GEOTECHNICAL EXPLORATION

CAMERON COMMERCIAL
Cameron Road near East Rundberg Lane
Austin, Texas
ALPHA Report No. A183125
December 21, 2018

Prepared for:

LDG DEVELOPMENT, LLC
1469 S. 4th Street
Louisville, Kentucky 40208
Attention: Mr. Jake Brown

Prepared By:

ALPHA TESTING

WHERE IT ALL BEGINS

December 21, 2018

LDG Development, LLC
1469 S. 4th Street
Louisville, Kentucky 40208

Attention: Mr. Jake Brown

Re: Geotechnical Exploration
Cameron Commercial
Cameron Road near East Rundberg Lane
Austin, Texas
ALPHA Report No. A183125

Attached is the report of the geotechnical exploration performed for the project referenced above. This study was authorized by Mr. Jake Brown with LDG Development, LLC on November 21, 2018 and performed in accordance with ALPHA Proposal No. 68497 dated November 21, 2018.

This report contains results of field explorations and laboratory testing and an engineering interpretation of these with respect to available project characteristics. The results and analyses were used to develop recommendations to aid design and construction of foundations and pavement.

ALPHA TESTING, INC. appreciates the opportunity to be of service on this project. If we can be of further assistance, such as providing materials testing services during construction, please contact our office.

Sincerely,

ALPHA TESTING, INC.

STATE OF TEXAS
ADAM J. HEIMAN
106047
LICENSED
PROFESSIONAL ENGINEER
12/21/18

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ALPHA REPORT NO. A183125

1.0 PURPOSE AND SCOPE

The purpose of this geotechnical exploration is for ALPHA TESTING, INC. (ALPHA) to evaluate for LDG DEVELOPMENT, LLC (Client) some of the physical and engineering properties of subsurface materials at selected locations on the subject site with respect to formulation of appropriate geotechnical design parameters for the proposed construction. The field exploration was accomplished by securing subsurface samples from widely spaced test borings performed across the expanse of the site. Engineering analyses were performed from results of the field exploration and results of laboratory tests performed on representative samples.

Also included are general comments pertaining to reasonably anticipated construction problems and recommendations concerning earthwork and quality control testing during construction. This information can be used to evaluate subsurface conditions and to aid in ascertaining construction meets project specifications.

Recommendations provided in this report were developed from information obtained in test borings depicting subsurface conditions only at the specific boring locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from those observed at the boring locations, and subsurface conditions at boring locations may vary at different times of the year. The scope of work may not fully define the variability of subsurface materials and conditions that are present on the site.

The nature and extent of variations between borings may not become evident until construction. If significant variations then appear evident, our office should be contacted to re-evaluate our recommendations after performing on-site observations and possibly other tests.

2.0 PROJECT CHARACTERISTICS

It is proposed to construct a new commercial building to be located on Cameron Road near E. Rundberg Lane in Austin, Texas. A site plan illustrating the general outline of the property is provided as Figure 1, Boring Location Plan, in the Appendix of this report. A site grading plan, including initial and final contours, was not available during the time of this study. For purposes of this investigation, we have assumed earthwork in the building pad area will consist of cuts and fills of 2 ft or less. A site plan illustrating the general outline of the property is provided at Figure 1, Boring Location Plan, in the Appendix of this report.

The project will include a single-story building and associated pavements. The building is anticipated to create light to moderate loads to be carried by a shallow foundation system with a grade supported floor slab designed for post-construction foundation movements of about 1 inch or less. Both asphalt and concrete pavement systems will be considered.

3.0 FIELD EXPLORATION

Subsurface conditions on the site were explored by drilling a total of three (3) borings in general accordance with ASTM D 420 using standard rotary drilling equipment. The corresponding location of each boring is provided in Table A.

TABLE A		
Locations	**Boring No.**	**Boring Depth, ft**
Building Area	B-1 and B-2	20
Pavement Area	B-4	5

The approximate location of each boring is shown on the Boring Location Plan, Figure 1, enclosed in the Appendix of this report. Details of drilling and sampling operations are briefly summarized in Methods of Field Exploration, Section A-1 of the Appendix.

Subsurface types encountered during the field exploration are presented on the boring logs included in the Appendix of this report. The boring logs contain our Field Technician's and Engineer's interpretation of conditions believed to exist between actual samples retrieved. Therefore, these boring logs contain both factual and interpretive information. Lines delineating subsurface strata on the boring logs are approximate and the actual transition between strata may be gradual.

4.0 LABORATORY TESTS

Selected samples of the subsurface materials were tested in the laboratory to evaluate their engineering properties as a basis in providing recommendations for foundation design and earthwork construction. A brief description of testing procedures used in the laboratory can be found in Methods of Laboratory Testing, Section B-1 of the Appendix. Individual test results are presented on Log of Borings or summary data sheets also enclosed in the Appendix.

5.0 GENERAL SUBSURFACE CONDITIONS

The Geologic Map of Texas, San Antonio Sheet, published by the University of Texas at Austin Bureau of Economic Geology, has mapped the Austin Chalk (Kau) formation in the general area of the project site. The Austin Chalk formation generally consists of clay, chalk, marl, and limestone. Although not common, Karst features such as caves, sinkholes, solution zones and collapse breccia may be encountered in the Austin Chalk Formation. No Karst features were encountered in the borings drilled at this site.

Karst features such as vugs, voids, solution cavities or sinkholes are not common in the Austin Chalk formation. While many Karst features are relatively minor and consist of solution-enlarged fractures or solution-enlarged features following a bedding plane, some Karst features can consist of caves or cavities that can significantly impact the proposed development. Karst features that are characteristic in marl were not encountered in our borings.

Within the 20-ft maximum depth explored on the site, subsurface materials consist generally of moderate plasticity FAT CLAY (CH), FAT CLAY with SAND (CH), and LEAN CLAY overlying MARL. Marl was encountered at depths ranging from about 14 to 15 ft below the existing ground surface at this site. The letters in parenthesis represent the soils' classification according to the Unified Soil Classification System (ASTM D 2488). More detailed stratigraphic information is presented on the boring logs attached to this report.

The 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 will begin to slake. *However, when being excavated this material typically behaves more like a rock than soil thereby requiring construction equipment and procedures typically used for rock. The contractor selected should have experience with excavation in this marl/rock.*

The clayey materials and marl encountered are considered relatively impermeable and are anticipated to have a relatively slow response to water movement. Therefore, several days of observation would be required to evaluate actual groundwater levels within the depths explored. Also, the groundwater level at the site is anticipated to fluctuate seasonally depending on the amount of rainfall, prevailing weather conditions and subsurface drainage characteristics.

Groundwater was not encountered during drilling at this site. However, it is common to detect seasonal groundwater from natural fractures within the clayey matrix and at the soil/rock (marl) interface, particularly during or after periods of precipitation. If more detailed groundwater information is required, monitoring wells or piezometers can be installed. Further details concerning subsurface materials and conditions encountered can be obtained from the boring logs provided in the Appendix.

6.0 DESIGN RECOMMENDATIONS

The following design recommendations were developed on the basis of the previously described Project Characteristics (Section 2.0) and General Subsurface Conditions (Section 5.0). If project criteria should change, our office should conduct a review to determine if modifications to the recommendations are required. Further, it is recommended our office be provided with a copy of the final plans and specifications for our review prior to construction.

6.1 General Considerations

The foundation system being considered to provide support for the proposed structure must satisfy two independent engineering criteria. One criterion is the foundation system must be designed with an appropriate factor of safety, or a performance limit state, to reduce the possibility of soil failure when subjected to axial and lateral load conditions. The other criterion is foundation movements, whether vertical, horizontal or rotational, must be within allowable operational limits of the structure. These criteria can be achieved for the planned structure foundations if they are designed and constructed in accordance with the recommendations contained in this report.

Design criteria given in this report were developed assuming the floor slab for the building will be constructed within 2 ft of existing grade. Substantial cutting and filling on the site (more than 2 ft) can alter the recommended foundation design parameters. Therefore, it is recommended ALPHA be contacted before performing other cutting and filling on site to verify the appropriate design parameters are utilized for final foundation design.

6.1.1 Vertical Movements

Expansive soils are present at this site. This report provides recommendations to help the effects of soil shrinkage and expansion. However, even if these recommendations are followed, some movement and cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils.

Grade supported structure at this site (including foundations) could experience soil-related potential seasonal movement (i.e. PVR) up to 3 inches. This potential seasonal movement was estimated in general accordance with methods outlined by the Texas Department of Transportation (TxDOT) Test Method Tex-124-E, using swell tests (ASTM D 4546, Method B), engineering judgment, and experience. The estimated movement was calculated assuming the moisture content of the in-situ soil within the normal zone of seasonal moisture content change varies between a "dry" condition and a "wet" condition as defined by Tex-124-E. Also, it was assumed a 1 psi surcharge load from the floor slab acts on the subgrade soils.

Movements exceeding those predicted above could occur if positive drainage of surface water is not maintained or if soils are subject to an outside water source, such as leakage from a utility line or subsurface moisture migration from off-site locations. However, soil movements may be reduced by implementing the subgrade improvement recommendations presented below, in Section 6.2 of this report.

6.1.2 Foundation Considerations

We understand that a shallow foundation system will support the structural loads for the proposed building. The shallow foundation system should consist of spread and continuous footings. Recommendations for these types of foundation systems are provided in the following sections.

6.2 Subgrade Preparation

Structures that are supported within 2 ft of existing grade could experience soil-related potential seasonal movement (i.e. PVR) up to 3 inches as discussed in Section 6.1.1. Potential seasonal movements can be reduced by improving the subgrade as recommended below:

6.2.1 Removal and Replacement with Select Fill (Option 1)

Potential seasonal movements can be reduced to about 1 inch by preparing the subgrade as recommended below:

> Over-excavate the existing on-site soils to 5 ft below the bottom of the floor slab in the building area. The building area is defined as the area directly beneath and at least 5 ft (horizontal) beyond the perimeter of the proposed building and appurtenances. Appurtenances are those items attached to the building, typically including, but not limited to, the building sidewalks, porches, ramps, stoops, etc.
>
> The building pad can be completed by placing and compacting select fill to the bottom of the floor slab in the building area. Select fill material requirements are described in Section 7.3. To provide a more uniform slab support and create a more all-weather working surface, the final 6 inches of the building pad could be constructed with flexible base (optional) to provide a working surface. Criteria for select fill and flexible base material are provided in Section 7.3 of this report.

If not covered with concrete flatwork or pavements, the upper 2 ft of the 5 ft overbuild should consist of a cohesive clay with a Plasticity Index (PI) between 20 to 35 percent. The purpose of the clay cap is to reduce the potential for water to infiltrate the building pad causing the subgrade soils to swell. The material should have at least 70 percent by weight passing the No. 200 Sieve and no more than 15 percent by weight retained in the No. 4 Sieve. The material should be compacted as recommended in Section 7.3 of this report, to reduce the risk of surface water infiltration into the select fill material and below the floor slab.

6.2.2 Moisture Conditioning On-site Soil with Select Fill Cap (Option 2)

Potential seasonal movements can be reduced to about 1 inch by preparing the building pad as recommended below:

> Over-excavate the existing on-site soils to 9 ft below the bottom of the floor slab in the building area and stockpile for reuse. The building area is defined as the area directly beneath and at least 5 ft (horizontal) beyond the perimeter of the proposed building and appurtenances. Appurtenances are those items attached to the building, typically including, but not limited to, the building sidewalks, porches, ramps, stoops, etc. *Note: The excavation may be terminated once the marl stratum is encountered. A representative from ALPHA should be present to verify the marl stratum prior to terminating the excavation.*
>
> After over-excavating to 9 ft below the bottom of the floor slab, place and compact moisture conditioned on-site soil to within 2 ft below the bottom of the floor slab in the building area. Moisture conditioning should be performed as discussed in Section 6.2.2.1.
>
> The building pad can be completed by placing and compacting select fill to the bottom of the floor slab in the building area. Select fill material should be placed in loose lifts of no more than 8 inches. To provide a more uniform slab support and

create a more all-weather working surface, the final 6 inches of the building pad could be constructed with flexible base (optional) to provide a working surface. Criteria for select fill and flexible base material are provided in Section 7.3 of this report.

6.2.2.1 Moisture-Conditioned On-site Soil

Moisture conditioning consists of processing and compacting the specified minimum thickness of on-site soil at a “target” moisture content approximated to range between 4 to 6 percentage points above the material’s optimum moisture content as determined by the standard Proctor method (ASTM D 698). Soils with relatively lower plasticity index values may need to be placed at moisture contents closer to optimum to allow for compaction. The moisture-conditioned soil should be placed in 8-in thick loose lifts and compacted to a dry density of 93 to 97 percent of standard Proctor maximum dry density.

Moisture conditioning of the on-site soil should extend at least 5 ft outside the perimeter beam and adjoining flatwork. If flatwork or paving is not planned adjacent to the structure (i.e. above the moisture-conditioned soils), a moisture barrier consisting of a minimum of 10 mil plastic sheeting with a clay cover should be placed above the moisture-conditioned soils that are outside the building perimeter. The clay cover should consist of a clay with a PI between 15 to 30 percent and at least 65 percent by weight passing the No. 200 Sieve.

Note: The moisture conditioned on-site soil should be maintained in a moist condition prior to placement of the required thickness of select fill, plastic sheeting, flatwork and/or pavement.

The resulting estimated potential seasonal movements were calculated assuming the moisture content of the moisture-conditioned soil varies between the “target” moisture content and the “wet” condition while the deeper undisturbed in-situ soil within the normal zone of seasonal moisture content change varies between the "dry" condition and the "wet" condition as defined by methods outlined in TxDOT Test Method Tex-124-E.

Note: It is the intent of the moisture-conditioning process described above to reduce the swell potential of the moisture conditioned soil to 1 percent or less. Additional laboratory tests (i.e., standard Proctors, absorption swell tests, etc.) should be conducted during construction to verify the “target” moisture content for moisture conditioning (estimated to range between 4 to 6 percentage points above the material’s optimum moisture content as defined by ASTM D 698) is sufficient to reduce the swell potential of the processed soil to 1 percent or less. In addition, it is recommended samples of the moisture conditioned material be routinely obtained during construction to verify the swell of the improved material is 1 percent or less.

Installation of moisture-conditioned soils should be monitored and tested on a full-time basis by a representative of ALPHA to verify the soils tested were placed with the proper lift thickness, moisture content, and degree of compaction.

6.3 Shallow Foundations

Our findings indicate a shallow foundation system could be utilized to support the structural loads of the proposed building. The proposed building could be supported by a shallow foundation system consisting of a grade supported floor slab with footings. Recommendations for shallow foundation systems are provided in the following sections.

6.3.1 Footings

Our findings indicate a shallow foundation system consisting of grade beams or spread footings, could be utilized to support the structural loads of the proposed building provided the subgrade is prepared as described above in Section 6.2.

Note: We do not recommend the use of spread footing foundations if subgrade improvement of the building pad will consist of moisture conditioning (Option 2) as described in Section 6.2.2. A slab foundation as discussed in Section 6.3.2 could be utilized if Option 2 is performed.

We recommend that exterior grade beams be at least 24 inches below final exterior grade and interior grade beams be supported at a nominal depth below the bottom of the floor slab. Grade beams should have a minimum dimension of 10 inches in width for bearing capacity considerations. Grade beams can be designed using a net allowable bearing pressure of 2,000 psf provided the subgrade is prepared as recommended in Option 1 and a net allowable bearing pressure of 1,500 psf provided the subgrade is prepared as recommended in Option 2 in Section 6.2. These bearing pressures include a factor of safety of at least 3.

Spread footings should bear at least 2 ft below final exterior grades and should have a minimum dimension of 24 inches for bearing capacity considerations. Spread footings can be designed using a net allowable bearing pressure of 2,000 psf provided the subgrade is prepared as recommended in Option 1 in Section 6.2.1. This bearing pressure includes a factor of safety of at least 3.

Also, footings subjected to lateral forces or overturning should be proportioned such that the resultant reaction force on the base of the footing lies within the middle one-third of the footing width. *Note: The footings should bear either completely on soil or completely on marl (rock) and should not bridge between the two. In the case where the footing is bearing on rock and soil, the rock should be undercut and at least 6 inches of select fill, flexible base, or processed marl should be provided below the footing.*

Post construction settlements for footing foundations as described above should be less than 1 inch, with differential settlements in the order of ¾ of an inch assuming proper construction. Careful monitoring during construction is necessary to locate any pockets or seams of unsuitable materials which might be encountered in excavations for footings. Unsuitable soils encountered at the foundation bearing level should be removed and replaced with either lean concrete (about 2,000 psi strength at 28 days), structural concrete, or compacted select fill as described in Section 7.3.

Resistance to sliding will be developed by friction along the base of the footings and passive earth pressure acting on the vertical face of the footing and/or a key installed in the base of the footings, if required. We recommend a coefficient of base friction of 0.35 along the bottom of the footing bearing on properly placed and compacted select fill or native granular soils. Passive resistance on the vertical face of the footing within 2 ft of the general excavation subgrade should be neglected. Passive resistance can be developed using a key constructed in the base of the footing and for any portion of the footing bearing at least 2 ft below the general excavation subgrade. For footings bearing against vertical, undisturbed cuts in properly placed and compacted select fill (see Section 7.3), an allowable uniform passive pressure of 300 psf per ft can be utilized.

6.3.2 Slab Foundation

A stiffened slab and grade beam foundation (slab foundation) may be used at this site. The slab foundation may be designed using the following parameters in Tables B.1 and B.2 provided that the building subgrade is prepared as discussed in Section 6.2:

TABLE B.1 OPTION 1: REMOVAL AND REPLACEMENT WITH SELECT FILL (SUBGRADE PREPARATION AS NOTED IN SECTION 6.2.1)	
Description	**Design Parameters**
Climatic rating / Thornthwaite Moisture Index	18 / -13
Effective Plasticity Index	20
Soil Support Index / Soil-Climate Rating Factor (1-C)	0.95/0.05
Edge Moisture Distance (e_m): Center Lift / Edge Lift	8.5 ft / 4.4 ft
Differential Soil Movement (y_m): Center Lift / Edge Lift	0.8 inch / 1.2 inches

TABLE B.2 OPTION 2: MOISTURE CONDITIONING (FOLLOWING SUBGRADE PREPARATION AS NOTED IN SECTION 6.2)	
Description	**Design Parameters**
Climatic rating / Thornthwaite Moisture Index	18 / -13
Effective Plasticity Index	25
Soil Support Index / Soil-Climate Rating Factor (1-C)	0.90/0.10
Edge Moisture Distance (e_m): Center Lift / Edge Lift	8.5 ft / 4.4 ft
Differential Soil Movement (y_m): Center Lift / Edge Lift	0.9 inch / 1.3 inch

The parameters indicated for the above design conditions are based on criteria published by the Wire Reinforcing Institute (WRI) and the Post-Tensioning Institute (PTI) 3rd Edition. The WRI method is essentially an empirical design technique and the parameters provided are based on our interpretation of the project boring and criteria published in the WRI design manual. The PTI method is based on the conditions encountered in the boring and using information and correlations published by PTI Third Edition and VOLFLO 1.5 computer program provided by Geostructural Tool Kit, Inc. (GTI). *Note: Minimum grade beam depths and widths are provided in Section 6.3.1 of this report.*

The use of a vapor retarder should be considered beneath concrete slabs in areas with moisture sensitive flooring. 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.

6.4 Flatwork

Exterior flatwork supported on-grade could be subjected to potential seasonal movements up to 3 inches as described in Section 6.1.1 of this report. Subgrade improvement, as discussed in Section 6.2, could be considered if it is desired to reduce these anticipated movements and to reduce the risk of potential for differential movements between the flatwork and adjoining structural elements. Subgrade improvement below flatwork is intended to maintain the potential for large differential movements between the flatwork and the structure. However, some differential movement should be expected. Therefore, allowances should be made for differential movements between the structure and the flatwork, including flexible connections and control joints. The use of sand as a leveling course below flatwork supported on expansive clays should be avoided. *Note: ALPHA should be contacted if supplemental recommendations are desired to reduce the potential seasonal movements in the flatwork area at this site.*

The flatwork should be installed to ensure drainage away from the structure. A positive slope away from the structure should be maintained. The slope should be sufficient to accommodate future potential movements. The flatwork should never be allowed to reach either a level plane or negative slope back toward the structure. In addition, a moisture seal should be provided at the joint between the flatwork and the foundation.

6.5 Seismic Considerations

TABLE C SEISMICPARAMETERS	
Description	**Values**
2015 International Building Code Site Classification (IBC) [1]	C [2]
Site Latitude (Degrees)	30.34936
Site Longitude (Degrees)	-97.67608
Mapped Spectral Acceleration for Short Periods (0.2-Second): (S_S) [3]	0.064 g
Mapped Spectral Acceleration for a 1-Second Period: (S_1) [3]	0.034 g

1	The site class definition was determined using SPT N-values in conjunction with section 1613.3.2 in the 2015 IBC and Table 20.3-1 in the 2010 ASCE-7.
2	Section 20.1 in the 2010 ASCE-7 requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100-foot soil profile determination. Borings extended to a maximum depth of 20 ft, and this seismic site class definition considers that hard soil continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be needed to confirm the conditions below the current depth of exploration.
3	The Spectral Acceleration values were determined using publicly available information provided on the United States Geological Survey (USGS) website. The spectral acceleration values can be used to determine the site coefficients using Tables 1613.3.3 (1) and 1613.3.3 (2) in the 2015 IBC.

6.6 Pavements

The soils encountered near the ground surface should be improved and prepared prior to construction of pavements at this site. To permit correlation between information from the borings and actual subgrade conditions exposed during construction, a qualified Geotechnical Engineer should be retained to provide subgrade monitoring and testing during construction. If there is any change in project criteria, the recommendations contained in this report should be reviewed by our office.

Based on our knowledge of the project, we anticipate that traffic loads will be produced primarily by automobile traffic and occasional fire trucks, delivery trucks and trash removal trucks. For this project, General Parking and Access Drives pavement alternatives have been provided. General Parking pavement is for areas expected to receive only automobile traffic. Access Drives includes drive lanes, fire lanes, trash pickup areas and main access drive areas. If heavier traffic loading is expected, ALPHA should be provided with the information and allowed to review these pavement sections.

Calculations used to determine the required pavement thickness are based only on the physical and engineering properties of the materials and conventional thickness determination procedures. Pavement joining the buildings should be constructed with a curb and the joint between the building and curb should be sealed. Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, reinforcing steel, joint design and environmental factors will significantly affect the service life and must be included in preparation of the construction drawings and specifications, but were not included in the scope of this study. Normal periodic maintenance will be required for all pavement to achieve the design life of the pavement system.

Recommendations for both Portland Cement Concrete (PCC) and asphalt concrete pavements are provided below. These types of pavement are not considered equal in performance. Over the life of the pavement structure, asphalt concrete pavement should be expected to have a shorter life and higher maintenance costs. Also, we recommend pavement in dumpster areas and areas receiving heavy truck traffic consist of PCC. The dumpster pads should be extended to include all wheels of any garbage trucks.

Note: The recommended pavement sections provided below are considered the minimum necessary to provide satisfactory performance based on the expected traffic loading. In some cases, City minimum standards for pavement section construction may exceed those provided below.

6.6.1 Pavement Subgrade Preparation

After final subgrade elevation has been achieved, the exposed subgrade preparation should consist of scarifying the exposed subgrade soils to a depth of at least 6 inches and then either lime stabilizing or recompacting the scarified soils to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 4 percentage points above the material's optimum moisture content. The pavement subgrade should be proofrolled as described in Section 7.1. Recommendations for subgrade preparation (recompacted subgrade and lime stabilized subgrade) are presented in Section 6.6.4.

It is recommended that subgrade preparation (recompacted subgrade and lime stabilized subgrade) extend at least 1 ft beyond the edge of the pavement to reduce effects of seasonal shrinking and swelling upon the extreme edges of pavement. Also, the curb should be constructed such that the base of the curb extends at least 6 inches into the pavement subgrade.

Pavement will have the same potential for movement as discussed in Section 6.1.1 (up to 3 inches). Good perimeter surface drainage with a minimum slope of 2 percent away from the pavement is recommended. Normal maintenance of pavement should be expected over the life of the pavement structures.

6.6.2 Portland Cement Concrete Pavement

Subgrade preparation as described in Section 6.6.1 is required for asphalt concrete pavement. The minimum recommended asphalt concrete pavement sections to be constructed are tabulated below. Pavement materials are described in Section 6.6.4.

TABLE D
PORTLAND CEMENT CONCRETE PAVEMENT SECTIONS

	General Parking 30,000 ESAL (inches)		**Access Drives 100,000 ESAL (inches)**	
Reinforced PCC	5.0	6.0	6.0	7.0
Lime Stabilized Subgrade	6.0	----	6.0	----
Recompacted Subgrade	----	6.0	----	6.0

A minimum of 7.0 inches of PCC is recommended for dumpster pads. The dumpster pads should be extended to include all wheels of any garbage trucks. PCC should have a minimum compressive strength of 4,000 lbs per sq inch (psi) at 28 days. Concrete should be designed with 5 $\pm$ 1 percent entrained air. Joints in concrete paving should not exceed 15 ft. Reinforcing steel should consist of No. 3 bars placed at 18 inches on-center in two directions. *Note: Refer to ACI 330 for additional information on pavement joints and reinforcement.*

6.6.3 Asphalt Concrete Pavement

Subgrade preparation as described in Section 6.6.1 is required for asphalt concrete pavement. The minimum recommended asphalt concrete pavement sections to be constructed are tabulated below. Pavement materials are described in Section 6.6.4.

TABLE E ASPHALT CONCRETE PAVEMENT SECTIONS				
	General Parking 10,000 ESAL (inches)		**Access Drives 75,000 ESAL (inches)**	
HMAC Surface Course	2.0	2.0	2.5	2.5
Flexible Base	6.0	8.0	9.0	12.0
Lime Stabilized Subgrade or Geogrid [1]	6.0	----	6.0	----
Recompacted Subgrade	----	6.0	----	6.0

[1] *Geogrid may be used in lieu of the 6-inch cement modified subgrade. Criteria for geogrid can be found in Section 6.6.4.*

6.6.4 Pavement Materials

Presented below are various materials that may be used to construct the pavement sections at this site. 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 (HMAC) Courses - The HMAC surface course should be plant mixed, hot laid Type C or D. The HMAC base course should also be plant mixed, hot laid Type A or B. 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.

Flexible Base – Flexible base should meet TxDOT Standard Specification Item 247 Grade 1-2, Type A. Flexible base should be compacted to a minimum of 95 percent of the materials maximum modified Proctor dry density (ASTM D 1557) at a moisture content of -2 to +2 percentage points of optimum moisture.

Lime Stabilized Subgrade – Due to the presence of clayey soils (with a PI over 20) at this site, the pavement subgrade may be treated with hydrated lime. The subgrade should be scarified to a depth of 6 inches and mixed with a minimum 6 percent hydrated lime (by dry soil weight) in conformance with TxDOT Standard Specification Item 260. Assuming an in-place unit weight of 100 pcf for the pavement subgrade soils, this percentage of lime equates to about 27 lbs of lime per square yard of treated subgrade. The actual amount of lime required should be confirmed by additional laboratory tests (ASTM C 977 Appendix XI) prior to construction. The soil-lime mixture should be compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of 0 to 4 percentage points above the mixture's optimum moisture content. In all areas where hydrated lime is used to stabilize subgrade soil, routine Atterberg-limit tests should be performed to verify the resulting plasticity index of the soil-lime mixture is at/or below 20 percent. **In addition, the clay soils at the final pavement subgrade should be tested for the presence of soluble sulfates prior to the use of lime.** Subgrade preparation utilizing lime stabilization as described herein will not prevent normal seasonal movement of the underlying untreated materials.

Geogrid – Geogrid may be used in lieu of the 6 inches of lime stabilization for asphalt pavements. The geogrid should consist of Tensar TX130S, Tensar Biaxial Type 1 or geogrid meeting TXDOT Type 2 specification. The geogrid should be placed at the bottom of the flexible base material layer. However, the pavement subgrade should still be moisture conditioned to a depth of about 6 inches

Recompacted Subgrade – The subgrade should be scarified to a depth of 6 inches and compacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of +1 to +4 percentage points of optimum moisture content.

6.7 Drainage

Adequate drainage should be provided to reduce seasonal variations in the moisture content of foundation soils. All pavement and sidewalks within 10 ft of the building should be sloped away from the building to prevent ponding of water around the building. Final grades within 10 ft of the building should be adjusted to slope away from the building at a minimum slope of 2 percent. **Maintaining positive surface drainage throughout the life of the structure is essential.**

In areas with pavement or sidewalks adjacent to the new structure, a positive seal must be maintained between the structure and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. Post-construction movement of pavement and flatwork is common. Normal maintenance should include examination of all joints in paving and sidewalks, etc. as well as resealing where necessary.

Several factors relate to civil and architectural design and/or maintenance, which can significantly affect future movements of the foundation and floor slab system:

- Preferably, a complete system of gutters and downspouts should carry runoff water a minimum of 5 ft from the completed structure.

- Large trees and shrubs should not be allowed closer to the foundations than a horizontal distance equal to roughly their mature canopy due to their significant moisture demand upon maturing. *Note: A landscape expert may be consulted to evaluate the precise extents of potential root growth for specific tree and shrub species so that root growth beneath the structure and pavements can be avoided.*

- Moisture conditions should be maintained "constant" around the edge of the slabs. Ponding of water in planters, in unpaved areas, and around joints in paving and sidewalks can cause slab movements beyond those predicted in this report.

- Planter box structures placed adjacent to the building should be provided with a means to assure concentrations of water are not available to the subsoil stratigraphy.

- The root systems from any existing trees cleared/removed at this site will have dried and desiccated the surrounding clay soils, resulting in soil with near-maximum swell potential. Clay soils surrounding tree root mats within the building areas or flatwork areas should be removed to a depth of 3 ft or to the top of the marl, whichever occurs first, and compacted in-place with moisture and density control as described in Section 7.3 of this report.

Trench backfill for utilities should be properly placed and compacted as outlined in Section 7.3 of this report and in accordance with requirements of local City standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should not become a conduit and allow access for surface or subsurface water to travel toward the new structure. Concrete cut-off collars or clay plugs should be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.

7.0 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Variations in subsurface conditions could be encountered during construction. To permit correlation between test boring data and actual subsurface conditions encountered during construction, it is recommended a registered Professional Engineering firm be retained to observe construction procedures and materials.

Some construction problems, particularly degree or magnitude, cannot be anticipated until the course of construction. The recommendations offered in the following paragraphs are intended not to limit or preclude other conceivable solutions, but rather to provide our observations based on our experience and understanding of the project characteristics and subsurface conditions encountered in the borings.

7.1 Site Preparation and Grading

Marl (rock) was encountered at depths ranging from 14 to 15 feet below the existing ground surface at this site. From our experience, this marl can be hard and difficult to excavate (including trenching), and difficulty excavating this material can increase with depth. Rock excavation methods (including, but not limited to rock teeth, rippers, jack hammers, or sawcutting) will be required to remove marl. Crushing equipment may be required to process this material if it is desired to utilize this material as on-site fill. **The contractor selected should have experience with excavation in this marl/rock.**

All areas supporting floor slabs, foundations, pavement, flatwork, or areas to receive new fill should be properly prepared.

- After completion of the necessary stripping, clearing, and excavating and prior to placing any required fill, the exposed soil subgrade should be carefully evaluated by probing and testing. Any undesirable material (organic material, wet, soft, or loose soil) still in place should be removed.

- The exposed soil subgrade should be further evaluated by proof-rolling with a heavy pneumatic tired roller, loaded dump truck or similar equipment weighing approximately 20 tons to check for pockets of soft or loose material hidden beneath a thin crust of possibly better soil.

- Proof-rolling procedures should be observed routinely by a Professional Engineer, or his designated representative.

- Any undesirable material (organic material, wet, soft, or loose soil) exposed during the proofroll should be removed and replaced with well-compacted material as outlined in Section 7.3.

- Prior to placement of any fill, the exposed soil subgrade should then be scarified to a minimum depth of 6 inches and recompacted as outlined in Section 7.3.

Slope stability analysis of embankments (natural or constructed) was not within the scope of this study. If fill is to be placed on existing slopes (natural or constructed) steeper than six (6) horizontal to one (1) vertical (6:1), the fill materials should be benched into the existing slopes in such a manner as to provide a minimum bench width of five (5) ft. This should provide a good contact between the existing soils and new fill materials, reduce potential sliding planes and allow relatively horizontal lift placements.

The contractor is responsible for designing any excavation slopes, temporary sheeting or shoring. Design of these structures should include any imposed surface surcharges. Construction site safety is the sole responsibility of the contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations. The contractor should also be aware that slope height, slope inclination or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state and/or federal safety regulations, such as OSHA Health and Safety Standard for Excavations, 29 CFR Part 1926, or successor regulations. Stockpiles should be placed well away from the edge of the excavation and their heights should be controlled so they do not surcharge the sides of the excavation. Surface drainage should be carefully controlled to prevent flow of water over the slopes and/or into the excavations. Construction slopes should be closely observed for signs of mass movement, including tension cracks near the crest or bulging at the toe. If potential stability problems are observed, a geotechnical engineer should be contacted immediately. Shoring, bracing or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of Texas.

Due to the nature of the clayey soils found near the surface at the borings, traffic of heavy equipment (including heavy compaction equipment) may create pumping and general deterioration of shallow soils. Therefore, some construction difficulties should be anticipated during periods when these soils are saturated.

7.2 Foundation Excavations

All foundation excavations should be monitored to verify foundations bear on suitable material. The bearing stratum exposed in the base of all foundation excavations should be protected against any detrimental change in conditions. Surface runoff water should be drained away from excavations and not allowed to collect. All concrete for foundations should be placed as soon as practical after the excavation is made. Prolonged exposure of the bearing surface to air or water will result in changes in strength and compressibility of the bearing stratum. All other excavations should not be left open for more than 48 hours.

Prolonged exposure of the bearing surface to air or water will result in changes in strength and compressibility of the bearing stratum. Excavations for grade beams for slab foundations, and spread footing foundations should be slightly deepened and cleaned to provide a fresh bearing surface.

Marl (rock) was encountered at depths ranging from 14 to 15 ft below the existing grades at this site. Rock excavation methods (including but not limited to rock teeth, rippers, jack hammers, or saw cutting) will be required to remove this material. **The contractor selected should have experience with excavation in this marl/rock.**

7.3 Fill Materials and Compaction

The following fill materials and compaction recommendations provided below are applicable for general site grading in the building area and other structural areas.

Select Fill – Materials used as select fill material should consist of a "non-expansive" material with a liquid limit less than 35 percent, a PI not less than about 5 percent or greater than 15 percent and contain no more than 0.5 percent fibrous organic materials, by weight. All select fill material should contain no deleterious material and should be compacted to a dry density of at least 95 percent standard Proctor maximum dry density (ASTM D 698) and within the range of 1 percentage point below to 3 percentage points above the material's optimum moisture content. *Note: The plasticity index and liquid limit of material used as select fill material should be routinely verified during placement using laboratory tests. Visual observation and classification should not be relied upon to confirm the material to be used as select fill material satisfies the above Atterberg-limit criteria.*

Flexible Base – Flexible base used in the building pad should consist of material meeting the requirements of TxDOT Standard Specifications Item 247, Type A, B, C or D, Grade 1-2. The flexible base should be compacted to at least 95 percent of modified Proctor maximum dry density (ASTM D 1557) and within the range of 2 percentage points below to 2 percentage points above the material's optimum moisture content. *Note: Any flexible base used for pavement applications should meet the requirements of Section 6.6.4.*

Processed Marl – Processed marl or other rock-like materials used as fill should be compacted to at least 95 percent of modified Proctor maximum dry density (ASTM D 1557). The compacted moisture content of marl or other rock-like materials used as fill is not considered crucial to proper performance. However, if the material's moisture content during placement is within 3 percentage points of optimum, the compactive effort required to achieve the minimum compaction criteria may be minimized. Individual rock pieces larger than 4 inches in dimension should not be used as fill. However, if rock fill is utilized within 2 ft below the bottom of floor slabs, the maximum allowable size of individual rock pieces should be reduced to 2 inches. Processed marl used as fill should incorporate sufficient fines to prevent the presence of voids around larger diameter rock pieces. A gradation of at least 40 percent passing a standard No. 4 sieve is recommended.

The following fill compaction recommendations provided below are applicable for general site grading.

> General Fill (Clay) – Clay soils should be compacted to a dry density between 95 and 100 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the clays during placement should be within the range of 1 to 4 percentage points above optimum. Clayey materials used as fill should be processed and the largest particle or clod should be less than 6 inches prior to compaction.
>
> General Fill (Granular) – Granular materials should be compacted to a dry density between 95 and 100 percent of standard Proctor maximum dry density (ASTM D 698). The compacted moisture content of the granular soils during placement should be within the range of -2 to +2 percentage points of optimum.

Prior to placement of any fill or foundation, the subgrade should be scarified to a depth of 6 inches and recompacted to a dry density of at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and within the range of -1 to +3 percentage points of the material's optimum moisture content. *Note: If the subgrade consists of rock (marl), the rock subgrade will not require re-compaction. However, the rock subgrade should be proofrolled as recommended in Section 7.1 of this report.*

In cases where either mass fills or utility lines are more than 10 ft deep, the fill/backfill below 10 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D-698) and within 2 percentage points of the material's optimum moisture content. The portion of the fill/backfill shallower than 10 ft should be compacted as outlined above.

Even if fill is properly compacted, fills in excess of about 10 ft are still subject to settlements over time of up to about 1 to 2 percent of the total fill thickness. This should be considered when designing utility lines under pavements and/or wall backfill.

Compaction should be accomplished by placing fill in about 8-inch thick loose lifts and compacting each lift to at least the specified minimum dry density. Field density and moisture content tests should be performed on each lift. As a guide, one test per 2,500 sq ft per lift is recommended in building areas. In larger site areas, a test frequency of one test per 5,000 sq ft or greater per lift may be used. Utility trench backfill should be tested at a rate of one test per lift per each 300 lineal ft of trench. A qualified geotechnical engineering firm should be retained to 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. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris or materials exceeding 4 inches in maximum dimension.

7.4 Groundwater

Groundwater was not encountered during drilling at this site. However, from our experience with similar soils, seasonal groundwater seepage could be encountered in excavations for grade beams, foundations, utility conduits and other general excavations. The risk of encountering seepage increases with depth of excavation and during or after periods of precipitation. Standard sump pits and pumping may be adequate to control minor seepage on a local basis in relatively shallow excavations.

Marl (rock) was encountered at depths ranging from 14 to 15 ft below the surface at this site. From our experience, seasonal seepage could occur where marl is at or near the final site grade. Subsurface drains may be required to intercept seasonal groundwater seepage in areas where marl is at or near final site grade. The need for subsurface drains or other de-watering devices across the site should be carefully addressed by the construction testing laboratory during construction. ALPHA can review any required drainage details once prepared.

In any areas where cuts are made to establish final grades at the site, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Subsurface drains may be required to intercept seasonal groundwater seepage. The need for these or other de-watering devices should be carefully addressed during construction. Our office could be contacted to visually observe the final grades to evaluate the need for such drains.

8.0 LIMITATIONS

Professional services provided in this geotechnical exploration were performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. The scope of services provided herein does not include an environmental assessment of the site or investigation for the presence or absence of hazardous materials in the soil, surface water or groundwater. ALPHA, upon written request, can be retained to provide these services.

ALPHA is not responsible for conclusions, opinions or recommendations made by others based on this data. Information contained in this report is intended for the exclusive use of the Client (and their designated design representatives), and is related solely to design of the specific structures outlined in Section 2.0. No party other than the Client (and their designated design representatives) shall use or rely upon this report in any manner whatsoever unless such party shall have obtained ALPHA's written acceptance of such intended use. Any such third party using this report after obtaining ALPHA's written acceptance shall be bound by the limitations and limitations of liability contained herein, including ALPHA's liability being limited to the fee paid to it for this report. Recommendations presented in this report should not be used for design of any other structures except those specifically described in this report. In all areas of this report in which ALPHA may provide additional services if requested to do so in writing, it is presumed that such requests have not been made if not evidenced by a written document accepted by ALPHA. Further, subsurface conditions can change with passage of time. Recommendations contained herein are not considered applicable for an extended period of time after the completion date of this report. It is recommended our office be contacted for a review of the contents of this report for construction commencing more than one (1) year after completion of this report. Non-compliance with any of these requirements by the Client or anyone else shall release ALPHA from any liability resulting from the use of, or reliance upon, this report.

Recommendations provided in this report are based on our understanding of information provided by the Client about characteristics of the project. If the Client notes any deviation from the facts about project characteristics, our office should be contacted immediately since this may materially alter the recommendations. Further, ALPHA is not responsible for damages resulting from workmanship of designers or contractors. It is recommended the Owner retain qualified personnel, such as a Geotechnical Engineering firm, to verify construction is performed in accordance with plans and specifications.

APPENDIX

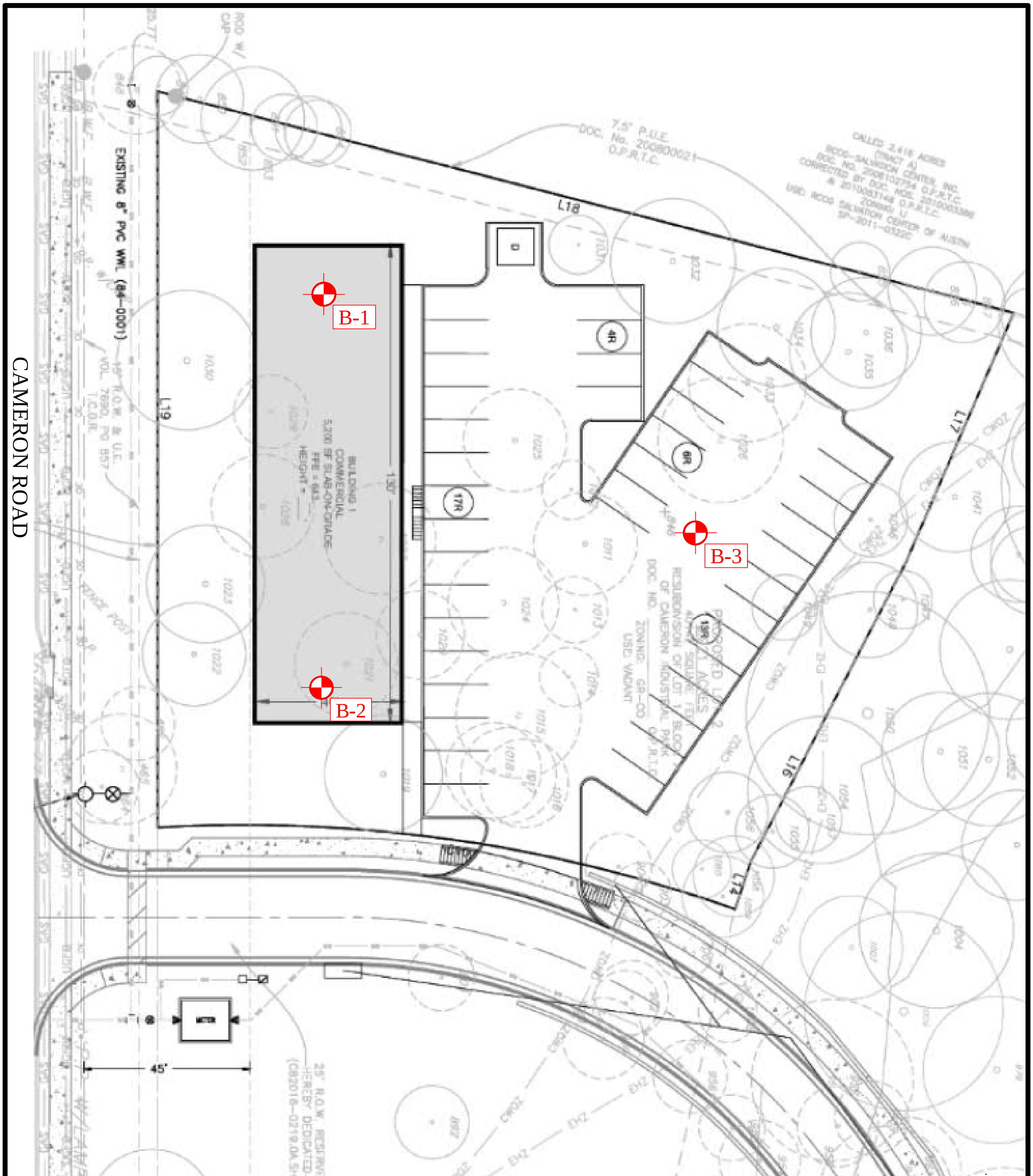
A-1 METHODS OF FIELD EXPLORATION

A truck-mounted, rotary drill rig equipped with continuous flight augers was used to advance the boreholes. A total of three (3) borings were performed for this geotechnical exploration at the approximate locations shown on the Boring Location Plan, Figure 1. The boring locations were staked by the client. The locations of the borings shown on the Boring Location Plan are considered accurate only to the degree implied by the methods used to define them. The approximate latitude and longitude coordinates at each boring location were obtained using a handheld GPS device.

Relatively undisturbed samples of the cohesive subsurface materials were obtained by hydraulically pressing 3-inch O.D. thin-wall sampling tubes into the underlying soils at selected depths (ASTM D 1587). These samples were removed from the sampling tubes in the field and evaluated visually. One representative portion of each sample was sealed in a plastic bag for use in future visual evaluations and possible testing in the laboratory.

Samples of granular and cohesive materials were obtained using split-spoon sampling procedures in general accordance with ASTM Standard D 1586. Disturbed samples were obtained at selected depths in the borings by driving a standard 2-inch O.D. split-spoon sampler 18 inches into the subsurface material using a 140-pound hammer falling 30 inches. The number of blows required to drive the split-spoon sampler the final 12 inches of penetration (N-value) is recorded in the appropriate column on the boring logs. However, if the sampler was not driven the initial 6-inch seating increment with 50 hammer blows, refusal (i.e. “ref”) is recorded along with the inches driven on the logs.

Our field representative prepared field logs as part of the field exploration. The field logs included visual descriptions of the materials encountered during drilling and their interpretation of the subsurface conditions between samples. The Log of Boring sheets included in this report represent the engineer’s interpretation of the field logs and include modifications based on visual observations using the Unified Soil Classification System (USCS) and testing of the samples in the laboratory. **Samples not consumed by testing will be retained in our laboratory for at least 30 days and then discarded unless the Client requests otherwise.**



GEOTECHNICAL EXPLORATION
CAMERON COMMERCIAL
CAMERON ROAD NEAR EAST RUNDBERG LANE
AUSTIN, TEXAS
ALPHA PROJECT NO. A183125

N

APPROXIMATE BORING LOCATIONS

ALPHA TESTING

BORING LOCATION PLAN
FIGURE 1

B-1 METHODS OF LABORATORY TESTING

Representative samples were inspected and classified by a qualified member of the Geotechnical Division and the boring logs were edited as necessary. To aid in classifying the subsurface materials and to determine the general engineering characteristics, natural moisture content tests (ASTM D 2216), and Atterberg-limit tests (ASTM D 4318). Results of all laboratory tests described above are provided on the accompanying boring logs as noted.

In addition to the Atterberg-limit tests, the expansive properties of the clay soils were further analyzed by absorption swell tests (ASTM D 4546, Method B). The swell test is performed by placing a selected sample in a consolidation machine and applying the overburden pressure and then allowing the sample to absorb water. When the sample exhibits very little tendency for further expansion, the height increase is recorded and the percent swell and total moisture gain calculated. Results of the absorption swell tests are provided on the Swell Test Data sheet, Figure 2, included in this appendix.

ALPHA TESTING

ALPHA REPORT NO.: A183125 DATE: 12/14/18

4740 Perrin Creek, Suite 480
San Antonio, Texas 78217
Geotechnical I Construction Materials I Environmental
www.alphatesting.com
TBPE Firm No. 813

TEST METHOD: ASTM D 4546, Method B

TESTED FOR: LDG Development, LLC
Louisville, Kentucky

PROJECT: Cameron Commercial
Austin, Texas

TECHNICIAN: Chris Shipman

SWELL TEST RESULTS

Boring No.	**B-1**	**B-2**					
Average Depth, ft	7	3					
Pocket Penetrometer, tsf	4.5+	4.5+					
Liquid Limit, %	47	40					
Plastic Limit, %	17	21					
Plastic Index, %	30	19					
Initial Moisture Content, %	17	19					
Final Moisture Content, %	21	23					
Unit Wet Weight (pcf)	126	120					
Unit Dry Weight (pcf)	107	101					
Percent Swell	0.1	-0.4					

FIGURE 2

ALPHA TESTING
WHERE IT ALL BEGINS

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Suite 480
San Antonio, Texas 78217
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LOG OF BORING NO.: B- 1

PROJECT NO.: A183125

Client: LDG Development, LLC
Project: Cameron Commercial
Start Date: 12/3/2018 **End Date:** 12/3/2018
Drilling Contractor:
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: Austin, Texas
Surface Elevation:
Longitude: -97.67608
Latitude: 30.34936
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
▽ On Rods (ft): NONE
▼ After Drilling (ft): DRY
▼ After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0–2.0		**FAT CLAY with SAND (CH)** dark brown	☒		17					19	57	24	33
2.0–14.0		**LEAN CLAY (CL)** tan	☒		19					18			
5			☒		52			88		14			
			■			4.5			107	17	47	17	30
10			☒		46					19			
14.0			☒		ref/3"					10			
14.0–20.0		**MARL** tan; weathered with clay seams and LIMESTONE fragments and layers											
15													
20			☒		ref/1"					9			
20.0		**BORING TERMINATED AT 20 FEET**											
25													

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LOG OF BORING NO.: B- 2

Sheet 1 of 1

PROJECT NO.: A183125

Client: LDG Development, LLC
Project: Cameron Commercial
Start Date: 12/3/2018 **End Date:** 12/3/2018
Drilling Contractor:
Drilling Method: CONTINUOUS FLIGHT AUGER

Location: Austin, Texas
Surface Elevation:
Longitude: -97.67616
Latitude: 30.34908
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
0–2.0		**FAT CLAY with SAND (CH)** dark brown 2.0				3.5		81		22			
2.0–11.0		**LEAN CLAY (CL)** tan				3.0			101	19	40	21	19
						4.5+				16			
5						4.5+				12			
					50/3"					13			
10		11.0											
11.0–15.0		**FAT CLAY (CH)** tan			29					21	53	25	28
15		15.0											
15.0–20.0		**MARL** tan; weathered with clay seams and LIMESTONE fragments and layers			ref/1"					10			
20		20.0											
		BORING TERMINATED AT 20 FEET											
25													

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LOG OF BORING NO.: B- 3

PROJECT NO.: A183125

Client: LDG Development, LLC
Location: Austin, Texas
Project: Cameron Commercial
Surface Elevation:
Start Date: 12/3/2018 **End Date:** 12/3/2018
Longitude: -97.67581
Drilling Contractor:
Latitude: 30.34913
Drilling Method: CONTINUOUS FLIGHT AUGER
Hammer Drop (lbs / in): 140 / 30

GROUND WATER OBSERVATIONS
On Rods (ft): NONE
After Drilling (ft): DRY
After ____ Hours (ft):

Depth, feet	Graphic Log	MATERIAL DESCRIPTION	Sample Type	Recovery % RQD	N Value (blows/ft)	Pocket Penetrometer (tsf)	Unconfined Comp. Strength (tsf)	% Passing No. 200 Sieve	Unit Dry Weight (pcf)	Water Content, %	Liquid Limit	Plastic Limit	Plasticity Index
		FAT CLAY with SAND (CH) dark brown				4.0				25	58	22	36
		2.0											
		LEAN CLAY (CL) tan				4.5				20			
						4.5				16			
5		5.0											
		BORING TERMINATED AT 5 FEET											
10													
15													
20													
25													

ALPHA TESTING
WHERE IT ALL BEGINS

KEY TO SOIL SYMBOLS AND CLASSIFICATIONS

SOIL & ROCK SYMBOLS

- (CH), High Plasticity CLAY
- (CL), Low Plasticity CLAY
- (SC), CLAYEY SAND
- (SP), Poorly Graded SAND
- (SW), Well Graded SAND
- (SM), SILTY SAND
- (ML), SILT
- (MH), Elastic SILT
- LIMESTONE
- SHALE / MARL
- SANDSTONE
- (GP), Poorly Graded GRAVEL
- (GW), Well Graded GRAVEL
- (GC), CLAYEY GRAVEL
- (GM), SILTY GRAVEL
- (OL), ORGANIC SILT
- (OH), ORGANIC CLAY
- FILL

SAMPLING SYMBOLS

- SHELBY TUBE (3" OD except where noted otherwise)
- SPLIT SPOON (2" OD except where noted otherwise)
- AUGER SAMPLE
- TEXAS CONE PENETRATION
- ROCK CORE (2" ID except where noted otherwise)

RELATIVE DENSITY OF COHESIONLESS SOILS (blows/ft)

VERY LOOSE	0 TO 4
LOOSE	5 TO 10
MEDIUM	11 TO 30
DENSE	31 TO 50
VERY DENSE	OVER 50

SHEAR STRENGTH OF COHESIVE SOILS (tsf)

VERY SOFT	LESS THAN 0.25
SOFT	0.25 TO 0.50
FIRM	0.50 TO 1.00
STIFF	1.00 TO 2.00
VERY STIFF	2.00 TO 4.00
HARD	OVER 4.00

RELATIVE DEGREE OF PLASTICITY (PI)

LOW	4 TO 15
MEDIUM	16 TO 25
HIGH	26 TO 35
VERY HIGH	OVER 35

RELATIVE PROPORTIONS (%)

TRACE	1 TO 10
LITTLE	11 TO 20
SOME	21 TO 35
AND	36 TO 50

PARTICLE SIZE IDENTIFICATION (DIAMETER)

BOULDERS	8.0" OR LARGER
COBBLES	3.0" TO 8.0"
COARSE GRAVEL	0.75" TO 3.0"
FINE GRAVEL	5.0 mm TO 3.0"
COURSE SAND	2.0 mm TO 5.0 mm
MEDIUM SAND	0.4 mm TO 5.0 mm
FINE SAND	0.07 mm TO 0.4 mm
SILT	0.002 mm TO 0.07 mm
CLAY	LESS THAN 0.002 mm