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NATIONAL DAM SAFETY PROGRAM. HARRISON COUNTY DAM C-2 (MO 10614)--ETC(U)
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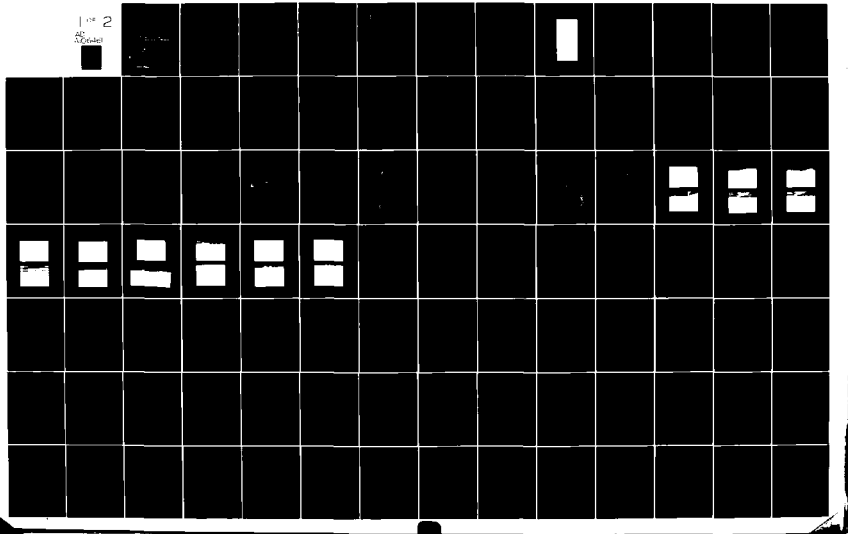

LEVEL II

MISSOURI-GRAND-CHARITON BASIN

AD A106461

HARRISON COUNTY DAM C-2

HARRISON COUNTY, MISSOURI

MO 10614

PHASE 1 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

MAR 1981

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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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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HARRISON COUNTY DAM C-2

HARRISON COUNTY, MISSOURI

MO 10614

PHASE 1 INSPECTION REPORT
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FOR: STATE OF MISSOURI

MARCH 1981

HARRISON COUNTY DAM C-2

HARRISON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10614

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI

UNDER DIRECTION OF

ST. LOUIS DISTRICT CORPS OF ENGINEERS

FOR

GOVERNOR OF MISSOURI

MARCH 1981

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO ATTENTION OF

SUBJECT: Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Harrison County Dam C-2 (MO 10614).

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:

a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.

b. Overtopping of the dam could result in failure of the dam.

c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division — 9 JUL 1981 — Date

APPROVED BY: SIGNED
Colonel, CE, Commanding — 10 JUL 1981 — Date

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Harrison County Dam C-2
State Located	Missouri
County Located	Harrison County
Stream	Panther Creek
Date of Inspection	3 March 1981

Harrison County Dam C-2 was inspected by a team of engineers from Black & Veatch, Consulting Engineers for the St. Louis District, Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. According to the St. Louis District, Corps of Engineers, failure would threaten lives and property. The estimated damage zone extends approximately six miles downstream of the dam. Within the estimated damage zone are four dwellings and two farm buildings. Contents of the estimated downstream damage zone were verified by the inspection team.

Our inspection and evaluation indicates the spillways do not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will not pass the probable maximum flood without overtopping but will pass 40 percent of the probable maximum flood. The spillways will pass the flood which has a one percent chance of occurrence in any given year (100-year flood). The spillway design flood recommended by the guidelines is 100 percent of the probable maximum flood. The probable maximum flood is defined as the flood discharge which may be expected from the most severe combination of critical meteorologic and hydrologic conditions which are reasonably possible in the region.

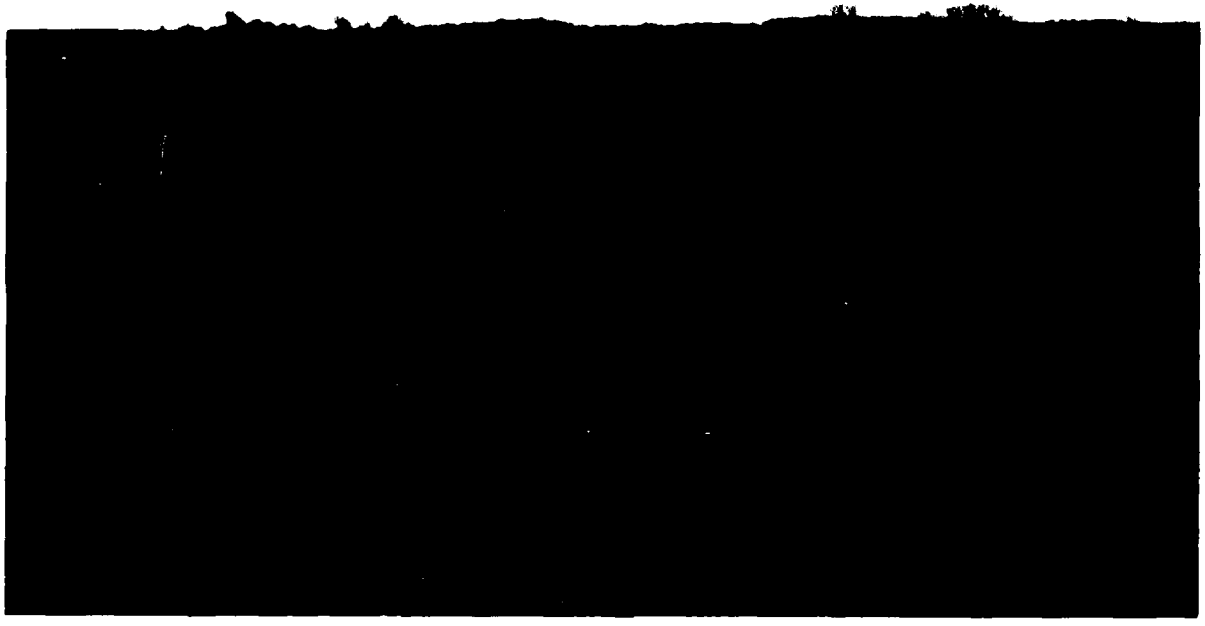
Based on visual observations, this dam appears to be in satisfactory condition. Deficiencies visually observed by the inspection team were erosion at the downstream toe of slope and at both abutment/embankment interfaces, a wet area downstream of the dam, the growth of trees on the embankment, animal burrows in the embankment, irregularities

in the downstream slope, vehicle tracks on the crest of the dam, and an inoperable slide gate at the low level inlet to the principal spillway drop structure. Seepage analyses required by the guidelines were not available.

There were no observed deficiencies or conditions existing at the time of the inspection which indicated an immediate safety hazard. Future corrective action and regular maintenance will be required to correct or control the described deficiencies. In addition, detailed seepage analyses of the existing dam, as required by the guidelines, should be performed. A detailed report discussing each of these deficiencies is attached.

Edwin R. Burton, PE
Missouri E-10137

Harry L. Callahan, Partner
Black & Veatch



OVERVIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
HARRISON COUNTY DAM C-2

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APPENDIX

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 District Engineer of the St. Louis District, Corps of Engineers, directed that a safety inspection of the Harrison County Dam C-2 be made.

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

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

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure located in the valley of Panther Creek (see Plate 1). The watershed is an area of low hills with fairly steep rugged terrain devoted primarily to grassland pasture and meadow. Timber occurs mostly adjacent to stream channels and along drainage ways. The dam is approximately 1,500 feet long along its crest and 54 feet high. The dam crest is 13 feet wide. The upstream slope of the dam is broken by a 10 foot wide berm about 12 feet below the crest and another berm just below the principal spillway level. The upstream slope is faced with riprap below the upper berm. The downstream face of the dam slopes uniformly from the crest to a graded 10 foot wide berm about 36 feet below the crest, then slopes to the valley floor below the dam.

(2) The principal spillway is a typical SCS design drop inlet structure with a pipe outlet. The rectangular reinforced concrete drop inlet structure has an overflow weir on two sides and is protected by an angle-iron trash rack supported by concrete walls. The outlet from the drop structure is through a 48-inch diameter reinforced concrete pipe that passes under the dam to a plunge pool and natural stream channel below the dam. The drop structure has a gated reinforced concrete pipe low-level inlet.

(3) The emergency spillway is a 180 foot wide trapezodial channel cut through the natural abutment around the right end of the dam. The emergency spillway has a natural limestone floor and right bank in the reach at the end of the dam. The downstream reach is grass lined in soil with 8-foot wide dikes along each bank. The dam embankment is protected from emergency spillway flows by a dike along the left bank of the spillway. Reference to right or left as used in this report is defined as right or left while facing in a downstream direction.

b. Location. The dam is located in east central Harrison County, Missouri, as indicated on Plate 1. The lake formed by the dam is in an area shown on the United States Geological Survey 15 minute series quadrangle map for Blythedale, Missouri in Section 36 of T65N, R27W. The lake is shown on the USGS 7.5 minute orthophotograph for Blythedale NW, Missouri.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, the dam and impoundment are in the intermediate size category. An intermediate size dam is classified as having a height less than 100 feet, but greater than or equal to 40 feet and/or a storage capacity less than 50,000 acre-feet, but greater than or equal to 1,000 acre-feet.

d. Hazard Classification. The hazard classification assigned by the Corps of Engineers for this dam is as follows: The Harrison County Dam C-2 has a high hazard potential, meaning that the dam is located where failure may cause loss of life, and serious damage to homes, agricultural, industrial and commercial facilities, and to important public utilities, main highways, or railroads. For the Harrison County Dam C-2, the estimated flood damage zone extends approximately six miles downstream of the dam. Within the estimated damage zone are four dwellings and two farm buildings. Contents of the estimated downstream damage zone were verified by the inspection team.

e. Ownership. The dam is owned by Jess Hale, Ridgeway, Missouri 64481.

f. Purpose of Dam. The dam forms a 67-acre lake used for recreation, flood control, water supply, and soil stabilization.

g. Design and Construction History. Data relating to the design and construction of the dam were available from the U.S. Department of Agriculture, Soil Conservation Service at Columbia, Missouri. Construction of the dam was completed in October, 1972 by Turner Construction Company, Maryville, Missouri.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, evaporation, and overflow through the uncontrolled spillways all combine to maintain a relatively stable water surface elevation.

1.3 PERTINENT DATA

a. Drainage Area - 5,831 acres

b. Discharge at Damsite.

(1) Normal discharge at the damsite is over a weir of the concrete drop inlet structure to a 48-inch reinforced concrete pipe through the embankment.

(2) Estimated experienced maximum flood at damsite - Unknown.

(3) Estimated ungated spillway capacity at maximum pool elevation 20,910 cfs (Probable Maximum Flood Pool El. 931.6).

c. Elevation (Feet above m.s.l.)(Survey elevations).

(1) Top of dam - 928.3 (see Plate 5)

(2) Principal spillway crest - 906.3

(3) Emergency spillway crest - 920.4

(4) Streambed at toe of dam - 873.8

(5) Maximum tailwater - Unknown.

d. Reservoir.

(1) Length of maximum pool - 1.7 miles ± (Probable maximum flood pool level)

(2) Length of normal pool - 4,600 feet ± (Principal spillway crest)

e. Storage (Acre-feet).

(1) Top of dam - 3,963

(2) Principal spillway crest - 424

(3) Emergency spillway crest - 2,079

(4) Design surcharge - 1,520 ±

f. Reservoir Surface (Acres).

(1) Top of dam - 471

(2) Principal spillway crest - 67

(3) Emergency spillway crest - 161

g. Dam.

(1) Type - Earth embankment

(2) Length - 1,500 feet ±

(3) Height - 54 feet ±

(4) Top width - 13 feet

(5) Side slopes - upstream face 1.0 V on 2.5 H design, 1.0 V on 2.6 H field measured, downstream face 1.0 V on 2.5 H design, and 1.0 V on 2.6 H field measured (See Plates 4 & 5).

(6) Zoning - Zone 1 - Core CH material, Zone 2 - upstream and downstream embankment CL material, Zone 3 upstream face limestone riprap, Zone 4 - lower upstream face limestone and shale rock (See Plate 4).

(7) Impervious core - CH material (See Plate 4).

(8) Cutoff - Impervious core trench.

(9) Grout curtain - None.

h. Diversion and Regulating Tunnel - None.

i. Principal Spillway (Survey elevations).

(1) Type - Overflow weir drop inlet structure to reinforced concrete pipe through dam.

(2) Crest elevation - 906.3 feet m.s.l.

(3) Inlet invert elevation - 887.4 feet m.s.l.

(4) Outlet invert elevation - 884.5 feet m.s.l.

(5) Gates - Slide gate at low level inlet to drop structure.

(6) Upstream channel - None.

(7) Downstream channel - Principal spillway pipe discharges to a riprap lined plunge pool, then to the natural stream below the dam.

j. Emergency Spillway (Survey elevation).

(1) Type - Trapezoidal open channel.

(2) Width of channel - 180 feet.

(3) Crest elevation - 920.4 feet m.s.l.

(4) Gates - None.

(5) Upstream channel - Each of the two arms, forming the lake contain a few trees.

(6) Downstream channel - Grass lined to natural stream below dam.

k. Regulating Outlets ("As-Built" elevation).

(1) Type - Slide gate low level inlet to drop structure.

(2) Inlet invert elevation - 888.5 feet m.s.l.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Design data in the form of a detailed geologic site investigation report, a design memorandum from the SCS Soils Mechanics Laboratory, "As-Built" drawings and hydrologic/hydraulic data were made available by the Soil Conservation Service. The geology report and design memorandum are included herein as Appendix B. Pertinent data from the "As-Built" drawings are included on Plates 3, 4, & 7. Hydrologic/Hydraulic data provided is included in Appendix A.

2.2 CONSTRUCTION

Construction records in the form of "As-Built" drawings were provided for the dam and spillways. A log of construction is available in the project file through the Soil Conservation Service, Columbia, Missouri office.

2.3 OPERATION

Operational records and documentation of past floods were unavailable.

2.4 GEOLOGY

The site of the dam and reservoir is located across a broad, steep-sided valley cut by Panther Creek. The dam impounds this creek and the drainage from its watershed in Harrrison County, Missouri.

The site is located within the Iowa and Missouri Till Plain. The soils of the area consist predominantly of silty clays (CL) with sand and gravel intermixed developed in Kansas age glacial till on the uplands and hill slopes, and silty clay to clayey silt (CL-ML) alluvium and terrace deposits on the valley floor. In addition there is a layer of silty sand (SM) that is present about 1 foot above the bedrock in the valley that is continous and is assumed to be permeable. Bedrock consists of the interbedded limestones and shales of the Pennsylvanian age Kansas City Group and is buried to a depth of generally greater than 10 feet.

The foundation of the dam is recent alluvial silty clay to clayey silt (CL-ML) overlying the Winterset Limestone of the Dennis Formation to a thickness of 6 to 10 feet. The emergency spillway is cut through this limestone formation at the centerline of the dam.

2.5 EVALUATION

a. Availability. Engineering data were obtained from the Soil Conservation Service as noted in Section 2.1.

b. Adequacy. Engineering data were available from which to make an assessment of the design and construction. Seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage analyses should be performed and made a matter of record.

c. Validity. The available engineering data on the design and construction were determined to be valid.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of Harrison County Dam C-2 was made on March 3, 1981. The inspection team consisted of Edwin Burton, team leader; Robert Pinker, geologist; Gary Van Riessen, geotechnical engineer; and David Rensing, hydrologist. The dam appeared to be in satisfactory condition. Specific observations are discussed below. No observations were made of the condition of the upstream face of the dam below the pool elevation at the time of the inspection.

b. Dam. The inspection team observed the following conditions at the dam. No cracking, sliding, sloughing or other signs of settlement or instability were observed. There were no instruments on the dam to measure performance.

A wet area was observed downstream of the dam between the principal spillway outlet and the emergency spillway (Photo 16). The inspection team believed that this wet area was due to poor drainage of local runoff. The downstream slope of the embankment had minor irregularities which appeared to be the result of cattle traffic. These irregularities consisted of two or three lines located about one quarter of the way up the slope from the toe where the slope was interrupted by a vertical drop of approximately one foot followed by a flat slope for about one and one half to two feet. Minor erosion was observed on the downstream face of the dam which appeared to have occurred before the grass cover had become established. Erosion gullies were beginning to develop at the embankment-abutment interfaces (Photo 15), on the upstream and downstream side at the left abutment, on the downstream side at the right abutment, and along the toe of the downstream slope (Photo 14) between the left end and the principal spillway. Riprap slope protection in good condition was provided on the upstream face below the upper berm (Photo 2). Slope protection was provided on the downstream slope, the crest, and the upstream slope above the riprap by a good stand of fescue grass. The grass was maintained by cattle grazing. Vehicular traffic has worn tracks and bare areas across the crest of the dam (Photos 3 & 4). Several small trees, 1-inch in size, were growing in the riprap on the upstream face (Photo 2). A few animal burrows were observed on the crest and upstream face of the dam (Photos 17 & 18). There was no evidence to indicate that the dam has ever been overtopped.

c. Appurtenant Structures. The inspection team observed the following items pertaining to the appurtenant structures. The drop inlet structure of the principal spillway appeared to be in good condition (Photos 7 & 8). No cracking, spalling, or other evidence of concrete deterioration was observed. The angle-iron trash rack was secure with no signs of rust. One log, 8 inches in diameter, was jammed against the trash rack but probably would not reduce the capacity of the

inlet. A low-level inlet for lake drawdown was provided on the reservoir side of the structure through a slide gate. The gate was in a closed position. The inspection team was unable to operate the gate. A small stream of water, estimated at approximately 1/2 gallon per minute, was leaking from the side of the gate. The inspection team was unable to measure the gate but estimated its size to be 18 inches in diameter.

The inspection team observed the downstream end of the 48-inch reinforced concrete principal spillway pipe (Photo 9). Three pipe sections supported by a concrete cradle were exposed. The pipe joints appeared to be tight with no obvious movement. The alinement of the pipe appeared to be true and straight when looking through the pipe from the downstream end. Some minor erosion and undercutting of the pipe cradle was observed. Erosion was noted in the plunge pool below the pipe outlet. The elevation of the bottom of the plunge pool at the pipe outlet was field surveyed to be about three feet lower than shown on the "As-Built" drawings.

The emergency spillway is a channel cut into the embankment at the right end of the dam (Photos 11 & 12). The channel was in good condition with no evidence of erosion. The floor of the spillway to about 50 feet downstream of the dam centerline was limestone bedrock. The channel floor for the downstream reach was protected from erosion by a good covering of fescue grass. The embankment was protected from flows in the emergency spillway by an earth dike along the left spillway bank (Photo 13). The dike was also grass covered.

There was no development in the spillway area which would suffer damage due to flow through the spillways.

d. Geology. The soils in the area of the dam and reservoir consist of low plastic silty clays developed in glacial till on the uplands and hillsides and alluvial silty clays to clayey silts on the valley floor. Depth to the interbedded limestones and shales of the Pennsylvanian age Dennis Formation is greater than 10 feet.

A sample of the material in the embankment was taken with an Oakfield sampler from near station 6+00 on the crest. The materials sampled were visually classified for engineering properties as silty sand (SM) top soil for the upper 1-1/2 feet and dark brown silty clay (CL) glacial till from 1-1/2 feet to 2-1/2 feet. The inspectors suspect that the lower sample was from core material. Both abutments are in stiff glacial till classified as silty clay (CL) material.

e. Reservoir Area. No slumping or slides of the reservoir banks were observed. The lake has two arms with Panther Creek forming the east arm and a lesser tributary forming the west arm. The upstream channel to the lake contains a few trees. The lake was noted to be clean with no appreciable siltation.

f. Downstream Channel. The spillways discharge to a natural stream channel containing no obstructions.

3.2 EVALUATION

The various deficiencies observed at the time of the inspection are not believed to represent an immediate safety hazard. They do, however, warrant monitoring and control.

The wet area observed downstream of the dam is believed to be due to poor drainage of local runoff. However, it should be observed during dry periods. If it does not begin to dry up during dry weather, then it should be considered a seep area and monitored regularly.

The gulley erosion observed at the abutment-embankment interfaces and at the toe of the downstream slope is where local runoff concentrates. Erosion control in these areas may require riprap or paving.

The irregularities observed on the downstream slope are believed to be the result of cattle traffic on the slopes and are not considered a problem at this time. If the slope irregularities become larger, however, it could lead to erosion and/or sloughing.

The vehicle tracks across the crest of the dam do not constitute a problem at this time but could result in erosion of the crest if not corrected.

The growth of trees on the embankment, if allowed to go unchecked, could cause deterioration of the embankment and displacement of the riprap slope protection. This could lead to erosion of the embankment. The roots of trees can loosen the embankment material and create voids through which water can pass.

Burrowing animals will continue to damage the embankment unless a program is undertaken to eliminate them. Piping failure of the embankment has resulted in similar small earth dams as the result of burrowing animal damage.

The low level slide gate inlet to the principal spillway drop structure is to provide for drawdown of the reservoir which is a safety feature. The design drawdown time is ten days. The inoperable condition of the gate will hinder and delay any drawdown operations if a crisis were to arise. The observed leakage from the gate is not considered a safety deficiency but if not corrected it will probably worsen and could result in draining the reservoir.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool is primarily controlled by rainfall, runoff, evaporation, transpiration, and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Maintenance is the responsibility of the Soil and Water Conservation District for the Panther Creek watershed. There was no evidence that a maintenance program was in effect. The grass cover is maintained by cattle grazing.

4.3 MAINTENANCE OF OPERATING FACILITIES

The slide gate at the low level inlet to the drop structure has not been maintained in an operating condition.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no existing warning system or preplanned scheme for alerting downstream residents for this dam.

4.5 EVALUATION

A maintenance program should be implemented to include removal of trees from the embankment and control of animal burrowing. The slide gate should be repaired and maintained.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Limited design data pertaining to hydrology and hydraulics were available from the Soil Conservation Service (SCS). Independent calculations were performed for this evaluation in accordance with the guidelines referenced in Section 1.1c and the St. Louis District Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 22 August 1980. The SCS data provided for an emergency spillway design for a 2 percent chance (50-year) storm of 6 hours duration. The design resulted in an emergency spillway maximum discharge of 718 cubic feet per second at a flow velocity of 5.7 feet per second and a maximum water surface elevation of 922.2. This design considered routing through three upstream structures. The freeboard design by SCS considered a 13.70 inch rainfall on an uncontrolled watershed to produce a maximum emergency spillway discharge with a maximum water surface elevation of 927.9. A copy of the design data is included in Appendix A.

b. Experience Data. The drainage area and lake surface area are from the "As-Built" data and from the USGS Blythedale, Missouri Quadrangle Map. The dam and spillway layouts are from a survey made during the inspection and from "As-Built" drawings.

c. Visual Observations.

(1) The principal spillway appears to be in good condition. The lake level at the time of the inspection was at the inlet weir crest with a small flow going over the weir. One large log was against the trash rack but was not effecting the spillway capacity. The spillway outlet pipe discharges with a free outfall into a plunge pool then to the natural channel of Panther Creek. There were no obstructions to flow through the principal spillway.

(2) The emergency spillway appeared to be in good condition. The floor of the spillway adjacent to the end of the dam was exposed limestone bedrock. The downstream spillway channel was grass lined. There were no obstructions to flow in the emergency spillway.

(3) Spillway discharges do not endanger the integrity of the dam.

d. Overtopping Potential. The spillways will not pass the probable maximum flood without overtopping the dam. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The spillway will pass 40 percent of the probable maximum flood without overtopping the dam. The spillway will pass the one percent probability flood as indicated by

comparison of the one percent probability rainfall total to the rainfall totals of the various ratios of the probable maximum storm. According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, a high hazard dam of intermediate size should pass 100 percent of the probable maximum flood. The portion of the estimated peak discharge of 50 percent of the probable maximum flood overtopping the dam would be 135 cfs of the total discharge from the reservoir of 13,345 cfs. The estimated duration of overtopping is 2.1 hours with a maximum height of 0.7 feet. The portion of the estimated peak discharge of the probable maximum flood overtopping the dam would be 15,900 cfs of the total discharge from the reservoir of 36,810 cfs. The estimated duration of overtopping is 4.8 hours with a maximum height of 3.3 feet. The embankment could be jeopardized should overtopping occur for these periods of time. The good stand of grass on the embankment will reduce the potential for erosion.

According to the St. Louis District, Corps of Engineers, the effect from rupture of the dam could extend approximately six miles downstream of the dam. Within the estimated damage zone are four dwellings and two farm buildings. Contents of the estimated downstream damage zone were verified by the inspection team. There does not appear to be any flood plain regulations or other constraints in force to limit future downstream development.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which affect the structural stability of this dam are discussed in section 3, paragraph 3.1b.

b. Design and Construction Data. Design data relating to the structural stability of the dam were available from the United States Department of Agriculture, Soil Conservation Service which consisted of Detailed Geologic Investigation of Dam Sites, 12-13-67 and Memorandum to James M. Dale, State Conservation Engineer from Lorn P. Dunnigan, Head Soil Mechanics Laboratory, SCS, dated April 30, 1968.

"As-Built" construction drawings, dated October 3, 1972 were available from the Soil Conservation Service.

As reported in the SCS data, samples for testing were obtained from borings located within the original site area. One jar and two undisturbed samples were submitted to the laboratory to represent the foundation materials. One large bag sample from the emergency spillway and eleven large bag samples from the flood plain area were submitted to represent available fill material.

Laboratory tests performed for the dam design include:

(1) Foundation Area.

a) Atterberg Limits

b) Sieve Analysis

c) Dry Unit Weight

d) One Dimensional Consolidation Test

e) Permeability

f) Triaxial Shear Test (CU)

(2) Embankment Materials.

a) Atterberg Limits

b) Sieve Analysis

c) Standard Proctor Test

d) Triaxial Shear Test (CU)

(3) Stability Loading Conditions.

Stability analyses performed by the SCS for the dam design included consideration of two loading conditions:

a) Steady Seepage

b) Full Drawdown

(4) Stability Analysis.

a) Maximum Section at Station 6+25: A slope stability analysis was made on the 2-1/2:1 upstream embankment slope using a modified Swedish circle method. Rapid drawdown from the emergency spillway to the base of the embankment is considered. The embankment will rest on bedrock after normal channel cleanout; therefore, the foundation is considered competent. Strength parameters used for the embankment are ϕ = 10.5°, c = 850 psf. No berms were considered in this analysis and the computed factor of safety is 1.58.

The downstream 2-1/2:1 embankment slope stability analysis considered a full phreatic line (no drain) and a competent foundation. With embankment strength parameters of ϕ = 10.5°, c = 850 psf the computed factor of safety is 1.66.

b) Flood plain Section at Station 6+10: The slope stability analysis of the 2-1/2:1 upstream embankment slope was made using the modified Swedish circle method. Rapid drawdown from the emergency spillway to the base of the embankment is considered. The embankment strength parameters used are ϕ = 10.5°, c = 850 psf. A foundation depth of 11 feet, strength parameters of ϕ = 14.5° and c = 400 psf were considered and the computed factor of safety is 1.29. No berms were considered in the analysis.

The downstream 2-1/2:1 embankment slope stability analysis considers a full phreatic line (no drain) and an 11-foot depth of foundation. The strength parameters considered are the same as the upstream and the computed factor of safety is 1.29.

(5) Evaluation. The available stability analyses performed by the SCS included the factor of safety for steady seepage and full drawdown loading conditions. Factors of safety for the maximum section were well within the acceptable limits suggested by Appendix D of the guidelines. The flood plain section safety factor is less than the acceptable limits; however, the analysis did not include the berms.

Stability analyses for the partial pool and earthquake loading conditions were not available. The conditions, assumptions, and strength parameters for the full drawdown and steady seepage stability analyses represent a more critical stability condition than for partial pool. The factors of safety determined for the steady seepage and full drawdown loading conditions are about equal to or greater than the suggested factor of safety for the partial pool loading condition.

Stability analyses for the earthquake loading conditions were not available. In accordance with the guidelines, the dam is located within Seismic Zone 1 with a designated seismic coefficient of 0.025 to be used in the conventional equivalent static force method of analysis.

Seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available. The design memorandum indicates that near positive cutoff is anticipated and a drain system was not considered necessary for stability of the embankment.

The embankment design provided for a settlement allowance of 1.5 feet. A crest of dam profile survey made as part of the inspection revealed that the anticipated settlement of the embankment has not taken place since construction of the dam.

c. Operating Records. No operational records were available for review by the inspection team.

d. Postconstruction Changes. There have been no post construction changes. Sheet 4 of the "As-Built" drawings shows a 15-inch low level inlet to the drop structure. Sheet 13 of the "As-Built" drawings shows the low level inlet to be 18 inches in diameter. The inspection team was unable to measure the size of this inlet.

e. Seismic Stability. The dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principles and conservatism should pose no serious stability problems during earthquakes in this zone. An assessement of the seismic stability is a requirement of the guidelines.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several conditions observed during the visual inspection by the inspection team should be monitored, corrected, and/or controlled. These are erosion at the downstream toe of slope and at both abutment/embankment interfaces, the wet area downstream of the dam, the growth of trees on the embankment, animal burrows in the embankment, irregularities in the downstream slope, vehicle tracks on the crest of the dam, and the inoperable slide gate. Seepage 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. The conclusions in this report were based only on performance history and visual conditions and the available engineering design data. The inspection team considers that these data are sufficient to support the conclusions herein. Seepage analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. It is the opinion of the inspection team that a program should be developed as soon as possible to implement remedial measures recommended in paragraph 7.2b. If the safety deficiencies listed in paragraph 7.1a are not corrected, they will continue to deteriorate and lead to a serious potential of failure. The item recommended in paragraph 7.2a should be pursued on a high priority basis.

d. Necessity for Phase II. The Phase I investigation does not raise any serious questions relating to the safety of the dam nor does it identify any serious dangers which would require a Phase II investigation. However, the additional analyses noted in paragraph 2.5b are necessary for compliance with the guidelines.

e. Seismic Stability. This dam is located in Seismic Zone 1 which is a zone of minor seismic risk. A properly designed and constructed earth dam using sound engineering principals and conservatism should pose no serious stability problems during earthquakes in this zone. However, an assessment of the seismic stability is required by the guidelines.

7.2 REMEDIAL MEASURES

a. Alternatives. The spillway capacity and/or height of the dam would need to be increased or the lake level would need to be permanently lowered to increase available flood storage in order to pass the spillway design flood.

b. Operation and Maintenance Procedures. The following operation and maintenance procedures are recommended and should be carried out under the direction of a professional engineer experienced in the design, construction, and maintenance of earth dams.

(1) The irregularities in the downstream slope should be monitored. If they become larger, grazing of cattle on the dam should be stopped or reduced. Should the irregularities continue to worsen, the condition should be evaluated by an engineer.

(2) The wet area below the dam noted during the visual inspection should be closely monitored during dry periods to determine if it is dam related. If it is determined to be due to seepage, it should be monitored and documented regularly and any significant changes should be evaluated.

(3) An improved maintenance program to remove and control the growth of brush and trees on the embankment should be developed.

(4) The erosion gullies at the downstream toe of slope and at the interface of the embankment and the right and left abutments should be backfilled with suitable material and compacted. Paved ditches, riprap, or other slope protection may be required to control the concentrated runoff.

(5) The animal burrows in the embankment should be corrected since they can lead to piping. Control measures should be implemented under the direction of a qualified engineer to discourage increased animal activity in the area. The embankment slope should be monitored during this repair.

(6) The slide gate for the low level inlet to the drop structure of the principal spillway should be repaired and maintained in working condition.

(7) Seepage analyses should be performed and made a matter of record.

(8) A detailed inspection of the dam should be made periodically. The results should be recorded and made a matter of record. More frequent inspections may be required if additional deficiencies are observed or the severity of the reported deficiencies increase.

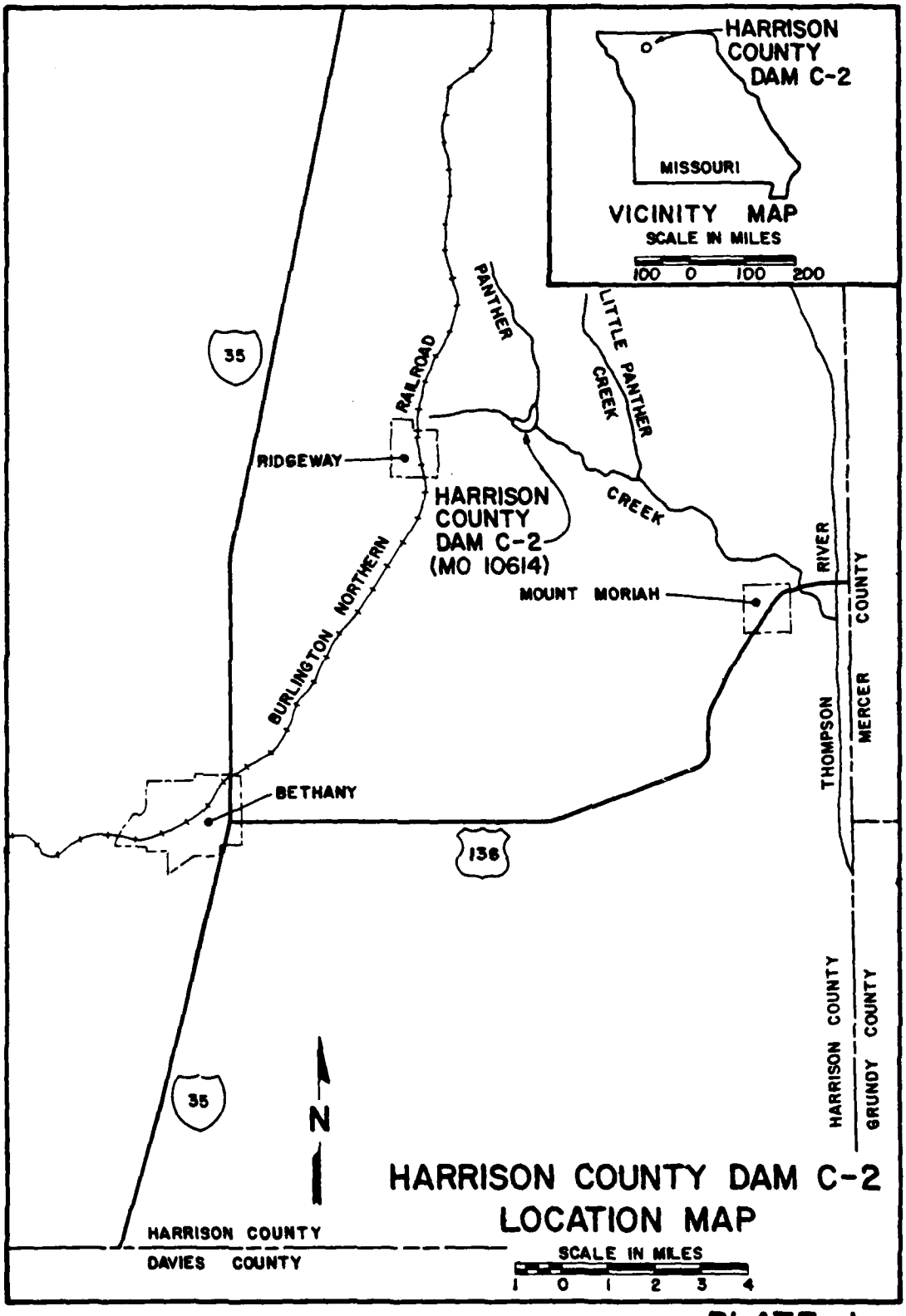

HARRISON COUNTY DAM C-2
MISSOURI
VICINITY MAP
SCALE IN MILES
100 0 100 200
35
RAILROAD
PANTHER
LITTLE PANTHER CREEK
CREEK
RIDGEWAY
HARRISON COUNTY DAM C-2 (MO 10614)
BURLINGTON NORTHERN
MOUNT MORIAH
RIVER
MERCER COUNTY
THOMPSON
BETHANY
136
HARRISON COUNTY
GRUNDY COUNTY
35
N
HARRISON COUNTY DAM C-2
LOCATION MAP
HARRISON COUNTY
DAVIES COUNTY
SCALE IN MILES
1 0 1 2 3 4

PLATE 1

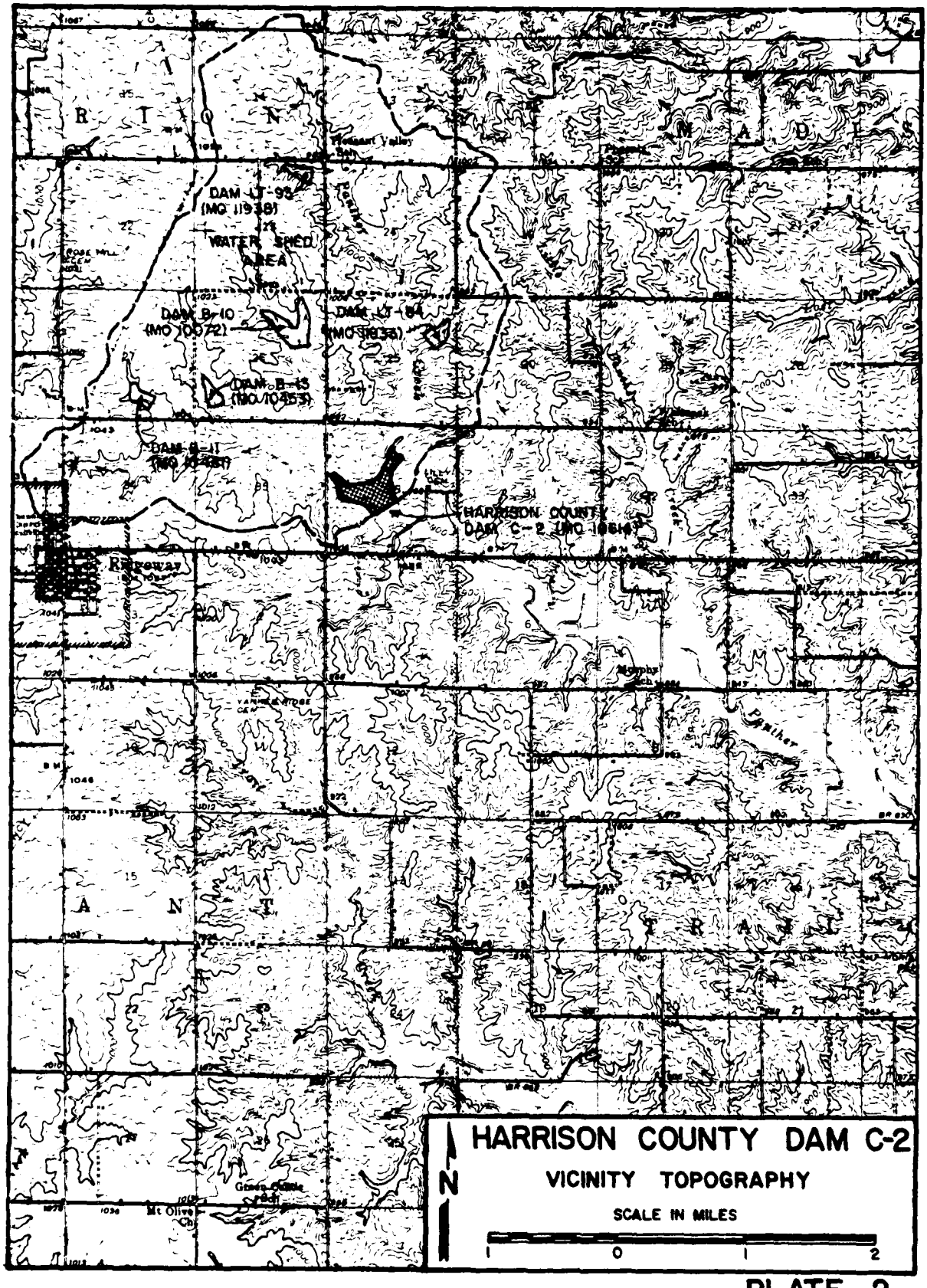
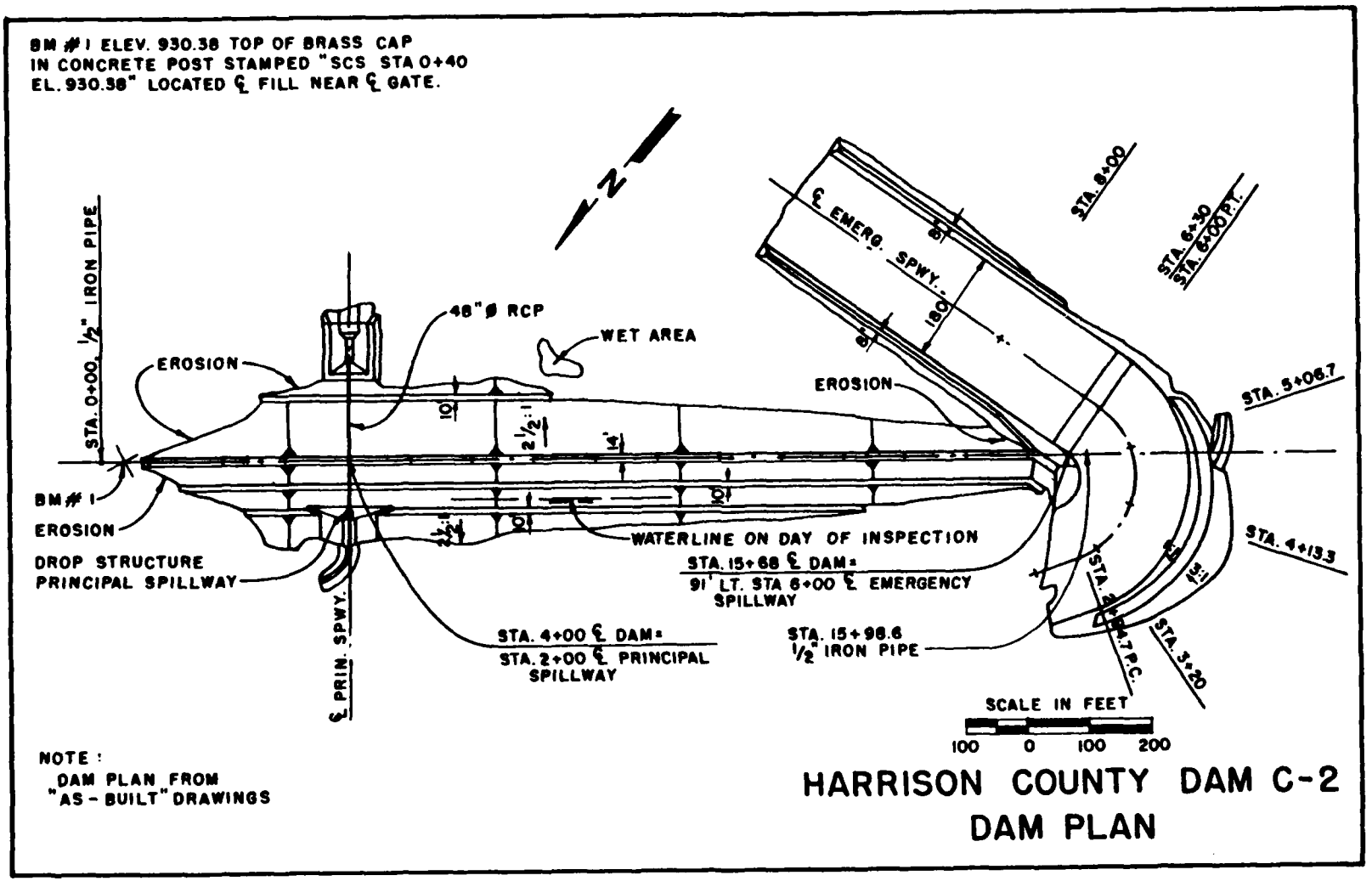

DAM LT-95
(MO 119381)
WATER SHED
AREA
DAM B-10
(MO 00772)
DAM LT-84
(MO 11836)
DAM B-13
(MO 10457)
DAM B-11
(MO 10456)
HARRISON COUNTY
DAM C-2 (MO 10614)
Ridgeway
Mt Olive
Ch
Panther
N
HARRISON COUNTY DAM C-2
VICINITY TOPOGRAPHY
SCALE IN MILES
1 0 1 2

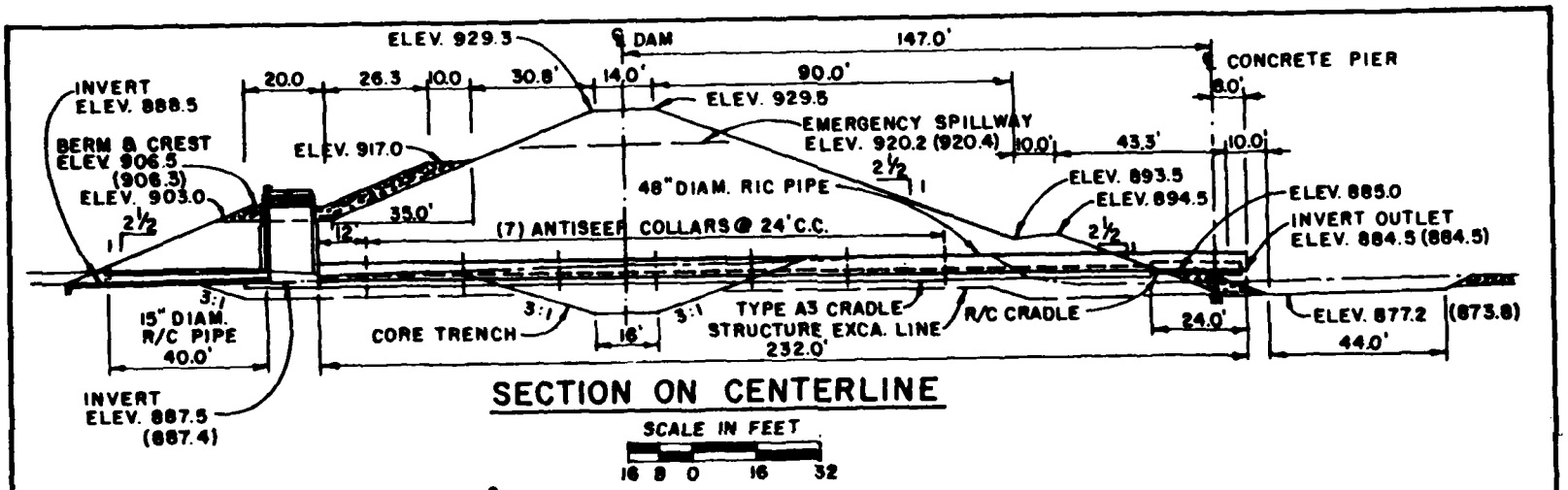
PLATE 2



NOTE :
"DAM PLAN FROM "AS-BUILT" DRAWINGS

HARRISON COUNTY DAM C-2
DAM PLAN

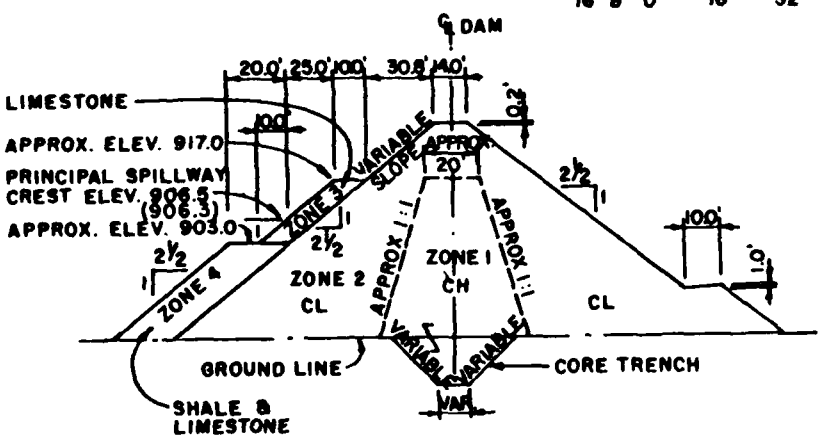
PLATE 3



SECTION ON CENTERLINE

SCALE IN FEET

16 8 0 16 32



TYPICAL SECTION OF EMBANKMENT

NOTE: TAKEN FROM "AS-BUILT" DRAWINGS
SURVEY ELEVATIONS SHOWN IN PARENTHESES.

HARRISON COUNTY DAM C-2
PRINCIPAL SPILLWAY & TYPICAL SECTION

PLATE 4

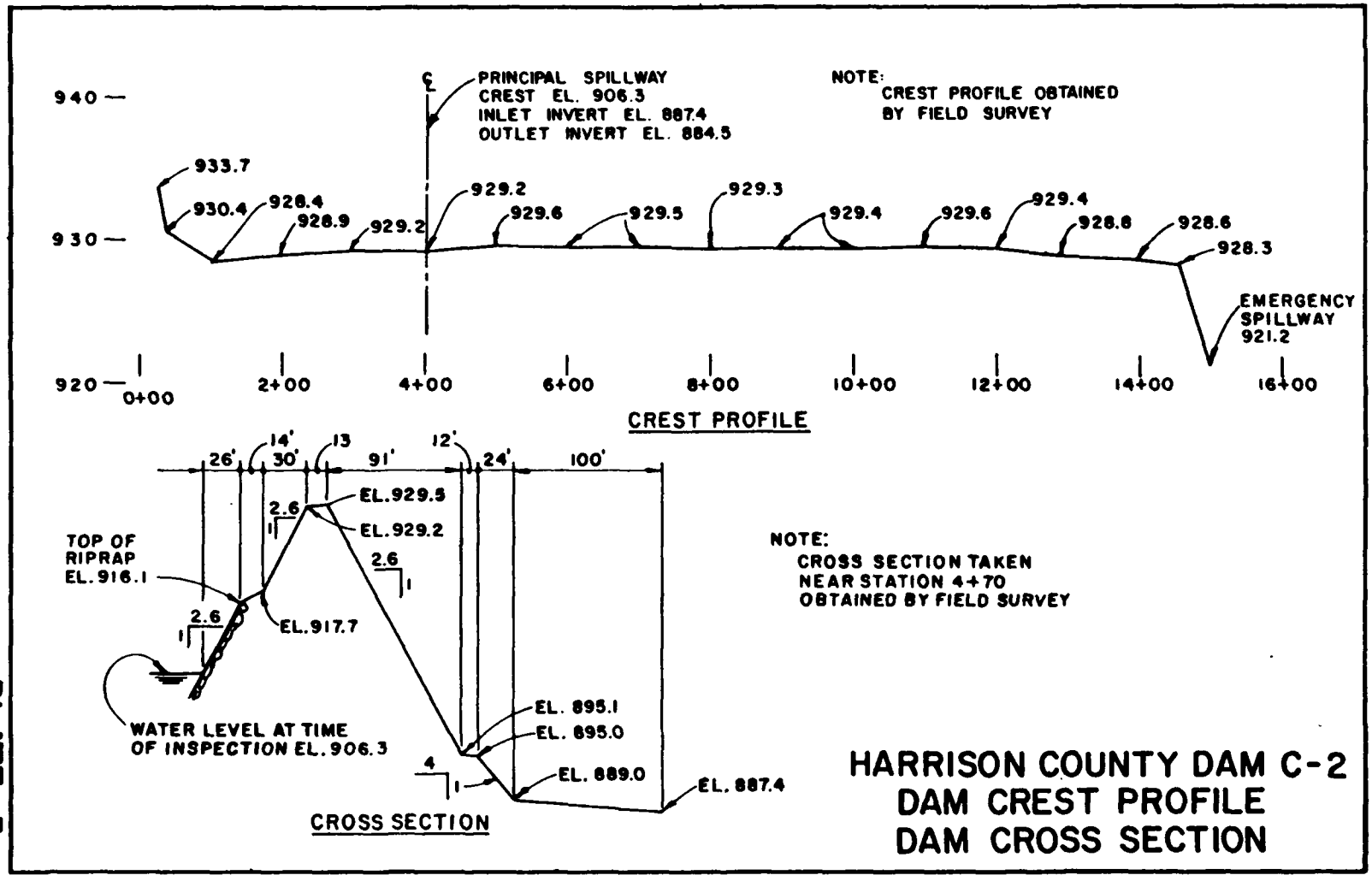
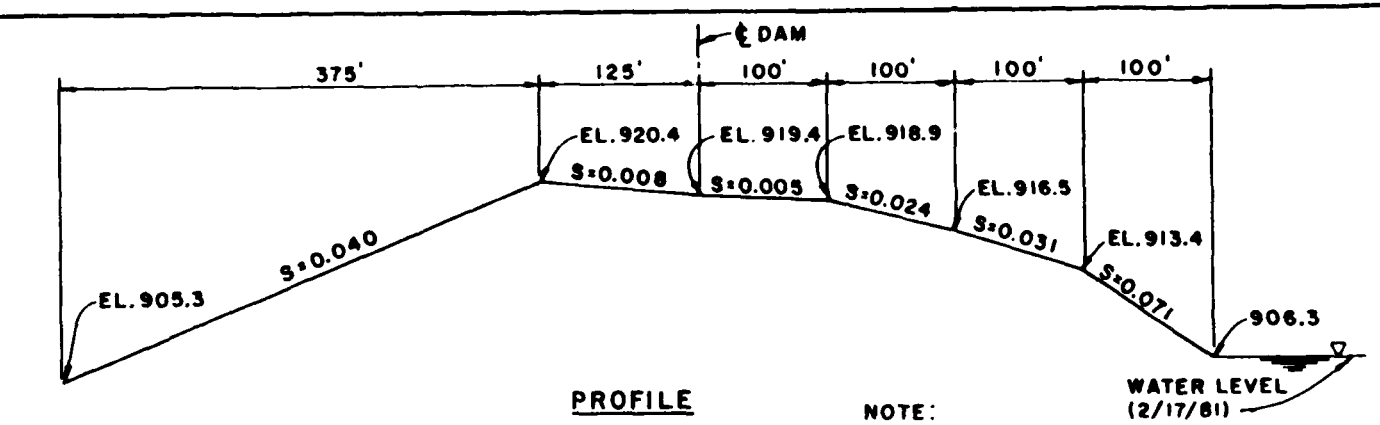


PLATE 5

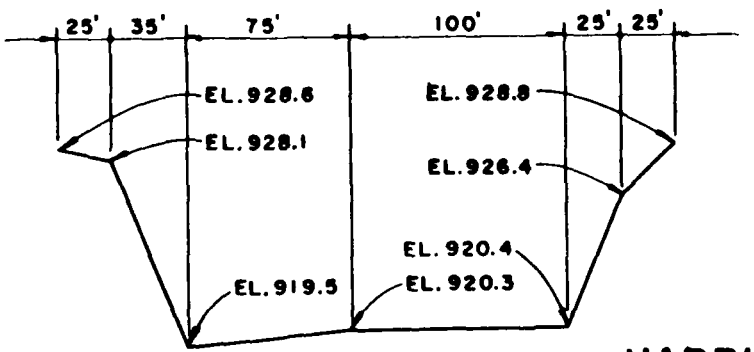
HARRISON COUNTY DAM C-2
DAM CREST PROFILE
DAM CROSS SECTION

PLATE 6



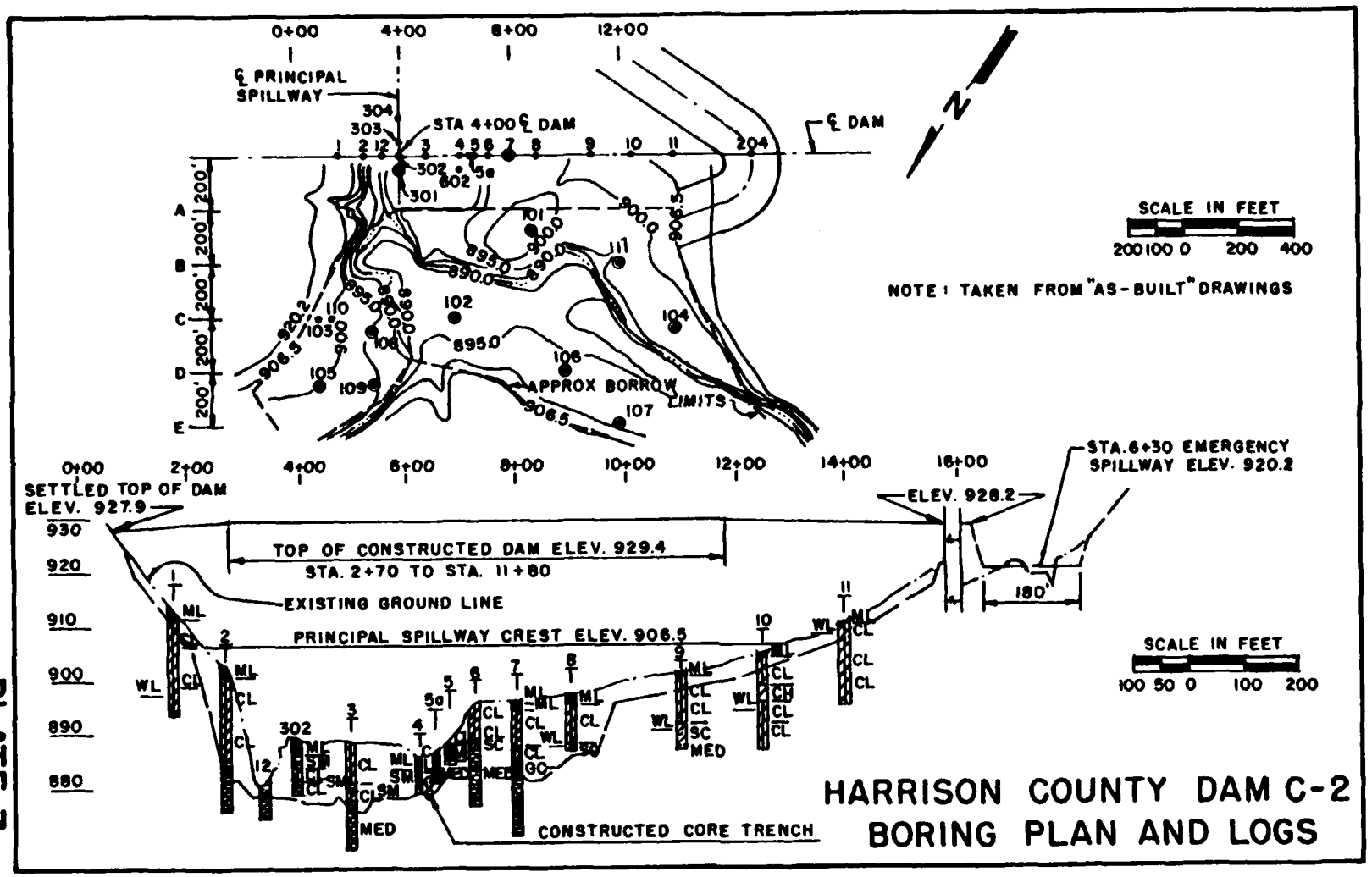
PROFILE

NOTE:
OBTAINED FROM
FIELD SURVEY



CROSS SECTION
AT CREST

HARRISON COUNTY DAM C-2
EMERGENCY SPILLWAY PROFILE
EMERGENCY SPILLWAY CROSS SECTION



HARRISON COUNTY DAM C-2
BORING PLAN AND LOGS

PLATE 7

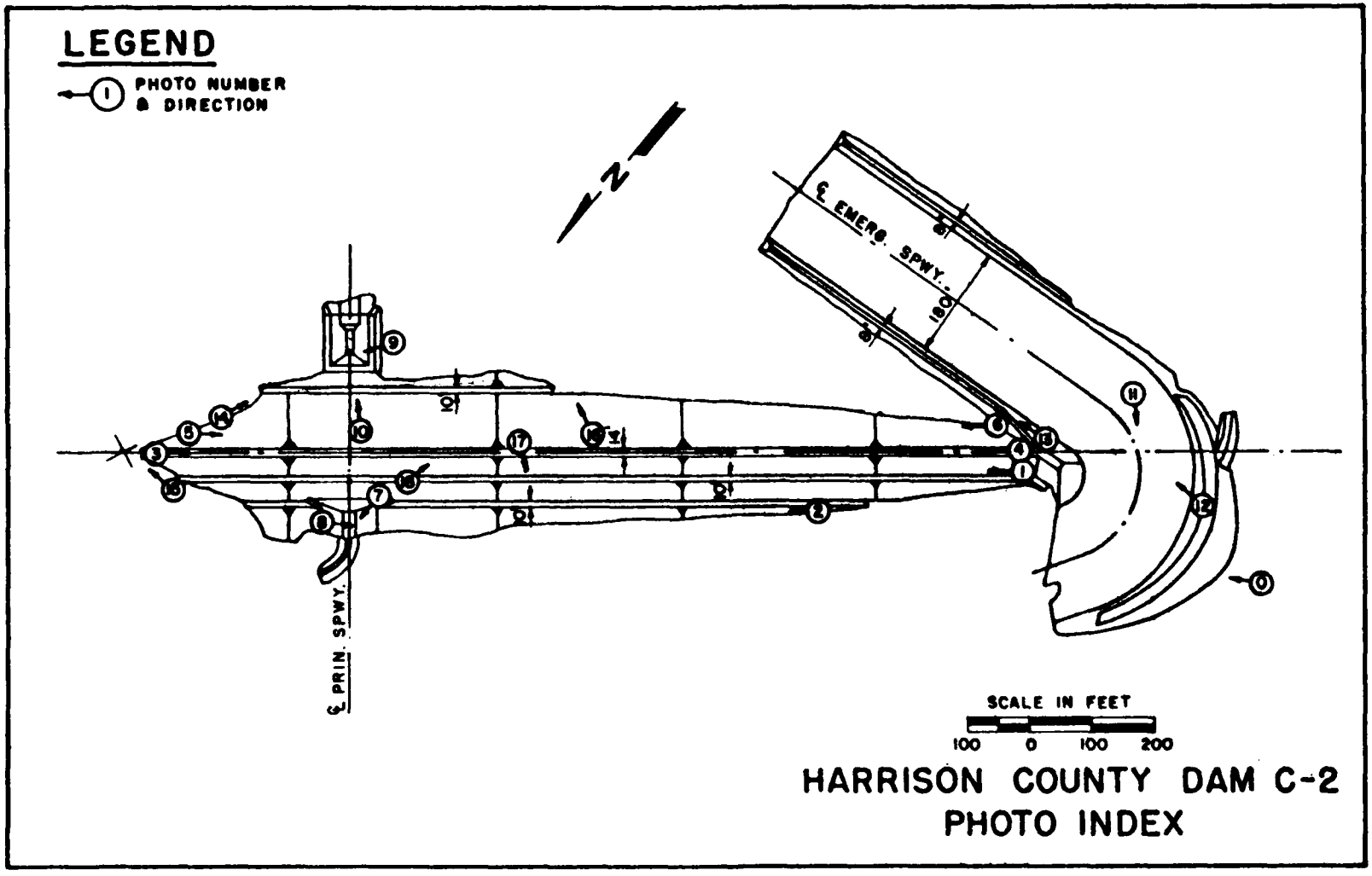

LEGEND
PHOTO NUMBER & DIRECTION
N
℄ EMERG. SPWY.
180'
℄ PRIN. SPWY.
SCALE IN FEET
100 0 100 200
HARRISON COUNTY DAM C-2
PHOTO INDEX

PLATE 8

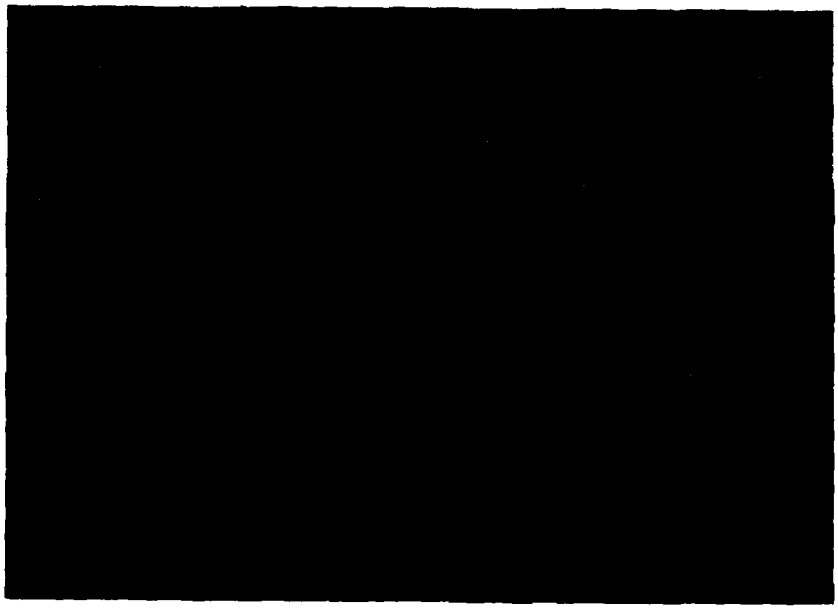


PHOTO 1: UPSTREAM FACE OF DAM

PHOTO 2: UPSTREAM FACE OF DAM AT WATERLINE

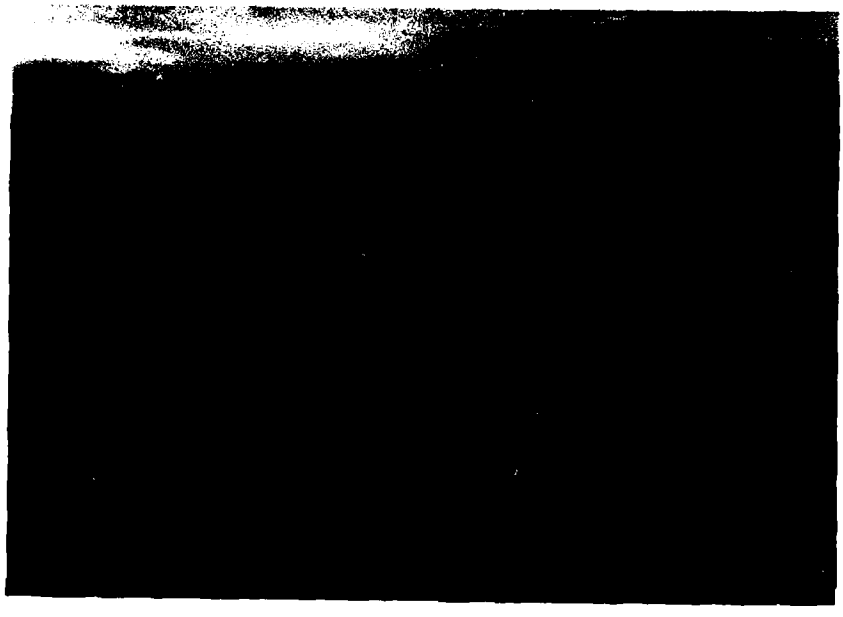


PHOTO 3: CREST OF DAM LOOKING WEST

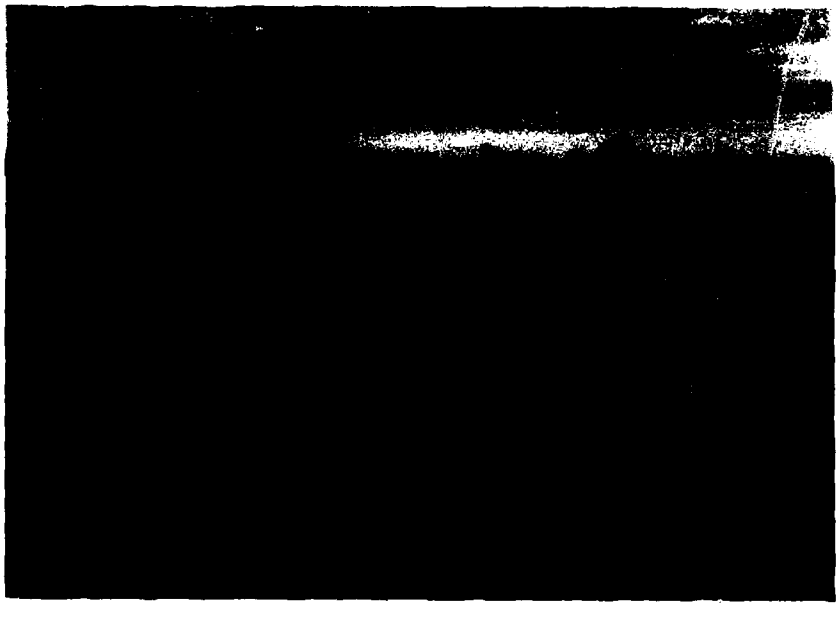


PHOTO 4: CREST OF DAM LOOKING EAST

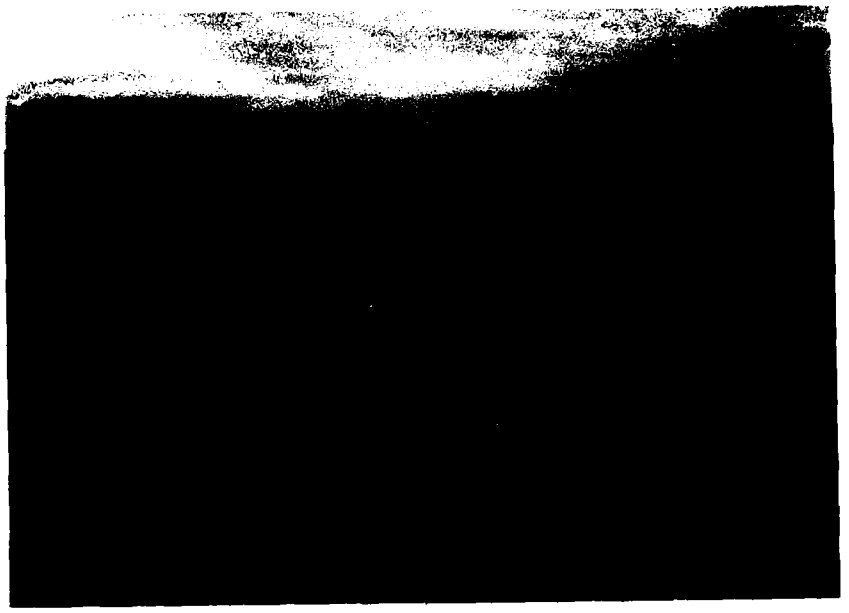


PHOTO 5: DOWNSTREAM FACE OF DAM LOOKING WEST

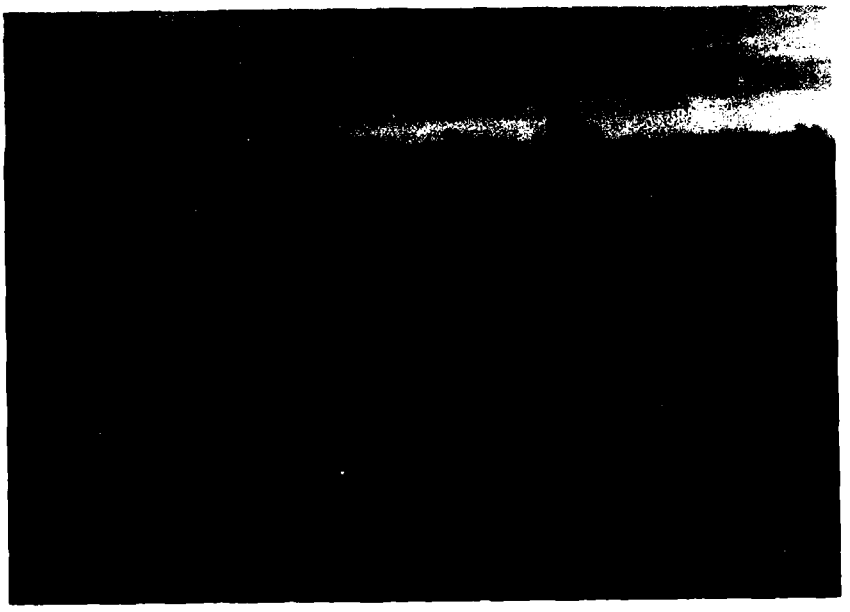


PHOTO 6: DOWNSTREAM FACE OF DAM LOOKING EAST

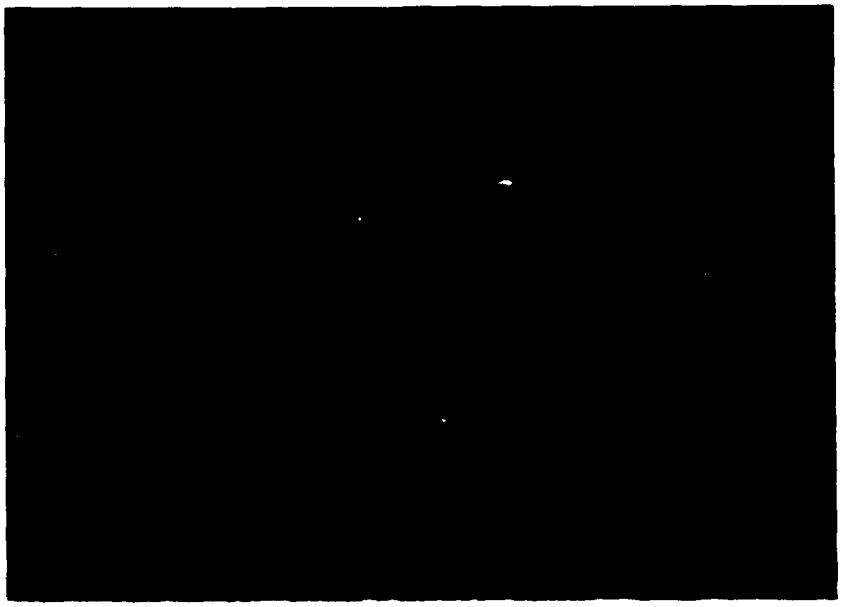


PHOTO 7: PRINCIPAL SPILLWAY DROP INLET STRUCTURE

PHOTO 8: PRINCIPAL SPILLWAY WEIR

PHOTO 9: PRINCIPAL SPILLWAY PIPE OUTLET

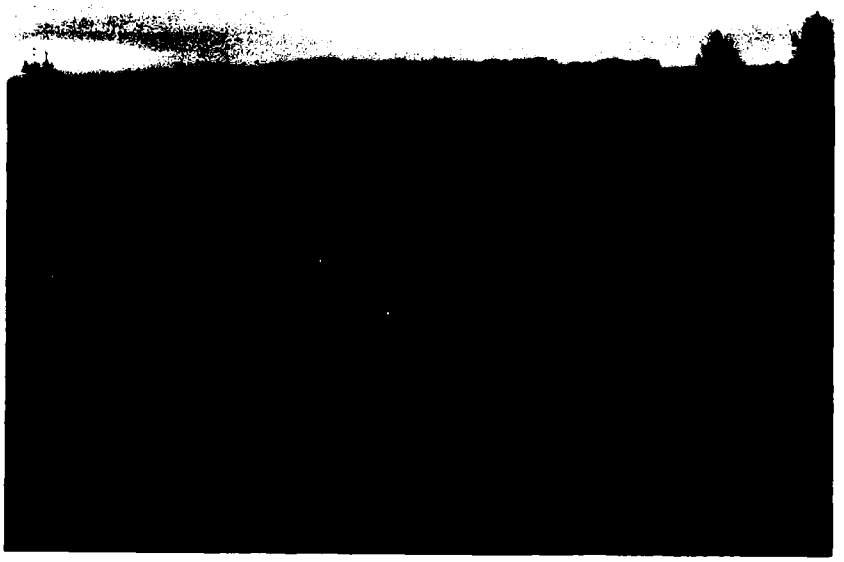


PHOTO 10: CHANNEL DOWNSTREAM OF PRINCIPAL SPILLWAY

PHOTO 11: EMERGENCY SPILLWAY LOOKING UPSTREAM

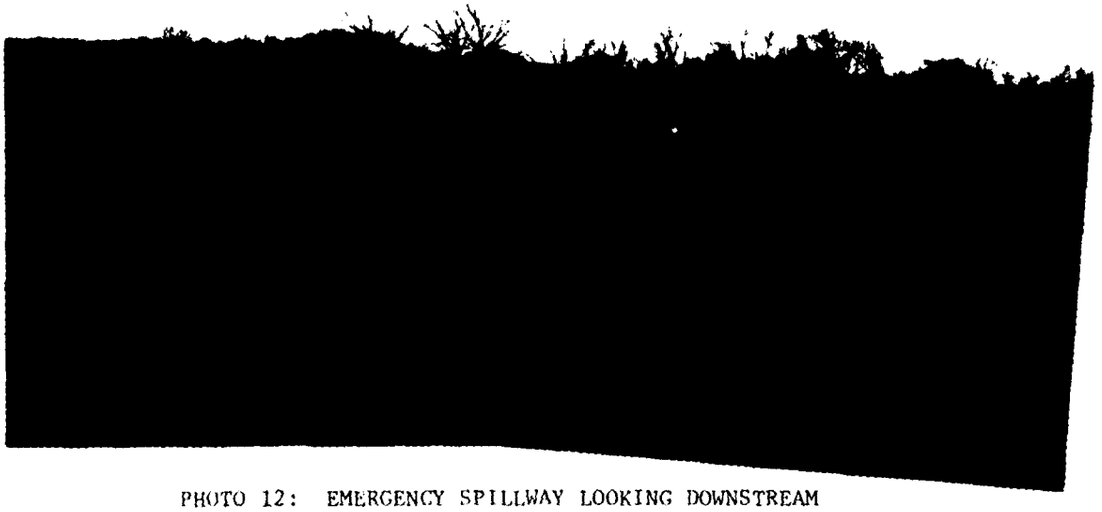


PHOTO 12: EMERGENCY SPILLWAY LOOKING DOWNSTREAM

PHOTO 13: DIKE ALONG LEFT BANK OF EMERGENCY SPILLWAY

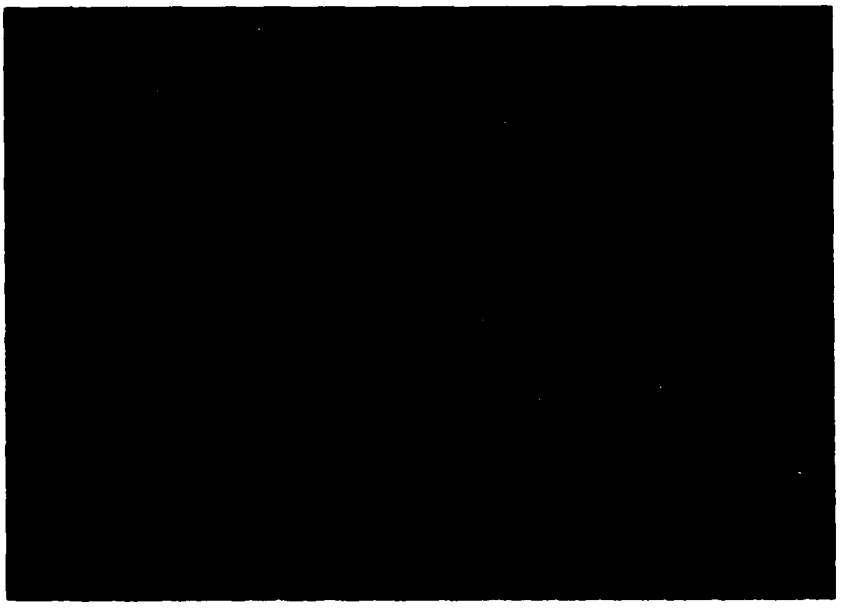


PHOTO 14: EROSION AT TOE OF DOWNSTREAM FACE OF DAM

PHOTO 15: EROSION AT LEFT ABUTMENT - UPSTREAM FACE OF DAM

PHOTO16: DRAINAGE DITCH DOWNSTREAM OF DAM

PHOTO 17: ANIMAL BURROW NEAR CREST OF DAM

PHOTO 18: ANIMAL BURROW ON UPSTREAM FACE OF DAM

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC ANALYSES

To determine the overtopping potential, flood routings were performed by applying the Probable Maximum Precipitation (PMP) to a synthetic unit hydrograph to develop the inflow hydrographs for Harrision County Dam C-2 and five upstream reservoirs, Harrison County Dam B-11, Harrison County Dam B-13, Harrison County Dam B-10, Tugglet's Dam LT-93, and Meek's Dam LT-84. The inflow hydrographs were then routed through the reservoirs and spillways. The overtopping analysis was determined using the computer program HEC-1 (Dam Safety Version) (1).

The PMP was determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33" (HMR-33) (2). Reduction factors were not applied. The rainfall distribution for the 24-hour PMP storm was determined according to the procedures outlined in HMR-33 and EM 1110-2-1411 (3). Comparison of the routings of the PMP storm ratios with the total rainfall of a 24 hour, one percent chance probability storm indicates that the one percent chance flood will not cause overtopping of Harrison County Dam C-2.

The synthetic unit hydrograph for the watershed was developed by the computer program using the Soil Conservation Service (SCS) method (1, 4). The parameters for the unit hydrograph are shown in Table 1. The lag and time of concentration for each watershed were obtained from SCS design data and were verified using the Kirpich and Snyder methods.

The SCS curve number (CN) method was used in computing the infiltration losses for the rainfall-runoff relationship. The CN values used, and the result from the computer output, are shown in Table 2.

Storms were routed through the six reservoirs noted above.

Routing through the reservoirs was performed using the modified Puls Method. The initial reservoir pool elevations for the routing of each storm were determined to be equivalent to the crest elevations of the principal spillways in accordance with antecedent storm conditions preceding the probable maximum storm outlined by the U.S. Army Corps of Engineers, St. Louis District (5). The hydraulic capacity of the spillways and the storage capacity of the reservoirs were defined by the elevation, surface area, storage, and discharge relationships shown in Table 3.

The rating curves for the spillways are shown in Table 4. The flow over the crests of the dams was determined using either the non-level dam crest option ($L and $V cards) or the weir flow option of the HEC-1 program. The program assumes critical flow over a broad-crested weir in the non-level dam crest option.

Breach analyses were performed using HEC-1 for reservoirs upstream of Harrison County Dam C-2 with spillway capacities less than 50 percent of the PMF. The breaching parameters are shown in Table 5.

The result of the routing analysis indicates that 40 percent of the Probable Maximum Flood (PMF) will not overtop Harrison County Dam C-2.

A summary of the routing analysis for different ratios of the PMF is shown in Table 6.

The computer input data and a summary of the output data are presented at the back of this appendix.

"As-Built" drawings and hydrologic/hydraulic design data for Harrison County Dam C-2 and the upstream reservoirs were made available by the SCS, Columbia, Missouri.

TABLE 1

SYNTHETIC UNIT HYDROGRAPH

Parameters:	Harrison County Dam B-10	Harrison County Dam B-11	Harrison County Dam B-13	Meek's Dam LT-84	Tugglet's Dam LT-93	Harrison County[4] Dam C-2 East Arm	Harrison County[4] Dam C-2 West Arm
Drainage Area (A)[1]	1.01 sq. mi.	0.32 sq. mi.	0.76 sq. mi.	0.39 sq. mi.	0.36 sq. mi.	3.52 sq. mi.	2.76 sq. mi.
Lag Time (L_g)	0.32 hour	0.19 hour	0.32 hour	0.22 hour	0.20 hour	1.33 hour	0.68 hour
Time of concentration (T_c)	0.53 hour[2]	0.31 hour[2]	0.54 hour[2]	0.37 hour[3]	0.34 hour[3]	2.21 hour[2]	1.14 hour[3]
Duration (D)	4.2 minutes	2.5 minutes	4.3 minutes	3.0 minutes	2.7 minutes	17.7 minutes	9.0 minutes

(Use 5 minutes in each case for the duration)

NOTES:

1 - Incremental drainage areas. Total drainage area for Harrison County Dam C-2 is 9.11 square miles.

2 - Obtained from SCS design data. These values are comparable to those calculated using the Kirpich method.

3 - Calculated using the Kirpich method.

4 - The portion of the Harrison County Dam C-2 drainage area below the upstream reservoirs was divided into the east and west arm for performing the hydrologic analyses.

Unit Hydrograph Ordinates
Discharge (cfs)*

Time (Min.)*	Harrison County Dam B-10	Harrison County Dam B-11	Harrison County Dam B-13	Meek's Dam LT-84
0	0	0	0	0
5	174	182	125	147
10	556	579	400	502
15	1,098	670	795	706
20	1,342	484	993	630
25	1,291	252	968	419
30	1,065	141	807	239
35	728	77	567	146
40	484	43	377	87
45	337	24	262	52
50	232	13	184	31
55	159	7	126	19
60	108	4	87	11
65	73	2	59	7
70	51	0	41	4
75	35		28	2
80	24		20	0
85	17		14	
90	12		10	
95	8		7	
100	5		4	
105	2		2	
110	0		0	

* From HEC-1 computer output

FORMULAS USED:

$$T_c = (11.9 \times L^3/H)^{0.385} (6)$$

$$L_g = 0.6\ T_c$$

$$D = 0.133\ T_c$$

Unit Hydrograph Ordinates
Discharge (cfs)*
(Continued)

Time (Min.)*	Tugglet's Dam LT-93	Harrison County Dam C-2 East Arm	Harrison County Dam C-2 West Arm
0	0	0	0
5	167	23	74
10	554	56	232
15	704	109	446
20	575	173	743
25	327	243	1,121
30	188	334	1,472
35	109	438	1,710
40	63	559	1,819
45	36	698	1,828
50	21	839	1,763
55	12	960	1,623
60	7	1,062	1,463
65	4	1,145	1,260
70	2	1,195	1,013
75	0	1,232	815
80		1,239	674
85		1,238	557
90		1,231	469
95		1,187	392
100		1,139	326
105		1,086	265
110		1,028	223
115		967	185
120		892	153
125		810	127
130		719	104
135		640	87
140		566	72
145		513	60
150		464	50
155		418	41
160		379	34
165		343	28
170		315	24
175		288	20
180		260	17
.		.	.
.		.	.
410		0	0

TABLE 2

RAINFALL-RUNOFF VALUES

Selected Storm Event	Storm Duration (Hours)	Rainfall (Inches)	Runoff (Inches)	Loss (Inches)
PMP				
Harrison County Dam B-10	24	31.07	29.91	1.16
Harrison County Dam B-11	24	31.07	29.78	1.29
Harrison County Dam B-13	24	31.07	29.78	1.29
Meek's Dam LT-84	24	31.07	29.78	1.29
Tugglet's Dam LT-93	24	31.07	29.78	1.29
Harrison County Dam C-2				
East Arm	24	31.07	29.78	1.29
West Arm	24	31.07	29.78	1.29

Additional Data:

	SCS Runoff Curve Number (CN)	
	AMC II[1]	AMC III[2]
Harrison County Dam B-10	79	91
Harrison County Dam B-11	78	90
Harrison County Dam B-13	78	90
Meek's Dam LT-84	78	90
Tugglet's Dam LT-93	78	90
Harrison County Dam C-2	78	90

[1] Obtained from SCS "As-Built" data

[2] Used for PMF runoff hydrograph calculations

TABLE 3

ELEVATION, SURFACE AREA, STORAGE, AND DISCHARGE RELATIONSHIPS

Elevation (feet-MSL)	Lake Surface Area (acres)	Lake Storage (acre-ft)	Spillway Discharge (cfs)
Harrison County Dam B-10			
*122.0[1]	19.2	128	0
**126.8	29.0	243	80
***129.1	35.7	318	498
Harrison County Dam B-11			
*80.0[1]	3.9	19	0
**84.0	6.9	40.6	40
***86.8	9.5	65	268
Harrison County Dam B-13			
*112.0[1]	11.6	93	0
**116.4	18.5	160	77
***118.7	28.8	214	780
Meek's Dam LT-84			
*94.0[1]	6	27	0
**96.9	9.9	48.7	5
***101.0	10.5	89	1,048
Tugglet's Dam LT-93			
*95.0[1]	5	25	0
**98.0	7.5	40	11
***101.3	10.3	88	478
Harrison County Dam C-2			
*906.3[2]	67	424	0
**920.4	161	2,079	362
***928.3	471	3,963	11,791

*Principal spillway inlet crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

The relationships in Table 3 were developed from the SCS "As-Built" data and the field measurements.

[1] Elevation based on arbitrary datum for specific site
[2] Elevation in feet m.s.l.

TABLE 4

SPILLWAY RATING CURVE

Reservoir Elevation	Principal Spillway Discharge (cfs)	Emergency Spillway Discharge (cfs)	Total Spillway Discharges (cfs)
Harrison County Dam B-10			
*122.0[1]	0	0	0
122.5	73	0	73
**126.8	80	0	80
127.8	80	100	180
***129.1	81	417	498
131.8	81	1,700	1,781
Harrison County Dam B-11			
*80.0[1]	0	0	0
82.0	12	0	12
**84.0	40	0	40
85.0	41	15	56
***86.8	44	224	268
89.0	48	970	1,018
Harrison County Dam B-13			
*112.0[1]	0	0	0
114.5	63	0	63
**116.4	77	0	77
117.5	79	222	301
***118.7	81	699	780
120.6	84	1,820	1,904
Meek's Dam LT-84			
*94.0[1]	0	0	0
95.0	2	0	2
**96.9	5	0	5
98.9	7	314	321
***101.0	8	1,040	1,048
103.9	9	2,680	2,689

TABLE 4

SPILLWAY RATING CURVE
(Continued)

Reservoir Elevation	Principal Spillway Discharge (cfs)	Emergency Spillway Discharge (cfs)	Total Spillway Discharges (cfs)
Tugglet's Dam LT-93			
*95.0[1]	0	0	0
96.0	3	0	3
**98.0	11	0	11
100.0	15	193	208
***101.3	18	460	478
103.0	20	985	1,005
Harrison County Dam C-2			
*906.3[2]	0	0	0
910.3	299	0	299
**920.4	362	0	362
924.4	384	3,616	4,000
***928.3	404	11,387	11,791
931.0	420	18,600	19,020

*Principal spillway crest elevation
**Emergency spillway crest elevation
***Top of dam elevation

[1] Elevation based on arbitrary datum for specific site

[2] Elevation in feet m.s.l.

METHOD USED:

Principal spillway release rates were determined from SCS "As-Built" data which utilized the weir flow and pipe flow equations.

Emergency spillway releases were determined from the SCS "As-Built" data and SCS Technical Release No. 39[7].

TABLE 5

BREACHING PARAMETERS

	Harrison *County* Dam B-10	Harrison *County* Dam B-11	Harrison *County* Dam B-13	Meek's *Dam* LT-84	Tugglet's *Dam* LT-93
Bottom Width of Breach (BRWID)	10.0 feet	10.0 feet	10.0 feet	10.0 feet	10.0 feet
Side Slope of Breach (z) (In feet horizontal to 1.0 feet vertical)	0.5	0.5	0.5	0.5	0.5
Elevation of Breach Bottom at Maximum Size of Breach (ELBM)	108.0 feet	68.0 feet	92.0 feet	85.0 feet	83.0 feet
Time for Breach to Develop to Maximum Size (TFAIL)	1.0 hour	1.0 hour	1.0 hour	1.0 hour	1.0 hour
Elevation of Water Surface Which Will Cause Dam to Fail (FAILEL)	129.10 feet	86.8 feet	118.7 feet	101.0 feet	101.3 feet

TABLE 6

RESULTS OF FLOOD ROUTINGS

Ratio of PMF	Peak Inflow (CFS)	Peak Lake Elevation (ft.-MSL)	Total Storage (AC.-FT.)	Peak Outflow (CFS)	Depth (ft.) Over Top of Dam	Duration of Overtopping (Hours)
-	0	*906.3	424	0	-	-
0.40	22,087	927.9	3,789	10,880	0	-
0.45	23,286	928.5	4,037	12,165	0.2	1.1
0.50	25,458	929.0	4,252	13,345	0.7	2.1
1.00	43,125	931.6	5,338	36,810	3.3	4.8

* Principal spillway crest elevation

BIBLIOGRAPHY

(1) U.S. Army Corps of Engineers, Hydrologic Engineering Center, Flood Hydrograph Package (HEC-1), Dam Safety Version, July 1978, Modification April 1980, Davis, Califoria.

(2) HMR 33, Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations from 6 to 48 Hours, U.S. Department of Commerce, NOAA, National Weather Service, 1956.

(3) U.S. Department of the Army, Corps of Engineers, Standard Project Flood Determinations, Civil Engineer Bulletin No. 52-8, EM 1110-2-1411, Revised 1965, Washington, D.C.

(4) U.S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, August 1972.

(5) U.S. Army Corps of Engineers, St. Louis District, Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams, 22 August 1980.

(6) U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, 1974, Washington, D.C.

(7) U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 39, Hydraulics of Broad-Crested Spillways, May 1968.

(8) U.S. Department of the Interior, Geological Survey, Techniques of Water Resources Investigations of the United States Geological Survey, Chapter A5, 1967.

(9) U.S. Department of Agriculture, Soil Conservation Service, Soil Interpretations Record, 1979.

APPENDIX B

GEOLOGIC INVESTIGATION
&
DESIGN MEMORANDUM

Form SCS-37-1
Sheet 1 of 5

10-59

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County Harrison; ___ k, ___ k, Sec. 36, T 65N R 27W; Watershed Panther Creek

Subwatershed ___ Fund class WP-08-5 (PP-2, WP-1, etc.) Site number C-2 Site group I Structure class a

Investigated by Paul F. Edmonds (Signature and title) Geologist Equipment used Failing 1500 (Type, size, make, model, etc.) Date 12-13-67

SITE DATA

Drainage area size 9.1 sq. mi., 5831 acres. Type of structure D.I. concrete Purpose Floodwater

Direction of valley trend (downstream) SE Maximum height of fill 45.8 feet. Length of fill 1450 feet.

Estimated volume of compacted fill required 122,000 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	476	67.5	25.6
Floodwater	1615	160	39.2

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Disected Till Plain Topography Rolling Attitude of beds: Dip 0 Strike —

Steepness of abutments: Left 23 percent; Right 9 percent. Width of floodplain at centerline of dam 300 feet

General geology of site: The site is located in National Soil Resource Area 109, the Iowa & Missouri Till Plain. The Kansan till occurs on the slopes & ridges with modern alluvium and terrace level alluvium occuring in the valley floor. Kansan till in the area is classified as a stiff CL, coarse material is predominately sand and fine gravel with few glacial rocks larger than cobbles. The stream channel has cut into and is now held by the underlying Winterset limestone which is a member of the Dennis Formation, Kansas City Group, Pennsylvanian System. The site is located in an area devoted to pasture & meadow. Timber occurs mostly adjacent to the stream channel and other drainage ways

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

C-2
Panther Creek
DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FORM SCS-376B
REV. 2-64
SHEET 2 OF 5

FEATURE E Dam, Principal Spillway, Emergency Spillway, Stream Channel, Drainage, Borrow
(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
	EXPLORATION	SAMPLING	UNDISTURBED (STATE TYPE)	DISTURBED LARGE	DISTURBED SMALL
6" Slat Auger	31 ~~37~~	12	2 Shelby	12 Bag	1 Jar
NX Core	6				
NX Core, pressure test	3				
TOTAL	40 ~~50~~	12	2	12	1

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The left abutment is stiff glacial Till Bedrock occured in Test Hole #2 at 17.6 feet, elevation 975.4. Pressure tests were made in the rock without water loss The right abutment is also till however, bedrock was not encountered in test holes #10 & #11 The bedrock of the valley floor has a rather uniform surface at approximate elevation 889.0 The overlying alluvium ranges in depth from 6 to 10 feet. An apparent old channel occurs on the right side as shown by Test Hole #4, ℄ station 6+25. Material in the lower part is classified SM and SC. Similar conditions were found 50 feet upstream and 35 feet downstream. The surface alluvium is classified CL except for the material adjacent to the channel in TH #302 which was classified ML A stratum of coarser material classified SM occurs about 1 foot above the contact of the bedrock This stratum is continous and believed permeable. A rock core was taken in TH #3. Rock occurred at 9.5' and was penetrated 4 feet with the slat auger The upper 2 feet of core appeared weathered and broken The remaining core was unweathered and sound rock The gentle slope from ℄ station 7+00 to approximately 13+00 is classified as stiff CL Terrace alluvium Test holes

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

C-2 Panther Creek
DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FORM SCS-376B
REV. 2-64
SHEET 3 OF 5

FEATURE _____

(CENTERLINE OF DAM, PRINCIPAL SPILLWAY, EMERGENCY SPILLWAY, THE STREAM CHANNEL, INVESTIGATIONS FOR DRAINAGE OF STRUCTURE, BORROW AREA, RESERVOIR BASIN, ETC.)

DRILLING PROGRAM

EQUIPMENT USED	NUMBER OF HOLES		NUMBER OF SAMPLES TAKEN		
	EXPLORATION	SAMPLING	UNDISTURBED (STATE TYPE)	DISTURBED LARGE	DISTURBED SMALL
TOTAL					

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

6, 7, 8, & 9 were bottomed in bedrock or carried to refusal. Rock core was taken in Test hole #6 and pressure test of the bedrock were made without water loss. Alluvium underlain with limestone at a relatively uniform elevation forms the foundation of the principal spillway. The alluvium is similar to the alluvium in the ℄ of Dam and is 10 to 12 feet deep. The pier location is in the channel and on bedrock. A core was taken from this test hole. Bedrock occurs at shallow depths on the centerline of the emergency spillway. The overburden is classified as stiff CL glacial till or residium. The underlying bed rock is mostly limestone with inter-bedded thin shale beds with lessor amounts of shale. The depth of weathering in the bedrock is approximately 3 to 7 feet. The underlying sound rock is thin to medium bedded limestone with interbedded gray shale. Borrow will be Terrace level alluvium classified stiff CL and alluvium classified ML and CL. There is sufficient borrow available below the crest elevation of the principal spillway. Bedrock occurs at shallow depth in the stream channel or the channel is on bedrock. Channel deposits are seasonal and change frequently.

Form SCS-376C
Sheet 4 of 5
For In-Service Use Only

USDA-SCS

10-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Missouri County Harrison Watershed Panther Creek Subwatershed _____

Site number C-2 Site group I Structure class a Investigated by Neal E. Kennedy (signature and title) Geologist Date 12-13-67

INTERPRETATIONS AND CONCLUSIONS

The weakest material in the embankment foundation appeared to be the alluvium of the valley floor. Samples were taken from TH 301, ℄ principal spillway 1+50 as being most representative of the material classified CL & SM. The alluvial material classified ML on the surface is confined to the area immediately adjacent to the right side of the channel and limited in extent. The old channel on the right side of the floodplain between ℄ stations 6+00 and 6+40 appears to extend the width of the foundation. The material to the right of station 6+50 is classified mostly a stiff CL and occurs as terrace level alluvium, Till or residium. The underlying coarse material in test holes 6, 7, 8 & 9 is classified SC & GC and believed not permeable. The GC material in TH #7 was sampled for laboratory classification. Several pressure tests were made in the bedrock with no unfavorable results even in the upper part of the limestone which was classified as weathered. at the proposed location of the principal spillway the alluvium varies somewhat in texture but the depth and the elevation of the underlying bedrock is generally uniform. The overburden of the emergency spillway was sampled for borrow and is representative of material which will not contain broken or weathered rock fragments. The depth of weathering of the bedrock is variable due to the different thickness and sequence of the shale and limestone beds and which was exposed to weathering. This was discussed with the project engineer and estimates were made on how much of the weathered rock could be classed as common excavation and are indicated on the engineers field design prints of the geology sheets. The underlying or unweathered rock will stand on a vertical cut.

Form SCS-376
Sheet 2 of 3
For In-Service Use Only

USDA-SCS

10-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

State Missouri County Harrison Watershed Bather Creek Subwatershed _____

Site number C-7 Site group _____ Structure class _____ Investigated by [signature] (Signature and title) Geologist Date _____

INTERPRETATIONS AND CONCLUSIONS

There is sufficient Borrow available below the crest elevation of the principal spillway, however, a higher water level in the alluvial areas at construction will increas haul distance

Estimated cu/yds of compacted fill available.

Borrow Hole	cu/yds	
101	19,200	
102, 104, 106, 109	30,000	per ft depth
103	3,600	
107	19,200	
105, 108	27,800	
Emergency Spillway	16,500	common
	7,500	Rock

Engineer's Report - Investigation of Dam site - Structure C-2, Panther Creek

Harold Townsend 12-13-67

CORE TRENCH: Recommended depths

Station	Elevations
1+00	920.0
2+40	902.0
3+10	878.0
5+00	876.5
6+50	876.5
7+30	883.5
8+00	882.0
9+00	885.0
9+50	895.0
12+00	900.0
14+00	907.0
15+60	917.0

3:1 slopes at both end of the core trench.

The recommended core trench depths will remove the weathered limestone or be in good CL material and should provide a positive core cutoff. Foundation drainage will not be needed to relief seepage through the foundation or embankment.

Rock excavation is not anticipated. Only material that is weathered and can be ripped will ~~be~~ need to be removed. This material will need to be wasted.

EMERGENCY SPILLWAY: Limestone was encountered in the inlet channel to the emergency spillway. Some of the overburden will be suitable for fill and should be classed as borrow. The weather limestone, shale and material with rock fragments too large for fill material should be classed as excavation common and wasted. This material should be wasted along the upstream toe of the dam in the deeper fill sections. Preliminary estimates indicate that there will be about ~~7500~~ cu yds of rock excavation. A zone fill is recommended so the rock excavation material utilized. This zone of rock fill should oh on the upstream face in the area of anticipated wave action.

STREAM CHANNEL CLEAN OUT: Excavation in the stream channel is recommended from the core trench to the upstream toe of the dam. The extent and depth will be ind icated on the field design prints of the geology sheets.

BORROW: Adequate fill material will be available from the energency spillway and the sediment pool areas. A wet construction period will limit depth of borrow in the sediment pool and lengthen the haul distance.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-931T
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N.F. Edmonds
DATE: 11-16-67
PROJECT: WP-07 ___ WP-08 5 FP-03 ___ P.L.-46 ___
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: L Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES TYPE 1	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES REM MIN. DIAM 2	SAMPLES REC. 3 %
1	1+75 913.4	0	1.5	Silt, slightly clayey, dark grayish brown, Topsoil		ML	SA							
		1.5	8	Clay, silty, yellowish brown and grag, moist, stiff till		CL	SA							
		8	20	Clay, silty, reddish brown and yellowish brown, moist, stiff till W.L. 16' 11-17-67		CL	SA							

1. CED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

R 64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co. | OWNER: | STATE: Mo
LOGGED BY: N. F. Edmonds | DATE: 11-15-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
2	7+70	0	2	Silt, clayey, dark grayish brown topsoil		ML	SA							
	993.0	2	10	Clay, silty, yellowish brown and gray slightly moist, stiff, subsoil		CL	SA							
		10	17.6	Clay, silty, reddish brown, moist, stiff Till		CL	SA							
		17.6	18	Limestone			SA							
		18	27.2	Limestone, gray, thinly bedded with interbedded gray shale, shale beds mostly 1/4" to 1/2 inch thick, one shale bed from 21 to 21.4. Pressure test was made from 18.5' to 27.2'. No water loss.			Red							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
R^ 7-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison County
OWNER:
STATE: MO
LOGGED BY: N. E. Edmonds
DATE: 11-14-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ PL-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ Fill

HOLE NO	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES REM 2 MIN DIAM	SAMPLES 3 REC. %
3	5+00 888.6	0	7.8	Clay, very silty with some fine sand, dark grayish brown, moist, medium alluvium		CL	SA							
		7.8	8.3	sand, silty, grayish brown, wet, medium fine & medium sand with 20% fines		SM	SA							
		8.3	9.5	Clay, silty with sand and gravel, dark grayish brown, saturated medium		CL	SA							
		9.5	9.9	Limestone, weathered, with clay.			SA							
		9.9	11.9	Limestone, weathered			Acd							30
		11.9	16.8	Limestone, with interbedded gray shale, Limestone thinly bedded,			↓							100
		16.8	17.8	Shale, gray,										90
		17.8	20	Shale, black, hardness 4, laminated.										90

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-511T
Rev. 7-64

WATERSHED	Panther Creek	SUB-WATERSHED	SITE NO. C-2
LOCATION	Harrison Co	OWNER	STATE Mo
LOGGED BY	N F Edmonds	DATE 11-9-67	PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT	Failing 1500	LOCATION OF HOLES	E Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES TYPE[1]	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES REM[2] MIN DIAM	SAMPLES REC.[3] %
3	6+25	0	2	Silt, clayey, with some sand, dark grayish brown, moist, medium		ML	SA							
4	885.5	2	6.5	Sand, silty, yellowish brown and grayish brown, estimated 15% fines with occasional gravel		SM	SM							
		6.5		Limestone, refusal Caved at 2.5' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N.F. Edmonds | DATE: 11-9-67 | PROJECT: WP-07 ___ WP-08 5 FP-03 ___ P.L.-46 ___
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: 2 Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES TYPE[1]	SAMPLES FROM FT.	SAMPLES TO FT.	CSE. %	REM[2] MIN. DIAM	REC.[3] %
5	6+80 689.0	0	1	Clay, silty, reddish brown, moist medium, slope wash		CL	SA							
		1	4	Silt, clayey, dark grayish brown, moist, medium alluvium		ML	SA							
		4	5	Limestone, weathered, w/clay.			SA							
		5		Limestone, refusal										
5a	6+55 887.0	0	3.5	Silt, clayey, dark grayish brown, moist medium, alluvium		CL	SA							
		3.5	6.5	Gravel, clayey, yellowish brown		GC	SA							
		6.5		Refusal at 6.5 w.L. 5' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-533T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N F Edmonds | DATE: 11-8-67 | PROJECT: WP-0. WP-08 5 FP-03 P.L.-46
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
# 6	7+25 896.3	0	6	clay, silty, reddish brown, slightly moist, stiff		CL	SA							
		6	8	clay, sandy, reddish brown, moist, stiff estimated 30% fine sand		CL	SA							
		8	9	Sand, clayey, reddish brown, moist, medium, fine sand with estimated 35% fines		SC	SA							
		9	9.5	clay, silty, reddish brown, moist, stiff		CL	SA							
		9.5	9.8	Limestone, weathered			SA							
		9.8		Limestone, refusal										
	7+30	0	9.2	Overburden			SA							
		9.2	13.0	Limestone, thinly bedded, light brown and weathered but has hardness of 4 to 5			Rod							
		13.0	19.9	Limestone, gray, thinly to medium beds, hardness of 5. with interbedded gray shale shale beds range in thikness from ½" to 3" Pressure test with no water loss.										

1. DISTURBED UNDISTURBED ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-593T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N F Edmonds | DATE: 11-8-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: L Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
7	8+00	0	1	Silt, slightly Clayey, dark brown Top soil		ML	SA							
	806.5	1	2	silt, slightly clayey, grayish brown, moist, medium		ML	SA							
		2	9	clay, silty, yellowish brown and gray slightly moist, hard, becomes moist and stiff at 6 feet		CL	SA							
		9	10	clay, gravelly, dark brown, moist stiff, coarse sand and fine gravel estimated 35%		CL	SA							
		10	13	Gravel, clayey, reddish brown, moist to very moist Refusal with auger at 13.2		GC	SA	1	D	10	11			
		13.2	24.4	Limestone with interbedded shale beds at 14.5 to 14.8; 16.6 to 16.9; 19.8 to 20.3			Rb							
		24.4	26.5	Shale			Rb							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N F Edmonds | DATE: 11-8-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: E Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
8	9+00	0	2	Silt, slightly clayey, brown and grayish brown moist topsoil		ML	SA							
	897.4	2	9	Clay, silty, reddish brown, moist stiff		CL	SA							
		9	10.4	Sand, clayey, reddish brown, moist medium, medium & coarse angular sand with occasional gravel, estimated 30 to 35% fines		SC	SA							
		10.4	10.6	Limestone, weathered			SA							
		10.6		Limestone, refusal W.L. 9.5 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5337
REV. 2-64

WATERSHED: Panther Creek
LOCATION: Harrison Co
SUB-WATERSHED:
OWNER:
SITE NO.: C-2
STATE: MO
LOGGED BY: N.F. Edmonds
DATE: 11-8-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: L. Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
9	11+00 901.6	0	1	silt, slightly clayey, topsoil		ML	SA							
		1	7	Clay, silty, yellowish brown and gray, moist, stiff		CL	SA							
		7	10	Clay, silty, with some fine sand, reddish brown, moist, stiff		CL	SA							
		10	14.4	Sand, clayey, reddish brown, moist medium, fine & medium sand with estimated 30% fines		SC	SA							
		14.4	14.6	Limestone, weathered			SA							
		14.6		Limestone, refusal W.L. 11' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

SCS-511T
REV. 2 64

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

WATERSHED Panther Creek | SUB-WATERSHED | SITE NO. C-2
LOCATION Harrison Co | OWNER | STATE MO
LOGGED BY N F Edmonds | DATE 11-7-67 | PROJECT: WP-07 ___ WP-08 5 FP-03 ___ P.L.-46 ___
DRILLING EQUIPMENT Failing 1500 | LOCATION OF HOLES E Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
10	12+50 904.8	0	1	silt, slightly clayey, dark grayish brown very moist, medium Topsoil		ML	SA							
		1	6	clay, silty, grayish brown and yellowish brown, moist, medium		CL	SA							
		6	9	clay, dark grayish brown and gray, moist stiff		CH	SA							
		9	13	clay, silty, reddish brown, moist, medium, Till		CL	SA							
		13	18	clay, silty, yellowish brown and gray, moist, medium, slightly sandy from 16 to 18', Till. W.L. 10.5 11-27-67		CL	SA							

1. DISTURBED UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co.
OWNER:
STATE: Miss
LOGGED BY: N F Edmonds
DATE: 11-16-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ 14+00

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
11	14+00	0	1	Silt, clayey, brown, Topsoil		ML	SA							
	911.0	1	3	Clay, silty, yellowish brown and gray, moist, stiff		CL	SA							
		3	10	Clay, silty, reddish brown, moist, stiff		CL	SA							
		10	16	Clay, silty, yellowish brown and gray moist, stiff, Till		CL	SA							
				W.L. 3' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N.E. Edmonds | DATE: 11-14-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ Fill

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
12	~~3735~~ 3740 881.0	0	1.6	Sand, w limestone cobbles, channel fill			SA							
		1.6	3.4	Limestone, with interbedded shale, predominately shale with poor recovery from 2.4 to 3.2. Upper limestone appears thinly bedded and unweathered			Red							50
		3.4	6.6	Limestone, thinly to medium bedded with thin interbedded shale seams, sound limestone, hardness 5										100

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N.F. Edmonds
DATE: 11-17-67
PROJECT: WP-07 ____ WP-08 ____ FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: Q Fill 8+85 Grid A+75

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
101	904.5	0	2	Clay, silty, reddish brown, moist stiff, Till		CL	SA							
		2	8.5	Clay, silty, yellowish brown and gray moist, stiff Till		CL	SA	1	D	0	8.5			
		~~7.5~~												
		7.5	8.5	Sand, clayey, gray		SC	SA							
				Refusal at 8.5										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: NF Edmonds | DATE: 11-16-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ 1+00 Grid C+00

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
103	904.5	0	1	Clay, silty, dark grayish brown Top soil		CL	SH							
		1	4	Clay, silty, reddish brown, moist stiff · Till		CL	SH							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY SHEET ___ OF ___ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5117
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N. F. Edmonds
DATE: 11-27-67
PROJECT: WP-07 ____ WP-08 5 FP-09 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ 6+00 Grid C+00

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES [1] TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES [2] REM MIN DIAM	SAMPLES [3] REC. %
102	893.6	0	5	silt, slightly clayey, dark brown alluvium becomes very moist at 5		ML	SA	1	0	0	4			
		5	6	silt, slightly sandy, very moist		ML	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-533T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: MO
LOGGED BY: N F Edmonds | DATE: 11-27-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ 12+00 Grid B+00

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
111	895.9	0	2	silt, clayey, with some sand, dark grayish brown alluvium		ML	SA							
		2	8	silt, clayey, dark grayish brown and brown, alluvium. W.L. 7.5' E.O.D		ML	SA	1	D	0	6			
104	896.3			℄ 14+00 Grid C+50										
		0	5	clay, silty, with some sand dark grayish brown alluvium		CL	SA	1	D	0	5			
		5	8	clay, silty, dark grayish brown, alluvium, becomes too wet for borrow at 6'										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5337
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N F Edmonds | DATE: 11-16-67 | PROJECT: WP-07 ___ WP-08 5 FP-03 ___ PL-46 ___
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: ℄ Fill 1+00 Grid D+50

HOLE NO.	STA & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM SMALL DIAM	SAMPLES 3 REC. %
105	897.0	0	2	Silt, clayey, dark grayish brown and grayish brown topsoil		ML	SA	1	D	0	2			
		2	8	Clay, silty, reddish brown, moist medium		CL	SA	2	D	2	8			
		8	10	Sand, clayey, brown, very moist, estimated 30% fines		SC								
109	894.9			℄ Fill 3+00 Grid D+50										
		0	6	Silt, clayey, w/some sand, dark grayish brown, moist alluvium		ML	SA	1	D	0	6			
		6	8	Sand, clayey, reddish brown, very moist, estimated 30% fines		SC	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-951T
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: WV
LOGGED BY: N F Edmonds
DATE: 11-27-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ 12+00 Grid E+00

HOLE NO	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
107	900.7	0	3.5	Silt, clayey, dark brown slopewash		ML	SA	1	D	0	3.5			
		3.5	8	clay, silty, yellowish brown and gray moist, stiff		CL	SA	2	D	3.5	8			
		8	12	clay silty grayish brown, moist to very moist, soft. W.L. 11' E.O.D		CL	SA							
106	895.8			℄ Fill 10+00 Grid D+00										
		0	2	Silt, slightly clayey, dark yellowish brown, alluvium		ML	SA	1	D	0	4			
		2	4	Silt, slightly clayey, dark grayish brown alluvium		ML	SA							
		4	8	Silt, sandy, reddish brown, moist To very moist at 6'		SM	SA							

1. DISTURBED-UNDISTURBED ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5137
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: MO
LOGGED BY: N F Edmonds
DATE: 11-16-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ Fill 3+00 Grid C+50

HOLE NO	STA & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
108	898.3	0	1	Silt, slightly clayey, dark grayish brown topsoil.		ML	SA							
		1	2	Silt, slightly, clayey, grayish brown moist, medium alluvium		ML	SA							
		2	10	Clay, silty, reddish brown, moist medium,		CL	SA	1	D	2	10			
		10	12	Sand, clayey, brown, very moist, medium, estimated 35% fines		SC	SA							
				No WL. 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS 5317
REV. 7-64

WATERSHED: Panther Creek	SUB-WATERSHED:	SITE NO.: C-2	
LOCATION: Harrison Co	OWNER:	STATE: Mo	
LOGGED BY: N F Edmonds	DATE: 11-16-67	PROJECT: WP-07 ___ WP-08 5 FP-03 ___ P.L.-46 ___	
DRILLING EQUIPMENT: Failing 1500		LOCATION OF HOLES: ℄ Fill 1+50 C+00	

HOLE NO.	STA & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
110	901.0	0	1.5	silt, clayey, dark grayish brown Top soil		ML	SA							
		1.5	8	Clay, silty, reddish brown, moist medium, Terrace alluvium		CL	SA							
		8	10	sand, clayey, brown, very moist medium No W.L. 11-27-67		SC	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-9997
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N. F. Edmonds
DATE: 11-20-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: E Emerg. Splwy

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
201	3+00 930.5	0	4.8	Clay, silty, yellowish brown and gray, Till, Refusal at 4.8		CL	SN							
		4.8	6.2	Limestone, weathered, broken			Rcl							50
		6.2	8.2	Limestone, gray, hard, thickly bedded										100
		8.2	9.6	Shale, yellowish brown, one limestone bed from 8.8 to 8.9.										
		9.6	11.4	Limestone, thin to medium beds with interbedded yellowish brown shale										
		11.4	20	Limestone, gray and dark gray, hard medium bedded. Thin shale bed from 13.9 to 14.0										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-9337
REV. 2 64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: MO
LOGGED BY: N.E. Edmonds | DATE: 11-22-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: @ Emerg. Spwy

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
202	4100 937.7	0	6	Clay, silty, yellowish brown and gray moist stiff till Refusal at 6!		CL	SA							
		6	8.5	Limestone, gray & buff, weathered, 2 beds 2' and .5' thick, one thin yellowish brown shale bed at 8'			RCd							90
		8.5	11.5	Shale, yellowish brown, with thin interbedded limestone less than 1" thick										70
		11.5	16	Limestone, gray, Thinly and medium bedded with interbedded dark gray shale and shaly limestone										100

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N. F. Edmonds
DATE: 11-22-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ Emerg Splwy 100' right

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
203	4+00	0	.5	silt, cloyey, brown topsoil		ML	SA							
	944.5	.5	10.3	clay, silty, yellowish brown and gray moist, stiff, till		CL	SA	1	D	.5	10			
		10.3	11.8	Limestone, light gray & buff, thinly bedded with interbedded yellowish brown shale, weathered			Red							100
		11.8	16.3	Limestone, light gray, medium bedded with thin shale partings			↓							100
		16.3	18.2	Shale, yellowish brown, with interbedded limestone beds about 1" thick										100
		18.2	20.2	Limestone, gray, with interbedded dark gray shale and shaly limestone										100

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek	SUB-WATERSHED:	SITE NO.: C-2	
LOCATION: Harrison Co	OWNER:	STATE: Miss	
LOGGED BY: N. F. Edmonds	DATE: 11-21-67	PROJECT: WP-07 ___ WP-08 5 FP-03 ___ P.L.-46 ___	
DRILLING EQUIPMENT: Failing 1500		LOCATION OF HOLES: L Emerg Spwy	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
204	5+00 932.0	0	2.5	Clay, silty, yellowish brown and grey Till Refusal at 2.5'		CL	SH							
		2.5	5.7	Limestone, weathered, broken w/clay			Rb							
		5.7	7.3	Shale, yellowish brown, with interbedded Thin limestone beds.			Rcd							
		7.3	15.7	Limestone, gray, Thinly and medium bedded with interbedded gray shale and shaly limestone.										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N F Edmonds | DATE: 11-21-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: FAILING 1500 | LOCATION OF HOLES: E' Emerg Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES REM 2 MIN. DIAM	SAMPLES REC. 3 %
207	2+00	0	8.5	Clay, silty, yellowish brown and gray moist, stiff, Till		CL	SA							
	918.5	8.5	9.6	Limestone, weathered with clay			SA							
		9.6	13.6	Limestone, gray, thinly bedded with interbedded yellowish brown shale			Rcd							50

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-5937
REV. 2-64

WATERSHED: Panther Creek	SUB-WATERSHED:	SITE NO.: C-2	
LOCATION: Harrison Co	OWNER:	STATE: Miss	
LOGGED BY: N. F. Edmonds	DATE: 11-22-67	PROJECT: WP-07 ____ WP-08 5 ____ FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: Failing 1500		LOCATION OF HOLES: E Emerg Spillway	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
208	2+50 924.5	0	3.3	Clay, silty, yellowish brown and gray, moist, stiff Refusal at 3.3		CL	SA							
209	2+25 921.5	0	4.3	Clay, silty, yellowish brown and gray, moist, stiff Refusal at 4.3.		CL	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS 555T
REV. 2-64

WATERSHED Panther Creek
SUB-WATERSHED
SITE NO. C-2
LOCATION Harrison Co
OWNER
STATE Mo
LOGGED BY N F Edmonds
DATE 11-22-67
PROJECT: WP-07 WP-08 5 FP-03 P.L.-46
DRILLING EQUIPMENT Failing 1500
LOCATION OF HOLES E. Emerg Spluy

HOLE NO	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
210	~~920~~ 5+25 929.5	0	1	Clay, silty, yellowish brown and gray, moist, stiff		CL	SA							
		1	3.5	Limestone, weathered, broken, with Clay weathered shale, yellowish brown. Refusal at 3.5			SA							
211	5+50 926.5	0	2.6	Clay, silty, yellowish brown and gray moist stiff Refusal at 2.6		CL	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-939f
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Mo
LOGGED BY: N.E. Edmonds | DATE: 11-27-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: & Emergency Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
215	921.5 6+00	0	3.2	clay, silty, yellowish brown, moist, stiff Refusal at 3.2		CL	SA							
212	4+00 100' Lt. 924.7	0	4.8	clay, silty, yellowish brown, moist, stiff Refusal at 4.8		CL	SA							
213	4+00 50' Lt. 931.0	0	4	clay, silty, yellowish brown, moist, stiff Refusal at 4.0.		CL	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: MO
LOGGED BY: N.F. Edmonds | DATE: 11-22-67 | PROJECT: WP-07 ____ WP-08 5 ____ FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: E Emergency spillway 150' right

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
214	4+00 946.8	0	.5	silt, slightly clayey, dark brown topsoil		ML	SA							
		.5	11.5	clay, silty, yellowish brown and gray, moist, stiff, Till		CL	SA							

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS 5337
REV. 2 64

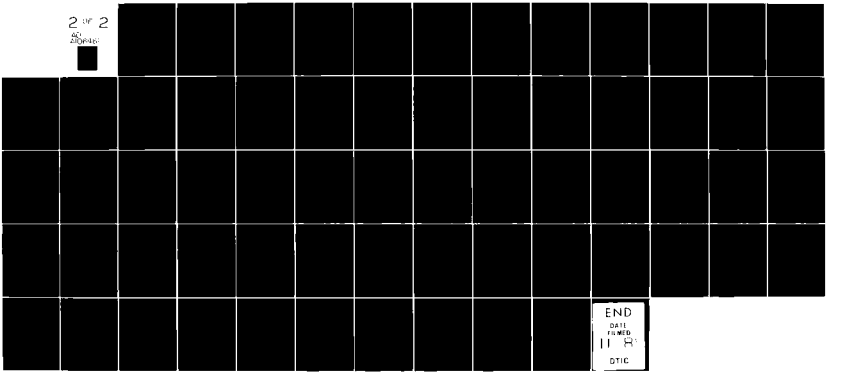
WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: Miss
LOGGED BY: N.F. Edmonds | DATE: 12-6-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L. 46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: E Emergency Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
221	3+00			100 feet Left										
	922.3	0	5	Clay, over burden		CL	SA							
				Refusal at 5'										
220	3+00			50 feet Left										
	926.4	0	1.4	Clay, over burden		CL	SA							
				Refusal at 1.4										
219	3+00			50 feet Right										
	932.0	0	2.7	Clay, over burden		CL	SA							
		2.7	3.4	Clay and broken rock		CL	SA							
				Refusal at 3.4										
218	3+00			100 feet Right										
	933.4	0	4.8	Clay, over burden		CL	SA							
		4.8	5	Clay & broken rock										
				Refusal at 5'										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

AD-A106 461 BLACK AND VEATCH KANSAS CITY MO F/G 13/13
NATIONAL DAM SAFETY PROGRAM. HARRISON COUNTY DAM C-2 (MO 10614)--ETC(U)
MAR 81 E R BURTON, H L CALLAHAN DACW43-81-C-0037
UNCLASSIFIED NL



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek	SUB-WATERSHED:	SITE NO.: C-2	
LOCATION: Harrison Co	OWNER:	STATE: Miss	
LOGGED BY: N.F. Edmonds	DATE: 12-5-67	PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____	
DRILLING EQUIPMENT: Failing 1500		LOCATION OF HOLES: ℄ Emergency Spillway	

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM (FT.)	HOLE DEPTH TO (FT.)	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM (FT.)	SAMPLES TO (FT.)	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
217	919.8 ~~Drlg~~ 2100			64 feet Right										
		0	4.3	Clay, overburden		CL	SA							
		4.3	5.2	Clay & broken rock		CL	SA							
				Refusal at 5.2										
216	923.0 2100			96 feet Right										
		0	3.4	Clay, overburden		CL	SA							
				Refusal at 3.4										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

SCS-933T
REV. 2-64

LOG OF TEST HOLES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SITE NO. C-2
STATE Mo

WATERSHED Panther Creek
SUB-WATERSHED
LOCATION Harrison Co
OWNER
DATE 12-6-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
LOGGED BY N.F. Edmonds
LOCATION OF HOLES E Emergency Spillway
DRILLING EQUIPMENT Failing 1500

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
226	5+00			100 feet Left										
	924.4	0	2.4	clay, overburden		CL	SA							
		2.4	4.3	Clay and broken rock										
		4.3	5.7	wea. limestone										
				Refusal at 5.7										
	5+00			50 feet Left										
225	929.4	0	4.6	clay, overburden		CL	SA							
		4.6	5	wea. limestone										
	5+00			50 feet Right										
224	921.0	0	.7	overburden		CL	SA							
				Refusal at .7										
				100 feet Right										
	5+00					CL	SA							
223	920.5	0	5	clay, overburden										
		5	6.6	Clay & broken rock										
				Refusal at 6.6										

1. DISTURBED-UNDISTURBED-ROCK CORE
2. COARSE MATERIAL REMOVED
3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-533T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co | OWNER: | STATE: MO
LOGGED BY: N.F. Edmonds | DATE: 11-9-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: E Prin. Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM. MIN. DIAM	SAMPLES 3 REC. %
301	1+50 889.0	0	2	silty, clayey, with some fine sand, dark grayish brown, moist, medium, alluvium		ML	SA							
		2	4	clay, very silty, dark grayish brown moist, medium		CL	SA	1	U	3	5.2			
		4	6	clay, very silty, with some fine & medium sand, moist, medium, brown		CL	SA							
		6	9.8	Sand, silty, yellowish brown and grayish brown, saturated, soft, fine & medium sand with estimated 15% fines, occasional limestone gravel in lower part		SM	SA	2	U	6.5	6.7 5.2			
		9.8		Limestone, refusal										
				Hole caved 6.5' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-ENG-
REV. 2-64

WATERSHED Panther Creek | SUB-WATERSHED | SITE NO. C-2
LOCATION Harrison Co | OWNER | STATE Mo
LOGGED BY N.F. Edmonds | DATE 11-9-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT Failing 1500 | LOCATION OF HOLES L Fill

HOLE NO.	STA & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
30-2	4+00 889.3	0	3	~~silty~~ Silt, sandy, dark grayish brown moist, medium, alluvium		ML	SA							
		3	6	Sand, silty, reddish brown, moist medium, fine & medium sand with estimated 15% fines		SM	SA							
		6	8	Clay, very silty, with some sand, dark grayish brown, moist, medium alluvium		CL	SA							
		8	~~10~~ 8	Sand, silty, dark grayish brown, saturated, soft		SM	SA							
		9	10.2	Clay, silty, yellowish brown, moist medium		CL	SA							
		10.2	10.4	Limestone, refusal			SA							
				W.L. 7.5' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: Mo
LOGGED BY: N.F. Edmonds
DATE: 11-9-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ Principal Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN DIAM	SAMPLES 3 REC. %
303	2+50 889.6	0	3	silt, slightly clayey with fine sand dark grayish brown moist alluvium		ML	SA							
		3	6	clay, silty, with fine sand, brown moist, medium		CL	SA							
		6	9	clay, silty, dark grayish brown, moist medium alluvium		CL	SA							
		9	10	Sand, clayey, yellowish brown, saturated soft, fine & medium sand with occasional gravel, estimated 25% fines		SC	SA							
		10	11.3	clay, gravelly, yellowish brown, moist, stiff		CL	SA							
		11.3		Limestone, refusal wtr. 8' - 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-933T
REV. 2-64

WATERSHED: Panther Creek | SUB-WATERSHED: | SITE NO.: C-2
LOCATION: Harrison Co. | OWNER: | STATE: Mo
LOGGED BY: N.F. Edmonds | DATE: 11-15-67 | PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500 | LOCATION OF HOLES: & Prin. Spillway

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES 2 REM MIN. DIAM	SAMPLES 3 REC. %
304	3+35 881.0	0	2.5	Sand with limestone cobbles in lower part Refusal at 2.5 feet		SP	SA							
		2.5	3.8	Limestone, weathered, broken			Rb							
		3.8	4.4	Limestone, sound rock			Rb							
		4.4	10.7	Limestone, Thinly bedded with interbedded gray shale. Shale bed less than ½" thick			Red							
		10.7	11.7	Shale, gray										
		11.7	12.5	Shale, black, hardness 4										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET ____ OF ____ SHEETS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

LOG OF TEST HOLES

SCS-ENGR
REV. 7-64

WATERSHED: Panther Creek
SUB-WATERSHED:
SITE NO.: C-2
LOCATION: Harrison Co
OWNER:
STATE: MO
LOGGED BY: N.F. Edmonds
DATE: 11-9-67
PROJECT: WP-07 ____ WP-08 5 FP-03 ____ P.L.-46 ____
DRILLING EQUIPMENT: Failing 1500
LOCATION OF HOLES: ℄ Fill 6+25 50' Right

HOLE NO.	STA. & SURFACE ELEVATION	HOLE DEPTH FROM FT.	HOLE DEPTH TO FT.	DESCRIPTION OF MATERIALS	N	USCS	TYPE BIT USED	SAMPLES NO.	SAMPLES 1 TYPE	SAMPLES FROM FT.	SAMPLES TO FT.	SAMPLES CSE. %	SAMPLES REM 2 MIN. DIAM	SAMPLES 3 REC. %
602	6+25	0	3	silt, clayey, dark grayish brown alluvium		ML	SA							
	885.5	3	5	silt, sandy, brown		ML	SA							
		5	6.5	sand, silty, yellowish brown, occasional gravel		SM	SA							
		6.5		Limestone, refusal Hole caved 4' 11-27-67										
601	6+35			℄ Fill 35' Left.										
	885.5	0	2	silt, sandy, brown alluvium		ML	SA							
		2	6	Gravel, silty, brown, estimated 15% fines		GM	SA							
		6.	6.3	Limestone, weathered w/clay										
		6.3		Limestone, refusal. Hole caved 3' 11-27-67										

1. DISTURBED-UNDISTURBED-ROCK CORE 2. COARSE MATERIAL REMOVED 3. PERCENT SAMPLE RECOVERY

SHEET 1 OF 1 SHEETS

SCS-384
7-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Part III - Flow Test Data

Hole No. 6 Name of Site C-2 Fairview Lake

Depth Treated: From 9.5 To 14.5; Formation Weathered limestone P 5 psi

Graph Plot No.	Pressure Gage psi	Total Pressure (Gage+P)	Start Time	Stop Time	Elapsed Time (Mins)	Water Meter Readings			
						Start Test	End of Test	Total Gals. Water Used	GPM
1	5	10	1618	1620	2	4.32	4.32	0	
2	15	20	1622	1624		4.32	4.37	.05	
3									
4									
5									
6									
7									

Remarks:

Depth Tested: From 14.5 To 19.5; Formation Weathered Limestone P 7 psi

1	6	13	1609	1611	2	4.28	4.28	0	
2	16	23	1615	1617	2	4.28	4.28	0	
3									
4									
5									
6									
7									

Remarks:

Hole # 2

Depth Tested: From 15 To 20; Formation Weathered Limestone P 10 psi

1	5	15	1604	1606	2	9.03	9.03	0	
2	10	20	1607	1609	2	9.03	9.03	0	

Remarks: water loss was around the packer

SCS-324
7-60

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Part III - Flow Test Data

Hole No. 2 Name of Site 2-2 Bitter Creek

Depth Treated: From 2.5 To 20; Formation Waterset Limestone P 6 psi

Graph Plot No.	Pressure Gage psi	Total Pressure (Gage+P)	Start Time	Stop Time	Elapsed Time (Mins)	Water Meter Readings			
						Start Test	End of Test	Total Gals. Water Used	GPM
1	5	11	1300	1302	2	4.5	4.5	0	
2	10	16		Factor would not read					
3									
4									
5									
6									
7									

Remarks:

Depth Tested: From 12.5 To 20; Formation Waterset Limestone P 7 psi

1									
2									
3									
4									
5									
6									
7									

Remarks:

Depth Tested: From ___ To ___; Formation _____ P _____ psi

Remarks:

UNITED STATES GOVERNMENT

Memorandum

TO : James M. Dale, State Conservation Engineer, SCS, Columbia, Missouri 65201 DATE: April 30, 1968

FROM : Lorn P. Dunnigan, Head, Soil Mechanics Laboratory, SCS, Lincoln, Nebraska 68508

SUBJECT: ENG 22-5, Missouri WP-08, Panther Creek, Site No. C-2 (Harrison County)

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 3 sheets.
2. Form SCS-127, Soil Permeability, 1 sheet.
3. Form SCS-128 and SCS-128A, Consolidation Test Data, 3 sheets (1 test).
4. Form SCS-355A, Triaxial Shear Test Data, 3 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 6 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 3 sheets.

DISCUSSION

FOUNDATION

A. Bedrock: The bedrock consists of thin to medium bedded limestone with interbedded gray shale which has been weathered to a depth of 3 to 7 feet. The bedrock appears to be relatively uniform at elevation 887± except in the channel alluvium area where it occurs at elevation 879±. There is a hump in the bedrock at Station 6+60.?+- The limestone bedrock is overlain, in the emergency spillway, by 2.0 to 10.0 feet of CL till.

B. Soil Classification: Both abutments are classified CL till. The thin layer of SC material to the right of Station 9+00 is considered to be of low permeability by the geologist.

C. Density: Undisturbed samples were taken from Test Hole 301. The sample taken from 3.0 to 5.?-foot depth has a dry density of 1.40 g/cc in the top portion and 1.76 g/cc in the lower portion. An undisturbed sample was submitted from Test Hole 301 at a depth of 6.5 to 8.7 feet. The dry density of this sample is in the range of 1.55 g/cc.

No blow counts were submitted.

D. Consolidation: A consolidation test was made on sample No. 68W1961"T". Based on the results of this test, and load of the embankment, the settlement in alluvium represented is estimated to approach one foot.

E. Permeability: A falling head permeability test was made on Sample 68W1961"T". The results of this test show a permeability rate of 0.1 ft/day. Data on pressure tests in the bedrock are reported in the geology report.

F. Shear Strength: A consolidated undrained shear test was made on Sample 68W1961"T" from TH 301. The test specimens were trimmed from the undisturbed sample and soaked prior to testing. The data obtained from the test represent two strata. An average strength value of $\phi = 14.5°$, $c = 400$ psf was used for design purposes.

EMBANKMENT MATERIALS

A. Classification: The borrow samples submitted are CL and CL-ML materials. The CL materials have liquid limits ranging from 20 to 40 and PI's ranging from 9 to 20. The CL-ML materials have liquid limits of 28 and 23 and PI's of 7. The material from the emergency spillway is CH material with liquid limit of 51 and PI of 30.

B. Compacted Density: The compacted dry density of borrow samples was 112.0 pcf for the sandier CL (68W1965), 106.0 pcf for the finer grained CL (68W1971) and 105.0 pcf (68W1972), 111.0 pcf for the Mix of samples (68W1966, 1967, 1970, 1974, 1975), and 101.0 pcf for the CH material from the emergency spillway (68W1964).

C. Shear Strength: Consolidated undrained shear tests were made on Samples 68W1972 and Mix of 68W1966, 1967, 1970, 1974, 1975. The shear strength parameters obtained for Sample 68W1972 are $\phi = 10.5°$, $c = 850$ psf. The shear strength parameters of the Mix are $\phi = 13.5°$, $c = 1100$ psf. These values are for saturated material at a minimum of 95% of standard Proctor density.

SLOPE STABILITY

A. Maximum Section at Station 6+25: A slope stability analysis was made on the 2 1/2:1 upstream embankment slope using a modified Swedish circle method. Rapid drawdown from the emergency spillway to the base of the embankment is considered. The embankment will rest on bedrock after normal channel cleanout; therefore, the foundation is considered competent. Strength parameters used for the embankment are $\phi = 10.5°$, $c = 850$ psf. No berms were considered in this analysis and the computed factor of safety is 1.58.

The downstream 2 1/2:1 embankment slope stability analysis considered a full phreatic line (no drain) and a competent foundation. With embankment strength parameters of $\phi = 10.5°$, $c = 850$ psf the computed factor of safety is 1.66.

3 -- James M. Dale -- 4/30/68
Lorn P. Dunnigan
Subj: ENG 22-5, Missouri WP-08, Panther Creek, Site No. C-2

B. Floodplain Section at Station 6+10: The slope stability analysis of the 2 1/2:1 upstream embankment slope was made using the modified Swedish circle method. Rapid drawdown from the emergency spillway to the base of the embankment is considered. The embankment strength parameters used are $\phi = 10.5°$, c = 850 psf. A foundation depth of 11 feet, strength parameters of $\phi = 14.5°$ and c = 400 psf was considered and the computed factor of safety is 1.29. No berms were considered in the analysis. 2 - 10' berm upstream

The downstream 2 1/2:1 embankment slope stability analysis considers a full phreatic line (no drain) and an 11-foot depth of foundation. The strength parameters considered are the same as the upstream and the computed factor of safety is 1.29. 10' berm down stream

RECOMMENDATIONS

A. Site Preparation: Investigational data indicates that limestone outcrops in the left abutment near the left channel bank. We suggest that the bedrock-soil contact be examined for overhangs when the cutoff trench is open. If overhangs are present they should be flattened and a check made to assure there are no overhangs elsewhere.

The alluvium material has a consolidation potential in the range of 0.095 ft/ft. Because of the high consolidation potential of the alluvium we suggest that the right channel bank be flattened to a 3:1 slope to reduce differential settlement. It already 3:1

B. Cutoff Trench: We concur with the engineer's recommended cutoff depths with the suggestion that concurrent with the inspection of the limestone bedrock, after the cutoff trench is open, the permeability of the SC stratum encountered in TH 8 should be evaluated to determine if it is necessary to deepen the trench in the vicinity of test hole No. 9 to cut off seepage through the foundation.

C. Principal Spillway: Material from TH 301 is stratified alluvium. The sample submitted from TH 301 to the Laboratory was logged in the field as CL. The sample is reported to be representative of the alluvial foundation material. A consolidation test was made on this material (Lab. sample 68W1961"T") and the test indicated a relatively high consolidation potential. Based on the test data the elongation potential is estimated to be in the range of 0.011 ft/ft. If this amount of settlement is intolerable, we suggest that you consider an alternate location. It is noted that the limestone bedrock occurs at elevation 883 in the vicinity of Station 6+25 and it might be possible to bottom the conduit on bedrock.

4 -- James M. Dale -- 4/30/68
Lorn P. Dunnigan
Subj: ENG 22-5, Missouri WP-08, Panther Creek, Site No. C-2

D. Drain: Near positive cutoff is anticipated with cutoff trench depths suggested and a drain is not considered necessary for stability of the embankment.

E. Embankment Design:

1. Placement of Materials: Selective placement of materials is suggested to utilize the higher plasticity CL materials like sample No. 68W1964, 68W1971, and 68W1972 in the center portion of the embankment. This type of material is expected to be more flexible than the low plasticity materials sampled.

   All materials should be placed at a minimum of 95 percent of standard Proctor density with a placement moisture controlled on the wet side of Proctor optimum.

2. Slopes: With the embankment at 95 percent of Proctor and no drain, the proposed 2 1/2:1 slopes are expected to be stable.

3. Settlement: An overfill allowance of 1.5 feet is suggested to compensate for residual consolidation within the foundation and embankment.

Prepared by:
Gerald N. Gibson
Gerald N. Gibson

Reviewed and Approved by:
Lorn P. Dunnigan
Lorn P. Dunnigan

Attachments

cc: James M. Dale (2)
E. D. Butler, Lincoln, Nebraska

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Classification	Fines					Sand					Gravel						Atterberg Limits		Unified Classification	Organic Matter %	Dispersion %	Dispersion - Grain Size Relationships			Undisturbed Sample Data		w_o	Special Tests
																					LL	PI									
68W		Panther Creek, Site No. C-2																													
1961	301.1	℄ Prin.Spwy., 1+50, S.Bar Core	3-5.2	'A	17	23	39	53	64	70	72	79	100								27	12	CL						1.80	19.0	26.9	
		Alluvium		'B	12	16	26	36	49	60	64	77	100								20	6	SC-SM						1.26	12.2		
1962	301.2	℄ Prin.Spwy., 1+50, S.Bar Core	6.5-8.7	'C	3	4	4	6	7	12	18	21	97	100							Non Plastic		SP-SM						1.55	5.7		
1963	7.1	℄ Fill, 8+00 Jar	10-11	GC	8	10	21	27	30	32	90	98	50	69	78	58	92	95	100		23	6	SC-SM							13.2		
1964	203.1	℄ Emer.Spwy.,100'Rt,4+00,Bag L.	5-10		40	45	58	71	73					100							51	30	CH			D	121.0	18.5		27.8	
		4,300 Common																														
		2,500 rock																														
1965	101.1	Borrow, A+75, 8+85, L.Bag	0-8.5	CL	27	31	46	57	69					100							34	18	CL			D	120	15.0		24.6	
		19,200 cu.yd. Fill																														
1966	102.1	Borrow, C+00, 6+00, L.Bag	0-4	ML	18	21	37	43	53					100							31	12	CL									
		102, 101, 106, 109 = 20,000 cu.yd per ft depth Alluvium																														
1967	104.1	Borrow, C+50, 14+00, L.Bag	0-5	CL	18	22	35	48	54					100							28	12	CL									
		Alluvium																														

MISSOURI (WP-08)

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Class Identification	Mechanical Analysis: Grain Size Distribution Expressed as Percent Finer by Dry Weight — Fines	Sand	Gravel	Atterberg Limits LL	Atterberg Limits PI	Unified Soil Classification	Soluble Salts %	Organic Matter %	Relationships of Standard / Modified: Optimum Moisture	Relationships of Standard / Modified: Max. Dry Density pcf	Relationships of Standard / Modified: Optimum Moisture %	Undisturbed Sample Data: Dry Density pcf	Undisturbed Sample Data: Moisture %	Gs	Special Tests
68W		Panther Creek, Site No. C-2																	
1974	109.1	Borrow, D+50, 3+00, L.Bag	0-6	ML	12 16 31 43 52		100	23	7	CL-ML									Sieve
		Alluvium																	
1975	111.1	Borrow, B+00, 12+00, L.Bag	0-6	ML	19 26 53 76 82		100	31	11	CL									
		Alluvium																	
1976																			
1977																			
1978	A1	IX											③	111.0	15.0		2.69	24	15 2 1/
1979																			
1980																			
1972	A1	IX											①	118.5	15.0		2.66		
1973																			

Revisions made 6/66

Laboratory Sample Number	Field Number	Location and Description	Depth	Field Classification	Fines					Sand	LL	PI	Classification					
6CW		Panther Creek, Site C-2																
1968	105.1	Borrow, D+50, 1+00, L.Bag	0-2	ML	13	18	23	68	76	100	28	7	CL-ML					
		Top Soil																
		105, 105 : 27,500 cu.yd.																
1969	105.2	" L.Bag	2-8	CL	23	27	45	69	66	100	31	15	CL					
		Alluvium																
1970	106.1	Borrow, D+00, 10+00, L.Bag	0-4	ML	17	23	46	58	73	100	20	9	CL					
		Alluvium																
1971	107.1	Borrow, E+00, 12+00, L.Bag	0-3.5	ML	23	30	56	83	91	100	35	17	CL	⑤	105.0	17.0	263	
		Slopewash																
		19,200 cu.yd.																
1972	107.2	" L.Bag	3.5-8	CL	29	35	66	72	75	100	40	20	CL	②	105.0	18.5	266	✓
1973	108.1	Borrow, C+50, 3+00, L.Bag	2-10	CL	24	35	45	65	74	100	33	16	CL					
		Alluvium																

LABORATORY NO.

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	CONSOLIDATION TEST

PROJECT and STATE		SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN Alluvium
TYPE OF SAMPLE	TESTED AT	APPROVED BY LP. DATE 1-26-68

CLASSIFICATION

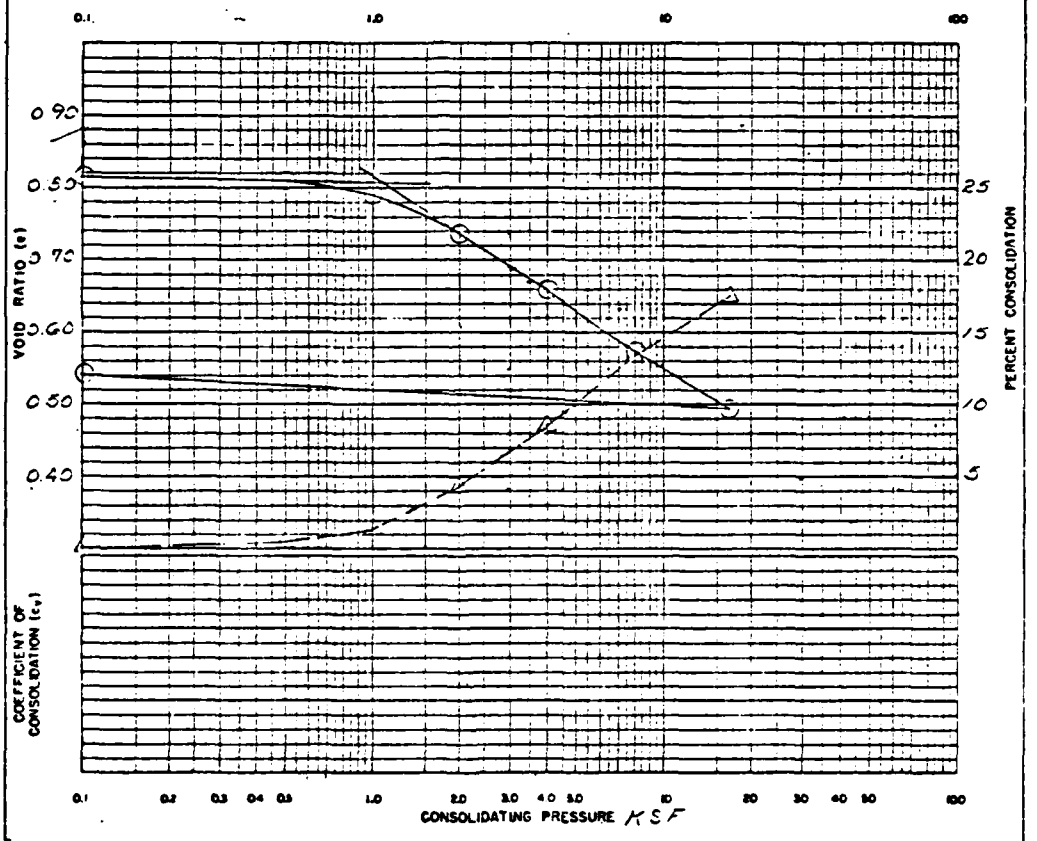
G_s LL 29 PI 12

INITIAL DENSITY γ_d

INITIAL VOID RATIO, e_o

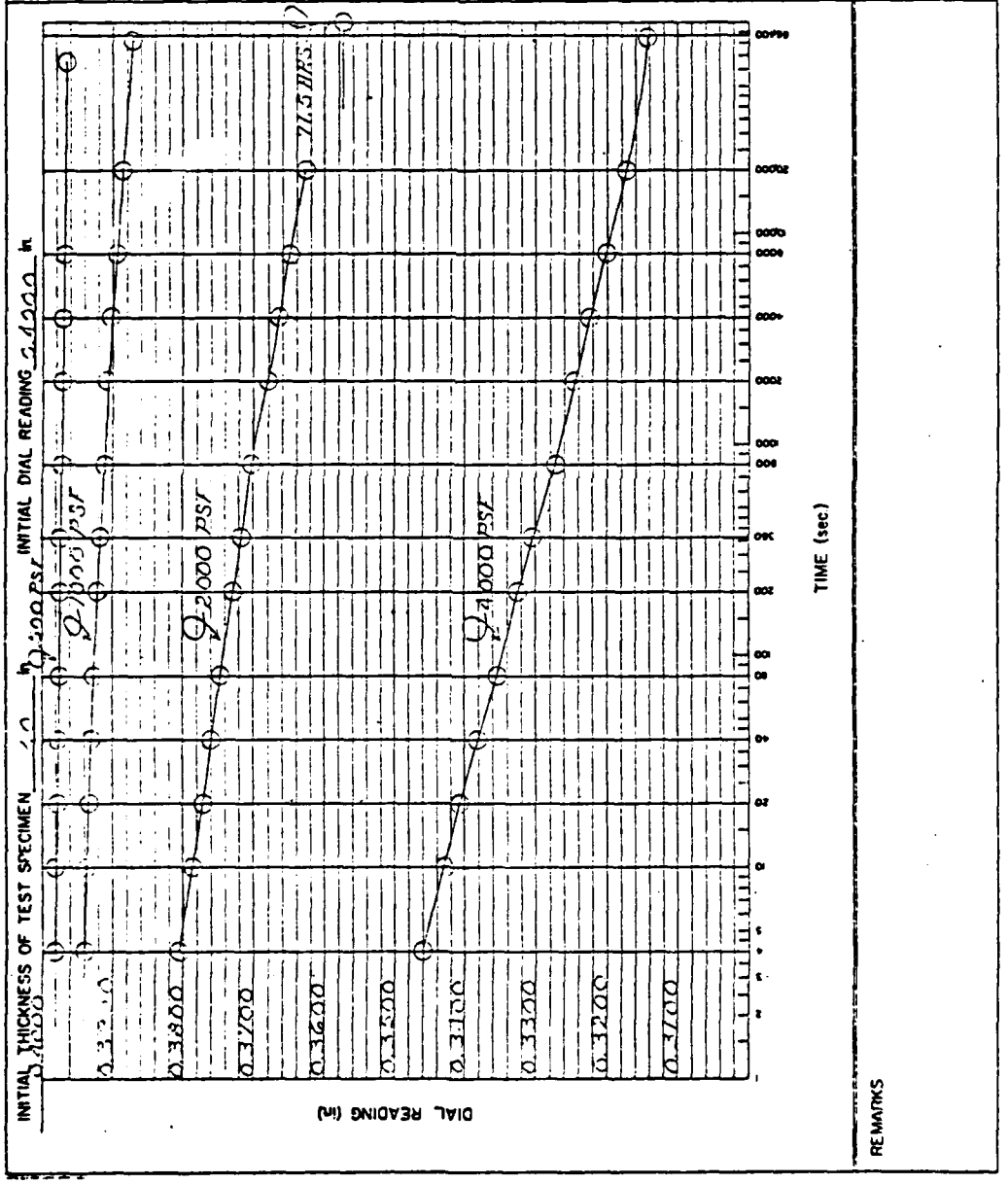
COMPRESSION INDEX, C_c 0.265

TEST SPECIFICATIONS:
Saturated at Start



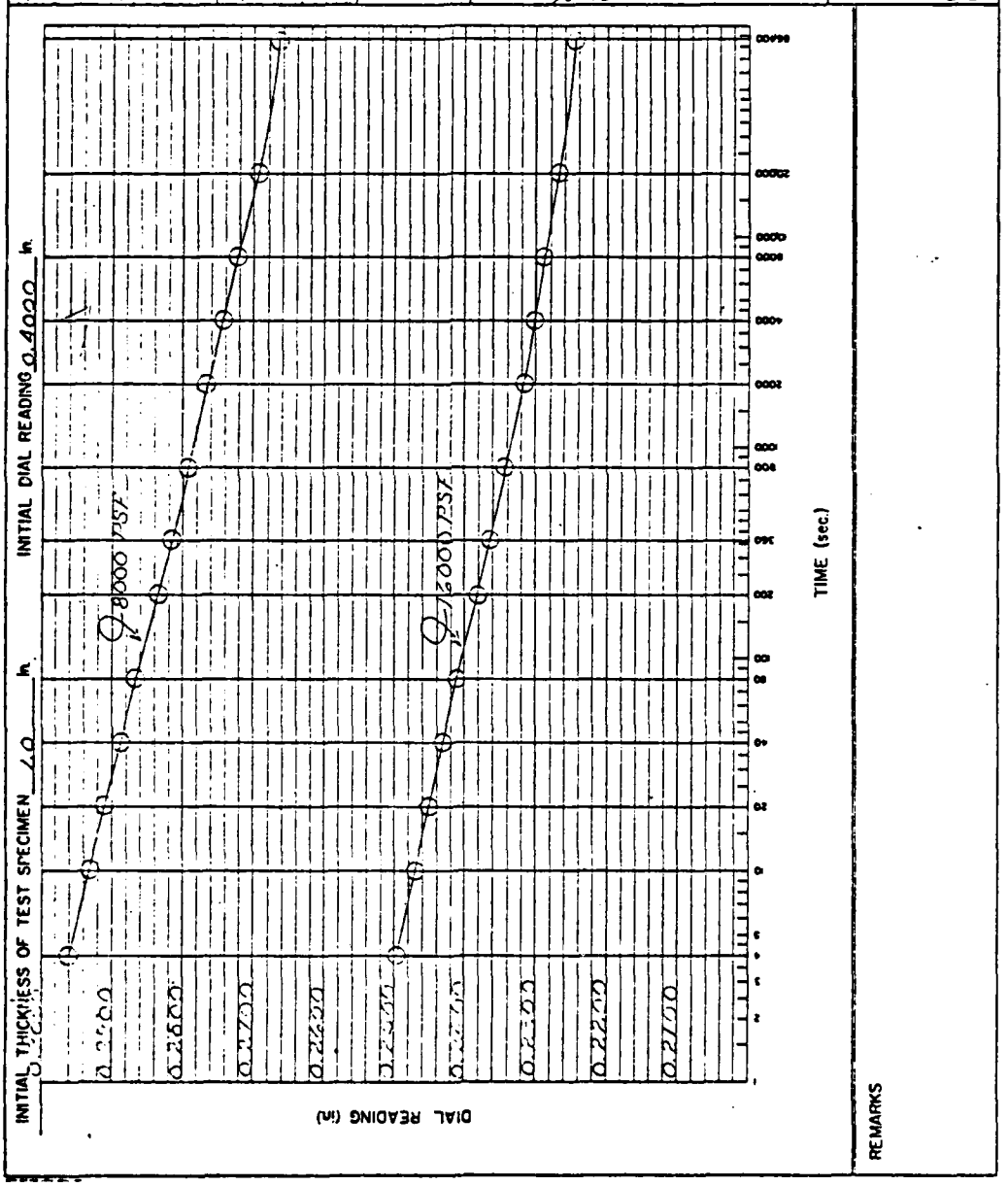
REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION
PROJECT and STATE		SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN Alluvium
TYPE OF SAMPLE	TESTED AT	APPROVED BY DATE 4-26-65



MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	LOG TIME CONSOLIDATION

PROJECT and STATE		SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN Alluvium
TYPE OF SAMPLE	TESTED AT	APPROVED BY [illegible] DATE 4-26-68



LABORATORY NO

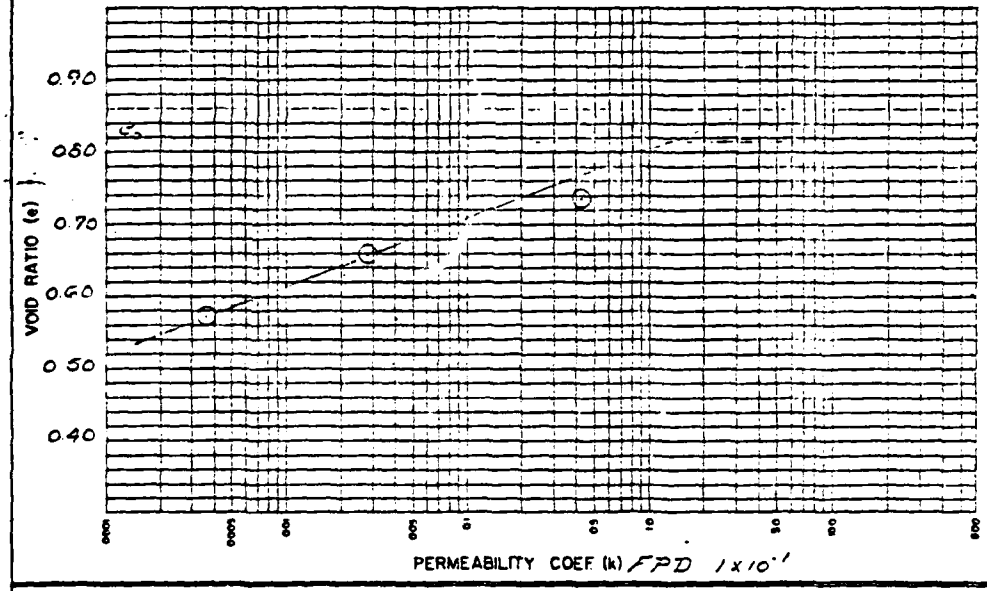
MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SOIL PERMEABILITY

PROJECT and STATE			SAMPLE LOCATION
FIELD SAMPLE NO	DEPTH	GEOLOGIC ORIGIN	
TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE

CLASSIFICATION CL LL 29 PI 12

SPECIFIC GRAVITY

TEST NO					G_s (-)#4	
INITIAL MOISTURE %					G_s (+)#4	
DRY DENSITY D-g/cc D pcf	1.53	1.60	1.65		G_m(Bulk)(+)#4	
VOID RATIO	0.7382	0.6595	0.5931		TEST SPECIFICATIONS	
PERMEABILITY COEF FPD	0.043	0.0027	0.00036		Falling Head Perm Test on the Consolidation Sample	
PERCOLATION COEF						
H/L DURING TEST						



REMARKS

Form SCS 355 A
Rev. 6-65

LABORATORY NO. [illegible]

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: [illegible] Site No. 2-2 Missouri
SAMPLE LOCATION: E Pit, Spoil, 1+ 00

FIELD SAMPLE NO.	DEPTH	GEOLOGIC ORIGIN
[illegible]	2-5.2'	Alluvium

TYPE OF SAMPLE	TESTED AT	APPROVED BY	DATE
Undisturbed	SML, Lincoln	[illegible]	4-25-69

INDEX TEST DATA

USCS CL ; LL 29 ; PI 12
% FINER (mm): 0.002 19 ; 0.005 23 ;
0.074 (# 200) 64
G_s (-#4) 2.65 ; G_s (+#4) _____
STANDARD: γ_d MAX. _____ pcf; w_o _____ %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

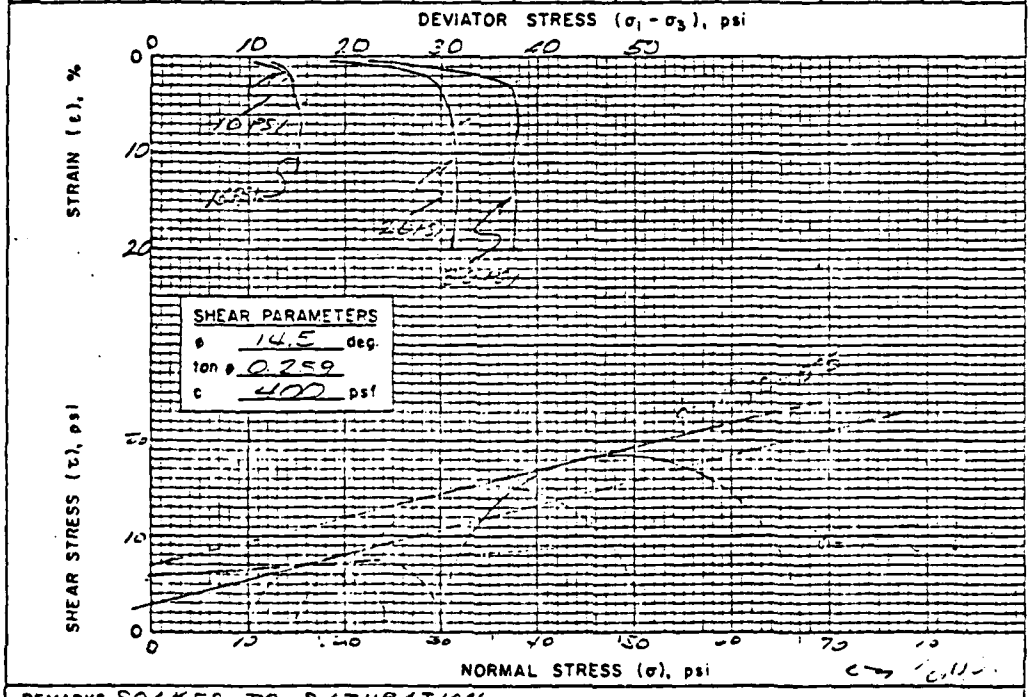
SPECIMEN DATA

HEIGHT 2.0 "; DIAMETER 1.41 "
MATERIALS TESTED PASSED _____ SIEVE
METHOD OF PREPARATION Trimmed From undisturbed core
MOLDING MOISTURE _____ %
MOLDED AT _____ % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☑
$\overline{CU}$ ☐
CD ☐

DRY DENSITY			MOISTURE CONTENT, %			TIME OF CONSOLI-DATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
INITIAL pcf ☐ g/cc ☒	CONSOLI-DATED pcf ☐ g/cc ☒		START OF TEST	DEG OF SAT. AT START OF TEST	END OF TEST				
1.50	1.54		22.9	79.2	21.4	6.67	10	14.3	2
1.62	1.66		21.7	90.4	19.7	6.15	20	[illegible]	5
1.61	1.62		22.1	90.6	19.4	6.10	30	37.0	[illegible]
1.47	1.53		24.5	80.8	21.6	5.83	15	15.1	[illegible]



REMARKS SOAKED TO SATURATION

Form SCS 355 A
Rev. 6-65

LABORATORY NO

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE: [illegible] Clark Site No. A-2 Michigan | SAMPLE LOCATION: Borrow

FIELD SAMPLE NO.: A2-K | DEPTH | GEOLOGIC ORIGIN: Mix (Alluvial)

TYPE OF SAMPLE: Remolded 2"x6" | TESTED AT: SML, Lincoln | APPROVED BY: [illegible] | DATE: 4-26-63

INDEX TEST DATA

USCS _____; LL _____; PI _____

% FINER (mm): 0.002 _____; 0.005 _____;

0.074 (# 200) _____

G_s (-#4) 2.63; G_s (+#4) _____

STANDARD: γ_d MAX. 111.0 pcf; w_o 15.0 %

MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

SPECIMEN DATA

HEIGHT 3.0"; DIAMETER 1.4"

MATERIALS TESTED PASSED #4 SIEVE

METHOD OF PREPARATION STATIC 3 LAYER COMPACTION AND SOAKED

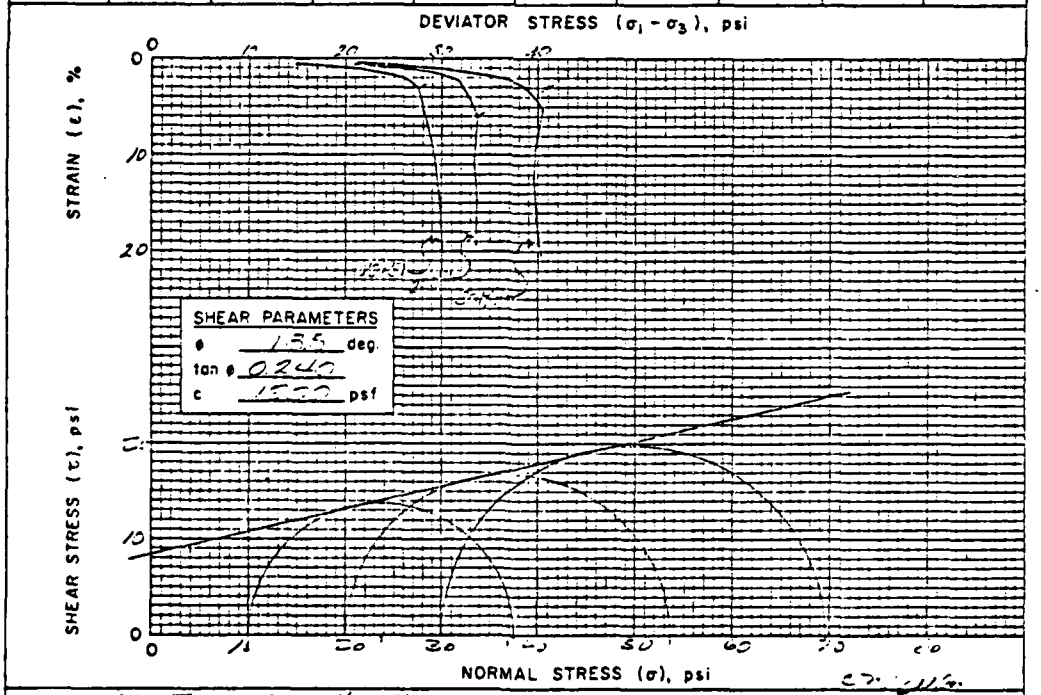
MOLDING MOISTURE 17.4 %

MOLDED AT 94.9% OF γ_d MAXIMUM

TYPE OF TEST

UU ☐ CU ☑ $\overline{CU}$ ☐ CD ☐

DRY DENSITY INITIAL pcf ☐ g/cc ☐	DRY DENSITY CONSOLIDATED pcf ☑ g/cc ☐	MOISTURE CONTENT, % START OF TEST	MOISTURE CONTENT, % DEG. OF SAT. AT START OF TEST	MOISTURE CONTENT, % END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
106.3	106.9	18.9	90.9	18.5	4.18	10	27.5	3
106.5	107.1	18.6	91.0	18.2	4.21	20	37.1	6
106.6	107.2	18.5	90.7	17.8	5.15	30	39.6	4



REMARKS TESTED @ 95.8% STD

Form SCS 353A
Rev. 6-70

LABORATORY NO 62011-202

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	TRIAXIAL SHEAR TEST

PROJECT and STATE [illegible] SAMPLE LOCATION Perrow F+00 12+00

FIELD SAMPLE NO 177-2 | DEPTH 2.5-9' | GEOLOGIC ORIGIN Glacial Till

TYPE OF SAMPLE Undisturbed | TESTED AT [illegible] | APPROVED BY [illegible] | DATE 4-26-68

INDEX TEST DATA

USCS CL ; LL 40 ; PI 20
% FINER (mm): 0.002 29 ; 0.005 35 ;
0.074 (#200) 75
G_s (-#4) 2.66 ; G_s (+#4) _____
STANDARD: γ_d MAX. 105.0 pcf; w_o 18.5 %
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %

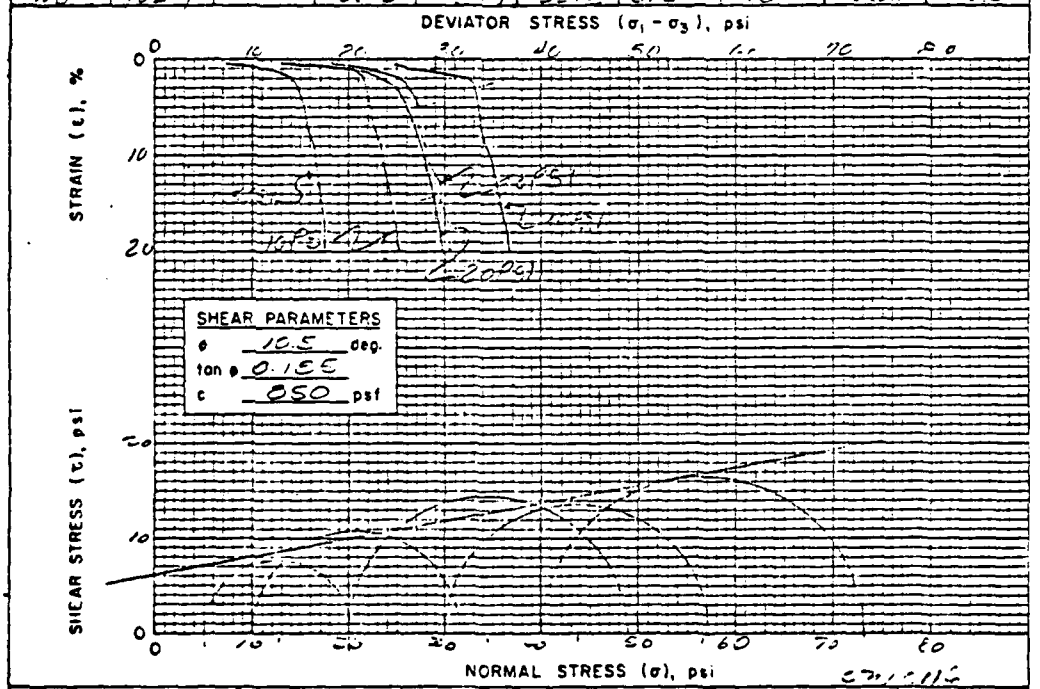
SPECIMEN DATA

HEIGHT 3.0 "; DIAMETER 1.4 "
MATERIALS TESTED PASSED #4 SIEVE
METHOD OF PREPARATION STATIC
COMPACTED IN 3 LIFTS
MOLDING MOISTURE 20.3 %
MOLDED AT 95.2 % OF γ_d MAXIMUM

TYPE OF TEST

UU ☐
CU ☒
$\overline{CU}$ ☐
CD ☐

DRY DENSITY			MOISTURE CONTENT, %						
INITIAL pcf ☒ g/cc ☐	CONSOLIDATED pcf ☒ g/cc ☐		START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST	TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ε (%)
100.0	100.0		23.3	93.6	23.3	5.92	10	21.5	5.0
100.2	100.6		23.1	92.6	22.8	6.08	20	28.5	10.2
99.4	101.2		25.7	93.7	22.6	5.78	30	33.2	5.0
98.6	99.0		24.6	95.7	24.4	6.60	5	15.7	4.9
100.2	102.4		23.5	95.9	23.2	6.22	40	38.1	3.0



REMARKS AVERAGE TEST δ_d = 95.1 % STD.

0504-GED-DWATTSVILLE, MD. 1968

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Panther Creek PC-2, Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
203.1	E Emer. Spwy. 100' Rt. 4+00	0.5'-10'

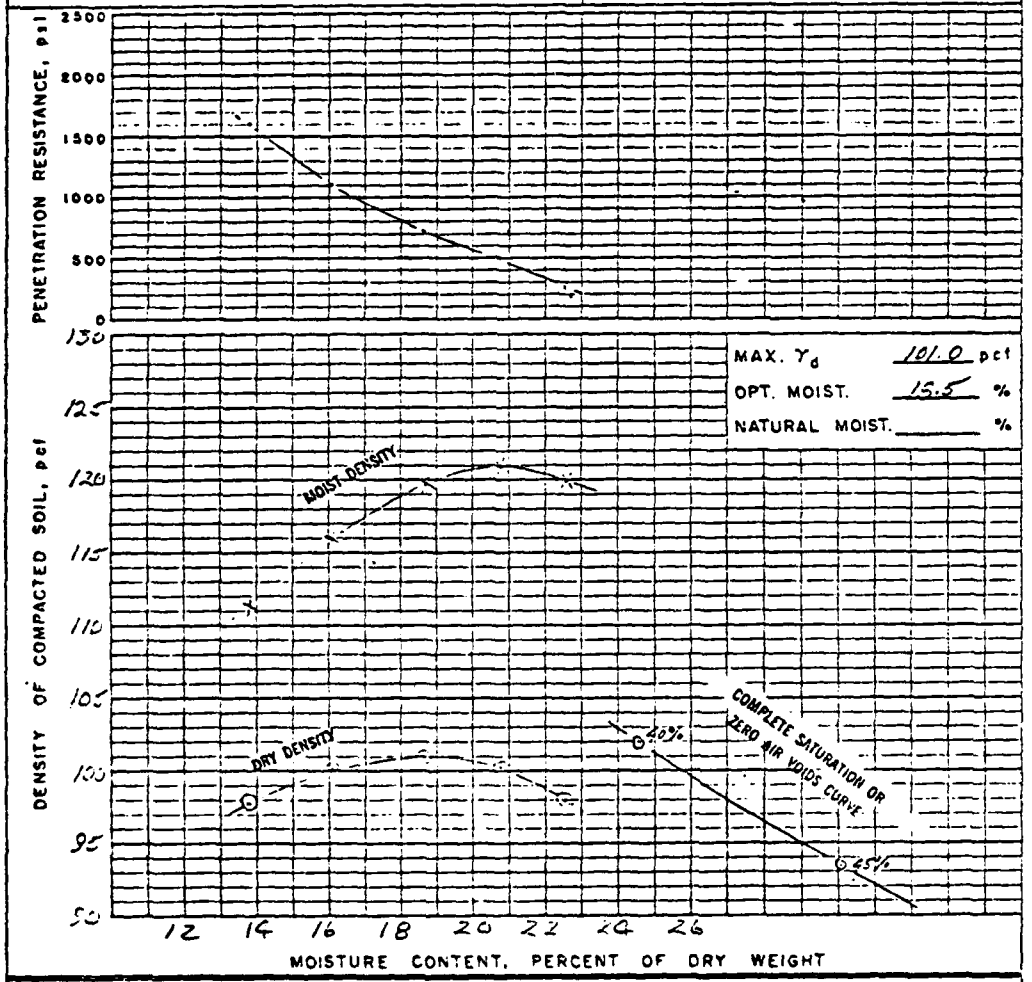
GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
Glacial Till	S.M.L. Lincoln	[illegible]	4-26-68

CLASSIFICATION CH LL 51 PI 30 CURVE NO. 1 OF 6

MAX. PARTICLE SIZE INCLUDED IN TEST ¼" STD.(ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.72 / PLUS NO. 4 } MOD.(ASTM D-1557) ☐; METHOD

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Gardner Creek FC-2, Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
101.1	Borrow, A+75 E+05	0 - 2.5'

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
Glacial Till	S.M.L. Lincoln	[illegible]	4-24-58

CLASSIFICATION CL LL 34 PI 18 CURVE NO. 2 OF 6

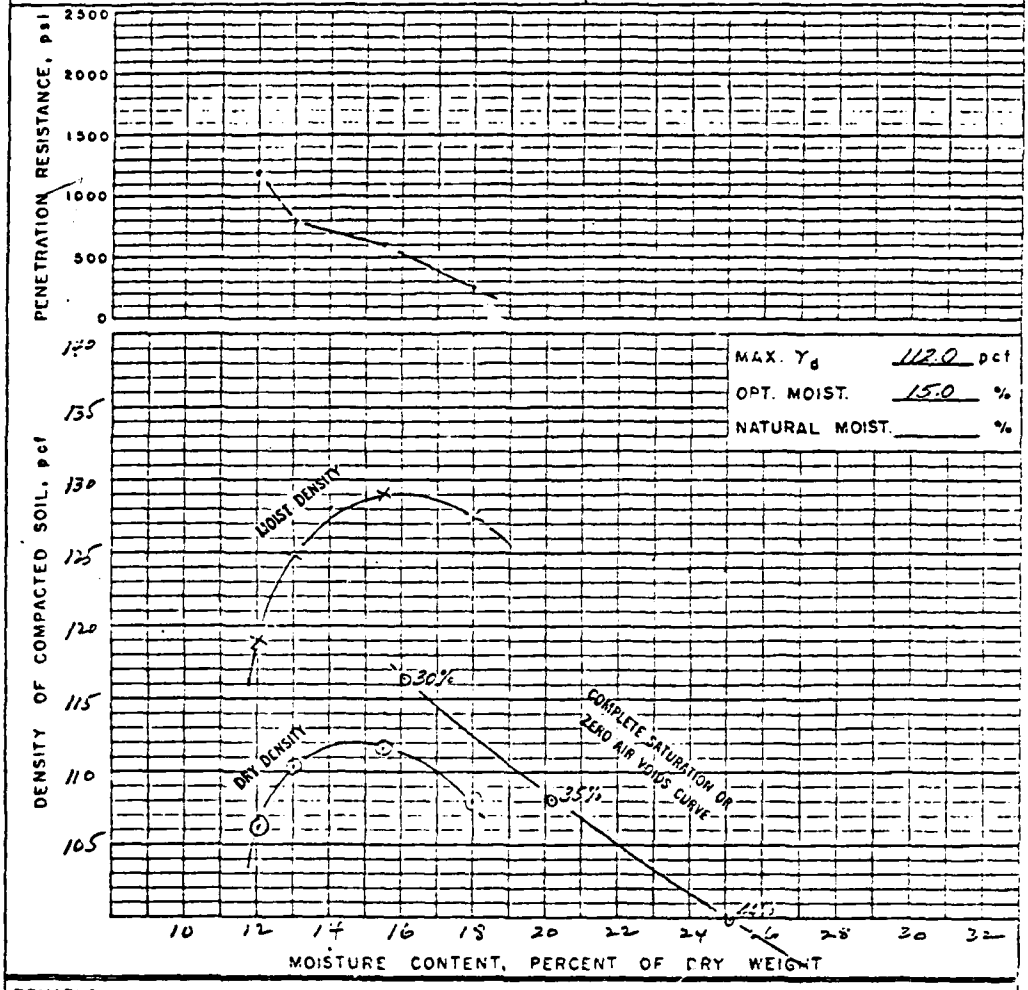
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.66 / PLUS NO. 4 ____

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT | U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE | COMPACTION AND PENETRATION RESISTANCE

PROJECT or STATE: Panther Creek #C-2, Missouri

FIELD SAMPLE NO.: Composite | LOCATION: Borrow Composite | DEPTH: 0-6'

GEOLOGIC ORIGIN: Mix (Alluvial) | TESTED AT: S.M.L. Lincoln | APPROVED BY: U. S. E. | DATE: 4-26-65

CLASSIFICATION: CL | LL: | PI: | CURVE NO.: 3 OF 6

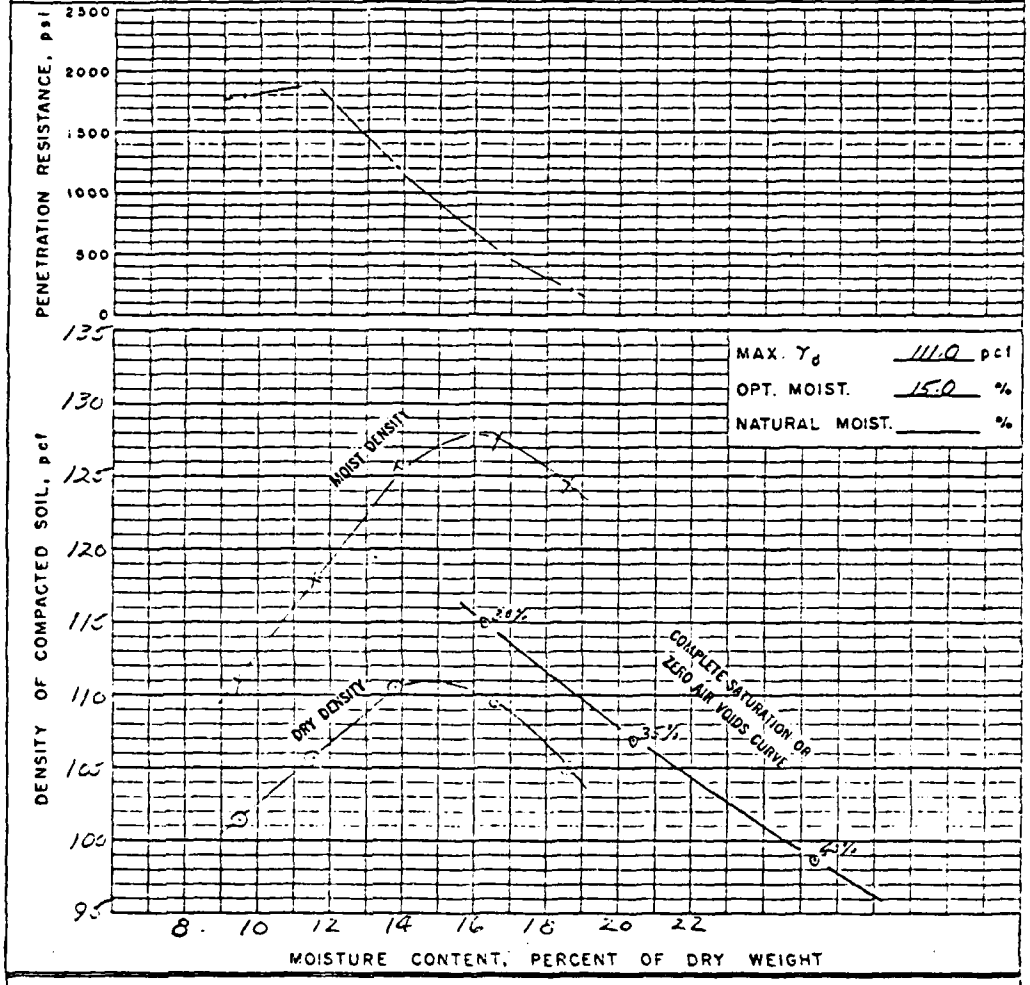
MAX. PARTICLE SIZE INCLUDED IN TEST: < #4 "

SPECIFIC GRAVITY (G_s): MINUS NO 4: 2.63; PLUS NO. 4:

STD. (ASTM D-698) ☒; METHOD: A

MOD. (ASTM D-1557) ☐; METHOD:

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Panther Creek # C-2 Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
105-2 & 105-1	Borrow Composite / C+50, 2+00 = 105-1 & 105-2	2-6 / 2-10

GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
Alluvium	C.M.C. Lincoln	D. J.	4-26-62

CLASSIFICATION CL LL ____ PI ____ CURVE NO. 4 OF 6

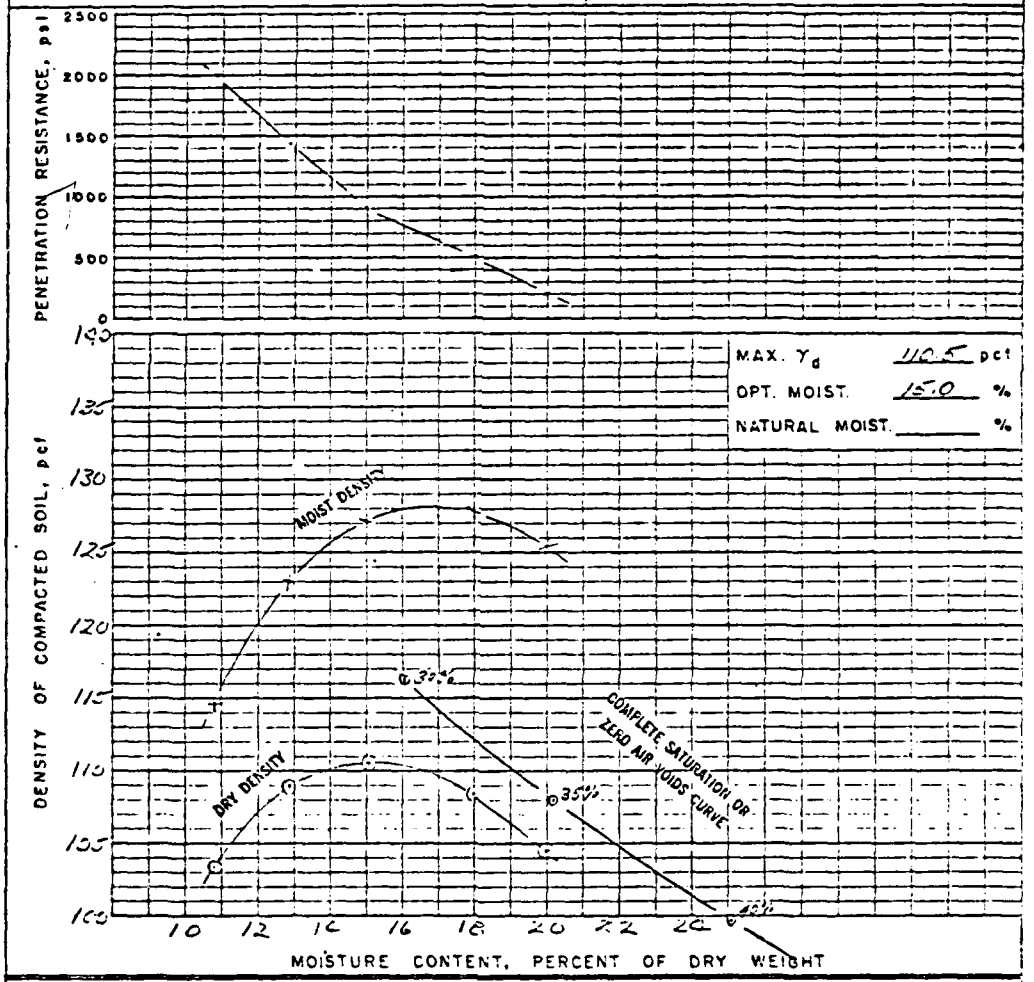
MAX. PARTICLE SIZE INCLUDED IN TEST ¾"

SPECIFIC GRAVITY (G_s) { MINUS NO 4 2.66 / PLUS NO. 4 ____ }

STD. (ASTM D-698) ☑; METHOD A

MOD (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

MATERIALS TESTING REPORT	U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT and STATE: Panther Creek #C-2, Missouri

FIELD SAMPLE NO.	LOCATION	DEPTH
1071	Borrow, E-02 12+00	0-3.5

GEOLOGIC ORIGIN	TESTED BY	APPROVED BY	DATE
Glacial Till derived	C.M.L. Liriola	D.H.C.	4-26-67

CLASSIFICATION CL LL 35 PI 17

MAX. PARTICLE SIZE INCLUDED IN TEST ¼ "

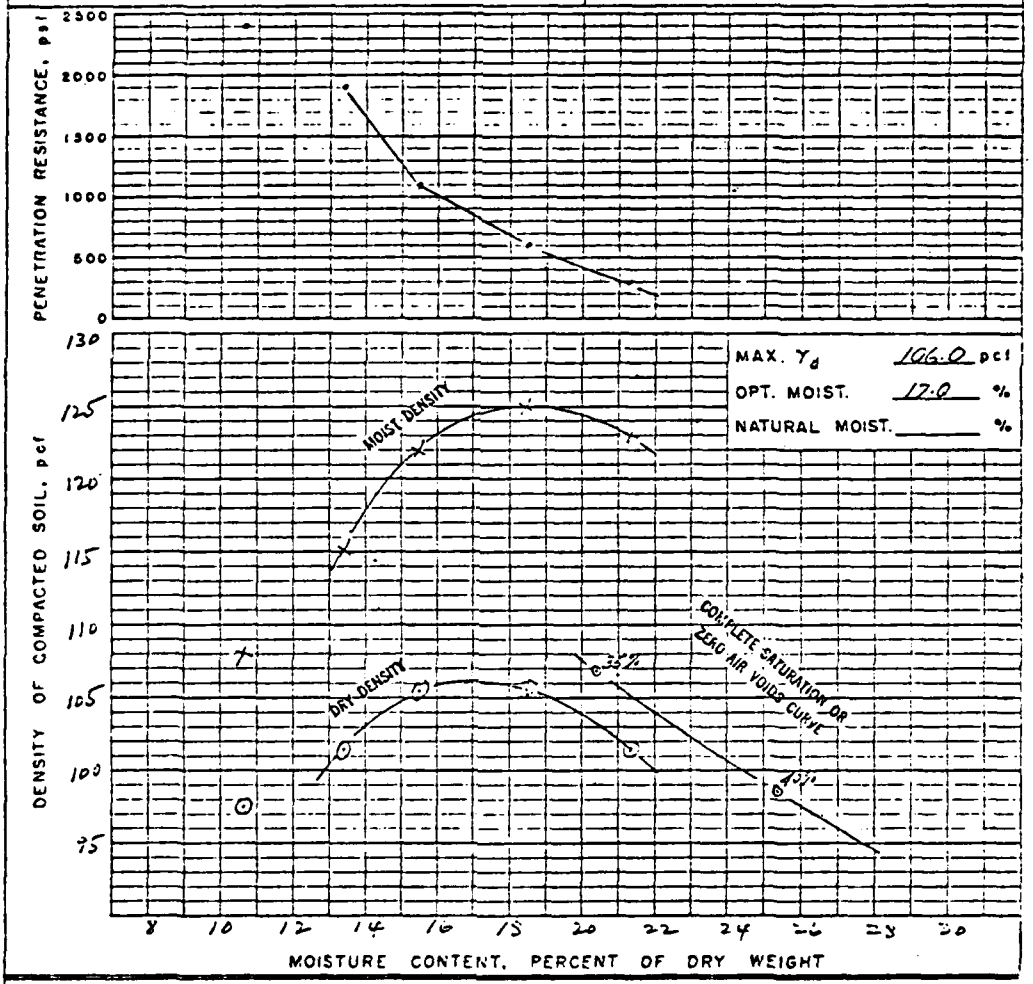
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.63 / PLUS NO. 4 ____

CURVE NO. 5 OF 6

STD. (ASTM D-698) ☒; METHOD A

MOD. (ASTM D-1557) ☐; METHOD ____

OTHER TEST ☐ (SEE REMARKS)



REMARKS

Laboratory No. 63-1177

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE

PROJECT OR STATE: Panther Creek "C-2", Missouri

FIELD SAMPLE NO	LOCATION	DEPTH
107.2	Borrow E 100 12+00	35'-8'

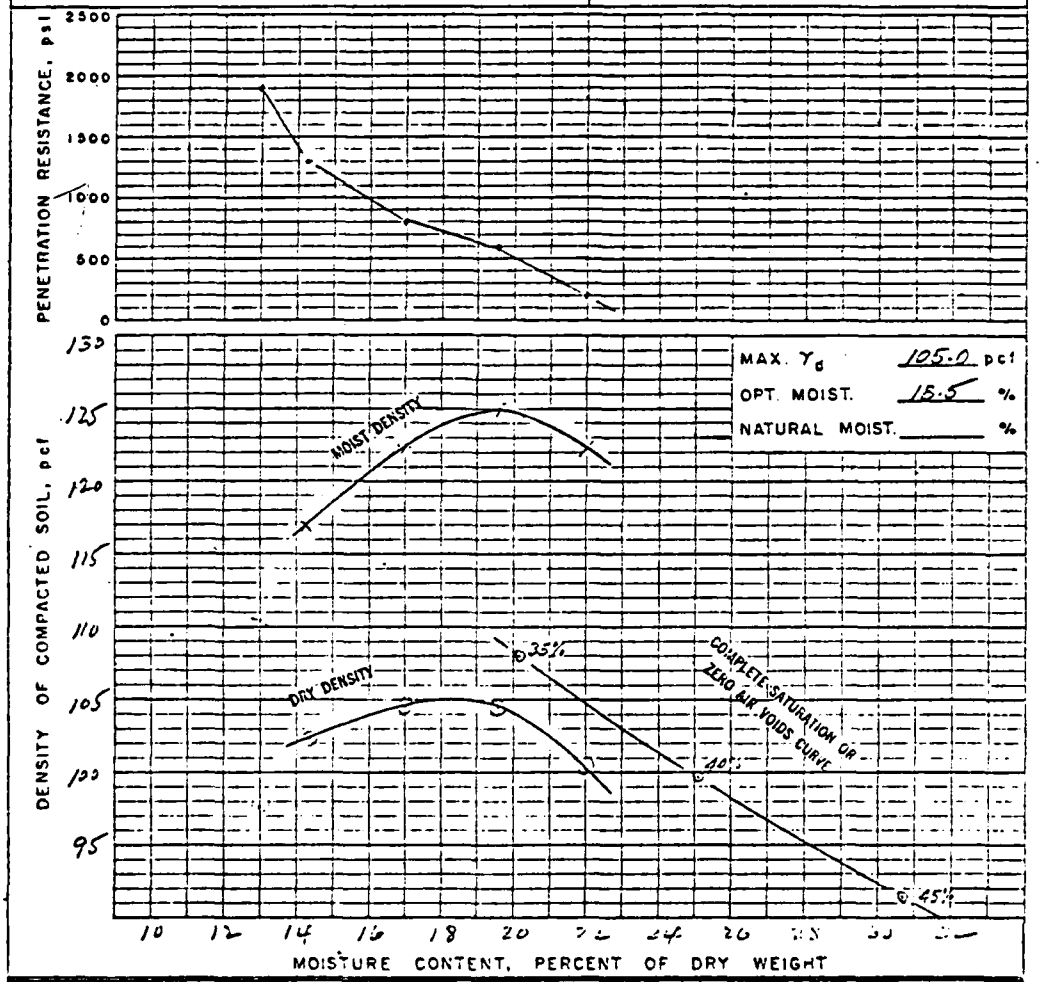
GEOLOGIC ORIGIN	TESTED AT	APPROVED BY	DATE
Glacial Till	C.M.L. Lincoln	W. J. [illegible]	4-26-63

CLASSIFICATION CL LL 40 PI 20 | CURVE NO. 6 OF 6

MAX. PARTICLE SIZE INCLUDED IN TEST < #4 " | STD. (ASTM D-698) ☒; METHOD A

SPECIFIC GRAVITY (G_s) { MINUS NO 4 2.66 / PLUS NO. 4 _____ | MOD. (ASTM D-1557) ☐; METHOD _____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 105.0 pcf

OPT. MOIST. 18.5 %

NATURAL MOIST. _____ %

REMARKS

Form SCS 337
Rev. 6-63

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY - SLOPE STABILITY ANALYSIS

MATERIALS TESTING REPORT

PROJECT and STATE: [illegible]

METHOD OF ANALYSIS: [illegible]

ANALYZED BY: [illegible]

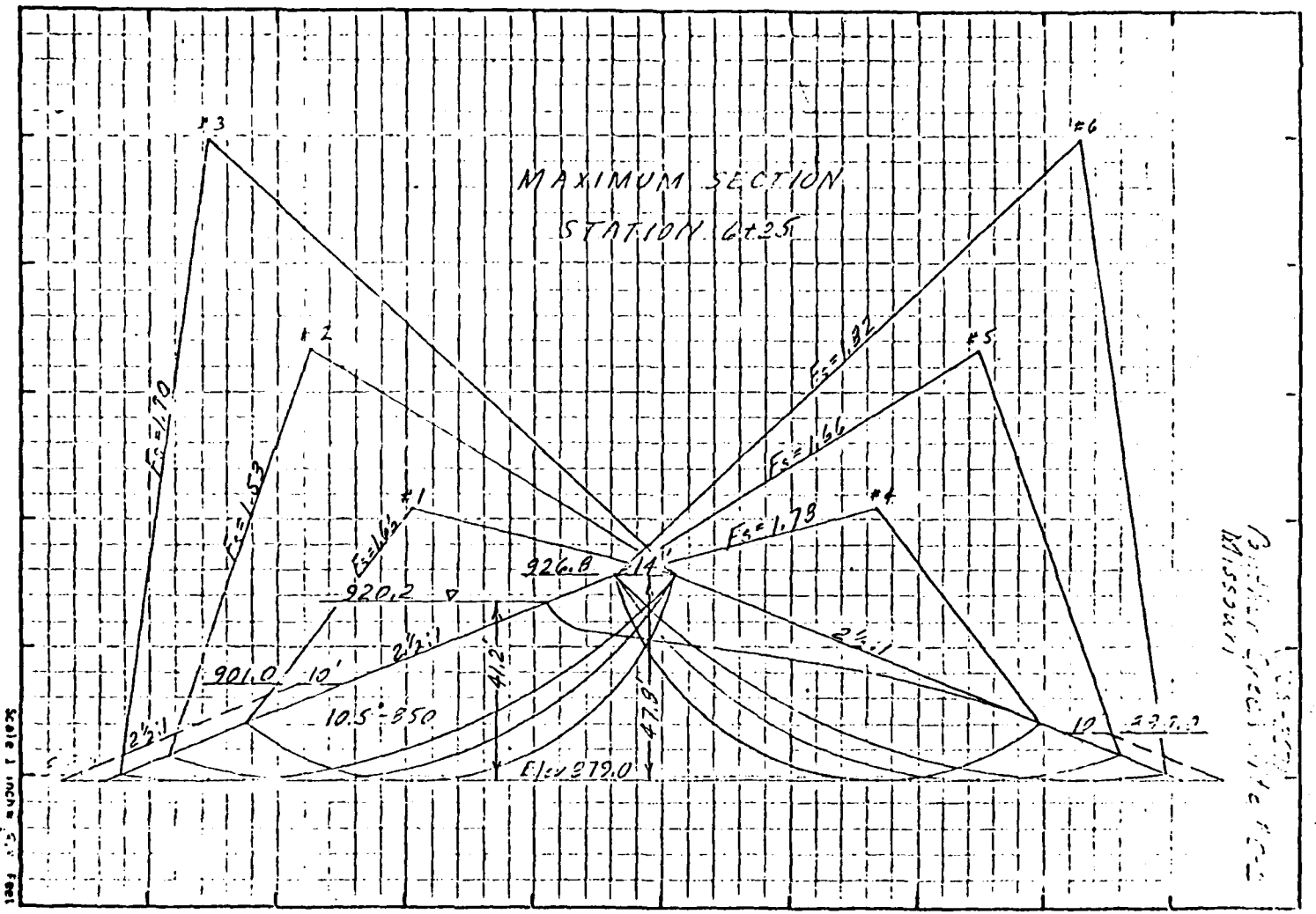
APPROVED BY: [illegible]

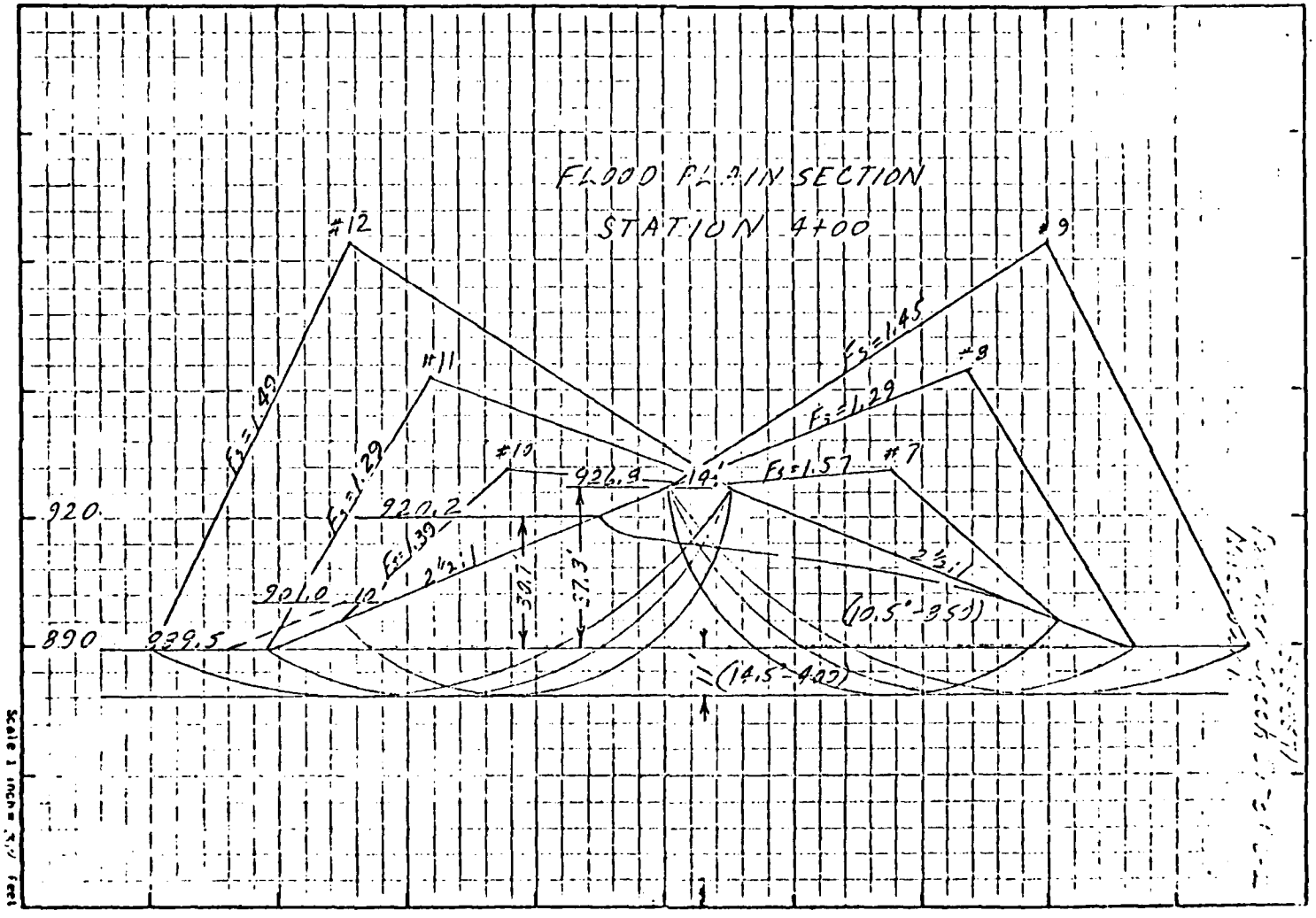
DATE: [illegible]

	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA γd (pcf)	γm (pcf)	γsat (pcf)	γsub (pcf)	φ (deg)	tan φ	c (psf)	REMARKS
①	Found.	CL	97.0		119.0	56.5	14.5	0.259	400	
②	Embank.	CL	99.7	118.0	123.0	60.5	10.5	0.185	850	
③	Embank.	CL	106.5	122.5	126.5	63.0	13.5	0.240	1200	
④										
⑤										
⑥										
⑦										
⑧										

TRIAL NO		SLOPE	CONDITIONS	F_s
			MAXIMUM SECTION @ STATION 6+25	
1	Up	2½:1	Full drawdown - No berm - Arc cut from opp. shldr. thru emb. (12.5°-352) only.	1.66
2	Up	2½:1	Same conditions as trial #1.	1.03
3	Up	2½:1	Same conditions as trial #1.	1.70
4	Dn	2½:1	No drawn - No berm - Arc cut from opp. shldr. thru emb. (12.5°-352) only.	1.73
5	Dn	2½:1	Same conditions as trial #4.	1.66
6	Dn	2½:1	Same conditions as trial #4.	1.92
			FLOOD PLAIN SECTION @ STATION 4+02	
7	Dn	2½:1	No drop - No berm - Arc cut from opp. shldr. thru emb. (10.5°-352) & 11' found (14.5°-402).	1.57
8	Dn	2½:1	Same conditions as trial #7.	1.22
9	Dn	2½:1	Same conditions as trial #7.	1.45
10	Up	2½:1	Full drawdown - No berm - Arc cut from opp. shldr. thru emb (10.5°-352) & 11' found (14.5°-402).	1.49
11	Up	2½:1	Same conditions as trial #10.	1.29
12	Up	2½:1	Same conditions as trial #10.	1.39

Sheet 1 of 1


MAXIMUM SECTION
STATION 6+25
#1
#2
#3
#4
#5
#6
Fs=1.70
Fs=1.53
Fs=1.66
Fs=1.92
Fs=1.78
926.8
920.2
901.0
10'
14'
2½:1
10.5 : 850
41.2'
47.8'
Elev 879.0'
10


FLOOD PLAIN SECTION
STATION 4+00
#12
#11
#10
#9
#8
#7
Fs=1.49
Fs=1.29
Fs=1.39
Fs=1.45
Fs=1.29
Fs=1.57
920
890
920.2
921.0
929.5
926.9
19.1'
30.1'
37.3'
2½:1
2½:1
(10.5'-3.5')
(14.5'-4.0')
Scale 1 inch = X.X feet

STRUCTURE DATA

Class of Structure: "a" Floodwater Retarding

Drainage Area (total): 5831 Ac. 9.11 Sq.Mi.

(uncontrolled) 4495 Ac. 7.02 Sq.Mi.

Time of Concentration: 2.21 Hours

Soil Cover Complex Number: 78 For A.M.C. II

Sediment Capacity Available 476 Ac.Ft. below Elev. 906.5

Total Sediment Capacity Available 476 Ac.Ft. ①

Capacity Equivalents (Vol.) 1.27 In.

Retarding Capacity Provided 1518 Ac.Ft. ①

Capacity Equivalents (Vol.) 4.05 In.

Water Supply Provided: _____ Ac.Ft.-Identify Uses

Principal Spillway:

Maximum Capacity ~~(low stage)~~ 339 c.f.s.

~~Maximum Capacity (high stage) _____ c.f.s.~~

10 Day Drawdown Elev. 906.5

Emergency Spillway:

Percent Chance Use 2 Storm Duration 6 Hours

Type Veg. Earth-Exit Channel / Rock-Inlet Channel n" Value Used 0.04

② Emergency Spillway Hydrograph for Class 6" Structures

Rainfall 7.90 in.

Runoff 5.31 in.

③ Peak Inflow 7237 c.f.s.

Maximum Discharge - Emergency Spillway 718 c.f.s.

Maximum Water Surface Elev. 922.2

Velocity of Flow (Ve) 5.7 f.p.s.

Supplementary Data and Special Design Features:

① Based on uncontrolled drainage area

② The following conditions existed:
a. Emergency Spillway Routing considered structure B-13, B-10, and B-11 in place.
b. Freeboard Routing considered total drainage area, uncontrolled.

③ Taken from Composite Hydrograph.

② Freeboard Hydrograph for Class 6" Structures

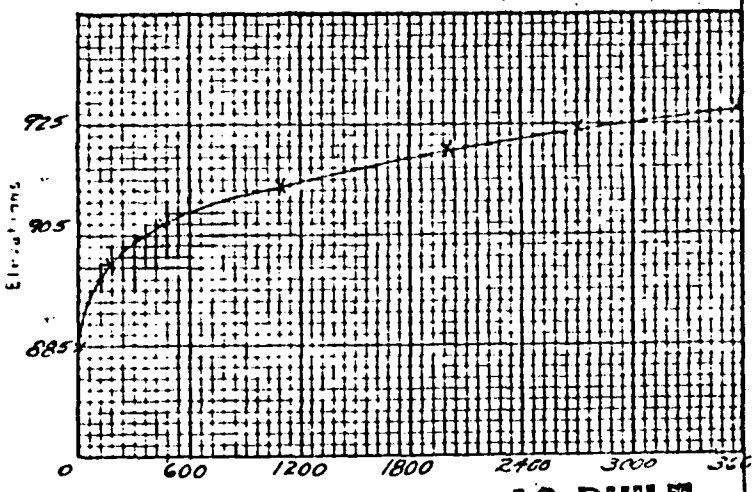
Rainfall 13.70 in.

Runoff 10.83 in.

Peak Inflow 18,516 c.f.s.

Maximum Discharge - Emergency Spillway 8774 c.f.s.

Maximum Water Surface Elev. 927.9



AS BUILT
10-3-72

Supplementary Data and Special Design Features:

1. The Emergency Spillway inlet channel was routed with a 0.00 slope. A 0.005 slope was used.
2. Principal Spillway Crest Elev. 906.5
3. Emergency Spillway Crest Elev. 920.2
4. Emergency Spillway Bottom Width = 180'
5. Settled Top of Dam Elev. 927.9
   H x S = 34.2 x 1994 = 78,165

STRUCTURE C-2
PANTHER CREEK WATERSHED P.L. 566
HARRISON COUNTY, MISSOURI

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

N.B.T. & R.W.R. 1959
J.G.Y. 9-69
R.W.R. & N.W.R. 7-69

SCS-27,929-E

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1979
  LAST MODIFICATION  03 APR 80
     1                A1***PHASE 1 DAM INSPECTION FOR STATE OF MISSOURI - ST.LOUIS DISTRICT COE***
     2                A2*** HARRISON COUNTY DAM C-2  MO ID # 10614      FILE - H219457*MO1.HARRISON
     3                A3 PROBABLE MAXIMUM STORM & OTHER RATIOS
     4                B    288        0        5        0        0        0        0        0        0        0
     5                U1     5
     6                J      1        9        1
     7                J*0.15  0.2      0.25     0.3      0.35     0.4      0.45     0.5      1.0
     8                K      0        1                                              1
     9                K*CALCULATE INFLOW HYDROGRAPH TO B-11
    10                H      1        2 0.320                    1.0
    11                P       23.9     101.     120.     130.
    12                T                                                    -1-90.
    13                W2      0.186
    14                X                1.
    15                K      1        2                                      1
    16                K1 ROUTE HYDROGRAPH THROUGH STRUCTURE B-11 (NO.ID.#10461)
    17                Y                                  1        1
    18                Y1     1                                        -80.0          -1
    19                Y480.   81.      82.      83.      84.      85.      86.      87.      88.      89.
    20                Y50.0   4.       12.      20.      40.      56.      142.     299.     666.     1018.
    21                S50.0   2.       6.       9.       13.      19.      29.      41.      58.      75.
    22                S666.   70.      74.      76.      78.      80.      82.      84.      86.      88.
    23                S980.
    24                S986.8
    25                SL0.    15.      430.
    26                SV66.8  86.9     87.9
    27                S010.   0.5      68.      1.       80.      86.8
    28                K      1        3                                      1
    29                K1 CHANNEL ROUTING TO STRUCTURE C-2
    30                Y                                  1        1
    31                Y1     1
    32                Y60.06  0.05     0.06     62.5     85.      8560.    0.0075
    33                Y70.0   85.      300.     72.      318.     65.5     322.     62.5     325.     62.5
    34                Y7330.  66.      360.     75.5     430.     85.
    35                K      0        4                                      1
    36                K1 CALCULATE INFLOW HYDROGRAPH TO B-13
    37                H      1        2 0.759                    1.0
    38                P       23.9     101.     120.     130.
    39                T                                                    -1-90.
    40                W2      0.324
    41                X                1.
    42                K      1        5                                      1
    43                K1 ROUTE HYDROGRAPH THROUGH STRUCTURE B-13 (NO.ID.#10453)
    44                Y                                  1        1
    45                Y1     1                                        -112.          -1
    46                Y4112.  112.5    113.     113.5    114.5    115.5    116.4    116.8    117.     117.5
    47                Y4118.  118.5    119.     119.6    119.8    120.     120.6    121.     122.
    48                Y50.0   15.      35.      47.      63.      73.      77.      125.     166.     301.
    49                Y5475.  684.     924.     1253.    1373.    1503.    1904.    2205.    3016.
    50                S50.0   2.       5.       13.      25.      50.      100.     150.     200.     240.
```



```
    51                S*89.   93.      96.      100.     103.     107.6    112.7    115.8    118.     120.
```

```
[illegible]
Y50.C  [illegible]                                                              301.
[illegible]
S50.0  2.      5.      13.     25.     50.     100.    150.    200.    240.
```



```
SE89.  93.     96.     100.    103.    107.6   112.7   115.8   118.    120.
SS112.
SD118.7
SL0.0  20.     585.
SV118.7 118.9  119.5
SP10.  0.5     92.     1.      112.    116.7
K      1       6                                       1
K1 CHANNEL ROUTING TO STRUCTURE C-2
Y                                      1       1
Y1     1
Y60.06 0.05    0.06    88.2    119.    6167.   0.0055
Y70.0  117.    410.    100.6   425.    93.3    470.    88.2    485.    88.4
Y7495. 96.     590.    98.6    580.    119.
K      C       7                                       1
K1 CALCULATE INFLOW HYDROGRAPH TO B-10
M      1       2 1.008                         1.0
P      23.9    101.    120.    130.
T                                                      -1.91.
W2     0.318
X              1.
K      1       8                                       1
K1 ROUTE HYDROGRAPH THROUGH STRUCTURE B-10 (MO.ID.#10072)
Y                                      1       1
Y1     1                                       -122.           -1
Y4122. 122.5   123.    123.5   124.    124.5   125.    125.75  126.8   127.8
Y4128.8 129.8  130.8   131.8   132.8
Y50.0  73.     74.     75.     76.     77.     78.     79.     80.     120.
Y5406. 711.    1161.   1781.   2431.
S50.0  37.     60.     93.     128.    169.    219.    278.    314.    350.
SE108. 114.    116.8   120.    122.    124.    126.    128.    129.    130.
SS122.
SD129.1
SL0.0  50.     690.
SV129.1 129.2  129.9
SW10.  0.5     108.    1.      122.    129.1
K      1       9                                       1
K1 CHANNEL ROUTING TO STRUCTURE C-2
Y                                      1       1
Y1     1
Y60.06 0.05    0.06    98.     130.    5670.   0.0060
Y70.0  130.    375.    109.    445.    190.    465.    98.     490.    98.
Y7500. 110.    593.    114.    740.    130.
K      C       10                                      1
K1 CALCULATE INFLOW HYDROGRAPH TO UNCONTROLLED AREA OF WEST ARM OF C-2
M      1       2 2.758                         1.0
P      23.9    101.    120.    130.
T                                                      -1.90.
W2     0.684
X              1.
K      5       11                                      1
```

```
K1 COMBINE HYDROGRAPHS FROM WEST ARM OF C-2
K     C     12                                                    1
K1 CALCULATE INFLOW HYDROGRAPH TO LT-93
M     1     2 0.358                          1.0
P       23.9    101.    120.    130.
T                                                  -1-90.        1
K2      0.204
X                 1.
K     1     13                                                    1
K1 ROUTE HYDROGRAPH THROUGH STRUCTURE LT-93 (NO.ID.#119380)
Y                                   1       1
Y1    1                                                 -95.          -1
Y495.   96.     97.     98.     98.5    99.     100.    101.3   101.5   102.
Y4103.  104.
Y50.0   3.      8.      11.     33.     76.     208.    478.    528.    669.
Y51005. 1412.
S50.0   20.4    24.8    40.5    268.4
SE83.   94.     95.     98.     114.
S895.
SD101.3 2.8     1.5     220.
SB10.   0.5     83.     1.      95.     101.3
K     1     14                                                    1
K1 CHANNEL ROUTING TO STRUCTURE C-2
Y                                   1       1
Y1    1
Y60.06  0.06    0.06    83.     134.    14830.  0.0051
Y70.0   134.    160.    114.    340.    94.     470.    83.     480.    83.
Y7590.  94.     780.    114.    1020.   134.
K     C     15                                                    1
K1 CALCULATE INFLOW HYDROGRAPH TO LT-84
M     1     2 0.388                          1.0
P       23.9    101.    120.    130.
T                                                  -1-90.
K2      0.223
X                 1.
K     1     16                                                    1
K1 ROUTE HYDROGRAPH THROUGH STRUCTURE LT-84 (NO.ID.#119350)
Y                                   1       1
Y1    1                                                 -94.          -1
Y494.   95.     96.     96.9    97.4    97.9    98.9    99.9    101.    101.2
Y4101.5 101.9   102.9   103.9
Y50.0   2.      4.      5.      42.     116.    321.    620.    1048.   1179.
Y51279. 1479.   2029.   2689.
S50.0   27.0    48.7    98.6    678.2
SE85.   94.     96.9    102.    122.
S894.
SD101.0 2.8     1.5     374.
SB10.   0.5     85.     1.      94.     101.
K     1     17                                                    1
K1 CHANNEL ROUTING TO STRUCTURE C-2
```



```
Y                                   1       1
```

```
151              Y                                   1       1
152              Y1     1
153              Y0.06  0.04    0.06    85.     142.    12330.  0.0054
154              Y3.0   142.    200.    122.    310.    102.    550.    85.     560.    85.
155              Y7750. 102.    1170.   122.    1670.   142.
156              K      0       18                                      1
157              KT CALCULATE INFLOW HYDROGRAPH TO UNCONTROLLED AREA OF EAST ARM OF C-2
158              M      1       2 3.520                 1.0
159              P      23.9    101.    120.    130.
160              T                                                -1-90.
161              W2     1.326
162              X              1.0
163              K      4       19                                      1
164              KT TOTAL INFLOW HYDROGRAPH TO C-2 (COMBINE FROM EAST & WEST ARMS)
165              K      1       20                                      1
166              KT ROUTING THROUGH STRUCTURE C-2 (NO.ID.810614)
167              Y                                   1       1
168              Y1     1                                        -906.3          -1
169              Y4906.3 906.8  907.3   908.3   910.3   917.    920.4   920.9   921.4   922.4
170              Y4923.4 924.4  925.4   926.4   927.4   928.4   929.    930.    931.
171              Y50.0  31.     84.     209.    259.    342.    362.    563.    720.    1520.
172              Y52660. 4000.  5760.   7570.   9820.   12010.  13210.  16110.  19020.
173              S50.0  120.    168.    300.    462.    1098.   2010.   2700.   3420.   8850.
174              SE885. 897.    900.    904.    907.    909.    920.    924.    927.    940.0
175              S$906.3
176              S$928.3
177              S10.0  60.     270.    540.    590.    890.    1150.   1390.   1420.   1435.
178              SV928.3 928.6  928.9   929.2   929.3   929.4   929.5   929.6   930.4   933.7
179              K      99
180              A
181              A
182              A
183              A
184              A
```

86.2	86.2	86.2	86.2	86.2	86.2	86.2	86.3	86.3	86.3
	.3	.5	86.3	86.	86			.4	6.5
86.6	86.6	86.7	86.8	87.0	87.1	87.2	87.3	87.5	87.6
87.7	87.8	88.0	88.0	88.1	88.1	88.2	88.2	88.3	88.3

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-1V TIME 17:48:24 CASE C2

88.3	88.4	88.4	88.4	88.5	88.5	88.5	88.6	88.6	88.6
88.7	88.7	88.7	88.7	88.8	88.8	88.9	89.1	89.4	89.8
90.2	90.5	90.8	90.9	90.9	90.9	90.9	91.0	91.0	91.0
90.9	90.9	90.8	90.6	90.5	90.4	90.3	90.2	90.0	89.9
89.8	89.7	89.5	89.4	89.4	89.3	89.2	89.1	89.1	89.0
88.9	88.8	88.7	88.6	88.5	88.4	88.4	88.3	88.2	88.1
88.1	88.0	87.9	87.8	87.7	87.5	87.4	87.3	87.2	87.1
87.0	86.9	86.8	86.8	86.7	86.6	86.6	86.5	86.4	86.4
86.3	86.3	86.2	86.2	86.1	86.1	86.1	86.0	86.0	86.0
85.9	85.9	85.9	85.9	85.8	85.8	85.8	85.8	85.8	85.7
85.7	85.7	85.7	85.7	85.7	85.7	85.7	85.6	85.6	85.6
85.6	85.6	85.6	85.6	85.6	85.6	85.6	85.6		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2024.	1037.	317.	317.	91346.
CMS	57.	29.	9.	9.	2587.
INCHES		24.86	30.42	30.42	30.42
MM		631.40	772.59	772.59	772.59
AC-FT		514.	629.	629.	629.
THOUS CU M		634.	776.	776.	776.

MAXIMUM STORAGE = 145.

MAXIMUM STAGE IS 91.0

SUB-AREA RUNOFF COMPUTATION

CALCULATE INFLOW HYDROGRAPH TO UNCONTROLLED AREA OF EAST ARM OF C-2

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
18	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	3.52	.00	3.52	1.00	.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
.00	23.90	101.00	120.00	130.00	.00	.00	.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSPX	RTIMP
0	.00	.00	1.00	.00	.00	1.00	-1.00	-90.00	.00	.00

CURVE NO = -90.00 WETNESS = -1.00 EFFECT CN = 90.00

UNIT HYDROGRAPH DATA

Tc= .00 LAG= 1.33

RECESSION DATA
STRTQ= .00 QRCSN= .00 RTIOR= 1.00

UNIT HYDROGRAPH 82 END OF PERIOD ORDINATES, TC= .00 HOURS, LAG= 1.33 VOL= 1.00

27.	56.	109.	173.	243.	334.	438.	559.	698.	839.	
966.	1062.	1145.	1195.	1232.	1239.	1238.	1231.	1187.	1139.	
1086.	1028.	967.	892.	810.	719.	640.	566.	513.	464.	
418.	379.	343.	315.	288.	260.	237.	214.	191.	173.	
158.	143.	129.	118.	107.	95.	87.	79.	70.	64.	
58.	53.	48.	44.	39.	35.	32.	29.	26.	24.	
22.	19.	18.	16.	15.	13.	12.	12.	11.	10.	
9.	8.	7.	6.	5.	5.	4.	3.	2.	2.	
1.	0.									

0 END-OF-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	.00	.01	0.	1.01	12.05	145	.20	.20	.01	1633.
1.01	.10	2	.01	.00	.01	0.	1.01	12.10	146	.20	.20	.01	1643.
1.01	.15	3	.01	.00	.01	0.	1.01	12.15	147	.20	.20	.01	1661.
1.01	.20	4	.01	.00	.01	0.	1.01	12.20	148	.20	.20	.00	1686.
1.01	.25	5	.01	.00	.01	0.	1.01	12.25	149	.20	.20	.00	1721.
1.01	.30	6	.01	.00	.01	0.	1.01	12.30	150	.20	.20	.00	1768.
1.01	.35	7	.01	.00	.01	0.	1.01	12.35	151	.20	.20	.00	1829.
1.01	.40	8	.01	.00	.01	0.	1.01	12.40	152	.20	.20	.00	1906.
1.01	.45	9	.01	.00	.01	0.	1.01	12.45	153	.20	.20	.00	2002.
1.01	.50	10	.01	.00	.01	0.	1.01	12.50	154	.20	.20	.00	2117.
1.01	.55	11	.01	.00	.01	0.	1.01	12.55	155	.20	.20	.00	2248.
1.01	1.00	12	.01	.00	.01	0.	1.01	13.00	156	.20	.20	.00	2393.
1.01	1.05	13	.01	.00	.01	0.	1.01	13.05	157	.24	.24	.00	2550.
1.01	1.10	14	.01	.00	.01	0.	1.01	13.10	158	.24	.24	.00	2716.
1.01	1.15	15	.01	.00	.01	0.	1.01	13.15	159	.24	.24	.00	2886.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.20	160	.24	.24	.00	3065.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.24	.24	.00	3244.
1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.24	.24	.00	3426.
1.01	1.35	19	.01	.00	.01	0.	1.01	13.35	163	.24	.24	.00	3607.
1.01	1.40	20	.01	.00	.01	0.	1.01	13.40	164	.24	.24	.00	3785.
1.01	1.45	21	.01	.00	.01	0.	1.01	13.45	165	.24	.24	.00	3963.
1.01	1.50	22	.01	.00	.01	0.	1.01	13.50	166	.24	.24	.00	4138.
1.01	1.55	23	.01	.00	.01	1.	1.01	13.55	167	.24	.24	.00	4310.
1.01	2.00	24	.01	.00	.01	1.	1.01	14.00	168	.24	.24	.00	4476.
1.01	2.05	25	.01	.00	.01	2.	1.01	14.05	169	.30	.30	.00	4636.
1.01	2.10	26	.01	.00	.01	2.	1.01	14.10	170	.30	.30	.00	4786.
1.01	2.15	27	.01	.00	.01	3.	1.01	14.15	171	.30	.30	.00	4933.
1.01	2.20	28	.01	.00	.01	4.	1.01	14.20	172	.30	.30	.00	5073.
1.01	2.25	29	.01	.00	.01	6.	1.01	14.25	173	.30	.30	.00	5210.
1.01	2.30	30	.01	.00	.01	8.	1.01	14.30	174	.30	.30	.00	5345.
1.01	2.35	31	.01	.00	.01	10.	1.01	14.35	175	.30	.30	.00	5478.
1.01	2.40	32	.01	.00	.01	12.	1.01	14.40	176	.30	.30	.00	5612.
1.01	2.45	33	.01	.00	.01	15.	1.01	14.45	177	.30	.30	.00	5747.
1.01	2.50	34	.01	.00	.01	18.	1.01	14.50	178	.30	.30	.00	5884.
1.01	2.55	35	.01	.00	.01	21.	1.01	14.55	179	.30	.30	.00	6022.
1.01	3.00	36	.01	.00	.01	25.	1.01	15.00	180	.30	.30	.00	6159.
1.01	3.05	37	.01	.00	.01	29.	1.01	15.05	181	.18	.18	.00	6293.
1.01	3.10	38	.01	.00	.01	33.	1.01	15.10	182	.37	.37	.00	6423.
1.01	3.15	39	.01	.00	.01	37.	1.01	15.15	183	.37	.37	.00	6548.

1.01	3.20	40	.01	.01	.01	41.	1.01	15.20	184	.55	.55	.00	6675.
1.01	3.25	41	.01	.01	.01	44.	1.01	15.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[redacted]													
1.01	3.10	38	.01	.00	.01	33.	1.01	15.10	182	.37	.37	.00	6423.
1.01	3.15	39	.01	.00	.01	37.	1.01	15.15	183	.37	.37	.00	6548.

1.01	3.20	40	.01	.01	.01	41.	1.01	15.20	184	.55	.55	.00	6675.
1.01	3.25	41	.01	.01	.01	46.	1.01	15.25	185	.64	.64	.00	6810.
1.01	3.30	42	.01	.01	.01	50.	1.01	15.30	186	1.56	1.55	.01	6975.
1.01	3.35	43	.01	.01	.01	55.	1.01	15.35	187	2.57	2.56	.01	7209.
1.01	3.40	44	.01	.01	.01	60.	1.01	15.40	188	1.01	1.01	.00	7506.
1.01	3.45	45	.01	.01	.01	65.	1.01	15.45	189	.64	.64	.00	7878.
1.01	3.50	46	.01	.01	.01	69.	1.01	15.50	190	.55	.55	.00	8311.
1.01	3.55	47	.01	.01	.01	74.	1.01	15.55	191	.37	.37	.00	8808.
1.01	4.00	48	.01	.01	.01	79.	1.01	16.00	192	.37	.37	.00	9389.
1.01	4.05	49	.01	.01	.01	84.	1.01	16.05	193	.28	.28	.00	10042.
1.01	4.10	50	.01	.01	.01	89.	1.01	16.10	194	.28	.28	.00	10764.
1.01	4.15	51	.01	.01	.01	93.	1.01	16.15	195	.28	.28	.00	11532.
1.01	4.20	52	.01	.01	.01	98.	1.01	16.20	196	.28	.28	.00	12283.
1.01	4.25	53	.01	.01	.01	102.	1.01	16.25	197	.28	.28	.00	12958.
1.01	4.30	54	.01	.01	.01	107.	1.01	16.30	198	.28	.28	.00	13536.
1.01	4.35	55	.01	.01	.01	111.	1.01	16.35	199	.28	.28	.00	14002.
1.01	4.40	56	.01	.01	.01	116.	1.01	16.40	200	.28	.28	.00	14331.
1.01	4.45	57	.01	.01	.01	120.	1.01	16.45	201	.28	.28	.00	14545.
1.01	4.50	58	.01	.01	.01	124.	1.01	16.50	202	.28	.28	.00	14637.
1.01	4.55	59	.01	.01	.01	129.	1.01	16.55	203	.28	.28	.00	14648.
1.01	5.00	60	.01	.01	.01	133.	1.01	17.00	204	.28	.28	.00	14570.
1.01	5.05	61	.01	.01	.01	137.	1.01	17.05	205	.22	.22	.00	14380.
1.01	5.10	62	.01	.01	.01	141.	1.01	17.10	206	.22	.22	.00	14133.
1.01	5.15	63	.01	.01	.01	144.	1.01	17.15	207	.22	.22	.00	13836.
1.01	5.20	64	.01	.01	.01	148.	1.01	17.20	208	.22	.22	.00	13496.
1.01	5.25	65	.01	.01	.01	152.	1.01	17.25	209	.22	.22	.00	13111.
1.01	5.30	66	.01	.01	.01	156.	1.01	17.30	210	.22	.22	.00	12672.
1.01	5.35	67	.01	.01	.01	159.	1.01	17.35	211	.22	.22	.00	12195.
1.01	5.40	68	.01	.01	.01	163.	1.01	17.40	212	.22	.22	.00	11694.
1.01	5.45	69	.01	.01	.01	166.	1.01	17.45	213	.22	.22	.00	11224.
1.01	5.50	70	.01	.01	.00	169.	1.01	17.50	214	.22	.22	.00	10784.
1.01	5.55	71	.01	.01	.00	172.	1.01	17.55	215	.22	.22	.00	10395.
1.01	6.00	72	.01	.01	.00	176.	1.01	18.00	216	.22	.22	.00	10036.
1.01	6.05	73	.06	.04	.02	180.	1.01	18.05	217	.02	.02	.00	9699.
1.01	6.10	74	.06	.04	.02	184.	1.01	18.10	218	.02	.02	.00	9385.
1.01	6.15	75	.06	.04	.02	191.	1.01	18.15	219	.02	.02	.00	9085.
1.01	6.20	76	.06	.04	.02	200.	1.01	18.20	220	.02	.02	.00	8800.
1.01	6.25	77	.06	.05	.02	211.	1.01	18.25	221	.02	.02	.00	8512.
1.01	6.30	78	.06	.05	.02	225.	1.01	18.30	222	.02	.02	.00	8216.
1.01	6.35	79	.06	.05	.02	243.	1.01	18.35	223	.02	.02	.00	7918.
1.01	6.40	80	.06	.05	.01	266.	1.01	18.40	224	.02	.02	.00	7606.
1.01	6.45	81	.06	.05	.01	293.	1.01	18.45	225	.02	.02	.00	7278.
1.01	6.50	82	.06	.05	.01	326.	1.01	18.50	226	.02	.02	.00	6942.
1.01	6.55	83	.06	.05	.01	363.	1.01	18.55	227	.02	.02	.00	6597.
1.01	7.00	84	.06	.05	.01	405.	1.01	19.00	228	.02	.02	.00	6242.
1.01	7.05	85	.06	.05	.01	456.	1.01	19.05	229	.02	.02	.00	5885.
1.01	7.10	86	.06	.05	.01	498.	1.01	19.10	230	.02	.02	.00	5531.
1.01	7.15	87	.06	.05	.01	548.	1.01	19.15	231	.02	.02	.00	5179.
1.01	7.20	88	.06	.05	.01	599.	1.01	19.20	232	.02	.02	.00	4836.
1.01	7.25	89	.06	.05	.01	651.	1.01	19.25	233	.02	.02	.00	4504.
1.01	7.30	90	.06	.05	.01	704.	1.01	19.30	234	.02	.02	.00	4179.
1.01	7.35	91	.06	.05	.01	755.	1.01	19.35	235	.02	.02	.00	3871.
1.01	7.40	92	.06	.05	.01	806.	1.01	19.40	236	.02	.02	.00	3580.
1.01	7.45	93	.06	.06	.01	856.	1.01	19.45	237	.02	.02	.00	3306.
1.01	7.50	94	.06	.06	.01	904.	1.01	19.50	238	.02	.02	.00	3049.
1.01	7.55	95	.06	.06	.01	950.	1.01	19.55	239	.02	.02	.00	2808.

1.01	8.00	96	.06	.06	.01	994.	1.01	20.00	240	.02	.02	.00	2556.
1.01	8.05	97	.06	.06	.01	1035.	1.01	20.05	241	.02	.02	.00	2386.
1.01	8.10	98	.06	.06	.01	1074.	1.01	20.10	242	.02	.02	.00	2207.
1.01	8.15	99	.06	.06	.01	1110.	1.01	20.15	243	.02	.02	.00	2044.
1.01	8.20	100	.06	.06	.01	1143.	1.01	20.20	244	.02	.02	.00	1906.
1.01	8.25	101	.06	.06	.01	1173.	1.01	20.25	245	.02	.02	.00	1777.
1.01	8.30	102	.06	.06	.01	1202.	1.01	20.30	246	.02	.02	.00	1660.
1.01	8.35	103	.06	.06	.01	1230.	1.01	20.35	247	.02	.02	.00	1555.
1.01	8.40	104	.06	.06	.01	1255.	1.01	20.40	248	.02	.02	.00	1459.
1.01	8.45	105	.06	.06	.01	1279.	1.01	20.45	249	.02	.02	.00	1373.
1.01	8.50	106	.06	.06	.00	1301.	1.01	20.50	250	.02	.02	.00	1294.
1.01	8.55	107	.06	.06	.00	1323.	1.01	20.55	251	.02	.02	.00	1223.
1.01	9.00	108	.06	.06	.00	1343.	1.01	21.00	252	.02	.02	.00	1156.
1.01	9.05	109	.06	.06	.00	1361.	1.01	21.05	253	.02	.02	.00	1100.
1.01	9.10	110	.06	.06	.00	1379.	1.01	21.10	254	.02	.02	.00	1047.
1.01	9.15	111	.06	.06	.00	1395.	1.01	21.15	255	.02	.02	.00	1000.
1.01	9.20	112	.06	.06	.00	1411.	1.01	21.20	256	.02	.02	.00	956.
1.01	9.25	113	.06	.06	.00	1425.	1.01	21.25	257	.02	.02	.00	916.
1.01	9.30	114	.06	.06	.00	1439.	1.01	21.30	258	.02	.02	.00	880.
1.01	9.35	115	.06	.06	.00	1451.	1.01	21.35	259	.02	.02	.00	846.
1.01	9.40	116	.06	.06	.00	1464.	1.01	21.40	260	.02	.02	.00	815.
1.01	9.45	117	.06	.06	.00	1475.	1.01	21.45	261	.02	.02	.00	787.
1.01	9.50	118	.06	.06	.00	1486.	1.01	21.50	262	.02	.02	.00	762.
1.01	9.55	119	.06	.06	.00	1496.	1.01	21.55	263	.02	.02	.00	738.
1.01	10.00	120	.06	.06	.00	1505.	1.01	22.00	264	.02	.02	.00	717.
1.01	10.05	121	.06	.06	.00	1514.	1.01	22.05	265	.02	.02	.00	697.
1.01	10.10	122	.06	.06	.00	1522.	1.01	22.10	266	.02	.02	.00	679.
1.01	10.15	123	.06	.06	.00	1530.	1.01	22.15	267	.02	.02	.00	662.
1.01	10.20	124	.06	.06	.00	1538.	1.01	22.20	268	.02	.02	.00	648.
1.01	10.25	125	.06	.06	.00	1545.	1.01	22.25	269	.02	.02	.00	636.
1.01	10.30	126	.06	.06	.00	1552.	1.01	22.30	270	.02	.02	.00	626.
1.01	10.35	127	.06	.06	.00	1558.	1.01	22.35	271	.02	.02	.00	617.
1.01	10.40	128	.06	.06	.00	1564.	1.01	22.40	272	.02	.02	.00	609.
1.01	10.45	129	.06	.06	.00	1570.	1.01	22.45	273	.02	.02	.00	602.
1.01	10.50	130	.06	.06	.00	1575.	1.01	22.50	274	.02	.02	.00	595.
1.01	10.55	131	.06	.06	.00	1580.	1.01	22.55	275	.02	.02	.00	589.
1.01	11.00	132	.06	.06	.00	1585.	1.01	23.00	276	.02	.02	.00	584.
1.01	11.05	133	.06	.06	.00	1590.	1.01	23.05	277	.02	.02	.00	579.
1.01	11.10	134	.06	.06	.00	1594.	1.01	23.10	278	.02	.02	.00	575.
1.01	11.15	135	.06	.06	.00	1598.	1.01	23.15	279	.02	.02	.00	571.
1.01	11.20	136	.06	.06	.00	1602.	1.01	23.20	280	.02	.02	.00	568.
1.01	11.25	137	.06	.06	.00	1606.	1.01	23.25	281	.02	.02	.00	564.
1.01	11.30	138	.06	.06	.00	1609.	1.01	23.30	282	.02	.02	.00	561.
1.01	11.35	139	.06	.06	.00	1613.	1.01	23.35	283	.02	.02	.00	559.
1.01	11.40	140	.06	.06	.00	1616.	1.01	23.40	284	.02	.02	.00	556.
1.01	11.45	141	.06	.06	.00	1619.	1.01	23.45	285	.02	.02	.00	554.
1.01	11.50	142	.06	.06	.00	1622.	1.01	23.50	286	.02	.02	.00	552.
1.01	11.55	143	.06	.06	.00	1625.	1.01	23.55	287	.02	.02	.00	551.
1.01	12.00	144	.06	.06	.00	1628.	1.02	.00	288	.02	.02	.00	549.
									SUM	31.07	29.78	1.29	800254.
										(789.)	(756.)	(33.)	(22660.67)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	14648.	8477.	2778.	2778.	799577.
CMS	415.	240.	79.	79.	22653.

INCHES	22.60	29.36	29.36	29.36	

		[illegible]	[illegible]UR	[illegible]OUR	[illegible]AL [illegible]
CFS	14648.	8477.	2778.	2778.	799577.
CMS	415.	240.	79.	79.	22653.

INCHES	22.40	29.36	29.36		29.36
MM	569.03	745.81	745.81		745.81
AC-FT	4204.	5509.	5509.		5509.
THOUS CU M	5185.	6796.	6796.		6796.

HYDROGRAPH AT STA 18 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.	1.	1.	1.
1.	2.	2.	3.	3.	4.	4.	5.	6.	6.
7.	8.	8.	9.	10.	10.	11.	12.	13.	13.
14.	15.	15.	16.	17.	17.	18.	19.	19.	20.
20.	21.	22.	22.	23.	23.	24.	24.	25.	25.
26.	26.	27.	28.	29.	30.	32.	34.	36.	40.
44.	49.	54.	61.	68.	75.	82.	90.	98.	106.
113.	121.	128.	136.	143.	149.	155.	161.	166.	171.
176.	180.	184.	188.	192.	195.	199.	201.	204.	207.
209.	212.	214.	216.	218.	220.	221.	223.	224.	226.
227.	228.	230.	231.	232.	233.	234.	235.	235.	236.
237.	238.	238.	239.	240.	240.	241.	241.	242.	242.
243.	243.	244.	244.	245.	247.	249.	253.	258.	265.
274.	284.	296.	310.	327.	359.	387.	407.	437.	460.
487.	514.	541.	568.	594.	621.	647.	671.	695.	718.
740.	761.	781.	802.	822.	842.	862.	883.	903.	924.
944.	963.	982.	1001.	1021.	1046.	1081.	1126.	1182.	1247.
1321.	1402.	1506.	1615.	1730.	1842.	1944.	2031.	2100.	2159.
2182.	2198.	2197.	2186.	2157.	2120.	2075.	2024.	1967.	1901.
1825.	1755.	1684.	1617.	1559.	1505.	1455.	1408.	1363.	1320.
1277.	1232.	1189.	1149.	1092.	1041.	993.	936.	883.	830.
777.	725.	676.	627.	581.	537.	496.	457.	421.	387.
358.	331.	307.	286.	266.	249.	233.	219.	206.	194.
183.	174.	165.	157.	150.	143.	137.	132.	127.	122.
118.	114.	111.	108.	105.	102.	99.	97.	95.	94.
93.	91.	90.	89.	88.	88.	87.	86.	86.	85.
85.	84.	84.	83.	83.	83.	83.	82.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2197.	1272.	417.	417.	119997.
CMS	62.	36.	12.	12.	3398.
INCHES		3.36	4.40	4.40	4.40
MM		85.35	111.87	111.87	111.87
AC-FT		831.	826.	826.	826.
THOUS CU M		778.	1019.	1019.	1019.

HYDROGRAPH AT STA 1R 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.	1.	1.	1.	2.
2.	2.	3.	4.	4.	5.	6.	7.	7.	8.
9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
19.	20.	20.	21.	22.	23.	24.	25.	26.	27.
27.	28.	29.	30.	30.	31.	32.	33.	33.	34.

HYDROGRAPH AT STA 18 FOR PLAN 1, RTIO 9

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/C2-1V TIME 17:48:24 CASE C2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	1.	1.	2.	2.	3.	4.	6.	8.
10.	12.	15.	18.	21.	25.	29.	33.	37.	41.
46.	50.	55.	60.	65.	69.	74.	79.	84.	89.
93.	98.	102.	107.	111.	116.	120.	124.	129.	133.
137.	141.	144.	149.	152.	156.	159.	163.	166.	169.
172.	176.	180.	184.	191.	200.	211.	225.	243.	266.
293.	326.	363.	405.	450.	498.	548.	599.	651.	704.
755.	806.	856.	904.	950.	994.	1035.	1074.	1110.	1143.
1173.	1202.	1230.	1255.	1279.	1301.	1323.	1343.	1361.	1379.
1395.	1411.	1425.	1439.	1451.	1464.	1475.	1486.	1496.	1505.
1514.	1522.	1533.	1538.	1545.	1552.	1558.	1564.	1570.	1575.
1580.	1585.	1590.	1594.	1598.	1602.	1606.	1609.	1613.	1616.
1619.	1622.	1625.	1628.	1637.	1643.	1661.	1686.	1721.	1768.
1829.	1906.	2002.	2117.	2249.	2393.	2550.	2716.	2888.	3065.
3244.	3424.	3607.	3785.	3963.	4138.	4310.	4476.	4636.	4788.
4937.	5079.	5210.	5345.	5478.	5612.	5747.	5884.	6027.	6159.
6297.	6423.	6548.	6675.	6810.	6975.	7209.	7506.	7878.	8311.
8809.	9389.	10042.	10764.	11532.	12283.	12958.	13538.	14002.	14331.
14545.	14657.	14669.	14570.	14380.	14133.	13836.	13496.	13111.	12672.
12195.	11699.	11224.	10784.	10355.	10038.	9699.	9385.	9085.	8800.
8517.	8216.	7919.	7656.	7279.	6942.	6597.	6242.	5885.	5531.
5179.	4836.	4504.	4179.	3871.	3580.	3306.	3049.	2808.	2588.
2386.	2207.	2048.	1906.	1777.	1660.	1555.	1459.	1373.	1294.
1223.	1158.	1100.	1047.	1000.	956.	916.	880.	846.	815.
787.	762.	738.	717.	697.	679.	662.	648.	636.	626.
617.	609.	602.	595.	589.	584.	579.	575.	571.	568.
564.	561.	559.	556.	554.	552.	551.	549.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	14648.	8477.	2778.	2778.	799977.
CMS	415.	240.	79.	79.	22653.
INCHES		22.40	29.36	29.36	29.36
MM		569.09	745.81	745.81	745.81
AC-FT		4204.	5509.	5509.	5509.
THOUS CU M		5185.	6796.	6796.	6796.

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COMBINE HYDROGRAPHS

TOTAL INFLOW HYDROGRAPH TO C-2 (COMBINE FROM EAST & WEST ARMS)

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
19	4	0	0	0	0	1	0	0

SUM OF 4 HYDROGRAPHS AT 19 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.	1.	1.	1.	2.	2.	3.	4.	5.

SUM OF 4 HYDROGRAPHS AT 19 PLAN 1 RTIO 5

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	2.	3.	4.	6.	7.	9.	12.

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-1V TIME 17:48:24 CASE C2

14.	17.	20.	23.	26.	29.	32.	35.	39.	42.
46.	49.	53.	56.	60.	63.	67.	70.	74.	77.
81.	84.	87.	91.	94.	97.	100.	103.	106.	109.
112.	115.	118.	120.	123.	126.	128.	131.	133.	136.
138.	141.	144.	150.	159.	172.	191.	216.	246.	279.
316.	355.	395.	435.	474.	512.	549.	585.	620.	653.
685.	716.	745.	772.	798.	823.	846.	867.	886.	904.
921.	937.	952.	966.	979.	991.	1001.	1014.	1024.	1034.
1043.	1052.	1060.	1068.	1076.	1083.	1089.	1096.	1102.	1107.
1113.	1119.	1124.	1129.	1134.	1138.	1143.	1147.	1152.	1156.
1160.	1165.	1169.	1174.	1178.	1183.	1187.	1192.	1196.	1201.
1206.	1210.	1214.	1219.	1223.	1245.	1275.	1324.	1394.	1486.
1595.	1716.	1845.	1977.	2110.	2241.	2369.	2489.	2607.	2723.
2842.	2963.	3086.	3207.	3328.	3446.	3561.	3676.	3788.	3900.
4012.	4130.	4255.	4389.	4529.	4677.	4828.	4981.	5131.	5276.
5419.	5562.	5662.	5769.	5918.	6119.	6476.	7053.	7897.	9770.
12535.	12162.	13655.	14831.	15768.	16555.	17229.	16006.	18784.	19466.
19977.	19616.	18777.	17639.	16621.	15332.	14309.	13403.	12592.	11869.
11121.	10488.	9935.	9433.	8993.	8603.	8245.	7919.	7598.	7273.
6916.	6534.	6129.	5714.	5369.	4912.	4532.	4172.	3841.	3552.
3287.	3044.	2821.	2613.	2422.	2249.	2092.	1947.	1815.	1694.
1585.	1487.	1400.	1322.	1252.	1188.	1130.	1077.	1030.	989.
950.	915.	883.	853.	826.	801.	778.	757.	737.	719.
702.	687.	672.	659.	646.	634.	624.	614.	605.	597.
590.	583.	577.	572.	566.	561.	557.	553.	549.	545.
542.	538.	535.	532.	530.	527.	525.	523.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19873.	8463.	2638.	2638.	759880.
CMS	563.	240.	75.	75.	21517.
INCHES		8.64	10.78	10.78	10.78
MM		219.47	273.70	273.70	273.70
AC-FT		4196.	5233.	5233.	5233.
THOUS CU M		5176.	6455.	6455.	6455.

SUM OF 4 HYDROGRAPHS AT 19 PLAN 1 RTIO 6

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	1.	2.	3.	5.	6.	9.	11.	13.
14.	19.	22.	26.	29.	33.	37.	40.	44.	48.
52.	56.	60.	64.	69.	73.	77.	81.	84.	88.
92.	96.	100.	103.	107.	111.	114.	118.	121.	125.
128.	131.	134.	138.	141.	144.	147.	150.	152.	155.
158.	161.	165.	171.	181.	196.	218.	247.	281.	319.
361.	406.	451.	497.	542.	586.	628.	668.	707.	745.
780.	814.	847.	877.	906.	933.	958.	982.	1004.	1024.
1043.	1061.	1078.	1093.	1108.	1122.	1135.	1147.	1159.	1170.
1180.	1190.	1200.	1209.	1217.	1225.	1233.	1240.	1247.	1254.
1261.	1267.	1274.	1280.	1286.	1293.	1299.	1305.	1311.	1317.
1323.	1329.	1335.	1341.	1347.	1352.	1358.	1363.	1369.	1374.
1380.	1385.	1390.	1396.	1406.	1427.	1462.	1517.	1598.	1702.
1827.	1964.	2111.	2263.	2415.	2564.	2709.	2849.	2986.	3123.
3264.	3409.	3556.	3708.	3859.	4010.	4159.	4303.	4445.	4584.

4729.	4860.	5039.	5207.	5379.	5555.	5735.	5912.	6087.	6269.
6400.	6540.	6671.	6835.	6969.	7244.	7760.	8591.	9802.	11486.
13595.	15758.	17695.	19241.	20465.	21543.	21960.	22087.	22054.	21974.
21782.	20452.	19324.	18133.	17019.	15995.	15059.	14262.	13587.	12768.
12068.	11424.	10866.	10363.	9921.	9525.	9162.	8827.	8492.	8139.
7749.	7322.	6869.	6402.	5945.	5507.	5086.	4685.	4314.	3987.
3686.	3413.	3162.	2929.	2714.	2518.	2339.	2177.	2028.	1893.
1770.	1661.	1563.	1476.	1397.	1325.	1261.	1202.	1149.	1100.
1056.	1018.	982.	949.	919.	892.	866.	843.	821.	801.
783.	766.	750.	735.	721.	708.	697.	686.	677.	668.
661.	654.	647.	641.	635.	630.	625.	621.	617.	613.
610.	606.	603.	600.	598.	595.	593.	591.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	22087.	9727.	3624.	3024.	870771.
CMS	625.	275.	86.	86.	24658.
INCHES		9.93	12.35	12.35	12.35
MM		252.24	313.64	313.64	313.64
AC-FT		4823.	5997.	5997.	5997.
THOUS CU M		5949.	7397.	7397.	7397.

SUM OF 4 HYDROGRAPHS AT 19 PLAN 1 RTIO 7

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	2.	4.	5.	7.	10.	12.	15.
19.	22.	25.	29.	33.	37.	41.	45.	50.	54.
59.	63.	68.	73.	77.	82.	86.	91.	95.	99.
104.	108.	112.	116.	121.	125.	129.	132.	136.	140.
144.	148.	151.	155.	158.	162.	165.	168.	171.	175.
178.	181.	185.	192.	204.	221.	245.	277.	316.	359.
407.	457.	508.	559.	610.	659.	705.	750.	797.	834.
874.	911.	947.	980.	1012.	1042.	1071.	1097.	1121.	1143.
1165.	1184.	1202.	1220.	1237.	1252.	1267.	1280.	1293.	1305.
1317.	1328.	1339.	1349.	1359.	1368.	1377.	1386.	1395.	1404.
1412.	1421.	1428.	1437.	1445.	1453.	1460.	1468.	1475.	1483.
1490.	1497.	1504.	1511.	1518.	1525.	1532.	1538.	1545.	1551.
1557.	1563.	1569.	1574.	1586.	1609.	1648.	1710.	1799.	1917.
2058.	2211.	2376.	2547.	2719.	2890.	3059.	3221.	3381.	3547.
3718.	3897.	4079.	4262.	4446.	4628.	4817.	4993.	5168.	5338.
5506.	5682.	5865.	6055.	6249.	6446.	6643.	6843.	7049.	7272.
7528.	7826.	8174.	8586.	9059.	9796.	10761.	12039.	13677.	15751.
17948.	19832.	21156.	21976.	22534.	22964.	23124.	23267.	23266.	22985.
21998.	20785.	19688.	18551.	17534.	16595.	15762.	15019.	14297.	13563.
12906.	12274.	11716.	11218.	10780.	10366.	10024.	9683.	9336.	8965.
8548.	8087.	7596.	7086.	6572.	6087.	5625.	5184.	4772.	4405.
4070.	3768.	3490.	3232.	2996.	2779.	2581.	2398.	2234.	2085.
1950.	1830.	1723.	1627.	1540.	1461.	1390.	1326.	1267.	1214.
1165.	1121.	1082.	1046.	1014.	984.	957.	931.	908.	884.
867.	848.	831.	815.	800.	787.	774.	763.	753.	744.
735.	728.	721.	715.	709.	703.	698.	693.	689.	685.
681.	678.	675.	672.	669.	666.	664.	661.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25286.	10879.	3384.	3384.	974524.

[illegible]	[illegible]	71.	715.	709.	707.	698.	693.	689.	685.
[illegible]	[illegible]	65.	672.	669.	66[illegible]	6[illegible]	[illegible]		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	23286.	10889.	3384.	3384.	974524.
CMS	659.	308.	96.	96.	27595.
INCHES		11.12	13.82	13.82	13.82
MM		282.38	351.01	351.01	351.01
AC-FT		5399.	6712.	6712.	6712.
THOUS CU M		6660.	8279.	8279.	8279.

SUM OF 4 HYDROGRAPHS AT 19 PLAN 1 RTIO 8

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	1.	2.	3.	4.	6.	8.	11.	14.	17.
20.	24.	28.	32.	37.	41.	46.	51.	55.	60.
65.	70.	75.	81.	86.	91.	96.	101.	106.	110.
115.	120.	125.	129.	134.	138.	143.	147.	151.	156.
160.	164.	168.	172.	176.	180.	183.	187.	191.	194.
197.	201.	206.	214.	227.	246.	273.	308.	351.	399.
452.	507.	564.	621.	677.	731.	782.	830.	877.	923.
966.	1007.	1046.	1083.	1118.	1151.	1182.	1211.	1237.	1262.
1285.	1307.	1327.	1347.	1365.	1382.	1398.	1413.	1428.	1442.
1455.	1468.	1480.	1492.	1504.	1515.	1526.	1537.	1548.	1558.
1568.	1578.	1587.	1597.	1606.	1615.	1625.	1634.	1642.	1651.
1659.	1668.	1676.	1684.	1691.	1699.	1706.	1713.	1719.	1726.
1732.	1739.	1744.	1750.	1762.	1787.	1830.	1898.	1997.	2128.
2282.	2456.	2642.	2837.	3034.	3231.	3430.	3624.	3816.	4015.
4217.	4428.	4646.	4868.	5090.	5307.	5517.	5723.	5923.	6115.
6307.	6492.	6692.	6904.	7135.	7394.	7702.	8067.	8485.	8958.
9495.	10113.	10786.	11530.	12328.	13192.	14205.	15465.	17067.	19069.
21299.	23325.	24851.	25458.	25453.	25948.	24369.	23508.	22544.	21420.
20741.	19902.	19140.	18430.	17732.	17064.	16419.	15780.	15137.	14493.
13861.	13263.	12709.	12204.	11756.	11353.	10979.	10621.	10256.	9859.
9408.	8906.	8369.	7811.	7248.	6696.	6188.	5704.	5253.	4842.
4474.	4135.	3829.	3545.	3285.	3047.	2830.	2630.	2447.	2282.
2135.	2003.	1886.	1781.	1686.	1600.	1522.	1452.	1388.	1330.
1277.	1229.	1186.	1146.	1110.	1077.	1048.	1021.	996.	973.
951.	932.	913.	896.	880.	866.	852.	840.	829.	820.
811.	803.	796.	789.	782.	777.	771.	766.	762.	757.
753.	750.	746.	743.	740.	737.	735.	733.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	25458.	12048.	3744.	3744.	1078264.
CMS	721.	341.	106.	106.	30533.
INCHES		12.30	15.29	15.29	15.29
MM		312.47	388.38	388.38	388.38
AC-FT		5974.	7426.	7426.	7426.
THOUS CU M		7369.	9160.	9160.	9160.

SUM OF 4 HYDROGRAPHS AT 19 PLAN 1 RTIO 9

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
1.	2.	3.	5.	8.	12.	16.	21.	27.	33.

40.	48.	56.	64.	73.	82.	92.	101.	111.	121.
131.	141.	151.	161.	171.	181.	191.	201.	211.	221.
231.	240.	249.	259.	268.	277.	286.	294.	303.	311.
320.	328.	336.	344.	352.	359.	367.	374.	382.	389.
396.	403.	413.	429.	454.	492.	547.	618.	702.	796.
897.	1003.	1110.	1218.	1324.	1423.	1519.	1611.	1700.	1787.
1869.	1948.	2024.	2098.	2168.	2235.	2298.	2358.	2414.	2467.
2518.	2566.	2612.	2656.	2697.	2737.	2775.	2811.	2846.	2879.
2911.	2941.	2970.	3000.	3029.	3058.	3087.	3116.	3146.	3178.
3209.	3241.	3273.	3307.	3340.	3374.	3407.	3439.	3472.	3506.
3540.	3573.	3604.	3634.	3664.	3694.	3724.	3753.	3781.	3807.
3833.	3858.	3881.	3904.	3939.	4000.	4102.	4262.	4494.	4803.
5179.	5607.	6069.	6605.	7192.	7833.	8532.	9280.	10127.	11112.
12215.	13457.	14786.	16148.	17517.	18830.	19031.	19710.	19993.	19814.
19492.	19167.	18869.	18744.	18764.	18845.	18944.	19052.	19162.	19267.
19397.	19498.	19591.	19709.	19912.	20300.	21457.	23368.	26050.	29475.
33271.	36808.	39767.	41747.	42837.	43125.	42733.	41859.	40591.	39061.
37343.	35122.	34843.	33677.	32544.	31478.	30442.	29426.	28398.	27344.
26292.	25254.	24279.	23386.	22598.	21887.	21224.	20586.	19918.	19183.
18329.	17357.	16288.	15156.	14053.	12985.	11958.	10982.	10082.	9267.
8532.	7867.	7255.	6694.	6179.	5710.	5286.	4902.	4555.	4243.
3962.	3712.	3492.	3295.	3119.	2960.	2817.	2688.	2572.	2467.
2371.	2284.	2206.	2136.	2072.	2014.	1960.	1912.	1867.	1827.
1790.	1756.	1724.	1695.	1669.	1644.	1621.	1601.	1584.	1569.
1555.	1543.	1531.	1521.	1512.	1503.	1495.	1488.	1481.	1475.
1469.	1464.	1459.	1454.	1450.	1446.	1443.	1439.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	43125.	23614.	7348.	7348.	2116358.
CMS	1221.	669.	208.	208.	59929.
INCHES		23.91	30.01	30.01	30.01
MM		607.21	762.28	762.28	762.28
AC-FT		11810.	14575.	14575.	14575.
THOUS CU M		14321.	17979.	17979.	17979.

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HYDROGRAPH ROUTING

ROUTING THROUGH STRUCTURE C-2 (PO.ID.913614)

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
20	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
.0	.000	.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	.000	.000	.000	-900.	-1

STAGE	905.30	906.80	907.30	908.30	910.30	917.00	920.40	920.90	921.40	922.40
	923.40	924.40	925.40	926.40	927.40	928.40	929.00	930.00	931.00	

NSTPS 1 NSTPL 0 LAG 0 AMSKK X ISK 0 STORA -9 ISPRAT

STAGE	906.30	906.80	907.30	908.30	910.30	917.00	920.40	920.90	921.40	922.40
	923.40	924.40	925.40	926.40	927.40	928.40	929.00	930.00	931.00	

FLOW	.00	31.00	84.00	209.00	299.00	342.00	362.00	563.00	720.00	1520.00
	2640.00	4000.00	5760.00	7570.00	9820.00	12010.00	13210.00	16110.00	19020.00	
CAPACITY=	0.	120.	168.	300.	462.	1098.	2010.	2700.	3420.	8850.
ELEVATION=	885.	897.	900.	904.	907.	909.	920.	924.	927.	940.

CREL	SPWID	COSW	EXPW	ELEVL	COQL	CAREA	EXPL
906.3	.9	.0	.0	.0	.0	.0	.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
928.3	.0	.0	0.

CREST LENGTH AT OR BELOW	0.	60.	270.	540.	590.	890.	1150.	1390.	1420.	1435.
ELEVATION	928.3	928.6	928.9	929.2	929.3	929.4	929.5	929.6	930.4	933.7

STATION 26, PLAN 1, RATIO 1

ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 92 SUB-STEP 1 TIME 7.67 HR
ESTIMATED W.S. ELEV 9.068284+02 CONTINUITY BALANCE -1.781836+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 93 SUB-STEP 1 TIME 7.75 HR
ESTIMATED W.S. ELEV 9.068636+02 CONTINUITY BALANCE -3.124330+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 94 SUB-STEP 1 TIME 7.83 HR
ESTIMATED W.S. ELEV 9.068998+02 CONTINUITY BALANCE -5.055556+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 95 SUB-STEP 1 TIME 7.92 HR
ESTIMATED W.S. ELEV 9.069369+02 CONTINUITY BALANCE -7.658159+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 96 SUB-STEP 1 TIME 8.00 HR
ESTIMATED W.S. ELEV 9.069747+02 CONTINUITY BALANCE -1.098257+01

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.	1.	1.	1.	1.	1.
1.	1.	1.	2.	2.	2.	2.	2.	3.	3.
3.	3.	4.	4.	4.	4.	5.	5.	6.	6.
6.	6.	7.	7.	7.	8.	8.	9.	9.	9.
10.	10.	10.	11.	11.	12.	12.	13.	14.	14.
15.	16.	17.	19.	20.	22.	23.	25.	27.	29.
31.	34.	38.	42.	46.	50.	52.	53.	54.	55.
55.	56.	57.	58.	59.	60.	61.	61.	62.	63.
64.	65.	66.	67.	68.	69.	70.	71.	72.	73.
74.	75.	76.	77.	78.	79.	80.	81.	82.	83.
84.	85.	86.	87.	89.	90.	91.	92.	94.	95.
96.	97.	99.	100.	101.	102.	104.	105.	106.	108.
109.	111.	113.	115.	117.	119.	121.	124.	127.	129.
132.	135.	139.	142.	145.	148.	152.	156.	160.	163.
167.	171.	176.	180.	184.	189.	193.	198.	203.	208.
213.	217.	214.	216.	218.	220.	222.	224.	227.	230.
233.	236.	240.	253.	270.	286.	300.	302.	304.	307.

INCHES	6.00	6.78	6.78	6.78
MM	152.31	172.18	172.18	172.18
AC-FT	2912.	3292.	3292.	3292.
THOUS CU M	3592.	4061.	4061.	4061.

STATION 20, PLAN 1, RATIO 6

ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 77 SUB-STEP 1 TIME 6.42 HR
ESTIMATED W.S. ELEV 9.068277+02 CONTINUITY BALANCE -1.261821+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 78 SUB-STEP 1 TIME 6.50 HR
ESTIMATED W.S. ELEV 9.068527+02 CONTINUITY BALANCE -2.032791+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 79 SUB-STEP 1 TIME 6.58 HR
ESTIMATED W.S. ELEV 9.068812+02 CONTINUITY BALANCE -2.317611+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 80 SUB-STEP 1 TIME 6.67 HR
ESTIMATED W.S. ELEV 9.069139+02 CONTINUITY BALANCE -5.418454+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 81 SUB-STEP 1 TIME 6.75 HR
ESTIMATED W.S. ELEV 9.069510+02 CONTINUITY BALANCE -8.760924+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 82 SUB-STEP 1 TIME 6.83 HR
ESTIMATED W.S. ELEV 9.069928+02 CONTINUITY BALANCE -1.389794+01

Evaluation of output and iterations within HEC-1 indicates that the results of this program run were not affected by the lack of convergence within the iterations for the routing through Harrison County Dam C-2.

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.	1.	1.	1.	1.	1.	2.	2.	2.	3.
3.	3.	4.	4.	5.	5.	6.	6.	7.	8.
8.	9.	10.	10.	11.	12.	13.	13.	14.	15.
16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
26.	27.	28.	29.	30.	32.	34.	37.	40.	43.
47.	51.	53.	54.	55.	56.	57.	59.	60.	62.
63.	65.	67.	69.	70.	72.	74.	76.	79.	81.
83.	85.	88.	91.	93.	96.	99.	102.	105.	107.
110.	113.	116.	119.	122.	125.	128.	131.	134.	137.
140.	143.	146.	149.	152.	155.	158.	162.	165.	168.
171.	174.	177.	180.	183.	187.	190.	193.	196.	199.
202.	206.	209.	210.	211.	212.	214.	215.	216.	218.
219.	221.	222.	224.	226.	229.	231.	233.	236.	239.
245.	257.	269.	281.	294.	300.	302.	304.	307.	309.
311.	314.	316.	319.	321.	324.	327.	330.	333.	336.
339.	342.	345.	348.	352.	355.	358.	361.	429.	585.
755.	1195.	1744.	2476.	3364.	4087.	4957.	5799.	6622.	7398.
8248.	8990.	9367.	9727.	10008.	10238.	10426.	10576.	10693.	10780.
10838.	10870.	10886.	10921.	10845.	10805.	10753.	10691.	10619.	10537.
10445.	10342.	10227.	10099.	9960.	9810.	9645.	9472.	9291.	9103.
8905.	8570.	8240.	7915.	7596.	7336.	7091.	6846.	6606.	6371.
6141.	5917.	5701.	5495.	5295.	5101.	4913.	4732.	4557.	4388.
4225.	4068.	3935.	3821.	3711.	3604.	3499.	3378.	3241.	3113.
2990.	2873.	2761.	2655.	2568.	2487.	2409.	2334.	2261.	2192.
2125.	2061.	1999.	1940.	1883.	1828.	1776.	1725.	1677.	1630.
1586.	1543.	1507.	1479.	1451.	1424.	1398.	1373.		

STORAGE

424.	424.	424.	424.	424.	424.	424.	424.	424.	424.

424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
[illegible]	[illegible]	[illegible]	[illegible]	424.	424.	424.	424.	424.	425.

[illegible]	[illegible]	[illegible]	[illegible]	1451	[illegible]	[illegible]	[illegible]	1607.	1630.

STORAGE

424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	425.
425.	425.	425.	425.	425.	425.	426.	426.	426.	426.
427.	427.	428.	428.	428.	429.	429.	430.	430.	431.
431.	432.	433.	433.	434.	435.	435.	436.	437.	437.
438.	439.	440.	441.	441.	442.	443.	444.	445.	446.
447.	448.	448.	449.	450.	451.	453.	454.	456.	457.
459.	462.	464.	467.	470.	474.	478.	482.	486.	491.
495.	500.	506.	511.	517.	523.	529.	535.	541.	548.
554.	561.	568.	576.	581.	589.	595.	603.	610.	617.
625.	632.	639.	647.	654.	662.	669.	677.	685.	692.
700.	708.	716.	723.	731.	739.	747.	755.	763.	771.
779.	786.	794.	802.	810.	818.	826.	834.	843.	851.
859.	867.	875.	883.	891.	900.	908.	917.	926.	936.
947.	958.	971.	984.	999.	1016.	1031.	1048.	1067.	1086.
1107.	1128.	1150.	1173.	1197.	1222.	1248.	1275.	1303.	1332.
1362.	1393.	1425.	1458.	1493.	1528.	1565.	1603.	1642.	1682.
1723.	1765.	1808.	1852.	1897.	1944.	1993.	2047.	2107.	2177.
2259.	2353.	2459.	2571.	2688.	2808.	2926.	3041.	3150.	3253.
3349.	3433.	3507.	3570.	3623.	3667.	3703.	3731.	3754.	3770.
3781.	3787.	3786.	3787.	3783.	3775.	3765.	3753.	3739.	3724.
3706.	3687.	3665.	3640.	3614.	3585.	3555.	3522.	3489.	3454.
3418.	3383.	3347.	3313.	3279.	3245.	3212.	3180.	3148.	3117.
3087.	3057.	3029.	3001.	2973.	2946.	2921.	2896.	2872.	2849.
2827.	2805.	2785.	2764.	2745.	2726.	2708.	2690.	2673.	2656.
2641.	2626.	2612.	2598.	2585.	2573.	2561.	2549.	2538.	2527.
2517.	2507.	2498.	2489.	2480.	2471.	2463.	2456.	2448.	2441.
2434.	2428.	2421.	2415.	2409.	2402.	2398.	2392.		

STAGE

906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.4	906.4	906.4	906.4	906.4	906.4	906.4	906.4	906.4
906.4	906.4	906.5	906.5	906.5	906.5	906.5	906.5	906.5	906.5
906.6	906.6	906.6	906.6	906.6	906.6	906.6	906.7	906.7	906.7
906.7	906.7	906.7	906.8	906.8	906.8	906.8	906.9	906.9	906.9
907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.1	907.1	907.1
907.1	907.1	907.1	907.2	907.2	907.2	907.2	907.2	907.2	907.3
907.3	907.3	907.3	907.4	907.4	907.4	907.4	907.4	907.5	907.5
907.5	907.5	907.6	907.6	907.6	907.6	907.7	907.7	907.7	907.7
907.7	907.8	907.8	907.8	907.8	907.9	907.9	907.9	907.9	908.0
908.0	908.0	908.0	908.1	908.1	908.1	908.1	908.2	908.2	908.2
908.2	908.3	908.3	908.3	908.4	908.4	908.4	908.4	908.5	908.5
908.5	908.6	908.6	908.6	908.7	908.7	908.8	908.8	908.9	909.0
909.1	909.4	909.6	909.9	910.2	910.5	910.8	911.1	911.5	911.8
912.2	912.6	912.9	913.3	913.8	914.2	914.6	915.1	915.6	916.0
916.5	917.0	917.6	918.1	918.6	919.2	919.8	920.2	920.6	921.0
921.4	922.0	922.6	923.3	923.9	924.4	924.9	925.4	925.9	926.3
926.7	927.0	927.2	927.4	927.5	927.6	927.7	927.7	927.8	927.8
927.9	927.9	927.9	927.9	927.9	927.8	927.8	927.8	927.8	927.7
927.7	927.6	927.6	927.5	927.5	927.4	927.3	927.2	927.2	927.1
927.0	926.8	926.7	926.6	926.4	926.3	926.1	926.0	925.9	925.7
925.6	925.5	925.4	925.2	925.1	925.0	924.9	924.8	924.7	924.6
924.5	924.4	924.4	924.3	924.2	924.1	924.0	923.9	923.8	923.7

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-1V TIME 17:48:24 CASE C2

	923.7	923.6	923.5	923.4	923.3	923.3	923.2	923.1	923.1	923.0
	922.9	922.9	922.8	922.8	922.7	922.7	922.6	922.6	922.5	922.5
	922.5	922.4	922.4	922.3	922.3	922.3	922.2	922.2		

PEAK OUTFLOW IS 10880. AT TIME 17.75 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10880.	7105.	2031.	2031.	584989.
CMS	308.	204.	58.	58.	16565.
INCHES		7.35	8.30	8.30	8.30
MM		186.59	210.70	210.70	210.70
AC-FT		3568.	4029.	4029.	4029.
THOUS CU M		4401.	4970.	4970.	4970.

STATION 20, PLAN 1, RATIO 7

ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 74 SUB-STEP 1 TIME 6.17 HR
ESTIMATED W.S. ELEV 9.069250+02 CONTINUITY BALANCE -1.103509+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 75 SUB-STEP 1 TIME 6.25 HR
ESTIMATED W.S. ELEV 9.069418+02 CONTINUITY BALANCE -1.573936+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 76 SUB-STEP 1 TIME 6.33 HR
ESTIMATED W.S. ELEV 9.069609+02 CONTINUITY BALANCE -2.258371+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 77 SUB-STEP 1 TIME 6.42 HR
ESTIMATED W.S. ELEV 9.068925+02 CONTINUITY BALANCE -3.317305+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 78 SUB-STEP 1 TIME 6.50 HR
ESTIMATED W.S. ELEV 9.069201+02 CONTINUITY BALANCE -4.990223+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 79 SUB-STEP 1 TIME 6.58 HR
ESTIMATED W.S. ELEV 9.069517+02 CONTINUITY BALANCE -7.625728+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 80 SUB-STEP 1 TIME 6.67 HR
ESTIMATED W.S. ELEV 9.069878+02 CONTINUITY BALANCE -1.169275+01

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.
1.	1.	1.	1.	1.	2.	2.	2.	3.	3.
3.	4.	4.	5.	5.	6.	7.	7.	8.	9.
9.	10.	11.	12.	13.	13.	14.	15.	16.	17.
18.	19.	20.	21.	22.	23.	24.	25.	27.	28.
29.	30.	32.	34.	36.	38.	41.	44.	47.	51.
53.	54.	55.	56.	57.	58.	60.	61.	63.	65.
66.	68.	70.	72.	74.	77.	79.	81.	83.	86.
89.	92.	95.	98.	101.	104.	107.	110.	114.	117.
120.	123.	127.	130.	133.	137.	140.	143.	147.	150.
153.	157.	160.	164.	167.	171.	174.	178.	181.	185.
188.	192.	195.	199.	202.	206.	209.	210.	212.	213.
214.	216.	217.	218.	220.	221.	222.	224.	225.	227.
229.	230.	232.	235.	237.	239.	247.	257.	269.	281.
293.	300.	302.	304.	306.	308.	311.	313.	316.	318.
321.	324.	327.	330.	333.	336.	338.	343.	346.	349.
353.	356.	360.	362.	481.	611.	749.	1083.	1454.	2007.
2660.	3501.	4195.	5051.	5902.	6753.	7578.	8555.	9244.	9768.

FLOOD HYDROGRAPH PACKAGE - HEC-1 PROGRAM H21/02-1V TIME 17:48:24 CASE C2

10620.	10599.	10942.	11232.	11474.	11672.	11832.	11959.	12051.	12113.
[illegible]									

908.4	908.4	908.5	908.5	908.5	908.6	908.6	908.6	908.7	908.7
908.7	908.8	908.8	908.9	908.9	909.0	909.1	909.4	909.6	909.9
910.2	910.5	910.8	911.1	911.4	911.8	912.1	912.5	912.9	913.3
913.8	914.2	914.6	915.1	915.6	916.1	916.6	917.1	917.7	918.3
918.8	919.5	920.0	920.4	920.7	921.1	921.4	921.9	922.3	922.8
923.4	924.0	924.5	925.0	925.5	925.9	926.4	926.8	927.1	927.4
927.6	927.8	927.9	928.0	928.2	928.2	928.3	928.4	928.4	928.5
928.5	928.5	928.5	928.5	928.4	928.4	928.4	928.4	928.3	928.3
928.2	928.2	928.1	928.0	928.0	927.9	927.8	927.7	927.6	927.5
927.5	927.4	927.3	927.2	927.1	926.9	926.8	926.6	926.4	926.3
926.1	926.0	925.8	925.7	925.6	925.4	925.3	925.2	925.1	925.0
924.9	924.8	924.7	924.6	924.5	924.4	924.3	924.2	924.1	924.1
924.0	923.9	923.8	923.7	923.6	923.5	923.5	923.4	923.3	923.2
923.2	923.1	923.0	923.0	922.9	922.9	922.8	922.8	922.7	922.7
922.6	922.6	922.5	922.5	922.5	922.4	922.4	922.4		

PEAK OUTFLOW IS 12165. AT TIME 17.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12165.	8372.	2379.	2379.	685069.
CMS	344.	237.	67.	67.	19399.
INCHES		8.55	9.71	9.71	9.71
MM		217.12	246.75	246.75	246.75
AC-FT		4152.	4718.	4718.	4718.
THOUS CU M		5121.	5820.	5820.	5820.

STATION 20, PLAN 1, RATIO 8

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.068186+02
PERIOD 71 SUB-STEP 1 TIME 5.92 HR
CONTINUITY BALANCE -1.035757+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.068396+02
PERIOD 72 SUB-STEP 1 TIME 6.00 HR
CONTINUITY BALANCE -1.447757+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.069608+02
PERIOD 73 SUB-STEP 1 TIME 6.08 HR
CONTINUITY BALANCE -1.969779+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.068824+02
PERIOD 74 SUB-STEP 1 TIME 6.17 HR
CONTINUITY BALANCE -2.644393+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.069351+02
PERIOD 75 SUB-STEP 1 TIME 6.25 HR
CONTINUITY BALANCE -3.557978+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.069293+02
PERIOD 76 SUB-STEP 1 TIME 6.33 HR
CONTINUITY BALANCE -4.861579+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.069560+02
PERIOD 77 SUB-STEP 1 TIME 6.42 HR
CONTINUITY BALANCE -6.808237+00

ITERATIVE SOLUTION DID NOT CONVERGE,
ESTIMATED W.S. ELEV 9.069862+02
PERIOD 78 SUB-STEP 1 TIME 6.50 HR
CONTINUITY BALANCE -9.784822+00

Evaluation of output and iterations within HEC-1 indicates that the results of this program run were not affected by the lack of convergence within the iterations for the routing through Harrison County Dam C-2.

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.
1.	1.	1.	1.	1.	2.	2.	2.	3.	3.
4.	4.	5.	5.	6.	7.	7.	8.	9.	10.
10.	11.	12.	13.	14.	15.	16.	17.	18.	19.

20.	21.	22.	23.	24.	25.	26.	27.	28.	30.	31.

[illegible]	[illegible]	[illegible]	0.	0.	0.	0.	0.	0.	0.
[illegible]	[illegible]	[illegible]	1.	1.	2				
4.	4.	5.	5.	6.	7.	7.	8.	9.	10.
10.	11.	12.	13.	14.	15.	16.	17.	18.	19.

20.	21.	22.	23.	25.	26.	27.	28.	30.	31.
33.	35.	37.	40.	42.	45.	48.	51.	57.	53.
54.	55.	56.	57.	59.	60.	62.	64.	65.	67.
69.	71.	74.	76.	78.	81.	83.	86.	89.	92.
95.	99.	102.	105.	109.	112.	116.	119.	123.	126.
130.	133.	137.	141.	144.	148.	152.	155.	159.	163.
167.	170.	174.	178.	182.	186.	190.	194.	198.	201.
205.	209.	211.	212.	213.	215.	216.	218.	219.	221.
222.	224.	225.	227.	228.	230.	231.	233.	234.	236.
238.	240.	248.	257.	267.	278.	289.	299.	301.	303.
305.	307.	309.	312.	314.	317.	320.	323.	325.	328.
332.	335.	338.	342.	345.	348.	352.	355.	359.	361.
467.	604.	738.	1065.	1407.	1859.	2377.	2981.	3620.	4223.
5036.	5866.	6790.	7755.	8862.	9483.	10032.	10525.	10969.	11363.
11711.	12017.	12265.	12465.	12662.	12856.	13007.	13131.	13228.	13297.
13335.	13345.	13329.	13291.	13235.	13164.	13082.	12991.	12892.	12786.
12677.	12566.	12412.	12266.	12109.	11934.	11739.	11534.	11319.	11097.
10868.	10635.	10399.	10161.	9922.	9679.	9433.	9189.	8947.	8554.
8157.	7777.	7442.	7158.	6883.	6618.	6362.	6115.	5878.	5652.
5439.	5232.	5033.	4843.	4660.	4484.	4316.	4154.	3999.	3884.
3772.	3664.	3559.	3457.	3322.	3192.	3069.	2951.	2839.	2733.
2633.	2553.	2476.	2403.	2332.	2264.	2199.	2136.	2076.	2019.
1964.	1911.	1860.	1811.	1764.	1719.	1676.	1635.		

STORAGE

424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	425.
425.	425.	425.	425.	425.	426.	426.	426.	427.	427.
427.	428.	428.	429.	429.	430.	431.	431.	432.	433.
433.	434.	435.	435.	436.	437.	438.	439.	440.	441.
442.	443.	444.	445.	446.	447.	448.	449.	450.	451.
452.	453.	454.	456.	457.	458.	460.	461.	463.	465.
468.	471.	474.	478.	482.	486.	491.	496.	502.	507.
513.	520.	526.	533.	540.	547.	555.	563.	570.	578.
587.	595.	603.	612.	620.	629.	638.	647.	656.	665.
674.	683.	692.	701.	711.	720.	730.	739.	749.	758.
768.	777.	787.	797.	807.	817.	826.	836.	846.	856.
866.	876.	886.	896.	907.	917.	927.	937.	948.	958.
968.	979.	989.	1000.	1010.	1021.	1032.	1043.	1055.	1067.
1081.	1096.	1111.	1129.	1147.	1167.	1188.	1210.	1233.	1258.
1285.	1312.	1341.	1372.	1404.	1438.	1473.	1509.	1547.	1586.
1627.	1669.	1712.	1755.	1802.	1850.	1899.	1951.	2006.	2063.
2124.	2188.	2255.	2326.	2400.	2478.	2556.	2640.	2729.	2826.
2934.	3050.	3173.	3296.	3414.	3525.	3628.	3722.	3806.	3881.
3948.	4006.	4057.	4101.	4139.	4171.	4197.	4218.	4234.	4244.
4250.	4252.	4249.	4243.	4235.	4223.	4210.	4196.	4177.	4158.
4137.	4113.	4086.	4057.	4025.	3990.	3953.	3914.	3873.	3831.
3787.	3743.	3698.	3652.	3607.	3561.	3515.	3470.	3425.	3381.
3339.	3298.	3259.	3221.	3185.	3150.	3116.	3083.	3052.	3021.
2992.	2964.	2937.	2911.	2886.	2862.	2839.	2817.	2796.	2775.
2756.	2737.	2718.	2700.	2683.	2667.	2651.	2636.	2622.	2608.
2595.	2583.	2571.	2560.	2549.	2539.	2529.	2519.	2510.	2501.
2492.	2484.	2476.	2469.	2462.	2455.	2448.	2442.		

STAGE

906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.4
906.4	906.4	906.4	906.4	906.4	906.4	906.4	906.4	906.4	906.5
906.5	906.5	906.5	906.5	906.5	906.5	906.6	906.6	906.6	906.6
906.6	906.6	906.7	906.7	906.7	906.7	906.7	906.8	906.8	906.8
906.8	906.8	906.9	906.9	906.9	906.9	907.0	907.0	907.0	907.0
907.0	907.0	907.0	907.0	907.1	907.1	907.1	907.1	907.1	907.1
907.2	907.2	907.2	907.2	907.2	907.3	907.3	907.3	907.3	907.4
907.4	907.4	907.4	907.5	907.5	907.5	907.6	907.6	907.6	907.6
907.7	907.7	907.7	907.8	907.8	907.8	907.8	907.9	907.9	907.9
908.0	908.0	908.0	908.1	908.1	908.1	908.1	908.2	908.2	908.2
908.3	908.3	908.3	908.4	908.4	908.4	908.5	908.5	908.5	908.6
908.6	908.6	908.7	908.7	908.7	908.8	908.8	908.8	908.9	908.9
908.9	909.0	909.2	909.4	909.6	909.8	910.1	910.3	910.6	910.9
911.3	911.6	911.9	912.3	912.7	913.1	913.5	914.0	914.4	914.9
915.4	915.9	916.4	916.9	917.5	918.1	918.7	919.3	919.9	920.3
920.7	921.0	921.4	921.8	922.3	922.7	923.2	923.7	924.1	924.5
925.3	925.5	926.0	926.5	927.0	927.3	927.5	927.7	927.9	928.1
928.3	928.4	928.5	928.6	928.7	928.8	928.9	928.9	928.9	929.0
929.0	929.0	929.0	929.0	929.0	928.9	928.9	928.9	928.8	928.8
928.7	928.7	928.6	928.5	928.4	928.4	928.3	928.2	928.1	928.0
927.9	927.8	927.7	927.6	927.4	927.3	927.2	927.1	927.0	926.8
926.7	926.5	926.3	926.2	926.0	925.9	925.7	925.6	925.5	925.3
925.2	925.1	925.0	924.9	924.8	924.7	924.6	924.5	924.4	924.3
924.2	924.2	924.1	924.0	923.9	923.8	923.7	923.6	923.5	923.5
923.4	923.3	923.3	923.2	923.1	923.1	923.0	923.0	922.9	922.8
922.8	922.7	922.7	922.7	922.6	922.6	922.5	922.5		

PEAK OUTFLOW IS 13345. AT TIME 17.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13345.	9503.	2727.	2727.	785299.
CMS	378.	269.	77.	77.	22237.
INCHES		9.70	11.14	11.14	11.14
MM		246.44	282.85	282.85	282.85
AC-FT		4712.	5408.	5408.	5408.
THOUS CU M		5812.	6671.	6671.	6671.

STATION 20, PLAN 1, RATIO 9

ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 57 SUB-STEP 1 TIME 4.75 HR
ESTIMATED W.S. ELEV 9.06F112+02 CONTINUITY BALANCE -1.258061+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 58 SUB-STEP 1 TIME 4.83 HR
ESTIMATED W.S. ELEV 9.06F437+02 CONTINUITY BALANCE -2.201745+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 59 SUB-STEP 1 TIME 4.92 HR
ESTIMATED W.S. ELEV 9.06F768+02 CONTINUITY BALANCE -3.549655+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 60 SUB-STEP 1 TIME 5.00 HR
ESTIMATED W.S. ELEV 9.069105+02 CONTINUITY BALANCE -5.352861+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 61 SUB-STEP 1 TIME 5.08 HR
ESTIMATED W.S. ELEV 9.069465+02 CONTINUITY BALANCE -7.651234+00
ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 62 SUB-STEP 1 TIME 5.17 HR
ESTIMATED W.S. ELEV 9.069790+02 CONTINUITY BALANCE -1.046142+01

Evaluation of output and iterations within HEC-1 indicates that the results of this program run were not affected by the lack of convergence within the iterations for the routing through Harrison County Dam C-2.

ITERATIVE SOLUTION DID NOT CONVERGE, PERIOD 120 SUB-STEP 1 TIME 10.00 HR
CONTINUITY BALANCE 3.103791+00

ESTIMATED W.S. ELEV 9.069135+02 CONTINUITY BALANCE -5.[illegible]+00
[illegible] ID [illegible] P [illegible] SUB-S 1 5.[illegible]
ESTIMATED W.S. ELEV 9.069445+02 CONTINUITY BALANCE -[illegible].234+00
ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 62 SUB-STEP 1 TIME 5.17 HR
ESTIMATED W.S. ELEV 9.069790+02 CONTINUITY BALANCE -1.046142+01

ITERATIVE SOLUTION DID NOT CONVERGE. PERIOD 120 SUB-STEP 1 TIME 10.00 HR
ESTIMATED W.S. ELEV 9.090003+02 CONTINUITY BALANCE 3.103793+00

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.	1.	1.
1.	2.	2.	2.	3.	3.	4.	5.	6.	7.
7.	8.	10.	11.	12.	13.	15.	16.	18.	19.
21.	22.	24.	26.	28.	30.	32.	36.	39.	43.
46.	50.	52.	53.	54.	54.	55.	56.	57.	57.
58.	59.	60.	61.	61.	62.	63.	65.	66.	68.
69.	71.	74.	76.	79.	82.	85.	89.	93.	98.
103.	107.	113.	118.	123.	129.	135.	141.	147.	153.
159.	166.	172.	179.	186.	192.	199.	206.	211.	217.
218.	218.	221.	224.	227.	229.	232.	235.	238.	241.
252.	263.	274.	285.	296.	300.	302.	304.	305.	307.
309.	313.	312.	314.	316.	317.	319.	321.	323.	325.
327.	329.	330.	332.	334.	336.	338.	340.	342.	344.
347.	349.	352.	355.	358.	361.	386.	522.	645.	844.
1164.	1563.	2112.	2708.	3449.	3990.	4720.	5442.	6162.	6858.
7506.	8230.	8904.	9271.	9617.	9948.	10265.	10575.	10878.	11173.
11463.	11746.	12023.	12275.	12531.	12805.	13121.	13577.	14299.	15320.
16505.	19117.	21775.	24668.	27558.	30229.	32520.	34336.	35642.	36446.
36835.	36810.	36559.	36111.	35536.	34866.	34130.	33347.	32529.	31679.
30804.	29911.	29011.	28119.	27250.	26416.	25620.	24862.	24137.	23423.
22714.	21990.	21236.	20461.	19661.	18854.	18053.	17269.	16518.	15827.
15212.	14667.	14167.	13702.	13291.	12958.	12706.	12438.	12180.	11916.
11639.	11362.	11087.	10814.	10544.	10278.	10016.	9757.	9497.	9243.
8994.	8631.	8231.	7852.	7567.	7231.	6965.	6711.	6467.	6233.
6009.	5794.	5594.	5402.	5219.	5044.	4876.	4715.	4561.	4414.
4273.	4139.	4011.	3913.	3822.	3733.	3648.	3565.	3485.	3390.
3289.	3193.	3101.	3014.	2932.	2853.	2779.	2708.		

STORAGE

424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
424.	424.	424.	424.	424.	424.	424.	424.	424.	424.
425.	426.	426.	426.	427.	427.	428.	428.	429.	430.
431.	432.	433.	434.	435.	436.	437.	438.	439.	441.
442.	444.	445.	447.	448.	450.	452.	454.	455.	457.
459.	461.	463.	465.	467.	469.	471.	473.	475.	478.
480.	482.	485.	487.	490.	493.	496.	499.	503.	508.
513.	520.	526.	534.	542.	551.	560.	571.	581.	593.
605.	617.	630.	643.	657.	672.	686.	701.	717.	733.
749.	765.	782.	799.	816.	833.	851.	869.	887.	905.
923.	942.	961.	980.	999.	1019.	1038.	1058.	1078.	1098.
1118.	1139.	1159.	1180.	1201.	1222.	1243.	1265.	1287.	1308.
1331.	1353.	1375.	1398.	1421.	1444.	1468.	1491.	1515.	1539.
1563.	1587.	1612.	1636.	1661.	1686.	1711.	1738.	1766.	1795.
1827.	1862.	1900.	1941.	1986.	2035.	2089.	2147.	2210.	2278.
2352.	2431.	2515.	2605.	2699.	2795.	2894.	2993.	3089.	3182.
3267.	3346.	3419.	3485.	3549.	3611.	3672.	3731.	3789.	3845.
3900.	3954.	4007.	4059.	4110.	4161.	4210.	4279.	4353.	4442.

4947.	4885.	4788.	4909.	5020.	5117.	5197.	5258.	5301.	5327.
5338.	5338.	5330.	5316.	5297.	5275.	5251.	5225.	5197.	5168.
5137.	5106.	5073.	5041.	5008.	4977.	4946.	4916.	4887.	4858.
4828.	4797.	4766.	4729.	4691.	4652.	4610.	4568.	4524.	4479.
4434.	4387.	4340.	4292.	4243.	4194.	4143.	4092.	4040.	3987.
3934.	3881.	3828.	3777.	3725.	3674.	3624.	3575.	3527.	3480.
3434.	3389.	3347.	3306.	3268.	3231.	3196.	3162.	3130.	3099.
3069.	3041.	3013.	2987.	2962.	2938.	2915.	2893.	2872.	2852.
2833.	2815.	2798.	2781.	2765.	2749.	2734.	2719.	2705.	2692.
2679.	2667.	2655.	2644.	2633.	2624.	2614.	2605.		

STAGE

906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3	906.3
906.3	906.3	906.3	906.3	906.3	906.4	906.4	906.4	906.4	906.4
906.4	906.4	906.5	906.5	906.5	906.5	906.5	906.6	906.6	906.6
906.6	906.7	906.7	906.7	906.7	906.8	906.8	906.8	906.9	906.9
906.9	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0	907.0
907.1	907.1	907.1	907.1	907.1	907.1	907.1	907.1	907.1	907.1
907.2	907.2	907.2	907.2	907.3	907.3	907.3	907.3	907.4	907.4
907.4	907.5	907.5	907.6	907.6	907.7	907.7	907.8	907.8	907.9
907.9	908.0	908.0	908.1	908.1	908.2	908.2	908.3	908.3	908.4
908.5	908.5	908.6	908.6	908.7	908.8	908.8	908.9	908.9	909.0
909.2	909.5	909.7	910.0	910.2	910.5	910.8	911.0	911.3	911.5
911.8	912.1	912.3	912.6	912.9	913.2	913.5	913.7	914.0	914.3
914.6	914.9	915.2	915.5	915.8	916.1	916.4	916.7	917.1	917.4
917.8	918.2	918.7	919.2	919.7	920.1	920.5	920.8	921.2	921.6
922.0	922.4	922.9	923.4	924.0	924.4	924.8	925.2	925.6	926.0
926.4	926.7	927.0	927.2	927.3	927.5	927.6	927.7	927.9	928.0
928.2	928.3	928.4	928.5	928.7	928.8	928.9	929.1	929.2	929.4
929.7	930.0	930.3	930.6	930.8	931.1	931.3	931.4	931.5	931.6
931.6	931.6	931.6	931.5	931.5	931.4	931.4	931.3	931.3	931.2
931.1	931.0	931.0	930.9	930.8	930.7	930.7	930.6	930.5	930.4
930.4	930.3	930.2	930.1	930.0	929.9	929.8	929.7	929.6	929.5
929.4	929.3	929.2	929.1	929.0	928.9	928.7	928.6	928.5	928.4
928.2	928.1	928.0	927.9	927.7	927.6	927.5	927.4	927.3	927.1
927.0	926.9	926.7	926.5	926.4	926.2	926.1	925.9	925.8	925.7
925.5	925.4	925.3	925.2	925.1	925.0	924.9	924.8	924.7	924.6
924.6	924.5	924.4	924.3	924.3	924.2	924.1	924.1	924.0	924.0
923.9	923.8	923.7	923.7	923.6	923.6	923.5	923.5		

PEAK OUTFLOW IS 36810. AT TIME 16.83 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	36810.	20564.	6249.	6249.	1799670.
CMS	1042.	582.	177.	177.	50961.
INCHES		21.00	25.52	25.52	25.52
MM		533.30	648.22	648.22	648.22
AC-FT		16197.	12394.	12394.	12394.
THOUS CU M		12578.	15288.	15288.	15288.

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 .15	RATIO 2 .20	RATIO 3 .25	RATIO 4 .30	RATIO 5 .35	RATIO 6 .40	RATIO 7 .45	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	1	.32	1	519.	692.	865.	1038.	1211.	1384.	1557.	1730.	3460.
	(	.83)	(	14.70)(	19.60)(	24.50)(	29.39)(	34.29)(	39.19)(	44.09)(	48.99)(	97.98)
ROUTED TO	2	.32	1	161.	1468.	1559.	1641.	1741.	2189.	2157.	1725.	2733.
	(	.83)	(	4.57)(	41.57)(	44.15)(	46.47)(	49.31)(	61.97)(	61.07)(	48.85)(	77.40)
ROUTED TO	3	.32	1	136.	1121.	1237.	1332.	1440.	1694.	1598.	1331.	2045.
	(	.83)	(	3.86)(	31.75)(	35.03)(	37.71)(	40.77)(	47.96)(	45.26)(	37.70)(	57.91)
HYDROGRAPH AT	4	.76	1	959.	1277.	1596.	1915.	2234.	2553.	2873.	3192.	6383.
	(	1.97)	(	27.11)(	36.15)(	45.19)(	54.23)(	63.27)(	72.30)(	81.34)(	90.38)(	180.76)
ROUTED TO	5	.76	1	299.	622.	4491.	4819.	5120.	5412.	5667.	6601.	5594.
	(	1.97)	(	8.29)(	17.61)(	127.16)(	136.45)(	144.97)(	153.25)(	160.47)(	186.93)(	158.42)
ROUTED TO	6	.76	1	271.	538.	3897.	4173.	4401.	4638.	4887.	5456.	4742.
	(	1.97)	(	7.68)(	15.22)(	110.34)(	118.15)(	124.63)(	131.32)(	138.40)(	154.49)(	134.29)
HYDROGRAPH AT	7	1.01	1	1286.	1715.	2144.	2573.	3002.	3431.	3859.	4288.	8577.
	(	2.61)	(	36.43)(	48.57)(	60.72)(	72.86)(	85.00)(	97.14)(	109.29)(	121.43)(	242.86)
ROUTED TO	8	1.01	1	207.	402.	4313.	4547.	4794.	5520.	5300.	4660.	5192.
	(	2.61)	(	5.86)(	11.39)(	122.13)(	128.75)(	135.76)(	156.30)(	150.09)(	131.95)(	147.02)
ROUTED TO	9	1.01	1	200.	396.	3546.	3817.	4081.	4669.	4582.	4073.	4900.
	(	2.61)	(	5.66)(	11.22)(	100.42)(	108.09)(	115.57)(	132.21)(	129.75)(	115.35)(	138.75)
HYDROGRAPH AT	10	2.76	1	2404.	3206.	4007.	4809.	5610.	6412.	7213.	8015.	16030.
	(	7.14)	(	68.09)(	90.78)(	113.48)(	136.18)(	158.87)(	181.57)(	204.26)(	226.96)(	453.92)
4 COMBINED	11	4.84	1	2731.	4173.	9813.	11692.	13432.	15439.	15926.	18537.	27498.
	(	12.55)	(	77.33)(	118.16)(	277.86)(	331.08)(	380.34)(	437.19)(	450.98)(	524.92)(	778.67)
HYDROGRAPH AT	12	.36	1	564.	751.	939.	1127.	1315.	1503.	1691.	1879.	3757.
	(	.93)	(	15.96)(	21.28)(	26.60)(	31.92)(	37.24)(	42.56)(	47.88)(	53.20)(	106.39)
ROUTED TO	13	.36	1	199.	311.	414.	1955.	2101.	2236.	2310.	2348.	2918.
	(	.93)	(	5.60)(	8.80)(	11.79)(	55.37)(	59.51)(	63.32)(	65.41)(	66.48)(	82.63)
ROUTED TO	14	.36	1	128.	183.	241.	880.	978.	1075.	1174.	1257.	1834.

FLOOD HYDROGRAPH PACKAGE - HEC-1

	(.9?)	(3.62)(	5.17)(	6.84)(	24.92)(	27.70)(	30.44)(	33.24)(	35.58)(	51.94)
HYDROGRAPH AT 15	.39	1 585.	780.	975.	1170.	1366.	1561.	1756.	1951.	3902.
	(1.00)	(16.57)(	22.10)(	27.62)(	33.14)(	38.67)(	44.19)(	49.72)(	55.24)(	110.48)
ROUTED TO 16	.39	1 321.	471.	608.	766.	917.	1586.	1649.	1690.	3503.
	(1.00)	(9.08)(	13.34)(	17.22)(	21.68)(	25.95)(	44.91)(	46.69)(	47.87)(	99.20)
ROUTED TO 17	.39	1 183.	258.	333.	428.	534.	1026.	1114.	1186.	2024.
	(1.00)	(5.17)(	7.30)(	9.42)(	12.12)(	15.13)(	29.04)(	31.56)(	33.58)(	57.31)
HYDROGRAPH AT 18	3.52	1 2197.	2930.	3662.	4394.	5127.	5859.	6591.	7324.	14648.
	(9.12)	(62.22)(	82.96)(	103.69)(	124.43)(	145.17)(	165.91)(	186.65)(	207.39)(	414.78)
4 COMBINED 19	9.11	1 4855.	7306.	13969.	17308.	19873.	22087.	23288.	25458.	43125.
	(23.60)	(137.47)(	206.88)(	395.56)(	490.10)(	562.75)(	625.42)(	659.38)(	720.90)(	1221.16)
ROUTED TO 20	9.11	1 360.	1792.	5298.	7437.	9368.	10880.	12165.	13345.	36810.
	(23.60)	(10.20)(	50.73)(	150.01)(	210.60)(	265.27)(	308.09)(	344.48)(	377.90)(	1042.35)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	80.00	80.00	86.80
STORAGE	19.	19.	65.
OUTFLOW	0.	0.	268.

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
.15	86.12	.00	59.	161.	.00	16.17	.00
.20	87.02	.22	67.	1468.	.35	16.83	15.92
.25	87.37	.57	76.	1569.	.48	16.62	15.75
.30	87.53	.73	71.	1651.	.52	16.54	15.67
.35	87.63	.83	72.	1752.	.58	16.48	15.58
.40	87.35	.55	69.	2203.	.71	16.12	15.25
.45	86.91	.11	66.	2157.	.37	15.67	14.67
.50	86.95	.15	66.	1730.	.42	15.29	14.33
1.00	87.11	.31	67.	2733.	.52	15.83	12.58

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.15	136.	65.3	16.83
.20	1121.	71.1	16.92
.25	1237.	71.4	16.75
.30	1332.	71.7	16.67
.35	1440.	72.0	16.58
.40	1694.	72.6	16.33
.45	1598.	72.4	15.83
.50	1331.	71.7	15.42
1.00	2045.	73.4	16.08

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	112.00	112.00	118.70
STORAGE	93.	93.	214.
OUTFLOW	0.	0.	780.

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
.15	117.66	.00	186.	299.	.00	16.67	.00
.20	118.35	.00	207.	622.	.00	16.33	.00
.25	119.03	.33	221.	4543.	.44	16.96	16.00
.30	119.38	.68	226.	4972.	.56	16.81	15.83
.35	119.60	.90	232.	5120.	.60	16.75	15.75
.40	119.72	1.02	234.	5412.	.67	16.67	15.67
.45	119.78	1.08	236.	5667.	.71	16.58	15.58
.50	118.74	.04	215.	6601.	.31	16.00	15.00
1.00	118.99	.29	220.	5594.	.54	14.00	13.00

PLAN 1 STATION 6

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.15	271.	91.0	17.42
.20	538.	92.1	16.67
.25	3897.	97.6	17.08
.30	4173.	97.9	16.92
.35	4401.	98.1	16.83
.40	4638.	98.3	16.75
.45	4887.	98.5	16.67
.50	5456.	99.1	16.08
1.00	4742.	98.4	16.25

SUMMARY OF DAM SAFETY ANALYSIS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	122.00	122.00	129.10
STORAGE	126.	128.	318.
OUTFLOW	0.	0.	498.

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
.15	127.92	.00	276.	207.	.00	18.25	.00
.20	128.78	.00	306.	402.	.00	17.33	.00
.25	129.55	.45	334.	4313.	.65	17.08	16.08
.30	129.99	.89	350.	4547.	.77	16.83	15.83
.35	130.22	1.12	358.	4794.	.85	16.67	15.67
.40	129.95	.85	348.	5320.	1.00	16.25	15.25
.45	129.41	.31	329.	5300.	.71	15.83	14.83
.50	129.48	.38	331.	4660.	.73	15.50	14.50
1.00	129.67	.57	338.	5192.	.83	16.17	12.67

PLAN 1 STATION 9

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.15	200.	100.1	18.50
.20	396.	101.0	17.75
.25	3546.	106.2	17.25
.30	3817.	106.5	17.00
.35	4081.	106.7	16.83
.40	4669.	107.2	16.42
.45	4582.	107.1	16.08
.50	4073.	106.7	16.00
1.00	4900.	107.4	16.42

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	95.00	95.00	101.30
STORAGE	25.	25.	88.
OUTFLOW	0.	0.	478.

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
.15	99.92	.00	68.	198.	.00	16.17	.00
.20	100.49	.00	76.	311.	.00	16.08	.00
.25	101.00	.00	83.	416.	.00	16.08	.00
.30	101.45	.15	90.	1582.	.35	16.81	15.92
.35	101.74	.44	94.	2101.	.48	16.75	15.83
.40	101.96	.66	97.	2336.	.54	16.67	15.75
.45	102.13	.83	99.	2377.	.60	16.60	15.67
.50	102.31	1.01	102.	2419.	.62	16.62	15.67
1.00	101.49	.18	90.	2018.	.50	15.92	13.58

PLAN 1 STATION 14

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.15	128.	84.4	18.00
.20	183.	85.0	17.67
.25	241.	85.6	17.42
.30	660.	87.3	17.00
.35	978.	87.5	16.92
.40	1075.	87.7	16.83
.45	1174.	88.0	16.83
.50	1257.	88.2	16.83
1.00	1834.	89.0	16.25

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	94.00	94.00	101.00
STORAGE	27.	27.	89.
OUTFLOW	0.	0.	1048.

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
.15	98.90	.00	68.	321.	.00	16.08	.00
.20	99.40	.00	73.	471.	.00	16.00	.00
.25	99.86	.00	78.	609.	.00	16.00	.00
.30	100.27	.00	82.	766.	.00	16.00	.00
.35	100.66	.00	86.	917.	.00	16.00	.00
.40	101.04	.04	89.	1586.	.17	16.92	15.92
.45	101.26	.26	91.	1649.	.33	16.83	15.83
.50	101.46	.46	93.	1690.	.37	16.83	15.83
1.00	102.32	1.32	108.	3519.	.71	15.90	15.58

PLAN 1 STATION 17

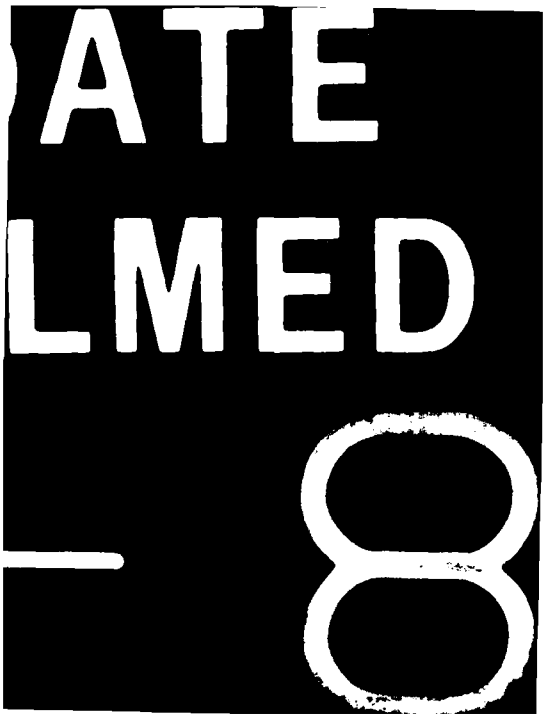
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.15	183.	86.5	17.00
.20	258.	87.1	16.83
.25	333.	87.7	16.67
.30	428.	88.1	16.58
.35	534.	88.3	16.50
.40	1026.	89.2	17.08
.45	1114.	89.3	17.00
.50	1186.	89.5	17.00
1.00	2024.	91.0	16.67

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	906.30	906.30	928.30
STORAGE	424.	424.	3963.
OUTFLOW	0.	0.	11791.

RATIO OF SPF	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
.15	920.11	.00	2030.	360.	.00	24.00	.00
.20	922.64	.00	2466.	1792.	.00	19.50	.00
.25	925.14	.00	2973.	5299.	.00	18.42	.00
.30	926.33	.00	3258.	7437.	.00	18.08	.00
.35	927.22	.00	3503.	9368.	.00	17.83	.00
.40	927.88	.00	3789.	10880.	.00	17.75	.00
.45	928.48	.18	4037.	12165.	1.08	17.67	.00
.50	928.99	.69	4252.	13345.	2.08	17.67	.00
1.00	931.59	3.29	5338.	36810.	4.83	16.83	.00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