Geotechnical Engineering Report

Community First - Phase 4
Austin, Texas
May 20, 2021
Terracon Project No. 96215049

Prepared for:
Mobile Loaves and Fishes
Austin, Texas

Prepared by:
Terracon Consultants, Inc.
Austin, Texas

May 20, 2021

Mobile Loaves and Fishes
803 S. Capital of Texas Hwy
Austin, Texas 78746

Attn: Ms. Sarah Satterlee
P: (512) 551-5456
E: sarah.satterlee@mlf.org

Re: Geotechnical Engineering Report
Community First - Phase 4
South of Burleson Rd near Norwood Ln
Austin, Texas
Terracon Project No. 96215049

Dear Ms. Satterlee:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P96215049 dated February 19, 2021. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, subgrade preparation, and the design and construction of foundations, pavements, and site improvements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Diego Munar Castaneda, P.E.
Project Geotechnical Engineer

Bryan S. Moulin, P.E.
Senior Principal, Geotechnical Department Manager

5/20/2021

REPORT TOPICS

INTRODUCTION 1
SITE CONDITIONS 1
PROJECT DESCRIPTION 2
GEOTECHNICAL CHARACTERIZATION 2
GEOTECHNICAL OVERVIEW 4
EARTHWORK 5
SHALLOW FOUNDATIONS 11
SEISMIC CONSIDERATIONS 16
FLOOR SLABS SUBGRADE PREPARATION 17
LATERAL EARTH PRESSURES 20
PAVEMENTS 22
SLOPE STABILITY 27
CORROSIVITY 29
GENERAL COMMENTS 30
FIGURES 31

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 ***GeoReport*** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS (Boring Logs and Laboratory Data)
SUPPORTING INFORMATION (General Notes, Unified Soil Classification System, Description of Rock Properties, and COA MSWL Form)

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report

Community First - Phase 4
South of Burleson Rd near Norwood Ln
Austin, Texas
Terracon Project No. 96215049
May 20, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Community First - Phase 4 project to be located South of Burleson Rd near Norwood Ln in Austin, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Site preparation and earthwork
- Excavation considerations
- Pavement design and construction
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification
- Lateral earth pressures

The geotechnical engineering Scope of Services for this project included the advancement of twelve (12) test borings designated B-1 through B-12 to depths ranging from approximately 15 to 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 and/or as separate graphs in the **Exploration Results** section.

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 South of Burleson Rd near Norwood Ln in Austin, Texas. See **Site Location**
Existing Improvements	Undeveloped.

Item	Description
Current Ground Cover	Soils, grass, weeds, scattered to dense trees
Existing Topography	Based on available topographic information, the site slopes from ~EL 540 feet in the southwest downhill to ~EL 515 feet in the northeast
Geology	Based on our review of available geological information, the site maps as containing Lower Colorado River Terrace Deposits and/or High Terrace Deposits primarily overlying the Taylor Group clays/shale. With nearing proximity to Onion Creek, the Taylor Group has been weathered away to expose the Austin Group limestone beneath the terrace deposit soils.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	Email, project layout and boring location plan provided by Ms. Sarah Satterlee with Mobile Loaves and Fishes on February 11, 2021.
Project Description	The project includes the construction of multiple 1 and 2 level structures as well as internal driveways and parking areas, a detention pond, rain gardens, and other infrastructure as part of Phase 4 of the Community First development.
Building Construction	Assumed to be steel-frame or pre-engineered metal buildings.
Finished Floor Elevation	Unknown but assumed to be ≤ 2 to 5 feet from existing grades.
Maximum Loads	Assumed to be lightly loaded.
Grading/Slopes	Assumed to be ≤ 2 to 5 feet from existing grades. Slopes assumed to be no steeper than 3H:1V (Horizontal to Vertical).
Free-Standing Retaining Walls	Site retaining walls assumed to be of up to 5 feet.
Below-Grade Areas	Detention ponds up to 10 to 15 feet below existing grades.
Pavements	Assumed both rigid (concrete) and flexible (asphalt) pavement sections should be considered.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

Model Layer	Layer Name	General Description
1	**Fat Clay**	Dark brown to brown, white, dark reddish brown, Fat Clay (CH) with varying amounts of sand and calcareous deposits.
2	**Lean Clay, Clayey Gravel, Clayey Sand**	Dark brown to light brown, reddish brown to light reddish brown, white, yellowish brown, Lean Clay (CL), Clayey Gravel (GC) and Clayey Gravel (SC) with calcareous nodules.
3[1]	**Shaley Fat Clay, Highly Weathered Shale**	Brown, reddish brown, white and light brown, hard, Shaley Fat Clay (CH) and Highly Weathered Shale.
4	**Limestone (Austin Group)**	Light brown, yellowish brown, reddish brown, white, light tan, Limestone with clay seams and layers, highly fractured to moderately fractured.

1. Stratum 3 only observed in borings B-1 and B-2 below Stratum 1 Fat Clay

Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, nor for the short duration the borings could remain open. However, this does not necessarily mean no groundwater may be present at the site as groundwater conditions can (and likely will) vary between the time of the geotechnical investigation and the timeframe of construction activities.

Groundwater seepage is possible at this site, particularly in the form of seepage traveling along pervious seams/fissures in the soil (such as the Stratum 2 soils), along the soil/limestone interface and/or in fissures/fractures within the limestone. A relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Please contact us if this is desired. Groundwater conditions should be evaluated immediately prior to construction.

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

Based on our test borings on-site, highly to very highly expansive soils that exhibit potential for volumetric change during moisture variations are present at this site. These subgrade soils at the surface may experience expansion and contraction due to changes in moisture content. Based on existing grades, the soils at the site exhibit a variable Potential Vertical Rise (PVR) ranging from about 2 to 4¾ inches as estimated by the TxDOT Method TEX-124-E. Extensive subgrade preparation is necessary in order to reduce post-construction movements to about 1-inch as discussed in the **Floor Slabs Subgrade Preparation** section.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if 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, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We can discuss these additional measures if desired.

The near-surface high to very high plasticity fat clay (Stratum 1 soils) could become problematic with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses the support of the structures on a monolithic slab-on-grade foundation or a spread/strip footing foundation bearing into select fill. The **Floor Slabs Subgrade Preparation** section addresses slab support of the structures.

Lateral earth pressures are provided for on-site retaining walls (i.e., double-formed walls) in the **Lateral Earth Pressures** section.

Asphaltic concrete and/or portland cement concrete pavement systems are recommended for this site. The **Pavements** section addresses the design of pavement systems.

Slope inclinations and construction recommendations are provided for cut and fill slopes (embankments). The **Slope Stability** section addresses cut and fill slopes.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. 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 areas should be stripped of all vegetation, loose soils, fill soils, top soils, construction debris, and other unsuitable material currently present at the site. Roots of trees to be removed within construction areas, if any, should be grubbed to full depths, including the dry soil around the roots. Site stripping/excavation operations in cut areas could loosen limestone rocks/boulders (especially in the vicinity of borings B-4, B-6, B-7 and B-11) which should either be properly broken down for re-use as fill or removed from the site. We recommend that Terracon be retained to assist in evaluating exposed subgrades during earthwork so that unsuitable materials, if any, are removed at the time of construction.

Proof-Rolling

Once initial subgrade elevations have been achieved (i.e., after cuts but prior to fills), the exposed subgrade in all construction areas (except landscaping) should be carefully and thoroughly proof-rolled with a 20-ton pneumatic roller, fully-loaded dump truck, or similar equipment to detect weak zones in the subgrade. Proof-rolling is not necessary in intact Stratum 4 limestone subgrade areas, if any is exposed during earthwork. Weak areas detected during proof-rolling, zones containing debris or organics, and voids resulting from removal of tree roots, fill, boulders, etc. should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils (or flowable fill). Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Moisture-Conditioned Subgrade

After proof-rolling, and just prior to placement of fill, the exposed soil subgrade in all construction areas (except landscaping) should be evaluated for moisture and density through field density testing. If the moisture and/or density test results do not meet the moisture and density requirements below, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted as per the fill compaction requirements. Moisture-density testing is not required in cut areas that expose the Stratum 4 limestone subgrade.

Excavations

Excavation operations deeper than about 4 to 6 feet may penetrate into the Stratum 4 limestone. While the Stratum 1 and 2 soils should be relatively easy to excavate in comparison to the underlying limestone, there is a probability of encountering limestone cobbles, boulders, seams, and layers within these soils. Our past experience with the Stratum 4 limestone, along with the data obtained during our field and laboratory programs (average compressive strength of 3,100 psi), indicates that the Stratum 4 limestone may require sawcutting, jackhammering, hoe-ramming, milling, or similar techniques to excavate.

Please note that Stratum 4 limestone was encountered at varying depths ranging from 4.5 to 18.5 feet below existing grades across the site (with 3 borings, B-1, B-2 and B-10, not encountering limestone to their termination depths of 15 to 20 feet), thus, the weathering profile of limestone can be unpredictable. In addition, the Stratum 2 soils appear to be the residual and/or severely weathered portions of the Austin limestone. These soils likely contain limestone gravel, cobbles and boulders. The Contractor should be prepared to encounter and properly excavate near-surface limestone anywhere on this site.

Our comments on excavation are based on our experience with the rock formation. Rock excavation depends on not only the rock hardness, weathering and fracture frequency, but also the contractor’s equipment, capabilities, and experience. Therefore, it should be the contractor’s responsibility to determine the most effective methods for excavation. The above comments are intended for information purposes for the design team only and may be used to review the contractor’s proposed excavation methods.

Temporary Groundwater Control

Although not encountered during our drilling operations, groundwater seepage might possibly be encountered during construction, especially after periods of wet weather and in excavations which penetrate the Stratum 2 soils and Stratum 4 limestone. Temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of drain laterals within the excavation could be required to remediate isolated water pockets.

Fill Material Types

Fill required to achieve design grade should be classified as select/structural fill and general fill. Select/structural fill is material used below, or within 5 feet of structures. General fill is material used to achieve grade in paving, non-reinforced earthen slopes, landscape, or other general areas (non-structural areas). Earthen materials used for select fill and general fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Specifications
Imported Select/Structural Fill [2,3,4]	CL, SC, and/or GC	■ TxDOT Item 247, Type A, Grade 3, OR ■ Percent Retained on No. 4 Sieve ≤ 40 percent with 7≤PI≤20 and rocks ≤ 4 inches in maximum dimensions, OR ■ Crushed concrete (TxDOT Item 247, Type D, Grade 3 or better)
Paving Fill and General Fill [5]	CH, CL, SC and/or GC	■ On-Site Soils: Rocks ≤ 4 inches in maximum dimension ■ Imported Soils: PI ≤ 50; Rocks ≤ 4 inches in maximum dimension

1. Structural and general fill should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. As an alternative to the Acceptable Specifications above, a low-plasticity granular material which does not meet these specifications may be used only if approved by Terracon.
3. Based on the laboratory testing performed during this exploration, the excavated Stratum 1 soils are not suitable for re-use as select fill. We do not recommend these soils be considered for re-use as select fill when planning budgets.
4. The excavated Stratum 2 soils and Stratum 4 limestone material may be acceptable for re-use as select fill provided that it is processed such that it meets one of the Acceptable Specifications above for Imported Select/Structural Fill. Please note that removal of higher plasticity soils/layers will be necessary to maintain plasticity indices of the material within acceptable range. In some situations, the difference between more highly plastic clay, lower plasticity silty soils, and appropriate material may not be readily distinguishable without the performance of appropriate lab testing. After initial processing of the fill material, samples should be submitted to Terracon for evaluation of proper gradation, plasticity index, and maximum rock size prior to re-use as select fill. We recommend that periodic testing be performed throughout the material excavation phase to check for conformance with the select fill requirements given above.

   It has been our experience that proper processing of excavated limestone often involves such processes as breaking down of larger rock with equipment, screening, removal of more highly plastic clay layers, etc. The Contractor's proposed methods of processing these materials should be reviewed prior to initiation of construction to check that these methods will produce an acceptable select fill material. The relative ease of mining and segregating the materials is unknown at this time.
5. Excavated on-site soils, if free of organics, debris, and rocks no larger than 4 inches may be considered for re-use as fill in pavement, landscape, or other general areas. Please note that the on-site Stratum 1 soils exhibit high to very high shrink/swell potential. For economic reasons, expansive soils are often used in pavement and/or flatwork areas. The owner should be aware that the risk exists for future movements of the subgrade soils which may result in movement and/or cracking of pavement and/or flatwork. If paving fill is imported, the PI should not exceed 50.

Fill Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows.

Material Type		Minimum Compaction Requirement (%)[1]	Moisture Content Range (%)	Maximum Loose Lift Thickness (in)[2]
Select/Structural Fill		95[3]	-3 to +3	8 inches
Moisture Conditioned Building Subgrade and Fill	**PI ≤ 25**	95	-3 to +3	
	PI > 25	92	+2 to +6	
Paving Fill, Paving Subgrade and General Fill	**PI ≤ 25**	95	-3 to +3	
	PI > 25	95	Optimum to +4	
Crushed Limestone Base (beneath pavements)		100[4]	-3 to +3	

1. Per the Standard Proctor Test (ASTM D 698).
2. Fill lift thickness must be reduced (typically 4 to 6 inches) if light compaction equipment is used, as is customary within a few feet of retaining walls and utility trenches.
3. **For fills greater than 5 feet in depth, if any, the compaction should be increased to at least 100 percent of the ASTM D 698 maximum dry unit weight.**
4. Per TEX-113-E.

Utility Trench Backfill

Leaking pipes underneath and/or near the foundations will increase the moisture content of the surrounding subgrade soils and will likely result in a PVR greater than discussed for these soils. 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. We recommend constructing an effective clay or flowable fill "trench plug" that extends at least 2 feet out from the face of the building exterior. The clay fill/flowable fill should be placed to completely surround the utility line and it should fill the utility trench completely in width and height, with the exception of topsoil at the surface. If clay plug is used, it should be fat clay with a minimum PI of 30 and should be compacted to comply with the water content and compaction recommendations for moisture conditioned building subgrade fill as specified in **Fill Compaction Requirements**. If flowable fill is used, it should be in accordance with TxDOT Item 401 or COA Item 402S.

Grading and Drainage

The performance of the proposed structures will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the structures does not occur. Accumulation of water near the structures may cause significant moisture variations in soils adjacent to the structures, thus increasing the potential for structural distress.

Effective drainage away from the structures must be provided during construction and maintained through the life of the proposed project. Infiltration of water into excavations should be prevented during construction. It is important that foundation soils are not allowed to become wetted. All grades must provide effective drainage away from the structures during and after construction. The most effective way to achieve this would be to provide concrete aprons (i.e., concrete sidewalks/pavements directly abutting the building) around the exterior perimeter of the structures for at least 6 feet (1 foot wider than the select fill overbuild). The concrete should be sloped to provide drainage away from the structures and all joints should be sealed, particularly those directly abutting the structures. In lieu of providing concrete aprons and if sloping unpaved ground is planned around the structures, then the select fill overbuild (recommended 5 feet beyond the building limits) should be excavated to a depth of at least 2 feet below final grades, removed and replaced with a minimum of 2 feet of moisture conditioned and compacted on-site fat clay soils. The fat clay soils should be compacted and moisture conditioned as per the **Fill Compaction Requirements** section of this report. This procedure is recommended to reduce the possibility of surface runoff infiltrating into the more pervious select fill soils and ponding below the proposed building. We would be glad to discuss other measures (e.g. horizontal or vertical barriers) to reduce moisture infiltration in unpaved areas, if desired. Exposed (unpaved) ground should be sloped at a minimum of 5 percent away from the structures for at least 10 feet beyond the perimeter of the structures. Locally, flatter grades may be necessary to transition ADA access requirement for flatwork.

Roof runoff and surface drainage should be collected and discharged away from the structures to prevent wetting of the foundation soils. Roof gutters should be installed and connected to downspouts and pipes directing roof runoff at least 10 feet away from the structures, or discharged on to positively sloped pavements.

Sprinkler mains and spray heads should preferably be located at least 5 feet away from the structures such that they cannot become a potential source of water directly adjacent to the structures. In addition, the owner and/or builder should be made aware that placing large bushes and trees adjacent to the structures may cause significant moisture variations in the soils underlying the structures. In general, tree roots can adversely influence the subsurface soil moisture content to a distance of 1 to 1½ times the mature height of the tree and beyond the tree canopy. Watering of vegetation should be performed in a timely and controlled manner and prolonged watering should be avoided. Landscaped irrigation adjacent to the foundation units should be minimized or eliminated. Special care should be taken such that underground utilities do not develop leaks with time.

After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structures, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration. Water permitted to pond next to the structures can result in greater soil movements than those discussed in this report. Estimated movements described in this report are based on effective drainage for the life of the structures and cannot be relied upon if effective drainage is not maintained.

Interceptor Drains

The geologic/topographic setting of this site creates a concern for possible infiltration of groundwater seepage into the proposed improvements, particularly in cut areas that expose the Stratum 4 limestone. Installation of perimeter interceptor trenches/drains (French drains) should be installed at the base of retaining walls (and where cuts expose limestone adjacent to the building) to intercept and remove groundwater before it has an opportunity to infiltrate into the adjacent improvements. Other groundwater encountered at the site during construction may possibly be diverted with interceptor trenches/drains along the uphill sides of the proposed improvements. In areas where groundwater outcrops are observed before or during construction, installation of such drains is highly recommended. If no such seepage is observed, drain installations could be considered non-mandatory. However, in situations where groundwater seepage is observed after construction is completed, such drain installations will likely be costlier as well as more intrusive to the constructed facilities.

In general, drains should extend at least 18 inches below the adjacent lowest grades and at least 18 inches below the building slab that is on the downhill side of the drain. The drain system should be designed to gravity flow and outlet downhill and away from the adjacent improvements. The drains should consist of a clean, washed, gravel section (at least 18 inches wide) meeting the gradation requirements of ASTM C 33, Grade 57, continuously wrapped in filter fabric (Mirafi 140N or equivalent). Perforated collector pipes with a minimum diameter of 4 inches should be provided for all sections of the wall drains. For drains installed along below-grade walls the granular drainage backfill should extend over the entire height and length of the wall, not just at the base of the wall, with the exception of a clay soil cap in the upper 18 inches below final grades. Terracon would be pleased to review the actual location, depth, and cross-sections of the drains with the other Design Team members prior to construction.

Earthwork Construction Considerations

Based on our test borings, highly to very highly expansive soils that exhibit potential for volumetric change during moisture variations are present at this site. These subgrade soils at the surface may experience expansion and contraction due to changes in moisture content. Based on existing grades, the soils at the site exhibit a variable Potential Vertical Rise (PVR) ranging from about 2 to 4¾ inches as estimated by the TxDOT Method TEX-124-E.

Shallow excavations, for the proposed structures and utilities, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided as much as possible. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be documented under the direction of the Geotechnical Engineer. This 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 and density/moisture testing of subgrade and fills. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to evaluate the conditions.

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. Fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet per lift of compacted fill in the building areas (with a minimum of 3 tests per lift) and 10,000 square feet per lift in pavement areas. A minimum of one density and water content test should be conducted for every 100 linear feet of compacted utility trench backfill in paving areas.

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

If the site has been prepared in accordance with the requirements noted in **Earthwork** and **Floor Slabs Subgrade Preparation**, the following design parameters are applicable for shallow foundations.

Design Parameters – Monolithic Slab-On-Grade

A monolithic slab-on-grade foundation system (either conventionally reinforced or post-tensioned) would be appropriate to support the proposed structures provided subgrade preparation as described in **Floor Slabs Subgrade Preparation** is followed. The slab foundation design parameters presented in the tables below are based on the criteria published by the Building Research Advisory Board (BRAB), the Prestressed Concrete Institute (PCI), and the Wire Reinforcement 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 BRAB, PCI, and WRI, and PTI design manuals.

Grade beams should bear on compacted select fill but not a combination of soil and Stratum 4 limestone materials within the buildings. If grade beams are to bear on soils and the Stratum 4 limestone is encountered during site preparation, the Stratum 4 limestone should be over-excavated as necessary to provide at least 12 inches of select fill under all grade beams.

Conventional Slab and Beam System Parameters

Description	Design Parameter
Minimum Embedment of Grade Beams below Final Grade [1]	24 inches
Bearing Stratum	Select Fill
Bearing Pressures (allowable) [2]	Net Dead plus Sustained Live Load – 1,700 psf Net Total Load – 2,500 psf
Subgrade Modulus (k) [3]	100 pci
Approximate Potential Vertical Rise (PVR)	About 1-inch [4,5]

1. Embedment is to reduce surface water migration below the foundation elements and to develop proper end bearing and is not based on structural considerations. The grade beam width and depth should be properly evaluated by the structural engineer. Grade beams may be thickened and widened at interior column locations to serve as spread footings at these concentrated load areas.
2. Grade beams should bear on compacted select fill.
3. Several design methods use the modulus of subgrade reaction, k, to account for soil properties in design of flat, floor slabs. The modulus of subgrade reaction is a spring constant that depends on the kind of soil, the degree of compaction, and the moisture content. Based on our recommendations provided in **Floor Slabs Subgrade Preparation**, the above indicated subgrade modulus can be used for design of a flat, grade-supported floor slab.
4. Differential movements may result from variances in subsurface conditions, loading conditions and construction procedures. We recommend that measures be taken whenever practical to increase the tolerance of the building to post-construction foundation movements. An example of such measures would be to provide

frequent control joints for exterior masonry veneers and interior sheetrock walls (particularly near doors and windows) to control cracking across such walls and concentrate movement along the joints.

5. The building subgrade should be properly prepared as described in **Floor Slabs Subgrade Preparation**.

BRAB/WRI/PCI Parameters			
Description	**Design Parameter**		
Design Plasticity Index (PI) [1]	BRAB/WRI/PCI	Prepared Subgrade [2]	26
Climatic Rating (C_w)			17
Unconfined Compressive Strength			1.0 tsf
Soil Support Index (C) for BRAB		Prepared Subgrade [2]	0.88

1. The BRAB effective PI is equal to the near surface PI if that PI is greater than all of the PI values in the upper 15 feet. If the near-surface PI is not highest (i.e., after the building pad is prepared), then the effective PI is the weighted average of the upper 15 feet. The WRI/PCI effective PI is always the weighted average of the PI values in the upper 15 feet.
2. The building subgrade should be properly prepared as described in **Floor Slabs Subgrade Preparation**.

Post Tensioning Institute (PTI) Parameters [1]		
Description		Design Parameter
Depth of Seasonal Moisture Change [2]		10 to 15 feet (or shallower at top of limestone)
Plasticity Index [3]		Select Fill – 15 Stratum 1 Soils – 36 to 64 Stratum 2 Soils – 11 to 48
Percent Finer than 2 Microns [3]		Select Fill – 20 Stratum 1 Soils – 64 to 90 Stratum 2 Soils – 23 to 71
Soil Fabric Factor		1.0
Approximate Thornthwaite Moisture Index		-12
Estimated Constant Soil Suction		3.5 pF
Range of Soil Suction		3.0 to 4.5 pF
Edge Moisture Variation Distance, e_m [4,5]	**Center Lift**	9.0 feet [6]
	Edge Lift	4.8 feet [6]
Differential Soil Movement, y_m [5]	**Center Lift**	0.7 inch [6]
	Edge Lift	1.0 inch [6]

1. Based on our analysis of the field and laboratory data, design parameters were computed using the Addendum to the 2004 Post-Tensioning Institute (PTI) method[1] for slab-on-grade design and the subsequent Errata to the Addendum approved by the PTI Slab-on-Grade Committee on February 7, 2008.
2. The moisture beneath a shallow foundation will change in response to wetting and drying conditions around the foundation perimeter. The moisture condition has a significant effect on slab behavior and is highly variable with time, changing seasonally, with annual climate conditions, drainage patterns, ground cover, and vegetation (trees and shrubs).
3. The plasticity index and the clay mineral percentage are values of the soil that can be estimated by laboratory tests, and, although variable from location to location, remain relatively constant with time.
4. The maximum moisture variation distance is termed the edge moisture variation distance, e_m, and is an important factor governing the design of post-tensioned floor slabs. The e_m is related to percent fine clay and climatic conditions as well as other parameters, such as soil fabric factor and unsaturated diffusion coefficient.
5. The differential movements, y_m, and edge moisture variation distances, e_m, were calculated by modeling soil profiles using the commercial software program VOLFLO as recommended by the PTI manual.
6. Values may be used provided subgrade preparation is implemented as described in **Floor Slabs Subgrade Preparation**.

Design Parameters – Footings

As an alternative to a monolithic slab-on-grade system, principal column and wall loads for the proposed structures may also be supported on isolated (spread) and/or continuous (strip) footings, with independent floor slabs. Design parameters for spread/strip footing foundations are provided below.

Footings should bear on compacted select fill but not a combination of soil and Stratum 4 limestone materials within the buildings. If footings are to bear on soils and the Stratum 4 limestone is encountered during site preparation, the Stratum 4 limestone should be over-excavated as necessary to provide at least 12 inches of select fill under all footings.

Description	Design Parameters	
Bearing Stratum	Select Fill	Stratum 4 Limestone
Minimum Embedment below Final Grade [1]	18 inches	-
Minimum Embedment into Bearing Stratum	-	6 inches
Minimum Footing Dimensions	Spread – 3 feet by 3 feet square Strip – 18 inches wide	
Allowable Bearing Pressure	2,500 psf	5,000 psf
Approximate Total Settlement [2]	≤1-inch	≤¾-inch

1. Post-Tensioning Institute, "Addendum No. 1 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2007.

Description	Design Parameters	
Estimated Differential Settlement [3]	Approximately ½ to ¾ of total settlement	
Nominal (unfactored) Passive Resistance [4,6]	360 psf per foot of depth	750 psf per foot of depth
Coefficient of Sliding Friction [5]	0.35	0.6
Nominal (unfactored) Uplift Resistance [6]	Foundation Weight (150 pcf) & Soil Weight (115 pcf)	

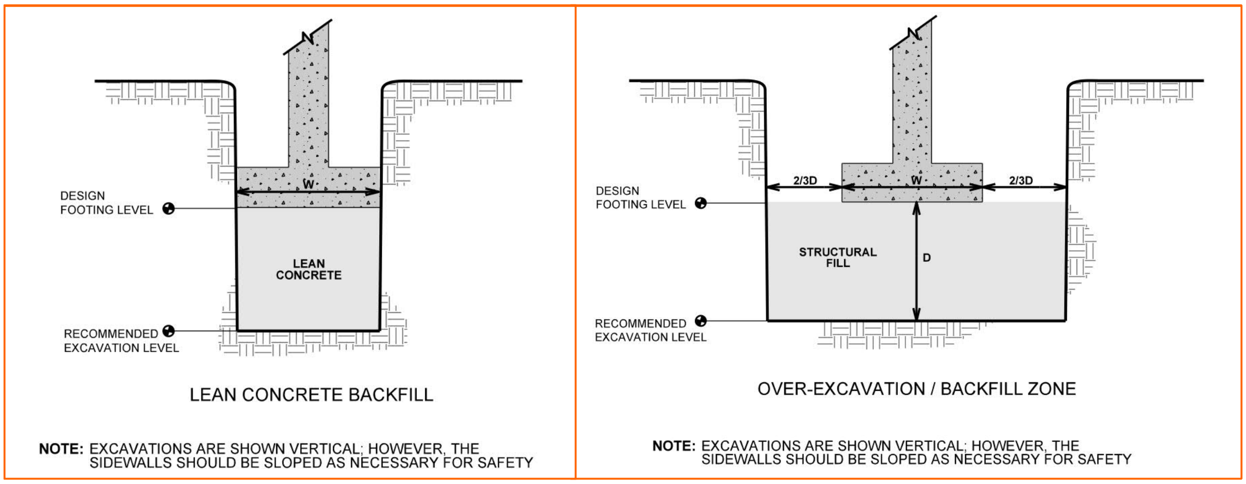
1. To bear within select fill or Stratum 4 limestone. Unsuitable or soft soils must be over-excavated and replaced per the recommendations presented in **Earthwork** and the building areas should be prepared as per **Floor Slabs Subgrade Preparation**.
2. The estimated post-construction settlement of the shallow footings is assuming proper construction practices are followed.
3. Differential settlements may result from variances in subsurface conditions, loading conditions and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.
4. Passive resistance should be neglected in the first 12 inches below finished grades. Care should be taken to avoid disturbance of the footing bearing area since loose material could increase settlement and decrease resistance to lateral loading. If the footing is formed during construction, the open space between the footings and the in-situ soils should be backfilled with concrete.
5. Lateral loads transmitted to the footings will be resisted by a combination of soil-concrete friction on the base of the footings and passive pressure on the side of the footings. We recommend that the allowable frictional resistance be limited to 500 psf in select fill soils and 1,000 psf in Stratum 4 limestone.
6. The nominal values should be reduced by an appropriate factor of safety to compute allowable values.

Foundation Construction Considerations

Footings/Grade beams should be neat excavated, if possible. If neat excavation is not possible, the foundation should be properly formed. If a toothed bucket is used, excavation with this bucket should be stopped approximately 6 inches above final grade of the footings and the footing excavation be completed with a smooth-mouthed bucket or by hand labor. In limestone subgrade areas, rock-trenching or saw-cutting equipment will likely be required. Debris in the bottom of the excavation should be removed prior to steel reinforcement placement. The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. If surface runoff water or groundwater seepage in excess of ½-inch accumulates at the bottom of the foundation excavation, it should be collected, removed, and not allowed to adversely affect the quality of the bearing surface.

If utilized, the post-tensioned slab-on-grade construction technique should be carefully observed by qualified personnel. The sophistication of this construction procedure requires careful attention to details such as concrete integrity and anchorages, along with tendon spacing, support, covering, and stressing. Poor construction could result in a non-functional slab foundation system.

If unsuitable bearing soils are encountered at the base of the planned footing excavation (such as low strength or disturbed soils), the footing excavations should be deepened to expose suitable bearing materials. The footings could then bear directly on these soils at the lower level, on lean concrete backfill placed in the excavations, or on compacted structural fill backfilled in the excavations and compacted as in **Earthwork**. This is illustrated in the figure below.



Concrete should be placed as soon as possible after excavation to reduce bearing soil disturbance. Soils at bearing level that become disturbed or saturated should be removed prior to placing reinforcing steel and concrete. Adequate water control/dewatering system will aid in minimizing the need for over-excavation and backfill of any soils disturbed by prolonged exposure. It is important that the foundation subgrade not be disturbed by construction activities (e.g., setting forms and placing reinforcing steel). If disturbance occurs, we recommend that the disturbed soils be removed and that the foundation subgrade be protected with the placement of a lean concrete "mud mat".

Foundation Construction Observation

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation construction be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation observation to be incorporated in the overall quality assurance program.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil/bedrock properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is C**. Subsurface explorations at this site were extended to a maximum depth of 15 to 20 feet feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS SUBGRADE PREPARATION

The subgrade soils are comprised of moderate to high plasticity clays exhibiting the potential to shrink/swell with changes in water content. However, construction of the floor slabs and revising site drainage creates the potential for gradual increased water contents within the soils. Increases in water content will/may cause the soils to swell and potentially damage the floor slabs.

Due to the potential for significant moisture fluctuations of subgrade material beneath the select fill pad, the exposed final subgrade should be prepared as discussed in the first three sub-sections of **Earthwork**.

The post-construction performance of the foundations will likely be influenced more by post-construction volumetric changes of the subgrade due to in-situ moisture variations than upon settlement due to foundation loads. Settlement response of select fill supported slabs will be influenced as much by the quality of construction and fill placements as 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.

Floor Slab Subgrade Preparation

Information about proposed grades and FFEs for the proposed buildings have not been provided to Terracon at this time, However, we assume that the planned FFE is within two feet of existing grades. If these assumptions are incorrect, Terracon should be notified to review and modify or verify recommendations in writing. Based on the variable subsurface conditions present at the site, we have provided subgrade preparation recommendations for two areas of the project site. Please note that our recommendations herein are based on borings located within the building areas as per Site Plan dated February 11, 2021.

Buildings located in the vicinity of borings B-1 and B-2 and B-3

For Building areas located within the red-shaded area indicated on the **Exploration Plan**, we recommend that Stratum 1 soils (primarily dark brown to brown) should be excavated to a depth of at least 8 feet below existing grades (ground surface at the time of our field program) and removed from the building areas to reduce the shrink/swell potential of the subgrade soils. The removed soils should be replaced with properly compacted select fill (7≤PI≤20) within all the building areas up to final grades

As an alternative to reduce the required select fill thickness by 1 foot, the underlying clays need to be excavated, moisture conditioned, and compacted to a depth of at least 2 feet below the select fill. Then, the select fill thickness may be reduced to 7 feet (i.e., 7 feet of select fill over 2 feet of moisture conditioned clay, for a total 9-foot thick building pad).

As a second alternative to reduce the required select fill thickness by 2 feet, the underlying clays need to be excavated, moisture conditioned, and compacted to a depth of at least 4 feet below the select fill. Then, the select fill thickness may be reduced to 6 feet (i.e., 6 feet of select fill over 4 feet of moisture conditioned clay, for a total 10-foot thick building pad).

A select fill pad combined with a moisture conditioned clay subgrade may be implemented in order to reduce post-construction shrink/swell movements to approximately 1-inch. The table below provides options for various preparation options depending on the amount of select fill desired below the bottom of the floor slab.

Buildings located in the vicinity of borings B-4 to B-12

For Building areas located south of the red-shaded area indicated on the **Exploration Plan**, we recommend that Stratum 1 soils (primarily dark brown to brown) should be excavated to a depth of at least 5 feet below existing grades (ground surface at the time of our field program) and removed from the building areas to reduce the shrink/swell potential of the subgrade soils. The excavation may be shallowed and select fill reduced (to no less than 2 feet) once the low plasticity Stratum 2 soils or Stratum 4 weathered limestone are exposed. The removed soils should be replaced with properly compacted select fill (7≤PI≤20) within all the building areas up to final grades.

General Comments for Pad Preparation

The above building subgrade preparation recommendations should be applied to an area extending a minimum of 5 feet outside of building areas including attached walkways and any other architectural members. We suggest the use of crushed limestone base in the upper 6 inches of the select fill pad from a standpoint of construction access during wet weather, as well as from a standpoint of floor slab support. A modulus of subgrade reaction of 100 pci may be used for slabs if the recommendations provided above are followed. With the subgrade preparation recommendations above, post-construction floor slab movements should be about 1 inch, as estimated by the Texas Department of Transportation (TxDOT) Method TEX-124-E.

For any flatwork (sidewalk, ramps, etc.) outside of the building areas which will be sensitive to movement, subgrade preparation as discussed above should be considered to reduce differential movements between the flatwork and the adjacent building. If subgrade preparation as given above for building areas is not implemented in the exterior flatwork areas, those areas may be susceptible to post-construction movements in excess of that given above.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

The potential movement values indicated are based upon moisture variations in the subgrade due to circumstances such as moisture increases due to rainfall and loss of evapotranspiration. In circumstances where significant water infiltration beneath the floor slab occurs (such as a leaking utility line or water seepage from outside the buildings resulting from poor drainage), movements in isolated floor slab areas could potentially be in excess of those indicated in this report.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means. Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

Floor Slab Construction Considerations

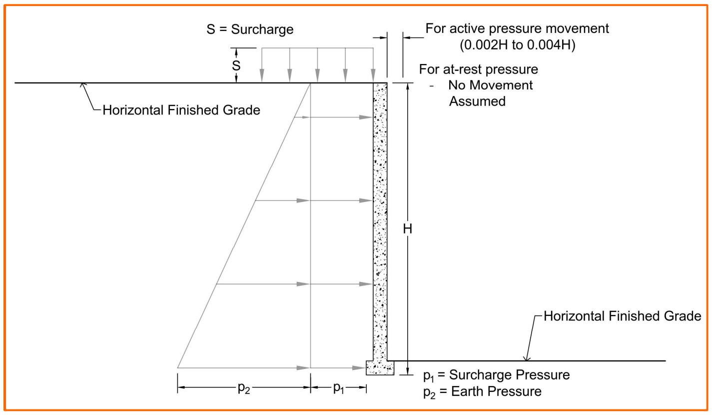
Design recommendations for floor slabs assume the requirements in **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structures and positive drainage of the subgrade and select fill pad beneath the floor slabs.

Finished subgrade within and for at least 10 feet beyond the floor slabs should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

LATERAL EARTH PRESSURES

Design Parameters

Site retaining walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated). The recommendations in this section apply to those walls (i.e., double-formed walls) which are installed in open cut or embankment fill areas such that the backfill extends out from the base at an angle of at least 45 degrees from vertical for the entire height and length of the wall.



Lateral Earth Pressure Design Parameters				
Backfill Type	Estimated Total Unit Weight, pcf[1]	Lateral Earth Pressure Coefficients[2]		
		At Rest, K_o	Active, K_A	Passive, K_P
Crushed Limestone	135	0.45	0.3	3.5
Clean Sand	120	0.5	0.35	3.0
Clean Gravel	120	0.45	0.3	3.5
Granular Select Fill	130	0.47	0.32	3.2

1. Compaction should be maintained between 95 and 100 percent of Standard Proctor (ASTM D 698) maximum dry density. Overcompaction can produce lateral earth pressure coefficients in excess of those provided.
2. Coefficients represent nominal (unfactored) values. Appropriate safety factors should be applied.

The above values do not include a hydrostatic or ground-level surcharge component. To prevent hydrostatic pressure build-up, retaining walls should incorporate functional drainage (via free-draining aggregate or manufactured drainage mats) within the backfill zone. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a uniform horizontal pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load, applied to the full height of the wall.

All retaining walls should be checked against failure due to overturning, sliding and overall slope stability. Such an analysis can only be performed once the dimensions of the wall and cut/fill scenarios are known. For retaining wall bearing capacity design, we recommend the following parameters.

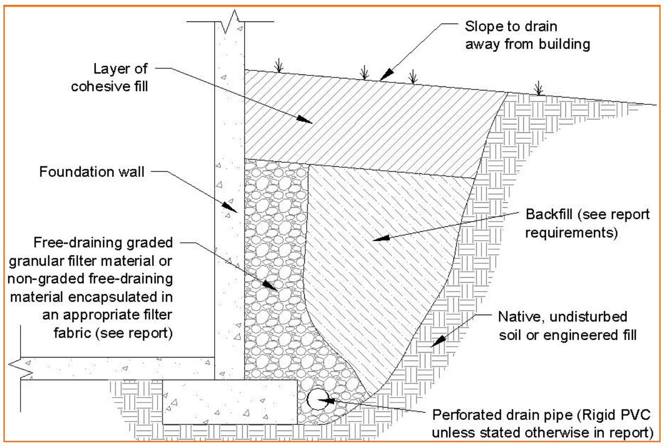
Bearing Material	Coefficient of Sliding Resistance	Maximum Allowable Sliding Resistance, psf	Maximum Footing Bearing Capacity, psf
Stratum 1 Soils [1,2]	0.3	300	2,000
Select Fill or Stratum 2 Soils[1,2]	0.35	500	2,500
Stratum 4 Limestone (on top, without embedment)	0.6	1,000	4,000
Stratum 4 Limestone (minimum 12-inch embedment)	0.7	1,500	6,000

1. There exists a higher movement potential for any retaining walls bearing on the Stratum 1 soils (up to 4¾ inches). If lower movement potential is desired, please contact us so that we may provide additional recommendations.
2. Frequent joints should be provided throughout the length of the retaining wall to reduce cracking due to differential movements caused by the shrink/swell movement of the fat clay subgrade.
3. If the subgrade is prepared as recommended in **Floor Slabs Subgrade Preparation**, the values for Select Fill may be considered.

We recommend that a “buffer zone” of at least 5 feet wide be applied between pavement areas and retaining walls (with a minimum height of 4 feet or more). This buffer zone should be increased to 10 feet for building areas. These recommended buffer zones are to reduce the potential of distress from any long-term (“creep”) movements of the wall and backfill. Pedestrian sidewalks may be exempted from the above criteria, however some distress could still be observed in the sidewalks due to movements of the retaining walls and backfill.

Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extending below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around an exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 10 percent passing the No. 8 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

Pavement designs are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. Support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as the Stratum 1 soils and some of the Stratum 2 soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is therefore important to minimize moisture changes in the subgrade to reduce shrink/swell movements. Proper site perimeter drainage should be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized.

Lime treatment of the Stratum 1 fat clay subgrade is suggested to enhance the workability and support characteristics of the subgrade as well as to provide a barrier to reduce moisture infiltration in the underlying clay subgrade. The lime treatment also helps to reduce the shrink/swell potential of the lime-treated layer. We should note that if lime treatment is planned, we recommend that the subgrade soils be investigated for the presence of sulfates during construction. Excessive concentrations of sulfates in the soils can result in poor performance of lime-treated subgrade. Based on numerous research studies performed by education institutions, regulatory agencies, and both public and private entities, soils that contain significant amounts of soluble sulfates are not optimal candidates for lime treatment and may result in excessive heave and subsequent distress to the pavements. Soluble sulfate levels of up to 3,000 ppm or less are generally considered to be acceptable for lime treatment. Soluble sulfate levels between 3,000 ppm and 10,000 ppm in clay soils are generally considered to be moderate to high and pose a greater risk to successful traditional lime treatment.

Although lime treatment of the subgrade will likely reduce differential movement and heave in the new pavement system, some differential movement will likely occur. Cracking of the concrete pavement due to differential movements should be expected.

Pavement Design Parameters

Design of Asphaltic Concrete (HMAC) pavements are based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-01; Guide for Design and Construction of Concrete Parking Lots.

Detailed traffic loads and frequencies were not available; however, we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with emergency vehicles, occasional garbage trucks, school buses, service trucks, and delivery trucks in driveways. If heavier traffic loading is expected or other traffic information is available, Terracon should be provided with the information and allowed to review the pavement sections provided herein. Tabulated below are the assumed traffic frequencies and loads used to design pavement sections for this project.

Pavement Area	Traffic Design Index	Description
Parking Areas (Passenger Vehicles Only)	DI-1	Light traffic – (ESALs [1]<5) Passenger cars and pickup trucks, no regular use by heavily loaded two axle trucks or lightly loaded larger vehicles.
Secondary Driveways (non-bus or truck delivery/loading/unloading areas)	DI-2 [2]	Light to medium traffic – (5≤ESALs≤20) Passenger cars and pickup trucks with no more than 50 heavily loaded two-axle trucks or lightly loaded three axle trucks per day. No regular use by heavily loaded trucks with three or more axles.
Primary Driveways, Bus, Loading/Unloading Areas and Dumpster Enclosures	DI-3	Medium traffic – (20<ESALs≤75) No more than 300 heavily loaded two axle trucks or lightly loaded three axle trucks and no more than 30 heavily loaded three axle trucks per day.

1. 18-kip equivalent single axle load applications.
2. For Fire Lanes to withstand the occasional HS-20 loading of 32,000 pounds per axle and up to 90,000-pound gross truck weight, use DI-2 pavements or thicker.

Pavement Section Thicknesses

The following tables provides options for HMAC and PCC pavement sections.

Asphaltic Concrete Design				
Layer	Thickness (inches)			
	DI-1		DI-2	
	Option 1A	Option 1B	Option 2A	Option 2B
Asphaltic Concrete (HMAC)	2.0	2.0	2.5	2.5
Crushed Limestone Base[1]	9.0	12.0	12.0	15.0
Lime Treated Subgrade	8.0	-	8.0	-
Moisture Conditioned Subgrade [2]	-	6.0	-	6.0

1. If the on-site soils are completely removed to expose the Stratum 4 limestone, the crushed limestone base thickness may be reduced by up to 3 inches, but in no case less than 6 inches thick.
2. Moisture-density testing is not necessary in areas that expose the Stratum 4 limestone subgrade, if any.

Portland Cement Concrete Design			
Layer	**Thickness (inches)**		
	DI-1	**DI-2**	**DI-3**
Reinforced Concrete (PCC) [1]	5	6 [2,3]	7 [2,3]
Moisture Conditioned Subgrade [4]	6	6	6

1. A thin course of crushed limestone base or clean sand at least 1 to 2 inches thick is recommended under the reinforced concrete in exposed Stratum 4 limestone subgrade areas, if any.
2. If the on-site soils are completely removed to expose the Stratum 4 limestone, the DI-2 and DI-3 concrete thicknesses may be reduced by ½ inch.
3. For the DI-2 and DI-3 traffic loading conditions, the reinforced concrete thickness may be reduced by ½ inch if the clay subgrade is lime treated to a depth of at least 8 inches instead of moisture conditioned.
4. Moisture-density testing is not necessary in areas that expose the Stratum 4 limestone subgrade, if any.

Rigid PCC pavements will perform better than HMAC pavements in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavements will perform better in areas subject to large or sustained loads, such as loading docks, dumpster enclosures.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. As an option, thicker sections could be constructed to decrease future maintenance.

Pavement Materials

Presented below are our recommended material requirements for the various pavement sections.

Item	Value
Hot Mix Asphaltic Concrete (HMAC) [1]	Plant mixed, hot laid Type D (Fine-Grade Surface Course) meeting the specifications in TxDOT Item 340 or COA Item 340.
Reinforced Portland Cement Concrete (PCC)	28-day flexural strength (third-point loading) ≥ 500 psi, or 28-day compressive strength ≥ 3,500 psi
Crushed Limestone Base [2]	TxDOT Item 247, Type A, Grade 1-2 or COA Item 210 compacted as outlined in **Earthwork**.
Lime Treated Subgrade [3,4]	If soil subgrade consists of high PI (≥30) with ≤ 15% gravel, lime treatment as per TxDOT Item 260 is applicable either through dry placement or slurry placement.
Moisture Conditioned Subgrade [5]	As outlined in **Earthwork**.

1. For acceptance and payment evaluation purposes, we recommend use of provisions in COA Item 340.
2. Each lift of base should be thoroughly proof-rolled just prior to placement of subsequent lifts and/or asphalt. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the base material should extend at least 18 inches behind curbs.
3. We anticipate that approximately 6 to 10 percent hydrated lime will be required to treat the subgrade soils. We suggest 8% lime be used for bidding purposes with add/deduct line items for 1 to 2% lime above or below the base bid items. Prior to the application of lime to the subgrade, the optimum percentage of lime to be added should be determined based on Plasticity Index (TEX-112-E) and/or pH (ASTM D 6276) laboratory tests conducted on mixtures of the subgrade soils with lime. Subgrade soil samples should be obtained from the pavement areas at the proposed final subgrade elevation. Please note that these tests require up to 5 business days to complete.
4. The lime should initially be blended with a mixing device such as a Pulvermixer, sufficient water added, and allowed to cure for at least 48 hours. After curing, mixing should continue until gradation requirements of TxDOT Item 260.4 are achieved. The mixture should then be moisture adjusted and compacted as outlined in Earthwork. Preparation of the lime-treated subgrade should extend at least 18 inches behind curbs.
5. Subgrade should not dry out or become saturated prior to pavement construction. The pavement subgrade should be thoroughly proof-rolled as outlined in **Earthwork**. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the moisture conditioned subgrade should extend at least 18 inches behind curbs.

Presented below are our recommendations for the construction of the reinforced concrete pavements.

Item	Value
Reinforcing Steel	DI-1 & DI-2: #3 bars spaced at 18 inches on center in both directions. DI-3: #4 bars spaced at 18 inches (or #3 bars spaced at 12 inches) on center in both directions. Rebar should be placed at midpoint of concrete section and supported on chairs prior to concrete placement.
Control (i.e., Contraction) Joint Spacing	In accordance with ACI 330R, control joints should be spaced no greater than 12.5 feet for 5-inch thick concrete and 15 feet for 6-inch thick or greater concrete. If sawcut, control joints should be cut within 6 to 12 hours of concrete placement. Sawcut joint should be at least ¼ of the slab thickness.
Expansion (i.e., Isolation) Joint Spacing	ACI 330R indicates that regularly spaced expansion joints may be deleted from concrete pavements, except adjacent to structures, manholes, inlets, light poles, etc. Therefore, the installation of expansion joints is optional and should be evaluated by the design/construction team. Expansion joints, if not sealed and maintained can allow infiltration of surface water into the subgrade.

Item	Value
Dowels at Expansion Joints	¾-inch smooth bars, 18 inches in length, with one end treated to slip, spaced at 12 inches on centers at each joint, and placed level at midpoint of concrete section.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install perimeter pavement drainage systems (i.e., French drains) surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Construct curb, gutter and/or sidewalk directly on clay subgrade soils rather than on granular base course materials.

SLOPE STABILITY

Cut Slopes

The table below provides the recommended slope inclinations for both permanent cut slopes and temporary cut slopes. In our opinion, cut slopes at the inclinations discussed below should be stable against a large-scale slide, however the potential for sloughing of loose soils zones exists.

Slope Type	Maximum Slope Inclinations
Temporary	1½(H):1(V) in on-site soils ½(H):1(V) in Stratum 4 limestone
Permanent	3(H):1(V) in on-site soils [1,2] 1(H):1(V) in Stratum 4 limestone

1. If steeper permanent slopes in cuts or embankments (natural soils or fill soils) are planned for final grading, then additional services will be required by Terracon to perform detailed slope stability analyses.
2. For slopes to be used by mowers or other maintenance equipment, slightly flatter 4H:1V slopes are generally preferable.

Exposed cut slopes will also be susceptible to further erosion due to the nature of the on-site soils and limestone. Installation of erosion control measures in such areas would be beneficial in reducing the potential slope stability which could result from excessive erosion. In addition to initial erosion control measures, the cut slopes should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

In regards to worker safety, Occupation Safety and Health Administration (OSHA) Safety and Health Standards require the protection of workers adjacent to excavations. The OSHA guidelines and directives should be adhered by the Contractor during construction to provide a safe working environment.

Buffer Zones Adjacent to Cut Slopes

Excavation methods which fracture the limestone significantly could result in decreased slope stability. To allow for some sloughing to occur, we recommend that a “buffer zone” at least 5 feet wide adjacent to pavement and other general areas be provided between the proposed construction areas and the permanent cut slopes (both at the toe and the crest). If buildings are planned near these areas, the buffer zones should be increased to at least 10 feet. This should help reduce the possibility of sloughing soils/rock from contacting the adjacent improvements on the downhill side and from undermining the improvements on the uphill side.

Embankment Fill Slopes

The table below provides the recommended slope inclinations for embankment fill slopes.

Slope Type	Maximum Slope Inclinations
Embankment Fill Slopes [1,2]	3(H):1(V) [3]

1. For slopes to be used by mowers or other maintenance equipment, slightly flatter 4H:1V slopes are generally preferable.

2. Fill placement for the embankments should proceed as outlined in **Earthwork**.
3. If steeper permanent slopes in cuts or embankments (natural soils or fill soils) are planned for final grading, then additional services will be required by Terracon to perform detailed slope stability analyses.

The embankment slopes should be properly protected from erosion. The use of rock rip-rap, erosion control fabrics, and/or vegetation is common). In addition to initial erosion control measures, the embankments should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

Embankments which are constructed on natural subgrade sloping steeper than 5(H):1(V) should be “keyed” into the subgrade at the toe of the embankment. The keyed-in toe should consist of a 12-foot wide section which is excavated into the subgrade such that a horizontal working surface is attained for compaction of the first embankment lift. Successive lifts should remain horizontal and should not tend to follow the slope of the natural subgrade.

The edges of fill embankments are often undercompacted in the field due to loose material being pushed off the edges as the embankment lifts are compacted. To reduce the possibility of this impacting the stability of the embankment fill, the embankments should be overbuilt and compacted as outlined in **Earthwork**. Then the embankment should be cut back to the slopes recommended above.

CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble and chloride. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Corrosivity Test Results Summary				
Boring	**Sample Depth (feet)**	**Soil Description**	**Soluble Sulfate (ppm)**	**Soluble Chloride (ppm)**
B-2	0-2	Fat Clay (Stratum 1)	54.7	<36.9
B-3	2-4	Fat Clay (Stratum 1)	61.3	<38.2
B-5	0-2	Fat Clay (Stratum 1)	56.0	<37.3
B-6	0-2	Lean Clay (Stratum 2)	46.5	<38.2
B-7	4-6	Fat Clay (Stratum 1)	56.3	42.0
B-12	2.4	Fat Clay (Stratum 1)	53.1	<39.1

Results of soluble sulfate testing indicate samples of the on-site soils tested range from Exposure Class S0 when classified in accordance with Table 13.3.1.1 of the ACI Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

GENERAL COMMENTS

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 this 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.

FIGURES

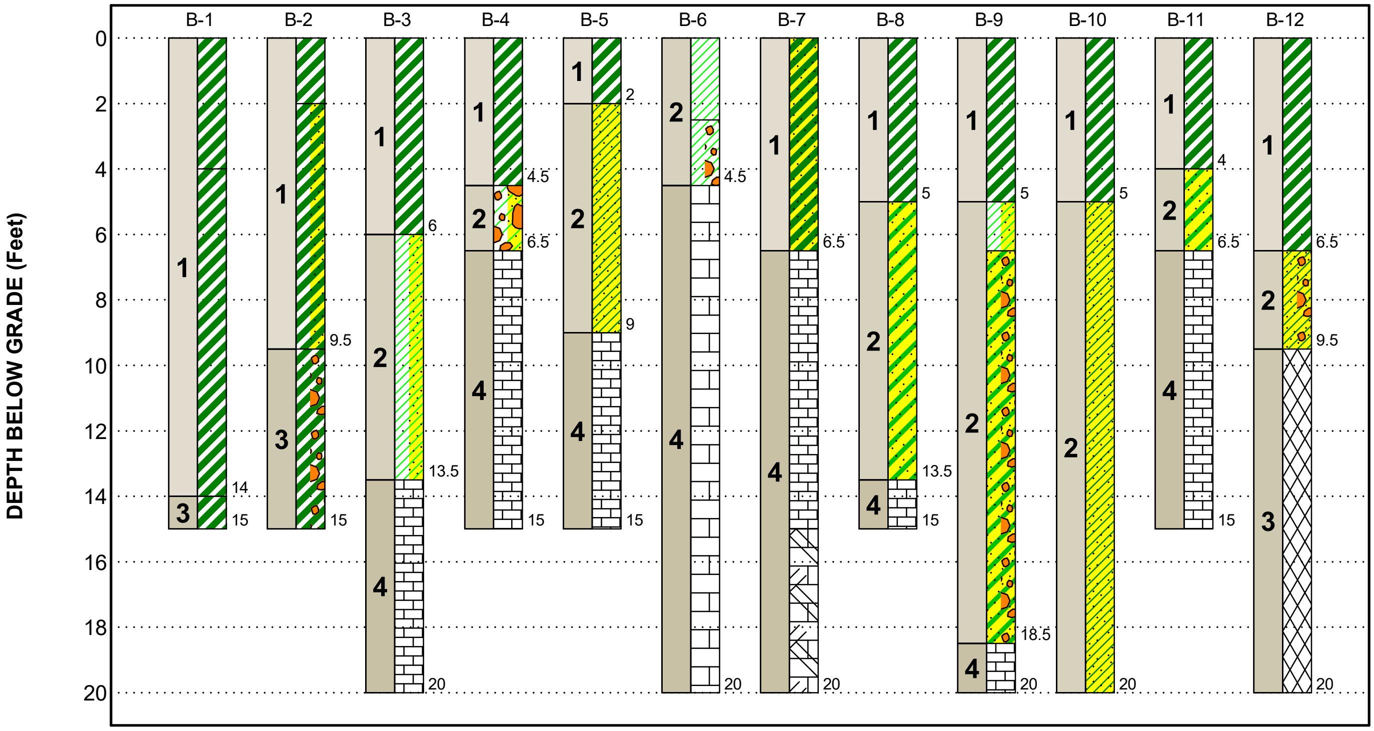
Contents:

GeoModel

GEOMODEL

Community First - Phase 4 ■ Austin, TX
Terracon Project No. 96215049

Terracon GeoReport



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Fat Clay	Dark brown to brown, white, dark reddish brown, Fat Clay (CH) with varying amounts of sand and calcareous deposits
2	Lean Clay, Clayey Gravel, Clayey Sand	Dark brown to light brown, reddish brown to light reddish brown, white, yellowish brown, Lean Clay (CL), Clayey Gravel (GC) and Clayey Sand (SC), with calcareous nodules
3	Shaley Fat Clay, Highly Weathered Shale	Brown, reddish brown, white and light brown, hard, Shaley Fat Clay (CH) and Highly Weathered Shale
4	Limestone (Austin Group)	Light brown, yellowish brown, reddish brown, white, light tan, Limestone with clay seams and layers, highly fractured to moderately fractured

LEGEND

- Fat Clay
- Fat Clay with Sand
- Fat Clay with Gravel
- Lean Clay with Sand
- Highly Weathered Limestone
- Clayey Gravel with Sand
- Sandy Lean Clay
- Lean Clay
- Lean Clay with Gravel
- Limestone
- Sandy Fat Clay
- Weathered Limestone
- Clayey Sand
- Clayey Sand with Gravel
- Sandy Lean Clay with Gravel

NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Location	Number of Borings	Boring Depth (feet)
Currently Accessible Areas	6	20 feet
	6	15 feet

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from available topographic information dated February 2, 2021. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted, track-mounted, rotary drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Four to five samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter (unless bedrock was encountered). Soil sampling was performed using thin-wall tube (shelby tubes) and/or split-barrel sampling procedures. The split-barrel samplers were driven in accordance with the standard test method for standard penetration test (SPT) and split-barrel sampling of soils (ASTM D1586/D1886M–18). Bedrock was sampled with either split-barrel-sampling spoons or continuously cored using NX wireline rock coring equipment. When sufficient bedrock was sampled, the borings were shallowed at the geotechnical engineer's discretion. We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil and rock strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- ASTM D4546 Standard Test Method for One-Dimensional Swell of Soils
- ASTM D7012, Method C Standard Test Method for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures
- TEX-620-J Determining Chloride and Sulfate Content of Soils

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Rock classification was conducted using locally accepted practices for engineering purposes; petrographic analysis may reveal other rock types. Rock core samples typically provide an improved specimen for this classification. Boring log rock classification was determined using the Description of Rock Properties.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan
Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Community First - Phase 4 ■ Austin, Texas
May 20, 2021 ■ Terracon Project No. 96215049

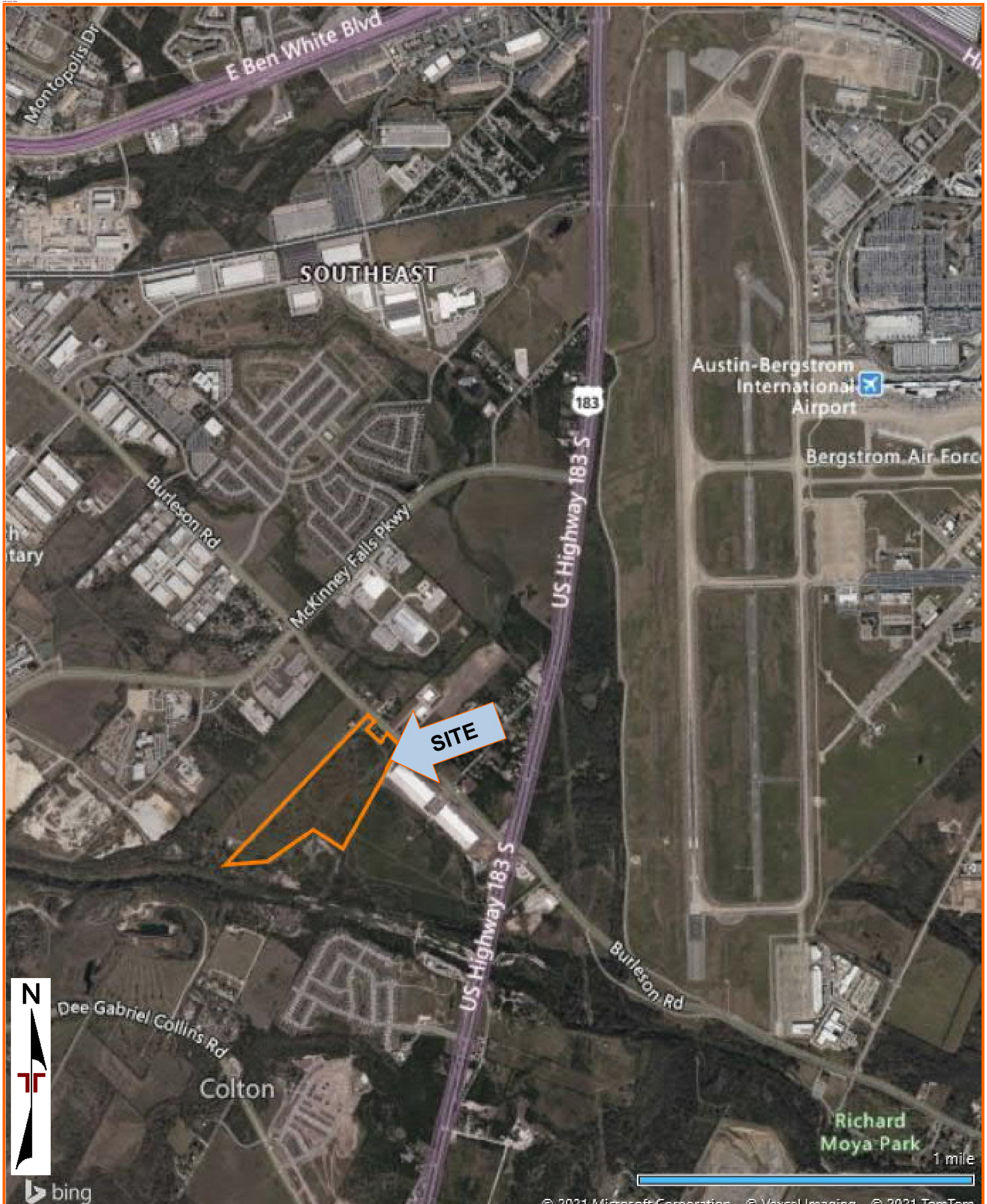


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Community First - Phase 4 ■ Austin, Texas
May 20, 2021 ■ Terracon Project No. 96215049

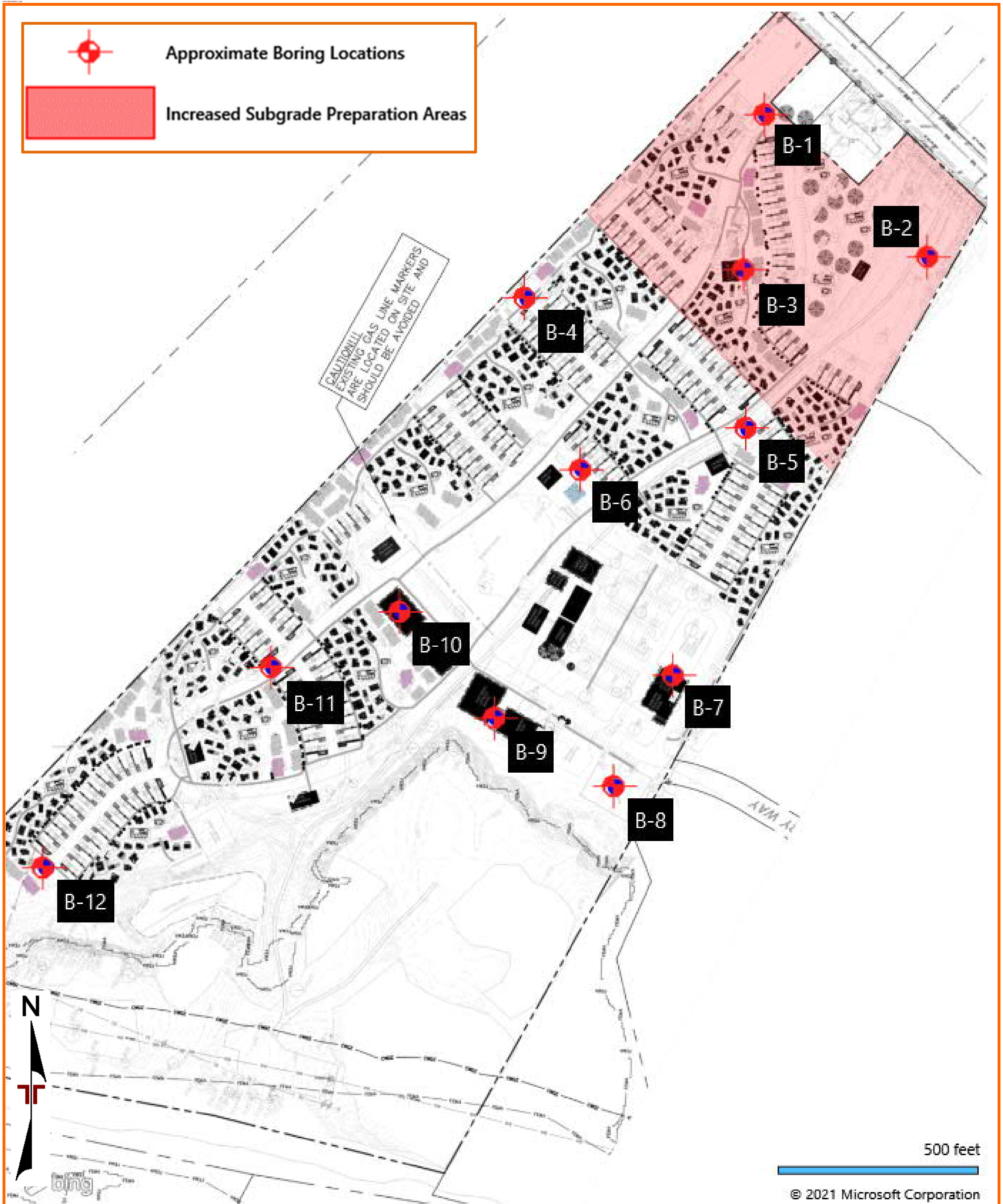


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-12)
Atterberg Limits (2 pages)
Grain Size Distribution (2 pages)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1877° Longitude: -97.6949°

Approximate Surface Elev.: 517 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, trace calcareous deposits, dark brown trace white, very stiff to hard					4.5 tsf (HP)		2.17	UC	4.43	3.4	26.9	92	80-25-55	
							2.5 tsf (HP)									
		4.0	513+/-													
		FAT CLAY (CH), with calcareous deposits, brown and white, very stiff to hard		5			4.0 tsf (HP)			UC	2.50	6.6	24.9	99	54-15-39	
							4.5 tsf (HP)						14.0			
							4.5 tsf (HP)						14.0			
				10												
		14.0	503+/-													
3		**SHALEY FAT CLAY (CH)**, with calcareous deposits, brown and white, hard					20-35-45/3"						14.6			
		15.0	502+/-	15												
		Boring Terminated at 15 Feet														

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-29-2021	Boring Completed: 03-29-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-2

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1867° Longitude: -97.6936°

Approximate Surface Elev.: 515 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, with calcareous deposits, dark brown trace white, hard					4.5 tsf (HP)						17.9		57-18-39	
	2.0		513+/-													
		FAT CLAY WITH SAND (CH), with calcareous deposits, brown and white, very stiff to hard					4.5 tsf (HP)			UC	2.70	6.5	13.7	118	50-14-36	78
				5			4.5 tsf (HP)						13.7			
							4.5 tsf (HP)			UC	8.65	2.8	10.8	121		
							23-36-41/4"						13.1			
	9.5		505.5+/-													
3		**SHALEY FAT CLAY (CH)**, with calcareous deposits, brown and reddish brown, hard		10												
							30-50/5"						15.4			
	15.0		500+/-	15												
		Boring Terminated at 15 Feet														

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-29-2021	Boring Completed: 03-29-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-3

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1866° Longitude: -97.6950°

Approximate Surface Elev.: 521 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, with calcareous deposits, dark brown and white, very stiff to hard				3.5 tsf (HP)						27.0			
						3.5 tsf (HP)			UC	3.49	6.4	21.6	102	78-21-57	91
		6.0 / 515+/-	5			4.5 tsf (HP)						19.4			
2		**LEAN CLAY WITH SAND (CL)**, with calcareous deposits, brown, reddish brown and white, very stiff to hard, possible varying to fat clay				4.5 tsf (HP)			UC	3.92	3.1	11.8	116	45-15-30	
			10			14-20-28 N=48						12.2			
		13.5 / 507.5+/-													
4		**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, with clay layers, light brown and yellowish brown, soft				50/3"						4.2			
			15												
		20.0 / 501+/-				42-50/4"						2.8			
		Boring Terminated at 20 Feet	20												

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-29-2021	Boring Completed: 03-29-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-4

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes
Austin, TX

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1864° Longitude: -97.6967°

Approximate Surface Elev.: 522 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)
1	4.5	**FAT CLAY (CH)**, with calcareous deposits, trace organics, dark brown and white, very stiff to hard	517.5+/-
2	6.5	**CLAYEY GRAVEL WITH SAND (GC)**, reddish brown, dense	515.5+/-
4	15.0	**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, white and light tan, moderately hard to hard	507+/-

Boring Terminated at 15 Feet

FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.5 tsf (HP)		4.49				21.6	93		
4.0 tsf (HP)			UC	6.29	3.9	17.0	110	86-22-64	
23-25-21 N=46						13.8		65-17-48	23
50/4"									
50/4"						3.3			
50/1"						3.1			

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-30-2021	Boring Completed: 03-30-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-5

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1855° Longitude: -97.6950°

Approximate Surface Elev.: 526 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	2.0	**FAT CLAY (CH)**, with calcareous deposits, trace organics, dark brown and white, very stiff	524+/-				4.5 tsf (HP)			UC	2.54	3.4	13.9	106		
2		**SANDY LEAN CLAY (CL)**, with calcareous deposits, trace gravel, light brown and light reddish brown, very stiff to hard					8-8-8 N=16						17.9		31-20-11	68
				5			7-13-16 N=29						14.7			
							18-25-31 N=56								33-14-19	
	9.0		517+/-				15-50/5"						10.3			
4		**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, light brown, soft to moderately hard		10												
	15.0	yellowish brown below 13.5 feet	511+/-				25-50/4"						11.5			
		Boring Terminated at 15 Feet		15												

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-29-2025	Boring Completed: 03-29-2025
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-6

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1853° Longitude: -97.6963°

Approximate Surface Elev.: 531 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) / RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2		**LEAN CLAY (CL)**, with calcareous seams, dark brown to brown, hard					4.5 tsf (HP)			UC	1.43	4.1	19.4	101	47-25-22	
	2.5		528.5+/-													
		LEAN CLAY WITH GRAVEL (CL), with calcareous deposits, yellowish brown and white, very stiff					8-12-12 N=24						20.0		33-22-11	71
	4.5		526.5+/-	5			50/5"						9.7			
4		**LIMESTONE (AUSTIN GROUP)**, with clay seams, tan, light yellowish brown, reddish brown and light brown, hard 50% drilling fluid loss at 6 feet highly fractured from 6 to 15 feet						85 / 35		UC	183.07		0.5	150		
		clay layer and 100% drilling fluid loss at 10 feet		10												
								100 / 58								
				15				100 / 87		UC	294.23		0.1	152		
	20.0		511+/-	20												

Boring Terminated at 20 Feet

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 6 feet, Air Rotary 6 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-30-2021	Boring Completed: 04-13-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-7

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes
Austin, TX

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1839° Longitude: -97.6956°

Approximate Surface Elev.: 524 (Ft.) +/-

MODEL LAYER	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) / RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**SANDY FAT CLAY (CH)**, trace calcareous deposits, dark brown, very stiff to hard					3.5 tsf (HP)			UC	4.06	4.3	30.3	90	86-25-61	
							4.5 tsf (HP)						23.0			
				5			4.0 tsf (HP)		4.59	UC	11.19	6.5	25.4	102	86-20-66	64
4	6.5	**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, tan and light brown, soft	517.5+/-				25-24-41 N=65						7.6			
							25-30-30 N=60						9.6			
		50% drilling fluid loss at 11 feet		10				63 / 0								
	15.0	100% drilling fluid loss at 15 feet	509+/-	15												
		WEATHERED LIMESTONE (AUSTIN GROUP), with clay layers, white, light brown, yellowish brown and light yellowish brown, highly fractured						100 / 7		UC	195.60		5.5	141		
	20.0	***Boring Terminated at 20 Feet***	504+/-	20												

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 11 feet, Air Rotary 11 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-30-2021	Boring Completed: 04-13-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-8

PROJECT: Community First - Phase 4

**CLIENT: Mobile Loaves and Fishes
Austin, TX**

**SITE: South of Burleson Rd near Norwood Ln
Austin, TX**

LOCATION See Exploration Plan

Latitude: 30.1831° Longitude: -97.6961°

Approximate Surface Elev.: 524 (Ft.) +/-

MODEL LAYER	DEPTH / DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1	**FAT CLAY (CH)**, trace sand, dark brown, very stiff to hard					4.25 tsf (HP)						35.3		86-27-59	
						4.0 tsf (HP)			UC	8.08	8.9	24.4	99	81-24-57	90
2	5.0 **SANDY LEAN CLAY (CL)**, light reddish brown, very stiff to hard	519+/-	5			8-10-10 N=20									
						13-22-25 N=47						8.1			
						26-46-4/1"									
4	13.5 **HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, with clay layers, light brown and yellowish brown, moderately hard	510.5+/-	10			50/3"									
	15.0 ***Boring Terminated at 15 Feet***	509+/-	15												

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 04-12-2021 | Boring Completed: 04-12-2021

Drill Rig: CME 75 | Driller: Core Tech Drilling, Inc.

Project No.: 96215049

BORING LOG NO. B-9

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1836° Longitude: -97.6970°

Approximate Surface Elev.: 531 (Ft.) +/-

MODEL LAYER	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, trace sand, dark brown, very stiff to hard					3.0 tsf (HP)						24.0			
		dark reddish brown below 2 feet					4.5 tsf (HP)									
	5.0		526+/-	5												
2		**LEAN CLAY WITH SAND (CL)**, with calcareous nodules, brown and white, very stiff, varies to fat clay					11-10-14 N=24						12.7		49-17-32	
	6.5		524.5+/-													
		CLAYEY SAND WITH GRAVEL (SC), light brown, medium dense to very dense					11-14-15 N=29									
		with limestone fragments below 8.5 feet					14-23-27/3"						5.6		30-16-14	41
				10												
		reddish brown below 13.5 feet					9-8-27 N=35						9.1			
				15												
	18.5		512.5+/-													
4		**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, light brown, hard					50/1"									
	20.0		511+/-	20												

Boring Terminated at 20 Feet

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 04-12-2021	Boring Completed: 04-12-2021
Drill Rig: CME 75	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-10

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1843° Longitude: -97.6977°

Approximate Surface Elev.: 534 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, trace sand, dark brown, very stiff to hard				4.0 tsf (HP)									
		dark reddish brown below 2 feet				4.5 tsf (HP)			UC	5.02	14	23.3	102	60-20-40	
		5.0 — 529+/-	5			11-11-11 N=22									
2		**LEAN CLAY (CL)**, calcareous, very pale brown, very stiff to hard; brown below 6.5 feet				10-11-13 N=24						11.4		26-14-12	
						12-14-16 N=30									
		trace limestone fragments below 13.5 feet				19-26-26 N=52									
						33-44-6/1"									
		20.0 — 514+/-	20												

Boring Terminated at 20 Feet

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 04-12-2021	Boring Completed: 04-12-2021
Drill Rig: CME 75	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-11

PROJECT: Community First - Phase 4

CLIENT: Mobile Loaves and Fishes Austin, TX

SITE: South of Burleson Rd near Norwood Ln Austin, TX

LOCATION See Exploration Plan

Latitude: 30.1839° Longitude: -97.6987°

Approximate Surface Elev.: 537 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, dark brown, very stiff to hard				4.5 tsf (HP)			UC	3.35	4.5	29.1	91	88-26-62	
						3.0 tsf (HP)						29.2			
		4.0 — 533+/-													
2		**CLAYEY SAND (SC)**, light brown, very dense	5			23-26-28 N=54						11.5		27-18-9	42
		6.5 — 530.5+/-													
4		**HIGHLY WEATHERED LIMESTONE (AUSTIN GROUP)**, tan, white, light brown and light yellowish brown, soft to moderately hard				36-50/5"						7.4			
						33-50/4"						9.0			
			10												
						24-26-29 N=55						3.2			
		15.0 — 522+/-	15												

Boring Terminated at 15 Feet

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 15 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-30-2021	Boring Completed: 03-30-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

BORING LOG NO. B-12

PROJECT: Community First - Phase 4

**CLIENT: Mobile Loaves and Fishes
Austin, TX**

**SITE: South of Burleson Rd near Norwood Ln
Austin, TX**

LOCATION See Exploration Plan

Latitude: 30.1826° Longitude: -97.7005°

Approximate Surface Elev.: 534 (Ft.) +/-

MODEL LAYER	GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	RECOVERY (%) RQD (%)	Swell (%)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1		**FAT CLAY (CH)**, dark brown and dark reddish brown, stiff to hard				4.0 tsf (HP)						27.4			
		with calcareous deposits below 2 feet				4.5 tsf (HP)			UC	1.72	3.6	22.0	96	74-20-54	
			5			4.5 tsf (HP)						15.2			
		6.5 — 527.5+/-													
2		**SANDY LEAN CLAY WITH GRAVEL (CL)**, reddish brown and tan, hard				18-30-28 N=58						5.8		43-14-29	57
		9.5 — 524.5+/-				26-35-50/2"						12.5			
3		**HIGHLY WEATHERED SHALE**, with gravel seams, light brown, soft to hard	10												
						50/4"						13.6			
			15												
						43-50/4"						6.9			
		20.0 — 514+/-	20												
		Boring Terminated at 20 Feet													

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

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 20 feet

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).

See Supporting Information for explanation of symbols and abbreviations.

Approximate surface elevation from topographic information dated 02/02/2021

Notes:

WATER LEVEL OBSERVATIONS

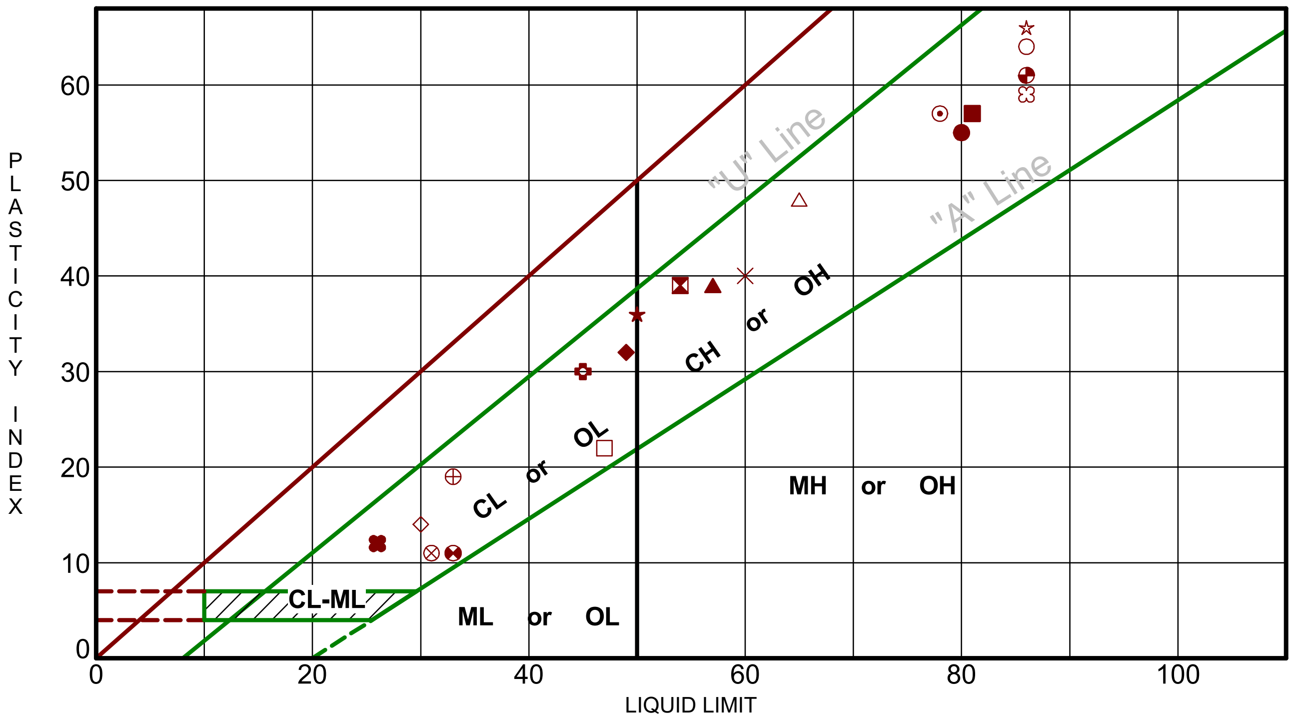
No free water observed

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

Boring Started: 03-30-2021	Boring Completed: 03-30-2021
Drill Rig: B-59	Driller: Core Tech Drilling, Inc.
Project No.: 96215049	

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	0 - 2	80	25	55			
⧗	B-1	4 - 6	54	15	39			
▲	B-2	0 - 2	57	18	39			
★	B-2	2 - 4	50	14	36	78.1	CH	FAT CLAY with SAND
⊙	B-3	2 - 4	78	21	57	90.8	CH	FAT CLAY
✿	B-3	6 - 8	45	15	30			
○	B-4	2 - 4	86	22	64			
△	B-4	4.5 - 6	65	17	48	22.8	GC	CLAYEY GRAVEL with SAND
⊗	B-5	2.5 - 4	31	20	11	68.2	CL	SANDY LEAN CLAY
⊕	B-5	6.5 - 8	33	14	19			
□	B-6	0 - 2	47	25	22			
●	B-6	2.5 - 4	33	22	11	71.1	CL	LEAN CLAY with GRAVEL
◕	B-7	0 - 2	86	25	61			
☆	B-7	4 - 6	86	20	66	64.3	CH	SANDY FAT CLAY
✿	B-8	0 - 2	86	27	59			
■	B-8	2 - 4	81	24	57	90.4	CH	FAT CLAY
◆	B-9	4.5 - 6	49	17	32			
◇	B-9	8.5 - 9.8	30	16	14	41.4	SC	CLAYEY SAND with GRAVEL
×	B-10	2 - 4	60	20	40			
✖	B-10	6.5 - 8	26	14	12			

PROJECT: Community First - Phase 4

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

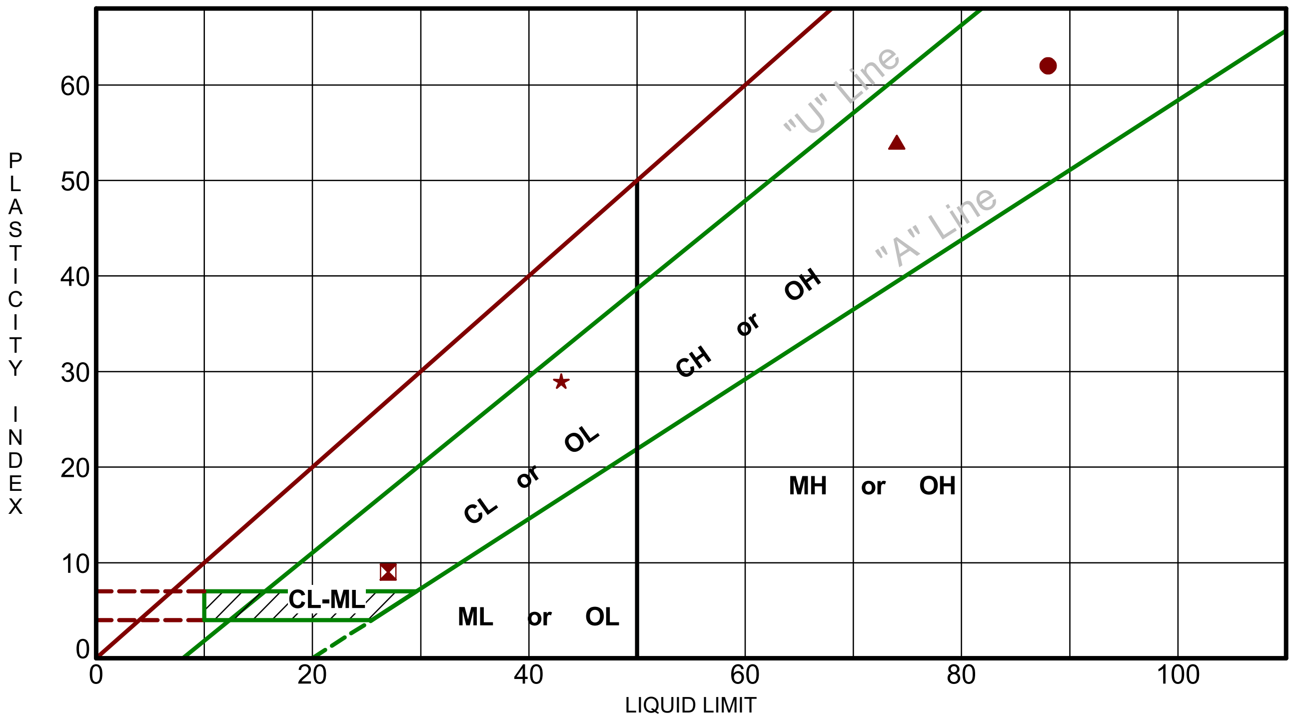
Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

PROJECT NUMBER: 96215049

CLIENT: Mobile Loaves and Fishes
Austin, TX

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-11	0 - 2	88	26	62			
⊠	B-11	4.5 - 6	27	18	9	41.8	SC	CLAYEY SAND
▲	B-12	2 - 4	74	20	54			
★	B-12	6.5 - 8	43	14	29	57.3	CL	SANDY LEAN CLAY with GRAVEL

PROJECT: Community First - Phase 4

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

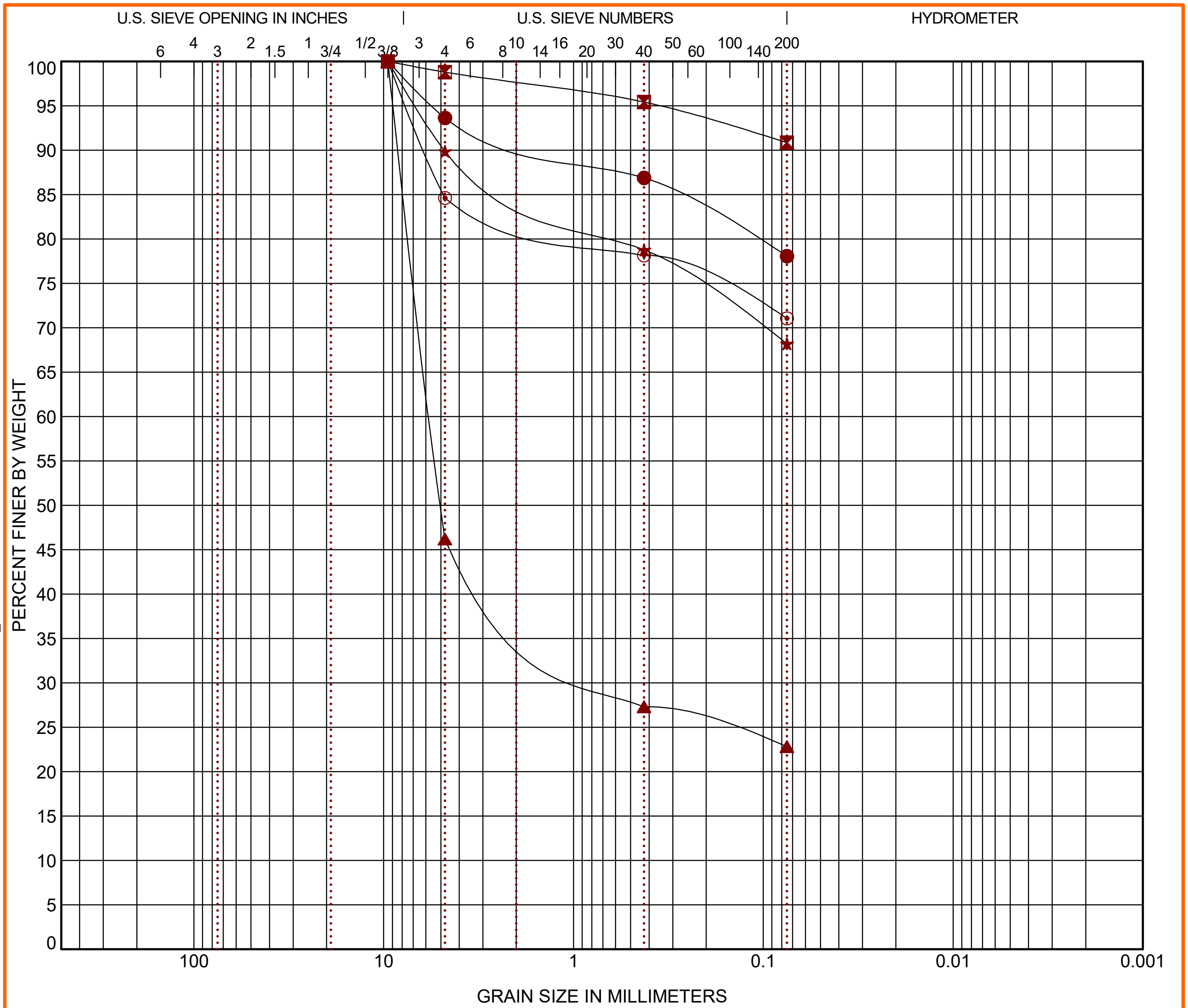
Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

PROJECT NUMBER: 96215049

CLIENT: Mobile Loaves and Fishes
Austin, TX

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-2	2 - 4	FAT CLAY with SAND (CH)		50	14	36		
☒	B-3	2 - 4	FAT CLAY (CH)		78	21	57		
▲	B-4	4.5 - 6	CLAYEY GRAVEL with SAND (GC)	13.8	65	17	48		
★	B-5	2.5 - 4	SANDY LEAN CLAY (CL)	17.9	31	20	11		
⊙	B-6	2.5 - 4	LEAN CLAY with GRAVEL (CL)	20.0	33	22	11		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-2	2 - 4	9.5				0.0	6.4	15.6		78.1	
☒	B-3	2 - 4	9.5				0.0	1.2	8.0		90.8	
▲	B-4	4.5 - 6	9.5	5.675	0.6		0.0	53.8	23.4		22.8	
★	B-5	2.5 - 4	9.5				0.0	10.1	21.7		68.2	
⊙	B-6	2.5 - 4	9.5				0.0	15.4	13.6		71.1	

PROJECT: Community First - Phase 4

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

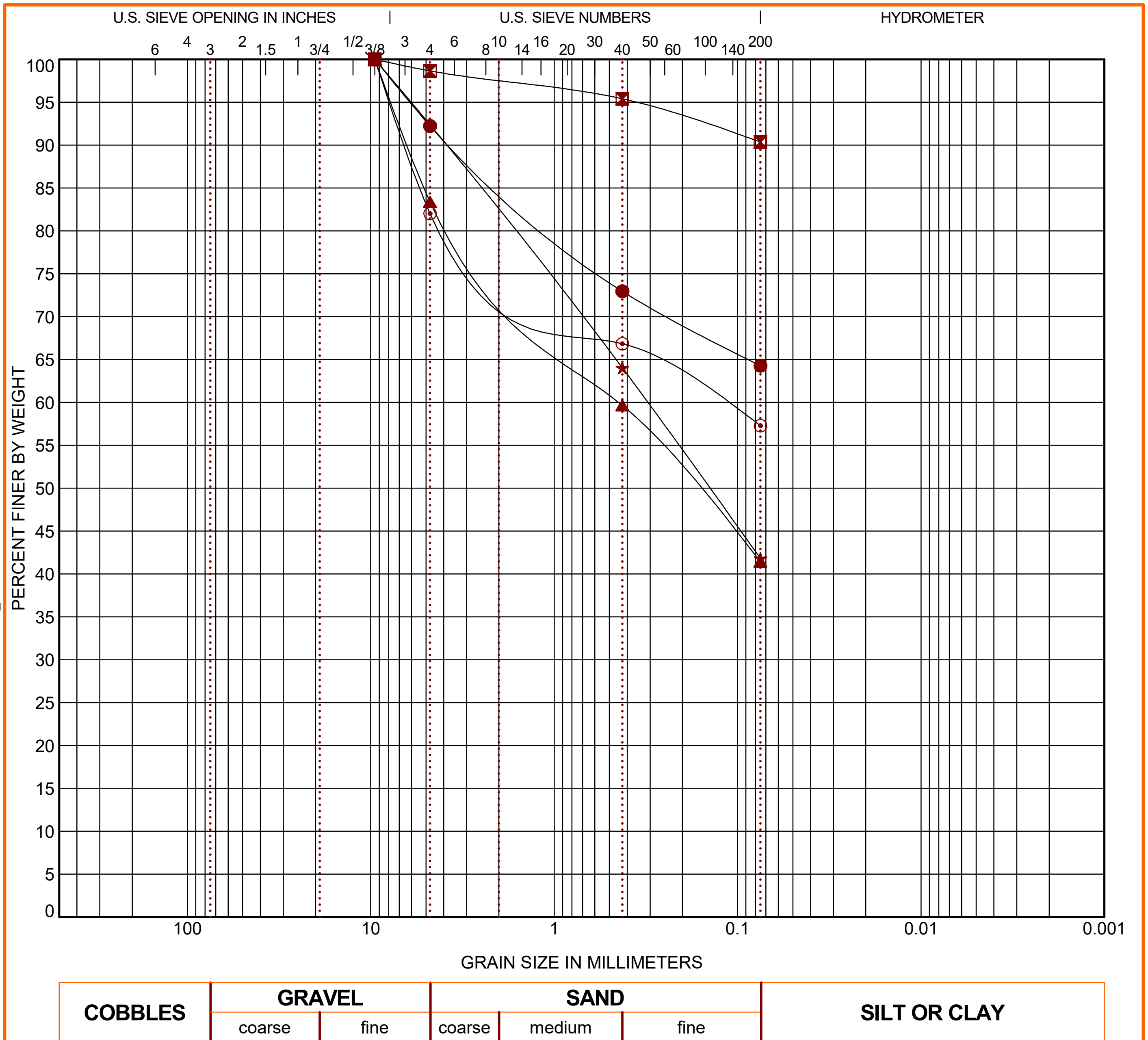
Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

PROJECT NUMBER: 96215049

CLIENT: Mobile Loaves and Fishes
Austin, TX

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



Boring ID		Depth	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
●	B-7	4 - 6	SANDY FAT CLAY (CH)	25.4	86	20	66		
⊠	B-8	2 - 4	FAT CLAY (CH)	24.4	81	24	57		
▲	B-9	8.5 - 9.8	CLAYEY SAND with GRAVEL (SC)	5.6	30	16	14		
★	B-11	4.5 - 6	CLAYEY SAND (SC)	11.5	27	18	9		
⊙	B-12	6.5 - 8	SANDY LEAN CLAY with GRAVEL (CL)	5.8	43	14	29		

Boring ID		Depth	D_{100}	D_{60}	D_{30}	D_{10}	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
●	B-7	4 - 6	9.5				0.0	7.8	28.0		64.3	
⊠	B-8	2 - 4	9.5				0.0	1.4	8.3		90.4	
▲	B-9	8.5 - 9.8	9.5	0.44			0.0	16.6	41.9		41.4	
★	B-11	4.5 - 6	9.5	0.31			0.0	7.6	50.6		41.8	
⊙	B-12	6.5 - 8	9.5	0.123			0.0	18.0	24.7		57.3	

PROJECT: Community First - Phase 4

SITE: South of Burleson Rd near Norwood Ln
Austin, TX

Terracon
5307 Industrial Oaks Blvd Ste 160
Austin, TX

PROJECT NUMBER: 96215049

CLIENT: Mobile Loaves and Fishes
Austin, TX

SUPPORTING INFORMATION

Contents:

General Notes
Unified Soil Classification System
Description of Rock Properties
City of Austin (COA) MSWL Form

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Community First - Phase 4 ■ Austin, TX

Terracon Project No. 96215049

SAMPLING

Rock Core

Shelby Tube

Standard Penetration Test

Split Spoon

WATER LEVEL

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.

FIELD TESTS

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.

UNIFIED SOIL CLASSIFICATION SYSTEM

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]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or [$Cc<1$ or $Cc>3.0$][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]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and/or [$Cc<1$ or $Cc>3.0$][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 / Liquid limit - not dried < 0.75	OL	Organic clay[K, L, M, N]
					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 / Liquid limit - not dried < 0.75	OH	Organic clay[K, L, M, P]
					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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[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.

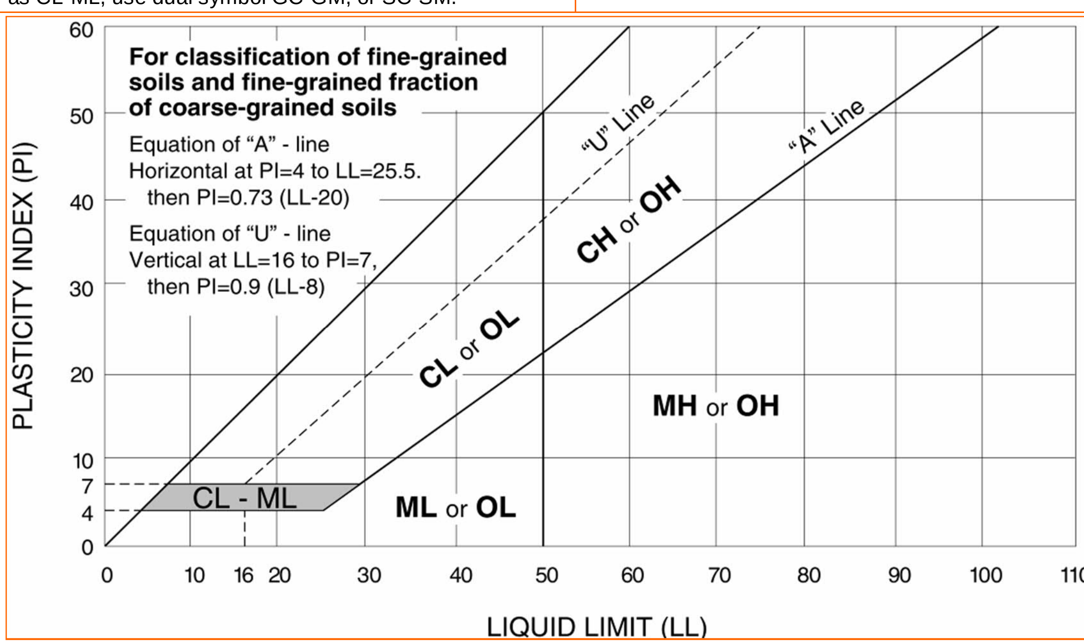
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] $PI \geq 4$ 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.



DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (tsf)**
Extremely weak	Indented by thumbnail	40-150 (3.9-10.8)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (10.8-50.4)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (50.4-288)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (288-504)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (504-1,080)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (1,080-2,592)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>2,592)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

Certification of Compliance with Ch. 25-1-83 – Applications Relating to a Closed Municipal Solid Waste Landfill

Site Address: **Community First – Phase 4 -** South of Burleson Rd, near Norwood Ln, Austin, Texas

---

Complete Section A if your site is:

- Less than or equal to 1 acre and **not** within a landfill buffer as shown on the City of Austin Closed Landfills maps.

Complete Section B if your site is:

- Greater than 1 acre; or
- Less than or equal to 1 acre **and** within a landfill buffer as shown on the City of Austin Closed Landfills map.

See back of form for information on where to obtain a map of Austin area closed landfills or how to obtain information about state development regulations.

Section A

The site for which I am submitting an application for subdivision, site plan, or building permit is less than 1 acre, is not within a landfill buffer, and I am not aware of any information indicating the site may contain any portion of a municipal waste landfill.

________________________ ________________________

Signature of Applicant | Print Name

Section B

In our opinion, the subject site does not contain a municipal solid waste landfill as referenced in TAC Ch. 330, Subch. T. This opinion is based on information gathered using:

☐ TCEQ Soil Test 2 –

■ TCEQ Soil Test 3 – Based upon geotechnical borings presented in Terracon Report No. 96215049, no evidence of an existing closed municipal solid waste landfill was encountered.

____

Signature of Professional Engineer

Diego Munar Castaneda, P.E.

Print Name

STATE OF TEXAS

DIEGO MUNAR CASTANEDA

122437

LICENSED

PROFESSIONAL ENGINEER

5/20/2021