RABA
KISTNER

GEOTECHNICAL DATA REPORT

FOR

SAN ANTONIO WATER SYSTEM
W-1 LEON CREEK: HIGHWAY 151 TO HIGHWAY 90
UPPER SEGMENT
SAN ANTONIO, TEXAS

50 YEARS RABA KISTNER
Building Better Tomorrows
12821 W. Golden Lane
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TBPE Firm F-3257

Project No. ASA16-016-01
January 21, 2019

Mr. Joseph Ortega, P.E.
Pape-Dawson Engineers, Inc.
2000 NW Loop 410
San Antonio, TX 78213

RE: Geotechnical Data Report
SAWS - W-1 Leon Creek Highway 90 to Highway 151
Upper Segment
San Antonio, Texas

Dear Mr. Ortega:

Raba Kistner Consultants, Inc. (RKCI) is pleased to submit the report of our Geotechnical Data Report for the above-referenced project. This study was performed in accordance with RKCI Proposal No. PSA15-168-00, dated October 29, 2015 and the amended agreement dated September 19, 2018. The purpose of this study was to drill borings along the proposed upper segment alignment, perform laboratory testing to evaluate and characterize subsurface conditions, and present our findings in a Geotechnical Data Report.

We appreciate the opportunity to be of service to you on this project. Please call the undersigned should you have any questions about the information presented in this data report.

Very truly yours,

RABA KISTNER CONSULTANTS, INC.

ERIC J. NEUNER
116311

1/21/2019

Eric J. Neuner, P.E.
Associate | Manager, San Antonio Engineering

SH/EJN/kv

Attachments

Copies Submitted: Above (Electronic Copy)

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GEOTECHNICAL DATA REPORT

For

SAN ANTONIO WATER SYSTEM
WR-1 LEON CREEK: HIGHWAY 151 TO HIGHWAY 90
UPPER SEGMENT
SAN ANTONIO, TEXAS

Prepared for

PAPE-DAWSON ENGINEERS, INC.
San Antonio, Texas

Prepared by

RABA KISTNER CONSULTANTS, INC.
San Antonio, Texas

PROJECT NO. ASA16-016-01

January 21, 2019

RABA KISTNER

TABLE OF CONTENTS

ATTACHMENTS

The following figures are attached and complete this report:

INTRODUCTION

RKCI has completed the authorized subsurface exploration for the Upper Segment of the proposed W-1 Leon Creek wastewater pipeline project, as illustrated on Figure 1. The overall project spans approximately from Loop 410 to US Highway 90 in San Antonio, Texas (approximately 4 miles). This data report briefly describes the procedures utilized during this study and presents our findings for the upper segment to aid in new wastewater line design and construction.

PROJECT DESCRIPTION

Based on the project information and the preliminary alignment drawing provided to us by Pape-Dawson Engineers, Inc., we understand that the wastewater line will generally start southeast of Loop 410 and terminate near U.S. 90 Access Road, in San Antonio, Texas. The Upper Segment alignment generally extends north and west of Leon Creek and terminates near South Brownleaf Drive in San Antonio, Texas. The majority of the construction is anticipated to be open cut with bore and jack sites beneath paved roads, creeks, and possibly other crossings.

LIMITATIONS

This geotechnical data report has been prepared in accordance with accepted Geotechnical Engineering practices in the region of south/central Texas and for the use of Pape-Dawson Engineers, Inc. (CLIENT) and its representatives for design purposes. This report may not contain sufficient information for purposes of other parties or other uses. This report is not intended for use in determining construction means and methods.

The data submitted in this report are based on 8 borings drilled along the proposed alignment, our understanding of the project information provided to us. If the project information described in this report is incorrect, is altered, or if new information is available, we should be retained to review and modify our findings as needed.

This data report may not reflect the actual variations of the subsurface conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. The construction process itself may also alter subsurface conditions. Our scope does not include an environmental assessment of the air, soil, rock, or water conditions either on or adjacent to the site. No environmental opinions are presented in this report.

BORINGS AND LABORATORY TESTS

Subsurface conditions at the site were evaluated by 8 borings drilled at the locations shown on the Boring Location Map, Figure 1. These locations are approximate and distances were measured using a hand-held, recreational-grade GPS locator. Ground surface elevations were estimated from the topography depicted on the preliminary alignment drawing provided by Pape-Dawson Engineers, Inc. The estimated ground surface elevation at each boring location and the boring bottom elevation are summarized in the following table.

Boring Summary – Upper Segment

Boring No.	Estimated Ground Surface Elevation (ft, MSL)	Estimated Boring Bottom Elevation (ft, MSL)
B-1	724.6	698.6
B-2	716.0	696.0
B-3	713.2	693.2
B-4	710.5	693.0
B-5	712.0	692.0
B-6	710.5	690.5
B-7	710.5	689.5
B-8	704.0	687.0

Borings were drilled using a truck-mounted drilling rig. During drilling operations, Split-Spoon (with Standard Penetration Test), Shelby Tube, and Grab Samples were collected. Each sample was visually classified in the laboratory by a member of our geotechnical engineering staff. The geotechnical index properties of the strata were evaluated by natural moisture content, Atterberg limits, percent passing a No. 200 sieve, and unconfined compressive strength tests. In addition, analytical testing was performed on select samples to evaluate the soil corrosivity (including pH, electrical resistivity, and sulfate and chloride content determinations). The results are presented in the following section.

The laboratory test results are presented in graphical or numerical form on the boring logs illustrated on Figures 2 through 9. A key to classification terms and symbols used on the logs is presented on Figure 10. The results of the laboratory and field testing are also tabulated on Figure 11 for ease of reference.

Standard Penetration Test results are noted as “blows per ft” on the boring logs and Figure 11, where “blows per ft” refers to the number of blows by a falling hammer required for 1 ft of penetration into the soil/weak rock (N-value). Where hard or dense materials were encountered, the tests were terminated at 50 blows even if one foot of penetration had not been achieved. When all 50 blows fall within the first 6 in. (seating blows), refusal “ref” for 6 in. or less will be noted on the boring logs and on Figure 11.

CORROSIVITY TESTING

The corrosivity characteristics of the select soil samples were evaluated using pH, resistivity, sulfate content, and chloride content tests. These tests were performed on selected sample specimens obtained from the subsurface materials. Results are summarized in the following table.

Corrosivity Testing Summary					
Boring	Composite Sample Depth (ft)	Resistivity (Ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-1	13-24.5	1,166	9.2	140	8.2
B-2	6.5-20	*	9.3	1,010	17.8
B-3	15-20	542	9.0	570	13.2
B-4	11-13	3,087	10.0	208	27.8
B-5	14-16	3,842	10.1	161	30.6
B-6	8.5-20	*	9.6	990	26.3
B-7	8.5-20.5	*	9.1	808	23.6
B-8	8.5-17	*	10.1	181	12.9

*Not enough sample to perform laboratory test.

GENERAL SITE CONDITIONS

SITE DESCRIPTION

The proposed upper segment of the wastewater line site extends across developed and undeveloped areas. There are a significant number of buried structures and existing utilities in the vicinity of these project alignments; it is also possible that abandoned foundations, structures, and utilities are present which were not encountered during field operations. The presence of buried structures (old utility structures, pavements, brick, debris, abandoned utilities, etc.) should be anticipated. The roadway crossings included in our exploration in this portion of the project site are listed below:

- West Commerce Street
- Highway 151
- Pinn Road

GEOLOGY

A review of the *Geologic Atlas of Texas, San Antonio Sheet*, indicates that this site is naturally underlain with soils of the Fluviatile Terrace Deposit (Borings B-1 through B-8). Fluviatile terrace deposits are stream bed deposits typically consisting of clays, sands, silts, and gravels. Such deposits can contain point bars, cutbanks, oxbows, and abandoned channel segments associated with variations in stream bed activity. As a result, soil profiles in terrace deposit areas may vary greatly over relatively short vertical and horizontal distances, and may contain water-bearing strata.

STRATIGRAPHY

The boring logs should be consulted for specific stratigraphic information at each individual location. Each stratum has been designated by grouping materials that possess similar physical and engineering characteristics. The boring logs should be consulted for more specific stratigraphic information. Unless noted on the boring logs, the lines designating the changes between various strata represent approximate boundaries. The transition between materials may be gradual or may occur between recovered samples. It should be noted that there can be variations from that shown or described on the boring logs.

The boring logs and related information depict subsurface conditions only at the specific locations and times where sampling was conducted. The passage of time may result in changes in conditions, interpreted to exist, at or between the locations where sampling was conducted.

GROUNDWATER

During drilling, groundwater was encountered in Borings B-1 through B-6, and B-8 at depths ranging from approximately 2.5 ft to 15 ft below the existing ground surface and our boring logs should be reviewed for specific information. The observed groundwater is summarized in the following table.

Boring No.	Estimated Ground Surface Elevation (ft, MSL)	Approximate Elevation (ft, MSL)	
		Seepage(1)	Groundwater(2)
B-1	724.6	710.6	711.9
B-2	716.0	Not Observed	713.1
B-3	713.2	708.2	698.4
B-4	710.5	708.0	708.0
B-5	712.0	708.5	708.5
B-6	710.5	703.0	703.2
B-8	704.0	692.0	695.2

1)noted by the logger during drilling
2)measured upon termination of the boring

The remaining borings remained dry throughout the exploration phase. Groundwater levels may not have stabilized, particularly in less permeable cohesive soil, prior to backfilling. Consequently, the indicated groundwater levels, or lack thereof, may not represent present or future levels. It is possible for groundwater to exist beneath this site at shallow depths on a transient basis following periods of precipitation and within permeable strata or fills. Fluctuations in groundwater levels occur due to variation in rainfall, surface water run-off, the stage of Leon Creek, or other factors not evident at the time of exploration. The construction process itself may also cause variations in the groundwater level.

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

ATTACHMENTS

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12821 West Golden Lane
San Antonio, Texas 78249
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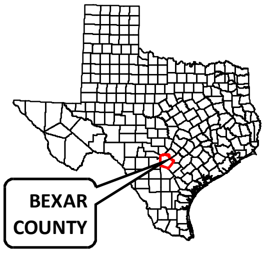
TBPE Firm Number 3257

SOURCE: Aerial Photography Obtained from the City of San Antonio (COSA) - 2013

BORING LOCATION MAP

SAWS W-1 LEON CREEK HWY 90 TO HWY 151
UPPER SEGMENT
SAN ANTONIO, TEXAS



PROJECT No.:
ASA16-016-00

ISSUE DATE:	01/18/2019
DRAWN BY:	CCL
CHECKED BY:	IM
REVIEWED BY:	EJN

FIGURE
1

NOTE: This Drawing is Provided for Illustration Only, May Not be to Scale and is Not Suitable for Design or Construction Purposes

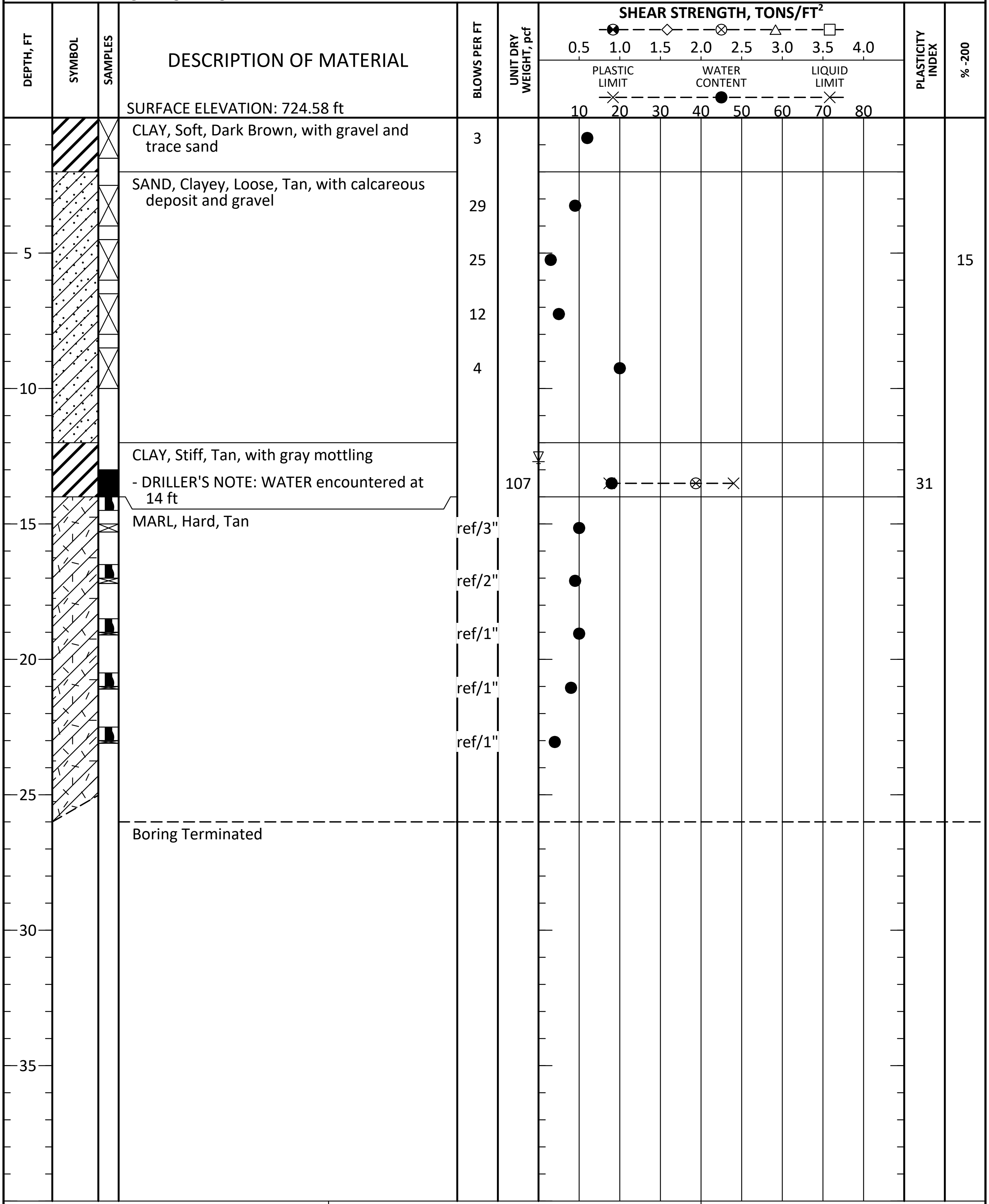
LOG OF BORING NO. B-1

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.44427; W 98.63338



SURFACE ELEVATION: 724.58 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
CLAY, Soft, Dark Brown, with gravel and trace sand	3			
SAND, Clayey, Loose, Tan, with calcareous deposit and gravel	29			
	25			15
	12			
	4			
CLAY, Stiff, Tan, with gray mottling - DRILLER'S NOTE: WATER encountered at 14 ft		107	31	
MARL, Hard, Tan	ref/3"			
	ref/2"			
	ref/1"			
	ref/1"			
	ref/1"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 26.0 ft
DATE DRILLED: 8/16/2016
DEPTH TO WATER: 12.7 ft
DATE MEASURED: 8/16/2016
PROJ. No.: ASA16-016-00
FIGURE: 2

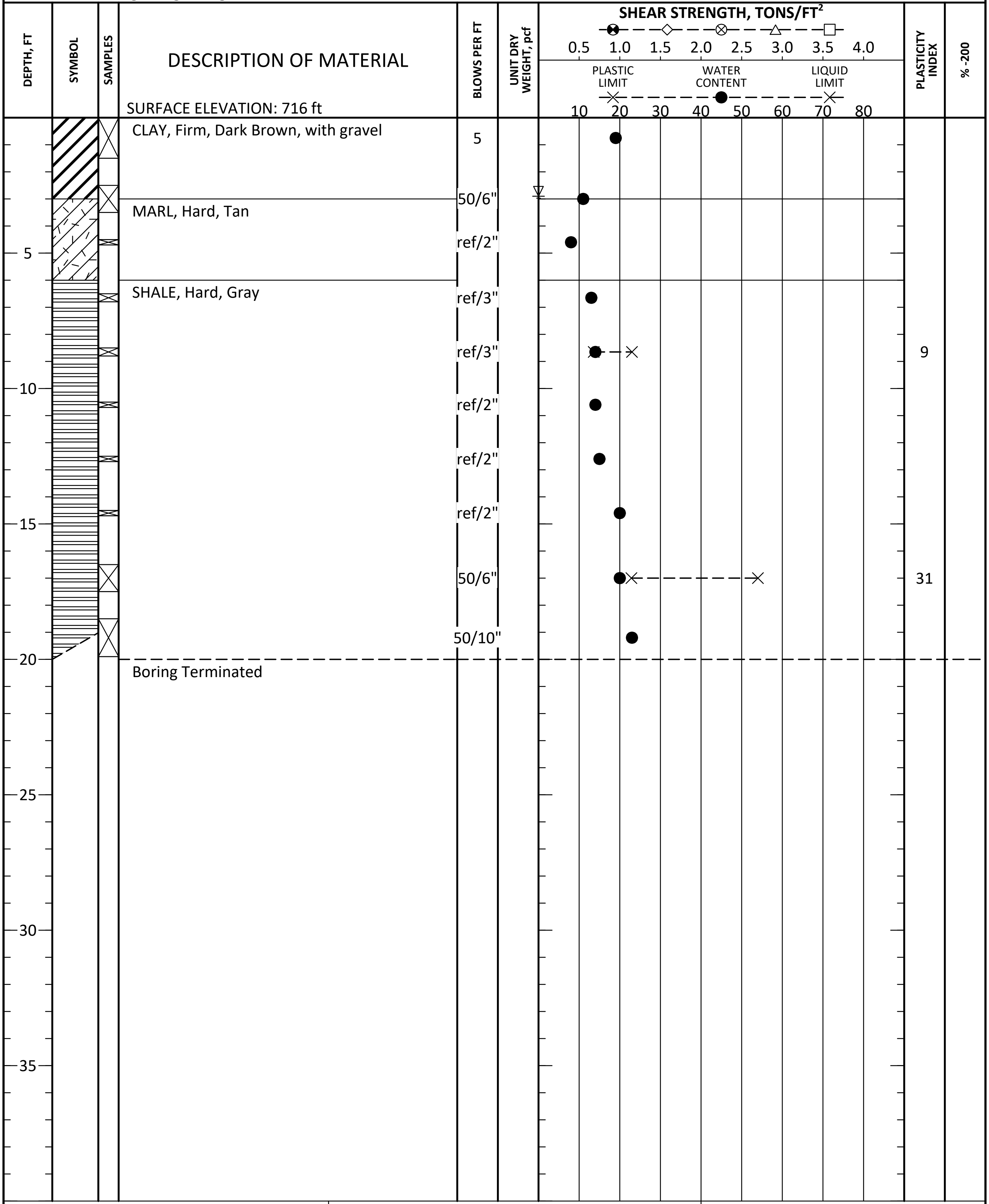
LOG OF BORING NO. B-2

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43712; W 98.62943



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 8/16/2016

DEPTH TO WATER: 2.9 ft
DATE MEASURED: 8/16/2016

PROJ. No.: ASA16-016-00
FIGURE: 3

LOG OF BORING NO. B-3

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

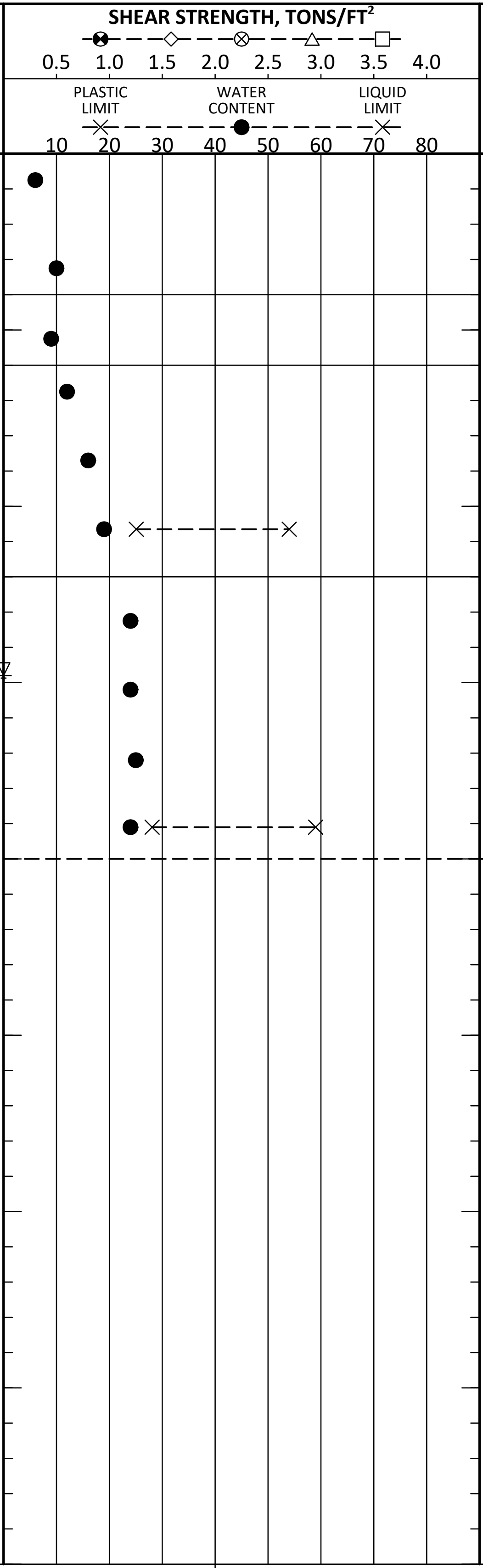
DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43914; W 98.62958

SURFACE ELEVATION: 713.17 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
POSSIBLE FILL: GRAVEL, Clayey, Loose to Medium Dense, Dark Brown, with sand	8			33
	16			
GRAVEL, Medium Dense to Very Dense, Tan with clay and sand - DRILLER'S NOTE: WATER encountered at 5 ft	22			
MARL, Hard, Tan	ref/6"			
	ref/5"			
	ref/4"		29	
SHALE, Hard, Gray	39			
	50/11"			
	50/10"			
	50/8"		31	
Boring Terminated				

DEPTH, FT: 5, 10, 15, 20, 25, 30, 35



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	20.0 ft	**DEPTH TO WATER:**	14.8 ft	**PROJ. No.:**	ASA16-016-00
DATE DRILLED:	9/2/2016	**DATE MEASURED:**	9/2/2016	**FIGURE:**	4

LOG OF BORING NO. B-4

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

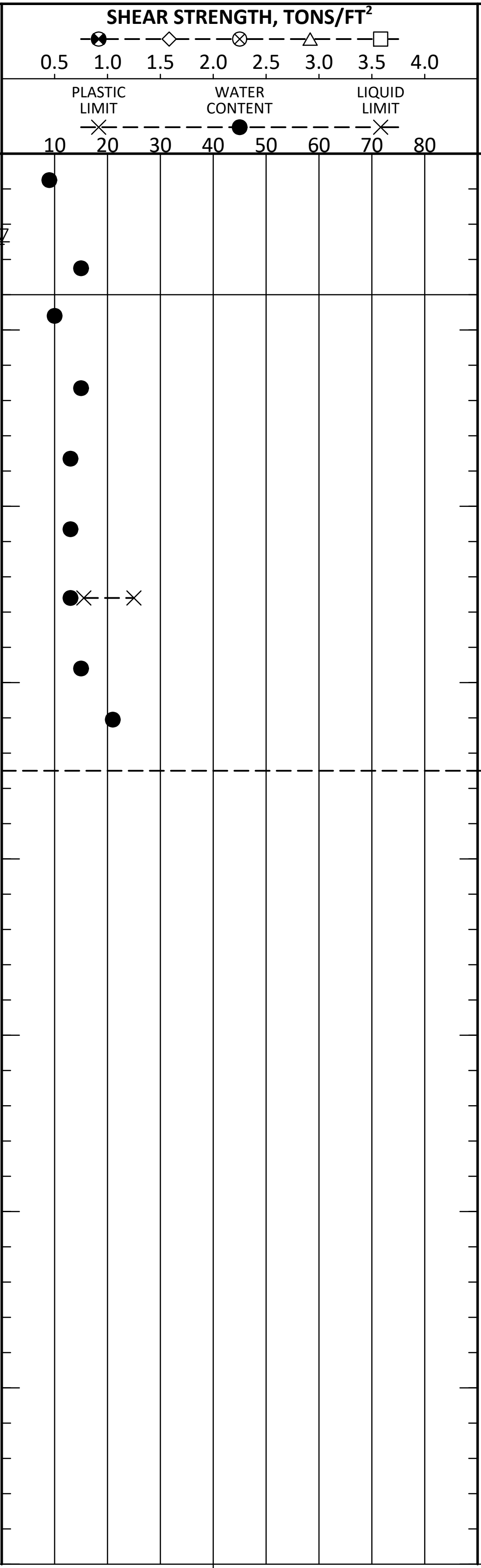
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43503; W 98.62828

SURFACE ELEVATION: 710.5 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
POSSIBLE FILL: GRAVEL, Clayey, Medium Dense, Dark Brown, with sand	10			
- DRILLER'S NOTE: WATER encountered at 2-1/2 ft	17			17
SHALE, Hard, Gray	ref/3"			
	ref/3"			
	ref/4"			
	ref/3"			
	ref/2"		9	
	ref/2"			
	ref/1"			
Boring Terminated				



DEPTH, FT: 5, 10, 15, 20, 25, 30, 35

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 17.5 ft
DATE DRILLED: 10/14/2016

DEPTH TO WATER: 2.5 ft
DATE MEASURED: 10/14/2016

PROJ. No.: ASA16-016-00
FIGURE: 5

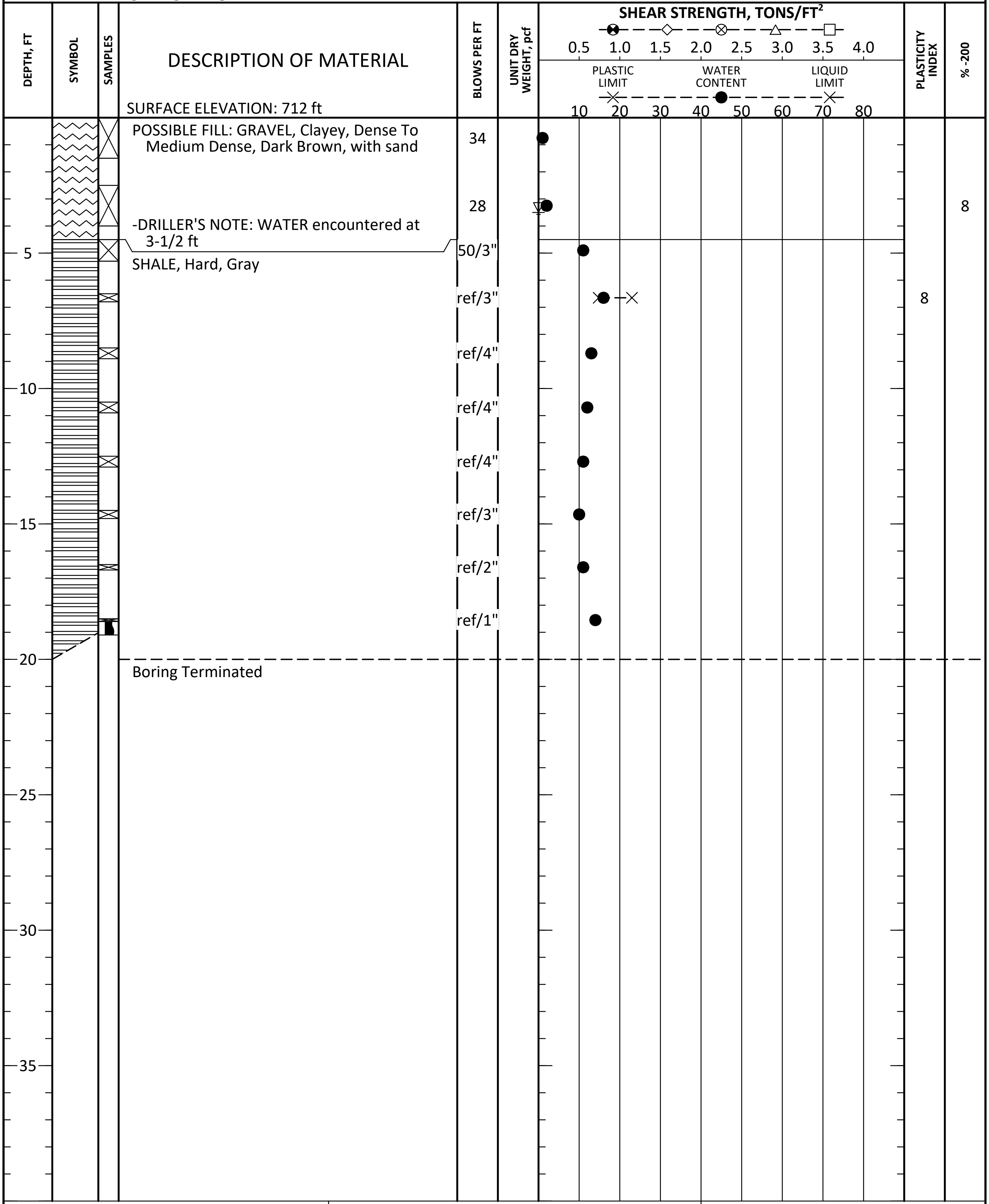
LOG OF BORING NO. B-5

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43412; W 98.62700



NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 10/14/2016

DEPTH TO WATER: 3.5 ft
DATE MEASURED: 10/14/2016

PROJ. No.: ASA16-016-00
FIGURE: 6

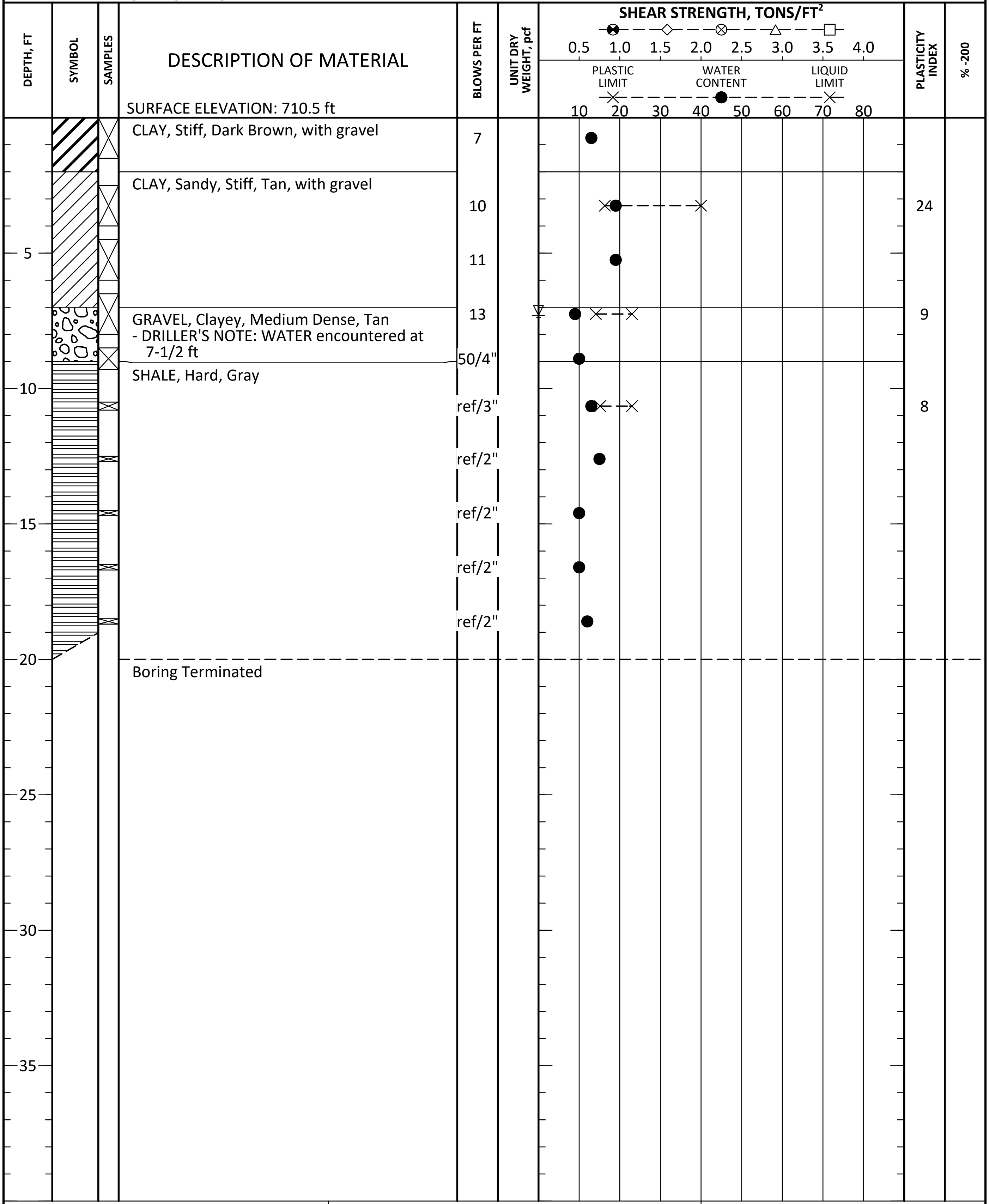
LOG OF BORING NO. B-6

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43200; W 98.62325



SURFACE ELEVATION: 710.5 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	CLAY, Stiff, Dark Brown, with gravel	7			
	CLAY, Sandy, Stiff, Tan, with gravel	10		24	
5		11			
	GRAVEL, Clayey, Medium Dense, Tan - DRILLER'S NOTE: WATER encountered at 7-1/2 ft	13		9	
		50/4"			
10	SHALE, Hard, Gray	ref/3"		8	
		ref/2"			
15		ref/2"			
		ref/2"			
		ref/2"			
20	Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED: 20.0 ft
DATE DRILLED: 8/16/2016
DEPTH TO WATER: 7.3 ft
DATE MEASURED: 8/16/2016
PROJ. No.: ASA16-016-00
FIGURE: 7

LOG OF BORING NO. B-7

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

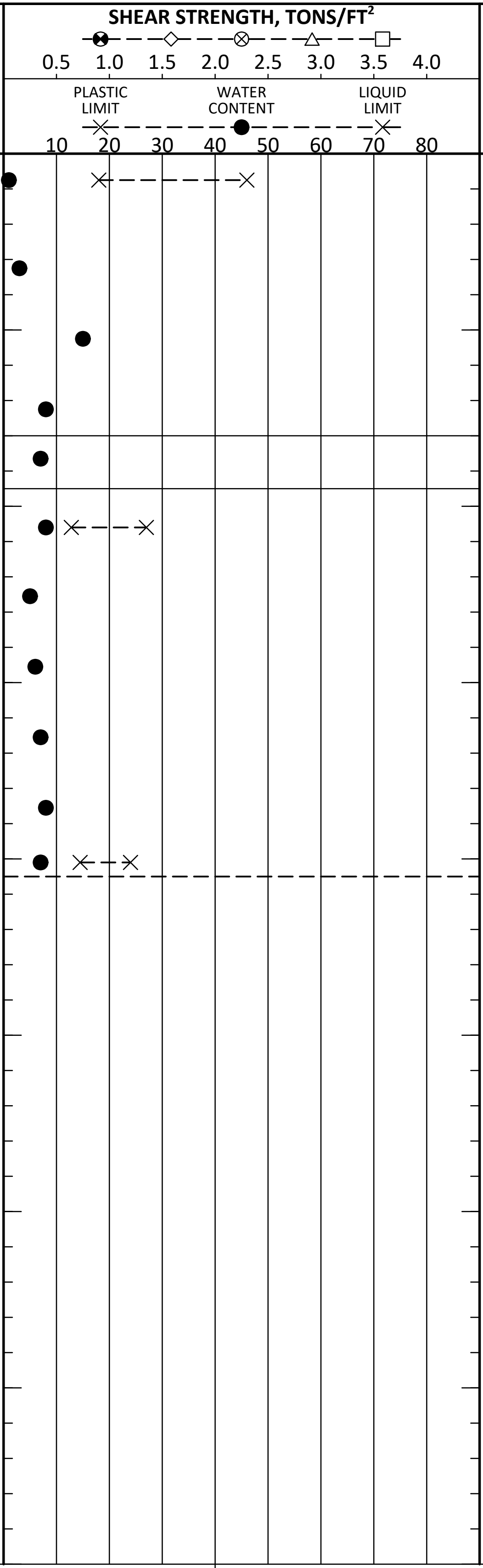
RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.43123; W 98.62104

SURFACE ELEVATION: 710.5 ft

DEPTH, FT	DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
	POSSIBLE FILL: CLAY, gravelly, Stiff to Hard, Dark Brown	7		28	
	- with gravel from 3 ft to 5-1/2 ft	30			
5		14			18
		18			
	MARL, Hard, Tan	ref/3"			
10	SHALE, Hard, Gray	ref/2"		14	
		ref/1"			
15		ref/1"			
		ref/1"			
		ref/1"			
20		ref/2"		10	
	Boring Terminated				
25					
30					
35					



DEPTH DRILLED: 21.0 ft
DATE DRILLED: 8/17/2016

DEPTH TO WATER: DRY
DATE MEASURED: 8/17/2016

PROJ. No.: ASA16-016-00
FIGURE: 8

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

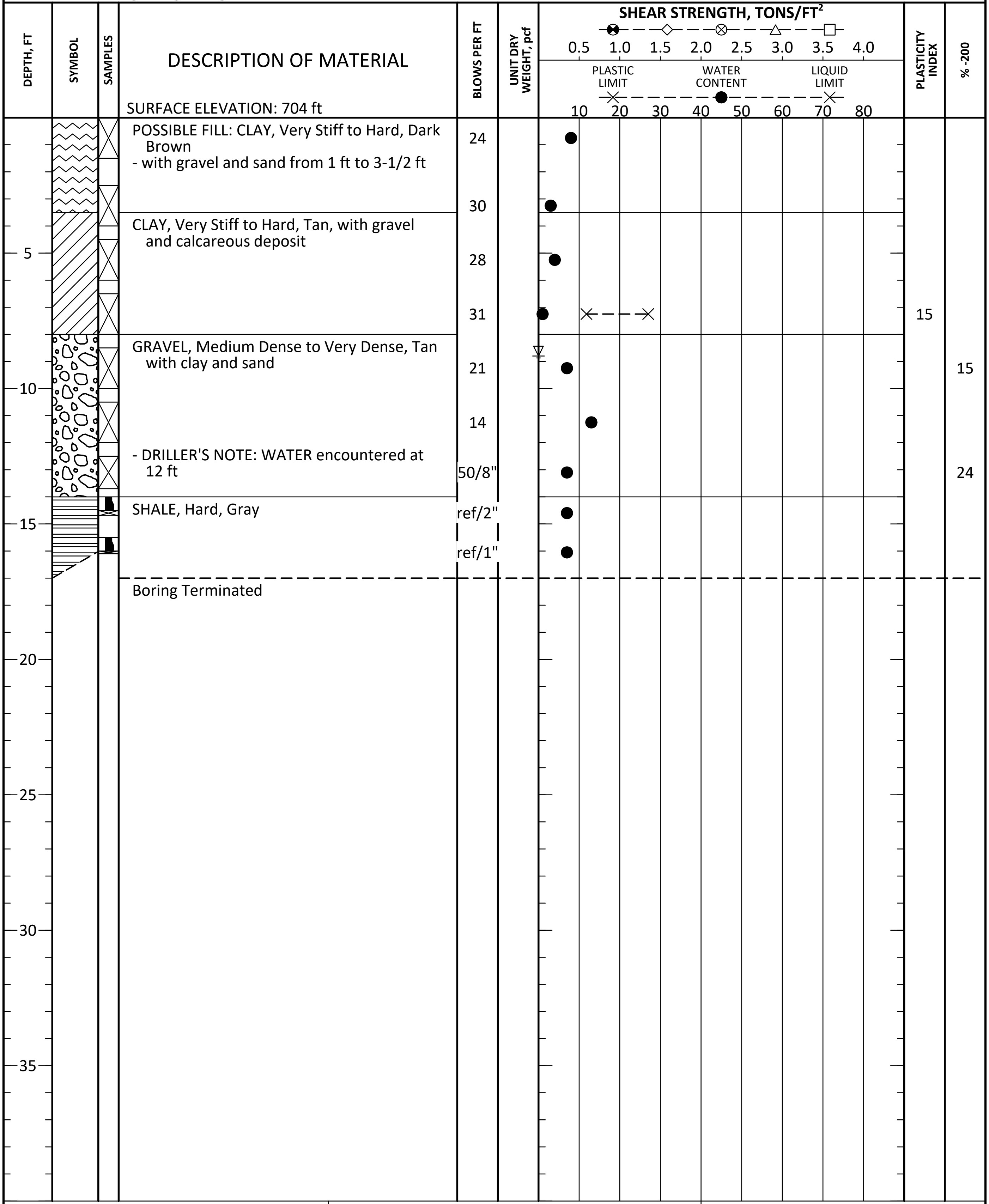
LOG OF BORING NO. B-8

SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

RABA KISTNER
TBPE Firm Registration No. F-3257

DRILLING METHOD: Straight Flight Auger

LOCATION: N 29.42924; W 98.61786



SURFACE ELEVATION: 704 ft

DESCRIPTION OF MATERIAL	BLOWS PER FT	UNIT DRY WEIGHT, pcf	PLASTICITY INDEX	% -200
POSSIBLE FILL: CLAY, Very Stiff to Hard, Dark Brown - with gravel and sand from 1 ft to 3-1/2 ft	24			
	30			
CLAY, Very Stiff to Hard, Tan, with gravel and calcareous deposit	28			
	31		15	
GRAVEL, Medium Dense to Very Dense, Tan with clay and sand	21			15
	14			
- DRILLER'S NOTE: WATER encountered at 12 ft	50/8"			24
SHALE, Hard, Gray	ref/2"			
	ref/1"			
Boring Terminated				

NOTE: THESE LOGS SHOULD NOT BE USED SEPARATELY FROM THE PROJECT REPORT

DEPTH DRILLED:	17.0 ft	**DEPTH TO WATER:**	8.8 ft	**PROJ. No.:**	ASA16-016-00
DATE DRILLED:	8/17/2016	**DATE MEASURED:**	8/17/2016	**FIGURE:**	9

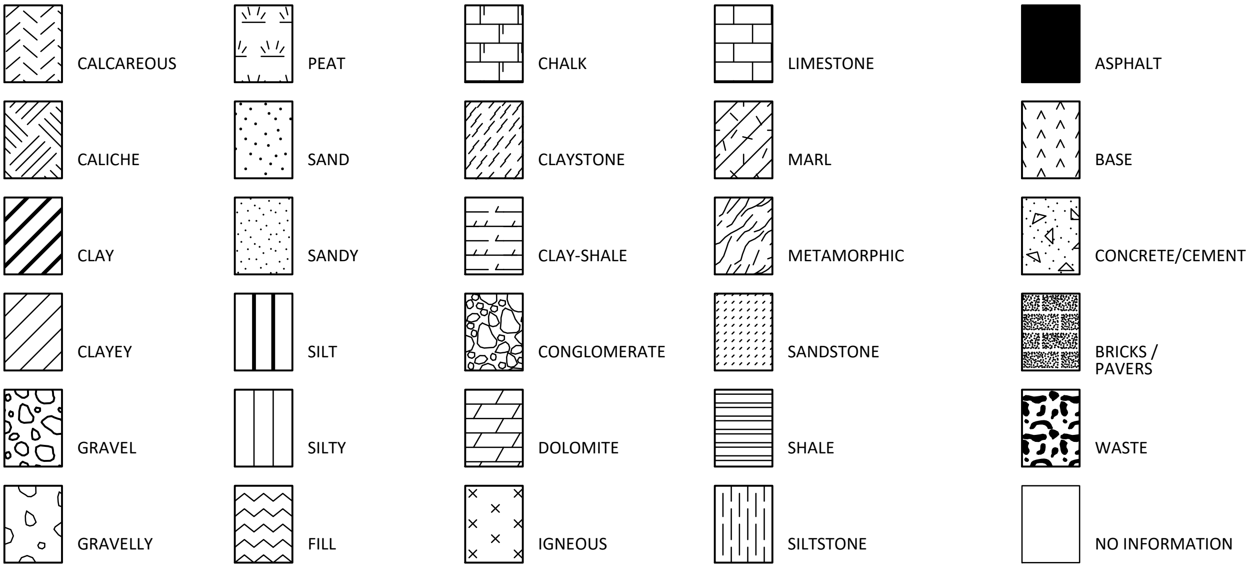
KEY TO TERMS AND SYMBOLS

MATERIAL TYPES

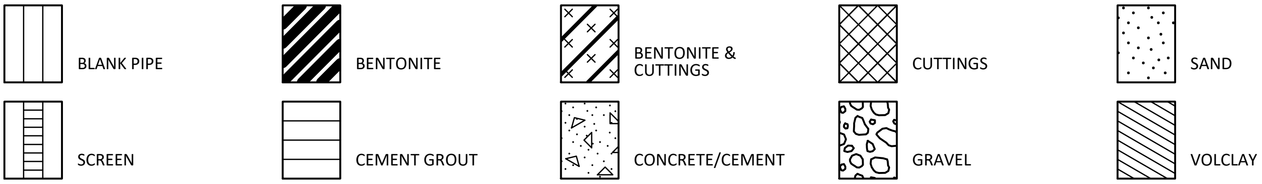
SOIL TERMS

ROCK TERMS

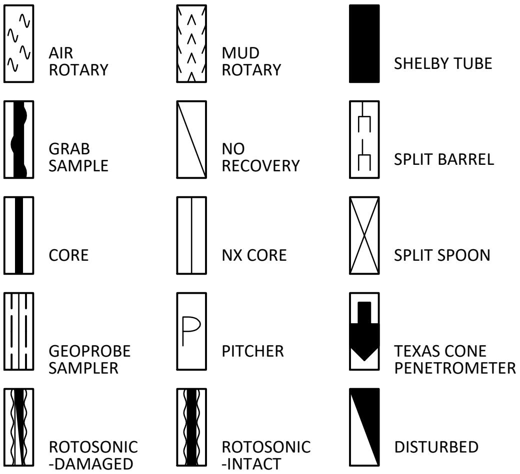
OTHER



WELL CONSTRUCTION AND PLUGGING MATERIALS



SAMPLE TYPES



STRENGTH TEST TYPES

⊗	POCKET PENETROMETER
◇	TORVANE
⊗	UNCONFINED COMPRESSION
△	TRIAXIAL COMPRESSION UNCONSOLIDATED-UNDRAINED
□	TRIAXIAL COMPRESSION CONSOLIDATED-UNDRAINED

NOTE: VALUES SYMBOLIZED ON BORING LOGS REPRESENT SHEAR STRENGTHS UNLESS OTHERWISE NOTED

PROJECT NO. ASA16-016-00

REVISED 04/2012

FIGURE 10a

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

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 SOILS 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 American Society for Testing and Materials D2487-06 and D2488-00, Volume 04.08, Soil and Rock; Dimension Stone; Geosynthetics; 2005.

The depths shown on the boring logs are not exact, and have been estimated to the nearest half-foot. Depth measurements may be presented in a manner that implies greater precision in depth measurement, i.e 6.71 meters. The reader should understand and interpret this information only within the stated half-foot tolerance on depth measurements.

RELATIVE DENSITY

Penetration Resistance Blows per ft	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
> 50	Very Dense

COHESIVE STRENGTH

Resistance Blows per ft	Consistency	Cohesion TSF
0 - 2	Very Soft	0 - 0.125
2 - 4	Soft	0.125 - 0.25
4 - 8	Firm	0.25 - 0.5
8 - 15	Stiff	0.5 - 1.0
15 - 30	Very Stiff	1.0 - 2.0
> 30	Hard	> 2.0

PLASTICITY

Plasticity Index	Degree of Plasticity
0 - 5	None
5 - 10	Low
10 - 20	Moderate
20 - 40	Plastic
> 40	Highly Plastic

ABBREVIATIONS

B = Benzene
T = Toluene
E = Ethylbenzene
X = Total Xylenes
BTEX = Total BTEX
TPH = Total Petroleum Hydrocarbons
ND = Not Detected
NA = Not Analyzed
NR = Not Recorded/No Recovery
OVA = Organic Vapor Analyzer
ppm = Parts Per Million

Qam, Qas, Qal = Quaternary Alluvium
Qat = Low Terrace Deposits
Qbc = Beaumont Formation
Qt = Fluviatile Terrace Deposits
Qao = Seymour Formation
Qle = Leona Formation
Q-Tu = Uvalde Gravel
Ewi = Wilcox Formation
Emi = Midway Group
Mc = Catahoula Formation
El = Laredo Formation
Kknm = Navarro Group and Marlbrook Marl
Kpg = Pecan Gap Chalk
Kau = Austin Chalk

Kef = Eagle Ford Shale
Kbu = Buda Limestone
Kdr = Del Rio Clay
Kft = Fort Terrett Member
Kgt = Georgetown Formation
Kep = Person Formation
Kek = Kainer Formation
Kes = Escondido Formation
Kew = Walnut Formation
Kgr = Glen Rose Formation
Kgru = Upper Glen Rose Formation
Kgrl = Lower Glen Rose Formation
Kh = Hensell Sand

KEY TO TERMS AND SYMBOLS (CONT'D)

TERMINOLOGY

SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.
Carbonate	Having more than 50% carbonate content.

SAMPLING METHODS

RELATIVELY UNDISTURBED SAMPLING

Cohesive soil samples are to be collected using three-inch thin-walled tubes in general accordance with the Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587) and granular soil samples are to be collected using two-inch split-barrel samplers in general accordance with the Standard Method for Penetration Test and Split-Barrel Sampling of Soils (ASTM D1586). Cohesive soil samples may be extruded on-site when appropriate handling and storage techniques maintain sample integrity and moisture content.

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140-pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

PROJECT NO. ASA16-016-00

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

FILE NAME: ASA16-016-00 FOR DATA REPORT - NO INVERT ELEVATION.GPJ 1/4/2019

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-1	0.0 to 1.5	3	12								
	2.5 to 4.0	29	9								
	4.5 to 6.0	25	3						15		
	6.5 to 8.0	12	5								
	8.5 to 10.0	4	20								
	13.0 to 14.0		18	48	17	31		107		1.94	UC
	14.0 to 14.5										
	15.0 to 15.3	ref/3"	10								
	16.5 to 17.0										
	17.0 to 17.2	ref/2"	9								
	18.5 to 19.0										
	19.0 to 19.1	ref/1"	10								
	20.5 to 21.0										
	21.0 to 21.1	ref/1"	8								
	22.5 to 23.0										
	23.0 to 23.1	ref/1"	4								
B-2	0.0 to 1.5	5	19								
	2.5 to 3.5	50/6"	11								
	4.5 to 4.7	ref/2"	8								
	6.5 to 6.8	ref/3"	13								
	8.5 to 8.8	ref/3"	14	23	14	9					
	10.5 to 10.7	ref/2"	14								
	12.5 to 12.7	ref/2"	15								
	14.5 to 14.7	ref/2"	20								
	16.5 to 17.5	50/6"	20	54	23	31					
	18.5 to 19.9	50/10"	23								
B-3	0.0 to 1.5	8	6						33		
	2.5 to 4.0	16	10								
	4.5 to 6.0	22	9								
	6.5 to 7.0	ref/6"	12								
	8.5 to 8.9	ref/5"	16								
	10.5 to 10.8	ref/4"	19	54	25	29					
	12.5 to 14.0	39	24								
	14.5 to 15.9	50/11"	24								
	16.5 to 17.9	50/10"	25								
	18.5 to 19.7	50/8"	24	59	28	31					
B-4	0.0 to 1.5	10	9								
	2.5 to 4.0	17	15						17		
	4.5 to 4.7	ref/3"	10								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

PROJECT NO. ASA16-016-00

RABA KISTNER

FIGURE 11a

RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

FILE NAME: ASA16-016-00 FOR DATA REPORT - NO INVERT ELEVATION.GPJ 1/4/2019

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-4	6.5 to 6.8	ref/3"	15								
	8.5 to 8.8	ref/4"	13								
	10.5 to 10.8	ref/3"	13								
	12.5 to 12.7	ref/2"	13	25	16	9					
	14.5 to 14.7	ref/2"	15								
	16.0 to 16.1	ref/1"	21								
	16.1 to 16.6										
B-5	0.0 to 1.5	34	1								
	2.5 to 4.0	28	2						8		
	4.5 to 5.3	50/3"	11								
	6.5 to 6.8	ref/3"	16	23	15	8					
	8.5 to 8.9	ref/4"	13								
	10.5 to 10.9	ref/4"	12								
	12.5 to 12.9	ref/4"	11								
	14.5 to 14.8	ref/3"	10								
	16.5 to 16.7	ref/2"	11								
	18.5 to 18.6	ref/1"	14								
	18.6 to 19.1										
B-6	0.0 to 1.5	7	13								
	2.5 to 4.0	10	19	40	16	24					
	4.5 to 6.0	11	19								
	6.5 to 8.0	13	9	23	14	9					
	8.5 to 9.3	50/4"	10								
	10.5 to 10.8	ref/3"	13	23	15	8					
	12.5 to 12.7	ref/2"	15								
	14.5 to 14.7	ref/2"	10								
	16.5 to 16.7	ref/2"	10								
	18.5 to 18.7	ref/2"	12								
B-7	0.0 to 1.5	7	1	46	18	28					
	2.5 to 4.0	30	3								
	4.5 to 6.0	14	15						18		
	6.5 to 8.0	18	8								
	8.0 to 8.5										
	8.5 to 8.8	ref/3"	7								
	10.0 to 10.5										
	10.5 to 10.7	ref/2"	8	27	13	14					
	12.0 to 12.5										
	12.5 to 12.6	ref/1"	5								
	14.0 to 14.5										

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RESULTS OF SOIL SAMPLE ANALYSES

PROJECT NAME: SAWS W-1 Leon Creek Hwy 90 to Hwy 151
Upper Segment
San Antonio, Texas

FILE NAME: ASA16-016-00 FOR DATA REPORT - NO INVERT ELEVATION.GPJ 1/4/2019

Boring No.	Sample Depth (ft)	Blows per ft	Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	USCS	Dry Unit Weight (pcf)	% -200 Sieve	Shear Strength (tsf)	Strength Test
B-7	14.5 to 14.6	ref/1"	6								
	16.0 to 16.5										
	16.5 to 16.6	ref/1"	7								
	18.0 to 18.5										
	18.5 to 18.6	ref/1"	8								
	19.5 to 20.0										
	20.0 to 20.2	ref/2"	7	24	14	10					
B-8	0.0 to 1.5	24	8								
	2.5 to 4.0	30	3								
	4.5 to 6.0	28	4								
	6.5 to 8.0	31	1	27	12	15					
	8.5 to 10.0	21	7						15		
	10.5 to 12.0	14	13								
	12.5 to 13.7	50/8"	7						24		
	14.0 to 14.5										
	14.5 to 14.7	ref/2"	7								
	15.5 to 16.0										
	16.0 to 16.1	ref/1"	7								

PP = Pocket Penetrometer TV = Torvane UC = Unconfined Compression FV = Field Vane UU = Unconsolidated Undrained Triaxial

CU = Consolidated Undrained Triaxial

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GBC
GEOTECHNICAL
BUSINESS COUNCIL
of the Geoprofessional Business Association

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