Geotechnical Engineering Report

KFC - Dugas
San Antonio, Texas
April 7, 2022
Terracon Project No. 90225074

Prepared for:
Gen2 Texas Properties, LLC
Kingman, Arizona

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

April 7, 2022

Gen2 Texas Properties, LLC
3845 Stockton Hill Rd.
Kingman, Arizona 86402

Attn: Mr. Jeff Ricks

Re: Geotechnical Engineering Report
KFC - Dugas
Dugas Road and Potranco Road
San Antonio, Texas
Terracon Project No. 90225074

Dear Mr. Ricks:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P90225074 dated February 28, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and pavements for the proposed project.

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

Sincerely,

Terracon Consultants, Inc.
(Firm Registration No. F3272)

Shasanka Dutta, P.E.
Project Engineer

Gregory P. Stieben, P.E.
Senior Consultant

STATE OF TEXAS
GREGORY P STIEBEN
59536
REGISTERED
PROFESSIONAL ENGINEER

Terracon Consultants, Inc. 6911 Blanco Road, San Antonio, Texas 78216
P [210] 641-2112 F [210] 641-2124 terracon.com Texas Professional Engineers No. 3272

REPORT TOPICS

ATTACHMENTS

Geotechnical Engineering Report

KFC - Dugas

Dugas Road and Potranco Road

San Antonio, Texas

Terracon Project No. 90225074

April 7, 2022

INTRODUCTION

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed KFC building to be located at Dugas Road and Potranco Road in San Antonio, Texas. The purposes of these services are to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per IBC
- Pavement design and construction
- Foundation design and construction
- Site preparation and earthwork
- Excavation considerations

The Geotechnical Engineering Scope of Services for this project included the advancement of four (4) test borings to depths ranging from about 6 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 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 at the intersection of Dugas Road and Potranco Road in San Antonio, Texas. See **Site Location**
Existing Improvements	None
Current Ground Cover	Soil and grass

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 are as follows:

Item	Description
Proposed Structures	The project includes construction of a 2,381 sq. ft. restaurant building, associated pavements and some light poles. The building will be supported on slab-on-grade foundation. In addition, light poles will be supported on drilled piers or spread footings.

GEOTECHNICAL CHARACTERIZATION

Subsurface Conditions

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. As part of our analyses, we identified the following soil type within the subsurface profile.

Description	General Description
Fat Clay[1]	Dark Brown; Hard
Lean Clay[2]	Tan, Dark Brown; Medium Stiff to Hard
Marl[3]	Tan; Hard

1/ The native FAT CLAY materials could undergo very high volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

2/ The native LEAN CLAY materials could undergo low volumetric changes (shrink/swell) should they experience changes in their in-place moisture content.

3/ The MARL are volumetrically stable when considered for expansive soil-related movements. MARL is defined in ASTM D 653-90 "Standard Terminology Relating to Soil, Rock and Contained Fluids" as "Calcareous clay usually containing from 35 to 65 percent calcium carbonate". The calcium carbonate is an indication of a cemented matrix of sand, silt or clay. When submerged in water, marl begins to slake. However, when excavated or drilled, this material typically behaves more like a rock than soil. Therefore, ***High power, high torque (rock) drilling and excavation equipment will be required for this stratum.***

It can be emphasized that the stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

Groundwater generally appears as either a permanent or temporary water source. Permanent groundwater is generally present year-round, which may or may not be influenced by seasonal and climatic changes. Temporary groundwater water is also referred to as a "perched" water source, which generally develops because of seasonal and climatic conditions.

The borings were advanced to the required depths using dry drilling techniques to evaluate groundwater conditions at the time of our field program. Groundwater was not observed in the borings while drilling, and for the short duration that the borings remained open. However, a relatively long period may be necessary for groundwater level to develop and stabilize in a borehole.

Seasonal variations such as amount of rainfall and runoff, climatic conditions and other factors generally result in fluctuations of the groundwater level over time. 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 foundation contractor should check the groundwater conditions just before foundation excavation activities. Long term observations in piezometers sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

GEOTECHNICAL OVERVIEW

The Finished Floor Elevation (FFE) for the building is not available currently. The following recommendations are based on a Finished Building Pad Elevation (FBPE) at or near existing grades. If any of this information changes, Terracon should be contacted to so that we can review and revise our recommendation as appropriate.

We understand the building will be supported on slab-on-grade foundation and the light poles will be supported on drilled piers or spread footings.

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

Expansion Potential

Expansive soils are present at portions of this site. The near surface, high plasticity Fat Clay could become unstable 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.

Based on our findings, the subsurface soils at this site generally exhibit low shrink/swell potential. Based on the information developed from our field and laboratory programs and on method TEX-124-E of the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate the subgrade soils at the site exhibit a Potential Vertical Rise (PVR) of about 1 inch in their present condition. It must be emphasized that the actual movements could be greater than the values presented in this report because of inadequate drainage, ponded water and moisture infiltration beneath the structure after construction.

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 unless the floor slab is suspended and supported by drilled pier foundations.** However, it should be possible to reduce the risk of movement for grade supported slab if the recommended building pad preparation measures are followed.

EARTHWORK

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

Site Preparation

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

- removal and replacement with Select Fill;
- chemical treatment (such as hydrated lime or portland cement) of the soil to dry and increase the stability of the subgrade; or
- drying by natural means if the schedule allows.

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

Building Pad Preparation

We have assumed the Finished Floor Elevation (FFE) of the building will be at or near existing grades at the site. Once existing and final grades and FFE have been determined, we should be contacted so that we can revise our recommendations, if necessary. The Potential Vertical Rise (PVR) of the subgrade is about 1 inch for the current conditions at the site. Recommendations for at-grade pad preparation to provide uniform support to the grade supported slabs and flatwork for this project site are provided below.

- After completing stripping operations as discussed in the **General Site Preparation** section, excavate and stockpile 3 feet of onsite soils in the building pad area. The building pad area is defined as the area that extends at least 5 feet (horizontal) beyond the perimeter of the proposed building or to the outside edge of any movement sensitive flatwork. The limits of the building pad should be indicated on the drawings.

- After excavating to the depth specified above, the exposed subgrade should be proof rolled with a fully loaded dump truck or comparable pneumatic tired vehicle to evidence any weak yielding zones. A Terracon Geotechnical Engineer or their representative should be present to observe proof rolling operations. If any weak yielding zones are present, they should be over excavated, both vertically and horizontally, to expose competent soil.

- After proof-rolling and the replacement of weak yielding zones, the exposed subgrade should be scarified, moisture conditioned between -2 and +3 percentage points of the optimum moisture content and compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- Place 3 feet of stockpiled soils in loose lifts of about 8 inches to restore grade. Each lift should be moisture conditioned between -2 and +3 percentage points of the optimum moisture content, and then compacted to at least 95 percent of the maximum dry density determined in accordance with ASTM D 698.

- This should result in about 3 feet of recompacted and moisture conditioned onsite soils beneath the floor slab.

- If grades are to be raised further, then Select Fill should be used to achieve Finished Building Pad Elevation (FBPE).

Flatwork

As previously stated, the subgrade soils at the project site exhibit a PVR of about 1 inch in their present condition. If the flatwork is grade supported and if soil related movement and cracking is not desired, the flatwork should be prepared as described under **Building Pad Preparation** section. Exterior improvements such as stairs that are attached to the building should be included in the building pad. Otherwise, differential movement between the building and exterior improvements may result in doors that "drag" when opened, etc. Another option to address this concern is adjustable legs on the stairs or to include stoops in the slab at door locations.

Fill Material Types

Earthen materials used for structural and general fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Comments
Select Fill	CL, SC ■ LL≤40 and 7<PI≤20 ■ % passing #200 sieve ≥35% ■ Maximum particle size 1½"	Can be placed at any location
On-Site Soil	CH, CL	See Note 2

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

2/ CH should not be used Select Fill. CL soils can be used as Select Fill if they meet the criteria of Select Fill. If proposed to use, these materials should be stockpiled and tested prior to use.

Fill Compaction Requirements

Select and general fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness	All fill should be placed in thin, loose lifts of about 8 inches, with compacted thickness not exceeding 6 inches.
Compaction of On-Site Soil and Select Fill	95 percent of the material's Standard Proctor maximum dry density (ASTM D 698).
Moisture Content of On-Site Soil and Select Fill	Between -2 and +3 percentage points of the optimum moisture content.

Grading and Drainage

Effective drainage should be provided during construction and maintained throughout the life of the new improvements. After pad construction, we recommend verifying final grades to document that effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary, as part of the structure's maintenance program.

Proper site drainage should be maintained during the entire construction phase so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access, particularly in cut areas. During construction, it is possible that the surficial soils may become excessively wet because of inclement weather conditions. When the moisture content of these clay soils elevates above what is considered to be the optimum range of moisture for compaction operations, they can become difficult to handle and compact. If such conditions create a hindrance to compaction operations or site access, lime or cement may be mixed with these soils to improve their workability. The additive can be mixed as per 2014 TxDOT Item 275 (cement) or 2014 TxDOT Item 260 (lime). The subgrade should be tested for sulfates prior to the use of lime. The purpose of the additive is to dry out the subgrade and improve site access. The strict requirements for curing and actual quantity of additive can be at the discretion of the contractor. The subgrade, however, should be compacted to at least 95 percent of the maximum dry density as per ASTM D 698 at moisture contents ranging from -2 to +3 percentage points of the optimum moisture content.

Flatwork and pavements will be subjected to post-construction movement. Maximum grades that are feasible should be used for paving and flatwork to prevent water from ponding. Allowances in final grades should also consider post-construction movement of flatwork, particularly if such movements are deemed critical. Where paving or flatwork abuts the structure, joints should be effectively sealed and maintained to prevent surface water infiltration. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a grade of at least five percent for at least 10 feet from perimeter walls (except in areas where ADA ramps are required; these should comply with state and local regulations). Backfill against grade beams, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of construction debris to reduce the possibility of moisture infiltration.

Planters and other surface features which could retain water in areas adjacent to the structures should be properly drained, designed, sealed or eliminated. Landscaped irrigation adjacent to the foundation systems should be properly designed and controlled to help maintain a relatively constant moisture content within 5 feet of the structure.

Utility trenches are a common source of water infiltration and migration. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Utility trenches that penetrate beneath the structure should be effectively sealed to restrict water intrusion and flow through the trenches that could migrate below the pad. We recommend constructing an effective clay “trench plug” that extends at least 5 feet out from the face of the building exterior. The plug material should consist of clay compacted at a water content at or above the soil’s optimum water content. The clay fill should be placed to completely surround the utility line and be compacted in accordance with recommendations in this report. The combination of 10 mil poly and flowable fill backfill can be used in place of a clay plug.

Earthwork Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving 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. 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 freezes, 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.

SHALLOW FOUNDATIONS

The proposed building may be supported on a slab-on-grade foundation.

Parameters commonly used to design slab foundations are provided in the table below. The slab foundation design parameters presented on the table below are based on conventional method and the criteria published by the Wire Reinforcement Institute (WRI).

Conventional Method Parameters	Value
Net Allowable Bearing Pressures [1]	2,000 psf
Subgrade Modulus (k)	100 pci
Potential Vertical Rise (PVR)	1 inch
WRI Method Parameters	
Design Plasticity Index (PI) [2]	22
Climatic Rating (C_w)	17
Soil – Climate Support Index (1-C)	0.07
1/ The net allowable bearing pressure provided above includes a Factor of Safety (FS) of at least 3.	
2/ Based on pad preparation recommended in this report.	

We recommend that perimeter grade beams be at least 30 inches below the finished exterior grade. These recommendations are for proper development of bearing capacity for the continuous beam sections of the foundation system and to reduce the potential for water to migrate beneath the slab foundation. These recommendations are not based on structural considerations. Grade beam depths may need to be greater than recommended herein for structural considerations and should be properly evaluated and designed by the Structural Engineer.

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

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

Spread Footings

Isolated spread footings may be used to support the light poles. Design recommendations for spread footings are presented in the table below.

Description	Parameter
Net allowable bearing pressure [1]	3,000 psf
Minimum dimensions	30 inches
Minimum embedment below finished grade for bearing	36 inches
Approximate total settlement from foundation loads [2]	About 1 inch
Ultimate passive pressure [3]	400 pcf, equivalent fluid density
Ultimate coefficient of sliding friction [4]	0.40

1/ The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any soft soils, if encountered, will be undercut and replaced with compacted structural fill. Based upon a minimum Factor of Safety of 3.

2/ The above settlement estimates from foundation loads have assumed that the maximum footing size is 6 feet for column footings and 1.5 feet for continuous footings and that the area has been thoroughly proof-rolled as recommended in this report.

3/ The spread footing foundation excavation sides must be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid. If the loaded side is sloped or benched, and then backfilled, the allowable passive pressure will be significantly reduced. Passive resistance in the upper 12 inches of the soil profile should be neglected. If passive resistance is used to resist lateral loads, the base friction should be neglected.

4/ A Factor of Safety of 2 should be applied to the ultimate value.

The spread footings can provide some uplift resistance for those structures subjected to wind or other induced structural loading. The uplift resistance of a spread footing may be computed using the effective weight of the soil above the spread footing along with the weight of the spread footing and structure. A soil unit weight of 120 pcf may be assumed for the on-site soils placed above the footing, provided the fill is properly compacted.

DEEP FOUNDATIONS

The light poles may be supported on straight-sided drilled piers bearing at a depth no shallower than 10 feet below existing grades.

Drilled piers may be designed for net allowable bearing pressure of 7,000 psf. This bearing pressure include factor of safety against a bearing capacity failure of approximately 3. An allowable side shear value of 700 psf, with an assumed factor of safety of at least 2, may be used to aid in resisting axial compressive loads on the piers. The side shear should be neglected for the upper 4 feet of soil in contact with the pier shaft. A lateral passive resistance of 200psf/ft may be used in design.

Construction Considerations

The pier excavations should be augered and constructed in a continuous manner. Steel and concrete should be placed in the pier excavation immediately following drilling and evaluation for proper bearing stratum, embedment, and cleanliness. In no circumstances should the pier excavation remain open overnight.

During our drilling operations, subsurface water was not encountered. However, subsurface water levels are influenced by seasonal and climatic conditions which result in fluctuations in subsurface water elevations. Therefore, the contractor should be prepared to use temporary casing should water be encountered and/or sloughing of the excavation sidewalls occur. The casing method is discussed below.

> Casing Method- Casing should provide stability of the excavation walls and should reduce water influx; however, casing may not completely eliminate subsurface water influx potential. The drilling subcontractor should determine casing depths and casing procedures. Water that accumulates in excess of 3 inches in the bottom of the pier excavation should be pumped out prior to steel and concrete placement. If the water is not pumped out, a closed-end tremie should be used to place the concrete completely to the bottom of the pier excavation in a controlled manner to effectively displace the water during concrete placement. If water is not a factor, concrete may be placed with a short tremie so the concrete is directed to the bottom of the pier excavation. The concrete should not be allowed to ricochet off the walls of the pier excavation nor off the reinforcing steel. If this operation is not successful or to the satisfaction of the foundation contractor, the pier excavation should be flooded with fresh water to offset the differential water pressure caused by the unbalanced water levels inside and outside of the casing. The concrete should be tremied completely to the bottom of the excavation with a closed-end tremie.

Removal of casing should be performed with extreme care and under proper supervision to reduce mixing of the surrounding soil and water with the fresh concrete. Rapid withdrawal of casing or the auger may develop suction that could cause the soil to intrude into the excavation. An insufficient head of concrete in the casing during its withdrawal could also allow the soils to intrude into the wet concrete. Both of these conditions may induce "necking", a section of reduced diameter, in the pier.

Drilled Shaft Lateral Load Design Parameters

The following table lists input values for use in LPILE analyses for the design of the piers supporting light poles. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included. **The designer should refer to the boring log nearest to the light pole to assess the thickness of soil strata.**

Stratum	L-Pile Soil Model	S_u (psf) [1]	γ (pcf) [1]	ε_{50} [1]	K (pci) [1]
Clay	Stiff Clay w/o Free Water	1,800	120	0.008	550
Marl	Stiff Clay w/o Free Water	6,000	120	0.004	1,200

1/ Definition of Terms:

Su: Undrained shear strength (Cohesion)

γ: Total unit weight

ε50: Non-default E50 strain

K: Horizontal modulus of subgrade reaction

Foundation Construction Monitoring

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that fill pad compaction and foundation installation be monitored full time by an experienced Terracon soil technician under the direction of our Geotechnical Engineer. During foundation installation, the base should be monitored to evaluate the condition of the subgrade. We would be pleased to develop a plan for compaction and foundation installation monitoring to be incorporated in the overall quality control program.

SEISMIC CONSIDERATIONS

Description	Value
2018 International Building Code Site Classification (IBC) [1]	C [2]
1/ The site class definition was determined using SPT N-values in conjunction with section 1613.3.2 in the 2018 IBC and Table 20.3-1 in the 2016 ASCE-7.	
2/ Borings extended to a maximum depth of 20 feet, and this seismic site class definition considers that similar conditions continue below the maximum depth of the subsurface exploration.	

PAVEMENTS

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

Subgrade Preparation

Prior to construction, any vegetation, loose topsoil and any otherwise unsuitable materials should be removed from the new pavement areas. After stripping, the subgrade should be proof-rolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with a 15-ton roller or fully loaded dump truck. Wet, soft, low-density or dry material should either be removed or moisture conditioned and recompacted to the moisture contents and densities described in section **Fill Compaction Requirements** prior to placing fill.

Design Recommendations

Traffic patterns and anticipated loading conditions were not available. However, we anticipate that traffic loads will be produced primarily by automobile traffic, delivery trucks, trash removal trucks and 18 wheelers. For this project Light and Heavy pavement section alternatives have been provided. Light is for areas expected to receive only passenger vehicles. Heavy assumes areas with heavy traffic, such as trash pickup areas, delivery areas and main access drive areas.

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

Material	Flexible Pavement Section Thickness	
	Light Duty (inches)	Heavy Duty (inches)
Hot Mix Asphaltic Concrete	2.0	3.0
Granular Base Material	10.0	14.0
Moisture Conditioned Subgrade	6.0	6.0

Material	Rigid Pavement Section Thickness	
	Light Duty (inches)	Heavy Duty (inches)
Reinforced Concrete	5.5	6.5
Moisture Conditioned Subgrade	6.0	6.0

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

Pavement Section Materials

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

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

  Pavement specimens, which shall be either cores or sections of asphaltic pavement, will be tested according to Test Method TEX-207-F. The nuclear-density gauge or other methods which correlate satisfactorily with results obtained from project pavement specimens may be used when approved by the Engineer. Unless otherwise shown on the plans, the Contractor shall be responsible for obtaining the required pavement specimens at their expense and in a manner and at locations selected by the Engineer.

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

- **Granular Base Material** - Base material may be composed of crushed limestone base meeting all of the requirements of 2014 TxDOT Item 247, Type A, Grade 1-2; including triaxial strength. The material should be compacted to at least 95 percent of the maximum dry density as determined in accordance with ASTM D 1557 at moisture contents ranging from -2 and +3 percentage points of the optimum moisture content.

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

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

Pavement Drainage

It is of paramount importance to maintain proper drainage, maintain subgrade moisture levels and provide routine maintenance on the pavement to help long-term pavement performance. The following recommendations should be implemented:

- The subgrade and the pavement surface should be designed to promote drainage, preferably at a minimum grade of 2 percent.

- Install joint sealant and seal cracks immediately.

- Extend curbs into the treated subgrade for a depth of at least 3 inches to help reduce moisture migration into the subgrade soils beneath the pavement section.

- Place compacted, low permeability clayey backfill against the exterior side of the curb and gutter.

- Avoid installation of landscape beds or islands in the pavement areas. If installed, slope subgrade in landscape islands to low points should drain to an appropriate outlet.

- Edge drains are recommended along pavement/ landscape borders.
- Strip (wick) drains installed behind the curbs will also help protect the pavements from water which ponds behind the curbs.
- A crack sealant compatible to both asphalt and concrete should be provided at all concrete-asphalt interfaces.

Note that even with the subgrade preparation and pavement maintenance measures, minor pavement distress should be anticipated.

Sulfate Test Results

The sulfate test results indicate that the sulfate concentration of the subgrades soils at the project site are about 78 mg/Kg. The sulfate concentration values are below the threshold level for adverse reactions based on TxDOT (>3,000mg/Kg), the National Lime Association (>3,000mg/Kg) and AASHTO (>5,000mg/Kg). Therefore, potential of adverse sulfate induced distress due to the addition of hydrated lime during lime stabilization is not a concern. Sulfate Test results are included in the **Exploration Results** section of this report.

Based on the test results, the severity of potential exposure of concrete to sulfate attack falls under Class 0. The degradation of concrete is caused by chemical agents in the soil or groundwater that react with concrete to either dissolve the cement paste or precipitate compounds which cause cracking and flaking. The concentration of water-soluble sulfates in the soils is a good indicator of the potential for chemical attack of concrete. Sulfate concentrations in soil can be used to evaluate the need for protection of concrete based on the following table.

Water Soluble Sulfate Content in Soil (mg/kg)	Severity of Potential Exposure
> 10,000	Class 3
1,500 – 10,000	Class 2
150 – 1,500	Class 1
0 – 150	Class 0

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.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring #	Boring Depth below Existing Grade (feet)	Planned Location
B-1 and B-2	20	Planned Building Area
B-3 and B-4	6	Planned Parking Area

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

Subsurface Exploration Procedures: We advanced the soil borings with a truck-mounted drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions).

Soils were sampled by means of split barrel sampling procedure. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration was recorded as the Standard Penetration Test (SPT) resistance value. The shelby tube and the split barrel samples were removed from the samplers in the field, visually classified, and appropriately sealed in sample containers to preserve in-situ moisture contents. We observed and recorded groundwater levels during drilling, coring and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

Our exploration team prepared field boring logs as part of the drilling operations. The sampling depths, visual classification of the materials encountered, SPT values, pocket penetrometer readings, other pertinent sampling information were recorded on the field boring logs.

Laboratory Testing

Samples obtained during the field program were visually classified in the laboratory by a Professional Geotechnical Engineer registered in the State of Texas in accordance with the Unified Soil Classification System (USCS) described in Attachments. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. Selected soil samples obtained from the site were tested for the following engineering properties:

- Moisture Content
- Atterberg Limits
- Particle Size Finer than No. 200 Sieve
- Sulfate Test

Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards. Final boring logs that were prepared represented the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and laboratory test results.

SITE LOCATION AND EXPLORATION PLANS

SITE LOCATION

KFC - Dugas ■ San Antonio, Texas
April 7, 2022 ■ Terracon Project No. 90225074

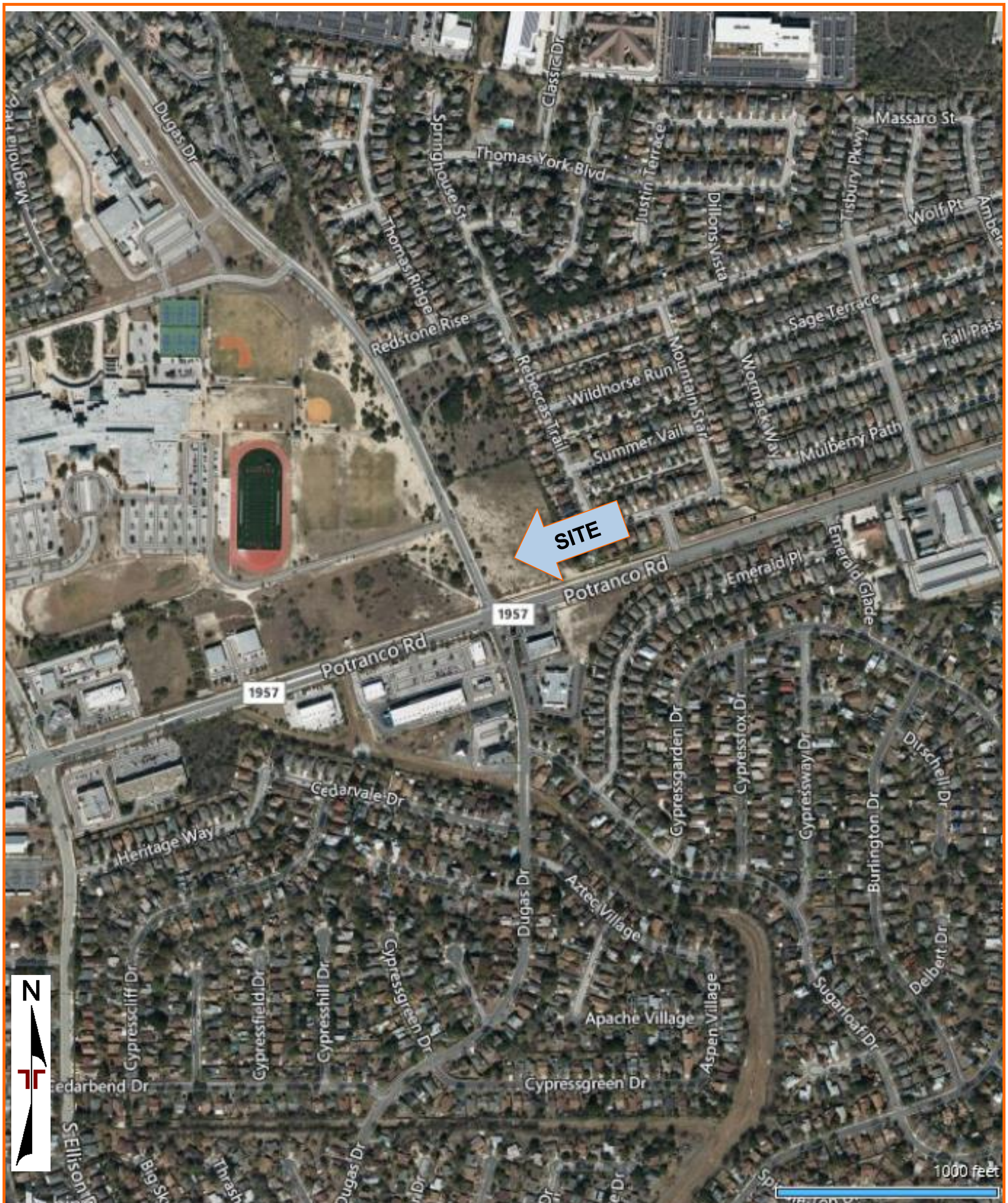

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

KFC - Dugas ■ San Antonio, Texas
April 7, 2022 ■ Terracon Project No. 90225074

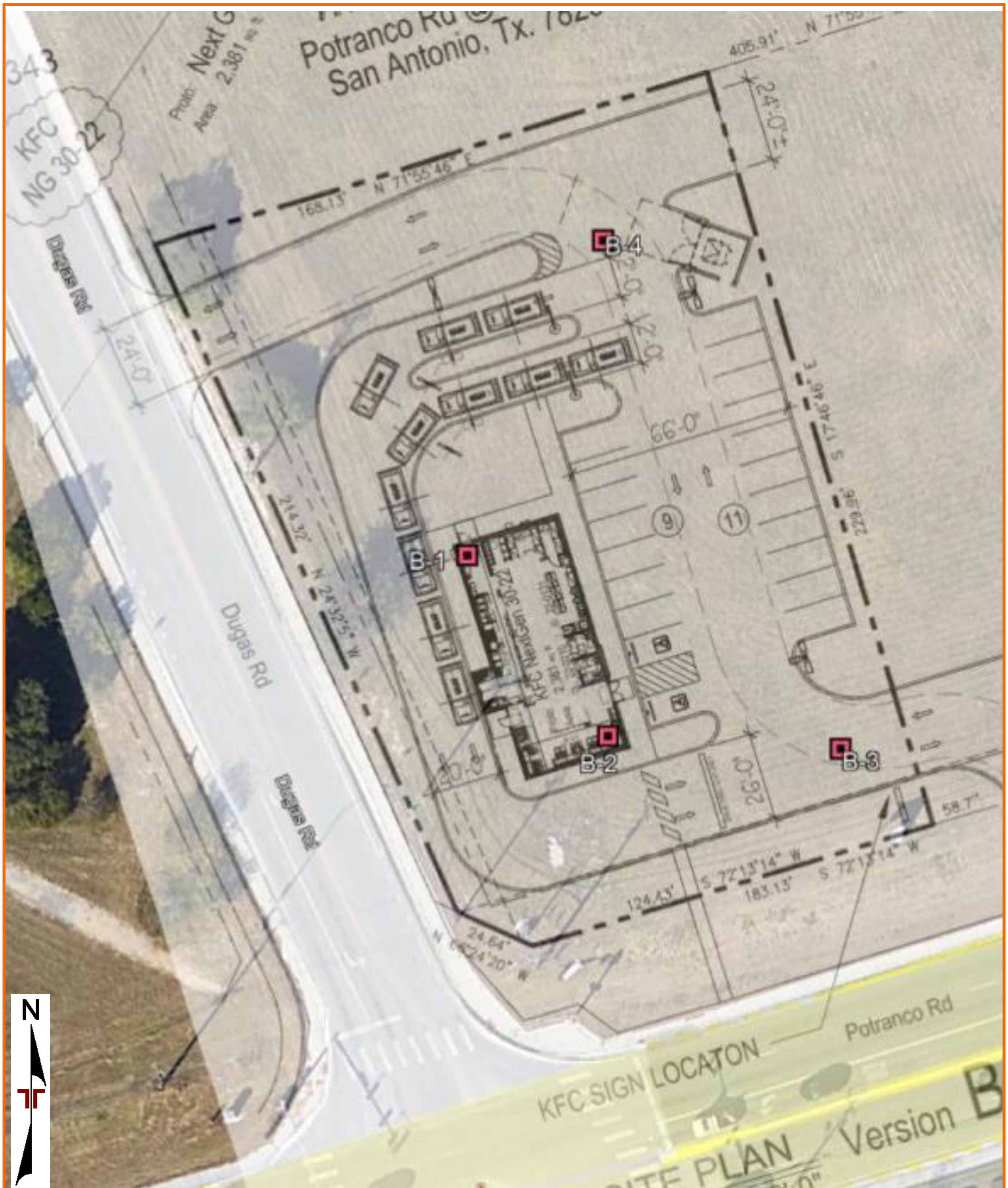

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY GOOGLE MAPS

EXPLORATION RESULTS

Contents:

BORING LOG NO. B-1

PROJECT: KFC - Dugas

CLIENT: Desert de Oro Foods, Inc.
Kingman, AZ

SITE: Dugas Road and Potranco Road
San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4388° Longitude: -98.6789°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		LEAN CLAY (CL), dark brown, medium stiff to hard			X	2-3-3 N=6	15.0	45-16-29	
		- tan below 2 feet			X	4-5-8 N=13	16.9		
	6.0		5		X	17-23-20 N=43	11.9	30-15-15	84
		MARL, tan, hard			X	15-31-50/0"	11.7		
						50/1"	8.3		
			10						
						50/2"	8.1		
			15						
	20.0				X	19-39-50/2"	12.8		
		Boring Terminated at 20 Feet	20						

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

Hammer Type: Automatic

Advancement Method:
Flight Auger

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

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 03-11-2021	Boring Completed: 03-11-2021
Drill Rig: CME-75	Driller: J.V.
Project No.: 90225074	

BORING LOG NO. B-2

PROJECT: KFC - Dugas

CLIENT: Desert de Oro Foods, Inc.
Kingman, AZ

SITE: Dugas Road and Potranco Road
San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4386° Longitude: -98.6788°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), dark brown, medium stiff to hard			X	3-3-2 N=5	14.1	46-23-23	
	- tan below 2 feet			X	5-6-4 N=10	15.2	37-19-18	
		5		X	18-20-17 N=37	13.7		
				X	32-50/5"	11.5		
	8.0							
	MARL, tan, hard			X	50/5"	8.4		
		10						
				X	50/3"	7.4		
		15						
				X	16-29-48 N=77	13.9		77
	20.0	20						
	Boring Terminated at 20 Feet							

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

Hammer Type: Automatic

Advancement Method:
Flight Auger

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

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 03-11-2021	Boring Completed: 03-11-2021
Drill Rig: CME-75	Driller: J.V.
Project No.: 90225074	

BORING LOG NO. B-3

PROJECT: KFC - Dugas

**CLIENT: Desert de Oro Foods, Inc.
Kingman, AZ**

**SITE: Dugas Road and Potranco Road
San Antonio, TX**

LOCATION See Exploration Plan

Latitude: 29.4386° Longitude: -98.6785°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	FAT CLAY (CH), dark brown, hard			X	9-16-20 N=36	15.7		
	2.0							
	LEAN CLAY (CL), tan, very stiff to hard			X	12-16-16 N=32	5.3		
		5		X	6-5-14 N=19	9.5	33-15-18	
	6.0							
	Boring Terminated at 6 Feet							

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

Hammer Type: Automatic

Advancement Method:
Flight Auger

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

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 03-11-2021	Boring Completed: 03-11-2021
Drill Rig: CME-75	Driller: J.V.
Project No.: 90225074	

BORING LOG NO. B-4

PROJECT: KFC - Dugas

CLIENT: Desert de Oro Foods, Inc.
Kingman, AZ

SITE: Dugas Road and Potranco Road
San Antonio, TX

LOCATION See Exploration Plan

Latitude: 29.4391° Longitude: -98.6788°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), tan, very stiff			X	2-8-11 N=19	12.1		
				X	3-6-9 N=15	5.5		
	6.0	5		X	3-4-18 N=22	11.0		
	Boring Terminated at 6 Feet							

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

Hammer Type: Automatic

Advancement Method:
Flight Auger

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

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
6911 Blanco Rd
San Antonio, TX

Boring Started: 03-11-2021	Boring Completed: 03-11-2021
Drill Rig: CME-75	Driller: J.V.
Project No.: 90225074	

SUPPORTING INFORMATION

Contents:

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Terracon GeoReport

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

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. 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

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12
GRAIN SIZE TERMINOLOGY		**PLASTICITY DESCRIPTION**	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

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 [J]		CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K, L, M, N]
			Liquid limit - not dried			Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K, L, M]
			PI plots below “A” line		MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K, L, M, P]
			Liquid limit - not dried			Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

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

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

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

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

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

[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 ≥ 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.