

REFERENCE: SF-840286

PROJECT: 17BP.9.PE.83

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	SF-840286	1	19

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

STRUCTURE
SUBSURFACE INVESTIGATION


COUNTY STOKES

PROJECT DESCRIPTION BRIDGE NO. 286 ON SR 1236
(N. OLD US 52) OVER LITTLE YADKIN RIVER

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND (SOIL & ROCK)
2B, 2C	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4-7	CROSS SECTIONS
8-12, 14-15, 17-18	BORE LOGS AND CORE REPORTS
13, 16	CORE PHOTOGRAPHS
19	SITE PHOTOGRAPH

PERSONNEL
J. K. STICKNEY
C. L. SMITH
B. E. FOSTER

INVESTIGATED BY J. E. BEVERLY ^{DS} 
DRAWN BY C. E. BURRIS
CHECKED BY C. R. LAVENDER, III
SUBMITTED BY K. B. MILLER
DATE OCTOBER 2020

CAUTION NOTICE

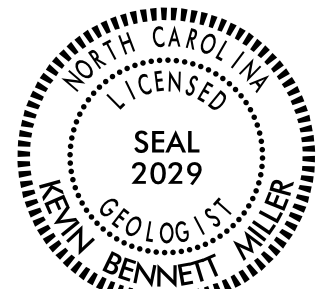
THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING 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 MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE 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.



Document signed by:

SIGNATURE


DATE

DOCUMENT NOT TO BE 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
(PAGE 1 OF 2)

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										RECOMMENDATION SYMBOLS									
U.S. STD. SIEVE SIZE OPENING (MM)										UNCLASIFIED EXCAVATION - UNSUITABLE WASTE UNCLASIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK									
BOULDER (BLDR.), COBBLE (COB.), GRAVEL (GR.), COARSE SAND (CSE. SD.), FINE SAND (F SD.), SILT (SL.), CLAY (CL.)										ABBREVIATIONS									
GRAIN SIZE MM, IN.										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									
SOIL MOISTURE - CORRELATION OF TERMS										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									
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION										SAMPLE ABBREVIATIONS									
LL - LIQUID LIMIT PL - PLASTIC LIMIT OM - OPTIMUM MOISTURE SHRINKAGE LIMIT SL - SHRINKAGE LIMIT										S - BULK SS - SPLIT SPOON ST - SHELBY TUBE RS - ROCK RT - RECOMPACTED TRIAXIAL RATIO CBR - CALIFORNIA BEARING RATIO									
PLASTICITY										EQUIPMENT USED ON SUBJECT PROJECT									
NON PLASTIC, SLIGHTLY PLASTIC, MODERATELY PLASTIC, HIGHLY PLASTIC										DRILL UNITS: CME-45C, CME-55, CME-550, VANE SHEAR TEST, PORTABLE HOIST									
COLOR										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									
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.										HAMMER TYPE: AUTOMATIC, MANUAL CORE SIZE: B, H, N NO. HAND TOOLS: POST HOLE DIGGER, HAND AUGER, SOUNDING ROD, VANE SHEAR TEST									

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

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 2 OF 2)

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. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC. ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS. SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS IN OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE. TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.</p>
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 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. <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.
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		
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 #2 - RAILROAD SPIKE IN 20" HICKORY -L- STA 23+37 233' RT N 935643 E 158781 ELEVATION: 844.92 FEET</p> <p>NOTES: FIAD = FILLED IMMEDIATELY AFTER DRILLING CAR = CASING ADVANCER REFUSAL</p> <p>EB2-A COLLAR ELEVATION TAKEN FROM TIN FILE 840286.LS.TIN DATED 2-17-2020</p>
		DATE: 8-15-14

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
 DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

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

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

**GEOLOGICAL STRENGTH INDEX (GSI) FOR
 JOINTED ROCKS (Hoek and Marinos, 2000)**

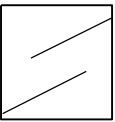
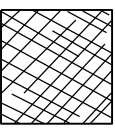
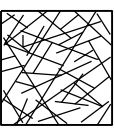

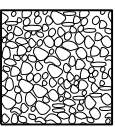
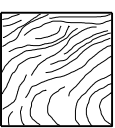
From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak 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

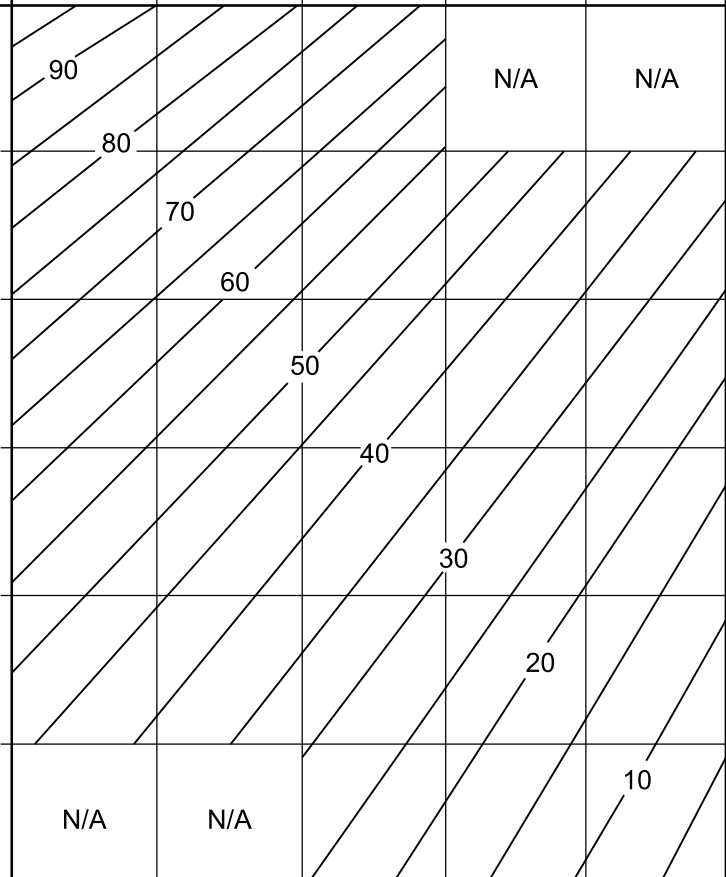
VERY GOOD Very rough, fresh unweathered surfaces	GOOD Rough, slightly weathered, iron stained surfaces	FAIR Smooth, moderately weathered and altered surfaces	POOR Slackensided, highly weathered surfaces with compact coatings or fillings or angular fragments	VERY POOR Slackensided, highly weathered surfaces with soft clay coatings or fillings
--	---	--	---	---

DECREASING SURFACE QUALITY →

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 ↓



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 (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

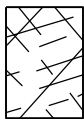
GOOD - Rough, slightly weathered surfaces

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

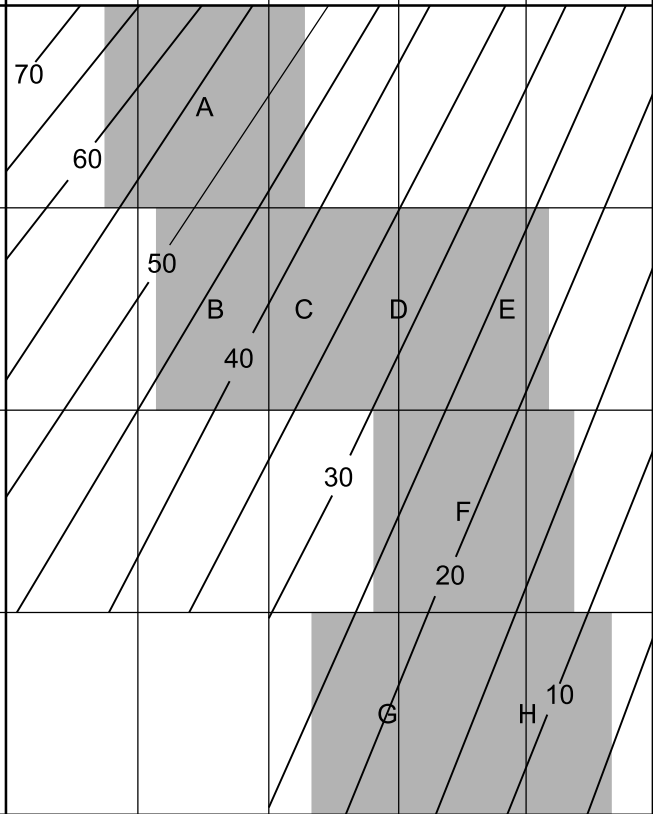


G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers



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

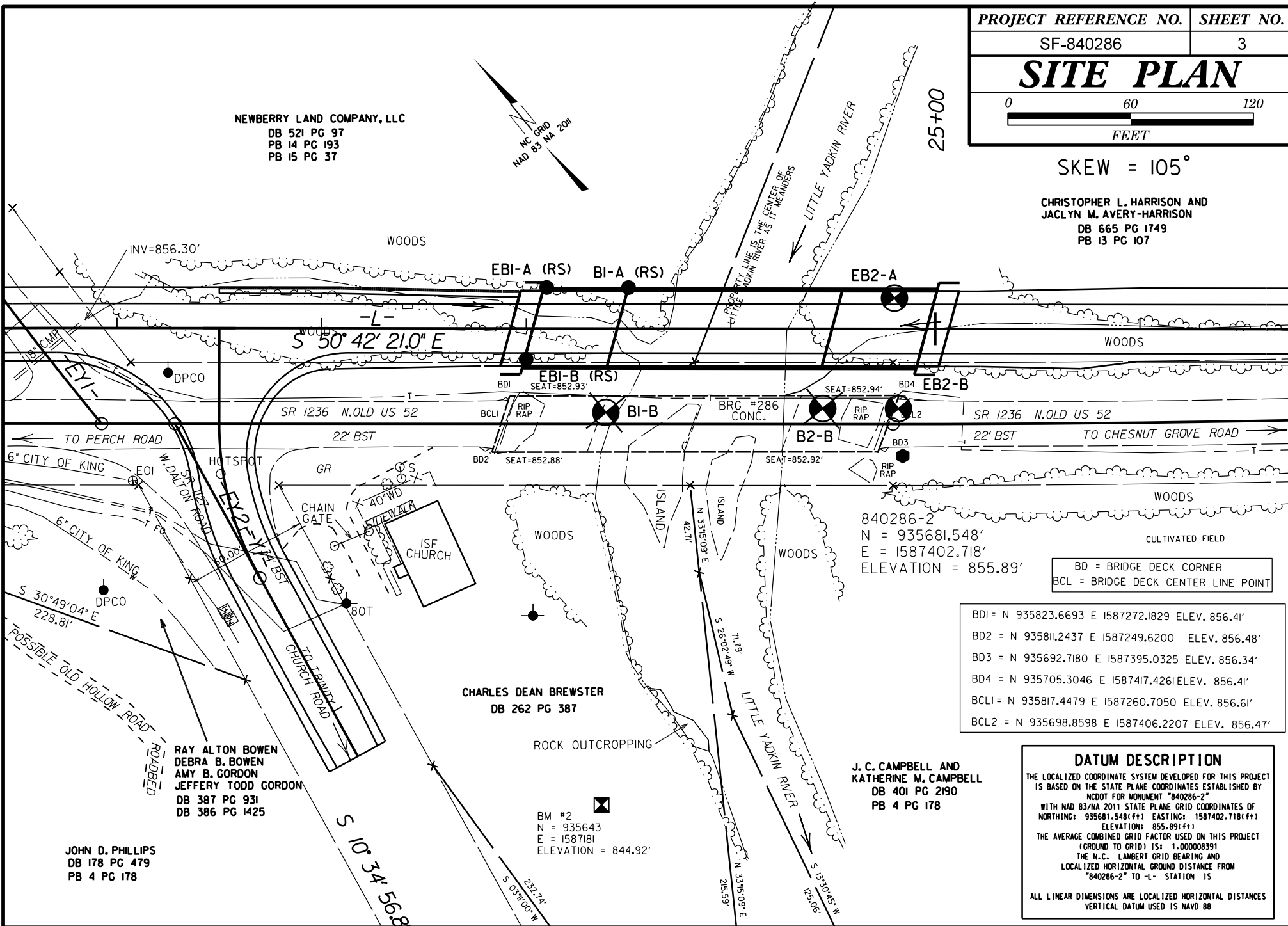


PROJECT REFERENCE NO.	SHEET NO.
SF-840286	3
SITE PLAN	

SKEW = 105°

CHRISTOPHER L. HARRISON AND
 JACLYN M. AVERY-HARRISON
 DB 665 PG 1749
 PB 13 PG 107

NEWBERRY LAND COMPANY, LLC
 DB 521 PG 97
 PB 14 PG 193
 PB 15 PG 37



840286-2
 N = 935681.548'
 E = 1587402.718'
 ELEVATION = 855.89'

BD = BRIDGE DECK CORNER
 BCL = BRIDGE DECK CENTER LINE POINT

- BD1 = N 935823.6693 E 1587272.1829 ELEV. 856.41'
- BD2 = N 935811.2437 E 1587249.6200 ELEV. 856.48'
- BD3 = N 935692.7180 E 1587395.0325 ELEV. 856.34'
- BD4 = N 935705.3046 E 1587417.4261 ELEV. 856.41'
- BCL1 = N 935817.4479 E 1587260.7050 ELEV. 856.61'
- BCL2 = N 935698.8598 E 1587406.2207 ELEV. 856.47'

DATUM DESCRIPTION
 THE LOCALIZED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON THE STATE PLANE COORDINATES ESTABLISHED BY NCDOT FOR MONUMENT "840286-2" WITH NAD 83/NA 2011 STATE PLANE GRID COORDINATES OF NORTHING: 935681.548(±); EASTING: 1587402.718(±±) ELEVATION: 855.89(±±) THE AVERAGE COMBINED GRID FACTOR USED ON THIS PROJECT (GROUND TO GRID) IS: 1.000008391 THE N.C. LAMBERT GRID BEARING AND LOCALIZED HORIZONTAL GROUND DISTANCE FROM "840286-2" TO -L- STATION IS ALL LINEAR DIMENSIONS ARE LOCALIZED HORIZONTAL DISTANCES VERTICAL DATUM USED IS NAVD 88

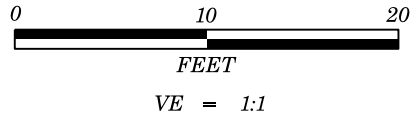
CHARLES DEAN BREWSTER
 DB 262 PG 387

J. C. CAMPBELL AND
 KATHERINE M. CAMPBELL
 DB 401 PG 2190
 PB 4 PG 178

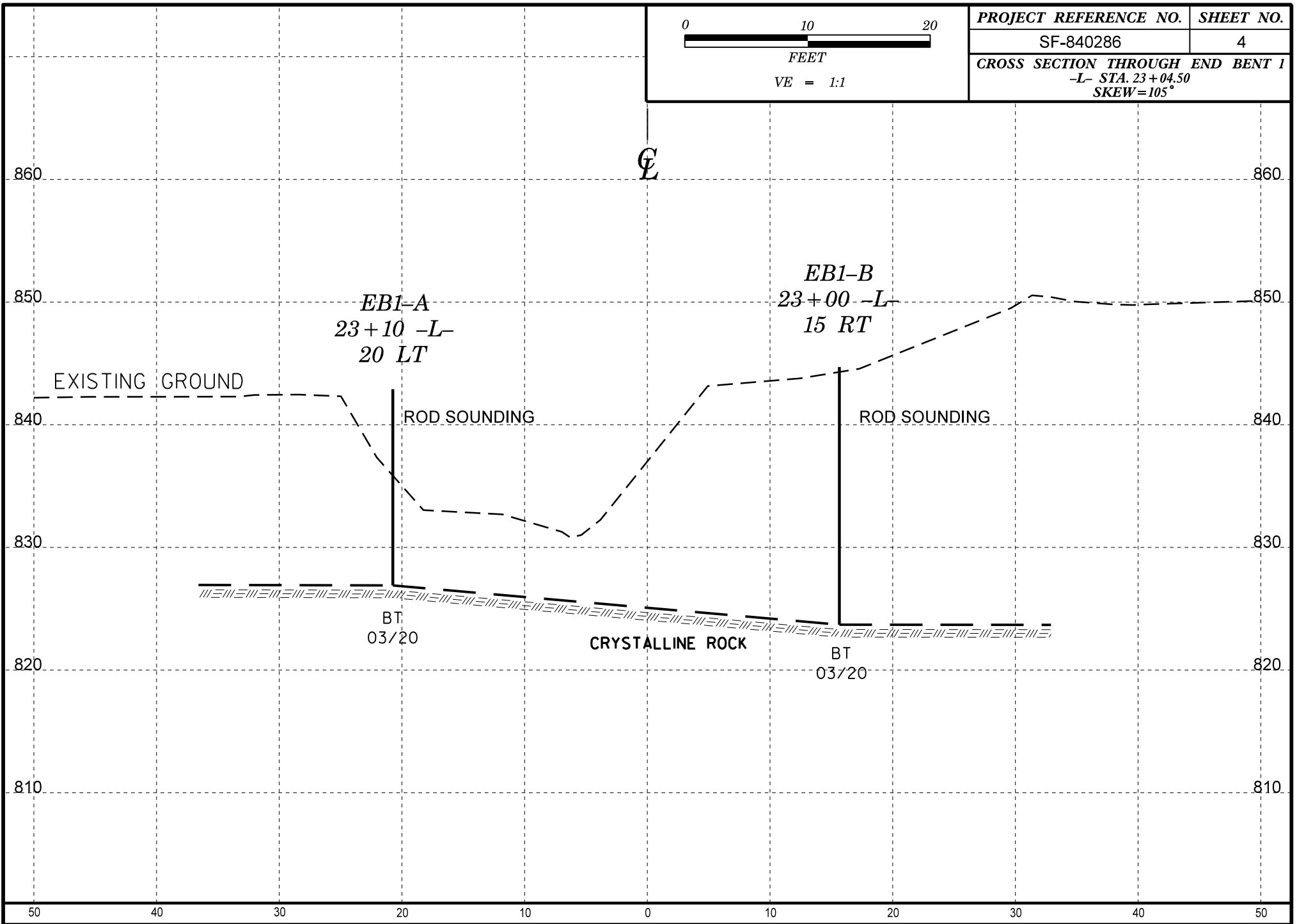
RAY ALTON BOWEN
 DEBRA B. BOWEN
 AMY B. GORDON
 JEFFERY TODD GORDON
 DB 387 PG 931
 DB 386 PG 1425

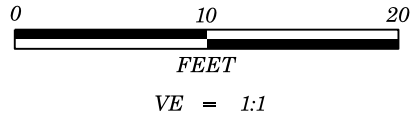
JOHN D. PHILLIPS
 DB 178 PG 479
 PB 4 PG 178

BM #2
 N = 935643
 E = 1587181
 ELEVATION = 844.92'

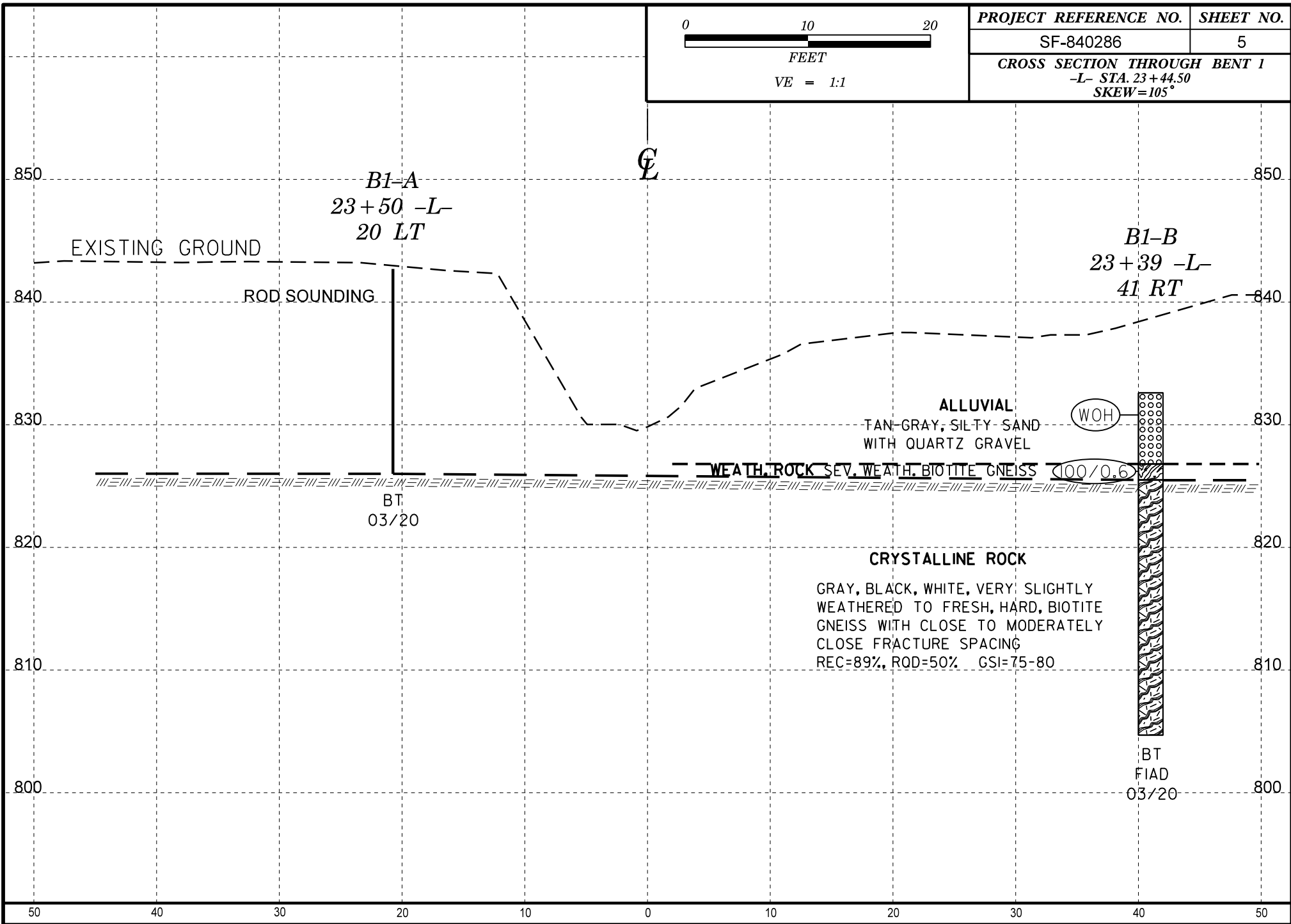


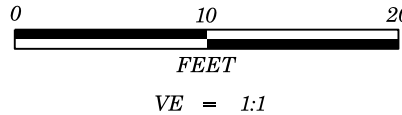
PROJECT REFERENCE NO.	SHEET NO.
SF-840286	4
CROSS SECTION THROUGH END BENT 1	
-L- STA. 23+04.50	
SKEW=105°	



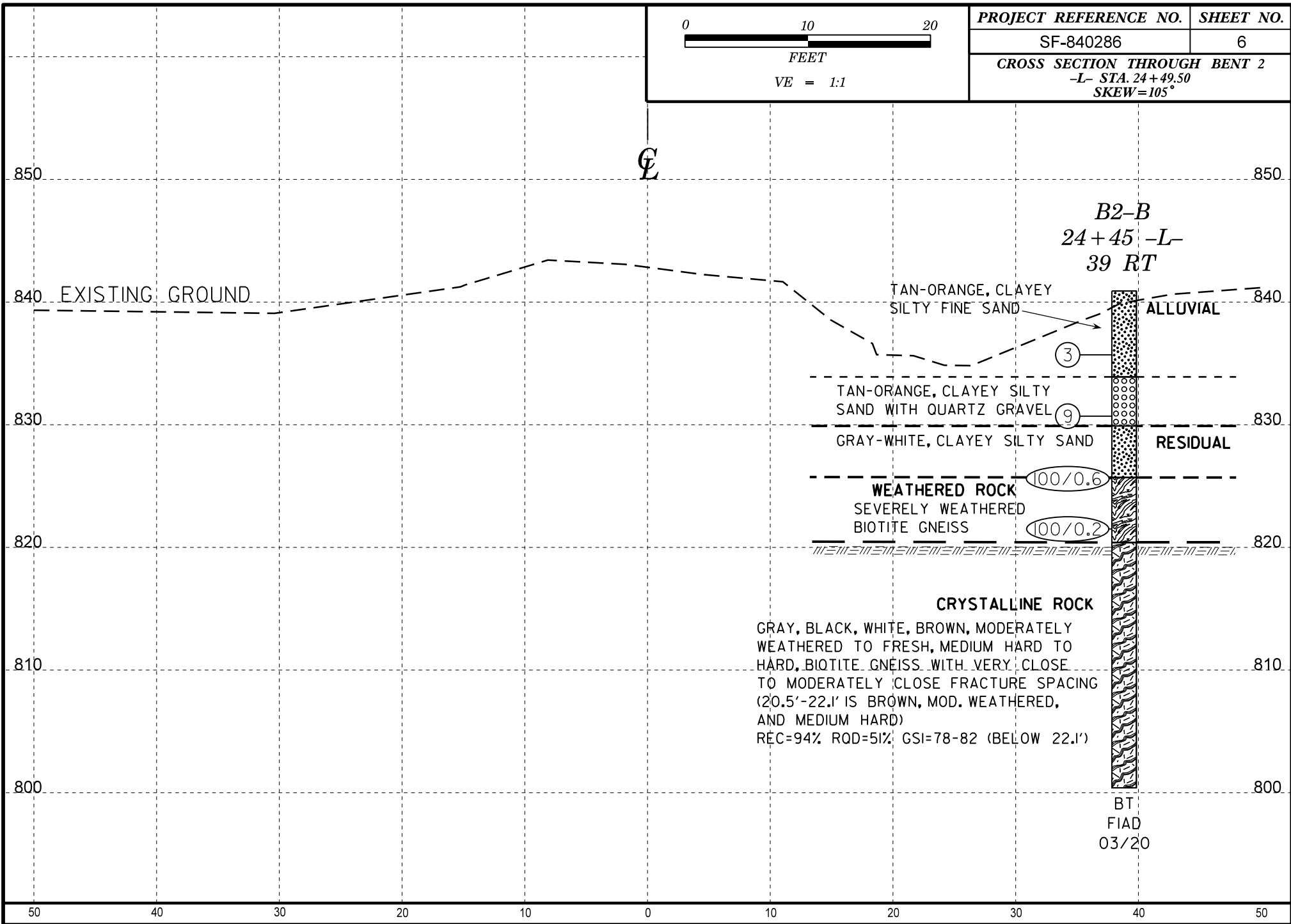


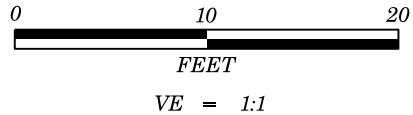
PROJECT REFERENCE NO.	SHEET NO.
SF-840286	5
CROSS SECTION THROUGH BENT 1	
-L- STA. 23+44.50	
SKEW=105°	



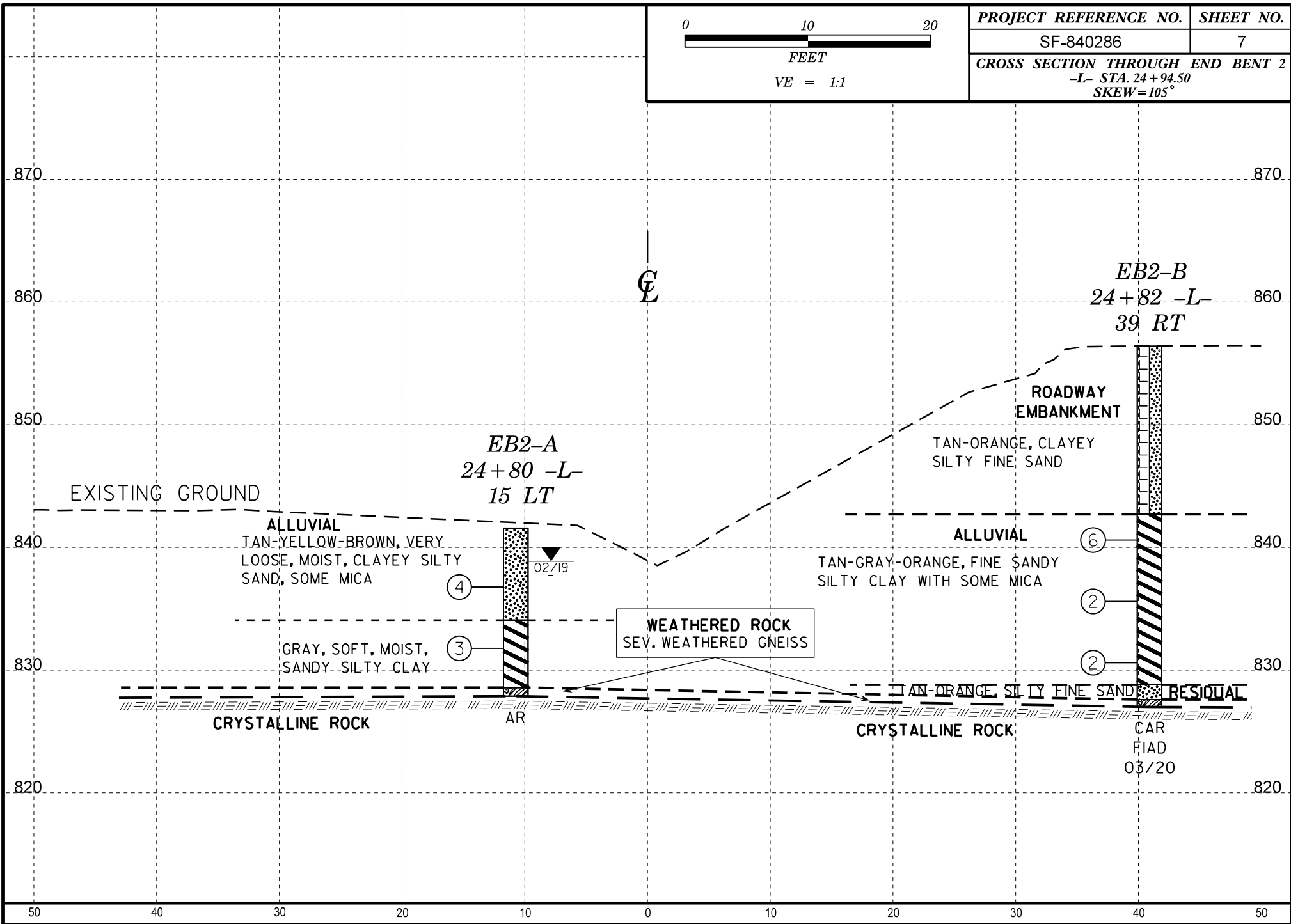


PROJECT REFERENCE NO.	SHEET NO.
SF-840286	6
CROSS SECTION THROUGH BENT 2 -L- STA. 24+49.50 SKEW=105°	





PROJECT REFERENCE NO.	SHEET NO.
SF-840286	7
CROSS SECTION THROUGH END BENT 2	
-L- STA. 24+94.50	
SKEW=105°	



GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.9.R.83			TIP SF-840286			COUNTY STOKES			GEOLOGIST Stickney, J. K.								
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER									GROUND WTR (ft)								
BORING NO. EB1-A (RS)			STATION 23+10			OFFSET 20 ft LT			ALIGNMENT -L-								
COLLAR ELEV. 842.9 ft			TOTAL DEPTH 16.0 ft			NORTHING 935,855			EASTING 1,587,320								
DRILL RIG/HAMMER EFF./DATE HFC0070 CME-550X 79% 12/16/2019						DRILL METHOD Rod Sounding			HAMMER TYPE Automatic								
DRILLER Smith, C. L.			START DATE 03/18/20			COMP. DATE 03/18/20			SURFACE WATER DEPTH N/A								
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100							
845																	
															842.9	GROUND SURFACE ROD SOUNDING	0.0
840																	
835																	
830																	
															826.9	Boring Terminated at Elevation 826.9 ft ON POSSIBLE WR / ROCK	16.0

NCDOT BORE SINGLE SF840286 GEO RDWY_BH.GPJ NC_DOT.GDT 10/20/20

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.9.R.83			TIP SF-840286			COUNTY STOKES			GEOLOGIST Stickney, J. K.								
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER										GROUND WTR (ft)							
BORING NO. EB1-B (RS)			STATION 23+00			OFFSET 15 ft RT			ALIGNMENT -L-								
COLLAR ELEV. 844.7 ft			TOTAL DEPTH 21.0 ft			NORTHING 935,835			EASTING 1,587,290								
DRILL RIG/HAMMER EFF./DATE HFC0070 CME-550X 79% 12/16/2019						DRILL METHOD Rod Sounding			HAMMER TYPE Automatic								
DRILLER Smith, C. L.			START DATE 03/18/20			COMP. DATE 03/18/20			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	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100							
845															844.7	GROUND SURFACE	0.0
840																ROD SOUNDING	
835																	
830																	
825																	
															823.7	Boring Terminated at Elevation 823.7 ft ON POSSIBLE WR / ROCK	21.0

NCDOT BORE SINGLE SF840286 GEO RDWY_BH.GPJ NC_DOT.GDT 10/20/20

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.9.R.83			TIP SF-840286			COUNTY STOKES			GEOLOGIST Stickney, J. K.							
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER									GROUND WTR (ft)							
BORING NO. B1-A (RS)			STATION 23+50			OFFSET 20 ft LT			ALIGNMENT -L-							
COLLAR ELEV. 842.7 ft			TOTAL DEPTH 16.7 ft			NORTHING 935,830			EASTING 1,587,351							
DRILL RIG/HAMMER EFF./DATE HFC0070 CME-550X 79% 12/16/2019						DRILL METHOD Rod Sounding			HAMMER TYPE Automatic							
DRILLER Smith, C. L.			START DATE 03/18/20			COMP. DATE 03/18/20			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	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
845																
														842.7	GROUND SURFACE	0.0
840											ROD SOUNDING	
835												
830												
										826.0	Boring Terminated at Elevation 826.0 ft ON POSSIBLE WR / ROCK	16.7

NCDOT BORE SINGLE SF840286 GEO RDWY_BH.GPJ NC_DOT.GDT 10/20/20

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 17BP.9.R.83	TIP SF-840286	COUNTY STOKES	GEOLOGIST Stickney, J. K.
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER			GROUND WTR (ft)
BORING NO. B1-B	STATION 23+39	OFFSET 41 ft RT	ALIGNMENT -L-
COLLAR ELEV. 832.6 ft	TOTAL DEPTH 27.9 ft	NORTHING 935,790	EASTING 1,587,304
DRILL RIG/HAMMER EFF./DATE HFC0070 CME-550X 79% 12/16/2019		DRILL METHOD NW Casing w/ Advancer	HAMMER TYPE Automatic
DRILLER Smith, C. L.	START DATE 03/11/20	COMP. DATE 03/11/20	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					
835															
	831.8	0.8												832.6	0.0
830			WOH	WOH	WOH										
	826.8	5.8												826.8	5.8
825			41	59.1										825.5	7.1
820															
815															
810															
805														804.7	27.9

NCDOT BORE SINGLE SF840286 GEO RDWY_BH.GPJ NC_DOT.GDT 10/20/20

CORE PHOTOGRAPHS

B1B

BOXES 1 & 2: 7.1 - 38.0 FEET



CORE PHOTOGRAPHS

B2B

BOX 1 & 2: 20.5 - 40.5 FEET



GEOTECHNICAL BORING REPORT

CORE LOG

WBS 17BP.9.R.83			TIP SF-840286			COUNTY STOKES			GEOLOGIST Stickney, J. K.		
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER									GROUND WTR (ft)		
BORING NO. B1-B			STATION 23+39			OFFSET 41 ft RT			ALIGNMENT -L-		
COLLAR ELEV. 832.6 ft			TOTAL DEPTH 27.9 ft			NORTHING 935,790			EASTING 1,587,304		
DRILL RIG/HAMMER EFF./DATE HFO0070 CME-550X 79% 12/16/2019						DRILL METHOD NW Casing w/ Advancer			HAMMER TYPE Automatic		
DRILLER Smith, C. L.			START DATE 03/11/20			COMP. DATE 03/11/20			SURFACE WATER DEPTH N/A		
CORE SIZE NX			TOTAL RUN 20.8 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) %			
825.54	825.5	7.1	0.8		(0.6)	(0.0)	(18.6)	(10.3)		Begin Coring @ 7.1 ft	
	824.7	7.9	5.0		75%	0%	89%	50%		CRYSTALLINE ROCK	7.1
					(4.4)	(0.4)				GRAY, BLACK, WHITE, VERY SLIGHTLY WEATHERED TO FRESH, HARD, BIOTITE GNEISS WITH CLOSE TO MODERATELY CLOSE FRACTURE SPACING	
	819.7	12.9	5.0		88%	8%				REC=89%, RQD=50%	
					(4.0)	(2.0)				GSI=75-80	
	815	17.9	5.0		80%	40%					
					(4.8)	(4.4)					
	815	17.9	5.0		96%	88%					
					(4.8)	(3.5)					
	810	22.9	5.0		96%	70%					
					(4.8)	(3.5)					
	805	27.9	5.0		96%	70%					
					(4.8)	(3.5)					
	805	27.9	5.0		96%	70%				Boring Terminated at Elevation 804.7 ft IN BIOTITE GNEISS	27.9

NCDOT CORE SINGLE SF840286_GEO_RDWY_BH.GPJ NC_DOT.GDT 10/14/20

GEOTECHNICAL BORING REPORT

CORE LOG

WBS 17BP.9.R.83				TIP SF-840286		COUNTY STOKES			GEOLOGIST Stickney, J. K.			
SITE DESCRIPTION BRIDGE NO. 286 ON SR 1236 (OLD US 52) OVER LITTLE YADKIN RIVER										GROUND WTR (ft)		
BORING NO. B2-B				STATION 24+45		OFFSET 39 ft RT			ALIGNMENT -L-		0 HR. Caved	
COLLAR ELEV. 840.9 ft				TOTAL DEPTH 40.5 ft		NORTHING 935,724			EASTING 1,587,387		24 HR. FIAD	
DRILL RIG/HAMMER EFF./DATE HFO0070 CME-550X 79% 12/16/2019						DRILL METHOD NW Casing w/ Advancer			HAMMER TYPE Automatic			
DRILLER Smith, C. L.				START DATE 03/12/20		COMP. DATE 03/12/20			SURFACE WATER DEPTH N/A			
CORE SIZE NX				TOTAL RUN 20.0 ft								
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)	
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %				
820.35												
	820.4	20.5	5.0		(4.2) 84%	(0.4) 8%	(18.8) 94%	(10.1) 51%		Begin Coring @ 20.5 ft	20.5	
	815.4	25.5	5.0		(4.9) 98%	(3.0) 60%				CRYSTALLINE ROCK GRAY, BLACK, WHITE, BROWN, MODERATELY WEATHERED TO FRESH, MEDIUM HARD TO HARD, BIOTITE GNEISS WITH VERY CLOSE TO MODERATELY CLOSE FRACTURE SPACING (20.5-22.1' IS BROWN, MODERATELY WEATHERED, AND MEDIUM HARD) REC=94%, RQD=51% GSI=78-82 (BELOW 22.1')		
815												
	810.4	30.5	5.0		(4.7) 94%	(3.0) 60%						
810												
	805.4	35.5	5.0		(5.0) 100%	(3.7) 74%						
805												
	800.4	40.5								Boring Terminated at Elevation 800.4 ft IN BIOTITE GNEISS	40.5	

NCDOT CORE SINGLE SF840286_GEO_RDWY_BH.GPJ NC_DOT.GDT 10/14/20

SITE PHOTOGRAPH

Bridge No. 86 on -L- (SR 1236) over Little Yadkin River



Looking from End Bent 1 toward End Bent 2