REFERENCE: B-4439

PROJECT: 38366

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4439	1	8

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *BRUNSWICK*

PROJECT DESCRIPTION *REPLACE BRIDGE NO. 100 ON SR 1342 (MAKATOKA ROAD NW) OVER MUDDY BRANCH*

SITE DESCRIPTION *STA. 17+07 -L-*

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.

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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

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S. PAPKE

MID-ATLANTIC

INVESTIGATED BY *D. KUBINSKI/S. PAPKE*

DRAWN BY *C. DRISCOLL*

CHECKED BY *T. WELLS*

SUBMITTED BY *KLEINFELDER, INC*

DATE *AUGUST 2019*

Prepared in the Office of:

KLEINFELDER
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NORTH CAROLINA PROFESSIONAL SEAL 037998 ENGINEER THOMAS R. WELLS

DocuSigned by:
Thomas R. Wells 9/6/2019
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SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
B-4439	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	—		—	—	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
	6 MX		NP												
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
- [ ] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [X] CASING [ ] W/ ADVANCER
- [ ] TRICONE _____" STEEL TEETH
- [X] TRICONE 2-15/16" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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: SEE NOTES

ELEVATION: N/A FEET

NOTES:

FIAD - FILLED IMMEDIATELY AFTER DRILLING

RAILROAD SPIKE AT STA. 16+80.00 -L- 29' RT (1250991FT.N., 2186737FT.E.) ELEVATION: 49.20

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
B-4439	3

SITE PLAN

0 40 80

FEET

NC GRID
NAD 83 NA 2011

TRIBUTARY WATER

WOODS

WLB

JS

E

GRAVEL

S NONMT

BRIDGE # 100

-L- (MAKATOKA RD NW)

TO SR 1340

TO SR 1344

EB1-A

EB2-A

B1-B

15

19

MUDDY BRANCH

NOTES:

SKEW ANGLES ON ALL BENTS = 90°

PROJECT REFERENCE NO.	SHEET NO.
B-4439	4

BRIDGE NO. 100 CENTERLINE PROFILE ON -L-

0 25 50
FEET
VE = 2.5

EB1-A
16+46
6' LT

B1-B
17+10
9' RT

EB2-A
17+60
5' LT

ROADWAY EMBANKMENT: ASPHALT

WATER SURFACE
04/19

06/19

	EB1-A	B1-B	EB2-A
A	22, 3		16, 5
	WOH	8	WOH
B			
C	10	3	18
	7	4	3
	WOH	2	WOH
	11	16	19
	45	26	3
	21	23	18
	100/0.7	56	29
	18	22	36
	17	17	16
	17	33	26
	18	16	67
	21	40	29
	49	39	45
	38	37	44
	46	33	39
	74	42	57
	BT	BT	BT

COASTAL PLAIN (PEEDEE FORMATION):
WET, LOOSE TO VERY LOOSE, GRAY, CLAYEY FINE TO COARSE SAND

COASTAL PLAIN (PEEDEE FORMATION):
WET, VERY SOFT TO SOFT, HIGHLY PLASTIC, GRAY, SILTY CLAY

COASTAL PLAIN (PEEDEE FORMATION):
WET, VERY SOFT TO SOFT, HIGHLY PLASTIC, GRAY, SILTY CLAY

COASTAL PLAIN (PEEDEE FORMATION)
WET TO MOIST, MEDIUM DENSE TO VERY DENSE, GRAY, LIGHT GRAY, DARK GRAY, AND TAN, CLAYEY FINE TO COARSE SAND TO SILTY FINE TO COARSE SAND WITH TRACE ROCK FRAGMENTS

NOTES:
GROUNDLINE TAKEN FROM PROJECT TIN FILE RECEIVED B4439_LS_TNL.TIN

INFERRED STRATIGRAPHY IS DRAWN THOUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILES

(A) ROADWAY EMBANKMENT:
MOIST, MEDIUM DENSE TO VERY LOOSE, BROWN TO GRAY TO ORANGE, SILTY FINE TO COARSE SAND TO CLAYEY COARSE TO FINE SAND

(B) ALLUVIAL:
WET TO SATURATED, VERY SOFT TO SOFT, DARK BROWN TO GRAY, MUCK WITH WOOD FRAGMENTS

(C) ALLUVIAL:
WET, LOOSE TO MEDIUM DENSE, BROWN AND GRAY, SILTY FINE TO COARSE SAND TO CLAYEY FINE SAND WITH TRACE OF ORGANIC MATTER

55 45 35 25 15 5 -5 -15 -25 -35 -45

15+75 16+00 16+25 16+50 16+75 17+00 17+25 17+50 17+75 18+00 18+25 18+50 18+75 19+00

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** D. Kubinski	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 16+46	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** 7.0
COLLAR ELEV. 48.8 ft	**TOTAL DEPTH** 89.1 ft	**NORTHING** 125,143	**EASTING** 2,186,716	**24 HR.** 5.6
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 06/27/19	**COMP. DATE** 06/28/19	**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)
50										
	47.7	1.1	9	14	8	22		M		48.8 0.0 GROUND SURFACE **ROADWAY EMBANKMENT** Asphalt (0.0 - 0.2 Foot)
45	46.2	2.6	3	2	1	3		M		46.2 2.6 Brown, Silty, Fine to Coarse SAND Gray and Brown, Clayey, Coarse to Fine SAND
	41.2	7.6	WOR	WOH	WOH	0		W		42.8 6.0 **ALLUVIAL** Dark Brown, MUCK
40										
	36.2	12.6	1	4	6	10		W		35.8 13.0 Brown and Gray, Silty, Fine to Coarse SAND with Trace of Organic Matter (Wood, Rootlets)
35										32.8 16.0 **COASTAL PLAIN** Gray, Clayey, Fine to Coarse SAND (Peedee Formation)
	31.2	17.6	4	2	5	7		W		
30										27.8 21.0 Highly Plastic, Gray, Silty CLAY (Peedee Formation)
	26.2	22.6	WOH	WOH	WOH	0		W		
25										22.8 26.0 Gray, Clayey, Fine to Coarse SAND (Peedee Formation)
	21.2	27.6	3	4	7	11		W		
20										17.8 31.0 Gray, Silty, Fine to Coarse SAND (Peedee Formation)
	16.2	32.6	14	23	22	45		W		
15										12.8 36.0 Light Gray, Clayey, Fine to Coarse SAND with Trace to Little Rock Fragments (Peedee Formation)
	11.2	37.6	6	11	10	21		W		
10										
	6.2	42.6	28	70	30/0.2	100/0.7		W		
5										
	1.2	47.6	10	8	10	18		W		
0										
	-3.8	52.6	7	8	9	17		W		
-5										
	-8.8	57.6	9	7	10	17		W		
-10										
	-13.8	62.6	10	9	9	18		W		
-15										
	-18.8	67.6	15	9	12	21		W		
-20										
	-23.8	72.6	18	20	29	49		W		
-25										
	-28.8	77.6	15	15	23	38		W		
-30										

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** D. Kubinski	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 16+46	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** 7.0
COLLAR ELEV. 48.8 ft	**TOTAL DEPTH** 89.1 ft	**NORTHING** 125,143	**EASTING** 2,186,716	**24 HR.** 5.6
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 06/27/19	**COMP. DATE** 06/28/19	**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
-30						Match Line				
	-33.8	82.6	12	18	28	46		W		-32.2 81.0 Gray, Silty, Fine to Coarse SAND (Peedee Formation)
-35										
	-38.8	87.6	13	20	54	74		W		-40.3 89.1 Boring Terminated at Elevation -40.3 ft in COASTAL PLAIN (PEEDEE FORMATION): SILTY SAND
-40										

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** S. Papke	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 17+10	**OFFSET** 9 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 40.4 ft	**TOTAL DEPTH** 81.2 ft	**NORTHING** 125,108	**EASTING** 2,186,772	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 07/01/19	**COMP. DATE** 07/01/19	**SURFACE WATER DEPTH** 3.0ft	

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))
45										
										WATER SURFACE (07/01/19)
40	40.4	0.0	3	3	5	8		M		40.4 GROUND SURFACE 0.0 **ALLUVIAL** Gray, MUCK with Wood Fragments
35	35.7	4.7	2	2	1	3		Sat.		
30	30.7	9.7	3	2	2	4		Sat.		32.9 7.5 **COASTAL PLAIN** Blue to Gray, Clayey Fine SAND (Peedee Formation)
25	25.7	14.7	WOR	1	1	2		Sat.		27.9 12.5 Highly Plastic, Gray, Silty CLAY with Wood Fragments (Peedee Formation)
20	20.7	19.7	6	6	10	16		Sat.		22.9 17.5 Gray to Tan, Silty Fine to Coarse SAND with Trace of Organic Matter (Wood) and Trace Rock Fragments (Peedee Formation)
15	15.7	24.7	4	13	13	26		W		
10	10.7	29.7	11	11	12	23		W		
5	5.7	34.7	21	22	34	56		W		
0	0.7	39.7	13	13	9	22		M		
-5	-4.3	44.7	8	7	10	17		W		-7.1 47.5 Gray, Silty, Clayey Fine SAND (Peedee Formation)
-10	-9.3	49.7	20	12	21	33		W		-12.1 52.5 Dark Gray, Silty Coarse to Fine SAND with Trace Rock Fragments (Peedee Formation)
-15	-14.3	54.7	7	7	9	16		W		
-20	-19.3	59.7	100	16	24	40		W		-22.1 62.5 Gray, Clayey Fine SAND (Peedee Formation)
-25	-24.3	64.7	16	14	25	39		W		-27.1 67.5 Gray, Silty Coarse to Fine SAND (Peedee Formation)
-30	-29.3	69.7	11	15	22	37		W		
-35	-34.3	74.7								

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** S. Papke	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 17+10	**OFFSET** 9 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 40.4 ft	**TOTAL DEPTH** 81.2 ft	**NORTHING** 125,108	**EASTING** 2,186,772	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 07/01/19	**COMP. DATE** 07/01/19	**SURFACE WATER DEPTH** 3.0ft	

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
-35			12	14	19	Match Line 33		M		Gray, Silty Coarse to Fine SAND (Peedee Formation) *(continued)*
-40	-39.3	79.7	14	18	24	42		M		-40.8 81.2 Boring Terminated at Elevation -40.8 ft in COASTAL PLAIN (PEEDEE FORMATION): SILTY SAND

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** D. Kubinski	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 17+60	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 48.4 ft	**TOTAL DEPTH** 89.3 ft	**NORTHING** 125,105	**EASTING** 2,186,824	**24 HR.** 5.5
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 06/28/19	**COMP. DATE** 06/28/19	**SURFACE WATER DEPTH** N/A	

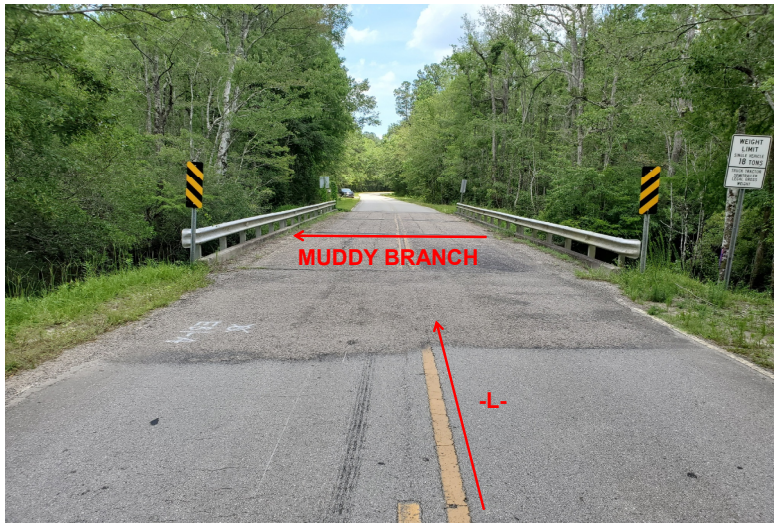
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) DEPTH (ft)
50										
	47.6	0.8	9	8	8	16		M		48.4 0.0 GROUND SURFACE **ROADWAY EMBANKMENT** Asphalt (0.0 - 0.2 Foot) Brown, Gray, and Orange, Silty, Fine to Coarse SAND
45	45.6	2.8	3	3	2	5		M		
										43.4 5.0 **ALLUVIAL** Dark Brown, MUCK
40	40.6	7.8	WOH	WOH	WOH	0		W		
										37.9 10.5 Gray, Silty, Fine to Coarse SAND
35	35.6	12.8	5	7	11	18		W		
										32.9 15.5 **COASTAL PLAIN** Gray, Clayey, Fine to Coarse SAND (Peedee Formation)
30	30.6	17.8	1	2	1	3		W		
										27.9 20.5 Highly Plastic, Gray, Silty CLAY (Peedee Formation)
25	25.6	22.8	WOH	WOH	WOH	0		W		
										22.9 25.5 Gray, Silty, Fine to Coarse SAND (Peedee Formation)
20	20.6	27.8	8	10	9	19		W		
										17.9 30.5 Highly Plastic, Gray, Silty CLAY (Peedee Formation)
15	15.6	32.8	WOH	1	2	3		W		
										12.9 35.5 Light Gray, Clayey, Fine to Coarse SAND with Trace Rock Fragments (Peedee Formation)
10	10.6	37.8	10	8	10	18		W		
5	5.6	42.8	5	8	21	29		W		
0	0.6	47.8	12	21	15	36		W		
-5	-4.4	52.8	7	7	9	16		W		
-10	-9.4	57.8	11	8	18	26		W		
-15	-14.4	62.8	8	30	37	67		W		-12.1 60.5 Gray, Silty, Fine to Coarse SAND with Trace Rock Fragments (Peedee Formation)
-20	-19.4	67.8	7	11	18	29		W		-17.1 65.5 Gray, Clayey, Fine to Coarse SAND (Peedee Formation)
-25	-24.4	72.8	17	25	20	45		W		
-30	-29.4	77.8								-27.1 75.5 Gray, Silty, Fine to Coarse SAND (Peedee Formation)

WBS 38366.1.2	**TIP** B-4439	**COUNTY** BRUNSWICK	**GEOLOGIST** D. Kubinski	
SITE DESCRIPTION Replace Bridge No. 100 on SR 1342 (Makatoka Road NW) over Muddy Branch				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 17+60	**OFFSET** 5 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 48.4 ft	**TOTAL DEPTH** 89.3 ft	**NORTHING** 125,105	**EASTING** 2,186,824	**24 HR.** 5.5
DRILL RIG/HAMMER EFF./DATE MID5464 CME-45C 90% 02/21/2019		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER B. Fowler	**START DATE** 06/28/19	**COMP. DATE** 06/28/19	**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
-30						Match Line				
			10	22	22	44		W		Gray, Silty, Fine to Coarse SAND (Peedee Formation) *(continued)*
-35	-34.4	82.8	14	16	23	39		W		
-40	-39.4	87.8	20	21	36	57		W		-40.9 89.3 Boring Terminated at Elevation -40.9 ft in COASTAL PLAIN (PEEDEE FORMATION): SILTY SAND

WBS: 38366.1.2, TIP: B-4439
REPLACE BRIDGE NO. 100 ON SR 1342 (MAKATOKA ROAD NW) OVER MUDDY BRANCH, STA. 17+07 -L-

SITE PHOTOGRAPHS



View Looking East along -L- from End Bent No. 1

View Looking South from Bridge along Muddy Branch