

REFERENCE: SF-890048

PROJECT: 41350

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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 NO. 048 OVER WATER
BRANCH ON SR 1714 (BURNSVILLE ROAD)

SITE DESCRIPTION -L- STATION 15+15

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-890048	1	14

CAUTION NOTICE

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

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

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

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

PERSONNEL

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INVESTIGATED BY ECS SOUTHEAST, LLP

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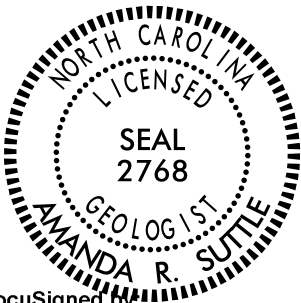
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SUBMITTED BY ECS SOUTHEAST, LLP

DATE DECEMBER 2022

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DocuSigned by
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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SUBSURFACE INVESTIGATION
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION										GRADATION										ROCK DESCRIPTION										TERMS AND DEFINITIONS																																																																																																																																																																																																																																																																																																																																																																																																		
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, <i>VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i>										<u>WELL-GRADED</u> - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. <u>UNIFORMLY GRADED</u> - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. <u>GAP-GRADED</u> - 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: <u>ANGULAR</u>, <u>SUBANGULAR</u>, <u>SUBROUNDED</u>, OR <u>ROUNDED</u>. 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 <table><tr><td></td><td>GRANULAR SOILS</td><td>SILT - CLAY SOILS</td><td>OTHER MATERIAL</td></tr><tr><td>ORGANIC MATERIAL</td><td></td><td></td><td></td></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> 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 <table><tr><td> ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION</td><td> DIP & DIP DIRECTION OF ROCK STRUCTURES</td><td> SLOPE INDICATOR INSTALLATION</td></tr><tr><td> SOIL SYMBOL</td><td> TEST BORING</td><td> CONE PENETROMETER TEST</td></tr><tr><td> ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT</td><td> AUGER BORING</td><td> SOUNDING ROD</td></tr><tr><td> INFERRED SOIL BOUNDARY</td><td> CORE BORING</td><td> TEST BORING WITH CORE</td></tr><tr><td> INFERRED ROCK LINE</td><td> MONITORING WELL</td><td> SPT N-VALUE</td></tr><tr><td> ALLUVIAL SOIL BOUNDARY</td><td> PIEZOMETER INSTALLATION</td><td></td></tr></table>											GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	ORGANIC 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	ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION	DIP & DIP DIRECTION OF ROCK STRUCTURES	SLOPE INDICATOR INSTALLATION	SOIL SYMBOL	TEST BORING	CONE PENETROMETER TEST	ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT	AUGER BORING	SOUNDING ROD	INFERRED SOIL BOUNDARY	CORE BORING	TEST BORING WITH CORE	INFERRED ROCK LINE	MONITORING WELL	SPT N-VALUE	ALLUVIAL SOIL BOUNDARY	PIEZOMETER INSTALLATION		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, CRYSTALS BRIGHT, 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. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i> SEVERE (SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF</i> VERY SEVERE (V SEV.) ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF</i> COMPLETE ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.										<u>ALLUVIUM (ALLUV.)</u> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. <u>AQUIFER</u> - A WATER BEARING FORMATION OR STRATA. <u>ARENACEOUS</u> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. <u>ARGILLACEOUS</u> - 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. <u>ARTESIAN</u> - 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. <u>CALCAREOUS (CALC.)</u> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. <u>COLLUVIUM</u> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. <u>CORE RECOVERY (REC.)</u> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. <u>DIKE</u> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. <u>DIP</u> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. <u>DIP DIRECTION (DIP AZIMUTH)</u> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. <u>FAULT</u> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. <u>FISSILE</u> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. <u>FLOAT</u> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. <u>FLOOD PLAIN (FP)</u> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. <u>FORMATION (FM.)</u> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. <u>JOINT</u> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. <u>LEDGE</u> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. <u>LENS</u> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. <u>MOTTLED (MOT.)</u> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. <u>PERCHED WATER</u> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. <u>RESIDUAL (RES.) SOIL</u> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. <u>ROCK QUALITY DESIGNATION (RQD)</u> - 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. <u>SAPROLITE (SAP.)</u> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. <u>SILL</u> - 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. <u>SLICKENSIDE</u> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. <u>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</u> - 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. <u>STRATA CORE RECOVERY (SREC.)</u> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. <u>STRATA ROCK QUALITY DESIGNATION (SRQD)</u> - 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. <u>TOPSOIL (TS.)</u> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.																																																																																																																																																																																																																																																																																																																																														
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SOIL LEGEND AND AASHTO CLASSIFICATION <table><tr><th>GENERAL CLASS.</th><th colspan="5">GRANULAR MATERIALS (≤ 35% PASSING #200)</th><th colspan="5">SILT-CLAY MATERIALS (> 35% PASSING #200)</th><th colspan="5">ORGANIC MATERIALS</th></tr><tr><th>GROUP CLASS.</th><th>A-1</th><th>A-1-b</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-7-5</th><th>A-7-6</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>SYMBOL</th><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>% PASSING #10 #40 #200</th><td>50 MX 30 MX 15 MX</td><td>50 MX 25 MX 10 MX</td><td>51 MN 35 MX 35 MX</td><td>51 MN 35 MX 35 MX</td><td>51 MN 35 MX 35 MX</td><td>51 MN 35 MX 35 MX</td><td>36 MN 36 MN</td><td>36 MN 36 MN</td><td>36 MN 36 MN</td><td>36 MN 36 MN</td><td>36 MN 36 MN</td><td>GRANULAR SOILS</td><td>SILT-CLAY SOILS</td><td>MUCK, PEAT</td><td></td></tr><tr><th>MATERIAL PASSING #40 LL PI</th><td>-</td><td>-</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td>40 MX 41 MN</td><td colspan="2">SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER</td><td colspan="2">HIGHLY ORGANIC SOILS</td></tr><tr><th>GROUP INDEX</th><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td colspan="2">SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER</td><td colspan="2">HIGHLY ORGANIC SOILS</td></tr><tr><th>USUAL TYPES OF MAJOR MATERIALS</th><td>STONE FRAGS. GRAVEL, AND SAND</td><td>FINE SAND</td><td>SILTY OR CLAYEY GRAVEL AND SAND</td><td>SILTY SOILS</td><td>CLAYEY SOILS</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER</td><td colspan="2">HIGHLY ORGANIC SOILS</td></tr><tr><th>GEN. RATING AS SUBGRADE</th><td colspan="5">EXCELLENT TO GOOD</td><td colspan="5">FAIR TO POOR</td><td colspan="2">FAIR TO POOR</td><td>POOR</td><td colspan="2">UNSUITABLE</td></tr></table> PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30										GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)					SILT-CLAY MATERIALS (> 35% PASSING #200)					ORGANIC MATERIALS					GROUP CLASS.	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RATING AS SUBGRADE	EXCELLENT TO GOOD					FAIR TO POOR					FAIR TO POOR		POOR	UNSUITABLE		CONSISTENCY OR DENSENESS <table><tr><th>PRIMARY SOIL TYPE</th><th>COMPACTNESS OR CONSISTENCY</th><th>RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)</th><th>RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)</th></tr><tr><td>GENERALLY GRANULAR MATERIAL (NON-COHESIVE)</td><td>VERY LOOSE MEDIUM DENSE DENSE VERY DENSE</td><td>< 4 4 TO 10 10 TO 30 30 TO 50 > 50</td><td>N/A</td></tr><tr><td>GENERALLY SILT-CLAY MATERIAL (COHESIVE)</td><td>VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD</td><td>< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30</td><td>< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 4</td></tr></table>										PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT ²)	GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY 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	RECOMMENDATION SYMBOLS <table><tr><td> UNDERCUT</td><td> UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE</td><td> UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK</td></tr><tr><td> SHALLOW UNDERCUT</td><td></td><td></td></tr></table> ABBREVIATIONS <table><tr><td>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</td><td>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</td><td>VST - VANE SHEAR TEST WEA. - WEATHERED % - UNIT WEIGHT % - DRY UNIT WEIGHT SAMPLE ABBREVIATIONS S - BULK SS - SPLIT SPOON ST - SHELBY TUBE RS - ROCK RT - RECOMPACTED TRIAXIAL CBR - CALIFORNIA BEARING RATIO</td></tr></table>										UNDERCUT	UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE	UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK	SHALLOW UNDERCUT			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	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 % - UNIT WEIGHT % - DRY UNIT WEIGHT SAMPLE ABBREVIATIONS S - BULK SS - SPLIT SPOON ST - SHELBY TUBE RS - ROCK RT - RECOMPACTED TRIAXIAL CBR - CALIFORNIA BEARING RATIO	ROCK HARDNESS <table><tr><th>VERY HARD</th><td>CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. 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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><th></th><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><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>COBBLE (COB.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>GRAVEL (GR.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>COARSE SAND (CSE, SD.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>FINE SAND (F SD.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>SILT (SL.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><th>CLAY (CL.)</th><td></td><td></td><td></td><td></td><td></td><td></td></tr></table> GRAIN SIZE: 305 IN. 75 3 2.0 0.25 0.05 0.005										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.)							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SOIL MOISTURE - CORRELATION OF TERMS <table><tr><th>SOIL MOISTURE SCALE (ATTERBERG LIMITS)</th><th>FIELD MOISTURE DESCRIPTION</th><th>GUIDE FOR FIELD MOISTURE DESCRIPTION</th></tr><tr><td>LL - LIQUID LIMIT PL - PLASTIC LIMIT</td><td>- SATURATED - (SAT.) - WET - (W)</td><td>USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE</td></tr><tr><td>OM - OPTIMUM MOISTURE SL - SHRINKAGE LIMIT</td><td>- MOIST - (M) - DRY - (D)</td><td>SOLID; AT OR NEAR OPTIMUM MOISTURE REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE</td></tr></table>										SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION	LL - LIQUID LIMIT PL - PLASTIC LIMIT	- SATURATED - (SAT.) - WET - (W)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE	OM - OPTIMUM MOISTURE SL - SHRINKAGE LIMIT	- MOIST - (M) - DRY - (D)	SOLID; AT OR NEAR OPTIMUM MOISTURE REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE	PLASTICITY <table><tr><th>NON PLASTIC</th><th>PLASTICITY INDEX (PI)</th><th>DRY STRENGTH</th></tr><tr><td>SLIGHTLY PLASTIC</td><td>0-5</td><td>VERY LOW</td></tr><tr><td>MODERATELY PLASTIC</td><td>6-15</td><td>SLIGHT</td></tr><tr><td>HIGHLY PLASTIC</td><td>16-25</td><td>MEDIUM</td></tr><tr><td></td><td>26 OR MORE</td><td>HIGH</td></tr></table>										NON PLASTIC	PLASTICITY INDEX (PI)	DRY STRENGTH	SLIGHTLY PLASTIC	0-5	VERY LOW	MODERATELY PLASTIC	6-15	SLIGHT	HIGHLY PLASTIC	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.										EQUIPMENT USED ON SUBJECT PROJECT <table><tr><th>DRILL UNITS:</th><th>ADVANCING TOOLS:</th><th>HAMMER TYPE:</th></tr><tr><td>☐ CME-45C</td><td>☐ CLAY BITS</td><td>☒ AUTOMATIC ☐ MANUAL</td></tr><tr><td>☐ CME-55</td><td>☐ 6" CONTINUOUS FLIGHT AUGER</td><td></td></tr><tr><td>☐ CME-550</td><td>☒ 8" HOLLOW AUGERS</td><td>CORE SIZE: ☐ -B ☐ -H</td></tr><tr><td>☐ VANE SHEAR TEST</td><td>☐ HARD FACED FINGER BITS</td><td>☒ -N Q2</td></tr><tr><td>☐ PORTABLE HOIST</td><td>☐ TUNG-CARBIDE INSERTS</td><td>HAND TOOLS: ☐ POST HOLE DIGGER ☐ HAND AUGER ☐ SOUNDING ROD ☐ VANE SHEAR TEST</td></tr><tr><td>☒ CME 75</td><td>☒ CASING ☐ W/ ADVANCER</td><td></td></tr><tr><td></td><td>☐ TRICONE ☐ * STEEL TEETH</td><td></td></tr><tr><td></td><td>☐ TRICONE ☐ * TUNG-CARB.</td><td></td></tr><tr><td></td><td>☒ CORE BIT</td><td></td></tr><tr><td></td><td>☐</td><td></td></tr></table>										DRILL UNITS:	ADVANCING TOOLS:	HAMMER TYPE:	☐ CME-45C	☐ CLAY BITS	☒ AUTOMATIC ☐ MANUAL	☐ CME-55	☐ 6" CONTINUOUS FLIGHT AUGER		☐ CME-550	☒ 8" HOLLOW AUGERS	CORE SIZE: ☐ -B ☐ -H	☐ VANE SHEAR TEST	☐ HARD FACED FINGER BITS	☒ -N Q2	☐ PORTABLE HOIST	☐ TUNG-CARBIDE INSERTS	HAND TOOLS: ☐ POST HOLE DIGGER ☐ HAND AUGER ☐ SOUNDING ROD ☐ VANE SHEAR TEST	☒ CME 75	☒ CASING ☐ W/ ADVANCER			☐ TRICONE ☐ * STEEL TEETH			☐ TRICONE ☐ * TUNG-CARB.			☒ CORE BIT			☐		FRACATURE SPACING <table><tr><th>TERM</th><th>SPACING</th></tr><tr><td>VERY WIDE</td><td>MORE THAN 10 FEET</td></tr><tr><td>WIDE</td><td>3 TO 10 FEET</td></tr><tr><td>MODERATELY CLOSE</td><td>1 TO 3 FEET</td></tr><tr><td>CLOSE</td><td>0.16 TO 1 FOOT</td></tr><tr><td>VERY CLOSE</td><td>LESS THAN 0.16 FEET</td></tr></table> BEDDING <table><tr><th>TERM</th><th>THICKNESS</th></tr><tr><td>VERY THICKLY BEDDED</td><td>4 FEET</td></tr><tr><td>THICKLY BEDDED</td><td>1.5 - 4 FEET</td></tr><tr><td>THINLY BEDDED</td><td>0.16 - 1.5 FEET</td></tr><tr><td>VERY THINLY BEDDED</td><td>0.03 - 0.16 FEET</td></tr><tr><td>THICKLY LAMINATED</td><td>0.008 - 0.03 FEET</td></tr><tr><td>THINLY LAMINATED</td><td>< 0.008 FEET</td></tr></table> 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.										TERM	SPACING	VERY WIDE	MORE THAN 10 FEET	WIDE	3 TO 10 FEET	MODERATELY CLOSE	1 TO 3 FEET	CLOSE	0.16 TO 1 FOOT	VERY CLOSE	LESS THAN 0.16 FEET	TERM	THICKNESS	VERY THICKLY BEDDED	4 FEET	THICKLY BEDDED	1.5 - 4 FEET	THINLY BEDDED	0.16 - 1.5 FEET	VERY THINLY BEDDED	0.03 - 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET	THINLY LAMINATED	< 0.008 FEET	TERMS AND DEFINITIONS <u>ALLUVIUM (ALLUV.)</u> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. <u>AQUIFER</u> - A WATER BEARING FORMATION OR STRATA. <u>ARENACEOUS</u> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. <u>ARGILLACEOUS</u> - 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. <u>ARTESIAN</u> - 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. <u>CALCAREOUS (CALC.)</u> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. <u>COLLUVIUM</u> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. <u>CORE RECOVERY (REC.)</u> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. <u>DIKE</u> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. <u>DIP</u> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. <u>DIP DIRECTION (DIP AZIMUTH)</u> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. <u>FAULT</u> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. <u>FISSILE</u> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. <u>FLOAT</u> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. <u>FLOOD PLAIN (FP)</u> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. <u>FORMATION (FM.)</u> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. <u>JOINT</u> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. <u>LEDGE</u> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. <u>LENS</u> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. <u>MOTTLED (MOT.)</u> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. <u>PERCHED WATER</u> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. <u>RESIDUAL (RES.) SOIL</u> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. <u>ROCK QUALITY DESIGNATION (RQD)</u> - 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. <u>SAPROLITE (SAP.)</u> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. <u>SILL</u> - 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. <u>SLICKENSIDE</u> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. <u>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</u> - 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. <u>STRATA CORE RECOVERY (SREC.)</u> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. <u>STRATA ROCK QUALITY DESIGNATION (SRQD)</u> - 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. <u>TOPSOIL (TS.)</u> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.									
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GROUP CLASS.	A-1	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-4	A-5	A-6	A-7-5	A-7-6	A-1, A-2	A-3	A-4, A-5	A-6, A-7																																																																																																																																																																																																																																																																																																																																																																																																																	
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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																																																																																																																																																																																																																																																																																																																																																																																																																													
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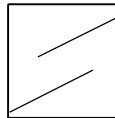
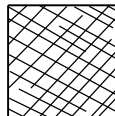
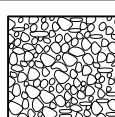
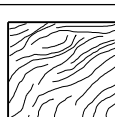
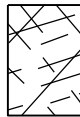
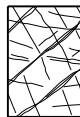
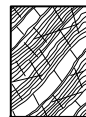
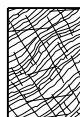
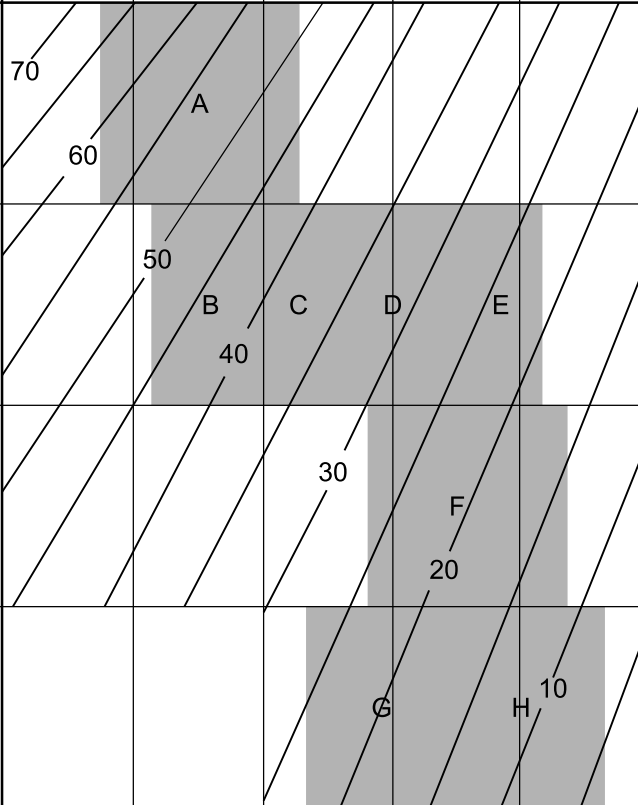
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

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)

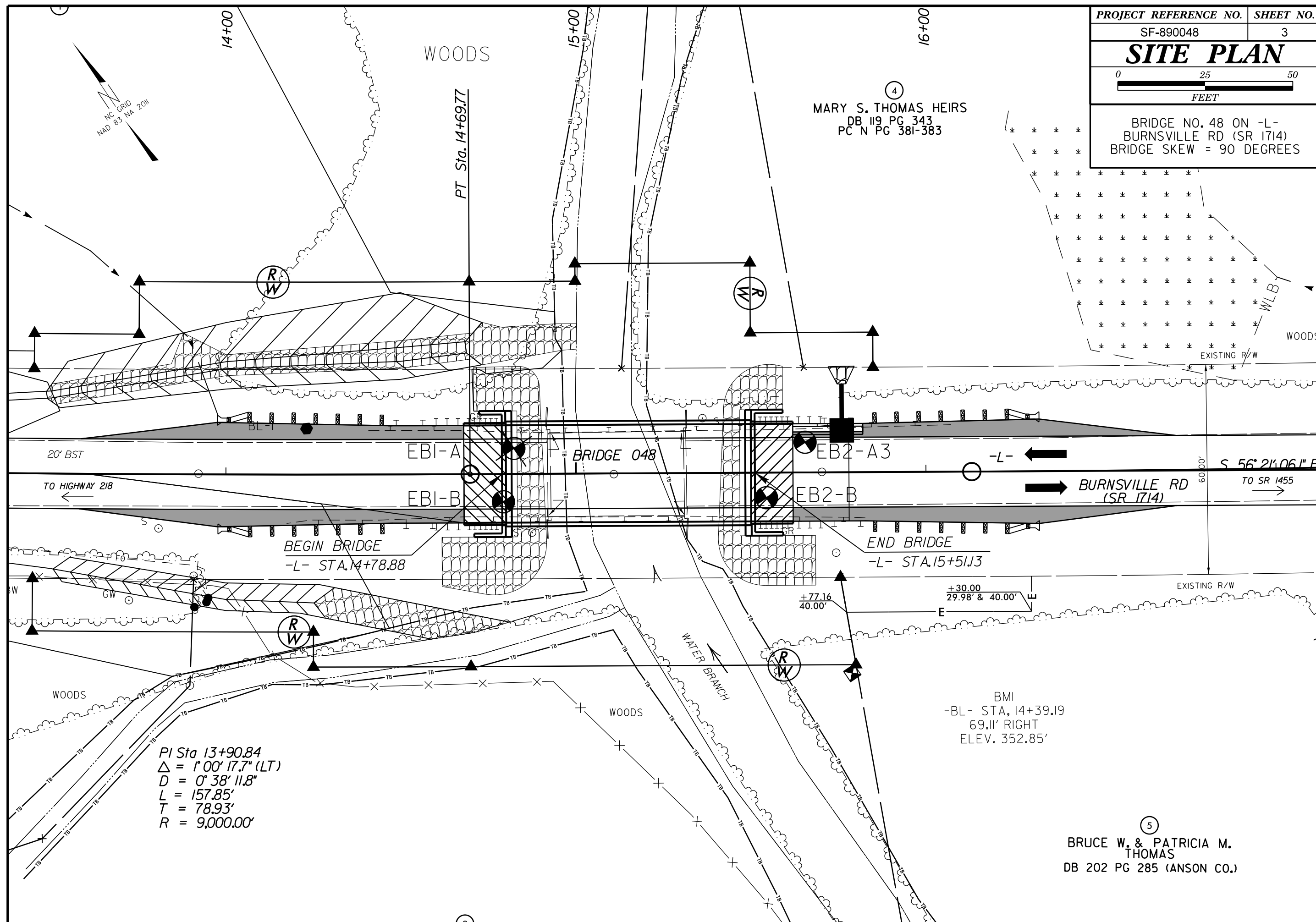
GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000) From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.		SURFACE CONDITIONS VERY GOOD Very rough, fresh unweathered surfaces GOOD Rough, slightly weathered, iron stained surfaces FAIR Smooth, moderately weathered and altered surfaces POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings		GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000) From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.		SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes) VERY GOOD - Very Rough, fresh unweathered surfaces GOOD - Rough, slightly weathered surfaces FAIR - Smooth, moderately weathered and altered surfaces POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings	
STRUCTURE		DECREASING SURFACE QUALITY ➡		COMPOSITION AND STRUCTURE			
 INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities  BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets  VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets  BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity  DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces  LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes		DECREASING INTERLOCKING OF ROCK PIECES ➡		 A. Thick bedded, very blocky sandstone The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.  B. Sandstone with thin inter-layers of siltstone  C. Sandstone and siltstone in similar amounts  D. Siltstone or silty shale with sandstone layers  E. Weak siltstone or clayey shale with sandstone layers  F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure  G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers  H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces. ➡ Means deformation after tectonic disturbance			

DATE: 8-19-16

SITE PLAN

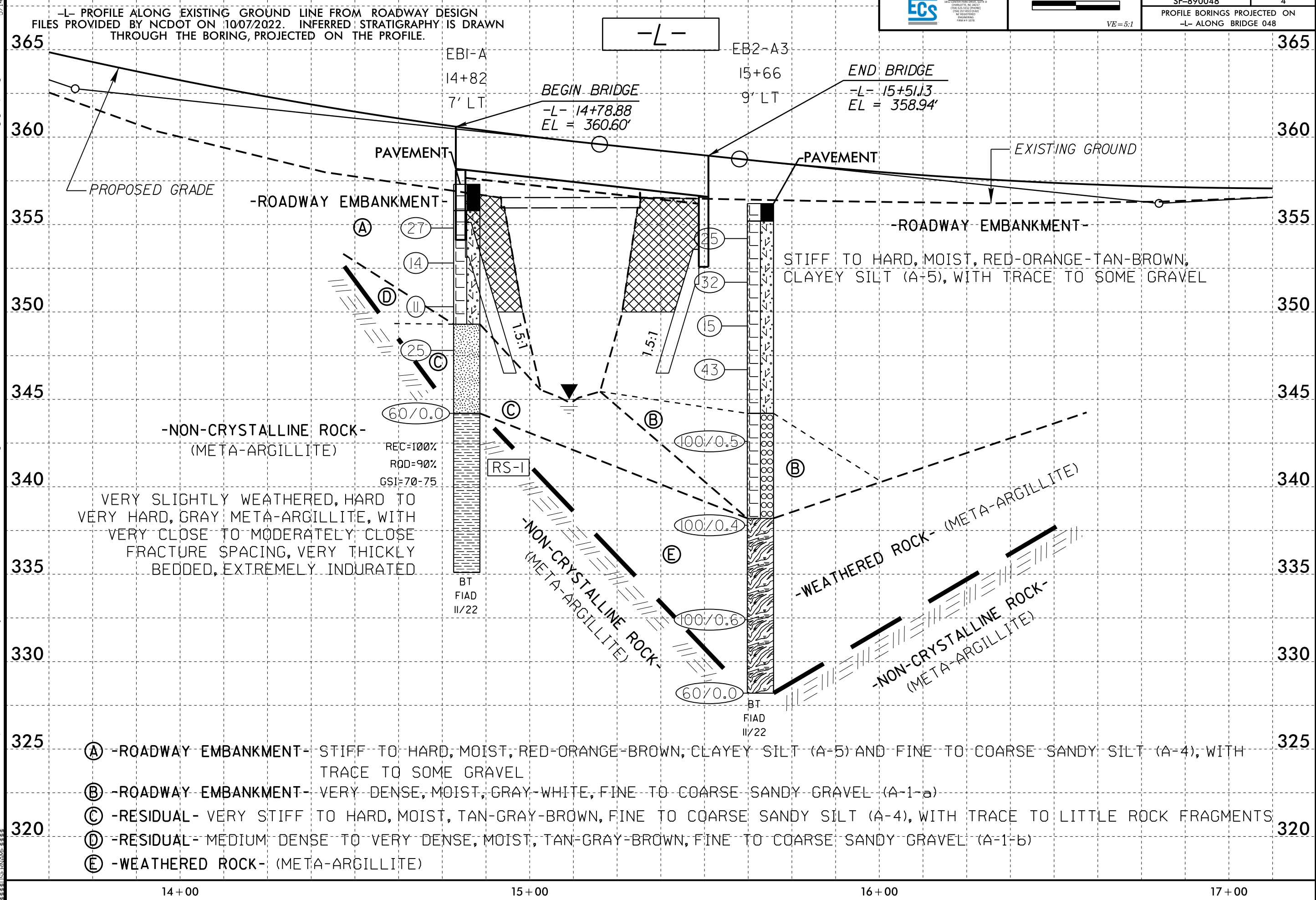


BRIDGE NO. 48 ON -L-
BURNSVILLE RD (SR 1714)
BRIDGE SKEW = 90 DEGREES

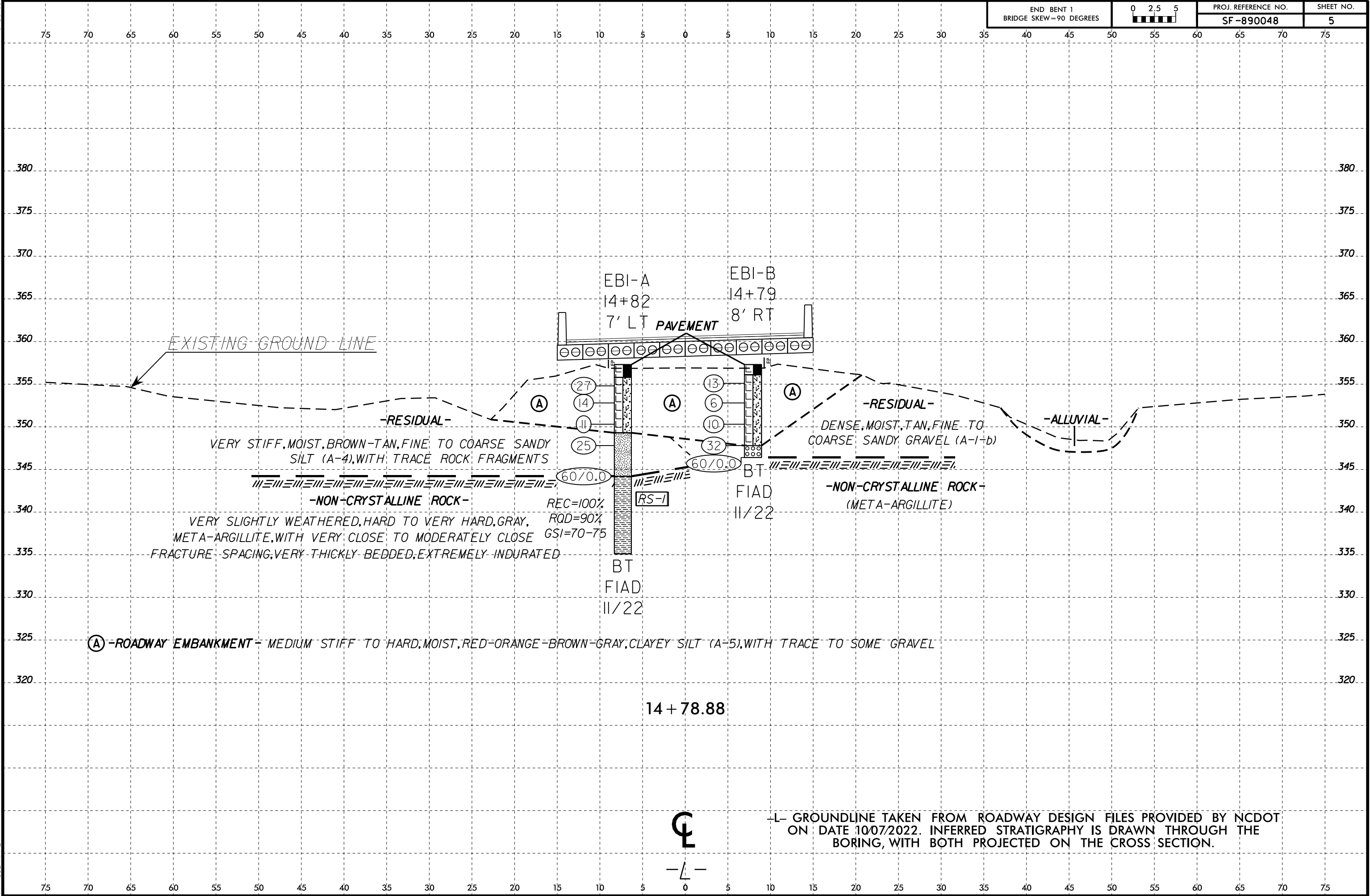


BRUCE W. & PATRICIA M.
THOMAS
DB 202 PG 285 (ANSON CO.)

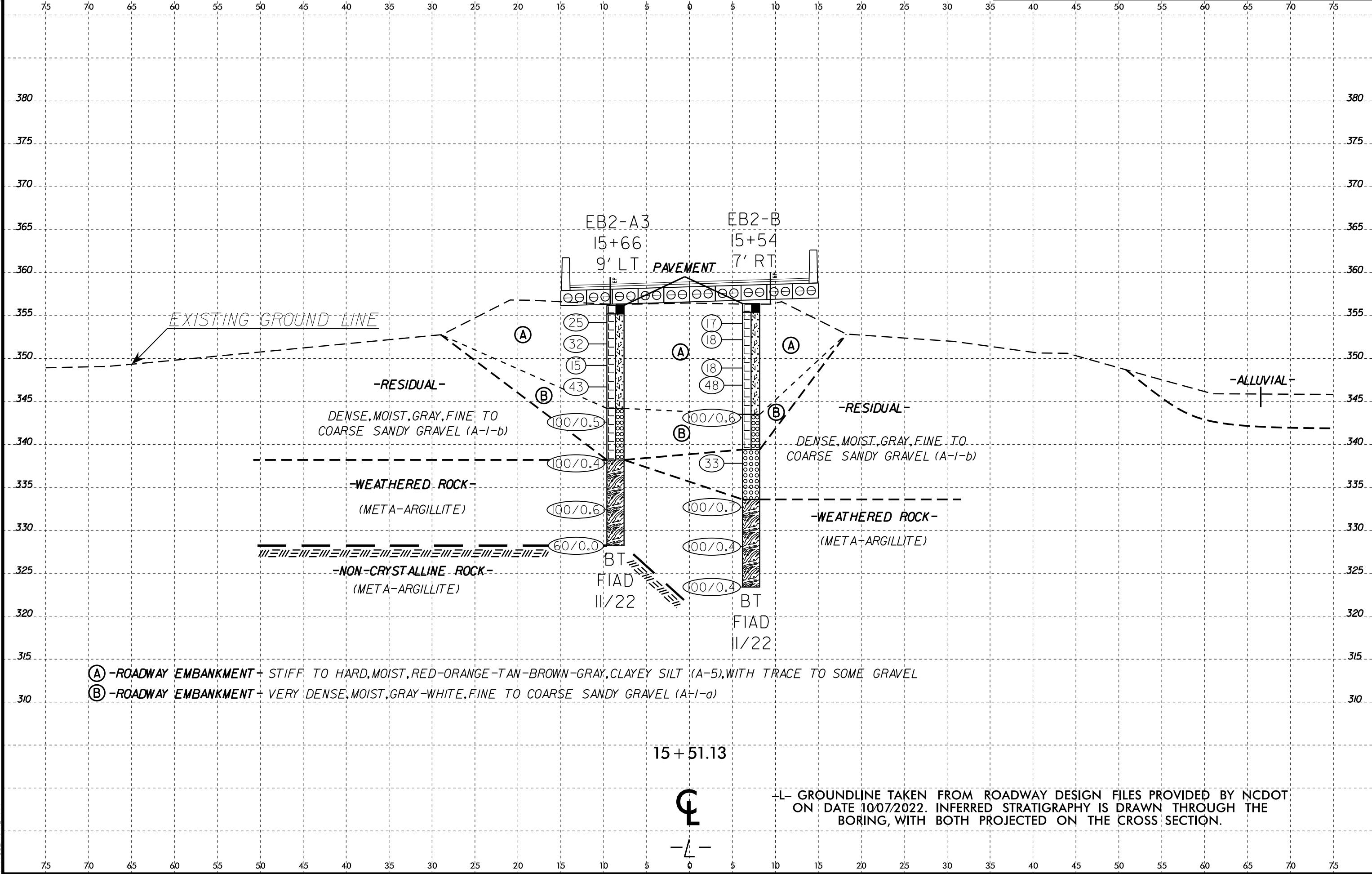
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C:\Users\jguth\OneDrive - ECS Corporate Services\08 GEO Projects\15000-15999\15300-15399\15339 - Bridge No. 048 over Water Branch on SR 1714 - GEO\CADD_GEO\TECH\XSC\R023.BR06.GEO.XSL.dgn
\$\$\$\$\$USERNAME\$\$\$\$\$



GEOTECHNICAL BORING REPORT

BORE LOG

WBS				BP10.R023.1				TIP				SF-890048				COUNTY				UNION				GEOLOGIST				A. Suttle																																											
SITE DESCRIPTION																				Bridge No. 48 over Water Branch on SR 1714 (Burnsville Road)																				GROUND WTR (ft)																															
BORING NO.								EB1-A								STATION								14+82								OFFSET								7 ft LT								ALIGNMENT								-L-								0 HR.				N/A			
COLLAR ELEV.								357.3 ft								TOTAL DEPTH								22.2 ft								NORTHING								495,107								EASTING								1,613,438								24 HR.				FIAD			
DRILL RIG/HAMMER EFF./DATE												ECS6727 CME 75 92% 07/21/2022												DRILL METHOD								NW Casing W/SPT & Core								HAMMER TYPE								Automatic																							
DRILLER								C. Osborne/S. Werley								START DATE								11/16/22								COMP. DATE								11/16/22								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																ELEV. (ft) DEPTH (ft)																																														
360																																																																							
		355.8		1.5		6 12 15																			357.3 GROUND SURFACE 0.0																																														
355		353.8		3.5		13 7 7																			355.8 ROADWAY EMBANKMENT 1.5																																														
																									Asphalt (0.2'), Gravel (1.3')																																														
		351.3		6.0		10 6 5																			Stiff to Very Stiff, Red-Orange-Brown, Clayey SILT (A-5), with trace to some gravel																																														
350		348.8		8.5		6 10 15																			349.3 RESIDUAL 8.0																																														
																									Very Stiff, Brown-Tan, Fine to Coarse Sandy SILT (A-4), with trace rock fragments																																														
345		344.2		13.1		60/0.0																			344.2 NON-CRYSTALLINE ROCK 13.1																																														
																									Very Slightly Weathered, Hard to Very Hard, Gray META-ARGILLITE, with Very Close to Moderately Close Fracture Spacing, Very Thickly Bedded, Extremely Indurated																																														
340																									REC = 100%, RQD = 90%, GSI = 70-75																																														
																									335.1 Boring Terminated at Elevation 335.1 ft In Non-Crystalline Rock (META-ARGILLITE) 22.2																																														

GEOTECHNICAL BORING REPORT

CORE LOG

WBS BP10.R023.1				TIP SF-890048				COUNTY UNION				GEOLOGIST A. Suttle										
SITE DESCRIPTION Bridge No. 48 over Water Branch on SR 1714 (Burnsville Road)												GROUND WTR (ft)										
BORING NO. EB1-A				STATION 14+82				OFFSET 7 ft LT				ALIGNMENT -L-				0 HR. N/A						
COLLAR ELEV. 357.3 ft				TOTAL DEPTH 22.2 ft				NORTHING 495,107				EASTING 1,613,438				24 HR. FIAD						
DRILL RIG/HAMMER EFF./DATE ECS6727 CME 75 92% 07/21/2022								DRILL METHOD NW Casing W/SPT & Core				HAMMER TYPE Automatic										
DRILLER C. Osborne/S. Werley				START DATE 11/16/22				COMP. DATE 11/16/22				SURFACE WATER DEPTH N/A										
CORE SIZE NQ				TOTAL RUN 9.1 ft																		
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %RQD (ft) %		SAMP. NO.	STRATA REC. (ft) %RQD (ft) %		L O G	DESCRIPTION AND REMARKS											DEPTH (ft)
344.2											Begin Coring @ 13.1 ft											
	344.2	13.1	5.0	N=60/0.0 2:45/1.0 1:21/1.0 2:44/1.0 2:19/1.0 1:27/1.0	(5.0) 100%	(4.6) 92%		(9.1) 100%	(8.2) 90%		344.2 NON-CRYSTALLINE ROCK Very Slightly Weathered, Hard to Very Hard, Gray META-ARGILLITE, with Very Close to Moderately Close Fracture Spacing, Very Thickly Bedded, Extremely Indurated											13.1
340	339.2	18.1					RS-1				REC = 100%, RQD = 90%, GSI = 70-75											
			4.1	1:52/1.0 1:59/1.0 2:10/1.0 1:59/1.0 2:16/0.1	(4.1) 100%	(3.6) 88%					RS-1: 16.2' - 16.6' Unit Weight = 169.1 pcf Unconfined Compressive Strength = 20,580psi / 2,963 ksf Boring Terminated at Elevation 335.1 ft In Non-Crystalline Rock (META-ARGILLITE)											
	335.1	22.2									335.1											22.2

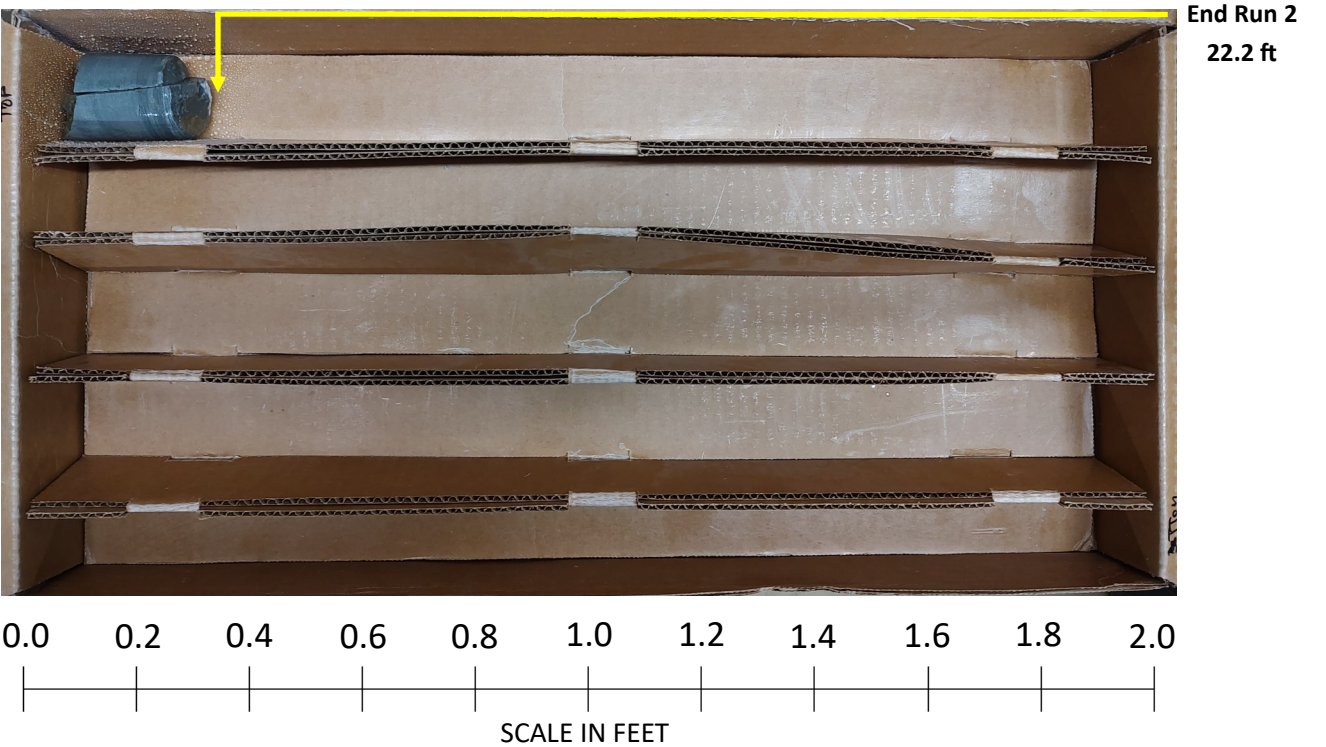
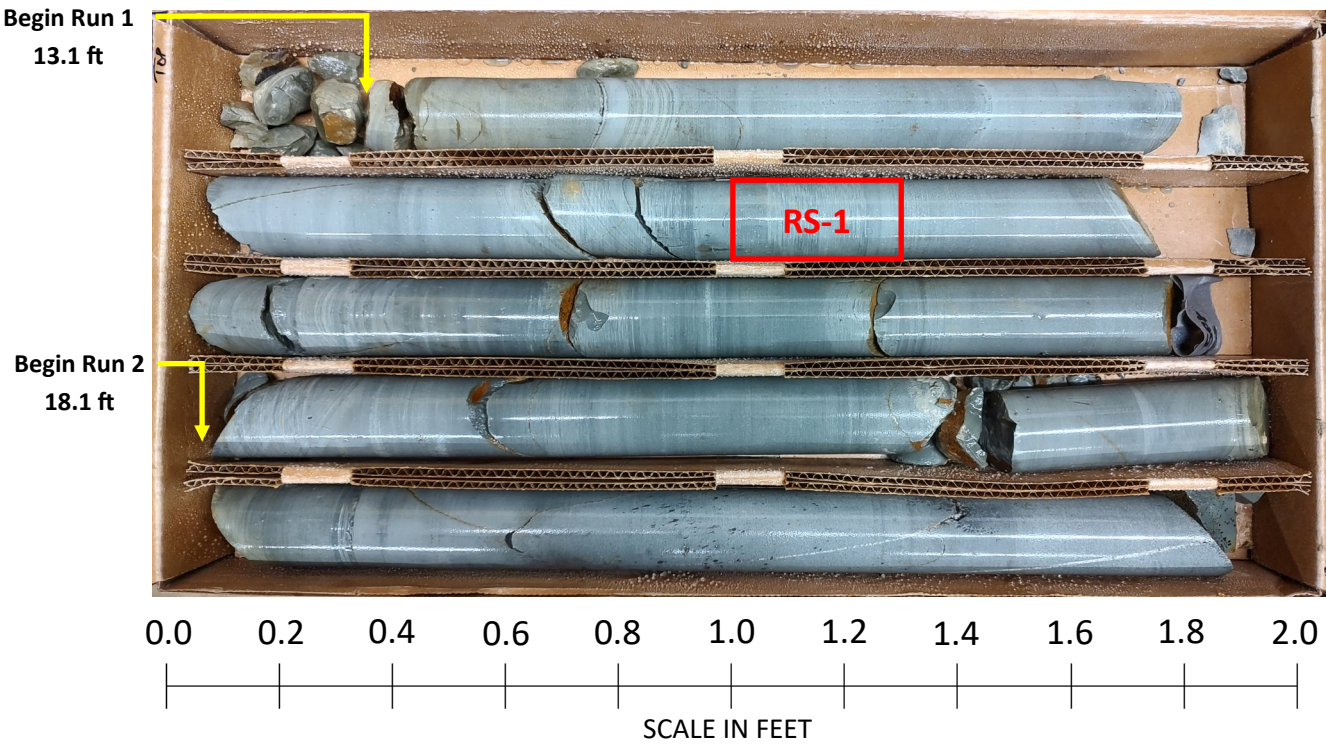


Bridge No. 048 over Water Branch on SR 1714 (Burnsville Road)

WBS - BP10.R023.1 TIP No. SF-890048

Rock Core Photographs: Boring - EB1-A

Station: 14+82 Offset: 7 ft LT



NC DOT BORE DOUBLE R023 GEO_GTM.GPJ NC DOT.GDT 12/12/22

WBS				BP10.R023.1				TIP				SF-890048				COUNTY				UNION				GEOLOGIST				A. Suttle																															
SITE DESCRIPTION																				Bridge No. 48 over Water Branch on SR 1714 (Burnsville Road)												GROUND WTR (ft)																											
BORING NO.				EB2-A				STATION				15+53				OFFSET				11 ft LT				ALIGNMENT				-L-				0 HR.		Dry																									
COLLAR ELEV.				356.2 ft				TOTAL DEPTH				10.7 ft				NORTHING				495,071				EASTING				1,613,500				24 HR.		FIAD																									
DRILL RIG/HAMMER EFF./DATE												ECS6727 CME 75 92% 07/21/2022												DRILL METHOD								H.S. Augers								HAMMER TYPE								Automatic											
DRILLER						C. Osborne						START DATE						11/18/22						COMP. DATE						11/18/22						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																																												
360																																																											
355		355.2		1.0		7			11		12											356.2 GROUND SURFACE 0.0																																					
																				355.4 ROADWAY EMBANKMENT 0.8																																							
																				Asphalt (0.2'), Gravel (0.6')																																							
		352.7		3.5		21			11		14											Stiff to Hard, Red-Orange-Tan-Gray-Brown, Clayey SILT (A-5), with trace to some gravel																																					
350		350.2		6.0		20			6		8																																																
		347.7		8.5		27			28		72/0.4																																																
		345.5		10.7		60/0.0														345.5 10.7																																							
																				Boring Terminated with Standard Penetration Test Refusal at Elevation 345.5 ft In Roadway Embankment (POSSIBLE BOULDER FILL)																																							
																				1.) High Blow Counts in Roadway Embankment Due to Possible Boulder Fill.																																							

NC DOT BORE DOUBLE R023 GEO_GTM.GPJ NC DOT.GDT 12/12/22

WBS				BP10.R023.1				TIP				SF-890048				COUNTY				UNION				GEOLOGIST				A. Suttle																															
SITE DESCRIPTION																				Bridge No. 48 over Water Branch on SR 1714 (Burnsville Road)																				GROUND WTR (ft)																			
BORING NO.				EB2-A3				STATION				15+66				OFFSET				9 ft LT				ALIGNMENT				-L-				0 HR.		Dry																									
COLLAR ELEV.				356.2 ft				TOTAL DEPTH				28.0 ft				NORTHING				495,062				EASTING				1,613,508				24 HR.		FIAD																									
DRILL RIG/HAMMER EFF./DATE												ECS6727 CME 75 92% 07/21/2022												DRILL METHOD								H.S. Augers								HAMMER TYPE								Automatic											
DRILLER						C. Osborne						START DATE						11/18/22						COMP. DATE						11/18/22						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																																																		
360																																																											
355		355.2		1.0																					356.2 GROUND SURFACE 0.0																																		
						9 11 14																			355.2 ROADWAY EMBANKMENT 1.0																																		
		352.7		3.5		33 12 20																			Asphalt (0.3'), Gravel (0.7')																																		
350		350.2		6.0		26 6 9																			Stiff to Hard, Red-Orange-Tan-Brown, Clayey SILT (A-5), with trace to some gravel																																		
		347.7		8.5		9 11 32																																																					
345		343.1		13.1		100/0.5																			344.2 12.0																																		
																									Very Dense, Gray-White, Fine to Coarse Sandy GRAVEL (A-1-a)																																		
340		338.2		18.0		100/0.4																			338.2 18.0																																		
																									(POSSIBLE BOULDER FILL)																																		
335		333.0		23.2		75 25/0.1																			WEATHERED ROCK																																		
																									Brown-Gray-Tan (META-ARGILLITE)																																		
330		328.2		28.0		60/0.0																			328.2 28.0																																		
																									Boring Terminated with Standard Penetration Test Refusal at Elevation 328.2 ft On Non-Crystalline Rock (META-ARGILLITE)																																		
																									1.) Boring Offset 13' Upstation from EB2-A																																		
																									2.) High Blow Counts in Roadway Embankment Due to Possible Boulder Fill.																																		

GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP10.R023.1				TIP SF-890048		COUNTY UNION		GEOLOGIST A. Suttle								
SITE DESCRIPTION Bridge No. 48 over Water Branch on SR 1714 (Burnsville Road)								GROUND WTR (ft)								
BORING NO. EB2-B		STATION 15+54		OFFSET 7 ft RT		ALIGNMENT -L-		0 HR. 27.2								
COLLAR ELEV. 356.4 ft		TOTAL DEPTH 33.0 ft		NORTHING 495,055		EASTING 1,613,490		24 HR. FIAD								
DRILL RIG/HAMMER EFF./DATE ECS6727 CME 75 92% 07/21/2022				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER C. Osborne		START DATE 11/17/22		COMP. DATE 11/17/22		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	L O G	SOIL AND ROCK DESCRIPTION		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV. (ft)	DEPTH (ft)	
360																
355	355.1	1.3												356.4	0.0	
	353.2	3.2	7	5	12									355.4	1.0	
350	349.9	6.5	10	10	8									ROADWAY EMBANKMENT		
	347.9	8.5	11	12	6									Asphalt (0.3'), Gravel (0.7')		
345	347.9	8.5	4	11	37									Very Stiff to Hard, Orange-Brown-Red-Gray, Clayey SILT (A-5), with trace gravel		
	343.7	12.7	81	19/0.1										343.5	12.9	
340	338.8	17.6	12	7	26									339.4	17.0	
	333.6	22.8	46	54/0.2										(POSSIBLE BOULDER FILL)		
330	328.5	27.9	100/0.4											RESIDUAL		
	323.8	32.6	100/0.4											Dense, Gray, Fine to Coarse Sandy GRAVEL (A-1-b)		
														333.6	22.8	
														WEATHERED ROCK		
														Gray (META-ARGILLITE)		
														323.4	33.0	
														Boring Terminated at Elevation 323.4 ft In Weathered Rock (META-ARGILLITE)		
														1.) High Blow Counts in Roadway Embankment Due to Possible Boulder Fill.		

NC DOT BORE DOUBLE R023 GEO GTM.GPJ NC DOT.GDT 12/12/22

SITE PHOTOGRAPHS



PHOTO 1: VIEW FACING BRIDGE 048 FROM -L- ALIGNMENT, FACING DOWNSTATION.



PHOTO 2: VIEW FACING BRIDGE 048 FROM -L- ALIGNMENT, FACING UPSTATION.



PHOTO 3: BOULDER FILL AT EB-2.



PHOTO 4: VIEW FACING DOWNSTREAM FROM BRIDGE.