

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	14SP.20441.2	1	17

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

**STRUCTURE  
SUBSURFACE INVESTIGATION**

PROJ. REFERENCE NO. 14SP.20441.2 F.A. PROJ. N/A  
 COUNTY Haywood  
 PROJECT DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road)  
 over Big Creek

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PERSONNEL

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NOTE - 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.

DRAWN BY: M. Brewer, E.I.





**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**  
**SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS**

**SOIL DESCRIPTION**

SOIL IS CONSIDERED TO BE THE 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 STANDARD PENETRATION TEST (ASTM 1206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

*VERY STIFF, GRN. SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6*

**SOIL LEGEND AND AASHTO CLASSIFICATION**

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)						SILT-CLAY MATERIALS (> 35% PASSING #200)						ORGANIC MATERIALS			
GROUP CLASS.	A-1		A-3	A-2		A-4	A-5	A-6	A-7	A-1, A-2	A-3	A-4, A-5	A-6, A-7			
SYMBOL	[Pattern]		[Pattern]	[Pattern]		[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]	[Pattern]
% PASSING	10 40 200		50 MX 10 MX 25 MX	51 MN 10 MX	35 MX 35 MX	35 MX 35 MX	36 MN 36 MN	36 MN 36 MN	36 MN 36 MN	40 MN 40 MN	41 MN 41 MN	41 MN 41 MN	41 MN 41 MN	41 MN 41 MN	41 MN 41 MN	41 MN 41 MN
LIQUID LIMIT	6 MX		NP	40 MX 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX	41 MN 10 MX
GROUP INDEX	0		0	0	4 MX	8 MX	12 MX	16 MX	No MX							
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND		SILTY SOILS		CLAYEY SOILS		SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER			HIGHLY ORGANIC SOILS			
GENERAL RATING AS A SUBGRADE	EXCELLENT TO GOOD						FAIR TO POOR			FAIR TO POOR	POOR	UNSUITABLE				

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

**CONSISTENCY OR DENSENESS**

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	<4 4 TO 10 10 TO 30 30 TO 50 >50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	<2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 >30	<0.25 0.25 TO 0.50 0.5 TO 1.0 1 TO 2 2 TO 4 >4

**TEXTURE OR GRAIN SIZE**

U.S. STD. SIEVE SIZE OPENING (MM)	4	10	40	60	200	270
	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)
GRAIN SIZE MM 305	75	2.0	0.25	0.05	0.005	
IN. 12	3					

**SOIL MOISTURE - CORRELATION OF TERMS**

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
LL - LIQUID LIMIT	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
PL - PLASTIC LIMIT	- WET - (W)	SEMI-SOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
OM - OPTIMUM MOISTURE SHRINKAGE LIMIT	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

**PLASTICITY**

NONPLASTIC	PLASTICITY INDEX (PI)	DRY STRENGTH
L.O.W. PLASTICITY	0-5	VERY LOW
MED. PLASTICITY	6-15	SLIGHT
HIGH PLASTICITY	16-25	MEDIUM
	26 OR MORE	HIGH

**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.

**GRADATION**

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.  
 UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)  
 GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

**ANGULARITY OF GRAINS**

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

**MINERALOGICAL COMPOSITION**

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

**COMPRESSIBILITY**

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

**PERCENTAGE OF MATERIAL**

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME
HIGHLY ORGANIC	>10%	>20%	HIGHLY
			1 - 10%
			10 - 20%
			20 - 35%
			35% AND ABOVE

**GROUND WATER**

▽ WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING  
 ▽ STATIC WATER LEVEL AFTER 24 HOURS  
 ▽PW PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA  
 ○ SPRING OR SEEP

**MISCELLANEOUS SYMBOLS**

	ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION		SPT TEST BORING		TEST BORING W/ CORE
	SOIL SYMBOL		AUGER BORING		SPT N-VALUE
	ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT		CORE BORING		SPT REFUSAL
	INFERRED SOIL BOUNDARY		MONITORING WELL		
	INFERRED ROCK LINE		PIEZOMETER INSTALLATION		
	ALLUVIAL SOIL BOUNDARY		SLOPE INDICATOR INSTALLATION		
	DIP & DIP DIRECTION OF ROCK STRUCTURES		CONE PENETROMETER TEST		
			SOUNDING ROD		

**ABBREVIATIONS**

AR - AUGER REFUSAL	FRAGS. - FRAGMENTS	w - MOISTURE CONTENT
BT - BORING TERMINATED	HL - HIGHLY	v - VERY
CL - CLAY	MED. - MEDIUM	WEA. - WEATHERED
CPT - CONE PENETRATION TEST	MICA - MICACEOUS	γ - UNIT WEIGHT
CSE. - COARSE	MOD. - MODERATELY	γ <sub>d</sub> - DRY UNIT WEIGHT
CT - CORING TERMINATED	NP - NON PLASTIC	<b>SAMPLE ABBREVIATIONS</b>
DMT - DILATOMETER TEST	ORG. - ORGANIC	S - BULK
DPT - DYNAMIC PENETRATION TEST	PMT - PRESSUREMETER TEST	SS - SPLIT SPOON
e - VOID RATIO	SAP. - SAPROLITIC	ST - SHELBY TUBE
EMBANK. - EMBANKMENT	SDY. - SANDY	RS - ROCK
F - FINE	SL. - SILT, SILTY	RT - RECOMPACTED TRIAXIAL
FOSS. - FOSSILIFEROUS	SLI. - SLIGHTLY	CBR - CALIFORNIA BEARING RATIO
FRAC. - FRACTURED, FRACTURES	TCR - TRICONE REFUSAL	

**EQUIPMENT USED ON SUBJECT PROJECT**

<b>DRILL UNITS:</b>	<b>ADVANCING TOOLS:</b>	<b>HAMMER TYPE:</b>
<input type="checkbox"/> MOBILE B- _____	<input type="checkbox"/> CLAY BITS	<input checked="" type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL
<input type="checkbox"/> BK-51	<input type="checkbox"/> 6' CONTINUOUS FLIGHT AUGER	<b>CORE SIZE:</b>
<input type="checkbox"/> CME-45C	<input checked="" type="checkbox"/> 8' HOLLOW AUGERS	<input type="checkbox"/> -B _____
<input checked="" type="checkbox"/> CME-75	<input type="checkbox"/> HARD FACED FINGER BITS	<input checked="" type="checkbox"/> -N02 _____
<input type="checkbox"/> PORTABLE HOIST	<input type="checkbox"/> TUNG.-CARBIDE INSERTS	<input type="checkbox"/> -H _____
<input type="checkbox"/> _____	<input checked="" type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER	<b>HAND TOOLS:</b>
<input type="checkbox"/> _____	<input type="checkbox"/> TRICONE _____ * STEEL TEETH	<input type="checkbox"/> POST HOLE DIGGER
<input type="checkbox"/> _____	<input type="checkbox"/> TRICONE _____ * TUNG.-CARB.	<input type="checkbox"/> HAND AUGER
<input type="checkbox"/> _____	<input checked="" type="checkbox"/> CORE BIT	<input type="checkbox"/> SOUNDING ROD
		<input type="checkbox"/> VANE SHEAR TEST

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ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL, 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, 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 DISLOGGED 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>	
<p><b>WEATHERED ROCK (WR)</b></p>		<p>NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES &gt; 100 BLOWS PER FOOT IF TESTED.</p>	<p><b>WEATHERING</b></p>
<p><b>CRYSTALLINE ROCK (CR)</b></p>		<p>FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.</p>	<p><b>FRESH</b> - ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING, ROCK RINGS UNDER HAMMER IF CRYSTALLINE.  <b>VERY SLIGHT (V SL.)</b> - 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.  <b>SLIGHT (SL.)</b> - 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.  <b>MODERATE (MOD.)</b> - SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW FLAKY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.  <b>MODERATELY SEVERE (MOD. SEV.)</b> - 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>  <b>SEVERE (SEV.)</b> - 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, YIELDS SPT N VALUES &gt; 100 BPF</i>  <b>VERY SEVERE (V SEV.)</b> - ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, YIELDS SPT N VALUES &lt; 100 BPF</i>  <b>COMPLETE</b> - 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.</p>
<p><b>NON-CRYSTALLINE ROCK (NCR)</b></p>		<p>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.</p>	<p><b>ROCK HARDNESS</b></p>
<p><b>COASTAL PLAIN SEDIMENTARY ROCK (CP)</b></p>		<p>COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.</p>	<p><b>VERY HARD</b> - CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.  <b>HARD</b> - CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.  <b>MODERATELY HARD</b> - 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.  <b>MEDIUM HARD</b> - CAN BE GROVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.  <b>SOFT</b> - CAN BE GROVED 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.  <b>VERY SOFT</b> - 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.</p>
<b>FRACTURE SPACING</b>		<b>BEDDING</b>	
<p><b>TERM</b></p>	<p><b>SPACING</b></p>	<p><b>TERM</b></p>	<p><b>THICKNESS</b></p>
<p>VERY WIDE</p>	<p>MORE THAN 10 FEET</p>	<p>VERY THICKLY BEDDED</p>	<p>&gt; 4 FEET</p>
<p>WIDE</p>	<p>3 TO 10 FEET</p>	<p>THICKLY BEDDED</p>	<p>1.5 - 4 FEET</p>
<p>MODERATELY CLOSE</p>	<p>1 TO 3 FEET</p>	<p>THINLY BEDDED</p>	<p>0.16 - 1.5 FEET</p>
<p>CLOSE</p>	<p>0.16 TO 1 FEET</p>	<p>VERY THINLY BEDDED</p>	<p>0.03 - 0.16 FEET</p>
<p>VERY CLOSE</p>	<p>LESS THAN 0.16 FEET</p>	<p>THICKLY LAMINATED</p>	<p>0.008 - 0.03 FEET</p>
<p></p>	<p></p>	<p>THINLY LAMINATED</p>	<p>&lt; 0.008 FEET</p>
<b>INDURATION</b>			
<p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p>			
<p><b>FRIABLE</b></p>	<p>RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p>		
<p><b>MODERATELY INDURATED</b></p>	<p>GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p>		
<p><b>INDURATED</b></p>	<p>GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p>		
<p><b>EXTREMELY INDURATED</b></p>	<p>SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>		
<p><b>BENCH MARK:</b> Survey Information provided by Vaughn &amp; Melton, Inc.</p>			
<p><b>ELEVATION:</b></p>			<p><b>FT.</b></p>
<p><b>NOTES:</b></p>			





SITE

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# SITE LOCATION PLAN

## Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek

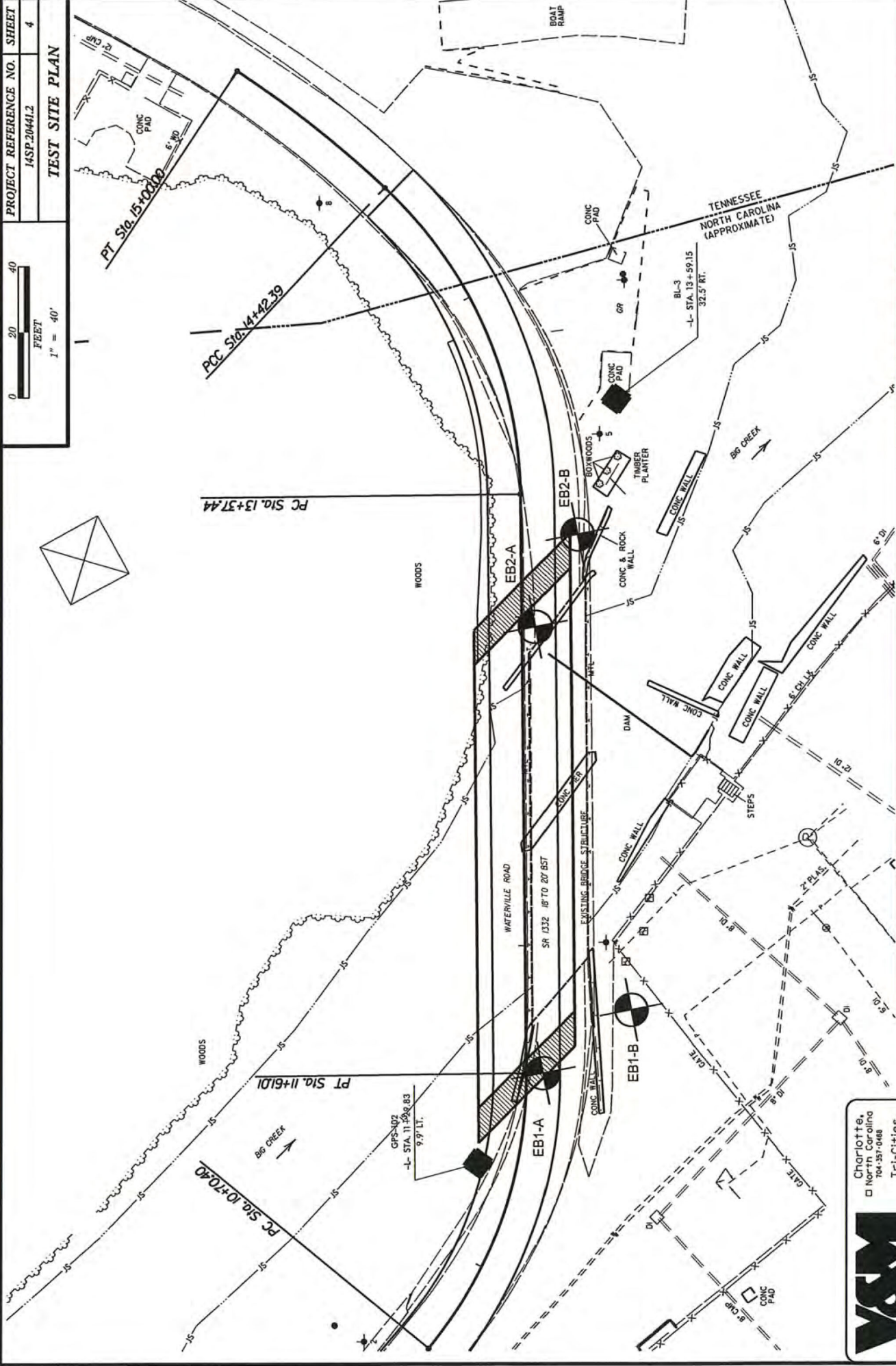
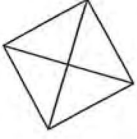
Scale: N.T.S. OR DMB    OR MJB    REV.

Prepared For:  
NCDOT WBS No.: 14SP.20441.2



Froehling & Robertson, Inc.  
2505 Hutchison-McDonald Road  
Charlotte, North Carolina





**TEST SITE PLAN**

PROJECT REFERENCE NO.: 14SP.20441.2	F&R PROJECT NO.: 63R-3026-0174
I.D. NO.: N/A	E.A. PROJECT NO.: N/A
COUNTY: HAYWOOD	
PROJECT DESCRIPTION: Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek	
SITE DESCRIPTION: Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek	
DRAWN BY: M. Brewer, E.I.	
CHECKED BY: M. Walko, P.E.	
DATE: November 2013	
SCALE: 1"=40'	

**FROEHLING & ROBERTSON, INC.**

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# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 14SP.20441.2	TIP N/A	COUNTY HAYWOOD	GEOLOGIST M. Brewer/R. Kral
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek			GROUND WTR (ft)
BORING NO. EB1-A	STATION 11+61	OFFSET 5 ft RT	ALIGNMENT -L-
COLLAR ELEV. 1,417.4 ft	TOTAL DEPTH 30.2 ft	NORTHING 761,842	EASTING 784,151
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012		DRILL METHOD NW Casing w/ Core	HAMMER TYPE Automatic
DRILLER J. Fowler	START DATE 10/07/13	COMP. DATE 10/08/13	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)	
1420																
	1,416.9	0.5	15	11	20										1,417.4	0.0
1415															1,416.3	0.5
	1,413.9	3.5	16	15	20										1,412.4	5.0
1410																
1405																
1400																
1395																
1390															1,390.2	27.2
															1,387.2	30.2
<p style="text-align: center;"><b>CRYSTALLINE ROCK</b> Dark gray, (PIGEON SILTSTONE).</p> <p style="text-align: center;">Boring Terminated at Elevation 1,387.2 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)</p> <p style="text-align: center;">1) Driller indicated auger refusal at 4.6' 2) Boring filled immediately after drilling due to location in the road.</p>																

NCDOT BORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174 GP.1 NC\_DOT\_GDT 6/22/16





# NCDOT GEOTECHNICAL ENGINEERING UNIT CORE BORING REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD		GEOLOGIST M. Brewer/R. Kral					
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek							GROUND WTR (ft)				
BORING NO. EB1-A		STATION 11+61		OFFSET 5 ft RT		ALIGNMENT -L-					
COLLAR ELEV. 1,417.4 ft		TOTAL DEPTH 30.2 ft		NORTHING 761,842		EASTING 784,151					
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012				DRILL METHOD NW Casing w/ Core		HAMMER TYPE Automatic					
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		TOTAL RUN 3.0 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) %			
1390.2	1,390.2	27.2	3.0	4:03/1.0	(3.0)	(1.9)	(3.0)	(1.9)		Begin Coring @ 27.2 ft	27.2
	1,387.2	30.2		2:37/1.0 2:46/1.0	100%	63%	100%	63%		CRystalline Rock Moderately weathered to slightly weathered, moderately hard to hard, dark gray, (PIGEON SILTSTONE), with very close to close fracture spacing.	30.2
										Boring Terminated at Elevation 1,387.2 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)	
										1) Driller indicated auger refusal at 4.6'	
										2) Boring filled immediately after drilling due to location in the road.	

NCDOT CORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174 GPJ NC DOT GDT 6/22/16





# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD		GEOLOGIST R. Kral										
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek							GROUND WTR (ft)									
BORING NO. EB1-B		STATION 11+80		OFFSET 32 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 1,415.7 ft		TOTAL DEPTH 28.6 ft		NORTHING 761,856		EASTING 784,181										
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012		DRILL METHOD NW Casing w/ Core		HAMMER TYPE Automatic												
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		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			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100			ELEV. (ft)	DEPTH (ft)		
1420																
1415														1,415.7	0.0	GROUND SURFACE
														1,412.2	0.5	Asphalt (0.5')
	1,412.2	3.5	10	10	25											<b>ROADWAY EMBANKMENT</b>
1410																Intermittent cobbles & boulders with brown, silty fine to coarse SAND (A-2-4), with little gravel.
	1,407.2	8.5	43	14	18											
1405														1,405.7	10.0	Boulder fill
																Advanced with NQ2 coring equipment.
1400																
1395																
1390														1,392.1	23.6	<b>CRYSTALLINE ROCK</b>
																Dark gray, (PIGEON SILTSTONE)
														1,387.1	28.6	Boring Terminated at Elevation 1,387.1 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)
																1) Driller indicated auger refusal at 10.0' 2) Boring filled immediately after drilling due to location in the road.

NCDOT BORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174 GPJ NC\_DOT\_GDT 6/22/16



# NCDOT GEOTECHNICAL ENGINEERING UNIT CORE BORING REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD		GEOLOGIST R. Kral					
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek							GROUND WTR (ft)				
BORING NO. EB1-B		STATION 11+80		OFFSET 32 ft RT		ALIGNMENT -L-					
COLLAR ELEV. 1,415.7 ft		TOTAL DEPTH 28.6 ft		NORTHING 761,856		EASTING 784,181					
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012				DRILL METHOD NW Casing w/ Core		HAMMER TYPE Automatic					
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		TOTAL RUN 5.0 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) %			
1392.1										Begin Coring @ 23.6 ft	
	1,392.1	23.6	5.0	3:56/1.0	(5.0)	(0.0)	(5.0)	(0.0)		1,392.1	23.6
1390				3:31/1.0	100%	0%	100%	0%		Moderately to slightly weathered, moderately hard, dark gray (PIGEON SILTSTONE), with very close to close fracture spacing.	
	1,387.1	28.6		4:24/1.0 3:51/1.0 5:26/1.0						1,387.1	28.6
										Boring Terminated at Elevation 1,387.1 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)	
										1) Driller indicated auger refusal at 10.0' 2) Boring filled immediately after drilling due to location in the road.	

NCDOT CORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174.GPJ NC\_DOT\_GDT 6/22/16





# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 14SP.20441.2	TIP N/A	COUNTY HAYWOOD	GEOLOGIST M. Brewer
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek			GROUND WTR (ft)
BORING NO. EB2-A	STATION 12+97	OFFSET 4 ft RT	ALIGNMENT -L-
COLLAR ELEV. 1,416.8 ft	TOTAL DEPTH 26.0 ft	NORTHING 761,976	EASTING 784,174
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012		DRILL METHOD NW Casing w/ Core	HAMMER TYPE Automatic
DRILLER J. Fowler	START DATE 10/07/13	COMP. DATE 10/08/13	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
1420															
1415	1,416.3	0.5	13	10	8								M	GROUND SURFACE Asphalt (0.2')	0.0
1410	1,413.3	3.5	13	4	6								M	ROADWAY EMBANKMENT Intermittent cobbles & boulders with brown, silty fine to coarse SAND (A-2-4), with little gravel.	7.4
1405														Boulder fill with gray, fine to coarse sandy GRAVEL (A-1-a).  Advanced with NQ2 coring equipment.	7.4
1400															16.0
1395														CRYSTALLINE ROCK Dark gray, (PIGEON SILTSTONE)	16.0
															26.0
Boring Terminated at Elevation 1,390.8 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)															
1) Driller indicated auger refusal at 7.4' 2) Driller indicated casing refusal at 16.0' 3) Boring filled immediately after drilling due to location in the road.															

NCDOT BORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174.GPJ NC\_DOT.GDT 6/22/16



# NCDOT GEOTECHNICAL ENGINEERING UNIT CORE BORING REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD		GEOLOGIST M. Brewer					
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek							GROUND WTR (ft)				
BORING NO. EB2-A		STATION 12+97		OFFSET 4 ft RT		ALIGNMENT -L-					
COLLAR ELEV. 1,416.8 ft		TOTAL DEPTH 26.0 ft		NORTHING 761,976		EASTING 784,174					
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012				DRILL METHOD NW Casing w/ Core		HAMMER TYPE Automatic					
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		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) %			
1400.8										Begin Coring @ 16.0 ft	
1400	1,400.8	16.0	5.0	13:12/1.0 7:06/1.0 5:32/1.0 4:42/1.0 4:37/1.0	(5.0) 100%	(3.0) 60%	(10.0) 100%	(5.7) 57%	CRYSTALLINE ROCK	Slightly weathered to fresh, hard, (PIGEON SILTSTONE), with very close to close fracture spacing.	16.0
1395	1,395.8	21.0	5.0	4:27/1.0 3:35/1.0 7:04/1.0 4:55/1.0 4:53/1.0	(5.0) 100%	(2.7) 54%					
	1,390.8	26.0								Boring Terminated at Elevation 1,390.8 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)	26.0
										1) Driller indicated auger refusal at 7.4' 2) Driller indicated casing refusal at 16.0' 3) Boring filled immediately after drilling due to location in the road.	





# NCDOT GEOTECHNICAL ENGINEERING UNIT

## BORELOG REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD		GEOLOGIST R. Kral	
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek							GROUND WTR (ft)
BORING NO. EB2-B		STATION 13+25		OFFSET 17 ft RT		ALIGNMENT -L-	
COLLAR ELEV. 1,415.9 ft		TOTAL DEPTH 14.9 ft		NORTHING 762,001		EASTING 784,192	
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012				DRILL METHOD NW Casing w/ Core		HAMMER TYPE Automatic	
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	LOG G	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
1420																
1415	1,415.9	0.0	7	17	12										GROUND SURFACE	0.0
															Asphalt (0.2)	
	1,412.4	3.5	14	11	6										<b>ROADWAY EMBANKMENT</b> Intermittent cobbles and boulders with brown, silty fine to coarse SAND (A-2-4), with some gravel.	
1410																
															Boulder fill	8.5
															Advance with NQ2 coring equipment.	9.9
1405															<b>CRYSTALLINE ROCK</b> Dark gray, (PIGEON SILTSTONE).	
															Boring Terminated at Elevation 1,401.0 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)	14.9

1) Driller indicated auger refusal at 8.5'  
 2) Boring filled immediately after drilling due to location in the road.

NCDOT BORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174.GPJ NC.DOT.GDT 6/22/16



# NCDOT GEOTECHNICAL ENGINEERING UNIT CORE BORING REPORT

WBS 14SP.20441.2		TIP N/A		COUNTY HAYWOOD			GEOLOGIST R. Kral				
SITE DESCRIPTION Bridge No. 174 on SR 1332 (Waterville Road) over Big Creek								GROUND WTR (ft)			
BORING NO. EB2-B		STATION 13+25		OFFSET 17 ft RT		ALIGNMENT -L-		0 HR. Dry			
COLLAR ELEV. 1,415.9 ft		TOTAL DEPTH 14.9 ft		NORTHING 762,001		EASTING 784,192		24 HR. FIAD			
DRILL RIG/HAMMER EFF./DATE F&R4637 CME-75 86% 10/5/2012				DRILL METHOD NW Casing w/ Core			HAMMER TYPE Automatic				
DRILLER J. Fowler		START DATE 10/07/13		COMP. DATE 10/08/13		SURFACE WATER DEPTH N/A					
CORE SIZE NQ2		TOTAL RUN 5.0 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) %	SAMP. NO.	REC. (ft) %			
1406											
1405	1,406.0	9.9	5.0	3:21/1.0 3:14/1.0 3:30/1.0 3:46/1.0 2:43/1.0	(4.5) 90%	(0.9) 18%		(4.5) 90%	(0.9) 18%		1,406.0
										Begin Coring @ 9.9 ft <b>CRYSTALLINE ROCK</b> Slightly weathered, moderately hard to hard, dark gray (PIGEON SILTSTONE), with very close to close fracture spacing.	9.9
	1,401.0	14.9								Boring Terminated at Elevation 1,401.0 ft IN CRYSTALLINE ROCK (PIGEON SILTSTONE)	14.9
										1) Driller indicated auger refusal at 8.5'. 2) Boring filled immediately after drilling due to location in the road.	

NCDOT CORE SINGLE 63R-3026-0174 DIV. 14 BRIDGE 174.GPJ NC\_DOT\_GDT 6/22/16

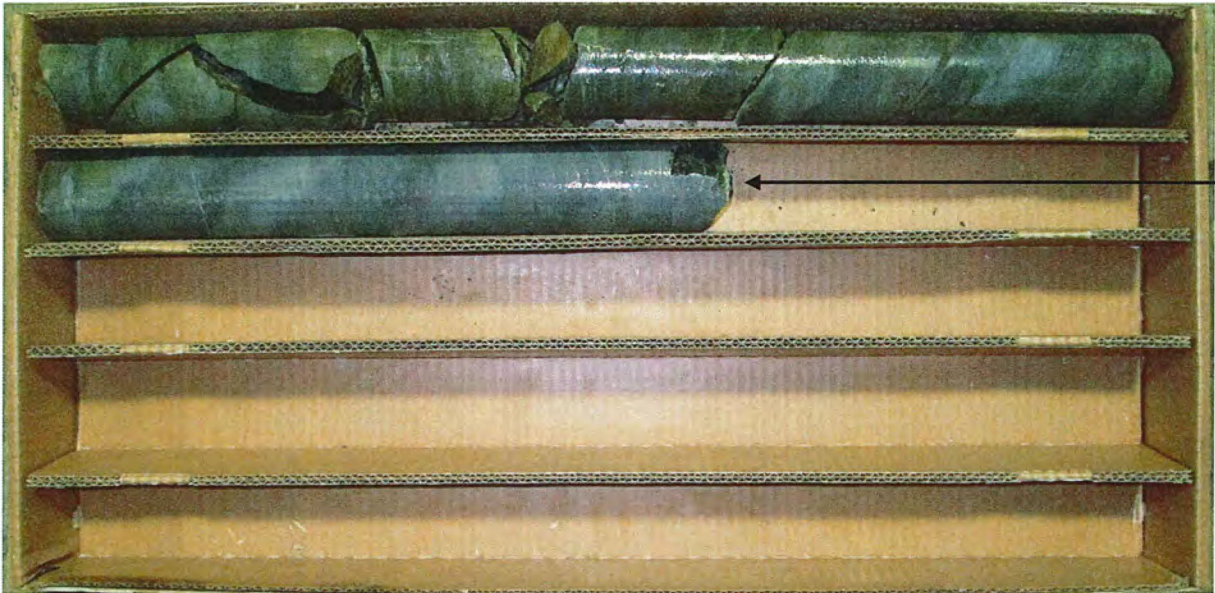




# Bridge No. 430174 on SR 1332 over Big Creek

## CORE PHOTOGRAPHS: EB1-A: Station 11+61, 5' RT

Begin Run 1  
27.2 feet



End Run 1  
30.2 feet





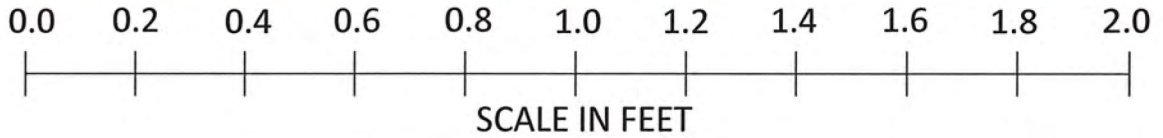
# Bridge No. 430174 on SR 1332 over Big Creek

## CORE PHOTOGRAPHS: EB1-B: Station 11+80, 32' RT

Begin Run 1  
23.6 feet



End Run 1  
28.6 feet

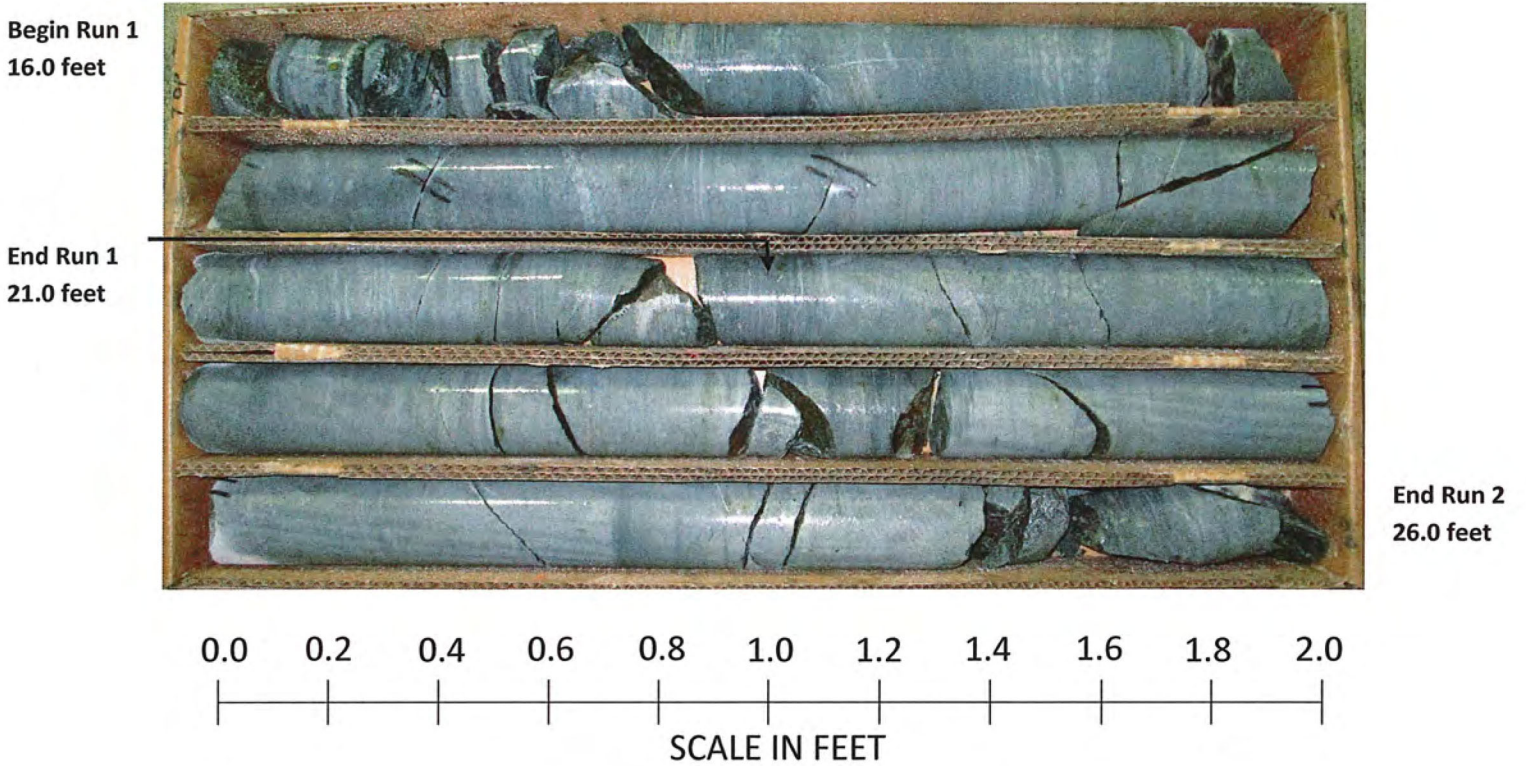






# Bridge No. 430174 on SR 1332 over Big Creek

## CORE PHOTOGRAPHS: EB2-A: Station 12+97, 4' RT





# Bridge No. 430174 on SR 1332 over Big Creek

## CORE PHOTOGRAPHS: EB2-B: Station 13+25, 17' RT

Begin Run 1  
9.9 feet



End Run 2  
14.9 feet

