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REPORT

For Forsyth County Department of Water and Sewer

Geotechnical Exploration
Hammonds Crossing 16" Water Main
Browns Bridge Rd, Keith Bridge Rd, & Martin Rd
Cumming, Forsyth County, Georgia

Project No.: FORPD-20-GA-04563-01

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30TH ANNIVERSARY 1990-2020

FORPD-20-GA-04563-01

October 15, 2020

Mr. Kyle Fikes
Forsyth County Department of Water & Sewer
110 East Main Street, Suite 150
Cumming, Georgia 30040

Via Email: DKFikes@forsythco.com

RE: Report of Geotechnical Exploration
Hammonds Crossing 16" Water Main
Browns Bridge Rd, Keith Bridge Rd, & Martin Rd
Cumming, Forsyth County, Georgia
Project No.: FORPD-20-GA-04563-01

Dear Mr. Fikes:

United Consulting is pleased to submit this report of our Geotechnical Exploration for the above-referenced project. We appreciate the opportunity to assist you with this project and look forward to our continued participation. Please contact us if you have any questions or if we can be of further assistance.

Sincerely,

UNITED CONSULTING

GEORGIA REGISTERED No. PE18510 PROFESSIONAL ENGINEER THOMAS ALLEN TYE

10/15/2020

Thomas A. Tye, P.E.
Senior Geotechnical Engineer

Scott D. Smelter
Principal

SRT/TAT/SDS/rg

unc-sps: Geotechnical Documents/FORPD-20-GA-04563-01 - Geo.docx

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1.0 EXECUTIVE SUMMARY

United Consulting has completed a Geotechnical Exploration for the Hammonds Crossing 16" Water Main project located along Browns Bridge Road, Keith Bridge Road, and Martin Road in Cumming, Forsyth County, Georgia. Please refer to the text of the report for a more detailed discussion of the items summarized below.

- 16 out of 21 borings drilled encountered between 2 to 8 feet of fill soils. The fill generally appeared to be free of debris and organic content, but slightly variable in consistency.

- Partially Weathered Rock (PWR) was encountered in boring B-8 starting at a depth of 6 feet (Elev. 1226 feet). Auger refusal did not occur in the borings to termination depths.

- Groundwater was encountered in boring B-9 at a depth of 10 feet at the time of drilling. It is likely that stabilized groundwater levels are several feet shallower then time of boring levels, and it is possible that perched water levels could develop at shallower depths at the site. The contractor should be prepared to manage perched water or groundwater as needed.

- The soil resistivity results varied from 29,000 to 82,000 ohm-cm, indicating a mild to low corrosion potential for uncoated steel.

- The lateral soil resistance values of 10 pci is presented for thrust block design based on the soil conditions (worse case) in the borings at this site.

2.0 PROJECT INFORMATION

The Project Site is located along Browns Bridge Road, Keith Bridge Road, and Martin Road in Cumming, Forsyth County, Georgia. The client provided a site plan which showed the location and alignment of the proposed pipeline routing. This site plan was used as a guide to locate the boundaries of the project site. The location of the project site is indicated on the attached Boring Location Plan (Figure 1).

At the time of our fieldwork, the site contained a number of commercial and residential structures, as well as wooded areas along the right-of-ways of the existing streets. The general location of the project site is shown on the attached Boring Location Plan (Figure 1).

We understand that the project consists of construction of approximately 8,500 linear feet of a 16-inch ductile iron water line starting at Station 0 + 00± located on Browns Bridge Road, at its intersection with Burruss Mill Road. The water main will then travel west-northwest along Browns Bridge Road, before turning north at Station 32 + 25± to join Keith Bridge Road at Station 39 + 25±. The water main will continue to travel east-northeast along Keith Bridge Road before turning north into Martin Road at Station 47 + 00±. The main will continue north along Martin Road before terminating at its intersection with Shadburn Road at Station 80 + 93±.

<u>If the actual plans and site grading information vary significantly, United Consulting must be contacted to determine if our recommendations should be re-evaluated and/or revised.</u>

3.0 PURPOSE

The purpose of this Geotechnical Exploration was to assess the general type and condition of the subsurface materials at the Project Site and to provide recommendations regarding the installation of the proposed pipeline either by tunnel boring or cut-and-cover construction method. Other geotechnical recommendations for site grading, earthwork, quality control and other geotechnical related issues, deemed pertinent to this project are provided herein.

4.0 SCOPE

The scope of our geotechnical exploration included the following items:

1. A visual reconnaissance of the site from a geotechnical standpoint;

2. Drilling twenty-one (21) Standard Penetration Test (SPT) borings to assess the quality and consistency of the subsurface soils;

3. Visual evaluation of the soil samples obtained during our field testing program for further identification and classification;

4. Performing laboratory testing consisting of five (5) grain size analysis with hydrometer, five (5) Atterberg Limits, and two (2) unconsolidated-undrained triaxial tests triaxial shear tests on representative soil samples as well as six (6) corrosivity tests at requested locations;

5. Analyzing the existing soil conditions with respect to the proposed construction; and

6. Preparing this report to document the results of our field-testing program, laboratory testing, engineering analysis, and to provide our findings and recommendations.

5.0 ALIGNMENT REVIEW

A foot and an automobile reconnaissance of the Project area were conducted as part of this exploration. We anticipate that the proposed water line will generally be constructed as open trench excavation. Road/lane closure will be required on each of the roads during the construction activities. We understand that jack and bore trenchless installation will be utilized across portions of the site. Underground utilities such as gas, water, sewer lines, and telephone cables were observed within the right of way. Some of the buried utility lines also crossed the roads.

6.0 SUBSURFACE CONDITIONS

The geotechnical exploration consisted of twenty-one (21) borings located along the proposed water main.

Initially, the borings encountered a thin layer of topsoil. Below the ground surface, each of the borings apart from B-15 through B-19 encountered between 2 to 8 feet of fill soils. The fill soils encountered consisted of firm to dense sand with varying amounts of silt, clay, mica, and rock fragments; or firm to very stiff silt with varying amounts of sand, clay, and gravel fragments; or soft to very stiff clay with varying amounts of sand, silt, and gravel fragments. Standard Penetration Test resistances (N-values) within the fill sands ranged from 12 bpf to 34 blows per foot (bpf); those within the fill silts ranged from 8 bpf to 19 bpf; and those within the fill clays ranged from 4 bpf to 27 bpf. Low consistency fill soils (N-value ≤ 5 bpf) were encountered within the top 6 feet in boring B-7.

Beneath the fill soils in the aforementioned borings and the ground surface in the remaining borings, typical residual soils of the Piedmont Physiographic Province of Georgia were encountered. The residual soils encountered generally consisted of firm to dense sand with varying amounts of silt, clay, mica, and rock fragments; or firm to hard silt with varying amounts of sand, clay, and gravel fragments; or very stiff to hard clay with varying amounts of sand, silt, and gravel fragments. The N-values within the residual sands ranged from 13 bpf to 48 bpf; those within the residual silts ranged from 8 bpf to 91 bpf; and those within the residual clays ranged from 20 bpf to 38 bpf.

Partially Weathered Rock (PWR) was encountered in boring B-8 starting at a depth of 6 feet (Elev. 1226 feet). PWR is a term for the residuum that can be penetrated by a soil drilling auger and has N-values in excess of 100 bpf. The PWR encountered was sampled as very dense silty sand with trace amounts of rock fragments.

Auger refusal did not occur in the borings to boring termination depths. Auger refusal is the depth that the boring cannot be advanced with a soil drilling auger. It may represent a seam of rock, a boulder or other hard obstruction, or the upper surface of relatively sound, massive rock.

Groundwater was encountered in boring B-9 at a depth of 10 feet at the time of drilling. Groundwater levels should be anticipated to fluctuate with the change of seasons, during periods of very low or high precipitation, or due change in floodplain or watershed upstream of the site.

A summary of the subsurface conditions is provided in the table below:

Table 1: Summary of Subsurface Conditions

Boring No.	Station	Elevation (ft.-msl)	Bottom of Water Main Elevation (ft.-msl)	Depth to Bottom of Fill Soils (ft.)	Depth to PWR (ft.)	Groundwater Depth (ft.)	Boring Termination Depth (ft.)
B-1	1+25	1245.88	1242	2	NE	NE	15
B-2	2+25	1248.58	1243	2	NE	NE	15
B-3	7+25	1254.15	1246	2	NE	NE	15
B-4	9+00	1255.59	1246	6	NE	NE	15
B-5	12+50	1256.53	1250	6	NE	NE	15
B-6	17+50	1250.34	1245	8	NE	NE	15
B-7	22+50	1242.46	1236	6	NE	NE	15
B-8	27+50	1229.53	1224	3	6	NE	15
B-9	32+25	1222.73	1214	6	NE	10	15
B-10	39+25	1244.79	1237	2	NE	NE	15
B-11	44+25	1248.46	1240	6	NE	NE	15
B-12	47+00	1246.86	1240	6	NE	NE	15
B-13	47+75	1246.79	1240	3	NE	NE	15
B-14	49+25	1247.92	1241	2	NE	NE	15
B-15	54+25	1254.97	1248	NE	NE	NE	15
B-16	59+25	1262.58	1256	NE	NE	NE	15
B-17	64+25	1263.62	1254	NE	NE	NE	15
B-18	69+25	1261.14	1254	NE	NE	NE	15
B-19	74+25	1259.21	1252	NE	NE	NE	15
B-20	79+25	1266.39	1259	2	NE	NE	15
B-21	80+93	1278.53	1271	2	NE	NE	15

NE – Not Encountered
Elevations should be considered approximate

For a more detailed description of the subsurface conditions encountered, please refer to the boring logs in The Appendix.

7.0 LABORATORY TESTING PROGRAM

Laboratory testing for this project included five (5) grain size analysis with hydrometer, five (5) Atterberg Limits, and two (2) unconsolidated-undrained (UU) triaxial shear tests on representative soil samples.

Additonally, six (6) corrosivity tests at requested locations were also conducted and the results of these tests are tabulated below:

Table 2: Soil Corrosivity Test Results

Boring	Depth (ft.)	Soil Classification/ Percent Fines	Soil pH (S.U.)	Soil Resistivity (ohm-cm)
B-7	6 – 7.5	SM / 18%	5.46	73,000
B-9	8 – 10	SM / 40%	5.43	30,000
B-16	0 – 1.5	ML / 68%	6.44	29,000
B-17	8.5 – 10	SM / 35%	4.19	37,000
B-20	0 – 1.5	--	4.86	36,000
B-20	3 – 5	SC / 39%	4.52	82,000

Table 3: UU Triaxial Shear Test Results

Boring	Depth (ft.)	Soil Dry Density (pcf)	Peak Soil Cohesion (psf)
B-9	8 - 10	79	495
B-20	3 – 5	112	600

Table 4: Additional Laboratory Data Summary

Boring No.	Depth (ft.)	Liquid Limit	Plastic Limit	Plasticity Index	Percent Fines	USCS Classi-fication	Water Content %
B-7	6-7.5	NV	NP	NP	18	SM	15.0
B-9	8 – 10	NV	NP	NP	40	SM	42.0
B-16	0 – 1.5	42	21	21	68	ML	18.0
B-17	8.5 – 10	NV	NP	NP	35	SM	27.1
B-20	3 – 5	48	27	21		SC	17.3

NP=Non-plastic

A narrative description of the laboratory tests and the laboratory test results are included in The Appendix.

8.0 DISCUSSION AND RECOMMENDATIONS

The following preliminary recommendations are based on our understanding of the proposed construction, the data obtained from the soil test borings, a site reconnaissance, and our experience with subsurface conditions similar to those encountered at the project site.

8.1 Existing Fill Soils

Fill soils were encountered in 16 out of 21 borings between 2 to 8 feet. The fill generally appeared to be free of debris and organic content, but slightly variable in consistency. Low consistency fill soils (N-value ≤ 5 bpf) were encountered within the top 6 feet in boring B-7.

As with any site containing undocumented existing fill materials, it is not uncommon to find deeper areas of fill, soft soils, trash pits or buried trash, topsoil, boulders, remnants of prior construction, blast rock, or other unsuitable materials within existing fill materials.

8.2 Site Preparation

Any abandoned lines should be removed from the area of the proposed construction. All excavations should be subsequently backfilled with properly compacted engineered fill. We do not recommend active or non-active utility lines located below the area of the proposed structures be left in place. Any abandoned utility pipes, if left in place and outside of the proposed building footprint, should be filled-in under pressure with cement grout having a minimum 28-day compressive strength of 500 pounds per square inch (psi). This would prevent localized cave-in upon eventual deterioration and loss of structural integrity of the pipe. Also, septic tanks, septic fields, and associated underground structures, if present, should be properly removed. The excavated trenches and pits associated with the removal of the buried structures should be backfilled with engineered fill.

8.3 Difficult Excavation

Partially Weathered Rock (PWR) was encountered in boring B-8 starting at a depth of 6 feet (Elev. 1226 feet). Auger refusal did not occur in the borings to termination depths.

It is also important to note that depths to PWR and rock can vary over short horizontal distances in the Piedmont geologic area, and PWR and rock could be encountered during construction at shallower depths between and outside the boring locations for this study.

The use of specialized excavation equipment (such as ram-hoes and jackhammers) is typically required for PWR excavation in confined (trench) excavations. Relatively hard PWR (N-values of 50/2” or less) and sound, massive, rock typically requires blasting for removal in mass or trench excavation.

Jack and bore methods will likely be used for installation of some of the proposed sewer line. If jack and bore is used to install the proposed sewer line, rock bits will be required for boring PWR with N-values of 50/2” or less and below the auger refusal depths.

Excavation techniques will vary based on the weathering of the materials, fracturing and jointing in the rock, and the overall stratigraphy of the feature. Actual field conditions usually display a gradual weathering progression with poorly defined and uneven boundaries between layers of different materials. We recommend that the following definitions for rock in earthwork excavation be included in bid documents:

1. General Excavation: Any material occupying an original volume of more than 1 cubic yard which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rating of not less than 80,000 lbs. usable pull (Caterpillar D-8 or larger).

2. Trench Excavation: Any material occupying an original volume of more than 1/2 cubic yard which cannot be excavated with a backhoe having a bucket curling force rated at not less than 40,000 lbs., using a rock bucket and rock teeth (Caterpillar model 330 or equivalent).

The costs of excavation vary with the type of material encountered and the quantities to be excavated. Hence, control of quantities is important. You may consider independent recording of the blasting contractors air track drilling in order to have independent verification of quantities. We will be happy to assist as requested by you with this undertaking.

8.4 Groundwater Considerations

Groundwater was encountered in boring B-9 at a depth of 10 feet at the time of drilling. Stabilized groundwater levels should be expected to be several feet higher than the time of boring levels.

Shallower groundwater should be expected near existing river/stream crossings and some control of groundwater during construction is expected in that area. It is possible that perched water levels could develop at shallower depths.

The contractor should be prepared for dewatering, and groundwater should be lowered to depths of at least 3 feet below excavation depths throughout construction unless jack and bore methods are used.

Management of groundwater during construction can likely be accomplished using perimeter and interior interconnected trenches gravity drained to appropriate outfalls. Where gravity drainage may not be possible, collected water would need to be routed to sumps and pumped for discharge.

8.5 Earthwork

The onsite soils, if free of organic and other deleterious materials, should generally be suitable for reuse as engineered fill with proper moisture control. Partially weathered rock (PWR) can be used as engineered fill if it breaks up sufficiently to meet gradation requirements. PWR can also be mixed with soil to meet gradation requirements.

Due to the presence of high silt contents (B-9 and B-16) some of the onsite soil may be sensitive to moisture variation. During rainy seasons, these soils will be difficult to dry with some moisture content tests results as high as 42% (B-9). As a practical consideration during extended periods of wet weather, wet onsite soils may need to be discarded and replaced with drier soils. These soils should be placed

within a narrow range of their optimum moisture content (typically within about 3± percent of optimum moisture) to achieve proper compaction. Typical restrictions on suitable fill are no organics, plasticity index less than 25, and maximum particle size of four inches, with not more than 30 percent greater than 3/4-inch. These restrictions should also be applied to imported borrow soils if needed.

Positive drainage should be maintained at all times to prevent saturation of exposed soils in case of sudden rains. Rolling the surface of disturbed soils will also improve runoff and reduce the soil moisture and construction delays. The degree of soil stability problems will also be dependent upon the precautions taken by the contractor to help protect the soils from saturation during construction.

Moisture-density determinations should be performed for each soil type used, to provide data necessary for quality assurance testing. Soil moisture contents at the time of compaction should be adjusted so that they are within moisture content limits that will allow the required compaction to be obtained.

8.6 Temporary Shoring/Thrust Block Design

Care should be exercised during construction within or adjacent to the existing roads. For shallow open-excavation, we recommend temporary appropriate shoring to maintain stability of slope, underground utilities, and roadways. Based on our experience with similar soils and field data, we recommend the following Table 5 summarizing the ultimate equivalent fluid pressures to be used in preliminary design for in-situ soils for temporary excavation bracing design.

Table 5: Summary of Ultimate Equivalent Fluid Pressures (Excavation Bracing and Thrust Blocks)

Pressure Conditions	Co-efficient of Earth Pressures	Ultimate Equivalent Fluid Pressure
Active (K_a)	0.36	42 psf/ft.
At-rest (K_o)	0.53	61 psf/ft.
Passive (K_p)	2.8	318 psf/ft.

These ultimate equivalent fluid pressures were calculated by the Rankine method using an estimated in-situ soil unit weight of 115 pcf, an average in-situ angle of internal friction of 28 degrees, and zero effective cohesion. The long-term cohesion strength parameter has not been utilized in the determination of the earth pressures. Generally, for this soil type, most of the long-term cohesive strength is lost as a result of exposure and disturbance during excavation. We can design reinforced earth retaining walls, sheet pile walls or excavation bracing, if needed. All excavations should be conducted per OSHA standards. Thrust blocks can be designed with the values presented in this section. A coefficient of lateral subgrade reaction value of 10 psi/inch could be used for thrust block design. A maximum design bearing pressure of 2,000 psf is recommended for underground structures.

8.7 Earth Slopes

We recommend that where fill is to be placed on existing slopes or gullies greater than 4(H):1(V), the slopes be benched to prevent sliding of the fill mass along the existing surface. This can be achieved by notching the slope face by at least about two feet horizontally with the compactor blade as each lift is compacted. A typical benching detail is provided in The Appendix.

Permanent slopes should be constructed no steeper than 2(H):1(V). Fill slopes of up to 20 feet in total height constructed to 2(H):1(V) should be acceptable for this project, assuming proper benching, and placement and compaction of engineered fill. Fill slopes greater than 20 feet must be evaluated for global stability and should be designed by a licensed Geotechnical Engineer. Slopes higher than 35 feet should be benched. If less than desirable soils, such as topsoil or wet soils are to be wasted on slopes, or if an appropriate level of quality control and compaction testing under the supervision of the geotechnical engineer is not planned during slope construction, 2(H):1(V) slopes will not likely be adequate, and flatter slopes should be considered.

All slopes should be protected from erosion during construction and provided with appropriate permanent vegetation or other cover after construction. Slopes should be protected from concentrated run-off flow by means of berms and drainage ditches to direct runoff around slopes or through concrete channels. Appropriate vegetative cover should consist of fast growing grasses that will rapidly create a dense root mat over the entire slope. Landscaping consisting of isolated shrubs and pine straw will not provide adequate slope protection.

A minimum building or retaining wall setback (from the nearest edge of foundations) of at least 10 feet from the crest of slopes is recommended. A minimum setback of 5 feet is recommended for pavement and curbs.

8.8 Fill Placement

Moisture-density determinations should be performed for each soil type used to provide data necessary for quality assurance testing. The natural moisture content at the time of compaction should be within moisture content limits that will allow the required compaction to be obtained. This is generally within three percentage points of the optimum moisture. The contractor should be prepared to increase or decrease soil water content.

The fill should be placed in thin lifts (not to exceed 8-inch loose thickness) and compacted. We recommend the fill within the top two feet of final grades be compacted to at least 98 percent of Standard Proctor (ASTM D 698) maximum dry density and at least 95 percent of Standard Proctor maximum dry density elsewhere on the site.

A Geotechnical Engineer on a full-time basis should observe grading operations. In-place density tests taken by that individual will assess the degree of compaction being obtained. The frequency of the testing should be determined by the Geotechnical Engineer.

8.9 Seismic Site Class

United Consulting utilized available geotechnical information (N-values) and our experience with the similar soil conditions to provide a seismic site class for the Site. United Consulting recommends that a seismic site classification of "Site Class D" be utilized for the site. The site coefficients are indicated in the table below. The resulting Spectral Response Acceleration Parameters and calculated Design Spectral Acceleration Parameters were determined. These parameters are summarized in Table 6.

Table 6 – Spectral Response Acceleration Parameters

Mapped Acceleration Parameters	Site Coefficients	Spectral Response Acceleration Parameters	Design Spectral Acceleration Parameters
S_s=0.222 g	F_a=1.6	S_{MS}=0.355g	S_{DS}=0.236g
S_1=0.091 g	F_v=2.4	S_{M1}=0.218 g	S_{D1}=0.146g

The design values in this table are appropriate for Risk Categories I-IV.

A site class determination based on the average N values is necessarily conservative. United Consulting's Geophysical team would be happy to provide a site-specific geophysical study to acquire soil shear wave velocity data to more precisely determine the seismic site classification, and possibly raise the Site Class to Site Class C, if your Structural Engineer believes it could help save design and construction costs.

8.10 Hydrocarbon and VOC Testing

Boring B5 was located adjoining to a former gasoline station. Prior to initiating the boring, the two split spoons were cleaned utilizing an Alconox solution. Based on the proximity of this location near the former gasoline station, soils were screened with an organic vapor monitor (OVM) at this boring. Soils were screened at approximate two-foot intervals by placing approximately 4 ounces of soil into a Zip Lock® type bag to allow for the collection of organic vapors, and placing the probe of the OVM into the space between the soil sample and the closure.

The OVM did not detect organic vapors within the soils screened. As the soil excavation is for utility pipe, the area of disturbance is anticipated to generally include from the surface to approximately six feet in depth. Based on this assumption, a soil sample was collected at a depth of three to five feet below the surface and analyzed for volatile organic compounds (VOCs) by EPA testing method 8260D, total petroleum hydrocarbons (TPH) gasoline range organics (GRO) by EPA testing method 8015C, and TPH diesel range organics (DRO) by EPA testing method 8015C. A deeper soil sample was collected at a depth of 13 to 15 feet and placed on hold. Soils from the three to five-foot sample were below the laboratory reporting limits for the constituents analyzed. As there were no detections within the shallow

soil sample, the deeper sample was not analyzed. Chain of Custody was used to maintain control of the samples and the associated containers and tests

.

A quality control sample was used during the investigation. This QC sample was a trip blank which consisted of vials of HPLC water prepared in the laboratory. The samples were transferred with the containers and the samples through the entire trip from the laboratory, to the field, and back to the laboratory. The QC samples were submitted for analytical testing of VOCs by United States EPA testing method 8260D. No VOC constituents were detected in the samples. In addition, the laboratory utilizes internal quality control measures during sample analysis. This is reported as surrogates (surr.) on the sample analysis report. These surrogate results are part of the quality control process and do not indicate the presence of constituents in the soil samples obtained from the project site boring.

Based on the laboratory results, impacts from the former gasoline station were not identified within the soil sample tested from Boring B5 at this time.

9.0 LIMITATIONS

This report is for the exclusive use of **Forsyth County, Freese and Nichols, Inc.,** and the designers of the project described herein, and may only be applied to this specific project. Our conclusions and recommendations have been prepared using generally accepted standards of Geotechnical Engineering practice in the State of Georgia. No other warranty is expressed or implied. Our firm is not responsible for conclusions, opinions or recommendations of others.

The right to rely upon this report and the data within may not be assigned without UNITED CONSULTING'S written permission.

The scope of this evaluation was limited to an evaluation of the load-carrying capabilities and stability of the subsoils. Oil, hazardous waste, radioactivity, irritants, pollutants, molds, or other dangerous substance and conditions were not the subject of this study. Their presence and/or absence are not implied or suggested by this report, and should not be inferred.

Our conclusions and recommendations are based upon design information furnished to us, data obtained from the previously described exploration and testing program and our past experience. They do not reflect variations in subsurface conditions that may exist intermediate of our borings, and in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our conclusions and recommendations based upon "on-site" observations of the conditions.

If the design or location of the project is changed, the preliminary recommendations contained herein must be considered invalid, unless our firm reviews the changes and our recommendations are either verified or modified in writing. When design is complete, we should be given the opportunity to review the foundation plan, grading plan, and applicable portions of the specifications to confirm that they are consistent with the intent of our recommendations.

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APPENDIX

General Notes/Narrative of Drilling Operations
Figure 1 – Boring Location Plan (6)
Browns Bridge Road Cross Section
Keith Bridge Road Cross Section
Martin Road Cross Section
Exploration Procedures
Laboratory Procedures
SPT Boring Logs (21)
Liquid and Plastic Test Report (1)
Grain Size Distribution Curves (1)
Triaxial Shear Test Report (4)
Soil Corrosion Series (1)

GENERAL NOTES

The soil classifications noted on the Boring Logs are visual classifications unless otherwise noted. Minor constituents of a soil sample are termed as follows:

Trace	0 - 10%
Some	11 - 35%
Suffix "y" or "ey"	36 - 49%

LEGEND

Split Spoon Sample obtained during Standard Penetration Testing

Relatively Undisturbed Shelby Tube Sample

Groundwater Level at Time of Boring Completion

Groundwater Level at 24 hours (or as noted) after Termination of Boring

w	Natural Moisture Content	
LL	Liquid Limit	
PL	Plastic Limit	Atterberg Limits
PI	Plasticity Index	
PF	Percent Fines (Percent Passing #200 Sieve)	
γ_d	Dry Unit Weight (Pounds per Cubic Foot or PCF	
γ_m	Moist or In-Situ Unit Weight (PCF)	
γ_{sat}	Saturated Unit Weight (PCF)	

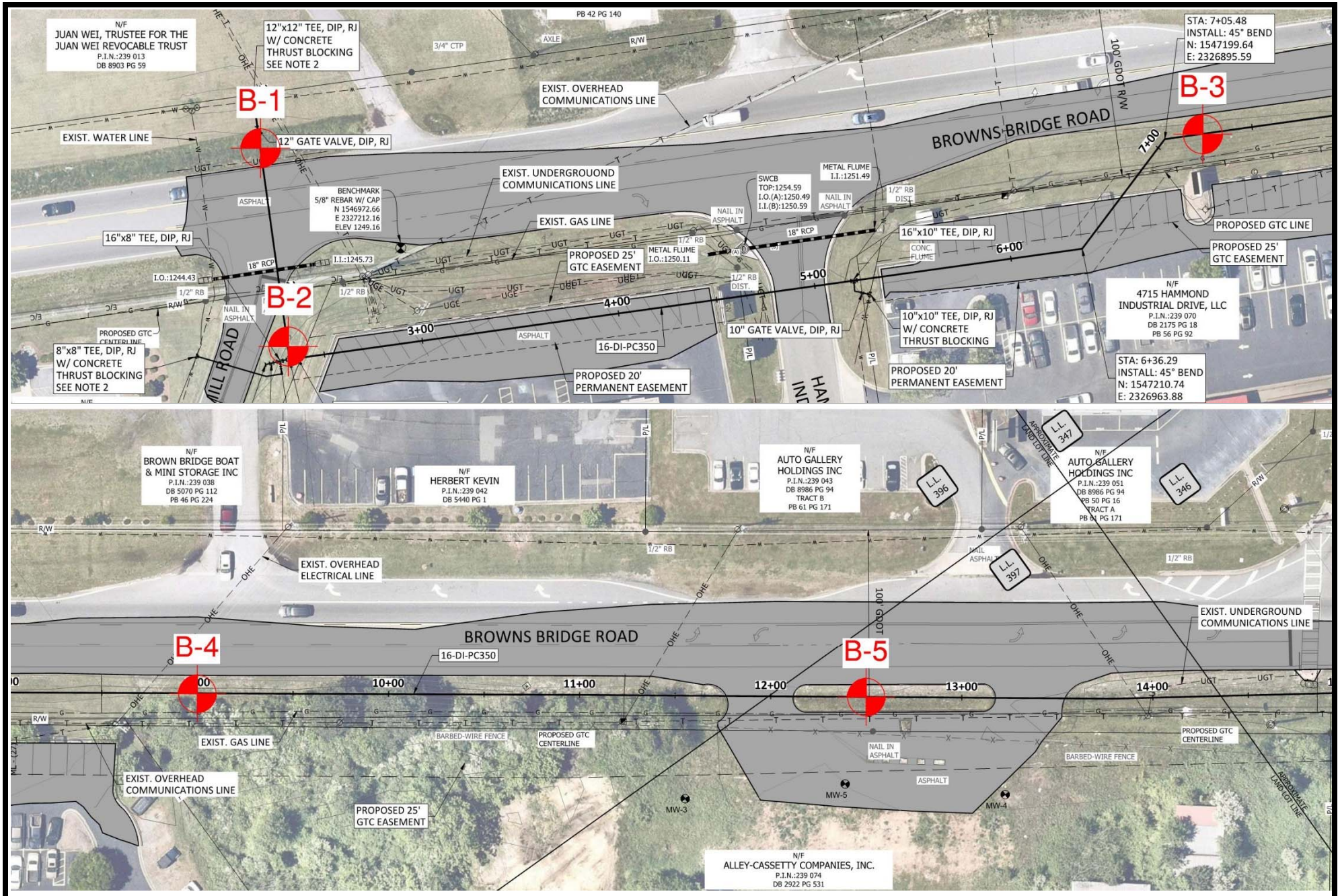
BORING LOG DATA NARRATIVE OF DRILLING OPERATION

The test borings were made by mechanically advancing helical hollow stem augers into the ground. Samples were collected at regular intervals in each of the borings following established procedures for performing the Standard Penetration Test in accordance with ASTM Specification D 1586. Soil samples were obtained with a standard 1.4" I.D. x 2.0" O.D. split barrel sampler. The sampler is first seated 6" to penetrate any loose cuttings and then driven an additional foot with the blows required of a 140-pound hammer freely falling a distance of 30 inches. The number of blows required to drive the sampler the final foot is designated the "standard penetration resistance." The driving resistance, known as the "N" value, can be correlated with the relative density of granular soils and the consistency of cohesive deposits.

The following table describes soil consistency and relative densities based on standard penetration resistance values (N) determined by the Standard Penetration Test (SPT).

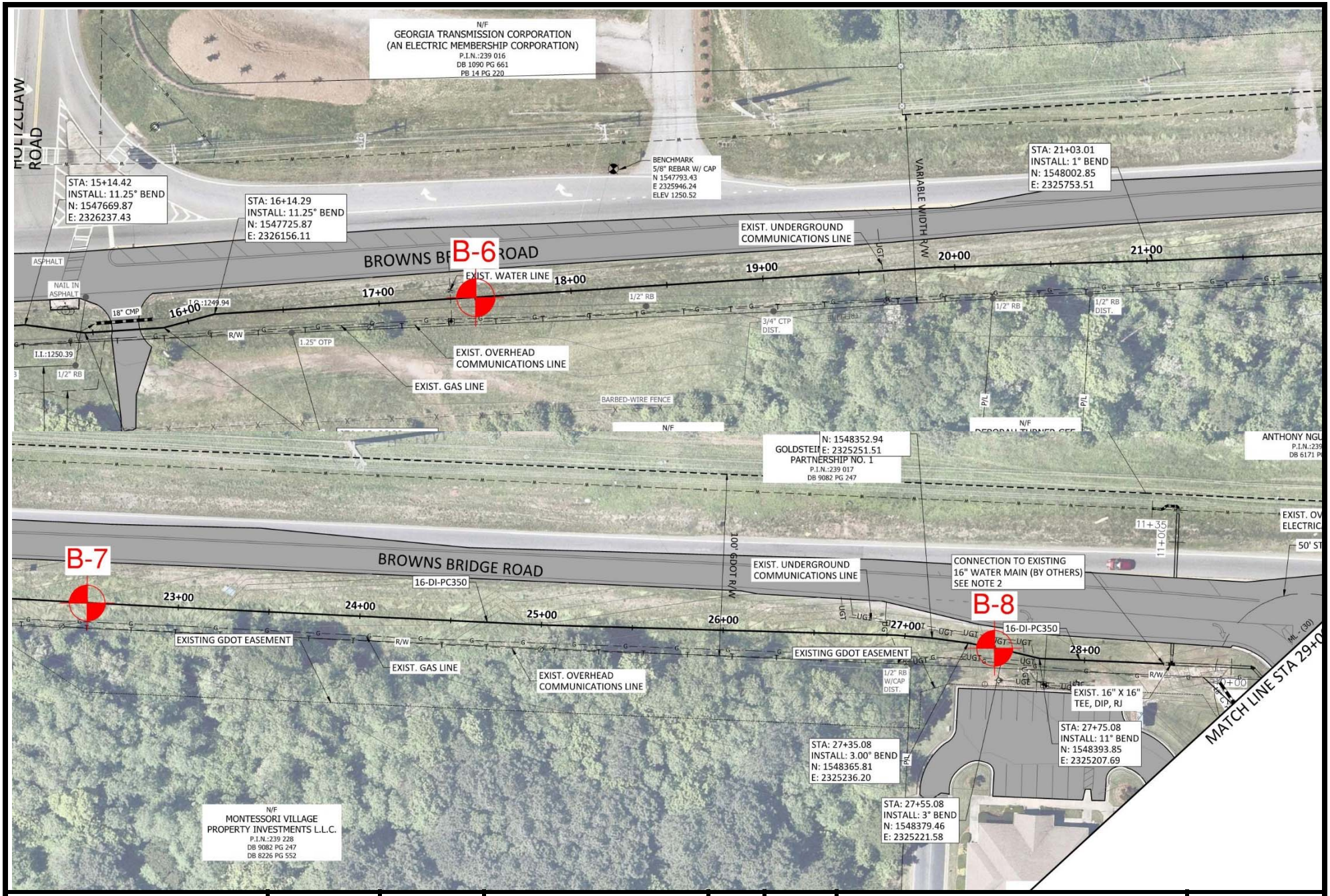
	"N"	Consistency
Clay and Silt	0-2	Very Soft
	3-4	Soft
	5-8	Firm
	9-15	Stiff
	16-30	Very Stiff
	Over 31	Hard

	"N"	Relative Density
Sand	0-4	Very Loose
	5-10	Loose
	11-19	Firm
	20-29	Medium Dense
	30-49	Dense
	50+	Very Dense



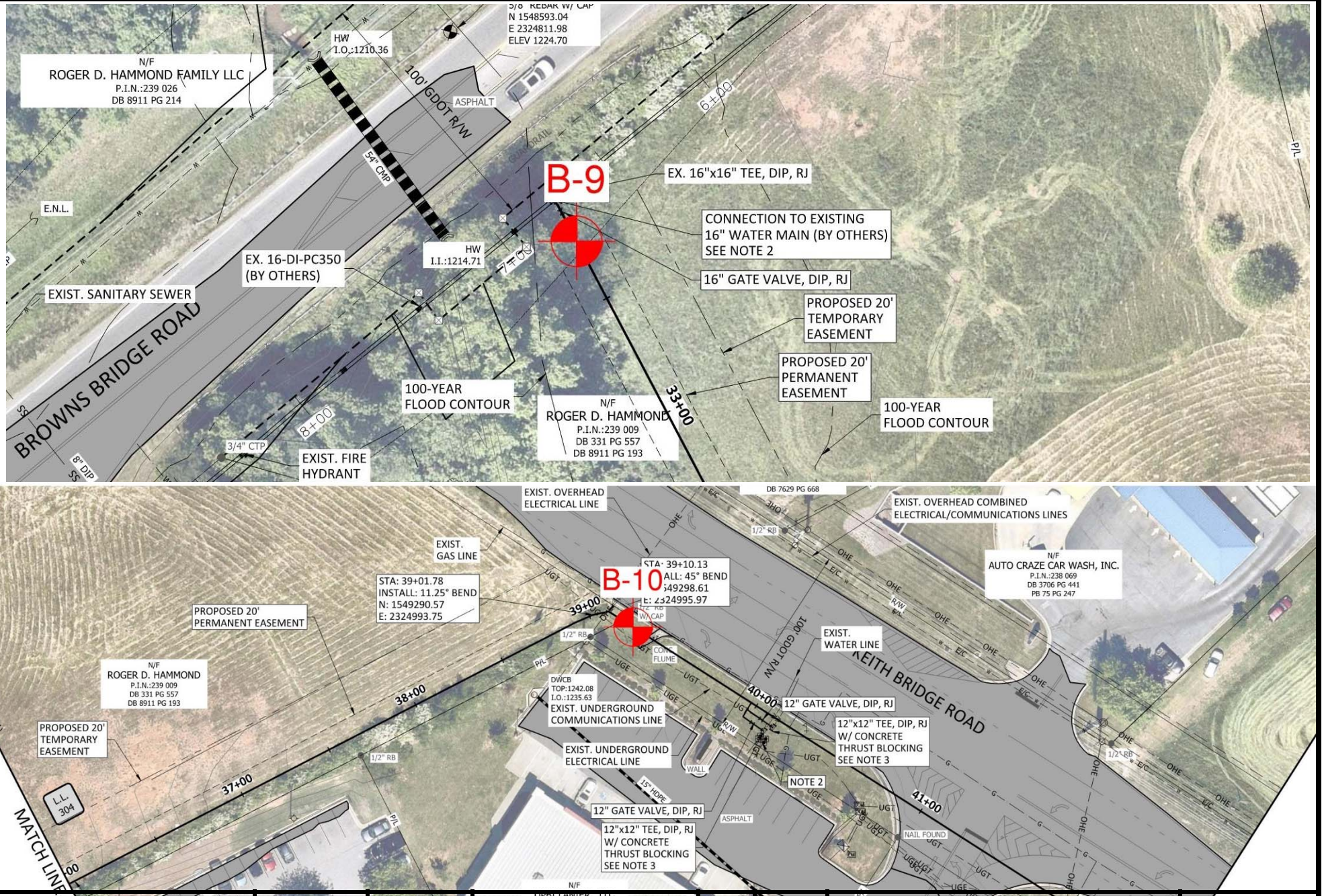
UNITED CONSULTING	Scale:	NTS	Notes	**Client:**	**Forsyth County Procurement**
	Prepared:	SRT		**Site:**	**Hammonds Crossing – 16" Water Main Browns Bridge Road Cumming, Forsyth County, Georgia**
	Checked:	TAT			
	Project No.:	FORPD-20-GA-04563-01		**Title:**	**Boring Location Plan**

FIG. 1
Page 1

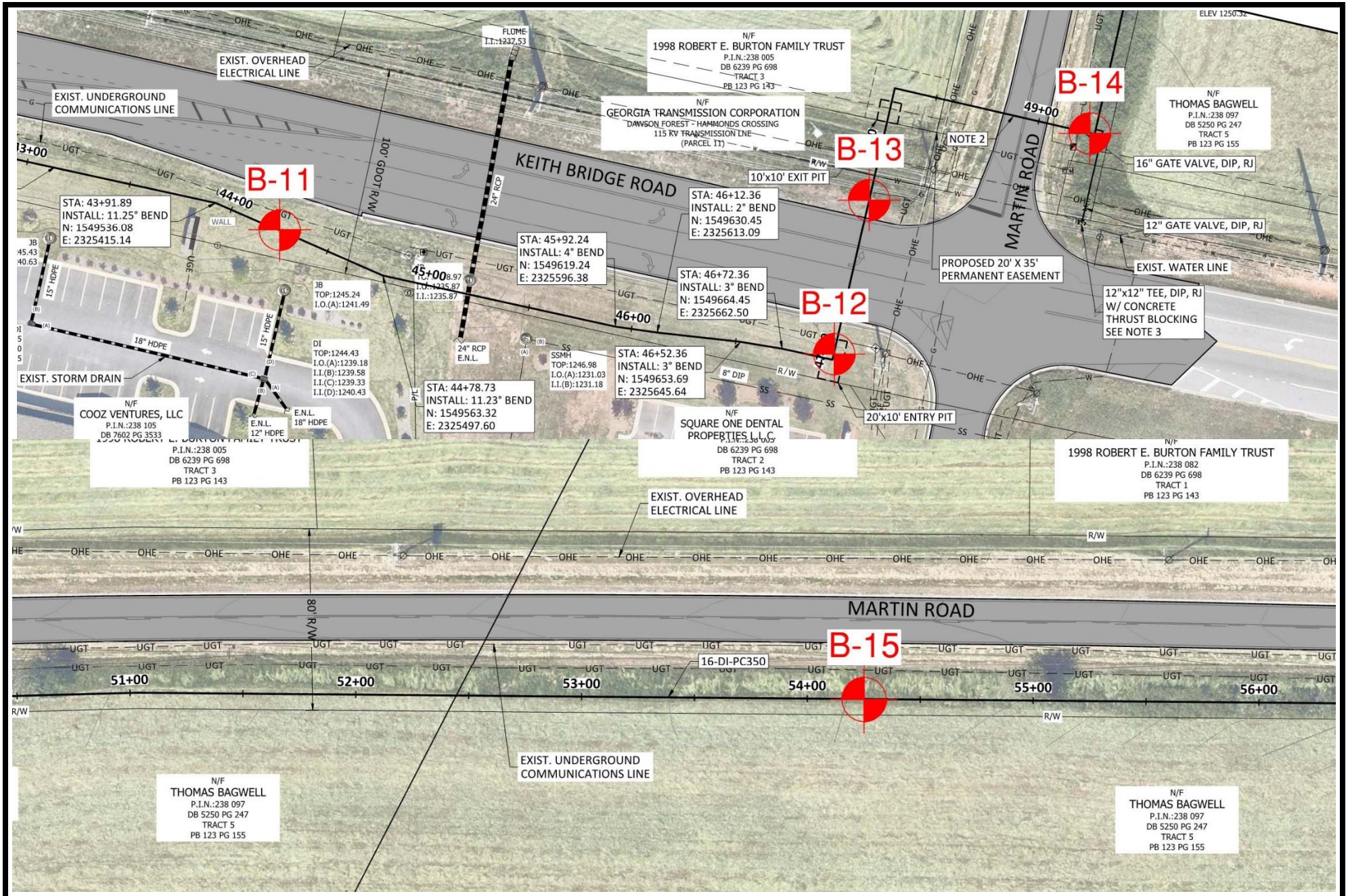


We're here for you UNITED CONSULTING		Scale:	NTS	Notes	**Client:** Forsyth County Procurement
		Prepared:	SRT		**Site:** Hammonds Crossing – 16" Water Main Browns Bridge Road Cumming, Forsyth County, Georgia
		Checked:	TAT		
		Project No.:	FORPD-20-GA-04563-01		**Title:** Boring Location Plan

FIG. 1
Page 2

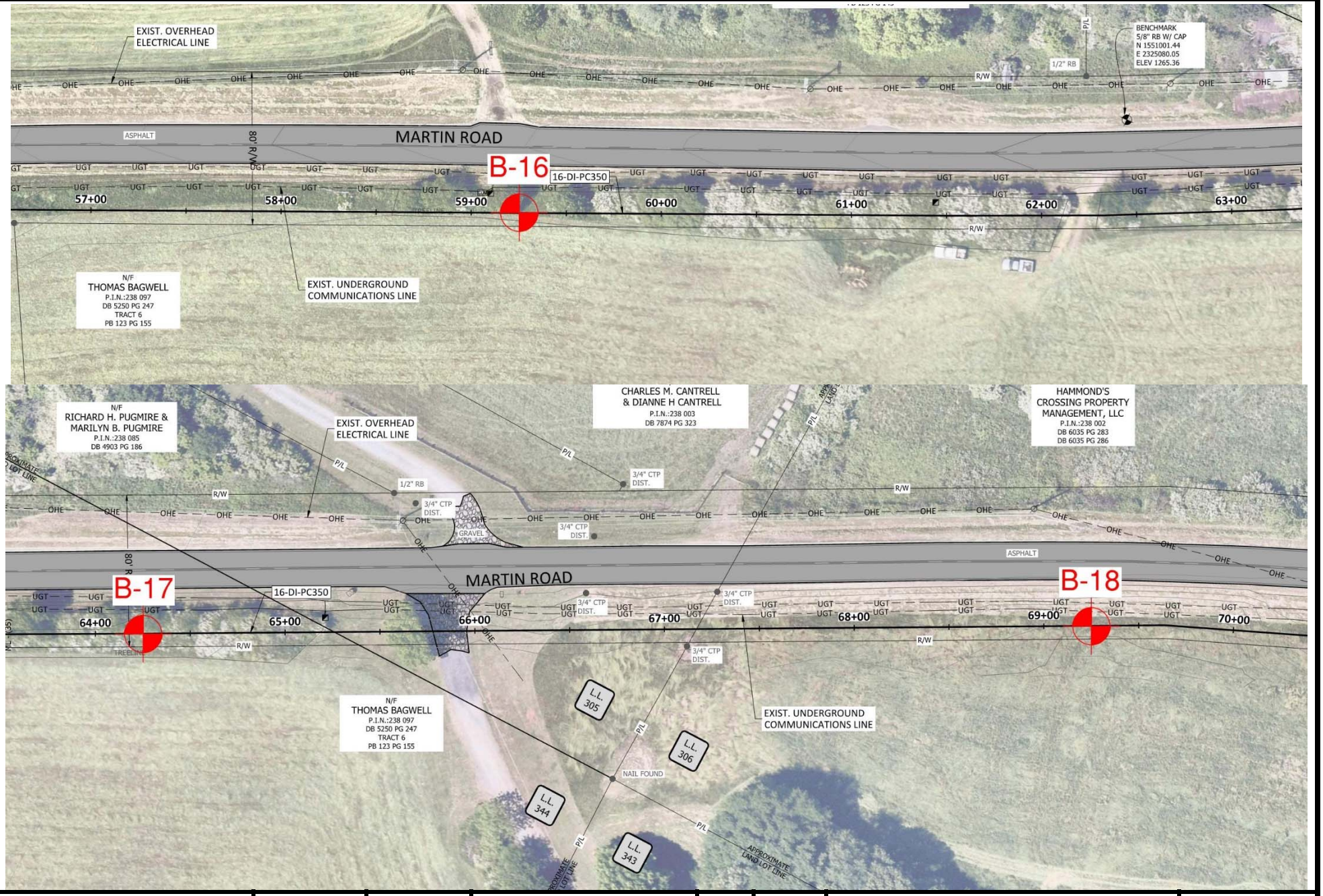


We're here for you UNITED CONSULTING		Scale:	NTS	Notes	**Client:** Forsyth County Procurement
		Prepared:	SRT		**Site:** Hammonds Crossing – 16" Water Main Keith Bridge Road & Browns Bridge Road Cumming, Forsyth County, Georgia
		Checked:	TAT		**Title:** Boring Location Plan
		Project No.:	FORPD-20-GA-04563-01		**FIG. 1** **Page 3**



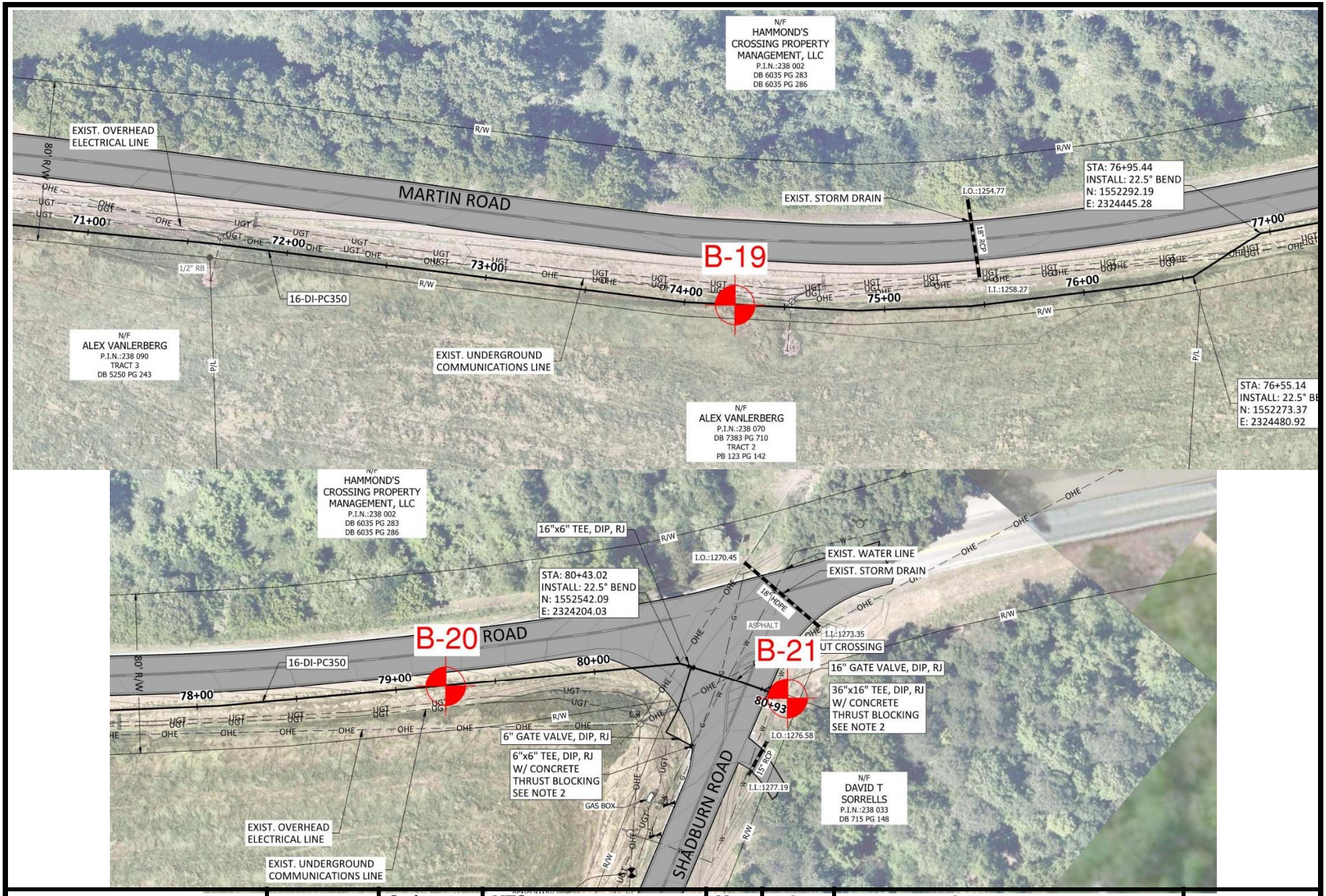
We're here for you UNITED CONSULTING		Scale:	NTS	Notes	**Client:**	**Forsyth County Procurement**
		Prepared:	SRT		**Site:**	**Hammonds Crossing – 16" Water Main Keith Bridge Road & Martin Road Cumming, Forsyth County, Georgia**
		Checked:	TAT			
		Project No.:	FORPD-20-GA-04563-01		**Title:**	**Boring Location Plan**

FIG. 1



We're here for you UNITED CONSULTING	N	Scale:	NTS	Notes	**Client:**	**Forsyth County Procurement**
		Prepared:	SRT		**Site:**	**Hammonds Crossing – 16" Water Main Martin Road Cumming, Forsyth County, Georgia**
		Checked:	TAT			
		Project No.:	FORPD-20-GA-04563-01		**Title:**	**Boring Location Plan**

FIG. 1



We're here for you UNITED CONSULTING		Scale:	NTS	Notes	**Client:**	**Forsyth County Procurement**
		Prepared:	SRT		**Site:**	**Hammonds Crossing – 16" Water Main Martin Road & Shadburn Road Cumming, Forsyth County, Georgia**
		Checked:	TAT			
		Project No.:	FORPD-20-GA-04563-01		**Title:**	**Boring Location Plan**

FIG. 1
Page 6

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SUBSURFACE DIAGRAM
Browns Bridge Road

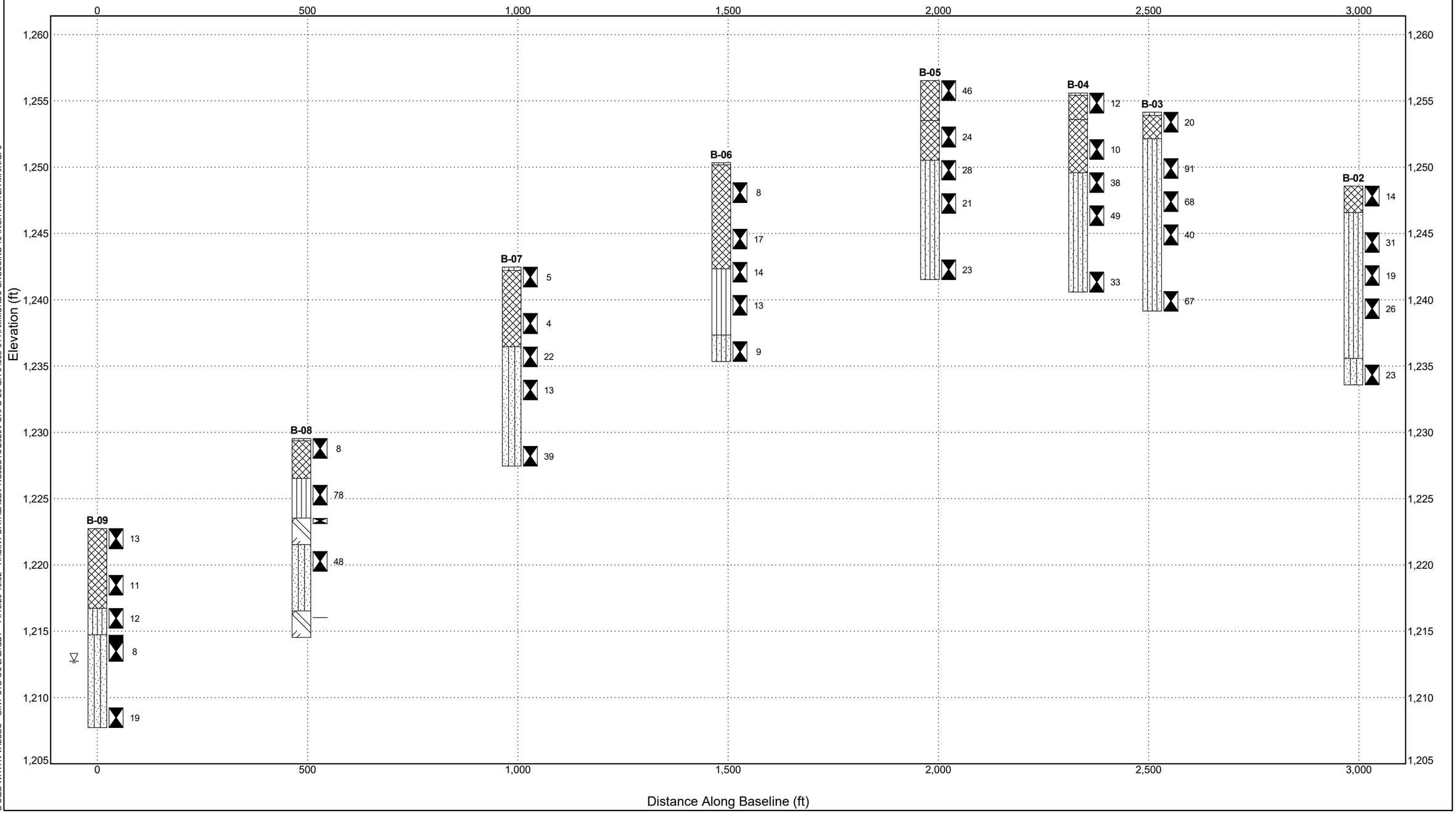
CLIENT Forsyth County Department of Water and Sewer

PROJECT NUMBER FORPD-20-GA-04563-01

PROJECT NAME Hammonds Crossing 16-inch Water Main

PROJECT LOCATION

Fill (made ground) | USCS Sandy Silt | USCS Silty Sand
Topsoil | USCS Silt | Partially Weathered Rock



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SUBSURFACE DIAGRAM
Keith Bridge Road

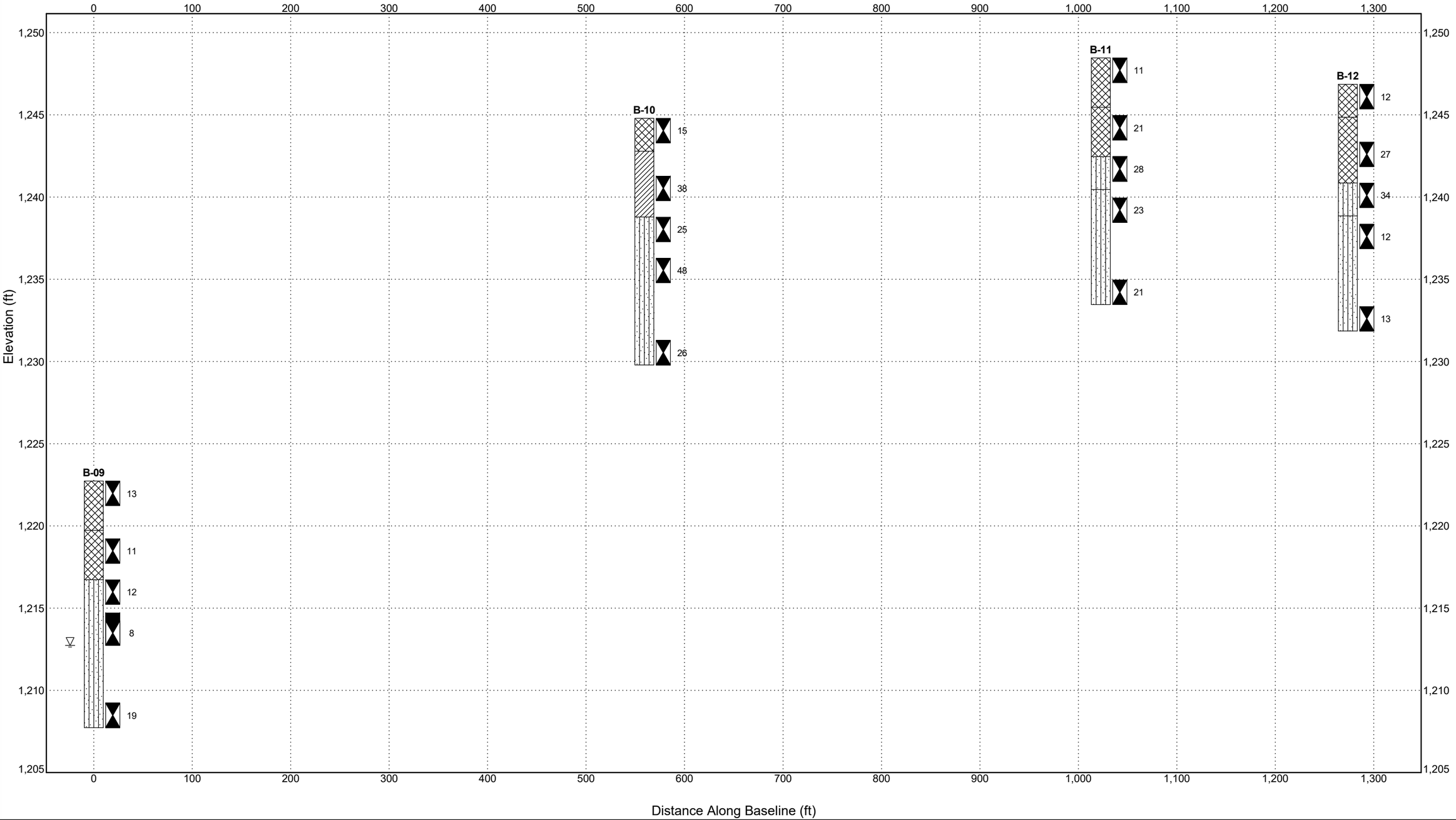
Fill (made ground) | USCS Sandy Silt | USCS Low Plasticity Clay

CLIENT Forsyth County Department of Water and Sewer

PROJECT NAME Hammonds Crossing 16-inch Water Main

PROJECT NUMBER FORPD-20-GA-04563-01

PROJECT LOCATION



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SUBSURFACE DIAGRAM
Martin Road

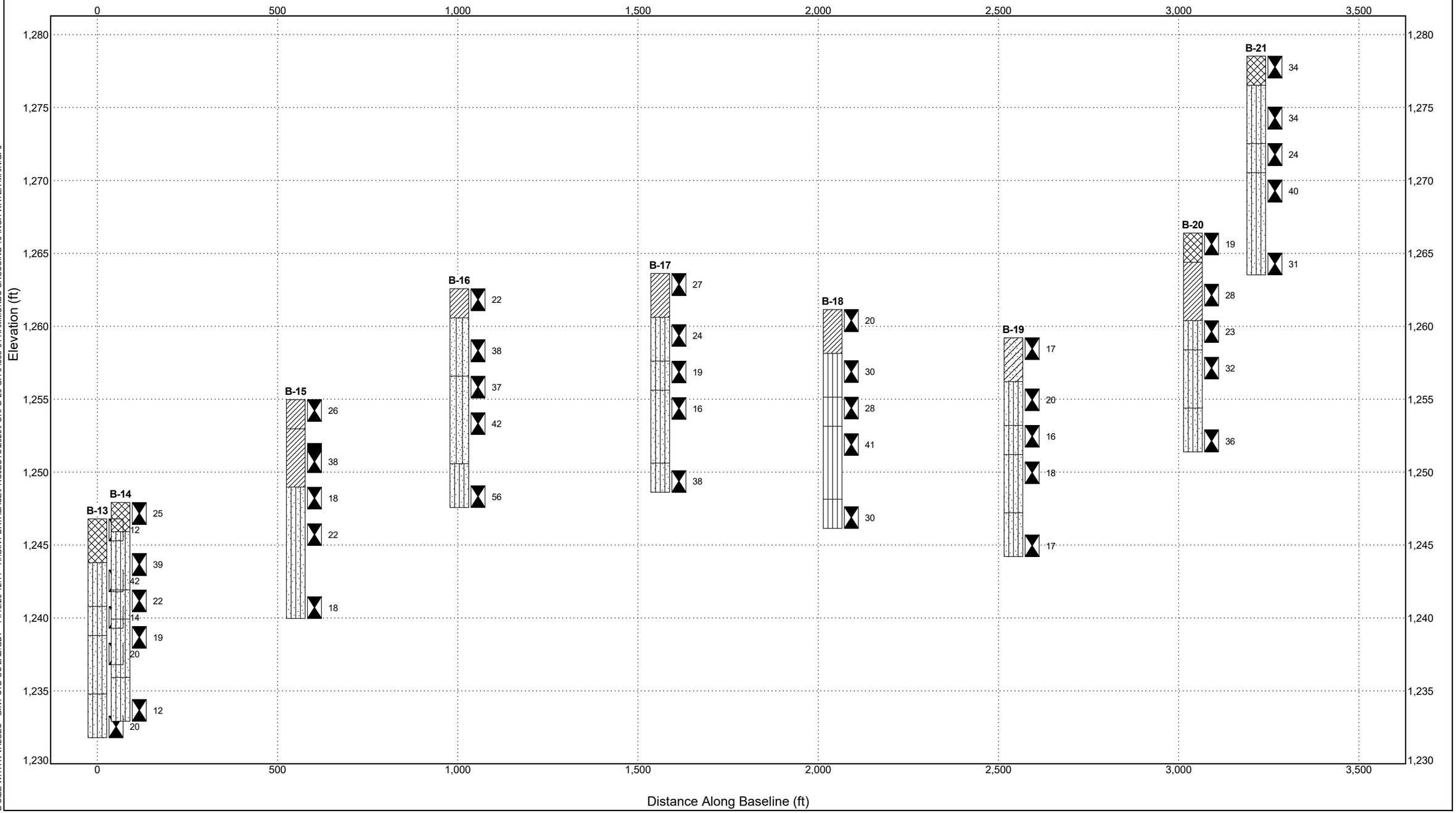
Fill (made ground) | USCS Sandy Silt | USCS Low Plasticity Clay
USCS Silty Sand | USCS Silt | USCS Clayey Sand

CLIENT Forsyth County Department of Water and Sewer

PROJECT NAME Hammonds Crossing 16-inch Water Main

PROJECT NUMBER FORPD-20-GA-04563-01

PROJECT LOCATION



EXPLORATION PROCEDURES

Twenty-one (21) SPT borings (designated B-1 through B-21) were drilled at approximate locations indicated on the attached Boring Location Plan (Figure 1). The SPT borings were performed in general accordance with ASTM D 1586. Soil samples obtained during testing were visually evaluated by the Project Engineer and classified according to the visual-manual procedure described in ASTM D 2488. A narrative of field operations is included in The Appendix.

The test locations in the field were determined by the Project Engineer using a handheld GPS unit. The test locations shown on the Boring Location Plan should, therefore, be considered *approximate*.

LABORATORY PROCEDURES

Grain Size (Sieve) Analysis with or without Hydrometer

Grain Size Analysis tests were performed to determine the particle size distribution of selected samples tested. The grain size distribution of soils coarser than a number 200 sieve was determined by passing the samples through a standard set of nested sieves. Materials finer than the number 200 sieves were suspended in water and the grain size distribution computed from the time rate of settlement of the different size particles. Air-dried soil passed through a #200 sieve. 50 grams of that must soak in s/c agent for a minimum of 8 hours. Soil is then put in graduated cylinder with a hydrometer. Readings are taken at specified times. A graph is drawn from data. These tests were similar to those described by ASTM D 421 and D 422. The results are included in The Appendix.

Liquid and Plastic Limits (Atterberg Limits)

Liquid Limit and Plastic Limit tests aid in the classification of the soils and provide an indication of the soil behavior with moisture change. The Plasticity Index is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The Liquid Limit is the moisture content at which the soil will flow as a heavy viscous fluid and is the upper limit of the plastic range, as determined in accordance with ASTM D 4318. The Plastic Limit is the moisture content at which the soil begins to lose its plasticity, as determined in accordance with ASTM D 4318. The Plasticity Index is the difference between the Liquid Limit and Plastic Limit. The Liquidity Index is the ratio of the difference between the in-place moisture and the plastic limit to the Plasticity Limit. The data obtained are in The Appendix.

Moisture Content

The moisture content was determined for selected soil samples obtained in the split spoon sampler. A representative portion of each sample was weighed and then placed in an oven and dried at 110 degrees Centigrade for at least 15 to 16 hours. After removal from the oven, the soil was again weighed. The weight of the moisture lost during drying thus was determined. From this data, the moisture content of the sample was then calculated as the weight of moisture divided by dry weight of the soil, expressed as a percentage. This test was conducted according to ASTM D 2216. The moisture content results are indicated on the attached boring logs.

Moisture content is a useful index of a soil's compressibility. If the soil is to be used as fill, the moisture content may be compared to the range of water content for which proper compaction may be achieved.

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BORING NUMBER B-01

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1245.88 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1246		Topsoil 3"										
		Sand--some silt and clay, trace rock fragments, roots; firm; brown (Fill)	SPT 1	44	4-7-9 (16)							
		Silt--some sand, trace clay, rock fragments; stiff; yellow (residual)										
1241			SPT 2	78	6-8-9 (17)							
		--sandy, trace mica, very stiff, red-brown	SPT 3	78	5-8-11 (19)							
1236		--some sand, trace gravel	SPT 4	89	9-10-8 (18)							
1231		--orange-brown	SPT 5	89	5-8-10 (18)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-02

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1248.58 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1249		Silt--some clay and sand, trace gravel, roots; stiff; brown (Fill)	SPT 1	33	5-8-6 (14)							
		Silt--sandy, trace clay, rock fragments, mica; very stiff; mottled (Residual)										
1244			SPT 2	44	7-15-16 (31)							
			SPT 3	89	5-9-10 (19)							
1239			SPT 4	78	6-13-13 (26)							
		Sand-silty, trace rock fragments and mica; medium dense; gray-brown										
1234			SPT 5	100	6-12-11 (23)							

Refusal at 15.0 feet.
Boring terminated at 15.0 feet.

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BORING NUMBER B-03

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1254.15 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1254		Topsoil 3"										
		Sand--silty, trace clay, roots, mica; medium dense; brown (Fill)	SPT 1	67	7-11-9 (20)							
		Silt--sandy, trace clay, rock fragments, mica; very hard; brown to white (Residual)										
1249			SPT 2	89	16-41-50 (91)							
		--brown	SPT 3	89	20-32-36 (68)							
1244		--hard	SPT 4	100	16-18-22 (40)							
1239		--very hard	SPT 5	89	17-22-45 (67)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-04

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1255.59 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1256		2" topsoil										
		Sand--silty, trace clay, rock fragments, roots; firm; brown (Fill)	SPT 1	33	8-6-6 (12)							
		Clay--sandy-silty, trace rock fragments; stiff; brown										
			SPT 2	56	4-4-6 (10)							
1251												
		Silt--sandy, trace clay, rock fragments, mica; very stiff; brown (Residual)	SPT 3	67	11-18-20 (38)							
			SPT 4	56	15-22-27 (49)							
1246												
			SPT 5	78	17-11-22 (33)							
1241												

Boring terminated at 15.0 feet.

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BORING NUMBER B-05

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1256.53 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1257		Sand--some clay, silt and gravel, trace roots, rock fragments; dense; brown (Fill)	SPT 1	56	14-21-25 (46)							
		--clayey; medium dense	SPT 2	89	10-11-13 (24)							
1252		Silt--sandy, trace clay, rock fragments, mica; very stiff; brown (Residual)	SPT 3	100	9-13-15 (28)							
			SPT 4	78	8-10-11 (21)							
1247												
1242			SPT 5	100	9-11-12 (23)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-06

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1250.34 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1250		Topsoil										
		Silt--sandy, trace clay, rock fragments, mica; firm; brown (Fill)	SPT 1	44	4-4-4 (8)							
		--clayey; very stiff										
1245			SPT 2	56	6-8-9 (17)							
		--stiff										
		Silt--clayey, trace sand, rock fragments; stiff; mottled (Residual)	SPT 3	44	5-7-7 (14)							
1240			SPT 4	67	4-5-8 (13)							
		Silt-sandy, trace rock fragments; stiff; mottled										
1235			SPT 5	56	3-4-5 (9)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-07

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1242.46 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1242		Topsoil 3"										
		Clay--sandy, some silt, trace roots, rock fragments; firm; brown (Fill)	SPT 1	50	7-3-2 (5)							
1237		--soft	SPT 2	33	2-2-2 (4)							
		Sand--some silt, trace clay, rock fragments, mica; medium dense; dark brown, tan (Residual) (SM)	SPT 3	78	8-10-12 (22)			15				pH=5.46, Resisitivity 73,000
1232		--firm; brown	SPT 4	67	7-7-6 (13)							
1227		--silty; dense	SPT 5	44	17-18-21 (39)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-08

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/11/2020 **DATE COMPLETED** 9/11/2020
GROUND ELEVATION 1229.53 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1230		Topsoil 2"										
		Clay--sandy, some silt, trace rock fragments, gravel, roots; firm; brown (Fill)	SPT 1	67	7-5-3 (8)							
		Silt--sandy, trace clay, mica, rock fragments; very hard; brown (Residual)	SPT 2	67	27-37-41 (78)							
1225		Partially Weathered Rock - sampled as Sand-silty, trace rock fragments; very dense; brown	SPT 3	80	50/5"							
		Sand--silty, trace clay, rock fragments, gravel, mica; very dense; brown	SPT 4	67	13-18-30 (48)							
1220												
		Partially Weathered Rock - sampled as Sand-silty, trace rock fragments; very dense; brown	SPT 5	0	50/0"							Difficult at 13
1215												

Boring terminated at 15.0 feet.

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BORING NUMBER B-09

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1222.73 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
▽ **AT TIME OF DRILLING** 10.00 ft / Elev 1212.73 ft
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1223		Clay--some silt and sand, trace rock fragments, roots; stiff; brown (Fill)	SPT 1	33	4-5-8 (13)							
1218		Silt--sandy, some clay, trace rock fragments, mica; stiff; tan	SPT 2	44	10-6-5 (11)							
		Silt--sandy, trace clay, mica, rock fragments; stiff; mottled (Residual)	SPT 3	67	5-6-6 (12)							
1213		▽ Sand, some silt, trace clay; firm; tan (SM)	ST 4 / SPT 5	33	4-4-4 (8)			42				pH=5.43, Resisitivity 30,000
1208		-firm; brown	SPT 6	78	5-5-14 (19)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-10

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1244.79 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1245		Silt--some clay and sand, trace rock fragments, roots; very stiff; brown (Fill)	SPT 1	33	6-7-8 (15)							
		Clay--silty-sandy, trace rock fragments; hard; tan-brown (Residual)										
1240			SPT 2	100	6-13-25 (38)							
		Silt--clayey, trace sand, rock fragments, mica; very stiff; mottled	SPT 3	78	6-8-17 (25)							
1235		--sandy, some clay; hard	SPT 4	78	20-22-26 (48)							
1230		--trace clay; very stiff	SPT 5	78	9-12-14 (26)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-11

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1248.46 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1248		Silt--sandy, trace clay, mica, organics, rock fragments; stiff; brown (Fill)	SPT 1	56	5-5-6 (11)							
1243		Clay--some silt and sand, trace rock fragments, organics; very stiff; tan	SPT 2	56	9-10-11 (21)							
		Silt--clayey, trace sand, rock fragments; very stiff; red-tan (Residual)	SPT 4	78	8-12-16 (28)							UD at 6'-8'
1238		--trace mica	SPT 5	89	8-10-13 (23)							
1233		--some sand, trace clay; tan	SPT 6	44	8-10-11 (21)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-12

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1246.86 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1247		Sand--silty, trace clay, mica, roots; firm; brown (Fill)	SPT 1	44	5-5-7 (12)							
		Clay--silty, some sand, trace mica, rock fragments; very stiff; brown										
1242			SPT 2	67	9-10-17 (27)							
		Silt--sandy, trace clay, rock fragments, mica; very stiff; tan (Residual)	SPT 3	78	11-16-18 (34)							
1237		--some gravel, trace sand and clay; stiff; tan	SPT 4	89	5-5-7 (12)							
1232			SPT 5	78	5-6-7 (13)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-13

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1246.79 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1247		Clay--some gravel and silt, trace sand, asphalt; stiff; red-brown (Fill)	SPT 1	33	9-5-7 (12)							
1242		Silt--clayey, trace sand, rock fragments; hard; red-tan (Residual)	SPT 2	78	12-17-25 (42)							
		--some gravel, trace clay; stiff	SPT 3	89	5-6-8 (14)							
1237		--trace mica; very stiff	SPT 4	89	7-9-11 (20)							
1232		--some sand	SPT 5		6-8-12 (20)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-14

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1247.92 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1248		Clay--sandy, some silt, trace roots, rock fragments; very stiff; brown (Fill)	SPT 1	33	12-12-13 (25)							
		Silt--some clay and sand, trace rock fragments; hard; tan-brown (Residual)										
1243			SPT 2	89	12-17-22 (39)							
		--trace clay, mica; very stiff; red-brown	SPT 3	56	7-10-12 (22)							
1238		--white to brown	SPT 4	78	7-8-11 (19)							
1233		--stiff; mottled	SPT 5	100	5-6-6 (12)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-15

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1254.97 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1255		Clay--sandy, some silt, roots, rock fragments; very stiff; brown (Residual)	SPT 1	33	7-11-15 (26)							
		--silty, some sand; hard										
			ST 2 SPT 3	89	11-17-21 (38)							UD at 3'-5'
1250												
		Silt--sandy, some clay, trace rock fragments, mica; very stiff; red-tan	SPT 4	78	8-8-10 (18)							
			SPT 5	89	8-10-12 (22)							
1245												
1240			SPT 6	100	7-8-10 (18)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-16

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/14/2020 **DATE COMPLETED** 9/14/2020
GROUND ELEVATION 1262.58 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1263		Silt-clayey, some sand, trace roots, mica; very stiff; red-brown (Residual) (ML)	SPT 1	44	11-11-11 (22)			18	42	21	21	pH=6.44, Resisitivity 29,000
		Sand--silty, some clay, trace rock fragments, mica; dense; white to red										
1258			SPT 2	78	13-18-20 (38)							
		Sand--some silt, trace clay, rock fragments, mica; dense; white	SPT 3	78	14-17-20 (37)							
1253			SPT 4	89	17-20-22 (42)							
		Silt--sandy, trace clay, rock fragments, mica; very dense; brown										
1248			SPT 5	89	16-24-32 (56)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-17

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1263.62 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1264		Clay--sandy, some silt, trace mica, rock fragments; very stiff; brown (Residual)	SPT 1	44	8-11-16 (27)							
1259		Silt--sandy, some clay, trace mica, rock fragments; very stiff; brown	SPT 2	78	7-11-13 (24)							
		--some gravel; pink-white	SPT 3	78	6-8-11 (19)							
1254		Sand, some silt, trace clay; firm; red brown to brown (SM)	SPT 4	78	7-7-9 (16)			27				pH=4.19, Resisitivity 37,000
1249		-dense; brown	SPT 5	78	15-16-22 (38)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-18

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1261.14 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1261		Clay--sandy, some silt, trace roots, rock fragments; very stiff; brown (Residual)	SPT 1	44	7-9-11 (20)							
		Silt--sandy, trace clay, rock fragments, mica; hard; brown	SPT 2	89	13-14-16 (30)							
1256												
			SPT 3	78	12-13-15 (28)							
		--trace gravel; very stiff										
			SPT 4	78	17-19-22 (41)							
1251		--hard										
1246		--red-brown	SPT 5	78	12-13-17 (30)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-19

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1259.21 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1259		Sand--clayey, some silt, trace roots, rock fragments; firm; brown (Residual)	SPT 1	56	7-10-7 (17)							
1254		Silt--sandy, trace clay, rock fragments, mica; very stiff; brown	SPT 2	100	7-9-11 (20)							
		--some clay and gravel; brown-white	SPT 3	89	6-7-9 (16)							
1249		--trace clay; brown	SPT 4	100	6-8-10 (18)							
1244		--some gravel; pink-white	SPT 5	94	8-8-9 (17)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-20

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1266.39 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1266		Silt--sandy, trace clay, rock fragments, gravel, roots; very stiff; brown (Fill)	SPT 1	44	6-8-11 (19)							pH=4.86, Resisitivity 36,000
1261		Sand, some clay, silt and gravel (rock fragments); medium dense; orange brown (Residual) (SC)	SPT 2	100	8-12-16 (28)			17	48	27	21	pH=4.52, Resisitivity 82,000
		Silt--some clay and sand, trace rock fragments; very stiff, brown	SPT 3	100	8-11-12 (23)							
1256		--hard	SPT 4	100	9-14-18 (32)							
1251		--sandy; red-brown	SPT 5	89	14-16-20 (36)							

Boring terminated at 15.0 feet.

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BORING NUMBER B-21

CLIENT Forsyth County Department of Water and Sewer
PROJECT NAME Hammonds Crossing 16-inch Water Main
PROJECT NUMBER FORPD-20-GA-04563-01
PROJECT LOCATION
DATE STARTED 9/15/2020 **DATE COMPLETED** 9/15/2020
GROUND ELEVATION 1278.53 ft **HOLE SIZE** inches
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
STATION **LOGGED BY** JCH
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

ELEVATION (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	UCS on Rock (psi)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	NOTES
1279		Sand--gravelly, trace silt, clay, rock fragments; dense; brown (Fill)	SPT 1	33	11-16-18 (34)							
		Silt--sandy, trace clay, rock fragments, mica; hard; brown (Residual)										
1274			SPT 2	78	11-15-19 (34)							
		--some clay; very stiff	SPT 3	67	10-11-13 (24)							
1269		--trace clay; hard	SPT 4	89	8-17-23 (40)							
1264			SPT 5	100	11-13-18 (31)							

Boring terminated at 15.0 feet.

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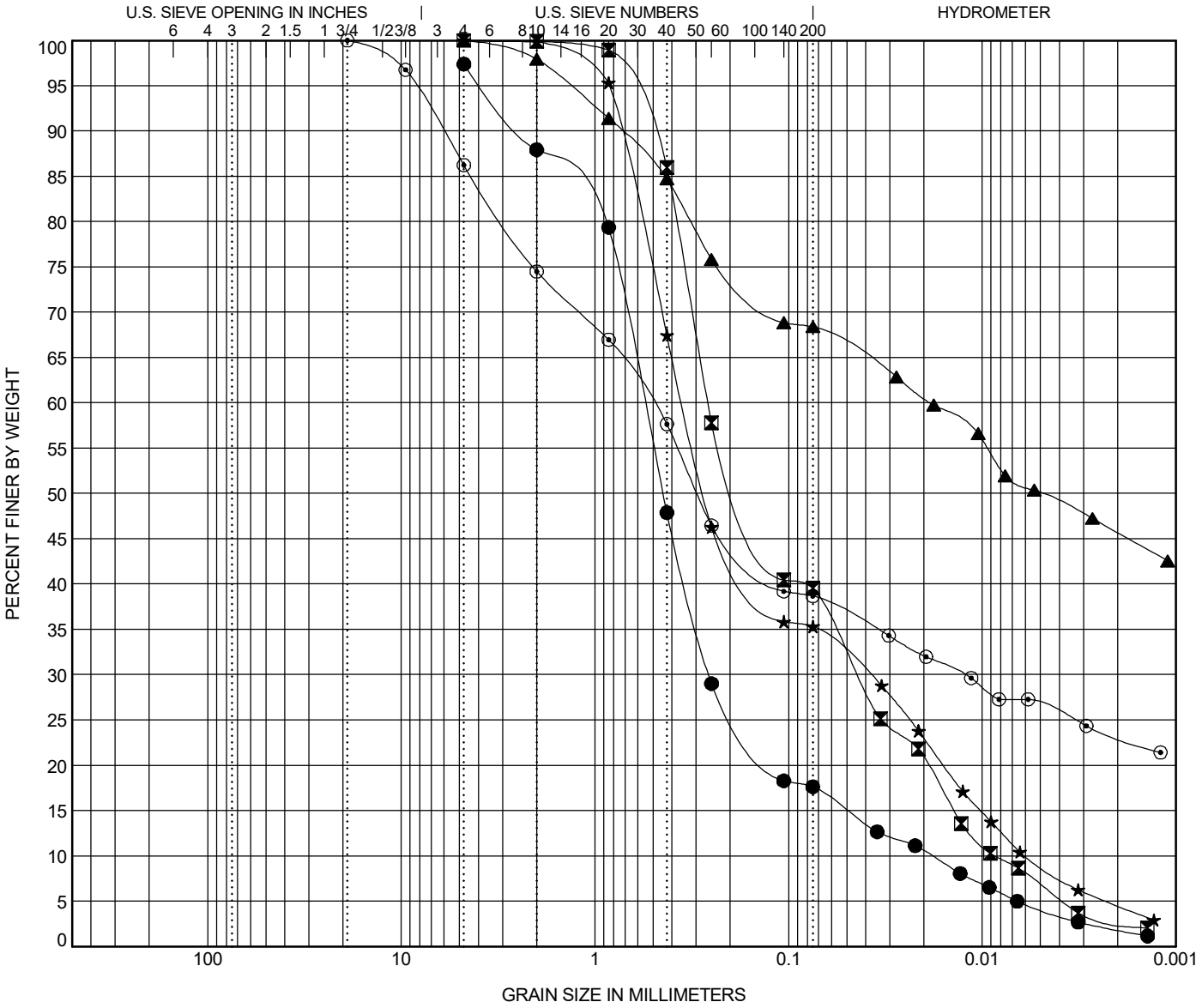
GRAIN SIZE DISTRIBUTION

CLIENT Forsyth County Water and Sewer Administration

PROJECT NAME Hammonds Crossing 16-inch Water Main

PROJECT NUMBER FORPD-20-GA-04563-01

PROJECT LOCATION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
● B-07	7.0	Sand, some silt, trace clay and gravel; brown (SM)				6.51	30.34
⊠ B-09	9.0	Sand, some silt, trace clay, tan (SM)				0.87	30.33
▲ B-16	1.0	Silt-clayey, some sand; red brown (ML)	42	21	21		
★ B-17	9.0	Sand, some silt, trace clay; red brown (SM)				0.71	59.09
⊙ B-20	4.0	Sand, some clay, gravel, and silt; orange brown (SC)	48	27	21		

BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-07	7.0	4.75	0.555	0.257	0.018		79.8	13.5	4.1
⊠ B-09	9.0	4.75	0.261	0.044	0.009	0.0	60.5	32.7	6.8
▲ B-16	1.0	4.75	0.018			0.0	31.6	18.4	50.0
★ B-17	9.0	4.75	0.353	0.039	0.006	0.0	64.7	26.4	8.9
⊙ B-20	4.0	19	0.506	0.012		13.8	47.6	12.0	26.6

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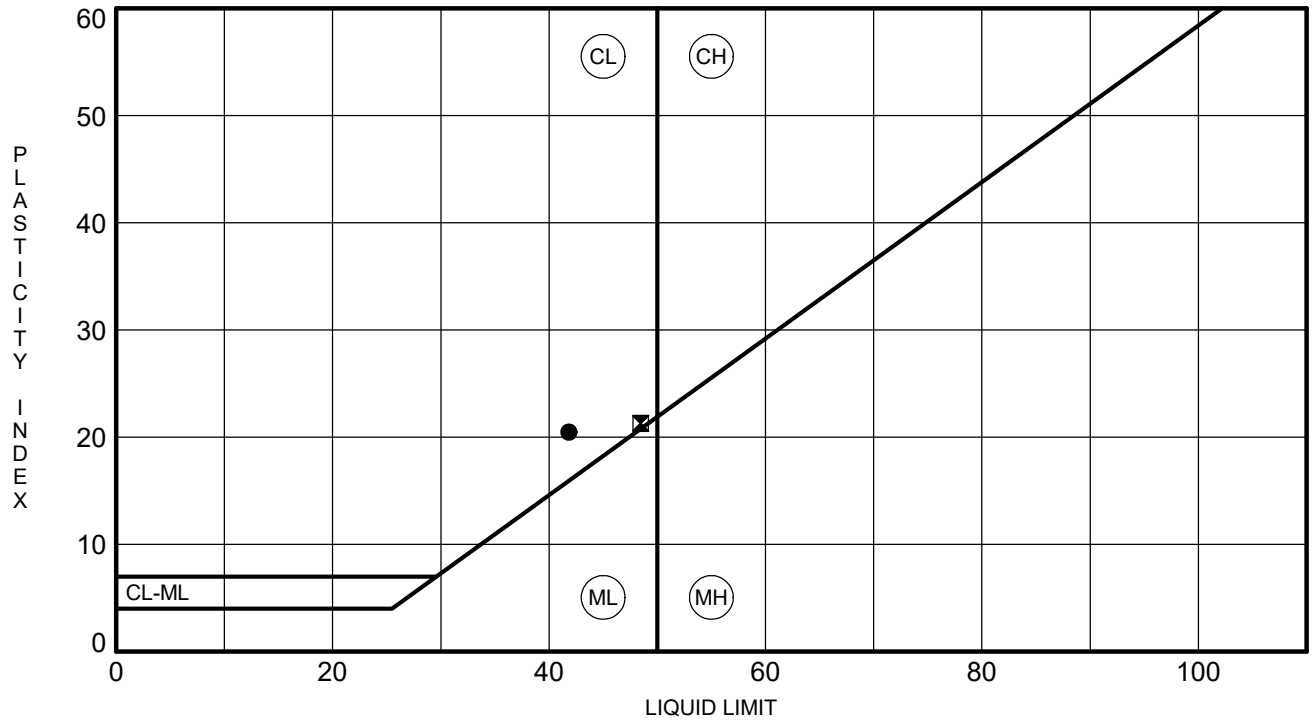
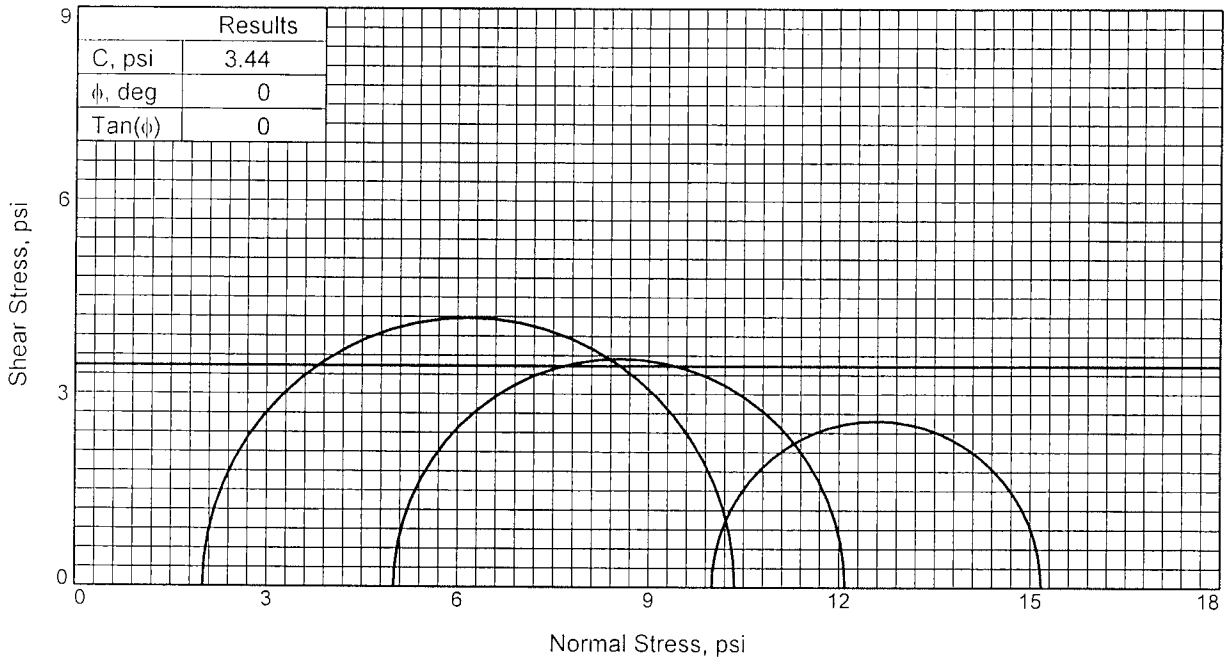
ATTERBERG LIMITS' RESULTS

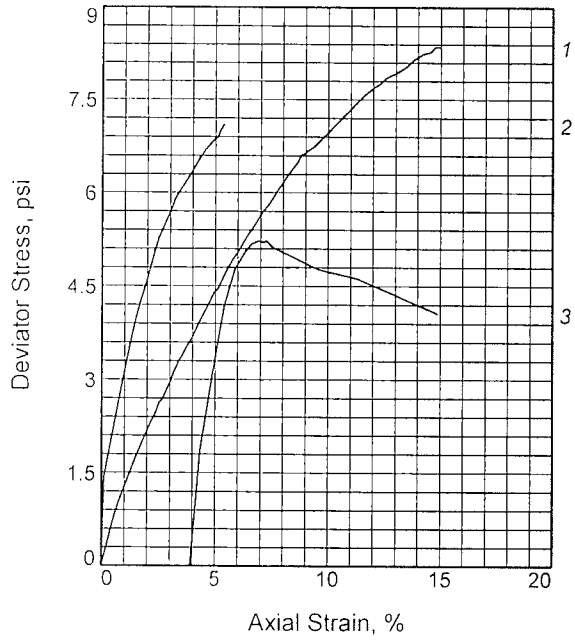
CLIENT Forsyth County Department of Water and Sewer **PROJECT NAME** Hammonds Crossing 16-inch Water Main

PROJECT NUMBER FORPD-20-GA-04563-01 **PROJECT LOCATION**



	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**B-16**	**1.0**	**42**	**21**	**21**	**68**	**Silt-clayey, some sand; red brown (ML)**
⊠	**B-20**	**4.0**	**48**	**27**	**21**	**39**	**Sand, some clay, gravel, and silt; orange brown (SC)**





Sample No.		1	2	3
Initial	Water Content, %	35.0	40.5	41.8
	Dry Density, pcf	84.1	79.0	76.3
	Saturation, %	94.2	96.5	93.3
	Void Ratio	1.0042	1.1338	1.2087
	Diameter, in.	2.87	2.87	2.87
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	37.2	42.0	44.8
	Dry Density, pcf	84.1	79.0	76.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.0042	1.1338	1.2087
	Diameter, in.	2.87	2.87	2.87
	Height, in.	5.60	5.60	5.60
Strain rate, in./min.		0.060	0.060	0.060
Back Pressure, psi		0.0	0.0	0.0
Cell Pressure, psi		2.0	5.0	10.0
Fail. Stress, psi		8.4	7.1	5.2
Ult. Stress, psi		8.4	7.1	4.1
σ_1 Failure, psi		10.4	12.1	15.2
σ_3 Failure, psi		2.0	5.0	10.0

Type of Test:
Unconsolidated Undrained
Sample Type: Undisturbed
Description: Sand, some silt, trace clay, tan

LL= NV **PI=** NP
Specific Gravity= 2.7
Remarks:

Client: Forsyrh Co Procurement Department

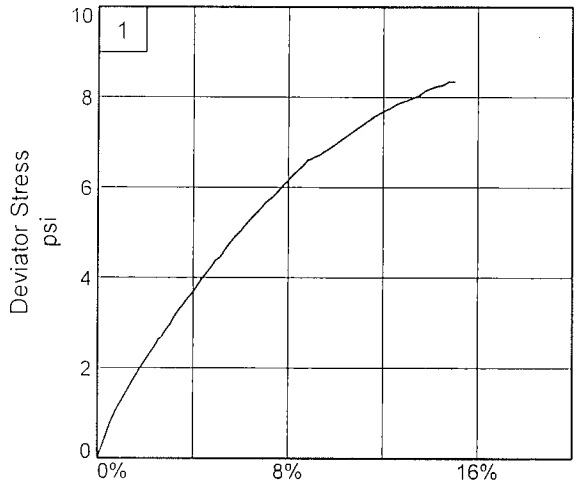
Project: Hammonds Crossing 16 Inch Water Main

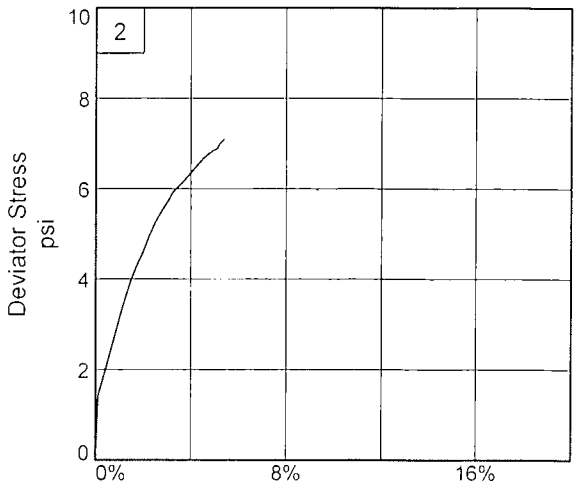
Sample Number: B-9 **Depth:** 8-10 ft

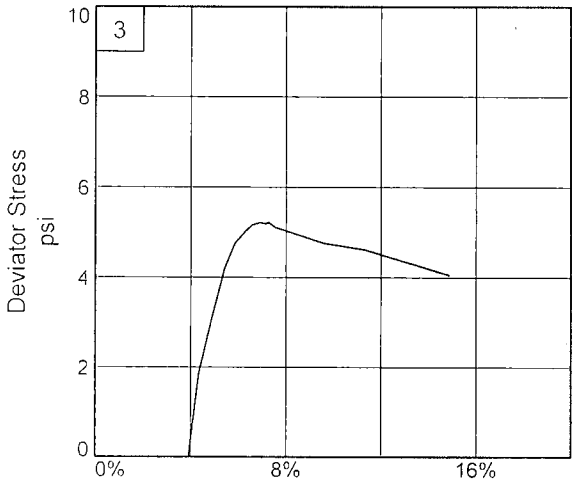
Proj. No.: FORPD20GA0456301 **Date Sampled:** 9/16/2020

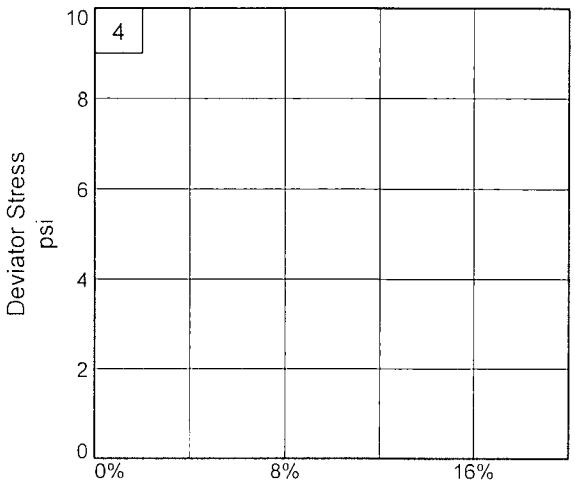
TRIAXIAL SHEAR TEST REPORT
United Consulting
Norcross, Georgia

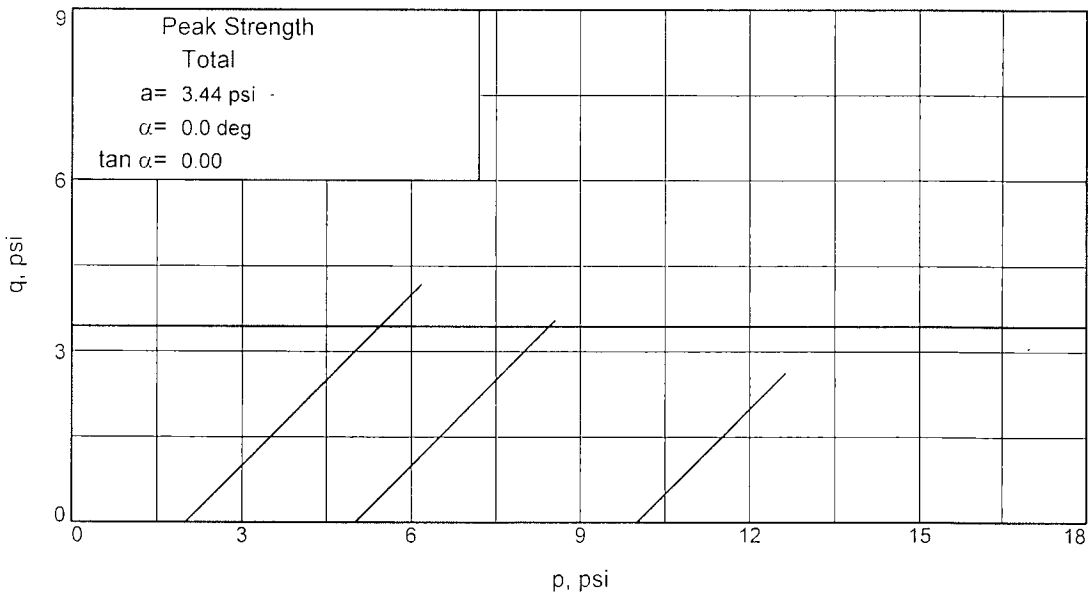
Figure _____





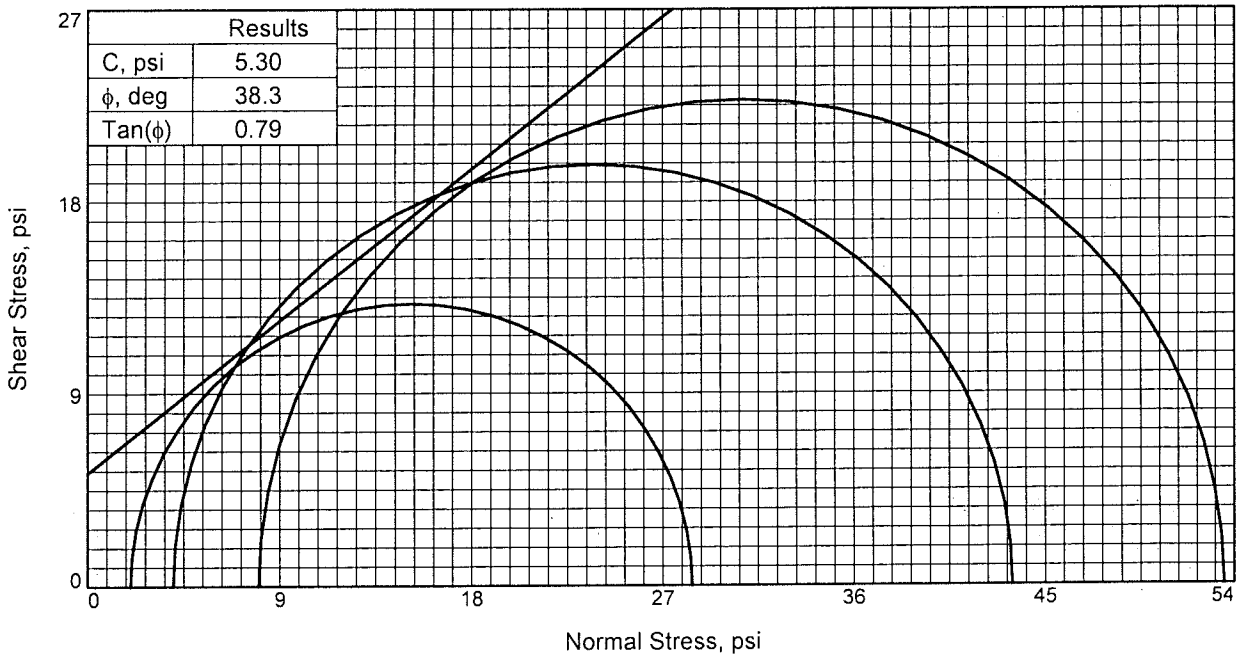


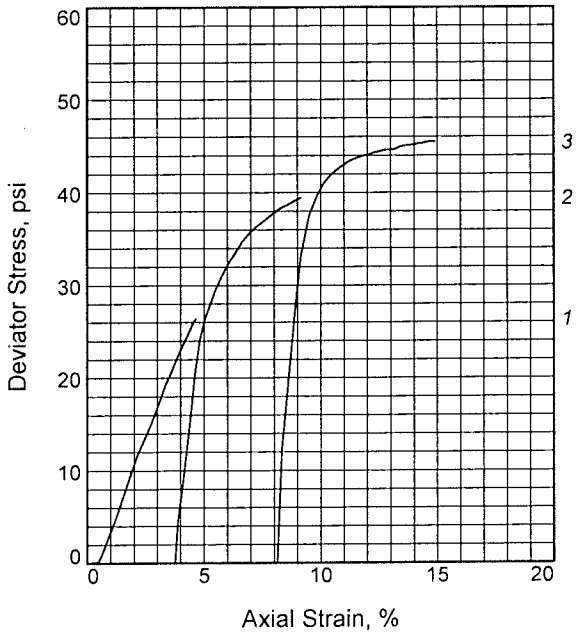




Client: Forsyrh Co Procurement Department
Project: Hammonds Crossing 16 Inch Water Main
Depth: 8-10 ft **Sample Number:** B-9
Project No.: FORPD20GA0456301 **Figure** _____

United Consulting





Sample No.		1	2	3
Initial	Water Content, %	17.8	17.8	17.8
	Dry Density, pcf	112.3	112.3	112.3
	Saturation, %	95.6	95.6	95.6
	Void Ratio	0.5014	0.5014	0.5014
	Diameter, in.	2.87	2.87	2.87
	Height, in.	5.60	5.60	5.60
At Test	Water Content, %	18.6	18.6	18.6
	Dry Density, pcf	112.3	112.3	112.3
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5014	0.5014	0.5014
	Diameter, in.	2.87	2.87	2.87
	Height, in.	5.60	5.60	5.60
Strain rate, in./min.		0.060	0.060	0.060
Back Pressure, psi		0.0	0.0	0.0
Cell Pressure, psi		2.0	4.0	8.0
Fail. Stress, psi		26.4	39.4	45.5
Ult. Stress, psi		26.4	39.4	45.5
σ_1 Failure, psi		28.4	43.4	53.5
σ_3 Failure, psi		2.0	4.0	8.0

Type of Test:
Unconsolidated Undrained

Sample Type: Undisturbed

Description: Sand, some clay, gravel, and silt, orange brown

LL= 48 **PL=** 27 **PI=** 21

Specific Gravity= 2.7

Remarks:

Client: Forsyrh Co Procurement Department

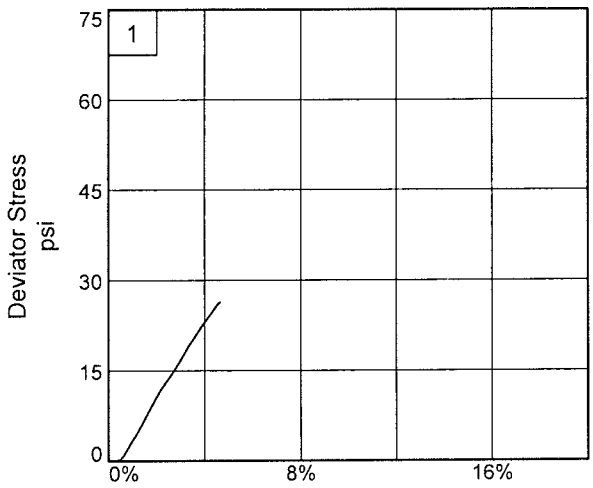
Project: Hammonds Crossing 16 Inch Water Main

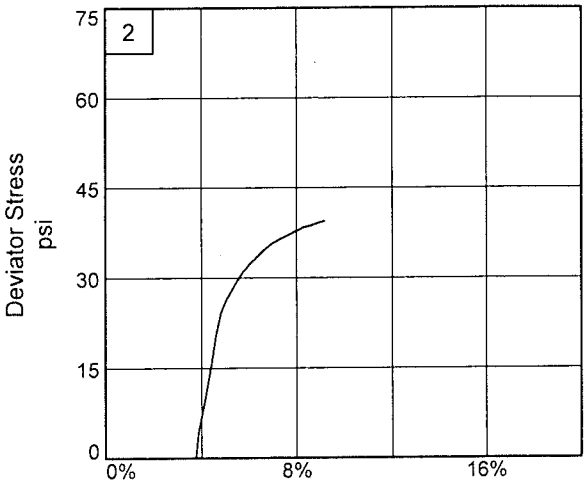
Sample Number: B-20 **Depth:** 3-5 ft

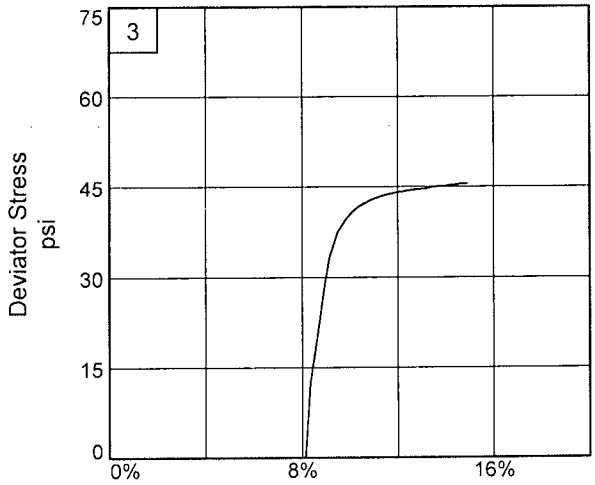
Proj. No.: FORPD20GA0456301 **Date Sampled:** 9/16/2020

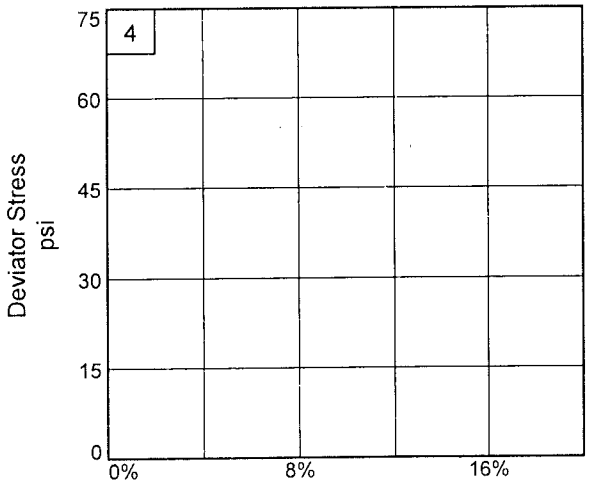
TRIAXIAL SHEAR TEST REPORT
United Consulting
Norcross, Georgia

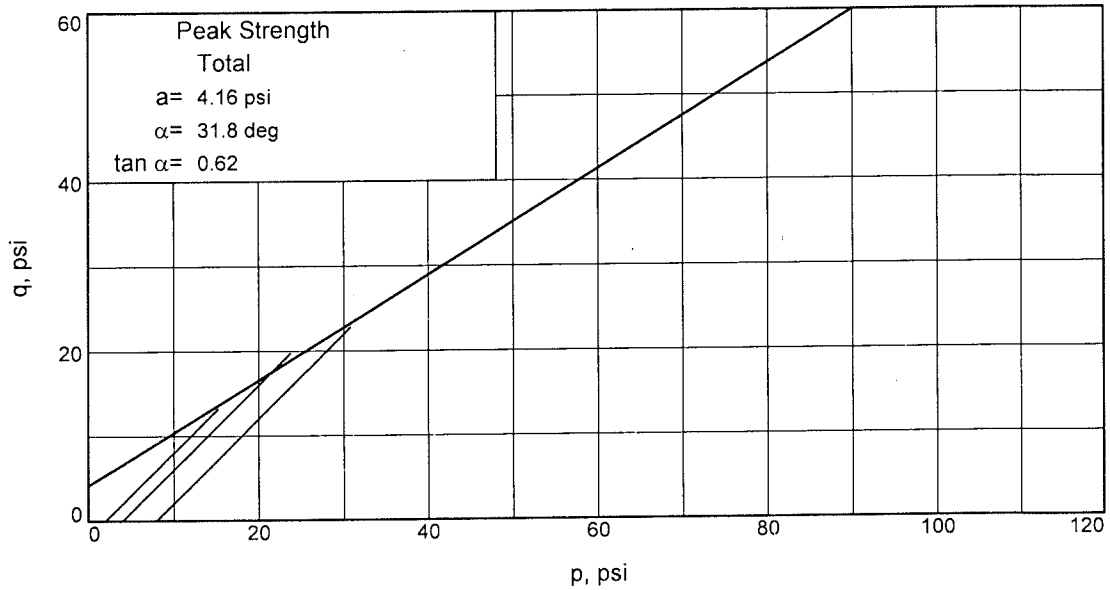
Figure _____











Client: Forsyrh Co Procurement Department
Project: Hammonds Crossing 16 Inch Water Main
Depth: 3-5 ft **Sample Number:** B-20
Project No.: FORPD20GA0456301 **Figure** _____

United Consulting

Corrosivity Series

ASTM G51, G57 / AASHTO T289, T288 / UC SOP L6, L40

PROJECT: Hammond Crossing

PROJECT No.: FORPD20GA0456301

TESTING DATE: 9/16/2020

	Sample ID	Soil pH s.u.	Soil Resistivity (Ω-cm)
1	B-9@8-10 ft	5.43	30,000
2	B-20@3-5 ft	4.52	82,000
3	B-7@6-7.5 ft	5.46	73,000
4	B-20@0-1.5 ft	4.86	36,000
5	B-17@8.5-10 ft	4.19	37,000
6	B-16@0-1.5 ft	6.44	29,000

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.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of 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.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

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