

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-400205	1	12

**REFERENCE: SF-400205**

**PROJECT: 17BP.7.R.135**

**STATE OF NORTH CAROLINA**  
**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**

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**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

COUNTY GUILFORD  
 PROJECT DESCRIPTION BRIDGE NO. 205 ON SR 2752  
(BETHEL CHURCH RD.) OVER ROCK CREEK

**CONTENTS**

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A, 2B, 2C	LEGEND
3	SITE PLAN
4-9	BORE LOGS, CORE LOGS, AND CORE PHOTOS

PERSONNEL  
TRIGON EXP.  
GOODNIGHT, D.J.

INVESTIGATED BY GOODNIGHT, D.J.  
 DRAWN BY CROCKETT, S.C.  
 CHECKED BY HAMM, J.R.  
 SUBMITTED BY FALCON ENG.  
 DATE OCTOBER 2019

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

- NOTES:
- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
  - BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.



*Stephen C Crockett* 10/21/2019  
 \_\_\_\_\_  
 SIGNATURE DATE

**DOCUMENT NOT CONSIDERED FINAL  
 UNLESS ALL SIGNATURES COMPLETED**

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT**

# SUBSURFACE INVESTIGATION

## SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 1 OF 2)

SOIL DESCRIPTION										GRADATION																																																																																																																				
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, <i>VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i>										<b>WELL GRADED</b> - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. <b>UNIFORMLY GRADED</b> - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. <b>GAP-GRADED</b> - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.																																																																																																																				
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**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT**

**SUBSURFACE INVESTIGATION**

**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS  
(PAGE 2 OF 2)**

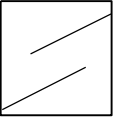
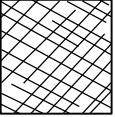


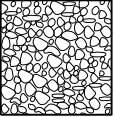

ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>		<p><b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.  <b>AQUIFER</b> - A WATER BEARING FORMATION OR STRATA.  <b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.  <b>ARGILLACEOUS</b> - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.  <b>ARTESIAN</b> - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.  <b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.  <b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.  <b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.  <b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.  <b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.  <b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.  <b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.  <b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.  <b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.  <b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.  <b>FORMATION (FM.)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.  <b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.  <b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.  <b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.  <b>MOTTLED (MOT.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.  <b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.  <b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.  <b>ROCK QUALITY DESIGNATION (RQD)</b> - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.  <b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.  <b>SILL</b> - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.  <b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.  <b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - NUMBER OF BLOWS IN OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.  <b>STRATA CORE RECOVERY (SREC.)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.  <b>STRATA ROCK QUALITY DESIGNATION (SRQD)</b> - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.  <b>TOPSOIL (TS.)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>	
	<b>WEATHERING</b>		
FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.		
VERY SLIGHT (V SL.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.		
SLIGHT (SL.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.		
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.		
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i>		
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES &gt; 100 BPF</i>		
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES &lt; 100 BPF</i>		
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.		
<b>ROCK HARDNESS</b>			
VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.		
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.		
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.		
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.		
SOFT	CAN BE GROOVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.		
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.		
<b>FRACTURE SPACING</b>		<b>BEDDING</b>	
<b>TERM</b>	<b>SPACING</b>	<b>TERM</b>	<b>THICKNESS</b>
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET
		THINLY LAMINATED	< 0.008 FEET
<b>INDURATION</b>			
FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.			
FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.		
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.		
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.		
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.		
		<p><b>BENCH MARK: BMI - BENCH TIE NAIL SET IN I4" OAK</b>  <b>N: 853708 E: 1823246</b>  <b>-L- STA. 14+85.60 OFFSET: 50.04' RT ELEVATION: 601.64 FEET</b></p>	
		<p><b>NOTES:</b>  <b>FIAD - FILLED IMMEDIATELY AFTER DRILLING</b></p>	
		DATE: 8-15-14	

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT**

**SUBSURFACE INVESTIGATION**

**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES  
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)**

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

<p><b>GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)</b></p> <p>From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.</p> <p><b>STRUCTURE</b></p>	<p><b>SURFACE CONDITIONS</b></p> <p><b>VERY GOOD</b> Very rough, fresh unweathered surfaces</p> <p><b>GOOD</b> Rough, slightly weathered, iron stained surfaces</p> <p><b>FAIR</b> Smooth, moderately weathered and altered surfaces</p> <p><b>POOR</b> Slackensided, highly weathered surfaces with compact coatings or fillings or angular fragments</p> <p><b>VERY POOR</b> Slackensided, highly weathered surfaces with soft clay coatings or fillings</p>	<p align="center"><b>DECREASING SURFACE QUALITY</b> →</p>			
<p><b>INTERLOCKING OF ROCK PIECES</b></p> <p>↓</p>	<p align="center"><b>DECREASING SURFACE QUALITY</b> →</p>				
 <p>INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p>	90	80	70	60	N/A
 <p>BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p>	80	70	60	50	40
 <p>VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p>	70	60	50	40	30
 <p>BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p>	60	50	40	30	20
 <p>DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p>	50	40	30	20	10
 <p>LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>	N/A	N/A	10	10	10

**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
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GEOTECHNICAL ENGINEERING UNIT**

# SUBSURFACE INVESTIGATION

## SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

**GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)**

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

**SURFACE CONDITIONS OF DISCONTINUITIES**  
(Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces

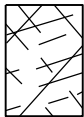
GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments

VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

**COMPOSITION AND STRUCTURE**



**A.** Thick bedded, very blocky sandstone. The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.



**B.** Sandstone with thin inter-layers of siltstone



**C.** Sandstone and siltstone in similar amounts



**D.** Siltstone or silty shale with sandstone layers



**E.** Weak siltstone or clayey shale with sandstone layers

**C, D, E, and G** - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H**.



**F.** Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure

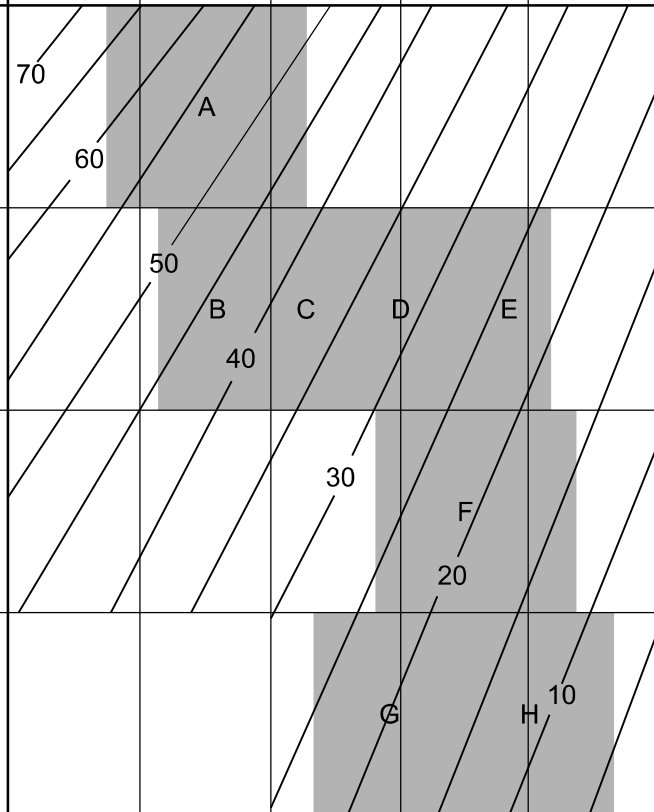


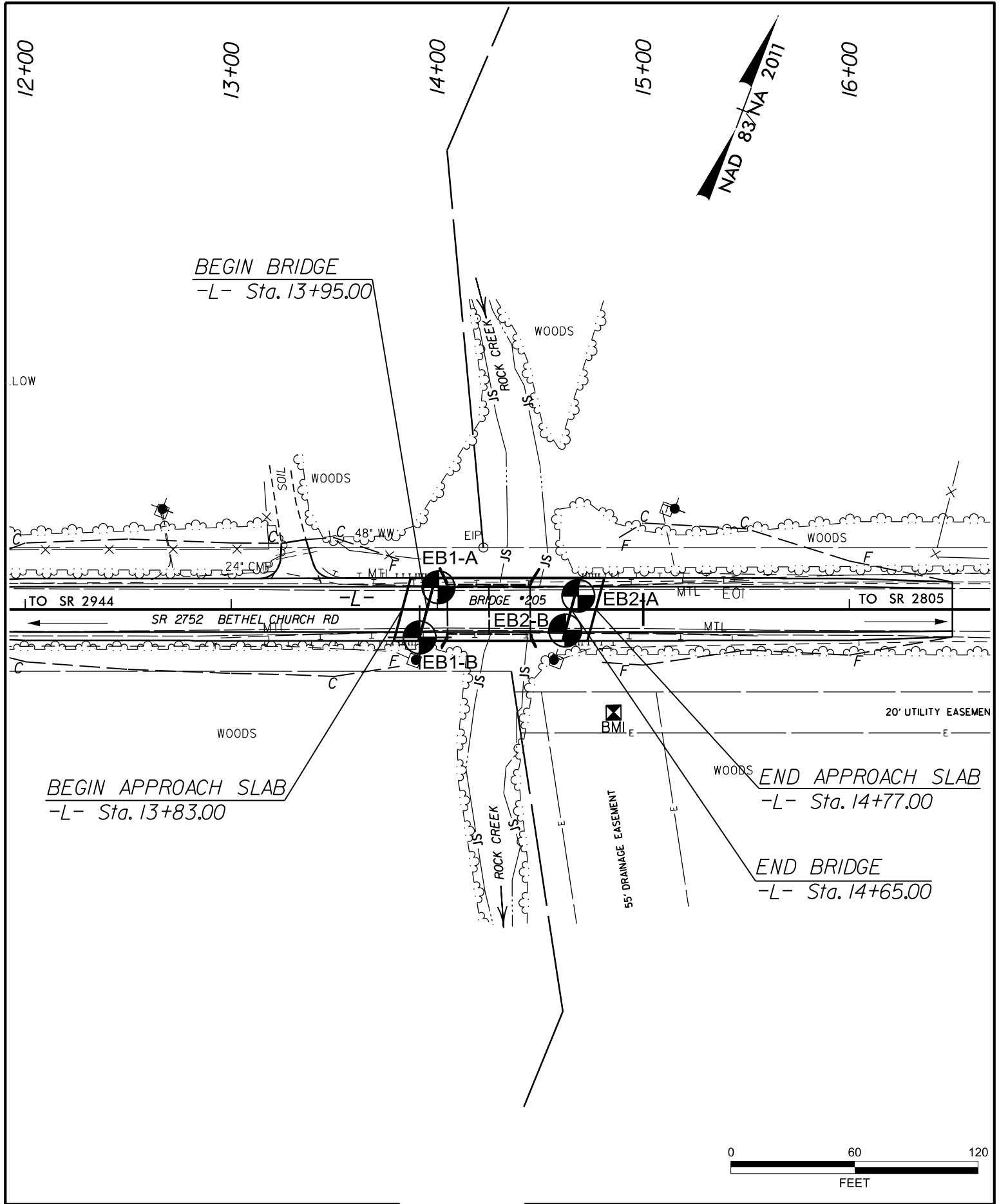
**G.** Undisturbed silty or clayey shale with or without a few very thin sandstone layers



**H.** Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

➔ Means deformation after tectonic disturbance





**NOTES:**

- PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM MOTT MACDONALD DATED MARCH 2019.
- BRIDGE SKEW: 105°



FALCON ENGINEERING, INC.  
 1210 TRINITY ROAD, SUITE 110  
 CARY, NC 27513  
 PHONE: 919.871.0800

**SITE PLAN**

BRIDGE NO. 205 ON SR 2752 (BETHEL CHURCH RD)  
 OVER ROCK CREEK  
 GUILFORD COUNTY, NORTH CAROLINA  
 WBS NO.: 17BP.7.R.135 | TIP NO.: SF-400205  
 FALCON PROJECT NO.: G18065.10

# GEOTECHNICAL BORING REPORT

## BORE LOG

<b>WBS</b> 17BP.7.R.135		<b>TIP</b> SF-400205		<b>COUNTY</b> GUILFORD		<b>GEOLOGIST</b> GOODNIGHT, D.J.											
<b>SITE DESCRIPTION</b> Bridge No. 205 on SR 2752 (Bethel Church Rd.) Over Rock Creek							<b>GROUND WTR (ft)</b>										
<b>BORING NO.</b> EB1-A		<b>STATION</b> 14+01		<b>OFFSET</b> 11 ft LT		<b>ALIGNMENT</b> -L-											
<b>COLLAR ELEV.</b> 605.2 ft		<b>TOTAL DEPTH</b> 13.5 ft		<b>NORTHING</b> 853,735		<b>EASTING</b> 1,823,145											
<b>DRILL RIG/HAMMER EFF./DATE</b> TRI8016 MOBILE B-57 97% 03/22/2019				<b>DRILL METHOD</b> H.S. Augers		<b>HAMMER TYPE</b> Automatic											
<b>DRILLER</b> Estep, J. E.		<b>START DATE</b> 08/20/19		<b>COMP. DATE</b> 08/20/19		<b>SURFACE WATER DEPTH</b> N/A											
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)		
610																	
605	604.2	1.0	2	3	9										605.2	GROUND SURFACE	0.0
600	601.7	3.5	2	1	1												
	599.2	6.0	WOH	WOH	1										599.7	<b>ROADWAY EMBANKMENT</b> TAN, SILTY SAND (A-2-4) WITH TRACE GRAVEL	5.5
595	596.7	8.5													597.2	<b>ALLUVIAL</b> TAN-GRAY, SANDY SILT (A-4)	8.0
	591.7	13.5	4	8	15										595.2	TAN, SILTY SAND (A-2-4) WITH TRACE GRAVEL	10.0
															591.7	<b>WEATHERED ROCK</b> TAN, GRANITIC ROCK	13.5
																Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 591.7 ft ON CR: GRANITIC ROCK	

NCDOT BORE SINGLE\_SF40205\_BORINGS.GPJ NC\_DOT.GDT 10/18/19


# GEOTECHNICAL BORING REPORT BORE LOG

WBS 17BP.7.R.135		TIP SF-400205		COUNTY GUILFORD		GEOLOGIST GOODNIGHT, D.J.											
SITE DESCRIPTION Bridge No. 205 on SR 2752 (Bethel Church Rd.) Over Rock Creek							GROUND WTR (ft)										
BORING NO. EB1-B		STATION 13+91		OFFSET 14 ft RT		ALIGNMENT -L-	0 HR. 11.1										
COLLAR ELEV. 605.4 ft		TOTAL DEPTH 17.2 ft		NORTHING 853,709		EASTING 1,823,142	24 HR. FIAD										
DRILL RIG/HAMMER EFF./DATE TRI8016 MOBILE B-57 97% 03/22/2019				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER Estep, J. E.		START DATE 08/21/19		COMP. DATE 08/21/19		SURFACE WATER DEPTH N/A											
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)		
610																	
605	604.4	1.0	3	2	2									605.4		GROUND SURFACE	0.0
	601.9	3.5	1	2	3									602.4		ROADWAY EMBANKMENT TAN, CLAYEY SILTY SAND (A-2-5) WITH TRACE GRAVEL	3.0
600	599.4	6.0	1	1	WOH									598.4		TAN, SILTY SAND (A-2-4)	7.0
	596.9	8.5	1	1	2									597.4		ALLUVIAL BROWN-TAN, SILTY F. SAND (A-2-4) WITH TRACE ROOTS	8.0
595	593.2	12.2	60/0.0											593.4		TAN, F. SANDY CLAYEY SILT (A-5)	12.0
														593.2		CRYSTALLINE ROCK GRAY, GRANITE	12.2
590														588.2		LIGHT GRAY, GRANITE	17.2
																Boring Terminated at Elevation 588.2 ft IN CR: GRANITE	

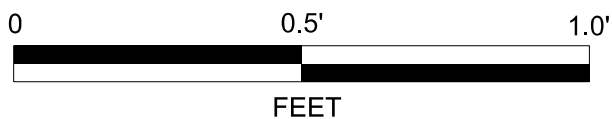
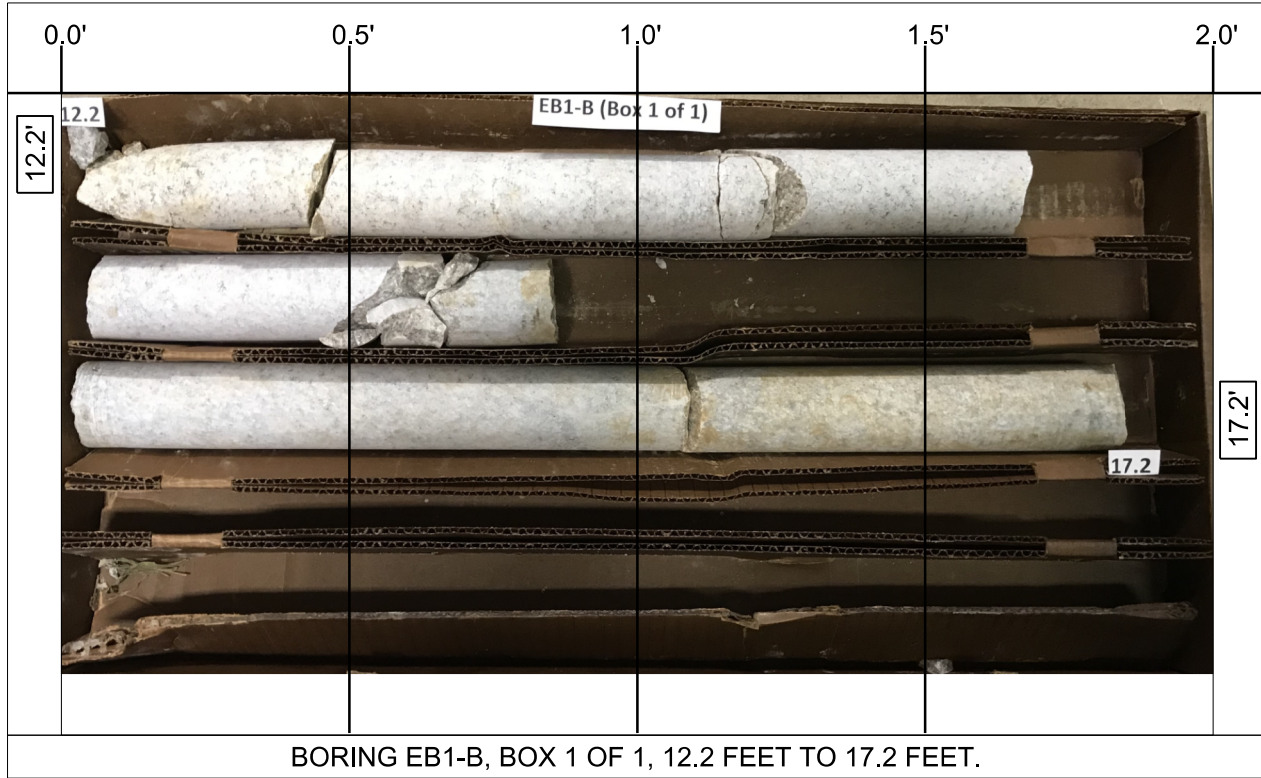
NCDOT BORE SINGLE\_SF40205\_BORINGS.GPJ NC\_DOT.GDT 10/18/19




# GEOTECHNICAL BORING REPORT CORE LOG

<b>WBS</b> 17BP.7.R.135				<b>TIP</b> SF-400205			<b>COUNTY</b> GUILFORD			<b>GEOLOGIST</b> GOODNIGHT, D.J.			
<b>SITE DESCRIPTION</b> Bridge No. 205 on SR 2752 (Bethel Church Rd.) Over Rock Creek										<b>GROUND WTR (ft)</b>			
<b>BORING NO.</b> EB1-B				<b>STATION</b> 13+91			<b>OFFSET</b> 14 ft RT			<b>ALIGNMENT</b> -L-		<b>0 HR.</b> 11.1	
<b>COLLAR ELEV.</b> 605.4 ft				<b>TOTAL DEPTH</b> 17.2 ft			<b>NORTHING</b> 853,709			<b>EASTING</b> 1,823,142		<b>24 HR.</b> FIAD	
<b>DRILL RIG/HAMMER EFF./DATE</b> TRI8016 MOBILE B-57 97% 03/22/2019							<b>DRILL METHOD</b> H.S. Augers			<b>HAMMER TYPE</b> Automatic			
<b>DRILLER</b> Estep, J. E.				<b>START DATE</b> 08/21/19			<b>COMP. DATE</b> 08/21/19			<b>SURFACE WATER DEPTH</b> N/A			
<b>CORE SIZE</b> NQ				<b>TOTAL RUN</b> 5.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)	
					REC. (ft)	RQD (%)		REC. (ft)	RQD (%)				
593.2											Begin Coring @ 12.2 ft		
	593.2	12.2	5.0	4:51/1.0 8:15/1.0 13:40/1.0 16:55/1.0 17:39/1.0	(4.8) 96%	(4.4) 88%		(4.8) 96%	(4.4) 88%		593.2 LIGHT GRAY, SLIGHT TO V. SLIGHTLY WEATHERED, HARD TO V. HARD, CLOSELY FRACTURED, GRANITE	12.2	
590	588.2	17.2									588.2 Boring Terminated at Elevation 588.2 ft IN CR: GRANITE	17.2	

NCDOT CORE SINGLE SF40205 BORINGS.GPJ NC\_DOT.GDT 10/18/19



 <p>FALCON ENGINEERING, INC. 1210 TRINITY ROAD, SUITE 110 CARY, NC 27513 PHONE: 919.871.0800</p>	<p><b>ROCK CORE PHOTOS</b></p> <p>BRIDGE NO, 205 ON SR 2752 (BETHEL CHURCH RD.), OVER ROCK CREEK GUILFORD COUNTY, NORTH CAROLINA WBS NO.: 17BP.7.R.135   TIP NO.: SF-400205 FALCON PROJECT NO.: G18065.10</p>
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# GEOTECHNICAL BORING REPORT

## BORE LOG

WBS 17BP.7.R.135	TIP SF-400205	COUNTY GUILFORD	GEOLOGIST GOODNIGHT, D.J.
SITE DESCRIPTION Bridge No. 205 on SR 2752 (Bethel Church Rd.) Over Rock Creek			GROUND WTR (ft)
BORING NO. EB2-A	STATION 14+68	OFFSET 7 ft LT	ALIGNMENT -L-
COLLAR ELEV. 606.3 ft	TOTAL DEPTH 18.6 ft	NORTHING 853,755	EASTING 1,823,210
DRILL RIG/HAMMER EFF./DATE TRI8016 MOBILE B-57 97% 03/22/2019			DRILL METHOD H.S. Augers
DRILLER Estep, J. E.			HAMMER TYPE Automatic
START DATE 08/21/19		COMP. DATE 08/21/19	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
610																
605	605.3	1.0	3	4	5									606.3	GROUND SURFACE	0.0
														605.3	<b>ROADWAY EMBANKMENT</b>	1.0
	602.8	3.5	1	1	3									603.3	0.5' BITUMINOUS ASPHALT, 0.5' AGGREGATE BASE COURSE	3.0
600	600.3	6.0	3	3	3									600.8	TAN AND GRAY, SILTY SAND (A-2-4) WITH TRACE GRAVEL	5.5
	597.8	8.5	3	3	1										TAN AND GRAY, CLAYEY SILTY SAND (A-2-5)	
595															<b>ALLUVIAL</b>	
	592.8	13.5	65	35/0.1										593.3	GRAY, SILTY SAND (A-2-4) WITH TRACE WOOD FRAGS. AND GRAVEL	13.0
590															<b>WEATHERED ROCK</b>	
	587.8	18.5	60/0.1							100/0.6				587.8	TAN, GRANITIC ROCK	18.5
														587.7	<b>CRYSTALLINE ROCK</b>	18.6
															TAN AND GRAY, GRANITIC ROCK	
															Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 587.7 ft IN CR: GRANITIC ROCK	

NCDOT BORE SINGLE\_SF40205\_BORINGS.GPJ NC\_DOT.GDT 10/18/19

# GEOTECHNICAL BORING REPORT

## BORE LOG

<b>WBS</b> 17BP.7.R.135			<b>TIP</b> SF-400205			<b>COUNTY</b> GUILFORD			<b>GEOLOGIST</b> GOODNIGHT, D.J.							
<b>SITE DESCRIPTION</b> Bridge No. 205 on SR 2752 (Bethel Church Rd.) Over Rock Creek									<b>GROUND WTR (ft)</b>							
<b>BORING NO.</b> EB2-B			<b>STATION</b> 14+62			<b>OFFSET</b> 10 ft RT			<b>ALIGNMENT</b> -L-							
<b>COLLAR ELEV.</b> 605.2 ft			<b>TOTAL DEPTH</b> 14.1 ft			<b>NORTHING</b> 853,737			<b>EASTING</b> 1,823,210							
<b>DRILL RIG/HAMMER EFF./DATE</b> TRI8016 MOBILE B-57 97% 03/22/2019						<b>DRILL METHOD</b> H.S. Augers			<b>HAMMER TYPE</b> Automatic							
<b>DRILLER</b> Estep, J. E.			<b>START DATE</b> 08/20/19			<b>COMP. DATE</b> 08/20/19			<b>SURFACE WATER DEPTH</b> N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	L O G	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)	
610																
605	604.2	1.0												605.2		GROUND SURFACE
	601.7	3.5	1	1	2											<b>ROADWAY EMBANKMENT</b>
600																TAN, CLAYEY SILTY SAND (A-2-5) WITH TRACE QUARTZ GRAVEL
	599.2	6.0	1	3	1											
	596.7	8.5	5	8	8									599.7		TAN-GRAY, SILTY SAND (A-2-4) WITH LITTLE GRAVEL
595														597.2		
	591.7	13.5	3	4	5											<b>ALLUVIAL</b>
	591.1	14.1														TAN, SLIGHTLY SILTY F. TO CSE. SAND (A-1-b)
														592.2		
														591.7		<b>WEATHERED ROCK</b>
														591.1		GRAY, GRANITIC ROCK
																<b>CRYSTALLINE ROCK</b>
																GRAY, GRANITIC ROCK
																Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 591.1 ft IN CR: GRANITIC ROCK

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