GEOTECHNICAL REPORT

Brunswick Pump Station 4044

Glynn County, Georgia

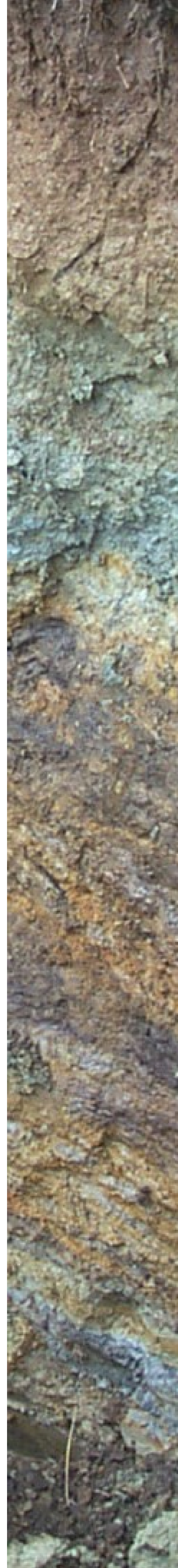
Prepared for:

Lovell Engineering and Associates
Valdosta, Georgia

Prepared by:

TTL, Inc.
Valdosta, Georgia

TTL Project No. 000210703434.00 (R-1)
January 26, 2022



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Valdosta, GA 31602
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January 26, 2022

Lovell Engineering and Associates
Attn.: Mr. Clayton Milligan, P.E.
3998 Inner Perimeter Road, Suite C
Valdosta, GA 31602

RE: Report of Subsurface Exploration
Brunswick Pump Station 4044
Brunswick, Glynn, Georgia
TTL Project No.: 000210703434.00 (R-1)

Clayton:

TTL, Inc. (*TTL*) is pleased to submit this revised Report of Geotechnical Exploration Services for the above-referenced project. If you have any questions regarding our report, or if additional services are needed, please do not hesitate to contact us.

The enclosed report contains a brief description of the site conditions and our understanding of the project. The geotechnical recommendations contained within this report are based on our understanding of the proposed development, the results of our field exploration and laboratory tests, and our experience with similar projects.

We appreciate the opportunity to be of professional service during this phase of the project, and look forward to working with you in the future.

Respectfully submitted,

TTL, Inc.

GEORGIA LICENSED No. 043332 Professional ENGINEER AERON R. MORRIS

Aeron R. Morris, M.C.E., P.E.
Project Engineer

January 26, 2022

COA License #: PEF004125
TTL Expiration Date: June 30, 2022

Matthew L. Gaston, P.E.
Senior Engineer
GA Reg. No.: PE034150

EXECUTIVE SUMMARY

This Geotechnical Report has been prepared for the Brunswick Pump Station 4044. The project site is located south of the Altama Connector, east of Scranton Connector and just northwest of Prime South Bank in Brunswick, Glynn County, Georgia.

It is TTL's understanding that development will consist of a new wet well supported on a mat foundation with an inverted wet well depth of approximately 26 feet below ground surface. The boring encountered poorly graded sand with SILT and poorly graded sand (SP-SM and SP) soils.

Special consideration should be given to the groundwater level encountered at 9 feet below ground surface at the time of testing. Zones of very loose to loose soils (N-values ≤10 bpf) were encountered between depths of 18.5 feet to 43.5 feet below ground surface. It is anticipated that the mat foundation subgrade soils will require over-excavation and backfilling with a #57 stone.

Provided the site is prepared according to the recommendations presented in this report, with a proposed wet well depth of 26 feet bgs, we recommend that the structure be designed using a net allowable soil bearing pressure of 2,000 psf for a mat foundation. Thickened slab sections supporting wall loads may be designed for local net allowable bearing pressure of 2,500 psf.

This summary is provided for convenience only. For those individuals and entities that may need more details or technical information from this report for their use, it must be read in its entirety to understand fully the information and recommendations provided for the Project.

PROJECT INFORMATION

Project Description

Item	Description
Project Location	The project site is located south of the Altama Connector, east of Scranton Connector and just northwest of Prime South Bank in Brunswick, Glynn County, Georgia. The approximate location is shown on the Site Location Plan in the Appendix.
Proposed Construction	The development will consist of a new wet well supported on a mat foundation with an inverted wet well depth of approximately 26 feet below ground surface.
Grading	TTL was not provided a finished floor elevation for the proposed structure, however we assume it will be close to existing grade level.

If the above information is not correct, please contact us so that we can make the necessary modifications to this document and our evaluation and recommendations, if needed.

Authorization

This Project was authorized by Mr. Clayton Milligan, P.E., with Lovell Engineering and Associates (LEA) via email dated Noevmber 1, 2021.

Exploration Findings

Site Conditions

Item	Description
Current Ground Cover	The current cover is predominately an open grassed lot with a tree and planted bushes. The area includes a sidewalk north of the Payless Shoe Source parking lot.
Existing topography	Based on site observations the project site is relatively flat with gradual fall toward the parking lot.

USDA Soil Survey

Based on the Natural Resource Conservation Services (NRCS) soil survey for Glynn County, Georgia, the near surface soils of this site are composed of Madarin Fine Sand (Ma). The published water table upper limit is about 18 to 30 inches below the top of ground surface, with a natural drainage class of somewhat poorly drained.

FIELD TESTING PROCEDURES

One soil test boring (B-01) was drilled at the site to a depth of 50 feet below ground surface (bgs). Standard Penetration Testing (SPT), in general accordance with ASTM D 1586, was performed at typical 2½-foot intervals in the upper 10 feet and at 5-foot intervals, thereafter. The borings were backfilled with soil cuttings upon completion.

In the Appendix attached to this letter, Figure 1 depicts the approximate site location and vicinity of the subject property. The approximate location of the soil boring is shown on the Boring Location Plan (Figure 2). The boring location was established based on the drawing provided to TTL by Lovell Engineering and Associates (LEA). The boring log (Log of Boring) graphically illustrates SPT data, groundwater levels, soil descriptions and stratifications.

LABORATORY TESTING

Two samples were subjected to laboratory classification tests to aid in evaluation of the site soils. Grain size analysis and moisture content testing were performed to evaluate the general characteristics of the soil and to confirm its classification. The results of these laboratory tests are presented on the Sieve Analysis Results report as well as on the boring logs in the Appendix attached to this letter. Brief descriptions of our laboratory procedures are also included in the Appendix.

Subsurface Stratigraphy

Subsurface conditions within the project limits were evaluated by drilling an exploratory boring at the approximate location shown on the Boring Location Plan in the appendix. Information from the exploratory boring is summarized below.

Stratum Surface Depth (ft.)	Approximate Depth to Bottom of Stratum (ft)	Material Description	Stratum Parameters
Surface Cover	≤1.25	Topsoil	
≤ 1.25	2.5	POORLY GRADED SAND with SILT, fine to medium (SP-SM)	N- value of 5

2.5	18.5	POORLY GRADED SAND with SILT, fine to medium (SP-SM)	N- values ranged from 16 to 43
18.5	43.5	POORLY GRADED SAND, fine to coarse (SP)	N- values ranged from WOH to 10
43.5	50	POORLY GRADED SAND (SP)	N- values ranged from 21 to 23

Additional information about the subsurface stratigraphy encountered at the exploratory boring location is provided on the soil boring log in the Appendix. The Boring Log presented in the Appendix represents our interpretation of the subsurface conditions based on tests and observations performed during the drilling operations at the test boring location, visual examination of the soil samples by a geotechnical engineer, and laboratory tests conducted on the retrieved soil samples. The USCS classifications enclosed in parenthesis indicate a visual classification. The lines designating the interfaces between various strata on the Boring Log represents the approximate strata boundary; however, the transition between strata may be more gradual than shown, especially where indicated by a broken line. All data should only be considered accurate at the exact test boring location.

Groundwater Conditions

Groundwater was encountered during drilling at a depth of 9 feet below ground surface. The exploratory boring was then backfilled with the spoils generated during drilling operations due to high foot traffic in the area. Delayed groundwater depth was not recorded. Groundwater levels will fluctuate with changes in rainfall and other seasonal conditions and may be different at the time of construction.

Subsurface groundwater is generally encountered as a ‘true’ or permanent continuous water source surface that is generally present year-round or as a discontinuous, isolated “‘perched”’ or temporary water surface. Both groundwater surfaces can be influenced by seasonal and climatic changes, precipitation, vegetation, surface runoff, water levels in nearby water bodies, and other factors. The groundwater level below the site may fluctuate up or down in response to such changes and may be at different levels than indicated on the exploration logs at times after the exploration. Temporary subsurface water generally develops as a result of seasonal and climatic conditions.

CONCLUSIONS AND RECOMMENDATIONS

The following geotechnical considerations have been prepared based on the data collected during this project, our experience with similar projects, and our knowledge of sites with similar surface and subsurface conditions.

The boring suggests that the base of the excavation for the footing bedding/stabilization stone will be in poorly graded sand (SP) soils. These soils are of very loose to loose consistency and can deteriorate upon being exposed especially with poor ground water control. It is anticipated that the well will need to be over-excavated through very loose soils and backfilled with #57 stone.

We recommend that the contract documents include provisions that the contractor be responsible for designing the dewatering system and maintaining temporary groundwater levels at least 2 feet below the base of the deepest proposed excavation and 2 feet below the fill pad surface during backfilling. Excessive water infiltration into the excavation will compromise slope stability and potentially foundation subgrades. Steps must be taken to keep the excavation open during construction. The steps could include drawing down the water table using a well point system, pumping from a sump, or the installation of temporary cross-braced sheet piles. Water should not be allowed to pond in the foundation excavations. Ponding water can lead to deterioration of the subgrade surface necessitating over-excavation of the softened soil. Project specifications should clearly detail the contractor's responsibility to notify the designers and geotechnical engineer if conditions are encountered in the field that would require remedial treatment or which could affect the integrity of the site or proposed foundation.

Based on the proposed wet well depth of 26 feet bgs, we recommend that the structure be designed using a net allowable soil bearing pressure of 2,000 psf for a mat foundation, following subgrade observations and recommended remedial work. Thickened slab sections supporting wall loads may be designed for local net allowable bearing pressure of 2,500 psf.

We recommend that 2-3 feet of washed #57 stone be placed beneath the wet well foundation, and that the subgrade be evaluated and approved by representatives of TTL prior to stone placement. We recommend that excavations below the elevation of the bottom of the pump station for stone placement be performed with TTL present and that adequate stone backfill be available on-site. After proper dewatering, the base of the excavation should be properly cleaned of excavator bucket teeth-loosened soil, prior to placing stone. This may require a plate welded across the bucket teeth or careful excavation with a curled bucket by a skilled operator.

The design for sheeting or shoring for a braced excavation should be left at the discretion of the contractor and should satisfy current OSHA guidelines. The stability of temporary slopes will be severely compromised by elevated groundwater levels and improper dewatering and the overall low to moderate consistency of the soils in the proposed excavation. In addition, available space for sloping will be limited.

The soils encountered in the boring appear to be generally suitable for reuse as structural fill. If in-place soils are to be reused, extensive drying in order to achieve required compaction should be anticipated. We recommend that all wet well backfill and subgrades for any ancillary structures be compacted to at least 95% of the Standard Proctor maximum dry density as determined by ASTM D 698. The top foot of fill beneath structures should be compacted to 98%. We recommend that clean sandy fill be used as backfill for at least the bottom 10 feet of an open excavation. We anticipate that seepage and groundwater conditions will require that fill soils below groundwater elevation consist of clean sands (SP or SM). Fill should be placed in thin lifts, 8 to 12 inches loose measure, and properly compacted. Thinner lifts will be required adjacent to structures and conduits where hand operated compaction equipment is used.

Since the structure will be constructed below the anticipated seasonal high groundwater level, it may be subject to uplift pressures in excess of the dead weight of the structure under adverse operational conditions. If additional resistance to uplift forces is required, a typical solution is to extend the bottom slab sufficiently to provide additional structural weight. A safety factor against uplift is provided by soil-to-structure shear resistance behind backfilled walls as discussed in the lateral earth pressure discussion included in the following paragraph. An additional margin of safety can be added and the effects of potential unbalanced uplift reduced by installing check valves designed to backflood the structure during periods of high groundwater. Preliminary computations should be based on an effective soil unit weight of 110 pounds per cubic foot (pcf) above the design groundwater elevation and 50 pcf below.

Generally, the design of any permanent retaining structure must include a determination of the lateral earth pressure that will act upon the structure. The lateral earth pressure is a function of the soil properties, the inclination of the backfill, any surcharge loads (such as equipment loads) applied behind the wall and the amount of deformation the wall system can undergo. Lateral earth pressures developed in the "active" condition are typically applicable for design of temporary sheeting or permanent freestanding retaining walls, if adequate wall movement can occur to fully mobilize the shear strength of the retained soils. Rigid permanent walls and laterally restrained walls should be designed for earth pressures resulting from the "at rest" condition. Passive earth pressure provides resistance to movement in front of the wall.

Based on our previous experience, the following earth pressure coefficients and equivalent fluid pressures are recommended for a horizontal backfill configuration and no surcharge loads. The earth pressures are for a drained condition and do not include hydrostatic pressure. The additional hydrostatic pressure component developed will depend on operational conditions and what, if any, drainage is provided behind the structure. A soil unit weight of 110 pcf was assumed based on a review of the soil materials encountered and our past experience.

Earth Pressure Condition	Earth Pressure Coefficient	Recommended Equivalent Fluid Pressure*
Active	$K_a = 0.33$	40 pcf
At-Rest	$K_o = 0.5$	55 pcf
Passive	$K_p = 3.0$	330 pcf

* These pressures are anticipated actual pressures under drained conditions and do not include any safety factors.

If traffic or other surcharge loads are located behind the wall, they may exert appreciable lateral pressure on the wall. In general, loads applied beyond an imaginary 45-degree line projected upward from the base of the wall into the retained materials may be neglected. The impact of all surcharge loads on retaining structures should be added to the recommended earth pressures to determine the total lateral pressure on the wall. Heavy compaction equipment should not operate within five feet of any wall unless the wall has been specifically designed to resist such forces. The compaction criteria previously recommended, 95% of the Standard Proctor (ASTM D 698) maximum dry density, is applicable. As a result, light compactors, hand tamps and thinner fill lifts should be anticipated immediately behind the wall. Alternatively, the wall could be designed to resist loading caused by compaction equipment.

Supplementary resistance to uplift is provided in shear behind the backfilled walls. A coefficient of friction of 0.30 may be considered in calculation of ultimate shear resistance contributed from effective, at rest lateral wall loads. Due to the variability of potential backfill materials and changes in hydrostatic conditions, we recommend a factor of safety of at least 2.0 be used in determining uplift resistance provided by shear behind walls.

We recommend that density testing of backfill be performed at a rate of at least 1 test for each vertical 2 feet of fill. This will likely result in full-time monitoring of backfilling operations. Areas that fail to achieve the recommended compaction criteria should be reworked and retested prior to proceeding with subsequent phases of construction.

LIMITATIONS

This geotechnical engineering report has been prepared for the exclusive use of our Client for specific application to this Project. This geotechnical engineering report has been prepared in accordance with generally accepted geotechnical engineering practices using that level of care and skill ordinarily exercised by licensed members of the engineering profession currently practicing under similar conditions in the same locale. No warranties, express or implied, are intended or made.

TTL understands that this geotechnical engineering report will be used by the Client and contractors involved with the design and construction of the Project. TTL should be invited to attend Project meetings (in person or teleconferencing) or be contacted in writing to address applicable issues relating to the geotechnical engineering aspects of the Project. TTL should also be retained to review the final construction plans and specifications to evaluate if the information and recommendations in this geotechnical engineering report have been properly interpreted and implemented in the design and specifications. This report has not been prepared as, and should not be used as, a design or specification document to be directly implemented by the contractor.

This geotechnical engineering report is based upon the information provided to us by the Client and exploratory borings drilled within the Project limits, laboratory testing of randomly selected soil samples recovered during drilling of the exploratory borings, and our engineering analyses and evaluation. The Client and readers of this geotechnical engineering report, should realize that subsurface variations and anomalies can exist across the site and between the exploratory boring locations. The Client and readers should realize that site conditions will change due to the modifying effects of seasonal and climatic conditions and conditions at times after the exploration may be different than reported herein.

The nature and extent of such site or subsurface variations may not become evident until construction commences or is in progress. If site and subsurface anomalies or variations exist or develop, TTL should be contacted immediately so that the situation can be if necessary, addressed with applicable recommendations. The contractor and applicable subcontractors should familiarize themselves with this report prior to the start of their construction activities, contact TTL for any interpretation or clarification of the report, or retain the services of their own consultants to interpret this report.

Unless stated otherwise in this report or in the contract documents between TTL and Client, our scope of services for this Project did not include, either specifically or by implication, any environmental or biological assessment of the site or buildings, or any identification or prevention of pollutants, hazardous materials or conditions at the site or within buildings. If the Client is concerned about the potential for such contamination or pollution, TTL should be contacted to provide a scope of additional services to address the environmental concerns. Also, permitting, site safety, excavation support, and dewatering requirements are the responsibility of others.

Should the nature, design, or location of the Project, as outlined in this geotechnical engineering report, be modified, the geotechnical engineering recommendations and guidelines provided in this document will not be considered valid unless TTL is authorized to review the changes and either verifies or modifies the applicable Project changes in writing. Additional information about the use and limitations of a geotechnical report is provided within the Geoprofessional Business Association document included at the end of this report.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will <u>not</u> likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will <u>not</u> be adequate to develop geotechnical design recommendations for the project.

Do <u>not</u> rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do <u>not</u> rely on an executive summary. Do <u>not</u> read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept* *responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are <u>not</u> final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are <u>Not</u> Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will <u>not</u> of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are <u>not</u> building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

APPENDIX A

SITE LOCATION MAP

BORING LOCATION PLAN

LEGEND SHEETS – SOIL

BORING LOGS

LABORATORY TEST RESULTS

Site Located At:
Approx. 31.215005° N, -81.484022° W

SITE LOCATION MAP

LOVELL ENGINEERING & ASSOCIATES

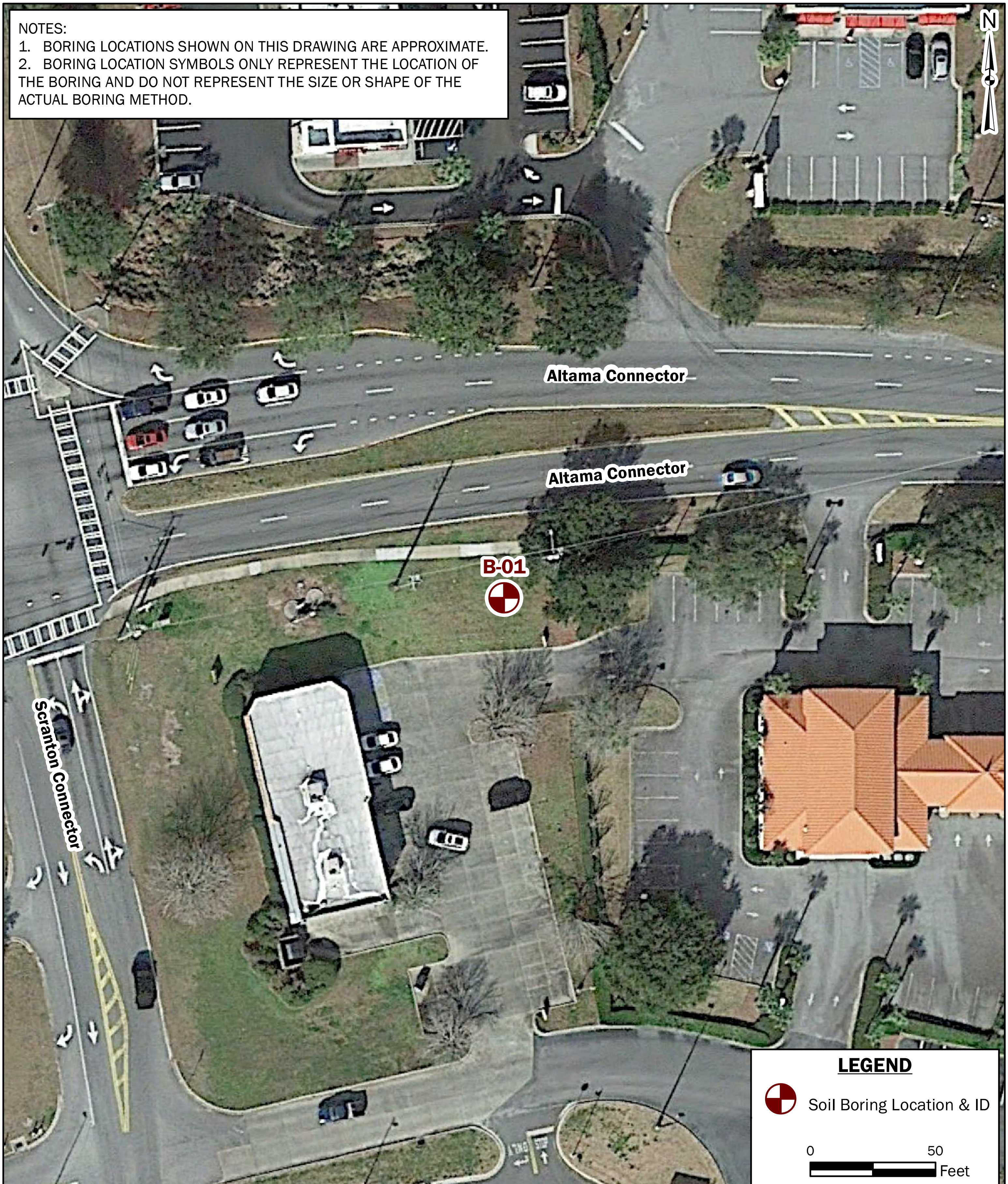
BRUNSWICK PUMP STATION 4044

BRUNSWICK, GLYNN COUNTY, GEORGIA

BASEMAP: Open Street Map (See Service Layer Credits).

DRAWN BY: DEK	
CHECKED BY: ARM	
DRAWING DATE: 12/9/2021	
REVISION DATE: N/A	
TTL JOB NO.: 000210703434.00	
APPROX. SCALE:	1 in = 2,000 ft

NOTES:
1. BORING LOCATIONS SHOWN ON THIS DRAWING ARE APPROXIMATE.
2. BORING LOCATION SYMBOLS ONLY REPRESENT THE LOCATION OF THE BORING AND DO NOT REPRESENT THE SIZE OR SHAPE OF THE ACTUAL BORING METHOD.



LEGEND

Soil Boring Location & ID

0 50 Feet

BORING LOCATION PLAN

LOVELL ENGINEERING & ASSOCIATES
BRUNSWICK PUMP STATION 4044
BRUNSWICK, GLYNN COUNTY, GEORGIA
BASEMAP: Google Earth Imagery, 1/25/2019 (0.22 ft Resolution).

DRAWN BY: DEK	
CHECKED BY: ARM	
DRAWING DATE: 12/9/2021	
REVISION DATE: N/A	
TTL JOB NO.: 000210703434.00	
APPROX. SCALE:	1 in = 50 ft

SOIL LEGEND

FINE- AND COARSE-GRAINED SOIL INFORMATION

FINE-GRAINED SOILS (SILTS AND CLAYS)

SPT N-Value	Consistency	Estimated Q_u (TSF)
0 - 1	Very Soft	0 - 0.25
2 - 4	Soft	0.25 - 0.5
5 - 8	Firm	0.5 - 1.0
9 - 15	Stiff	1.0 - 2.0
16 - 30	Very Stiff	2.0 - 4.0
31+	Hard	4.0+

Q_u = Unconfined Compression Strength

COARSE-GRAINED SOILS (SANDS AND GRAVELS)

SPT N-Value	Relative Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51+	Very Dense

PARTICLE SIZE

Name	Size (US Std. Sieve)
Boulders	>300 mm (>12 in.)
Cobbles	75 mm to 300 mm (3 - 12 in.)
Coarse Gravel	19 mm to 75 mm (3/4 - 3 in.)
Fine Gravel	4.75 mm to 19 mm (#4 - 3/4 in.)
Coarse Sand	2 mm to 4.75 mm (#10 - #4)
Medium Sand	0.425 mm to 2 mm (#40 - #10)
Fine Sand	0.075 mm to 0.425 mm (#200 - #40)
Silts and Clays	< 0.075 mm (< #200)

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms	Percent of Dry Weight
"Trace"	< 15
"With"	15 - 30
Modifier	> 30

RELATIVE PROPORTIONS OF CLAYS AND SILTS

Descriptive Terms	Percent of Dry Weight
"Trace"	< 5
"With"	5 - 12
Modifier	> 12

CRITERIA FOR DESCRIBING MOISTURE CONDITION

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

CRITERIA FOR DESCRIBING CEMENTATION

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

CRITERIA FOR DESCRIBING STRUCTURE

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note the thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
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 such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

SAMPLERS AND DRILLING METHODS

- AUGER CUTTINGS
- BAG/BULK SAMPLE
- GRAB SAMPLE
- CONTINUOUS SAMPLES
- SHELBY TUBE SAMPLE
- PITCHER SAMPLE
- STANDARD PENETRATION SPLIT-SPOON SAMPLE
- SPLIT-SPOON SAMPLE WITH NO RECOVERY
- DYNAMIC CONE PENETROMETER
- ROCK CORE

WATER LEVEL SYMBOLS

- WATER LEVEL AT TIME OF DRILLING
- PERCHED WATER OBSERVED AT DRILLING
- DELAYED WATER LEVEL OBSERVATION
- CAVE-IN DEPTH
- OBSERVED SEEPAGE

ABBREVIATIONS AND ACRONYMS

WOH	Weight of Hammer	N-Value	Sum of the blows for last two 6-in increments of SPT
WOR	Weight of Rod		
Ref.	Refusal	NA	Not Applicable or Not Available
ATD	At Time of Drilling	OD	Outside Diameter
DCP	Dynamic Cone Penetrometer	PPV	Pocket Penetrometer Value
Elev.	Elevation	SFA	Solid Flight Auger
ft.	feet	SH	Shelby Tube Sampler
HSA	Hollow Stem Auger	SS	Split-Spoon Sampler
ID	Inside Diameter	SPT	Standard Penetration Test
in.	inches	USCS	Unified Soil Classification System
lbs	pounds		

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

COARSE GRAINED SOILS (>50% of the material is larger than the #200 sieve)	GRAVELS (>50% of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu > 4 Cc = 1-3	GW	Well-graded gravels, gravel-sand mixtures with trace or no fines
			Cu ≤ 4 and/or Cc < 1 Cc > 3	GP	Poorly-graded gravels, gravel-sand mixtures with trace or no fines
		GRAVEL WITH 5% TO 12% FINES	Cu > 4 Cc = 1-3	GW-GM	Well-graded gravels, gravel-sand mixtures with silt fines
				GW-GC	Well-graded gravels, gravel-sand mixtures with clay fines
			Cu ≤ 4 and/or Cc < 1 Cc > 3	GP-GM	Poorly-graded gravels, gravel-sand mixtures with silt fines
				GP-GC	Poorly-graded gravels, gravel-sand mixtures with clay fines
		GRAVEL WITH MORE THAN 12% FINES		GM	Silty gravels, gravel-silt-sand mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
				GC-GM	Clayey gravels, gravel-sand-clay-silt mixtures
	SANDS (>50% of coarse fraction is smaller than the #4 sieve)	CLEAN SAND WITH <5% FINES	Cu > 6 Cc = 1-3	SW	Well-graded sands, sand-gravel mixtures with trace or no fines
			Cu ≤ 6 and/or Cc < 1 Cc > 3	SP	Poorly-graded sands, sand-gravel mixtures with trace or no fines
		SAND WITH 5% TO 12% FINES	Cu > 6 Cc = 1-3	SW-SM	Well-graded sands, sand-gravel mixtures with silt fines
				SW-SC	Well-graded sands, sand-gravel mixtures with clay fines
			Cu ≤ 6 and/or Cc < 1 Cc > 3	SP-SM	Poorly-graded sands, sand-gravel mixtures with silt fines
				SP-SC	Poorly-graded sands, sand-gravel mixtures with clay fines
		SAND WITH MORE THAN 12% FINES		SM	Silty sands, sand-gravel-silt mixtures
				SC	Clayey sands, sand-gravel-clay mixtures
				SC-SM	Clayey sands, sand-gravel-clay-silt mixtures
FINE GRAINED SOILS (>50% of material is smaller than the #200 sieve)	SILTS & CLAYS (Liquid Limit less than 50)			ML	Inorganic silts with low plasticity
				CL	Inorganic clays of low plasticity, gravelly or sandy clays, silty clays, lean clays
				CL-ML	Inorganic clay-silts of low plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS (Liquid Limit more than 50)			MH	Inorganic silts of high plasticity, elastic silts
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays and organic silts of high plasticity

USCS - HIGHLY ORGANIC SOILS

Primarily organic matter, dark in color, organic odor

PT	Peat, humus, swamp soils with high organic contents

OTHER MATERIALS

- BITUMINOUS CONCRETE (ASPHALT)
- CONCRETE
- CRUSHED STONE/AGGREGATE BASE
- TOPSOIL
- FILL
- UNDIFFERENTIATED ALLUVIUM
- UNDIFFERENTIATED OVERBURDEN
- BOULDERS AND COBBLES

UNIFORMITY COEFFICIENT

$$C_u = D_{60}/D_{10}$$

COEFFICIENT OF CURVATURE

$$C_C = (D_{30})^2/(D_{60} x D_{10})$$

Where:

D_{60} = grain diameter at 60% passing
D_{30} = grain diameter at 30% passing
D_{10} = grain diameter at 10% passing

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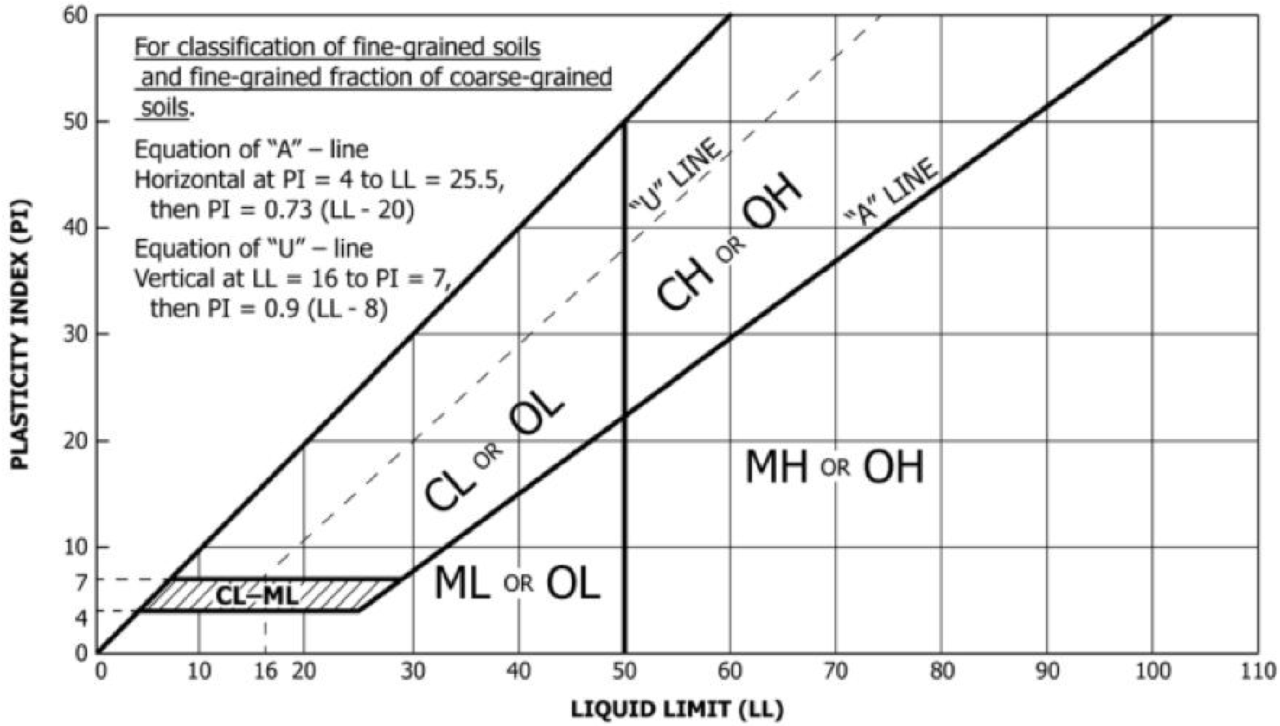
PLASTICITY CHART FOR USCS CLASSIFICATION OF FINE-GRAINED SOILS



IMPORTANT NOTES ON TEST BORING RECORDS

1) The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.

2) Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown. Solid lines are used to indicate a change in the material type, particularly a change in the USCS classification. Dashed lines are used to separate two materials that have the same material type, but that differ with respect to two or more other characteristics (e.g. color, consistency).

3) No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

4) Logs represent general soil and rock conditions observed at the point of exploration on the date indicated.

5) In general, Unified Soil Classification System (USCS) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.

6) Fine-grained soils that plot within the hatched area on the Plasticity Chart, and coarse-grained soils with between 5% and 12% passing the #200 sieve require dual USCS symbols as presented on the previous page.

7) If the sampler is not able to be driven at least 6 inches, then 50/X" indicates that the sampler advanced X inches when struck 50 times with a 140-pound hammer falling 30 inches.

8) If the sampler is driven at least 6 inches, but cannot be driven either of the subsequent two 6-inch increments, then either 50/X" or the sum of the second 6-inch increment plus 50/X" for the third 6-inch increment will be indicated.
Example 1: Recorded SPT blow counts are 16 - 50/4", the SPT N-value will be shown as N = 50/4"
Example 2: Recorded SPT blow counts are 18 - 25 - 50/2", the SPT N-value will be shown as N = 75/8"

TTL

Lovell Engineering Associates, PC
Brunswick Pump Station 4044

Brunswick, Georgia

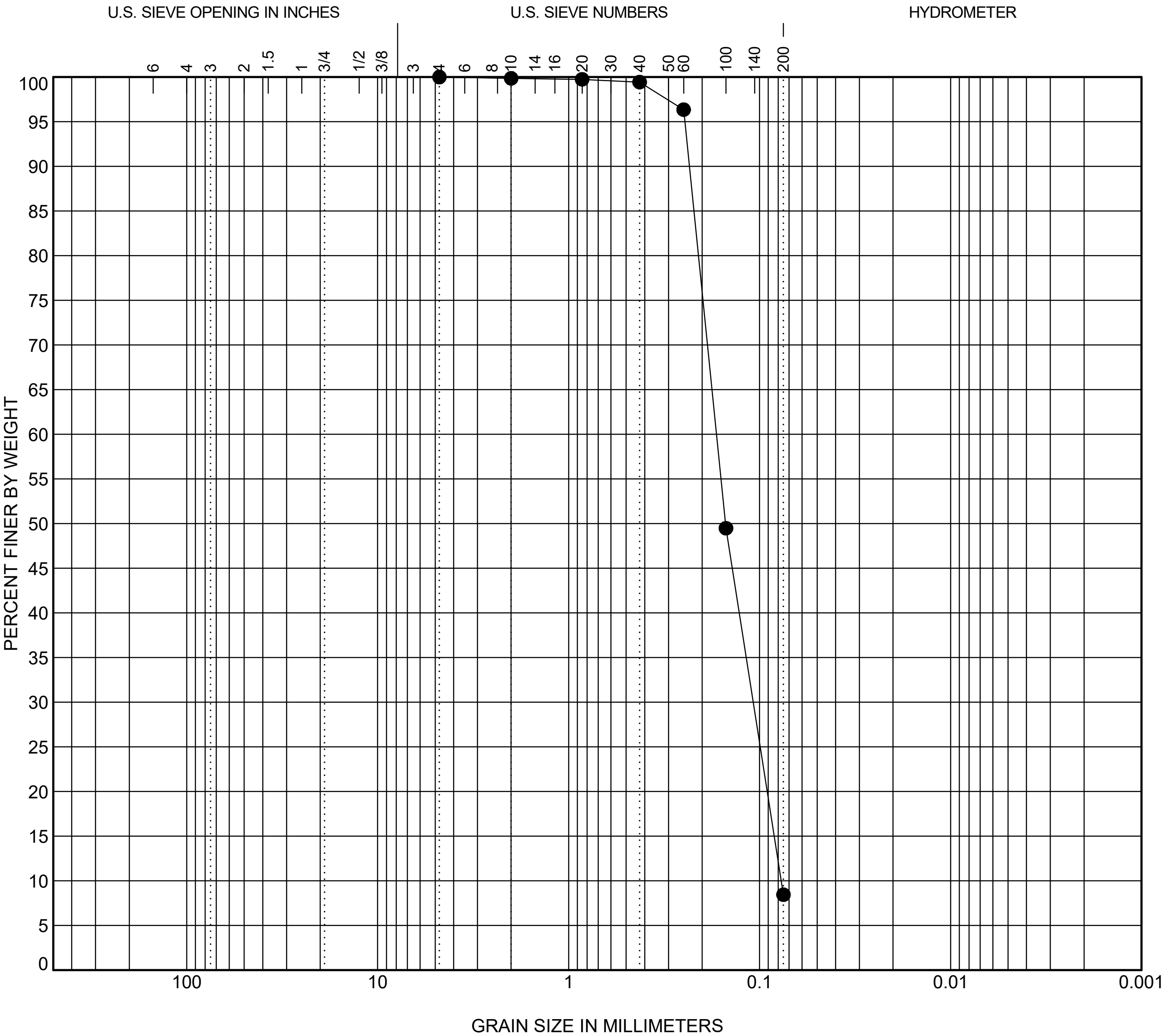
Log of B-01

Drilling Co.:	*Betts Environmental recovery*	TTL Project No.:	*000210703434.00*	Remarks:
Driller:	*R. Lashley*	Date Drilled:	*12/6/2021*	
Logged by:	*A. Morris*	Boring Depth:	*50 feet*	
Equipment:	*CME 55 ATV*	Boring Elevation:	*Ground Surface*	
Hammer Type:	*Automatic*	Coordinates:	*Not Available*	
Drilling Method:	*Hollow Stem Auger w/SPT Sampling*	Water Level at Time of Drilling: *9 ft BGS* Cave-In at Time of Drilling: *N/A*		Delayed Water Level: *N/A* Delayed Water Observation Date: *N/A*

SAMPLE DATA

ELEVATION (ft)	DEPTH (ft)	MATERIALS DESCRIPTION	TYPE	BORE/CORE DATA: 1st 6" - 2nd 6" - 3rd 6" / N-VALUE BLOWS/FT	P: TONS/SOFT	RQD / % REC	MOISTURE CONTENT (%)	LL (LIQUID LIMIT)	PL (PLASTIC LIMIT)	PI (PLASTICITY INDEX)	DRY DENSITY (psf)	SHEAR STRENGTH (psf)	FAILURE STRAIN (%)	CONFINING PRESSURE (psi)	% PASSING #200 SIEVE
	0	TOPSOIL (15 inches)													
		COASTAL PLAIN: POORLY GRADED SAND with SILT, fine to medium, dark brown, moist (SP-SM)	X	2 - 2 - 3 N = 5											
			X	6 - 8 - 9 N = 17				NP	NP	NP					8.4
	5		X	7 - 7 - 9 N = 16											
		-becomes light-brown	X	9 - 20 - 23 N = 43											
	10														
			X	7 - 12 - 14 N = 26											
	15														
		POORLY GRADEDSAND, fine to coarse, dark-gray, wet (SP)	X	1 - 2 - 2 N = 4											
	20														
			X	WOH - WOH - WOH N = 0											
	25														
			X	WOH - 1 - 1 N = 2				NP	NP	NP					3.2
	30														
		-becomes moist below 33.5 feet	X	4 - 3 - 3 N = 6											
	35														
			X	3 - 5 - 5 N = 10											
	40														
		POORLY GRADED SAND, fine to coarse, light to dark gray, wet (SP)	X	4 - 10 - 11 N = 21											
	45														
			X	5 - 9 - 14 N = 23											
	50	Boring terminated at 50 feet.													
	55														

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**B-01** **3.5 - 5.0 feet**
Description	**POORLY GRADED SAND with SILT (SP-SM)**
Sampled by:	
Sample Location:	**B-01**
Date Sampled:	**12/6/2021**

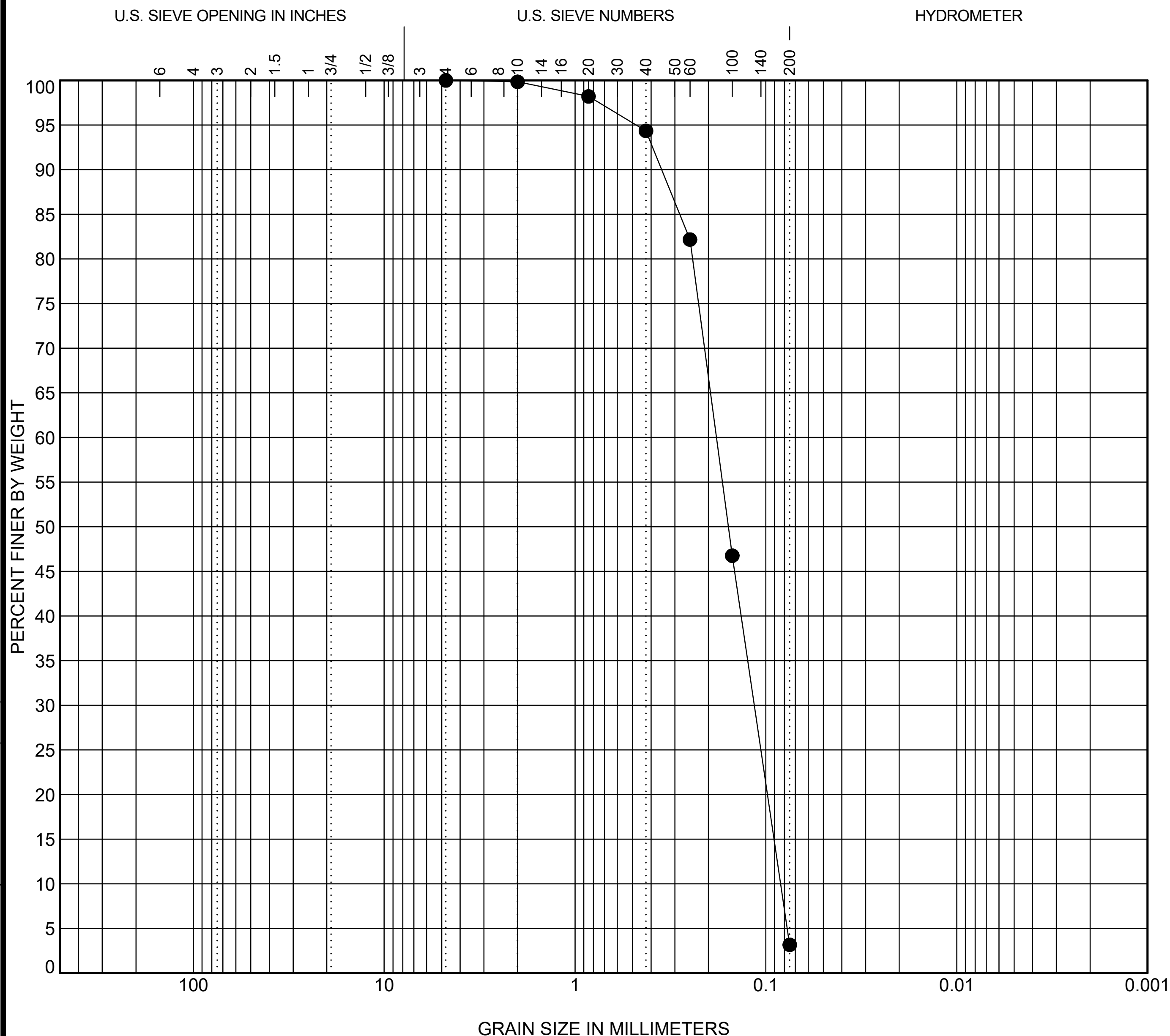
wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
---	**NP**	**NP**	**NP**	**0.9**	**2.2**	**4.75**	**0.17**	**0.11**	**0.077**	**0.0**	**91.6**	**8.4**	

TTL

SIEVE ANALYSIS RESULTS

Client: Lovell Engineering Associates, PC
Project: Brunswick Pump Station 4044
Location: Brunswick, Georgia
Project Number: 000210703434.00

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample ID	**B-01** **28.5 - 30.0 feet**
Description	**POORLY GRADED SAND (SP)**
Sampled by:	
Sample Location:	**B-01**
Date Sampled:	**12/6/2021**

wc (%)	LL	PL	PI	Cc	Cu	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
---	**NP**	**NP**	**NP**	**0.9**	**2.2**	**4.75**	**0.18**	**0.11**	**0.084**	**0.0**	**96.8**	**3.2**	

TTL

SIEVE ANALYSIS RESULTS

Client: Lovell Engineering Associates, PC
Project: Brunswick Pump Station 4044
Location: Brunswick, Georgia
Project Number: 000210703434.00

V:\PROJECTS\2021\PROJECTS\000210703434.00 BRUNSWICK PUMP STATION 4044\LAB.GPJ 12/15/21 Report:SIEVE ANALYSIS (AUTO)

APPENDIX B

EXPLORATION AND LABORATORY TESTING PROCEDURES

EXPLORATION PROCEDURES

Field Locating of Explorations

The boring location was provided to TTL via an aerial image and located utilizing a hand-held GPS. The boring location should not be considered more accurate than implied by the methods used. Existing elevations were not provided to TTL. Surveying the test location for vertical and horizontal control was beyond the scope of this exploration.

Soil Borings

The boring was drilled using conventional hollow-stem auger drilling methods by an ATV drill rig. Soil samples were obtained at selected depths in general accordance with the Standard Penetration Test (SPT) described in ASTM D1586. For this test, a split-barrel sampler is driven into the soil through three increments of 6 inches with blows from a 140-pound hammer falling 30 inches. The number of hammer blows required to advance the split-barrel sampler through each increment is recorded, and the sum of the final two blow counts is called the "N-value," with units of blows per foot (bpf). The N values recorded during the sampling process provide an index to the strength and compressibility of the soil.

Groundwater Measurements

The borehole was checked for the presence of groundwater after removing the drill tools, by lowering a measuring tape down the open borehole. The depth to groundwater was recorded to the nearest ½ foot.

Backfilling Boreholes

The borehole was backfilled to the ground surface with auger cuttings after making the final groundwater measurement. Auger cuttings sometimes consolidate after backfilling causing the top of the backfill column to settle and leaving an open hole at the ground surface. Return trips to the site to top-off backfill that has settled was not part of our scope of services.

LABORATORY TESTING PROCEDURES

Classification and Index Testing

The recovered soil samples were classified in the lab by a geoprofessional using the USCS as a guide. Samples were tested for the following properties in general accordance with the applicable ASTM standards:

- Moisture content (ASTM D2216); and
- Particle Size Distribution by Sieve Analysis (ASTM D6913).

Results of tests for moisture content and percent fines are presented on the boring log in Appendix A.