Mr. Robbie Kirk, PE
Roadway Department Manager
SEPI Engineering & Construction
11020 David Taylor Drive, Suite 115
Charlotte, NC 28262

October 1, 2018

RE: TIP U-5738, WBS 50163.1.1
Rowan County, North Carolina
Structure Subsurface Investigation for Bridge over Town Creek on SR 2528 between SR 2540 and US 601

Dear Mr. Kirk,

HDR Engineering, Inc. has completed the structure subsurface investigation for the proposed Structure on -L- of SR 2528 (Julian Rd.) between SR 2540 and US 601. Borings were taken by HDR in accordance with Geotechnical Engineering Unit requirements and are shown within the attached report for the following bent locations: End Bent 1, Bent 1, and End Bent 2.

The following information is included within this structure subsurface investigation report:

1. Title sheet
2. Soil and rock legends
3. Site plan with boring locations
4. Subsurface profile
5. Subsurface cross sections at each bent location
6. Soil boring and rock coring logs
7. Rock core photos
8. Soil and rock laboratory test results
9. Site photos

hdrinc.com
555 Fayetteville Street, Suite 900, Raleigh NC 27601
T 919.232.6600 **F** 919.785.1187

Please contact me if you have any questions.

Sincerely,
HDR ENGINEERING, INC.

Michael Batten Digitally signed by Michael Batten
Date: 2018.10.01 17:00:33-04'00'

Michael G. Batten, PE
Senior Geotechnical Engineer
Professional Associate

Attachments

Bridge over Town Creek Structure Subsurface Investigation

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	U-5738	1	23

REFERENCE: U-5738

PROJECT: 50163

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY ROWAN

PROJECT DESCRIPTION BRIDGE NO. 201 ON SR 2528 (JULIAN ROAD) OVER TOWN CREEK

SITE DESCRIPTION SR 2528 (JULIAN ROAD) FROM SR 2667 (SUMMIT PARK DRIVE) TO US 601 (JAKE ALEXANDER BLVD.) IN SALISBURY

CONTENTS

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

PERSONNEL

J.K. CRENSHAW

C. TAYLOR

O.F. WOODARD

INVESTIGATED BY J.K. CRENSHAW

DRAWN BY W. SHUECRAFT

CHECKED BY M.G. BATTEN

SUBMITTED BY M.G. BATTEN

DATE OCTOBER 2018

SIGNATURE DATE

PROJECT REFERENCE NO.	SHEET NO.
U-5738	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE,
VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6			
SYMBOL														
% PASSING #10 #40 #200	50 MX 30 MX 15 MX	50 MX 25 MX	51 MN 10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
MATERIAL PASSING #40 LL PI	— 6 MX		— NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	NO MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE	< 4 4 TO 10 10 TO 30 30 TO 50 > 50	N/A
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD	< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30	< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE SL — SHRINKAGE LIMIT	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NON PLASTIC	0-5	VERY LOW
SLIGHTLY PLASTIC	6-15	SLIGHT
MODERATELY PLASTIC	16-25	MEDIUM
HIGHLY PLASTIC	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE.
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHEN THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

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

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	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

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT / DPT DMT / VST PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING WITH CORE
- SPT N-VALUE

RECOMMENDATION SYMBOLS

- UNDERCUT
- SHALLOW UNDERCUT
- UNCLASSIFIED EXCAVATION - UNSUITABLE WASTE
- UNCLASSIFIED EXCAVATION - ACCEPTABLE DEGRADABLE ROCK
- UNCLASSIFIED EXCAVATION - ACCEPTABLE, BUT NOT TO BE USED IN THE TOP 3 FEET OF EMBANKMENT OR BACKFILL

ABBREVIATIONS

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

SAMPLE ABBREVIATIONS

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

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [X] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [X] CASING [ ] W/ ADVANCER
- [X] TRICONE 2 15/16 " STEEL TEETH
- [ ] TRICONE _____ " TUNG.-CARB.
- [X] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -N Q2

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD 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. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

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

BEDDING

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

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:
BM-3
N: 693351 E: 1555918 ELEVATION: 717.28 FEET

NOTES:

FIAD - FILLED IMMEDIATELY AFTER DRILLING

BORING AND GROUND SURFACE ELEVATIONS AQUIRED FROM 'U5738_DOC.tin' RECEIVED ON 1/20/2018

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
U-5738	2A

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

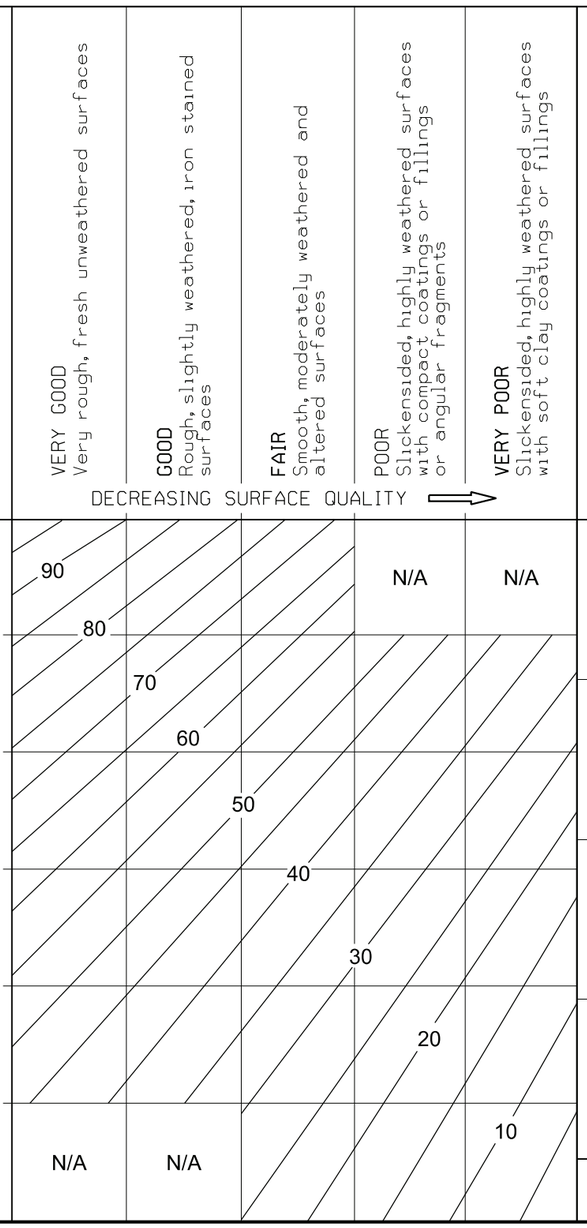
AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

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.

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

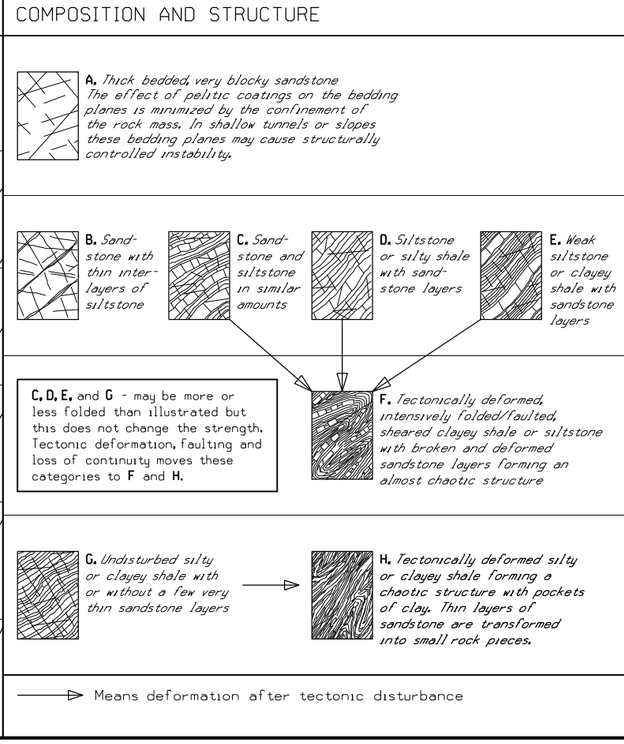


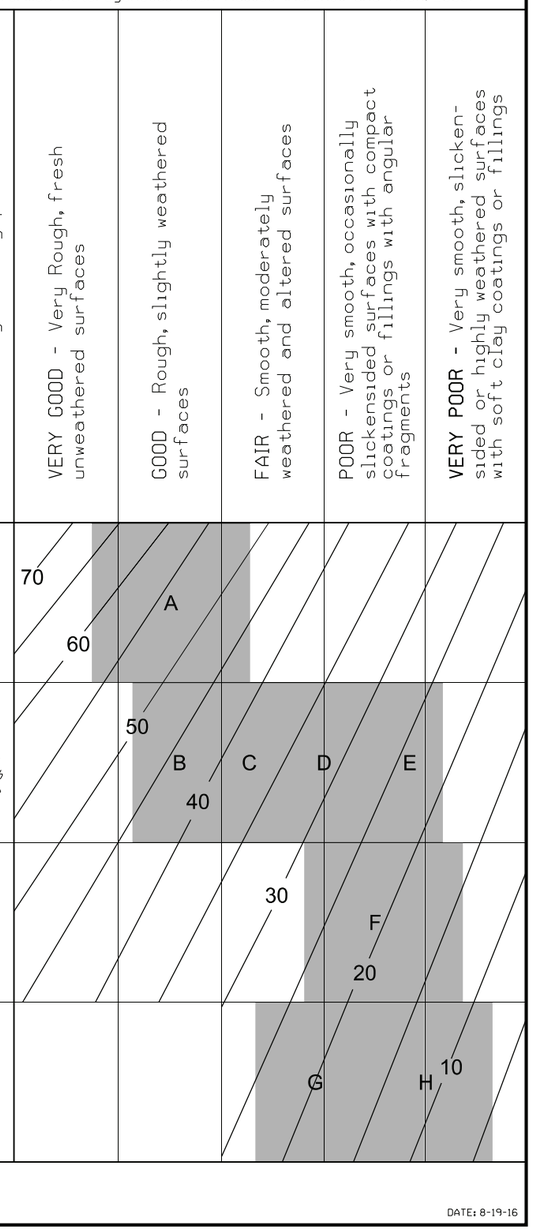
AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

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.

COMPOSITION AND STRUCTURE





DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
U-5738	3

SITE PLAN

0 50 100
FEET

68 69 70 71 72 73 74

BEGIN BRIDGE
-L- POT Sta.70+15.00

END BRIDGE
-L- POT Sta. 71+30.00

END APPROACH SLAB
-L- POT Sta. 71+54.00

BEGIN APPROACH SLAB
-L- POT Sta.69+91.00

RESIDUAL

ALLUVIAL

WOODS

EBI-A

BI-A

EB2-A

EB2-C

EBI-C

EBI-B

EB2-B

TO SR 2540
RICHIE RD.

N 7° 36' 07.5" W

ROADWAY EMBANKMENT

SR 2528 JULIAN RD., 26' BST

TO US 601
JAKE ALEXANDER BLVD

JS

TOWN CREEK

65°00' 00"

7/2/99

0	50	100

FEET

VE = 2.5

PROJECT REFERENCE NO.	SHEET NO.
U-5738	4

BRIDGE NO. 201
PROFILE CL OF -L-

GROUNDLINE PROFILE CREATED FROM u5738_DDC.tin FILE RECEIVED FROM NCDOT DATED 01-19-2018
INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE

760
740
720
700
680
660
640
620
600

EB1-C
70+09
12' RT
ST-1

EB2-C
71+27
3' LT

6
56
100/0.5
100/0.5
60/0.1
02/18
ST-1
16
63
99
59
60/0.1
BT
FIAD

Moderately to severely weathered, soft to hard, very close to moderately closely fractured, brown and white, METATUFF
REC 99%, RQD 25%
BT

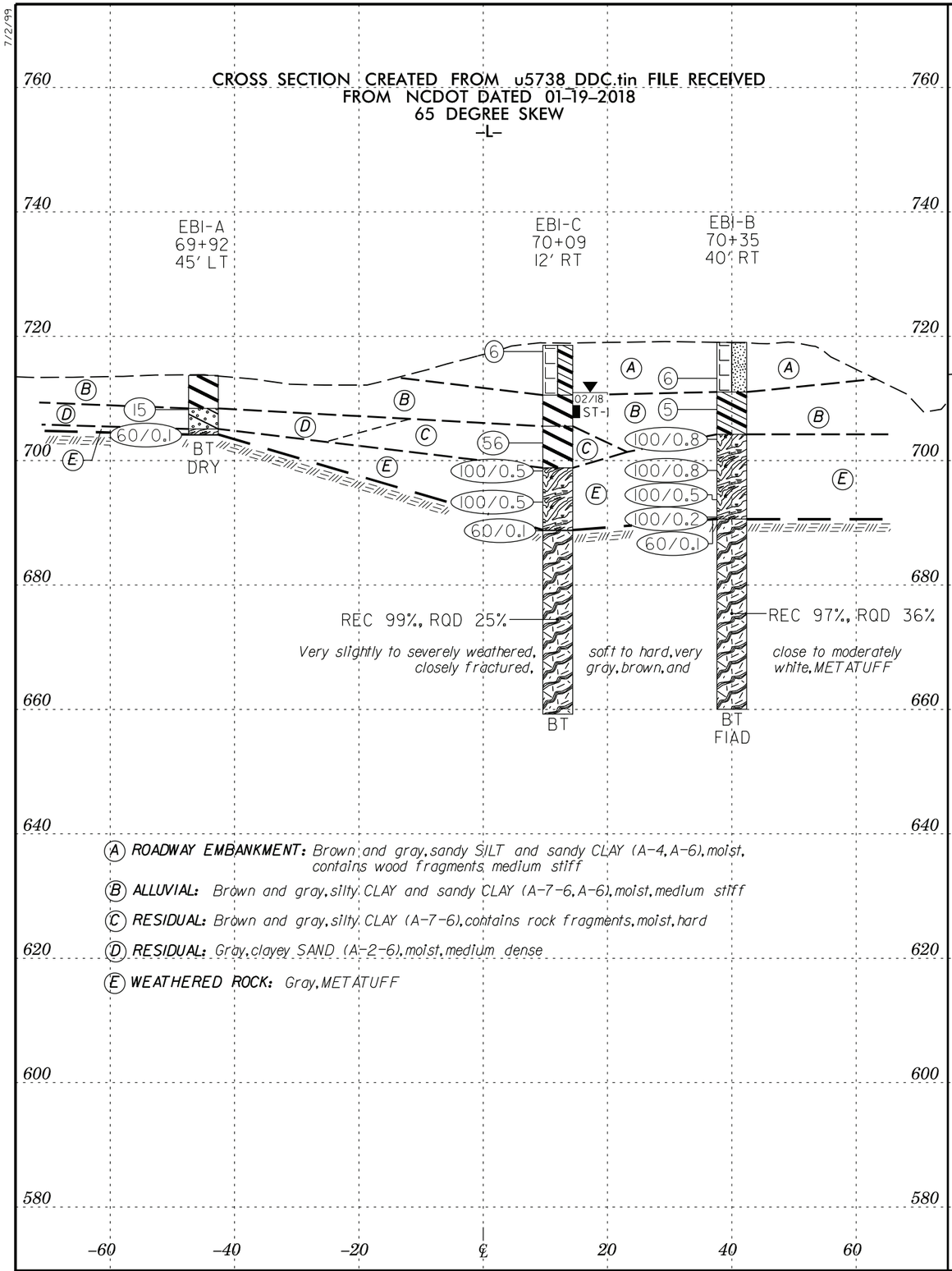
(A) **ROADWAY EMBANKMENT:** Brown and gray, sandy CLAY (A-6), contains wood fragments, moist, medium stiff.
(B) **ALLUVIAL:** Brown and gray, fine to coarse, sandy CLAY (A-7-6, A-6), moist to wet, medium stiff
(C) **RESIDUAL:** Brown and gray, silty CLAY (A-7-6), contains rock fragments, moist, hard
(D) **RESIDUAL:** Gray, brown, and green, silty SAND (A-2-4, A-3), moist to wet, medium dense to very dense
(E) **WEATHERED ROCK:** Gray, METATUFF

67+50 68+00 68+50 69+00 69+50 70+00 70+50 71+00 71+50 72+00 72+50 73+00 73+50 74+00

7/2/99

PROJECT REFERENCE NO.	SHEET NO.
U-5738	5

CROSS SECTION CREATED FROM u5738_DDC.tin FILE RECEIVED
FROM NCDOT DATED 01-19-2018
65 DEGREE SKEW
-L-



(A) **ROADWAY EMBANKMENT:** *Brown and gray, sandy SILT and sandy CLAY (A-4, A-6), moist, contains wood fragments, medium stiff*

(B) **ALLUVIAL:** *Brown and gray, silty CLAY and sandy CLAY (A-7-6, A-6), moist, medium stiff*

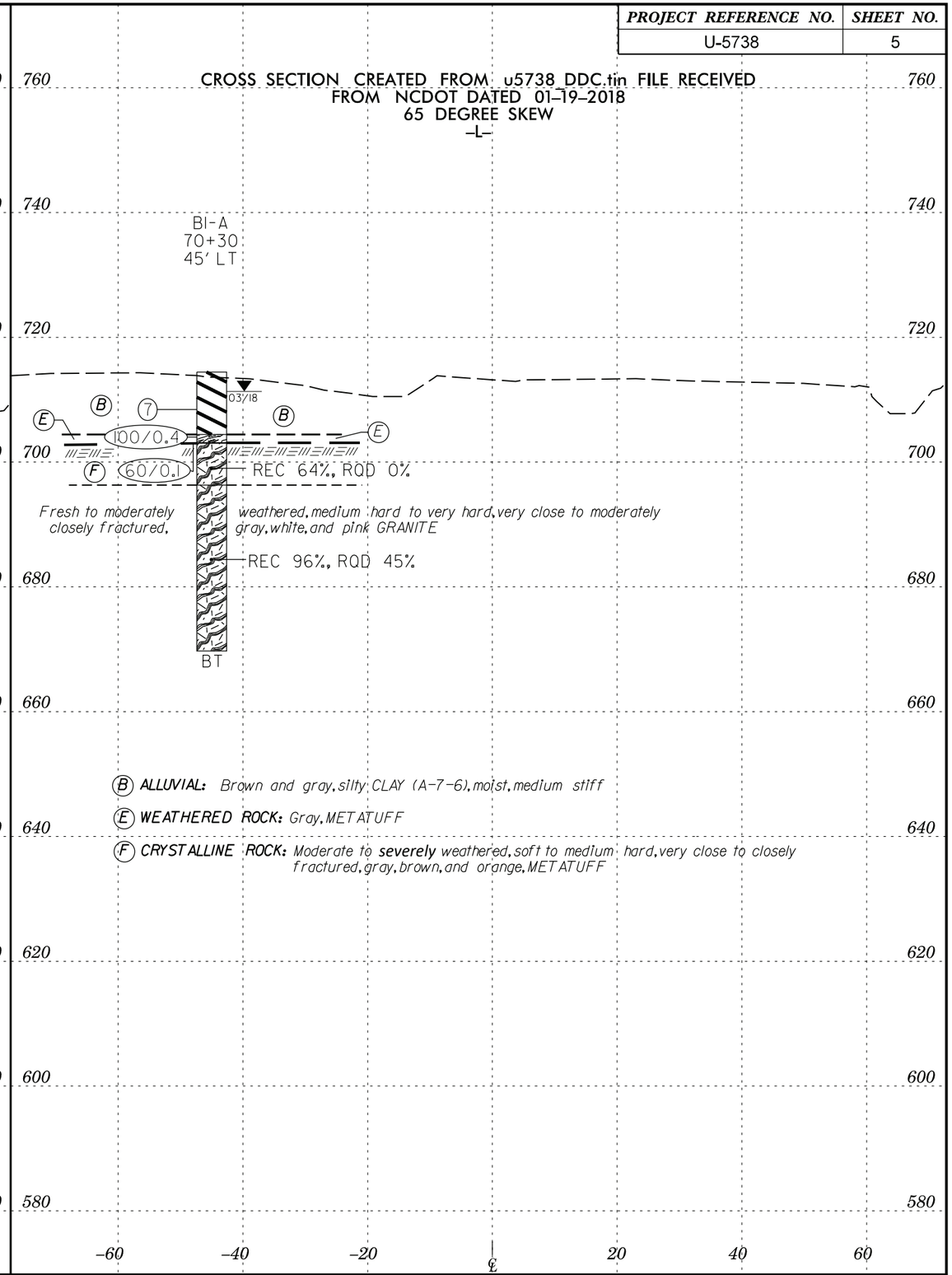
(C) **RESIDUAL:** *Brown and gray, silty CLAY (A-7-6), contains rock fragments, moist, hard*

(D) **RESIDUAL:** *Gray, clayey SAND (A-2-6), moist, medium dense*

(E) **WEATHERED ROCK:** *Gray, METATUFF*

HORIZ. SCALE (FEET) 0 20 40	VE = N/A	**BRIDGE NO. 201 – END BENT 1 CROSS SECTION – STA. 70+15.00**

CROSS SECTION CREATED FROM u5738_DDC.tin FILE RECEIVED
FROM NCDOT DATED 01-19-2018
65 DEGREE SKEW
-L-



(B) **ALLUVIAL:** *Brown and gray, silty CLAY (A-7-6), moist, medium stiff*

(E) **WEATHERED ROCK:** *Gray, METATUFF*

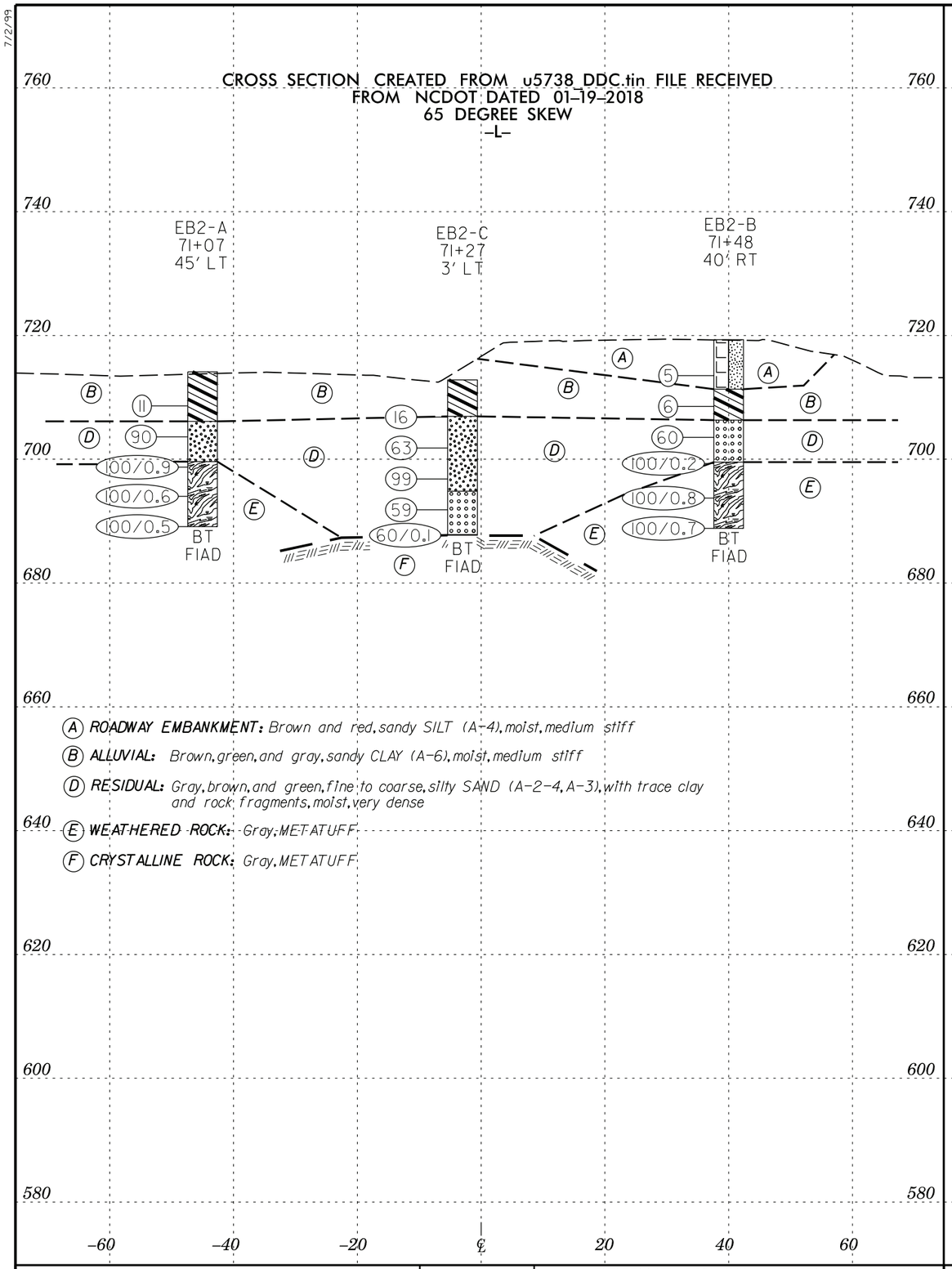
(F) **CRYSTALLINE ROCK:** *Moderate to* ***severely*** *weathered, soft to medium hard, very close to closely fractured, gray, brown, and orange, METATUFF*

HORIZ. SCALE (FEET) 0 20 40	VE = N/A	**BRIDGE NO. 201 – BENT 1 CROSS SECTION – STA. 70+50.00**

7/2/99

PROJECT REFERENCE NO.	SHEET NO.
U-5738	6

CROSS SECTION CREATED FROM u5738_DDC.tin FILE RECEIVED
FROM NCDOT DATED 01-19-2018
65 DEGREE SKEW
-L-



(A) **ROADWAY EMBANKMENT:** *Brown and red, sandy SILT (A-4), moist, medium stiff*

(B) **ALLUVIAL:** *Brown, green, and gray, sandy CLAY (A-6), moist, medium stiff*

(D) **RESIDUAL:** *Gray, brown, and green, fine to coarse, silty SAND (A-2-4, A-3), with trace clay and rock fragments, moist, very dense*

(E) **WEATHERED ROCK:** *Gray, METATUFF*

(F) **CRYSTALLINE ROCK:** *Gray, METATUFF*

HORIZ. SCALE (FEET) 0 20 40

VE = N/A

BRIDGE NO. 201 - END BENT 2
CROSS SECTION - STA. 71+30.00

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 69+92	**OFFSET** 45 ft LT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 713.7 ft	**TOTAL DEPTH** 9.6 ft	**NORTHING** 693,141	**EASTING** 1,556,024	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 03/03/18	**COMP. DATE** 03/03/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
715										713.7 GROUND SURFACE 0.0
										ALLUVIAL Brown and gray, silty CLAY (A-7-6), medium stiff
710	709.2	4.5	3	4	11	15		M		708.4 5.3
										RESIDUAL Gray, clayey SAND (A-2-6), medium dense
705	704.2	9.5	60/0.1			60/0.1				705.1 8.6
										704.2 9.5 **WEATHERED ROCK** Gray, METATUFF
										704.1 9.6 **CRYSTALLINE ROCK** Gray, METATUFF
										Boring Terminated with Standard Penetration Test Refusal at Elevation 704.1 ft in CRYSTALLINE ROCK (METATUFF)
										Strata Break in Split Spoon at 5.3 feet.

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 70+35	**OFFSET** 40 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 719.0 ft	**TOTAL DEPTH** 59.0 ft	**NORTHING** 693,195	**EASTING** 1,556,102	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 02/27/18	**COMP. DATE** 02/27/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
720										719.0 GROUND SURFACE 0.0
										ROADWAY EMBANKMENT Brown and gray, clayey SILT (A-4), medium stiff
715	714.2	4.8	1	3	3	6		M		711.0 8.0
										RESIDUAL Gray and brown, sandy CLAY (A-6), medium stiff
710	709.2	9.8	2	2	3	5		M		704.2 14.8
										WEATHERED ROCK Gray, METATUFF
705	704.2	14.8	31	69/0.3		100/0.8				
700	699.2	19.8	30	70/0.3		100/0.8				
695	694.2	24.8	100/0.5			100/0.5				
690	691.1 / 690.7	27.9 / 28.3	100/0.2	60/0.1		100/0.2 60/0.1				690.7 28.3 690.6 28.4 **CRYSTALLINE ROCK** Gray, METATUFF METATUFF
685										
680							RS-2			
675										
670										
665										
660										660.0 59.0 Boring Terminated at Elevation 660.0 ft in CRYSTALLINE ROCK (METATUFF) Auger refusal at 28.3 feet.

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 70+35	**OFFSET** 40 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 719.0 ft	**TOTAL DEPTH** 59.0 ft	**NORTHING** 693,195	**EASTING** 1,556,102	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 02/27/18	**COMP. DATE** 02/27/18	**SURFACE WATER DEPTH** N/A	
CORE SIZE N 2	**TOTAL RUN** 30.6 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft)	RUN R D (ft)	SAMP. NO.	STRATA REC. (ft)	STRATA R D (ft)	LOG	DESCRIPTION AND REMARKS
690.6											Begin Coring 28.4 ft
690	690.6	28.4	0.6	1 35/0.6	(0.6) 100	(0.0) 0		(29.2) 95	(10.7) 35		ELEV. (ft) 690.6 **CRYSTALLINE ROCK** DEPTH (ft) 28.4
	690.0	29.0	5.0	1 58 2 38 3 01 3 56 2 07	(4.7) 94	(0.0) 0					Very slight to moderately severely weathered, moderately hard to hard, very close to closely fractured, gray and brown, METATUFF
685	685.0	34.0	5.0	1 59 2 18 2 33 2 12 2 29	(4.6) 92	(3.3) 66					
680	680.0	39.0	5.0	2 19 2 46 2 55 2 25 2 35	(5.0) 100	(0.9) 18	RS-2				
675	675.0	44.0	5.0	1 42 4 19 1 37 2 18 2 22	(4.9) 98	(0.9) 18					
670	670.0	49.0	5.0	1 37 1 42 1 48 1 43 1 50	(4.4) 88	(3.4) 68					
665	665.0	54.0	5.0	2 03 2 44 2 09 1 57 2 18	(5.0) 100	(2.2) 44					
660	660.0	59.0									ELEV. (ft) 660.0 DEPTH (ft) 59.0
											Boring Terminated at Elevation 660.0 ft in CRYSTALLINE ROCK (METATUFF)
											Auger refusal at 28.3 feet.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB1-C	**STATION** 70+09	**OFFSET** 12 ft RT	**ALIGNMENT** -L-	**0 HR.** 9.9
COLLAR ELEV. 718.5 ft	**TOTAL DEPTH** 59.3 ft	**NORTHING** 693,166	**EASTING** 1,556,078	**24 HR.** 7.6
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring		**HAMMER TYPE** Automatic
DRILLER Woodard, O.F.	**START DATE** 02/28/18	**COMP. DATE** 02/28/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
720										718.5 GROUND SURFACE	0.0
										ROADWAY EMBANKMENT Brown and gray, sandy CLAY (A-6), contains wood fragments, medium stiff	
715	713.8	4.7	3	3	3	6		M			
710										710.5 **ALLUVIAL** Brown and gray, fine to coarse, sandy CLAY (A-7-6(13)), medium stiff	8.0
705	703.8	14.7	12	19	37	56		37		705.5 **RESIDUAL** Brown and gray, silty CLAY (A-7-6), contains rock fragments, hard	13.0
700	698.8	19.7	100/0.5			100/0.5		M		698.8 **WEATHERED ROCK** Gray, brown, and orange, METATUFF	19.7
695	693.8	24.7	100/0.5			100/0.5					
690	688.8	29.7	60/0.1			60/0.1				688.8 **CRYSTALLINE ROCK** Gray, brown, and orange, METATUFF METATUFF	29.7
685										688.7	29.8
680											
675											
670											
665											
660							RS-3			659.2	59.3

Boring Terminated at Elevation 659.2 ft in CRYSTALLINE ROCK (METATUFF)

Other Samples
ST-1 (9.7 - 11.7)

NCDOT BORE DOUBLE BRIDGE BORINGS-THIS IS THE MOST UPDATED FILE.GPJ NC_DOT.GDT 10/1/18

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB1-C	**STATION** 70+09	**OFFSET** 12 ft RT	**ALIGNMENT** -L-	**0 HR.** 9.9
COLLAR ELEV. 718.5 ft	**TOTAL DEPTH** 59.3 ft	**NORTHING** 693,166	**EASTING** 1,556,078	**24 HR.** 7.6
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 02/28/18	**COMP. DATE** 02/28/18	**SURFACE WATER DEPTH** N/A	
CORE SIZE N 2	**TOTAL RUN** 29.5 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft)	RUN R D (ft)	SAMP. NO.	STRATA REC. (ft)	STRATA R D (ft)	LOG	DESCRIPTION AND REMARKS
688.7											Begin Coring 29.8 ft
685	688.7	29.8	4.5	2 54/0.5 1 58 3 29 2 05 2 23	(4.4) 98	(0.0) 0		(29.2) 99	(7.3) 25		688.7 **CRYSTALLINE ROCK** 29.8 Moderately to severely weathered, soft to hard, very close to moderately closely fractured, brown and white, METATUFF
	684.2	34.3									
680			5.0	1 52 1 54 1 56 2 19 2 56	(5.0) 100	(0.6) 12					
	679.2	39.3									
675			5.0	2 16 2 20 1 56 1 58 2 05	(5.0) 100	(2.6) 52					
	674.2	44.3									
670			5.0	1 55 2 06 2 01 2 10 2 19	(4.8) 96	(1.1) 22					
	669.2	49.3									
665			5.0	1 58 2 07 2 20 2 18 2 24	(5.0) 100	(1.2) 24					
	664.2	54.3									
660			5.0	2 03 2 19 2 07 2 04 2 21	(5.0) 100	(1.8) 36	RS-3				
	659.2	59.3									659.2 59.3 Boring Terminated at Elevation 659.2 ft in CRYSTALLINE ROCK (METATUFF)

Other Samples
ST-1 (9.7 - 11.7)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 70+30	**OFFSET** 45 ft LT	**ALIGNMENT** -L-	**0 HR.** 2.2
COLLAR ELEV. 714.4 ft	**TOTAL DEPTH** 44.7 ft	**NORTHING** 693,179	**EASTING** 1,556,019	**24 HR.** 3.1
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring		**HAMMER TYPE** Automatic
DRILLER Woodard, O.F.	**START DATE** 03/03/18	**COMP. DATE** 03/03/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
715										714.4 GROUND SURFACE	0.0
										ALLUVIAL Gray and brown, silty CLAY (A-7-6), moist, medium stiff	
710	709.4	5.0	2	3	4	7		M			
705	704.4	10.0	100/0.4			100/0.4				704.4	10.0
	703.1	11.3	60/0.1			60/0.1				703.1 **WEATHERED ROCK** Gray and brown, METATUFF	11.3
700										703.0 **CRYSTALLINE ROCK** Gray, brown, and orange, METATUFF METATUFF	11.4
695										696.3 GRANITE	18.1
690											
685											
680							RS-1				
675											
670										669.7	44.7
										Boring Terminated at Elevation 669.7 ft in CRYSTALLINE ROCK (METATUFF) Auger refusal at 11.3 feet.	

NCDOT BORE DOUBLE BRIDGE BORINGS-THIS IS THE MOST UPDATED FILE.GPJ NC_DOT.GDT 10/1/18

GEOTECHNICAL BORING REPORT
CORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 70+30	**OFFSET** 45 ft LT	**ALIGNMENT** -L-	**0 HR.** 2.2
COLLAR ELEV. 714.4 ft	**TOTAL DEPTH** 44.7 ft	**NORTHING** 693,179	**EASTING** 1,556,019	**24 HR.** 3.1
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 03/03/18	**COMP. DATE** 03/03/18	**SURFACE WATER DEPTH** N/A	
CORE SIZE N 2	**TOTAL RUN** 33.3 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft)	RUN R D (ft)	SAMP. NO.	STRATA REC. (ft)	STRATA R D (ft)	LOG	DESCRIPTION AND REMARKS
703											Begin Coring 11.4 ft
700	703.0	11.4	3.3	0 35/0.3 1 45 2 30 2 17	(3.3) 100	(0.0) 0		(4.3) 64	(0.0) 0		703.0 **CRYSTALLINE ROCK** 11.4 Moderately to severely weathered, soft to medium hard, very close to closely fractured, gray, brown, and orange, METATUFF
	699.7	14.7									
			5.0	1 15 1 22 2 08 2 27 2 01	(2.6) 52	(1.1) 22					696.3 18.1
695	694.7	19.7						(25.6) 96	(11.9) 45		Fresh to moderately weathered, medium hard to very hard, very close to moderately closely fractured, gray, white, and pink, GRANITE
			5.0	1 31 1 43 1 53 2 05 2 16	(4.9) 98	(1.8) 36					
690	689.7	24.7									
			5.0	2 00 2 41 2 29 2 18 2 07	(4.7) 94	(1.3) 26					
685	684.7	29.7									
			5.0	2 26 2 11 3 50 2 42 2 40	(5.0) 100	(2.2) 44	RS-1				
680	679.7	34.7									
			5.0	1 59 2 10 2 21 2 36 3 22	(4.9) 98	(1.3) 26					
675	674.7	39.7									
			5.0	2 27 3 01 2 52 2 56 3 18	(5.0) 100	(4.2) 84					
670	669.7	44.7									669.7 44.7 Boring Terminated at Elevation 669.7 ft in CRYSTALLINE ROCK (METATUFF) Auger refusal at 11.3 feet.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 71+07	**OFFSET** 45 ft LT	**ALIGNMENT** -L-	**0 HR.** 12.0
COLLAR ELEV. 714.1 ft	**TOTAL DEPTH** 25.0 ft	**NORTHING** 693,255	**EASTING** 1,556,009	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 03/04/18	**COMP. DATE** 03/04/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	ELEV. (ft)	DEPTH (ft)
715										GROUND SURFACE	714.1	0.0
								M		**ALLUVIAL** Gray, brown, and green, silty and sandy CLAY (A-6), stiff		
710	709.6	4.5	4	4	7	11 — 90					706.1	8.0
705	704.6	9.5	28	45	45			M		**RESIDUAL** Brown, gray, and green, fine to coarse SAND (A-2-4), contains rock fragments, very dense		
700	699.6	14.5	36	64/0.4		100/0.9				**WEATHERED ROCK** Brown, green, and gray, METATUFF	699.6	14.5
695	694.6	19.5	75	25/0.1		100/0.6						
690	689.6	24.5	100/0.5			100/0.5				Boring Terminated at Elevation 689.1 ft in WEATHERED ROCK (METATUFF)	689.1	25.0

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 71+48	**OFFSET** 40 ft RT	**ALIGNMENT** -L-	**0 HR.** 21.0
COLLAR ELEV. 719.3 ft	**TOTAL DEPTH** 30.5 ft	**NORTHING** 693,307	**EASTING** 1,556,087	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 02/27/18	**COMP. DATE** 02/27/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	ELEV. (ft)	DEPTH (ft)
720										GROUND SURFACE	719.3	0.0
										ROADWAY EMBANKMENT Brown and red, sandy SILT (A-4), medium stiff		
715	714.5	4.8	2	2	3	5		M			711.3	8.0
710	709.5	9.8	2	3	3	6 — 60		M		**ALLUVIAL** Gray and brown, sandy CLAY (A-6), medium stiff	706.3	13.0
705	704.5	14.8	16	34	26			M		**RESIDUAL** Brown, gray, and red, SAND (A-3), with trace clay and rock fragments, very dense		
700	699.5	19.8	100/0.2			100/0.2					699.5	19.8
695	694.5	24.8	41	59/0.3		100/0.8				**WEATHERED ROCK** Gray and brown, METATUFF		
690	689.5	29.8	46	54/0.2		100/0.7					688.8	30.5
										Boring Terminated at Elevation 688.8 ft in WEATHERED ROCK (METATUFF)		

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 50163.1.1	**TIP** U-5738	**COUNTY** ROWAN	**GEOLOGIST** Taylor, C.	
SITE DESCRIPTION Bridge No. 201 on SR 2528 (JULIAN ROAD) OVER TOWN CREEK				**GROUND WTR (ft)**
BORING NO. EB2-C	**STATION** 71+27	**OFFSET** 3 ft LT	**ALIGNMENT** -L-	**0 HR.** 13.8
COLLAR ELEV. 712.8 ft	**TOTAL DEPTH** 25.1 ft	**NORTHING** 693,281	**EASTING** 1,556,048	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE HDR9935 CME-55 85% 03/20/2018		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Woodard, O.F.	**START DATE** 03/04/18	**COMP. DATE** 03/04/18	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
715											
										712.8 GROUND SURFACE	0.0
710										**ALLUVIAL** Gray and brown, sandy CLAY (A-6), medium stiff	
	707.8	5.0	2	4	12	16		M		706.9	5.9
705										**RESIDUAL** Gray, brown, and green, silty SAND (A-2-4), medium dense to very dense	
	702.8	10.0	23	30	33	63		M			
700											
	697.8	15.0	23	48	51	99		M			
695										694.8	18.0
	692.8	20.0	12	29	30	59		W		Gray, brown, and green, silty SAND (A-3), very dense	
690											
	687.8	25.0	60/0.1			60/0.1				687.8	25.0
										687.7 **CRYSTALLINE ROCK** Gray, METATUFF	25.1
										Boring Terminated with Standard Penetration Test Refusal at Elevation 687.7 ft in CRYSTALLINE ROCK (METATUFF)	
										Strata Break in Split Spoon at 5.9 feet.	

CORE PHOTOGRAPHIC RECORD

U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

U-5738 – EB1-B
STA. 27+53 @ 27’ Rt. Box 1 of 4: 8.3 FEET
DRY

0.0 1.0 2.0
FEET

U-5738 – EB1-B
STA. 27+53 @ 27’ Rt. Box 2 of 4: 8.4 FEET
DRY

0.0 1.0 2.0
FEET

U-5738 – EB1-B
STA. 27+53 @ 27’ Rt. Box 1 of 4: 8.3 FEET
WET

0.0 1.0 2.0
FEET

U-5738 – EB1-B
STA. 27+53 @ 27’ Rt. Box 2 of 4: 8.4 FEET
WET

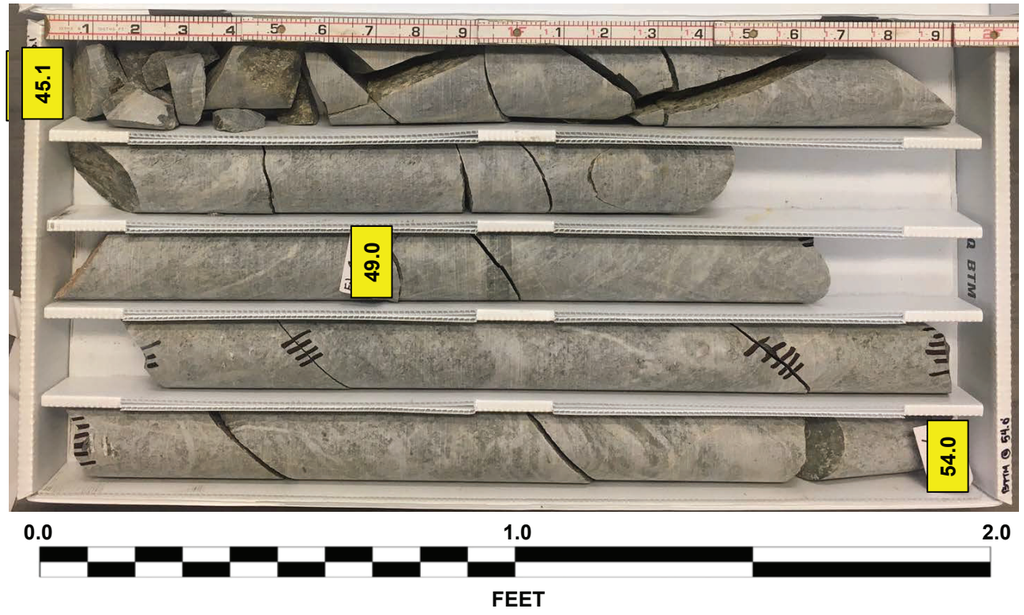
0.0 1.0 2.0
FEET

CORE PHOTOGRAPHIC RECORD

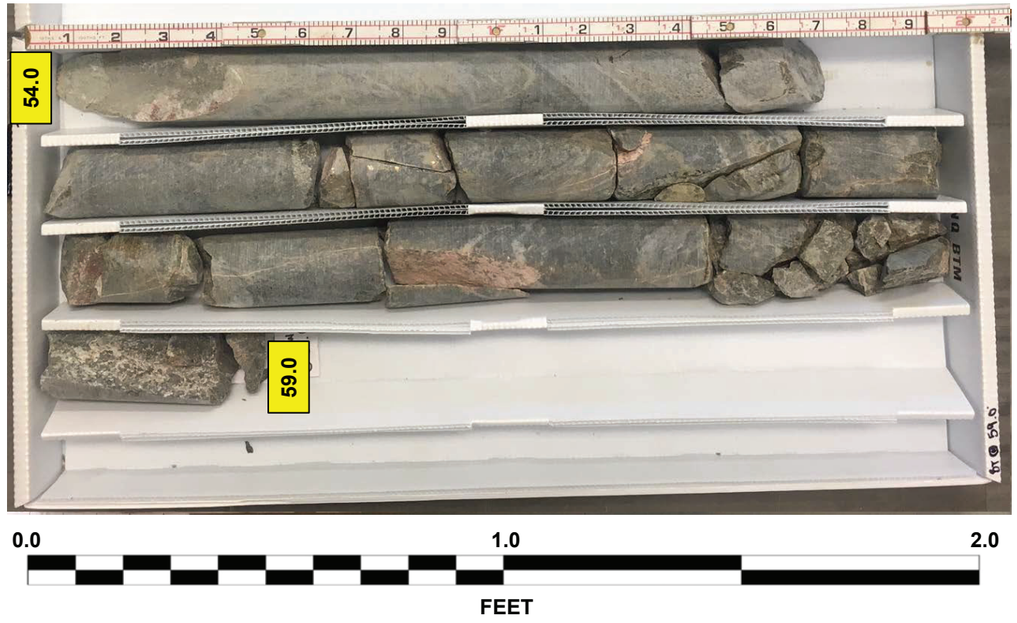
U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

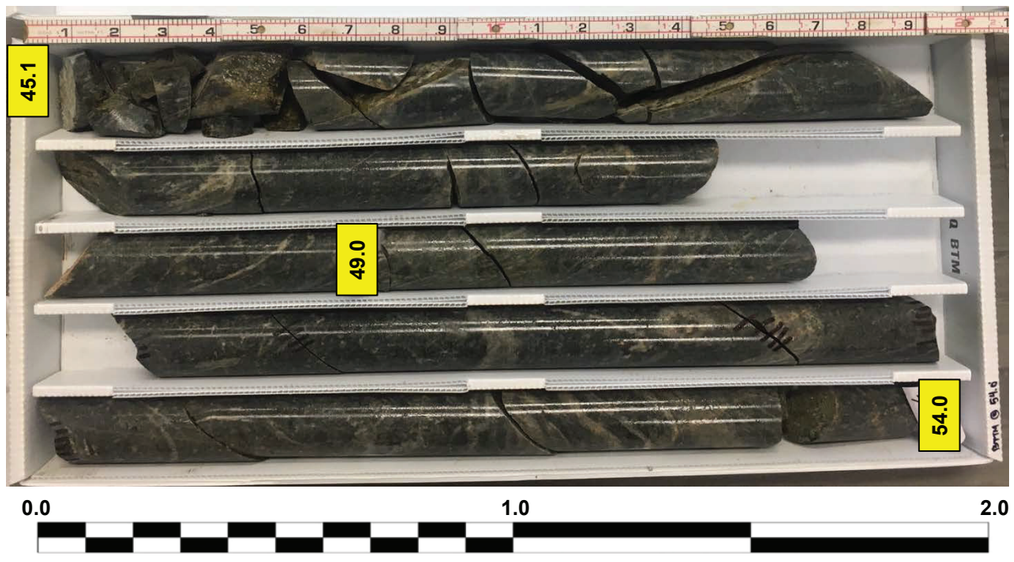
U-5738 – EB1-B
STA. 27+53 @ 27' Rt. Box 3 of 4: 8.9 FEET
DRY



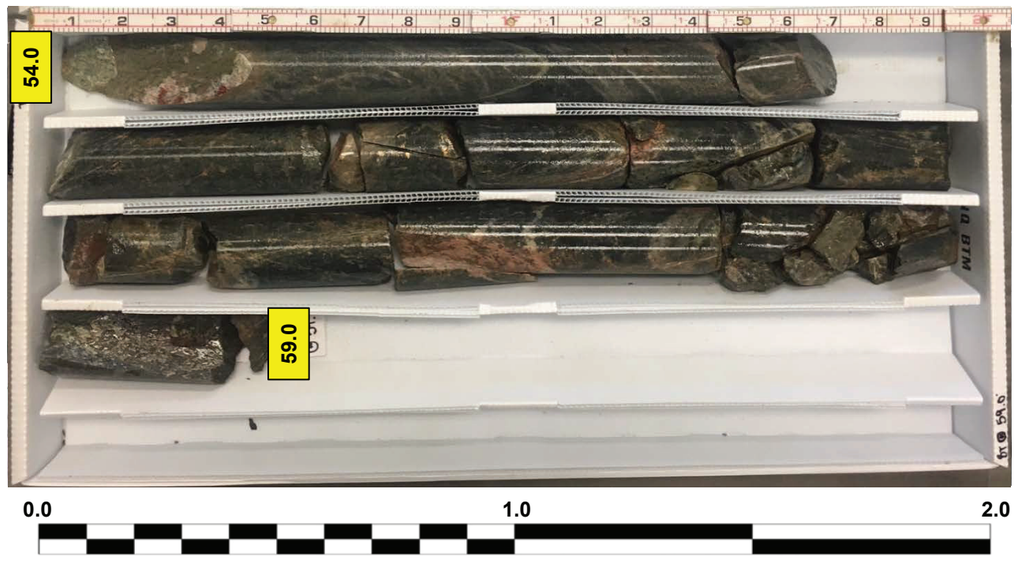
U-5738 – EB1-B
STA. 27+53 @ 27' Rt. Box 4 of 4: 5.0 FEET
DRY



U-5738 – EB1-B
STA. 27+53 @ 27' Rt. Box 3 of 4: 8.9 FEET
WET



U-5738 – EB1-B
STA. 27+53 @ 27' Rt. Box 4 of 4: 5.0 FEET
WET



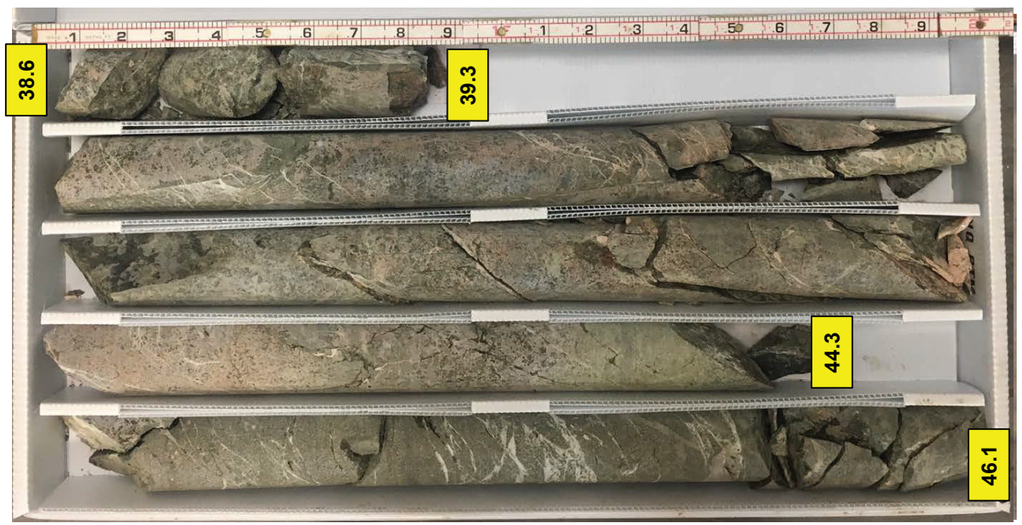
CORE PHOTOGRAPHIC RECORD

U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

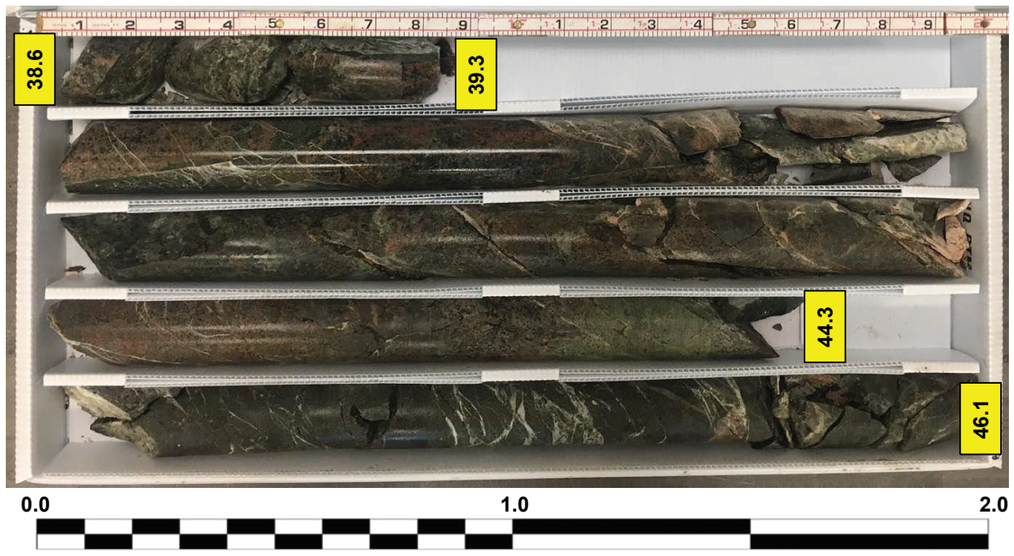
U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 1 of 4: 8.8 FEET
DRY

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 2 of 4: 7.5 FEET
DRY



U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 1 of 4: 8.8 FEET
WET

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 2 of 4: 7.5 FEET
WET



CORE PHOTOGRAPHIC RECORD

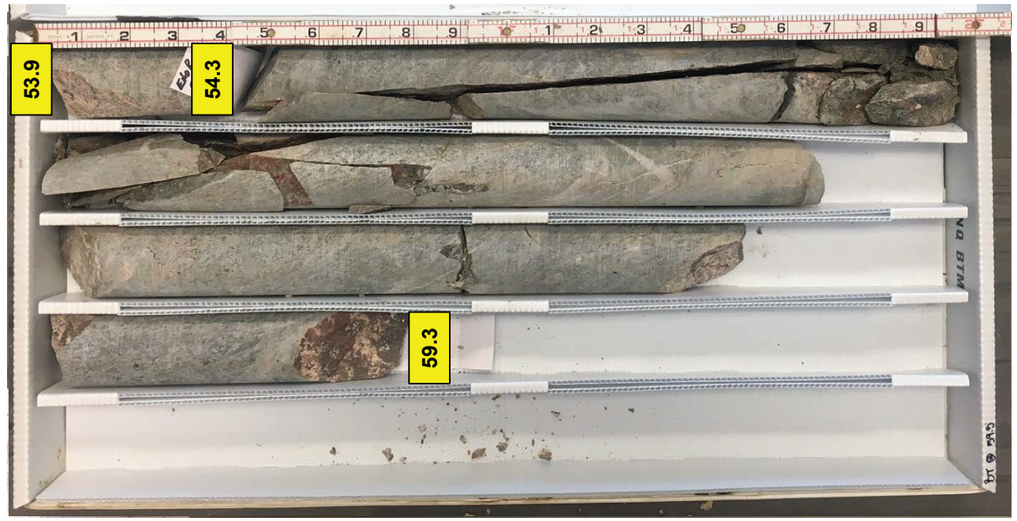
U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 3 of 4: 7.8 FEET
DRY

0.0 1.0 2.0
FEET

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 4 of 4: 5.4 FEET
DRY

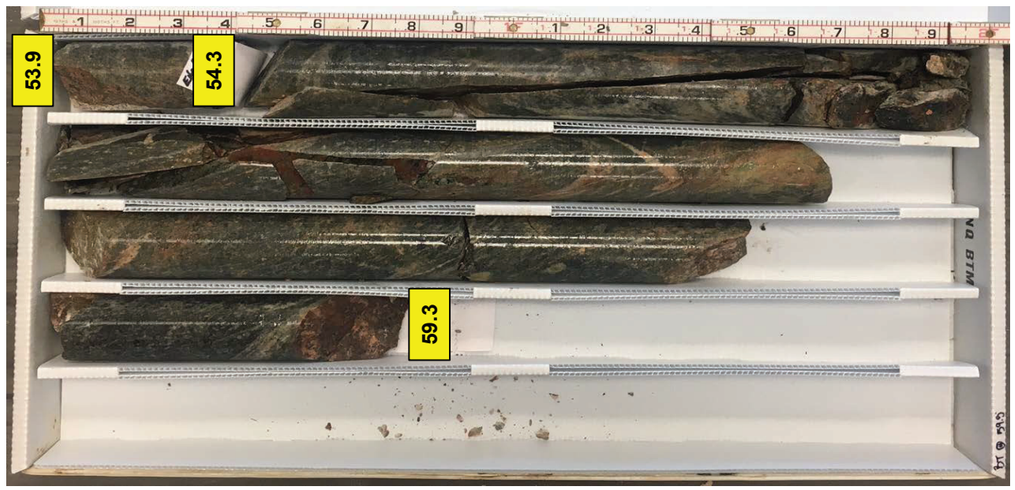


0.0 1.0 2.0
FEET

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 3 of 4: 7.8 FEET
WET

0.0 1.0 2.0
FEET

U-5738 – EB1-C
STA. 27+53 @ 27’ Rt. Box 4 of 4: 5.4 FEET
WET



0.0 1.0 2.0
FEET

CORE PHOTOGRAPHIC RECORD

U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

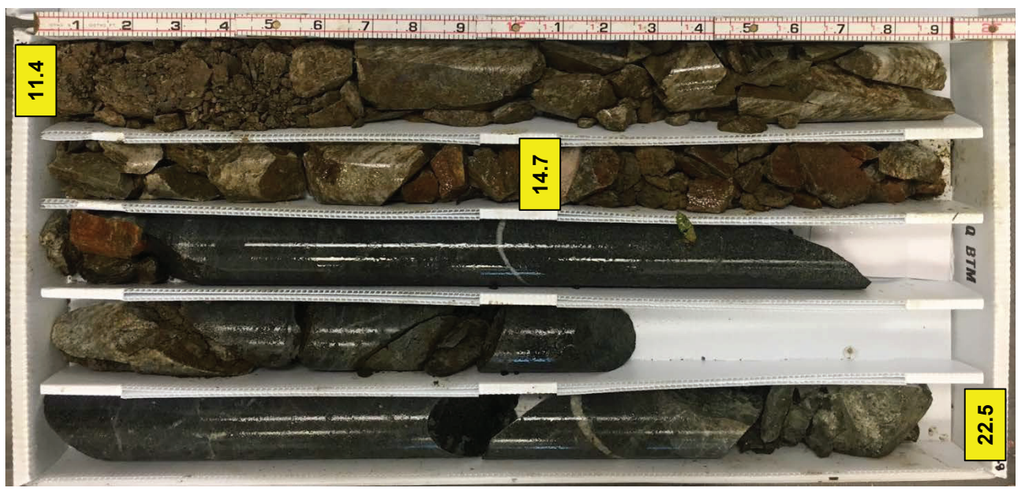
U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 1 of 4: 11.1 FEET
DRY

0.0 1.0 2.0
FEET

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 2 of 4: 8.4 FEET
DRY

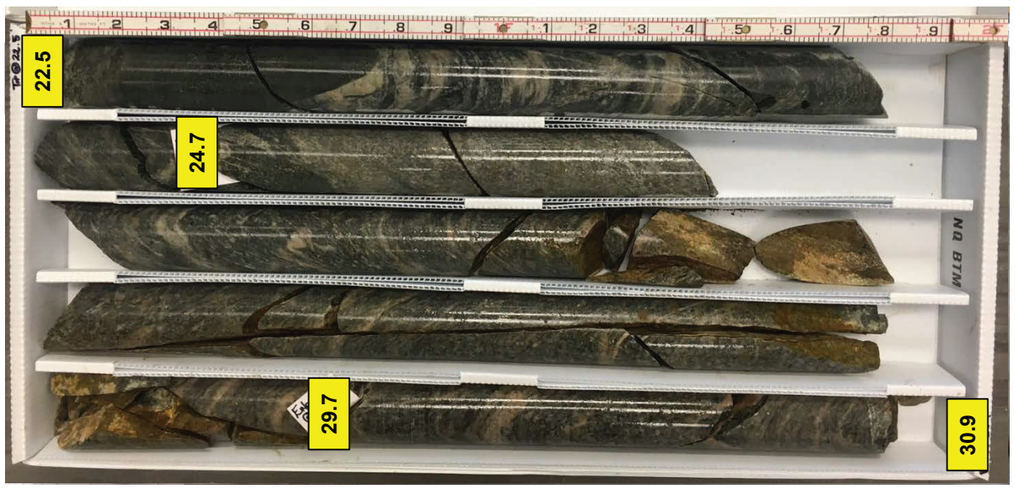
0.0 1.0 2.0
FEET

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 1 of 4: 11.1 FEET
WET



0.0 1.0 2.0
FEET

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 2 of 4: 8.4 FEET
WET



0.0 1.0 2.0
FEET

CORE PHOTOGRAPHIC RECORD

U-5738

SR2526 (Julian Road) widening- Bridge over Town Creek

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 3 of 4: 7.4 FEET
DRY

0.0 1.0 2.0
FEET

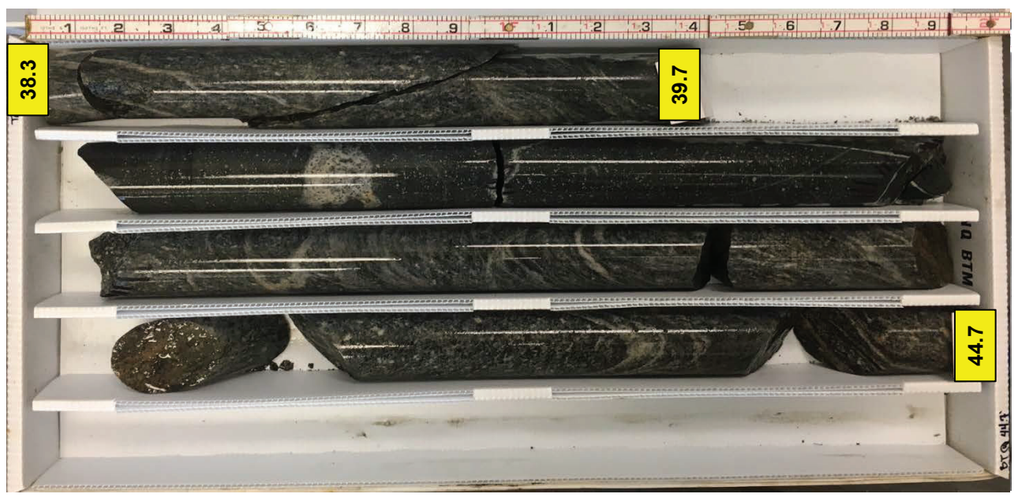
U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 4 of 4: 8.4 FEET
DRY

0.0 1.0 2.0
FEET

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 3 of 4: 7.4 FEET
WET

0.0 1.0 2.0
FEET

U-5738 – B1-A
STA. 27+53 @ 27’ Rt. Box 4 of 4: 8.4 FEET
WET



0.0 1.0 2.0
FEET

PROJECT REFERENCE NO.	SHEET NO.
U-5738	21

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
ST-1	12 RT	70+09	9.7-11.7	A-7-6(13)	49	22	16	19	41.3	23.7	93.4	85.2	63.2	37.0	-

PROJECT REFERENCE NO.	SHEET NO.
U-5738	22

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

SAMPLE NO.	BORING NO.	DEPTH (FT.)	ROCK TYPE	GEOLOGIC MAP UNIT	RUN RQD	LENGTH (FT)	DIAMETER (FT)	UNIT WEIGHT (PCF)	UNCONFINED COMPRESSIVE STRENTH (PSI)	YOUNG'S MODULUS (PSI)	SPLITTING TENSILE STRENGTH (PSI)	REMARKS
RS-1	B1-A	32.3-32.95	GRANITE	DSg	44%	0.358	0.166	168	18390	-	-	-
RS-2	L-EB1-B	40.2-40.85	METATUFF	CVz	18%	0.355	0.166	170	3492	-	-	-
RS-3	L-EB1-C	57.3-58.1	METATUFF	CVz	36%	0.378	0.166	171	10336	-	-	-

Photo 1: Looking upstream Town Creek

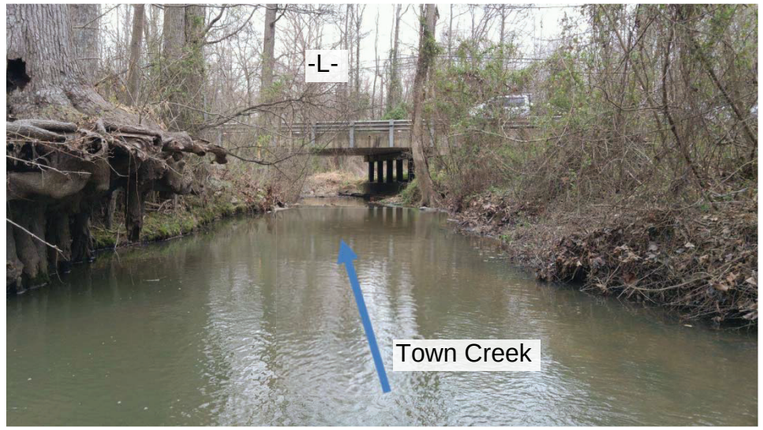


Photo 2: Looking downstream Town Creek

Photo 3: Looking South (Down-Station) along SR 2526 (Julian Road)