

AD-A105 891

HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE
NATIONAL DAM SAFETY PROGRAM. STRUCTURE NUMBER 1 - LITTLE SNI-A--ETC(U)
SEP 78 H P HOSKINS

F/G 13/13

DACW43-78-C-0155

NL

UNCLASSIFIED

1 of 1

AD-A
10-1-80

END
DATE
FILMED
11-81
DTIC

AD A105891 MISSOURI
MISSOURI-KANSAS CITY BASIN
LEVEL

STRUCTURE NO. 1 - LITTLE SNI-A-BAR CREEK
LAFAYETTE COUNTY, MISSOURI
MO 10480



PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DTIC FILE COPY



PREPARED BY: HOSKINS-WESTERN-SONDEREGGER, INC.
FOR: STATE OF MISSOURI

SEPTEMBER, 1978

This document has been approved
for public release and sale; its
distribution is unlimited.

10 10 19

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Structure No. 1 Little Sni-A-Bar Creek Lafayette County, Missouri (MO 10480)		5. TYPE OF REPORT & PERIOD COVERED (9) Final Report
7. AUTHOR(s) Hoskins-Western-Sonderegger, Inc.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSD-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		8. CONTRACT OR GRANT NUMBER(s) (15) DACW43-78-C-0155
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSD-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (12) 41
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (10) Harold P. Hoskins		12. REPORT DATE (11) September 1978
		13. NUMBER OF PAGES Approximately 95
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) (6) National Dam Safety Program. Structure Number 1 - Little Sni-A-Bar Creek (MO 10480), Missouri - Kansas City Basin, Lafayette County, Missouri. Phase I Inspection Report.		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

394234

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

RESPONSIBILITY. The controlling DoD office will be responsible for completion of the Report Documentation Page, DD Form 1473, in all technical reports prepared by or for DoD organizations.

CLASSIFICATION. Since this Report Documentation Page, DD Form 1473, is used in preparing announcements, bibliographies, and data banks, it should be unclassified if possible. If a classification is required, identify the classified items on the page by the appropriate symbol.

COMPLETION GUIDE

General. Make Blocks 1, 4, 5, 6, 7, 11, 13, 15, and 16 agree with the corresponding information on the report cover. Leave Blocks 2 and 3 blank.

Block 1. Report Number. Enter the unique alphanumeric report number shown on the cover.

Block 2. Government Accession No. Leave Blank. This space is for use by the Defense Documentation Center.

Block 3. Recipient's Catalog Number. Leave blank. This space is for the use of the report recipient to assist in future retrieval of the document.

Block 4. Title and Subtitle. Enter the title in all capital letters exactly as it appears on the publication. Titles should be unclassified whenever possible. Write out the English equivalent for Greek letters and mathematical symbols in the title (see "Abstracting Scientific and Technical Reports of Defense-sponsored RDT/E," AD-667 000). If the report has a subtitle, this subtitle should follow the main title, be separated by a comma or semicolon if appropriate, and be initially capitalized. If a publication has a title in a foreign language, translate the title into English and follow the English translation with the title in the original language. Make every effort to simplify the title before publication.

Block 5. Type of Report and Period Covered. Indicate here whether report is interim, final, etc., and, if applicable, inclusive dates of period covered, such as the life of a contract covered in a final contractor report.

Block 6. Performing Organization Report Number. Only numbers other than the official report number shown in Block 1, such as series numbers for in-house reports or a contractor/grantee number assigned by him, will be placed in this space. If no such numbers are used, leave this space blank.

Block 7. Author(s). Include corresponding information from the report cover. Give the name(s) of the author(s) in conventional order (for example, John R. Doe or, if author prefers, J. Robert Doe). In addition, list the affiliation of an author if it differs from that of the performing organization.

Block 8. Contract or Grant Number(s). For a contractor or grantee report, enter the complete contract or grant number(s) under which the work reported was accomplished. Leave blank in in-house reports.

Block 9. Performing Organization Name and Address. For in-house reports enter the name and address, including office symbol, of the performing activity. For contractor or grantee reports enter the name and address of the contractor or grantee who prepared the report and identify the appropriate corporate division, school, laboratory, etc., of the author. List city, state, and ZIP Code.

Block 10. Program Element, Project, Task Area, and Work Unit Numbers. Enter here the number code from the applicable Department of Defense form, such as the DD Form 1498, "Research and Technology Work Unit Summary" or the DD Form 1634, "Research and Development Planning Summary," which identifies the program element, project, task area, and work unit or equivalent under which the work was authorized.

Block 11. Controlling Office Name and Address. Enter the full, official name and address, including office symbol, of the controlling office. (Equates to funding/sponsoring agency. For definition see DoD Directive 5200.20, "Distribution Statements on Technical Documents.")

Block 12. Report Date. Enter here the day, month, and year or month and year as shown on the cover.

Block 13. Number of Pages. Enter the total number of pages.

Block 14. Monitoring Agency Name and Address (if different from Controlling Office). For use when the controlling or funding office does not directly administer a project, contract, or grant, but delegates the administrative responsibility to another organization.

Blocks 15 & 15a. Security Classification of the Report: Declassification/Downgrading Schedule of the Report. Enter in 15 the highest classification of the report. If appropriate, enter in 15a the declassification/downgrading schedule of the report, using the abbreviations for declassification/downgrading schedules listed in paragraph 4-207 of DoD 5200.1-R.

Block 16. Distribution Statement of the Report. Insert here the applicable distribution statement of the report from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 17. Distribution Statement (of the abstract entered in Block 20, if different from the distribution statement of the report). Insert here the applicable distribution statement of the abstract from DoD Directive 5200.20, "Distribution Statements on Technical Documents."

Block 18. Supplementary Notes. Enter information not included elsewhere but useful, such as: Prepared in cooperation with . . . Translation of (or by) . . . Presented at conference of . . . To be published in . . .

Block 19. Key Words. Select terms or short phrases that identify the principal subjects covered in the report, and are sufficiently specific and precise to be used as index entries for cataloging, conforming to standard terminology. The DoD "Thesaurus of Engineering and Scientific Terms" (TEST), AD-672 000, can be helpful.

Block 20. Abstract. The abstract should be a brief (not to exceed 200 words) factual summary of the most significant information contained in the report. If possible, the abstract of a classified report should be unclassified and the abstract to an unclassified report should consist of publicly-releasable information. If the report contains a significant bibliography or literature survey, mention it here. For information on preparing abstracts see "Abstracting Scientific and Technical Reports of Defense-Sponsored RDT&E," AD-667 000.



DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: STRUCTURE NO. 1 - LITTLE SNI-A-BAR CREEK
PHASE I INSPECTION REPORT

This report presents the results of field inspection and evaluation of Structure No. 1 - Little Sni-A-Bar Creek:

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

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

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

SUBMITTED BY: **SIGNED**
Chief, Engineering Division

30 NOV 1978

Date

APPROVED BY: **SIGNED**
Colonel, CE, District Engineer

30 NOV 1978

Date

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or	
Special	
A	

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam Structure No. 1 - Little Sni-I-Bar Creek
State Located Missouri
County Located Lafayette County
Stream Little Sni-I-Bar Creek
Date of September 15, 1978
Inspection

Structure No. 1 - Little Sni-I-Bar Creek was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderregger, Inc. The purpose of the inspection was to make an assessment of the general 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. Failure would threaten life and property. The estimated damage zone extends ten miles downstream of the dam. Within the damage zone are three to four houses, six improved road crossings, and one railroad crossing. The floodplain is farmed.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. The spillways will pass the 100-year frequency flood without overtopping the dam. The spillways will also pass 39% of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Additional deficiencies, in accordance with the guidelines, are the lack of seepage and stability analysis. These analyses should be obtained in the future.

Deficiencies visually observed by the inspection team were trees and shrubs growing on both slopes, small rills and washes on both slopes, several rodent holes on the downstream slope, logs and trash lodged around the trash rack of the principal spillway riser and some erosion and/or sloughing along the east bank of the stilling basin.

Several items of preventive maintenance need to be initiated by the owner. These are described in detail in the body of the report.


Harold P. Hoskins, P.E.
Hoskins-Western-Sonderregger, Inc.
Lincoln, Nebraska

SUBMITTED BY **SIGNED**
Chief, Engineering Division

30 NOV 1978
Date

APPROVED BY **SIGNED**
Colonel, CE, District Engineer

30 NOV 1978
Date



PHOTOGRAPH NO. 1
OVERVIEW
FROM WEST UPSTREAM SIDE

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
STRUCTURE NO. 1 - LITTLE SNI-I-BAR CREEK
ID NO. MO. 10480

TABLE OF CONTENTS

<u>Paragraph No.</u>	<u>Title</u>	<u>Page No.</u>
SECTION 1 - PROJECT INFORMATION		
1.1	General	1
1.2	Description of Project	1
1.3	Pertinent Data	2
SECTION 2 - ENGINEERING DATA		
2.1	Design	6
2.2	Construction	6
2.3	Operation	6
2.4	Evaluation	6
SECTION 3 - VISUAL INSPECTION		
3.1	Findings	7
3.2	Evaluation	8
SECTION 4 - OPERATIONAL PROCEDURES		
4.1	Procedures	9
4.2	Maintenance of Dam	9
4.3	Maintenance of Operating Facilities	9
4.4	Description of Any Warning System in Effect	9
4.5	Evaluation	9
SECTION 5 - HYDRAULIC/HYDROLOGIC		
5.1	Evaluation of Features	10
SECTION 6 - STRUCTURAL STABILITY		
6.1	Evaluation of Structural Stability	12
SECTION 7 - ASSESSMENT/REMEDIAL MEASURES		
7.1	Dam Assessment	13
7.2	Remedial Measures	13

APPENDIX A - MAPS

Plate 1	Vicinity Topography
Plate 2	Location Map

APPENDIX B - PHOTOGRAPHS

Photographs of Dam and Lake (No. 2 through No. 13)

APPENDIX C - PLANS AND REPORTS

Soil Conservation Service	Sheet 3 of 21
Soil Conservation Service	Sheet 4 of 21
Soil Conservation Service	Sheet 5 of 21
Soil Conservation Service	Sheet 16 of 21
Soil Conservation Service	Sheet 17 of 21
Soil Conservation Service	Sheet 18 of 21
Soil Conservation Service	Sheet 19 of 21
Soil Conservation Service	Sheet 20 of 21
Soil Conservation Service	Sheet 1 of 1
Soil Conservation Service	Soil Mechanics/Soils Engineering Report
Soil Conservation Service	Geology Report

APPENDIX D - HYDROLOGIC COMPUTATIONS

Plate D1	Inflow Hydrographs
----------	--------------------

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Structure No. 1 - Little Sni-I-Bar Creek 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 a compacted earth fill approximately 1200 feet long with maximum height of about 50 feet. Topography adjacent to the dam is moderately steep to gently rolling. Upland soils consist of silty clay loess (CL or ML). Soils on the slopes are derived from loess. Shale and limestone underlie the surface soil deposits.
 - (2) The primary or principal spillway consists of a reinforced concrete riser (drop inlet) with a 48 inch diameter reinforced concrete pipe conduit outlet.
 - (3) The emergency spillway consists of a vegetated earth channel cut into CL loess on the left (west) abutment. It has a bottom width of 350 feet and side slopes of 3H on 1V.
- b. Location. The dam is located in the central portion of Lafayette County, Missouri, as shown on Plate 2. The dam is shown on Plate 1 in the NE $\frac{1}{4}$ of Section 8 and the NW $\frac{1}{4}$ of Section 9, T49N, R27W. The lake formed by the dam is shown in the E $\frac{1}{2}$ of Section 8, the NE $\frac{1}{4}$ of Section 17, the W $\frac{1}{2}$ of Section 9 and the W $\frac{1}{2}$ of Section 16, T49N, R27W.

- 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, this dam and impoundment is in the intermediate size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends ten miles downstream of the dam. Within the damage zone are three to four houses, six improved road crossings and one railroad crossing. The floodplain is farmed.
- e. Ownership. The dam is owned by the Lafayette County Soil and Water Conservation District, 120 West 19th St., Higginsville, Missouri 64037.
- f. Purpose of Dam. The purpose of the dam is flood control.
- g. Design and Construction History. The dam was constructed in 1973. The design and plans for construction were prepared by the Soil Conservation Service (SCS), Columbia, Missouri. Portions of these plans are included with this report as Appendix C.
- h. Normal Operating Procedure. All spillways are uncontrolled and the permanent pool level is dependent upon runoff and evaporation.

1.3 PERTINENT DATA

- a. Drainage Area - 9200 Acres (SCS value checked by consultant).
- b. Discharge at Damsite.
 - (1) All discharge at the damsite is through an uncontrolled reinforced concrete riser drop inlet principal spillway (4' x 12' riser opening) and a grassed earth channel ungated emergency spillway (350' bottom width).
 - (2) Estimated maximum flood at damsite - unknown.
 - (3) The principal spillway capacity varies from 0 c.f.s. at elevation 774 feet to 349 c.f.s. at the crest of the emergency spillway (788.6 feet).
 - (4) The principal spillway capacity at maximum pool elevation (794.24) is 375 c.f.s. Maximum pool elevation is that design value for freeboard pool level as furnished on SCS as-built plans.
 - (5) The total spillway capacity at maximum pool elevation is 12200 c.f.s.

- (6) The total spillway capacity at maximum pool elevation is 12600 c.f.s.

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

- (1) Top of dam - 796.0 (SCS plans) - 795.8 (Survey 15 September, 1978).
- (2) Principal spillway crest - 774.0.
- (3) Emergency spillway crest - 788.6.
- (4) Streambed at centerline of dam - 746 ±.
- (5) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 13000 feet ±.

e. Storage (Acre-feet). Top of dam - 6700.

f. Reservoir Surface (Acres).

- (1) Top of dam - 555 acres±.
- (2) Spillway crest (principal) - 105±
(emergency) - 319±.

g. Dam

- (1) Type - earth embankment.
- (2) Length - 1200 feet ±.
- (3) Height - 50 feet ±.
- (4) Top width - 14 feet.
- (5) Side Slopes
 - (a) Downstream - 2.5H on 1V with 10 foot berm at elevation 762 feet
 - (b) Upstream - 2.5H on 1V with 10 foot berm at elevation 770 feet
- (6) Zoning - none (homogeneous embankment)
- (7) Impervious Core - all embankment material shown as silty clay (CL).

(8) Cutoff - The plans show cutoff varying in depth from 4 to 15 feet with 12 foot bottom width and side slopes varying from 1H on 1V to 3H on 1V.

(9) Grout curtain - none.

(10) Drains - Plans show foundation and embankment (chimney) drain on the right abutment (centerline station 14+20 to 15+70±).

(11) Wave Protection - Riprap from elevation 770 to 779.

h. Diversion Channel and Regulating Tunnel. None

i. Spillway

(1) Principal

(a) Type - Uncontrolled drop inlet (4.0 feet width x 12.0 length x 15.0 feet depth) reinforced concrete riser with rectangular weir orifice inlet and a 48 inch reinforced concrete pressure pipe.

(b) Size of weir orifice - 4 5.75 feet length sections.

(c) Crest elevation - 774.0 M.S.L.

(2) Emergency

(a) Type - standard SCS grassed earth channel with case 4 approach channel profile and splitter dike (2 feet high, 8 feet crest width, and 3:1 side slopes) extending downstream from control section on centerline (see SCS plans appendix).

(b) Control section - 350 foot bottom width; 3(h):1(v) left bank and 2.5:1 right bank.

(c) Crest elevation - 788.6 feet M.S.L.

(d) Upstream channel - 43° curved channel in good condition.

(e) Downstream channel - heavy grass in good condition.

j. Regulating Outlet

(1) Principal Spillway

(a) Reinforced concrete inlet (inlet invert elevation 760.0) with 24-inch diameter R/C pipe.

(b) 24-inch diameter rising stem slide gate and 24-inch diameter removable handwheel with lift (see as-built plans) at outlet into riser (outlet invert elevation 760.0).

(2) Emergency Spillway - none.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

Data on the Geologic and Soil Mechanics investigation, hydraulic/hydrologic computations and "as-built" construction plans were supplied by the SCS, Columbia, Mo. This information is shown in Appendix C and Appendix D.

2.2 CONSTRUCTION

No construction data were readily available; however, it is reported that the dam was constructed with SCS engineering supervision and standard inspection and quality control procedures.

2.3 OPERATION

All spillways are uncontrolled. It was reported that the emergency spillway has not operated and that the maximum pool level was about 3 feet above the level of the riprap (elevation 782 feet $\pm$) in the spring of 1978.

No information was available on operation of the regulated drain or drawdown system.

2.4 EVALUATION

- a. Availability. The engineering data shown in Appendix C were readily available from the SCS, Columbia, Mo.
- b. Adequacy. The available data are considered adequate to assess the design and stability of the structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. The available engineering data for this structure are considered valid.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of Structure No. 1 - Little Sni-I-Bar Creek was made on September 15, 1978. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: Rey Decker, Geology and Soil Mechanics; Garold Ulmer, Civil Engineer; Richard Walker and Gordon Jamison, Hydrology. Mr. Struchtemeyer, landowner on the east side of the dam, assisted the inspection party with access to the dam.

Results of the visual inspection are summarized below. Photographs are shown in Appendix B.

- b. Dam. Rough measurements of the profile along the crest of the dam and emergency spillway centerline and cross-sections of the embankment and spillway indicate that the dam was constructed according to the plans shown in Appendix C.

The plans show a constructed embankment crest elevation of 796.0 feet with a settled crest elevation of 794.4. Measurements along the centerline of the dam indicate that the crest elevation is 795.8 feet from about C stations 7+00 to 18+00, the right (east) abutment (stationing according to plans). The crest elevation of the embankment extension on the left end along the emergency spillway was measured as 795.3 feet. (Crest elevations are based upon principal spillway crest elevation of 774.0)

The dam is covered with an excellent growth of adapted grasses and legumes.

A few small trees and shrubs were observed on the downstream slope. Several small cottonwood trees are growing along the waterline on the upstream slope.

Several small rills and washes were observed on both slopes of the dam. These probably result from small drying cracks that were also observed on the crest and slopes of the dam. Several rodent holes were also observed on the downstream slope.

The foundation - embankment drain was not discharging at the time of the inspection. There were no indications of seepage on the downstream slope or along the toe of the dam.

No slips, sloughs or abnormal deformations were observed on the embankment or abutments.

The riprap on the upstream slope appeared to be in good shape.

c. Appurtenant Structures

- (1) Principal spillway. There were no indications of spalling or deterioration of the principal spillway riser nor the concrete pipe outlet. The lake level was just below (0.1 ft.) the crest elevation of the spillway at the time of the inspection. A number of logs and tree branches, up to 6 inches in diameter, were lodged around the trash rack of the spillway.

The riprap in the stilling basin appeared to be satisfactory. Some erosion and/or sloughing was noted on the right (east) bank of the stilling basin about 30 feet downstream from the spillway outlet and above the level of the riprap.

- (2) Emergency spillway. The emergency spillway is well vegetated with adapted grasses and legumes. A splitter dike about 3 feet high is located along the centerline of the spillway. The spillway looks very good with no evidence of erosion or slides in the bottom or side slopes.
- (3) Drawdown facility. The plans show a 24 inch R/C pipe entering the base of the principal spillway riser. Flow through this system is controlled by a 24 inch rising stem slide gate. This system is designed as a drawdown facility to evacuate the reservoir. It is not known whether or not the gate is operable.

- d. Reservoir Area. No excessive wave wash, or erosion or slides were observed along the shore of the reservoir.

- e. Downstream Channel. The channel downstream from the principal spillway appeared to be open and unobstructed.

3.2 EVALUATION

None of the conditions observed indicate a need for immediate remedial action. Trees and shrubs on both slopes and logs and trash around the inlet to the principal spillway are deficiencies which could ultimately impair the integrity of the dam and/or the intended operation of the spillways if left uncontrolled or uncorrected.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The pool level is normally controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillways. Procedures for operating the drawdown facility are not known.

4.2 MAINTENANCE OF DAM

The dam is reasonably well maintained. Action should be taken to correct the minor deficiencies noted in Sections 3 and 7.2.

4.3 MAINTENANCE OF OPERATING FACILITIES

It is not known if the drawdown facility is operable nor if and when the system has been operated.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The dam and appurtenances appear to be well maintained with the exception of some laxity in controlling tree growth on the embankment and allowing trash and logs to accumulate around the principal spillway inlet. Controlling vegetation on the embankment slopes will facilitate inspection and evaluation (for repair) of rodent holes and rill erosion.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. Pertinent hydraulic and hydrologic data which were taken from as-built plans furnished by the SCS are tabulated in Appendix D as Hydrologic Computations. The supporting computations are attached.
- b. Experience Data. The drainage area and elevation-storage curve were taken from the SCS as-built plans. The reservoir water surface areas were developed from the USGS Odessa North 7 1/2' quadrangle and compared with the as-built. The hydraulic computations for spillways and dam overtopping discharge ratings were based on the data taken from the as-built plans. Surveys made during the field inspections revealed no major discrepancies as far as the structural components of the dam and spillways were concerned.
- c. Visual Observations.
 - (1) Principal and emergency spillways are in good condition.
 - (2) The emergency spillway does not appear to have ever been used.
 - (3) The emergency spillway channel exit is in the left hillside approximately 600 feet downstream from the dam toe. Spillway releases will not endanger the integrity of the dam.
- d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping. One-half the PMF will overtop the dam a maximum of 1.3 ft. and for a period of 3.4 hours. The spillways will pass 39% of the PMF without overtopping the dam. The existing spillways will pass the 24-hour 100-year frequency flood without overtopping. The results of the routings through the dam are tabulated in regards to the following conditions. Since the spillway is not capable of passing a minimum of one-half of the PMF without overtopping the dam and causing failure, the spillway is considered seriously inadequate and the dam is accordingly considered unsafe.

<u>Frequency</u>	<u>Peak Inflow Discharge c.f.s.</u>	<u>Peak Outflow Discharge c.f.s.</u>	<u>Maximum Pool Elevation</u>	<u>Top of Dam Min. Elev. 794.4</u>	<u>Time Dam Overtopping Hrs.</u>
100 Yr.	11,600	2,500	790.6	+3.8	-
1/2 PMF	26,900	18,500	795.7	-1.3	3.4
PMF	54,300	47,400	798.4	-4.0	5.9
0.39 PMF	21,000	13,200	794.4	0	-

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillways.

The St. Louis District, Corps of Engineers, in a letter dated 13 August, 1978 has estimated the damage zone as extending ten miles downstream from the dam. Within the damage zone are three to four houses, six improved road crossings and one railroad crossing. The floodplain is farmed. Field inspection verified this.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observations. Maintenance features that could affect the long time safety of the dam are discussed in Section 3.2.

Hydraulic/hydrologic analyses presented in Section 5 indicate that the dam will be overtopped by the probable maximum flood with settled crest elevation of 794.4 feet. Under those conditions, water would flow over the top of the dam to a maximum depth of 4 feet for about 6 hours. It is doubtful that this structure could withstand such flows without seriously impairing the structural stability of the dam.

- b. Design and Construction Data. The engineering data, analyses, and plans supplied by SCS conform with accepted practice and are considered adequate to assess the structural stability of the dam. There is no reason to question the adequacy of construction supervision and quality control.
- c. Operating Records. There are no appurtenant structures that require operational functions.
- d. Post Construction Changes. The inspection party is not aware of any post construction changes.
- e. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of this magnitude is not expected to cause structural failure of this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

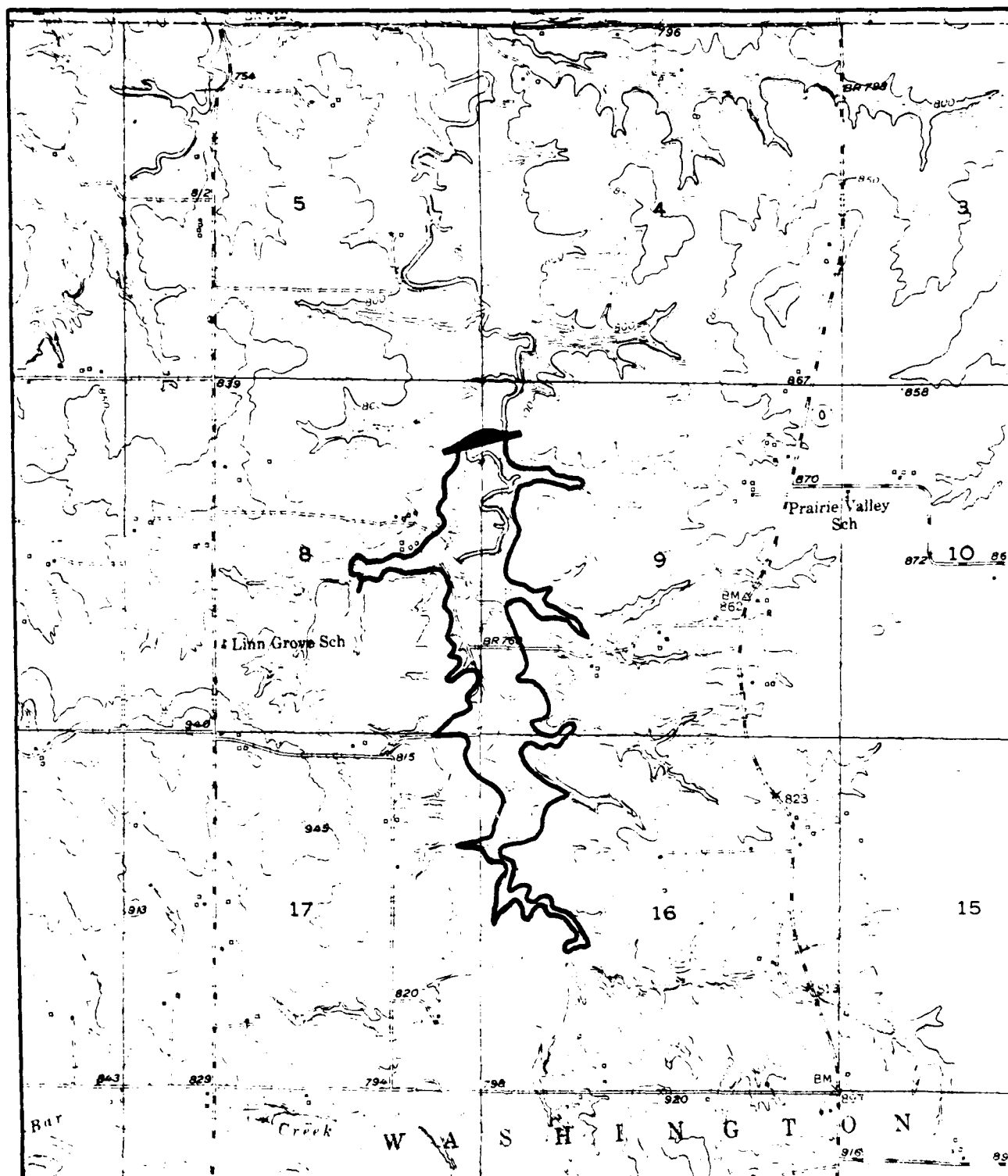
7.1 DAM ASSESSMENT

- a. Safety. The few deficiencies in maintenance that were observed, a few small trees on the embankment slopes and logs around the inlet to the principal spillway, should be corrected or controlled. With the assumptions used for the hydrologic analyses, the probable maximum flood (PMF) will overtop the dam. Under present conditions, the flood resulting from 1/2 PMF will overtop the left end of the dam to a depth of 1.3 feet.
- b. Adequacy of Information. The information presented in this report is considered adequate to assess the safety of the structure. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. There does not appear to be an immediate urgency to accomplish the remedial measures discussed in paragraph 7.2.
- d. Necessity for Phase II. Based on the results of the Phase I inspection, Phase II investigations are not considered necessary.
- e. Seismic Stability. An earthquake of the magnitude to be expected in this area should not be hazardous to this dam.

7.2 REMEDIAL MEASURES

- a. Alternatives.
 - (1) The size of the emergency spillway and/or the height of the dam should be increased to pass the probable maximum flood without overtopping the dam.
 - (2) Increasing the height of the dam on the left (west) end would allow passage of 0.5 of the probable maximum flood without overtopping the dam. Under this alternative it is recommended that surveys be conducted annually along the crest of the dam to monitor the settlement characteristics of this structure.
- b. O & M Maintenance and Procedures.
 - (1) The trees should be removed from the slopes of the dam, and the logs and trash should be removed from the entrance to the principal spillway.
 - (2) A program of regular maintenance and inspection should be initiated. This program should be designed to control vegetation on the dam, keep the principal spillway open and repair rodent holes and rill erosion on the slopes of the dam.

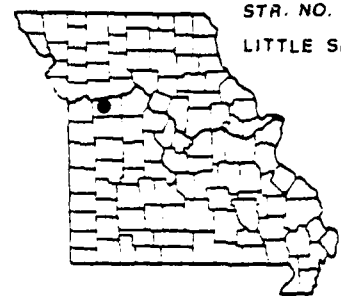
APPENDIX A
MAPS



SCALE IN FEET
2000 1000 0 2000 4000
1000 500 0 1000
SCALE IN METERS

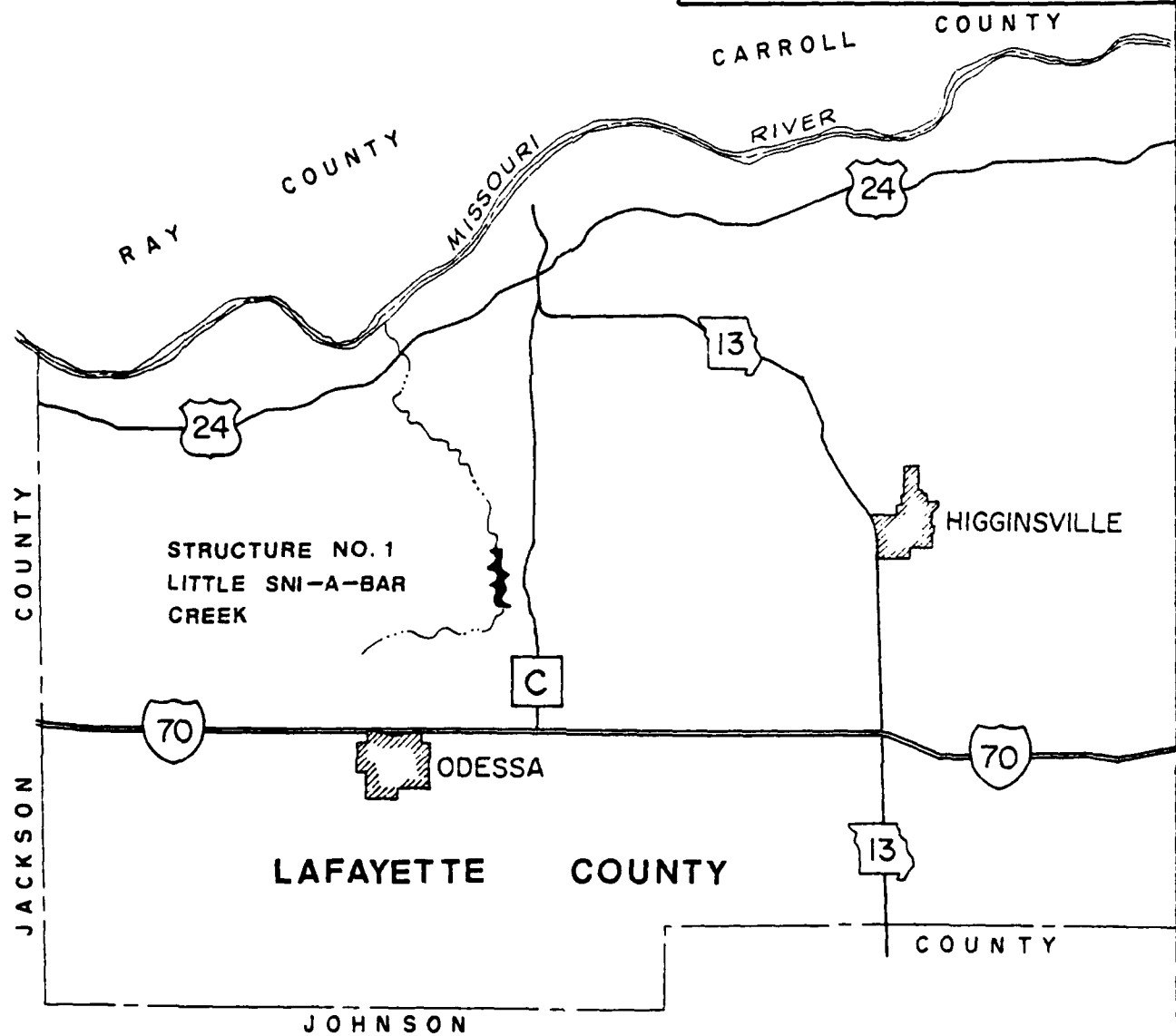
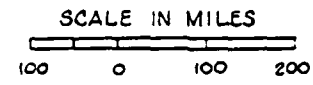


STRUCTURE NO. 1
LITTLE SNI-A-BAR
CREEK
VICINITY TOPOGRAPHY
PLATE I



STR. NO. 1
LITTLE SNI-A-BAR

VICINITY MAP



JACKSON COUNTY

RAY COUNTY

CARROLL COUNTY

STRUCTURE NO. 1
LITTLE SNI-A-BAR
CREEK

C

HIGGINSVILLE

ODESSA

LAFAYETTE COUNTY

COUNTY

JOHNSON



LOCATION MAP
PLATE 2

APPENDIX B
PHOTOGRAPHS



PHOTO. NO. 2
LOOKING EAST ACROSS
EMERGENCY SPILLWAY
FROM WEST ABUTMENT.
SPLITTER DIKE IN
CENTER OF PICTURE.



PHOTO. NO. 3
FOREBAY OF EMERGENCY
SPILLWAY, CREST AND
UPSTREAM SLOPE OF
DAM FROM WEST ABUTMENT.



PHOTO. NO. 4
LOOKING UPSTREAM
FROM CONTROL SECTION
OF EMERGENCY SPILLWAY
TOWARD WEST SIDE OF
SPILLWAY.



PHOTO. NO. 5
LOOKING UPSTREAM
INTO FOREBAY OF
EMERGENCY SPILLWAY
TOWARD EAST SIDE
OF SPILLWAY.



PHOTO. NO. 6
LOOKING DOWNSTREAM
ALONG CENTER LINE
OF EMERGENCY SPILLWAY.
SPLITTER DIKE IN
CENTER OF PICTURE.



PHOTO. NO. 7
DOWNSTREAM SLOPE
FROM WEST.



PHOTO. NO. 8
LOOKING UPSTREAM
AT PRINCIPAL
SPILLWAY RISER.



PHOTO. NO. 9
LOOKING DOWNSTREAM
AT PRINCIPAL SPILLWAY
OUTLET.

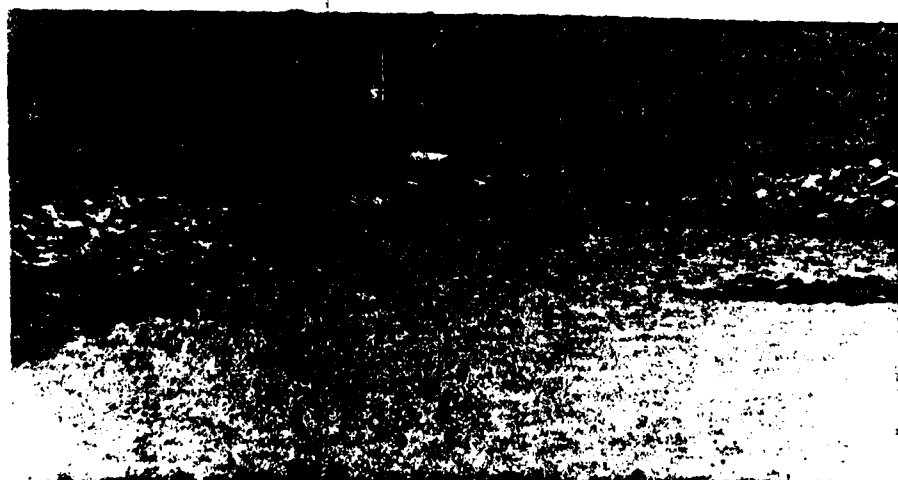


PHOTO. NO. 10
LOOKING UPSTREAM
AT PRINCIPAL SPILLWAY
OUTLET.



PHOTO. NO. 11
LOOKING EAST ACROSS
STILLING BASIN AT
EROSION ON EAST BANK
OF BASIN ABOVE
RIPRAP.



PHOTO. NO. 12
UPSTREAM SLOPE
FROM WEST END.



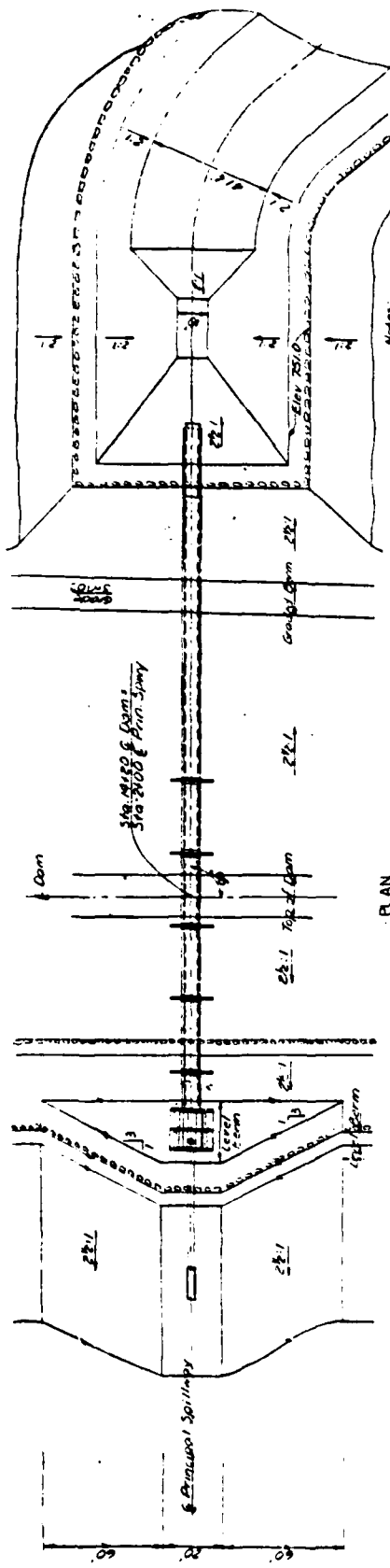
PHOTO. NO. 13
RIPRAP ON UPSTREAM
SLOPE AND SMALL
COTTONWOOD TREES
IN FOREGROUND.

APPENDIX C
PLANS AND REPORTS

V

Details on Sheet 2, 3, 4

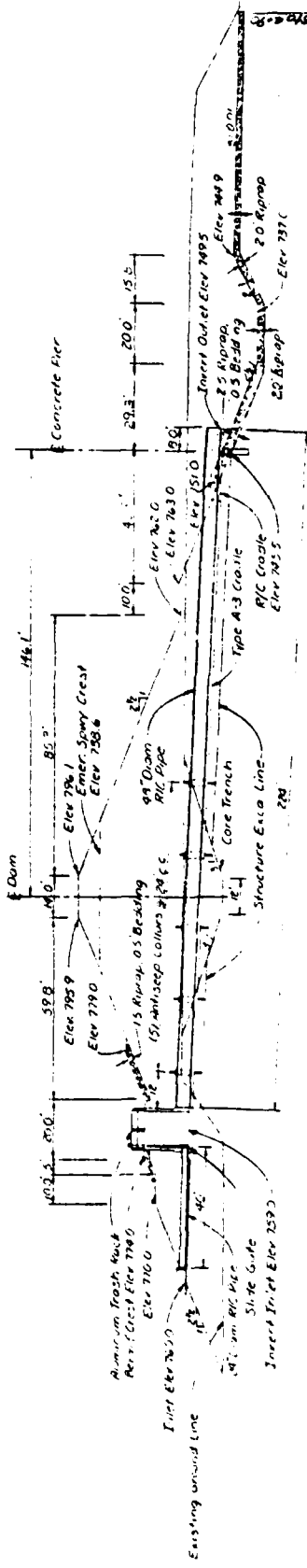
Details on Sheets 9, 10, 11



PLAN

Notes:

1. Conduit in accordance with the elevations given in the table below
2. Conduit elevations other than those shown will be furnished by the Engineer, when required
3. Antiseep collars shall not be placed closer than two feet to a pipe joint



SECTION ON CENTERLINE



PIPE	CONDUIT	INLET	ELEVATION
0	0	0	7290
10	10	10	7300
20	20	20	7310
30	30	30	7320
40	40	40	7330
50	50	50	7340
60	60	60	7350
70	70	70	7360
80	80	80	7370
90	90	90	7380
100	100	100	7390
110	110	110	7400
120	120	120	7410
130	130	130	7420
140	140	140	7430
150	150	150	7440
160	160	160	7450
170	170	170	7460
180	180	180	7470
190	190	190	7480
200	200	200	7490
210	210	210	7500
220	220	220	7510
230	230	230	7520
240	240	240	7530
250	250	250	7540
260	260	260	7550
270	270	270	7560
280	280	280	7570
290	290	290	7580
300	300	300	7590
310	310	310	7600
320	320	320	7610
330	330	330	7620
340	340	340	7630
350	350	350	7640
360	360	360	7650
370	370	370	7660
380	380	380	7670
390	390	390	7680
400	400	400	7690
410	410	410	7700
420	420	420	7710
430	430	430	7720
440	440	440	7730
450	450	450	7740
460	460	460	7750
470	470	470	7760
480	480	480	7770
490	490	490	7780
500	500	500	7790
510	510	510	7800
520	520	520	7810
530	530	530	7820
540	540	540	7830
550	550	550	7840
560	560	560	7850
570	570	570	7860
580	580	580	7870
590	590	590	7880
600	600	600	7890
610	610	610	7900
620	620	620	7910
630	630	630	7920
640	640	640	7930
650	650	650	7940
660	660	660	7950
670	670	670	7960
680	680	680	7970
690	690	690	7980
700	700	700	7990
710	710	710	8000
720	720	720	8010
730	730	730	8020
740	740	740	8030
750	750	750	8040
760	760	760	8050
770	770	770	8060
780	780	780	8070
790	790	790	8080
800	800	800	8090
810	810	810	8100
820	820	820	8110
830	830	830	8120
840	840	840	8130
850	850	850	8140
860	860	860	8150
870	870	870	8160
880	880	880	8170
890	890	890	8180
900	900	900	8190
910	910	910	8200
920	920	920	8210
930	930	930	8220
940	940	940	8230
950	950	950	8240
960	960	960	8250
970	970	970	8260
980	980	980	8270
990	990	990	8280
1000	1000	1000	8290

QUANTITIES

- Concrete - Class 4000
- Steel Bar Reinforcement
- Pipe Conduit - Reinforced Concrete (Pressure) 48" Diam. Steel Ring Type Joint / Rubber Gasket
- Aluminum Trash Vault
- Slide Gate, 8' x 10'

AS BUILT

9-18-78

STRUCTURE NO. 1

R/C DROP INLET FOR 48" DIAM PIPE

GENERAL LAYOUT

LITTLE SAI-A-BAR WATERSHED PL 566

LAFAYETTE COUNTY, MISSOURI

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

DATE

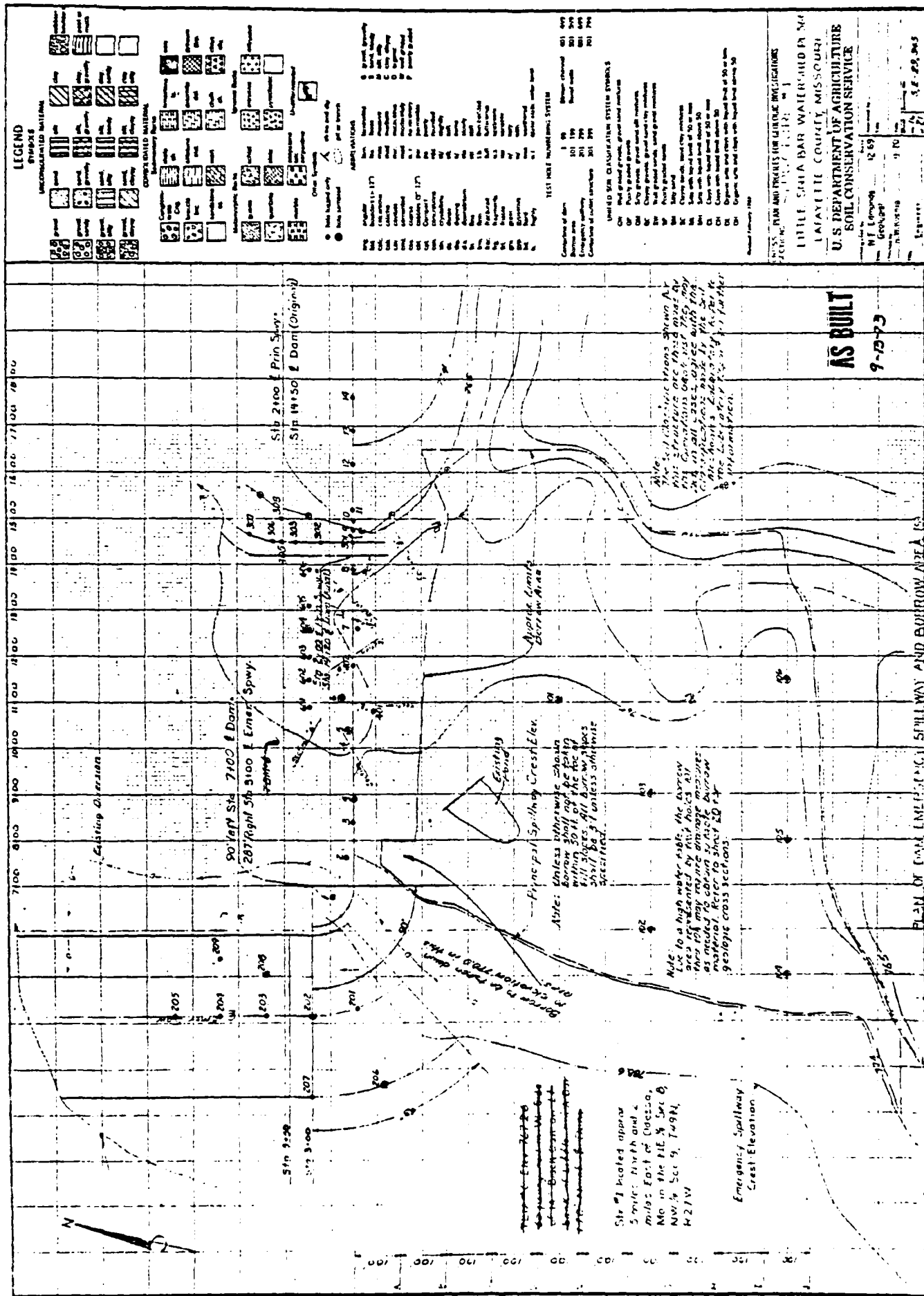
BY

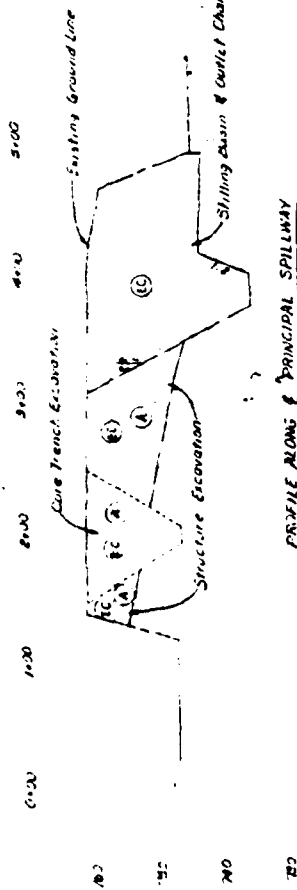
CHKD

APP'D

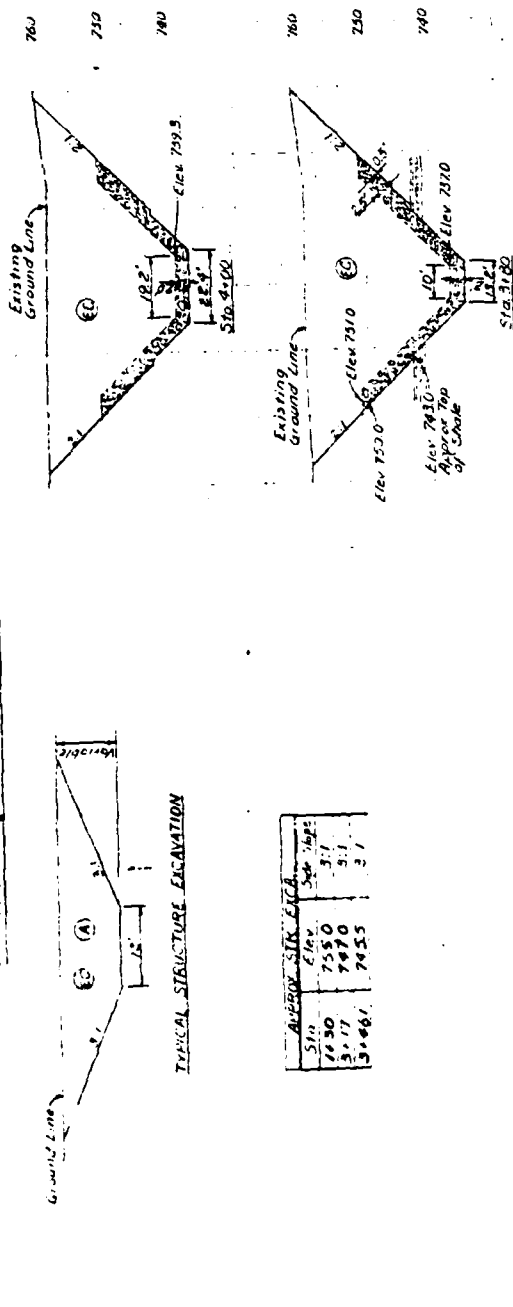
B.C.S. Form 8 (Rev. 12-10-71)

5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 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, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100





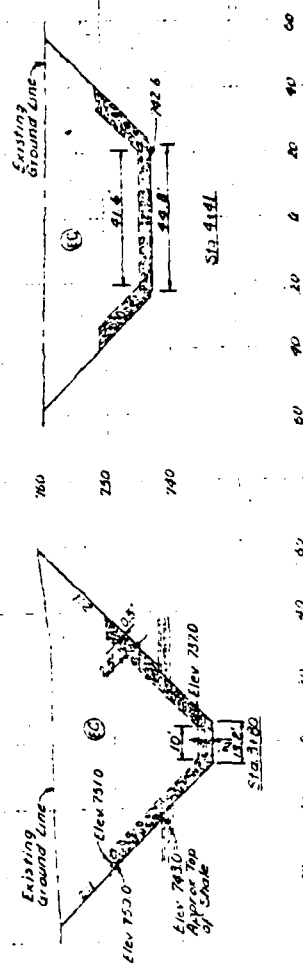
PROFILE ALONG PRINCIPAL SPILLWAY



TYPICAL STRUCTURE EXCAVATION

Station	Elev	Side Slope
6+00	755.0	3:1
6+10	747.0	3:1
6+20	745.5	3:1

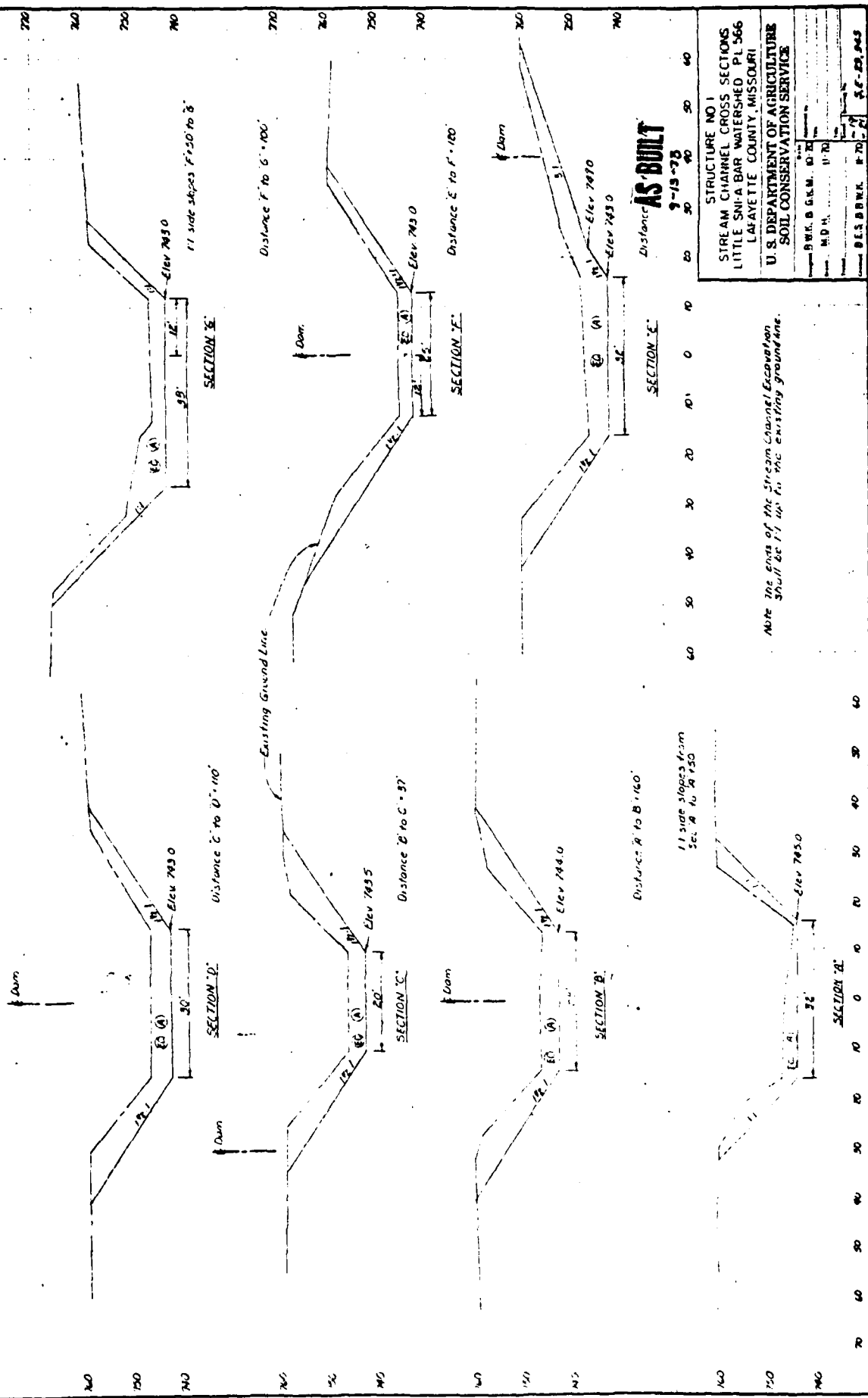
CROSS SECTIONS STILLING BASIN & OUTLET CHANNEL



AS BUILT

STRUCTURE NO. 1

PRINCIPAL SPILLWAY EXCAVATION
LITTLE-SNIA-BAR WATERSHED PL 566
LAFAYETTE COUNTY, MISSOURI
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
DATE: 8-1-54
BY: J. L. H. H. H.
SCALE: 1" = 20' HORIZ. 1" = 10' VERT.
1-1-54



AS BUILT

9-15-78

STRUCTURE NO. 1	
STREAM CHANNEL CROSS SECTIONS	
LITTLE SNIA BAR WATERSHED PL 566	
LAFAYETTE COUNTY, MISSOURI	
U. S. DEPARTMENT OF AGRICULTURE	
SOIL CONSERVATION SERVICE	
BY: B. G. M. D. R.	DATE: 11-78
MDH	11-78
DESIGNED BY: B. G. M. D. R.	DATE: 11-78

Note: The ends of the Stream Channel Excavation shall be 11 ft. to the existing groundline.

STRUCTURE DATA

Class of Structure * "a" Floodwater Retarding
 Drainage Area (total) 2197 Ac. 14.37 Sq.Mi.
 (uncontrolled) 2197 Ac. 14.37 Sq.Mi.
 Time of Concentration 2.3 Hours
 Soil Cover Complex Number 78 For A.M.C. II
 Segment Capacity Available 651 Ac.Ft. below Elev. 774.0
 Total Sediment Capacity Available 651 Ac.Ft.
 Capacity Equivalents (Vol.) 0.85 In.
 Retarding Capacity Provided 3080 Ac.Ft.
 Capacity Equivalents (Vol.) 4.02 In.
 Water Supply Provided None Ac.Ft.-Identify Uses

Principal Spillway:

Maximum Capacity flow stage 351 c.f.s.
 Maximum Capacity (high stage) 774.0 c.f.s.
 10 Day Drawdown Elev. 774.0

Emergency Spillway:

Percent Chance Use 2 Storm Duration 6 Hours
 Type Vegetated Earth "n" Value Used 0.04
 Emergency Spillway Hydrograph for Class * "a" Structures

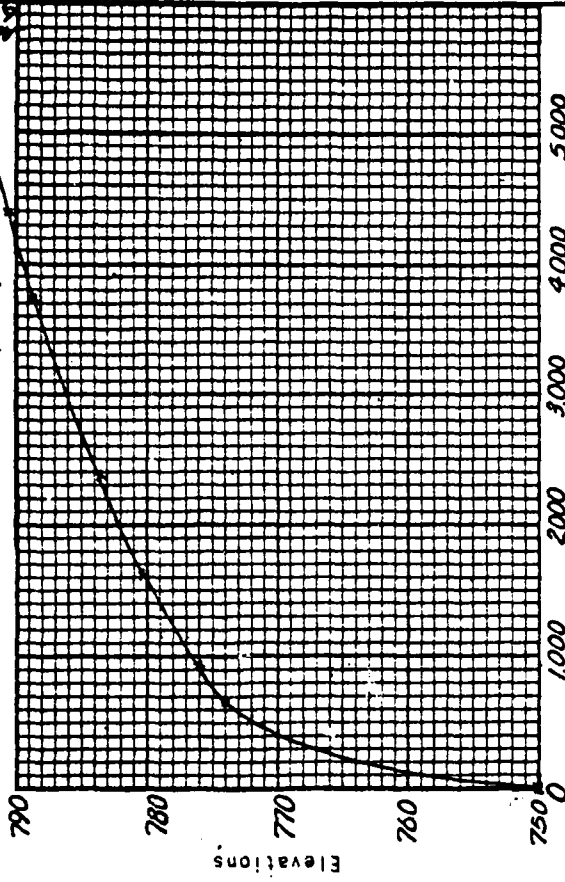
Rainfall ** 7.95 in.
 Runoff 5.36 in.
 Peak Inflow 13,865 c.f.s.
 Maximum Discharge - Emergency Spillway 1693 c.f.s.
 Maximum Water Surface Elev. 790.36
 Velocity of Flow (V) 5.9 f.p.s.

Supplementary Data and Special Design Features:

Principal Spillway Crest Elev. = 774.0
 Emergency Spillway Crest Elev. = 788.6
 Emergency Spillway Bottom Width = 350'
 Top of Settled Dam Elev. = 794.4
 Height x Storage = 43.6 x 3,731 = 162,672

Freeboard Hydrograph for Class * "a" Structures
 Rainfall ** 13.67 in.
 Runoff 10.80 in.
 Peak Inflow 28,375 c.f.s.
 Maximum Discharge - Emergency Spillway 12,758 c.f.s.
 Maximum Water Surface Elev. 794.24

Reservoir Capacity



AS BUILT
9-13-73

Total Storage - Ac.Ft.

Supplementary Data and Special Design Features:

* Class "b" hydrologic Criteria used for design.
 ** Areal Correction = 97% of Point Rainfall.
 Emergency Point Rainfall = 8.2 inches
 Freeboard Point Rainfall = 14.1 inches

STRUCTURE NO. 1	
LITTLE SW-A-BAR WATERSHED PL-566	
LAFAYETTE COUNTY, MISSOURI	
U. S. DEPARTMENT OF AGRICULTURE	
SOIL CONSERVATION SERVICE	
Designed by <u>RWA & GKM R72</u>	Checked by <u>B.C.S.</u>
Dated <u>8-70</u>	Drawn by <u>M.M.B. & P.M. 11-70</u>
Project No. <u>5E-29,345-N</u>	

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory
800 "J" Street, Lincoln, Nebraska 66508

SUBJECT: ENG 22-5, Missouri WP-08, Little Sní-A-Bar
Site No. 1 (Lafayette County)

DATE: September 18, 1970

TO: James M. Dale, State Conservation Engineer
SCS, Columbia, Missouri

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 5 sheets.
2. Form SCS-128 & 128A, Consolidation Test Data, 7 sheets (2 tests).
3. Form SCS-127, Soil Permeability, 2 sheets.
4. Form SCS-355A, Triaxial Shear Test Data, 3 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 11 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 4 sheets.

DISCUSSION

FOUNDATION

- A. Bedrock. The bedrock underlying the site is shale and sandstone of the Kansas City Group, Missourian Series, of the Pennsylvanian System. The bedrock surface drops abruptly in the right abutment between test holes 10 and 11, which is a distance of 25 feet.
- B. Classification. Soil cover over the left abutment is loess and ranges from 13 to 31 feet in thickness, and is field classified as CL with ML topsoil. Field samples of this material (Sample Nos. 4.2, 4.3, 4.4, and 4.5) from 13 feet through 24 feet are classified as CL's with liquid limits ranging from 33 to 43 and PI's ranging from 13 to 22. Field sample No. 4.1 from the 9-foot to 10-foot depth has a liquid limit of 50 and PI of 28 and is classified in the Laboratory as CL or CH. These samples are thought to be representative of the loess material on the left abutment and the right abutment to the right of the bedrock dropoff near Station 15+10.

The alluvium in the floodplain is reported to be uniform, and the upper 10 to 14 feet is classified as ML. This material was sampled in test hole 6, and Samples 6.1 and 6.2 have liquid limits of 26 and 27 with PI's of 3 and 5. They are classed as CL and CL-ML, respectively. In test hole 8, Samples 8.1 and 8.2 have liquid limits of 29 and 25 with PI's of 6 and 5, respectively. They are classed as ML and CL-ML, respectively.

Below the upper 10 to 14 feet and extending to bedrock the alluvium is field classified as very silty CL. In test hole No. 6, Samples 6.3 and 6.4 have liquid limits of 28 and PI's of 5, and are classed as ML. In test hole No. 8, Samples 8.3, 8.4, and 8.6 have liquid limits ranging from 30 to 34 with PI's ranging from 9 to 15, and are classed as CL.

A greenish gray, firm CL was reported above the bedrock on the left side of the valley. This material was sampled in test hole 5 by Sample 5.1. This sample has a liquid limit of 23 and PI of 4 and is classed CL-ML. Twenty-two percent of this material is sand size.

The alluvium is reported to become firmer near the abutments. Holes drilled 95 feet downstream from the centerline (TH's 601 through 606) indicate that old channel deposits are mixed with the alluvium in the valley section and directly overlie the bedrock in test holes 402 and 6.

- C. Permeability. The geologist reports that no permeable materials were encountered at the site. Falling head permeability tests were made on Sample 70W1935 (Fld. No. 8.5) and Sample 70W1936 (Fld. No. 8.6). Sample 70W1935 is CL-ML material and has a permeability rate near 0.03 ft/day, and Sample 70W1936 is CL material and has a permeability rate near 0.002 ft/day.
- D. Dry Unit Weight. The dry unit weight of Sample 70W1926 is 1.69 gm/cc. This sample represents the silty clay alluvium overlying the bedrock. The sample was taken from 18 to 19 feet in TH 5.

The dry density of Sample 70W1935 ranged from 1.43 gm/cc to 1.48 gm/cc. This sample was taken from 9 to 11 feet in TH 8 and represents the upper alluvium of the floodplain. Sample 70W1936 from 16 to 18 feet in TH 8 represents the silty clay overlying the bedrock and has a dry density of 1.54 gm/cc.

Blow count was also taken in TH 8 but the elevation of the water table in the hole was not recorded.

At 10 to 11 feet, N = 3; at 15 to 16 feet, N = 5; and at 20 to 21 feet, N = 5 was reported in the test hole logs.

Blow count was also taken in TH 6 and was recorded as N = 3 from 5 to 6 feet, N = 2 from 10 to 11 feet, N = 2 from 15 to 15.5 feet, N = 7 from 15.5 to 16 feet, and N = 7 from 18 to 19 feet.

- E. Consolidation. Consolidation tests were made on Samples 70W1935 and 70W1936. The test specimens were flooded throughout the tests. At station 14+50 about 11 feet of the ML alluvium overlie 14 feet of the CL alluvium which rests on the bedrock. Settlement in the foundation was estimated on the basis of Sample 70W1935 representing the upper 11 feet of alluvium and on Sample 70W1936 representing the lower 13 feet of the alluvium. At the intersection of the dam and of the conduit, settlement in the range of 1.2 feet was computed. The fill is 29.1 feet in height at this location. At station 13+50 about 9 feet of the CL alluvium underlies the 47-foot embankment.

Settlement in the foundation alluvium was estimated on the basis of Sample 70W1936 representing this material, and settlement in the range of 0.58 foot was computed. At station 15+30 about 5 feet of ML underlie the 24-foot embankment. Settlement in the foundation alluvium was estimated on the basis of Sample 70W1935 being representative of the ML alluvium, and settlement in the range of 0.2 foot was computed.

- F. Shear Strength. Consolidated undrained triaxial shear tests were made on Samples 70W1935 and 70W1936, which represent the ML alluvium and CL alluvium, respectively. In both tests, the test specimens were trimmed from the undisturbed sample. The test specimens of Sample 70W1935 were soaked prior to testing but the test specimens of Sample 70W1936 were tested at their natural water content. In both cases saturation of the test specimens was at least 95 percent of theoretical saturation. Shear strength parameters of $\phi = 25^\circ$, $c = 100$ psf were interpreted for the ML alluvium represented by Sample 70W1935, and shear strength parameters of $\phi = 23^\circ$, $c = 150$ psf were interpreted for the CL alluvium represented by Sample 70W1936.

EMBANKMENT

- A. Classification. Emergency spillway samples 202.1 through 208.2 (Laboratory sample numbers 70W1940 through 70W1947) have liquid limits ranging from 43 to 33 and PI's ranging from 21 to 14. Borrow samples 101.1, 102.1 and 102.2 (Laboratory sample Nos. 70W1948, 70W1949, and 70W1950) are classified in the Laboratory as CL's. Borrow sample 105.1 (Laboratory No. 70W1951) has a liquid limit of 28 and PI of 6 and is classed as CL-ML. A detailed report of each sample's properties will be found in the attached Form SCS-354's.
- B. Density. Standard Proctor compaction tests were made on 7 of the samples from the emergency spillway. Compacted dry density of these samples ranges from 103.0 pcf to 111.5 pcf and optimum moisture averages near 18 percent. Standard Proctor compaction tests were also made on the four borrow samples, and the compacted dry density of these samples ranges from 102.5 pcf to 108.5 pcf with optimum moisture averaging near 18 percent. See the attached Form SCS-354 for individual sample densities and optimum moisture contents.
- C. Shear Strength. Sample 70W1941 from the emergency spillway is thought to be typical of the borrow materials at the site. A consolidated undrained triaxial shear test was made on this sample. The test specimens were molded near Proctor density and soaked prior to testing. At the time of testing the test specimens were near theoretical saturation, and shear strength parameters of $\phi = 12.5^\circ$, $c = 875$ psf were interpreted from the test.

James M. Dale

4

Subj: Missouri WP-08, Little Sni-A-Bar, Site No. 1

SLOPE STABILITY

- A. Maximum Section at Station 12+00. At this location the embankment will be 50.6 feet in height, resting on 9 feet of alluvium over bedrock.

The analyses were made by a modification of the Swedish circle method and considered $2\frac{1}{2}:1$ upstream and downstream slopes, rapid drawdown from the base of the emergency spillway elevation to the base of the fill (full drawdown), full phreatic surface (no drain), and 10-foot wide berms on the upstream and downstream slopes. The embankment shear strength parameters are $\phi = 12.5^\circ$, $c = 875$ psf, and both sets of shear strength parameters for the alluvial foundation were tried in the analyses. The weakest factor of safety found was 1.28 from an arc cutting through the embankment ($\phi = 12.5^\circ$, $c = 875$ psf) upstream and 9 feet into the foundation with shear strength parameters of $\phi = 23^\circ$, $c = 150$ psf.

- B. Floodplain Section at Station 12+60. At this location the embankment will be 35.1 feet high resting on 22 feet of alluvial materials over the bedrock. The analyses consider the same conditions as the maximum section above. The weakest factor of safety of 1.39 was found in the upstream arc cutting through the embankment ($\phi = 12.5^\circ$, $c = 875$ psf) and 22 feet into the alluvial foundation with shear strength parameters of $\phi = 25^\circ$, $c = 100$ psf.

The stability analyses of both sections assume that depths of material shown on the centerline profile sheet 2 of 3 of Form SCS-35B for this site are level upstream and downstream. Because of the meander of the stream channel, the sections represented by the analyses are a little more severe than the conditions that exist in the field.

SETTLEMENT ANALYSIS

Settlement estimates made along the $\frac{1}{2}$ of the structure indicate settlement of 1.2 feet at Station 14+50, and settlement of 0.2 foot at Station 15+30. This is a differential of about 1 foot in a horizontal distance of 100 feet. The slope of the bedrock surface is quite steep here, and there is a possibility of tension cracks developing unless some corrective measures are taken.

RECOMMENDATIONS

- A. Cutoff Trench. We concur with the trench depths and width recommended by the project engineer between $\frac{1}{2}$ stations 9+50 and 13+90. We suggest that the trench be deepened to the left of $\frac{1}{2}$ station 9+50 to about 5 feet to penetrate the zone of surface disturbances. To the right of $\frac{1}{2}$ station 13+90 differential cracking may be a problem, as previously discussed in the settlement analysis. To defend against this condition, we suggest that the trench be wider than normal from $\frac{1}{2}$ station 13+90 to the vicinity of $\frac{1}{2}$ station 15+30 in order to flatten the bedrock

James M. Dale

5

Subj: Missouri WP-08, Little Sni-A-Bar, Site No. 1

through this area. Flattening the bedrock will insure better soil-to-bedrock contact and spread the load from the fill through this section. We suggest the trench be deepened to the right of station 15+30 to penetrate the zone of surface disturbances. The trench depths suggested should provide good cutoff of underseepage since the permeability of the alluvium under the trench is relatively low. We suggest the trench backfill and the material in the center section of the dam consist of the more plastic borrow materials to obtain the maximum deformability. Place the backfill at a minimum of 95 percent of standard Proctor density and control moisture at or wet of optimum.

- B. Principal Spillway. At the proposed location (Station 14+50) the foundation consists of 24 feet of compressible alluvium assumed to be represented by Samples 70W1935 and 70W1936. Based on the consolidation tests of these samples, embankment height of 29.1 feet, and computed in accordance with TR 18 (Rev.), horizontal strain in the range of 0.011 ft/ft is expected at this location. At Station 13+90 (TH No. 8) the foundation depth is reduced to 22 feet of alluvium. Based on an embankment height of 33.1 feet, and the same consolidation tests, horizontal strain in the range of 0.009 ft/ft was computed at this location. We recommend that the conduit backfill be like that suggested for the cutoff trench. The cutoff trench suggested is quite deep and it may be necessary to deepen the conduit trench and to flare the side slopes of the cutoff trench in order to reduce the strain on the conduit. A ϕ angle of 30° is suggested for conduit loading computations.
- C. Drain. Permeability of the foundation alluvial blanket over the bedrock is relatively low and a drain is not necessary for stability of the slopes. The soil blanket over the bedrock appears to be relatively thick in all areas except on the right abutment where it may thin over the bedrock ledge. It appears the suggested cutoff trench will be quite effective in all areas with the possible exception of the right abutment where drainage may be required. We suggest that the need for a drain be evaluated in the field. If a drain is used to provide a controlled outlet for the bedrock, the drain fill may consist of any uniformly graded sand-gravel mixture that contains less than 3-5 percent nonplastic fines.
- D. Embankment Design.
1. Placement of Materials. A homogeneous embankment is suggested. However, we suggest that the borrow materials with higher PI's be placed in the center portion of the fill to improve embankment deformability and lower the possibility of tension drying cracks. We recommend placing the embankment at a minimum of 95 percent of standard Proctor density with placement moisture controlled at or wet of optimum.

James M. Dale

6

Subj: Missouri WP-08, Little Sni-A-Bar, Site No. 1

2. Slopes. The slope stability analyses indicate that the proposed $2\frac{1}{2}$:1 upstream and downstream slopes with 10-foot berms have acceptable factors of safety.
3. Settlement. An overfill allowance of 1.6 feet is suggested to compensate for residual settlement within the fill and foundation.

Prepared by:

Gerald N. Gibson
Gerald N. Gibson

Reviewed and Approved by:

Lorn P. Dunnigan
Lorn P. Dunnigan
Head
Soil Mechanics Laboratory

Attachments

cc:

James M. Dale (1)
Gerald K. McElhiney, Higginsville, Mo.
E. D. Butler, Lincoln, Nebraska

5/11/70		Ht. = 49'		Class "B"		Floodwater		U.S. DEPARTMENT OF AGRICULTURE		NATIONAL ASSOCIATION OF FLOOD CONTROL DISTRICTS	
704		MISSOURI		Little Salt-A-bar Site: 1		S. Bog		9-10		CL	
1921 4.1		f Dam 8+90		S. Bog		9-10		CL		CL	
1922 4.2		" "		S. Bog		13-14		CL		CL	
1923 4.3		" "		S. Bog		16-17		CL		CL	
1924 4.4		" "		S. Bog		18-19		CL		CL	
1925 4.5		" "		S. Bog		23-24		CL		CL	
1926 5.1		f Dam 10' L 10+40		Unit 1st		18-19		CL		CL	
1927 6.1		f Dam 25' L 11+10		Jar		5-6		ML		ML	
1928 6.2		" "		Jar		10-11		ML		ML	
1929 6.3		" "		Jar		15-16		CL		ML	

U.S. DEPARTMENT OF AGRICULTURE
BUREAU OF AGRICULTURAL ECONOMICS
WASHINGTON, D. C. 20250

[illegible]

CS 450

5/14/10
Page 338
J. M. SCS 330

2. DATA ACQUISITION

DATA DEVELOPMENT

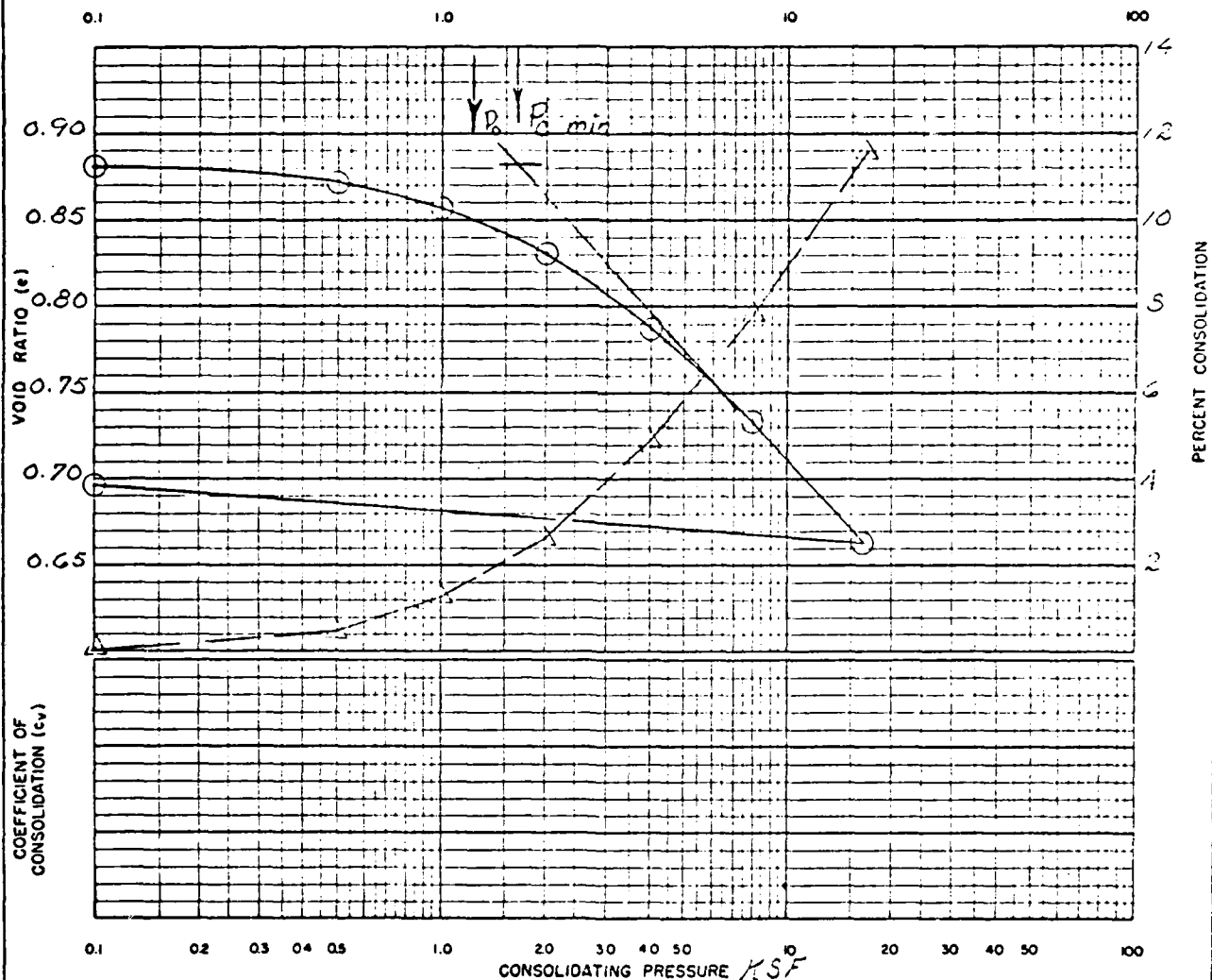
[illegible]

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

PROJECT and STATE <u>LITTLE SYDIA BAR, MO. MISSOURI</u>	SAMPLE LOCATION <u>C. DAM 14100</u>
--	--

FIELD SAMPLE NO. <u>55</u>	DEPTH <u>9.0'-11.0'</u>	GEOLOGIC ORIGIN <u>Alluvium</u>	APPROVED BY <u>H. N. D.</u>
TYPE OF SAMPLE <u>UNDISTURBED</u>		TESTED AT <u>SAUL-ALYCOLE</u>	
			DATE <u>8-20-70</u>

CLASSIFICATION <u>CL-MH</u> G_s <u>2.65</u> LL <u>27</u> PI <u>6</u> INITIAL DENSITY γ_d <u>1.42 g/cc</u> INITIAL VOID RATIO, e_0 <u>0.55</u> COMPRESSION INDEX, C_c <u>0.215</u>	TEST SPECIFICATIONS: <u>Saturated at Start</u>
--	---



REMARKS Appears to be normally consolidated.

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		LOG TIME CONSOLIDATION	
PROJECT and STATE SW-A-227 VOL MISSOURI				SAMPLE LOCATION 23A11-2400	
FIELD SAMPLE NO. 60	DEPTH 0.0-1.0'	GEOLOGIC ORIGIN Alluvium		DATE 8-20-70	
TYPE OF SAMPLE UNDISTURBED	TESTED AT SUL-LIVCC/M	APPROVED BY G. H. A.			

INITIAL THICKNESS OF TEST SPECIMEN 1.0 in.

INITIAL DIAL READING 0.4000 in.

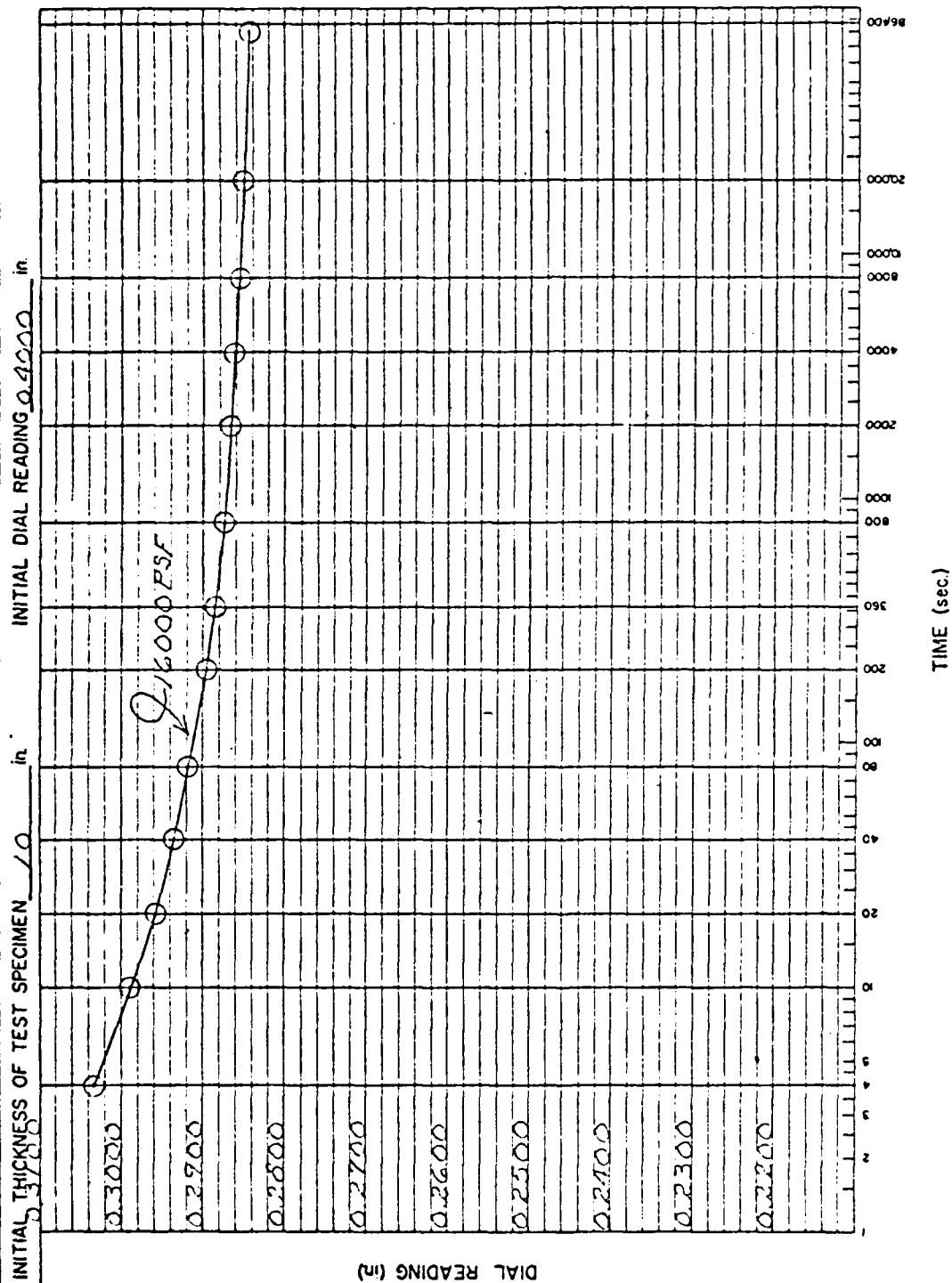
DIAL READING (in)

TIME (sec)

REMARKS

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

PROJECT and STATE <i>LITTLE SW-1-140 MISSOURI</i>		SAMPLE LOCATION <i>E. DAM 1400</i>	
FIELD SAMPLE NO. <i>83</i>	DEPTH <i>92'-40"</i>	GEOLOGIC ORIGIN <i>Alluvium</i>	
TYPE OF SAMPLE <i>UNDISTURBED</i>	TESTED AT <i>SW-1-140</i>	APPROVED BY <i>G. N. L.</i>	DATE <i>8-20-70</i>



REMARKS

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

PROJECT and STATE

SW-1-B-17 101 MISSOURI

SAMPLE LOCATION

R. 24M 14-03

FIELD SAMPLE NO.

S-1

DEPTH

140'-150'

GEOLOGIC ORIGIN

TYPE OF SAMPLE

UNDISTURBED

TESTED AT

SM-LIVCOLE

APPROVED BY

DATE

CLASSIFICATION

CL

TEST SPECIFICATIONS:

Saturated at Start

G_s

2.65

LL

30

PI

10

INITIAL DENSITY γ_d

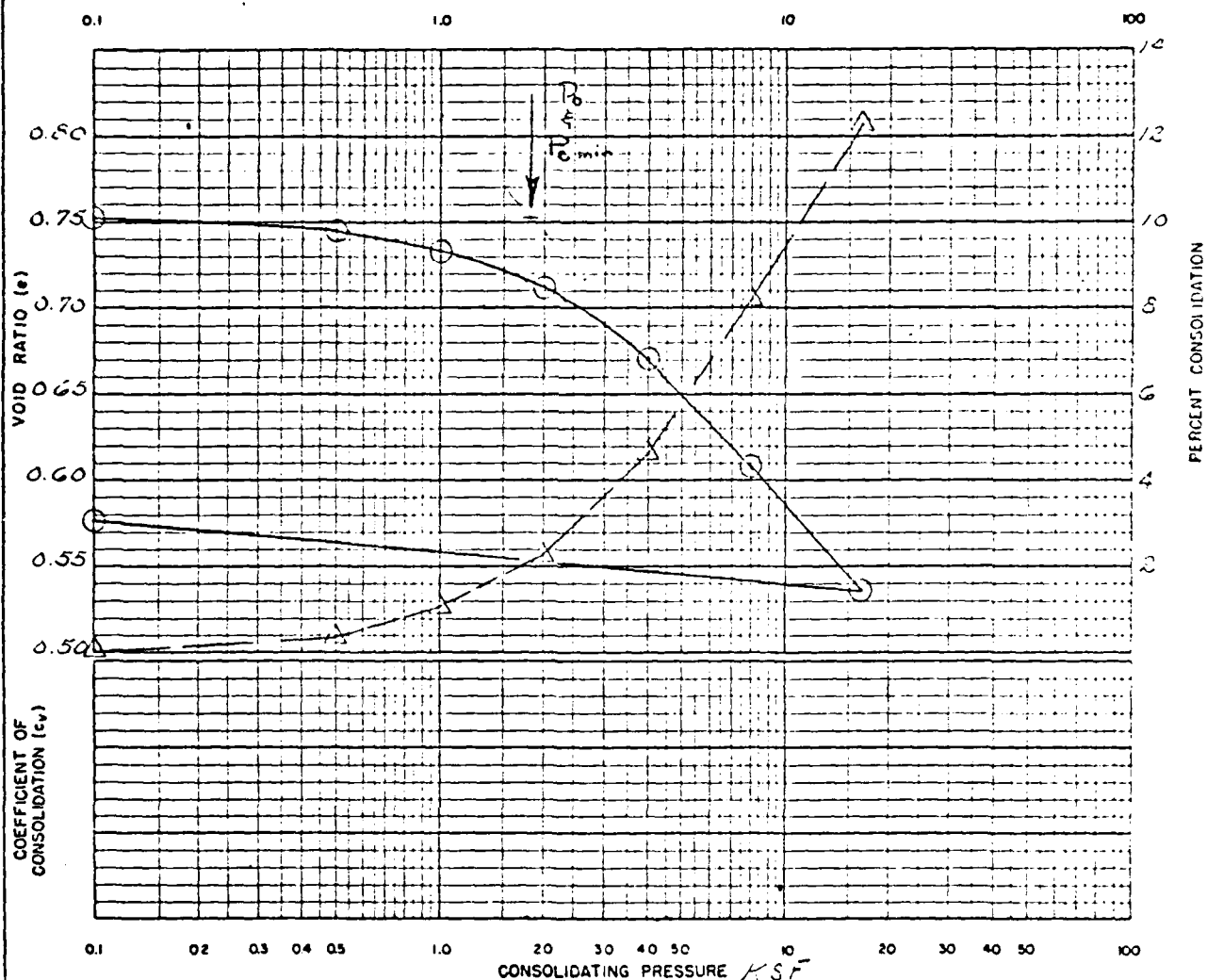
1.53 g/cc

INITIAL VOID RATIO, e_0

0.57

COMPRESSION INDEX, C_c

0.326



REMARKS

Appears to be normally consolidated.

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		LOG TIME CONSOLIDATION	
PROJECT and STATE <i>USDA SW-3-525 YO / MISSOURI</i>				SAMPLE LOCATION <i>2 DAM 14-20</i>	
FIELD SAMPLE NO. <i>8.4</i>	DEPTH <i>16.2'-18.0'</i>	GEOLOGIC ORIGIN			
TYPE OF SAMPLE <i>UNTESTED</i>	TESTED AT <i>SW-3-LINCOLN</i>	APPROVED BY			DATE

INITIAL THICKNESS OF TEST SPECIMEN 1.0 in.

INITIAL DIAL READING 0.4000 in.

DIAL READING (in)

TIME (sec)

500 PSF

1000 PSF

2000 PSF

4000 PSF

70.25 HRS

REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		LOG TIME CONSOLIDATION	
PROJECT and STATE <u>LITTLE ROCK, ARK. / MISSOURI</u>				SAMPLE LOCATION <u>2 DAM 14100</u>	
FIELD SAMPLE NO. <u>501</u>	DEPTH <u>120'-150'</u>	GEOLOGIC ORIGIN			
TYPE OF SAMPLE <u>UNDISTURBED</u>	TESTED AT <u>SMI-LINCOLN</u>	APPROVED BY		DATE	

INITIAL THICKNESS OF TEST SPECIMEN 1.0 in.

INITIAL DIAL READING 0.4200 in.

Time (sec)	Dial Reading (in)
0	0.4200
10	0.3950
20	0.3800
30	0.3700
40	0.3600
50	0.3500
60	0.3400
70	0.3350
80	0.3320
90	0.3300
100	0.3300

REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		LOG TIME CONSOLIDATION	
PROJECT and STATE <u>LITTLE SWI-A-BAY NO. 1 MISSOURI</u>				SAMPLE LOCATION <u>E. DAM 14+00</u>	
FIELD SAMPLE NO. <u>86</u>	DEPTH <u>62'-48.0'</u>	GEOLOGIC ORIGIN			
TYPE OF SAMPLE <u>UNDISTURBED</u>	TESTED AT <u>SWL-LINCOLN</u>	APPROVED BY			DATE

INITIAL DIAL READING 0.4000 in

INITIAL THICKNESS OF TEST SPECIMEN 1.0 in

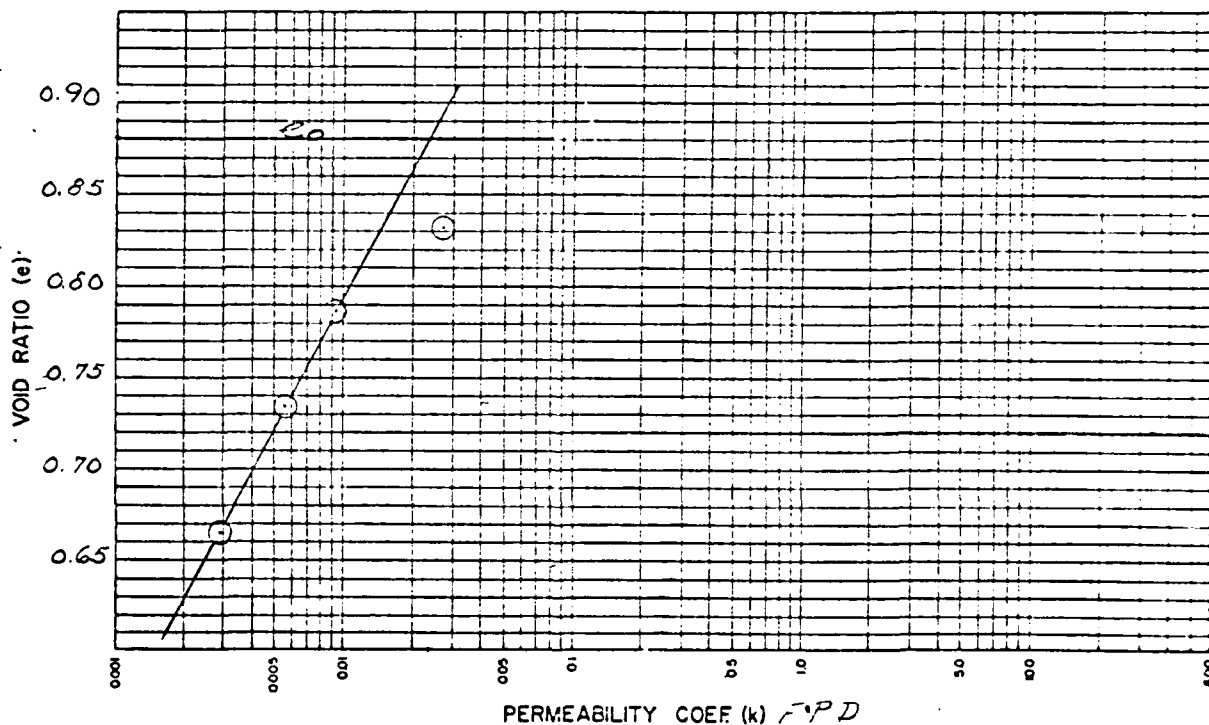
DIAL READING (in)

TIME (sec)

7160000 PSI

REMARKS

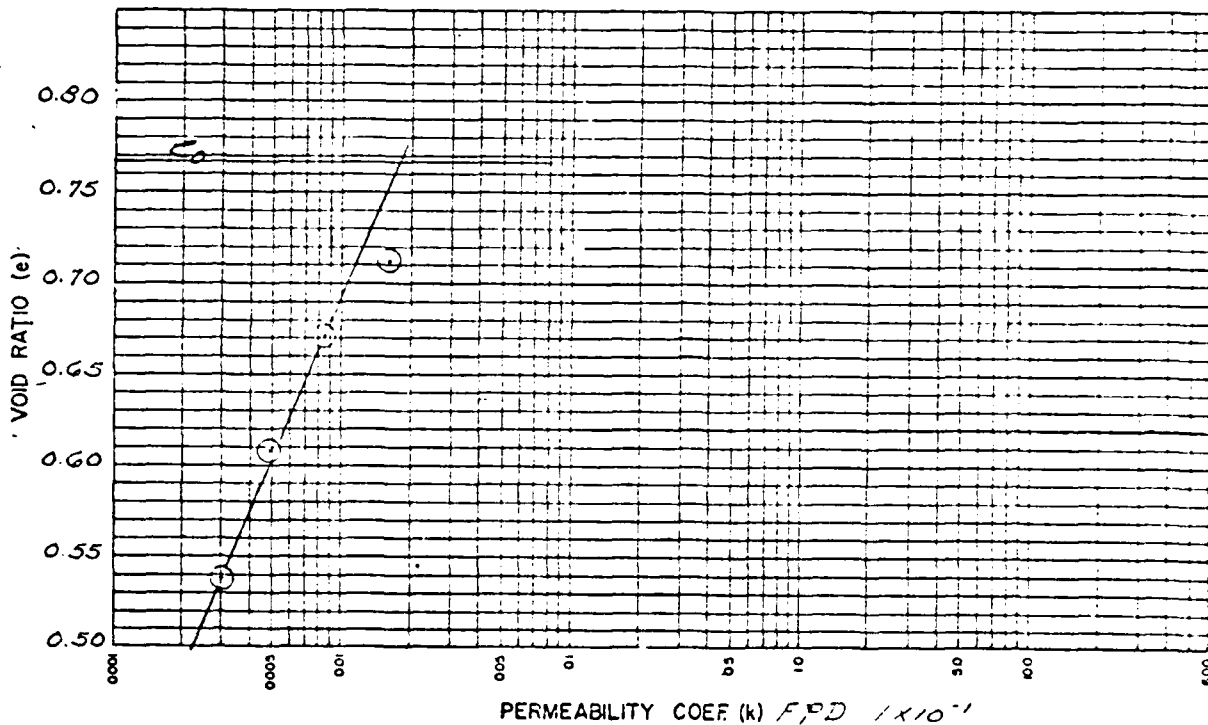
MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		SOIL PERMEABILITY	
PROJECT and STATE SVA-4-12 HAI MISSOURI				SAMPLE LOCATION V. DAM 14100	
FIELD SAMPLE NO S-5	DEPTH 90'-110'	GEOLOGIC ORIGIN Alluvium			
TYPE OF SAMPLE UNDISTURBED	TESTED AT SVA-4-14100	APPROVED BY S. N. B.		DATE 8-20-70	
CLASSIFICATION CL-ML LL 27 PI 6				SPECIFIC GRAVITY	
TEST NO.	2000	1000	5000	10000	G _s (-) #4
INITIAL MOISTURE %					G _s (+) #4
DRY DENSITY $\frac{\sigma}{\text{pcf}}$	1.36	1.49	1.54	1.60	G _m (Bulk)(+) #4
VOID RATIO	0.6310	0.7579	0.7328	0.6625	TEST SPECIFICATIONS Falling Head Permeability Test on the Consolidation Sample
PERMEABILITY COEF k_{FD}	0.0227	0.0023	0.0055	0.0029	
PERCOLATION COEF					
H _v /L DURING TEST					



REMARKS

$K \approx 0.03 \text{ ft/day}$

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		SOIL PERMEABILITY	
PROJECT and STATE <i>1/2 MI. SW 1/4 Sec 34, T14N, R10E, S1E</i>				SAMPLE LOCATION <i>Point 1000</i>	
FIELD SAMPLE NO. <i>51</i>	DEPTH <i>150'-155'</i>	GEOLOGIC ORIGIN <i>Alluvium</i>			
TYPE OF SAMPLE <i>UNDISTURBED</i>	TESTED AT <i>SAIL-LINCOLN</i>	APPROVED BY <i>G.N.G.</i>	DATE <i>8-20-70</i>		
CLASSIFICATION <i>CL</i> <i>LL 30 PI 10</i>				SPECIFIC GRAVITY	
TEST NO.	<i>3000</i>	<i>4000</i>	<i>5000</i>	<i>6000</i>	$G_s (-)^{*4}$ <i>2.65</i>
INITIAL MOISTURE %					$G_s (+)^{*4}$
DRY DENSITY ☐ g/cc ☐ pcf	<i>1.57</i>	<i>1.60</i>	<i>1.67</i>	<i>1.74</i>	$G_m(Bulk)(+)^{*4}$
VOID RATIO	<i>0.7112</i>	<i>0.6522</i>	<i>0.6083</i>	<i>0.5383</i>	TEST SPECIFICATIONS <i>Falling Head Perm Test on The Consolidation Sample</i>
PERMEABILITY COEF <i>FPD 0.0016</i>	<i>0.00055</i>	<i>0.00049</i>	<i>0.00030</i>		
PERCOLATION COEF					
H/L DURING TEST					



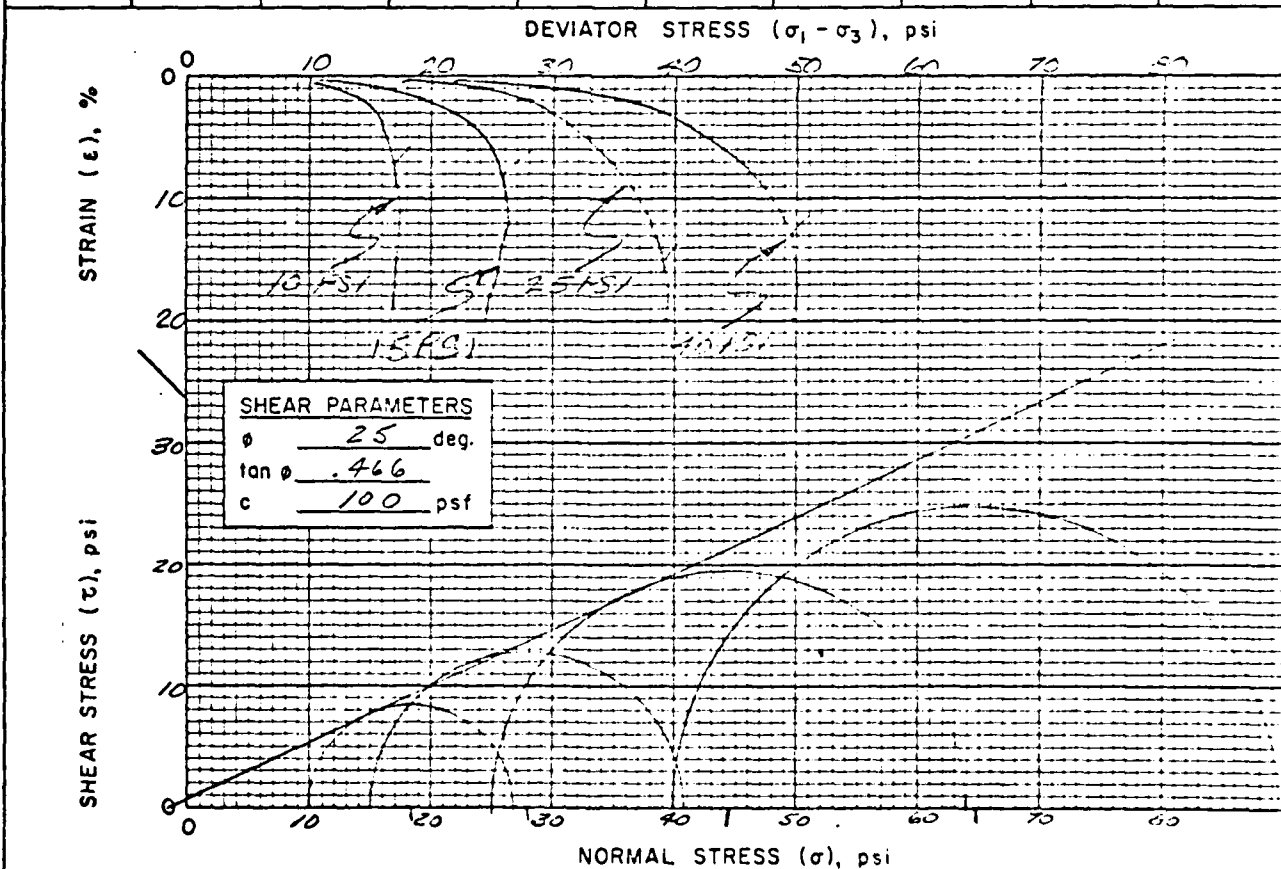
REMARKS

K ≈ 0.002 ft/day

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

PROJECT and STATE <u>LITTLE SUITE-D-300 SITE 1 MISSOURI</u>		SAMPLE LOCATION <u>ROAD 14+50</u>	
FIELD SAMPLE NO. <u>6.5</u>	DEPTH <u>9-11'</u>	GEOLOGIC ORIGIN <u>Alluvium</u>	
TYPE OF SAMPLE <u>UNDISTURBED</u>	TESTED AT <u>SLC-LINCOLN</u>	APPROVED BY <u>J. N. G</u>	DATE <u>8-20-70</u>
INDEX TEST DATA		SPECIMEN DATA	
USCS <u>CL-ML</u> ; LL <u>27</u> ; PI <u>6</u>		HEIGHT <u>3.0</u> "; DIAMETER <u>1.4</u> "	
% FINER (mm): 0.002 <u>14</u> ; 0.005 <u>19</u> ; 0.075 (#200) <u>69</u>		MATERIALS TESTED PASSED <u>#4</u> SIEVE	
G _s (#4) <u>2.67</u> ; G _s (+4) _____		METHOD OF PREPARATION <u>TRIMMED</u>	
STANDARD: γ_d MAX. _____ pcf; w ₀ _____ %		FROM AN UNDISTURBED CORE	
MODIFIED: γ_d MAX. _____ pcf; w ₀ _____ %		MOLDING MOISTURE _____ %	
		MOLDED AT _____ % OF γ_d MAXIMUM	
		TYPE OF TEST	
		UU ☐	
		CU ☒	
		C $\bar{U}$ ☐	
		CD ☐	

DRY DENSITY		MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ϵ (%)
INITIAL pcf ☐ g/cc ☒	CONSOLIDATED pcf ☐ g/cc ☒	START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
1.24	1.45	30.4	75.0	28.1	4.53	10	16.8	7.0
1.47	1.52	29.4	96.1	26.4	5.32	15	25.7	8.0
1.48	1.57	30.3	100.0	26.5	4.63	25	38.9	15.0
1.48	1.60	29.7	78.7	24.8	4.72	40	49.5	13.0



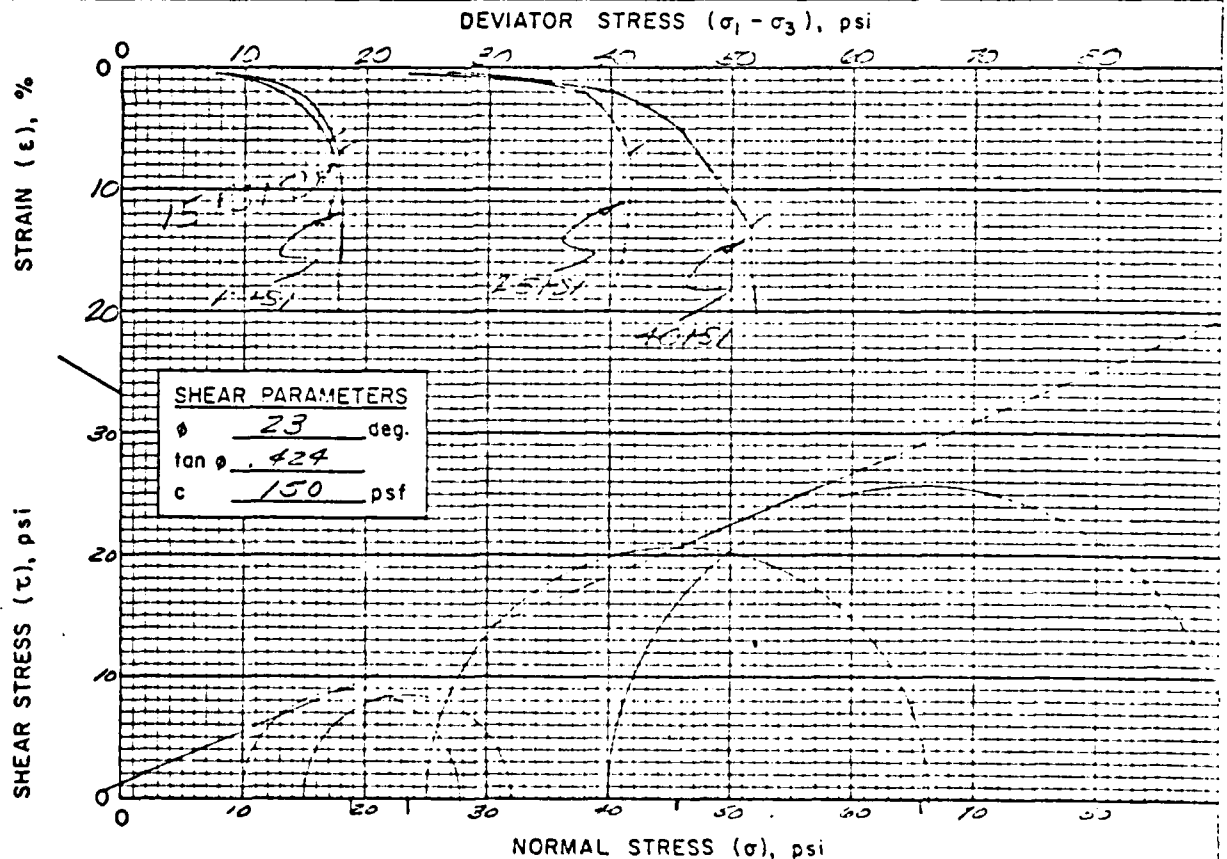
REMARKS SOAKED TO SATURATE

MATERIALS
TESTING REPORTU. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TRIAxIAL SHEAR TEST

PROJECT and STATE <u>LITTLE SALT-4-542 SITE: 1 MISSOURI</u>		SAMPLE LOCATION <u>E. DAM 15+00</u>	
FIELD SAMPLE NO. <u>8.6</u>	DEPTH <u>13-18'</u>	GEOLOGIC ORIGIN <u>Alluvium</u>	
TYPE OF SAMPLE <u>UNDISTURBED</u>	TESTED AT <u>SMU - LINCOLN</u>	APPROVED BY <u>J. N. H.</u>	DATE <u>8-20-70</u>
INDEX TEST DATA		SPECIMEN DATA	
USCS <u>CL</u> ; LL <u>30</u> ; PI <u>10</u>		HEIGHT <u>3.0</u> "; DIAMETER <u>1.4</u> "	
% FINER (mm): 0.002 <u>15</u> ; 0.005 <u>33</u> ; 0.075 (#200) <u>94</u>		MATERIALS TESTED PASSED <u>#4</u> SIEVE	
G _s (-#4) <u>2.65</u> ; G _s (+#4) _____		METHOD OF PREPARATION <u>TRIMMED</u>	
STANDARD: γ_d MAX. _____ pcf; w_0 _____ %		MOLDING MOISTURE _____ %	
MODIFIED: γ_d MAX. _____ pcf; w_0 _____ %		MOLDED AT _____ % OF γ_d MAXIMUM	
		TYPE OF TEST	
		UU ☐	
		CU ☒	
		CU ☐	
		CD ☐	

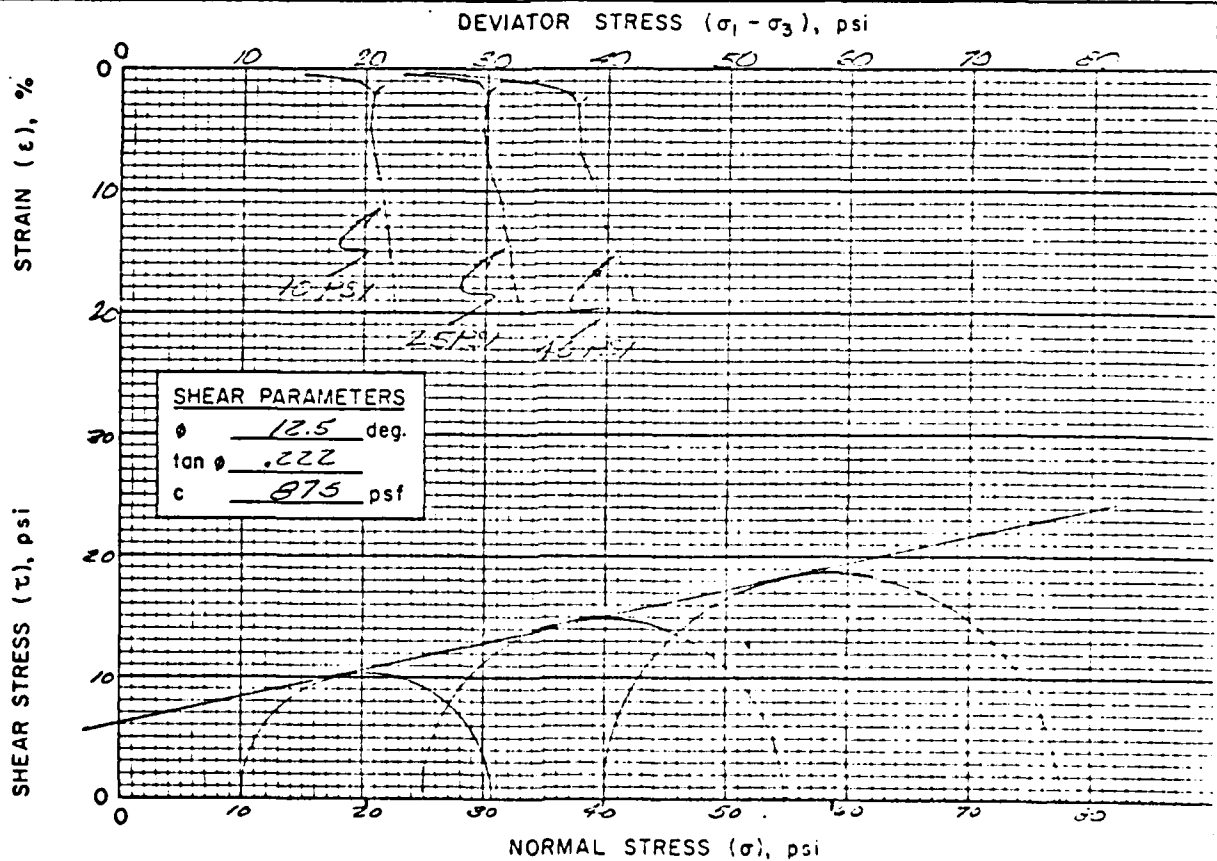
DRY DENSITY		MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ϵ (%)
INITIAL pcf ☐ g/cc ☒	CONSOLIDATED pcf ☐ g/cc ☒	START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
1.517	1.520	27.5	96.3	27.4	6.50	10	17.7	7.0
1.49	1.52	26.7	96.3	27.5	5.18	15	16.7	6.0
1.52	1.53	28.1	99.6	27.6	6.20	25	41.3	7.0
1.53	1.53	28.0	100.0	26.0	6.38	40	51.5	13.0

REMARKS TESTED AT NATURAL H₂O

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

PROJECT and STATE <u>LITTLE SALT-A-EG SITE 1 MISSOURI</u>		SAMPLE LOCATION <u>E. FINES. SP. 3+00</u>	
FIELD SAMPLE NO. <u>202.2</u>	DEPTH <u>5-10'</u>	GEOLOGIC ORIGIN <u>LOESS</u>	
TYPE OF SAMPLE <u>COMPACTED</u>	TESTED AT <u>S.M. - LINCOLN</u>	APPROVED BY <u>G. N. G.</u>	DATE <u>8-20-70</u>
INDEX TEST DATA		SPECIMEN DATA	
USCS <u>CL</u> ; LL <u>39</u> ; PI <u>16</u>		HEIGHT <u>3.0</u> "; DIAMETER <u>1.4</u> "	
% FINER (mm): 0.002 <u>24</u> ; 0.005 <u>25</u> ; 0.074 (# 200) <u>75</u>		MATERIALS TESTED PASSED <u>#4</u> SIEVE	
G_s (-#4) <u>2.62</u> ; G_s (+#4) _____		METHOD OF PREPARATION <u>STATIC &</u>	
STANDARD: γ_d MAX. <u>103.0</u> pcf; w_o <u>19.0</u> %		<u>LAYER COMPACTION & SCALED</u>	
MODIFIED: γ_d MAX. _____ pcf; w_o _____ %		MOLDING MOISTURE <u>20.2</u> %	
		MOLDED AT <u>94.3</u> % OF γ_d MAXIMUM	
		TYPE OF TEST	
		UU ☐	
		CU ☒	
		CU ☐	
		CD ☐	

DRY DENSITY		MOISTURE CONTENT, %			TIME OF CONSOLIDATION (hrs.)	MINOR PRINCIPAL STRESS σ_3 (psi)	DEVIATOR STRESS $\sigma_1 - \sigma_3$ (psi)	AXIAL STRAIN AT FAILURE, ϵ (%)
INITIAL pcf ☒ g/cc ☐	CONSOLIDATED pcf ☒ g/cc ☐	START OF TEST	DEG. OF SAT. AT START OF TEST	END OF TEST				
96.5	97.3	26.2	96.3	25.7	15.98	10	20.6	2.0
96.7	99.0	26.1	96.0	24.6	16.17	25	29.9	2.0
96.5	100.2	26.3	96.7	23.8	16.10	40	37.4	3.0

REMARKS AVERAGE TEST $\gamma_d = 93.8$ % STD

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

PROJECT and STATE Little Sni-a-bar #1 MISSOURI

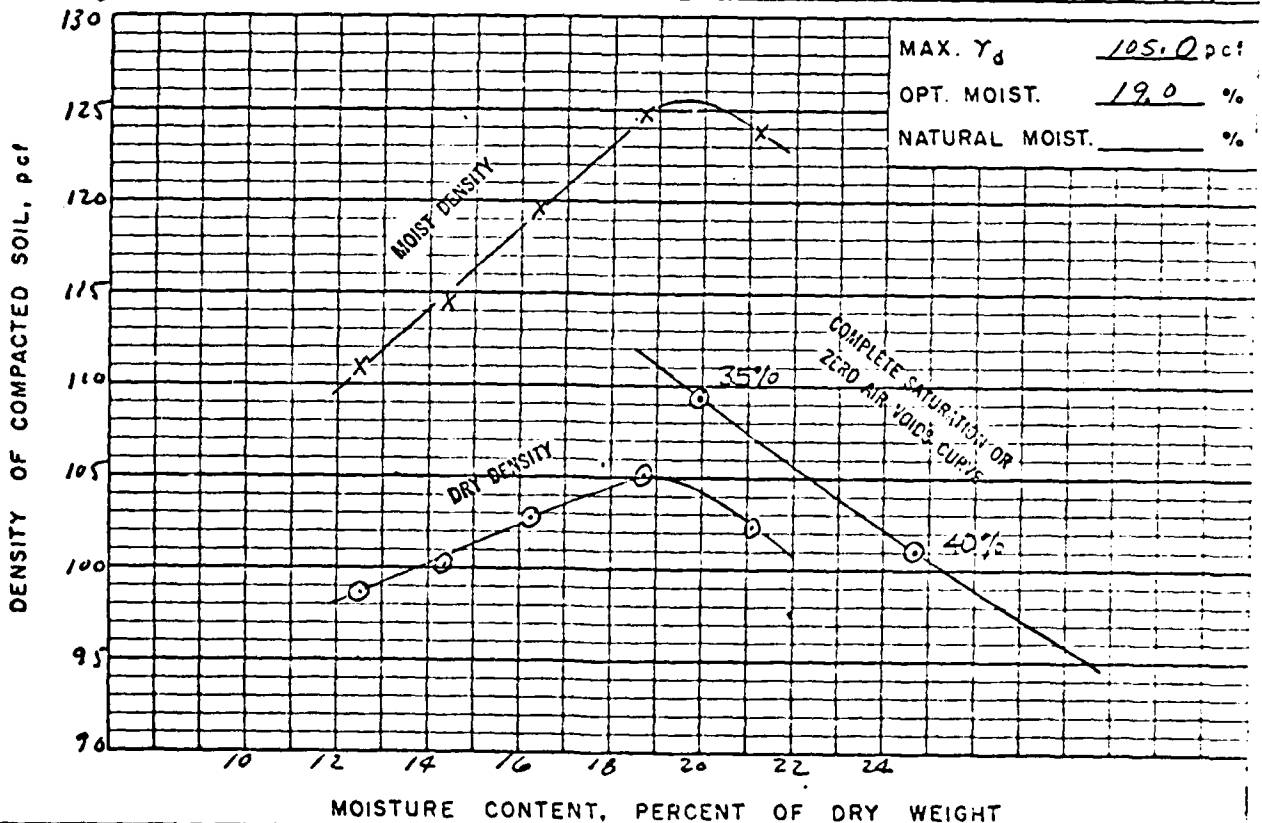
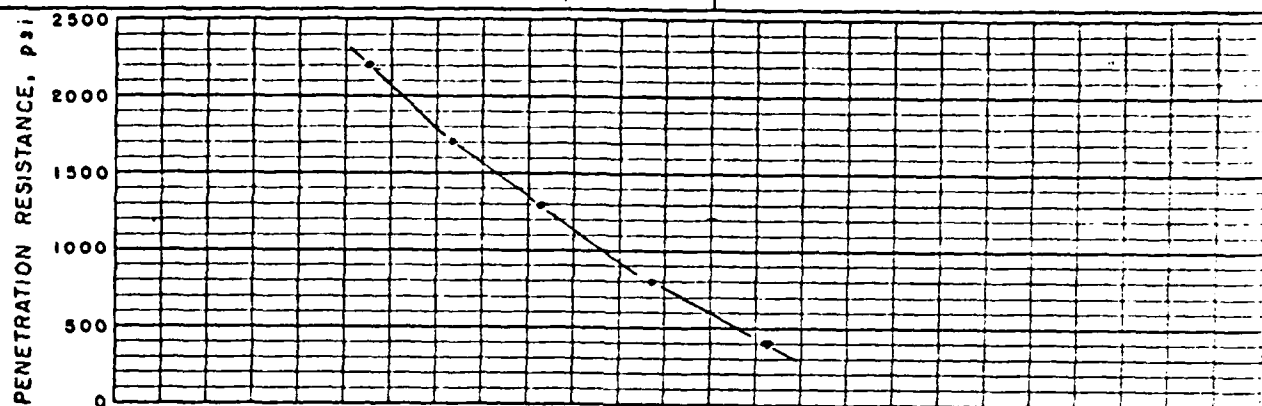
FIELD SAMPLE NO. <u>202.1</u>	LOCATION <u>E Emer. Spwy 3+00</u>	DEPTH <u>1.0-5.0'</u>
----------------------------------	--------------------------------------	--------------------------

GEOLOGIC ORIGIN <u>LOESS</u>	TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>J.H.B.</u>	DATE <u>8-20-70</u>
---------------------------------	---------------------------------	------------------------------	------------------------

CLASSIFICATION CL LL 43 PI 21 CURVE NO. 1 OF 11

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

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.70
PLUS NO. 4 _____ MOD. (ASTM D-1557) ☐; METHOD _____
OTHER TEST ☐ (SEE REMARKS)

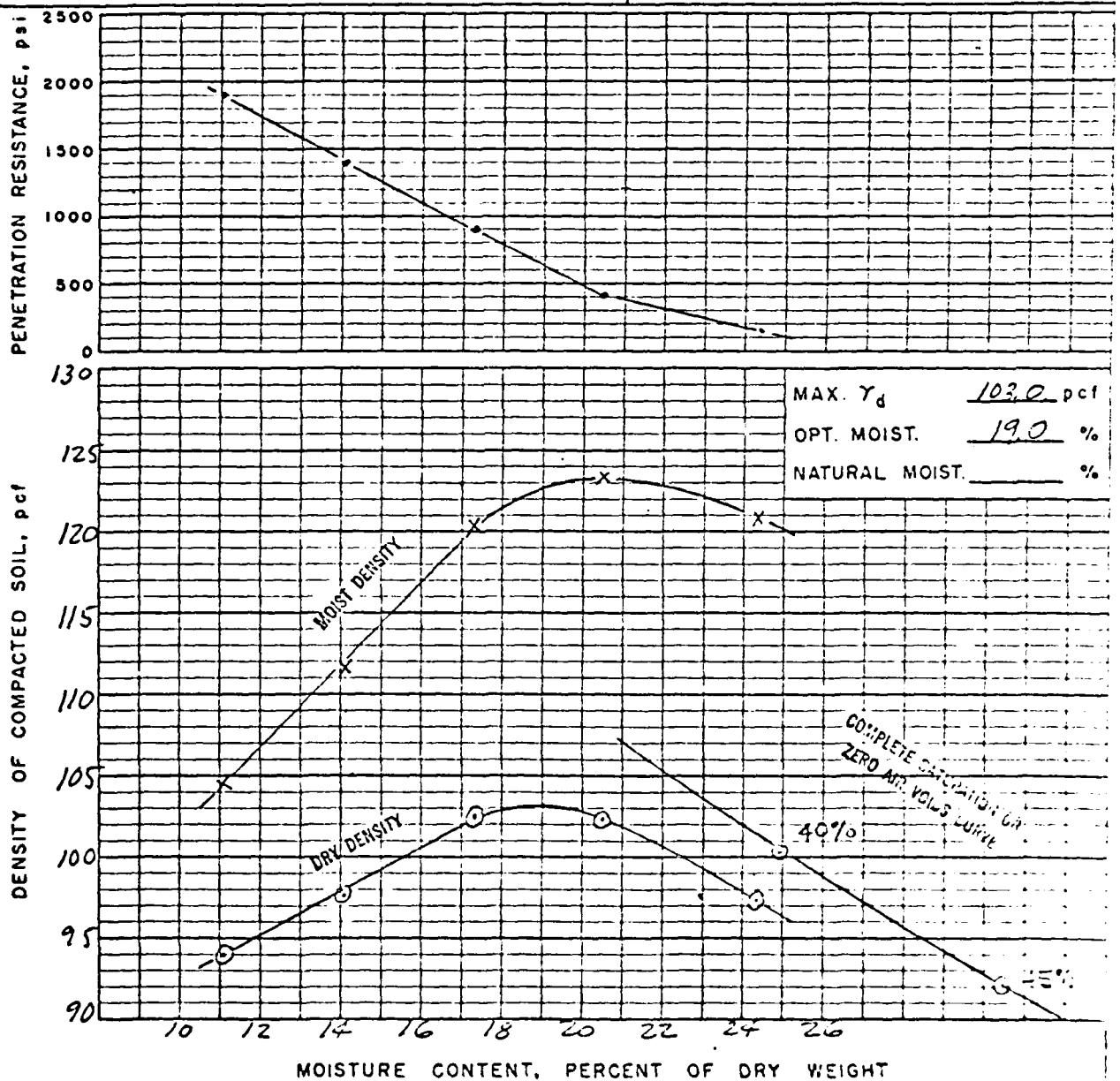


MAX. γ_d 105.0 pcf
OPT. MOIST. 19.0 %
NATURAL MOIST. _____ %

REMARKS

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

PROJECT and STATE <u>LtH/2 Sni-a-bar #1</u> <u>MISSOURI</u>		
FIELD SAMPLE NO. <u>203.2</u>	LOCATION <u>E Emer. Spwy. 3+00</u>	DEPTH <u>5.0-10.0'</u>
GEOLOGIC ORIGIN <u>LOESS</u>	TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>J.N.G.</u> DATE <u>8-20-70</u>
CLASSIFICATION <u>CL</u> <u>LL 39</u> <u>PI 16</u>		CURVE NO. <u>2</u> OF <u>11</u>
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u>		STD. (ASTM D-698) ☒ ; METHOD <u>A</u>
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.68</u>		MOD. (ASTM D-1557) ☐ ; METHOD _____
		OTHER TEST ☐ (SEE REMARKS)
		PLUS NO. 4 _____



REMARKS

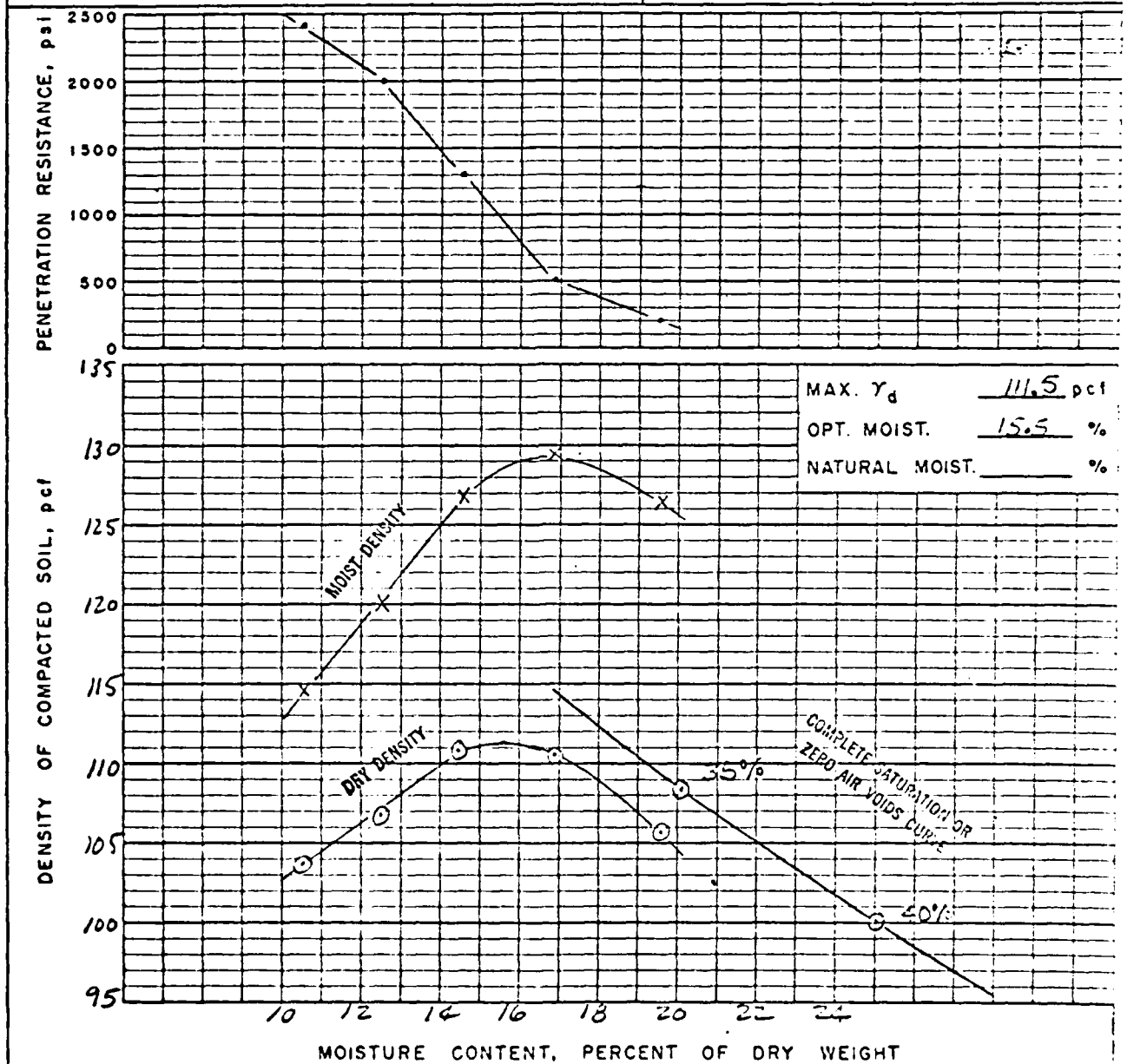
MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	COMPACTION AND PENETRATION RESISTANCE
-------------------------------------	---	--

PROJECT and STATE Little Snig-bar #1 Missouri

FIELD SAMPLE NO. <u>202.3</u>	LOCATION <u>Emer. Hwy. 3+00</u>	DEPTH. <u>11.0-14.0'</u>
----------------------------------	------------------------------------	-----------------------------

GEOLOGIC ORIGIN <u>LOESS</u>	TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>Ln. G.</u>	DATE <u>8-20-70</u>
---------------------------------	---------------------------------	------------------------------	------------------------

CLASSIFICATION <u>CL</u> LL <u>33</u> PI <u>14</u>	CURVE NO. <u>3</u> OF <u>11</u>
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u>	STD. (ASTM D-698) ☒ ; METHOD <u>A</u>
SPECIFIC GRAVITY (G _s) {	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

Little Sn'-a-bar #1 Missouri

FIELD SAMPLE NO.
206.1

LOCATION

Emer. Spwy. 17.5' L 2+00

DEPTH

1.0'-6.0'

GEOLOGIC ORIGIN

LOESS

TESTED AT

SML-LINCOLN

APPROVED BY

J.N.G.

DATE

8-20-70

CLASSIFICATION CL LL 41 PI 19

CURVE NO. 4 OF 11

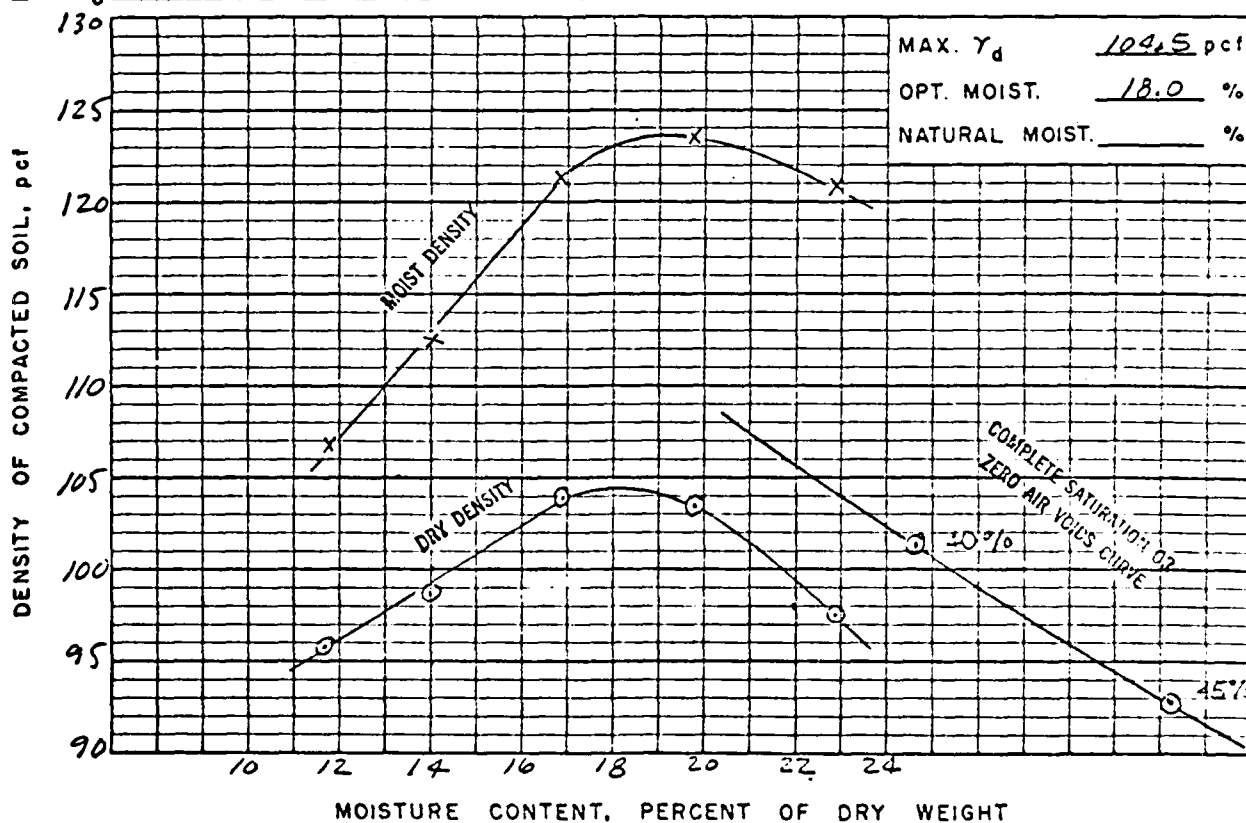
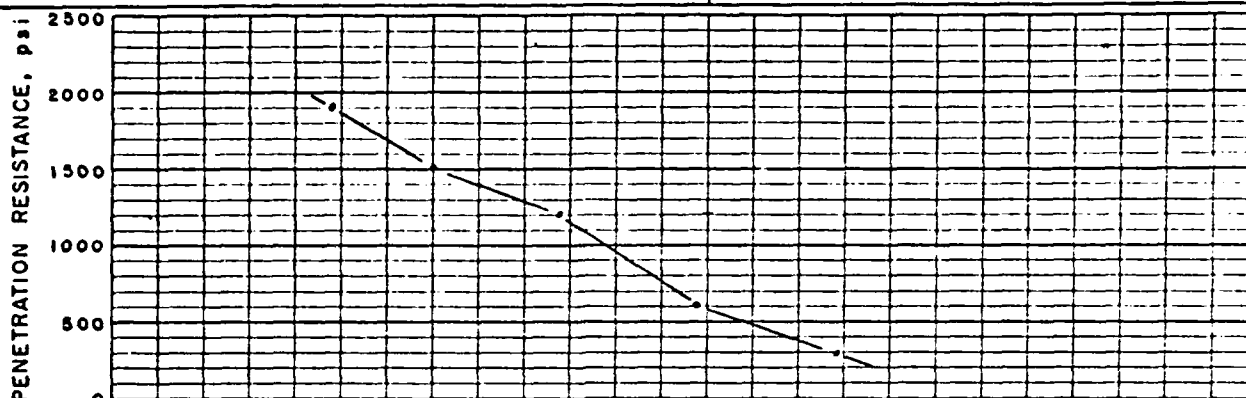
MAX. PARTICLE SIZE INCLUDED IN TEST < #4 "

STD. (ASTM D-698) ☒ METHOD A

SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.70
PLUS NO. 4 _____

MOD. (ASTM D-1557) ☐ METHOD _____

OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.5 pcf
OPT. MOIST. 18.0 %
NATURAL MOIST. _____ %

REMARKS

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

PROJECT and STATE Little Sn-1-a-bar #1 Missouri

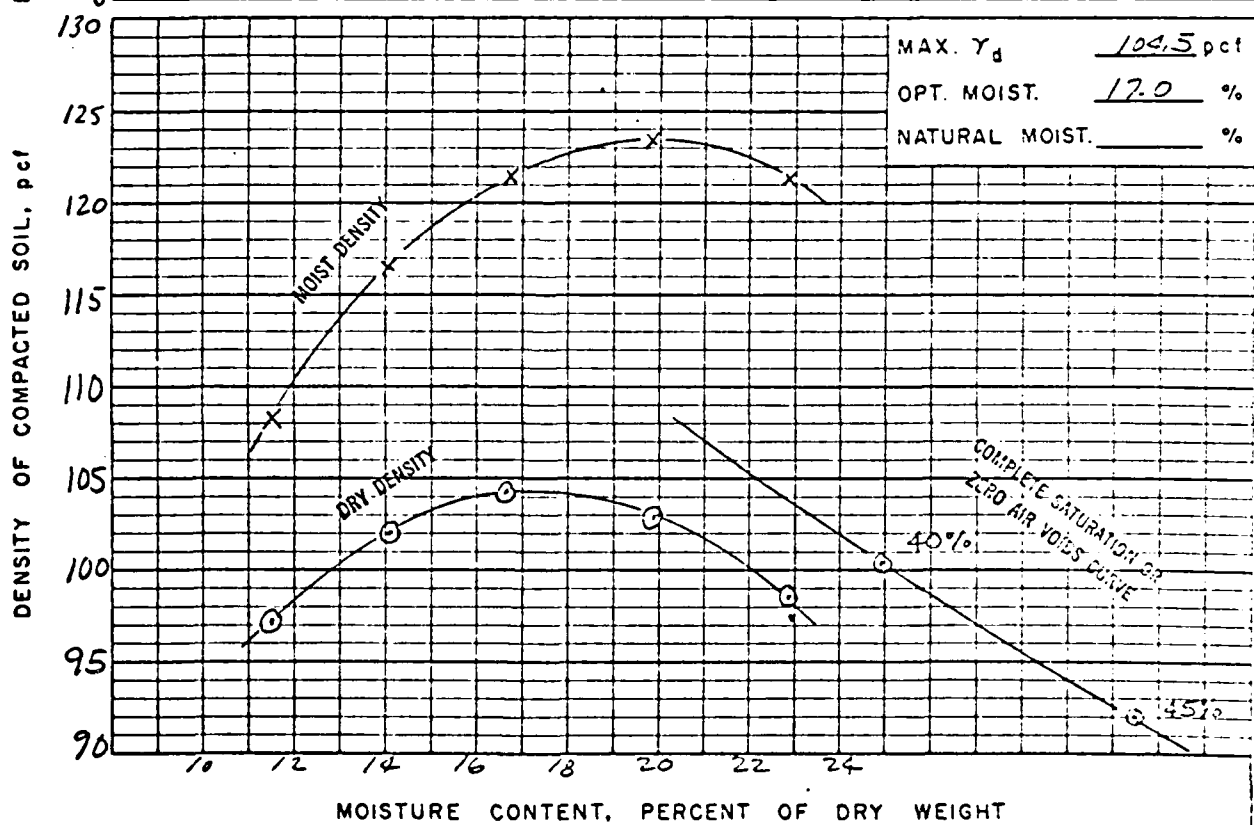
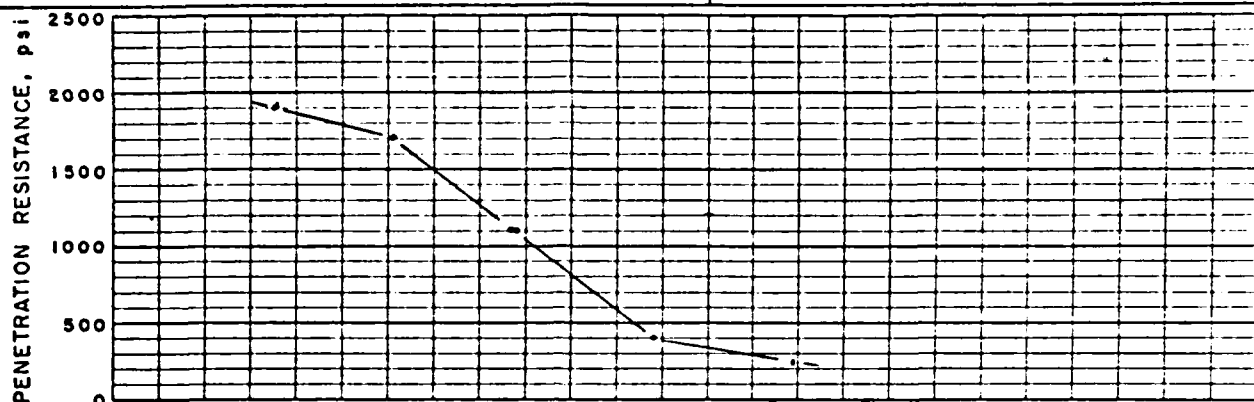
FIELD SAMPLE NO. 206.2 LOCATION E Emer. Spwy. 175' L 2+00 DEPTH 6.0'-10.0'

GEOLOGIC ORIGIN LOESS TESTED AT SML-LINCOLN APPROVED BY GNH DATE 8-20-70

CLASSIFICATION CL LL 37 PI 15 CURVE NO. 5 OF 11

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

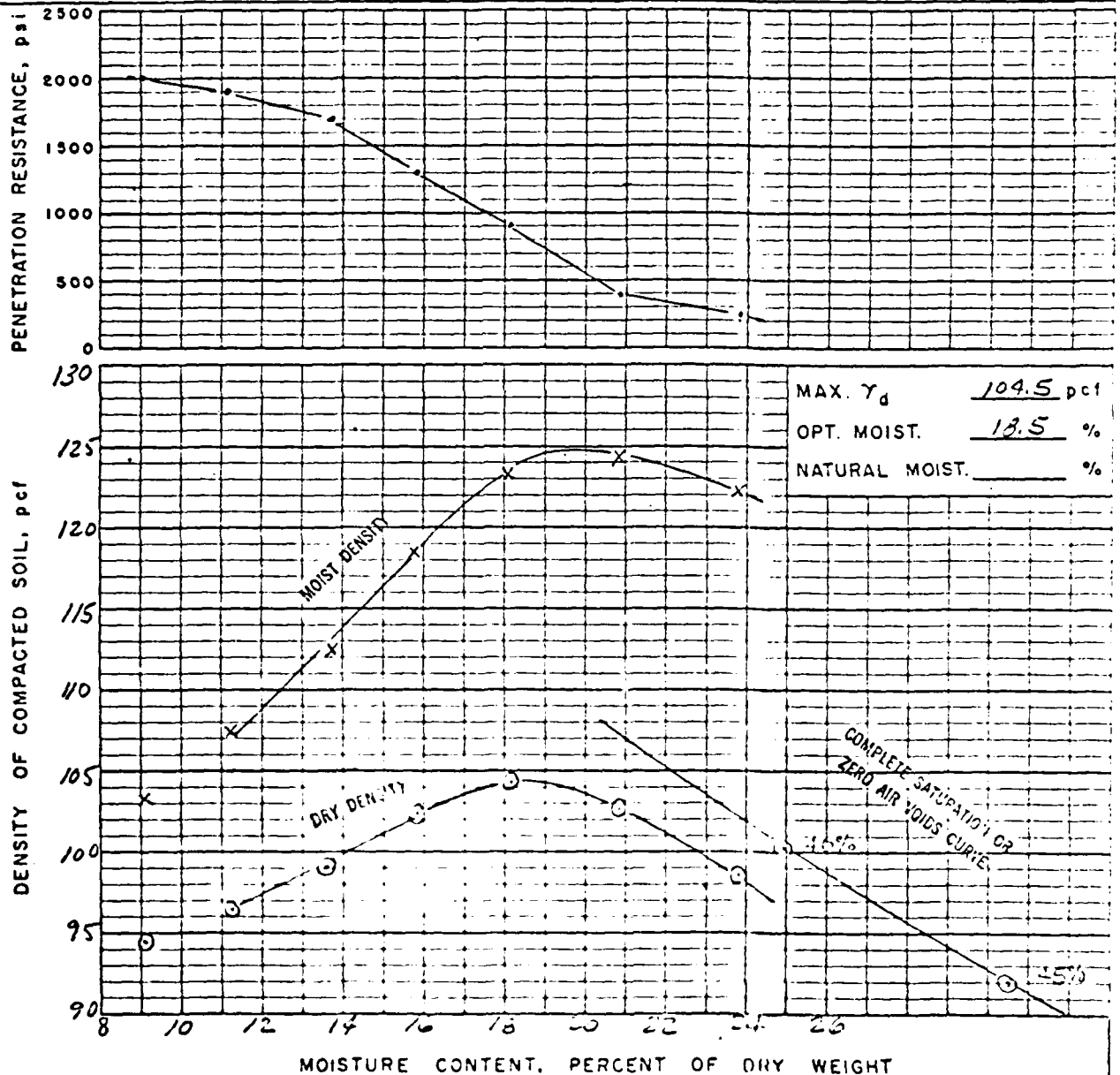
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 2.63 MOD. (ASTM D-1557) ☐; METHOD
PLUS NO. 4 OTHER TEST ☐ (SEE REMARKS)



MAX. γ_d 104.5 pcf
OPT. MOIST. 17.0 %
NATURAL MOIST. %

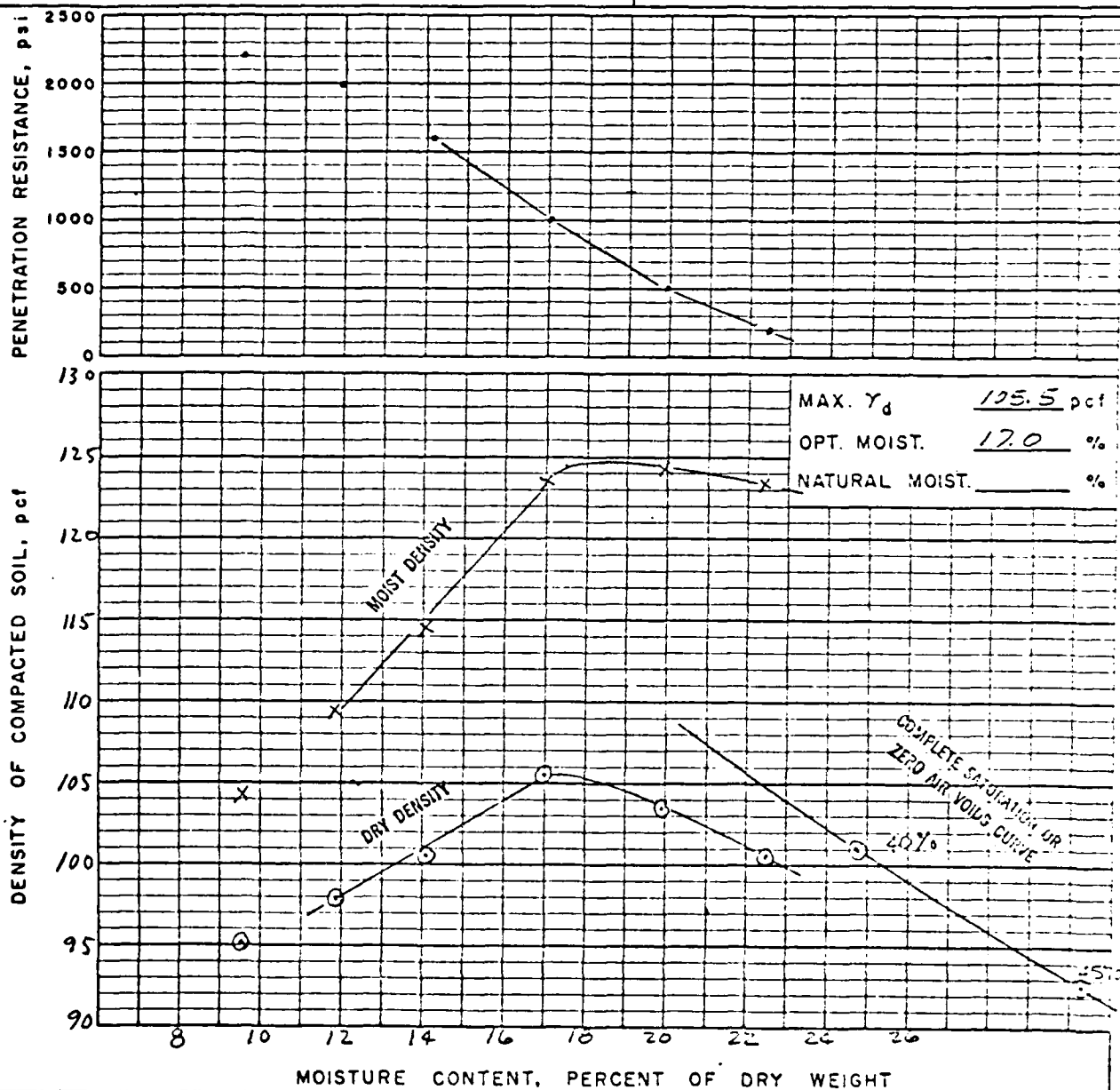
REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT and STATE <u>Little Sni-a-bar #1</u> <u>MISSOURI</u>					
FIELD SAMPLE NO. <u>208.1</u>		LOCATION <u>E Emer Spwy. 90' R. 4+00</u>			DEPTH <u>1.0'-6.0'</u>
GEOLOGIC ORIGIN <u>LOESS</u>		TESTED AT <u>SML-LINCOLN</u>		APPROVED BY <u>H.N.G.</u>	DATE <u>8-20-70</u>
CLASSIFICATION <u>CL</u> <u>LL 42</u> <u>PI 21</u>				CURVE NO. <u>6</u> OF <u>11</u>	
MAX. PARTICLE SIZE INCLUDED IN TEST <u><#4</u>				STD. (ASTM D-698) ☒ ; METHOD <u>A</u>	
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.68</u>				MOD. (ASTM D-1557) ☐ ; METHOD <u> </u>	
				OTHER TEST ☐ (SEE REMARKS)	



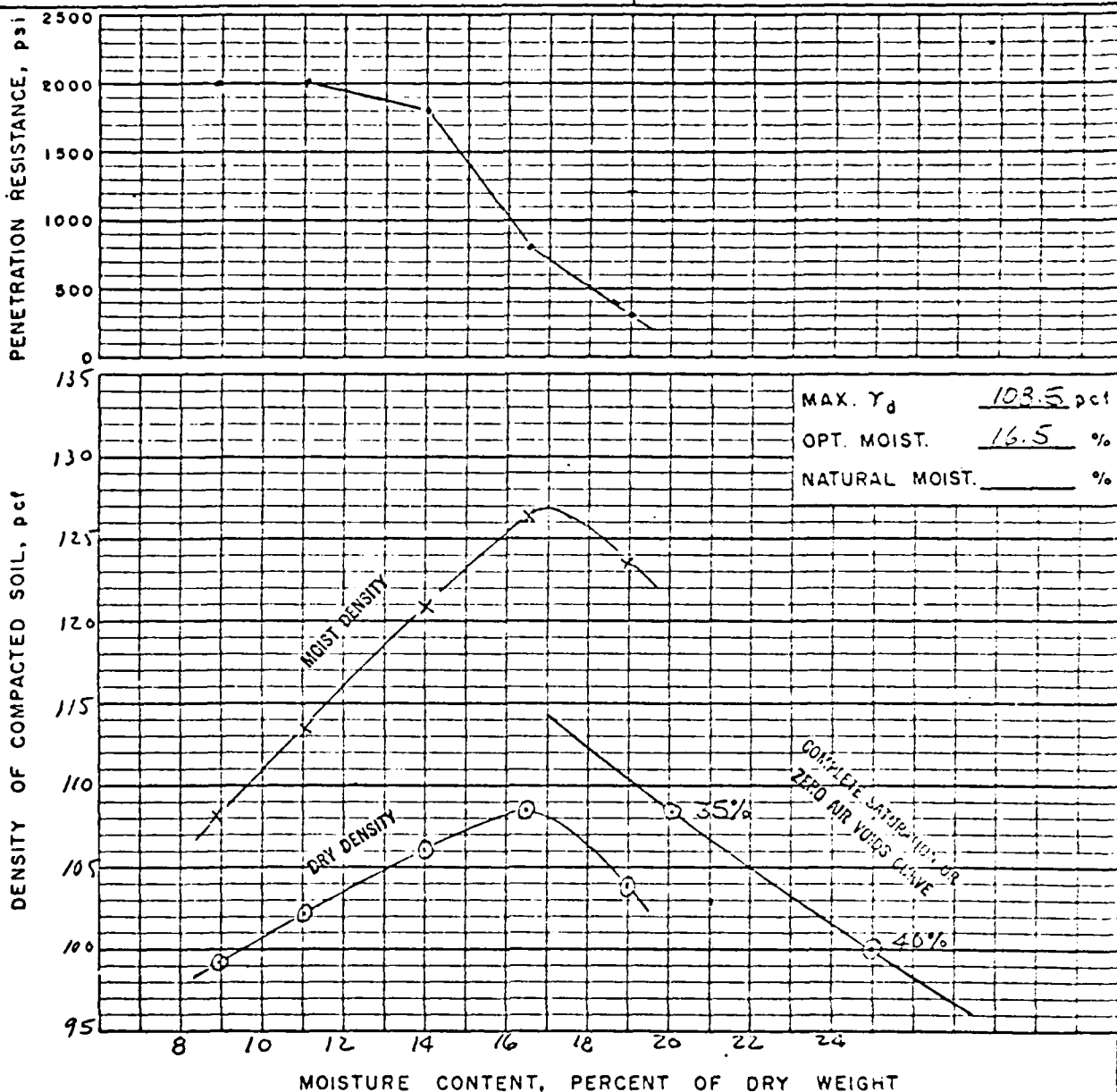
REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT and STATE Little Snr-o-bar #1 MISSOURI					
FIELD SAMPLE NO. 204.2		LOCATION E Emer. Spwy. 90' R 4+00			DEPTH 6.0-11.0'
GEOLOGIC ORIGIN LOESS		TESTED AT SML-LINCOLN	APPROVED BY H. N. H.		DATE 8-20-70
CLASSIFICATION CL LL 37 PI 15			CURVE NO. 7 OF 11		
MAX. PARTICLE SIZE INCLUDED IN TEST < # 4			STD. (ASTM D-698) ☒ ; METHOD A		
SPECIFIC GRAVITY (G _s) { MINUS NO. 4 2.70 PLUS NO. 4			MOD. (ASTM D-1557) ☐ ; METHOD		
OTHER TEST ☐ (SEE REMARKS) -					



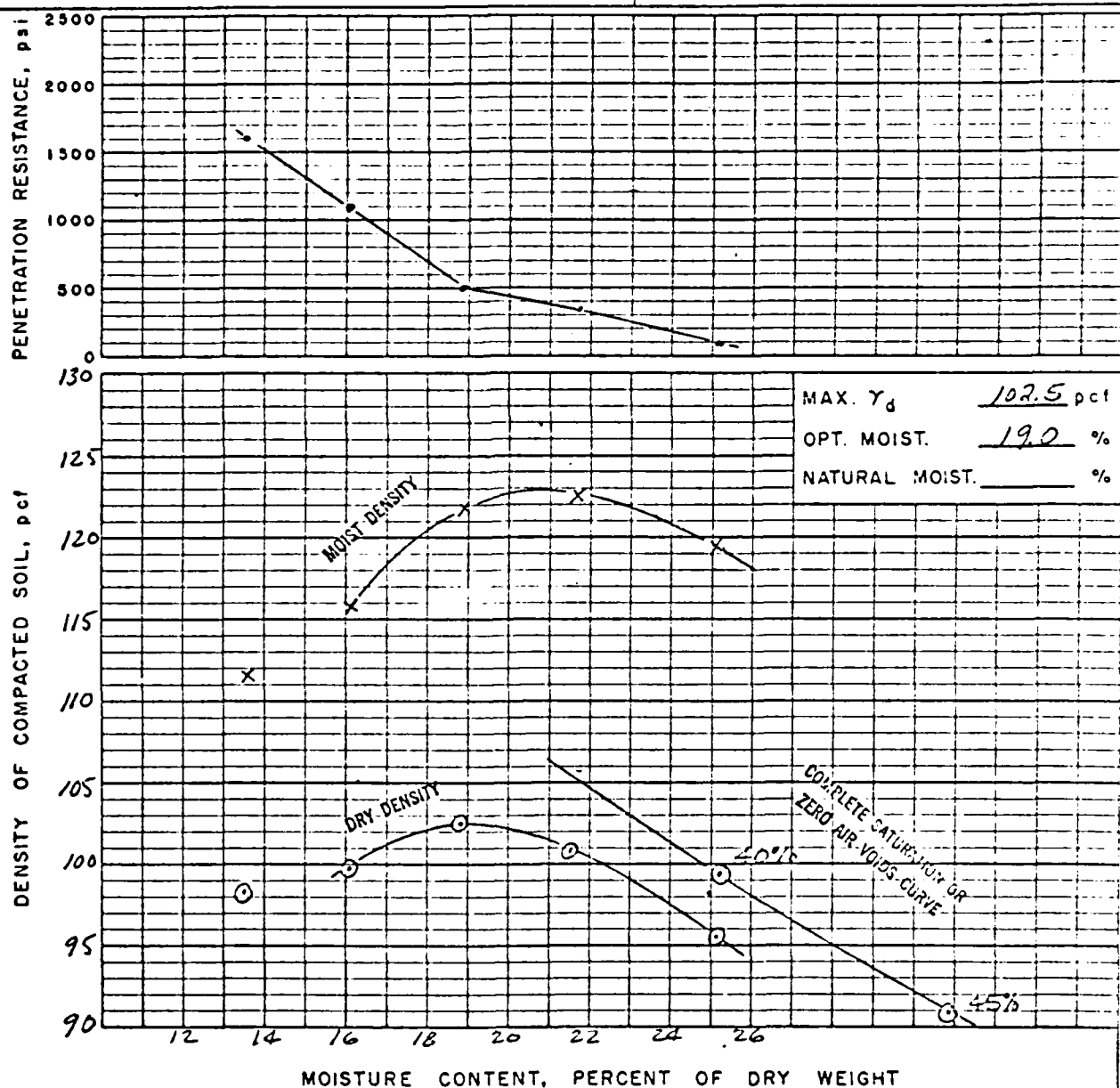
REMARKS

MATERIALS		U. S. DEPARTMENT of AGRICULTURE		COMPACTION AND	
TESTING REPORT		SOIL CONSERVATION SERVICE		PENETRATION RESISTANCE	
PROJECT and STATE <u>Little sni-a-bar #1 Missouri</u>					
FIELD SAMPLE NO. <u>121.1</u>		LOCATION <u>Borrow, D+50 11+05</u>		DEPTH <u>1.0'-5.0'</u>	
GEOLOGIC ORIGIN <u>Alluvium</u>		TESTED AT <u>SML-LINCOLN</u>		APPROVED BY <u>YNA</u>	
DATE <u>3-10-70</u>					
CLASSIFICATION <u>CL</u> LL <u>31</u> PI <u>10</u>				CURVE NO. <u>8</u> OF <u>11</u>	
MAX. PARTICLE SIZE INCLUDED IN TEST <u><#4</u>				STD. (ASTM D-698) ☒ METHOD <u>A</u>	
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.67</u>				MOD. (ASTM D-1557) ☐ METHOD <u></u>	
				OTHER TEST ☐ (SEE REMARKS)	



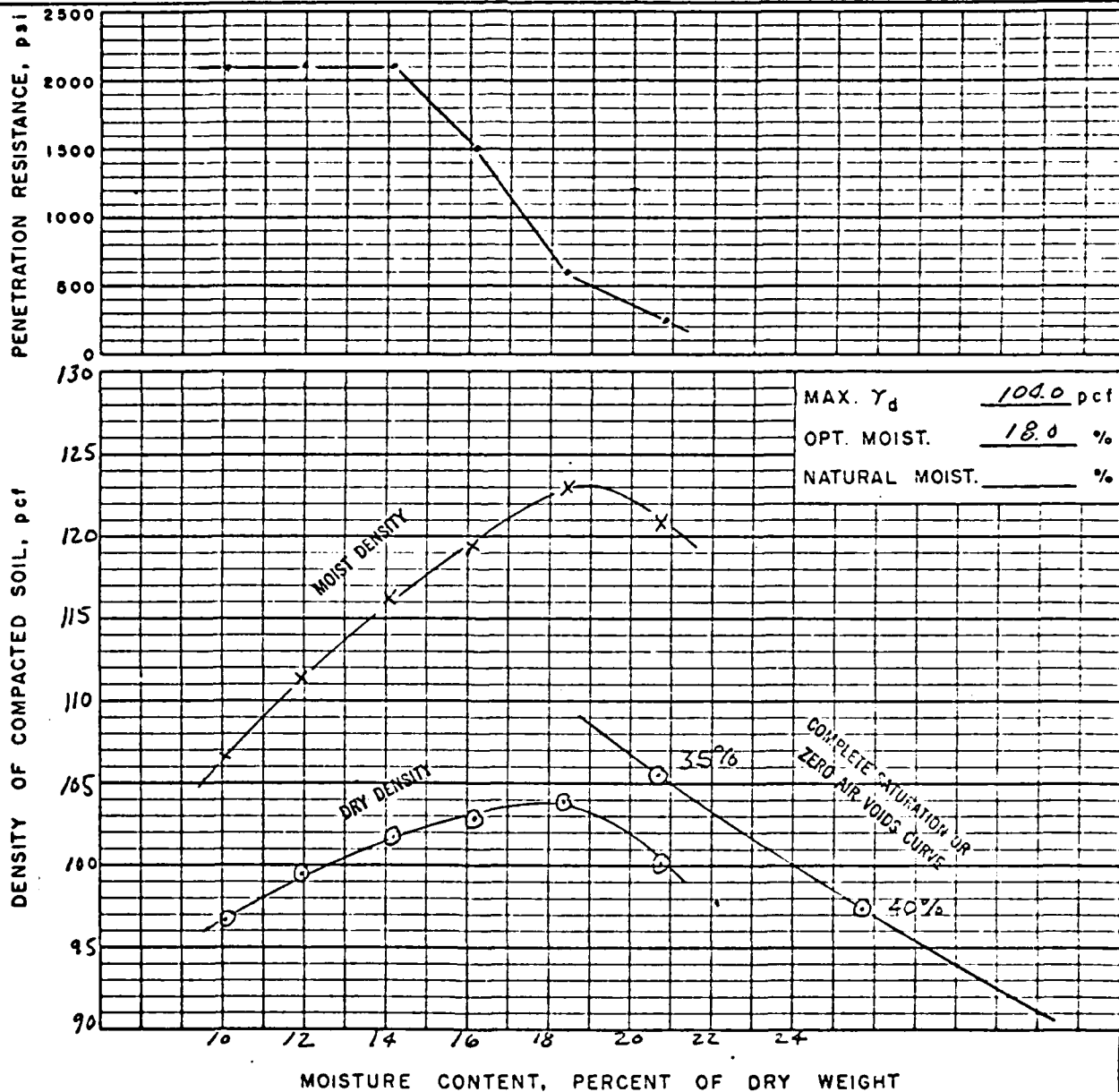
REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT and STATE <u>Little Snig-a-bar #1</u> <u>Missouri</u>					
FIELD SAMPLE NO. <u>102.1</u>		LOCATION <u>Borrow, F+50 6+00</u>			DEPTH <u>2.0 - 3.0'</u>
GEOLOGIC ORIGIN <u>Alluvium</u>		TESTED AT <u>SML-LINCOLN</u>		APPROVED BY <u>J.N.B.</u>	DATE <u>8-10-70</u>
CLASSIFICATION <u>CL</u> <u>LL 45</u> <u>PI 25</u>				CURVE NO. <u>9</u> OF <u>11</u>	
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u>				STD. (ASTM D-698) ☒ ; METHOD <u>A</u>	
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.65</u>				MOD. (ASTM D-1557) ☐ ; METHOD <u> </u>	
				OTHER TEST ☐ (SEE REMARKS)	



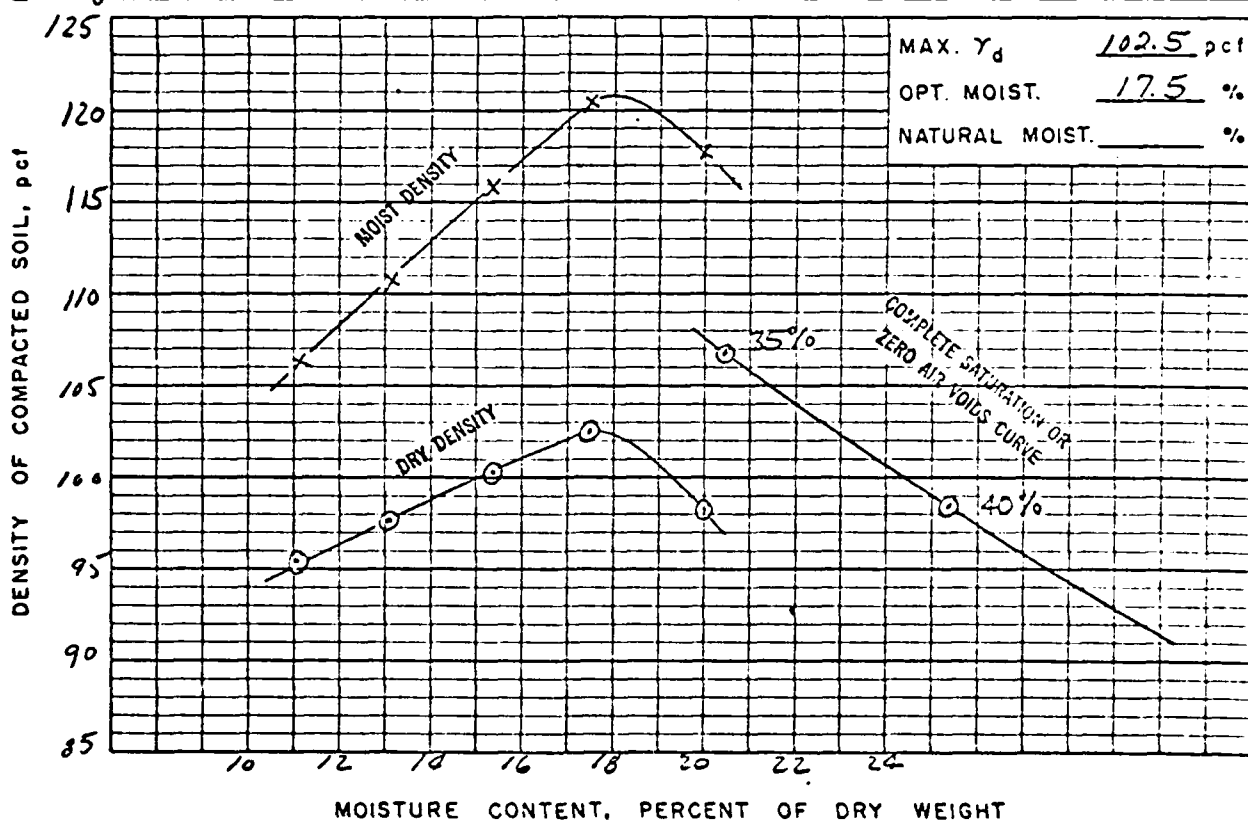
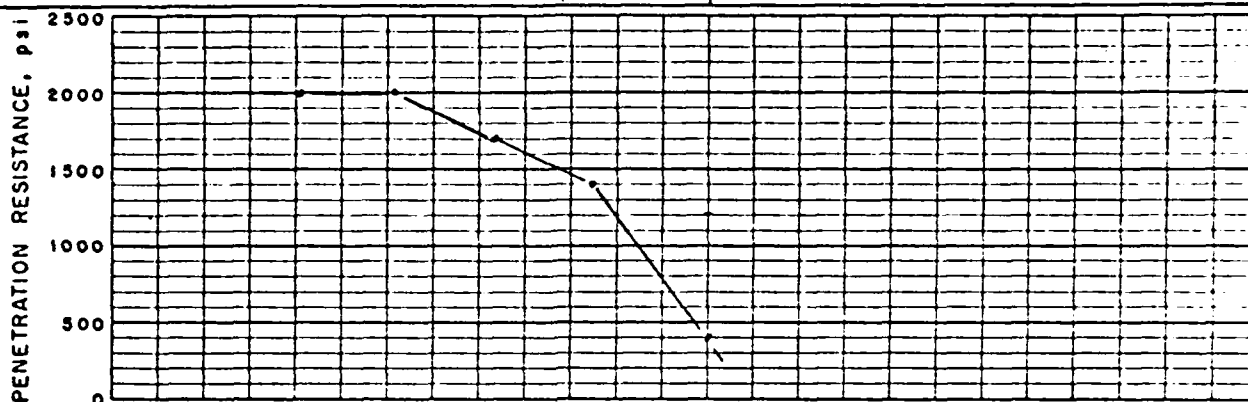
REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT and STATE <u>Little Sn-a-bar #1</u> <u>Missouri</u>					
FIELD SAMPLE NO. <u>102.2</u>		LOCATION <u>Borrow F+50; 6+00</u>			DEPTH <u>3.0'-5.0'</u>
GEOLOGIC ORIGIN <u>Alluvium</u>		TESTED AT <u>SML-LINCOLN</u>		APPROVED BY <u>G.N.G.</u>	DATE <u>8-20-70</u>
CLASSIFICATION <u>CL</u> LL <u>30</u> PI <u>10</u>				CURVE NO. <u>10</u> OF <u>11</u>	
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u>				STD. (ASTM D-698) ☒ ; METHOD <u>A</u>	
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.60</u>				MOD. (ASTM D-1557) ☐ ; METHOD _____	
				PLUS NO. 4 _____	
OTHER TEST ☐ (SEE REMARKS)					



REMARKS

MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		COMPACTION AND PENETRATION RESISTANCE	
PROJECT and STATE <u>Little Sn-a-bar #1 Missouri</u>					
FIELD SAMPLE NO. <u>105.1</u>		LOCATION <u>Borrow, I+50 B+00</u>			DEPTH <u>0.0'-1.0'</u>
GEOLOGIC ORIGIN <u>Alluvium</u>		TESTED AT <u>SML-LINCOLN</u>	APPROVED BY <u>J.N.G.</u>	DATE <u>8-20-70</u>	
CLASSIFICATION <u>CL-ML LL 28 PI 6</u>			CURVE NO. <u>11</u> OF <u>11</u>		
MAX. PARTICLE SIZE INCLUDED IN TEST <u>< #4</u>			STD. (ASTM D-698) ☒ ; METHOD <u>A</u>		
SPECIFIC GRAVITY (G_s) { MINUS NO. 4 <u>2.63</u>			MOD. (ASTM D-1557) ☐ ; METHOD <u> </u>		
			PLUS NO. 4 <u> </u>		
			OTHER TEST ☐ (SEE REMARKS)		



REMARKS

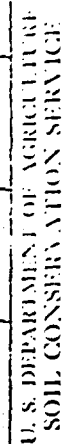
MATERIALS TESTING REPORT		U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE		SUMMARY - SLOPE STABILITY ANALYSIS	
PROJECT and STATE <i>SN1-A-BA SITE #1 MISSOURI</i>				DATE <i>2-4-70</i>	
METHOD OF ANALYSIS <i>SWEDISH CIRCLE</i>			ANALYZED AT <i>S.M.L. LIN. 2114 N.R.</i>		APPROVED BY <i>J.N.G.</i>

SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA					REMARKS	F _s	
		Y _d (pcf)	Y _m (pcf)	Y _{soil} (pcf)	Y _{sub} (pcf)	θ (deg)			c (psf)
① Found.	CL-MH	91.7		119.5	57.0	25	466	120	
② Found.	CL	94.5		121.5	52.0	23	424	150	
③ Embank.	CL	94.5	115.0	123.2	42.5	12.5	222	275	
④									
⑤									
⑥									
⑦									
⑧									
Maximum Section @ Station 12+00									
1 Up	2 1/2:1	Full drawdown - No berm - Arc cut thru emb (12.5°-375) only.						1.59	
2 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 774.0 - Arc cut thru emb. (12.5°-375) & 9' found (25°-100).						1.29	
2A Up	2 1/2:1	Same conditions as trial #2, except found (23°-150).						1.29	
3 Up	2 1/2:1	Same conditions as trial #2A.						1.33	
4 Up	2 1/2:1	Same conditions as trial #2A.						1.41	
5 Up	2 1/2:1	No berm - No berm - Arc cut thru emb (12.5°-375) only.						1.69	
6 Up	2 1/2:1	No berm - 10' berm @ elev. 762.0 - Arc cut thru emb. (12.5°-375) & 9' found (23°-150).						1.38	
7 Up	2 1/2:1	Same conditions as trial #6.						1.32	
8 Up	2 1/2:1	Same conditions as trial #6.						1.50	
Flared Plain Section @ Station 12+50									
9 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 774 - Arc cut thru emb. (12.5°-375) & 11' found (23°-150).						1.51	
10 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 774 - Arc cut thru emb. (12.5°-375) & 22' found (23°-150).						1.42	
10A Up	2 1/2:1	Same conditions as trial #10 except found (25°-100).						1.42	
11 Up	2 1/2:1	Same conditions as trial #10.						1.42	
11A Up	2 1/2:1	Same conditions as trial #10A.						1.31	
12 Up	2 1/2:1	Same conditions as trial #10A.						1.59	

Continued on sheet 2 of 4

[illegible]

STATION 12+00
NORTH 35 WEST



RECEIVED BY
A. J. L.

(continued) NO 7-5-50

DATE 66-1-22

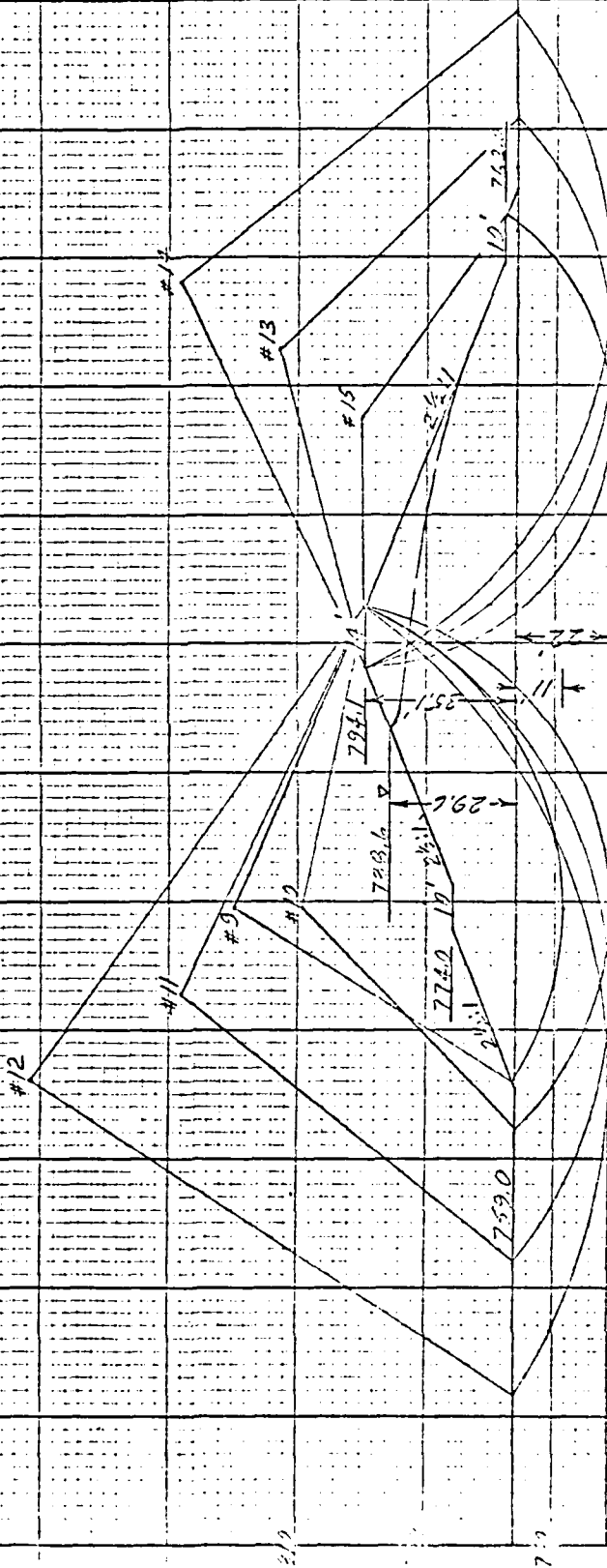
203

Scuba #230

18705514

EL220 PLAIN SECTION

STATION 12+60


$$\text{Scale: } 1'' = 30'$$
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

19 074010

CHECKED BY

9-11-6

Dr. Anna W. F. W. SCS-357

1943

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

10-59

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Missouri County Lafayette ; NW 9 NE 8 , T 49N R 27W ; Watershed Little Sni-A-Bar
 Subwatershed _____ Fund class WP-08-15 Site number 1 Site group I Structure class a
 (FP-2, WP-1, etc.)
 Investigated by Paul J. Benoit Equipment used Falling 1500 Date 3-3-70
 (signature and title) (Type, size, make, model, etc.)

SITE DATA

Drainage area size 14.37 sq. mi., 9197 acres. Type of structure D1 48" R/C Purpose Floodwater
 Direction of valley trend (downstream) N Maximum height of fill 49 feet. Length of fill 1200 feet
 Estimated volume of compacted fill required 97,715 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
☒ Sediment	<u>651</u>	<u>105</u>	<u>29</u>
☐ Floodwater	<u>3080</u>	<u>318.6</u>	<u>43.6</u>
_____	_____	_____	_____

SURFACE GEOLOGY AND PHYSIOGRAPHY

Cherokee Prairie
 Physiographic description River Hill Loess Topography rolling Attitude of beds: Dip -- Strike --
 Steepness of abutments: Left 9 percent; Right 9 percent. Width of floodplain at centerline of dam 450 feet
 General geology of site: The site is located in a transitional area from National Land Resource Area 107, the Iowa and Missouri Loess Hills and Resource Area 112, the Cherokee Prairies. The modified loess occurs on the upper slopes and ridges. The underlying bedrock is shale and sandstone of the Kansas City Group, Missourian Series, of the Pennsylvanian System.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

FEATURE E of Dam, Principal Spillway, Emergency Spillway, 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)	LARGE DISTURBED	SMALL DISTURBED
5" Slat Auger	31	8		12 bag	8 bag
3" Shelby		2	3 Shelby		4 bag
Std. Split Tube		2			4 Jar
3" Tri-cone bit	2				
TOTAL	33	12	3	12	16

SUMMARY OF FINDINGS
(INCLUDE ONLY FACTUAL DATA)

The abutments are modified loess classified as firm to stiff clay (CL). The alluvium of the foundation area is clayey silt (ML) in the upper part and a silty clay (CL) in the lower part. The alluvium forms the foundation of the principal spillway. Shale is the predominate underlying bedrock, however, a prominent sandstone bed was encountered in test holes 11 and 12. The bed is absent in test hole 10 which is located 25 feet to the left. Refusal on limestone was encountered in test holes 5, 6, 7, 401, and 402. Shale is the uppermost bedrock along the centerline of the principal spillway. The emergency spillway cuts on the left abutment will be the principal source of borrow material. Other borrow will be available from the alluvium within easy haul distance. The stream channel meanders across the centerline of the dam. Channel deposits of flat shale and sandstone gravel was 2.5 to 3 feet deep in test holes 401 and 402. The underlying alluvium is classified silty clay (CL). The stream channel appears stable at the present, however, some shifting of the bed load gravels will occur seasonally.

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED Little Sni-A-Bar		SUBWATERSHED	COUNTY Lafayette	STATE Missouri
SITE NO. 1	SITE GROUP 1	STRUCTURE CLASS a	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST) <i>Neil J. Edwards</i>	DATE 3-3-70

INTERPRETATIONS AND CONCLUSIONS

Foundation

The bedrock surface drops abruptly between test holes 10 and 11, a distance of 25 feet. Some gravel was noted below 13 feet in test holes 9 and 10 but no slabs or boulders were encountered as might usually be expected. Shale cover extends as far as the sandstone and no seepage hazards are apparent. The alluvium is generally uniform throughout the foundation area. The upper 10 to 14 feet is classified as ML, soft when wet, and contains a noticeable amount of very fine sand below the upper layer of modern sediments. This is underlain by yellowish brown and gray, wet, soft alluvium frequently encountered in the glacial till and loess soil areas. The material is classified as very silty CL. A greenish gray firm CL occurs above the bedrock on the left side of the valley. Shelby tube samples were taken of these three representative materials. The greenish gray material was difficult to sample since some gravel was encountered. This gravel occurs in thin lens and was not noticeable when augering the holes. The consistency of the alluvium becomes firmer near the abutments as classified in test holes 4, 9 and 10. Test holes 601 through 606 were drilled 95 feet downstream from the centerline. Some lens or discontinuous strata of iron concretions and flat shale and sandstone gravels were encountered, however, all materials were mixed in clay and classified as CL. No materials classified as permeable were encountered. Refusal in the test holes at the centerline was on the limestone bed encountered from 35 to 37 feet in test hole 11.

Principal Spillway

The principal spillway is to be relocated and undisturbed samples were taken at Station 14+00. The refusal in test hole 305, station 3+55, correlates well with the limestone bed in test hole 11 at the centerline. This appears to be a sound bed.

Emergency Spillway and Borrow Areas

The emergency spillway cuts are in the loess and loess soil and will furnish the major part of the borrow material for the dam. Other borrow can be obtained from the alluvial area below the crest elevation, of the principal spillway, however, the existing pond and high water levels may limit the depth and location of the material.

Channel

It was not possible to investigate the designated channel sections. The two holes drilled in the channel are believed representative of the channel deposits throughout the foundation area.

PROJECT ENGINEER'S RECOMMENDATIONS
LITTLE SNI-A-BAR
STRUCTURE #1

1. FOUNDATION

General Statement - The foundation on this site is compressible, there will be settlement. I recommend a combination foundation and chimney drain. The chimney drain to be in contact with the steep rock ledge on the right abutment to pick up any water that may seep along the ledge from differential settlement.

- 1.1 Core - After consulting with the state Design Engineer, I moved the center line of the structure 150 feet up stream as now shown on the Geologic sheets. The reason for moving the center line was to eliminate the cost of a long outlet channel and to eliminate the double excavation cost of channel and core excavation. The core is now superimposed on the moderately meandering channel. For the simplicity of computing yardages and of establishing bid items, the core will extend from each end of the dam to approximately 9 + 50 and 13 + 90. The excavation between stations 9 + 50 and 13 + 90 will be called channel cleanout. This excavation will be made to a depth to function as a core trench cutoff. The following core grades are recommended:

<u>Station</u>	<u>Elevation</u>
6 + 00	789
6 + 80	782
7 + 50	774
9 + 00	765
9 + 20	760
9 + 60	743
13 + 80	745
15 + 10	752
15 + 30	765
16 + 10	778
16 + 90	785
17 + 90	792

Rock ledge should be inspected and sloped. All projections should be removed to avoid creating an opening during settlement.

- 1.2 Channel Cleanout - See attached cross sections.

<u>Station</u>	<u>Elevation</u>	<u>Width</u>	<u>Slope</u>
Section A	745.0	32	1 : 1
Section A + 50			1 1/2 : 1
Section B	744.0	28	1 1/2 : 1
Section C	743.5	20	1 1/2 : 1
Section D	743.0	30	1 1/2 : 1
Section E	743.0	32	1 1/2 : 1 +
Section F	743.0	25	1 1/2 : 1
Section F + 50			1 : 1
Section G	743.0	38	1 : 1

If consolidation in the foundation is less than anticipated, consideration should be given to changing all the side slopes to 1 : 1 to reduce the excavation yardage.

- 1.3 Structure excavation - Should remove all ML material. This will be approximately the pipe grade. Grade will not be known until riser height is determined. To eliminate shear along the cut slopes when consolidation of the foundation occurs, the minimum side slopes should be 2 : 1 with a 12 foot bottom.

2. CHANNEL OUTLET

A plunge basin will be required to stabilize the deep cut slopes. A 15 foot wide outlet with 2 : 1 slopes is recommended.

3. BORROW

Needed - $97,715 \times 1.3 = 127,000$ cu. yd.

Available - 72,000 c.y. from emergency; most of it is good quality CL material.

There is an adequate quantity of ML material a short distance up stream of the dam to complete the borrow requirement. The CL should be used for backfilling the excavated areas and building the inner part of the dam.

Shear test of borrow is not requested since the CL material from the emergency spillway is a good quality material that will be used in the center of the dam.

Based on laboratory classifications the following samples may be composited:

202.1	202.2	202.3
206.1	206.2	206.3
208.1	208.2	

Gerald McElhiney
Project Engineer, Higginsville, Mo.

APPENDIX D
HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. The Mockes dimensionless standard curvilinear unit hydrograph and SCS TR-20 program were used to develop the inflow hydrographs (see Plate D1). The inflow hydrograph for the 100-year flood was generated by the consultant using the TR-20 program.
 - a. Six-hour, twelve-hour, and twenty-four hour 100-year rainfall for the dam location was taken from NOAA Technical Paper 40. The 36-hour probable maximum precipitation was taken from curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis District policy and guidance for hydraulics and hydrology. A 36-hour probable maximum storm was selected by the consultant because of the relatively large drainage area, time of concentration and length of downstream damage zone. This decision also gave an effective base flow ahead of the maximum 24-hour rainfall.
 - b. Drainage area = 14.37 square miles (SCS).
 - c. Time of concentration of runoff - 2.3 hours (SCS).
 - d. The antecedent storm conditions were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMCIII). The initial pool elevation was assumed at the crest of the principal spillway. The (SCS AMCIII) antecedent storm conditions were also used for the 100-year storm event. This was done because base conditions (SCS AMCII) reflect only a maximum annual flood precedence condition on numerous watersheds. The 100-year event is rarer and would be preceded by a greater degree of saturation of the watershed. SCS AMCIII.
 - e. The total 24-hour storm duration losses for the 100-year storm were 1.44 inches. The total losses for the 36-hour duration 1/2 PMF storm were 1.00 inch. The total losses for the PMF storm were 0.77 inch. These relatively low losses on the PMF storms are created by the longer storm duration of 36 hours. The watershed was determined to be made up predominately of Ladoga and Pershing soils which are, respectively, in the B and C Hydrologic Soil Group classifications. A grid weighting system and consideration of land usage gave a resultant SCS curve No. of 78 for SCS AMCII. These data are based on SCS runoff curve No. 90 and antecedent moisture conditions from SCS AMCIII.
 - f. Average soil loss rates = 0.04 inch per hour approximately.

2. The weir/full pipe flow discharge ratings were developed for the principal spillway using standard formulas and criteria from SCS publication Design Manual EWP-5. The emergency spillway discharge rating was developed using the SCS emergency spillway computer program "RESIN" and the results compared closely with the values furnished by the SCS for both the emergency and principal spillways. The flows over the dam crest were based on the broad-crested weir equation $Q = CLH^{3/2}$, where H is the head on the dam crest; the coefficient C which varies with head was taken from the USGS publication "TWRI, Book 3, Chapter 5, Measurement of Peak Discharge at Dams by Indirect Methods".
3. Floods were routed through the reservoir using the TR-20 program which uses the "Modified Puls" method to determine the capabilities of the spillways and dam embankment crest. A routing time interval of 0.5 hour was used. The storm rainfall patterns, inflow hydrographs and routed outflow hydrographs are shown on Plate D1.

