

REFERENCE: SF-480214

PROJECT: 17BP.12.R.50

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	17BP.12.R.50	1	16

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

STRUCTURE
SUBSURFACE INVESTIGATION

COUNTY IREDELL
PROJECT DESCRIPTION BRIDGE NO. 214 ON SR 1896
OVER PATTERSON CREEK

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3	SITE PLAN
4-5	CROSS SECTION(S)
6-13	BORE LOG(S) & CORE REPORT(S) & CORE PHOTOGRAPH(S)

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SUBMITTED BY K.B. MILLER
DATE January 2017

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SIGNATURE DATE

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SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS
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SOIL DESCRIPTION										GRADATION									
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6										WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.									
SOIL LEGEND AND AASHTO CLASSIFICATION										ANGULARITY OF GRAINS									
GENERAL CLASS. GRANULAR MATERIALS (≤ 35% PASSING #200) SILT-CLAY MATERIALS (> 35% PASSING #200) ORGANIC MATERIALS										MINERALOGICAL COMPOSITION									
GROUP CLASS. A-1, A-3, A-2, A-4, A-5, A-6, A-7, A-1, A-2, A-3, A-4, A-5, A-6, A-7										MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.									
SYMBOL										COMPRESSIBILITY									
% PASSING #10, #40, #200										SLIGHTLY COMPRESSIBLE LL < 31 MODERATELY COMPRESSIBLE LL = 31 - 50 HIGHLY COMPRESSIBLE LL > 50									
MATERIAL PASSING #40 LL, PI										PERCENTAGE OF MATERIAL									
GROUP INDEX										ORGANIC MATERIAL GRANULAR SOILS SILT-CLAY SOILS OTHER MATERIAL									
USUAL TYPES OF MAJOR MATERIALS										GROUND WATER									
GEN. RATING AS SUBGRADE										WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING STATIC WATER LEVEL AFTER 24 HOURS PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA SPRING OR SEEP									
CONSISTENCY OR DENSENESS										MISCELLANEOUS SYMBOLS									
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT ²)										ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT INFERRED SOIL BOUNDARY INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY									
TEXTURE OR GRAIN SIZE										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									
U.S. STD. SIEVE SIZE OPENING (MM)										RECOMMENDATION SYMBOLS									
BOULDER (BLDR.), COBBLE (COB.), GRAVEL (GR.), COARSE SAND (CSE. SD.), FINE SAND (F SD.), SILT (SL.), CLAY (CL.)										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									
GRAIN SIZE										ABBREVIATIONS									
SOIL MOISTURE - CORRELATION OF TERMS										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 γ - UNIT WEIGHT γ _d - DRY UNIT WEIGHT									
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION										SAMPLE ABBREVIATIONS									
PLASTICITY										EQUIPMENT USED ON SUBJECT PROJECT									
PLASTICITY INDEX (PI) DRY STRENGTH										DRILL UNITS: CME-45C, CME-55, CME-550, VANE SHEAR TEST, PORTABLE HOIST, CME-550X 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 HAMMER TYPE: AUTOMATIC, MANUAL CORE SIZE: -B, -H, -N, XWL HAND TOOLS: POST HOLE DIGGER, HAND AUGER, SOUNDING ROD, VANE SHEAR TEST									
COLOR										DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.									

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SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS
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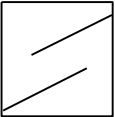
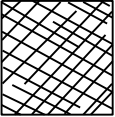


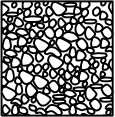

ROCK DESCRIPTION		TERMS AND DEFINITIONS
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>		<p>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.</p> <p>AQUIFER - A WATER BEARING FORMATION OR STRATA.</p> <p>ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.</p> <p>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.</p> <p>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.</p> <p>CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.</p> <p>COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.</p> <p>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.</p> <p>DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.</p> <p>DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.</p> <p>DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.</p> <p>FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.</p> <p>FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.</p> <p>FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.</p> <p>FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.</p> <p>FORMATION (FM) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.</p> <p>JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.</p> <p>LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.</p> <p>LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.</p> <p>MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.</p> <p>PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.</p> <p>RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.</p> <p>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.</p> <p>SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.</p> <p>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.</p> <p>SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.</p> <p>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.</p> <p>STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.</p> <p>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.</p> <p>TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>
<p>WEATHERED ROCK (WR)  NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.</p>		
<p>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.</p>		
<p>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.</p>		
<p>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.</p>		
WEATHERING		
FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.	
VERY SLIGHT (V SL.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN. CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.	
SLIGHT (SL.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.	
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.	
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. <u>IF TESTED, WOULD YIELD SPT REFUSAL</u>	
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. <u>IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF</u>	
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. <u>IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF</u>	
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.	
ROCK HARDNESS		
VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.	
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.	
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.	
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.	
SOFT	CAN BE GROOVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.	
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGER NAIL.	
FRACTURE SPACING		BEDDING
TERM	SPACING	TERM THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED 4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED 1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED 0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED 0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED 0.008 - 0.03 FEET
		THINLY LAMINATED < 0.008 FEET
INDURATION		
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.	
		<p>BENCH MARK: BM #1 RR SPIKE IN 14" SWEET GUM AT -L- STATION 13+86.33, 62.4' RT, N: 796813.67, E: 1445684.46 ELEVATION: 818.69 FEET</p>
		<p>NOTES: NM= NOT MEASURED</p>

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**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
 FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)**

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

<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>STRUCTURE</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>INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p>	90			N/A	N/A	
 <p>BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p>	80	70				
 <p>VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p>		60				
 <p>BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p>		50	40	30		
 <p>DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p>				20		
 <p>LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>	N/A	N/A			10	

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**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
 FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)**

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

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces

GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

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

VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

COMPOSITION AND STRUCTURE



A. Thick bedded, very blocky sandstone. The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.



B. Sandstone with thin inter-layers of siltstone



C. Sandstone and siltstone in similar amounts



D. Siltstone or silty shale with sandstone layers



E. Weak siltstone or clayey shale with sandstone layers

C, D, E, and G - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to F and H.



F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure



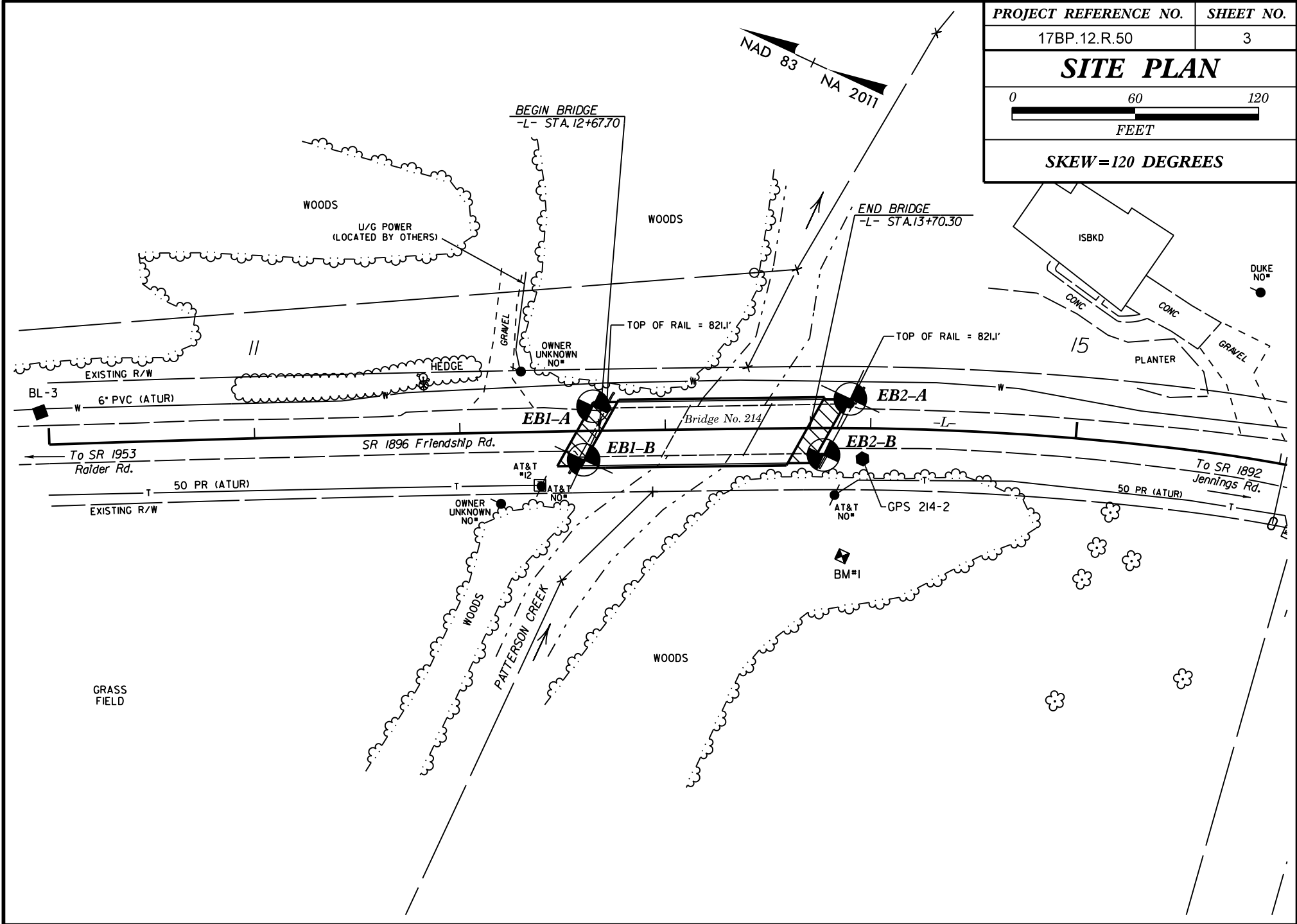
G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers

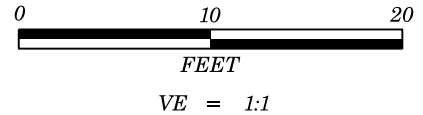


H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

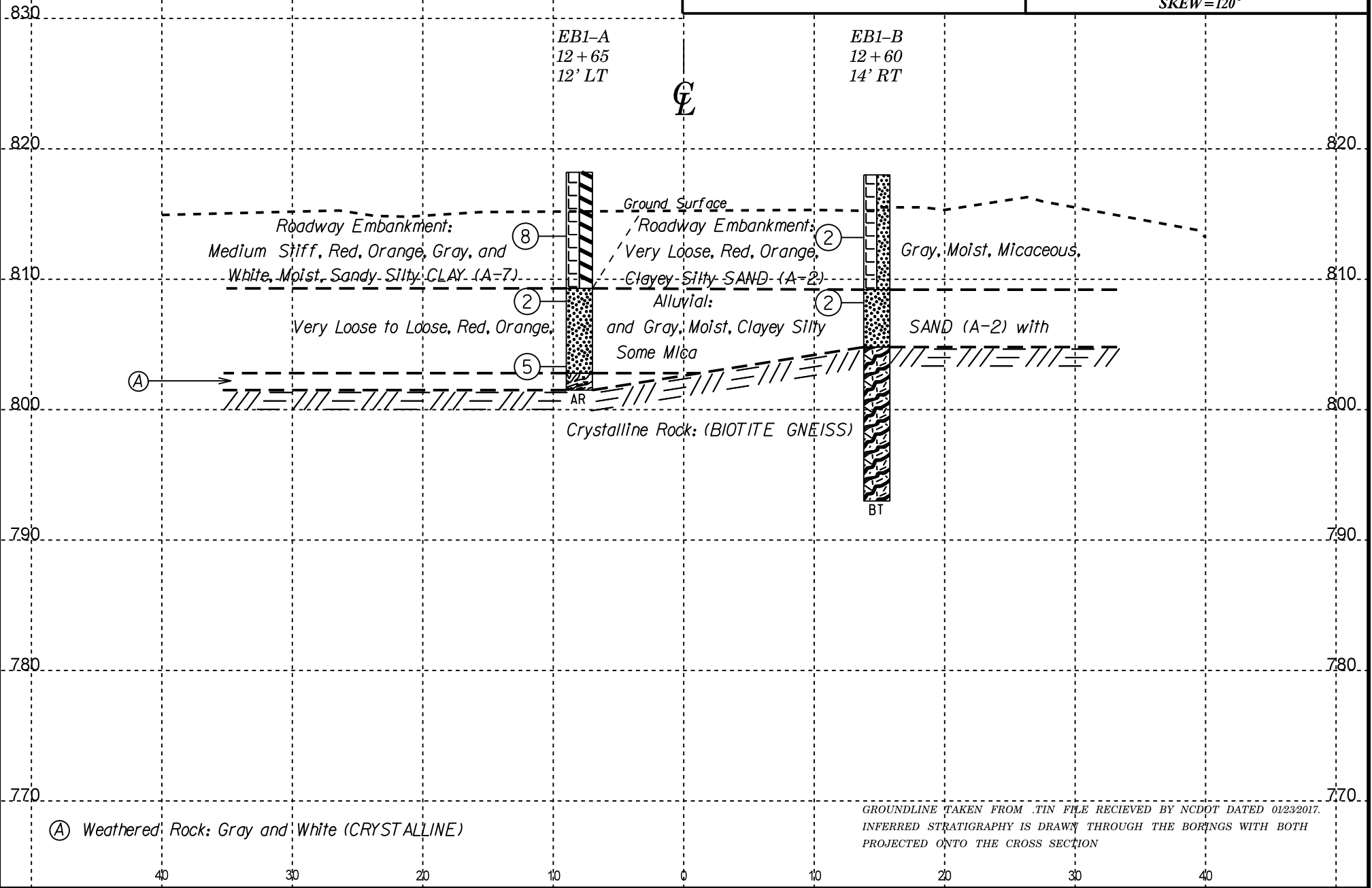
➤ Means deformation after tectonic disturbance

PROJECT REFERENCE NO.	SHEET NO.
17BP.12.R.50	3
SITE PLAN	
 0 60 120 FEET	
SKEW=120 DEGREES	

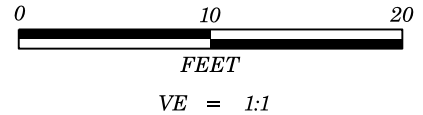




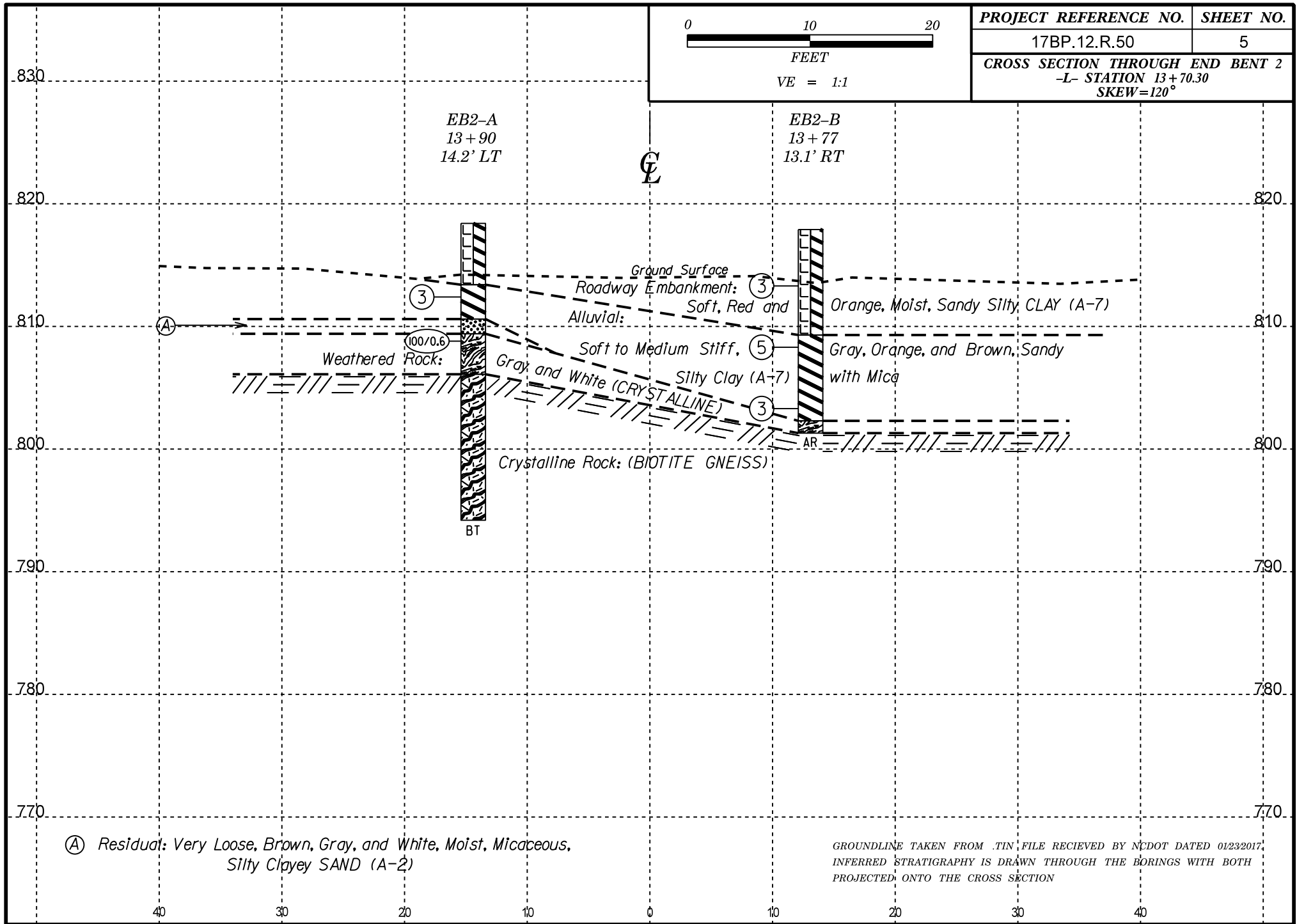
PROJECT REFERENCE NO.	SHEET NO.
17BP.12.R.50	4
CROSS SECTION THROUGH END BENT 1 -L- STATION 12+67.70 SKEW=120°	



GROUNDLINE TAKEN FROM TIN FILE RECEIVED BY NCDOT DATED 01/23/2017.
INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH
PROJECTED ONTO THE CROSS SECTION



PROJECT REFERENCE NO.	SHEET NO.
17BP.12.R.50	5
CROSS SECTION THROUGH END BENT 2	
-L- STATION 13+70.30	
SKEW=120°	



(A) Residual: Very Loose, Brown, Gray, and White, Moist, Micaceous, Silty Clayey SAND (A-2)

GROUNDLINE TAKEN FROM TIN FILE RECEIVED BY NCDOT DATED 01/23/2017, INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT BORE LOG

WBS 17BP.12.R.50			TIP SF-480214			COUNTY IREDELL			GEOLOGIST Stickney, J. K.									
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek										GROUND WTR (ft)								
BORING NO. EB1-A			STATION 12+65			OFFSET 12 ft LT			ALIGNMENT -L-									
COLLAR ELEV. 818.2 ft			TOTAL DEPTH 16.7 ft			NORTHING 796,954			EASTING 1,445,699									
DRILL RIG/HAMMER EFF./DATE HFC0072 CME-550X 85% 05/20/2016						DRILL METHOD H.S. Augers			HAMMER TYPE Automatic									
DRILLER Smith, C. L.			START DATE 01/17/17			COMP. DATE 01/17/17			SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)				
			0.5ft	0.5ft	0.5ft	0	25	50	75	100								
820														818.2	GROUND SURFACE	0.0		
815	814.3	3.9	3	4	4								ROADWAY EMBANKMENT Red, Orange, Gray, and White, Micaceous, Sandy Silty CLAY (A-7)					
810	809.3	8.9	2	1	1						M						809.3	8.9
805	804.3	13.9	1	1	4						M						802.8	15.4
														801.5	WEATHERED ROCK (BIOTITE GNEISS)	16.7		
Boring Terminated by Auger Refusal at Elevation 801.5 ft on Crystalline Rock (BIOTITE GNEISS)																		

NCDOT BORE SINGLE SF480214_GEO_BH_BRD0214.GPJ_NC_DOT.GDT 1/26/17

GEOTECHNICAL BORING REPORT


BORE LOG

WBS 17BP.12.R.50			TIP SF-480214			COUNTY IREDELL			GEOLOGIST Stickney, J. K.							
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek										GROUND WTR (ft)						
BORING NO. EB1-B			STATION 12+60			OFFSET 14 ft RT			ALIGNMENT -L-							
COLLAR ELEV. 818.0 ft			TOTAL DEPTH 25.0 ft			NORTHING 796,948			EASTING 1,445,674							
DRILL RIG/HAMMER EFF./DATE HFC0072 CME-550X 85% 05/20/2016						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic							
DRILLER Smith, C. L.			START DATE 01/17/17			COMP. DATE 01/18/17			SURFACE WATER DEPTH N/A							
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	L O G MOI	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100			ELEV. (ft)	DEPTH (ft)		
820														818.0	0.0	GROUND SURFACE
815	814.2	3.8				.....	.....	.....	.....							ROADWAY EMBANKMENT Red, Orange, and Gray, Micaceous, Clayey Silty SAND (A-2)
810	809.2	8.8	1	1	1	.....	.....	.....	.....			M		809.2	8.8	ALLUVIAL Red, Orange, and Gray, Clayey Silty SAND (A-2)
805						.....	.....	.....	.....			M		804.8	13.2	CRYSTALLINE ROCK (BIOTITE GNEISS)
800						.....	.....	.....	.....			
795						.....	.....	.....	.....					793.0	25.0	Boring Terminated at Elevation 793.0 ft in Crystalline Rock (BIOTITE GNEISS)

NCDOT BORE SINGLE SF480214_GEO_BH_BRD0214.GPJ_NC_DOT.GDT 1/26/17

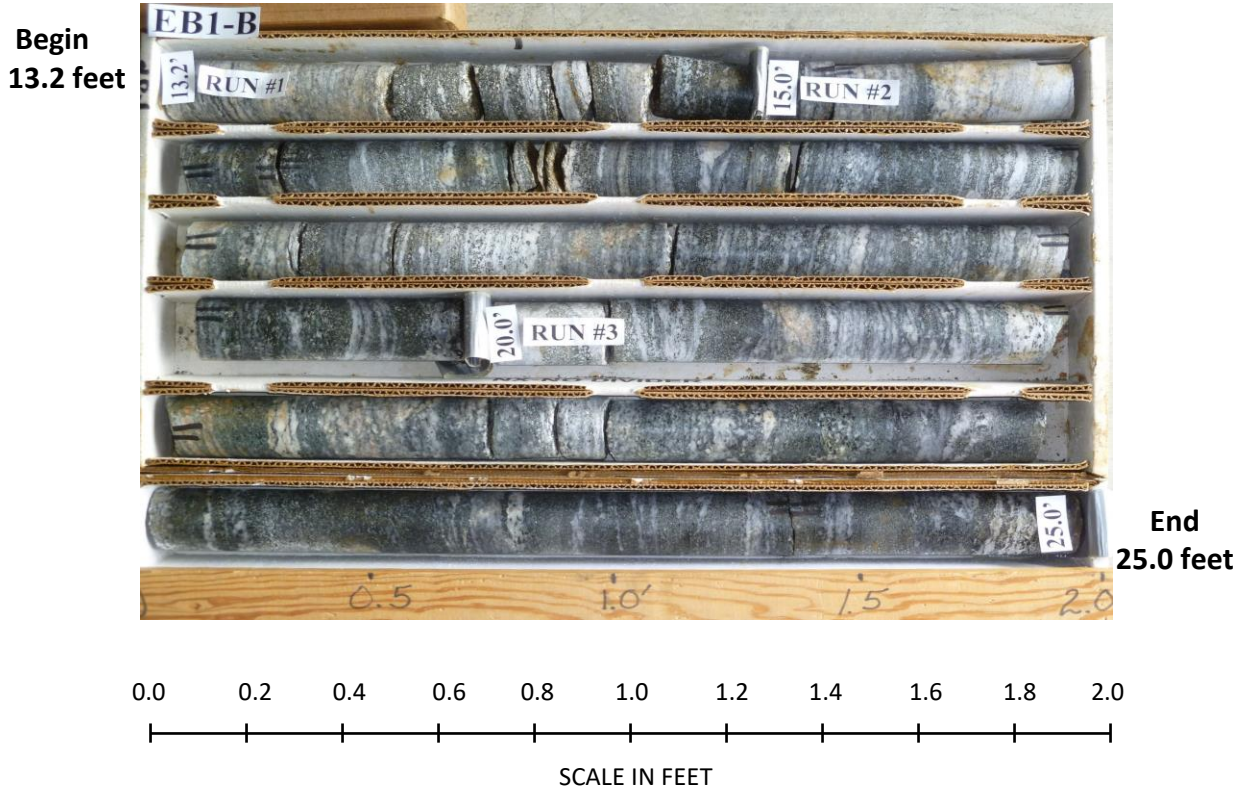
GEOTECHNICAL BORING REPORT

CORE LOG

WBS 17BP.12.R.50			TIP SF-480214			COUNTY IREDELL			GEOLOGIST Stickney, J. K.			
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek										GROUND WTR (ft)		
BORING NO. EB1-B			STATION 12+60			OFFSET 14 ft RT			ALIGNMENT -L-			
COLLAR ELEV. 818.0 ft			TOTAL DEPTH 25.0 ft			NORTHING 796,948			EASTING 1,445,674			
DRILL RIG/HAMMER EFF./DATE HFO0072 CME-550X 85% 05/20/2016						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic			
DRILLER Smith, C. L.			START DATE 01/17/17			COMP. DATE 01/18/17			SURFACE WATER DEPTH N/A			
CORE SIZE NX			TOTAL RUN 11.8 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		L O G	DESCRIPTION AND REMARKS	
					REC. (ft) %	RQD (ft) %		REC. (ft) %	RQD (ft) %			
804.8											Begin Coring @ 13.2 ft	
	804.8 803.0	13.2 15.0	1.8	NM/1.8	(1.3) 72%	(0.5) 28%		(11.3) 96%	(9.4) 80%		804.8 CRYSTALLINE ROCK Black-Gray-White, Fresh, Hard, BIOTITE GNEISS with Very Close to Wide Fracture Spacing GSI=80-82	13.2
			5.0	1:51/1.0 1:55/1.0 1:47/1.0 1:45/1.0 1:48/1.0	(5.0) 100%	(4.5) 90%						
	798.0	20.0										
			5.0	1:53/1.0 1:50/1.0 1:51/1.0 1:52/1.0 1:50/1.0	(5.0) 100%	(4.4) 88%						
	793.0	25.0									793.0	
											Boring Terminated at Elevation 793.0 ft in Crystalline Rock (BIOTITE GNEISS)	25.0

NCDOT CORE SINGLE SF480214_GEO_BH_BRD0214.GPJ NC_DOT.GDT 1/26/17

**CORE PHOTOGRAPH: Bridge No. 214 on SR 1896 (Friendship Rd.)
over Patterson Creek, EB1-B 12+60, 14.0' RT**



GEOTECHNICAL BORING REPORT


BORE LOG

WBS 17BP.12.R.50		TIP SF-480214		COUNTY IREDELL		GEOLOGIST Stickney, J. K.									
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek							GROUND WTR (ft)								
BORING NO. EB2-A		STATION 13+90		OFFSET 14 ft LT		ALIGNMENT -L-	0 HR. Dry								
COLLAR ELEV. 818.4 ft		TOTAL DEPTH 24.2 ft		NORTHING 796,842		EASTING 1,445,756	24 HR. NM								
DRILL RIG/HAMMER EFF./DATE HFC0072 CME-550X 85% 05/20/2016				DRILL METHOD SPT Core Boring		HAMMER TYPE Automatic									
DRILLER Smith, C. L.		START DATE 01/17/17		COMP. DATE 01/18/17		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
820															
815	813.4	5.0	2	1	2									818.4	0.0
810	809.4	9.0	67	33/0.1										813.4	5.0
805														810.6	7.8
800														809.4	9.0
795														806.1	12.3
														806.1	12.3
														794.2	24.2

NCDOT BORE SINGLE SF480214_GEO_BH_BRD0214.GPJ_NC_DOT.GDT 1/24/17

GEOTECHNICAL BORING REPORT

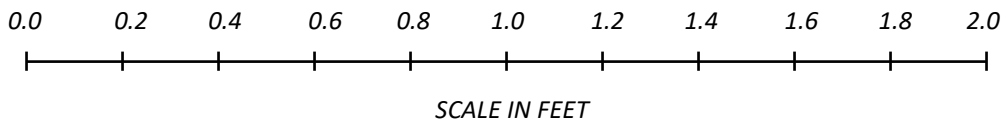
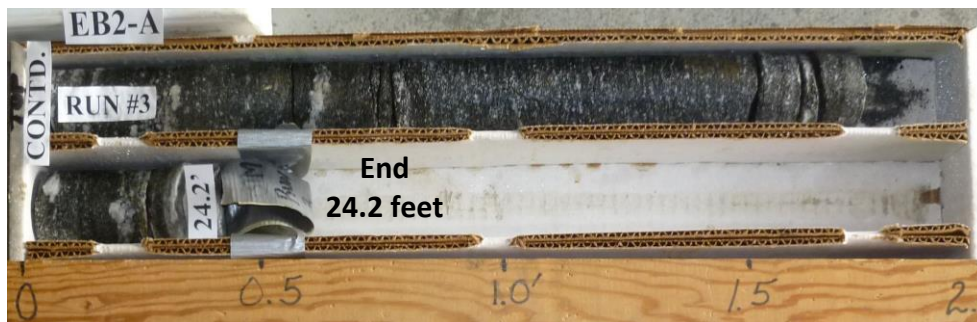
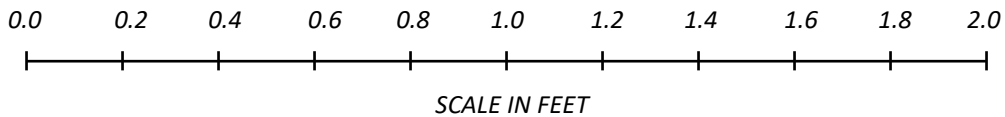
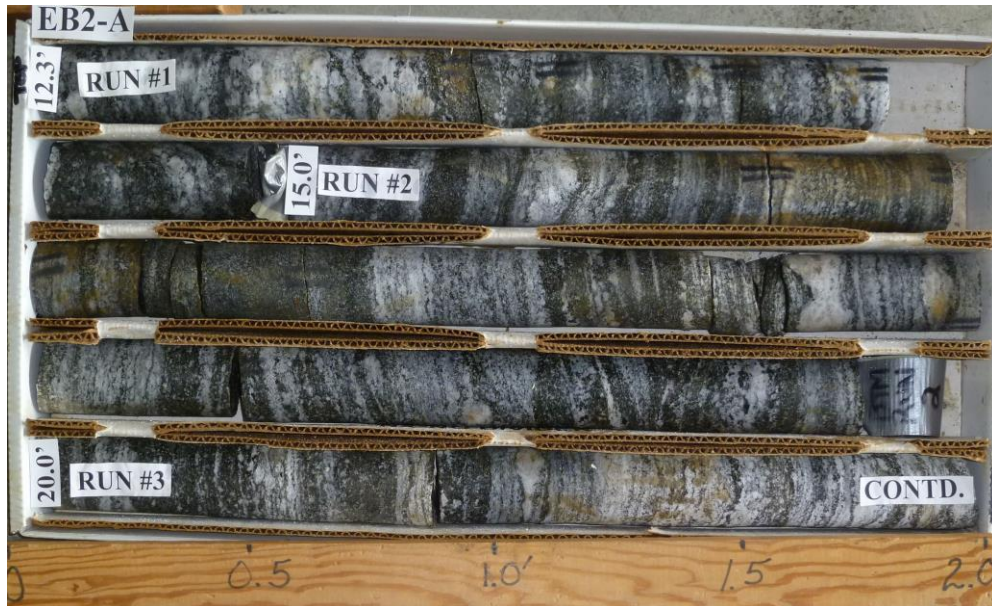
CORE LOG

WBS 17BP.12.R.50			TIP SF-480214			COUNTY IREDELL			GEOLOGIST Stickney, J. K.		
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek										GROUND WTR (ft)	
BORING NO. EB2-A			STATION 13+90			OFFSET 14 ft LT			ALIGNMENT -L-		
COLLAR ELEV. 818.4 ft			TOTAL DEPTH 24.2 ft			NORTHING 796,842			EASTING 1,445,756		
DRILL RIG/HAMMER EFF/DATE HFO0072 CME-550X 85% 05/20/2016						DRILL METHOD SPT Core Boring			HAMMER TYPE Automatic		
DRILLER Smith, C. L.			START DATE 01/17/17			COMP. DATE 01/18/17			SURFACE WATER DEPTH N/A		
CORE SIZE NX			TOTAL RUN 11.9 ft								
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %			
806.1											
805	806.1	12.3	2.7	1:33/1.0 1:35/1.7	(2.2) 81%	(2.2) 81%	(11.4) 96%	(10.2) 86%		806.1	12.3
	803.4	15.0								Black-Gray-White, Very Slightly Weathered to Fresh, Hard, BIOTITE GNEISS with Very Close to Wide Fracture Spacing GSI=79-81	
			5.0	1:25/1.0 1:25/1.0 1:27/1.0 1:30/1.0 1:29/1.0	(5.0) 100%	(4.7) 94%					
800	798.4	20.0									
			4.2	1:30/1.0 1:35/1.0 1:37/1.0 1:34/1.0 1:33/0.2	(4.2) 100%	(3.2) 76%					
795	794.2	24.2								794.2	24.2
Boring Terminated at Elevation 794.2 ft in Crystalline Rock (BIOTITE GNEISS)											

NCDOT CORE SINGLE SF480214_GEO_BH_BRD0214.GPJ NC_DOT.GDT 1/24/17

**CORE PHOTOGRAPH: Bridge No. 214 on SR 1896 (Friendship Rd.)
over Patterson Creek, EB2-A 13+90, 14.2' LT**

**Begin
12.3 feet**



GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.12.R.50		TIP SF-480214		COUNTY IREDELL		GEOLOGIST Stickney, J. K.									
SITE DESCRIPTION Bridge No. 214 on SR 1896 over Patterson Creek							GROUND WTR (ft)								
BORING NO. EB2-B		STATION 13+77		OFFSET 13 ft RT		ALIGNMENT -L-									
COLLAR ELEV. 817.9 ft		TOTAL DEPTH 16.6 ft		NORTHING 796,843		EASTING 1,445,725									
DRILL RIG/HAMMER EFF./DATE HFC0072 CME-550X 85% 05/20/2016				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic									
DRILLER Smith, C. L.		START DATE 01/17/17		COMP. DATE 01/17/17		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
820														GROUND SURFACE	0.0
815	814.3	3.6	1	2	1	•	•	•	•				M	ROADWAY EMBANKMENT Red and Orange, Sandy Silty CLAY (A-7)	
810	809.3	8.6	2	2	3	•	•	•	•				M	ALLUVIAL Orange, Brown, and Gray, Sandy Silty CLAY (A-7) with Mica	8.6
805	804.3	13.6	1	1	2	•	•	•	•				M	WEATHERED ROCK (BIOTITE GNEISS)	15.6
														Boring Terminated by Auger Refusal at Elevation 801.3 ft on Crystalline Rock (BIOTITE GNEISS)	16.6

NCDOT BORE SINGLE SF480214_GEO_BH_BRD0214.GPJ_NC_DOT.GDT 1/24/17