M-K FERGUSON
WSSRAP LIBRARY
FILE NO. GR-470

ED 94

WELDON SPRING SITE REMEDIAL ACTION PROJECT

DISPOSAL FACILITY
GEOTECHNICAL CHARACTERIZATION REPORT
MKES REPORT NO. 3840R-7005-0

OCTOBER 1991

REVISION 0

PREPARED BY

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES DIVISION
180 HOWARD STREET
SAN FRANCISCO, CALIFORNIA 94105

FOR

MK-FERGUSON COMPANY
AND
JACOBS ENGINEERING GROUP
7295 HIGHWAY 94 SOUTH
ST. CHARLES, MISSOURI 63301

TABLE OF CONTENTS

SECTION			PAGE
1	INTRODUCTION		1
	1.1	Objectives	1
	1.2	Scope	1
	1.3	Background	2
	1.4	Other Related Studies and References	3
2	SYNOPSIS OF GEOTECHNICAL INVESTIGATIONS		6
	2.1	General	6
	2.2	Previous Field Investigations by Others	6
	2.3	PMC Phase I and Phase II Investigations	10
		2.3.1 Disposal Facility Area	10
		2.3.2 Areas Outside the Disposal Facility Area	11
		2.3.3 Potential Borrow Sources	11
	2.4	Assessment of Pre-Phase III Investigations	11
	2.5	PMC Phase III Investigation	16
3	SUMMARY OF TESTING PROGRAMS AND RESULTS		18
	3.1	Summary of Geotechnical Testing Programs	18
	3.2	Subsurface and Potential Borrow Source Materials and Data Reduction	25
	3.3	Classification and Index Properties	43
		3.3.1 Particle-Size Analysis	43
		3.3.2 Atterberg Limits/Plasticity	45
		3.3.3 Specific Gravity	57

TABLE OF CONTENTS

SECTION			PAGE
	3.3.4	Natural Moisture Content	65
	3.3.5	In Situ Density	67
3.4		Moisture-Density and Capillary-Moisture Relations	67
	3.4.1	Standard Proctor Compaction	67
	3.4.2	Capillary-Moisture Relationships	68
3.5		Strength and Deformation Characteristics	74
	3.5.1	Unconsolidated-Undrained (UU) Triaxial Compression	74
	3.5.2	Consolidated-Undrained (CU) Triaxial Compression	79
	3.5.3	California Bearing Ratio	80
3.6		Volume Change Characteristics	102
	3.6.1	One-Dimensional Consolidation	102
	3.6.2	Cation Exchange Capacity	105
3.7		Permeability	105
3.8		Corrosivity	110
	3.8.1	Resistivity	110
	3.8.2	Sulfates and Chlorides	110
	3.8.3	Acidity/Alkalinity	112
	3.8.4	Percent Solids	112
3.9		Standard Penetration Test	112
3.10		Quality Assurance	113

TABLE OF CONTENTS

SECTION PAGE

4 CONCLUSIONS AND RECOMMENDATIONS 114

4.1 Site Description and Subsurface Conditions 114
4.2 Materials 120

4.2.1 Topsoil 120
4.2.2 Subsoil 120
4.2.3 Satisfactory Materials 121
4.2.4 Unsatisfactory and Unstable Materials 121
4.2.5 Low-Permeability Soils 122

4.3 Potential Borrow Sources 123

4.3.1 Topsoil/Subsoil 123
4.3.2 Low Permeability Material 123

4.4 Soil Properties and Parameters 126

4.4.1 Unit Weights 127
4.4.2 Strength Parameters for Stability Analysis 127
4.4.3 Soil Parameters for Settlement Estimates 128
4.4.4 Permeability of Soil Liners and Cover Components 128
4.4.5 Cracking Potential 130
4.4.6 Corrosiveness of Soils 131

4.5 Site Preparation and Earthwork 132

4.5.1 Clearing and Grubbing 132
4.5.2 Excavation, Filling and Backfilling 133

TABLE OF CONTENTS

SECTION PAGE

5 REFERENCES 135

APPENDIXES

A MKES Phase III Field Investigation Program
A-1 IOC Report on Phase III Field Investigation
A-2 Logs of Phase III Borings
B MKES Phase III Investigation Test Results
C Calculation for Evaluation of Soil Properties

LIST OF FIGURES

FIGURE		PAGE
1-1	Area and Vicinity Map of the Weldon Spring Site	4
1-2	Site Location Plan and Limit of Possible Disposal Area	5
2-1	Location Map for Borings, Test Pits and Geologic Profiles	7
2-2	Location Map for Test-Pits for Potential Off-Site Clay Borrow Sources	8
3-1	Summary Plot of Gradation Limits — Topsoil/Fill	46
3-2	Summary Plot of Gradation Limits — Loess	47
3-3A	Summary Plot of Gradation Limits— Ferrelview Clay: Overall Values	48
3-3B	Summary Plot of Gradation Limits— Ferrelview Clay: Northern CP	49
3-3C	Summary Plot of Gradation Limits— Ferrelview Clay: Southern CP	50
3-3D	Summary Plot of Gradation Limits— Ferrelview Clay: TSA	51
3-3E	Summary Plot of Gradation Limits— Ferrelview Clay: MSA	52
3-4	Summary Plot of Gradation Limits — Clay Till	53
3-5	Summary Plot of Gradation Limits — Basal Till	54
3-6	Summary Plot of Gradation Limits — Residuum	55
3-7	Summary Plot of Gradation Limits — Potential Borrow Source No. 1	56
3-8	Summary of Atterberg Limits — Topsoil/Fill	58
3-9	Summary of Atterberg Limits - Loess	59
3-10	Summary of Atterberg Limits — Ferrelview Clay: Overall Values	60
3-11	Summary of Atterberg Limits — Clay Till	61
3-12	Summary of Atterberg Limits — Basal Till	62
3-13	Summary of Atterberg Limits — Residuum	63
3-14	Summary of Atterberg Limits — Potential Borrow Source No. 1	64
3-15	Summary of Compaction Tests — Various Soil Units	69
3-16	Summary of Compaction Tests — Potential Borrow Source No. 1	70
3-17	Summary of Capillary Moisture Tests - Remolded Loess	71
3-18	Summary of Capillary Moisture Tests - Remolded Ferrelview Clay	72
3-19	Summary of Capillary Moisture Tests - Potential Borrow Source No. 1	73

LIST OF FIGURES
(Continued)

FIGURE		PAGE
3-20	Summary of Strength Envelopes — UU Triaxial, Undisturbed Sample - Loess	75
3-21	Summary of Strength Envelopes — UU Triaxial, Undisturbed Sample - Ferrelview Clay	76
3-22	Summary of Strength Envelopes — UU Triaxial, Undisturbed Sample - Clay Till	77
3-23	Summary of Strength Envelopes — UU Triaxial, Undisturbed Sample - Basal Till	78
3-24A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Topsoil/Fill	81
3-24B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Topsoil/Fill	82
3-25A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Loess	83
3-25B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Loess	84
3-26A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Ferrelview Clay	85
3-26B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Ferrelview Clay	86
3-27A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Clay Till	87
3-27B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Clay Till	88
3-28A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Basal Till	89
3-28B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Basal Till	90
3-29A	Summary of Total Strength Envelopes — CU Triaxial, Undisturbed Sample - Residuum	91

LIST OF FIGURES
(Continued)

FIGURE		PAGE
3–29B	Summary of Effective Strength Envelopes — CU Triaxial, Undisturbed Sample - Residuum	92
3–30	Summary of Strength Envelopes — UU Triaxial, Remolded Sample - Loess	93
3–31	Summary of Strength Envelopes — UU Triaxial, Remolded Sample - Ferrelview	94
3–32A	Summary of Total Strength Envelopes — CU Triaxial, Remolded Sample - Loess	95
3–32B	Summary of Effective Strength Envelopes — CU Triaxial, Remolded Sample - Loess	96
3–33A	Summary of Total Strength Envelopes — CU Triaxial, Remolded Sample - Ferrelview	97
3–33B	Summary of Effective Envelopes — CU Triaxial, Remolded Sample - Ferrelview	98
3–34	Summary of Strength Envelopes — UU Triaxial, Remolded Sample - Potential Borrow Source No. 1	99
3–35A	Summary of Total Strength Envelopes — CU Triaxial, Remolded Sample - Potential Borrow Source No. 1	100
3–35B	Summary of Effective Strength Envelopes — CU Triaxial, Remolded Sample - Potential Borrow Source No. 1	101
3–36	Distribution of Preconsolidation Pressures - Overall Area	104
4–1	Geologic Profile, Section B	115
4–2	Geologic Profile, Section D	116
4–3	Geologic Profile, Section F	117
4–4	Geologic Profile, Section G	118
4–5	Legend For Geologic Profiles	119
4–6	Representative Preconsolidation Pressure of In-situ Soils	129

LIST OF TABLES

TABLE		PAGE
2-1	General Information Regarding Borings and Test Pits	9
2-2	Number of Valid Tests Performed in Investigations Conducted Prior to 1988	12
2-3	Number of Tests Performed in MKE Phases I and II Investigations	13
2-4	Total Number of Valid Tests Performed as of 1990 and the Recommended Minimum Number of Geotechnical Laboratory Tests	15
3-1	Average Values of Laboratory Testing Results From Previous (Pre-1988) Investigations	19
3-2	Summary of Soil Testing Programs	21
3-3	Number and Types of Laboratory Test Activity According to Specific Areas	24
3-4	Summary of Soil Test Results (Phase I, II and III)	26
3-5	Summary of Averaging of Index Properties for Overall Site Area	40
3-6	Summary of Averaging of Index Properties for Disposal Cell Area	41
3-7	Summary of Averaging of Index Properties for Potential Borrow Source No. 1.	42
3-8	Legend of Symbols used in Graphs	44
3-9	Additional Soil Properties Calculated from Average Values of Test Results	66
3-10	Laboratory CBR Test Results	102
3-11	Summary of Consolidation Parameters from Tests on Undisturbed Samples	103
3-12	Summary of Coefficient of Permeability for Undisturbed On-Site Soils	106
3-13	Summary of Coefficient of Permeability for Remolded On-Site Soils	108
3-14	Summary of Coefficient of Permeability for Remolded Borrow Soils	109
3-15	Corrosivity Test Results	111
3-16	Typical SPT Blow Counts for Various Soil Units	113
4-1	Recommended Unit Weights and Strength Parameters for Stability Analysis for In-Situ Soil Units and Compacted Fill Materials	124
4-2	Recommended Soil Parameters for Settlement Estimates for DF	125
4-3	Relationship Between Atterberg Limits and Volume Change of Material	131

1 INTRODUCTION

1.1 Objectives

This report presents the results of Phases I, II and III geotechnical investigations conducted by the Project Management Contractor (PMC) and soil parameters and other recommendations for the design of a disposal facility (DF) for the Weldon Spring Site Remedial Action Project (WSSRAP). The geotechnical investigations were conducted to support the remedial investigation, feasibility study, siting, design and construction of a proposed disposal facility in the vicinity of the Chemical Plant at the Weldon Spring Site (WSS); and to provide data for design of various on-site areas and temporary facilities such as the administration building, Raffinate Pit Dike No. 4, Temporary Storage Area (TSA), Material Staging Area (MSA) and the Water Treatment Plant (WTP) facilities. The Phase II investigation also included an exploration of two off-site borrow areas as potential sources of clayey soils.

The WSSRAP Chemical Plant Geotechnical Investigations Report (MKF and JEG 1990b), which contains an abridged treatise on the background, surface feature, geology and hydrogeology of the site and presents the PMC Phases I and II (also referred to as MKE or MKES Phases I and II) geotechnical field investigation and laboratory test results, should be used as a supplemental document for this report. To avoid repetition in presenting the background and Phases I and II investigation testing results, the geotechnical investigation report (MKF and JEG 1990b) is referred to frequently herein.

1.2 Scope

This report specifically addresses the geotechnical engineering aspects of the subsurface soils within the vicinity of the proposed cell(s) of the disposal facility and suitable clayey materials from potential borrow sources for the design of a disposal cell at the WSS. The scope does not cover geotechnical engineering aspects of all areas investigated and is limited to the scoping items listed below:

1. Collect, organize, reduce and evaluate available geotechnical test results from MKE Phases I, II and III programs. Summarize findings in tables, charts and graphs.

2. Prepare geotechnical cross-sections (geologic profiles).

3. Develop conclusions and recommendations of geotechnical parameters for the investigated soils for disposal cell design calculations on foundation settlement, cover and liner material, cracking potential, embankment stability and subgrade bearing.

The scope does not include the following specific items that were addressed in separate studies or reports.

1. Geophysical investigation assessment.

2. Geotechnical engineering conclusions and recommendations for the excavation and removal of the raffinate pit dikes and sludges, and the design and construction of the TSA, MSA, WTP facilities and access and haul roads.

3. Hydraulic conductivity of the subsurface soil strata.

4. Geology and hydrogeology of the WSS.

5. Contamination of the subsurface soils.

6. Conclusions and recommendations for design elements not listed in Scoping Item 3.

1.3 Background

The WSSRAP is being conducted as a major System Acquisition under the Surplus Management Program (SFMP) of the United States Department of Energy (DOE). The major goals are to eliminate the potential hazards to the public and the

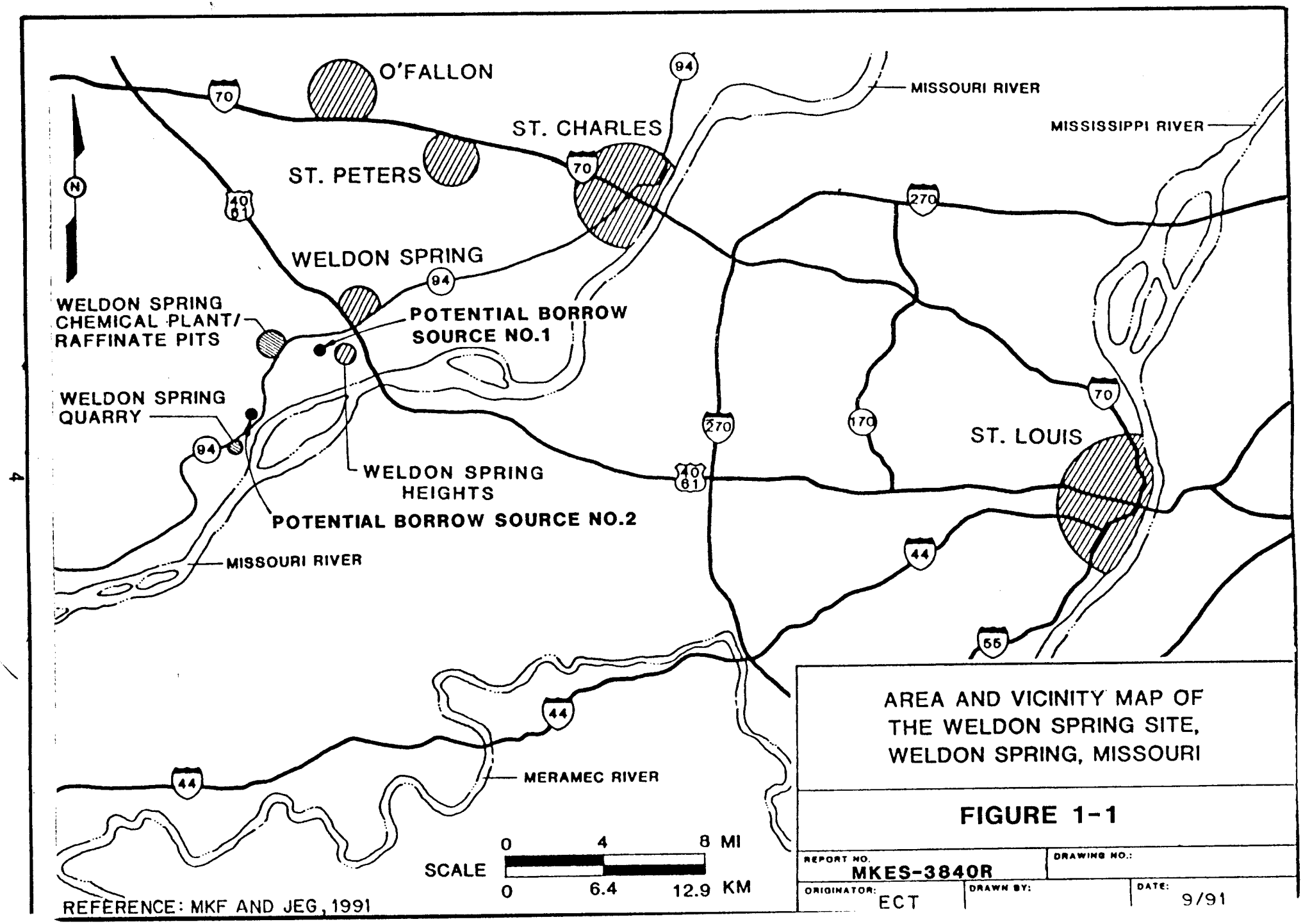
environment that are associated with contamination at the WSS and, to the extent possible, to make surplus real property available for other uses.

As illustrated in Figure 1-1, the WSS is located approximately 30 miles west of St. Louis, Missouri, in southwestern St. Charles County. The site is in an area just west of Missouri State Highway 94, approximately 2 miles southwest of its junction with U.S. Highway 40 (Interstate 64). The respective locations of potential off-site Borrow Source Nos. 1 and 2, for low permeability (clayey) soil are approximately two miles east and south of the WSS. It should be noted that Borrow Source No. 1 is located across Highway 94 from the WSS.

The embankment portion of the proposed disposal facility (DF), also referred to as the disposal cell, will be used for long-term storage of untreated, treated and/or processed contaminated waste materials from the WSS. The possible limit suitable for the disposal facility, as identified in the Siting Study (MKES 1991b), and various proposed and existing temporary facilities are shown in Figure 1-2.

1.4 Other Related Studies and References

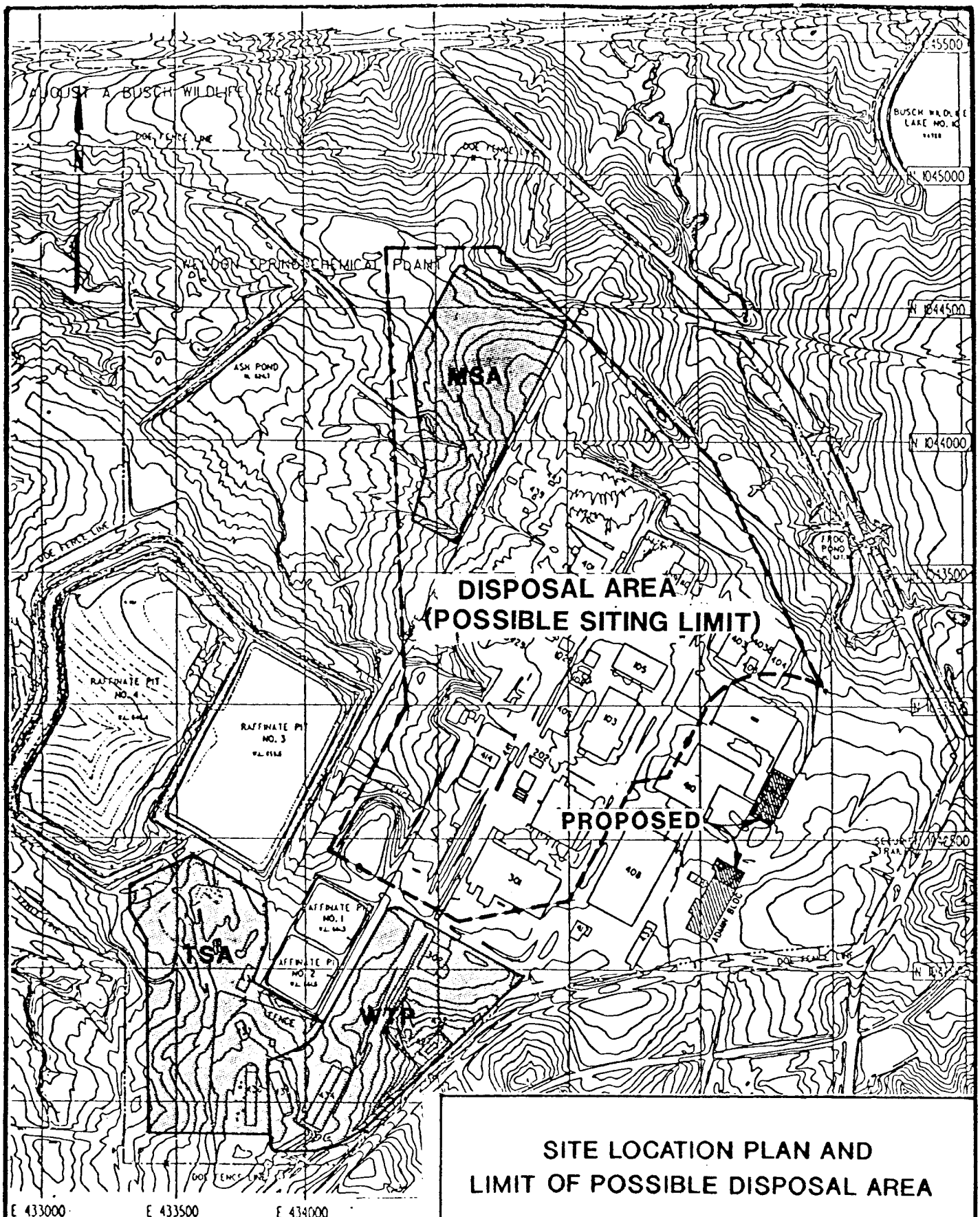
The PMC Phases I, II, and III geotechnical investigations were conducted by MK Environmental Services (MKES) as part of the PMC field data collection for the remedial investigation/feasibility study process. In addition to providing geotechnical parameters for DF design, the data and results were used to support other remedial investigation (RI) documents and special studies, including the RI report (MKF and JEG 1990c), site suitability study (MKF and JEG 1990a), chemical plant (site) geotechnical investigations report (MKF and JEG 1990b), grading plan study (MKES 1991d), liner and foundation studies (MKES 1991c); and temporary facilities design including the TSA, MSA and WTP. Brief descriptions of these facilities were included in Section 1 of the geotechnical investigations report (MKF and JEG 1990b).



AREA AND VICINITY MAP OF THE WELDON SPRING SITE, WELDON SPRING, MISSOURI

FIGURE 1-1

REPORT NO.	DRAWING NO.:
MKES-3840R	
ORIGINATOR: ECT	DRAWN BY:
DATE: 9/91	



LEGEND:

- EXISTING BUILDING TO REMAIN
- PERMANENT BUILDING TO BE ADDED

500 0 500

SCALE FEET

SITE LOCATION PLAN AND LIMIT OF POSSIBLE DISPOSAL AREA

FIGURE 1-2

REPORT NO.	DRAWING NO.:	
MKES-3840R		
ORIGINATOR: ECT	DRAWN BY:	DATE: 9/91

2 SYNOPSIS OF GEOTECHNICAL INVESTIGATIONS

2.1 General

Field investigations of the subsurface strata at the Weldon Spring Site (WSS) have been conducted by various organizations since 1955 for site characterization, geophysical studies, hydrogeology studies and acquisition of data for design of on-site facilities. As part of these investigations, 167 boreholes (including borings drilled for installation of monitoring wells) have been drilled and 41 test pits have been excavated. Locations and identifying numbers for these holes, wells and test pits are shown in Figure 2-1. General information regarding each series of borings and test pits is presented in Table 2-1. The results of these investigations and the investigation for low-permeability soils at two potential borrow sources near the site (see Figures 1-1 and 2-2), are discussed herein.

Brief synopses of investigations preceding Phase III are presented in Sections 2.2 through 2.4 below. The Phase III investigation is described in detail in Section 2.5.

2.2 Previous Field Investigations By Others

Previous geotechnical investigations by various organizations other than the PMC and the years when they were performed are listed below. Numbers in parentheses represent the year in which the corresponding reports were published.

- U.S. Army Corps of Engineers (COE) - 1954 (1955, 1970)
- Henry M. Reitz Consulting Engineers (HMR) - 1963 (1964)
- Bechtel National, Inc. (BNI) - 1982-1984 (1984)
- Bechtel National, Inc. (BNI) - 1986 (1987)

The PMC and its off-site engineering support group (primarily MKES) have reviewed and evaluated these geotechnical investigations in depth. The purposes of

LEGEND:

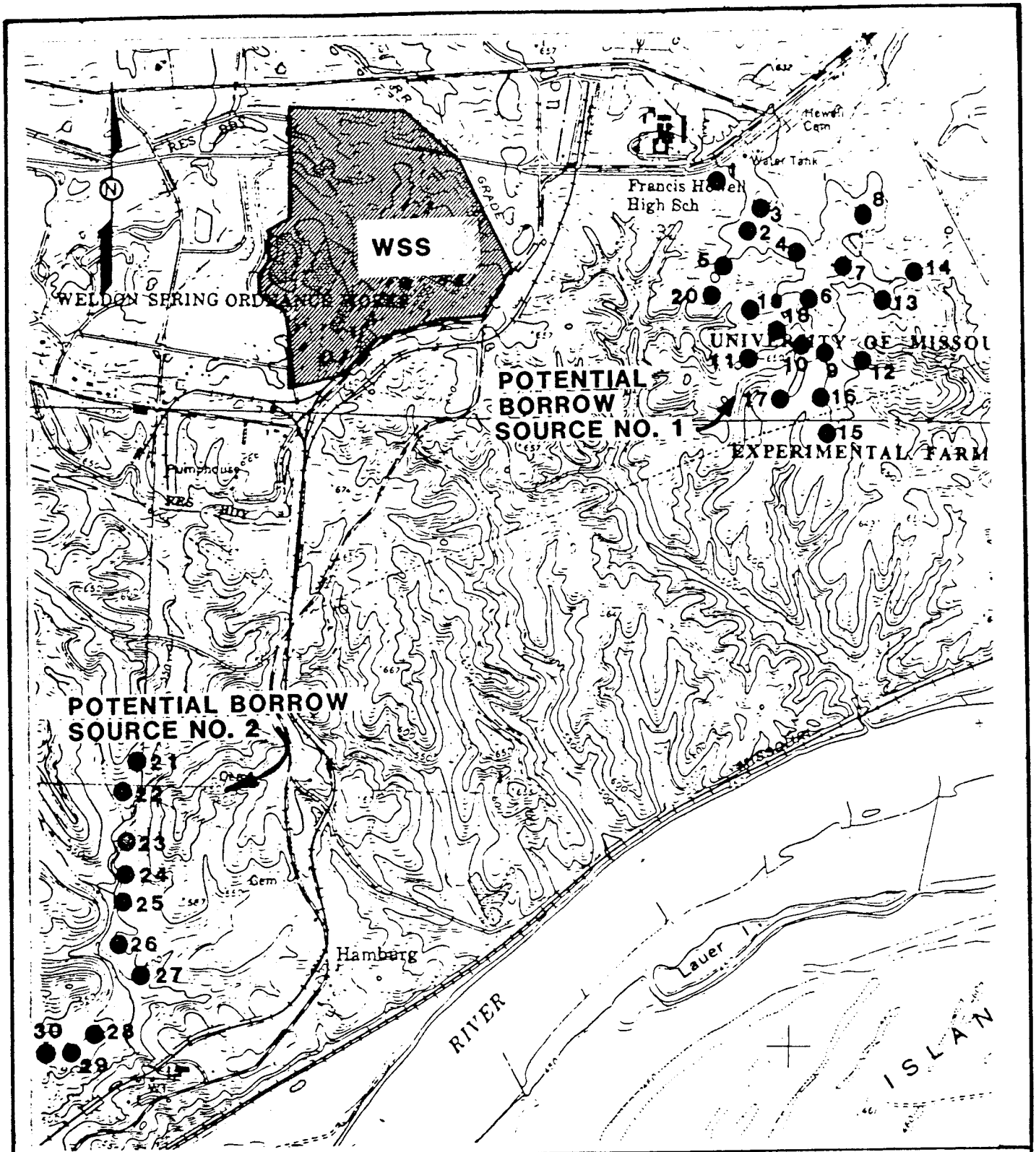
- G-54-11 — U.S. C.O.E. BOREHOLE (1954-55)
- TR-15 — BNI TEST PIT (1982)
- B-22 — BNI MONITOR WELL (1983), OLD I.D. IN PARENTHESIS
- T-6 — BNI TEST PIT (1983)
- G-24 — BNI BOREHOLE (1983)
- (GMW-11) — BNI MONITORING WELL (1986), OLD I.D. IN PARENTHESIS
- GT-57 — MKE PHASE I BOREHOLE (1988)
- MW-4023 — MKF AND JEG MONITORING WELL (1988), INCLUDING INCORPORATED BNI WELLS (B AND GMW SERIES)
- PW-3 OR OB-2J — MKE PUMPING WELL (1988)
- GT-2T82 — MKE PHASE I TEST PIT (1988)
- AH-2 GT-67P OR GTS-7 — MKE PHASE II BOREHOLE (1989)
- TPMS-9 — MKF TEST PIT (1990)
- G-68 — MKE PHASE III BOREHOLE (1991)
- — — — LIMIT OF SPECIFIC AREA FOR DATA REDUCTION

200 0 200 400
SCALE FEET

TEST PITS, MONITOR WELLS AND BOREHOLES LOCATION MAP

FIGURE 2-1

REPORT NO.: MKES-3840R-7005		DRAWING NO.:
ORIGINATOR: ECT	DRAWN BY: RBC/AMA	DATE:



LEGEND:

8 ● TEST PIT LOCATION (TPBS-8)

0 2000 4000 FT

0 609.6 1219.2 M

SCALE

REFERENCE: MKF AND JEG, 1991
SOURCE MAP: USGS QUAD MAP

OFF-SITE CLAY BORROWS SOURCES TEST PIT LOCATION MAP

FIGURE 2-2

REPORT NO. MKES-3840R	EXHIBIT NO.:	
ORIGINATOR ECT	DRAWN BY: JM	DATE: 9/91

Table 2-1

General Information Regarding Borings and Test Pits

Designation	Type and Area	Firm/Agency	Year
AH-1 and AH-2	Angled borehole number - chemical plant area	PMC (Phase II)	1989
B-1 to B-22	Borehole number - raffinate pit area	Bechtel National, Inc.	1983
B-15A, etc.	Replacement hole for B-15	Bechtel National, Inc.	1983
G-1 to G-24	Borehole number - chemical plant area	Bechtel National, Inc.	1986
G-54-1 to G-54-11	Borehole number - chemical plant area	Corps of Engineers	1954
GMW-3 series	Borehole completed as a monitoring well (NG)	Bechtel National, Inc.	1986
GT-2T71 to GT-2T82	Test pit number - chemical plant area	PMC (MKES Phase I)	1988
GT-31 to GT-36	Borehole number - raffinate pit No. 4	PMC (MKES Phase I)	1988
GT-37 to GT-41	Borehole number - admin. bldg. area	PMC (MKES Phase I)	1988
GT-42 to GT-57	Borehole number - chemical plant area	PMC (MKES Phase I)	1988
GT-58P to GT 67P	Borehole number - chemical plant area -P added if hole completed as piezometer	PMC (MKES Phase II)	1989
GT-68 to GT-74	Borehole number - chemical plant area	PMC (MKES Phase III)	1991
GTS-1 to GTS-7	Borehole number - temporary storage area	PMC (MKES Phase II)	1989
MW-2001 series	Monitoring well number - within chemical plant area (NG)	PMC	1988-1989
MW-3001 series	Monitoring well number - wells completed adjacent to the Chemical plant area (NG)	PMC	1988-1989
MW-4001 series	Monitoring well number - wells completed outside WSS area (NG)	PMC	1988-1989
PW-1 to PW-3	Pumping well number - Chemical Plant Area (NG)	PMC	1989
OB-2j	Observation well adjacent to pumping well (NG)	PMC	1989
T-1 to T-6	Backhoe trench number	Bechtel National, Inc.	1986
TPBS-1 to TPBS-30	Test pit number - borrow source area	PMC (MKES Phase II)	1989
TPMS-1 to TPMS-9	Test pit number - materials storage area	PMC (Phase II addition)	1990
TR-1 to TR-15	Trench number - Chemical Plant Area	Bechtel National, Inc.	1983

NOTES: NG stands for Non-Geotechnical holes.
Reference: MKF and JEG 1990b

each investigation and the findings are summarized and presented in the Geophysical/Geotechnical Investigation Sampling Plan Report (MKF and JEG 1988).

2.3 PMC Phase I and Phase II Investigations

The Geophysical/Geotechnical Investigation Sampling Plan (MKF and JEG 1988) proposed additional investigations necessary to demonstrate the suitability of the site for construction of a satisfactory disposal facility. The PMC Phases I and II Investigations, conducted in 1988 and 1989 respectively, were based on the sampling plan recommendations and the conceptualized disposal cell areas identified from 1987 through 1989. The geotechnical aspects of these investigations consisted of engineering characterization of the subsurface soils in the raffinate pit dike No. 4, the administration building area, the Temporary Storage Area, and the proposed disposal cell area in the chemical plant vicinity. These investigations also included the evaluation of the on-site upper strata materials and potential off-site borrow source clayey materials as possible fill materials for the remedial action.

A total of 46 boreholes and 51 test pits were completed in these two phases. Details of these investigations were presented in the Chemical Plant geotechnical investigations report (MKF and JEG 1990b).

2.3.1 Disposal Facility Area

The WSS disposal facility (DF), as proposed in 1987 and 1988 and for which the Phase I and Phase II investigations were performed, was located in a rectangularly shaped area approximately bounded by a line 750 feet west of the eastern site boundary, the limits of the existing chemical plant buildings at the north end, and raffinate pits No. 1 and No. 3 on the southern and western sides, respectively. It should be noted that the current conceptual DF area has been extended into the northwestern corner where the Material Staging Area is currently located. The area to be covered by the disposal facility has changed from approximately 36 acres in the 1987 and 1988 conceptual studies, to 56 acres in the 1991 conceptual siting study.

2.3.2 Areas Outside the Disposal Facility Area

Other site facility areas investigated during the Phase I and Phase II investigations include: the administration building, the raffinate pit dike No. 4, the Temporary Staging Area, and the Material Staging Area. The Phase III investigation included the site water treatment plant facilities. Figure 1-2 indicates the approximate locations of these facilities.

2.3.3 Potential Borrow Sources

Potential borrow materials for construction consist of on-site uncontaminated subsurface soils (within the upper 15 feet where excavation may take place but possibly excluding some unsatisfactory loess and fill) for general fill, and selected off-site clayey borrow sources (Sources No. 1 and 2) for low permeability liner or cover materials for DF construction as well as for general fill. Additional borrow source investigations will be performed under other PMC support studies (not part of this scope).

2.4 Assessment of Pre-Phase III Investigations

In 1991, the conceptual layout of the disposal cell was revised and expanded to adjust for updated waste quantity and design criteria changes, as presented in the siting study report (MKES 1991a). Based on this study, an assessment of the deficiency of previous geotechnical data was completed and planning for an additional investigation to obtain the required additional data (PMC Phase III investigation) was performed. This assessment, which is described below, is specifically intended for the design of the disposal cell and the site water treatment plant facilities, and does not include off-site borrow sources nor other site construction facilities. As stated above, additional investigation of off-site borrow sources will be evaluated by other supporting studies.

To assess the data deficiency, the numbers of valid laboratory tests performed in previous investigations were summarized. A valid test is one where testing procedure and result appear reasonable. The numbers of tests performed on samples of various WSS subsurface soil strata in investigations prior to 1988 are presented in Table 2-2. The numbers of tests performed in PMC Phases I and II geotechnical investigations are listed in Table 2-3. The number of tests performed as of the end of 1990 (Pre-PMC

TABLE 2-2
NUMBER OF VALID TESTS PERFORMED IN
INVESTIGATIONS CONDUCTED PRIOR TO 1988

TESTS	Ferrelview Clay			Clay Till			Basal Till		
	BNI (1984)	BNI (1987)	TOTAL	BNI (1984)	BNI (1987)	TOTAL	BNI (1984)	BNI (1987)	TOTAL
Sieve Analysis	5	10	15	2	18	20	-	6	6
Atterberg Limits	5	8	13	2	16	18	-	5	5
Shrinkage Limit	-	-	-	-	-	-	-	-	-
Specific Gravity	4	11	15	2	17	19	-	1	1
In situ Moisture	15	7	22	7	15	22	-	3	3
In situ Dry Density	12	7	19	5	14	19	-	5	5
Compaction	-	-	3 *	-	-	-	-	-	-
U U Test	1	-	1	-	-	-	-	-	-
C U Test	1	-	1	-	-	-	-	-	-
Consolidation	-	-	-	-	-	-	-	-	-
Permeability	-	-	-	-	-	-	-	-	-

No tests were performed on Topsoil/Fill, Loess or Residuum

* 1 Compaction test by COE, 2 by HMR

Ref : MKF & JEG 1988

TABLE 2-3
NUMBER OF TESTS PERFORMED IN
MKE PHASES I & II INVESTIGATIONS

TESTS	Loess	Ferrelview Clay	Clay Till	Basal Till	Residuum	TOTAL
Sieve Analysis	12	39	14	4	7	76
Atterberg Limits	13	45	10	2	2	72
Shrinkage Limit	5	7	1	0	0	13
Specific Gravity	4	23	10	2	2	41
In situ Moisture	17	71	16	3	12	119
In situ Dry Density	11	33	15	3	4	66
Compaction	0	16	0	0	0	16
U U Test	1	12	2	1	0	16
C U Test	1	7	2	1	1	12
Consolidation	2	10	6	0	3	21
Permeability	3	13	9	3	2	30

Phase III) and the recommended minimum number of tests from the sampling plan (MKF and JEG 1988) are shown in Table 2–4.

The deficiencies identified below arise mainly from the changes in the conceptual plan of the disposal cell from 1988 until the present, and the lack of good quality undisturbed samples for the Clay Till, Basil Till and Residuum materials. The results of the deficiency analysis for each soil stratum are:

- Topsoil/Fill and Loess – These two layers are scheduled to be removed and hence the numbers of tests performed on these layers are considered to be adequate from a foundation design standpoint.

- Ferrelview (Formation) clay - Though this layer seems to have been adequately sampled and tested for previous cell locations, there are certain geographic regions, mainly the northwestern corner and the northern and southern portions of the potential disposal cell area, where additional data are needed because of the possible extensions of the disposal facility into these areas. Additional information is also needed for the design of temporary facilities such as the site water treatment plant and retention ponds. Therefore additional tests, including strength and consolidation tests, are recommended for the Phase III testing program.

- Clay Till - The previous investigations (pre-1988, MKE Phase I and MKE Phase II) of this soil stratum concentrated mainly on classification testing of disturbed samples due to the lack of undisturbed samples for strength and consolidation tests. Additional testing is required in Phase III to remedy this deficiency.

- Basal Till and Residuum - The number of tests on Basal Till does not meet the requirements given in Table 2–4. Testing of Residuum is also minimal due to the lack of soil samples. However, because of the depth and the anticipated strength and stiffness of these materials, the impact to the disposal cell design is minor and therefore, the normal minimum test requirement of 3 to 5 tests for strength and consolidation parameters can be waived to

TABLE 2-4
TOTAL NUMBER OF VALID TESTS PERFORMED AS OF JULY 1991
AND THE RECOMMENDED MINIMUM NUMBER OF
GEOTECHNICAL LABORATORY TESTS

TESTS	Loess		Ferrelview Clay		Clay Till		Basal Till		Residuum	
	Performed as of 1991	ecommended minimum (1)	Performed as of 1991	ecommended minimum (1)	Performed as of 1991	ecommended minimum (1)	Performed as of 1991	ecommended minimum (1)	Performed as of 1991	ecommended minimum (1)
Sieve Analysis	20	(2)	45	5	17	5	9	5	12	(2)
Atterberg Limits	22		48	12	15	12	7	12	3	
Shrinkage Limit	4		4	-	1	-	0	-	0	
Specific Gravity	6		24	3	10	3	5	3	4	
In situ Moisture	25		59	18	24	18	7	18	14	
In situ Dry Density	10		31	18	21	18	6	18	7	
Compaction	0		16	2	0	2	0	2	0	
U U Test	6		13	5	4	5	2	5	0	
C U Test	3		8	3	3	3	3	3	1	
Consolidation	3		11	5	7	5	3	5	3	
Permeability	14		35	5	16	5	6	5	5	

(1) Ref : MKF & JEG 1988

(2) No minimum number was recommended for Loess and Residuum materials

reduce time and cost factors. Undisturbed samples obtained from the Phase III investigation were tested to determine soil characteristics.

2.5 PMC Phase III Investigation

The PMC Phase III geotechnical investigation was conducted between April and September 1991. The field activity, consisting of the drilling and sampling of 7 boreholes at the WSS, was completed on April 15, 1991; and the laboratory testing of soil samples, conducted by Chen-Northern, Inc. and JTC Environmental Consultants, Inc., was completed in August 1991. The locations of the boreholes, numbered GT-68 through GT-74, are shown in Figure 2-1. Drilling was performed by Geotechnology Services, Inc. under the supervision of a geotechnical engineer from M-K Environmental Services. A field report and the boring logs are presented in Appendix A-1 and A-2, respectively.

Drilling was accomplished with a Central Mining Equipment CME-750 drill rig using continuous hollow-stem flight-augers having an outside diameter (O.D.) of 7.5 inches and an inside diameter (I.D.) of 3.75 inches. All holes were drilled to auger refusal at the top of bedrock. No rock coring was performed and groundwater level was not measured.

Soil sampling was performed on 2.5 foot centers. Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. Standard Penetration Test (SPT) sampler. Selected portions of each SPT sample were placed in capped glass jars. Relatively undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four 6-inch long, 2.5-inch I.D. brass liners were placed inside the California sampler to retrieve samples. Each retrieved, 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches beyond the lead auger using a 140-pound safety hammer, free-falling 30 inches. The number of blows required to drive the SPT sampler for each 6-inch interval was recorded and the final two 6-inch drives were summed and expressed as blows per foot (commonly known as STP blow counts for the STP method). Undisturbed samples, where possible, were obtained by hydraulically pushing 3.0-inch diameter, 36-inch long steel Shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped, and taped. Any excess

space in the tube after waxing was filled with cuttings to prevent or minimize movement of the sample within the tube.

Soils encountered were described in accordance with the Unified Soil Classification System (USCS). Samples not selected for testing were stored on-site in Building 410.

All borings were abandoned by plugging with Volclay Grout manufactured by American Colloid Company, following standard procedure performed in earlier WSSRAP investigations.

3 SUMMARY OF TESTING PROGRAMS AND RESULTS

3.1 Summary of Geotechnical Testing Programs

The purpose of the laboratory testing programs was to provide geotechnical data to characterize the subsurface soils and potential clayey Borrow Source Nos. 1 and 2 for use in various studies and design of the proposed disposal cell and related facilities. Geotechnical engineering parameters were or will be developed from laboratory test results and substantiated by comparison to field data and empirical values.

Test results from the pre-PMC investigations (prior to 1988) were reviewed and evaluated by the PMC in 1988. The findings were presented in the Geophysical/Geotechnical Investigation Sampling Plan (MKF and JEG 1988). For reference, Table 3-1 shows the summary of average test results from pre-PMC investigations. The numbers of valid results from tests of each type performed in these investigations are shown in Table 2-2.

The PMC geotechnical laboratory testing programs for Phases I, II and III investigations were conducted by various laboratories from June 1988 to July 1991. The numbers and types of all tests performed for each soil stratum under these three phases are listed in Table 2-4. A total of 9 testing programs for the disposal cell site vicinity, intermittently numbered one through twelve, were implemented. Table 3-2 summarizes the dates each program was transmitted for testing and the respective laboratory assigned for the testing. These programs were planned in stages to facilitate testing as samples were obtained during field investigations. Typically, each program specified which soil samples would be tested, the type of tests, the testing methods and specific testing instructions.

The five laboratories that conducted the testing were:

- Chen-Northern, Inc., Denver, CO
- Geotechnology Engineering and Environmental Services Inc. (Geotechnology), St. Louis, MO

TABLE 3-1: AVERAGE VALUES OF LABORATORY TESTING RESULTS FROM PREVIOUS (PRE-1988) INVESTIGATIONS. (Sh. 1 of 2)

Unit	Statistic[a]	% of Grain Size				Liquid Limit[b]	Plastic Index	Unified Soil Classif.	Specific Gravity	Unit Weight		Moisture Content	Centrifuge Moisture
		Gravel	Sand	Silt	Clay				(g/cm^3)	Dry (lb/ft^3)	Wet (lb/ft^3)	Equiv. (%)	
Loess	Na	0	4.4	64	31.6	30	13	CL	2.58	98.8	110.0	--	--
	S	0	1.3	3	4.0	--	--	--	--	7.1	12.4	--	--
	N	5	5	5	5	1	1	1	1	6	6	0	0
Ferrelview Formation	Na	2.8	9.8	49.6	39.6	52.2	35.1	CL-CH	2.61	101.3	122.3	24.7	45.4
	S	4.1	5.5	6.9	10.9	7.8	7.5	--	0.07	12.4	9.4	0.6	8.5
	N	10	10	10	10	8	8	8	11	8	8	7	5
Clay Till	Na	0.4	22.4	31.7	45.6	50.3	34.2	CL	2.60	104.8	123.8	19.3	39.7
	S	1.0	4.5	2.4	4.5	10.5	8.4	--	0.09	4.4	7.0	3.0	5.7
	N	18	18	18	18	16	16	16	18	14	14	15	13
Basal Till	Na	10.7	18.7	39.8	30.8	41.6	23.6	GC-CL	2.45	99.8	118.6	20.9	38.5
	S	17.1	14.3	23.0	8.1	14.1	11.7	--	--	7.8	8.1	3.8	2.1
	N	6	6	6	6	5	5	5	1	5	5	3	2
Fill	Na	20	48	19	13			SM	2.45				
	S	--	--	--	--			--	--				
	N	1	1	1	1			1	1				

[a] Statistics given are: Na - mean; S = sample standard deviation; N = number of test results in computation of statistic

[b] Blanks indicate data of the type indicated were not available in the Bechtel National (1987) reference

[c] Void ratio = (specific gravity x unit weight of water -1)/dry unit weight

[d] Specific retention - centrifuge moisture equivalent x 0.80

[e] Specific yield = porosity - specific retention

[f] Saturation = (specific gravity x moistre content)/void ratio

[g] Activity = plastic index/percent of clay

TABLE 3-1: (CONT.) AVERAGE VALUES OF LABORATORY TESTING RESULTS FROM PREVIOUS (PRE-1988) INVESTIGATIONS. (Sh. 2 of 2)

Unit	Statistic[a]	Void Ratio[c]	Porosity (%)	Specific Retention (%)[d]	Specific Yield (%)[e]	Saturation[f]	Activity[g]	Effective Cation Exch. Cap. (meq/100g)	Distribution Ratio (mg/l)
Loess	Na	--	--	--	--	--	--	--	--
	S	--	--	--	--	--	--	--	--
	N	--	--	--	--	--	--	0	0
Ferrelview	Na	0.61	38	36	2	100	0.89	60.3	54.8
Formation	S	--	--	--	--	--	--	0.1	9.7
	N	--	--	--	--	--	--	2	2
Clay Till	Na	0.55	35	32	3	91.2	0.75	69.0	34.2
	S	--	--	--	--	--	--	11.7	6.2
	N	---	--	--	--	--	--	2	2
Basal Till	Na	0.53	35	31	4	96.6	0.77	29.0	206
	S	--	--	--	--	--	--	--	--
	N	--	--	--	--	--	--	1	1
Fill	Na	--	--	--	--	--	--		
	S	--	--	--	--	--	--		
	N	--	--	--	--	--	--		

[a] Statistics given are: Na = mean; S = sample standard deviation; N = number of test results in computation of statistic

[b] Blanks indicate data of the type indicated were not available in the Bechtel National (1987) reference

[c] Void ratio = (specific gravity x unit weight of water -1)/dry unit weight

[d] Specific retention = centrifuge moisture equivalent x 0.80

[e] Specific yield = porosity - specific retention

[f] Saturation = (specific gravity x moisture content)/void ratio

[g] Activity = plastic index/percent of clay

See Section 12 for SI conversion factors.

TABLE 3-2 Summary of Soil Testing Programs

TEST PROGRAM #	REQUEST NO.	DATE REQUESTED	PURPOSE	LABORATORY
1	1	06/23/88	Administration Building	Chen-Northern, Inc.
2	2	07/27/88	Raffinate pit No. 4	Chen-Northern, Inc.
3	3	10/14/88	Disposal cell	Chen-Northern, Inc.
5	2A	05/26/89	Disposal cell	Geotechnology/metaTRACE/Chen-Northern
6	3A	06/26/89	Borrow sources	Geotechnology/metaTRACE/Chen-Northern /Hannibal Testing
7	2B	08/25/89	Disposal cell	Geotechnology Services, Inc.
8	5	10/11/89	Temporary Storage Area	Geotechnology Services, Inc.
11	8	08/03/90	Material Staging Area	Geotechnology Services, Inc.
12		05/08/91	Chemical Plant and Site WTP	Geotechnology Services, Inc.

- MetaTRACE, Inc., Earth City, MO
- Hannibal Testing Laboratories, Inc. (HTL), Hannibal, MO
- JTC Environmental Consultants, Inc. (JTC), Maryland, MO

Chen-Northern performed the first group of tests, in 1988. Geotechnology performed the laboratory testing in 1989 and 1990, except for the cation exchange capacity tests and the capillary moisture tests, which were subcontracted to metaTRACE, Inc. and to Chen-Northern, Inc., respectively. In situ samples taken by drive tube methods from the vertical walls of off-site clay borrow test pits in 1989 were tested by Hannibal Testing Laboratory for natural moisture content and dry density. Chen-Northern again performed soil tests in 1991; and the soil chemical tests were performed by JTC Environmental Consultants, Inc.

Soil test samples from 1988 were shipped in specially constructed wooden boxes to Chen-Northern in Denver by overnight air freight. These samples were discarded following the testing. Samples designated for Geotechnology were transported to their St. Louis location in site vehicles. The samples from the material staging area were returned to the site for storage for possible future testing. The rest were discarded after testing. Samples for Chen-Northern in 1991 were transported to the Denver location by air. Samples for JTC were transported by land to the Maryland location. These samples are being stored at the laboratories after testing and will be discarded 12 months following completion of the test program.

Standard test methods were used to conduct the testing to follow standard practices and to assure that the laboratory test results are reliable and compatible with empirical correlations. Most of the laboratory soil tests were performed in accordance with the American Society for Testing and Materials (ASTM) standard test procedures (ASTM 1991). The triaxial shear tests, which included the consolidated undrained compression tests with pore pressure measurements (R tests), the unconsolidated undrained compression tests (Q tests), and the triaxial constant-head permeability tests, were all performed in accordance with the methods described in U.S. Army Corps of Engineers Manual EM 1110-2-1906 (COE 1970). The cation exchange capacity test

was performed in accordance with U.S. Environmental Protection Agency's (EPA 1988) SW 846, 3rd edition, Test Method 9081. The pH, sulfate content, and chloride content tests for soil corrosivity were performed in accordance with EPA Methods for Chemical Analysis of Water and Wastes (MCAWW) test methods (EPA 1982).

Special instructions or slight modifications to the standard test methods were included in the test programs. These usually included specified confining pressures for triaxial shear and consolidation tests, consolidation loading increments, and density and water content for remolded specimens.

The laboratory tests and methods used in the testing programs included (ASTM 1990, COE 1970, SCS 1967, EPA 1982 and 1988):

- Sieve Analysis - ASTM C136
- Sieve Analysis with Hydrometer - ASTM D422
- Atterberg Limits - ASTM D4318
- Shrinkage Limit - ASTM D427
- Unit Weight/Void Ratio - ASTM C29
- Specific Gravity - ASTM D854
- Moisture Content - ASTM D2216
- Dry Density - ASTM D2937
- One Dimensional Consolidation Test - ASTM D2435
- Triaxial (R) Compression Test - EM 1906, Appendix X
- Triaxial (Q) Compression Test - EM 1906, Appendix X
- Triaxial Permeability - EM 1906, Appendix VII
- Capillary-Moisture Relationships - ASTM D2325 and D3152
- Moisture-Density Relationships - ASTM D698
- Cation Exchange Capacity - EPA SW 846, #9081
- Sulfate and Chloride Contents - MCAWW 325.3 and 375.4
- Acidity/Alkaline, pH - MCAWW 150.1
- Percent Solids - MCAWW 325.3
- Soil Resistivity - ASTM G57, with modification.

Table 3-3 shows the number of tests by each test method on samples from the administration building area, the material staging area, the raffinate pit No. 4 dike, the

TABLE 3-3 : NUMBER & TYPE OF LABORATORY TEST ACTIVITY ACCORDING TO SPECIFIC AREAS

TESTS	CHEMICAL PLANT	MATERIALS STAGING AREA	RAFFINATE PIT # 4 DIKE	BORROW SOURCES	ADMINISTRATION BUILDING
Sieve Analysis	46	17	16	18	6
Atterberg Limits	35	16	14	20	10
Shrinkage Limit	4	-	-	4	7
Specific Gravity	30	-	3	13	3
In situ Moisture	82	-	16	20	11
In situ Dry Density	57	-	10	-	8
Compaction	13	16	-	12	1
U U Test	17	-	-	6	2
C U Test	7	-	5	6	-
Consolidation	21	-	-	3	3
Permeability	45	17	1	13	-
Capillary Moisture	8	-	-	12	-
Cation Exchange Capacity	8	-	-	6	-

clay borrow sources, and the chemical plant area including the TSA. A brief discussion of the significance and applicability of each type of test and test results is presented in the following sections.

Table 3-4 shows the summary of all soil test results from the MKE Phases I, II and III investigation programs. Laboratory test data and results (Phases I and II) received by the PMC prior to December 1990 were presented in the Appendix of the geotechnical investigations report (MKF & JEG 1990b). Test data results (Phases II and III) received by the PMC after December 1990 are included in Appendix B.

3.2 Subsurface and Potential Borrow Source Materials and Data Reduction

The soils for testing consisted of the subsurface soils at the WSS and clayey soils in the two selected potential clayey borrow sources shown in Figure 1-1.

The subsurface (overburden) soils at the WSS were grouped according to the geologic stratified units identified during field investigations and soil data reduction. Geologic profiles (cross sections) were generated based on boring log data and test results (Figures 4-1 through 4-4). The geologic units encountered at the site, from original ground surface to top of weathered bedrock, are: Topsoil, Fill, Loess, Ferrelview clay, Clay Till, Basal Till and Residuum. Most of the subsurface soils at the site were clayey soils with varying degrees of silty, sandy or gravelly contents. A small percentage, usually within the loess or deeper geologic units such as the basal till and the residuum, were clayey silt or clayey gravels. A summary description of each geologic unit (also referred to as soil unit or soil type) from the earlier reports (MKF and JEG 1990a and b) is presented here for reference.

- Topsoil/Fill - The uppermost soil unit at the site consists of large areas of disturbed fill and a thin veneer (less than 6 inches) of top soil. Fill is highly variable in thickness and composition. Large volumes of fill were used in constructing the existing dikes for the raffinate pits and Ash Pond (up to 20 feet thickness). Fill was also used for general site embankment construction, site grading, and drainage control prior to the construction of the chemical plant structures.

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterization

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural w	Natural γ_d	Compaction* Optimum w	Compaction* Optimum γ_d	Shear Strength Test	Initial w av	Initial γ_d av	c	phi	Consolidation Cc	Cr	Pp	Permeability w	Permeability γ_d	Permeability k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-31	ST-02	4.0	6.5	CL	0	10	90	36	20		2.68	20.9	103.1																	F
	ST-06	18.0	20.5		0	4	96					20.1	104.6																	F
GT-32	ST-01	1.0	3.5	CL	0	4	96	32	13			20.1	101.4			CU	27.3	97.2	c=550 c'=330	ϕ=25 ϕ'=40										L
	ST-02	9.0	10.5	CH	0	15	85	64	46			26.4	90.5			CU	30.7	92.5	c=410 c'=110	ϕ=10 ϕ'=21										F
																														C
	ST-05	18.5	21.0		3	8	89					36.3	82.9																	
																														D
GT-33	ST-04	5.0	7.5	CL	0	4	96	45	27							CU	30.6	92.5	c=600 c'=610	ϕ=5 ϕ'=8				32.0	90.4	1.1E-7 (0.12)				L
	ST-14	22.0	24.5	CL	0	6	94	30	10			15.7	100.7																	
																														D
GT-34	SS-05	7.0	8.5	CH	0	20	80	55	38			20.8																		F
	SB-17	27.0	28.5	CL	0	7	93	40	23			15.4	111.0																	
																														D
GT-35	SS-02	3.0	4.5	CH	0	10	90	59	41			22.5																		D
	SS-08	13.0	14.5	CL	0	14	86	49	31		2.63	18.9																		D
	SS-11	17.5	19.0									16.0																		D
	SB-15	25.0	26.5	CL	0	5	95	42	25			20.8	104.6			CU	23.3	103.5	c=330 c'=400	ϕ=14 ϕ'=20										L
	SS-20	31.0	32.5	CL	0	1	99	45	25			19.8																		D
GT-36	ST-06	8.5	11.0	CL	0	22	78	48	32			22.6	100.2			CU	24.5	101.5	c=180 c'=160	ϕ=18 ϕ'=24										D
	SS-09	14.0	15.5	CL	0	5	95	43	24			23.8																		L
	ST-12	18.5	21.0	CL	0	1	99	46	29		2.70	21.5	97.8																	
																														L
GT-37	SB-01	1.5	3.0	CH				58	34	8																				L
	ST-03	5.0	7.5	CL	0	3	97	45	29	11	2.67	24.4	101.2			UU	26.7	96.4	1160											L
	SS-05	9.0	10.5									20.7																		F
	ST-06	10.5	13.0	CH	0	3	97	55	39			25.1	100.3																	I
																														L
GT-38	SS-02	3.0	4.5	CL	0	2	98	37	18	19.4		21.8				UU	29.7	95.5	1110											L
	ST-03	4.5	7.0	CL	0	1	99	48	29	18.4		27.3	96.8																	

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterization

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction* Optimum		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
																	Initial												
					Gravel	Sand	Fines	LL	PI			w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)			
		ft	ft	USCS	%	%	%	%	%	%	G	%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-39	SS-02	4.0	5.5	CL	0	1	99	38	19	15.9		26.8	105.0																F
GT-39	ST-03	5.5	8.0								2.66	23.2	100.6	17.9	107.5														F
	COMP	5.5	12.0																										F
GT-39	ST-05	12.0	14.5	CH	0	6	94	65	48		2.68	25.1	99.4																
																													TS
GT-41	SS-02	3.5	4.0	CL				48	28	11.8		27.9	94.4																D
	SS-02	4.0	4.5	CL				48	28	12.8		28.6	95.1																F
	SS-04	6.0	7.5	CL				40	23			24.5																	
																													C
GT-42	ST-05	9.5	12.0									16.9	113.3																C
	SB-08	17.0	18.5									12.4	119.4																
																													L
GT-43	SS-02	1.5	3.0									14.5																	F
	ST-04	6.0	8.5	CL				48	32		2.66	24.4	98.6			CU	31.4	91.0	c=460 c'=430	ϕ=9 ϕ'=12				27.0 to 30.5	95.7 to 91.6	<9.0E-4 (0.07)** <7.0E-8 (0.29)**				
																													C
	ST-10	21.5	23.8	CL	0	26	74	47	32		2.71	18.6	106.5			UU	19.1	106.5	860					21.7 to 31.4	106.3 to 106.8	<6.0E-8 (0.43)** <4.0E-8 (0.72)**				B
	SB-17	40.0	41.5	CL				31	12		2.59	17.6	109.9																
																													R
	SS-19	50.0	51.0		29	46	25					20.4																	
																													C
GT-44	ST-03	5.0	7.5									17.6	106.2			CU	19.5	105.8	c=190 c'=180	ϕ=24 ϕ'=32									
	SB-10	22.5	24.0									45.0	76.5																R
																													TS
GT-45	SS-01	1.0	2.5									18.1																	F
	ST-04	7.5	10.0									21.3	103.3																C
	ST-07	15.0	17.5									22.1	104.5											19.9 to 23.5	106.5 to 102.8	<8.0E-5 (0.21)** <2.0E-8 (0.58)**				
GT-46	ST-03	5.0	7.5									22.1	99.6								0.202	0.027	6.6	20.0 to 23.3	103.7 to 103.0	5.0E-4 (0.07)** 3.0E-6 (0.43)**				F
GT-47	ST-05	10.0	12.5	CL	0	2	98	45	28		2.69	22.9	99.5								0.216	0.060	6.5						F
																													C
	SB-09	20.0	21.5	CH				51	36			20.5	72.4																R
	SS-14	32.5	34.0									14.8																	

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterization

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-54	ST-03	4.5	7.0	CL	0	3	97	42	25			21.8	100.1			CU	24.9	98.6	c=370 c'=390	ϕ=19 ϕ'=25										TS
GT-54	SS-08	17.0	18.5									21.8																		L
GT-55	ST-02	2.5	5.0									22.8	96.0																	L
	ST-04	7.5	10.0	CL/CH	0	1	99	50	29		2.75	30.7	89.4								0.260	0.041	6.7	28.8 to 30.9	94.0 to 92.8	1.0E-5 (0.14)** <2.0E-6 (0.5)**				L
	ST-06	12.5	15.0	CH	0	1	99	51	33		2.82	22.8	103.7			UU	23.4	101.0	1460		0.462	0.042	18.5			8.0E-09				F
	ST-08	17.5	20.0	CL				42	27			22.5	103.0			UU	22.5	103.0	1390											F
GT-55	SB-12	27.5	29.0					70	50			25.2	99.6			CU	23.7	101.4	c=205 c'=260	ϕ=13 ϕ'=16	0.268	0.096	7.6			2.0E-09				R
GT-56	ST-02	5.0	7.5	CL	0	2	98	30	12		2.62	20.4	101.1			UU	18.7	103.9	2330		0.380	0.033	9.9			2.9E-08				L
																CU	22.1	103.7	c=330 c'=230	ϕ=25 ϕ'=31									
	ST-04	10.0	12.5									26.5	98.1											26.7 to 29.7	96.2 to 92.6	2.0E-7 (0.14)** <3.0E-8 (0.5)**				F
	ST-06	15.0	17.0	CL	0	26	74	44	29			19.0	109.9								0.248	0.061	30.0			2.9E-09				C
	SB-08	19.5	21.0	CL	0	19	81	42	27		2.66	21.5	105.6			UU	21.4	105.6	1660											C
	SS-09	22.0	23.5	CH	4	6	90	71	50			27.1																		R
GT-57	SS-02	5.0	6.5									26.3																		L
	ST-03	7.5	10.0	CL				42	25			27.4	93.5			UU	20.9	104.4	1690											L
	ST-06	15.6	16.5									22.7																		F
	SB-11	27.5	29.0		55	10	35					17.1																		R
GT-58P	ST-01	2.5	5.0	CH	0	4	96	54	23			22.9														2.0E-7 (1) 4.0E-7 (3)				L
	ST-03	7.5	10.0	CH	0	5	95	66	46		2.69	16.6									0.202	0.040	7.0	21.9 to 23.8	104.8	6.0E-8 (1) <1.0E-9 (3)				F
	ST-09	22.5	24.0								2.65										0.150	0.018	14.5			4.0E-8 (2) <1.0E-9 (4)				C
	SB-11	28.5	29.0	GC	50	10	40					1.3	117.4																	R
GT-59	ST-02	5.0	7.5																					23.0 to 21.8	102.4	4.0E-7 (1) 2.0E-7 (3)				F

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial												
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)			
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-59	ST-06	15.0	17.5																					19.3 to 20.2	110.5	<1.0E-9 (2)				C
GT-60P	ST-04	12.5	15.0								2.72	22.0	104.5								0.170	0.035	8.2							F
GT-60P	ST-10	27.5	30.0	CL	0	21	79	44	27		2.70	19.0	109.5								0.152	0.045	7.6	18.7 to 19.6	109.1	5.0E-8 (3) <1.0E-9 (6)				C
	SB-15	41.0	41.5	CL	7	16	77	35	13							CU	19.9	105.3	c=850 c'=360	ϕ=20 ϕ'=34				19.0 to 20.9	105.5 105.1	7.0E-8 (4) 2.0E-7 (7)				B
	SS-16	45.0	46.5	SC	33	37	30																							B
	SB-17	48.5	49.0	SC	22	50	28																	13.9 to 22.4	105.1	3.0E-7 (4) 2.0E-7 (7)				B
GT-61	SS-13	32.5	34.0	CH	0	27	73																							C
	SB-18	50.5	51.5	GC	36	34	30					11.0	118.9																	B
GT-62	ST-07	17.5	20.0									28.0												25.7 to 24.5	100.3	5.0E-8 (2) <1.0E-9 (4)				F
	SB-15	38.0	39.0	GC	43	17	40				2.76										0.372	0.075	10.3	7.8 to 15.8	100.1	3.0E-5 (3) 6.0E-8 (5)				R
GT-63P	ST-01	2.5	5.0	CH	6	7	87	56	32															22.9 to 24.2	100.4	7.0E-9 (1)				F
	ST-09	22.5	25.0	CL	0	25	75	45	28		2.75	16.4	113.9								0.203	0.036	15.0	17.6 to 19.1	110.0	9.0E-9 (2)				C
	SB-15	38.0	38.5	SC	40	45	15																							R
GT-65P	SB-16	40.0	41.5	GC	42	24	34																	29.5 to 33.0	81.3	8.0E-7 (4) 4.0E-7 (7)				R
GT-67P	ST-08	20.0	22.5																					17.9 to 19.8	110.2	1.0E-7 (2)				C
GT-68	6810	25.0	25.7	CL	5	24	71	47	34		2.69	16.5	110								0.220	0.058	12.4							C
	6813	32.5	34.0	CL	1	4	95	40	27																					B
	6815	37.5	39.0		9	7	84																							R
GT-69	6906	15	17.5	CL	0	28	72	41	29			14.1	112.1			UU			7150											C

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-69	6908	20	22.5	CL				40	25		2.77	15.6	116.3			UU			6960												B
																CU	15.6	116.3	c=1270	ϕ=19	0.177	0.042	16.5							
																			c'=1320	ϕ'=25										
	6910	25	26.5								(-4) 2.74 (+4) 2.59	9.6																			R
GT-70	7004	10	12.5	CL	0	7	93	41	26		2.75	18.8	110.1			CU	18.8	110.1	c=750	ϕ=16	0.215	0.061	13.3								F
																			c'=850	ϕ'=20										
GT-71	7108	20	22.5	CL	0	32	68	47	33			16.3	111			CU	11.3	111.0	c=730	ϕ=17											C
																			c'=860	ϕ'=21										
	7110	25	27.5	CH				54	39		2.72	20.9	106.2			CU	20.9	106.2	c=640	ϕ=21	0.417	0.068	23.4								B
																			c'=790	ϕ'=28										
	7112	30	31.5								(-4) 2.74 (+4) 2.44	22.5	88																		R
GT-73	7306	15	17.5	CH	0	16	84	64	45		2.74	32.4	92.4								0.305	0.131	3.0								F
	7314	35	36.5	CL				38	22		2.71	22.5	102.3								0.162	0.037	2.8								B
GT-73	7316	40	41.5	CL-CH				50	33		(4) 2.70 (+4) 2.56	10.2																			R
GT-74	7402	5	7.5	CH	0	3	97	55	42			24.2	99.9			CU	24.2	99.9	c=750	ϕ=16											TS
																			c'=680	ϕ'=23										
	7406	15	17.5	CL	1	27	72	42	30			17.8	110.3			CU	17.8	110.3	c=160	ϕ=23											C
																			c'=180	ϕ'=32										
GT-2T71	BU-01A	3.5	6.5	CL	0	2	98	39	17		2.69	28.3		15.4	108.0	CU	18.8	105.2	c=0	ϕ=14								20.2			F
	BU-02A	6.5	12.0	CH	0	3	97	52	37	8	2.51	17.3		18.5	106.9	UU	21.2	101.8	2020		0.245	0.039	4.0	21.0 to 23.65	104.4	2.0E-8 (1)	20.5	88.26		F
GT-2T72	BU-01A	7.5	10.5	CL-M	0	5	95	27	6		2.68	22.1		12.5	116.1														49.02		F
GT-2T74	BU-01A	4.0	8.5	CL	0	3	97	42	24		2.74	25.9		16.1	106.3	CU	18.5	102.0	c=820	ϕ=13								17.2	83.91		L
																			c'=290	ϕ'=29										
GT-2T75	BU-01A	2.5	6.5	CL	0	1	99	39	17		2.61	20.8				UU	26.7	97.4	2320	5								17.4			F
	BU-01A	4.0	8.5	CL										17.6	108.0																F

Note : Values of w & γ_d for UU & CU tests are average values.

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

See page 12 of this table for legend of Soil Units

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterization

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)			
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-2T75	BU-02B	6.5	12.0	CH	0	3	97	77	56	7	2.71	23.1		20.1	102.3	CU	23.6	98.3	c=310 c'=0	ϕ=13 ϕ'=21	0.214	0.033	6.0	23.4 to 24.9	97.5	<1.0E-9 (1)	21.2	78.00		F
GT-2T77	BU-01B	1.5	4.0	CH	0	1	99	50	33		2.55	16.6		16.6	104.3	CU	19.2	99.8	c=335 c'=270	ϕ=14 ϕ'=23							17.9	70.21		F
	BU-02A	7.0	10.5	CL	0	3	97	49	26		2.66	24.6		19.2	104.4									22.0 to 22.3	103	2.0E-8 (1)	21.6	59.65		F
GT-2T78	BU-01A	4.0	6.5	CL	0	2	98	30 28	11 10		2.71	14.7		11.7	114.9	UU	14.3	110.3	2310								13.4	33.23		L
	BU-02B	6.5	12.0	CH	0	3	97	58	39		2.69	20.1		14.6 21.3	115.6 104.2	UU	23.9	98.7	2310					24.0 to 29.1	99.2	4.0E-8 (1)	24.2	71.69		F
GT-2T79	BU-01A	1.0	6.5	CL	0	2	98	49	26	18	2.72	14.0																		F
	BU-02A	6.5	12.0	CH	0	3	97	62	43			23.1																		F
GT-2T80	BU-01A	0.5	8.0	CL	0	4	96	38	18			18.1																		F
GT-2T81	BU-01A	0.5	6.5	CL	1	10	89	36	18	11		20.4																		TS
	BU-02A	6.5	12.0	CL	0	4	96	40	23			21.0																		TS
GT-2T82	BU-01A	0.5	3.5	CL	0	4	96	42	23			13.8																		F
	BU-02A	3.5	6.0	CH	0	3	97	53	31			25.2																		F
	BU-03A	6.0	10.0	CL	2	21	77	48	27			16.2																		C

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Temporary Storage Area

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GTS-1	ST-03	5.0	7.5	CL	0	3	97	40	20			23.3	97.5	17.5 (comp GTS-3	102.8 with ST-02									21.1 to 23.8	98.4	2.0E-7 (1) (comp with GTS-3,ST-02)				F
GTS-2	ST-02	2.5	5.0									25.5	95.0	18.3 (comp with (GTS-4,ST-04)	103.0									21.7 to 22.7	97.8	8.0E-8 (1) (comp with GTS-4,ST-04)				F
	ST-04	7.5	10.0									20.6	102.5																	F
	COMP	2.5	10.0	CL	0	3	97	44	24																					
GTS-3	ST-02	5.0	7.5	CH	1	3	96	53	34			29.6	89.9	(composite see GTS-1 ST-03)												(composite see GTS-1 ST-03)				F
GTS-4	ST-02	2.5	5.0	CH	8	4	88	51	28			28.4	92.3	17.7 (comp)	105.3									20.8 to 21.4	102.3	2.0E-7 (1) (composite)				F
	ST-04	7.5	10.0	CL	0	6	94	41	21			21.5	102.9	(See GTS-2 ST-02)																F
GTS-5	BULK	0.0	5.0	CH	1	7	92	53	35			21.7		17.5	106.4									20.7 to 23.6	101.0	2.0E-8 (1)				TS
GTS-6	BULK	0.0	5.0	CL	0	1	99	43	21			19.7		18.3	104.6									21.6 to 23.0	100.0	1.0E-7 (1)				F
GTS-7	BULK	0.0	5.0	CH	0	5	95	59	35			23.8		19.2	102.7									21.0 to 24.6	99.2	5.0E-8 (1)				TS

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Materials Staging Area

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPMS-1	BU-01	0.0	6.0	CH	0	7	93	51	32			20.0		17.4	103.0									17.7 to 25.1	98.6	7.0E-8 (1)			2.45	F
TPMS-2	BU-01	0.0	2.0	CL	0	6	94	49	29			18.3		18.7	104.3									18.2 to 29.8	100.2	2.0E-8 (1)				L
	BU-02	2.0	6.0	CH	0	20	80	67	46			21.9		21.0	100.6									20.7 to 29.6	95.2	<1.0E-9 (1)			2.25	F
TPMS-3	BU-01	1.0	6.0	CL	0	16	84	39	19			22.4		17.1	104.0									17.7 to 24.1	99.5	3.0E-7 (1)			2.74	F
TPMS-4	BU-01	1.0	3.5	CL	0	10	90	49	29			20.0		18.6	105.4									18.8 to 28.2	99.7	9.0E-9 (1)				L
	BU-02	4.0	6.5	CH	0	14	86	73	49			27.5		22.8	95.5									21.3 to 33.1	92.3	<1.0E-9 (1)				F
TPMS-5	BU-01	1.0	7.0	CL	0	4	96	37	20			19.8		15.9	108.1									17.2 to 23.0	100.9	2.0E-6 (1)			3.75	L
	BU-02	8.0	10.0	CH	0	2	98	73	49			26.6		21.7	97.8									20.9 to 32.9		9.0E-9 (1)				F
TPMS-6	BU-01	1.0	5.0	CL	0	2	98	40	22			15.7		16.4	104.0									16.9 to 25.7	99.4	3.0E-7 (1)				L
	BU-02	5.5	7.5	CH	0	4	96	72	47			19.4		21.3	100.4									20.6 to 28.0	94.8	<1.0E-9 (1)				F
TPMS-7	BU-01	1.0	7.0	CL	0	4	96	37	20			19.7		17.4	107.2									17.5 to 21.9	102.4	1.0E-7 (1)				L
	BU-02	7.0	9.5	CH	0	3	97	82	58			20.3		21.1	94.7									15.5 to 29.3	101.7	1.0E-7 (1)				F
TPMS-8	BU-01	1.0	5.0	CL	0	3	97	30	11			9.9		16.3	108.0									16.1 to 20.5	103.5	6.0E-8 (1)			2.43	L
	BU-02	5.0	10.5	CH	0	6	94	63	44			23.1		21.4	98.6									20.0 to 32.2	95.1	<1.0E-9 (1)			1.55	F
	BU-03	12.0	14.0		0	45	55					11.1																		C
TPMS-9	BU-01	1.0	7.0	CL	0	3	97	38	18			16.5		15.4	104.9									15.0 to 22.8	100.5	3.0E-7 (1)			3.05	L
	BU-02	8.0	15.0	CH	0	5	95	69	45			15.1		24.1	95.9									23.7 to 34.6	90.2	4.0E-8 (1)				F

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Potential Borrow Source No. 1

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPBS-1	2A	2.6	7.1	CL	0	9	91	31	13		2.65	11.1		15.6	110.4	UU	18.3	107.5	2810					18.4 to 19.1	108.2	3.0E-7 (1)	16.2	56.08		
																CU	18.5	107.4	c=1040 c'=1160	ϕ=16 ϕ'=21									
	3A	7.1	9.2	MH				60	21		2.7	26.4		20.1	105.6	UU	21.9	100.7	2500											
																CU	22.2	100.9	c=170 c'=170	ϕ=17 ϕ'=23	0.28	0.05	1.275					57.03		
	4A	9.2	14.1	CL	1	37	62	42	18	22	2.55	20.5		14.6	116.1									17.3 to 18.2	111.0	4.0E-8 (1)	15.6			
TPBS-6	1A	0.6	9.1	ML	0	3	97	38	11		2.64	24.6		19.3	102.9	UU	22.5	98.4	2860					23.3 to 23.2	99.9	2.0E-8 (1)	19.2			
																CU	22.8	99.7	c=590 c'=490	ϕ=19 ϕ'=26									
	2A	9.1	12.6	CH				64	44		2.74	24.9		20.9	100.3	UU	21.5	98.5	3340		0.22	0.07	1.32	24.3 to 28.9	94.6	1.0E-8 (1)	24.4	79.91		
																CU	24.3	95.2	c=390 c'=270	ϕ=10 ϕ'=18									
TPBS-8	1A	0.6	4.3	CL	0	2	98	34	16		2.73	21.8		17.4	108	UU	20.1	103	2300					20.8 to 21.3	102.9	3.0E-8 (1)	20.2			
																CU	20.5	104.1	c=630 c'=195	ϕ=19 ϕ'=35									
	2A	4.3	8.5	CL	0	2	98	31	12	16	2.64	13.3		15.6	109.4									19.6 to 20.2	106.0	2.0E-7 (1)	16.0			
	3A	8.5	11.9	CL/CH	0	2	98	50	30		2.59	21.0		20.5	101.9	UU	21.6	99.5	2600											
																CU	23.8	97.3	c=445 c'=510	ϕ=9 ϕ'=10	0.2	0.06	1.21	23.9 to 28.9	97.3	5.0E-9 (1)	23.0	75.26		
TPBS-10	1A	0.6	6.1	ML				49	17			23.5												20.2 to 27.0	102.1	1.0E-7 (1)	19.7			
	2A	8.2	10.9	ML	0	3	97	43	11			20.1												21.1 to 24.4	101.7	2.0E-8 (1)	20.8			
	3A	10.9	13.4	CH	0	5	95	61	43	9		23.1												24.5 to 30.1	97.0	<1.0E-9 (1)	24.7	74.21		
TPBS-11	1A	0.6	10.4	CL	0	3	97	33	12		2.72	25.3												20.9 to 23.3	99.5	3.0E-8 (1)	18.2			
	2A	10.4	12.3	CH	0	2	98	57	27	11	2.69	27.4												22.3 to 31.2	98.5	3.0E-8 (1)	27.2	73.52		
TPBS-13	Test 1	4.6	5	CL								27.7	92.2																	

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Potential Borrow Source No. 1

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Specific Gravity	Natural		Compaction* Optimum		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	Initial w av	Initial γ_d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPBS-14	2A	2.9	8.4	CL	0	2	98	35	15			25.2																		
TPBS-14	3A	8.4	11.8	ML	0	2	98		NP			22.4																		
	Test 2	4.9	5.3	CL								25.9	93.6																	
TPBS-15	1A	2.4	10.8	ML	0	3	97	41	9			25.5																		
	2A	10.8	12.9	CH	2	4	94	71	50			28.1																		
	3A	7.1	9.2		1	13	86																							
	Test 3	5.9	6.3	CL								23.8	89.1																	
TPBS-16	Test 4	5.4	5.8	CL								24.3	98.7																	
TPBS-17	Test 5	6.0	6.4	CL								24.8	96.8																	
TPBS-18	Test 6	4.8	5.2	CL								19.9	97.5																	
TPBS-19	Test 7	4.9	5.3	CL								24.0	99.0																	
TPBS-20	Test 8	5.4	5.8	CL								25.6	96.7																	

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

TABLE 3-4 : SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Potential Borrow Source No. 2

Test Pit Number	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction*		Shear Strength					Consolidation			Permeability			Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
														Optimum			Initial													
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	w	γ_d	w	γ_d	Test	w av	d av	c	phi	Cc	Cr	Pp	w	γ_d	k (Conf Pr)				
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPBS-23	1A	0.7	13.1	CL	0	3	97	37	21		2.71	26.2		18.2	106.3									21.5 to 22.1	102.0	4.0E-7 (1)				
	Test 9	5.7	6.1	CL								28.3	91.8																	
TPBS-25	Test 11	4.1	4.5	CL								23.5	100.1																	
TPBS-26	Test 10	4.9	5.3	CL								24.8	98.9																	
TPBS-28	1A	0.7	9.9	CL	0	5	95	38	19		2.65	23.2		14.9	109.8															
	Test 12	3.8	4.2	CL								26.4	95.2																	
TPBS-29	Test 13	4.8	5.2	CL								28.0	96.1																	
TPBS-30	1A	1.8	12.4	ML	0	10	90	37	12		2.62	28.0		18.3	104.6															
	Test 14	4.9	5.3	CL								26.4	95.3																	

LEGEND FOR SOIL UNITS

- D Dike Fill
- TS Top Soil/Existing Fill
- L Loess
- F Ferrelview Clay
- C Clay Till
- B Basal Till
- R Residuum

Note : Values of w & γ_d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

See page 12 of this table for legend of Soil Units

* Std Proctor Test

** Unreliable test results due to low confining pressures, which resulted in higher values.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Laboratory test results for this material indicate that the moisture content ranges from 20 to 29%, the dry unit weight from 94 to 102 pounds per cubic foot (pcf), the fines content (minus No. 200 sieve) from 79 to 97% and the plasticity index (PI) from 11 to 42.

- Loess - the Loess unit underlying the topsoil/fill is randomly scattered across the site, possibly because it is a wind blown deposit (MGS 1977). Loess distribution may also have been affected by extensive reworking of the upper subsurface during site preparation and construction. Loess thicknesses ranging from a few inches to 10.5 feet were encountered during field investigations. Materials from this unit consist primarily of a mottled gray silt to dark yellowish-orange, clayey silt or silty clay. The Loess exhibits low to medium plasticity with a PI ranging from 10 to 34. It does not collapse when wet like other wind deposited soils that are commonly called loess and are typically found in this part of the country. Fines content ranges from 90 to 99%. The moisture content ranges from 10 to 31% and the dry unit weight ranges from 89 to 105 pcf.

- Ferrelview - The Ferrelview (Formation) clay, which underlies the Loess unit, is one of the more extensive soil units within the site overburden. Unit thickness ranges from a few inches to 22 feet. This soil is typically dark, yellowish-orange to brown with grey mottling, silty clay and clayey silt, very stiff and of low to high plasticity (PI from 6 to 58). The percent of fines encountered ranges from 80 to 99%, the moisture content from 10 to 31%, and the dry unit weight from 90 to 111 pcf.

  Some Ferrelview clay contains a higher percentage of silt, possibly derived from the underlying clay till. Samples of clay from this formation have a characteristic conchoidal fracture and often exhibit slickensides.

- Clay Till - The Clay Till underlying the Ferrelview clay is the most horizontally extensive soil unit at the WSS. The thickness of this unit ranges up to 30 feet. It consists of massive and very stiff, yellowish brown, silty clay and clayey silt having a medium to high plasticity with minor amounts of sand

and rounded to subrounded gravel. The PI generally ranges from 25 to 50. The fines content ranges from 55 to 95. The moisture content ranges from 11 to 36%, and the dry unit weight from 72 to 119 pcf.

- Basal Till - The Basal Till is found mostly in the western and north-central portions of the site. The unit ranges in thickness from 0 to 8 feet. It is typically a yellowish brown, sandy-silty-gravelly clay to clayey gravel. The Basal Till is more gravelly than the overlying soil units. Test results show that the PI generally ranges 12 and 39, the fines from 28 to 98%, the moisture content from 11 to 26%, and the dry unit weight from 102 to 119 pcf.

- Residuum - The Residuum is found immediately above the bedrock throughout the site region. It is laterally extensive on the site. This soil unit is interpreted to be a pre-Pleistocene weathering horizon of the underlying bedrock (BNI 1984). Its thickness varies from 0 to approximately 25 feet. The material is a distinctive red to yellow, consisting of gravelly clay to gravelly silt, clayey sand, and gravel. The gravel consists of angular, weathered chert or limestone rock fragments. The interstitial clay is often highly plastic and forms a tight matrix around the gravel-sized rock fragments. Samples obtained for testing probably represent residuum with higher fines content because of poor sample recovery from residuum with higher gravel content. The PI for the interstitial clay portion ranges from 33 to 50. Fines in the tested samples range from 15 to 90%, moisture content ranges from 1 to 45% and the dry unit weight from 77 to 117 pcf.

The typical range of values for each soil type given above are for the overall site. To reduce and evaluate the soil test results, average (arithmetic mean) values were specifically calculated according to soil types for overall site area and for the disposal cell area. These average values are presented in Tables 3-5 and 3-6. Table No. 3-7 presents the average values for the suitable off-site clay borrow source investigated so far, namely, Source No. 1. The number of tests (points), maximum and minimum values and standard deviation are also shown in these tables. The values for borrow source No. 2 were not summarized because it was found to be unsuitable as a clay source (see section 4,3).

TABLE 3-5 :SUMMARY OF AVERAGING OF INDEX PROPERTIES FOR OVERALL AREA

Project Name WSSRAP

Hole or Trench #	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrin -kage	Specific Gravity	Natural		
		From	To	USCS	Gravel	Sand	Fines	LL	PI	Limit	G	Water Content	Unit Weight d	Weight t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
TOPSOIL/FILL														
Number of points					6	6	6	9	9	4		10	5	5
Mean Values					0.3	8.3	91.3	47.5	29.7	10.7		22.2	100.0	123.0
Maximum Values					1.0	21.0	97.0	59.0	42.0	18.1		28.6	102.3	124.2
Minimum Values					0.0	3.0	79.0	33.0	11.0	10.7		20.4	94.4	120.7
Standard Deviation					0.5	6.1	6.1	8.4	8.9	2.8		2.7	3.1	1.3
LOESS														
Number of points					20	20	20	22	22	4	6	25	10	10
Mean Values					0.0	3.2	96.9	41.6	22.2	14.4	2.70	20.8	98.3	120.9
Maximum Values					0.0	10.0	99.0	58.0	34.0	19.4	2.75	30.7	104.7	126.8
Minimum Values					0.0	1.0	90.0	30.0	10.0	8.3	2.62	9.9	89.4	116.5
Standard Deviation					0.0	2.2	2.2	8.0	7.1	4.7	0.04	4.7	4.3	3.4
FERRELVIEW CLAY														
Number of points					45	45	45	48	48	4	24	59	31	31
Mean Values					0.3	5.1	94.6	52.2	32.8	12.3	2.69	22.6	100.0	123.6
Maximum Values					8.0	20.0	99.0	82.0	58.0	17.5	2.82	32.4	111.0	133.1
Minimum Values					0.0	1.0	80.0	27.0	6.0	7.3	2.51	13.8	89.9	114.4
Standard Deviation					1.5	4.4	4.7	12.5	11.8	4.5	0.07	3.9	5.2	4.1
CLAY TILL														
Number of points					17	17	17	15	15		10	24	21	20
Mean Values					0.9	23.2	75.9	48.8	32.9		2.71	19.2	105.7	127.9
Maximum Values					5.0	45.0	95.0	74.0	50.0		2.79	36.3	119.4	134.2
Minimum Values					0.0	5.0	55.0	39.0	25.0		2.65	11.1	72.4	113.0
Standard Deviation					1.6	9.0	8.6	9.1	7.1		0.04	5.8	11.3	5.1
BASAL TILL														
Number of points					9	9	9	7	7		5	7	6	6
Mean Values					12.1	21.8	66.1	40.0	23.7		2.69	18.9	109.2	128.4
Maximum Values					36.0	50.0	98.0	54.0	39.0		2.77	25.7	118.9	134.4
Minimum Values					0.0	2.0	28.0	31.0	12.0		2.59	11.0	101.6	120.9
Standard Deviation					13.7	15.8	27.9	6.7	8.6		0.06	4.4	6.6	4.4
RESIDUUM														
Number of points					12	12	12	3	3		4	14	4	4
Mean Values					37.9	19.3	42.8	63.7	44.3		2.74	18.8	95.4	115.6
Maximum Values					65.0	46.0	90.0	71.0	50.0		2.76	45.0	117.4	124.7
Minimum Values					4.0	6.0	15.0	50.0	33.0		2.70	1.3	76.5	107.8
Standard Deviation					18.3	13.2	23.2	9.7	8.0		0.02	10.0	15.1	6.6

TABLE 3-6 :SUMMARY OF AVERAGING OF INDEX PROPERTIES FOR DISPOSAL CELL AREA

Project Name WSSRAP

Hole or Trench #	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Specific Gravity	Natural		
		From	To	USCS	Gravel	Sand	Fines	LL	PI		G	Water Content	Unit d	Weight t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
TOPSOIL/FILL														
Number of points								1	1			2	1	1
Mean Values								33.0	11.0			22.2	102.3	124.2
Maximum Values								33.0	11.0			22.9	102.3	124.2
Minimum Values								33.0	11.0			21.4	102.3	124.2
Standard Deviation								0.0	0.0			0.8	0.0	0.0
LOESS														
Number of points					12	12	12	12	12		3	14	3	3
Mean Values					0.0	3.7	96.3	40.5	20.7		2.69	19.4	95.5	118.8
Maximum Values					0.0	10.0	99.0	54.0	29.0		2.75	30.7	101.1	121.7
Minimum Values					0.0	1.0	90.0	30.0	11.0		2.62	9.9	89.4	116.9
Standard Deviation					0.0	2.3	2.3	8.1	6.4		0.05	5.0	4.8	2.1
FERRELVIEW CLAY														
Number of points					24	24	24	27	27	2	17	32	14	14
Mean Values					0.0	4.9	95.1	56.5	36.9	12.4	2.70	22.3	100.7	124.3
Maximum Values					0.0	20.0	99.0	82.0	58.0	17.5	2.82	28.0	110.1	130.8
Minimum Values					0.0	1.0	80.0	39.0	17.0	7.3	2.55	14.0	90.3	115.3
Standard Deviation					0.0	4.8	4.8	12.5	10.9	5.1	0.06	3.5	4.6	3.6
CLAY TILL														
Number of points					12	12	12	11	11		8	17	15	14
Mean Values					0.8	25.8	73.5	48.5	33.0		2.70	18.2	106.5	128.8
Maximum Values					5.0	45.0	84.0	74.0	50.0		2.79	33.7	119.4	134.2
Minimum Values					0.0	15.0	55.0	39.0	25.0		2.65	11.1	72.4	118.6
Standard Deviation					1.7	7.7	7.3	9.5	7.0		0.04	4.8	11.2	3.8
BASAL TILL														
Number of points					8	8	8	6	6		4	6	5	5
Mean Values					13.6	24.0	62.4	40.3	24.0		2.69	18.3	110.6	129.0
Maximum Values					36.0	50.0	98.0	54.0	39.0		2.77	25.7	118.9	134.4
Minimum Values					0.0	2.0	28.0	31.0	12.0		2.59	11.0	101.6	120.9
Standard Deviation					13.8	15.4	27.3	7.1	9.3		0.07	4.5	6.4	4.6
RESIDUUM														
Number of points					9	9	9	2	2		2	11	4	4
Mean Values					33.3	17.7	49.0	70.5	50.0		2.75	19.8	95.4	115.6
Maximum Values					65.0	46.0	90.0	71.0	50.0		2.76	45.0	117.4	124.7
Minimum Values					4.0	6.0	18.0	70.0	50.0		2.74	1.3	76.5	107.8
Standard Deviation					18.4	12.1	23.4	0.5	0.0		0.01	10.9	15.1	6.6

TABLE 3-7 :SUMMARY OF AVERAGING OF INDEX PROPERTIES FOR POTENTIAL BORROW SOURCE NO. 1

Project Name WSSRAP

Hole or Trench #	Sample Number	Depth		Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage	Specific Gravity	Natural		
		From	To	USCS	Gravel	Sand	Fines	LL	PI	Limit	G	Water Content	Unit Weight d	Weight t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
Number of points					15	15	15	16	16	4	10	25	8	8
Mean Values					0.3	6.1	93.6	46.3	21.8	14.5	2.67	23.2	95.5	118.8
Maximum Values					2.0	37.0	98.0	71.0	50.0	22.2	2.74	28.1	99.0	122.8
Minimum Values					0.0	2.0	62.0	31.0	9.0	8.5	2.55	11.1	89.1	110.3
Standard Deviation					0.6	8.8	9.0	12.5	12.8	5.2	0.06	3.9	3.3	3.9

Data processing, reduction and averaging of the large number of test results were accomplished by utilizing the standard PC software programs LOTUS(Lotus 1986) and ALLWAYS(Funk Software 1988). The PC program GRAPHER(Golden Software 1988) was also used to prepare summary graphs and charts, utilizing data already entered in LOTUS. Evaluation of the test results and soil properties was performed as a formal calculation, and is presented in Appendix C. For presentation, specific symbols were selected for each type of soil unit and used consistently in the graphs throughout the report. Table No. 3-8 presents a legend of the symbols used in those graphs.

The soils were tested in the undisturbed (in situ) state and in some cases, in the remolded (compacted) state. The undisturbed state applies to all geologic soil units encountered and the test results will be used mainly for foundation analyses. The remolded state applies primarily to the Ferrelview clay unit because soils within this unit will be excavated due to site grading and are suitable candidate soils as backfill or common fill.

The clayey soils at the two potential borrow sources were investigated mainly for their suitability as potential disposal facility liner and low permeability materials and secondly, as common fill material.

3.3 Classification and Index Properties

To verify, identify and characterize the soil units, a suite of tests consisted of particle size analysis, Atterberg limits, specific gravity, natural water content and dry unit weight was performed. Using the results of these tests and the descriptions provided in the boring logs, samples from field investigations were classified according to the Unified Soil Classification System (ASTM D2487). Unless indicated otherwise, all average values presented in this report represent overall site values.

3.3.1 Particle-Size Analysis

The particle-size analysis or sieve analysis, with or without hydrometer, determines the distribution of the various particle sizes in soil. Standard sieves are used to separate particles of all sizes except silts and clays, for which a hydrometer analysis is used. Particle size distribution is used to classify soils, estimate permeability (using empirical correlations), and analyze the potential for particle migration at the interface of two soils.

TABLE 3-8 : LEGENDS OF SYMBOLS USED IN GRAPHS

⊹	TOPSOIL/FILL
○	LOESS
□	FERRELVIEW CLAY
◁	CLAY TILL
◇	BASAL TILL
☆	RESIDUUM

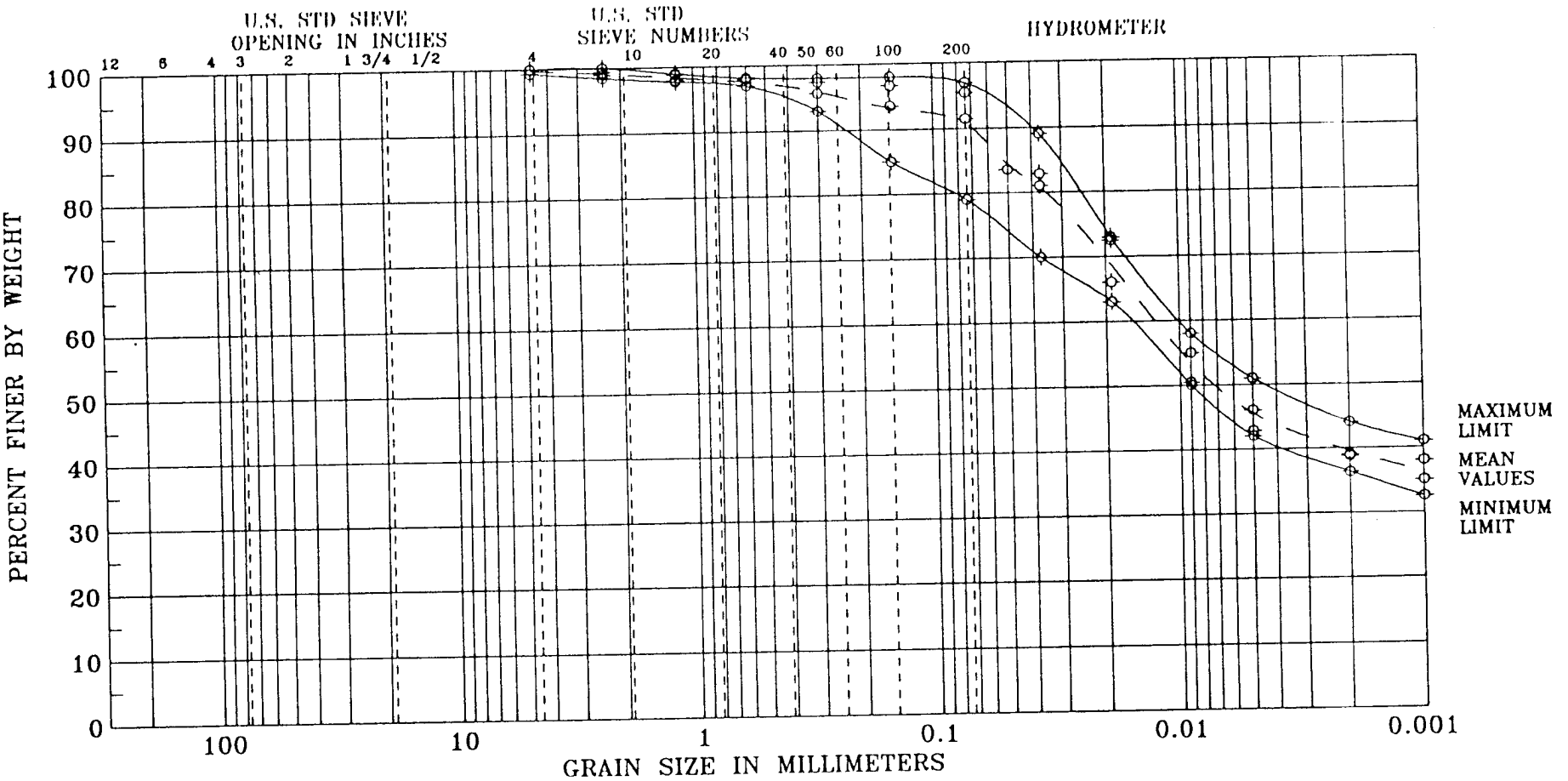
Most of the soils encountered at the site contain more than 50 percent (by weight) of fines (percent passing #200 sieve). Therefore, the average (arithmetic mean) fines content was calculated for each soil type and presented for comparison and soil characterization.

As can be seen from Table 3-5, an overall average fines content of 88% was calculated for the topsoil/fill geologic unit, 97% for Loess, 95% for Ferrelview clay, 76% for Clay Till, 66% for Basal Till and 42% for Residuum. The percent of fines generally decreases with the deeper geologic units as the gravel content increases. The average values indicate that with the exception of the Residuum, all soil units are classified as silts or clays. The gradation test results for each geologic unit are plotted in Figures 3-1 through 3-6. The grain size curves plotted in the figures represent the average values and the maximum and minimum limits. The plots show that the grain size distribution within each soil unit, geographically within the site, are generally uniform with no apparent differences. Furthermore, the results for the Ferrelview Clay are plotted for the overall site area and the following four geographical areas: the northern chemical plant area, the southern chemical plant area, the Temporary Storage Area and the Material Staging Area (Figures 3-2B through 3-2E). The limits of each area are shown in Figure 2-1. Gradation test summary for Potential Clay Borrow Source No. 1 is shown in Figure 3-7. The average fines content is 94%.

3.3.2 Atterberg Limits/Plasticity

Atterberg limits are index properties, and include liquid limit, plastic limit, and plasticity index. These properties are used in classifying soils and estimating relative plasticity, consistency, and activity. In some cases, these properties also correlate with compressibility, permeability, compactability, shear-strength and shrink-swell characteristics.

The shrinkage limit is typically defined to be the water content required to just fill the voids of a cohesive soil at the minimum void ratio obtained by drying. It is used to determine the shrinkage potential or possibility of development of cracks in cohesive soils. The results range from 12 to 15% for materials tested, which include Loess, Ferrelview clay, topsoil/fill and Borrow Source No. 1 materials.

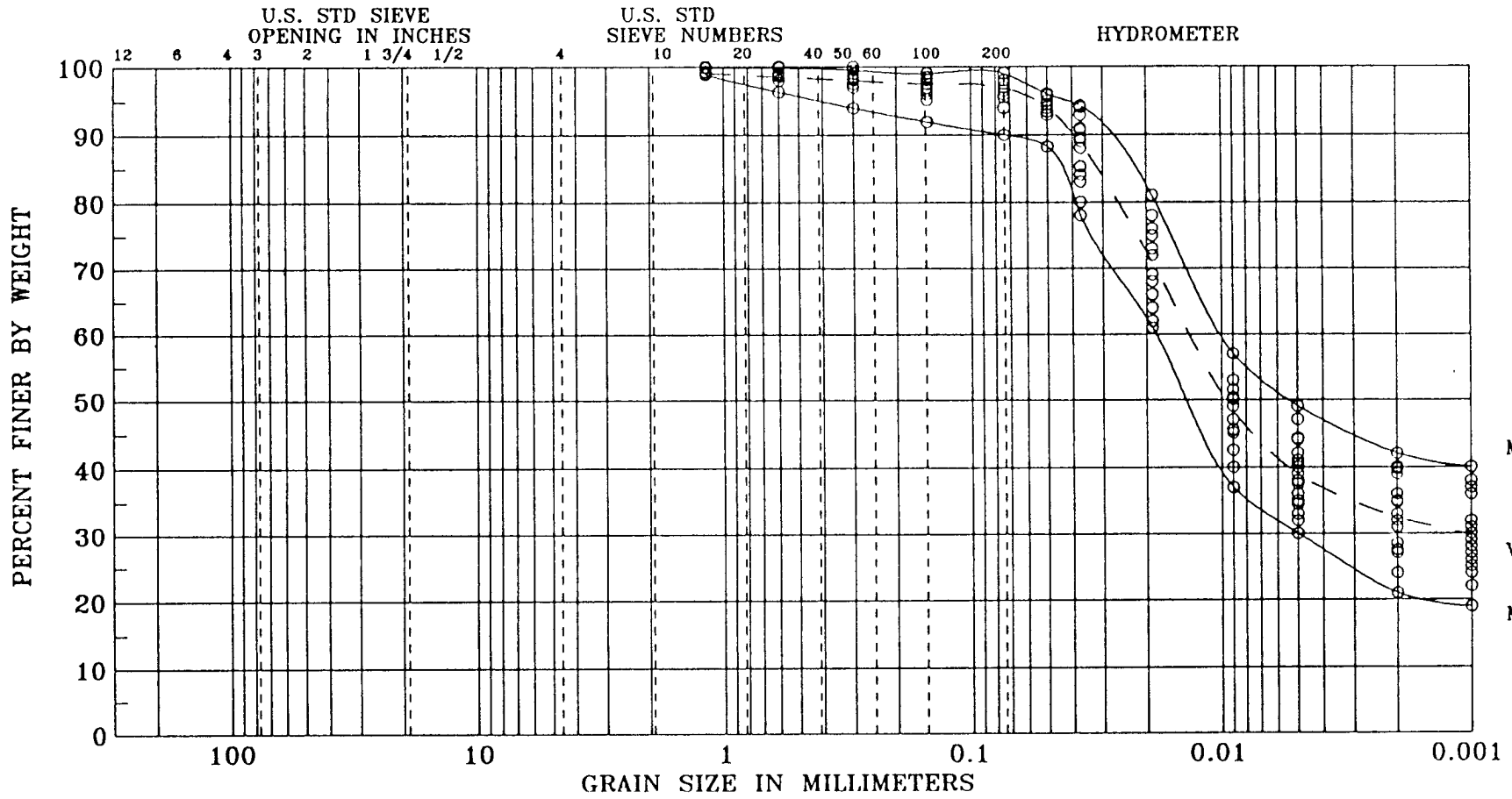


SUMMARY PLOT OF GRADATION LIMITS

TOPSOIL/FILL
OVERALL AREA

FIGURE 3-1

REPORT NO.MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:



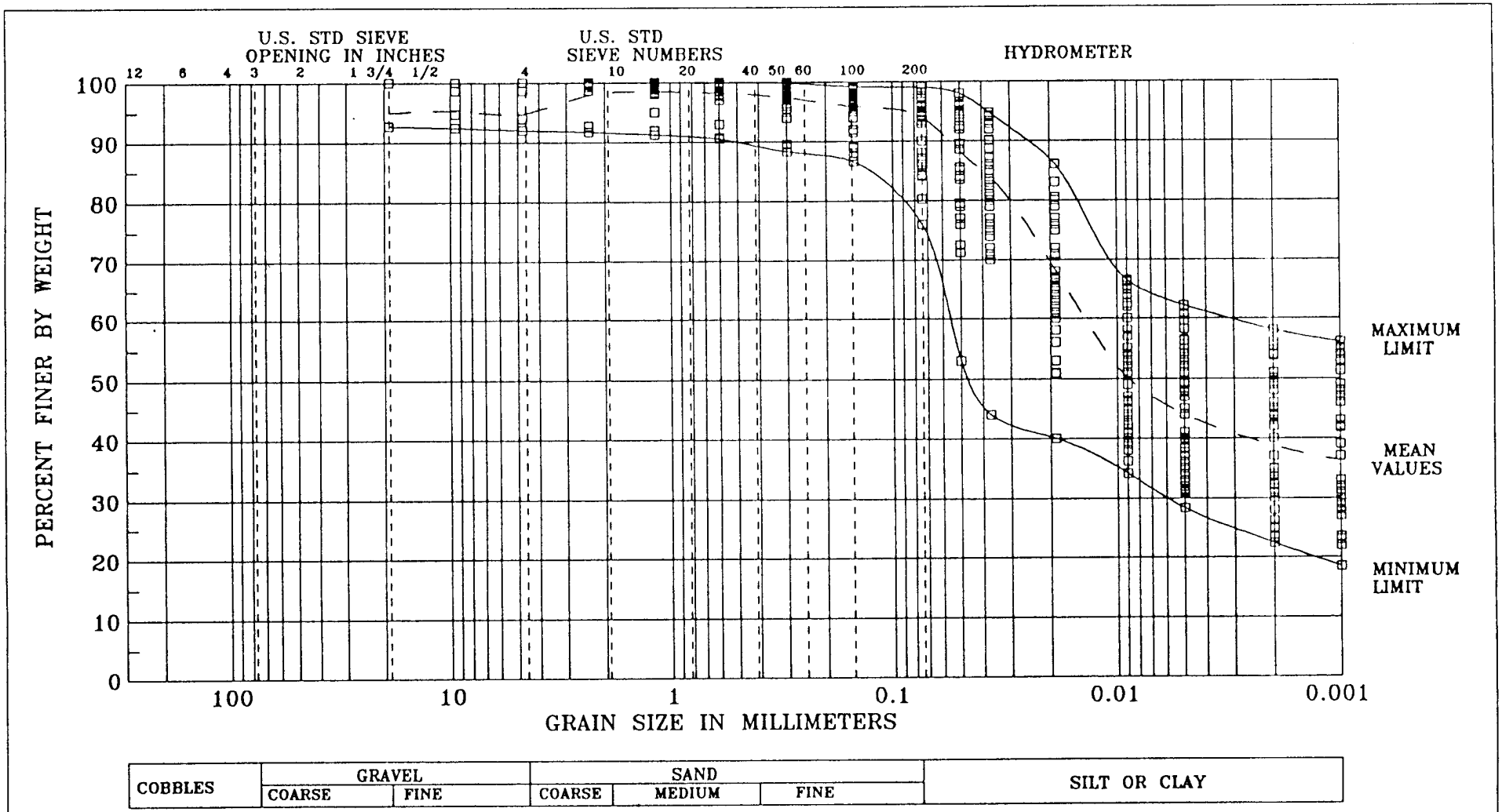
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SUMMARY PLOT OF GRADATION LIMITS

LOESS
OVERALL AREA

FIGURE 3-2

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:

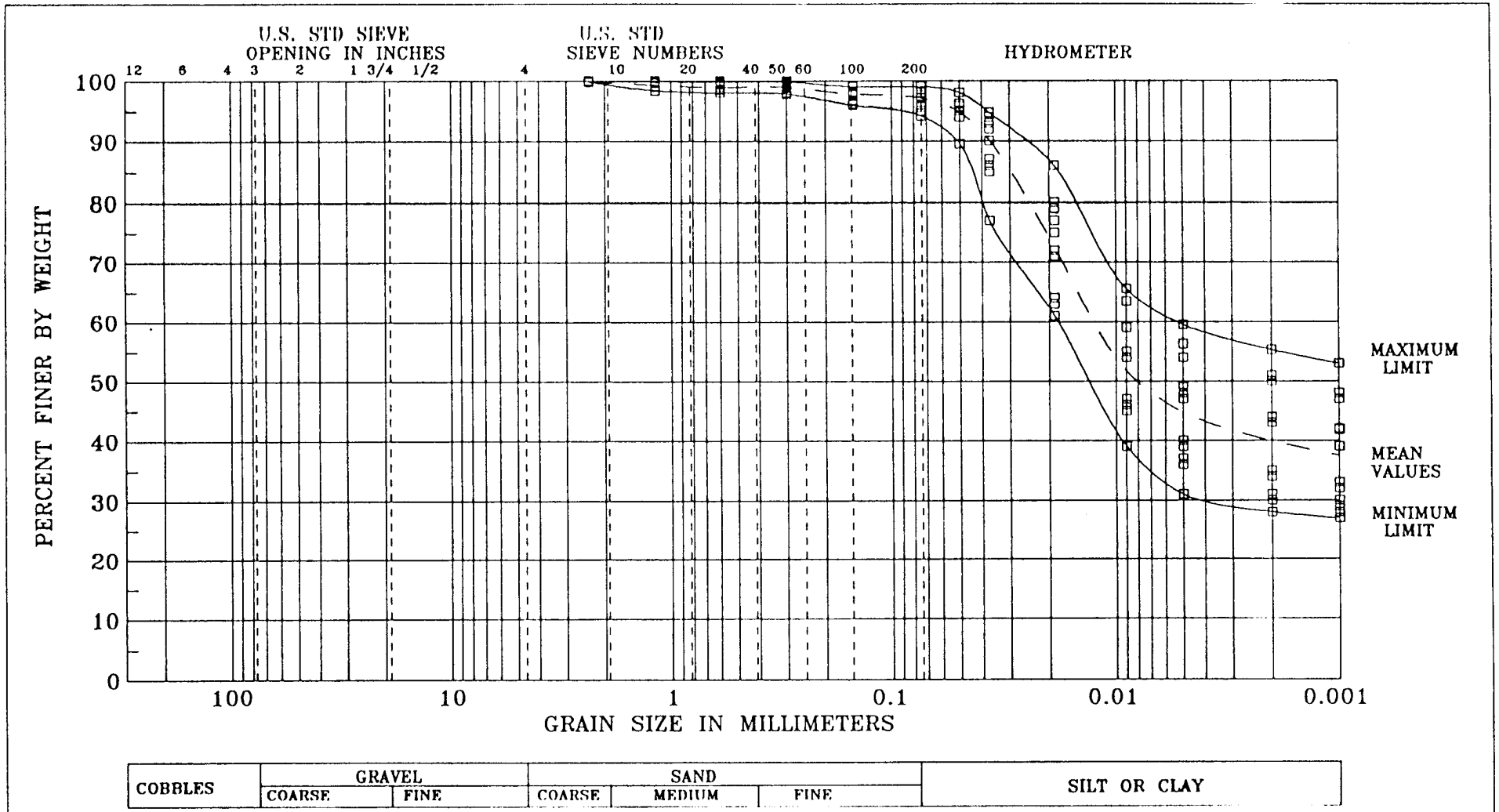


SUMMARY PLOT OF GRADATION LIMITS

FERRELVIEW CLAY
OVERALL VALUES

FIGURE 3-3 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:

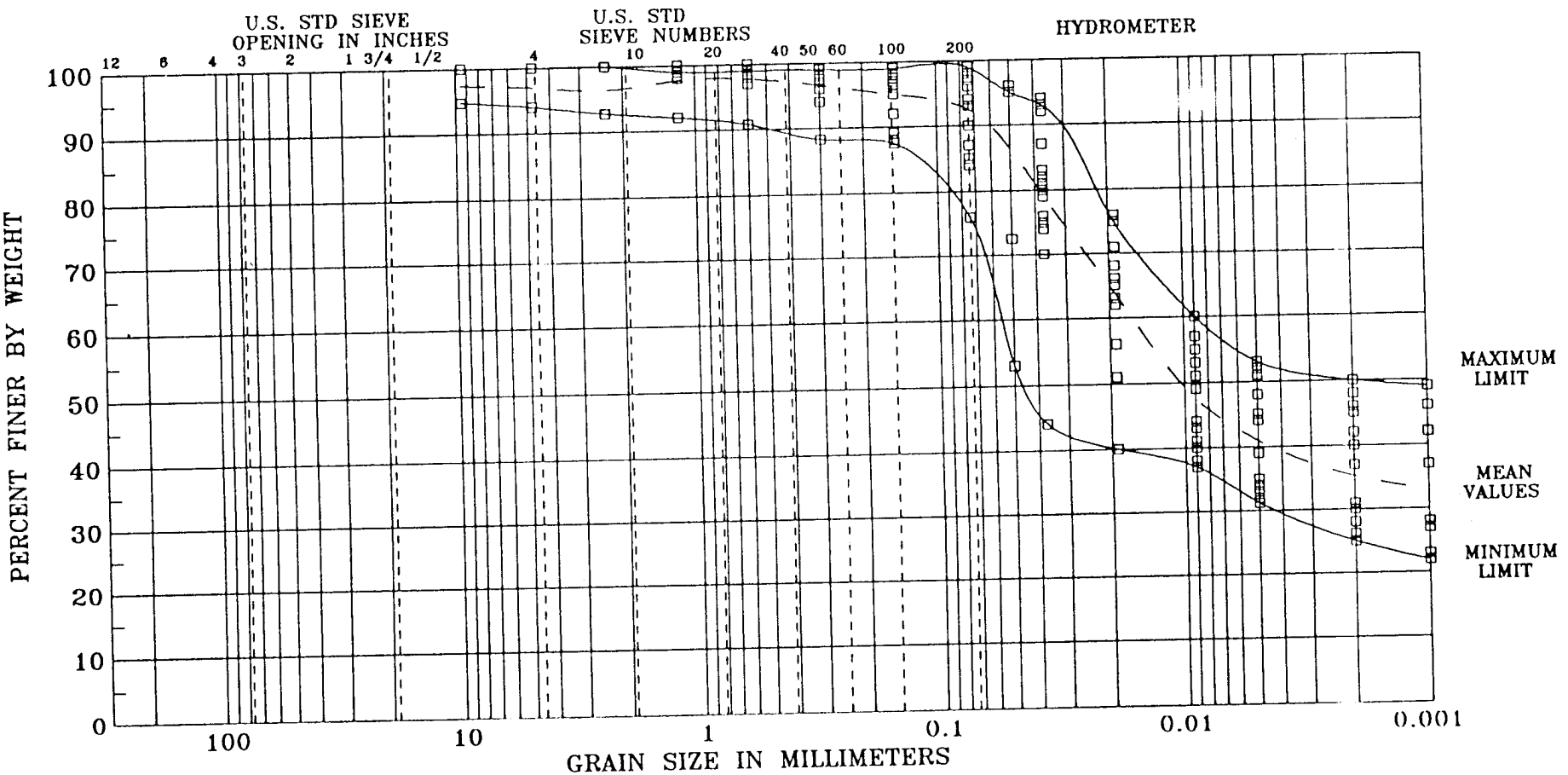


SUMMARY PLOT OF GRADATION LIMITS

FERRELVIEW CLAY
NORTHERN CHEMICAL PLANT AREA

FIGURE 3-3 B

REPORT NO.MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:



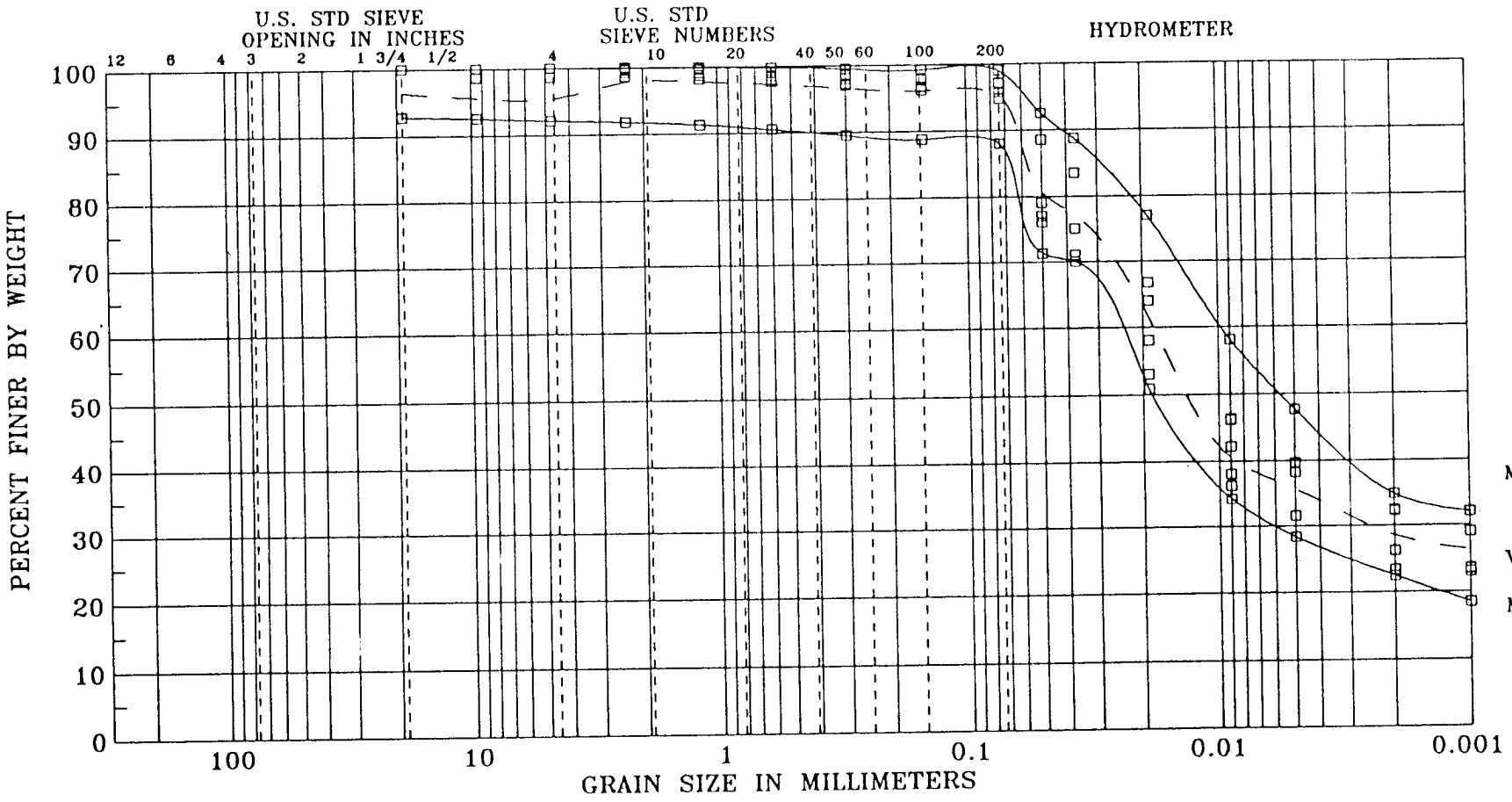
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SUMMARY PLOT OF GRADATION LIMITS

FERRELVIEW CLAY
SOUTHERN CHEMICAL PLANT AREA

FIGURE 3-3 C

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:



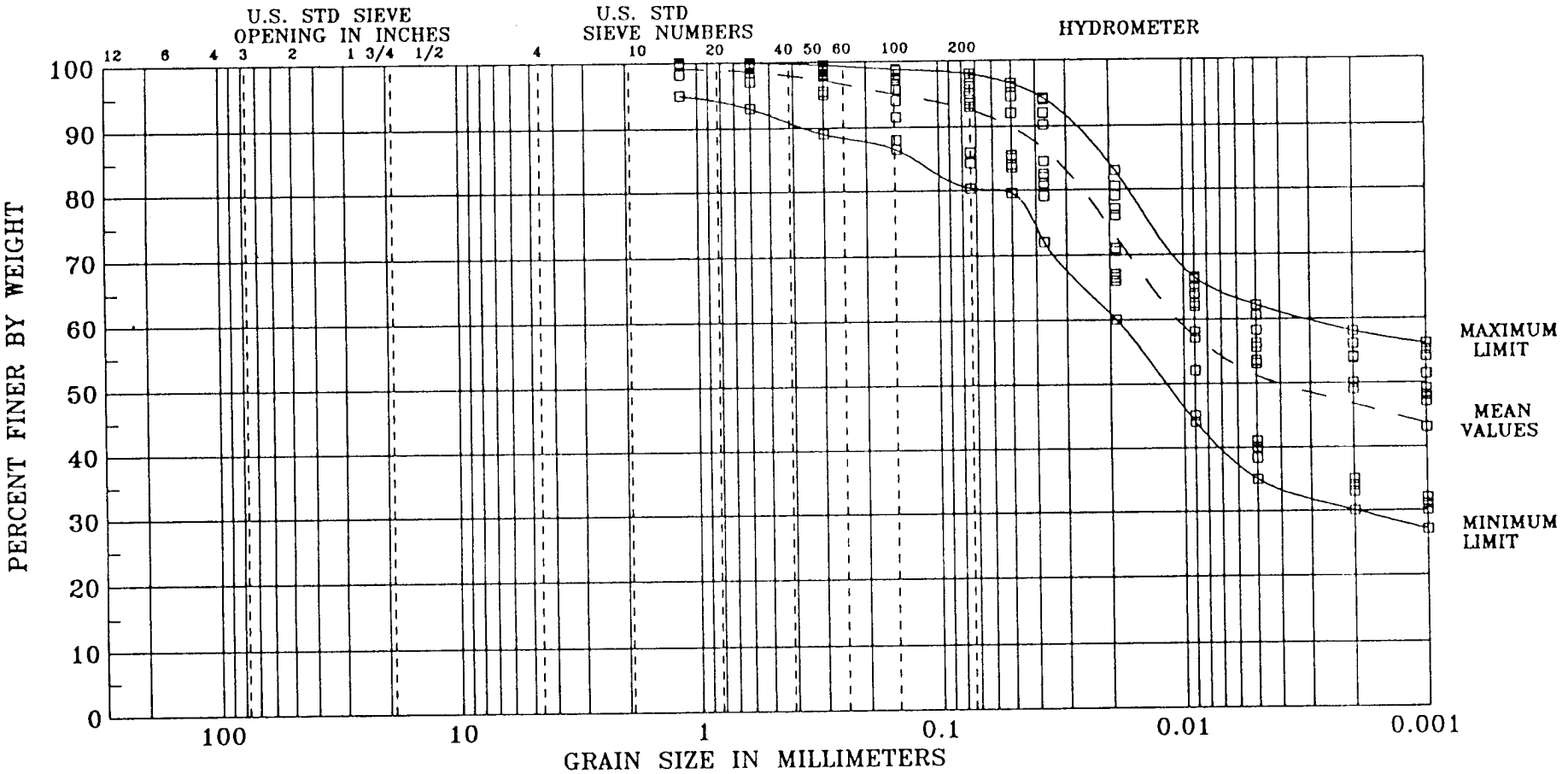
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SUMMARY PLOT OF GRADATION LIMITS

FERRELVIEW CLAY
TEMPORARY STORAGE AREA

FIGURE 3-3 D

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:

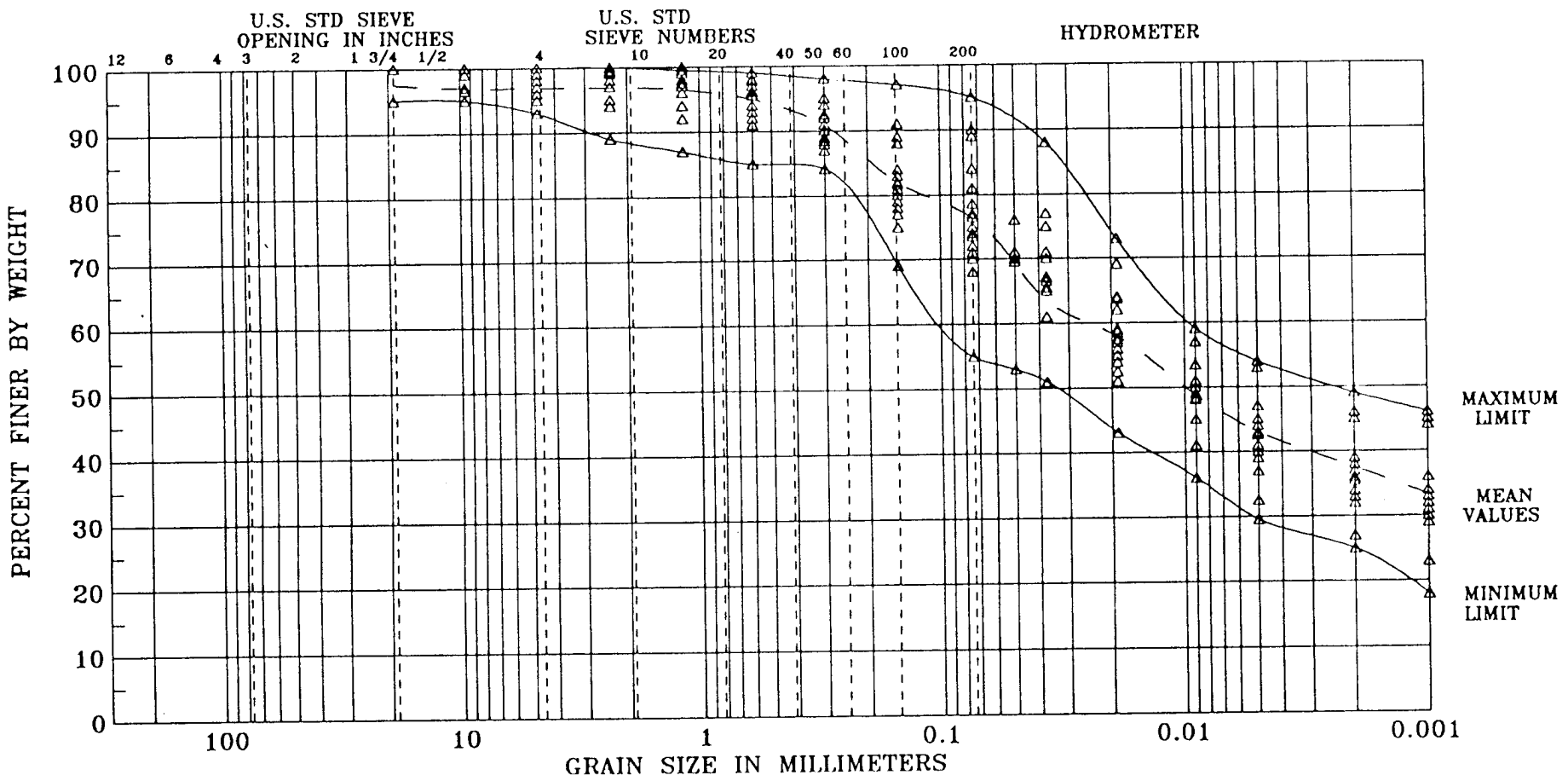


SUMMARY PLOT OF GRADATION LIMITS

FERRELVIEW CLAY
MATERIALS STAGING AREA

FIGURE 3-3 E

REPORT NO. MKES -3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:



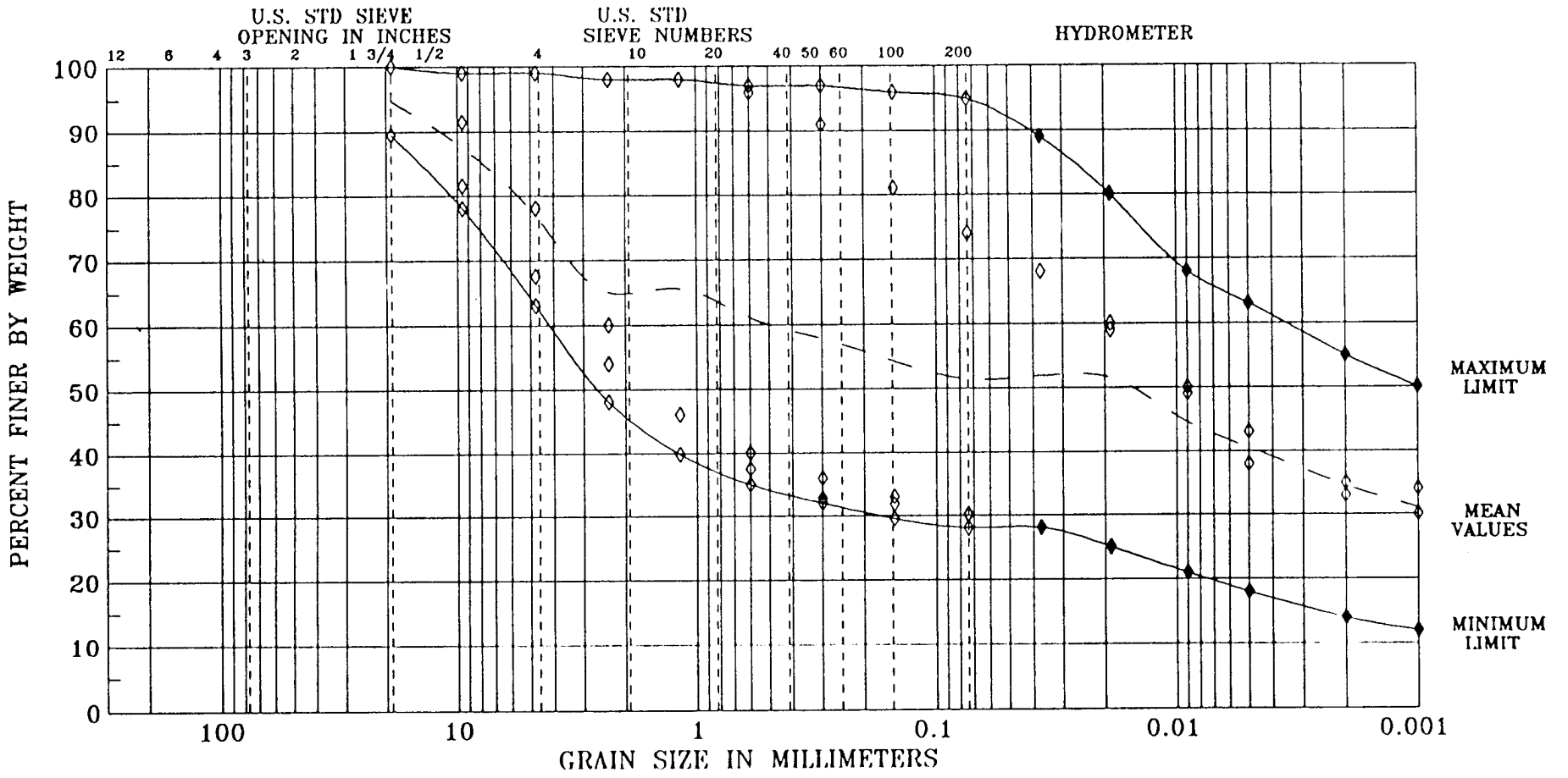
COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SUMMARY PLOT OF GRADATION LIMITS

CLAY TILL
OVERALL AREA

FIGURE 3-4

REPORT NO. MKES -3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:



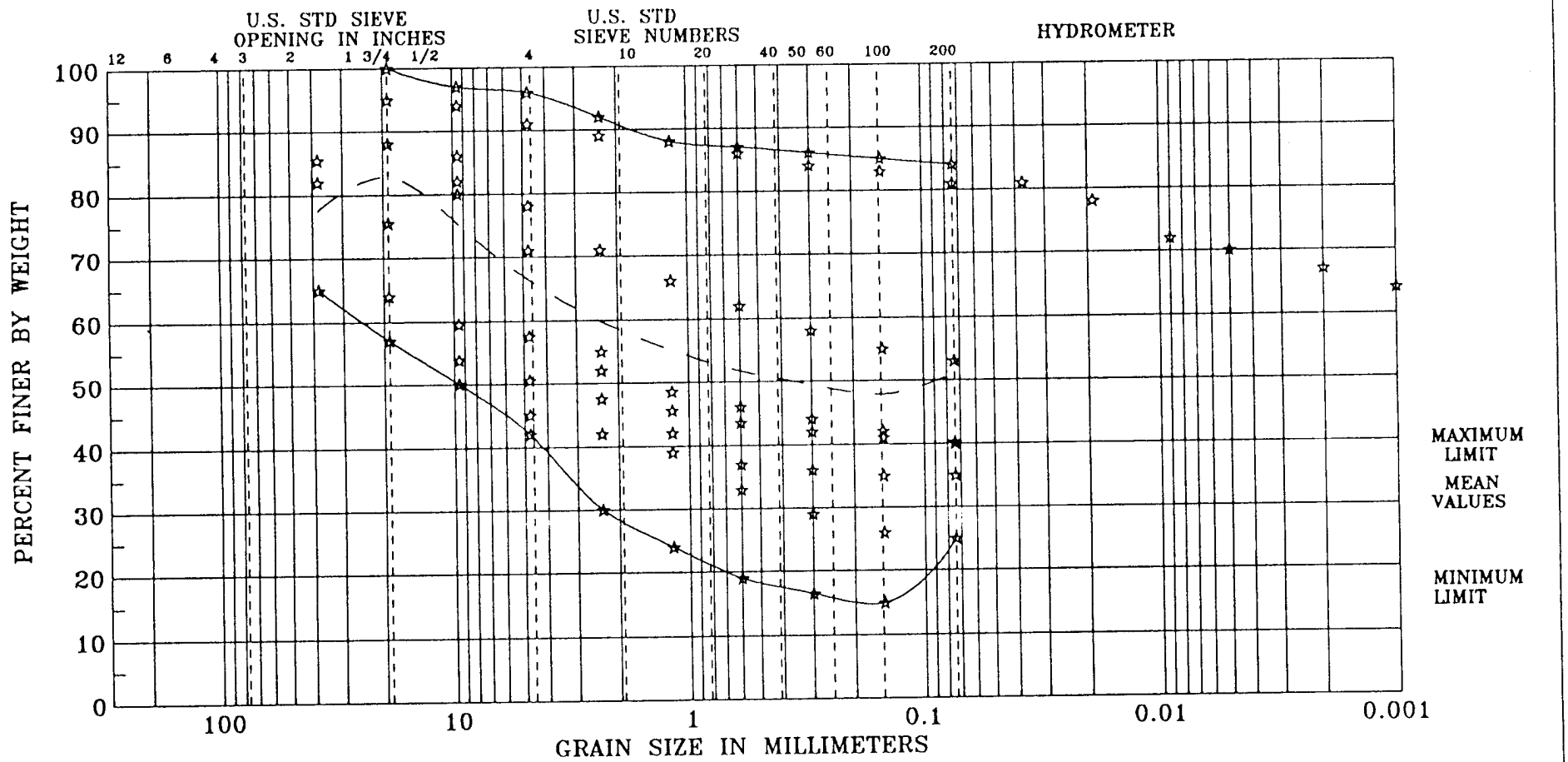
♦ ASSUMED VALUES

SUMMARY PLOT OF GRADATION LIMITS

BASAL TILL
OVERALL AREA

FIGURE 3-5

REPORT NO. MKES -3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE: 09/23/91



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

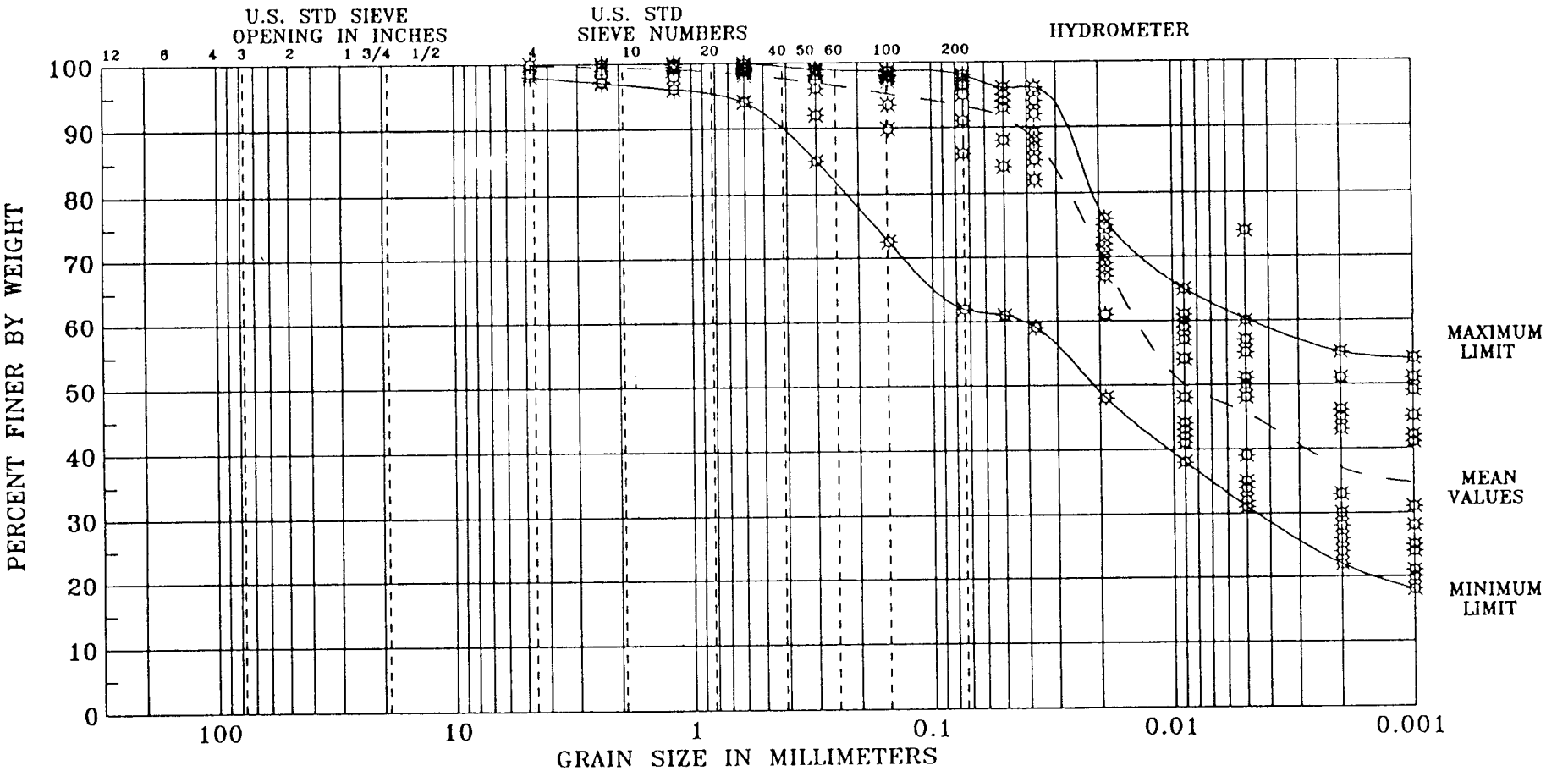
SUMMARY PLOT OF GRADATION LIMITS

RESIDUUM
OVERALL AREA

FIGURE 3-6

REPORT NO. MKES -3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:

SS



SUMMARY PLOT OF GRADATION LIMITS

POTENTIAL BORROW SOURCE NO. 1

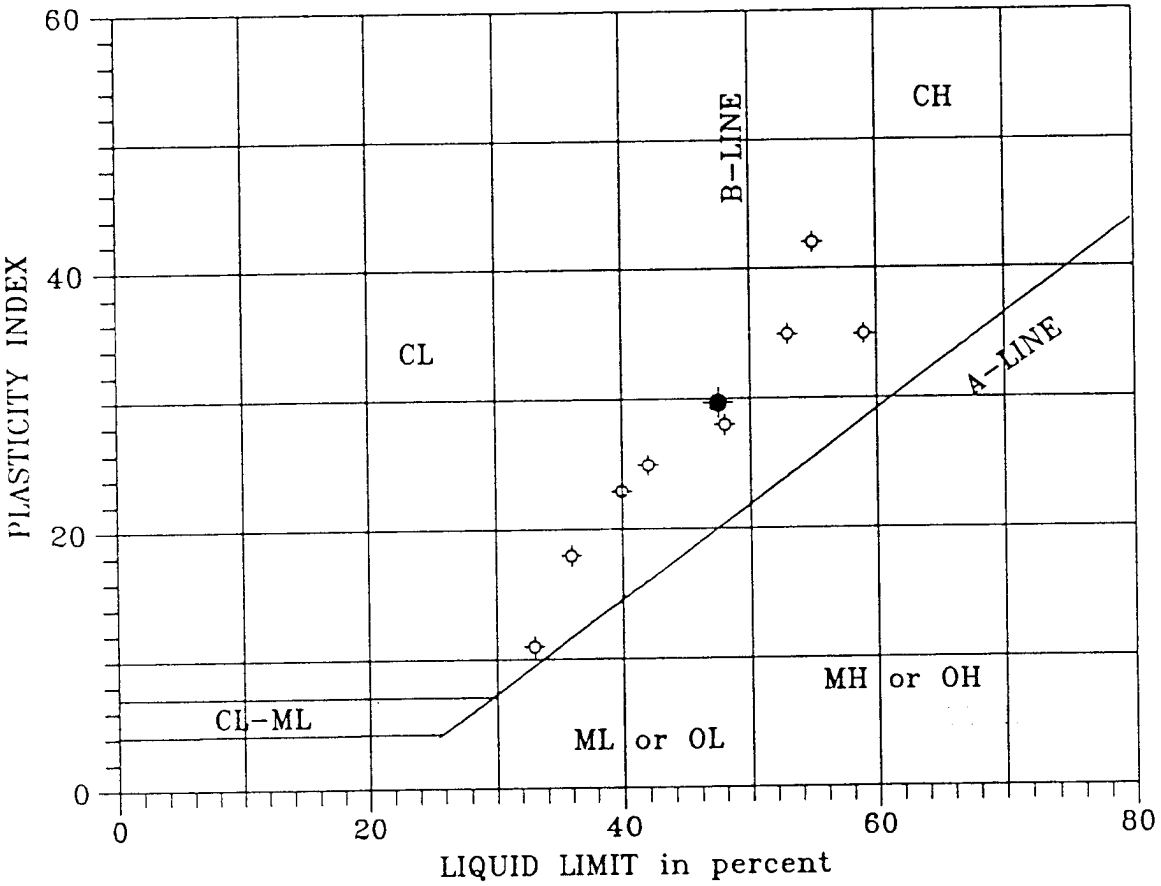
FIGURE 3-7

REPORT NO.MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN BY: ND	DATE:

The results of the Atterberg limits for the various geologic units are plotted on the plasticity charts in Figures 3-8 through 3-13, and for Borrow Source No. 1 in Figure 3-14. The topsoil and fill materials are predominantly classified in the CL and CH categories according to the Unified Soil Classification System. The average liquid limit (LL) is 48% and the average plastic index (PI) is 30. The Loess is predominately CL except for one sample classified as CH and one as MH. The average LL is 42% and the average PI is 23. As stated above, test results for the Ferrelview clay are divided into the northern chemical plant area, southern chemical area, material staging area (MSA) and Temporary Storage Area (TSA) and plotted. This was performed because of the large number of data points available for this soil unit and also because of the need to determine if the soil characteristics vary with geographical distribution. Different symbols other than the standard ones cited earlier were used in the plot. With the exception of the material in the MSA, the plasticity of the Ferrelview clay does not show any areal trend or difference across the site. This soil unit, as a whole for the site, consists of CL and CH materials covering a broad range of plasticity values. With the exception of one sample classified as CL-ML material (LL=27, PI=6), the liquid limit for the soil unit ranges from 36 to 82% with an average of about 50%, and the PI ranges from 16 to 58 with an average of about 32. One sample was classified in the CL-ML category. The Ferrelview clay in the MSA in general has a higher plasticity than the rest of the site (CH material), with an average LL of 62% and PI of 42. The Clay Till is a CL-CH material with an average LL of 48% and average PI of 33. The Basal Till is predominantly a CL material; only one sample is classified in the CH category. The average LL is 40% and the average PI is 24. Only three Atterberg limit tests were performed on the Residuum matrix due to the gravelly nature of the Residuum. The fines content in the Residuum is highly plastic with an average LL of 64% and a PI of 44. Soils from potential clay Borrow Source No. 1 consist predominantly of CL, with some CH and ML classifications. The overall LL ranges from 31 to 71% and the overall PI ranges from 9 to 50. The overall average LL is 46% and PI is 22.

3.3.3 Specific Gravity

Specific gravity is the ratio of the weight of a given unit volume of any solid material to the weight of a given unit of water (at 4°C). When used with the unit weight and moisture content of a soil, the specific gravity can be applied to many



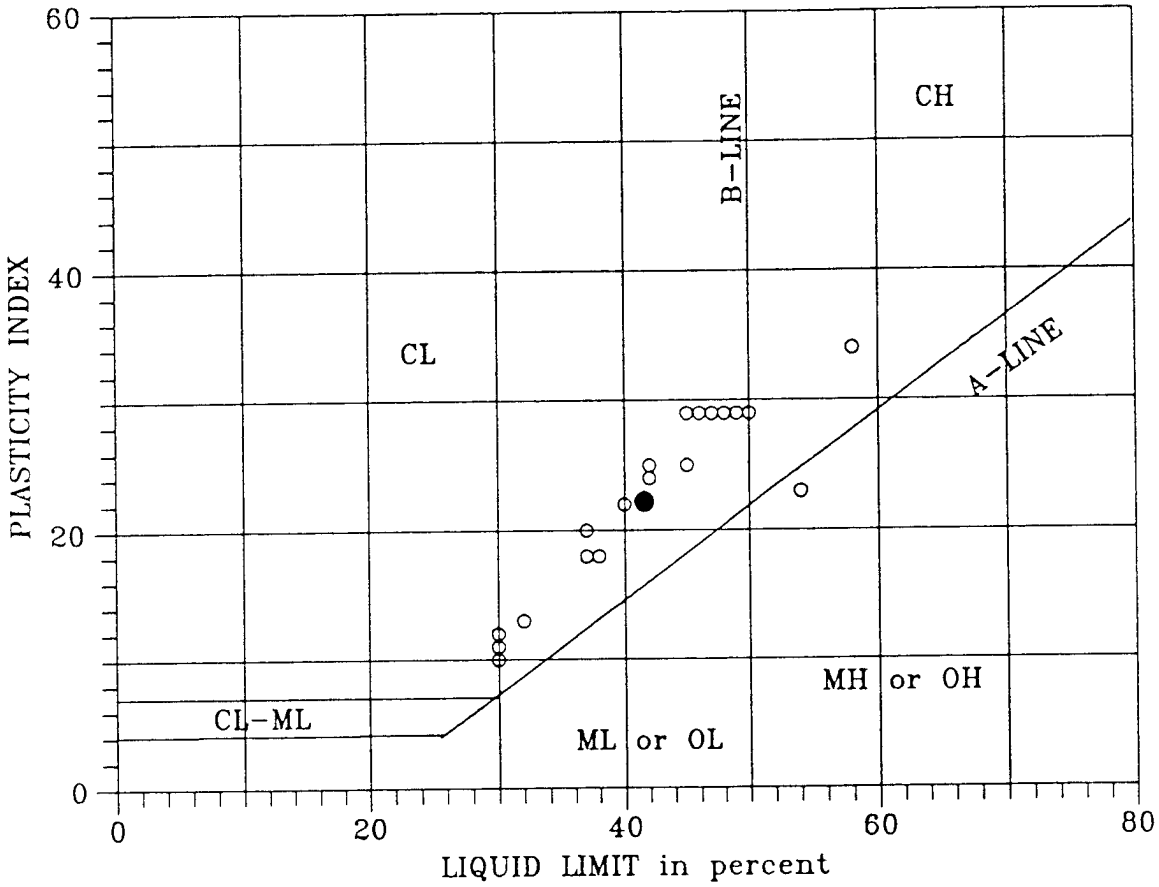
Average Value

PLASTICITY CHART FOR

TOPSOIL/FILL
OVERALL AREA

FIGURE 3-8

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



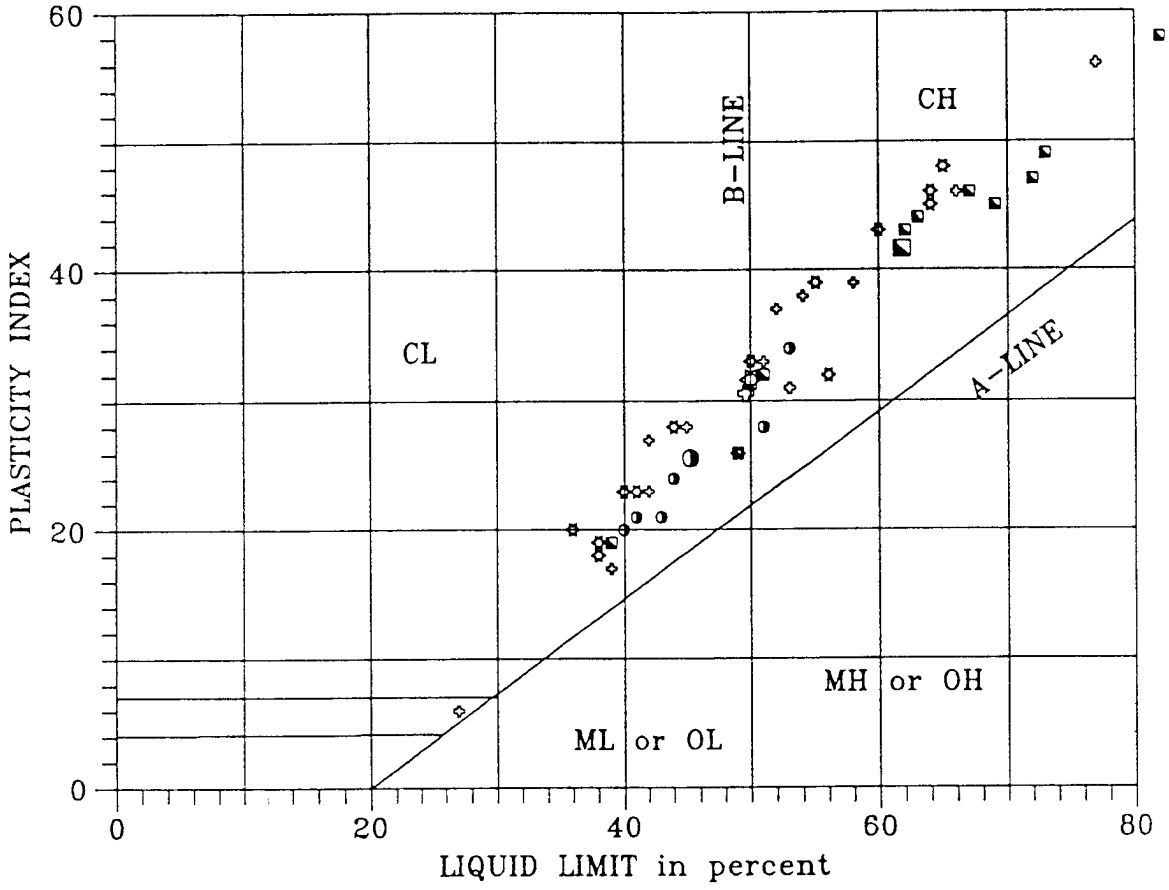
● Average Value

PLASTICITY CHART FOR

LOESS
OVERALL AREA

FIGURE 3-9

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



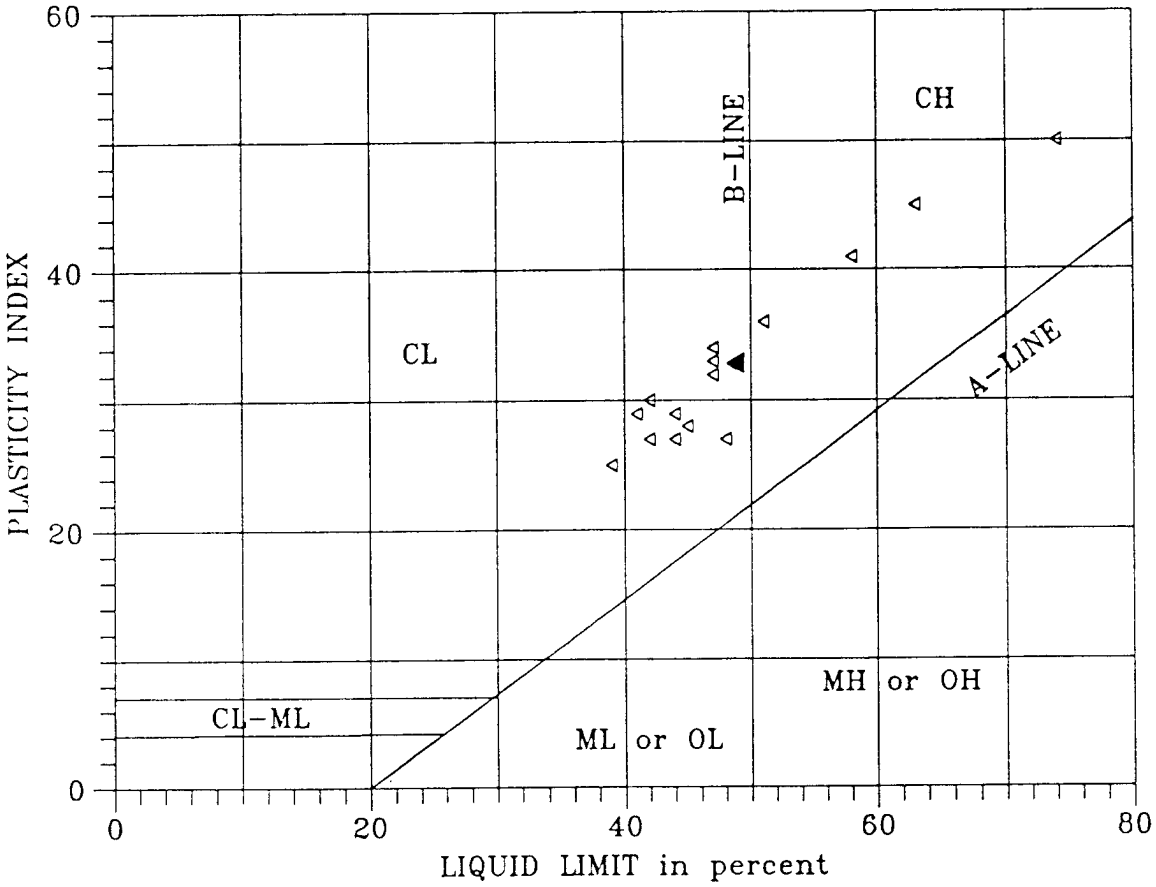
- Northern Chemical Plant Area (N.C.P)
- N.C.P Average Value
- Southern Chemical Plant Area (S.C.P)
- S.C.P Average Value
- Materials Staging Area (M.S.A)
- M.S.A Average Value
- Temporary Storage Area (T.S.A)
- T.S.A Average Value

PLASTICITY CHART FOR

FERRELVIEW CLAY
OVERALL VALUES

FIGURE 3-10

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



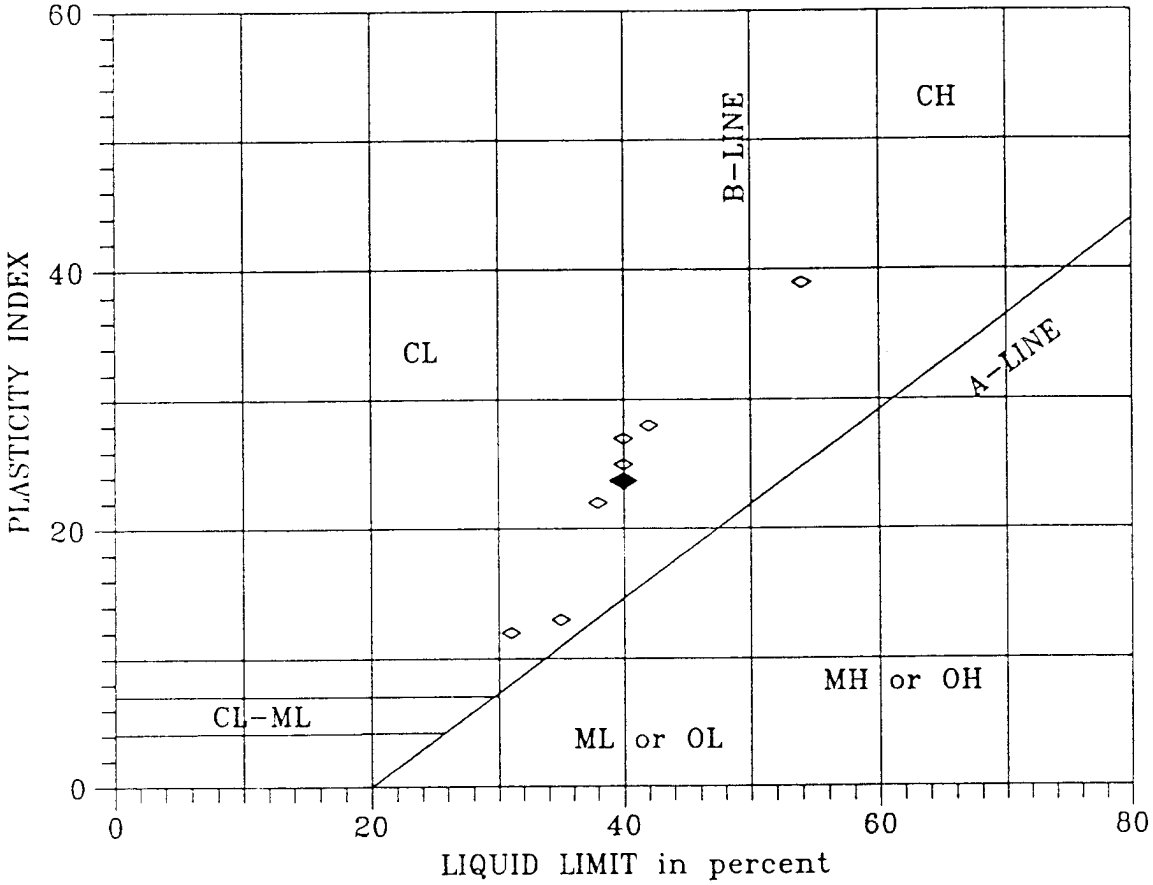
◀ Average Value

PLASTICITY CHART FOR

CLAY TILL
OVERALL AREA

FIGURE 3-11

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991



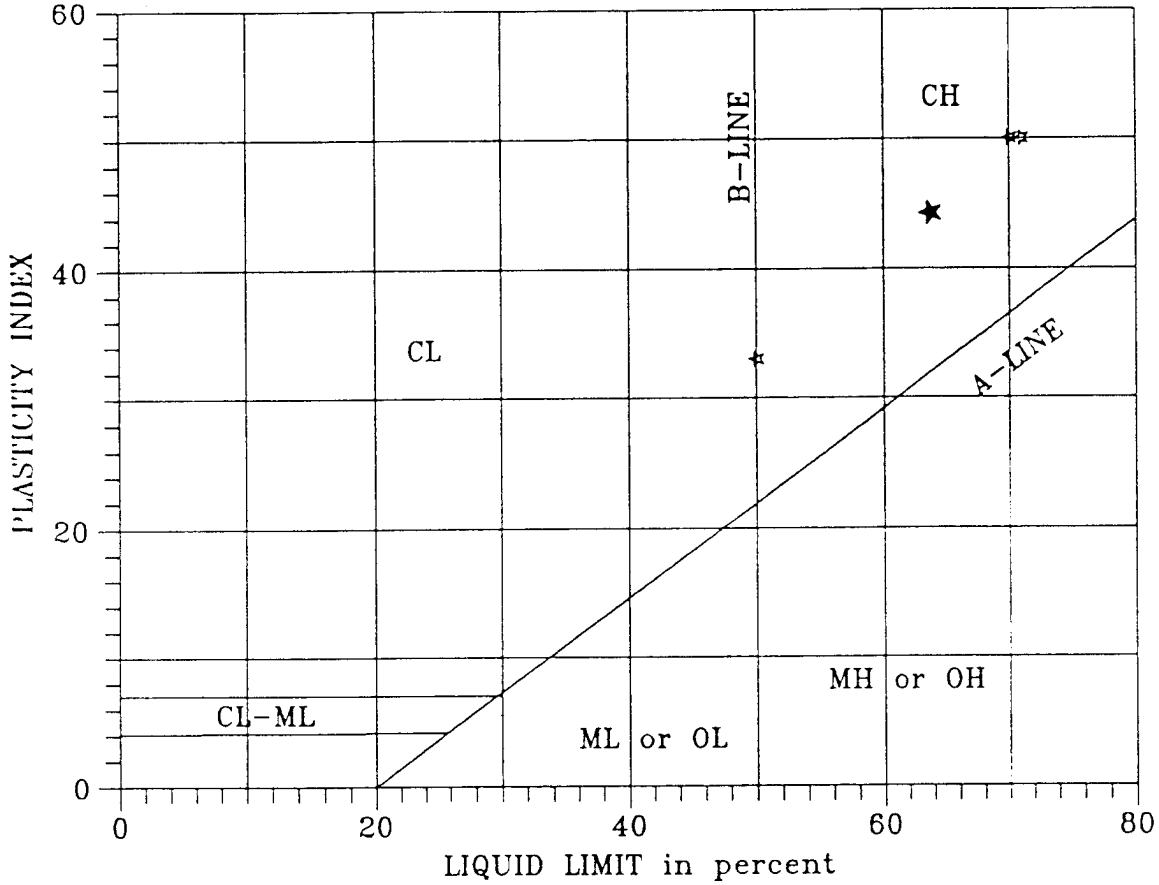
◆ Average Value

PLASTICITY CHART FOR

BASAL TILL
OVERALL AREA

FIGURE 3-12

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991



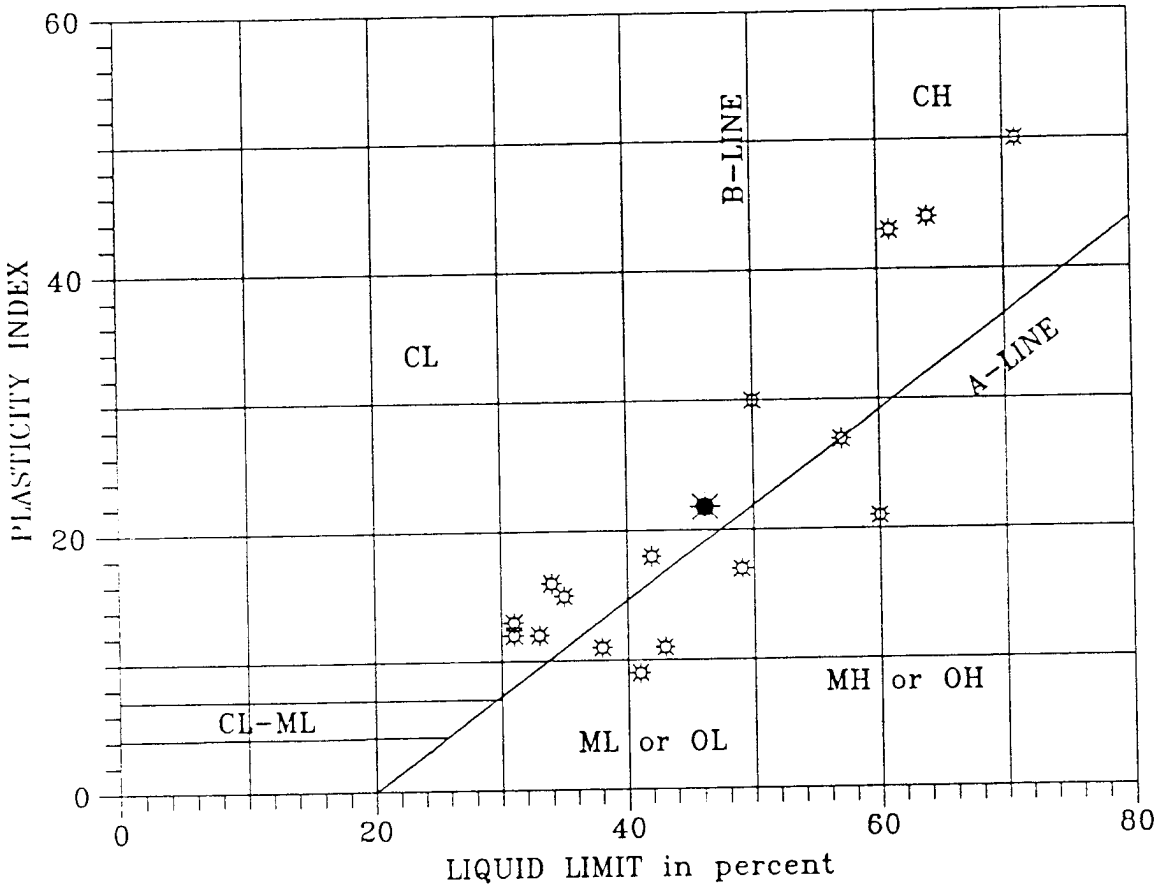
★ Average Value

PLASTICITY CHART FOR

RESIDUUM
OVERALL AREA

FIGURE 3-13

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991



Average Value

PLASTICITY CHART FOR

POTENTIAL BORROW SOURCE NO. 1
OVERALL AREA

FIGURE 3-14

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991

equations expressing relationships among air, water and soil solids; to determine additional basic parameters such as void ratio, degree of saturation, porosity and effective porosity. Table 3-9 shows the calculated average values of these parameters for each of Loess, Ferrelview clay, Clay Till and Basal Till soil type. The average values is obtained by averaging the calculated parameter using test results of specific gravity, moisture content and dry unit weight from individual samples. Due to the lack of test results for individual soil samples for the Topsoil/fill and residuum, the additional basic parameters were calculated using average values of specific gravity, moisture content and dry unit weight from these two soil types.

The specific gravity (Table 3-9) averages about 2.7 for the Topsoil/Fill, Loess, Ferrelview clay, clay Till and Basal Till, and 2.74 for Residuum. These values are typical for the types of soils encountered. The void ratios calculated using the average values range from 0.57 for Basal Till to 0.79 for Residuum. Degrees of saturation range from 65% for Residuum to 94% for Ferrelview clay. The porosities range from 0.35 for Basal Till to 0.44 for Residuum and the effective porosities range from 0.02 for the Ferrelview clay to 0.16 for Residuum.

3.3.4 Natural Moisture Content

The moisture content test determines the moisture content, or pore water content (% of dry soil weight) of a soil-water mixture. It is used extensively in determining soil index properties, soil behavior correlations, and soil consistency. The moisture content, defined as the ratio of the weight of water in the pores of soil to the weight of the soil, is used in most equations expressing relationships among air, water, and solids in a soil. When used with Atterberg limits, moisture content can provide some indication of whether a soil is reconsolidated.

The natural moisture content or water content of the soil is the moisture content of the soil in the in-situ condition when the soil sample was taken. It should be noted that the moisture content for samples obtained near the ground surface or above permanent groundwater level will vary seasonally due to climactic factors such as temperature, rainfall, length of dry period, etc., whereas for samples from deep below the ground surface or below the permanent water level, it will probably not change much over a seasonal period.

TABLE 3-9 : ADDITIONAL SOIL PROPERTIES CALCULATED FROM AVERAGE VALUES OF TEST RESULTS

	OVERALL AVERAGE VALUES			CALCULATED VALUES			
Soil Type	Specific Gravity Gs	Natural Moisture Content w (%)	Dry Unit Weight γ_d (pcf)	Void ratio (1) e	Deg of Saturation (2) S (%)	Porosity (3) n	Effective Porosity (4) n_e
TOPSOIL/FILL	2.70 *	23.4	98.4	0.712 (5)	88.7 (5)	0.416 (5)	0.047 (5)
LOESS	2.70	20.8	98.3	0.705	90.4	0.411	0.040
FERRELVIEW	2.69	22.6	100.0	0.678	94.3	0.403	0.022
CLAY TILL	2.71	19.2	105.7	0.619	93.2	0.378	0.025
BASAL TILL	2.69	18.9	109.2	0.571	90.6	0.362	0.035
RESIDUUM	2.74	18.8	95.4	0.792 (5)	65.0 (5)	0.442 (5)	0.155 (5)

Formulas for Calculation :

(1) $e = (Gs * \gamma_w / \gamma_d) - 1$

(2) $S = Gs * w/e$

(3) $n = e/(1+e)$

(4) $n_e = (1-S)n$

(5) Overall average values used because of lack of specific data.

* Assumed value.

The overall average natural moisture content values for the site soils were calculated and shown in Tables 3-5 and 3-9. These values typically range from 19 to 23% and do not exhibit large variation with soil types and depths. The overall average natural moisture content for the soils at potential clay Borrow Source No. 1 is 23%.

3.3.5 In Situ Density

The dry density test is used to determine the dry unit weight of a soil. It is the basis for determining overburden stresses and other soil properties useful in settlement calculations. In situ density can also be used as an indicator of past stresses and loadings on the soil, and to determine soil horizons and volume-weight relationships.

The average dry density values for each site soil type are shown in Tables 3-5 and 3-9. The total (moist) unit weight was calculated using the moisture content and the dry unit weight test results for each soil sample tested. The average total unit weight was calculated by averaging each calculated total unit weight. The overall average dry and total unit weights, respectively, are 101 and 123 pounds per cubic foot (pcf) for the topsoil/fill; 98 and 121 pcf for Loess; 100 and 124 pcf for Ferrelview clay; 106 and 128 pcf for Clay Till; 109 and 128 pcf for Basal Till and 95 and 116 pcf for Residuum. The overall average dry unit weight for Borrow Source No. 1 soils is 96 pcf and the average total unit weight is 119 pcf.

3.4 Moisture-Density and Capillary-Moisture Relations

3.4.1 Standard Proctor Compaction

The compaction test develops moisture-density characteristics for a soil that is compacted at a specified energy level. Each soil has unique moisture-density characteristics. The test utilized a standard compaction mold and a hammer to compact the soil. A series of tests at varying moisture contents yields a compaction curve from which the maximum dry density and the optimum moisture content (OMC) can be determined. The minimum density and range of water content to be used in the field can then be specified.

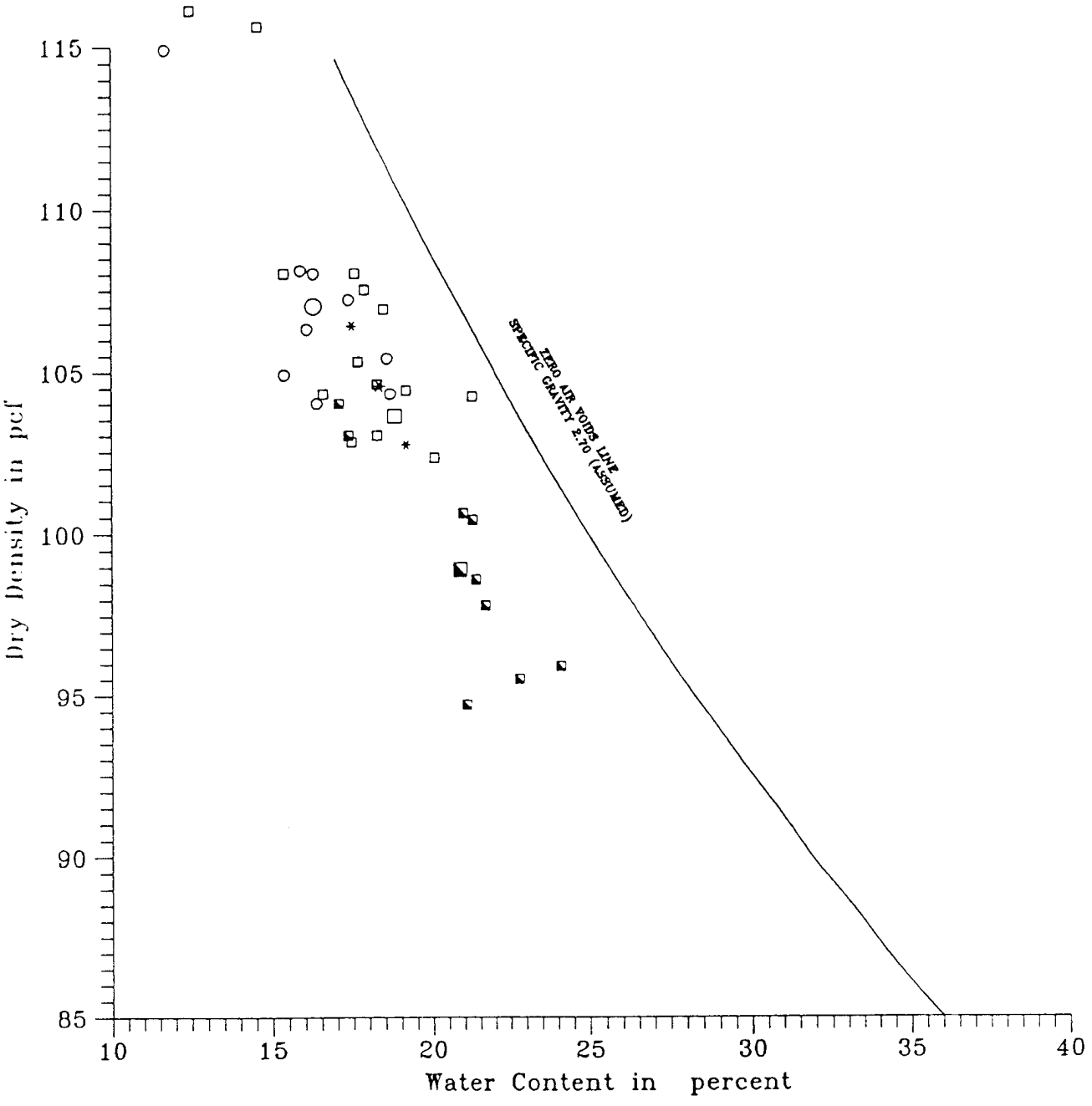
Compaction tests were performed on soils which will potentially require compaction during remedial operations. These include both materials to be relocated and potential backfill or fill materials originated either on-site or off-site. The test results (maximum dry density and OMC) for on-site soil units are plotted in Figures 3-15 and for potential clay Borrow Source No. 1 in Figure 3-16. Average values were also calculated and plotted in the graph. In general, the Loess exhibits the highest compacted dry density. The Ferrelview clay shows a wide range of values, with a maximum dry density from 94 to 116 pcf and OMC from 12 to 25%. The CH material from the MSA generally has a maximum dry density of less than 100 pcf. The average maximum dry density and the average optimum moisture content, respectively, are 105 pcf and 18.5% for the topsoil/fill material; 107 pcf and 16% for Loess; 104 pcf and 19% for Ferrelview clay; and 107 pcf and 18% for Borrow Source No. 1. Basil Till and Residuum materials were not tested due to their greater depth at the site.

3.4.2 Capillary-Moisture Relationships

The capillary-moisture relationship test determines the moisture content retained in the soil subjected to a given soil-water tension. The tensions applied usually range from 1 to 15 atmospheres (bars). The test results are used to estimate the long-term moisture content of the soil, for radon barrier design, and for correlating unsaturated hydraulic conductivities with soil saturation. The moisture content at 15 bar tension, generally defined as the wilting point of the soil, is normally considered as the long term moisture content, according to one of several procedures used to determine the long term moisture content.

This test was performed on selected soil samples of Loess and Ferrelview clay, because these materials will be placed in the disposal cell. Twelve tests were performed on borrow source materials. The sample specimens were remolded (compacted) to 95% of standard Proctor maximum dry density at 3% above optimum moisture content to simulate the anticipated recommended remedial action compaction requirement.

Results are shown in Figures 3-17, 3-18 and 3-19 for Loess, Ferrelview clay and Potential Borrow Source No. 1, respectively. The moisture content at 15 bar averages



* Dike Fill Material
✳ Dike Fill Average Value
○ Loess
◎ Loess Average Value
□ Ferrelview Clay
▣ Ferrelview Clay Average Value
◩ Ferrelview Clay (M.S.A)
◪ M.S.A Average Value

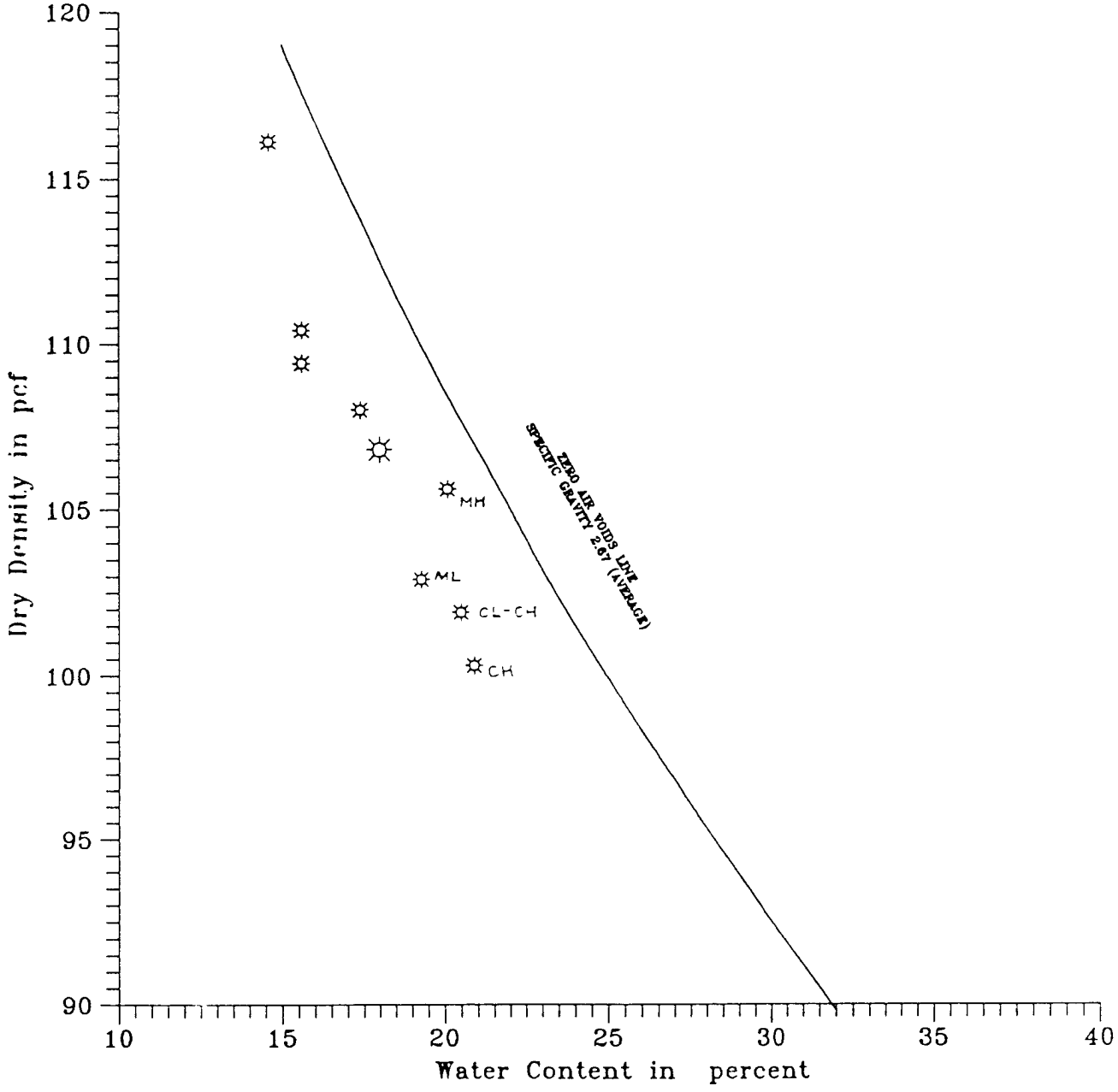
SUMMARY OF COMPACTION TESTS

OVERALL AREA

VARIOUS SOIL UNITS

FIGURE 3-15

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



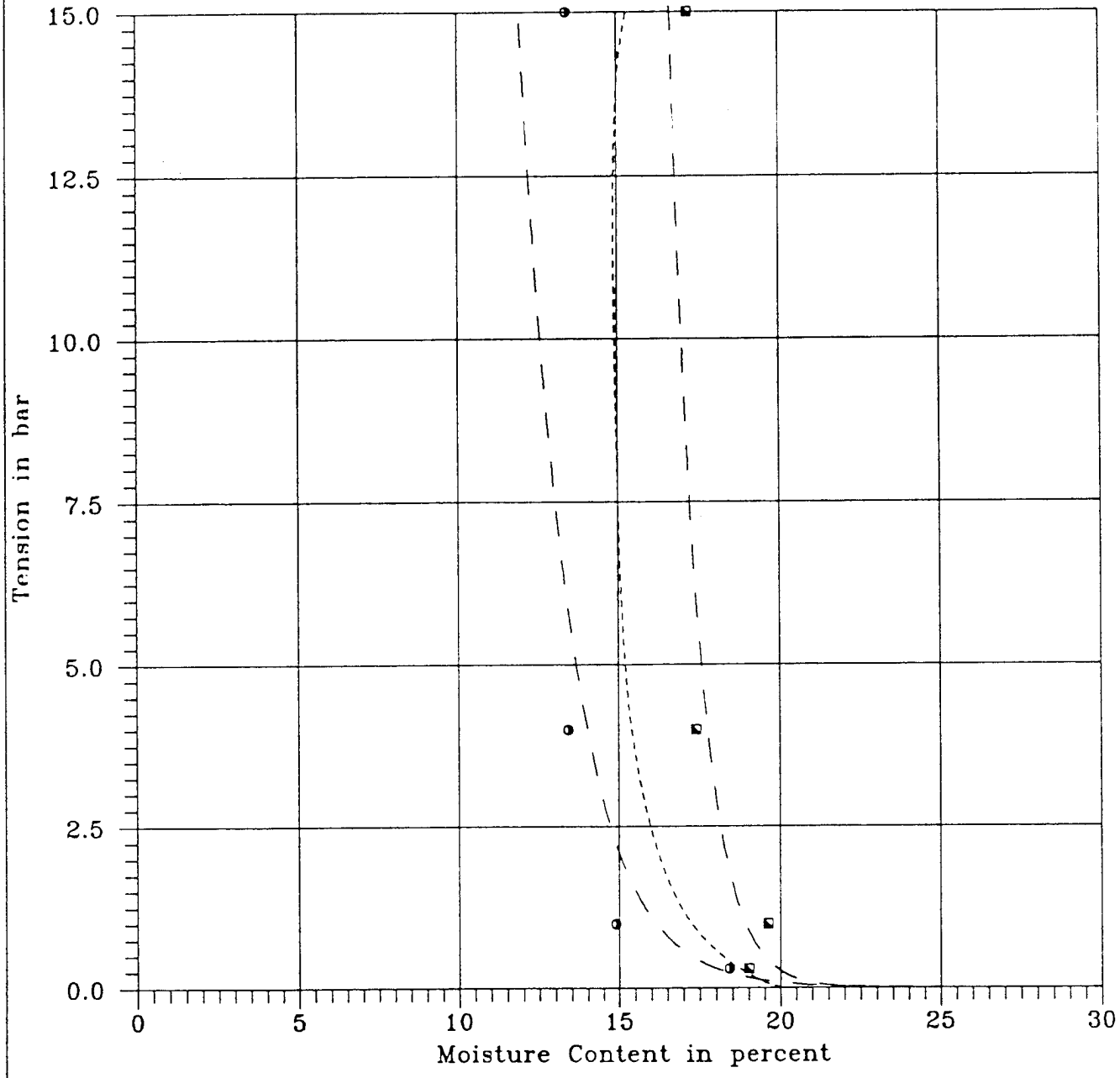
Potential Borrow Source No. 1
Average Value

SUMMARY OF COMPACTION TESTS

POTENTIAL BORROW SOURCE NO. 1

FIGURE 3-16

REPORT NO. MKES-3840R-7005		DRAWING NO.
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991



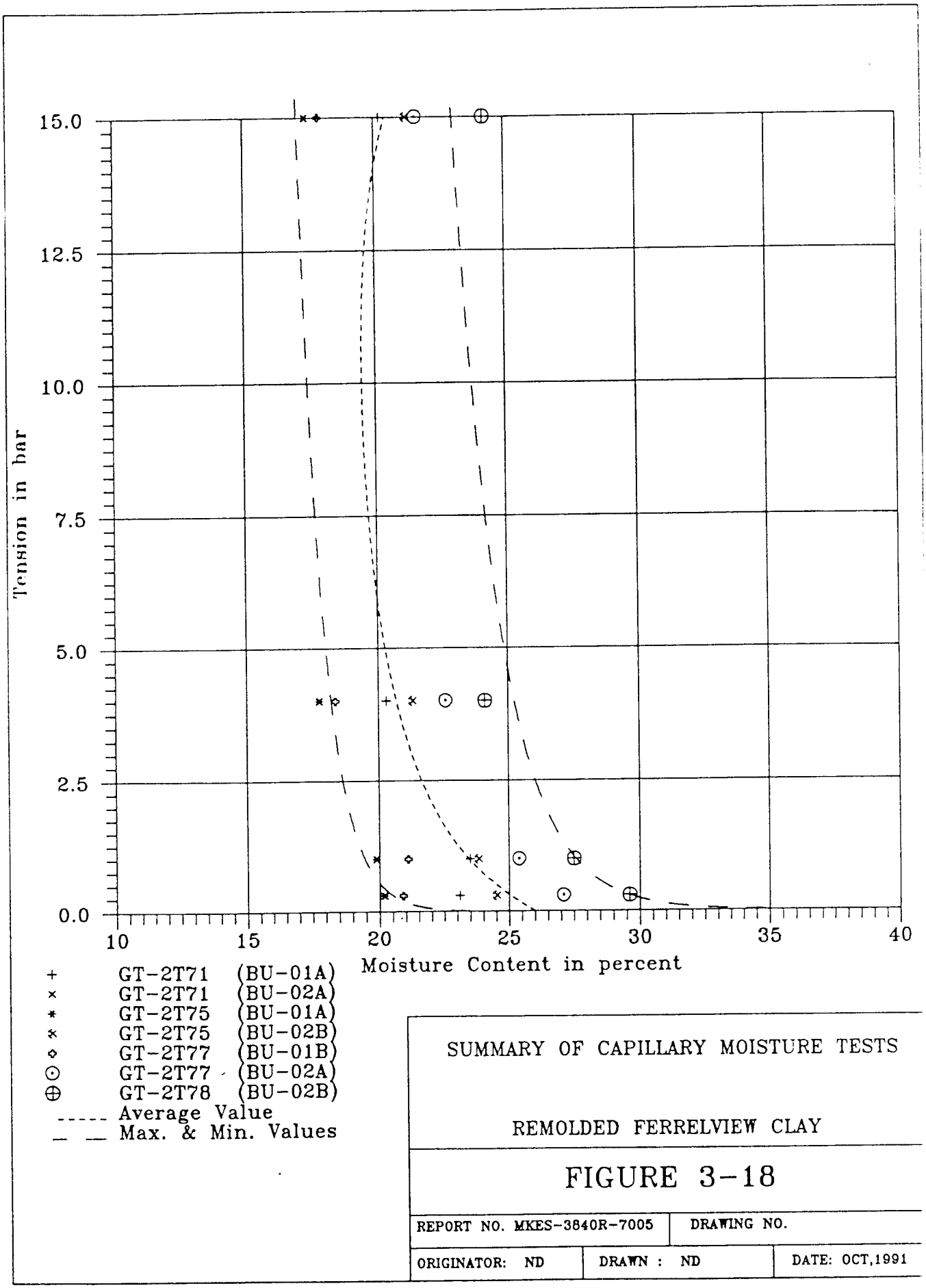
▪ GT-2T74 (BU-01A)
• GT-2T78 (BU-01A)
----- Average Value
_ _ Max. & Min. Values

SUMMARY OF CAPILLARY MOISTURE TESTS

REMOLDED LOESS

FIGURE 3-17

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991

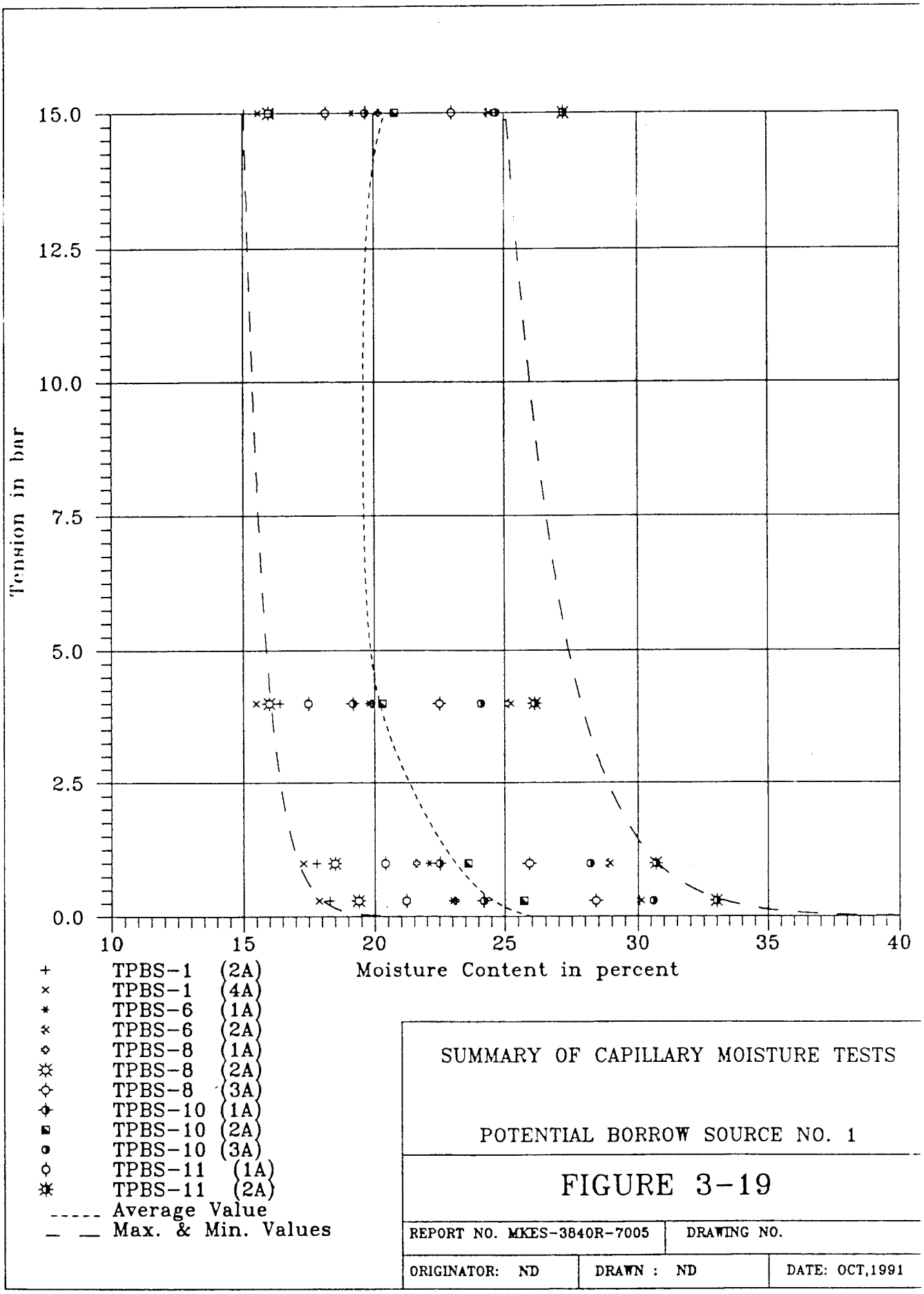


SUMMARY OF CAPILLARY MOISTURE TESTS

REMOLDED FERRELVIEW CLAY

FIGURE 3-18

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991



SUMMARY OF CAPILLARY MOISTURE TESTS

POTENTIAL BORROW SOURCE NO. 1

FIGURE 3-19

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991

about 16% for Loess and 20% for Ferrelview clay. These values are very close to the average optimum molding moisture content values (see Section 3.4.1) determined from standard Proctor compaction tests. The range of 15-bar values for Borrow Source No. 1 material is from 16 to 27%, which is about 0 to 7% above the range of optimum moisture content obtained from the Standard Proctor testing.

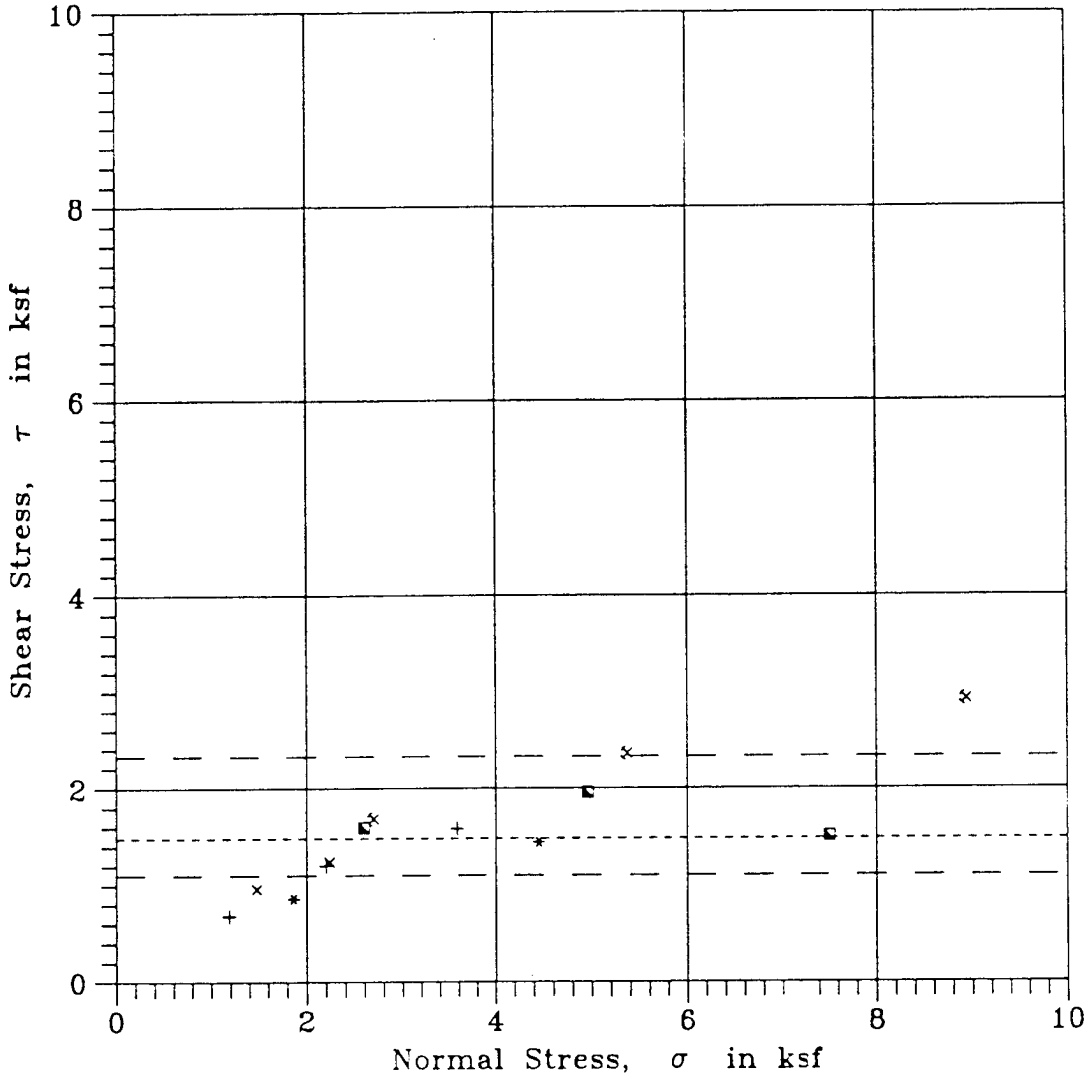
3.5 Strength and Deformation

3.5.1 Unconsolidated - Undrained (UU) Triaxial Compression

The UU triaxial compression or Q test determines the total shear strength parameters and stress/strain characteristics of a soil. The test simulates short-term or end-of-construction conditions by not allowing excess pore pressures resulting from confining and axial stresses to dissipate. A series of samples of a soil are tested at different confining pressures to develop the parameters and characteristics.

UU tests were performed on undisturbed samples of on-site soils to determine the total shear strength parameters for soil units which have to bear the load of the disposal and other facilities. Some UU tests were also performed on compacted samples of potential borrow source materials to determine their remodeled strength characteristics. UU tests were also performed on remolded samples of on-site materials to evaluate their effectiveness as potential borrow materials. The peak deviation stress $(\sigma_1 - \sigma_3)_{max}$ was taken as the failure criterion. Most samples were saturated when tested. Unsaturated test specimens are noted as such in the appropriate figures. For saturated cohesive soils, the cohesion is equal to the undrained shear strength, Su, which is the radius of the Mohr's Circle, $(\sigma_1 - \sigma_3)/2$. Su values from unsaturated test specimen will usually be higher than those from saturated conditions and therefore, in most analytical cases, only interpretation of strength from saturated condition is used.

Results of the undrained shear strength of undisturbed samples of in-situ soils at the site are shown in Figure 3-20 through 3-23. Average undrained shear strength (Su) values for saturated condition for Loess range from 1100 psf to 2330 psf with an arithmetic mean of 1490 psf. Ferrelview clay Su values range from 870 psf to 1460 psf with a mean value of 1180 psf. Su values for Clay Till have a minimum value of 860 psf and a maximum of 1660 psf with an average value of 1260 psf. The high Su values from unsaturated samples were omitted from averaging because it would be



LEGEND :

+	GT-37	(ST-03)
×	GT-38	(ST-03)
*	GT-50	(ST-02)
⊠	GT-56	(ST-02)
◘	GT-57	(ST-03)
— —	Max. & Min Values	
-----	Average Values	

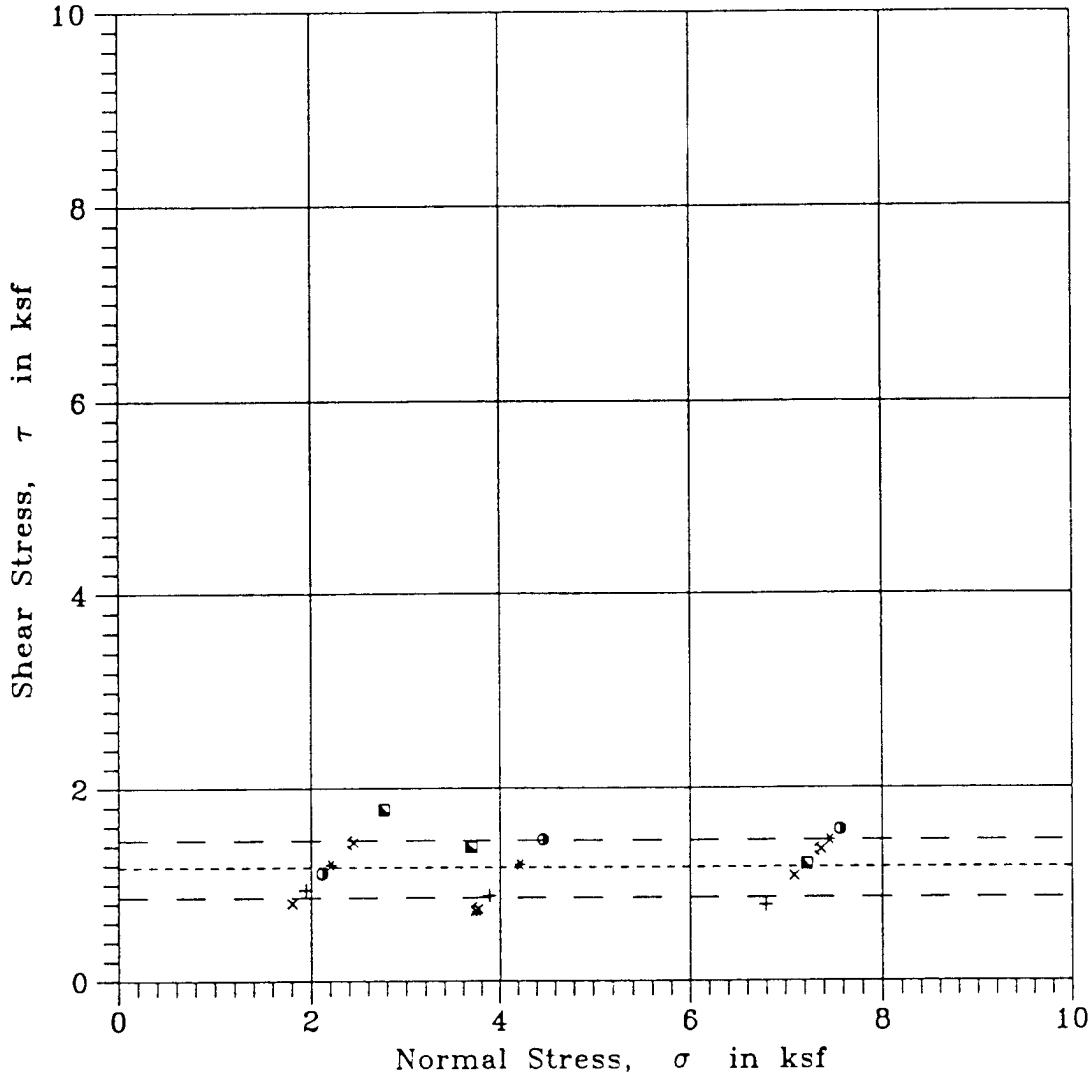
SUMMARY OF STRENGTH ENVELOPES

UU TRIAXIAL TEST, UNDISTURBED SAMPLE

LOESS

FIGURE 3-20

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



LEGEND :

+	GT-48	(ST-03)
×	GT-48	(ST-07)
*	GT-51	(ST-03)
⊠	GT-52	(ST-04)
◙	GT-55	(ST-06)
◍	GT-55	(ST-08)
-----	Average Value	
— —	Max. & Min. values	

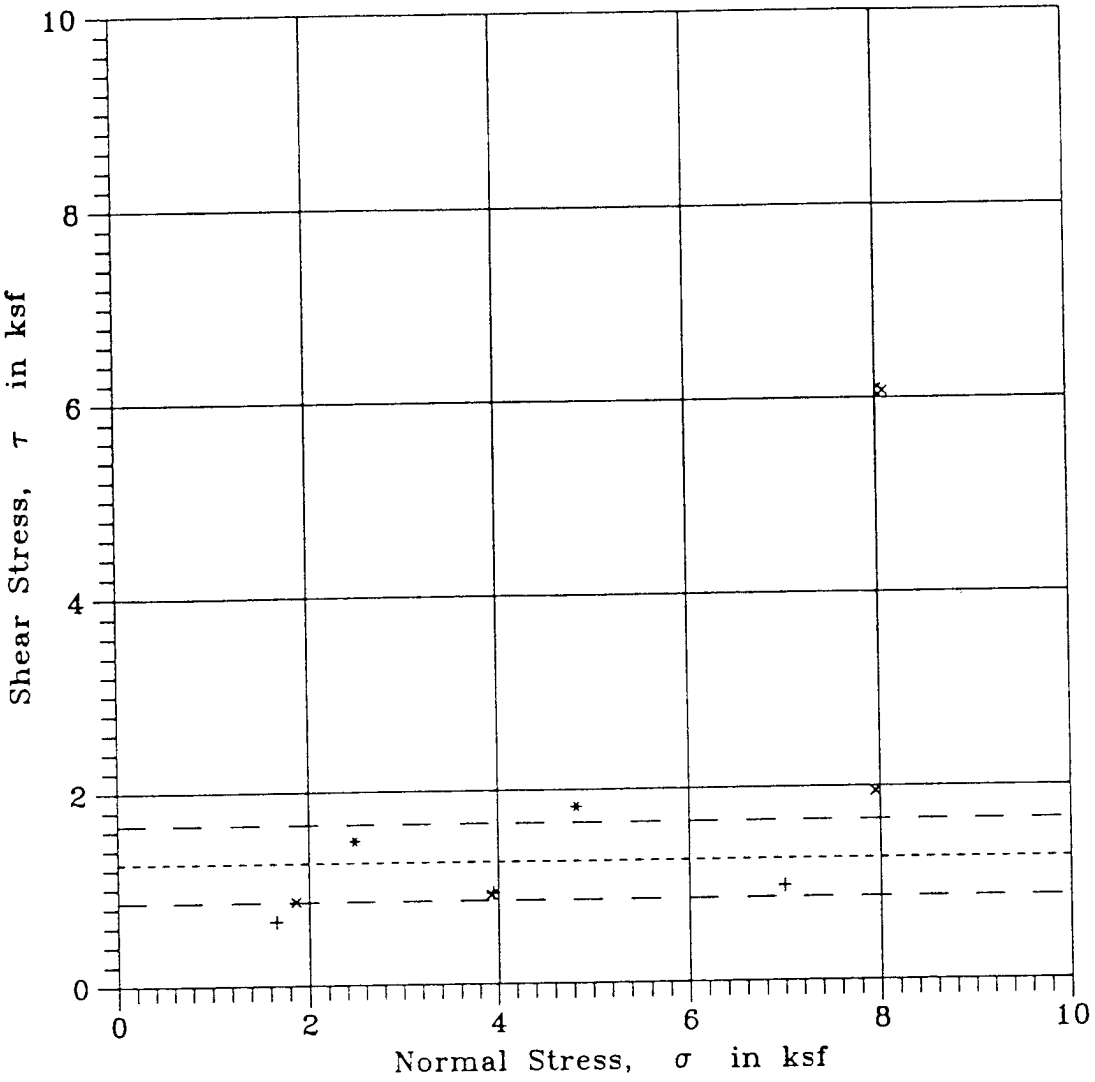
SUMMARY OF STRENGTH ENVELOPES

UU TRIAXIAL TEST, UNDISTURBED SAMPLE

FERRELVIEW CLAY

FIGURE 3-21

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



LEGEND :

+	GT-43	(ST-10)
×	GT-50	(ST-06)
*	GT-56	(ST-08)
※	GT-69	(6906) (1)
-----	Average Values	
— —	Max. & Min. values	

(1) Unsaturated sample. Values not included in averaging.

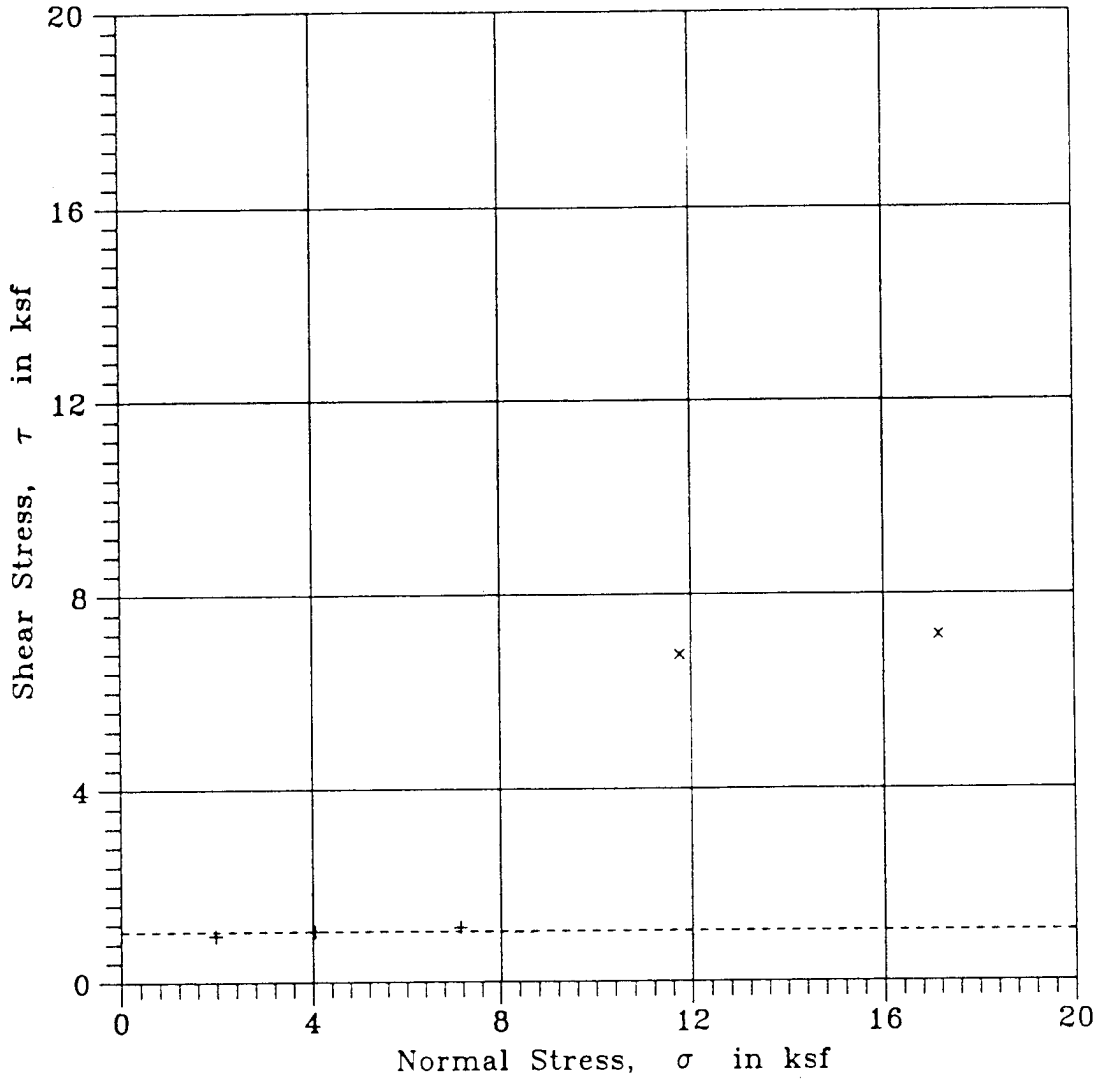
SUMMARY OF STRENGTH ENVELOPES

UU TRIAXIAL TEST, UNDISTURBED SAMPLE

CLAY TILL

FIGURE 3-22

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



LEGEND :

\+ GT-52 (ST-14)(1)

× GT-69 (6908)

----- Average Value

(1)Unsaturated sample values not included in averaging.

SUMMARY OF STRENGTH ENVELOPES

UU TRIAXIAL TEST, UNDISTURBED SAMPLE

BASAL TILL

FIGURE 3-23

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

unconservative if used. Thus the only valid Su result obtained for Basal Till was 1060 psf.

A UU test was performed on one remolded Loess sample at unsaturated condition (Figure 3-30). The average Su was 5060 psf. Since this value is for unsaturated condition, it was not used. The Su values for remolded Ferrelview clay range from 2020 psf to 2320 psf with an average value of 2220 psf (Figure 3-31).

For potential Borrow Source No. 1 material, the Su values for remolded samples ranged from 2300 psf to 3260 psf with an average value of 2720 psf (Figure 3-34).

All remolded samples were compacted to 95% maximum dry density at about 3% above optimum moisture content, as determined from the standard proctor compaction test.

3.5.2 Consolidated - Undrained (CU) Triaxial Compression

The CU triaxial compression or R test determines total and effective shear strength parameters and stress/strain characteristics of a soil. The test simulates undrained loading under long-term conditions by allowing consolidation of the soil sample before uniaxial loading is applied. A series of samples of a soil are tested at different consolidation/confining pressures to develop the parameters and characteristics.

CU tests were performed on undisturbed and remolded samples of Loess and Ferrelview clay materials. Some CU tests were also performed on potential Borrow Source No. 1 materials. All samples were tested under saturated or close to saturated condition unless otherwise noted. Remolded samples were compacted to 95% of maximum dry density at about 3% above the optimum moisture content as determined from the Standard Proctor compaction tests.

The failure criterion was defined as the loading conditiona at maximum ratio of the effective stresses, i.e. $(\sigma_1'/\sigma_3')_{max}$. To determine the values of the total and effective shear strength parameters, plots on p-q diagram consisting of variables q vs p at failure were generated from test results for each specimen; where p is the average of the principal stresses, σ_1 and σ_3, and q is one-half the difference of the principal stresses, i.e., $(\sigma_1 - \sigma_3)/2$.

The best fit line was plotted for each test sample (generally 3 specimens) to determine the variables a and α. The a is the q-intercept of the best fit line on the p-q diagram and α is the angle it makes with the horizontal. For effective parameters, a' and α' were obtained from p-q plots of effective stress test results. The shear

strength parameters of cohesion, c, and angle of internal friction, ϕ, and c' and ϕ' (for effective) were obtained using the following equations:

1. $\phi = \sin^{-1}\tan\alpha$
2. $c = a/\cos\phi$
3. $\phi' = \sin^{-1}\tan\alpha'$
4. $c' = a'/\cos\phi'$

The p-q plots, commonly called the K_f-lines, are shown on Figures 3–24 through 3–29 for undisturbed on site soils and Figures 3–32 and 3–33 for remolded on site soils. Remolded Borrow Source No. 1 material is shown in Figure 3-35. The plots were drawn by plotting all p-q values of one particular geologic unit on one figure and also plotting a K_f-line of average values for that unit as a dashed line. The maximum and minimum K_f-lines are also shown, when applicable.

Among the undisturbed samples, Topsoil had an average c value of 560 psf and ϕ of 17.5°, and an average c' value of 535 psf and ϕ' of 24°. The corresponding c, ϕ and c', ϕ' values for Loess were 440 psf, 25° and 280 psf, 35.5°. Ferrelview clay had c = 502 psf, ϕ = 12.4°, c' = 440 psf and ϕ' = 18°. Clay till had c = 360 psf, ϕ = 21°, c' = 407 psf and ϕ' = 28°. The Basil Till had c = 920 psf, ϕ = 20°, c' = 823 psf and ϕ' = 29°. Only one test was performed on Residuum material, mainly to serve as a check on its strength parameters. It had a c of 205 psf, ϕ of 13°, c' of 260 psf, and ϕ' of 29°.

The single test performed on remolded Loess gave a c value of 820 psf, ϕ of 13°, c' of 290 psf and ϕ' of 29°. The corresponding values for remolded Ferrelview clay were 323 psf, 13.5°, 90 psf and 19°.

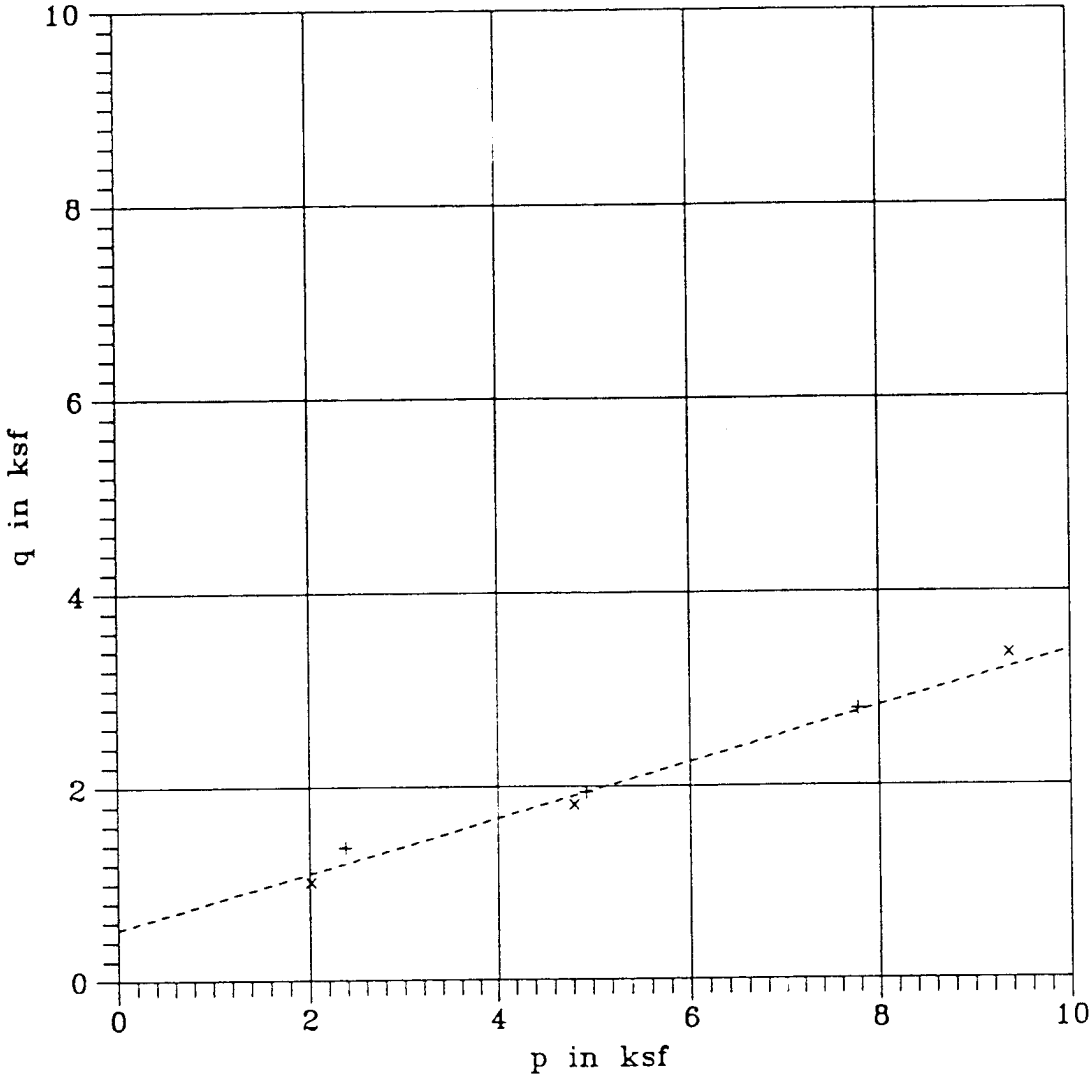
The shear strength parameters for the potential borrow source materials were c = 544 psf, ϕ = 15°, c' = 466 psf and ϕ' = 22°.

3.5.3 California Bearing Ratio

The California Bearing Ratio (CBR) is generally used to design pavements for roads or areas with traffic loads.

Laboratory CBR tests were performed on test pit samples from the Material Staging Area. The tests were one-specimen tests, soaked, using a 6-inch mold and a

Summary of average values :
a = 534.1 psf, α= 16.7 °
c = 560.0 psf, Φ= 17.5 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
+ GT-74 (7402)
× GT-54 (ST-03)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

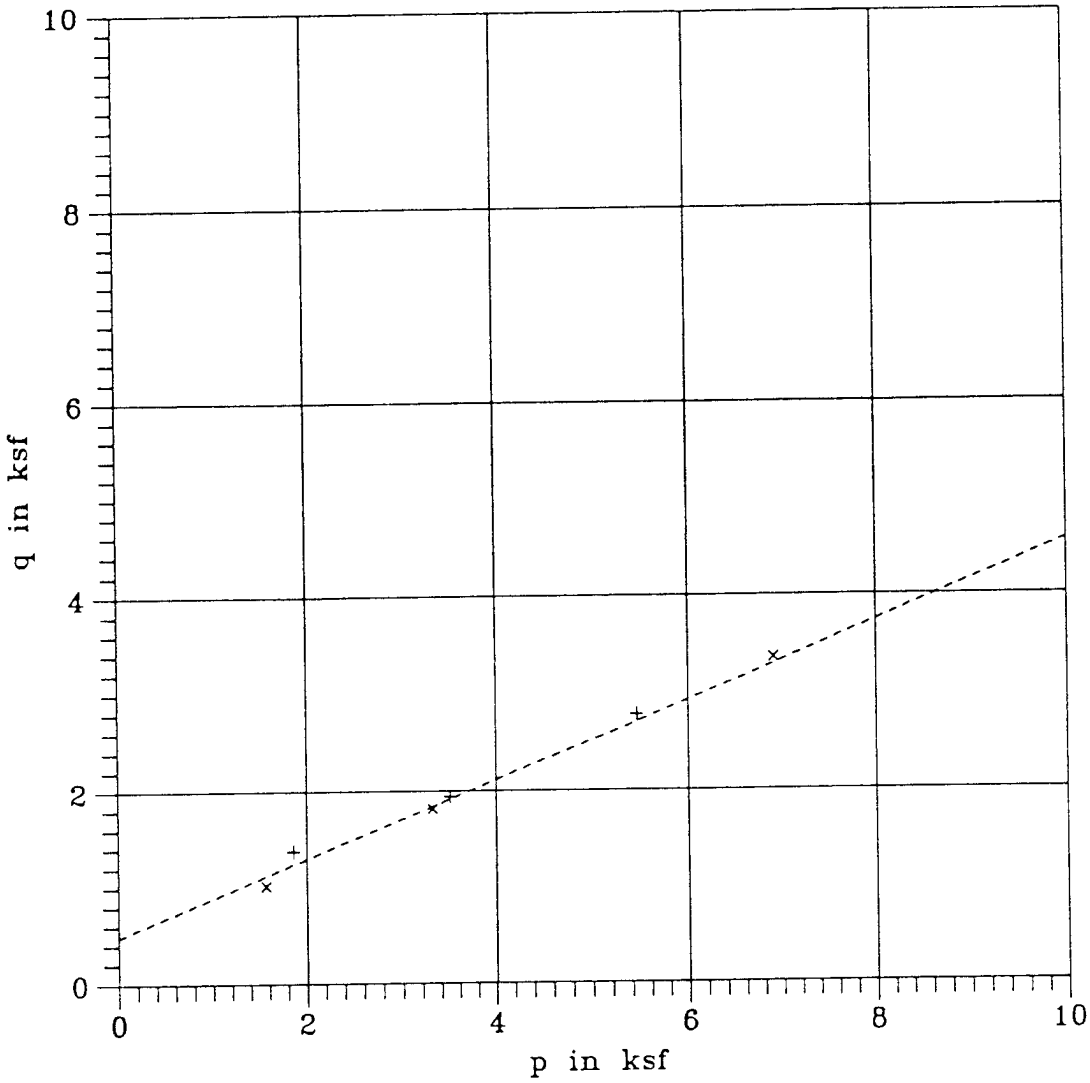
CU TRIAXIAL, UNDISTURBED SAMPLE

TOPSOIL/FILL

FIGURE 3-24 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 488.7 psf, α= 22.1 °
c = 535.0 psf, Φ= 24.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
+ GT-74 (7402)
× GT-54 (ST-03)
----- Average Envelope

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

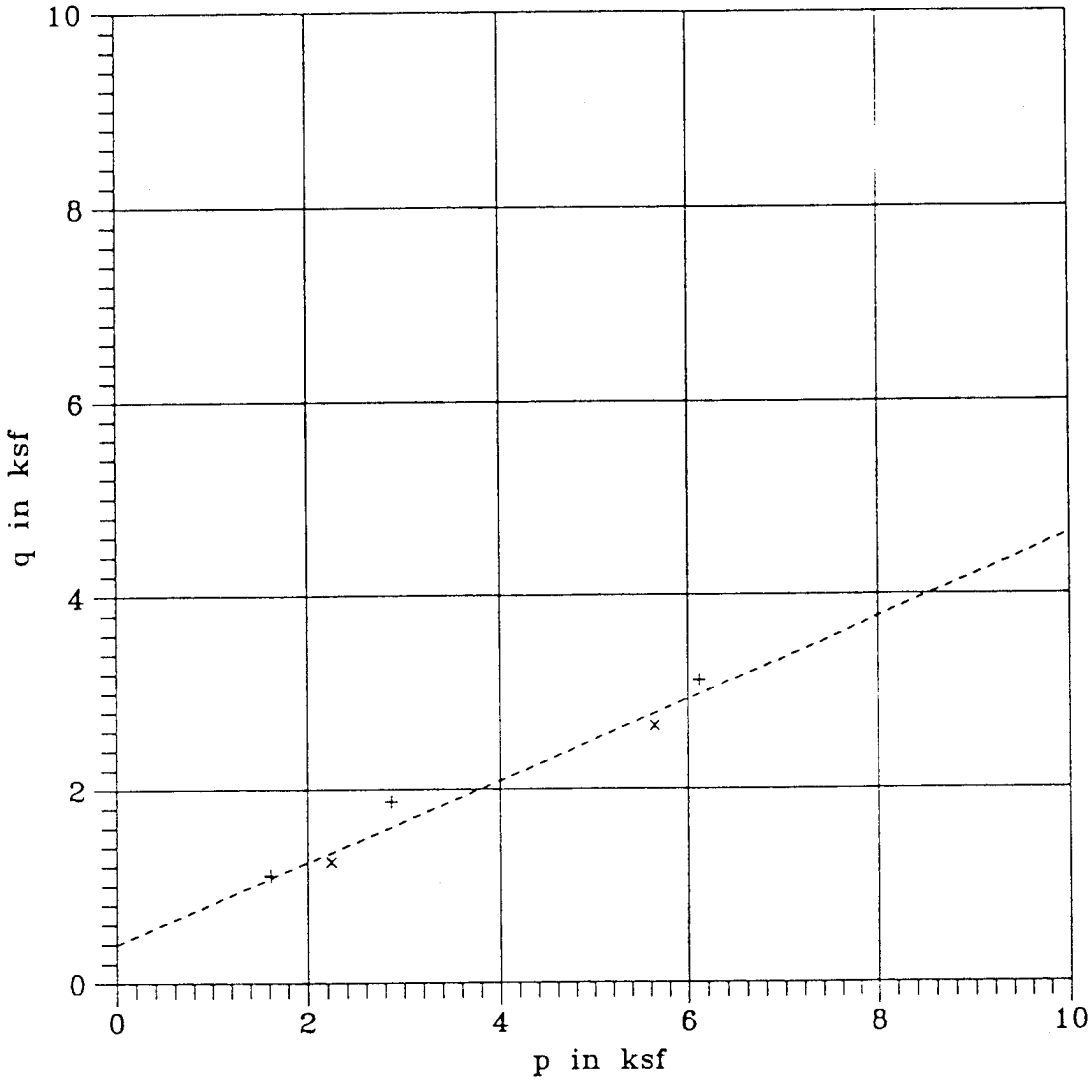
CU TRIAXIAL, UNDISTURBED SAMPLE

TOPSOIL/FILL

FIGURE 3-24 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 398.8 psf, α= 22.9 °
c = 440.0 psf, Φ= 25.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
+ GT-32 (ST-01)
× GT-56 (ST-02)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

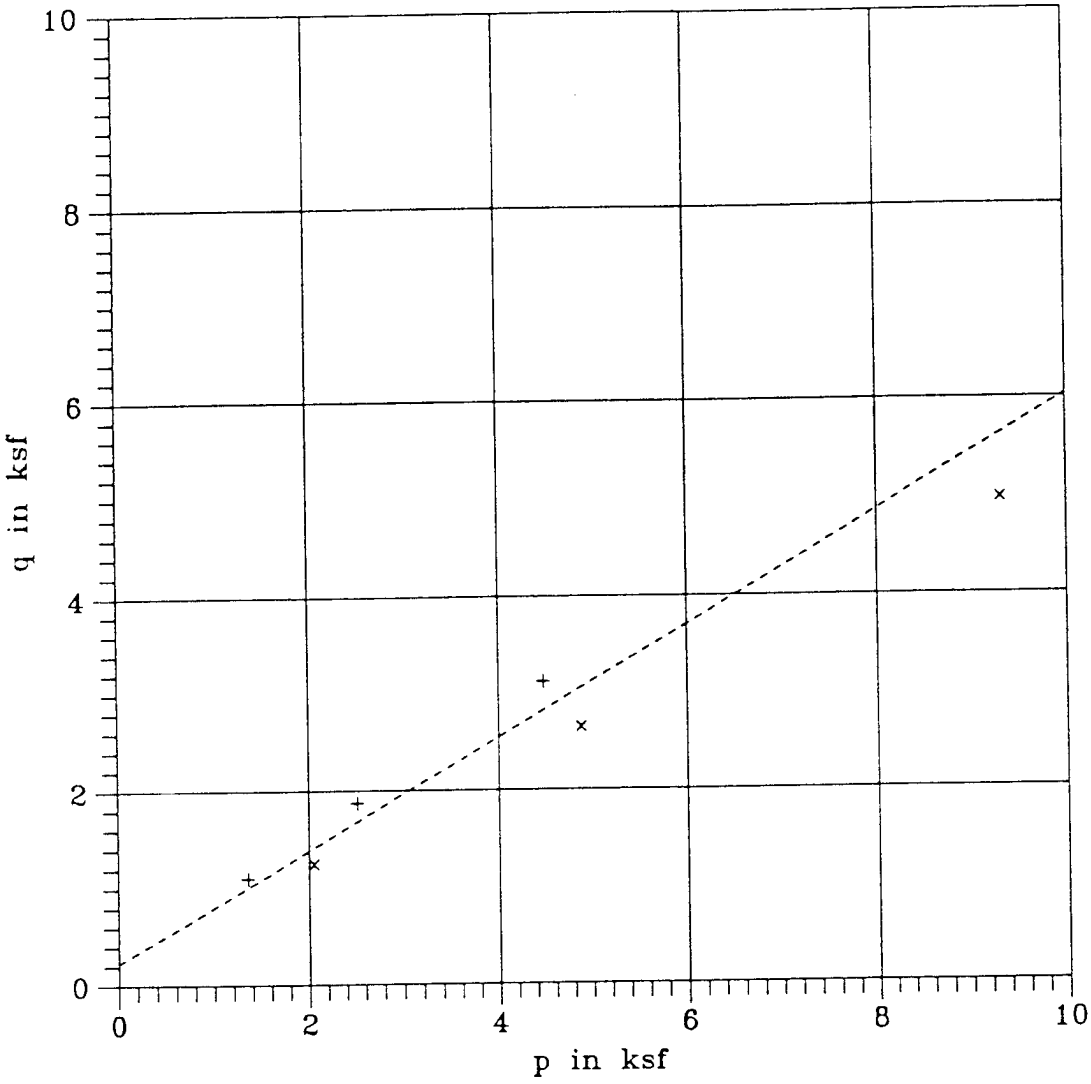
CU TRIAXIAL, UNDISTURBED SAMPLE

LOESS

FIGURE 3-25 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 228.0 psf, α= 30.1 °
c = 280.0 psf, Φ= 35.5 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
\+ GT-32 (ST-01)
× GT-56 (ST-02)
----- Average Envelope

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

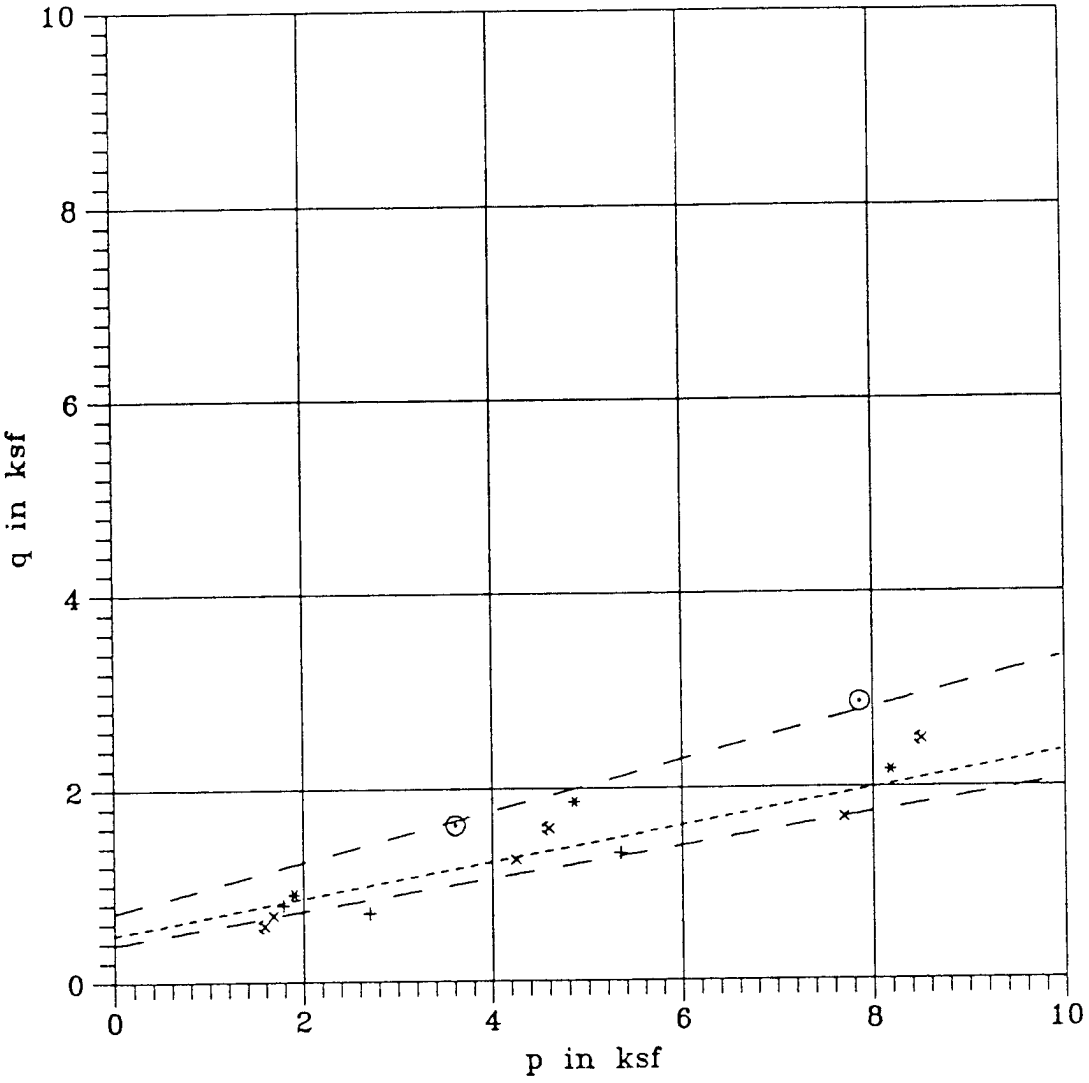
CU TRIAXIAL, UNDISTURBED SAMPLE

LOESS

FIGURE 3-25 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 490.3 psf, α= 12.1 °
c = 502.0 psf, Φ= 12.4 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

+	GT-32 (ST-02)
×	GT-43 (ST-04)
*	GT-48 (ST-05)
⁂	GT-52 (ST-06)
⊙	GT-70 (7004)
-----	Average Envelope
_ _	Max. & Min. Envelopes

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

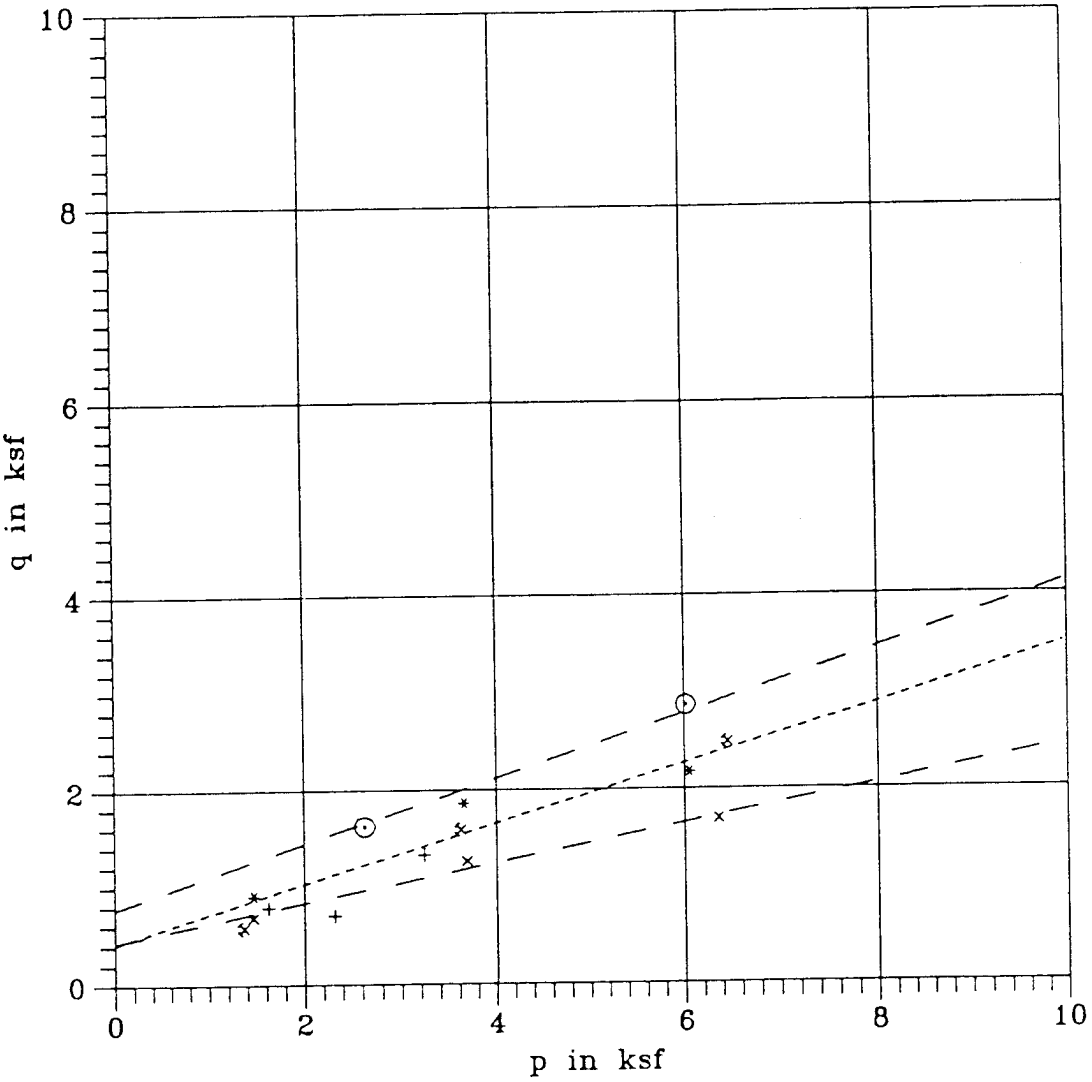
CU TRIAXIAL, UNDISTURBED SAMPLE

FERRELVIEW CLAY

FIGURE 3-26 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 418.5 psf, α= 17.2 °
c = 440.0 psf, Φ= 18.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

+ GT-32 (ST-02)
× GT-43 (ST-04)
* GT-48 (ST-05)
⁎ GT-52 (ST-06)
⊙ GT-70 (7004)
----- Average Envelope
_ _ Max. & Min. Envelopes

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

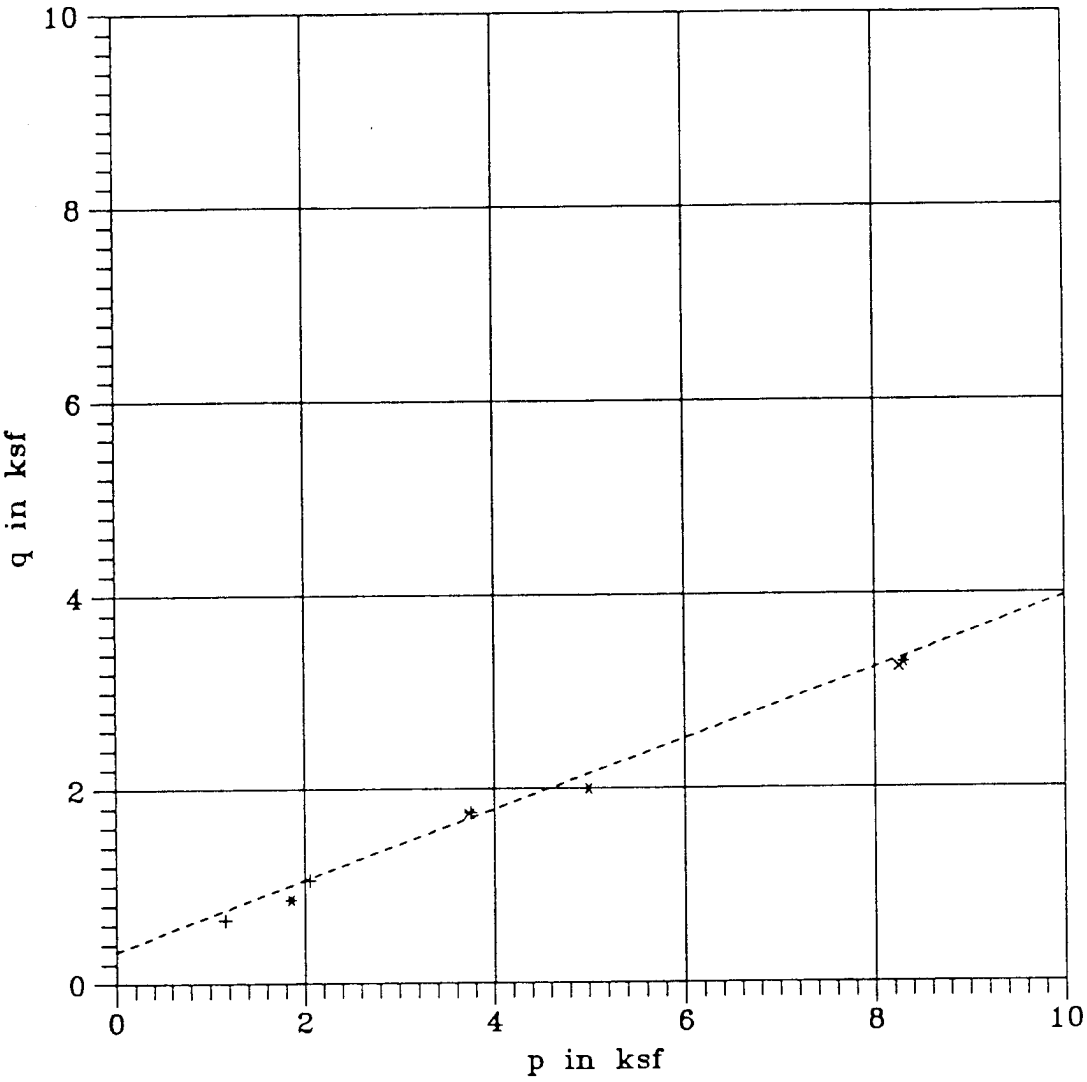
CU TRIAXIAL, UNDISTURBED SAMPLE

FERRELVIEW CLAY

FIGURE 3-26 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 335.3 psf, α= 20.0 °
c = 360.0 psf, Φ= 21.3 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

\+ GT-44 (ST-03)
× GT-71 (7108)
* GT-74 (7406)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

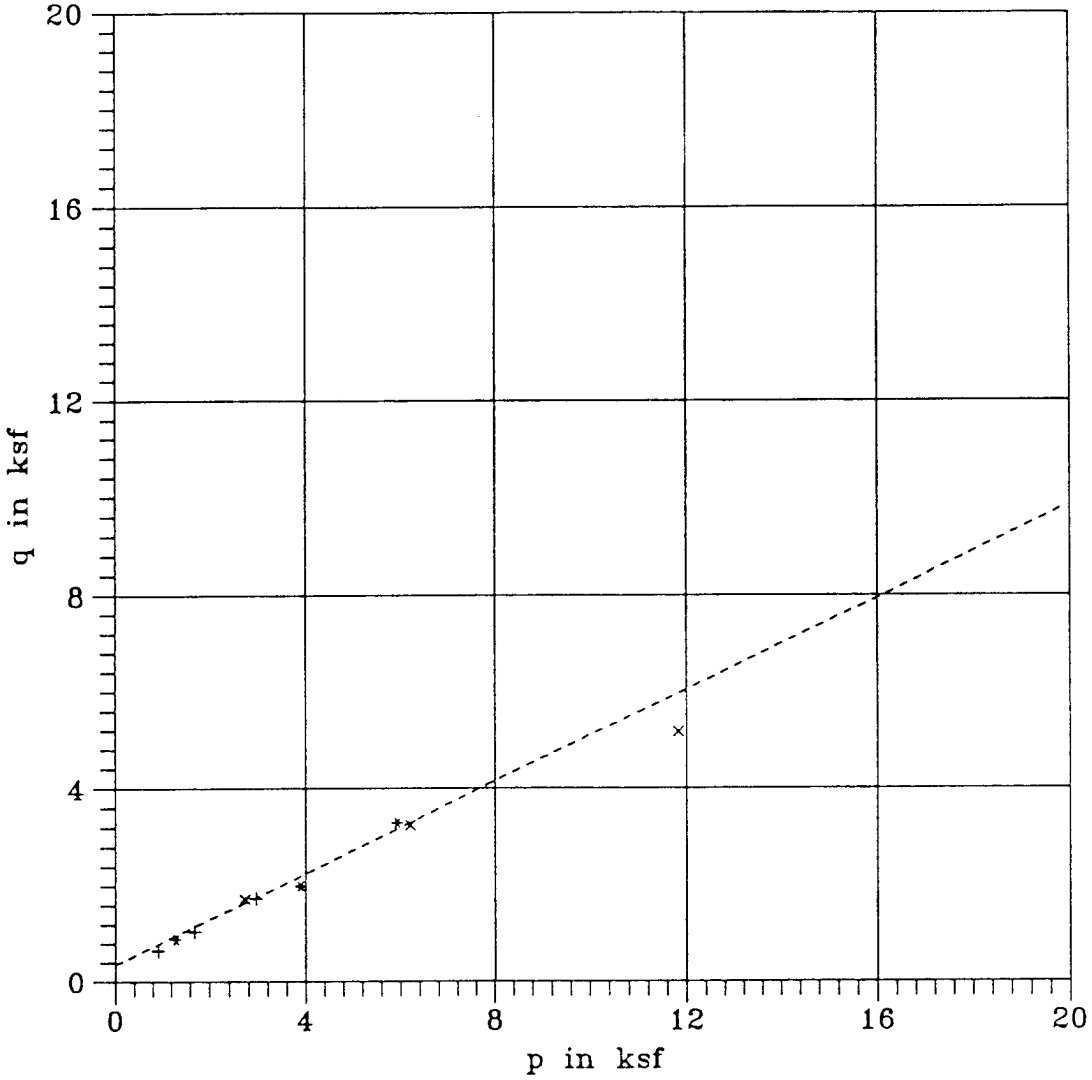
CU TRIAXIAL, UNDISTURBED TEST

CLAY TILL

FIGURE 3-27 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 406.7 psf, α= 28.3 °
c = 358.0 psf, Φ= 25.4 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

\+ GT-44 (ST-03)
× GT-71 (7108)
* GT-74 (7406)
----- Average Envelope

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

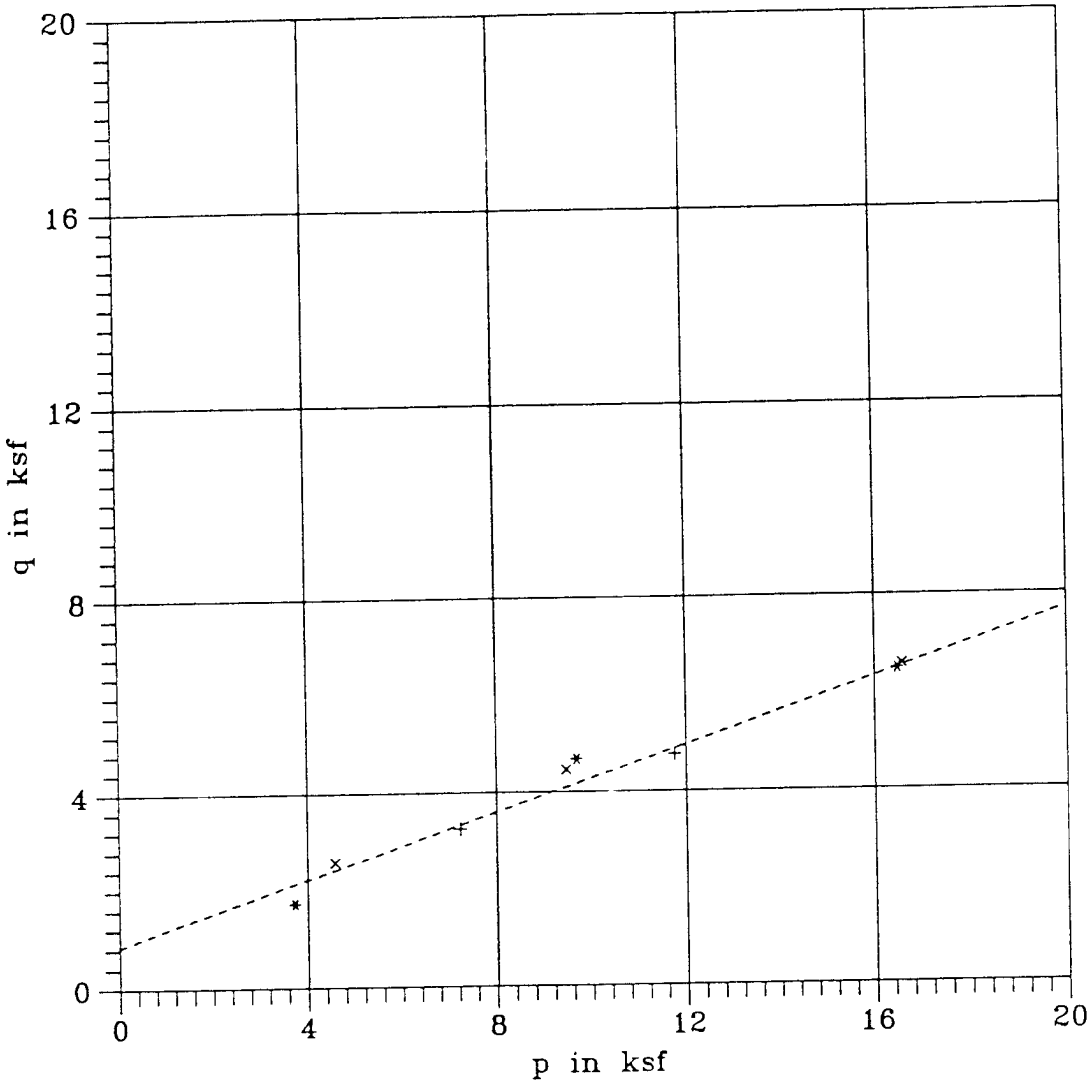
CU TRIAXIAL, UNDISTURBED TEST

CLAY TILL

FIGURE 3-27 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 864.5 psf, α= 18.9 °
c = 920.0 psf, Φ= 20.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
\+ GT-60P (SB-15)
× GT-69 (6908)
* GT-71 (7110)

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

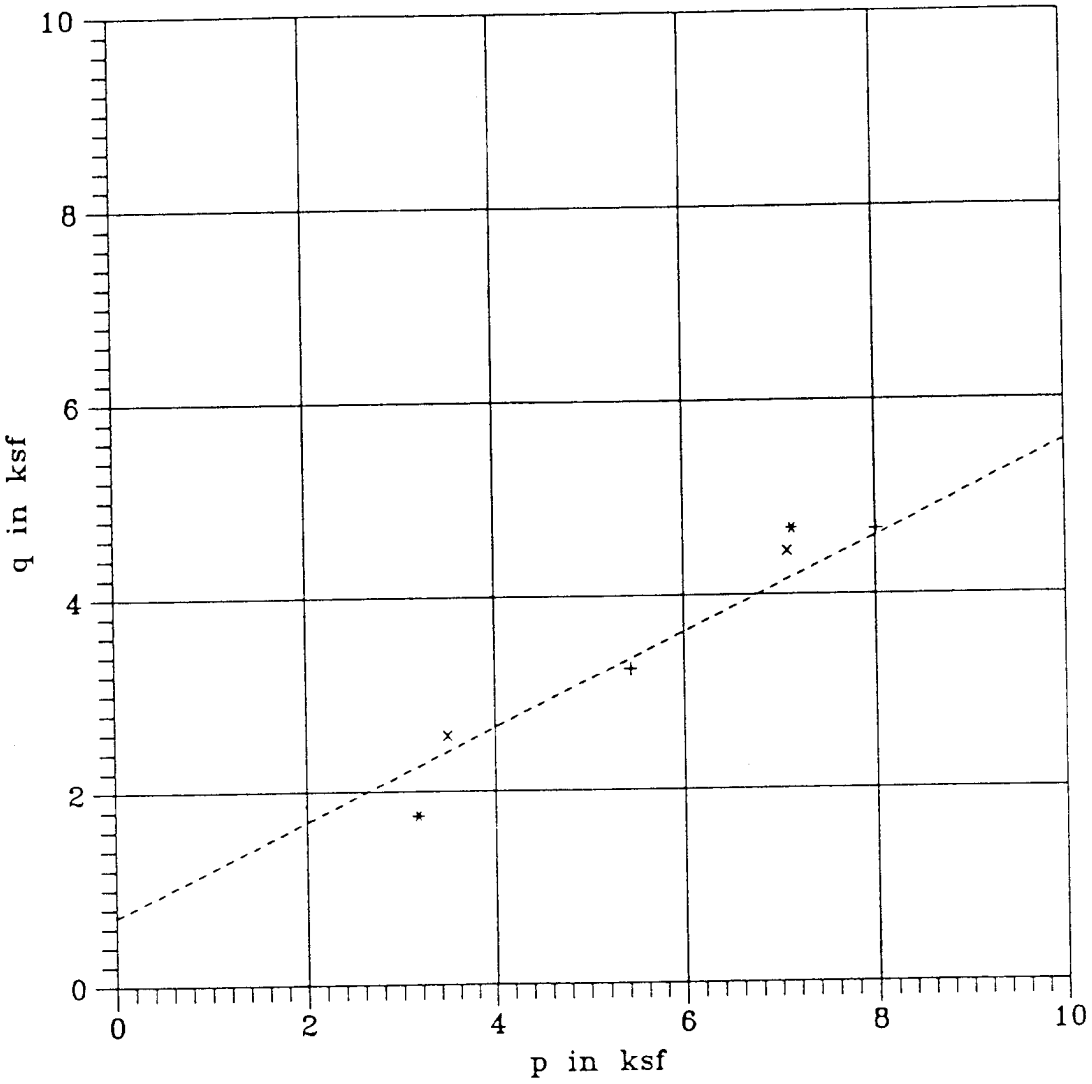
CU TRIAXIAL, UNDISTURBED TEST

BASAL TILL

FIGURE 3-28 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 720.1 psf, α= 25.9 °
c = 823.3 psf, Φ= 29.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
+ GT-60P (SB-15)
× GT-69 (6908)
* GT-71 (7110)

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

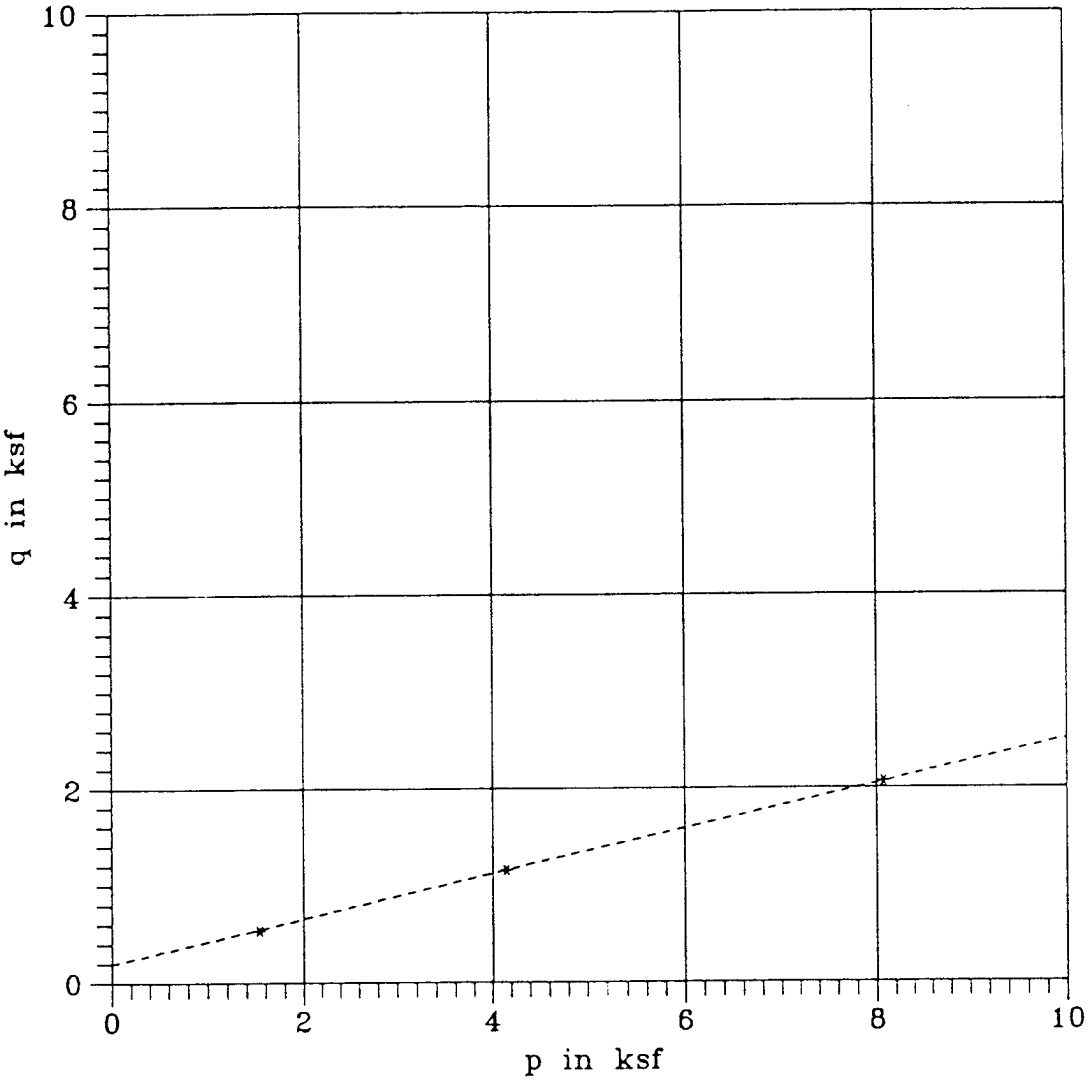
CU TRIAXIAL, UNDISTURBED TEST

BASAL TILL

FIGURE 3-28 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE :

Summary of average values :
a = 200.0 psf, α= 13.0 °
c = 205.0 psf, Φ= 13.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

* GT-55 (SB-12)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

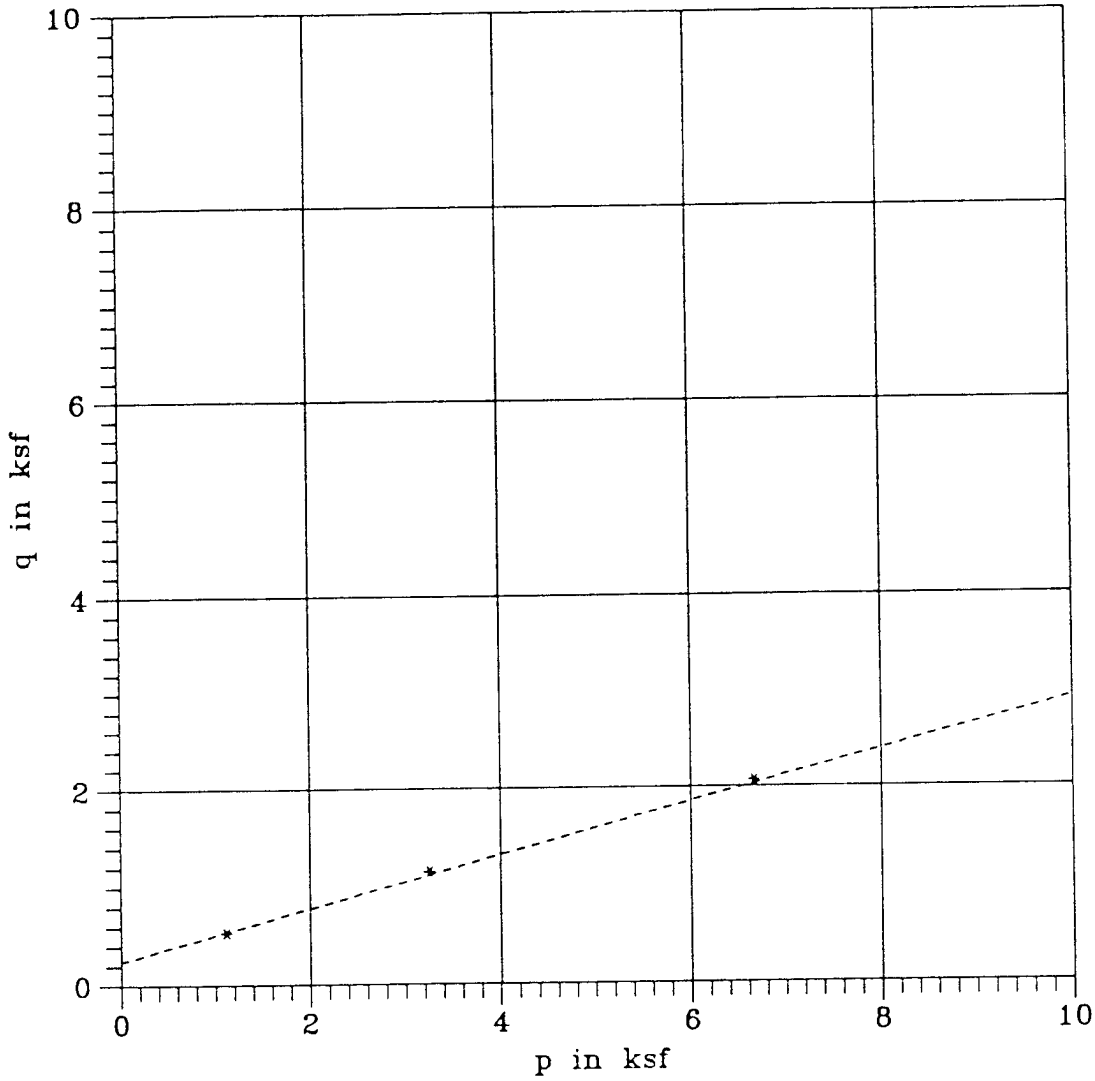
CU TRIAXIAL, UNDISTURBED SAMPLE

RESIDUUM

FIGURE 3-29 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 250.0 psf, α= 15.0 °
c = 260.0 psf, Φ= 16.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

* GT-55 (SB-12)
----- Average Envelope

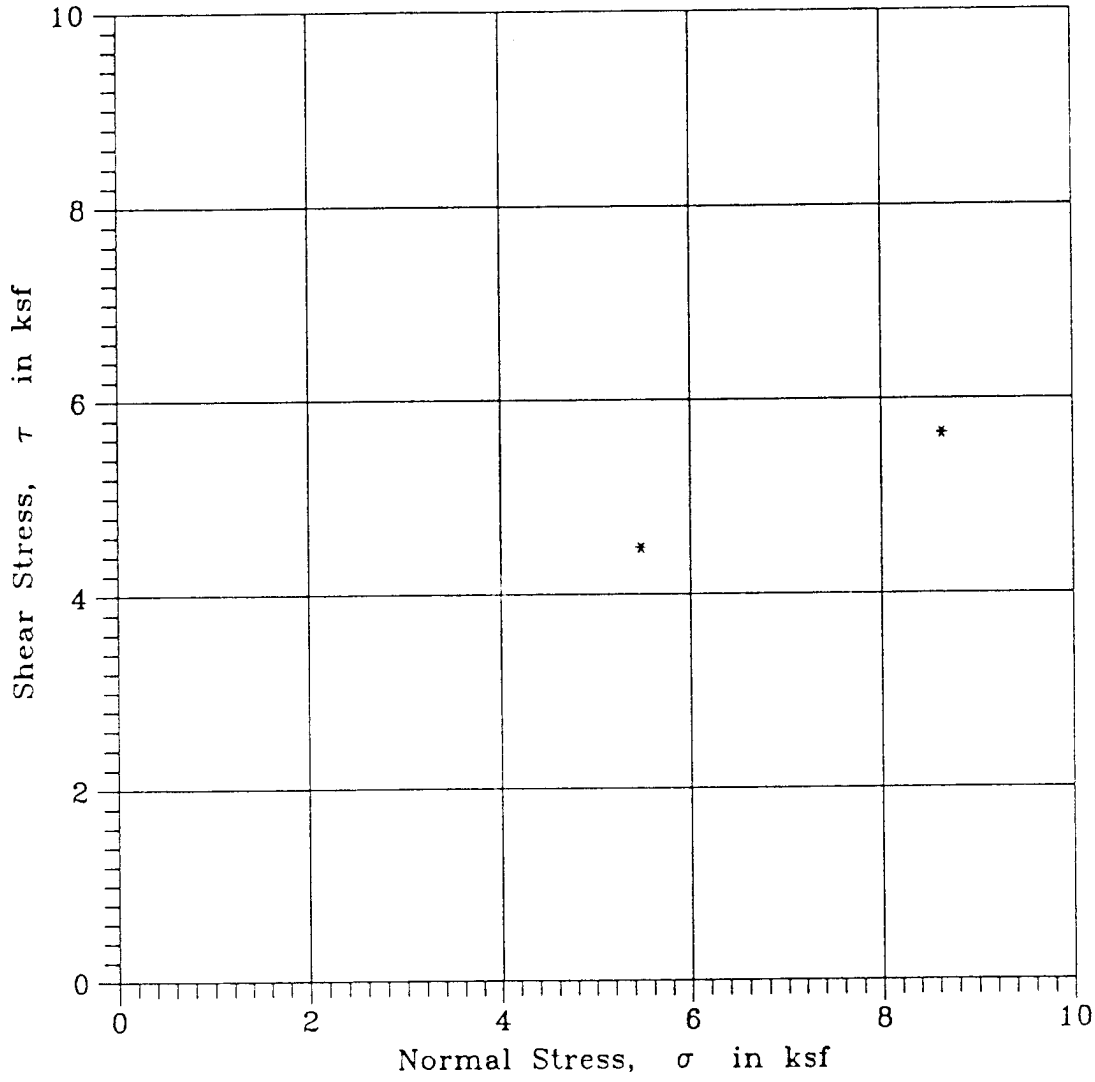
SUMMARY OF EFFECTIVE STRENGTH ENVELOPE FROM p-q DIAGRAM

CU TRIAXIAL, UNDISTURBED SAMPLE

RESIDUUM

FIGURE 3-29 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



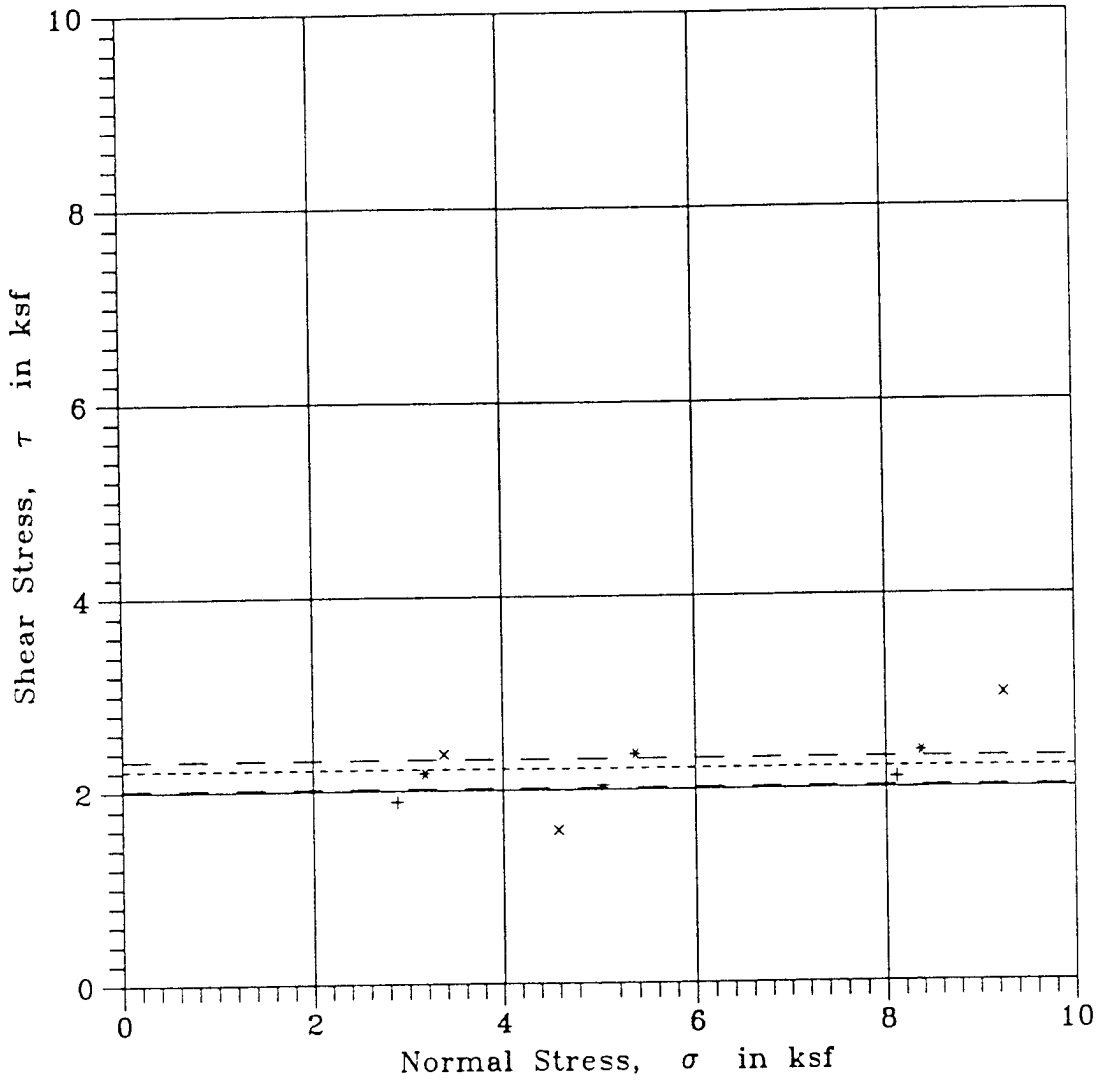
LEGEND :

* GT-2T78 (BU-01A)

SUMMARY OF STRENGTH ENVELOPES
UU TRIAXIAL TEST, REMOLDED SAMPLE
LOESS

FIGURE 3-30

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



LEGEND :

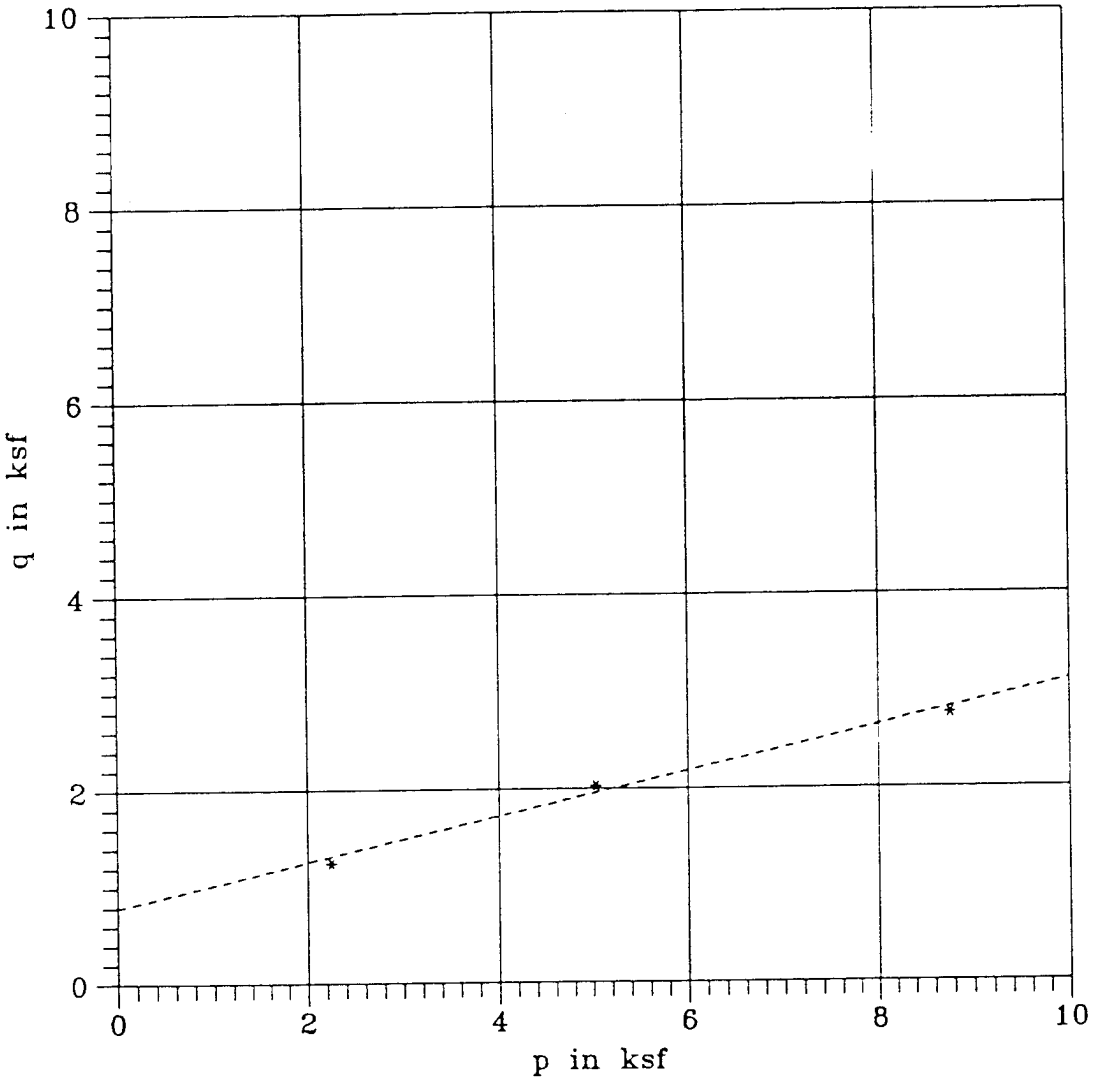
+ GT-2T71 (BU-02A)
× GT-2T75 (BU-01A)
* GT-2T78 (BU-02B)
----- Average Envelope
— — Max. & Min. Envelopes

SUMMARY OF STRENGTH ENVELOPES
UU TRIAXIAL TEST, REMOLDED SAMPLE
FERRELVIEW

FIGURE 3-31

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 800.0 psf, α= 13.0 °
c = 820.0 psf, Φ= 13.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

* GT-2T74 (BU-01A)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

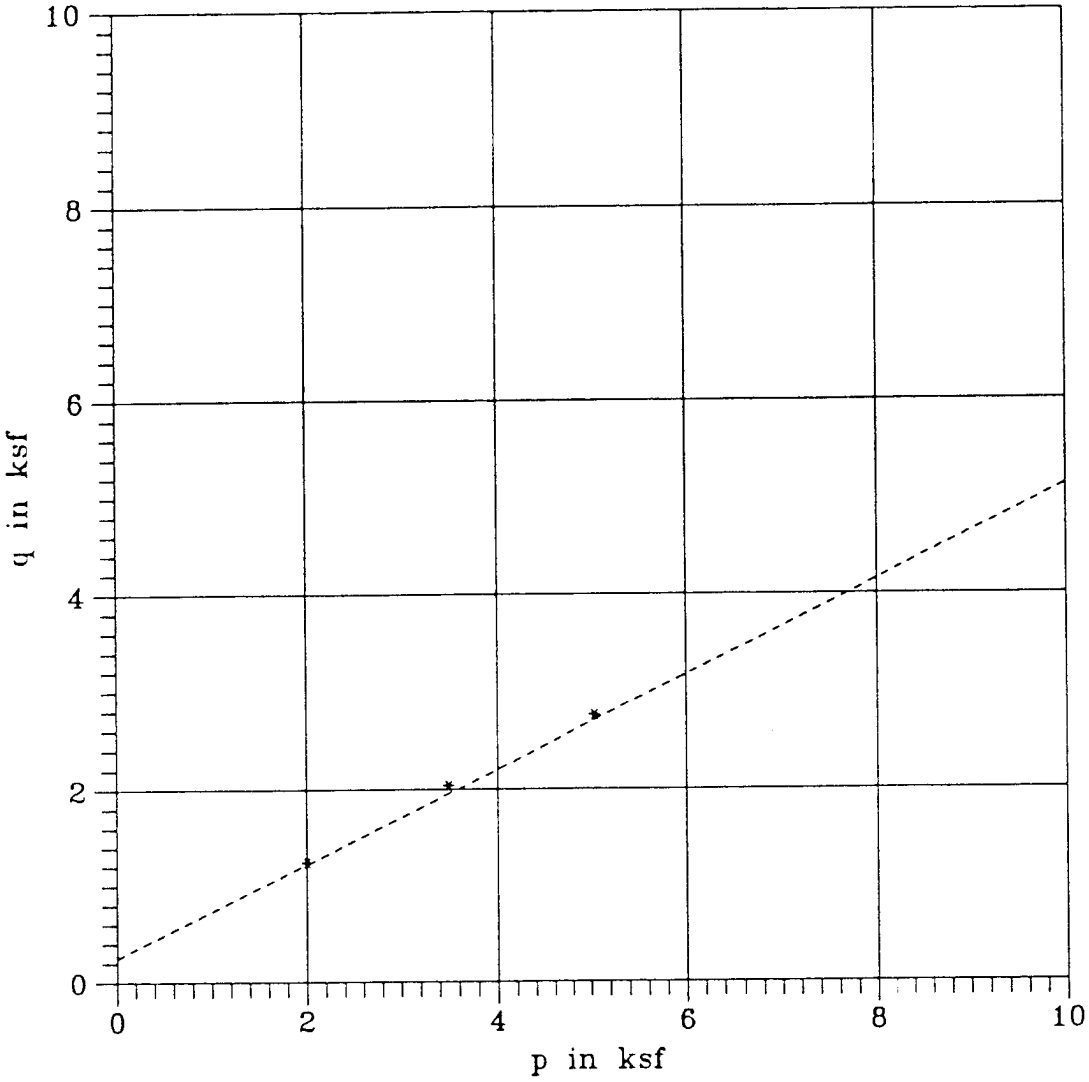
CU TRIAXIAL TEST, REMOLDED SAMPLE

LOESS

FIGURE 3-32 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 250.0 psf, α= 26.0 °
c = 290.0 psf, Φ= 29.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

* GT-2T74 (BU-01A)

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

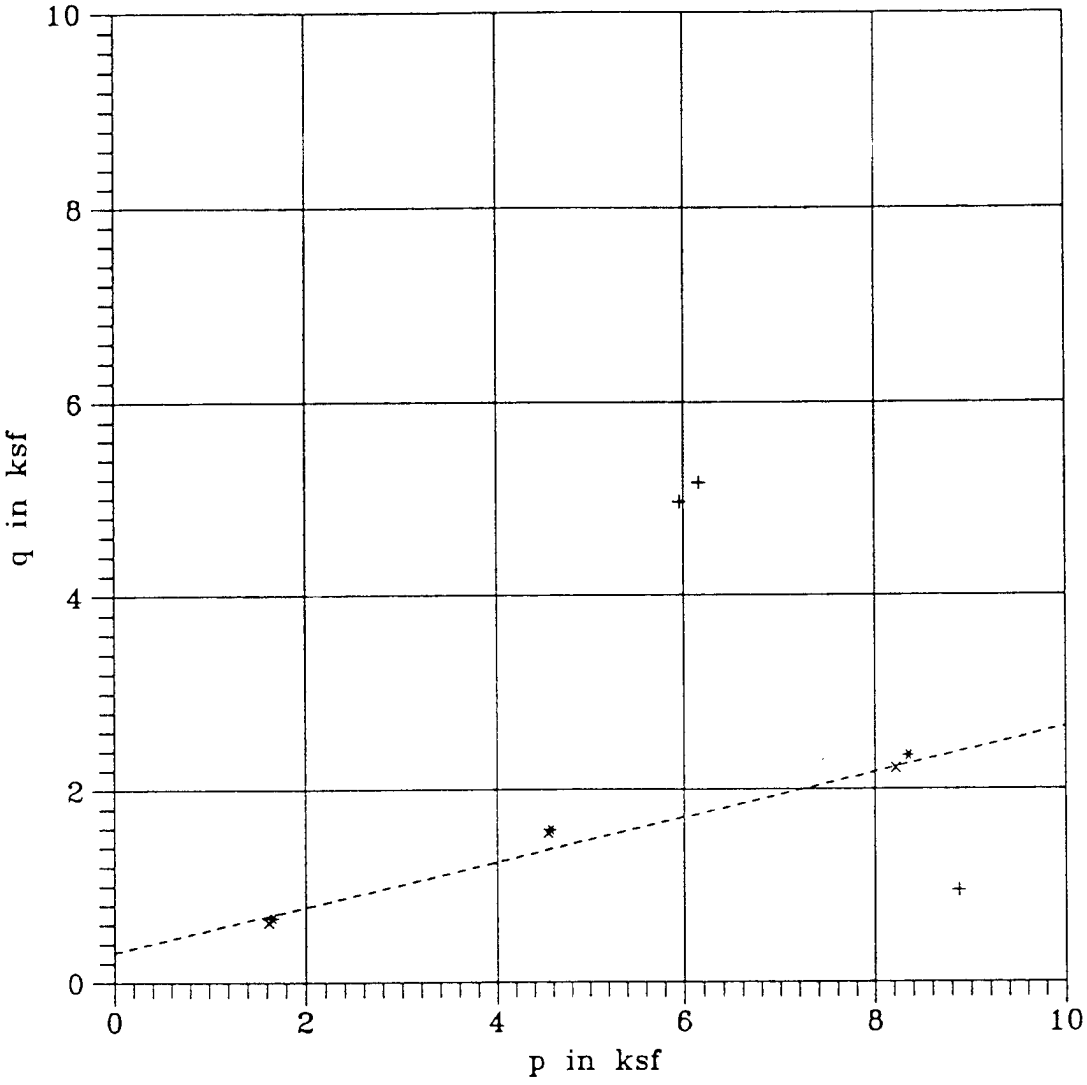
CU TRIAXIAL TEST, REMOLDED SAMPLE

LOESS

FIGURE 3-32 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 313.6 psf, α= 13.1 °
c = 322.5 psf, Φ= 13.5 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

\+ GT-2T71 (BU-01A)
× GT-2T75 (BU-02B)
* GT-2T77 (BU-01B)
----- Average Envelope

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

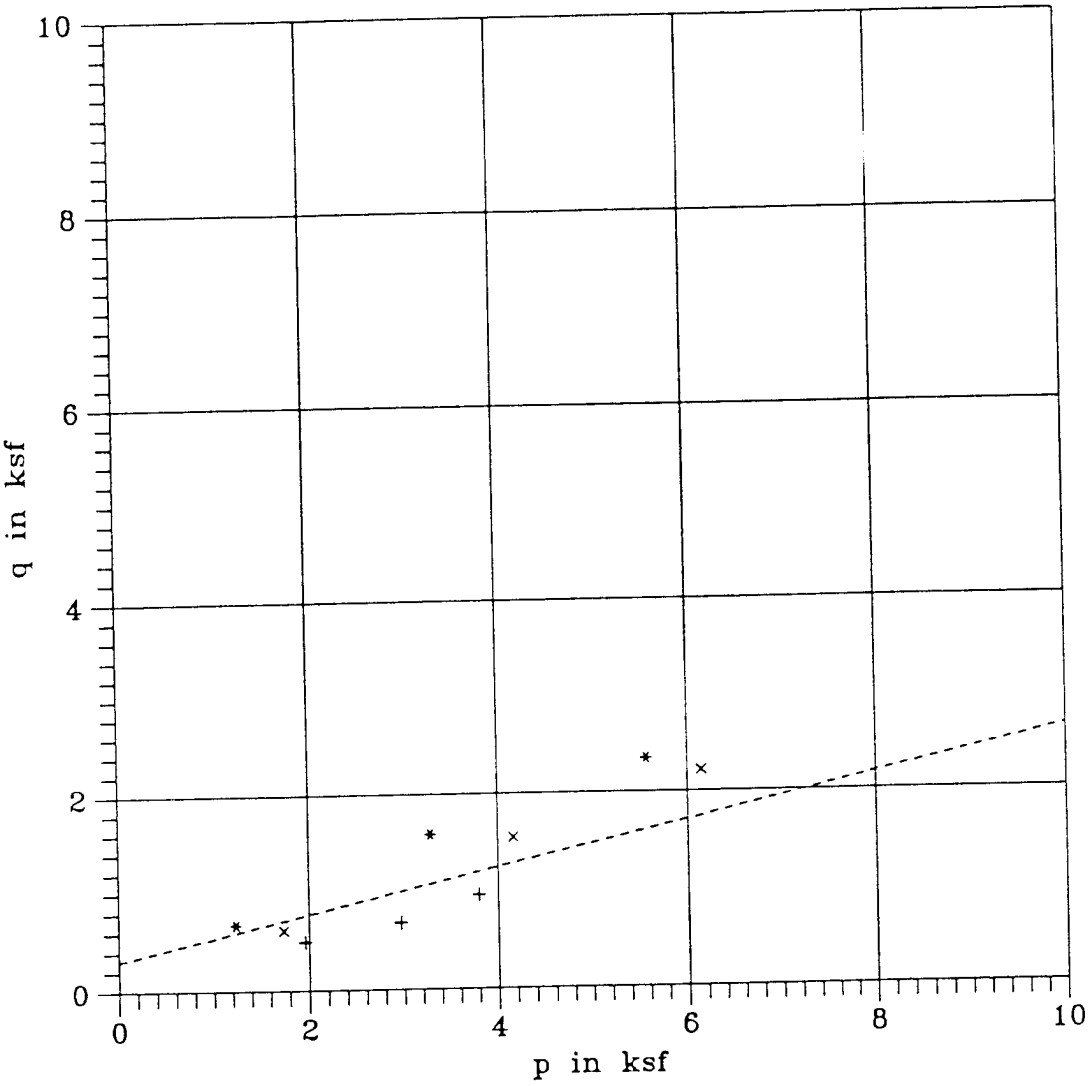
CU TRIAXIAL TEST, REMOLDED SAMPLE

FERRELVIEW CLAY

FIGURE 3-33 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 85.0 psf, α= 18.3 °
c = 90.0 psf, Φ= 19.3 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :
+ GT-2T71 (BU-01A)
× GT-2T75 (BU-02B)
* GT-2T77 (BU-01B)

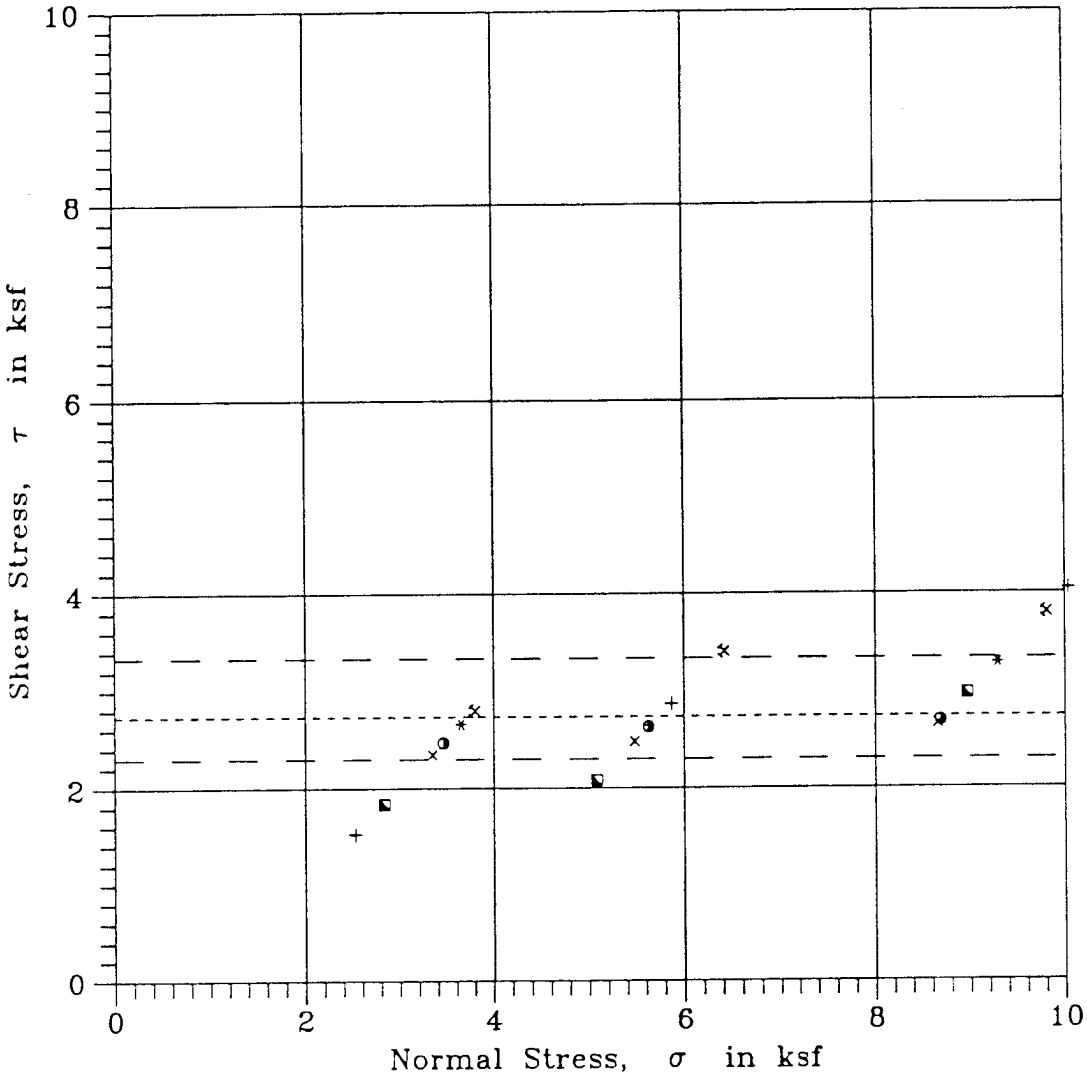
SUMMARY OF EFFECTIVE STRENGTH ENVELOPE FROM p-q DIAGRAM

CU TRIAXIAL TEST, REMOLDED SAMPLE

FERRELVIEW CLAY

FIGURE 3-33 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991



LEGEND :

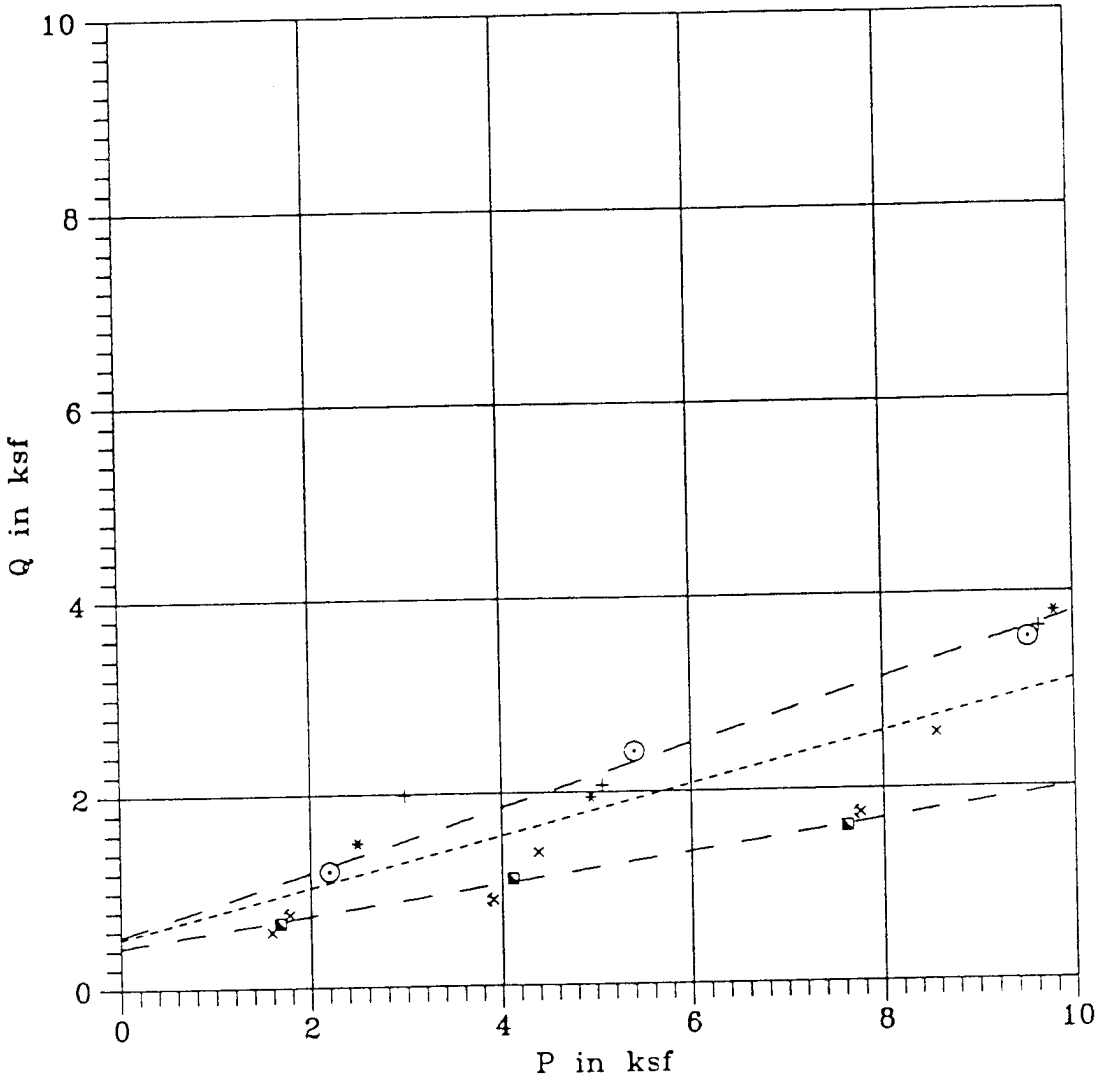
+ TPBS-1 (2A)
× TPBS-1 (3A)
* TPBS-6 (1A)
× TPBS-6 (2A)
■ TPBS-8 (1A)
● TPBS-8 (3A)
----- Average Envelope
— — Max. & Min. Envelopes

SUMMARY OF STRENGTH ENVELOPES
UU TRIAXIAL TEST, REMOLDED SAMPLE
POTENTIAL BORROW SOURCE NO. 1

FIGURE 3-34

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 525.7 psf, α= 14.5 °
c = 544.2 psf, Φ= 15.0 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

+	TPBS-1 (2A)
×	TPBS-1 (3A)
*	TPBS-6 (1A)
⊗	TPBS-6 (2A)
⊙	TPBS-8 (1A)
◙	TPBS-8 (3A)
-----	Average Envelope
_ _	Max. & Min. Envelopes

SUMMARY OF TOTAL STRENGTH ENVELOPES FROM p-q DIAGRAM

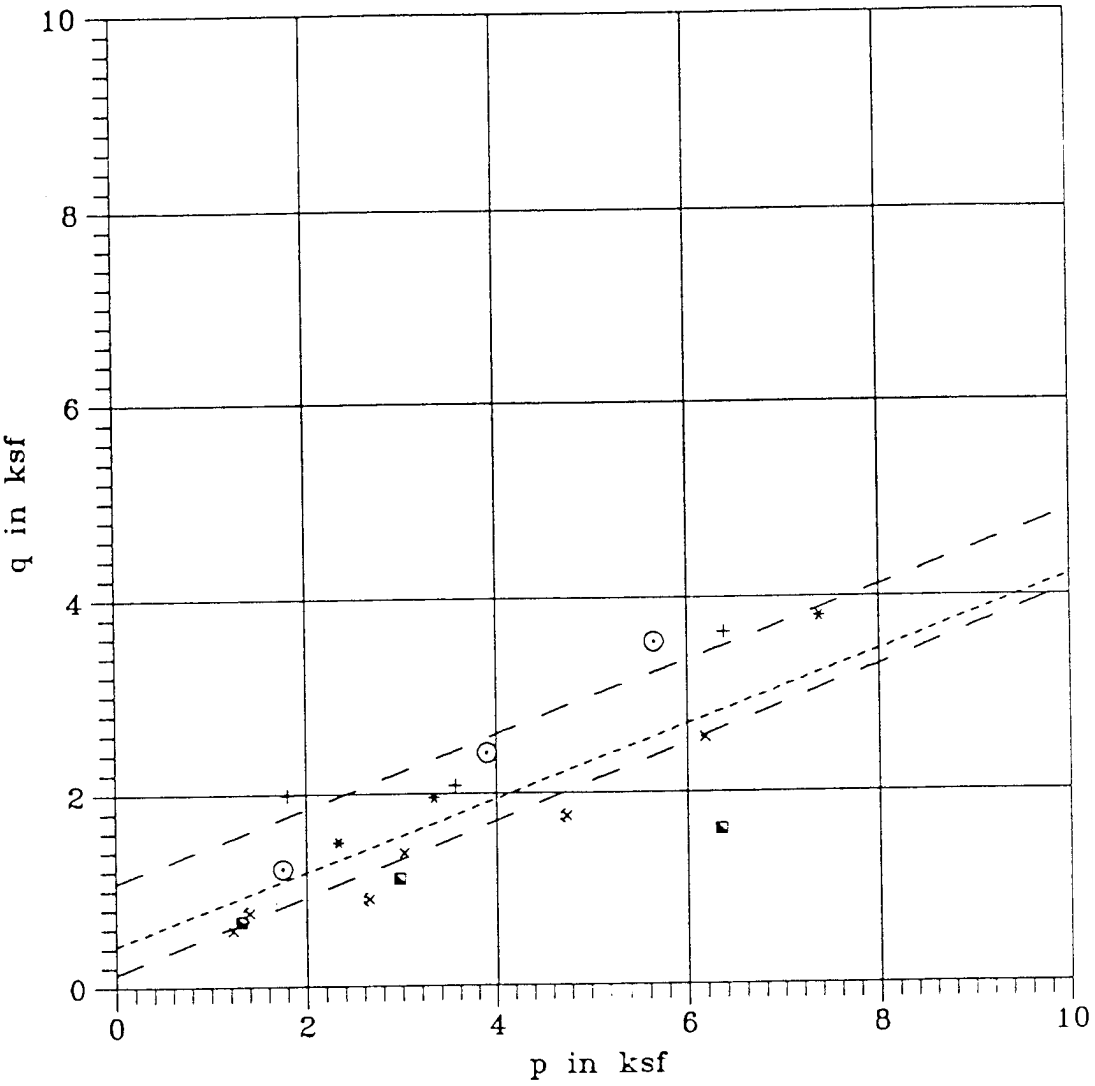
CU TRIAXIAL TEST, REMOLDED SAMPLE

POTENTIAL BORROW SOURCE NO. 1

FIGURE 3-35 A

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

Summary of average values :
a = 398.8 psf, α= 22.9 °
c = 465.8 psf, Φ= 22.2 °



NOTES :
1. α and a are from graph.
2. $\Phi = \sin^{-1}\tan\alpha$, $c = a/\cos\Phi$

LEGEND :

+	TPBS-1 (2A)
×	TPBS-1 (3A)
*	TPBS-6 (1A)
⊗	TPBS-6 (2A)
⊙	TPBS-8 (1A)
◙	TPBS-8 (3A)
-----	Average Envelope
_ _	Max. & Min. Envelopes

SUMMARY OF EFFECTIVE STRENGTH ENVELOPES FROM p-q DIAGRAM

CU TRIAXIAL TEST, REMOLDED SAMPLE

POTENTIAL BORROW SOURCE NO. 1

FIGURE 3-35 B

REPORT NO. MKES-3840R-7005	DRAWING NO.	
ORIGINATOR : ND	DRAWN : ND	DATE: OCT,1991

35-pound surcharge weight. The soils were compacted to about 95% of maximum dry density as determined from ASTM D698 test method and natural moisture content prior to testing. Table 3-10 lists the laboratory CBR test results. The CBR values range from 1.6 to 3.8, with an average value of 2.6. These values are typical for highly plastic clays (CH).

Table 3-10
Laboratory CBR Test Results

Test Pit and Sample No.	Depth (ft)	Dry Density Before Soaking (pcf)	Molding Moisture (%)	Swell (%)	CBR
TPMS-1, BU-01	0.0–6.0	98	18.1	0.2	2.5
TPMS-2, BU-02	2.0–6.0	96	22.5	1.5	2.3
TPMS-3, BU-01	1.0–6.0	99	17.8	0.8	2.7
TPMS-5, BU-01	0.0–7.0	102	16.7	-0.2	3.8
TPMS-8, BU-01	1.0–5.0	102	16.9	-0.2	2.4
TPMS-8, BU-01	5.0–10.5	94	22.5	1.6	1.6
TPMS-9, BU-01	1.0–7.0	99	16.0	0.2	3.1

3.6 Volume Change Characteristics

3.6.1 One-Dimensional Consolidation

The one-dimensional consolidation test determines consolidation characteristics for a soil. A sample is axially loaded and allowed to drain while being restrained laterally. The decrease in void ratio is measured as a function of loading and time. The consolidation characteristics obtained are used to estimate the rate and magnitude of consolidation under actual loading conditions. For in-situ materials the tests were performed on undisturbed samples. For borrow source or relocated materials, the test

were performed on remolded samples compacted to 95% maximum dry density determined from Standard Proctor compaction tests, at moisture contents 3% above optimum.

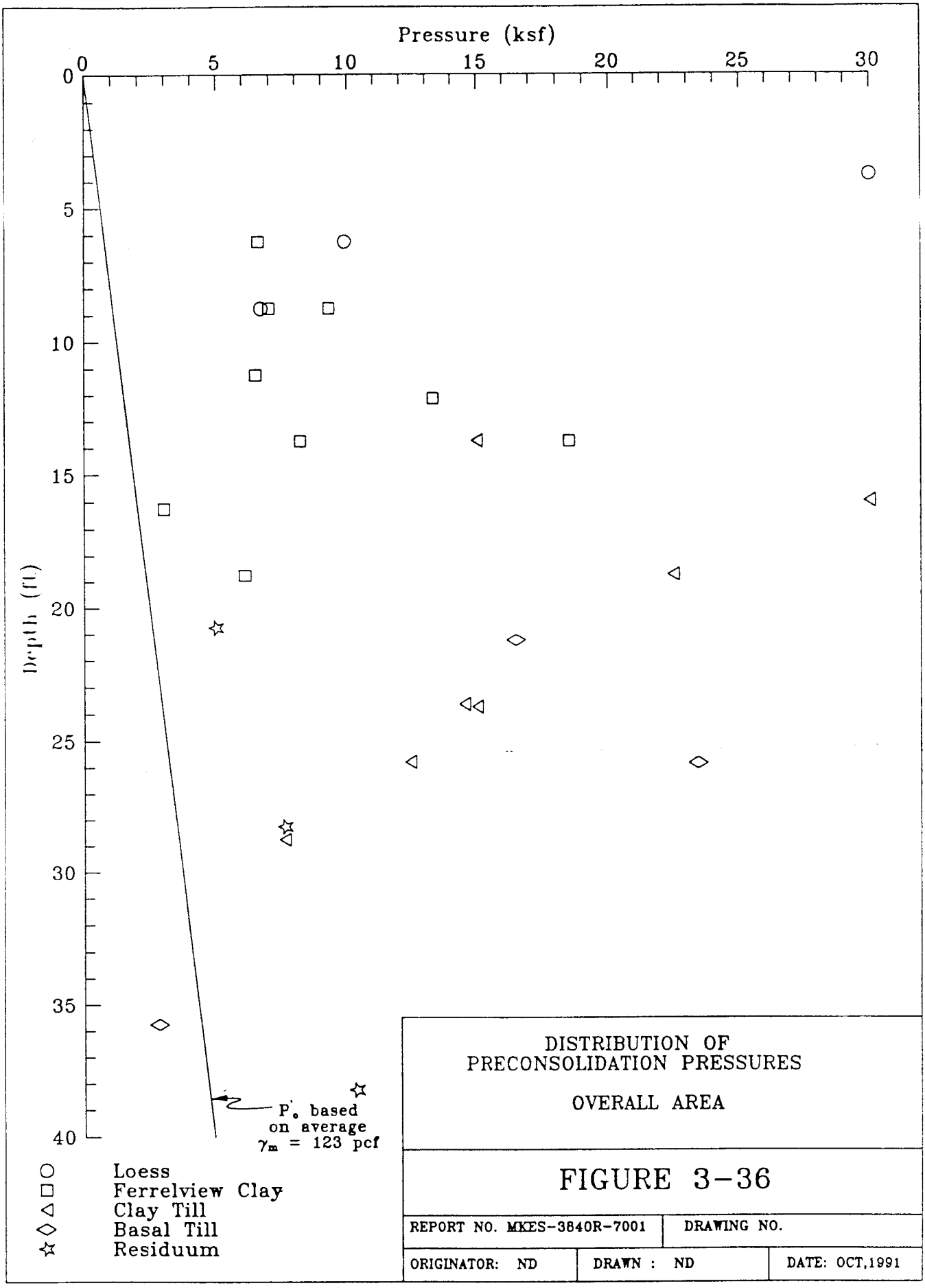
The calculations to determine parameters from consolidation curves are included in Appendix C. The parameters include compression (C_c) and recompression (C_r) indices and the preconsolidation pressure (P_p). Results for the undisturbed samples are summarized in Table 3-4. The average values for each soil type were calculated on soil samples obtained within the whole site (overall site). The average, maximum and minimum values of each geologic unit are shown in Table 3-11. The values are within typical ranges for fine-grained soils.

Table 3-11
Summary of Consolidation Parameters From Tests
on Undisturbed Samples (for overall site).

Geologic Unit	Compression Index, C_c			Recompression Index, C_r		
	Average	Maximum	Minimum	Average	Maximum	Minimum
Top Soil/Fill	*	*	*	*	*	*
Loess	0.290	0.380	0.230	0.035	0.041	0.032
Ferrelview Clay	0.256	0.462	0.170	0.064	0.131	0.027
Clay Till	0.210	0.260	0.150	0.052	0.075	0.018
Basal Till	0.252	0.417	0.162	0.049	0.068	0.037
Residuum	0.302	0.372	0.265	0.089	0.097	0.075

*No test data. This layer will be removed during construction.

The preconsolidation pressures for undisturbed samples are presented in Figures 3-36 for overall site soils. It should be noted that the disposal area soils are a subset of the overall site soils. Comparison of the preconsolidation pressures to existing overburden pressures indicates that all of the soils are over consolidated, with the Basal Till and Residuum to a lesser extent.



DISTRIBUTION OF PRECONSOLIDATION PRESSURES

OVERALL AREA

FIGURE 3-36

REPORT NO. MKES-3840R-7001	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991

3.6.2 Cation Exchange Capacity

The cation exchange capacity (CEC) is the charge or electrical attraction for cations per unit mass as measured in milequivalents per 100 grams of soil. The CEC is an indicator of the presence of various clay minerals such as kaolinite, illite, or montmorillinite in the soil. The clay mineral types are used in evaluating the expansiveness of a soil. It should be noted here that Petry (1980) indicated that CEC is, by itself, not an indicator of clay soil activity. The potential for activity may be predicted only when utilized with the type and amount of cations in the soil.

Only two CEC tests were performed on Loess. The two CEC values measured are 84 meq/100 g and 33 meq/100 g. Six CEC tests were performed on Ferrelview Clay and six on Borrow Source No. 1 materials. The values range from 49 to 88 meq/100 g for Ferrelview Clay and 56 to 80 meq/100g for Borrow Source No. 1 material. The average value of CEC for Ferrelview Clay was about 70 meq/100 g. The average value for Borrow Source No. 1 material was also 70 meq/100 g. From Mitchell (1976) the clay minerals seem to be of the Smectite type which consists of Montmorillonite, Saponite, Illites and Vermiculite.

3.7 Permeability

The constant-head triaxial permeability test measures the permeability, or hydraulic conductivity, of a saturated soil that is subjected to a constant head and hydraulic gradient. The tests are performed at different confining pressures to simulate in situ loading conditions. The hydraulic conductivity of a soil is used to determine seepage and groundwater flow rates. It is also used as a measure of relative imperviousness. This test was performed on both undisturbed and remolded samples. The permeability (or hydraulic conductivity) of the in-situ soil strata were discussed in detail in the site suitability report (MKF and JEG 1990a). Table 3-12 gives an updated tabulation of all valid test results* and the logarithmic mean for these results, including results from the Temporary Storage Area. The average coefficient of permeability for in-situ soils (undisturbed) are: 6.1×10^{-8} cm/sec for Loess, 1.3×10^{-8} cm/sec for Ferrelview clay, 6.9×10^{-9} cm/sec for Clay Till, 1.7×10^{-7} cm/sec for Basal Till and 2.6×10^{-7} cm/sec for Residuum.

*Valid Test results are defined in Sec. 2.4.

TABLE 3-12 : SUMMARY OF COEFFICIENT OF PERMEABILITY FOR UNDISTURBED ON SITE SOILS (Sheet 1 of 2)

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	COEFF. OF PERMEABILITY (cm/sec)	LOGARITHMIC MEAN (cm/sec)
DIKE FILL				
GT-33	ST-04	5.0 - 7.5	1.1E-07	1.1E-07
LOESS				
GT-50	ST-02	2.5 - 5.0	3.0E-04 **	
GT-50	ST-02	2.5 - 5.0	2.0E-05 **	
GT-55	ST-04	7.5 - 10.0	1.0E-05 **	
GT-55	ST-04	7.5 - 10.0	6.0E-06 **	
GT-56	ST-02	5.0 - 7.5	2.9E-08	
GT-58P	ST-01	2.5 - 5.0	2.0E-08	
GT-58P	ST-01	2.5 - 5.0	4.0E-07	6.1E-08
FERRELVIEW				
GT-43	ST-04	6.0 - 8.5	9.0E-04 **	
GT-43	ST-04	6.0 - 8.5	7.0E-08 **	
GT-46	ST-03	5.0 - 7.5	5.0E-04 **	
GT-46	ST-03	5.0 - 7.5	3.0E-06 **	
GT-48	ST-05	12.5 - 15.0	1.0E-08 **	
GT-48	ST-07	17.5 - 20.0	1.0E-09	
GT-48	ST-05	12.5 - 15.0	6.0E-04 **	
GT-52	ST-06	15.0 - 17.5	3.0E-06 **	
GT-55	ST-06	12.5 - 15.0	8.0E-09	
GT-56	ST-04	10.0 - 12.5	3.0E-08 **	
GT-56	ST-04	10.0 - 12.5	2.0E-07 **	
GT-58P	ST-03	7.5 - 10.0	6.0E-08	
GT-58P	ST-03	7.5 - 10.0	1.0E-09	
GT-59	ST-02	5.0 - 7.5	4.0E-07	
GT-59	ST-02	5.0 - 7.5	2.0E-07	
GT-62	ST-07	17.5 - 20.0	5.0E-08	
GT-62	ST-07	17.5 - 20.0	1.0E-09	
GT-63P	ST-01	2.5 - 5.0	7.0E-09	1.3E-08

NOTE : ** Unreliable test results due to low confining pressures used in testing. Data not used in computing mean values.

TABLE 3-12 : SUMMARY OF COEFFICIENT OF PERMEABILITY FOR UNDISTURBED ON SITE SOILS (Sheet 2 of 2)

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	COEFF. OF PERMEABILITY (cm/sec)	LOGARITHMIC MEAN (cm/sec)
CLAY TILL				
GT-45	ST-07	15.0 - 17.5	8.0E-05 **	
GT-45	ST-07	15.0 - 17.5	2.0E-08 **	
GT-50	SB-08	17.5 - 19.0	2.0E-07 **	
GT-50	SB-08	17.5 - 19.0	7.0E-08 **	
GT-51	ST-07	15.0 - 17.5	2.0E-08 **	
GT-51	ST-07	15.0 - 17.5	3.0E-06 **	
GT-51	SB-09	20.0 - 21.5	3.0E-07 **	
GT-51	SB-09	20.0 - 21.5	5.0E-08 **	
GT-56	ST-06	15.0 - 17.0	2.9E-09	
GT-58P	ST-09	22.5 - 24.0	4.0E-08	
GT-58P	ST-09	22.5 - 24.0	1.0E-09	
GT-59	ST-06	15.0 - 17.5	1.0E-09	
GT-60P	ST-10	27.5 - 30.0	1.0E-09	
GT-60P	ST-10	27.5 - 30.0	5.0E-08	
GT-63P	ST-09	22.5 - 25.0	9.0E-09	
GT-67P	ST-08	20.0 - 22.5	1.0E-07	6.9E-09
BASAL TILL				
GT-43	SB-17	40.0 - 41.5	6.0E-08 **	
GT-43	SB-17	40.0 - 41.5	4.0E-08 **	
GT-60P	SB-17	48.5 - 49.0	3.0E-07	
GT-60P	SB-15	41.0 - 41.5	2.0E-07	
GT-60P	SB-17	48.5 - 49.0	2.0E-07	
GT-60P	SB-15	41.0 - 41.5	7.0E-08	1.7E-07
RESIDUUM				
GT-55	SB-12	27.5 - 29.0	2.0E-09	
GT-62	SB-15	38.0 - 39.0	3.0E-05	
GT-62	SB-15	38.0 - 39.0	6.0E-08	
GT-65P	SB-16	40.0 - 41.5	8.0E-07	
GT-65P	SB-16	40.0 - 41.5	4.0E-07	2.6E-07

NOTE : ** Unreliable test results due to low confining pressures used in testing. Data not used in computing mean values.

TABLE 3-13 : SUMMARY OF COEFFICIENT OF PERMEABILITY FOR REMOLDED ON SITE SOILS

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	COEFF. OF PERMEABILITY (cm/sec)	LOGARITHMIC MEAN (cm/sec)
DIKE FILL				
GTS-5	BULK	0.0 - 5.0	2.0E-08	
GTS-7	BULK	0.0 - 5.0	5.0E-08	3.2E-08
LOESS				
TPMS-2	BU-01	0.0 - 2.0	2.0E-08	
TPMS-4	BU-01	1.0 - 3.5	9.0E-09	
TPMS-5	BU-01	1.0 - 7.0	2.0E-06	
TPMS-6	BU-01	1.0 - 5.0	3.0E-07	
TPMS-7	BU-01	1.0 - 7.0	1.0E-07	
TPMS-8	BU-01	1.0 - 5.0	6.0E-08	
TPMS-9	BU-01	1.0 - 7.0	3.0E-07	1.1E-07
FERRELVIEW				
GT-2T71	BU-02A	6.5 - 12.0	2.0E-08	
GT-2T75	BU-02B	6.5 - 12.0	1.0E-09	
GT-2T77	BU-02A	7.0 - 10.5	2.0E-08	
GT-2T78	BU-02B	6.5 - 12.0	4.0E-08	
TPMS-1	BU-01	0.0 - 6.0	7.0E-08	
TPMS-2	BU-02	2.0 - 6.0	1.0E-09	
TPMS-3	BU-01	1.0 - 6.0	3.0E-07	
TPMS-4	BU-02	4.0 - 6.5	1.0E-09	
TPMS-5	BU-02	8.0 - 10.0	9.0E-09	
TPMS-6	BU-02	5.5 - 7.5	1.0E-09	
TPMS-7	BU-02	7.0 - 9.5	1.0E-07	
TPMS-8	BU-02	5.0 - 10.5	1.0E-09	
TPMS-9	BU-02	8.0 - 15.0	4.0E-08	
GTS-1	ST-03	5.0 - 7.5	2.0E-07	
GTS-2	ST-02	2.5 - 5.0	8.0E-08	
GTS-4	ST-02	2.5 - 5.0	2.0E-07	
GTS-6	BULK	0.0 - 5.0	1.0E-07	1.9E-08

NOTE : ** Unreliable test results due to low confining pressures used in testing. Data not used in computing mean values.

TABLE 3-14 : SUMMARY OF COEFFICIENT OF PERMEABILITY FOR REMOLDED BORROW SOURCE SOILS

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	COEFF. OF PERMEABILITY (cm/sec)	LOGARITHMIC MEAN (cm/sec)
POTENTIAL BORROW SOURCE NO. 1				
TPBS-1	2A	2.6 - 7.1	3.0E-07	
TPBS-1	4A	9.2 - 14.1	4.0E-08	
TPBS-6	1A	0.6 - 9.1	2.0E-08	
TPBS-6	2A	9.1 - 12.6	1.0E-08	
TPBS-8	1A	0.6 - 4.3	3.0E-08	
TPBS-8	2A	4.3 - 8.5	2.0E-07	
TPBS-8	3A	8.5 - 11.9	5.0E-09	
TPBS-10	1A	0.6 - 6.1	1.0E-07	
TPBS-10	2A	8.2 - 10.9	2.0E-08	
TPBS-10	3A	10.9 - 13.4	1.0E-09	
TPBS-11	1A	0.6 - 10.4	3.0E-08	
TPBS-11	2A	10.4 - 12.3	3.0E-08	2.7E-08

NOTE : ** Unreliable test results due to low confining pressures used in testing. Data not used in computing mean values.

Test results from remolded on-site surficial soils (Fill, Loess, and Ferrelview clay) and remolded Borrow Source No. 1 soils are shown in Tables 3-13 and 3-14, respectively. A logarithmic mean coefficient of permeability of 1.4×10^{-7} cm/sec was obtained for the remolded on-site Loess and 1.0×10^{-8} cm/sec for remolded on-site Ferrelview clay soils. An average value of 2.7×10^{-8} cm/sec was obtained for the remolded Borrow Source No. 1 soils. The samples were compacted to about 95% of maximum dry density as determined by the ASTM D698 test method, at a moisture content of about 3% above optimum moisture content.

3.8 Corrosivity

A series of solids content, resistivity and chemical tests was performed on samples of the upper layer of on-site soils to determine the potential corrosive effects of harmful substances in the foundation soil on concrete and steel used in the construction of the disposal facilities. Six samples of Ferrelview clay and one sample of Clay Till, all from depths from 2.5 to 9 feet were selected for testing. The test results are shown in Table 3-15. A discussion of the test results is presented in Section 4.4.6.

3.8.1 Resistivity

The earth resistivity is a measure of the ability of the soil to serve as an electrolyte, and is an indicator of corrosivity of the soil. The soil samples were compacted in a modified "Miller" box and tested at various moisture contents, generally starting with the natural moisture content and increasing in increments of 7 to 15 percent. The resistivities generally varied from 740 to 1960 ohm-cm.

3.8.2 Sulfates and Chlorides

Sulfate and chloride content values were determined in the laboratory on leachate from the soil samples. The sulfate content for all test samples ranges from non-measurable (below quantitation limit) to 0.08%. The average sulfate content is 0.06%. The chloride contents range from 0.02% to 0.03% with an average value of 0.022%.

Table 3-5
Corrosivity Test Results

Boring No.	Sample No.	Depth (feet)	Soil	Soil Resistivity (ohm-cm)	Sulfates (mg/kg)	Chlorides (mg/kg)	pH (pH)	Percent Solids (%)
GT-68	SS-6801	2.5-4.0	Ferrelview clay	1940	864	193	7.3	85.9
GT-69	SS-6901	2.5-4.0	Ferrelview clay	1060	243	297	7.07	88.2
GT-69	SS-6903	7.5-9.0	Clay Till	1030	BQL	344	6.37	80.7
GT-70	SS-7003	7.5-9.0	Ferrelview clay	1160	BQL	214	7.49	84.6
GT-71	SS-7103	7.5-9.0	Ferrelview clay	870	509	242	6.91	85.7
GT-72	SS-7201	2.5-4.0	Ferrelview clay	1310	243	272	6.35	88.5
GT-73	SS-7301	2.5-4.0	Ferrelview clay	1600	428	170	5.39	76.8

BQL = Below Quantitation Limit

3.8.3 Acidity/Alkalinity

Acidity/Alkalinity (pH) tests determine the acidity or alkalinity of water in soils by an indicator paper. Excess of either can have detrimental effects on concrete buried in the ground. A moderate degree of acidity can cause corrosion of metals. In soil stabilization, some resinous materials are unsuitable for alkaline soils but may be satisfactory with neutral or slightly acid soils.

The pH values measured in the laboratory ranges from 5.4 to 7.5. The average value was 6.7.

3.8.4 Percent Solids

The percent solids in a soil is not a direct indicator of the corrosiveness of a soil. However, this test is generally performed to identify the percentage of solids in the soil specimen for chemical analysis. The percent solids from test results ranges from 77 to 89% with on average value of 84%.

3.9 Standard Penetration Test (SPT)

The standard penetration test (SPT) is a field test performed during drilling operations. A standard split-spoon sampler is driven with a standard-weight hammer (weighing 140 pounds), free-falling 30 inches. The number of blows required to advance the last 12 inches of the samples in each 18-inch advancement interval is referred to as the SPT blow count. The sampling equipment and methodology are described in Section 2.4 and in the Geotechnical Investigation Report (MKF and JEG 1990). The SPT was conducted at frequent intervals to obtain soil samples and the SPT blow counts in each borehole.

The blow counts correlate roughly to various soil properties, such as relative density of granular soils and the strength consistency of cohesive soils. The test is also useful as a supplement to other test results, such as approximate unit weight, angle of internal friction, and unconfined compressive strength.

Table 3-6
Typical SPT BLow Counts for Various Soil Unit
(for values measured in boreholes within cross-sections shown in report only)

Soil Unit	Range of STP Blow, Counts per foot	Average Blow Counts, N	Consistency
Fill	6-28	12	Medium to Stiff
Loess	6-18	11	Medium to Stiff
Ferrelview Clay	4-23	12	Medium to Stiff
Clay Till	6-85	20	Medium to Very Stiff
Basal Till	18-50	33	Very Stiff to Hard
Residuum	13-84	43	Very Stiff to Hard

The blow counts measured within the bore holes shown in the geologic profiles (Figures 4-1 through 4-4) are presented in the profiles. Table 3-16 shows the range of values and the average values of blow counts measured for each soil type within the profiles. The corresponding soil consistencies correlated from empirical relationships are also shown. On this basis the Fill, Loess and Ferrelview clay soils are categorized as medium to stiff; the Clay Till as medium to very stiff and Basil Till and Residuum, as very stiff to hard.

3.10 Quality Assurance

The geotechnical investigation program activities were implemented with each organization's quality assurance (QA) programs. The procedures used in field and laboratory testing, where appropriate, followed the corresponding standard procedures published by authoritative organizations including the American Society for Testing and Materials (ASTM), the U.S. Army Corps of Engineers (COE), the U.S. Environmental Protection Agency (EPA), and the U.S. Soil Conservation Service (SCS). Data reduction, review, and reporting by Morrison Knudsen Company's Environmental Services Group (MKES) were performed in accordance with the MKES' WSSRA Project Procedures and Quality Assurance Manual (MKES 1991).

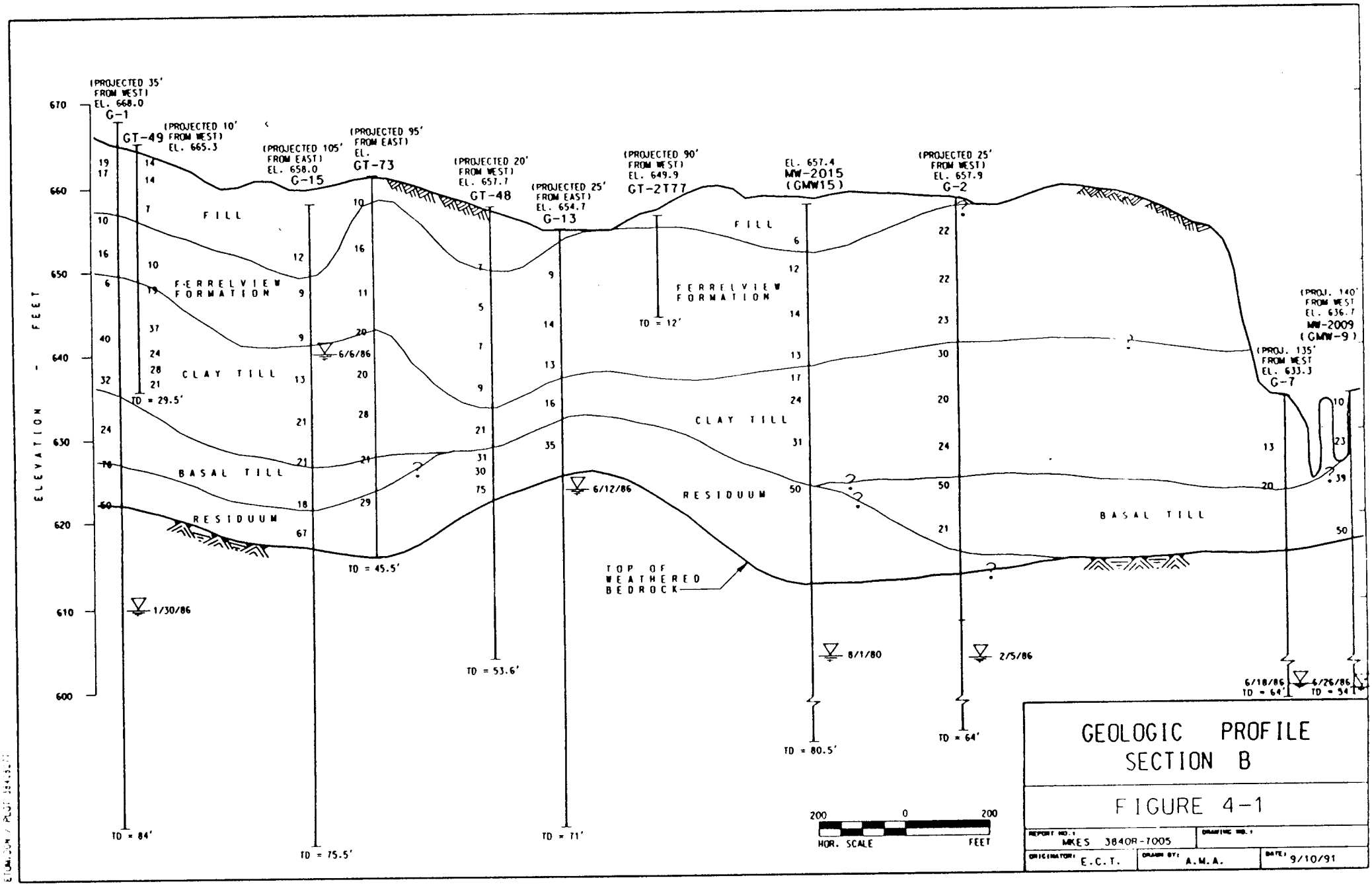
4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Site Description and Subsurface Condition

The possible siting area of the cells for the proposed disposal facility (DF) meeting the siting criteria (see Figure 1-2) is located mostly in the existing chemical plant area, with the northeastern limit located 350 feet from the existing fence line, the eastern limit 350 feet from the existing administration building, the southwestern portion 100 feet from Raffinate Pits 2 and 3, and the northwestern portion in the existing Material Staging Area. The suitability of the site for the WSS disposal facility was addressed in the site suitability study (MKF and JEG 1990a).

The DF site consists of numerous abandoned buildings and associated structures and equipment which will be demolished as part of the WSS remedial action. The existing topography is generally flat, sloping gently from the higher elevation of about 672 feet above mean sea level (MSL) near the central portion of the CP area, to lower elevations of about 650 to 640 feet near the limits of the DF siting area, except in the northern end, where the elevation drops to an average of about 630 feet. Abrupt changes in surface elevation occur in natural depressed areas or where man-made earth-moving activities, such as construction of drainage ditches and spoil piles, have taken place. A detailed description of the surface features of the site is presented in the Geotechnical Investigation Report (MKF and JEG 1990b). The proposed drainage features of the site are presented in Support Study 16 for Grading Plan (MKES 1991c) and the Surface Erosion Control Plan (MKES 1991e).

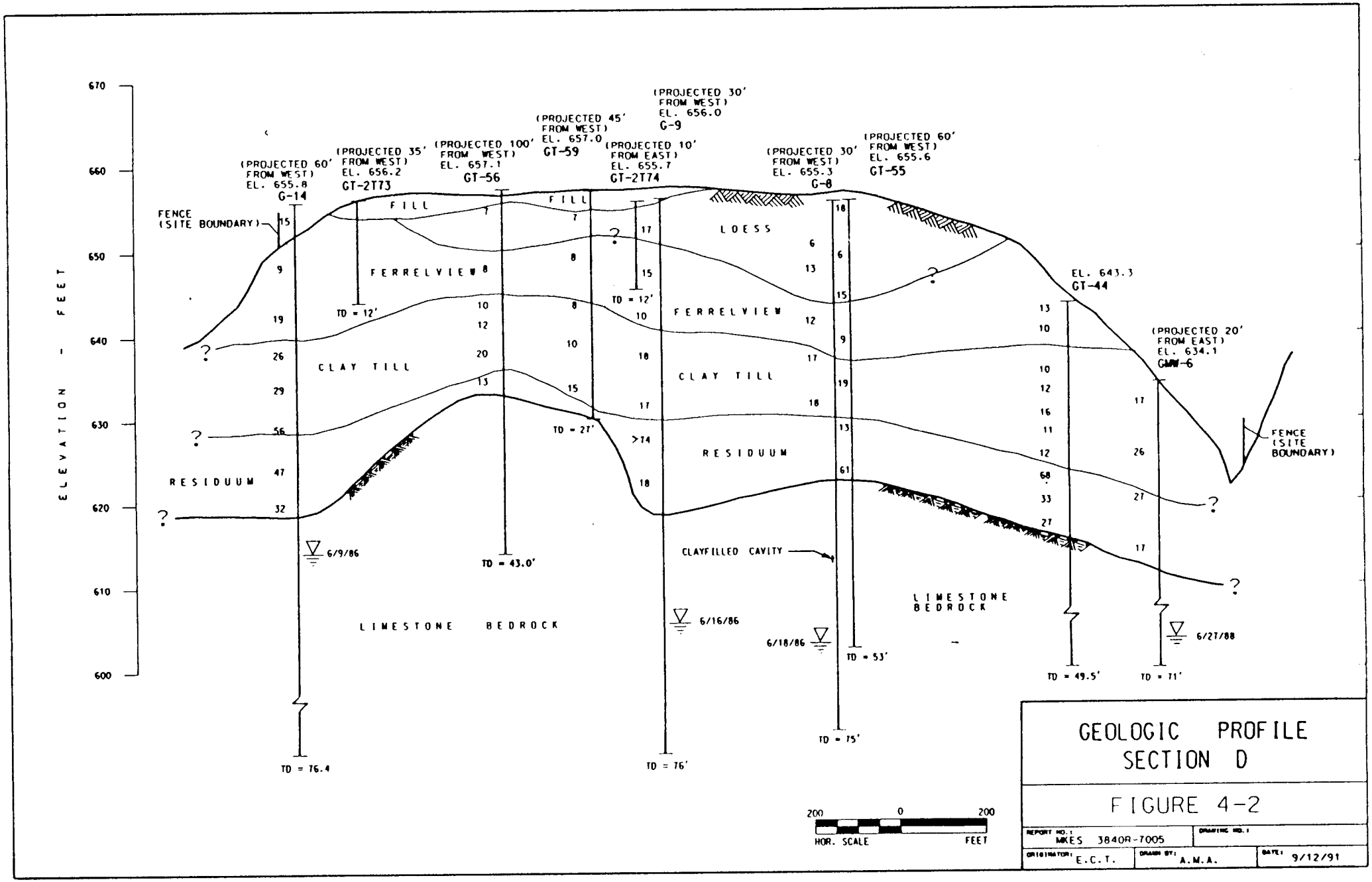
The proposed disposal facility (including the liner system) will be founded within or below the Ferrelview clay stratum. Cut and fill will be required to meet design grading requirements. The suitability of various on-site soil materials is discussed in the following sections. The hydrogeological conditions were discussed in the site suitability report (MKF and JEG 1990a). Geologic profiles (cross-sections) showing subsurface soil strata are shown in Figures 4-1 through 4-4. A legend for the geologic profiles is shown in Figure 4-5. Location of the sections are shown in Figure 2-1. The profiles are idealized and are presented for illustrative purposes only. The soil layering is based on interpolation and extrapolation between test pits and bore holes



GEOLOGIC PROFILE SECTION B

FIGURE 4-1

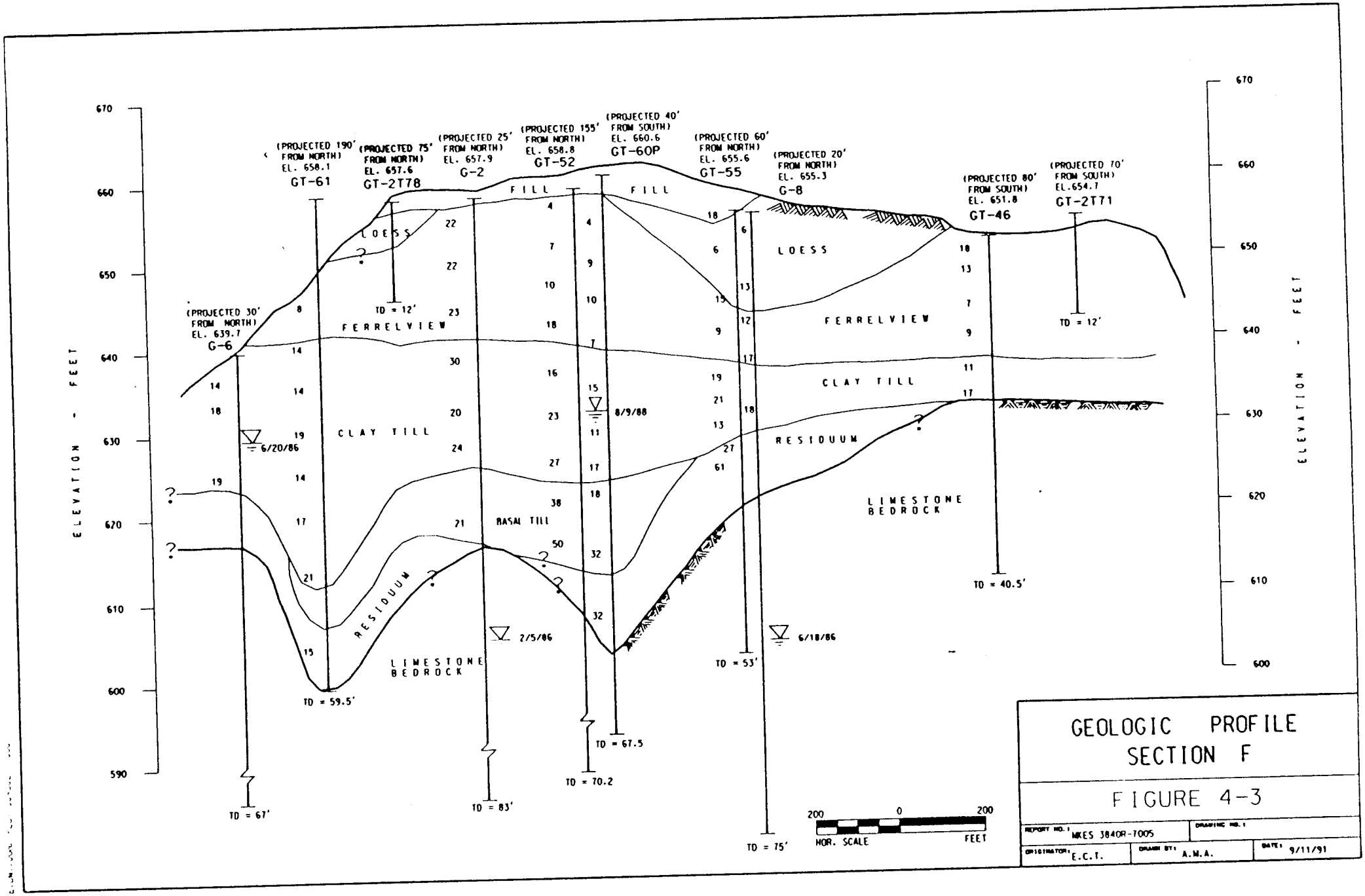
REPORT NO.: MKES 3840R-7005	DRAWING NO.:	
ORIGINATOR: E.C.T.	DRAWN BY: A.M.A.	DATE: 9/10/91



GEOLOGIC PROFILE SECTION D

FIGURE 4-2

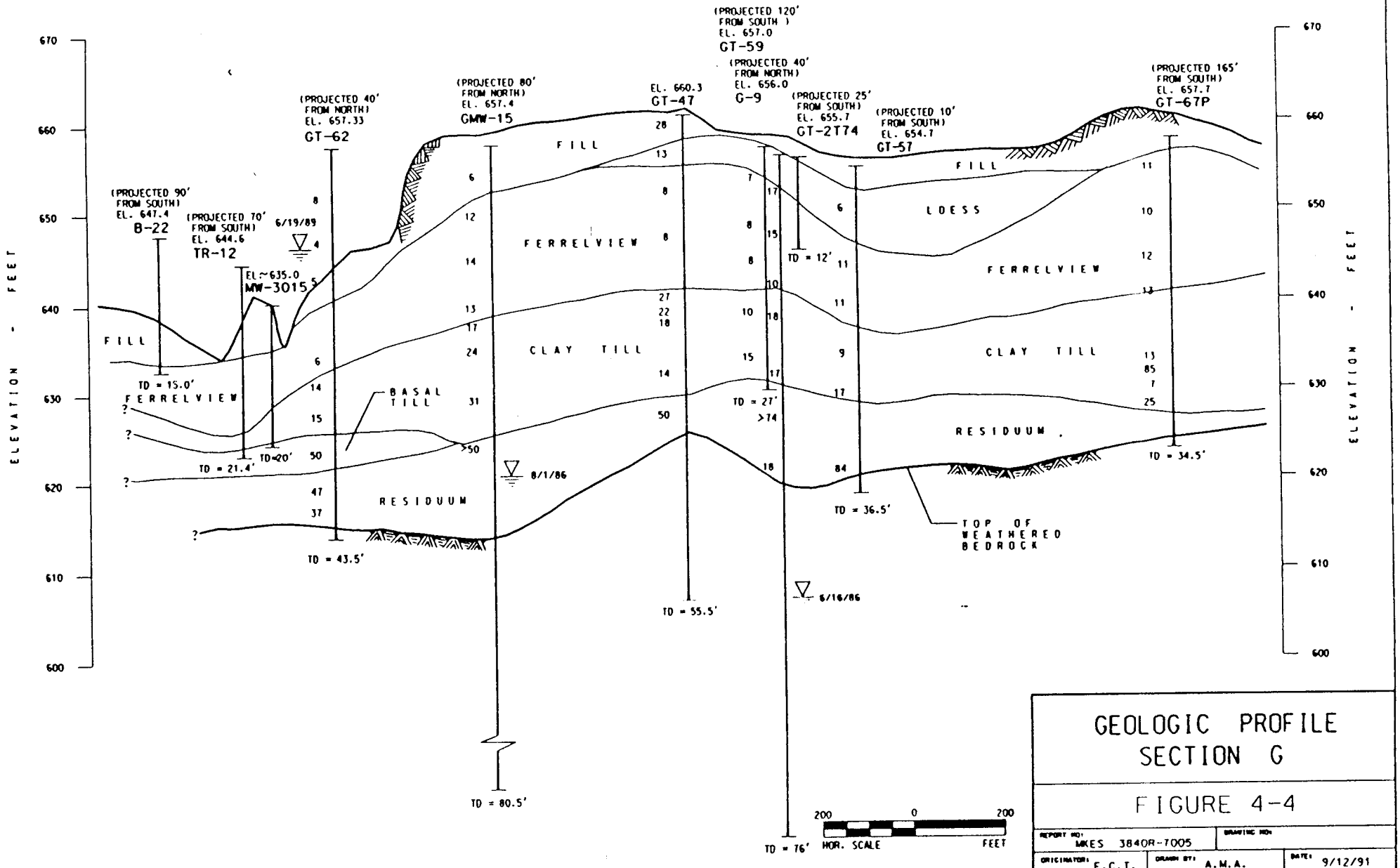
REPORT NO.: MKES 3840R-7005	DRAWING NO.:		
ORIGINATOR: E.C.T.	DRAWN BY: A.M.A.	DATE: 9/12/91	



GEOLOGIC PROFILE
SECTION F

FIGURE 4-3

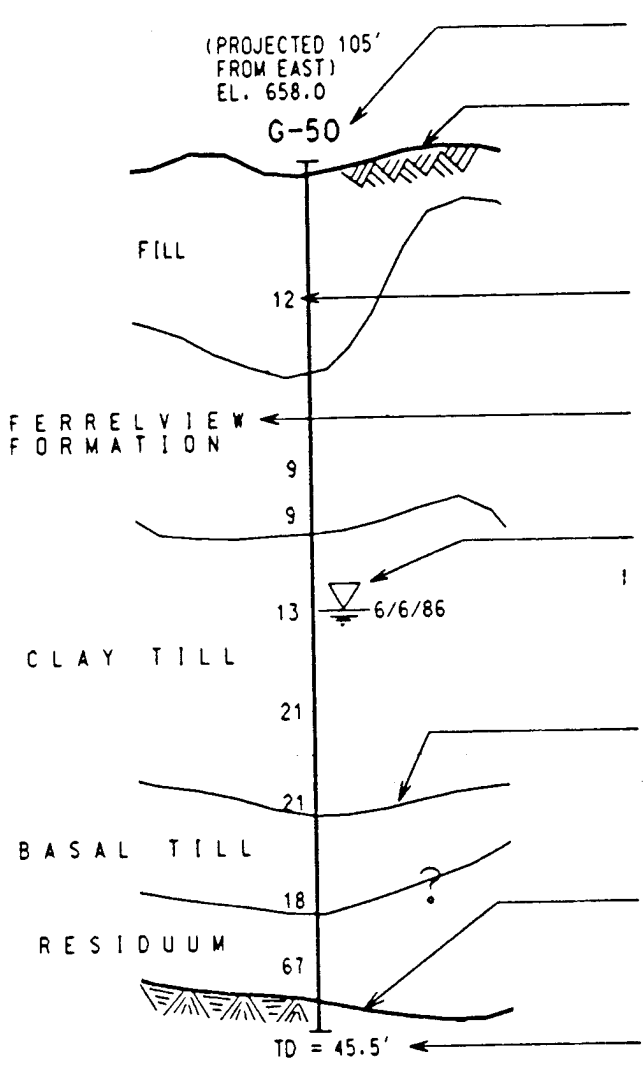
REPORT NO.: MKES 3840R-7005
DRAWING NO.:
ORIGINATOR: E.C.T.
DRAWN BY: A.M.A.
DATE: 9/11/91



GEOLOGIC PROFILE SECTION G

FIGURE 4-4

REPORT NO: MKES 3840R-7005		GRAPHIC NO:	
ORIGINATOR: E.C.T.	DRAWN BY: A.M.A.	DATE: 9/12/91	



GEOLOGIC PROFILE LEGEND

FIGURE 4-5

REPORT NO.: MKES 3840R-7005	DRAWING NO.:	
ORIGINATOR: E.C.T.	DRAWN BY: A.M.A.	DATE: 10/29/91

ETOM5.dgn

and may not represent the actual subsurface conditions between these points. The characteristics of the various soil units shown were described in Section 3.2.

4.2 Materials

4.2.1 Topsoil

Topsoil encountered within the construction area should be stripped and removed. The stripped topsoil, if uncontaminated, should be stockpiled for later use in revegetation; if contaminated, the material should be placed in a contaminated storage area or in the WSS disposal cell.

4.2.2 Subsoil

The subsoil to be encountered during construction at the site will be mostly Loess, Fill, raffinate pit dike fill, Ferrelview clay, and a few pockets of the deeper underlying Clay Till.

If suitable and uncontaminated, the Loess, Fill and dike fill materials should be removed and stockpiled for use as general fill and backfill materials. Contaminated Loess should be spoiled and place in the disposal cell at a later date as determined by the sequencing plans. Some of the uncontaminated Loess material could be too silty or uniformly sized for use as sound engineering fill material. This material should be used in areas designated as random fill or discarded in designated spoil areas.

In most cases, the bottom of the disposal cell will be founded within the Ferrelview clay stratum; in the other cases, within the Clay Till stratum. Both these materials are suitable as foundation subgrade for the cell. Location of the cell bottom may require embankment construction to achieve siting criteria for soil depth above bedrock. Excavated materials, if uncontaminated, should be stockpiled for general fill and backfill. Contaminated materials should be placed in a spoil pile and later disposed of in the disposal cell.

4.2.3 Satisfactory Materials

Satisfactory materials for general and random fill, and for backfill, should be uncontaminated materials from required excavation within the site, or materials from approved borrow sources, that have a maximum particle size less than six inches and less than 5% by weight of organic matter or debris; in addition, materials for general fill or backfill, should be those classified as GC, GM, SC, SM, CL and CH according to ASTM D2487 (ASTM 1991); for random fill or backfill material, or other specifically approved locations, the soil could be those classified as GW, GP, SW, SP, SM and ML. The materials can be combinations, such as CL-CH, or SP-SC, within each of their own groupings. Moisture conditioning to meet compaction requirements may be necessary.

Most of the soils encountered at the site, such as Fill, Ferrelview clay and Clay Till are satisfactory materials. Some Loess units were found to contain high silt contents; however, subject to approval by a qualified field engineer, these materials could be used for general or random fill.

4.2.4 Unsatisfactory and Unstable Materials

Materials which are frozen, contaminated, or contain excess organic matter, debris, or cobbles, or classify according to ASTM D2487 as MH, PT, OL and OH would be unsatisfactory as general fill or backfill.

Materials that are classified as GW, GP, SW, SP, SM and ML would be unsatisfactory except in specifically approved locations or as random fill or backfill. Most of the Loess material at the site should be considered unsuitable as fill unless approved by a qualified field engineer. CH materials with PI above 50 may require special conditioning for compactibility, prior to placement as fill, and may, in some cases, be deemed unsuitable as fill.

Unstable materials may be identified by the presence of waving or rutting under construction equipment traffic or by the difficulty in achieving proper compaction. Potentially unstable materials are fine-grained soils with moisture contents near or above the plastic limit as determined by ASTM D4318.

4.2.5 Low-Permeability Soils

Low-permeability soils are required as a component of the cover system and in a compacted clay liner in the leachate collection and liner system. Materials having all of the following characteristics are acceptable for use as low-permeability material on this project:

- Imported from approved borrow sources.
- Classify according to ASTM D2487 as CL or CH.
- Contain at least 60-percent fines (minus No. 200 sieve size).
- Have a liquid limit greater than 30 percent and a plasticity index greater than 10 but less than 50.
- Have no more than 10-percent gravel-size particles, with a maximum particle size of less than 2 inches.
- Are free of organic matter and debris.
- Have a maximum nominal clod size of 2 inches before placement for compaction.
- Can be brought to within the specified moisture range immediately before compaction, without requiring excessive drying.

Materials that meet these characteristics are obtainable from potential Borrow Source No. 1 or from other approved borrow sources yet to be identified. The Ferrelview clay formation is also a good source meeting the required characteristics.

4.3 Potential Borrow Sources

4.3.1 Topsoil/Subsoil

Topsoils at both Borrow Source Nos. 1 and 2 range from six inches to about one foot thick. These soils can be stripped and saved for revegetation purpose.

Soils underneath the topsoil layer at both sources can be utilized as common fill. These materials are mainly silty clay, clayey silt, and silty sandy gravel. Soil classification test results were summarized in Table 3-4.

4.3.2 Low Permeability Soil

Of the two potential clay borrow sources investigated, only source No. 1 is a suitable source for low permeability soils. The subsurface soils at source No. 2 contain numerous layers or lenses of silty and gravelly materials, which are not suitable as low permeability soils. No further investigation of material at this site was performed after a review of soil classification indices and test pit logs.

Borrow Source No. 1 was found to contain suitable materials for low permeability (clay) soils for use such as radon barrier or liner components of the disposal facilities. Test pit logs show that silty clay and clayey silt (CL-ML) of low to medium plasticity exist from the bottom of the top soil layer to approximately 9 feet depth. A highly plastic clay (CH) layer is usually found beneath the CL-ML material. Soil classification test results are presented in Section 3. The recommended shear strength and consolidation parameters for analyses for remolded soils compacted at 95% maximum dry density at about 3% above optimum moisture content as determined from the ASTM D698 test method (Standard Proctor) are presented in Tables 4-1 and 4-2, respectively.

Both these parameters are within the expected range of values for clayey soils and will not cause critical concerns from slope or foundation stability or settlement standpoints. The high plasticity indices of some of these materials place them into high volume change potential category (see Table 4-3), which indicates that these soils may be subjected to shrinkage cracking if the moisture content of the soil changes drastically

Table 4-1

Recommended Unit Weights and Strength Parameters for Stability Analysis for In-situ Soils Units and Compacted Fill Materials

MATERIALS	UNITS WEIGHTS (pcf)		STRENGTH PARAMETERS[1]				
			Short-Term Static	Long-Term Static		Seismic and Rapid Drawdown	
	Moist (γ_m)	Sat. (γ_{sat})	Su (psf)	C' (psf)	ϕ'(°)	C (psf)	ϕ (°)
Top Soil/Fill	123	126		450	23	450	16
Loess	121	124	1200	250	33	350	25
Ferrelview Clay	124	125	1000	300	16	400	10
Clay Till	128	129	1000	240	25	200	19
Basal Till	128	131	1000	600	27	700	19
Residuum	116	123	1000[5]	250	16	200	13
Compacted Fill[2][6] (on site soil)	126	127[3]	1800[4]	50	20	450	13
Compacted Fill[6] Borrow Source No. 1	119	122	2000	400	13	300	18

NOTES:

(1) Representative Value = Mean Value - ½ Standard Deviation and rounded off.

(2) Based on combined results from remolded Loess and Ferrelview clay samples.

(3) Assumed value.

(4) Based on CL material from DM 7.2-39 (Ref. 3) instead of su=2000 psf from test (Value used is somewhat conservative because the CH material has a higher su value).

(5) Assume same strengths as Basal Till.

(6) Compacted to 95% maximum dry density of ASTM D698 Test (Standard Proctor) mehtod.

Table 4-2
Recommended Soil Parameters for Settlement Estimates for Disposal Facility

Soil Unit	Total Unit Weight γ_t (pcf)	Initial Void Ratio e_0	Compression Index C_c			Recompression Index C_r			Coeff. of Consolidation C_v (ft^2/yr)	Preconsolidation Pressure P_p (psf)	Over-Consolidation Ratio OCR
			UB	Mean	LB	UB	Mean	LB			
Exist. Fill[1]	123	0.708	0.355	0.290	0.225	0.039	0.035	0.031	20.5	8300	9.5
Loess	121	0.708	0.355	0.290	0.225	0.039	0.035	0.031	20.5	8300	9.5
Ferrelview	124	0.732	0.347	0.256	0.164	0.094	0.064	0.034	29.6	7500	6.0
Clay Till	128	0.574	0.245	0.210	0.174	0.065	0.052	0.038	74.0	7800	3.2
Basal Till	128	0.604	0.369	0.252	0.135	0.063	0.049	0.035	25.3	P_0[2]	1.0[2]
Residuum	116	1.027	0.352	0.302	0.252	0.099	0.089	0.079	3.6	7600	2.9

[1] Consolidation parameters are assumed to be the same as that of the Loess material.
[2] Assumed normally consolidated.

NOTES: UB = Upper Bound
LB = Lower Bound

at any time. Special attention should also be given during design to ensure that the low PI materials can withstand expected differential subsidence.

As discussed above, both the CL-ML and CH materials typically extend from below the topsoil layer to at least 12 feet depth. Rough quantity estimates indicated that at least 1.5 million cu. yds. of suitable materials are available. These materials can be excavated with front-end loaders or dozers and loaded into "over the highway" haul trucks, which can travel on the existing highway as part of the hauling route. Another possible means of transportation is a conveyor system. In addition, the material could be loaded, transported and unloaded with scrapers, provided a specially constructed haul route, including highway crossing with or without grade separation, is approved and implemented, to cross highway (Highway 94) which separates the site and the borrow source. Detailed study of transportation alternatives will be undertaken in another special study by the PMC.

4.4 Soil Properties and Parameters

Part of the soil test result evaluation is to provide material properties for analysis and calculation during disposal facility design phases. Soil properties for slope stability, settlement, cracking and subgrade bearing calculations are required. Only materials with available field or laboratory test results from the investigation programs will be addressed. Materials that may be imported from unknown sources or materials such as vitrified or chemically stabilized products that may be generated during remedial action will not be included. No evaluation of test results from raffinate pit dikes was performed unless the results have a direct impact on disposal cell design and analysis.

Soil parameters for moisture content, unit weight, strength and consolidation for analytical purposes are shown in Tables 4-1 and 4-2. These values were developed based on test results for the overall site. It can also be noted that there is little difference or trend between test results for the whole site and results specifically from within the disposal area. Therefore, these values should be used as general averages for most engineering applications for the disposal area (such as for slope stability and settlement analyses). Where major differences are observed for certain parameters for other areas, the test results should be examined separately.

Parameters for the various on-site geologic units and for compacted on-site and off-site borrow soils were developed from laboratory test results or empirical correlations. In most cases, the recommended value is the average value based on the valid data points.

4.4.1 Unit Weights

The moist unit weights and saturated unit weights are shown in Table 4-1. These unit weights are determined by multiplying the dry unit weight by the sum of one plus the moisture content, expressed in decimal form. The moisture content of the soil could vary according to the anticipated condition. For example, the natural moisture content (as tested) would be used to calculate the in-situ moist unit weight of the soil or the moisture content (by calculation) at saturated condition for a soil inundated for a long period. On the other hand, for unit weight for radon barrier calculation (not included), the long term moisture content (driest state) or the dry unit weight should be used because this would give a more conservative analytical result.

4.4.2 Strength Parameters for Stability Analysis

The recommended strength properties of various soils within the overall disposal facility site are shown in Table 4-1. Strength parameters for in-situ and compacted soils (at about 95% maximum dry density and 3% above OMC as determined by ASTM D698) were determined based on average values from laboratory test results (triaxial shear tests) and empirical correlations. Total strength parameters from unconsolidated-undrained (UU) triaxial shear tests were determined for short-term condition studies. Effective strength parameters from CU tests were developed for long-term condition studies and total strength parameters from CU tests for long term seismic conditions.

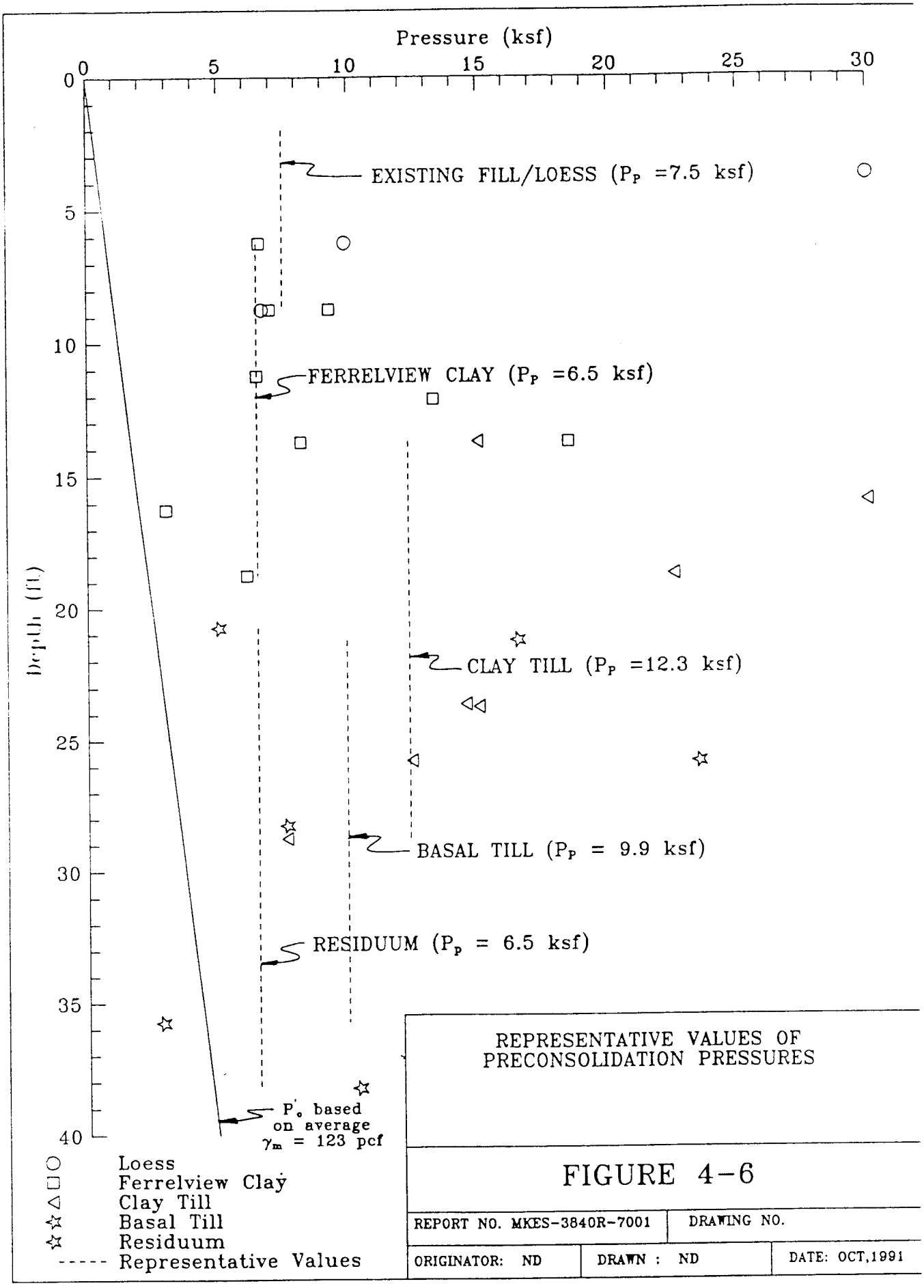
The strength properties for each soil were developed in general by slightly reducing the mean value of each soil to account for uncertainties and built-in conservatism. In cases where a few or only one test result is available for a particular soil unit, empirical values, correlations with STP blow counts, or conservative assumptions were used in developing the recommended analytical values.

4.4.3 Soil Parameters for Settlement Estimates

To estimate the settlement, soil properties such as the unit weight and void ratio are required. The unit weights are shown in Table 4-1. The soil parameters developed from the consolidation tests include preconsolidation pressure (P_p'), compression (C_c) and recompression (C_r) indices and overconsolidation ratio (OCR). The average values of these parameters for the various soil units are presented in Table 4-2. The compression and recompression ratios ($C_{\epsilon C}$ and $C_{\epsilon R}$) were calculated using the void ratio (Appendix C). The representative preconsolidation pressures, P_p', of in-situ materials recommended for settlement analysis are plotted in Figure 4-6 for the overall site. The recommended Pp' value for each soil unit was determined by reducing the average value to a reasonable amount to allow for conservatism. Values from empirical correlations were calculated and used in the evaluation process. When averaging, extremely high values were deleted. These high values do not agree with values from empirical correlations and would introduce unconservatism into the analysis if used. A detailed study of the geologic, loading and preconsolidation history of each geologic unit may provide additional insight into the preconsolidation characteristics, but is beyond the scope of this report. As Figure 4-5 illustrates, all preconsolidation pressure values (except one) exceed the corresponding effective overburden consolidation pressures implying that all soil units are preconsolidated. The slight trend of preconsolidation pressure decreasing with depth for Clay Till and Basal Till is not conclusive, and therefore can be conservatively neglected. For settlement estimates in conjunction with the recommended representative P_p', the compression and recompression indices shown in Table 4-2 can be used. The table shows the average values calculated and the upper and lower bounds of values obtained from the test results. Again, the recommended values are slightly less than the calculated average to allow for uncertanties and conservatism.

4.4.4 Permeability of Soil Liners and Cover Components

The permeability of the soil liner and cover components are based on test results for remolded soil samples from potential borrow sources compacted to 95% of the maximum dry density at about 3% over OMC as determined in accordance with ASTM D698. The triaxial constant head permeability test results for remolded clayey material from potential Borrow Source No. 1 are shown in Table 3-15. The average



REPRESENTATIVE VALUES OF PRECONSOLIDATION PRESSURES

FIGURE 4-6

REPORT NO. MKES-3840R-7001	DRAWING NO.	
ORIGINATOR: ND	DRAWN : ND	DATE: OCT,1991

(logarithmic mean) coefficient of permeability was calculated as 2.7×10^{-8} cm/sec, which is almost an order of magnitude less than the maximum allowable permeability of 1×10^{-7} cm/sec. The material, from a laboratory test result standpoint, meets the required permeability criteria. However, because permeability values from field compacted condition are generally different than those prepared in laboratory, it is recommended that the permeability of the candidate soils be determined using test fills to obtain more accurate values.

4.4.5 Cracking Potential

Low-permeability soils that are required as a component of a cover system or as the compacted liner in a leachate collection system may have a potential for cracking due to soil characteristics and the following causes: 1) differential settlement and 2) shrinkage from drying. The cracking susceptibility of a soil can be assessed from soil indices such as the plastic index (from the Atterberg limits) and the shrinkage limit.

The potential effects of differential settlement can be analyzed by comparing the tesnile strains developed as a result of settlement to the tensile strains required to cause cracking

The tensile strain that causes cracking is a function of the plasticity index and the moisture content of the soil. For soils compacted at moisture contents which are no drier than about 3% below optimum moisture content, an equation for the lower bound failure tensile strain, ϵ_f, has been developed based on measured values (MKE 1989). The equation is:

$$\epsilon_f = 0.05 + 0.003PI.$$

Cracking potential is considered to be significant if the tensile strain from settlement analysis is larger than the failure tensile strain of the soil. For potential Borrow Source No. 1, the average PI is found to be 22. The failure tensile strain therefore is at least 0.12. This value can be compared with the results of settlement analyses to determine if the cracking potential is significant.

To avoid cracking due to soil shrinkage, a soil having a "low" shrink-swell potential should be used if possible. The "shrink-swell" (volume change) potential is defined in Table 4-3.

Soils Borrow Source No. 1 have an average shrinkage limit of 15 and an average PI of 22; based on Table 4-3 for a humid area, this soil is classified as having a low

"shrink-swell" potential. Based on this table, if this soil is used as radon barrier material, no extra thickness is needed to compensate for possible shrinkage effects.

Table 4-3
Relationship Between Atterberg Limits and Volume Change Potential
(Ref. MKE 1989)

Volume Change Potential	Plasticity Index, PI		Shrinkage Limit, w_s	Extra Radon Barrier Thickness to be Provided (inches)
	Arid Area	Humid Area		
Low	0-15	0-30	> 12	0
Moderate	15-30	30-50	10-12	6
High	30	50	< 10	12

4.4.6 Corrosiveness of Soils

Many tables exist for correlating corrosivity with electrical resistivity. The relationship of soil corrosivity to resistivity is generally divided into four or five classes. The resistivity classification presented in papers authored by Husock (Husock 1976) and McIntosh (McIntosh 1982) is as follows:

Soil Resistivity (ohm-cm)	Category
Less than 2,000	Very corrosive
2,000 - 5,000	Corrosive
5,000 - 10,000	Moderately corrosive
10,000 - 25,000	Mildly corrosive
Over 25,000	Progressively less corrosive

Compared to other published tables, this classification system is conservative.

The test results show that the resistivity values measured at the natural moisture content average about 1270 ohm-cm, which place the soil in the very corrosive category. In fact, with the exception of one test, all results are less than 2,000 ohm-cm for the moisture content range of 9 to 57 percent.

Because of the potential for corrosion of both ferrous and non-ferrous metal, protective measures such as coating or cathodic protection should be used for metal structures, or since the laboratory determined resistivity is a general indicator only, field resistivity testing could be performed to obtain more accurate values for final design.

Sulfates in soils can attack and cause the disintegration of concrete or the corrosion of metal pipes. The presence of chlorides in the ground can accelerate the corrosion of buried metals. Even at moderate concentrations, the chloride salts can lead to concrete deterioration. A soil sulfate content greater than 0.10% usually requires the use of Type II or V cement. A chloride content of less than 2% is considered to be innocuous.

The maximum and the average values from the test results (see Section 3.8.2) were 0.08 and 0.06%, respectively for sulfate content and 0.03 and 0.02% respectively for chloride content. All values are less than the corresponding limits of concern and therefore, deterioration of concrete due to the presence of inorganic salts in the soils is not anticipated.

The average pH value of the soils was determined as 6.7. This value is close to the neutral pH value of 7 which indicates that attack on the concrete or steel by acids is not likely.

4.5 Site Preparation and Earthwork

4.5.1 Clearing and Grubbing

Areas to be graded as part of remedial activities should be cleared of bushes and trees and stripped of organic topsoil, roots, grass, debris, loosefill, and other unsuitable materials at the time of grading. Uncontaminated stripped topsoils should be stockpiled for later use (see Section 4.2.1). In no case should the stripped topsoil be reused as engineered fill.

The exposed surface should be scarified to a minimum depth of 8 inches. The scarified material should be properly moisture-conditioned to near optimum moisture content and be compacted to at least 95% of maximum dry density as determined by the American Society of Testing Materials (ASTM D698 test method). If significant pumping or yielding, or both, occur during scarification or recompaction, it will be necessary to stabilize the upper portion of the permanent subgrade foundation by removing the unsuitable material and replaced with a suitable material, or by adding soil admixtures such as lime, cement or fly ash to the subgrade soil. For temporary subgrade foundations, stabilization may include the use of reinforcement such as geotextiles or geosynthetics.

4.5.2 Excavation, Filling and Backfilling

Conventional equipment such as bulldozers, backhoes or scrapers can be used for site grading, trench and foundation excavation. Unusual difficulty is not expected in excavating the on-site soils except the Residuum and weathered rock. However, excavation to these depths is not anticipated. Construction dewatering is generally not necessary unless some localized perched water is encountered. Areas adjacent to existing pads such as the raffinate pits or Ash Pond could be a source of perched ground water. In all cases where excavation dewatering is required, all proper health and safety precautions should be taken to avoid contamination of personnel and equipment.

Temporary construction slopes and excavations should be stabilized as follows: In excavations less than 4 feet deep, a vertical cut slope may be used for short construction periods. In excavations deeper than 4 feet, either shoring or cuts sloped to 0.75 to 1 (H:V) may be used. Flatter slopes may be required in localized areas due to soil strength variation. Temporary slopes for specific construction facilities such as sediment ponds or dikes should be specifically analyzed and designed.

Permanent cut and fill slopes for facilities other than the disposal cell may follow the following general guidelines: 2:1 (H:V) slopes may be used for cuts that are not greater than 20 feet in height and 3:1 (H:V) slopes for heights up to 30 feet. Slopes greater than 30 feet high should be provided with intermediate benches at least 8 feet wide and spaced every 20 and 30 vertical feet for 2:1 (H:V) and 3:1 (H:V) cut slopes, respectively. The inside fill slopes for construction facilities such as dikes or ponds should be no steeper than 2:1 (H:V). The outside fill slopes should be no steeper

than 2.5:1 (H:V). It is recommended that slope stability analysis be performed to confirm the above recommendations for individual cases where cuts or fills are greater than 20 feet.

All fill or backfill should be compacted to a minimum 90% of maximum dry density based on the Standard Proctor (ASTM D698) test method. Fill or backfill in areas such as structural or road subgrades (top 3 feet) should be compacted at a minimum 95% of maximum dry density based on the ASTM D698 test method. These materials should be free of deleterious materials and rocks greater than 4 inches in size. The materials should be placed in thin lifts, and moisture conditioned prior to compaction.

Material and compaction requirements for individual components of the disposal cell are being studied separately and are not stated here.

5 REFERENCES

ASTM, see American Society for Testing and Materials

American Society for Testing and Materials, 1991. Annual Book of ASTM Standards. Philidelphia.

Bechtel National, Inc., 1983a. Weldon Spring Storage Site 1982 - 1983, Geologic Characterization. July.

Bechtel National, Inc., 1984. Geologic Report, Weldon Spring Raffinate Pits Site. Prepared for U.S. Department of Energy, Oak Ridge Operations Office. DOE/OR/20722-6. November.

Bechtel National, Inc., 1987. Hydrogeological Characterization Report for Weldon Spring Chemical Plant, Weldon Spring, Missouri. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. DOE/OR/20722-137. July.

BNI, see Bechtel National, Inc.

COE, see U.S. Army Corps of Engineers.

EPA, see U.S. Environmental Protection Agency

Funk Software, Inc., 1988. ALLWAYS, 1st Edition, Cambridge, MA.

Geotechnology Services, Inc., 1988. Final Report, Volumes I and II Geophysical Investigation Specification 3589-SC-WP028, Weldon Spring Chemical Plant. Prepared for MK-Ferguson Company. December.

Golden Software, Inc., 1988. GRAPHER, Version 1.79, Golden, CO.

GSI, see Geotechnology Services, Inc.

Henry M. Reitz, Consulting Engineers, 1964. Design Memorandum for 12M Cubic Feet-Raffinate Pit, Atomic Energy Commission Plant, Weldon Spring, Missouri. January.

Husock, Bernard, 1976. Causes of Underground Corrosion - Presented at Appalachian Underground Corrosion Short Course. West Virginia University, Morgantown, West Virginia. May.

Lotus, see Lotus Development Corporation.

Lotus Development Corporation, 1986. LOTUS 1-2-3, Version 2.01, Cambridge, MA.

McIntosh, Donald H., 1982. Grounding Where Corrosion Protection is Required. IEEE Transactions on Industry Applications, Vol. IA-18, No. 6. November.

Mitchell, James K., 1976. Fundamentals of Soil Behavior. John Wiley & Sons.

MKES, see MK-Environmental Services

MK-Environmental Services, 1991a. *WSSRAP - Disposal Facility Geotechnical Investigation - MKE Phase III (1991) Technical Memorandum 5121-TM-776-00, Scope of Work and Guidelines for Drilling, Sampling and Laboratory Testing Program.* Prepared for MK-Ferguson and Jacobs Engineering Group. San Francisco. March.

MK-Environmental Services, 1991b. *WSSRAP - Disposal Facility Siting Study Report,* Rev. 1. MKES Report No. 5121R-722-1. Prepared for MK-Ferguson Company and Jacobs Engineering Group. San Francisco. April.

MK-Environmental Services, 1991c. *WSSRAP - Disposal Facility Liner and Foundation Assessment Report*, Rev. B. MKES Report No. 3840R-7001-B. Prepared for MK-Ferguson Company and Jacobs Engineering Group. San Francisco. October.

MK-Environmental Services, 1991d. *WSSRAP - Disposal Facility Grading Plan Supporting Study*, Rev. C. MKES Report No. 3840R-797-C. Prepared for MK-Ferguson and Jacobs Engieering Group. San Francisco. July.

MK-Environmental Services, 1991e. *WSSRAP - Disposal Facility Erosion Control Plan* Draft. Prepared for MK-Ferguson and Jacobs Engineering Group. Boise.

MKF and JEG, see MK-Ferguson Company and Jacobs Engineering Group.

MK-Ferguson Company and Jacobs Engineering Group, 1988. *Geophysical/Geotechnical Investigation Sampling Plan.* Rev. 1. DOE/OR/21548-014. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. July.

MK-Ferguson and Jacobs Engineering Group, 1990a. Suitability of the Weldon Spring Site for Potential Location of a Disposal Facility for the Weldon Spring Site Remediation Action PRoject, Weldon Spring, Missouri. DOE/OR/21548-102 Revision 0. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. September.

MK-Ferguson Company and Jacobs Engineering Group, 1990b. *WSSRAP - Chemical Plant Geotechnical Investigations.* Rev. 0. DOE/OR/21548-158. Prepated for U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. December.

MK-Ferguson Company and Jacobs Engineering Group, 1990c. *Remedial Investigation Report for the Weldon Spring Site Remedial Action Project*, DOE/21548-074, Rev. 0. Prepared for the U.S. Department of Energy, Oak Ridge Operations Office, Weldon Spring Site Remedial Action Project, St. Charles, Missouri. December (Draft)

MK-Ferguson Company and Jacobs Engineering Group, 1991. *WSSRAP - Geotechnical Investigation Sampling Plan.* Rev. 0. DOE/OR/21548-190. Prepated for U.S. Department of Energy, Oak Ridge Operations Office. St. Charles, MO. April.

Petry, Thomas M. et al., 1980. Relationships and Variations of Properties of Clay 4th International Conference on Expansive Soils, ASCE. June.

SCS, See U.S. Soil Conservation Service.

U.S. Army Corps of Engineers, Office of the District Engineer, St. Louis District, 1955. Report of Foundaton Investigation, United State Atomic Energy Commission, Weldon Spring, Missouri. February.

U.S. Army Corps of Engineers, 1970. Engineering Manual, Engineering Design Stability of Earth and Rockfill Dams. EM 1110-2-1902. Washington, D.C. April.

U.S. Environmental Protection Agency, 1982. Test Methods - Technical Additions to Methods for Chemical Analysis of Water and Wastes. Environmental Monitoring and Support Laboratory, Cincinnati, OH. December.

U.S. Environmental Protection Agency, 1988. SW846, Volume 1C.

U.S. Soil Conservation Service, 1967. Soil Survey Laboratory Methods and Procedures for Collecting Soild Samples. Soil Survey Investigations Report No. 1. U.S. Department of Agriculture. Washington, D.C.

APPENDIX A

MKES PHASE III FIELD INVESTIGATION PROGRAM

APPENDIX A-1

IOC REPORT ON PHASE III FIELD INVESTIGATION

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

INTER-OFFICE CORRESPONDENCE

FILE NUMBER: 3840-D:EN-I-01-4165-00

DATE: 14 May 1991

TO: Ed Tom

FROM: Eerik Rennat

LOCATION: San Francisco

LOCATION: San Francisco

SUBJECT: WSSRAP - DC
GEOTECHNICAL DRILLING
PHASE III

This report presents the edited field boring logs and the procedures performed during the drilling and soil sampling of 7 additional exploratory borings at the location of the proposed disposal cell, Weldon Springs Site Remedial Action Project (WSSRAP). Boring locations are shown on the accompanying Boring Location Plan. The investigation will provide additional geotechnical design parameters for construction of a waste disposal facility. The drilling program was prepared following the directions from the Department of Energy (DOE) document, Geophysical/Geotechnical Investigation Sampling Plan.

Drilling was conducted from April 5 through April 15, 1991 by Geotechnology Services, Inc. under subcontract WP228. Don Houston and Paul Guerrin performed as driller and driller's helper, respectively. Sample logging, documentation and drilling supervision was performed by Eerik Rennat of Morrison-Knudsen Environmental Services (San Francisco).

Prior to initiating the drilling, the drill rig and all drilling tools were thoroughly decontaminated with high pressure water. Additionally, the rear of the rig and drilling tools were decontaminated between borings. Personal protective equipment consisted of gloves, safety boots, hard hats and eye protection. Hearing protection was worn when within 15 feet of the drill rig during drilling operations. A safety meeting was held each day prior to the commencement of work.

All boreholes except GT-73 were located in uncontaminated areas. Radiation personnel from the PMC assisted in locating GT-73 and were present during drilling through the shallow contaminated materials.

All personnel had received the OSHA 40-hour hazardous waste safety training (29CFR 1910.120) plus site-specific WSSRAP radiation safety instruction conducted by a site health physicist. All personnel wore thermoluminescent dosimitry (TLD) badges and provided entrance and exit urine samples.

Drilling was accomplished with a CME-750 drill rig using continuous flight hollow-stem augers having an outside (O.D.) diameter of 7-1/2 inches and an inside (I.D.) diameter of 3-3/4 inches. All holes were drilled to auger refusal at the top of bedrock. No rock coring was performed.

Soil sampling was performed on 2-1/2 foot centers. Disturbed soil samples were obtained using a 2.0-inch O.D., 1.5-inch I.D. Standard Penetration (SPT) sampler. SPT samples were placed in capped glass jars. Relatively undisturbed samples were obtained using a California split-barrel sampler having an O.D. of 3.0 inches and I.D. of 2.5 inches. Four 6-inch long, 2.5-inch I.D. brass liners were placed inside the California sampler. Each retrieved 6-inch liner was capped and taped. Both the SPT and California samplers were driven a depth of 18 inches beyond the lead auger using a 140-pound safety hammer free-falling 30 inches. The number of blows required to drive each 6-inch interval was recorded and the final two 6-inch drives were summed and expressed as blows per foot. Undisturbed samples, where possible, were obtained by hydraulically pushing 3.0-inch diameter, 36-inch long steel Shelby tubes to a depth of 30 inches. Upon retrieval, both ends of the tube were sealed with molten bee's wax, capped, and taped. Any excess space in the tube after waxing was filled with cuttings to minimize movement of the sample within the tube.

Soils encountered were described in accordance with the Unified Soil Classification System. SPT samples were photographed.

A daily diary was maintained documenting all drilling activities. Chain-of-custody forms were completed showing soil samples collected. All samples were stored on-site in building 410.

All borings were abandoned by plugging with Volclay Grout manufactured by American Colloid Company. Volclay consists of a high-solids bentonite clay powder with a 4% added initiator which causes the grout to set up to a plastic consistency. Each 50-pound bag of Volclay powder was mixed with approximately 23 gallons of clear water to yield a grout

mixture of 9.4 lbs/gal or denser. Density was verified with a scale. The Volclay powder was jetted through a hopper into a tub and thoroughly mixed by circulating through the rig mud pump. Two pounds of initiator were added per 50-pound bag of Volclay. Once mixed, the grout slurry was pumped through the hollow stem augers, the augers were retrieved, and the hole topped off. Holes were checked for settling of the grout after 24 hours and topped off if necessary.

Upon completion of the drilling, the drill rig, all drilling tools, and the water truck were decontaminated with high pressure water prior to demobilizing the site.

EAR:afp

APPENDIX A-2

LOGS OF PHASE III BORINGS

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number GT-68

Project: Weldon Springs Site Remedial Action Project	Location: NW of MSA
Coordinates: (AEC) N101328.3, W51437.0	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 53.5 / Depth Casing & Size: -- / Hole Size: 7 1/2" (Auger
Elevation: 643.0	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 53.5
Water Level: Dry	Fluid & Additives: None / Date Start: 4/5/91 9:00 / Date Finish: 4/5/91 15:45 / Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							ORGANIC SILT (ML) Lt-med brown, dry, hard, some organics — TOPSOIL
							Silty Clay
		2.5-4	SS 6801	14"	10-34-41		Mottled lt brown and lt. gray, moist, stiff, plastic some Fe and Mn staining, occasional small (1/4") clasts. CL
5		5-7.5	ST 6802	26"			
		7.5-9	SS 6803	14"	3-6-8 (14)		
10		10-12.5	ST 6804	25"			
		12.5-14	SS 6805	18"	4-9-15 (24)		FERRELVIEW
15		15-16	ST 6806	13"			-ST pushed only 15"
		17.5-19	SS 6807	6"	13-21-20 (41)		Clay
							Mottled lt. orange and lt. gray, slightly moist to moist, stiff, some Fe staining, Mn staining along irregular fractures, 10% subrounded sand, occasiona small gravel (chert and feldspor) CL - CH
20		20-22.5	ST 6808	26"			
		22.5-24	SS 6809	17"	6-9-12 (21)		CLAY TILL
25							

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project Number:	Boring Number:	Sheet 2 of 2
3840	GT - 68	

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
		25-27.5	ST 6810	28"			(cont'd)
		27.5-29	SS 6811	19"	5-9-11 (20)		
30		30-31	ST 6812	10"			- ST pushed only 12" CLAY TILL
		32.5-34	SS 6813	20"	4-6-12 (18)		Clay Sand and Sandy Clay Lt. orange to pinkish brown, moist, medium to stiff, plastic, angular gravel clasts.
35		35-36.5	SS 6814	14"	25-19-26 (45)		SC - CL BASAL TILL Gravelly Clay and Clayey Gravel
		37.5-39	SS 6815	14"	15-19-43 (62)		Red-orange, moist, stiff, less plastic, 40-60% angular sand and gravel, often Fe stained, mostly chert GC - CL
40		40-41.5	SS 6816	15"	20-43-50/5" ---		
		42.5-44	SS 6817	17"	13-14-25 (39)		
45		45-46.5	SS 6818	14"	12-47-20 (67)		- less red coloring, wet toward bottom
		47.5-49	SS 6819	12"	8-8-7 (15)		
50		50-51.5	SS 6820	12"	10-8-10 (18)		RESIDUUM
							Auger Refusal at 53.5 feet
55							

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT-69

Project: Weldon Springs Site Remedial Action Project	Location: 200' NW of Bldg. 109, at foot of slope
Coordinates: (AEC) N101092.9, W50327.1	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 31.5 / Depth Casing & Size: -- / Hole Size: 7 1/2" (Auger
Elevation: 647.1	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 31.5
Water Level: Dry	Fluid & Additives: None / Date Start: 4/08/91 15:00 / Date Finish: 4/11/91 9:00 / Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
							Silty Clay Mottled lt. to med. brown and lt. gray, moist, medium stiff, plastic, occasional Fe and Mn staining; Dk brown organics near top CL
		2.5-4	SS 6901	14"	1-4-5 (9)		
	5						
		5 7.5	ST 6902	15"			
							FERRELVIEW
		7.5-9	SS 6903	18"	2-7-10 (17)		Clay Orange-brown, moist, stiff, plastic, Mn staining along irregular fractures, 10% quartz sand considerable whitish calcite below 12.5' CL - CH
	10						
		10-12.5	ST 6904	28"			
		12.5-14	SS 6905	18"	3-10-15 (25)		
	15						- ST pushed only 24"
		15-17.5	ST 6906	24"			
							CLAY TILL
		17.5-19	SS 6907	18"	6-14-20 (34)		Clayey Sand and Sandy Clay Mottled lt. gray and lt. brown, slightly moist, stiff low plasticity, Fe and Mn staining, some calcite SC - CL
	20						
		20-22.5	ST 6908	27"			
							BASAL TILL
		22.5-24	SS 6909	19"	6-11-29 (40)		Reddish, moist, stiff, plastic, Mn staining along irregular fractures; angular chert gravel, increasing with depth Gravelly Clay and Clayey Gravel
	25						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES
A Division of MK-Ferguson

Project Number: 3840	Boring Number: GT - 69	Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
	25-26.5	CS 6910	12"	(52-41-31)		(cont'd)
	27.5-29	SS 6911	17"	3-20-18 (38)		- orange-brown color, 50% chert gravel, occasional calcite encrustation GC - CL
30	30	CS --	2"	(100/1")		RESIDUUM
						Auger Refusal at 31.5'
35						
40						
45						
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT - 70

Project: Weldon Springs Site Remedial Action Project	Location: W of MSA
Coordinates: (AEC) N10082[illegible].1 W51328.1	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 29.5
Depth Casing & Size: --	Hole Size: 7 1/2" (Auger)
Elevation: 634.5	Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 29.5	
Water Level: Dry	Fluid & Additives: None
Date Start: 4/08/91 9:45	Date Finish: 4/08/91 12:30
Logger: E. Rennat	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
							Silty Clay
		2.5-4	SS 7001	14"	3-4-7 (11)		Grey-brown, moist to very moist, Fe staining, occasional chert clasts. CL
	5	5-6.5	ST 7002	18"			- ST pushed only 18"
		7.5-9	SS 7003	18"	3-6-7 (13)		
	10	10-12.5	ST 7004	24"			
		12.5-14	SS 7005	18"	4-16-30 (46)		- 1" chert piece in shoe of SS
							FERRELVIEW
	15	14-15.5	SS 7006	12"	43-40-26 (66)		Silty Clay and Clayey Sand
							Brown, slightly moist to moist, very stiff, very Fe rich, up to 50% 1/4" chert fragments CL - SC
		17.5-19	SS 7007	11"	12-9-20 (29)		
	20	20-21	ST 7008	12			- ST pushed only 1'
		22.5-24	SS 7009	12"	8-6-7 (13)		
							CLAY TILL/BASAL TILL
	25						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES

Project Number:	Boring Number:	Sheet 2 of 2
3840	GT - 70	

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25-26	ST 7010	12"			(cont'd) - ST pushed only 1'
	27.5-28.5	SS 7011	10"	30-34-50/4" (-)		Gravelly Clay Brown, moist, Fe rich - sand lens from 28 to 28.4', with gravel RESIDUUM
30						Auger Refusal at 29.5'
35						
40						
45						
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT - 71

Project: Weldon Springs Site Remedial Action Project	Location: 70'W of SW corner of Bldg. 201
Coordinates: (AEC) N99758.2, W50300.1	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 34.5 / Depth Casing & Size: -- / Hole Size: 7 1/2" (Auger)
Elevation: 659.3	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 34.5
Water Level: Dry	Fluid & Additives: None / Date Start: 4/11/91 10:50 / Date Finish: 4/11/91 15:05 / Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							Silty Clay
		2.5-4	SS 7101	12"	4-6-8 (14)		Mottled lt. to med. brown and gray, moist, plastic, stiff, occasional Fe and Mn staining. CL
	5	5-7.5	ST 7102	21"			
		7.5-9	SS 7103	13"	1-5-8 (13)		
	10	10-12.5	ST 7104	27"			
		12.5-14	SS 7105	18"	2-6-8 (14)		
							FERRELVIEW
	15	15-17.5	ST 7106	26"			Clay Mottled lt. brown and gray, moist, plastic, stiff, 5% medium to coarse subrounded chert sand, occasional 1/4" chert clasts. CL - CH
		17.5-19	SS 7107	19"	3-6-8 (14)		
	20	20-22.5	ST 7108	27"			
		22.5-24	SS 7109	18"	4-7-7 (14)		
	25						CLAY TILL

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project Number: 3840	Boring Number: GT - 71	Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25-27.5	ST 7110	27"			Sandy Clay Lt. brown, moist, plastic, stiff, occasional Fe and Mn staining, chert clasts CL
	27.5-29	SS 7111	19"	6-10-15 (25)		
						BASAL TILL
30	30-31.5	CS 7112	15"	(21-36-20)		Gravelly Clay Lt orange, moist, plastic, stiff, some Mn staining along fractures; angular chert clasts up to 1", up to 30% toward bottom CL
	32.5-34	SS 7113	11"	15-15-50/5		
						RESIDUUM
35						Auger Refusal at 34.5'
40						
45						
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT - 72

Project: Weldon Springs Site Remedial Action Project	Location: 200' E of Bldg. 302
Coordinates: (EC) N99200.8, W50074.0	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 34' / Depth Casing & Size: -- / Hole Size: 7 1/2" (Auger)
Elevation: 557.5	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 34'
Water Level: Dry	Fluid & Additives: None / Date Start: 4/12/91 8:00 / Date Finish: 4/12/91 11:20 / Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							- Dark brown organics near surface
		2.5-4	SS 7201	13"	4/5/6 (11)		Silty Clay Mottled lt. to med. brown and gray, moist plastic, stiff, occasional Fe and Mn staining, occasional angular chert clasts. CL
	5	5-7.5	ST 7202	25"			
		7.5-9	SS 7203	17"	3/5/6 (11)		
	10	10-12.5	ST 7204	26"			
		12.5-14	SS 7205	16"	2/5/7		
	15	15-16.5	CS 7206	18"	(4/9/13)		
		17.5-19	SS 7207	17"	2/7/9 (16)		
	20	20-22.5	ST 7208	28"			FERRELVIEW Clay Mottled lt. brown, orange and lt. gray, moist, plastic stiff to very stiff, Fe and Mn staining, often along fractures 5% coarse angular chert sand, occasional angular chert clasts up to 1". CL - CH
		22.5-24	SS 7209	20"	5/10/15 (25)		
	25						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES

Project Number: 3840	Boring Number: GT - 72	Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
						(cont'd)
	25-27.5	ST 7210	26"			
	27.5-29	SS 7211	18"	10/14/16 (30)		CLAY TILL Gravelly Sandy Clay Black with brown, moist, stiff, plastic, 40% fine to medium subrounded chert gravel, whitish calcite encrustations below 30'. CL
30						
	30-31.5	CS 7212	11"	(14-100/2")		
	32.5-34	SS 7213	6"	50/5"		BASAL TILL
35						Auger Refusal at 34'
40						
45						
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT - 73

Project: Weldon Springs Site Remedial Action Project
Location: 100' W of SW corner of Bldg. 302
Coordinates: (AEC) N99072.7 W50456.6
Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted
Depth Top of Rock: 45.5'
Depth Casing & Size: --
Hole Size: 7 1/2" (Auger)
Elevation: 660.0
Angle from Vert. and Bearing: Vertical
Depth Bottom of Hole: 45.5'
Water Level: Dry
Fluid & Additives: None
Date Start: 4/15/91 11:20
Date Finish: 4/15/91 16:10
Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
							Silt Dk brown with organics, moist (radiologically contaminated up to 400 cts/min) ML
							FILL
		2.5-4	SS 7301	13"	2/4/6 (10)		Silty Clay Lt. to med. brown with gray, moist, plastic, stiff, Fe and Mn staining increasing with depth, occasional angular chert clasts CL
	5	5-7.5	ST 7302	28"			
		7.5-9	SS 7303	16"	1/5/8 (13)		
	10	10-12.5	ST --	4"			- no sample
		12.5-14	SS 7305	16"	1/4/7 (11)		
	15	15-17.5	ST 7306	23"			
							FERRELVIEW
		17.5-19	SS 7307	20"	4/8/12 (20)		Clay Lt. gray-brown, moist, plastic, slight Fe and Mn staining, 5% medium to coarse subrounded chert and quartz sand, occasional whitish calcite, occasional gravel-size chert clasts. CL - CH
	20	20-22.5	ST 7308	28"			
		22.5-24	SS 7309	18"	5/8/12 (20)		
	25						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project Number: 3840	Boring Number: GT - 73	Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
						(cont'd)
	25-27.5	ST 7310	27"			
	27.5-29	SS 7311	21"	5/12/16 (28)		
30						
	30-32.5	ST 7312	15"			- ST pushed only 20"
	32.5-34	SS 7313	21"	6/10/11 (21)		CLAY TILL
						Silty Clay Gray, moist, plastic, medium stiffness (softer than above), little sand, no gravel, some Fe staining. CL
35	35-36.5	CS 7314	19"	(7/11/15)		
						BASAL TILL
	37.5-39	SS 7315	17"	5/9/20 (29)		Gravelly Sandy Clay Lt. to dk brown to 40', orange below 40', medium to coarse sand, increasing angular chert gravel with depth. CL
40	40-41.5	CS 7316	15"	(24/37/		
	42.5-44	CS 7317	7"	34-50/2"		
45						RESIDUUM
						Auger Refusal at 45.5'
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2
Project Number: 3840
Hole Number: GT - 74

Project: Weldon Springs Site Remedial Action Project	Location: Proposed Water Treatment Plant Area
Coordinates: (AEC) N98676.0 W50266.6	Drilling Contractor: Geotechnology Services, Inc.
Drill Make and Model: CME 750, ATV mounted	Depth Top of Rock: 34.5 / Depth Casing & Size: -- / Hole Size: 7 1/2" (Auger
Elevation: 653.2	Angle from Vert. and Bearing: Vertical / Depth Bottom of Hole: 34.5
Water Level: Dry	Fluid & Additives: None / Date Start: 4/16/91 / Date Finish: 4/16/91 / Logger: E. Rennat

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION
							Clayey Silt and Silty Clay Med. brown, moist, plastic; dk brown organics near top, occasional chert clast up to 1/2". CL - ML
		2.5 -4	SS 7401	5"	2/3/6 (9)		
5		5- 7.5	ST 7402	26"			TOPSOIL/FILL
		7.5 9	SS 7403	14"	1/4/6 (10)		Silty Clay Mottled lt. brown and lt. med. gray, moist, plastic, CL
10		10- 12.5	ST 7404	27"			FERRELVIEW
		12.5 -14	SS 7405	18"	1/5/7 (12)		Clay Lt. brown, orange and gray, moist, plastic, stiff, 5% medium to coarse rounded to subrounded chert sand, Fe and Mn staining. CL - CH
15		15- 17.5	ST 7406	28"			- ST pushed only 28"
		17.5 -19	SS 7407	18"	3/8/9 (17)		- 10% fine subrounded gravel, gray
20		20- 22.5	ST 7408	23"			- ST pushed only 26"
		22.5 -24	SS 7409	22"	3/8/9 (17)		
25							

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project Number: 3840	Boring Number: GT - 74	Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP Location:

Elevation: Drilling Contractor:

Drilling Method and Equipment:

Water Level and Date: Start Finish: Logger:

ELEVATION / DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE & NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION (Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol)
	25-27.5	ST 7410	24"			(cont'd)
						CLAY TILL
	27.5-29	SS 7412	14"	9/23/25 (48)		Clayey Gravel Whitish with orange Fe staining, angular chert, 30% sandy clay, whitish calcite encrustations. GC
30	30-30.5	CS -	3"	(100/5")		- no sample
	32.5-33	SS -	2"	50/2"		- no sample
35						Auger Refusal at 34.5'
40						
45						
50						
55						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

APPENDIX B

MKES PHASE III INVESTIGATION TEST RESULTS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

IN-SITU MOISTURE AND DENSITY DETERMINATION

SITE ID: WSSRAP

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

* Average of three values

LOCATION ID	SAMPLE ID	DEPTH INTERVAL (FT)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	
Disposal Facility	GT-6810	25.0-25.7	16.5	110.0	
"	GT-6906	15.0-17.5	14.1	112.1	*
"	GT-6908	20.0-22.5	15.6	116.3	
"	GT-6910	25.0-26.5	9.6	NP	
"	GT-7004	10.0-12.5	18.8	110.1	
"	GT-7108	20.0-22.5	16.3	111.0	*
"	GT-7110	25.0-27.5	20.9	106.2	*
"	GT-7112	30.0-31.5	22.5	88.0	
"	GT-7306	15.0-17.5	32.4	92.4	
"	GT-7314	35.0-36.5	22.5	102.3	
"	GT-7316	40.0-41.5	10.2	NP	
"	GT-7402	5.0-7.5	24.2	99.9	
"	GT-7406	15.0-17.5	17.8	110.3	*

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

MECHANICAL SIEVE TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-8-91

CHECKED BY: LAB SKM

LAB NAME: CNI

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	% PASSING STANDARD SIEVE NUMBERS *										
		3"	1 1/2"	3/4"	3/8"	#4	#8	#16	#30	#50	#100	#200
GT-6510	25.0-27.5		100	95	95	95	95	94	92	88	78	71
6513	32.5-34.0			100	99	99	98	98	97	97	96	95
6515	37.5-39.0			100	94	91	89	88	87	86	85	84
6706	15.0-17.5					100	99	97	94	89	80	72
6708	20.0-22.5				100	90	89	88	86	82	74	67
6710	25.0-26.5	100	62	55	47	35	28	24	22	20	19	18
7004	10.0-12.5							100	99	98	94	93
7108	20.0-22.5						100	99	97	91	77	68
7110	25.0-27.5							100	99	99	99	98
7112	30.0-31.5		100	82	70	64	62	61	60	59	58	57
7306	15.0-17.5						100	99	98	94	88	84
7314	35.0-36.5					100	99	99	99	98	97	96
7316	40.0-41.5		100	66	56	40	36	32	29	27	24	23
7402	5.0-7.5					100	99	98	97	93	85	79
7406	15.0-17.5			100	99	99	97	96	94	89	79	72

*ENTER ONLY VALUES LESS THAN 100%. TEST PROCEDURE: ASTM D 422-63 (1990)

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

HYDROMETER ANALYSIS TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-8-91

CHECKED BY: LAB SKM

LAB NAME: CNI

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	% FINER THAN (mm) *							
		.074 mm	.05 mm	.037 mm	.019 mm	.009 mm	.005 mm	.002 mm	.001 mm
GT-6810	25.0-27.5	71	—	(.030) 61	54	(.008) 45	(.006) 43	(.003) 36	33
GT-6813	32.5-34.0	95	—	(.028) 72	59	(.008) 42	(.006) 38	(.003) 33	30
GT-6815	37.5-39.0	—	—	—	—	—	—	—	—
GT-6906	15.0-17.5	72	—	(.029) 61	55	(.008) 42	(.006) 40	(.003) 32	29
GT-6908	20.0-22.5	67	—	(.029) 61	51	(.011) 44	(.006) 37	(.003) 31	28
GT-6910	25.0-26.5	—	—	—	—	—	—	—	—
GT-7004	10.0-12.5	93	—	(.028) 72	60	(.008) 39	(.006) 35	(.003) 30	27
GT-7108	20.0-22.5	68	—	(.030) 57	(.020) 51	(.008) 42	(.006) 39	(.003) 34	31
GT-7110	25.0-27.5	98	—	(.027) 84	(.018) 71	(.008) 51	(.006) 49	(.003) 44	40
GT-7112	30.0-31.5	57	—	(.028) 52	(.018) 50	(.008) 48	(.006) 46	(.003) 45	44
GT-7306	15.0-17.5	84	—	(.028) 74	(.018) 66	(.008) 54	(.006) 51	(.003) 46	42
GT-7314	35.0-36.5	96	—	(.023) 77	60	(.011) 47	(.006) 34	(.003) 30	28
GT-7316	40.0-41.5	23	—	(.031) 22	(.020) 21	(.011) 20	(.006) 19	(.003) 17	16
GT-7402	5.0-7.5	79	—	(.028) 70	(.018) 63	(.009) 54	(.006) 51	(.003) 44	41
GT-7406	15.0-17.5	72	—	(.030) 61	56	(.008) 44	(.006) 41	(.003) 37	32

TEST PROCEDURE: ASTM D 422-63 (1990)

* ENTER ONLY VALUE LESS THAN 100%

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

PHYSICAL PROPERTY TEST RESULTS

SITE ID: WSSRAP
LOCATION ID: Disposal Facility
DATE: 8-8-91
CHECKED BY: LAB SKM
LAB NAME: CNI
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	SPECIFIC GRAVITY
GT-6310	25.0-27.5	47	13	34	2.69
GT-6313	32.5-34.0	40	13	27	—
GT-6906	15.0-17.5	41	12	29	—
GT-6908	20.0-22.5	40	15	25	2.77
GT-6910	25.0-26.5	—	—	—	(-4) 2.74 (+4) G_a = 2.59
GT-7004	10.0-12.5	41	15	26	2.75
GT-7108	20.0-22.5	47	14	33	—
GT-7110	25.0-27.5	54	15	39	2.72
GT-7112	30.0-31.5	—	—	—	(-4) 2.74 (+4) G_a = 2.44
GT-7306	15.0-17.5	64	19	45	2.74
GT-7314	35.0-36.5	38	16	22	2.71
GT-7316	40.0-41.5	50	17	33	(-4) 2.70 (+4) G_a = 2.56
GT-7402	5.0-7.5	55	13	42	—
GT-7406	15.0-17.5	42	12	30	—

TEST PROCEDURE: ASTM D-4318-84 AND ASTM D854-83 (1990)

CONSOLIDATION TESTS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-20-91

CHECKED BY LAB: SKM

LAB NAME: CNI

TAC: _____

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-6E10	25.0-27.5	250	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.3	15.6	80.3	0.525

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
118.0	18.3	100+	0.425

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.515	N/A
WATER ADDED	0.547	N/A
500	0.542	1.35×10^{-4}
1000	0.535	N/A
2000	0.522	6.20×10^{-4}
4000	0.507	1.67×10^{-3}
8000	0.487	7.99×10^{-4}
16,000	0.454	5.24×10^{-4}
32,000	0.409	1.56×10^{-4}
64,000	0.350	1.03×10^{-4}
128,000	0.283	6.98×10^{-4}
32,000	0.304	N/A
8000	0.351	N/A
2000	0.404	N/A
500	0.424	N/A
250	0.425	N/A

TEST PROCEDURE: ASTM D 2435-90

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

[illegible] #6810 CONSOL ENTERED BY SKM [illegible] BY SKM

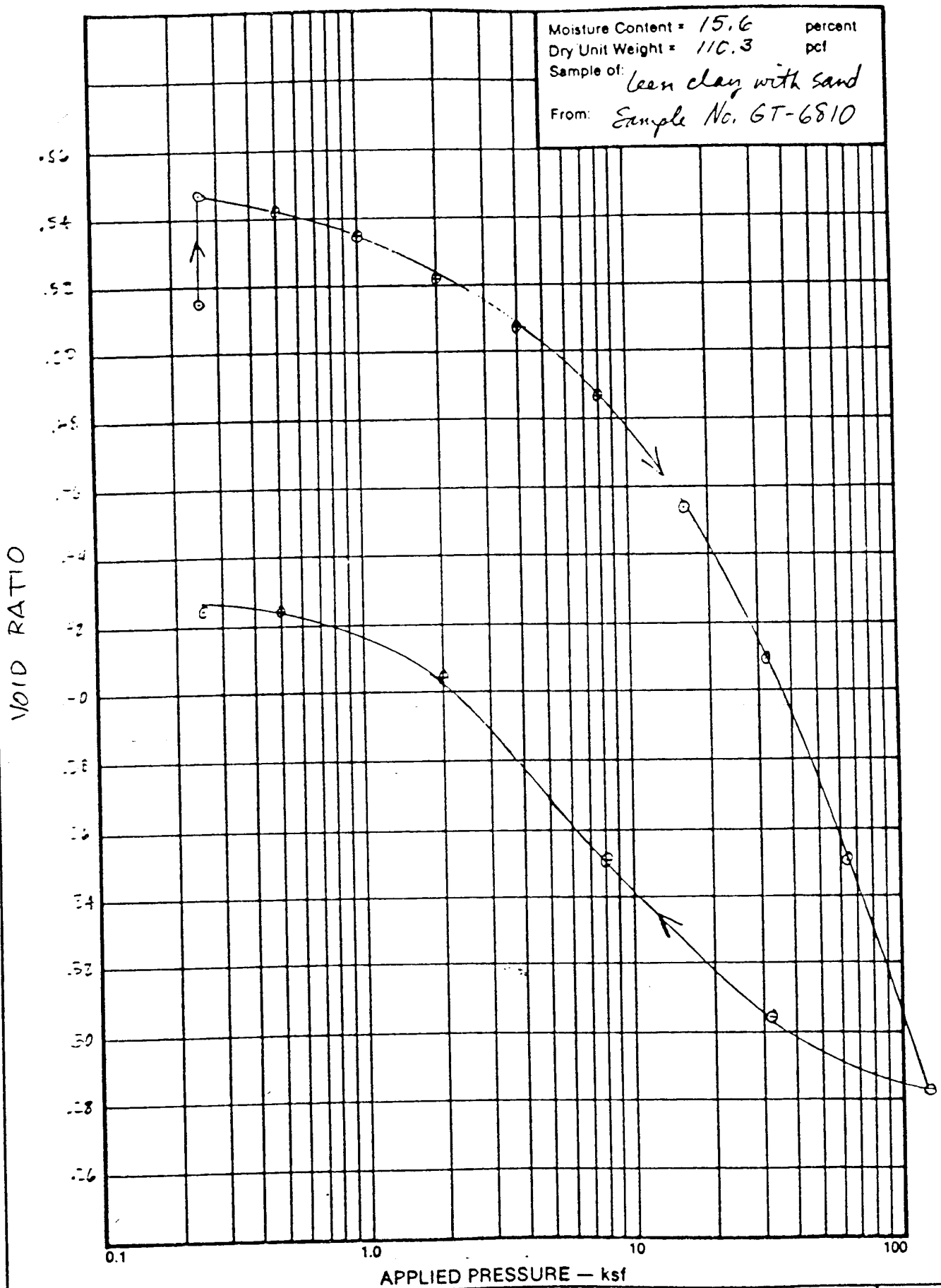
INITIAL WET WEIGHT OF SAMPLE g = [illegible]
INITIAL DRY WEIGHT OF SAMPLE g = 62.46
FINAL WET WEIGHT OF SAMPLE g = 73.91
FINAL DRY WEIGHT OF SAMPLE g = 62.46
INITIAL SAMPLE DIAMETER in = 1.9270
INITIAL SAMPLE HEIGHT in = 0.7400
SPECIFIC GRAVITY = 2.6940
NUMBER OF INPUT DATA = 17
TIME USED TO CALCULATE CV sec =T50
DIAL READING FORWARD OR BACKWARD ? =BW

No.	PRESSURE(ksf)	DIAL READING(in)	T90/T50(sec)
1	0	.2012	0
2	.25	.20598	0
3	.25	.1905	0
4	.5	.1926	1320
5	1	.19619	0
6	2	.20247	282
7	4	.20968	103
8	8	.21944	210
9	16	.23554	309
10	32	.2572	984
11	64	.2857	1380
12	.128	.3187	1860
13	32	.3081	0
14	8	.2856	0
15	2	.2598	0
16	.5	.25	0
17	.25	.2497	0

TEST NO. =1-169-91 #6810 CONSOL ENTERED BY SKM [illegible] BY SKM

INITIAL MOISTURE CONTENT. % = 15.6
INITIAL DRY UNIT WEIGHT PCF =110.3
INITIAL DEG. OF SATURATION. % = 80.3
INITIAL VOID RATIO. =0.525
FINAL MOISTURE CONTENT. % = 18.3
FINAL DRY DENSITY. PCF =118.0
FINAL DEG. OF SATURATION. % =116.3

p ksf	e	dH %	Cv cm2/sec	Av ft2/k	Mv ft2/k	K cm/sec
0.0000	0.5246	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.5148	0.6459	0.00E+00	3.94E-02	2.58E-02	0.00E+00
0.2500	0.5467	+1.4459	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.5423	+1.1622	1.35E-04	1.73E-02	1.14E-02	3.14E-09
1.0000	0.5349	+0.6770	0.00E+00	1.48E-02	9.70E-03	0.00E+00
2.0000	0.5220	0.1716	6.20E-04	1.29E-02	8.49E-03	1.08E-08
4.0000	0.5071	1.1459	1.67E-03	7.43E-03	4.87E-03	1.66E-08
8.0000	0.4870	2.4649	7.99E-04	5.03E-03	3.30E-03	5.38E-09
16.0000	0.4539	4.6405	5.24E-04	4.15E-03	2.72E-03	2.91E-09
32.0000	0.4092	7.5676	1.56E-04	2.79E-03	1.83E-03	5.83E-10
64.0000	0.3505	11.4189	1.03E-04	1.83E-03	1.20E-03	2.54E-10
128.0000	0.2834	15.8243	6.98E-05	1.05E-03	6.88E-04	9.82E-11
32.0000	0.3044	14.4459	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.0000	0.3507	11.4054	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.0000	0.4039	7.9189	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.4241	6.5946	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.4247	6.5541	0.00E+00	0.00E+00	0.00E+00	0.00E+00



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

CA-1A-78

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-10-91

CHECKED BY LAB: SKM

LAB NAME: CNI

TAC: _____

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-69CE	22.0-22.5	250	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
117.6	15.1	89.7	0.467

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
128.7	14.6	100+	0.344

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.461	N/A
WATER ADDED	0.483	N/A
500	0.482	1.18×10^{-4}
1000	0.478	3.31×10^{-4}
2000	0.472	1.80×10^{-3}
4000	0.461	1.45×10^{-3}
8000	0.447	1.23×10^{-3}
16,000	0.427	1.28×10^{-3}
32,000	0.398	5.79×10^{-4}
64,000	0.344	2.73×10^{-4}

TEST PROCEDURE: ASTM D 2435-90

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

1-369-91 WSSRAP #6908 CONSOL ENTERED BY SKM CKED BY SKM

INITIAL WET WEIGHT OF SAMPLE g = 80.00
INITIAL DRY WEIGHT OF SAMPLE g = 69.49
FINAL WET WEIGHT OF SAMPLE g = 79.61
FINAL DRY WEIGHT OF SAMPLE g = 69.49
INITIAL SAMPLE DIAMETER in = 1.9300
INITIAL SAMPLE HEIGHT in = 0.7680
SPECIFIC GRAVITY = 2.7700
NUMBER OF INPUT DATA = 11
TIME USED TO CALCULATE Cv sec =T50
DIAL READING FORWARD OR BACKWARD T =BW

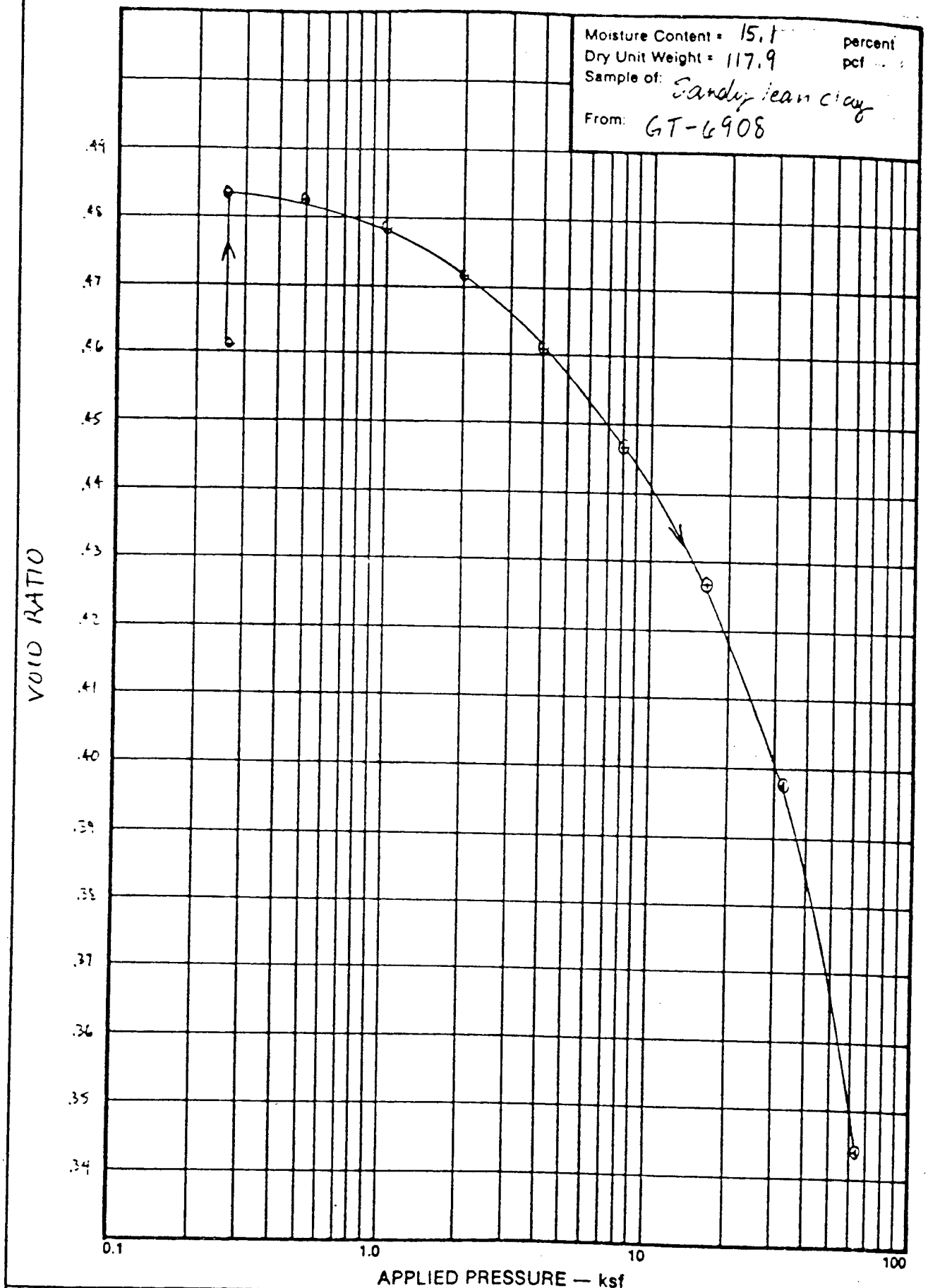
NO.	PRESSURE(ksf)	DIAL READING(in)	T90/T50(sec)
1	0	.19052	0
2	.25	.19351	0
3	.25	.18186	0
4	.5	.18243	1620
5	1	.1845	576
6	2	.18806	105
7	4	.1937	129
8	8	.2011	150
9	16	.2115	141
10	32	.2268	300
11	64	.2549	600

TEST NO. =1-369-91 WSSRAP #6908 CONSOL ENTERED BY SKM CKED BY SKM

INITIAL MOISTURE CONTENT. % = 15.1
INITIAL DRY UNIT WEIGHT PCF =117.9
INITIAL DEG. OF SATURATION. % = 89.7
INITIAL VOID RATIO. =0.467
FINAL MOISTURE CONTENT. % = 14.6
FINAL DRY DENSITY. PCF =128.7
FINAL DEG. OF SATURATION. % =117.3

p ksf	e	dH %	Cv cm2/sec	Av ft2/k	Mv ft2/k	k cm/sec
0.0000	0.4669	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.4612	0.3893	0.00E+00	2.28E-02	1.56E-02	0.00E+00
0.2500	-0.4834	+1.1250	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.4824	+1.0534	1.18E-04	4.20E-03	2.86E-03	6.92E-10
1.0000	0.4784	+0.7839	3.31E-04	7.91E-03	5.39E-03	3.65E-09
2.0000	0.4716	+0.3203	1.80E-03	6.80E-03	4.64E-03	1.71E-08
4.0000	0.4608	0.4141	1.45E-03	5.39E-03	3.67E-03	1.09E-08
8.0000	0.4467	1.3776	1.23E-03	3.53E-03	2.41E-03	6.04E-09
16.0000	0.4268	2.7318	1.28E-03	2.48E-03	1.69E-03	4.41E-09
32.0000	0.3976	4.7240	5.79E-04	1.83E-03	1.25E-03	1.47E-09
64.0000	-0.3439	8.3828	2.73E-04	1.68E-03	1.14E-03	6.37E-10

* 128 KSF LOAD,
REBOUND NOT POSSIBLE
DUE TO UNEVEN COLLAPSE
OF SAMPLE DURING 128K LOADING.
(SEE DIAGRAM)



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

CA-1A-79

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-20-91

CHECKED BY LAB: SKM

LAB NAME: CNI

TAC: _____

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-7004	12.0-12.3	250	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
96.6	25.1	88.8	0.775

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
103.2	25.8	100+	0.661

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.772	N/A
WATER ADDED	0.785	N/A
500	0.782	1.96×10^{-4}
1000	0.776	7.92×10^{-4}
2000	0.765	3.97×10^{-4}
4000	0.746	3.56×10^{-4}
8000	0.723	4.49×10^{-4}
16,000	0.690	2.07×10^{-4}
32,000	0.640	3.51×10^{-4}
64,000	0.584	3.30×10^{-4}
128,000	0.514	2.39×10^{-4}
32,000	0.534	N/A
8000	0.563	N/A
2000	0.601	N/A
500	0.650	N/A
250	0.661	N/A

TEST PROCEDURE: ASTM D 2435-90

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

[illegible] CONSOL ENTERED BY SKM [illegible] BY SKM

INITIAL WET WEIGHT OF SAMPLE	g =	68.[illegible]
INITIAL DRY WEIGHT OF SAMPLE	g =	54.40
FINAL WET WEIGHT OF SAMPLE	g =	68.43
FINAL DRY WEIGHT OF SAMPLE	g =	54.40
INITIAL SAMPLE DIAMETER	in =	1.9190
INITIAL SAMPLE HEIGHT	in =	0.7420
SPECIFIC GRAVITY	=	2.7470
NUMBER OF INPUT DATA	=	17
TIME USED TO CALCULATE Cv	sec =	T50
DIAL READING FORWARD OR BACKWARD	T =	FW

No.	PRESSURE(ksf)	DIAL READING(in)	T90/T50(sec)
1	0	.208	0
2	.25	.20657	0
3	.25	.21224	0
4	.5	.21092	900
5	1	.20849	222
6	2	.2037	438
7	4	.1959	480
8	8	.1862	372
9	16	.1725	780
10	32	.1516	438
11	64	.1283	438
12	128	.1091	558
13	32	.1073	0
14	8	.1195	0
15	2	.1353	0
16	.5	.1557	0
17	.25	.1605	0

TEST NO. =1-369-91 #7004 CONSOL ENTERED BY SKM [illegible] BY SKM

INITIAL MOISTURE CONTENT.	% =	25.1
INITIAL DRY UNIT WEIGHT	PCF =	96.6
INITIAL DEG. OF SATURATION.	% =	88.8
INITIAL VOID RATIO.	=	0.775
FINAL MOISTURE CONTENT.	% =	25.8
FINAL DRY DENSITY.	PCF =	103.2
FINAL DEG. OF SATURATION.	% =	107.1

p ksf	e	dH %	Cv cm2/sec	Av ft2/k	Mv ft2/k	k cm/sec
0.0000	0.7749	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00
.2500	0.7716	0.1900	0.00E+00	1.35E-02	7.60E-03	0.00E+00
0.2500	0.7851	+0.5714	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.7819	+0.3935	1.96E-04	1.26E-02	7.12E-03	2.85E-09
1.0000	0.7761	+0.0660	7.92E-04	1.16E-02	6.55E-03	1.06E-08
2.0000	0.7647	0.5795	3.97E-04	1.15E-02	6.46E-03	5.24E-09
4.0000	0.7460	1.6307	3.56E-04	9.33E-03	5.26E-03	3.83E-09
8.0000	0.7228	2.9380	4.49E-04	5.80E-03	3.27E-03	3.00E-09
16.0000	0.6900	4.7844	2.07E-04	4.10E-03	2.31E-03	9.78E-10
32.0000	0.6400	7.6011	3.51E-04	3.12E-03	1.76E-03	1.26E-09
64.0000	0.5843	10.7412	3.30E-04	1.74E-03	9.81E-04	6.61E-10
128.0000	0.5144	14.6766	2.39E-04	1.09E-03	6.15E-04	3.00E-10
32.0000	0.5341	13.5714	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.0000	0.5632	11.9272	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.0000	0.6010	9.7978	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.6498	7.0485	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.6613	6.4016	0.00E+00	0.00E+00	0.00E+00	0.00E+00

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-22-91

CHECKED BY LAB: SAM

LAB NAME: CNI

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-711C	25.8-25.9	250	N/A

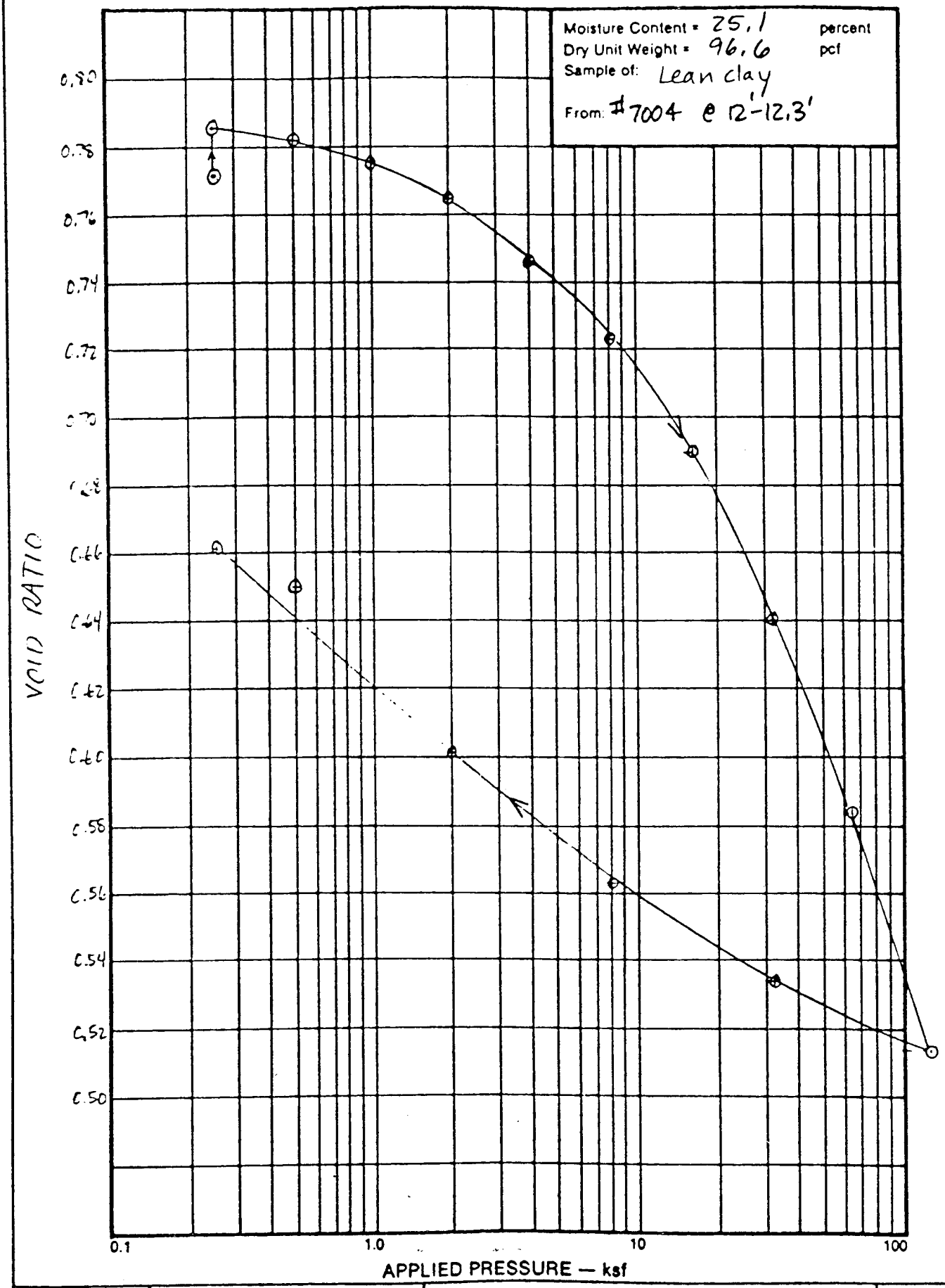
INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
100.-	25.7	100.8	0.693

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
115.4	23.8	100+	0.473

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.687	N/A
WATER ADDED	0.718	N/A
500	0.717	N/A
1000	0.712	N/A
2000	0.704	2.12×10^{-4}
4000	0.690	2.23×10^{-4}
8000	0.672	2.34×10^{-4}
16,000	0.645	3.27×10^{-4}
32,000	0.598	1.55×10^{-4}
64,000	0.473	2.34×10^{-4}

TEST PROCEDURE: ASTM D 2435-90

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

CA-1A-79

[illegible] Q [illegible] Entered by [illegible] Chkd by [illegible]

INITIAL WET WEIGHT OF SAMPLE	g =	74.45
INITIAL DRY WEIGHT OF SAMPLE	g =	59.24
FINAL WET WEIGHT OF SAMPLE	g =	73.35
FINAL DRY WEIGHT OF SAMPLE	g =	59.24
INITIAL SAMPLE DIAMETER	in =	1.9300
INITIAL SAMPLE HEIGHT	in =	0.7690
SPECIFIC GRAVITY	=	2.7220
NUMBER OF INPUT DATA	=	11
TIME USED TO CALCULATE Cv	sec =	T50
DIAL READING FORWARD OR BACKWARD	=	Bw

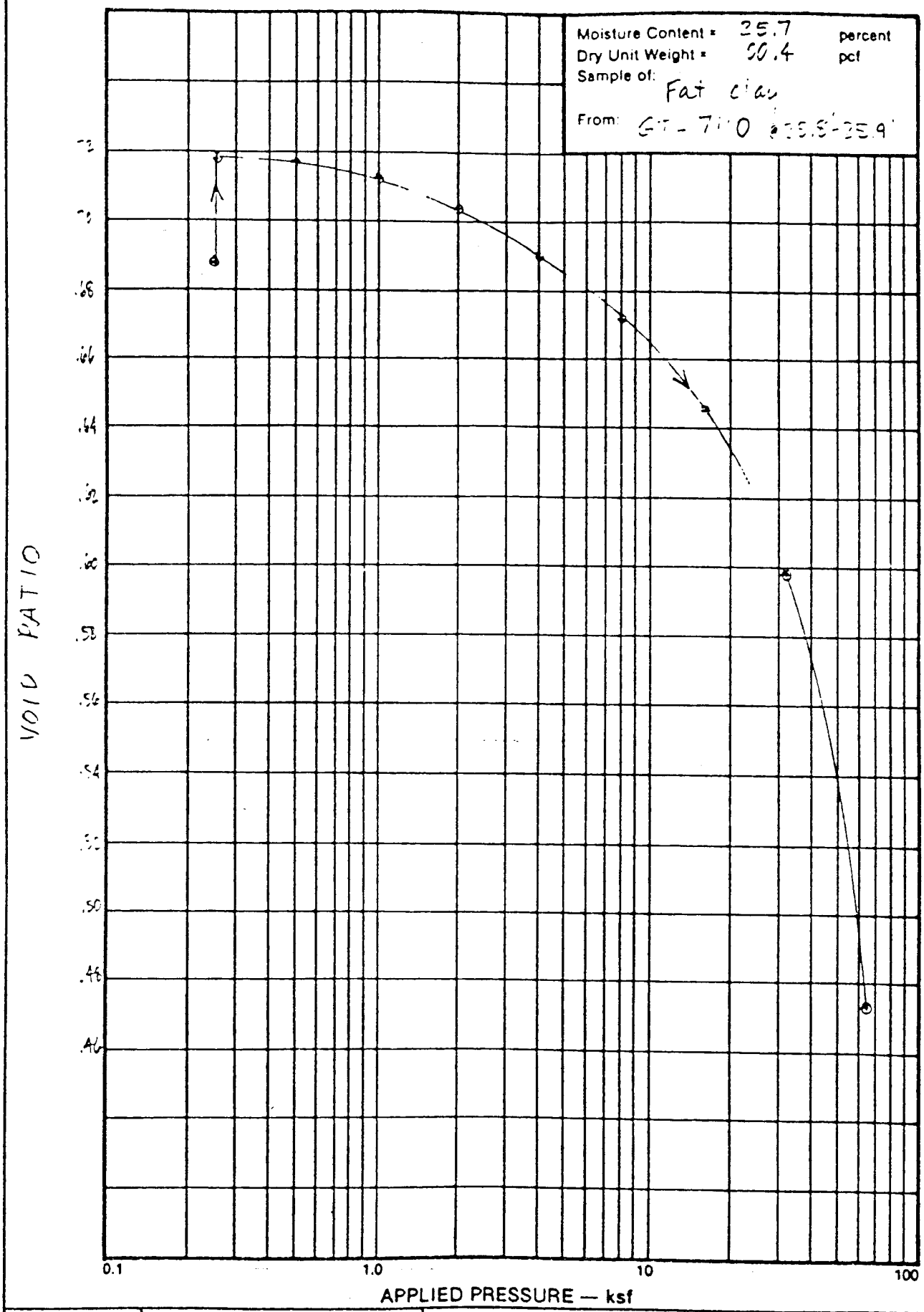
No.	PRESSURE(ksf)	DIAL READING(in)	T90/T50(sec)
1	0	.1891	0
2	.25	.1917	0
3	.25	.17792	0
4	.5	.17828	0
5	1	.18034	0
6	2	.18438	900
7	4	.19056	845
8	8	.1986	792
9	16	.21105	552
10	32	.23209	1110
11	64	.2891	660

[illegible] #[illegible]-[illegible]-[illegible] #7112 Consol Entered by [illegible] Chkd by [illegible]

INITIAL MOISTURE CONTENT,	% =	25.7
INITIAL DRY UNIT WEIGHT	PCF =	100.4
INITIAL DEG. OF SATURATION	% =	100.8
INITIAL VOID RATIO,	=	0.693
FINAL MOISTURE CONTENT,	% =	23.8
FINAL DRY DENSITY,	PCF =	115.4
FINAL DEG. OF SATURATION,	% =	137.1

p ksf	e	dH %	Cv cm2/sec	Av ft2/k	Mv ft2/k	k cm/sec
[illegible]	0.6931	0.0000	0.00E+00	0.00E-00	0.00E+00	0.00E+00
[illegible]	0.6874	0.3381	0.00E+00	2.29E-02	1.35E-02	0.00E+00
[illegible]	0.7177	+1.4538	0.00E+00	0.00E+00	0.00E+00	0.00E+00
[illegible]	0.7169	+1.4070	0.00E+00	3.17E-03	1.87E-03	0.00E+00
[illegible]	[illegible]	+1.1391	0.00E+00	9.07E-03	5.36E-03	0.00E+00
[illegible]	[illegible]	+0.6138	3.12E-04	8.89E-03	5.25E-03	2.28E-09
[illegible]	[illegible]	0.1899	2.23E-04	6.80E-03	4.02E-03	1.83E-09
[illegible]	0.6722	1.2354	2.34E-04	4.43E-03	2.61E-03	1.25E-09
[illegible]	0.6448	2.8544	3.27E-04	3.43E-03	2.02E-03	1.35E-09
[illegible]	0.5985	5.5904	1.55E-04	2.90E-03	1.71E-03	3.43E-10
64.0000	0.4729	13.0039	2.34E-04	3.92E-03	2.32E-03	1.11E-09

*128 KSF LOAD, REBOUND NOT POSSIBLE DUE TO UNEVEN COLLAPSE OF SAMPLE DURING 128K LOADING.



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

CA-1A-79

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-10-91

CHECKED BY LAB: SKM

LAB NAME: CNI

TAC:

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-7396	17.0-17.5	250	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
92.4	32.4	104.4	0.851

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
107.2	25.0	100+	0.596

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.840	N/A
WATER ADDED	0.938	N/A
500	0.935	5.90×10^{-5}
1000	0.920	2.26×10^{-5}
2000	0.885	2.27×10^{-5}
4000	0.833	2.13×10^{-5}
8000	0.767	2.00×10^{-5}
16,000	0.688	2.11×10^{-5}
32,000	0.622	2.06×10^{-5}
64,000	0.535	3.22×10^{-5}
128,000	0.421	1.57×10^{-5}
32,000	0.480	N/A
8000	0.569	N/A
2000	0.596	N/A

TEST PROCEDURE: ASTM D 2435-90

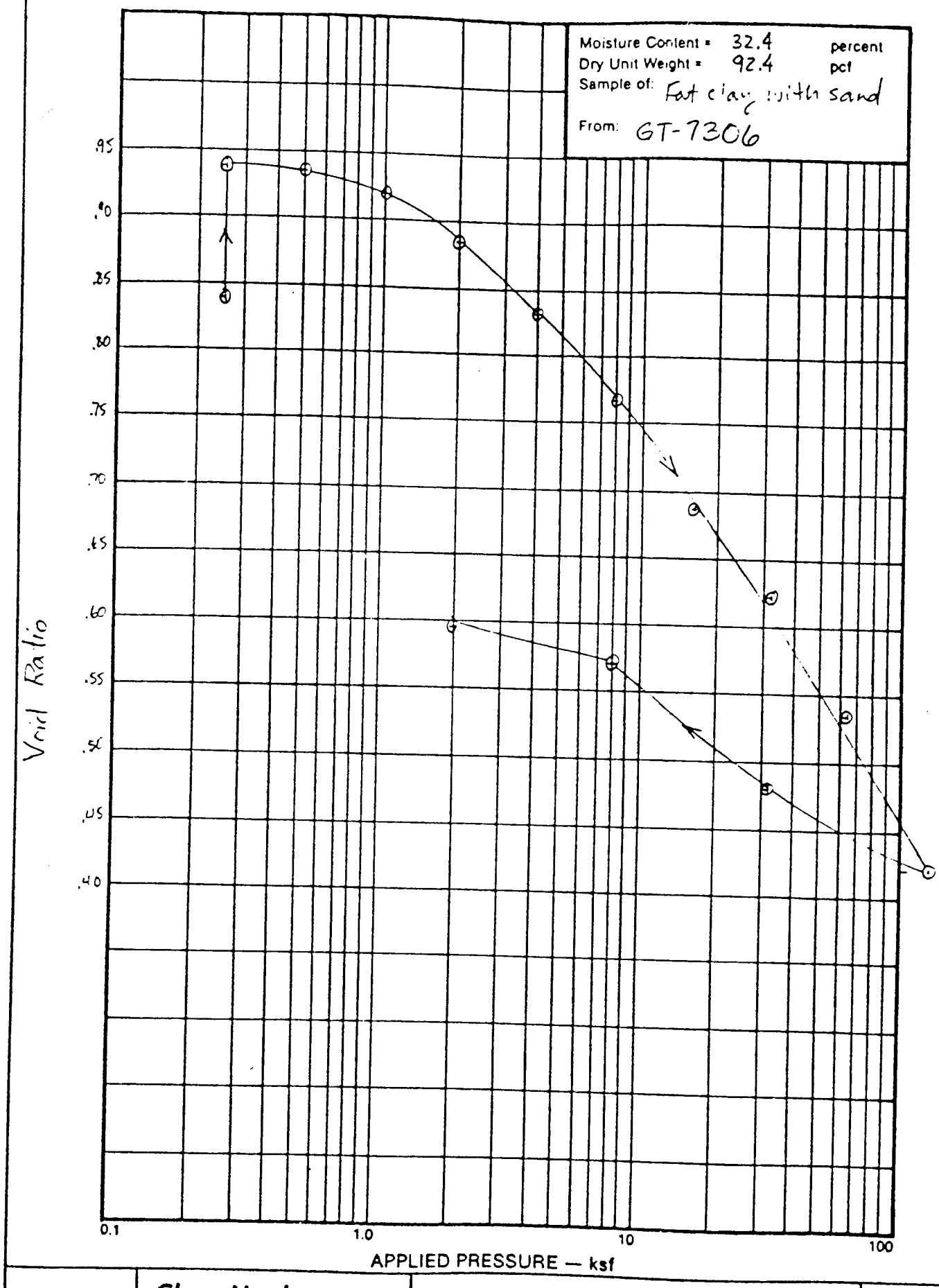
NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

TEST NO. =1-T6R-91 WESRAF #7306 CONSOL ENTERED BY EKM CHKED BY EKM
INITIAL WET WEIGHT OF SAMPLE g = 69.49
INITIAL DRY WEIGHT OF SAMPLE g = 52.85
FINAL WET WEIGHT OF SAMPLE g = 66.04
FINAL DRY WEIGHT OF SAMPLE g = 52.85
INITIAL SAMPLE DIAMETER in = 1.9260
INITIAL SAMPLE HEIGHT in = 0.7480
SPECIFIC GRAVITY = 2.7410
NUMBER OF INPUT DATA = 15
TIME USED TO CALCULATE Cv sec =T50
DIAL READING FORWARD OR BACKWARD T =FW

No.	PRESSURE(ksf)	DIAL READING(in)	T90/T50(sec)
1	0	.2145	0
2	.25	.20982	0
3	.25	.2497	0
4	.5	.24836	3300
5	1	.24227	9520
6	2	.228	8220
7	4	.20701	8400
8	8	.18035	8400
9	16	.1485	7720
10	32	.1213	6900
11	64	.0882	4020
12	128	.0405	720
13	32	.0647	0
14	8	.1005	0
15	2	.1112	0

TEST NO. =1-T6R-91 WESRAF #7306 CONSOL ENTERED BY EKM CHKED BY EKM
INITIAL MOISTURE CONTENT. % = 32.4
INITIAL DRY UNIT WEIGHT PCF = 82.4
INITIAL DEG. OF SATURATION. % =104.4
INITIAL VOID RATIO. =0.851
FINAL MOISTURE CONTENT. % = 25.0
FINAL DRY DENSITY. PCF =107.2
FINAL DEG. OF SATURATION. % =114.9

P	e	OCR	Cv	Av	Mv	k
ksf		%	cm2/sec	ft2/#	ft2/#	cm/sec
0.1250	0.8512	0.0000	1.00E+00	0.00E+00	0.00E+00	1.00E+00
0.2500	0.8285	0.6257	0.00E+00	4.63E-02	2.50E-02	1.00E+00
0.3750	0.8087	+4.7059	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.7950	+4.5257	5.90E-05	1.33E-02	7.17E-03	5.64E-10
1.0000	0.7199	+3.7126	2.26E-05	3.01E-02	1.63E-02	7.53E-10
2.0000	0.8546	+1.8048	2.27E-05	3.53E-02	1.91E-02	8.84E-10
4.0000	0.8326	1.0013	2.13E-05	2.60E-02	1.40E-02	6.12E-10
8.0000	0.7667	4.5655	2.00E-05	1.65E-02	8.91E-03	3.64E-10
16.0000	0.6878	8.8235	2.11E-05	9.85E-03	5.32E-03	2.30E-10
32.0000	0.6218	12.3930	2.06E-05	4.13E-03	2.23E-03	9.39E-11
64.0000	0.5351	17.0722	3.22E-05	2.71E-03	1.46E-03	9.61E-11
128.0000	0.4206	21.2620	1.57E-05	1.79E-03	9.67E-04	3.11E-11
32.0000	0.4804	20.0267	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.0000	0.5690	15.2406	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.0000	0.5955	13.8102	0.00E+00	0.00E+00	0.00E+00	0.00E+00



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

CA-1A-79

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATION TEST RESULTS

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-8-91

CHECKED BY LAB: SKM

LAB NAME: CNI

TAC: _____

SAMPLE ID	DEPTH INTERVAL (FT)	BEGINNING SUBMERGED STRESS (PSF)	COMPACTION (%)
GT-7314	35.0-36.5	250	N/A

INITIAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.3	22.5	93.3	0.651

FINAL CONDITIONS			
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
115.3	20.0	100+	0.466

TEST RESULTS		
AXIAL STRESS (PSF)	VOID RATIO e	COEFFICIENT OF CONSOLIDATION (cm^2/sec)
250	0.646	N/A
WATER ADDED	0.652	N/A
500	0.648	5.76×10^{-5}
1000	0.637	N/A
2000	0.619	4.08×10^{-4}
4000	0.588	6.21×10^{-4}
8000	0.552	1.49×10^{-3}
16,000	0.510	1.63×10^{-3}
32,000	0.467	1.34×10^{-3}
64,000	0.424	1.47×10^{-3}
128,000	0.370	1.65×10^{-3}
32,000	0.381	N/A
8000	0.398	N/A
2000	0.427	N/A
500	0.454	N/A
250	0.466	N/A

TEST PROCEDURE: ASTM D 2435-90

NOTE: INDIVIDUAL TIME-RATE INCREMENTS TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS

[illegible] AVERAGE RITA CONSOL ENTERED BY EVM CHKED B. EVM

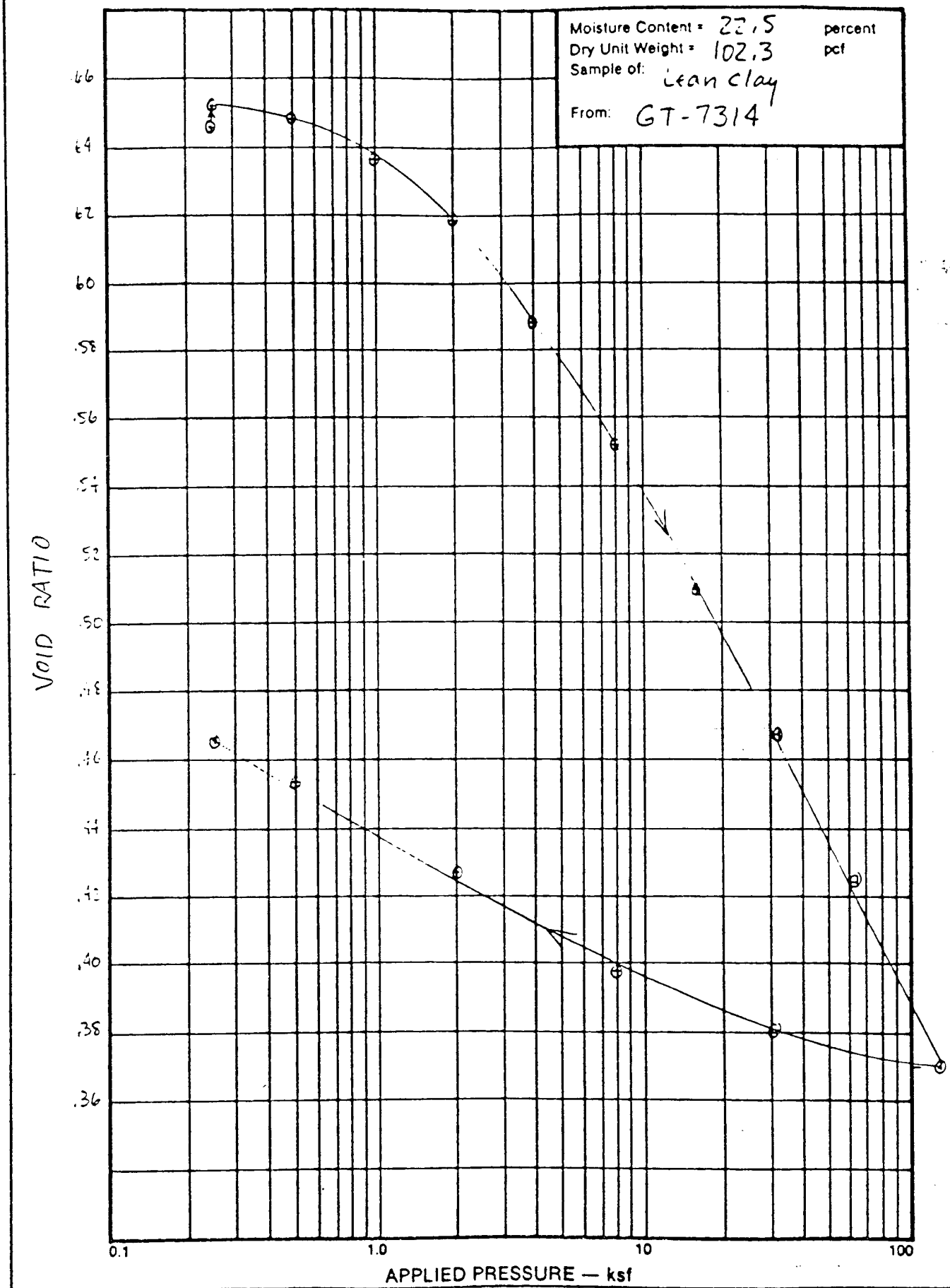
INITIAL WET WEIGHT OF SAMPLE = 47.45
INITIAL DRY WEIGHT OF SAMPLE = 51.82
FINAL WET WEIGHT OF SAMPLE = 52.19
FINAL DRY WEIGHT OF SAMPLE = 51.82
INITIAL SAMPLE DIAMETER = 1.9700
INITIAL SAMPLE HEIGHT = 1.0600
SPECIFIC GRAVITY = 2.7060
NUMBER OF INPUT DATA = 17
TIME USED TO CALCULATE CV sec = T50
DIAL READING FORWARD OR BACKWARD = FW

NO.	PRESSURE(ksf)	DIAL READING(in)	T50 (sec)
1	0	.2106	0
2	.25	.2085	0
3	.25	.21098	0
4	.5	.20937	2400
5	1	.20497	0
6	2	.19771	330
7	4	.18516	210
8	8	.17655	84
9	16	.1639	78
10	32	.1368	84
11	64	.1197	42
12	.25	.0963	60
13	32	.1025	0
14	8	.1076	0
15	2	.10982	0
16	.5	.1015	0
17	.25	.1034	0

[illegible] NO. 1-DRY-FI WORKUP RITA CONSOL ENTERED BY EVM CHKED BY EVM

[illegible] MOISTURE CONTENT. % = 22.8
INITIAL DRY UNIT WEIGHT PCF =102.8
INITIAL DEG. OF SATURATION. % = 93.3
INITIAL VOID RATIO. =0.651
FINAL MOISTURE CONTENT. % = 20.0
[illegible] DRY DENSITY. PCF =118.3
[illegible] DEG. OF SATURATION. % =116.1

P	e	H	Cv	mv	k	
ksf		in	cm2/sec	ft2/lb	ft2/lb	cm/sec
0.0000	1.0614	0.0000	1.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.6482	0.7182	0.00E+00	2.13E-02	1.27E-02	0.00E+00
0.2500	0.6521	+0.0394	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.6483	0.1924	5.76E-05	1.53E-02	9.27E-03	1.09E-09
1.0000	0.6374	0.8500	0.00E+00	2.17E-02	1.32E-02	0.00E+00
2.0000	0.6193	1.9530	4.08E-04	1.82E-02	1.10E-02	9.19E-09
4.0000	0.5878	3.8545	6.21E-04	1.57E-02	9.51E-03	1.21E-08
8.0000	0.5515	6.0515	1.49E-03	9.07E-03	5.49E-03	1.67E-08
16.0000	0.5096	8.5909	1.63E-03	5.24E-03	3.17E-03	1.06E-08
32.0000	0.4668	11.1818	1.34E-03	2.67E-03	1.62E-03	4.43E-09
64.0000	0.4240	13.7727	1.47E-03	1.34E-03	8.10E-04	2.44E-09
128.0000	0.3704	17.0152	1.65E-03	8.37E-04	5.07E-04	1.71E-09
32.0000	0.3809	16.3788	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.0000	0.3980	15.3485	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.0000	0.4269	13.5985	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.5000	0.4535	11.9848	0.00E+00	0.00E+00	0.00E+00	0.00E+00
0.2500	0.4658	11.2424	0.00E+00	0.00E+00	0.00E+00	0.00E+00



1-369-91	Chen-Northern, Inc.	SWELL-CONSOLIDATION TEST RESULTS	Fig.

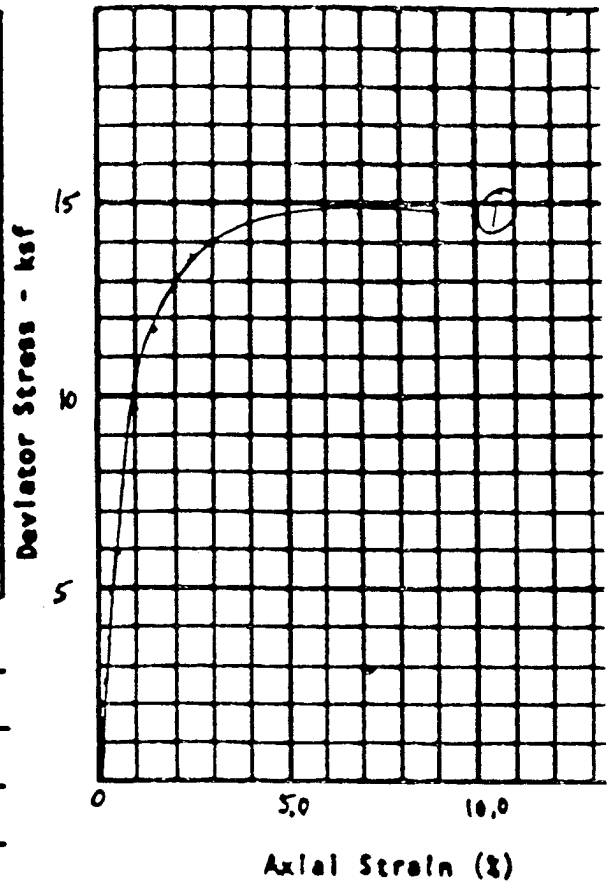
UNCONSOLIDATED UNDRAINED TESTS

Chen Northern, Inc.

Consulting Engineers and

Consulting Soil and Foundation Engineers

TEST NUMBER	①	2	3	4
LOCATION	GT 68 #6810 @ 26'-26.5'			
HEIGHT - INCH	5.546			
DIAMETER - INCH	2.860			
WATER CONTENT - %	16.5			
DRY DENSITY - pcf	110.0			
$\sigma_1 - \sigma_3$ - ksf	14.83			
σ_3 - ksf	5.00			
σ_1 - ksf	19.83			



TYPE OF SPECIMEN: Shelby tube

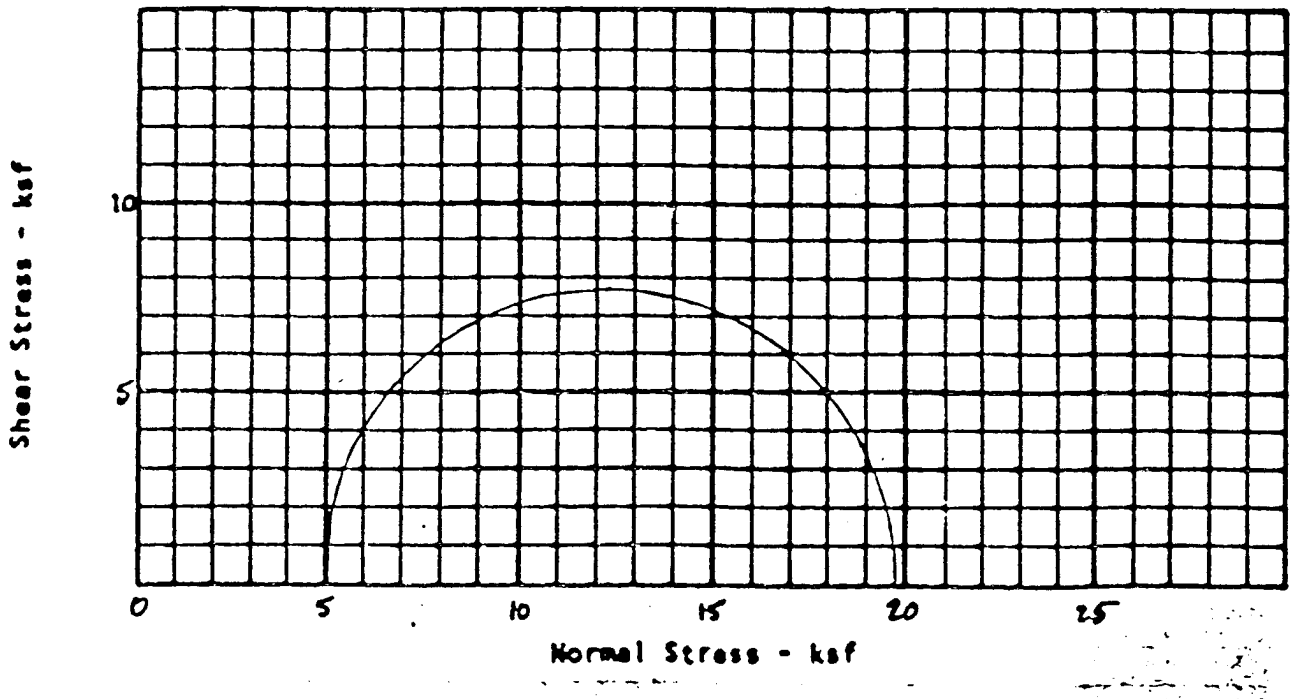
SOIL DESCRIPTION: lean clay with sand

TYPE OF TEST: unconsolidated undrained unsaturated triaxial compressive strength (UU)

TAN ϕ

ϕ

COHESION - ksf



1-369-91

TRIAXIAL SHEAR TEST RESULTS

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility

LOCATION ID: WSSRAP

DATE: 8-7-91

LAB NAME: CNI

CHECKED BY: LAB SUM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6810	26.0-26.5	N/A	4996

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.0	16.5	83.9	0.530

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.0	16.3	83.0	0.530

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0	14 710	10.0		
1568	0.1	14 672	10.1		
2685	0.2	14 542	10.6		
3800	0.3	14 461	10.9		
4869	0.4	14 421	11.0		
5979	0.5	14 389	11.1		
9699	1.0				
11 728	1.5				
12 876	2.0				
13 575	2.5				
13 986	3.0				
14 464	4.0				
14 698	5.0				
14 795	6.0				
14 826	7.0				
14 830	8.0				
14 793	9.0				

TEST PROCEDURE: ASTM D 2850-87

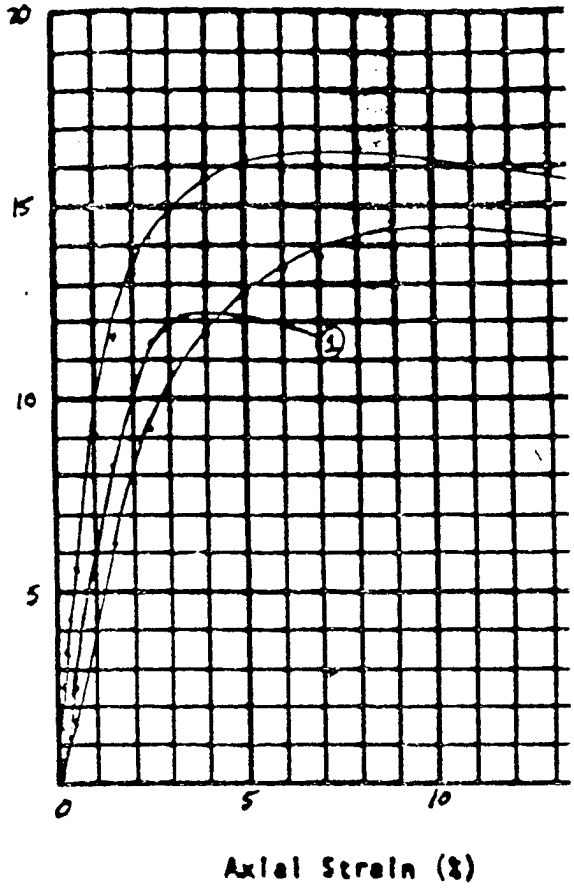
ATTACHMENT 11

Chen-Northern, Inc.

Consulting Engineers and S

Consulting Soil and Foundation Engineers

TEST NUMBER	①	②	③	4
LOCATION	GT 49 — 11.0-11.5'	#6906 → 16.5'-17.0'	16.0'-16.5'	
HEIGHT - INCH	5.826	5.778	5.875	
DIAMETER - INCH	2.852	2.864	2.870	
WATER CONTENT - %	14.1	14.1	14.0	
DRY DENSITY - pcf	112.14	113.7	110.2	
$\sigma_1 - \sigma_3$	12.14	16.35	14.42	
σ_3 - ksf	2.00	5.00	9.99	
σ_1 - ksf	14.14	21.35	24.41	



TYPE OF SPECIMEN: shelby tube

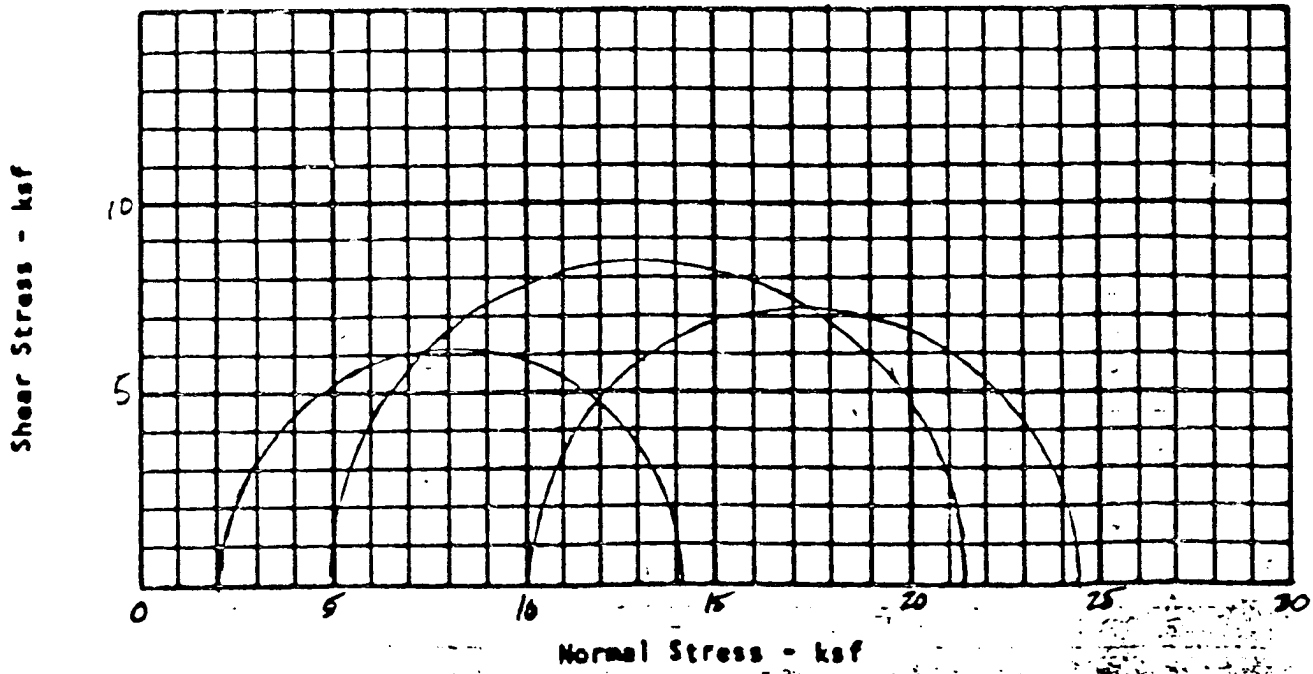
SOIL DESCRIPTION: lean clay with sand

TYPE OF TEST: unconsolidated undrained unsaturated, triaxial compressive strength (UU)

TAN ϕ _____

ϕ _____

COHESION - ksf _____



MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility

LOCATION ID: WSSRAP

DATE: 8-7-91

LAB NAME: CNI

CHECKED BY: LAB 8KM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6906	17.0-17.5	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
112.4	14.1	76.3	0.500

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
112.4	14.1	76.1	0.500

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0				
225	0.1				
630	0.2				
1348	0.3				
1931	0.4				
2534	0.5				
5445	1.0				
8193	1.5				
10206	2.0				
11406	2.5				
11916	3.0				
12140	4.0				
12027	4.7				
11930	5.3				
11846	5.8				
11763	6.1				

ATTACHMENT 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility

LOCATION ID: WSSRAP

DATE: 8-7-91

LAB NAME: CNI

CHECKED BY: LAB 8KM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6906	16.5-17.0	N/A	4996

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
113.7	14.1	78.9	0.482

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
113.7	14.1	78.9	0.482

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0	16194	10.0		
1429	0.1	16074	11.0		
2476	0.2	15953	12.0		
3432	0.3	15830	13.0		
4386	0.4	15648	14.0		
5605	0.5	15485	15.0		
9095	1.0				
11647	1.5				
13231	2.0				
14166	2.5				
14874	3.0				
15665	4.0				
16075	5.0				
16242	6.0				
16318	7.0				
16349	8.0				
16293	9.0				

ATTACHMENT 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility

LOCATION ID: WSSRAP

DATE: 8-7-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6906	16.0-16.5	N/A	9994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.2	14.0	71.5	0.529

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.2	13.8	70.5	0.529

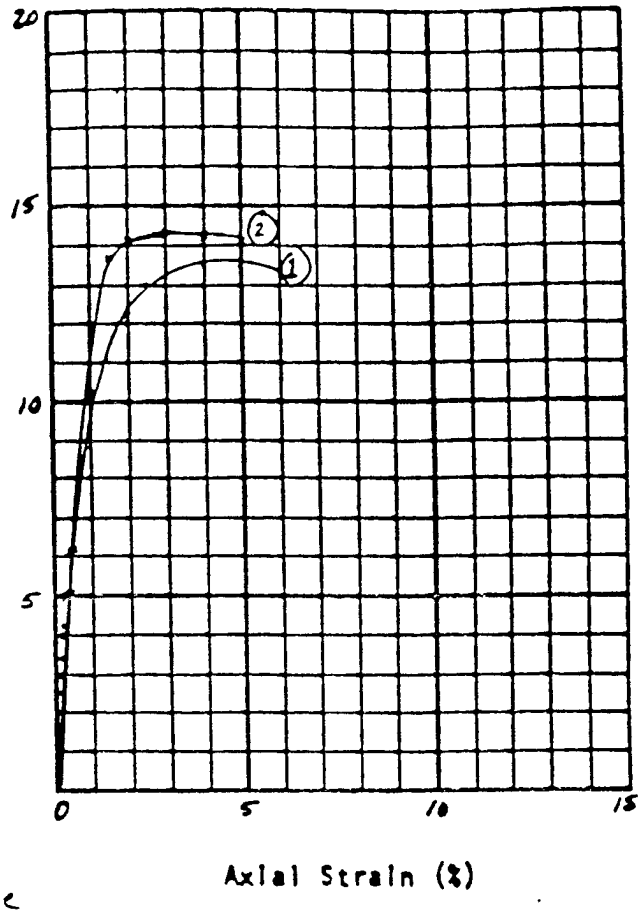
TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0	14424	10.0		
445	0.1	14422	11.0		
622	0.2	14378	12.0		
843	0.3	14252	13.0		
1286	0.4	14051	14.0		
1750	0.5	13850	15.0		
4341	1.0				
6249	1.5				
7897	2.0				
9159	2.5				
9846	3.0				
11774	4.0				
12815	5.0				
13475	6.0				
13890	7.0				
14171	8.0				
14341	9.0				

ATTACHMENT 11

Chen & Northern, Inc.

TEST NUMBER	1	2	3	4
LOCATION	GT 69 20.7-21.3 +6908	GT 69 21.3-21.8 -6908		
HEIGHT - INCH	5.903	5.906		
DIAMETER - INCH	2.874	2.872		
WATER CONTENT - %	15.7	15.3		
DRY DENSITY - pcf	116.5	117.0		
$\sigma_1 - \sigma_3$ - ksf	13.52	14.32		
σ_3 - ksf	5.00	10.00		
σ_1 - ksf	18.52	24.32		



TYPE OF SPECIMEN Shelby Tube

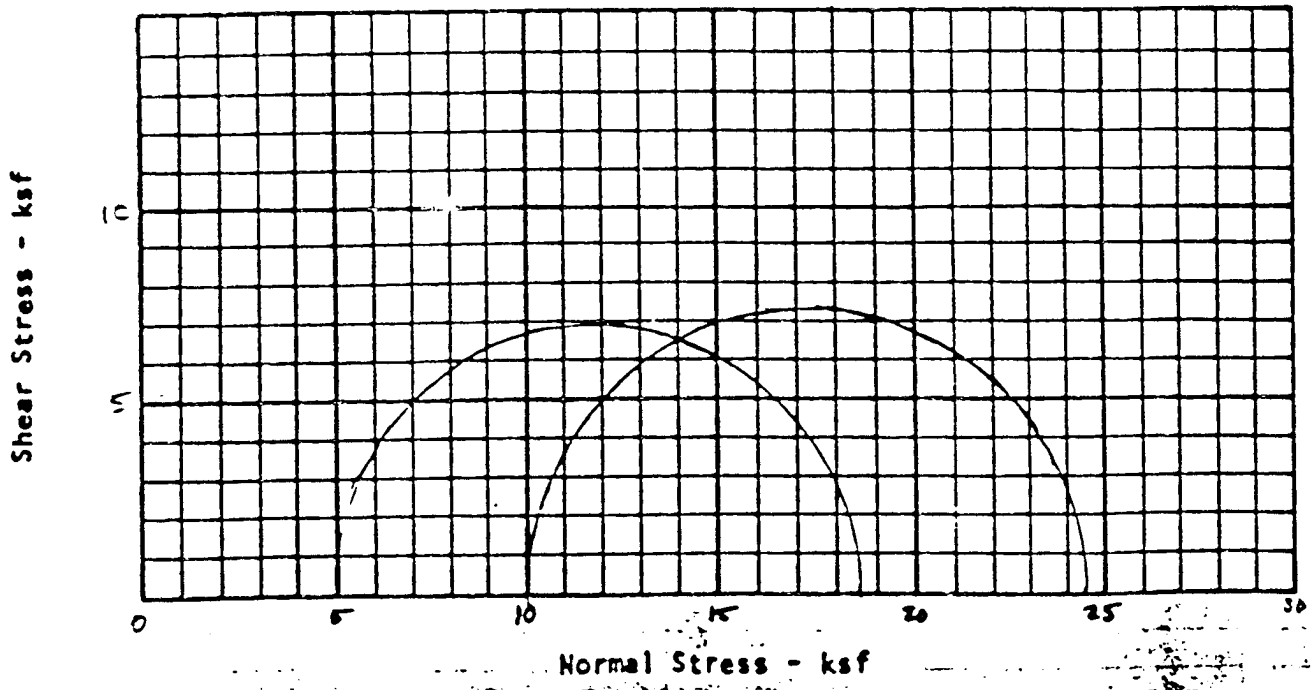
SOIL DESCRIPTION ~~Clay [illegible]~~ Sandy lean clay

TYPE OF TEST Unconsolidated undrained, unsaturated, triaxial compressive strength (UU)

TAN Ø

Ø

COHESION - ksf



TRIAXIAL SHEAR TEST RESULTS

1-369-91

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility

LOCATION ID: WSSRAP

DATE: 8-7-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6908	20.7 - 21.3	N/A	4997

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
116.5	15.7	89.7	0.485

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
116.5	15.7	89.6	0.485

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0				
1663	0.1				
2548	0.2				
3342	0.3				
4201	0.4				
5036	0.5				
8790	1.0				
11107	1.5				
12247	2.0				
13094	2.5				
13220	3.0				
13510	4.0				
13517	5.0				
13396	5.5				

ATTACHMENT 11

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: Disposal Facility
LOCATION ID: WSSRAP
DATE: 8-7-91
LAB NAME: CNI
CHECKED BY: LAB SVM
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-6908	21.3-21.8	N/A	9994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
117.0	15.3	88.9	0.478

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
117.0	15.3	88.7	0.478

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)
0	0				
1688	0.1				
2950	0.2				
4033	0.3				
5092	0.4				
6171	0.5				
10255	1.0				
12655	1.5				
13680	2.0				
14174	2.5				
14317	3.0				
14276	4.0				

ATTACHMENT 11

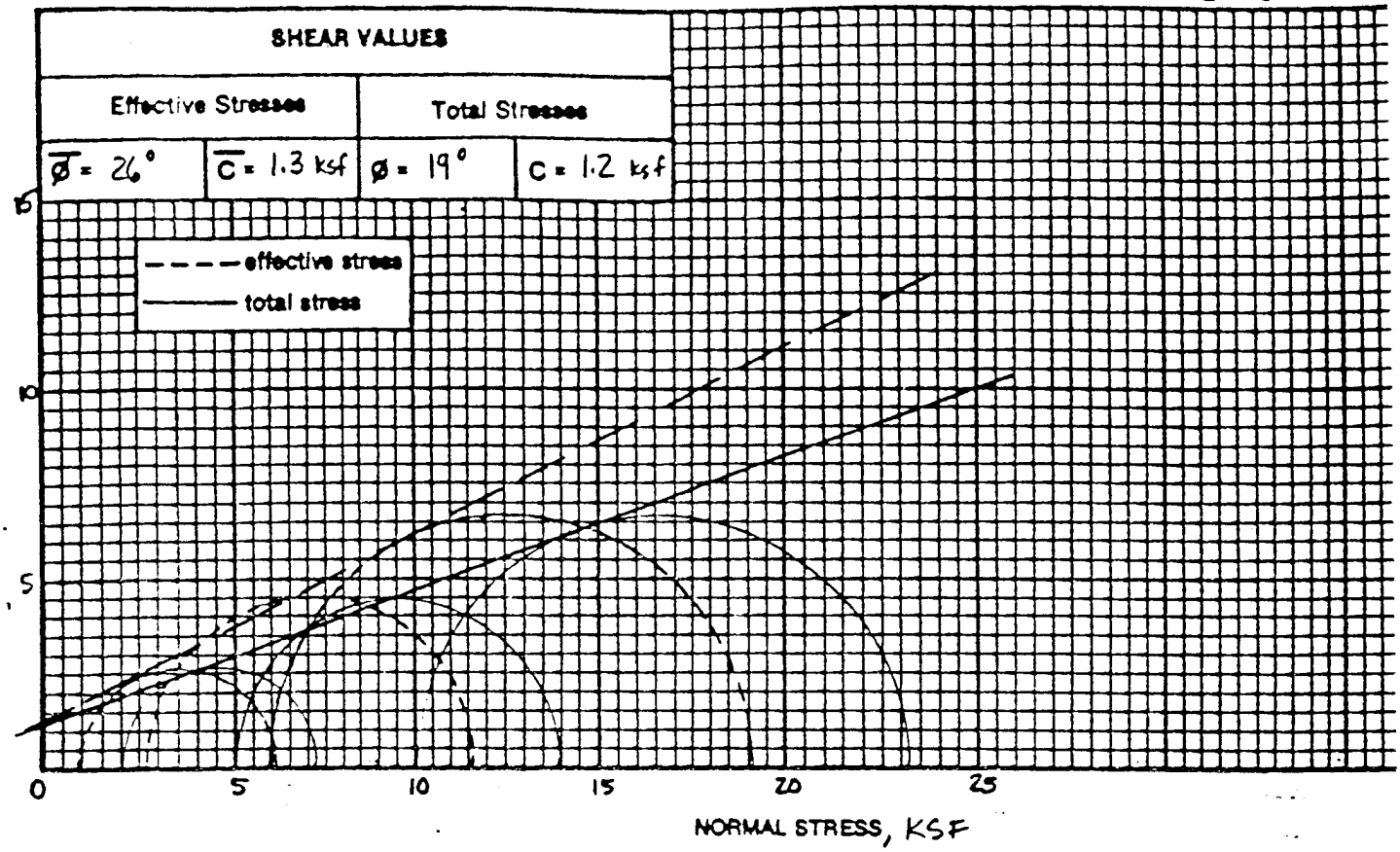
CONSOLIDATED UNDRAINED TESTS

CHEN-NORTHERN, INC.

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1-369-91
Date 8-6-91
Type of Test MULTI-STAGED, SATURATED, CONSOLIDATED, UNDRAINED WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 26°	$\bar{C}$ = 1.3 ksf	ϕ = 19°	C = 1.2 ksf

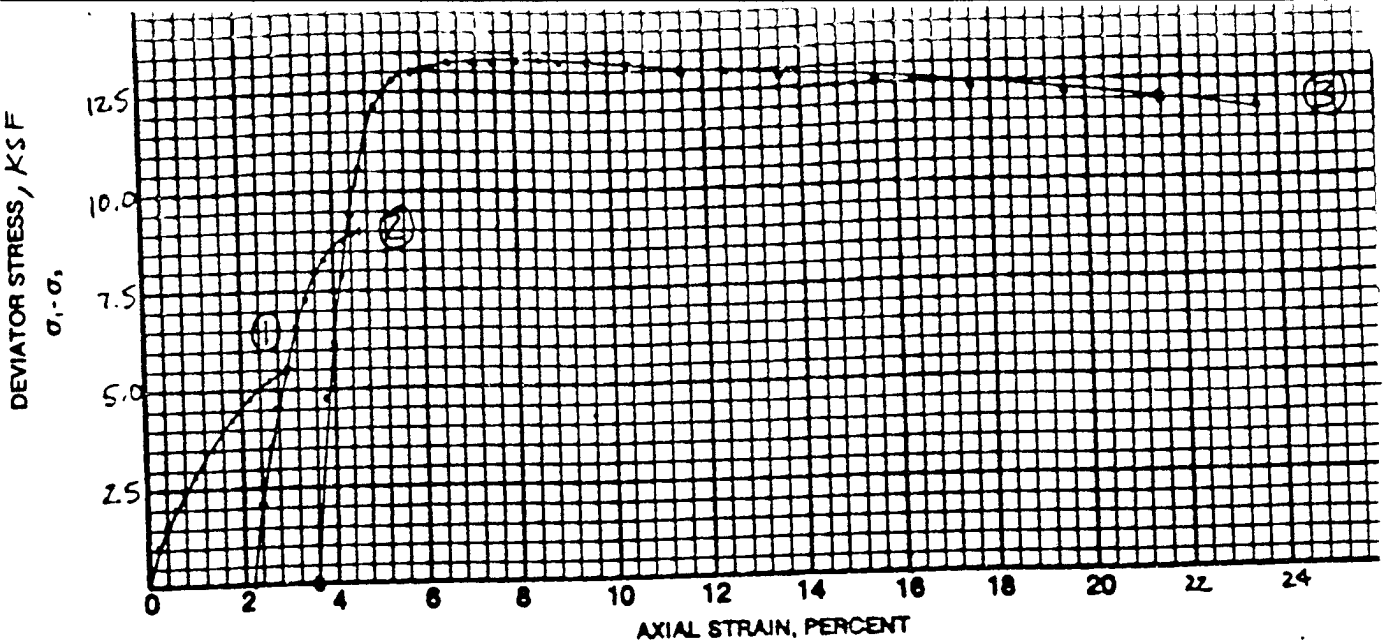


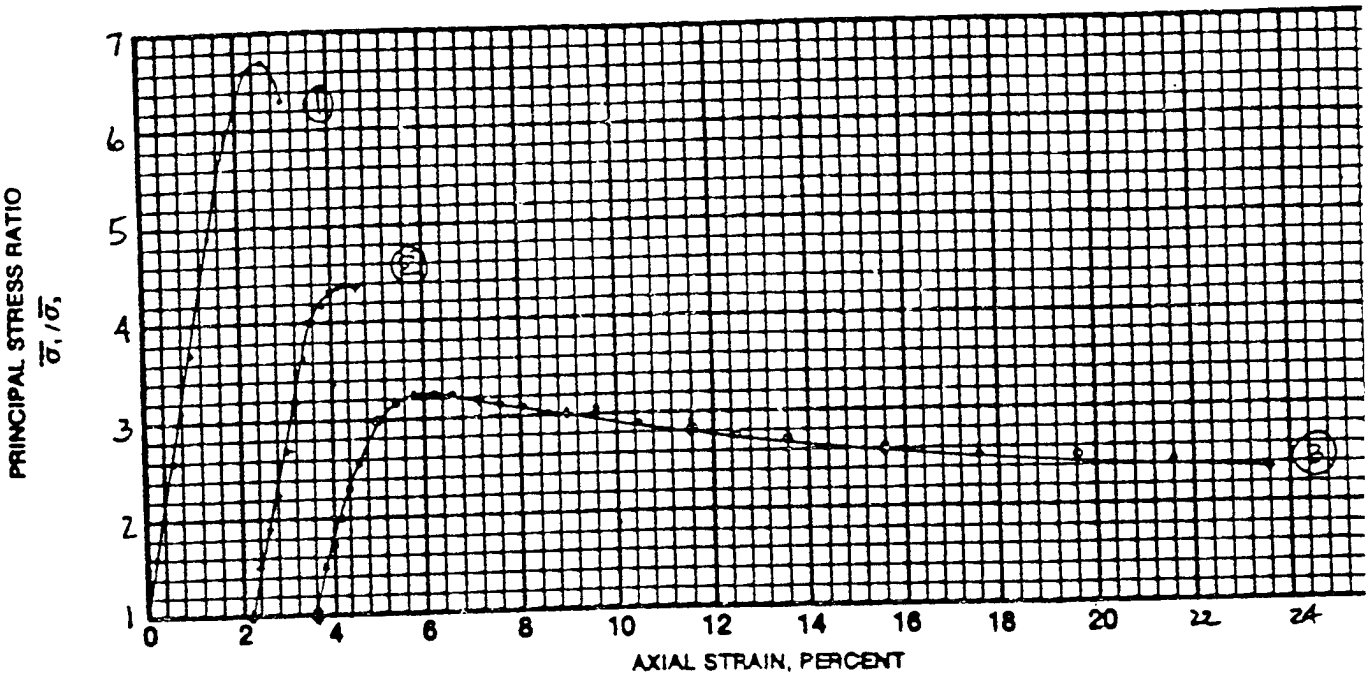
STAGE Specimen Number	Specimen Location		Initial Specimen Data					Soil Descripti
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-6908	21.8-22.3	Shelby	5.787	2.870	116.3	15.6	Sandy lea
2	"	"	"	—	—	—	—	"
3	"	"	"	—	—	—	—	"

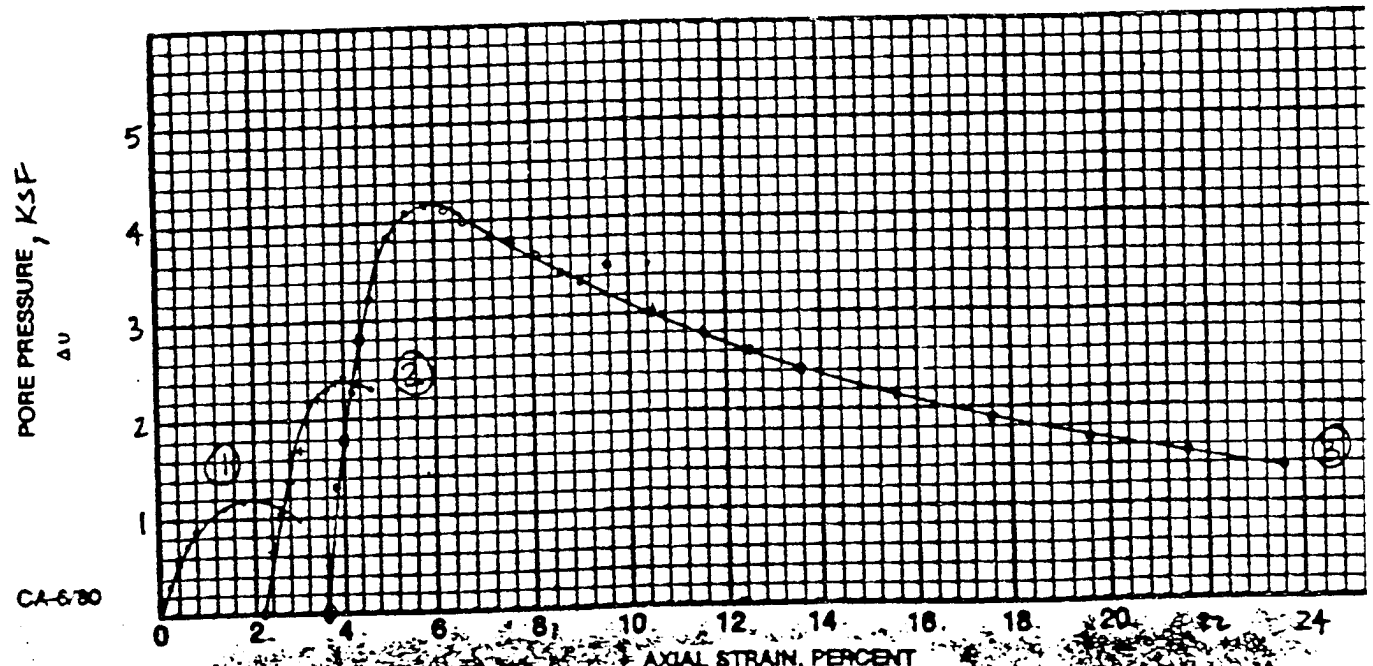
STAGE Specimen Number	"B" Parameter	Test Values at Failure-Maximum Principal Stress Ratio							Remark
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ %	
1	0.99	2.00	7.17	5.17	0.91	6.07	1.09	2.6	UNITS IN K
2	—	5.00	13.91	8.91	2.64	11.54	2.36	2.2	"
3	—	10.00	23.16	13.16	5.90	19.07	4.09	2.6	"

Remarks:

Fig







CA-6/80

46908 CU TRIAX

Chen Northe

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-6908	21.8 - 22.3	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
116.3	15.6	88.7	0.487	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
114.9	17.6	96.7	0.506

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2002	0			
0.21	2739	317			
0.40	3011	547			
0.60	3258	734			
0.80	3518	864			
1.00	3811	919			
1.40	4445	1094			
1.80	5064	1152			
2.19	5607	1152			
2.61	6073	1094			
3.01	6466	979			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.

USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-6908	21.8-22.3	N/A	4997

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
114.9	17.6	96.7	0.506	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
116.2	17.0	96.5	0.488

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	4997	0			
0.19	6422	662			
0.41	7453	1037			
0.60	8184	1382			
0.79	8895	1699			
1.01	9573	2002			
1.20	10 098	2218			
1.40	10 526	2333			
1.61	10 881	2390			
1.80	11 135	2419			
2.00	11 339	2390			
2.21	11 541	2362			
2.40	11 708	2304			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB SVM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-6908	21.8-22.3	N/A	9994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
116.2	17.0	96.5	0.488	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
117.4	16.5	96.4	0.473

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	9994	0	4.50	19643	3629
0.20	12912	1325	5.04	19761	3456
0.39	14351	1800	5.50	19853	3341
0.59	15538	2304	6.00	19650	3514
0.81	16573	2822	7.01	20129	2995
1.00	17346	3254	7.99	20212	2794
1.40	18261	3859	9.00	20296	2606
1.79	18642	4090	10.00	20380	2419
2.20	18870	4147	12.00	20459	2131
2.60	19066	4090	13.99	20498	1901
2.99	19225	4003	16.00	20566	1670
3.64	19414	3830	18.01	20489	1526
4.00	19514	3744	20.12	20427	1382

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

Client: Northern, Illinois

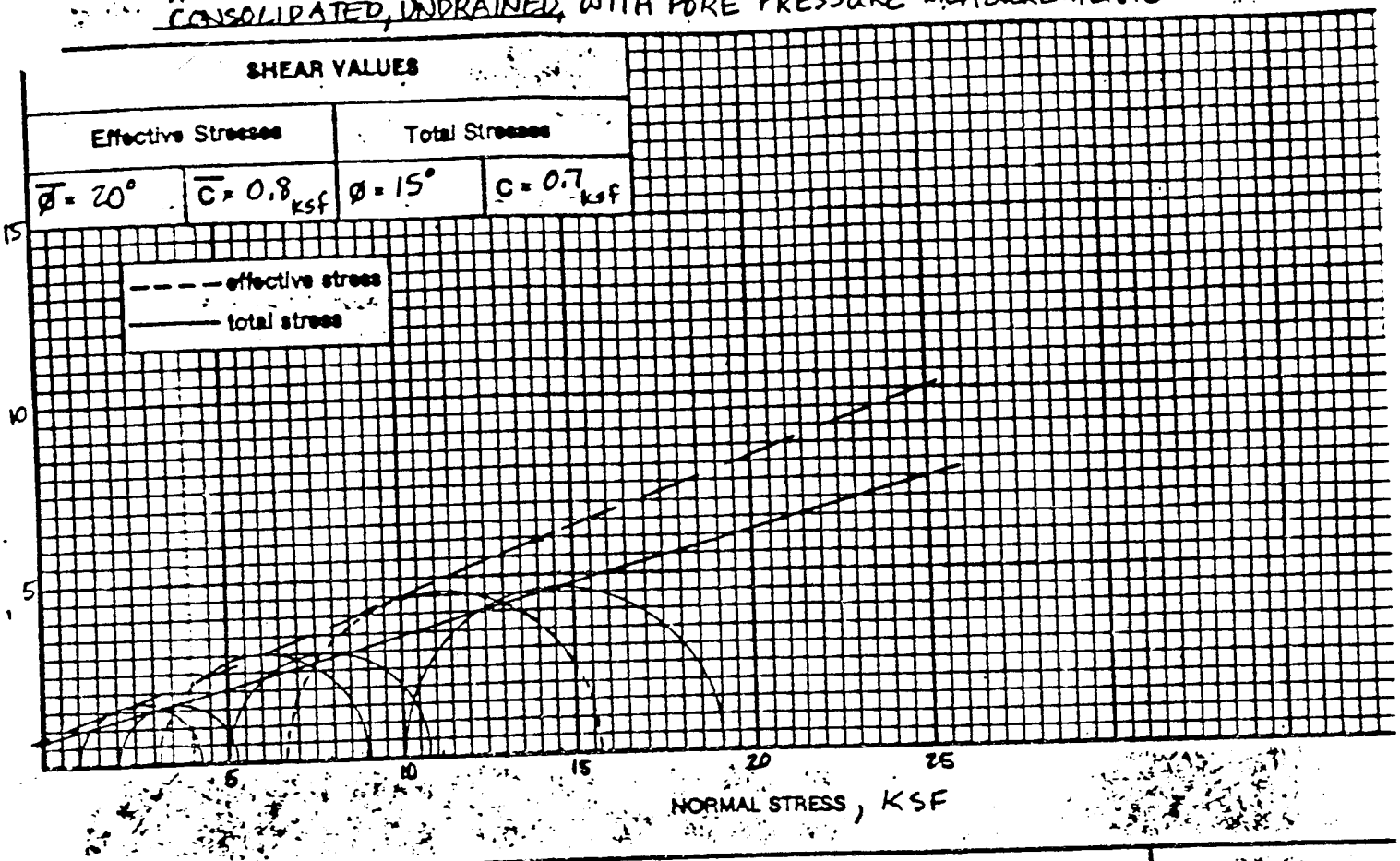
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1-369-91

Date 8-7-91

Type of Test MULTI-STAGED SATURATED, CONSOLIDATED, UNDRAINED, WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 20°	$\bar{C}$ = 0.8 ksf	ϕ = 15°	C = 0.7 ksf

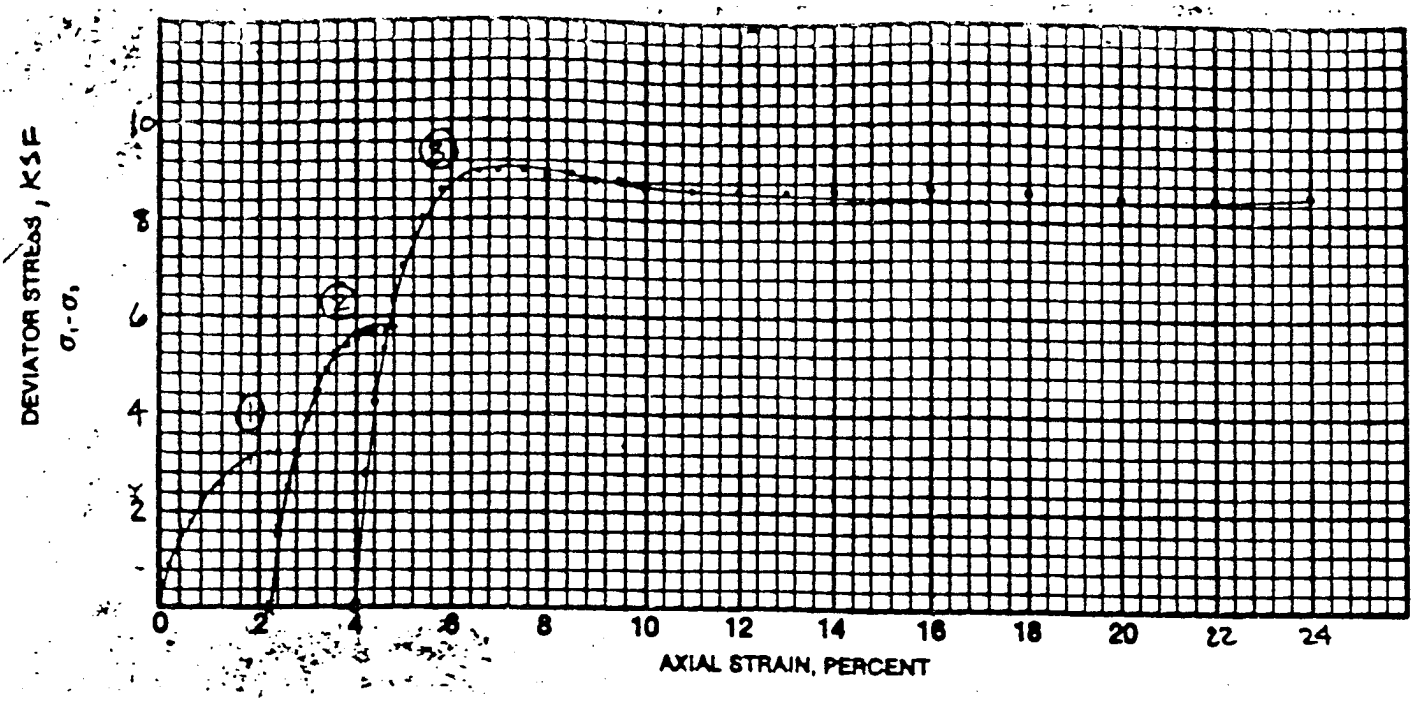


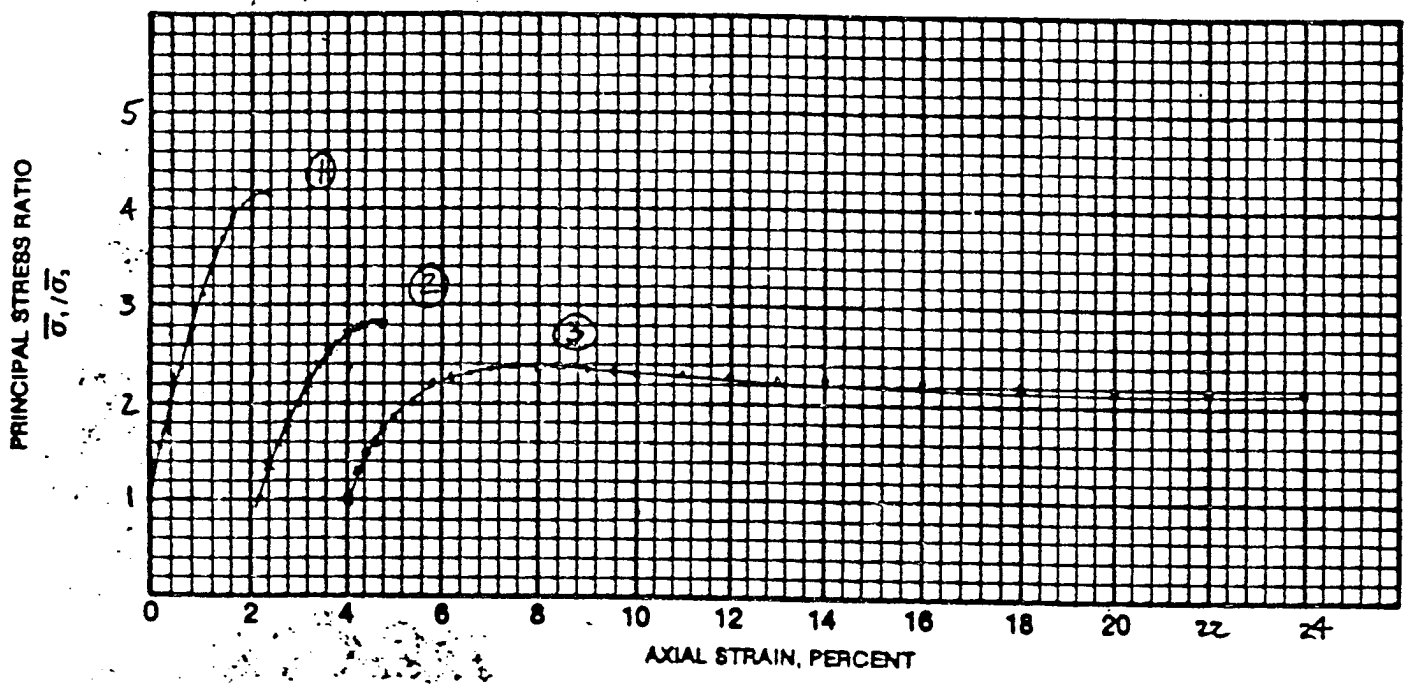
STAGE Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-7004	10.8-11.3	Shelby	6.115	2.868	110.1	18.8	lean clay
2	"	"	"	—	—	—	—	"
3	"	"	"	—	—	—	—	"

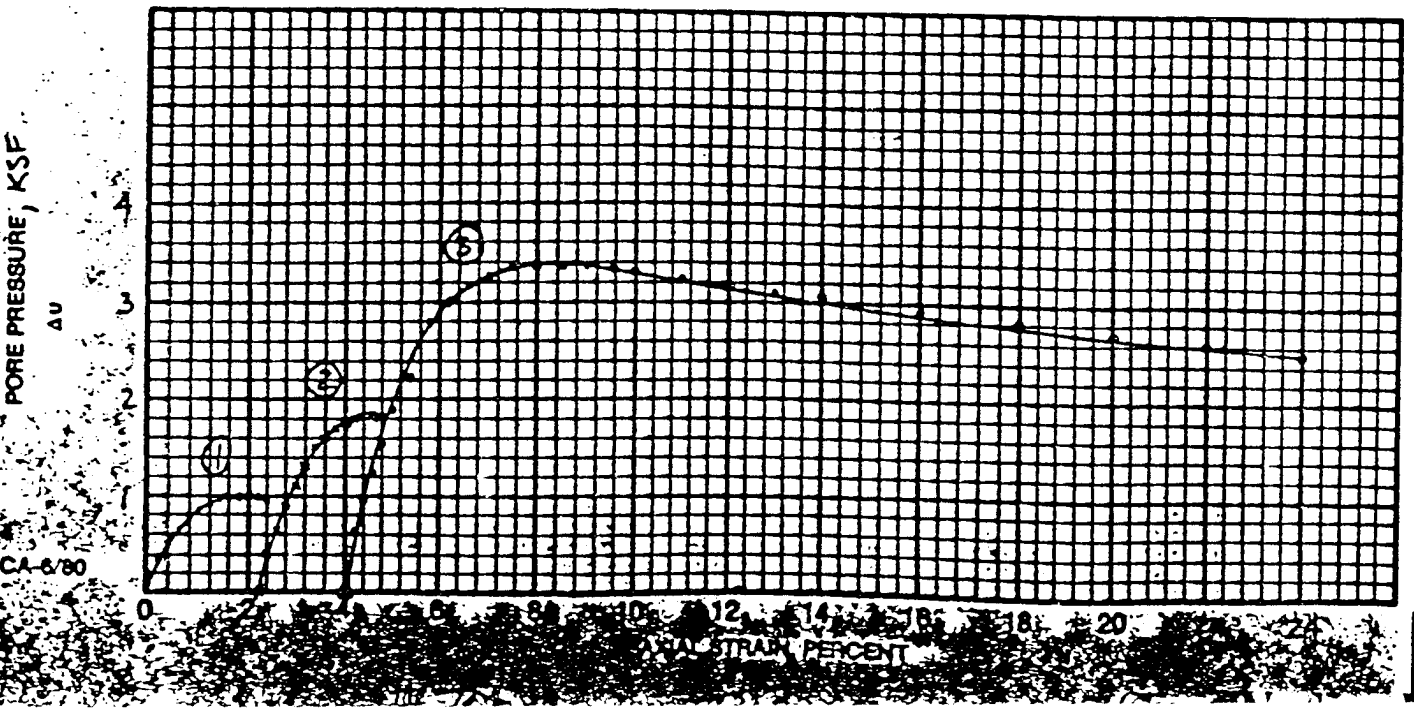
STAGE Specimen Number	"B" Parameter	Test Values at Failure-Maximum Principal Stress Ratio							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Δ Percent Strain ϵ%	
1	0.98	2.00	5.23	3.23	1.02	4.25	0.98	2.2	UNITS IN
2	"	5.00	10.74	5.74	3.15	8.89	1.84	2.4	"
3	"	10.00	18.98	8.98	6.65	15.63	3.34	3.8	"

Remarks:

Fig.


DEVIATOR STRESS, KSF
$\sigma_1 - \sigma_3$
0
2
4
6
8
10
12
14
16
18
20
22
24
AXIAL STRAIN, PERCENT


PRINCIPAL STRESS RATIO
$\bar{\sigma}_1 / \bar{\sigma}_3$
1
2
3
4
5
0
2
4
6
8
10
12
14
16
18
20
22
24
AXIAL STRAIN, PERCENT


PORE PRESSURE, KSF
Δu
1
2
3
4
0
2
4
6
8
10
12
14
16
18
20
22
24
AXIAL STRAIN, PERCENT

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-16-91

LAB NAME: CNI

CHECKED BY: LAB SAM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7004	10.8 - 11.3	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
110.1	18.8	92.7	0.558	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
108.7	21.5	100 +	0.578

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2002	0			
0.20	2579	346			
0.39	2930	518			
0.60	3155	662			
0.80	3364	778			
1.00	3535	864			
1.20	3712	922			
1.41	3894	950			
1.60	4012	979			
1.80	4114	979			
2.00	4194	979			
2.19	4252	979			
2.40	4338	950			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP
LOCATION ID: Disposal Facility
DATE: 8-16-91
LAB NAME: CNI
CHECKED BY: LAB SKM
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7004	10.8-11.3	N/A	4997

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
108.7	21.5	100+	0.578	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.8	20.4	100+	0.548

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	4997	0	2.59	8952	1814
0.20	6163	432			
0.40	6825	662			
0.60	7353	893			
0.80	7725	1123			
1.00	8117	1310			
1.20	8397	1498			
1.40	8553	1613			
1.61	8694	1699			
1.81	8798	1757			
2.01	8865	1786			
2.19	8868	1814			
2.39	8892	1843			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP
LOCATION ID: Disposal Facility
DATE: 8-16-91
LAB NAME: CNI
CHECKED BY: LAB SVM
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7004	10.8 - 11.3	N/A	9994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
110.8	20.4	100+	0.548	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
112.6	19.5	100+	0.524

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	9994	0	4.50	15 528	3370
0.20	12 127	662	5.01	15 468	3341
0.41	13 294	950	5.50	15 492	3312
0.60	14 064	1238	6.00	15 454	3283
0.80	14 713	1555	7.00	15 418	3226
1.00	15 163	1872	8.01	15 463	3168
1.40	15 797	2246	9.00	15 536	3082
1.81	15 796	2794	10.00	15 627	3053
2.20	15 824	3010	12.00	15 781	2938
2.61	15 778	3168	14.01	15 735	2822
3.00	15 741	3254	16.00	15 743	2707
3.50	15 630	3341	18.00	15 862	2621
4.00	15 553	3370	20.00	16 056	2534

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.

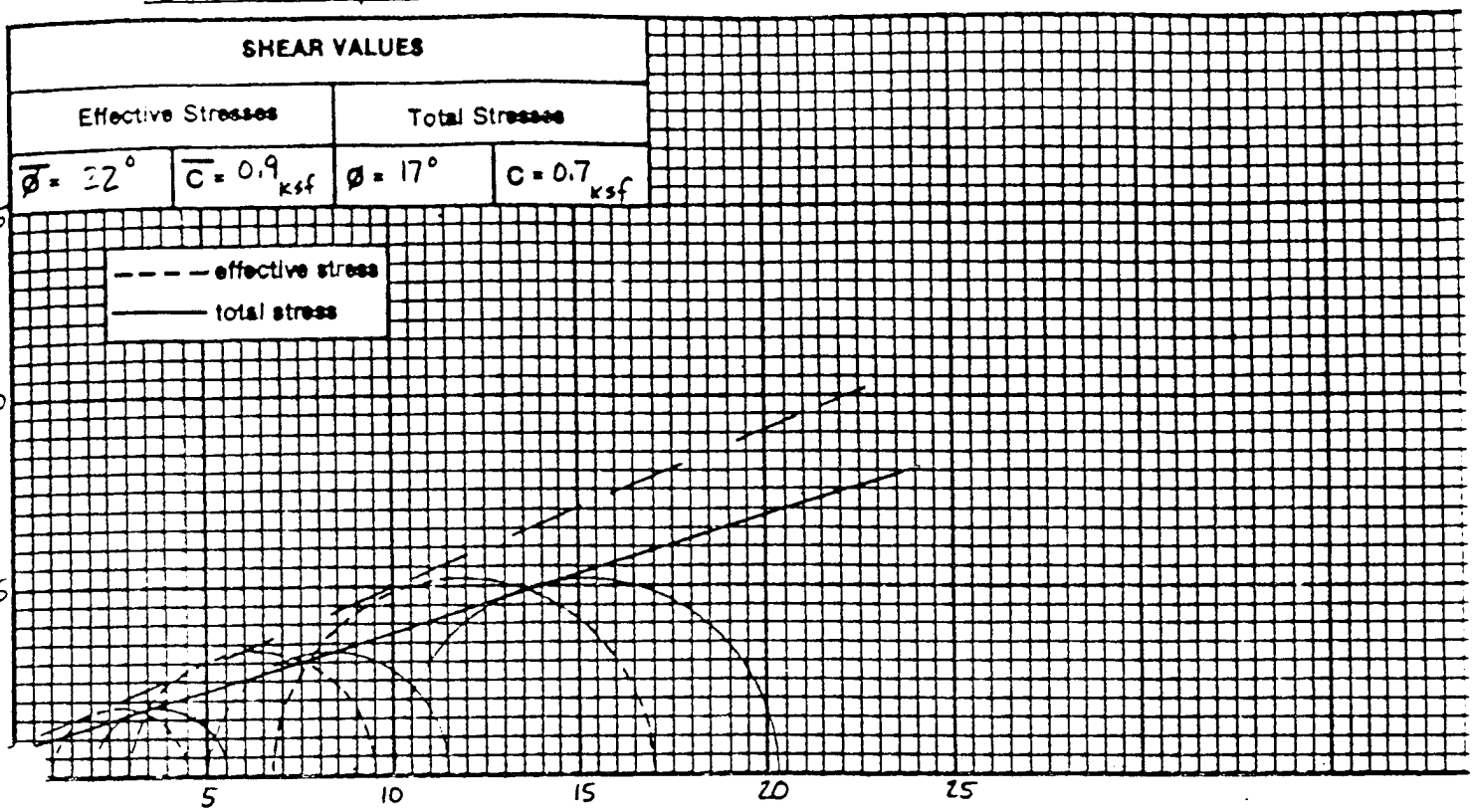
TEST PROCEDURE: EM-1110-2-1906

Chen Northern, Inc.

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1-369-91
Date 8-7-91
Type of Test SATURATED, CONSOLIDATED, UNDRAINED WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 32°	$\bar{C}$ = 0.9 ksf	ϕ = 17°	C = 0.7 ksf

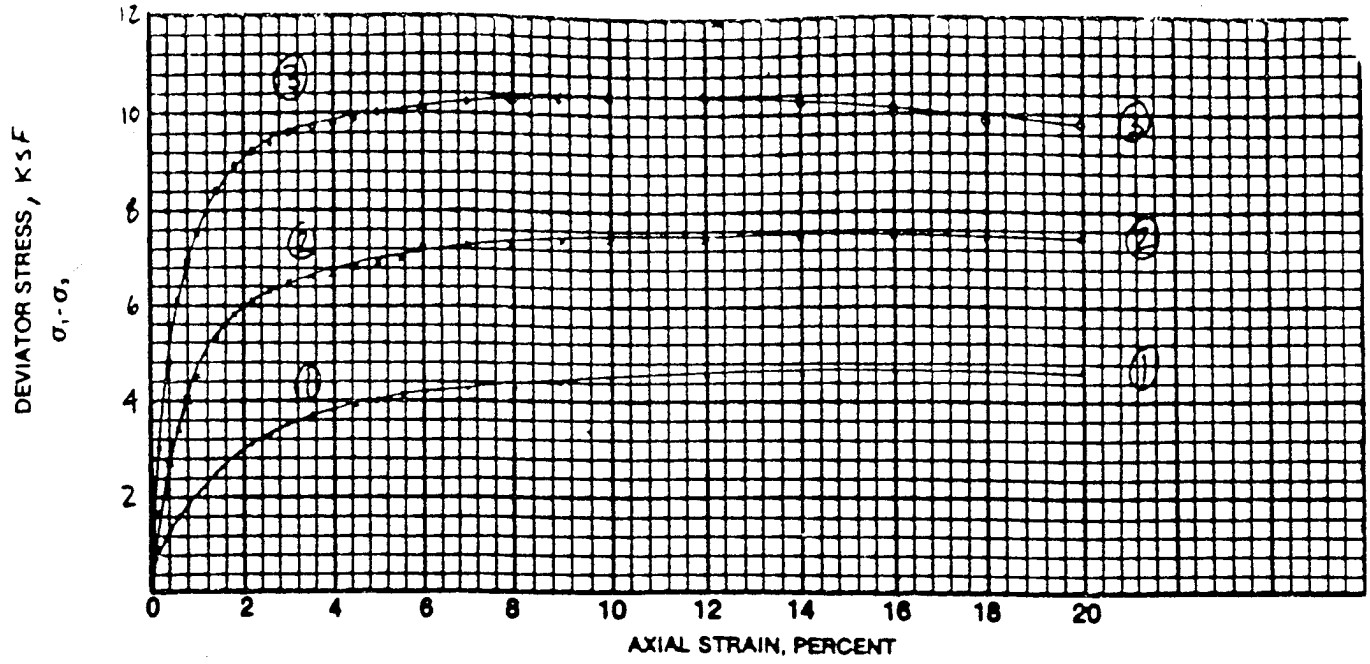


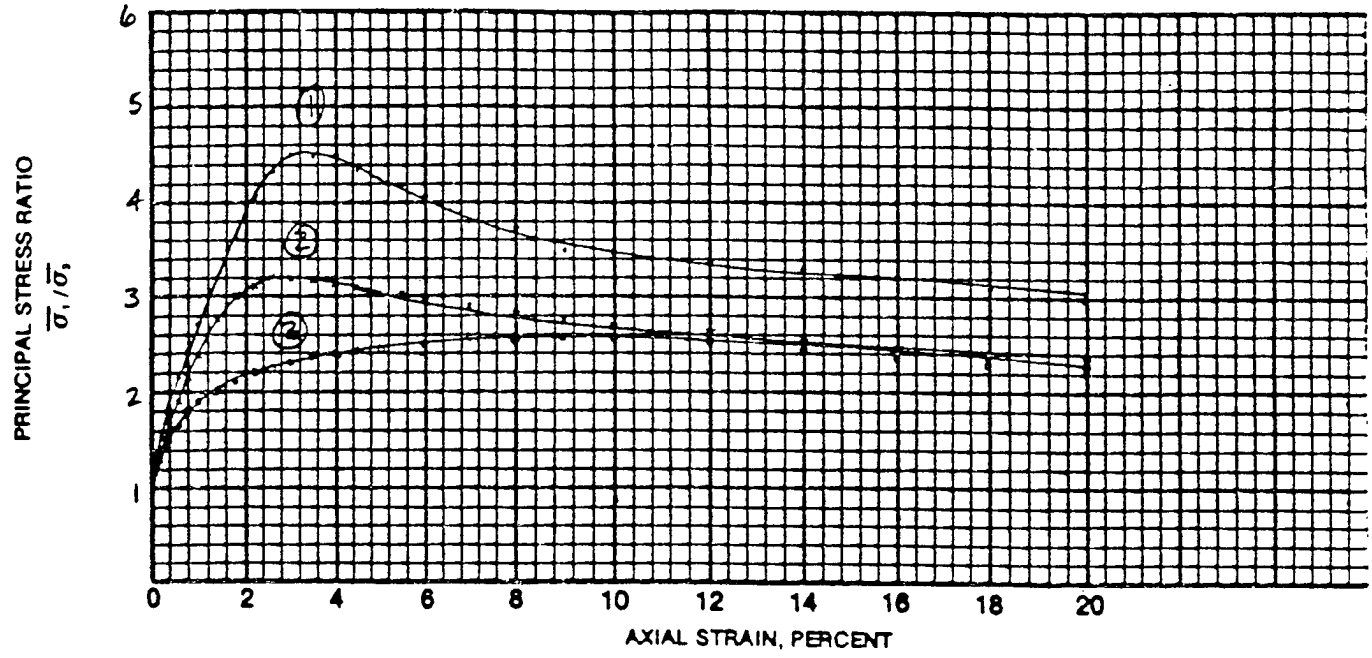
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-7108	20.3-20.9	Shelby	5.922	2.872	109.4	19.1	Sandy lean clay
2	"	20.9-21.5	"	6.030	2.880	111.8	17.5	"
3	"	21.5-22.0	"	6.170	2.878	111.7	12.3	"

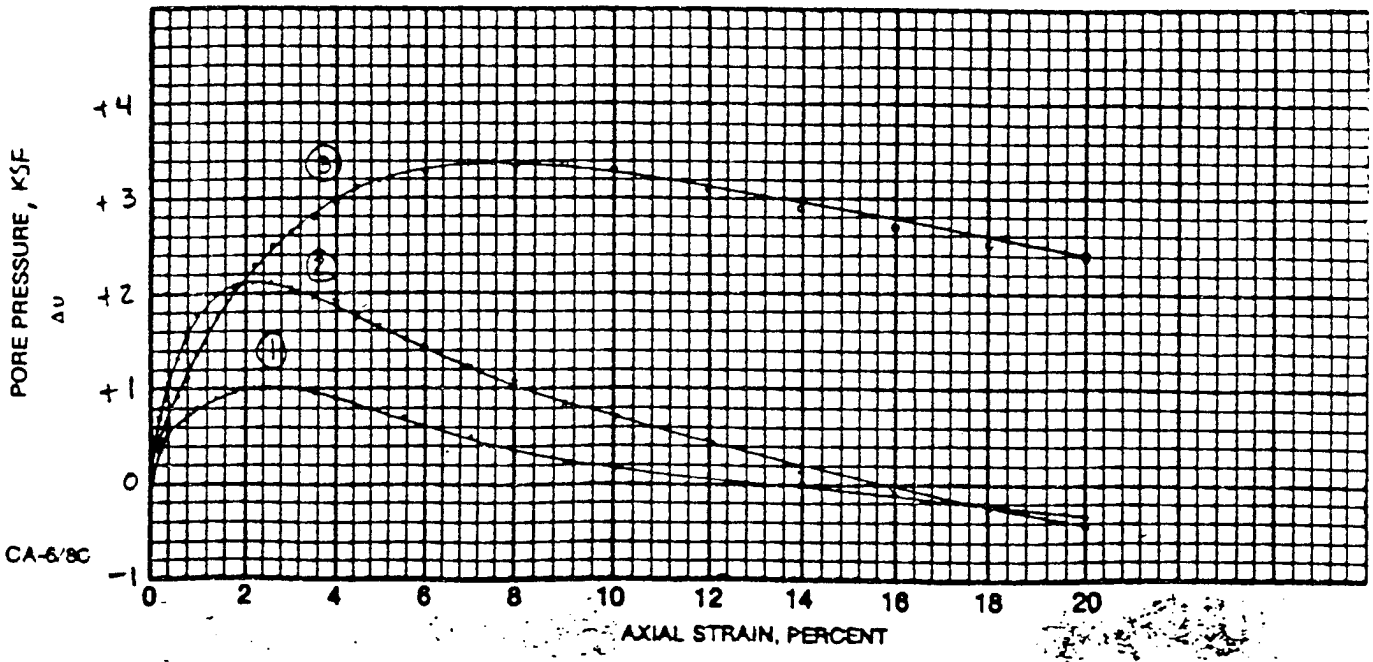
Specimen Number	"B" Parameter	Test Values at Failure-Maximum Principal Stress Ratio							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ %	
1	0.99	2.00	5.47	3.47	0.99	4.46	1.01	3.00	UNITS IN KSF
2	0.99	5.00	11.49	6.49	2.96	9.45	2.04	3.00	"
3	0.97	10.00	20.33	10.33	6.66	16.99	3.34	9.00	"

Remarks:

Fig. ____







CA-6/8C

#7108 CU TRIAX

Chen Northern

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-16-91

LAB NAME: CNI

CHECKED BY: LAB SUM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7108	20.3-20.9	N/A	2002

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
109.4	19.1	95.4	0.541	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
110.5	21.7	99.5	0.589

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2002	0	4.50	5073	835
0.20	2458	403	5.01	5233	778
0.41	2727	518	5.50	5371	720
0.61	2952	634	6.06	5535	634
0.80	3097	720	7.04	5795	490
1.00	3241	806	8.00	5965	374
1.40	3571	893	9.00	6131	259
1.79	3842	950	10.05	6303	173
2.20	4068	1008	11.99	6444	86
2.60	4307	1008	14.00	6593	0
2.99	4461	1008	16.00	6718	-86
3.50	4708	950	18.00	6893	-230
4.01	4897	907	20.03	6996	-346

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-16-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7108	20.9-21.5	N/A	5000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
111.8	17.5	93.2	0.507	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
111.8	18.6	98.7	0.508

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	5000	0	4.49	10 057	1757
0.20	6017	691	5.00	10 251	1642
0.40	6630	1037	5.50	10 423	1526
0.60	7057	1325	6.00	10 556	1440
0.80	7430	1555	7.00	10 846	1238
1.00	7720	1757	8.00	11 112	1037
1.40	8294	1987	9.00	11 347	864
1.80	8725	2074	10.07	11 573	691
2.20	9016	2102	12.00	11 909	432
2.61	9226	2102	14.00	12 171	173
3.01	9449	2045	16.00	12 425	- 86
3.51	9650	1958	17.99	12 650	-259
3.99	9851	1872	20.00	12 703	-432

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED – UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-16-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7108	21.5-22.0	N/A	9999

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
111.7	12.3	65.5	0.509	0.97

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
113.9	17.8	99.8	0.481

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	9999	0	4.50	16 828	3082
0.20	12647	374	5.03	16 835	3168
0.39	14157	634	6.00	16 848	3283
0.61	15171	893	7.00	16 889	3341
0.80	15790	1123	8.00	16 963	3341
1.00	16 185	1354	9.00	16 993	3341
1.40	16 659	1728	10.00	17077	3283
1.81	16 861	2016	12.12	17309	3082
2.20	16 914	2275	14.00	17337	2909
2.60	16 936	2477	16.00	17 374	2707
3.04	16 915	2650	18.00	17398	2534
3.50	16 876	2794	20.01	17424	2390
4.01	16 844	2966			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

Chen Northern, Inc.

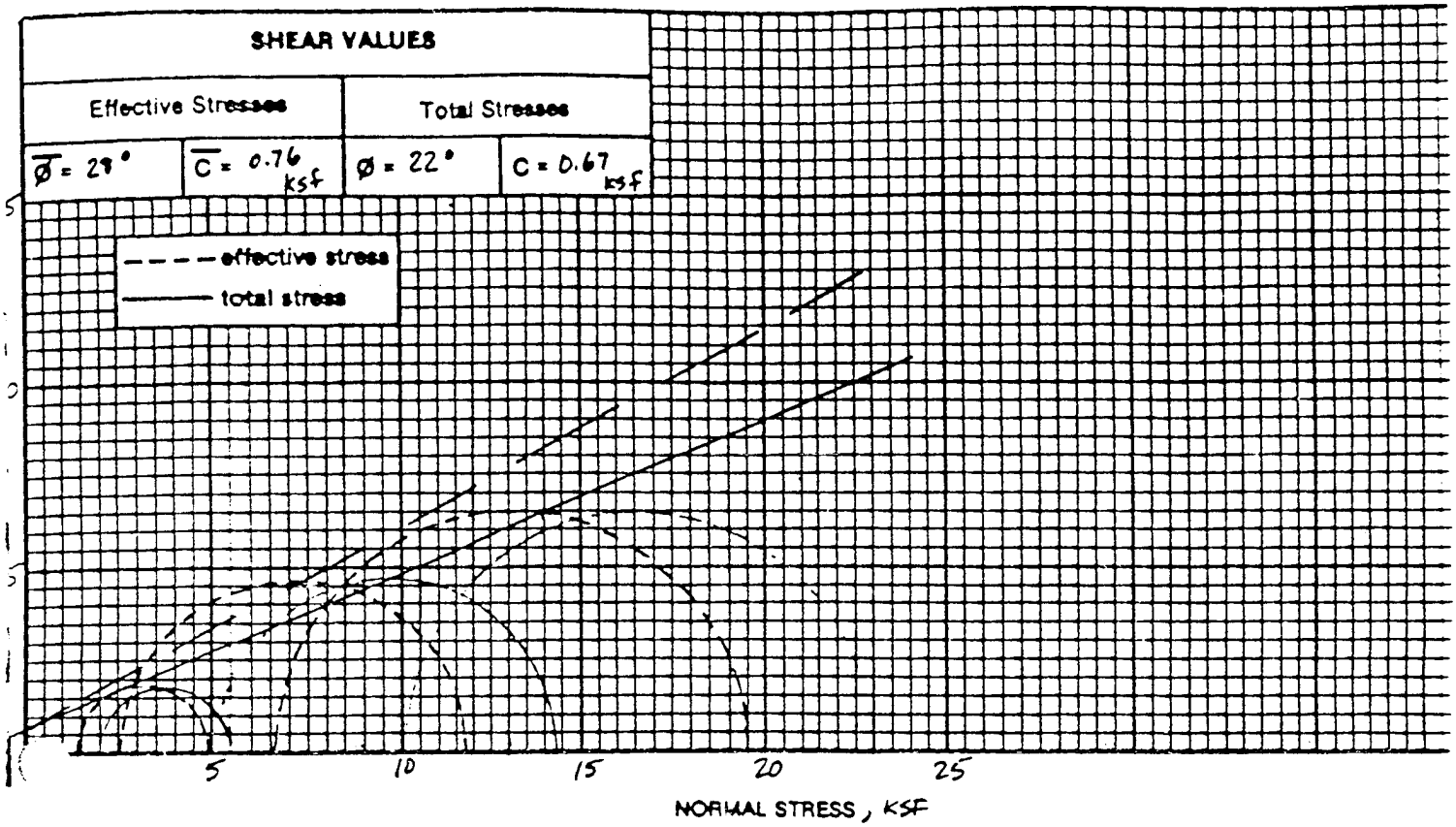
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1-369-91

Date 8-15-91

Type of Test SATURATED, CONSOLIDATED, UNDRAINED WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 29°	$\bar{C}$ = 0.76 ksf	ϕ = 22°	C = 0.67 ksf

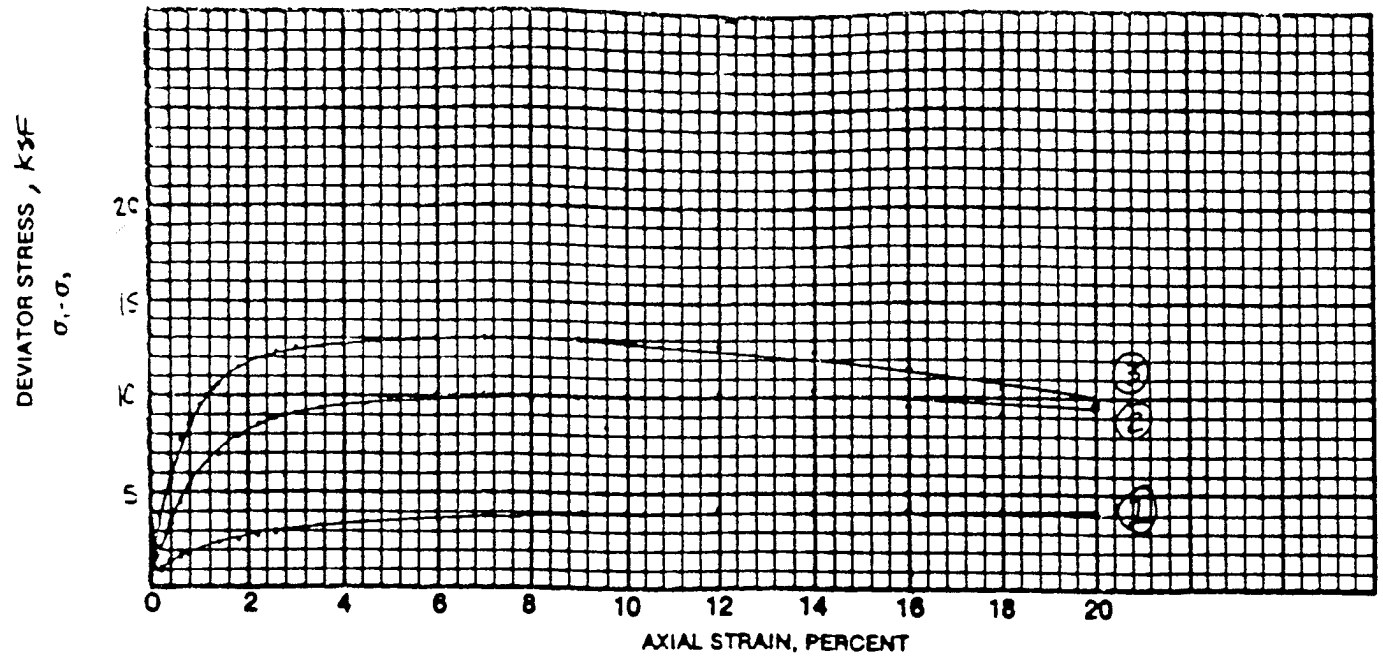


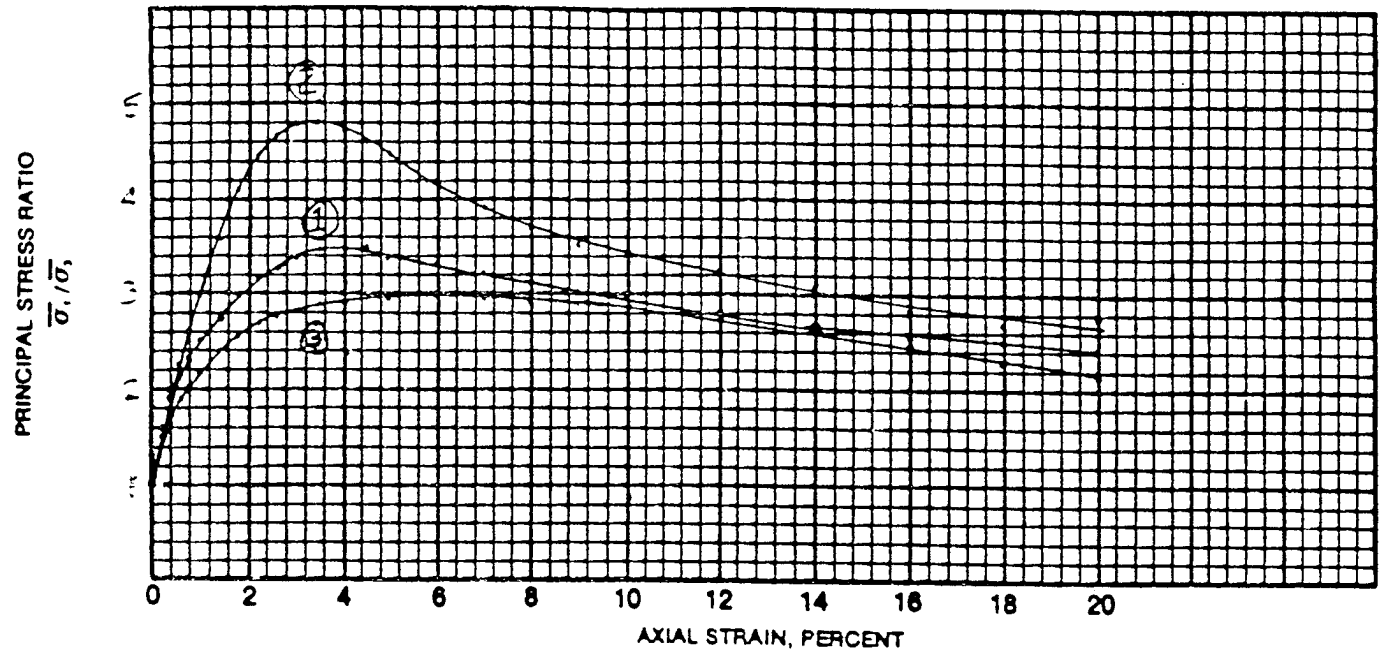
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-7110	26.9-27.4	Shelby	6.057	2.865	105.4	21.2	FAT CLAY
2	"	26.4-26.9	"	5.902	2.872	107.5	20.5	"
3	"		"	6.150	2.874	105.7	20.9	"

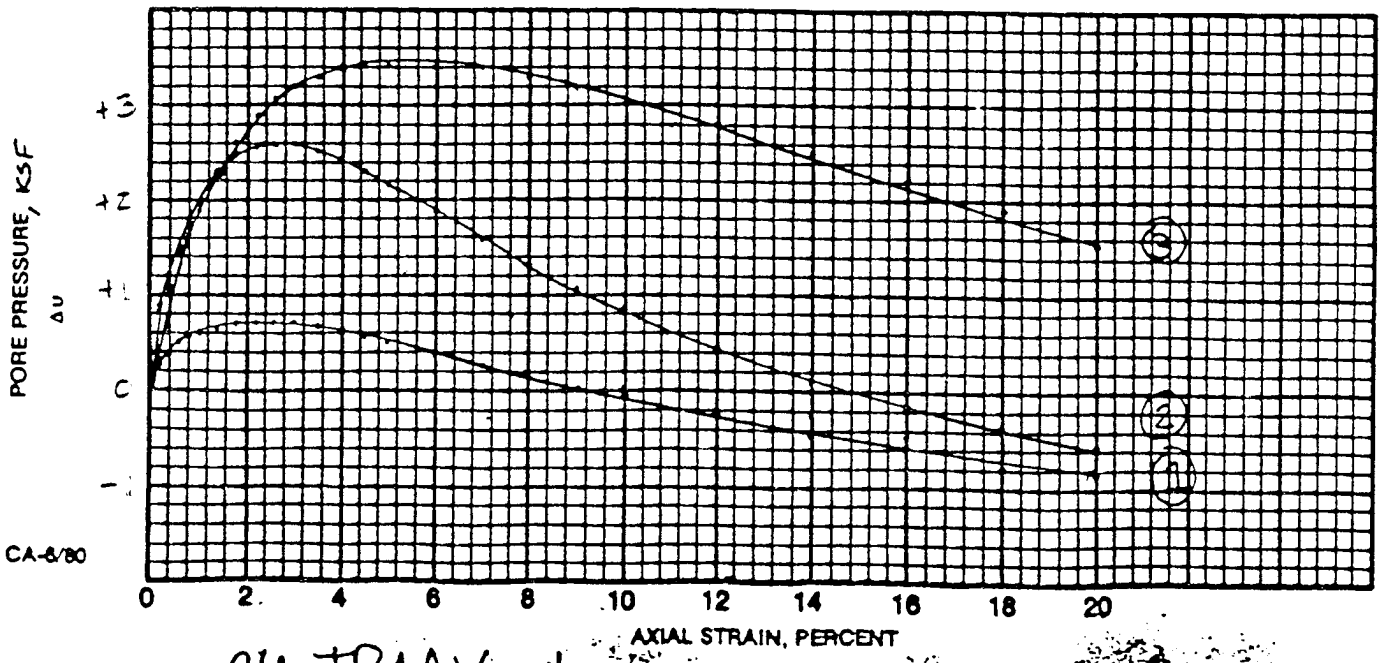
Specimen Number	"B" Parameter	Test Values at Failure-Maximum PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ%	
1	1.00	2.00	5.48	3.48	1.42	4.91	0.58	4.5	UNITS IN KSF
2	0.97	5.00	14.35	9.35	2.46	11.81	2.53	3.5	"
3	0.98	10.00	22.95	12.95	6.57	19.52	3.43	6.0	"

Remarks: NOTE: A LEAK DEVELOPED DURING THE CONSOLIDATION PHASE OF SPECIMEN 2 AND THE SAMPLE WAS RESATURATED AND RECONSOLIDATED BEFORE SHEARING.

Fig. ____







CA-6/80

CU TRIAX #7110

Chen Northern

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-20-91

LAB NAME: CNI

CHECKED BY: LAB SVM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7110	26.9-27.4	N/A	2000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
105.4	21.2	94.3	0.613	1.00

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.5	23.2	95.9	0.658

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2000	0	4.50	4908	576
0.20	2781	259	5.01	5064	504
0.40	3060	389	6.00	5326	389
0.60	3216	490	7.01	5557	259
0.79	3370	547	8.00	5751	144
0.99	3481	605	9.09	5939	29
1.40	3692	662	10.00	6083	-58
1.80	3889	691	12.00	6348	-259
2.20	4112	691	14.00	6457	-461
2.60	4270	691	16.00	6737	-634
3.01	4426	691	18.00	7012	-792
3.50	4606	662	20.00	7056	-922
4.00	4793	605			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-20-91

LAB NAME: CNI

CHECKED BY: LAB SUM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7110	26.4-26.9	N/A	5000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
107.5	20.5	96.1	0.581	0.97

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
108.4	21.2	100+	0.567

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	5000	0	4.49	12 369	2304
0.21	6297	893	5.01	12 630	2160
0.39	7168	1210	6.00	13 086	1872
0.60	7908	1498	7.00	13 386	1570
0.81	8497	1757	8.01	13 613	1296
1.00	8966	1958	9.00	13 837	1066
1.41	9739	2275	10.00	14159	864
1.80	10 314	2477	12.00	14 661	461
2.20	10 804	2563	14.04	15 105	86
2.61	11 193	2592	16.00	14 705	-173
3.00	11 501	2592	18.00	14 461	-374
3.50	11 812	2534	19.99	15 346	-576
4.00	12 120	2434			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-20-91

LAB NAME: CNI

CHECKED BY: LAB SCM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7110	25.9-26.4	N/A	9999

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
105.7	20.9	93.6	0.608	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
106.3	21.4	97.2	0.599

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	9999	0	4.50	19 391	3427
0.20	13 070	835	5.01	19 428	3427
0.40	14638	1066	6.00	19 523	3427
0.68	16 291	1440	7.00	19 571	3384
0.81	16 831	1613	8.00	19 675	3283
1.00	17 497	1872	8.99	19 812	3168
1.40	18 335	2304	10.00	19 863	3053
1.80	18 801	2621	12.01	19 926	2779
2.21	19 056	2880	14.00	19 779	2506
2.60	19 180	3053	16.04	19 237	2218
3.00	19 265	3197	18.00	18 652	1901
3.51	19 319	3312	19.99	18 157	1555
4.00	19 359	3398			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP
LOCATION ID: Disposal Facility
DATE: 8-17-91
LAB NAME: CNI
CHECKED BY: LAB SKM
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7112	30.0 - 31.5	N/A	2000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
88.0	22.5	68.5	0.860	0.97

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
94.7	29.4	100 +	0.727

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2000	0	2.60	3101	835
0.21	2341	29			
0.39	2781	58			
0.60	2932	173			
0.80	3091	346			
1.01	3140	461			
1.19	3117	547			
1.40	3127	634			
1.61	3132	691			
1.79	3104	749			
2.00	3119	763			
2.20	3105	806			
2.41	3105	835			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

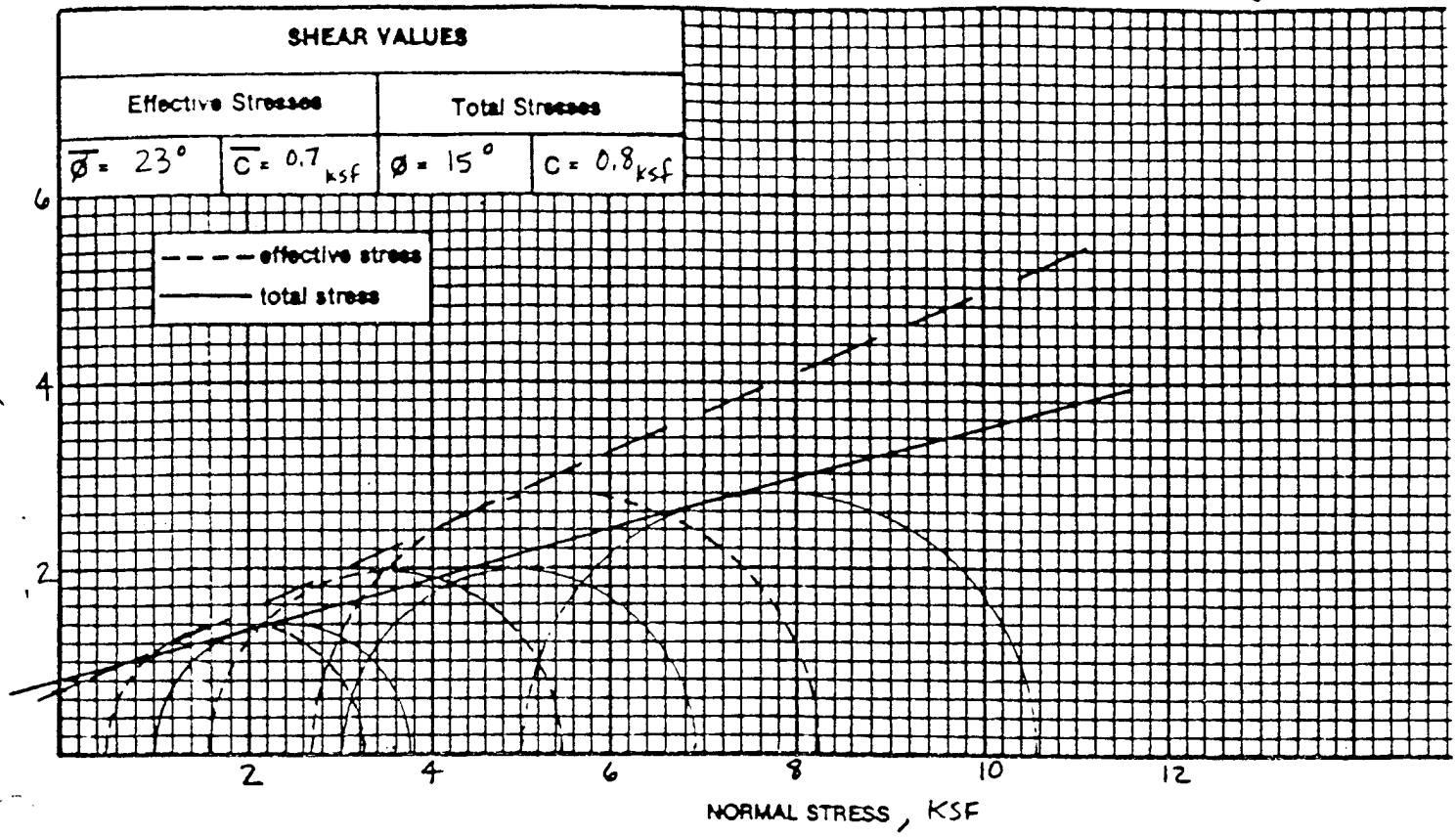
TEST PROCEDURE: EM-1110-2-1906

Chen Northern, Inc.

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1-369-91
Date 8-6-91
Type of Test MULTI-STAGED, SATURATED, CONSOLIDATED, UNDRAINED WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 23°	$\bar{C}$ = 0.7 ksf	ϕ = 15°	C = 0.8 ksf

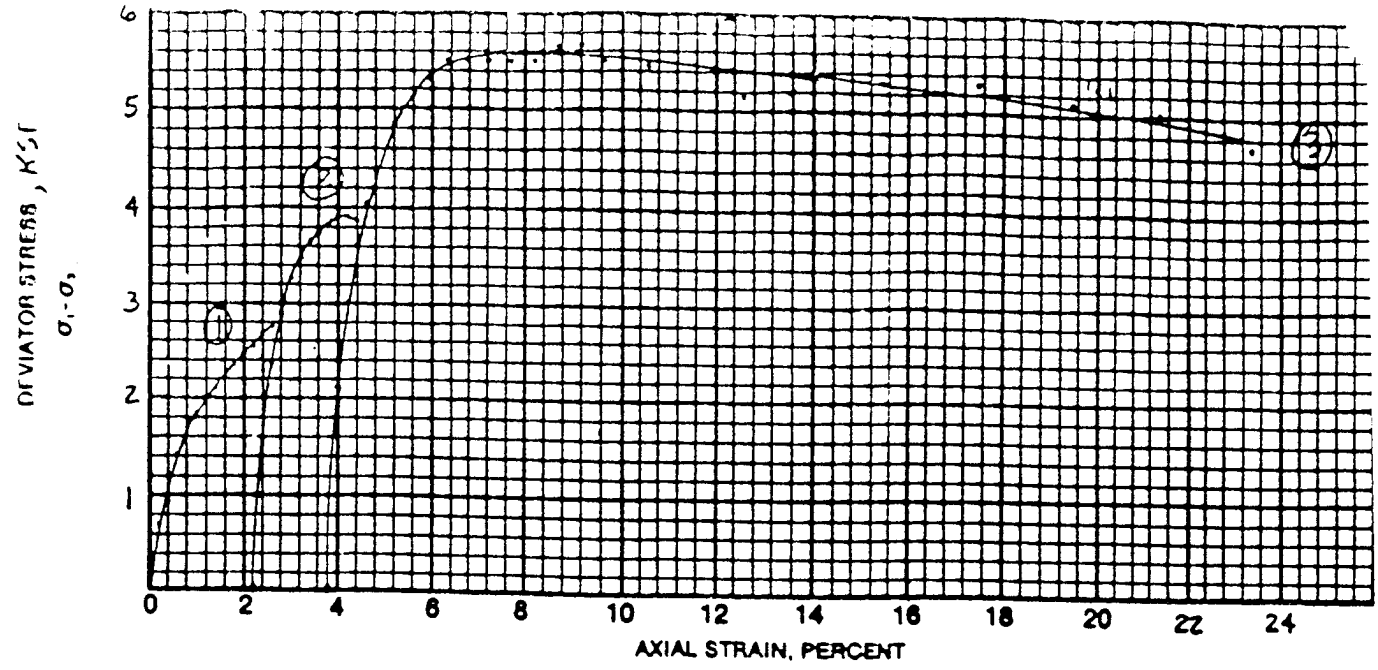


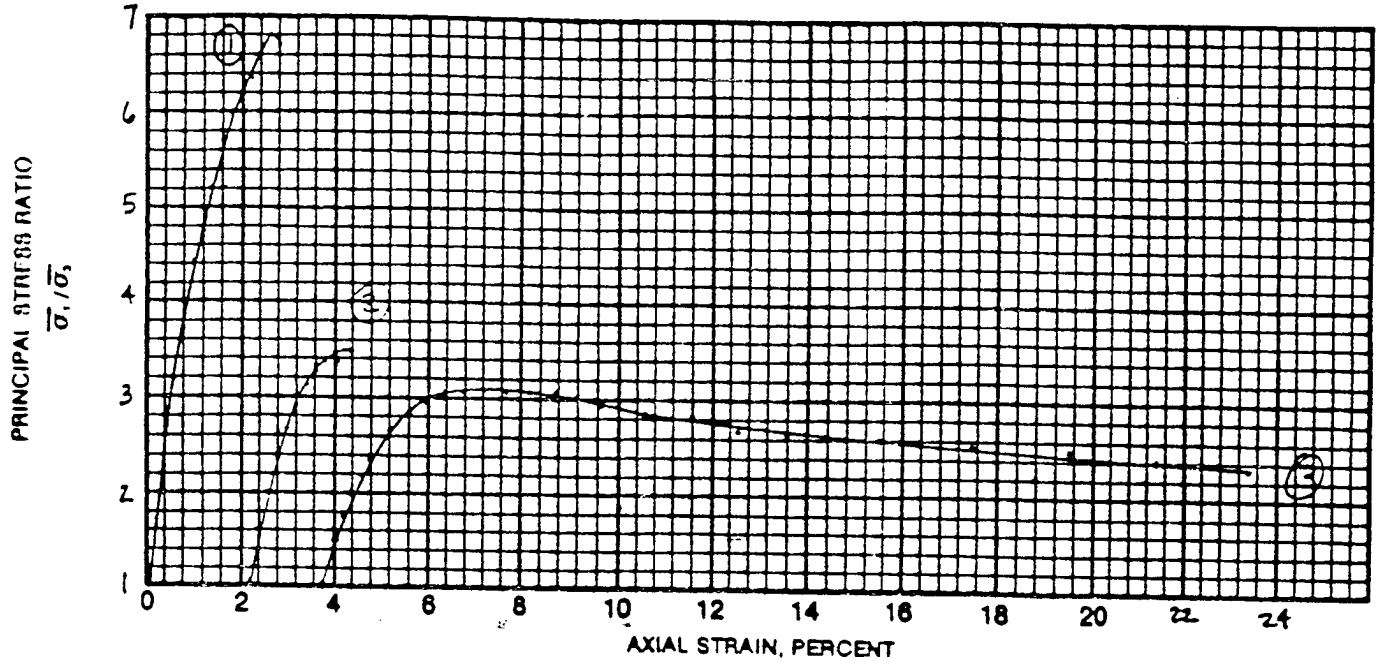
STAGE Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-7402	5.0-7.5	Shelby	5.914	2.871	99.9	24.2	Fat clay wit
2	"	"	"	—	—	—	—	"
3	"	"	"	—	—	—	—	"

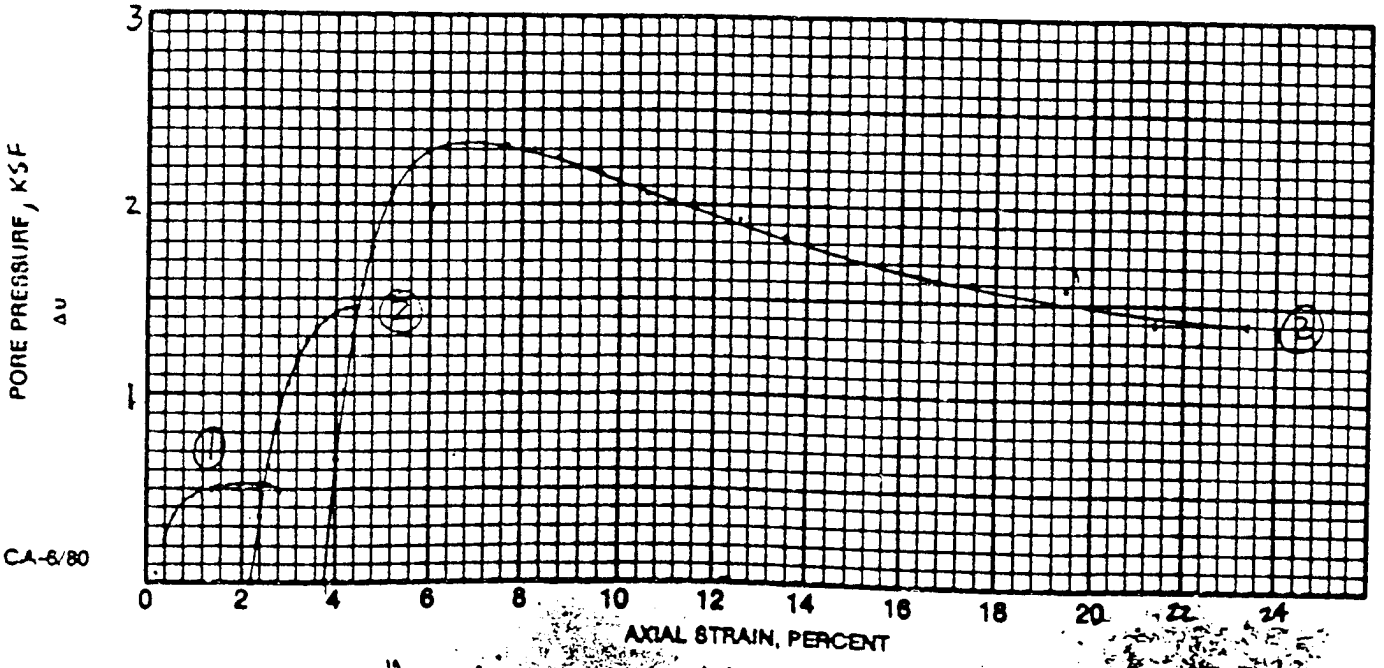
STAGE Specimen Number	"B" Parameter	Test Values at Failure-Maximum Principal Stress Ratio							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Δ Percent Strain ϵ%	
1	0.98	1.00	3.75	2.75	0.48	3.23	0.52	2.6	UNITS IN KSF
2	—	3.00	6.88	3.88	1.56	5.43	1.44	2.0	"
3	—	5.00	10.55	5.55	2.68	8.23	2.32	3.4	"

Remarks:

Fig. ____







CA-6/80

#7402 CU TRIAX

Chen Northern, I

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-21-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7402	5.0-7.5	N/A	994

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
99.9	24.2	95.2	0.687	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
101.3	25.6	100.0	0.692

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	994	0	2.60	3228	518
0.20	1639	43	2.80	3359	490
0.40	1716	230			
0.61	2064	346			
0.79	2202	403			
1.00	2362	461			
1.20	2534	461			
1.40	2633	490			
1.60	2709	518			
1.80	2835	518			
1.99	2940	518			
2.19	3022	518			
2.39	3147	518			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-21-91

LAB NAME: CNI

CHECKED BY: LAB SVM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7402	5.0-7.5	N/A	2995

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
101.3	25.6	100.0	0.692	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
102.0	24.2	100.0	0.653

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2995	0			
0.21	4224	346			
0.40	4751	634			
0.60	5002	864			
0.80	5198	1037			
1.00	5289	1181			
1.19	5372	1267			
1.40	5402	1339			
1.61	5438	1382			
1.80	5489	1411			
2.01	5430	1440			
2.20	5401	1440			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-21-91

LAB NAME: CNI

CHECKED BY:. LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7402	5.0-7.5	N/A	4997

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
102.0	24.2	100.0	0.653	N/A

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
103.7	23.2	100.0	0.625

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	4997	0	4.40	8247	2290
0.19	6435	648	4.90	8376	2261
0.40	6985	1022	5.38	8427	2203
0.58	7301	1310	5.86	8384	2174
0.79	7463	1570	6.84	8378	2059
0.98	7613	1771	7.82	8441	2002
1.38	7778	2059	8.80	8242	1915
1.75	7906	2203	9.81	8353	1829
2.15	8021	2290	11.74	8627	1685
2.54	8148	2318	13.70	8674	1598
2.94	8170	2318	15.66	8544	1570
3.42	8231	2318	17.60	8618	1397
3.92	8158	2318	19.56	8334	1397

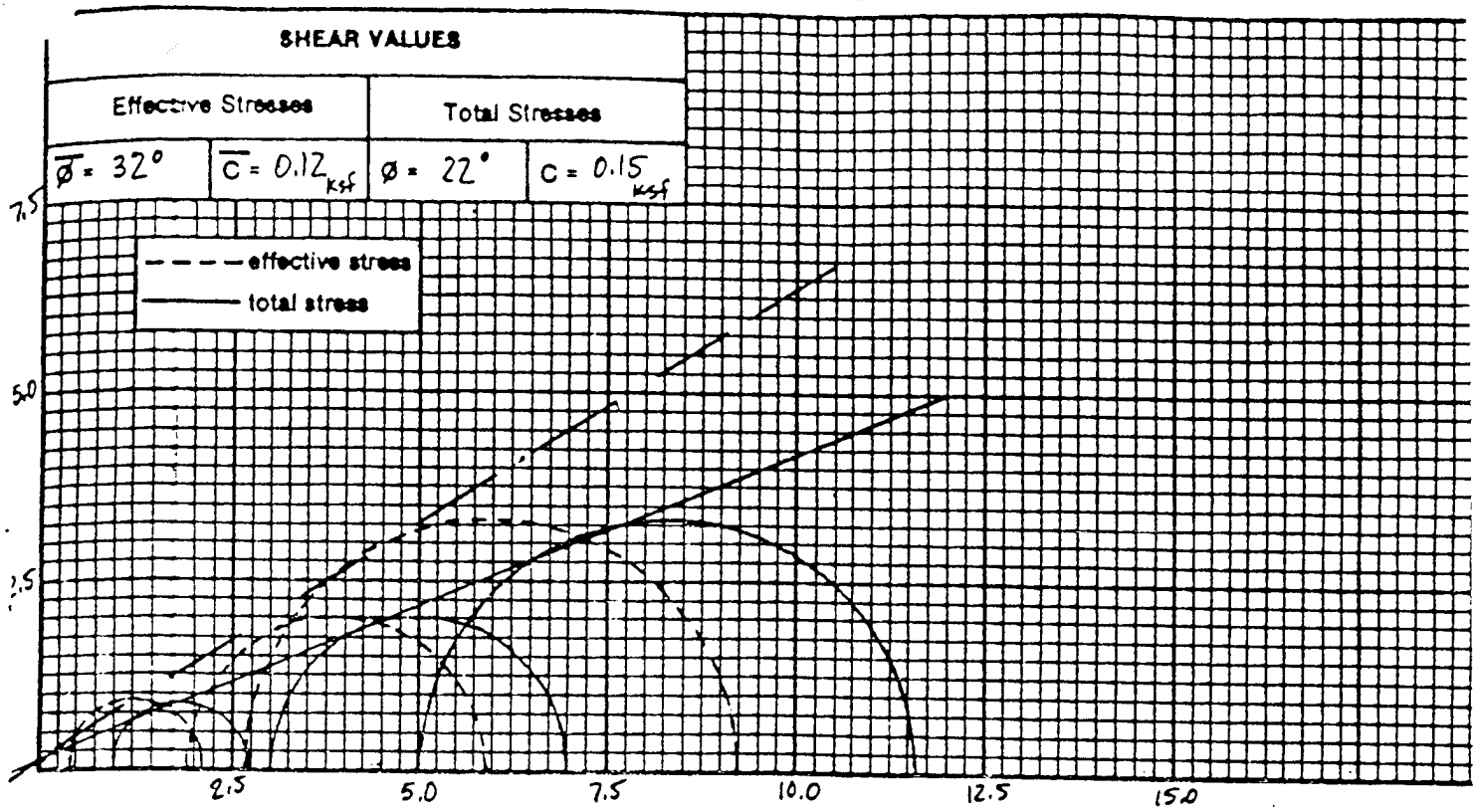
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

SHEAR STRENGTH OF SOIL
IN TRIAXIAL COMPRESSION

Job No. 1-369-91
Date 8-15-91
Type of Test SATURATED, CONSOLIDATED, UNDRAINED WITH PORE PRESSURE MEASUREMENTS

SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 32°	$\bar{C}$ = 0.12 ksf	ϕ = 22°	C = 0.15 ksf

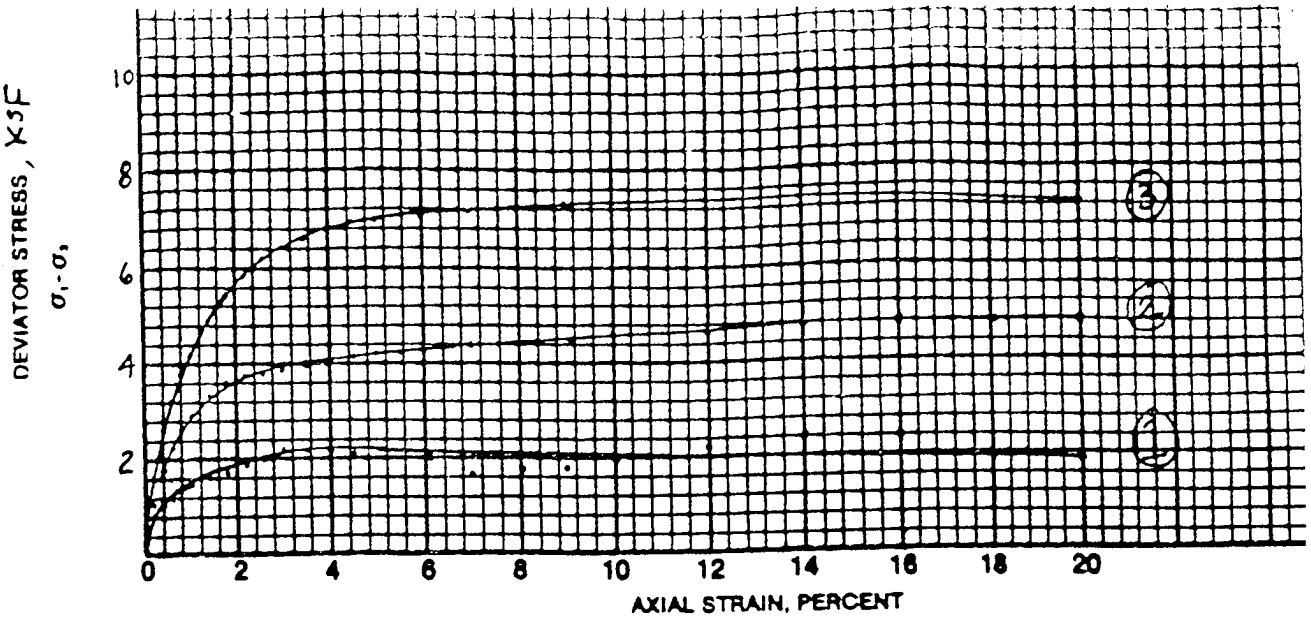


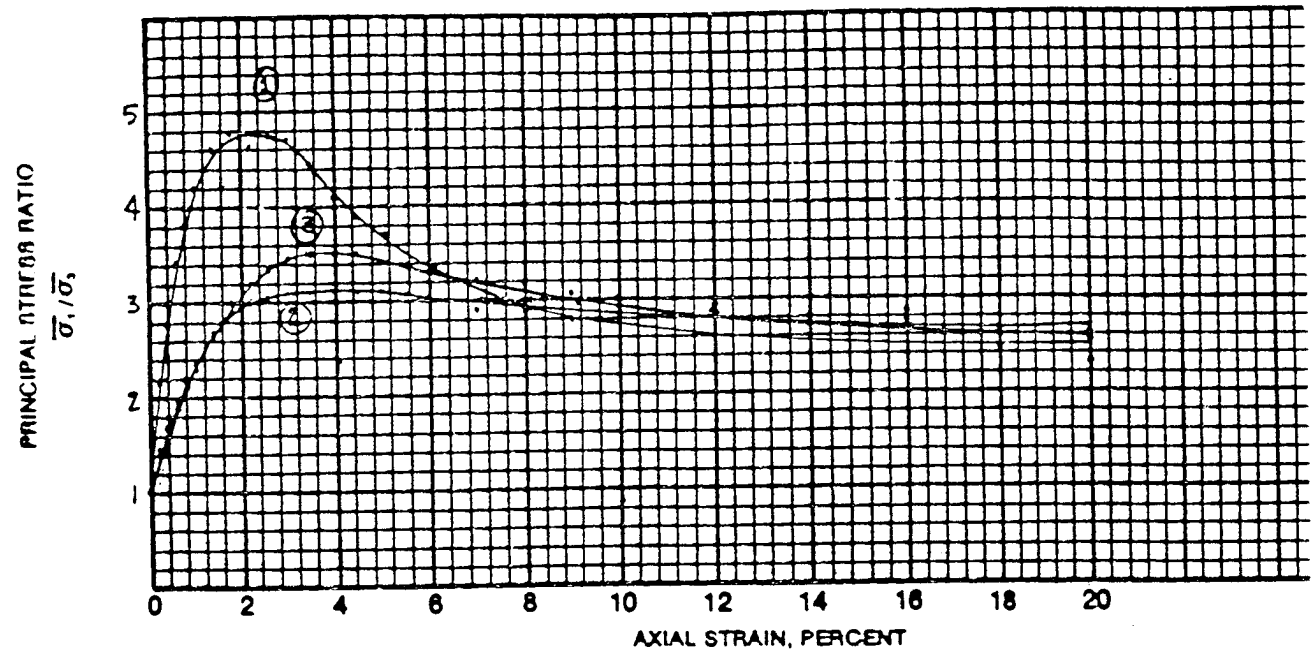
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-7906	15.8-16.3	Shelby	5.795	2.865	109.1	17.8	lean clay w/sand
2	"	16.3-16.8	"	5.645	2.872	109.3	18.1	"
3	"	16.8-17.3	"	5.644	2.865	112.4	17.5	"

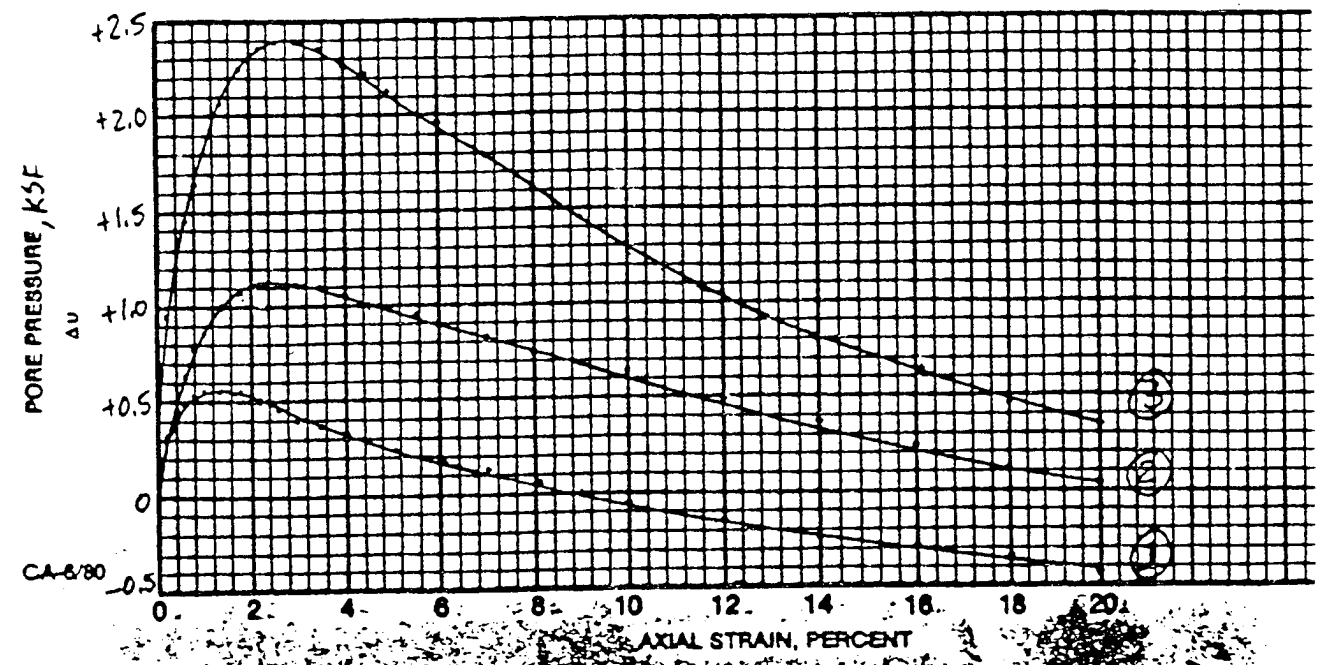
Specimen Number	"B" Parameter	Test Values at Failure-Maximum Principal Stress Ratio							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ %	
1	0.99	1.00	2.71	1.71	0.45	2.16	0.55	1.8	Units in ksf
2	0.98	3.00	7.00	4.00	1.90	5.90	1.09	3.5	"
3	0.99	5.00	11.60	6.60	2.64	9.24	2.36	3.5	"

Remarks:

Fig. ____







CA-6/80

CU TRIAX 3401

Chen North

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP
LOCATION ID: Disposal Facility
DATE: 8-17-91
LAB NAME: CNI
CHECKED BY: LAB [signature]
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7406	15.8-16.3	N/A	999

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
109.1	17.8	88.4	0.545	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
105.8	21.2	96.7	0.594

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	999	0	4.49	2751	288
0.21	1466	317	5.15	2836	230
0.40	1660	403	6.09	2792	173
0.60	1745	490	7.00	2532	130
0.81	1854	518	8.06	2705	58
1.00	1898	547	9.00	2804	0
1.41	2085	547	10.00	3019	-58
1.80	2164	547	12.01	3368	-144
2.20	2364	490	14.00	3667	-230
2.61	2555	461	16.00	3686	-288
3.00	2795	403	17.99	3275	-346
3.50	2770	374	20.00	3315	-432
4.00	2785	317			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB Grem

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7406	16.3-16.8	N/A	2995

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURA-TION (%)	VOID RATIO e	B PARAM.
109.3	18.1	90.0	0.542	0.98

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
107.8	20.1	96.2	0.564

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	2995	0	4.50	6109	1008
0.20	3800	288	5.00	6199	979
0.41	4280	461	5.50	6268	950
0.60	4605	634	6.00	6366	893
0.83	4846	778	7.04	6553	821
0.99	4994	864	8.12	6695	749
1.40	5292	1008	9.08	6806	691
1.81	5472	1094	10.00	6916	634
2.20	5600	1123	12.01	7151	490
2.61	5713	1123	14.01	7368	374
3.00	5782	1123	16.00	7568	230
3.49	5897	1094	18.14	7686	115
4.01	6003	1051	20.01	7768	29

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Facility

DATE: 8-17-91

LAB NAME: CNI

CHECKED BY: LAB SKM

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-7406	16.8 - 17.3	N/A	4997

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
112.4	17.5	94.6	0.500	0.99

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
111.8	19.1	100 +	0.508

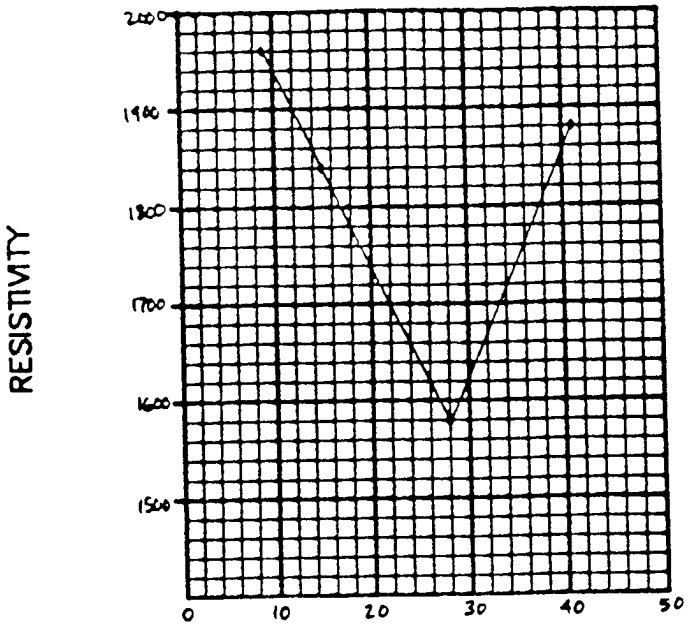
TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
0	4997	0	4.50	9650	2218
0.20	5844	965	5.00	9806	2131
0.41	6345	1210	6.00	10 114	1958
0.60	6770	1440	6.99	10 377	1786
0.80	7111	1642	8.01	10 634	1613
1.00	7325	1814	9.00	10 870	1440
1.41	7813	2074	10.00	11 033	1296
1.80	8186	2246	11.99	11 325	1037
2.21	8502	2362	14.00	11 558	806
2.60	8774	2390	16.14	11 678	634
3.01	9027	2390	18.01	11 833	461
3.50	9236	2362	20.00	11 860	346
4.00	9501	2275			

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12



Resistivity (Ohm-Cm)	Moisture content (%)
1960	8.7
1840	15.1
1580	27.9
1880	40.7

Natural Moisture Content 9.7 %

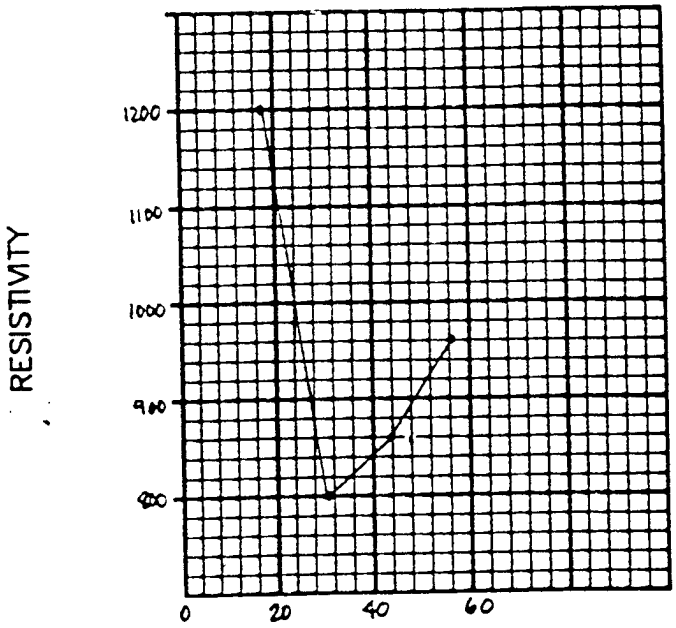
Natural Dry Density — pcf

pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-6801 @ 2.5'-4.0'



Resistivity (Ohm-Cm)	Moisture content (%)
1200	17.6
800	30.7
860	43.7
960	56.8

Natural Moisture Content 22.0 %

Natural Dry Density — pcf

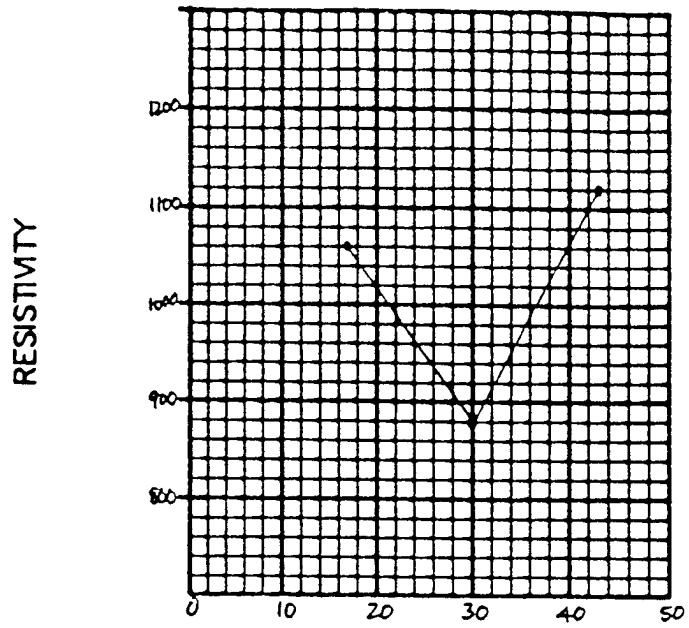
pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-6901 @ 2.5'-4.0'

1-369-91	Chen Northern, Inc.	LABORATORY RESISTIVITY TEST RESULTS	Fig.



Resistivity (Ohm-Cm)	Moisture content (%)
1080	16.9
880	29.9
1120	42.9

Natural Moisture Content 19.3 %

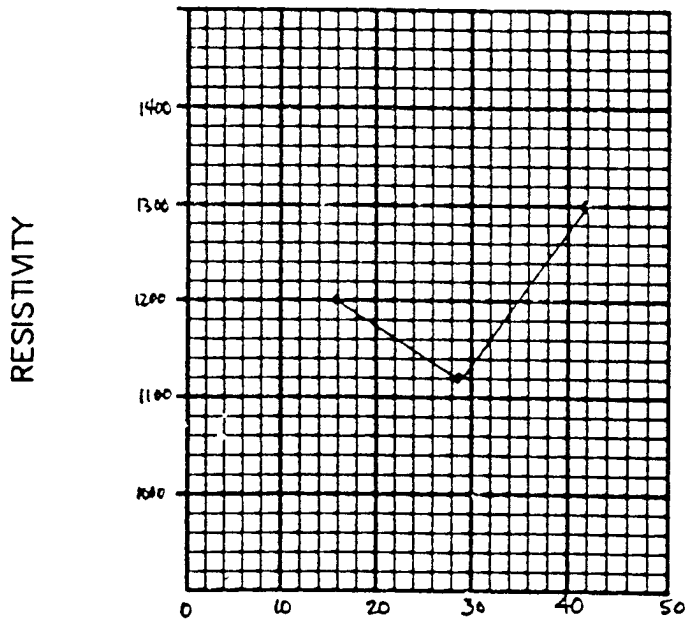
Natural Dry Density — pcf

pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-6903 @ 7.5'-9.0'



Resistivity (Ohm-Cm)	Moisture content (%)
1200	15.8
1120	28.7
1300	41.6

Natural Moisture Content 22.8 %

Natural Dry Density — pcf

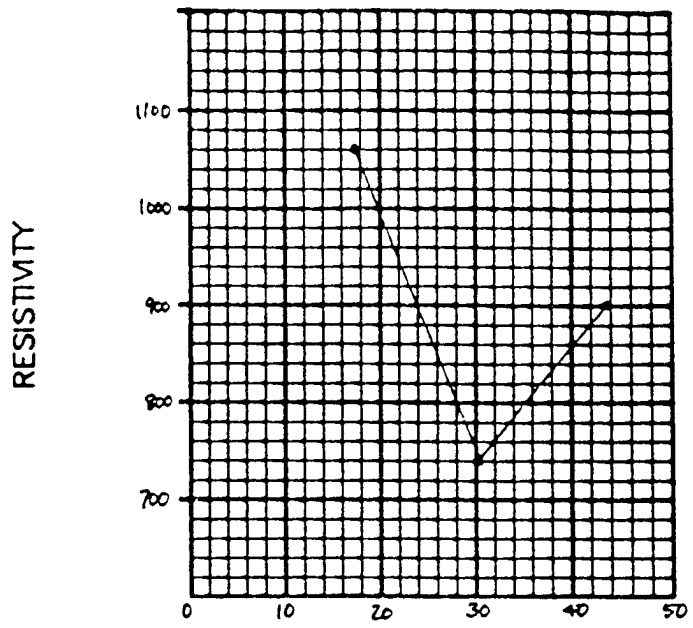
pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-7003 @ 7.5'-9.0'

1-369-91	Chen Northern, Inc.	LABORATORY RESISTIVITY TEST RESULTS	Fig.



Resistivity (Ohm-Cm)	Moisture content (%)
1060	17.4
740	30.5
900	43.5

Natural Moisture Content 25.3 %

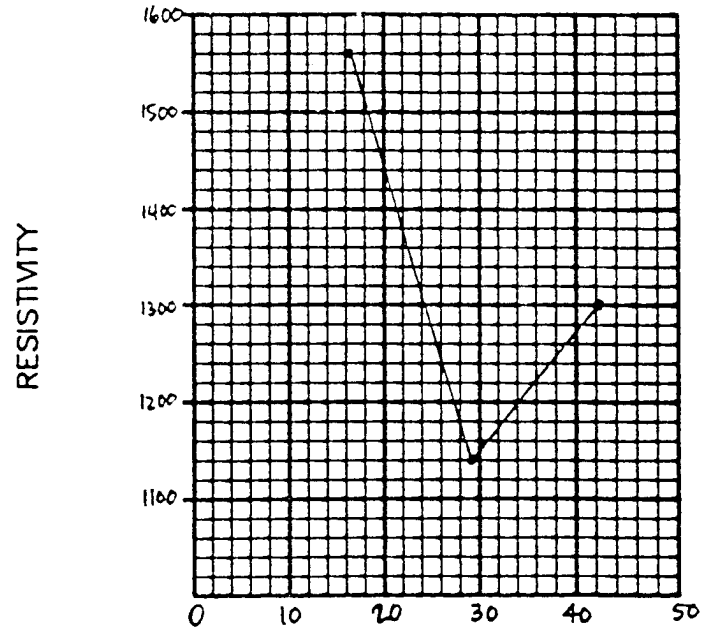
Natural Dry Density — pcf

pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-7103 @ 7.5'-9.0'



Resistivity (Ohm-Cm)	Moisture content (%)
1560	16.5
1140	29.4
1300	42.4

Natural Moisture Content 24.1 %

Natural Dry Density — pcf

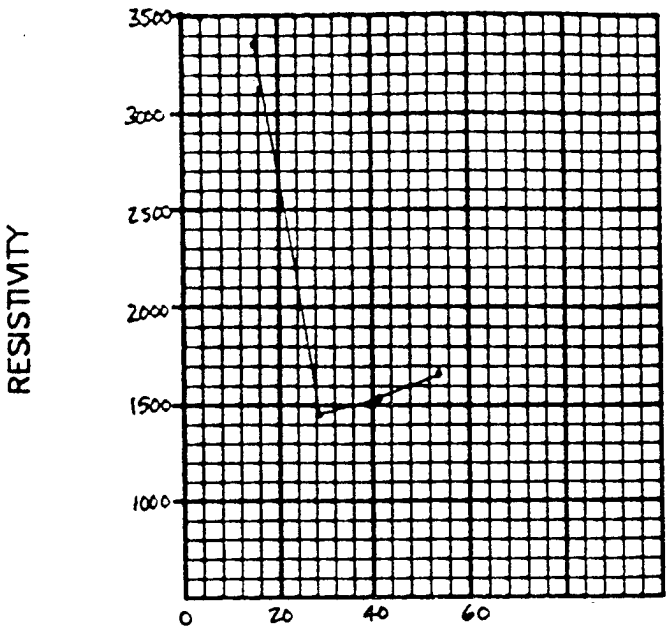
pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-7201 @ 2.5'-4.0'

1-369-91	Chen Northern, Inc.	LABORATORY RESISTIVITY TEST RESULTS	Fig.



Resistivity (Ohm-Cm)	Moisture content (%)
3380	15.7
1460	28.6
1520	41.4
1660	54.3

Natural Moisture Content 27.5 %

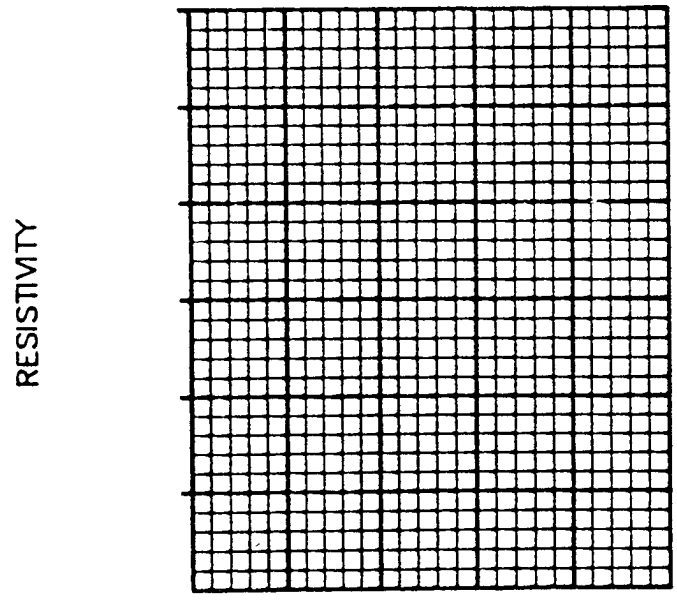
Natural Dry Density — pcf

pH —

Gravel — % Sand — % Silt and Clay — %

Liquid Limit — % Plasticity Index — %

Sample of From GT-7301 @ 2.5'-4.0'



Resistivity (Ohm-Cm)	Moisture content (%)

Natural Moisture Content ____ %

Natural Dry Density ____ pcf

pH ____

Gravel % Sand % Silt and Clay %

Liquid Limit % Plasticity Index %

Sample of From

1-369-91	Chen Northern, Inc.	LABORATORY RESISTIVITY TEST RESULTS	Fig.

ANALYTICAL RESULTS

WET CHEMISTRY ANALYSIS RESULTS

ID: 9106049-01A
Client ID: SS-6801-040591-B

Collected: 04/05/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	193	114	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	85.9	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	864	223	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	7.30	---	pH	VM 07/08/91

ID: 9106049-02A
Client ID: SS-6901-040891-B

Collected: 04/08/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	297	113	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	88.2	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	243	226	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	7.07	---	pH	VM 07/08/91

ID: 9106049-03A
Client ID: SS-6903-040891-B

Collected: 04/08/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	344	121	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	80.7	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	BQL	241	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	6.37	---	pH	VM 07/08/91

ID: 9106049-04A
Client ID: SS-7003-040891-B

Collected: 04/08/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	214	114	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	84.6	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	BQL	230	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	7.49	---	pH	VM 07/08/91

Notes and definitions for this report:
BQL = Below Quantitation Limit

WET CHEMISTRY ANALYSIS RESULTS

ID: 9106049-05A
Client ID: SS-7103-041191-B

Collected: 04/11/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	242	117	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	85.7	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	509	230	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	6.91	---	pH	VM 07/08/91

ID: 9106049-06A
Client ID: SS-7201-041291-B

Collected: 04/12/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	272	110	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	88.5	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	243	226	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	6.35	---	pH	VM 07/08/91

ID: 9106049-07A
Client ID: SS-7301-041591-B

Collected: 04/15/91
Matrix: SOIL

Parameter	Method	Result	Det.Lim.	Units	Analyzed by
Chloride	MCAWW 325.3	170	129	mg/Kg	VHM 06/26/91
Percent Solids	MCAWW 160.3	76.8	---	%	CS 06/12/91
Sulfate	MCAWW 375.4	428	260	mg/Kg	DJS 07/05/91
pH	MCAWW 150.1	5.39	---	pH	VM 07/08/91

Notes and definitions for this report:
BQL = Below Quantitation Limit

APPENDIX C

CALCULATION FOR EVALUATION OF SOIL PROPERTIES

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

WSSRA PROJECT
CALCULATION COVER SHEET

3840-D:50-C-01-4179-A00

CALC. NO. DC-793-00

CONTRACT NO. 3840 DISCIPLINE _____ NO. OF SHEETS 173

PROJECT

WSSRAP

FEATURE

DISPOSAL CELL

ITEM

EVALUATION OF SOIL PROPERTIES (Material Properties)

SOURCES OF DATA

See Sh. i – iv

SOURCES OF FORMULAE & REFERENCES

See Sh i – iv

PRELIMINARY CALC. ☒ FINAL CALC. ☐ SUPERSEDES CALC. NO. 755-00

REV. NO.	REVISION	CALCULATION BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	—	N Doraswamy	9/12/91	E C Tom, KORE J.S. Ramdeen	9/25/91	DW Reppard	9/25/91

FEA160

REFERENCES & DATA SOURCES

1. Bechtel National, Inc., "Engineering Evaluation of Alternatives for the Disposition of the W. Spring Raffinate Pits", April 1984. pp H-6. MKE Doc. No. 5121-R:EN-R-07-0001-00.

2. Morrison-Knudsen Engineers, Inc., "Geotechnical Foundation Investigation". MKE Doc. No. 5121-G:EN-R-01-1378-00

3. Bechtel National, Inc., "Hydrogeological Characterization Report For the Weldon Spring Chemical Plant, App. A. Boring Logs", MKE Doc. No. 5121-C:GE-R-02-0264-00.

4. Chen-Northern, Inc., "WSSRAP. Laboratory Test Results", MKE Doc. No. 5121-D:EN-R-09-0458-00; 5121-D:EN-L-09-0473-00; 5121-R:EN-L-09-0281-00.

5. Morrison-Knudsen Engineers, Inc., "WSSRAP- Administration Bldg, Geotechnical Parameters", Dwg. A88. MKE Doc. No. _____

6. U.S. Navy, "Soil Mechanics", NAVFAC Design Manual DM-7.1, May 1982.

7. Mitchell, J.K., "CE 270B Class Notes, U.C. Berkeley", Jan. 1986.

8. Schmertmann, J.H., "The Undisturbed Consolidation Behavior of Clay," Trans. ASCE, Vol. 120, 1955, pp. 1201-1233.

9. Skempton, A.W., "Discussion. The Planning and Design of the New Hong Kong Airport," Proceedings of the Institution of Civil Engineers, 1957, London, 7, pp. 305-307.

10. Ladd, C.C. et al., "Stress-Deformation and Strength Characteristics, State-of-The-Art Report, 9th ICSMFE, Tokyo, 1977 p. 421-494.

11. Duncan, J.M. and Buchignani, A.L., "An Engineering Manual For Settlement Studies", Department of Civil Engineering, University of California, Berkeley, June 1976.

12. Jamiolkowski, M. et al, "New Developments in Field and Laboratory Testing of Soils," Proc. Eleventh ICSMFE, San Francisco, Vol. 1 pp 57-153., 1985

13. Morrison-Knudsen Engineers, Inc., "WSSRAP-DC, I.O.C. -- Additional Boreholes to Obtain Samples for Permeability Determination for DC Overburden Soil", MKE Doc. No. 5121-D:EN-I-01-0533-00.

14. U.S. Navy, "Foundations and Earth Structures", NAVFAC Design Manual DM-7.2, May 1982.

15. U.S.B.R., "Draft Design Standards".

16. Mitchell, J.K., "Fundamentals of Soil Behavior", Wiley.

17. Lade, P.V. and Lee, K.L., "Engineering Properties of Soils," Mechanics and Structures Department, School of Engineering and Applied Science, UCLA, May 1976.

18. Seed, R.B., Mitchell, J.K., and Seed, H.B., "Slope Stability Failure Investigation Landfill Unit B-19, Phase I-A, Kettleman Hills, California", Dept. of Civil Engineering, U.C. Berkeley, July, 1988.

19. Terzaghi, K. and Peck, R.B., "Soil Mechanics in Engineering Practice", John Wiley & Sons, 1967, pp. 30.

20. Chen, Fu Hua, "Foundations on Expansive Soils", Developments in Geotechnical Engineering 12, 1975.

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840-827
Designed ND
Checked JSR

Sheet iii
File No.
Date 9/18/91
Date 9/24/91

21. Chen-Northern, Inc, Laboratory Test Results. MKES Doc. No. 3840-D:SD-R-08-4100-00

22. LOTUS 1-2-3 Vers. 2.01, © Lotus Development Corp., 1986 Cambridge, MA.

23. GRAPHER, Version 1.79, © Golden Software Inc, 1988 Golden, CO.

24. ALLWAYS, 1st Edition, © Funk Software, Inc, October 1988 Cambridge, MA

25. Disposal Cell: Settlement Analysis Calc. (In progress)

NOTE:

The pages indicated here are taken from Calculation No. DC-755-00, which is a voided calculation. The following page numbers were crossed out & replaced with new page numbers for this calculation.

Page number for Calculation #DC-755-00	Page number in this calculation
5	4
6	5
28	36
42	59
97	163
98	164
130	171
131	172
Appendix A	Appendix A
B	B

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP | Contract No. 3840 | Sheet 1
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked JCR | Date 09/23/91 | Date 9/24/91

INDEX

		SHEET NUMBER
1.	SUMMARY OF AVERAGE TEST RESULTS	2
2.	PURPOSE & INTRODUCTION	4
3.	LOCATIONS OF BOREHOLES & SOIL SAMPLE CLASSIFICATION	6
4.	SOIL PROFILES	17-23
5.	SUMMARY OF SOIL TEST RESULTS	24-35
6.	PHYSICAL & INDEX PROPERTIES	36-46
7.	SIEVE ANALYSIS RESULTS	47-58
8.	SHEAR STRENGTH RESULTS	59-100
	C U TEST RESULTS 59-94	
	U U TEST RESULTS 95-100	
9.	CONSOLIDATION TEST RESULTS	101-147
10.	PRECONSOLIDATION PRESSURE ESTIMATION	148-155
11.	COMPACTION CHARACTERISTICS	156-160
12.	CATION EXCHANGE CAPACITY TESTS	161
13.	CALIFORNIA BEARING RATIO TEST RESULTS	162
14.	PERMEABILITY TEST RESULTS	163
15.	CAPILLARY MOISTURE TEST RESULTS	168-170
16.	SWELLING POTENTIAL	171-172

APPENDICES

A.	C U & U U TEST DATA	173-329
B.	GRAIN SIZE DISTRIBUTION CURVES	330

SUMMARY OF AVERAGE SOIL TEST RESULTS

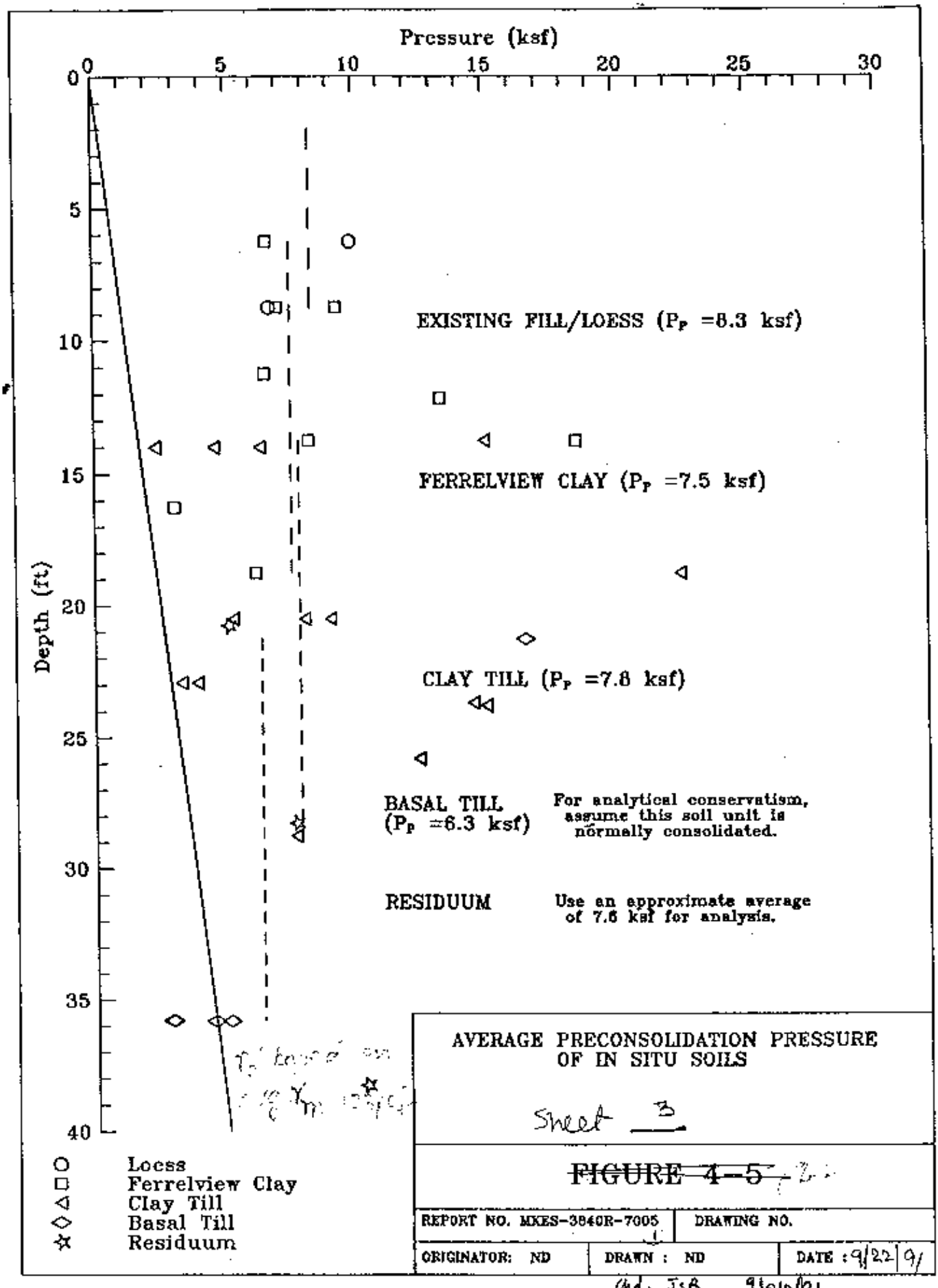
Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Soil Unit	Mechanical Analysis			Atterberg Limits		Shrink-age Limit	Specific Gravity	Natural		Compaction Optimum		Shear Strength			Consolidation			Permeability	Capillary Moisture @ 15 bar	Cation Exch Cap	Calif Bearing Ratio
	Gravel	Sand	Fines	LL	PI		G	w	d	w	d	Test	c	phi	Cc	Cr	Pp	k			
	%	%	%	%	%	%		%	pcf	%	pcf		psf	deg			ksf	cm/sec	%	meq/100g	
IN-SITU MATERIALS																					
LOESS	0	3	97	42	22	14	2.7	20.8	98.3	-	-	CU	c=440 c'=280	O=25 O'=36	0.290	0.035	-8.3	3.20E-07			
												UU	Su=1490								
FERRELVIEW CLAY	0	5	95	52	33	12	2.69	22.6	100	-	-	CU	c=500 c'=440	O=12 O'=18	0.256	0.064	-7.5	6.90E-08			
												UU	Su=1180								
CLAY TILL	1	23	76	49	33		2.71	19.2	105.7	-	-	CU	c=360 c'=410	O=21 O'=28	0.210	0.052	-7.8	2.60E-08			
												UU	Su=1260								
BASAL TILL	12	22	66	40	24		2.69	18.9	109.2	-	-	CU	c=920 c'=820	O=20 O'=29	0.252	0.049	6.3	1.90E-07			
												UU	Su=1060								
RESIDUUM	38	19	43	64	44		2.74	18.8	95.4	-	-	CU	c=205 c'=260	O=13 O'=16	0.302	0.089	-7.6	6.30E-06			
REMOLDED MATERIALS																					
TOPSOIL/FILL	1	8	91	46	27	13	2.70 *	23.4	98.4	18.4	104.6	CU	c=560 c'=535	O=18 O'=24				3.50E-08			
												UU									
LOESS	0	3	97	42	22	14	2.7	-	-	16.3	107	CU	c=820 c'=290	O=13 O'=29					15.3	58.57	3.08
												UU	Su=5060								
FERRELVIEW	0	5	95	52	33	12	2.69	-	-	18.8	103.6	CU	c=320 c'=90	O=14 O'=19	0.230	0.036	5	8.30E-08	20.4	69.47	2.25
												UU	Su=2220								
POTENTIAL BORROW SOURCE NO. 1	0	6	94	46	22	15	2.67	23.2	95.5	18.0	106.8	CU	c=540 c'=470	O=15 O'=22	0.230	0.060	1.3	6.50E-08	20.4	69.34	
												UU	Su=2720								

Sheet 2

* Assumed Value

Designe ND 09/22/91
Checke ISR 09/22/91



AVERAGE PRECONSOLIDATION PRESSURE OF IN SITU SOILS

Sheet 3

~~FIGURE 4-5~~

REPORT NO. MKES-3840R-7005	DRAWING NO.
ORIGINATOR: ND	DRAWN : ND	DATE : 9/22/91

Chd. JSR 9/24/91

I PURPOSE & INTRODUCTION

The pupose of this calculation is to determine the geotechnical properties of 1). the in-situ disposal site soils, and 2) imported materials (waste & cover materials) which will comprise the proposed disposal facilities. These properties are required for evaluation of the embankment stability, both end-of-construction and long term conditions, liquefaction potential, differential settlement and cracking potential of the embankments.

Geotechnical investigations were performed at the Chemical plant area, raffinate pit #4 and administration building area of the disposal site. Boring logs (Ref. 243) indicate that these areas within the Weldon Spring site have the same general subsurface conditions. In general, there is an upper layer of fill and/or aeolian deposits, loess, which is underlain by a Pleistocene deposit of Ferguson Formation. The Ferguson Formation is underlain by a clay till stratum. Underlying the clay till is most of the Chemical plant area is the basal till. Underlying the basal till in Chemical Plant area and Ferguson Formation in other areas is the residuum, below which is the limestone bedrock. (see sh. 10-22 for soil profiles which were developed based on ref 2 & 3)

Laboratory tests available as of May, 1989 (Ref. 4) on samples from these areas provide data for evaluation of mainly the in-situ properties of the soils. Except for the raffinate dike fill material, lab. results from Chemical plant (C.P.), Raffinate Pits (R.P.) and Administration building (A.

areas were combined together for evaluation.

Imported materials include riprap and drain material, radon barrier, bottom clay liner, chemical plant waste material (WSCP), Cerany waste material (WSQ), waste materials from vicinity properties (WSVP), treated raffinate pit waste sludge (WSRP), general fill material, Claymax, and flexible membrane liner (HDPE). Lab. tests on these materials are not available as of May, 1989. Therefore the engineering properties are either based on reasonable assumptions or empirical correlations. (see sh. 3 + 11b).

The engineering properties evaluated here include index properties, shear strength, consolidation characteristics, moisture-density relationship, swelling potentials, and hydraulic conductivity.

The boring logs are from Ref. 2 & 3. And lab. test data are from Ref. 4.

LOCATION OF BOREHOLES

For the purpose of this calculation, the site is divided into 4 areas as shown in Figure on Sheet 16. The geographic line of 100,000 N (AEC coordinate system) was arbitrarily chosen to divide the site into the Northern Chemical Plant (NCP) area, & the Southern Chemical Plant (SCP) area. Furthermore, the Materials Staging Area (MSA) & the Temporary Storage Area (TSA) were identified in the NCP & SCP areas as shown. Note that these are not the actual boundaries of the MSA or TSA areas; neither are they the footprints of the MSA or TSA areas. The boundaries shown in figure on Sheet 16 are for data reduction purposes only.

Sheets 7,8&9, shows the list of boreholes used in this calculations. From the geologic profiles shown on Sheets 17 through 23, & using the Boring logs Refs 2&3 the soil samples have been separated into the various soil units & have been presented in Table on Sheets 24 through 35.

BOREHOLES USED IN THIS CALCULATION

Bore hole Number	MISSOURI STATE PLANE		ATOMIC ENERGY COMMN.	
	NORTHING	EASTING	NORTHING	WESTING
GT-31	1042895.5	432884.2	99119.3	52130.8
GT-32	1043615.7	433277.3	99939.8	52126.5
GT-33	1043559.5	433301.0	99901.6	52079.0
GT-34	1043305.2	433024.0	99546.3	52202.1
GT-35	1042848.3	432962.8	99115.1	52039.3
GT-36	1042612.1	432872.7	98864.4	52006.5
GT-37	1042256.8	435503.6	99800.0	49522.0
GT-38	1042191.6	435413.9	99700.0	49570.0
GT-39	1042320.2	435596.8	99900.0	49470.0
GT-41	1042367.6	435508.8	99900.0	49570.0
GT-42	1044103.0	435041.7	101206.0	50804.6
GT-43	1044561.3	435309.8	101736.6	50786.1
GT-44	1043508.0	435776.3	101030.8	49875.6
GT-45	1043030.9	436122.8	100775.2	49344.2
GT-46	1042667.6	435931.8	100364.8	49340.0
GT-47	1042742.7	435076.0	100024.8	50128.9
GT-48	1042359.7	434370.7	99353.0	50568.1
GT-50	1042405.1	434012.4	99223.0	50905.0
GT-51	1042778.3	434380.0	99725.9	50758.5
GT-52	1043326.5	435156.6	100577.0	50335.0
GT-53	1043280.2	434625.0	100284.0	50781.0
GT-54	1043030.5	435792.3	100618.0	49635.0
GT-55	1043061.1	435465.7	100490.0	49937.0
GT-56	1042372.1	435055.7	99689.0	49971.0
GT-57	1042550.8	435415.6	100017.0	49739.0
GT-58P	1043524.0	435580.9	100952.3	50055.2
GT-59	1042559.5	435164.9	99905.7	49963.8
GT-60P	1043125.2	435132.5	100388.4	50260.4
GT-61	1043518.3	434869.0	100609.3	50679.2
GT-62	1043013.9	434652.0	100062.4	50630.9
GT-63P	1042148.5	433230.3	98626.1	51472.0
GT-65P	1044560.3	434882.4	101533.0	51161.1
GT-67P	1042376.1	436118.9	100196.8	49036.8
GT-68	1044511.2	434542.4	101328.8	51437.0
GT-69	1043776.9	435407.5	101092.9	50327.1
GT-70	1044015.2	434398.8	100824.1	51328.1
GT-71	1042589.2	434797.9	99758.2	50300.1
GT-72	1041991.3	434732.5	99200.8	50074.0
GT-73	1042060.0	434334.9	99072.7	50456.6
GT-74	1041620.7	434313.9	98676.0	50266.6
GTS-1	1041953.0	433685.8	98670.0	50978.0

BOREHOLES USED IN THIS CALCULATION

Bore hole Number	MISSOURI STATE PLANE		ATOMIC ENERGY COMMN.	
	NORTHING	EASTING	NORTHING	WESTING
GTS-2	1041424.0	433602.9	98165.0	50800.0
GTS-3	1041506.0	433334.7	98110.0	51075.0
GTS-4	1041910.4	433353.8	98475.0	51250.0
GTS-5	1042025.2	433420.5	98607.7	51245.8
GTS-6	1042211.8	433759.8	98933.0	51035.7
GTS-7	1042233.5	433378.3	98771.0	51381.8
GT-2T71	1042583.1	436123.4	100381.3	49131.3
GT-2T72	1043148.0	436093.1	100864.2	49426.0
GT-2T74	1042596.5	435299.8	100002.3	49862.6
GT-2T75	1043617.5	435446.0	100970.4	50218.3
GT-2T77	1042732.0	434493.4	99739.0	50636.7
GT-2T78	1043460.4	434736.0	100495.3	50768.8
GT-2T79	1044329.9	434728.0	101256.9	51188.4
GT-2T80	1042353.1	433416.7	98894.6	51404.7
GT-2T81	1042506.5	432971.3	98818.2	51869.6
GT-2T82	1043863.5	433357.6	100196.1	52173.4
TPMS-1	1043678.1	434437.4	100545.6	51134.1
TPMS-2	1043801.9	434584.6	100724.4	51063.3
TPMS-3	1043923.7	434476.2	100780.3	51216.5
TPMS-4	1043956.0	434700.8	100915.3	51034.1
TPMS-5	1044139.3	434723.0	101087.2	51101.6
TPMS-6	1044156.0	434446.4	100970.6	51353.0
TPMS-7	1044426.8	434432.2	101202.2	51493.9
TPMS-8	1044598.8	434583.0	101425.2	51442.8
TPMS-9	1044252.0	434850.9	101247.1	51042.5
TPBS-1	1044071.3	439552.7	103318.9	46817.9
TPBS-2	1043432.5	439939.9	102940.3	46173.9
TPBS-3	1044587.1	438279.9	103169.0	48183.0
TPBS-4	1043097.7	440349.6	102840.0	45654.4
TPBS-5	1042961.9	439583.2	102356.8	46264.6
TPBS-6	1042369.1	440854.6	102438.3	44864.2
TPBS-7	1042865.9	441172.7	103026.5	44819.9
TPBS-8	1043578.6	441516.2	103816.9	44855.7
TPBS-9	1041564.8	441008.7	101803.4	44346.9
TPBS-10	1041550.3	440675.9	101632.7	44633.0
TPBS-11	1041626.3	439988.4	101373.4	45274.2
TPBS-12	1041260.0	441332.7	101688.8	43917.1
TPBS-13	1042507.6	441939.5	103074.9	43974.9
TPBS-14	1042733.9	442161.4	103379.4	43887.0
TPBS-15	1040527.6	441017.9	100894.7	43846.7
TPBS-16	1041033.5	441024.2	101343.0	44081.2

BOREHOLES USED IN THIS CALCULATION

Bore hole Number	MISSOURI STATE PLANE		ATOMIC ENERGY COMMN.	
	NORTHING	EASTING	NORTHING	WESTING
TPBS-17	1041050.7	440432.9	101077.6	44609.8
TPBS-18	1041846.0	440354.3	101740.4	45056.4
TPBS-19	1042226.3	439982.0	101898.5	45564.6
TPBS-20	1042302.1	439213.0	101600.4	46277.4
TPBS-21	1035776.0	431284.0	92093.5	50160.5
TPBS-22	1035319.1	431048.3	91579.5	50151.2
TPBS-23	1034664.7	431132.3	91043.3	49766.8
TPBS-24	1034026.5	431092.6	90462.6	49498.9
TPBS-25	1033430.8	431094.9	89939.4	49214.2
TPBS-26	1032969.4	431062.8	89518.0	49023.6
TPBS-27	1032350.8	431030.4	88958.1	48758.6
TPBS-28	1031686.4	430597.9	88168.0	48824.0
TPBS-29	1031532.0	430195.4	87841.1	49105.1
TPBS-30	1031340.5	429726.5	87450.1	49427.0

SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth From ft	Depth To ft
TOPSOIL/FILL			
GT-51	SS-01	0.0	1.5
GT-53	ST-02	2.5	4.0
GT-54	ST-03	4.5	7.0
GT-74	7402	5	7.5
GT-41	SS-02	3.5	4.0
	SS-02	4.0	4.5
GT-45	SS-01	1.0	2.5
GTS-5	BULK	0.0	5.0
GTS-7	BULK	0.0	5.0
GT-2T81	BU-01A	0.5	6.5
	BU-02A	6.5	12.0
DIKE FILL			
GT-33	ST-04	5.0	7.5
GT-34	SS-05	7.0	8.5
GT-35	SS-02	3.0	4.5
	SS-08	13.0	14.5
	SS-11	17.5	19.0
	SB-15	25.0	26.5
GT-36	ST-06	8.5	11.0
	SS-09	14.0	15.5

SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth	
		From	To
		ft	ft
LOESS			
GT-32	ST-01	1.0	3.5
GT-33	ST-14	22.0	24.5
GT-35	SS-20	31.0	32.5
GT-36	ST-12	18.5	21.0
GT-37	SB-01	1.5	3.0
	ST-03	5.0	7.5
GT-38	SS-02	3.0	4.5
	ST-03	4.5	7.0
GT-43	SS-02	1.5	3.0
GT-50	ST-02	2.5	5.0
GT-54	SS-08	17.0	18.5
GT-55	ST-02	2.5	5.0
GT-55	ST-04	7.5	10.0
GT-56	ST-02	5.0	7.5
GT-57	SS-02	5.0	6.5
GT-57	ST-03	7.5	10.0
GT-58P	ST-01	2.5	5.0
GT-2T74	BU-01A	4.0	8.5
GT-2T78	BU-01A	4.0	6.5
TPMS-2	BU-01	0.0	2.0
TPMS-4	BU-01	1.0	3.5
TPMS-5	BU-01	1.0	7.0
TPMS-6	BU-01	1.0	5.0
TPMS-7	BU-01	1.0	7.0
TPMS-8	BU-01	1.0	5.0
TPMS-9	BU-01	1.0	7.0

SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth From ft	Depth To ft
FERRELVIEW CLAY			
GT-31	ST-02	4.0	6.5
	ST-06	18.0	20.5
GT-32	ST-02	9.0	10.5
GT-34	SB-17	27.0	28.5
GT-37	SS-05	9.0	10.5
GT-37	ST-06	10.5	13.0
GT-39	SS-02	4.0	5.5
	ST-03	5.5	8.0
	ST-04	9.5	12.0
	ST-05	12.0	14.5
GT-41	SS-04	6.0	7.5
GT-43	ST-04	6.0	8.5
GT-45	ST-04	7.5	10.0
GT-46	ST-03	5.0	7.5
GT-47	ST-05	10.0	12.5
GT-48	ST-03	7.5	10.0
GT-48	ST-05	12.5	15.0
GT-48	ST-07	17.5	20.0
GT-51	ST-03	5.0	7.5
GT-52	ST-04	10	12.5
GT-52	ST-06	15	17.5
GT-53	ST-04	7.5	10.0
GT-55	ST-06	12.5	15.0
GT-55	ST-08	17.5	20.0
GT-56	ST-04	10.0	12.5
GT-57	ST-06	15.6	16.5
GT-58P	ST-03	7.5	10.0
GT-59	ST-02	5.0	7.5
GT-60P	ST-04	12.5	15.0
GT-62	ST-07	17.5	20.0
GT-63P	ST-01	2.5	5.0
GT-70	7004	10	12.5
GT-73	7306	15	17.5
GTS-1	ST-03	5.0	7.5
GTS-2	ST-02	2.5	5.0
GTS-2	ST-04	7.5	10.0
GTS-2	COMP	2.5	10.0
GTS-3	ST-02	5.0	7.5

SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth	
		From	To
		ft	ft
GTS-4	ST-02	2.5	5.0
GTS-4	ST-04	7.5	10.0
GTS-6	BULK	0.0	5.0
GT-2T71	BU-01A	3.5	6.5
GT-2T71	BU-02A	6.5	12.0
GT-2T72	BU-01A	7.5	10.5
~~GT-2T74~~	~~BU-01A~~	~~7.0~~	~~10.5~~
GT-2T75	BU-01A	2.5	6.5
GT-2T75	BU-01A	4.0	8.5
GT-2T75	BU-02B	6.5	12.0
GT-2T77	BU-01B	1.5	4.0
GT-2T77	BU-02A	7.0	10.5
GT-2T78	BU-02B	6.5	12.0
GT-2T79	BU-01A	1.0	6.5
GT-2T79	BU-02A	6.5	12.0
GT-2T80	BU-01A	0.5	8.0
GT-2T82	BU-01A	0.5	3.5
GT-2T82	BU-02A	3.5	6.0
TPMS-1	BU-01	0.0	6.0
TPMS-2	BU-02	2.0	6.0
TPMS-3	BU-01	1.0	6.0
TPMS-4	BU-02	4.0	6.5
TPMS-5	BU-02	8.0	10.0
TPMS-6	BU-02	5.5	7.5
TPMS-7	BU-02	7.0	9.5
TPMS-8	BU-02	5.0	10.5
TPMS-9	BU-02	8.0	15.0

SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth	
		From	To
		ft	ft
CLAY TILL			
GT-32	ST-05	18.5	21.0
GT-42	ST-05	9.5	12.0
	SB-08	17.0	18.5
GT-43	ST-10	21.5	23.8
GT-44	ST-03	5.0	7.5
GT-45	ST-07	15.0	17.5
GT-47	SB-09	20.0	21.5
GT-50	ST-06	12.5	15.0
GT-50	SB-08	17.5	19.0
GT-51	ST-07	15.0	17.5
GT-51	SB-09	20.0	21.5
GT-52	SS-09	22.5	24.0
GT-52	SS-11	27.5	29.0
GT-53	ST-08	17.5	20.0
GT-56	ST-06	15.0	17.0
GT-56	SB-08	19.5	21.0
GT-58P	ST-09	22.5	24.0
GT-59	ST-06	15.0	17.5
GT-60P	ST-10	27.5	30.0
GT-61	SS-13	32.5	34.0
GT-63P	ST-09	22.5	25.0
GT-67P	ST-08	20.0	22.5
GT-68	6810	25	25.7
GT-69	6906	15	17.5
GT-71	7108	20	22.5
GT-74	7406	15	17.5
GT-2T82	BU-03A	6.0	10.0
TPMS-8	BU-03	12.0	14.0

SOIL SAMPLES BY SOIL UNIT

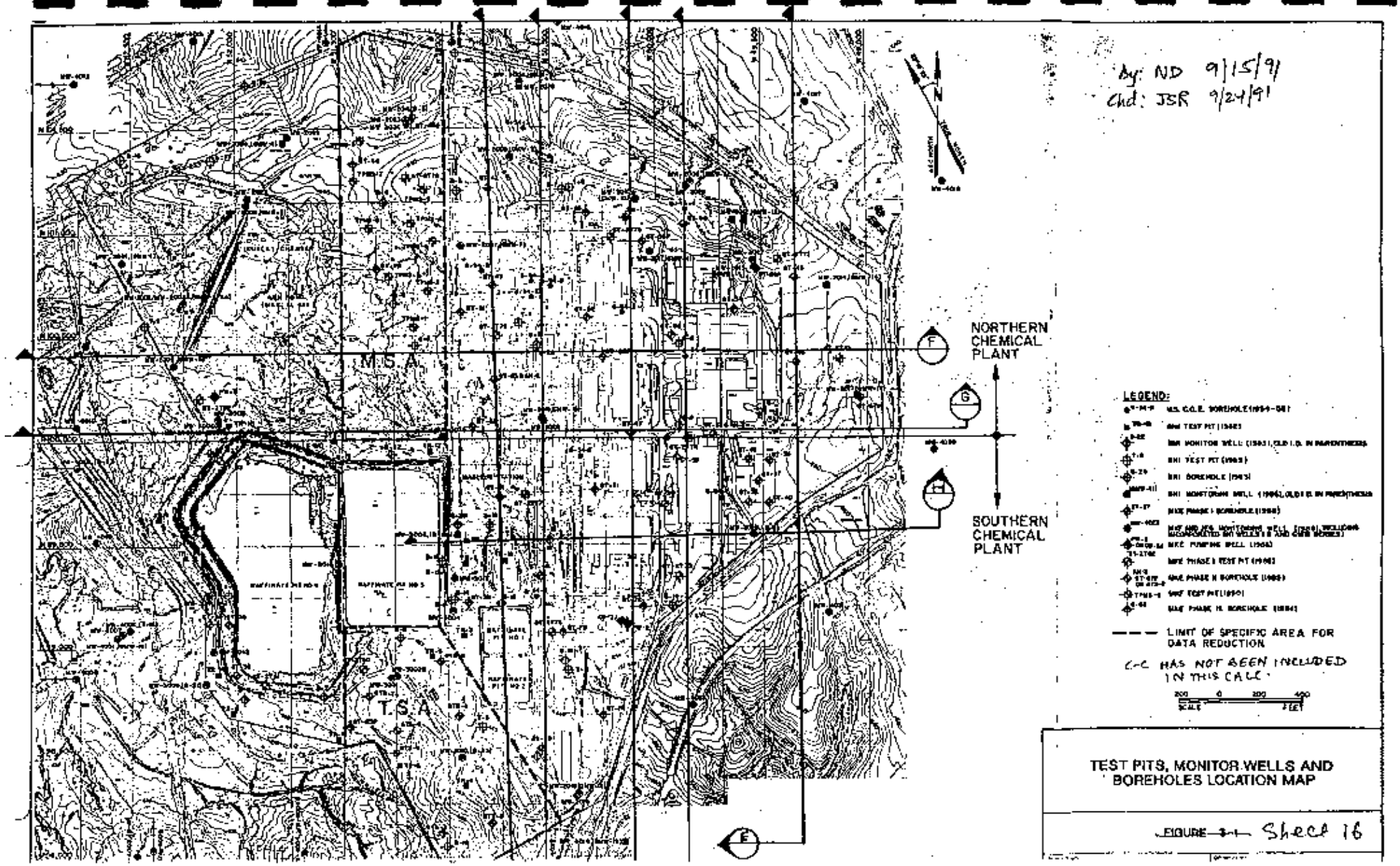
Hole Number	Sample Number	Depth	
		From	To
		ft	ft
BASAL TILL			
GT-43	SB-17	40.0	41.5
GT-52	SB-14	35.0	36.5
GT-52	SS-17	42.5	44.0
GT-60P	SB-15	41.0	41.5
GT-60P	SS-16	45.0	46.5
GT-60P	SB-17	48.5	49.0
GT-61	SB-18	50.5	51.5
GT-62	SB-13	32.8	33.3
GT-68	6813	32.5	34
GT-69	6908	20	22.5
GT-71	7110	25	27.5
GT-73	7314	35	36.5

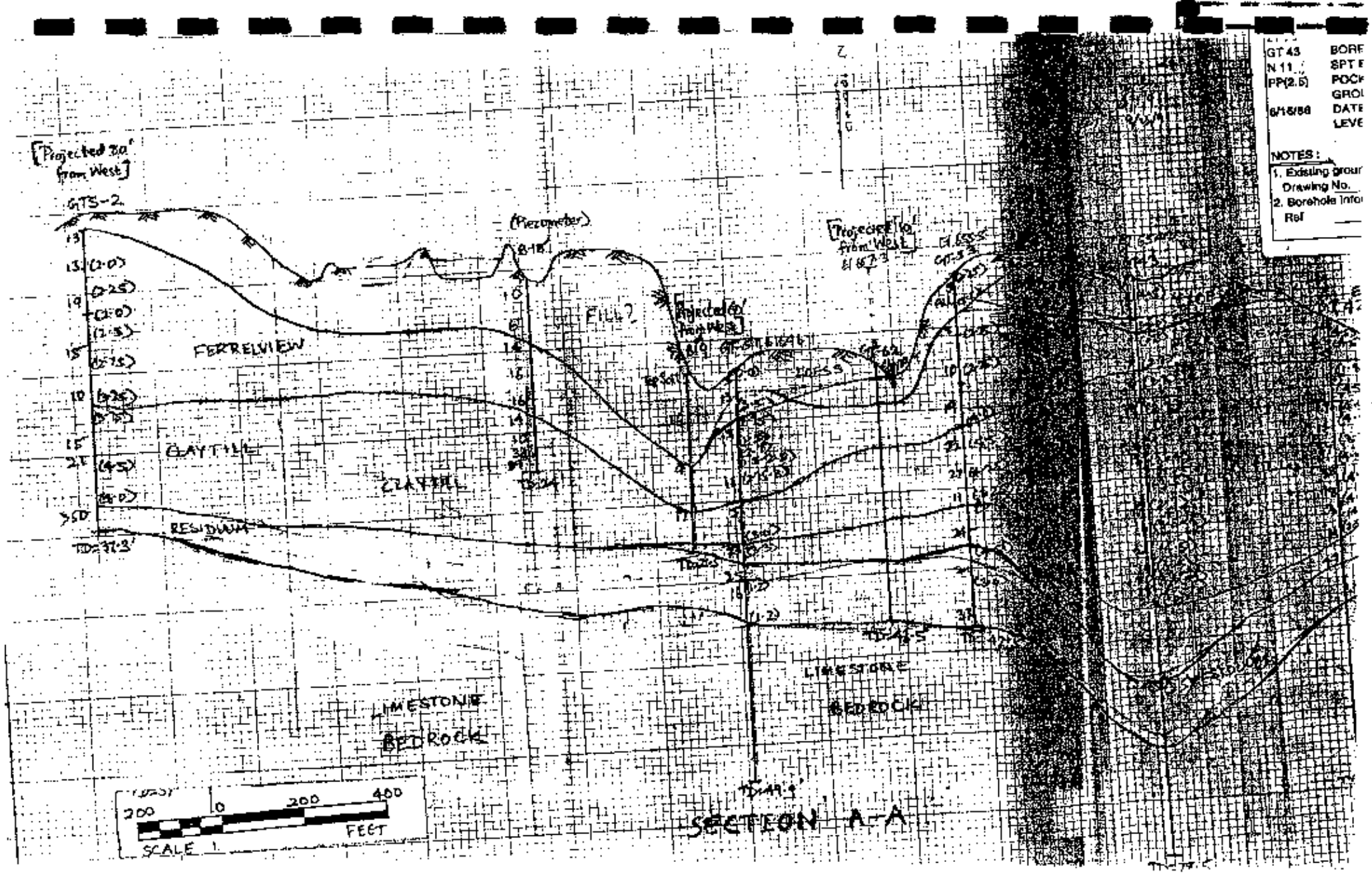
SOIL SAMPLES BY SOIL UNIT

Hole Number	Sample Number	Depth	
		From	To
		ft	ft
RESIDUUM			
GT-43	SS-19	50.0	51.0
GT-44	SB-10	22.5	24.0
GT-47	SS-14	32.5	34.0
GT-48	SS-12	30.0	31.5
GT-50	SS-14	32.5	34.0
GT-51	SS-11	25	26.5
GT-53	SS-15	35.0	36.5
GT-55	SB-12	27.5	29.0
GT-56	SS-09	22	23.5
GT-57	SB-11	27.5	29.0
GT-58P	SB-11	28.5	29.0
GT-62	SB-15	38.0	39.0
GT-63P	SB-15	38.0	38.5
GT-65P	SB-16	40.0	41.5
GT-68	6815		
GT-69	6910	25	26.5
GT-71	7112	30	31.5
GT-73	7316	40	41.5

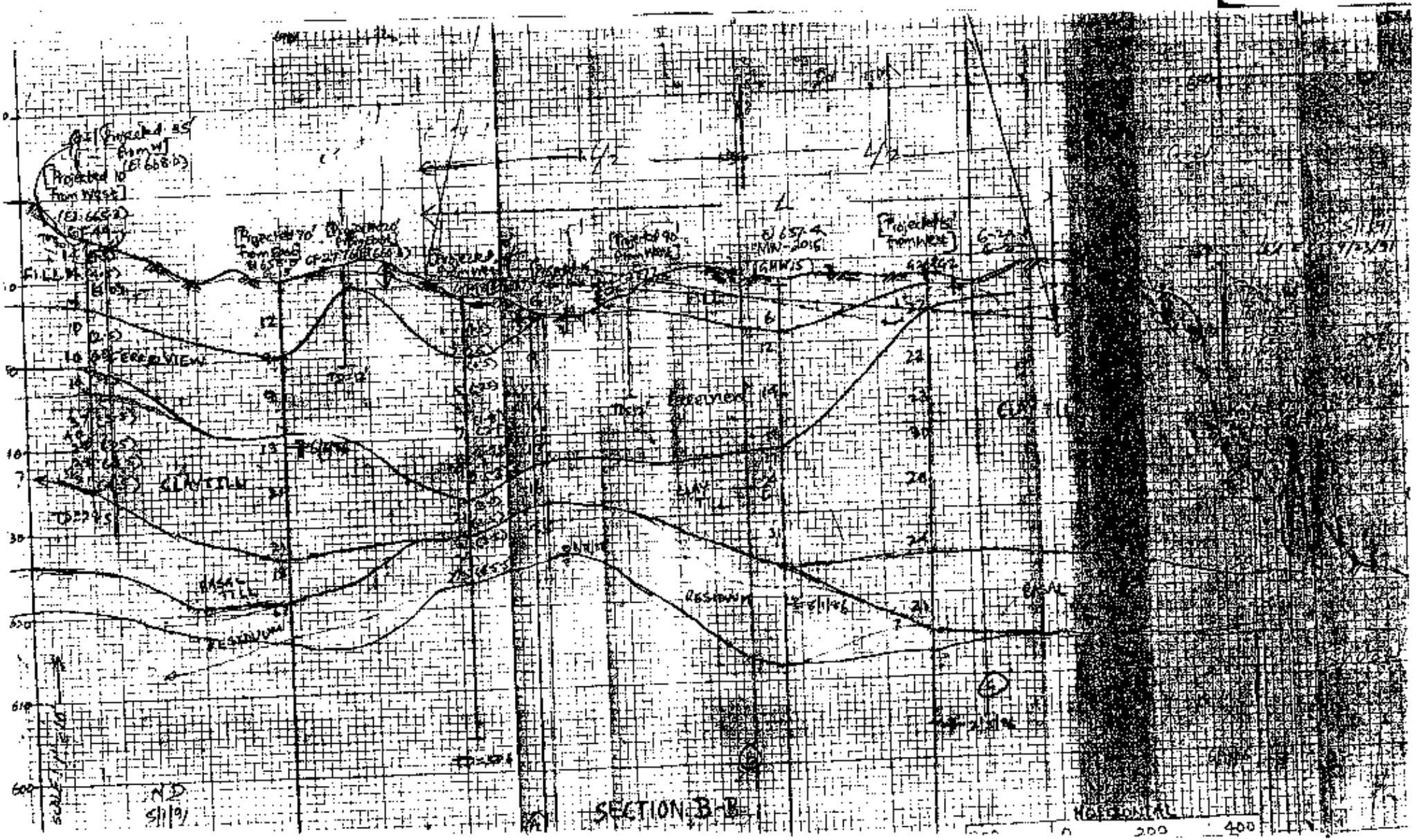
SOIL SAMPLES BY SOIL UNIT

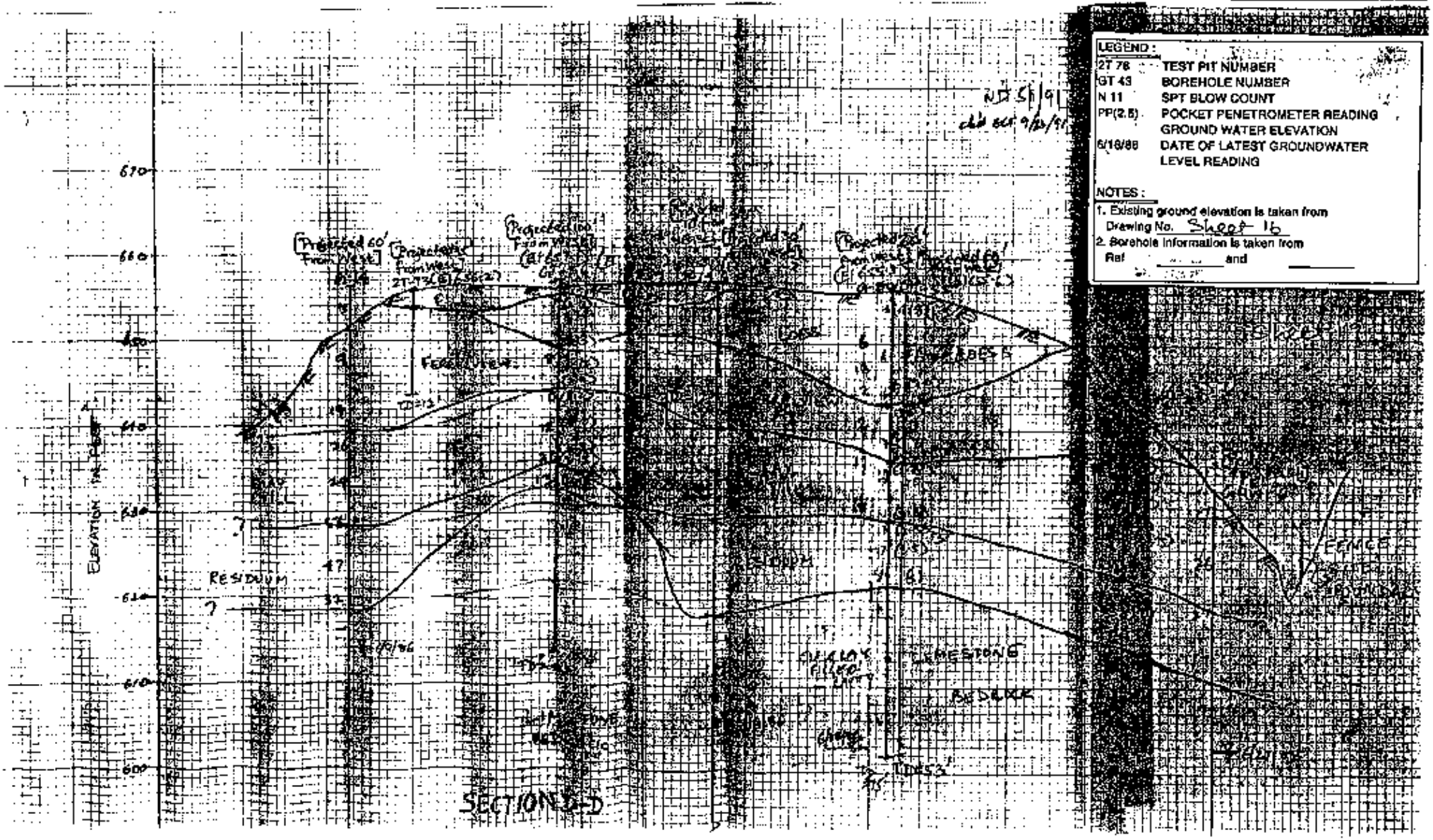
Hole Number	Sample Number	Depth From ft	Depth To ft
POTENTIAL BORROW SOURCE			
TPBS-1	2A	2.6	7.1
	3A	7.1	9.2
	4A	9.2	14.1
TPBS-6	1A	0.6	9.1
	2A	9.1	12.6
TPBS-8	1A	0.6	4.3
	2A	4.3	8.5
	3A	8.5	11.9
TPBS-10	1A	0.6	6.1
	2A	8.2	10.9
	3A	10.9	13.4
TPBS-11	1A	0.6	10.4
	2A	10.4	12.3
TPBS-13	Test 1	4.6	5
TPBS-14	2A	2.9	8.4
	3A	8.4	11.8
	Test 2	4.9	5.3
TPBS-15	1A	2.4	10.8
	2A	10.8	12.9
	3A	7.1	9.2
	Test 3	5.9	6.3
TPBS-16	Test 4	5.4	5.8
TPBS-17	Test 5	6.0	6.4
TPBS-18	Test 6	4.8	5.2
TPBS-19	Test 7	4.9	5.3
TPBS-20	Test 8	5.4	5.8
TPBS-23	1A	0.7	13.1
	Test 9	5.7	6.1
TPBS-25	Test 11	4.1	4.5
TPBS-26	Test 10	4.9	5.3
TPBS-28	1A	0.7	9.9
	Test 12	3.8	4.2
TPBS-29	Test 13	4.8	5.2
TPBS-30	1A	1.8	12.4
	Test 14	4.9	5.3

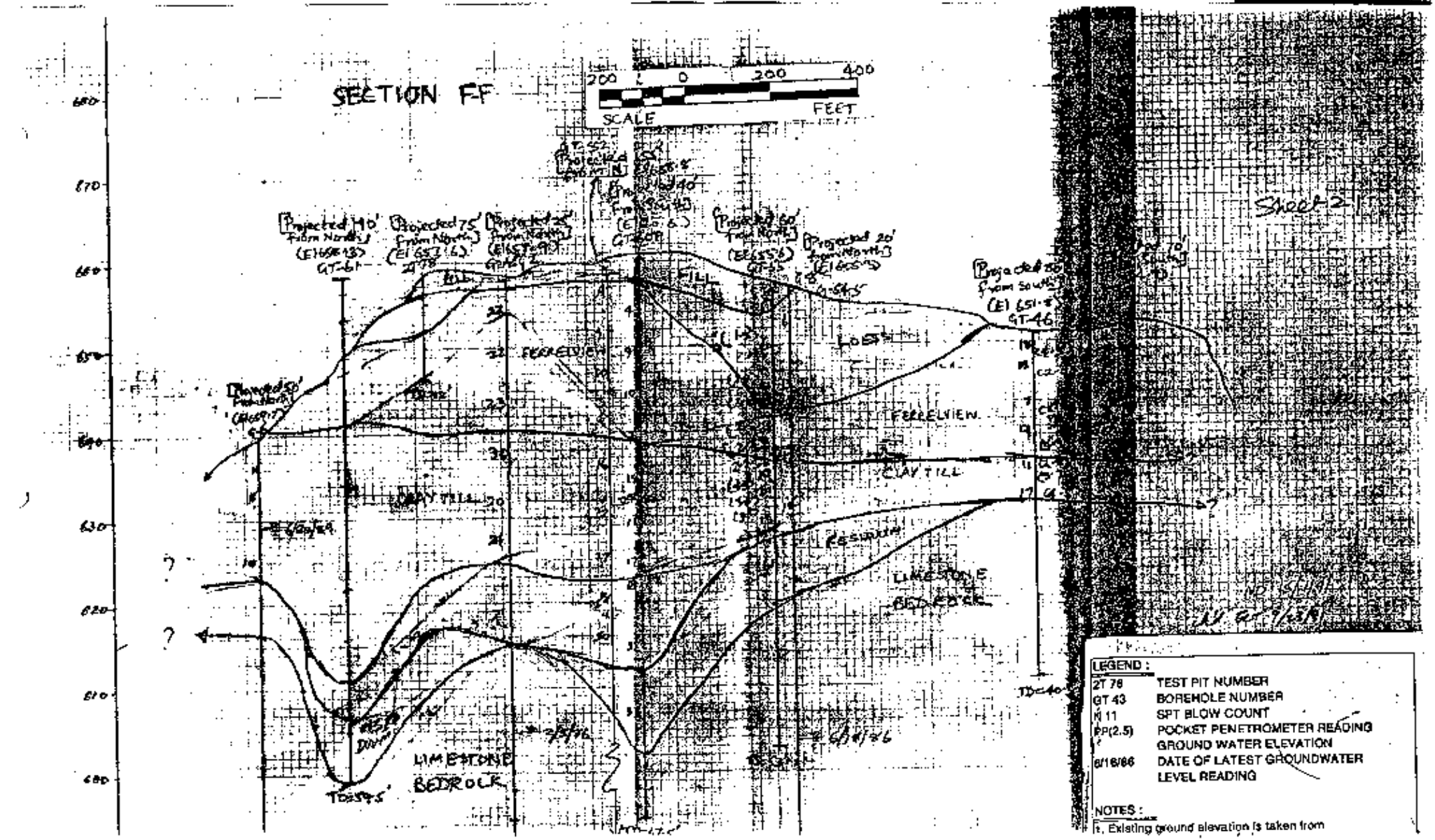

By: ND 9/15/91
Chd: JSR 9/24/91
NORTHERN CHEMICAL PLANT
SOUTHERN CHEMICAL PLANT
M.S.A.
T.S.A.
F
G
H
E
A B C D
LEGEND:
LIMIT OF SPECIFIC AREA FOR DATA REDUCTION
C-C HAS NOT BEEN INCLUDED IN THIS CALC.
200 0 200 400
SCALE FEET
TEST PITS, MONITOR WELLS AND BOREHOLES LOCATION MAP
FIGURE 3-1 Sheet 16

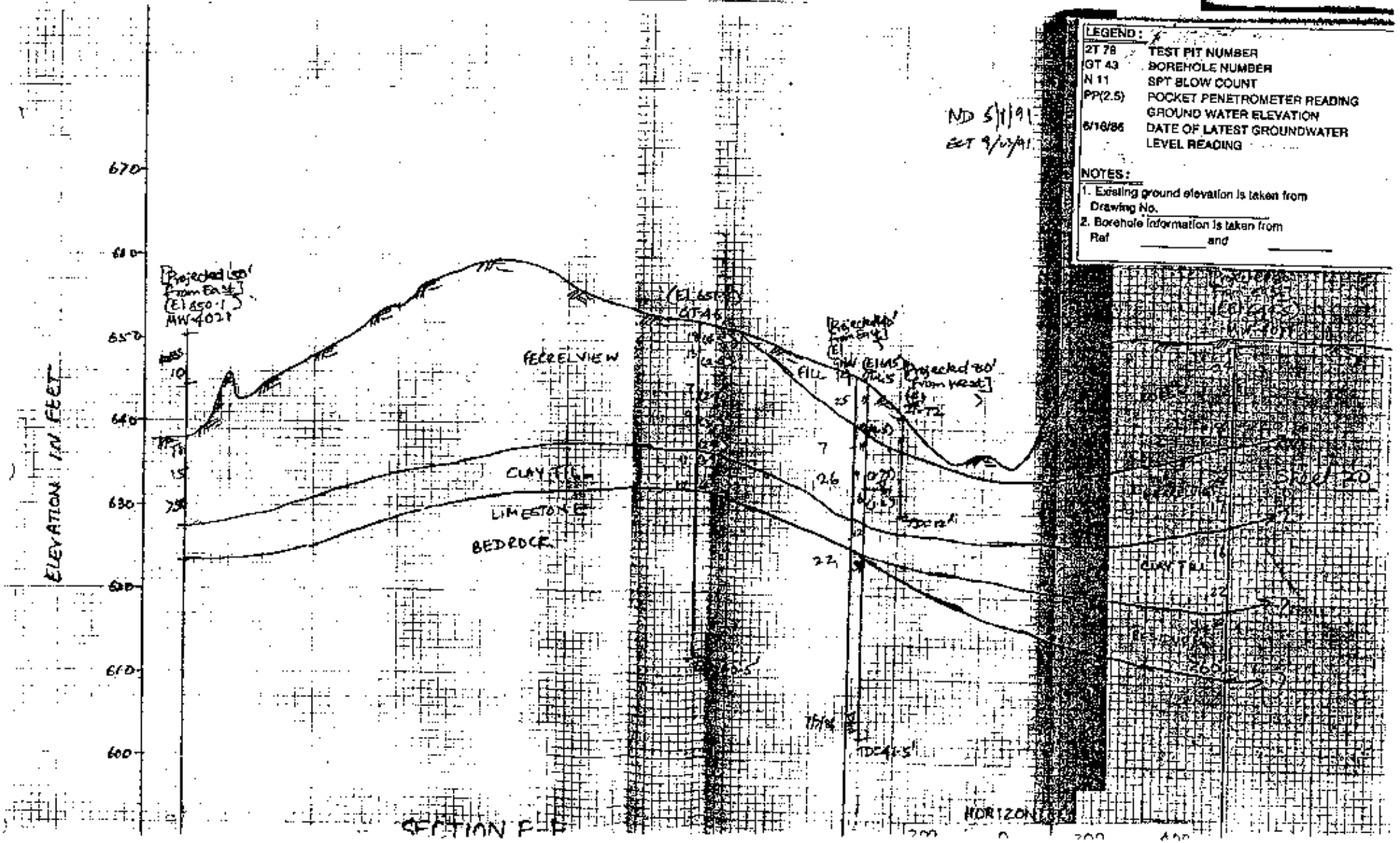


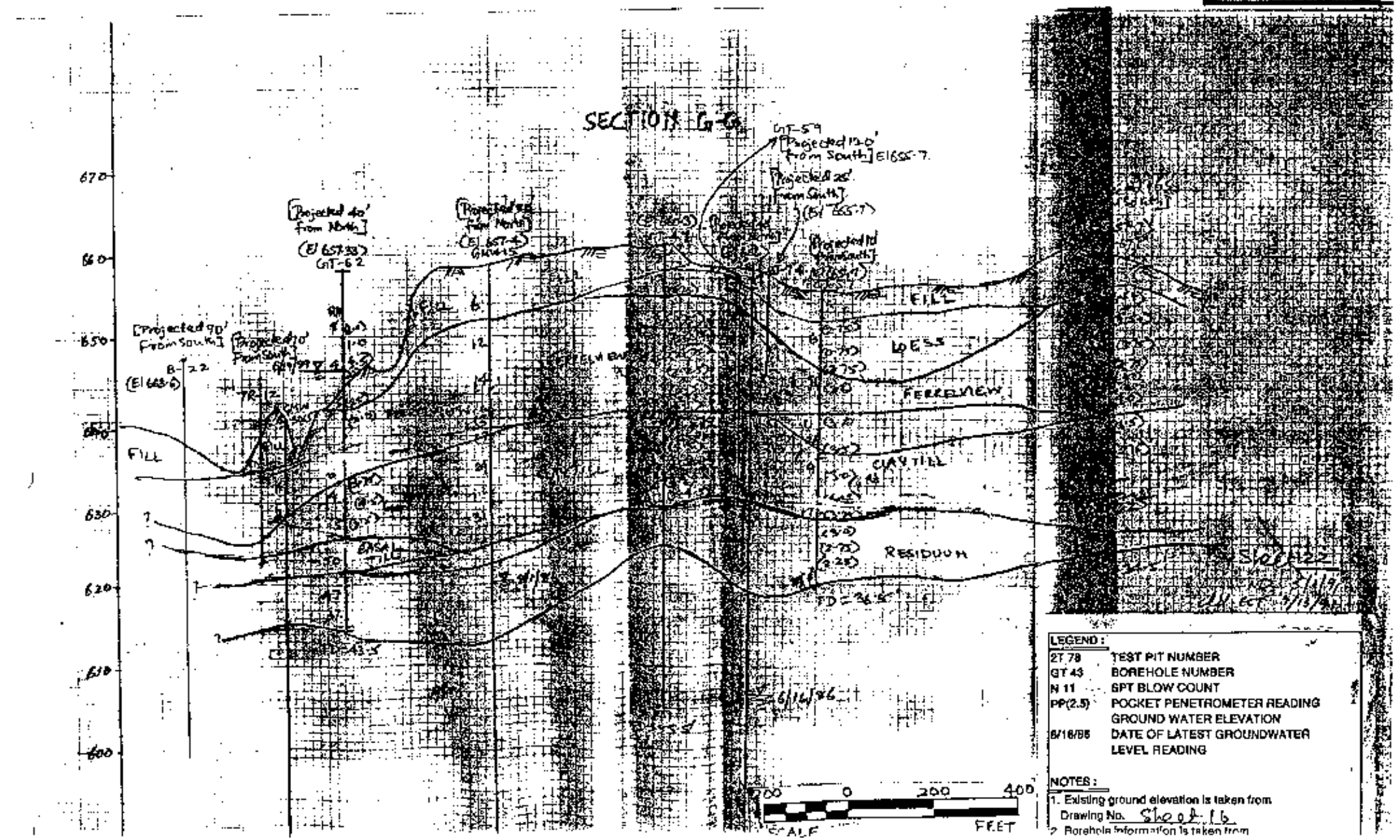
GT 43
N 11
PP(2.5)
6/16/86
BORE
SPT E
POCK
GROU
DATE
LEVE
NOTES:
1. Existing grour
Drawing No.
2. Borehole Info
Ref
[Projected 30' from West]
GTS-2
(Piezometer)
FILL?
[Projected 60' from West]
[Projected 10' from West]
FERRELVIEW
CLAYTILL
CLAYTILL
RESIDUUM
LIMESTONE
BEDROCK
LIMESTONE
BEDROCK
SECTION A-A
200
0
200
400
FEET
SCALE 1


SECTION B-B
HORIZONTAL
0
200
400


LEGEND :
2T 78 TEST PIT NUMBER
GT 43 BOREHOLE NUMBER
N 11 SPT BLOW COUNT
PP(2.5) POCKET PENETROMETER READING
GROUND WATER ELEVATION
6/16/86 DATE OF LATEST GROUNDWATER LEVEL READING
NOTES :
1. Existing ground elevation is taken from Drawing No. Sheet 16
2. Borehole information is taken from Ref and
ELEVATION IN FEET
670
660
650
640
630
620
610
600
RESIDUUM
LIMESTONE
BEDROCK
FENCE
SECTION D-D


SECTION FF
SCALE
FEET
200
0
200
400
Sheet 2
FILL
LOESS
FERRELVIEW
CLAY TILL
RESIDUUM
LIMESTONE BEDROCK
LIMESTONE BEDROCK
GT-61
GT-46
TD=40
LEGEND :
2T 78 TEST PIT NUMBER
GT 43 BOREHOLE NUMBER
N 11 SPT BLOW COUNT
PP(2.5) POCKET PENETROMETER READING
GROUND WATER ELEVATION
6/16/86 DATE OF LATEST GROUNDWATER LEVEL READING
NOTES :
1. Existing ground elevation is taken from


LEGEND:
2T 78 TEST PIT NUMBER
GT 43 BOREHOLE NUMBER
N 11 SPT BLOW COUNT
PP(2.5) POCKET PENETROMETER READING
GROUND WATER ELEVATION
6/16/86 DATE OF LATEST GROUNDWATER LEVEL READING
NOTES:
1. Existing ground elevation is taken from Drawing No.
2. Borehole information is taken from Ref and
ND 5/1/91
ELEVATION IN FEET
670
660
650
640
630
620
610
600
FERRELVIEW
CLAY FILL
LIMESTONE
BEDROCK
FILL
HORIZONTAL
SECTION F-F

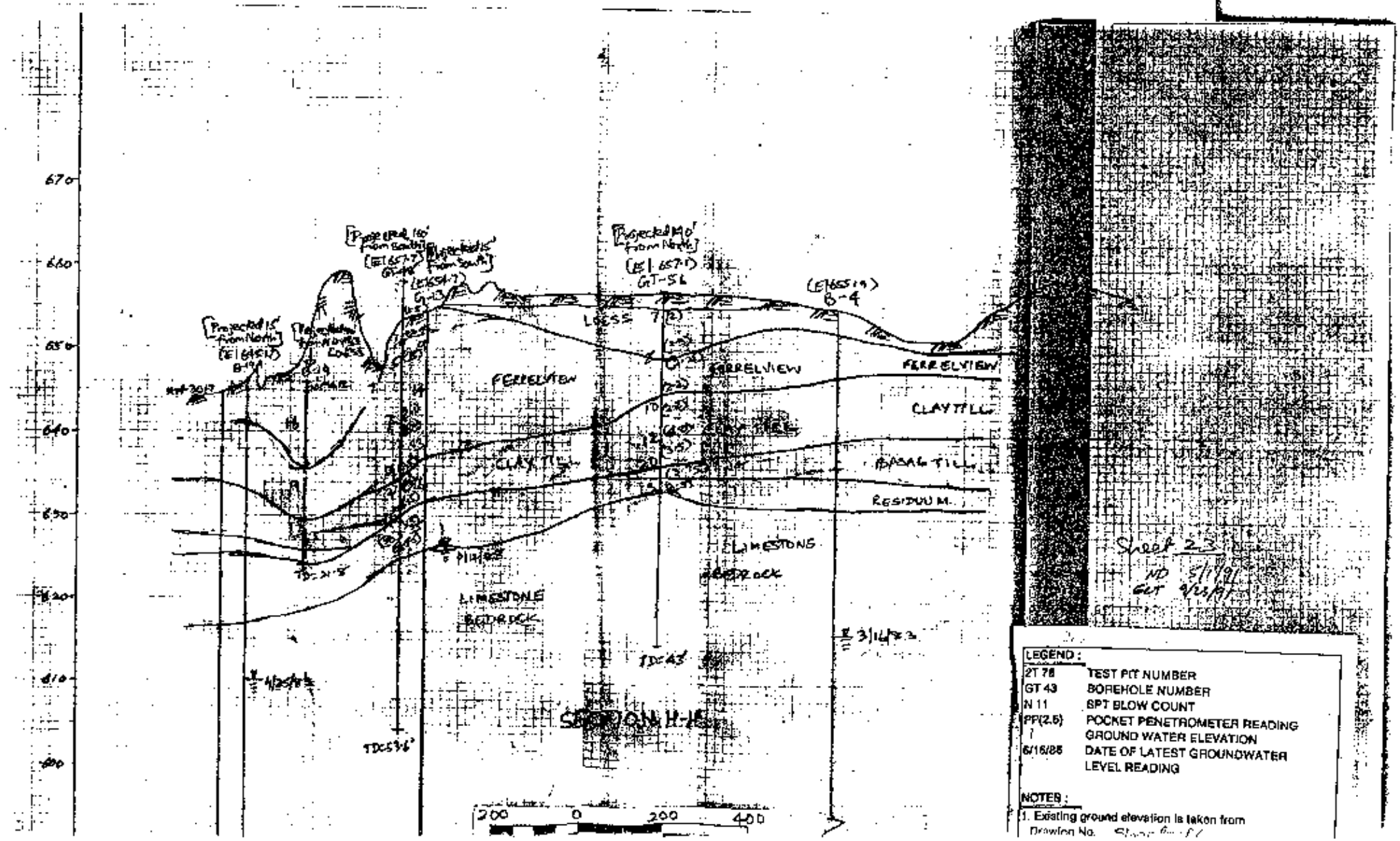


LEGEND :

2T 78	TEST PIT NUMBER
GT 43	BOREHOLE NUMBER
N 11	SPT BLOW COUNT
PP(2.5)	POCKET PENETROMETER READING
	GROUND WATER ELEVATION
6/16/86	DATE OF LATEST GROUNDWATER LEVEL READING

NOTES :

1. Existing ground elevation is taken from Drawing No. Sheet 16
2. Borehole information is taken from



LEGEND :

2T 78	TEST PIT NUMBER
GT 43	BOREHOLE NUMBER
N 11	SPT BLOW COUNT
PP(2.5)	POCKET PENETROMETER READING
⊥	GROUND WATER ELEVATION
6/16/85	DATE OF LATEST GROUNDWATER LEVEL READING

NOTES :

1. Existing ground elevation is taken from Drawing No. [illegible]

Sheet 24

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w sv	Initial d sv	c	phi	Consolidation Cc	Cc	Pp	Permeability w	d	k (Coef Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-31	ST-02	4.0	6.5	CL	0	10	90	36	20		2.68	20.9	103.1																	F
	ST-06	18.0	20.5		0	4	96					20.1	104.6																	F
GT-32	ST-01	1.0	3.5	CL	0	4	96	32	13			20.1	101.4			CU	27.3	97.2	c=550 c'=330	0=25 0'=40										L
	ST-02	9.0	10.5	CH	0	15	85	64	46			26.4	90.5			CU	30.7	92.5	c=410 c'=110	0=10 0'=21										F
	ST-05	18.5	21.0		3	8	89					36.3	82.9																	C
GT-33	ST-04	5.0	7.5	CL	0	4	96	45	27							CU	30.6	92.5	c=600 c'=610	0=5 0'=8				32.0	90.4	1.1E-7 (0.12)				DF
	ST-14	22.0	24.5	CL	0	6	94	30	10			15.7	100.7																	L
GT-34	SS-05	7.0	8.5	CH	0	20	80	55	38			20.8																		DF
	SB-17	27.0	28.5	CL	0	7	93	40	23			13.4	111.0																	F
GT-35	SS-02	3.0	4.5	CH	0	10	90	59	41			22.5																		DF
	SS-08	13.0	14.5	CL	0	14	86	49	31		2.63	18.9																		DF
	SS-11	17.5	19.0									16.0																		DF
	SB-15	25.0	26.5	CL	0	5	95	42	25			20.8	104.5			CU	23.3	103.5	c=330 c'=400	0=14 0'=20										DF
	SB-20	31.0	32.5	CL	0	1	99	45	25			19.8																		L
GT-36	ST-06	8.5	11.0	CL	0	22	78	48	32			22.6	100.2			CU	24.5	101.5	c=180 c'=160	0=18 0'=24										DF
	SS-09	14.0	15.5	CL	0	5	95	43	24			23.8																		DF
	ST-12	18.5	21.0	CL	0	1	99	46	29		2.70	21.5	97.8																	L
GT-37	SB-01	1.5	3.0	CH				58	34	8																				L
	ST-03	5.0	7.5	CL	0	3	97	45	29	11	2.67	24.4	101.2			UU	26.7	96.4	1160											L
	SS-05	9.0	10.5									20.7																		F
	ST-06	10.5	13.0	CH	0	3	97	55	39			25.1	100.3																	P
GT-38	SS-02	3.0	4.5	CL	0	2	98	37	18	19.4		21.8				UU	29.7	95.5	1110											L
	ST-03	4.3	7.0	CL	0	1	99	48	29	18.4		27.3	96.8																	L
GT-39	SS-02	4.0	5.5	CL	0	1	99	38	19	13.9		26.8	105.0																	F

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Sheet 25

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Compaction* Optimum d	Shear Strength Test	Initial w sv	Initial d sv	c	phi	Consolidation Cc	Cr	Pp	Permeability w	Permeability d	k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-39	ST-03	5.5	8.0								2.66	23.2	100.6	17.9	107.5															F
	COMP	5.5	12.0																											F
GT-39	ST-05	12.0	14.5	CH	0	6	94	65	48		2.68	25.1	99.4																	
GT-41	SS-02	3.5	4.0	CL				48	28	11.8		27.9	94.4																	DP
	SS-02	4.0	4.5	CL				48	28	12.8		28.6	95.1																	DP
	SS-04	6.0	7.5	CL				40	23			24.5																		F
GT-42	ST-05	9.5	12.0									16.9	113.3																	C
	SB-08	17.0	18.5									12.4	119.4																	
																														L
GT-43	SS-02	1.5	3.0									14.5																		F
	ST-04	6.0	8.5	CL				48	32		2.66	24.4	98.6			CU	31.4	91.0	c=460 c'=430	0=9 0'=12				27.0 to 30.5	95.7 to 91.6	<9.0E-6 (0.07)** <7.0E-8 (0.29)**				C
	ST-10	21.5	23.8	CL	0	26	74	47	32		2.71	18.6	106.5			UU	19.1	106.5	860					21.7 to 31.4	106.3 to 106.5	<6.0E-8 (0.43)** <4.0E-8 (0.72)**				B
	SB-17	40.0	41.5	CL				31	12		2.59	17.6	109.9																	R
	SS-19	50.0	51.0		29	46	25					20.4																		
																														C
GT-44	ST-03	5.0	7.5									17.6	106.2			CU	19.5	105.8	c=190 c'=180	0=24 0'=32										R
	SB-10	22.5	24.0									45.0	76.5																	
																														DP
GT-45	SS-01	1.0	2.5									18.1																		L
	ST-04	7.5	10.0									21.3	103.3																	C
	ST-07	15.0	17.5									22.1	104.5											19.9 to 23.5	106.5 to 102.8	<8.0E-5 (0.21)** <2.0E-8 (0.58)**				
GT-46	ST-03	5.0	7.5									22.1	99.6								0.202	0.027	6.6	20.0 to 23.3	103.7 to 103.0	5.0E-4 (0.07)** 3.0E-6 (0.43)**				F
GT-47	ST-05	10.0	12.5	CL	0	2	98	45	28		2.69	22.9	99.5								0.216	0.060	6.5							F
	SB-09	20.0	21.5	CH				51	36			20.5	72.4																	C
	SS-14	32.5	34.0									14.8																		R
GT-48	ST-03	7.5	10.0	CL	0	3	97	41	23			27.7	90.3			UU	25.4	95.6	870											F

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Originated by : ND DATE : 19-Sep-91

Checked by : EOT Date : 9/20/91

Sheet 26

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From (ft)	Depth To (ft)	Lab Class USCS	Mechanical Analysis Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	PI (%)	Shrinkage Limit (%)	Specific Gravity G	Natural w (%)	Natural d (pcf)	Compaction* Optimum w (%)	Compaction* Optimum d (pcf)	Shear Strength Test	Initial w (%)	Initial d (pcf)	c (psf)	phi (deg)	Consolidation Cc	Cr	Pp (ksf)	Permeability w (%)	d (pcf)	k (cm/sec) (kef)	Capillary Moisture (%)	Cation Exch Cap (meq/100g)	Calif Bearing Ratio	Soil Unit
GT-48	ST-05	12.5	15.0									22.4	101.3			CU	24.2	100.5	c=660 c'=650	D=11 O'=16				22.4 to 25.7	101.3 to 99.2	6.0E-4 (0.14)** <1E-8 (0.30)**				F
	ST-07	17.5	20.0	CH	0	2	98	60	43		2.67	27.8	93.9			UU	27.9	95.5	880		0.335	0.066	6.1			<1.0E-9				F
	SS-12	30.0	31.5									18.5																		R
GT-50	ST-02	2.5	5.0	CL	0	1	99	47	29		2.72	21.1	104.7			UU	27.9	91.8	1160		0.230	0.032	30.0	25.5 to 26.3	102.7 to 98.2	3.0E-4 (0.07)** 2.0E-5 (0.43)**				L
	ST-06	12.5	15.0	CH	0	5	95	63	45		2.74	26.9	95.8			UU	26.0	97.3	1250		0.260	0.075	15.0							C
	SB-08	17.5	19.0									14.0	114.3											14.4 to 20.9	113.8 to 107.4	2.0E-7 (0.22)** 7.0E-8 (0.58)**				C
	SS-14	32.5	34.0									18.0																		R
GT-51	SS-01	0.0	1.5	CL				33	11			22.9																	TC	DR
	ST-03	5.0	7.5	CL	0	2	98	44	28		2.63	21.4	101.6			UU	23.9	98.6	1290											P
	ST-07	15.0	17.5	CL	0	30	70	39	25		2.68	17.5	112.6											16.5 to 19.4	113.2 to 108.6	3.0E-6 (0.22)** 2.0E-8 (0.58)**				C
	SB-09	20.0	21.5	CH	4	15	81	74	50		2.79	33.7	88.7								0.265	0.097	5.0	28.1 to 33.5	93.7 to 87.7	3.0E-7 (0.29)** 5.0E-8 (0.65)**				C
	SS-11	25	26.5									10.1																		R
GT-52	ST-04	10	12.5	CH				61	44			23.9	101.3			UU	23.6	100.6	1180											P
	ST-06	15	17.5								2.79	23.8	100.5			CU	23.6	102.8	c=230 c'=160	0=16 O'=21				25.0 to 30.8	100.1 to 91.7	<3E-6 (0.22)*				P
	SS-09	22.5	24.0									18.2																		C
	SS-11	27.5	29.0									15.6	115.0 ***																	C
	SB-14	35.0	36.5	CL	0	26	74	42	28		2.68	19.0	101.6			UU	16.5	111.3	1060											R
	SS-17	42.5	44.0									25.7																		R
GT-53	ST-02	2.5	4.0									21.4	102.3																JC	DE
	ST-04	7.5	10.0	CH	0	3	97	54	36		2.73	22.3	103.8								0.193	0.092	9.3							P
	ST-08	17.5	20.0	CH	0	16	84	58	41		2.70	21.6	104.8								0.236	0.068	22.5							C
	SS-15	35.0	36.5		22	25	53					23.1																		R
GT-54	ST-03	4.5	7.0	CL	0	3	97	42	25			21.8	100.1			CU	24.9	98.6	c=370 c'=300	0=19 O'=25										YS

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Sad Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Sheet 2.7

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Compaction* Optimum d	Shear Strength Test	Initial w sr	Initial d sr	c	phi	Consolidation Cc	Cr	Pp	Permeability w	Permeability d	Permeability k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-54	SS-06	17.0	18.5									21.8																		L
GT-55	ST-02	2.5	5.0									22.8	96.0																	L
	ST-04	7.5	10.0	CL/CH	0	1	99	50	29		2.75	30.7	89.4								0.260	0.041	6.7	28.5 to 30.9	94.0 to 92.8	1.0E-5 (0.14)** <2.0E-6 (0.5)**				L
	ST-06	12.5	15.0	CH	0	1	99	51	33		2.82	22.6	103.7			UU	23.4	101.0	1460		0.462	0.042	18.5			8.0E-09				F
	ST-08	17.5	20.0	CL				42	27			22.5	103.0			UU	22.5	103.0	1390											F
GT-55	SB-12	27.5	29.0					70	50			25.2	99.6			CU	23.7	101.4	c=205 c'=260	0=13 0'=16	0.268	0.096	7.6			2.0E-09				R
GT-56	ST-02	5.0	7.5	CL	0	2	98	30	12		2.62	20.4	101.1			UU	18.7	103.9	2330		0.380	0.033	9.9			2.9E-08				L
																CU	22.1	103.7	c=330 c'=230	0=25 0'=31										
	ST-04	10.0	12.5									26.5	98.1											26.7 to 29.7	96.2 to 92.6	2.0E-7 (0.14)** <3.0E-8 (0.5)**				F
	ST-06	15.0	17.0	CL	0	26	74	44	29			19.0	109.9								0.248	0.061	30.0			2.9E-09				C
	SB-08	19.5	21.0	CL	0	19	81	42	27		2.66	21.5	105.6			UU	21.4	103.6	1650											C
	SS-09	22.0	23.5	CH	4	6	90	71	50			27.1																		R
GT-57	SS-02	5.0	6.5									26.3																		E
	ST-03	7.5	10.0	CL				42	25			27.4	93.5			UU	20.9	104.4	1690											F
	ST-05	15.6	16.5									22.7																		R
	SB-11	27.5	29.0		55	10	35					17.1																		R
GT-58P	ST-01	2.5	5.0	CH	0	4	96	54	23			22.9														2.0E-7 (1) 4.0E-7 (3)				F
	ST-03	7.5	10.0	CH	0	5	95	66	46		2.69	16.6									0.202	0.040	7.0	21.9 to 23.6	104.2	6.0E-8 (1) <1.0E-9 (3)				F
	ST-09	22.5	24.0								2.65										0.150	0.018	14.5			4.0E-8 (2) <1.0E-9 (4)				C
	SB-11	28.5	29.0	GC	50	10	40					1.3	117.4																	R
GT-59	ST-02	5.0	7.5																					23.0 to 21.8	102.4	4.0E-7 (1) 2.0E-7 (3)				F
	ST-06	15.0	17.5																					19.3 to 20.2	110.3	<1.0E-9 (2)				C
GT-60P	ST-04	12.5	15.0								2.72	22.0	104.5								0.170	0.035	5.2							F

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w nv	Initial d nv	c	phi	Consolidation Cc	Cv	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			tsf	%	pcf	cm/sec (kaf)	%	meq/100g		
GT-60P	ST-10	27.5	30.0	CL	0	21	79	44	27		2.70	19.0	109.5								0.152	0.045	7.6	18.7 to 19.6	109.1	5.0E-8 (3) <1.0E-9 (6)				C
	SB-15	41.0	41.5	CL	7	16	77	35	13							CU	19.9	105.3	c=850 c'=360	0-20 0'-34				19.0 to 20.9	105.5 105.1	7.0E-8 (4) 2.0E-7 (7)				B
	SB-16	45.0	46.5	SC	33	37	30																							E
	SB-17	48.5	49.0	SC	22	50	28																	13.9 to 22.4	103.1	5.0E-7 (4) 2.0E-7 (7)				B
GT-61	SS-13	32.5	34.0	CH	0	27	73																							C
	SB-18	50.5	51.5	GC	36	34	30					11.0	118.9																	E
GT-62	ST-07	17.5	20.0									28.0												23.7 to 24.5	100.9	5.0E-8 (2) <1.0E-9 (5)				F
	SB-15	38.0	39.0	GC	43	17	40				2.76										0.372	0.075	10.3	7.8 to 15.8	100.1	3.0E-5 (3) 6.0E-8 (5)				K
GT-63P	ST-01	2.5	5.0	CH	6	7	87	56	32															22.9 to 24.2	100.4	7.0E-9 (1)				P
	ST-09	22.5	25.0	CL	0	25	75	45	28		2.75	16.4	113.9								0.203	0.036	15.0	17.6 to 19.1	110.0	9.0E-9 (2)				C
	SB-15	38.0	38.5	SC	40	45	15																							K
GT-65P	SB-16	40.0	41.5	GC	42	24	34																	29.5 to 33.0	81.3	8.0E-7 (4) 4.0E-7 (7)				K
GT-67P	ST-06	20.0	22.5																					17.9 to 19.8	110.2	1.0E-7 (2)				C
GT-68	6810	25	25.7		5	24	71	47	34		2.69	16.5	110						**		0.220	0.038	12.4							C
	6813	32.5	34		1	4	95	40	27																					B
	6815				9	7	84																							K
GT-69	6906	15	17.5		0	28	72	41	29			14.1	112.1			UU			7150											C
	6908	20	22.5													UU			6960											
								40	25		2.77	15.6	116.3			CU	15.6	116.3	c=1270 c'=1320	0-19 0'=25	0.177	0.042	16.5							B
	6910	25	26.5								(-4) 2.74	9.6																		K
											(+4) 2.59																			

Notes : Values of w & d for UU & CU tests are average values.
Shear strength,consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Sheet 29

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From (ft)	Depth To (ft)	Lab Class USCS	Mechanical Analysis Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	PI (%)	Shrink-age Limit (%)	Specific Gravity G	Natural w (%)	Natural d (pcf)	Compaction* Optimum w (%)	Compaction* Optimum d (pcf)	Shear Strength Test	Initial w av (%)	Initial d av (pcf)	c (psf)	phi (deg)	Consolidation Cc	Consolidation Cr	Consolidation Pp (ksf)	Permeability w (%)	Permeability d (pcf)	Permeability k (Coef Pr) (cm/sec (lef))	Capillary Moisture (%)	Cation Exch Cap (meq/100g)	Calif Bearing Ratio	Soil Unit
GT-70	7004	10	12.5		0	7	93	41	26		2.75	18.8	110.1			CU	18.8	110.1	c=750 c'=850	0=16 0'=20	0.215	0.061	13.3							F
GT-71	7108	20	22.5		0	32	68	47	33			16.3	111			CU	11.3	111.0	c=730 c'=860	0=17 0'=21										C
	7110	25	27.5					54	39		2.72	20.9	106.2			CU	20.9	106.2	c=640 c'=790	0=21 0'=28	0.417	0.068	23.4							B
	7112	30	31.5								(-4) 2.74 (+4) 2.44	22.5	88																	R
GT-73	7306	15	17.5		0	16	84	64	45		2.74	32.4	92.4								0.305	0.131	3.0							F
	7314	35	36.5					38	22		2.71	22.5	102.3								0.162	0.037	2.8							B
GT-73	7316	40	41.5					50	33		(-4) 2.70 (+4) 2.56	10.2																		R
GT-74	7402	5	7.5		0	3	97	55	42			24.2	99.9			CU	24.2	99.9	c=730 c'=680	0=16 0'=23										TS
	7406	15	17.5		1	27	72	42	30			17.8	110.3			CU	17.8	110.3	c=160 c'=180	0=23 0'=32										C
																											20.2			F
GT-2T71	BU-01A	3.5	6.5	CL	0	2	98	39	17		2.69	28.3		15.4	106.0	CU	18.8	105.2	c=0	0=14										F
	BU-02A	6.5	12.0	CH	0	3	97	52	37	8	2.51	17.9		18.5	106.9	UU	21.2	101.8	2020		0.245	0.039	4.0	21.0 to 23.65	104.4	2.0E-8 (1)	20.5	88.26		F
																												49.02		F
GT-2T72	BU-01A	7.5	10.5	CL-M	0	5	95	27	6		2.68	22.1		12.5	116.1																
GT-2T74	BU-01A	4.0	8.5	CL	0	3	97	42	24		2.74	25.9		16.1	106.3	CU	18.5	102.0	c=820 c'=290	0=13 0'=29							17.2	83.91		L
																											17.4			F
GT-2T75	BU-01A	2.5	6.5	CL	0	1	99	39	17		2.61	20.8				UU	26.7	97.4	2320	5										F
	BU-01A	4.0	8.5	CL										17.6	108.0															F
	BU-02B	6.5	12.0	CH	0	3	97	77	56	7	2.71	23.1		20.1	102.3	CU	23.6	98.3	c=310 c'=0	0=13 0'=21	0.214	0.033	6.0	23.4 to 24.9	97.5	<1.0E-9 (1)	21.2	78.00		F
																											17.9	70.21		F
GT-2T77	BU-01B	1.5	4.0	CH	0	1	99	50	33		2.55	16.6		16.6	104.3	CU	19.2	99.8	c=335 c'=270	0=14 0'=23										
	BU-02A	7.0	10.5	CL	0	3	97	49	26		2.66	24.6		19.2	104.4									22.0 to 22.3	103	2.0E-8 (1)	21.6	59.65		F

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise noted.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Originated by : ND DATE : 19-Sep-91

Checked by : [illegible] Date : 9/20/91

Sheet 30

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Geotechnical Characterisation

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Compaction* Optimum d	Shear Strength Test	Initial w sv	Initial d sv	c	phi	Consolidation Cc	Cr	Pp	Permeability w	Permeability d	Permeability k (Coef Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
GT-2T78	BU-01A	4.0	6.5	CL	0	2	98	30	11		2.71	14.7		11.7	114.9	UU	14.3	110.3	2310								13.4	33.23		L
								28	10																					
	BU-02B	6.5	12.0	CH	0	3	97	58	39		2.69	20.1		14.6	115.6	UU	23.9	98.7	2310					24.0 to	99.2	4.0E-8 (1)	24.2	71.69		F
														21.3	104.2									29.1						F
GT-2T79	BU-01A	1.0	6.5	CL	0	2	98	49	26	18	2.72	14.0																		F
	BU-02A	6.5	12.0	CH	0	3	97	62	43			23.1																		
																														F
GT-2T80	BU-01A	0.5	8.0	CL	0	4	96	38	18			12.1																		
																														DP
GT-2T81	BU-01A	0.5	6.5	CL	1	10	89	36	18	11		20.4																	15	DF
	BU-02A	6.5	12.0	CL	0	4	96	40	25			21.0																	15	
																														F
GT-2T82	BU-01A	0.5	3.5	CL	0	4	96	42	23			13.6																		F
	BU-02A	3.5	6.0	CH	0	3	97	53	31			23.2																		C
	BU-03A	6.0	10.0	CL	2	21	77	48	27			16.2																		

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise noted.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Temporary Storage Area

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w av	Initial d av	c	phi	Consolidation Cc	Cr	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (lef)	%	meq/100g		
GTS-1	ST-03	5.0	7.5	CL	0	3	97	40	20			23.3	97.5	17.5 (comp GTS-3	102.8 with ST-02									21.1 to 23.8	98.4	2.0E-7 (1) (comp with GTS-3,ST-02)				P
GTS-2	ST-02	2.5	5.0									25.5	95.0	18.3 (comp with (GTS-4,ST-04)	103.0									21.7 to 22.7	97.8	8.0E-8 (1) (comp with GTS-4,ST-04)				F
	ST-04	7.5	10.0									20.6	102.5																	F
	COMP	2.5	10.0	CL	0	3	97	44	24																					
GTS-3	ST-02	5.0	7.5	CH	1	3	96	53	34			29.6	89.9	(composite see GTS-1 ST-03)												(composite see GTS-1 ST-03)				F
GTS-4	ST-02	2.5	5.0	CH	1	4	88	51	28			28.4	92.3	17.7 (comp)	105.3									20.8 to 21.4	102.3	2.0E-7 (1) (composite)				P
	ST-04	7.5	10.0	CL	0	6	94	41	21			21.5	102.9	(See GTS-2 ST-02																F
GTS-5	BULK	0.0	5.0	CH	1	7	92	53	35			21.7		17.5	106.4									20.7 to 23.6	101.0	2.0E-8 (1)			T5	P
GTS-6	BULK	0.0	5.0	CL	0	1	99	43	21			19.7		18.3	104.6									21.6 to 23.0	100.0	1.0E-7 (1)				F
GTS-7	BULK	0.0	5.0	CH	0	5	95	59	35			23.8		19.2	102.7									21.0 to 24.6	99.2	5.0E-8 (1)			T5	P

Note : Values of w & d for UU & CU tests are average values.
Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Sheet 32

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Materials Staging Area

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Compaction* Optimum d	Shear Strength Test	Initial w av	Initial d av	c	phi	Consolidation Cc	Cr	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Calcium Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPMS-1	BU-01	0.0	6.0	CH	0	7	93	51	32			20.0		17.6	103.0									17.7 to 25.1	98.6	7.0E-8 (1)			2.45	F
TPMS-2	BU-01	0.0	2.0	CL	0	6	94	49	29			18.3		18.7	104.3									18.2 to 29.8	100.2	2.0E-8 (1)				L
	BU-02	2.0	6.0	CH	0	20	80	67	46			21.9		21.0	100.6									20.7 to 29.6	95.2	<1.0E-9 (1)			2.25	F
TPMS-3	BU-01	1.0	6.0	CL	0	16	84	39	19			22.4		17.1	104.0									17.7 to 26.1	99.5	3.0E-7 (1)			2.74	F
TPMS-4	BU-01	1.0	3.5	CL	0	10	90	49	29			20.0		18.6	105.4									18.8 to 28.2	99.7	9.0E-9 (1)				L
	BU-02	4.0	6.5	CH	0	14	86	73	49			27.5		22.8	95.5									21.3 to 33.1	92.3	<1.0E-9 (1)				F
TPMS-5	BU-01	1.0	7.0	CL	0	4	96	37	20			19.8		15.9	108.1									17.2 to 25.0	100.9	2.0E-8 (1)			3.75	L
	BU-02	8.0	10.0	CH	0	2	98	75	49			26.6		21.7	97.8									20.9 to 32.9		9.0E-9 (1)				F
TPMS-6	BU-01	1.0	5.0	CL	0	2	98	40	22			15.7		16.4	104.0									16.9 to 25.7	99.4	3.0E-7 (1)				L
	BU-02	5.5	7.5	CH	0	4	96	72	47			19.4		21.3	100.4									20.6 to 28.0	94.8	<1.0E-9 (1)				F
TPMS-7	BU-01	1.0	7.0	CL	0	4	96	37	20			19.7		17.4	107.2									17.5 to 21.9	102.4	1.0E-7 (1)				L
	BU-02	7.0	9.5	CH	0	3	97	82	58			20.3		21.1	94.7									15.5 to 29.3	101.7	1.0E-7 (1)				F
TPMS-8	BU-01	1.0	5.0	CL	0	3	97	30	11			9.9		16.3	108.0									16.1 to 20.5	105.5	6.0E-8 (1)			2.43	L
	BU-02	5.0	10.5	CH	0	6	94	63	44			23.1		21.4	98.6									20.0 to 32.2	95.1	<1.0E-9 (1)			1.55	F
	BU-03	12.0	14.0		0	45	55					11.1																		C
TPMS-9	BU-01	1.0	7.0	CL	0	3	97	38	18			16.5		15.6	104.9									15.0 to 22.8	100.5	3.0E-7 (1)			3.05	L
	BU-02	8.0	15.0	CH	0	5	95	69	45			15.1		24.1	95.9									23.7 to 34.6	90.2	4.0E-8 (1)				F

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

SUMMARY OF SOIL TEST RESULTS

Job No. 3540 Project Name WSSRAP Feature Potential Borrow Source No. 1

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w sv	Initial d sv	c	phi	Consolidation Cc	Cr	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (kf)	%	meq/100g		
TPBS-1	2A	2.6	7.1	CL	0	9	91	31	13		2.65	11.1		15.6	110.4	UU	18.3	107.5	2810					18.4 to 19.1	108.2	3.0E-7 (1)	16.2	56.08		
																CU	18.5	107.4	c=1040 c'=1160	0=16 0'=21										
	3A	7.1	9.2	MH				60	21		2.7	26.4		20.1	105.6	UU	21.9	100.7	2500									57.03		
																CU	22.2	100.9	c=170 c'=170	0=17 0'=23	0.28	0.05	1.275							
	4A	9.2	14.1	CL	1	37	62	42	18	22	2.55	20.5		14.6	116.1									17.3 to 18.2	111.0	4.0E-8 (1)	15.6			
TPBS-6	1A	0.6	9.1	ML	0	3	97	38	11		2.64	24.6		19.3	102.9	UU	22.5	98.4	2860					23.3 to 23.2	99.9	2.0E-8 (1)	19.2			
																CU	22.8	99.7	c=590 c'=490	0=19 0'=26										
	2A	9.1	12.6	CH				64	44		2.74	24.9		20.9	100.3	UU	21.5	98.3	3340		0.22	0.07	1.32	24.3 to 28.9	94.6	1.0E-8 (1)	24.4	79.91		
																CU	24.3	95.2	c=390 c'=270	0=10 0'=18										
TPBS-8	1A	0.6	4.3	CL	0	2	98	34	16		2.73	21.8		17.4	108	UU	20.1	103	2300					20.8 to 21.3	102.9	3.0E-8 (1)	20.2			
																CU	20.5	104.1	c=630 c'=195	0=19 0'=35										
	2A	4.3	8.5	CL	0	2	98	31	12	16	2.64	13.3		15.6	109.4									19.6 to 20.2	106.0	2.0E-7 (1)	16.0			
	3A	8.5	11.9	CL/CH	0	2	98	50	30		2.59	21.0		20.5	101.9	UU	21.6	99.5	2600		0.2	0.06	1.21	23.9 to 28.9	97.3	5.0E-9 (1)	23.0	75.26		
																CU	23.8	97.3	c=445 c'=310	0=9 0'=10										
TPBS-10	1A	0.6	6.1	ML				49	17			23.5												20.2 to 27.0	102.1	1.0E-7 (1)	19.7			
	2A	8.2	10.9	ML	0	3	97	43	11			20.1												21.1 to 24.4	101.7	2.0E-8 (1)	20.8			
	3A	10.9	13.4	CH	0	5	95	61	43	9		23.1												24.5 to 30.1	97.0	<1.0E-9 (1)	24.7	74.21		
TPBS-11	1A	0.6	10.4	CL	0	3	97	33	12		2.72	25.3												20.9 to 23.3	99.5	3.0E-8 (1)	18.2			
	2A	10.4	12.3	CH	0	2	98	57	27	11	2.69	27.4												22.3 to 31.2	98.5	3.0E-8 (1)	27.2	73.52		
TPBS-13	Test 1	4.6	5	CL								27.7	92.2																	
TPBS-14	2A	2.9	8.4	CL	0	2	98	35	15			25.2																		

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Potential Borrow Source No. 1

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w av	Initial d av	c	phi	Consolidation Cc	Cr	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Cation Exch Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPBS-14	3A	8.4	11.8	ML	0	2	98		NP			22.4																		
	Test 2	4.9	5.3	CL								25.9	93.6																	
TPBS-15	1A	2.4	10.8	ML	0	3	97	41	9			25.5																		
	2A	10.8	12.9	CH	2	4	94	71	50			28.1																		
	3A	7.1	9.2		1	13	86																							
	Test 3	5.9	6.3	CL								23.8	89.1																	
TPBS-16	Test 4	5.4	5.8	CL								24.3	98.7																	
TPBS-17	Test 5	6.0	6.4	CL								24.8	96.8																	
TPBS-18	Test 6	4.8	5.2	CL								19.9	97.5																	
TPBS-19	Test 7	4.9	5.3	CL								24.0	99.0																	
TPBS-20	Test 8	5.4	5.8	CL								25.6	96.7																	

Note : Values of w & d for UU & CU tests are average values.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated.

* Std Proctor Test

** Unreliable test results due to low confining pressures used in testing.

*** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

Sheet 3.5

SUMMARY OF SOIL TEST RESULTS

Job No. 3840 Project Name WSSRAP Feature Potential Borrow Source No. 2

Test Pit Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural w	Natural d	Compaction* Optimum w	Optimum d	Shear Strength Test	Initial w	Initial d	c	phi	Consolidation Cc	Cr	Pp	Permeability w	d	k (Conf Pr)	Capillary Moisture	Cation Exch. Cap	Calif Bearing Ratio	Soil Unit
		ft	ft		%	%	%	%	%	%		%	pcf	%	pcf		%	pcf	psf	deg			ksf	%	pcf	cm/sec (ksf)	%	meq/100g		
TPBS-23	1A	0.7	13.1	CL	0	3	97	37	21		2.71	26.2		18.2	106.3									21.5 to 22.1	102.0	4.0E-7 (1)				
	Test 9	5.7	6.1	CL								28.3	91.8																	
TPBS-25	Test 11	4.1	4.5	CL								29.5	100.1																	
TPBS-26	Test 10	4.9	5.3	CL								24.8	98.9																	
TPBS-28	1A	0.7	9.9	CL	0	5	95	30	19		2.65	23.2		14.9	109.8															
	Test 12	3.8	4.2	CL								26.4	95.2																	
TPBS-29	Test 13	4.8	5.2	CL								28.0	96.1																	
TPBS-30	1A	1.8	12.4	ML	0	10	90	37	12		2.62	28.0		18.3	104.6															
	Test 14	4.9	5.3	CL								26.4	95.3																	

Note : Values of w & d for UU & CU tests are average values. * Std Proctor Test ** Unreliable test results due to low confining pressures used in testing.

Shear strength, consolidation and permeability tests were performed on undisturbed samples unless otherwise stated. *** Possible unreliable results due to testing being performed on Split Spoon samples (disturbed sampling method).

V. IN-SITU MATERIALS

- LOESS
- FERRELVIEW FORMATION
- CLAY TILL
- BASAL TILL
- RESIDUUM
- RAFFINATE PIT #4 DIKE FILL (Note: Will be relocated. The in-situ properties evaluated here are for references only)

The geotechnical investigations carried out on the raffinate pit materials revealed that the raffinate pit dike is safe against slope failure. The raffinate pit materials are going to be removed & hence they are not dealt with in this calculation except for listing the results in the summary table.

The grain size analysis summaries were analyzed for the Northern Chemical Plant area, Southern Chemical Plant area, Materials Staging area & Temporary Storage area for the Ferrelview formation only to see the geographic variation in grain size characteristics for Ferrelview clay.

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - TOPSOIL/FILL

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural Water Content	Unit Weight δ_d	Unit Weight δ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
GT-41	SS-02	3.5	4.0	CL				40	28	11.8		27.9	94.4	120.7
	SS-02	4.0	4.5	CL				40	28	12.8		28.6	95.1	122.3
GT-45	SS-01	1.0	2.5							18.1				
GT-51	SS-01	0.0	1.5					33	11			22.9		
GT-53	ST-02	2.5	4.0									21.4	102.3	134.2
GT-54	ST-03	4.5	7.0	CL	0	3	97	42	25			21.8	100.1	121.9
GT-74	7402	5.0	7.5		0	21	79	35	42			24.2	99.9	124.1
GTS-5	BULK	0.0	5.0	CH	1	7	92	53	35			21.7		
GTS-7	BULK	0.0	5.0	CH	0	5	95	59	35			23.8		
	BU-01A	0.5	6.5	CL	1	10	89	36	18	11		20.4		
	BU-02A	6.5	12.0	CL	0	4	96	40	23			21.0		
Number of points					6	6	6	9	9	4		10	5	5
Mean Values					0.5	8.3	91.3	46.0	27.3	13.4		23.4	98.4	122.6
Maximum Values					1.0	21.0	97.0	59.0	42.0	18.1		28.6	102.3	134.2
Minimum Values					0.0	3.0	79.0	33.0	11.0	10.7		20.4	94.4	120.7
Standard Deviation					0.5	6.1	6.1	8.4	8.9	2.8		2.7	3.1	1.3

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 39
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked K Lee | Date 9/19/91 | Date 9/20/91

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - LOESS

Hole Number	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrink-age Limit	Specific Gravity G	Natural Water Content	Unit Weight γ_d	Unit Weight γ_t
		ft	ft		%	%	%	%	%	%			pcf	pcf
GT-32	ST-01	1.0	3.5	CL	0	4	96	32	13			20.1	101.4	121.8
GT-33	ST-14	22.0	24.5	CL	0	6	94	30	10			15.7	100.7	116.5
GT-35	SS-20	31.0	32.5	CL	0	1	99	45	25			19.2		
GT-36	ST-12	18.5	21.0	CL	0	1	99	46	29		2.70	21.5	97.8	118.8
GT-37	SB-01	1.5	3.0	CH				58	34	8				
	ST-03	5.0	7.5	CL	0	3	97	43	29	11	2.67	24.4	101.2	125.9
GT-38	SS-02	3.0	4.5	CL	0	2	98	37	18	19		21.8		
	ST-03	4.5	7.0	CL	0	1	99	48	29	18		27.3	96.8	123.3
GT-43	SS-02	1.5	3.0									14.5		
GT-50	ST-02	2.3	5.0	CL	0	1	99	47	29		2.72	21.1	104.7	126.8
GT-54	SS-08	17.0	18.5									21.2		
GT-55	ST-02	2.5	5.0									22.8	96.0	117.8
	ST-04	7.5	10.0	CL-CH	0	1	99	50	29		2.75	30.7	89.4	116.9
GT-56	ST-02	5.0	7.3	CL	0	2	98	30	12		2.62	20.4	101.1	121.7
GT-57	SS-02	5.0	6.5									26.9		
	ST-03	7.5	10.0	CL				42	23			27.4	93.5	119.2
GT-58F	ST-01	2.5	5.0	CH	0	4	96	54	33			22.9		
GT-2T14	BU-01A	4.0	8.5	CL	0	3	97	42	24			25.9		
GT-2T18	BU-01A	4.0	6.5	CL	0	2	98	30	11		2.71	14.7		
TPMS-2	BU-01	0.0	2.0	CL	0	6	94	49	29			18.3		
TPMS-4	BU-01	1.0	3.5	CL	0	10	90	49	29			20.0		
TPMS-5	BU-01	1.0	7.0	CL	0	4	96	37	20			19.8		
TPMS-6	BU-01	1.0	5.0	CL	0	2	98	40	22			15.7		
TPMS-7	BU-01	1.0	7.0	CL	0	4	96	37	20			19.7		
TPMS-8	BU-01	1.0	5.0	CL	0	3	97	30	11			9.9		
TPMS-9	BU-01	1.0	7.0	CL	0	3	97	38	18			16.5		

Number of points	20	20	20	22	22	4	6	23	10	10
Mean Values	0.0	3.2	96.9	41.6	23.2	14.4	2.70	20.8	98.3	120.9
Maximum Values	0.0	10.0	99.0	58.0	34.0	19.4	2.75	30.7	104.7	126.8
Minimum Values	0.0	1.0	90.0	30.0	10.0	8.3	2.62	9.9	89.4	116.5
Standard Deviation	0.0	2.2	2.2	8.0	7.1	4.7	0.04	4.7	4.3	3.4

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 40
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked K. Lee | Date 9/19/91 | Date 9/20/91

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - FERRELVIEW CLAY (Page 1 of 2)

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural Water Content	Unit Weight γ_d	Unit Weight γ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
GT-31	ST-02	4.0	6.5	CL	0	10	90	36	20		2.68	20.9	103.1	124.6
	ST-06	18.0	20.3		0	4	96					20.1	104.6	125.6
GT-32	ST-02	9.0	10.5	CH	0	15	85	64	46			26.4	90.5	114.4
GT-34	SB-17	27.0	28.5	CL	0	7	93	40	23			15.4	111.0	128.1
GT-37	SS-05	9.0	10.5									20.7		
	ST-06	10.3	13.6	CH	0	3	97	53	39			25.1	100.3	125.5
GT-39	SS-02	4.0	5.5	CL	0	1	99	38	19	16		26.8	105.0	133.1
	ST-03	5.5	8.0								2.66	23.3	100.6	123.9
	ST-05	12.0	14.5	CH	0	6	94	65	48		2.68	25.1	99.4	124.3
GT-41	SS-04	6.0	7.5	CL				40	23			24.5		
GT-43	ST-04	6.0	8.5	CL				48	32		2.68	24.4	98.6	122.7
GT-45	ST-04	7.5	10.0									21.3	103.3	125.3
GT-46	ST-03	5.0	7.5									22.1	99.6	121.6
GT-47	ST-05	10.0	12.5	CL	0	2	98	45	28		2.69	22.9	99.5	122.3
GT-48	ST-03	7.5	10.0	CL	0	3	97	41	23			27.7	90.3	115.5
	ST-05	12.5	15.0									22.4	101.3	124.0
	ST-07	17.5	20.0	CH	0	2	98	60	43		2.67	27.2	95.9	120.8
GT-51	ST-03	5.0	7.5	CL	0	2	98	44	28		2.63	21.4	101.6	123.3
GT-52	ST-04	10.0	12.5	CH				61	44			23.9	101.3	125.5
	ST-06	15.0	17.5								2.79	23.8	100.5	124.4
GT-53	ST-04	7.5	10.0	CH	0	3	97	54	38		2.73	22.3	103.8	126.9
GT-55	ST-06	12.5	15.0	CH	0	1	99	51	33		2.82	22.8	103.7	127.3
	ST-08	17.5	20.0	CL				42	27			22.5	103.0	126.2
GT-56	ST-06	10.0	12.5									26.5	99.1	124.1
GT-57	ST-06	15.6	16.5									22.9		
GT-58P	ST-03	7.5	10.0	CH	0	5	95	66	46		2.69	16.6		
GT-60P	ST-04	12.5	15.0								2.72	22.0	104.5	127.5
GT-62	ST-07	17.5	20.0									28.0		
GT-63P	ST-01	3.5	5.0	CH	6	7	87	56	32					
GT-70	7004	10.0	12.5		0	7	93	41	26		2.75	18.8	110.1	130.8
GT-75	7506	15.0	17.5		0	16	84	64	45		2.74	32.4	92.4	122.3
GTS-1	ST-03	5.0	7.5	CL	0	3	97	40	20			23.3	97.5	120.2
GTS-2	ST-02	2.5	5.0									25.5	95.0	119.2
	ST-04	7.5	10.0									20.6	102.5	123.6
	COMP	2.5	10.0	CL	0	3	97	44	24					
GTS-3	ST-02	5.0	7.5	CH	1	3	96	53	34			29.6	89.9	116.5
GTS-4	ST-02	2.5	5.0	CH	8	4	88	51	28			28.4	92.3	118.5
	ST-04	7.5	10.8	CL	0	6	94	41	21			21.3	102.9	125.0
GTS-6	BULK	0.0	5.0	CL	0	1	99	43	24			19.7		

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - FERRELVIEW CLAY (Page 2 of 2)

Hole or Trench #	Sample Number	Depth From ft	Depth To ft	Lab Class USCS	Mechanical Analysis Gravel %	Sand %	Fines %	Atterberg Limits LL %	PI %	Shrinkage Limit %	Specific Gravity G	Natural Water Content %	Unit Weight γ_d pcf	Unit Weight γ_t pcf
GT-2T71	BU-01A	3.5	6.5	CL	0	2	98	39	17		2.69	28.3		
	BU-02A	6.5	12.0	CH	0	3	97	52	37	8	2.51	47.3		
GT-2T72	BU-01A	7.5	10.5	CL-ML	0	5	95	27	6		2.68	22.1		
GT-2T74	BU-01A	7.0	10.5								2.74			
GT-2T75	BU-01A	2.5	6.5	CL	0	1	99	39	17		2.61	20.8		
	BU-02B	6.5	12.0	CH	0	3	97	77	56	7	2.71	23.1		
GT-2T77	BU-01B	1.5	4.0	CH	0	1	99	50	33		2.55	16.6		
	BU-02A	7.0	10.5	CL	0	3	97	49	26		2.66	24.6		
GT-2T78	BU-02B	6.5	12.0	CH	0	3	97	58	39		2.69	20.1		
GT-2T79	BU-01A	1.0	6.5	CL	0	2	98	49	26	18	2.72	14.0		
	BU-02A	6.5	12.0	CH	0	3	97	62	43			23.1		
GT-2T80	BU-01A	0.5	5.0	CL	0	4	96	38	18			16.1		
GT-2T82	BU-01A	0.5	3.5	CL	0	4	96	42	23			13.8		
	BU-02A	3.5	6.0	CH	0	3	97	53	31			25.2		
TPMS-1	BU-01	0.0	6.0	CH	0	7	93	51	32			20.0		
TPMS-2	BU-02	2.0	6.0	CH	0	20	80	67	46			21.9		
TPMS-3	BU-01	1.0	6.0	CL	0	16	84	39	19			22.4		
TPMS-4	BU-02	4.0	6.5	CH	0	14	86	73	49			27.5		
TPMS-5	BU-02	8.0	10.0	CH	0	2	98	73	49			26.6		
TPMS-6	BU-02	5.5	7.5	CH	0	4	96	72	47			19.4		
TPMS-7	BU-02	7.0	9.5	CH	0	3	97	82	58			20.9		
TPMS-8	BU-02	5.0	10.5	CH	0	6	94	63	44			23.1		
TPMS-9	BU-02	8.0	15.0	CH	0	5	95	69	45			15.1		

Number of points	45	45	45	48	48	4	24	39	31	31
Mean Values	0.3	5.1	94.6	52.2	32.8	12.3	2.69	22.6	100.0	123.6
Maximum Values	8.0	20.0	99.0	82.0	58.0	17.5	2.82	32.4	111.0	133.1
Minimum Values	0.0	1.0	80.0	27.0	6.0	7.9	2.51	13.8	89.9	114.4
Standard Deviation	1.5	4.4	4.7	12.5	11.8	4.5	0.07	3.9	5.2	4.1

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - CLAY TILL

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Gravity	Specific Water	Natural Unit	Natural Weight
				USCS	Gravel	Sand	Fines	LL	PI		G	Content	γ_d	γ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
GT-32	ST-05	18.5	21.0		3	8	89					36.3	82.9	113.0
GT-42	ST-05	9.5	12.0									16.9	113.3	132.4
	SB-08	17.0	18.5									12.4	119.4	134.2
GT-43	ST-10	21.5	23.8	CL	0	26	74	47	32		2.71	18.6	106.5	126.9
GT-44	ST-03	5.0	7.5									17.6	106.2	124.9
GT-45	ST-07	15.0	17.5									22.1	104.5	127.6
GT-47	SB-09	20.0	21.5	CH				51	36			20.5	72.4	*87.2
GT-50	ST-06	12.5	15.0	CH	0	5	95	63	45		2.74	25.9	95.8	121.6
	SB-08	17.5	19.0									14.0	114.3	130.3
GT-51	ST-07	15.0	17.5	CL	0	30	70	39	25		2.68	17.5	112.6	132.3
	SB-09	20.0	21.5	CH	4	15	81	74	50		2.79	33.7	88.7	118.6
GT-52	SS-09	22.5	24.0									19.2		
	SS-11	27.5	29.0									15.6	115.0	132.9
GT-53	ST-08	17.5	20.0	CH	0	16	84	58	41		2.70	21.6	104.8	127.4
GT-56	ST-06	15.0	17.0	CL	0	26	74	44	29			19.0	109.9	130.8
	SB-08	19.5	21.0	CL	0	19	81	42	27		2.66	21.5	105.6	128.3
GT-58P	ST-09	22.5	24.0								2.65			
GT-60P	ST-10	27.5	30.0	CL	0	21	79	44	27		2.70	19.0	109.8	130.3
GT-61	SS-13	32.5	34.0	CH	0	27	73							
GT-63P	ST-09	22.5	25.0	CL	0	25	75	45	28		2.75	16.4	113.9	132.6
GT-68	6810	23.0	25.7		5	24	71	43	34		2.69	16.5	110.0	128.2
GT-69	6906	15.0	17.5		0	28	72	41	29			14.1	112.1	127.9
GT-71	7108	20.0	22.5		0	32	68	47	33			16.3	111.0	129.1
GT-74	7406	12.0	17.5		1	27	72	42	30			17.8	110.3	129.9
GT-TH2	BU-03A	6.0	10.0	CL	2	21	77	48	27			16.2		
TPMS-8	BU-03	12.0	14.0		0	45	55					11.1		

Number of points	17	17	17	15	15		10	24	21	20
Mean Values	0.9	23.2	75.9	48.8	32.9		2.71	19.2	105.7	127.9
Maximum Values	5.0	45.0	95.0	74.0	50.0		2.79	36.3	119.4	134.2
Minimum Values	0.0	5.0	55.0	39.0	25.0		2.65	11.1	72.4	113.0
Standard Deviation	1.6	9.0	8.6	9.1	7.1		0.04	5.8	11.3	5.1

* Value too low to be included in computing average value.

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - BASAL TILL

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class	Mechanical Analysis			Atterberg Limits		Shrinkage Limit	Specific Gravity	Natural		
												Water	Unit	Weight
				USCS	Gravel	Sand	Fines	LL	PI		G	Content	γ_d	γ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
GT-43	SB-17	40.0	41.5	CL				31	12		2.59	17.6	109.9	129.2
GT-52	SB-14	35.0	36.5	CL	0	26	74	42	28		2.68	19.0	101.6	120.9
	SS-17	42.5	44.0									25.7		
GT-60P	SB-15	41.0	41.5	CL	7	16	77	35	13					
	SS-16	45.0	46.5	SC	33	37	30							
	SB-17	48.5	49.0	SC	22	50	28							
GT-61	SB-18	50.5	51.5	GC	36	34	30					11.0	118.9	132.0
GT-68	6813	32.5	34.0		1	4	95	40	27					
GT-69	6908	20.0	22.5		10	23	67	40	25		2.77	15.6	116.3	134.4
GT-71	7110	25.0	27.5		0	2	98	54	39		2.72	20.9	106.2	128.4
GT-73	7314	35.0	36.5		0	4	96	38	22		2.71	22.5	102.9	125.3
Number of points		9	9	9	7	7		5	7	6	6			
Mean Values		12.1	21.0	66.1	40.0	23.7		2.69	18.9	109.2	126.4			
Maximum Values		36.0	50.0	98.0	54.0	39.0		2.77	25.7	118.9	134.4			
Minimum Values		0.0	2.0	28.0	31.0	12.0		2.59	11.0	101.6	120.9			
Standard Deviation		13.7	15.8	27.9	6.7	8.6		0.06	4.4	6.6	4.4			

SUMMARY OF INDEX PROPERTIES
OVERALL AREA

Project Name: WSSRAP - RESIDUUM

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural Water Content	Unit Weight γ_d	Unit Weight γ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
GT-43	SS-19	50.0	51.0		29	46	25					20.4		
GT-44	SB-10	22.5	24.0									45.0	76.5	110.9
GT-47	SB-14	32.5	34.0									14.8		
GT-48	SS-12	30.0	31.5									16.3		
GT-50	SB-14	32.5	34.0									18.0		
GT-51	SB-11	25.0	26.5									10.1		
GT-53	SS-15	35.0	36.3		22	25	53					23.1		
GT-55	SB-12	27.5	29.0					70	50			25.3	99.6	124.7
GT-56	SS-09	23.0	23.3	CH	4	6	90	71	50			27.1		
GT-57	SB-11	27.5	29.0		55	10	35					17.1		
GT-58P	SB-11	28.5	29.0	GC	50	10	40					1.3	117.4	118.9
GT-62	SB-15	38.0	39.0	GC	43	17	40				2.76			
GT-63P	SB-15	38.0	38.5	SC	40	45	15							
GT-65P	SB-16	40.0	41.5	GC	42	24	34							
GT-68	6815	37.5	39.0		9	7	84							
GT-69	6910	25.0	26.5		65	17	18				**2.74	9.8		
GT-71	7112	30.0	31.5		36	7	57				**2.74	22.3	88.0	107.8
GT-72	7316	40.0	41.5		60	17	23	50	33		**2.70	10.2		

Number of points	12	12	12	3	3		4	14	4	4
Mean Values	37.9	19.3	42.8	53.7	44.3		2.74	18.8	95.4	115.6
Maximum Values	65.0	46.0	90.0	71.0	50.0		2.76	45.0	117.4	124.7
Minimum Values	4.0	6.0	15.0	50.0	33.0		2.70	1.3	76.5	107.8
Standard Deviation	18.9	13.3	23.2	9.7	8.0		0.02	10.8	15.1	6.6

** For Soil < No. 4 Sieve only. G values for Soil > No. 4 Sieve are not included herein.

SUMMARY OF INDEX PROPERTIES

Project Name: WSSRAP – POTENTIAL BORROW SOURCE NO. 1

Hole or Trench #	Sample Number	Depth From	Depth To	Lab Class USCS	Mechanical Analysis Gravel	Sand	Fines	Atterberg Limits LL	PI	Shrinkage Limit	Specific Gravity G	Natural Water Content	Unit Weight γ_d	Unit Weight γ_t
		ft	ft		%	%	%	%	%	%		%	pcf	pcf
TPBS-1	2A	2.6	7.1	CL	0	9	91	31	13		2.65	11.1		
	3A	7.1	9.2	MH				60	21		2.7	26.4		
	4A	9.2	14.1	CL	1	37	62	42	18	22	2.55	20.5		
TPBS-6	1A	0.6	9.1	ML	0	3	97	34	11		2.64	24.6		
	2A	9.1	12.6	CH				64	44		2.74	24.9		
TPBS-8	1A	0.6	4.3	CL	0	2	98	34	16		2.73	21.8		
	2A	4.3	8.5	CL	0	2	98	31	12	16	2.64	13.3		
	3A	8.5	11.9	CL/CH	0	2	98	50	30		2.59	21.0		
TPBS-10	1A	0.6	6.1	ML				49	17			23.5		
	2A	8.2	10.9	ML	0	3	97	43	11			20.1		
	3A	10.9	13.4	CH	0	5	95	61	43	9		23.1		
TPBS-11	1A	0.6	10.4	CL	0	3	97	33	12		2.72	25.3		
	2A	10.4	12.3	CH	0	2	98	57	27	11	2.69	27.4		
TPBS-13	Test 1	4.6	5	CL								27.7	92.2	117.7
TPBS-14	2A	2.9	8.4	CL	0	2	98	35	15			25.2		
	3A	8.4	11.8	ML	0	2	98					21.4		
	Test 2	4.9	5.3	CL								25.9	93.6	117.8
TPBS-15	1A	2.4	10.8	ML	0	3	97	41	9			25.5		
	2A	10.8	12.9	CH	2	4	94	71	50			28.1		
	3A	7.1	9.2		1	13	86							
	Test 3	5.9	6.3	CL								23.8	89.1	110.3
TPBS-16	Test 4	5.4	5.8	CL								24.3	98.7	122.7
TPBS-17	Test 5	6.0	6.4	CL								24.8	96.8	120.8
TPBS-18	Test 6	4.8	5.3	CL								19.9	97.5	116.9
TPBS-19	Test 7	4.9	5.3	CL								24.0	99.0	122.8
TPBS-20	Test 8	5.4	5.8	CL								25.6	96.7	121.5
Number of points		13	13	15	16	16	4	10	25	8	1			
Mean Values		0.3	6.1	93.6	46.3	21.8	14.5	2.67	23.2	95.5	116.6			
Maximum Values		2.0	37.0	98.0	71.0	50.0	22.2	2.74	28.1	99.0	122.8			
Minimum Values		0.0	2.0	62.0	31.0	9.0	8.5	2.55	11.1	88.1	110.3			
Standard Deviation		0.6	8.8	9.0	12.5	12.8	5.2	0.06	3.9	3.3	3.9			

Properties calculated from test results on previous sheets.

Soil Type	OVERALL AVERAGE VALUES			CALCULATED VALUES			
	Specific Gravity Gs	Natural Moisture Content w (%)	Dry Unit Weight γ_d (pcf)	Void ratio (1) e	Deg of Saturation (2) S (%)	Porosity (3) n	Effective Porosity (4) n_e
TOPSOIL/FILL	2.70 *	23.4	98.4	0.712	88.7	0.416	0.047
LOESS	2.70	20.8	98.3	0.714	78.7	0.417	0.089
FERRELVIEW	2.69	22.6	100	0.679	89.6	0.404	0.042
CLAY TILL	2.71	19.2	105.7	0.600	86.7	0.375	0.050
BASAL TILL	2.69	18.9	109.2	0.537	94.7	0.349	0.019
RESIDUUM	2.74	18.8	95.4	0.792	65.0	0.442	0.155

Formulas for Calculation :

(1) $e = (Gs * \gamma w / \gamma d) - 1$

(2) $S = Gs * w / e$

(3) $n = e/(1+e)$

(4) $n_e = (1-S)n$

* Assumed value.

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
TOPSOIL/FILL																		
GT-54	ST-03					100.0	99.0	98.0	98.0	98.0	97.0		89.0	73.0	55.0	46.0	39.0	38.0
GT-74	7402				100.0	99.0	98.0	97.0	93.0	85.0	79.0		70.0	63.0	58.0	51.0	44.0	41.0
GTS-5	BULK				99.3	98.5	97.8	97.0	95.7	93.6	91.5	83.5	81.0	66.0	50.0	42.8	38.7	35.0
GTS-7	BULK				99.9	99.4	98.8	98.2	97.4	96.7	95.5	85.0	82.8	72.5	50.5	42.0	36.3	32.5

NUMBER OF POINTS	3.0	4.0	4.0	4.0	4.0	4.0	4.0	2.0	4.0	4.0	4.0	4.0	4.0	4.0
MEAN VALUES	99.7	99.2	98.4	97.6	96.0	93.3	90.8	84.3	80.7	68.6	53.4	45.5	39.5	36.6
MAXIMUM VALUES	100.0	100.0	99.0	98.2	98.0	98.0	97.0	85.0	89.0	73.0	58.0	51.0	44.0	41.0
MINIMUM VALUES	99.3	98.5	97.8	97.0	93.0	85.0	79.0	83.5	70.0	63.0	50.0	42.0	36.3	32.5
STANDARD DEVIATION	0.3	0.5	0.5	0.6	1.9	5.1	7.1	0.8	6.9	4.3	3.3	3.5	2.8	3.2

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DC
Item MATERIAL PROPERTIES

Contract No. 3340-827
Designed ND
Checked JSK

Sheet 47
File No. 9/20/91
Date 9/24/91

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
LOESS									99.0	97.0	96.0		83.0	62.0	40.0	32.0	24.0	22.0
GT-32	ST-01							99.0	98.0	96.0	94.0		78.0	61.0	37.0	30.0	21.0	19.0
GT-33	ST-14									99.0	99.0		88.0	72.0	50.0	39.0	32.0	30.0
GT-35	SS-20								99.0	99.0	99.0		91.0	73.0	50.0	40.0	32.0	29.0
GT-36	ST-12						99.0	99.0	98.0	98.0	97.0		84.0	72.0	49.0	41.0	35.0	32.0
GT-37	ST-03						99.0	99.0	99.0	98.0	98.0		84.0	68.0	45.0	35.0	27.0	25.0
GT-38	SS-02									99.0	99.0		88.0	76.0	53.0	41.0	33.0	31.0
	ST-03									99.0	99.0		89.0	69.0	47.0	39.0	32.0	30.0
GT-50	ST-02									99.0	99.0		89.0	75.0	57.0	49.0	42.0	40.0
GT-55	ST-04								99.0	98.0	98.0		80.0	62.0	40.0	30.0	24.0	22.0
GT-56	ST-02					99.4	98.8	98.0	97.5	97.0	96.5	95.8	94.3	76.0	51.5	40.5	34.8	31.0
GT-58P	ST-01						99.0	98.5	98.0	97.5	97.0	95.0	94.0	81.0	57.0	47.0	39.0	37.0
GT-2T74	BU-01A							98.8	98.5	98.0	98.0	96.0	94.0	72.0	49.0	38.0	32.0	31.0
GT-2T76	BU-01A						99.0	98.0	97.0	95.2	94.0	93.0	90.7	73.0	51.5	44.0	39.7	38.0
TPMS-2	BU-01						99.0	96.3	94.0	92.0	90.0	88.2	85.2	64.0	50.0	44.2	40.0	36.0
TPMS-4	BU-01						99.0	98.0	97.0	96.5	95.5	93.0	91.0	72.0	50.3	42.0	36.0	30.0
TPMS-5	BU-01							99.8	99.5	98.5	97.5	93.5	89.5	69.0	47.0	37.5	31.0	26.0
TPMS-6	BU-01						99.8	99.0	98.2	97.0	96.0	95.0	93.0	73.0	49.0	36.0	31.0	28.0
TPMS-7	BU-01						99.3	99.0	98.3	97.5	97.0	94.5	91.0	66.0	42.5	33.0	27.5	24.0
TPMS-8	BU-01						99.0	98.5	98.0	97.5	97.0	94.0	91.0	78.0	45.5	34.5	28.5	27.0
TPMS-9	BU-01																	
NUMBER OF POINTS							10.0	13.0	16.0	21.0	21.0	11.0	21.0	21.0	21.0	21.0	21.0	21.0
MEAN VALUES							99.1	98.5	98.0	97.5	96.9	94.0	88.7	71.0	48.3	38.9	32.5	29.8
MAXIMUM VALUES							99.8	99.8	99.5	99.0	99.0	96.0	94.3	81.0	57.0	49.0	42.0	40.0
MINIMUM VALUES							98.8	96.3	94.0	92.0	90.0	88.2	78.0	61.0	37.0	30.0	21.0	19.0
STANDARD DEVIATION							0.3	0.8	1.2	1.6	2.2	2.1	4.6	5.4	5.1	5.1	5.7	5.5

MORRISON-KNUDSEN CORPORATION

Project WSSRAP

Feature DC

Item MATERIAL PROPERTIES

Contract No. 68-W8-0827

Designed ND

Checked JSK

File No. 9120.91

Date 9/20/91

Date 9/24/91

Sheet 48

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
FERRELVIEW CLAY																		
GT-31	ST-02							98.0	96.0	92.0	90.0		75.0	56.0	40.0	34.0	30.0	27.0
	ST-06							98.0	98.0	97.0	96.0		82.0	62.0	40.0	32.0	25.0	22.0
GT-32	ST-02						98.0	97.0	94.0	89.0	85.0		76.0	68.0	57.0	53.0	50.0	49.0
GT-34	SB-17							99.0	97.0	95.0	93.0		80.0	62.0	44.0	34.0	28.0	27.0
GT-37	ST-06						99.0	99.0	99.0	98.0	97.0		82.0	66.0	51.0	45.0	39.0	37.0
GT-39	SS-02									99.0	99.0		79.0	65.0	43.0	33.0	25.0	23.0
	ST-05							99.0	98.0	96.0	94.0		81.0	71.0	60.0	52.0	48.0	46.0
GT-47	ST-05							99.0	99.0	98.0	98.0		77.0	63.0	45.0	39.0	35.0	33.0
GT-48	ST-03							99.0	99.0	98.0	97.0		92.0	71.0	49.0	39.0	31.0	28.0
	ST-07								99.0	99.0	98.0		87.0	71.0	57.0	51.0	45.0	42.0
GT-51	ST-03								99.0	99.0	98.0		83.0	63.0	43.0	35.0	31.0	28.0
GT-53	ST-04								99.0	98.0	97.0		87.0	71.0	55.0	49.0	44.0	42.0
GT-55	ST-06									99.0	99.0		85.0	64.0	46.0	40.0	34.0	32.0
GT-58P	ST-03							99.8	99.2	96.8	94.2	89.5	86.0	72.0	55.0	48.0	43.8	41.8
GT-63P	ST-01			94.8	94.0	92.8	92.0	90.8	88.3	87.5	87.0	72.5	70.0	51.0	38.0	31.2	26.2	23.0
GT-70	~~ST-04~~						100.0	99.0	98.0	94.0	93.0		72.0	60.0	45.0	35.0	30.0	27.0
GT-73	~~ST-06~~					100.0	99.0	98.0	94.0	88.0	84.0		74.0	66.0	57.0	51.0	46.0	42.0
GTS-1	ST-03					99.6	99.2	98.6	98.0	97.7	97.2	76.0	75.0	58.0	36.2	28.3	22.4	18.5
GTS-2	ST-02/ST-04					99.7	99.6	99.0	98.5	97.9	97.0	92.5	88.7	77.0	46.2	38.2	32.3	32.0
GTS-3	ST-02			98.7	98.7	98.7	98.2	97.7	97.0	96.7	95.8	79.0	75.0	66.8	42.2	39.7	34.8	32.0
GTS-4	ST-02		92.8	92.5	92.1	91.8	91.3	90.5	89.5	88.8	88.0	71.3	70.0	50.8	34.2	28.3	23.3	23.0
	ST-04					99.3	98.8	98.0	97.3	96.2	94.8	77.0	71.0	53.0	38.0	31.5	26.2	23.5
GTS-6	BULK						99.9	99.8	99.5	99.2	99.0	88.5	83.5	64.0	46.3	47.7	32.2	29.0
GT-2T7	BU-01A								99.5	99.0	99.0	95.0	94.0	75.0	45.0	36.0	31.0	28.0
	BU-02A								99.5	98.0	97.0	94.0	90.0	72.0	54.0	47.0	43.0	39.0
GT-2T2	BU-01A						99.9	98.5	98.0	96.0	95.0	95.0	92.0	61.0	39.0	31.0	28.0	27.0

MORRISON-KNUDSEN CORPORATION

Project WSS EAP D.C.

Feature MATERIAL PROPERTIES

Item

Contract No. 3840-827

Designed ND

Checked JSC

Sheet 49

File No.

Date 9/20/91

Date 9/24/91

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
GT-2T75	BU-01A								99.8	98.0	99.0	98.0	94.0	80.0	47.0	37.0	30.0	29.0
	BU-02B						99.8	99.5	99.0	98.2	97.2	96.2	94.8	86.0	63.4	56.3	51.0	48.0
GT-2T77	BU-01B						99.0	99.0	96.0	94.0	76.0	53.0	44.0	40.0	37.0			
	BU-02A							98.5	98.0	97.5	97.0	95.0	93.0	75.0	55.0	48.0	42.0	42.0
GT-2T78	BU-02B					99.8	99.0	98.0	98.0	97.8	97.0	95.0	94.0	77.0	59.0	54.0	50.0	47.0
GT-2T79	BU-01A							99.8	99.0	98.0	98.0	96.0	94.0	83.0	52.0	41.0	34.0	32.0
	BU-02A						99.9	99.3	98.8	97.9	97.0	96.0	94.3	79.0	62.5	58.2	53.8	51.3
GT-2T80	BU-01A						99.0	98.0	97.5	96.5	96.0	95.0	92.0	68.0	41.0	34.0	28.0	27.0
GT-2T82	BU-01A					99.8	98.4	98.0	97.8	96.2	96.0	95.0	93.0	71.0	46.0	39.0	34.0	30.0
	BU-02A						99.6	99.4	98.8	98.1	97.0	95.8	94.0	79.0	65.5	59.5	55.3	53.0
TPMS-1	BU-01						99.8	99.0	97.8	95.8	93.5	92.0	90.2	66.5	44.0	40.0	35.0	31.0
TPMS-2	BU-02						99.5	98.5	95.0	88.0	80.3	79.5	79.0	70.5	62.0	55.5	50.0	47.0
TPMS-3	BU-01						95.0	93.0	89.0	86.5	84.3	83.5	82.5	66.0	44.0	38.3	33.0	30.0
TPMS-4	BU-02						98.2	97.0	95.5	91.5	86.0	85.5	84.5	79.0	66.5	62.2	58.0	56.0
TPMS-5	BU-02							99.8	99.5	98.5	97.5	96.5	94.0	77.0	64.0	56.2	54.0	49.0
TPMS-6	BU-02							99.9	99.0	98.8	96.0	94.5	92.0	76.0	65.0	60.5	58.0	55.0
TPMS-7	BU-02						99.8	99.0	98.2	97.5	96.5	96.0	94.0	80.5	66.2	60.5	56.0	54.0
TPMS-8	BU-02						99.9	99.2	98.5	97.0	94.0	84.0	82.0	71.0	58.0	53.0	49.0	43.0
TPMS-9	BU-02						99.9	99.5	98.5	97.0	95.0	85.0	81.0	67.0	57.0	53.5	50.0	48.0

NUMBER OF POINTS	3.0	3.0	9.0	26.0	37.0	43.0	45.0	45.0	30.0	45.0	45.0	45.0	44.0	44.0	44.0
MEAN VALUES	95.3	94.9	97.9	98.5	98.2	97.4	95.9	94.1	88.1	83.9	68.2	50.2	44.0	38.7	36.2
MAXIMUM VALUES	98.7	98.7	100.0	100.0	99.9	99.8	99.2	99.0	98.0	94.8	86.0	66.5	62.2	58.0	56.0
MINIMUM VALUES	92.5	92.1	91.8	91.3	90.5	88.3	86.5	76.0	53.0	44.0	40.0	34.2	28.3	22.4	18.5
STANDARD DEVIATION	2.6	2.8	3.0	2.2	2.2	2.7	3.5	5.3	10.2	9.8	9.2	9.3	10.0	10.6	10.5

MORRISON-KNUDSEN CORPORATION

Project WSSLRP

Feature MATERIAL PROPERTIES

Item

Contract No. 3840-827

Designed JD

Checked JSR

Sheet 50

File No.

Date 9/20/91

Date 9/24/91

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
CLAY TILL																		
GT-32	ST-05				97.0	94.0	92.0	91.0	90.0	89.0	89.0							
GT-43	ST-10						99.0	97.0	92.0	82.0	74.0		65.0	57.0	51.0	45.0	37.0	34.0
GT-50	ST-06							99.0	98.0	97.0	95.0		88.0	73.0	59.0	53.0	49.0	46.0
GT-51	ST-07					98.0	96.0	93.0	87.0	75.0	70.0		61.0	51.0	41.0	37.0	33.0	30.0
	SB-09		100.0	97.0	96.0	92.0	88.0	86.0	84.0	83.0	81.0		81.0	78.0	72.0	70.0	67.0	64.0
GT-53	ST-08							98.0	95.0	88.0	84.0		77.0	69.0	59.0	53.0	46.0	44.0
GT-56	ST-06						99.0	97.0	92.0	81.0	74.0		67.0	59.0	51.0	45.0	38.0	36.0
	SB-08						99.0	97.0	92.0	82.0	81.0		70.0	62.0	50.0	44.0	39.0	36.0
GT-60P	ST-10					99.5	99.0	97.8	94.0	84.0	78.6	76.0	71.0	63.7	53.5	47.0	49.0	34.0
GT-61	SS-13					99.0	98.0	95.5	90.2	81.7	73.5	70.0	65.5	57.5	48.3	42.8	36.0	31.0
GT-63P	ST-09					99.3	98.0	96.2	92.5	83.0	75.0	71.0	67.2	58.5	48.0	42.5	35.5	31.0
GT-68	ST-10	100.0	95.0	95.0	95.0	95.0	94.0	92.0	88.0	78.0	71.0			54.0	49.0	43.0	36.0	33.0
GT-69	ST-06				100.0	99.0	97.0	94.0	89.0	80.0	72.0			55.0	48.0	40.0	32.0	29.0
GT-71	ST-08					100.0	99.0	97.0	91.0	77.0	68.0			51.0	45.0	39.0	34.0	31.0
GT-74	ST-06		100.0	99.0	99.0	97.0	96.0	94.0	89.0	79.0	72.0			56.0	48.0	41.0	37.0	32.0
GT-2T82	BU-03A				98.0	98.0	97.5	96.0	92.0	80.0	77.0	76.0	75.0	64.0	57.0	54.0	46.0	45.0
TPMS-8	BU-03						99.5	97.0	88.5	69.0	55.0	53.0	51.0	43.0	36.0	32.5	27.0	18.0

NUMBER OF POINT	1.0	3.0	3.0	6.0	11.0	15.0	17.0	17.0	17.0	17.0	5.0	13.0	16.0	16.0	16.0	16.0	16.0
MEAN VALUES	100.0	98.3	97.0	97.5	97.3	96.7	95.1	90.8	81.7	75.9	69.2	64.5	59.5	51.0	45.6	40.1	35.9
MAXIMUM VALUE	100.0	100.0	99.0	100.0	100.0	99.5	99.0	98.0	97.0	95.0	76.0	88.0	78.0	72.0	70.0	67.0	64.0
MINIMUM VALUES	100.0	95.0	95.0	95.0	92.0	88.0	86.0	84.0	69.0	55.0	53.0	0.0	43.0	36.0	32.5	27.0	18.0
STANDARD DEVIA	0.0	2.4	1.6	1.7	2.5	3.1	3.1	3.2	5.9	8.6	8.5	20.6	8.5	8.0	8.5	9.2	9.8

MORRISON-KNUDSEN CORPORATION
Project WSS RAP
Feature D.C.
Item MATERIAL PROPERTIES
Contract No. 9840-827
Designed ND
Checked JSR
Sheet 51
File No.
Date 9/20/94
Date 4/12/94

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C
Item MATERIAL PROPERTIES

Contract No. 38410-827
Designed ND
Checked JSK

Sheet 52
File No.
Date 9/20/91
Date 9/25/91

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
BASAL TILL																		
GT-52	SB-14						98.0	96.0	91.0	81.0	74.0		68.0	60.0	50.0	43.0	35.0	34.0
GT-60P	SB-15			96.5	93.0	89.0	87.0	85.0	84.2	80.0	76.5	69.5	66.5	52.5	36.0	29.5	25.0	23.0
	SS-16		89.5	81.5	67.5	54.0	46.0	40.0	36.0	33.0	30.0							
	SB-17			91.5	78.0	60.0	46.0	37.5	32.0	29.5	28.0							
GT-61	SB-18			78.0	63.0	48.0	39.8	35.0	32.8	31.8	30.2							
GT-62	SB-13																	
GT-68	SB-13		100.0	99.0	99.0	98.0	98.0	97.0	97.0	96.0	95.0			59.0	49.0	38.0	33.0	30.0

NUMBER OF POINTS	2.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	1.0	2.0	3.0	3.0	3.0	3.0	3.0
MEAN VALUES	94.8	89.3	80.1	69.8	69.1	65.1	62.2	58.6	55.6	69.5	67.3	57.2	45.0	36.8	31.0	29.0
MAXIMUM VALUES	100.0	99.0	99.0	98.0	98.0	97.0	97.0	96.0	95.0	69.5	68.0	60.0	50.0	43.0	35.0	34.0
MINIMUM VALUES	89.5	78.0	63.0	48.0	39.8	35.0	32.0	29.5	28.0	69.5	66.5	52.5	36.0	29.5	25.0	23.0
STANDARD DEVIATION	5.3	8.2	14.0	19.9	25.5	27.9	28.8	27.6	27.0	0.0	0.8	3.3	6.4	5.6	4.3	4.5

SUMMARY OF SIEVE ANALYSIS RESULTS
OVERALL AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
RESIDUUM																		
GT-43	SS-19		88.0	82.0	71.0	55.0	42.0	33.0	29.0	26.0	25.0							
GT-53	SS-15		95.0	86.0	78.0	71.0	66.0	62.0	58.0	55.0	53.0							
GT-56	SS-09			97.0	96.0	95.0	94.0	92.0	92.0	91.0	90.0							
GT-57	SB-11	82.0	64.0	50.0	45.0	42.0	39.0	37.0	36.0	35.0	35.0							
GT-58P	SB-11	65.0	57.0	53.8	50.5	47.5	45.5	43.5	42.0	41.0	40.0							
GT-62	SB-15			80.0	57.5	52.0	48.5	46.0	44.0	42.0	40.2							
GT-63P	SB-15	85.5	75.5	59.5	42.0	30.0	24.0	19.0	16.5	15.0								
GT-68	SB-15		100.0	94.0	91.0	89.0	88.0	87.0	86.0	85.0	84.0							
NUMBER OF POINT		3.0	6.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.0		0.0	0.0	0.0	0.0	0.0	0.0
MEAN VALUES		77.5	79.9	75.3	66.4	60.2	55.9	52.4	50.4	48.8	52.5		ERR	ERR	ERR	ERR	ERR	ERR
MAXIMUM VALUE		85.5	100.0	97.0	96.0	95.0	94.0	92.0	92.0	91.0	90.0		ERR	ERR	ERR	ERR	ERR	ERR
MINIMUM VALUES		65.0	57.0	50.0	42.0	30.0	24.0	19.0	16.5	15.0	25.0		ERR	ERR	ERR	ERR	ERR	ERR
STANDARD DEVIA		9.0	15.8	17.2	19.4	21.4	23.0	24.3	25.0	25.2	23.2		ERR	ERR	ERR	ERR	ERR	ERR

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 3840-927
Designed ND
Checked JSR

Sheet 53
File No.
Date 9/20/94
Date 9/25/94

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C
Item MATERIAL PROPERTIES

Contract No. 3840-827
Designed MD
Checked

Sheet 54
File No.
Date 9/26/01
Date

SUMMARY OF SIEVE ANALYSIS RESULTS
NORTHERN CHEMICAL PLANT AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
GT-47	ST-05							99.0	99.0	98.0	98.0		77.0	63.0	45.0	39.0	35.0	33.0
GT-53	ST-04								99.0	98.0	97.0		87.0	71.0	55.0	49.0	44.0	42.0
GT-55	ST-06									99.0	99.0		85.0	64.0	46.0	40.0	34.0	32.0
GT-58P	ST-03							99.8	99.2	96.8	94.2	89.5	86.0	72.0	55.0	48.0	43.8	41.8
GT-2T71	BU-01A								99.5	99.0	99.0	95.0	94.0	75.0	45.0	36.0	31.0	28.0
	BU-02A								99.5	98.0	97.0	94.0	90.0	72.0	54.0	47.0	43.0	39.0
GT-2T72	BU-01A						99.9	98.5	98.0	96.0	95.0	95.0	92.0	61.0	39.0	31.0	28.0	27.0
GT-2T75	BU-01A								99.8	98.0	99.0	98.0	94.0	80.0	47.0	37.0	30.0	29.0
	BU-02B						99.8	99.5	99.0	98.2	97.2	96.2	94.8	86.0	63.4	56.3	51.0	48.0
GT-2T78	BU-02B					99.8	99.0	98.0	98.0	97.8	97.0	95.0	94.0	77.0	59.0	54.0	50.0	47.0
GT-2T82	BU-01A					99.8	98.4	98.0	97.8	96.2	96.0	95.0	93.0	71.0	46.0	39.0	34.0	30.0
	BU-02A						99.6	99.4	98.8	98.1	97.0	95.8	94.0	79.0	65.5	59.5	55.3	53.0

NUMBER OF POINTS	2.0	5.0	7.0	11.0	12.0	12.0	9.0	12.0	12.0	12.0	12.0	12.0	12.0
MEAN VALUES	99.8	99.3	98.9	98.9	97.8	97.1	94.8	90.1	72.6	51.7	44.7	39.9	37.5
MAXIMUM VALUES	99.8	99.9	99.8	99.8	99.0	99.0	98.0	94.8	86.0	65.5	59.5	55.3	53.0
MINIMUM VALUES	99.8	98.4	98.0	97.8	96.0	94.2	89.5	77.0	61.0	39.0	31.0	28.0	27.0
STANDARD DEVIATION		0.6	0.7	0.6	0.9	1.5	2.2	5.2	7.1	7.9	8.6	8.7	8.5

SUMMARY OF SIEVE ANALYSIS RESULTS
SOUTHERN CHEMICAL PLANT AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
GT-31	ST-02							98.0	96.0	92.0	90.0		75.0	56.0	40.0	34.0	30.0	27.0
	ST-06							98.0	98.0	97.0	96.0		82.0	62.0	40.0	32.0	25.0	22.0
GT-32	ST-02						98.0	97.0	94.0	89.0	85.0		76.0	68.0	57.0	53.0	50.0	49.0
GT-34	SB-17							99.0	97.0	95.0	93.0		80.0	62.0	44.0	34.0	28.0	27.0
GT-37	ST-06						99.0	99.0	99.0	98.0	97.0		82.0	66.0	51.0	45.0	37.0	37.0
GT-39	SS-02									99.0	99.0		79.0	65.0	43.0	33.0	25.0	23.0
	ST-05							99.0	98.0	96.0	94.0		81.0	71.0	60.0	52.0	48.0	46.0
GT-48	ST-03							99.0	99.0	98.0	97.0		92.0	71.0	49.0	39.0	31.0	28.0
	ST-07								99.0	99.0	98.0		87.0	71.0	57.0	51.0	45.0	42.0
GT-51	ST-03								99.0	99.0	98.0		83.0	63.0	43.0	35.0	31.0	28.0
GT-63P	ST-01			94.8	94.0	92.8	92.0	90.8	88.3	87.5	87.0	72.5	70.0	51.0	38.0	31.2	26.2	23.0
GT-73	~~ST-06~~ 7306					100.0	99.0	98.0	94.0	88.0	84.0		74.0	66.0	57.0	51.0	46.0	42.0
GT-2T77	BU-01B						99.0	99.0	96.0	94.0	76.0	53.0	44.0	40.0	37.0			
	BU-02A							98.5	98.0	97.5	97.0	95.0	93.0	75.0	55.0	48.0	42.0	42.0
GT-2T80	BU-01A						99.0	98.0	97.5	96.5	96.0	95.0	92.0	68.0	41.0	34.0	28.0	27.0

NUMBER OF POINTS	1.0	1.0	2.0	6.0	12.0	14.0	15.0	15.0	4.0	15.0	15.0	15.0	14.0	14.0	14.0
MEAN VALUES	94.8	94.0	96.4	97.7	97.8	96.6	95.0	92.5	78.9	79.3	63.7	47.5	40.9	35.2	33.1
MAXIMUM VALUES	94.8	94.0	100.0	99.0	99.0	99.0	99.0	99.0	95.0	93.0	75.0	60.0	53.0	50.0	49.0
MINIMUM VALUES	94.8	94.0	92.8	92.0	90.8	88.3	87.5	76.0	53.0	44.0	40.0	37.0	31.2	25.0	22.0
STANDARD DEVIATION		0.0	3.6	2.6	2.2	2.8	3.9	6.5	17.5	11.5	8.7	7.8	8.3	8.9	9.1

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 340-827
Designed AD
Checked JSR

Sheet 55
File No.
Date 9/23/91
Date 9/25/91

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 3840 827
Designed ND
Checked JSR

Sheet 56
File No.
Date 9/20/91
Date 9/25/91

SUMMARY OF SIEVE ANALYSIS RESULTS
TEMPORARY ~~STAGING~~ STORAGE AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
GTS-1	ST-03					99.6	99.2	98.6	98.0	97.7	97.2	76.0	75.0	58.0	36.2	28.3	22.4	18.5
GTS-2	ST-02/ST-04					99.7	99.6	99.0	98.5	97.9	97.0	92.5	88.7	77.0	46.2	38.2	32.3	32.0
GTS-3	ST-02			98.7	98.7	98.7	98.2	97.7	97.0	96.7	95.8	79.0	75.0	66.8	42.2	39.7	34.8	32.0
GTS-4	ST-02		92.8	92.5	92.1	91.8	91.3	90.5	89.5	88.8	88.0	71.3	70.0	50.8	34.2	28.3	23.3	23.0
	ST-04					99.3	98.8	98.0	97.3	96.2	94.8	77.0	71.0	53.0	38.0	31.5	26.2	23.5
GTS-6	BULK						99.9	99.8	99.5	99.2	99.0	88.5	83.5	64.0	46.3	47.7	32.2	29.0

NUMBER OF POINTS	1.0	2.0	2.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
MEAN VALUES	92.8	95.6	95.4	97.8	97.8	97.3	96.6	96.1	95.3	80.7	77.2	61.6	40.5	35.6	28.5	26.3
MAXIMUM VALUES	92.8	98.7	98.7	99.7	99.9	99.8	99.5	99.2	99.0	92.5	88.7	77.0	46.3	47.7	34.8	32.0
MINIMUM VALUES	92.8	92.5	92.1	91.8	91.3	90.5	89.5	88.8	88.0	71.3	70.0	50.8	34.2	28.3	22.4	18.5
STANDARD DEVIATION	0.0	3.1	3.3	3.0	3.0	3.1	3.3	3.4	3.5	7.4	6.7	8.9	4.7	7.0	4.8	5.0

MORRISON-KNUDSEN CORPORATION

Project INSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 840-827
Designed NLD
Checked JSR

Sheet 57
File No.
Date 9/20/91
Date 9/25/91

SUMMARY OF SIEVE ANALYSIS RESULTS
MATERIALS STAGING AREA

Borehole Number	Sample Number	1 1/2" 38.100 mm	3/4" 19.050 mm	3/8" 9.525 mm	#4 4.750 mm	#8 2.360 mm	#16 1.180 mm	#30 0.600 mm	#50 0.300 mm	#100 0.150 mm	#200 0.074 mm	0.050 mm	0.037 mm	0.019 mm	0.009 mm	0.005 mm	0.002 mm	0.001 mm
GT-70	~~ST-04~~ 7004						100.0	99.0	98.0	94.0	93.0		72.0	60.0	45.0	35.0	30.0	27.0
GT-2T79	BU-01A							99.8	99.0	98.0	98.0	96.0	94.0	83.0	52.0	41.0	34.0	32.0
	BU-02A						99.9	99.3	98.8	97.9	97.0	96.0	94.3	79.0	62.5	58.2	53.8	51.3
TPMS-1	BU-01						99.8	99.0	97.8	95.8	93.5	92.0	90.2	66.5	44.0	40.0	35.0	31.0
TPMS-2	BU-02						99.5	98.5	95.0	88.0	80.3	79.5	79.0	70.5	62.0	55.5	50.0	47.0
TPMS-3	BU-01						95.0	93.0	89.0	86.5	84.3	83.5	82.5	66.0	44.0	38.3	33.0	30.0
TPMS-4	BU-02						98.2	97.0	95.5	91.5	86.0	85.5	84.5	79.0	66.5	62.2	58.0	56.0
TPMS-5	BU-02							99.8	99.5	98.5	97.5	96.5	94.0	77.0	64.0	56.2	54.0	49.0
TPMS-6	BU-02							99.9	99.0	98.8	96.0	94.5	92.0	76.0	65.0	60.5	58.0	55.0
TPMS-7	BU-02						99.8	99.0	98.2	97.5	96.5	96.0	94.0	80.5	66.2	60.5	56.0	54.0
TPMS-8	BU-02						99.9	99.2	98.5	97.0	94.0	84.0	82.0	71.0	58.0	53.0	49.0	43.0
TPMS-9	BU-02						99.9	99.5	98.5	97.0	95.0	85.0	81.0	67.0	57.0	53.5	50.0	48.0

NUMBER OF POINTS	9.0	12.0	12.0	12.0	12.0	11.0	12.0	12.0	12.0	12.0	12.0	12.0
MEAN VALUES	99.1	98.6	97.2	95.0	92.6	89.9	86.6	73.0	57.2	51.2	46.7	43.6
MAXIMUM VALUES	100.0	99.9	99.5	98.8	98.0	96.5	94.3	83.0	66.5	62.2	58.0	56.0
MINIMUM VALUES	95.0	93.0	89.0	86.5	80.3	79.5	72.0	60.0	44.0	35.0	30.0	27.0
STANDARD DEVIATION	1.5	1.8	2.8	4.0	5.6	6.1	7.1	6.8	8.4	9.4	10.2	10.3

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 3840-827
Designed ND
Checked JSR

Sheet 58
File No.
Date 9/20/91
Date 9/25/91

SUMMARY OF SIEVE ANALYSIS RESULTS
POTENTIAL BORROW SOURCE

Borehole Number	Sample Number	1 1/2" 38.100	3/4" 19.050	3/8" 9.525	#4 4.750	#8 2.360	#16 1.180	#30 0.600	#50 0.300	#100 0.150	#200 0.074	0.050	0.037	0.019	0.009	0.005	0.002	0.001
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
TPBS-1	2A				100.0	100.0	99.5	98.0	96.0	93.5	91.0	88.0	85.0	61.0	38.0	31.0	24.0	21.0
	3A				98.5	97.2	96.0	94.1	92.0	89.8	86.0	84.0	82.0	71.0	61.0	57.0	51.0	49.0
	4A				99.9	99.0	97.9	94.0	85.0	72.5	62.0	61.0	59.0	48.0	38.0	35.0	30.0	20.0
TPBS-6	1A				100.0	99.9	99.4	98.7	98.0	97.8	97.0	96.0	92.0	70.0	48.0	39.0	33.0	31.0
TPBS-8	1A				100.0	99.9	99.9	99.5	99.0	98.7	98.0	95.0	92.0	73.0	42.0	31.0	22.0	21.0
	2A				100.0	99.5	99.0	98.5	98.0	98.0	97.5	96.0	96.0	68.0	41.0	31.0	24.0	18.0
	3A				100.0	100.0	99.9	99.1	98.8	98.1	98.0	95.0	92.0	75.0	59.0	51.0	46.0	45.0
TPBS-10	2A				100.0	100.0	100.0	99.5	99.0	98.0	96.5	95.0	94.0	71.0	54.0	48.0	43.0	42.0
	3A				100.0	100.0	99.9	99.2	98.1	97.0	95.0	93.0	89.0	73.0	60.0	55.0	51.0	51.0
TPBS-11	1A				100.0	100.0	99.8	99.1	99.0	97.5	97.0	94.0	92.0	69.0	42.0	32.0	26.0	24.0
	2A				100.0	100.0	99.5	99.0	98.5	97.5	96.5	95.0	93.0	76.0	67.0	62.0	57.0	56.0
TPBS-14	2A				100.0	100.0	100.0	99.9	99.0	98.7	98.0	96.0	88.0	69.0	44.0	74.0	28.0	28.0
	3A					100.0	100.0	99.5	99.0	98.5	97.5	96.0	92.0	72.0	57.0	50.0	45.0	41.0
TPBS-15	1A				100.0	100.0	100.0	99.9	99.0	98.0	97.0	96.0	87.0	67.0	43.0	34.0	26.0	25.0
	2A				98.0	97.0	96.0	95.5	95.0	94.0	93.0	92.0	88.0	73.0	60.0	55.0	51.0	50.0

NUMBER OF POINTS	14.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
MEAN VALUES	99.7	99.5	99.1	98.2	96.9	95.2	93.3	91.5	88.1	69.1	50.3	45.7	37.1	34.8
MAXIMUM VALUES	100.0	100.0	100.0	99.9	99.0	98.7	98.0	96.0	96.0	76.0	67.0	74.0	57.0	56.0
MINIMUM VALUES	98.0	97.0	96.0	94.0	85.0	72.5	62.0	61.0	59.0	48.0	38.0	31.0	22.0	18.0
STANDARD DEVIATION	0.6	1.0	1.3	1.9	3.7	6.5	9.0	8.8	8.5	6.6	9.5	13.0	11.9	12.9

C) SHEAR STRENGTH

Both Unconsolidation-undrained (UU) tests and consolidation-undrained (CU) tests with pore pressure measurement were performed on the site soils. UU tests were performed on all the site soil types except residuum, and CU tests on all except basal till. Effective stress parameters ($\bar{C}$, $\bar{\phi}$; for long-term static condition) & total stress parameters (C & ϕ; for long-term seismic condition) are obtained for each soil type (see sh. 4560). Undrained shear strength, S_u for design at short-term conditions for each soil type is represented by the average of all the UU test values available for that soil type, (see sh. 64-64 95-97). Since no UU tests were available for residuum, it is assumed that it has the same value as basal till. C-ϕ and $\bar{C}$-$\bar{\phi}$ parameters for basal till are assumed to be the same as those for clay till.

The data for each shear test is in Appendix A. Note that for CU test, $\left(\frac{\bar{\sigma}_1}{\bar{\sigma}_3}\right)_{max}$ is reached before $(\bar{\sigma}_1 - \bar{\sigma}_3)_{max}$, indicating that the soil is overconsolidated. (Ref. 7). Failure is defined as $(\bar{\sigma}_1/\bar{\sigma}_3)_{max}$. For UU test, $(\sigma_1 - \sigma_3)_{max}$ is taken as the failure criteria.

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840-827
Designed ND
Checked JSR

Sheet 61
File No.
Date 9/17/91
Date 9/02/91

SUMMARY OF CONSOLIDATED UNDRAINED TESTS REMOLDED SAMPLES

Hole or Trench #	Sample Number	STRENGTH PARAMETERS: TOTAL PARAMETERS c (psf)	TOTAL PARAMETERS ø (°)	EFFECTIVE PARAMETERS c' (psf)	EFFECTIVE PARAMETERS ø' (°)
Loess					
GT-2T74	BU-01A	820.00	13.00	290.00	29.00
Ferrelview Clay					
GT-2T71	BU-01A			0.00	14.00
GT-2T75	BU-02B	310.00	13.00	0.00	21.00
GT-2T77	BU-01B	335.00	14.00	270.00	23.00
Mean Values		322.50	13.50	90.00	19.33
Overall Avg.		488	13.3	140	22.
σ		258	0.6	162	6

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3890-227
Designed ND
Checked JSR

Sheet
File No.
Date 9/17/91
Date 9/24/91

SUMMARY OF CONSOLIDATED UNDRAINED TESTS POTENTIAL BORROW SOURCE NO. 1

Hole or Trench #	Sample Number	STRENGTH PARAMETERS			
		TOTAL PARAMETERS		EFFECTIVE PARAMETERS	
		C (psf)	ϕ (°)	C' (psf)	ϕ' (°)
TPBS-1	2A	1040.00	16.00	1160.00	21.00
	3A	170.00	17.00	170.00	23.00
TPBS-6	1A	590.00	19.00	490.00	26.00
	2A	390.00	10.00	270.00	18.00
TPBS-8	1A	630.00	19.00	195.00	35.00
	3A	445.00	9.00	510.00	10.00
Mean Values		544.17	15.00	465.83	22.17
σ		292.2	4.4	367.5	8.3

CONSOLIDATED UNDRAINED TESTS

Hole or Trench #	Sample Number	Total Parameters σ_1 ksf	σ_3 ksf	$P=(\sigma_1+\sigma_3)/2$ ksf	$Q=(\sigma_1-\sigma_3)/2$ ksf	Effective Parameters σ_1' ksf	σ_3' ksf	$P'=(\sigma_1'+\sigma_3')/2$ ksf	$Q=(\sigma_1'-\sigma_3')/2$ ksf
Topsoil/Fill									
GT-74	7402	3.75	1.00	2.38	1.38	3.23	0.48	1.86	1.38
		6.88	3.00	4.94	1.94	5.43	1.56	3.50	1.93
		10.55	5.00	7.78	2.78	8.23	2.68	5.46	2.78
GT-54	ST-03	3.03	0.99	2.01	1.02	2.59	0.55	1.57	1.02
		6.63	3.00	4.81	1.82	5.13	1.50	3.31	1.82
		12.73	6.01	9.37	3.36	10.26	3.54	6.90	3.36
Loess									
GT-32	ST-01	2.72	0.50	1.61	1.11	2.46	0.25	1.35	1.11
		4.74	0.99	2.87	1.87	4.39	0.65	2.52	1.87
		9.25	3.00	6.12	3.13	7.60	1.35	4.48	3.13
GT-56	ST-02	3.50	0.99	2.25	1.25	3.31	0.81	2.06	1.25
		8.30	3.00	5.65	2.65	7.54	2.23	4.88	2.65
		15.96	6.01	10.98	4.98	14.29	4.33	9.31	4.98
GT-2T74	BU-01A	3.50	1.00	2.25	1.25	3.26	0.76	2.01	1.25
		7.06	3.00	5.03	2.03	5.54	1.46	3.50	2.04
		11.52	6.00	8.76	2.76	7.80	2.28	5.04	2.76
Ferrelview Clay									
GT-32	ST-02	2.58	0.99	1.79	0.80	2.43	0.84	1.63	0.80
		3.42	2.00	2.71	0.71	3.03	1.61	2.32	0.71
		6.67	4.00	5.33	1.33	4.58	1.92	3.25	1.33
GT-43	ST-04	2.37	0.99	1.68	0.69	2.15	0.78	1.46	0.69
		5.51	3.00	4.25	1.26	4.95	2.43	3.69	1.26
		9.38	6.01	7.69	1.69	8.04	4.67	6.36	1.69
GT-48	ST-05	2.82	0.99	1.90	0.91	2.38	0.56	1.47	0.91
		6.72	3.00	4.86	1.86	5.52	1.80	3.66	1.86
		10.36	6.01	8.18	2.18	8.23	3.87	6.05	2.18
GT-52	ST-06	2.16	0.99	1.58	0.58	1.94	0.78	1.36	0.58
		6.17	3.00	4.58	1.59	5.21	2.03	3.62	1.59
		10.98	6.01	8.49	2.49	8.93	3.96	6.45	2.49
GT-70	7004	5.23	2.00	3.62	1.62	4.25	1.02	2.64	1.62
		10.74	5.00	7.87	2.87	8.89	3.15	6.02	2.87
		18.98	10.00	14.49	4.49	15.63	6.65	11.14	4.49
GT-2T71	BU-01A	10.92	10.00	10.46	0.46	2.46	1.46	1.96	0.50
		11.32	10.00	10.66	0.66	3.72	2.30	3.01	0.71
		9.82	7.92	8.87	0.95	4.76	2.84	3.80	0.96

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840-27 Sheet 64
Designed ND File No.
Checked JSR Date 9/12/91 Date 9/16/91

CONSOLIDATED UNDRAINED TESTS

Hole or Trench #	Sample Number	Total Parameters σ_1 ksf	σ_3 ksf	$P=(\sigma_1+\sigma_3)/2$ ksf	$Q=(\sigma_1-\sigma_3)/2$ ksf	Effective Parameters σ_1' ksf	σ_3' ksf	$P=(\sigma_1'+\sigma_3')/2$ ksf	$Q=(\sigma_1'-\sigma_3')/2$ ksf
GT-2T75	BU-02B	2.24	1.00	1.62	0.62	2.36	1.12	1.74	0.62
		6.10	3.00	4.55	1.55	5.72	2.62	4.17	1.55
		10.44	6.00	8.22	2.22	8.36	3.92	6.14	2.22
GT-2T77	BU-01B	2.34	1.00	1.67	0.67	1.92	0.56	1.24	0.68
		6.16	3.00	4.58	1.58	4.88	1.70	3.29	1.59
		10.70	6.00	8.35	2.35	7.92	3.22	5.57	2.35
Clay Till									
GT-44	ST-03	1.81	0.50	1.16	0.66	1.58	0.27	0.93	0.65
		3.12	0.99	2.05	1.06	2.76	0.63	1.69	1.06
		5.51	2.00	3.76	1.76	4.72	1.21	2.97	1.76
GT-71	7108	5.47	2.00	3.74	1.74	4.46	0.99	2.73	1.74
		11.49	5.00	8.25	3.25	9.45	2.96	6.21	3.25
		20.33	10.00	15.17	5.17	16.99	6.66	11.83	5.17
GT-74	7406	2.71	1.00	1.86	0.86	2.16	0.45	1.31	0.86
		7.00	3.00	5.00	2.00	5.90	1.90	3.90	2.00
		11.60	5.00	8.30	3.30	9.24	2.64	5.94	3.30
Basal Till									
GT-60P	SB-15	10.50	4.00	7.25	3.25	8.68	2.18	5.43	3.25
		16.52	7.00	11.76	4.76	12.86	3.34	8.10	4.76
GT-69	6908	7.17	2.00	4.59	2.59	6.07	0.91	3.49	2.58
		13.91	5.00	9.46	4.46	11.54	2.64	7.09	4.45
		23.16	10.00	16.58	6.58	19.07	5.90	12.49	6.59
GT-71	7110	5.48	2.00	3.74	1.74	4.91	1.42	3.17	1.75
		14.35	5.00	9.68	4.68	11.81	2.46	7.14	4.68
		22.95	10.00	16.48	6.48	19.52	6.57	13.05	6.48
Residuum									
GT-55	SB-12	2.08	0.99	1.54	0.54	1.66	0.58	1.12	0.54
		5.31	3.00	4.15	1.16	4.41	2.10	3.26	1.16
		10.14	6.01	8.07	2.07	8.73	4.59	6.66	2.07

Note : Q calculated using Total & Effective Stresses are sometimes not equal due to rounding off effects.

CONSOLIDATED UNDRAINED TESTS

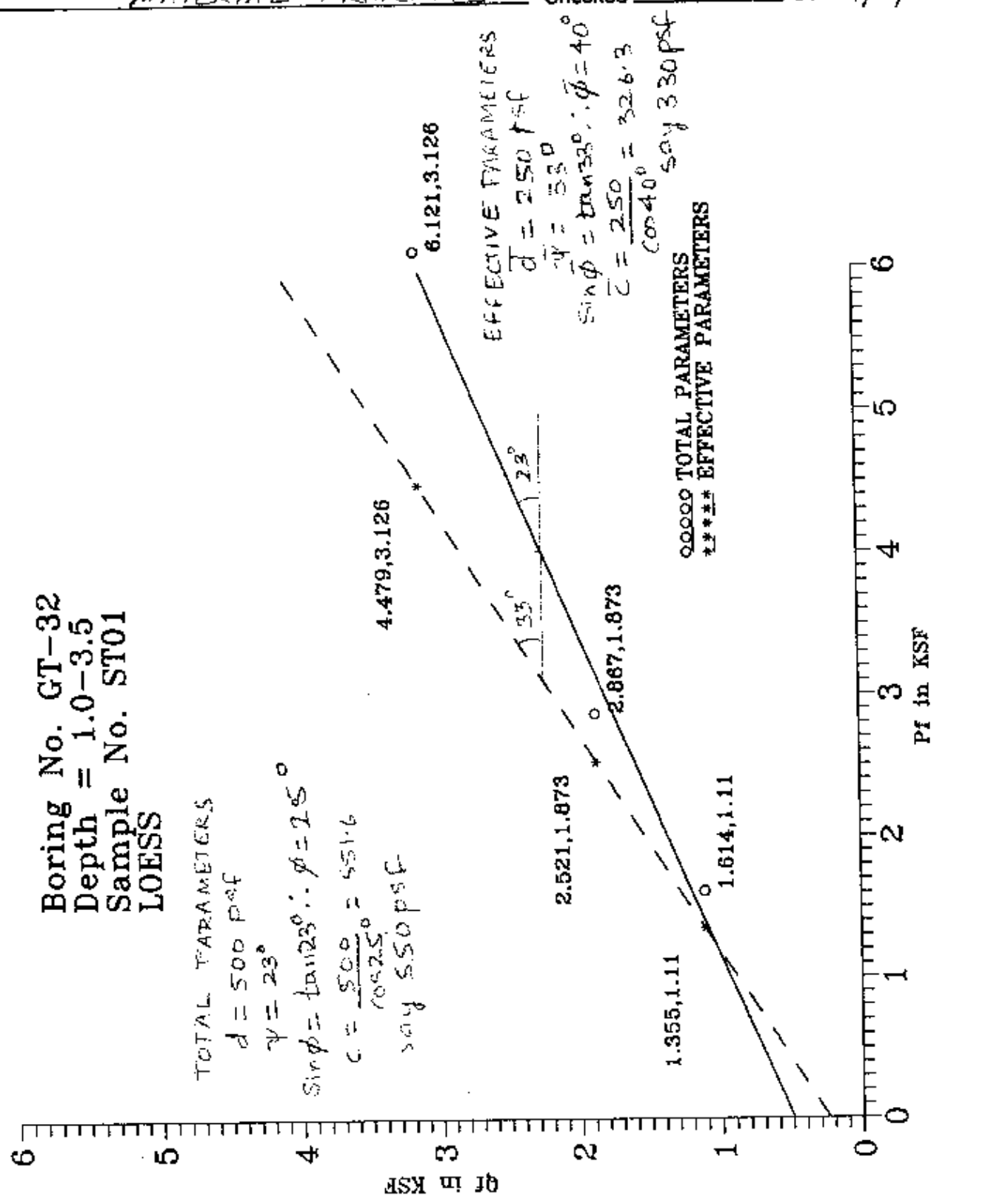
Hole or Trench #	Sample Number	Total Parameters σ_1 ksf	σ_3 ksf	P= $(\sigma_1+\sigma_3)/2$ ksf	Q= $(\sigma_1-\sigma_3)/2$ ksf	Effective Parameters σ_1' ksf	σ_3' ksf	P= $(\sigma_1'+\sigma_3')/2$ ksf	Q= $(\sigma_1'-\sigma_3')/2$ ksf
Potential Borrow Source									
TPBS-1	2A	4.98	1.00	2.99	1.99	3.80	-0.18	1.81	1.99
		7.14	3.00	5.07	2.07	5.64	1.48	3.56	2.08
		13.28	6.00	9.64	3.64	10.02	2.74	6.38	3.64
	3A	2.18	1.00	1.59	0.59	1.82	0.64	1.23	0.59
		5.78	3.00	4.39	1.39	4.42	1.64	3.03	1.39
		11.14	6.00	8.57	2.57	8.74	3.62	6.18	2.56
TPBS-6	1A	4.00	1.00	2.50	1.50	3.84	0.84	2.34	1.50
		6.90	3.00	4.95	1.95	5.30	1.38	3.34	1.96
		13.60	6.00	9.80	3.80	11.18	3.58	7.38	3.80
	2A	2.54	1.00	1.77	0.77	2.16	0.62	1.39	0.77
		4.80	3.00	3.90	0.90	3.56	1.74	2.65	0.91
		9.50	6.00	7.75	1.75	6.50	2.98	4.74	1.76
TPBS-8	1A	3.42	1.00	2.21	1.21	2.98	0.54	1.76	1.22
		7.82	3.00	5.41	2.41	6.32	1.50	3.91	2.41
		13.06	6.00	9.53	3.53	9.20	2.12	5.66	3.54
	3A	2.36	1.00	1.68	0.68	2.00	0.64	1.32	0.68
		5.24	3.00	4.12	1.12	4.10	1.86	2.98	1.12
		9.24	6.00	7.62	1.62	7.96	4.72	6.34	1.62

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. SR4D
Designed ND
Checked JSR

Sheet 66
File No.
Date 9/6/91
Date 9/12/91

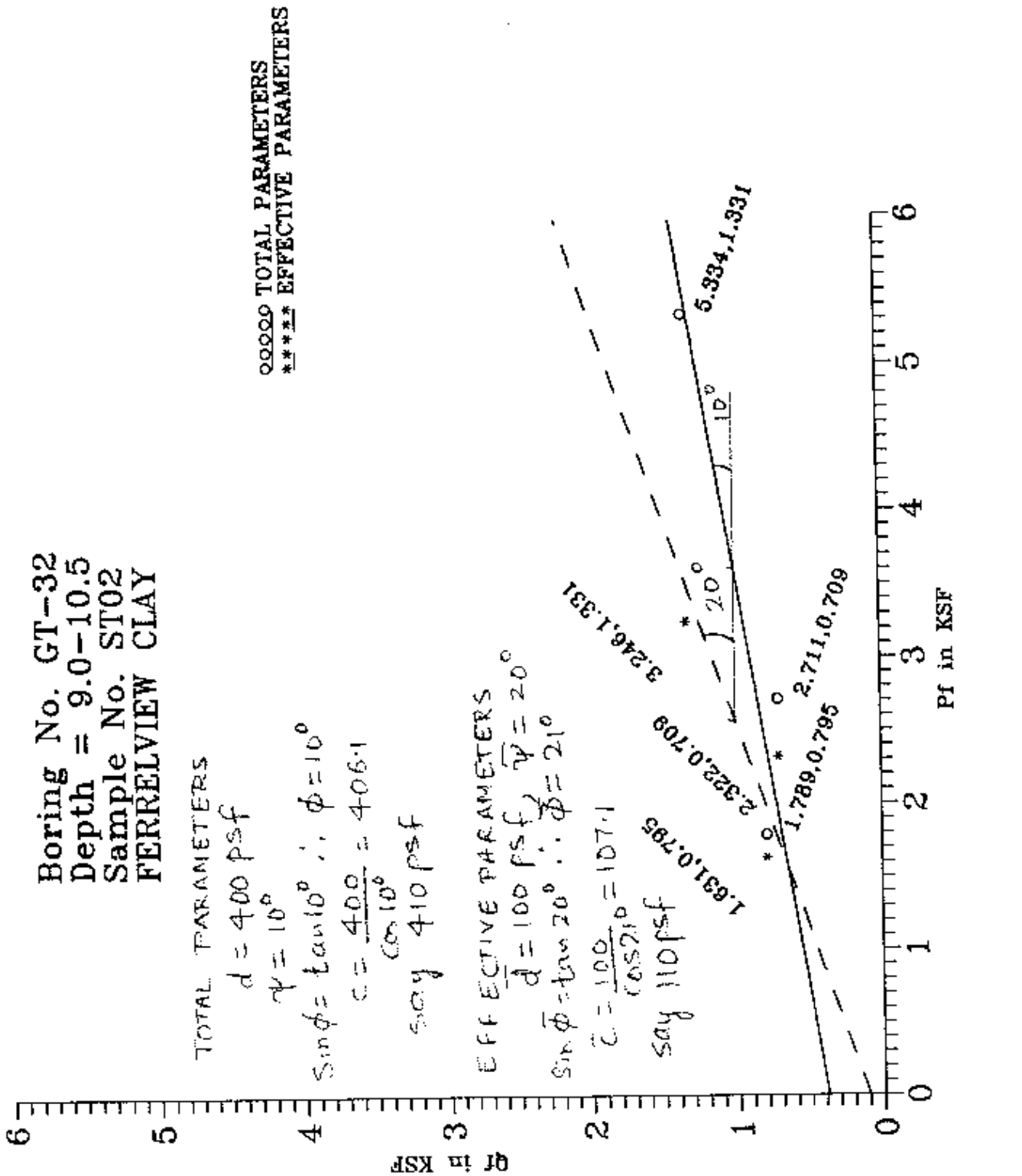


MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 67
File No.
Date 9/6/91
Date 9/17/91

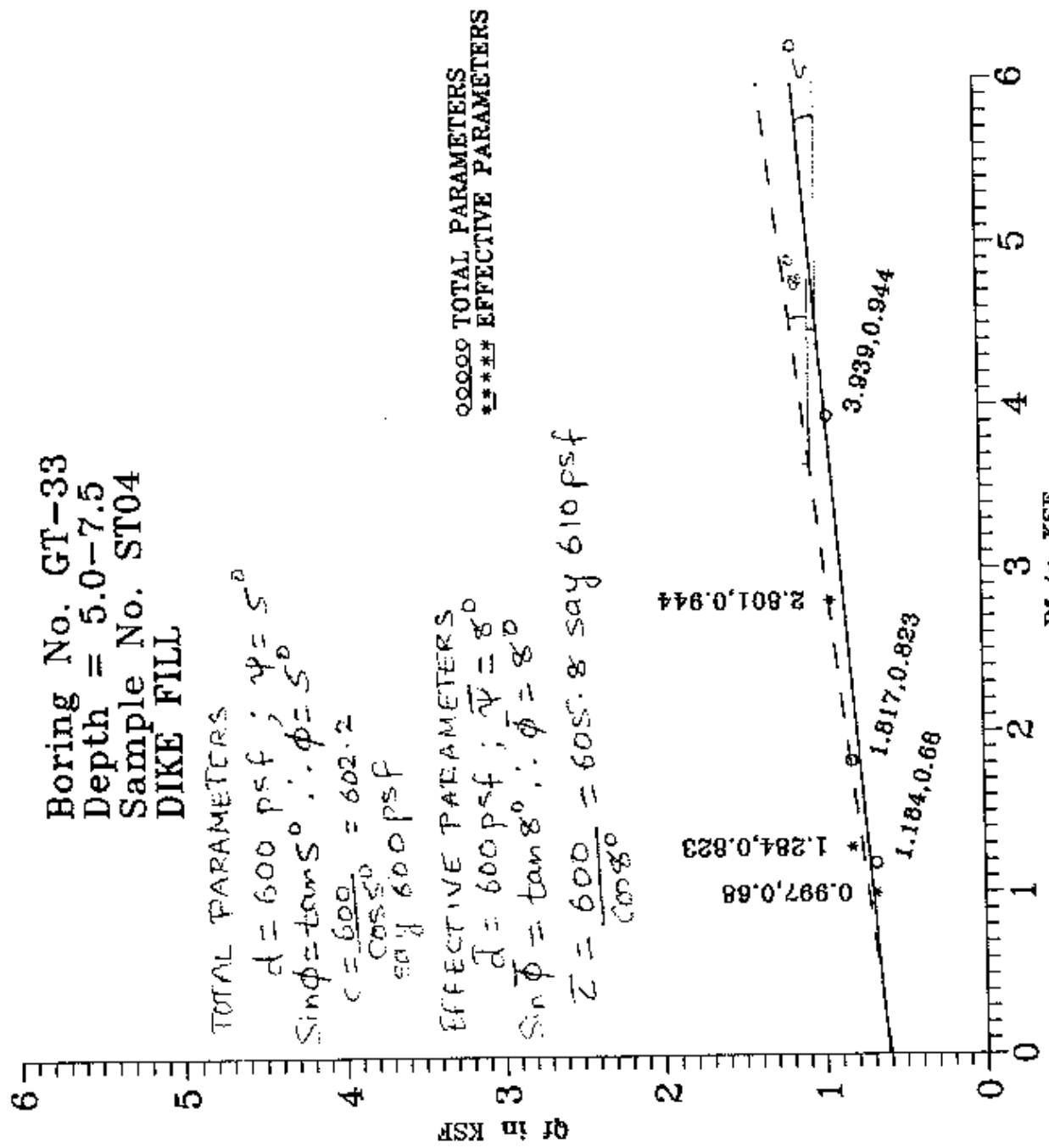


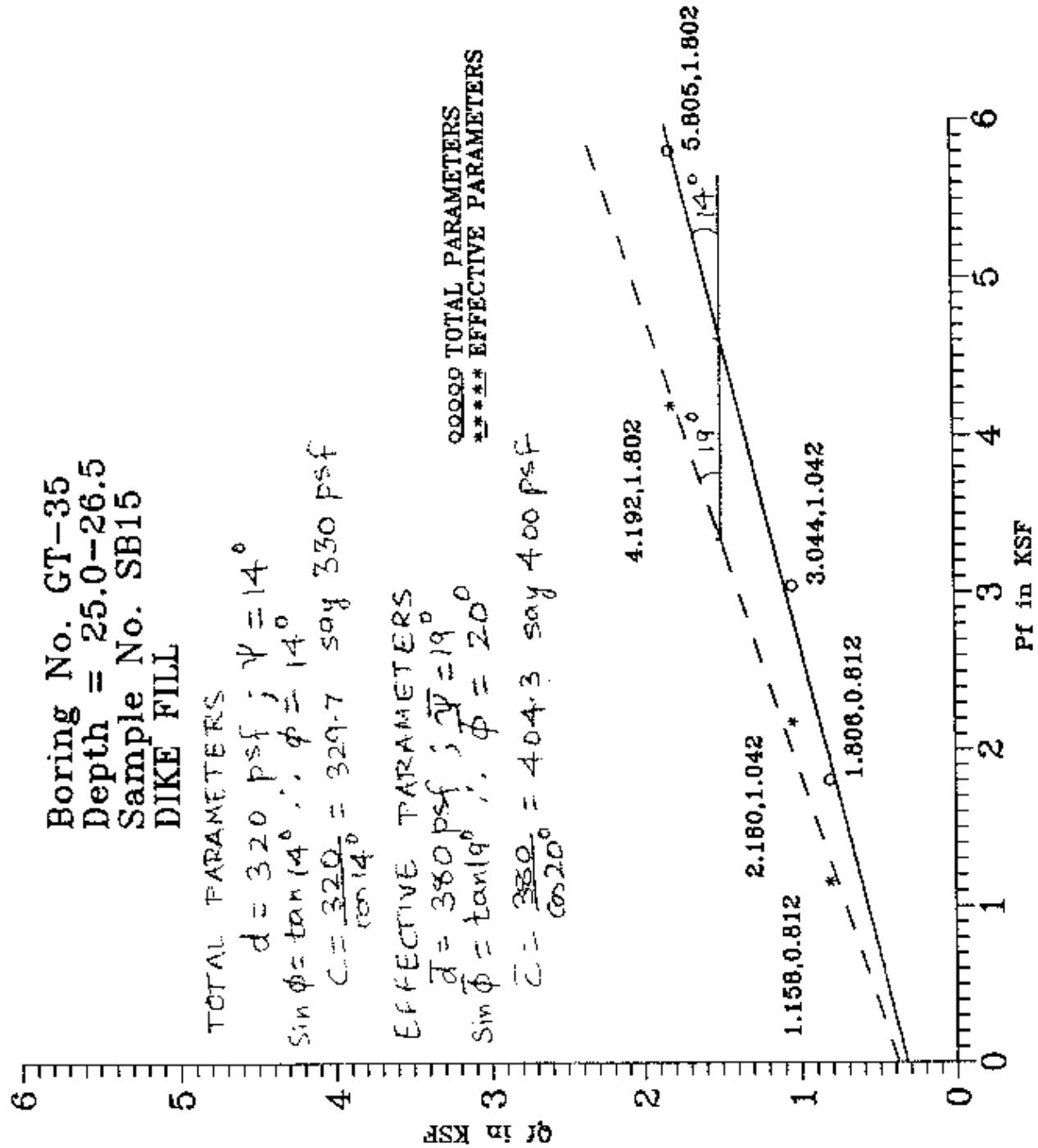
MORRISON-KNUDSEN CORPORATION

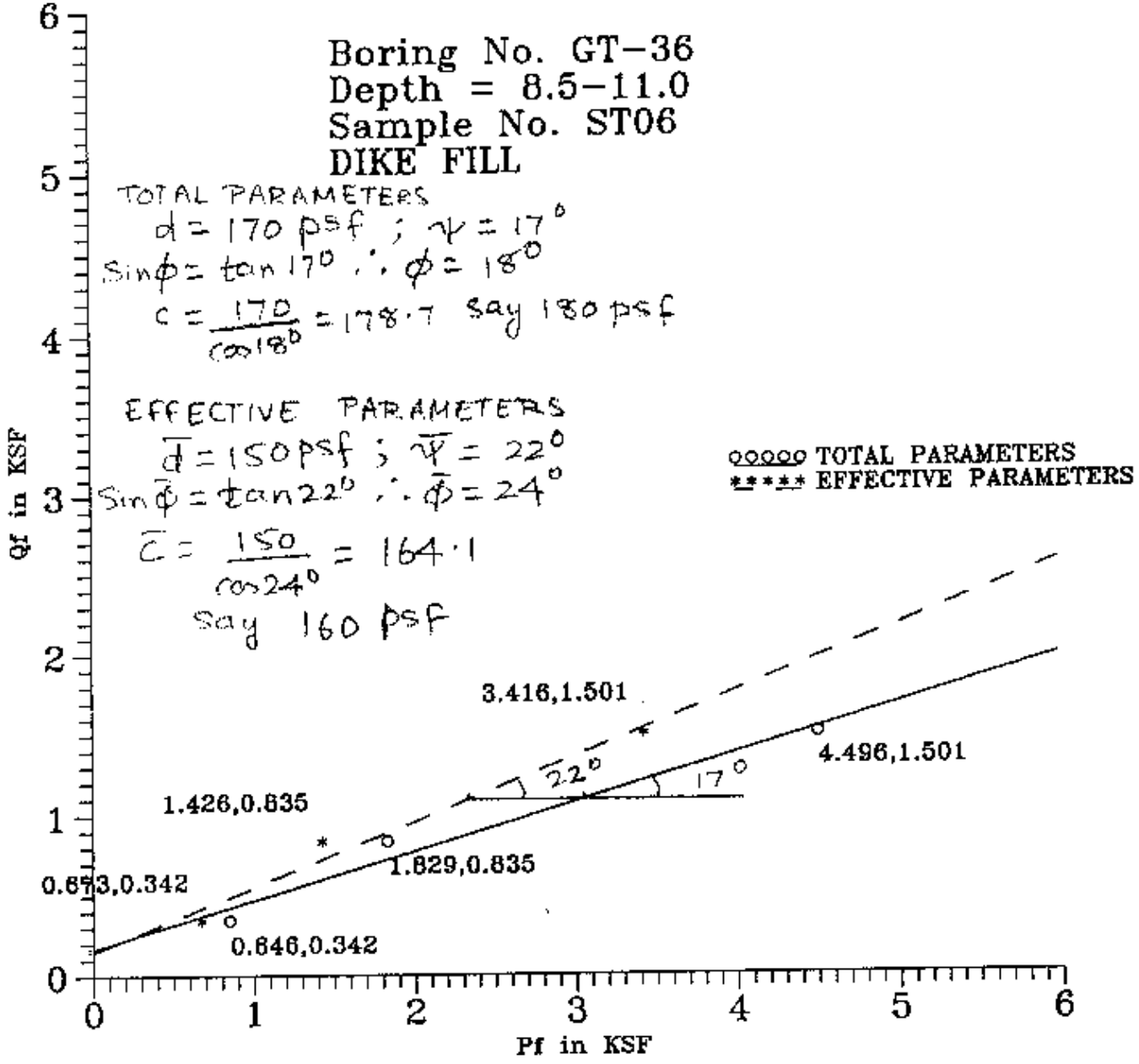
Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed MD
Checked JSR

Sheet 68
File No.
Date 9/16/91
Date 9/24/91



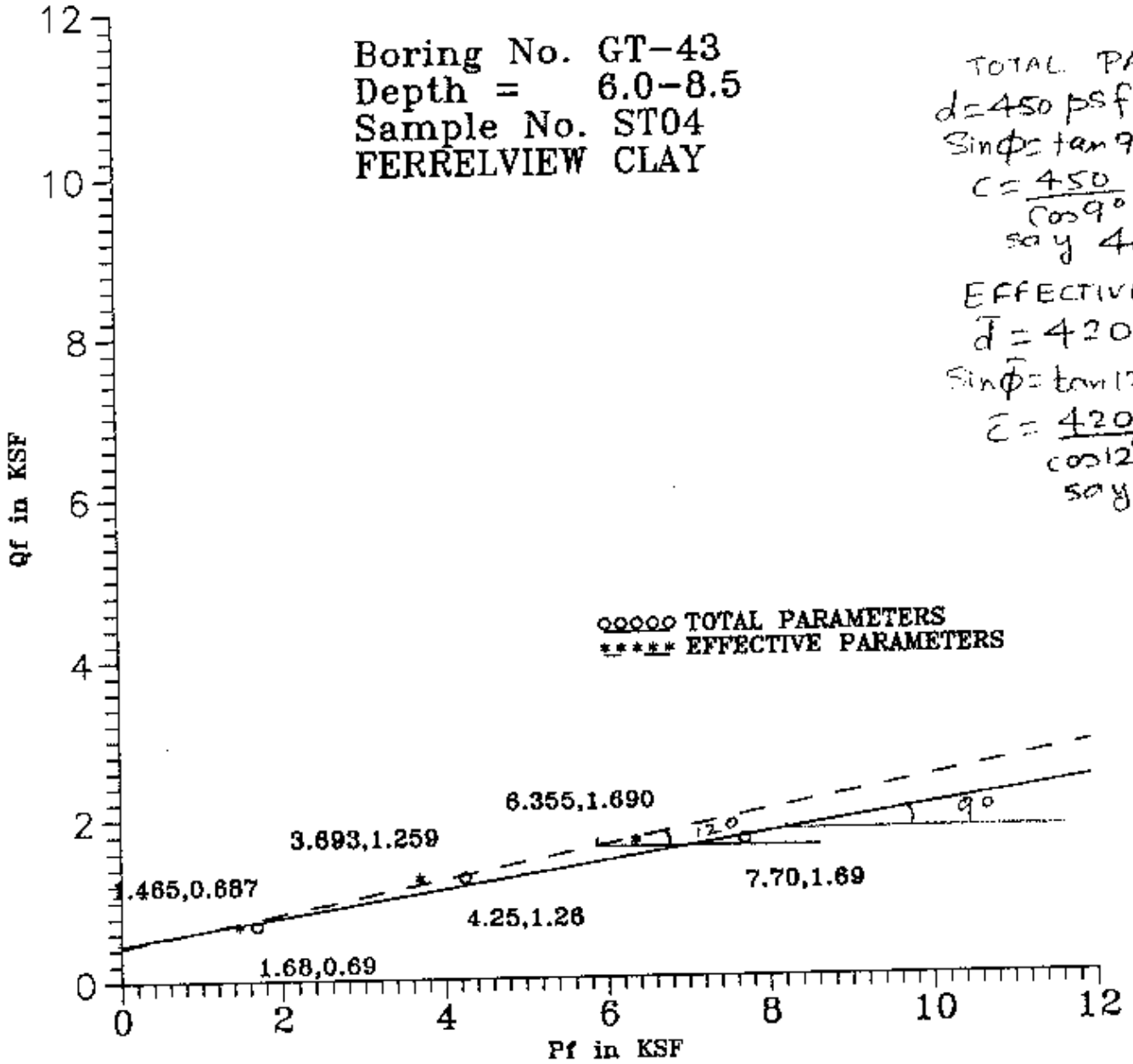

Boring No. GT-35
Depth = 25.0-26.5
Sample No. SB15
DIKE FILL
TOTAL PARAMETERS
$\phi = 320$ psf ; $\psi = 14°$
Sin ϕ = tan 14° ∴ $\phi = 14°$
$C = \frac{320}{\cos 14°} = 329.7$ say 330 psf
EFFECTIVE PARAMETERS
$\bar{\phi} = 380$ psf ; $\bar{\psi} = 19°$
Sin $\bar{\phi}$ = tan 19° ∴ $\bar{\phi} = 20°$
$\bar{C} = \frac{380}{\cos 20°} = 404.3$ say 400 psf
00000 TOTAL PARAMETERS
***** EFFECTIVE PARAMETERS
4.192,1.802
5.805,1.802
3.044,1.042
2.180,1.042
1.808,0.812
1.158,0.812
19°
14°
qr in KSF
Pf in KSF
0
1
2
3
4
5
6



MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed ND
Checked JSR
Sheet 70
File No.
Date 9/6/91
Date 9/24/91

Boring No. GT-43
Depth = 6.0-8.5
Sample No. ST04
FERRELVIEW CLAY



TOTAL PARAMETERS
$d = 450$ psf ; $\Psi = 9°$
$\sin\phi = \tan 9° \therefore \phi = 9°$
$c = \frac{450}{\cos 9°} = 455.6$
say 460 psf

EFFECTIVE PARAMETERS
$\bar{d} = 420$ psf ; $\bar{\Psi} = 12°$
$\sin\bar{\phi} = \tan 12° \therefore \bar{\phi} = 12°$
$\bar{c} = \frac{420}{\cos 12°} = 429.3$
say 430 psf

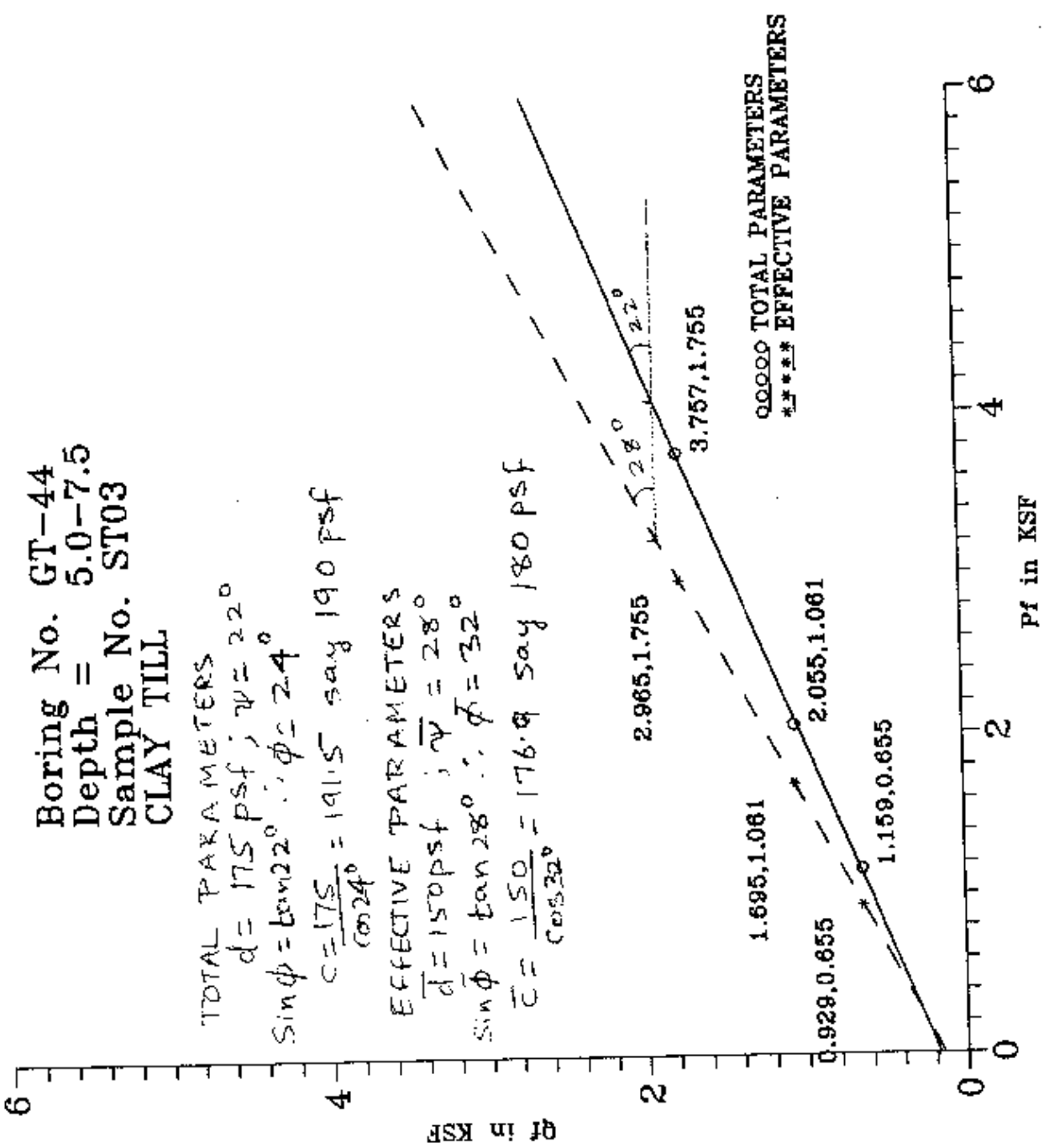
MORRISON-KNUDSEN CORPORATION
Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed ND
Checked JSR
Date 9/6/94
Date 9/9/94
Sheet 71
File No.

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 72
File No.
Date 9/6/91
Date 9/17/91



MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

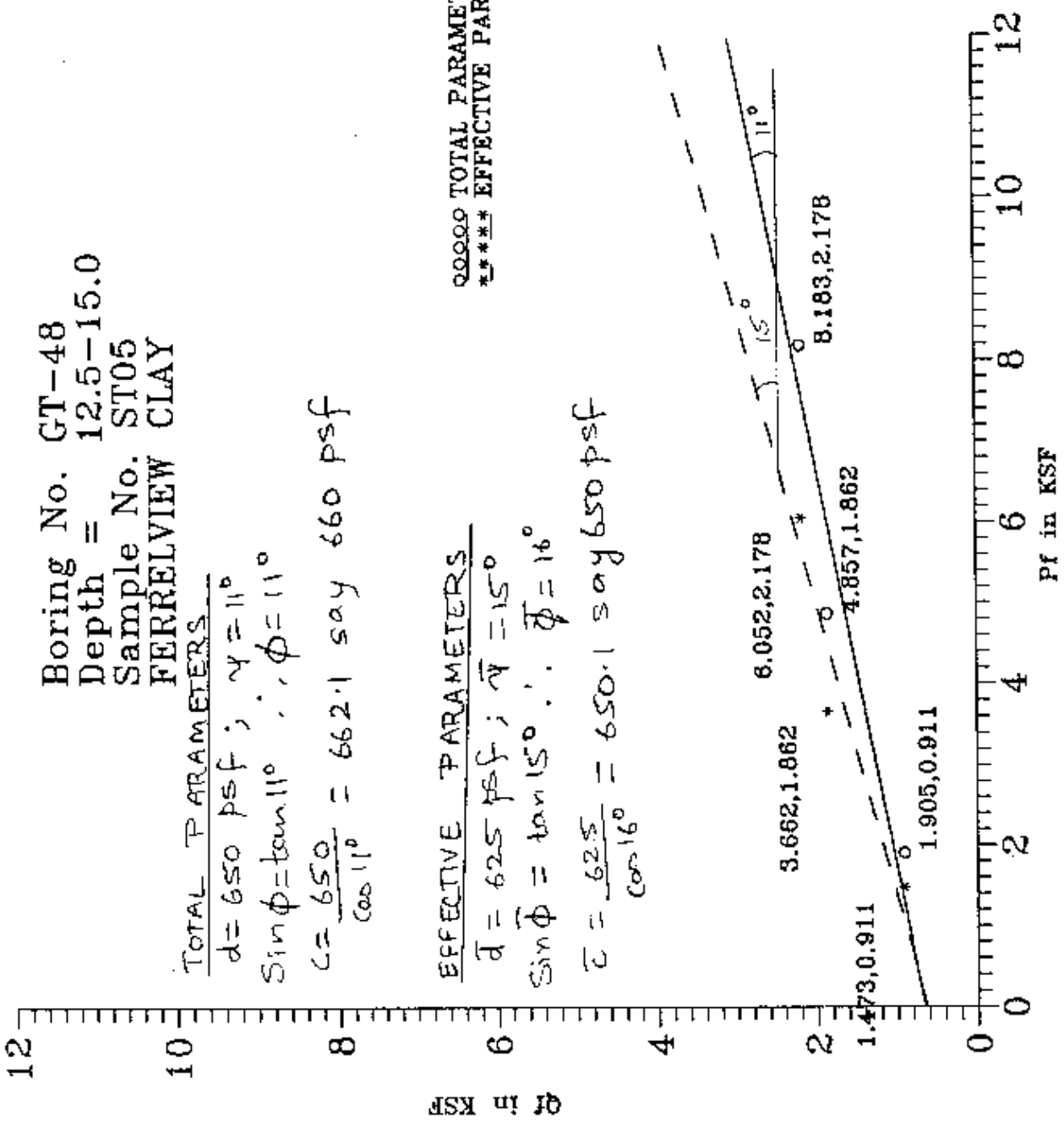
Contract No. 3840
Designed ND
Checked JSR

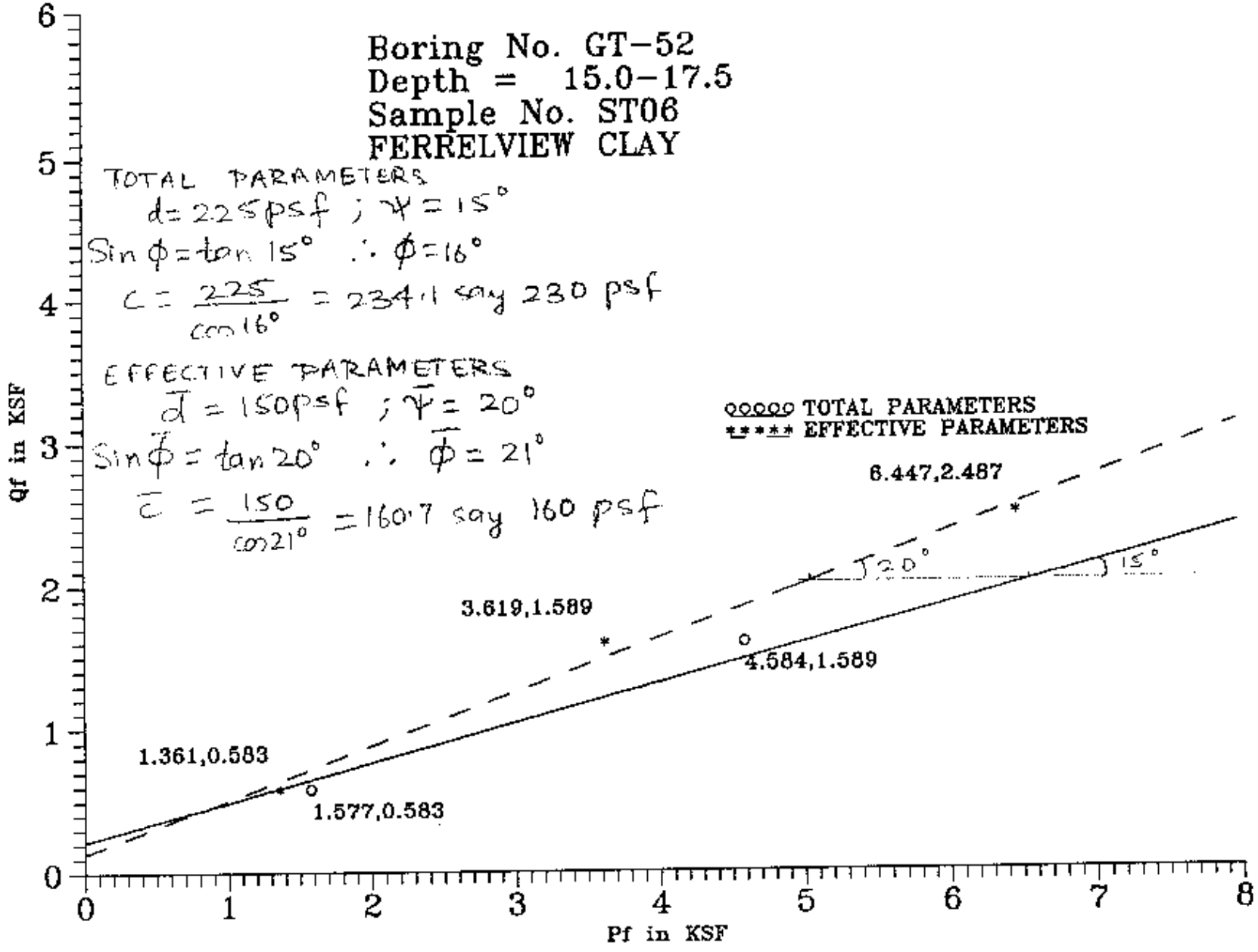
Sheet 73
File No.
Date 09/06/91
Date 9/17/91

Boring No. GT-48
Depth = 12.5-15.0
Sample No. ST05
FERRELVIEW CLAY

TOTAL PARAMETERS
$d = 650$ psf ; $\gamma = 11°$
$\sin\phi = \tan 11° \therefore \phi = 11°$
$c = \frac{650}{\cos 11°} = 662.1$ say 660 psf

EFFECTIVE PARAMETERS
$\bar{d} = 625$ psf ; $\bar{\gamma} = 15°$
$\sin\bar{\phi} = \tan 15° \therefore \bar{\phi} = 16°$
$\bar{c} = \frac{625}{\cos 16°} = 650.1$ say 650 psf



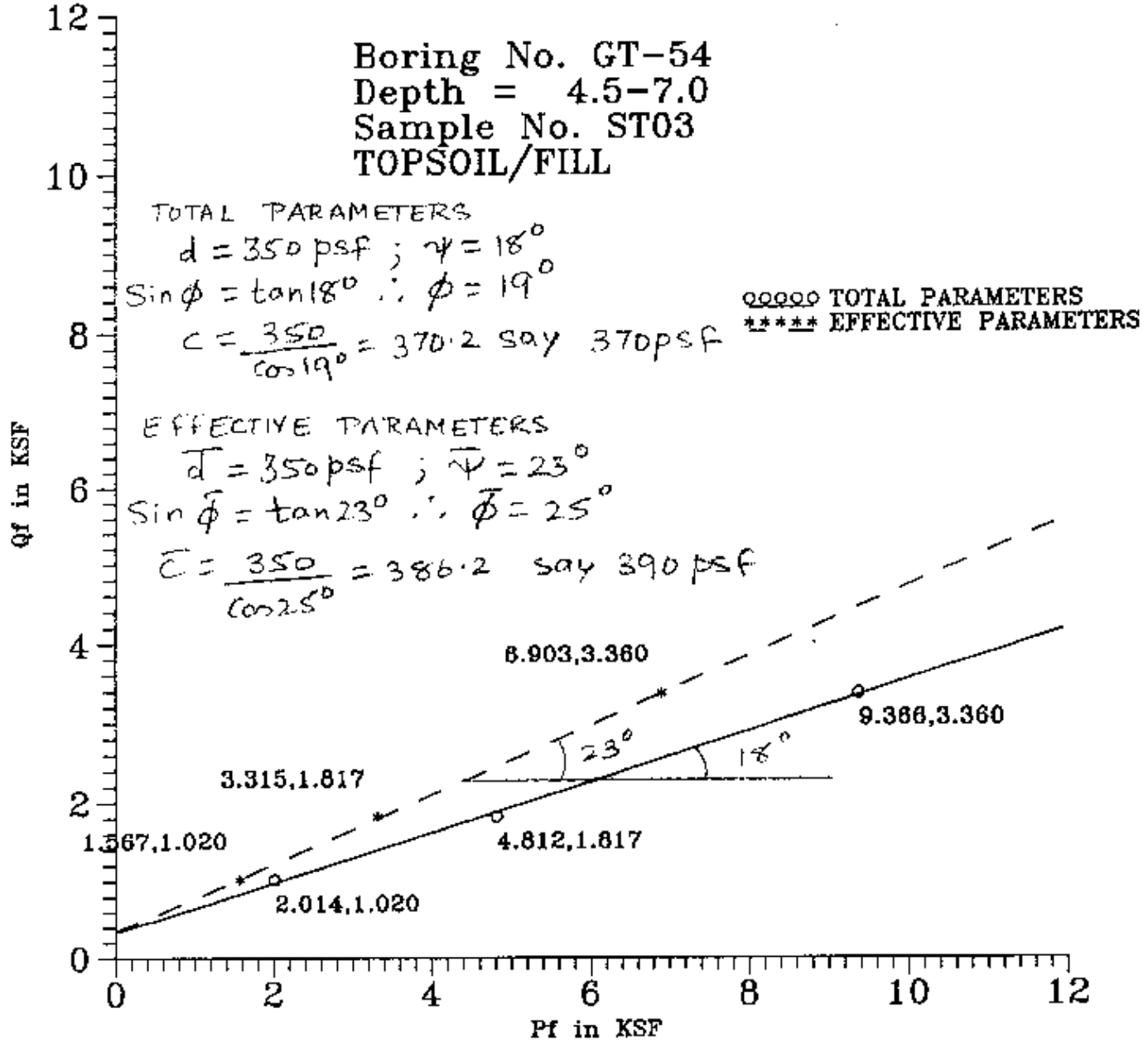


MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
8.492,2.4

Contract No. 3840
Designed ND
Checked JSR

Sheet 7
File No.
Date 9/6/91
Date 9/17/91

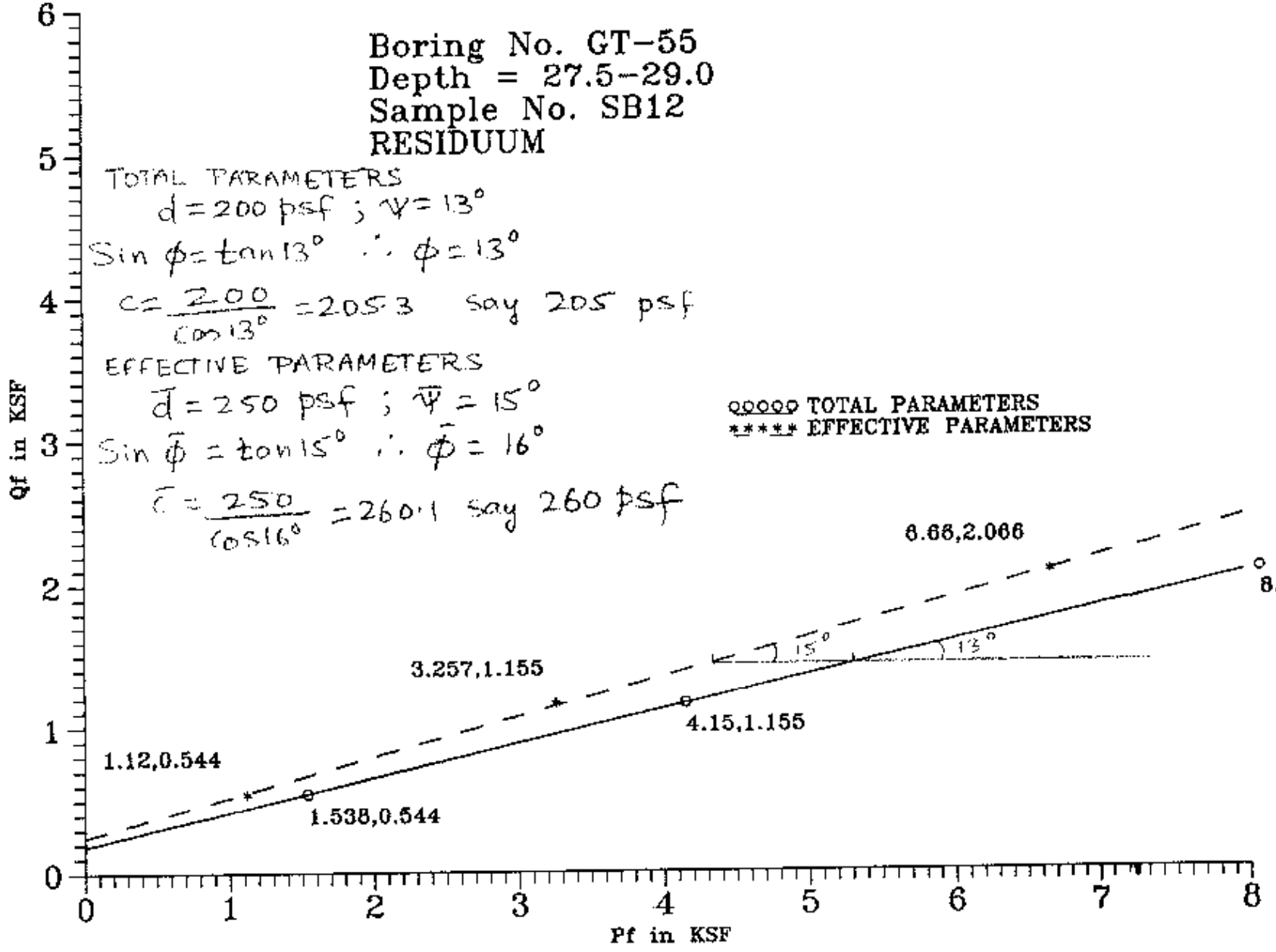


MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DIS POSAL CELL
Item MATERIAL PROPERTIES

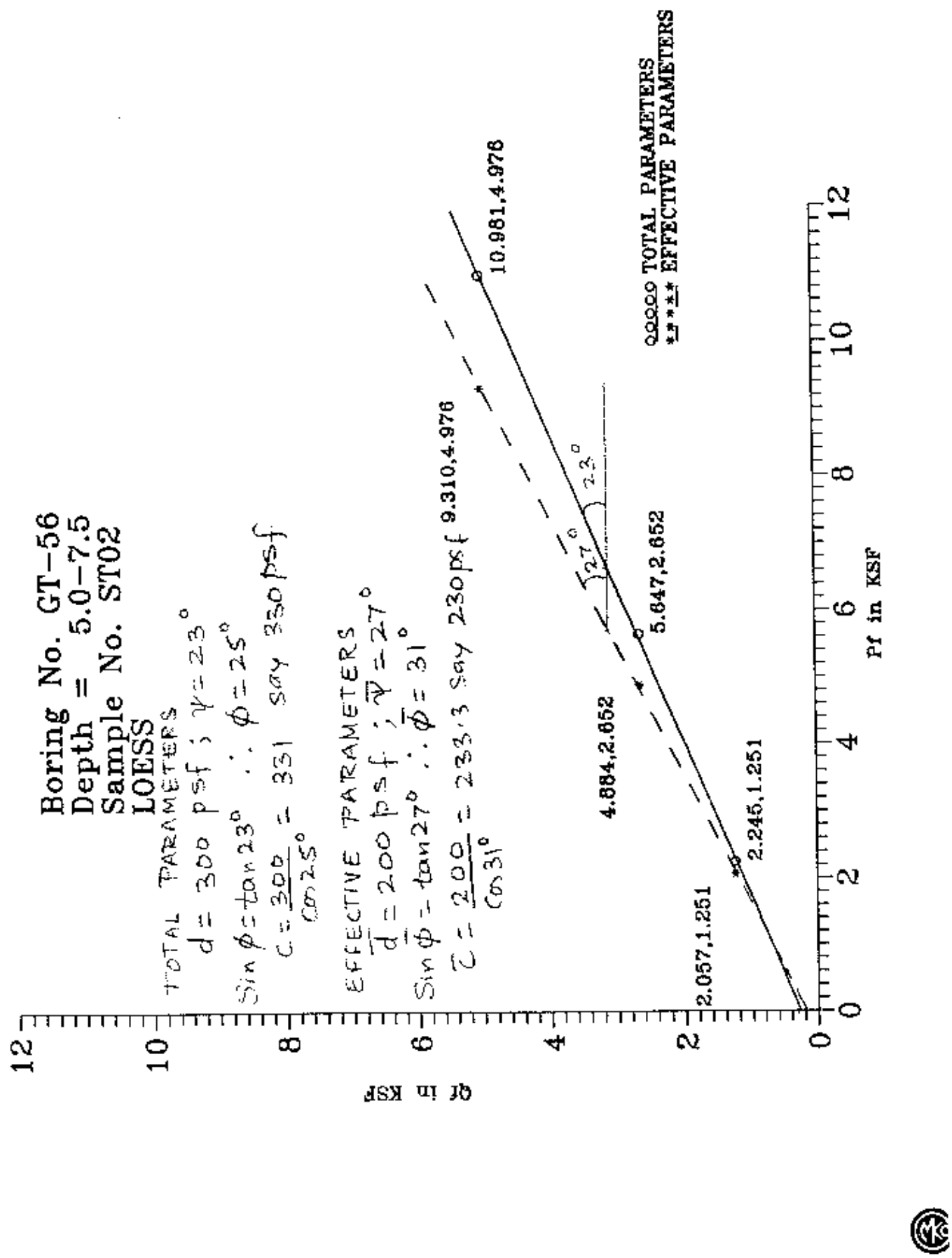
Contract No. 3840
Designed NP
Checked JSR

Sheet 75
File No.
Date 9/6/91
Date 9/17/91



MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed ND
Checked JSR
Sheet 76
File No.
Date 9/6/91
Date 9/17/91

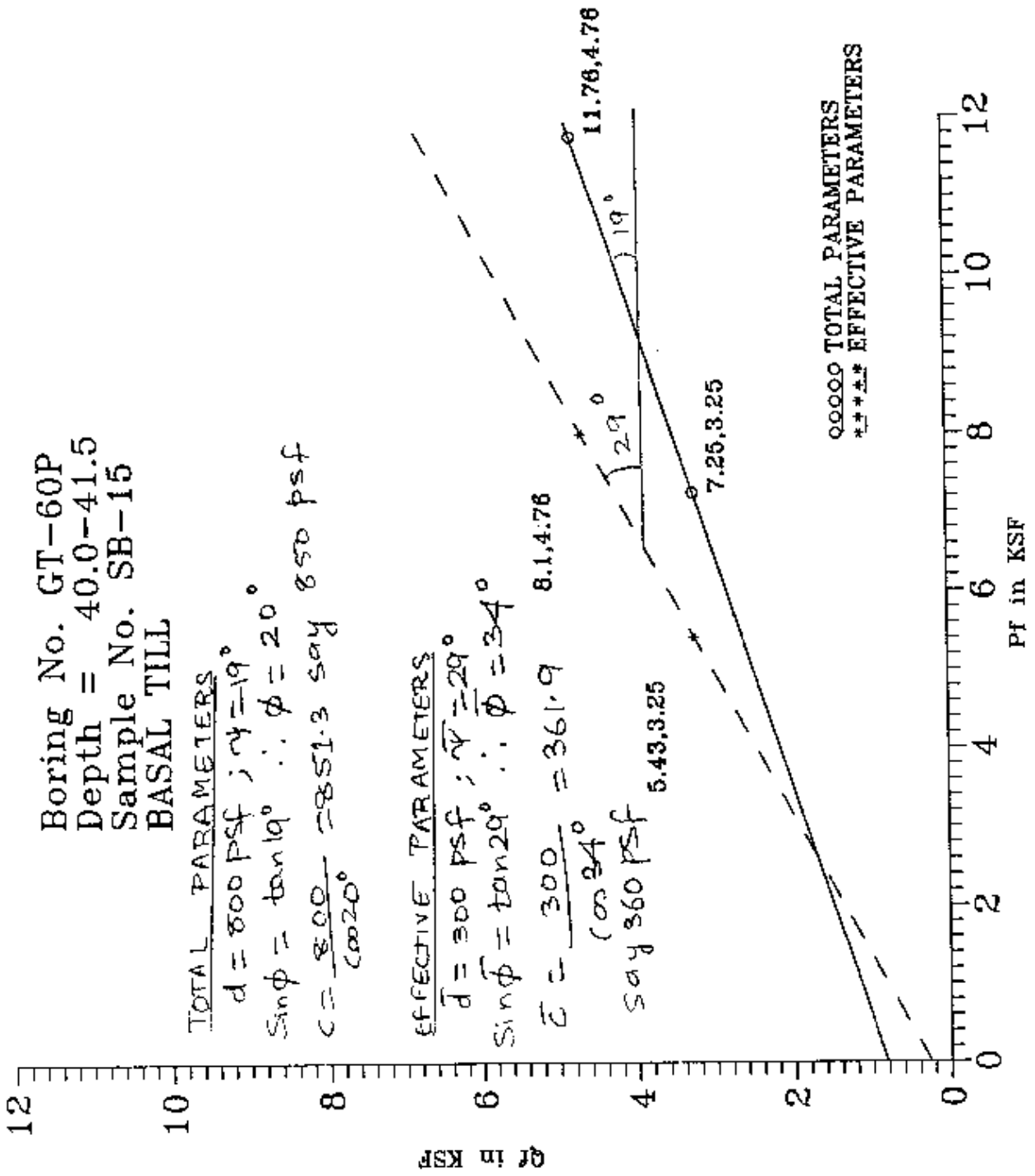

Boring No. GT-56
Depth = 5.0-7.5
Sample No. ST02
LOESS
TOTAL PARAMETERS
d = 300 psf ; ψ = 23°
Sin φ = tan 23° ∴ φ = 25°
c = 300 / cos 25° = 331 say 330 psf
EFFECTIVE PARAMETERS
d = 200 psf ; ψ = 27°
Sin φ = tan 27° ∴ φ = 31°
c = 200 / cos 31° = 233.3 say 230 psf
00000 TOTAL PARAMETERS
***** EFFECTIVE PARAMETERS
10.981,4.976
9.310,4.976
5.647,2.652
4.884,2.652
2.245,1.251
2.057,1.251
27°
23°
qf in KSF
0
2
4
6
8
10
12

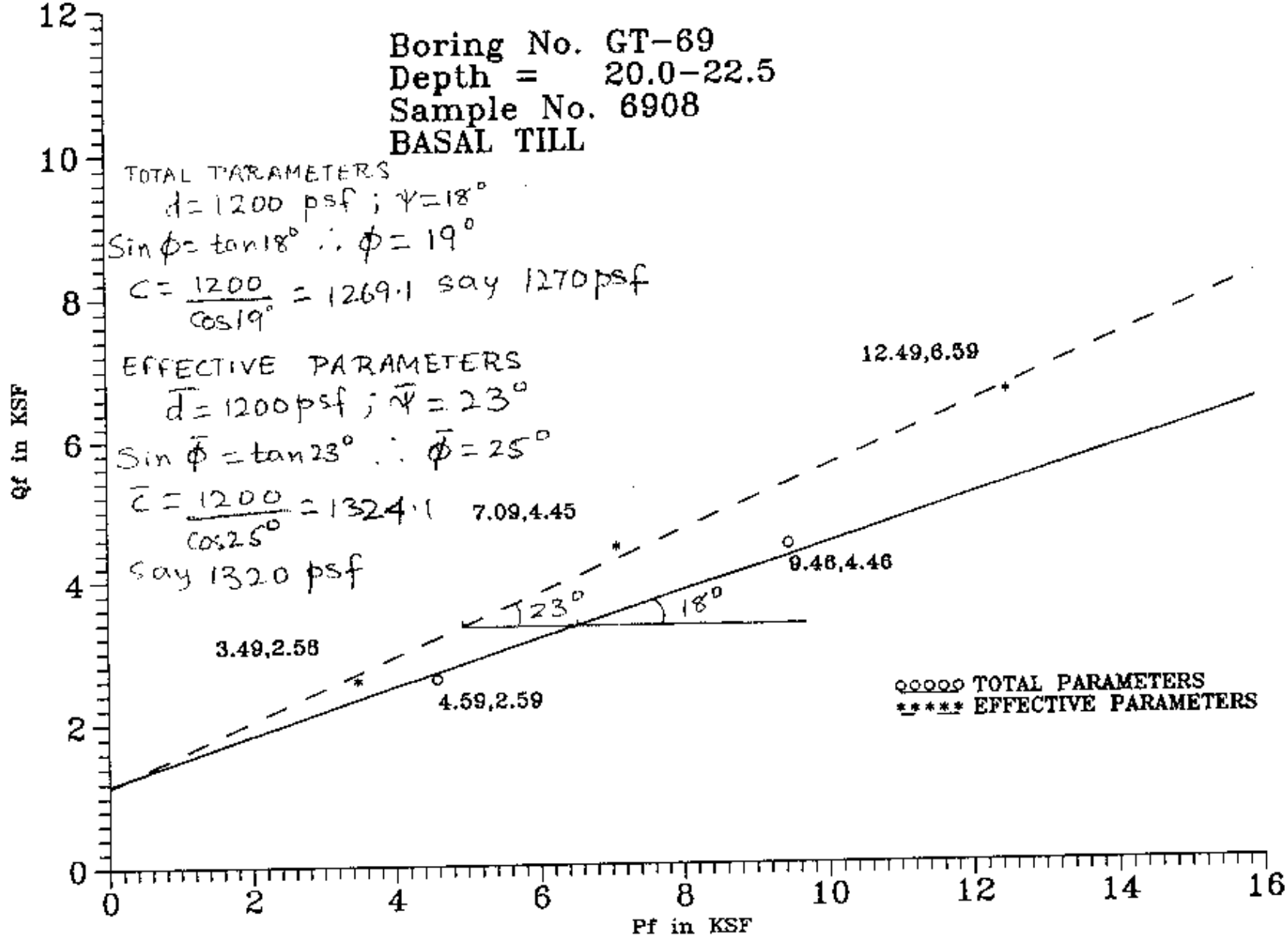
MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 78
File No.
Date 09/06/91
Date 9/17/91





MORRISON-KNUDSEN CORPORATION

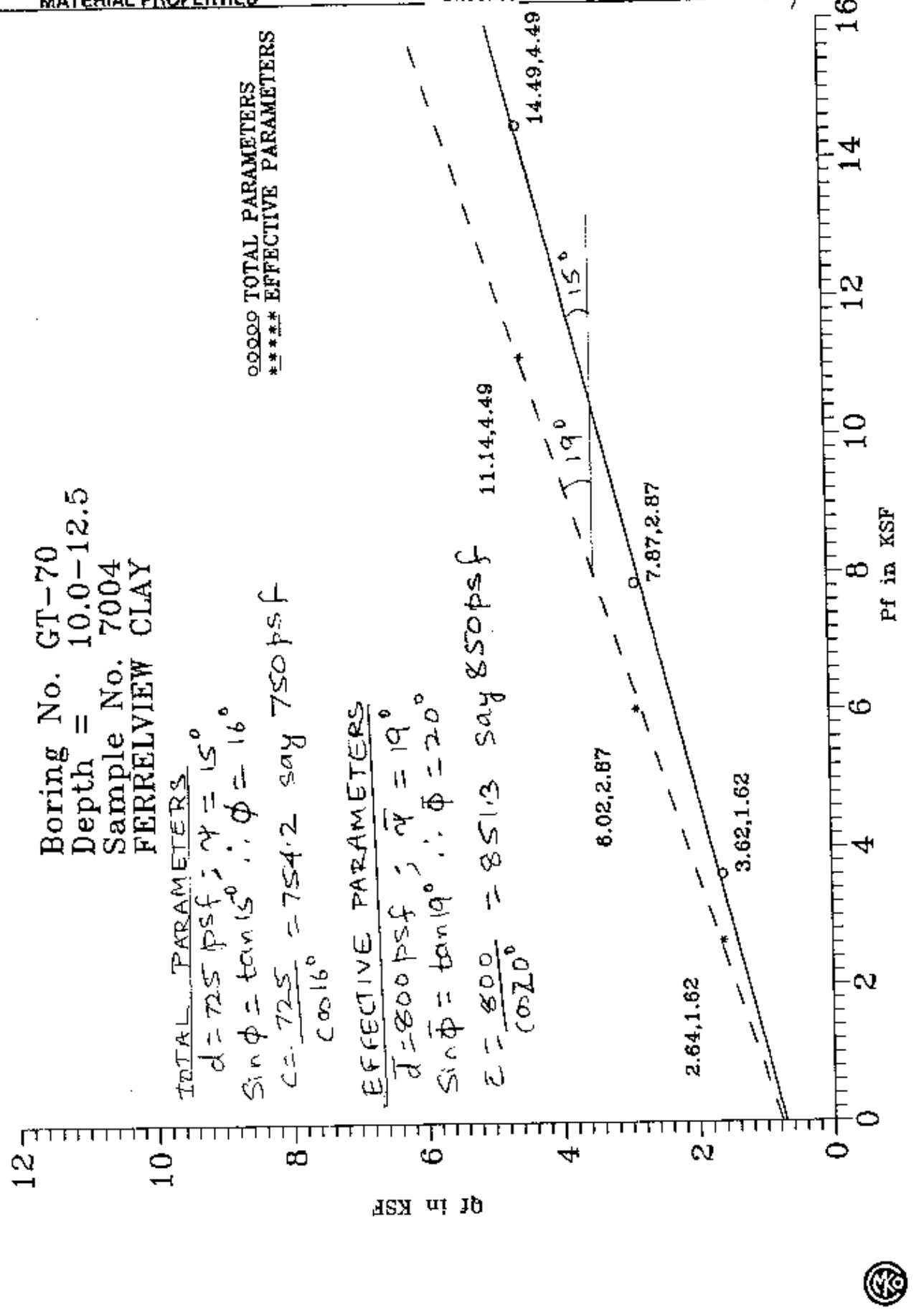
Project WSSR AP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 2840
Designed AJD
Checked TSR
Date 9/6/91
Date 9/17/91
Sheet 79
File No.

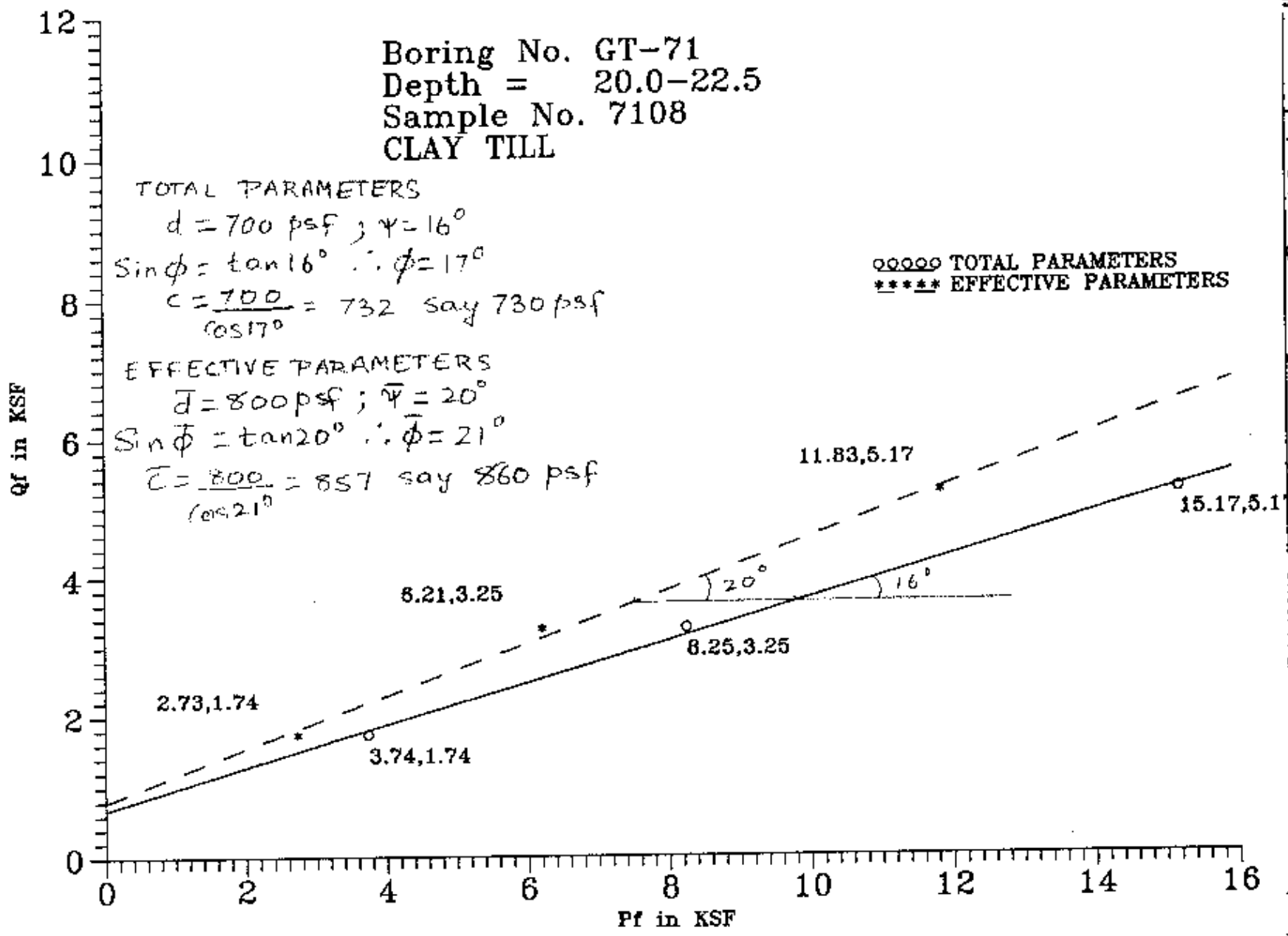
MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 80
File No.
Date 09/06/91
Date 9/17/91



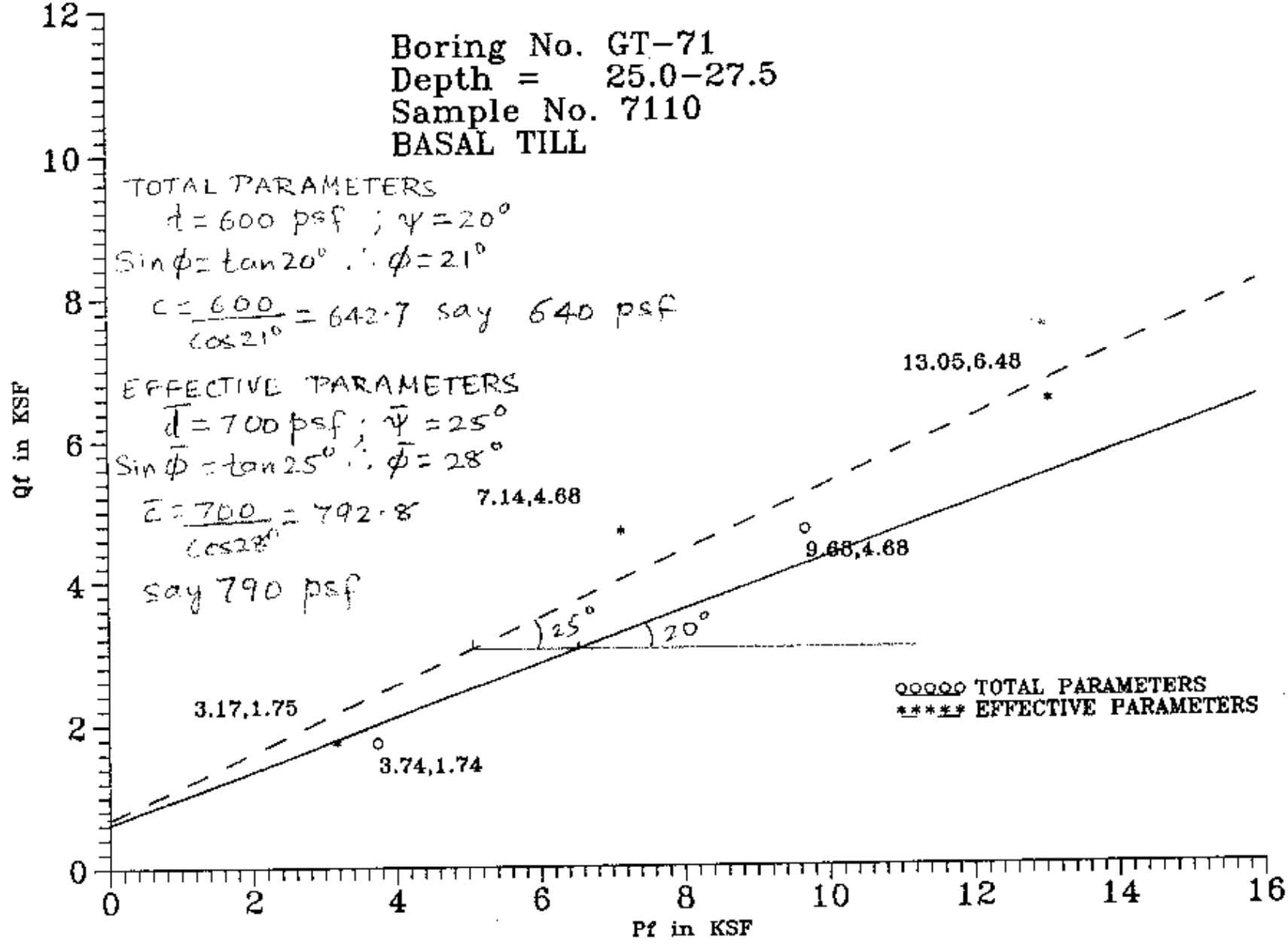


MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3646
Designed ND
Checked JSR

Sheet 81
File No. 9/6/91
Date 9/17/91



MORRISON-KNUDSEN CORPORATION

Project WSS RAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed ND
Checked JSR
Sheet 82
File No.
Date 9/6/91
Date 9/17/91

Boring No. GT-74
Depth = 5.0-7.5
Sample No. 7402
TOPSOIL/FILL

TOTAL PARAMETERS

$d = 725$ psf ; $\nu = 15°$

$\sin\phi = \tan 15°$ ∴ $\phi = 16°$

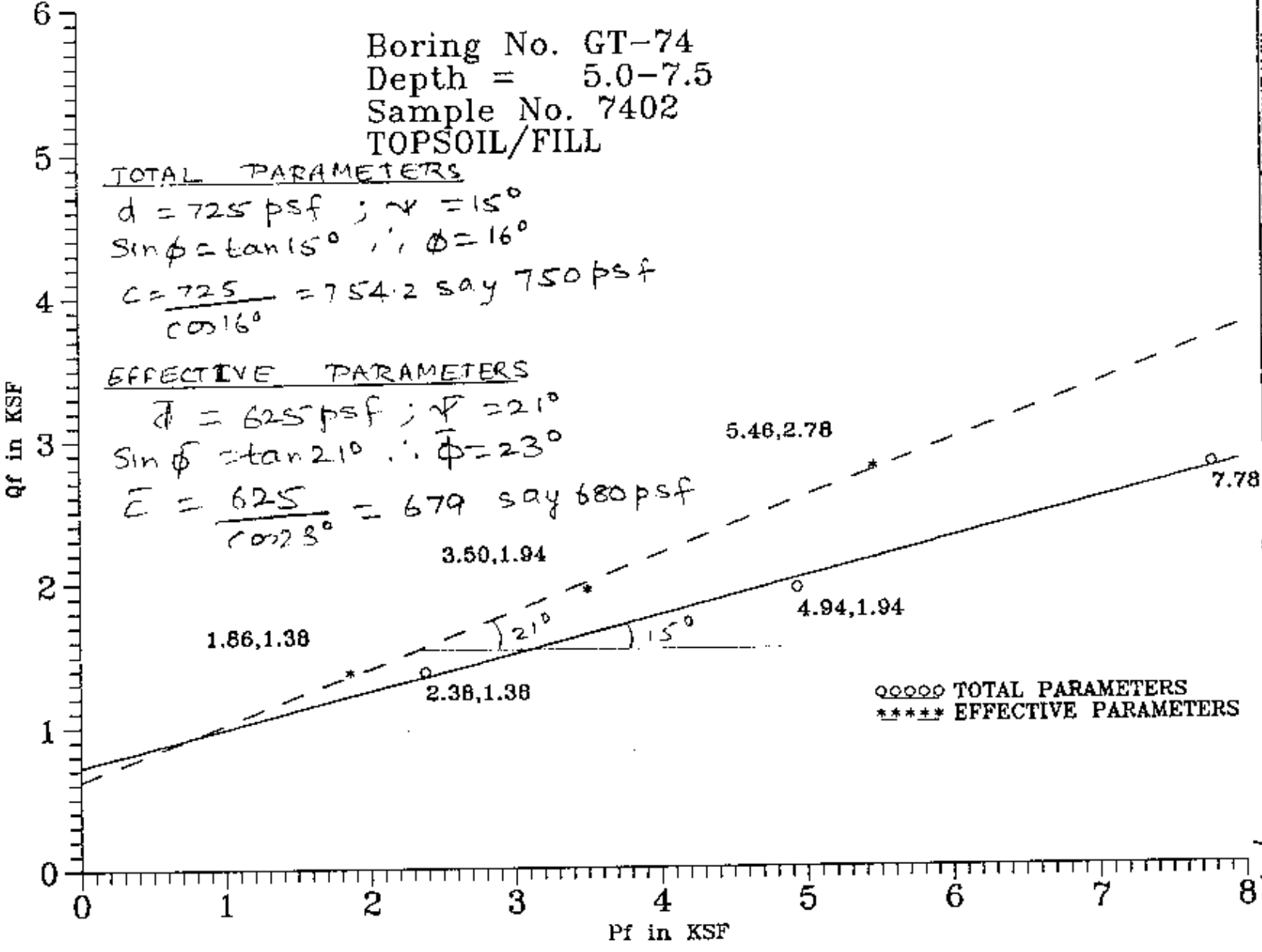
$c = \frac{725}{\cos 16°} = 754.2$ say 750 psf

EFFECTIVE PARAMETERS

$\bar{d} = 625$ psf ; $\bar{\nu} = 21°$

$\sin\bar{\phi} = \tan 21°$ ∴ $\bar{\phi} = 23°$

$\bar{c} = \frac{625}{\cos 23°} = 679$ say 680 psf



MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked ISR

Sheet 8.3
File No.
Date 09/06/91
Date 9/12/91

Boring No. GT-74
Depth = 15.0-17.5
Sample No. 7406
CLAY TILL

TOTAL PARAMETERS

$d = 150$ psf ; $\psi = 21°$

$\sin\phi = \tan 21°$ $\therefore \phi = 23°$

$C = \frac{150}{\cos 23°} = 163$ say 160 psf

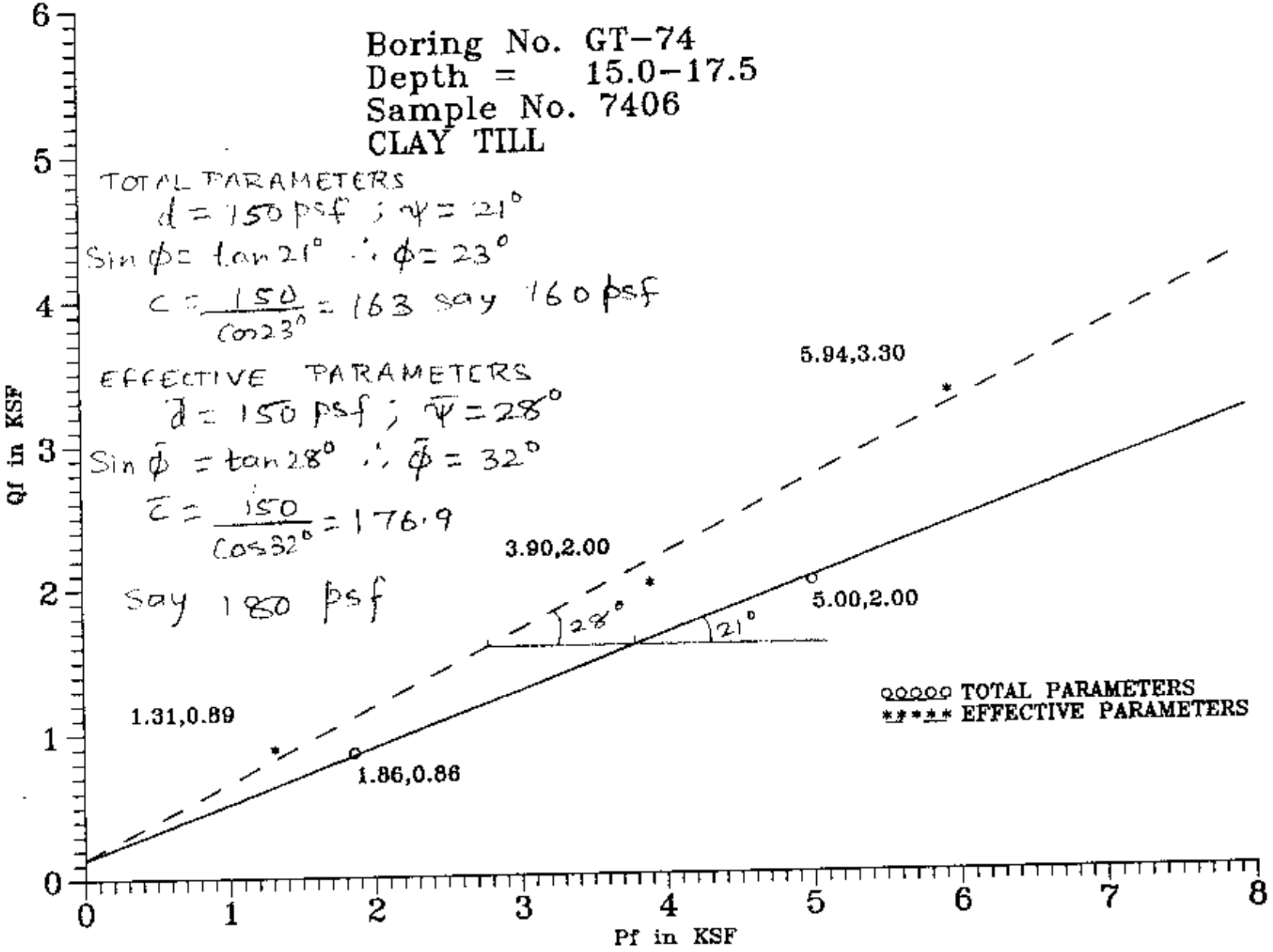
EFFECTIVE PARAMETERS

$\bar{d} = 150$ psf ; $\bar{\psi} = 28°$

$\sin\bar{\phi} = \tan 28°$ $\therefore \bar{\phi} = 32°$

$\bar{C} = \frac{150}{\cos 32°} = 176.9$

say 180 psf



MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature BAS POSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed NLP
Checked JSR

Sheet 84
File No.
Date 9/17/91
Date 9/17/91

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 85
File No.
Date 09/06/91
Date 9/17/91

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked TSR

Sheet
File No.
Date 09/06/91
Date 9/12/91

Boring No. GT-2T74
Depth = 4.0-8.5
Sample No. BU-01A
LOESS

TOTAL PARAMETERS

$d = 800$ psf ; $\Psi = 13°$

$\sin\phi = \tan 13° \therefore \phi = 13°$

$C = \frac{800}{\cos 13°} = 821$ say 820 psf

EFFECTIVE PARAMETERS

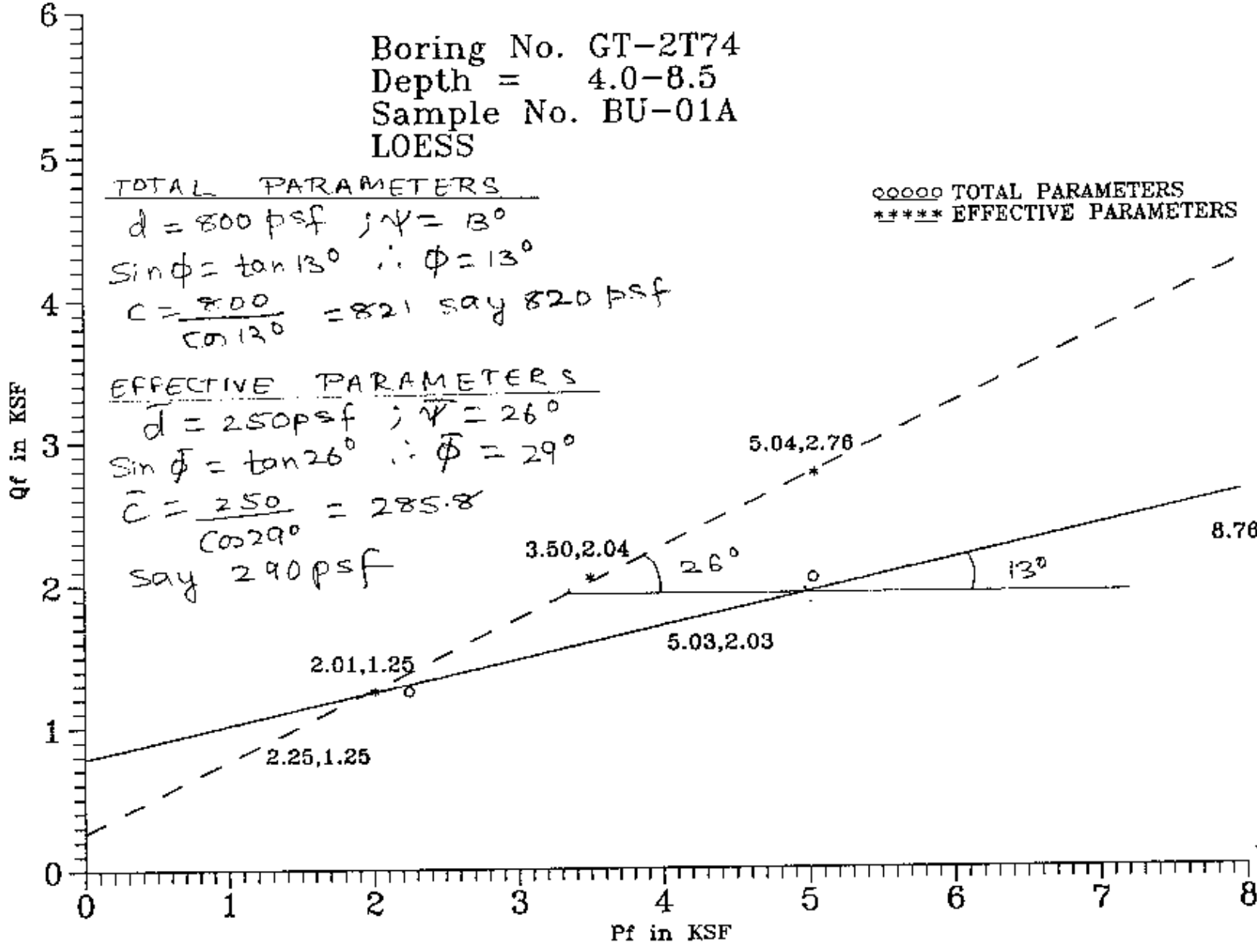
$d = 250$ psf ; $\Psi = 26°$

$\sin\phi = \tan 26° \therefore \phi = 29°$

$C = \frac{250}{\cos 29°} = 285.8$

say 290 psf

ooooo TOTAL PARAMETERS
***** EFFECTIVE PARAMETERS



Boring No. GT-2T75
Depth = 6.5-12.0
Sample No. BU-02B
FERRELVIEW CLAY

TOTAL PARAMETERS

$d = 300$ psf ; $\Psi = 13°$

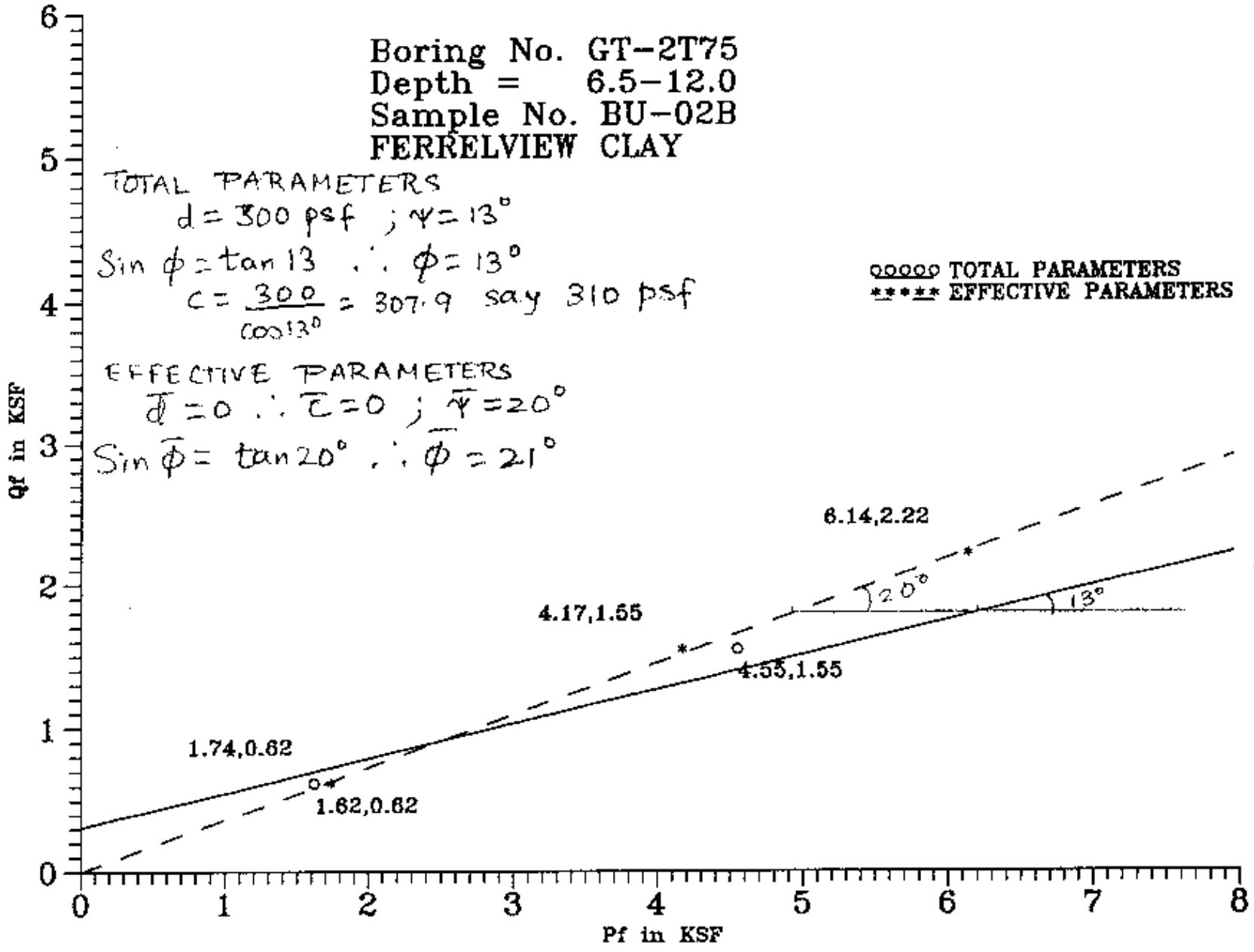
$\sin\phi = \tan 13 \therefore \phi = 13°$

$c = \frac{300}{\cos 13°} = 307.9$ say 310 psf

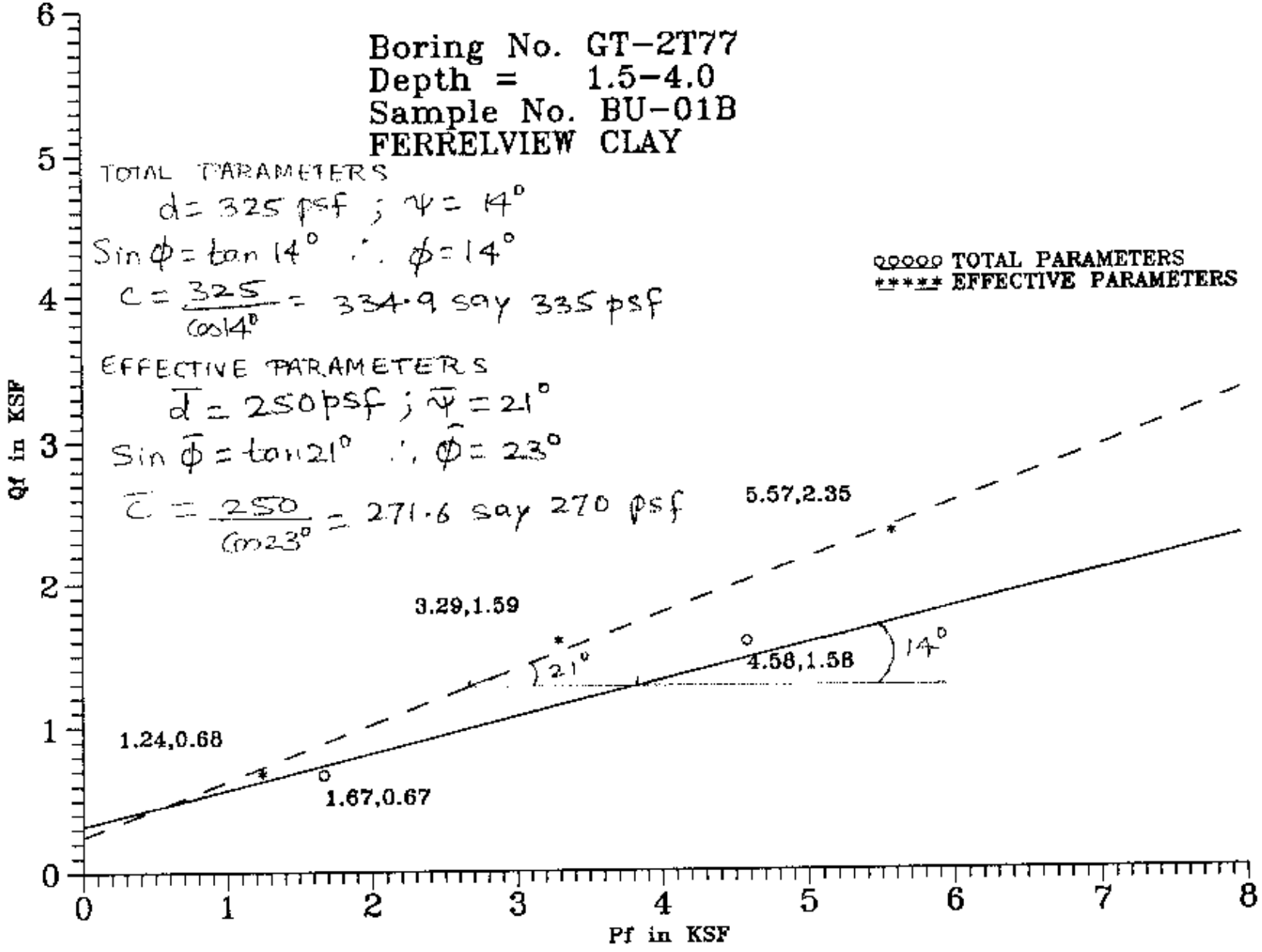
EFFECTIVE PARAMETERS

$\bar{d} = 0 \therefore \bar{c} = 0$; $\bar{\Psi} = 20°$

$\sin\bar{\phi} = \tan 20° \therefore \bar{\phi} = 21°$



MORRISON-KNUDSEN CORPORATION
Project WSSR AP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed WD
Checked JSR
Date 9/6/91
Date 9/12/91
Sheet 57
File No.



MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3840
Designed ND
Checked JSR
Sheet 88
File No.
Date 9/6/91
Date 9/17/91

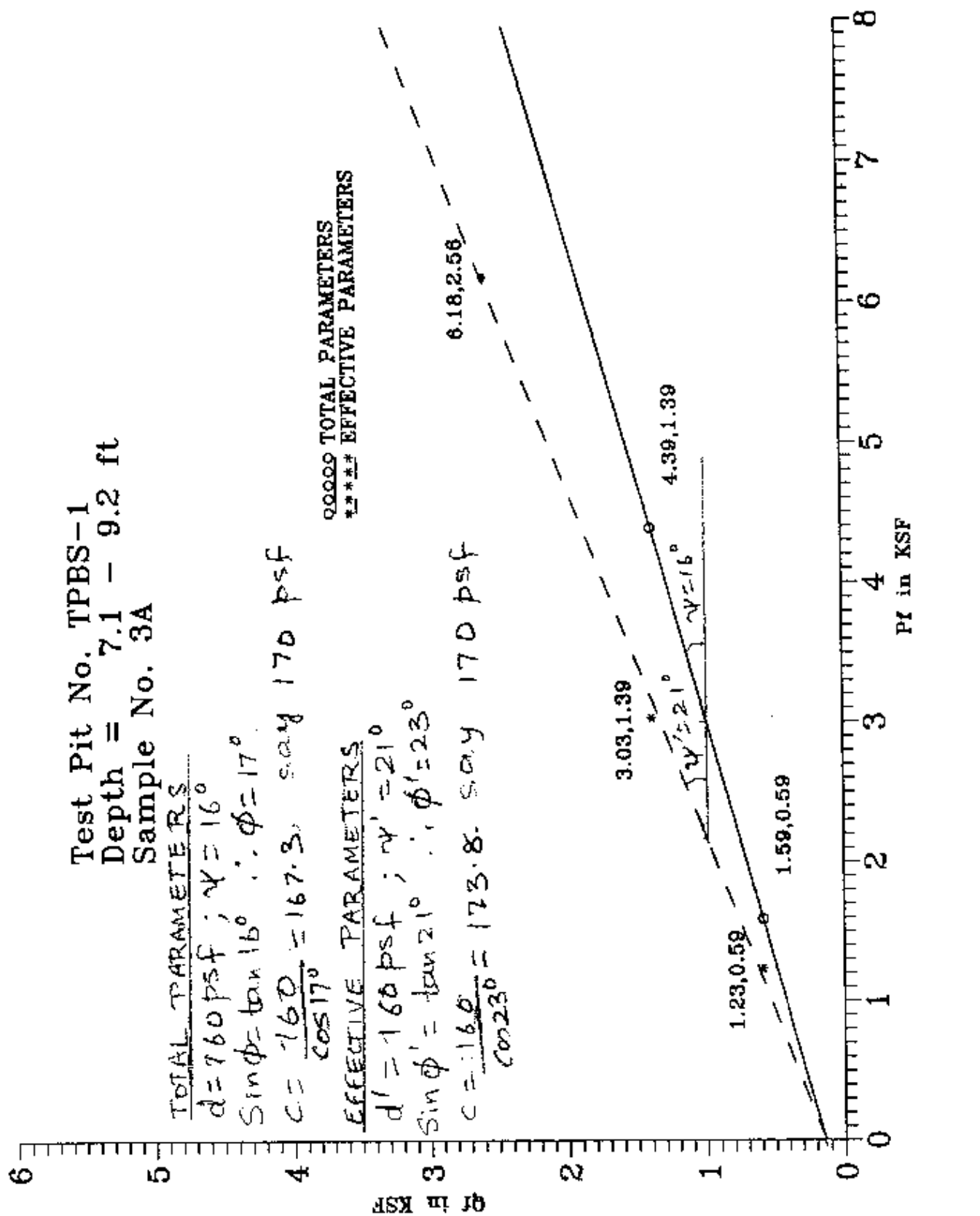
MORRISON-KNUDSEN CORPORATION

Project WESRAD
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 59
File No.
Date 9/6/91
Date 9/17/91

8.57



MORRISON-KNUDSEN CORPORATION

Project WSCRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

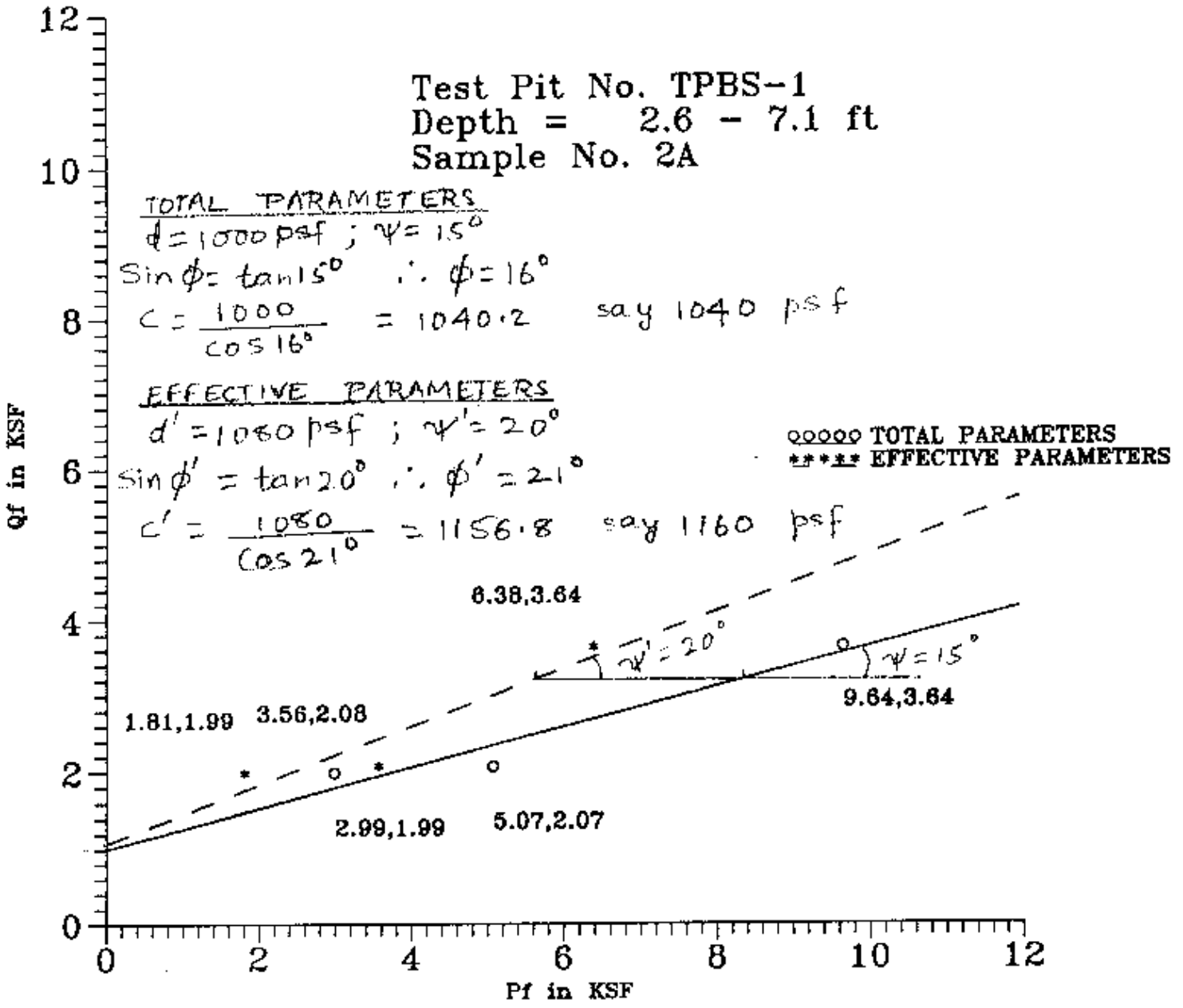
Contract No. 3848
Designed RD
Checked JSR

Sheet 90
File No. 9/6/91
Date 9/17/91

Test Pit No. TPBS-1
Depth = 2.6 - 7.1 ft
Sample No. 2A

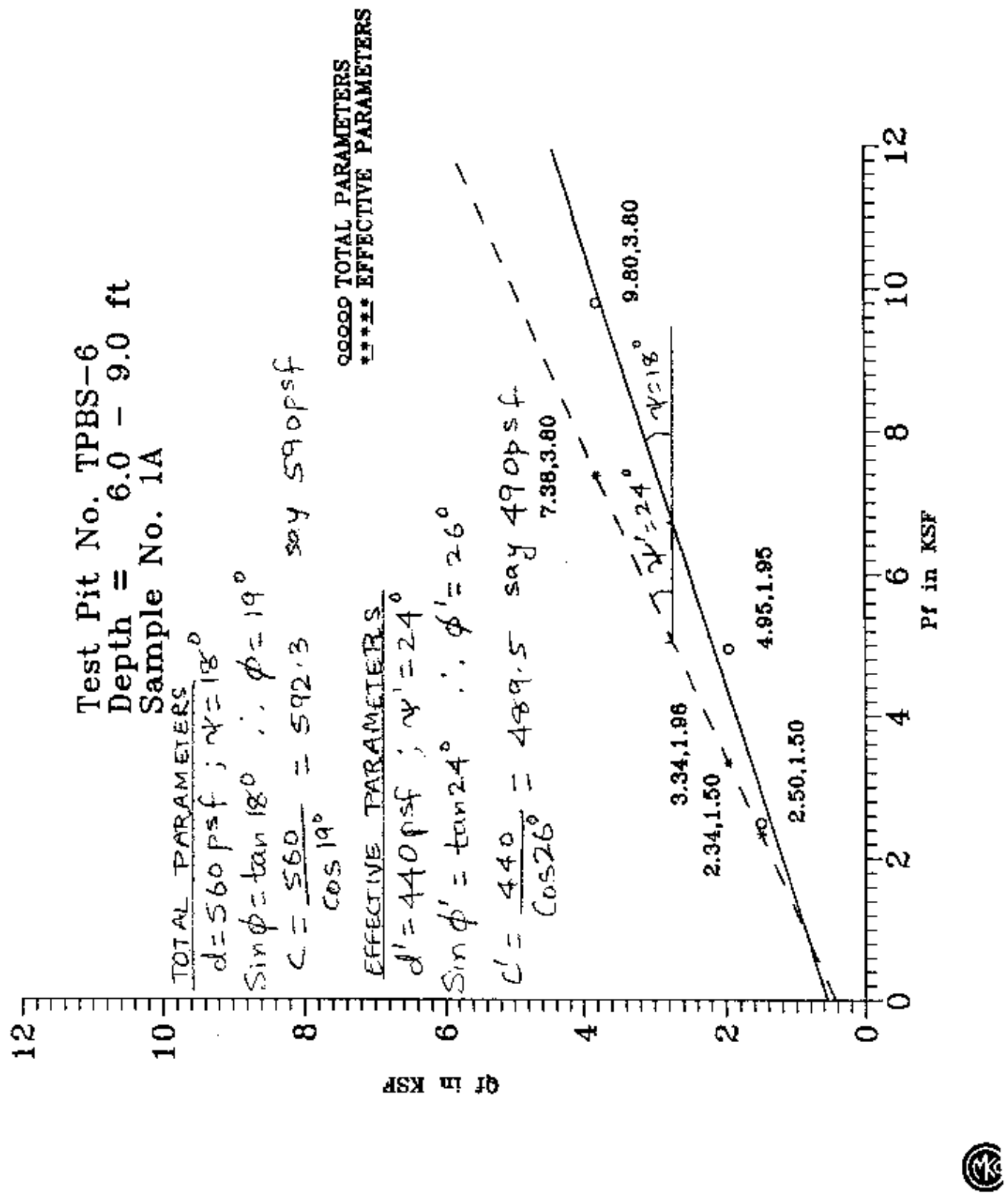
TOTAL PARAMETERS
$\phi = 1000$ psf ; $\psi = 15^\circ$
$\sin\phi = \tan 15^\circ \quad \therefore \phi = 16^\circ$
$C = \frac{1000}{\cos 16^\circ} = 1040.2$ say 1040 psf

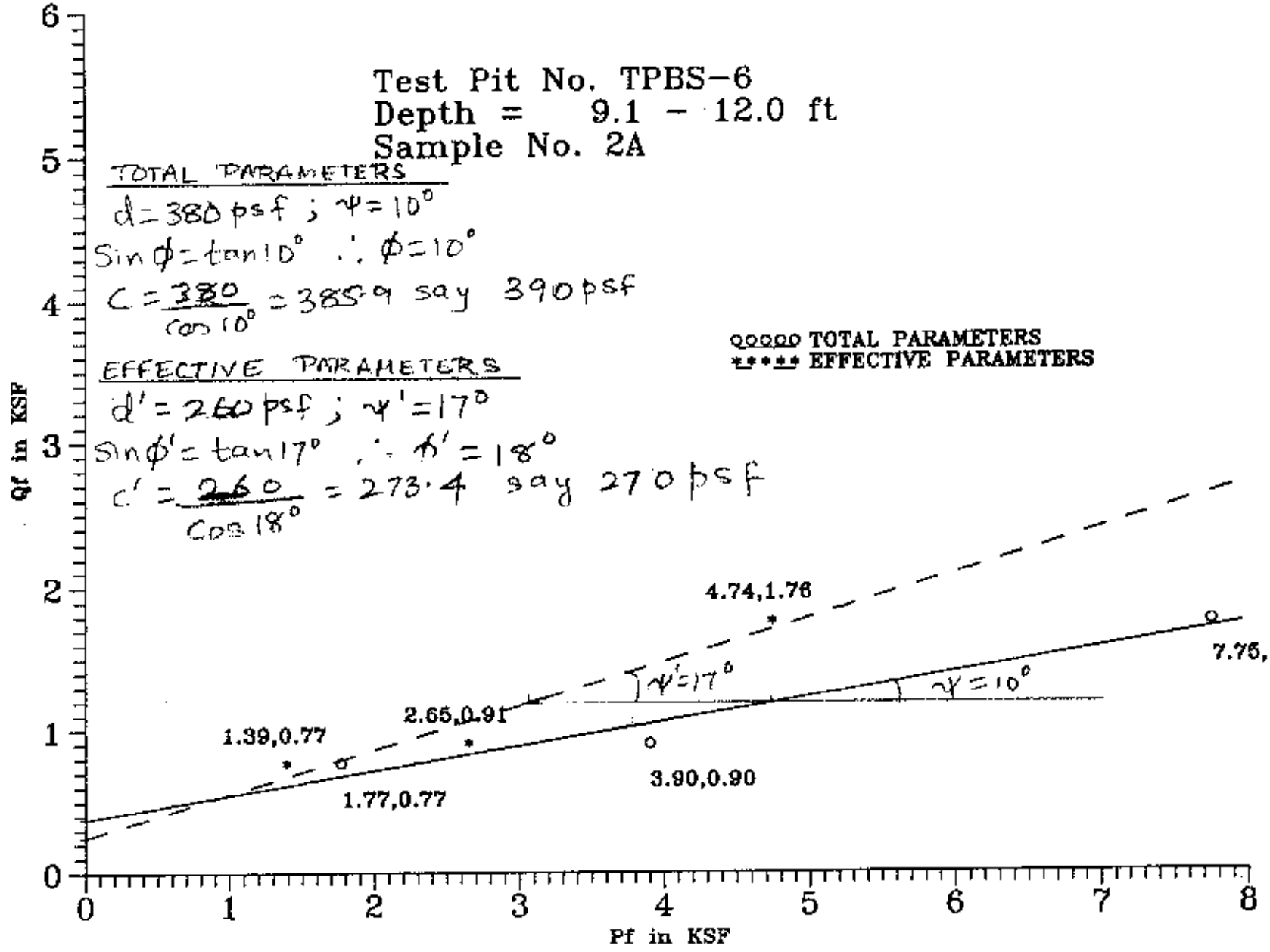
EFFECTIVE PARAMETERS
$\phi' = 1080$ psf ; $\psi' = 20^\circ$
$\sin\phi' = \tan 20^\circ \quad \therefore \phi' = 21^\circ$
$C' = \frac{1080}{\cos 21^\circ} = 1156.8$ say 1160 psf



MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 91
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked JSR | Date 9/6/91 | Date 9/17/91





MORRISON-KNUDSEN CORPORATION

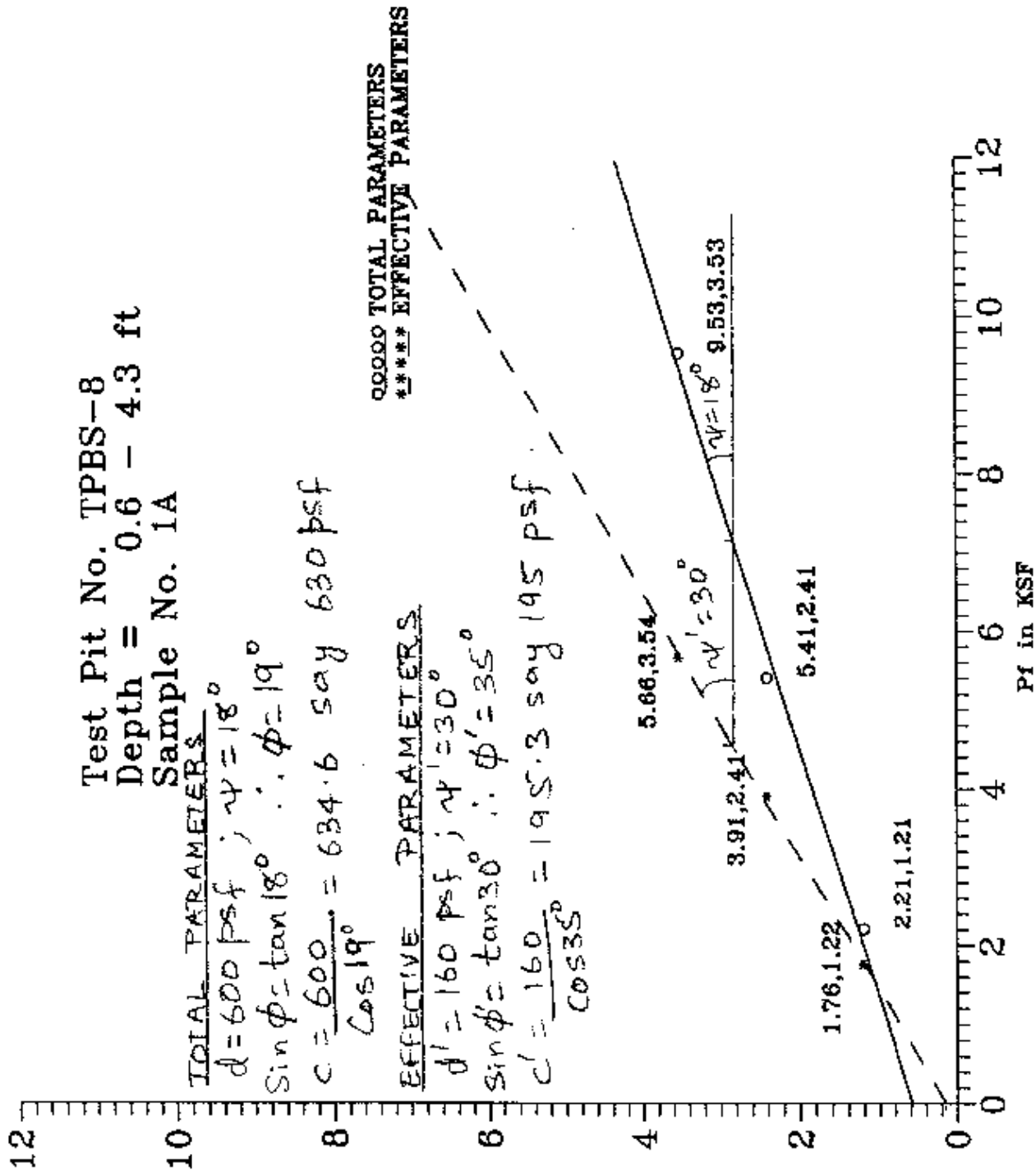
Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES
Contract No. 3240
Designed ND
Checked JSR
Sheet 92
File No.
Date 9/6/91
Date 9/17/91

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked JSR

Sheet 93
File No.
Date 9/16/91
Date 9/17/91



MORRISON-KNUDSEN CORPORATION

Project WSSR AP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed NP
Checked SR
Date 9/4/91
Date 9/11/91
Sheet 9A
File No.

Test Pit No. TPBS-8
Depth = 8.5 - 11.5 ft
Sample No. 3A

TOTAL PARAMETERS

$d = 440$ psf ; $\psi = 9°$

$\sin\phi = \tan 9°$ $\therefore \phi = 9°$

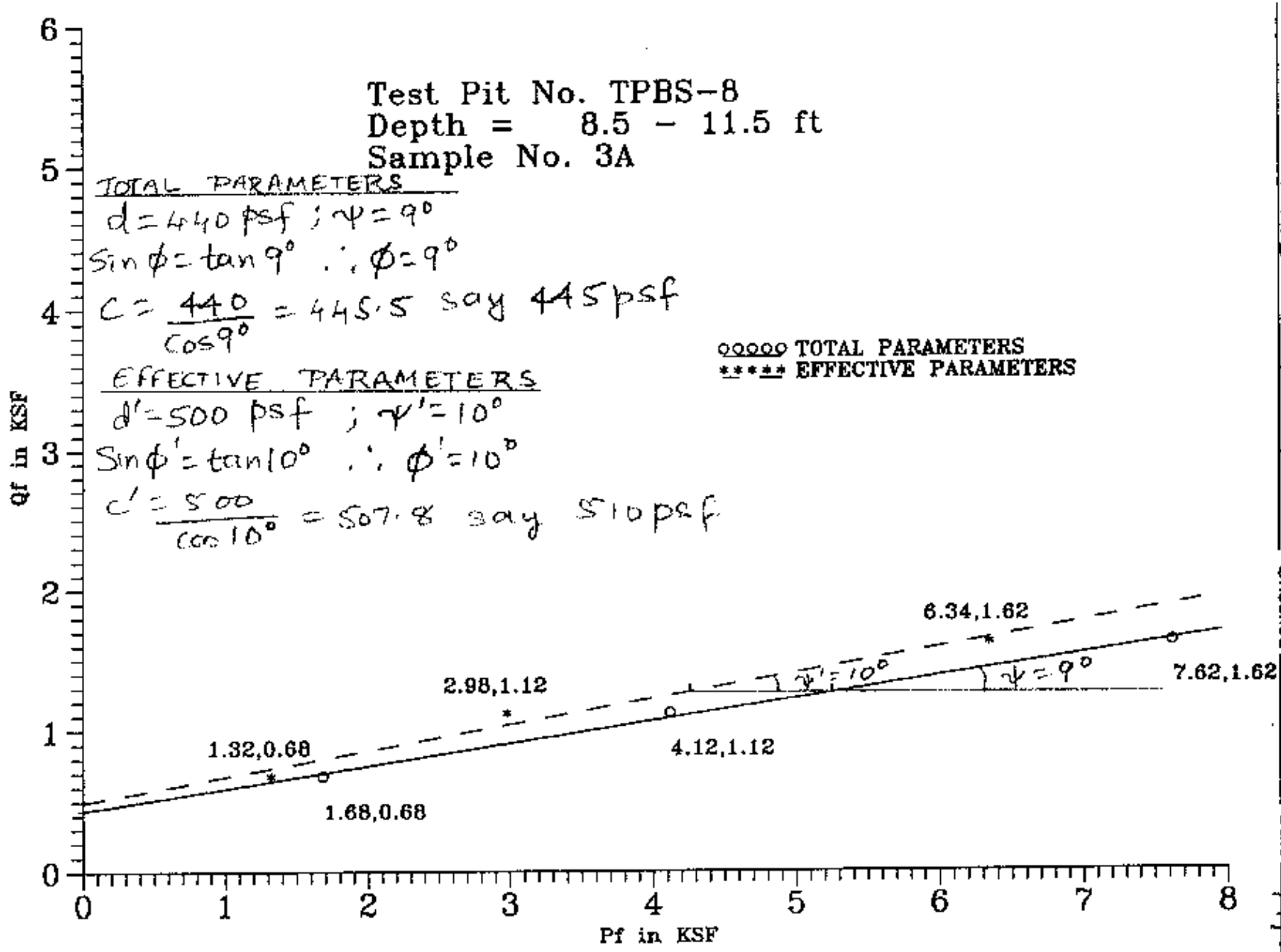
$C = \frac{440}{\cos 9°} = 445.5$ say 445 psf

EFFECTIVE PARAMETERS

$d' = 500$ psf ; $\psi' = 10°$

$\sin\phi' = \tan 10°$ $\therefore \phi' = 10°$

$c' = \frac{500}{\cos 10°} = 507.8$ say 510 psf



SUMMARY OF UNCONSOLIDATED UNDRAINED TESTS
UNDISTURBED SAMPLES

Hole or Trench #	Sample Number	Average Cohesion ksf
Loess		
GT-37	ST-03	1.16
GT-38	ST-03	1.11
GT-50	ST-02	1.16
GT-56	ST-02	2.33
GT-57	ST-03	1.69
Mean Value		1.49
Ferrelview Clay		
GT-48	ST-03	0.87
	ST-07	0.88
GT-51	ST-03	1.29
GT-52	ST-04	1.18
GT-55	ST-06	1.46
	ST-08	1.39
Mean Value		1.18
Clay Till		
GT-43	ST-10	0.86
GT-50	ST-06	1.25
GT-56	SB-08	1.66
GT-69	6906	7.15 (1)
Mean Value		1.26
Basal Till		
GT-52	SB-14	1.06
GT-69	6908	6.96 (1)

(1) Unsaturated Samples. Not included in averaging.

SUMMARY OF UNCONSOLIDATED UNDRAINED TESTS

REMOLDED SAMPLES

Hole or Trench #	Sample Number	Average Cohesion
		ksf
Loess		
GT-2T78	BU-01A	5.06
Ferrelview Clay		
GT-2T71	BU-02A	2.02
GT-2T75	BU-01A	2.32
GT-2T78	BU-02B	2.31
Mean Value		2.22

Unsaturated

SUMMARY OF UNCONSOLIDATED UNDRAINED TESTS
POTENTIAL BORROW SOURCE NO. 1

Hole or Trench #	Sample Number	Average Cohesion
		ksf
TPBS-1	2A	2.81
	3A	2.50
TPBS-6	1A	2.86
	2A	3.26
TPBS-8	1A	2.30
	3A	2.60
Mean Value		2.72

UNCONSOLIDATED UNDRAINED TESTS

Hole or Trench #	Sample Number	σ_1	σ_3	Deviator Stress	$P=(\sigma_1+\sigma_3)/2$	$Q=(\sigma_1-\sigma_3)/2$	Average Cohesion
		ksf	ksf	ksf	ksf	ksf	ksf
Loess/Fill							
GT-37	ST-03	1.88	0.50	1.38	1.19	0.69	
		3.41	0.99	2.41	2.20	1.21	
		5.18	2.00	3.18	3.59	1.59	1.16
GT-38	ST-03	2.45	0.50	1.94	1.48	0.97	
		3.49	0.99	2.50	2.24	1.25	1.11
GT-50	ST-02	2.73	1.00	1.73	1.87	0.87	
		5.90	3.00	2.90	4.45	1.45	1.16
GT-56	ST-02	4.38	1.00	3.38	2.69	1.69	
		7.72	3.00	4.72	5.36	2.36	
		11.86	6.00	5.86	8.93	2.93	2.33
GT-57	ST-03	4.20	1.00	3.20	2.60	1.60	
		6.92	3.00	3.92	4.96	1.96	
		9.02	6.00	3.02	7.51	1.51	1.69
GT-2T78	BU-01A	9.96	1.00	8.96	5.48	4.48	
		14.28	3.01	11.28	8.64	5.64	
		22.06	6.00	16.06 @	14.03	8.03	5.06 *
Ferrelview Clay							
GT-48	ST-03	2.89	1.00	1.89	1.95	0.95	
		4.78	3.00	1.78	3.89	0.89	
		7.57	6.00	1.57	6.79	0.79	0.87
	ST-07	2.62	1.00	1.62	1.81	0.81	
		4.47	3.00	1.47	3.74	0.73	
		8.18	6.00	2.18	7.09	1.09	0.88
GT-51	ST-03	3.41	1.00	2.41	2.21	1.21	
		5.43	3.00	2.43	4.22	1.21	
		8.92	6.00	2.92	7.46	1.46	1.29
GT-52	ST-04	3.88	1.00	2.88	2.44	1.44	
		4.51	3.00	1.51	3.76	0.75	
		8.71	6.00	2.71	7.36	1.36	1.18
GT-55	ST-06	4.54	0.99	3.55	2.77	1.78	
		5.07	2.30	2.77	3.69	1.39	
		8.43	6.00	2.43	7.22	1.21	1.46

UNCONSOLIDATED UNDRAINED TESTS

Hole or Trench #	Sample Number	σ_1 ksf	σ_3 ksf	Deviator Stress ksf	$P=(\sigma_1+\sigma_3)/2$ ksf	$Q=(\sigma_1-\sigma_3)/2$ ksf	Average Cohesion ksf
Ferrelview Clay (Contd.)							
GT-55	ST-08	3.24	1.00	2.24	2.12	1.12	
		5.94	3.00	2.94	4.47	1.47	
		9.13	6.00	3.13	7.57	1.57	1.39
GT-2T71	BU-02A	4.78	1.00	3.78	2.89	1.89	
		7.10	3.00	4.10	5.05	2.05	
		10.22	6.00	4.22	8.11	2.11	2.02 *
GT-2T75	BU-01A	5.76	1.00	4.76	3.38	2.38	
		6.18	3.00	3.18	4.59	1.59	
		~~12.24~~ 11.84	~~6.28~~ 6	~~5.96~~ 5.58	~~9.26~~ 9.05	~~2.98~~ 2.79	2.25 ~~2.32~~ *
GT-2T78	BU-02B	5.36	1.00	4.36	3.18	2.18	
		7.74	3.00	4.74	5.37	2.37	
		10.76	6.00	4.76	8.38	2.38	2.31 *
Clay Till							
GT-43	ST-10	2.33	1.00	1.33	1.67	0.67	
		4.89	3.00	1.89	3.95	0.94	
		7.97	6.00	1.97	6.99	0.98	0.86 7
GT-50	ST-06	2.73	1.00	1.73	1.87	0.87	
		4.85	3.00	1.85	3.93	0.92	
		9.89	6.00	3.89	7.95	1.95	1.25
GT-56	SB-08	3.98	1.00	2.98	2.49	1.49	
		6.65	3.00	3.65	4.83	1.83	1.66
GT-68	6810	19.83	5.00	14.83	12.42	7.42	* * (1)
GT-69	6906	14.14	2.00	12.14	8.07	6.07	
		21.35	5.00	16.35	13.18	8.18	
		24.41	9.99	14.42	17.20	7.21	7.15 (1)
Basal Till							
GT-52	SB-14	2.95	1.00	1.95	1.98	0.98	
		5.09	3.00	2.09	4.05	1.05	
		8.29	6.00	2.29	7.15	1.14	1.06
GT-69	6908	18.52	5.00	13.52	11.76	6.76	
		24.32	10.00	14.32	17.16	7.16	6.96 (1)

* Test performed on remolded samples from Test Pits.

* * No value of average cohesion, since only 1 test was performed.

(1) Unsaturated Sample.

@ Result not used in computing average cohesion.

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 1 of 8
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked JSR | Date 9/18/01 | Date 9/20/91

UNCONSOLIDATED UNDRAINED TESTS

Hole or Trench #	Sample Number	σ_1	σ_3	Deviator Stress	$P=(\sigma_1+\sigma_3)/2$	$Q=(\sigma_1-\sigma_3)/2$	Average Cohesion
		ksf	ksf	ksf	ksf	ksf	ksf
Potential Borrow Source No. 1							
TPBS-1	2A	4.06	1.00	3.06	2.53	1.53	
		8.74	3.00	5.74	5.87	2.87	
		~~14.08~~ 13.06	6.00	~~8.08~~ 7.06	~~10.04~~ 9.53	~~4.04~~ 3.53	~~2.81~~ 2.64
	3A	5.70	1.00	4.70	3.35	2.35	
		7.96	3.00	4.96	5.48	2.48	
		11.32	6.00	5.32	8.66	2.66	2.50
TPBS-6	1A	6.32	1.00	5.32	3.66	2.66	
		8.28	3.00	5.28	5.64	2.64	
		12.58	6.00	6.58	9.29	3.29	2.86
	2A	6.60	1.00	5.60	3.80	2.80	
		9.82	3.00	6.82	6.41	3.41	
		13.16	6.00	7.16	9.58	3.58	3.26
TPBS-8	1A	4.68	1.00	3.68	2.84	1.84	
		7.16	3.00	4.16	5.08	2.08	
		11.94	6.00	5.94	8.97	2.97	2.30
	3A	5.94	1.00	4.94	3.47	2.47	
		8.26	3.00	5.26	5.63	2.63	
		11.38	6.00	5.38	8.69	2.69	2.60

CONSOLIDATION PARAMETERS
OVERALL VALUES

Hole Number	Sample Number	Depth From	Depth To	LL	PL	PI	Cc	Cr	e_o	$C_{\varepsilon c}$	$C_{\varepsilon r}$	Pp
		ft	ft									ksf
Loess												
GT-50	ST-02	2.5	5.0	47	18	29	0.230	0.032	0.600	0.144	0.020	(1) 30.0
GT-55	ST-04	7.5	10.0	50	21	29	0.260	0.041	0.816	0.143	0.023	6.7
GT-56	ST-02	5.0	7.5	30	18	12	0.380	0.033	0.707	0.223	0.019	9.9
Mean Values				42	19	23	0.290	0.035	0.708	0.170	0.021	8.3
Standard Deviation				9	1	8	0.065	0.004		0.037	0.001	
Upper Bound Values				51	20	31	0.355	0.039		0.207	0.022	
Lower Bound Values				33	18	15	0.225	0.031		0.133	0.020	
Ferrelview Clay												
GT-46	ST-03	5.0	7.5				0.202	0.027	0.658	0.122	0.016	6.6
GT-47	ST-05	10.0	12.5	45	17	28	0.216	0.060	0.703	0.127	0.035	6.5
GT-48	ST-07	17.5	20.0	60	17	43	0.335	0.086	0.790	0.187	0.048	6.1
GT-53	ST-04	7.5	10.0	54	16	38	0.193	0.092	0.680	0.115	0.055	9.3
GT-55	ST-06	12.5	15.0	51	18	33	0.462	0.042	0.693	0.273	0.025	(1) 18.5
GT-58P	ST-03	7.5	10.0	66	20	46	0.202	0.040	0.770	0.114	0.023	7.0
GT-60P	ST-04	12.5	15.0				0.170	0.035	0.666	0.102	0.021	8.2
GT-70	7004	10.0	12.5	41	15	26	0.215	0.061	0.775	0.121	0.034	13.3
GT-73	7306	15.0	17.5	64	19	45	0.305	0.131	0.851	0.165	0.071	3.0
(2) GT-2T71	BU-02A	6.5	12.0	52	15	37	0.245	0.039	0.691	0.145	0.023	4.0
(2) GT-2T75	BU-02B	6.5	12.0	77	21	56	0.214	0.033	0.697	0.126	0.019	6.0
Mean Values				54	17	37	0.256	0.064	0.732	0.147	0.036	7.5
Standard Deviation				9	2	8	0.091	0.030		0.051	0.016	
Upper Bound Values				63	19	45	0.347	0.094		0.199	0.052	
Lower Bound Values				45	15	29	0.164	0.034		0.096	0.020	

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

MORRISON-KNUDSEN CORPORATION
WSSRAP

Project
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K-Lee

Sheet 102
File No.
Date 9/6/91
Date 9/6/91

CONSOLIDATION PARAMETERS
OVERALL VALUES

Hole Number	Sample Number	Depth From	Depth To	LL	PL	PI	Cc	Cr	e_o	$C_{\varepsilon c}$	$C_{\varepsilon r}$	Pp
		ft	ft									ksf
Clay Till												
GT-50	ST-06	12.5	15.0	63	18	45	0.260	0.075	0.675	0.155	0.045	15.0
GT-53	ST-08	17.5	20.0	58	17	41	0.236	0.068	0.601	0.147	0.042	(1) 22.5
GT-56	ST-06	15.0	17.0	44	15	29	0.248	0.061	0.569	0.158	0.039	(1) 30.0
GT-58P	ST-09	22.5	24.8				0.150	0.018	0.480	0.101	0.012	14.5
GT-60P	ST-10	27.5	30.0	44	17	27	0.152	0.045	0.573	0.097	0.029	7.6
GT-63P	ST-09	22.5	25.0	45	17	28	0.203	0.036	0.595	0.127	0.023	15.0
GT-68	6810	25.0	27.5	47	13	34	0.220	0.058	0.525	0.144	0.038	12.4
Mean Values				50	16	34	0.210	0.052	0.574	0.133	0.033	12.9
Standard Deviation				8	2	7	0.035	0.013		0.021	0.008	
Upper Bound Values				58	18	41	0.245	0.065		0.154	0.041	
Lower Bound Values				42	14	27	0.174	0.038		0.112	0.025	
Basal Till												
GT-69	6908	20.0	22.5	40	15	25	0.177	0.042	0.467	0.121	0.029	16.5
GT-71	7110	25.0	27.5	54	15	39	0.417	0.068	0.693	0.246	0.040	(1) 23.4
GT-73	7314	35.0	36.5	38	16	22	0.162	0.037	0.651	0.098	0.022	2.8
Mean Values				44	15	29	0.252	0.049	0.604	0.155	0.030	9.7
Standard Deviation				7	0	7	0.117	0.014		0.065	0.007	
Upper Bound Values				51	16	36	0.369	0.063		0.220	0.038	
Lower Bound Values				37	15	22	0.135	0.035		0.090	0.023	
Residuum												
GT-51	SB-09	20.0	21.5	74	24	50	0.265	0.097	1.034	0.130	0.048	5.0
GT-55	SB-12	27.5	29.0	70	20	50	0.268	0.096	0.740	0.154	0.055	7.6
GT-62	SB-15	37.5	39.0				0.372	0.075	1.307	0.161	0.033	10.3
Mean Values				72	22	50	0.302	0.089	1.027	0.154	0.045	7.6
Standard Deviation				2	2	0	0.050	0.010		0.020	0.009	
Upper Bound Values				74	24	50	0.352	0.099		0.174	0.055	
Lower Bound Values				70	20	50	0.252	0.079		0.134	0.036	

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

OVERALL VALUES

Pp and Po' Data

Hole Number	Sample Number	Depth From ft	Depth To ft	Approx. Depth ft	Pp ksf	Po' ksf	O.C.R Pp/Po'
Loess							
GT-50	ST-02	2.5	5.0	3.75	(1) 30.0	0.48	(1) 62.5
GT-55	ST-04	7.5	10.0	8.75	6.7	1.10	6.1
GT-56	ST-02	5.0	7.5	6.25	9.9	0.77	12.9
				Mean	8.3	Mean	9.5
Ferrelview Clay							
GT-46	ST-03	5.0	7.5	6.25	6.6	0.64	10.3
GT-47	ST-05	10.0	12.5	11.25	6.5	1.20	5.4
GT-48	ST-07	17.5	20.0	18.75	6.1	2.00	3.1
GT-53	ST-04	7.5	10.0	8.75	9.3	1.20	7.8
GT-55	ST-06	12.5	15.0	13.75	(1) 18.5	1.70	(1) 10.9
GT-58P	ST-03	7.5	10.0	8.75	7.0	1.10	6.4
GT-60P	ST-04	12.5	15.0	13.75	8.2	1.70	4.8
GT-70	7004	10.0	12.5	12.15	13.3	1.50	8.9
GT-73	7306	15.0	17.5	16.25	3.0	2.00	1.5
(2) GT-2T71	BU-02A	6.5	12.0	9.25	4.0	1.20	3.3
(2) GT-2T75	BU-02B	6.5	12.0	9.25	6.0	1.20	5.0
				Mean	7.5	Mean	6.0

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

(3) Underconsolidated.

OVERALL VALUES

Pp and Po' Data

Hole Number	Sample Number	Depth From ft	Depth To ft	Approx. Depth ft	Pp ksf	Po' ksf	O.C.R Pp/Po'
Clay Till							
GT-50	ST-06	12.5	15.0	13.75	15.0	1.70	8.8
GT-53	ST-08	17.5	20.0	18.75	(1) 22.5	2.30	(1) 9.8
GT-56	ST-06	15.0	17.0	16.00	(1) 30.0	2.10	(1) 14.3
GT-58P	ST-09	22.5	24.8	23.65	14.5	3.00	4.8
GT-60P	ST-10	27.5	30.0	28.75	7.6	3.60	2.1
GT-63P	ST-09	22.5	25.0	23.75	15.0	3.00	5.0
GT-68	6810	25.0	27.5	25.80	12.4	3.20	3.9
				Mean	12.9	Mean	4.9
Basal Till							
GT-69	6908	20.0	22.5	21.25	16.5	2.70	6.1
GT-71	7110	25.0	27.5	25.85	(1) 23.4	3.30	(1) 7.1
GT-73	7314	35.0	36.5	35.75	2.8	4.50	(3) 0.6
				Mean	9.7	Mean	3.4
Residuum							
GT-51	SB-09	20.0	21.5	20.75	5.0	2.20	2.3
GT-55	SB-12	27.5	29.0	28.25	7.6	3.40	2.2
GT-62	SB-15	37.5	39.0	38.25	10.3	2.40	4.3
				Mean	7.6	Mean	2.9

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

(3) Underconsolidated.

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
LOESS/FILL						
GT-50	ST-02	2.5	5.0	30.0	1.0	1.20E-04
					2.0	2.44E-04
					4.0	2.40E-04
					8.0	2.67E-04
					16.0	2.02E-04
					32.0	1.45E-04
					64.0	3.72E-04
					128.0	5.16E-05
GT-55	ST-04	7.5	10.0	6.7	1.0	9.69E-04
					2.0	6.69E-04
					4.0	9.36E-04
					8.0	6.65E-04
					16.0	4.57E-04
					32.0	3.82E-04
					64.0	4.21E-04
GT-56	ST-02	5.0	7.5	9.9	2.0	3.53E-04
					4.0	1.79E-03
					16.0	1.67E-03
					32.0	1.80E-03
					100.0	3.34E-04
					Average	6.04E-04

20.50 ft /yr

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
FERRELVIEW CLAY						
GT-46	ST-03	5.0	7.5	6.6	1.0	2.94E-03
					2.0	9.73E-04
					4.0	2.21E-03
					8.0	3.73E-03
					16.0	2.66E-03
					64.0	1.13E-03
GT-47	ST-05	10.0	12.5	6.5	1.0	1.37E-04
					2.0	1.76E-04
					4.0	2.93E-04
					8.0	2.83E-04
					16.0	2.07E-04
					32.0	3.38E-04
					64.0	1.99E-04
					120.0	1.84E-04
GT-48	ST-07	17.5	20.0	6.1	0.5	8.18E-05
					1.0	4.55E-05
					2.0	5.25E-05
					4.0	3.89E-05
					8.0	4.55E-05
					16.0	4.26E-05
					32.0	3.73E-05
					64.0	3.97E-05
GT-53	ST-04	7.5	10.0	9.3	1.0	8.43E-05
					2.0	6.38E-05
					4.0	6.13E-05
					8.0	6.36E-05
					16.0	4.58E-05
					32.0	3.32E-05
					64.0	3.43E-05
GT-55	ST-06	12.5	15.0	18.5	2.0	1.46E-04
					4.0	2.95E-04
					16.0	2.36E-04
					32.0	2.19E-04
					64.0	5.88E-04
					100.0	1.90E-04
GT-58P	ST-03	7.5	10.0	7.0	2.0	1.68E-02
					4.0	1.66E-02
					8.0	1.18E-04
					16.0	6.45E-05
					32.0	6.45E-05
					62.8	5.38E-05

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
FERRELVIEW CLAY (Cont'd)						
GT-60P	ST-04	12.5	15.0	10.0	2.0	6.56E-04
					4.0	4.30E-04
					8.0	2.47E-04
					16.0	1.40E-04
					32.0	7.53E-05
					62.8	4.30E-05
GT-70	7004	10.0	12.5	11.0	0.5	1.96E-04
					1.0	7.92E-04
					2.0	3.97E-04
					4.0	3.56E-04
					8.0	4.49E-04
					16.0	2.07E-04
					32.0	3.51E-04
					64.0	3.30E-04
					128.0	2.39E-04
GT-73	7306	15.0	17.5	3.0	0.5	5.90E-05
					1.0	2.26E-05
					2.0	2.27E-05
					4.0	2.13E-05
					8.0	2.00E-05
					16.0	2.11E-05
					32.0	2.06E-05
					64.0	3.22E-05
					128.0	1.67E-05
(1) GT-2T71	BU-02A	6.5	12	5	8.0	6.45E-05
					16.0	3.23E-05
					32.0	4.30E-05
					62.8	4.30E-05
(1) GT-2T75	BU-02B	6.5	12	7	2.0	3.10E-03
					4.0	5.27E-04
					8.0	1.72E-04
					16.0	4.30E-05
					32.0	5.38E-05
					62.8	5.38E-05
					Average	8.73E-04

29.63 ft /yr

(1) Cv values are not included in computing the average value because this is a remolded sample from soil recovered from a test pit.

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2 /sec
CLAY TILL						
GT-50	ST-06	12.5	15.0	15.0	2.0	6.67E-05
					4.0	1.03E-04
					8.0	1.07E-04
					16.0	1.10E-04
					32.0	1.09E-04
					64.0	7.02E-05
GT-53	ST-08	17.5	20	22.5	4.0	1.49E-04
					8.0	1.04E-04
					32.0	6.05E-05
					64.0	1.21E-04
					128.0	4.80E-04
GT-56	ST-06	15.0	17.0	30.0	1.0	5.96E-05
					2.0	2.09E-04
					4.0	2.88E-04
					8.0	2.54E-04
					16.0	1.20E-04
					32.0	6.94E-05
					64.0	5.71E-05
GT-58P	ST-09	22.5	24.8	16.0	16.0	5.38E-04
					32.0	2.47E-04
					62.8	1.61E-04
GT-60P	ST-10	27.5	30.0	8.5	2.0	2.91E-02
					4.0	1.16E-03
					8.0	4.84E-04
					16.0	3.23E-04
					32.0	1.61E-04
					62.8	1.29E-04
GT-63P	ST-09	22.5	25	16	1.0	3.52E-02
					2.0	6.94E-03
					4.0	5.72E-03
					8.0	1.44E-03
					16.0	6.67E-04
					32.0	3.33E-04
					62.8	1.83E-04
GT-68	6810	25.0	27.5	10.0	2.0	6.20E-04
					4.0	1.67E-03
					8.0	7.99E-04
					16.0	5.24E-04
					32.0	1.56E-04
					64.0	1.03E-04
					128.0	6.98E-05
					Average	2.18E-03

74.00 ft /yr

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2 /sec
BASAL TILL						
GT-69	6908	20.0	22.5	16.0	0.5	1.18E-04
					1.0	3.31E-04
					2.0	1.80E-03
					4.0	1.45E-03
					8.0	1.23E-03
					16.0	1.28E-03
					32.0	5.79E-04
					64.0	2.73E-04
GT-71	7110	25.0	27.5	21.0	2.0	2.12E-04
					4.0	2.23E-04
					8.0	2.34E-04
					16.0	3.27E-04
					32.0	1.55E-04
					64.0	2.34E-04
GT-73	7314	35.0	36.5	3.0	0.5	5.76E-05
					1.0	0.00E+00
					2.0	4.08E-04
					4.0	6.21E-04
					8.0	1.49E-03
					16.0	1.63E-03
					32.0	1.34E-03
					64.0	1.47E-03
					128.0	1.65E-03
					Average	7.44E-04

25.26 ft /yr

OVERALL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	Pp	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
RESIDUUM						
GT-51	SB-09	20.0	21.5	5.0	1.0	9.66E-05
					2.0	2.04E-04
					4.0	2.71E-04
					8.0	1.43E-04
					16.0	1.18E-04
					32.0	7.63E-05
					64.0	5.93E-05
GT-55	SB-12	27.5	29.0	7.6	1.0	6.39E-05
					2.0	5.42E-05
					4.0	5.82E-05
					8.0	7.26E-05
					32.0	4.92E-05
					64.0	2.99E-05
GT-62	SB-15	38.5	39.0	10.5	16.0	2.04E-04
					32.0	1.18E-04
					62.8	9.68E-05
					Average	1.07E-04

3.64 ft /yr

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 1/1
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked KEPE | Date 9/5/91 | Date 9/6/91

DISPOSAL CELL AREA

Pp and Po' Data

Hole Number	Sample Number	Depth From	Depth To	Approx. Depth	Pp	Po'	O.C.R
		ft	ft	ft	ksf	ksf	Pp/Po'
Loess							
GT-55	ST-04	7.5	10.0	8.75	6.7	1.10	6.1
GT-56	ST-02	5.0	7.5	6.25	9.9	0.77	12.9
				Mean	8.3	Mean	9.5
Ferrelview Clay							
GT-47	ST-05	10.0	12.5	11.25	6.5	1.20	5.4
GT-48	ST-07	17.5	20.0	18.75	6.1	2.00	3.1
GT-53	ST-04	7.5	10.0	8.75	9.3	1.20	7.8
GT-55	ST-06	12.5	15.0	13.75	(1) 18.5	1.70	(1) 10.9
GT-58P	ST-03	7.5	10.0	8.75	7.0	1.10	6.4
GT-60P	ST-04	12.5	15.0	13.75	8.2	1.70	4.8
GT-70	7004	10.0	12.5	12.15	13.3	1.50	8.9
(2) GT-2T75	BU-02B	6.5	12.0	9.25	6.0	1.20	5.0
				Mean	8.4	Mean	6.1
Clay Till							
GT-53	ST-08	17.5	20.0	18.75	(1) 22.5	2.30	(1) 9.8
GT-56	ST-06	15.0	17.0	16.00	(1) 30.0	2.10	(1) 14.3
GT-58P	ST-09	22.5	24.8	23.65	14.5	3.00	4.8
GT-60P	ST-10	27.5	30.0	28.75	7.6	3.60	2.1
GT-68	6810	25.0	27.5	25.80	12.4	3.20	3.9
				Mean	11.5	Mean	3.6
Basal Till							
GT-69	6908	20.0	22.5	21.25	16.5	2.70	6.1
GT-71	7110	25.0	27.5	25.85	(1) 23.4	3.30	(1) 7.1
				Mean		Mean	
Residuum							
GT-51	SB-09	20.0	21.5	20.75	5.0	2.20	2.3
GT-55	SB-12	27.5	29.0	28.25	7.6	3.40	2.2
GT-62	SB-15	37.5	39.0	38.25	10.3	2.40	4.3
				Mean	7.6	Mean	2.9

(1) Pp values are too high to be included in computing average values.
(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

CONSOLIDATION PARAMETERS
DISPOSAL CELL AREA

Hole Number	Sample Number	Depth From	Depth To	LL	PL	PI	Cc	Cr	e_o	$C_{\varepsilon c}$	$C_{\varepsilon r}$	Pp
		ft	ft									ksf
Loess												
GT-55	ST-04	7.5	10.0	50	21	29	0.260	0.041	0.816	0.143	0.023	6.7
GT-56	ST-02	5.0	7.5	30	18	12	0.380	0.033	0.707	0.223	0.019	9.9
Mean Values				40	20	21	0.320	0.037	0.762	0.183	0.021	8.3
Standard Deviation				10	2	9	0.060	0.004		0.040	0.002	
Upper Bound Values				50	21	29	0.380	0.041		0.223	0.023	
Lower Bound Values				30	18	12	0.260	0.033		0.143	0.019	
Ferrelview Clay												
GT-47	ST-05	10.0	12.5	45	17	28	0.216	0.060	0.703	0.127	0.035	6.5
GT-48	ST-07	17.5	20.0	60	17	43	0.335	0.086	0.790	0.187	0.048	6.1
GT-53	ST-04	7.5	10.0	54	16	38	0.193	0.092	0.680	0.115	0.055	9.3
GT-55	ST-06	12.5	15.0	51	18	33	0.462	0.042	0.693	0.273	0.025	(1) 18.5
GT-58P	ST-03	7.5	10.0	66	20	46	0.202	0.040	0.770	0.114	0.023	7.0
GT-60P	ST-04	12.5	15.0				0.170	0.035	0.666	0.102	0.021	8.2
GT-70	7004	10.0	12.5	41	15	26	0.215	0.061	0.775	0.121	0.034	13.3
(2) GT-2775	BU-02B	6.5	12.0	77	21	56	0.214	0.033	0.697	0.126	0.019	6.0
Mean Values				53	17	36	0.256	0.059	0.725	0.148	0.034	8.4
Standard Deviation				8	2	7	0.097	0.021		0.057	0.012	
Upper Bound Values				61	19	43	0.353	0.080		0.205	0.046	
Lower Bound Values				45	15	29	0.159	0.038		0.091	0.022	

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

CONSOLIDATION PARAMETERS
DISPOSAL CELL AREA

Hole Number	Sample Number	Depth From ft	Depth To ft	LL	PL	PI	Cc	Cr	e_o	$C_{\varepsilon c}$	$C_{\varepsilon r}$	Pp ksf
Clay Till												
GT-53	ST-08	17.5	20.0	58	17	41	0.236	0.068	0.601	0.147	0.042	22.5 (1)
GT-56	ST-06	15.0	17.0	44	15	29	0.248	0.061	0.569	0.158	0.039	30.0 (1)
GT-58P	ST-09	22.5	24.8				0.150	0.018	0.480	0.101	0.012	14.5
GT-60P	ST-10	27.5	30.0	44	17	27	0.152	0.045	0.573	0.097	0.029	7.6
GT-68	6810	25.0	27.5	47	13	34	0.220	0.058	0.525	0.144	0.038	12.4
Mean Values				48	16	33	0.201	0.050	0.550	0.130	0.032	11.5
Standard Deviation				6	2	5	0.042	0.018		0.025	0.011	
Upper Bound Values				54	18	38	0.243	0.068		0.155	0.043	
Lower Bound Values				42	14	28	0.159	0.032		0.105	0.021	
Basal Till												
GT-69	6908	20.0	22.5	40	15	25	0.177	0.042	0.467	0.121	0.029	16.5
GT-71	7110	25.0	27.5	54	15	39	0.417	0.068	0.693	0.246	0.040	23.4 (1)
Mean Values				47	15	32	0.297	0.055	0.580	0.184	0.035	16.5
Standard Deviation				7	0	7	0.120	0.013		0.063	0.006	
Upper Bound Values				54	15	39	0.417	0.068		0.247	0.041	
Lower Bound Values				40	15	25	0.177	0.042		0.121	0.029	
Residuum												
GT-51	SB-09	20.0	21.5	74	24	50	0.265	0.097	1.034	0.130	0.048	5.0
GT-55	SB-12	27.5	29.0	70	20	50	0.268	0.096	0.740	0.154	0.055	7.6
GT-62	SB-15	37.5	39.0				0.372	0.075	1.307	0.161	0.033	10.3
Mean Values				72	22	50	0.302	0.089	1.027	0.148	0.045	7.6
Standard Deviation				2	2	0	0.050	0.010		0.013	0.009	
Upper Bound Values				74	24	50	0.352	0.099		0.162	0.055	
Lower Bound Values				70	20	50	0.252	0.079		0.135	0.036	

(1) Pp values are too high to be included in computing average values.

(2) Data are not included in computing the average values because this is a remolded sample from soil recovered from a test pit.

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
LOESS/FILL						
GT-55	ST-04	7.5	10.0	6.7	1.0	9.69E-04
					2.0	6.69E-04
					4.0	9.36E-04
					8.0	6.65E-04
					16.0	4.57E-04
					32.0	3.82E-04
					64.0	4.21E-04
GT-56	ST-02	5.0	7.5	9.9	2.0	3.53E-04
					4.0	1.79E-03
					16.0	1.67E-03
					32.0	1.80E-03
					100.0	3.34E-04
					Average	8.70E-04

29.55 ft /yr

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2 /sec
FERRELVIEW CLAY						
GT-47	ST-05	10.0	12.5	6.5	1.0	1.37E-04
					2.0	1.76E-04
					4.0	2.93E-04
					8.0	2.83E-04
					16.0	2.07E-04
					32.0	3.38E-04
					64.0	1.99E-04
					120.0	1.84E-04
GT-48	ST-07	17.5	20.0	6.1	0.5	8.18E-05
					1.0	4.55E-05
					2.0	5.25E-05
					4.0	3.89E-05
					8.0	4.55E-05
					16.0	4.26E-05
					32.0	3.73E-05
					64.0	3.97E-05
GT-53	ST-04	7.5	10.0	9.3	1.0	8.43E-05
					2.0	6.38E-05
					4.0	6.13E-05
					8.0	6.36E-05
					16.0	4.58E-05
					32.0	3.32E-05
					64.0	3.43E-05
GT-55	ST-06	12.5	15.0	18.5	2.0	1.46E-04
					4.0	2.95E-04
					16.0	2.36E-04
					32.0	2.19E-04
					64.0	5.88E-04
					100.0	1.90E-04
GT-58P	ST-03	7.5	10.0	7.0	2.0	1.68E-02
					4.0	1.66E-02
					8.0	1.18E-04
					16.0	6.45E-05
					32.0	6.45E-05
					62.8	5.38E-05

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv		
		ft	ft	ksf	ksf	cm^2 /sec		
FERRELVIEW CLAY (Cont'd)								
GT-60P	ST-04	12.5	15.0	10.0	2.0	6.56E-04		
					4.0	4.30E-04		
					8.0	2.47E-04		
					16.0	1.40E-04		
					32.0	7.53E-05		
					62.8	4.30E-05		
GT-70	7004	10.0	12.5	11.0	0.5	1.96E-04		
					1.0	7.92E-04		
					2.0	3.97E-04		
					4.0	3.56E-04		
					8.0	4.49E-04		
					16.0	2.07E-04		
					32.0	3.51E-04		
					64.0	3.30E-04		
					128.0	2.39E-04		
(1) GT-2T75	BU-02B	6.5	12.0	7.0	2.0	3.10E-03		
					4.0	5.27E-04		
					8.0	1.72E-04		
					16.0	4.30E-05		
					32.0	5.38E-05		
					62.8	5.38E-05		
					Average	8.58E-04	29.14	ft /yr

(1) Cv values are not included in computing the average value because this is a remolded sample from soil recovered from a test pit.

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2/sec
CLAY TILL						
GT-53	ST-08	17.5	20.0	22.5	4.0	1.49E-04
					8.0	1.04E-04
					32.0	6.05E-05
					64.0	1.21E-04
					128.0	4.80E-04
GT-56	ST-06	15.0	17.0	30.0	1.0	5.96E-05
					2.0	2.09E-04
					4.0	2.88E-04
					8.0	2.54E-04
					16.0	1.20E-04
					32.0	6.94E-05
					64.0	5.71E-05
GT-58P	ST-09	22.5	24.8	16.0	16.0	5.38E-04
					32.0	2.47E-04
					62.8	1.61E-04
GT-60P	ST-10	27.5	30.0	8.5	2.0	2.91E-02
					4.0	1.16E-03
					8.0	4.84E-04
					16.0	3.23E-04
					32.0	1.61E-04
					62.8	1.29E-04
GT-68	6810	25.0	27.5	10.0	2.0	6.20E-04
					4.0	1.67E-03
					8.0	7.99E-04
					16.0	5.24E-04
					32.0	1.56E-04
					64.0	1.03E-04
					128.0	6.98E-05
					Average	1.37E-03

46.35 ft /yr

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv		
		ft	ft	ksf	ksf	cm^2/sec		
BASAL TILL								
GT-69	6908	20.0	22.5	16.0	0.5	1.18E-04		
					1.0	3.31E-04		
					2.0	1.80E-03		
					4.0	1.45E-03		
					8.0	1.23E-03		
					16.0	1.28E-03		
					32.0	5.79E-04		
					64.0	2.73E-04		
GT-71	7110	25.0	27.5	21.0	2.0	2.12E-04		
					4.0	2.23E-04		
					8.0	2.34E-04		
					16.0	3.27E-04		
					32.0	1.55E-04		
					64.0	2.34E-04		
					Average	6.03E-04	20.48	ft /yr

DISPOSAL CELL AREA
COEFFICIENT OF CONSOLIDATION Cv

Hole or Trench No	Sample Number	Depth From	Depth To	P'p	Applied Pressure	Cv
		ft	ft	ksf	ksf	cm^2 /sec
RESIDUUM						
GT-51	SB-09	20.0	21.5	5.0	1.0	9.66E-05
					2.0	2.04E-04
					4.0	2.71E-04
					8.0	1.43E-04
					16.0	1.18E-04
					32.0	7.63E-05
					64.0	5.93E-05
GT-55	SB-12	27.5	29.0	7.6	1.0	6.39E-05
					2.0	5.42E-05
					4.0	5.82E-05
					8.0	7.26E-05
					32.0	4.92E-05
					64.0	2.99E-05
GT-62	SB-15	38.5	39.0	10.5	16.0	2.04E-04
					32.0	1.18E-04
					62.8	9.68E-05
					Average	1.07E-04

3.64 ft /yr

Bore hole # GT-58P
Sample # ST-03
Depth, ft 7.5-10'
Soil Unit FERRELVIEW

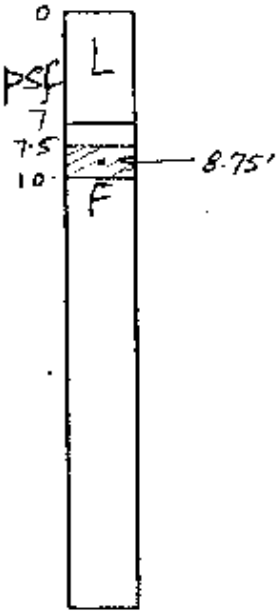
e_o = Hv/Hs = (Hi − Hs) / Hs

where
Hi = Initial height, in = 1
Hs = Solids height, in = 0.56499
Hv = Voids height, in = 0.43501

$e_o = \frac{1-0.56499}{0.56499} = 0.7699$

$P'_o = (7 \times 121) + (1.75 \times 124) = 1064$ psf
say 1060 psf

$P_p = 7000$ psf



From e – log p curve

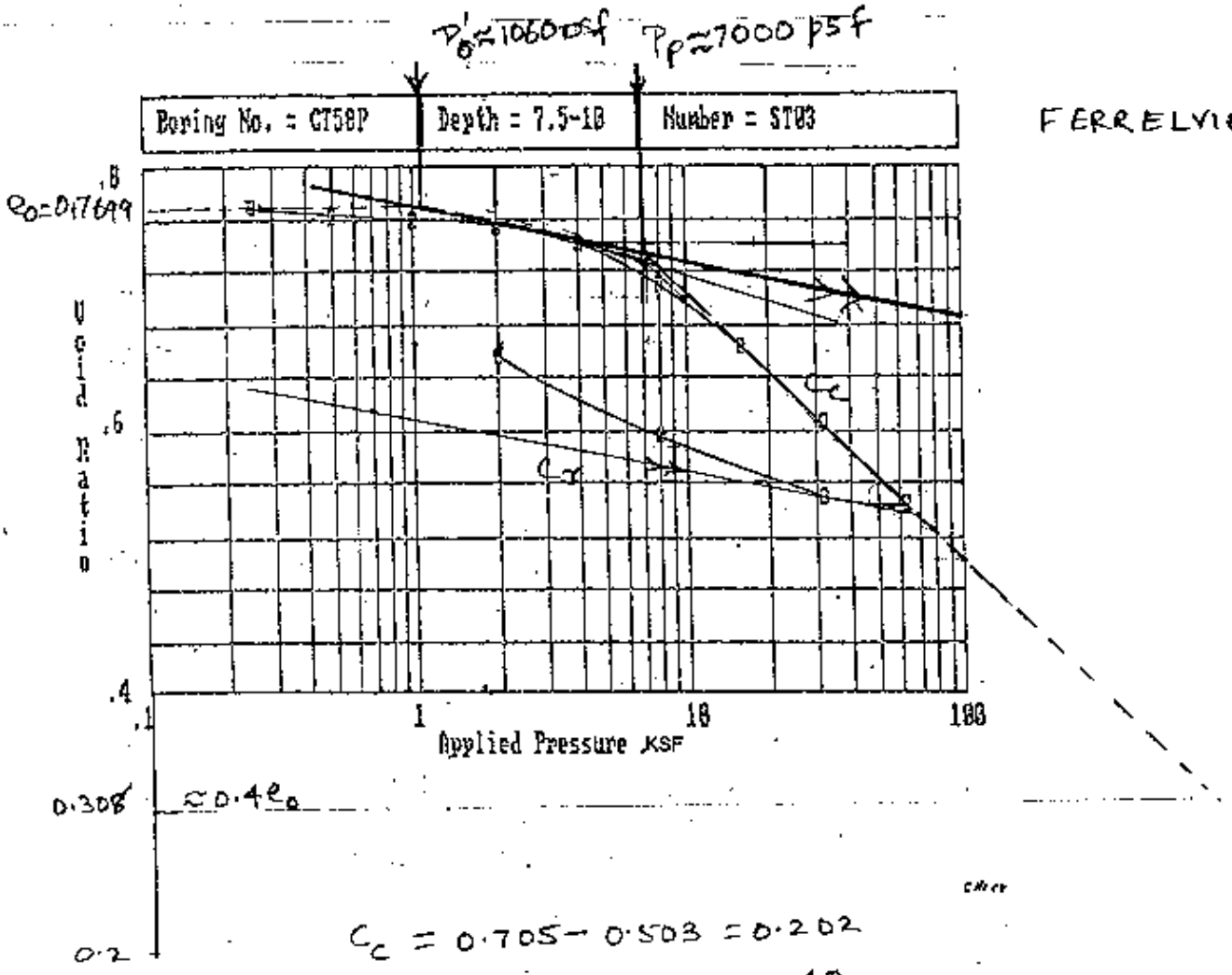
$C_c = 0.705 - 0.503 = 0.202$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.202}{1.7699} = 0.114$

$C_r = 0.61 - 0.57 = 0.040$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.040}{1.7699} = 0.023$

O.C.R = $\frac{7000}{1060} = 6.6$



$C_c = 0.705 - 0.503 = 0.202$

$C_r = 0.61 - 0.57 = 0.040$

Bore hole # GT-58P
Sample # ST-09
Depth, ft 22.5-24.8
Soil Unit CLAY TILL

e_o = Hv/Hs = (Hi – Hs) / Hs

where

Hi = Initial height, in = 1.002

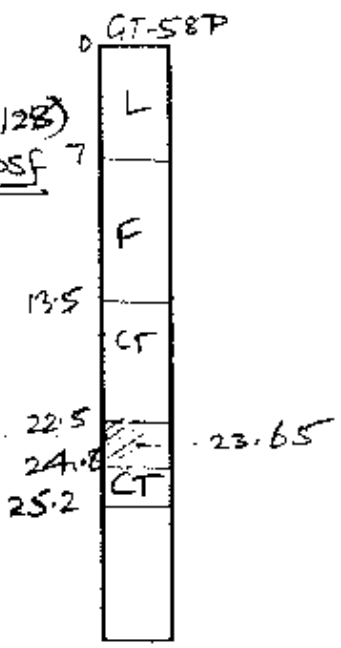
Hs = Solids height, in = 0.67685

Hv = Voids height, in = 0.32515

$$e_o = \frac{1.002 - 0.67685}{0.67685} = 0.4804$$

$$P'_o = (7 \times 121) + (6.5 \times 124) + (10.15 \times 128)$$
$$= 2952.2 \text{ psf} \quad \text{say } \underline{2950 \text{ psf}}$$

P_p = 14,500 psf



From e – log p curve

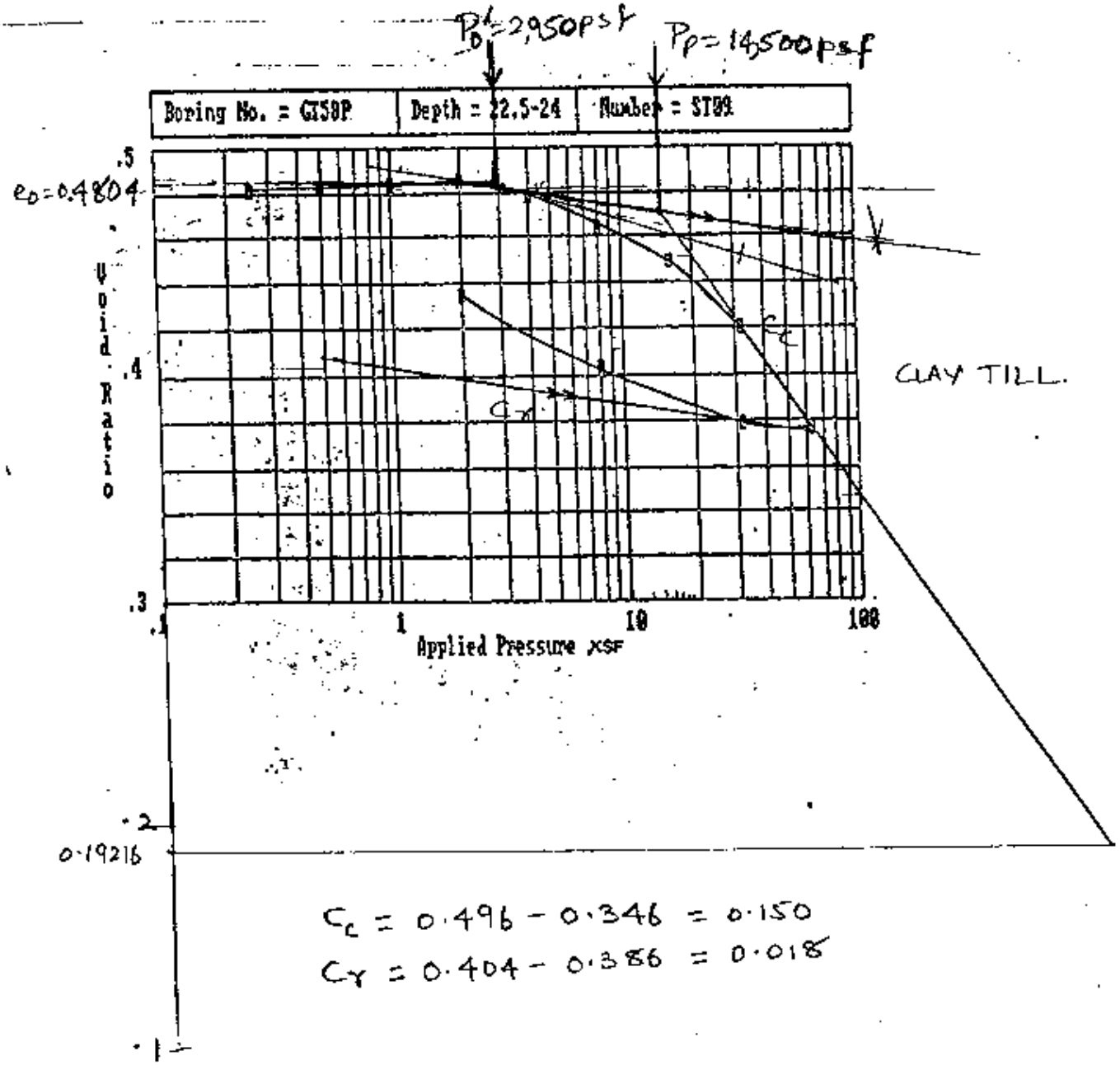
$$C_c = 0.496 - 0.346 = 0.15$$

$$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.150}{1.4804} = 0.101$$

$$C_r = 0.404 - 0.386 = 0.018$$

$$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.018}{1.4804} = 0.012$$

$$\text{O.C.R} = \frac{14,500}{2,950} = 4.9$$



$C_c = 0.496 - 0.346 = 0.150$

$C_r = 0.404 - 0.386 = 0.018$

Bore hole # GT-60P
Sample # ST-04
Depth, ft 12.5-15
Soil Unit FERRELVIEW

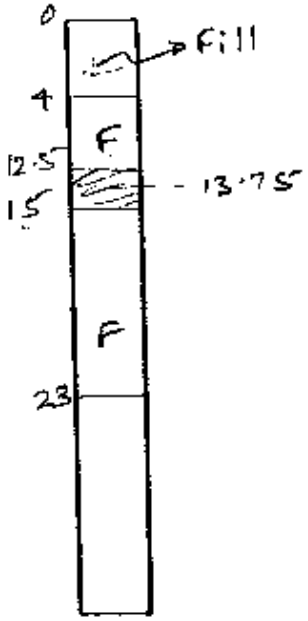
e_o = Hv/Hs = (Hi − Hs) / Hs

where
Hi = Initial height, in = 0.999
Hs = Solids height, in = 0.59982
Hv = Voids height, in = 0.39918

$$e_o = \frac{0.999 - 0.59982}{0.59982} = 0.6655$$

$$P'_o = (4 \times 123) + (9.75 \times 124)$$
$$= 1701 \text{ psf say } \underline{1700 \text{ psf}}$$

P_p = 8,200 psf



From e − log p curve

$C_c = 0.630 - .460 = 0.170$

$$C_{\varepsilon c} = \frac{0.170}{1.6655} = 0.102$$

$C_r = 0.549 - 0.514 = 0.035$

$$C_{\varepsilon r} = \frac{0.035}{1.6655} = 0.021$$

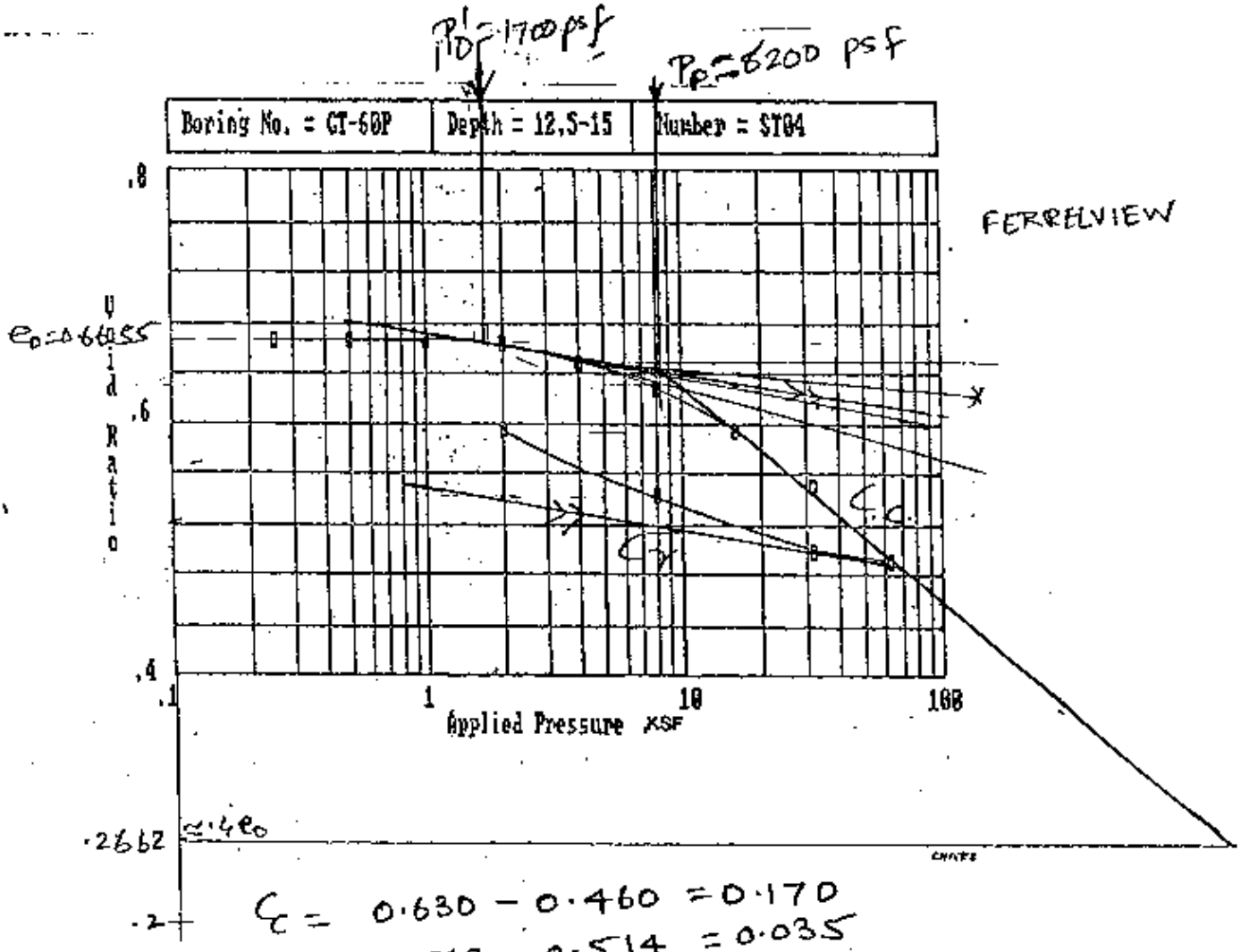
$$O.C.R = \frac{8200}{1700} = 4.8$$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 125
File No.
Date 09/02/91
Date 9/17/91



$C_c = 0.630 - 0.460 = 0.170$

$C_r = 0.549 - 0.514 = 0.035$

Bore hole # GT-60P
Sample # ST-10
Depth, ft 27.5-30
Soil Unit CLAY TILL

e_o = Hv/Hs = (Hi – Hs) / Hs

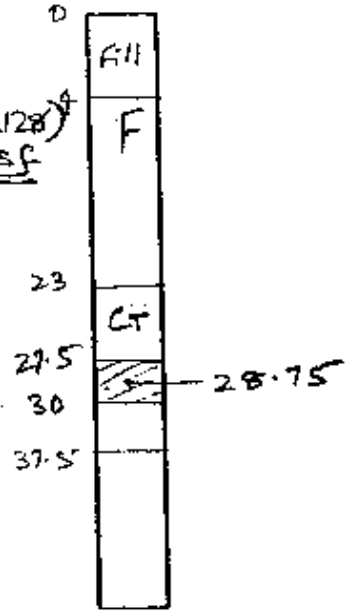
where

Hi = Initial height, in = 0.998
Hs = Solids height, in = 0.63458
Hv = Voids height, in = 0.36342

$$e_o = \frac{0.998 - .63458}{.63458} = 0.5727$$

$$P'_o = (4 \times 123) + (19 \times 124) + (5.75 \times 128)^{\#}$$
$$= 3584 \text{ psf} \quad \text{say } 3580 \text{ psf}$$

P_p = 7,600 psf



From e – log p curve

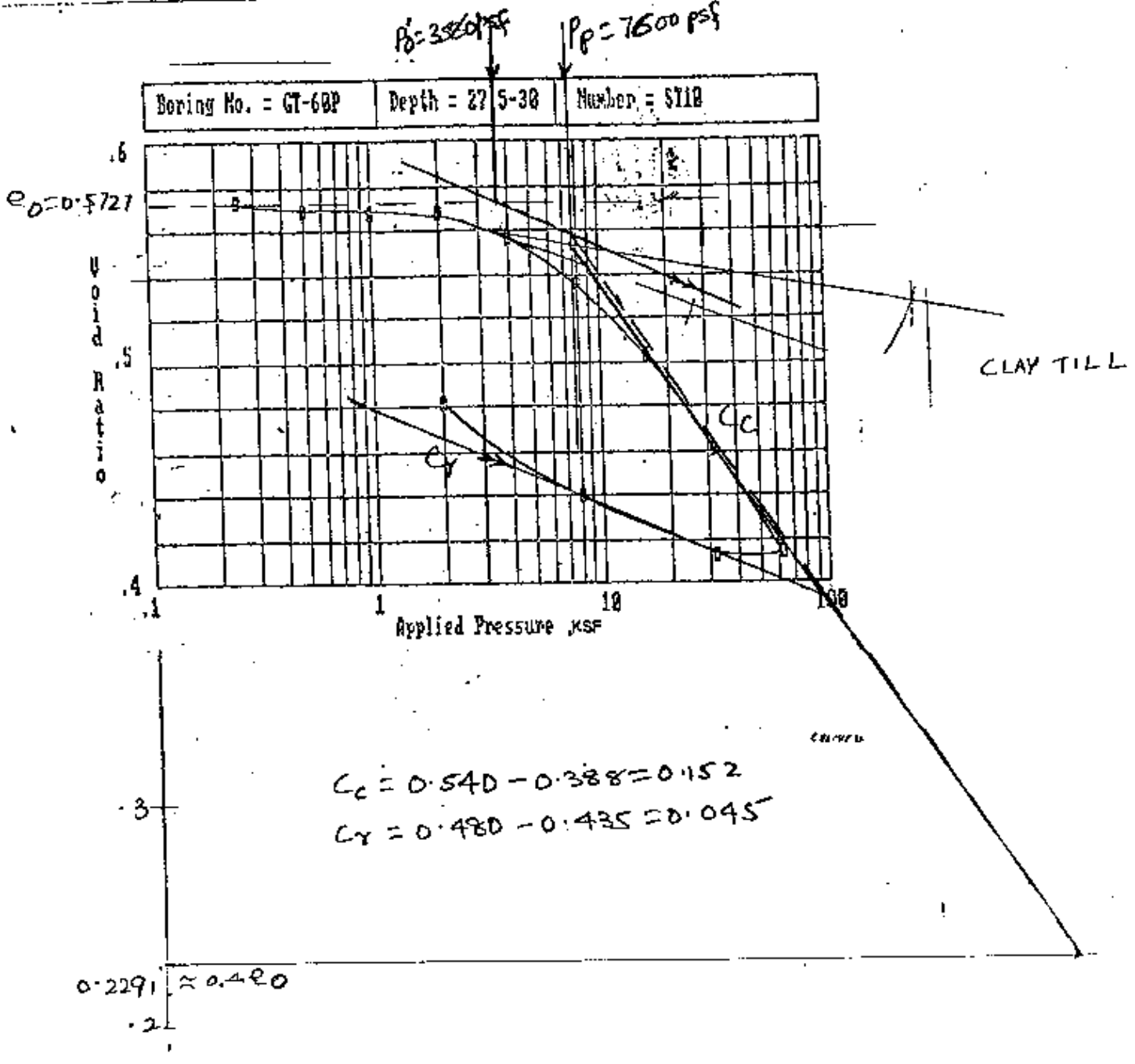
$C_c = 0.54 - .388 = 0.152$

$$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.152}{1.5727} = 0.097$$

$C_r = 0.480 - 0.435 = 0.045$

$$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.045}{1.5727} = 0.029$$

$$O.C.R = \frac{7600}{3580} = 2.1$$


Pc = 3800 psf
Pp = 7600 psf
Boring No. = GT-68P
Depth = 27.5-30
Number = ST18
.6
.5
.4
Void Ratio
e0 = 0.5721
.1
1
10
100
Applied Pressure, KSF
CLAY TILL
Cc
Cr
3
2
0.2291
≈ 0.480
Cc = 0.540 - 0.388 = 0.152
Cr = 0.480 - 0.435 = 0.045

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 128
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked K. Lee | Date 9/2/91 | Date 9/17/91

Bore hole # GT-62
Sample # SB-15
Depth, ft 37.5-39
Soil Unit RESIDUUM

e_o = Hv/Hs = (Hi − Hs) / Hs

where

Hi = Initial height, in = 1.124

Hs = Solids height, in = 0.48726

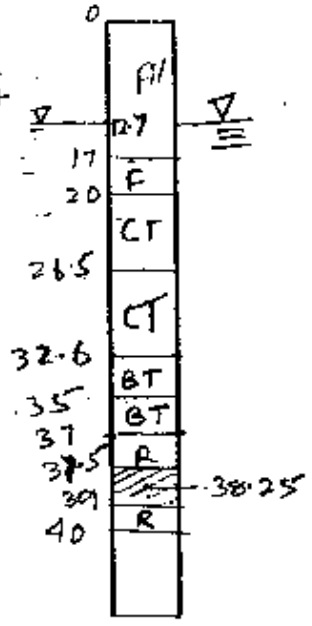
Hv = Voids height, in = 0.63674

$$e_o = \frac{1.124 - 0.48726}{.48726} = 1.3068$$

$$P'_o = (17 \times 123) + (3 \times 124) + (7 \times 128) + (1.25 \times 116) - (38.25 \times 62.4)$$

$$= 2400 \text{ psf}$$

P_p = 10,300 psf



From e − log p curve

$C_c = 1.270 - 0.898 = 0.372$

$$C_{\varepsilon c} = \frac{C_c}{1 + e_o} = \frac{0.372}{2.3068} = 0.161$$

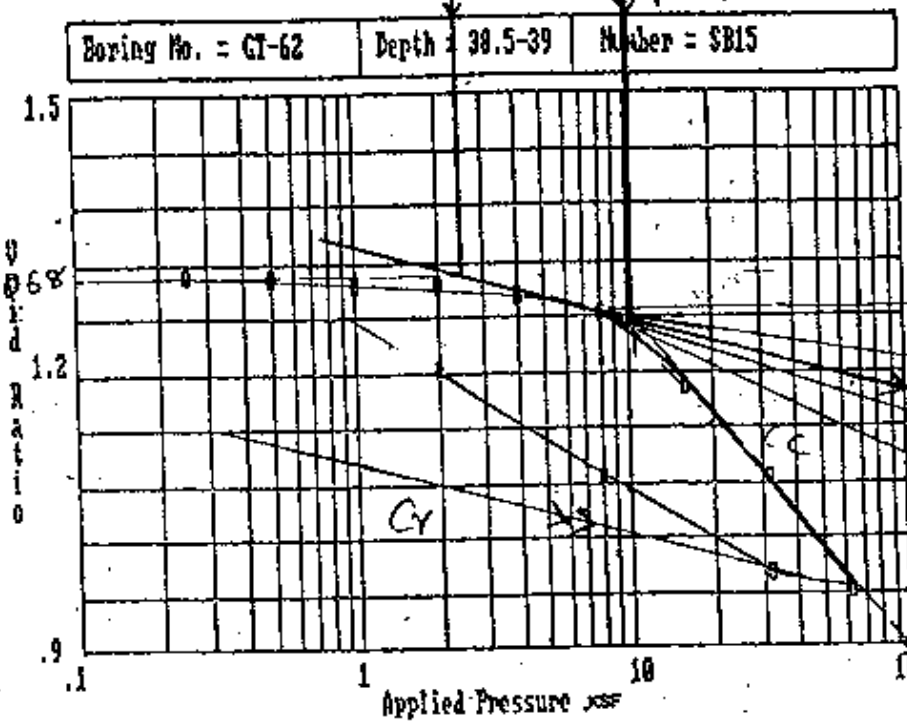
$C_r = 1.101 - 1.026 = 0.075$

$$C_{\varepsilon r} = \frac{C_r}{1 + e_o} = \frac{0.075}{2.3068} = 0.033$$

$$O.C.R = \frac{10,300}{2,400} = 4.3$$

$P_o' = 2400$ psf

$P_p = 10{,}300$ psf



RESIDUUM

$e_o = 1.398$

Δe_o

.523

.6

.3

$C_c = 1.270 - 0.898 = 0.372$

$C_r = 1.101 - 1.026 = 0.075$

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 130
Feature DISPOSAL CELL | Designed ND | File No.
Item MATERIAL PROPERTIES | Checked K.Okee | Date 9/2/91 | Date 9/17/91

Bore hole # GT-63P
Sample # ST-09
Depth, ft 22.5-25
Soil Unit CLAY TILL

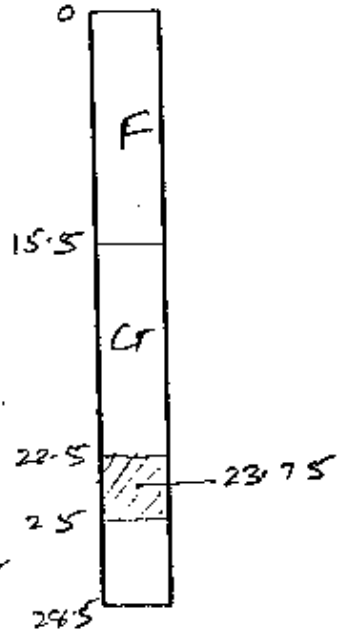
e_o = Hv/Hs = (Hi - Hs) / Hs

where
Hi = Initial height, in = 1
Hs = Solids height, in = 0.627
Hv = Voids height, in = .373

$e_o = \frac{1-.627}{.627} = 0.5949$

$P'_o = (15.5' \times 124) + (8.25 \times 126)$
$= 2978$ psf say 2980 psf

$P_p = 15,000$ psf



From e - log p curve

$C_c = 0.603 - 0.4 = 0.203$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.203}{1.5949} = 0.127$

$C_r = .507 - .471 = 0.036$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.036}{1.5949} = 0.023$

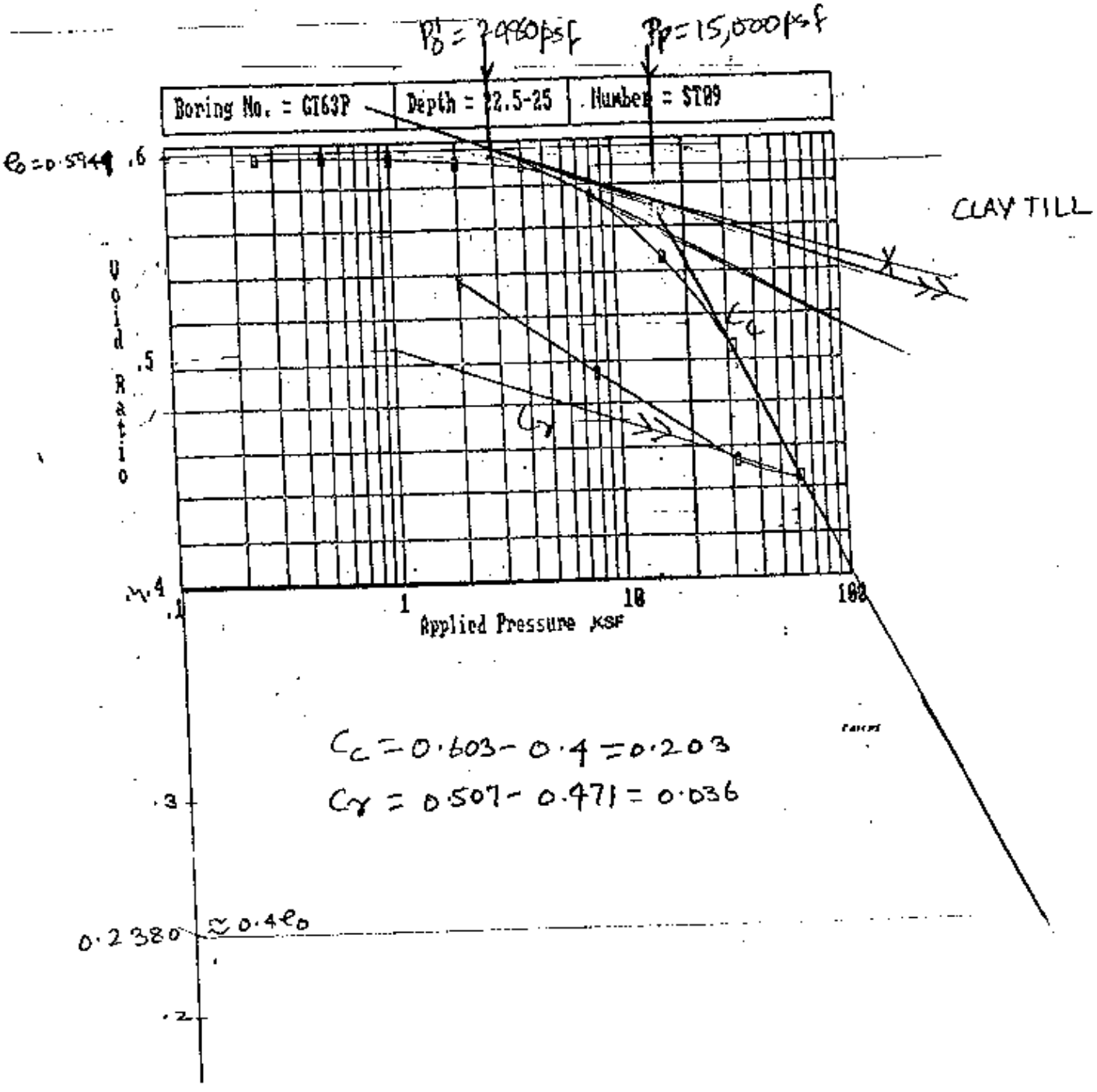
O.C.R = $\frac{15,000}{2,980} = 5.0$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K Lee

Sheet 131
File No.
Date 09/02/91
Date 9/17/91



Bore hole # GT-2T71
Sample # BU-02A
Depth, ft 6.5-12
Soil Unit FERRELVIEW

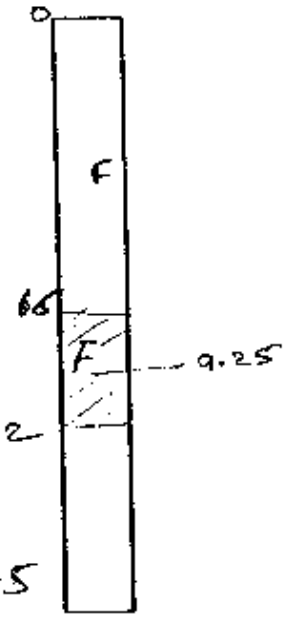
e_o = Hv/Hs = (Hi – Hs) / Hs

where
Hi = Initial height, in = 1
Hs = Solids height, in = .59129
Hv = Voids height, in = .40871

$$e_o = \frac{1-.59129}{.59129} = 0.6912$$

$$P'_o = 9.25 \times 124 = 1147 \text{ psf}$$
$$\approx 1150 \text{ psf}$$

$$P_p = 4000 \text{ psf}$$



From e – log p curve

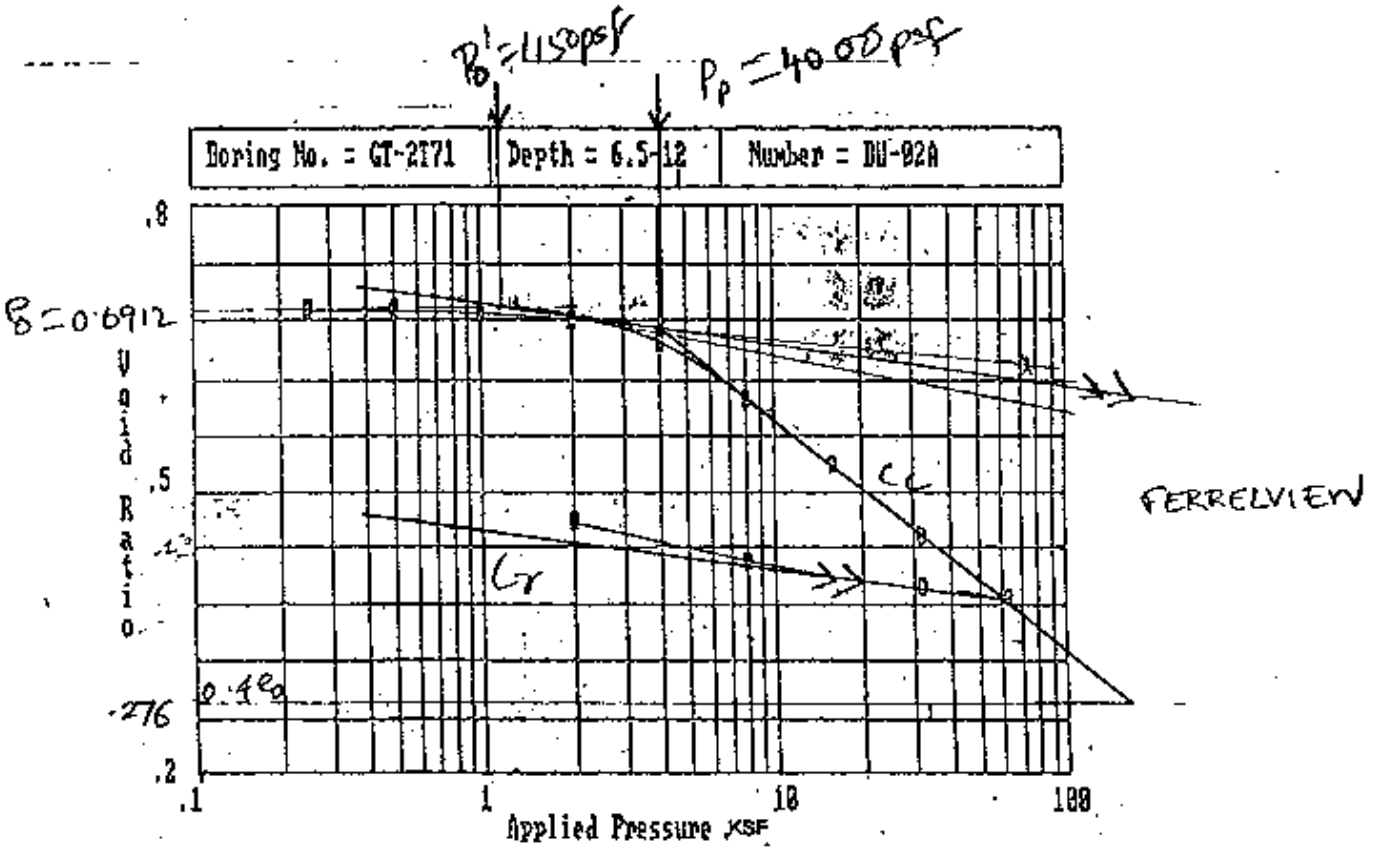
$$C_c = 0.577 - 0.332 = 0.245$$

$$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.245}{1.6912} = 0.145$$

$$C_r = 0.459 - 0.420 = 0.039$$

$$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.039}{1.6912} = 0.023$$

$$\text{O.C.R} = \frac{4000}{1150} = 3.5$$



$C_c = 0.577 - 0.332 = 0.245$

$C_r = 0.459 - 0.420 = 0.039$

Bore hole # GT-2T75
Sample # BU-02B
Depth, ft 6.5 -12
Soil Unit FERRELVIEW

e_o = Hv/Hs = (Hi – Hs) / Hs

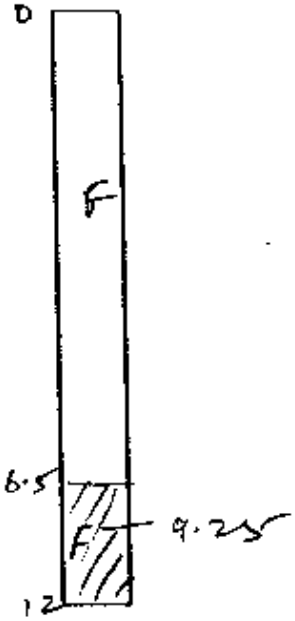
where

Hi = Initial height, in = 0.998
Hs = Solids height, in = 0.58821
Hv = Voids height, in = 0.40979

$$e_o = \frac{0.998 - .58821}{.58821} = 0.6967$$

$$P'_o = 9.25 \times 124 = 1147 \text{ psf} \approx 11.50 \text{ psf}$$

$$P_p = 6000 \text{ psf}$$



From e – log p curve

$$C_c = 0.639 - 0.425 = 0.214$$

$$C_{\Sigma c} = \frac{C_c}{1+e_o} = \frac{0.214}{1.6967} = 0.126$$

$$C_r = 0.526 - 0.493 = 0.033$$

$$C_{\Sigma r} = \frac{C_r}{1+e_o} = \frac{0.033}{1.6967} = 0.019$$

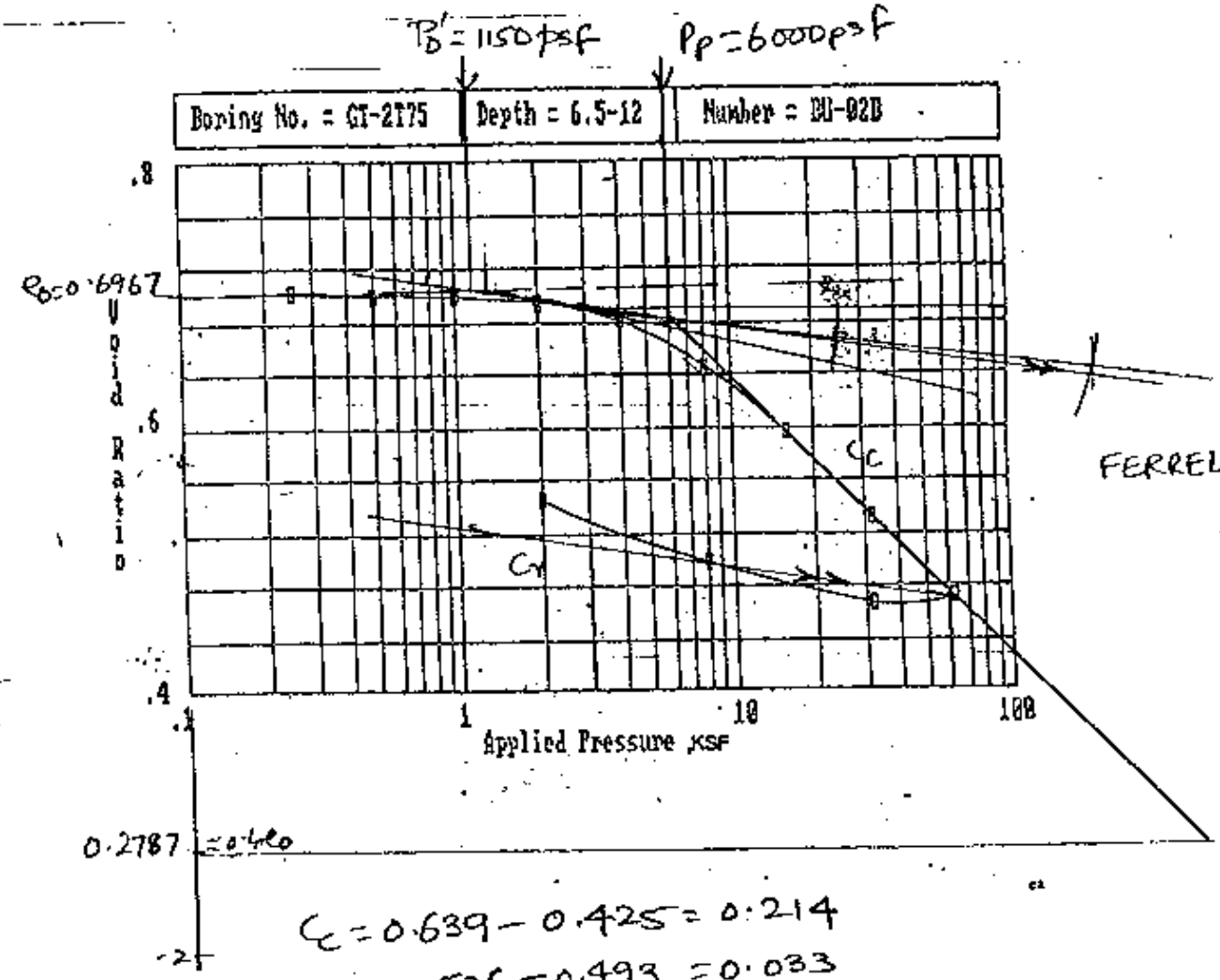
$$\text{O.C.R} = \frac{6000}{11.50} = 5.2$$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked R. Koe

Sheet 135
File No.
Date 09/02/91
Date 9/17/91



FERRELVIEW CLAY

$C_c = 0.639 - 0.425 = 0.214$

$C_r = 0.526 - 0.493 = 0.033$

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K Lee

Sheet 136
File No.
Date 9/2/91
Date 9/17/91

Bore hole # GT-68
Sample # 6810
Depth, ft @ 25-27.5
Soil Unit CLAY TILL

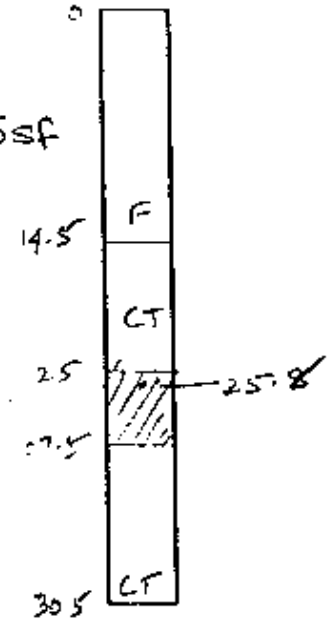
e_o = Hv/Hs = (Hi - Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.525$

$P'_o = (14.5 \times 124) + (11.3 \times 128)$
$= 3244$ psf say 3240 psf

$P_p = 12,400$ psf



From e - log p curve

$C_c = 0.532 - 0.312 = 0.220$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.22}{1.525} = 0.144$

$C_r = 0.406 - 0.348 = 0.058$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.058}{1.525} = 0.038$

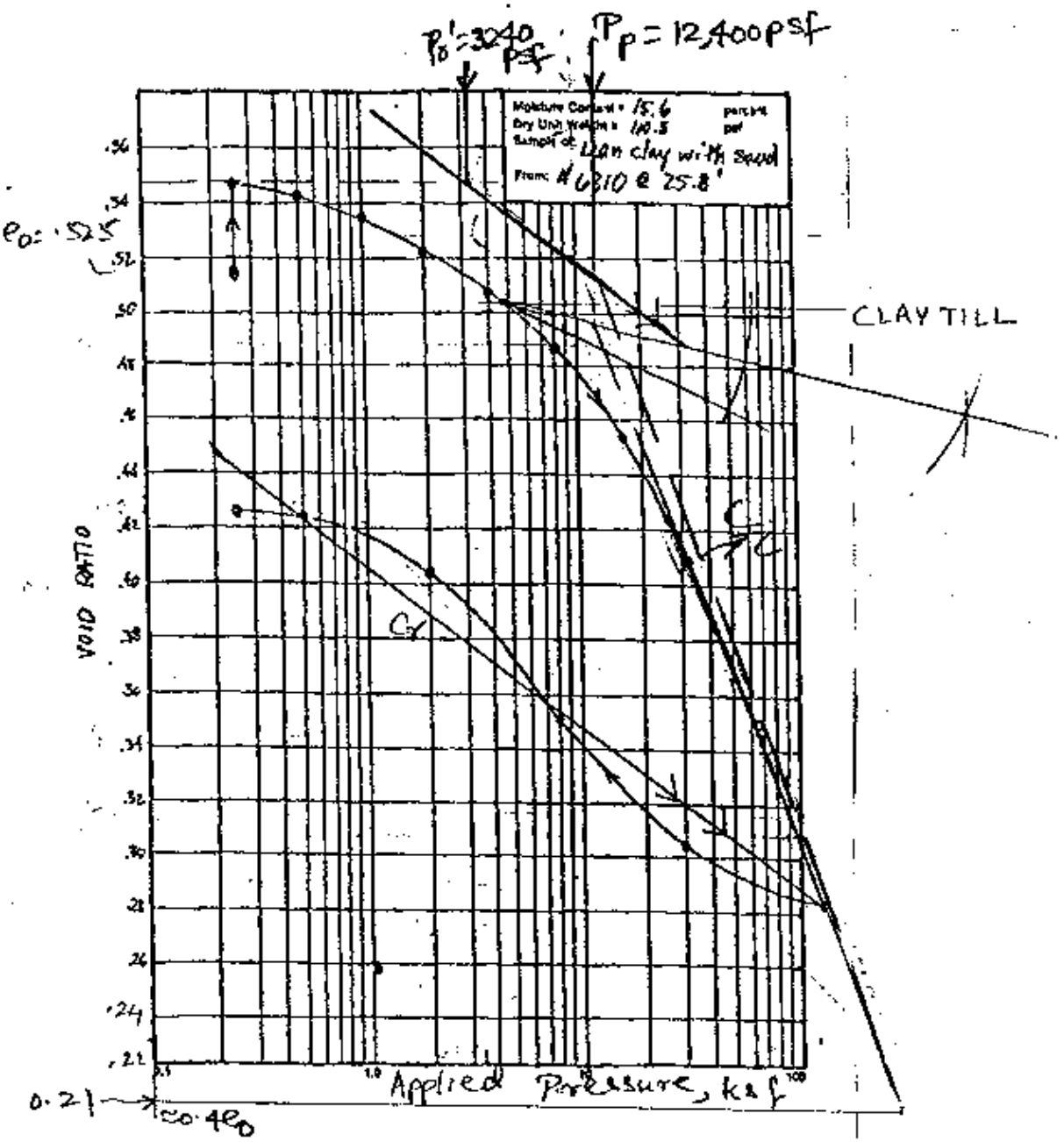
O.C.R = $\frac{12,400}{3240} = 3.8$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 137
File No.
Date 09/02/91
Date 9/17/91



$C_c = 0.532 - 0.312 = 0.220$

$C_r = 0.406 - 0.348 = 0.058$

Bore hole # GT-69
Sample # 6908
Depth, ft 20 - 22.5'
Soil Unit BASAL TILL

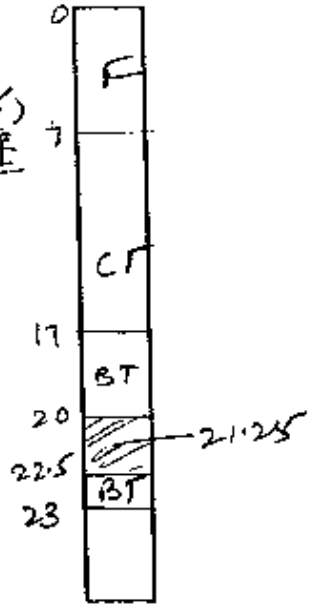
e_o = Hv/Hs = (Hi - Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.467$

$P'_o = (7 \times 124) + (10 \times 126) + (4.25 \times 128)$
$= 2692$ psf say 2690 psf

$P_p = 16{,}500$ psf



From e – log p curve

$C_c = \frac{0.488 - 0.35}{\log(\frac{60}{10})} = 0.177$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.177}{1.467} = 0.121$

Assuming no sample disturbance

$C_r = 0.420 - 0.378 = 0.042$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.042}{1.467} = 0.029$

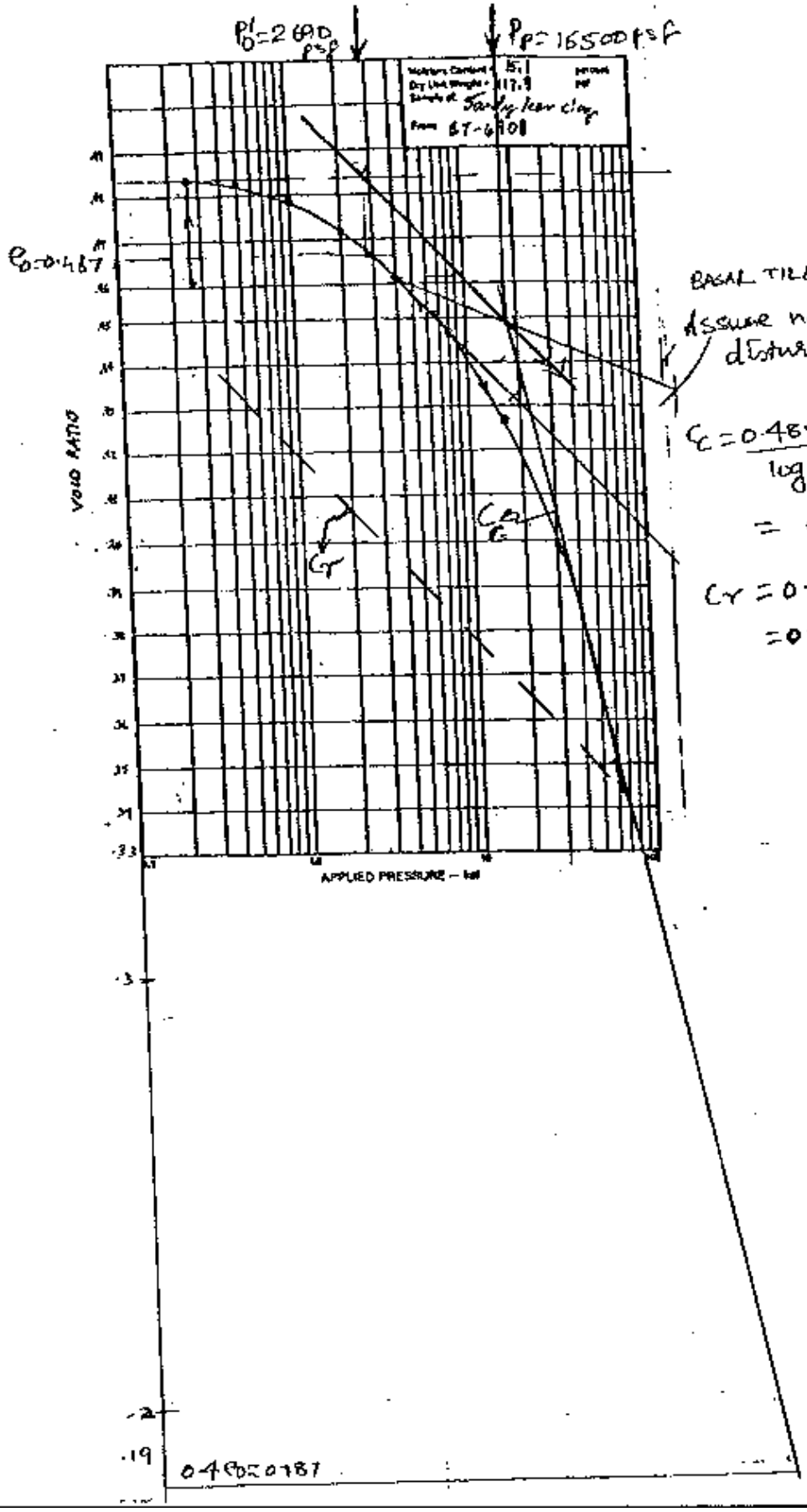
O.C.R = $\frac{16{,}500}{2{,}690} = 6.1$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Koe

Sheet 139
File No.
Date 09/02/91
Date 9/17/91



BASAL TILL
Assume no sample disturbance

$$C_c = \frac{0.488 - 0.35}{\log\left(\frac{60}{10}\right)} = 0.177$$

$$C_r = 0.420 - 0.378 = 0.042$$

Bore hole # GT-70
Sample # 7004
Depth, ft 10 – 12.5
Soil Unit FERRELVIEW

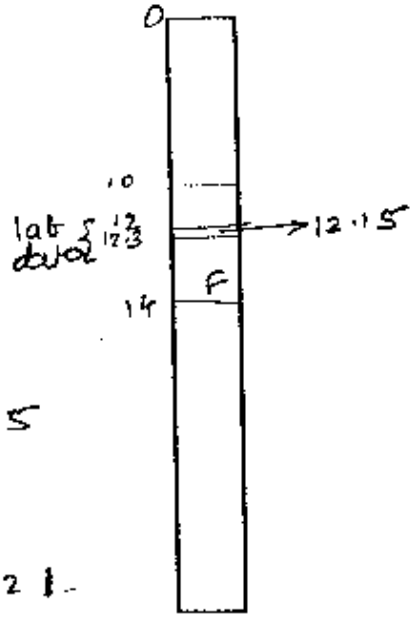
e_o = Hv/Hs = (Hi – Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.775$

$p'_o = 12.15 \times 124 = 1506.6$
say 1510 psf

$P_p = 13,300$ psf



From e – log p curve

$C_c = 0.751 - 0.536 = 0.215$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.215}{1.775} = 0.121$

$C_r = 0.624 - 0.563 = 0.061$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.061}{1.775} = 0.034$

O.C.R = $\frac{13,300}{1,510} = 8.8$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

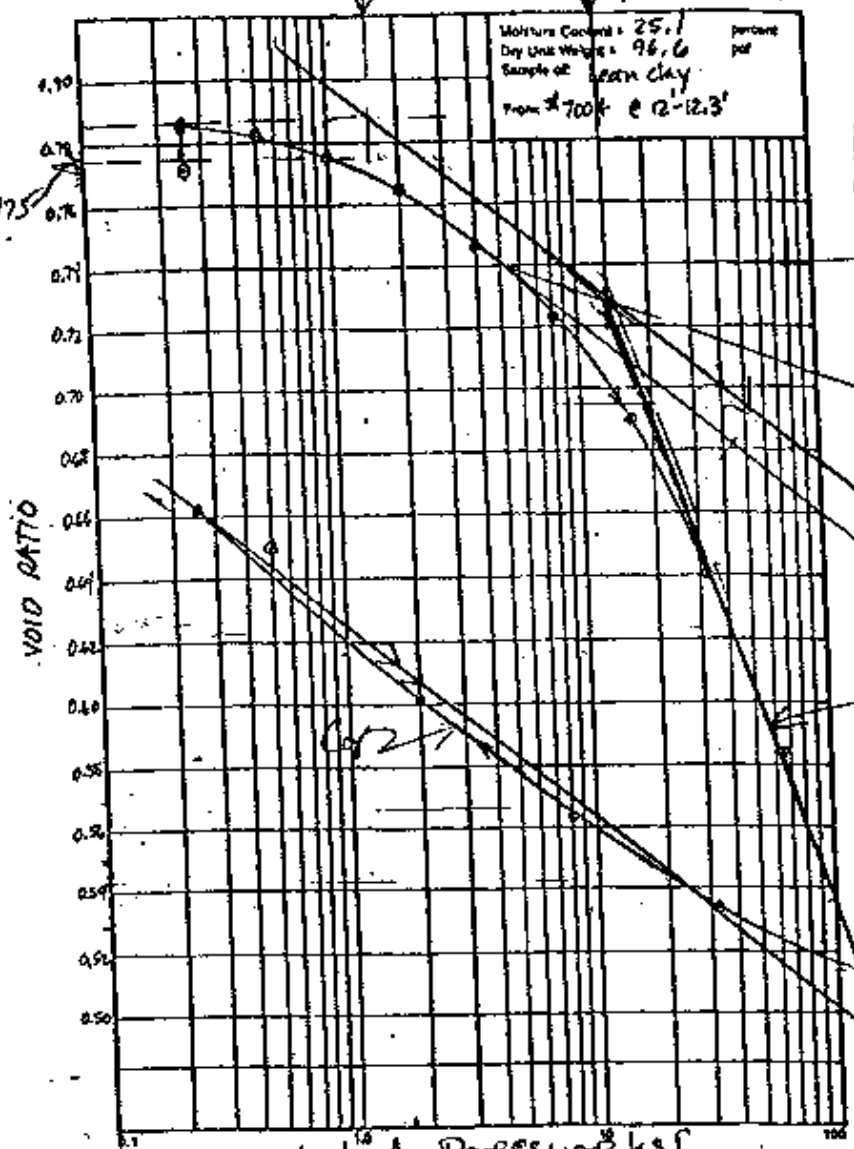
Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 141
File No.
Date 09/02/91
Date 9/17/91

$P_o' = 1,510$ psf

$P_p = 13,300$ psf $\Rightarrow O.C.R = 8.8$



FERRELVIEW CLAY

$e_o = 0.775$

C_c

C_r

$C_c = 0.751 - 0.536 = 0.215$

$C_r = 0.624 - 0.563 = 0.061$

$\approx .4\, e_o = .31$

Bore hole # 9T-71
Sample # 7110
Depth, ft 25 — 27.5
Soil Unit BASAL TILL

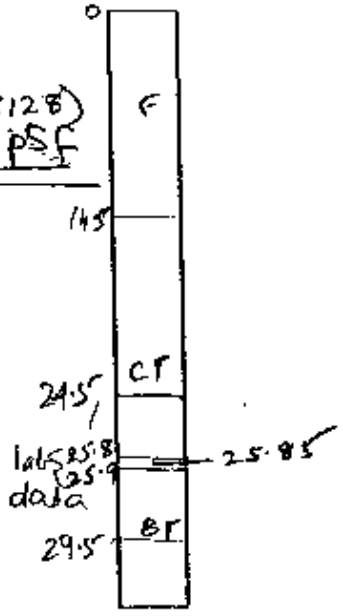
e_o = Hv/Hs = (Hi − Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.693$

$P'_o = (14.5 \times 124) + (10 \times 128) + (1.35 \times 128)$
$= 3251$ psf say 3250 psf

$P_p = 23,400$ psf



From e − log p curve

$C_c = \frac{0.687 - 0.460}{\log(\frac{70}{20})} = 0.417$

$C_{\Sigma c} = \frac{C_c}{1 + e_o} = \frac{0.417}{1.693} = 0.246$

$C_r = 0.596 - 0.528$ (Assuming no sample disturbance)
$= 0.068$

$C_{\Sigma r} = \frac{C_r}{1 + e_o} = \frac{0.068}{1.693} = 0.04$

O.C.R = $\frac{23,400}{3,250} = 7.2$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

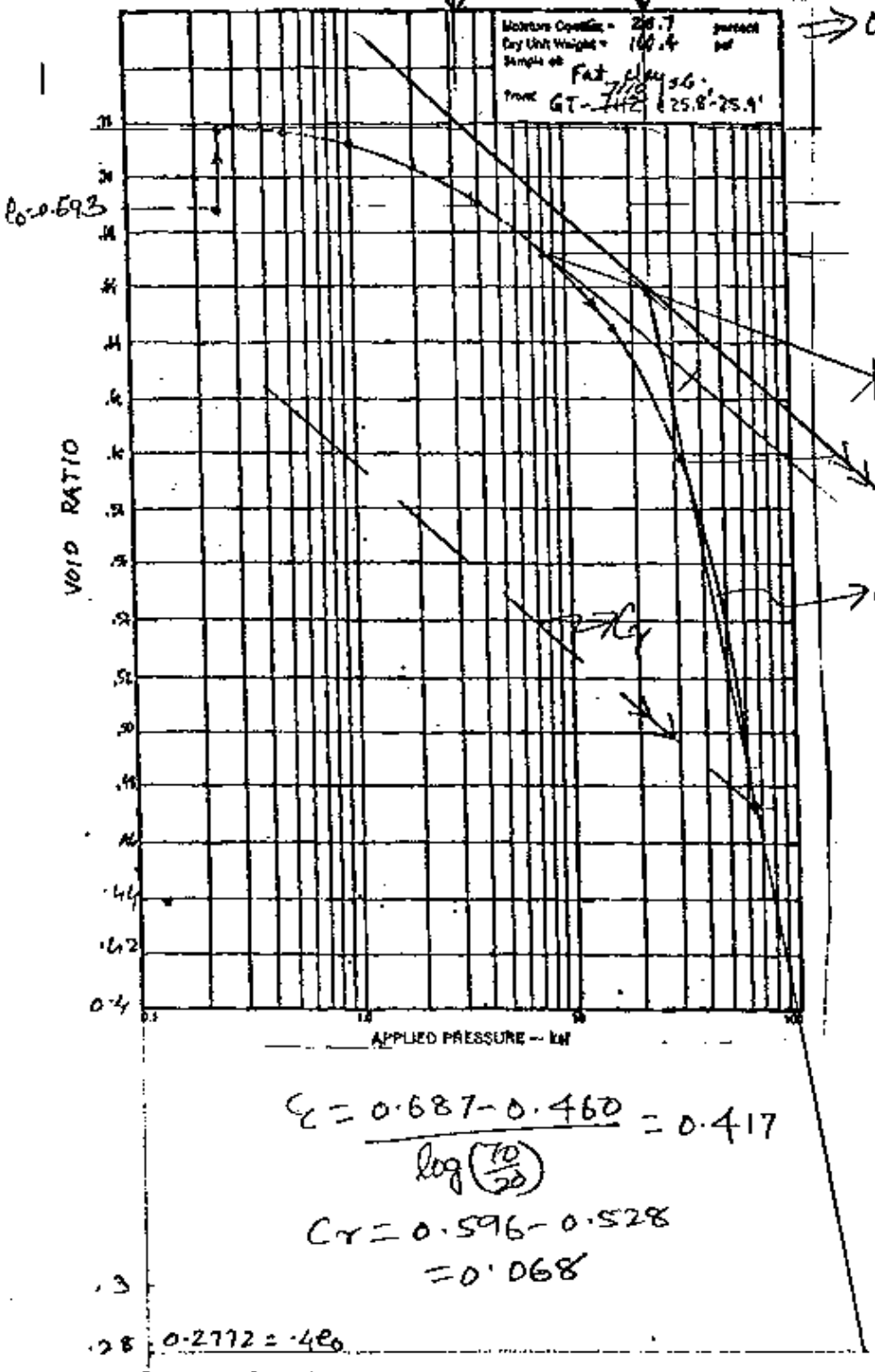
Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 143
File No.
Date 09/02/91
Date 9/17/91

P_f=3,250psf P_p=23,400psf

⇒ O.C.R = 7.2



BASAL TILL
Assume no sample disturbance

C_c

C_r

$$C_c = \frac{0.687 - 0.460}{\log\left(\frac{70}{20}\right)} = 0.417$$

$$C_r = 0.596 - 0.528 = 0.068$$

Bore hole # GT-73
Sample # 7306
Depth, ft 15-17.5
Soil Unit FERRELVIEW

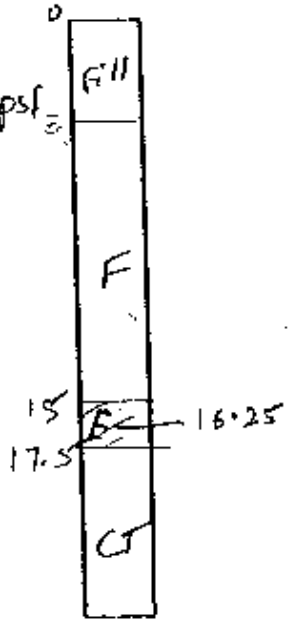
e_o = Hv/Hs = (Hi – Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.851$

$P'_o = (3 \times 123) + (13.25 \times 124) = 2012 psf$
say 2010 psf

$P_p = 3000 psf$



From e – log p curve

$C_c = 0.764 - 0.459 = 0.305$

$C_{\Sigma c} = \frac{C_c}{1+e_o} = \frac{0.305}{1.851} = 0.165$

$C_r = .686 - 0.555 = 0.131$

$C_{\Sigma r} = \frac{C_r}{1+e_o} = \frac{0.131}{1.851} = 0.071$

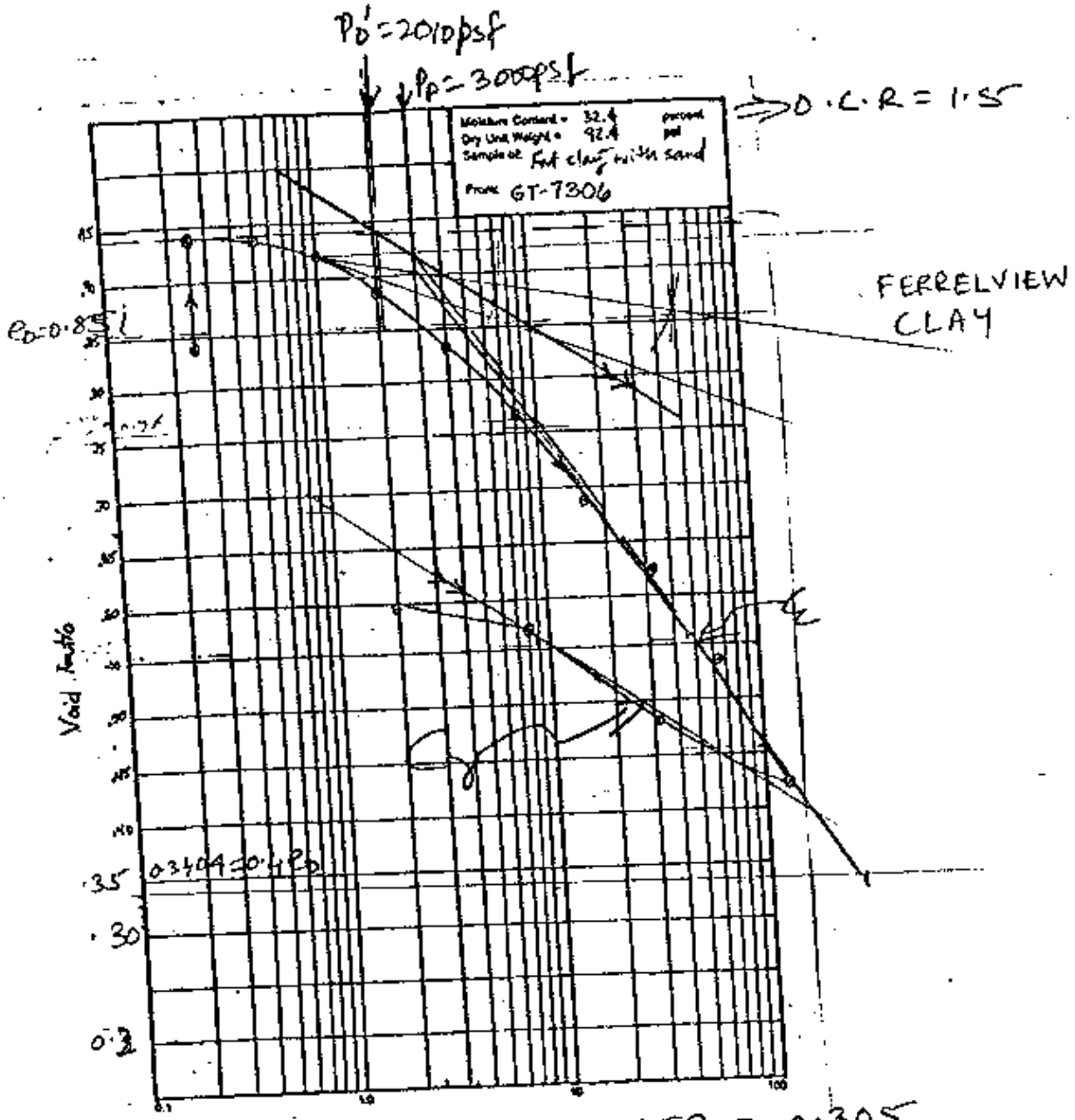
O.C.R = $\frac{3000}{2010} = 1.5$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 145
File No.
Date 09/02/91
Date 9/17/91



$C_c = 0.764 - 0.459 = 0.305$

$C_r = 0.686 - 0.555 = 0.131$

MORRISON-KNUDSEN CORPORATION

Project WSSRAP | Contract No. 3840 | Sheet 146
Feature DISPOSAL CELL | Designed ND | File No. | Date 9/2/91
Item MATERIAL PROPERTIES | Checked K. Lee | Date 9/17/91

NOTE: $P_p < P_o'$

Bore hole # GT-73
Sample # 7314
Depth, ft 35-36.5
Soil Unit BASALTILL

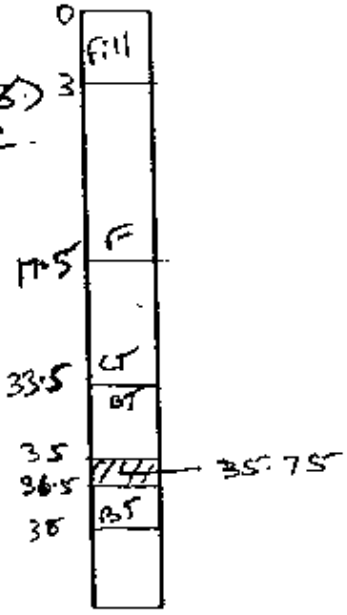
e_o = Hv/Hs = (Hi – Hs) / Hs

where
Hi = Initial height, in
Hs = Solids height, in
Hv = Voids height, in

$e_o = 0.651$

$P'_o = (3 \times 125) + (14.5 \times 124) + (16 \times 128) + (2.25 \times 128) = 4503$ psf
Say 4500 psf

$P_p = 2,760$ psf



From e – log p curve

$C_c = 0.557 - 0.395 = 0.162$

$C_{\varepsilon c} = \frac{C_c}{1+e_o} = \frac{0.162}{1.651} = 0.098$

$C_r = 0.437 - 0.4 = 0.037$

$C_{\varepsilon r} = \frac{C_r}{1+e_o} = \frac{0.037}{1.651} = 0.022$

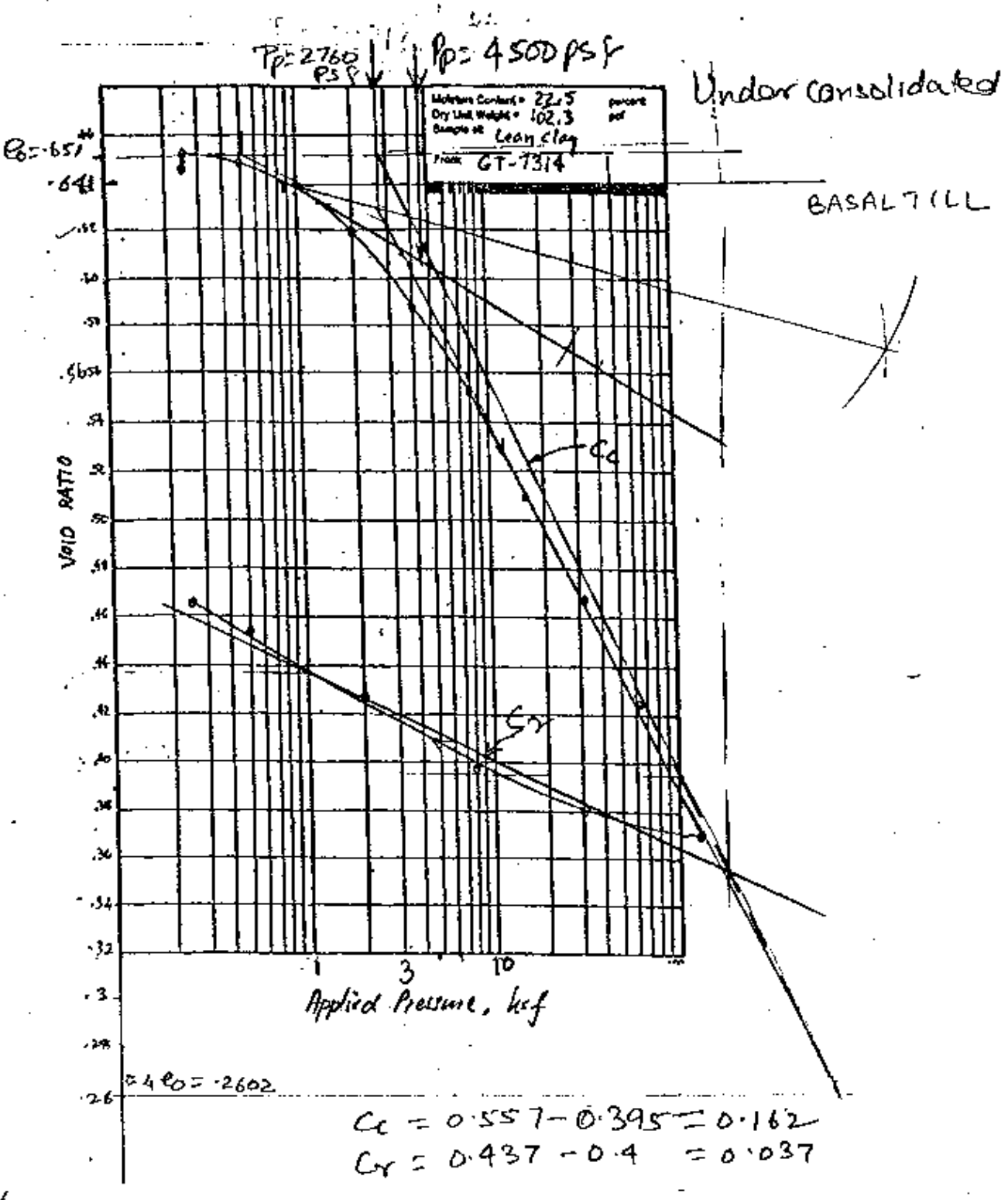
O.C.R = $\frac{2,760}{4500} = 0.6$

MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

Project WSSRAP
Feature DISPOSAL CELL
Item MATERIAL PROPERTIES

Contract No. 3840
Designed ND
Checked K. Lee

Sheet 147
File No.
Date 09/02/91
Date 9/17/91



$C_c = 0.557 - 0.395 = 0.162$

$C_r = 0.437 - 0.4 = 0.037$

MORRISON-KNUDSEN CORPORATION

Project WSSRAP
Feature D.C.
Item MATERIAL PROPERTIES

Contract No. 3910-827
Designed ND
Checked

Sheet 148
File No.
Date 9/20/91
Date

sheets 149 to 155 show the estimation of preconsolidation pressure by empirical correlations (Ref 25). Sheet 3 shows the estimated Pp's to be used..

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet 4

Project WELDON SPRING : WSSRAP - DC — Contract No. 3890 — File No. 827
Feature DISPOSAL CELL — Designed K. Lee — Date 8/20/91
Item SETTLEMENT ANALYSIS — Checked _____ — Date _____

PRECONSOLIDATION PRESSURE ESTIMATION BY EMPIRICAL CORRELATIONS

- consider Clay Till and Basal Till only ; due to lack of consolidation test data.

ND 9/23/91
Sheet 149

Ref: 25

Mat'l Type	Sample No.	Depth (ft)	LL	PI	Su (psf)
Clay Till	*GT-43, ST-10	21.5 - 23.8	47	32	860
	GT-50, ST-06	12.5 - 15.0	63	45	1250
	*GT-56, SB-8	19.5 - 21.0	42	27	1660
Basal Till	*GT-52, SB-14	35.0 - 36.5	42	28	1060

* Within DC Area.

By Skempton's 1957 Correlation :

$$\left(\frac{Su}{P'}\right)_{NC} = 0.11 + 0.0037(PI) \quad , \text{ where}$$

Su = Undrained Shear Strength,

P' = Consolidation pressure

By Duncan & Buchignani's 1976 Method = Method 1

$$Pp = \frac{Su}{(Su/P')_{NC}} \quad , \text{ where}$$

Pp = Preconsolidation pressure.

Mat'l Type	Sample No.	Depth (ft)	PI	Su (psf)	$(Su/P')_{NC}$	Pp (psf)	OCR
Clay Till	GT-43, ST-10	21.5 - 23.8	32	860	0.23	3740	1.3
	GT-50, ST06	12.5 - 15.0	45	1250	0.28	4960	2.6
	GT-56, SB-8	19.5 - 21.0	27	1660	0.21	7900	3.2
Basal Till	GT-52, SB-14	35.0 - 36.5	28	1060	0.21	5040	1.1

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Sheet 2

Project WELDON SPRINGS : WSSRAP - DC — Contract No. 3860 — File No. 827
Feature DISPOSAL CELL — Designed K. Lee — Date 8/20/91
Item SETTLEMENT ANALYSIS — Checked ____ — Date ____

PRECONSOLIDATION PRESSURE ESTIMATION (Cont.)

By Ladd et al. 1977 Method: Method 2

ND 9/23/91
Sheet 150
Ref: 25

$$\left(\frac{Su}{p'}\right)_{OC} = \left(\frac{Su}{p'}\right)_{NC} \times OCR^{0.8}$$

$$\Rightarrow OCR = \frac{Pp}{Po'} = \left[\frac{\left(Su/p'\right)_{OC}}{\left(Su/p'\right)_{NC}}\right]^{1.25}$$

$$\therefore Pp = Po' \cdot \left[\frac{\left(Su/p'\right)_{OC}}{\left(Su/p'\right)_{NC}}\right]^{1.25}$$

$(Su/p')_{NC}$ (see Sh. 3)

Mat'l Type	Sample No.	PI	TE	DSS	TC	Average
Clay Till	GT-43, ST-10	32	0.185	0.245	0.310	0.25
	GT-50, ST-06	45		0.256		0.26
	GT-56, SB-8	27	0.180	0.240	0.310	0.24
Basal Till	GT-52, SB-4	28	0.180	0.240	0.310	0.24

Mat'l Type	Approx. Depth (ft)	Su (psf)	Po' (psf) (1)	Su/Po'	$\left[\left(Su/p'\right)/\left(Su/p'\right)_{NC}\right]^{1.25}$	Pp (psf)	OCR
Clay Till	22-65	860	2786	0.31	1.31	3640	1.3
	13.75	1250	1691	0.74	3.70	6250	3.7
	20.25	1660	2491	0.67	3.61	8990	3.6
Basal Till	35-75	1060	4397	0.24	1.00	4400	1.0

(1) Po' = Effective overburden pressure = $\gamma_{(marg)} \cdot H = 123H$

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project WELDON SPRING : WSSRAP - DC
Feature DISPOSAL CELL
Item SETTLEMENT ANALYSIS

Contract No. 3840
Designed K. Lee
Checked

Sheet 5
File No. 827
Date 8/20/91
Date

PRECONSOLIDATION PRESSURE ESTIMATION (cont.)

By Liquid Index vs. Pp (DM7.1-142, see sh. 4) : Method 3

NJD 9/23/91

$$LI = \frac{Wsat - PL}{LL - PL} = \frac{Wsat - PL}{PI}$$

Sheet 151
Ref: 25

$$Wsat = \frac{e}{Gs} \cdot \gamma_w \qquad e = \frac{Gs \cdot \gamma_w}{\gamma_d} - 1$$

Mat'l Type	Sample No.	PL	PI	Gs	γ_d (pcf)	Wsat (%)
Clay Till	GT-43, ST-10	15	32	2.71	107	21
	GT-50, ST-06	18	45	2.74	96	29
	GT-56, SB-8	15	27	2.66	106	21
Basal Till	GT-52, SB-14	14	28	2.68	102	24

Mat'l Type	Sample No.	LI	S_u (psf)	S_r (psf) (SD)	$S_t = S_u/S_r$	Pp (psf)	OCR
Clay Till	GT-43, ST-10	0.19	860	970	1.0	3120	1.1
	GT-50, ST-06	0.24	1250	800	1.0	2150	1.3
	GT-56, SB-8	0.22	1660	870	1.9	5240	2.1
Basal Till	GT-52, SB-14	0.36	1060	420	2.5	2850	0.65

SUMMARY OF RESULTS

Mat'l Type	Sample No.	Approx. Depth (ft)	Po' (psf)	Method	Pc (psf)	OCR
Clay Till	GT-43, ST-10	22.6'	2786	1	3740	1.3
				2	3640	1.3
				3	3120	1.1
	GT-50, ST-06	13.75'	1691	1	4460	2.6
				2	6250	3.7

ENG 375/89 (EXCEL)

MK-ENVIRONMENTAL SERVICES
A DIVISION OF MK-FERGUSON

Project WELDON SPRING : WSSRAP - DC
Feature DISPOSAL CELL
Item SETTLEMENT ANALYSIS

Contract No. 3840 Sheet 4
Designed K. Lee File No. 827
Checked Date 9/9/91
ND 9/23/91

Sheet 152
Ref: 25

SUMMARY OF RESULTS (cont.)

Mat'l Type	Sample No.	Approx. Depth (ft)	Pc' (psf)	Method	Pc (psf)	OCR
Clay Till	GT-50, ST-06	13.75	1691	3	~~2450~~	1.3
	GT-56, SB-8	20.25	2491	1	~~7900~~ !	3.2
				2	~~8990~~ !	3.6
				3	~~5240~~ !	2.1
	Overall Average Values				5050	2.2
	Disposal Cell Average Values (excluding GT-50)				5440	2.1
Basal Till	GT-52, SB-14	~~35.75~~ !	4397	1	~~5040~~ !	1.1
				2	~~4400~~ !	1.0
				3	~~2850~~ !	0.65
	Overall & Disposal Cell Average Values				4100	0.92

TOTAL AVERAGE VALUES (Lab Test Results + Empirical Results):

Mat'l Type	Area	Pc (psf)	OCR	
Clay Till	Overall	7800	3.2	
	DC	7500	2.6	
Basal Till	Overall	6300	1.9	← used.
	DC	7200	2.2	

ENG 375/89 (ENG)

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: LUSSRAP
Feature: DC
Item: Material Properties

Contract No. 5127
Designed: AYL
Checked:

Sheet 92
File No.
Date 5/9/89
Date

ND 9/23/91
Sheet 153
Ref: 25

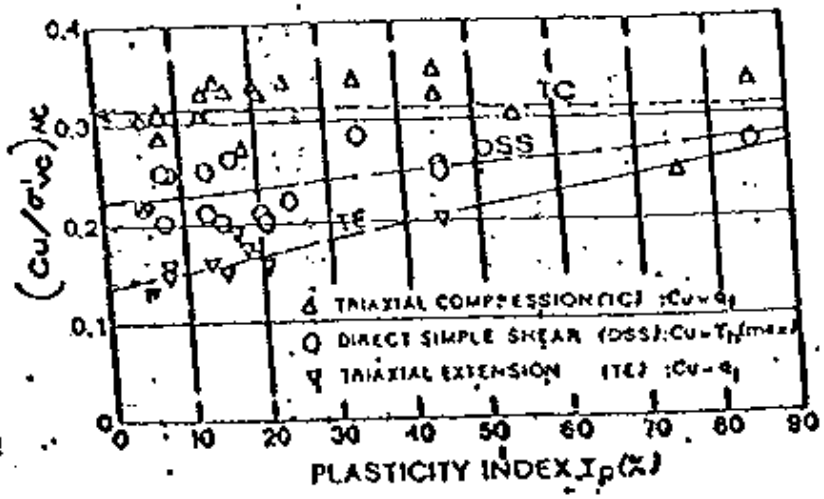


Fig.21: Undrained Strength Anisotropy from CK_oU Tests Performed on Normally Consolidated Clays [Data from Lefebvre et al. (1983), Vaid and Campanella (1974) and Various Publications by MIT and NGI].

JAMIOLKOWSKI ET AL (REF. 12)

Ref.: Jamiolkowski, M., et al. 1985, "New Developments in Field and Laboratory Testing of Soils," Proceedings of Eleventh ICSMFE, San Francisco, Vol. 1, pp. 57–153.

*NOTE: For TC: $\left(\frac{Cu}{\sigma'_{vc}}\right)_{NC} = 0.31$

For DSS: $\left(\frac{Cu}{\sigma'_{vc}}\right)_{NC} = 0.22 + 0.0008\, I_p$ ($\equiv$ Avg.)

~~16~~

ND 9/23/91
Sheet 154
Ref: 25

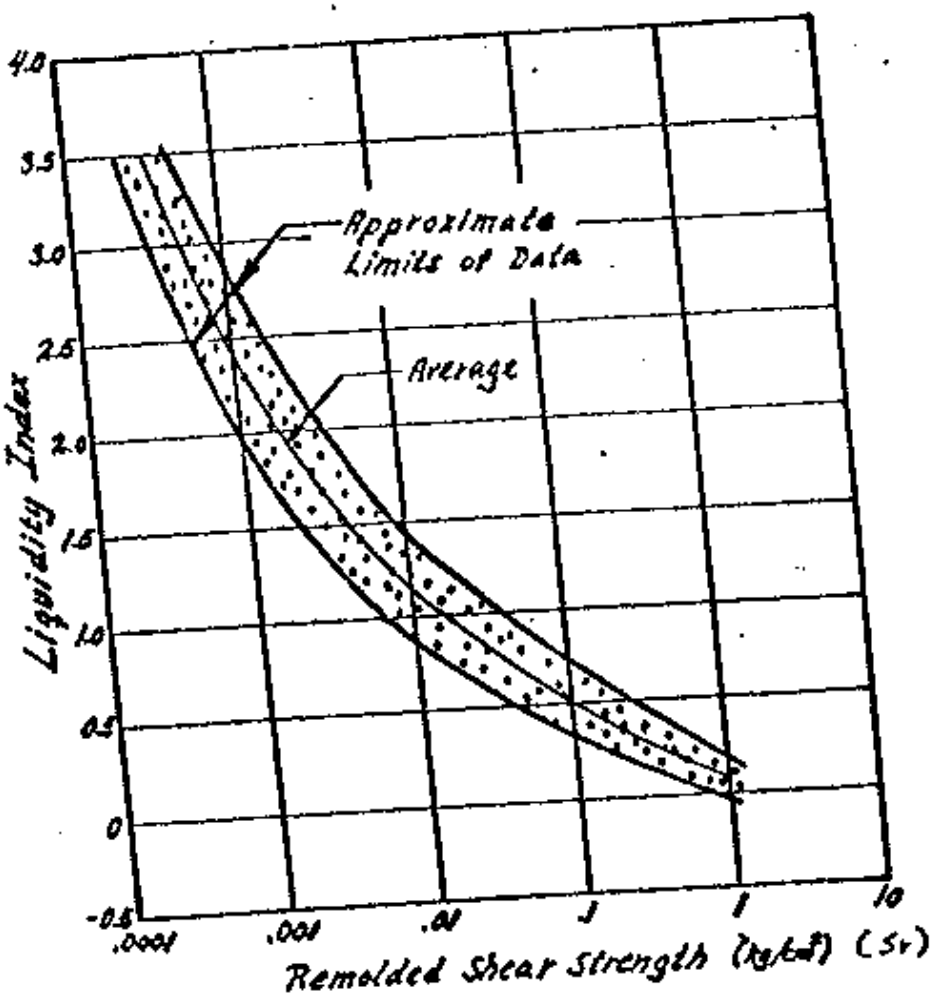


Fig. 14. Remolded Shear Strength Versus Liquidity Index Relationships for Different Clays (After Houston and Mitchell, 1969).

Ref.: Houston, W.N., and Mitchell, J.K., 1969, "Property Interrelationships in Sensitive Clays," Journal of the Soil Mechanics and Foundations Division, ASCE, Vol. 95, No. SM4, Proc. Paper 6666, July, pp. 1037-1062.

ND 9/23/91
Sheet 155
Ref: 25

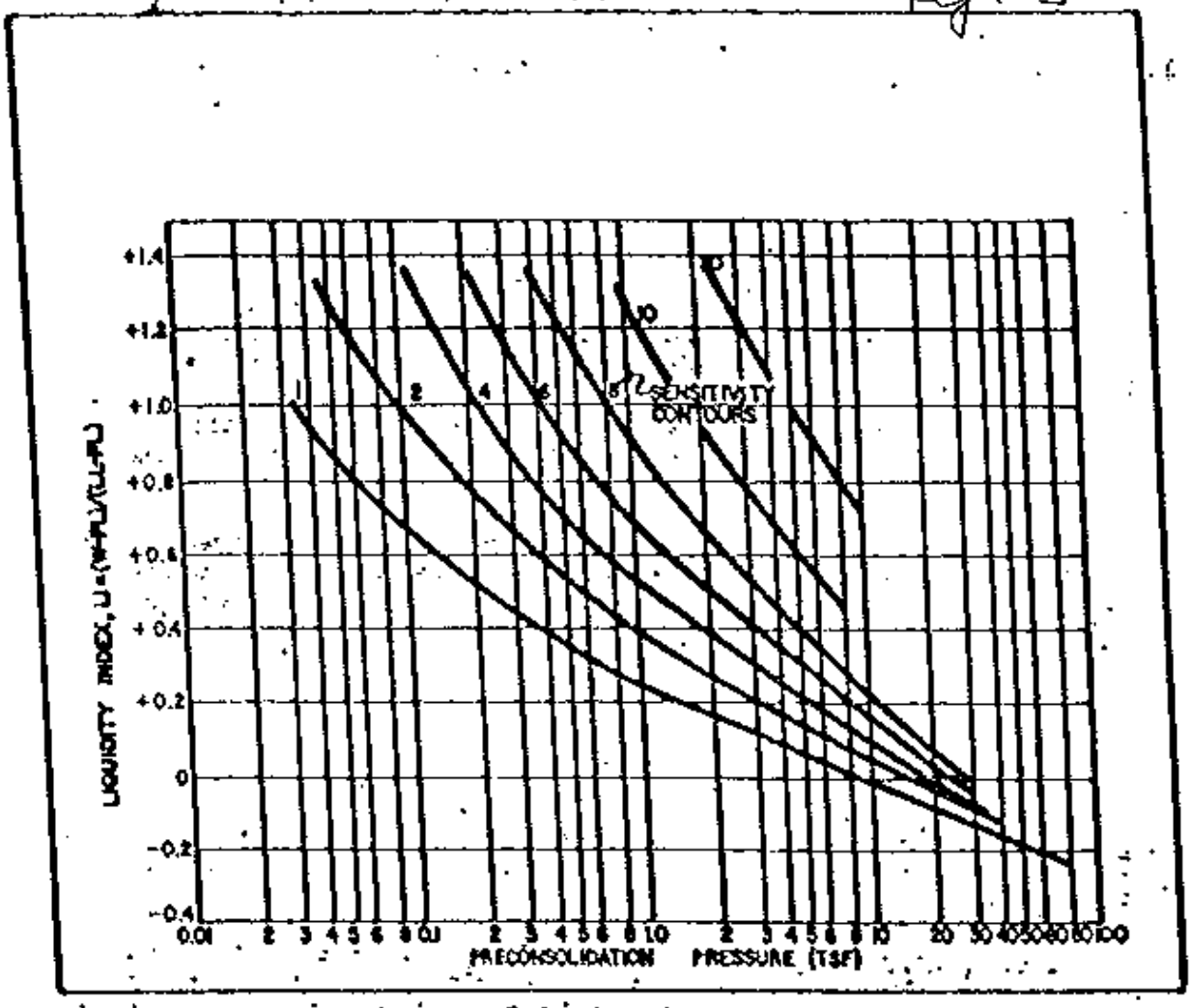


FIGURE 3
Preconsolidation Pressure ve. Liquidity Index

* NOTE: W is saturated moisture content (Wsat), not in-situ moisture content (Wn).

For S = 100% ⇒ $W_{sat} = \frac{e}{G_s}$, where

$$e = \frac{G_s \cdot \gamma_w}{\gamma_d} - 1$$

Sensivity, St = $\frac{\text{Undisturbed shear strength}}{\text{Remolded Shear strength}}$

COMPACTION CHARACTERISTICS:

Compaction tests were carried out on Topsoil/Fill, Loess, Fernelview Clay & potential borrow source materials to assess their optimum dry densities & moisture contents.

These are presented in Sheets 157 to 160.

SUMMARY OF COMPACTION TESTS

Test Pit Number	Sample Number	Depth		Compaction	
		From	To	Optimum w	γ_d
		ft	ft	%	pcf
Topsoil/Fill					
GTS-5	BULK	0.0	5.0	17.5	106.4
GTS-7	BULK	0.0	5.0	19.2	102.7
Number of points				2	2
Mean Values				18.4	104.6
Maximum Values				19.2	106.4
Minimum Values				17.5	102.7
Standard Deviation				0.8	1.8

SUMMARY OF COMPACTION TESTS

Test Pit Number	Sample Number	Depth		Compaction	
		From	To	Optimum w	δ d
		ft	ft	%	pcf
Loess					
GT-2T74	BU-01A	4.0	8.5	16.1	106.3
GT-2T78	BU-01A	4.0	6.5	11.7	114.9
TPMS-2	BU-01	0.0	2.0	18.7	104.3
TPMS-4	BU-01	1.0	3.5	18.6	105.4
TPMS-5	BU-01	1.0	7.0	15.9	108.1
TPMS-6	BU-01	1.0	5.0	16.4	104.0
TPMS-7	BU-01	1.0	7.0	17.4	107.2
TPMS-8	BU-01	1.0	5.0	16.3	108.0
TPMS-9	BU-01	1.0	7.0	15.4	104.9

Number of points			9	9
Mean Values			16.3	107.0
Maximum Values			18.7	114.9
Minimum Values			11.7	104.0
Standard Deviation			2.0	3.1

SUMMARY OF COMPACTION TESTS

Test Pit Number	Sample Number	Depth		Compaction	
		From	To	Optimum w	γ_d
		ft	ft	%	pcf
Ferrelview Clay					
GT-39	ST-03	5.5	8.0	17.9	107.5
GT-2T71	BU-01A	3.5	6.5	15.4	108.0
	BU-02A	6.5	12.0	18.5	106.9
GT-2T72	BU-01A	7.5	10.5	12.5	116.1
GT-2T75	BU-01A	4.0	8.5	17.6	108.0
	BU-02B	6.5	12.0	20.1	102.3
GT-2T77	BU-01B	1.5	4.0	16.6	104.3
	BU-02A	7.0	10.5	19.2	104.4
GT-2T78	BU-02B	6.5	12.0	14.6	115.6
				21.3	104.2
GTS-1	ST-03	5.0	7.5	17.5	102.8
GTS-2	ST-02	2.5	5.0	18.3	103.0
GTS-4	ST-02	2.5	5.0	17.7	105.3
GTS-6	BULK	0.0	5.0	18.3	104.6
TPMS-1	BU-01	0.0	6.0	17.4	103.0
TPMS-2	BU-02	2.0	6.0	21.0	100.6
TPMS-3	BU-01	1.0	6.0	17.1	104.0
TPMS-4	BU-02	4.0	6.5	22.8	95.5
TPMS-5	BU-02	8.0	10.0	21.7	97.8
TPMS-6	BU-02	5.5	7.5	21.3	100.4
TPMS-7	BU-02	7.0	9.5	21.1	94.7
TPMS-8	BU-02	5.0	10.5	21.4	98.6
TPMS-9	BU-02	8.0	15.0	24.1	95.9

Number of points			23	23
Mean Values			18.8	103.6
Maximum Values			24.1	116.1
Minimum Values			12.5	94.7
Standard Deviation			2.7	5.3

SUMMARY OF COMPACTION TESTS

Test Pit Number	Sample Number	Depth		Compaction	
		From	To	Optimum w	γ_d
		ft	ft	%	pcf
Potential Borrow Source No. 1					
TPBS-1	2A	2.6	7.1	15.6	110.4
	3A	7.1	9.2	20.1	105.6
	4A	9.2	14.1	14.6	116.1
TPBS-6	1A	0.6	9.1	19.3	102.9
	2A	9.1	12.6	20.9	100.3
TPBS-8	1A	0.6	4.3	17.4	108
	2A	4.3	8.5	15.6	109.4
	3A	8.5	11.9	20.5	101.9

Number of points			8	8
Mean Values			18.0	106.8
Maximum Values			20.9	116.1
Minimum Values			14.6	100.3
Standard Deviation			2.4	4.9

SUMMARY OF CATION EXCHANGE CAPACITY TESTS

CALIFORNIA BEARING RATIO TEST RESULTS

Test Pit Number	Sample Number	Depth From	Depth To	Cap meq/100g	California Bearing Ratio
Loess					
GT-2T74	BU-01A	ft	ft	33.91	
GT-2T76	BU-01A			33.23	
LOESS					
Number of points				2.00	
Mean Values	TPMS-5	BU-01	1.0	7.0	38.57	3.75
Maximum Values	TPMS-8	BU-01	1.0	5.0	33.91	2.43
Minimum Values	TPMS-9	BU-01	1.0	7.0	33.23	3.05
Standard Deviation					25.34	
Number of points						3
Mean Values						3.08
Maximum Values	BU-02A				68.26	3.75
Minimum Values	BU-01A				49.02	2.43
Standard Deviation	BU-02B				68.00	0.54
GT-2T77	BU-01B				70.21	
FERRELVIEW CLAY	BU-02A				59.65	
GT-2T78	BU-02B				71.69	
TPMS-1	BU-01		6.0	6.0		2.45
Number of points	TPMS-2	BU-02	2.0	6.0	6.00	2.25
Mean Values	TPMS-3	BU-01	1.0	6.0	9.47	2.74
Maximum Values	TPMS-8	BU-02	5.0	10.5	68.26	1.55
Minimum Values					49.02	
Standard Deviation					12.56	
Number of points						4
Mean Values						2.25
Potential Borrow Source Stock						2.74
TPBS-2	2A				56.08	1.55
Maximum Values	3A				57.03	0.44
Minimum Values						
Standard Deviation						
TPBS-6	2A				79.91	
TPBS-8	3A				75.26	
TPBS-10	3A				74.21	
TPBS-11	2A				73.52	

Number of points	6.00
Mean Values	69.34
Maximum Values	79.91
Minimum Values	56.08
Standard Deviation	9.27

f) HYDRAULIC CONDUCTIVITY
PERMEABILITY TEST RESULTS

Falling head triaxial permeability tests were performed on Loess, Jewelview Formation, Clay till, basal till and residuum materials. (Ref 4) However, apparently all the permeability tests' confining pressures were applied in 'psi' units rather than the 'ksf' units as recommended in MK's proposed test program. The use of extremely low confining pressures (0.5-1.5 psi) has resulted in most cases unreasonably high permeability values than values normally anticipated for the type of soil and loading conditions for the cell design. As a matter of fact, these low pressures were even much lower than the in-situ confining pressures of the soil samples. The samples at such low confining pressures were believed to be in a disturbed state. Thus giving such high permeabilities. These high values should not be used. However, the test results from the higher confining pressures (3.5 ± psi) give average permeability for each soil type, except Loess & Basal Till, of less than 1×10^{-7} cm/sec. (see Table on sh. 165-167). These results illustrated that the permeability of the overburden soils are probably adequate to meet the State criterion, especially at higher loading conditions.

SUMMARY OF COEFFICIENT OF PERMEABILITY FOR REMOLDED ON SITE SOILS

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	SOIL UNIT	COEFF. OF PERMEABILITY (cm/sec)	~~GEOMETRIC~~ Arithmetic MEAN (cm/sec)
GTS-5	BULK	0.0 - 5.0	~~DIKE FILL~~ TOPSOIL	2.0E-08	
GTS-7	BULK	0.0 - 5.0	~~DIKE FILL~~ TOPSOIL	5.0E-08	3.5E-08
GT-2T71	BU-02A	6.5 - 12.0	FERRELVIEW	2.0E-08	
GT-2T75	BU-02B	6.5 - 12.0	FERRELVIEW	1.0E-09	
GT-2T77	BU-02A	7.0 - 10.5	FERRELVIEW	2.0E-08	
GT-2T78	BU-02B	6.5 - 12.0	FERRELVIEW	4.0E-08	
GTS-1	ST-03	5.0 - 7.5	FERRELVIEW	2.0E-07	
GTS-2	ST-02	2.5 - 5.0	FERRELVIEW	6.0E-08	
GTS-4	ST-02	2.5 - 5.0	FERRELVIEW	2.0E-07	
GTS-6	BULK	0.0 - 5.0	FERRELVIEW	1.0E-07	8.3E-08

SUMMARY OF COEFFICIENT OF PERMEABILITY FOR REMOLDED BORROW SOURCE NO.1 SOILS

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	SOIL UNIT	COEFF. OF PERMEABILITY (cm/sec)	~~GEOMETRIC~~ Arithmetic MEAN (cm/sec)
TPBS-1	2A	2.6 - 7.1		3.0E-07	
TPBS-1	4A	9.2 - 14.1		4.0E-08	
TPBS-6	1A	0.6 - 9.1		2.0E-06	
TPBS-6	2A	9.1 - 12.6		1.0E-08	
TPBS-8	1A	0.6 - 4.3		3.0E-08	
TPBS-8	2A	4.3 - 8.5		2.0E-07	
TPBS-8	3A	8.5 - 11.9		5.0E-09	
TPBS-10	1A	0.6 - 6.1		1.0E-07	
TPBS-10	2A	6.2 - 10.9		2.0E-08	
TPBS-10	3A	10.9 - 13.4		1.0E-09	
TPBS-11	1A	0.6 - 10.4		3.0E-08	
TPBS-11	2A	10.4 - 12.3		3.0E-08	6.5E-08

SUMMARY OF COEFFICIENT OF PERMEABILITY FOR UNDISTURBED ON SITE SOILS

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	SOIL UNIT	COEFF. OF PERMEABILITY (cm/sec)	Arithmetic GEOMETRIC MEAN (cm/sec)
GT-33	ST-04	5.0 - 7.5	DIKE FILL	1.1E-07	1.1E-07
GT-50	ST-02	2.5 - 5.0	LOESS	3.0E-04 **	
GT-50	ST-02	2.5 - 5.0	LOESS	2.0E-05 **	
GT-55	ST-04	7.5 - 10.0	LOESS	1.0E-05 **	
GT-55	ST-04	7.5 - 10.0	LOESS	5.0E-06 **	
GT-56	ST-02	5.0 - 7.5	LOESS	2.9E-08	
GT-58P	ST-01	2.5 - 5.0	LOESS	2.0E-06	
GT-58P	ST-01	2.5 - 5.0	LOESS	4.0E-07	
TPMS-2	BU-01	0.0 - 2.0	LOESS	2.0E-06	
TPMS-4	BU-01	1.0 - 3.5	LOESS	9.0E-09	
TPMS-5	BU-01	1.0 - 7.0	LOESS	2.0E-06	
TPMS-6	BU-01	1.0 - 5.0	LOESS	3.0E-07	
TPMS-7	BU-01	1.0 - 7.0	LOESS	1.0E-07	
TPMS-8	BU-01	1.0 - 5.0	LOESS	6.0E-08	
TPMS-9	BU-01	1.0 - 7.0	LOESS	3.0E-07	3.2E-07
GT-43	ST-04	6.0 - 8.5	FERRELVIEW	9.0E-04 **	
GT-43	ST-04	6.0 - 8.5	FERRELVIEW	7.0E-06 **	
GT-46	ST-03	5.0 - 7.5	FERRELVIEW	5.0E-04 **	
GT-46	ST-03	5.0 - 7.5	FERRELVIEW	3.0E-06 **	
GT-48	ST-05	12.5 - 15.0	FERRELVIEW	1.0E-06 **	
GT-48	ST-07	17.5 - 20.0	FERRELVIEW	1.0E-09	
GT-48	ST-05	12.5 - 15.0	FERRELVIEW	6.0E-04 **	
GT-52	ST-06	15 - 17.5	FERRELVIEW	3.0E-06 **	
GT-55	ST-06	12.5 - 15.0	FERRELVIEW	8.0E-09	
GT-56	ST-04	10.0 - 12.5	FERRELVIEW	3.0E-06 **	
GT-56	ST-04	10.0 - 12.5	FERRELVIEW	2.0E-07 **	
GT-58P	ST-03	7.5 - 10.0	FERRELVIEW	6.0E-06	
GT-58P	ST-03	7.5 - 10.0	FERRELVIEW	1.0E-09	
GT-59	ST-02	5.0 - 7.5	FERRELVIEW	4.0E-07	
GT-59	ST-02	5.0 - 7.5	FERRELVIEW	2.0E-07	
GT-62	ST-07	17.5 - 20.0	FERRELVIEW	5.0E-08	
GT-62	ST-07	17.5 - 20.0	FERRELVIEW	1.0E-09	
GT-63P	ST-01	2.5 - 5.0	FERRELVIEW	7.0E-09	
TPMS-1	BU-01	0.0 - 6.0	FERRELVIEW	7.0E-08	
TPMS-2	BU-02	2.0 - 6.0	FERRELVIEW	1.0E-09	
TPMS-3	BU-01	1.0 - 6.0	FERRELVIEW	3.0E-07	
TPMS-4	BU-02	4.0 - 6.5	FERRELVIEW	1.0E-09	

Note – ** Unreliable test results due to low confining pressures used in testing.
Data not used in computing geometric mean

SUMMARY OF COEFFICIENT OF PERMEABILITY FOR UNDISTURBED ON SITE SOILS

Arithmetic

BOREHOLE NUMBER	SAMPLE NUMBER	SAMPLE DEPTH (ft)	SOIL UNIT	COEFF. OF PERMEABILITY (cm/sec)	GEOMETRIC MEAN (cm/sec)
TPMS-5	BU-02	8.0 - 10.0	FERRELVIEW	9.0E-09	
TPMS-6	BU-02	5.5 - 7.5	FERRELVIEW	1.0E-09	
TPMS-7	BU-02	7.0 - 9.5	FERRELVIEW	1.0E-07	
TPMS-8	BU-02	5.0 - 10.5	FERRELVIEW	1.0E-09	
TPMS-9	BU-02	8.0 - 15.0	FERRELVIEW	4.0E-08	6.9E-08
GT-45	ST-07	15.0 - 17.5	CLAY TILL	8.0E-05 **	
GT-45	ST-07	15.0 - 17.5	CLAY TILL	2.0E-08 **	
GT-50	SB-08	17.5 - 19.0	CLAY TILL	2.0E-07 **	
GT-50	SB-08	17.5 - 19.0	CLAY TILL	7.0E-08 **	
GT-51	ST-07	15.0 - 17.5	CLAY TILL	2.0E-08 **	
GT-51	ST-07	15.0 - 17.5	CLAY TILL	3.0E-06 **	
GT-51	SB-09	20.0 - 21.5	CLAY TILL	3.0E-07 **	
GT-51	SB-09	20.0 - 21.5	CLAY TILL	5.0E-08 **	
GT-56	ST-06	15.0 - 17.0	CLAY TILL	2.9E-09	
GT-58P	ST-09	22.5 - 24.0	CLAY TILL	4.0E-08	
GT-58P	ST-09	22.5 - 24.0	CLAY TILL	1.0E-09	
GT-59	ST-06	15.0 - 17.5	CLAY TILL	1.0E-09	
GT-60P	ST-10	27.5 - 30.0	CLAY TILL	1.0E-09	
GT-60P	ST-10	27.5 - 30.0	CLAY TILL	5.0E-08	
GT-63P	ST-09	22.5 - 25.0	CLAY TILL	9.0E-09	
GT-67P	ST-06	20.0 - 22.5	CLAY TILL	1.0E-07	2.6E-08
GT-43	SB-17	40.0 - 41.5	BASAL TILL	6.0E-08 **	
GT-43	SB-17	40.0 - 41.5	BASAL TILL	4.0E-08 **	
GT-60P	SB-17	48.5 - 49.0	BASAL TILL	3.0E-07	
GT-60P	SB-15	41.0 - 41.5	BASAL TILL	2.0E-07	
GT-60P	SB-17	48.5 - 49.0	BASAL TILL	2.0E-07	
GT-60P	SB-15	41.0 - 41.5	BASAL TILL	7.0E-06	1.9E-07
GT-55	SB-12	27.5 - 29.0	RESIDUUM	2.0E-09	
GT-62	SB-15	38.0 - 39.0	RESIDUUM	3.0E-05	
GT-62	SB-15	38.0 - 39.0	RESIDUUM	6.0E-06	
GT-65P	SB-16	40.0 - 41.5	RESIDUUM	8.0E-07	
GT-65P	SB-16	40.0 - 41.5	RESIDUUM	4.0E-07	6.3E-06

Note – ** Unreliable test results due to low confining pressures used in testing.
Data not used in computing geometric mean

SUMMARY OF CAPILLARY MOISTURE TESTS

Test Pit Number	Sample Number	Depth		Capillary Moisture (%)			
		From	To	0.3	1.0	4.0	15.0
		ft	ft	bar	bar	bar	bar
LOESS							
GT-2T74	BU-01A	4.0 ~~7.5~~	8.5 ~~10.5~~	19.0	19.6	17.4	17.2
GT-2T78	BU-01A	4.0	6.5	18.4	14.9	13.4	13.4

Number of points	2	2	2	2
Mean Values	18.7	17.3	15.4	15.3
Maximum Values	19.0	19.6	17.4	17.2
Minimum Values	18.4	14.9	13.4	13.4
Standard Deviation	0.3	2.4	2.0	1.9

SUMMARY OF CAPILLARY MOISTURE TESTS

Test Pit Number	Sample Number	Depth		Capillary Moisture (%)			
		From	To	0.3	1.0	4.0	15.0
		ft	ft	bar	bar	bar	bar
FERRELVIEW CLAY							
GT-2T71	BU-01A	3.5	6.5	23.1	23.5	20.3	20.2
	BU-02A	6.5	12.0	22.7	22.9	20.3	20.5
GT-2T75	BU-01A	2.5	6.5	20.2	19.9	17.8	17.4
	BU-02B	6.5	12.0	24.5	23.8	21.3	21.2
GT-2T77	BU-01B	1.5	4.0	20.9	21.1	18.4	17.9
	BU-02A	7.0	10.5	27.1	25.4	22.6	21.6
GT-2T78	BU-02B	6.5	12.0	29.6	27.5	24.1	24.2

Number of points	7	7	7	7
Mean Values	24.0	23.4	20.7	20.4
Maximum Values	29.6	27.5	24.1	24.2
Minimum Values	20.2	19.9	17.8	17.4
Standard Deviation	3.1	2.4	2.1	2.1

SUMMARY OF CAPILLARY MOISTURE TESTS

Test Pit Number	Sample Number	Depth		Capillary Moisture (%)			
		From	To	0.3	1.0	4.0	15.0
		ft	ft	bar	bar	bar	bar
POTENTIAL BORROW SOURCE NO. 1							
TPBS-1	2A	2.6	7.1	18.3	17.8	16.4	16.2
	4A	9.2	14.1	17.9	17.3	15.5	15.6
TPBS-6	1A	0.6	9.1	23.0	22.1	19.8	19.2
	2A	9.1	12.6	30.1	28.9	25.2	24.4
TPBS-8	1A	0.6	4.3	23.1	21.6	19.9	20.2
	2A	4.3	8.5	19.4	18.5	16.0	16.0
	3A	8.5	11.9	28.4	25.9	22.5	23.0
TPBS-10	1A	0.6	6.1	24.2	22.5	19.2	19.7
	2A	8.2	10.9	25.7	23.6	20.3	20.8
	3A	10.9	13.4	30.6	28.2	24.1	24.7
TPBS-11	1A	0.6	10.4	21.2	20.4	17.5	18.2
	2A	10.4	12.3	33.0	30.7	26.1	27.2

Number of points	12	12	12	12
Mean Values	24.6	23.1	20.2	20.4
Maximum Values	33.0	30.7	26.1	27.2
Minimum Values	17.9	17.3	15.5	15.6
Standard Deviation	4.8	4.3	3.5	3.6

SWELLING POTENTIAL:

The clay borrow material for the radon barrier needs to be checked for its swelling potential. Lab test results on the Ferrelview clay material (Sh 40-41) show that the Ferrelview clay material has high fine contents & plasticity index which may be an indication of the expansive nature of the soil. Since swelling which can result in differential settlement & thus cracking is a concern, the swelling potential of the Ferrelview clay is evaluated here on Sh 172.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRAP
Feature: DC
Item: Material Properties

Contract No. 3841-827 ~~5121~~
Designed: PYL
Checked: ND
Rev. by ND

Sheet: 13H72
File No.:
Date: 3/3/89
Date: 9/10/91
9/12/91

FROM OEDOMETER TEST (Ref. 4 d21) + (sh 120-147)

BOREHOLE NO.	SAMPLE NO	DEPTH (FT.)	% SWELL AT 250 psf INUNDATION PRESSURE (1)	SWELLING PRESSURE (psf)	USCS
FERRELVIEW					
GT46	ST03	5.0 - 7.5	0.12	400	
GT47	ST05	10.0 - 12.5	1.23	2000	
GT48	ST07	17.5 - 20.0	2.40	2200	
GT53	ST04	7.5 - 10.0	2.75	4500	
GT55	ST06	12.5 - 15.0	0.47	1050	
GT56	ST02	5.0 - 7.5	0.36	1000	
GT-70	7004	12.0 - 12.3	0.761	250	
GT-73	7306	15.0 - 17.5	5.33	250	
CLAY TILL					
GT-68	68-10	25-25.7	2.09	250	
BASAL TILL					
GT-69	6908	20-22.5	1.51	250	
GT-71	7110	25-27.5	1.79	250	
GT-73	7314	35-36.5	0.36	250	

NOTES:

(1) % swell = $\frac{(e_2 - e_1)}{1 + e_0} \times 100\%$; where e_1 = void ratio after wetting, e_2 = void ratio before wetting } @ 250 p.

Refer to sh 120-147 for e - log p curves.

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WESRAP	Contract No. ~~5707~~ 3841.827	Sheet ~~136~~ 173	
Feature DC	Designed PYC	File No.	Date 5/10/89
Item Material Properties	Checked ND	Date 9/12/91	

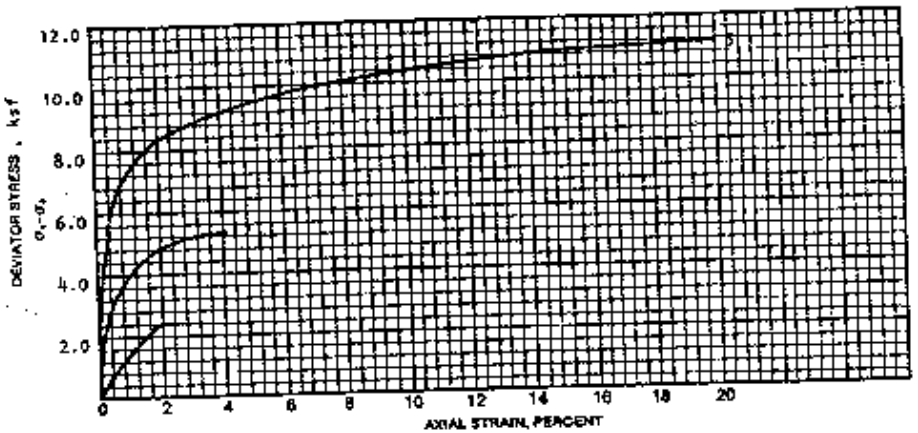
APPENDIX A

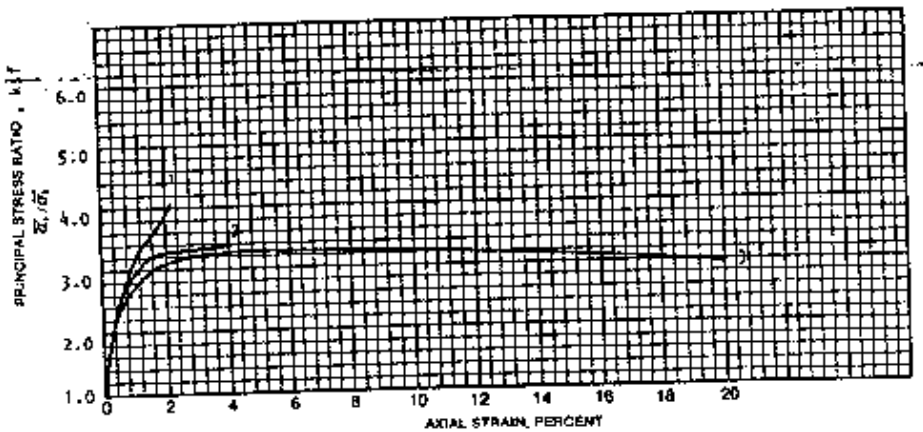
CU & UU TEST DATA ANALYSIS

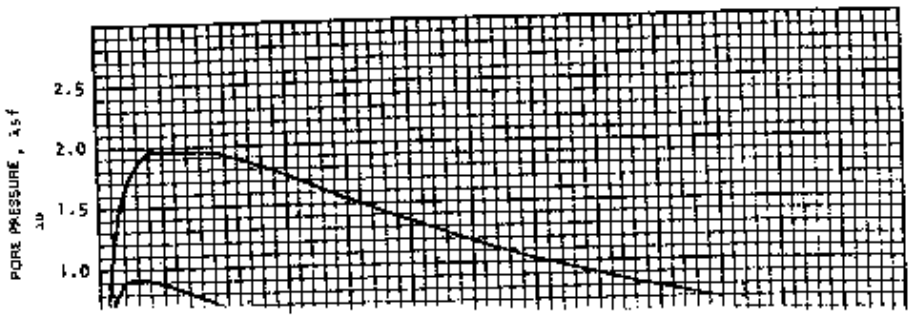
CU TEST

SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

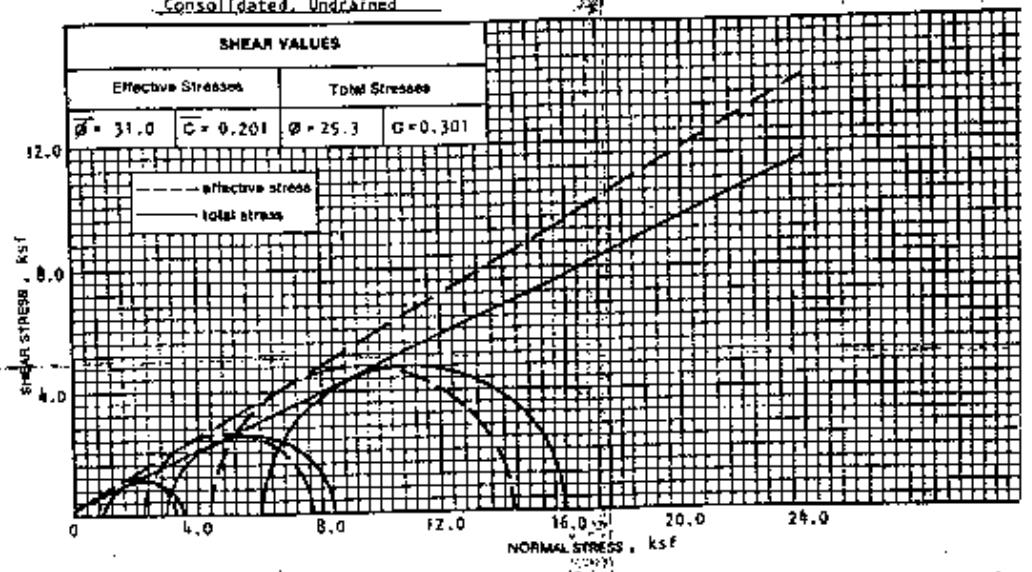
Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 31.0	$\bar{C}$ = 0.201	ϕ = 25.3	C = 0.301



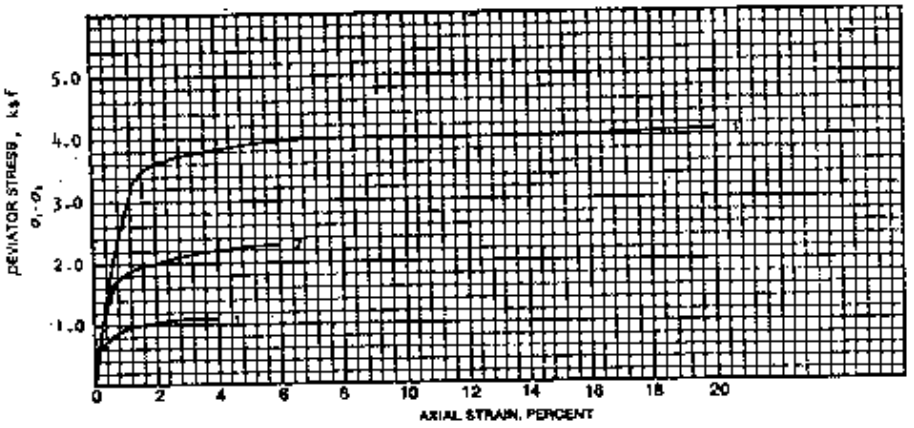
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL
2*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL
3*	GT-56	5.0-7.5	ST	7.0	2.877	103.7	22.1	Lean clay - CL
			(ST-02)					

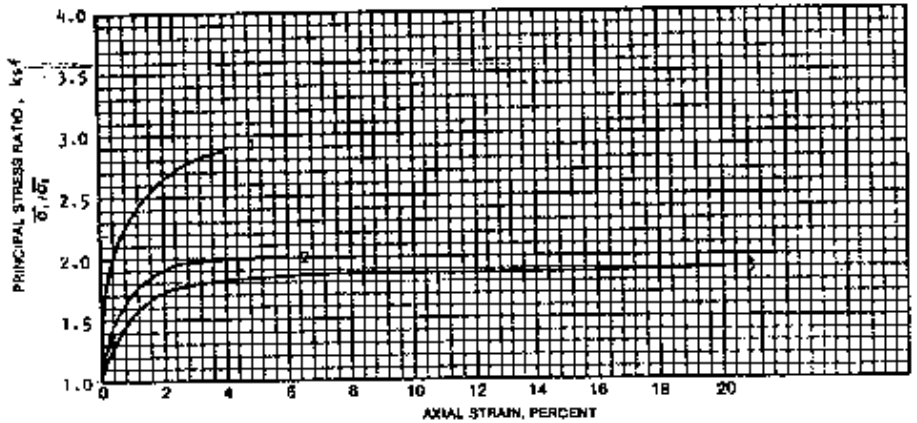
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ_1%	
1*	.97	0.994	3.496	2.502	0.806	3.308	0.187	2.2	
2*	.97	2.995	8.299	5.304	2.232	7.536	0.763	3.5	
3*	.97	6.005	15.956	9.951	4.333	14.285	1.670	7.1	

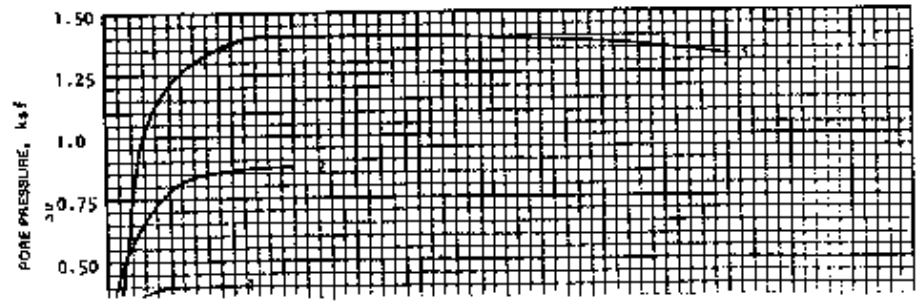
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

From Ref 4

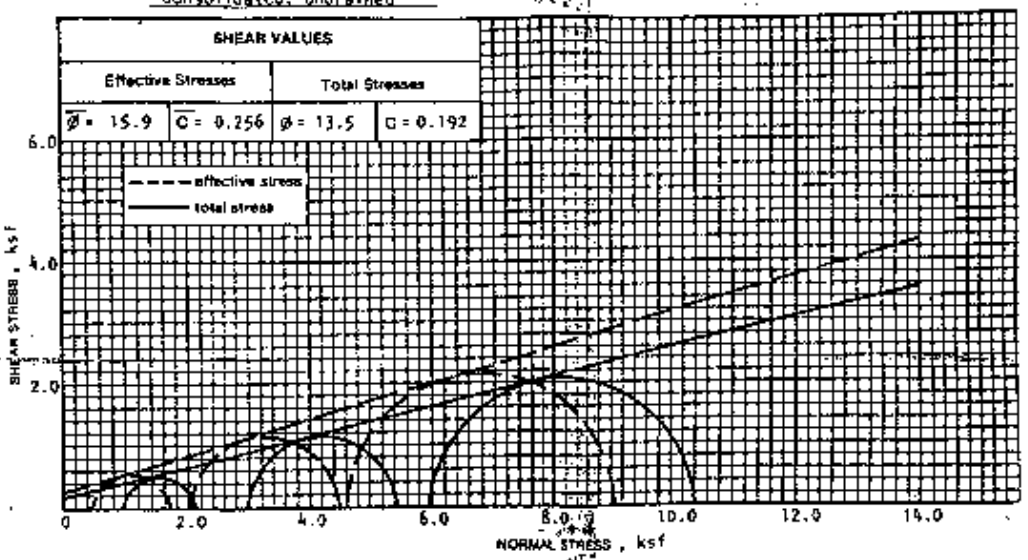
Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 15.9	$\bar{C}$ = 0.256	ϕ = 13.5	C = 0.192



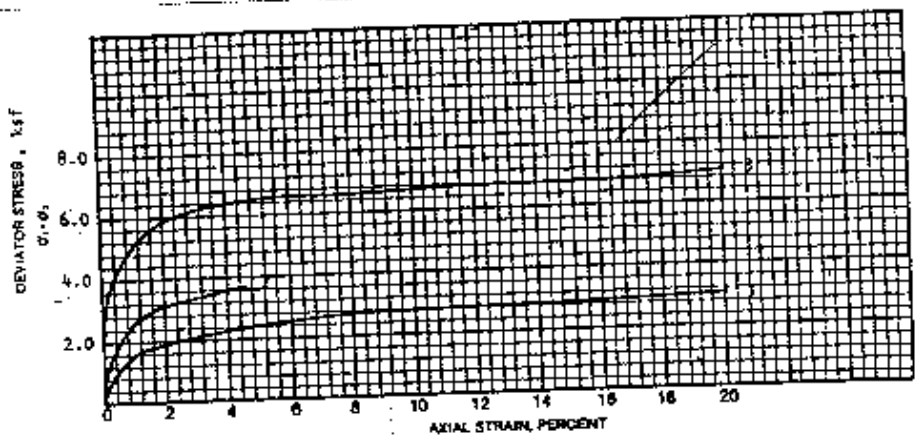
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH
2*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH
3*	GT-55	27.5-29.0	SB	5.568	2.374	101.4	23.7	Fat clay - CH
			(SB-12)					

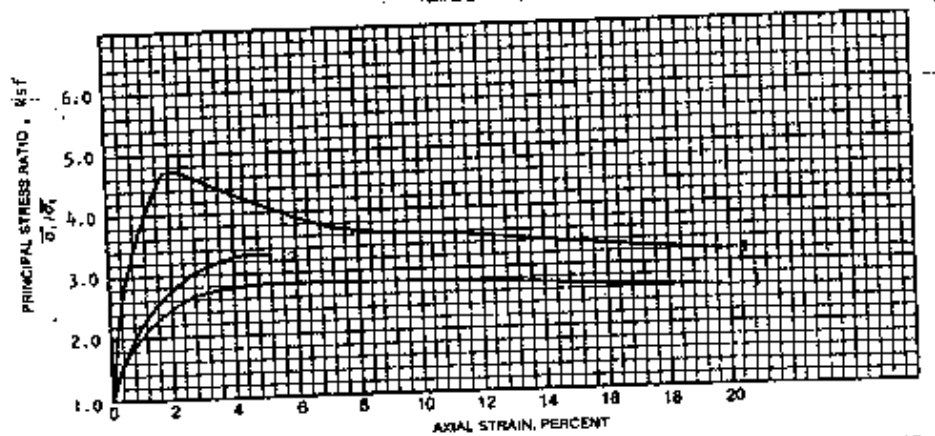
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1 - \sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ε_1 %	
1*	.95	0.994	2.082	1.088	0.576	1.664	0.418	3.5	
2*	.95	2.995	5.305	2.310	2.102	4.412	0.893	5.5	
3*	.95	6.005	10.137	4.132	4.554	8.726	1.411	10.4	

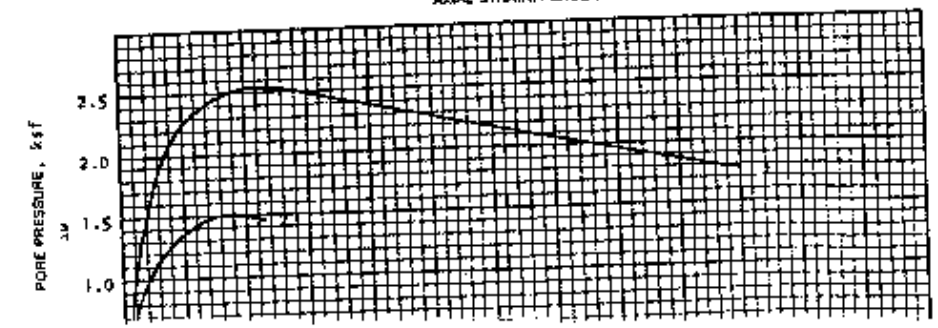
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

From Ref 4

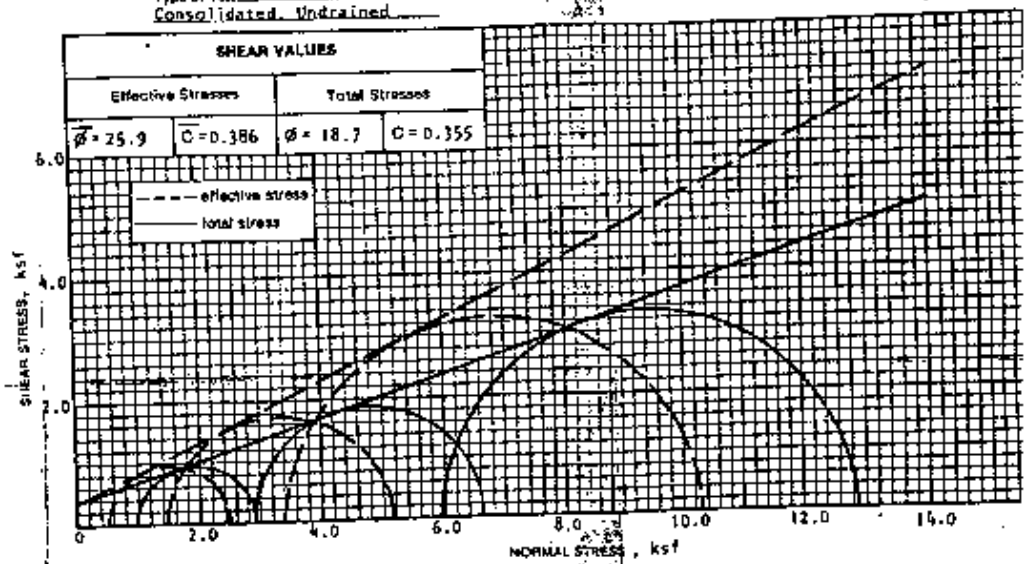
Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 25.9	$\bar{C}$ = 0.386	ϕ = 18.7	C = 0.355



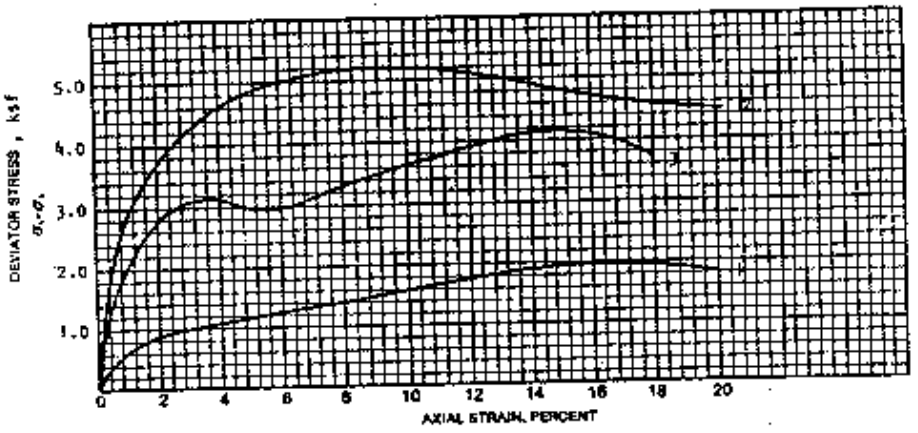
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-54	4.5-7.0	ST	5.912	2.876	96.8	25.0	Lean clay - CL
2	GT-54	4.5-7.0	ST	6.035	2.870	99.5	24.9	Lean clay - CL
3	GR-54	4.5-7.0	ST	6.035	2.870	99.5	24.9	Lean clay - CL
			(ST-03)					

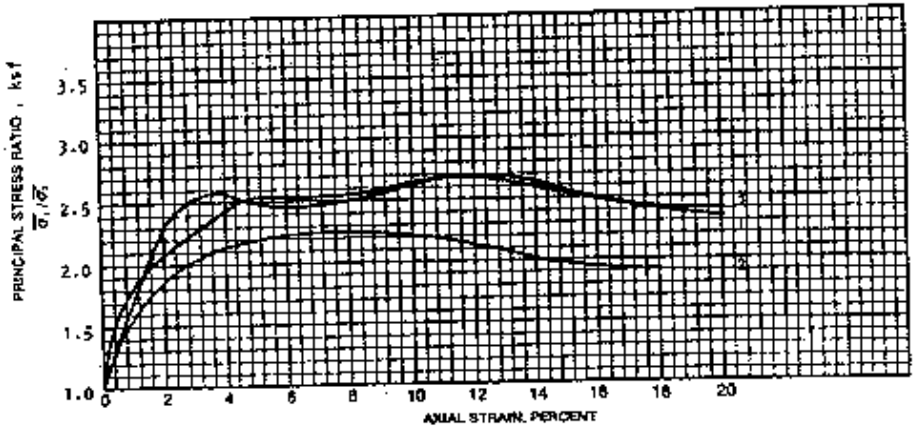
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ %	
1	.95	0.994	3.033	2.039	0.547	2.586	0.446	2.6	
2	.95	2.995	6.628	3.633	1.498	5.131	1.498	4.0	
3	.95	6.005	12.726	6.721	3.542	10.264	2.462	7.0	

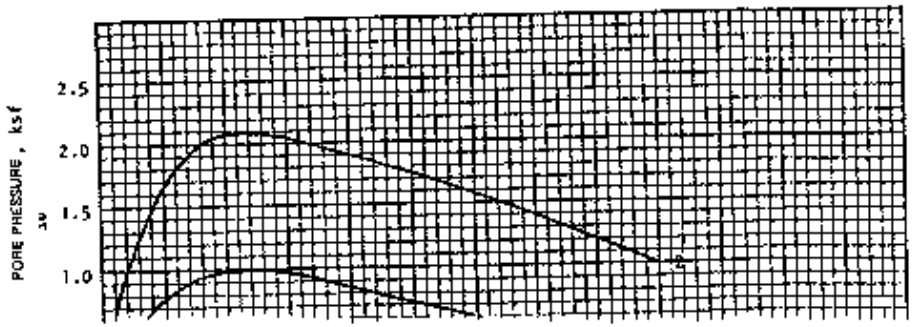
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained

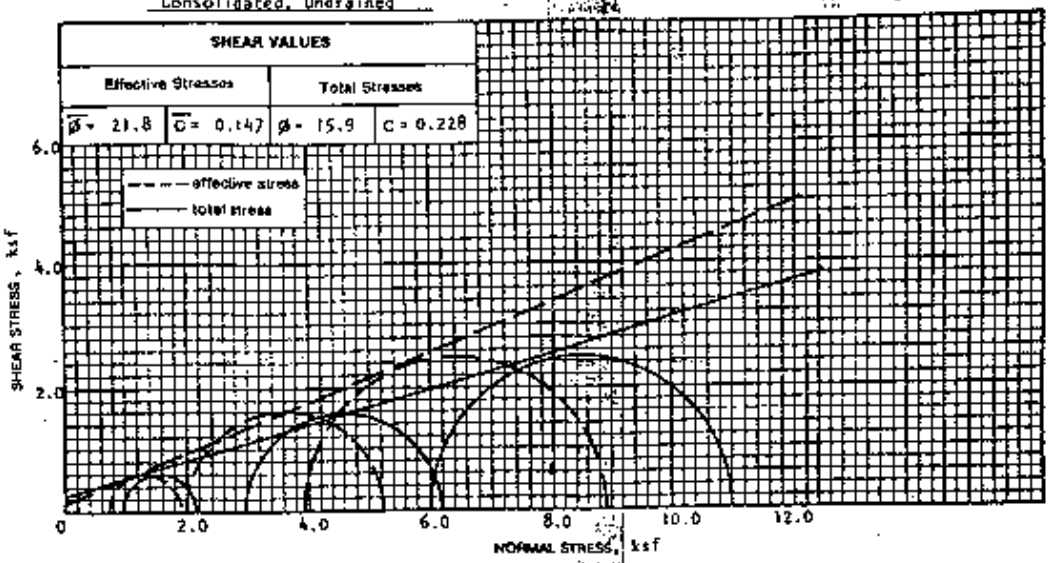
From Ref 4 clay fill







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 21.8	$\bar{C}$ = 0.147	ϕ = 15.9	C = 0.228



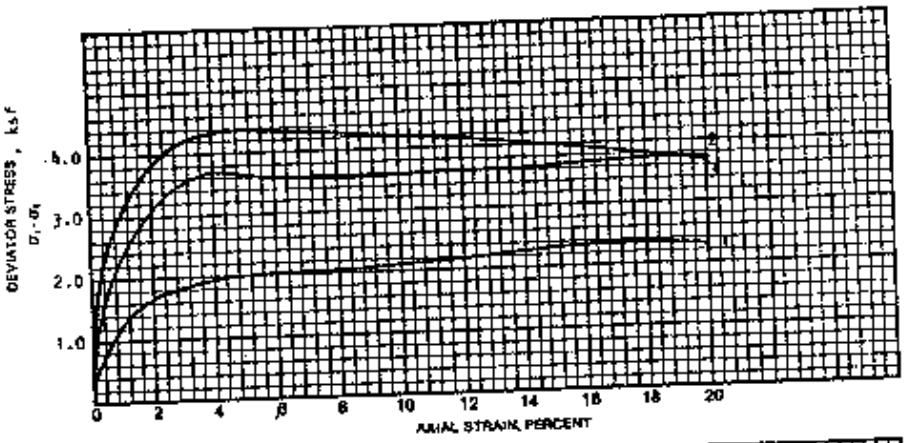
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-52	15.0-17.5	ST	6.082	2.880	101.5	24.5	Lean clay - CL
2	GT-52	15.0-17.5	ST	5.972	2.878	102.6	23.5	Lean clay - CL
3	GT-52	15.0-17.5	ST	6.049	2.883	104.3	22.7	Lean clay - CL
			(ST-66)					

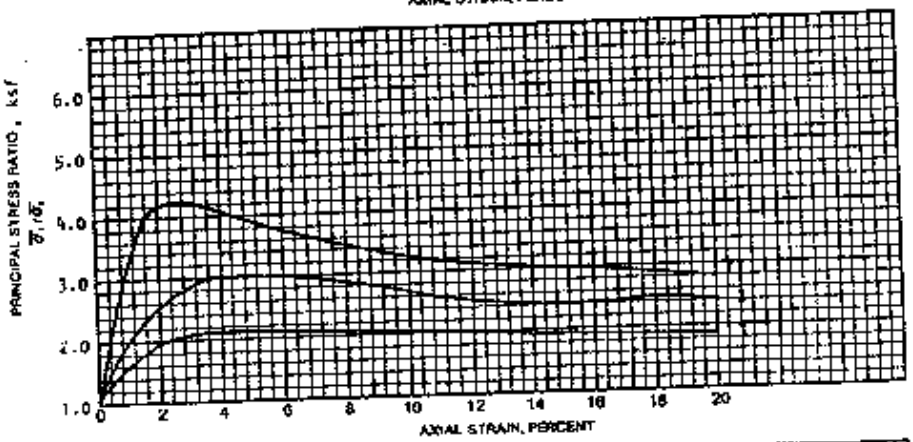
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ϵ_1%	
1	.95	0.994	2.160	1.166	0.778	1.944	0.216	4.5	
2	.95	2.995	6.172	3.177	2.039	5.208	0.965	3.5	
3	.93	6.005	10.979	4.974	3.960	8.934	2.045	6.0	

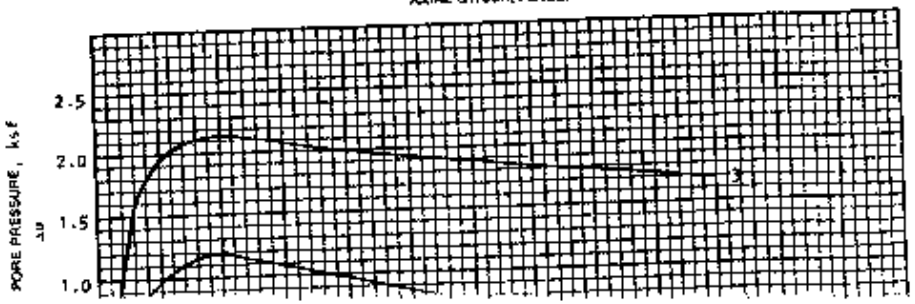
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

Job No. 1 296 89
Date January 1989
Type of Test Saturated, Consolidated, Undrained

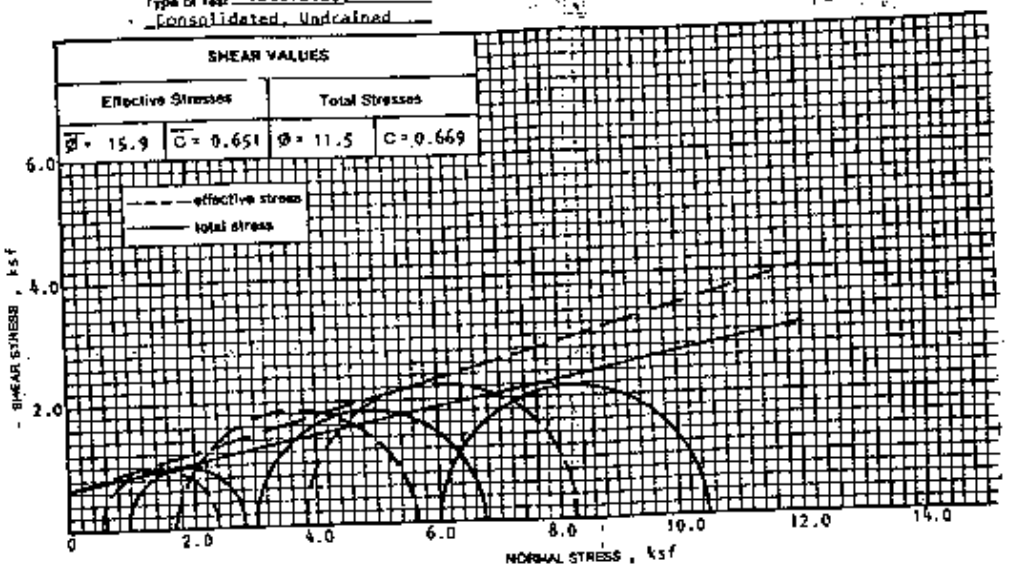
Form Ref 4 Preliminary







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 15.9	$\bar{C}$ = 0.651	ϕ = 11.5	C = 0.669



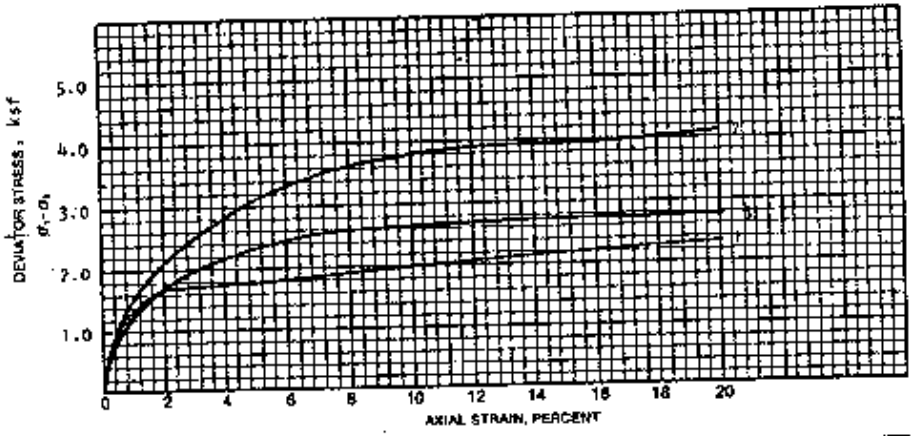
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-48	12.5-15.0	ST	6.082	2.879	102.0	22.9	Fat clay - CH
2	GT-48	12.5-15.0	ST	6.105	2.877	102.1	23.6	Fat clay - CH
3	GT-48	12.5-15.0	ST	6.006	2.885	97.5	26.1	Fat clay - CH
			(ST-05)					

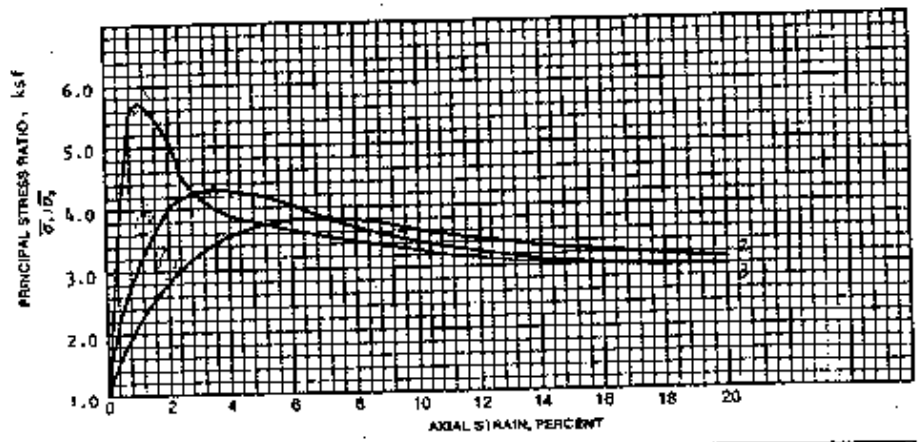
Specimen Number	B-bar Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ε %	
1	.97	0.994	2.815	1.821	.552	2.383	0.432	3.0	
2	.95	2.995	6.719	3.724	1.800	5.524	1.195	4.0	
	.95	6.005	10.361	4.356	3.874	8.230	2.131	4.5	

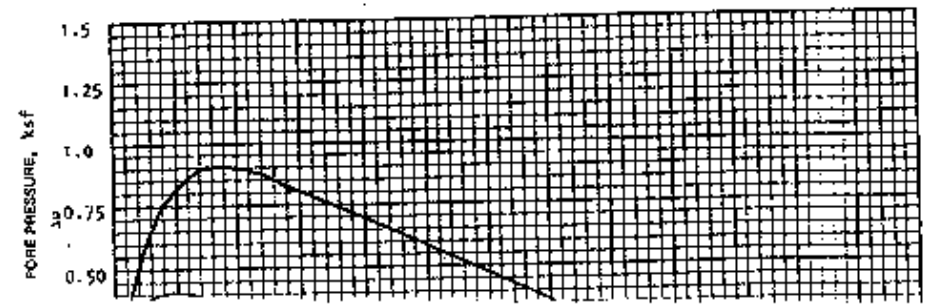
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

From Reg 4 clay Till

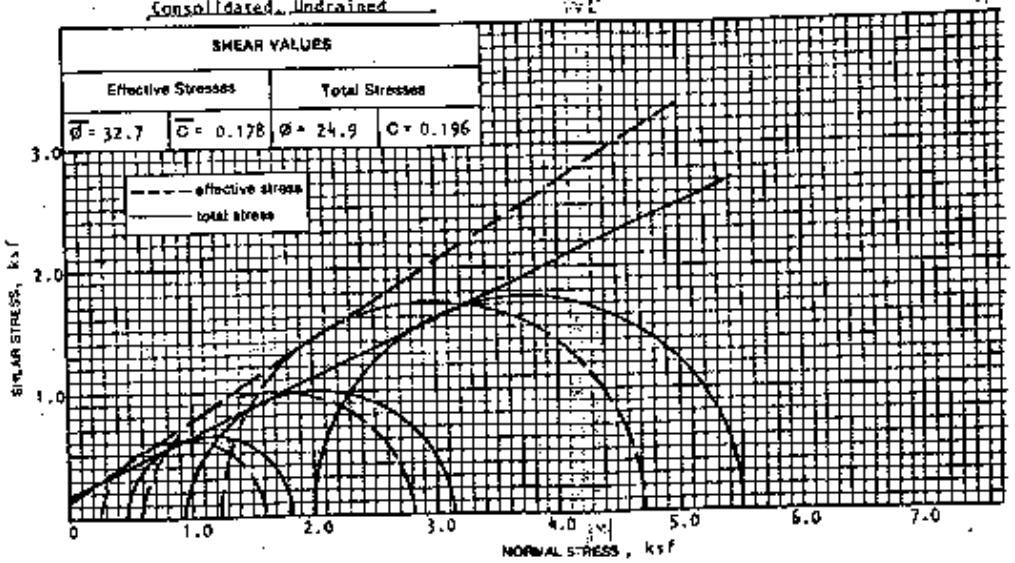
Job No. 1 296 89
Date January 20, 1989
Type of Test Saturated, Consolidated, Undrained







SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 32.7	$\bar{C}$ = 0.178	ϕ = 24.9	C = 0.196



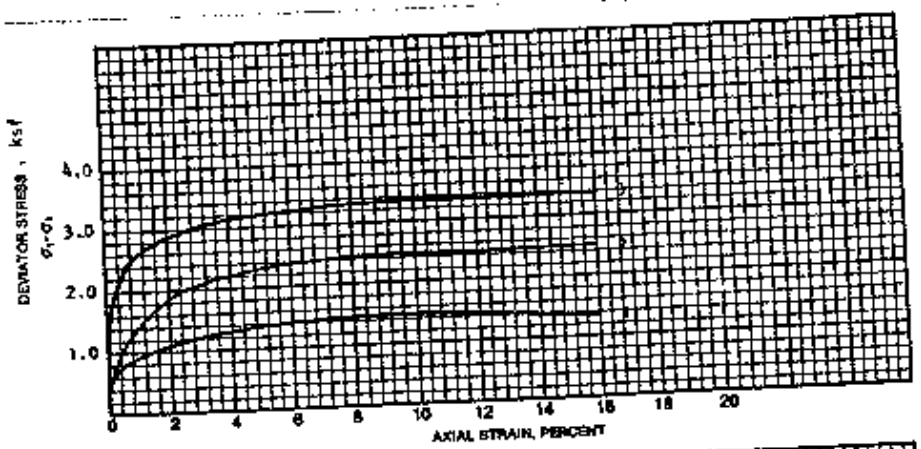
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-44	5.0-7.5	ST	6.051	2.375	107.0	18.6	Lean clay - CL
2	GT-44	5.0-7.5	ST	6.062	2.364	104.7	20.2	Lean clay - CL
3	GT-44	5.0-7.5	ST	6.14	2.338	105.8	19.7	Lean clay - CL
			(57-03)					

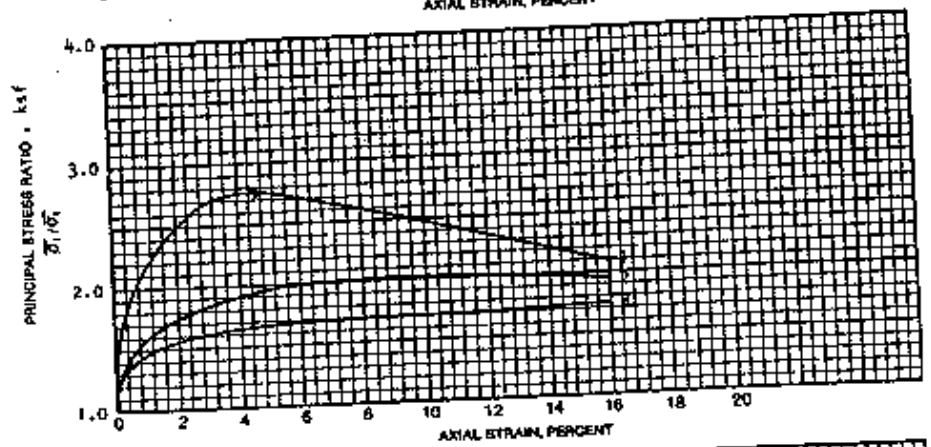
Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure μ	Percent Strain ε_1%	
1	.97	0.504	1.814	1.310	0.274	1.583	0.230	1.0	
2	.98	0.994	3.115	2.121	0.634	2.755	0.360	3.5	
	.98	2.000	5.512	3.510	1.210	4.720	0.792	7.0	

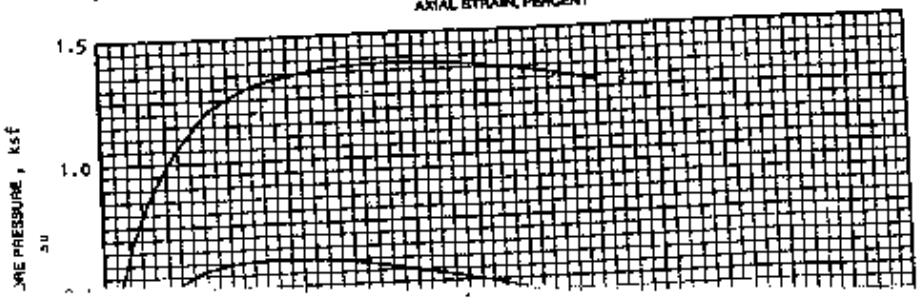
SHEAR STRENGTH OF SOIL IN TRIAXIAL COMPRESSION

From Red 4 Foundation

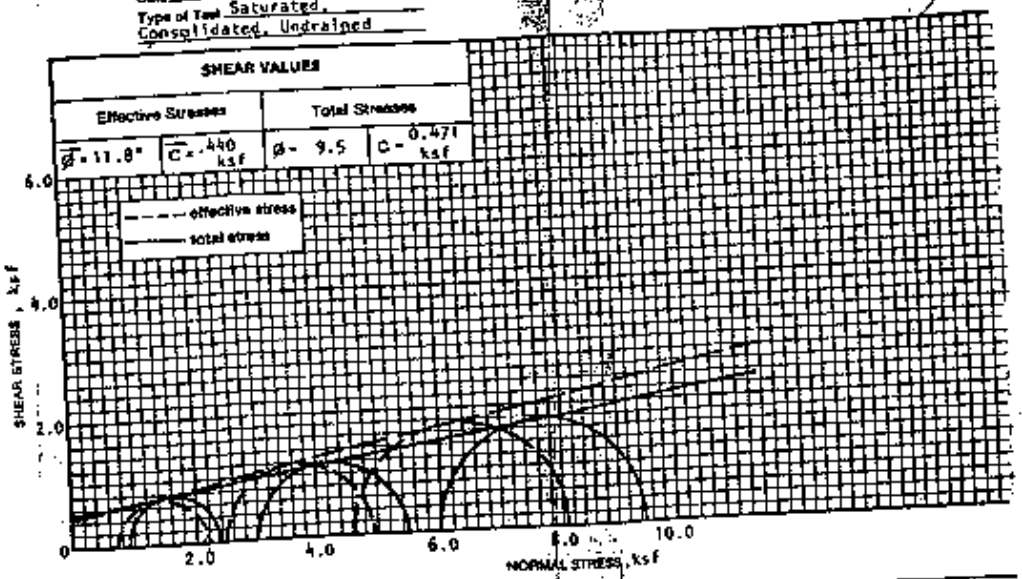
Job No. 1 296 89
Date January 19, 1989
Type of Test Saturated, Consolidated, Undrained





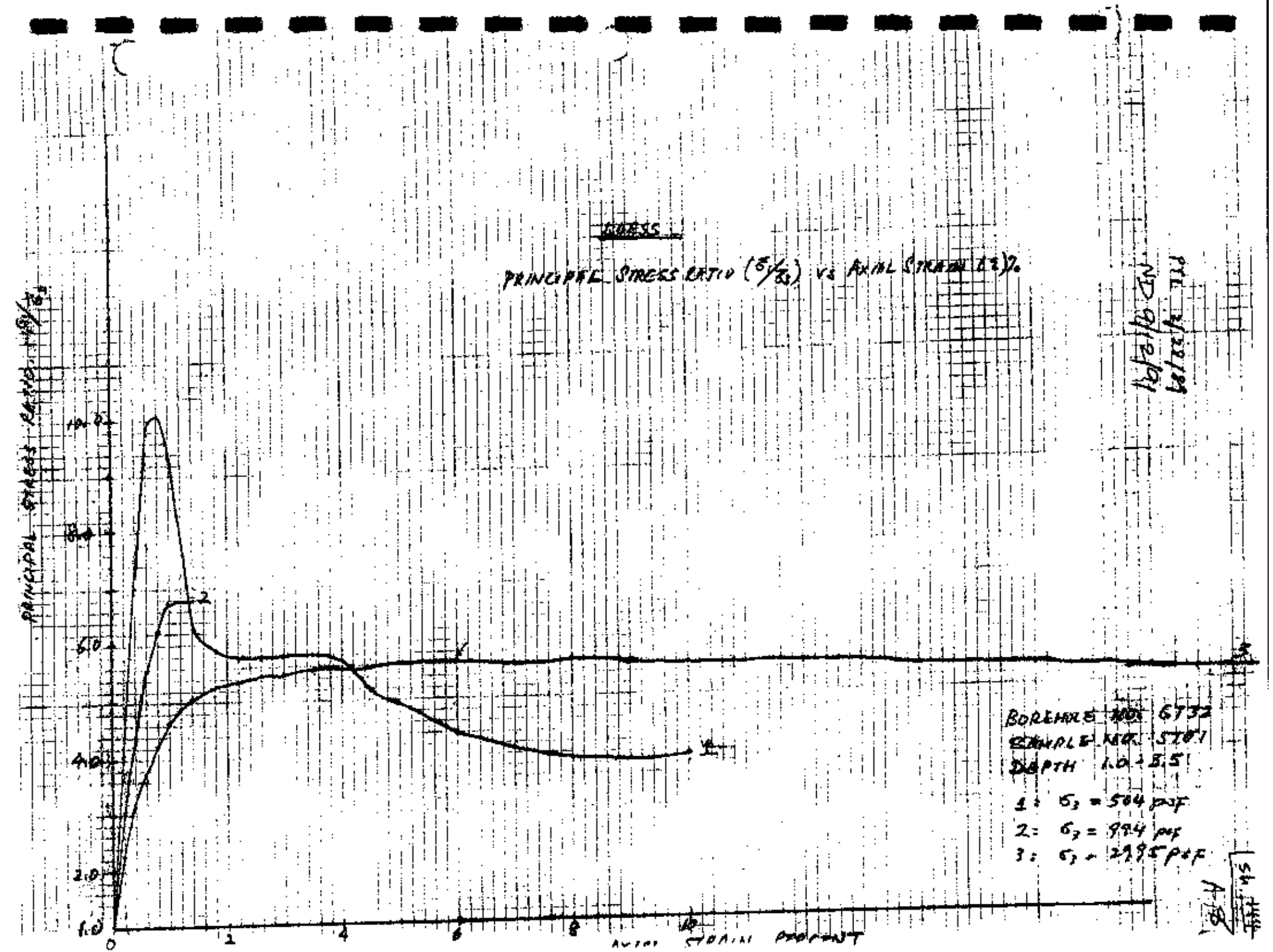


SHEAR VALUES			
Effective Stresses		Total Stresses	
$\bar{\phi}$ = 11.8°	$\bar{C}$ = .440 ksf	ϕ = 9.5	C = 0.471 ksf



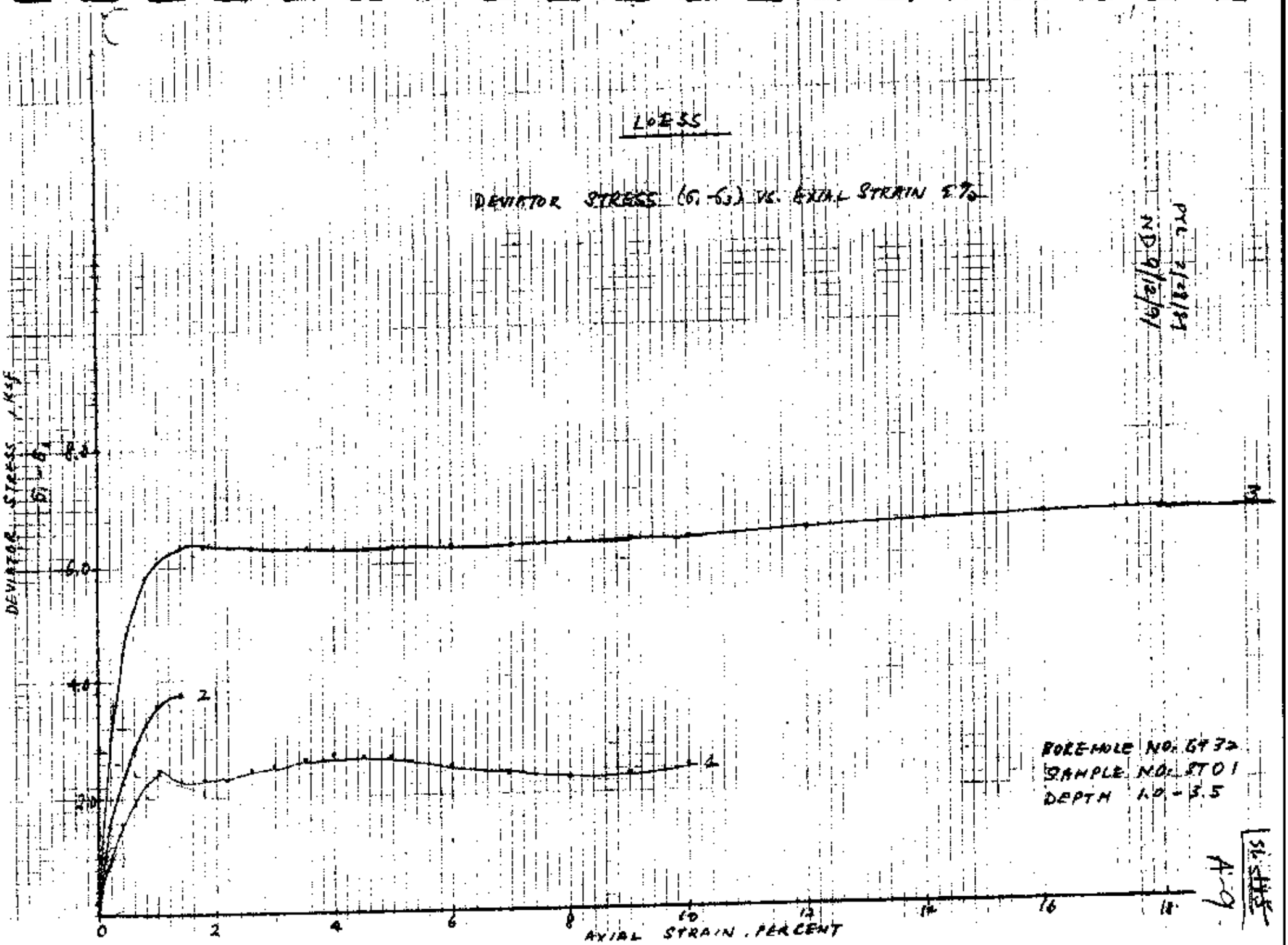
Specimen Number	Specimen Location		Initial Specimen Data					Soil Description
	Boring Number	Depth (Ft)	Sample Type	Length (in)	Diameter (in)	Dry Density (P.C.F.)	Moisture Content (%)	
1	GT-43	6.0-8.5	ST	6.092	2.882	95.5	27.8	Lean clay - CL
2	GT-43	6.0-8.5	ST	6.088	2.878	89.9	32.3	Lean clay - CL
3	GT-43	6.0-8.5	ST	5.991	2.878	87.6	34.2	Lean clay - CL
			(ST-04)					

Specimen Number	"B" Parameter	TEST VALUES AT MAXIMUM PRINCIPAL STRESS RATIO							Remarks
		Total Confining Stress σ_3	Total Axial Stress σ_1	Deviator Stress $\sigma_1-\sigma_3$	Effective Lateral Stress $\bar{\sigma}_3$	Effective Axial Stress $\bar{\sigma}_1$	Pore Pressure u	Percent Strain ε_1%	
1	.96	0.994	2.367	1.373	0.778	2.151	0.216	4.51	
2	.98	2.995	5.513	2.518	2.434	4.952	0.562	9.99	
3	.96	6.005	9.384	3.379	4.466	8.044	1.339	14.029	


STRESS
PRINCIPAL STRESS RATIO (σ_1/σ_3) vs AXIAL STRAIN (ε%)
PRINCIPAL STRESS RATIO σ_1/σ_3
AXIAL STRAIN PERCENT
0
1
4
6
8
10
1.0
2.0
4.0
6.0
8.0
10.0
1
2
3
BOREHOLE NO. 6732
SAMPLE NO. ST-1
DEPTH 1.0 - 5.5'
1: σ_3 = 504 psf
2: σ_3 = 994 psf
3: σ_3 = 2985 psf

LOESS

DEVIATOR STRESS $(\sigma_1 - \sigma_3)$ VS. AXIAL STRAIN ε_1%



BOREHOLE NO. GT 32
SAMPLE NO. ST 01
DEPTH 1.0 - 3.5

PLATE A-9

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP — Contract No. 5121 — Sheet 446 A-10
Feature DC — Designed PYL — File No.
Item Material Properties — Checked ND — Date 2/28/89 — Date 9/12/91

GT 32 ST01 σ_3 = 504 LOESS

Axial Strain ε (%)	① $\bar{\sigma}_1$ (psf)	② Δμ	①+② σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1 / \bar{\sigma}_3$
0.2	1176	216	1392	888	288	4.083
0.41	1836	259	2095	1591	245	7.494
0.60	2132	288	2410	1906	216	9.824
0.80	2464	259	2723	2219	245	10.057
1.01	2788	202	2990	2486	302	9.232
1.40	2705	72	2777	2273	432	6.262
1.80	2806	29	2835	2331	475	5.907
2.20	2893	0	2893	2389	504	5.740
2.60	2986	-14	2972	2468	518	5.764
2.99	3079	-29	3050	2546	533	5.777
3.50	3168	-43	3125	2621	547	5.792
4.00	3271	-72	3199	2695	576	5.679
4.51	3293	-130	3163	2659	634	5.194
4.99	3322	-173	3149	2645	677	4.907
6.00	3223	-230	2993	2489	934	4.391
6.99	3141	-259	2882	2378	763	4.117
8.00	3081	-288	2793	2289	792	3.890
9.00	3147	-317	2830	2326	821	3.833
10.00	3280	-331	2949	2445	835	3.928

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP — Contract No. 3840-827 5121 — Sheet 147A-11
Feature DC — Designed PYL — File No.
Item Material Properties — Checked ND — Date 2/28/89 9/12/91

GT32-ST01 LOESS γ_{dry} = 99.4 pcf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.2	2324	230	2554	1560	764	3.042
0.4	2955	317	3272	2278	677	4.365
0.6	3460	374	3834	2840	620	5.581
0.8	3866	374	4240	3246	620	6.235
1.00	4169	374	4543	3549	620	6.724
1.40	4393	346	4739	3745	648	6.779 ←

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

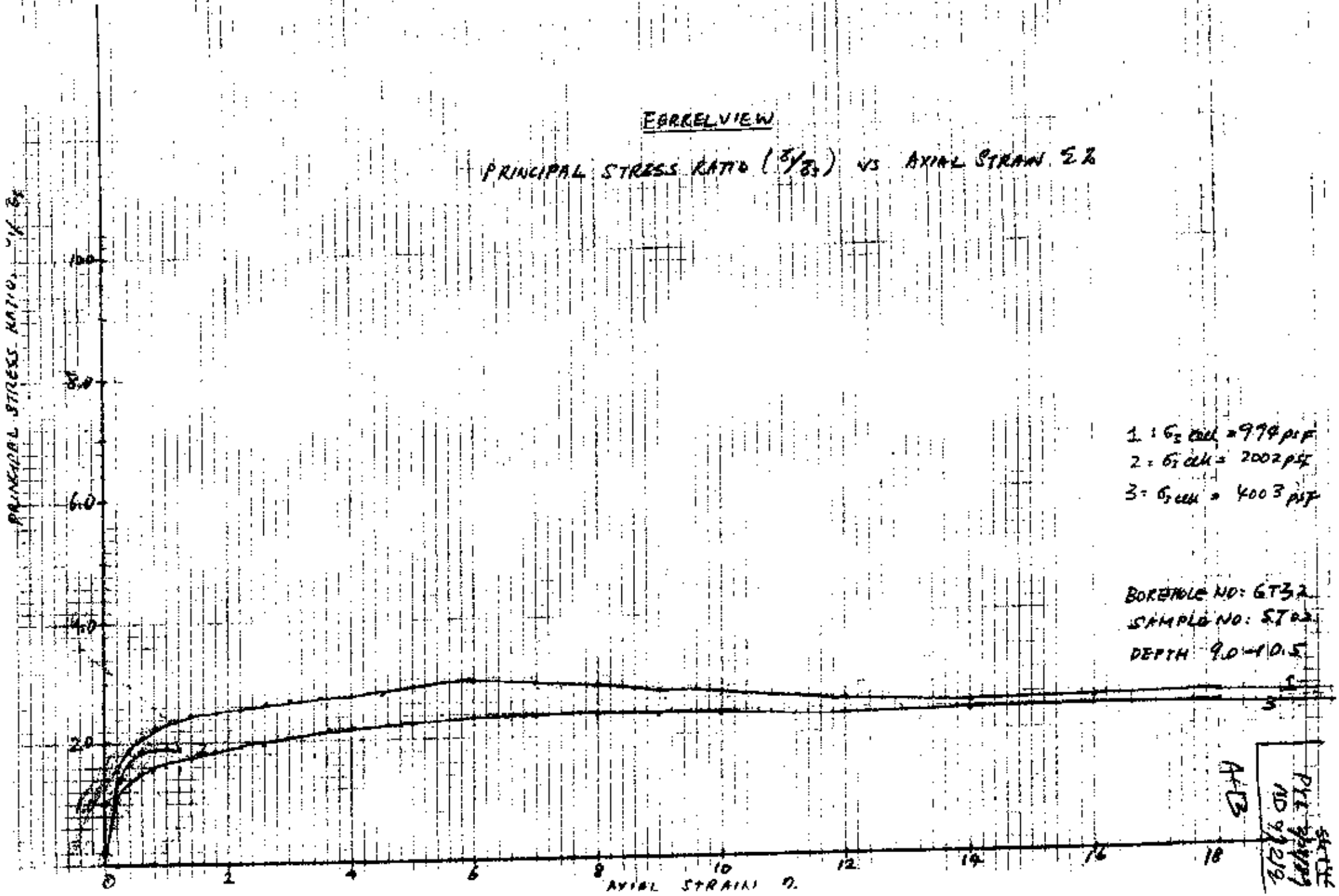
Project USSR&P — Contract No. 8840-827 — Sheet C-18A-12
Feature DC — Designed PYL — File No.
Item Material Properties — Checked ND — Date 9/2/91

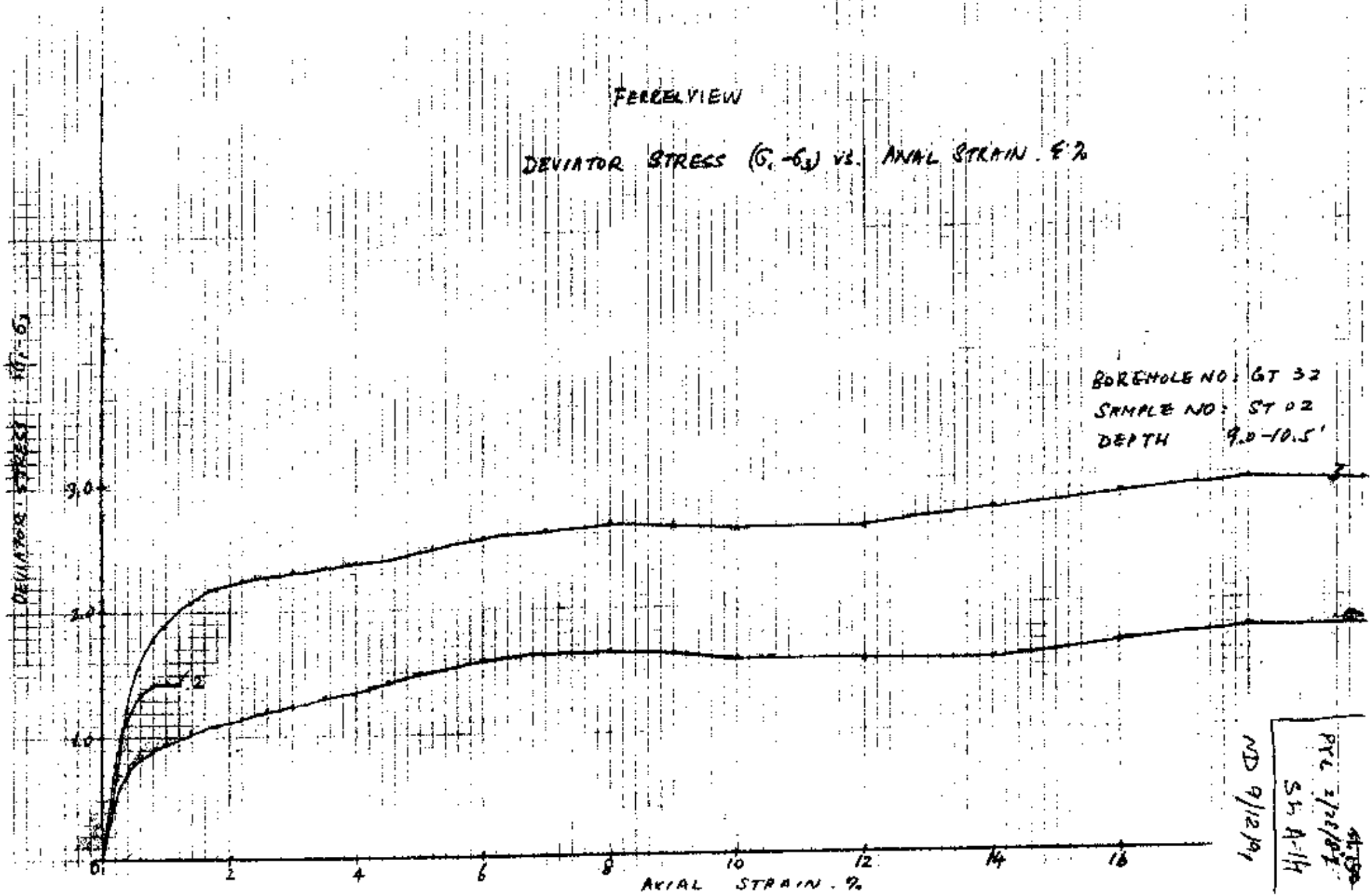
GT32-ST01 LOESS — σ_{3cell} = 2995 psf

ε (%)	$\bar{\sigma}_1$ (psf)	Δu	σ_1 (psf)	$\sigma_1 - \sigma_3$ (psf)	$\bar{\sigma}_3$ (psf)	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	5386	619	6005	3010	2396	2.247
0.41	6519	936	9455	4460	2059	3.166
0.59	7128	1109	8237	5242	1886	3.779
0.80	7589	1210	8799	5804	1785	4.252
1.00	7773	1310	9083	6088	1685	4.613
1.40	7902	1426	9328	6333	1569	5.036
1.79	7818	1498	9316	6321	1497	5.222
2.20	7776	1541	9317	6322	1454	5.348
2.60	9712	1570	9282	6287	1425	5.412
2.99	7677	1584	9261	6266	1411	5.441
3.50	9641	1613	9254	6259	1382	5.529
4.01	7603	1627	9230	6235	1368	5.558
4.50	7597	1627	9224	6229	1368	5.553
5.01	7588	1642	9230	6235	1353	5.608
6.00	7604	1642	9246	6251	1353	5.620
7.00	7645	1627	9272	6277	1368	5.588
8.00	9686	1627	9313	6318	1368	5.618
9.00	7754	1598	9352	6357	1397	5.550
10.00	7801	1584	9385	6390	1411	5.529
12.01	7919	1555	9474	6479	1440	5.499
13.99	8015	1512	9527	6532	1483	5.405
16.00	8127	1469	9596	6601	1526	5.326
17.99	8170	1440	9610	6615	1555	5.254
20.01	8186	1411	9597	6602	1584	5.168

EARRELVIEW

PRINCIPAL STRESS RATIO (σ_3/σ_1) VS AXIAL STRAIN ε_1 %




FERRELVIEW
DEVIATOR STRESS ($\sigma_1 - \sigma_3$) vs. ANAL STRAIN. ε%
BOREHOLE NO: GT 32
SAMPLE NO: ST 02
DEPTH 9.0-10.5'
DEVIATOR STRESS ($\sigma_1 - \sigma_3$)
3.0
2.0
1.0
0
2
4
6
8
10
12
14
16
AXIAL STRAIN. %
ND 9/12/91
PYL 2/28/91
SL A-1H

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRAP
Feature: PL
Item: Material Properties

Contract No. 3890-827 ~~5121~~
Designed: PYL
Checked: ND

Sheet: ~~A-1~~ A-15
File No.:
Date: 2/28/89
Date: 9/12/91

GT32-ST02 FERRELVIEW

σ_{1cell} = 994 psf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.2	1345	130	1475	481	864	1.557
0.39	1497	202	1699	705	792	1.890
0.61	1582	230	1812	818	764	2.071
0.80	1632	259	1891	897	735	2.220
1.00	1681	259	1940	946	735	2.287
1.39	1755	274	2029	1035	720	2.438
1.80	1830	259	2089	1095	735	2.490
2.20	1898	245	2143	1149	749	2.534
2.61	1951	245	2196	1202	749	2.605
3.00	1990	245	2235	1241	749	2.657
3.50	2066	230	2296	1302	764	2.704
4.00	2114	216	2330	1336	778	2.717
4.50	2230	187	2417	1423	807	2.763
5.00	2306	187	2493	1499	807	2.857
6.00	2426	158	2584	1590	836	2.902
7.00	2487	130	2617	1623	864	2.878
8.00	2534	101	2635	1641	893	2.838
9.00	2543	72	2615	1621	922	2.758
10.00	2543	29	2572	1578	965	2.635
12.00	2586	-14	2572	1578	1008	2.565
14.00	2639	-86	2553	1559	1080	2.444
16.00	2808	-130	2678	1684	1124	2.498
18.00	2957	-173	2784	1790	1167	2.534
20.00	2972	-202	2770	1776	1196	2.485

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRAP
Feature: DC
Item: Material Properties

Contract No. 3840-827 ~~5121~~
Designed: PYL
Checked: ND

Sheet: A-16
File No.:
Date: 2/28/89
Date: 9/12/91

GT32 - ST02 FERREVIEW

$\sigma_{3\,cm}$ = 2002 psf

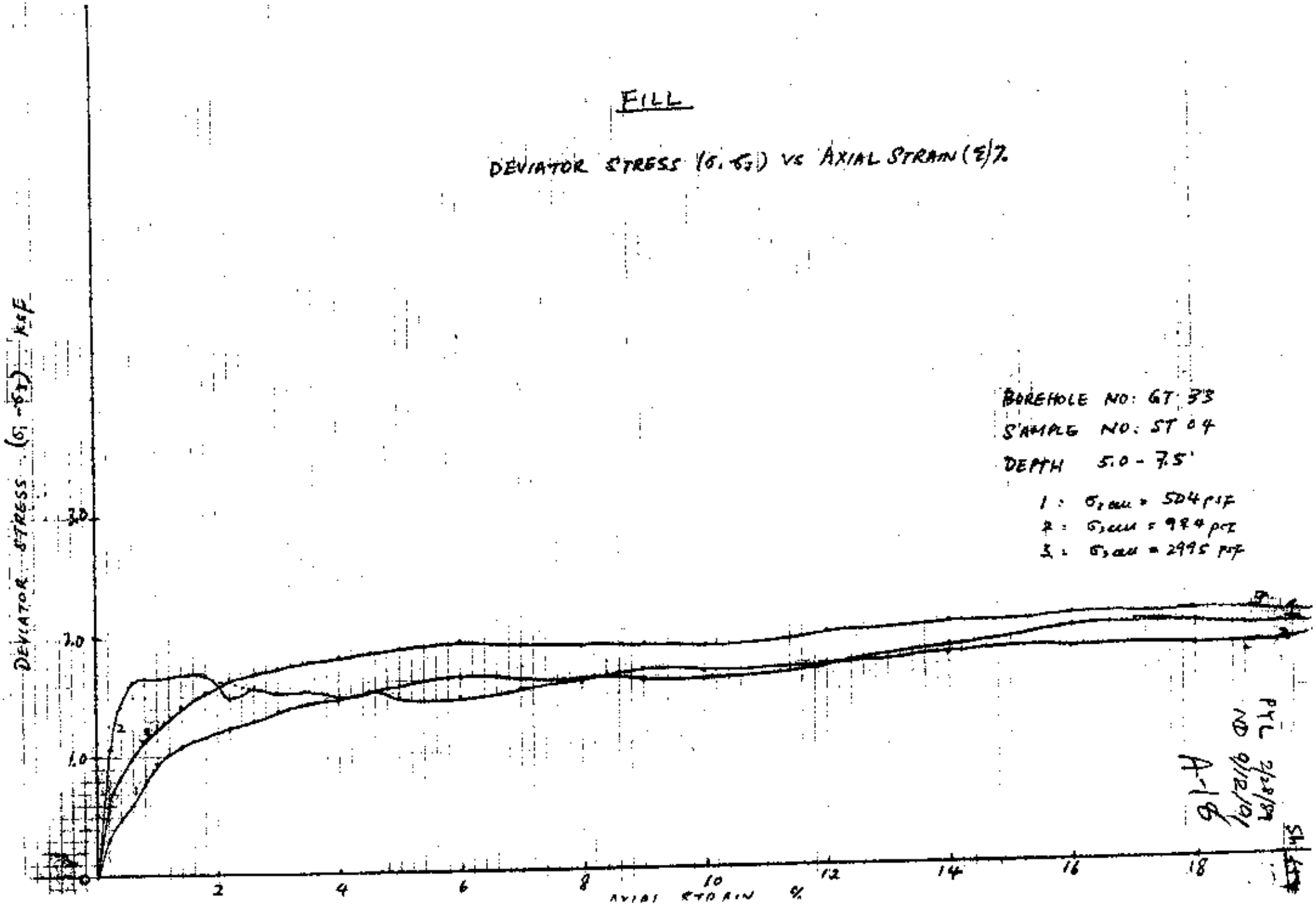
ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	2601	173	2774	772	1829	1.422
0.40	2864	302	3166	1164	1700	1.685
0.60	3011	346	3357	1355	1656	1.818
0.79	3045	360	3405	1403	1642	1.854
1.01	3038	374	3412	1410	1628	1.866
1.21	3030	389	3419	1417	1613	1.878 ←

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP — Contract No. 3840-827 5121 — Sheet ~~153~~ A-17
Feature DL — Designed PYL — File No. —
Item Material Properties — Checked MD — Date 2/28/89 — Date 9/2/91

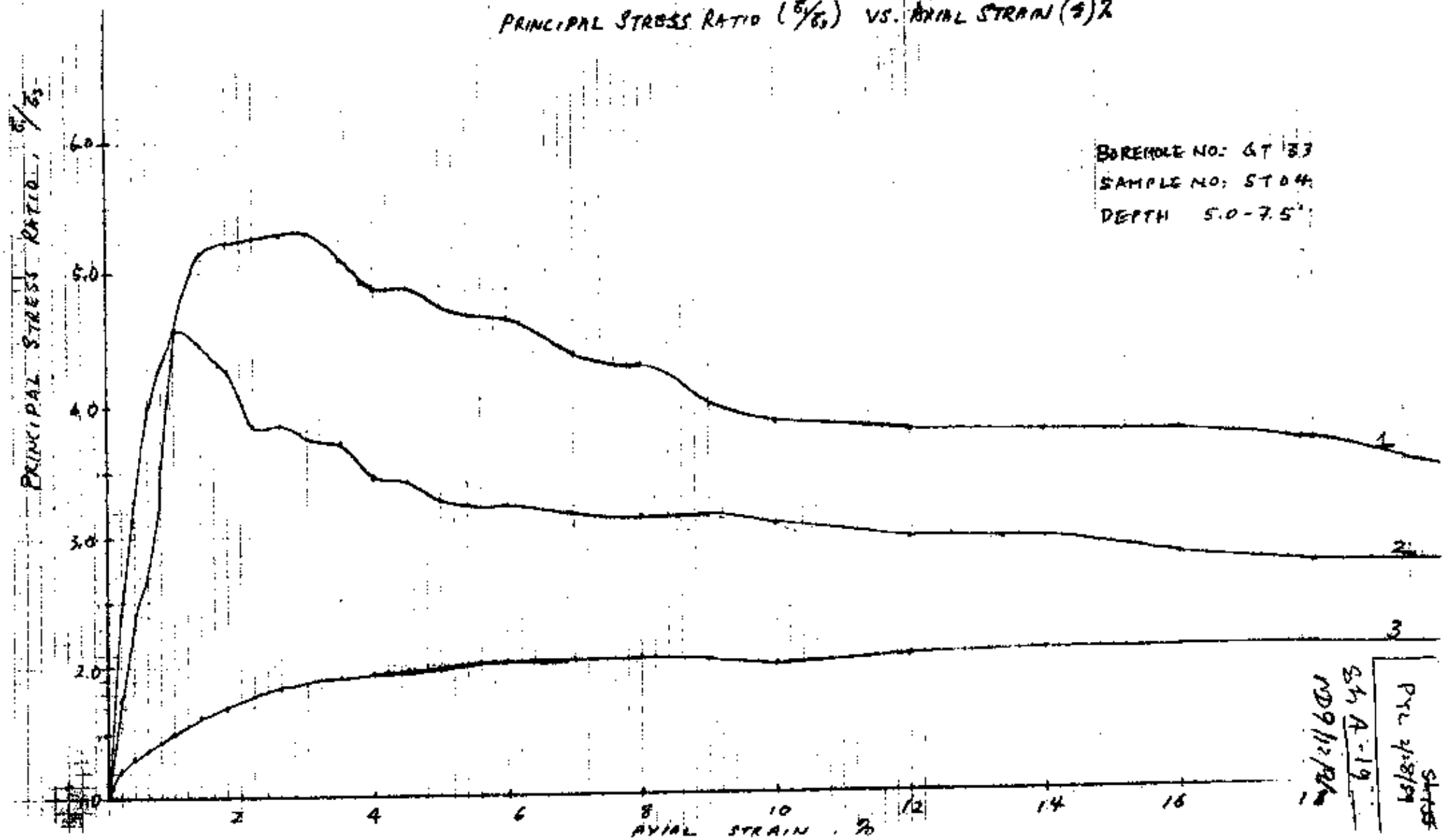
GT32 -ST02 FERRELVIEW — σ_3 cell = 4003 psf

ε_z (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1-\sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	4596	86	4682	679	3917	1.173
0.40	4923	288	5211	1208	3715	1.325
0.59	5036	533	5569	1566	3470	1.451
0.81	4999	778	5777	1774	3225	1.550
1.00	4920	979	5899	1896	3024	1.627
1.40	4813	1267	6080	2077	2736	1.759
1.80	4743	1454	6197	2194	2549	1.861
2.21	4667	1584	6251	2248	2419	1.929
2.60	4613	1670	6283	2280	2333	1.977
3.00	4529	1786	6315	2312	2217	2.043
3.50	4400	1944	6344	2341	2059	2.137
4.00	4392	2002	6394	2391	2001	2.195
5.01	4439	2030	6469	2466	1973	2.250
6.00	4490	2074	6564	2561	1929	2.328
7.00	4542	2074	6616	2613	1929	2.355
8.01	4577	2088	6665	2662	1915	2.390 ←
8.99	4549	2088	6637	2634	1915	2.375
10.00	4539	2088	6627	2624	1915	2.370
12.01	4580	2045	6625	2622	1958	2.339
14.00	4765	2002	6767	2764	2001	2.381
15.99	4937	1944	6881	2878	2059	2.398
18.00	5097	1872	6969	2966	2131	2.392
20.00	5189	1742	6931	2928	2261	2.295


FILL
DEVIATOR STRESS ($\sigma_1 - \sigma_3$) VS AXIAL STRAIN (ε)%
BOREHOLE NO: GT 33
SAMPLE NO: ST 04
DEPTH 5.0 - 7.5'
1 : $\sigma_{3\,eff}$ = 504 psf
2 : $\sigma_{3\,eff}$ = 994 psf
3 : $\sigma_{3\,eff}$ = 2995 psf
DEVIATOR STRESS ($\sigma_1 - \sigma_3$) ksf
AXIAL STRAIN %
0
1.0
2.0
3.0
2
4
6
8
10
12
14
16
18
PYL 2/28/89
ND 9/12/91
A-16

FILL

PRINCIPAL STRESS RATIO (σ_1/σ_3) VS. AXIAL STRAIN (ε)%



SHTS
PYL 2/18/89
Sh A-19
ND 9/12/89

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRAP
Feature: DC
Item: Material Properties
Contract No. 3840827 ~~5721~~
Designed: PYL
Checked: ND
Sheet: A-20
File No.:
Date: 2/28/89
Date: 9/12/91

GT 33-ST04 Dike Fill

σ_{3cell} = 504 psf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	757	72	829	325	432	1.752
0.40	861	130	991	487	374	2.302
0.60	961	144	1105	601	360	2.669
0.81	1072	202	1274	770	302	3.550
1.01	1189	245	1434	930	259	4.591
1.40	1333	245	1578	1074	259	5.147
1.80	1428	230	1658	1154	274	5.212
2.20	1513	216	1729	1225	288	5.253
2.60	1597	202	1799	1295	302	5.288
3.01	1677	187	1864	1360	317	5.290 ←
3.50	1761	158	1919	1415	346	5.090
4.00	1819	130	1949	1445	374	4.864
4.50	1892	115	2007	1503	389	4.864
5.01	1970	86	2056	1552	418	4.713
6.00	2059	58	2117	1613	446	4.617
7.01	2066	29	2095	1591	475	4.349
8.00	2088	14	2102	1598	490	4.261
9.01	2109	-29	2080	1576	533	3.957
10.00	2136	-58	2078	1574	562	3.801
12.00	2273	-101	2172	1668	605	3.757
14.00	2475	-158	2317	1813	662	3.739
16.00	2672	-216	2456	1952	720	3.711
18.00	2750	-259	2491	1987	763	3.604
20.02	2759	-317	2442	1938	821	3.361

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WISSRAP
Feature: DC
Item: Material Properties
Contract No. 3840-827 ~~5121~~
Designed: PYL
Checked: ND
Sheet: A-21 ~~154~~
File No.
Date: 2/28/89
Date: 9/12/91

GT33 -ST04 Dike Fill

σ_{3cell} = 994 psf.

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	1846	230	2076	1082	764	2.416
0.39	2037	374	2411	1417	620	3.285
0.60	2174	446	2620	1626	548	3.967
0.80	2158	490	2648	1654	504	4.282
1.00	2107	533	2640	1646	461	4.570
1.40	2182	504	2686	1692	490	4.453
1.80	2213	475	2688	1694	519	4.264
2.20	1988	475	2463	1469	519	3.830
2.60	2106	446	2552	1558	548	3.843
3.01	2057	446	2503	1509	548	3.754
3.50	2081	432	2513	1519	562	3.703
4.00	2090	389	2475	1481	609	3.432
4.50	2110	374	2484	1490	620	3.403
5.00	2114	346	2460	1466	648	3.262
5.99	2125	331	2456	1462	663	3.205
7.01	2215	288	2503	1509	706	3.137
8.00	2324	245	2569	1575	749	3.103
9.00	2459	202	2661	1667	792	3.105
10.00	2451	187	2638	1644	807	3.037
12.00	2557	115	2672	1678	879	2.909
14.00	2640	86	2726	1732	908	2.907
16.01	2793	-14	2779	1785	1008	2.771
18.00	2863	-72	2791	1797	1066	2.686
20.01	3001	-130	2871	1877	1124	2.670

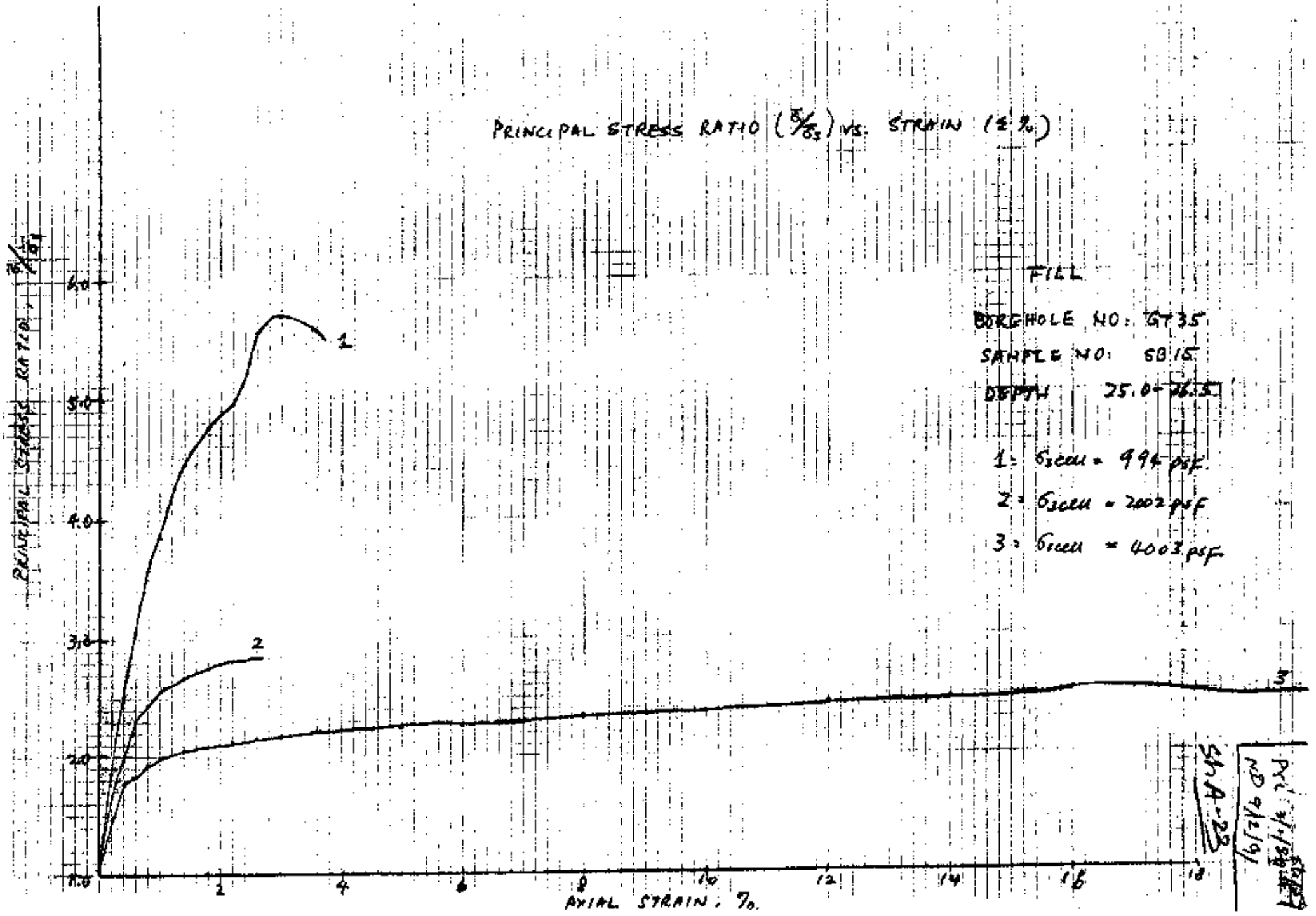
MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

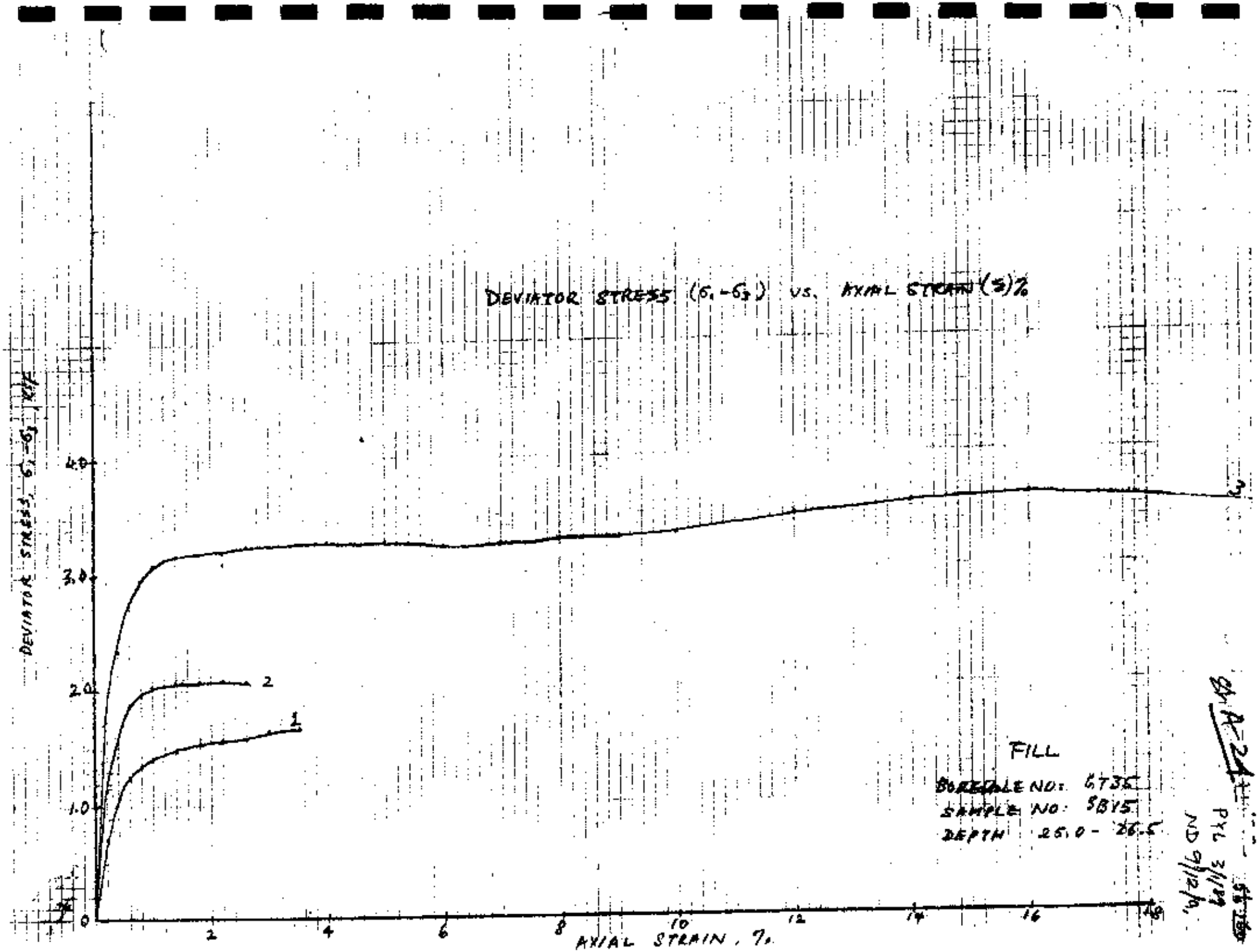
Project: WSSRAP
Feature: DC
Item: Material Properties
Contract No. 3848-827
Designed: TYC
Checked: ND
Sheet: T58A-22
File No.:
Date: 2/28/89
Date: 9/12/91

GT33-ST04 Dike Fill

σ_3 cell = 2995 psf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	3421	173	3594	599	2822	1.212
0.41	3546	288	3834	839	2707	1.310
0.59	3601	389	3990	995	2606	1.382
0.80	3618	490	4108	1113	2505	1.444
1.00	3649	562	4211	1216	2433	1.500
1.41	3693	706	4399	1404	2289	1.613
1.79	3715	806	4521	1526	2189	1.697
2.20	3755	878	4633	1638	2117	1.774
2.61	3717	950	4667	1672	2045	1.818
3.00	3744	979	4723	1728	2016	1.857
3.50	3764	1022	4786	1791	1973	1.908
4.00	3738	1066	4804	1809	1929	1.938
4.49	3754	1080	4834	1839	1915	1.960
4.99	3775	1094	4869	1874	1901	1.986
5.99	3797	1109	4906	1911	1886	2.013
6.99	3771	1123	4894	1899	1872	2.014
8.01	3745	1138	4883	1888	1857	2.017
9.01	3756	1123	4879	1884	1872	2.006
10.01	3718	1123	4841	1846	1872	1.986
12.00	3837	1123	4960	1965	1872	2.050
14.00	3888	1123	5011	2016	1872	2.077
16.00	3941	1094	5035	2040	1901	2.073
18.00	3982	1066	5048	2053	1929	2.064
19.99	3997	1022	5019	2024	1973	2.026


PRINCIPAL STRESS RATIO (σ_1/σ_3) VS. STRAIN (ε %)
FILL
BOREHOLE NO: GT35
SAMPLE NO: 6B15
DEPTH 25.0-26.5'
1: σ_{3cell} = 996 psf
2: σ_{3cell} = 2002 psf
3: σ_{3cell} = 4003 psf
PRINCIPAL STRESS RATIO σ_1/σ_3
AXIAL STRAIN, %
1.0
2.0
3.0
4.0
5.0
6.0
2
4
6
8
10
12
14
16
18
1
2
SHA-22
PVC 4/12/91
ND 4/12/91


DEVIATOR STRESS ($\sigma_1 - \sigma_3$) VS. AXIAL STRAIN (ε)%
DEVIATOR STRESS, $\sigma_1 - \sigma_3$, KSF
AXIAL STRAIN, %
0
1.0
2.0
3.0
4.0
2
4
6
8
10
12
14
16
18
1
2
3
FILL
BOREHOLE NO: GT35
SAMPLE NO: SBY5
DEPTH 25.0 - 26.5
PYL 3/1/89
ND 9/12/9

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project LOSRAP
Feature DC
Item Material Properties

Contract No. 3640-827 5424
Designed PYL
Checked MD

Sheet 46TA25
File No.
Date 3/1/89
Date 9/12/91

① GT35-SB15 Dike fill σ_3 cell = 994 psf

ε (%)	$\bar{\sigma}_1$	Δμ	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}/\bar{\sigma}_3$
0.20	1528	173	1701	707	821	1.861
0.40	1760	302	2052	1058	692	2.529
0.60	1853	389	2242	1248	605	3.063
0.80	1866	475	2335	1341	519	3.584
1.00	1892	504	2396	1402	490	3.861
1.41	1924	562	2486	1492	432	4.454
1.81	1921	590	2511	1517	404	4.755
2.21	1932	605	2537	1543	389	4.967
2.59	1914	648	2562	1568	346	5.532
2.99	1970	648	2618	1624	346	5.694
3.50	2007	634	2641	1647	360	5.575

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRHP
Feature: DC
Item: Material Properties

Contract No. 3840-827 ~~5121~~
Designed: PYL
Checked: ND

Sheet: ~~462~~ A26
File No.:
Date: 3/1/89
Date: 9/12/91

(2) GT35-SB15
σ_3 cell = 2002 psf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.21	2858	274	3132	1130	1728	1.654
0.39	3150	418	3568	1566	1584	1.989
0.60	3316	562	3878	1876	1440	2.303
0.80	3319	648	3967	1965	1354	2.451
1.01	3320	706	4026	2024	1296	2.562
1.40	3271	778	4049	2047	1224	2.672
1.79	3250	821	4071	2069	1181	2.752
2.21	3244	850	4094	2092	1152	2.816
2.60	3221	864	4085	2083	1138	2.830

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP
Feature DC
Item Material Properties

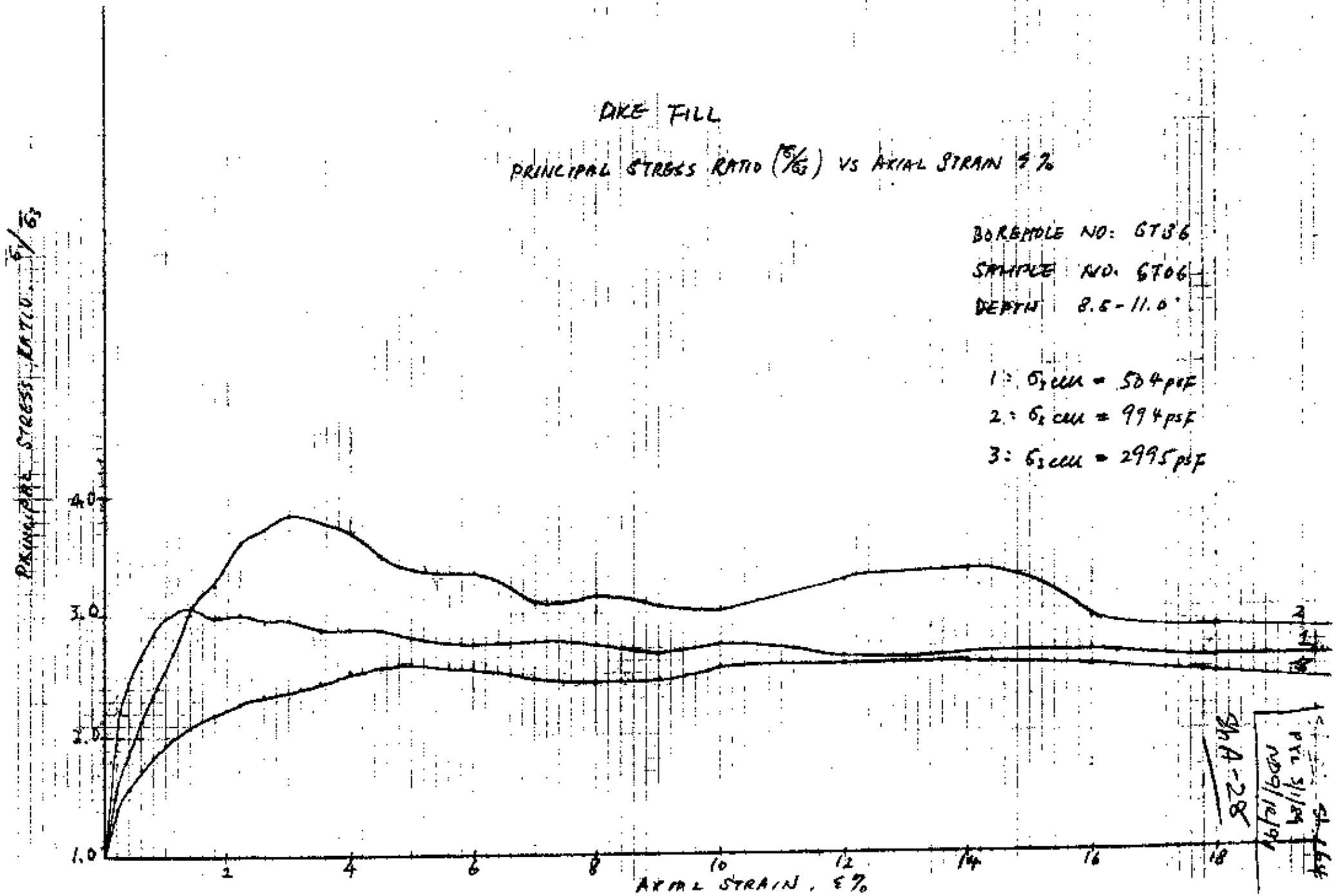
Contract No. 3840-827 (512)
Designed PYL
Checked ND

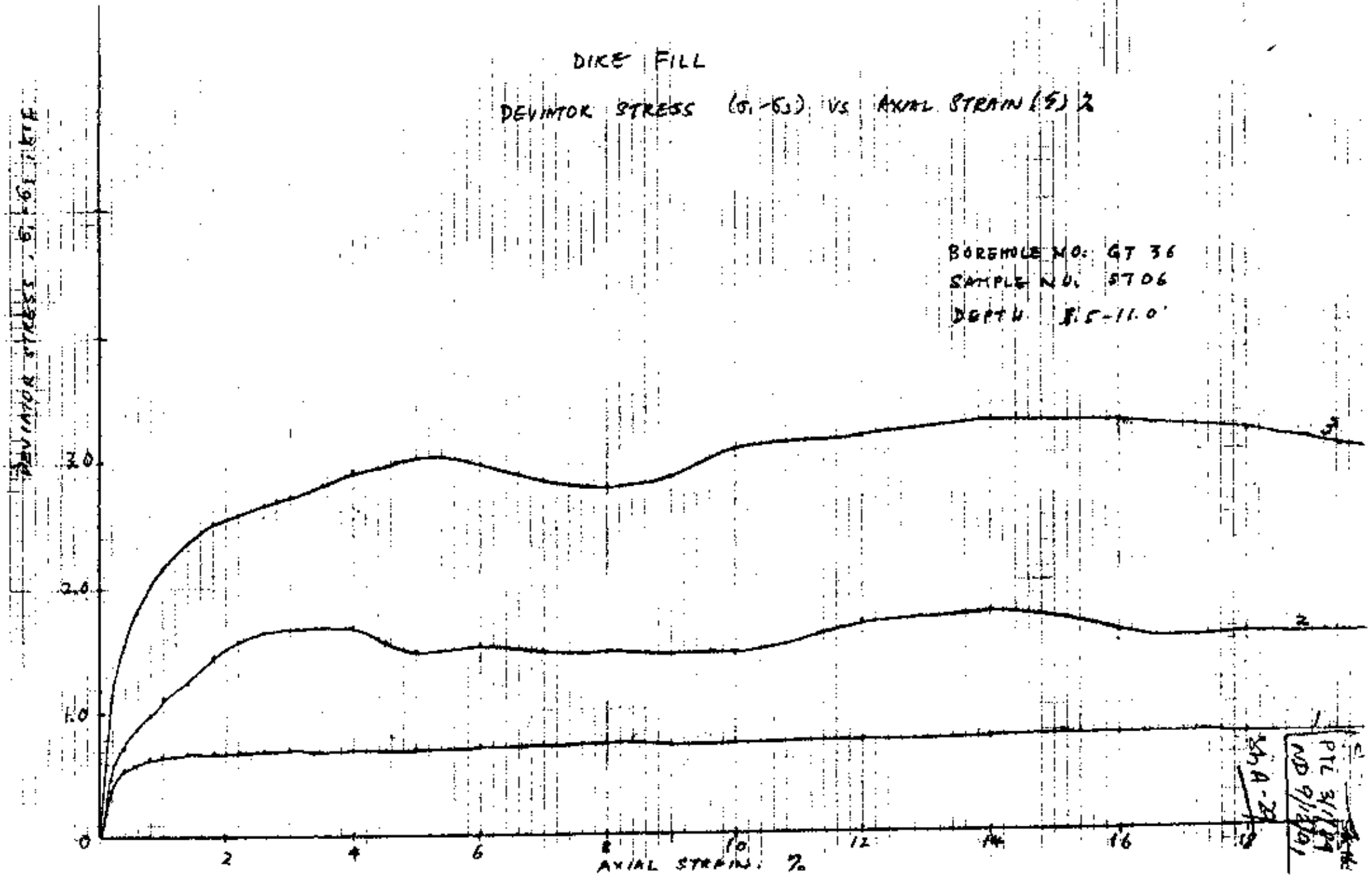
Sheet 463A-27
File No.
Date 3/1/89
Date 9/12/91

GT35 -5B15

(3) σ_3 cell = 4003 psf

ε (%)	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.21	5516	774	5790	1787	3729	1.479
0.40	5879	461	6340	2337	3542	1.660
0.61	6100	634	6734	2731	3369	1.811
0.80	6210	763	6973	2970	3240	1.917
1.01	6225	864	7089	3086	3139	1.983
1.41	6174	994	7168	3165	3009	2.052
1.81	6105	1080	7185	3182	2923	2.089
2.21	6036	1166	7202	3199	2837	2.128
2.61	6010	1210	7220	3217	2793	2.152
3.01	5984	1253	7237	3234	2750	2.176
3.49	5940	1310	7250	3247	2693	2.206
4.00	5923	1329	7262	3259	2664	2.223
4.50	5877	1368	7245	3242	2635	2.230
5.01	5846	1411	7257	3254	2592	2.255
6.00	5769	1454	7223	3220	2549	2.263
7.01	5749	1498	7247	3244	2505	2.295
8.00	5771	1526	7297	3294	2477	2.330
9.01	5734	1555	7289	3286	2448	2.342
10.00	5739	1570	7309	3306	2433	2.359
12.00	5882	1598	7480	3477	2405	2.446
13.99	5976	1584	7560	3557	2419	2.470
15.99	5994	1613	7607	3604	2390	2.508 ←
17.99	5959	1613	7572	3569	2390	2.493
19.99	5887	1598	7485	3482	2405	2.448


DIKE FILL
PRINCIPAL STRESS RATIO (σ_1/σ_3) VS AXIAL STRAIN ε %
BOREHOLE NO: GT36
SAMPLE NO. GT06
DEPTH 8.5 - 11.0'
1: σ_3 cell = 504 psf
2: σ_3 cell = 994 psf
3: σ_3 cell = 2995 psf
PRINCIPAL STRESS RATIO, σ_1/σ_3
4.0
3.0
2.0
1.0
2
4
6
8
10
12
14
16
18
AXIAL STRAIN, ε %
2
1
3
Sh A-28
PYL 3/1/89
ND9/12/91


DIKE FILL
DEVIATOR STRESS (σ1-σ3) VS AXIAL STRAIN (ε) %
BOREHOLE NO: GT 36
SAMPLE NO: 5706
DEPTH 8.5-11.0'
DEVIATOR STRESS, σ1-σ3, KTF
3.0
2.0
1.0
0
2
4
6
8
10
12
14
16
18
AXIAL STRAIN, %
3
2
1
PTL 3/1/89
ND 9/12/91
Sh A-29

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project: WSSRAP
Feature: DC
Item: Material Properties

Contract No. 2841-827 ~~6124~~
Designed: PYL
Checked: ND

Sheet: A-30 ~~166~~
File No.:
Date: 3/1/89
Date: 9/12/91

① GT 36-5706 Dike Fill
σ_3 ccu = 504 psf

ε %	$\bar{\sigma}_1$	$\Delta\mu$	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.19	815	86	901	397	418	1.950
0.40	887	144	1031	527	360	2.464
0.60	954	144	1098	594	360	2.650
0.81	978	158	1136	632	346	2.827
1.00	990	173	1163	659	331	2.991
1.41	1014	173	1187	683	331	3.063
1.79	1034	158	1192	688	346	2.988
2.20	1040	158	1198	694	346	3.006
2.60	1056	144	1200	696	360	2.933
3.00	1062	144	1206	702	360	2.950
3.50	1073	130	1203	699	374	2.869
4.01	1074	130	1204	700	374	2.872
4.50	1070	130	1200	696	374	2.861
4.99	1089	115	1204	700	389	2.799
5.99	1103	115	1218	714	389	2.737
7.00	1119	101	1220	716	403	2.777
8.00	1138	86	1224	720	418	2.722
9.00	1148	72	1220	716	432	2.657
10.00	1142	86	1228	724	418	2.732
12.00	1205	43	1248	744	461	2.614
14.01	1212	43	1255	751	461	2.629
15.99	1221	43	1264	760	461	2.649
18.00	1232	29	1261	757	475	2.594
20.00	1235	29	1264	760	475	2.600

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP — Contract No. 3840-827 -5121 — Sheet 117A-31
Feature DC — Designed PYL — Date 3/4/89
Item Material Properties — Checked ND — Date 9/12/91

GT 36 - ST06 · Dike fill
(2) $\sigma_{3,cell}$ = 994 psf

ε %	$\bar{\sigma}_1$	Δμ	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	1407	86	1493	499	908	1.550
0.40	1547	158	1705	711	836	1.850
0.60	1660	216	1876	882	778	2.134
0.80	1747	245	1992	998	749	2.332
1.01	1848	259	2107	1113	735	2.514
1.39	1930	302	2232	1238	632	3.054
1.80	2097	346	2443	1449	648	3.236
2.20	2181	389	2570	1576	605	3.605
2.60	2245	389	2634	1640	605	3.711
3.00	2260	403	2663	1669	591	3.824 ←
3.51	2287	389	2676	1682	605	3.780
3.99	2293	374	2667	1673	620	3.698
4.50	2154	374	2528	1534	620	3.474
5.00	2098	374	2472	1478	620	3.384
6.01	2167	346	2513	1519	648	3.344
9.00	2170	331	2501	1469	701	3.096
8.00	2161	302	2463	1469	692	3.123
8.99	2147	288	2435	1441	706	3.041
10.00	2162	274	2436	1442	720	3.003
12.00	2444	245	2689	1695	749	3.263
14.01	2533	230	2763	1769	764	3.315
16.00	2404	173	2577	1583	821	2.928
18.00	2406	144	2550	1556	850	2.831
20.00	2427	130	2557	1563	864	2.809

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP Contract No. 3848-827 Sheet A-32
Feature DC File No.
Item Material Properties Designed PYL Date 3/1/89
Checked ND Date 9/12/91

GT36 - ST06 Dike Fill

③ $\sigma_{3\,cell}$ = 2995 psf

ε (%)	$\bar{\sigma}_1$	Δμ	σ_1	$\sigma_1 - \sigma_3$	$\bar{\sigma}_3$	$\bar{\sigma}_1/\bar{\sigma}_3$
0.20	3938	202	4140	1145	2793	1.410
0.40	4180	360	4540	1545	2635	1.586
0.60	4309	490	4799	1804	2505	1.720
0.80	4415	590	5005	2010	2405	1.836
1.00	4468	691	5159	2164	2304	1.939
1.40	4557	821	5378	2383	2174	2.096
1.80	4605	893	5498	2503	2102	2.191
2.20	4629	950	5579	2584	2045	2.264
2.60	4672	979	5651	2656	2016	2.317
3.00	4691	1008	5699	2704	1987	2.361
3.49	4767	1037	5804	2809	1958	2.435
4.00	4841	1066	5907	2912	1929	2.510
4.51	4869	1080	5949	2954	1915	2.543
5.00	4917	1080	5997	3002	1915	2.568 ←
6.00	4914	1051	5965	2970	1944	2.528
7.00	4754	1066	5820	2825	1929	2.464
8.00	4716	1051	5767	2772	1944	2.426
9.00	4808	1037	5845	2850	1958	2.456
10.00	5032	1022	6054	3059	1973	2.550
12.00	5181	979	6160	3165	2016	2.570
14.00	5344	922	6266	3271	2073	2.578
16.00	5358	864	6222	3227	2131	2.514
18.00	5324	821	6145	3150	2174	2.449
20.00	5197	792	5989	2994	2203	2.359

Test # 4
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP
LOCATION ID: Disposal Cell
DATE: 6-4-90
LAB NAME: Geotechnology, Inc.
CHECKED BY: LAD 4-7
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-60P SB-15	40.0-41.5		4000
			7000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
105.5	19.0	87.6	0.58	98.2
105.1	20.88	95.3	0.59	96.9

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
---	20.4	---	---
	19.8		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

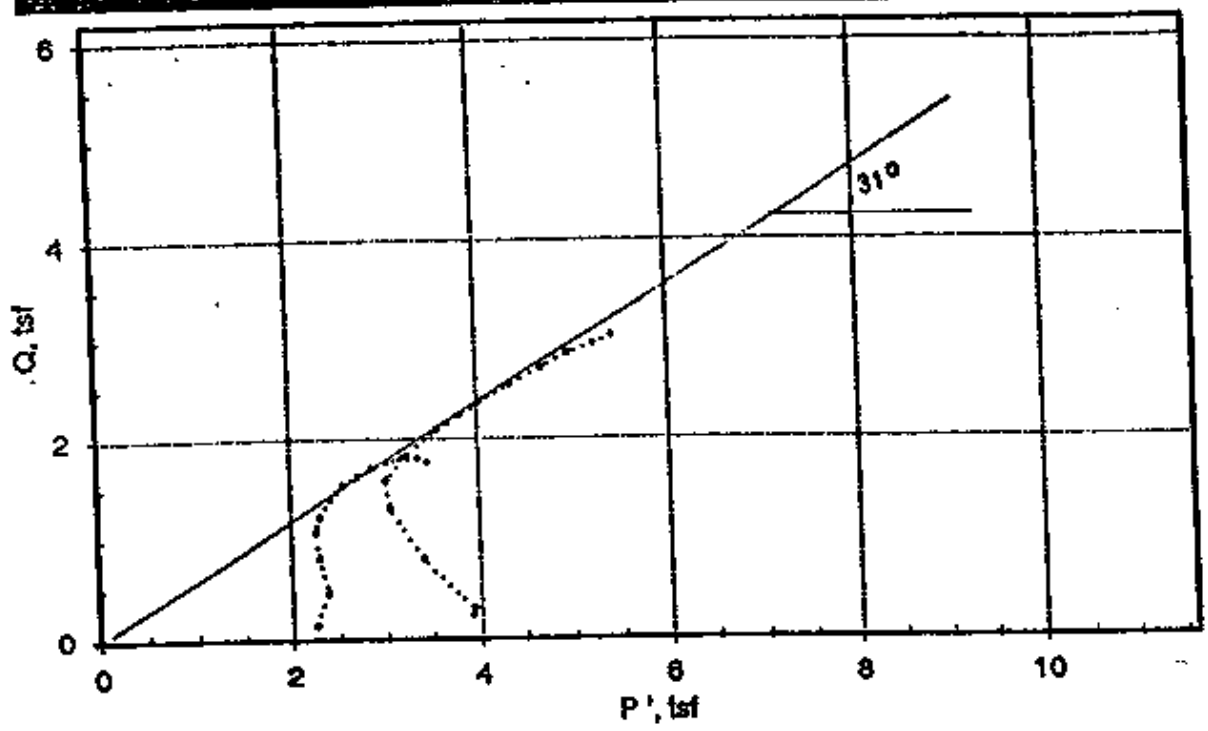
TEST PROCEDURE: EM 1110-2-1906

ATTACHMENT 12

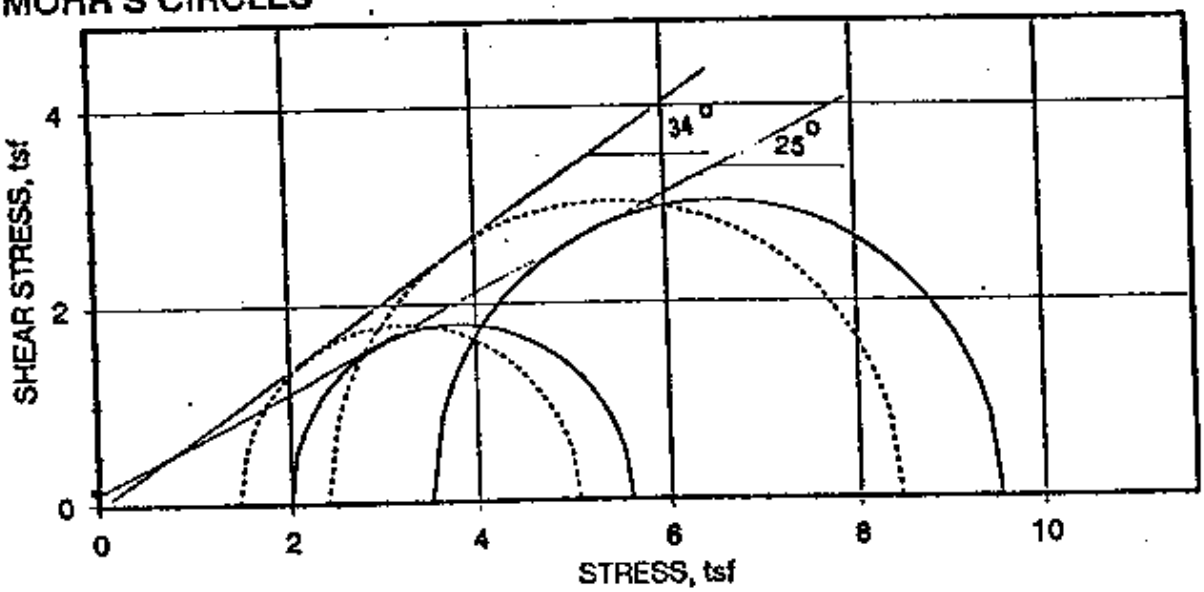
ENG-12 (4/87) x Assumed G_s of 2.67

Sh. A-34

WSSRAP - JOB NO: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress ——— Effective Stress .....

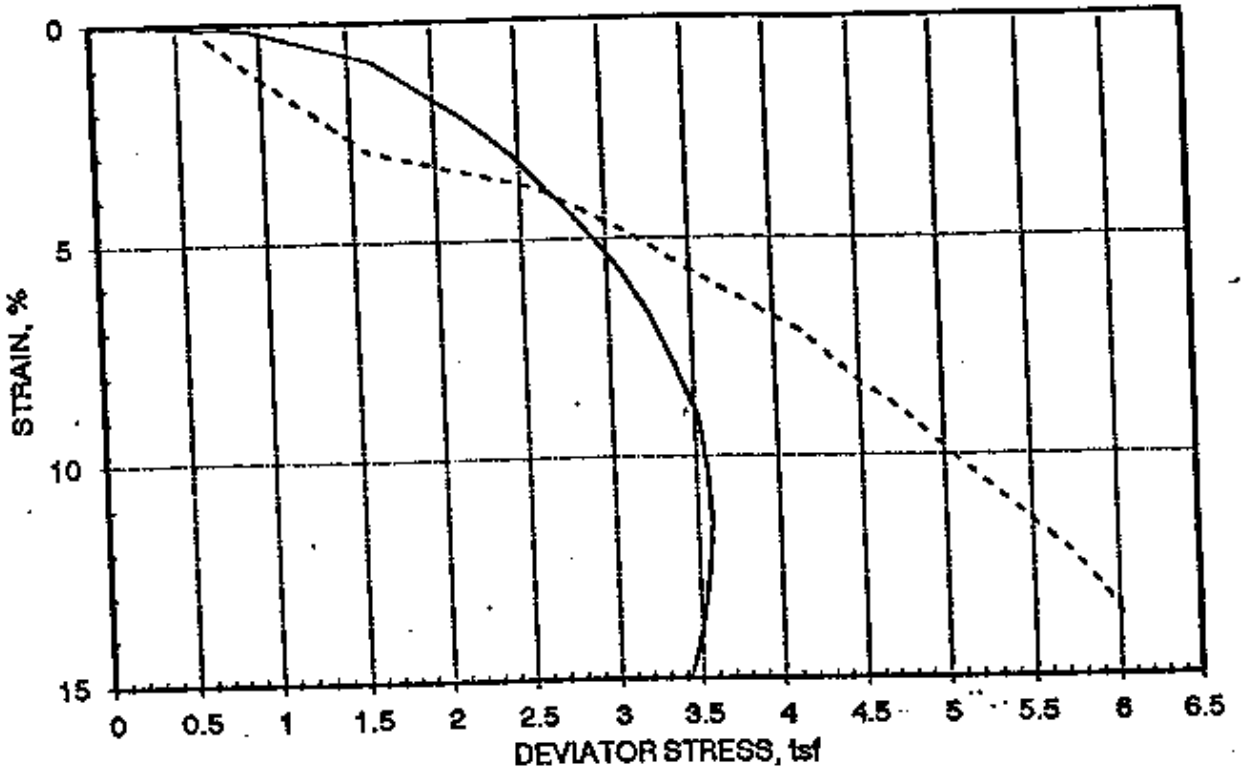
Boring No: GT-60P
Sample No: SB-15
Depth: 40-41.5 FT.

05

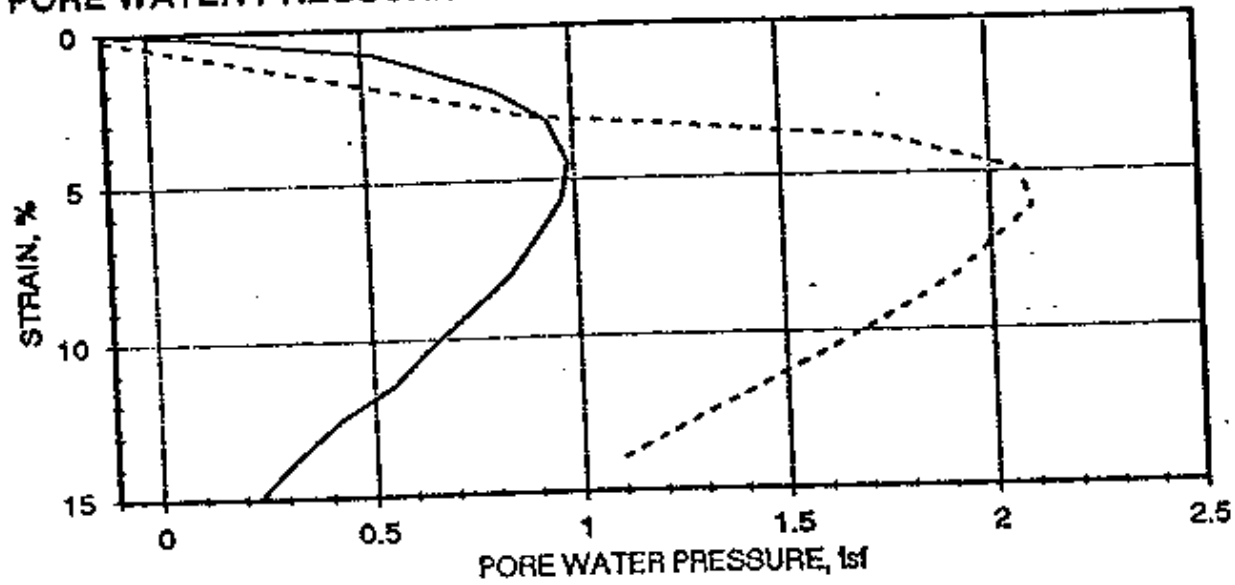
Sh A-35

B

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



STAGE 1 STAGE 2 STAGE 3

Boring No: GT-60P
Sample No: SB-15
Depth: 40-41.5 FT.

Sh A-36

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

T3

E 1

SAMPLE HEIGHT	=	4.42 INCHES	BORING NO	GT-60P
SAMPLE DIAMETER	=	2.38 INCHES	SAMPLE NO	SB-15
SAMPLE AREA	=	4.46 IN^2	DEPTH	40-41.5 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY
BACK PRESSURE	=	75.00 PSI		
CONFINING PRESSURE	=	~~27.80 PSI~~ = 4 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
CELL PRESSURE	=	102.80 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	19.00	20.41
DEGREE OF SATURATION (%)	85.91	
DRY DENSITY (pcf)	105.49	
VOID RATIO	0.60	

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	$\bar{\sigma}_1/\bar{\sigma}_3$	P' tsf
17.80	2.00	73.55	-0.10	0.05	4.47	0.29	2.29	0.14	2.11	2.39	1.13	2.25
57.80	7.00	76.20	0.09	0.16	4.47	0.93	2.93	0.47	1.92	2.85	1.48	2.38
102.40	38.00	82.37	0.53	0.86	4.50	1.64	3.64	0.82	1.47	3.11	2.12	2.29
136.80	95.00	86.43	0.82	2.15	4.56	2.16	4.16	1.08	1.18	3.34	2.83	2.26
158.00	137.00	88.02	0.94	3.10	4.61	2.47	4.47	1.23	1.06	3.53	3.33	2.30
182.10	195.00	88.69	0.99	4.41	4.67	2.81	4.81	1.40	1.02	3.82	3.75	2.42
200.90	248.00	88.51	0.97	5.61	4.73	3.06	5.06	1.53	1.03	4.09	3.97	2.56
215.80	298.00	87.61	0.91	6.74	4.79	3.25	5.25	1.62	1.09	4.34	3.96	2.72
229.10	352.00	86.60	0.84	7.97	4.85	3.40	5.40	1.70	1.17	4.57	3.91	2.87
240.70	404.00	85.30	0.74	9.14	4.91	3.53	5.53	1.76	1.26	4.79	3.8	3.02
247.80	464.00	83.57	0.62	10.50	4.99	3.58	5.58	1.79	1.38	4.96	3.59	3.17
251.10	505.00	82.57	0.55	11.43	5.04	3.59	5.58	1.79	1.46	5.04	3.45	3.25
253.20	555.00	80.88	0.42	12.56	5.10	3.57	5.57	1.79	1.58	5.15	3.26	3.36
253.60	612.00	79.24	0.31	13.85	5.18	3.52	5.53	1.76	1.70	5.22	3.07	3.46
250.30	662.00	78.18	0.23	14.98	5.25	3.43	5.43	1.72	1.77	5.21	2.94	3.49

$\sigma_1 = 10.5$ ksf.
$\sigma_3 = 4.0$ ksf
$\bar{\sigma}_1 = 8.68$ ksf
$\bar{\sigma}_3 = 2.18$ ksf.

Request # 2.
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY.

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSFAB
LOCATION ID: DISPOSAL CELL
DATE: 1-4-90
LAB NAME: Geotechnology, Inc
CHECKED BY: LAB 44
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-2771 BU-01A	3.5 - 6.5	97.3	1000
		97.2	3000
		97.3	6000

INITIAL CONDITIONS

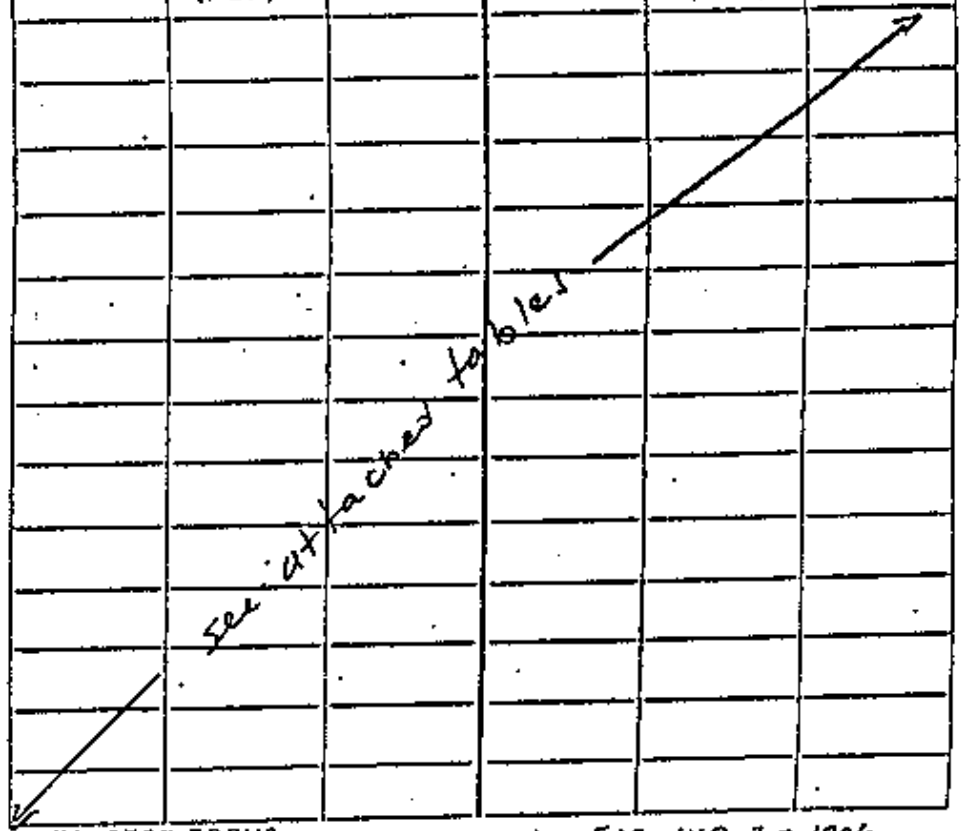
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
105.0	18.4	84.9	0.60	93.7
104.9	18.7	85.5	0.60	93.6
105.2	18.9	86.1	0.60	95.8

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	21.4		
	20.6		
	19.6		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)



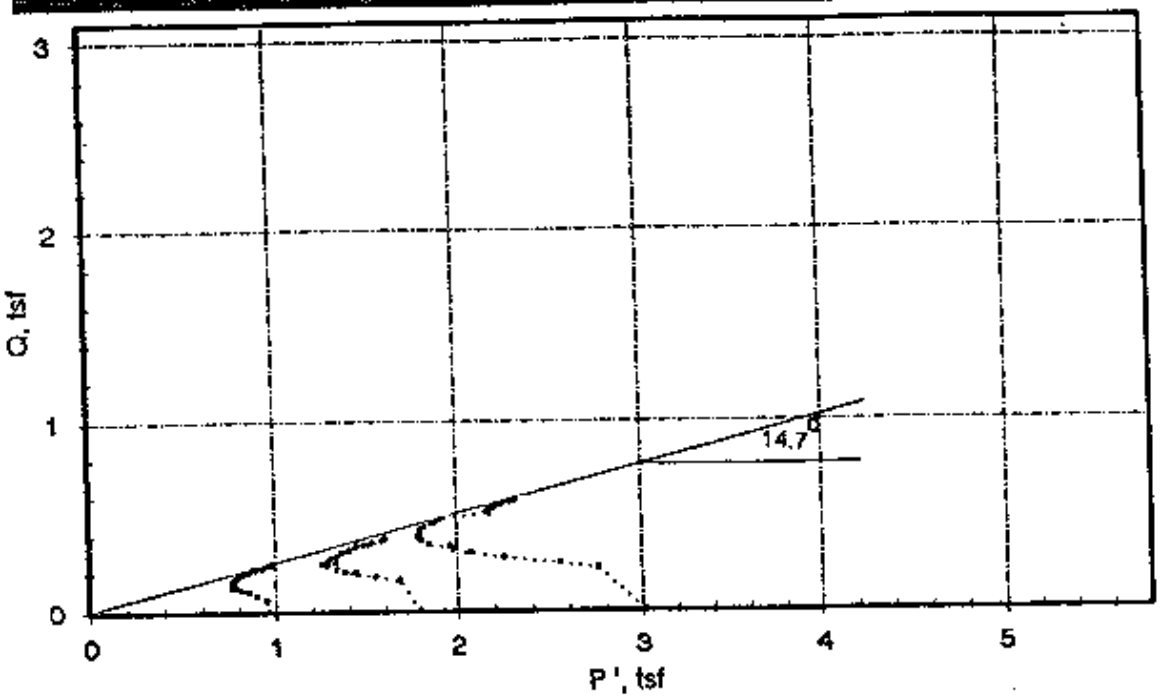
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

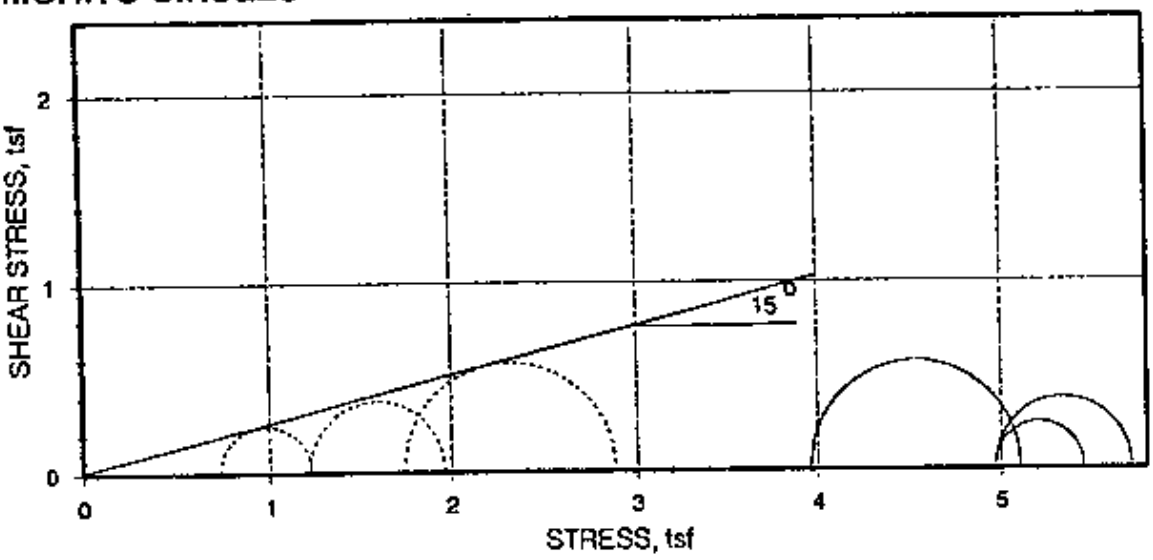
A-38

ATTACHMENT 12

WSSRAP - JOB NO:- 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES

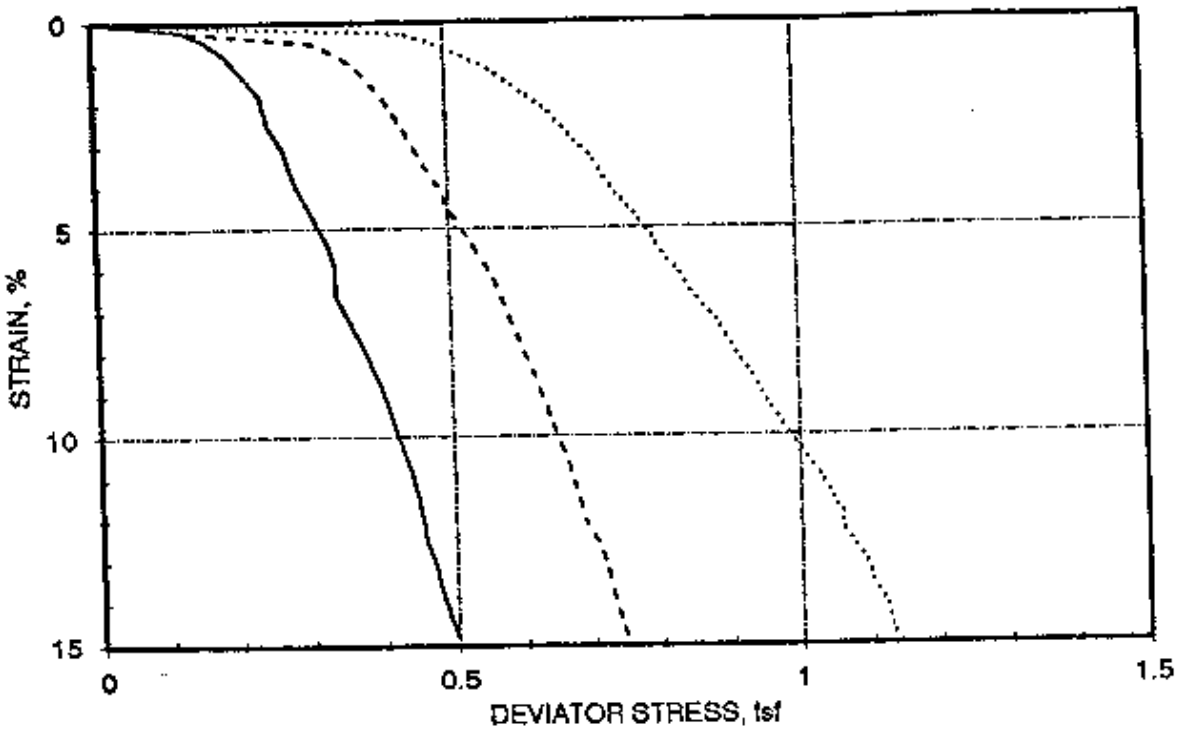


Total Stress Effective Stress

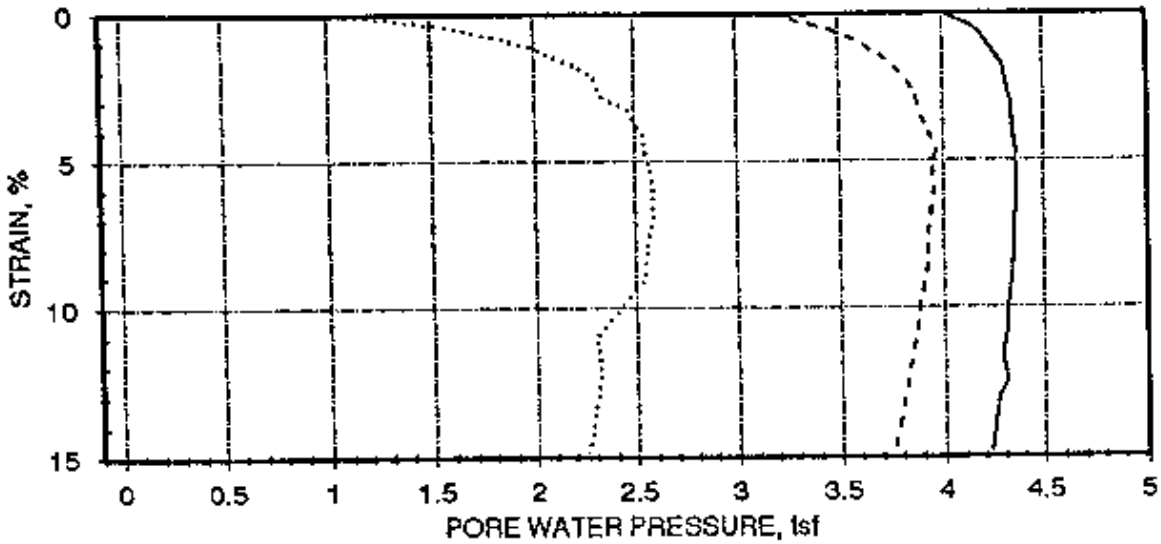
Boring No: GT-2T71
Sample No: BU-01A
Depth: 3.5-6.5 ft

A-40

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: GT-2T71
Sample No: BU-01A
Depth: 3.5-6.5 ft

A-41

GEOTECHNOLOGY INC
CONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295

STAGE 1

SAMPLE HEIGHT	=	2.94 INCHES	BORING NO	GT-2T71
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.60 IN^2	DEPTH	3.5-6.5 ft
			SAMPLE DESCRIPTION	Brown, silty CLAY - CL
BACK PRESSURE	=	6.90 PSI		
CONFINING PRESSURE	=	69.00 PSI = 9.94 ksf		
CELL PRESSURE	=	75.90 PSI		

LOAD DIAL div	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	σ_1/σ_3	P' tsf
0.00	0.00	62.52	4.00	0.00	0.00	0.00	0.00	0.00	0.96	0.96	1	0.96
9.40	6.50	63.61	4.08	0.22	1.61	0.13	5.10	0.06	0.88	1.01	1.15	0.95
11.90	12.00	64.53	4.15	0.41	1.61	0.16	5.13	0.08	0.82	0.98	1.2	0.90
14.20	23.00	65.26	4.20	0.78	1.62	0.19	5.16	0.10	0.77	0.96	1.25	0.86
16.30	40.00	66.05	4.26	1.36	1.63	0.22	5.19	0.11	0.71	0.93	1.31	0.82
17.60	52.00	66.57	4.30	1.77	1.63	0.24	5.20	0.12	0.67	0.91	1.36	0.79
18.80	74.00	66.96	4.32	2.52	1.65	0.25	5.22	0.13	0.64	0.89	1.39	0.77
20.30	90.50	67.20	4.34	3.08	1.65	0.27	5.24	0.13	0.63	0.89	1.41	0.76
21.20	105.00	67.21	4.34	3.58	1.66	0.28	5.25	0.14	0.63	0.90	1.43	0.77
22.50	119.00	67.33	4.35	4.05	1.67	0.29	5.26	0.15	0.62	0.91	1.47	0.76
23.80	138.00	67.43	4.36	4.70	1.68	0.31	5.28	0.15	0.61	0.92	1.51	0.76
25.30	158.50	67.47	4.36	5.40	1.70	0.33	5.29	0.16	0.61	0.93	1.52	0.77
26.20	174.20	67.48	4.36	5.94	1.71	0.34	5.30	0.17	0.61	0.94	1.54	0.77
26.90	193.50	67.45	4.36	6.59	1.72	0.34	5.31	0.17	0.61	0.95	1.56	0.78
28.30	215.00	67.35	4.35	7.33	1.73	0.36	5.33	0.18	0.62	0.97	1.56	0.79
30.40	235.50	67.31	4.35	8.02	1.74	0.38	5.35	0.19	0.62	1.00	1.61	0.81
32.20	258.50	67.19	4.34	8.81	1.76	0.40	5.37	0.20	0.63	1.03	1.63	0.83
33.30	274.00	67.06	4.33	9.34	1.77	0.41	5.38	0.21	0.64	1.05	1.64	0.84
34.40	292.00	66.94	4.32	9.95	1.78	0.42	5.39	0.21	0.65	1.07	1.65	0.86
35.90	318.00	66.70	4.31	10.83	1.80	0.44	5.40	0.22	0.66	1.10	1.67	0.88
37.10	340.00	66.55	4.29	11.58	1.81	0.45	5.42	0.22	0.67	1.12	1.67	0.90
38.30	367.00	66.80	4.31	12.50	1.83	0.46	5.43	0.23	0.66	1.11	1.682	0.88
39.40	381.00	66.18	4.27	12.98	1.84	0.47	5.44	0.23	0.70	1.17	1.67	0.93
41.20	405.00	65.91	4.25	13.80	1.86	0.48	5.45	0.24	0.72	1.20	1.67	0.96
42.60	435.00	65.70	4.23	14.82	1.88	0.50	5.46	0.25	0.73	1.23	1.685	0.98

$\sigma_1 = 10.92$ ksf

$\sigma_3 = 9.44$ ~~10.0~~ ksf

$\bar{\sigma}_1 = 2.46$ ksf

$\bar{\sigma}_3 = 1.46$ ksf

A-42

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

STAGE 2

SAMPLE HEIGHT	=	2.93 INCHES	BORING NO	GT-2T71
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.60 IN^2	DEPTH	3.5-6.5 ft
			SAMPLE DESCRIPTION	Brown, silty CLAY - CL
BACK PRESSURE	=	20.80 PSI		
CONFINING PRESS	=	69.00 PSI = 9.92 ksf		
CELL PRESSURE	=	89.80 PSI		

LOAD DIAL div	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	σ_1/σ_3	P' tsf
0.00	0.00	64.99	3.18	0.00	0.00	0.00	0.00	0.00	1.79	1.79	1	1.79
23.80	15.00	68.69	3.45	0.51	1.61	0.32	5.29	0.16	1.52	1.84	1.24	1.68
27.00	29.00	70.85	3.60	0.99	1.62	0.37	5.33	0.18	1.36	1.73	1.27	1.55
29.50	46.00	72.58	3.73	1.57	1.62	0.40	5.37	0.20	1.24	1.64	1.32	1.44
31.30	60.00	73.61	3.80	2.05	1.63	0.42	5.39	0.21	1.17	1.59	1.36	1.38
33.10	77.00	74.40	3.86	2.63	1.64	0.44	5.41	0.22	1.11	1.55	1.4	1.33
35.80	103.00	75.02	3.90	3.52	1.66	0.47	5.44	0.24	1.06	1.54	1.45	1.30
37.10	118.00	75.34	3.93	4.03	1.67	0.49	5.46	0.24	1.04	1.53	1.47	1.28
38.50	132.00	75.93	3.97	4.51	1.67	0.50	5.47	0.25	1.00	1.50	1.5	1.25
40.00	147.00	75.63	3.95	5.02	1.68	0.52	5.49	0.26	1.02	1.54	1.51	1.28
43.60	180.00	75.62	3.95	6.14	1.70	0.56	5.53	0.28	1.02	1.58	1.55	1.30
46.40	218.00	75.43	3.93	7.44	1.73	0.59	5.56	0.29	1.03	1.62	1.57	1.33
49.30	251.00	75.24	3.92	8.57	1.75	0.62	5.58	0.31	1.05	1.67	1.59	1.36
51.90	282.00	74.87	3.89	9.62	1.77	0.64	5.61	0.32	1.07	1.72	1.61	1.40
55.10	319.00	74.44	3.86	10.89	1.79	0.67	5.64	0.34	1.11	1.78	1.6	1.44
57.60	353.00	74.02	3.83	12.05	1.82	0.69	5.66	0.35	1.14	1.83	1.61	1.48
59.10	369.00	73.80	3.82	12.59	1.83	0.71	5.67	0.35	1.15	1.86	1.62	1.51
60.70	386.00	73.55	3.80	13.17	1.84	0.72	5.69	0.36	1.17	1.89	1.62	1.53
63.60	425.00	73.06	3.76	14.51	1.87	0.74	5.71	0.37	1.21	1.95	1.61	1.58
64.50	440.00	72.85	3.75	15.02	1.88	0.75	5.72	0.38	1.22	1.97	1.61	1.60

$\sigma_1 = 11.32$ ksf (9.92)

$\sigma_3 = 10.0$ ksf

$\bar{\sigma}_1 = 3.66$ ksf (3.72)

$\bar{\sigma}_3 = 2.28$ ksf (2.3)

A-43

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

STAGE 3

SAMPLE HEIGHT	=	2.97	INCHES	BORING NO	GT-2T71
SAMPLE DIAMETER	=	1.43	INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.59	IN^2	DEPTH	3.5-6.5 ft
				SAMPLE DESCRIPTION	Brown, silty CLAY - CL
BACK PRESSURE	=	41.70	PSI		
CONFINING PRESS	=	55.00	PSI = 7.92 ksf		
CELL PRESSURE	=	96.70	PSI		

LOAD DIAL div	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	σ_1/σ_3	P' tsf
0.00	0.00	54.96	0.95	0.00	0.00	0.00	0.00	0.00	3.01	3.01	1	3.01
31.80	8.00	61.38	1.42	0.27	1.60	0.44	4.40	0.22	2.54	2.98	1.17	2.76
36.10	16.00	64.72	1.66	0.54	1.60	0.49	4.45	0.25	2.30	2.80	1.22	2.55
41.40	33.00	69.36	1.99	1.11	1.61	0.56	4.52	0.28	1.97	2.53	1.28	2.25
45.40	51.00	72.26	2.20	1.72	1.62	0.61	4.57	0.31	1.76	2.37	1.35	2.07
47.50	62.00	73.60	2.30	2.09	1.63	0.64	4.60	0.32	1.66	2.30	1.39	1.98
51.20	83.00	74.20	2.34	2.80	1.64	0.68	4.64	0.34	1.62	2.30	1.42	1.96
53.30	97.00	76.05	2.47	3.27	1.65	0.71	4.67	0.35	1.49	2.19	1.47	1.84
56.30	122.00	76.91	2.54	4.11	1.66	0.74	4.70	0.37	1.42	2.17	1.53	1.80
58.70	138.00	77.18	2.55	4.65	1.67	0.77	4.73	0.38	1.41	2.17	1.54	1.79
60.80	152.00	77.46	2.57	5.13	1.68	0.79	4.75	0.40	1.39	2.18	1.57	1.78
62.80	168.00	77.49	2.58	5.67	1.69	0.81	4.77	0.41	1.38	2.20	1.59	1.79
64.50	181.00	77.65	2.59	6.10	1.70	0.83	4.79	0.42	1.37	2.20	1.61	1.79
66.60	197.00	77.62	2.59	6.64	1.71	0.85	4.81	0.43	1.37	2.23	1.63	1.80
69.20	213.00	77.57	2.58	7.18	1.72	0.88	4.84	0.44	1.38	2.26	1.64	1.82
72.20	238.00	77.23	2.56	8.03	1.73	0.91	4.87	0.46	1.40	2.31	1.65	1.86
73.70	251.00	77.09	2.55	8.47	1.74	0.93	4.89	0.46	1.41	2.34	1.66	1.87
76.20	269.00	76.91	2.54	9.07	1.75	0.95	4.91	0.48	1.42	2.38	1.68	1.90
84.00	326.00	73.64	2.30	10.99	1.79	1.03	4.99	0.51	1.66	2.69	1.62	2.17
85.10	335.00	73.83	2.31	11.30	1.80	1.04	5.00	0.52	1.65	2.68	1.62	2.16
86.20	345.00	73.90	2.32	11.64	1.80	1.05	5.01	0.52	1.64	2.69	1.64	2.16
87.20	351.00	73.93	2.32	11.84	1.81	1.06	5.02	0.53	1.64	2.69	1.64	2.17
88.10	362.00	73.89	2.32	12.21	1.82	1.06	5.02	0.53	1.64	2.70	1.65	2.17
91.00	384.00	73.77	2.31	12.95	1.83	1.09	5.05	0.54	1.65	2.74	1.66	2.19
92.30	400.00	73.56	2.29	13.49	1.84	1.10	5.06	0.55	1.67	2.76	1.65	2.21
94.70	418.00	73.30	2.28	14.10	1.86	1.12	5.08	0.56	1.68	2.80	1.67	2.24
96.80	437.00	73.00	2.25	14.74	1.87	1.13	5.09	0.57	1.71	2.84	1.66	2.27
98.60	452.00	72.86	2.24	15.24	1.88	1.15	5.11	0.57	1.72	2.86	1.66	2.29
99.70	463.00	72.60	2.22	15.62	1.89	1.15	5.11	0.58	1.74	2.89	1.66	2.31

σ_1 = 9.82 ksf

σ_3 = 7.92 ksf

$\bar{\sigma}_1$ = 4.76 ksf

$\bar{\sigma}_3$ = 2.84 ksf

Regual #2

P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED – UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WJSRAP

LOCATION ID: Dupaul Cell

DATE: 7-8-90

LAB NAME: Geotechnology Inc

CHECKED BY: LAB 47

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-2779 Bu-0:4	4-8.5	95.7	1000
		97.3	3000
		95.4	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
101.5	18.0	74.1	.68	100.0
103.2	19.0	79.3	.66	96.9
101.2	18.0	71.5	.69	97.3

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	22.5		
	19.6		
	19.3		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

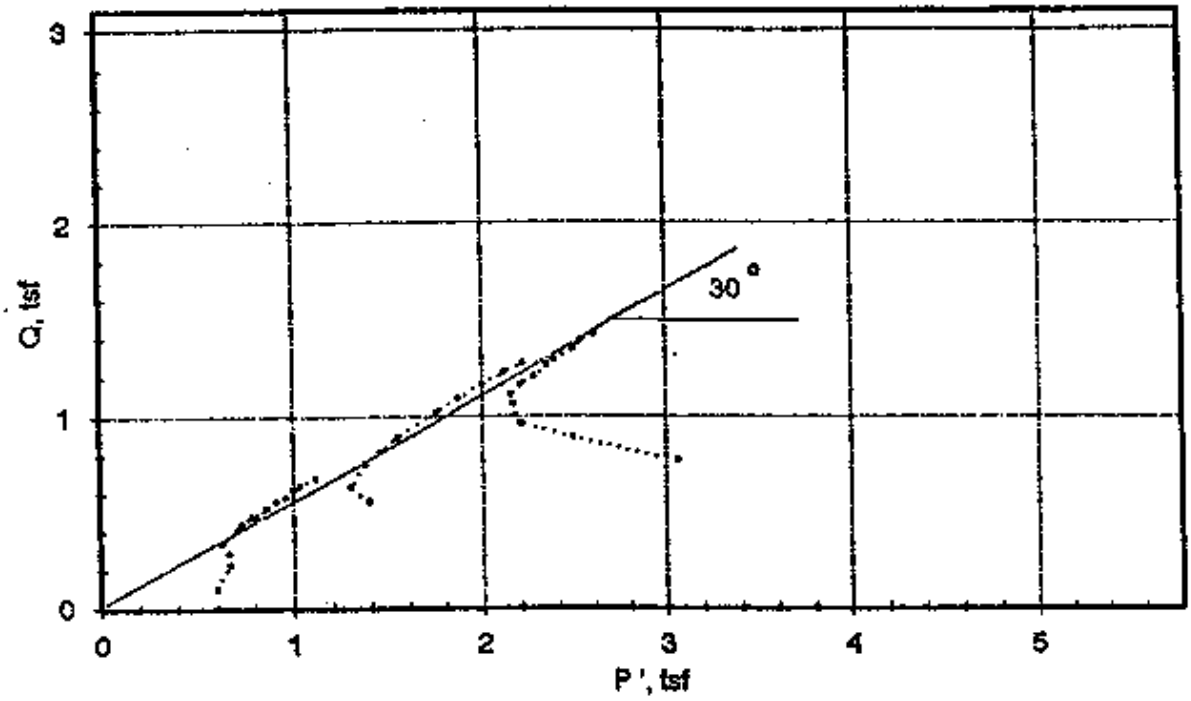
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM - 110-2-1906

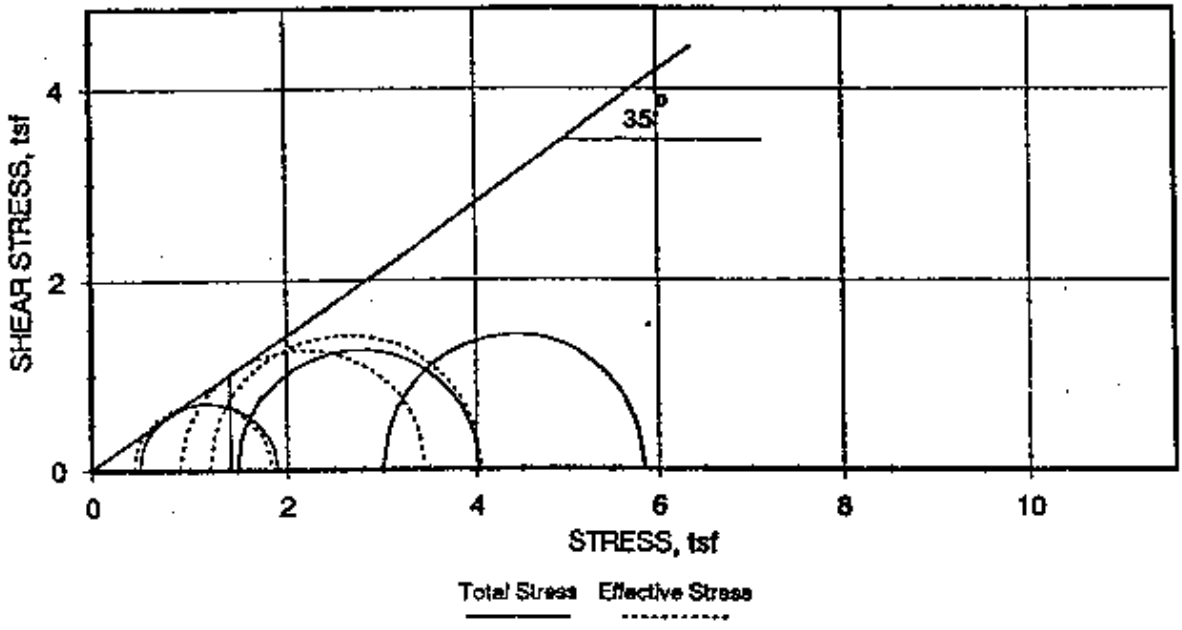
ATTACHMENT 12

SH_A-45

WSSRAP - JOB NO:- 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



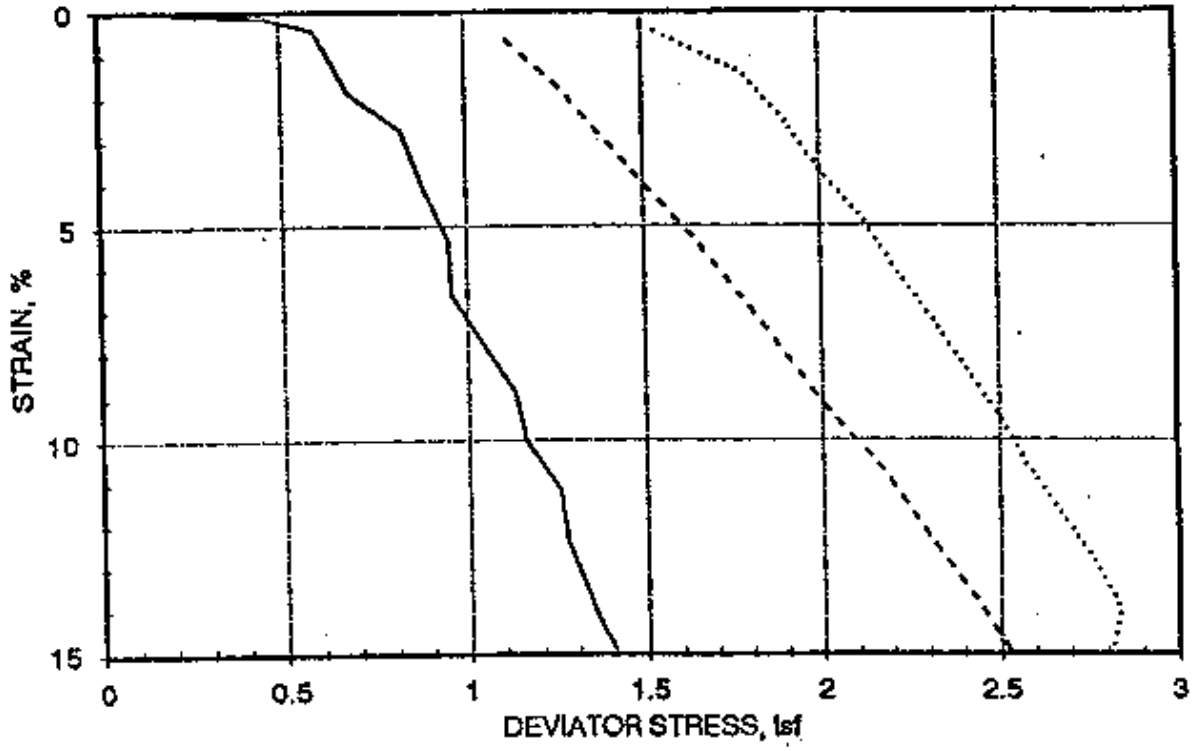
Boring No: GT-2T74
Sample No: BU-01A
Depth: 4-8.5

P 3.

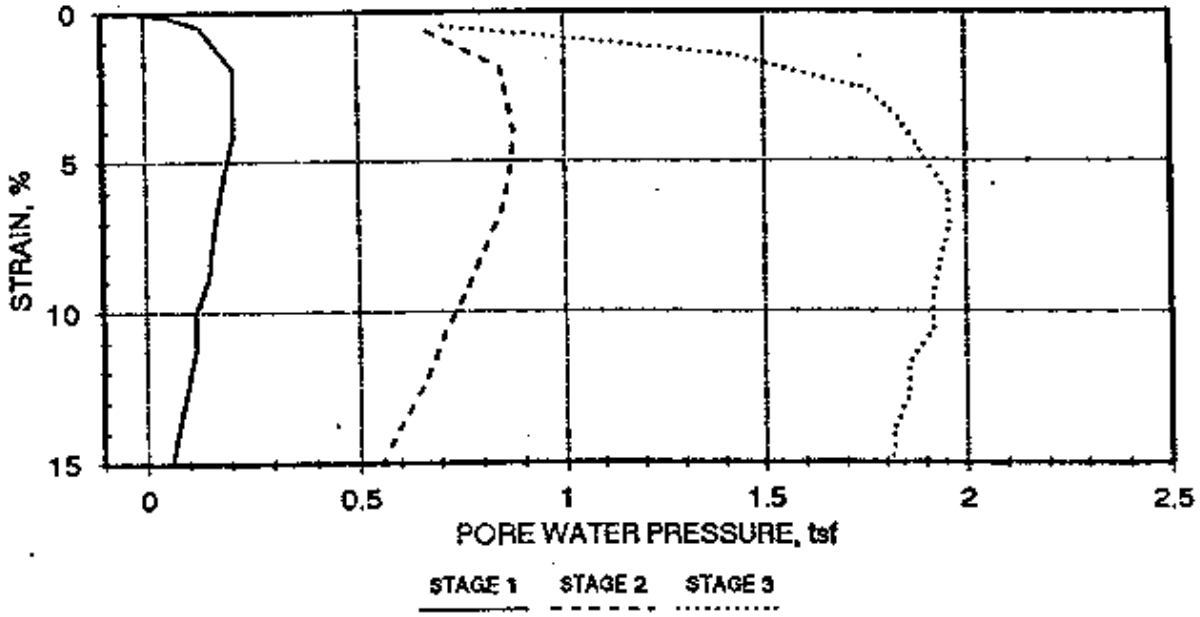
Sh A±46

A

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: GT-2T74
Sample No: BU-01A
Depth: 4-8.5

04

Sh A-47

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

A

STAGE I

SAMPLE HEIGHT	=	2.83 INCHES	BORING NO	GT-2T74
SAMPLE DIAMETER	=	1.42 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.59 IN^2	DEPTH	4-8.5
			SAMPLE	
			DESCRIPTION	Grayish brown CLAY
BACK PRESSURE	=	85.00 PSI		
CONFINING PRESSURE	=	6.90 PSI = 0.994 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
CELL PRESSURE	=	91.90 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	18.52	21.18
DEGREE OF SATURATION (%)	75.68	
DRY DENSITY (pcf)	101.45	
VOID RATIO	0.66	

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR	$\bar{\sigma}_1/\bar{\sigma}_3$	P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf		tsf
4.60	2.00	84.95	-0.00	0.07	1.59	0.21	0.70	0.10	0.50	0.71	1.42	0.60
10.10	4.00	85.71	0.05	0.14	1.59	0.46	0.95	0.23	0.45	0.90	2	0.67
13.00	13.00	86.77	0.13	0.46	1.60	0.59	1.08	0.29	0.37	0.95	2.57	0.66
15.40	53.00	87.86	0.21	1.87	1.62	0.68	1.18	0.34	0.29	0.97	3.34	0.63
18.60	78.00	87.88	0.21	2.75	1.64	0.82	1.31	0.41	0.29	1.11	3.83	0.70
20.20	116.00	87.90	0.21	4.09	1.66	0.88	1.37	0.44	0.29	1.16	4	0.73
22.30	151.00	87.65	0.19	5.33	1.68	0.95	1.45	0.48	0.31	1.26	4.06	0.78
22.80	188.00	87.35	0.17	6.64	1.71	0.96	1.46	0.48	0.33	1.29	3.91	0.81
25.00	218.00	87.23	0.16	7.70	1.73	1.04	1.54	0.52	0.34	1.38	4.06	0.86
27.40	251.00	87.08	0.15	8.86	1.75	1.13	1.63	0.56	0.35	1.48	4.23	0.91
28.60	283.00	86.67	0.12	9.99	1.77	1.16	1.66	0.58	0.38	1.54	4.05	0.96
31.10	316.00	86.67	0.12	11.15	1.79	1.25	1.75	0.62	0.38	1.63	4.29	1.00
32.10	351.00	86.36	0.10	12.39	1.82	1.27	1.77	0.64	0.40	1.67	4.18	1.03
35.20	403.00	86.00	0.07	14.23	1.86	1.36	1.86	0.68	0.42	1.79	4.26	1.11
36.70	425.00	85.77	0.06	15.00	1.87	1.41	1.91	0.71	0.44	1.85	4.2	1.15

$\sigma_1 = 3.5$ ksf
$\sigma_3 = {}^{0.99}_{+}$ ksf
$\bar{\sigma}_1 = 3.26$ ksf
$\bar{\sigma}_3 = .76$ ksf

SL A-48

GEOTECHNOLOGY INC
CONSOLIDATED - UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

SAMPLE HEIGHT	=	2.92 INCHES	BORING NO	GT-2T74
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.61 IN^2	DEPTH	4-8.5
			SAMPLE DESCRIPTION	Grayish brown CLAY
BACK PRESSURE	=	75.00 PSI		
CONFINING PRESS	=	20.80 PSI = 3 ksf		
CELL PRESSURE	=	95.80 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	$\bar{\sigma}_1/\sigma_3$	P' tsf
25.20	19.00	84.24	0.67	0.65	1.62	1.12	2.62	0.56	0.83	1.95	2.35	1.39
28.90	54.00	86.74	0.85	1.85	1.64	1.27	2.77	0.63	0.65	1.92	2.95	1.29
34.90	117.00	87.25	0.88	4.01	1.68	1.50	3.00	0.75	0.62	2.12	3.42	1.37
38.60	154.00	87.09	0.87	5.28	1.70	1.64	3.13	0.82	0.63	2.26	3.59	1.45
42.40	194.00	86.77	0.85	6.65	1.72	1.77	3.27	0.89	0.65	2.42	3.72	1.54
50.10	275.00	85.61	0.76	9.42	1.78	2.03 *	3.53	1.02	0.73	2.77	3.79	1.75
54.30	312.00	84.85	0.71	10.69	1.80	2.17	3.67	1.09	0.79	2.96	3.75	1.87
59.00	361.00	84.12	0.66	12.37	1.84	2.31	3.81	1.16	0.84	3.16	3.76	2.00
63.00	400.00	83.40	0.60	13.71	1.86	2.43	3.93	1.22	0.89	3.33	3.74	2.11
66.70	440.00	82.65	0.55	15.08	1.89	2.54	4.03	1.27	0.95	3.48	3.64	2.21

$\sigma_1 = 7.06$ ksf
$\sigma_3 = 3$ ksf
$\bar{\sigma}_1 = 5.54$ ksf
$\bar{\sigma}_3 = 1.46$ ksf

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

Sh A-49

A

STAGE 3

SAMPLE HEIGHT	=	2.88	INCHES	BORING NO	GT-2T74
SAMPLE DIAMETER	=	1.42	INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.59	IN^2	DEPTH	4-8.5
				SAMPLE DESCRIPTION	Grayish brown CLAY
BACK PRESSURE	=	55.00	PSI		
CONFINING PRESS	=	41.70	PSI = 6 ksf		
CELL PRESSURE	=	96.70	PSI		

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR	$\frac{\bar{\sigma}_1}{\bar{\sigma}_3}$	P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf		tsf
34.20	13.00	64.88	0.71	0.45	1.60	1.54	4.54	0.77	2.29	3.83	1.67	3.06
40.00	41.00	74.70	1.42	1.42	1.62	1.78	4.78	0.89	1.58	3.37	2.13	2.48
43.40	76.00	79.43	1.76	2.64	1.64	1.91	4.91	0.96	1.24	3.15	2.54	2.20
45.90	106.00	80.51	1.84	3.68	1.65	2.00	5.00	1.00	1.17	3.16	2.7	2.17
49.30	140.00	81.36	1.90	4.86	1.67	2.12	5.12	1.06	1.10	3.22	2.93	2.16
52.40	176.00	82.29	1.96	6.11	1.70	2.22	5.23	1.11	1.04	3.26	3.13	2.15
55.30	208.00	82.29	1.96	7.22	1.72	2.32	5.32	1.16	1.04	3.36	3.23	2.20
58.10	240.00	81.89	1.94	8.34	1.74	2.41	5.41	1.20	1.07	3.47	3.24	2.27
61.40	274.00	81.63	1.92	9.52	1.76	2.51	5.51	1.26	1.09	3.60	3.3	2.34
63.90	305.00	81.64	1.92	10.59	1.78	2.58	5.59	1.29	1.08	3.67	3.4	2.38
67.00	337.00	80.88	1.86	11.71	1.80	2.67	5.68	1.34	1.14	3.81	3.34	2.48
69.90	367.00	80.80	1.86	12.75	1.83	2.76	5.76	1.38	1.14	3.90	3.42	2.52
73.10	402.00	80.32	1.82	13.96	1.85	2.84	5.85	1.42	1.18	4.02	3.41	2.60
75.70	732.00	79.84	1.79	25.43	2.14	2.55	5.55	1.28	1.21	3.77	3.12	2.49

$\sigma_1 = 11.52$ ksf

$\sigma_3 = 6$ ksf

$\bar{\sigma}_1 = 7.8$ ksf

$\bar{\sigma}_3 = 2.28$ ksf

Request # 2

P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Disposal Cell

DATE: 6-4-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAD 47

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT2775 BU-02B	6.5-12'	103 96.2 96.6	1000 3600 6000

INITIAL CONDITIONS

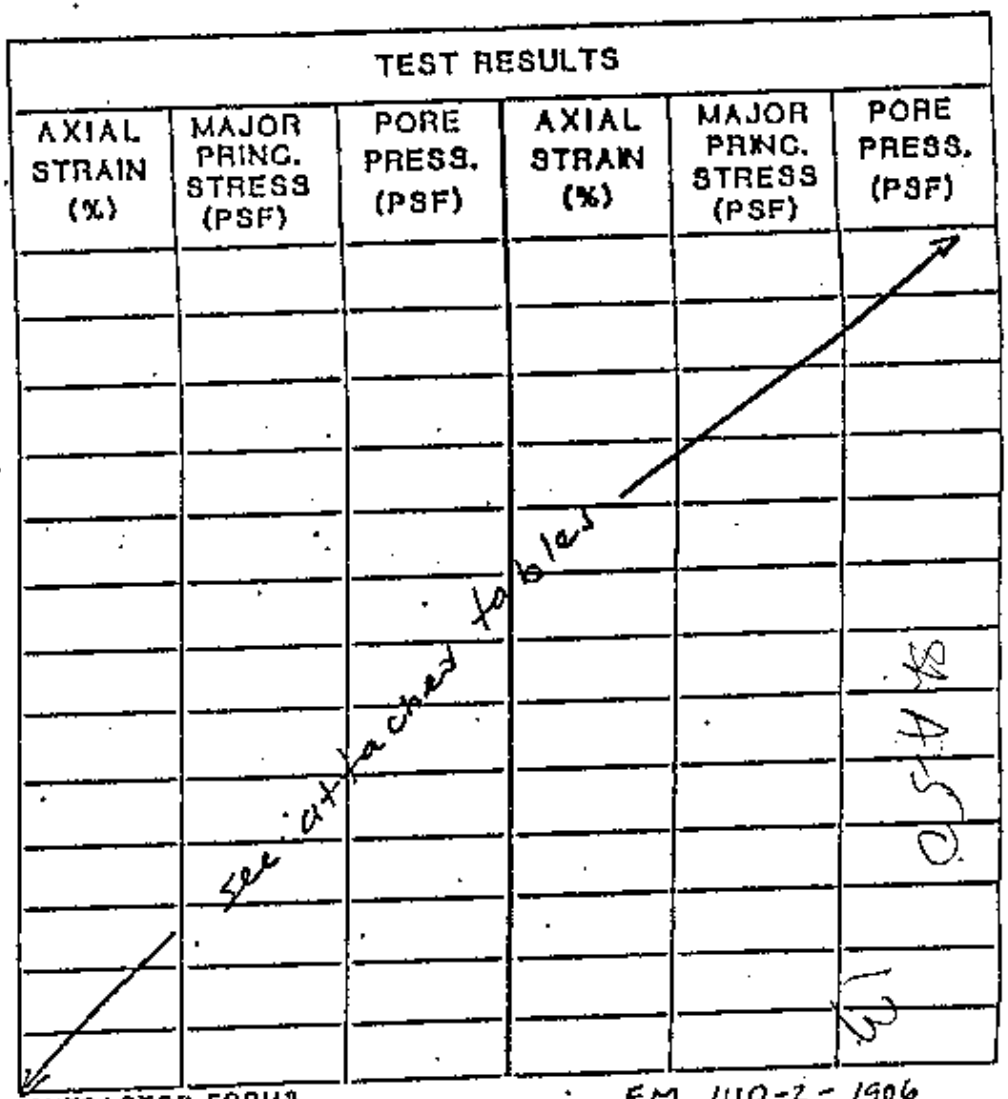
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
97.5	23.4	86.3	0.73	95.6
98.5	23.0	89.6	0.72	96.8
98.8	23.7	90.3	0.72	99.5

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	24.1 24.1 23.4		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)



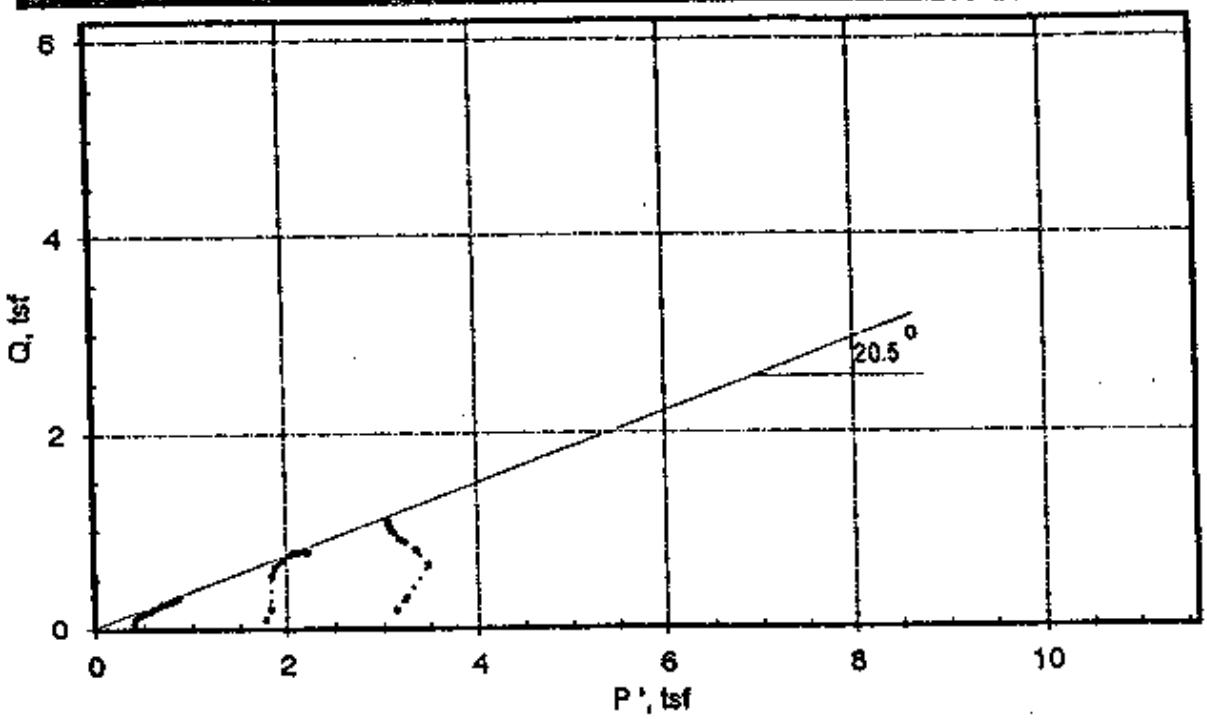
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

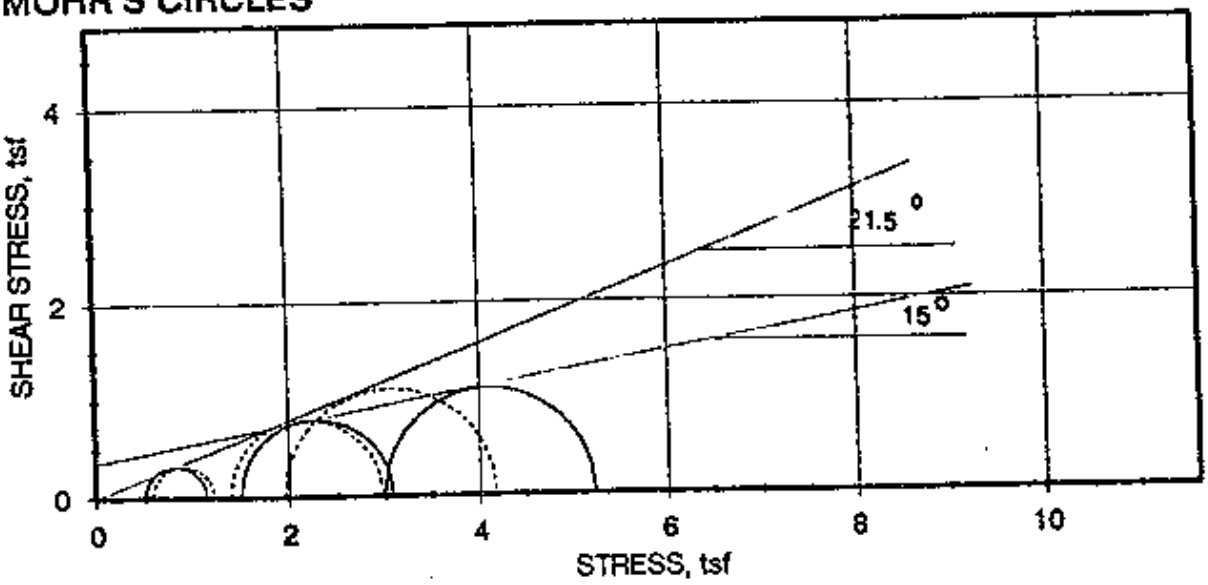
ATTACHMENT 12

SHA-51

WSSRAP - JOB NO:- 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES

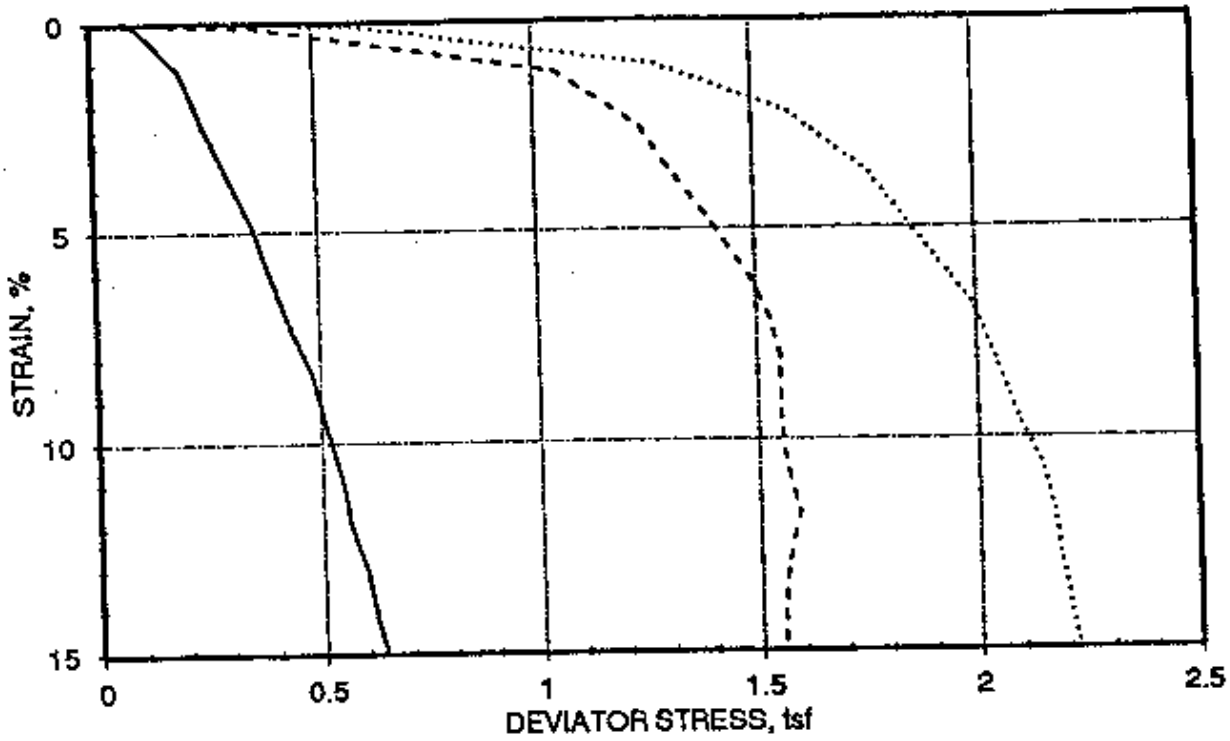


Total Stress ——— Effective Stress .....

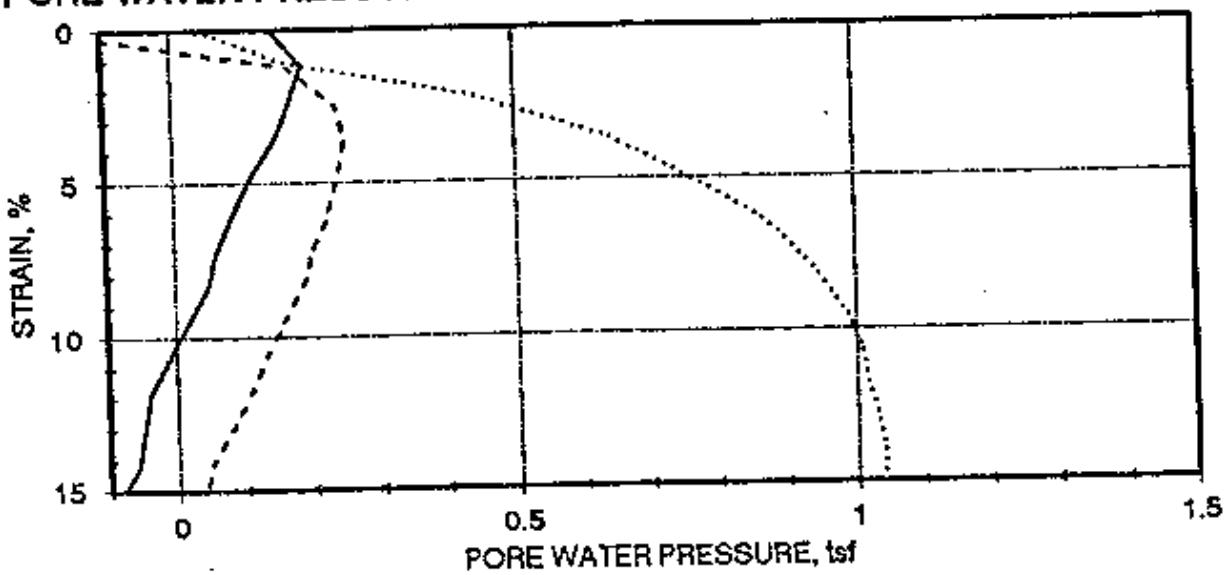
Boring No: GT-2T75
Sample No: BU-02B
Depth: 6.5-12 FT.

Sh. A-52

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: GT-2T75
Sample No: BU-02B
Depth: 6.5-12 FT.

Sh A-53

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

GE 1

SAMPLE HEIGHT	=	2.77 INCHES	BORING NO	GT-2T75
AMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
AMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY to CLAY
ACK PRESSURE	=	95.00 PSI		
CONFINING PRESSURE	=	6.94 PSI = 1 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
ELL PRESSURE	=	101.94 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	23.36	24.92
DEGREE OF SATURATION (%)	89.36	
DRY DENSITY (pcf)	98.77	
VOID RATIO	0.71	

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	$\frac{\bar{\sigma}_1}{\bar{\sigma}_3}$	P' P' tsf
1.60	1.00	97.04	0.15	0.04	1.60	0.07	0.57	0.04	0.35	0.42	1.2	0.39
2.30	3.00	97.15	0.15	0.11	1.61	0.10	0.60	0.05	0.34	0.45	1.32	0.40
4.50	32.00	97.64	0.19	1.16	1.62	0.20	0.70	0.10	0.31	0.51	1.65	0.41
5.80	67.00	97.43	0.17	2.42	1.64	0.25	0.75	0.13	0.32	0.58	1.81	0.45
6.90	98.00	97.07	0.15	3.54	1.66	0.30	0.80	0.15	0.35	0.65	1.86	0.50
8.50	136.00	96.58	0.11	4.91	1.69	0.36	0.86	0.18	0.39	0.75	1.92	0.57
9.20	162.00	96.24	0.09	5.85	1.70	0.39	0.89	0.19	0.41	0.80	1.95	0.60
10.60	203.00	95.83	0.06	7.33	1.73	0.44	0.94	0.22	0.44	0.88	2	0.66
11.60	229.00	95.66	0.05	8.27	1.75	0.48	0.98	0.24	0.45	0.93	2.07	0.69
12.50	262.00	95.27	0.02	9.46	1.77	0.51	1.01	0.25	0.48	0.99	2.06	0.73
13.70	305.00	94.79	-0.02	11.01	1.80	0.55	1.05	0.27	0.51	1.06	2.08	0.79
14.10	328.00	94.49	-0.04	11.84	1.82	0.56	1.06	0.28	0.54	1.09	2.02	0.82
15.40	360.00	94.36	-0.05	13.00	1.84	0.60	1.10	0.30	0.55	1.15	2.09	0.85
16.20	393.00	94.17	-0.06	14.19	1.87	0.62	1.12	0.31	0.56	1.18	2.11	0.87
16.70	415.00	93.83	-0.08	14.98	1.89	0.64	1.14	0.32	0.58	1.22	2.1	0.90

$\sigma_1 = 2.24$ ksf

$\sigma_3 = 1$ ksf

$\bar{\sigma}_1 = 2.36$ ksf

$\bar{\sigma}_3 = 1.12$ ksf

Sh A-54

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

T3

SAMPLE HEIGHT	=	2.81 INCHES	BORING NO	GT-2T75
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY to CLAY
BACK PRESSURE	=	75.00 PSI		
CONFINING PRESS	=	20.82 PSI = 3 ksf		
CELL PRESSURE	=	95.82 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR $\bar{\sigma_1}/\bar{\sigma_3}$ tsf	P' tsf
4.00	2.00	72.34	-0.19	0.07	1.60	0.18	1.68	0.09	1.69	1.87 1.11	1.78
8.30	4.00	72.94	-0.15	0.14	1.60	0.37	1.87	0.19	1.65	2.02 1.22	1.83
23.70	34.00	77.39	0.17	1.21	1.62	1.05	2.55	0.53	1.33	2.38 1.79	1.85
28.20	71.00	78.35	0.24	2.53	1.64	1.24	2.74	0.62	1.26	2.50 1.98	1.88
30.30	101.00	78.42	0.25	3.60	1.66	1.31	2.81	0.66	1.25	2.57 2.06	1.91
32.60	134.00	78.30	0.24	4.78	1.68	1.40	2.90	0.70	1.26	2.66 2.11	1.96
35.30	174.00	78.03	0.22	6.20	1.71	1.49	2.99	0.75	1.28	2.77 2.16	2.03
36.60	200.00	77.72	0.20	7.13	1.72	1.53	3.03	0.77	1.30	2.83 2.18	2.07
37.40	226.00	77.58	0.19	8.06	1.74	1.55	3.05	0.77	1.31	2.86 2.18	2.09
38.00	262.00	77.16	0.16	9.34	1.76	1.55	3.05	0.78	1.34	2.89 2.16	2.12
38.70	297.00	76.74	0.13	10.59	1.79	1.56	3.06	0.78	1.37	2.93 2.14	2.15
39.90	328.00	76.48	0.11	11.69	1.81	1.59	3.09	0.79	1.39	2.98 2.14	2.19
39.80	364.00	76.17	0.08	12.98	1.84	1.56	3.06	0.78	1.41	2.97 2.11	2.19
40.10	396.00	75.76	0.05	14.12	1.86	1.55	3.05	0.78	1.44	2.99 2.08	2.22
40.40	421.00	75.59	0.04	15.01	1.88	1.55	3.04	0.77	1.46	3.00 2.05	2.23

σ_1 = 6.1 ksf
σ_3 = 3 ksf
$\bar{\sigma_1}$ = 5.72 ksf
$\bar{\sigma_3}$ = 2.62 ksf

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

Sh A-55

JE 3

SAMPLE HEIGHT	=	2.80 INCHES	BORING NO	GT-2T75
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY to CLAY
BACK PRESSURE	=	55.00 PSI		
CONFINING PRESS	=	41.64 PSI = 6 ksf		
CELL PRESSURE	=	96.64 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP taf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS taf	MAJOR PR.STR taf	Q taf	EFF MINOR taf	EFF MAJOR taf	$\bar{\sigma_1}/\bar{\sigma_3}$	P' taf
7.90	2.00	55.55	0.04	0.07	1.60	0.36	3.35	0.18	2.96	3.31	1.12	3.14
13.20	3.00	55.78	0.06	0.11	1.60	0.59	3.59	0.30	2.94	3.54	1.2	3.24
28.80	30.00	57.27	0.16	1.07	1.62	1.28	4.28	0.64	2.83	4.12	1.46	3.48
35.80	62.00	61.07	0.44	2.21	1.64	1.58	4.57	0.79	2.56	4.14	1.62	3.35
40.50	102.00	63.94	0.64	3.64	1.66	1.76	4.76	0.88	2.35	4.11	1.75	3.23
42.60	129.00	65.19	0.73	4.60	1.68	1.83	4.83	0.91	2.26	4.09	1.81	3.18
45.90	172.00	66.79	0.85	6.13	1.70	1.94	4.94	0.97	2.15	4.09	1.9	3.12
47.40	190.00	67.33	0.89	6.78	1.72	1.99	4.99	0.99	2.11	4.10	1.94	3.10
49.20	224.00	68.03	0.94	7.99	1.74	2.04	5.04	1.02	2.06	4.10	1.99	3.08
51.40	267.00	68.78	0.99	9.52	1.77	2.09	5.09	1.05	2.01	4.10	2.04	3.05
53.20	297.00	68.98	1.01	10.59	1.79	2.14	5.14	1.07	1.99	4.13	2.08	3.06
54.60	333.00	69.18	1.02	11.88	1.81	2.17	5.16	1.08	1.98	4.14	2.09	3.06
55.60	357.00	69.26	1.03	12.73	1.83	2.18	5.18	1.09	1.97	4.16	2.11	3.06
56.70	390.00	69.42	1.04	13.91	1.86	2.20	5.20	1.10	1.96	4.16	2.12	3.06
58.00	421.00	69.45	1.04	15.01	1.88	2.22	5.22	1.11	1.96	4.18	2.13	3.07

$\sigma_1 = 10.44$ ksf

$\sigma_3 = 6$ ksf

$\bar{\sigma_1} = 8.36$ ksf

$\bar{\sigma_3} = 3.92$ ksf

Requal #2

P.O. # 3507-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSS RAP

LOCATION ID: Disposal Cell

DATE: 7-18-90

LAB NAME: Geotechnology, Inc

CHECKED BY: LAB YY

TAC ______

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
GT-2T77 BU-018	15-4	93.5	1000
		96.2	3000
		96.3	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
99.2	19.5	81.5	.60	97.0
100.1	19.3	83.5	.55	98.4
100.1	17.4	81.7	.59	95.1

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	25.7		
	25.0		
	21.9		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

see attached sheet

SM A-56

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

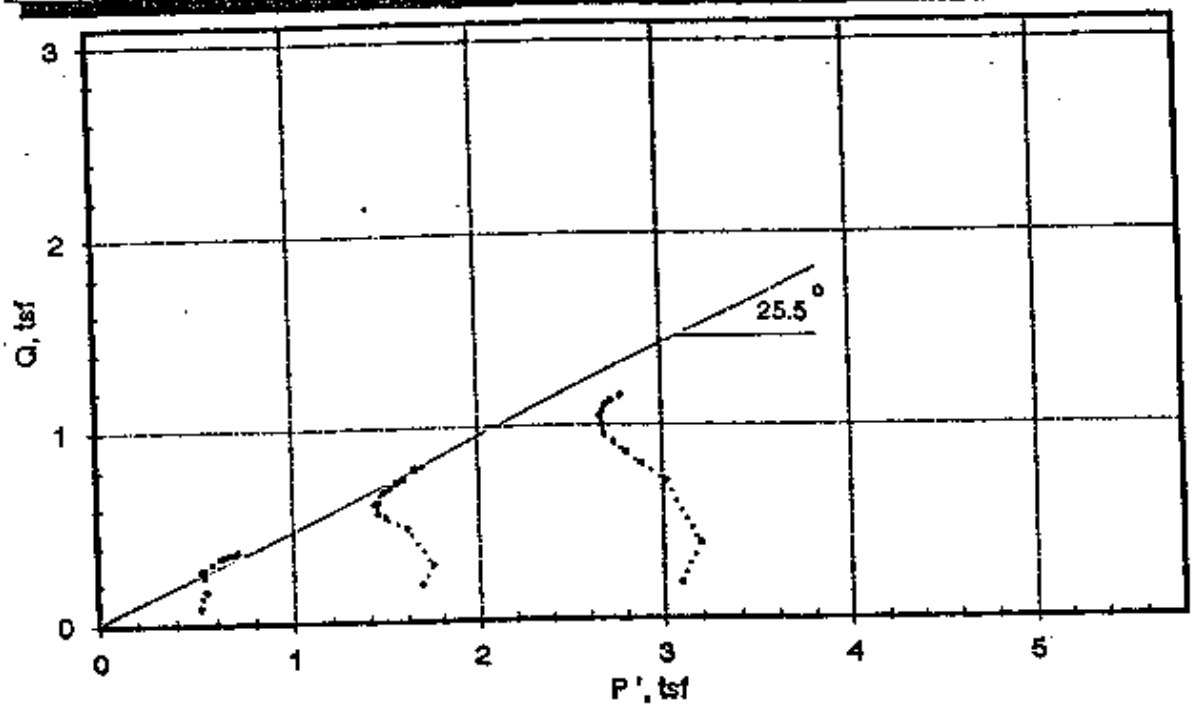
TEST PROCEDURE: EM-1110-2-1906

ATTACHMENT 12

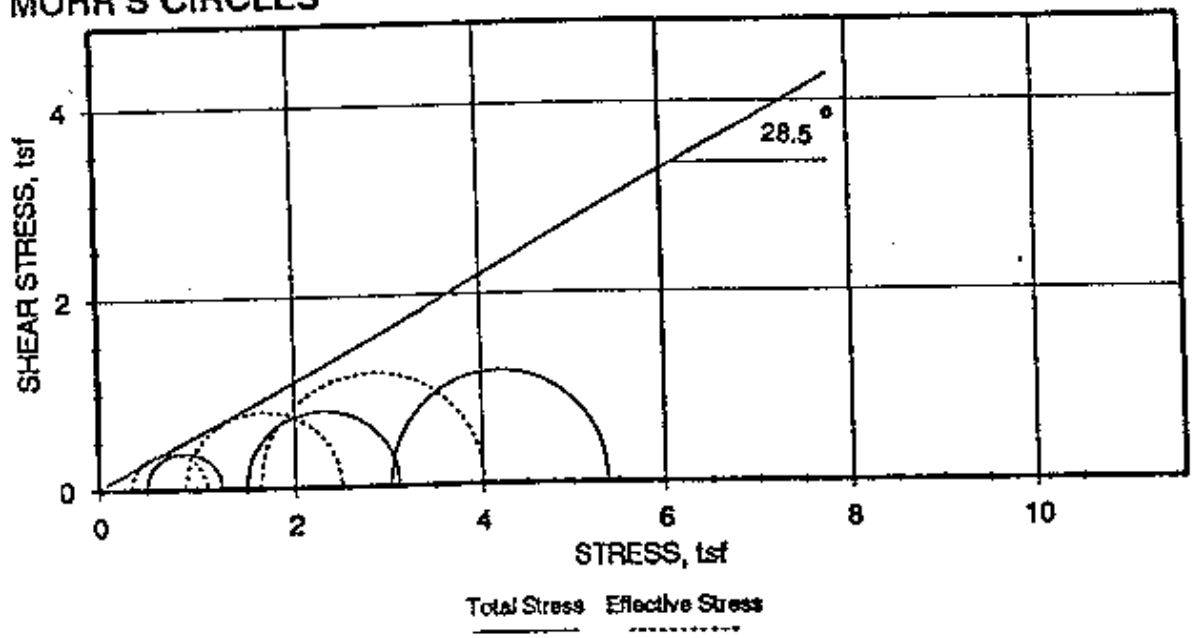
SL A-57

14

WSSRAP - JOB NO:- 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress ——— Effective Stress ----------

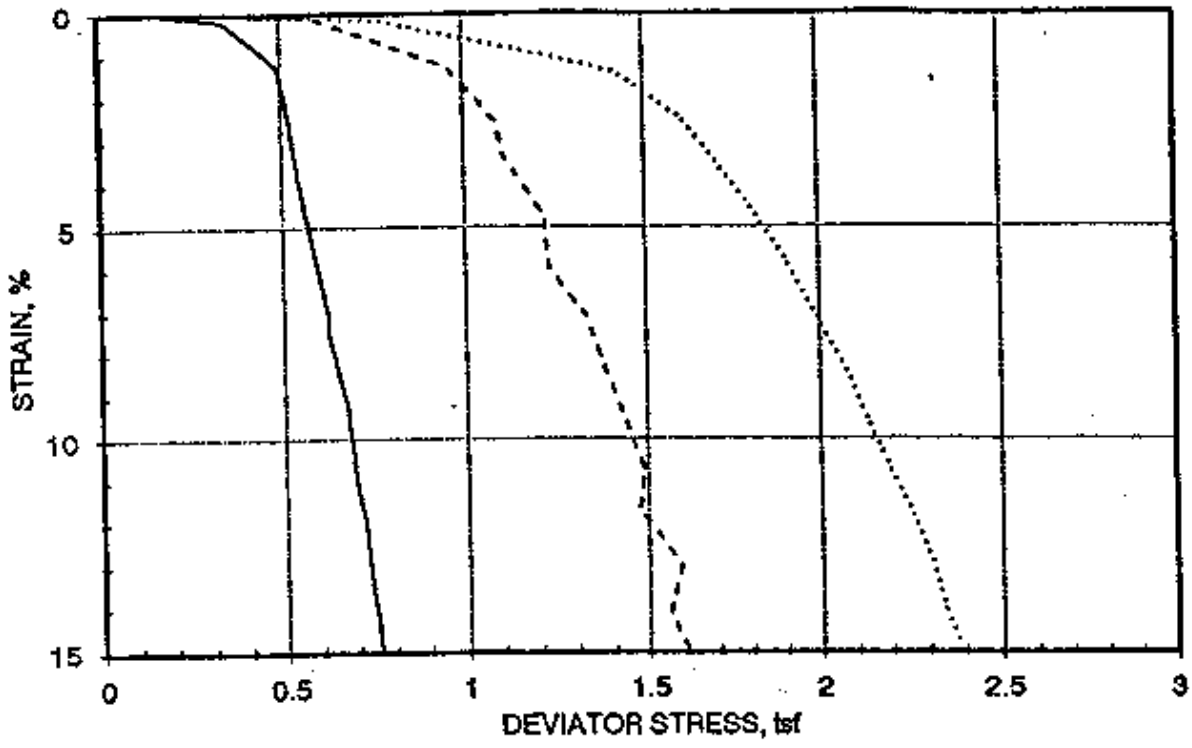
Boring No: GT-2T77
Sample No: BU-01B
Depth: 1.5-4 FT

P 5

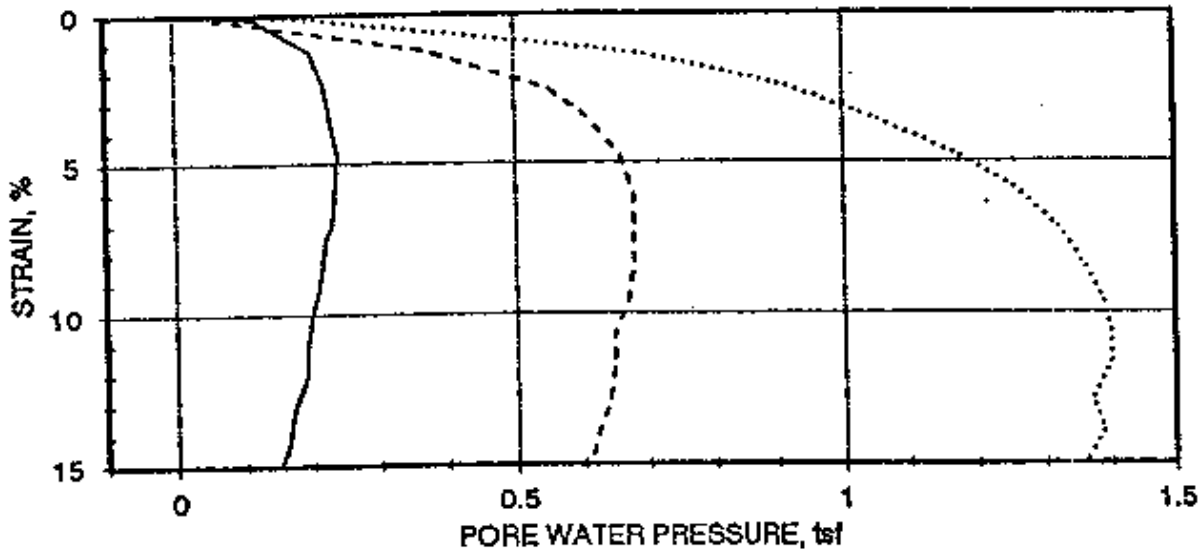
Sh A-58

~~A~~

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



STAGE 1 STAGE 2 STAGE 3

Boring No: GT-2T77
Sample No: BU-01B
Depth: 1.5-4 FT

SL

Checked by: SA

Sh. A-59

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 1

SAMPLE HEIGHT	=	2.95 INCHES	BORING NO	GT-2T77	
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01B	
SAMPLE AREA	=	1.59 IN^2	DEPTH	1.5-4 FT	
			SAMPLE DESCRIPTION	Grayish brown, CLAY	
BACK PRESSURE	=	65.00 PSI			
CONFINING PRESSURE	=	6.90 PSI = 0.994 ksf	SPECIFIC GRAVITY	2.7 (Assumed)	
CELL PRESSURE	=	71.90 PSI		INITIAL	FINAL
			MOISTURE CONTENT (%)	19.26	25.05
			DEGREE OF SATURATION (%)	74.43	
			DRY DENSITY (pcf)	99.19	
			VOID RATIO	0.70	

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	σ1/σ3	P' tsf
3.50	1.00	65.82	0.06	0.03	1.60	0.16	0.65	0.08	0.44	0.60	1.36	0.52
7.60	5.00	66.60	0.12	0.17	1.60	0.34	0.84	0.17	0.38	0.72	1.89	0.55
11.10	37.00	67.79	0.20	1.25	1.62	0.49	0.99	0.25	0.30	0.79	2.63	0.54
11.90	71.00	68.08	0.22	2.41	1.63	0.52	1.02	0.26	0.28	0.80	2.86	0.54
12.40	108.00	68.22	0.23	3.66	1.66	0.54	1.04	0.27	0.26	0.80	3.08	0.53
13.00	138.00	68.28	0.24	4.67	1.67	0.56	1.06	0.28	0.26	0.82	3.15	0.54
14.80	207.00	68.19	0.23	7.01	1.72	0.62	1.12	0.31	0.27	0.89	3.3	0.58
14.90	221.00	68.11	0.22	7.49	1.72	0.62	1.12	0.31	0.27	0.90	3.33	0.58
16.40	270.00	67.97	0.21	9.15	1.76	0.67	1.17	0.34	0.28	0.96	3.43	0.62
16.70	292.00	67.83	0.20	9.89	1.77	0.68	1.18	0.34	0.29	0.97	3.34	0.63
17.50	330.00	67.69	0.19	11.18	1.80	0.70	1.20	0.35	0.30	1.00	3.33	0.65
18.00	354.00	67.60	0.19	11.99	1.81	0.72	1.21	0.36	0.31	1.02	3.29	0.67
18.60	388.00	67.39	0.17	13.14	1.84	0.73	1.23	0.36	0.32	1.05	3.28	0.69
19.40	425.00	67.20	0.16	14.40	1.86	0.75	1.25	0.37	0.34	1.09	3.21	0.71
19.90	443.00	67.10	0.15	15.01	1.88	0.76	1.26	0.38	0.35	1.11	3.17	0.73

$\sigma_1 = 2.34$ ksf

$\sigma_3 = 0.99$ ksf

$\overline{\sigma_1} = 1.92$ ksf

$\overline{\sigma_3} = .56$ ksf

SA-50

GEOTECHNOLOGY INC
CONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

14

SAMPLE HEIGHT	=	2.91 INCHES	BORING NO	GT-2T77
SAMPLE DIAMETER	=	1.42 INCHES	SAMPLE NO	BU-01B
SAMPLE AREA	=	1.59 IN^2	DEPTH	1.5-4 FT
			SAMPLE DESCRIPTION	Grayish brown, CLAY
BACK PRESSURE	=	65.00 PSI		
CONFINING PRESS	=	20.80 PSI = 3 ksf		
CELL PRESSURE	=	85.80 PSI		

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	$\frac{\sigma_1}{\sigma_3}$	P' tsf
8.40	1.00	65.06	0.00	0.03	1.59	0.38	1.88	0.19	1.49	1.87	1.26	1.68
12.90	3.00	65.59	0.04	0.10	1.59	0.58	2.08	0.29	1.46	2.04	1.4	1.75
21.50	36.00	70.20	0.37	1.24	1.61	0.96	2.46	0.48	1.12	2.08	1.66	1.60
24.70	73.00	72.67	0.55	2.51	1.63	1.09	2.59	0.54	0.95	2.03	2.14	1.49
25.50	96.00	73.37	0.60	3.30	1.65	1.11	2.61	0.56	0.89	2.01	2.26	1.45
28.30	139.00	74.15	0.66	4.77	1.67	1.22	2.72	0.61	0.84	2.06	2.45	1.45
28.90	173.00	74.47	0.68	5.94	1.69	1.23	2.73	0.61	0.82	2.04	2.49	1.43
31.70	207.00	74.49	0.68	7.11	1.71	1.33	2.83	0.67	0.81	2.15	2.65	1.48
33.30	243.00	74.45	0.68	8.34	1.74	1.38	2.88	0.69	0.82	2.20	2.68	1.51
35.20	280.00	74.33	0.67	9.61	1.76	1.44	2.94	0.72	0.83	2.26	2.72	1.55
36.80	311.00	74.01	0.65	10.68	1.78	1.49	2.98	0.74	0.85	2.33	2.74	1.59
37.10	340.00	74.08	0.65	11.67	1.80	1.48	2.98	0.74	0.84	2.33	2.77	1.58
40.30	378.00	73.95	0.64	12.98	1.83	1.59	* 3.08	0.79	0.85	2.44	2.87	1.65
40.20	411.00	73.66	0.62	14.11	1.85	1.56	3.06	0.78	0.87	2.44	2.8	1.65
41.80	437.00	73.51	0.61	15.00	1.87	1.61	3.10	0.80	0.88	2.49	2.82	1.69

σ_1 = 6.16 ksf
σ_3 = 3 ksf
$\bar{\sigma}_1$ = 4.88 ksf
$\bar{\sigma}_3$ = 1.7 ksf

57

Sh A-61

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 3

SAMPLE HEIGHT	=	2.93 INCHES	BORING NO	GT-2T77
SAMPLE DIAMETER	=	1.42 INCHES	SAMPLE NO	BU-01B
SAMPLE AREA	=	1.59 IN^2	DEPTH	1.5-4 FT
			SAMPLE DESCRIPTION	Grayish brown, CLAY
BACK PRESSURE	=	55.00 PSI		
CONFINING PRESS	=	41.67 PSI = 6 ksf		
CELL PRESSURE	=	96.67 PSI		

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	$\frac{\bar{\sigma}_1}{\bar{\sigma}_3}$	P' tsf
8.00	1.00	56.24	0.09	0.03	1.59	0.36	3.36	0.18	2.91	3.27	1.12	3.09
17.30	5.00	57.84	0.20	0.17	1.60	0.78	3.78	0.39	2.80	3.58	1.28	3.19
31.90	40.00	64.63	0.69	1.36	1.61	1.42	4.42	0.71	2.31	3.73	1.61	3.02
36.30	71.00	67.64	0.91	2.42	1.63	1.60	4.60	0.80	2.09	3.69	1.77	2.89
39.30	104.00	69.58	1.05	3.54	1.65	1.71	4.71	0.86	1.95	3.66	1.88	2.81
42.20	139.00	71.26	1.17	4.74	1.67	1.82	4.82	0.91	1.83	3.65	1.99	2.74
44.50	168.00	72.43	1.25	5.73	1.69	1.90	4.90	0.95	1.75	3.64	2.08	2.69
47.50	209.00	73.30	1.32	7.12	1.71	1.99	4.99	1.00	1.68	3.68	2.19	2.68
50.20	248.00	73.95	1.36	8.45	1.74	2.08	5.08	1.04	1.64	3.71	2.26	2.67
52.50	283.00	74.32	1.39	9.65	1.76	2.14	5.14	1.07	1.61	3.75	2.33	2.68
54.30	311.00	74.41	1.40	10.60	1.78	2.19	5.19	1.10	1.60	3.80	2.38	2.70
56.30	343.00	74.41	1.40	11.69	1.80	2.25	5.25	1.12	1.60	3.85	2.41	2.73
58.60	378.00	74.09	1.37	12.88	1.83	2.31	5.31	1.15	1.63	3.93	2.41	2.78
60.20	406.00	74.26	1.39	13.84	1.85	2.34	* 5.35	1.17	1.61	3.96	2.46	2.79
62.30	440.00	73.92	1.36	15.00	1.87	2.39	5.39	1.20	1.64	4.03	2.46	2.84

$\sigma_1 = 10.7$ ksf

$\sigma_3 = 6$ ksf

$\bar{\sigma}_1 = 7.92$ ksf

$\bar{\sigma}_3 = 3.22$ ksf

Request #3
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSURAP
LOCATION ID: Harrow Jones Ave #1
DATE: 1 4 90
LAB NAME: Geotechnology Inc.
CHECKED BY: LAB 77
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TPGS - 2A	2.6 - 7.1	98.8	1800
		97.2	3000
		96.5	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
108.2	18.4	42.3	0.53	96.8
107.4	18.6	91.3	0.54	97.7
106.6	18.6	89.4	0.55	98.2

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	19.1		
	18.7		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

See attached tables

SHAGE

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

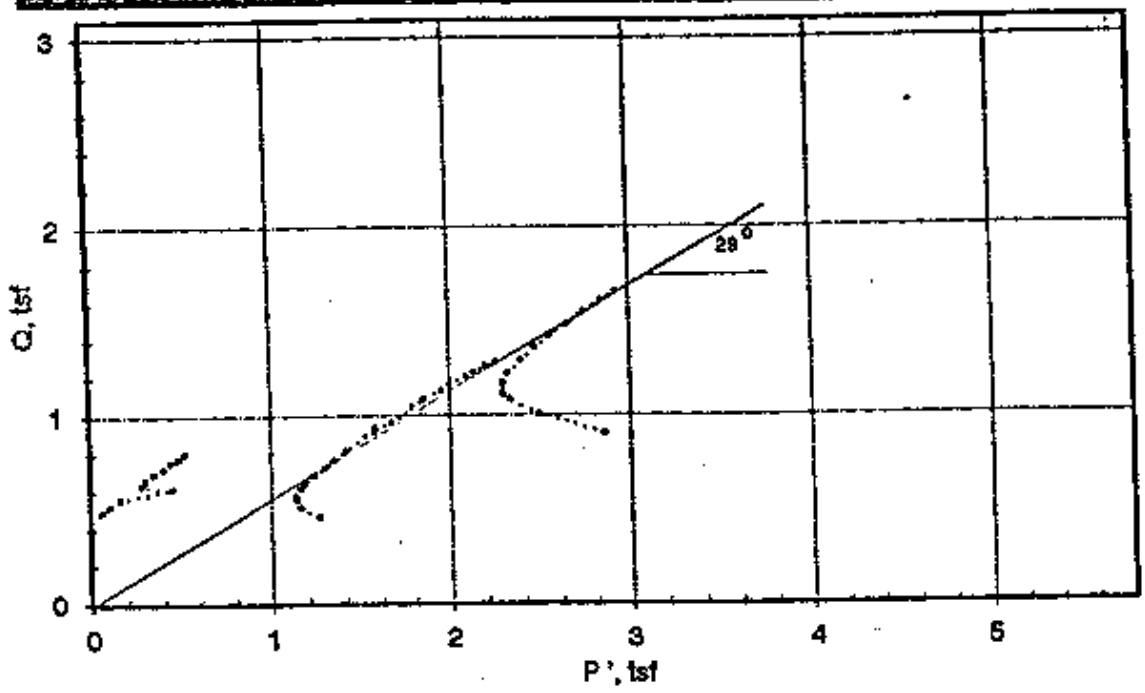
MKF-AL-ENG-12 (4/87)

ATTACHMENT 12

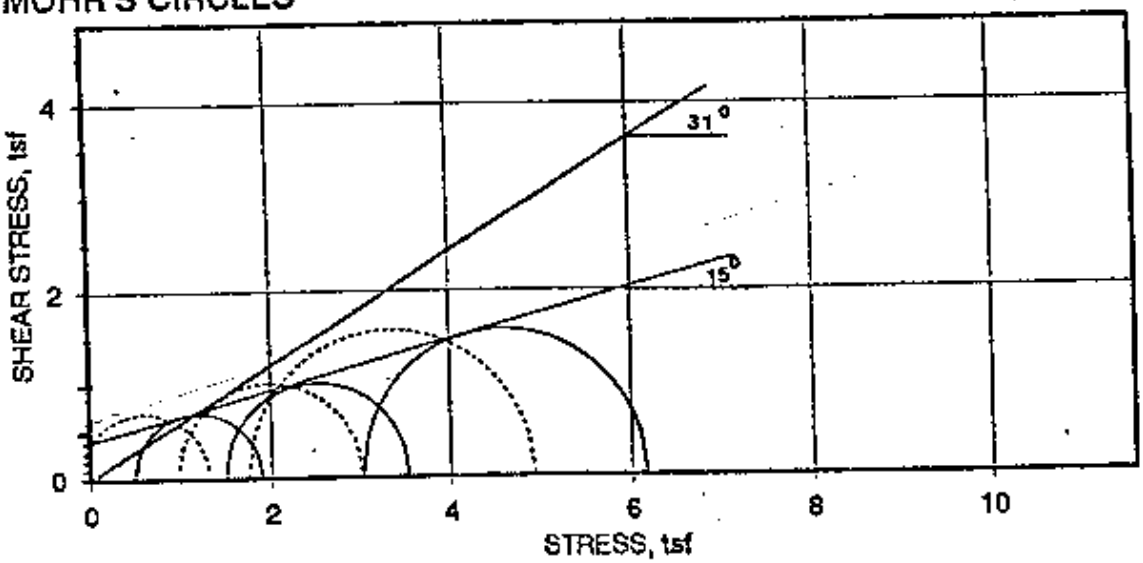
68

Sh A-63

WSSRAP - JOB NO:- 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES

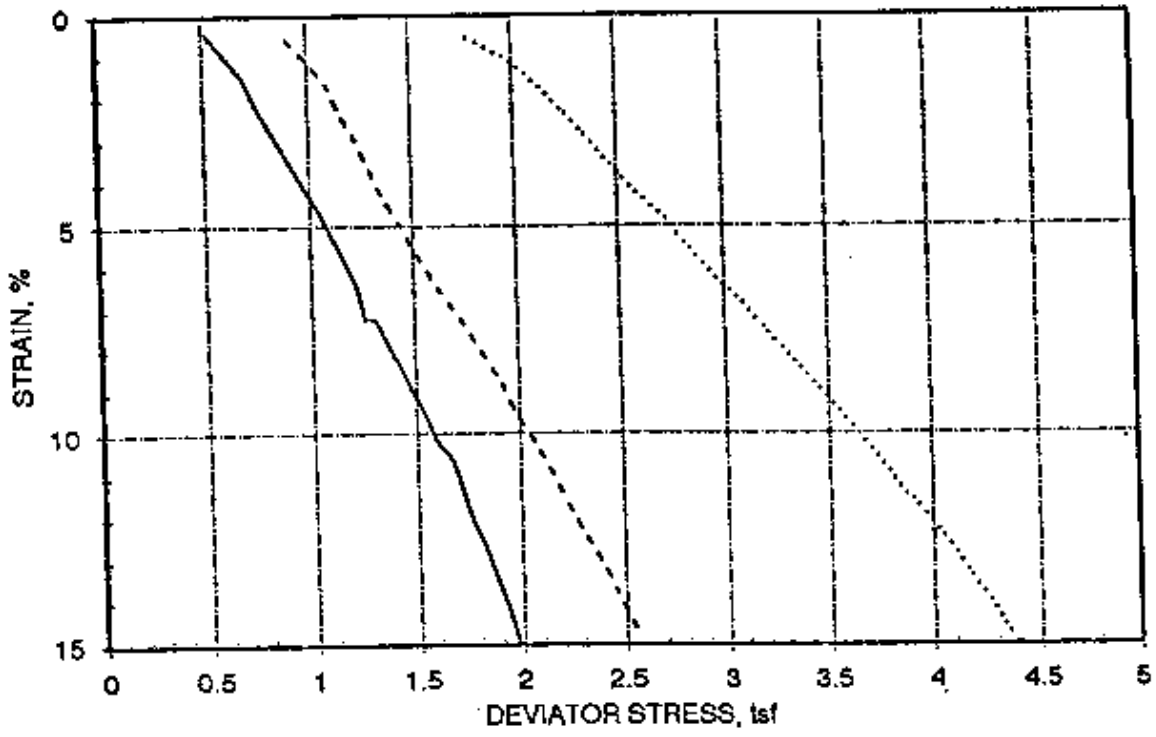


Boring No: TPBS-1
Sample No: 2A
Depth: 2.6-7.1

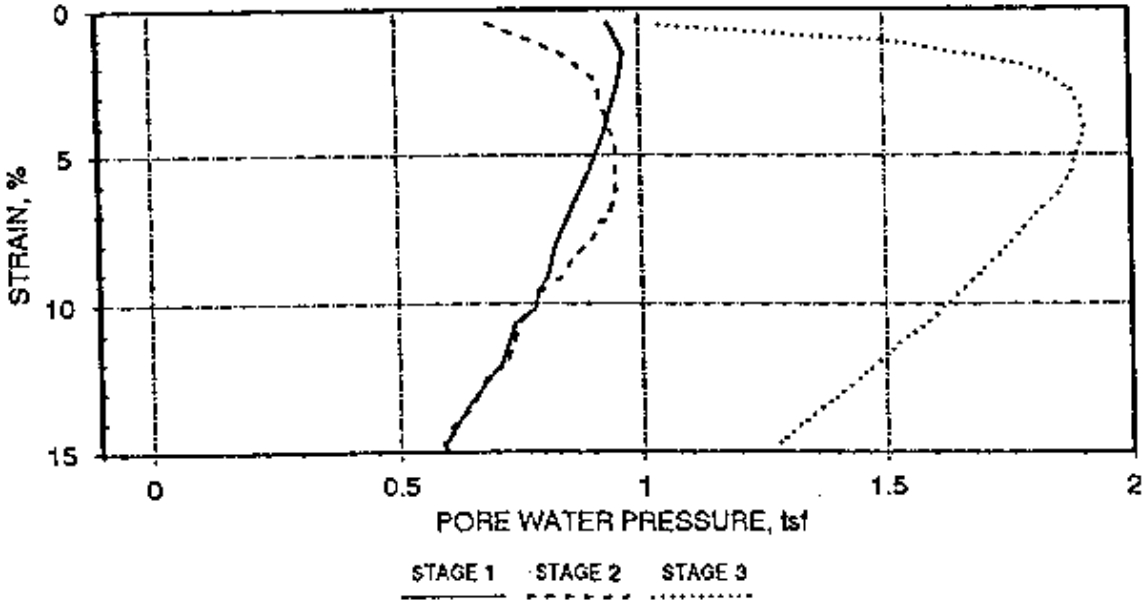
checked KF

Sh A-64

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: TPBS-1
Sample No: 2A
Depth: 2.6-7.1

SHA 65

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 1

SAMPLE HEIGHT	=	2.88 INCHES
SAMPLE DIAMETER	=	1.42 INCHES
SAMPLE AREA	=	1.59 IN^2
BACK PRESSURE	=	45.00 PSI
CONFINING PRESSURE	=	6.94 PSI = 1 ksf
CELL PRESSURE	=	51.94 PSI

BORING NO	TPBS-1
SAMPLE NO	2A
DEPTH	2.6-7.1
SAMPLE DESCRIPTION	Grayish brown, silty CLAY
SPECIFIC GRAVITY	2.7 (Assumed)

	INITIAL	FINAL
MOISTURE CONTENT (%)	18.24	19.11
DEGREE OF SATURATION (%)	88.23	
DRY DENSITY (pcf)	108.12	
VOID RATIO	0.56	

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR (σ_1) tsf	Q tsf	EFF MINOR tsf	EFF MAJOR (σ_1) tsf	P' P' tsf
11.50	13.00	58.09	0.94	0.45	1.60	0.52	1.02	0.26	-0.44	0.07	-0.18
15.40	43.00	58.53	0.97	1.49	1.62	0.69	1.19	0.34	-0.47	0.21	-0.13
17.60	69.00	58.34	0.96	2.40	1.63	0.78	1.28	0.39	-0.46	0.32	-0.07
22.60	118.00	57.90	0.93	4.10	1.66	0.98	1.48	0.49	-0.43	0.55	0.06
24.00	132.00	57.73	0.92	4.58	1.67	1.04	1.53	0.52	-0.42	0.62	0.10
26.10	155.00	57.44	0.90	5.38	1.68	1.12	1.62	0.56	-0.40	0.72	0.16
28.90	184.00	57.12	0.87	6.39	1.70	1.22	1.72	0.61	-0.37	0.85	0.24
30.00	208.00	56.85	0.85	7.22	1.72	1.26	1.76	0.63	-0.35	0.90	0.28
31.30	208.00	56.85	0.85	7.22	1.72	1.31	1.81	0.66	-0.35	0.96	0.30
33.00	226.00	56.58	0.83	7.85	1.73	1.37	1.87	0.69	-0.33	1.04	0.35
34.80	243.00	56.34	0.82	8.44	1.74	1.44	1.94	0.72	-0.32	1.12	0.40
36.60	262.00	56.24	0.81	9.10	1.75	1.50	2.00	0.75	-0.31	1.19	0.44
37.90	275.00	55.94	0.79	9.55	1.76	1.55	2.05	0.77	-0.29	1.26	0.49
39.30	293.00	55.81	0.78	10.17	1.77	1.60	2.10	0.80	-0.28	1.32	0.52
41.70	306.00	55.25	0.74	10.63	1.78	1.68	2.18	0.84	-0.24	1.45	0.60
44.60	348.00	54.93	0.71	12.08	1.81	1.77	2.27	0.89	-0.22	1.56	0.67
45.70	358.00	54.61	0.69	12.43	1.82	1.81	2.31	0.90	-0.19	1.62	0.71
48.30	390.00	53.95	0.64	13.54	1.84	1.89	2.39	0.94	-0.14	1.74	0.80
49.70	407.00	53.66	0.62	14.13	1.85	1.93	2.43	0.96	-0.12	1.81	0.84
50.70	421.00	53.40	0.60	14.62	1.87	1.96	2.46	0.98	-0.11	1.85	0.87
51.80	434.00	53.21	0.59	15.07	1.88	1.99	2.49	0.99	-0.09	1.90	0.90 ←

SL A-66

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

SAMPLE HEIGHT	=	2.94 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	2.6-7.1
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY
BACK PRESSURE	=	65.00 PSI		
CONFINING PRESS	=	20.82 PSI = 3 ksf		
CELL PRESSURE	=	85.82 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
20.30	17.00	74.60	0.69	0.58	1.60	0.91	2.41	0.46	0.81	1.72	1.26
22.80	34.00	76.71	0.84	1.16	1.61	1.02	2.52	0.51	0.66	1.67	1.16
24.80	51.00	77.66	0.91	1.74	1.62	1.10	2.60	0.55	0.59	1.69	1.14
26.00	67.00	78.05	0.94	2.28	1.63	1.15	2.65	0.57	0.56	1.71	1.13
28.00	88.00	78.25	0.95	3.00	1.64	1.23	2.73	0.61	0.55	1.77	1.16
29.30	103.00	78.25	0.95	3.51	1.65	1.28	2.78	0.64	0.55	1.82	1.18
31.30	124.00	78.19	0.95	4.22	1.67	1.35	2.85	0.68	0.55	1.90	1.23
33.60	146.00	77.98	0.93	4.97	1.68	1.44	2.94	0.72	0.56	2.01	1.29
35.70	166.00	77.76	0.92	5.65	1.69	1.52	3.02	0.76	0.58	2.10	1.34
38.20	188.00	77.44	0.90	6.40	1.70	1.61	3.11	0.81	0.60	2.22	1.41
41.60	216.00	77.01	0.86	7.35	1.72	1.74	3.24	0.87	0.63	2.37	1.50
44.00	237.00	76.67	0.84	8.07	1.73	1.83	3.33	0.91	0.66	2.48	1.57
46.80	261.00	76.18	0.80	8.88	1.75	1.93	3.42	0.96	0.69	2.62	1.66
48.50	277.00	75.89	0.78	9.43	1.76	1.98	3.48	0.99	0.71	2.70 3.8	1.71
51.10	299.00	75.48	0.75	10.18	1.78	2.07	* 3.57	1.04	0.74	2.82 3.91	1.78
53.50	319.00	75.06	0.72	10.86	1.79	2.15	3.65	1.08	0.77	2.93 3.8	1.85
56.60	347.00	74.43	0.68	11.81	1.81	2.25	3.75	1.13	0.82	3.07 3.9	1.95
58.50	364.00	74.05	0.65	12.39	1.82	2.31	3.81	1.16	0.85	3.16 3.9	2.00
61.50	389.00	73.54	0.61	13.24	1.84	2.41	3.91	1.20	0.88	3.29 3.94	2.09
63.00	402.00	73.28	0.60	13.68	1.85	2.45	3.95	1.23	0.90	3.36 3.93	2.13
65.20	423.00	72.79	0.56	14.40	1.86	2.52	4.02	1.26	0.94	3.46 3.98	2.20
66.80	438.00	72.38	0.53	14.91	1.87	2.57	(4.07)	(1.28)	(0.97)	(3.53) 3.94	2.25

Sh A-67

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 3

SAMPLE HEIGHT	=	2.94 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.42 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	2.6-7.1 FT.
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY
BACK PRESSURE	=	45.00 PSI		
CONFINING PRESS	=	41.70 PSI = 6 ksf		
CELL PRESSURE	=	86.70 PSI		

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR	P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf	tsf
39.70	16.00	59.50	1.04	0.54	1.60	1.79	4.79	0.90	1.96	3.75	2.85
44.70	32.00	66.08	1.52	1.09	1.61	2.00	5.01	1.00	1.48	3.49	2.49
48.50	54.00	69.38	1.76	1.84	1.62	2.16	5.16	1.08	1.25	3.41	2.33
50.30	66.00	70.43	1.83	2.25	1.62	2.23	5.23	1.11	1.17	3.40	2.29
53.10	82.00	71.09	1.88	2.79	1.63	2.34	5.34	1.17	1.12	3.46	2.29
55.80	100.00	71.43	1.90	3.40	1.64	2.44	5.45	1.22	1.10	3.54	2.32
59.60	123.00	71.55	1.91	4.19	1.66	2.59	5.59	1.29	1.09	3.68	2.39
63.00	141.00	71.29	1.89	4.80	1.67	2.72	5.72	1.36	1.11	3.83	2.47
66.40	163.00	71.05	1.88	5.55	1.68	2.84	5.85	1.42	1.13	3.97	2.55
69.90	185.00	70.72	1.85	6.30	1.69	2.97	5.97	1.48	1.15	4.12	2.64
73.30	202.00	70.15	1.81	6.88	1.71	3.09	6.10	1.55	1.19	4.29	2.74
76.70	222.00	69.63	1.77	7.56	1.72	3.21	6.22	1.61	1.23	4.44	2.84
79.70	240.00	69.20	1.74	8.17	1.73	3.32	6.32	1.66	1.26	4.58	2.92
83.10	259.00	68.62	1.70	8.82	1.74	3.44	6.44	1.72	1.30	4.74	3.02
89.00	292.00	67.62	1.63	9.94	1.76	3.63 *	6.64	1.82	1.37	5.01	3.19
93.50	318.00	66.77	1.57	10.83	1.78	3.78	6.78	1.89	1.43	5.21	3.32
96.40	335.00	66.15	1.52	11.41	1.79	3.87	6.87	1.94	1.48	5.35	3.42
97.70	341.00	65.99	1.51	11.61	1.80	3.92	6.92	1.96	1.49	5.41	3.45
101.90	365.00	65.15	1.45	12.43	1.81	4.05	7.05	2.02	1.55	5.60	3.57
106.10	390.00	64.25	1.39	13.28	1.83	4.17	7.17	2.09	1.62	5.79	3.70
109.60	411.00	63.41	1.33	13.99	1.85	4.27	7.28	2.14	1.68	5.95	3.81
111.80	427.00	62.92	1.29	14.54	1.86	4.33	7.33	2.17	1.71	6.04	3.88
114.90	444.00	62.37	1.25	15.12	1.87	4.42	7.42	2.21	1.75	6.17	3.96

Requal #3

P.O. # 3509.1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED – UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WSSRAP

LOCATION ID: Borrow Source #1

DATE: 7-18-90

LAB NAME: Geotechnology Inc.

CHECKED BY: LAB 77

TAG

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TPBJ-1 3A	7.1 - 9.2	95.5	1000
		95.7	3000
		95.5	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
100.7	22.1	88.5	.67	100.0
101.2	21.1	89.8	.66	98.1
100.8	22.3	89.7	.67	95.1

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	26.3		
	24.1		
	23.1		

TEST RESULTS

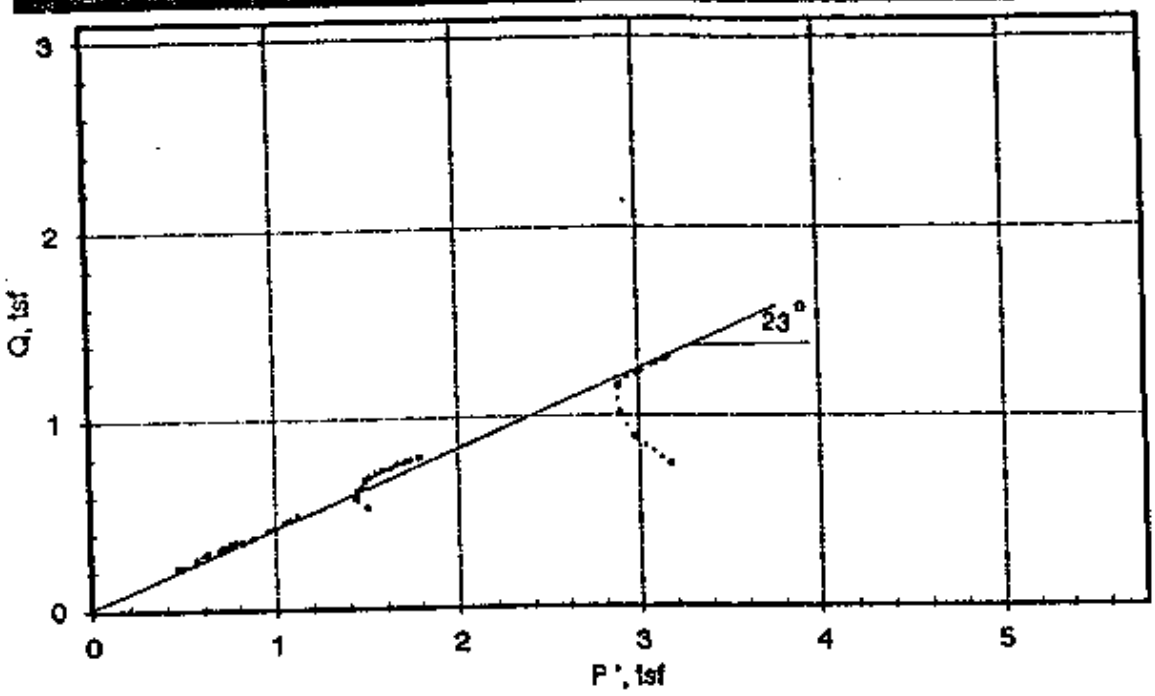
AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)
	See	attached	sheet		SA-68

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

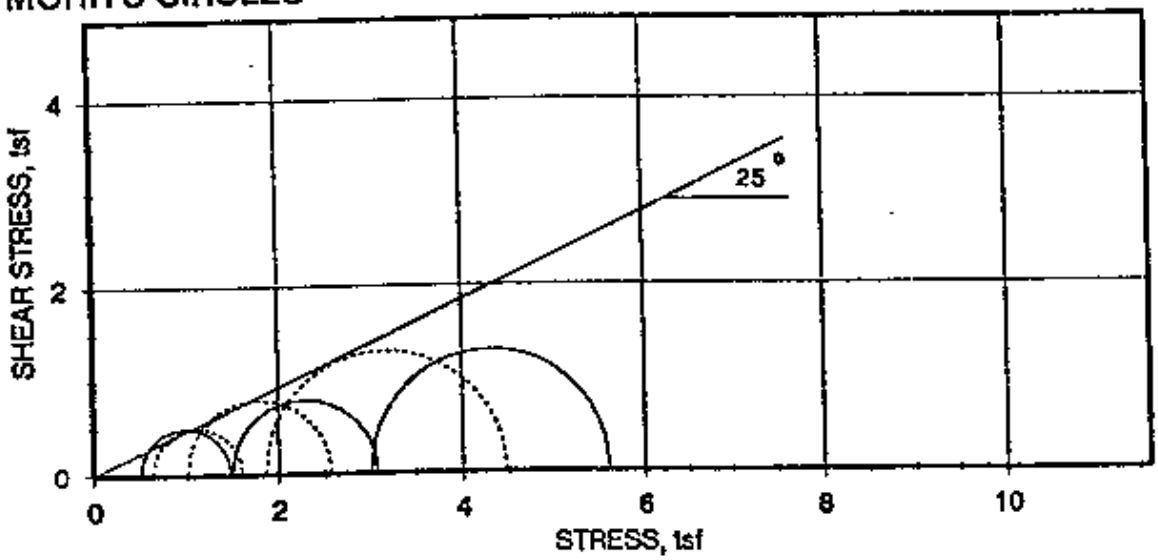
TEST PROCEDURE: EM-1110-2-1906

Sh A-69

WSSRAP - JOB NO.: 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



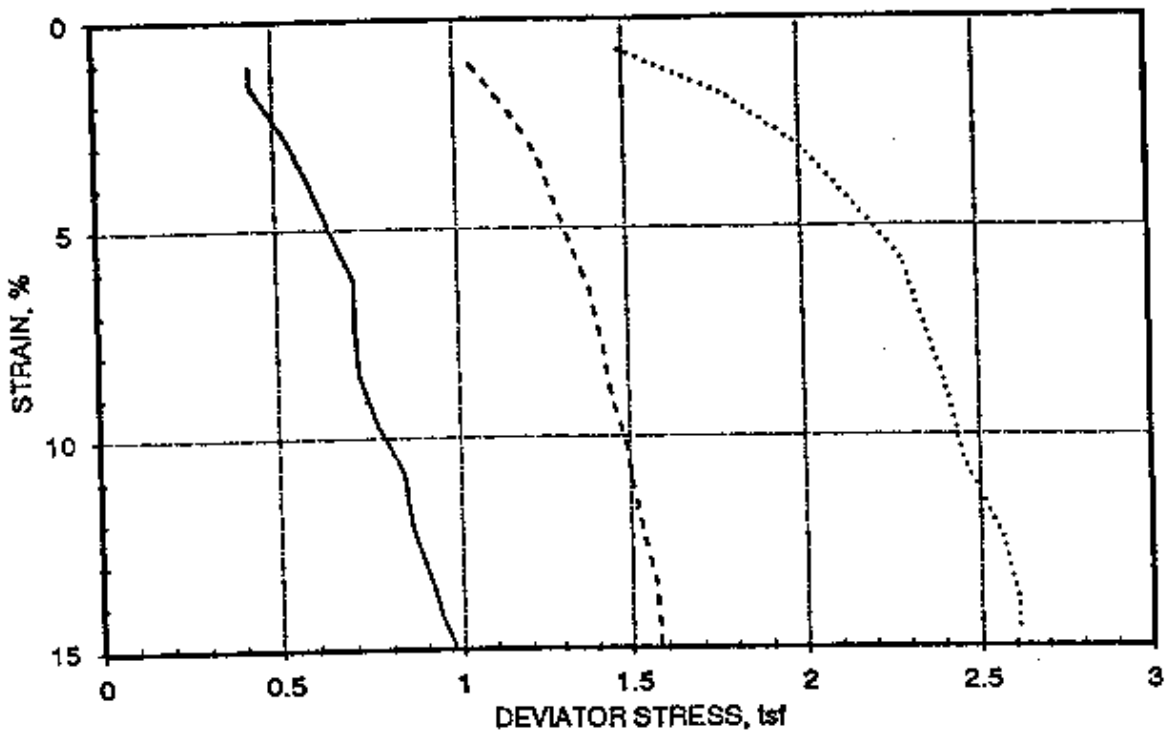
Total Stress ——— Effective Stress .....

Boring No: TPBS-1
Sample No: 3A
Depth: 7.1-9.2 FT.

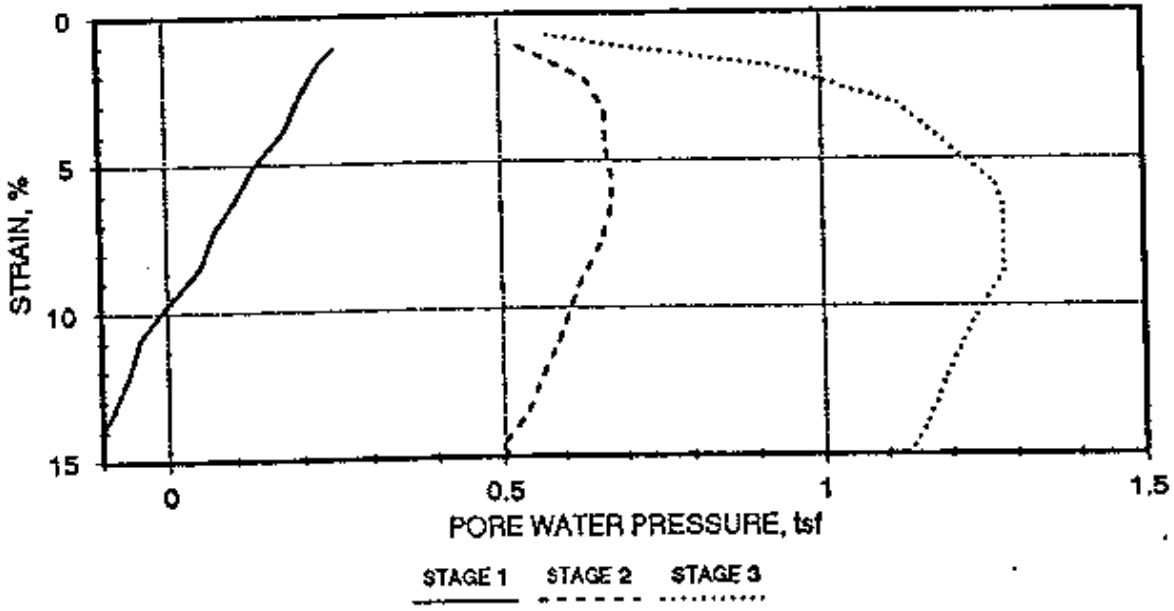
P 2

Sh A-70

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: TPBS-1
Sample No: 3A
Depth: 7.1-9.2 FT.

2

checked by: JA

SHA-71

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 1

SAMPLE HEIGHT	=	2.88 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.60 IN^2	DEPTH	7.1-9.2 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY to CLAY
BACK PRESSURE	=	85.00 PSI		
CONFINING PRESSURE	=	6.94 PSI = 1 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
CELL PRESSURE	=	91.94 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	22.05	26.27
DEGREE OF SATURATION (%)	88.80	
DRY DENSITY (pcf)	100.85	
VOID RATIO	0.67	

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' P' tsf
9.80	31.00	88.53	0.25	1.08	1.61	0.44	0.94	0.22	0.25	0.68	0.46
10.00	45.00	88.26	0.23	1.56	1.62	0.44	0.94	0.22	0.26	0.71	0.49
12.10	79.00	87.79	0.20	2.74	1.64	0.53	1.03	0.27	0.30	0.83	0.56
13.70	110.00	87.49	0.18	3.82	1.66	0.59	* 1.09	0.30	0.32	0.91	0.62
15.30	146.00	86.82	0.13	5.07	1.68	0.65	1.15	0.33	0.37	1.02	0.70
16.70	180.00	86.40	0.10	6.25	1.70	0.71	1.21	0.35	0.40	1.10	0.75
17.00	208.00	85.98	0.07	7.22	1.72	0.71	1.21	0.36	0.43	1.14	0.78
17.50	244.00	85.63	0.05	8.47	1.74	0.72	1.22	0.36	0.45	1.18	0.82
18.80	280.00	85.03	0.00	9.72	1.77	0.77	1.26	0.38	0.50	1.26	0.88
20.90	312.00	84.49	-0.04	10.83	1.79	0.84	1.34	0.42	0.54	1.38	0.96
21.70	349.00	84.18	-0.06	12.12	1.82	0.86	1.36	0.43	0.56	1.42	0.99
23.60	391.00	83.69	-0.09	13.58	1.85	0.92	1.42	0.46	0.59	1.51	1.05
24.40	410.00	83.54	-0.11	14.24	1.86	0.94	1.44	0.47	0.60	1.55	1.08
25.60	432.00	83.17	-0.13	15.00	1.88	0.98	1.48	0.49	0.63	1.61	1.12

BL A-72

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

SAMPLE HEIGHT	=	2.98 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.60 IN^2	DEPTH	7.1-9.2 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY to CLAY
BACK PRESSURE	=	85.00 PSI		
CONFINING PRESS	=	20.83 PSI = 3 ksf		
FULL PRESSURE	=	105.83 PSI		

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf	P' tsf
23.60	32.00	92.35	0.53	1.08	1.62	1.05	2.55	0.53	0.97	2.02	1.50	3.17
26.40	66.00	93.85	0.64	2.22	1.64	1.16	2.66	0.58	0.86	2.02	1.44	2.97
28.50	98.00	94.35	0.67	3.29	1.65	1.24	2.74	0.62	0.83	2.07	1.45	2.89
29.90	131.00	94.35	0.67	4.40	1.67	1.29	2.79	0.64	0.83	2.11	1.47	2.88
31.50	163.00	94.40	0.68	5.48	1.69	1.34	2.84	0.67	0.82	2.16	1.49	2.88
33.00	193.00	94.47	0.68	6.49	1.71	1.39 *	2.89	0.69	0.82	2.21	1.51	2.93
34.40	234.00	94.21	0.66	7.87	1.74	1.43	2.93	0.71	0.84	2.26	1.55	3.00
35.50	268.00	93.81	0.63	9.01	1.76	1.45	2.95	0.73	0.87	2.32	1.59	3.09
36.70	300.00	93.46	0.61	10.08	1.78	1.49	2.99	0.74	0.89	2.38	1.63	3.14
37.80	333.00	93.21	0.59	11.19	1.80	1.51	3.01	0.76	0.91	2.42	1.66	3.16
39.10	369.00	92.77	0.56	12.40	1.83	1.54	3.04	0.77	0.94	2.48	1.71	
40.20	402.00	92.54	0.54	13.51	1.85	1.57	3.06	0.78	0.96	2.52	1.74	
41.00	434.00	91.97	0.50	14.59	1.87	1.58	3.08	0.79	1.00	2.57	1.79	
41.30	446.00	92.04	0.51	14.99	1.88	1.58	3.08	0.79	0.99	2.57	1.78	

Request #
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WJJRAP
LOCATION ID: Barrow Source #1
DATE: 1-9-90
LAB NAME: Geotechnology, Inc.
CHECKED BY: LAB YY
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TPBJ-6 1A	.6 - 9	97.0	1000
		96.1	3000
		97.4	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
99.9	23.3	94.7	0.65	99.3
98.9	22.5	88.7	0.67	99.0
100.2	22.5	91.6	0.65	100.0

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	23.0		
	22.8		
	22.0		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

See attached tables

8A-74

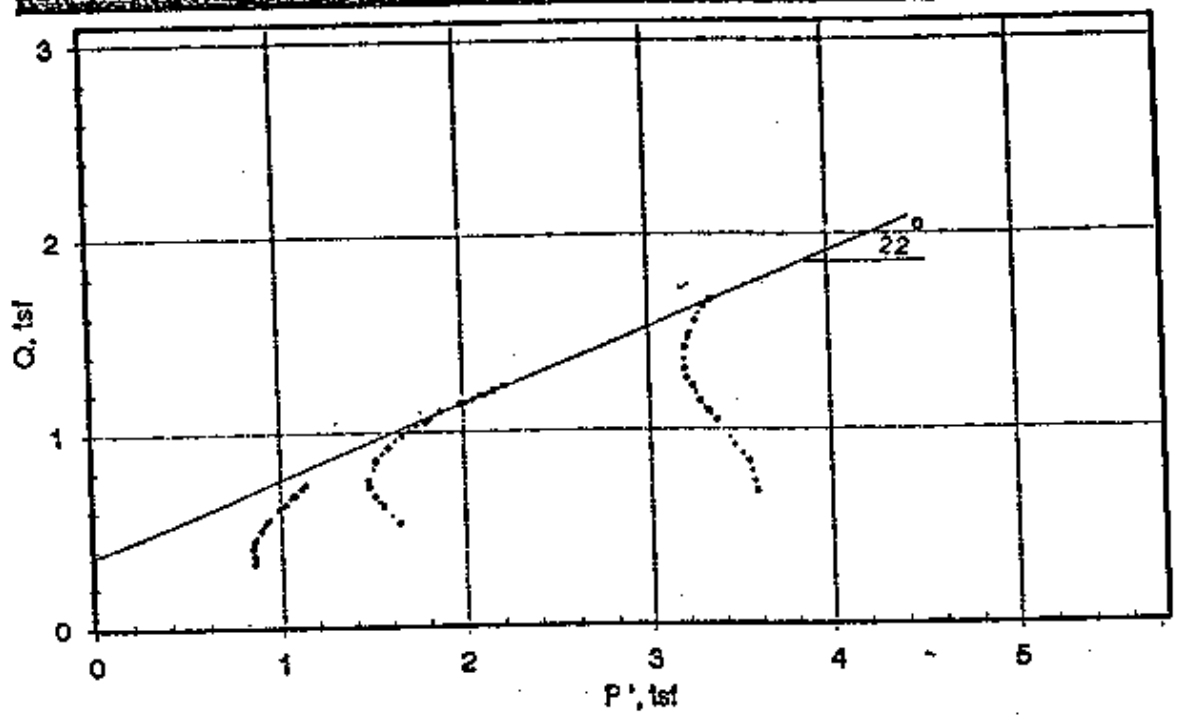
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

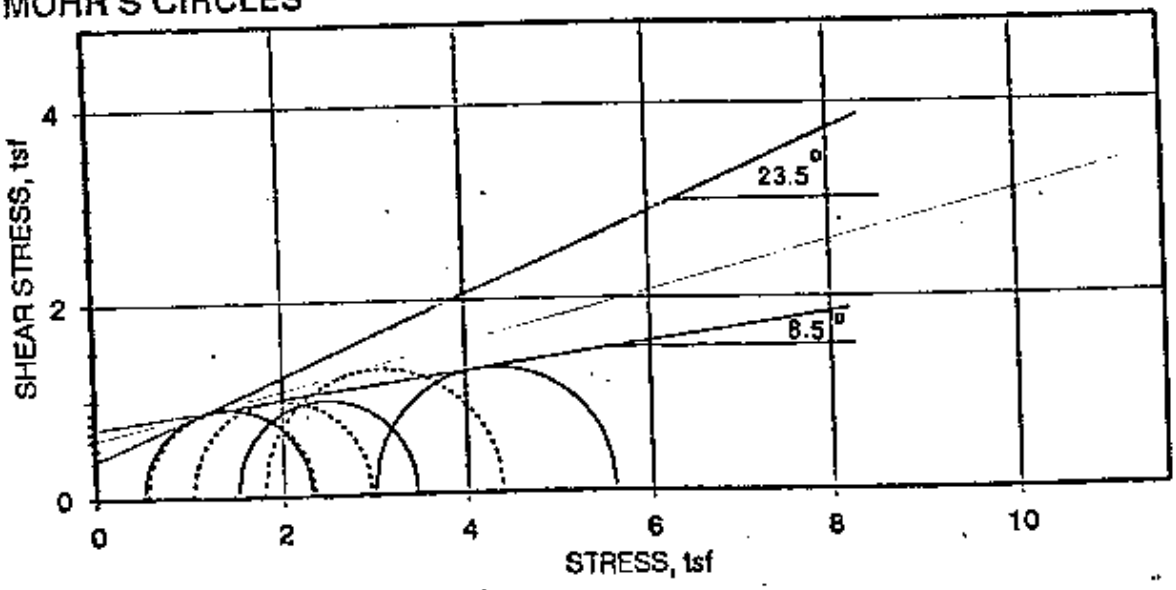
ATTACHMENT 12

Sh A-75

WSSRAP - JOB NO:- 11295.000
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



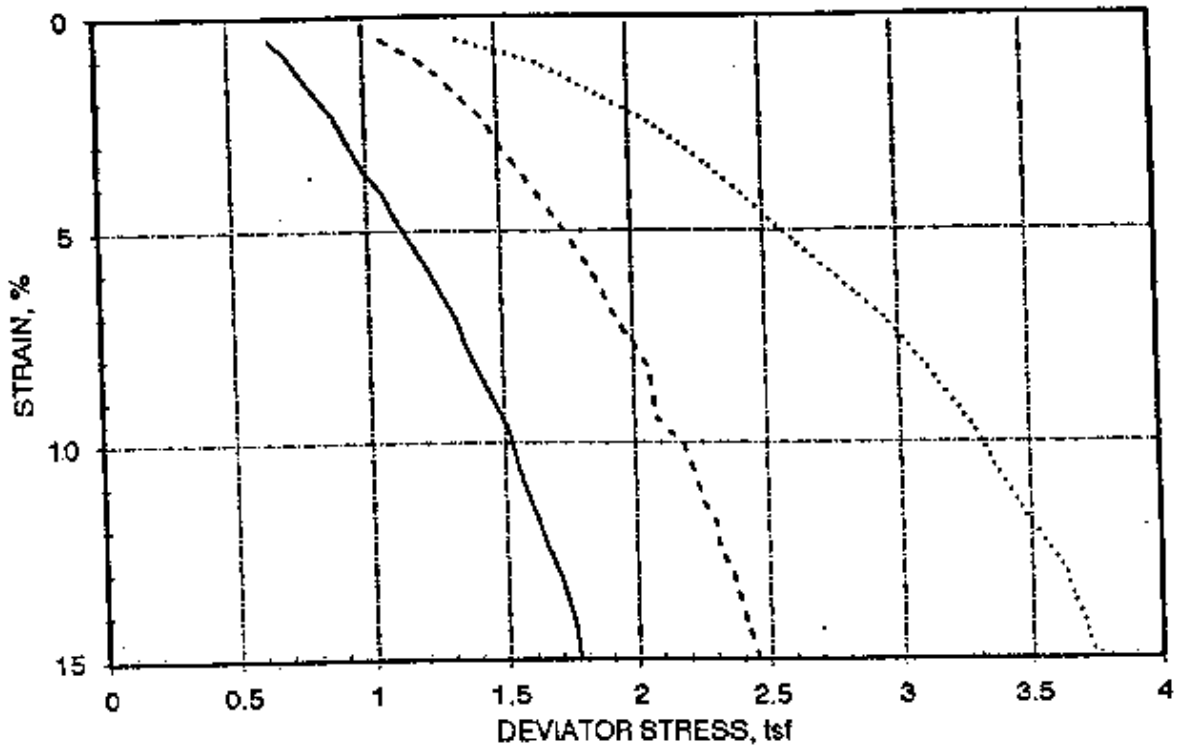
Total Stress ——— Effective Stress ----------

Boring No: TPPS-6
Sample No: 1A
Depth: 6-9 FT.

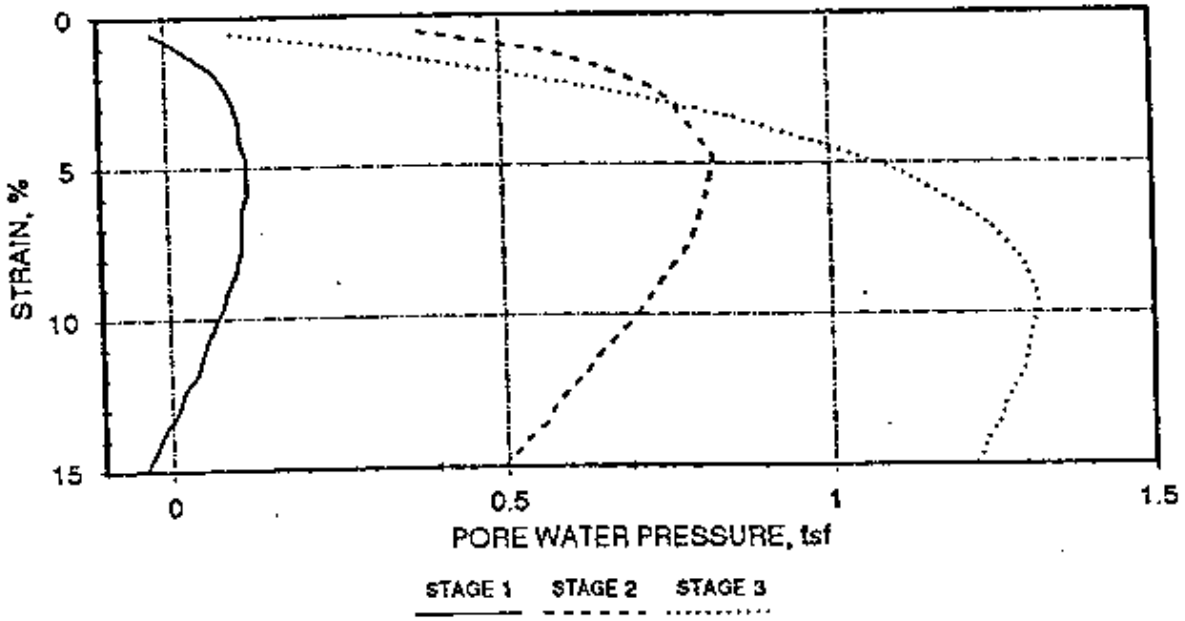
K 27

Sr A-76

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



Boring No: TPPS-6
Sample No: 1A
Depth: 6-9 FT.

Sh A-77

GEOTECHNOLOGY INC
CONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

STAGE 1

SAMPLE HEIGHT	=	2.90 INCHES	BORING NO	TBPS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	6-9 FT.
			SAMPLE DESCRIPTION	
BACK PRESSURE	=	45.00 PSI		
CONFINING PRESSURE	=	6.94 PSI = 1 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
CELL PRESSURE	=	51.94 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	23.28	23.21
DEGREE OF SATURATION (%)	91.60	
DRY DENSITY (pcf)	99.91	
VOID RATIO	0.69	

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' P' tsf
14.80	16.00	44.71	-0.02	0.55	1.60	0.66	1.16	0.33	0.52	1.19	0.85
16.00	26.00	45.17	0.01	0.90	1.61	0.72	1.22	0.36	0.49	1.20	0.85
18.40	51.00	45.98	0.07	1.76	1.62	0.82	1.32	0.41	0.43	1.25	0.84
20.10	68.00	46.27	0.09	2.34	1.63	0.89	1.39	0.44	0.41	1.29	0.85
21.20	84.00	46.40	0.10	2.89	1.64	0.93	1.43	0.46	0.40	1.33	0.86
22.80	104.00	46.48	0.11	3.58	1.65	0.99	1.49	0.50	0.39	1.39	0.89
24.40	119.00	46.58	0.11	4.10	1.66	1.06	1.56	0.53	0.39	1.44	0.91
25.80	137.00	46.67	0.12	4.72	1.67	1.11	1.61	0.55	0.38	1.49	0.93
28.70	171.00	46.65	0.12	5.89	1.69	1.22	1.72	0.61	0.38	1.60	0.99
30.00	186.00	46.59	0.11	6.41	1.70	1.27	1.77	0.63	0.39	1.65	1.02
31.80	205.00	46.47	0.11	7.06	1.72	1.33	1.83	0.67	0.39	1.73	1.06
32.70	221.00	46.46	0.11	7.61	1.73	1.36	1.86	0.68	0.39	1.76	1.08
34.30	245.00	46.38	0.10	8.44	1.74	1.42	1.92	0.71	0.40	1.82	1.11
35.60	260.00	46.25	0.09	8.96	1.75	1.46	1.96	0.73	0.41	1.87	1.14
36.90	280.00	46.12	0.08	9.65	1.77	1.51	* 2.00	0.75	0.42	1.92	1.17
38.50	307.00	45.84	0.06	10.58	1.78	1.55	2.05	0.78	0.44	1.99	1.22
39.50	323.00	45.65	0.05	11.13	1.79	1.58	2.08	0.79	0.45	2.04	1.25
40.80	343.00	45.50	0.04	11.82	1.81	1.62	2.12	0.81	0.46	2.09	1.28
41.70	359.00	45.33	0.02	12.37	1.82	1.65	2.15	0.82	0.48	2.13	1.30
43.20	379.00	45.16	0.01	13.06	1.83	1.70	2.20	0.85	0.49	2.18	1.34
44.30	396.00	44.91	-0.01	13.64	1.85	1.73	2.23	0.86	0.51	2.23	1.37
45.10	411.00	44.70	-0.02	14.16	1.86	1.75	2.25	0.87	0.52	2.27	1.40
46.20	435.00	44.46	-0.04	14.98	1.88	1.77	2.27	0.89	0.54	2.31	1.43

Sh A-78

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

SAMPLE HEIGHT	=	2.95 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	6-9 FT.
			SAMPLE DESCRIPTION	
BACK PRESSURE	=	45.00 PSI		
CONFINING PRESS	=	20.80 PSI = 3 ksf		
CELL PRESSURE	=	65.80 PSI		

LOAD p	STRAIN DIAL div	FWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
23.80	16.00	50.30	0.38	0.54	1.60	1.07	2.57	0.53	1.12	2.18	1.65
27.70	34.00	52.76	0.56	1.15	1.61	1.24	2.73	0.62	0.94	2.17	1.56
30.10	51.00	54.15	0.66	1.73	1.62	1.34	2.83	0.67	0.84	2.17	1.51
32.80	71.00	55.22	0.74	2.41	1.63	1.45	2.94	0.72	0.76	2.21	1.48
34.20	86.00	55.72	0.77	2.91	1.64	1.50	3.00	0.75	0.73	2.22	1.48
39.70	139.00	56.49	0.83	4.71	1.67	1.71	3.21	0.85	0.67	2.38	1.52
43.10	172.00	56.44	0.82	5.83	1.69	1.83	3.33	0.92	0.67	2.51	1.59
46.60	211.00	56.16	0.80	7.15	1.72	1.95	* 3.45	0.98	0.69	2.65 ≈ 84	1.67
48.20	227.00	55.97	0.79	7.69	1.73	2.01	3.51	1.00	0.71	2.72	1.71
49.70	243.00	55.73	0.77	8.23	1.74	2.06	3.56	1.03	0.73	2.78	1.75
51.10	277.00	55.18	0.73	9.39	1.76	2.09	3.59	1.05	0.76	2.86	1.81
54.00	297.00	54.85	0.71	10.06	1.77	2.19	3.69	1.10	0.79	2.98	1.88
56.90	340.00	53.91	0.64	11.52	1.80	2.27	3.77	1.14	0.86	3.13	1.99
58.00	351.00	53.80	0.63	11.89	1.81	2.31	3.80	1.15	0.86	3.17	2.02
58.80	368.00	53.36	0.60	12.47	1.82	2.32	3.82	1.16	0.90	3.22	2.06
60.10	382.00	53.09	0.58	12.94	1.83	2.36	3.86	1.18	0.92	3.28	2.10
61.20	401.00	52.73	0.56	13.59	1.85	2.39	3.89	1.19	0.94	3.33	2.13
62.30	418.00	52.41	0.53	14.16	1.86	2.41	3.91	1.21	0.96	3.38	2.17
63.80	440.00	51.93	0.50	14.91	1.87	2.45	3.95	1.23	1.00	3.45	2.22
64.10	444.00	51.87	0.49	15.05	1.88	2.46	3.96	1.23	1.00	3.46	2.23

SM A-79

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

STAGE 3

SAMPLE HEIGHT	=	2.91 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	6-9 FT.
			SAMPLE DESCRIPTION	

BACK PRESSURE	=	45.00 PSI	
CONFINING PRESS	=	41.63 PSI	= 5.99 ksf
CELL PRESSURE	=	86.63 PSI	

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR	P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf	tsf
30.20	16.00	46.37	0.10	0.55	1.60	1.36	4.35	0.68	2.90	4.25	3.58
37.10	32.00	48.97	0.29	1.10	1.61	1.66	4.65	0.83	2.71	4.37	3.54
47.40	73.00	54.26	0.67	2.51	1.64	2.09	5.08	1.04	2.33	4.42	3.37
49.90	86.00	55.63	0.77	2.96	1.64	2.19	5.18	1.09	2.23	4.42	3.33
52.50	100.00	56.96	0.86	3.44	1.65	2.29	5.29	1.14	2.14	4.42	3.28
56.20	121.00	58.54	0.97	4.17	1.66	2.43	5.43	1.22	2.02	4.45	3.24
58.60	136.00	59.51	1.04	4.68	1.67	2.52	5.52	1.26	1.95	4.47	3.21
61.40	153.00	60.45	1.11	5.27	1.68	2.63	5.62	1.31	1.88	4.51	3.20
67.30	188.00	61.87	1.21	6.47	1.71	2.84	5.84	1.42	1.78	4.62	3.20
70.30	206.00	62.33	1.25	7.09	1.72	2.95	5.95	1.47	1.75	4.70	3.22
75.00	239.00	62.99	1.30	8.23	1.74	3.11	6.10	1.55	1.70	4.81	3.26
79.70	274.00	63.30	1.32	9.43	1.76	3.26	6.26	1.63	1.68	4.94	3.31
81.60	290.00	63.30	1.32	9.98	1.77	3.32	6.31	1.66	1.68	5.00	3.34
83.50	307.00	63.24	1.31	10.57	1.78	3.37	6.37	1.69	1.68	5.06	3.37
87.90	344.00	62.99	1.30	11.84	1.81	3.50	6.50	1.75	1.70	5.20	3.45
92.30	377.00	62.63	1.27	12.98	1.83	3.63	6.62	1.81	1.73	5.35	3.54
93.80	394.00	62.45	1.26	13.56	1.85	3.66	6.66	1.83	1.74	5.40	3.57
95.60	412.00	62.18	1.24	14.18	1.86	3.70	6.70	1.85	1.76	5.46	3.61
97.30	430.00	62.05	1.23	14.80	1.87	3.74	6.74	1.87	1.77	5.51	3.64
99.10	436.00	61.74	1.21	15.01	1.88	3.80	6.80	1.90	1.79	5.59	3.69

Request # 3
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WJJPAP
LOCATION ID: Barrow Jones
DATE: 3/6/90
LAB NAME: Geotechnology Inc
CHECKED BY: LAB 47
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TPB3-G 2A	9.1-12	94.2	1000
		94.9	3000
		95.7	6000

INITIAL CONDITIONS

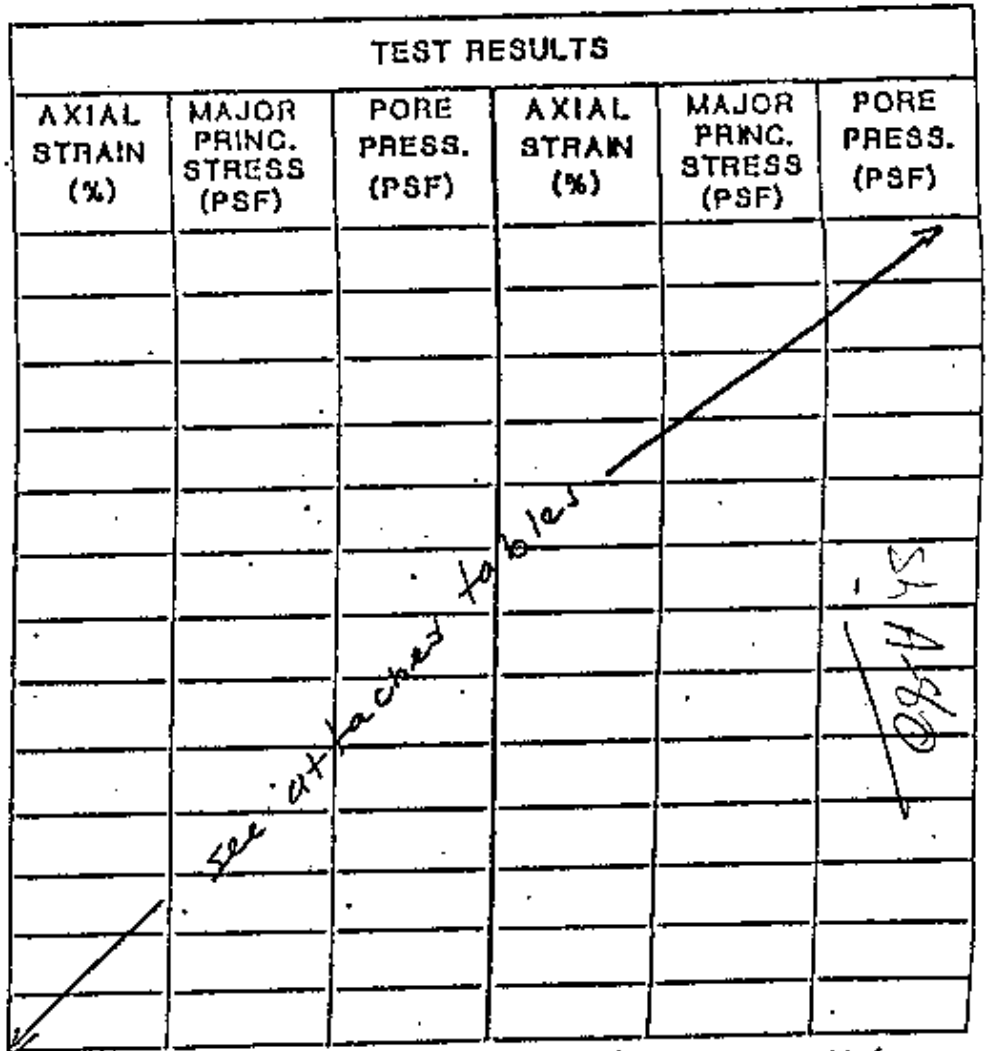
DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
96.5	24.3	82.3	0.81	95.2
95.8	24.0	82.0	0.80	96.5
96.0	24.5	86.0	0.79	96.7

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	28.9		
	29.5		
	26.3		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)



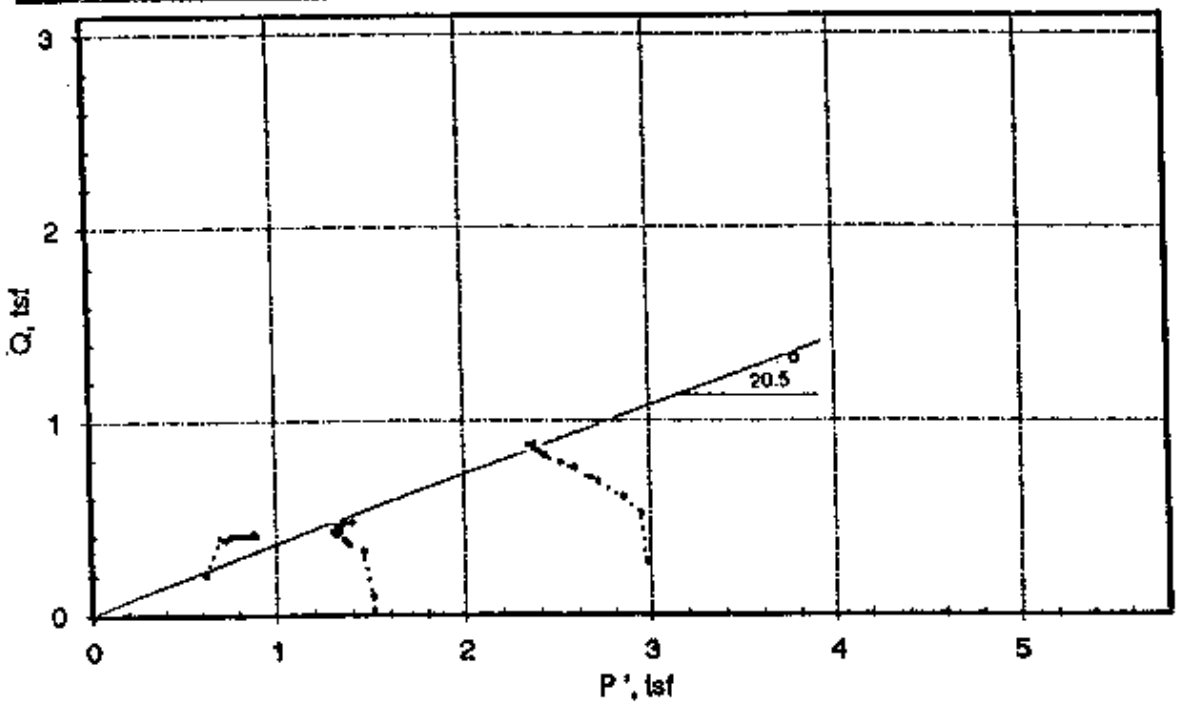
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

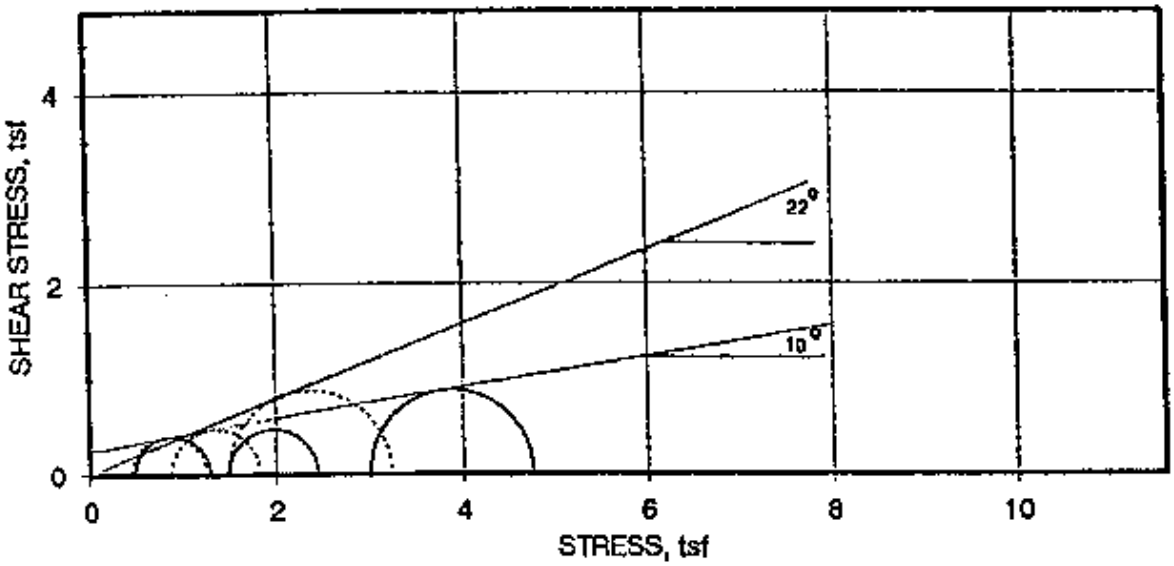
MKF-AL-ENG-12 (4/87)

Sh A-81

WSSRAP - JOB NO:- 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



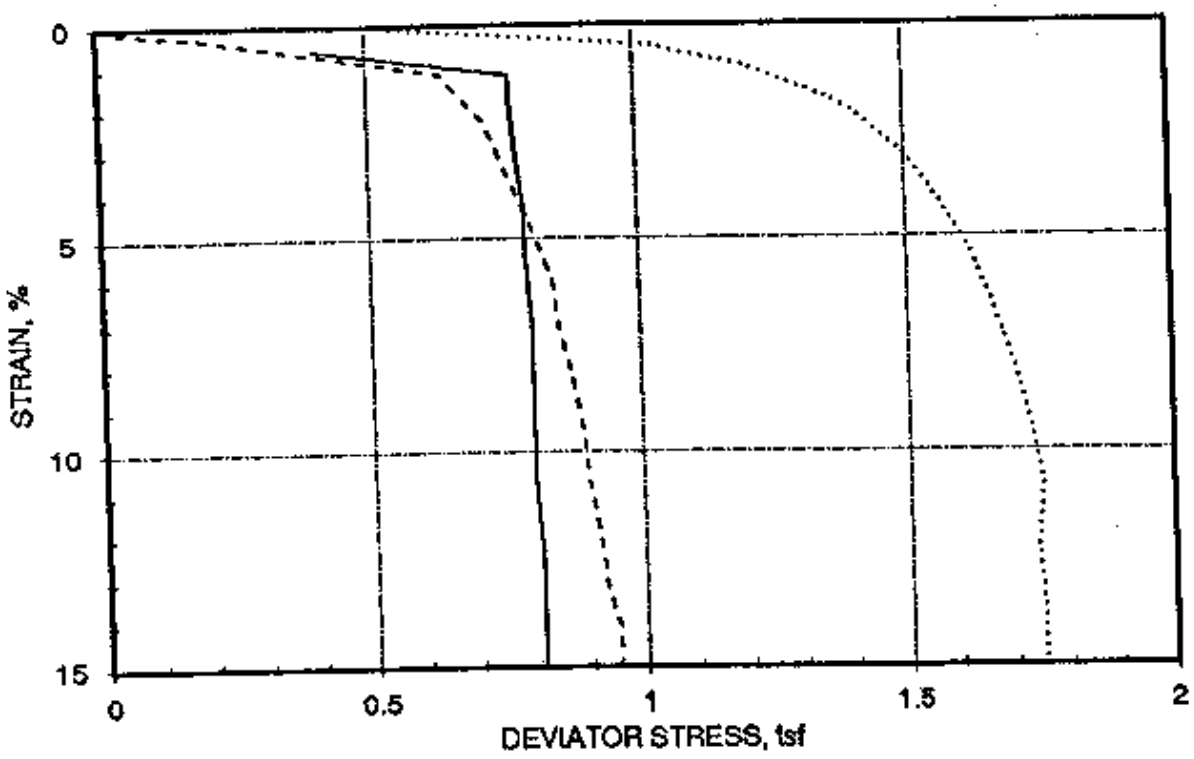
Total Stress ——— Effective Stress ----------

Boring No: TPBS-6
Sample No: 2A
Depth: 9.1-12 FT.

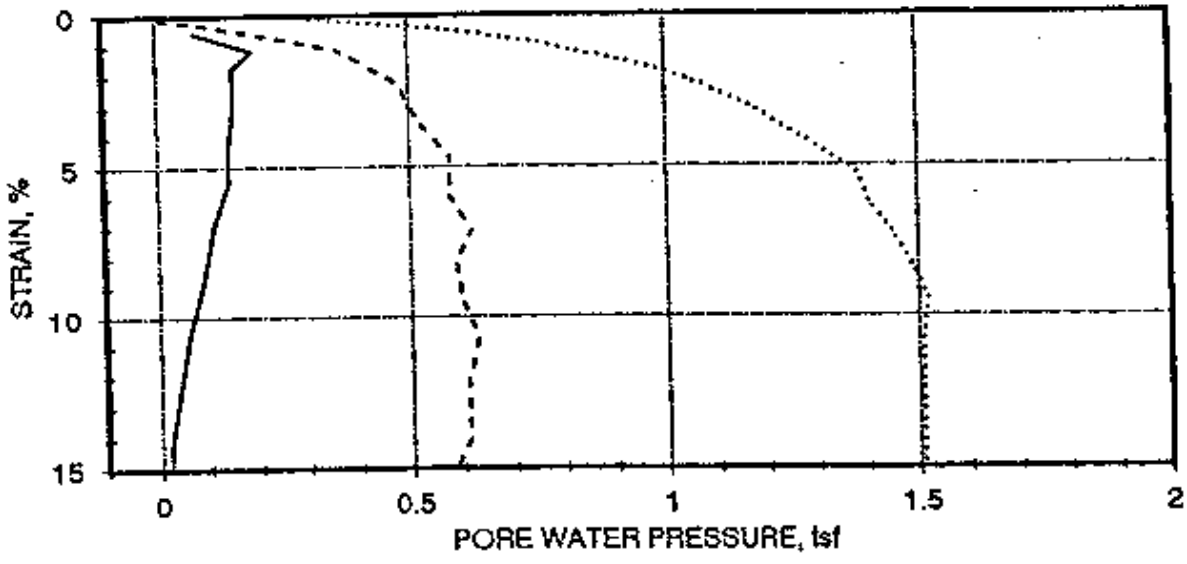
N 4

Sh A-82

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



STAGE 1 STAGE 2 STAGE 3

Boring No: TPBS-6
Sample No: 2A
Depth: 9.1-12 FT.

Sh A-83

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

STAGE 1

SAMPLE HEIGHT	=	2.93 INCHES	BORING NO		TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO		2A
SAMPLE AREA	=	1.61 IN^2	DEPTH		9.1-12 FT.
			SAMPLE DESCRIPTION		Gray CLAY
BACK PRESSURE	=	75.00 PSI			
CONFINING PRESSURE	=	6.94 PSI = 1 ksf	SPECIFIC GRAVITY		2.7 (Assumed)
CELL PRESSURE	=	81.94 PSI		INITIAL	FINAL
			MOISTURE CONTENT (%)	24.31	28.86
			DEGREE OF SATURATION (%)	83.84	
			DRY DENSITY (pcf)	94.50	
			VOID RATIO	0.78	

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR		P' P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf		tsf
8.90	17.00	76.08	0.08	0.58	1.62	0.40	0.90	0.20	0.42	0.82	1.95	0.62
17.40	34.00	77.62	0.19	1.16	1.62	0.77	* 1.27	0.39	0.31	1.08	2.08	0.70
17.40	50.00	77.15	0.15	1.71	1.63	0.77	1.27	0.38	0.34	1.11		0.73
17.90	92.00	77.07	0.15	3.14	1.66	0.78	1.28	0.39	0.35	1.13		0.74
18.30	126.00	76.93	0.14	4.31	1.68	0.79	1.28	0.39	0.36	1.15	2.29	0.75
18.70	159.00	76.88	0.14	5.43	1.70	0.79	1.29	0.40	0.36	1.16		0.76
19.10	205.00	76.52	0.11	7.01	1.73	0.80	1.30	0.40	0.39	1.19		0.79
19.60	255.00	76.26	0.09	8.71	1.76	0.80	1.30	0.40	0.41	1.21		0.81
19.90	309.00	75.82	0.06	10.56	1.80	0.80	1.30	0.40	0.44	1.24		0.84
20.60	361.00	75.58	0.04	12.34	1.83	0.81	1.31	0.40	0.46	1.27		0.86
21.10	418.00	75.29	0.02	14.29	1.87	0.81	1.31	0.41	0.48	1.29		0.88
21.20	439.00	75.23	0.02	15.00	1.89	0.81	1.31	0.40	0.48	1.29	2.28	0.89

Sh A-84

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

SAMPLE HEIGHT	=	2.80 INCHES	BORING NO	TPB5-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.60 IN^2	DEPTH	9.1-12 FT.
			SAMPLE DESCRIPTION	Gray CLAY
BACK PRESSURE	=	85.00 PSI		
CONFINING PRESS	=	20.83 PSI = 3 ksf		
CELL PRESSURE	=	105.83 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
1.00	3.60	85.16	0.01	0.13	1.61	0.04	1.54	0.02	1.49	1.53	1.51
4.00	7.60	86.08	0.08	0.27	1.61	0.18	1.68	0.09	1.42	1.60	1.51
14.50	32.00	89.97	0.36	1.14	1.62	0.64	2.14	0.32	1.14	1.79	1.46
16.30	63.00	91.62	0.48	2.25	1.64	0.72	2.22	0.36	1.02	1.74	1.38
17.60	97.00	92.29	0.52	3.47	1.66	0.76	2.26	0.38	0.97	1.74	1.36
18.70	130.00	93.07	0.58	4.65	1.68	0.80	2.30	0.40	0.92	1.72	1.32
19.80	168.00	93.07	0.58	6.00	1.71	0.84	2.34	0.42	0.92	1.75	1.34
20.30	198.00	93.65	0.62	7.08	1.73	0.85	2.35	0.42	0.88	1.72	1.30
21.10	227.00	93.25	0.59	8.11	1.75	0.87	2.37	0.44	0.91	1.78	1.34
21.90	264.00	93.34	0.60	9.44	1.77	0.89	2.39	0.45	0.90	1.79	1.34
22.50	299.00	93.70	0.63	10.69	1.80	0.90	2.40	0.45	0.87	1.78	1.32
23.30	342.00	93.46	0.61	12.22	1.83	0.92	2.42	0.46	0.89	1.81	1.35
24.00	370.00	93.50	0.61	13.22	1.85	0.93	2.43	0.47	0.89	1.82	1.36
24.50	393.00	93.49	0.61	14.05	1.87	0.95	2.45	0.47	0.89	1.83	1.36
24.80	421.00	93.00	0.58	15.05	1.89	0.95	2.45	0.47	0.92	1.87	1.40

Sh A-85

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

STAGE 3

SAMPLE HEIGHT	=	2.76 INCHES
SAMPLE DIAMETER	=	1.43 INCHES
SAMPLE AREA	=	1.61 IN^2

BORING NO	TPBS-6
SAMPLE NO	2A
DEPTH	9.1-12 FT.
SAMPLE DESCRIPTION	Gray CLAY

BACK PRESSURE	=	75.00 PSI
CONFINING PRESS	=	41.67 PSI = 6 ksf
CELL PRESSURE	=	116.67 PSI

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
11.90	2.00	79.02	0.29	0.07	1.61	0.53	3.53	0.27	2.71	3.24	2.98
23.00	13.00	82.85	0.57	0.47	1.61	1.03	4.03	0.51	2.44	3.46	2.95
27.10	26.00	85.40	0.75	0.94	1.62	1.20	4.20	0.60	2.25	3.45	2.85
30.80	48.00	88.44	0.97	1.74	1.63	1.36	4.36	0.68	2.03	3.39	2.71
32.10	58.00	89.39	1.04	2.10	1.64	1.41	4.41	0.70	1.96	3.37	2.67
34.50	84.00	91.27	1.17	3.04	1.66	1.50	4.50	0.75	1.83	3.33	2.58
36.30	112.00	92.67	1.27	4.05	1.67	1.56	4.56	0.78	1.73	3.29	2.51
38.10	144.00	94.12	1.38	5.21	1.69	1.62	4.62	0.81	1.62	3.24	2.43
39.20	171.00	94.48	1.40	6.19	1.71	1.65	4.65	0.82	1.60	3.25	2.42
40.30	200.00	95.12	1.45	7.24	1.73	1.68	4.68	0.84	1.55	3.23	2.39
41.60	230.00	95.64	1.49	8.32	1.75	1.71	4.71	0.85	1.51	3.22	2.37
42.70	261.00	96.18	1.52	9.44	1.77	1.73	4.73	0.87	1.48	3.21	2.34
43.80	298.00	95.92	1.51	10.78	1.80	1.75	4.75	0.88	1.49	3.25	2.37
44.30	338.00	95.97	1.51	12.23	1.83	1.74	4.74	0.87	1.49	3.23	2.36
45.10	376.00	96.01	1.51	13.60	1.86	1.75	4.75	0.87	1.49	3.23	2.36
45.90	411.00	95.97	1.51	14.87	1.89	1.75	4.75	0.88	1.49	3.24	2.37
45.80	415.00	95.97	1.51	15.01	1.89	1.74	4.75	0.87	1.49	3.24	2.36

Request # 3
P.O. # 3509 - 1002 - 3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED - UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: WJRAP
LOCATION ID: Barrow Source
DATE: 3/6/90
LAB NAME: Geotechnology, Inc.
CHECKED BY: LAB YY
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TP8J-8 1A	0.6 - 4.3	95.7	1000
		97.4	3000
		96.6	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
102.9	20.8	86.6	0.66	98.7
105.6	20.3	89.5	0.62	97.3
104.3	20.1	87.5	0.63	94.4

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	21.3		
	19.5		
	18.6		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

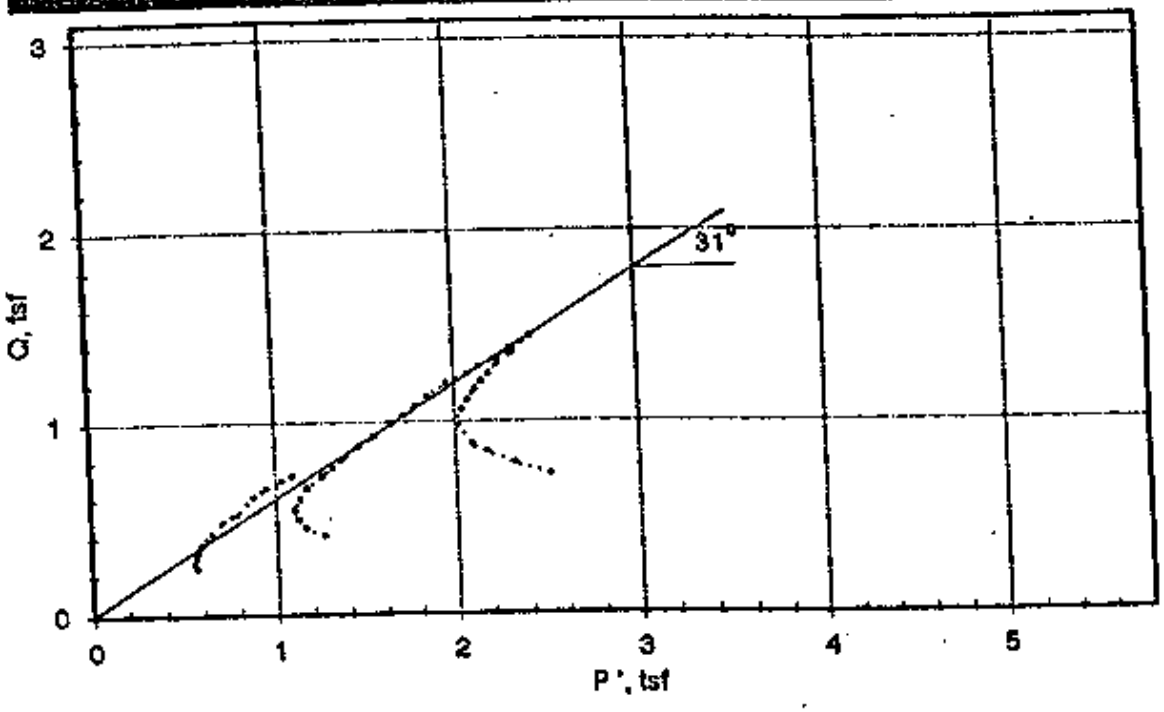
NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS.
Use ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

TEST PROCEDURE: EM 1110-2-1906

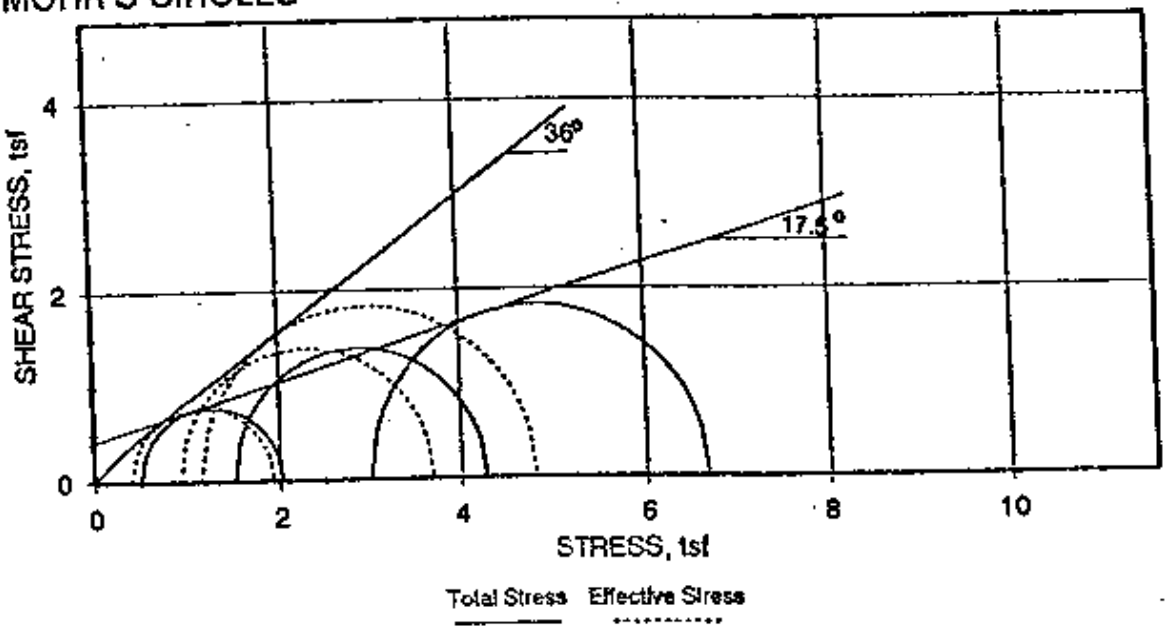
ATTACHMENT 12

Sh A-87

WSSRAP - JOB NO.: 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



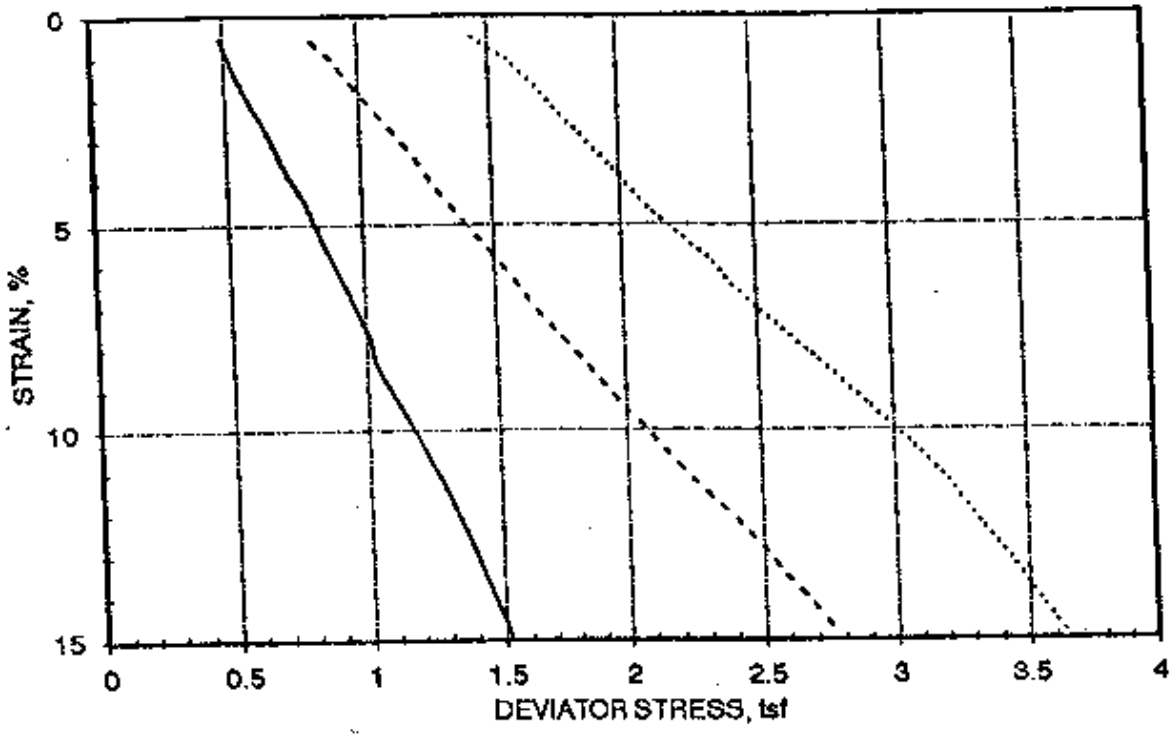
Total Stress ——— Effective Stress ----------

Boring No: TPBS-8
Sample No: 1A
Depth: 0.6-4.3 FT.

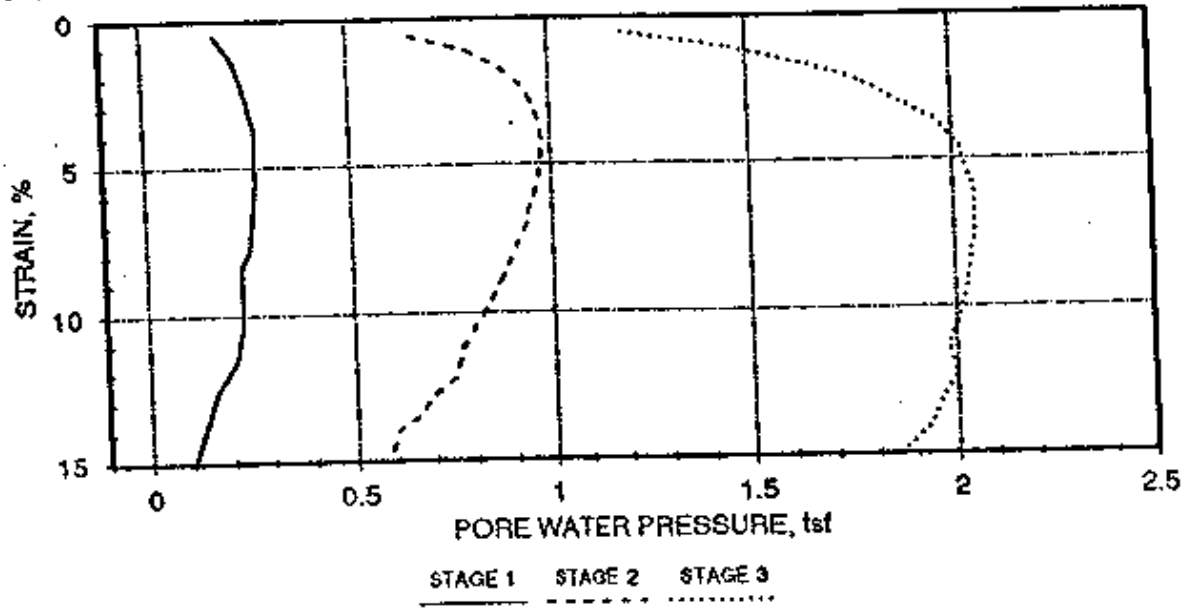
4

Sh A-88

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



STAGE 1 STAGE 2 STAGE 3

Boring No: TPBS-8
Sample No: 1A
Depth: 0.6-4.3 FT.

1

Checked by: S.

Sh A-89

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

STAGE 1

SAMPLE HEIGHT	=	2.99 INCHES
SAMPLE DIAMETER	=	1.43 INCHES
SAMPLE AREA	=	1.59 IN^2
BACK PRESSURE	=	45.00 PSI
CONFINING PRESSURE	=	6.94 PSI = 1 ksf
CELL PRESSURE	=	51.94 PSI

BORING NO	TPBS-8
SAMPLE NO	1A
DEPTH	0.6-4.3 FT.
SAMPLE DESCRIPTION	Brown, silty CLAY
SPECIFIC GRAVITY	2.7 (Assumed)

	INITIAL	FINAL
MOISTURE CONTENT (%)	20.78	21.34
DEGREE OF SATURATION (%)	87.84	
DRY DENSITY (pcf)	102.82	
VOID RATIO	0.64	

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' P' tsf
10.90	17.00	47.54	0.18	0.57	1.60	0.49	0.99	0.24	0.32	0.81	0.56
12.20	41.00	48.05	0.22	1.37	1.62	0.54	1.04	0.27	0.28	0.82	0.55
13.60	66.00	48.39	0.24	2.21	1.63	0.60	1.10	0.30	0.26	0.86	0.56
14.50	79.00	48.51	0.25	2.64	1.64	0.64	1.14	0.32	0.25	0.88	0.57
16.50	111.00	48.76	0.27	3.72	1.66	0.72	1.22	0.36	0.23	0.95	0.59
18.30	134.00	48.79	0.27	4.49	1.67	0.79	1.29	0.39	0.23	1.02	0.62
19.90	162.00	48.79	0.27	5.42	1.69	0.85	1.35	0.42	0.23	1.08	0.65
22.60	202.00	48.64	0.26	6.76	1.71	0.95	1.45	0.48	0.24	1.19	0.71
24.40	232.00	48.48	0.25	7.77	1.73	1.02	1.52	0.51	0.25	1.27	0.76
25.20	251.00	48.16	0.23	8.40	1.74	1.04	1.54	0.52	0.27	1.31	0.79
30.00	310.00	48.16	0.23	10.38	1.78	1.21	1.71	0.61	0.27	1.49	0.88
32.60	343.00	47.86	0.21	11.48	1.80	1.30	1.80	0.65	0.29	1.60	0.95
35.10	378.00	47.24	0.16	12.65	1.83	1.38	1.88	0.69	0.34	1.72	1.03
37.20	412.00	46.85	0.13	13.79	1.85	1.45	1.95	0.72	0.37	1.81	1.09
39.80	449.00	46.41	0.10	15.03	1.88	1.53	2.03	0.76	0.40	1.92	1.16

checked by

Sh A-90

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

SAMPLE HEIGHT	=	2.88 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.60 IN^2	DEPTH	0.6-4.3 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY

BACK PRESSURE	=	55.00 PSI
CONFINING PRESS	=	20.89 PSI = 3 ksf
CELL PRESSURE	=	75.89 PSI

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
18.50	17.00	64.13	0.66	0.59	1.61	0.83	2.33	0.41	0.85	1.68	1.26
20.40	31.00	66.06	0.80	1.08	1.61	0.91	2.41	0.45	0.71	1.62	1.16
22.20	48.00	67.22	0.88	1.67	1.62	0.98	2.49	0.49	0.62	1.61	1.12
24.40	69.00	68.10	0.94	2.40	1.64	1.07	2.58	0.54	0.56	1.63	1.10
27.70	99.00	68.53	0.97	3.44	1.65	1.21	2.71	0.60	0.53	1.74	1.13
29.90	120.00	68.65	0.98	4.17	1.67	1.29	2.80	0.65	0.52	1.81	1.17
33.90	155.00	68.42	0.97	5.38	1.69	1.45	2.95	0.72	0.54	1.98	1.26
35.80	171.00	68.30	0.96	5.94	1.70	1.52	3.02	0.76	0.55	2.06	1.31
37.90	190.00	68.09	0.94	6.60	1.71	1.60	3.10	0.80	0.56	2.16	1.36
39.20	200.00	68.01	0.94	6.94	1.72	1.64	3.15	0.82	0.57	2.21	1.39
41.80	221.00	67.69	0.91	7.67	1.73	1.74	3.24	0.87	0.59	2.33	1.46
44.80	242.00	67.33	0.89	8.40	1.74	1.85	3.35	0.92	0.62	2.47	1.54
48.70	271.00	66.82	0.85	9.41	1.76	1.99	3.49	0.99	0.65	2.64	1.65
50.90	285.00	66.51	0.83	9.90	1.77	2.07	3.57	1.03	0.68	2.74	1.71
53.30	303.00	66.14	0.80	10.52	1.78	2.15	3.65	1.08	0.70	2.85	1.78
56.20	322.00	65.76	0.77	11.18	1.80	2.25	3.75	1.13	0.73	2.98 4.03	1.85
60.90	352.00	65.48	0.75	12.22	1.82	2.41	* 3.91	1.20	0.75	3.16 4.21	1.95
63.80	370.00	64.58	0.69	12.85	1.83	2.51	4.01	1.25	0.81	3.32 4.10	2.07
66.20	388.00	64.17	0.66	13.47	1.85	2.58	4.09	1.29	0.84	3.43	2.14
68.60	403.00	63.29	0.60	13.99	1.86	2.66	4.16	1.33	0.91	3.57	2.24
72.10	427.00	63.08	0.58	14.83	1.88	2.77	4.27	1.38	0.92	3.69	2.31

16

[illegible]

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

Sh A-91

STAGE 3

SAMPLE HEIGHT	=	2.85 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.61 IN^2	DEPTH	0.6-4.3 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY
BACK PRESSURE	=	45.00 PSI		
CONFINING PRESS	=	41.60 PSI = 5.99 ksf		
CELL PRESSURE	=	86.60 PSI		

LOAD	STRAIN DIAL	PWP +BP	PWP	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	Q	EFF MINOR	EFF MAJOR	P'
p	div	psi	tsf			tsf	tsf	tsf	tsf	tsf	tsf
32.40	15.00	61.71	1.20	0.53	1.61	1.44	4.44	0.72	1.79	3.24	2.51
35.30	30.00	65.20	1.45	1.05	1.62	1.57	4.56	0.78	1.54	3.11	2.32
37.90	48.00	67.91	1.65	1.69	1.63	1.67	4.67	0.84	1.35	3.02	2.18
39.80	64.00	69.61	1.77	2.25	1.64	1.74	4.74	0.87	1.22	2.97	2.10
45.60	104.00	72.26	1.96	3.65	1.67	1.97	4.96	0.98	1.03	3.00	2.02
49.40	130.00	72.99	2.02	4.57	1.68	2.11	5.11	1.06	0.98	3.09	2.04
52.00	147.00	73.24	2.03	5.17	1.69	2.21	5.21	1.11	0.96	3.17	2.07
55.40	168.00	73.50	2.05	5.90	1.71	2.34	5.33	1.17	0.94	3.28	2.11
57.50	184.00	73.47	2.05	6.47	1.72	2.41	5.41	1.21	0.95	3.36	2.15
60.00	199.00	73.52	2.05	6.99	1.73	2.50	5.50	1.25	0.94	3.44	2.19
62.50	213.00	73.50	2.05	7.48	1.74	2.59	5.59	1.30	0.94	3.54	2.24
66.30	236.00	73.34	2.04	8.29	1.75	2.73	5.72	1.36	0.95	3.68	2.32
71.30	265.00	73.16	2.03	9.31	1.77	2.90	5.89	1.45	0.97	3.87	2.42
76.90	298.00	72.91	2.01	10.47	1.79	3.09	6.08	1.54	0.99	4.07	2.53
80.60	319.00	72.56	1.98	11.21	1.81	3.21	6.20	1.60	1.01	4.22	2.62
84.80	350.00	72.72	2.00	12.30	1.83	3.33	6.33	1.67	1.00	4.33	2.67
87.70	369.00	72.35	1.97	12.97	1.85	3.42	6.42	1.71	1.03	4.45	2.74
91.80	400.00	71.81	1.93	14.05	1.87	3.54	* 6.53	1.77	1.06	4.60	2.83
96.20	429.00	70.68	1.85	15.07	1.89	3.66	6.66	1.83	1.15	4.81	2.98

Request #3

P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

CONSOLIDATED – UNDRAINED TRIAXIAL "R" TEST WITH PORE PRESSURE MEASUREMENT

SITE ID: CWSRAP

LOCATION ID: Borrow Source #1

DATE: 7-18-95

LAB NAME: Geotechnology, Inc.

CHECKED BY: LAB YY

TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION %	CELL CONFINING PRESSURE (PSF)
TP6W-8 3A	8.5 - 11.5	93.2	1000
		96.0	3000
		95.1	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e	B PARAM.
97.2	23.2	96.9	0.66	97.2
97.8	23.5	99.9	0.63	97.3
96.9	24.2	98.3	0.67	98.5

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	23.3		
	23.8		
	24.3		

TEST RESULTS

AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)	AXIAL STRAIN (%)	MAJOR PRINC. STRESS (PSF)	PORE PRESS. (PSF)

see attached sheet

NOTE: CONSOLIDATION DATA TO BE ATTACHED ON LABORATORY SUBCONTRACTOR FORMS. USE ONE FORM PER PHASE OF MULTI-PHASE TRIAXIAL TESTS.

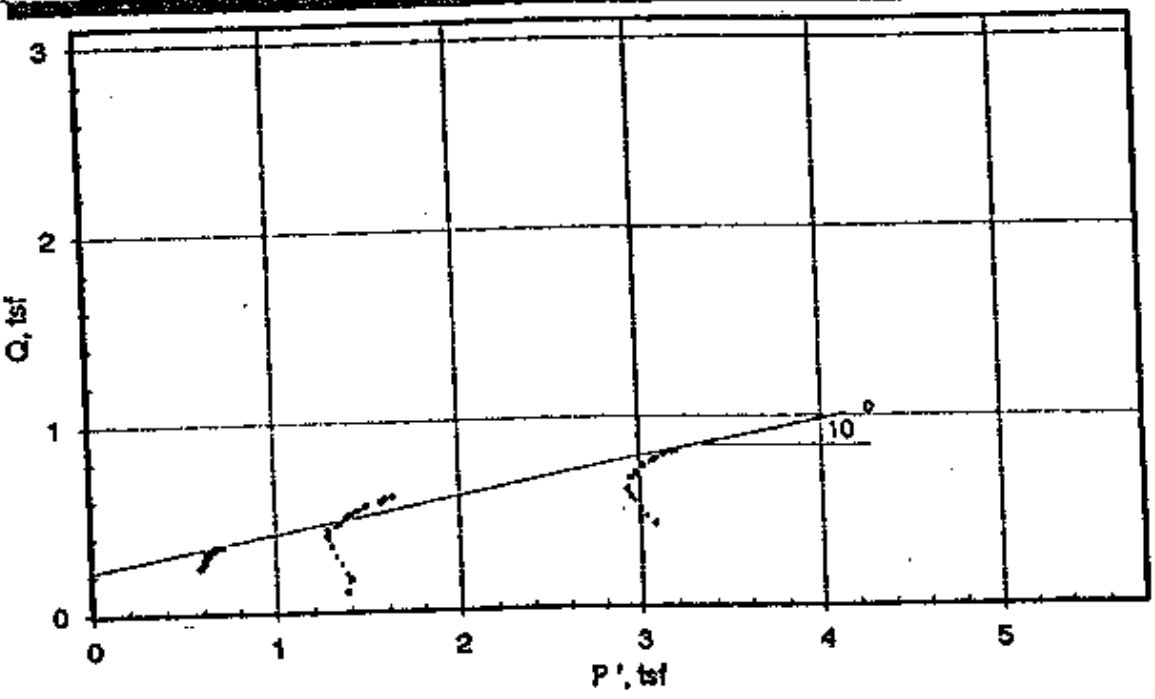
TEST PROCEDURE: EM-1110-1-1906

ATTACHMENT 1

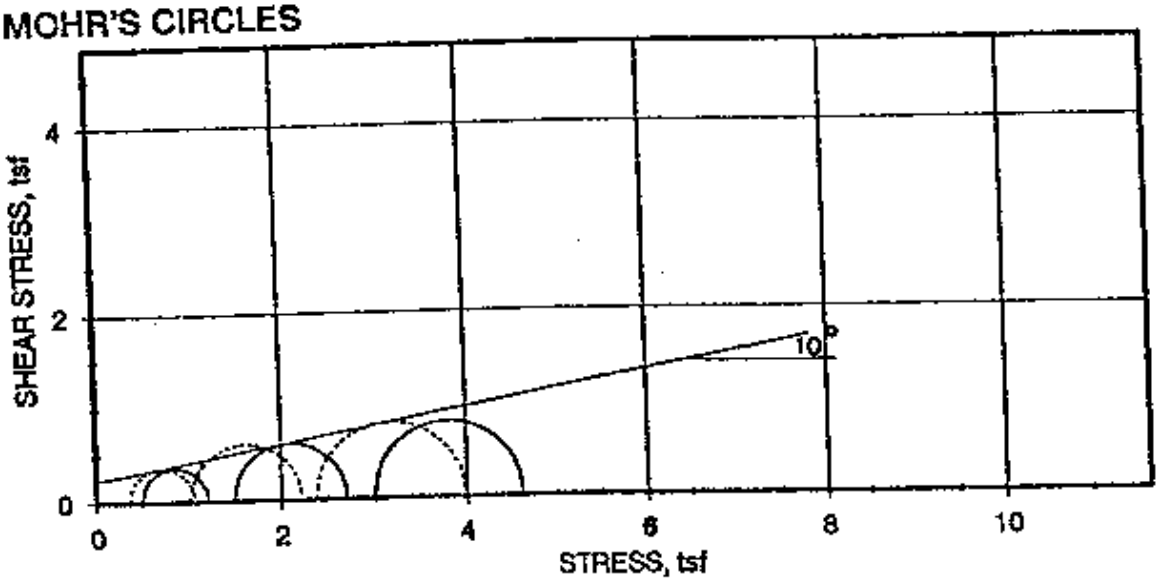
SL A-93

+A

WSSRAP - JOB NO:- 11295
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST
STRESS PATH



MOHR'S CIRCLES



Total Stress ——— Effective Stress - - - - - -

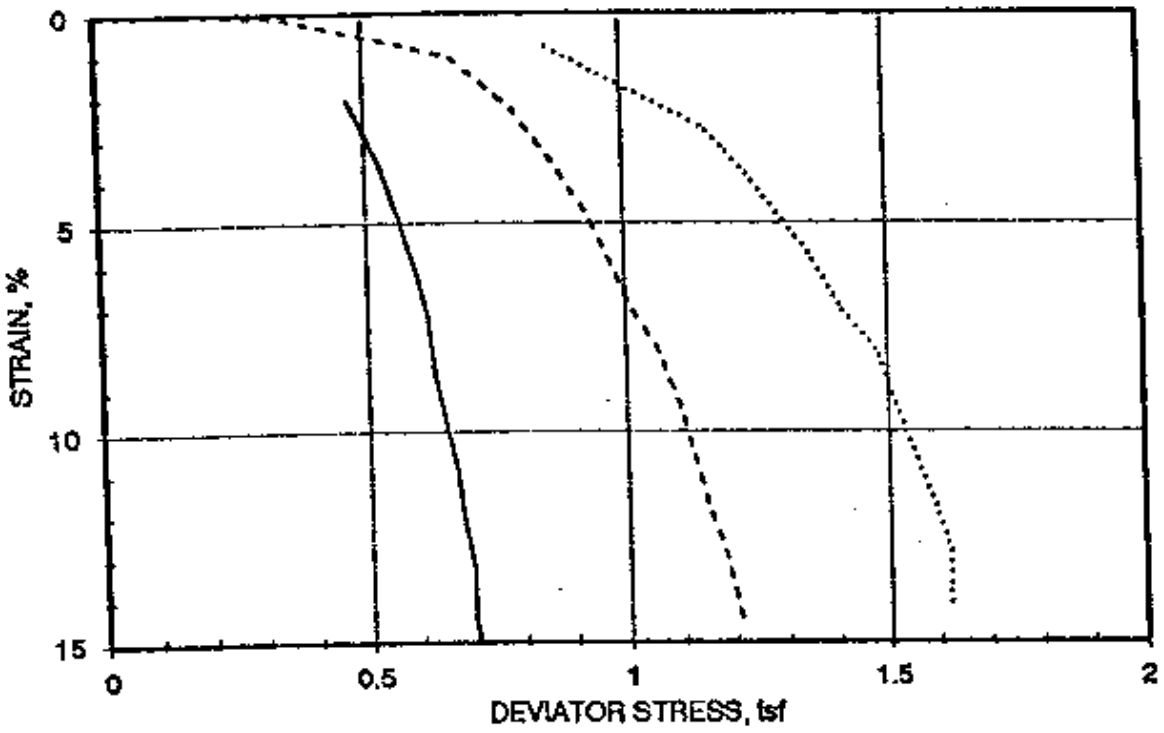
Boring No: TPBS-8
Sample No: 3A
Depth: 8.5-11.5 FT.

checked by : J.P

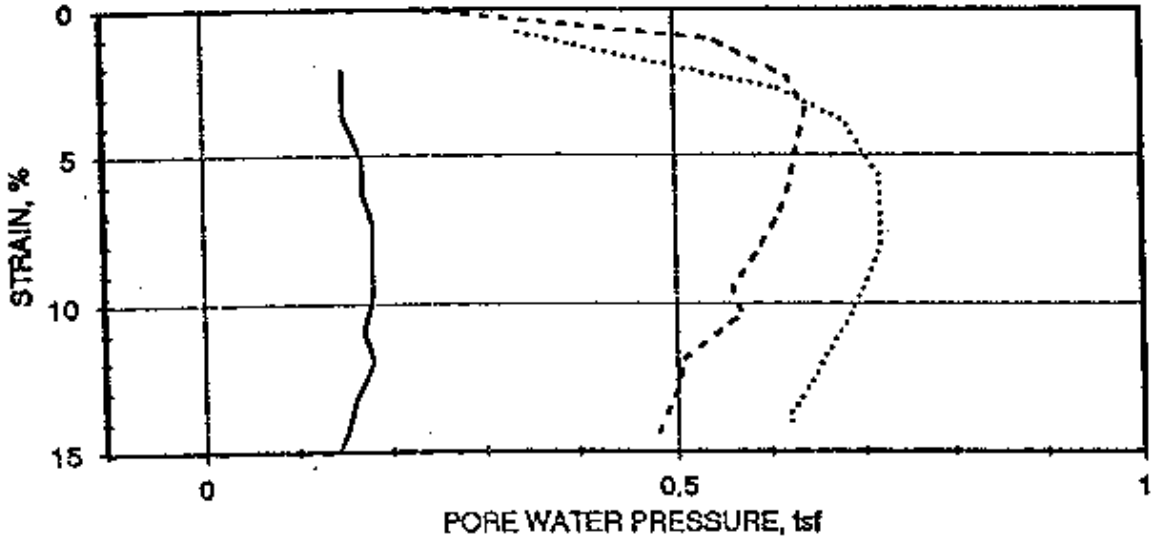
Sh A-94

A

STRESS - STRAIN PLOT



PORE WATER PRESSURE - STRAIN PLOT



STAGE 1 STAGE 2 STAGE 3

Boring No: TPBS-8
Sample No: 3A
Depth: 8.5-11.5 FT.

checked by: da

SH A-95

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

STAGE 1

SAMPLE HEIGHT	=	2.83 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.60 IN^2	DEPTH	8.5-11.5 FT.
			SAMPLE DESCRIPTION	Gray CLAY
BACK PRESSURE	=	85.00 PSI		
CONFINING PRESSURE	=	6.90 PSI = 0.994 ksf	SPECIFIC GRAVITY	2.7 (Assumed)
CELL PRESSURE	=	91.90 PSI		

	INITIAL	FINAL
MOISTURE CONTENT (%)	23.21	28.86
DEGREE OF SATURATION (%)	85.63	
DRY DENSITY (pcf)	97.29	
VOID RATIO	0.73	

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	F' F' tsf
10.70	58.00	87.12	0.15	2.05	1.64	0.47	0.97	0.24	0.34	0.81	0.58
11.20	73.00	87.14	0.15	2.58	1.65	0.49	0.99	0.24	0.34	0.83	0.59
12.20	103.00	87.03	0.15	3.65	1.66	0.53	1.02	0.26	0.35	0.88	0.61
13.30	144.00	87.38	0.17	5.10	1.69	0.57	1.06	0.28	0.33	0.89	0.61
14.30	177.00	87.38	0.17	6.27	1.71	0.60	1.10	0.30	0.33	0.93	0.63
14.80	205.00	87.51	0.18	7.26	1.73	0.62	1.11	0.31	0.32	0.93	0.62
15.40	244.00	87.49	0.18	8.64	1.76	0.63	1.13	0.32	0.32	0.95	0.63
16.00	274.00	87.54	0.18	9.70	1.78	0.65	1.15	0.32	0.31	0.96	0.64
16.70	309.00	87.38	0.17	10.94	1.80	0.67	1.16	0.33	0.33	0.99	0.66
17.20	338.00	87.50	0.18	11.96	1.82	0.68	* 1.18	0.34	0.32	1.00	0.66
18.00	375.00	87.21	0.16	13.27	1.85	0.70	1.20	0.35	0.34	1.04	0.69
18.30	408.00	87.04	0.15	14.44	1.87	0.70	1.20	0.35	0.35	1.05	0.70
18.60	426.00	86.90	0.14	15.08	1.89	0.71	1.21	0.35	0.36	1.07	0.71

checked by :

SLA-96

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

SAMPLE HEIGHT	=	2.82 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.60 IN^2	DEPTH	8.5-11.5 FT.
			SAMPLE DESCRIPTION	Gray CLAY
BACK PRESSURE	=	75.00 PSI		
CONFINING PRESS	=	20.83 PSI = 3 ksf		
CELL PRESSURE	=	95.83 PSI		

LOAD P	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	P' tsf
4.50	1.00	78.06	0.22	0.04	1.60	0.20	1.70	0.10	1.28	1.48	1.38
7.70	3.00	78.77	0.27	0.11	1.60	0.35	1.85	0.17	1.23	1.57	1.40
15.10	29.00	82.47	0.54	1.03	1.62	0.67	2.17	0.34	0.96	1.63	1.30
18.00	65.00	83.56	0.62	2.30	1.64	0.79	2.29	0.40	0.88	1.68	1.28
19.70	96.00	83.94	0.64	3.40	1.66	0.86	2.36	0.43	0.86	1.71	1.28
21.60	134.00	83.69	0.63	4.75	1.68	0.93	2.43	0.46	0.87	1.80	1.34
23.30	173.00	83.55	0.62	6.13	1.70	0.98	2.48	0.49	0.88	1.87	1.38
24.20	197.00	83.45	0.61	6.98	1.72	1.01	2.51	0.51	0.89	1.90	1.40
25.50	228.00	83.19	0.59	8.08	1.74	1.06	2.55	0.53	0.91	1.97	1.44
26.90	267.00	82.78	0.56	9.46	1.77	1.10	2.60	0.55	0.94	2.04 2.17	1.49
27.80	292.00	82.89	0.57	10.35	1.78	1.12 *	2.62	0.56	0.93	2.05 2.19	1.49
28.90	334.00	82.10	0.51	11.84	1.81	1.15	2.65	0.57	0.99	2.14 2.16	1.56
30.00	365.00	81.88	0.50	12.93	1.84	1.18	2.68	0.59	1.00	2.18	1.59
31.30	408.00	81.62	0.48	14.46	1.87	1.21	2.71	0.60	1.02	2.23	1.63

checked by: [illegible]

Sh A-97

GEOTECHNOLOGY INC
CONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

STAGE 3

SAMPLE HEIGHT	=	2.95 INCHES	BORING NO	TPB5-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.60 IN^2	DEPTH	8.5-11.5 FT.
			SAMPLE DESCRIPTION	Gray CLAY
BACK PRESSURE	=	75.00 PSI		
CONFINING PRESS	=	41.60 PSI = 5.99 ksf		
CELL PRESSURE	=	116.60 PSI		

LOAD p	STRAIN DIAL div	PWP +BP psi	PWP tsf	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	Q tsf	EFF MINOR tsf	EFF MAJOR tsf	F' tsf
19.30	24.00	79.78	0.34	0.81	1.61	0.86	3.86	0.43	2.65	3.51	3.08
26.20	80.00	83.54	0.61	2.71	1.64	1.15	4.14	0.57	2.38	3.53	2.95
28.30	111.00	84.39	0.68	3.76	1.66	1.23	4.22	0.61	2.32	3.55	2.93
31.70	169.00	84.94	0.72	5.73	1.70	1.35	4.34	0.67	2.28	3.62	2.95
33.60	209.00	84.97	0.72	7.09	1.72	1.41	4.40	0.70	2.28	3.68	2.98
35.70	238.00	84.98	0.72	8.07	1.74	1.48	4.47	0.74	2.28	3.75	3.02
38.10	299.00	84.53	0.69	10.14	1.78	1.54	4.54	0.77	2.31	3.85	3.08
40.00	345.00	84.14	0.66	11.70	1.81	1.59	4.59	0.80	2.34	3.93 .68	3.13
41.30	379.00	83.84	0.64	12.85	1.84	1.62	* 4.62	0.81	2.36	3.98	3.17
41.60	403.00	83.55	0.62	13.67	1.85	1.62	4.61	0.81	2.38	4.00 .68	3.19
42.00	419.00	83.55	0.62	14.21	1.86	1.62	4.62	0.81	2.38	4.00	3.19

checked by: JA

UU-test

St A-98 #169

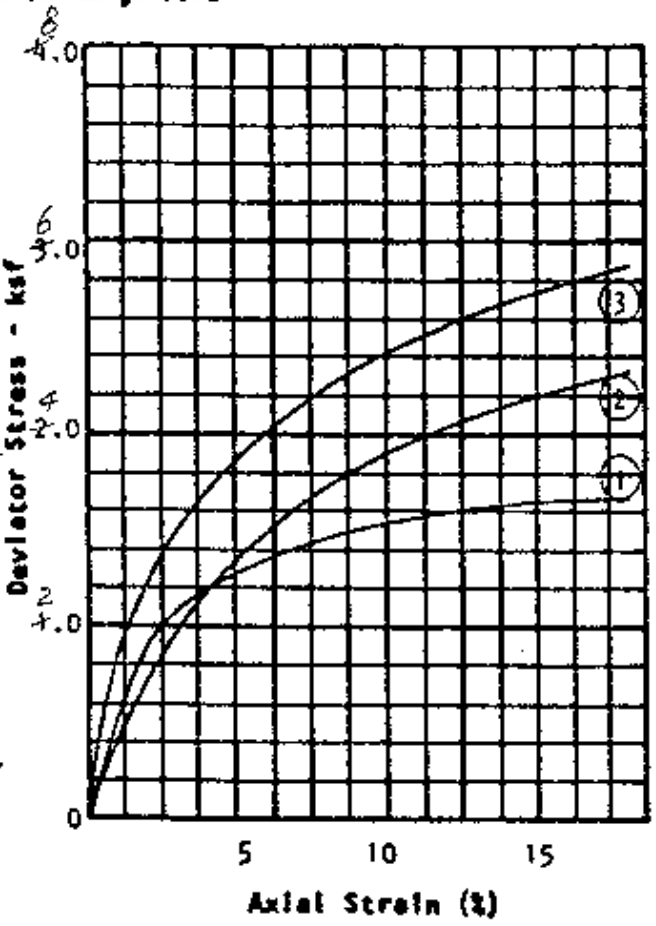
FERRELVIEW

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-56 ST-02 5.0 - 7.5			avg.
HEIGHT - INCH	5.36	5.41	5.40	
DIAMETER - INCH	2.88	2.88	2.88	
WATER CONTENT - %	23.2	11.3	21.5	18.7
DRY DENSITY - pcf	98.9	109.7	103.2	103.9
$\sigma_1-\sigma_3$ - ksf	3.38	4.72	5.86	4.65
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 2330



TYPE OF SPECIMEN: Natural Shelby Tube

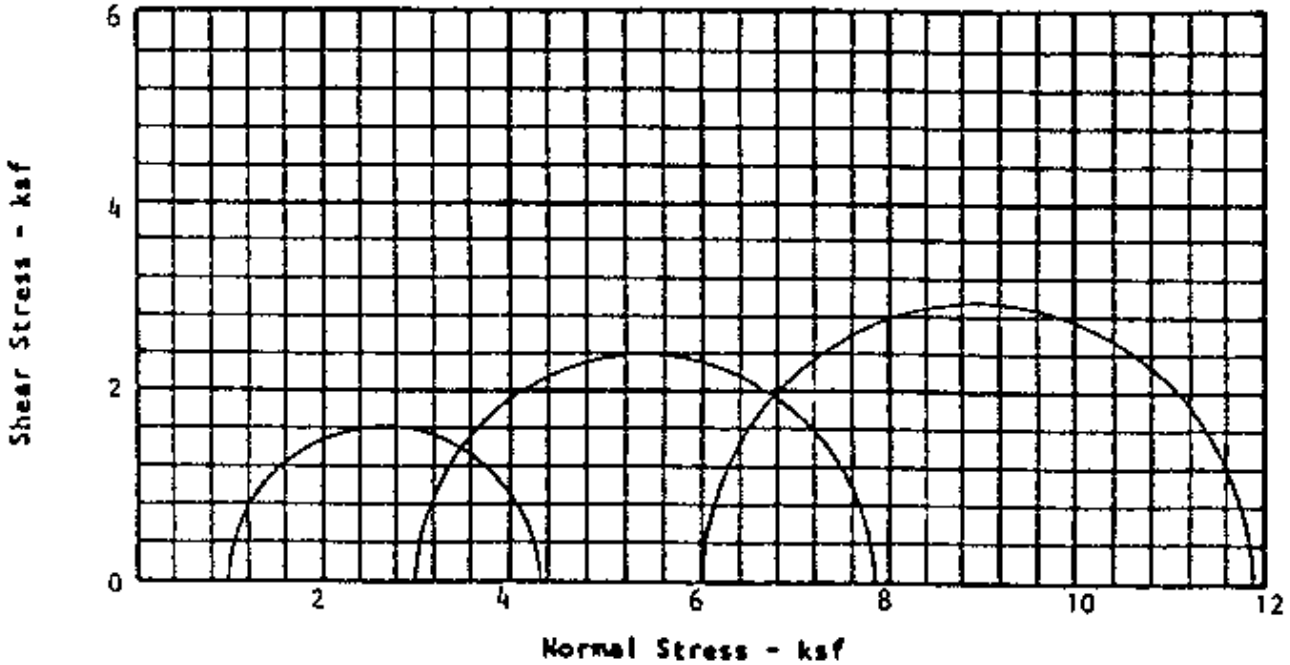
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 2.33



REF. 4

Sh A-99 ~~SL-120~~

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

~~LOCKE~~ FERRELVIEW

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-57 ST-03 7.5 - 10.0			Avg.
HEIGHT - INCH	6.02	5.86	5.98	
DIAMETER - INCH	2.88	2.88	2.87	
WATER CONTENT - %	20.8	19.8	22.0	20.9
DRY DENSITY - pcf	104.2	104.8	104.3	104.4
$\sigma_1 - \sigma_3$ - ksf	3.20	3.92	3.02	3.38
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

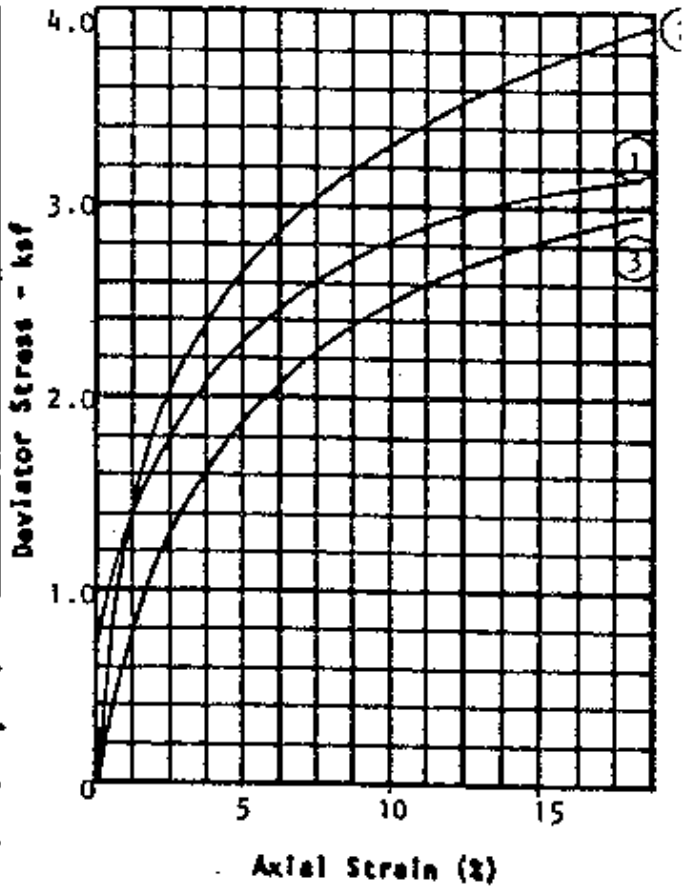
S_u - psf 1690

TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated

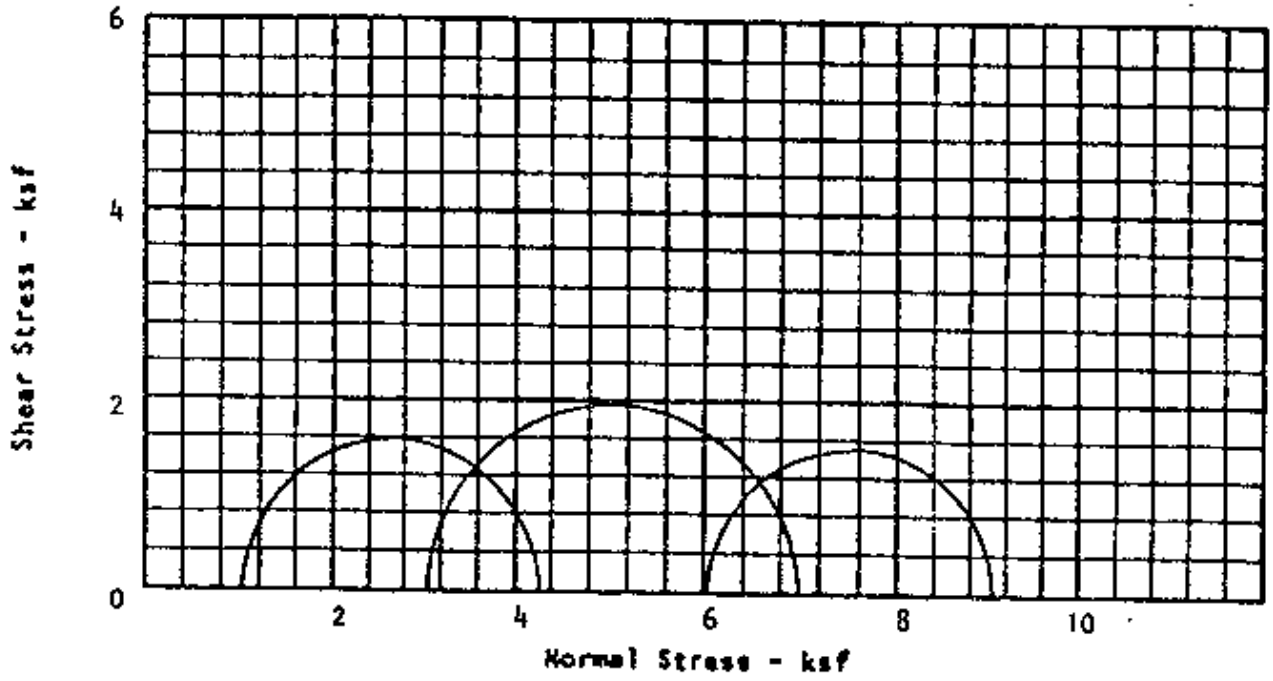
Undrained



TAN ϕ N/A

ϕ N/A

Avg. COHESION - ksf 1.69



REF. 4

TRIAXIAL SHEAR TEST RESULTS

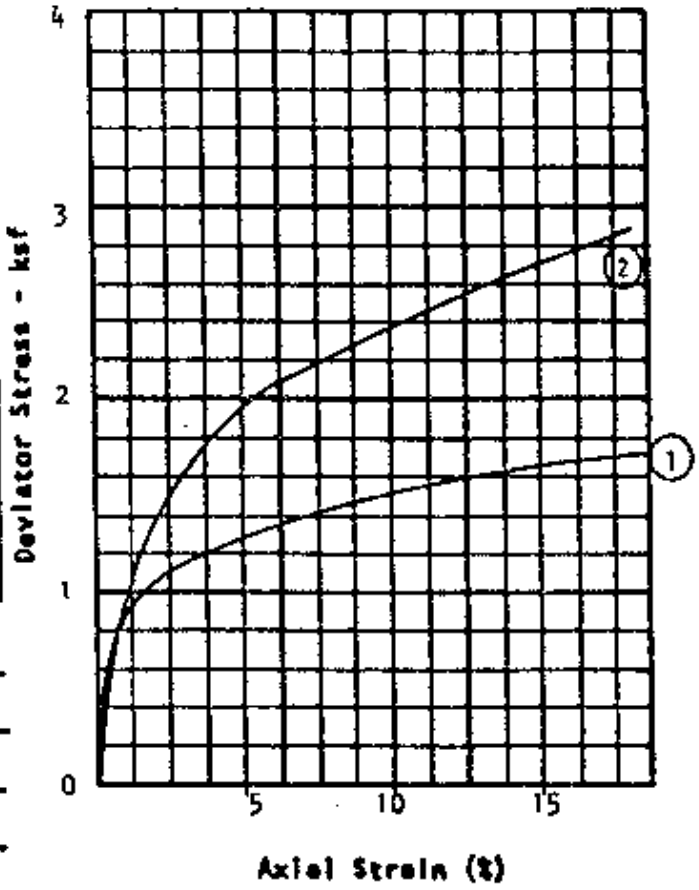
LOESS
Sh A-100

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-50 ST-02 2.5 - 5.0			Avg
HEIGHT - INCH	5.08	5.49		
DIAMETER - INCH	2.84	2.88		
WATER CONTENT - %	28.9	26.8		27.9
DRY DENSITY - pcf	87.5	96.0		91.8
$\sigma_1-\sigma_3$ - ksf	1.73	2.90		2.32
σ_3 - ksf	1.00	3.00		
σ - ksf				

Sh -psf 1160



TYPE OF SPECIMEN: Natural Shelby Tube

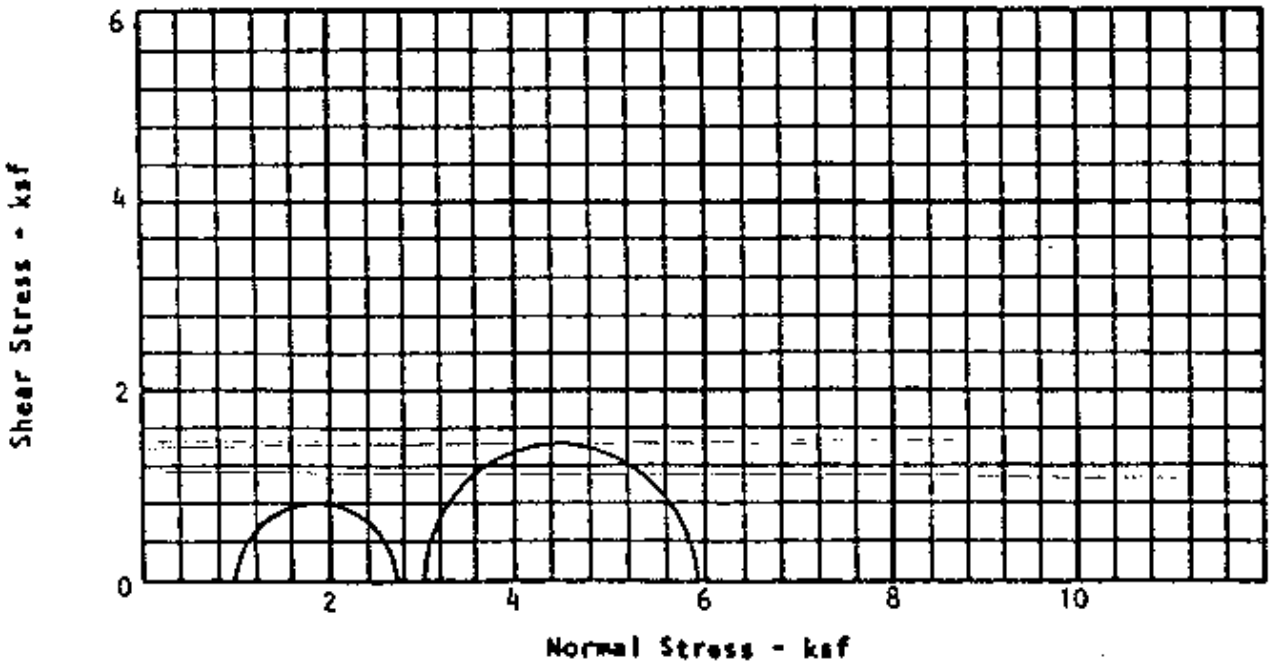
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.16



REF. 1

~~Sh 177~~

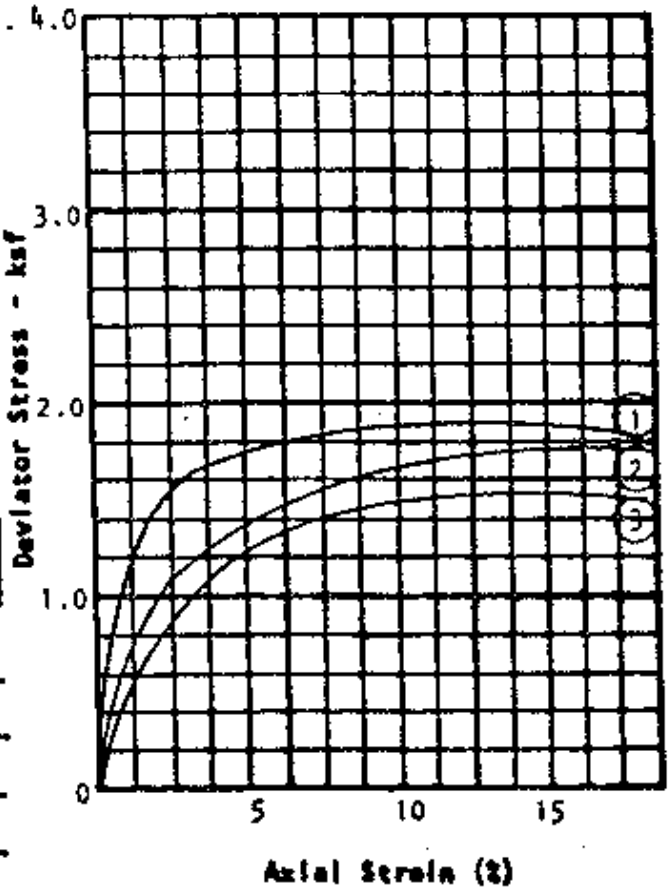
FERRELVIEW SL A-101

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-48 ST-03 7.5 - 10.0			Avg.
HEIGHT - INCH	5.72	5.89	5.83	
DIAMETER - INCH	2.89	2.88	2.89	
WATER CONTENT - %	24.5	25.9	25.7	25.4
DRY DENSITY - pcf	95.8	95.3	97.0	96.0
$\sigma_1 - \sigma_3$ - ksf	1.89	1.78	1.57	1.75
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 870



TYPE OF SPECIMEN: Natural Shelby Tube

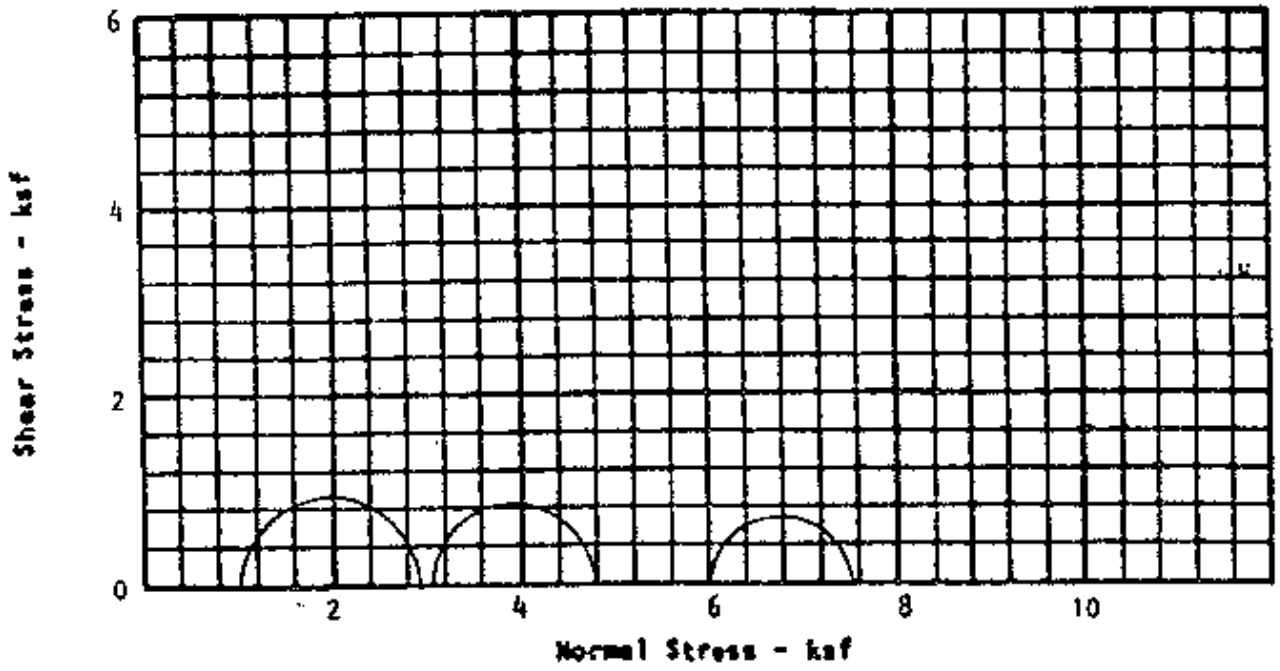
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: .87



REF. 4

FERRELVIEW
SHA-102

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

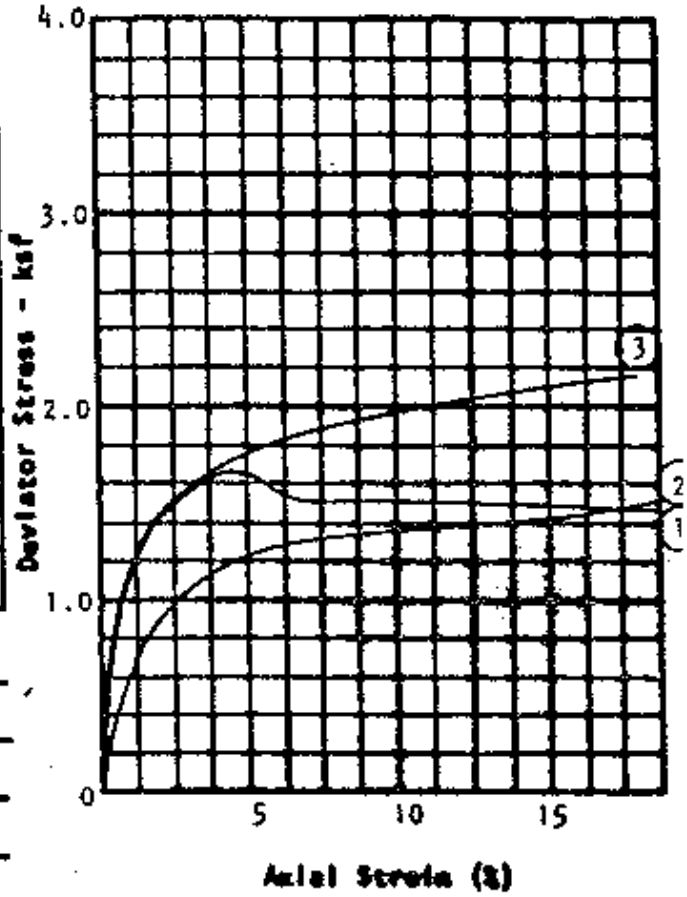
TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-48 ST-07 17.5 - 20.0			Avg.
HEIGHT - INCH	5.93	5.92	5.92	
DIAMETER - INCH	2.89	2.88	2.89	
WATER CONTENT - %	29.1	26.4	28.2	27.9
DRY DENSITY - pcf	93.5	97.5	95.4	95.5
$\sigma_1 - \sigma_3$ - ksf	1.62	1.47	2.18	1.76
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

Su - pcf 880

TYPE OF SPECIMEN Natural Shelby Tube

SOIL DESCRIPTION Fat clay, CH

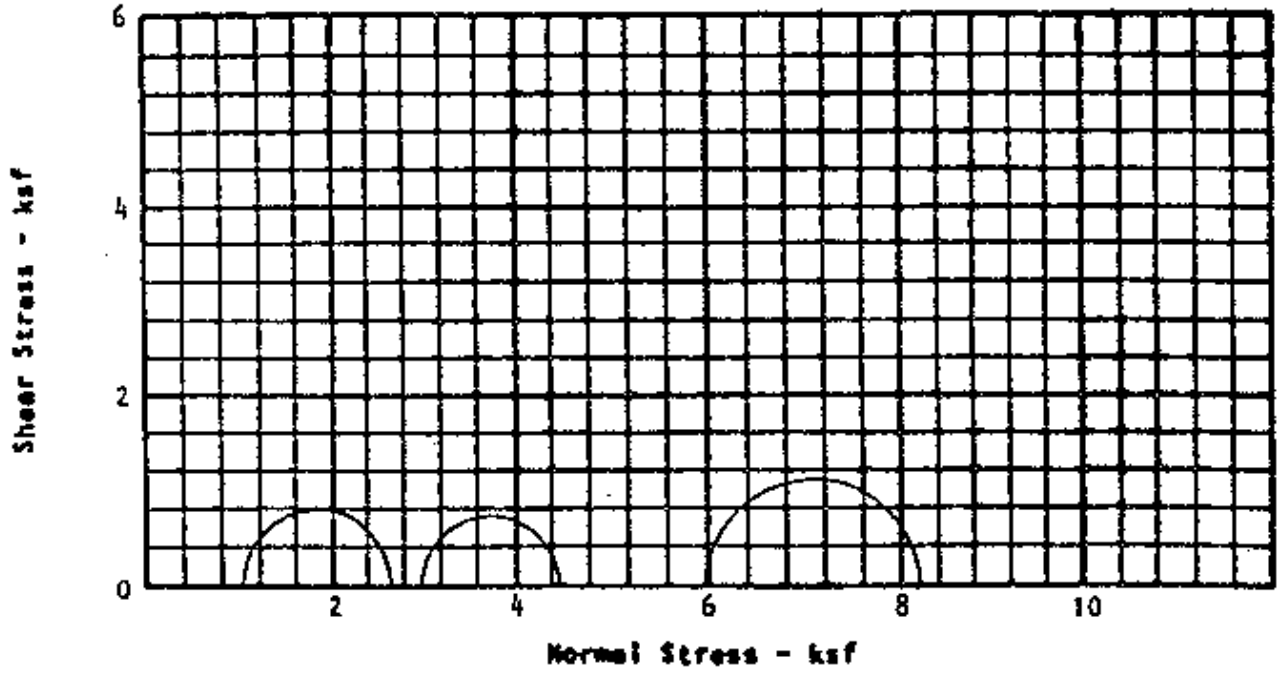
TYPE OF TEST Saturated - Unconsolidated, Undrained



TAN ϕ N/A

ϕ N/A

Avg. COHESION - ksf 0.88



REF. 4

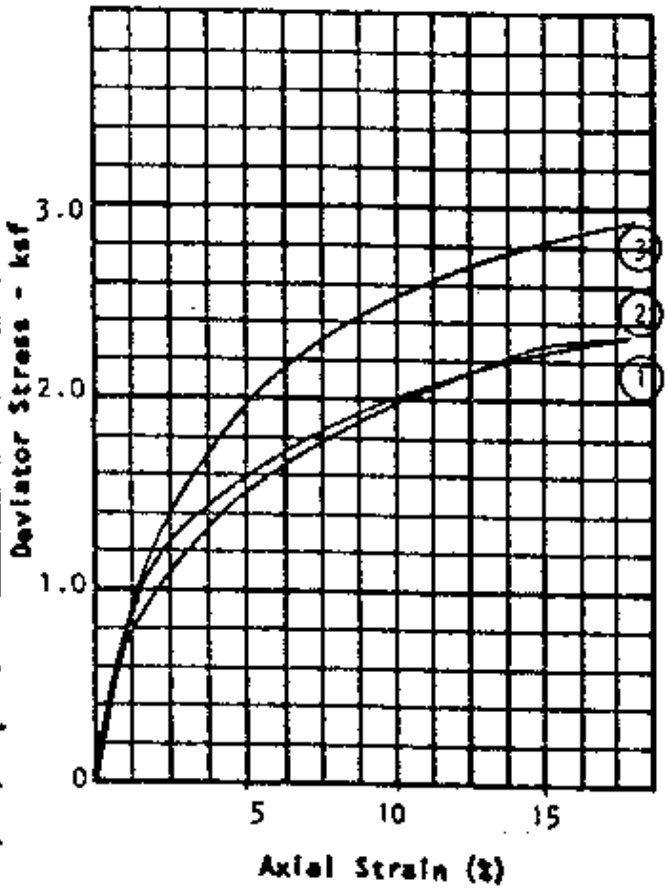
CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

FERRELVIEW
SHA-103

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-S1 ST-03 5.0 - 7.5			Avg.
HEIGHT - INCH	5.90	5.97	5.86	
DIAMETER - INCH	2.87	2.86	2.86	
WATER CONTENT - %	23.6	24.0	24.0	23.9
DRY DENSITY - pcf	99.1	98.0	98.8	98.6
$\sigma_1-\sigma_3$ - ksf	2.41	2.43	2.92	2.59
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 1290



TYPE OF SPECIMEN: Natural Shelby Tube

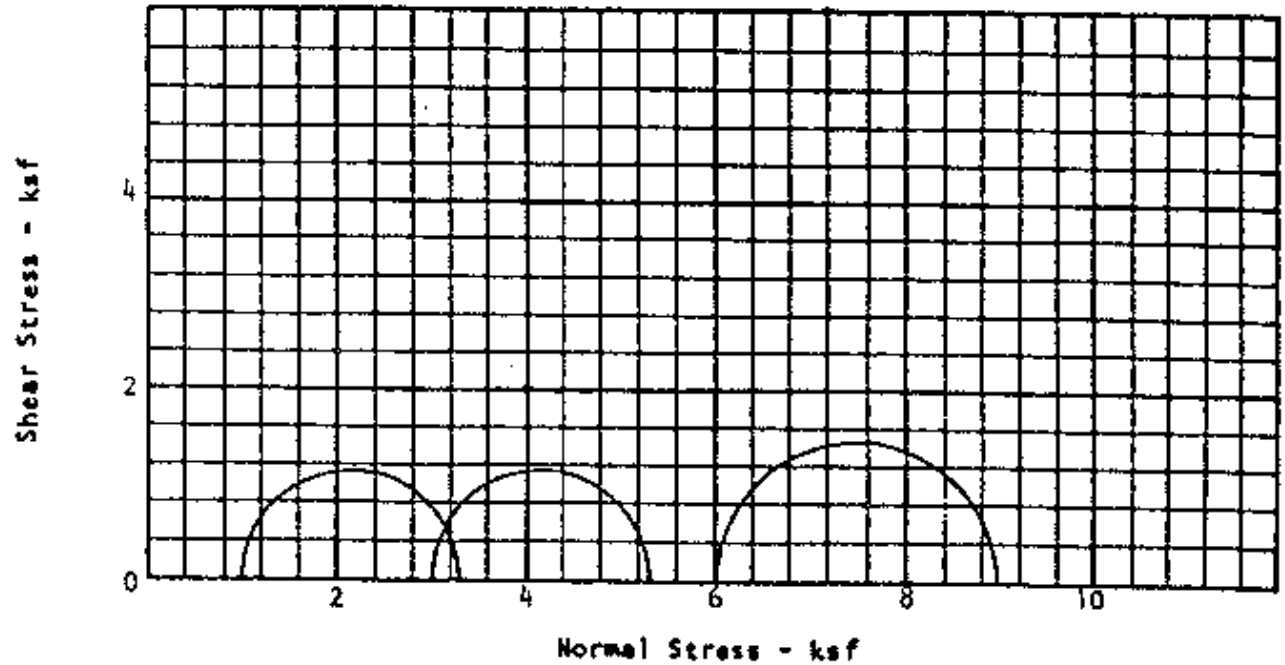
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.29



REF. 4

1 206 89

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

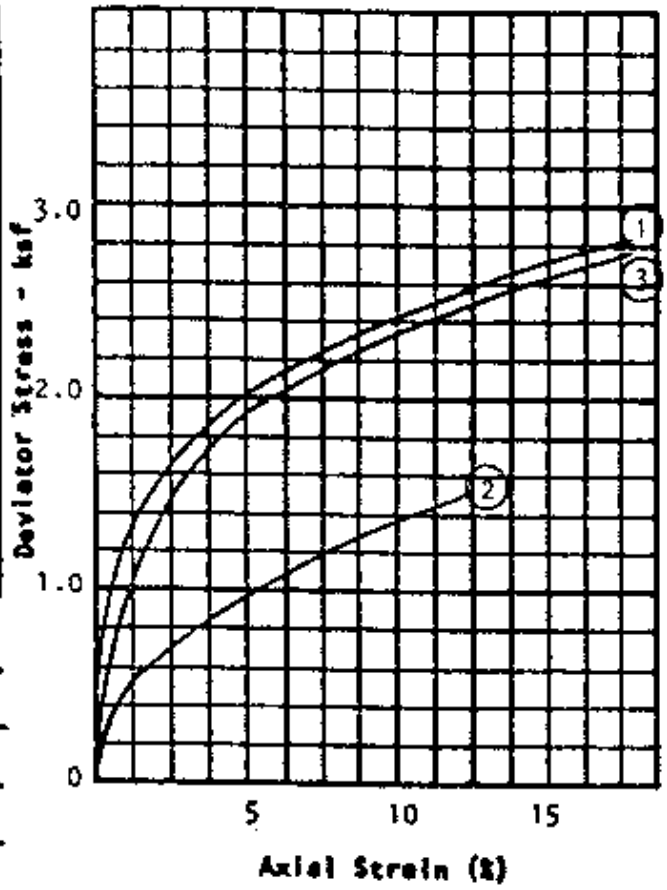
TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-52 ST-04 10.0 - 12.5			Avg.
HEIGHT - INCH	5.97	5.98	5.76	
DIAMETER - INCH	2.89	2.87	2.87	
WATER CONTENT - %	23.2	23.4	24.3	23.6
DRY DENSITY - pcf	101.9	100.5	99.3	100.6
$\sigma_1 - \sigma_3$ - ksf	2.88	1.51	2.71	2.37
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 1180

TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Fat clay, CH

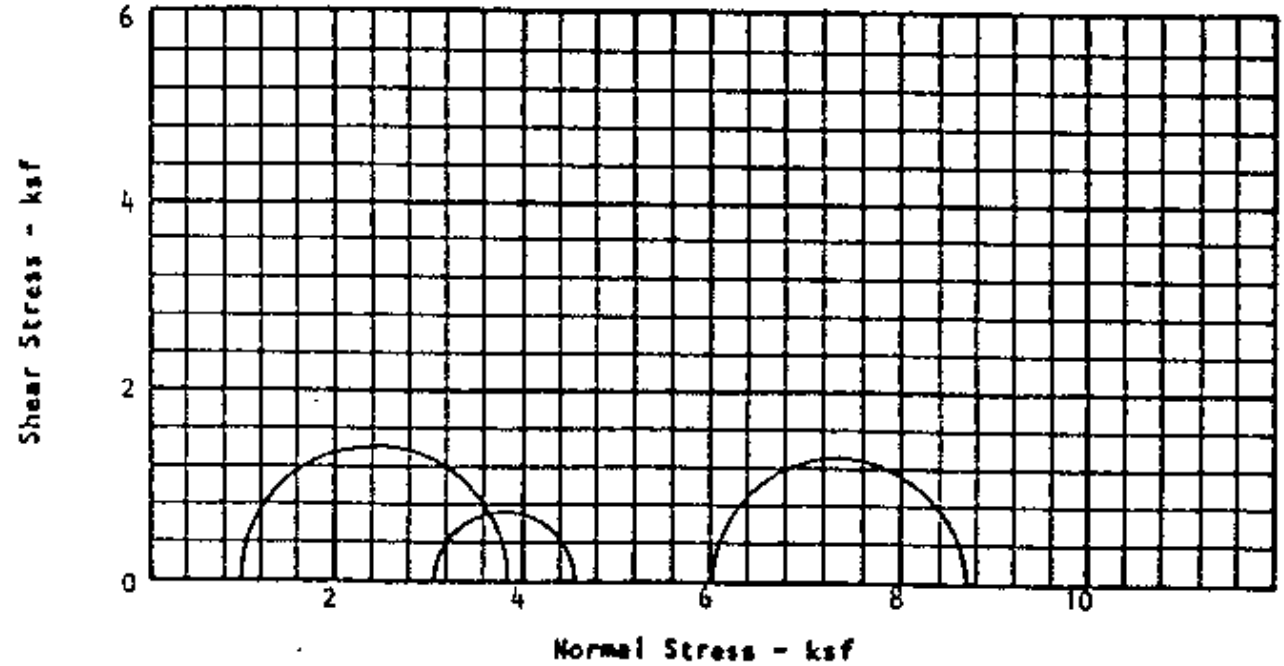
TYPE OF TEST: Saturated - Unconsolidated Undrained



TAN ϕ = N/A

ϕ = N/A

Avg. COHESION - ksf = 1.18



REF 4

UU-test

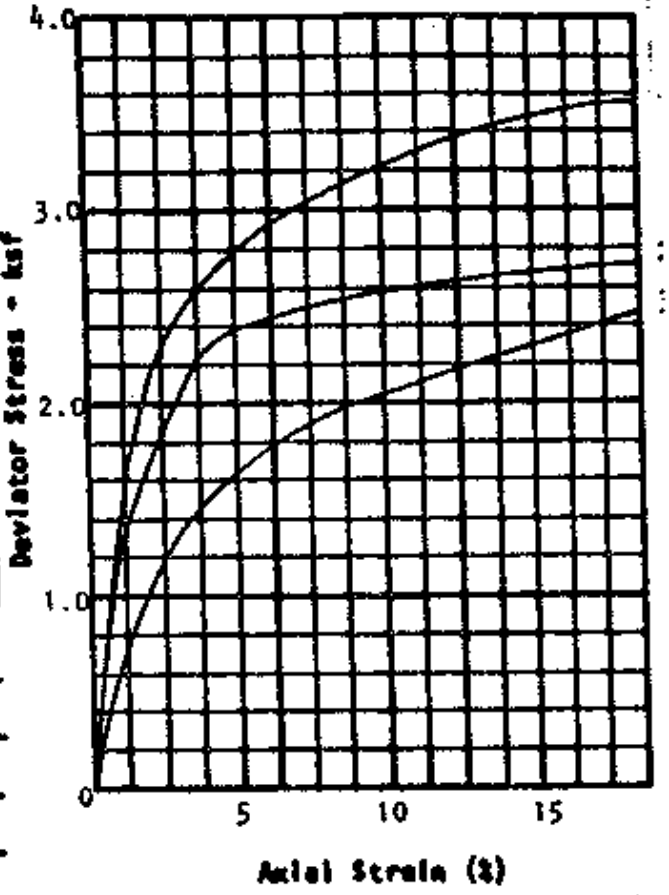
Sh A-105 Foreland

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION	GT-55 ST-06 12.5-15.0			Avg.
HEIGHT - INCH	6.029	5.869	5.369	
DIAMETER - INCH	2.874	2.874	2.874	
WATER CONTENT - %	22.1	23.8	24.3	23.4
DRY DENSITY - pcf	103.5	100.7	98.9	101.0
$\sigma_1 - \sigma_3$ - ksf	3.55	2.77	2.43	2.92
σ_1 Total - ksf	4.54	5.07	8.43	
σ_3 - ksf	.99	2.30	6.00	

Su -psf 1460



TYPE OF SPECIMEN: Natural

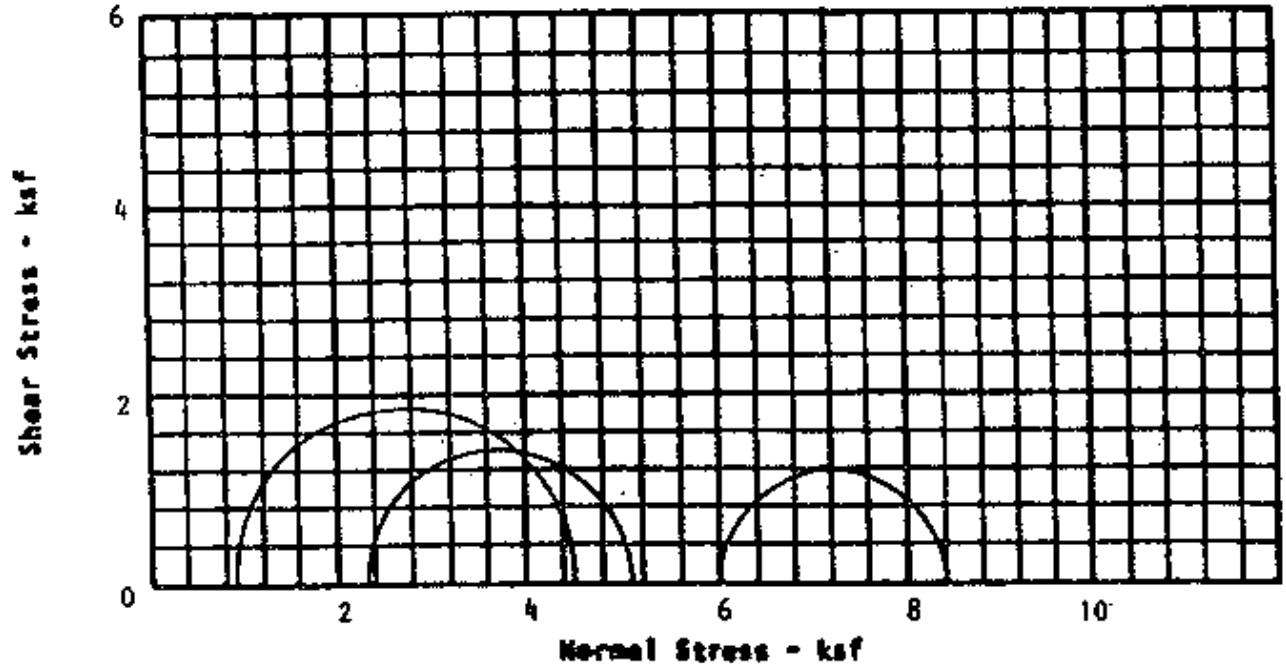
SOIL DESCRIPTION: Fat clay, CH

TYPE OF TEST: Saturated, Unconsolidated, Undrained.

TAN ø: N/A

ø: N/A

COHESION - ksf: Avg. = 1.46 ✓ ok



REF. 4

TRIAXIAL SHEAR TEST RESULTS

Fig. 14

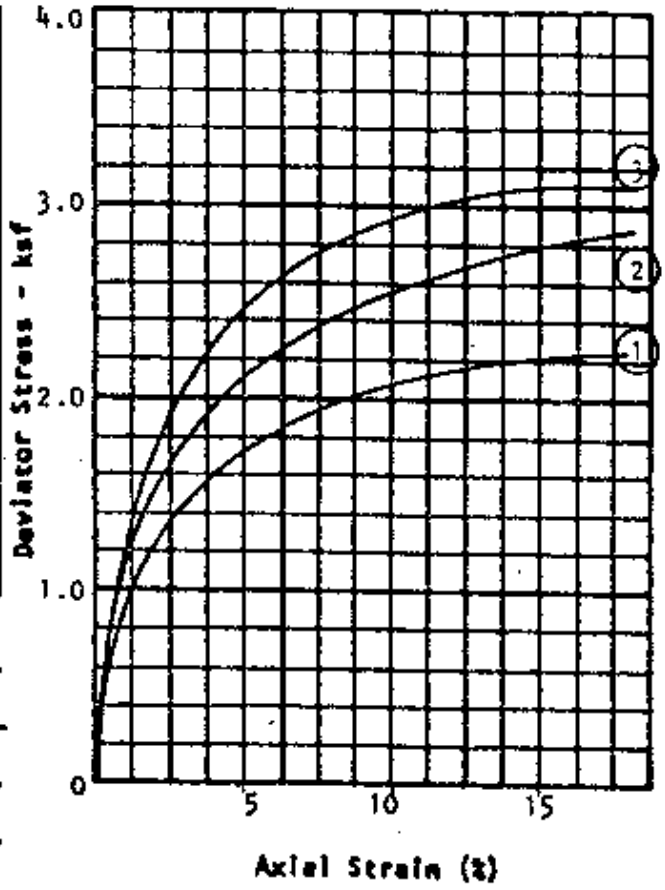
SA-106
FOR REVIEW

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-55 ST-08 17.5 - 20.0			Avg.
HEIGHT - INCH	5.81	5.74	5.76	
DIAMETER - INCH	2.87	2.87	2.83	
WATER CONTENT - %	22.8	21.9	22.8	22.5
DRY DENSITY - pcf	103.2	104.0	101.9	103.0
$\sigma_1 - \sigma_3$ - ksf	2.24	2.94	3.13	2.77
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

Su -1/3f 1.39



TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Fat clay, CH

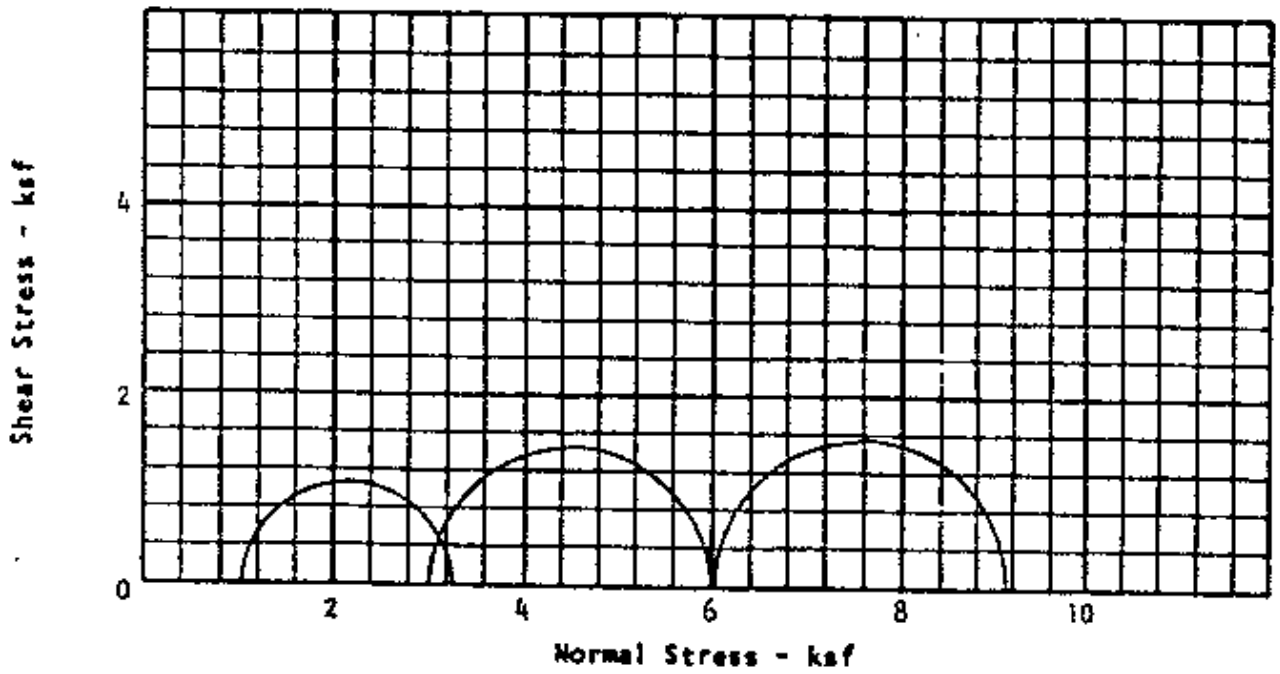
TYPE OF TEST: Saturated - Unconsolidated

Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.38



REF. 4

CLAY TILL
SLA-107

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

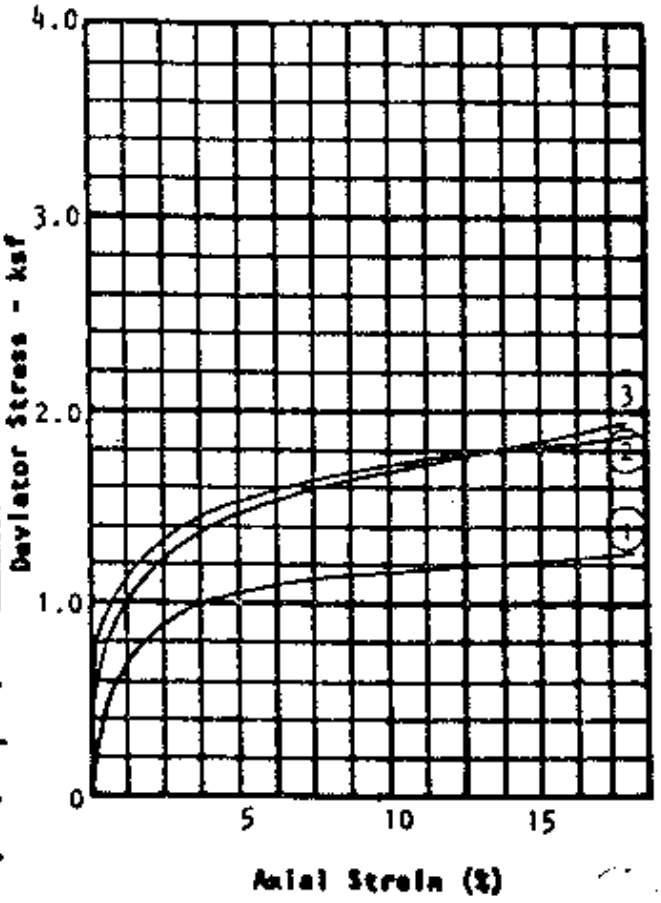
TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-43 ST-10 21.5 - 23.8			Avg.
HEIGHT - INCH	5.97	5.77	5.90	
DIAMETER - INCH	2.87	2.87	2.88	
WATER CONTENT - %	18.8	18.8	19.6	19.1
DRY DENSITY - pcf	107.0	106.7	105.7	106.5
$\sigma_1-\sigma_3$ - ksf	1.33	1.89	1.97	1.73
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

Su -psf 870

TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Lean clay, CL

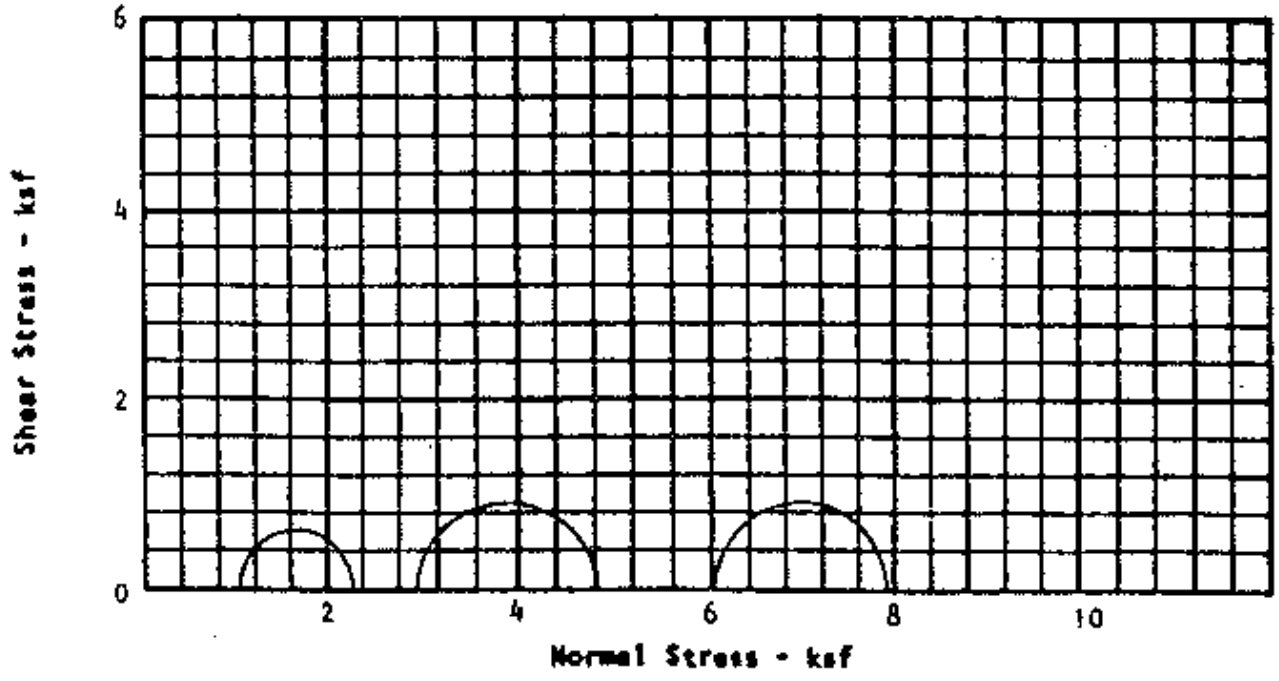
TYPE OF TEST: Saturated - Unconsolidated
Undrained



TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 0.87



REF 4

CLAY TILL ~~Sh 79~~

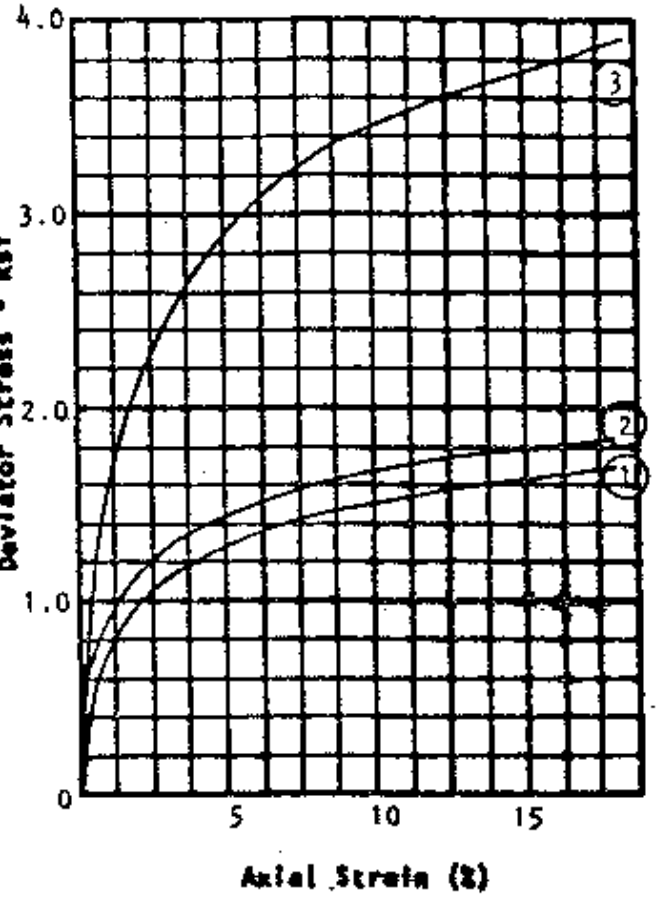
SHA-108

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-50 ST-06 12.5 - 15.0			Avg.
HEIGHT - INCH	5.87	5.86	6.22	
DIAMETER - INCH	2.88	2.88	2.84	
WATER CONTENT - %	28.7	26.3	23.0	26.0
DRY DENSITY - pcf	93.9	97.3	100.7	~~97.3~~
$\sigma_1-\sigma_3$ - ksf	1.73	1.85	3.89	2.49
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 1250



TYPE OF SPECIMEN: Natural Shelby Tube

SOIL DESCRIPTION: Fat clay, CH

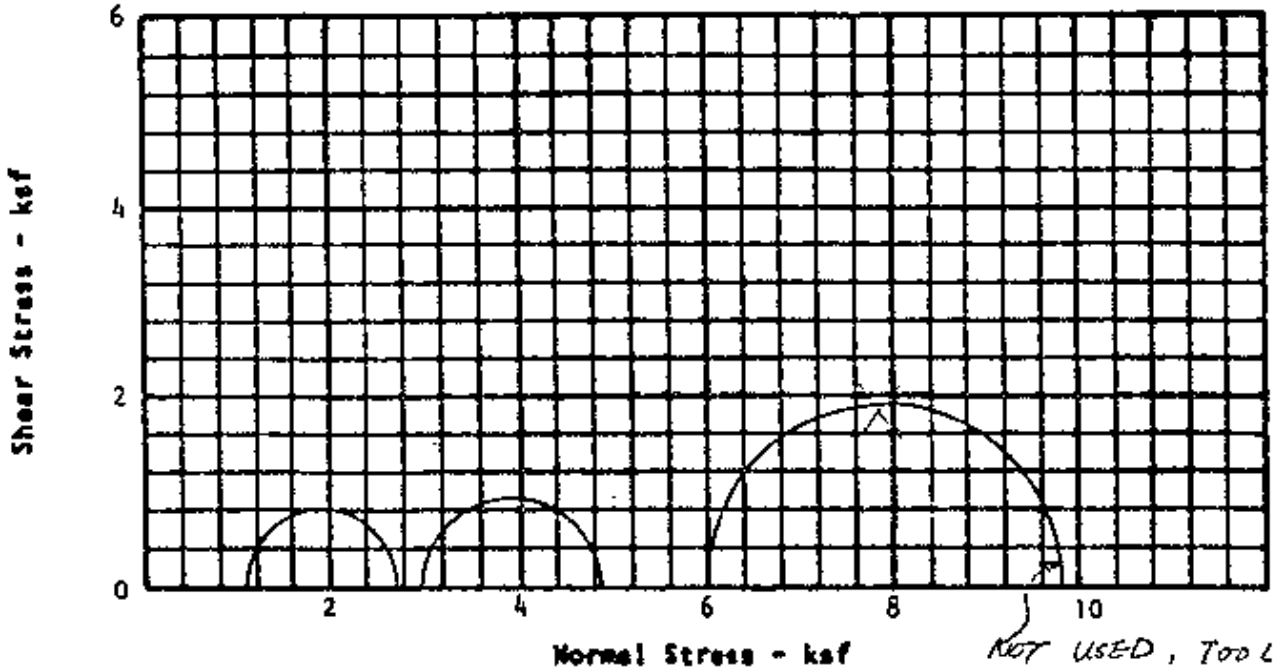
TYPE OF TEST: Saturated - Unconsolidated

Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: ~~1.25~~ 0.895



NOT USED, TOO LARGE

REF 4

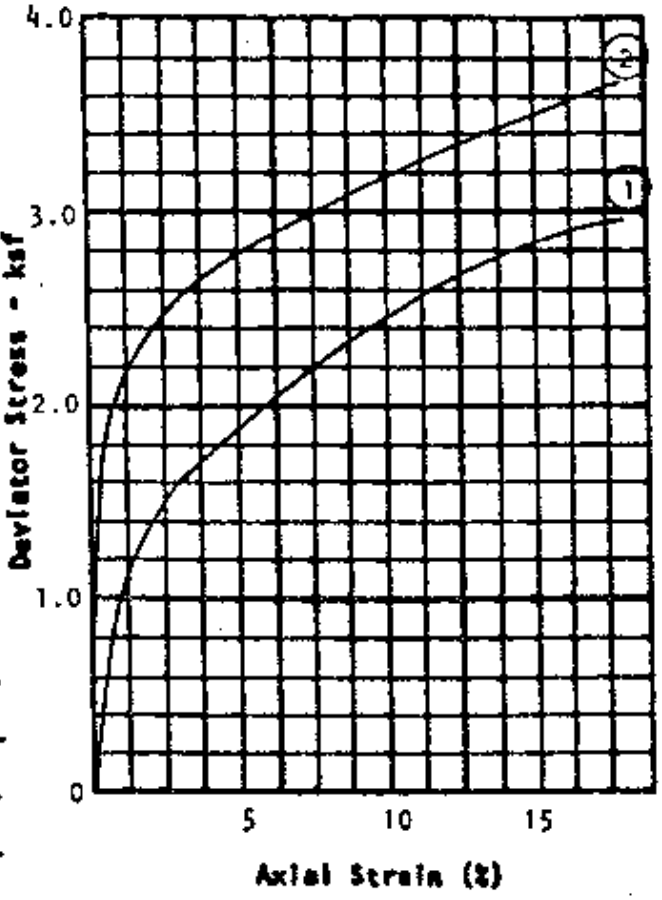
CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

CLAY TILL
21-A109

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DETPH, Ft.	GT-56 SB-08 19.5 - 21.0			Avg.
HEIGHT - INCH	4.78	5.67		
DIAMETER - INCH	2.38	2.37		
WATER CONTENT - %	18.5	24.2		21.9
DRY DENSITY - pcf	110.4	100.7		105.6
$\sigma_1 - \sigma_3$ - ksf	2.98	3.65		3.32
σ_3 - ksf	1.00	3.00		
σ - ksf				

S_u - psf 1660



TYPE OF SPECIMEN: Natural Shelby Tube

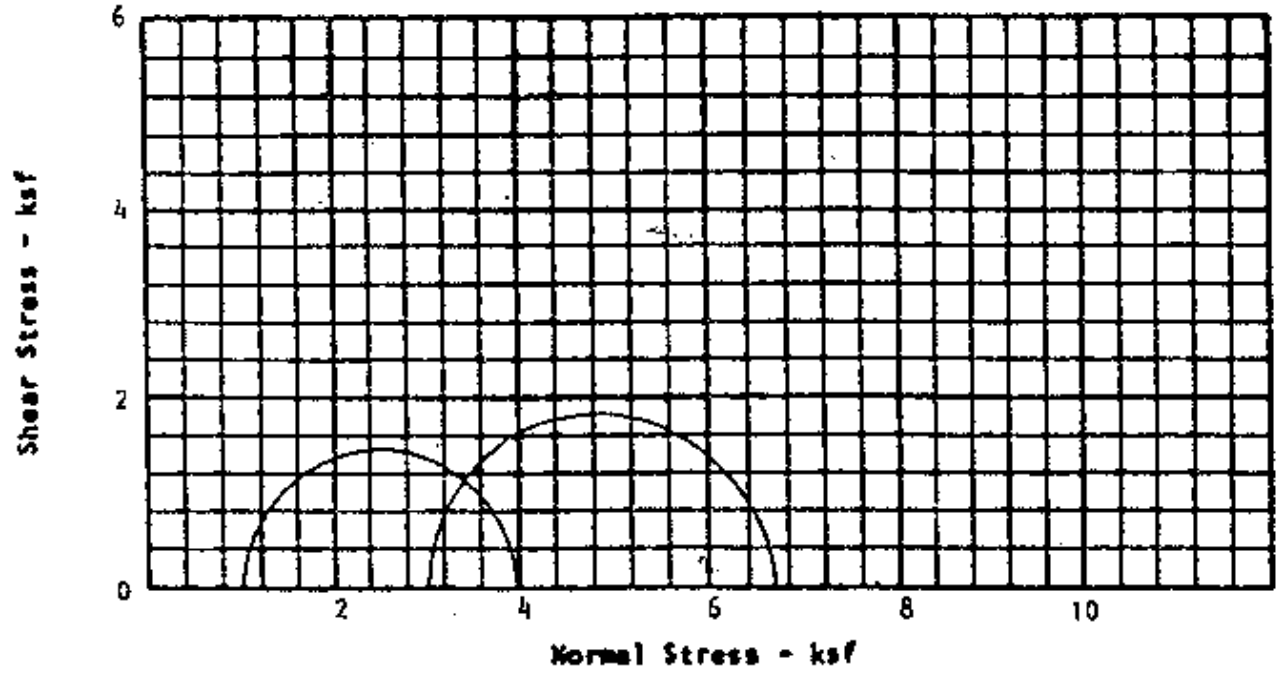
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated, Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.66



REF 4

~~SHEET~~

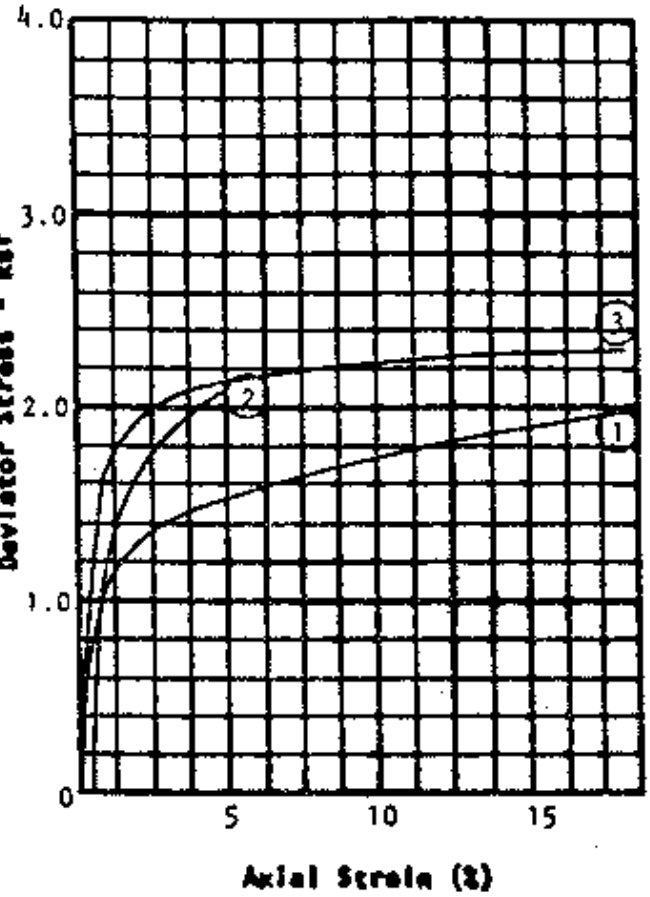
BASAL TILL
SHEET 10

CHEN AND ASSOCIATES

Consulting Soil and Foundation Engineers

TEST NUMBER	1	2	3	4
LOCATION, No. SAMPLE, No. DEPTH, Ft.	GT-52 SB-14 35.5 - 36.0			Avg.
HEIGHT - INCH	5.91	5.70	5.52	
DIAMETER - INCH	2.37	2.37	2.41	
WATER CONTENT - %	19.0	15.3	15.3	16.5
DRY DENSITY - pcf	101.6	116.2	116.2	111.3
$\sigma_1-\sigma_3$ - ksf	1.95	2.09	2.29	2.11
σ_3 - ksf	1.00	3.00	6.00	
σ - ksf				

S_u - psf 1060



TYPE OF SPECIMEN: Natural Shelby Tube

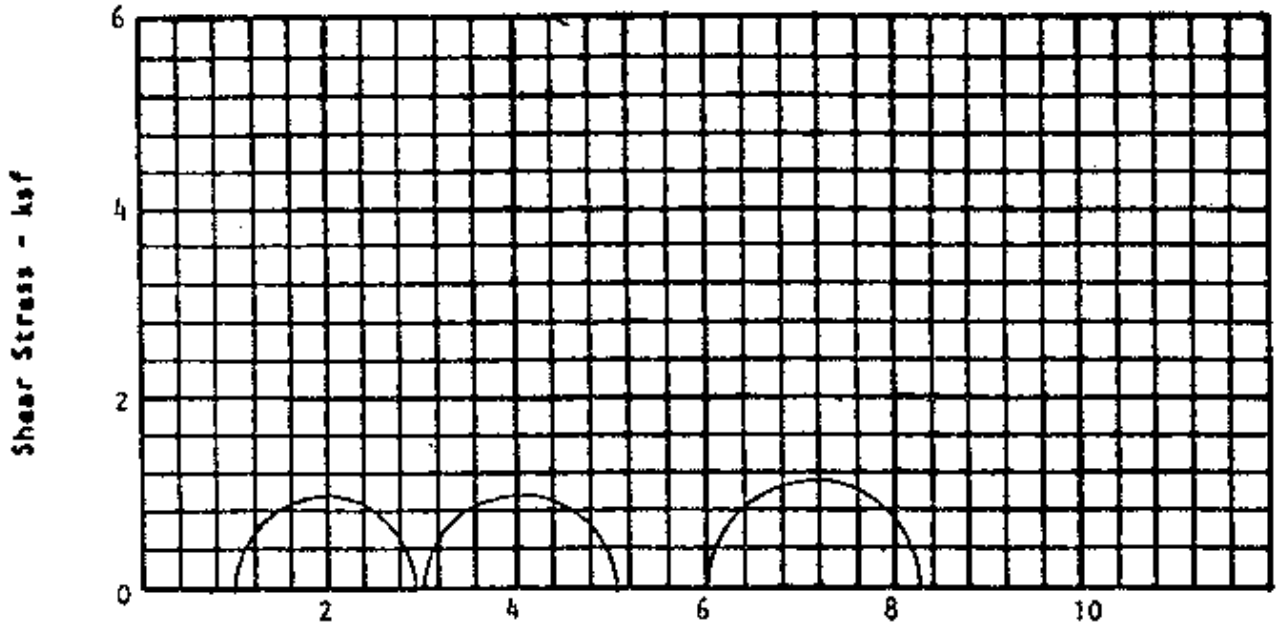
SOIL DESCRIPTION: Lean clay, CL

TYPE OF TEST: Saturated - Unconsolidated, Undrained

TAN ϕ: N/A

ϕ: N/A

Avg. COHESION - ksf: 1.06



REF. 4

Requon # 2
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: LUJJ RAP
LOCATION ID: DISPOSAL CELL
DATE: 1-9-90
LAB NAME: Geotechnology
CHECKED BY: LAB 44
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GI-2778 34-01A	4-6	97.5	1000
		95.6	3000
		95.0	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
112.1	14.7	78.3	0.53
109.9	14.1	70.9	0.54
109.1	14.1	69.5	0.55
110.0	14.3		

Avg

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	15.7	Unsaturated	
	15.4		
	14.2		

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

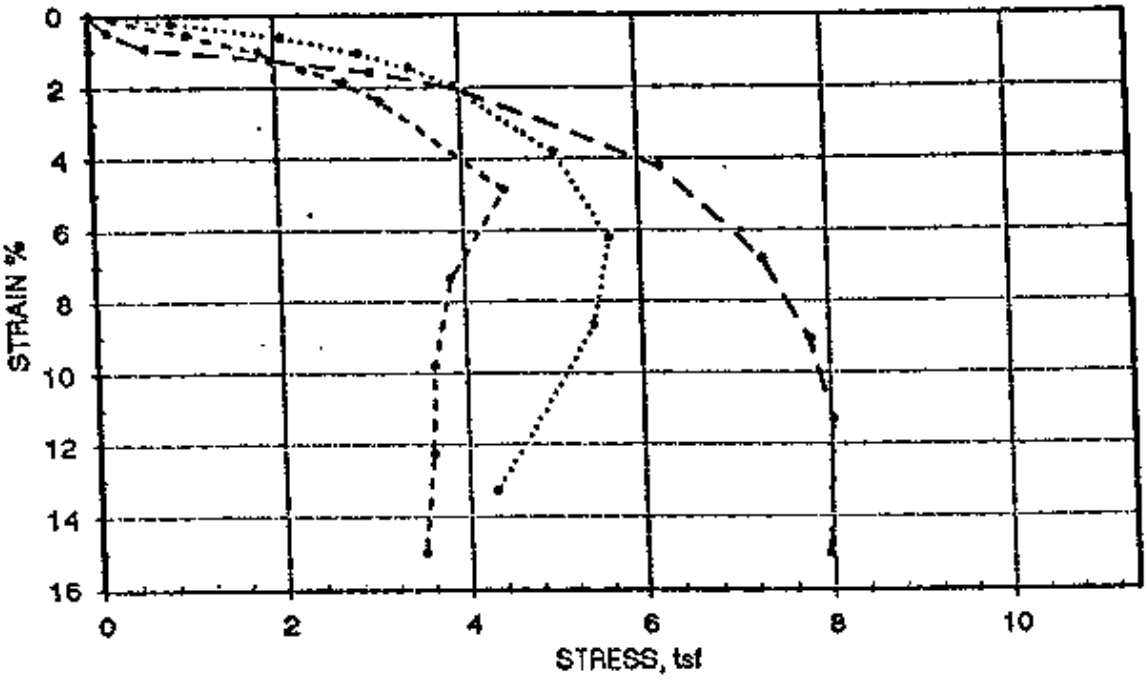
see attached tables

SAA-11A

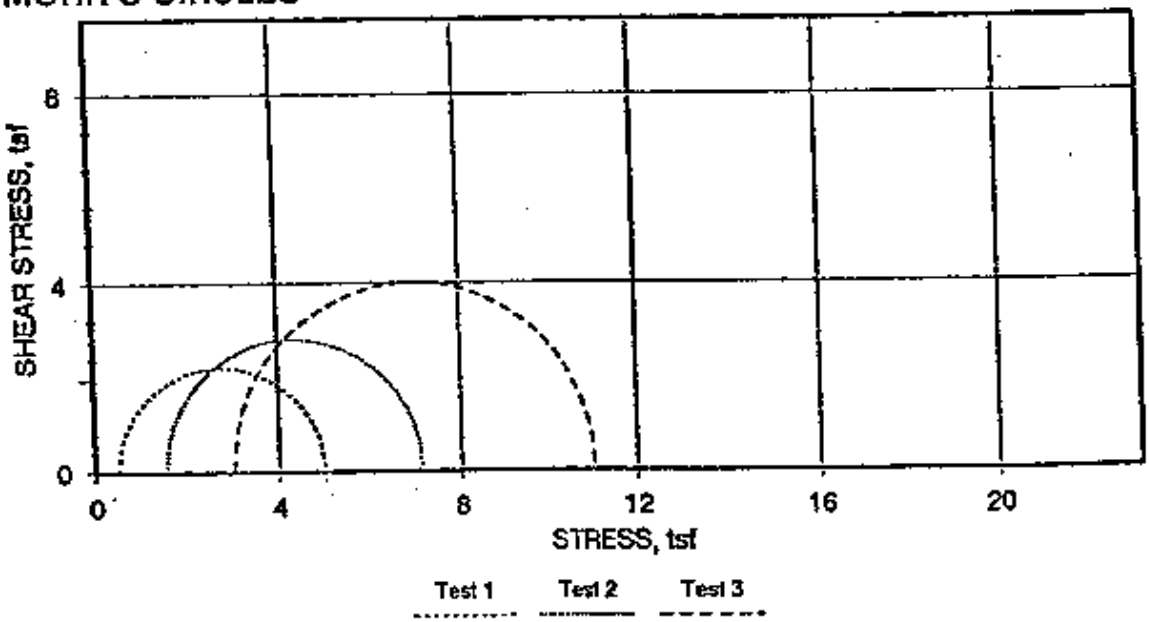
ATTACHMENT

SLA-112

WSSRAP - JOB NO. 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: GT-2778
Sample No: BU-01A
Depth: 4-6 FT.

Sh. A-13

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

TEST 1

SAMPLE HEIGHT	=	2.93 INCHES	BORING NO	GT-2T78
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.60 IN^2	DEPTH	4-6 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
23.30	16.00	0.55	1.61	1.04	1.54	0.52
41.10	30.00	1.03	1.61	1.83	2.33	0.92
52.10	44.00	1.50	1.62	2.31	2.81	1.16
61.70	55.00	1.88	1.63	2.73	3.23	1.36
71.20	70.00	2.39	1.64	3.13	3.63	1.57
104.40	142.00	4.85	1.68	4.48	4.98	2.24
92.20	214.00	7.32	1.72	3.85	4.35	1.93
89.80	286.00	9.78	1.77	3.65	4.15	1.83
91.40	358.00	12.24	1.82	3.62	4.12	1.81
91.30	439.00	15.01	1.88	3.50	4.00	1.75

$q_f = 4.98$ tsf = 9.96 ksf

$\sigma_3 = 1$ ksf

$q_f = 4.48$ ksf

$p_f = 5.48$ ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

Sh A-14

TEST 2

SAMPLE HEIGHT	=	3.02	1.424	BORING NO	GT-2T78
SAMPLE DIAMETER	=	1.43 INCHES		SAMPLE NO	BU-01A
SAMPLE AREA	=	1.60 IN^2		DEPTH	4-6 FT.
				SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	20.87 PSI
CELL PRESSURE	=	20.87 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.90	7.00	0.23	1.61	0.89	2.39	0.45
46.70	19.00	0.63	1.61	2.08	3.59	1.04
65.30	32.00	1.06	1.62	2.90	4.40	1.45
77.90	44.00	1.46	1.63	3.45	4.95	1.72
89.50	59.00	1.96	1.64	3.94	5.44	1.97
116.60	115.00	3.81	1.67	5.03	6.54	2.52
133.90	187.00	6.20	1.71	5.64	7.14	2.82
132.60	261.00	8.66	1.76	5.44	6.94	2.72
110.60	400.00	13.27	1.85	4.31	5.81	2.15

$\sigma_1 = 7.14 \text{ tsf} = 14.28 \text{ ksf}$

$\sigma_3 = 3.1005$

$q_f = \frac{14.28 - 3.1005}{2} = 5.64 \text{ ksf}$ ✓

$P_f = \frac{17.2805}{2} = 8.64 \text{ ksf}$ ✓

LLL by JF

SA A-115

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

TEST 3

SAMPLE HEIGHT	=	2.83 INCHES	BORING NO	GT-2T78
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.59 IN^2	DEPTH	4-6 FT.
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	41.64 PSI
CELL PRESSURE	=	41.64 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	14.00	0.49	1.60	0.20	3.20	0.10
13.50	26.00	0.92	1.61	0.60	3.60	0.30
43.90	35.00	1.24	1.61	1.96	4.96	0.98
68.10	45.00	1.59	1.62	3.03	6.02	1.51
88.80	56.00	1.98	1.63	3.93	6.93	1.96
144.20	119.00	4.20	1.66	6.24	9.23	3.12
173.80	193.00	6.81	1.71	7.31	10.31	3.66
190.00	257.00	9.07	1.75	7.80	10.80	3.90
200.60	320.00	11.30	1.80	8.03	11.03	4.02
207.20	425.00	15.01	1.88	7.95	10.95	3.98

$\sigma_1 = 11.03 tsf = 22.06 ksf$

$\sigma_3 = 6 ksf$

$q_f = \frac{16.06}{2} = 8.03 ksf$

$P_f = \frac{28.06}{2} = 14.03 ksf$

checked by J.

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

S1 A-116

TEST 1

SAMPLE HEIGHT	=	2.90 INCHES	BORING NO	GT-2171
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02A
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY to CLAY

γ_d = 101.3 pcf — Unsaturated.
w_i = 21.5%

CONFINING PRESSURE	=	6.90 PSI
CELL PRESSURE	=	6.90 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.20	14.00	0.48	1.61	0.81	1.31	0.41
22.60	30.00	1.03	1.62	1.00	1.50	0.50
24.70	42.00	1.45	1.63	1.09	1.59	0.55
26.80	57.00	1.96	1.64	1.18	1.68	0.59
28.60	72.00	2.48	1.64	1.25	1.75	0.63
34.40	136.00	4.68	1.68	1.47	1.97	0.74
41.30	242.00	8.34	1.75	1.70	2.20	0.85
44.50	301.00	10.37	1.79	1.79	2.29	0.90
47.40	370.00	12.75	1.84	1.86	2.35	0.93
49.60	433.00	14.92	1.88	1.89	2.39	0.95

σ_1 = 4.78 ksf
σ_3 = 1 ksf

$q_f = \frac{\sigma_1 - \sigma_3}{2} = 1.89$ ksf
$P_f = \frac{\sigma_1 + \sigma_3}{2} = 2.89$ ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295

sh A-17

TEST 2

SAMPLE HEIGHT	=	2.90 INCHES	BORING NO	GT-2T71
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02A
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY to CLAY

γ_d = 102.1 pcf
ω_i = 21.0%

Unsaturated.

CONFINING PRESS	=	20.83 PSI
CELL PRESSURE	=	20.83 PSI = 3 ksf

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.20	12.00	0.41	1.61	0.59	2.09	0.30
18.20	28.00	0.96	1.62	0.81	2.31	0.40
21.50	45.00	1.55	1.63	0.95	2.45	0.48
24.30	55.00	1.89	1.63	1.07	2.57	0.54
26.50	71.00	2.45	1.64	1.16	2.66	0.58
34.90	140.00	4.82	1.69	1.49	2.99	0.75
41.10	212.00	7.30	1.73	1.71	3.21	0.86
45.60	284.00	9.78	1.78	1.85	3.35	0.92
49.80	354.00	12.19	1.83	1.96	3.46	0.98
53.70	435.00	14.98	1.89	2.05	3.55	1.02

σ_1 = 7.1 ksf
σ_3 = 3 ksf

q_f = 2.05 ksf
P_f = 5.05 ksf

1 tsf = 2 ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

Sh A-18

TEST 3

SAMPLE HEIGHT	=	2.98 INCHES	BORING NO	GT-2T71
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02A
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT
			SAMPLE	
$\gamma_d = 101.9$ pcf		Unsaturated.	DESCRIPTION	Greyish brown, silty
$w_i = 21.1\%$				CLAY to CLAY
CONFINING PRESS	=	41.63 PSI		
CELL PRESSURE	=	41.63 PSI = 6 ksf		

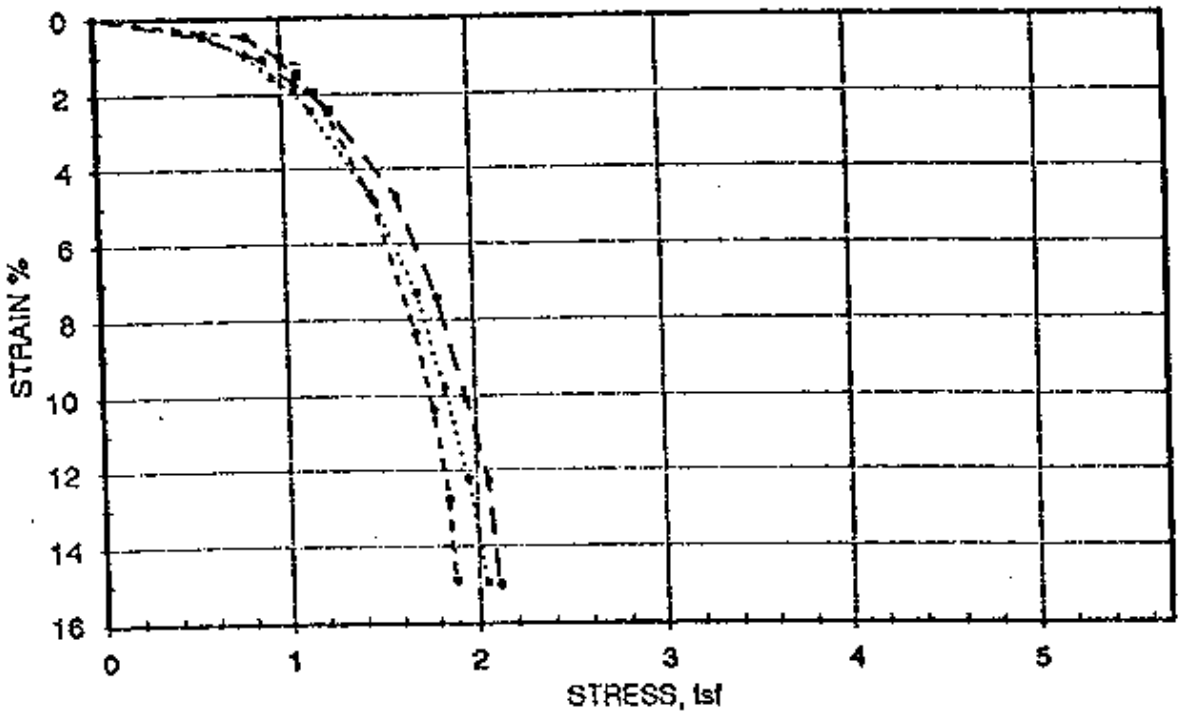
LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
13.00	14.00	0.47	1.61	0.58	3.58	0.29
20.20	32.00	1.07	1.62	0.90	3.90	0.45
24.10	49.00	1.65	1.63	1.07	4.06	0.53
26.20	58.00	1.95	1.63	1.15	4.15	0.58
28.70	72.00	2.42	1.64	1.26	4.26	0.63
37.70	141.00	4.73	1.68	1.61	4.61	0.81
43.70	221.00	7.42	1.73	1.82	4.82	0.91
48.50	300.00	10.07	1.78	1.96	4.96	0.98
52.30	365.00	12.26	1.83	2.06	5.06	1.03
55.20	447.00	15.01	1.88	2.11	5.11	1.05

$\sigma_1 = 10.22$ ksf
$\sigma_3 = 6$ ksf

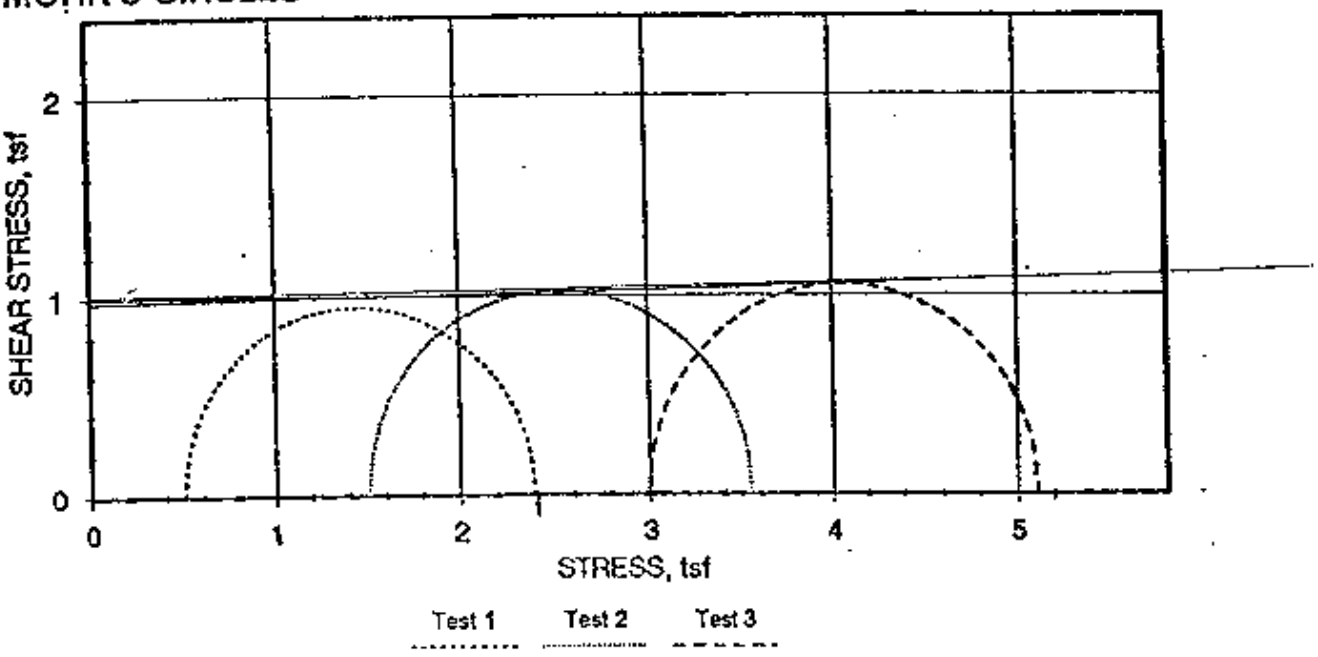
$q_f = 2.11$ ksf
$p_f = 8.11$ ksf

SHA-119

WSSRAP; JOB NO: 11295
UNCONSOLIDATED, UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: GT-2T71
Sample No: BU-02A
Depth: 6.5-12 FT

Sh A-120

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

TEST 1

SAMPLE HEIGHT	=	2.75 INCHES	BORING NO	GT-2775
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.60 IN^2	DEPTH	
			SAMPLE DESCRIPTION	Brown, silty CLAY

$\gamma_t = 89.9$ pcf
$w_i = 41.9\%$
Unsaturated.

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	1.00	0.04	1.60	0.25	0.75	0.12
12.90	16.00	0.58	1.61	0.58	1.08	0.29
15.90	31.00	1.13	1.62	0.71	1.21	0.35
18.00	43.00	1.56	1.63	0.80	1.30	0.40
20.30	56.00	2.03	1.63	0.89	1.39	0.45
27.80	122.00	4.43	1.68	1.19	1.69	0.60
33.90	179.00	6.50	1.71	1.42	1.92	0.71
49.50	313.00	11.37	1.81	1.97	2.47	0.99
62.70	428.00	15.55	1.90	2.38	2.88	1.19

σ_1 5.76 ksf
σ_3 = 1 ksf

$q_f = 2.38$ ksf
$p_f = 3.38$ ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

SH A-121

TEST 2

SAMPLE HEIGHT	=	2.87 INCHES	BORING NO	GT-2T75
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.59 IN^2	DEPTH	
			SAMPLE DESCRIPTION	Brown, silty CLAY

$\gamma_d = 104.1$ pcf Unsaturated.
$\omega_i = 18.7\%$

CONFINING PRESS	=	20.83 PSI
CELL PRESSURE	=	20.83 PSI = 3ksf

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.90	13.00	0.45	1.60	0.58	2.08	0.29
14.80	28.00	0.98	1.61	0.66	2.16	0.33
16.30	42.00	1.47	1.62	0.73	2.22	0.36
17.20	56.00	1.95	1.63	0.76	2.26	0.38
18.20	70.00	2.44	1.63	0.80	2.30	0.40
22.70	140.00	4.89	1.68	0.97	2.47	0.49
27.20	211.00	7.36	1.72	1.14	2.64	0.57
31.40	281.00	9.81	1.77	1.28	2.78	0.64
36.20	352.00	12.29	1.82	1.43	2.93	0.72
41.60	441.00	15.39	1.89	1.59	3.09	0.79
41.80	465.00	16.23	1.90	1.58	3.08	0.79

$\sigma_1 = 6.16$ ksf
$\sigma_3 = 3$ ksf

$q_f = 1.58$ ksf
$p_f = 4.58$ ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

Sh A-122

TEST 3

SAMPLE HEIGHT	=	2.97 INCHES	BORING NO	GT-2T75
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-01A
SAMPLE AREA	=	1.61 IN^2	DEPTH	
			SAMPLE DESCRIPTION	Brown, silty CLAY

$\gamma_d = 103.9$ pcf ∴ Unsaturated.
$w_i = 18.7\%$

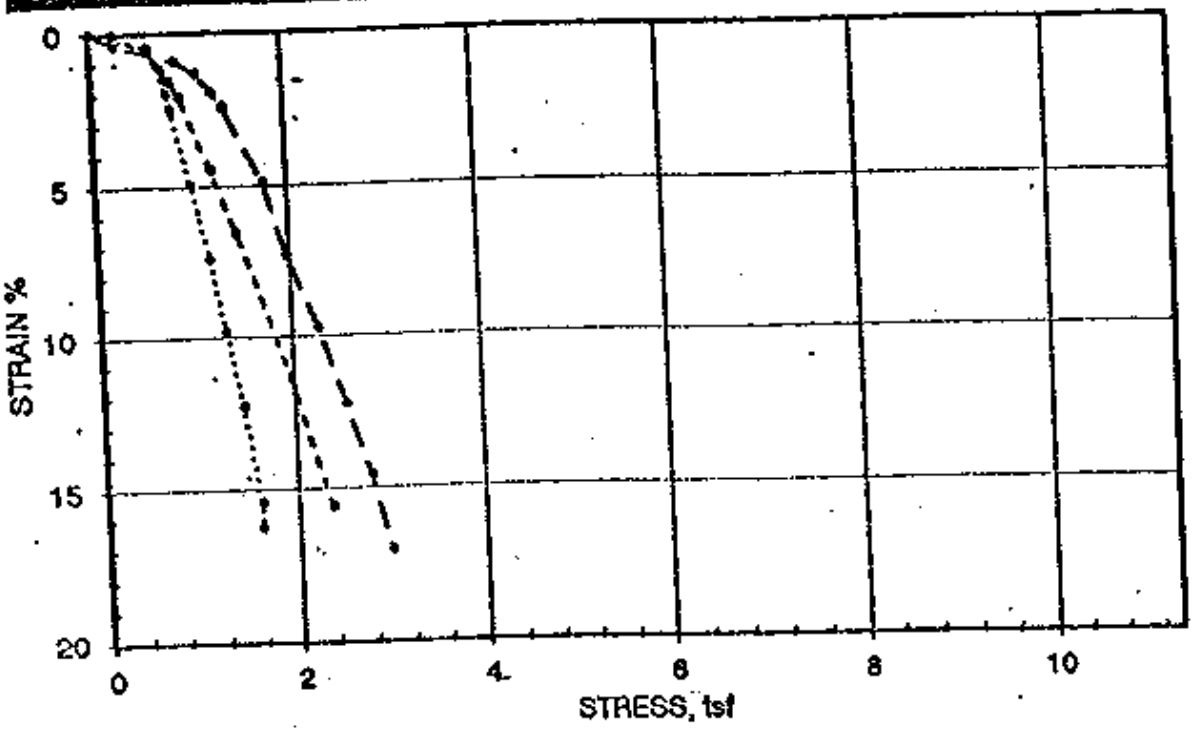
CONFINING PRESS	=	43.50 PSI
CELL PRESSURE	=	43.50 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.50	12.00	0.40	1.61	0.25	3.38	0.12
19.30	27.00	0.91	1.62	0.86	3.99	0.43
24.20	39.00	1.31	1.63	1.07	4.20	0.54
27.80	56.00	1.89	1.64	1.22	4.35	0.61
30.50	71.00	2.39	1.65	1.33	4.47	0.67
40.70	144.00	4.85	1.69	1.74	4.87	0.87
47.40	215.00	7.24	1.73	1.97	5.10	0.99
56.60	288.00	9.70	1.78	2.29	5.42	1.15
65.10	364.00	12.26	1.83	2.56	5.69	1.28
72.90	432.00	14.55	1.88	2.79	5.92	1.40
80.20	505.00	17.01	1.94	2.98	6.12	1.49

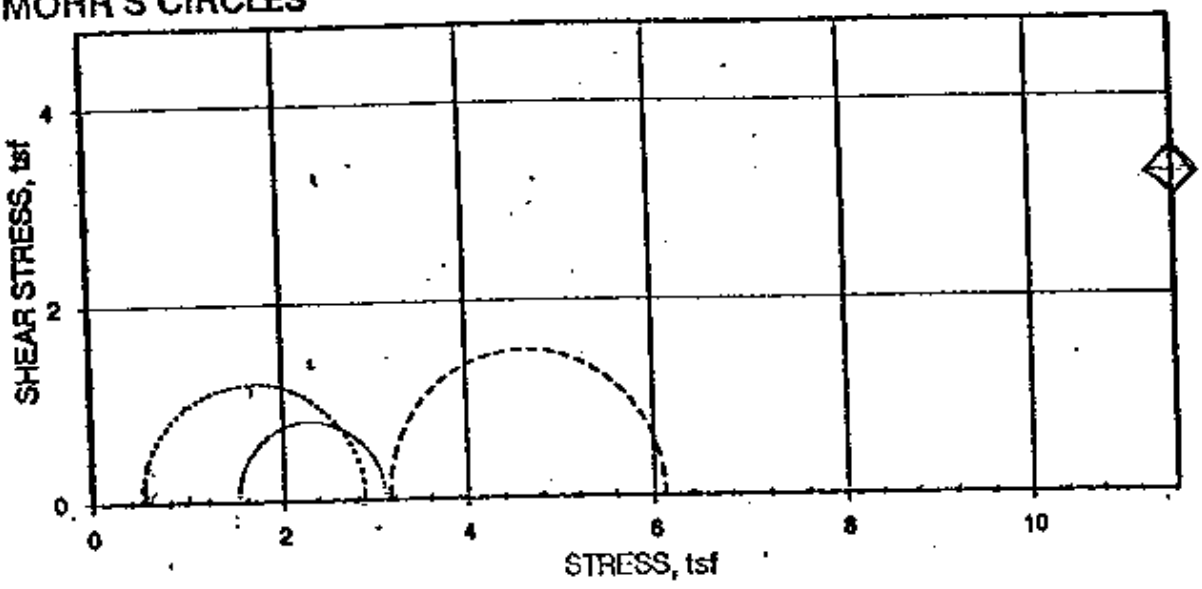
$\sigma_1 = 12.24$ ksf $q_f = 2.99$ ksf
$\sigma_3 = 6.26$ ksf $P_f = 9.25$ ksf

Sh A123

WSSRAP, JOB NO. 11295
UNCONSOLIDATED-UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Test 1 Test 2 Test 3

Boring No: GT-2T75
Sample No: BU-01A
Depth:

Reguest #3
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: WWCAP
LOCATION ID: 1295
DATE: 1-4-90
LAB NAME: Geotechnology, Inc
CHECKED BY: LAB YT
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
TP85-1 2A	2.6 - 7.1	97.1	1000
		97.3	3000
		97.5	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
107.6	17.6	87.9	.57
107.5	18.4	89.6	.57
107.7	17.9	85.6	.56
107.5	18.3		

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	18.3	Unsaturated	
	18.2		
	17.0		

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

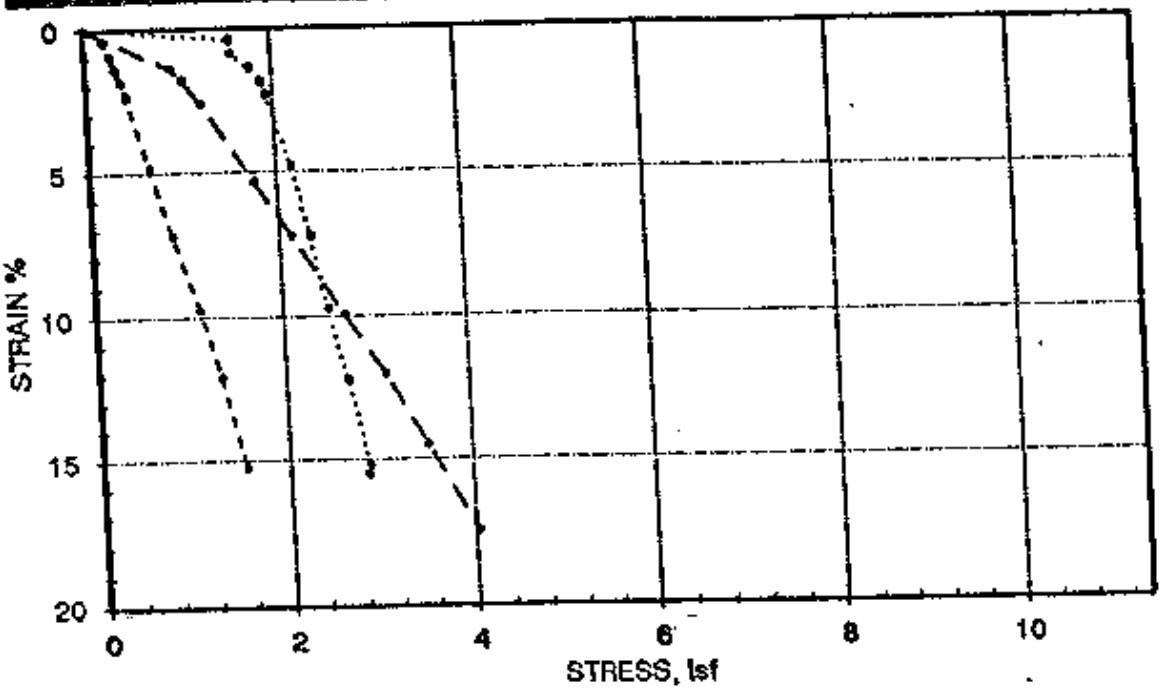
AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

see attached table

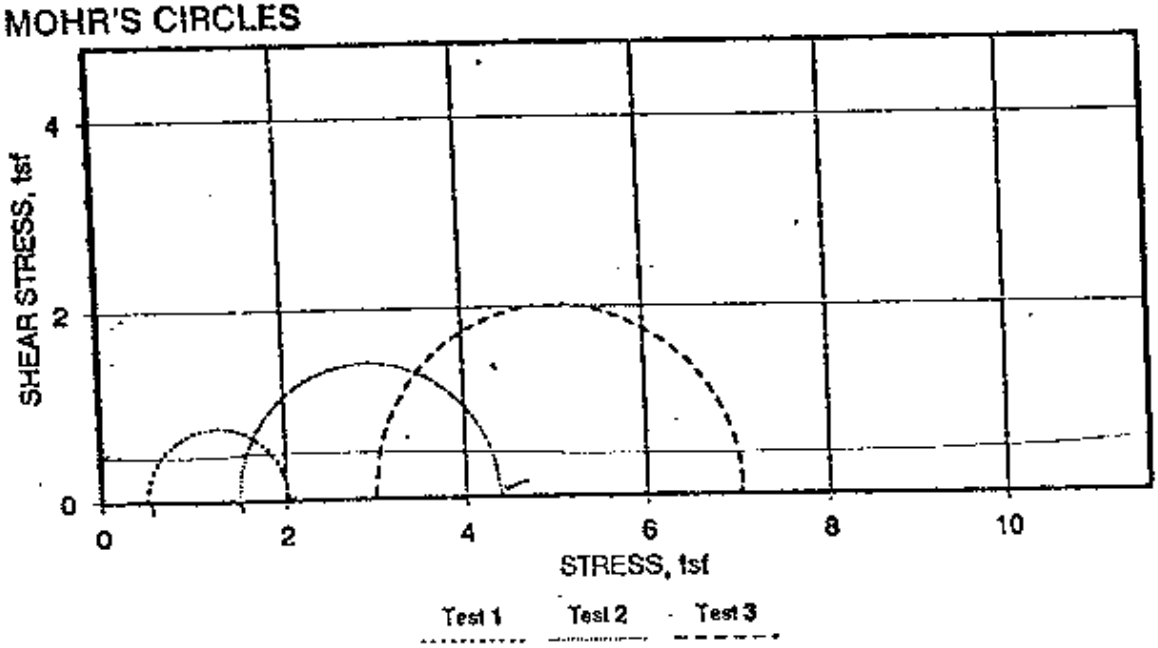
ATTACHMENT

Sh A125

WSSRAP - JOB NO:- 11295
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: TPBS-1
Sample No: 2A
Depth: 2.6 - 7.1

Sh A-126

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

TEST 1

SAMPLE HEIGHT	=	2.90 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	2.6 - 7.1
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESSURE = 6.94 PSI , 99 1ksf
CELL PRESSURE = 6.94 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.50	12.00	0.41	1.60	0.20	0.70	0.10
5.90	26.00	0.90	1.61	0.26	0.76	0.13
7.00	40.00	1.38	1.62	0.31	0.81	0.16
8.10	53.00	1.83	1.62	0.36	0.86	0.18
9.30	68.00	2.35	1.63	0.41	0.91	0.21
14.70	140.00	4.83	1.68	0.63	1.13	0.32
20.00	208.00	7.18	1.72	0.84	1.34	0.42
26.80	282.00	9.73	1.77	1.09	1.59	0.55
32.60	350.00	12.08	1.81	1.29	1.79	0.65
40.10	441.00	15.22	1.88	1.53	$\boxed{2.03}$	0.77

$\frac{1t}{2000}$ = ~~2000~~ P

$\frac{6.94}{2000} \times 1kL$

1.53 + 1 = 2.53 =

$\sigma_1 = 2.03\,tsf = 4.06\,ksf$

$\sigma_3 = 1\,ksf$

$q_f = 1.53$

$p_f = 2.53$

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295

SHA127

TEST 2

SAMPLE HEIGHT	=	2.87 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.60 IN^2	DEPTH	2.6 - 7.1
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	20.82 PSI
CELL PRESSURE	=	20.82 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
34.20	11.00	0.38	1.60	1.54	3.03	0.77
34.60	25.00	0.87	1.61	1.55	3.05	0.77
39.50	39.00	1.36	1.62	1.76	3.26	0.88
42.40	53.00	1.85	1.63	1.88	3.38	0.94
43.80	66.00	2.30	1.63	1.93	3.43	0.96
50.50	138.00	4.81	1.68	2.17	3.67	1.08
56.00	208.00	7.25	1.72	2.34	3.84	1.17
61.50	279.00	9.73	1.77	2.50	4.00	1.25
67.70	350.00	12.21	1.82	2.68	4.18	1.34
75.00	435.00	15.17	1.88	2.87	4.37	1.43
74.80	444.00	15.49	1.89	2.85	4.35	1.42

$\sigma_1 = 4.37$

$\sigma_3 = 3$

$\varphi_f = .685$

$P_f = 3.685$

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295

Sh A-128

TEST 3

SAMPLE HEIGHT	=	2.92 INCHES	BORING NO	TPBS-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.60 IN^2	DEPTH	2.6 - 7.1
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	41.67 PSI
CELL PRESSURE	=	41.67 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.40	40.00	1.37	1.63	0.90	3.90	0.45
23.10	52.00	1.78	1.63	1.02	4.02	0.51
27.50	76.00	2.60	1.65	1.20	4.20	0.60
41.40	156.00	5.34	1.69	1.76	4.76	0.88
51.40	211.00	7.22	1.73	2.14	5.14	1.07
66.30	290.00	9.93	1.78	2.68	5.68	1.34
77.90	350.00	11.98	1.82	3.08	6.08	1.54
91.90	423.00	14.48	1.88	3.53	6.53	1.76
109.20	511.00	17.49	1.94	4.04	7.04	2.02

$\sigma_1 = 7.04$
$\sigma_3 = 6$

$\varphi_f = 1.52$
$P_f = 6.52$

$C = 0.912$ ksf
$= 900$ psf

GEOTECHNOLOGY INC

UNCONSOLIDATED – UNDRAINED TEST DATA

WSSRAP – JOB NO:- 11295

Sh A-129

TEST 3

SAMPLE HEIGHT	=	2.88 INCHES	BORING NO	TPB5-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.61 IN^2	DEPTH	7.1 - 9.2 FT
			SAMPLE DESCRIPTION	Brown silty CLAY trace fine gravel and sand

γ_d = 100.9 pcf
w_i = 21.6 %

- Unsaturated

CONFINING PRESS	=	41.63 PSI
CELL PRESSURE	=	41.63 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.70	14.00	0.49	1.61	0.88	3.88	0.44
27.40	27.00	0.94	1.62	1.22	4.21	0.61
37.50	54.00	1.88	1.64	1.65	4.65	0.82
40.90	69.00	2.40	1.65	1.79	4.79	0.89
43.80	83.00	2.89	1.65	1.91	4.90	0.95
52.60	150.00	5.22	1.69	2.24	5.23	1.12
57.80	211.00	7.34	1.73	2.40	5.40	1.20
62.60	282.00	9.81	1.78	2.53	5.53	1.27
66.50	350.00	12.17	1.83	2.62	5.62	1.31
70.10	441.00	15.34	1.90	2.66	5.66	1.33

σ_1 = 11.32 ksf
σ_3 = 6 ksf

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

SH A-130

TEST 2

SAMPLE HEIGHT	=	2.92 INCHES	BORING NO	TPB5-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.61 IN^2	DEPTH	7.1 - 9.2 FT
			SAMPLE DESCRIPTION	Brown silty CLAY trace fine gravel and sand

γ_d = 101.3 pcf
ω = 21.8%

Unsaturated

CONFINING PRESS	=	20.83 PSI
CELL PRESSURE	=	20.83 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.40	5.00	0.17	1.61	0.78	2.28	0.39
23.50	15.00	0.51	1.61	1.05	2.55	0.52
28.60	31.00	1.06	1.62	1.27	2.77	0.63
32.60	49.00	1.68	1.63	1.44	2.94	0.72
35.70	67.00	2.29	1.64	1.56	3.06	0.78
45.80	140.00	4.79	1.69	1.95	3.45	0.98
52.70	212.00	7.26	1.73	2.19	3.69	1.10
56.60	280.00	9.59	1.78	2.29	3.79	1.15
60.60	351.00	12.02	1.83	2.39	3.89	1.20
65.10	438.00	15.00	1.89	2.48	3.98	1.24

σ_1 = 7.96

σ_3 =

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

Sh A-131

TEST 1

SAMPLE HEIGHT	=	2.91 INCHES	BORING NO	TPB5-1
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.61 IN^2	DEPTH	7.1 - 9.2 FT
			SAMPLE DESCRIPTION	Brown silty CLAY trace fine gravel and sand
γ_d = 99.9 pcf		- Unsaturated		
w_i = 22.0 %				
CONFINING PRESSURE	=	6.90 PSI		
CELL PRESSURE	=	6.90 PSI		

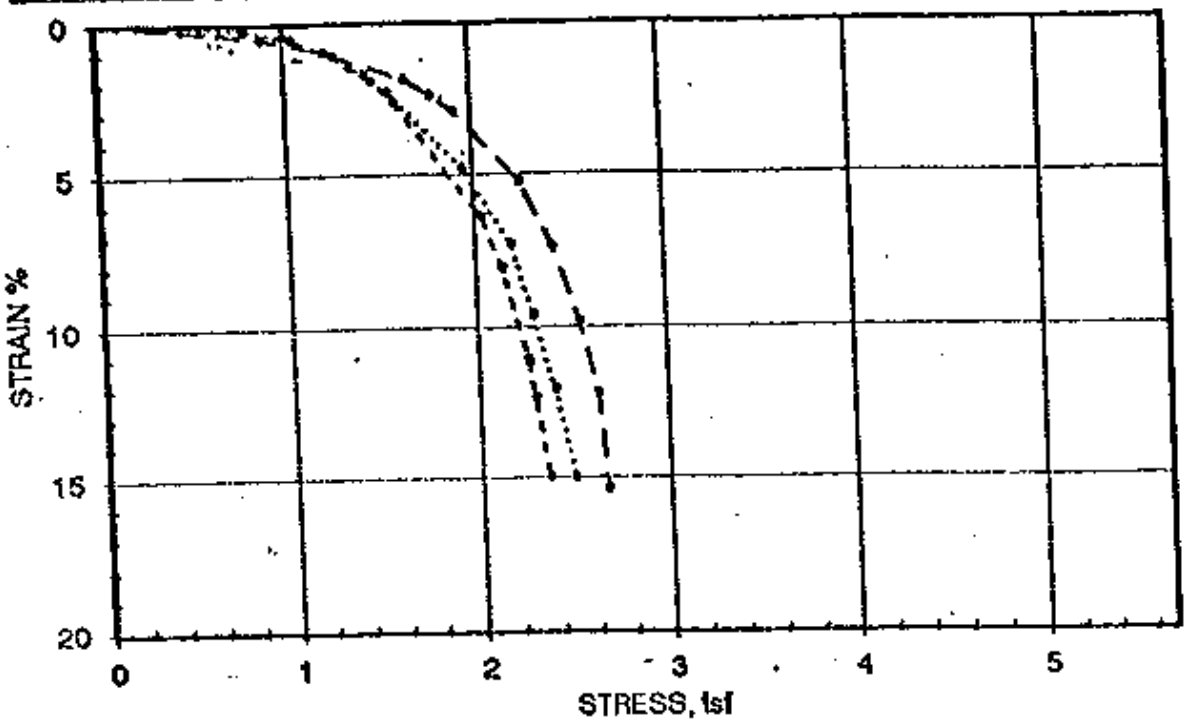
LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.70	12.00	0.41	1.62	1.01	1.51	0.50
27.70	28.00	0.96	1.63	1.22	1.72	0.61
30.90	42.00	1.44	1.64	1.36	1.86	0.68
33.60	56.00	1.92	1.64	1.47	1.97	0.74
36.50	75.00	2.58	1.66	1.59	2.08	0.79
48.90	184.00	6.32	1.72	2.04	2.54	1.02
52.10	233.00	8.01	1.75	2.14	2.64	1.07
57.00	322.00	11.07	1.81	2.26	2.76	1.13
58.50	358.00	12.30	1.84	2.29	2.79	1.15
61.90	435.00	14.95	1.90	2.35	2.85	1.18

$\sigma_1 = 5.7$

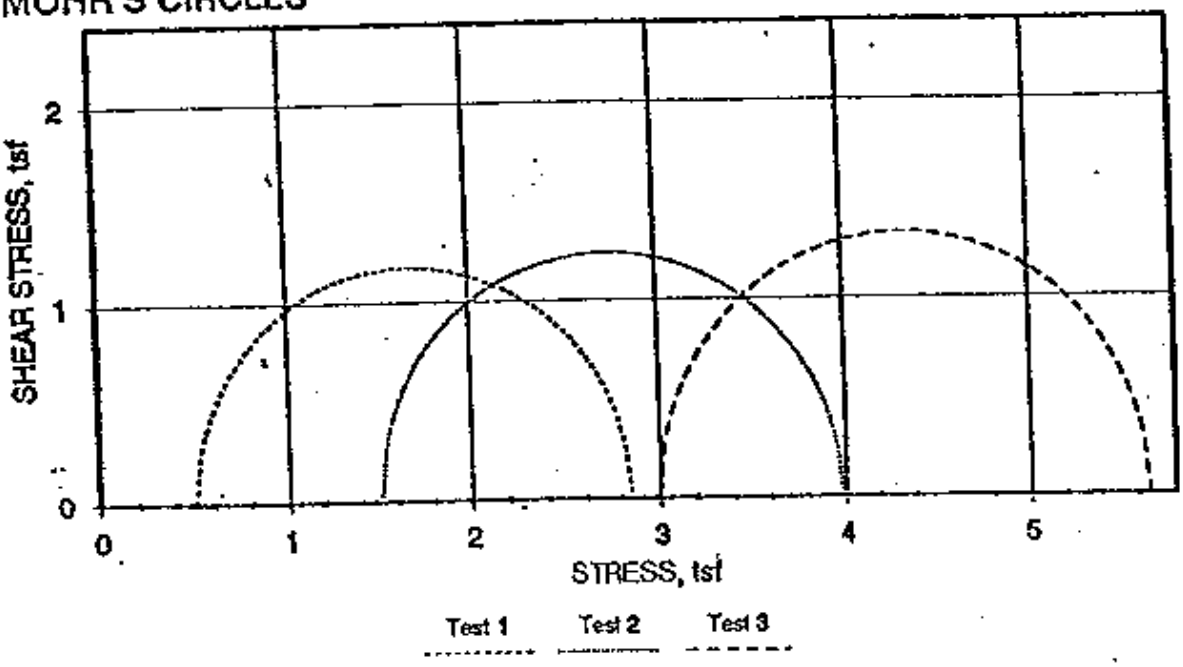
$\sigma_3 = 1$

Sh A-132

WSSRAP JOB NO. 11295
UNCONSOLIDATED UNDRAINED TEST
STRESS PATH



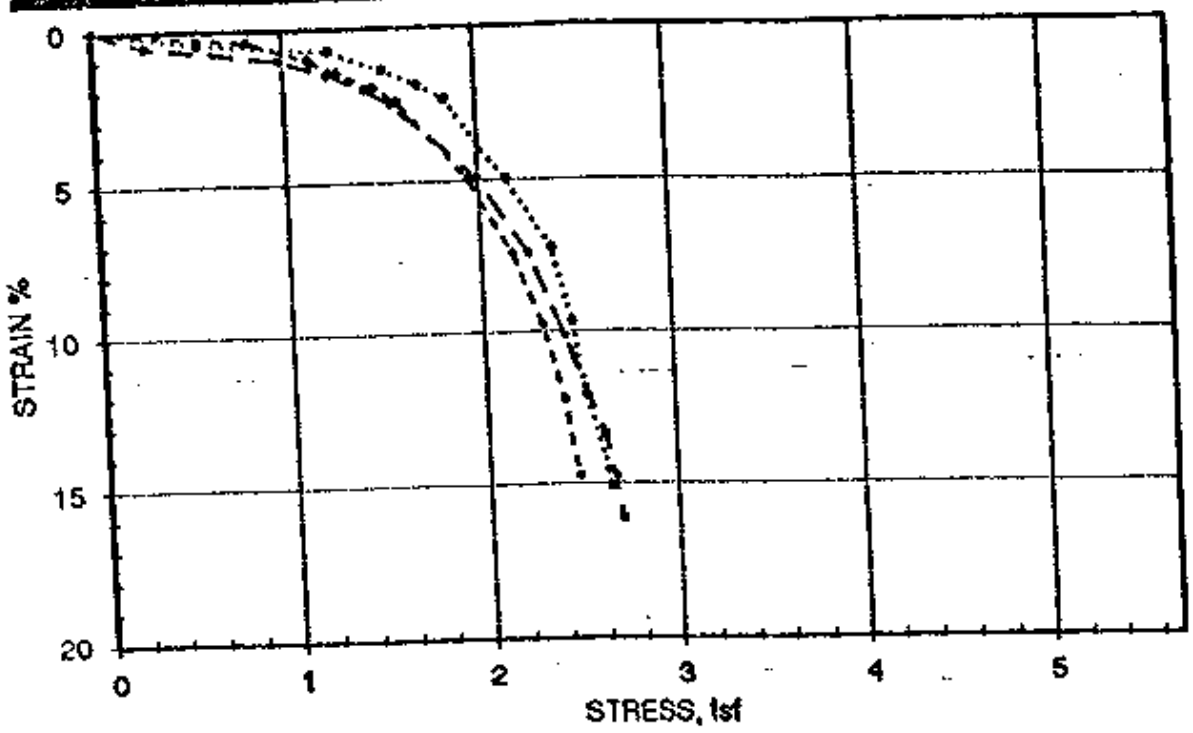
MOHR'S CIRCLES



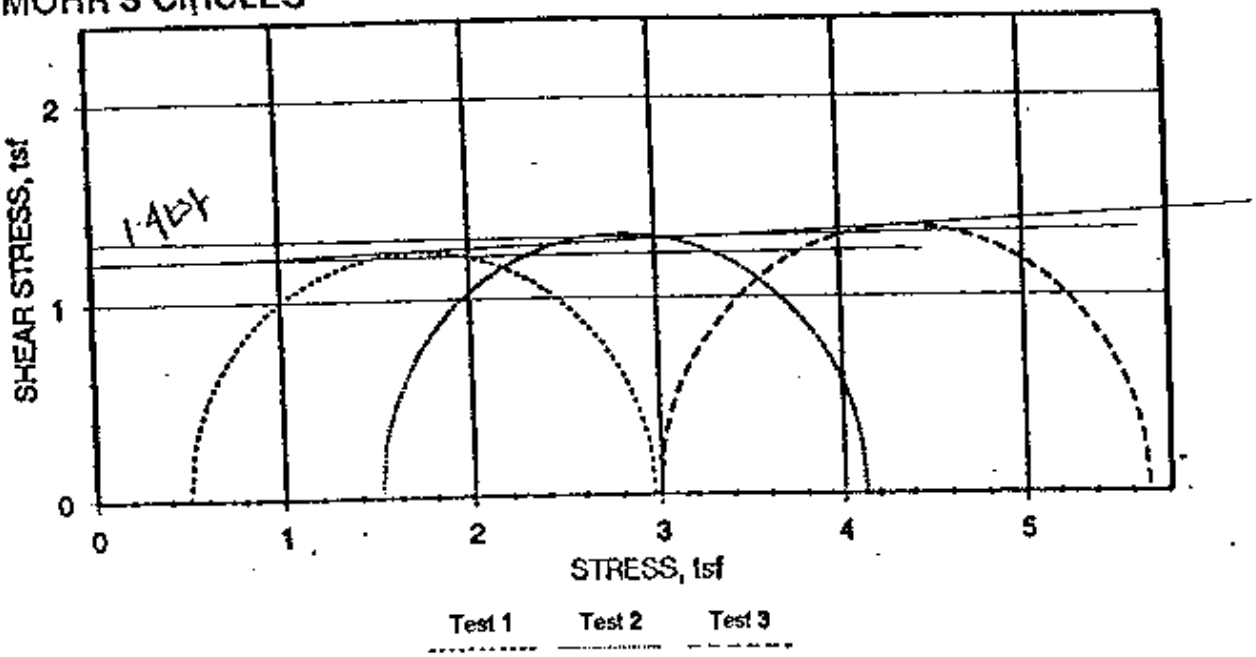
Boring No: TPB5-1
Sample No: 3A
Depth: 7.1 - 9.2 FT

Sh A-133

WSSRAP, JOB NO. 11295
UNCONSOLIDATED, UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: TPB-8
Sample No: 3A
Depth: 8.5 - 11.5 FT

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

Sh A-134

TEST 1

SAMPLE HEIGHT	=	2.99 INCHES	BORING NO	TPB-8
SAMPLE DIAMETER	=	1.44 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.62 IN^2	DEPTH	8.5 - 11.5 FT
γ_d = 98.8 pcf			SAMPLE DESCRIPTION	Gray silty CLAY to CLAY
w_i = 21 %				
CONFINING PRESSURE	=	6.90 PSI		
CELL PRESSURE	=	6.90 PSI		

LOAD	STRAIN DIAL	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS	MAJOR PR.STR	SHEAR STRESS
p	div			tsf	tsf	tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
18.20	12.00	0.40	1.62	0.81	1.30	0.40
25.90	30.00	1.00	1.63	1.14	1.64	0.57
29.10	43.00	1.44	1.64	1.28	1.77	0.64
33.40	58.00	1.94	1.65	1.46	1.95	0.73
36.30	72.00	2.41	1.66	1.58	2.07	0.79
46.10	147.00	4.91	1.70	1.95	2.45	0.98
52.70	221.00	7.38	1.75	2.17	2.67	1.09
57.40	292.00	9.76	1.79	2.31	2.80	1.15
61.70	367.00	12.26	1.84	2.41	2.91	1.20
65.10	441.00	14.73	1.90	2.47	2.97	1.24

$\sigma_1 = 5.94$

$\sigma_3 = 1$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295

SH A-135

TEST 2

SAMPLE HEIGHT	=	2.98 INCHES	BORING NO	TPB-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.62 IN^2	DEPTH	8.5 - 11.5 FT
			SAMPLE DESCRIPTION	Gray silty CLAY to CLAY

$\gamma_d = 99.6$ pcf
$w_i = 21.7\%$

CONFINING PRESS	=	20.80 PSI
CELL PRESSURE	=	20.80 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
12.40	13.00	0.44	1.62	0.55	2.05	0.28
28.10	22.00	0.74	1.63	1.24	2.74	0.62
34.40	41.00	1.38	1.64	1.51	3.01	0.76
38.60	56.00	1.88	1.65	1.69	3.19	0.84
42.00	70.00	2.35	1.65	1.83	3.33	0.91
50.80	147.00	4.93	1.70	2.15	3.65	1.08
57.20	215.00	7.21	1.74	2.37	3.86	1.18
61.10	288.00	9.66	1.79	2.46	3.96	1.23
64.40	361.00	12.11	1.84	2.52	4.02	1.26
68.80	434.00	14.56	1.89	2.62	4.12	1.31
69.40	449.00	15.07	1.90	2.63	4.13	1.31

$\sigma_1 = 8.26$
$\sigma_3 = 3$

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295

Sh A-136

TEST 3

SAMPLE HEIGHT	=	2.96 INCHES	BORING NO	TPB-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	3A
SAMPLE AREA	=	1.61 IN^2	DEPTH	8.5 - 11.5 FT
			SAMPLE DESCRIPTION	Grey silty CLAY to CLAY

$\gamma_d = 100.2$ pcf

$w_i = 20.8\%$

CONFINING PRESS	=	41.63 PSI
CELL PRESSURE	=	41.63 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.10	15.00	0.51	1.61	0.27	3.27	0.14
22.10	29.00	0.98	1.62	0.98	3.98	0.49
27.90	44.00	1.49	1.63	1.23	4.23	0.62
32.30	59.00	1.99	1.64	1.42	4.42	0.71
35.50	73.00	2.47	1.65	1.55	4.55	0.78
46.90	145.00	4.90	1.69	2.00	5.00	1.00
54.30	218.00	7.36	1.73	2.25	5.25	1.13
60.10	299.00	10.10	1.79	2.42	5.42	1.21
67.30	396.00	13.38	1.85	2.61	5.61	1.31
69.50	436.00	14.73	1.88	2.68	5.65	1.33
71.60	477.00	16.11	1.91	2.69	5.69	1.35

$\sigma_1 = 11.38$ ksf

$\sigma_3 = 6$ ksf

Request # 3
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: WJJRAP
LOCATION ID: Borrow Source 411
DATE: 1-9-90
LAB NAME: Geotechnology Inc.
CHECKED BY: LAB 47
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
TPBJ-6 1A	0.6-9.1	95.2	1000
		96.0	3000
		95.7	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
98.0	22.5	87.2	0.68
98.6	22.5	89.0	0.67
95.5	22.5	88.3	0.67

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	21.6	Unsaturated	
	22.6		
	22.1		

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

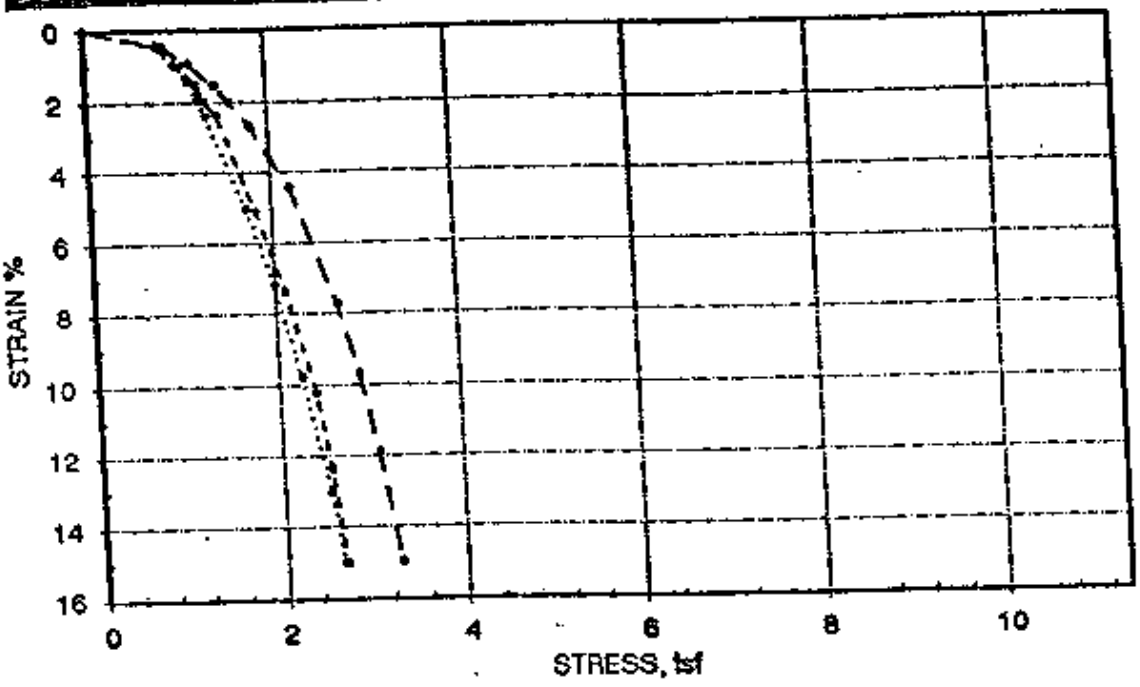
See attached tables

Sh A-137

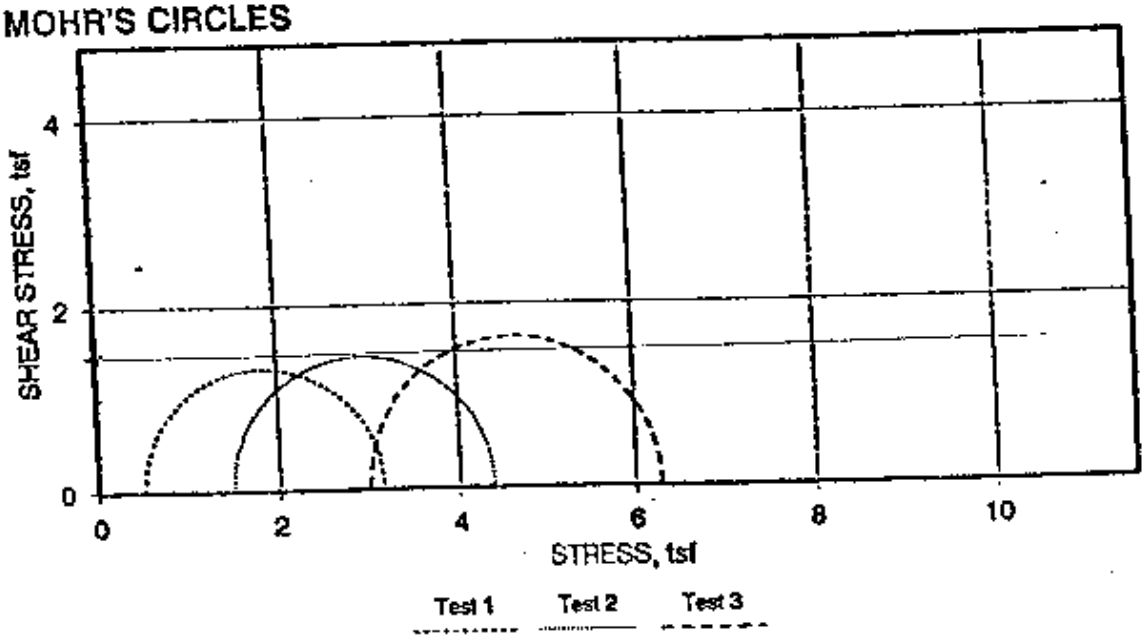
ATTACHMENT

Sh. A-138

WSSRAP - JOB NO:- 11295,000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: TPBS-6
Sample No: 1A
Depth: 0.6-9.1

Sh A-139

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

TEST 1

SAMPLE HEIGHT	=	2.96 INCHES	BORING NO	TPB5-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	0.6-9.1
			SAMPLE DESCRIPTION	

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.80	14.00	0.47	1.60	0.80	1.30	0.40
23.80	29.00	0.98	1.61	1.06	1.56	0.53
27.60	44.00	1.49	1.62	1.23	1.73	0.61
30.20	58.00	1.96	1.63	1.34	1.84	0.67
33.20	70.00	2.37	1.63	1.46	1.96	0.73
43.00	151.00	5.10	1.68	1.84	2.34	0.92
50.70	218.00	7.37	1.72	2.12	2.62	1.06
59.10	302.00	10.21	1.78	2.40	2.90	1.20
64.20	365.00	12.34	1.82	2.54	3.04	1.27
69.40	444.00	15.01	1.88	2.66	3.16	1.33

$\sigma_1 = 3.16 \text{ tsf} = 6.32 \text{ ksf}$

$\sigma_3 = 6.94 \text{ psi} = .9994 \approx 1 \text{ ksf}$

$q_f = \frac{\sigma_1 - \sigma_3}{2} = 2.66 \text{ ksf}$

$p_f = \frac{\sigma_1 + \sigma_3}{2} = 3.66 \text{ ksf}$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

Sh A-140

TEST 2

SAMPLE HEIGHT	=	2.94 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	0.6-9.1
			SAMPLE DESCRIPTION	

CONFINING PRESS	=	20.80 PSI
CELL PRESSURE	=	20.80 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
17.60	13.00	0.44	1.60	0.79	2.29	0.40
22.10	28.00	0.95	1.61	0.99	2.49	0.49
25.40	41.00	1.40	1.62	1.13	2.63	0.57
28.20	57.00	1.94	1.63	1.25	2.75	0.62
30.30	70.00	2.38	1.63	1.34	2.83	0.67
40.60	148.00	5.04	1.68	1.74	3.24	0.87
48.00	213.00	7.18	1.72	2.01	3.51	1.01
55.50	287.00	9.77	1.77	2.26	3.76	1.13
64.10	383.00	13.04	1.83	2.52	4.01	1.26
68.90	441.00	15.01	1.88	2.64	4.14	1.32

$\sigma_1 = 4.14 \text{ tsf} = 8.28 \text{ ksf}$

$\sigma_3 = 20.8 \text{ psi} = 2.9952 \approx 3 \text{ ksf}$

$q_f = \frac{\sigma_1 - \sigma_3}{2} = 2.64 \text{ ksf}$

$p_f = \frac{\sigma_1 + \sigma_3}{2} = 5.64 \text{ ksf}$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

Sh A-141

TEST 3

SAMPLE HEIGHT	=	2.98 INCHES	BORING NO	TPB5-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	0.6-9.1
			SAMPLE DESCRIPTION	

CONFINING PRESS	=	41.64 PSI
CELL PRESSURE	=	41.64 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
19.40	14.00	0.47	1.60	0.87	3.87	0.44
25.80	28.00	0.94	1.61	1.15	4.15	0.58
32.40	45.00	1.51	1.62	1.44	4.44	0.72
36.20	59.00	1.98	1.63	1.60	4.60	0.80
41.50	80.00	2.68	1.64	1.82	4.82	0.91
51.50	132.00	4.43	1.67	2.22	5.22	1.11
64.40	230.00	7.71	1.73	2.68	5.68	1.34
70.90	289.00	9.69	1.77	2.89	5.89	1.45
77.40	354.00	11.87	1.81	3.08	6.08	1.54
85.70	447.00	14.99	1.88	3.29	6.29	1.64

$\sigma_1 = 6.29\ ksf = 12.58\ ksf$

$\sigma_3 = 41.64\ psi = 5.9962 \approx 6\ ksf$

$q_f = \frac{\sigma_1 - \sigma_3}{2} = 3.29\ ksf$

$p_f = \frac{\sigma_1 + \sigma_3}{2} = 9.29\ ksf$

Request # 3
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: WSJ RAP
LOCATION ID: Borrow Source # 1
DATE: 1-9-90
LAB NAME: Geotechnology, Inc
CHECKED BY: LAB 99
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
TPBJ-6 2A	9.1-12.1	98.8	1000
		97.1	3000
		97.7	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
99.1	20.1	78.6	0.73
98.4	22.0	81.7	0.74
98.0	21.6	79.4	0.73

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	22.1	Unsaturated	
	21.8		
	21.7		

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

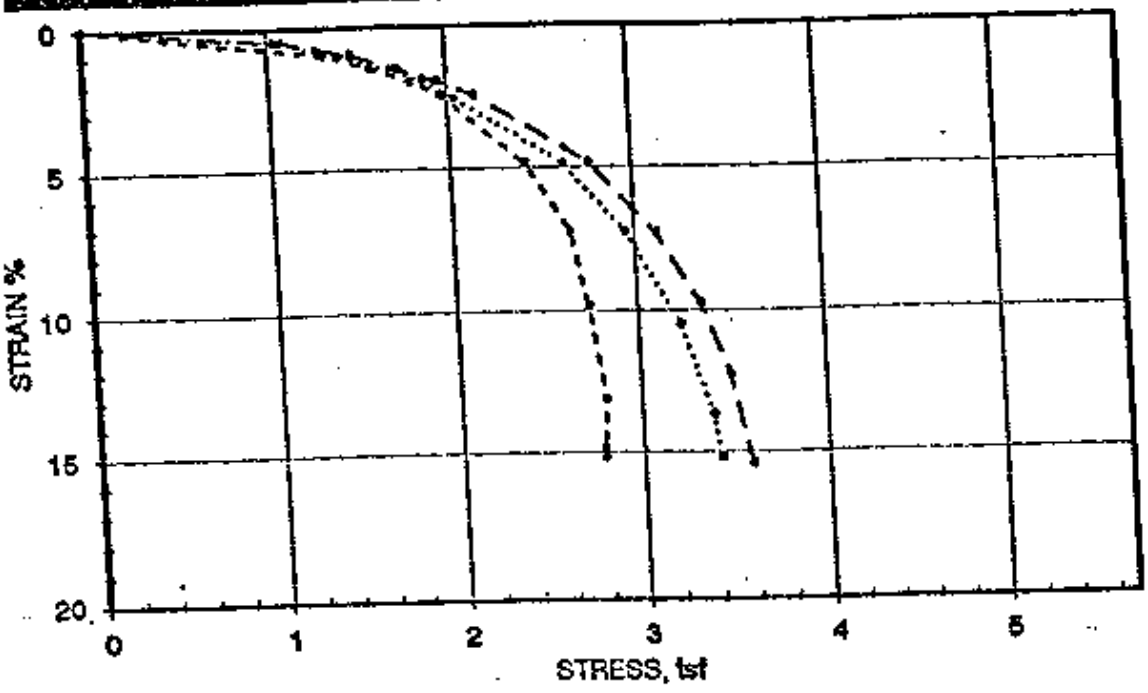
See attached tables

Sh A-142

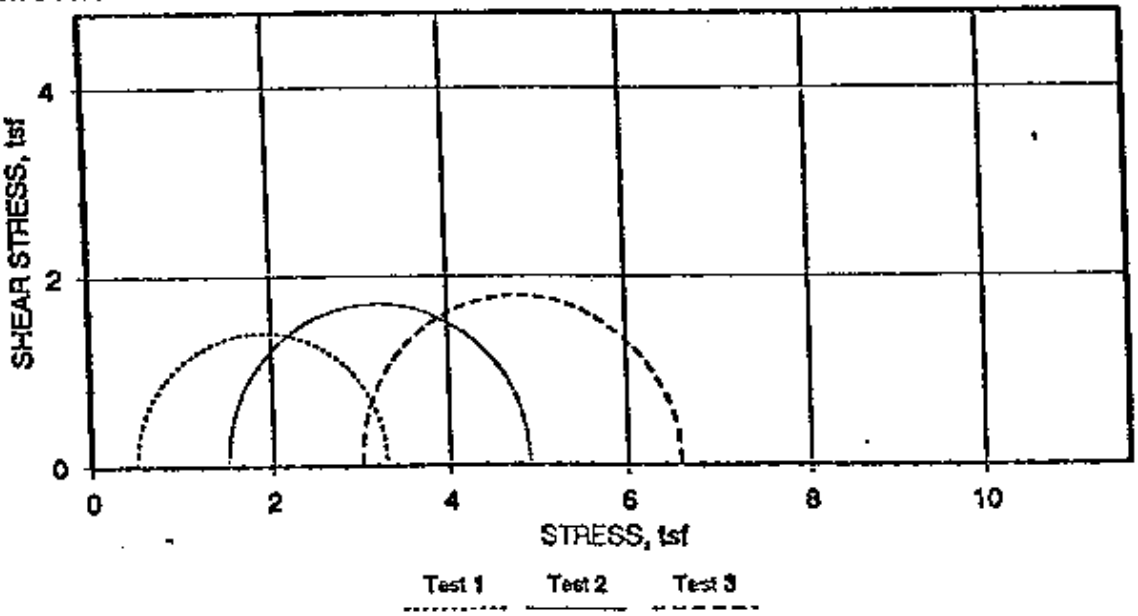
ATTACHMENT

Sh A143

WSSRAP - JOB NO: - 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: TPBS-6
Sample No: 2A
Depth: 8.1-12.1 FT.

checked k

SHA-144

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

TEST 1

SAMPLE HEIGHT	=	2.97 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	9.1-12.1 FT.
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
29.40	28.00	0.94	1.61	1.31	1.81	0.66
35.30	42.00	1.42	1.62	1.57	2.07	0.79
40.60	57.00	1.92	1.63	1.80	2.30	0.90
44.70	71.00	2.39	1.63	1.97	2.47	0.98
56.20	143.00	4.82	1.68	2.41	2.91	1.21
63.10	214.00	7.22	1.72	2.64	3.14	1.32
67.10	291.00	9.81	1.77	2.73	3.23	1.37
71.30	388.00	13.08	1.83	2.80	3.30	1.40
72.40	440.00	14.83	1.87	2.78	3.28	1.39
72.60	449.00	15.14	1.88	2.78	3.28	1.39

$\sigma_1 = 3.30 \text{ tsf} = 6.6 \text{ ksf}$

$\sigma_3 = 6.94 \text{ tsf} = 1 \text{ ksf}$

$\gamma_f = \frac{6.6-1}{2} = 2.8 \text{ ksf}$

$P_f = \frac{6.6+1}{2} = 3.8 \text{ ksf}$

sh A 145

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

TEST 2

SAMPLE HEIGHT	=	2.96 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	9.1-12.1 FT.
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY

CONFINING PRESS	=	20.80 PSI
CELL PRESSURE	=	20.80 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
23.20	14.00	0.47	1.60	1.04	2.54	0.52
31.40	29.00	0.98	1.61	1.40	2.90	0.70
42.20	55.00	1.86	1.63	1.87	3.37	0.93
46.40	74.00	2.50	1.64	2.04	3.54	1.02
61.00	144.00	4.87	1.68	2.62	4.12	1.31
70.50	214.00	7.24	1.72	2.95	4.45	1.48
79.90	309.00	10.46	1.78	3.23	4.73	1.61
86.70	403.00	13.64	1.85	3.38	4.88	1.69
89.10	448.00	15.16	1.88	3.41	(4.91)	1.71

$\sigma_1 = 491 \text{ ksf} = 9.82 \text{ ksf}$

$\sigma_3 = 3 \text{ ksf}$

$q_f = \frac{9.82 - 3}{2} = 3.41 \text{ ksf}$

$p_f = \frac{9.82 + 3}{2} = 6.41 \text{ ksf}$

enclosed

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

Sh A-146

TEST 3

SAMPLE HEIGHT	=	2.94 INCHES	BORING NO	TPBS-6
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	2A
SAMPLE AREA	=	1.59 IN^2	DEPTH	9.1-12.1 FT.
			SAMPLE DESCRIPTION	Grayish brown, silty CLAY

CONFINING PRESS	=	41.64 PSI
CELL PRESSURE	=	41.64 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
24.00	14.00	0.48	1.60	1.08	4.08	0.54
32.70	28.00	0.95	1.61	1.46	4.46	0.73
38.70	43.00	1.46	1.62	1.72	4.72	0.86
44.00	56.00	1.91	1.63	1.95	4.95	0.97
48.80	71.00	2.42	1.63	2.15	5.15	1.07
64.20	142.00	4.83	1.68	2.76	5.76	1.38
74.50	214.00	7.28	1.72	3.12	6.12	1.56
82.00	286.00	9.73	1.77	3.34	6.34	1.67
87.80	359.00	12.22	1.82	3.48	6.48	1.74
93.80	452.00	15.38	1.88	3.58	6.58	1.79

$\sigma_1 = 6.58\ tsf = 13.16\ ksf$

$\sigma_3 = 6\ ksf$

$q_f = \frac{13.16 - 6}{2} = 3.58$

$p_f = \frac{13.16 + 6}{2} = 9.58$

Request # 3
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED - UNDRAINED TRIAXIAL "Q" TEST

SITE ID: LOSJ RAP
LOCATION ID: Boring Source #1
DATE: 1-9-90
LAB NAME: Geotechnology, Inc.
CHECKED BY: LAB YY
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
TPBJ-8 /4	0.6 - 4.3	95.8	1000
		97.0	3000
		95.4	6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
101.3	20.8	82.6	0.67
104.9	20.2	89.2	0.61
103.0	19.6	82.8	0.64

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	20.3	Unsaturated	
	20.1		
	19.4		

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

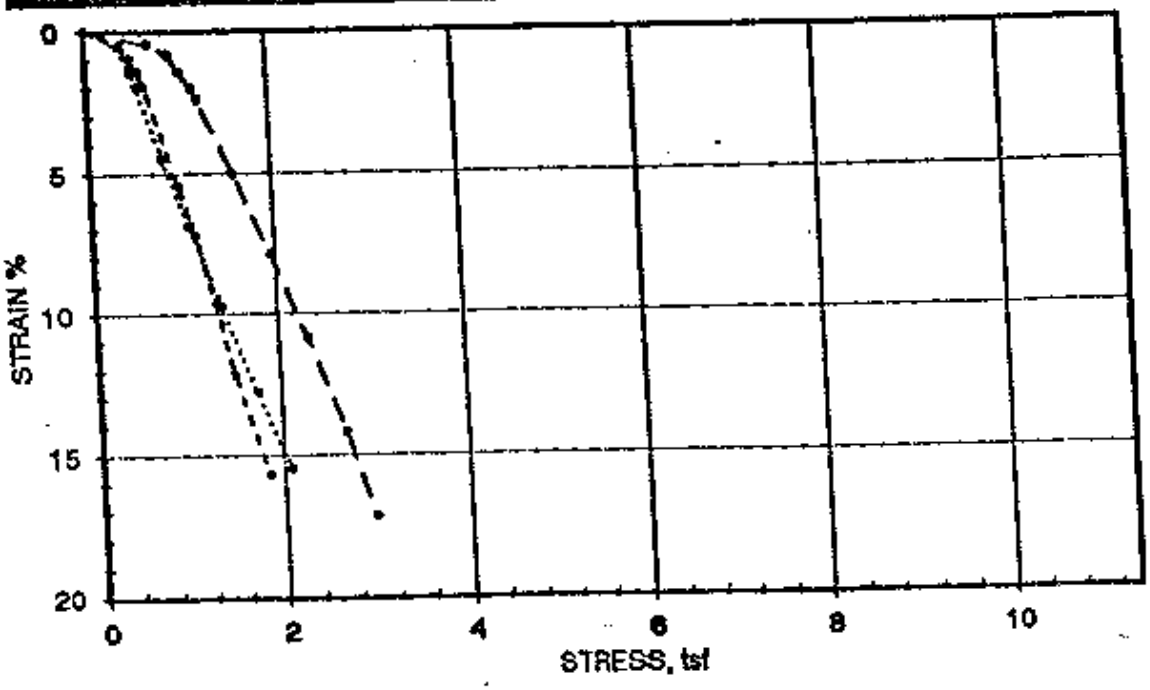
AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

See attached table

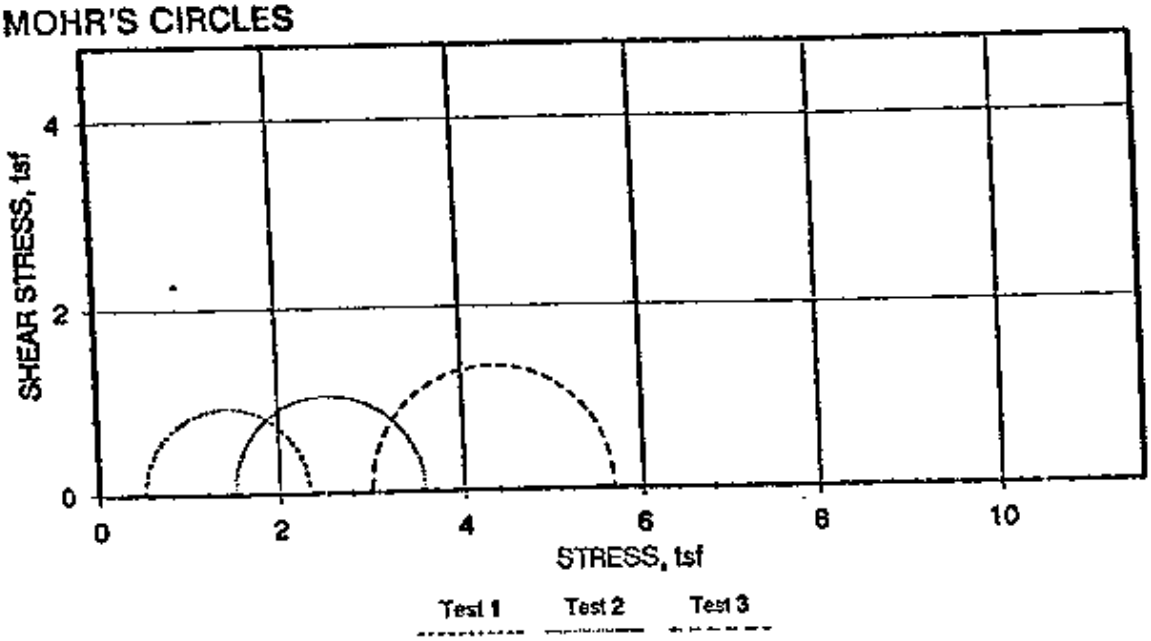
ATTACHMENT 1

Sh A-148

WSSRAP - JOB NO.: 11295.000
UNCONSOLIDATED - UNDRAINED TEST
STRESS PATH



MOHR'S CIRCLES



Boring No: TPBS-8
Sample No: 1A
Depth: 0.6-4.3

Sh A-149

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:- 11295.000

TEST 1

SAMPLE HEIGHT	=	2.83 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.60 IN^2	DEPTH	0.6-4.3
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.70	13.00	0.46	1.61	0.39	0.89	0.19
10.80	26.00	0.92	1.62	0.48	0.98	0.24
12.70	39.00	1.38	1.62	0.56	1.06	0.28
14.00	54.00	1.91	1.63	0.62	1.12	0.31
22.40	154.00	5.44	1.69	0.95	1.45	0.48
26.40	204.00	7.20	1.73	1.10	1.60	0.55
32.20	272.00	9.60	1.77	1.31	1.81	0.65
37.70	343.00	12.11	1.82	1.49	1.99	0.74
48.50	443.00	15.64	1.90	1.84	2.34	0.92

$\sigma_1 = 2.34 \text{ tsf} = 4.68 \text{ ksf}$

$\sigma_3 = 1 \text{ ksf}$

$q_f = \frac{4.68 - 1}{2} = 1.84 \text{ ksf}$

$P_f = \frac{4.68 + 1}{2} = 2.84 \text{ ksf}$

Sh A-150

GEOTECHNOLOGY INC
UNCONSOLIDATED - UNDRAINED TEST DATA
WSSRAP - JOB NO:- 11295.000

TEST 2

SAMPLE HEIGHT	=	2.96 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.61 IN^2	DEPTH	0.6-4.3
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	20.83 PSI
CELL PRESSURE	=	20.83 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
8.20	15.00	0.51	1.62	0.37	1.86	0.18
11.00	43.00	1.45	1.63	0.49	1.99	0.24
12.30	57.00	1.93	1.64	0.54	2.04	0.27
18.30	132.00	4.46	1.68	0.78	2.28	0.39
24.90	203.00	6.86	1.73	1.04	2.54	0.52
33.80	288.00	9.73	1.78	1.37	2.87	0.68
44.80	378.00	12.77	1.84	1.75	3.25	0.87
55.00	457.00	15.43	1.90	2.08	3.58	1.04

$\sigma_1 = 3.58\ tsf = 7.16\ Ksf$

$\sigma_3 = 3\ Ksf$

$q_f = \frac{7.16-3}{2} = 2.08\ ksf$

$p_f = \frac{7.16+3}{2} = 5.08\ ksf$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295.000

Sh A-151

TEST 3

SAMPLE HEIGHT	=	2.91 INCHES	BORING NO	TPBS-8
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	1A
SAMPLE AREA	=	1.59 IN^2	DEPTH	0.6-4.3
			SAMPLE DESCRIPTION	Brown, silty CLAY

CONFINING PRESS	=	41.64 PSI
CELL PRESSURE	=	41.64 PSI

LOAD P	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
15.10	12.00	0.41	1.60	0.68	3.68	0.34
19.90	23.00	0.79	1.61	0.89	3.89	0.45
22.60	41.00	1.41	1.62	1.01	4.00	0.50
25.50	58.00	1.99	1.63	1.13	4.13	0.56
27.00	69.00	2.37	1.63	1.19	4.19	0.60
36.60	145.00	4.98	1.68	1.57	4.57	0.79
47.20	229.00	7.87	1.73	1.96	4.96	0.98
57.70	315.00	10.82	1.79	2.32	5.32	1.16
69.50	412.00	14.15	1.86	2.69	5.69	1.35
79.50	499.00	17.14	1.92	2.97	5.97	1.49

$\sigma_1 = 5.97 \text{ tsf} = 11.94 \text{ ksf}$

$\sigma_3 = 6 \text{ ksf}$

$q_f = \frac{11.94 - 6}{2} = 2.97 \text{ ksf}$

$p_f = \frac{11.94 + 6}{2} = 8.97 \text{ ksf}$

Regwon # 2
P.O. # 3509-1002-3445

MK-FERGUSON
A MORRISON KNUDSEN COMPANY

UNCONSOLIDATED – UNDRAINED TRIAXIAL "Q" TEST

SITE ID: WSSRAP
LOCATION ID: Disposal Cell
DATE: 6-4-90
LAB NAME: Geotechnology
CHECKED BY: LAB KJ
TAC

SAMPLE ID	DEPTH INTERVAL (FT)	COMPACTION (%)	CELL CONFINING PRESSURE (PSF)
GT-2178 BU-02B	6.5-12'	94.7 95.0 95.1	1600 3000 6000

INITIAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
98.7	24.0	92.1	0.70
99.0	23.8	92.0	0.70
99.1	24.0	93.1	0.69

FINAL CONDITIONS

DRY DENSITY (PCF)	MOISTURE CONTENT (%)	DEGREE OF SATURATION (%)	VOID RATIO e
	23.7 23.6 23.9	Unsaturated	

TEST PROCEDURE: ASTM EM 1110-2-1906

TEST RESULTS

AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)	AXIAL STRESS (PSF)	AXIAL STRAIN (%)

ATTACHMENT

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

TEST 1

SAMPLE HEIGHT	=	2.90 INCHES	BORING NO	GT-2T78
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
SAMPLE AREA	=	1.59 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Grayish brown CLAY

CONFINING PRESSURE	=	6.94 PSI
CELL PRESSURE	=	6.94 PSI

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
23.30	14.00	0.48	1.60	1.05	1.55	0.52
30.50	30.00	1.04	1.61	1.36	1.86	0.68
33.40	42.00	1.45	1.62	1.49	1.99	0.74
35.80	55.00	1.90	1.63	1.59	2.09	0.79
37.80	70.00	2.42	1.63	1.67	2.16	0.83
44.50	145.00	5.01	1.68	1.91	2.41	0.95
49.50	233.00	8.05	1.73	2.05	2.55	1.03
51.70	282.00	9.74	1.77	2.11	2.61	1.05
54.10	352.00	12.16	1.82	2.15	2.65	1.07
56.90	434.00	14.99	1.88	2.18	2.68	1.09

$\sigma_1 = 2.68\ tsf = 5.36\ ksf$

$\sigma_3 = 1\ ksf$

$q_f = 2.18\ ksf$

$P_f = 3.18\ ksf$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

Sh A-154

EST 2

SAMPLE HEIGHT	=	2.93 INCHES	BORING NO	GT-2T78
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Grayish brown CLAY
CONFINING PRESS	=	20.83 PSI		
CELL PRESSURE	=	20.83 PSI		

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
21.60	15.00	0.51	1.61	0.97	2.47	0.48
31.40	34.00	1.16	1.62	1.40	2.89	0.70
34.30	42.00	1.44	1.62	1.52	3.02	0.76
38.00	61.00	2.09	1.64	1.67	3.17	0.84
39.80	71.00	2.43	1.64	1.75	3.25	0.87
47.00	139.00	4.75	1.68	2.01	3.51	1.01
52.60	225.00	7.69	1.74	2.18	3.68	1.09
55.50	272.00	9.30	1.77	2.26	3.76	1.13
59.50	368.00	12.58	1.83	2.34	3.84	1.17
62.10	439.00	15.01	1.88	2.37	3.87	1.19
0.00						

$\sigma_1 = 3.87 \text{ tsf} = 7.74 \text{ ksf}$

$\sigma_3 = 3 \text{ ksf}$

$\sigma_f = 2.37 \text{ ksf}$

$P_f = 5.37 \text{ ksf}$

GEOTECHNOLOGY INC
UNCONSOLIDATED – UNDRAINED TEST DATA
WSSRAP – JOB NO:– 11295

TEST 3

SAMPLE HEIGHT	=	2.88 INCHES	BORING NO	GT-2178
SAMPLE DIAMETER	=	1.43 INCHES	SAMPLE NO	BU-02B
SAMPLE AREA	=	1.60 IN^2	DEPTH	6.5-12 FT.
			SAMPLE DESCRIPTION	Grayish brown CLAY

Sh. A-155

CONFINING PRESS	=	41.64 PSI	
CELL PRESSURE	=	41.64 PSI	

LOAD p	STRAIN DIAL div	PERCENT STRAIN	CORRECTED AREA	DEVIATOR STRESS tsf	MAJOR PR.STR tsf	SHEAR STRESS tsf
0.00	0.00	0.00	0.00	0.00	0.00	0.00
20.10	12.00	0.42	1.61	0.90	3.90	0.45
29.90	29.00	1.01	1.62	1.33	4.33	0.67
35.40	42.00	1.46	1.63	1.57	4.57	0.78
38.90	55.00	1.91	1.63	1.72	4.71	0.86
42.00	70.00	2.43	1.64	1.84	4.84	0.92
50.10	141.00	4.90	1.68	2.14	5.14	1.07
55.00	215.00	7.47	1.73	2.29	5.29	1.14
58.20	293.00	10.18	1.78	2.35	5.35	1.18
60.40	362.00	12.57	1.83	2.37	5.37	1.19
62.40	432.00	15.01	1.88	2.38	5.38	1.19

$\sigma_1 = 5.38 tsf \doteq 10.76 ksf$

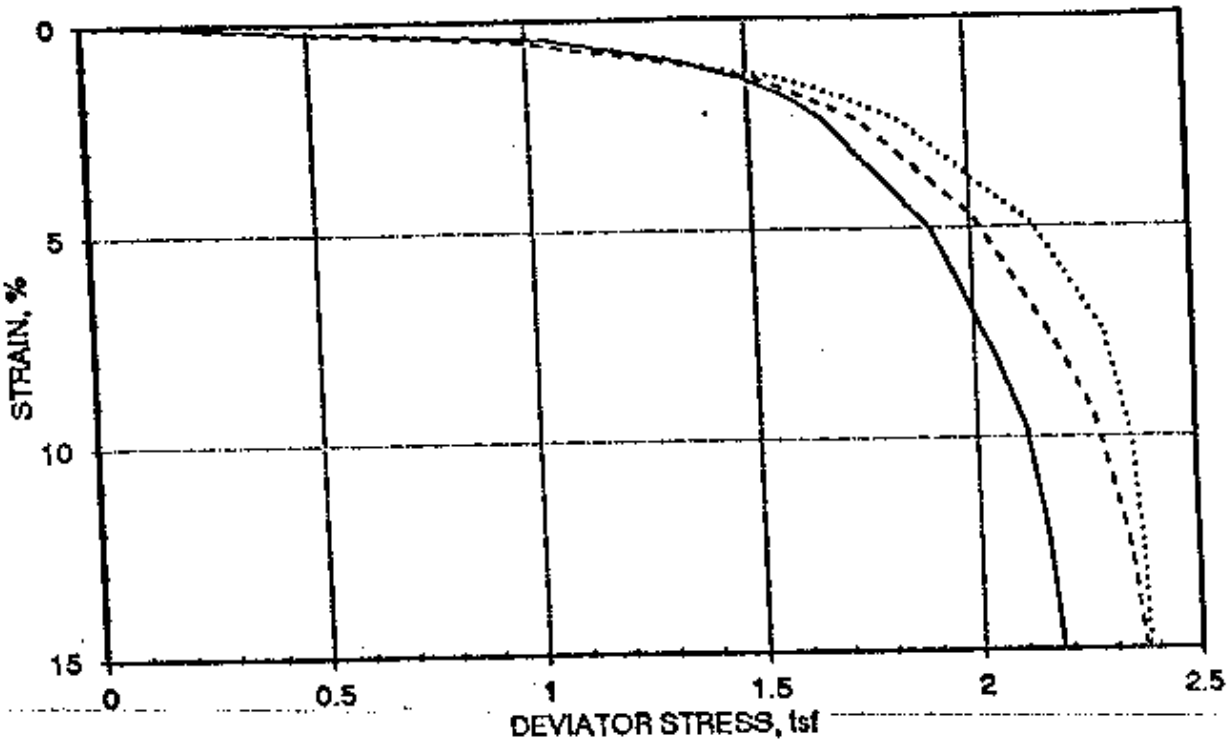
$\sigma_3 = 6 ksf$

$q_f = 2.38 ksf$

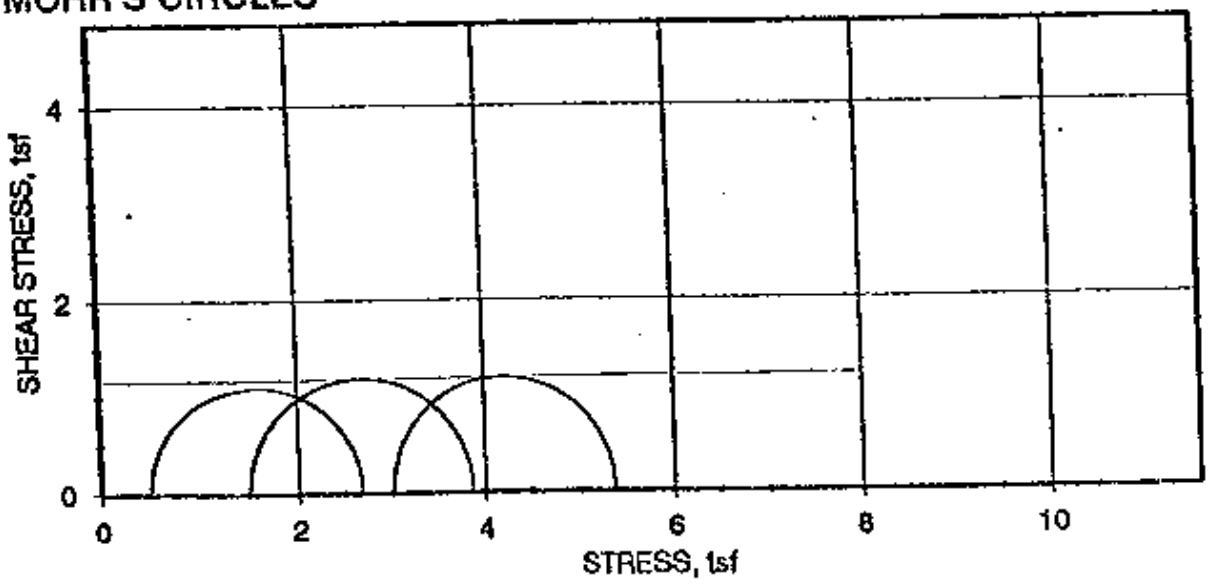
$p_f = 8.38 ksf$

Sh A-156

STRESS - STRAIN PLOT



MOHR'S CIRCLES



Boring No: GT-2178
Sample No: BU-02B
Depth: 6.5-12 FT.

D-1

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Project WSSRAP
Feature DC
Item Material Prop.

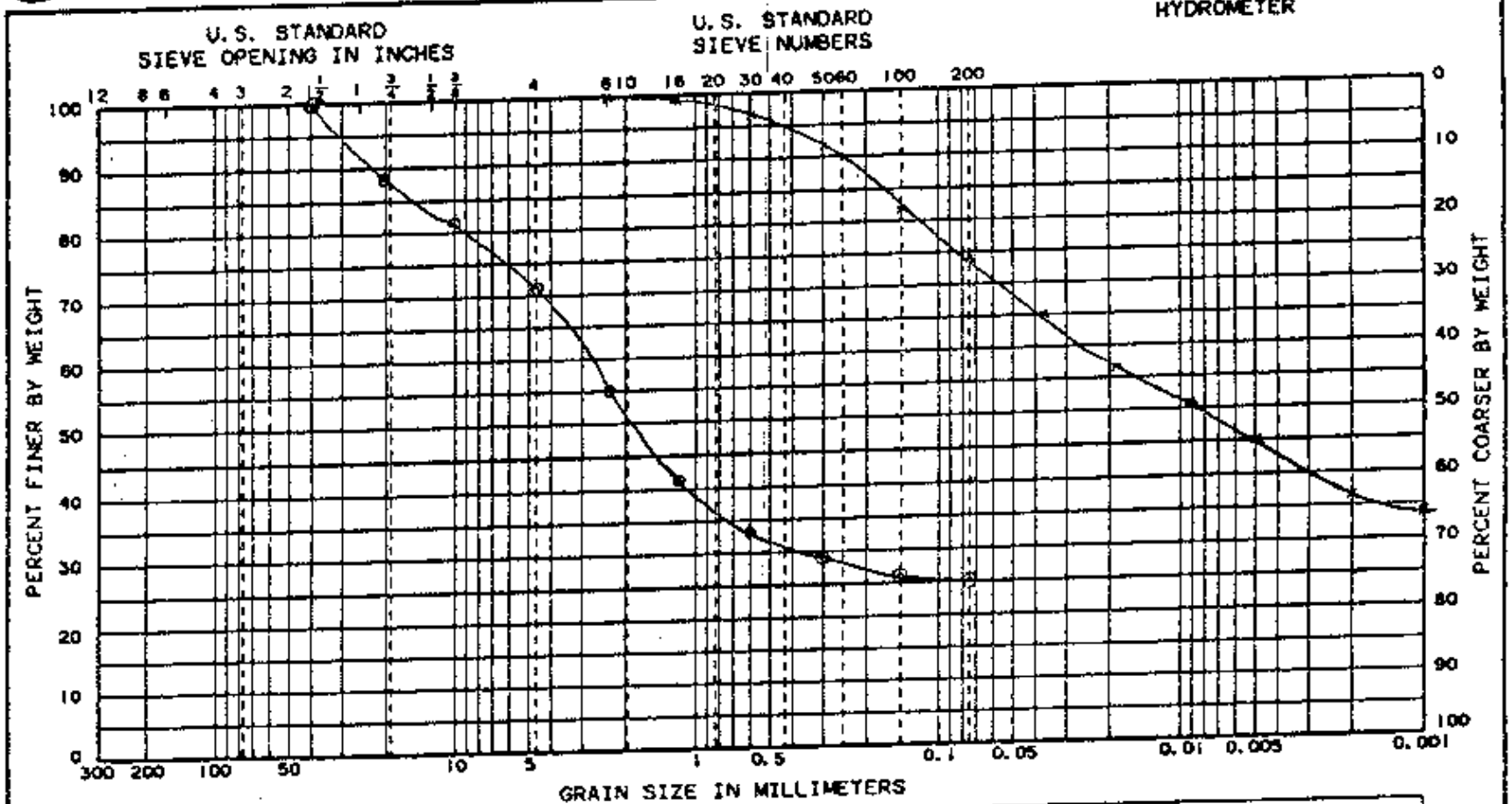
Contract No. 3840-827 / 512
Designed PYL
Checked ND

Sheet 12
File No.
Date 5/8/89
Date 9/12/91

APPENDIX B

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



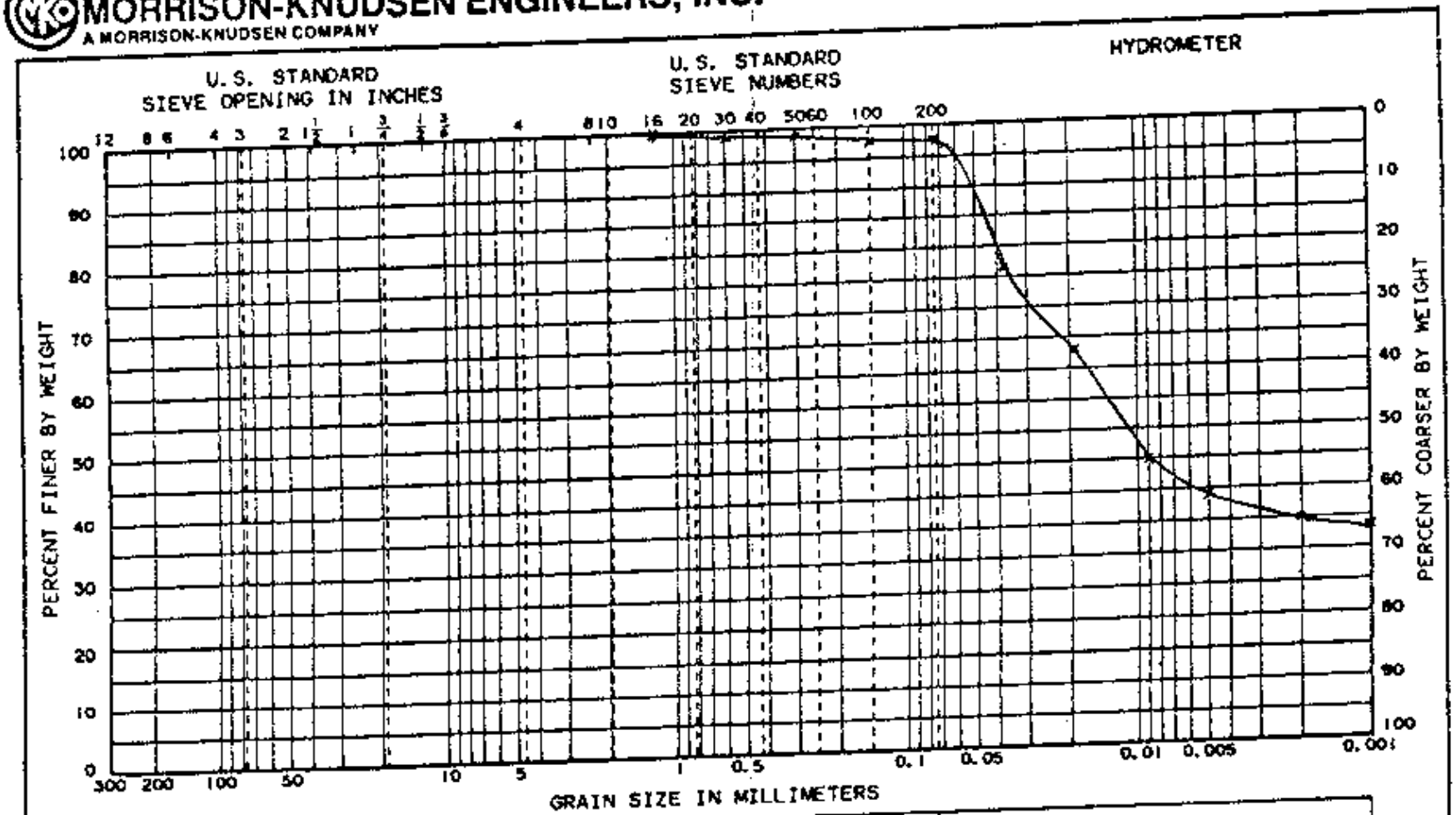
SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WX	LL	PL	PI
GT43/ST10	21.5 -23.75	CLAY TILL	18.6	47	15	32
SS19	50.0-52.0	RESIDUUM	30.4	-	-	-

PROJECT W55RAP
JOB NO. 5121
AREA Chemical Plant
HOLE NO. GT 43
DATE 2/23/89 PYC

CAB110

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WX	LL	PL	PI
X ST 05	10.0 - 12.5	FERRELVIEW	22.9	45	17	28

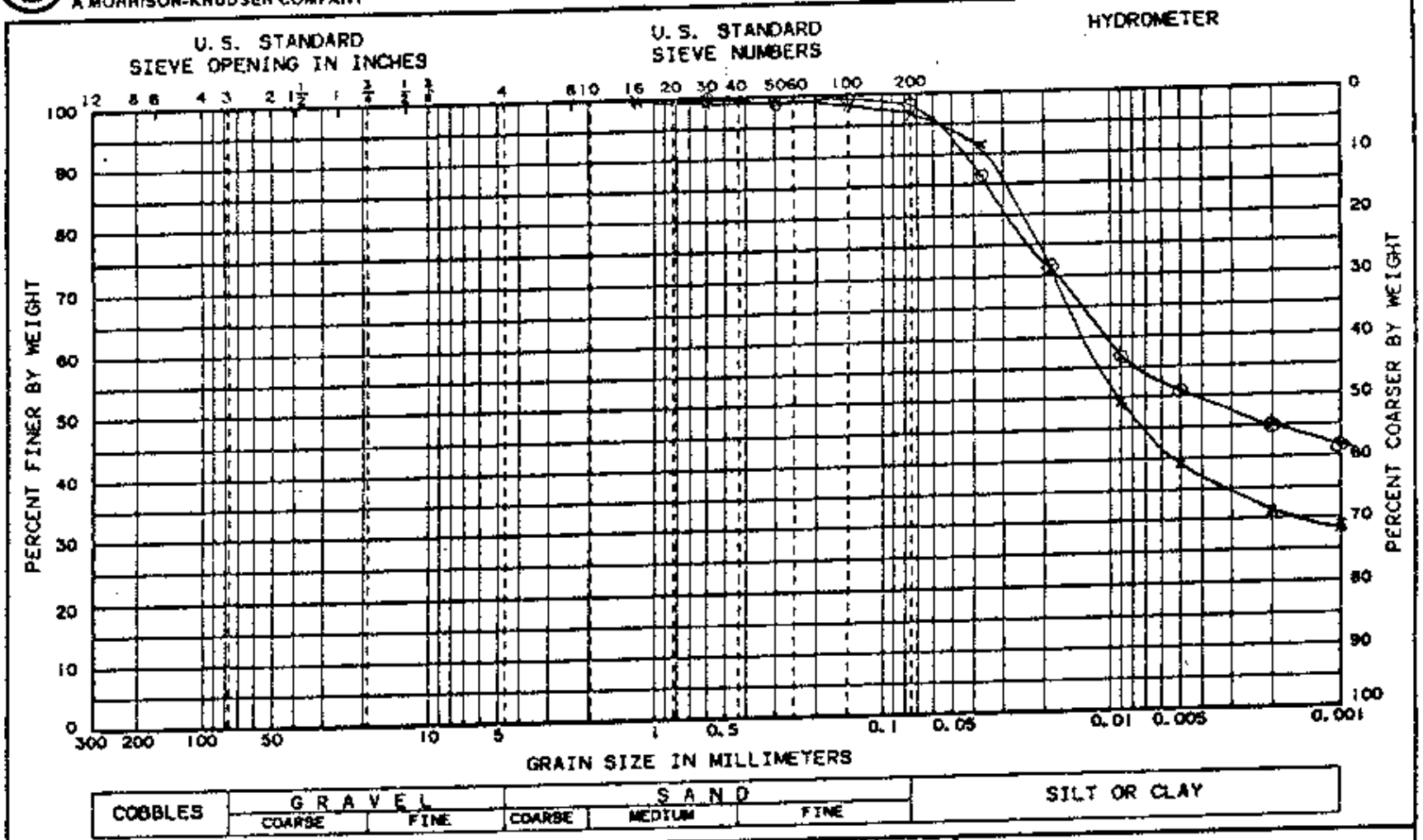
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE # GT47
DATE 2/23/89 PYC

CAB110

Sh. 184
Sh. B3

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
X ST 03	7.5 - 10.0	FERRELVIEW	27.7	41	18	23
⊙ ST 07	17.5 - 20.0	↓	27.8	60	17	43

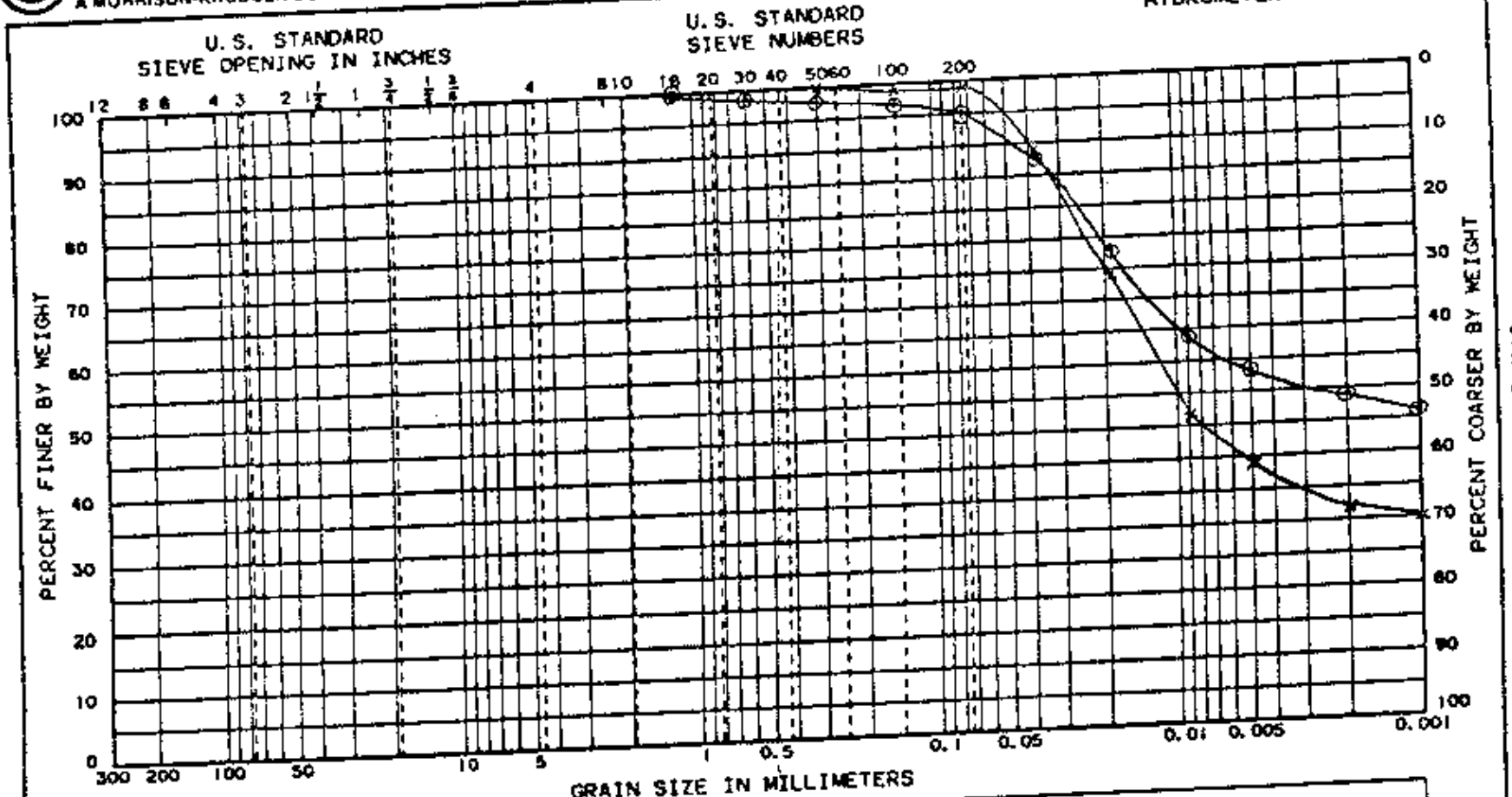
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE NO. GT 48
DATE 2/23/89 PYL

CAB110

~~GT 185~~
SLB-4

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WX	LL	PL	PI
×ST 02	2.5 - 5.0	LOESS	21.1	47	18	29
⊙ST 06	12.5 - 15.0	CLAY TILL	26.9	63	18	45

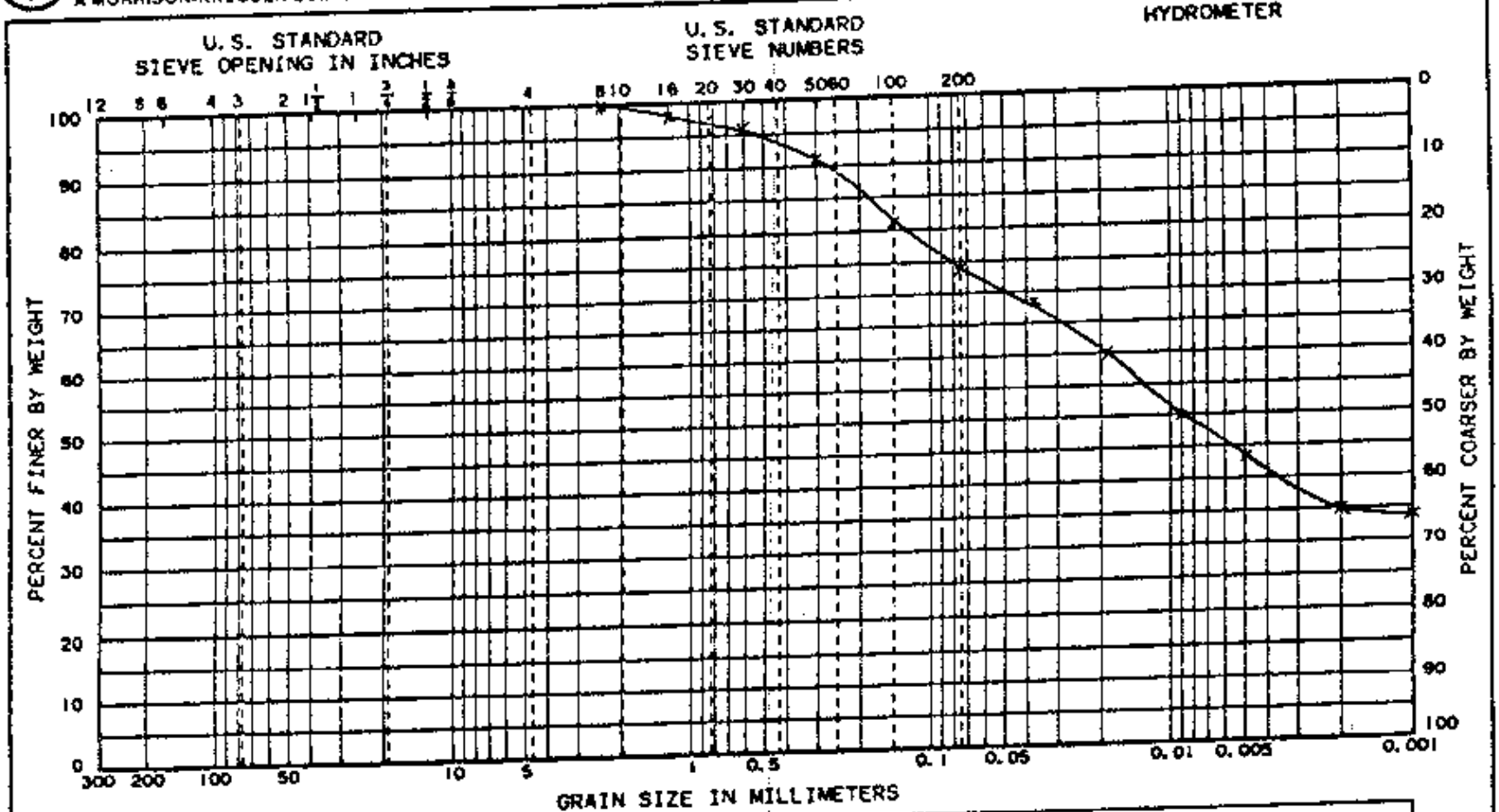
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE No. GT 50
DATE 2/23/89 PTL

CAB110

ST 8.5

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WX	LL	PL	PI
x SB 14	35.0-36.5	BASAL TILL ?	19.0	42	14	28

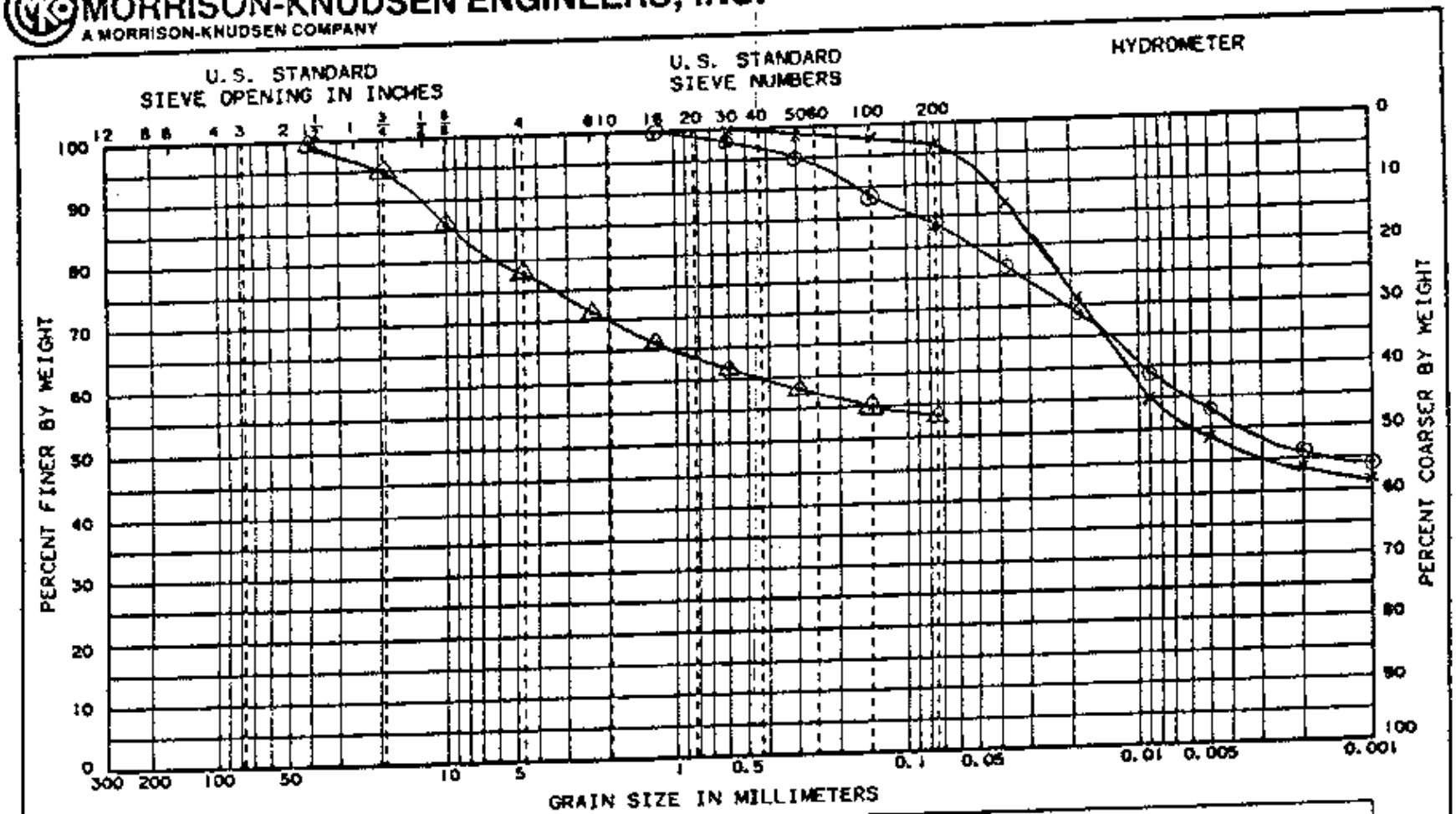
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE No. GT 52
DATE 2/23/89 PYL

CAB110

Sh 6-7

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WK	LL	PL	PI
ST 04	7.5 - 10.0	FERRELVITIOL	22.3	54	16	38
ST 08	17.5 - 20.0	CLAY TILL	21.6	58	17	41
ST 15	35.0-36.5	RESIDUUM	23.1	—	—	—

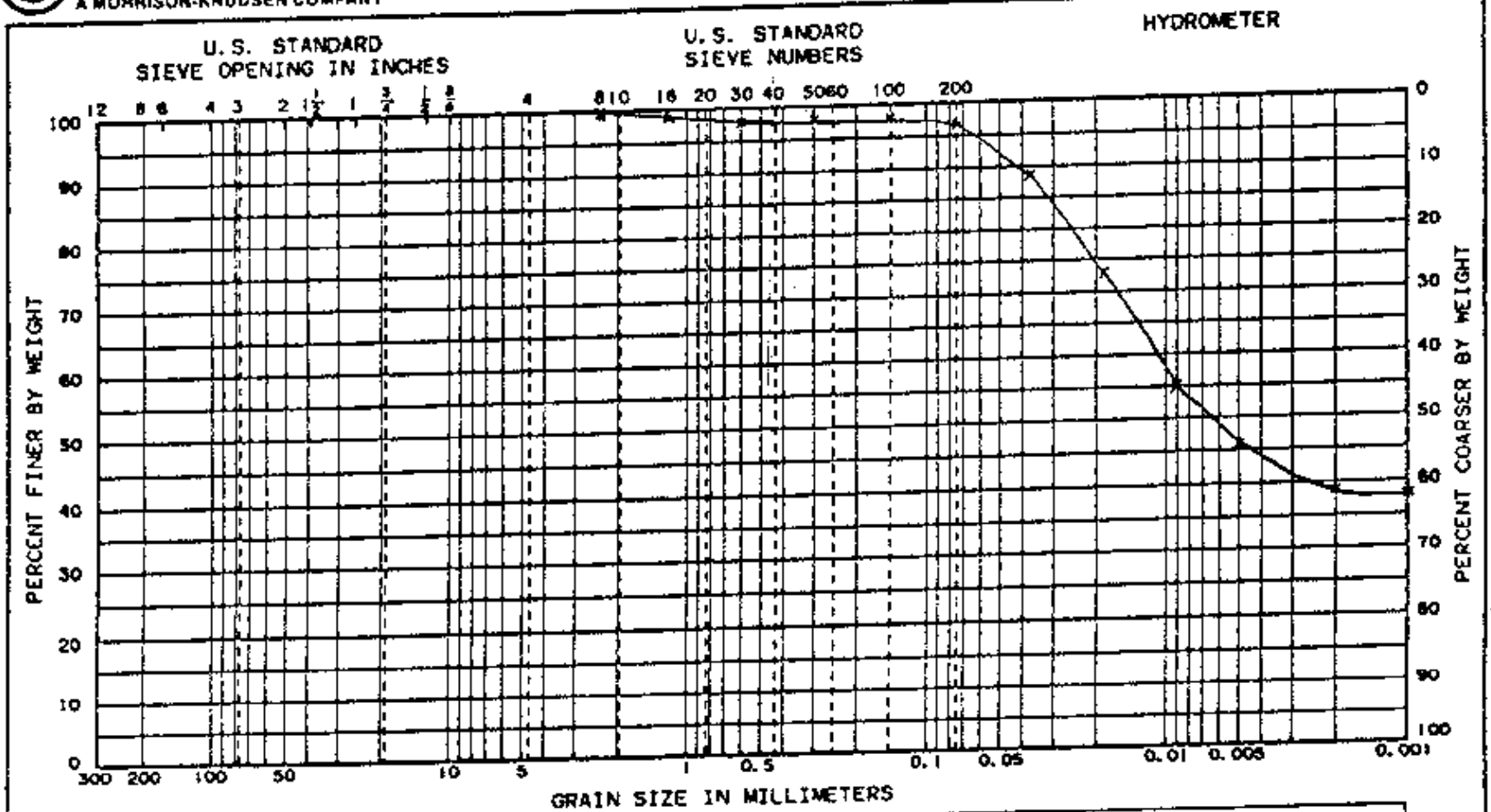
PROJECT WISSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE NO: GT 53
DATE 2/23/89 PYL

CAB110

54-184
54 B-8

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WK	LL	PL	PI
X ST 03	4.5 - 7.0	FILL ?	21.8	42	17	25

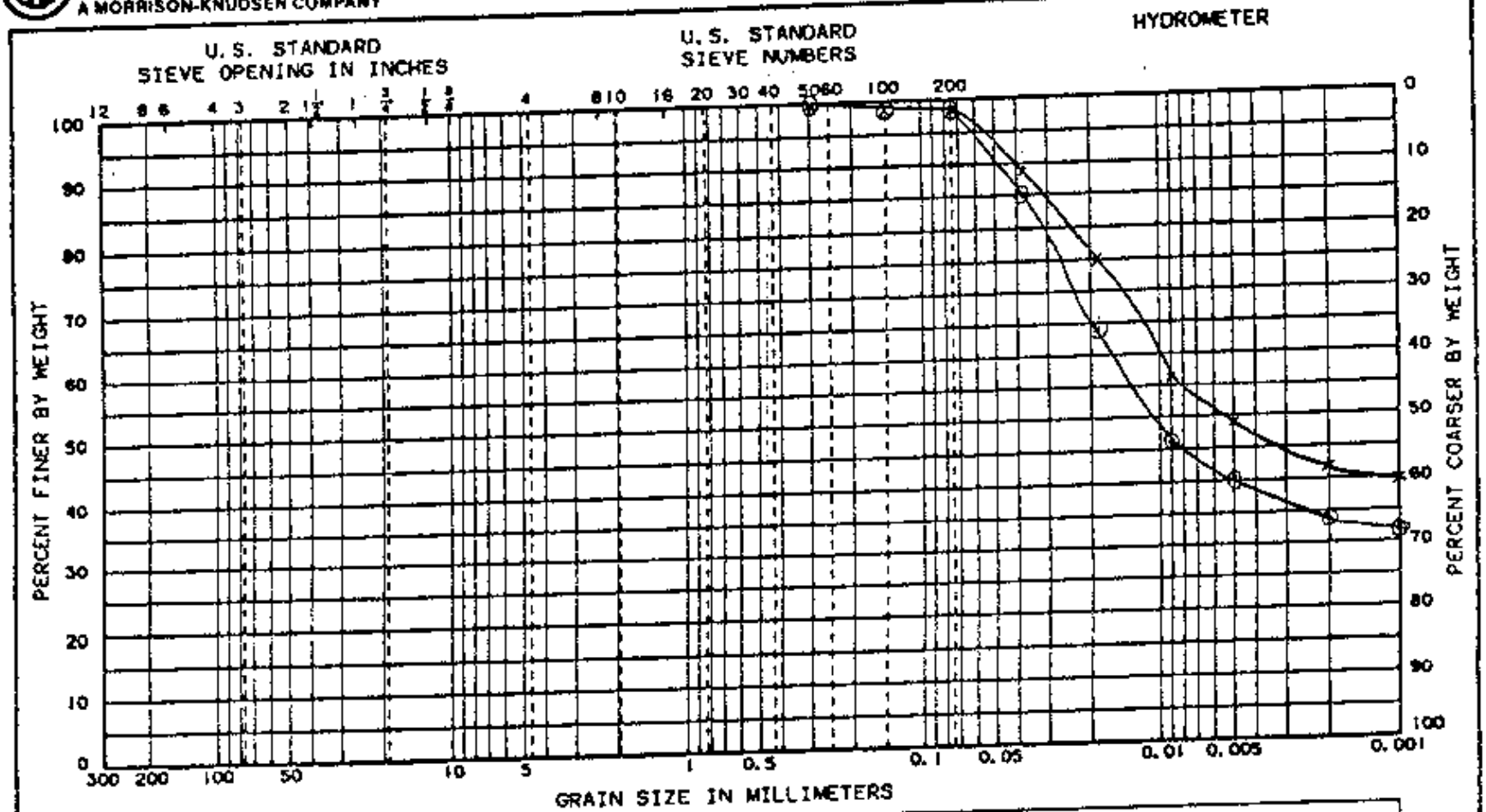
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE NO. GT 54
DATE 2/23/89 PYC

CA8110

5-4-89

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WK	LL	PL	PI
x ST 04	7.5 - 10.0	LOESS	30.7	50	21	29
⊙ ST 06	12.5 - 15.0	FERRELVIEW	22.8	51	18	33

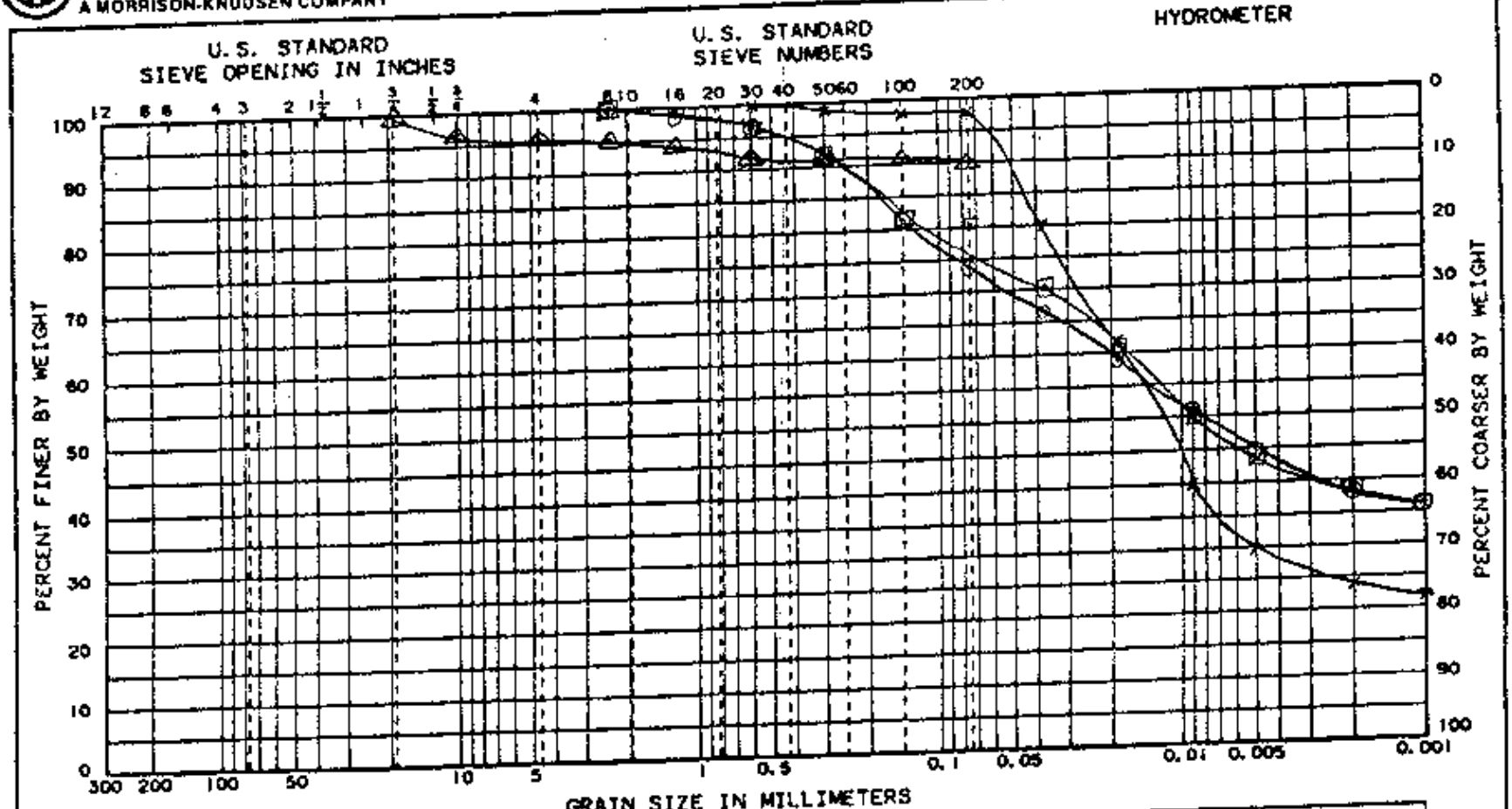
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE NO. GT 2.5
DATE 2/23/89 PTL

CAS110

9-14-
Sh 6-10

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WX	LL	PL	PI
X ST02	5.0 - 7.5	~~LOESS~~ Fewsiview	20.4	30	18	12
⊙ ST06	15.0 - 17.0	CLAY TILL	19.0	44	15	29
⊞ SB08	19.5 - 21.0	CLAY TILL				
△ SS09	22.0 - 23.5	CLAY TILL	27.1	71	21	50

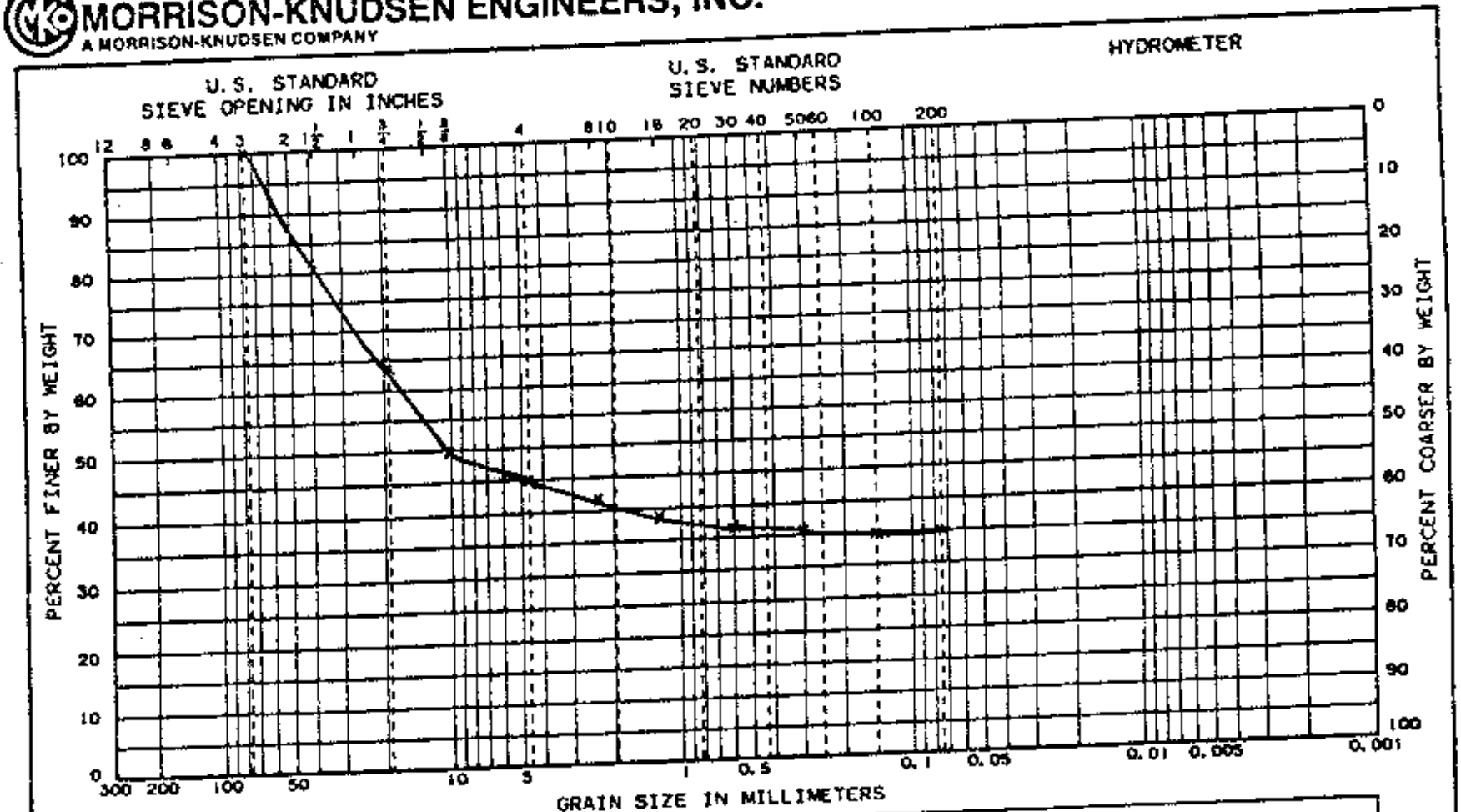
PROJECT WSSRAP
JOB NO. 5121
AREA CHEMICAL PLANT
HOLE NO. GT 56
DATE 3/23/89 PTL

CAB110

5121

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WK	LL	PL	PI
x SB11	27.5-29.0	RESIDUUM	17.1	—	—	—

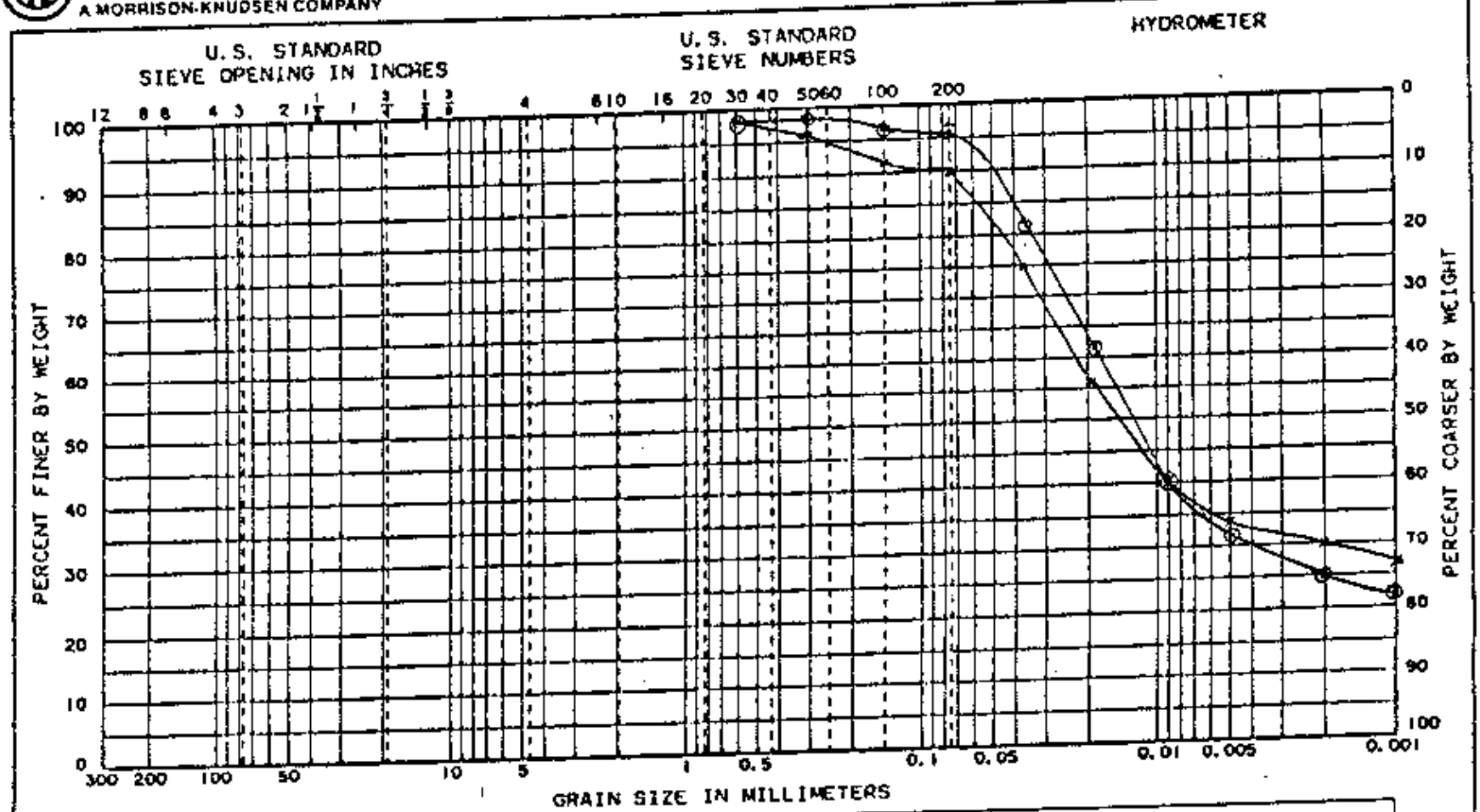
PROJECT WESRAP
JOB NO. 512-1
AREA CHEMICAL PLANT
HOLE NO. GT57
DATE 2/23/89 PYL

CA8110

SB-12

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT WK	LL	PL	PI
X ST02	4.0 - 6.5	CL Fernleview	20.9	36	16	20
ST06	18.0 - 20.5	Fernleview				

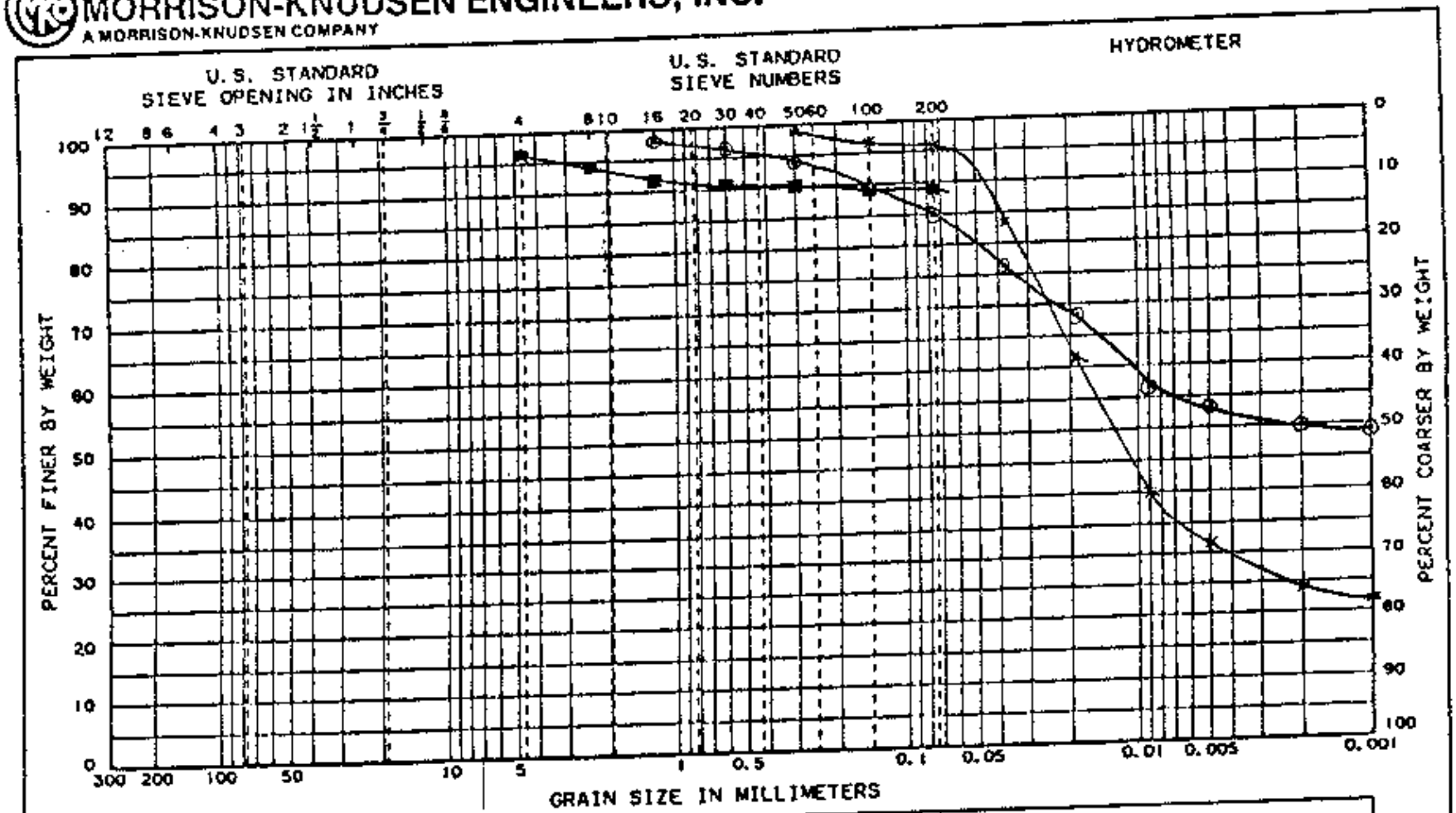
PROJECT
JOB NO.
AREA Ralphston Pit #4
HOLE NO. GT 31
DATE 3/1/89 PYL

CAB110

Sht 1 of 1
Sh. B-13

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
X ST-01	1.0 - 3.5	Loess				
⊙ ST-02	9.0 - 10.5	Ferndview				
■ ST-05	18.5 - 21.0	Residuum ? clay till ?				

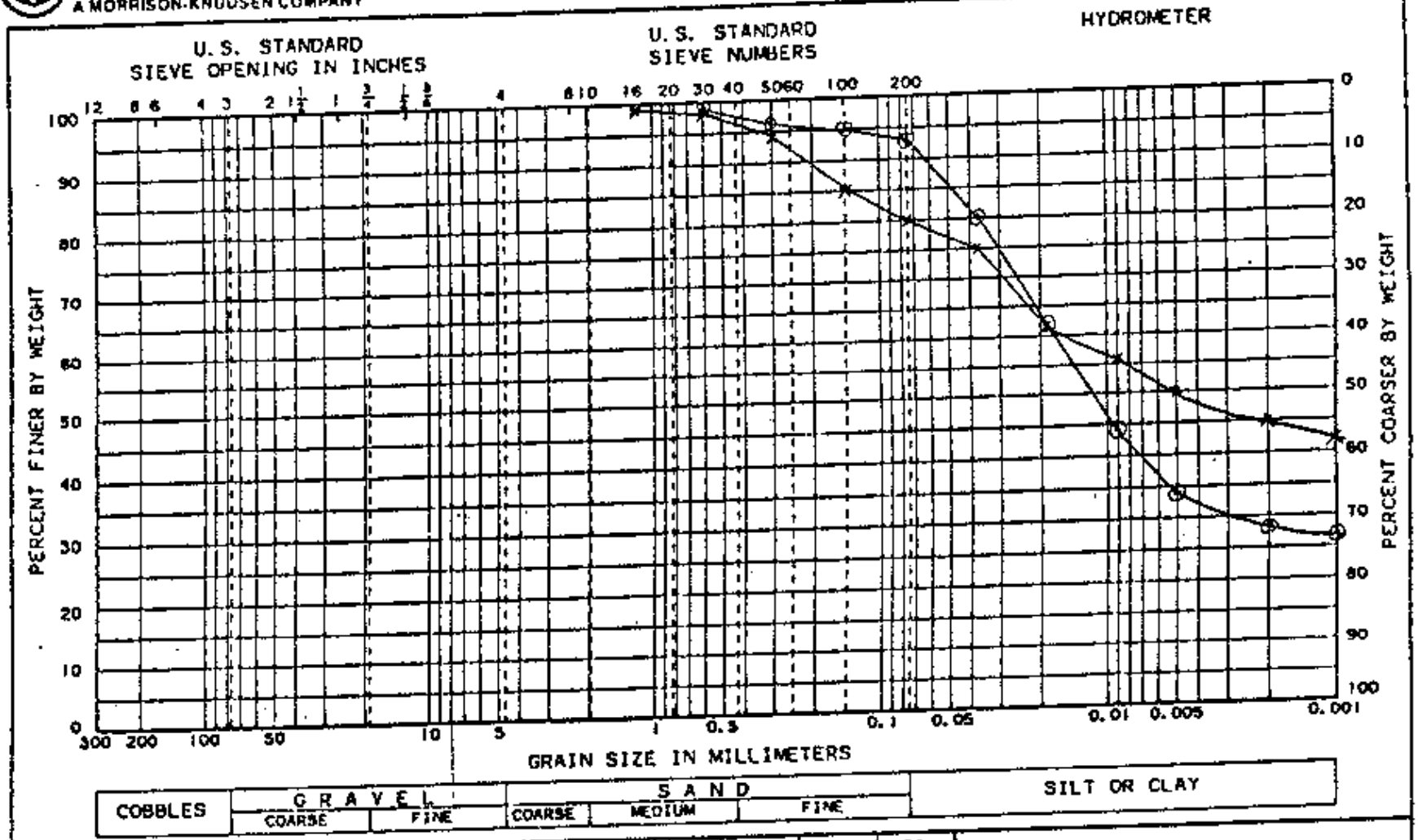
PROJECT
JOB NO.
AREA Raffuta Pit #4
HOLE NO: GT 3a
DATE 3/1/89 PYL

CA8110

Sh. 8 of 14

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GRAIN SIZE ANALYSIS



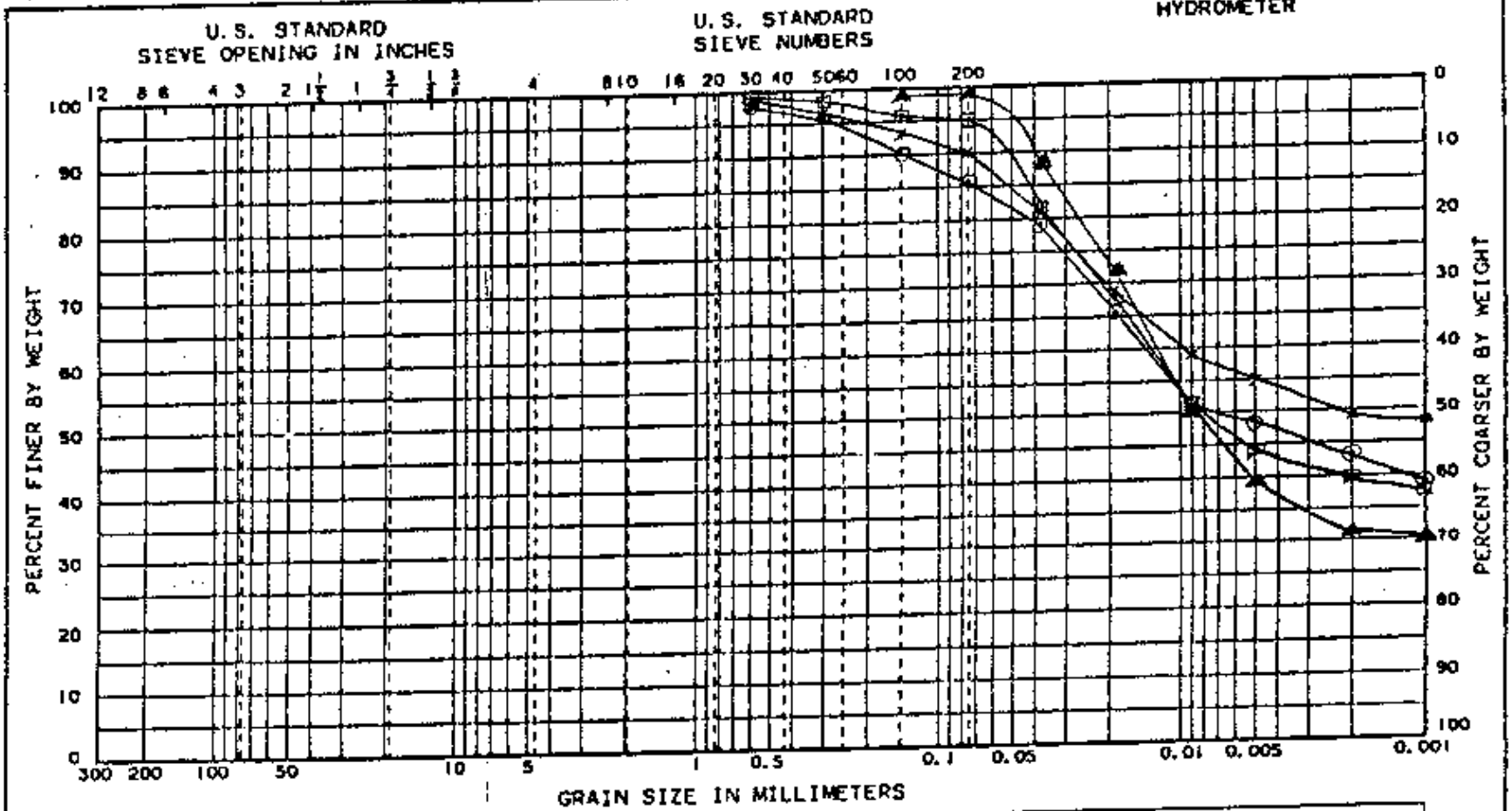
SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
x SS05	7.0-8.5	Dike fill				
⊙ SB17	27.0-28.5	Fenchiew				

PROJECT
JOB NO.
AREA Raffinate Pit #4
HOLE NO: GT34
DATE 3/11 89 PTL

CAB110

S1B16

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY



GRAIN SIZE ANALYSIS

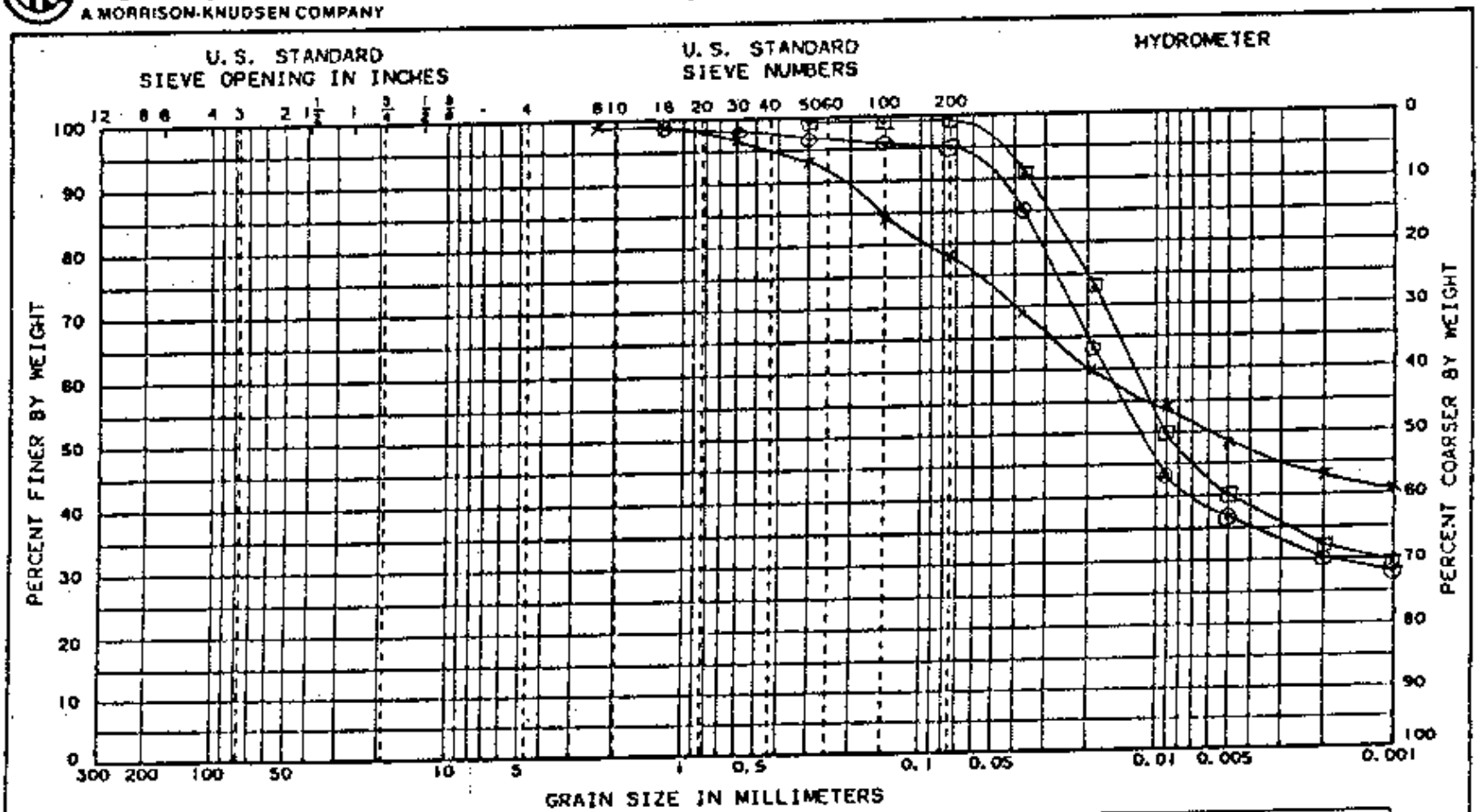
SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
X SS02	3.0 - 4.5	Dike fill				
⊙ SS08	13.0 - 14.5					
⊡ SB15	25.0 - 26.5					
▲ SS20	31.0 - 32.5	Loess				

PROJECT
JOB NO.
AREA Raffinate Pit #4
HOLE NO: GT 35
DATE 3/1/89 PYL

CAB110

~~SH 198~~
SHB17

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY



GRAIN SIZE ANALYSIS

SAMPLE NO.	ELEV. OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
× ST 06	8.5 - 11.0	Dike fill				
⊙ SS 09	14.0 - 15.5	"				
⊡ ST 12	18.5 - 21.0	Loess				

PROJECT
JOB NO.
AREA Raffinate Pit #4
HOLE NO: GT 36
DATE

CAB110

8/9/15