

REFERENCE: 17BP.8.R.133

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	17BP.8.R.133	1	14

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

**STRUCTURE
SUBSURFACE INVESTIGATION**

COUNTY MONTGOMERY
PROJECT DESCRIPTION REPLACE BRIDGE NO. 610123
ON -L- (SR 1340 /OKEEWEMEE RD) OVER WEST
FORK LITTLE RIVER

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND (SOIL & ROCK)
2B, 2C	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4-II	BORE LOGS AND CORE PHOTOGRAPHS

PERSONNEL
A. RODRIGUEZ
T. MILLER

INVESTIGATED BY S&ME, INC.
DRAWN BY C. CHANDLER
CHECKED BY K. HILL
SUBMITTED BY L. CAMPOS
DATE APRIL 2019



9751 SOUTHERN PINE BLVD
CHARLOTTE, NC 28273
(704) 523-4726

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DocuSigned by:
Luis Campos 4/30/2019
72275FD8E0A38437 SIGNATURE DATE

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

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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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, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6										WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.									
SOIL LEGEND AND AASHTO CLASSIFICATION										ANGULARITY OF GRAINS									
GENERAL CLASS. GRANULAR MATERIALS (<= 35% PASSING #200) SILT-CLAY MATERIALS (> 35% PASSING #200) ORGANIC MATERIALS										MINERALOGICAL COMPOSITION									
GROUP CLASS. A-1, A-3, A-2, A-4, A-5, A-6, A-7, A-1-A2, A-3, A-4, A-5, A-6, A-7										MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.									
SYMBOL										COMPRESSIBILITY									
% PASSING #10, #40, #200										SLIGHTLY COMPRESSIBLE LL < 31 MODERATELY COMPRESSIBLE LL = 31 - 50 HIGHLY COMPRESSIBLE LL > 50									
MATERIAL PASSING #40 LL, PI										PERCENTAGE OF MATERIAL									
GROUP INDEX										ORGANIC MATERIAL GRANULAR SOILS SILT - CLAY SOILS OTHER MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										GROUND WATER									
GEN. RATING AS SUBGRADE										WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING STATIC WATER LEVEL AFTER 24 HOURS PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA SPRING OR SEEP									
CONSISTENCY OR DENSENESS										MISCELLANEOUS SYMBOLS									
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT ²)										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT INFERRED SOIL BOUNDARY INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY									
TEXTURE OR GRAIN SIZE										RECOMMENDATION SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM)										UNDECUT UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL SHALLOW UNDECUT UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK									
GRAIN SIZE										ABBREVIATIONS									
SOIL MOISTURE - CORRELATION OF TERMS										EQUIPMENT USED ON SUBJECT PROJECT									
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION										DRILL UNITS: CME-45C, CME-55, CME-550, VANE SHEAR TEST, PORTABLE HOIST									
PLASTICITY										ADVANCING TOOLS: CLAY BITS, 6" CONTINUOUS FLIGHT AUGER, 8" HOLLOW AUGERS, HARD FACED FINGER BITS, TUNG-CARBIDE INSERTS, CASING W/ ADVANCER, TRICONE STEEL TEETH, TRICONE TUNG-CARB., CORE BIT									
PLASTICITY INDEX (PI) DRY STRENGTH										HAMMER TYPE: AUTOMATIC, MANUAL CORE SIZE: B, H, N Q HAND TOOLS: POST HOLE DIGGER, HAND AUGER, SOUNDING ROD, VANE SHEAR TEST									
COLOR										DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.									

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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>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - 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. ARTESIAN - 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. CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (ROD) - 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. SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. SILL - 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. SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - 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. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (SROD) - 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. TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>	
WEATHERED ROCK (WR)		NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.	
CRYSTALLINE ROCK (CR)		FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.	
NON-CRYSTALLINE ROCK (NCR)		FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.	
COASTAL PLAIN SEDIMENTARY ROCK (CP)		COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.	
WEATHERING			
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 > 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 < 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.	
ROCK HARDNESS			
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 FINGER NAIL.	
FRACTURE SPACING		BEDDING	
TERM	SPACING	TERM	THICKNESS
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
INDURATION			
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>BENCH MARK: BMI BENCHTIE SET IN 15' GUM, STA. 15.+66.66 -L-, 82.76' LT N 609142, E 1751295</p> <p style="text-align: right;">ELEVATION: 470.15 FEET</p>	
		<p>NOTES: FIAD: FILLED IMMEDIATELY AFTER DRILLING</p>	
		DATE: 8-15-14	

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**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)

**GEOLOGICAL STRENGTH INDEX (GSI) FOR
JOINTED ROCKS (Hoek and Marinos, 2000)**

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.

SURFACE CONDITIONS

VERY GOOD
Very rough, fresh unweathered surfaces

GOOD
Rough, slightly weathered, iron stained surfaces

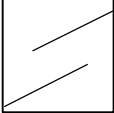
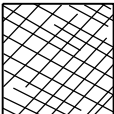
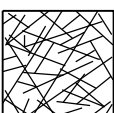

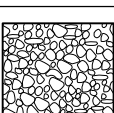
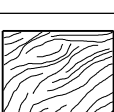
FAIR
Smooth, moderately weathered and altered surfaces

POOR
Slackensided, highly weathered surfaces with compact coatings or fillings or angular fragments

VERY POOR
Slackensided, highly weathered surfaces with soft clay coatings or fillings

DECREASING SURFACE QUALITY →

STRUCTURE

	INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities
	BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets
	VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets
	BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity
	DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces
	LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes

DECREASING INTERLOCKING OF ROCK PIECES

90				N/A	N/A
80					
	70				
	60				
		50			
		40			
			30		
			20		
				10	
N/A	N/A				

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**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

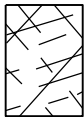
GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

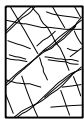
POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments

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.



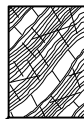
B. Sandstone with thin inter-layers of siltstone



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

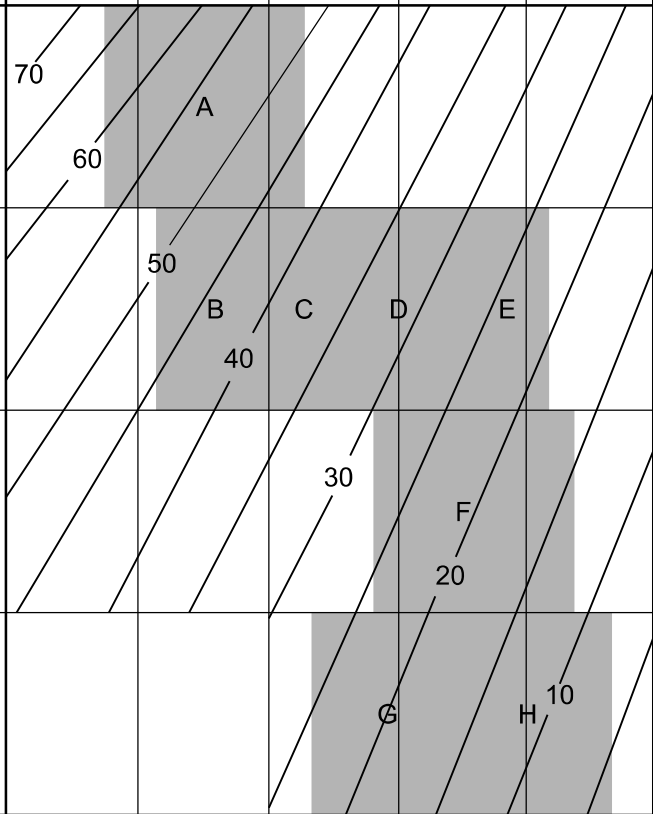


G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers



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



PROJECT REFERENCE NO.	SHEET NO.
17BP.8.R.133	3
SITE PLAN	
 0 30 60 FEET	



BMI 470.15'
 -BL- STA 8+64.32
 82.76' LEFT
 BENCHTIE SET IN 15" GUM



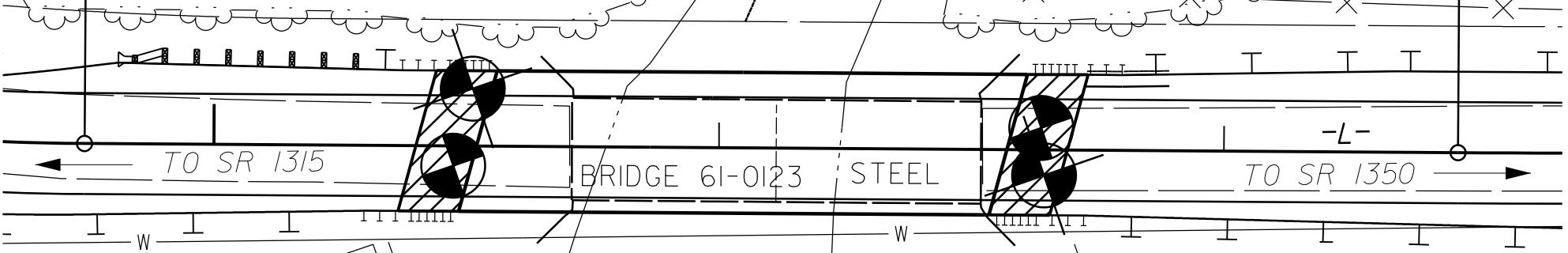
15

WOODS

EBI-A

EB2-A

SKEW 105°



EBI-B

EB2-B

WEST FORK LITTLE RIVER

WOODS

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.133		TIP N/A		COUNTY MONTGOMERY		GEOLOGIST Rodriguez, A.									
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340							GROUND WTR (ft)								
BORING NO. EB1-A		STATION 15+51		OFFSET 11 ft LT		ALIGNMENT -L-	0 HR. 11.0								
COLLAR ELEV. 471.9 ft		TOTAL DEPTH 18.5 ft		NORTHING 609,108		EASTING 1,751,346	24 HR. FIAD								
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018				DRILL METHOD SPT Core Boring		HAMMER TYPE Automatic									
DRILLER Miller, T.		START DATE 11/02/18		COMP. DATE 11/02/18		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					
475															
470	468.4	3.5	2	1	2									GROUND SURFACE	0.0
														ROADWAY EMBANKMENT	
														TAN, SANDY SILT (A-4)	
465	463.4	8.5	2	1	3									ALLUVIAL	7.0
														TAN AND ORANGE, SILTY CLAY (A-7-5)	
460	458.4	13.5	60/0.0											CRYSTALLINE ROCK	13.5
														GRAY METAVOLCANIC - EPICLASTIC,	
														MODERATELY TO VERY SLIGHTLY	
														WEATHERED, HARD, VERY CLOSE TO	
														MODERATELY CLOSE FRACTURE	
														SPACING	18.5
														REC = 100%	
														RQD = 58%	
														GSI = 70-80	
														Boring Terminated at Elevation 453.4 ft In Crystalline Rock	

NCDOT BORE SINGLE MONT_123.GPJ NC_DOT.GDT 4/30/19

GEOTECHNICAL BORING REPORT

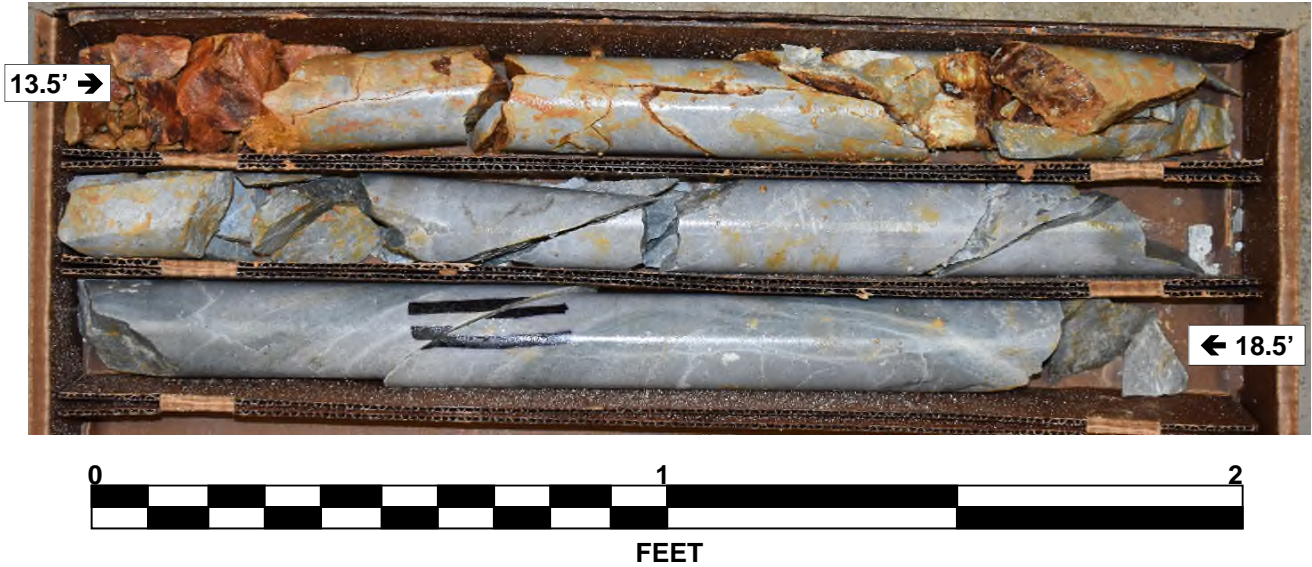
CORE LOG

WBS 17BP.8.R.133		TIP N/A		COUNTY MONTGOMERY		GEOLOGIST Rodriguez, A.					
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340							GROUND WTR (ft)				
BORING NO. EB1-A		STATION 15+51		OFFSET 11 ft LT		ALIGNMENT -L-	0 HR. 11.0				
COLLAR ELEV. 471.9 ft		TOTAL DEPTH 18.5 ft		NORTHING 609,108		EASTING 1,751,346	24 HR. FIAD				
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018				DRILL METHOD SPT Core Boring		HAMMER TYPE Automatic					
DRILLER Miller, T.		START DATE 11/02/18		COMP. DATE 11/02/18		SURFACE WATER DEPTH N/A					
CORE SIZE NQ		TOTAL RUN 5.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %			
458.4										Begin Coring @ 13.5 ft	
	458.4	13.5	5.0	N=60/0.0 2:15 1:30 2:00	(5.0) 100%	(2.9) 58%	(5.0) 100%	(2.9) 58%	458.4	CRYSTALLINE ROCK GRAY METAVOLCANIC - EPICLASTIC, MODERATELY TO VERY SLIGHTLY WEATHERED, HARD, VERY CLOSE TO MODERATEY CLOSE FRACTURE SPACING	13.5
455	453.4	18.5		1:15 2:00					453.4	GSI = 70-80 Boring Terminated at Elevation 453.4 ft In Crystalline Rock	18.5

NCDOT CORE SINGLE MONT_123.GPJ NC_DOT.GDT 4/30/19

CORE PHOTOS

WBS No: 17BP.8.R.133		County: Montgomery	Boring No.: EB1-A
Site Description: Bridge 610123 on SR 1340 Over West Fork Little River		Driller: T. Miller	
Collar Elev.: 471.9 ft	Core Size: NQ	Equipment: CME-55	Geologist: A. Rodriguez
Elev. at T.D.: 453.4 ft	Total Depth: 18.5 ft	Total Run: 5.0 ft	Date: 11/02/2018



Box 1 of 1; Top of Box @ 13.5 Feet; Bottom of Box @ 18.5 Feet

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.133		TIP N/A		COUNTY MONTGOMERY		GEOLOGIST Rodriguez, A.									
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340							GROUND WTR (ft)								
BORING NO. EB1-B		STATION 15+47		OFFSET 4 ft RT		ALIGNMENT -L-	0 HR. Dry								
COLLAR ELEV. 472.2 ft		TOTAL DEPTH 17.1 ft		NORTHING 609,099		EASTING 1,751,359	24 HR. FIAD								
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic									
DRILLER Miller, T.		START DATE 11/01/18		COMP. DATE 11/01/18		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					
475															
470	468.7	3.5	3	2	1								W	GROUND SURFACE 0.0 ASPHALT (12 INCHES) 1.0 ROADWAY EMBANKMENT BROWN, SILTY CLAY (A-7-5)	
465	463.7	8.5	2	1	4								W	ALLUVIAL BROWN, SILTY CLAY (A-7-5)	7.0
460	458.7	13.5	17	83/0.4										WEATHERED ROCK (METAVOLCANIC - EPICLASTIC)	12.0
	455.2	17.0	60/0.1							100/0.9				CRYSTALLINE ROCK (METAVOLCANIC - EPICLASTIC) Boring Terminated with Standard Penetration Test Refusal at Elevation 455.1 ft In Crystalline Rock	17.0
															17.1

NCDOT BORE SINGLE MONT_123.GPJ NC_DOT.GDT 4/30/19

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.133		TIP N/A		COUNTY MONTGOMERY		GEOLOGIST Rodriguez, A.									
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340							GROUND WTR (ft)								
BORING NO. EB2-A		STATION 16+64		OFFSET 4 ft LT		ALIGNMENT -L-	0 HR. Dry								
COLLAR ELEV. 471.9 ft		TOTAL DEPTH 16.1 ft		NORTHING 609,212		EASTING 1,751,390	24 HR. FIAD								
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic									
DRILLER Miller, T.		START DATE 11/02/18		COMP. DATE 11/02/18		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					
475															
470														471.9 GROUND SURFACE 0.0	
														471.0 ASPHALT (11 INCHES) 0.9	
	468.4	3.5	2	1	1									ROADWAY EMBANKMENT GRAY AND BROWN, SILTY CLAY (A-7-5)	
465														464.9	7.0
	463.4	8.5	1	2	1									ALLUVIAL GRAY, SILTY CLAY (A-7-5)	
460															
	458.4	13.5	1	1	4										
	455.9	16.0	60/0.1			60/0.1								455.9 16.0	
														455.8	16.1
														CRYSTALLINE ROCK (METAVOLCANIC - EPICLASTIC) Boring Terminated with Standard Penetration Test Refusal at Elevation 455.8 ft In Crystalline Rock	

NCDOT BORE SINGLE MONT_123.GPJ NC_DOT.GDT 4/30/19

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.8.R.133	TIP N/A	COUNTY MONTGOMERY	GEOLOGIST Rodriguez, A.
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340			GROUND WTR (ft)
BORING NO. EB2-B	STATION 16+64	OFFSET 5 ft RT	ALIGNMENT -L-
COLLAR ELEV. 471.7 ft	TOTAL DEPTH 26.4 ft	NORTHING 609,209	EASTING 1,751,399
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018		DRILL METHOD SPT Core Boring	HAMMER TYPE Automatic
DRILLER Miller, T.	START DATE 11/01/18	COMP. DATE 11/01/18	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						
475																
470														471.7	GROUND SURFACE	0.0
														470.7	ASPHALT (12 INCHES)	1.0
															ROADWAY EMBANKMENT RED AND ORANGE, CLAY (A-7-5)	
465	468.2	3.5	1	2	1								M	464.7		7.0
															ALLUVIAL GRAY, SILTY CLAY (A-7-6)	
460	463.2	8.5	WOH	WOH	WOH								W			
455	458.2	13.5	WOH	WOH	2								W			
450	455.3	16.4	60/0.0										W	455.3	CRYSTALLINE ROCK GRAY METAVOLCANIC - EPICLASTIC, SLIGHTLY WEATHERED, HARD, CLOSE TO MODERATELY CLOSE FRACTURE SPACING	16.4
														448.0	REC = 100% RQD = 51% GSI = 70-80	23.7
														445.3	CRYSTALLINE ROCK GRAY BROWN METAVOLCANIC - EPICLASTIC, MODERATELY WEATHERED, HARD, VERY CLOSE TO CLOSE FRACTURE SPACING	26.4
															REC = 85% RQD = 0% GSI = 40-45	
															Boring Terminated at Elevation 445.3 ft In Crystalline Rock	

GEOTECHNICAL BORING REPORT

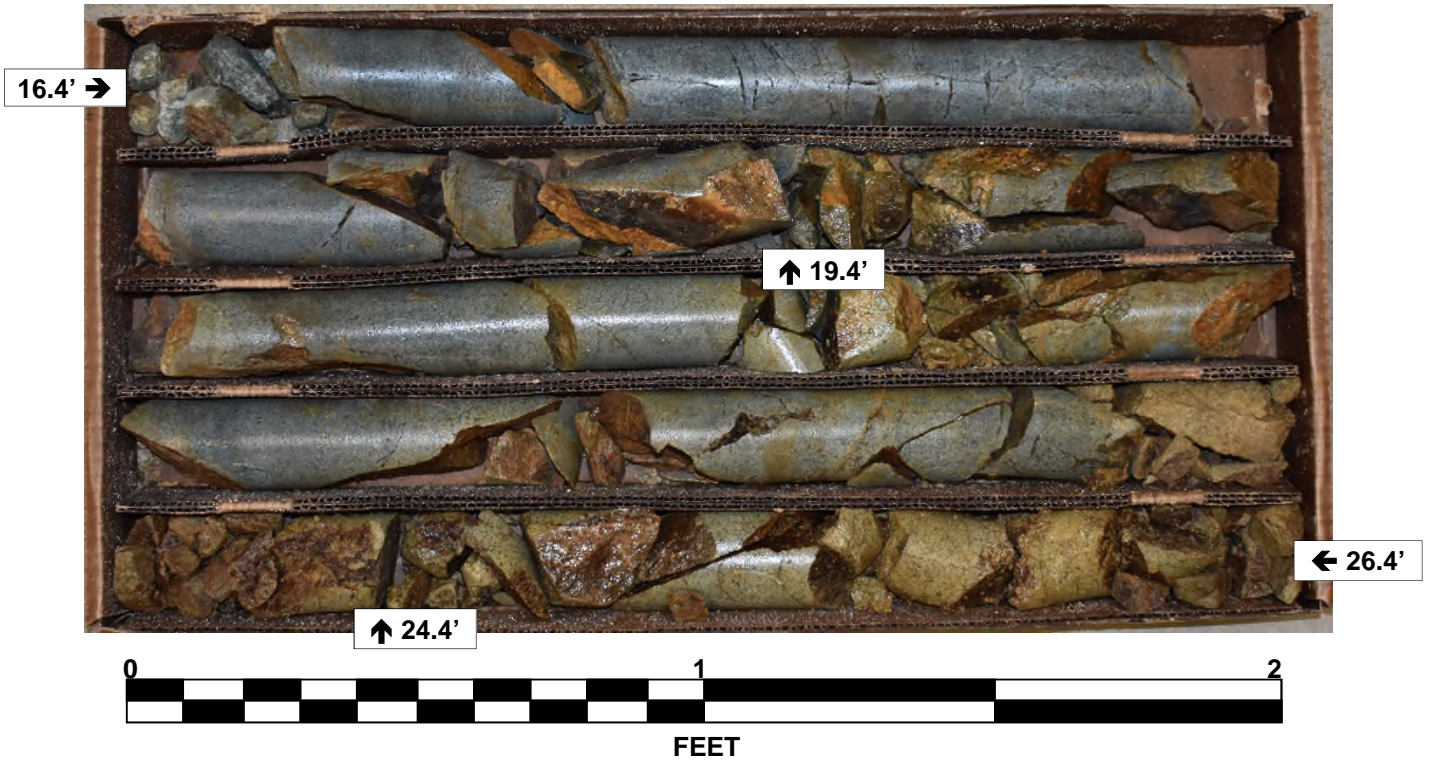
CORE LOG

WBS 17BP.8.R.133			TIP N/A			COUNTY MONTGOMERY			GEOLOGIST Rodriguez, A.			
SITE DESCRIPTION Bridge 610123 Over West Fork Little River on SR 1340										GROUND WTR (ft)		
BORING NO. EB2-B			STATION 16+64			OFFSET 5 ft RT			ALIGNMENT -L-			
COLLAR ELEV. 471.7 ft			TOTAL DEPTH 26.4 ft			NORTHING 609,209			EASTING 1,751,399			
DRILL RIG/HAMMER EFF./DATE SME8245 CME-55 90% 09/06/2018						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic			
DRILLER Miller, T.			START DATE 11/01/18			COMP. DATE 11/01/18			SURFACE WATER DEPTH N/A			
CORE SIZE NQ			TOTAL RUN 10.0 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)	
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %				
455.3												
	455.3	16.4	3.0	N=60/0.0 1:30	(3.0)	(1.7)	(7.3)	(3.7)		455.3	16.4	
	452.3	19.4		2:00	100%	57%	100%	51%		CRISTALLINE ROCK		
450			5.0	1:30						GRAY METAVOLCANIC - EPICLASTIC, SLIGHTY WEATHERED, HARD, CLOSE TO MODERATELY CLOSE FRACTURE SPACING		
				1:45	(5.0)	(2.0)				GSI = 70-80		
	447.3	24.4		1:30	100%	40%				448.0	23.7	
			2.0	1:15								
	445.3	26.4		1:45	(1.6)	(0.0)	(2.3)	(0.0)		445.3	26.4	
				1:45	80%	0%	85%	0%		CRISTALLINE ROCK GRAY BROWN METAVOLCANIC - EPICLASTIC, MODERATELY WEATHERED, HARD, VERY CLOSE TO CLOSE FRACTURE SPACING GSI = 40-45 Boring Terminated at Elevation 445.3 ft In Crystalline Rock		

NCDOT CORE SINGLE MONT_123.GPJ NC_DOT.GDT 4/30/19

CORE PHOTOS

WBS No: 17BP.8.R.133		County: Montgomery	Boring No.: EB2-B
Site Description: Bridge 610123 on SR 1340 Over West Fork Little River		Driller: T. Miller	
Collar Elev.: 471.7 ft	Core Size: NQ	Equipment: CME-55	Geologist: A. Rodriguez
Elev. at T.D.: 445.3 ft	Total Depth: 26.4 ft	Total Run: 10.0 ft	Date: 11/01/2018



Box 1 of 1; Top of Box @ 16.4 Feet; Bottom of Box @ 26.4 Feet