

REFERENCE: SF-890052

PROJECT: BP10.R003.1

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

STRUCTURE  
SUBSURFACE INVESTIGATION

COUNTY UNION  
PROJECT DESCRIPTION BRIDGE #52 OVER  
MANESS BRANCH ON SR 1725 (DEEP SPRINGS RD)

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-890052	1	14

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DATE JUNE 2022



STEWART



DocuSign by Donald W. Brown Jr. 06/30/2022  
C06817555770411... 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

SOIL DESCRIPTION

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*

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-4, A-5		
SYMBOL												
% PASSING #10 #40 #200												
MATERIAL PASSING #40 LL PI	— 6 MX		— NP									
GROUP INDEX	0		0		4 MX		8 MX		12 MX		16 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	
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD				FAIR TO POOR				FAIR TO POOR		POOR	
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 0.5 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
	4.75	2.00	0.42	0.25	0.075	0.053
			COARSE SAND (CSE. SD.)		FINE SAND (F. SD.)	
BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)			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 PL OM SL	LIQUID LIMIT (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
	WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
	MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

PLASTICITY INDEX (PI)	DRY STRENGTH	
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	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.
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GRADATION

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.

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 WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LL < 31
MODERATELY COMPRESSIBLE	LL = 31 - 50
HIGHLY COMPRESSIBLE	LL > 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

GROUND WATER

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

MISCELLANEOUS SYMBOLS

ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION

SOIL SYMBOL

ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT

INFERRED SOIL BOUNDARY

INFERRED ROCK LINE

ALLUVIAL SOIL BOUNDARY

DIP & DIP DIRECTION OF ROCK STRUCTURES

TEST BORING

AUGER BORING

CORE BORING

MONITORING WELL

PIEZOMETER INSTALLATION

SLOPE INDICATOR INSTALLATION

CONE PENETROMETER TEST

SOUNDING ROD

TEST BORING WITH CORE

SPT N-VALUE

RECOMMENDATION SYMBOLS

UNDERCUT

SHALLOW UNDERCUT

UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE

UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK

UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

ABBREVIATIONS

AR - AUGER REFUSAL  
BT - BORING TERMINATED  
CL - CLAY  
CPT - CONE PENETRATION TEST  
CSE. - COARSE  
DMT - DILATOMETER TEST  
DPT - DYNAMIC PENETRATION TEST  
e - VOID RATIO  
F - FINE  
FOSS. - FOSSILIFEROUS  
FRAC. - FRACTURED, FRACTURES  
FRAGS. - FRAGMENTS  
HL - HIGHLY

MED. - MEDIUM  
MICA. - MICACEOUS  
MOD. - MODERATELY  
NP - NON PLASTIC  
ORG. - ORGANIC  
PMT - PRESSUREMETER TEST  
SAP. - SAPROLITIC  
SD. - SAND, SANDY  
SL. - SILT, SILTY  
SLI. - SLIGHTLY  
TCR - TRICONE REFUSAL  
w - MOISTURE CONTENT  
V - VERY

VST - VANE SHEAR TEST  
WEA. - WEATHERED  
γ - UNIT WEIGHT  
γ<sub>d</sub> - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK  
SS - SPLIT SPOON  
ST - SHELBY TUBE  
RS - ROCK  
RT - RECOMPACTED TRIAXIAL  
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:

☐ CME-45C

☐ CME-55

☒ CME-550

VANE SHEAR TEST

PORTABLE HOIST

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

☐ PDC BIT 2-15/16 " O.D.

HAMMER TYPE:

☒ AUTOMATIC ☐ MANUAL

CORE SIZE:

☐ -B \_\_\_\_\_

☐ -H \_\_\_\_\_

☒ -N Q \_\_\_\_\_

HAND TOOLS:

☐ POST HOLE DIGGER

☐ HAND AUGER

☐ SOUNDING ROD

☐ VANE SHEAR TEST

☐ \_\_\_\_\_

ROCK DESCRIPTION

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:

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, CRYSTALLINE, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.

VERY SLIGHT (V SLI.)

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 (SLI.)

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. *IF TESTED, WOULD YIELD SPT REFUSAL*

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. *IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF*

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. *IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF*

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 PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.

SOFT

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.

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

TERM

VERY WIDE

WIDE

MODERATELY CLOSE

CLOSE

VERY CLOSE

SPACING

MORE THAN 10 FEET

3 TO 10 FEET

1 TO 3 FEET

0.16 TO 1 FOOT

LESS THAN 0.16 FEET

BEDDING

TERM

VERY THICKLY BEDDED

THICKLY BEDDED

THINLY BEDDED

VERY THINLY BEDDED

THICKLY LAMINATED

THINLY LAMINATED

THICKNESS

4 FEET

1.5 - 4 FEET

0.16 - 1.5 FEET

0.03 - 0.16 FEET

0.008 - 0.03 FEET

< 0.008 FEET

INDURATION

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.

TERMS AND DEFINITIONS

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 (RQD) - 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 (SRQD) - 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.

BENCH MARK: BM\*2: RR SPIKE IN 42" OAK AT N469031.599, E161020.487

ELEVATION: 454.06 FEET

NOTES:  
EXISTING GROUND SURFACE SHOWN WAS TAKEN FROM ELECTRONIC TIN FILE (DATED JULY 2021).

FIAD: FILLED IMMEDIATELY AFTER DRILLING

DATE: 8-15-14

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

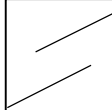
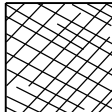


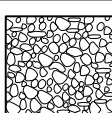
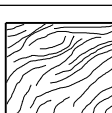
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

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

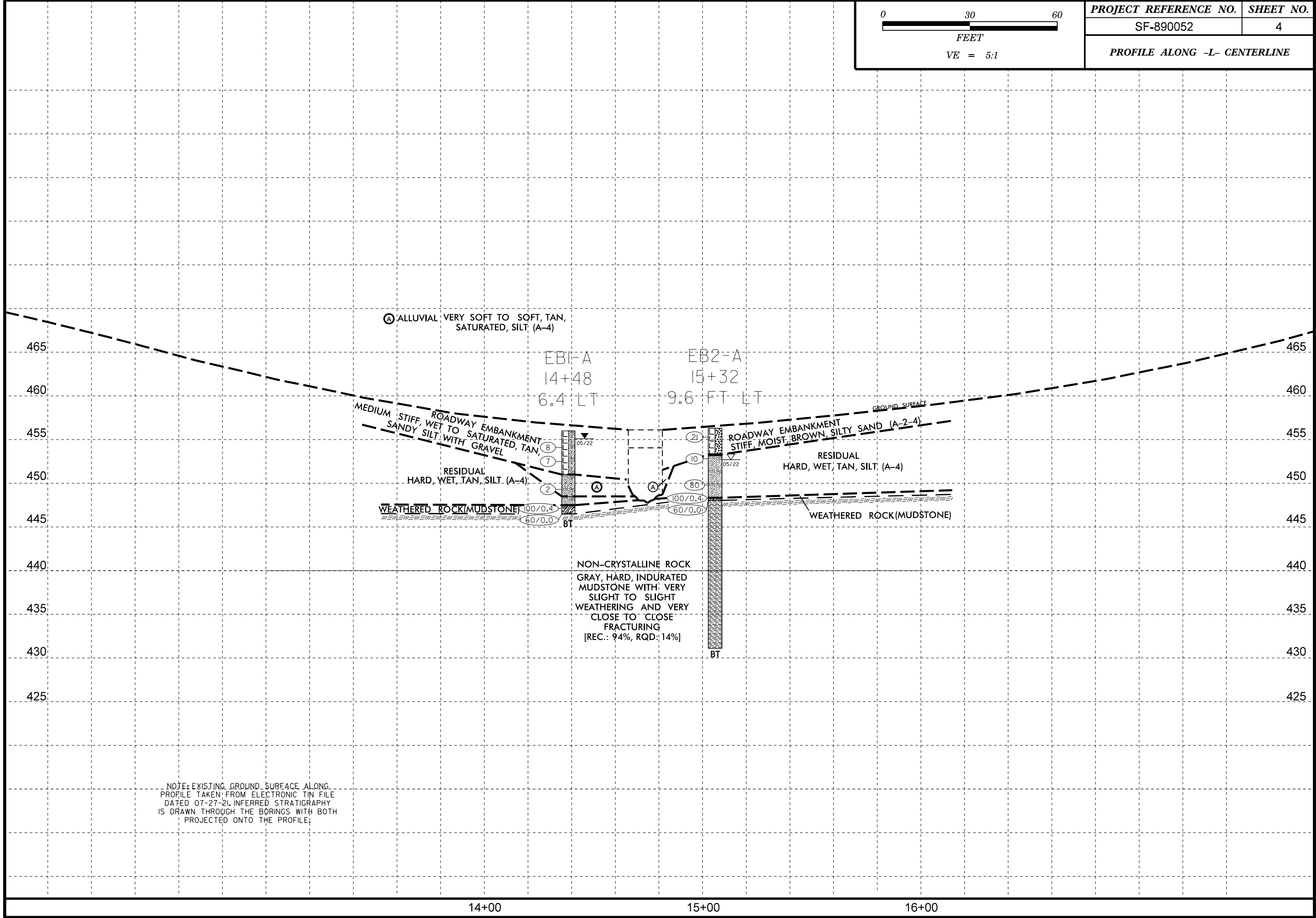
AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

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

<p>GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)</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>SURFACE CONDITIONS</p> <p>VERY GOOD Very rough, fresh unweathered surfaces</p> <p>GOOD Rough, slightly weathered, iron stained surfaces</p> <p>FAIR Smooth, moderately weathered and altered surfaces</p> <p>POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments</p> <p>VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings</p>		<p>DECREASING SURFACE QUALITY ➡</p>		<p>GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)</p> <p>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.</p>		<p>SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)</p> <p>VERY GOOD - Very Rough, fresh unweathered surfaces</p> <p>GOOD - Rough, slightly weathered surfaces</p> <p>FAIR - Smooth, moderately weathered and altered surfaces</p> <p>POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments</p> <p>VERY POOR - Very smooth, slicken-sided or highly weathered surfaces with soft clay coatings or fillings</p>	
<p>STRUCTURE</p>						<p>COMPOSITION AND STRUCTURE</p>			
<p>DECREASING INTERLOCKING OF ROCK PIECES ⇓</p>									
	INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities	90						70	
	BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets	80						60	
	VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets		70						
	BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity		60						
	DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces			50					
	LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes			40					
				30					
					20				
						10			
		N/A	N/A						

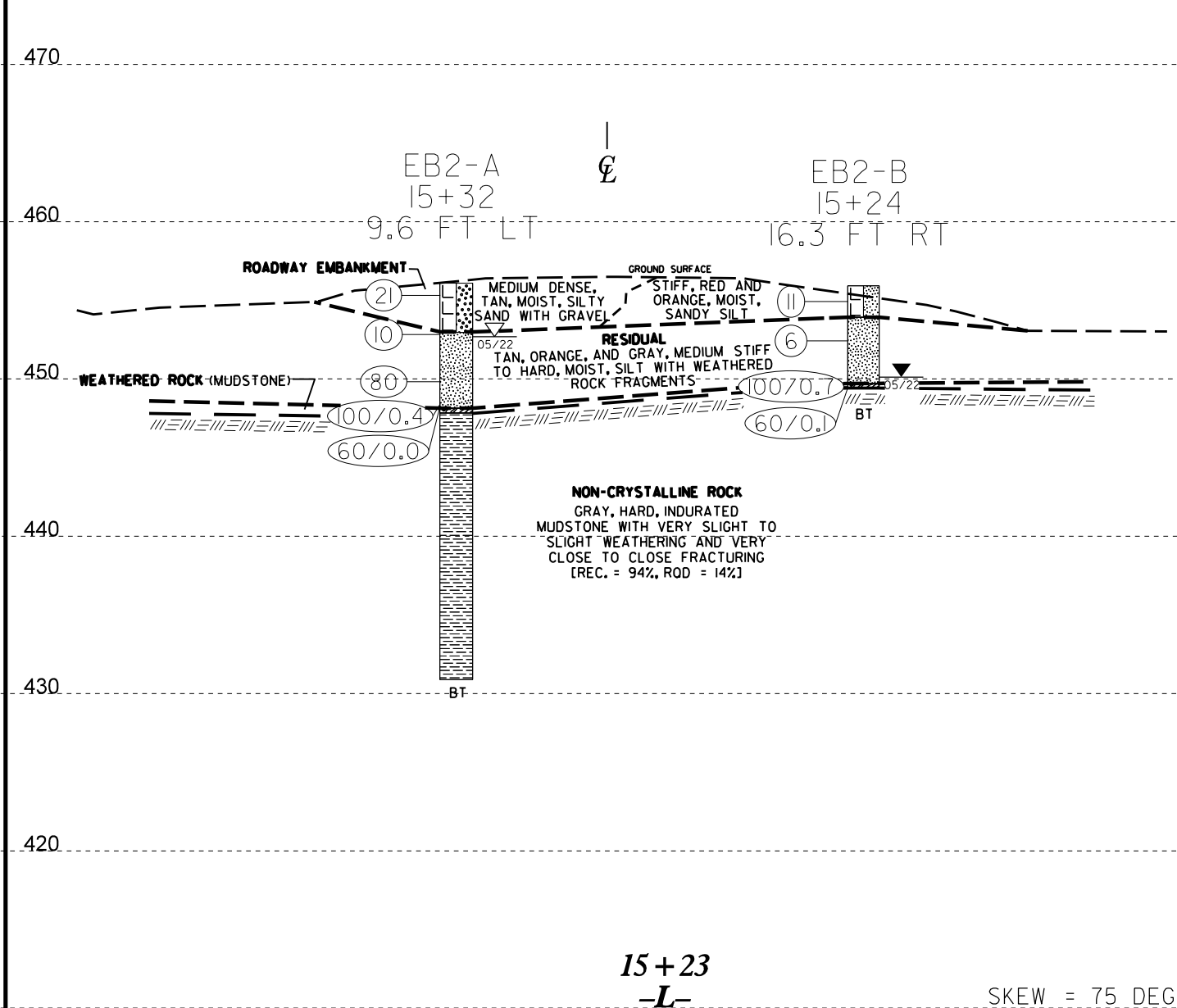
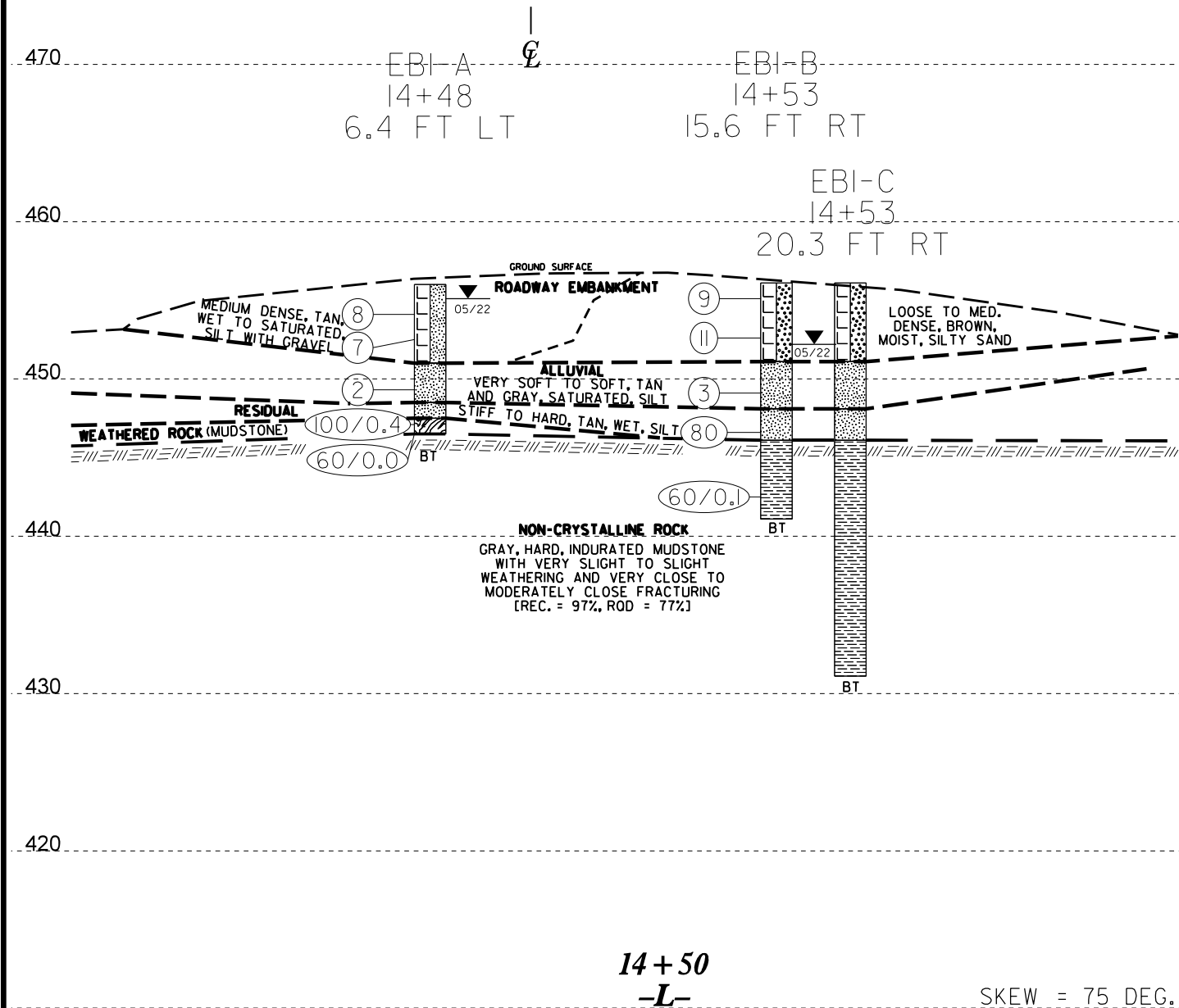






NOTE: EXISTING GROUND SURFACE CROSS SECTION AT END BENT NO. 1 TAKEN FROM ELECTRONIC TIN FILE DATED 07-27-21. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.

NOTE: EXISTING GROUND SURFACE CROSS SECTION AT END BENT NO. 2 TAKEN FROM ELECTRONIC TIN FILE DATED 07-27-21. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION.




NCDOT BORE DOUBLE SF890052 GEO\_BRDG0052 BH.GPJ NC\_DOT.GDT 05/24/22

WBS				BP10.R003.1				TIP				SF-890052				COUNTY				UNION				GEOLOGIST				T. PARK																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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BORING NO.				EB1-B				STATION				14+53				OFFSET				16 ft RT				ALIGNMENT				L				0 HR.		2.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
COLLAR ELEV.				456.1 ft				TOTAL DEPTH				15.0 ft				NORTHING				468,977				EASTING				1,610,121				24 HR.		3.9																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
DRILL RIG/HAMMER EFF./DATE										CAT1303 CME-550 92% 02/03/2022										DRILL METHOD										Mud Rotary										HAMMER TYPE										Automatic																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
DRILLER						P. MCCAIN						START DATE						05/02/22						COMP. DATE						05/03/22						SURFACE WATER DEPTH												N/A																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																															
			0.5ft	0.5ft	0.5ft	0	25	50	75	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
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GEOTECHNICAL BORING REPORT  
BORE LOG

CORE LOG

WBS BP10.R003.1			TIP SF-890052			COUNTY UNION			GEOLOGIST T. PARK					
SITE DESCRIPTION BRIDGE NO. 52 OVER MANESS BRANCH ON SR 1725 (DEEP SPRINGS RD)									GROUND WTR (ft)					
BORING NO. EB1-C			STATION 14+53			OFFSET 20 ft RT			ALIGNMENT L			0 HR. N/A		
COLLAR ELEV. 456.1 ft			TOTAL DEPTH 25.0 ft			NORTHING 468,973			EASTING 1,610,123			24 HR. FIAD		
DRILL RIG/HAMMER EFF./DATE CAT1303 CME-550 92% 02/03/2022						DRILL METHOD Mud Rotary			HAMMER TYPE Automatic					
DRILLER P. MCCAIN			START DATE 05/03/22			COMP. DATE 05/03/22			SURFACE WATER DEPTH N/A					
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT				SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				
460														
455													456.1 GROUND SURFACE	0.0
													ROADWAY EMBANKMENT	
													BROWN SILTY SAND	
450													451.1	5.0
													ALLUVIAL	
													TAN AND GRAY SILT	
													448.1	8.0
445													RESIDUAL	
													TAN SILT	10.0
													NON-CRYSTALLINE ROCK	
													GRAY, HARD, INDURATED MUDSTONE	
													WITH VERY SLIGHT TO SLIGHT	
440													WEATHERING AND VERY CLOSE TO	
													MODERATELY CLOSE FRACTURING	
													[REC. = 97%, RQD = 77%]	
435														
													431.1	25.0
													Boring Terminated at Elevation 431.1 ft in	
													Non-Crystalline Rock (Mudstone)	
													OFFSET BORING FOR EB1-B. BORING	
													WAS ADVANCED TO ROCK WITHOUT	
													SPT. SOIL LITHOLOGY TAKEN FROM	
													BORING EB1-B.	

WBS BP10.R003.1				TIP SF-890052				COUNTY UNION				GEOLOGIST T. PARK							
SITE DESCRIPTION BRIDGE NO. 52 OVER MANESS BRANCH ON SR 1725 (DEEP SPRINGS RD)												GROUND WTR (ft)							
BORING NO. EB1-C				STATION 14+53				OFFSET 20 ft RT				ALIGNMENT L				0 HR. N/A			
COLLAR ELEV. 456.1 ft				TOTAL DEPTH 25.0 ft				NORTHING 468,973				EASTING 1,610,123				24 HR. FIAD			
DRILL RIG/HAMMER EFF./DATE CAT1303 CME-550 92% 02/03/2022								DRILL METHOD Mud Rotary				HAMMER TYPE Automatic							
DRILLER P. MCCAIN				START DATE 05/03/22				COMP. DATE 05/03/22				SURFACE WATER DEPTH N/A							
CORE SIZE NQ				TOTAL RUN 15.0 ft															
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. RQD (ft) (%)		SAMP. NO.	STRATA REC. RQD (ft) (%)		L O G	DESCRIPTION AND REMARKS								
446.1											Begin Coring @ 10.0 ft								
445	446.1	10.0	1.0	1.08/1.0	(0.5)	(0.0)		(14.5)	(11.5)		446.1 NON-CRYSTALLINE ROCK 10.0								
			5.0	1.17/1.0	50%	0%		97%	77%		GRAY, HARD, INDURATED MUDSTONE WITH VERY SLIGHT TO SLIGHT WEATHERING AND VERY CLOSE TO MODERATELY CLOSE FRACTURING								
				1.19/1.0	(5.0)	(5.0)													
				1.15/1.0	100%	100%													
				1/1.0															
440	440.1	16.0		1.09/1.0															
			5.0	1.1/1.0	(5.0)	(3.1)													
				1.06/1.0	100%	62%													
				1.08/1.0															
435	435.1	21.0		1.32/1.0															
			4.0	3.59/1.0															
				1.15/1.0	(4.0)	(3.4)													
				1.08/1.0	100%	85%													
				1.18/1.0															
	431.1	25.0		1.04/1.0							431.1 Boring Terminated at Elevation 431.1 ft in Non-Crystalline Rock (Mudstone) 25.0								

NCDOT BORE DOUBLE\_SF890052\_GEO\_BRDG890052\_BH.GPJ NC\_DOT.GDT 05/13/22

NCDOT BORE DOUBLE SF890052\_GEO\_BRDG890052\_BH.GPJ NC\_DOT.GDT 05/16/22

WBS    BP10.R003.1					TIP    SF-890052					COUNTY    UNION					GEOLOGIST    T. PARK											
SITE DESCRIPTION    BRIDGE NO. 52 OVER MANESS BRANCH ON SR 1725 (DEEP SPRINGS RD)															GROUND WTR (ft)											
BORING NO.    EB2-A					STATION    15+32					OFFSET    10 ft LT					ALIGNMENT    L					0 HR.    3.6						
COLLAR ELEV.    456.3 ft					TOTAL DEPTH    25.2 ft					NORTHING    469,023					EASTING    1,610,190					24 HR.    FIAD						
DRILL RIG/HAMMER EFF./DATE    CAT1303 CME-550 92% 02/03/2022										DRILL METHOD    Mud Rotary					HAMMER TYPE    Automatic											
DRILLER    P. MCCAIN					START DATE    05/02/22					COMP. DATE    05/03/22					SURFACE WATER DEPTH    N/A											
CORE SIZE    NQ					TOTAL RUN    17.2 ft																					
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	ROD (ft) %	SAMP. NO.	STRATA REC. (ft) %	ROD (ft) %	L O G	DESCRIPTION AND REMARKS															
448.3	448.3	8.0	1.0	N=60/0.0 5.5/1.0	(0.0) 0%	(0.0) 0%		(16.2) 94%	(2.4) 14%		Begin Coring @ 8.0 ft															
445	447.3	9.0	5.1	2.35/1.1 2.03/1.0 2.01/1.0 1.23/1.0 1.47/1.0	(5.1) 100%	(0.8) 16%					NON-CRYSTALLINE ROCK															
											GRAY, HARD, INDURATED MUDSTONE WITH VERY SLIGHT TO SLIGHT WEATHERING AND VERY CLOSE TO CLOSE FRACTURING															
440	442.2	14.1	5.1	1.59/1.1 2.18/1.0 2.09/1.0 1.35/1.0 1.18/1.0	(5.1) 100%	(1.0) 20%																				
435	437.1	19.2	5.0	1.24/1.0 0.59/1.0 1.07/1.0 1.11/1.0 1.16/1.0	(5.0) 100%	(0.0) 0%																				
	432.1	24.2																								
	431.1	25.2	1.0	1.15/1.0	(1.0) 100%	(0.6) 60%					431.1															
												Boring Terminated at Elevation 431.1 ft on Non-Crystalline Rock (Mudstone)														

GEOTECHNICAL BORING REPORT  
BORE LOG

WBS BP10.R003.1			TIP SF-890052		COUNTY UNION		GEOLOGIST T. PARK							
SITE DESCRIPTION BRIDGE NO. 52 OVER MANESS BRANCH ON SR 1725 (DEEP SPRINGS RD)							GROUND WTR (ft)							
BORING NO. EB2-B			STATION 15+24		OFFSET 16 ft RT		ALIGNMENT L		0 HR. 5.3					
COLLAR ELEV. 455.9 ft			TOTAL DEPTH 6.5 ft		NORTHING 468,996		EASTING 1,610,190		24 HR. 5.8					
DRILL RIG/HAMMER EFF./DATE CAT1303 CME-550 92% 02/03/2022					DRILL METHOD Mud Rotary			HAMMER TYPE Automatic						
DRILLER P. MCCAIN			START DATE 05/02/22		COMP. DATE 05/03/22		SURFACE WATER DEPTH N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100		MOI	LO G	ELEV. (ft) DEPTH (ft)
460														
	455.9	0.0												455.9 GROUND SURFACE 0.0
455			3	7	4							M		453.9 ROADWAY EMBANKMENT 2.0
	453.4	2.5	3	3	3							M		RED AND ORANGE, SANDY SILT
	450.7	5.2												RESIDUAL
450	449.5	6.4	5	48	52/0.2							W		TAN, GRAY, AND RED, SILT
			60/0.1											449.7 6.2
														449.4 6.5
														WEATHERED ROCK
														GRAY, MUDSTONE
														Boring Terminated with Standard
														Penetration Test Refusal at Elevation 449.4
														ft in Non-Crystalline Rock (Mudstone)

NCDOT BORE DOUBLE SF890052\_GEO\_BRDG0052\_BH.GPJ NC\_DOT.GDT 05/24/22



CORE PHOTOGRAPHS

BRIDGE NO. 52 ON SR 1725 (DEEP SPRINGS RD) OVER MANESS BRANCH

BORING EBI-C  
STA. 14+53 -L-, 16 FT RT  
DEPTH: 10.0 FT TO 16.0 FT



BORING EBI-C  
STA. 14+53 -L-, 16 FT RT  
DEPTH: 16.0 FT TO 21.0 FT





CORE PHOTOGRAPHS

BRIDGE NO. 52 ON SR 1725 (DEEP SPRINGS RD) OVER MANESS BRANCH

**BORING EB1-C**  
**STA. 14+53 -L-, 16 FT RT**  
**DEPTH: 21.0 FT TO 25.0 FT**

START OF  
RUN #4  
@ 21.0 FT



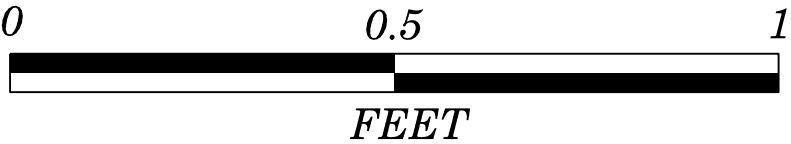
END OF  
CORING  
25.0 FT

**BORING EB2-A**  
**STA. 15+32 -L-, 10 FT LT**  
**DEPTH: 8.0 FT TO ~15.5 FT**

START OF  
RUN #2\*  
9.0 FT



RUN #3  
CONT'D ON  
NEXT SHEET



START OF  
RUN #3  
13.1 FT

\*RUN #1 HAD 0% REC



CORE PHOTOGRAPHS

BRIDGE NO. 52 ON SR 1725 (DEEP SPRINGS RD) OVER MANESS BRANCH

BORING EB2-A  
STA. 15+32 -L-, 10 FT LT  
DEPTH: ~16.5 FT TO 25.2 FT

RUN #3  
CONT'D FROM  
PREV SHEET

START OF  
RUN #4  
19.2 FT



END OF  
RUN #3  
AT 19.2 FT

BORING EB2-A  
STA. 15+32 -L-, 10 FT LT  
DEPTH: 24.2 FT TO 25.2 FT

START OF  
RUN #5  
24.2 FT



END OF  
CORING  
25.21 FT





***SITE PHOTOGRAPH***

BRIDGE NO. 52 ON SR 1725 (DEEP SPRINGS RD) OVER MANESS BRANCH



VIEW LOOKING EAST