

GEOTECHNICAL INVESTIGATION

PROPOSED NEW COMMUNITY PARK
FAIR PARK
CITY OF DALLAS
DALLAS, TEXAS

AGG REPORT NO. DE21-063

OCTOBER 4, 2021

PREPARED FOR:

PACHECO KOCK
DALLAS, TEXAS

PRESENTED BY:

Geotechnical Engineering – Construction Services – Construction Materials Engineering Testing
3228 Halifax Street - Dallas, TX 75247 Ph. 972.444.8889 FX. 972.444.8893

ALLIANCE GEOTECHNICAL GROUP

GEOTECHNICAL ENGINEERING
ENVIRONMENTAL CONSULTING
CONSTRUCTION MATERIALS ENGINEERING AND TESTING
CONSTRUCTION INSPECTION

October 4, 2021

Mr. Kyle Harris, RPLS
Pacheco Koch
7557 Rambler Rd. #1400
Dallas, Texas 75231

Office: (972) 235-3031
Email: kharris@pkce.com

Re: Geotechnical Investigation
Proposed New Community Park
Fair Park
City of Dallas
AGG Report No. DE20-063

Dear Mr. Harris:

Please find enclosed our report summarizing the results of the geotechnical investigation performed at the above referenced project. We trust the recommendations derived from this investigation will provide you with the information necessary to complete your proposed project successfully.

For your future construction materials testing and related quality control requirements, it is recommended that the work be performed by Alliance Geotechnical Group, Inc. in order to maintain continuity of inspection and testing services for the project under the direction of the Geotechnical Project Engineer.

We thank you for the opportunity to provide you with our professional services. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,
ALLIANCE GEOTECHNICAL GROUP, INC.

Francis Mbogning P.E.
Project Engineer

ALLIANCE GEOTECHNICAL GROUP
STATE OF TEXAS
MICHAEL DAINE ROLAND
96043
LICENSED
PROFESSIONAL ENGINEER

Michael D Roland, P.E.
Vice President

MEMBER ACIL

Dallas • Ft. Worth • Prosper • Conroe • Huntsville • Dayton
3228 Halifax Street, Dallas, Texas 75247
Tel: 972-444-8889 • Fax: 972-444-1970 • www.aggengr.com

AAPR

TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION ---- 1
1.1 PROJECT DESCRIPTION 1
1.2 PURPOSE AND SCOPE 1
2.0 FIELD INVESTIGATION ---- 1
3.0 LABORATORY TESTING ---- 2
4.0 SITE AND SUBSURFACE CONDITIONS ---- 3
4.1 GENERAL SITE CONDITIONS 3
4.2 SITE GEOLOGY 3
4.3 SUBSURFACE CONDITIONS 3
4.4 GROUNDWATER CONDITIONS 4
5.0 ANALYSES AND RECOMMENDATIONS ---- 4
5.1 SOIL MOVEMENT 4
5.1.1 EASTERN PORTION OF SITE 4
5.1.2 MIDDLE AND WESTERN PORTIONS OF SITE 4
5.2 EXISTING FILL SOILS 5
5.3 STRAIGHT SHAFT FOUNDATION SYSTEM 5
5.3.1 DRILLED SHAFT SOIL INDUCED UPLIFT LOADS 7
5.3.2 LATERALLY LOADED PIERS 8
5.3.3 DRILLED SHAFT CONSTRUCTION CONSIDERATIONS 10
5.3.4 GRADE BEAMS 11
5.4 FLOOR SLAB 12
5.4.1 STRUCTURALLY SUPPORTED FLOOR SLAB 12
5.4.2 SLAB-ON-GRADE FLOOR SLAB 13
5.4.2.1 PARKING GARAGE STRUCTURE - SITE PREPARATION 13
5.4.2.2 WATER FEATURE & PAVILION STRUCTURES - SITE PREPARATION 15
5.5 FLAT WORK AND PIPING CONSIDERATIONS 17
5.6 SHALLOW FOUNDATION SYSTEMS 18
6.0 ARCHITECTURAL AND STRUCTURAL DETAILING ---- 22
7.0 PAVEMENT RECOMMENDATIONS ---- 23
7.1 EXISTING FILL SOILS 23
7.2 SUBGRADE PREPARATION 23
7.3 RECOMPACTED PAVEMENT SUBGRADE 24
7.4 DRIVE APPROACHES 25
7.5 PAVEMENT SECTIONS 25
7.6 PAVEMENT CONSIDERATIONS 26
8.0 NEW SIDEWALK CONSTRUCTION ---- 27
9.0 EARTHWORK GUIDELINES ---- 29
9.1 SITE GRADING AND DRAINAGE 29
9.2 UTILITY TRENCH EXCAVATION 30
9.3 PROOFROLLING AND SUBGRADE PREPARATION 30
9.4 ON-SITE CLAY FILL PLACEMENT IN PAVEMENT AND LANDSCAPING AREAS 30
9.5 ON-SITE SOIL PLACEMENT IN STRUCTURAL AREAS 31
9.5.1 MOISTURE CONDITIONING PRIOR TO COMPACTION 31
9.5.2 QUALITY ASSURANCE REQUIREMENTS 31
9.6 SELECT FILL PLACEMENT IN BUILDING AREAS 32
10.0 TREE EFFECTS ---- 32
11.0 FIELD SUPERVISION ---- 32

12.0 LIMITATIONS ---------- 33

FIGURES

FIGURE

PLAN OF BORINGS ---------- 1
LOGS OF BORINGS ---------- 2 thru 24
LEGEND - KEY TO LOG TERMS & SYMBOLS ---------- 25
SWELL TEST RESULTS ---------- 26

GEOTECHNICAL INVESTIGATION
PROPOSED NEW COMMUNITY PARK
FAIR PARK
CITY OF DALLAS

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION

The project consists of converting an existing Fair Park parking lot into a community park. The limits of the community park begin just south of Exposition Avenue and extends north to Gaisford Street. It is understood that a new parking garage, community pavilion, interactive water feature and trail will be constructed. The parking garage will be constructed on the eastern portion of the subject site. The exact locations for the proposed pavilion and water feature is currently unknown. However, these structures will be constructed on the middle and/or western portions of the subject site.

Grading information was not available at the time of this investigation. For the purpose of this report, we have assumed that cut and fills will be minimal (2 feet or less) in order to achieve final grades.

1.2 PURPOSE AND SCOPE

The purposes of this geotechnical investigation were to: 1) explore the subsurface conditions at the site, 2) evaluate the pertinent engineering properties of the subsurface materials, 3) provide foundation recommendations for the proposed new structures, 4) provide concrete pavement recommendations, and 5) provide comments and recommendations for site grading and drainage. This report was prepared in general accordance with Alliance Geotechnical Group's Proposal P20-0930r1 dated September 30, 2020.

2.0 FIELD INVESTIGATION

The field investigation consisted of drilling a total of eleven (11) test borings (Borings B-1 thru B-11) across the site. Six (6) structural test borings (Borings B-6 thru B-11) were drilled in the vicinity of the proposed parking garage structure. Four (4) structural test borings (Borings B-1, B-3, B-4 and B-5) were located in potential areas of the proposed pavilion and water feature structures. These structural test borings were advanced until the bearing stratum (very hard gray limestone) was encountered and penetrated to termination depths

ranging from 45 to 80 feet below the existing ground surface. In addition to these structural borings, one (1) pavement boring (Boring B-2) was advanced to a depth of about 10 feet below the existing ground surface.

A truck-mounted auger drill rig was used to advance the test borings and to obtain samples for laboratory evaluation. The borings were located at the approximate locations shown on the Plan of Borings (Figure 1).

Undisturbed samples of cohesive soils were obtained at intermittent intervals with standard, thin-walled, seamless tube samplers. These samples were extruded in the field, logged, sealed, and packaged to protect them from disturbance and maintain their in-situ moisture content during transportation to our laboratory.

The relative density of the overburden soils were occasionally evaluated by the Standard Penetration test in conjunction with split spoon sampling. The Standard Penetration test involves driving a standard 2 inch diameter sampler a total of 18 inches and recording the blow counts and driving distances for each 6 inch or 50 blow increment. The first 6 inch drive is for seating purposes. The results of the Standard Penetration test are recorded at the respective testing depths on the Logs of Borings.

The rock encountered in the test borings was evaluated by the Texas Department of Transportation Penetrometer (TxDOT Cone) tests. The TxDOT Cone is driven with the resulting penetration in inches recorded for 100 blows. The results of the TxDOT Cone test are recorded at the respective testing depths on the Logs of Borings. In addition, the rock was further evaluated by rock coring of three (3) of the parking garage borings (Borings B-6, B-8 and B-10).

The results of the boring program are presented on the Logs of Borings, Figures 2 thru 24. A key to the descriptive terms and symbols used on the logs is presented on Figure 25.

3.0 LABORATORY TESTING

Laboratory tests were performed on representative samples of the soil to aid in classification of the soil materials. These tests included Atterberg limits tests, percent passing #200 sieve, moisture content tests, and unit weight determinations. Hand penetrometer tests were performed on the clay soil samples to provide indications of the swell potential and the foundation bearing properties of the subsurface strata. Unconfined

compression strength testing was performed on selected rock core samples to provide foundation bearing properties.

To provide additional information about the swell characteristics of these soils at their in-situ moisture conditions, absorption swell tests were performed on selected samples of the clay soils. The results of our testing program are presented on the Logs of Borings (Figures 2 thru 24) and on the Swell Test Results (Figure 26).

4.0 SITE AND SUBSURFACE CONDITIONS

4.1 GENERAL SITE CONDITIONS

The project consists of converting an existing parking lot into a community park located on the eastern portion of Fair Park. The limits of the community park begin just south of Exposition Avenue and extends north to Gaisford Street. The subject area is currently covered with concrete pavement. The site gently slopes downward from the east towards the west with elevation differences across the site on the order of 20 feet. See Plan of Borings (Figure 1) for location, configuration and aerial view.

4.2 SITE GEOLOGY

As shown on the Dallas sheet of the Geologic Atlas of Texas, the site is located in an area where Fluviatile Terrace deposits are overlying the Austin Chalk Formation. Fluviatile Terrace deposits are Quaternary Age deposits consisting of gravel, sand, silt and clay. The Austin Chalk formation typically consists of limestone overlain by clayey soils. Soils derived from this formation are typically moderately to highly plastic clays exhibiting high shrink/swell with variations in moisture content.

4.3 SUBSURFACE CONDITIONS

Subsurface conditions encountered in the borings, including descriptions of the various strata, their depths, and thicknesses, are presented on the Logs of Borings. Note that depth on all borings refers to the depth from the existing grade or ground surface present at the time of the investigation. Boundaries between the various soil types are approximate.

The upper soils present within the eastern portion of the site consists primarily of expansive clay soils. Whereas, the upper soils present within the middle and western portions of the site are highly variable ranging from non-plastic sand, clayey sand, sandy clay and expansive clay soils.

4.4 GROUNDWATER CONDITIONS

The borings were advanced using hollow stem auger methods. Advancement of the borings using these methods allows observation of the initial zones of seepage. Groundwater was encountered during drilling within the deeper test borings at depths ranging from 14 to 49 feet below the existing ground surface. Shallower groundwater levels should be anticipated in all areas if construction occurs after periods of rain in the form of seepage through the sand layers.

It is not possible to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The subsurface water conditions are subject to change with variations in climatic conditions and are functions of subsurface soil conditions, and rainfall.

5.0 ANALYSES AND RECOMMENDATIONS

5.1 SOIL MOVEMENT

5.1.1 EASTERN PORTION OF SITE

The subsurface exploration within the eastern portion of the site (Borings B-6 thru B-11) within the proposed garage structure area revealed the presence of deep highly expansive clay soils. Potential soil swell movement calculations were performed using swell test results, pocket penetrometer readings, and moisture content tests to estimate the swell potential of the soil. Potential soil swell movement values based upon existing moisture conditions and current grades are estimated to be on the order of up to 9 inches.

5.1.2 MIDDLE AND WESTERN PORTIONS OF SITE

The subsurface exploration within the middle and western portions of the site (water feature and pavilion areas) revealed highly variable soil conditions. The upper soils in these areas of the site consist of non-plastic sands, clayey sands, sandy clays and some highly expansive clay soils. The sands are non-expansive. The clayey soils have a low to moderate swell potential. The sandy clays and clays have a moderate to high swell potential. Potential soil swell movement calculations were performed using swell test results, pocket penetrometer readings, and moisture content tests to estimate the swell potential of the soil. Potential soil swell movement values based upon existing moisture conditions and current grades for each test boring area are estimated as shown in Table 1.

TABLE 1. ESTIMATED POTENTIAL UPWARD SOIL SWELL MOVEMENTS

Boring Number	Potential Soil Swell Movements
B-1	2 inches
B-2	< 1 inch
B-3	5 inches
B-4	3 inches
B-5	< 1 inch

5.2 EXISTING FILL SOILS

Existing fill soils were encountered within three of the test borings (Boring B-3, B-4 and B-6). The existing fill soils extended to depths ranging from 1.5 to 5.5 feet below the existing ground surface. If the existing fill soils were placed in an uncontrolled manner without engineering supervision and without proper moisture / compaction verification of each fill lift, some settlement should be anticipated for slab-on-grade floor slabs, retaining walls, pavements and flatwork placed over existing uncontrolled fill soils.

5.3 STRAIGHT SHAFT FOUNDATION SYSTEM

The proposed new parking garage structure should be supported by cased straight sided continuously reinforced shaft piers. The proposed new water feature and pavilion structures could also be supported by cased straight sided continuously reinforced shaft piers. As an alternative to cased straight shaft piers (as a potential valued engineering approach), consideration could be given to supported these structures on auger cast piles. See Notes 3 and 4 below.

The cased straight shaft piers should be founded in the very hard gray unweathered limestone stratum. The very hard gray unweathered limestone was first encountered at depths ranging from 31 to 57 feet below the existing ground surface at the boring locations. The depth to very hard gray unweathered limestone at each structural boring location is summarized below.

Boring Number	Depth to Very Hard Gray Unweathered Limestone
B-1	31 feet
B-3	38 feet
B-4	33 feet
B-5	42 feet
B-6	51.5 feet
B-7	57 feet
B-8	53.5 feet
B-9	51 feet
B-10	53 feet
B-11	52 feet

The allowable end bearing pressure and side resistance pressures are provided in Table 2 and have been developed based on the assumption that a minimum 2 pier diameter clear spacing will be provided between piers. For piers touching, a 50% reduction in skin friction should be used. Where the clear spacing is 2D, no reduction is necessary. For a spacing between 0 and 2D, a straight line interpolation should be used.

The skin friction values provided are for compression loading and for resistance to soil swell uplift. For other tension loads, the allowable skin friction is 50% of the value indicated above.

These foundations should be subject to settlements of about one-half inch. Differential settlements should be about one-quarter inch.

TABLE 2. ALLOWABLE BEARING VALUES

SHAFT LOADING TYPE	**BEARING STRATA**
	VERY HARD GRAY UNWEATHERED LIMESTONE
Axial End Bearing	60,000 psf **
Skin Friction Side Resistance	8,000 psf *

* For penetrations into very hard gray unweathered limestone exceeding 2 feet as verified by the AGG geotechnical team. The skin friction values provided are for compression loading and for resistance to soil swell uplift. For other tension loads, the allowable skin friction is 50% of the value indicated above. All pier penetrations (below temporary casing) may be counted on for resistance to soil swell uplift.

**A minimum 5 feet or 1 pier diameter into very hard gray unweathered limestone (whichever is greater) is recommended to develop the allowable end bearing pressure.

Larger penetrations may be required for axial loading and soil swell uplift resistance. Penetrations into gray weathered limestone (identified by iron staining or tan colored seams) should not be counted on for the design penetrations during pier installations. The design penetrations should be counted on only for penetrations into continuous very hard gray unweathered limestone below any temporary casing as verified by AGG. Penetrations should only be counted below the bottom of the casing within the bearing stratum.

Note 1: We recommend that an AGG Geotechnical Engineer be present at the start of the drill pier operations in order to identify the proper bearing stratum to field personnel.

Note 2: A minimum shaft diameter of 18 inches should be used for the straight shaft piers. In addition, we recommend that a maximum length to diameter ratio of 30 be used for design of the drilled shafts.

Note 3: In lieu of using cased straight shaft piers to support the proposed structures, consideration can be given to using auger cast piles. If auger cast piles are used, the auger cast piles should be designed by the Structure Engineer and/or piling specialist to penetrate into the bearing stratum. The allowable bearing values provided in Table 1 should initially be used for design but needs to be confirmed (see Note 4.). The auger cast piles should be constructed in general accordance with the recommendations within this report for straight shaft piers.

Note 4: We recommend that pile load testing be performed by the contractor under the observations of an AGG Geotechnical Engineer to verify the design parameters provided above. In addition, we recommend that the first three (3) auger cast piles and at least 10% of the remaining auger cast piles thereafter be integrity tested. We recommend that the integrity testing be performed using sonic echo testing methods. These tests will assist in the evaluation of the integrity of the auger cast piles. We recommend that AGG be retained to perform the sonic echo testing on the auger cast piles.

5.3.1 DRILLED SHAFT SOIL INDUCED UPLIFT LOADS

All piers will be subject to uplift loads as a result of swelling within the overlying clays. Straight shafts should be designed by the Structural Engineer with adequate penetration lengths in order to have sufficient anchorage in resisting uplift forces generated by soil swelling. The piers should have sufficient continuous vertical reinforcing steel extending to the bottom of the piers to resist the computed net uplift loads (uplift less dead load).

The magnitude of the uplift loads varies with the shaft diameter, soil parameters, free water sources, and the depth of the active clays acting on the shaft. The uplift pressures can be approximated at this site by assuming a uniform uplift pressure of 2,500 psf acting on the shaft perimeter for a depth of 12 feet for the proposed parking garage structure and for a depth of 8 feet for the proposed water feature and pavilion structures. If over-excavation

and moisture conditioning of the clay soils are performed in accordance with this report in order to reduce the potential upward soil swell movements to one inch, the uniform uplift pressure could be reduced to 1,500 psf.

5.3.2 LATERALLY LOADED PIERS

For evaluating shaft deflections, L-Pile parameters for each soil and rock strata are provided below for individual laterally loaded drilled shafts. The parameters indicated above and below do not include reductions related to group effects (see Note 2 below).

Neglect passive resistance within upper 5 feet below finish grade or 5 feet below top of pier, whichever is deeper.

For overburden clay, sandy clay and calcareous clay soils (below 5 feet neglected depth)					
Water Level Condition	**Material Type for LPile**	**Undrained Cohesion (psf)**	**Total Soil Unit Weight (pcf)**	**Strain Factor E_{50}**	**Static Horizontal Modulus of Subgrade Reaction, k (pci)**
Above Water	Soft Clay without Free Water	1,000	120.0	0.01	100
Below Water	Soft Clay with Free Water	1,000	58.0	0.01	100

FOR OVERBURDEN SANDS BELOW REQUIRED 5 FOOT NEGLECT DEPTH				
Water Level Condition	**Material Type for LPile**	**Effective Soil Unit Weight (pcf)**	**Friction Angle**	**Static Horizontal Modulus of Subgrade Reaction, k (pci)**
Above Water	Loose Sand without Free Water	125.0	28	25
Below Water	Loose Sand with Free Water	63.0	28	20

Design Parameter	Design Values Very Hard Unweathered Gray Limestone
Material Type	Weak Rock
Effective Unit Weight, pcf	140.0 above water 78.0 below water
Young's Modulus, psi	40,000
Uniaxial Compressive Strength (PSF)	60,000
Rock Quality Index (RQD, %)	90
Stiffness Constant (Km)	0.0004

Note 1: Groundwater seepage was encountered within the deeper test borings at depths ranging from 14 to 49 feet below the existing ground surface. Shallower groundwater water levels should also be considered for design to account for elevated groundwater levels during we weather periods.

Note 2: Reduction factors must be applied to account for group effects for laterally loaded piers. If the center to center spacing is less than 7D for laterally loaded piers, then an L-Pile study using the Ensoft Group Pile Program would be required to determine the appropriate reduction factors that must be applied for laterally loaded piers. Alliance Geotechnical Group should be retained to work with the Structural Engineer in performing the Group Pile Analyses, if required. This includes group effects in the direction of loading, side by side effects, and effects in skewed directions. Otherwise, the Structural Engineer could use the information in the below paragraphs to conservatively approximate reductions for group effects.

In order to determine the appropriate reduction for group effects of a pier in a group, the reduction for side by side effects (R_{SS}), the reduction for in-line loading effects (R_{IL}), and the reduction for skewed effects (R_{SK}) will need to be determined for each adjacent pier and multiplied together to determine the reduction factor for the subject pier in the group. The reduction for in-line loading effects (R_{IL}) will consist of either leading pier (R_{LP}) or trailing pier (R_{TP}). Each of these reductions should be determined as recommended below.

Reduction due to Side by Side effects (R_{SS})

For 1D center to center spacing (piers touching), 64% of the lateral resistance should be used. Where the center to center spacing is 4D, no reduction is necessary. For a spacing between 1D and 4D, a straight line interpolation should be used.

Reduction due to Leading Pier (R_{LP})

For 1D center to center spacing (piers touching), 70% of the lateral resistance should be used. Where the center to center spacing is 4D, no reduction is necessary. For a spacing between 1D and 4D, a straight line interpolation should be used. Reduction due to Trailing Pier (R_{TP})

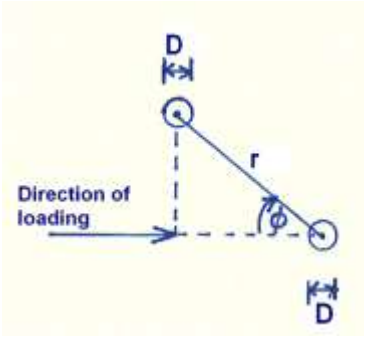
For 1D center to center spacing (piers touching), 47% of the lateral resistance should be used. Where the center to center spacing is 4D, 80% of the lateral resistance should be used. For a spacing between 1D and 4D, a straight line interpolation should be used between the 47% to 80% of lateral resistance. Where the center to center spacing is 7D, no reduction is necessary. For a spacing between 4D and 7D, a straight line interpolation should be used between the 80% and 100% of lateral resistance.

Reduction due to Skewed Pier (R_{SK})

The reduction factor for skewed piers (piers neither side-by-side or in line with the direction of loading) should be determined by the below formula.

$$R_{SK} = (R_{IL}^2 \cos^2 Ø + R_{SS}^2 \sin^2 Ø)^{1/2}$$

The reduction for in-line loading effects (R_{IL}) will consist of either leading pier (R_{LP}) or trailing pier (R_{TP}) whichever one is applicable to the loading direction. The center to center spacing is based upon r/D and Ø (where Ø is the angle between the direction of loading and the line between the piers as shown in the detail below).



Note 3: For all of the above reduction factors, if different size piers are used in a group, D used in the above formulas should be the largest pier diameter in the group.

5.3.3 DRILLED SHAFT CONSTRUCTION CONSIDERATIONS

Groundwater was encountered above the bearing stratum within all of the deeper test borings. In addition, caving sands and gravels were also encountered above the bearing stratum. Therefore, temporary casing will be required for all piers. Temporary casing should

be properly seated and sealed within the very hard unweathered gray limestone to prevent seepage into the drilled shaft excavation. Care must be taken that a sufficient head of plastic concrete is maintained within the casing during extraction.

Note 1: The design penetrations should be counted on only for penetrations into continuous very hard gray unweathered limestone beneath temporary casing. Penetrations within the casing length should be ignored.

Concrete used for the shafts should have a slump of 6 to 8 inches and placed in a manner to avoid striking the reinforcing steel and walls of the shaft during placement. Complete installation of individual shafts should be accomplished within an 8-hour period in order to help prevent deterioration of bearing surfaces. The drilling of individual shafts should be excavated in a continuous operation and concrete placed as soon as practical after completion of the drilling. No shaft should be left open for more than 8 hours.

We recommend that Alliance Geotechnical Group be retained to observe and document the drilled pier construction. The engineer, or his representative, should document the shaft diameter, penetration, depth, casing installations and extractions, cleanliness, plumbness of the shaft, and the type of bearing material. Significant deviations from the specified or anticipated conditions should be reported to the owner's representative and to the structural engineer. The drilled pier excavation should be observed to verify the bottom of the excavation is dry and thoroughly cleaned of cuttings after completion.

Note 2: “Mushrooming” should not be allowed around piers, pier caps or grade beams.

5.3.4 GRADE BEAMS AND PIER CAPS

Grade beams and/or pier caps supported by straight shaft piers should be constructed over void spaces. A minimum void space of 4 inches should be provided between the bottom of these members and the subgrade. This is assuming site modification work is performed as specified in this report to reduce the soil swell to one inch in preparation for slab-on-grade construction. If structural floors are used, minimum 12 inch void spaces should be specified below grade beams and/or pier caps for the proposed parking garage structure and minimum 8 inch void spaces should be specified below grade beams for the proposed water feature and pavilion structures.

Permanent retainer forms should be used. Structural cardboard forms are one acceptable means of providing this void beneath these members. Care must be exercised during

concrete placement to avoid collapsing the cardboard void boxes. The cardboard carton forms should not be allowed to become wet or crushed prior to concrete placement.

The exterior portions of the grade beams along the perimeter of the structures should be carefully backfilled with on-site clayey soils unless specified otherwise below. The backfill soils should be placed at a moisture content between optimum and +3% above optimum. The fill should be compacted to 95 percent of maximum dry density as determined in accordance with ASTM D–698 (Standard Proctor).

Note 1: Prior to backfilling leave out areas along grade beam, it must be verified by AGG that all clay soil that has become dry along the leave-out areas during construction is removed and moisture conditioned prior to backfilling.

5.4 FLOOR SLAB

Potential soil swell movements based upon existing conditions have been estimated to be up to 9 inches for the proposed parking garage structure and up to 5 inches for the proposed water feature and pavilion structures. Due to the potential for slab movements, the floor slabs should either be structurally supported and suspended above the site soils by a void space or should consist of slabs-on-grade that are placed over moisture conditioned clay soils capped with low PI select fill.

5.4.1 STRUCTURALLY SUPPORTED FLOOR SLAB

Due to the potential for excessive slab movements, one method of minimizing the effects of soil movements in areas sensitive to movement would be the use of structurally supported floor slabs suspended above the underlying soils by a crawl space or by a minimum twelve (12) inch void space for the proposed parking garage structure or by a minimum eight (8) inch void space for the proposed water feature and pavilion structures. Permanent earth retainer forms must be used. The void spaces created between the bottom of the floor slabs and the subgrade will serve to reduce distress resulting from swell pressures generated by the clays. If structural floors are used, the void space should be drained. Any crawl space should be ventilated and drained. Grade within the crawl space below the suspended slab should be at least 2%. A suitable vapor barrier should be used below all floor slabs.

Structural cardboard forms could be used to provide the required voids beneath the floor slab. If carton forms are used, care should be taken to assure that the void boxes are not allowed to become wet or crushed prior to or during concrete placement and finishing operations. Masonite placed on top of the carton forms should be used to reduce the risk of crushing the carton forms during concrete placement and finishing operations. As a quality

control measure during construction, “actual” concrete quantities placed should be checked against “anticipated” quantities. Significant concrete “overage” would be an early indication of a collapsed void.

Note 1: A crawl space would be preferred and is recommended to allow access for maintenance. This would allow utility lines to be hung to the floor system and suspended above the expansive clays by at least 12 inches at the parking garage and by at least 8 inches at the water feature and pavilion structures. Otherwise, soil swell movements beneath utility lines could cause leaks or crush the pipe at connections to floor fixtures unless appropriate details are used to prevent upward pipe movement (such as Plumbing Void Systems). All utility penetrations through or beneath grade beams or through floor slabs should be sleeved appropriately to accommodate differential soil swell movement. See Section 5.1 of this report.

Note 2: Differential upward piping movements should be anticipated where sub-floor piping transitions into expansive soil at the building perimeter. Flexible piping connections should be used at the building perimeter to accommodate differential upward movements. See Section 5.1 of this report.

Note 3: Concrete cut-off collars should be used for below grade piping adjacent to the building perimeter to minimize water seepage into the crawl space via utility trenches.

5.4.2 SLAB-ON-GRADE FLOOR SLAB

A slab-on-grade floor system may be used at this site for the proposed structures. Site preparation work will be required in order to lower the potential soil movements for slab-on-grade construction. Recommendations for site preparation work to reduce the anticipated soil swell movements to 1 inch are presented below in Section 5.4.2.1 for the parking garage structure and in Section 5.4.2.2 for the water feature and pavilion structures.

5.4.2.1 Parking Garage Structure – Site Preparation

1. Excavate to a depth of 12 feet below the existing ground surface as verified by AGG. Excavations should extend 2 feet beyond building lines, 20 feet beyond drive approach slabs or 2 foot beyond adjacent sidewalks and entry areas, whichever is greater. We recommend that Alliance Geotechnical Group review the excavation plan for compliance with this report prior to construction bidding.

2. As a valued engineering approach, we recommend that the excavation operations be performed to a depth of 8 feet below the existing ground surface and no deeper until test pits are performed. After excavating to 8 feet, test pits should be performed to depths of 4 feet below the base of cut under the direction of an AGG Engineer to

see if the deeper clay soils are adequately moist with a swell potential of one (1) percent or less. If the deeper clay soils are adequately moist with a swell potential of one (1) percent or less, excavation and moisture conditioning from 8 to 12 feet will not be required. If dry expansive clay soils are found, they should be excavated, moisture conditioned and replaced in accordance with Item 4 below.

Note 1: We recommend that a line item be placed in the bid documents for the deeper excavation and moisture conditioning in order that the owner may receive a credit if moist soils are encountered within the test pits and lesser excavation and moisture conditioning are required.

3. After excavation has been performed, the upper 8 inches of base of cut should be scarified and compacted as specified below in Item 4.

4. Fill to within 18 inches of bottom of building pad using the on-site soils.

   Clay soils: On-site clay soils having a PI between 35 and 44 can be used as fill within the building pad if these clay soils are moisture conditioned and placed in controlled lifts. Compact on-site clay soils at +5% to +8% above optimum moisture content to a minimum of 92% of Standard Proctor density (ASTM D698). Clay soils with PI of 45 or greater should not be used within the building pads.

   Sandy Clay: Sandy clay soils having a PI between 20 and 34 should be compacted at +2% to +5% above optimum to a minimum of 95% of ASTM D698.

   Clayey Sand: Clayey sand and very sandy clay soils having a PI between 4 and 19 should be compacted at -1% to +2% of optimum to a minimum of 95% of ASTM D698. Sands having a PI of less than 4 should not be used as fill within the building pads.

   Proper moisture conditioning should be indicated with hand penetrometer readings within the following ranges for the clay soils.

Material Type	Pocket Penetrometer Range
Clay Soils	1.2 tsf to 2.0 tsf
Sandy Clay	2.0 tsf to 3.0 tsf

Note 1: The upper 8 inches of moisture conditioned clay soils directly beneath the low PI select fill cap should be compacted at +2% to +5% above optimum moisture content to a minimum of 95% of Standard Proctor density (ASTM D698) for clay and sandy clay soils and compacted at -2% to +2% of optimum moisture content to a minimum of 98% of ASTM D 698 for clayey sand and very sandy clay soils.

Note 2: These “targeted” moisture contents are subject to soil swell and compressive strength verifications and adjustment per Section 9.5.2 of this report.

5. Fill to final pad grade with a minimum of 18 inches of low PI select fill consisting of 2 – 6 inch lifts of low PI sandy select fill and capping with 6 inches of flex base. The select fill should extend to the excavation limits (see Item 1 above). The material used as sandy select fill should be a very sandy clay to clayey sand (uniform consistency free of clay clods) with a liquid limit less than 35 and a plasticity index between 4 and 15. The fill should be spread in loose lifts, less than 8 inches thick, and uniformly compacted to a minimum of 98% of ASTM Standard D 698 between –2% and +2% of the soil's optimum moisture content.

   The upper 6 inches should consist of crushed “Chico” stone and/or recycled crushed concrete flex base. The flex base should be compacted at optimum to +2% above optimum to a minimum of 95% of Modified Proctor density (ASTM D1557). The base materials should comply with TxDOT Item 247, Type D, Grades 1 or 2.

6. The upper 18 inches of fill in unpaved areas near the structures should consist of compacted on–site clay to minimize water infiltration into the select fill (compact in maximum 8 inch lifts at optimum to +3% above optimum moisture to a minimum of 95% ASTM D 698).

7. Moisture condition of completed pads must be maintained until all slabs are in place. This will be particularly important along the building perimeter where clay soils will possibly be exposed after excavations for grade beams. The use of 6 inches of select fill above exposed clay excavations would reduce moisture losses during prolonged dry weather conditions.

Note 3: Prior to backfilling grade beam or below grade wall excavations, the moisture condition of any exposed clay soils must be verified by AGG. Any dry clay having a swell potential over 1% prior to placement of any backfill in any area should be replaced with select fill. All grade beam and wall backfill should consist of low PI select fill.

All work should be performed in accordance with the Earthwork Guidelines (Section 9.0) of this report.

Note 4: See Section 10.0 of this report regarding the potential for long-term floor slab settlements due to tree effects.

A polyethylene moisture barrier is recommended below all floor slabs where floor coverings or painted floor surfaces will be applied with products which are sensitive to moisture or if products stored on the building floors are sensitive to moisture. Procedures for installation of vapor barriers are recommended in ACI 302.

5.4.2.2 Water Feature & Pavilion Structures – Site Preparation

1. Excavate to a depth of 8 feet below the existing ground surface or until low plastic to non-plastic sands are encountered as verified by AGG. Based upon results of the test borings, the below excavation depths are anticipated at each of the test boring locations.

Boring Number	Anticipated Excavation Depths
B-1	3 feet
B-3	5.5 feet
B-4	8 feet
B-5	2 feet

Excavations should extend 2 feet beyond building lines or 2 foot beyond adjacent sidewalks and entry areas, whichever is greater. We recommend that Alliance Geotechnical Group review the excavation plan for compliance with this report prior to construction bidding.

2. After excavation has been performed, the upper 8 inches of base of cut should be scarified and compacted as specified below in Item 3.

3. Fill to within 12 inches of bottom of building pad using the on-site soils.

Clay soils: On-site clay soils having a PI between 35 and 44 can be used as fill within the building pad if these clay soils are moisture conditioned and placed in controlled lifts. Compact on-site clay soils at +5% to +8% above optimum moisture content to a minimum of 92% of Standard Proctor density (ASTM D698). Clay soils with PI of 45 or greater should not be used within the building pads.

Sandy Clay: Sandy clay soils having a PI between 20 and 34 should be compacted at +2% to +5% above optimum to a minimum of 95% of ASTM D698.

Clayey Sand: Clayey sand and very sandy clay soils having a PI between 4 and 19 should be compacted at -1% to +2% of optimum to a minimum of 95% of ASTM D698. Sands having a PI less than 4 should not be used as fill within the building pads.

Proper moisture conditioning should be indicated with hand penetrometer readings within the following ranges for the clay soils.

Material Type	Pocket Penetrometer Range
Clay Soils	1.2 tsf to 2.0 tsf
Sandy Clay	2.0 tsf to 3.0 tsf

Note 1: These “targeted” moisture contents are subject to soil swell and compressive strength verifications and adjustment per Section 9.5.2 of this report.

4. Fill to final pad grade with a minimum of 12 inches of low PI select fill. The select fill should extend to the excavation limits (see Item 1 above). The material used as sandy select fill should be a very sandy clay to clayey sand (uniform consistency free of clay clods) with a liquid limit less than 35 and a plasticity index between 4 and 15. The fill should be spread in loose lifts, less than 8 inches thick, and uniformly compacted to a minimum of 98% of ASTM Standard D 698 between –2% and +2% of the soil's optimum moisture content.

5. The upper 18 inches of fill in unpaved areas near the structures should consist of compacted on–site clay to minimize water infiltration into the select fill (compact in maximum 8 inch lifts at optimum to +3% above optimum moisture to a minimum of 95% ASTM D 698).

6. Moisture condition of completed pads must be maintained until all slabs are in place. This will be particularly important along the building perimeter where clay soils will possibly be exposed after excavations for grade beams. The use of 6 inches of select fill above exposed clay excavations would reduce moisture losses during prolonged dry weather conditions.

Note 2: Prior to backfilling grade beam or below grade wall excavations, the moisture condition of any exposed clay soils must be verified by AGG. Any dry clay having a swell potential over 1% prior to placement of any backfill in any area should be replaced with select fill. All grade beam and wall backfill should consist of low PI select fill.

All work should be performed in accordance with the Earthwork Guidelines (Section 9.0) of this report.

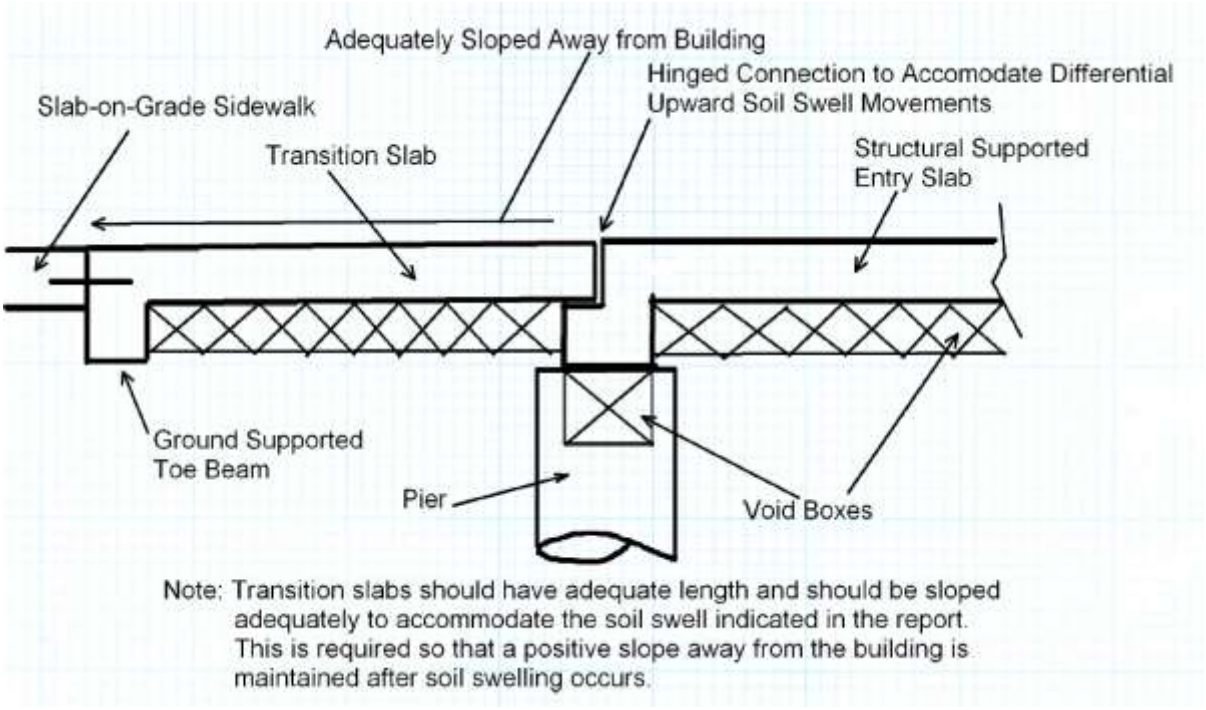
Note 3: See Section 10.0 of this report regarding the potential for long-term floor slab settlements due to tree effects.

A polyethylene moisture barrier is recommended below all floor slabs where floor coverings or painted floor surfaces will be applied with products which are sensitive to moisture or if products stored on the building floors are sensitive to moisture. Procedures for installation of vapor barriers are recommended in ACI 302.

5.5 FLAT WORK AND PIPING CONSIDERATIONS

Provisions should be made for post-construction differential upward movement of adjacent flat work and piping. Site grading plans should include provisions for the effects of soil swell movements on access and entry slabs, adjacent sidewalks and all pavements. See Section 5.1 of this report. Utility line details and fixtures should consider the potential for differential movement beneath any piping. To prevent potential tripping hazards, access and entry slabs should be elevated above the adjacent sidewalks and pavement slabs (where possible).

If a structural supported floor slab is used, we recommend that all access and entry slabs also be structurally supported on drilled shafts and suspended above the active clays by a minimum 12 inch drained void space for the parking garage structure and by a minimum 8 inch drained void space for the water feature and pavilion structures. To prevent potential tripping hazards, these access and entry slabs should be elevated above adjacent sidewalks and pavement slabs and provided with transition slabs over the required void space that are hinged at grade beam connections and provided with toe beams at connections to adjacent flatwork. The toe beam should be founded a minimum of 16 inches below the adjacent void space and be designed for an allowable bearing of 1,500 psf. Hand probings are recommended to be performed by AGG at the bottom of the toe beam to verify adequate bearing. A schematic detail of a transition slab is provided below.



All void spaces should be drained. We recommend that Alliance Geotechnical Group be retained to review the project drawings and specifications to ensure compliance with the geotechnical report.

5.6 SHALLOW FOUNDATION SYSTEMS

Shallow foundation systems may be considered to support the proposed lightly loaded water feature and pavilion structures if some foundation movements are acceptable. Site preparation work is required, as specified below, to reduce the potential soil swell

movements and to provide the allowable bearing capacity. The site preparation work specified below should be performed in order to reduce the potential soil swell movements to about 1 inch.

1. Excavate to a depth of 8 feet below the existing ground surface or until low plastic to non-plastic sands are encountered as verified by AGG. Based upon results of the test borings, the below excavation depths are anticipated at each of the test boring locations.

Boring Number	Anticipated Excavation Depths
B-1	3 feet
B-3	5.5 feet
B-4	8 feet
B-5	2 feet

Excavations should extend 5 feet beyond perimeter footings or 2 foot beyond adjacent sidewalks and entry areas, whichever is greater. We recommend that Alliance Geotechnical Group review the excavation plan for compliance with this report prior to construction bidding.

2. After excavation has been performed, the upper 8 inches of base of cut should be scarified and compacted as specified below in Item 3.

3. Fill to within 36 inches of bottom of building pad using the on-site soils.

   Clay soils: On-site clay soils having a PI between 35 and 44 can be used as fill within the building pad if these clay soils are moisture conditioned and placed in controlled lifts. Compact on-site clay soils at +5% to +8% above optimum moisture content to a minimum of 92% of Standard Proctor density (ASTM D698). Clay soils with PI of 45 or greater should not be used within the building pads.

   Sandy Clay: Sandy clay soils having a PI between 20 and 34 should be compacted at +2% to +5% above optimum to a minimum of 95% of ASTM D698.

   Clayey Sand: Clayey sand and very sandy clay soils having a PI between 4 and 19 should be compacted at -1% to +2% of optimum to a minimum of 95% of ASTM D698. Sands having a PI less than 4 should not be used as fill within the building pads.

   Proper moisture conditioning should be indicated with hand penetrometer readings within the following ranges for the clay soils.

Material Type	Pocket Penetrometer Range
Clay Soils	1.2 tsf to 2.0 tsf
Sandy Clay	2.0 tsf to 3.0 tsf

Note 1: The upper 8 inches of moisture conditioned clay soils directly beneath the low PI select fill cap should be compacted at +2% to +5% above optimum moisture content to a minimum of 95% of Standard Proctor density (ASTM D698) for clay and sandy clay soils and compacted at -2% to +2% of optimum moisture content to a minimum of 98% of ASTM D 698 for clayey sand and very sandy clay soils.

Note 2: These "targeted" moisture contents are subject to soil swell and compressive strength verifications and adjustment per Section 9.5.2 of this report.

4. Fill to final pad grade with a minimum of 36 inches of low PI select fill. The select fill should extend to the excavation limits (see Item 1 above). The material used as sandy select fill should be a very sandy clay to clayey sand (uniform consistency free of clay clods) with a liquid limit less than 35 and a plasticity index between 8 and 15. The fill should be spread in loose lifts, less than 8 inches thick, and uniformly compacted to a minimum of 98% of ASTM Standard D 698 between –2% and +2% of the soil's optimum moisture content.

5. The upper 18 inches of fill in unpaved areas near the structures should consist of compacted on–site clay to minimize water infiltration into the select fill (compact in maximum 8 inch lifts at optimum to +3% above optimum moisture to a minimum of 95% ASTM D 698).

6. Moisture condition of completed pads must be maintained until all slabs are in place. This will be particularly important along the building perimeter where clay soils will possibly be exposed after excavations for grade beams. The use of 6 inches of select fill above exposed clay excavations would reduce moisture losses during prolonged dry weather conditions.

Note 3: Prior to backfilling grade beam or below grade wall excavations, the moisture condition of any exposed clay soils must be verified by AGG. Any dry clay having a swell potential over 1% prior to placement of any backfill in any area should be replaced with select fill. All grade beam and wall backfill should consist of low PI select fill.

All work should be performed in accordance with the Earthwork Guidelines (Section 9.0) of this report.

Note 4: See Section 10.0 of this report regarding the potential for long-term floor slab settlements due to tree effects.

A polyethylene moisture barrier is recommended below all floor slabs where floor coverings or painted floor surfaces will be applied with products which are sensitive to moisture or if products stored on the building floors are sensitive to moisture. Procedures for installation of vapor barriers are recommended in ACI 302.

Shallow footing foundation systems founded on a minimum of 12 inches of low PI select fill soils over moisture conditioned soils may be used to support the proposed structure if the site preparation work recommended above is performed. We recommend that the footings be founded at depths of at least 18 inches below lowest adjacent final grade and founded on compacted low PI select fill.

Continuous wall footings should be at least 18 inches wide and designed for an allowable soil bearing capacity of 1,200 psf. Column footings should be at least 3 feet square and designed for an allowable soil bearing capacity of 1,500 psf.

These footings should be subject to differential settlements of about one inch. If the above site preparation work is performed, the footings will also be subject to differential soil swell movements of about 1 inch.

Trees and deep rooted shrubs should not be allowed within 35 feet of the structures to minimize any settlement that could occur due to ground shrinkage caused by moisture absorption of tree root systems (tree root desiccation). Also, the ground beneath the drip line should not be paved. It should be landscaped and irrigated. See Section 8.0 for tree effects.

Footings at this site will be subjected to differential movement caused by post-construction settlement and soil swell heave. Closely spaced vertical crack control joints (10 to 15 foot spacings) should be used along the full height of all walls to control cracking associated with differential foundation movements.

All footings should be constructed using neat vertical cuts without forming the footing base. Forming of footing stem walls may be used. The foundation plan and the utility plan should be cross-checked to verify that no utility line excavation extends beneath the bearing influence of any footing (approximated by 1.5H:1V slope extending downward from the edges of the footings). Trench cuts extending beneath the footings (or within their bearing influence) should be avoided, if possible. Otherwise, the trench backfill should consist of lean concrete or compacted select fill within the bearing influence of the footing.

We recommend that an Alliance Geotechnical Group Geotechnical Engineer or a qualified engineering technician observe the footing excavations prior to placing concrete. The foundation bearing area should be level or suitably benched. It should be free of loose or soft soil, ponded water, and debris prior to the inspection. If a rain event occurs after footing excavations, water ponding within the footing excavations should be pumped out immediately. Any wet softened soil should be excavated until stiff clay fill is encountered and the footing deepened.

6.0 ARCHITECTURAL AND STRUCTURAL DETAILING

It should be recognized that even slight differential movements of floor slabs due to settlements and/or shrink/swell soil movements of about one-half inch +/- can cause cracking of interior sheetrock walls, ceilings, floor slabs, floor coverings, and masonry walls that are sensitive to movements. In order to minimize cracking, deep cased straight shaft piers founded within unweathered rock in conjunction with structural floors over a void space or crawlspace would be needed. In order to reduce costly maintenance associated with these periodic repairs caused by minor floor movement, we recommend the following.

1. Use resilient floor and wall coverings that can accommodate differential movement without cracking.

2. Provide closely spaced joints within interior and exterior walls to control cracking and reduce irregular crack patterns and maintenance (especially over doors and windows).

3. Coordinate with General Contractor and all subcontractors regarding the need for appropriate jointing in all interior and exterior walls to reduce future cracking and maintenance after occupancy.

4. The Architect should advise the Owner regarding the likelihood of future maintenance due to minor movement of ground supported floor slabs so that Owner expectations are not unreasonable. The Owner should be advised that future maintenance should be expected over the life of the facility.

5. A landscape architect and arborist should be contacted for recommendations for root barriers and irrigated tree wells for trees within 35 feet of the building or pavement. The ground beneath the un-pruned drip lines of trees should not be paved unless an arborist is consulted regarding the installation of root barriers and irrigated tree wells.

7.0 PAVEMENT RECOMMENDATIONS

Projected traffic data was not available during this study. Due to the nature of the proposed construction, we assume that light vehicle traffic and occasional medium to heavy truck / bus traffic will be present on the drive areas. The following recommendations are based upon these assumed conditions.

Note: Differential upward pavement movements are likely at this site due to soil swelling and should be anticipated during design of the grading plan. Site modification could be performed within pavement areas to reduce the potential for differential pavement movements if desired. See Section 5.1 of this report for potential movements. If it is desired to minimize differential upward pavement movements, AGG should be contacted for recommendations.

7.1 EXISTING FILL SOILS

Existing fill soils were encountered within three of the test borings (Boring B-3, B-4 and B-6). The existing fill soils extended to depths ranging from 1.5 to 5.5 feet below the existing ground surface. If the existing fill soils were placed in an uncontrolled manner without engineering supervision and without proper moisture / compaction verification of each fill lift, excessive settlements / consolidation should be anticipated for pavements and flatwork placed over uncontrolled fill soils.

In order to provide adequate pavement support where existing fill soils are present within pavement areas, we recommend that the existing fill soils be tested for compaction to a minimum depth of 4 feet below final pavement subgrade. If compaction levels are less than 95% of ASTM D698, excavation of the existing fill soils will need to be performed to a minimum depth of 4 feet below the bottom of pavement to provide the minimum pavement support required for design. Pavement settlements could still occur where deeper non-compact fill is present. If it is desired to minimize settlement in pavement areas sensitive to settlements, all non-compact fill should be removed and replaced in thin compacted lifts.

7.2 SUBGRADE PREPARATION

Surficial soils along the proposed new pavements are anticipated to vary from expansive sandy clay soils to low-plastic sands and silts. The clayey soils react with hydrated lime which serves to improve their support value at higher moisture levels and provides a firm, uniform subgrade beneath the paving. Cement stabilization is used to improve the support value of sandy soils. Due to the highly variable subgrade soils, it is recommended that subgrade stabilization not be performed for these pavements.

In lieu of subgrade stabilization, eight (8) inches of crushed “Chico” stone and/or recycled crushed concrete flex base should be used. The flex base should be compacted at optimum to +2% above optimum to 95% Modified Proctor density (ASTM D1557). The base materials should comply with TxDOT Item 247, Type D, Grades 1 or 2. Prior to placing the flex base, the subgrade should be proofrolled in accordance with the Section 7.6 of this report. The upper 8 inches should be compacted at -1% and +2% of optimum moisture to a minimum of 98% of Standard Proctor density (ASTM D 698) just prior to flex base placement.

Only on-site soil (comparable to the underlying subgrade soil) should be used for fine grading the pavement areas. After fine grading, the subgrade should be watered if needed and re-compacted in order to re-achieve the moisture and density levels discussed above and provide a tight non-yielding subgrade.

Non-plastic sand should be specifically prohibited beneath pavement areas during final grading, since these more porous soils can allow water inflow, resulting in heave and strength loss of subgrade soils. It should be specified that only clay soils will be allowed for fine grading. After fine grading each area in preparation for paving, the subgrade surface should be lightly moistened, as needed, and recompacted to obtain a tight non-yielding subgrade.

The subgrade moisture content and density must be maintained until paving is completed. The subgrade should be watered just prior to paving to assure concrete placement over a moist subgrade.

Note: If a rain event occurs prior to placement of flex base, the subgrade should be aerated and re-tested prior to paving.

Due to the presence of expansive clay soils, post construction upward pavement movements should be anticipated. Inspection during construction is particularly important to insure proper construction procedures are followed.

7.3 RECOMPACTED PAVEMENT SUBGRADE

In lieu of placing crushed stone flex base, a thickened concrete section could be used over a compacted subgrade. The upper eight (8) inches of subgrade soil should be compacted at -1% to +2% above optimum moisture to a minimum of 98% Standard Proctor density (ASTM D 698). The subgrade should be proof-rolled prior to subgrade compaction.

Proofrolling and removal and replacement of soft materials should be performed in accordance with Section 7.6 of this report.

Only on-site clayey soil should be used for fine grading the pavement areas. After fine grading, the subgrade should be watered if needed and re-compacted in order to re-achieve the moisture and density levels discussed above and provide a tight non-yielding subgrade. Sand should not be allowed for use in fine grading the pavement areas as discussed previously. The subgrade moisture content and density must be maintained until paving is completed. The subgrade should be watered just prior to paving to assure concrete placement over a moist subgrade.

Note: If a rain event occurs prior to paving, the subgrade should be aerated and re-tested prior to paving.

7.4 DRIVE APPROACHES

Water should not be allowed to pond in drive approaches prior to paving. Density tests should be performed on the subgrade soils in each drive approach prior to fine grading in preparation for paving to verify compliance with project specifications.

7.5 PAVEMENT SECTIONS

Tables 3 and 4 present the recommended pavement sections for this project:

TABLE 3. LIGHT DUTY PAVEMENT SECTION

AUTOMOBILE TRAFFIC ONLY (Automobile Parking Stalls)
PCC SECTION
5 inches Portland Cement Concrete
8 inches Scarified and Compacted Subgrade *****

* Although not required by designed, placement of crushed stone flex base could be performed to improve performance and reduce maintenance.

TABLE 4. MODERATE DUTY PAVEMENT SECTIONS

MODERATE DUTY PAVEMENT (Moderate Heavy Truck Use) **
PCC SECTION 6 inches Portland Cement Concrete 8 inches Crushed Stone Flex Base Or 7 inches Portland Cement Concrete 8 inches Scarified and Compacted Subgrade

** For 25 truck / bus repetitions per week (20-year design life).

The concrete should have a minimum 28 day compressive strength of 3600 psi within automobile only pavement and 4,000 psi within truck drive areas. Concrete quality will be important in order to produce the desired flexural strength and long term durability. We recommend that the concrete have 5% entrained air plus or minus 1%. The concrete should be placed at a slump of 4 inches plus or minus 1 inch for hand pours and a slump of 2 inches plus or minus 1 inch for machine finish pours.

Proper joint placement and design is critical to pavement performance. Load transfer at all longitudinal joints and maintenance of watertight joints should be accomplished by use of tie bars. Control joints should be sawed as soon as possible after placing concrete and before shrinkage cracks occur. All joints including sawed joints should be properly cleaned and sealed as soon as possible to avoid infiltration of water.

Our previous experience indicates that joint spacing on 12 to 15 foot centers have generally performed satisfactorily. It is our recommendation that the concrete pavement be reinforced with a minimum of No. 3 bars placed on chairs on approximately 18-inch centers in each direction. We recommend that the perimeter of the pavements have a stiffening curb section to prevent possible distress due to heavy wheel loads near the edge of the pavements and to provide channelized drainage.

7.6 PAVEMENT CONSIDERATIONS

It is recommended that provisions be made in the contract to provide for proofrolling in areas where the subgrade will support new pavements. It is also recommended that an item be included for removal and replacement of soft materials, which are identified by this procedure.

Proofrolling can generally be accomplished using a heavy (25 ton or greater total weight) pneumatic tired roller making several passes over the areas. Where soft or compressible zones are encountered, these areas should be removed to a firm subgrade. Wet or very moist surficial materials may need to be undercut and either dried or replaced with proper compaction or replaced with a material which can be properly compacted. Any resulting void areas should be backfilled to finished subgrade in 6 inch compacted lifts compacted to a minimum of 95 percent of maximum dry density as determined by ASTM D 698 at optimum to +2%. The upper 8 inches of subgrade soil within pavement areas should be compacted at -1% to +2% of optimum moisture to a minimum of 98% Standard Proctor density (ASTM D 698).

Achieving the required field density is dependent upon the adequate pulverization of the clay fill materials, the magnitude of compaction energy and the maintenance of field moisture near optimum. All joints and pavements should be inspected at regular intervals to ensure proper performance and to prevent crack propagation.

The soils at the site are active and differential heave within the pavement areas should be anticipated and considered during design of the final grading plan. See Section 5.1. The service life of paving may be reduced due to water infiltration into subgrade soils through heave induced cracks in the paving section. This will result in softening and loss of strength of the subgrade soils. A regular maintenance program to seal paving cracks will help prolong the service life of the paving.

The life of the pavement can be increased with proper drainage. Areas should be graded to prevent ponding adjacent to curbs or pavement edges. Backfill materials, which could hold water behind the curb, should not be permitted. Compacted clay soils should be used as fill behind the curbs. Flat pavement grades should be avoided.

8.0 NEW SIDEWALK CONSTRUCTION

We understand that new pedestrian sidewalks / trails will be constructed across the site. After the site has been stripped and any required cuts have been made, the base of cut should be proof-rolled. Proofrolling and removal and replacement of soft materials should be performed in accordance with Section 7.6 of this report. Afterwards, filling to raise grades should consist of native soils having a PI of at least 4. The fill should be placed in maximum 8 inch loose lifts and compacted at optimum to +3% above optimum moisture to a minimum of 95% of ASTM D698. We recommend that the upper eight (8) inches of

subgrade soil should be compacted at -1% to +2% above optimum moisture to a minimum of 98% Standard Proctor density (ASTM D 698).

Only on-site clayey soil should be used for fine grading the pavement areas. After fine grading, the subgrade should be watered if needed and re-compacted in order to re-achieve the moisture and density levels discussed above and provide a tight non-yielding subgrade. Sand should not be allowed for use in fine grading the pavement areas as discussed previously. The subgrade moisture content and density must be maintained until paving is completed. The subgrade should be watered just prior to paving to assure concrete placement over a moist subgrade.

Note: If a rain event occurs prior to paving, the subgrade should be aerated and re-tested prior to paving.

The site preparation work should extend two feet beyond the edges of the sidewalks (where possible). It will be important that the moisture and compaction of the subgrade be maintained until all sidewalks have been poured. Please note that non-plastic sand should not be used beneath the sidewalks for leveling as previously discussed in this report.

We recommend that the proposed new pedestrian sidewalks / trails consist of reinforced concrete with a minimum thickness of 4 inches assuming that these sidewalks will not be subject to vehicle traffic. If the sidewalks will be subject to vehicle traffic, then AGG will need to determine that actual required sidewalk thickness based upon the anticipated loadings. The concrete should have a minimum 28 day compressive strength of 3,600 psi. We recommend that the concrete have 5% entrained air plus or minus 1%. The concrete should be placed at a slump of 4 inches plus or minus 1 inch for hand pours and a slump of 2 inches plus or minus 1 inch for machine finish pours.

Proper joint placement and design is critical to pavement performance. Load transfer at all longitudinal joints and maintenance of watertight joints should be accomplished by use of tie bars and dowels. Control joints should be sawed as soon as possible after placing concrete and before shrinkage cracks occur. All joints including sawed joints should be properly cleaned and sealed as soon as possible to avoid infiltration of water.

Our previous experience indicates that joint spacing on 12 to 15 foot centers have generally performed satisfactorily. It is our recommendation that the concrete sidewalks be reinforced with No. 3 bars placed on chairs on approximately 18-inch centers in each direction.

It should be noted that the new sidewalks will be subjected to differential movements due to soil swelling and shrinkage especially within tree areas. See Section 5.1 of this report.

9.0 EARTHWORK GUIDELINES

9.1 SITE GRADING AND DRAINAGE

All grading should provide positive drainage away from the proposed structure and should prevent water from collecting or discharging near the foundation. Water must not be permitted to pond adjacent to the structure during or after construction. Otherwise, differential soil swell movements, and resulting differential foundation movements could exceed the estimates contained within this report.

Leave outs for drilled shafts or areas along the perimeter of the structures should not be allowed to collect and hold water. These leave outs should be pumped out as needed.

Surface drainage gradients should be designed to divert surface water away from the building and edges of pavements. Surface drainage gradients of sidewalks, pavements, and landscaping, within 20 feet of the buildings should be constructed with maximum slopes allowed by local codes and maintained after occupancy (5% minimum in landscaping areas and 2% minimum for flatwork subject to ADA requirements). If flatter grades are used, a permanent horizontal moisture barrier should be used for a distance of 15 feet from the building (20 mil poly sheeting with UV protection attached to the building and covered with 16 inches of on-site compacted clay (compacted in 8 inch lifts above optimum to a minimum of 95% of ASTM 698).

Provisions should be made for large post-construction differential upward movement of adjacent flat work. Site grading plans should include provisions for the effects of soil swell movements on access and entry slabs, adjacent sidewalks, and all pavements. See Section 5.1 of this report.

The roofs should be provided with gutters and downspouts to prevent the discharge of rainwater directly onto the ground adjacent to the building foundation. Downspouts should discharge directly onto well-drained areas or drainage swales, if possible. Roof downspouts and surface drain outlets should discharge into erosion–resistant areas. Water permitted to pond in planters, open areas, or areas with unsealed joints next to the structures can result in excessive slab or pavement movements as indicated in this report.

Exterior sidewalks and pavements will be subject to large post construction movement as indicated in this report. These potential movements should be considered during preparation of the grading plan. Flat grades should be avoided. Where concrete pavement is used, joints should also be sealed to prevent the infiltration of water. Since post construction movement of pavement and flat work will occur, joints particularly around the building should be periodically inspected and resealed where necessary.

9.2 UTILITY TRENCH EXCAVATION

Trench excavation for utilities should be sloped or braced in the interest of safety. Attention is drawn to OSHA Safety and Health Standards (29 CFR 1926/1910), Subpart P, regarding trench excavations greater than 5 feet in depth. Fill placement in trenches should be performed as specified below.

9.3 PROOFROLLING AND SUBGRADE PREPARATION

Prior to placing fill in non-building areas, the exposed subgrade in areas to receive fill should be stripped and proofrolled using a fully loaded dump truck. Proofrolling can generally be accomplished using a heavy (25 ton or greater total weight) pneumatic tired roller making several passes over the areas. Where soft or compressible zones are encountered, these areas should be removed to a firm subgrade. Wet or very moist surficial materials may need to be undercut and either dried or replaced with proper compaction or replaced with a material which can be properly compacted. Any resulting void areas should be backfilled to finished subgrade in 8 inch compacted lifts compacted to a minimum of 95% of maximum dry density as determined by ASTM D 698 at optimum to +3% of its optimum moisture content. The upper 8 inches of subgrade soil should be compacted at -1% to +2% of optimum moisture to a minimum of 98% Standard Proctor density (ASTM D 698).

9.4 ON-SITE CLAY FILL PLACEMENT IN PAVEMENT AND LANDSCAPING AREAS

The on-site surficial clays may be used for general grading and filling. The fill materials should be free of surficial vegetation or debris. Clay materials should be spread in loose lifts, less than 8 inches thick and uniformly compacted to a minimum of 95% of the maximum density as determined by ASTM D 698 (Standard Proctor) between optimum to +3% above its optimum moisture content. The upper 8 inches of subgrade soil should be compacted at -1% to +2% of optimum moisture to a minimum of 98% Standard Proctor density (ASTM D 698).

9.5 ON-SITE SOIL PLACEMENT IN STRUCTURAL AREAS

On-site soils may be used as fill in building areas. All fill should be placed and compacted in maximum 8-inch lifts as specified previously in this report.

9.5.1 MOISTURE CONDITIONING PRIOR TO COMPACTION

Each layer shall be leveled with approved equipment. After spreading, each layer shall be thoroughly manipulated by plowing, discing, or other approved methods of the full depth of the layer being placed to reduce the soil clod size to less than 3 inches in order to insure uniform density and moisture distribution for proper compaction. The moisture content at the time of compaction shall be within the range specified in these special provisions. If the material is too dry, it shall be moistened by watering before and during manipulation, to properly condition the material for compaction. If the material is too wet, the compaction operation shall be delayed until the moisture content has been reduced to within satisfactory compaction range.

Because of time of completion limitations, thoroughly processing of the on-site clay soils will be required during manipulation if the moisture content is below optimum at the time of placement. Each fill lift should be processed until the soil mixture is free of large clods to allow uniform moisture distribution and uniform compaction within the entire fill lift. This is particularly important if highly plastic clay soils are to be used as fill in the building pads. The amount of processing and reworking required to achieve uniform moisture conditions can be reduced by pre-wetting the onsite soils prior to placement.

9.5.2 QUALITY ASSURANCE REQUIREMENTS

As a quality control measure, pocket penetrometer (P.P.) tests shall be performed with each field density test during construction as further verification that proper moisture conditioning is being achieved within the clay fill soils. Proper moisture conditioning should be indicated with hand penetrometer readings within the following ranges.

Material Type	Pocket Penetrometer Range
Clay Soils	1.2 tsf to 2.0 tsf
Sandy Clay	2.0 tsf to 3.0 tsf

Similarly, P.P. tests should be performed on each Proctor Compaction Point in the laboratory for correlation and verification of the desired P.P. range with respect to Proctor moisture, density and swell (with verification that volumetric swell is less than 1% at the targeted moisture content). Prior to construction, it should be confirmed that the “targeted moisture contents” recommended in this report will result in an average volumetric swell of

less than 1%. This swell testing should be performed in conjunction with all proctor compaction testing. If the targeted moisture contents result in an average swell of over 1% or in a P.P. value outside the range indicated above, AGG should be contacted to determine if the intent of the geotechnical design is being achieved with respect to required swell reduction and bearing capacity.

9.6 SELECT FILL PLACEMENT IN BUILDING AREAS

The material used as select fill should be a sandy clay to clayey sand (uniform consistency free of clay clods) having a Liquid Limit of less than 35 and a Plasticity Index between 4 and 15. The PI of the select fill should be increased to between 8 and 15 for footing construction. The select fill should be uniformly compacted in 6 inch lifts to a minimum of 98 percent of ASTM Standard D 698 between -2% and +2% above the soil's optimum moisture content. The upper 18 inches of fill in unpaved areas near the building should consist of compacted on–site clay to minimize water infiltration into the select fill (compacted in maximum 8 inch lifts at optimum to +3% above optimum moisture to a minimum of 95% ASTM D698).

10.0 TREE EFFECTS

It should be recognized that concrete slabs (floor slabs, plaza, sidewalks, flatwork and pavements) and retaining walls will be subject to long term settlements due to ground shrinkage caused by moisture absorption of tree root systems. To minimize long term settlements, trees and deep rooted shrubs should not be located within 35 feet of critical flatwork areas sensitive to movement in order to minimize settlements caused by ground shrinkage associated with moisture absorption of the tree root systems. Also, the area beneath the un-pruned mature tree drip lines and to limits of at least 10 feet beyond the drip line should not be paved. The area beneath the drip line should be landscaped and irrigated. Otherwise, an arborist should be contacted regarding the installation, effectiveness, and use of root barriers and tree wells to minimize future slab-on-grade foundation and flatwork settlements due to ground shrinkage caused by tree root absorption.

11.0 FIELD SUPERVISION

Many problems can be avoided or solved in the field if proper inspection and testing services are provided. It is recommended that all pier excavations, footing excavations, proofrolling, site and subgrade preparation, subgrade stabilization and pavement construction be monitored by a qualified engineering technician. Density tests should be

performed to verify compaction and moisture content of any earthwork. Inspection should be performed prior to and during concrete placement operations. Alliance Geotechnical Group employs a group of experienced, well-trained technicians for inspection and construction materials testing who would be pleased to assist you on this project.

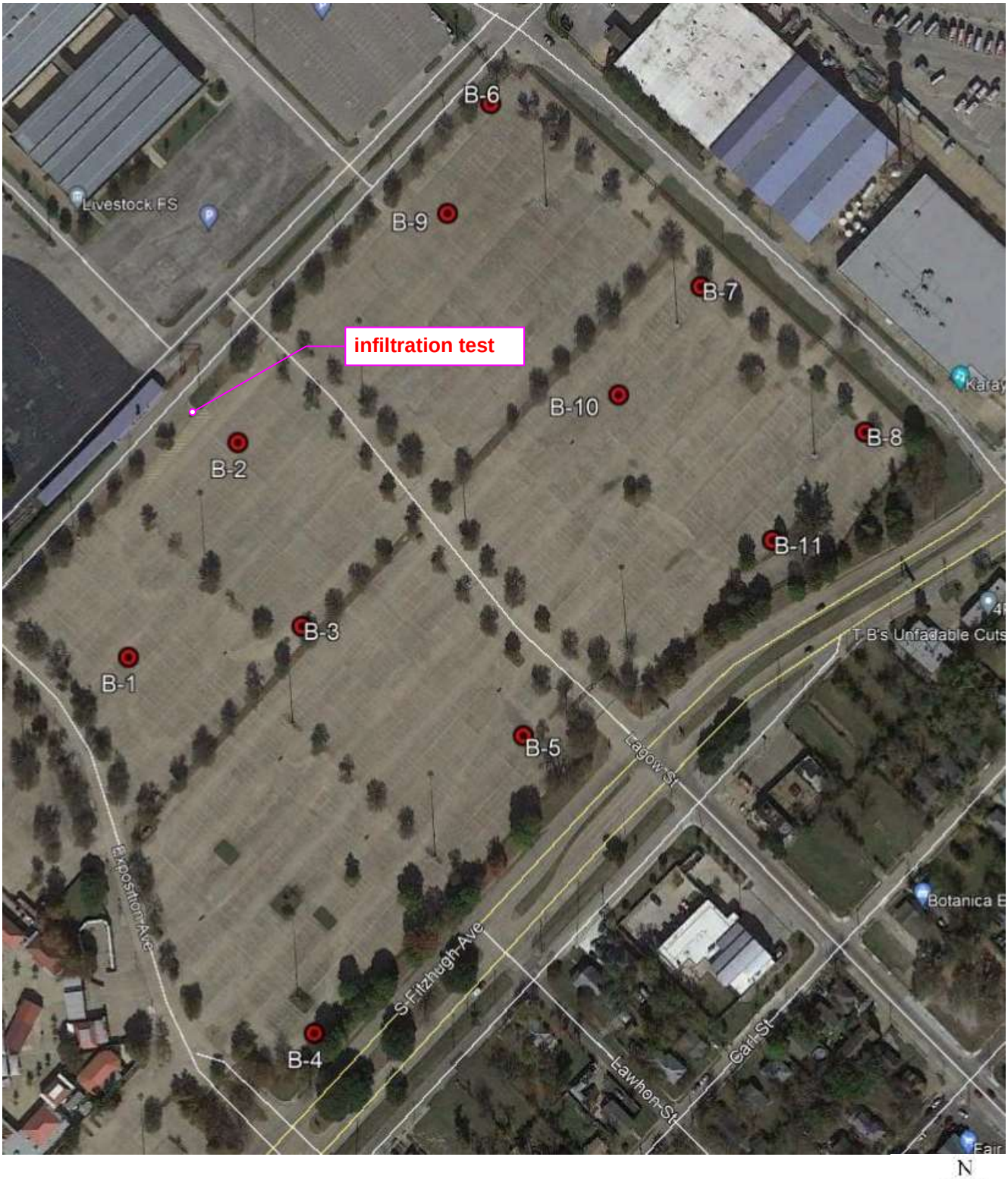
12.0 LIMITATIONS

The professional services, which have been performed, the findings obtained, and the recommendations prepared were accomplished in accordance with currently accepted geotechnical engineering principles and practices. The possibility always exists that the subsurface conditions at the site may vary somewhat from those encountered in the test borings. The number and spacing of test borings were chosen in such a manner as to decrease the possibility of undiscovered abnormalities, while considering the nature of loading, size, and cost of the project. If there are any unusual conditions differing significantly from those described herein, Alliance Geotechnical Group, Inc. should be notified to review the effects on the performance of the recommended foundation system.

The recommendations given in this report were prepared exclusively for the use of the client, their client and their consultants. The information supplied herein is applicable only for the design of the previously described development to be constructed at locations indicated at this site and should not be used for any other structures, locations, or for any other purpose.

We will retain the samples acquired for this project for a period of 30 days subsequent to the submittal date printed on the report. After this period, the samples will be discarded unless otherwise notified by the owner in writing.

FIGURES



ALLIANCE GEOTECHNICAL GROUP	Project No: DE21-063	**PLANS OF BORINGS**
	PROPOSED NEW COMMUNITY PARK DALLAS, TEXAS	FIGURE NO: 1

LOG OF BORING B-1

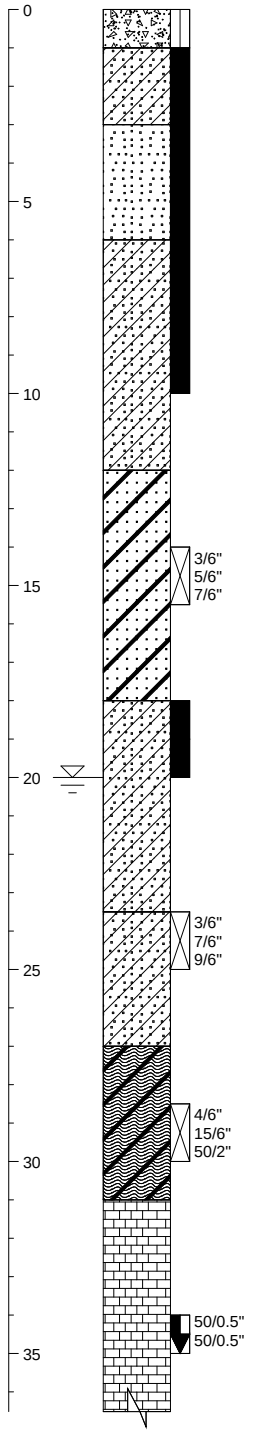
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/22/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **20 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
9" CONCRETE over 3" Gravel									
Reddish brown clayey SAND	10						4.5+ 3.5		
Reddish brown SAND, w/ clayey sand seams	6								
Reddish brown clayey SAND, w/ sand seams and layers	17 9	35	15	20	21		1.5 1.0		
Reddish brown sandy CLAY	15						1.5		
Reddish brown clayey SAND, w/ sand seams							1.5 2.0		
-Water seepage at 23 feet during drilling									
Tan clayey SAND, w/ gravel Sand and gravel layers below 25 feet									
Tan calcareous CLAY, w/ severely weathered limestone layers									
Very hard gray LIMESTONE									

Notes:

FIGURE:2

LOG OF BORING B-1

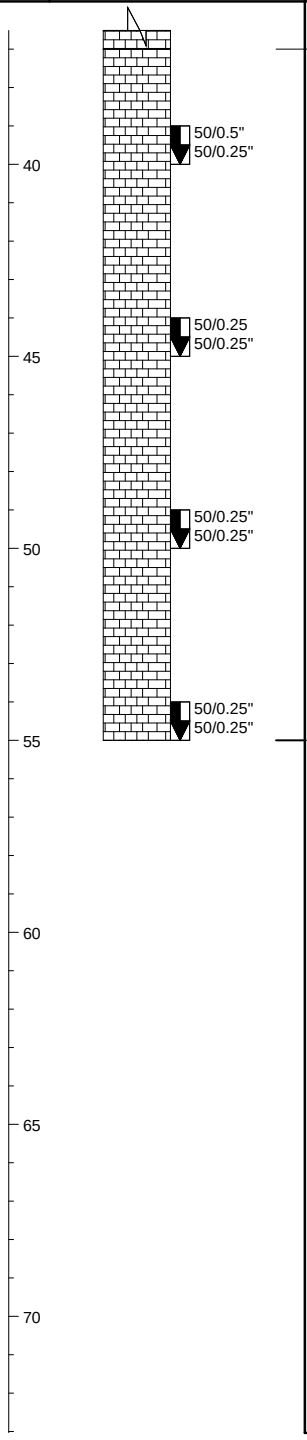
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/22/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **20 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		Very hard gray LIMESTONE									
		Boring terminated at 55 feet									

Notes:

FIGURE:3

LOG OF BORING B-2

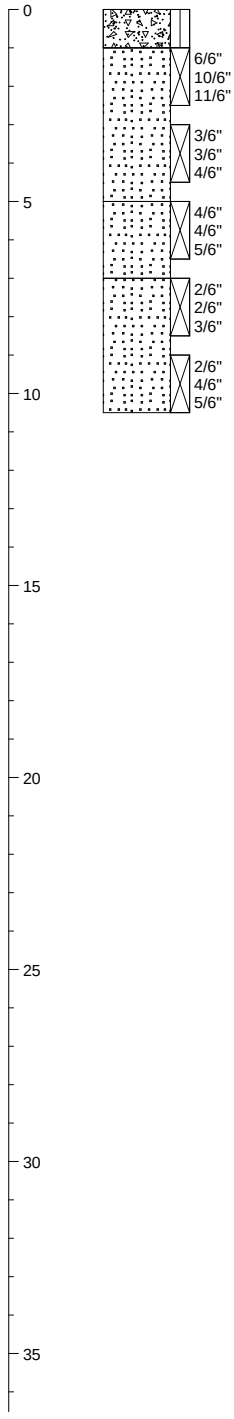
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/4/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **DRY**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		6" CONCRETE over 2" GRAVEL									
		Tan SAND, w/ clayey sand seams	9				15				
			6								
		Light gray SAND, w/ clayey sand seams	6								
		Light brown and tan SAND, w/clayey sand seams	17								
		Boring terminated at 10.5 feet									

Notes:

FIGURE:4

LOG OF BORING B-3

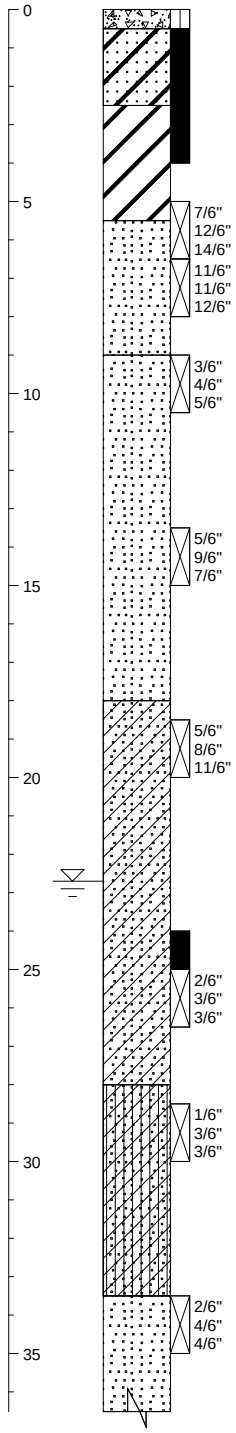
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/30/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **22.7 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		4" CONCRETE over 2" Gravel									
		Dark brown, brown, tan sandy CLAY, w/ calcareous nodules and trace gravel (FILL)	14	46	15	31		121	4.5++ 4.5++ 4.5++		
		Dark brown and brown CLAY, w/ gravel, calcareous nodules, brick pieces and iron deposits (FILL)	21	66	23	43		106	4.5++		
		Tan fine SAND, w/ trace gravel	1				6				
		Brown SAND and GRAVEL	5								
		Brown and light brown clayey SAND, w/ sand layers							3.0		
		-Water seepage at 26 feet during drilling							2.0		
		Light brown silty clayey SAND									
		Brown SAND -sand and gravel layers below 36 feet									

Notes:

FIGURE:5

LOG OF BORING B-3

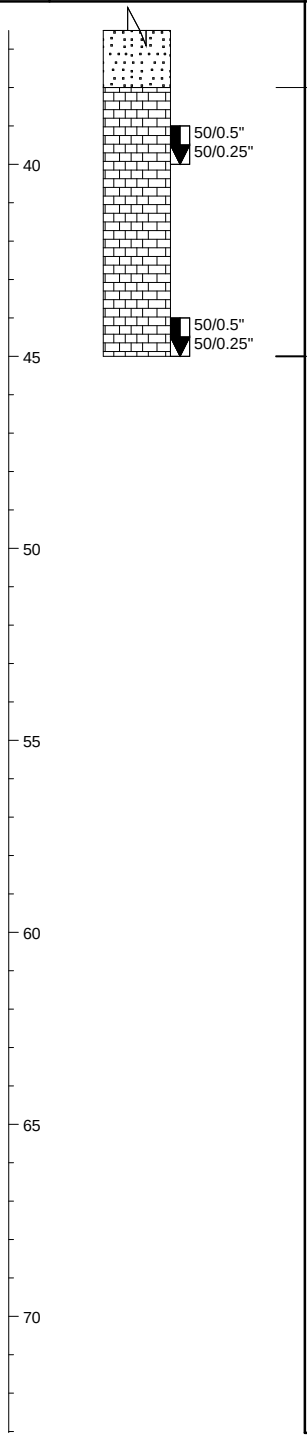
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/30/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **22.7 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		Brown SAND									
		Very hard gray LIMESTONE									
		Boring terminated at 45 feet									

Notes:

FIGURE:6

LOG OF BORING B-4

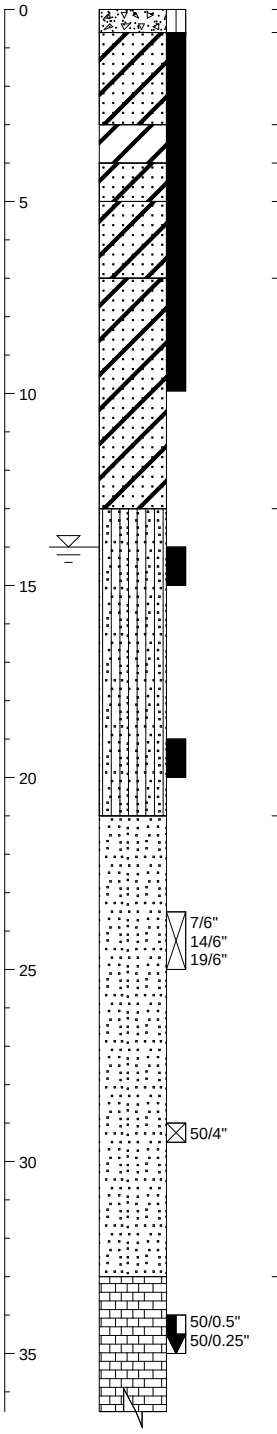
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/30/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **14 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
	6" CONCRETE over 2" GRAVEL									
	Light brown sandy CLAY, w/ sand seams and asphalt pieces (FILL)	27	45	34	11			2.5		
	Brown and grayish brown CLAY, w/ sand, calcareous nodules and gravel (FILL)							3.0		
		14						3.2		
	Dark brown very sandy CLAY, w/ iron stains							4.0		
	Brown sandy CLAY, w/ iron stains	18	48	18	30		112	4.5		
	Light brown sandy CLAY, w/ calcareous nodules							3.7		
								4.5		
		18	49	18	31		112	4.2		
	Tan silty SAND	10								
	-Water seepage at 18 feet during drilling									
	Brown SAND									
	-Brown Sand & Gravel @ 27'									
	Very hard gray LIMESTONE									

Notes:

FIGURE:7

LOG OF BORING B-4

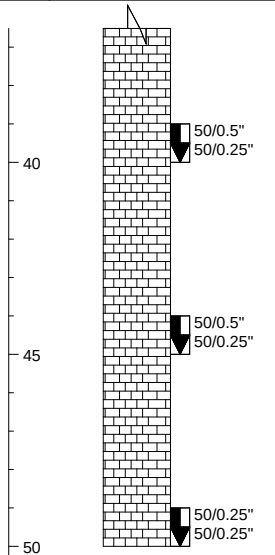
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/30/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **14 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		Very hard gray LIMESTONE									
		Boring terminated at 50 feet									

Notes:

FIGURE:8

LOG OF BORING B-5

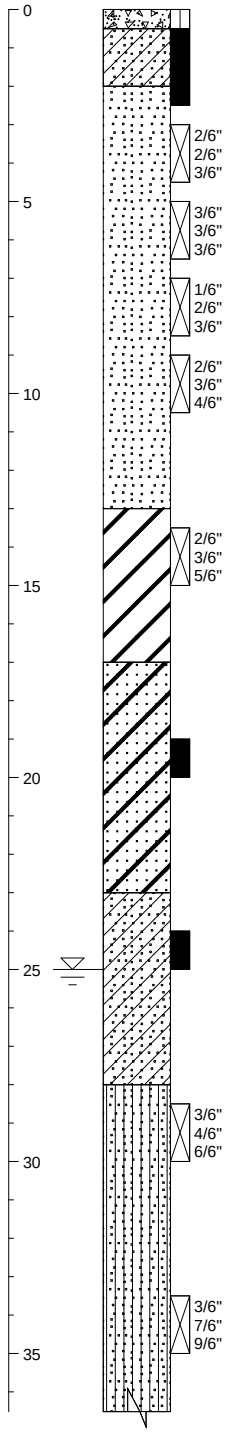
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/4/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **25 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		4" CONCRETE over 2" GRAVEL BASE									
		Light brown clayey SAND	14						2.5		
		Brown and light brown SAND	5				3				
		Brown CLAY, jointed, w/ trace gravel and iron stains	21						3.25		
		Brown sandy CLAY							3.0		
		Light brown and tan clayey SAND	13						3.5		
		Light brown silty SAND, w/ gravel -Water seepage at 29 feet									

Notes:

FIGURE:9

LOG OF BORING B-5

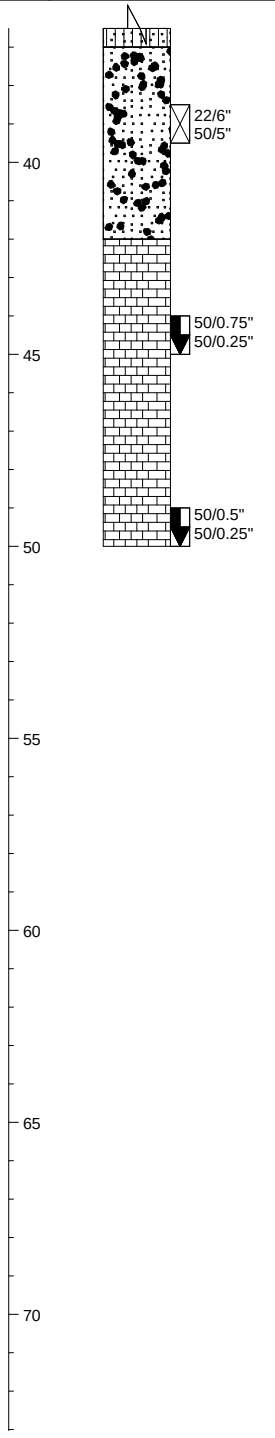
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/4/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **25 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
Brown SAND and GRAVEL									
Very hard gray LIMESTONE									
Boring terminated at 50 feet									

Notes:

FIGURE:10

LOG OF BORING B-6

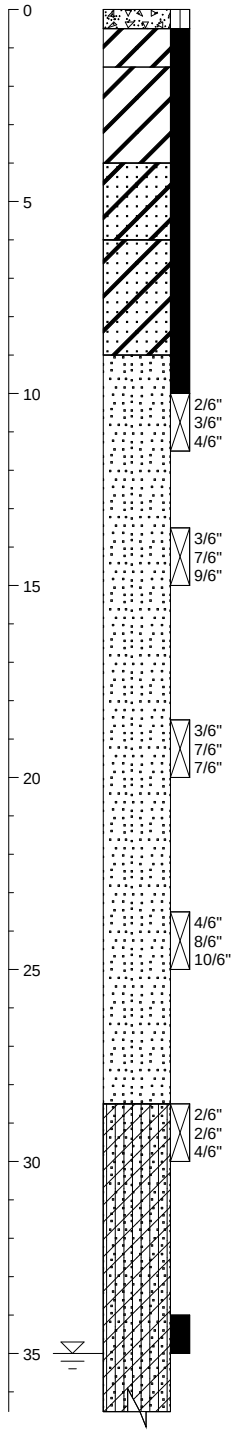
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/5/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **35 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
	4" CONCRETE over 2.5" CONCRETE fragments							4.5++		
	Dark brown CLAY, w/ reddish brown clay and iron stains (FILL)	19	54	19	35		107	4.5++ 4.5++		
	Dark brown CLAY, jointed, w/ iron stains							4.5++		
	Brown sandy CLAY, w/ calcareous nodules and iron stains	15	51	18	33	74	111	4.5++ 4.5++		
	Reddish brown clayey SAND, w/ gravel and calcareous nodules	10	32	15	17	46	108	4.5++ 4.5		
	Tan SAND	2								
	Tan silty clayey SAND	15						2.0		

Notes:

FIGURE:11

LOG OF BORING B-6

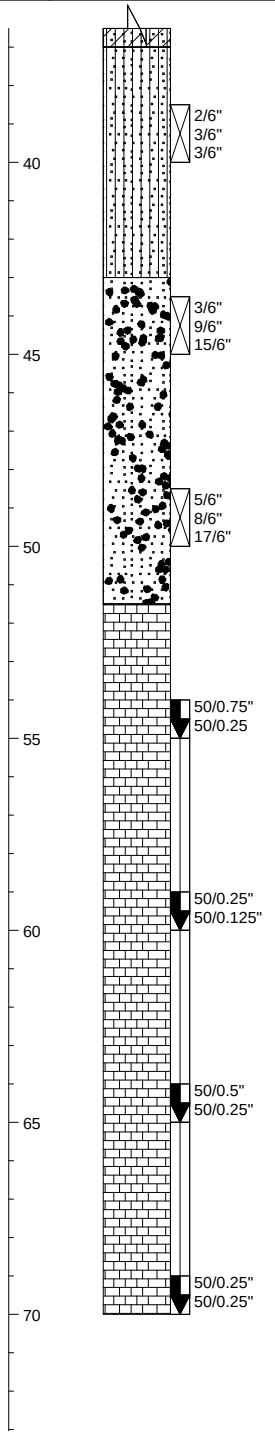
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/5/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **35 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
	Tan silty SAND -Water seepage at 38.5 feet during drilling									
	Brown SAND and GRAVEL									
	Very hard gray LIMESTONE	13					123		354.7	1.7
		11					127		233.8	1.4
		13					123		218.8	1.6
	Boring terminated at 70 feet									

Notes:

FIGURE:12

LOG OF BORING B-7

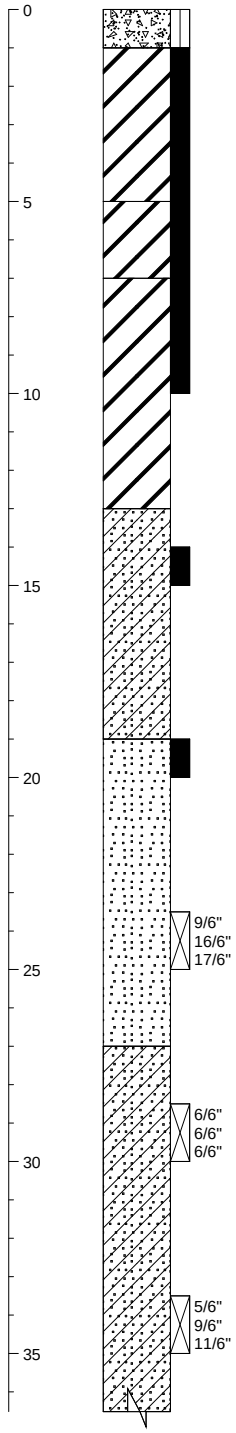
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/19/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **40 FEET**

Depth to water when checked: was:

Depth to caving when checked: was:



DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
7" CONCRETE over 4" GRAVEL									
Dark brown CLAY, jointed, w/ calcareous nodules and iron nodules	21	68	24	44		106	4.5++ 4.5++ 4.5++ 4.5++		
Brown CLAY, jointed, w/ calcareous nodules	20	63	23	40		106	4.5++ 4.5++		
Tan and brown CLAY, jointed, w/ calcareous nodules	18	59	20	39		119	4.5++ 4.5++ 4.5++		
Tan and light gray clayey SAND	9	25	13	12	38				
Tan SAND	2								
Reddish brown clayey SAND, w/ trace gravel	12								

Notes:

FIGURE:13

Alliance Geotechnical Group, Inc.

LOG OF BORING B-7

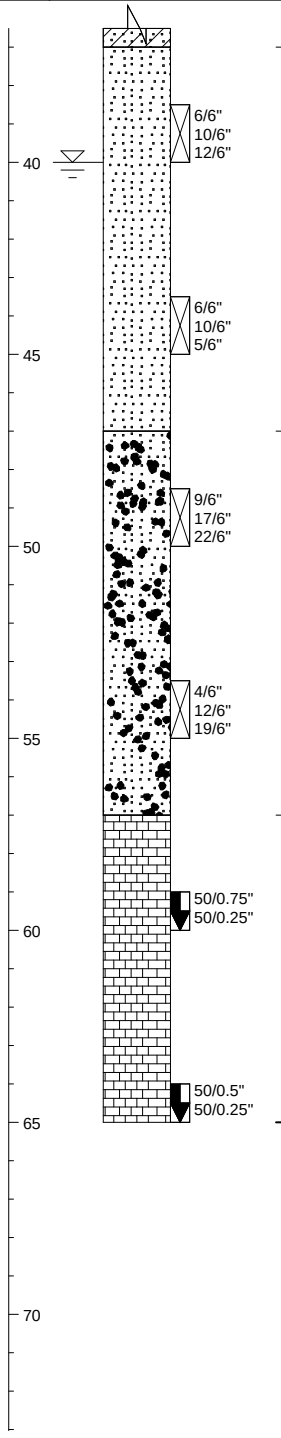
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/19/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **40 FEET**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		Tan SAND									
		-Water seepage at 45 feet during drilling									
		Tan SAND and GRAVEL									
		Very hard gray LIMESTONE									
		Boring terminated at 65 feet									

Notes:

FIGURE:14

LOG OF BORING B-8

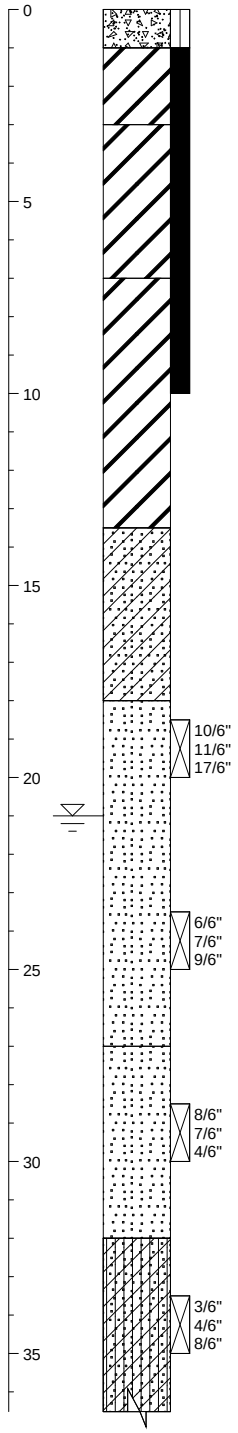
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/29/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **21 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		8" CONCRETE over 4" GRAVEL									
		Dark grayish brown CLAY, jointed, w/ calcareous nodules and iron stains	28						2.7 3.0		
		Brown CLAY, jointed, w/ calcareous nodules and iron stains	26						3.0 2.5 3.0 2.7		
		Tan CLAY, jointed, w/ calcareous nodules and iron stains	21						3.0 3.0 3.7		
		Reddish brown clayey SAND									
		Tan SAND	3				2				
		Brown SAND									
		Brown silty clayey SAND -Water seepage at 33 feet	11								

Notes:

FIGURE:15

LOG OF BORING B-8

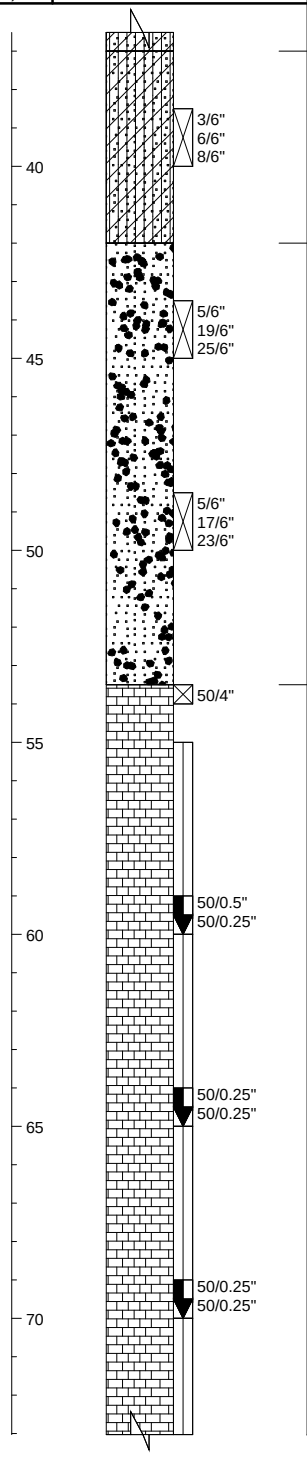
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/29/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **21 feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
	Brown silty clayey SAND									
	Brown SAND and GRAVEL									
	Very hard gray LIMESTONE									
		14					123		339.5	2.1
		13					122		383.8	2.1
		11					125		286.2	1.4

Notes:

FIGURE:16

LOG OF BORING B-8

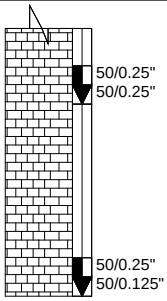
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/29/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **21 feet**

Depth to water when checked: was:

Depth to caving when checked: was:

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
75		Very hard gray LIMESTONE	13					122		352.2	1.7
80		Boring terminated at 80 feet									
85											
90											
95											
100											
105											

Notes:

FIGURE:17

LOG OF BORING B-9

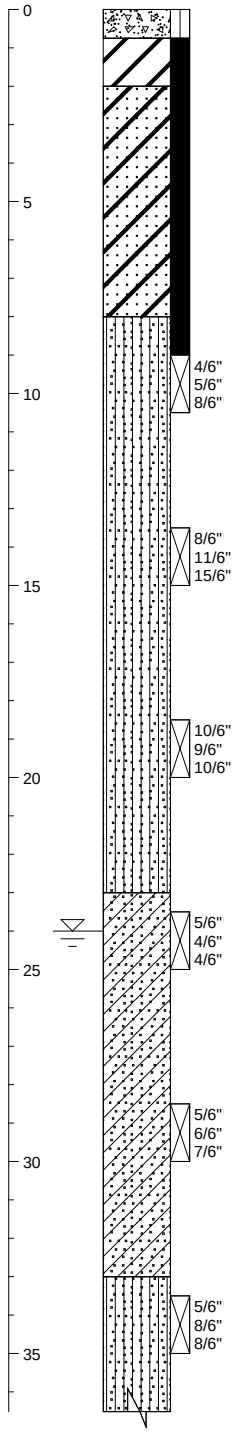
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/23/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **24 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
6" CONCRETE over 3" GRAVEL									
Dark brown CLAY, jointed							4.5+ 3.7		
Brown sandy CLAY, w/ calcareous nodules	11	40	13	27		120	4.5+ 4.5+ 4.5++ 4.5++ 4.5+ 4.5++		
Tan silty SAND	5								
Brown silty clayey SAND	11								
Brown silty SAND -Water seepage at 34 feet during drilling									

Notes:

FIGURE:18

LOG OF BORING B-9

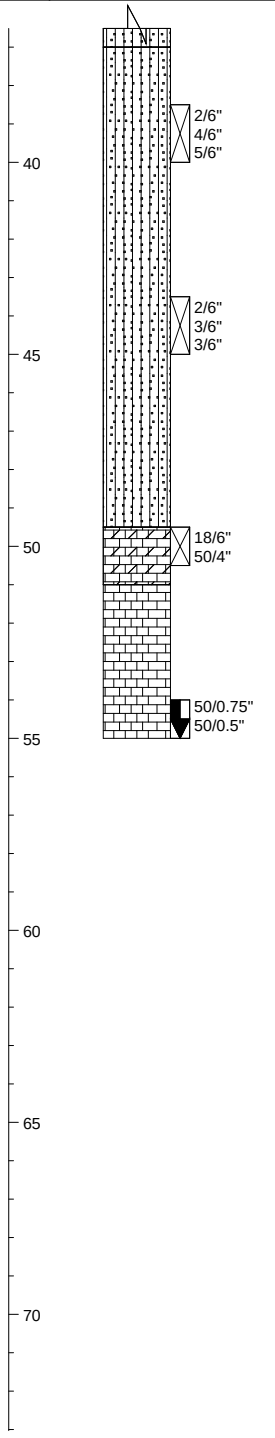
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/23/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **24 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		Brown silty SAND	18								
		-Sand and Gravel layers below 46 feet									
		Hard to very hard tan weathered LIMESTONE, fractured w/ clay seams									
		Very hard gray LIMESTONE									
		Boring terminated at 55 feet									

Notes:

FIGURE:19

LOG OF BORING B-10

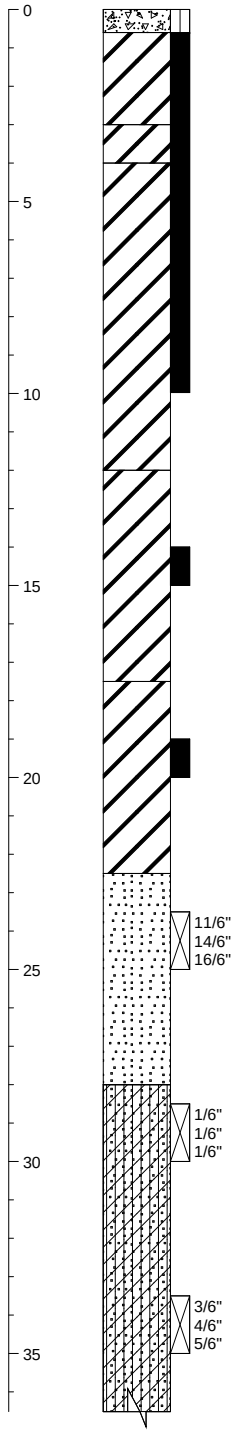
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/23/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **49 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
0	5.5' CONCRETE over 2" GRAVEL									
	Dark grayish brown CLAY, jointed, w/ calcareous nodules	27						2.0 2.2 2.5		
	Brown CLAY, jointed, w/ calcareous nodules							3.0		
5	Light brown CLAY, jointed, w/ sand, calcareous nodules and iron stains	20	53	18	35			3.2 3.0 3.7 3.7 4.0 3.5		
10										
15	Light brown and reddish brown CLAY, jointed, w/ iron stains and calcareous nodules							4.0		
20	Reddish brown and gray CLAY, jointed, w/ calcareous seams	25						4.0		
25	Brown SAND									
30	Brown silty clayey SAND									
35										

Notes:

FIGURE:20

LOG OF BORING B-10

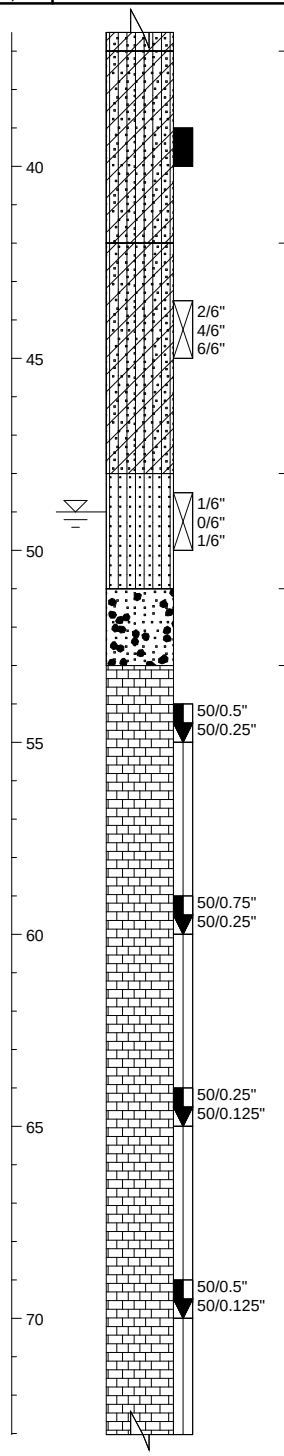
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/23/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **49 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
Brown silty clayey SAND							1.0		
Brown silty clayey SAND -Water seepage at 42 feet during drilling									
Brown and tan silty SAND									
Tan SAND and GRAVEL									
Very hard gray LIMESTONE	12					124		259.1	2.1
	13					121		279.7	1.6
	13					124		328.7	1.6
	11					127		277.1	1.8

Notes:

FIGURE:21

LOG OF BORING B-10

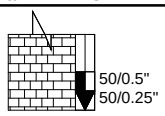
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **7/23/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **49 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:

ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
75	 50/0.5" 50/0.25"	Very hard gray LIMESTONE									
		Boring terminated at 75 feet									
80											
85											
90											
95											
100											
105											

Notes:

FIGURE:22

LOG OF BORING B-11

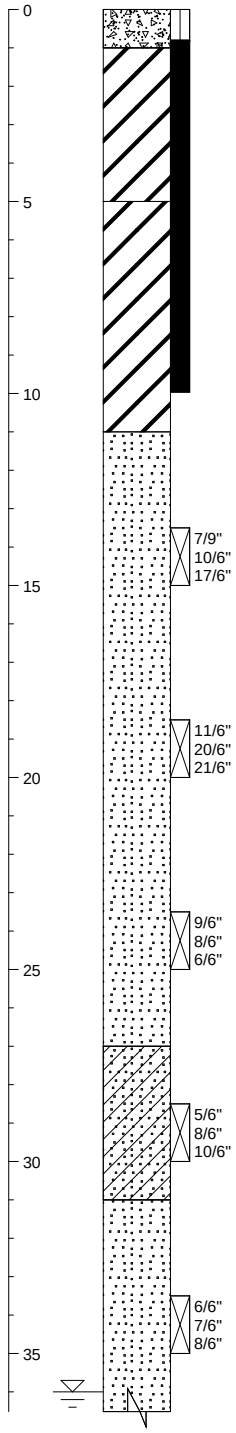
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/19/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **36 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	SOIL SYMBOLS SAMPLER SYMBOLS & FIELD TEST DATA	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
		6" CONCRETE over 4" GRAVEL									
		Brown CLAY, jointed, w/ calcareous nodules	17						4.5++		
									4.5++		
									4.5++		
		Tan and light gray CLAY, jointed, w/ calcareous nodules							4.5++		
			12						4.5++		
									4.5++		
									4.5++		
		Tan SAND	1				3				
		Reddish brown clayey SAND									
		Tan SAND	9								

Notes:

FIGURE:23

LOG OF BORING B-11

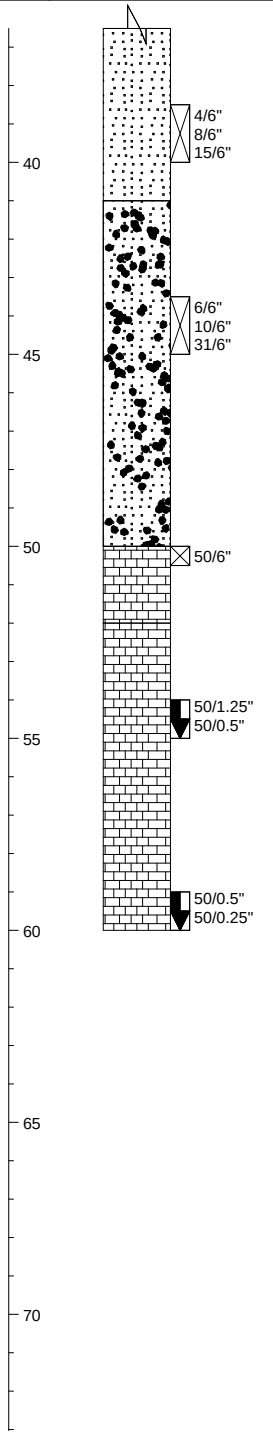
Project: **Fair Park Community Park** Project No.: **DE21-063**

Date: **8/19/2021** Elev.: Location: **See Figure 1**

Depth to water at completion of boring: **36 Feet**

Depth to water when checked: was:

Depth to caving when checked: was:



ELEVATION/ DEPTH (feet)	DESCRIPTION	MC %	LL %	PL %	PI %	-200 %	DD pcf	P.PEN tsf	UNCON ksf	Strain %
	Tan SAND -Water seepage at 40 feet during drilling									
	Tan SAND and GRAVEL	13				5				
	Hard to very hard tan weathered LIMESTONE, fractured									
	Very hard gray LIMESTONE									
	Boring terminated at 60 feet									

Notes:

FIGURE:24

KEY TO LOG TERMS & SYMBOLS

Symbol	Description
Strata symbols	
	CONCRETE
	SAND, clayey
	SAND
	CLAY, sandy
	CLAY, Calcareous
	LIMESTONE
	CLAY
	SAND, clayey silty
	SAND, silty

Symbol	Description
	SAND, GRAVEL
	LIMESTONE, weathered
	SILT, sandy
Misc. Symbols	
	Water table at boring completion
	Boring continues
Soil Samplers	
	Rock Core
	Thin Wall Shelby Tube
	Standard Penetration Test
	Auger

Notes:

1. Exploratory borings were drilled on dates indicated using truck mounted drilling equipment.

2. Water level observations are noted on boring logs.

3. Results of tests conducted on samples recovered are reported on the boring logs. Abbreviations used are:

DD = natural dry density (pcf)	LL = liquid limit (%)
MC = natural moisture content (%)	PL = plastic limit (%)
Uncon.= unconfined compression (tsf)	PI = plasticity index
P.Pen.= hand penetrometer (tsf)	-200 = percent passing #200

4. Rock Cores
   - REC = (Recovery) sum of core sample recovered divided by length of run, expressed as percentage.
   - RQD = (Rock Quality Designation) sum of core sample recovery 4" or greater in length divided by the run, expressed as percentage.

FIGURE:25

SWELL TEST RESULTS

BORING NO.	DEPTH (FEET	UNIT WEIGHT (pcf)	ATTERBURG LIMITS			IN-SITU MOISTURE CONTENT	FINAL MOISTURE CONTENT	LOAD (psf)	% VERTICAL SWELL
			LL	PL	PI				
B-3	1-2	120.7	46	15	31	13.8	19.0	188	7.6
B-3	3-4	106.3	66	23	43	20.7	25.2	438	7.3
B-4	6-7	112.2	45	34	11	18.0	19.3	813	1.2
B-4	9-10	111.7	49	18	31	18.1	19.0	1188	0.7
B-6	2-3	106.8	54	19	35	18.6	24.6	313	7.9
B-6	5-6	110.6	51	18	33	14.8	20.4	677	5.3
B-6	7-8	108.3	32	15	17	10.2	15.9	938	1.5
B-7	2-3	105.6	68	24	44	21.4	27.5	313	8.4
B-7	5-6	106.2	63	23	40	20.0	24.0	688	5.1
B-7	9-10	119.4	59	20	39	17.6	21.1	1188	4.9
B-9	4-5	119.8	40	13	27	10.6	14.4	563	4.5

PROCEDURE:

1. Sample placed in confining ring, design load (including overburden) applied, free water with surfactant made available, and sample allowed to swell completely.
2. Load removed and final moisture content determined.

ALLIANCE GEOTECHNICAL GROUP

SWELL TEST RESULTS		
FAIR PARK COMMUNITY PARK		
DALLAS, TEXAS		
ALLIANCE GEOTECHNICAL GROUP		
DE21-063	Date: 08/17/2021	FIGURE 26