



12821 W. Golden Lane
P.O. Box 690287, San Antonio, TX 78269-0287
(512) 699-9090 FAX (512) 699-6426

Project No. ASA91-020-00
July 8, 1991

Mr. Charles Daugherty
The PB/MK Team
Redbird Business Center, Building 5
5610 Redbird Center Drive, Suite 400
Dallas, Texas 75237

Re.: Geotechnical Report
LINAC/LEB Facilities
Superconducting Super Collider

Dear Mr. Daugherty:

Submitted here is a report of subsurface conditions along the path of the proposed Linear Accelerator (LINAC) and Low Energy Booster (LEB) facilities of the Superconducting Super Collider in Ellis County, Texas. At the request of The PB/MK Team, our study was limited to field drilling activities and laboratory analyses of soil specimens gathered from the test borings. Engineering analyses and recommendations concerning design and construction of the LINAC/LEB facilities were not included within the scope of work for this study and, therefore, are not addressed in this report. This work was conducted under PB/MK Subcontract No. SC-A43-1013, dated February 4, 1991.

FIELD EXPLORATION AND LABORATORY TESTS

Borings Subsurface conditions at the sites were evaluated by twelve borings drilled at the locations shown on the Plan of Borings, Plate 1. Boring designations for the study areas are tabulated below:

<u>Study Area</u>	<u>Boring Designations</u>
Linear Accelerator	LIN-1 through LIN-5
Low Energy Booster	LEB-1 through LEB-7

The number of borings included in this study, their field locations, and their termination depths were selected by The PB/MK Team. Grid coordinates and surface elevations for the boring locations were provided by PB/MK, and are shown on the individual boring logs. The borings were drilled in accordance with ASTM D 420 procedures to depths

ranging from 20 to 43 ft below existing grades using a rotary drilling rig.

A field log was prepared for each boring by a staff geologist. Each log contains information concerning the boring method, drill crew, time of drilling, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel, sand or rock, and observations of ground water.

The final logs represent our interpretation of the contents of the field logs for the purpose delineated by our client. The final logs are included in the Illustrations section of this report, Plates 2 through 13. A key to classification terms and symbols used on the logs appears on Plate 14.

Sampling The following samples were collected as a part of our subsurface exploration procedures:

<u>Type of Sample</u>	<u>ASTM Procedure</u>	<u>Number Collected</u>
Auger	D 1452	1
Split-Spoon		13
Undisturbed Shelby Tube	D 1587	27
NX Core, feet	D 2113	268.9

Representative portions of all soil samples, as well as all rock core recovered, were sealed to reduce moisture loss, placed in protective containers, and transported to our laboratory for testing.

Laboratory Testing In the laboratory, each sample was inspected and classified by a geotechnical engineer. The geotechnical engineering properties of the soils/rock were evaluated by the following tests selected by PB/MK:

<u>Type of Test</u>	<u>Procedure</u>	<u>Number Conducted</u>
Moisture Content	ASTM D 2216	11
Atterberg Limits	ASTM D 2217 ASTM D 4318	3
Dry Unit Weight	ASTM D 2938	7
Unconfined Compression	ASTM D 2938	5
Swell Tests	ASTM D 4546*	2

* modified slightly to allow determination of swell pressure and free swell characteristics

The results of all laboratory tests are presented in graphical or numerical form on the appropriate boring log and Plates 15 and 16.

GENERAL SITE AND SUBSURFACE CONDITIONS

Existing Conditions The project site generally consists of an open, native grass-covered tract of land most recently used for livestock grazing. The topography in this region is generally described as gently rolling, with the ground surface at the LINAC/LEB site sloping downward toward a shallow creek traversing the west side of the site in a north-south direction. Based on the existing topography, site drainage is considered to be fair to good.

Stratigraphy The soils/rock underlying the proposed LINAC/LEB areas can be divided into four generalized strata that possess similar physical and engineering characteristics, as described below.

Stratum I consists of light to dark brown and black clays and extends to depths ranging from 1.0 to 9.0 ft below existing grades in the test borings. These clays are indicated to be plastic to highly plastic, with measured liquid limits varying from 57 to 73 percent and corresponding plasticity indices varying from 38 to 49. Designated as CH soils under the Unified Soil Classification System (USCS), clays of this plasticity are generally recognized to possess moderate to high shrink/swell potential. Laboratory swell testing on one specimen of these clays indicates a measured swell pressure of 750 psf and a free swell of 1.76 percent. Based on the results of hand penetrometer tests performed on undisturbed specimens, these clays exhibit stiff to hard consistencies.

Stratum II consists of tan and white, calcareous, silty clays with calcareous deposits and extends to depths of 2.4 to 10 ft below existing grades in several of the test borings. These silty clays are visually assessed to be moderately plastic, with a measured swell pressure of 400 psf and a free swell of 0.8 percent. Penetration resistance values recorded in these soils vary from 25 blows to in

excess of 50 blows per 12 in. of sampler penetration, indicating very stiff to hard clay consistencies.

Stratum III consists of tan, weathered, soft to moderately hard limestone of the Austin Chalk Formation and extends to depths varying from 7.4 to 19.9 ft below existing grades in the test borings. Argillaceous seams and close horizontal partings/joints are common within this formation. Recovery ratios and rock quality designations (RQD) measured for core runs performed in this stratum substantiate the weathered, intermittently jointed nature of the limestone, with RQD values varying from 20 to 96 percent. The low RQD value measured in Core Run No. 1 of Boring LEB-2 is believed to be primarily the result of the weathered, closely jointed nature of the upper reaches of the limestone formation, which in turn may have resulted in partial core blockage during drilling.

Stratum IV consists of gray to dark gray, unweathered, soft to moderately hard limestone of the Austin Chalk Formation and extends to at least the 20 to 43 ft termination depths of the test borings. Argillaceous seams/layers and close joints (varying from horizontal to vertical) are common in this stratum within the depths explored. Recovery ratios were excellent for core runs performed in this stratum, while RQD values varied from good to excellent (in excess of 80 percent). Unconfined compressive strengths measured for specimens of the unweathered limestone vary from 95 to 157 tsf.

Ground Water Ground water was not encountered in the test borings prior to the introduction of drilling fluids for rock coring activities. However, ground water seepage may exist on a transient basis within the weathered upper reaches of the Stratum III limestone, particularly following periods of heavy precipitation.

* * * * *

The following illustrations are attached and complete this report:

Plate 1	Plan of Borings
Plates 2 through 13	Logs of Borings
Plate 14	Key to Terms and Symbols
Plates 15 and 16	Swell Test Results

Project No. ASA91-020-00
July 8, 1991

5.

We appreciate the opportunity to be of service to you on this project. Please call should you have questions concerning the contents of this report, or other aspects of the project.

Very truly yours,

RABA-KISTNER CONSULTANTS, INC.

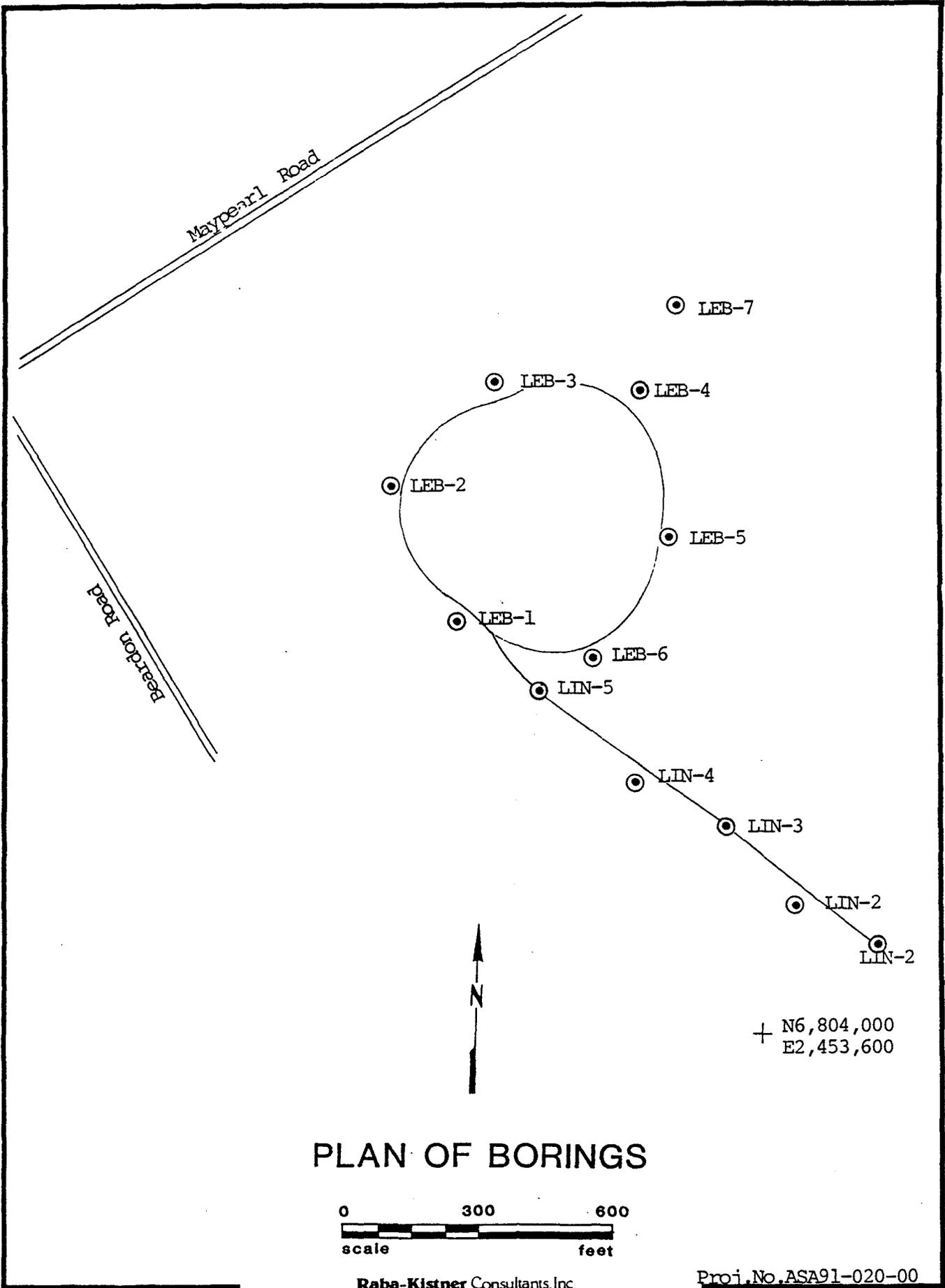
A. Scot Harrell

A. Scot Harrell, P.E.
Project Manager



ASH/cad
Copies submitted: Above (4)

I L L U S T R A T I O N S



PLAN OF BORINGS



Raba-Kistner Consultants, Inc.

Proj. No. ASA91-020-00
Plate 1

**LOG OF BORING NO. LIN-1
LINAC FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

***LOCATION:** N6804953.00/E24553870.00

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200	
						10	20	30	40	50	60	70		
						PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT			
			SURFACE ELEVATION: 654.50'											
			CLAY, Very Stiff, Moist, Black (CH) 1.9'	7/8/17										
5			CLAY, Silty, Calcareous, Very Stiff, Friable, Tan and Yellow with marly seams/lenses (extremely weathered limestone) 5.5'	50										
10			LIMESTONE, Weathered, Soft to Medium Hard, Slightly Fossiliferous, Tan - intermittent closely-spaced horizontal partings in Core Run #1 - 70 degree closed fracture from 12' to 12.5' - argillaceous from 12.5' to 12.8' - horizontal parting at 13.2' - argillaceous from 14.3' to 14.5' - slightly argillaceous from 17.5' to 18' 18'											
20			LIMESTONE, Unweathered, Medium Hard, Gray - argillaceous from 18' to 18.2' - very argillaceous from 22.8' to 23.6' - argillaceous from 25.2' to 25.3'		118								140	
25														
30														
35			START: 9:40 AM END: 1:10 PM											
40			GEOLOGIST: MICHAEL A. GILES DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON											
45														
50			Core Run # Core Depth (ft) % Rec % RQD											
			1 5.5-11 71 35											
			2 11-21 99 74											
			3 21-30.4 100 98											
DEPTH DRILLED: 30.4'				DEPTH TO WATER:				PROJ. No. ASA91-020-00						
DATE DRILLED: 6-10-91				DATE MEASURED:				PLATE 2						

* Location revised, final location N6804181/E2453870

**LOG OF BORING NO. LIN-2
LINAC FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6804281.00 / E2453670.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200
				10	20	30	40	50	60	70	
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT		
				+	-	+					
				10	20	30	40	50	60	70	
	SURFACE ELEVATION: 657.80'										
	CLAY, Very Stiff, Plastic, Moist, Dark Brown 2.0'			3.5							
5	CLAY, Silty, Weathered, Very Stiff to Hard, Moderately Plastic, Slightly Moist, Yellowish-Tan - extremely weathered limestone lense at 3.8' 4.0'			4.5+							
10	LIMESTONE, Weathered, Soft to Moderately Hard, Tan - slightly argillaceous, closely spaced horizontal partings from 6.6' to 8' - argillaceous, close horizontal partings from 9.3' to 10.1' - close horizontal partings from 10.1' to 16.8' - vertical joints from 10.5' to 11' and 12.5' to 12.9' - very argillaceous from 12.9' to 15.1' - 25 degree joint at 15.9' 16.8'										
25	LIMESTONE, Unweathered, Moderately Hard, Gray - horizontal partings at 19.1' and 19.3' - very argillaceous, dark gray from 19.3' to 20.2' - 80 degree closed joint from 27' to 28'										
35	START: 1:20 PM END: 3:45 PM										
40	GEOLOGIST: MICHAEL A. GILES DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON										
45	Core Run # Depth (ft) % Rec. % RQD										
50	1 5-15 87 47										
	2 15-25 98 81										
	3 25-30 100 100										

DEPTH DRILLED: 30.0'
DATE DRILLED: 6-10-91

DEPTH TO WATER:
DATE MEASURED:

PROJ. No. ASA91-020-00
PLATE 3

**LOG OF BORING NO. LIN-3
LINAC FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

***LOCATION:** N6804553.00/E2453523.00

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	⊗ UNCONF. COMPRESSION, tsf							% -200
						10	20	30	40	50	60	70	
						PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT		
			SURFACE ELEVATION: 658.40'			+-----●-----+							
			CLAY, Moist, Dark Brown to Black 1.0'	50/5									
5			CLAY, Silty, Calcareous, Hard, Slightly Moist, Light Tan (extremely weathered limestone) 2.4'										
10			LIMESTONE, Weathered, Moderately Hard, Tan - slightly argillaceous seam at 7.1' - vertical joint from 10' to 10.4' 10.4'										
15			LIMESTONE, Unweathered, Moderately Hard, Gray - slightly argillaceous, dark gray from 10.4' to 11.2' - close horizontal partings from 11.2' to 13' - very argillaceous, dark gray from 14.2' to 14.8' - 60 degree joint at 14.6' - slightly argillaceous seams from 15.8' to 16' and 19.7' to 20.1 - close horizontal partings from 23.6' to 23.8' - very argillaceous, dark gray from 24.4' to 25.4' - 80 degree joint from 25.2' to 26.9' - dark gray from 28.2' to 29.3'										
20													
25													
30													
35			START: 4:00 PM END: 6:15 PM										
40			GEOLOGIST: MICHAEL A. GILES										
45			DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON										
50			Core Core Depth Run # (ft) % Rec. % RQD										
			1 5-10 98 96										
			2 10-20 100 88										
			3 20-30 92 90										
DEPTH DRILLED: 30.0'			DEPTH TO WATER:			PROJ. No. ASA91-020-00							
DATE DRILLED: 6-10-91			DATE MEASURED:			PLATE 4							

* Location revised, final location N6804451/E2453523

**LOG OF BORING NO. LIN-4
LINAC FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



**Raba-Kistner
Consultants, Inc.**

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6804553.00 / E2453325.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf				X-200			
				10	20	30	40		50	60	70
				PLASTIC LIMIT		WATER CONTENT			LIQUID LIMIT		
	SURFACE ELEVATION: 657.70'										
0 - 8.1'	CLAY, Very Stiff, Highly Plastic, Moist, Dark Brown	50/6"		3.25							
				2.75							
				2.75							
				3.00							
8.1' - 10.1'	LIMESTONE, Weathered, Argillaceous, Soft to Moderately Hard, Tan										
10.1' - 15.0'	LIMESTONE, Unweathered, Moderately Hard, Gray - slightly argillaceous, dark gray from 10.1' to 10.6' - very argillaceous from 14' to 14.5'										
15.0' - 19.7'	- slightly argillaceous from 19.5' to 19.7'										
19.7' - 24.4'	- very argillaceous, dark gray from 24.4' to 25.2' and 26.7' to 26.9'		116								
24.4' - 26.7'											
26.7' - 28.2'	- slightly argillaceous from 28.2' to 29'										
28.2' - 29.0'											
29.0' - 30.0'											
30.0' - 35.0'											
35.0' - 40.0'	START: 7:05 AM END: 9:10 AM										
40.0' - 45.0'	GEOLOGIST: MICHAEL A. GILES DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON										
45.0' - 50.0'	Core Run # Core Depth (ft) % Rec. % RQD										
	1 10-20 100 98										
	2 20-29 100 96										
50.0' - 55.0'											
55.0' - 60.0'											
60.0' - 65.0'											
65.0' - 70.0'											
70.0' - 75.0'											
75.0' - 80.0'											
80.0' - 85.0'											
85.0' - 90.0'											
90.0' - 95.0'											
95.0' - 100.0'											

DEPTH DRILLED: 29.0'	DEPTH TO WATER:	PROJ. No. ASA91-020-00
DATE DRILLED: 6-11-91	DATE MEASURED:	PLATE 5

**LOG OF BORING NO. LIN-5
LINAC FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6804769.00/E2453128.00

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf			X-200			
						10	20	30		40	50	60
						PLASTIC WATER LIQUID						
						LIMIT	CONTENT	LIMIT				
						+	+	+				
						10	20	30	40	50	60	70
0			SURFACE ELEVATION: 658.80'									
0 - 5.5			CLAY, Very Stiff, Plastic, Moist, Dark Brown - lighter brown with depth			315						
5.5 - 8.5			CLAY, Silty, Very Stiff, Moderately Plastic to Plastic, Moist, Tan and White with caliche and calcareous nodules - weathered limestone lenses and fragments at 8' - groundwater seepage at 8' - ferrous stained from 8' to 9.5'	8/5/6 50/3'		2.0						
8.5 - 10						3.0						
10 - 16.2			LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - intermittent closely-spaced horizontal partings to 15.2' - 30 degree joint at 14.7' - slightly argillaceous from 15.4' to 15.7'									109
16.2 - 28.5			LIMESTONE, Unweathered, Moderately Hard, Gray - argillaceous with horizontal partings from 19.1' to 19.6' - very argillaceous, dark gray from 24.1' to 24.5' - slightly argillaceous from 27.5' to 28.5'									
28.5 - 30.0												
30.0 - 35.0												
35.0 - 40.0												
40.0 - 45.0												
45.0 - 50.0												
50.0 - 55.0												
55.0 - 60.0												

START: 9:50 AM
END: 11:50 AM

GEOLOGIST:
MICHAEL A. GILES

DRILL CREW:
LARRY TAYLOR
JAMES STUBBS
JOHN SALMON

Core

Core Run #	Depth (ft)	% Rec.	% RQD
1	10-20	74	55
2	20-30	99	90

DEPTH DRILLED: 30.0'	DEPTH TO WATER: 8.00'	PROJ. No. ASA91-020-00
DATE DRILLED: 6-12-91	DATE MEASURED: 6-12-91	PLATE 6

LOG OF BORING NO. LEB-1
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
 Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6804953.00 / E2452924.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200	
				10	20	30	40	50	60	70		
				PLASTIC LIMIT		WATER CONTENT			LIQUID LIMIT			
	SURFACE ELEVATION: 661.80'											
5	CLAY, Very Stiff, Highly Plastic, Moist, Dark Brown			4.0	+	+	+	+	+	+		
	- light brown with calcareous nodules below 7.5'	*										
10	- silty, calcareous, moderately plastic below 8' (extremely weathered limestone)											
	9.0'											
15	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan											
	- argillaceous with close horizontal partings from 10' to 11.1'											
	- unweathered, gray to dark gray from 13.2' to 14.4'											
20	- very argillaceous from 14.4' to 15.1'											
	15.8'											
25	LIMESTONE, Unweathered, Soft to Moderately Hard, Gray to Dark Gray											
	- slightly fossiliferous from 16.8' to 18.7'											
	- very argillaceous from 20.5' to 20.9'; 25.4' to 26.2' and 27.5' to 27.7'											
30												
	START : 9:25 AM											
	END: 11:15 AM											
35	GEOLOGIST: MICHAEL A. GILES											
40	DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON											
	Core											
	Core Depth											
45	Run # (ft) % Rec. % RQD											
	1 10-20 95 86											
	2 20-30 100 96											
50	BLOW COUNTS RECORDED: * = 3/8/32											

DEPTH DRILLED: 28.0'
DATE DRILLED: 6-11-91

DEPTH TO WATER:
DATE MEASURED:

PROJ. No. ASA91-020-00
PLATE 7

**LOG OF BORING NO. LEB-2
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805219.00 / E2452820.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200
				10	20	30	40	50	60	70	
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT		
	SURFACE ELEVATION: 664.20'										
5	CLAY, Stiff to Very Stiff, Highly Plastic, Moist, Dark Brown			3.0							
	6.0'			1.75							
				1.0							
10	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - argillaceous with close horizontal partings in Core Run #1 - slightly argillaceous with close horizontal partings from 11.5 to 12.3										
15	- very argillaceous, brown and tan from 15.8 to 16.5 - clay-filled joint at 16.8'										
17.6'											
20	LIMESTONE, Unweathered, Soft to Moderately Hard, Gray to Dark Gray - very argillaceous with 45 degree joint from 21.4' to 21.6' - horizontal partings at 21.8'		124							157	
25											
30											
35	START: 11:45 AM END: 1:15 PM										
40	GEOLOGIST: MICHAEL A. GILES DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON										
45											
50	Core Run # Core Depth (ft) % Rec. % RQD										
	1 6-10 50 20										
	2 10-20 98 87										
	3 20-23 100 87										

DEPTH DRILLED: 23.0'	DEPTH TO WATER:	PROJ. No. ASA91-020-00
DATE DRILLED: 6-11-91	DATE MEASURED:	PLATE 8

**LOG OF BORING NO. LEB-3
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805451.00 / E2453057.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-1288
				10	20	30	40	50	60	70	
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT		
	SURFACE ELEVATION: 671.90'			+-----●-----+							
				10	20	30	40	50	60	70	
0	CLAY, Very Stiff, Highly Plastic, Moist, Dark Brown			⊗ 2.0							
3.0		*		⊗ 2.5							
5	LIMESTONE, Weathered, Soft to Moderately Hard, Light tan										
7.4											
10	LIMESTONE, Unweathered, Soft to Moderately Hard, Gray to Dark Gray										
11.7	- close horizontal partings from 11.7' to 12.3'										
12.3	- argillaceous from 12.3' to 13.2'										
13.2	and 17.4' to 17.9'										
15											
20											
22.4	- slightly argillaceous, dark gray from 22.4' to 22.9'										
22.9											
25											
26.2	- argillaceous from 26.2' to 26.6'										
26.6											
30											
31.9	- very argillaceous, dark gray from 31.9' to 32.4'		130	●							
32.4	- 25 degree joint at 32.4'										
32.4											129 ⊗
35											
36.9	- very argillaceous with 30 degree joints from 36.9' to 37.5'										
37.5											
40											
45											
50											

START: 3:10 PM
END: 6:05 PM

LOG OF BORING NO. LEB-3 (continued)
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805451.00 / E2453057.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	⊗ UNCONF. COMPRESSION, tsf							X-200																			
				10	20	30	40	50	60	70																				
				PLASTIC LIMIT		WATER CONTENT			LIQUID LIMIT																					
	SURFACE ELEVATION: 671.90'			+	-	-	-	-	+																					
				10	20	30	40	50	60	70																				
60	<p>GEOLOGIST: MICHAEL A. GILES</p> <p>DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON</p>																													
65																														
70	<table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="width: 10%;">Core Run #</th> <th style="width: 15%;">Core Depth (ft)</th> <th style="width: 15%;">% Rec.</th> <th style="width: 15%;">% RQD</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>5-10</td> <td>80</td> <td>80</td> </tr> <tr> <td>2</td> <td>10-20</td> <td>98</td> <td>92</td> </tr> <tr> <td>3</td> <td>20-30</td> <td>99</td> <td>97</td> </tr> <tr> <td>4</td> <td>30-40</td> <td>100</td> <td>97</td> </tr> </tbody> </table>	Core Run #	Core Depth (ft)	% Rec.	% RQD	1	5-10	80	80	2	10-20	98	92	3	20-30	99	97	4	30-40	100	97									
Core Run #	Core Depth (ft)	% Rec.	% RQD																											
1	5-10	80	80																											
2	10-20	98	92																											
3	20-30	99	97																											
4	30-40	100	97																											
75																														
80	<p>BLOW COUNTS RECORDED: * = 37/30/20/0.5"</p>																													
85																														
90																														
95																														
100																														
105																														

DEPTH DRILLED: 40.0'	DEPTH TO WATER:	PROJ. No. ASA91-020-00
DATE DRILLED: 6-11-91	DATE MEASURED:	PLATE 9 (continued)

LOG OF BORING NO. LEB-4
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
 Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805415.00 / E2453384.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200	
				10	20	30	40	50	60	70		
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT			
	SURFACE ELEVATION: 674.90'											
0-3.0	CLAY, Hard, Highly Plastic, Moist, Dark Brown - silty, calcareous, moderately plastic, tan below 2' (extremely weathered limestone)			4.5+								
3.0-15.0	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - close horizontal partings from 5.0' to 5.3' - 28 degree joint at 6.1' - argillaceous with close horizontal partings from 6.1' to 6.4' - slightly argillaceous, ferrous stained from 8.8' to 9.1' - 40 to 50 degree joints from 9.7' to 9.9' - argillaceous with close horizontal partings from 10.0' to 10.7' - slightly argillaceous from 10.7' to 11.4' - argillaceous, ferrous stained with 15 degree joint from 11.4' to 11.5' - slightly argillaceous from 12.6' to 13.3' - 20 degree joint at 13.0'											
15.0-20.0	LIMESTONE, Unweathered, Moderately Hard, Gray											
20.0-30.0	START: 7:50 AM END: 9:20 AM											
30.0-35.0	GEOLOGIST: MICHAEL A. GILES											
35.0-40.0	DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON											
40.0-45.0	Core Core Depth Run # (ft) % Rec. % RQD											
45.0-50.0	1 5-10 98 70 2 10-20 92 74											

DEPTH DRILLED: 20.0'
DATE DRILLED: 6-12-91

DEPTH TO WATER: -----
DATE MEASURED:

PROJ. No.: ASA91-020-00
PLATE 10

LOG OF BORING NO. LEB-4 (continued)
 LEB FACILITY - SSC PROJECT
 WAXAHACHIE, TEXAS



Raba-Kistner
 Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805415.00 / E2453384.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	⊗ UNCONF. COMPRESSION, tsf							X-200
				10	20	30	40	50	60	70	
				PLASTIC LIMIT		WATER CONTENT			LIQUID LIMIT		
	SURFACE ELEVATION: 674.90'										
	BLOW COUNTS RECORDED: * = 16/50/3"										
60											
65											
70											
75											
80											
85											
90											
95											
100											
105											

DEPTH DRILLED: 20.0'
 DATE DRILLED: 6-12-91

DEPTH TO WATER:
 DATE MEASURED:

PROJ. No. ASA91-020-00
 PLATE 10 (continued)

LOG OF BORING NO. LEB-5
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805100.00 / E2453414.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200	
				10	20	30	40	50	60	70		
				PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT				
	SURFACE ELEVATION: 672.60'											
0 - 4.5'	CLAY, Very Stiff to Hard, Highly Plastic, Moist, Dark Brown			4.5+								
4.5' - 8.0'	CLAY, Slightly Silty, Hard, Moderately Plastic to Plastic, Moist, Tan/Gray/Yellow with caliche deposits			4.0								
8.0' - 16.4'	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - slightly argillaceous with close horizontal partings from 11.6' to 13' - 30 degree joint at 12' - close horizontal partings from 13' to 15.1' - 30 degree joint at 16'			4.5+								
16.4' - 26.2'	LIMESTONE, Unweathered, Soft to Moderately Hard, Gray to Dark Gray - slightly argillaceous with close horizontal partings from 23.1' to 24.6' - slightly argillaceous from 25.9' to 26.2'											
26.2' - 30.4'	- argillaceous with 20 degree joints from 30' to 30.4'											
30.4' - 35.7'	- argillaceous from 35.4' to 35.7' - 20 degree joint at 35.7'											
35.7' - 40.8'	- very argillaceous from 40.4' to 41.6' - 30 degree joint at 40.8'											
40.8' - 50'												
50'	START: 2:30 PM END: 5:35 PM											

DEPTH DRILLED: 43.0'
DATE DRILLED: 6-12-91

DEPTH-TO-WATER:
DATE MEASURED:

PROJ. No. ASA91-020-00
PLATE 11

LOG OF BORING NO. LEB-5 (continued)
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
 Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805100.00 / E2453414.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	⊗ UNCONF. COMPRESSION, tsf							% -200																			
				10	20	30	40	50	60	70																				
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT																					
	SURFACE ELEVATION: 672.60'																													
60																														
65	GEOLOGIST: MICHAEL A. GILES																													
70	DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON																													
75	<table border="1"> <thead> <tr> <th>Core Run #</th> <th>Core Depth (ft)</th> <th>% Rec.</th> <th>% RQD</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>10-20</td> <td>99</td> <td>68</td> </tr> <tr> <td>2</td> <td>20-30</td> <td>99</td> <td>92</td> </tr> <tr> <td>3</td> <td>30-40</td> <td>99</td> <td>97</td> </tr> <tr> <td>4</td> <td>40-43</td> <td>100</td> <td>87</td> </tr> </tbody> </table>	Core Run #	Core Depth (ft)	% Rec.	% RQD	1	10-20	99	68	2	20-30	99	92	3	30-40	99	97	4	40-43	100	87									
Core Run #	Core Depth (ft)	% Rec.	% RQD																											
1	10-20	99	68																											
2	20-30	99	92																											
3	30-40	99	97																											
4	40-43	100	87																											
80																														
85	BLOW COUNTS RECORDED: * = 4/50/5"																													
90																														
95																														
100																														
105																														

DEPTH DRILLED: 43.0'	DEPTH TO WATER:	PROJ. No. ASA91-020-00
DATE DRILLED: 6-12-91	DATE MEASURED:	PLATE 11 (continued)

LOG OF BORING NO. LEB-6
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS



Raba-Kistner
 Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6804827.00 / E2453254.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200	
				10	20	30	40	50	60	70		
				PLASTIC LIMIT			WATER CONTENT		LIQUID LIMIT			
	SURFACE ELEVATION: 662.50'											
0 - 1.8'	CLAY, Hard, Highly Plastic, Moist, Dark Brown	*		4.5+								
1.8' - 7.4'	CLAY, Silty, Calcareous, Hard, Moderately Plastic, Slightly Moist, Tan/Gray/Yellow with caliche deposits (extremely weathered limestone)	**		4.5+								
7.4' - 19.9'	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - slightly argillaceous, closely spaced partings in Core Run #1 - 60 degree joint in Core Run #1 (believed to be located between 8' to 10' depth) - slightly argillaceous from 10.3' to 10.5' and 14.7' to 15.5' - 40 degree joint at 11.6' - unweathered, gray from 18.0' to 18.7' - very argillaceous from 18.7' to 19.3'											
19.9' - 24.6'	LIMESTONE, Unweathered, Moderately Hard, Gray to Dark Gray - slightly argillaceous from 24.1' to 24.6'											
24.6' - 25.3'	START: 11:30 AM END: 2:15 PM											
25.3' - 35'	GEOLOGIST: MICHAEL A. GILES											
35' - 45'	DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON											
45' - 50'	Core Run # Depth (ft) % Rec. % RQD											
	1 5.3-10.3 76 46											
	2 10.3-20.3 100 90											
	3 20.3-25.3 100 92											
	BLOW COUNTS RECORDED: * = 45/50/5" ** = 50/4.5"											

DEPTH DRILLED: 25.3'	DEPTH TO WATER:	PROJ. No. ASA91-020-00
DATE DRILLED: 6-12-91	DATE MEASURED:	PLATE 12

**LOG OF BORING NO. LEB-7
LEB FACILITY - SSC PROJECT
WAXAHACHIE, TEXAS**



Raba-Kistner

Consultants, Inc.

DRILLING

METHOD: Hollow Stem Auger / NX Core Barrel

LOCATION: N6805600.00 / E2453430.00

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	UNCONF. COMPRESSION, tsf							X-200
				10	20	30	40	50	60	70	
				PLASTIC LIMIT		WATER CONTENT		LIQUID LIMIT			
	SURFACE ELEVATION: 674.70'										
0-3.2'	CLAY, Very Stiff to Hard, Highly Plastic, Moist, Dark Brown - silty, calcareous, moderately plastic, tan below 2.4' (extremely weathered limestone)			⊗ 4.0							
3.2-14.7'	LIMESTONE, Weathered, Soft to Moderately Hard, Light Tan - slightly argillaceous, closely spaced horizontal partings in Core Run #1 - 9 inch vertical joint in Core Run #1 (believed to be located between 8' to 10' in depth) - numerous joints (mostly closely-spaced horizontal partings) from 10.0' to 14.7' - 80 degree joint at 10.7' - 50 degree joint at 10.9' - argillaceous seam at 12.4' - argillaceous from 13.4' to 14.7'	*		⊗ 4.5+							
14.7-25.0'	LIMESTONE, Unweathered, Moderately Hard, Gray to Dark Gray										
35-40'	START: 7:10 AM END: 8:50 AM										
40-45'	GEOLOGIST: MICHAEL A. GILES DRILL CREW: LARRY TAYLOR JAMES STUBBS JOHN SALMON										
45-50'	Core Core Depth Run # (ft) % Rec. % RQD										
	1 5-10 80 42										
	2 10-20 100 54										
	BLOW COUNTS RECORDED: * = 50/6"										

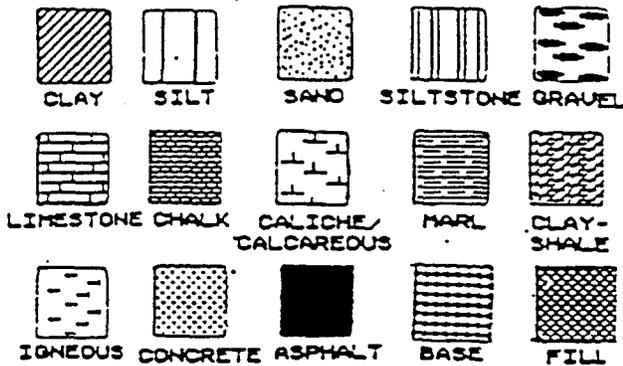
DEPTH DRILLED: 20.0'
DATE DRILLED: 6-13-91

DEPTH TO WATER: -
DATE MEASURED: -

PROJ. No. ASA91-020-00
PLATE 13

SYMBOLS AND TERMS USED ON BORING LOGS

SOIL OR ROCK TYPES (shown in symbols column)



SAMPLER TYPES (shown in sample column)



STRENGTH TEST RESULTS

- Pocket Penetrometer
- Torvane
- Unconfined Compression

TRIAXIAL COMPRESSION

- Unconsolidated-undrained
- Consolidated-undrained
- Cohesion (Total)
- Angle of Internal Friction (Total)
- Cohesion (Effective)
- Angle of Internal Friction (Effective)

NOTE: Values symbolized on boring logs represent shear strengths unless otherwise noted.

TERMS DESCRIBING CONSISTENCY, CONDITION OR TEXTURE

Terms used in this report to describe soils with regard to their consistency or conditions are in general accordance with the discussion presented in Article 45 of SOIL MECHANICS IN ENGINEERING PRACTICE, Terzaghi and Peck, John Wiley & Sons, Inc. 1967, using the most reliable information available from the field and laboratory investigations. Terms used for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No. 3-357, Waterways Experiment Station, March 1953.

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	having inclined planes of weakness that are slick and glossy in appearance
Fissured	containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical
Laminated	composed of thin layers of varying colors and texture
Interbedded	composed of alternate layers of different soil types
Calcareous	containing appreciable quantities of calcium carbonate
Well graded	having wide range in grain sizes and substantial amounts of all intermediate particle sizes
Poorly graded	predominantly of one grain size, or having a range of sizes with some intermediate size missing

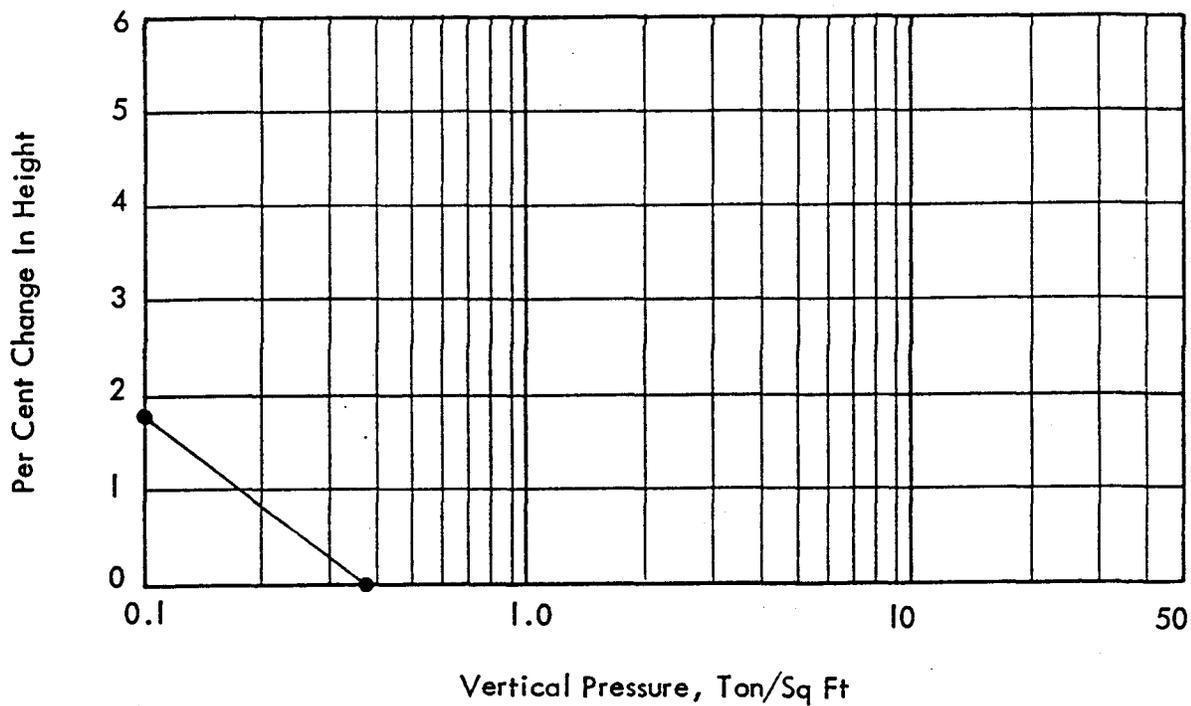
TERMS DESCRIBING CONSISTENCY OR CONDITION

RELATIVE DENSITY		COHESIVE STRENGTH			PLASTICITY	
Penetration Resistance, blows per ft	Relative Density	Penetration Resistance, blows per ft	Consistency	Cohesion TSF	Plasticity Index	Degree of Plasticity
0-4	Very loose	0-2	Very Soft	0-0.125	0-5	None
4-10	Loose	2-4	Soft	0.125-0.25	5-10	Low
10-30	Medium Dense	4-8	Firm	0.25-0.5	10-20	Moderate
30-50	Dense	8-15	Stiff	0.5-1.0	20-40	Plastic
>50	Very Dense	15-30	Very Stiff	1.0-2.0	>40	Highly Plastic
		>30	Hard	>2.0		

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

Boring: LEB-1 Depth: 0'-2.5'
Material: CLAY, Dark Brown

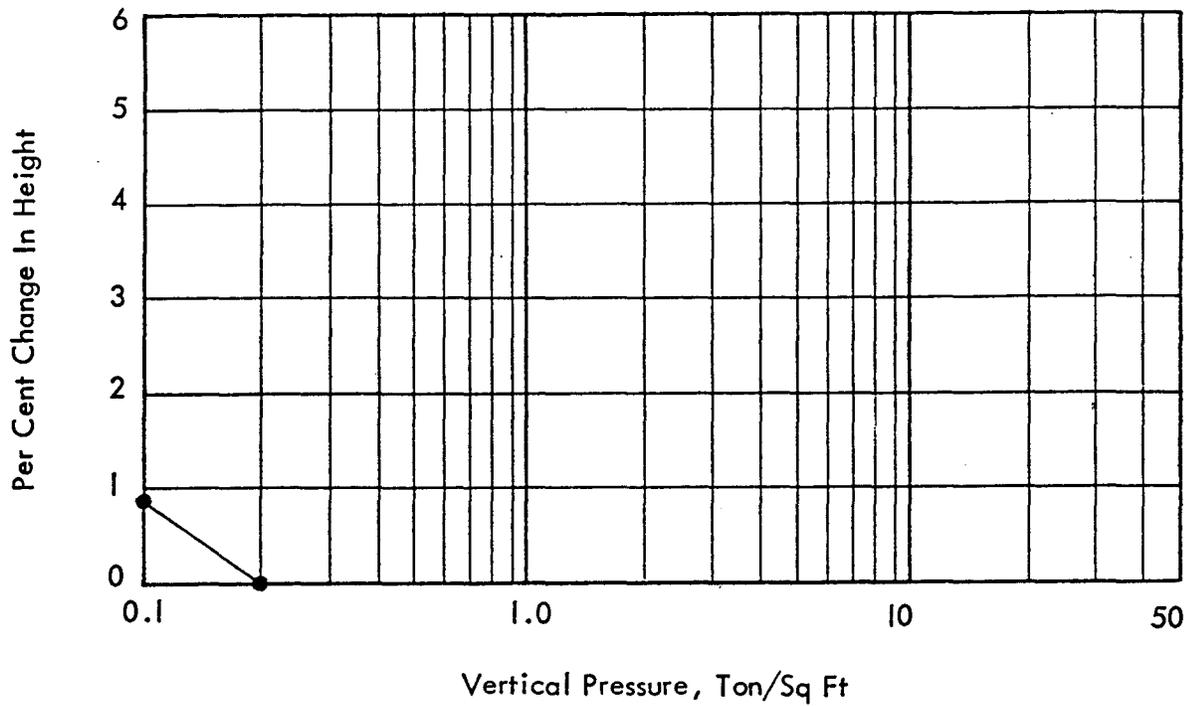
Unit Dry Weight: 85.0 lb/cu ft
Water Content: 32.2 %
Liquid Limit:
Plastic Limit:



SWELL TEST RESULTS

Boring: LIN-5 Depth: 5'-7.5'
Material: CLAY, Silty, Tan and White
with Caliche deposits
(extremely Weathered Lime-
stone)

Unit Dry Weight: 95.5 lb/cu ft
Water Content: 26.7 %
Liquid Limit:
Plastic Limit:



SWELL TEST RESULTS