• Geotechnical Engineering
• Construction Materials
Engineering & Testing
• Soils • Asphalt • Concrete

November 9, 2021

Urban Civil, LLC
190 South Seguin Ave.
New Braunfels, Texas 78130

Attention: Nancy Turner

SUBJECT: **SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM AND PAVEMENT EVALUATION FOR THE PROPOSED HERITAGE OAKS SUBDIVISION ROADWAYS SCHERTZ, TEXAS RETL Project No.: G221509**

Dear Ms. Turner,

In accordance with our agreement, we have conducted a subsurface exploration and pavement evaluation for the above referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report, an electronic copy of which is being transmitted herewith. RETL will provide up to two (2) versions of this report in hard copy at the request of the client.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions and Rock Engineering and Testing Laboratory, Inc. (RETL), would be pleased to continue its role as the Geotechnical Engineer during project implementation.

RETL also has great interest in providing materials testing and observation services during the construction phase of this project. If you will advise us of the appropriate time to discuss these engineering services, we will be pleased to meet with you at your convenience.

Sincerely,

Kyle D. Hammock, P.E.
Vice President - San Antonio

Rock Engineering & Testing Laboratory, Inc.
www.rocktesting.com

6817 Leopard Street • Corpus Christi, Texas 78409-1703
Office: (361) 883-4555 • Fax: (361) 883-4711

10856 Vandale St. • San Antonio, Texas 78216-3625
Office: (210) 495-8000 • Fax: (210) 495-8015

No.1 Roundville Lane • Round Rock, Texas 78664
Office: (512) 284-8022 • Fax: (512) 284-7764

SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM, AND PAVEMENT EVALUATION FOR THE PROPOSED HERITAGE OAKS SUBDIVISION ROADWAYS SCHERTZ, TEXAS

RETL PROJECT NUMBER: G221509

PREPARED FOR:

URBAN CIVIL, LLC
190 SOUTH SEGUIN AVE.
NEW BRAUNFELS, TEXAS 78130

NOVEMBER 9, 2021

PREPARED BY:

ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE ST.
SAN ANTONIO, TEXAS 78216
PHONE: (210) 495-8000; FAX: (210) 495-8015

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NUMBER 2101

J.R. Eichelberger, III, P.E.
Senior Project Engineer

TABLE OF CONTENTS

INTRODUCTION

This report presents the results of a subsurface exploration and pavement evaluation for the proposed Heritage Oaks Subdivision Roadways to be constructed in Schertz, Texas. This study was conducted for Urban Civil, LLC.

Authorization

The work for this project was performed in accordance with RETL Proposal Number SGP062421A dated July 2, 2021. The proposal contained a scope of work, lump sum fee and limitations. The proposal was approved and signed by Nancy Turner on July 9, 2021 and returned to RETL via email. The client delayed the start of the project to allow for site clearing to provide access for the drill rig.

Purpose and Scope

The purpose of this exploration was to evaluate the soil and rock conditions at the site and to provide pavement recommendations suitable for the proposed subdivision roadways.

The scope of the exploration and evaluation included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soil and rock, provision of pavement recommendations, and preparation of this report.

The scope of services did not include an environmental assessment. Any statements in this report, or on the boring logs, regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

General

The exploration and analysis of the subsurface conditions reported herein are considered sufficient in detail and scope to form a reasonable basis for the pavement design. The recommendations submitted for the proposed project are based on the available subsurface information and the preliminary design details provided by the client. If the civil engineer requires additional soil parameters to complete the pavement design, RETL will provide the requested information as a supplement to this report.

The Geotechnical Engineer states that the findings, recommendations, specifications or professional advice contained herein, have been presented after being prepared in a manner consistent with the level of care and skill ordinarily exercised by reputable members of the Geotechnical Engineer's profession practicing contemporaneously under similar conditions in the locality of the project. RETL operates in general accordance with "*Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*", (ASTM D3740). No other representations are expressed or implied, and no warranty or guarantee is included or intended.

FIELD EXPLORATION

Scope

The field exploration was completed to evaluate the engineering characteristics of the pavement materials and included a reconnaissance of the project site, drilling the test borings, and recovering disturbed split spoon and relatively undisturbed Shelby tube samples.

A total of ten (10) borings were performed at the site and were drilled to a depth of 10-feet below the existing ground surface within the proposed new subdivision roadway alignment. RETL determined the number, depth, and general location of the borings and staked the borings in the field. RETL performed the boring operations. Bulk samples of subgrade were also collected at boring locations B-4, B-7, and B-9. Upon completion of the drilling operations and obtaining the groundwater observations, the bore holes were backfilled with excavated soil and the site cleaned as required. A Boring Location Plan is provided in the Appendix of this report.

Drilling and Sampling Procedures

The borings were performed using a drilling rig equipped with a rotary head and solid flight auger drilling methods were used to advance the boreholes to their desired depths. Disturbed samples were obtained employing split-barrel sampling procedures in general accordance with the procedures for "*Penetration Test and Split-Barrel Sampling of Soils*" (ASTM D1586). Relatively undisturbed soil samples were obtained using thin-wall tube sampling procedures in accordance with the procedures for "*Thin Walled Tube Sampling of Soils*" (ASTM D1587).

The samples were classified in the field, placed in plastic bags, marked according to their boring number, depth, and any other pertinent field data, stored in special containers and delivered to the laboratory for testing.

Field Tests and Measurements

Penetration Tests - During the sampling procedures, standard penetration tests (SPT) were performed to obtain the standard penetration value of the soil. The standard penetration value (N) is defined as the number of blows of a 140-pound hammer falling 30 inches required to advance the split-barrel sampler 1-foot into the soil. The sampler is lowered to the bottom of the previously cleaned drill hole and advanced by blows from the hammer. The number of blows is recorded for each of three successive 6-inch penetrations. The "N" value is obtained by adding the second and third 6-inch increment number of blows. The results of standard penetration tests indicate the relative density of cohesionless soils and comparative consistency of cohesive soils, thereby providing a basis for estimating the relative strength and compressibility of the soil profile components.

Water Level Observations - Water level observations were obtained during the test boring operations and are noted on the boring logs provided in the Appendix. The amount of water in open boreholes largely depends on the permeability of the soil and rock encountered at the boring locations. In relatively pervious soils, such as sandy soils, the indicated depths are usually reliable groundwater levels. In relatively impervious soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, proximity to a body of water, and recent rainfall conditions may influence the depth to the groundwater.

Ground Surface Elevations - Ground surface elevations were not provided at the boring locations. All depths referred to in this report are reported from the actual ground surface elevations at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

In addition to the field investigation, a laboratory-testing program was conducted to determine additional pertinent engineering characteristics of the subgrade materials necessary in developing the pavement recommendations for the roadways.

The laboratory-testing program included supplementary visual classification (ASTM D2487) on all samples. In addition, selected samples were subjected water content tests (ASTM D2216), Atterberg limits tests (ASTM D4318), percent material finer than the #200 sieve tests (ASTM D1140), moisture density relationship tests (ASTM D698), California Bearing Ratio (CBR) tests (ASTM D1883), pH tests (ASTM D4972), lime series (TEX Method 121E), and sulfate content determination (TEX Method 145E). Estimated soil strengths were obtained in the field using a hand penetrometer.

All phases of the laboratory-testing program were conducted in general accordance with applicable ASTM or TxDOT Specifications. The results of these tests are to be found in this report or on the accompanying boring logs provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of subsurface materials encountered in the test borings have been visually classified and are described in detail on the boring logs. The results of the standard penetration tests, strength tests, water level observations, and laboratory tests are presented on the boring logs in numerical form.

Representative samples of the soils were placed in polyethylene bags and are now stored in the laboratory for further analysis, if desired. Unless notified to the contrary, all samples will be disposed of 3 months after issuance of this report.

The stratification of the soil and rock, as shown on the boring logs, represents the soil and rock conditions at the actual boring locations. Variations may occur between, or beyond, the boring locations. Lines of demarcation represent the approximate boundary between different soil and rock types, but the transition may be gradual, or not clearly defined. It should be noted that, whereby the test borings were drilled and sampled by experienced technicians, it is sometimes difficult to record changes in stratification within narrow limits. In the absence of foreign substances, it is also difficult to distinguish between discolored soils and clean soil fill.

Seismic Site Class

The field investigation did not include a 100-foot deep boring, therefore, the soil properties are not known in sufficient detail to determine the Site Class per ASCE 7 Chapter 20. This section states that where site-specific data are not available to a depth of 100-feet, appropriate soil and rock properties are permitted to be estimated by the registered design professional preparing the soil investigation report based on known geologic conditions. This site has firm to hard clay soils and very hard weathered limestone and competent limestone materials extending to the 10-foot depth. Table 20.3-1 Site Class Definitions of ASCE 7 Chapter 20, indicates that Site Class D materials should have soil undrained shear strengths between 1,000 and 2,000 psf and standard penetration resistances between 15 and 50 blows per foot. The on-site soils extending to the 10-foot depth have strengths similar to Site Class D materials; therefore, RETL recommends that Site Class D, “stiff soil profile” be assumed.

Generalized Soil and Rock Conditions

The subsurface conditions at the project site generally consist of fat clays (CH), fat clays with gravel, clayey sands, weathered limestone, and competent limestone rock which extend to the boring termination depths of 10-feet. The fat clay soils are high to very high in plasticity with tested plasticity indices (PI) ranging from 38 to 53 and the clayey sand and weathered limestone materials are low to moderate in plasticity with tested plasticity indices (PI) of 10 to 22. Standard Penetration values (N) of the fat clays ranged from 6 to 32 blows per foot and hand penetrometer readings that ranged from 2.0 to greater than 4.5 tsf indicating the fat clay soils are firm to hard in consistency. Standard Penetration values (N) of the clayey sands ranged from 25 to 63 blows per foot indicating the clayey sand soils are very stiff to hard in consistency. Standard Penetration Values (N) of the weathered limestone and limestone rock ranged from 72 blows for 11-inches of penetration to 50 blows for refusal. It is important to note that possible lean clay fill materials were encountered in the upper 4-feet of boring B-10.

Sulfate Test Results

The sulfate test results on representative subgrade samples are provided in the following table:

UPPER CLAY SUBGRADE SULFATE TEST RESULTS	
Boring No.	**Sulfate (ppm)**
B-4 (Bulk)	160
B-7 (Bulk)	Negligible
B-9 (Bulk)	40

The TxDOT Technical Memorandum for treatment of soils containing sulfates with lime indicates the following risk levels:

SULFATE RISK LEVELS	
Sulfate (ppm)	**Risk**
<3,000	Low
3,000-5,000	Moderate
5,000-8,000	Moderate to High
>8,000	High and Unacceptable

The sulfate concentrations indicate the subgrade soils at the site are in a low risk level of using lime as a treatment method.

Lime Series and pH Test Results

The lime series and pH test results on the bulk subgrade samples are provided in the following tables:

BORING B-4 BULK SUBGRADE SAMPLE LIME SERIES AND pH TEST RESULTS		
% Lime	**LL / PI**	**pH**
0	69 / 43	7.8
2	42 / 12	11.8
4	41 / 8	12.3
6	41 / 8	12.4
8	41 / 8	12.4
10	41 / 8	12.5

BORING B-7 BULK SUBGRADE SAMPLE LIME SERIES AND pH TEST RESULTS		
% Lime	**LL / PI**	**pH**
0	63 / 38	7.8
2	44 / 14	12.3
4	42 / 9	12.4
6	42 / 9	12.4
8	42 / 8	12.4
10	41 / 7	12.4

BORING B-9 BULK SUBGRADE SAMPLE LIME SERIES AND pH TEST RESULTS		
% Lime	**LL / PI**	**pH**
0	70 / 45	7.8
2	50 / 17	12.3
4	50 / 13	12.4
6	49 / 11	12.5
8	50 / 11	12.5
10	49 / 11	12.5

Where: LL = Liquid Limit (%)
PI = Plasticity Index

The results indicate the subgrade soils should be treated with 6-percent lime to consistently reduce the plasticity index (PI) and pH to acceptable levels.

Groundwater Observations

Groundwater was not encountered in the borings during the drilling operations and the borings were dry upon completion of the drilling. It should be noted that water levels in open boreholes may require anywhere from several hours to several days to stabilize depending on the permeability of the soils and that groundwater levels at this site may be subject to seasonal conditions, recent rainfall, drought, or temperature effects.

PAVEMENT RECOMMENDATIONS

It is understood that new subdivision roadways with a total approximate length of 8,000 LF and an emergency access road with an approximate length of 1,300 LF utilizing flexible pavements will be constructed for Heritage Oaks Subdivision. In designing the proposed pavements, the existing subgrade conditions must be considered together with the expected traffic use and loading conditions.

The conditions that influence pavement design can be summarized as follows:

1. Bearing values of the subgrade. These values can be represented by a California Bearing Ratio (CBR) for the design of flexible asphalt pavements.
2. Vehicular traffic, in terms of the number and frequency of vehicles and their range of axle loads.
3. Probable increase in vehicular use over the life of the pavement.

4. The availability of suitable materials to be used in the construction of the pavement and their relative costs.

Specific laboratory testing to define the subgrade strength (i.e. CBR/K values) has been performed for this analysis. **Based upon the CBR test results, the plasticity indices, and strengths of the clay subgrade soils, a CBR value 2.0 has been selected for the clays. However, in some areas it is anticipated that the subgrade will consist of weathered or competent limestone rock with a minimum estimated CBR of 8.0.** The rock subgrade design section should only be used when all of the overburden clay has been removed and the intact weathered limestone or competent limestone is exposed. Clean, on-site milled limestone screenings may be utilized as embankment fill in the rock subgrade areas and utilize the rock subgrade design pavement section. It is anticipated that the actual subgrade type may vary within a roadway alignment. In streets where both clay and rock subgrade is present, the pavement section should transition linearly from the edge of the rock subgrade over a minimum distance of 100-feet to the clay subgrade pavement section. Additionally, the pavement sections should have a minimum length of 500-feet between transition zones.

We have evaluated the proposed new subdivision roadways using the City of Schertz Design Specifications: Section 3 – Street Requirements. The residential area will be classified as “Local Type Street/Fire Lane” streets and the Wiederstein Road extension will be classified as a “Collector” street. **The required AASHTO 18-kip ESAL for a “Local Type Street/Fire Lane” street is 100,000 and for a “Collector” street is 1,000,000 in accordance with the City of Schertz Design Specifications.**

RETL used the following pavement design parameters for the flexible pavement design:

AASHTO PAVEMENT DESIGN PARAMETER	DESIGN VALUE
Local Street Reliability (R)	70%
Collector Street Reliability (R)	90%
Overall Deviation	0.45
Initial Serviceability	4.2
Local Street Terminal Serviceability	2.0
Collector Street Terminal Serviceability	2.5
Subgrade Design CBR	2.0 (clay) or 8.0 (rock)
Design Life	20 years

The following lime treated subgrade, limestone base, and hot mix asphaltic concrete layer coefficients were selected for the pavement design:

Pavement Constituent	Layer Coefficient (α)
Lime Stabilized Subgrade	0.08
New Crushed Limestone Base (TxDOT Item 247 Type A, Grade 1-2)	0.14
Type D HMAC	0.44

The recommended hot mixed asphaltic concrete (HMAC) pavement sections are provided in the following tables:

LOCAL TYPE STREET/FIRE LANE (CLAY SUBGRADE) MINIMUM 18-kip ESAL VALUE = 100,000 AASHTO MINIMUM STRUCTURAL NUMBER = 2.5		
Pavement Constituent	Option 1	Option 2
HMAC Type C or D	3”	3”
HMAC Type B	---	---
Crushed Limestone Base	6”	8”
Lime Stabilized Subgrade	---	6”
Moisture Conditioned Subgrade	6”	---
TENSAR Geogrid	TX-5	---
AASHTO Structural No.	2.95	2.92
Calculated 18-kip ESAL	132,600	121,800

LOCAL TYPE A STREET/FIRE LANE (ROCK SUBGRADE) MINIMUM 18-kip ESAL VALUE = 100,000 AASHTO MINIMUM STRUCTURAL NUMBER = 2.5	
Pavement Constituent	Option 3*
HMAC Type C or D	3”
Crushed Limestone Base	9”
TENSAR Geogrid	---
Rock Subgrade	Yes
AASHTO Structural No.	2.58
Calculated 18-kip ESAL	493,300

The pavement section thicknesses for Option 3 are governed by the City of Schertz criteria that the HMAC surface course have a minimum thickness of 3-inches and that the pavement section have a minimum AASHTO Structural Number of 2.5

COLLECTOR (CLAY SUBGRADE) MINIMUM 18-kip ESAL VALUE = 1,000,000 AASHTO MINIMUM STRUCTURAL NUMBER = 2.9		
Pavement Constituent	Option 4	Option 5
HMAC Type C or D	3”	3”
HMAC Type B	4”	4”
Crushed Limestone Base	8”	10”
Lime Stabilized Subgrade	---	8”
Moisture Conditioned Subgrade	6”	---
TENSAR Geogrid	TX-5	---
AASHTO Structural No.	4.81	4.88
Calculated 18-kip ESAL	1,067,800	1,169,600

COLLECTOR (ROCK SUBGRADE) MINIMUM 18-kip ESAL VALUE = 1,000,000 AASHTO MINIMUM STRUCTURAL NUMBER = 2.9		
Pavement Constituent	Option 6	Option 7
HMAC Type C or D	3”	3”
HMAC Type B	6”	---
Crushed Limestone Base	---	15”
Rock Subgrade	Yes	Yes
AASHTO Structural No.	3.60	3.42
Calculated 18-kip ESAL	1,470,000	1,074,000

Subgrade and Embankment

After all surface organics and deleterious materials have been removed and the desired subgrade elevation has been achieved, the upper 6-inches of exposed subgrade soils should be compacted to a minimum density of 95-percent of the maximum dry unit weight of the subgrade soils as determined by TEX 114E and at or above the optimum moisture content. Any embankment fill required to achieve the final subgrade elevation shall be placed in maximum 8-inch loose lifts and compacted as specified above. Subgrade consisting of consisting of intact weathered limestone or limestone rock will not require scarification or compaction testing.

Lime Stabilized Subgrade

Lime placement and mixing operations should be performed in accordance with TXDOT ITEM 260 *“LIME TREATMENT (ROAD MIXED).”* Lime stabilization of the clay subgrade soils is recommended to reduce the effect of soil heave on the pavements. Lime shall be properly mixed at a minimum rate of 6-percent of the maximum dry unit weight of the raw subgrade soils as determined by the standard Proctor (TEX 114-E). This percentage equates to approximately 27 pounds per square yard per 6-inch treatment depth and approximately 36 pounds per square yard per 8-inch treatment depth.

After proper curing time, usually 48 to 72 hours, the lime stabilized soils should be remixed and compacted to a minimum density of 95-percent of the maximum dry unit weight of the lime stabilized subgrade soils as determined by a standard Proctor test (TEX 114-E) and at, or above, the optimum moisture content.

Geogrid

Geogrid should be Tensar TX-5 and should be overlapped in accordance with the manufacturer's recommendations. Geogrid will significantly improve the long-term performance of the pavements and reduce cracking.

Limestone Base

Base materials should meet the requirements set forth in the Texas Department of Transportation (TxDOT) 2014 Standard Specifications for Construction of Highways, Streets and Bridges; Item 247, Type A, Grade 1-2. The base material should be placed in maximum 8-inch thick loose lifts and compacted to a minimum density of 95-percent of the maximum dry density as determined by TEX 113E. The moisture content of the base materials should be maintained within 2-percentage points of the optimum moisture content.

Hot Mix Asphalt

Asphalt concrete should meet the requirements set forth in TxDOT Item 340 or 341, Type B, C, or D. The Type C and D asphaltic concrete should be compacted to 91.5 to 96.3-percent of the maximum theoretical specific gravity of the mixture determined according to test method TEX 227-F. Pavement cores should be tested for density according to test method TEX 207-F.

Drainage

Proper drainage is very important to achieve the desired performance from flexible asphaltic concrete pavements. RETL has assumed that good drainage will be incorporated into the project and the pavements will be fast draining and puddle free. Low or flat areas in asphalt pavements allow standing water and quick deterioration of the pavement primarily due to saturation of the underlying pavement materials and subgrade soils.

It should be noted that groundwater and/or saturated soils with free water may be encountered during construction. These areas will have to be remediated on a case by case basis with the installation of drain systems and piping to collect and remove the water from the pavement areas. A minimum of 1-percent slope in the pavement surface is recommended. Additionally, RETL recommends that full depths curbs (extending through all base materials and into the subgrade soils) be constructed along the exterior alignment of the pavement.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed project, a consultation should be arranged to review any changes with respect to the prevailing soil conditions. At that time, it may be necessary to submit supplementary recommendations.

It is recommended that the services of RETL be engaged to test and evaluate the subgrade soils in the pavement areas prior to placing pavement constituents in order to verify that the bearing soils are consistent with those encountered in the borings. RETL cannot accept any responsibility for any conditions that deviate from those described in this report, nor for the performance of the pavements if not engaged to also provide construction observation and testing for this project. If it is required for RETL to accept any liability, then RETL must agree with the plans and perform such observation during construction as we recommend.

All sheeting, shoring and bracing of trenches, pits and excavations should be made the responsibility of the contractor and should comply with all current and applicable local, state and federal safety codes, regulations and practices, including the Occupational Safety and Health Administration.

APPENDIX

BORING LOCATION PLAN

NO SCALE
BORING LOCATIONS ARE APPROXIMATE

November 9, 2021
Urban Civil, LLC
RETL Project No.: G221509

HERITAGE OAKS SUBDIVISION ROADWAYS
Schertz, Texas

ROCK ENGINEERING AND TESTING LABORATORY, INC.
10856 VANDALE STREET
SAN ANTONIO, TEXAS 78216
(210) 495-8000

LOG OF BORING 01

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/08/2021

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SPT S-1		N= 6	31	68	23	45			91	**FAT CLAY**, dark brown, moist, firm. (CH)
	2											
	3	SPT S-2		N= 12	27							Same as above, stiff.
	4											
	5	SH S-3		P= 4.0	30	78	25	53			95	Same as above, very stiff. (CH)
	6											
	7	SH S-4		P= 3.0	33							**FAT CLAY**, dark brown, moist, very stiff.
	8											
	9	SH S-5		P= 3.0	28							Same as above.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58096°, W -98.28958°

LOG OF BORING 02

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/11/2021

DRILLING METHOD(S):
Solid Flight Auger/Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SPT S-1		N= 50/5"	9						18	**WEATHERED LIMESTONE**, light brown, dry, very hard.
	2											
	3	SPT S-2		N= 50/1"	8							**LIMESTONE**, light brown, dry, very hard.
	4											
	5	SPT S-3		N= 50/0"	8							Same as above.
	6											
	7	SPT S-4		N= 50/0"	9							Same as above.
	8											
	9	SPT S-5		N= 50/0"								**LIMESTONE**, light brown, dry, very hard.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58258°, W -98.28798°

LOG OF BORING 03

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/11/2021

DRILLING METHOD(S):
Solid Flight Auger/Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
												CLAY, dark brown.
	1	SPT S-1		N= 5-50/5"	22	37	24	13			43	**WEATHERED LIMESTONE**, brown and light brown, moist, very hard.
	2											
	3	SPT S-2		N= 50/1"	7							**LIMESTONE**, light brown, dry, very hard.
	4											
	5	SPT S-3		N= 50/0"	6							Same as above.
	6											
	7	SPT S-4		N= 50/0"	4							Same as above.
	8											
	9	SPT S-5		N= 50/0"	4							**LIMESTONE**, light brown, dry, very hard.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58424°, W -98.28947°

LOG OF BORING 04

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/19/2021

DRILLING METHOD(S):
Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 2.0	27	67	25	42			65	**SANDY FAT CLAY**, dark brown, moist, stiff. (CH)
	2											
	3	SH S-2		P= 2.0	30							Same as above, dark brown to brown.
	4											
	5	SH S-3		P= 4.5	23							**GRAVELLY FAT CLAY**, brown, moist, very stiff.
	6											
	7	SPT S-4		N= 18	20	58	20	38			69	Same as above, brown to light brown. (CH)
	8											
	9	SPT S-5		N= 50/5"	3						20	**WEATHERED LIMESTONE** light brown, dry, very hard. (14% gravel)
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58482°, W -98.29204°

LOG OF BORING 05

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/19/2021

DRILLING METHOD(S):
Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SPT S-1		N= 7	35	69	26	43			95	**FAT CLAY**, dark brown, moist, firm. (CH)
	2											
	3	SPT S-2		N= 19	29							Same as above, with gravel, brown, very stiff.
	4											
	5	SPT S-3		N= 32	9	60	20	40			51	**GRAVELLY FAT CLAY**, with calcareous material, brown, moist, hard. (CH)
	6											
	7	SPT S-4		N= 22-50/5"	4						31	**WEATHERED LIMESTONE** light brown, dry, very hard. (38% gravel)
	8											
	9	SPT S-5		N= 38-50/1"	3							Same as above.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58616°, W -98.29181°

LOG OF BORING 06

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/19/2021

DRILLING METHOD(S):
Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
												CLAY, dark brown.
	1	SPT S-1		N= 5-50/5"	18	34	24	10			31	**WEATHERED LIMESTONE** light brown, moist, very hard.
	2											
	3	SPT S-2		N= 50/4"	9							Same as above, dry.
	4											
	5	SPT S-3		N= 50/1"	8							Same as above.
	6											
	7	SPT S-4		N= 50/3"	10							**WEATHERED LIMESTONE** light brown, moist, very hard.
	8											
	9	SPT S-5		N= 50/1"	10							Same as above.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58689°, W -98.29014°

LOG OF BORING 07

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/11/2021

DRILLING METHOD(S):
Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SPT S-1		N= 5	34	68	25	43			89	**FAT CLAY**, dark brown, moist, frim. (CH)
	2											
	3	SPT S-2		N= 50/3"	13						28	**LIMESTONE**, light brown, moist, very hard.
	4											
	5	SPT S-3		N= 50/0"	5							**LIMESTONE**, light brown, dry, very hard.
	6											
	7	SPT S-4		N= 50/1"	6							Same as above.
	8											
	9	SPT S-5		N= 50/1"	9							Same as above.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58642°, W -98.28866°

LOG OF BORING 08

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/11/2021

DRILLING METHOD(S):
Air Rotary

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		SPT S-1		N= 40	14						33	**CLAYEY SAND**, dark brown, moist, hard.
	1											
	2											
	3	SPT S-2		N= 50/4"	7							**WEATHERED LIMESTONE**, light brown, dry, very hard.
	4											
	5	SPT S-3		N= 50/0"	3							**LIMESTONE**, light brown, dry, very hard.
	6											
	7	SPT S-4		N= 50/0"	2							Same as above.
	8											
	9	SPT S-5		N= 50/0"	3							Same as above.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58506°, W -98.28788°

LOG OF BORING 09

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/08/2021

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SH S-1		P= 4.5+	20	58	19	39			70	**SANDY FAT CLAY (possible fill)**, brown, moist, very stiff. (CH)
	2											
	3	SH S-2		P= 4.5+	24							**FAT CLAY**, dark brown, moist, very stiff.
	4											
	5	SH S-3		P= 4.5+	23							Same as above.
	6											
	7	SH S-4		P= 4.5+	25	75	22	53			95	Same as above. (CH)
	8											
	9	SH S-5		P= 3.5	30							**FAT CLAY**, dark brown, moist, very stiff.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58202°, W -98.29100°

LOG OF BORING 10

Rock Engineering & Testing Laboratory, Inc.
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-80000
Fax: 210-495-8015

CLIENT: Urban Civil, LLC
PROJECT: Heritage Oaks Subdivision Roadways
LOCATION: Schertz, Texas
NUMBER: G221509
DATE(S) DRILLED: 10/08/2021

DRILLING METHOD(S):
Solid Flight Auger

GROUNDWATER INFORMATION:
Groundwater was not encountered during the drilling operations and the boring was dry upon the completion of the drilling operations.

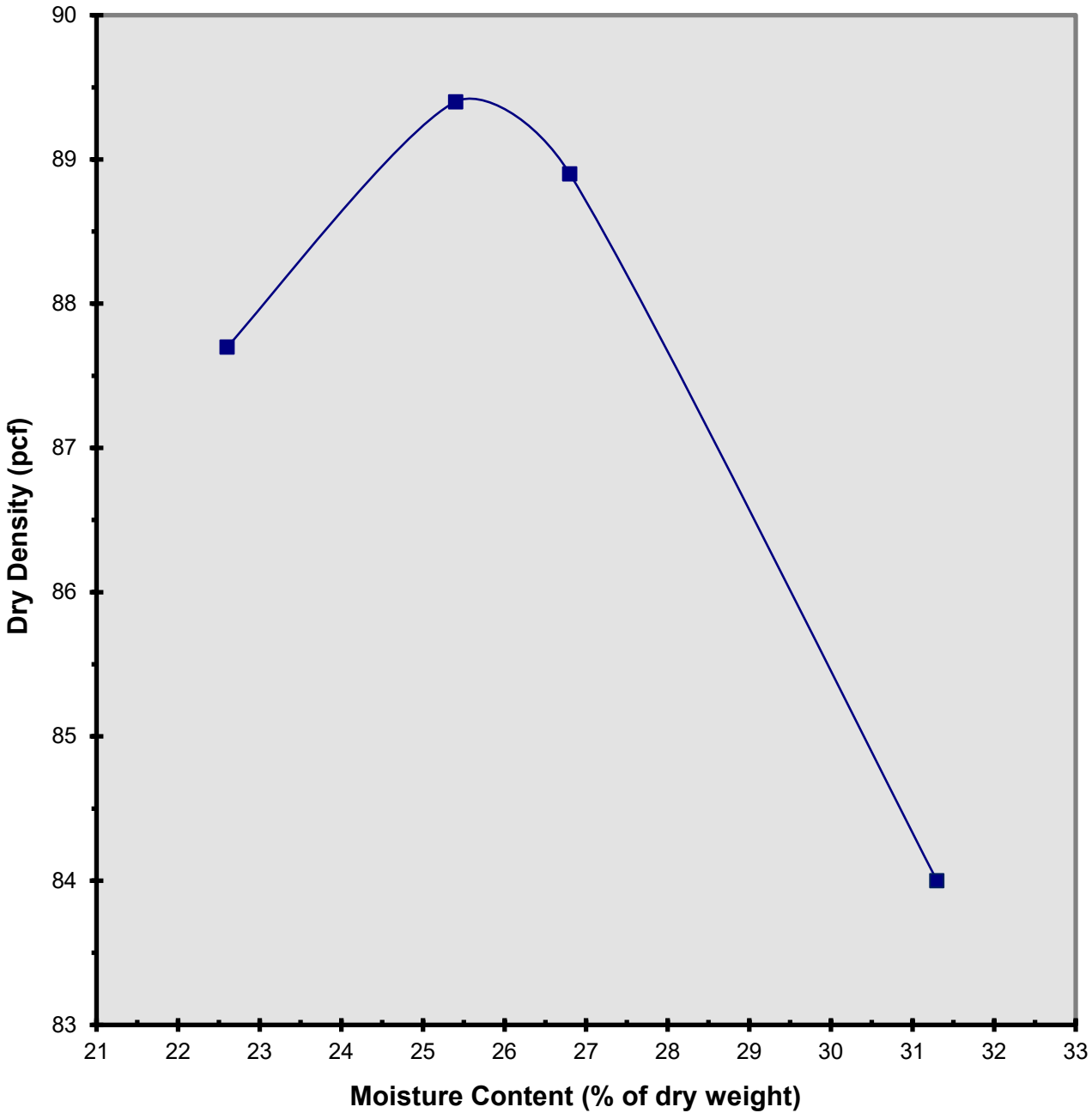
SURFACE ELEVATION: N/A

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1	SPT S-1		N= 14	23	37	18	19			66	**GRAVELLY LEAN CLAY (possible fill)**, dark brown, moist, stiff. (CL)
	2											
	3	SPT S-2		N= 7	25						73	**LEAN CLAY WITH GRAVEL (possible fill)**, dark brown, moist, firm.
	4											
	5	SPT S-3		N= 25	11							**CLAYEY SAND** with weathered limestone, light brown, moist, very stiff.
	6											
	7	SPT S-4		N= 63	6	37	15	22			21	Same as above, dry, hard.
	8											
	9	SPT S-5		N= 50/5"	6							**WEATHERED LIMESTONE** light brown, dry, very hard.
	10											Boring termianted at a depth of 10-feet.

N - STANDARD PENETRATION TEST RESISTANCE
Qc - STATIC CONE PENETROMETER TEST INDEX
P - POCKET PENETROMETER RESISTANCE

REMARKS:
Boring location determined by RETL. Drilling operations performed by RETL.
GPS Coordinates: N 29.58360°, W -98.29225°

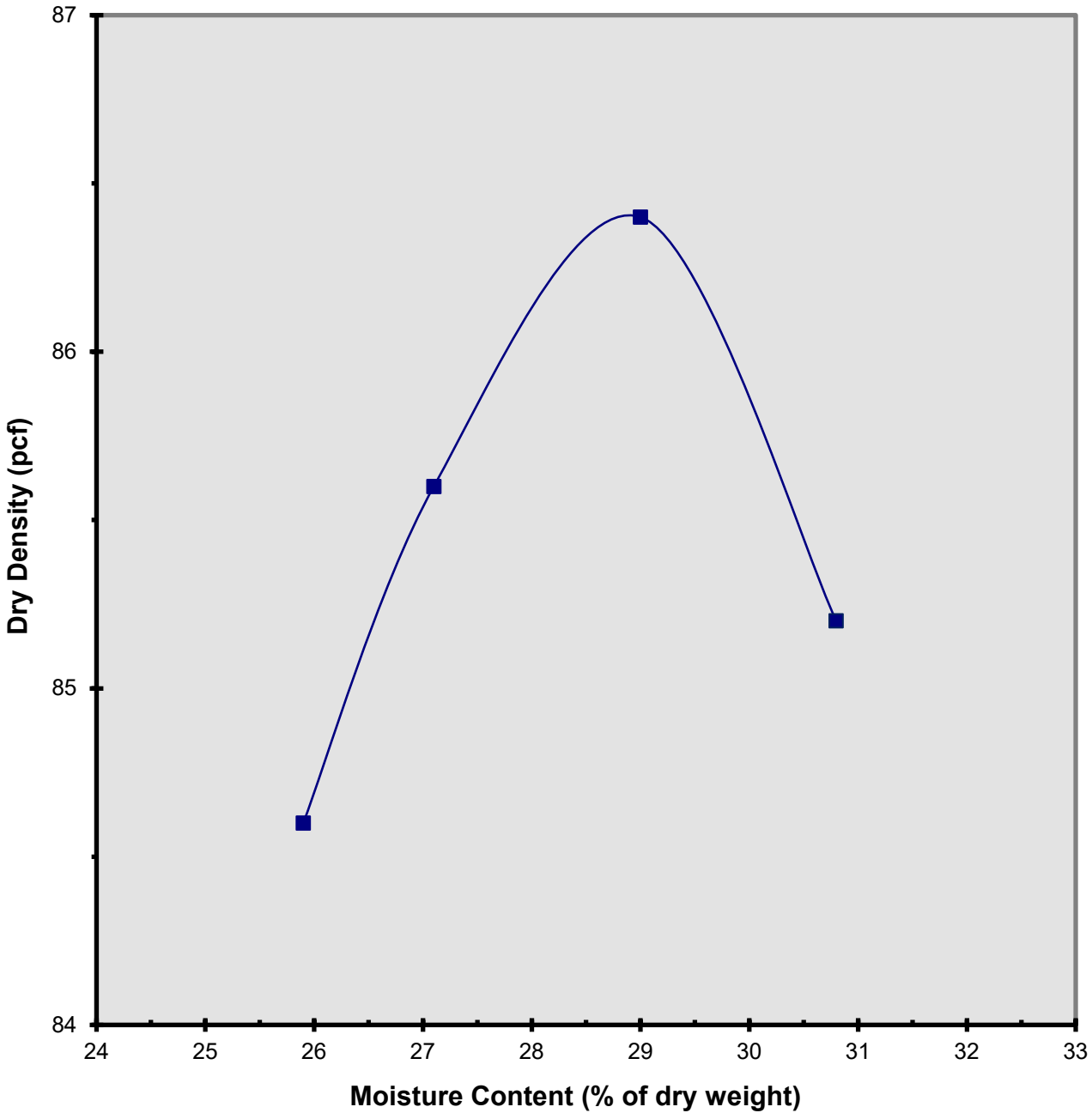
DENSITY VERSUS MOISTURE CURVE
(ASTM D698)



PROJECT	MAXIMUM LAB DENSITY	LAB DATA
Heritage Oaks Subdivision Roadways Schertz, Texas	89.4 pcf ASTM D698	LL = 69 PI = 43 Minus #200 = 62%
SAMPLE DESCRIPTION	**OPTIMUM MOISTURE**	**RETL PROJ. NO.**
Boring B-4 Bulk Sample Dark Brown Sandy Fat Clay (CH)	25.5%	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

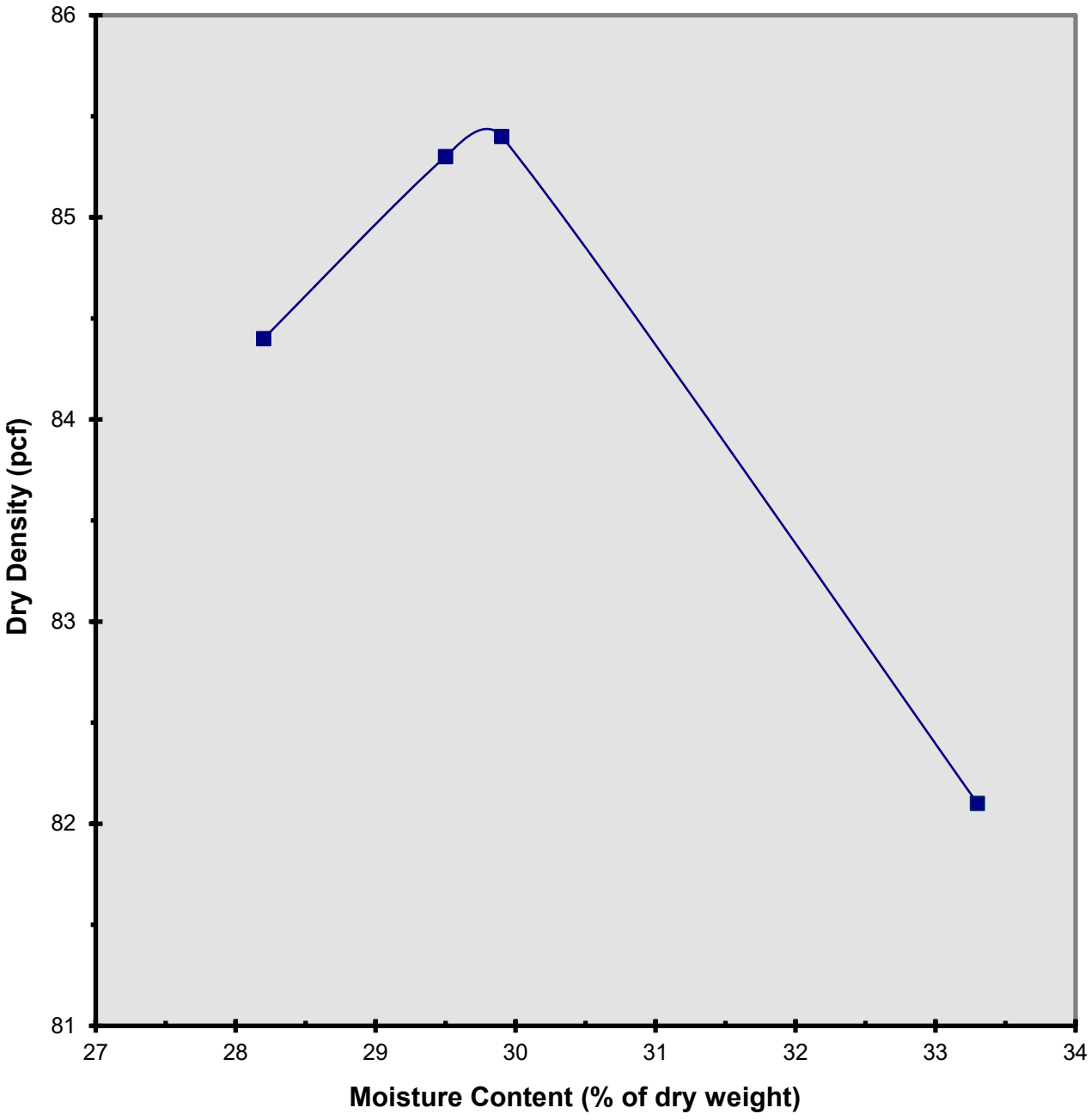
DENSITY VERSUS MOISTURE CURVE
(ASTM D698)



PROJECT	MAXIMUM LAB DENSITY	LAB DATA
Heritage Oaks Subdivision Roadways Schertz, Texas	86.4 pcf ASTM D698	LL = 63 PI = 38 Minus #200 = 69%
SAMPLE DESCRIPTION	**OPTIMUM MOISTURE**	**RETL PROJ. NO.**
Boring B-7 Bulk Sample Dark Brown Sandy Fat Clay (CH)	28.8%	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

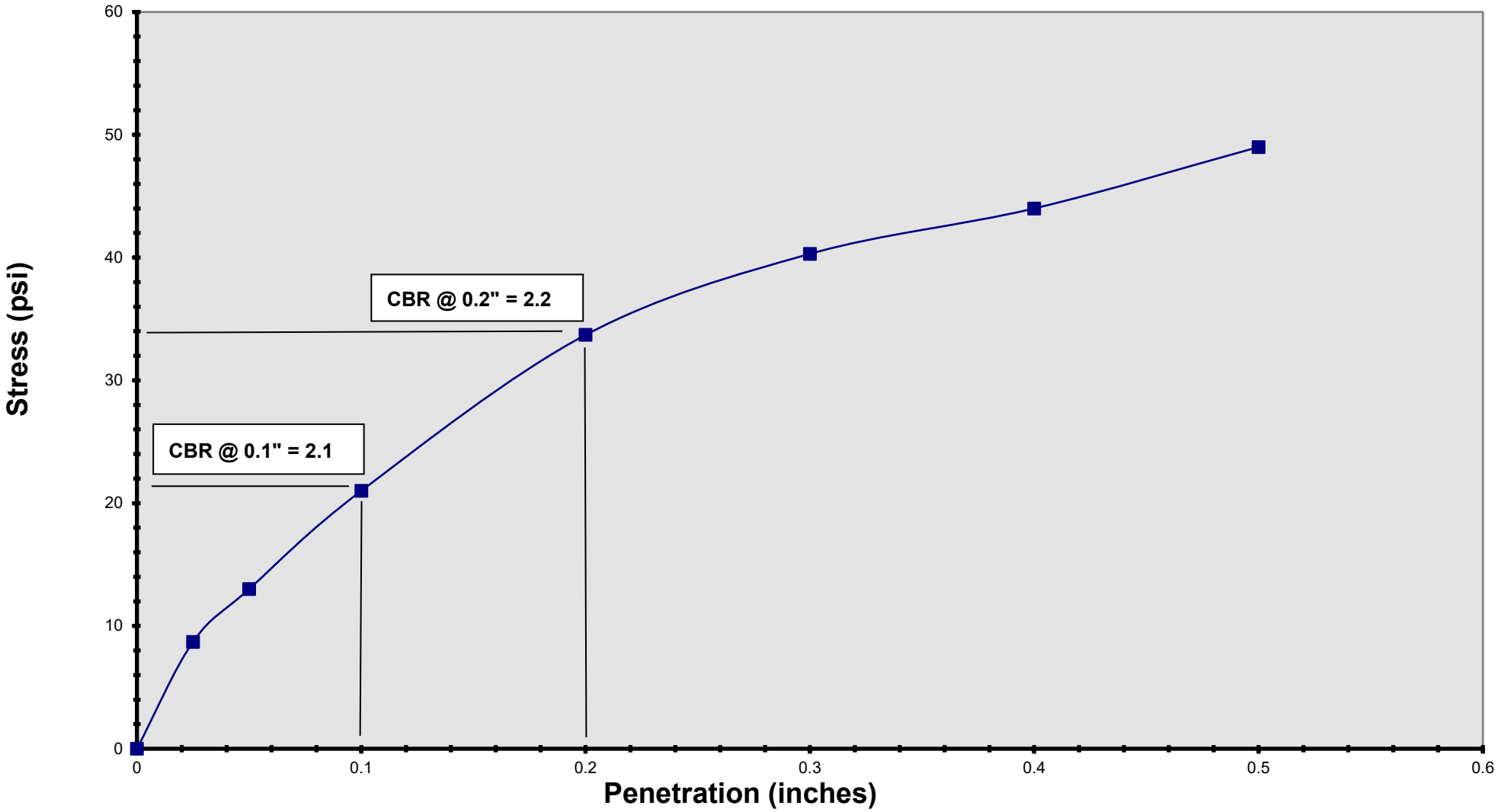
DENSITY VERSUS MOISTURE CURVE
(ASTM D698)



PROJECT	MAXIMUM LAB DENSITY	LAB DATA
Heritage Oaks Subdivision Roadways Schertz, Texas	85.4 pcf ASTM D698	LL = 70 PI = 45 Minus #200 = 82%
SAMPLE DESCRIPTION	**OPTIMUM MOISTURE**	**RETL PROJ. NO.**
Boring B-9 Bulk Sample Brown Fat Clay w/ Sand (CH)	29.9%	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

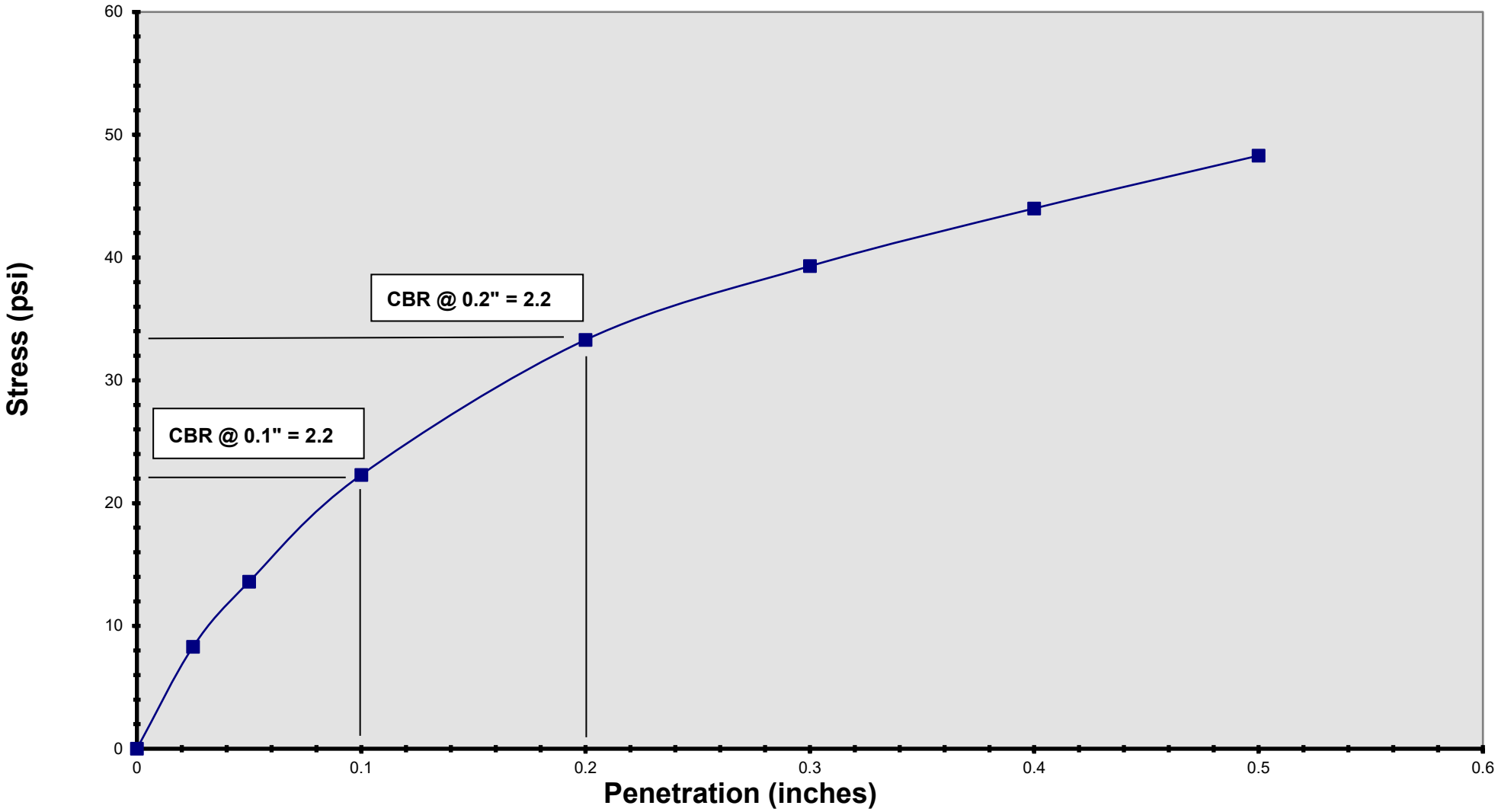
CBR - Stress versus Penetration Curve
(ASTM D1883)



PROJECT DESCRIPTION	MOLDED DRY DENSITY	CBR @ 0.1 INCH PENETRATION	TEST DATE
Heritage Oaks Subdivision Roadways Schertz, Texas	83.2 pcf (93.0% of max density)	2.1	November 2021
SAMPLE DESCRIPTION	**MOLDED MOISTURE CONT.**	**CBR @ 0.2 INCHES PENETRATION**	**RETL PROJ. NO.**
Boring B-4 Bulk Sample Dark Brown Sandy Fat CLAY (CH)	26.2%	2.2	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

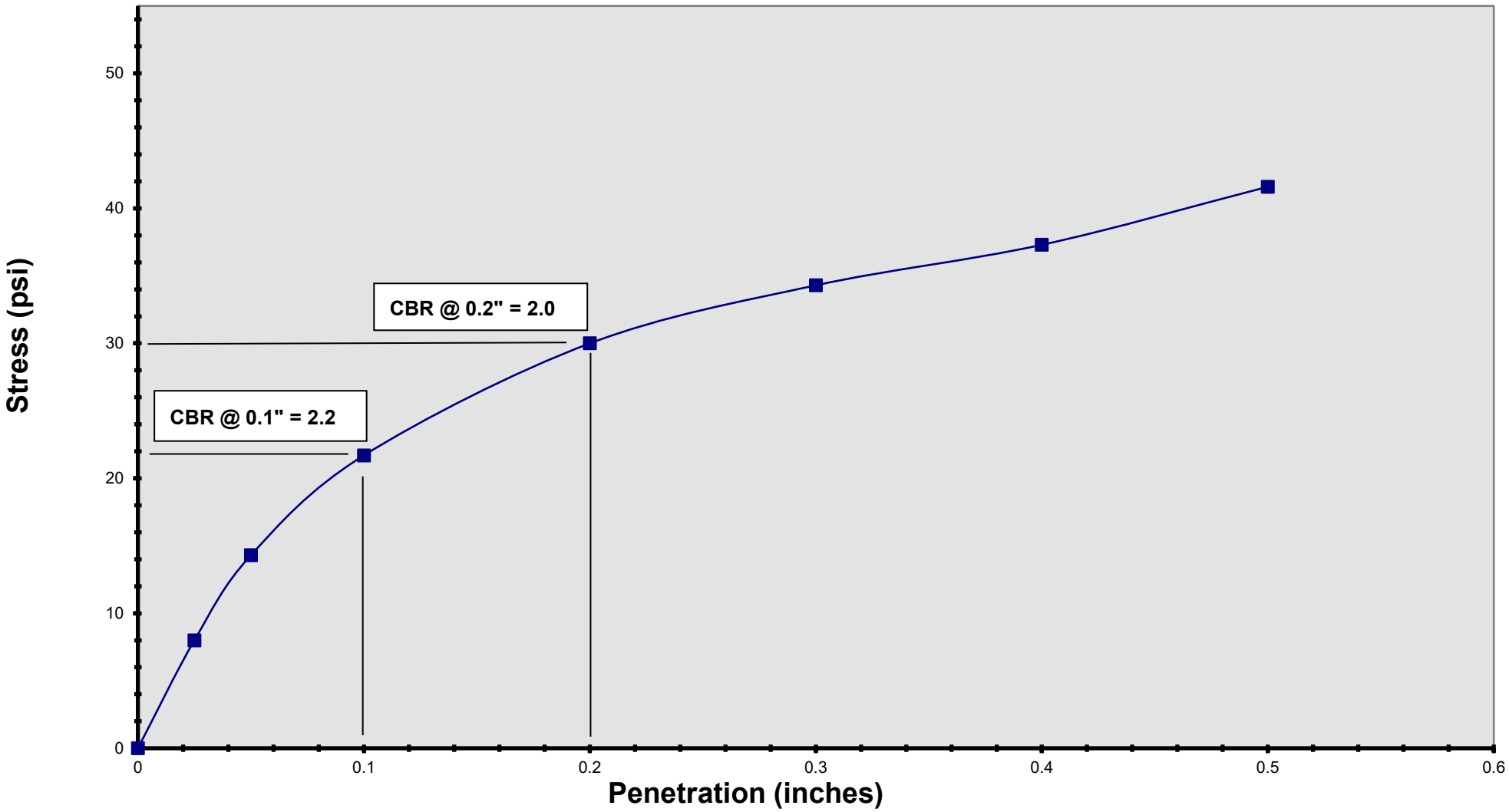
CBR - Stress versus Penetration Curve
(ASTM D1883)



PROJECT DESCRIPTION	MOLDED DRY DENSITY	CBR @ 0.1 INCH PENETRATION	TEST DATE
Heritage Oaks Subdivision Roadways Schertz, Texas	82.4pcf (95.4% of max density)	2.2	November 2021
SAMPLE DESCRIPTION	**MOLDED MOISTURE CONT.**	**CBR @ 0.2 INCHES PENETRATION**	**RETL PROJ. NO.**
Boring B-7 Bulk Sample Dark Brown Sandy Fat CLAY (CH)	29.3%	2.2	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

CBR - Stress versus Penetration Curve
(ASTM D1883)



PROJECT DESCRIPTION	MOLDED DRY DENSITY	CBR @ 0.1 INCH PENETRATION	TEST DATE
Heritage Oaks Subdivision Roadways Schertz, Texas	79.3 pcf (93.0% of max density)	2.2	November 2021
SAMPLE DESCRIPTION	**MOLDED MOISTURE CONT.**	**CBR @ 0.2 INCHES PENETRATION**	**RETL PROJ. NO.**
Boring B-9 Bulk Sample Brown Fat CLAY w/ Sand (CH)	30.6%	2.0	G221509

ROCK ENGINEERING AND TESTING LABORATORY, INC.

Engineering & Testing
Laboratory, Inc.

Rock Engineering & Testing Laboratory
10856 Vandale Street
San Antonio, TX 78216
Telephone: 210-495-8000

KEY TO SOIL CLASSIFICATION AND SYMBOLS

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		SYMBOL	NAME
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well Graded Gravels or Gravel-Sand mixtures, little or no fines
		GP	Poorly Graded Gravels or Gravel-Sand mixtures, little or no fines
		GM	Silty Gravels, Gravel-Sand-Silt mixtures
		GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SAND AND SANDY SOILS	SW	Well Graded Sands or Gravelly Sands, little or no fines
		SP	Poorly Graded Sands or Gravelly Sands, little or no fines
		SM	Silty Sands, Sand-Silt Mixtures
		SC	Clayey Sands, Sand-Clay mixtures
	SILTS AND CLAYS LL < 50	ML	Inorganic Silts and very fine Sands, Rock Flour, Silty or Clayey fine Sands or Clayey Silts
		CL	Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
		OL	Organic Silts and Organic Silt-Clays of low plasticity
	SILTS AND CLAYS LL > 50	MH	Inorganic Silts, Micaceous or Diatomaceous fine Sandy or Silty soils, Elastic Silts
		CH	Inorganic Clays of high plasticity, Fat Clays
		OH	Organic Clays of medium to high plasticity, Organic Silts
NON USCS MATERIALS			Limestone
			Marl/Claystone
			Sandstone

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 (VARVED) - composed of thin layers of varying color and texture, usually grading from sand or silt at the bottom to clay at the top

CRUMBLY - cohesive soils which break into small blocks or crumbs on drying

CALCAREOUS - containing appreciable quantities of calcium carbonate, generally nodular

WELL GRADED - having wide range in grain sizes and substantial amounts of all intermediate particle sizes

POORLY GRADED - predominantly of one grain size uniformly graded) or having a range of sizes with some intermediate size missing (gap or skip graded)

SYMBOLS FOR TEST DATA

- Groundwater Level (Initial Reading)
- Groundwater Level (Final Reading)
- Shelby Tube Sample
- SPT Samples
- Auger Sample
- Rock Core
- Texas Cone Penetrometer
- Grab Sample

TERMS DESCRIBING CONSISTENCY OF SOIL

COARSE GRAINED SOILS		FINE GRAINED SOILS		
DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	DESCRIPTIVE TERM	NO. BLOWS/FT. STANDARD PEN. TEST	UNCONFINED COMPRESSION TONS PER SQ. FT.
Very Loose	0 - 4	Very Soft	< 2	< 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.50
Medium	10 - 30	Firm	4 - 8	0.50 - 1.00
Dense	30 - 50	Stiff	8 - 15	1.00 - 2.00
Very Dense	over 50	Very Stiff	15 - 30	2.00 - 4.00
		Hard	over 30	over 4.00

Field Classification for "Consistency" of Fine Grained Soils is determined with a 0.25" diameter penetrometer