A UES COMPANY

- GEOTECHNICAL ENGINEERING
- CONSTRUCTION MATERIALS ENGINEERING & TESTING
- SOILS • ASPHALT • CONCRETE

April 4, 2023

HW Pecan Crossing, LLC
2119 McCullough Avenue
San Antonio, Texas 78212

Attention: Charlie Aycock

SUBJECT: **SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM, AND FOUNDATION AND PAVEMENT RECOMMENDATIONS FOR THE PROPOSED PECAN CROSSING RETAIL**
FM 725 & E. COUNTY LINE ROAD
NEW BRAUNFELS, TEXAS
ROCK Project Number: G223134

Dear Mr. Aycock,

In accordance with our agreement, Rock Engineering & Testing Laboratory, LLC (ROCK) performed a subsurface exploration and foundation and pavement evaluation for the referenced project. The results of this exploration, together with our recommendations, are presented in the accompanying report, an electronic copy of which is being transmitted herewith. ROCK will provide up to two (2) hard copies of this report at your request.

Often, because of design and construction details that occur on a project, questions arise concerning soil conditions. ROCK would be pleased to continue its role as the Geotechnical Engineer during project implementation.

ROCK also has great interest in providing materials testing and special inspection 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

SUBSURFACE EXPLORATION, LABORATORY TESTING PROGRAM, AND FOUNDATION AND PAVEMENT RECOMMENDATIONS FOR THE PROPOSED PECAN CROSSING RETAIL FM 725 & E. COUNTY LINE ROAD NEW BRAUNFELS, TEXAS

ROCK PROJECT NUMBER: G223134

PREPARED FOR:

HW PECAN CROSSING, LLC
2119 MCCULLOUGH AVENUE
SAN ANTONIO, TEXAS 78212

APRIL 4, 2023

PREPARED BY:

ROCK ENGINEERING & TESTING LABORATORY, LLC
10856 VANDALE ST.
SAN ANTONIO, TX 78216
PHONE: (210) 495-8000; FAX: (210) 495-8015

TEXAS BOARD OF PROFESSIONAL ENGINEERS
FIRM REGISTRATION NUMBER 2101

STATE OF TEXAS
KYLE D. HAMMOCK
72962
LICENSED
PROFESSIONAL ENGINEER

STATE OF TEXAS
Darren W. Lantz
94868
LICENSED
PROFESSIONAL ENGINEER

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

Darren W. Lantz, P.E.
Senior Geotechnical Engineer

ENGINEERING AND TESTING LABORATORY LLC ROCK
A UES COMPANY

TABLE OF CONTENTS

INTRODUCTION

This report presents the results of a subsurface exploration and foundation and pavement evaluation for the proposed Pecan Crossing Retail to be constructed at the intersection of FM 725 & E. County Line Road in New Braunfels, Texas. This study was conducted for HW Pecan Crossing, LLC for the specific project and subsurface conditions described herein.

Authorization

The work for this project was performed in accordance with ROCK Proposal No. SGP020723A dated February 7, 2023. The proposal contained a scope of work, fee, and limitations. The proposal was approved and signed by Charles W. Aycock on February 15, 2023, and returned to ROCK via email.

Purpose and Scope

The purpose of this study was to provide applicable foundation and pavement design recommendations for the proposed project. The project includes the construction of a new 18,028 SF retail building and associated pavements. The scope of this study included the subsurface exploration, field and laboratory testing, engineering analysis and evaluation of the subsurface soils, development of foundation and pavement recommendations suitable for the proposed project, and preparation of this report.

The scope of services did not include an environmental assessment. Any statements in this report, or on the Logs of Boring, 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 foundation and pavement designs. The recommendations submitted for the proposed project are based on the available soil information and the preliminary design details provided to ROCK by Charlie Aycock with HW Pecan Crossing, LLC. If other design criteria are required for the structural and civil engineers to complete the foundation and pavement designs, and the requested information can be obtained from the agreed upon scope of work, ROCK 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.

ROCK operates in 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, completed in order to evaluate the engineering characteristics of the subsurface conditions, included a reconnaissance of the project site, drilling test borings and recovering disturbed and relatively undisturbed samples of the subsurface materials encountered at the test boring locations. ROCK performed a total of six (6) borings at the site. The table below provides the boring location, number, and depth:

SUMMARY OF BORING INFORMATION		
Boring Location	**Boring Identification**	**Boring Depth (ft)**
Retail Building	B-1	20
	B-2	20
Paving	B-3	6
	B-4	6
	B-5	6
	B-6	6

During the sample recovery operations, the soils encountered were classified and recorded on Logs of Boring in accordance with "*Standard Guide for Field Logging of Subsurface Exploration of Soil and Rock*", (ASTM D5434). Upon completion of the drilling operations and obtaining the groundwater observations, the drill holes were backfilled with excavated soil.

ROCK personnel determined the number, depth, and location of the borings. The borings were located in the field by ROCK personnel and ROCK completed the drilling operations. A Boring Location Plan is provided in the Appendix of this report.

Drilling and Sampling Procedures

The test borings were performed using a drilling rig equipped with a rotary head turning solid flight augers to advance the boreholes to the termination 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 obtained by this procedure were extruded by a hydraulic ram in the field.

The samples obtained from the test borings were classified in the field, placed in plastic bags, marked according to boring number, depth and any other pertinent field data, and stored in special containers. The samples were delivered to the laboratory for testing at the completion of the drilling operations.

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 from the hammer. 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.

Groundwater Observations - Groundwater observations were made during the test boring operations and are noted on the Logs of Boring provided in the Appendix. The amount of water in an open borehole largely depends on the permeability of the soils encountered at the boring location. In relatively pervious soils, such as sandy soils, the indicated depth is usually a reliable groundwater level. In relatively impervious soils, such as clayey soils, a suitable estimate of the groundwater depth may not be possible, even after several days of observation. Seasonal variations, temperature, land-use, and recent rainfall conditions may influence the depth to groundwater.

Ground Surface Elevations - Actual ground surface elevations were not provided or surveyed at the boring locations. The approximate ground surface elevations at the boring locations were interpolated from the provided “*Pecan Crossing Grading Exhibit*” prepared by INK Civil and dated March 1, 2023. The depths referred to in this report are reported from the ground surface at the boring locations during the time of our field investigation.

LABORATORY TESTING PROGRAM

A laboratory-testing program was conducted to supplement the information obtained during the field investigation. The results of the laboratory-testing program provide additional pertinent engineering characteristics of the subsurface materials necessary in analyzing the behavior of the foundation and pavement systems for the proposed project.

The laboratory-testing program included performing supplementary visual classification (ASTM D2487) and moisture content tests (ASTM D2216). In addition, selected samples were subjected to Atterberg limits tests (ASTM D4318), percent material finer than the #200 sieve tests (ASTM D1140), and a one-dimensional swell test (ASTM D4546). Estimated soil strengths of cohesive soil samples retrieved with a Shelby tube were obtained using a hand penetrometer.

The laboratory-testing program was conducted in general accordance with applicable ASTM Specifications. The results of these tests are presented on the accompanying Logs of Boring provided in the Appendix.

SUBSURFACE CONDITIONS

General

The types of materials encountered in the test borings have been visually classified and are described in detail on the Logs of Boring. The results of the standard penetration tests, water level observations, strength tests and other laboratory tests are presented on the Logs of Boring 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, the samples will be disposed of three months after issuance of this report.

The stratification of the soil, as shown on the Logs of Boring, represents the 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 types, but the transition may be gradual, or not clearly defined.

It should be noted that, whereas the test borings were drilled and sampled by experienced drillers, 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.

Soil Conditions

This site has significant topographic relief and much of the undulation results from previous fill placement at the site. At boring locations B-1, B-2, B-3 and B-5, fat clay and lean clay fill soils were encountered at the surface and ranged in thickness from approximately 1-foot to approximately 8½-feet. The tested plasticity index (PI) test values within the fill soils ranged from 17 to 46 and Standard Penetration Tests (N Values) ranged from 9 to 37 blows per foot of penetration, indicating the soils are generally stiff to hard in consistency.

Beneath the fill soils at boring locations B-1, B-2, B-3 and B-5, and from the surface at boring locations B-4 and B-6, the subsurface conditions encountered at the site consist primarily of fat clay soils; however, some lean clay soils were also present. The natural fat clay soils are high in plasticity with tested plasticity index (PI) values ranging from 33 to 46, while the natural lean clay soils are moderate in plasticity with a tested plasticity index (PI) value of 23. Standard Penetration Tests (N Values) and other strength tests within the natural fat and lean clay soils ranged from 8 to 42 blows per foot, indicating the soils are generally stiff to hard in consistency.

Exceptions to the above generalized descriptions do exist. Detailed descriptions of the subsurface materials encountered at the boring locations are provided on the Logs of Boring included in the Appendix.

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 properties are permitted to be estimated by the registered design professional preparing the soil investigation report based on known geologic conditions. This site has stiff to hard fat and lean clay soils extending to depths of 20-feet.

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 20-foot depth have strengths similar to Site Class D materials; therefore, ROCK recommends that Site Class D, “stiff soil profile” be assumed.

Groundwater Observations

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

FOUNDATION DISCUSSION AND RECOMMENDATIONS

Project Description

Based on the information provided to ROCK, it is understood that the project will consist of the construction of a new 18,028 SF retail building as well as automobile parking and driveway areas. The type of building construction has not been provided; however, we have assumed that the retail building will be constructed using concrete tilt-wall panels and structural steel framing.

In order to accommodate floor slab cuts for future tenant utility installations, which is typical for retail buildings, it is anticipated that an unstiffened ground-supported floor slab will be used. It is also anticipated that the planned foundation for this project will consist of shallow grade beams for support of the tilt wall panels cast monolithically with the unstiffened floor slab and interior spread footings for support of columns and roof loads. Foundation design loads were not provided; however, our experience with similar type structures indicates maximum concentrated loads would be on the order of 75-kips and wall loads will be in the range of 1½ to 2-kips per linear foot.

The "*Pecan Crossing Grading Exhibit*" prepared by INK Civil and provided to our office indicates that the existing site grades within the footprint of the retail building are highly variable with a total elevation difference of approximately 18-feet. A relative high elevation of approximately El. 645 feet exists at the southeast corner of the proposed building footprint and a relative low elevation of approximately El. 627 feet exists at the northwest corner of the proposed building footprint.

The Finished Floor Elevation (FFE) for the retail building has not been established or provided. However, the grading exhibit indicates that the lot will be rough graded to approximately El. 637 feet in the proposed building area, indicating the FFE will likely be set near El. 638 feet. In order to accomplish the rough grade elevation of El. 637 feet in the building area, the site will require up to approximately 10-feet of fill and up to approximately 8-feet of cut. These maximum cut and fill values do not include any necessary building pad preparation procedures as recommended in this report.

PVR Discussion

The fat and lean clay soils encountered in the test borings at this site are high to moderate in plasticity. **The calculated total potential vertical rise (PVR) for slab-on-grade construction at this site ranges from approximately 2½ to 4½-inches.** The PVR was calculated using the Texas Department of Transportation Method TEX-124E and took into account the average depth of active zone, estimated to extend to a depth of approximately 15-feet, and the Atterberg limits test results of the soils encountered within the active zone.

It is important to note that the PVR value provided herein was calculated using the Texas Department of Transportation Method TEX-124E and represents the vertical rise that can be experienced by relatively dry subsoils subjected to increases in soil moisture content resulting from capillary effects or rainwater. The TEX-124E method is widely used in Texas for predicting expansive soil movements and has been found to be reasonably accurate for moisture variations resulting from normal seasonal and climatic controlled conditions (environmental conditions). The actual movement of the subsoils is dependent upon their change in moisture content.

Conditions that allow the soils to become saturated or significantly exceed typical moisture variations resulting from environmental conditions or exceed the dry and wet boundary conditions established by the TEX-124E method, such as poor drainage, broken utilities, and variations in subsurface groundwater sources, may result in higher magnitudes of moisture related soil movements than calculated by the PVR method provided herein.

It is anticipated that when completely inundated with water and allowed to become saturated, which would likely be the case if proper drainage around the structure is not provided or if a broken plumbing line was to occur, the subgrade soils could swell 2 times or more the magnitude estimated by the TEX-124E PVR represented herein, as is evidenced by a tested swell of 6.7-percent in Boring B-2. Differential vertical movements may occur over a distance equal to the depth of the active zone and can potentially be equal to the expected total movements.

For the slab-on-grade building foundation with an unstiffened floor slab, the building pad should be prepared as necessary to not qualify as "expansive" in accordance with Chapter 18 of the International Building Code (IBC). In order to accomplish this, two options for building pad construction are provided herein. These building pad options are as generally outlined below and presented in the following table.

<u>Option 1</u>: Undercut existing soils and replace undercut excavation with compacted select fill material.

<u>Option 2</u>: Undercut existing soils, replace undercut excavation with moisture conditioned on-site clay soils and compacted select fill material.

BUILDING PAD OPTIONS FOR UNSTIFFENED SLAB-ON-GRADE (SITE "NOT CONSIDERED EXPANSIVE" PER IBC) (FF = 638 ft)		
Item	**Option 1**	**Option 2**
Compacted Select Fill	10 feet El 637.5 ft – El 627.5 ft	7.5 feet El 637.5 ft – El 630.0 ft
Moisture Conditioned On-Site Soils	---	5.0 feet El 630.0 ft – El 625.0 ft

For movement sensitive flatwork adjacent to the building, the PVR value can be reduced to a "not considered expansive" condition by preparing pads as outlined above or extending the building pad beneath the movement sensitive flatwork. The PVR can be reduced in any movement sensitive flatwork areas to approximately 1-inch by undercutting the existing subgrade soils as required to place 7½-feet of select fill beneath the movement sensitive flatwork.

<u>Footing and Slab-on-Grade Recommendations</u>

As indicated before, a shallow foundation consisting of grade beams and spread footings, cast monolithically with unstiffened grade-supported floor slabs, are anticipated to be the planned foundations for the support of the tilt walls and interior columns, respectively. This foundation and floor slab system is feasible provided that the site is prepared as detailed in the **"<u>PVR Discussion</u>"** and **"<u>Site Preparation</u>"** sections of this report, to achieve a site classified as "Not Considered Expansive" per the IBC.

The beams and footings bearing in properly compacted select fill may be designed for an allowable unit soil bearing pressure of up to 2,000 psf. This value incorporates a design safety factor of at least 3.0. The beams should be a minimum of 12-inches wide to reduce the potential for localized shear failure and be founded at least 2-feet below the site grades adjacent to the foundation.

For the design of the floor slab, a building pad constructed with properly compacted select fill caped with 1-foot of crushed limestone base material will result in a subgrade modulus of $\boldsymbol{k_p}$ **= 150 pci**. This modulus is based on empirical equations that estimate the results of 1-foot square plate load tests. However, the slab should be designed using reduced modulus values based on the slab width by using the equation given below:

$$k_s = k_p\ (1/B_m)^{0.5}$$

Where: k_s = Modulus of subgrade reaction for the specific slab width, pci.
k_p = Modulus of subgrade reaction for a 1-foot square plate, pci.
B_m = Slab width, feet.

A grade-supported floor slab and shallow foundations may be subject to slight differential movements resulting in potential distress and cosmetic damage to rigid interior walls, floor coverings and partitions. The potential for this cosmetic damage should be understood and addressed during the design and construction phases of this project. The magnitude of movement can be reduced with good construction practices including performing the recommended preparation of the subgrade, compaction of the select fill building pad materials and maintaining the integrity of the beam and footing excavations prior to concrete placement.

The foundation excavations should be observed by a representative of ROCK prior to steel or concrete placement to assess that the foundation materials are capable of supporting the design loads and to identify the acceptability of the select fill materials under the footings.

Soft or loose zones encountered at footing excavations should be removed to the level of competent materials as directed by the Geotechnical Engineer. Cavities formed as a result of excavation of soft or loose zones should be backfilled with properly compacted select fill.

After opening, footing excavations should be observed, and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If it is required that footing excavations be left open an extended period, they should be protected to reduce evaporation or entry of moisture.

PAVEMENT CONSIDERATIONS

In designing the proposed parking areas and driveways, 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, or a Modulus of Subgrade Reaction (K) for rigid concrete 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 not been performed for this analysis. Based upon local experience and the plasticity index values of the in-situ subgrade soils, the CBR and K value for design have been selected as 3 and 100 pci, respectively.

Since traffic counts and design vehicles have not been provided, it is possible to provide a non-engineered pavement section suitable for light and heavy-duty service based on pavement sections that have provided adequate serviceability for other projects in the area.

Automobile parking areas and the driveways can be designed with either a flexible or rigid pavement. It is important that the exposed subgrade is properly prepared prior to pavement installation.

Flexible Pavements

The recommended light and heavy-duty flexible pavement section options, using the locally available base material, are provided in the following tables:

Light Duty Flexible Pavement (Passenger Car Parking Areas)	
Hot Mix Asphaltic Concrete	2"
Limestone Base Material (TxDOT Item 247 Grade 1-2)	8"
TENSAR Geogrid	TX-5
Compacted Subgrade	6"

Heavy Duty Flexible Pavement (Driveways)	
Hot Mix Asphaltic Concrete	2"
Limestone Base Material (TxDOT Item 247 Grade 1-2)	12"
TENSAR Geogrid	TX-5
Compacted Subgrade	6"

Allowances for proper drainage and proper material selection of base materials are most important for performance of asphaltic pavements. Ruts and birdbaths in asphalt pavements allow for quick deterioration of the pavement primarily due to saturation of the underlying base materials and subgrade soils.

Rigid Concrete Pavements

The use of concrete for paving has become more prevalent in recent years due to the long-term maintenance cost benefits of concrete pavement compared to asphalt pavements. Concrete pavement is recommended in areas that receive continuous repetitive traffic such as the parking lot entrances, loading areas and trash dump approach areas. The recommended light and heavy-duty rigid concrete pavement sections are provided in the following table:

Rigid Pavement	Light Duty (Parking Areas)	Heavy Duty (Driveways)
Reinforced Concrete	5½"	7"
Compacted Subgrade	6"	6"

The heavy-duty concrete at the location of the trash dumpster should be 8-inches in thickness and be large enough to accommodate both the front and rear wheels of the vehicles used to pick up the trash dumpsters. Maintenance or operations managers need to stress the importance of placing the trash dumpsters in their proper locations to reduce the distress trash pickup operations place on the pavement.

Pavement Material Recommendations

Compacted Subgrade – After stripping the site and/or excavating to achieve the final subgrade elevation, and prior to subgrade compaction, the exposed subgrade should be proof-rolled with a minimum 15-ton rubber tire dump truck or water truck under the supervision of ROCK to detect any soft areas prior to fill placement. If any soft pockets or pumping areas are identified, the objectionable materials should be removed to expose firm materials and the excavation replaced with compacted fill.

The upper 6-inches of exposed subgrade soils should then be compacted to at least 95-percent of the maximum dry density as determined by the standard Proctor test (ASTM D698). The moisture content of the subgrade soils should be maintained at or above the optimum moisture content.

General FILL - After subgrade preparation is complete, the placement of properly compacted General FILL soils may begin in the paved areas to raise the grades, where required. General FILL soils could consist of on-site soils free of organics and other deleterious materials or imported soils with a maximum plasticity index of 30.

The FILL used to raise the grade where required in the proposed parking and drive areas should be placed in no greater than 8-inch thick loose lifts. Each lift should be compacted to at least 95-percent of the maximum dry density (100-percent where the total fill thickness is greater than 5-feet) as determined by the Standard Proctor test (ASTM D698). The moisture content of the General FILL soils should be maintained at or above the optimum moisture content value.

Base Material - 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 the modified Proctor test (ASTM D1557). The moisture content of the base materials should be maintained within 2-percentage points of the optimum moisture content.

Geogrid - It is recommended that geogrid be placed beneath the base material and on top of the compacted subgrade. Geogrid should be Tensar TX-5 and should be placed and overlapped in accordance with the manufacturer’s recommendations. Alternate or replacement geogrids, including alternate Tensar geogrid products, are not allowed as a direct substitution.

If alternate geogrid products are desired for use, additional base material thickness will apply and ROCK should be contacted for the specific recommendations. If a direct substitution with an alternate geogrid is proposed by the local geogrid distributor, the geogrid should come with a pavement design specific for the site that is sealed by a licensed professional engineer in the state of Texas and that pavement design shall supersede the pavement recommendations provided herein.

Hot Mix Asphaltic Concrete - Hot mix asphaltic concrete should meet the requirements set forth in TxDOT Item 340 or 341; Type D surface course. The asphaltic concrete should be compacted to between 91.5 and 96.3-percent of the theoretical density.

Rigid Concrete - The concrete pavement should be properly reinforced and jointed, as per ACI, and should have a minimum 28-day compressive strength of 3,000 psi. Expansion joints should be spaced no greater than 60-feet and should be sealed with an appropriate sealant so that moisture infiltration into the subgrade soils and resultant concrete deterioration at the joints is minimized.

Control joint spacing should not exceed 15-feet and preferably less to adequately control cracking. The joints should be thoroughly cleaned, and sealant should be installed without overfilling before the pavement is opened to traffic. Based on past experience with concrete pavements supported on similar subgrade soils, ROCK recommends that reinforcement for concrete pavement consist of #4 bars (1/2-inch diameter) spaced at 18-inches on center each way. The splice length for #4 bars should not be less than 20-inches.

SITE IMPROVEMENT METHODS

General Considerations

A majority of foundation related problems are attributable, at least in part, to poor drainage. Cohesive soils can expand or shrink by absorbing or losing water, respectively. Reducing the variation in moisture content can reduce the variation in volume. A number of measures may be used to attain a reduction in subsoil moisture content variations, thus reducing the soil's volume change potential. Some of these measures are outlined below:

- During construction, a positive drainage scheme should be implemented to prevent ponding of water on the subgrade in the foundation areas.
- Positive drainage should be maintained around the structure through a roof/gutter system connected to piping or directed to paved surfaces, transmitting water away from the foundation perimeters. In addition, positive grades sloping away from the foundation should be designed and implemented for the area extending at least 10-feet away from the foundation perimeters.
- Utility trenches should not be backfilled with sand or gravel to assure the trenches do not serve as aqueducts that could transport water beneath the structure due to excessive surface water infiltration. The upper 12-inches of backfill adjacent to the foundation in unpaved areas should consist of properly compacted lean clay. Clay collars or plugs should be installed within the trench just outside of the building pad to prevent horizontal migration of water into the building pad.
- Vegetation placed in landscape beds that are adjacent to the structure should be limited to plants and shrubs that will not exceed a mature height of 3-feet. Large bushes and trees should be planted away from the foundations at a distance that will exceed their full mature height and canopy width.

Project features beyond the scope of those discussed above should be planned and designed similarly to attain a region of relatively uniform moisture content within the foundation area. Poor drainage schemes resulting in soil moisture and volume changes are generally the primary cause of shallow foundation problems.

Concrete Flatwork

Concrete site flatwork, sidewalks and paving will be subject to substantial PVR movements of up to about 4½-inches or more when constructed over the clay soils at this site, as detailed in the **"PVR Discussion"** section of this report. Changes in the moisture content of the supporting highly plastic soils causes volumetric changes, resulting in differential movements of the flatwork. Provisions in the site development should be made in order to maintain relative uniform moisture contents of the supporting soils.

Individual concrete panels of concrete flatwork should be dowelled together to reduce trip hazards as a result of differential movements within the flatwork. All efforts should be made to avoid having situations where site flatwork panels are partially supported on compacted select fill soils and partially supported on highly plastic subgrade soils which will result in differential movement and may also result in a negative slope back to the building causing ponding of water next to the structure or allow water to enter the building threshold.

If it is desired to increase the performance level and reduce the PVR for concrete flatwork adjacent to the building, the select fill building pad could be extended to the edge of the movement sensitive flatwork adjacent to the building, or select fill could be placed to achieve a 1-inch PVR, as recommended in the "**PVR Discussion**" section of this report.

CONSTRUCTION CONSIDERATIONS

Building Pad Preparation

In order to achieve a building site that does not qualify as "expansive" per the IBC (for use with an unstiffened slab-on-grade foundation), it will be necessary to prepare the building pad using one of the following options. The recommendations are based on a FFE of El. 638.0 feet and assume an approximate 6-inch thick floor slab. For both options, the undercut and improvement areas should extend a minimum of 5-feet outside the perimeter of the proposed building structure and a minimum of 2-feet outside any movement sensitive appurtenances including ramps, stoops, patios and sidewalks constructed adjacent to the building.

Option 1 – Undercut and Replace with Select Fill

Remove the existing subgrade soils to an elevation of El. 627.5 feet to allow for the placement of a minimum of 10-feet of properly compacted, non-expansive select fill material beneath the building floor slab.

Once the excavation operations in the building area are performed, the exposed subgrade soils should be proof-rolled with a minimum 20-ton rubber-tired dump truck or loader under the supervision of ROCK to detect any soft areas prior to fill placement.

If any soft pockets or pumping areas are identified, the soft materials should be removed to expose firm materials and the excavation replaced with compacted fill. The ROCK Geotechnical Engineer must approve the subgrade condition prior to the placement of engineered select fill materials.

After proofrolling operations are completed, the exposed subgrade soils shall be scarified to a depth of 6-inches, moisture conditioned if necessary, and compacted to at least 95-percent of the maximum dry density as determined by the standard Proctor (ASTM D698). The moisture content of the subgrade soils should be maintained at or above the optimum moisture content.

Upon completion of the subgrade preparation operations, at least 10-feet of properly compacted select fill material should be placed to achieve an elevation of approximately El. 637.5 feet. The select fill shall be placed in such a manner to provide a uniform fill pad thickness supporting the proposed building. Excavation of grade beams and footings may proceed after placement of the select fill is complete.

<u>Option 2</u> – Undercut, Place Moisture Conditioned On-Site Fill and Select Fill

Remove the existing subgrade soils to an elevation of El. 625.0 feet to allow for the placement of a minimum of 5-feet of properly compacted moisture conditioned on-site soils and a minimum of 7.5-feet of properly compacted, non-expansive select fill material beneath the building floor slab.

Once the excavation operations in the building area are performed, the exposed subgrade soils should be proof-rolled with a minimum 20-ton rubber-tired dump truck or loader under the supervision of ROCK to detect any soft areas prior to fill placement. If any soft pockets or pumping areas are identified, the soft materials should be removed to expose firm materials and the excavation replaced with compacted fill. The ROCK Geotechnical Engineer must approve the subgrade condition prior to the placement of engineered select fill materials.

After proofrolling operations are completed, the exposed subgrade soils shall be scarified to a depth of 6-inches, moisture conditioned if necessary, and compacted to at least 95-percent of the maximum dry density as determined by the standard Proctor (ASTM D698). The moisture content of the subgrade soils should be maintained at or above the optimum moisture content.

Upon completion of the subgrade preparation operations, 5-feet of properly compacted moisture conditioned on-site soil fill material should be placed to achieve an elevation of approximately El. 630.0 feet.

After placing the moisture conditioned on-site soil fill material to El. 630.0 feet, at least 7.5-feet of properly compacted select fill material should be placed to achieve an elevation of approximately El. 637.5 feet. The select fill shall be placed in such a manner to provide a uniform fill pad thickness supporting the proposed building. Excavation of grade beams and footings may proceed after placement of the select fill is complete.

Engineered Building Pad Materials

The following items are engineered materials and specifications that apply to the above referenced building pad preparation options.

Select Fill - Select fill material used at this site for the building pad could consist of imported crushed limestone base. Imported limestone base select fill should meet the plasticity and gradation requirements set forth in Texas Department of Transportation (TxDOT) Standard Specifications 2014; Item 247, Type A, Grade 1-2.

Alternate pit run select fill soils may also be considered for select fill and should have a maximum liquid limit of 40-percent, a minimum of 30-percent gravel sized particles and a plasticity index (PI) between 5 and 15. Pit run select fill materials should be capped with a minimum of 12-inches of crushed limestone base. The proposed select fill shall be submitted to ROCK for testing and approval prior to use.

Select fill soils should be placed in no greater than 8-inch thick loose lifts and shall be compacted to at least 95-percent of the maximum dry density as determined by the modified proctor (ASTM D1557). The moisture content of the select fill soils should be maintained within 2-percentage points of the optimum moisture content.

Moisture Conditioned On-Site Soils - Moisture conditioned on-site soil material used in the building areas should be compacted to between 92 and 96-percent of the maximum dry density as determined by the standard Proctor (ASTM D698). The moisture content of the moisture conditioned fill soils should be maintained at or above 4-percentage points over the optimum moisture content.

Earthwork and Foundation Acceptance

Exposure to the environment may weaken the soils at the foundation and pavement bearing levels if excavations remain open for long periods of time. Therefore, it is recommended that the foundation and pavement excavations be extended to the design subgrade elevation and the foundation and pavement be constructed and as soon as possible to minimize potential damage to the bearing soils.

The foundation and pavement bearing levels should be free of loose or soft soil, ponded water or debris and should be observed prior to concreting by the Geotechnical Engineer, or his designated representative. Foundation concrete or pavement materials should not be placed on soils that have been disturbed by seepage. If the bearing soils are softened by water intrusion, the unsuitable soils must be removed from the foundation excavations and be replaced with properly compacted select fill prior to placement of concrete or pavement materials.

The Geotechnical Engineer or his designated representative should approve the condition of the exposed subgrade and monitor the placement of all fill materials. As a guideline, a minimum of one in-place density test should be performed on the subgrade and each lift of fill for each 3,000 SF or a minimum of three in-place densities per testing interval. Any areas not meeting the required compaction should be recompacted and retested until compliance is met.

Vapor Retarder

A polyolefin vapor retarder with a permeance of less than 0.1 US perms (ASTM E96) and Class A strength should be placed under the concrete floor slab on the select fill building pad to reduce the transmission of water vapor from the supporting soil through the concrete slab and to function as a slip sheet to reduce subgrade drag friction. A film thickness of 10 mils (0.25 mm) is typically used for reduced vapor transmission and durability during and after its installation. The vapor retarder should be installed according to ASTM E1643, "Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs."

All penetrations through the vapor retarder should be sealed to ensure its integrity. The vapor retarder should be taped around all openings to ensure the effectiveness of the barrier. Grade stakes should not be driven through the barrier and care should be taken to avoid punctures during reinforcement and concrete placement. Placement of slab concrete directly on the vapor retarder increases the risks of surface dusting, blistering and slab curling making good concrete practice critical. A low water to cement ratio concrete mix design combined with proper and adequate curing procedures will help ensure a good quality slab.

Utilities

Utilities that project through a slab-on-grade floor or walls should be designed with either some degree of flexibility, or with sleeves, in order to prevent damage to these lines should movement occur.

Expansion Joints

Expansion or control joints should be designed and placed in various portions of the structure especially rigid masonry walls. Properly planned placement of these joints will assist in controlling the degree and location of material cracking that normally occurs due to material shrinkage, thermal affects, soil movements and other related structural conditions.

GENERAL COMMENTS

If significant changes are made in the character or location of the proposed structure, 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.

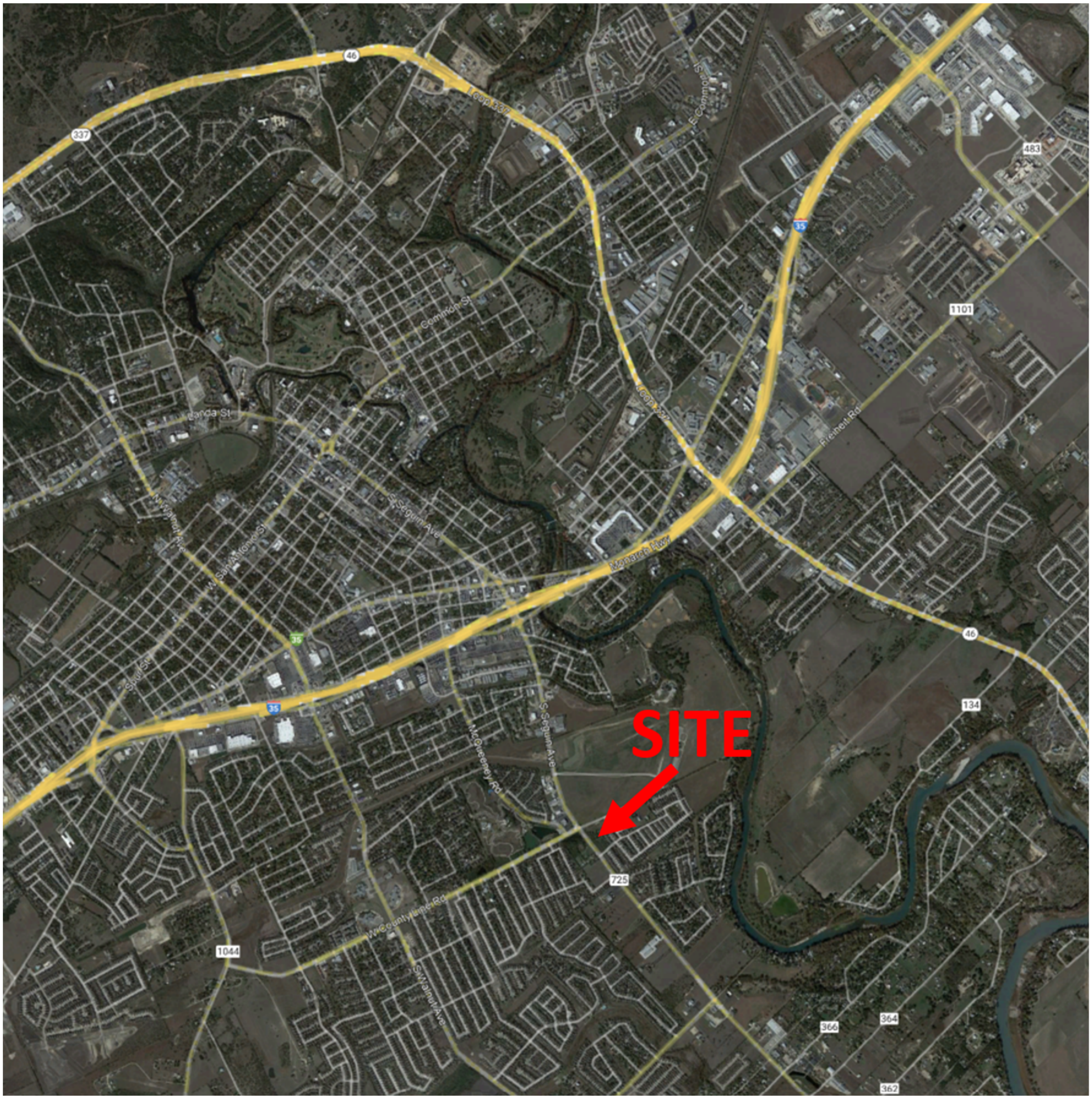
It is recommended that the services of ROCK be engaged to test and evaluate the soils in the undercut excavations prior to placing select fill and in the foundation and pavement excavations prior to concreting or placement of pavement materials, to verify that the bearing soils are consistent with those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

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

SITE VICINITY MAP

NO SCALE
LOCATION IS APPROXIMATE



April 4, 2023
HW Pecan Crossing, LLC
RETL Project No.: G223134

PECAN CROSSING RETAIL
FM 725 & E. County Line Road
New Braunfels, Texas

ENGINEERING AND TESTING LABORATORY LLC
ROCK
A UES COMPANY

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

BORING LOCATION PLAN

NO SCALE
LOCATIONS ARE APPROXIMATE

April 4, 2023
HW Pecan Crossing, LLC
RETL Project No.: G223134

PECAN CROSSING RETAIL
FM 725 & E. County Line Road
New Braunfels, Texas

A UES COMPANY

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

LOG OF BORING B-1

Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134

DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 628 feet

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
		SPT S-1		N=37	10	33	16	17			85	**LEAN CLAY WITH GRAVEL FILL**, light brown, moist, hard. (CL)
		SPT S-2		N=15	13							**FAT CLAY**, dark brown, moist, stiff.
	5	SH S-3		P=4.5+	14	53	20	33			95	Same as above, very stiff. (CH)
		SPT S-4		N=20	14	56	20	36			93	Same as above, dark brown to brown. (CH)
	10	SPT S-5		N=42	10	42	19	23			90	**LEAN CLAY**, light brown, moist, hard. (CL)
	15	SPT S-6		N=29	18							**FAT CLAY**, light brown and gray, moist, very stiff.
		SH S-7		P=4.5+	15							Same as above.
	20											Boring terminated at a depth of 20-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67678°, W -98.10379°

LOG OF BORING B-2

Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015
A UES COMPANY

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134
DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 645 feet

Soil Symbol	Depth (FT)	Sample Number	N: Blows/FT, P: Tons/SQ FT, T: Tons/SQ FT, Qc: Tons/SQ FT	Moisture Content (%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Dry Density Pounds/CU.FT	Compressive Strength (Tons/SQ FT)	Minus No. 200 Sieve (%)	Description of Stratum
Fill		SPT S-1	N=9	22	61	18	43			94	**FAT CLAY FILL**, dark brown, moist, stiff. (CH)
		SPT S-2	N=12	22	64	18	46			95	Same as above. (CH)
	5	SH S-3	P=4.5+	19							Same as above, brown and light brown, very stiff. (swell= 6.7%, final moisture= 32%)
		SPT S-4	N=9	22							**FAT CLAY FILL**, brown, moist, stiff.
CH		SH S-5	P=4.5+	25	64	18	46			95	**FAT CLAY**, dark brown, moist, very stiff. (CH)
	10										
		SH S-6	P=4.5+	14							Same as above, brown to light brown.
	15										
		SPT S-7	N=37	15	52	16	36			91	Same as above, light brown and gray, moist, hard.
	20										Boring terminated at a depth of 20-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67624°, W -98.10343°

LOG OF BORING B-3

Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015
A UES COMPANY

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134

DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 643 feet

FIELD DATA				LABORATORY DATA							
SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0–1	SPT S-1	N=12	8							**LEAN CLAY WITH GRAVEL FILL**, brown, dry, stiff.
	1–4	SPT S-2	N=15	14	60	17	43			95	**FAT CLAY**, dark brown, moist, stiff. (CH)
	4–6	SH S-3	P=4.5+	13							Same as above, with gravel, very stiff.
	6										Boring terminated at a depth of 6-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67619°, W -98.10391°

LOG OF BORING B-4

Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

A UES COMPANY

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134

DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 624 feet

SOIL SYMBOL	DEPTH (FT)	SAMPLE NUMBER	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT Qc: TONS/SQ FT	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0–2	SPT S-1		N=12	13	52	19	33			83	**FAT CLAY WITH GRAVEL**, dark brown, moist, stiff. (CH)
	2.5–4	SPT S-2		N=21	17							Same as above, light brown, very stiff.
	4.5–6	SPT S-3		N=25	19							Same as above.
	6											Boring terminated at a depth of 6-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67716°, W -98.10386°

LOG OF BORING B-5

ROCK Engineering and Testing Laboratory LLC — A UES COMPANY

Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134

DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 631 feet

FIELD DATA				LABORATORY DATA							
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	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–2	SPT S-1		N=12	17	56	23	33			93	**FAT CLAY FILL**, brown, moist, stiff. (CH)
2–6	SPT S-2		N=18	10							**FAT CLAY**, dark brown, dry, very stiff.
	SH S-3		P=4.5+	11							Same as above.
6											Boring terminated at a depth of 6-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67661°, W -98.10335°

LOG OF BORING B-6

A UES COMPANY
Rock Engineering & Testing Laboratory LLC
10856 Vandale Street
San Antonio, Texas 78216
Telephone: 210-495-8000
Fax: 210-495-8015

CLIENT: HW Pecan Crossing, LLC
PROJECT: Pecan Crossing Retail Devlopment
LOCATION: FM 725 & E. County Line Rd; N.B., TX
NUMBER: G223134

DATE(S) DRILLED: 03/13/2023

DRILLING METHOD(S):
Solid Flight Auger

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

SURFACE ELEVATION: +/- El. 645 feet

FIELD DATA				LABORATORY DATA							
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	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–2.5	SPT S-1		N=8	15	65	24	41			92	**FAT CLAY**, dark brown, moist, stiff. (CH)
2.5–6	SH S-2		P=4.5+	10							**LEAN CLAY WITH SAND**, with calcareous material, light brown, dry, very stiff.
	SPT S-3		N=14	9							Same as above, stiff.
6											Boring terminated at a depth of 6-feet.

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

REMARKS:
Boring location determined by ROCK. Drilling operations performed by ROCK.
GPS Coordinates: N 29.67596°, W -98.10282°

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

A UES COMPANY

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