GEOTECHNICAL EXPLORATION

SHADE STRUCTURE
THE QUAD AT UTPB
4901 E. University Boulevard
Odessa, Texas
ALPHA Report No. A230910
April 28, 2023

Prepared for:

WEST TEXAS CONSULTANTS, INC.
405 SW 1st Street
Andrews, Texas 79714

Attention: Randy Shaffer

Prepared By:

ALPHA TESTING
WHERE IT ALL BEGINS

ALPHA TESTING
A Universal Engineering Sciences Company

Geotechnical
Construction Materials
Environmental
TBPELS Firm No. 813

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April 28, 2023

West Texas Consultants
405 SW 1st Street
Andrews, Texas 79714

Attention: Randy Shaffer

Re: Geotechnical Exploration
Shade Structure
The Quad at UTPB
4901 University Boulevard
Odessa, Texas
ALPHA Report No. A230910

Attached is the report of the geotechnical exploration performed for the referenced project. This study was authorized by Randy Shaffer with West Texas Construction, Inc. on April 5, 2023 and performed in accordance with ALPHA Proposal No. 96716-R dated March 22, 2023.

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.

ALPHA TESTING, LLC 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, LLC

Sebastian L. Aleman
Project Manager
SLA/MLM

Mark L. McKay, P.E.
Associate Principal

STATE OF TEXAS
MARK L. McKAY
91067
LICENSED
PROFESSIONAL ENGINEER
4/28/2023

Copy: West Texas Consultants, Inc.; Randy Shaffer; via email

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ALPHA REPORT NO. A230910

1.0 PURPOSE AND SCOPE

The purpose of this geotechnical exploration is for ALPHA TESTING, LLC (ALPHA) to evaluate for WEST TEXAS CONSULTANTS, INC. (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 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 the 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 from the boring 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

The project will include two new open shade structures (approximately 1,500 and 3,000 SF) to be located at 4901 E. University Boulevard in Odessa, Texas. A site plan illustrating the general outline of the property is provided as Figure 1, Boring Location Plan, included in the Appendix. A site grading plan, including initial and final contours, was not available at the time of this study. For the purpose of writing this report, we have assumed the final site grades will be at or near existing grade (within 1 ft).

The new shade structures are anticipated to create light loads to be carried by a shallow foundation system consisting of spread footings at this site. A floor slab is not planned for the shade structures.

2.1 Pre-Existing Conditions

During our field exploration activities for this project, existing structures consisting of University Buildings, light poles, and sidewalks were noted by our field representative. This site is developed and consists of manicured landscaping consisting of grass, weeds, and trees throughout the site. No rock outcrop was noted.

3.0 FIELD EXPLORATION

Subsurface conditions on the site were explored by drilling a total of two (2) 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** [1]
Structure Area	B-1 and B-2	8 to 18½
[1] *Borings were terminated early due to auger refusal.*		

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 Log of Borings sheets (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 sheets or summary data sheets also enclosed in the Appendix.

5.0 GENERAL SUBSURFACE CONDITIONS

The Geologic Map of Texas, published by the University of Texas at Austin, Bureau of Economic Geology, has mapped the Windblown Cover Sand (Qcs) formation and the Playa Deposits (Qp) formation in the general area of the project site. The Windblown Cover Sand formation generally consists of fine-to medium-grained quartz, silty, calcareous, caliche nodules common, massive, grayish red sand, clayey sand, and sandstone. The Playa Deposits generally consists of clay silt and sand.

Within the 18½ -ft maximum depth explored on the site, subsurface materials consist generally of low to moderate plasticity FILL: CLAYEY SAND (SC), SANDY LEAN CLAY (CL), and CALICHE. Caliche (rock) was encountered at depths ranging from about 6 to 7 ft below the existing ground surface in the borings at this site. Apparent fill material was also encountered to a depth of about 4 ft below the existing ground surface in the borings at this site. The fill should be considered uncontrolled if compaction records cannot be located. 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 granular materials are considered relatively permeable and are anticipated to have a relatively fast response to water movement. The clayey materials and the caliche (rock) 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, in the granular materials, and at the soil/rock 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. *Note: Granular materials were encountered in the borings at this site. From our experience, these materials can be hard and difficult to excavate (including trenching), and could require forming and/or casing, especially if groundwater is encountered during construction.*

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, including structure location on the site, 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 review prior to construction.

6.1 General Considerations

The foundation system being considered to provide support for the proposed shade 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 foundation if they are designed and constructed in accordance with the recommendations contained in this report.

Design criteria given in this report were developed assuming final grades are within 1 ft of existing grade. Substantial cutting and filling (more than 1 ft) on the site 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 Existing Fill

As discussed in Section 5.0, existing fill was encountered to a depth of about 4 ft below existing grade at Boring B-1 and Boring B-2, and fill may be present in other areas of the site. In practice, it is difficult to accurately delineate fill soils that are similar to the native soils based on discrete test boreholes. Therefore, the recorded fill depths should be considered estimates and may vary somewhat from the actual fill depths. Test pits could be performed prior to construction to assess the lateral extent, depth, and nature of the existing fill. ALPHA would be pleased to assist with a test pit program if desired.

If compaction records of the existing fill are not available, the fill should be considered uncontrolled. Footings should extend below any existing uncontrolled fill to bear on native clay soils or the fill should be removed and re-compacted per the recommendations in Section 7.3.

6.1.2 Vertical Movements

Our findings indicate grade supported structures (including foundations) constructed within 1 ft of the existing building area's FFE could experience soil-related potential movement (i.e. PVR) up to about 1 inch. *Note: These PVR values were estimated assuming dry soil conditions and using on-site or similar soil with a Plasticity Index (PI) of 20 or less to raise grades a maximum of 1 ft.*

These potential seasonal movements were estimated in general accordance with methods outlined by the Texas Department of Transportation (TxDOT) Test Method Tex-124-E, engineering judgment, and experience. The estimated movements were 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.

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.

6.2 Subgrade Preparation

Structures supported within 1 ft of existing grade could experience soil-related potential seasonal movements up to 1 inch as discussed in Section 6.1.2. However, the upper 4 ft contains undocumented fill material and could experience settlement over 1 inch in its present condition due to applied structural loading. The potential seasonal movements can be maintained and settlement reduced at about 1 inch by properly preparing the subgrade as recommended below.

Remove all of the existing fill materials below and 3 ft beyond the perimeter of the footing. The fill was encountered to a depth of 4 ft in our borings. Fill may be deeper in other areas of the site and the contractor should remove all fill below the footings plus 3 ft beyond the perimeter of the footing.

After over-excavating all of the existing fill, place and compact select fill or base material to the footing elevation directly below and 3 ft beyond the perimeter of the bottom of the footing. *Note: Criteria for select fill and flexible base are provided in Section 7.3. On-site soil may be used as select fill provided it meets the select fill criteria provided in Section 7.3.*

In lieu of removing and re-compacting the existing uncontrolled fill material, the footing could be extended to bear on native soils. Native soils were encountered at a depth of 4 ft in our borings, but may be deeper. Alpha should be present to verify native soils have been encountered when deepening the footings.

6.3 Shallow Footing Foundation System for the Shade Structure

The structural frame for the proposed shade structure may be supported using a shallow footing foundation system bearing on select fill placed and compacted as recommended in Section 6.2 and Section 7.3, or the footing could be extended through any existing fill to bear on native soils. Existing fill was encountered to a depth of 4 ft in the borings at this site. The depth of the existing fill could be greater at other locations. Concrete for footings should be placed as soon as practical to prevent the soils at the base of the excavations from excessively drying.

Footings bearing at a minimum depth of 2 ft and on select fill material or native soils may be designed using a net allowable soil bearing pressure of 2,000 lbs per square ft. In using net pressure, the weight of the footing and backfill over the footing need not be considered. Footings subject to lateral forces or overturning should be proportioned such that the soil reaction force acting on the bottom of the footing lies within the middle one-third of the footing. Spread footings should have a minimal dimension of 24 inches for bearing capacity considerations.

Careful monitoring during construction is necessary to locate any pockets or seams of unsuitable materials, which might be encountered in excavations for footings. Existing fill and other unsuitable materials encountered at the foundation bearing level, should be removed and replaced with lean concrete (about 2,000 psi strength at 28 days), structural concrete, flexible base, select fill, or backfill compacted to at least 95 percent of standard Proctor maximum dry density (ASTM D 698) and at a moisture content within 2 percentage points of the material's optimum moisture content. *Note: Criteria for select fill and flexible base material are provided in Section 7.3 of this report.*

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 a key installed in the base of the footings, if required. We recommend a coefficient of base friction of 0.3 be used along the bottom of the footing. The available passive earth resistance on the vertical face of the footing and a key constructed in the base of the footing may be calculated using an allowable uniform passive earth pressure of 500 psf below a depth of 2 ft from adjacent grade for cohesive soils.

6.4 Seismic Considerations

TABLE E SEISMICPARAMETERS	
Description	**Values**
2018 International Building Code Site Classification (IBC) [1]	D [2]
Site Latitude (Degrees)	31.88901
Site Longitude (Degrees)	-102.32826
Mapped Spectral Acceleration for Short Periods (0.2-Second): (S_S) [3]	0.139 g
Mapped Spectral Acceleration for a 1-Second Period: (S_1) [3]	0.035 g
[1] The site class definition was determined using SPT N-values in conjunction with section 1613.2.2 in the 2018 IBC and ASCE 7-16.	
[2] ASCE 7-16 requires a site soil profile determination extending to a depth of 100 ft for seismic site classification. The current scope does not include the required 100-ft soil profile determination. Borings extended to a maximum depth of 18½ ft, and this seismic site class definition considers that stiff to 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 1613.2.3 (1) and 1613.2.3 (2) in the 2018 IBC.	

6.5 Drainage and Other Considerations

Adequate drainage should be provided to reduce seasonal variations in the moisture content of foundation soils. All pavement and sidewalks within 5 ft of the structure should be sloped away from the structure to prevent ponding of water around the structure. Final grades within 5 ft of the structure should be adjusted to slope away from the structure at a minimum slope of 2 percent. **Maintaining positive surface drainage throughout the life of the structure is essential.**

7.0 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Variations in subsurface conditions could be encountered during construction. To permit correlation between 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

All areas supporting foundations, 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 probing or 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 and probing 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.

If fill is to be placed on existing slopes (natural or constructed) steeper than six horizontal to one vertical (6:1), the fill materials should be benched into the existing slopes in such a manner as to provide a minimum bench-key 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.

Slope stability analysis of embankments (natural or constructed) was not within the scope of this study.

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 boring, 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. Long-lasting exposure of the bearing surface to air or water will result in changes in strength and compressibility of the bearing stratum. All 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. Therefore, if delays occur, excavations for spread footings should be slightly widened, deepened and cleaned to provide a fresh bearing surface.

7.3 Fill Materials and Compaction

The following fill materials and compaction recommendations 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 20 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.

The following fill compaction recommendations provided below are applicable for general site grading outside the building area. *Note: Imported soils used as general fill should consist of material with a PI not greater than 20 percent.*

> 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 0 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 0 to +4 percentage points of the material's optimum moisture content.

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. 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. *Note: We recommend any imported fill to be used at this site be approved by ALPHA prior to placement.*

7.4 Utilities

In cases where utility lines are more than 12 ft deep, the trench backfill below 12 ft should be compacted to at least 100 percent of standard Proctor maximum dry density (ASTM D 698) and within –2 to +2 percentage points of the material's optimum moisture content. The portion of the trench backfill shallower than 12 ft should be compacted as previously outlined. Density tests should be performed on each lift (maximum 12-inch thick) and should be performed as the trench is being backfilled. *Note: Even if the utility backfill is properly compacted, fills in excess of about 12 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 pavement over utility lines and/or other areas with deep fill.*

If utility trenches or other excavations extend to or beyond a depth of 5 ft below construction grade, the contractor or others shall be required to develop an excavation safety plan to protect personnel entering the excavation or excavation vicinity. The collection of specific geotechnical data and the development of such a plan, which could include designs for sloping and benching or various types of temporary shoring, is beyond the scope of this study. Any such designs and safety plans shall be developed in accordance with current OSHA guidelines and other applicable industry standards.

7.5 Groundwater

Groundwater was encountered as shallow as about 8½ ft below existing grade in Boring B-2 during drilling at this site. From our experience with similar soils, seasonal groundwater seepage could be encountered in excavations for spread footings, 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.

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

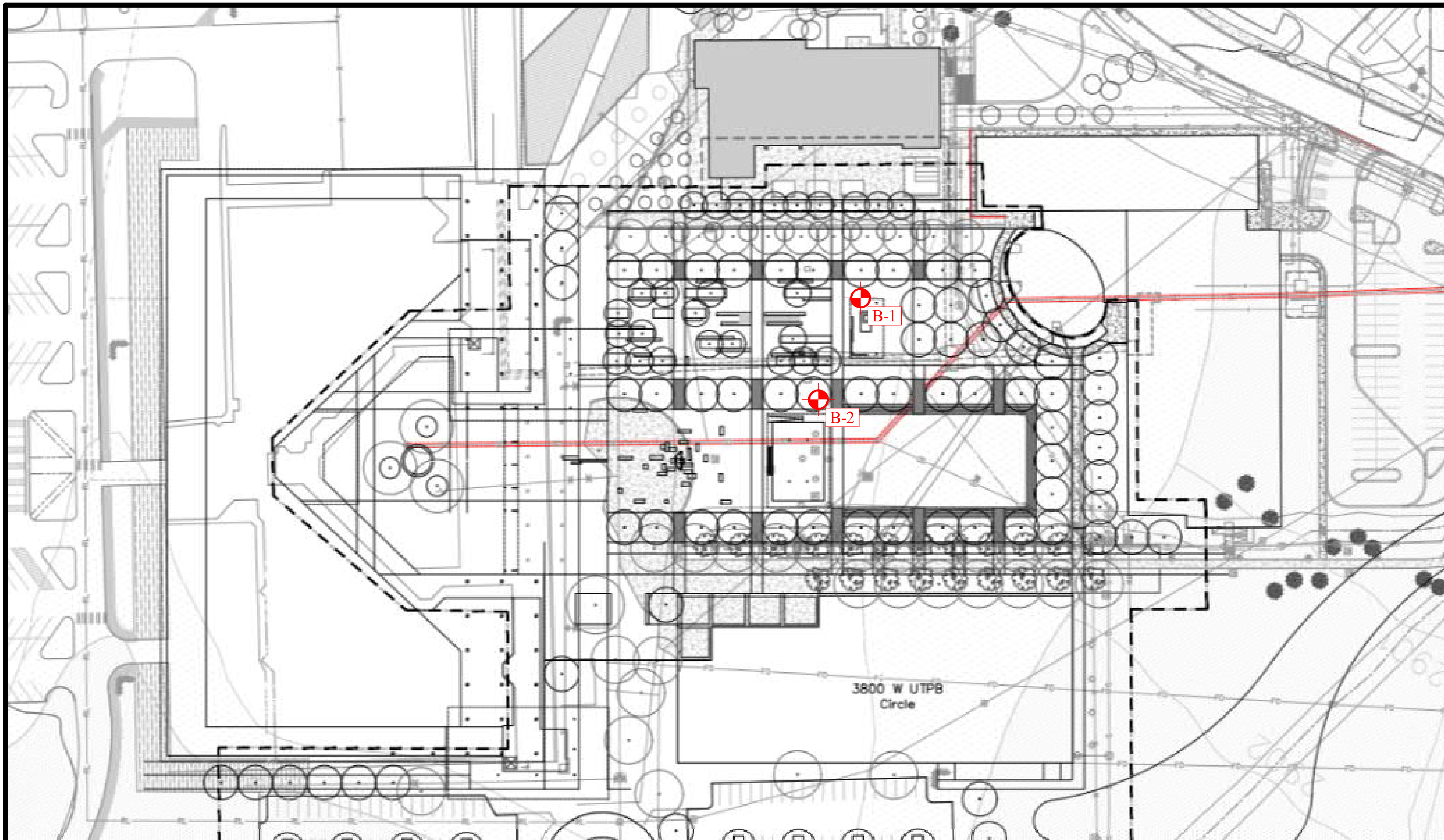
A-1 METHODS OF FIELD EXPLORATION

Using standard rotary drilling equipment, two (2) test borings were performed for this geotechnical exploration. The test borings were drilled at the approximate location shown on the Boring Location Plan – Figure 1. The boring locations were established in the field by using a handheld GPS device or by pacing or taping and estimating right angles from landmarks which could be identified in the field and as shown on the site plan provided during this study. The locations of the test boring shown on the Boring Location Plan is considered accurate only to the degree implied by the methods used to define them.

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 examined visually. One representative portion of each sample was sealed in a plastic bag for use in future visual examinations and possible testing in the laboratory.

In addition, representative 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 Borings 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
SHADE STRUCTURE - THE QUAD AT UTPB
4901 EAST UNIVERSITY BOULEVARD
ODESSA, TEXAS
ALPHA PROJECT NO. A230910

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), Atterberg-limit tests (ASTM D 4318), and percent passing No. 200 Sieve (ASTM D 1140) were performed on selected samples. Pocket penetrometer tests were conducted on all undisturbed samples. Results of the laboratory tests 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). The swell test is performed by placing a selected sample in a consolidation machine and applying either the approximate current or expected 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 Log of Borings sheets, included in this Appendix.

ALPHA TESTING

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TBPE Firm No. 813

ALPHA REPORT NO.: A230910 DATE: 4/20/23

TEST METHOD: ASTM D 4546, Method B

TESTED FOR: West Texas Consultants, Inc.
Andrews, Texas

PROJECT: Shade Structure - The Quad at UTPB
Odessa, Texas

TECHNICIAN: Chris Shipman

SWELL TEST RESULTS

Boring No.	**B-1**						
Average Depth, ft	3						
Pocket Penetrometer, tsf	4.5+						
Liquid Limit, %	27						
Plastic Limit, %	10						
Plastic Index, %	17						
Initial Moisture Content, %	11						
Final Moisture Content, %	15						
Unit Wet Weight (pcf)	131						
Unit Dry Weight (pcf)	118						
Percent Swell	-0.3						

FIGURE 2

Our test results and reports are for the exclusive use of the Client (and their designated recipients on file in our office) and shall not be reproduced and/or distributed except with express approval of Alpha. The use of our name and test results must receive our written approval. Test results and reports apply only to the samples tested and/or observed, and are not indicative of the qualities of apparently identical or similar specimens.

ALPHA TESTING
WHERE IT ALL BEGINS

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LOG OF BORING NO.: B- 1

Sheet 1 of 1

PROJECT NO.: A230910

Client: West Texas Consultants, Inc.
Location: Odessa, Texas
Project: Shade Structure - The Quad at UTPB
Surface Elevation:
Start Date: 4/17/2023 **End Date:** 4/17/2023
Longitude: -102.32826
Drilling Contractor:
Latitude: 31.88901
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	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
0–4.0	**FILL: CLAYEY SAND (SC)** reddish-brown				4.5+				8			
					4.5+			118	11	27	10	17
4.0	- becoming reddish-tan from 3 to 4 feet											
4.0–7.0	**CLAYEY SAND (SC)** dark brown			23					8	22	14	8
7.0				ref/0"								
7.0–8.0	**CALICHE** tan								33			
8.0	**BORING TERMINATED AT 8 FEET**											

BORING TERMINATED EARLY DUE TO AUGER REFUSAL

ALPHA TESTING
WHERE IT ALL BEGINS

4740 Perrin Creek
Suite 480
San Antonio, Texas
Phone: 210-249-2100
Fax: 210-249-2101
www.alphatesting.com

LOG OF BORING NO.: B- 2

PROJECT NO.: A230910

Client: West Texas Consultants, Inc.
Location: Odessa, Texas
Project: Shade Structure - The Quad at UTPB
Surface Elevation:
Start Date: 4/17/2023 **End Date:** 4/17/2023
Longitude: -102.32851
Drilling Contractor:
Latitude: 31.88885
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
		FILL: CLAYEY SAND (SC) reddish-brown				4.5+				6			
						3.0				9			
		- becoming reddish-tan from 3 to 4 feet; 4.0											
5		**CLAYEY SAND (SC)** dark brown; 6.0			15			22		7	20	13	7
		CALICHE tan; 8.0			ref/0"					9			
10		**CLAYEY SAND (SC)** tan with gravel and partially cemented seams and layers			40			33		12	36	21	15
						4.5+				16			
15		18.5			ref/0"					29			
20		**BORING TERMINATED AT 18½ FEET**											
25		BORING TERMINATED EARLY DUE TO AUGER REFUSAL											

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