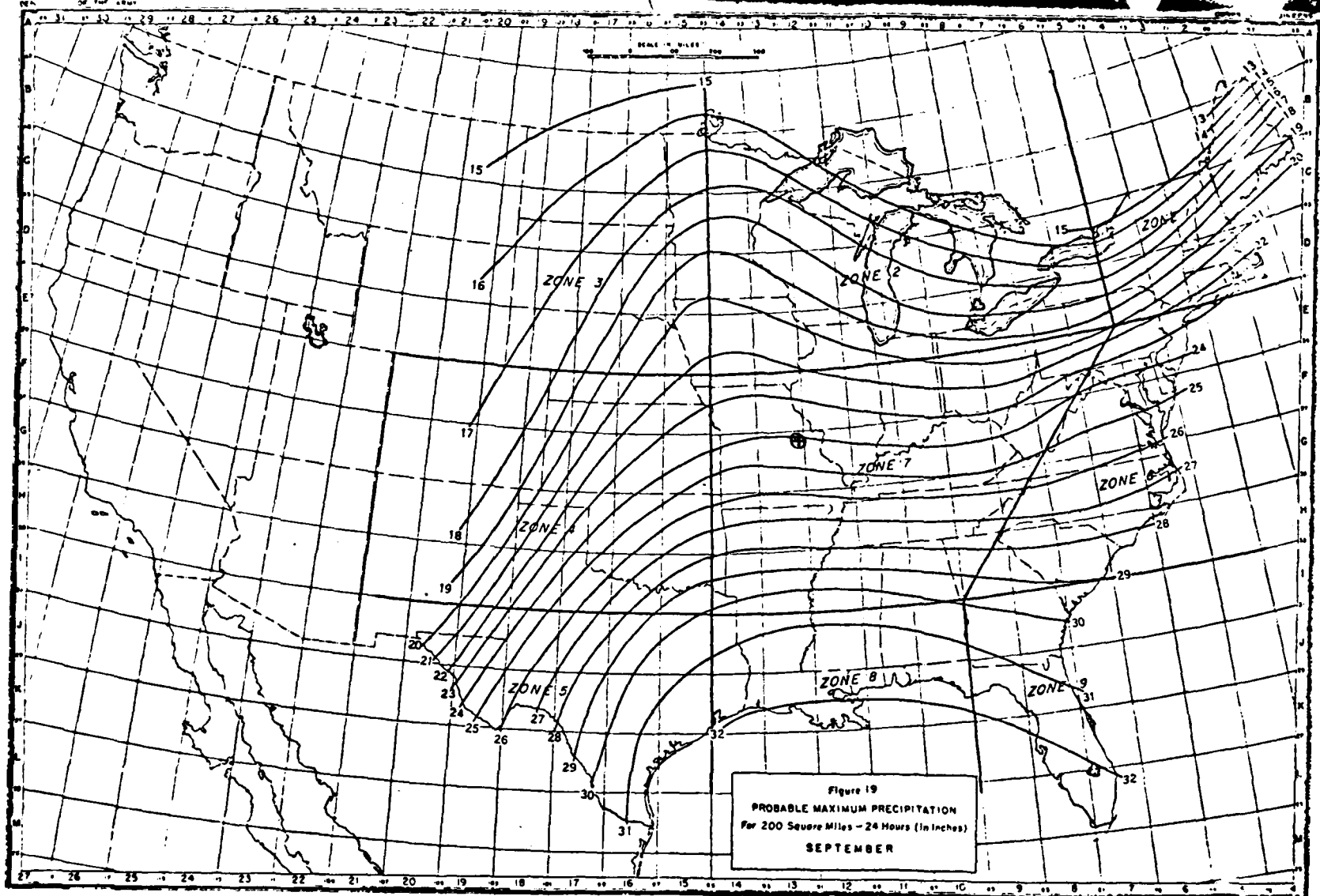


Figure 19
PROBABLE MAXIMUM PRECIPITATION
For 200 Square Miles – 24 Hours (in inches)
SEPTEMBER

SMP FOR 200 SQ. MI. CHART
LOCATION = 24")

KRUEGER LAKE DAM (MO. 11007)
LOCATION OF CENTROID
OF WATERSHED:
LAT. = 38°40'59" LONG. = 91°12'57"

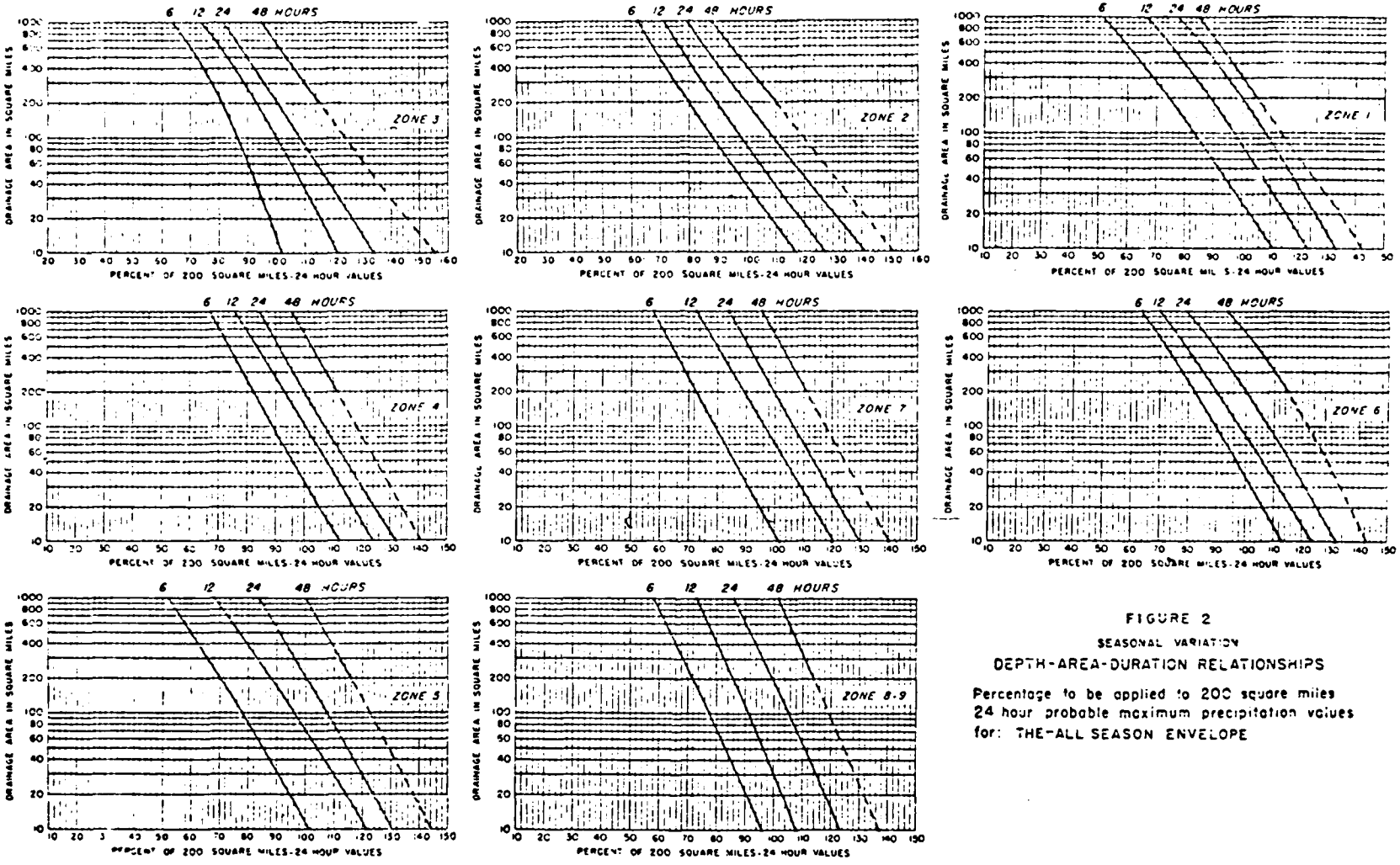


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI — SHEET NO. 1 OF
DAM # 11007 — JOB NO. 1240-001-1
UNIT HYDROGRAPH PARAMETERS — BY KLB VMAS DATE 5-29-7

1. DRAINAGE AREA = 116 AC. = 0.18 SQ. MI.
2. LENGTH OF STREAM = (1.00" X 2000' = 2000') = 0.38 mi
3. ELEVATION AT DRAINAGE DIVIDE ALONG THE LONGEST STREAM, $H_1 = 860'$
4. RESERVOIR ELEVATION AT SPILLWAY CREST, $H_2 = 608$
5. DIFFERENCE IN ELEVATION, $\Delta H = 860 - 608 = 252'$
6. AVERAGE SLOPE OF STREAM $= \frac{\Delta H}{L} = \frac{252}{2000} = 12.6\%$
7. TIME OF CONCENTRATION:
   a) BY KIRPICH FORMULA:
   $$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.7 \times 0.38^3}{252}\right)^{0.385} = 0.10 \text{ HR}$$
   b) BY VELOCITY ESTIMATE.
   SLOPE = 12.6% ⇒ AVERAGE VELOCITY = 5 FPS
   $$\therefore T_c = \frac{0.38 \times 5280}{5 \times 60 \times 60} = 0.11 \text{ HR}$$
   USE $T_c = 0.10$ HR.
8. LAG TIME, $L_t = 0.6 \times 0.10 = 0.060$ HR
9. UNIT DURATION $D \leq \frac{L_t}{3} = \frac{0.060}{3} = 0.020 < 0.083$
   USE $D = 0.083$ HR = 5 MIN
10. TIME TO PEAK, $T_p = \frac{D}{2} + L_t = \frac{0.083}{2} + 0.060 = 0.10$ HR
11. PEAK DISCHARGE, $q_p = \frac{484 \cdot A}{T_p}$
    $$q_p = \frac{484 \cdot (0.18)}{0.10} = 871 \text{ CFS}$$

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI SHEET NO. 1 OF

DAM # MO. 11007 JOB NO. 1240-001

HYDROLOGIC SOIL GROUP & SCS CURVE NUMBER BY MAS DATE 5/31/79

MISSOURI DAM # MO. 11007

DETERMINATION OF HYDROLOGIC SOIL GROUP AND CURVE NUMBER

1. Watershed Soils consist of B and D group soils. B group soils are predominent

   Assume Hydrologic Soil Group 'B' for the whole watershed.

2. Most of the watershed is wooded and covered by grass. Assume "fair" Hydrologic condition for infiltration

   Thus

   CN = 60 for Soil Gr. B & AMC II

   $\Rightarrow$ CN = 78 for AMC III

HEC1DB INPUT DATA

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

A                          DAM SAFETY INSPECTION - MISSOURI
A                             KRUEGER LAKE DAM (11007)
A                PMF AND [illegible] PERCENT PMF DETERMINATION AND ROUTING
B     300      [illegible]      5      [illegible]      0      0      0      [illegible]      0      0
B1      [illegible]
J       1                1
J1    1.0    [illegible]
K       [illegible]  11007                                    1
K1   INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS
M       1      [illegible]    0.18            [illegible]    1.0
P            24.1    [illegible]    120    130
T                                                     -1    -79.0
W2            0.0[illegible]
X       0      0      1
K       1  11007                  [illegible]                1
K1   ROUTE HYDROGRAPH THROUGH KRUEGER LAKE DAM
Y                             1        1
Y1      1                                          -60[illegible]      -1
Y4  608.0  608.73  [illegible]  [illegible]  609.4[illegible]  610.[illegible]  612.13  612.8[illegible]
Y5     0.     52.    [illegible]    11[illegible].    557.   [illegible]24.   6[illegible]43.  10[illegible]47.
$S     [illegible].    1.5    51.7   10[illegible]   111.[illegible]   24[illegible]   [illegible]38.[illegible]
$E   575.    580.    600.    60[illegible].    60[illegible].    620.    6[illegible]0.
$$   60[illegible].
$D   61[illegible].
K      [illegible]9
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1:00.7
ROUTE HYDROGRAPH TO 110.7
END OF NETWORK

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

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

RUN  DATE= 79/06/27.
     TIME= 09.16.02.
```

DAM SAFETY INSPECTION - MISSOURI
KRUEGER LAKE DAM (11007)
PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NO	NSUB	NMIN	ISAV	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	0	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= 1.00 .50

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

SUB-AREA RUNOFF COMPUTATION

INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11007	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.18	0.00	.18	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.10	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

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

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

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .06

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NHG IS AT LAG/2)

UNIT HYDROGRAPH 6 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .06 VOL= 1.00

7998 . 401. 115. 30. 1.

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP A	MO. A	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP B
					END-OF-PERIOD FLOW								
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.20	.18	.02	254.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.20	.18	.02	255.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.20	.18	.02	256.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.20	.18	.02	257.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.20	.19	.02	258.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.20	.19	.01	259.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.24	.22	.02	289.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.24	.22	.02	307.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.24	.23	.02	312.
1.01	.50	10	.01	0.00	.01	0.	1.01	13.20	160	.24	.23	.02	314.
1.01	.55	11	.01	0.00	.01	0.	1.01	13.25	161	.24	.23	.01	315.
1.01	1.	12	.01	0.00	.01	0.	1.01	13.30	162	.24	.23	.01	316.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.35	163	.24	.23	.01	317.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.40	164	.24	.23	.01	318.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.45	165	.24	.23	.01	318.
1.01	1.20	16	.01	0.00	.01	0.	1.01	13.50	166	.24	.23	.01	319.
1.01	1.25	17	.01	0.00	.01	0.	1.01	13.55	167	.24	.23	.01	320.
1.01	1.30	18	.01	0.00	.01	0.	1.01	14.00	168	.24	.23	.01	320.
1.01	1.35	19	.01	0.00	.01	0.	1.01	14.05	169	.30	.29	.01	367.
1.01	1.40	20	.01	0.00	.01	0.	1.01	14.10	170	.30	.29	.01	393.
1.01	1.45	21	.01	0.00	.01	0.	1.01	14.15	171	.30	.29	.01	400.
1.01	1.50	22	.01	0.00	.01	0.	1.01	14.20	172	.30	.29	.01	403.
1.01	1.55	23	.01	0.00	.01	0.	1.01	14.25	173	.30	.29	.01	404.
1.01	2.00	24	.01	0.00	.01	0.	1.01	14.30	174	.30	.29	.01	404.
1.01	2.05	25	.01	0.00	.01	0.	1.01	14.35	175	.30	.29	.01	405.
1.01	2.10	26	.01	0.00	.01	0.	1.01	14.40	176	.30	.29	.01	406.
1.01	2.15	27	.01	0.00	.01	0.	1.01	14.45	177	.30	.29	.01	406.
1.01	2.20	28	.01	0.00	.01	0.	1.01	14.50	178	.30	.29	.01	407.
1.01	2.25	29	.01	0.00	.01	0.	1.01	14.55	179	.30	.29	.01	407.
1.01	2.30	30	.01	0.00	.01	0.	1.01	15.00	180	.30	.29	.01	408.
1.01	2.35	31	.01	0.00	.01	0.	1.01	15.05	181	.18	.18	.01	316.
1.01	2.40	32	.01	0.00	.01	0.	1.01	15.10	182	.57	.56	.01	408.
1.01	2.45	33	.01	0.00	.01	0.	1.01	15.15	183	.57	.56	.01	474.
1.01	2.50	34	.01	0.00	.01	0.	1.01	15.20	184	.55	.54	.01	630.
1.01	2.55	35	.01	0.00	.01	0.	1.01	15.25	185	.64	.63	.01	790.
1.01	3.00	36	.01	0.00	.01	0.	1.01	15.30	186	1.66	1.63	.03	1569.
1.01	3.05	37	.01	0.00	.01	0.	1.01	15.35	187	2.76	2.72	.04	2777.
1.01	3.10	38	.01	0.00	.01	0.	1.01	15.40	188	1.01	.99	.01	2104.
1.01	3.15	39	.01	0.00	.01	0.	1.01	15.45	189	.64	.63	.01	1284.
1.01	3.20	40	.01	0.00	.01	0.	1.01	15.50	190	.55	.54	.01	915.
1.01	3.25	41	.01	0.00	.01	0.	1.01	15.55	191	.37	.36	.00	653.
1.01	3.30	42	.01	0.00	.01	0.	1.01	16.00	192	.37	.36	.00	540.
1.01	3.35	43	.01	.00	.01	0.	1.01	16.05	193	.28	.28	.00	445.
1.01	3.40	44	.01	.00	.01	0.	1.01	16.10	194	.28	.28	.00	402.
1.01	3.45	45	.01	.00	.01	0.	1.01	16.15	195	.28	.28	.00	391.
1.01	3.50	46	.01	.00	.01	0.	1.01	16.20	196	.28	.28	.00	388.
1.01	3.55	47	.01	.00	.01	1.	1.01	16.25	197	.28	.28	.00	388.
1.01	4.00	48	.01	.00	.01	1.	1.01	16.30	198	.28	.28	.00	388.
1.01	4.05	49	.01	.00	.01	1.	1.01	16.35	199	.28	.28	.00	388.
1.01	4.10	50	.01	.00	.01	1.	1.01	16.40	200	.28	.28	.00	388.
1.01	4.15	51	.01	.00	.01	1.	1.01	16.45	201	.28	.28	.00	388.
1.01	4.20	52	.01	.00	.01	1.	1.01	16.50	202	.28	.28	.00	388.
1.01	4.25	53	.01	.00	.01	2.	1.01	16.55	203	.28	.28	.00	388.
1.01	4.30	54	.01	.00	.01	2.	1.01	17.00	204	.28	.28	.00	388.
1.01	4.35	55	.01	.00	.01	2.	1.01	17.05	205	.22	.22	.00	340.

1.01	4.40	56	.01	.00	.01	2.	1.01	17.10	206	.22	.22	.00	310.
1.01	4.45	57	.01	.00	.01	2.	1.01	17.15	207	.22	.22	.00	307.
1.01	4.50	58	.01	.00	.01	2.	1.01	17.20	208	.22	.22	.00	306.
1.01	4.55	59	.01	.00	.01	3.	1.01	17.25	209	.22	.22	.00	305.
1.01	5.00	60	.01	.00	.01	3.	1.01	17.30	210	.22	.22	.00	305.
1.01	5.05	61	.01	.00	.01	3.	1.01	17.35	211	.22	.22	.00	305.
1.01	5.10	62	.01	.00	.01	3.	1.01	17.40	212	.22	.22	.00	306.
1.01	5.15	63	.01	.00	.01	3.	1.01	17.45	213	.22	.22	.00	308.
1.01	5.20	64	.01	.00	.01	3.	1.01	17.50	214	.22	.22	.00	305.
1.01	5.25	65	.01	.00	.01	3.	1.01	17.55	215	.22	.22	.00	305.
1.01	5.30	66	.01	.00	.01	3.	1.01	18.00	216	.22	.22	.00	305.
1.01	5.35	67	.01	.00	.01	4.	1.01	18.05	217	.02	.02	.00	146.
1.01	5.40	68	.01	.00	.01	4.	1.01	18.10	218	.02	.02	.00	58.
1.01	5.45	69	.01	.00	.01	4.	1.01	18.15	219	.02	.02	.00	36.
1.01	5.50	70	.01	.00	.01	4.	1.01	18.20	220	.02	.02	.00	30.
1.01	5.55	71	.01	.00	.01	4.	1.01	18.25	221	.02	.02	.00	28.
1.01	6.00	72	.01	.00	.01	4.	1.01	18.30	222	.02	.02	.00	28.
1.01	6.05	73	.07	.02	.05	15.	1.01	18.35	223	.02	.02	.00	28.
1.01	6.10	74	.07	.02	.05	23.	1.01	18.40	224	.02	.02	.00	28.
1.01	6.15	75	.07	.02	.05	27.	1.01	18.45	225	.02	.02	.00	28.
1.01	6.20	76	.07	.02	.04	30.	1.01	18.50	226	.02	.02	.00	28.
1.01	6.25	77	.07	.02	.04	32.	1.01	18.55	227	.02	.02	.00	28.
1.01	6.30	78	.07	.03	.04	34.	1.01	19.00	228	.02	.02	.00	28.
1.01	6.35	79	.07	.03	.04	37.	1.01	19.05	229	.02	.02	.00	28.
1.01	6.40	80	.07	.03	.04	39.	1.01	19.10	230	.02	.02	.00	28.
1.01	6.45	81	.07	.03	.04	41.	1.01	19.15	231	.02	.02	.00	28.
1.01	6.50	82	.07	.03	.04	42.	1.01	19.20	232	.02	.02	.00	28.
1.01	6.55	83	.07	.03	.03	44.	1.01	19.25	233	.02	.02	.00	28.
1.01	7.00	84	.07	.03	.03	46.	1.01	19.30	234	.02	.02	.00	28.
1.01	7.05	85	.07	.03	.03	47.	1.01	19.35	235	.02	.02	.00	28.
1.01	7.10	86	.07	.04	.03	49.	1.01	19.40	236	.02	.02	.00	28.
1.01	7.15	87	.07	.04	.03	50.	1.01	19.45	237	.02	.02	.00	28.
1.01	7.20	88	.07	.04	.03	52.	1.01	19.50	238	.02	.02	.00	28.
1.01	7.25	89	.07	.04	.03	53.	1.01	19.55	239	.02	.02	.00	28.
1.01	7.30	90	.07	.04	.03	54.	1.01	20.00	240	.02	.02	.00	28.
1.01	7.35	91	.07	.04	.03	55.	1.01	20.05	241	.02	.02	.00	28.
1.01	7.40	92	.07	.04	.03	56.	1.01	20.10	242	.02	.02	.00	28.
1.01	7.45	93	.07	.04	.03	57.	1.01	20.15	243	.02	.02	.00	28.
1.01	7.50	94	.07	.04	.02	59.	1.01	20.20	244	.02	.02	.00	28.
1.01	7.55	95	.07	.04	.02	59.	1.01	20.25	245	.02	.02	.00	28.
1.01	8.00	96	.07	.04	.02	60.	1.01	20.30	246	.02	.02	.00	28.
1.01	8.05	97	.07	.04	.02	61.	1.01	20.35	247	.02	.02	.00	28.
1.01	8.10	98	.07	.05	.02	62.	1.01	20.40	248	.02	.02	.00	28.
1.01	8.15	99	.07	.05	.02	63.	1.01	20.45	249	.02	.02	.00	28.
1.01	8.20	100	.07	.05	.02	64.	1.01	20.50	250	.02	.02	.00	28.
1.01	8.25	101	.07	.05	.02	65.	1.01	20.55	251	.02	.02	.00	28.
1.01	8.30	102	.07	.05	.02	65.	1.01	21.00	252	.02	.02	.00	28.
1.01	8.35	103	.07	.05	.02	66.	1.01	21.05	253	.02	.02	.00	28.
1.01	8.40	104	.07	.05	.02	67.	1.01	21.10	254	.02	.02	.00	28.
1.01	8.45	105	.07	.05	.02	67.	1.01	21.15	255	.02	.02	.00	28.
1.01	8.50	106	.07	.05	.02	68.	1.01	21.20	256	.02	.02	.00	28.
1.01	8.55	107	.07	.05	.02	69.	1.01	21.25	257	.02	.02	.00	28.
1.01	9.00	108	.07	.05	.02	69.	1.01	21.30	258	.02	.02	.00	28.
1.01	9.05	109	.07	.05	.02	70.	1.01	21.35	259	.02	.02	.00	28.
1.01	9.10	110	.07	.05	.02	70.	1.01	21.40	260	.02	.02	.00	28.
1.01	9.15	111	.07	.05	.02	71.	1.01	21.45	261	.02	.02	.00	28.
1.01	9.20	112	.07	.05	.02	71.	1.01	21.50	262	.02	.02	.00	28.
1.01	9.25	113	.07	.05	.02	72.	1.01	21.55	263	.02	.02	.00	28.
1.01	9.30	114	.07	.05	.01	72.	1.01	22.00	264	.02	.02	.00	28.
1.01	9.35	115	.07	.05	.01	73.	1.01	22.05	265	.02	.02	.00	28.

1.01	9.40	116	.07	.05	.01	73.	1.01	22.10	266	.02	.02	.00	28.
1.01	9.45	117	.07	.05	.01	74.	1.01	22.15	267	.02	.02	.00	28.
1.01	9.50	118	.07	.05	.01	74.	1.01	22.20	268	.02	.02	.00	28.
1.01	9.55	119	.07	.05	.01	75.	1.01	22.25	269	.02	.02	.00	28.
1.01	10.00	120	.07	.05	.01	75.	1.01	22.30	270	.02	.02	.00	28.
1.01	10.05	121	.07	.05	.01	75.	1.01	22.35	271	.02	.02	.00	28.
1.01	10.10	122	.07	.05	.01	76.	1.01	22.40	272	.02	.02	.00	28.
1.01	10.15	123	.07	.05	.01	76.	1.01	22.45	273	.02	.02	.00	28.
1.01	10.20	124	.07	.05	.01	76.	1.01	22.50	274	.02	.02	.00	28.
1.01	10.25	125	.07	.06	.01	77.	1.01	22.55	275	.02	.02	.00	28.
1.01	10.30	126	.07	.06	.01	77.	1.01	23.00	276	.02	.02	.00	28.
1.01	10.35	127	.07	.06	.01	77.	1.01	23.05	277	.02	.02	.00	28.
1.01	10.40	128	.07	.06	.01	78.	1.01	23.10	278	.02	.02	.00	28.
1.01	10.45	129	.07	.06	.01	78.	1.01	23.15	279	.02	.02	.00	28.
1.01	10.50	130	.07	.06	.01	78.	1.01	23.20	280	.02	.02	.00	28.
1.01	10.55	131	.07	.06	.01	79.	1.01	23.25	281	.02	.02	.00	28.
1.01	11.00	132	.07	.06	.01	79.	1.01	23.30	282	.02	.02	.00	28.
1.01	11.05	133	.07	.06	.01	79.	1.01	23.35	283	.02	.02	.00	28.
1.01	11.10	134	.07	.06	.01	79.	1.01	23.40	284	.02	.02	.00	28.
1.01	11.15	135	.07	.06	.01	80.	1.01	23.45	285	.02	.02	.00	28.
1.01	11.20	136	.07	.06	.01	80.	1.01	23.50	286	.02	.02	.00	28.
1.01	11.25	137	.07	.06	.01	80.	1.01	23.55	287	.02	.02	.00	28.
1.01	11.30	138	.07	.06	.01	80.	1.02	0.00	288	.02	.02	.00	28.
1.01	11.35	139	.07	.06	.01	81.	1.02	.05	289	0.00	0.00	0.00	12.
1.01	11.40	140	.07	.06	.01	81.	1.02	.10	290	0.00	0.00	0.00	3.
1.01	11.45	141	.07	.06	.01	81.	1.02	.15	291	0.00	0.00	0.00	1.
1.01	11.50	142	.07	.06	.01	81.	1.02	.20	292	0.00	0.00	0.00	0.
1.01	11.55	143	.07	.06	.01	81.	1.02	.25	293	0.00	0.00	0.00	0.
1.01	12.00	144	.07	.06	.01	82.	1.02	.30	294	0.00	0.00	0.00	0.
1.01	12.05	145	.20	.16	.02	175.	1.02	.35	295	0.00	0.00	0.00	0.
1.01	12.10	146	.20	.18	.02	229.	1.02	.40	296	0.00	0.00	0.00	0.
1.01	12.15	147	.20	.18	.02	244.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12.20	148	.20	.18	.02	249.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12.25	149	.20	.18	.02	251.	1.02	.55	299	0.00	0.00	0.00	0.
1.01	12.30	150	.20	.18	.02	252.	1.02	1.00	300	0.00	0.00	0.00	0.
									SUM	31.73	28.18	3.15	39279.
										(796.)(716.)(80.)(1112.26)			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2777.	450.	136.	131.	39264.
CMS	79.	13.	4.	4.	1112.
INCHES		28.26	28.18	28.18	28.18
MM		590.69	715.83	715.83	715.83
AC-FT		223.	270.	270.	270.
THOUS CU M		275.	334.	334.	334.

HYDROGRAPH AT STA 11007 FOR 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.	1.	1.	1.	1.
1.	1.	2.	2.	2.	3.	3.	3.	3.	3.
3.	3.	3.	3.	3.	3.	4.	4.	4.	4.
4.	4.	15.	23.	27.	30.	33.	36.	37.	39.
40.	42.	44.	46.	47.	49.	50.	52.	53.	54.
55.	56.	57.	59.	59.	60.	61.	62.	63.	64.

65.	65.	66.	67.	67.	68.	69.	69.	70.	70.
71.	71.	72.	72.	73.	73.	74.	74.	75.	75.
76.	76.	76.	76.	77.	77.	77.	78.	78.	78.
79.	79.	79.	79.	80.	80.	80.	80.	81.	81.
81.	81.	81.	82.	174.	229.	244.	249.	251.	252.
254.	255.	256.	257.	258.	259.	289.	307.	312.	314.
315.	316.	317.	318.	319.	319.	320.	320.	367.	393.
400.	403.	404.	404.	405.	406.	406.	407.	407.	408.
316.	408.	474.	634.	790.	1569.	2777.	2104.	1284.	916.
654.	540.	445.	402.	391.	388.	388.	388.	388.	388.
388.	388.	388.	388.	340.	314.	307.	306.	305.	305.
305.	305.	305.	305.	305.	305.	166.	58.	36.	30.
28.	28.	28.	28.	28.	28.	28.	28.	23.	28.
28.	28.	28.	28.	28.	26.	26.	28.	28.	28.
28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	28.	28.	28.	28.	28.
28.	28.	28.	28.	23.	28.	28.	28.	28.	28.
28.	28.	28.	28.	28.	28.	29.	28.	12.	3.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2777.	450.	166.	131.	39264.
CMS	79.	13.	4.	4.	1112.
INCHES	---	23.26	28.18	28.18	28.18
MM		590.69	715.83	715.83	715.83
AC-FT		223.	270.	270.	270.
THOUS CU M		275.	334.	334.	334.

HYDROGRAPH AT STA 11007 FOR PLAN 1, RTIO 2

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.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	8.	11.	13.	15.	16.	17.	18.	19.
20.	21.	22.	23.	24.	24.	25.	26.	26.	27.
28.	28.	29.	29.	30.	30.	31.	31.	32.	32.
32.	33.	33.	33.	34.	34.	34.	35.	35.	35.
35.	36.	36.	36.	36.	37.	37.	37.	37.	37.
38.	38.	38.	38.	38.	39.	39.	39.	39.	39.
39.	39.	40.	40.	40.	40.	40.	40.	40.	40.
40.	41.	41.	41.	88.	114.	122.	124.	126.	126.
127.	127.	128.	128.	129.	129.	145.	153.	156.	157.
158.	158.	158.	159.	159.	159.	160.	160.	183.	196.
200.	201.	202.	202.	203.	203.	203.	203.	204.	204.
158.	204.	237.	317.	395.	785.	1388.	1052.	642.	458.
326.	270.	223.	201.	195.	194.	194.	194.	194.	194.
194.	194.	194.	194.	170.	157.	154.	153.	153.	153.
153.	153.	153.	153.	153.	153.	73.	29.	18.	15.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.
14.	14.	14.	14.	14.	14.	14.	14.	14.	14.

14.	14.	14.	14.	14.	14.	14.	14.	6.	2.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1384.	225.	68.	65.	19632.
CMS	39.	6.	2.	2.	556.
INCHES		11.63	14.09	14.09	14.09
MM		295.35	357.91	357.91	357.91
AC-FT		112.	135.	135.	135.
THOUS CU M		138.	167.	167.	167.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH KRUEGER LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11007	1	0	0	2	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	3	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-600.	-1

STAGE	608.00	606.73	609.00	609.09	609.44	610.80	612.13	612.88
FLOW	0.00	52.00	90.00	115.00	357.00	2624.00	6845.00	10245.00

CAPACITY=	0.	2.	52.	103.	112.	240.	638.
ELEVATION=	575.	580.	600.	608.	609.	620.	640.

CREL	SPWID	COOD	EXPW	ELEVL	COOL	CAREA	EXPL
608.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
609.0	0.0	0.0	0.

STATION 11007, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

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.
0.	0.	0.	0.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	2.	2.	2.	2.	2.
2.	2.	3.	4.	5.	6.	7.	9.	10.	12.
13.	15.	16.	18.	19.	21.	22.	24.	25.	27.
28.	30.	31.	33.	34.	35.	37.	38.	39.	41.

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

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

OPERATION	STATION	AREA	PLAN	RATIO 1 1.00	RATIO 2 .50
				RATIOS APPLIED TO FLOWS	
HYDROGRAPH AT	11007	.16	1	2777.	1348.
		(.47)		(78.63)(	39.32)(
ROUTED TO	11007	.15	1	2204.	1030.
		(.47)		(62.41)(	30.86)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	60[illegible].00	608.00	609.00
STORAGE	103.	103.	112.
OUTFLOW	0.	0.	90.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	610.55	1.55	130.	2204.	6.42	15.67	0.00
.50	609.68	.88	122.	1090.	5.42	15.67	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

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

RUN  DATE= 79/06/07.
     TIME= 09.16.40.
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DAM SAFETY INSPECTION - MISSOURI
KRUEGER LAKE DAM (11007)
PERCENT OF PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .10 .11 .12 .13 .14 .15 .16 .17 .18

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SUB-AREA RUNOFF COMPUTATION

INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11007	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.18	0.00	.18	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.10	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

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

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

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .06

RECESSION DATA
STRTG= 0.00 GRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

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

SUM 31.33 28.18 3.15 39279.
(796.)(716.)(80.1(1112.26(

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH KRUEGER LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11007	1	0	0	0	0	1	0	0

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-608.	-1

STAGE	608.00	608.75	609.00	609.09	609.44	610.80	612.13	612.88
FLOW	0.00	52.00	90.00	115.00	357.00	2624.00	6843.00	10243.00
CAPACITY=	0.	2.	52.	103.	112.	242.	638.	
ELEVATION=	575.	580.	600.	608.	609.	620.	640.	

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
608.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
609.0	0.0	0.0	0.

PEAK OUTFLOW IS 82. AT TIME 15.83 HOURS

PEAK OUTFLOW IS 96. AT TIME 15.83 HOURS

PEAK OUTFLOW IS 111. AT TIME 15.83 HOURS

PEAK OUTFLOW IS 137. AT TIME 15.83 HOURS

PEAK OUTFLOW IS 166. AT TIME 15.75 HOURS

PEAK OUTFLOW IS 193. AT TIME 15.75 HOURS

PEAK OUTFLOW IS 219. AT TIME 15.75 HOURS

PEAK OUTFLOW IS 290. AT TIME 15.75 HOURS

PEAK OUTFLOW IS 266. AT TIME 15.75 HOURS

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .10	RATIO 2 .11	RATIO 3 .12	RATIO 4 .13	RATIO 5 .14	RATIO 6 .15	RATIO 7 .16	RATIO 8 .17	RATIO 9 .18
HYDROGRAPH AT	11007	.18	1	276.	305.	333.	361.	389.	417.	444.	472.	500.
		(.47)		(7.80)	(8.65)	(9.44)	(10.22)	(11.01)	(11.79)	(12.58)	(13.37)	(14.15)
ROUTED TO	11007	.18	1	82.	96.	111.	137.	166.	193.	219.	244.	266.
		(.47)		(2.33)	(2.70)	(3.15)	(3.88)	(4.70)	(5.48)	(6.21)	(6.90)	(7.52)