Geotechnical Engineering Report

Fairfield Inn & Suites by Marriott
Lufkin, Texas
May 23, 2019
Terracon Project No. 93195042

Prepared for:
Langston Construction, Inc.
Lufkin, Texas

Prepared by:
Terracon Consultants, Inc.
Lufkin, Texas

May 23, 2019

Langston Construction, Inc.
1000 S. Medford Drive, Ste. A
Lufkin, Texas 75901

Attn: Mr. Josh Fullerton – Project Manager
P: (936) 632 9847
E: josh@langstonconstruction.com

Re: Geotechnical Engineering Report
Fairfield Inn & Suites by Marriott
3715 S. Medford Drive
Lufkin, Texas
Terracon Project No. 93195042

Dear Mr. Fullerton:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P93195042 dated May 6, 2019. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.
(Texas Firm Registration No. F-3272)

Kevin Raul Ali, P.E.
Senior Associate / Office Manager

William M. Martin, P.E, APMP
Senior Geotechnical Engineer

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

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

Geotechnical Engineering Report

Fairfield Inn & Suites by Marriott
3715 S. Medford Drive
Lufkin, Texas
Terracon Project No. 93195042
May 23, 2019

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Fairfield Inn & Suites by Marriott to be located at 3715 S. Medford Drive in Lufkin, Texas. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

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

The geotechnical engineering Scope of Services for this project included the advancement of three test borings to a depth of approximately 25 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 3715 S. Medford Drive in Lufkin, Texas. Approximate GPS: 31.312422°, -94.713664° See **Site Location**
Existing Improvements	None
Current Ground Cover	Grass and weeds.

Item	Description
Existing Topography	Based on a Google Earth Pro image, it appears the site is relatively flat with less than 2 feet of elevation change across the building footprint.

PROJECT DESCRIPTION

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

Item	Description
Proposed Structures	The project includes the construction of a new three-story Fairfield inn building covering an area of about 17,500 square feet with associated parking areas and drives.
Building Construction	Unknown.
Finished Floor Elevation	Unknown. However, FFE is expected to be within 2 feet of existing site grade.
Maximum Loads	Unknown
Grading/Slopes	Final slope angles of as steep as 3H:1V (Horizontal: Vertical) are expected.
Below-Grade Structures	Below-grade swimming pool.
Free-Standing Retaining Walls	None anticipated
Pavements	Pavement recommendations are beyond our scope of services for this project.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface soil and groundwater conditions based upon our review of the data and our understanding of the geologic setting. The following paragraphs provide a representation of the subsurface characterization. A brief summary of field and laboratory data is also included.

This geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

In general, the soil stratigraphy at this site is layers of clayey sand, silty sand, sandy silty clay, sandy lean clay, and fat clay.

The samples of clayey sand were classified using the percent fines determination, and the amount of material passing the No. 200 sieve measured in the clayey sand samples were 42 and 43 percent. The samples of clayey sand that were tested and classified using the Atterberg limits test had plasticity indices of 9 and 12 indicating a low to moderate potential for shrink/swell movement. The silty sands are considered non-plastic.

The samples of sandy lean clay, sandy silty clay and fat clay that were tested and classified using the Atterberg limits test had plasticity indices ranging from 7 to 40, indicating a low to high potential for shrink/swell movement. The samples of sandy lean clay, sandy silty clay and fat clay were further classified using the percent fines determination, and the amount of material passing the No. 200 sieve measured in the samples ranged from 50 to 98 percent.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; however, the in-situ transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and immediately after completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Boring Depth (feet) [1]	Approximate Depth to Groundwater while Drilling (feet) [1]	Approximate Depth to Groundwater upon completion (feet) [1]
B-1	25	Not observed	Dry and open to 25
B-2	25	Not observed	Dry and open to 25
B-3	25	25	23 and open to 25

1. Below ground surface

The absence of groundwater in some of the borings does not necessarily mean the borings terminated above groundwater. Due to the low permeability of some soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long-term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Design finished floor elevation for the planned building and the grading plan were not available at the time of this report. That information should be provided to Terracon so that our recommendations can be reviewed, and revised if necessitated by the proposed grading plan.

Some of the near surface soil at this site could be weak and unsuitable to support foundations and floor slabs. Additional site preparation could be necessary in some areas to mitigate weak soil and prepare the subgrade for support of building foundations and floor slabs. Our soil borings drilled as part of our first field mobilization did not include strength information. We will collect strength information as part of our second field mobilization. We will review the data from our second field mobilization and revise our recommendations if necessitated by the subsurface soil strength values.

The near surface soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. The effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement, are provided in the **Earthwork** section.

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. Some of these options are discussed in this report.

As tentatively planned by the project design team, a shallow foundation system and floor slab-on-grade on a select fill pad can be used for the proposed building if the risk of shrink/swell and settlement movement is acceptable, and provided the subgrade is prepared as discussed in this report, including stripping, overexcavation and placement of compacted select fill. Recommendations are provided in the following sections for preparation of the subgrade, and construction of the select fill building pad, foundations, and floor slab. The **Shallow Foundations** section addresses support of the building bearing on native soil or select fill. The **Floor Slabs** section addresses slab-on-grade support of the building.

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

EARTHWORK

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

Site Preparation

Prior to placing fill, existing vegetation and root mat should be removed. Complete stripping of the topsoil should be performed in the proposed building area.

Some of the near surface soil at this site could be weak and unsuitable to support foundations and floor slabs. Additional site preparation could be necessary in some areas to mitigate weak soil and prepare the subgrade for support of building foundations and floor slabs.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the direction of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequently addressed by the Geotechnical Engineer. Such areas should either be removed or modified by stabilizing with lime or lime fly-ash Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Fill Material Types

Fill required to achieve design grade should be classified as structural fill and general fill. Structural fill is material used below, or within 5 feet of structures. Earthen materials used for fill should meet the following material property requirements:

Soil Type [1]	USCS Classification and Parameters	Acceptable Placement Location
Structural Fill	Clayey Sand (SC) 4≤PI≤15 LL = 40% or less Less than 45% passing the No. 200 Sieve	Must be used to construct the structural fill pad under the grade-supported slab. Structural fill should also be considered below exterior concrete flatwork to reduce potential movements.

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

Fill Compaction Requirements

Structural fill should meet the following compaction requirements.

Item	Structural Fill
Maximum Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2, 3]	95% of maximum 98% of maximum below 5-foot depth where fill thickness is greater than 5 feet
Water Content Range [1]	-3% to +3% of optimum

1. Maximum dry density and optimum water content as determined by the standard Proctor test (ASTM D 698).
2. High plasticity cohesive fill should not be compacted to more than 100 percent of standard Proctor maximum dry density.
3. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254).

Utility Trench Backfill

For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. The trench should provide an effective trench plug that extends at least 5 feet from the face of the building exterior. The plug material should consist of cementitious flowable fill or low permeability clay. The trench plug material should be placed to surround the utility line. If used, the clay trench plug material should be placed and compacted to comply with the water content and compaction recommendations for structural fill stated previously in this report.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

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

Although not observed in our borings, perched groundwater could affect overexcavation efforts, especially for over-excavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps could be necessary to achieve the recommended depth of over-excavation.

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

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

Construction Observation and Testing

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proofrolling, and mitigation of areas delineated by the proofroll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet (minimum of 3 per lift) of compacted fill in the building areas. One density and water content test should be performed for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. If unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

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

Some of the near surface soil at this site could be weak and unsuitable to support foundations and floor slabs. Additional site preparation could be necessary in some areas to mitigate weak soil and prepare the subgrade for support of building foundations and floor slabs. Our soil borings drilled as part of our first field mobilization did not include strength information. We will collect strength information as part of our second field mobilization. We will review the data from our second field mobilization and revise our recommendations if necessitated by the subsurface soil strength values.

Design Parameters – Compressive Loads

Description	Individual Column	Continuous Wall
Minimum Embedment Below Finished Grade Around Perimeter of Structure[1]	18 inches	18 inches
Recommended Bearing Stratum[1]	Natural competent soil or compacted structural fill Bearing stratum to be verified by Terracon	
Minimum Dimension	30 inches	18 inches
Maximum Net Allowable Bearing Pressure, Dead Load Plus Sustained Live Load[2, 3]	2,000 psf	1,600 psf
Maximum Net Allowable Bearing Pressure, Total Load[2,3]	2,400 psf	2,000 psf
Estimated Total Settlement[4]	1 inch or less	
Estimated Differential Settlement[5]	Approximately ½ of total settlement	
Allowable Passive Pressure[6]	1,000 psf	

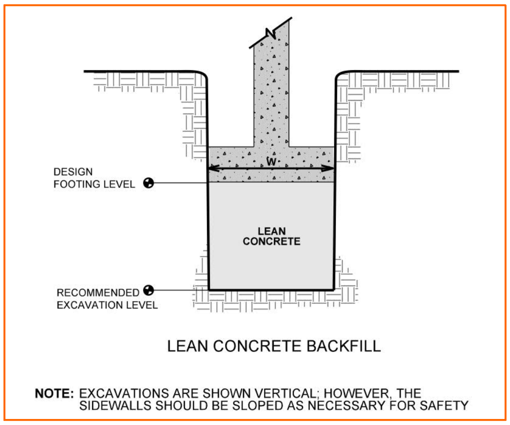
Description	Individual Column	Continuous Wall
Allowable Frictional Resistance[7]	250 psf	
Uplift Resistance[8]	Foundation weight: 150 pcf Soil weight: 120 pcf	

1. To bear within natural competent soil or structural fill soils.
2. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be undercut and replaced with properly compacted structural fill.
3. Use whichever loading condition yields the larger size footing.
4. Provided proper construction practices are followed. A clear distance between footings of one footing size of the larger of the two footings should not produce overlapping stress distributions, and adjacent footings would essentially behave as independent foundations. We expect that settlements experienced during construction may be on the order of 40 percent of the total settlements.
5. Differential settlements may result from variances in subsurface conditions, loading conditions and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads. Differential settlements between shallow foundations and drilled piers should be expected to approach the total settlement of the shallow foundations.
6. Lateral loads transmitted to the shallow spread footings will be resisted by a combination of soil-concrete friction on the base of the footing and passive pressure on the sides of the footing. The passive pressure along the exterior face of the footings should be neglected within the upper 3 feet due to surface effects unless pavement and/or flatwork is provided up to the edge of the structure.
7. Frictional resistance between bottom of footing and compacted structural fill or undisturbed native soil.
8. Structural uplift loads on the shallow footings may be resisted by the weight of the foundation and supported structure plus the weight of soil backfill directly above the foundation. The ultimate uplift capacity of shallow footings should be reduced by an appropriate factor of safety to compute allowable uplift capacity.

Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

FLOOR SLABS

Based on the information developed from our field and laboratory programs and on method Tex-124-E in the Texas Department of Transportation (TxDOT) Manual of Testing Procedures, we estimate that the subgrade soils have potential vertical rise (PVR) values of less than one inch at the existing ground surface. Those PVR values were estimated using existing moisture conditions, as well as assuming dry conditions for the upper 6 feet, and average to wet conditions below 6 feet. The actual movements could be greater if poor drainage, ponded water, and/or other sources of moisture are allowed to infiltrate beneath the structure after construction. Removal of existing soil and/or placement of fill would change the PVR values, as would changing the moisture conditions used for analysis.

The PVR at the existing ground surface is generally less than one inch, therefore a structural fill pad may not be necessary to reduce the PVR if the building can tolerate the indicated movement. However, to provide uniform bearing for the building floor slab, we recommend a structural fill pad at least 2 feet thick should be constructed below the design finished subgrade elevation for the building. As a minimum, at least 6 inches of surficial soil should be stripped before placement of structural fill. The structural fill pad should extend a minimum of 5 feet beyond the edge of the proposed structure.

The thickness of structural fill required to provide a PVR of about one inch maximum should be further evaluated after the site topographic map, grading plan and design finished floor elevations are available.

The structural fill pad should extend a minimum of 5 feet beyond the edge of the proposed structure. The final exterior grade adjacent to the slab should be sloped to promote positive drainage away from the structures. Following overexcavation of the soil to the specified depth, and prior to placement of structural fill, the exposed subgrade soils should be thoroughly proof-rolled and/or evaluated by Terracon using other methods, and prepared as outlined in **Earthwork**.

The subgrade and structural fill soils should be prepared as outlined in **Earthwork**, which contains material and placement requirements for structural fill, as well as other subgrade preparation recommendations. Design parameters for the floor slab assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure.

Some of the near surface soil at this site could be weak and unsuitable to support foundations and floor slabs. Additional site preparation could be necessary in some areas to mitigate weak soil and prepare the subgrade for support of building foundations and floor slabs. Our soil borings drilled as part of our first field mobilization did not include strength information. We will collect strength information as part of our second field mobilization. We will review the data from our second field mobilization and revise our recommendations if necessitated by the subsurface soil strength values.

Floor Slab Design Parameters

The grade-supported slab should be designed using the following recommendations.

Item	Description
Slab Support	Select fill at least 2 feet thick
Estimated Potential Vertical Rise (PVR)	Approximate 1 inch

The slab should be structurally independent of spread footing or continuous footing foundations that are not cast monolithically with the slab to allow independent movement. Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional jointing recommendations, refer to the ACI Design Manual.

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

Floor Slab Construction Considerations

Finished subgrade within, and for at least 5 feet beyond, the floor slab should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and select fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

Terracon should observe the condition of the floor slab subgrade immediately prior to placement of the floor slab support course, reinforcing steel and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Boring Depth (feet)	Planned Location
3	25	Planned building area

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

Subsurface Exploration Procedures: We advance the borings with an ATV-mounted rotary drill rig using continuous flight augers (solid stem and/or hollow stem as necessary depending on soil conditions). Five samples are typically obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. We observe and record groundwater levels during drilling and sampling. For safety purposes, all borings are backfilled with auger cuttings after their completion.

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

Laboratory Testing

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

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils

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

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

EXHIBIT - SITE LOCATION PLAN

Fairfield Inn & Suites by Marriott ■ Lufkin, Texas

May 23, 2019 ■ Terracon Project No. 93195042

Terracon GeoReport

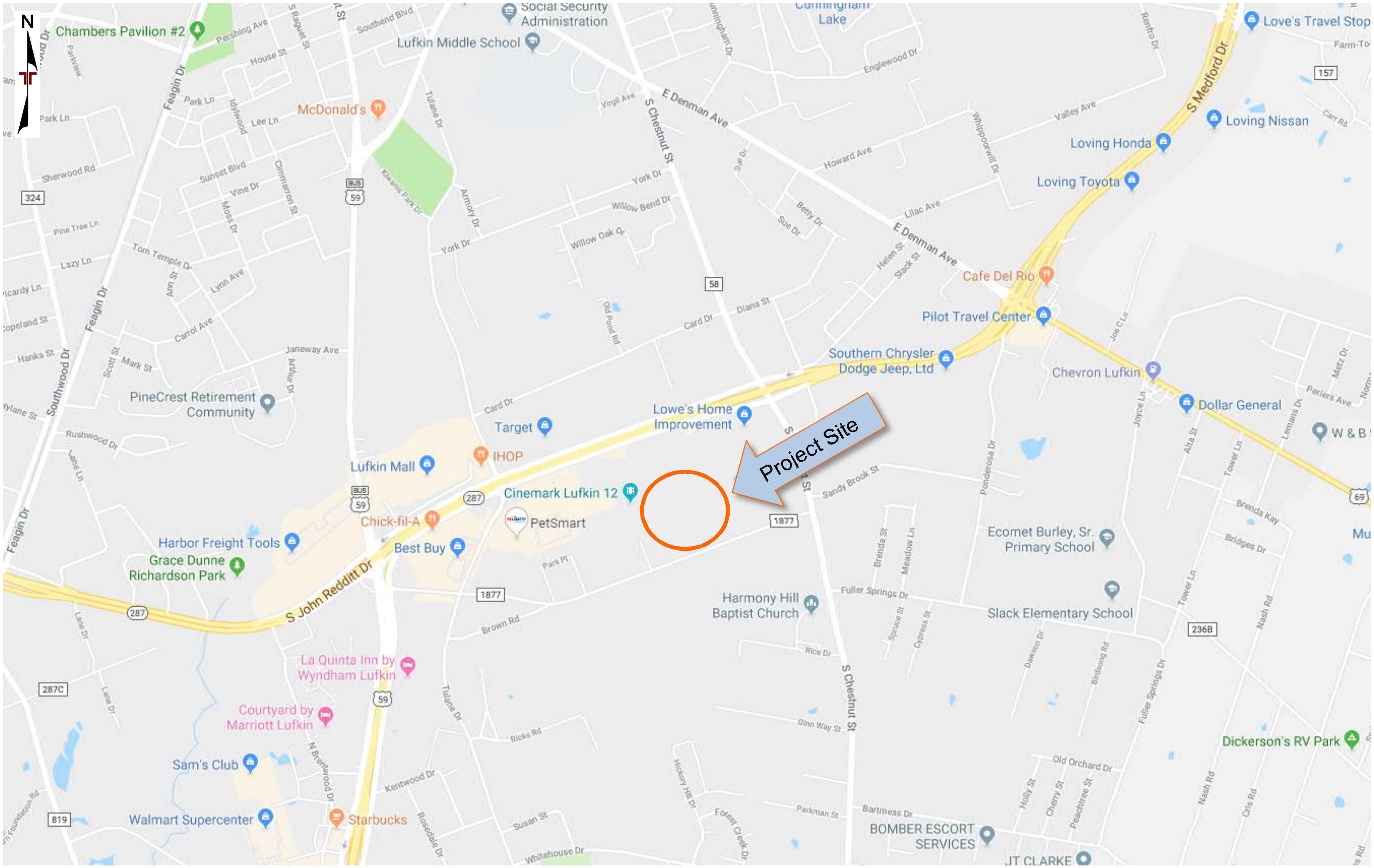


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXHIBIT - EXPLORATION LOCATION PLAN
Fairfield Inn & Suites by Marriott ■ Lufkin, Texas
May 23, 2019 ■ Terracon Project No. 93195042

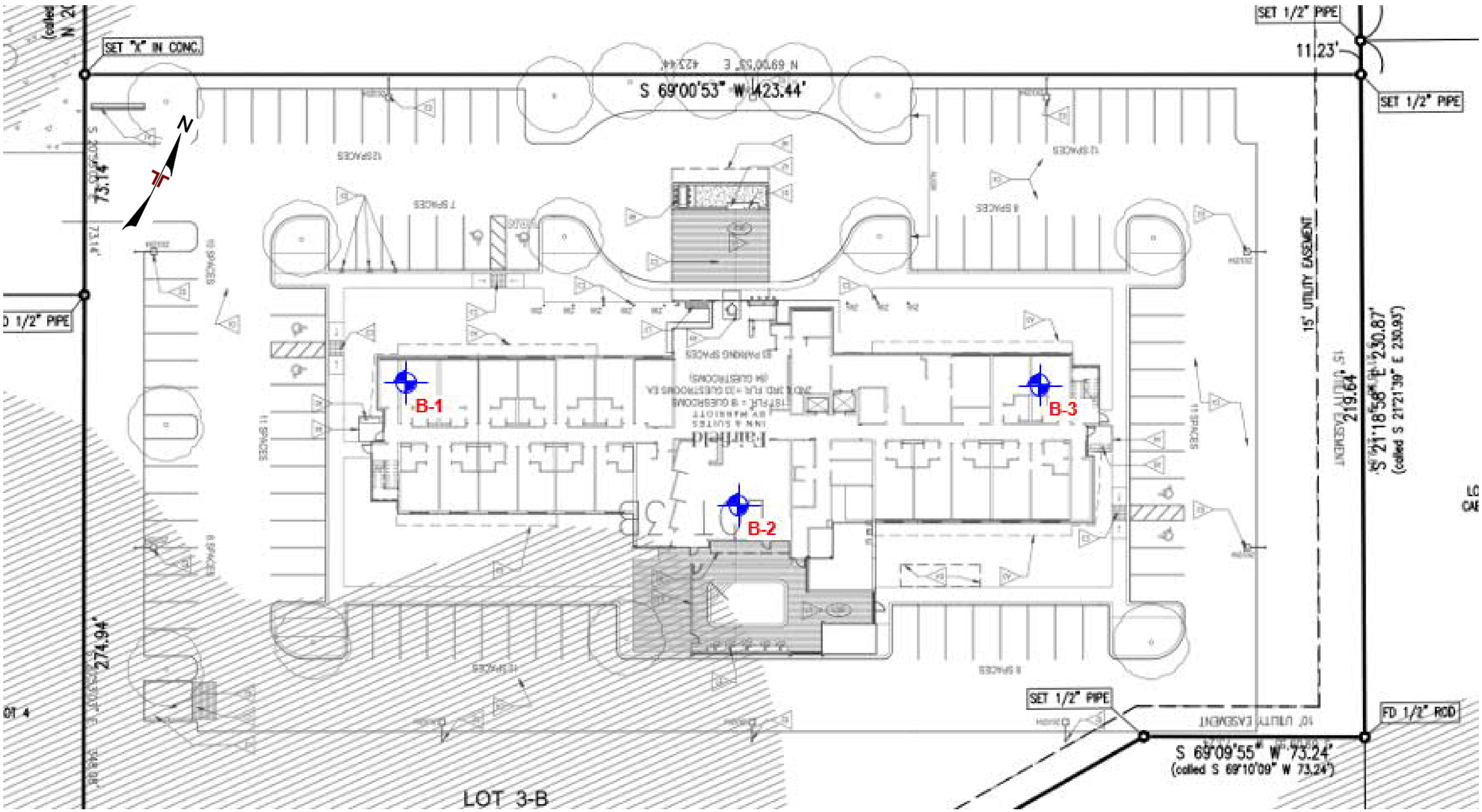


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY Google Earth Pro™

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-3)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Fairfield Inn & Suite by Marriott

CLIENT: Langston Construction Inc
Lufkin, Texas

SITE: 3715 S. Medford Drive
Lufkin, Texas

LOCATION See Exploration Plan

Latitude: 31.3125° Longitude: -94.7137°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), tan			Hand					13		26-14-12	43
4.0				Hand								
	SANDY LEAN CLAY (CL), tan	5		Hand					13		44-18-26	58
				Hand								
		10		Hand								
		15		Hand								
		20		Hand								
25.0		25		Hand					26		37-16-21	65
	Boring Terminated at 25 Feet											

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

Hammer Type: Rope and Cathead

Advancement Method:
Dry auger to 25 feet

Abandonment Method:
Boring backfilled with Auger Cuttings

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater was not observed during drilling

Dry and open to 25 ft upon completion

Terracon
1609 S Chestnut St, Ste 107
Lufkin, TX

Boring Started: 05-20-2019	Boring Completed: 05-20-2019
Drill Rig: Buggy	Driller: DAS
Project No.: 93195042	

BORING LOG NO. B-2

PROJECT: Fairfield Inn & Suite by Marriott

CLIENT: Langston Construction Inc
Lufkin, Texas

SITE: 3715 S. Medford Drive
Lufkin, Texas

LOCATION See Exploration Plan

Latitude: 31.3124° Longitude: -94.7133°

GRAPHIC LOG	DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	2.0	**SILTY SAND (SM)**, brown			Hand auger								
		SANDY SILTY CLAY (CL-ML), brown			Hand auger								
		- dark brown and dark gray below 4 feet	5		Hand auger					15		21-14-7	50
					Hand auger								
	13.0		10		Hand auger								
		FAT CLAY (CH), tan	15		Hand auger								
			20		Hand auger					31		69-29-40	98
	25.0	- brown and tan below 23 feet	25		Hand auger								
		Boring Terminated at 25 Feet											

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

Hammer Type: Rope and Cathead

Advancement Method:
Dry auger to 25 feet

Abandonment Method:
Boring backfilled with Auger Cuttings

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater was not observed during drilling

Dry and open to 25 ft upon completion

Terracon
1609 S Chestnut St, Ste 107
Lufkin, TX

Boring Started: 05-20-2019	Boring Completed: 05-20-2019
Drill Rig: Buggy	Driller: DAS
Project No.: 93195042	

BORING LOG NO. B-3

PROJECT: Fairfield Inn & Suite by Marriott

CLIENT: Langston Construction Inc Lufkin, Texas

SITE: 3715 S. Medford Drive Lufkin, Texas

LOCATION See Exploration Plan

Latitude: 31.3126° Longitude: -94.713°

GRAPHIC LOG / DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2.0	**SILTY SAND (SM)**, brown			Hand								
	CLAYEY SAND (SC), dark brown			Hand					13		23-14-9	42
		5		Hand								
8.0				Hand								
	SANDY LEAN CLAY (CL), dark gray			Hand					17		22-13-9	50
		10										
		15		Hand								
18.0												
	FAT CLAY (CH), light tan			Hand					29		55-24-31	98
		20										
			▽									
25.0		25	▽	Hand								
	Boring Terminated at 25 Feet											

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

Hammer Type: Rope and Cathead

Advancement Method:
Dry auger to 25 feet

Abandonment Method:
Boring backfilled with Auger Cuttings

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

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *during drilling*

▽ *And open to 25 ft upon completion*

Terracon
1609 S Chestnut St, Ste 107
Lufkin, TX

Boring Started: 05-20-2019	Boring Completed: 05-20-2019
Drill Rig: Buggy	Driller: DAS
Project No.: 93195042	

SUPPORTING INFORMATION

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Fairfield Inn & Suites by Marriott ■ Lufkin, Texas

May 23, 2019 ■ Terracon Project No. 93195042

Terracon GeoReport

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

DESCRIPTIVE SOIL CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A” line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below “A” line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line	CH	Fat clay [K, L, M]
			PI plots below “A” line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

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

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

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

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

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

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

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

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.