# GEOTECHNICAL SUBURFACE EXPLORATION

For

**PROPOSED POPEYES LOUISIANA KITCHEN RESTAURANT**
**525 441 HISTORIC HIGHWAY**
**CORNELIA, GEORGIA**

Prepared for

**CAPITAL GROWTH BULCHALTER, INC.**
**361 Summit Boulevard, Suite 110**
**Birmingham, AL 35243**

Prepared by

**Professional Service Industries, Inc.**
**95 Chastain Road, Suite 301**
**Kennesaw, Georgia 30144**

**Telephone (770) 424-6200**

**PSI PROJECT NO. 472539**

**December 15, 2017**

Project Number: 472539
December 15, 2017

Professional Service Industries, Inc.
95 Chastain Road, Suite 301, Kennesaw, GA 30144
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James Kirk Farley, PE
**Capital Growth Buchalter, Inc.**
361 Summit Boulevard, Suite 110
Birmingham, AL 35243

**RE: Report of Geotechnical Subsurface Exploration**
**Proposed Popeyes Louisiana Kitchen Restaurant**
525 441 Historic Highway
Cornelia, Habersham County, Georgia

Dear Kirk Farley:

Professional Service Industries, Inc. (PSI), an Intertek company, has completed a subsurface exploration program at the site of the above referenced project. The services were completed in general accordance with the PSI Proposal Number 472-225274 dated October 16, 2017. The following report presents the results of our study as well as opinions and recommendations pertaining to the geotechnical aspects of the project.

## 1 PROJECT INFORMATION

### 1.1 Site Location and Project Description

The site is a 1.3 acre previously graded, relatively level track of land west of Highway 441 in Cornelia, Georgia. It is bound by two adjacent restaurants to the north and south, an access/entrance road to the east and graded property to the west. The graded property to the west includes storm drains and utility stubs. The ground surface is covered with sparse grass. Based on probing and observation of drilling rig traffic, the ground surface was firm and dry at the time of our field exploration.

The site is proposed to be developed with a Popeyes Louisiana Kitchen Restaurant. Based on our experience with similar developments, we anticipate the restaurant will have a slab on grade with a preferred foundation of shallow spread footings or a turn down monolithic slab. We anticipate maximum structural loads will be less than 2 kips per linear foot for walls and 50 kips for isolated columns. A grading plan has not been developed, but we anticipate planned grades will only require cuts and fills of less than 2 feet.

The recommendations provided in this report are based in part on the project information described above. If any of the noted information is incorrect or has changed, please inform PSI so that we may amend the recommendations presented in this report, if appropriate.

### 1.2 Scope of Geotechnical Services

The purpose of this exploration was to provide a geotechnical study for the primary purpose of developing geotechnical recommendations for support of design of foundations and pavements for the planned project. The scope of work for this exploration included the following:

- PSI contacted the Georgia 811 Utilities Protection Center (UPC) to locate existing underground public utilities on-site.
- PSI performed a site reconnaissance and located the borings in the field, based upon the provided site information.
- Eight Standard Penetration Test (SPT) soil borings were performed at the approximate locations shown on the Boring Location Plan using a Geoprobe drilling rig. Borings B-1 through B-4 were performed within or near the proposed building area and B-5 thru B-8 were performed in proposed parking and drive areas. Soil test borings were performed at this site using hollow-stem, continuous flight augers. At regular intervals, Standard Penetration Test and sampling operations were conducted in general compliance with ASTM D1586 using an automatic hammer. Hammer calibration data was not available so the N-values obtained were not corrected and the penetration resistance values presented in this report represent the field obtained data.
- We classified samples of soil obtained during the drilling operations and prepared boring logs for the test locations describing the types of soil encountered and other pertinent information in general accordance with the Unified Soil Classification System (USCS).
- We conducted a geotechnical engineering evaluation of the available data to develop conclusions and design recommendations regarding appropriate foundation, floor slab, and pavement designs for the proposed development.
- The Seismic Site Class was determined, based on Standard Penetration Test (SPT) N-values, in accordance with the 2012 International Building Code (IBC).
- We prepared this engineering report presenting PSI's boring logs, site observations and recommendations for development of the site.

PSI is providing a Phase I Assessment for the property which is submitted separately. PSI did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same.

### 1.3 Site Geology

The site is located within the Piedmont Physiographic Province of Georgia. Native soils in upland areas within this province are formed from the in-place weathering and decomposition of native igneous and metamorphic bedrock materials. In undisturbed areas, the residual soils near the ground surface are generally finer grained in texture due to advanced weathering. With depth, materials tend to be coarser grained and exhibit relict structure and fabric from the underlying bedrock. Separating the residual soil from the underlying parent bedrock is typically a transition zone of high consistency material referred to as

partially weathered rock (PWR). PWR is defined as residual soil with standard penetration resistance (ASTM D1586) of at least 100 blows per foot (bpf).

The weathering processes that produced the residual soils and partially weathered rock were extremely variable. Differential weathering of the parent bedrock has resulted in highly variable subsurface conditions, and can include abrupt changes in soil type and consistency over relatively short horizontal and vertical distances. Furthermore, depths to rock can also be highly variable; and suspended boulders, discontinuous rock layers/lenses, or rock pinnacles can be present within the residual soils and transitional zones of soft weathered rock.

Naturally developed soils can be modified by man by excavation and placement of fill. Fill can be composed of different soil types from various sources and can also contain debris. The engineering properties of fill depend primarily on its composition, density and moisture content. No grading plans or inspection reports were provided for the previous grading that appears to have occurred at the site.

## 2 SUBSURFACE CONDITIONS

### 2.1 Soil Boring Results

The following subsurface description is of a generalized nature and intended to highlight the major subsurface stratification features and material characteristics. The borings encountered apparent fill underlain by residual soils. A thin layer of disturbed soils with roots from the site's stabilization grasses was noted to penetrate the ground about 4 to 6 inches. Below the disturbed zone all borings encountered apparent fill. Borings B-1 through B-4 penetrated the fill at depths of 6 to 13 feet below grade. Two of the pavement area borings penetrated the fill at depths of 6 to 8 feet, and the remaining two borings terminated in the fill. The fill was described as silty sand with penetration resistance values of 7 to 13 blows per foot. At the base of the fill, or at the transition to residual soils, some soils with a trace of topsoil were encountered. No large organic debris or fibrous organic materials were observed in fill samples.

Below the fill where penetrated, residual soils were encountered. The residual soils were generally clayey silts with some silty sands. Standard Penetration Tests varied from 5 to 11 blows per foot. Borings terminated in residual soils or fill and no weathered rock or auger refusal was encountered to the depths drilled.

Groundwater was not apparent at any of the boring locations at the time of drilling or at the completion of the days drilling. Fluctuation of groundwater levels should be anticipated with seasonal and climatic changes in rainfall. It is recommended that the Contractor determine if groundwater exists within the anticipated excavation depths prior to the start of grading and storm drain piping operations.

The Boring Logs, included in the Appendix, should be reviewed for specific information at the test locations. These records include soil descriptions, stratification, penetration resistance, locations of the samples, and other pertinent data. The soil classifications are based on visual and tactile methods and not on laboratory testing so they should be considered approximate. The material description shown on the logs represent the conditions only at the actual boring location at the time of our exploration. Variations may occur and should be expected between boring locations. Since fill was encountered

which has been placed by man, significant variation in fill soil type or the existence of debris or organic materials may exist between borings. Lines of stratification demarcation shown on the logs and discussed in the preceding paragraphs represent the approximate boundary between subsurface materials, but the transition may be more gradual than indicated.

# 3 CONCLUSIONS AND RECOMMENDATIONS

## 3.1 General

The following geotechnical design recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions encountered. If there are any changes in these project criteria, a review should be made by PSI to determine if modifications to the recommendations are warranted.

We note that previously placed fill was encountered in the borings. We do not know the origin of the fill or if density test were performed during placement. At the boring locations, the results of penetration testing indicate the fill was placed with at least moderate compaction effort, and the fill samples obtained were free of organics or debris except at the transition to residual soils were some topsoil stained soils were observed. As with all man-placed fill, there is a risk that fills that are under-compacted or contain debris may exist between borings which could impact foundation support. This risk can be reduced but not eliminated, by thorough evaluation of the fill at the time of construction with subgrade evaluations including proofrolling and footing subgrade evaluations including hand augering. This risk can only be eliminated by excavation of all previously placed fill and replacing it with engineering supervision.

The following sections include our recommendations for geotechnical related design and construction.

## 3.2 Site Preparation

Any topsoil, vegetation, soft and/or loose soils, or other unsuitable materials should be stripped from the construction areas. Under no circumstances should organic-laden soils be placed as fill beneath or within 10 horizontal feet of building, pavement, or other "structural" areas.

Following the stripping of the upper disturbed materials, vegetation and roots and prior to placing compacted engineered fill materials, the areas should be evaluated by proof rolling. Proof rolling should be performed by traversing the construction areas with a fully loaded dump truck or similar rubber-tired equipment with a minimum weight of 15 tons and a maximum weight of 25 tons. Proof rolling operations should be observed by a representative of PSI. Unstable soft or wet soils which are revealed by proof rolling and which cannot be adequately densified in place should be undercut and replaced with compacted Engineered Fill meeting the requirements of Section 3.4 or removed and soil conditioned. If these soils are of suitable classification as outlined below, they may be placed and compacted following moisture adjustment under the recommendations of the PSI representative. A similar evaluation by proof rolling with the observation of a PSI geotechnical engineer is recommended in areas cut to grade.

## 3.4 Engineered Fill

Materials selected to be used as structural fill should not contain more than 3 percent by weight of organic matter and be free of any waste construction debris, or other deleterious materials. Fill materials should have a Standard Proctor (ASTM D 698) maximum dry density of at least 95 pounds per cubic foot (pcf) and a maximum particle size of 3 inches or less. It is preferable if the fill has an Atterberg

Liquid Limit less than 50, a Plasticity Index of less than 30. Preferred soil types for use as fill meet the requirements for classification as SM, SW, SP, SC, GM, GW, GC, CL, and ML as long as they also meet the grain size limitations outlined above. Soils which classify as OH, OL, and PT are not suitable for use as fill. It is anticipated that most of the on-site materials will meet the recommended preferred soil fill requirements. We recommend that proposed engineered fill materials which come from off-site sources be tested prior to beginning earthwork to determine if they meet the above criteria.

The moisture content of fill soils at the time of placement and compaction should be between optimum and three percentage points above their optimum moisture content. More stringent moisture limits may be necessary with certain soils. We recommend that the structural fill be compacted to a minimum of 95 percent of the Standard Proctor maximum dry density (ASTM D-698). The upper 12 inches beneath pavement and grade slab areas should further compacted to 98 percent of the maximum dry density. It is recommended that the fill be placed in lifts not exceeding 8 inches in loose thickness.

Density testing should be performed by a soils technician working under the supervision of a geotechnical engineer to determine the degree of compaction. Areas that do not meet the compaction requirement should be further compacted and retested. The frequency of testing will depend on the area of fill placement and the rate at which the fill is placed. As a guidance we recommend one tests be performed for every 5000 square feet of fill in underfloor areas for every 1 to 2 vertical feet of fill placement (typically every two or three lifts). Testing frequency should be increased in confined areas such as pipe trenches or wall backfills.

### 3.4 Foundation Recommendations

Once the proposed building footprint area has been prepared as described herein, it is our opinion that the proposed building can be supported on conventional shallow foundations. We recommend that spread footings and continuous wall foundations be designed for a maximum net allowable soil bearing capacity of 2,000 pounds per square foot or less. The recommended soil bearing pressure includes a factor of safety of at least 3 against shear failure. Isolated column foundations should have a minimum width of 24 inches and continuous wall foundations should have a minimum width of 18 inches. All foundations should bear at a minimum depth of 18 inches below the lowest adjacent final ground surface for frost penetration and protective embedment.

Because of variations in subsurface conditions and the presence of undocumented previously placed fill all footing excavations should be observed and approved by the Geotechnical Engineer of Record or his authorized representative. Foundation bearing surface evaluations should be performed in each foundation excavation prior to placement of reinforcing steel. These evaluations should be performed by a representative of PSI to confirm that the design allowable soil bearing capacity is available and that our design assumptions about the subgrade are applicable to the conditions encountered during construction. The foundation bearing surface evaluations should be performed using a combination of visual observation, hand auger borings and dynamic cone penetrometer testing.

If soft or loose soil pockets, or fill containing debris or excess organic are observed during the footing evaluations, the footing should be extended to suitable bearing material, or these materials should be removed and replaced with suitable compacted structural fill. Water and possibly some loose soil may collect in the footing excavations as a result of surface precipitation and near ground surface seepage.

Water, loose soil and soil softened by water should be removed from the bottom of the footing excavations before placing concrete. We recommend that foundations be cast the same day the excavations are made.

The moisture content of the foundation soils should not be allowed to dry to more than 3 percentage points below optimum moisture. Excessive drying prior to concrete placement could lead to later problems associated with shrink swell potential.

Footing excavations should be protected from surface water run-off and freezing. If water is allowed to accumulate within a footing excavation and soften the bearing soils, or if the bearing soils are allowed to freeze, the deficient soils should be removed from the excavation prior to concrete placement.

### 3.5 Settlement

Following the recommendations stated above, we estimate potential post-construction total settlements will generally be less than 1 inch. Differential settlement is estimated to be generally less than ½ inch between adjacent columns or along 20 feet of continuous footing length. Although total and differential settlements of these magnitudes are usually considered tolerable for most commercial construction, we recommend consulting the project structural engineer to confirm.

### 3.6 Floor Slab Recommendations

A concrete slab-on-grade floor system bearing in suitable engineered fill or residual soil may be utilized for the building. We recommend that a minimum 4-inch thick granular mat be placed beneath the floor slab to enhance drainage and provide a capillary break. In areas with moisture sensitive floor finishes or if required by code or the floor manufacturer, polyethylene sheeting should be placed to act as a vapor retarder. Where vapor retarders are used, the contractor must follow appropriate slab finishing and curing methods to reduce the risk of slab curling. The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage. The floor slab should not be rigidly connected to columns, walls, or foundations. If the slab design is based on subgrade modulus, a modulus value of 100 pci may be assumed for the residual soils and engineered fill.

The precautions listed below should be followed for construction of slabs-on-grade. These details will not reduce the amount of slab movement, but are intended to reduce potential damage should some settlement of the supporting subgrade take place.

- Isolation joints should be used between foundations and the slab, or the transitions should be suitably reinforced. The occurrence of concrete shrinkage cracks, and problems associated with concrete curing may be reduced and/or controlled by limiting the water/cement ratio of the concrete, proper concrete placement, finishing, and curing, and by the placement of crack control joints at frequent intervals, particularly, where re-entrant slab corners occur. The American Concrete Institute (ACI) recommends a maximum panel size (in feet) equal to approximately two to three times the thickness of the slab (in inches) in both directions. Details of the ACI recommendations for slab design and construction are provided in ACI 302.1.

- Some increase in moisture content is inevitable as a result of development and associated landscaping; however, extreme moisture content increases can be detrimental to floor slab

performance. This can be largely controlled by proper and responsible site drainage, building maintenance and irrigation practices.

- All backfill in areas supporting slabs should be moisture conditioned and compacted as described earlier in this report. Backfill in all interior and exterior water and sewer line trenches should be carefully compacted.

- Exterior slabs should be isolated from the building. These slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the building foundation or superstructure.

The soil subgrade in the area of concrete slab-on-grade support is often disturbed during foundation and superstructure construction. We recommend that the floor slab subgrade be evaluated by a representative of PSI immediately prior to final slab subgrade preparation. The moisture content of the soils should be adjusted to within 3 percent of optimum moisture prior to final slab subgrade preparation and slab construction. If low consistency soils are encountered which cannot be adequately densified in place, such soils should be removed and replaced with well-compacted fill material or with well-compacted crushed stone materials.

### 3.7 Drainage Considerations

It is not anticipated that special groundwater control measures will be required during construction. We recommend that the Contractor determine the actual groundwater levels at the time of construction to determine groundwater impact on the construction procedures. Water should not be allowed to collect in the foundation excavations, on the floor slab areas, or on prepared subgrade of the construction area either during or after construction. The subgrade beneath structures should be sloped to a low point to facilitate removal of any collected rainwater, groundwater, or surface runoff. Positive site drainage (i.e. sloping grade) should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slab area of the building.

### 3.8 Excavation Considerations

We anticipate the fill and residual soils can be excavated with conventional grading equipment such as bulldozers, front end loaders and backhoes.

### 3.9 Slope Considerations

Our scope of services did not include a detailed evaluation of slope stability for permanent or temporary slopes, consequently the following recommendations are based on our experience with similar soils. Temporary slopes should be constructed in accordance with OSHA or other regulatory guidelines. The contractor is solely responsible for construction of safe excavations. Permanent slopes up to 10 feet high may be constructed no steeper than 2H:1V. Slopes should be constructed of engineered fill compacted to at least 95 percent of the Standard Proctor maximum dry density (ASTM D-698) or residual soils. Buildings should be set back at least 10 feet from the crest of slopes or as required by regulatory authorities. We recommend pavements be set back at least 5 feet from the crest edge.

### 3.10 Pavement Design

The site soils can support both properly designed flexible and rigid pavement. Flexible pavement systems on commercial projects in this region typically consist of Graded Aggregate Base overlain by hot mix asphaltic concrete base (where dictated by load), binder and hot mix asphaltic concrete wearing surface. Rigid pavement sections (Portland Cement Concrete) merit consideration for areas to receive relatively highly concentrated sustained loads such as loading dock aprons, dumpster pads, and storage areas. Rigid pavement will distribute concentrated loads over a greater area, hence reducing the possibility of high stress concentrations to the subgrade.

Detailed traffic loading has not been provided for this site. PSI can provide recommendations for pavement thicknesses once traffic data is provided if desired.

All pavements should be sloped a minimum of one percent to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature pavement deterioration.

We recommend that the pavement subgrade be evaluated by a representative of PSI immediately prior to placing GAB. If low consistency soils are encountered which cannot be adequately densified in place, such soils should be removed and replaced with well-compacted soil fill or crushed stone materials. We note that the subgrade surface should be compacted prior to pavement construction in accordance with the "*Structural Fill"* section of this report.

### 3.11 Seismic Design Calculations

The project site is located within a municipality that employs the International Building Code, 2012 edition. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface. To define the Site Class for this project, we have interpreted the results of soil test borings drilled within the project site and estimated appropriate soil properties below the base of the borings to a depth of 100 feet based upon data available in published geologic reports as well as our experience with subsurface conditions in the general site area.

Based upon our evaluation, it is our opinion that the subsurface conditions within the site are consistent with the characteristics of Site Class "D". The associated USGS-NEHRP probabilistic ground motion values for the general site area were obtained from the USGS geohazards web page and are presented in the table below.

**Ground Motion Values***

| Period (sec) | Mapped MCE Spectral Response Acceleration (g) | | Site Coefficients | | Adjusted MCE Spectral Response Acceleration (g) | | Design Spectral Response Acceleration (g) | |
|---|---|---|---|---|---|---|---|---|
| | $PGA$ | 0.118 | $F_{PGA}$ | 1.563 | | | $PGA_M$ | 0.185 |
| 0.2 | $S_s$ | 0.244 | $F_a$ | 1.600 | $S_{MS}$ | 0.390 | $S_{DS}$ | 0.260 |
| 1.0 | $S_1$ | 0.101 | $F_v$ | 2.397 | $S_{M1}$ | 0.242 | $S_{D1}$ | 0.161 |

** For Latitude 34.266 degrees and Longitude -85.156 degrees.*

The Site Coefficients, Fa and Fv presented in the above table were also obtained from the noted USGS web page, as a function of the site classification and mapped spectral response acceleration at the short ($S_S$) and 1-second ($S_1$) periods, but can also be interpolated from IBC Tables 1613.3.3(1) and 1613.3.3(2).

For Seismic Design Category designations of C, D, E or F, which are contingent on the structure "Occupancy Category", the code also, requires an assessment of slope stability and surface rupture due to faulting or lateral spreading. Detailed evaluations of these factors were beyond the scope of this study. However, the following table presents a qualitative assessment of these issues considering the site class, the subsurface soil properties, the groundwater elevation and probabilistic ground motions:

**Qualitative Seismic Site Assessments**

| Hazard | Relative Risk | Comments |
|---|---|---|
| Liquefaction | Low | The subsurface silty materials contain sufficient fines to limit the potential for liquefaction. |
| Slope Stability* | Low | The probabilistic ground accelerations are low and site grades are relatively flat. |
| Surface Rupture | Low | No active faults underlie the site. |

*A slope stability analysis, including its stability during a seismic event, was beyond the scope of work.

## 4 REPORT LIMITATIONS

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area at the time of this report. No other warranties are implied or expressed.

The recommendations submitted are based on the available soil information obtained by PSI and information provided by Capital Growth Buchalter, Inc. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation or other recommendations are required. If PSI is not retained to perform these functions, PSI cannot be responsible for the impact of those conditions on the performance of the project.

After the plans and specifications are more complete, the geotechnical engineer should be retained to review them to assess that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of Capital Growth Buchalter, Inc for the specific application to the proposed Popeyes Louisiana Kitchen Restaurant on 441 Historic Highway in Cornelia, Habersham County, Georgia.

Thank you for the opportunity to be of service on this project. Should you have any questions or if we can be of further assistance, please do not hesitate to contact our office.

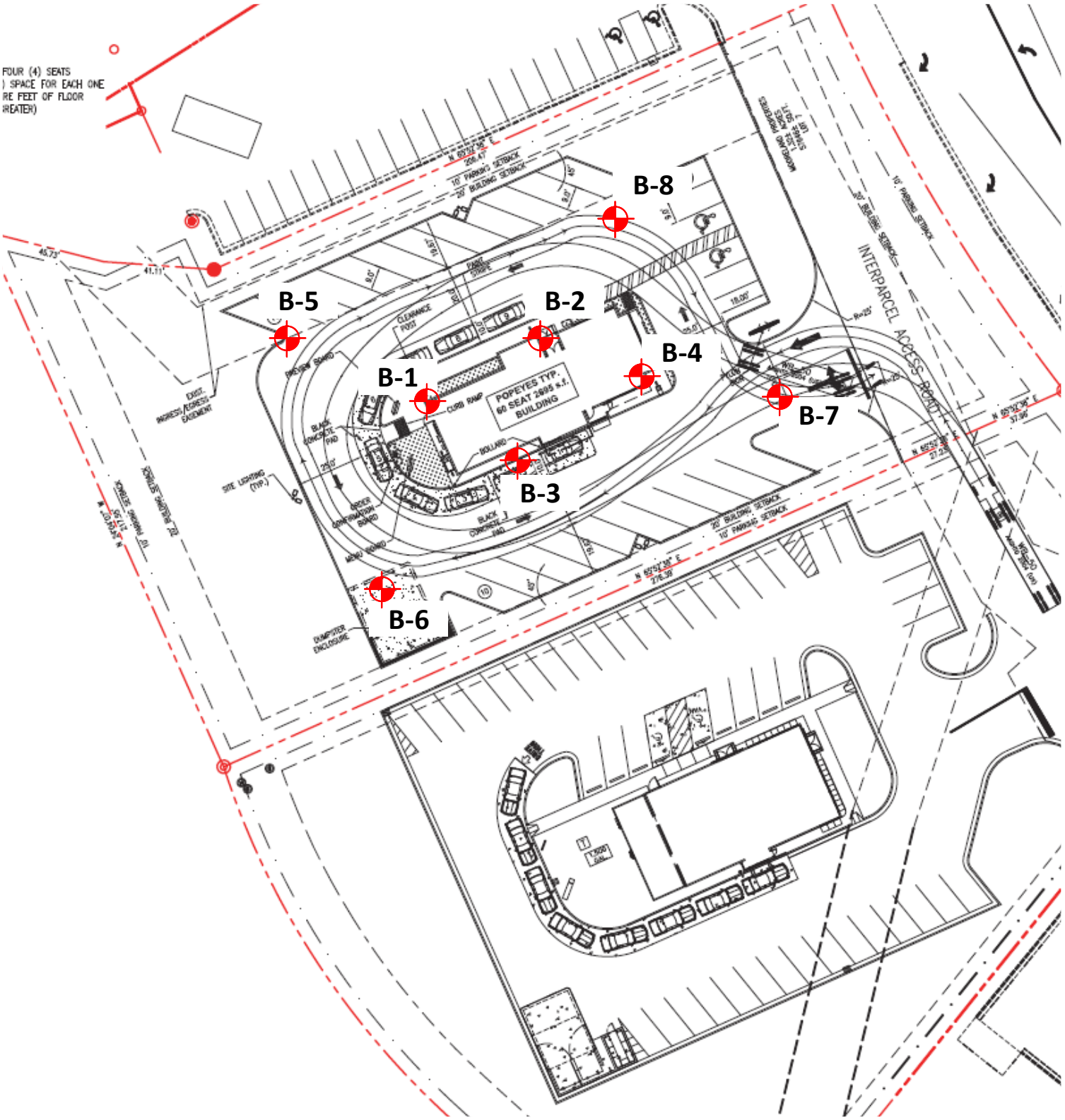
For Professional Service Industries, Inc.

John H. Fiely, PE
Department Manager
Geotechnical Services

GEORGIA REGISTERED NO. 16632 PROFESSIONAL ENGINEER JOHN H. FIELY 2-15-17

Lloyd T. Lasher, Jr.
Principal Consultant

Attachments: Boring Location Plan
Boring Logs
Soil Classification Chart




Test locations shown of client provided plan for indication of approximate test locations only.

Project Name:

Popeyes Louisiana Kitchen
525 Historic highway 441
Cornelia GA

Project No.: 472539

Date: December 2017

# Figure 1: Test Location Diagram

Legend:

Approximate Boring Locations

N

0 ft. 30 ft. 50 ft. 100 ft.

APPROXIMATE SCALE

intertek psi

# BORING B-1

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 15.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

| Water | | |
|---|---|---|
| | While Drilling | N/A |
| | Upon Completion | NONE |
| | Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose Moist Brown Red Silty SAND (SM) | SM | 5-4-4 N=8 | | | |
| | 5 | | | | | | | 4-5-4 N=9 | | | |
| | | | | | | RESIDUUM: Stiff Moist Red Brown Sandy SILT (ML) | ML | 3-4-6 N=10 | | | |
| | | | | | | Loose Moist Red Gray Tan Silty SAND (SM) | | 6-4-6 N=10 | | | |
| | 10 | | | | | | SM | | | | |
| | 15 | | | | | Boring Terminated at 15 Feet | | 4-3-4 N=7 | | | |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Professional Service Industries, Inc.
95 Chastain Road NW, Suite 301
Kennesaw, GA 30144
Telephone: (770) 424-6200


**PROJECT NO.:** 472539
**PROJECT:** Proposed Popeye's Louisiana Kitchen
**LOCATION:** 525 Historic Hwy. 441
Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-2

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 15.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose Moist Brown Red Silty SAND (SM) | | 3-3-4 N=7 | | | |
| | 5 | | | | | Dark Brown, with clay, trace topsoil and fine roots | SM | 5-4-4 N=8 | | | |
| | | | | | | | | 4-4-5 N=9 | | | |
| | 10 | | | | | RESIDUUM: Loose Moist Red Brown Silty SAND (SM), trace clay | SM | 4-4-5 N=9 | | | |
| | | | | | | Loose Moist Tan Orange Silty SAND (SM) | SM | 3-2-3 N=5 | | | |
| | 15 | | | | | Boring Terminated at 15 Feet | | | | | |


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**PROJECT NO.:** 472539
**PROJECT:** Proposed Popeye's Louisiana Kitchen
**LOCATION:** 525 Historic Hwy. 441
Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-3

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 15.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/Root Zone Thickness = 6 inches | | | | | |
| | | | | | | FILL: Medium Dense Moist Tan Silty SAND (SM) | SM | 6-6-5 N=11 | | | |
| | 5 | | | | | FILL: Loose Moist Red Brown Gray Silty SAND (SM), with clay | SM | 3-4-3 N=7 | | | |
| | | | | | | FILL: Loose Moist Tan Gray Silty SAND (SM) | SM | 3-4-6 N=10 | | | |
| | 10 | | | | | | | 4-3-5 N=8 | | | |
| | | | | | | RESIDUUM: Firm Moist Red Brown Clayey SILT (ML) | ML | 4-4-3 N=7 | | | |
| | 15 | | | | | Boring Terminated at 15 Feet | | | | | |


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Professional Service Industries, Inc.
95 Chastain Road NW, Suite 301
Kennesaw, GA 30144
Telephone: (770) 424-6200


**PROJECT NO.:** 472539
**PROJECT:** Proposed Popeye's Louisiana Kitchen
**LOCATION:** 525 Historic Hwy. 441
Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-4

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 15.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose Moist Gray Tan Silty SAND (SM) | SM | 6-4-6 N=10 | | | |
| | 5 | | | | | FILL: Loose to Medium Dense Moist Red Brown Gray Clayey Silty SAND (SM) | SM | 4-4-6 N=10<br>4-5-5 N=10<br>3-4-7 N=11 | | | |
| | 10 | | | | | RESIDUUM: Medium Dense Moist Brown Silty SAND (SM), trace topsoil | SM | 4-5-6 N=11 | | | |
| | 15 | | | | | Boring Terminated at 15 Feet | | | | | |


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Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-5

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 10.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/Root zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose to Medium Dense Moist Gray Brown Silty SAND (SM) | | 4-5-5 N=10 | | | |
| | 5 | | | | | | SM | 5-5-6 N=11 | | | |
| | | | | | | | | 3-6-7 N=13 | | | |
| | | | | | | RESIDUUM: Stiff Moist Red Brown Clayey SILT (MH) | MH | 5-6-5 N=11 | | | |
| | 10 | | | | | Boring Terminated at 10 Feet | | | | | |


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Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-6

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 10.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose to Medium Dense Moist Tan Gray Brown Silty SAND (SM) | | 5-6-5 N=11 | | | |
| | 5 | | | | | | SM | 4-3-4 N=7 | | | |
| | | | | | | | | 5-4-6 N=10 | | | |
| | 10 | | | | | Boring Terminated at 10 Feet | | 4-5-5 N=10 | | | |


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**LOCATION:** 525 Historic Hwy. 441
Cornelia, GA

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# BORING B-7

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 10.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil/ Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Stiff Moist Brown Tan Sandy SILT (ML) | | 6-5-6 N=11 | | | |
| | 5 | | | | | | ML | 4-5-4 N=9 | | | |
| | | | | | | | | 4-4-7 N=11 | | | |
| | | | | | | POSSIBLE FILL: Stiff Moist Red Brown Sandy SILT (ML) | ML | 6-5-6 N=11 | | | |
| | 10 | | | | | Boring Terminated at 10 Feet | | | | | |


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Cornelia, GA

The stratification lines represent approximate boundaries. The transition may be gradual.

# BORING B-8

| | | | |
|---|---|---|---|
| **DATE STARTED:** | 12/5/17 | **DRILL COMPANY:** | Betts Env. Recovery |
| **DATE COMPLETED:** | 12/5/17 | **DRILLER:** Danny | **LOGGED BY:** J. Fiely |
| **COMPLETION DEPTH** | 10.0 ft | **DRILL RIG:** | GeoProbe 7822DT |
| **BENCHMARK:** | N/A | **DRILLING METHOD:** | Hollow Stem Auger |
| **ELEVATION:** | N/A | **SAMPLING METHOD:** | SS |
| **LATITUDE:** | | **HAMMER TYPE:** | Automatic |
| **LONGITUDE:** | | **EFFICIENCY** | N/A |
| **STATION:** N/A | **OFFSET:** N/A | **REVIEWED BY:** | L. Lasher |

**REMARKS:**

**Water**

| | |
|---|---|
| While Drilling | N/A |
| Upon Completion | NONE |
| Delay | N/A |

**BORING LOCATION:**

| Elevation (feet) | Depth, (feet) | Graphic Log | Sample Type | Sample No. | Recovery (inches) | MATERIAL DESCRIPTION | USCS Classification | SPT Blows per 6-inch (SS) | Moisture, % | STANDARD PENETRATION TEST DATA N in blows/ft ◎ × Moisture ◪ PL ✚ LL (0, 25, 50) STRENGTH, tsf ▲ Qu ✳ Qp (0, 2.0, 4.0) | Additional Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | Topsoil /Root Zone Thickness = 4 inches | | | | | |
| | | | | | | FILL: Loose Moist Tan Gray Silty SAND (SM) | SM | 6-6-4 N=10 | | | |
| | 5 | | | | | | | 4-3-5 N=8 | | | |
| | | | | | | RESIDUUM: Firm Moist Red Clayey SILT (ML), with sand | ML | 3-4-4 N=8 | | | |
| | 10 | | | | | Boring Terminated at 10 Feet | | 3-2-3 N=5 | | | |


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# GENERAL NOTES

## SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

## DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
RC: Rock Core
TC: Texas Cone
BS: Bulk Sample
PM: Pressuremeter
CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

## SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
$N_{60}$: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
$Q_u$: Unconfined compressive strength, TSF
$Q_p$: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL),%
DD: Dry unit weight, pcf
▼,▽,⧩ Apparent groundwater level at time noted

## RELATIVE DENSITY OF COARSE-GRAINED SOILS

| Relative Density | N - Blows/foot |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium Dense | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | 50 - 80 |
| Extremely Dense | 80+ |

## ANGULARITY OF COARSE-GRAINED PARTICLES

| Description | Criteria |
|---|---|
| Angular: | Particles have sharp edges and relatively plane sides with unpolished surfaces |
| Subangular: | Particles are similar to angular description, but have rounded edges |
| Subrounded: | Particles have nearly plane sides, but have well-rounded corners and edges |
| Rounded: | Particles have smoothly curved sides and no edges |

## GRAIN-SIZE TERMINOLOGY

| Component | Size Range |
|---|---|
| Boulders: | Over 300 mm (>12 in.) |
| Cobbles: | 75 mm to 300 mm (3 in. to 12 in.) |
| Coarse-Grained Gravel: | 19 mm to 75 mm (¾ in. to 3 in.) |
| Fine-Grained Gravel: | 4.75 mm to 19 mm (No.4 to ¾ in.) |
| Coarse-Grained Sand: | 2 mm to 4.75 mm (No.10 to No.4) |
| Medium-Grained Sand: | 0.42 mm to 2 mm (No.40 to No.10) |
| Fine-Grained Sand: | 0.075 mm to 0.42 mm (No. 200 to No.40) |
| Silt: | 0.005 mm to 0.075 mm |
| Clay: | <0.005 mm |

## PARTICLE SHAPE

| Description | Criteria |
|---|---|
| Flat: | Particles with width/thickness ratio > 3 |
| Elongated: | Particles with length/width ratio > 3 |
| Flat & Elongated: | Particles meet criteria for both flat and elongated |

## RELATIVE PROPORTIONS OF FINES

| Descriptive Term | % Dry Weight |
|---|---|
| Trace: | < 5% |
| With: | 5% to 12% |
| Modifier: | >12% |

# GENERAL NOTES

(Continued)

## CONSISTENCY OF FINE-GRAINED SOILS

| $Q_U$ - TSF | N - Blows/foot | Consistency |
|---|---|---|
| 0 - 0.25 | 0 - 2 | Very Soft |
| 0.25 - 0.50 | 2 - 4 | Soft |
| 0.50 - 1.00 | 4 - 8 | Firm (Medium Stiff) |
| 1.00 - 2.00 | 8 - 15 | Stiff |
| 2.00 - 4.00 | 15 - 30 | Very Stiff |
| 4.00 - 8.00 | 30 - 50 | Hard |
| 8.00+ | 50+ | Very Hard |

## MOISTURE CONDITION DESCRIPTION

| Description | Criteria |
|---|---|
| Dry: | Absence of moisture, dusty, dry to the touch |
| Moist: | Damp but no visible water |
| Wet: | Visible free water, usually soil is below water table |

## RELATIVE PROPORTIONS OF SAND AND GRAVEL

| Descriptive Term | % Dry Weight |
|---|---|
| Trace: | < 15% |
| With: | 15% to 30% |
| Modifier: | >30% |

## STRUCTURE DESCRIPTION

| Description | Criteria |
|---|---|
| Stratified: | Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick |
| Laminated: | Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick |
| Fissured: | Breaks along definite planes of fracture with little resistance to fracturing |
| Slickensided: | Fracture planes appear polished or glossy, sometimes striated |
| Blocky: | Cohesive soil that can be broken down into small angular lumps which resist further breakdown |
| Lensed: | Inclusion of small pockets of different soils |
| Layer: | Inclusion greater than 3 inches thick (75 mm) |
| Seam: | Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample |
| Parting: | Inclusion less than 1/8-inch (3 mm) thick |

## SCALE OF RELATIVE ROCK HARDNESS

| $Q_U$ - TSF | Consistency |
|---|---|
| 2.5 - 10 | Extremely Soft |
| 10 - 50 | Very Soft |
| 50 - 250 | Soft |
| 250 - 525 | Medium Hard |
| 525 - 1,050 | Moderately Hard |
| 1,050 - 2,600 | Hard |
| >2,600 | Very Hard |

## ROCK BEDDING THICKNESSES

| Description | Criteria |
|---|---|
| Very Thick Bedded | Greater than 3-foot (>1.0 m) |
| Thick Bedded | 1-foot to 3-foot (0.3 m to 1.0 m) |
| Medium Bedded | 4-inch to 1-foot (0.1 m to 0.3 m) |
| Thin Bedded | 1¼-inch to 4-inch (30 mm to 100 mm) |
| Very Thin Bedded | ½-inch to 1¼-inch (10 mm to 30 mm) |
| Thickly Laminated | 1/8-inch to ½-inch (3 mm to 10 mm) |
| Thinly Laminated | 1/8-inch or less "paper thin" (<3 mm) |

## ROCK VOIDS

| Voids | Void Diameter |
|---|---|
| Pit | <6 mm (<0.25 in) |
| Vug | 6 mm to 50 mm (0.25 in to 2 in) |
| Cavity | 50 mm to 600 mm (2 in to 24 in) |
| Cave | >600 mm (>24 in) |

## GRAIN-SIZED TERMINOLOGY

(Typically Sedimentary Rock)

| Component | Size Range |
|---|---|
| Very Coarse Grained | >4.76 mm |
| Coarse Grained | 2.0 mm - 4.76 mm |
| Medium Grained | 0.42 mm - 2.0 mm |
| Fine Grained | 0.075 mm - 0.42 mm |
| Very Fine Grained | <0.075 mm |

## ROCK QUALITY DESCRIPTION

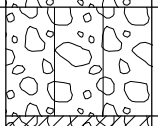
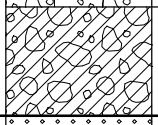
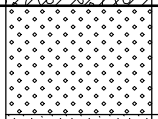
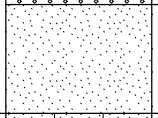
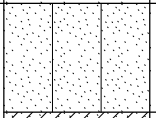
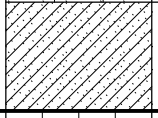
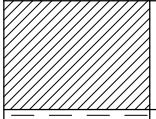
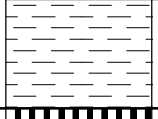
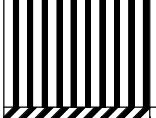
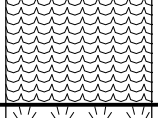
| Rock Mass Description | RQD Value |
|---|---|
| Excellent | 90 -100 |
| Good | 75 - 90 |
| Fair | 50 - 75 |
| Poor | 25 -50 |
| Very Poor | Less than 25 |

## DEGREE OF WEATHERING

| | |
|---|---|
| Slightly Weathered: | Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact. |
| Weathered: | Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife. |
| Highly Weathered: | Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife. |

# SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

| MAJOR DIVISIONS | | | SYMBOLS: GRAPH | SYMBOLS: LETTER | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | GRAVEL AND GRAVELLY SOILS<br>MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | CLEAN GRAVELS<br>(LITTLE OR NO FINES) |  | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | |  | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) |  | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | |  | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| | SAND AND SANDY SOILS<br>MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | CLEAN SANDS<br>(LITTLE OR NO FINES) |  | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | |  | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | | SANDS WITH FINES<br>(APPRECIABLE AMOUNT OF FINES) |  | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | |  | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS<br>MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 |  | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | |  | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | |  | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 |  | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | |  | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | |  | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | |  | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

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