Geotechnical Engineering Report

Proposed Commercial Development at Nacogdoches Road
San Antonio, Texas

October 12, 2021
Terracon Project No. 90215215

Prepared for:
CVC Nacogdoches LP
Austin, Texas

Prepared by:
Terracon Consultants, Inc.
San Antonio, Texas

October 12, 2021

CVC Nacogdoches LP
3605 Hillbrook Dr.
Austin, Texas 78731

Attn: Mr. Chris V. Cox

Re: Geotechnical Engineering Report
Proposed Commercial Development at Nacogdoches Road
N Loop 1604 E and Nacogdoches Road
San Antonio, Texas
Terracon Project No. 90215215

Dear Mr. Cox:

We have completed the Geotechnical Engineering services for the above referenced project. This report presents the findings of the subsurface exploration and provides geotechnical recommendations for the proposed project.

We appreciate the opportunity to work with you on this project and look forward to contributing to the ongoing success of this project by providing **Materials Testing and Special Inspection** services during construction. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
(Firm Registration: TX F3272)

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REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Geotechnical Engineering Report

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N Loop 1604 E and Nacogdoches Road
San Antonio, Texas
Terracon Project No. 90215215
October 12, 2021

INTRODUCTION

This revised report presents the results of our subsurface exploration and geotechnical engineering services performed for the Proposed Commercial Development at Nacogdoches Road to be located near the intersection of N Loop 1604 E and Nacogdoches Road in San Antonio, Texas. This study was performed in general accordance with Terracon Proposal No. P90215215 dated August 12, 2021. The notice to proceed was provided on August 26, 2021. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Pavement design and construction
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC 2018

The geotechnical engineering scope of services for this project included the advancement of twelve (12) test borings to a depth of about 20 feet below existing site grades. Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section of this report.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at the Southeast corner of N Loop 1604 E and Nacogdoches Road in San Antonio, Texas. Lot 4, 5, 9 and 10 will be used for this development.
Existing Improvements	The site is undeveloped. Based on the available historical aerial image, some grading operations have previously been performed at the site.
Current Ground Cover	Bare soil, grass and trees.
Existing Topography	Based on our field visit, the site is sloping downward from north to south.

PROJECT DESCRIPTION

Item	Description
Information Provided	Mr. Mark R. Johnson, PE, with Balanced Site Design, LLC has provided us site plan via an email dated August 11, 2021.
Proposed Structure	The planned project will consist of some retail and restaurant buildings, parking lots and access drives.
Building Construction	The buildings may be supported on slab-on-grade foundation systems.
Finished Floor Elevation	Not available at the time of this report.
Pavements	Both rigid (concrete) and flexible (asphalt) pavement sections should be considered.

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting and planned construction. The following table provides our geotechnical characterization.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, foundation options and pavement options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Based on the results of the borings, subsurface conditions at the boring locations can be generalized as follows:

Approximate Depth (feet)	Material Description	Consistency/ Density
0 to 4	FILL: GRAVEL ; tan and dark brown, with limestone chips and clay seams *(encountered in boring B-1 only)*	Medium Dense
0 to 8	FILL: LEAN CLAY (CL) [1]; yellowish brown	Very Stiff
0 to 2	FILL: FAT CLAY (CH) [2]; brown, dark brown and tan, yellowish brown, light brown	Stiff to Very Stiff
2 to 20	LEAN CLAY (CL) and SANDY LEAN CLAY (CL) [1]; yellowish brown, brown and light brown	Stiff to Hard
4½ to 20	FAT CLAY (CH) [2]; dark brown to brown, light brown to yellowish brown	Stiff to Hard

Approximate Depth (feet)	Material Description	Consistency/ Density
1	The FILL: LEAN CLAY (CL), LEAN CLAY (CL) & SANDY LEAN CLAY (CL) materials could undergo moderate volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.	
2	The FILL: FAT CLAY (CH) & FAT CLAY (CH) materials could undergo high to very high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content	

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was encountered in the deep borings drilled at the site and are tabulated below.

Boring No.	During Drilling (feet) [1]
B-1	---
B-2	---
B-3	---
B-4	15
B-5	13
B-6	14
B-7	14
B-8	16
B-9	14
B-10	12
B-11	10
B-12	11
1	Groundwater depths are based on the below existing grade during our field activities and depths are rounded to nearest ½ feet.

The borings were backfilled with soil cuttings after the drilling operations and groundwater observations were completed. Specific information concerning groundwater is noted on the boring logs presented in **Exploration Results.**

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

The following recommendations are based upon the data obtained from our field and laboratory programs, project information provided to us and on our experience with similar subsurface and site conditions.

The foundation being considered to provide support for the planned structure must satisfy two independent engineering criteria with respect to the subsurface conditions encountered at this site. One criterion is the foundation system must be designed with an appropriate factor of safety to reduce the possibility of a bearing capacity failure of the soils underlying the foundation when subjected to axial and lateral load conditions. The other criterion is movement of the foundation system due to compression (consolidation or shrinkage) or expansion (swell) of the underlying soils must be within tolerable limits for the structure.

Expansive Soil Considerations

Based on our findings, the subsurface soils at this site generally exhibit a high expansion potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils in the building area exhibit a Potential Vertical Rise (PVR) of about 2 to 3 inches in its present condition. The actual movements could be greater than the values presented in this report if inadequate drainage, ponded water, and/or other sources of moisture are allowed to infiltrate beneath the structure after construction. Based on the PVR results, building subgrade modifications to provide a uniform soil support for foundation will be required and are discussed in this report.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible without suspending the floor slab and supporting the building by drilled pier foundation system. However, soil movements may be reduced by implementing the recommendations presented in the **Building Pad Preparation** section of this report. Also, movement can be reduced by suspending the floor slab. Terracon would be pleased to discuss other construction alternatives with you upon request.

Any differential movement can result in minor cracks in the floor slab and walls, warped and sticking doors, and other operational and cosmetic problems that are annoying and require frequent maintenance and/or repairs. To design for possible foundation movements, provisions should be included to reduce unsightly cracking by using frequent saw cuts in the floor slab; architectural joints should be used in long runs of masonry or stucco and above openings in both exterior and interior walls. As an alternate, paneling with less brittle materials should be considered.

Sulfate Considerations

Sulfate tests were performed on selected sample collected from the borings to check for possible adverse reactions with lime or cement treatment. Testing was not performed on all borings nor at all depths. Sulfate content concentrations for a boring along with its approximate depth and nearest boring number is as follows:

Sulfate Test Results (IC/TxDOT 620J)		
Boring	**Depth (feet)**	**Sulfate Content (ppm)**
B-2	0 – 2	99.9
B-8	2½ – 4	95.4
B-12	2½ – 4	68.7

The test results indicate sulfate values are less than 100 ppm. The sulfate effect at this site is considered to be low.

EARTHWORK

Earthwork will include clearing and grubbing, excavations and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. These recommendations include critical quality criteria as necessary to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Construction operations may encounter difficulties due to the wet or soft surface soils becoming a general hindrance to equipment due to rutting and pumping of the soil surface, especially during and soon after periods of wet weather. If the subgrade cannot be adequately compacted to minimum densities as described in the **Fill Compaction Requirements** section of this report, one of the following measures may be required:

- removal and replacement with select fill;
- chemical treatment of the soil to dry and increase the stability of the subgrade; or
- drying by natural means if the schedule allows.

In our experience with similar soils in this area, chemical treatment (hydrated lime or cement) may be an effective method to increase the supporting value of wet and weak subgrade. Terracon should be contacted for additional recommendations if chemical treatment of the soils is needed.

Prior to construction, all vegetation, loose topsoil and any otherwise unsuitable materials should be removed from the construction area. The stripped materials consisting of vegetation and organic materials should be wasted from the site, or used to revegetate landscaped areas or exposed slopes after completion of grading operations. Wet or dry material should either be removed or moisture conditioned and recompacted. After stripping and grubbing, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a fully loaded dump truck or equivalent pneumatic tired vehicle. Soils that are observed to rut or deflect excessively (typically greater than 1-inch) under the moving load should be undercut and replaced with properly compacted on-site soils. The proof-rolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather.

Existing Fill

Existing fill materials were observed at the site to a depths of about 4 to 8 feet. Based on the blow counts, the fill appears to be moderately compacted. Based on building type and anticipated load, we believe the fill can remain in place. However, even with the recommended construction procedures, there is an inherent risk that the compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations furnished in this report.

It should be emphasized that geotechnical sampling is usually conducted with a small diameter bore hole. Therefore, understanding of the fill type, size etc., are limited to those observed at the boring locations. It is possible that different conditions could exist at other locations of the site.

Test Pits

Geotechnical sampling is usually conducted with small diameter boreholes. Therefore, an accurate understanding of the fill thickness is limited to those observed at the boring locations. The small diameter borings will not provide reliable information on the presence and size of oversized materials, such as boulders. <u>Therefore, we recommend that test pits be performed at the site to better classify and identify the fill materials and to explore for unsuitable materials.</u> The test pits may be performed in the building pad areas. At least two test pits be performed in each building pad area to a depth of about 10 to 12 feet from the existing grade. The excavated soil free from debris and other unsuitable material can be placed back in thin lifts and recompacted with the backhoe buckets to come up to the mentioned excavated depth in **Building Pad Preparation** and then the stated steps should be followed to prepare the building pad. Test pit excavation should be performed under the direction of the Geotechnical Engineer or their authorized representative

Building Pad Preparation

As previously mentioned, the existing PVR at this site is about 2 to 3 inches. Moreover, the upper soil at site appears to be relatively dry when compared to the corresponding plastic limits. The following soil modification methods may be considered to maintain the soil movement to a more desirable level and provide uniform support to the grade supported slabs and flatwork for this project site. The recommendations provided in this section are based on the Finished Floor Elevation (FFE) near existing grades.

- Remove vegetation, topsoil and other deleterious materials from building pad area as discussed in the **Site Preparation** section. The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building and any adjacent flatwork. The limits of the building pad should be indicated on the drawings for the project.

- Excavate existing grades in the building pad area below the FBPE, based on the depths provided below should result in the following approximate estimated PVR values. The excavation depths are below existing grade.

Building No.	Excavation Depth (Feet)	Depth of Moisture Conditioned & Compacted Onsite Soil Below FBPE	Thickness of Select Fill to Achieve FBPE	Approximate Estimated Resulting PVR
1	---	---	---	2 to 2½ inches
	8 feet	4 feet	4 feet	1 inch
	10 feet	6 feet	4 feet	½ inch (non-expansive) *
2	---	---	---	2 to 2½ inches
	9 feet	5 feet	4 feet	1 inch
	11 feet	7 feet	4 feet	½ inch (non-expansive) *
3 & 4	---	---	---	2½ to 3 inches
	10 feet	5 feet	5 feet	1 inch
	12 feet	6 feet	6 feet	½ inch (non-expansive) *

* By preparing the building pad as per this recommendation, Section 1808.6.3 “Removal of Expansive Soils” of the 2018 IBC, will be applicable.

- After removing the onsite clay soil from the building pad area as per the table above, proof-roll the exposed subgrade in the building pad area with at least a 15-ton roller, or equivalent equipment, to evidence any weak yielding zones. A Terracon geotechnical engineer or their representative should be present to observe proof-rolling operations. Segregate the tan and yellowish-brown clay soil from the dark brown soil and stockpile the tan and yellowish-brown soil for later use as fill in the building pad area. The dark brown and brown soils and gravel fill are not suitable for reuse as moisture conditioned fill in the building pad area.

- Over-excavate any confirmed weak yielding zones, both vertically and horizontally, and replace with competent soil. The exposed subgrade should be moisture conditioned between 0 and +4 percentage points of the optimum moisture content and then compact to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- After proof-rolling and the replacement of weak yielding zones, place back the stockpiled onsite yellowish-brown and tan soil at the bottom of the excavation in compacted lifts to depth mentioned in the table below the FBPE.

- The onsite soil must be processed to produce a homogeneous mass such that no individual dry clods of soil are present and moisture is distributed throughout the soil mass. While means and methods are the responsibility of the contractor, these criteria will probably require that the soil undergo at least 3 steps during construction as follows:

  - Excavation and stockpiling. The mass excavation of the site clayey soils should be accomplished in relatively thin layers and stockpiled in a broad area where the soil can be processed and thoroughly wetted. Tall pyramidal mounds should be avoided.

  - Processing and Compacting. The stockpiled soils will need to be processed prior to being placed in the building pad area. Processing of the soil will require the breakdown of any dry clumps or clods of soil. This can be accomplished by alternately drying and wetting of the soil and working the soil with a maintainer, reclaimer, pulvermixer, dozer or disc. However, the thoroughness of the moisture conditioning, mixing, and compaction should be that typically used to create a landfill liner or soil liner. The actual process should be proposed by the earthwork subcontractor. After sufficient processing, the soil should be moisture conditioned and compacted as previously discussed. Compaction should be accomplished using sheep's foot type compactors to ensure bonding between each lift. Steel wheeled or rubber-tired compactors should not be used for compaction of the moisture conditioned clay fill. The surface of each compacted layer should not be allowed to dry between lifts. If a lift is left exposed to the elements overnight, then the surface should be wetted and recompacted prior to proceeding with the next lift.

- <u>Monitoring</u>. To reduce the risks involved when using expansive clay as structural fill, the recommendations provided in this report should be strictly followed. Therefore, a Terracon representative working under the direction of the project Geotechnical Engineer should be present full-time during earthwork activities for building pad construction. Furthermore, a pre-construction meeting should be held to discuss earthwork operations.

- Moisture conditioning and mixing the clay soil to produce a homogenous mass may create a wet “muddy” ground condition. Conventional equipment with rubber tires may have difficulties traversing the moisture conditioned area, and pulling (dragging) or pushing the equipment with track-mounted machinery may be required to adequately work the area as described herein. The earthwork contractor should be cognizant of these wet and soft ground conditions that may occur when planning and bidding for this option.

- The onsite soil should be placed in loose lifts of about 8 inches and compacted thickness not exceeding 6 inches. Onsite soil should be moisture conditioned between +2 and +6 percentage points of the optimum moisture content and should be compact to between 92 to 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- After placing back the onsite tan and yellowish-brown soil in moisture conditioned and compacted lifts at the bottom of the excavation as per mentioned depths in the above table, imported select fill should then be used to achieve the Finished Building Pad Elevation (FBPE). Imported select fill should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content and then compact to at least 98 percent of the maximum dry density determined in accordance with ASTM D 698.

- To provide a more uniform slab support and create a more all-weather working surface, we recommend constructing the final 6 inches of the pad with granular select fill. Details regarding select fill materials, placement and compaction are presented in the following sections **Fill Material Types** and **Fill Compaction Requirements**.

<u>Clay Cap-</u> If not covered with concrete flatwork or pavements, the upper 2 feet (clay “cap”) of the 5-foot (horizontal) overbuild should consist of a cohesive clay with a PI between 25 to 40 percent. The purpose of the clay cap is to reduce the potential for water to infiltrate the building pad causing the subgrade soils to swell. The clay "cap" material should have at least 70 percent by weight passing the No. 200 Sieve and no more that 15 percent by weight retained in the No. 4 Sieve. The clay “cap” may be replaced with concrete flatwork or pavement extending to the edge of the foundation. Properly compacted, this clay layer should help to reduce migration of moisture into the select fill below. On-site dark brown clay soil may be used for the clay “cap” provided it meets the criteria listed above.

Details regarding subgrade preparation, fill materials, placement and compaction are presented in the following sections **Fill Material Types** and **Fill Compaction Requirements**.

Building Perimeter Protection: We understand landscape beds will be adjacent to the building. We recommend the vegetation be limited to small shallow-rooted shrubs and low groundcover for landscape areas along the building perimeters. Plants should be carefully selected to avoid species which will produce lateral migrating root structures which would tend to deplete the moisture from the prepared building pad. We recommend the construction of a vertical moisture barrier wall to maintain constant soil moisture:

- A perimeter Vertical Moisture Barrier Wall (VMBW) may be considered to help reduce the potential for moisture content changes in the soils beneath the floor slab, thereby reducing the potential for differential movement. The VMBW should extend to at least 12 inches below the prepared pad as per the recommendations above. The VMBW should be positioned below the exterior grade beams and should be a minimum of 12 inches wide. Flowable fill can be used for the VMBW. The interior side of the VMBW should be covered with a 20-mil layer of polyethylene sheeting extending up the interior side and overlaps with the vapor barrier beneath the slab.

Fill Material Types

Select fill and granular select fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Granular select fill [2]	Varies	Upper 6 inches of the building pad.
Select fill	CL (LL≤40) and(7≤PI≤18)	All locations and elevations.
On-Site Soil	FILL: GC FILL: CL FILL: CH CH CL	■ Onsite soil is not suitable to use as select fill. ■ Onsite Gravel (GC) cannot be used in the building pad area. ■ Yellowish brown, light brown onsite soil (CL) can be used as moisture conditioned and compacted fill in the building pad area at the bottom of the excavation. If an inadequate amount of yellowish brown and light brown onsite soil is available, supplement with imported comparable material approved by geotechnical engineer or select fill. ■ Dark brown and brown clay (CH) is not suitable for use in the building pad. It may be used in pavement and landscape areas.

1 Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

2	Granular select fill should consist of 2014 TxDOT Item 247, Type A, Grade 1-2 crushed limestone base material. Plasticity Index (PI) should range from 5 to 15.

Fill Compaction Requirements

Select fill and granular select fill should meet the following compaction requirements.

Item	Structural Fill
Fill Lift Thickness	All fill should be placed in thin, loose lifts of about 8 inches, with compacted thickness not exceeding 6 inches.
Compaction of Onsite Soil	**In the Building Pad Area** 92 to 95 percent of materials standard Proctor maximum dry density (ASTM D 698). **For Pavement Subgrade** 95 percent of materials standard Proctor maximum dry density (ASTM D 698).
Compaction of Imported Select Fill & Granular Select Fill	98 percent of materials standard Proctor maximum dry density (ASTM D 698).
Moisture Content of On-Site Clay Soil	**In the Building Pad Area** 92 to 95 percent of materials standard Proctor maximum dry density (ASTM D 698). **For Pavement Subgrade** 95 percent of materials standard Proctor maximum dry density (ASTM D 698).
Moisture Content of Imported Select Fill and Imported Granular Select Fill	The materials should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content.

Utility Trench Backfill

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must be designed to provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Based upon the subsurface conditions determined from the geotechnical exploration, subgrade soils exposed during construction are anticipated to be relatively stable. However, the stability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. If unstable conditions develop, workability may be improved by scarifying and drying. Over excavation of wet zones and replacement with granular materials may be necessary. Lightweight excavation equipment may be required to reduce subgrade pumping. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance.

All temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Construction Observation and Testing

The earthwork efforts should be monitored under the observation of the Geotechnical Engineer or their representative. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the observation of the Geotechnical Engineer or their representative. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

Slab-on-Grade Foundation Recommendations

The proposed buildings may be supported on a monolithic stiffened slab and grade beam foundation if the design PVR is greater than ½ inch. For a prepared building pad with a design PVR of ½ inch, it may be considered a non-expansive site, and a flat slab system may be used. As stated previously, remedial earthwork measures will be required to reduce potential post-construction movements to a tolerable level as recommended in **Building Pad Preparation** section.

Parameters commonly used to design this type of foundation are provided on the table below. The slab foundation design parameters presented on the table below are based on the criteria published by the Wire Reinforcing Institute (WRI) and the Post-Tensioning Institute (PTI) 3rd Edition. These are essentially empirical design methods and the recommended design parameters are based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience, and the criteria published in the WRI and PTI design manuals.

Conventional Method	**Prepared Subgrade [1]**	
Net Allowable Bearing Pressures [2]	2,500 psf	
Subgrade Modulus (k)	90 pci	
WRI Method		
Potential Vertical Rise (PVR) [1]	**½ inches**	**1 inch**
Effective Plasticity Index (PI)	24	27
Soil / Climate Rating Factor (1- C)	0.10	0.13

PTI Method 3rd Edition		
Thornthwaite Moisture Index (I_m)	-13	
Depth of Constant Soil Suction	9 feet	
Constant Soil Suction	3.6 pF	
Potential Vertical Rise (PVR) [1]	**½ inch**	**1 inch**
Edge Moisture Variation Distance (e_m):		
Center Lift	8.9 feet	8.3 feet
Edge Lift	4.5 feet	4.3 feet
Differential Soil Movement (y_m):		
Center Lift	0.8 inch	1.1 inches
Edge Lift	1.2 inches	1.5 inches
Coefficient of Slab-Subgrade Friction (μ):	0.75 to 1.00	

1. Based on preparing the building pad as discussed in this report.
2. The net allowable bearing pressure provided above includes a Factor of Safety (FS) of at least 3.

We recommend that perimeter grade beams be at least 36 inches below the finished exterior grade. This recommendation is for proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. This recommendation is not based on structural considerations. Grade beam depths may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the Structural Engineer. Interior grade beams (if any) should be sized by the structural engineer to provide adequate stiffness to the slab. The grade beams or slab portions may be thickened and widened to serve as spread footings at concentrated load areas.

For a slab foundation system designed and constructed as recommended in this report, post construction settlements should be less than 1 inch. Settlement response of a select fill supported slab is influenced more by the quality of construction than by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the building pad and foundation.

The use of a vapor retarder should be considered beneath concrete slabs-on-grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slabs will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions about the use and placement of a vapor retarder.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be observed by the Geotechnical Engineer or their represented. Grade beams for the slab foundation and footings should preferably be neat excavated. Excavation should be accomplished with a smooth-mouthed bucket. If a toothed bucket is used, excavation with this bucket should be stopped 6 inches above final grade and the grade beam excavation completed with a smooth-mouthed bucket or by hand labor. Debris in the bottom of the excavation should be removed prior to steel placement. Due to the presence of sandy clay soils, grade beams and footings excavation may experience caving. Therefore, the foundation contractor should be prepared to use forms.

The foundation excavations should be sloped sufficiently to create internal sumps for runoff collection and removal of water. If surface runoff water or subsurface water seepage in excess of 1 inch accumulates at the bottom of the foundation excavation, it should be collected and removed and not allowed to adversely affect the quality of the bearing surface. Special care should be taken to protect the exposed soils from being disturbed or drying out prior to placement of the concrete.

SEISMIC CONSIDERATIONS

Description	Value
2018 International Building Code Site Classification (IBC) [1]	D [2]

1. The site class definition was determined using SPT N-values in conjunction with the 2018 IBC and Table 20.3-1 in the 2010 ASCE-7.
2. Borings extended to a maximum depth of 35 feet, and this seismic site class definition considers that similar conditions continue below the maximum depth of the subsurface exploration.

PAVEMENTS

Both flexible and rigid pavement systems may be considered for the project. Based on our knowledge of the project, we anticipate that traffic loads will be produced primarily by automobile traffic and occasional delivery and trash removal trucks.

Subgrade Preparation

Prior to construction, any vegetation, loose topsoil and any otherwise unsuitable materials should be removed from the new pavement areas. After stripping, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a fully loaded dump truck or equivalent pneumatic tired vehicle. Wet, soft, low-density or dry material should either be removed or moisture conditioned and recompacted to the moisture contents and densities described in section **Fill Compaction Requirements** prior to placing fill.

Due to the presence of the expansive clay soil at the site, movement up to 2½ inches should be expected. If the movement of the pavement is not acceptable, then the pavement subgrade should be prepared similar to the building pad provided in the **Building Pad Preparation** section of this report.

Design Recommendations

For this project Light and Heavy pavement section alternatives have been provided. Light is for areas expected to receive only car traffic. Heavy assumes areas with heavy traffic, such as trash pickup areas and main access drive areas.

The flexible pavement section was designed in general accordance with the National Asphalt Pavement Association (NAPA) Information Series (IS-109) method (Class 1 for Light and Class 2 for Heavy). The rigid pavement section was designed using the American Concrete Institute (ACI 330R-01) method (Traffic Category A (ADTT=0) for Light and A-1 (ADTT=10) for Heavy). If heavier traffic loading is expected, Terracon should be provided with the information and allowed to review these pavement sections.

	FLEXIBLE PAVEMENT SYSTEM (inches)	
	Light Duty	Heavy Duty
Hot Mix Asphaltic Concrete	2.0	3.0
Granular Base Material [1]	12.0	14.0
Moisture Conditioned Subgrade	6.0	6.0

1. Type B (black base) material may be used in place of crushed limestone base material. Every 4 inches of crushed limestone base material may be replaced with 1 inch of asphaltic base material. However, the minimum thickness of the asphaltic base material is 4 inches.

	RIGID PAVEMENT SYSTEM (inches)	
	Light Duty	Heavy Duty
Reinforced Concrete	6.0	7.0
Moisture Conditioned Subgrade	6.0	6.0

Pavement areas that will be subjected to heavy wheel and traffic volumes, such as waste bin or "dumpster" areas, entrance/exit ramps, and delivery areas, should be a rigid pavement section constructed of reinforced concrete. The concrete pavement areas should be large enough to properly accommodate the vehicular traffic and loads. For example:

- The dumpster pad should be large enough so that the wheels of the collection truck are entirely supported on the concrete pavement during lifting of the waste bin; and

- The concrete pavement should extend beyond any areas that require extensive turning, stopping, and maneuvering.

The pavement design engineer should consider these and other similar situations when planning and designing pavement areas. Waste bin and other areas that are not designed to accommodate these situations often result in localized pavement failures.

The pavement section has been designed using generally recognized structural coefficients for the pavement materials. These structural coefficients reflect the relative strength of the pavement materials and their contribution to the structural integrity of the pavement. If the pavement does not drain properly, it is likely that ponded water will infiltrate the pavement materials resulting in a weakening of the materials. As a result, the structural coefficients of the pavement materials will be reduced and the life and performance of the pavement will be shortened. The Asphalt Institute recommends a minimum of 2 percent slope for asphalt pavements. The importance of proper drainage cannot be overemphasized and should be thoroughly considered by the project team.

Pavement Section Materials

Presented below are selection and preparation guidelines for various materials that may be used to construct the pavement sections. Submittals should be made for each pavement material. The submittals should be reviewed by the Geotechnical Engineer and appropriate members of the design team and should provide test information necessary to verify full compliance with the recommended or specified material properties.

- **Hot Mix Asphaltic Concrete Surface Course -** The asphaltic concrete surface course should be plant mixed, hot laid Type C or D Surface. Each mix should meet the master specifications requirements of 2014 TXDOT Standard Specifications Item 341, Item SS 3224 (2011) and specific criteria for the job mix formula. The mix should be compacted between 91 and 95 percent of the maximum theoretical density as measured by TEX-227-F. The asphalt cement content by percent of total mixture weight should fall within a tolerance of ±0.3 percent asphalt cement from the specific mix. In addition, the mix should be designed so 75 to 85 percent of the voids in the mineral aggregate (VMA) are filled with asphalt cement. The grade of the asphalt cement should be PG 70-22 or higher performance grade. Aggregates known to be prone to stripping should not be used in the hot mix. If such aggregates are used measures should be taken to mitigate this concern. The mix should have at least 70 percent strength retention when tested in accordance with TEX-531-C.

  Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method TEX-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project pavement specimens may be used when approved by the Engineer.

Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required pavement specimens at their expense and in a manner and at locations selected by the Engineer.

- **Concrete -** Concrete should have a minimum 28-day design compressive strength of 4,000 psi.

- **Granular Base Material -** Base material may be composed of crushed limestone base or crushed concrete meeting all of the requirements of 2014 TxDOT Item 247, Type A, Grade 1-2; including triaxial strength. The material should be compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D1557 at moisture contents ranging from -2 and +3 percentage points of the optimum moisture content.

- **Moisture Conditioned Subgrade -** The subgrade should be scarified to a depth of 6 inches and then moisture conditioned and compacted as recommended in the **Fill Compaction Requirements**. section of this report.

Details regarding subgrade preparation, fill materials, placement and compaction are presented in **Earthwork** section under subsections **Fill Material Types** and **Fill Compaction Requirements**.

Pavement Joints and Reinforcement

The following is recommended for all concrete pavement sections in this report. Refer to ACI 330 “Guide for Design and Construction of Concrete Parking Lots” for additional information.

Item	Description
Distributed Reinforcing Steel	No. 3 reinforcing steel bars at 18 inches on-center-each-way, Grade 60. It is imperative that the distributed steel be positioned accurately in the pavement cross section, namely 2 inches from the top of the pavement.
Contraction Joint Spacing	12.5 feet each way for pavement thickness of 5 to 5.5 inches. 15 feet each way for pavement thickness of 6 inches or greater. Saw cut control joints should be cut within 6 to 12 hours of concrete placement.
Contraction Joint Depth	At least ¼ of pavement thickness.
Contraction Joint Width	One-fourth inch or as required by joint sealant manufacturer.
Construction Joint Spacing	To attempt to limit the quantity of joints in the pavement, consideration can be given to installing construction joints at contraction joint locations, where it is applicable.

Item	Description
Construction Joint Depth/Width	Full depth of pavement thickness. Construct sealant reservoir along one edge of the joint. Width of reservoir to be ¼ inch or as required by joint sealant manufacturer. Depth of reservoir to be at least ¼ of pavement thickness.
Isolation Joint Spacing	As required to isolate pavement from structures, etc.
Isolation Joint Depth	Full depth of pavement thickness.
Isolation Joint Width	One-half to 1 inch or as required by the joint sealant manufacturer.
Expansion Joint	In this locale, drying shrinkage of concrete typically significantly exceeds anticipated expansion due to thermal affects. As a result, the need for expansion joints is eliminated provided all joints (including saw cuts) are sealed. Construction of an unnecessary joint may be also become a maintenance problem. All joints should be sealed. If all joints, including sawcuts, are not sealed then expansion joints should be installed.

All construction joints have dowels. Dowel information varies with pavement thickness as presented as follows:

Pavement Thickness	6 inches	7 inches
Dowels	¾ inch diameter	$^7/_8$ inch diameter
Dowel Spacing	12 inches on center	12 inches on center
Dowel Length	14 inches long	16 inches long
Dowel Embedment	6 inches	7 inches

Pavement Drainage and Maintenance

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section.

Long-term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventative maintenance. The following recommendations should be implemented to help promote long-term pavement performance:

- The subgrade and the pavement surface should be designed to promote proper surface drainage, preferably at a minimum grade of 2 percent;
- Install joint sealant and seal cracks immediately;
- Extend curbs into the treated subgrade for a depth of at least 4 inches to help reduce moisture migration into the subgrade soils beneath the pavement section; and

- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.
- Slope subgrade in landscape islands to low points should drain to an appropriate outlet.
- Edge drains are recommended along pavement/ landscape borders.

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Planned Location	Boring Numbers	Boring Depth (feet) [1]
Building 1	B-1 thru B-3	20
Building 2	B-4 thru B-6	20
Building 3	B-7 thru B-9	20
Building 4	B-10 thru B-12	20

1. Below existing ground surface.

Boring Layout and Elevations: We use handheld GPS equipment to locate borings with an estimated horizontal accuracy of +/-20 feet.

Subsurface Exploration Procedures: We advance soil borings with a truck-mounted drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Five samples are obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling is typically performed using thin-wall tube and/or split-barrel sampling procedures. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples are placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observe and record groundwater levels during drilling and sampling.

Our exploration team prepares field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs include visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in this Appendix. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content
- Atterberg Limits
- Soils Finer than No. 200 Mesh Sieve
- Sulfate Tests

Sample Disposal

All samples were returned to our laboratory. The samples not tested in the laboratory will be stored for a period of 30 days subsequent to submittal of this report and will be discarded after this period, unless other arrangements are made prior to the disposal period.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

Proposed Commercial Development at Nacogdoches Road ■ San Antonio, TX
October 12, 2021 ■ Terracon Project No. 90215215

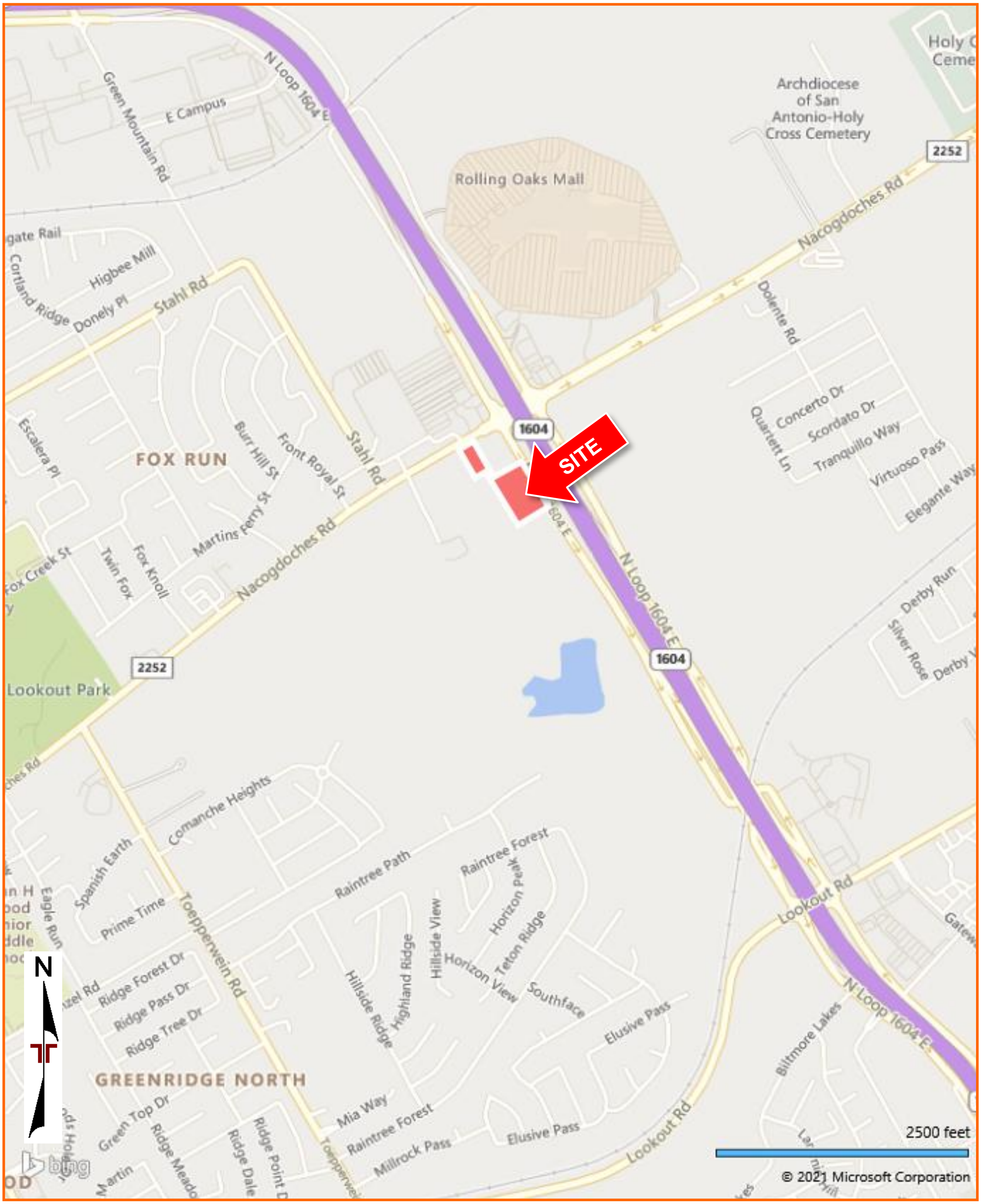

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

ROAD MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Proposed Commercial Development at Nacogdoches Road ■ San Antonio, TX
October 12, 2021 ■ Terracon Project No. 90215215

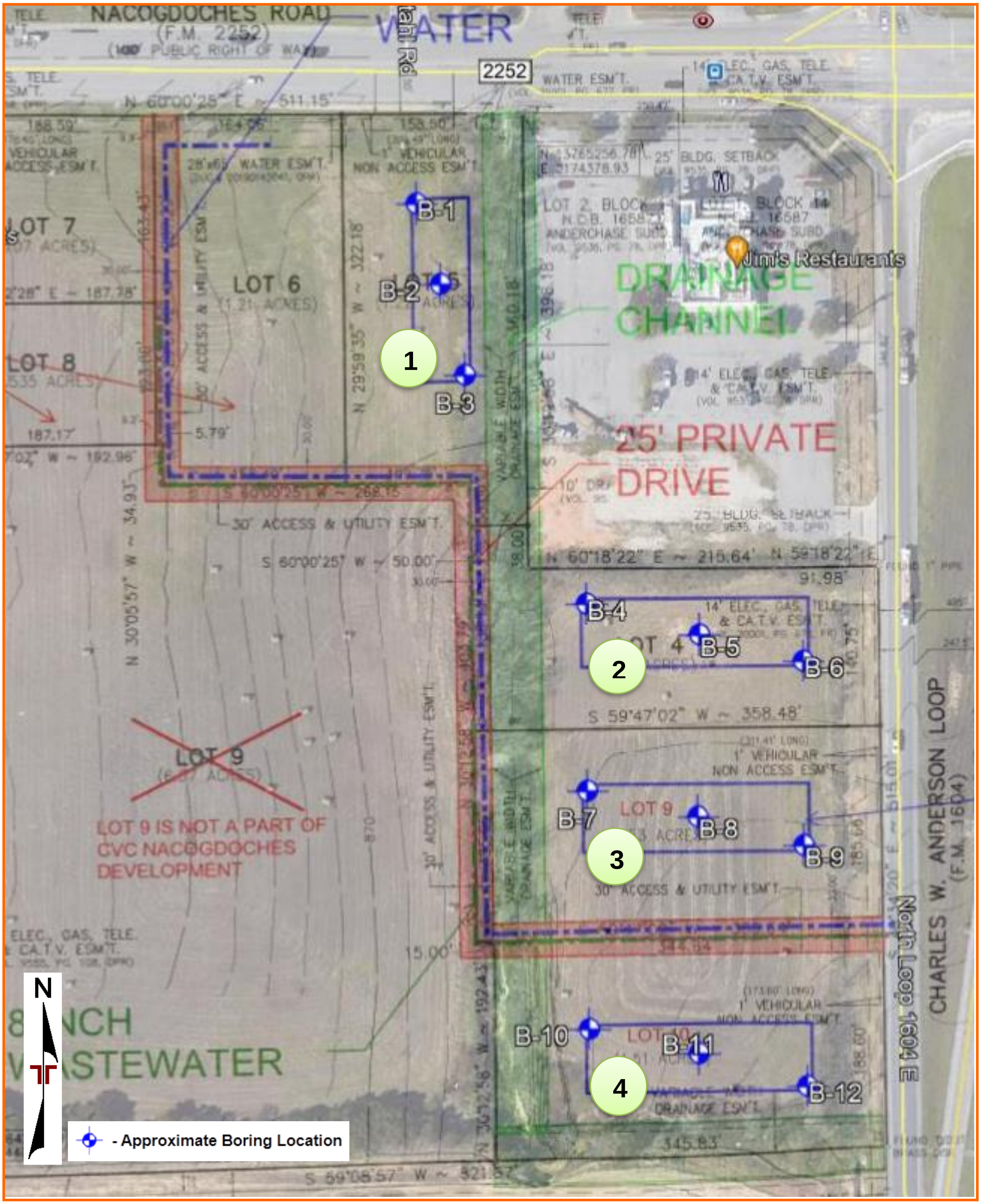

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY GOOGLE EARTH®

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: **Proposed Commercial Development at Nacogdoches Road**

CLIENT: **CVC Nacogdoches, LP Austin, Texas**

SITE: **N Loop 1604 E and Nacogdoches Road San Antonio, Texas**

LOCATION See Exploration Plan

Latitude: 29.5906° Longitude: -98.3534°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - GRAVEL (GC), tan and dark brown, medium dense, with Limestone chips and Fat Clay (CH) seams				6-12-8 N=20	17.0		
					7-7-10 N=17	10.7		
	4.0							
	FAT CLAY (CH), brown, hard	5			4.5 (HP)	21.2		
					4.5+ (HP)	18.8	70-26-44	
					4.5+ (HP)	20.9		
	10.0	10						
	SANDY LEAN CLAY (CL), yellowish brown, hard, marly				20-50/3"	9.4	29-13-16	
		15						
					50/1"	9.3		
	20.0	20						
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

No free water observed during augering

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-2

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP
Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road
San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5905° Longitude: -98.3533°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY (CL), with sand, yellowish brown, very stiff			X	8-10-16 N=26	7.8	35-17-18	
				X	8-5-5 N=10	20.6		
4.0	**LEAN CLAY (CL)**, dark brown to brown, stiff	5		X	6-6-8 N=14	17.5	35-16-19	
6.0	**SANDY LEAN CLAY (CL)**, sandy, yellowish brown, very stiff to hard			X	7-10-14 N=24	13.9		
		10		X	7-10-17 N=27	11.6		69
		15		X	16-21-20 N=41	12.1		
20.0		20		X	18-26-30 N=56	11.7		
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

No free water observed during augering

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-3

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5903° Longitude: -98.3531°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		FILL - LEAN CLAY (CL), with sand, yellowish brown, very stiff			X	6-8-8 N=16	9.1		74
	2.0	**LEAN CLAY (CL)**, brown and light brown, stiff to very stiff			X	5-4-5 N=9	18.5		
		- sandy between 4 and 6 feet	5		X	8-10-18 N=28	18.2		
		- yellowish brown, hard below 6 feet			X	12-14-20 N=34	13.2	43-15-28	
			10		X	16-18-21 N=39	12.7		
			15		X	31-27-30 N=57	10.9	32-13-19	
		- marly below 18 feet				50/1"	8.2		
	20.0	*Boring Terminated at 20 Feet*	20						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

No free water observed during augering

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-4

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5900° Longitude: -98.3525°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY (CL), yellowish brown, very stiff - dark brown clay at the surface				6-8-13 N=21	9.9		
					16-8-21 N=29	10.2	38-15-23	89
		5			13-15-12 N=27	15.8		
	8.0				10-10-11 N=21	10.6		
	FAT CLAY (CH), dark brown, stiff				1.75 (HP)	15.2	69-26-43	
		10						
					2.0 (HP)	26.6		
		15	▽					
	- tan below 18 feet				2.0 (HP)	18.0		
	20.0	20						
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *15 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-5

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5901° Longitude: -98.3521°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY (CL), yellowish brown, very stiff			SPT	5-5-11 N=16	11.5	37-18-19	
				SPT	10-10-9 N=19	10.7		
		5		SPT	8-7-7 N=14	16.4		
7.0	**FAT CLAY (CH)**, trace gravel, dark brown to brown, stiff			SPT	30-13-15 N=28	27.7		
9.0	**LEAN CLAY (CL)**, yellowish brown, hard			Shelby tube	1.75 (HP)	19.3		83
		10	▽ (13 ft)					
				SPT	26-24-31 N=55	15.8	34-18-16	
		15						
20.0		20		SPT	18-18-20 N=38	26.3		
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *13 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-6

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP
Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road
San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5901° Longitude: -98.3518°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - LEAN CLAY (CL), with sand, yellowish brown, stiff to very stiff			X	6-3-5 N=8	10.9		
				X	8-8-10 N=18	10.7		
		5		X	5-6-8 N=14	10.2	38-16-22	76
	6.0							
	LEAN CLAY (CL), yellowish brown, very stiff to hard			X	15-10-13 N=23	20.3		
		10		X	10-18-26 N=44	20.2	38-16-22	
		15	▽	X	18-21-30 N=51	16.5		
				X	19-26-25 N=51	17.2		
	20.0	20						
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *14 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-10-2021	Boring Completed: 09-10-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-7

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP
Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road
San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5896° Longitude: -98.3522°

DEPTH (ft)	Description	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
0.0–2.0	**FILL - FAT CLAY (CH)**, brown, very stiff, with roots	7-7-8 N=15			
2.0–4.5	**FILL - LEAN CLAY (CL)**, yellowish brown, hard	21-16-15 N=31	16.3		87
4.5–20.0	**FAT CLAY (CH)**, dark brown, stiff to very stiff	8-10-8 N=18	28.0	58-24-34	
		13-12-14 N=26	28.2		
	- light brown to yellowish brown below 8 feet	4-5-6 N=11	31.0		
	(water level ▽ at 14 feet)	5-8-9 N=17	18.4	65-22-43	
	- hard below 18 feet	11-16-28 N=44	18.3		
20.0	*Boring Terminated at 20 Feet*				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *14 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-8

PROJECT: Proposed Commercial Development at Nacogdoches Road

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

CLIENT: CVC Nacogdoches, LP Austin, Texas

LOCATION See Exploration Plan

Latitude: 29.5897° Longitude: -98.3519°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY (CH), yellowish brown, stiff			X	5-7-6 N=13	20.6		
2.0	**FILL - LEAN CLAY (CL)**, yellowish brown, very stiff			X	8-10-9 N=19	10.1	31-15-16	78
		5		X	10-12-15 N=27	13.0		
6.0	**FAT CLAY (CH)**, dark brown, very stiff to hard			X	8-14-21 N=35	26.2		
	- light brown to yellowish brown below 8 feet			X	10-21-18 N=39	26.8	66-25-41	
		10						
		15		X	6-8-8 N=16	25.2		
			▽ (16 ft)					
	- hard below 18 feet			X	12-15-26 N=41	14.6		
20.0	***Boring Terminated at 20 Feet***	20						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *16 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-9

PROJECT: **Proposed Commercial Development at Nacogdoches Road**

CLIENT: **CVC Nacogdoches, LP Austin, Texas**

SITE: **N Loop 1604 E and Nacogdoches Road San Antonio, Texas**

LOCATION See Exploration Plan

Latitude: 29.5897° Longitude: -98.3516°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY (CH), light brown, stiff			X	6-5-5 N=10	26.7		
2.0	**FILL - LEAN CLAY (CL)**, tan, stiff to very stiff			X	8-7-7 N=14	19.8		
	- yellowish brown below 4 feet	5		X	5-6-10 N=16	16.4	35-17-18	
6.0	**FAT CLAY (CH)**, dark brown, very stiff to hard			X	12-16-19 N=35	21.6	53-22-31	
		10		X	21-16-19 N=35	27.9		
	- yellowish brown below 13 feet	15	▽	X	5-10-8 N=18	17.6		
20.0		20		X	12-18-24 N=42	16.8		
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *14 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-10

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP, Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road, San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5891° Longitude: -98.3519°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY (CH), brown, stiff			X	6-5-7 N=12	25.2		
2.0	**FILL - LEAN CLAY (CL)**, yellowish brown, stiff to hard			X	25-23-26 N=49	16.2		92
		5		X	4-5-5 N=10	18.4		
6.0	**FAT CLAY (CH)**, dark brown, stiff to very stiff			X	8-7-19 N=26	23.0	54-23-31	
	- medium stiff between 8 and 10 feet			X	3-3-3 N=6	27.6		
		10						
			▽ (12 ft)					
	- yellowish brown below 13 feet			X	4-7-7 N=14	17.5	65-22-43	
		15						
20.0		20		X	10-12-15 N=27	18.2		
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *12 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-11

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5892° Longitude: -98.3515°

DEPTH (ft)	Description	Water Level Observations	Sample Type	Field Test Results	Water Content (%)	Atterberg Limits LL-PL-PI	Percent Fines
0.0–2.0	**FILL - FAT CLAY (CH)**, with gravel, dark brown to brown, stiff		X	6-7-7 N=14	21.2		
2.0–7.0	**FILL - LEAN CLAY (CL)**, yellowish brown, stiff to hard		X	8-10-7 N=17	9.9	32-14-18	
			X	12-16-15 N=31	17.3		
7.0–20.0	**FAT CLAY (CH)**, dark brown to yellowish brown, stiff to hard		X	21-16-20 N=36	15.4		
		▽ (10 ft)	X	6-8-10 N=18	24.4	66-22-44	
			X	4-5-6 N=11	17.6		
			X	8-10-7 N=17	16.7		
20.0	***Boring Terminated at 20 Feet***						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *10 feet during drilling*

6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

BORING LOG NO. B-12

PROJECT: Proposed Commercial Development at Nacogdoches Road

CLIENT: CVC Nacogdoches, LP Austin, Texas

SITE: N Loop 1604 E and Nacogdoches Road San Antonio, Texas

LOCATION See Exploration Plan

Latitude: 29.5892° Longitude: -98.3512°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FILL - FAT CLAY (CH), dark brown and tan, stiff			X	3-4-5 N=9	30.5		
2.0	**FILL - LEAN CLAY (CL)**, yellowish brown, very stiff			X	6-7-7 N=14	11.8	35-15-20	
		5		X	5-7-10 N=17	14.0		
6.0	**FAT CLAY (CH)**, dark brown, stiff to very stiff			X	5-5-4 N=9	22.0		
		10		X	10-12-14 N=26	23.0		
			▽					
	- yellowish brown below 13 feet	15		X	8-10-15 N=25	17.6	56-18-38	
20.0		20		X	12-10-10 N=20	16.9		
	Boring Terminated at 20 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Auger

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *11 feet during drilling*

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 09-11-2021	Boring Completed: 09-11-2021
Drill Rig: CME75	Driller: Ramco/Jason
Project No.: 90215215	

SUPPORTING INFORMATION

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Proposed Commercial Development at Nacogdoches Road ■ San Antonio, Texas

Terracon Project No. 90215215

SAMPLING	WATER LEVEL	FIELD TESTS
Shelby Tube Split Spoon	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** **Cave In Encountered** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** — **Standard Penetration Test Resistance (Blows/Ft.)** **(HP)** — **Hand Penetrometer** **(T)** — **Torvane** **(DCP)** — **Dynamic Cone Penetrometer** **UC** — **Unconfined Compressive Strength** **(PID)** — **Photo-Ionization Detector** **(OVA)** — **Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]		GW	Well-graded gravel [F]
			Cu < 4 and/or 1 > Cc > 3 [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]		SW	Well-graded sand [I]
			Cu < 6 and/or 1 > Cc > 3 [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G, H, I]
			Fines classify as CL or CH		SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line		CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K, L, M]
			PI plots below "A" line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.