

REFERENCE: SF-790254

PROJECT: 17BP.9.R.96

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

STRUCTURE
SUBSURFACE INVESTIGATION

COUNTY ROWAN
 PROJECT DESCRIPTION BRIDGE NO. 254 OVER KERR
CREEK ON CALDWELL ROAD (SR 1547)

 SITE DESCRIPTION STA. 15+55 -L-

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STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-790254	1	

CAUTION NOTICE

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

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

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1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
 2. 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.

PERSONNEL

H. FISCHER, GIT

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DATE APRIL, 2023

Prepared In the Office of:

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DocuSigned by

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SIGNATURE

04/20/2023
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										GRADATION										ROCK DESCRIPTION										TERMS AND DEFINITIONS																																																																																																																																																																																			
<p>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 208, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, <i>VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i></p>										<p>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.</p>										<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 DISLOGGED 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 (N 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>																																																																																																																																																																																			
<p style="text-align: center;">SOIL LEGEND AND AASHTO CLASSIFICATION</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th rowspan="2">GENERAL CLASS.</th> <th colspan="7">GRANULAR MATERIALS (≤ 35% PASSING #200)</th> <th colspan="3">SILT-CLAY MATERIALS (> 35% PASSING #200)</th> <th colspan="2">ORGANIC MATERIALS</th> </tr> <tr> <th>A-1</th> <th>A-3</th> <th>A-2</th> <th>A-2-4</th> <th>A-2-5</th> <th>A-2-6</th> <th>A-2-7</th> <th>A-4</th> <th>A-5</th> <th>A-6</th> <th>A-7</th> <th>A-1, A-2</th> <th>A-3</th> <th>A-4, A-5</th> <th>A-6, A-7</th> </tr> <tr> <th>GROUP CLASS.</th> <td>A-1-a</td> <td>A-1-b</td> <td>A-2-4</td> <td>A-2-5</td> <td>A-2-6</td> <td>A-2-7</td> <td>A-4</td> <td>A-5</td> <td>A-6</td> <td>A-7</td> <td>A-1, A-2</td> <td>A-3</td> <td>A-4, A-5</td> <td>A-6, A-7</td> </tr> <tr> <th>SYMBOL</th> <td colspan="7">[Pattern]</td> <td colspan="3">[Pattern]</td> <td colspan="2">[Pattern]</td> <td colspan="2">[Pattern]</td> </tr> <tr> <th>% PASSING #10 #40 #200</th> <td>50 MX 30 MX 15 MX</td> <td>50 MX 25 MX</td> <td>51 MN 10 MX</td> <td>35 MX</td> <td>35 MX</td> <td>35 MX</td> <td>35 MX</td> <td>36 MN</td> <td>36 MN</td> <td>36 MN</td> <td>36 MN</td> <td>GRANULAR SOILS</td> <td>SILT-CLAY SOILS</td> <td>MUCK, PEAT</td> </tr> <tr> <th>MATERIAL PASSING #40 LL PI</th> <td colspan="7">[Values]</td> <td colspan="3">[Values]</td> <td colspan="2">[Values]</td> <td colspan="2">[Values]</td> </tr> <tr> <th>GROUP INDEX</th> <td colspan="7">[Values]</td> <td colspan="3">[Values]</td> <td colspan="2">[Values]</td> <td colspan="2">[Values]</td> </tr> <tr> <th>USUAL TYPES OF MAJOR MATERIALS</th> <td colspan="2">STONE FRAGS. 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A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	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]		% PASSING #10 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT	MATERIAL PASSING #40 LL PI	[Values]							[Values]			[Values]		[Values]		GROUP INDEX	[Values]							[Values]			[Values]		[Values]		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		GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR			FAIR TO POOR		POOR		UNSATURABLE		PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30															<p style="text-align: center;">MINERALOGICAL COMPOSITION</p> <p>MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.</p>										<p style="text-align: center;">WEATHERING</p> <p>FRESH: ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.</p> <p>VERY SLIGHT (IV 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.</p> <p>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.</p> <p>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.</p> <p>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></p> <p>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></p> <p>VERY SEVERE (IV 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></p> <p>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.</p>										<p style="text-align: center;">PERCENTAGE OF MATERIAL</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th></th> <th>GRANULAR SOILS</th> <th>SILT - CLAY SOILS</th> <th>OTHER MATERIAL</th> </tr> <tr> <td>TRACE OF ORGANIC MATTER</td> <td>2 - 3%</td> <td>3 - 5%</td> <td>TRACE 1 - 10%</td> </tr> <tr> <td>LITTLE ORGANIC MATTER</td> <td>3 - 5%</td> <td>5 - 12%</td> <td>LITTLE 10 - 20%</td> </tr> <tr> <td>MODERATELY ORGANIC</td> <td>5 - 10%</td> <td>12 - 20%</td> <td>SOME 20 - 35%</td> </tr> <tr> <td>HIGHLY ORGANIC</td> <td>> 10%</td> <td>> 20%</td> <td>HIGHLY 35% AND ABOVE</td> </tr> </table>											GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE 1 - 10%	LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE 10 - 20%	MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME 20 - 35%	HIGHLY ORGANIC	> 10%	> 20%	HIGHLY 35% AND ABOVE
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<p style="text-align: center;">GROUND WATER</p> <p>▽ WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING</p> <p>▽ PW STATIC WATER LEVEL AFTER 24 HOURS</p> <p>▽ PW PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA</p> <p>○ SPRING OR SEEP</p>										<p style="text-align: center;">MISCELLANEOUS SYMBOLS</p> <p>ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION</p> <p>SOIL SYMBOL</p> <p>ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT</p> <p>INFERRED SOIL BOUNDARY</p> <p>INFERRED ROCK LINE</p> <p>ALLUVIAL SOIL BOUNDARY</p> <p>DIP & DIP DIRECTION OF ROCK STRUCTURES</p> <p>SPT TEST BORING</p> <p>AUGER BORING</p> <p>CORE BORING</p> <p>MONITORING WELL</p> <p>PIEZOMETER INSTALLATION</p> <p>SLOPE INDICATOR INSTALLATION</p> <p>CONE PENETROMETER TEST</p> <p>SOUNDING ROD</p> <p>TEST BORING WITH CORE</p> <p>SPT N-VALUE</p>										<p style="text-align: center;">RECOMMENDATION SYMBOLS</p> <p>UNDERCUT</p> <p>SHALLOW UNDERCUT</p> <p>UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE</p> <p>UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK</p> <p>UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL</p>																																																																																																																																																																																													
<p style="text-align: center;">TEXTURE OR GRAIN SIZE</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>U.S. STD. SIEVE SIZE OPENING (MM)</th> <td>4</td> <td>10</td> <td>40</td> <td>60</td> <td>200</td> <td>270</td> </tr> <tr> <td></td> <td>4.75</td> <td>2.00</td> <td>0.42</td> <td>0.25</td> <td>0.075</td> <td>0.053</td> </tr> <tr> <th>BOULDER (BLDR.)</th> <th>COBBLE (COB.)</th> <th>GRAVEL (GR.)</th> <th>COARSE SAND (CSE. SD.)</th> <th>FINE SAND (F SD.)</th> <th>SILT (SL.)</th> <th>CLAY (CL.)</th> </tr> <tr> <td>GRAIN SIZE</td> <td>MM 305 IN. 12</td> <td>75</td> <td>2.0</td> <td>0.25</td> <td>0.05</td> <td>0.005</td> </tr> </table>										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	BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)	GRAIN SIZE	MM 305 IN. 12	75	2.0	0.25	0.05	0.005	<p style="text-align: center;">ABBREVIATIONS</p> <p>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 HI. - HIGHLY</p> <p>MED. - MEDIUM MICA - MICACEOUS MOD. - MODERATELY NP - NON PLASTIC ORG. - ORGANIC PMT - PRESSUREMETER TEST SAP. - SAPROLITIC SD. - SAND, SANDY SL. - SILTY, SILTY SLI. - SLIGHTLY TCR - TRICONE REFUSAL w - MOISTURE CONTENT V - VERY</p> <p>VST - VANE SHEAR TEST WEA. - WEATHERED W - UNIT WEIGHT W_d - DRY UNIT WEIGHT</p> <p>SAMPLE ABBREVIATIONS</p> <p>S - BULK SS - SPLIT SPOON ST - SHELBY TUBE RS - ROCK RT - RECOMPACTED TRIAXIAL CBR - CALIFORNIA BEARING RATIO</p>																																																																																																																																																																											
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<p style="text-align: center;">COLOR</p> <p>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.</p>										<p style="text-align: center;">INDURATION</p> <p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p> <p>FRIABLE: RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p> <p>MODERATELY INDURATED: GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p> <p>INDURATED: GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p> <p>EXTREMELY INDURATED: SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>										<p style="text-align: center;">NOTES:</p> <p>One of the proposed borings (EBI-B) was in significant conflict with overhead power lines. This boring was deleted with the permission of NCDOT's foundation design engineer, Shiping Yang, Ph.D., P.E.</p> <p>MnO = Manganese Oxide</p>																																																																																																																																																																																													
<p style="text-align: center;">FRAC. MARK: BM#2 - RR Spike in 17' Poplar</p> <p>N:685669</p> <p>E:505814</p> <p style="text-align: right;">ELEVATION: 723.26 FEET</p>										<p style="text-align: center;">DATE: 8-15-14</p>																																																																																																																																																																																																							

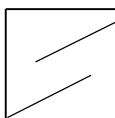
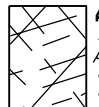
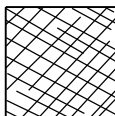





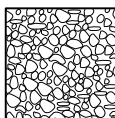

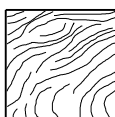



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

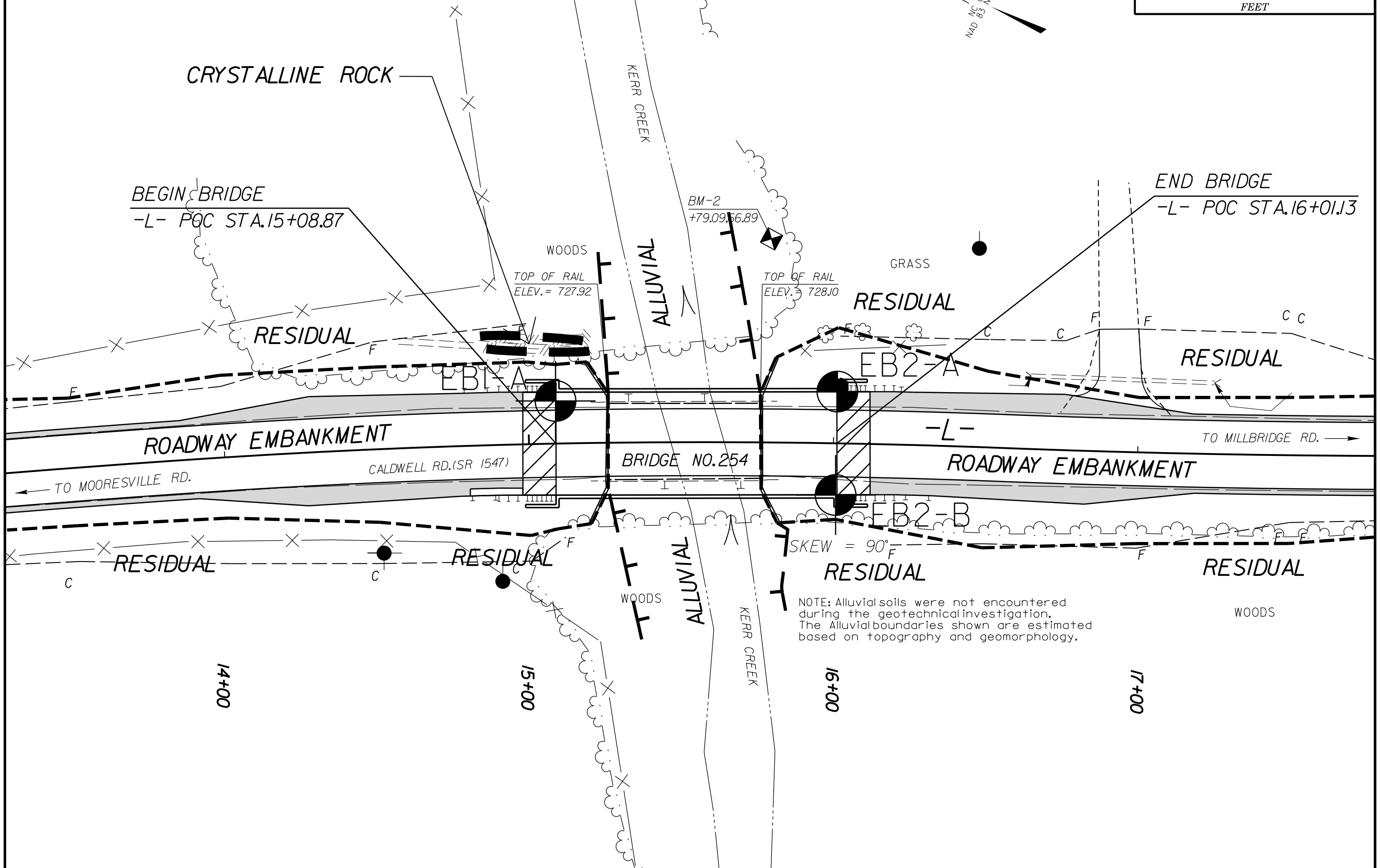
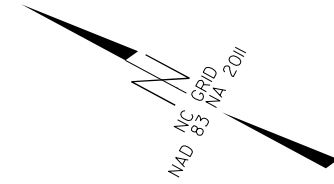
SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

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

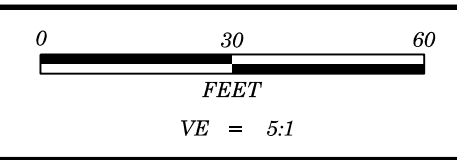
AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)	SURFACE CONDITIONS					GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)	SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)				
<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>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>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>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, slickensided or highly weathered surfaces with soft clay coatings or fillings</p>
STRUCTURE	DECREASING SURFACE QUALITY →					COMPOSITION AND STRUCTURE					
 <p>INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p>	90			N/A	N/A	 <p>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.</p>	70	A			
 <p>BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p>	80	70				 <p>B. Sandstone with thin inter-layers of siltstone</p>	60	A	B	C	D
 <p>VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p>		60	50			 <p>C. Sandstone and siltstone in similar amounts</p>	50	B	C	D	E
 <p>BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p>			40	30		 <p>D. Siltstone or silty shale with sandstone layers</p>	40	B	C	D	E
 <p>DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p>				20		 <p>E. Weak siltstone or clayey shale with sandstone layers</p>	30	B	C	D	E
 <p>LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>	N/A	N/A		10		 <p>F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure</p>	20	B	C	D	E
						 <p>G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers</p>	10	B	C	D	E
						 <p>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.</p>		B	C	D	E

→ Means deformation after tectonic disturbance

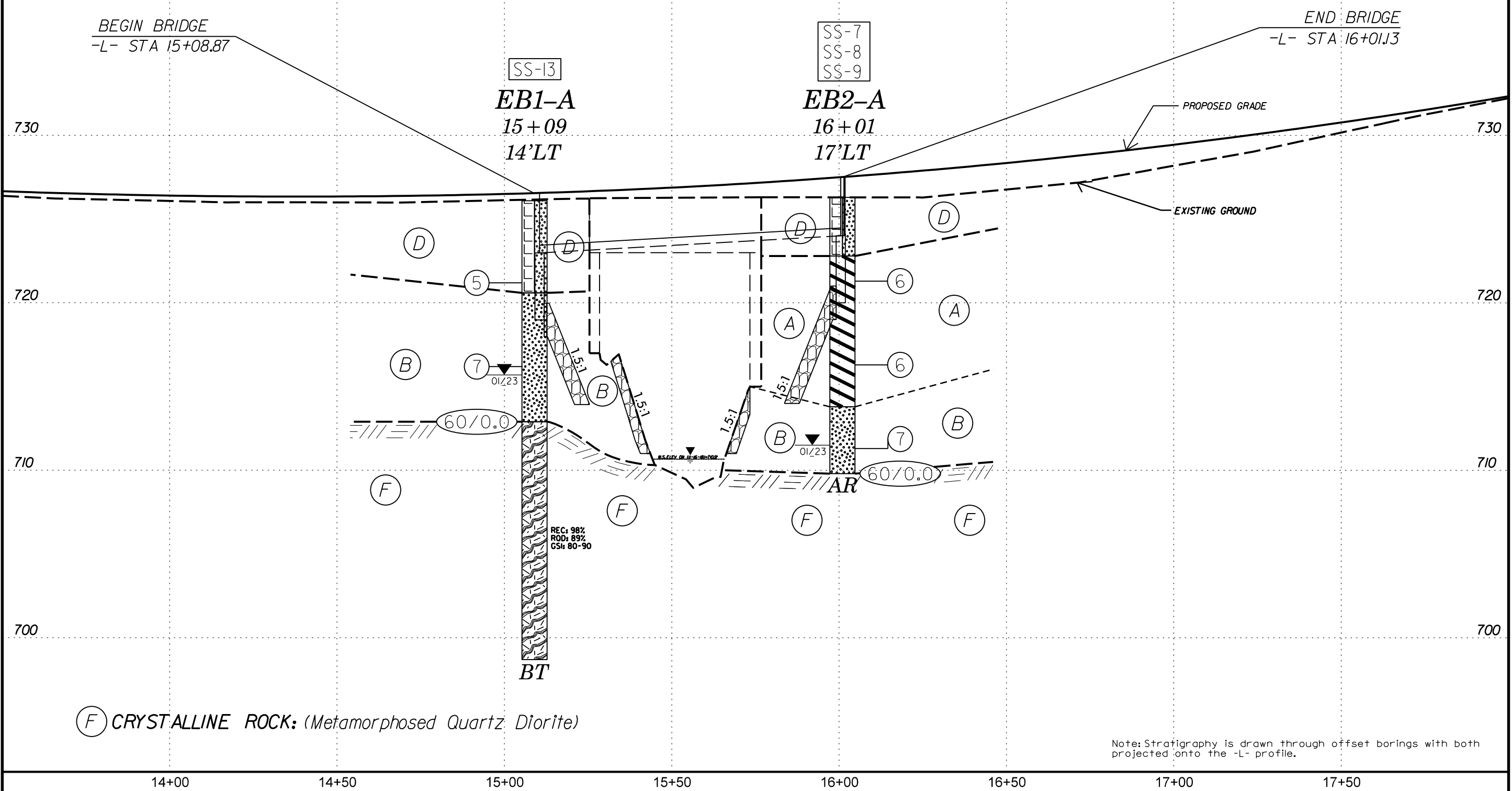


NOTE: Alluvial soils were not encountered during the geotechnical investigation. The Alluvial boundaries shown are estimated based on topography and geomorphology.



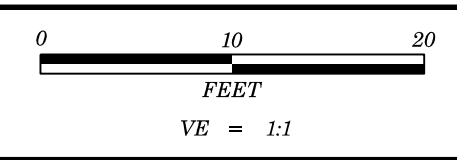
PROJECT REFERENCE NO.	SHEET NO.
SF-790254	4
BRIDGE NO. 254 (-L- PROFILE LEFT)	

- (D) **ROADWAY EMBANKMENT:** brown to orange-brown, moist, loose, silty SAND (A-2-4) with little clay and gravel, trace mica
- (A) **RESIDUAL:** orange-brown, moist to wet, medium stiff, moderately plastic, highly sandy, silty CLAY (A-7-6) with trace gravel-sized rock fragments, some to little mica and MnO
- (B) **RESIDUAL:** orange-brown to dark gray, moist to saturated, loose, silty SAND (A-2-4) with little clay, trace gravel-sized rock fragments and mica

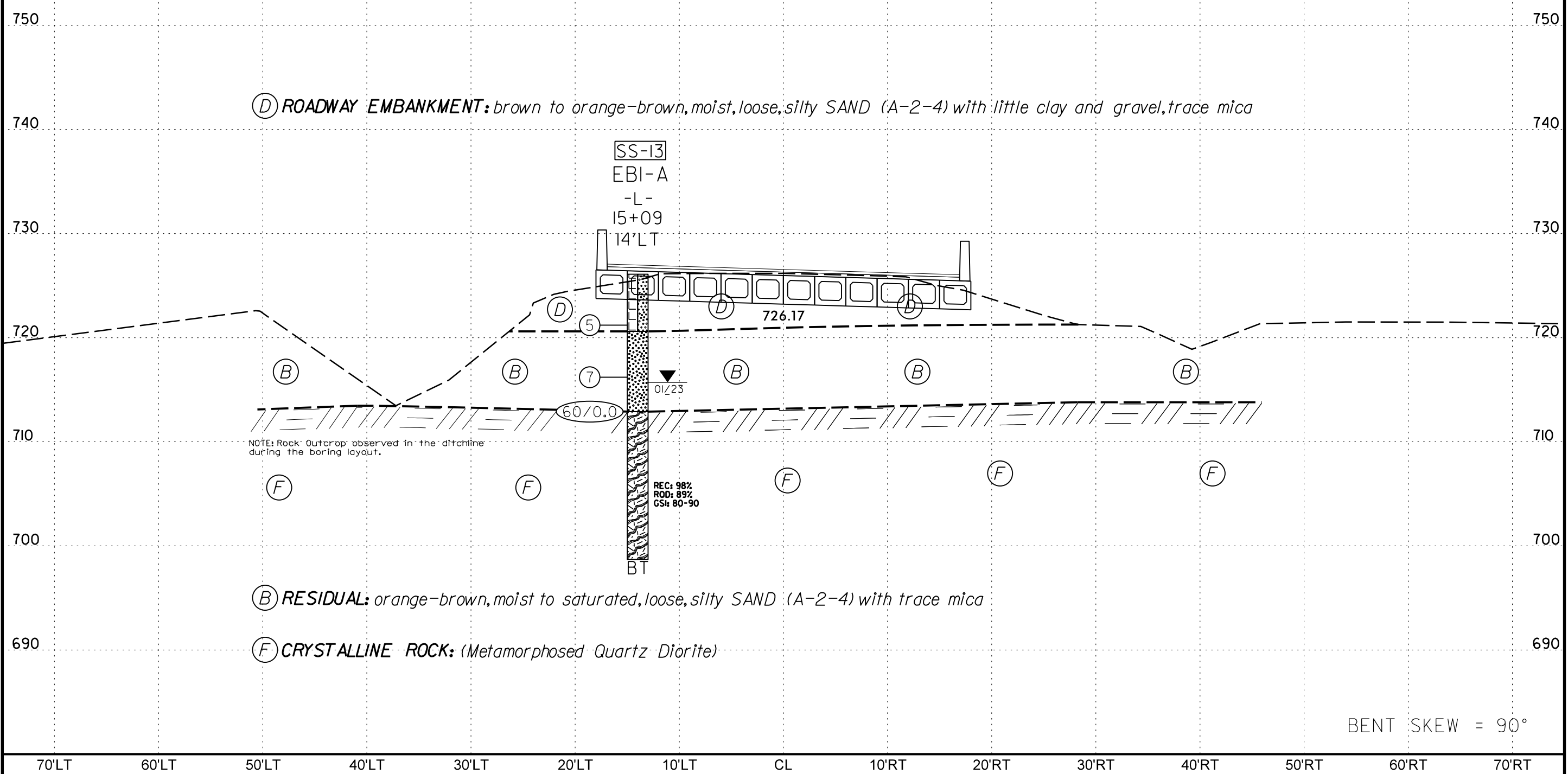


(F) **CRYSTALLINE ROCK:** (Metamorphosed Quartz Diorite)

Note: Stratigraphy is drawn through offset borings with both projected onto the -L- profile.



PROJECT REFERENCE NO.	SHEET NO.
SF-790254	5
BRIDGE NO. 254 (END BENT 1)	



(D) **ROADWAY EMBANKMENT:** brown to orange-brown, moist, loose, silty SAND (A-2-4) with little clay and gravel, trace mica

SS-13
EBI-A
-L-
15+09
14'LT

REC: 98%
ROD: 89%
GSI: 80-90

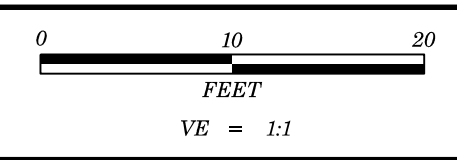
NOTE: Rock outcrop observed in the ditchline during the boring layout.

(B) **RESIDUAL:** orange-brown, moist to saturated, loose, silty SAND (A-2-4) with trace mica

(F) **CRYSTALLINE ROCK:** (Metamorphosed Quartz Diorite)

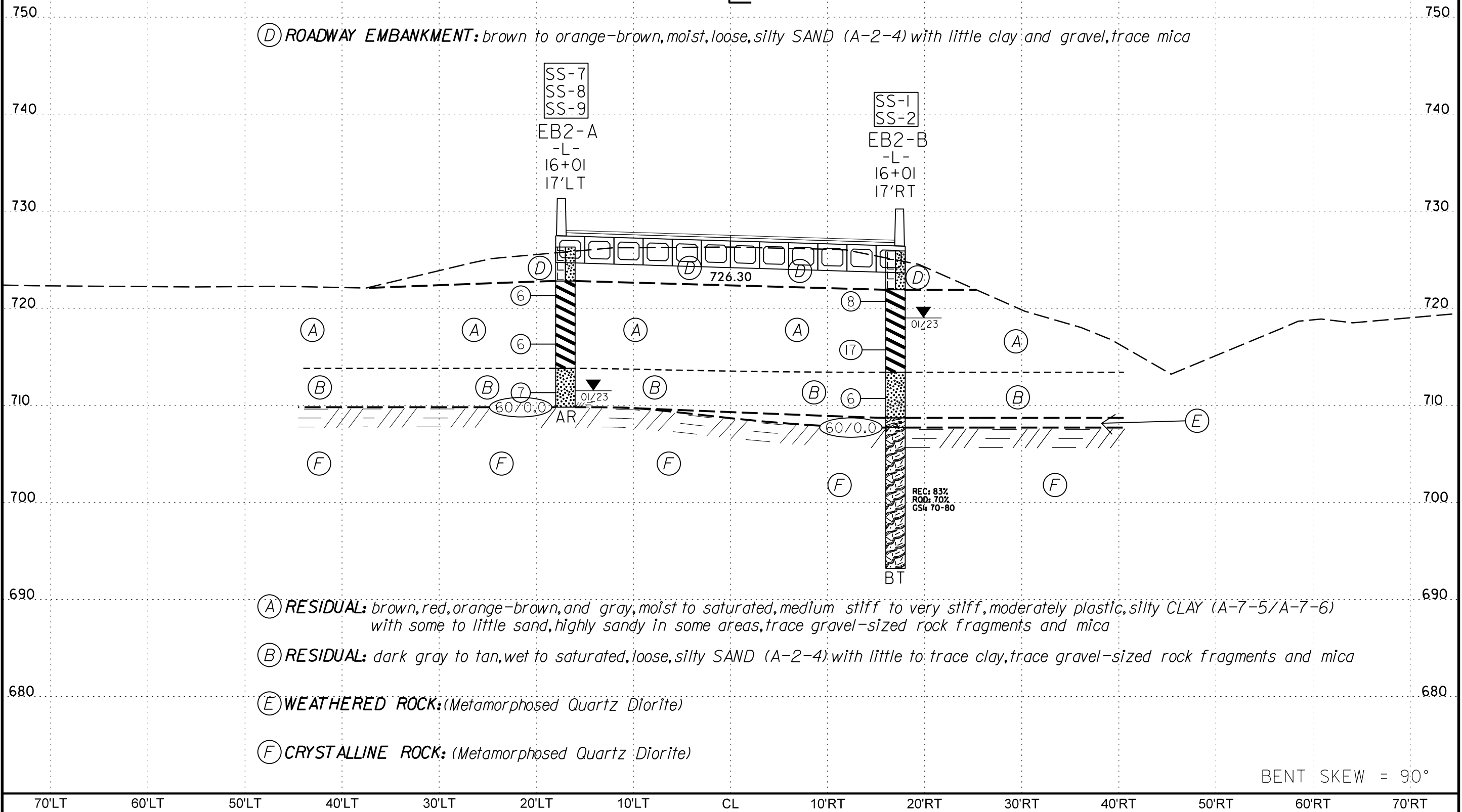
BENT SKEW = 90°

70'LT 60'LT 50'LT 40'LT 30'LT 20'LT 10'LT CL 10'RT 20'RT 30'RT 40'RT 50'RT 60'RT 70'RT



PROJECT REFERENCE NO.	SHEET NO.
SF-790254	6
BRIDGE NO. 254 (END BENT 2)	

CL
 -L-



(D) **ROADWAY EMBANKMENT:** brown to orange-brown, moist, loose, silty SAND (A-2-4) with little clay and gravel, trace mica

SS-7
 SS-8
 SS-9
 EB2-A
 -L-
 16+01
 17'LT

SS-1
 SS-2
 EB2-B
 -L-
 16+01
 17'RT

REC: 83%
 ROD: 70%
 GS: 70-80

(A) **RESIDUAL:** brown, red, orange-brown, and gray, moist to saturated, medium stiff to very stiff, moderately plastic, silty CLAY (A-7-5/A-7-6) with some to little sand, highly sandy in some areas, trace gravel-sized rock fragments and mica

(B) **RESIDUAL:** dark gray to tan, wet to saturated, loose, silty SAND (A-2-4) with little to trace clay, trace gravel-sized rock fragments and mica

(E) **WEATHERED ROCK:** (Metamorphosed Quartz Diorite)

(F) **CRYSTALLINE ROCK:** (Metamorphosed Quartz Diorite)

BENT SKEW = 90°

GEOTECHNICAL BORING REPORT BORE LOG

WBS 17BP.9.R.96		TIP SF-790254		COUNTY ROWAN		GEOLOGIST Fischer, H.									
SITE DESCRIPTION Bridge No. 254 over Kerr Creek on Caldwell Road (SR 1547)							GROUND WTR (ft)								
BORING NO. EB2-B		STATION 16+01		OFFSET 17 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 725.9 ft		TOTAL DEPTH 32.7 ft		NORTHING 685,611		EASTING 1,505,750									
DRILL RIG/HAMMER EFF./DATE SUM2603 CME-550X 83% 11/12/2021		DRILL METHOD SPT Core Boring		HAMMER TYPE Automatic											
DRILLER Moseley, M.G.		START DATE 01/18/23		COMP. DATE 01/18/23		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					
730															
725															
720	721.7	4.2	4	3	5										
715	716.7	9.2	4	5	12										
710	711.7	14.2	4	3	3										
705	707.7	18.2	60/0.0												
700															
695															

NCDOT BORE SINGLE SF790254_GEO_RDWY_L.GPJ_NC_DOT.GDT 4/11/23

GEOTECHNICAL BORING REPORT CORE LOG

WBS 17BP.9.R.96		TIP SF-790254		COUNTY ROWAN		GEOLOGIST Fischer, H.						
SITE DESCRIPTION Bridge No. 254 over Kerr Creek on Caldwell Road (SR 1547)							GROUND WTR (ft)					
BORING NO. EB2-B		STATION 16+01		OFFSET 17 ft RT		ALIGNMENT -L-						
COLLAR ELEV. 725.9 ft		TOTAL DEPTH 32.7 ft		NORTHING 685,611		EASTING 1,505,750						
DRILL RIG/HAMMER EFF./DATE SUM2603 CME-550X 83% 11/12/2021		DRILL METHOD SPT Core Boring		HAMMER TYPE Automatic								
DRILLER Moseley, M.G.		START DATE 01/18/23		COMP. DATE 01/18/23		SURFACE WATER DEPTH N/A						
CORE SIZE NQ2		TOTAL RUN 14.5 ft										
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (%)	RQD (%)		REC. (%)	RQD (%)			
707.7	707.7	18.2	4.5	N=60/0.0 0.37/0.5 1.22/1.0 1.59/1.0 2.54/1.0 4.10/1.0	(3.9)	(3.2)		(12.1)	(10.1)		Begin Coring @ 18.2 ft	18.2
705					87%	71%		83%	70%		white, gray, and black with some orange-brown (iron-oxide) staining, especially around fractures, mostly slight to very slight weathering with some moderate to moderate severely weathered zones (interpreted from core loss), mostly hard to very hard, moderately hard in the more weathered zones, generally close fracture spacing with one set of healed high angle fractures noted, METAMORPHOSED QUARTZ DIORITE. GSI = 70-80	
700	703.2	22.7	5.0	0.56/1.0 1.02/1.0 1.00/1.0 1.03/1.0 1.09/1.0	(4.5)	(4.3)						
695	698.2	27.7	5.0	0.54/1.0 1.15/1.0 1.09/1.0 0.56/1.0 1.46/1.0	(3.7)	(2.6)						
	693.2	32.7									Boring Terminated at Elevation 693.2 ft in Crystalline Rock (METAMORPHOSED QUARTZ DIORITE) - Topsoil Thickness = 0.3 Feet - Auger Refusal at 18.2 Feet - Began Coring at 18.2 Feet	32.7

NCDOT CORE SINGLE SF790254_GEO_RDWY_L.GPJ_NC_DOT.GDT 4/11/23

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.9.R.96		TIP SF-790254		COUNTY ROWAN		GEOLOGIST Fischer, H.										
SITE DESCRIPTION Bridge No. 254 over Kerr Creek on Caldwell Road (SR 1547)							GROUND WTR (ft)									
BORING NO. EB2-A		STATION 16+01		OFFSET 17 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 726.3 ft		TOTAL DEPTH 16.5 ft		NORTHING 685,626		EASTING 1,505,780										
DRILL RIG/HAMMER EFF./DATE SUM2603 CME-550X 83% 11/12/2021				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER Moseley, M.G.		START DATE 01/18/23		COMP. DATE 01/18/23		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				ELEV. (ft)	DEPTH (ft)	
730																
725															726.3	0.0
															722.8	3.5
720	722.3	4.0	3	2	4	6					SS-7	26%				
715	717.3	9.0	3	3	3	6					SS-8	24%				
	712.3	14.0	3	2	5	7					SS-9				713.8	12.5
710	709.8	16.5													709.8	16.5
			60/0.0													

NCDOT BORE DOUBLE SF790254_GEO_RDWY_L.GPJ NC_DOT.GDT 4/11/23

Boring Terminated with Standard Penetration Test Refusal at Elevation 709.8 ft on Crystalline Rock (METAMORPHOSED QUARTZ DIORITE)

- Topsoil Thickness = 0.1 Feet
- Auger Refusal at 16.5 Feet
- SS-9 Soil Moisture = 24%

CORE PHOTOGRAPHS

EB1-A

BOXES 1 & 2: 13.2 - 27.4 FEET



EB2-B

BOXES 1 & 2: 18.2 - 32.7 FEET



SUMMARY OF LABORATORY DATA

WBS Number: 17BP.9.R.96

TIP Number: SF-790254

County: Rowan

Description: Bridge No. 254 over Kerr Creek on Caldwell Road (SR 1547)



Sample No.	Boring ID	Alignment	Station	Offset	Sample Depth (ft.)	Natural Moisture Content (%)	AASHTO Classification	Atterberg Limits			Gradation Results							
								L.L.	P.L.	P.I.	Retained #4 Sieve (%)	Pass #10 Sieve (%)	Pass #40 Sieve (%)	Pass #200 Sieve (%)	Coarse Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
SS-13	EB1-A	-L-	15+09	14'LT	3.9 - 5.4	17.2	A-2-4	38	30	8	20	72	53	26	40.5	29.3	16.7	13.5
SS-7	EB2-A	-L-	16+01	17'LT	4.0 - 5.5	25.5	A-7-6	41	24	17	1	98	82	48	28.2	29.4	14.3	28.1
SS-8	EB2-A	-L-	16+01	17'LT	9.0 - 10.5	23.9	A-7-6	44	28	16	1	99	86	56	22.2	28.0	17.2	32.6
SS-9	EB2-A	-L-	16+01	17'LT	14.0 - 15.5	24.1	A-2-4	31	22	9	9	85	69	33	33.4	34.9	11.7	20.0
SS-1	EB2-B	-L-	16+01	17'RT	4.2 - 5.7	23.2	A-7-6	42	26	16	6	91	74	43	31.1	30.1	17.6	21.2
SS-2	EB2-B	-L-	16+01	17'RT	9.2 - 10.7	33.8	A-7-5	55	31	24	0	100	95	84	8.3	11.1	47.3	33.3

SITE PHOTOGRAPHS

Bridge No. 254 on -L- (SR 1547) over Kerr Creek



Looking South towards End Bent 1



Looking North towards End Bent 2