STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BR-0093	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY ROCKINGHAM

PROJECT DESCRIPTION REPLACE BRIDGE 780035 ON NC 770 OVER MAYO RIVER

REFERENCE: BR-0093

PROJECT: 67093

CONTENTS

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DATE JUNE 2023

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07/10/2023
DATE

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

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:
- [ ] CME-45C
- [X] 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
- [X] TRICONE 3 1/4 " STEEL TEETH
- [ ] TRICONE _____ " TUNG.-CARB.
- [X] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B _____ [ ] -H _____
- [X] -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: BL-4 N:991691.81 E:1720281.74

ELEVATION: 678.66 FEET

NOTES:

FIAD - FILLED IMMEDIATELY AFTER DRILLING

- PAVEMENT / ABC STONE

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
BR-0093	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

DECREASING INTERLOCKING OF ROCK PIECES ⇩

SURFACE CONDITIONS

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

DECREASING SURFACE QUALITY ⇨

	VERY GOOD	GOOD	FAIR	POOR	VERY POOR
	Very rough, fresh unweathered surfaces	Rough, slightly weathered, iron stained surfaces	Smooth, moderately weathered and altered surfaces	Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments	Slickensided, highly weathered surfaces with soft clay coatings or fillings
	90	80	N/A	N/A	
	70	60	50	40	30
	20	N/A	N/A	10	

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

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 interlayers 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

SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)

VERY GOOD	GOOD	FAIR	POOR	VERY POOR
Very Rough, fresh unweathered surfaces	Rough, slightly weathered surfaces	Smooth, moderately weathered and altered surfaces	Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings
70				
60	A			
50				
40	B	C	D	E
30				
20			F	
10		G		H

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
BR-0093	3

SITE PLAN

0 40 80

FEET

SKEW=75°

WOODS

JS

MAYO RIVER

CONC

16+00

20+00

END BRIDGE

BL-4

MTL

EB1-A

EB1-B

B1-A

B1-B

BRIDGE #35

CONC DECK

B2-A

B2-B

EB2-A

EB1-B

TOP OF RAIL
-L- STA. 16+40 16' RT
ELEV.: 681.5 FT

BEGIN BRIDGE

TOP OF RAIL
-L- STA. 19+14 16' RT
ELEV.: 681.5 FT

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 16+36	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 679.0 ft	**TOTAL DEPTH** 42.3 ft	**NORTHING** 991,686	**EASTING** 1,720,293	**24 HR.** 32.1
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/25/23	**COMP. DATE** 04/25/23	**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)
680										
	679.0	0.0								GROUND SURFACE
	678.4	0.6								**ROADWAY EMBANKMENT** Pavement
675	676.2	2.8	8	4	5	9				675.7 / 3.3 Loose, gray, GRAVEL (A-1-b), with some sand and trace silt Medium stiff to stiff, brown, red sandy SILT (A-4), contains trace root fragments, micaceous
670	671.2	7.8	3	4	3	7				
665	666.2	12.8	2	2	3	5				663.0 / 16.0 Loose, brown, silty SAND (A-2-4), micaceous
660	661.2	17.8	2	2	3	5				658.0 / 21.0 **ALLUVIAL** Loose, gray and brown, silty SAND (A-2-4), contains some root fragments, micaceous
655	656.2	22.8	1	3	3	6				653.0 / 26.0 Medium stiff, brown, slightly plastic, sandy CLAY (A-6(6)), with some silt, micaceous
650	651.2	27.8	1	2	3	5	SS-25	26%		648.0 / 31.0 **RESIDUAL** Medium stiff, brown, non-plastic, sandy SILT (A-4(1)), with little clay, micaceous
645	646.2	32.8	2	3	4	7	SS-26	32%		643.0 / 36.0 Very dense, brown, silty SAND (A-2-4), micaceous, saprolitic
640	641.2	37.8	41	20	51	71				638.5 / 40.5 **WEATHERED ROCK** Gray and Brown, (GNEISS)
	636.7	42.3	60/0.0			60/0.0				636.7 / 42.3 Boring Terminated with Standard Penetration Test Refusal at Elevation 636.7 ft On Crystalline Rock (GNEISS) Drill rig chatter 40.5 - 42.3 ft BGS. Drill bit refusal at 42.3 ft BGS.

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. EB1-B	**STATION** 16+47	**OFFSET** 4 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 678.7 ft	**TOTAL DEPTH** 49.1 ft	**NORTHING** 991,676	**EASTING** 1,720,307	**24 HR.** Caved
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/24/23	**COMP. DATE** 04/24/23	**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
680										
	678.7	0.0								GROUND SURFACE
	678.1	0.6								**ROADWAY EMBANKMENT** Pavement
675	675.3	3.4	8	5	3	8				Medium stiff to stiff, brown, sandy SILT (A-4), with trace gravel, micaceous
670	670.3	8.4	1	2	5	7				
665	665.3	13.4	2	2	3	5				661.7 / 17.0 **ALLUVIAL** Loose, brown and gray, silty SAND (A-2-4), with trace gravel, micaceous
660	660.3	18.4	1	3	4	7				
655	655.3	23.4	3	2	3	5				651.7 / 27.0 **RESIDUAL** Medium stiff to stiff, brown and gray, slightly plastic, sandy CLAY (A-6(5)), with some silt, micaceous, mottled
650	650.3	28.4	1	2	3	5	SS-15	25%		
645	645.3	33.4	3	4	4	8				641.7 / 37.0 **WEATHERED ROCK** Brown and gray, (GNEISS)
640	640.3	38.4	43	57/0.4		100/0.9				
635	635.9	42.8	100/0.2			100/0.2				
630	630.9	47.8	18	33	67/0.3	100/0.8				629.6 / 49.1 Boring Terminated with Standard Penetration Test Refusal at Elevation 629.6 ft In Weathered Rock (GNEISS)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 17+13	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 638.4 ft	**TOTAL DEPTH** 23.1 ft	**NORTHING** 991,711	**EASTING** 1,720,364	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/25/23	**COMP. DATE** 04/26/23	**SURFACE WATER DEPTH** 1.8ft	

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)
640										WATER SURFACE (04/25/23)
										638.4 GROUND SURFACE 0.0
	637.6	0.8								**RESIDUAL** Very dense, gray, silty SAND (A-2-4), with trace rock fragments, saprolitic
			20	26	58	84				
635	635.3	3.1	60/0.0			60/0.0		Water loss 3.1 - 23.1. Little to no water return.		635.3 **CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, slight weathering, moderately hard to hard, close to moderately close fracture spacing
										632.9 5.5 REC = 100% (2.4') RQD = 54% (1.3') GSI = 40-50
										WEATHERED ROCK Gray and white with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, moderate to severe weathering, very soft to moderately hard, very close to close fracture spacing
630										630.3 8.1 REC=62% (1.6') RQD=31% (0.8') GSI=30-40
							RS-1			**CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, fresh to moderately severe weathering, soft to very hard, very close to moderately close fracture spacing
625										REC = 99% (14.9') RQD = 63% (9.5') GSI = 30-40
620							RS-2			615.3 23.1 Boring Terminated at Elevation 615.3 ft In Crystalline Rock (GNEISS)
										Deck to mudline: 38.0 ft Total casing: 45.0 ft Drill bit refusal at 3.1 ft BGS.

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 17+13	**OFFSET** 12 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 638.4 ft	**TOTAL DEPTH** 23.1 ft	**NORTHING** 991,711	**EASTING** 1,720,364	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/25/23	**COMP. DATE** 04/26/23	**SURFACE WATER DEPTH** 1.8ft	
CORE SIZE N	**TOTAL RUN** 20.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft) / DEPTH (ft)
635.3											Begin Coring @ 3.1 ft
635	635.3	3.1	5.0	0:32/1.0	(4.0) 80%	(2.1) 42%		(2.4) 100%	(1.3) 54%		635.3 **CRYSTALLINE ROCK** 3.1 Gray and white with orange, GNEISS, micaceous, slight weathering, moderately hard to hard, close to moderately close fracture spacing
				1:00/1.0							GSI = 40-50
				1:15/1.0							632.9 5.5
				1:07/1.0				(1.6) 62%	(0.8) 31%		**WEATHERED ROCK** Gray and white with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, moderate to severe weathering, very soft to moderately hard, very close to close fracture spacing
				1:27/1.0							GSI=30-40
630	630.3	8.1	5.0	1:52/1.0	(4.9) 98%	(3.1) 62%		(14.9) 99%	(9.5) 63%		630.3 8.1 **CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, fresh to moderately severe weathering, soft to very hard, very close to moderately close fracture spacing
				1:59/1.0			RS-1				GSI = 30-40
				1:45/1.0							
				1:22/1.0							
				3:22/1.0							
625	625.3	13.1	5.0	1:43/1.0	(5.0) 100%	(2.9) 58%					
				1:24/1.0							
				1:28/1.0							
				1:56/1.0							
				2:05/1.0							
620	620.3	18.1	5.0	1:33/1.0	(5.0) 100%	(3.5) 70%					
				1:46/1.0							
				2:19/1.0			RS-2				
				2:14/1.0							
				2:12/1.0							
	615.3	23.1									615.3 23.1 Boring Terminated at Elevation 615.3 ft In Crystalline Rock (GNEISS)
											Deck to mudline: 38.0 ft Total casing: 45.0 ft Drill bit refusal at 3.1 ft BGS.

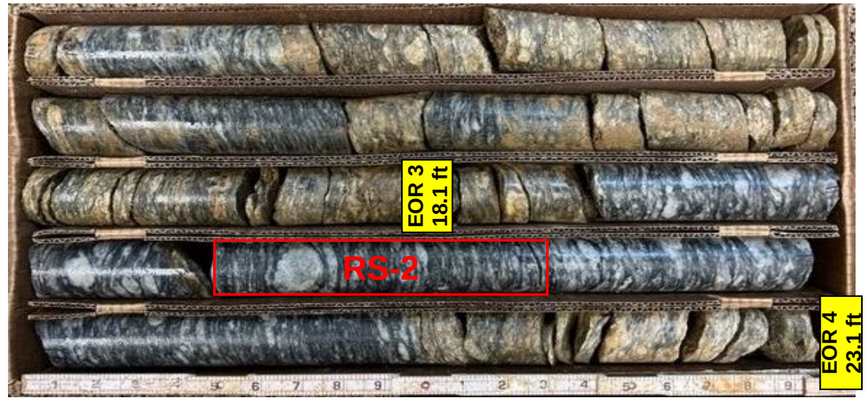
CORE PHOTOGRAPH
REPLACE BRIDGE 780035 ON NC 770 OVER MAYO RIVER

B1-A
BOX 1 OF 2: 3.1 - 13.1 FEET

0 1 2

APPROXIMATE SCALE IN FEET

B1-A
BOX 2 OF 2: 13.1 - 23.1 FEET



0 1 2

APPROXIMATE SCALE IN FEET

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 17+12	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 638.4 ft	**TOTAL DEPTH** 6.0 ft	**NORTHING** 991,696	**EASTING** 1,720,369	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/26/23	**COMP. DATE** 04/26/23	**SURFACE WATER DEPTH** 1.8ft	

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
										WATER SURFACE (04/26/23)
640										ELEV. (ft) DEPTH (ft)
										638.4 GROUND SURFACE 0.0
	636.2	2.2	100/0.2			100/0.2		Sat.		**ALLUVIAL** 636.4 Very loose to loose, gray, SAND (A-3), with trace silt 2.0
635										**WEATHERED ROCK**
	633.0	5.4	60/0.0			60/0.0				633.0 Gray, GNEISS, micaceous 5.4
	632.4	6.0	60/0.0			60/0.0				632.4 **CRYSTALLINE ROCK** 6.0
										Gray, GNEISS, micaceous
										Boring Terminated with Standard Penetration Test Refusal at Elevation 632.4 ft In Crystalline Rock (GNEISS)
										Deck to mudline: 37.8 ft Total casing: 42.0 ft Drill bit refusal at 6.0 ft BGS.

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 18+23	**OFFSET** 11 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 638.3 ft	**TOTAL DEPTH** 5.0 ft	**NORTHING** 991,746	**EASTING** 1,720,470	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/26/23	**COMP. DATE** 04/26/23	**SURFACE WATER DEPTH** 2.0ft	

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
										WATER SURFACE (04/26/23)
640										
										638.3 GROUND SURFACE 0.0
								Sat.		**ALLUVIAL**
	635.4	2.9	100/0.2			100/0.2				635.8 Very loose to loose, brown, SAND (A-3), with trace to little silt and mica 2.5
635										**WEATHERED ROCK**
	633.3	5.0	60/0.0			60/0.0				633.3 Gray and brown, GNEISS 5.0
										Boring Terminated with Standard Penetration Test Refusal at Elevation 633.3 ft On Crystalline Rock (GNEISS)
										Deck to mudline: 36.0 ft Total casing: 42.0 ft Drill bit refusal at 5.0 ft BGS.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 18+25	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 639.7 ft	**TOTAL DEPTH** 23.1 ft	**NORTHING** 991,731	**EASTING** 1,720,476	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/27/23	**COMP. DATE** 04/27/23	**SURFACE WATER DEPTH** 1.4ft	

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)
										WATER SURFACE (04/27/23)
640										639.7 / 0.0 GROUND SURFACE
										ALLUVIAL Very loose to loose, brown and white, SAND (A-3)
								Sat.		
						60/0.0				635.6 / 4.1
635										**CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, very slight to moderate weathering, moderately hard, close fracture spacing
										634.6 / 5.1 REC=100% (1.0') RQD=100% (1.0') GSI=80-90
										632.6 / 7.1 **WEATHERED ROCK** Gray and white with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, moderate to moderately severe weathering, soft to medium hard, very close fracture spacing
630							RS-3			REC=25% (0.5') RQD=0% GSI=15-20
										CRYSTALLINE ROCK Gray and white with orange, GNEISS, micaceous, fresh to moderate weathering, medium hard to hard, very close to close fracture spacing
										REC=100% (11.7') RQD=51% (6.0') GSI=40-50
625							RS-4			
										620.9 / 18.8 **WEATHERED ROCK** Gray, white, and brown with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, severe to very severe weathering, very soft to soft, very close to close fracture spacing
620										619.9 / 19.8 REC=50% (0.5') RQD=0% GSI=15-20
										616.6 / 23.1 **CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, fresh, hard, close to moderately close fracture spacing
										REC=100% (3.3') RQD=97% (3.2) GSI=80-90
										Boring Terminated at Elevation 616.6 ft In Crystalline Rock (GNEISS)
										Deck to mudline: 34.5 ft Total casing: 42.0 ft Drill bit refusal at 4.1 ft BGS.

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 18+25	**OFFSET** 5 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 639.7 ft	**TOTAL DEPTH** 23.1 ft	**NORTHING** 991,731	**EASTING** 1,720,476	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** NW Casing W/SPT & Core	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/27/23	**COMP. DATE** 04/27/23	**SURFACE WATER DEPTH** 1.4ft	
CORE SIZE N	**TOTAL RUN** 19.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft) / DEPTH (ft)
635.6											Begin Coring @ 4.1 ft
635	635.6	4.1	4.0	1:22/1.0	(2.5) 63%	(1.7) 43%		(1.0) 100%	(1.0) 100%		635.6 / 4.1 **CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, very slight to moderate weathering, moderately hard, close fracture spacing
				1:22/1.0				(0.5) 25%	(0.0) 0%		634.6 / 5.1 GSI=80-90
				1:33/1.0							**WEATHERED ROCK**
				1:43/1.0				(11.7) 100%	(6.0) 51%		632.6 / 7.1 Gray and white with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, moderate to moderately severe weathering, soft to medium hard, very close fracture spacing
	631.6	8.1									GSI=15-20
630			5.0	1:26/1.0	(4.8) 96%	(2.9) 58%	RS-3				**CRYSTALLINE ROCK** Gray and white with orange, GNEISS, micaceous, fresh to moderate weathering, medium hard to hard, very close to close fracture spacing
				1:34/1.0							GSI=40-50
				1:58/1.0							
				2:05/1.0							
				1:57/1.0							
	626.6	13.1									
625			5.0	2:04/1.0	(5.0) 100%	(2.4) 48%					
				1:49/1.0							
				1:45/1.0			RS-4				
				1:44/1.0							
				1:33/1.0							
	621.6	18.1									
620			5.0	1:10/1.0	(4.7) 94%	(3.2) 64%					
				1:12/1.0							
				1:00/1.0							
				1:35/1.0							
				1:52/1.0							
	616.6	23.1									

620.9 / 18.8 **WEATHERED ROCK** Gray, white, and brown with orange, weathered rock with crystalline rock lenses (GNEISS), micaceous, severe to very severe weathering, very soft to soft, very close to close fracture spacing (0.5) 50% (0.0) 0%

619.9 / 19.8 GSI=15-20 (3.3) 100% (3.2) 97%

CRYSTALLINE ROCK Gray and white, GNEISS, micaceous, fresh, hard, close to moderately close fracture spacing

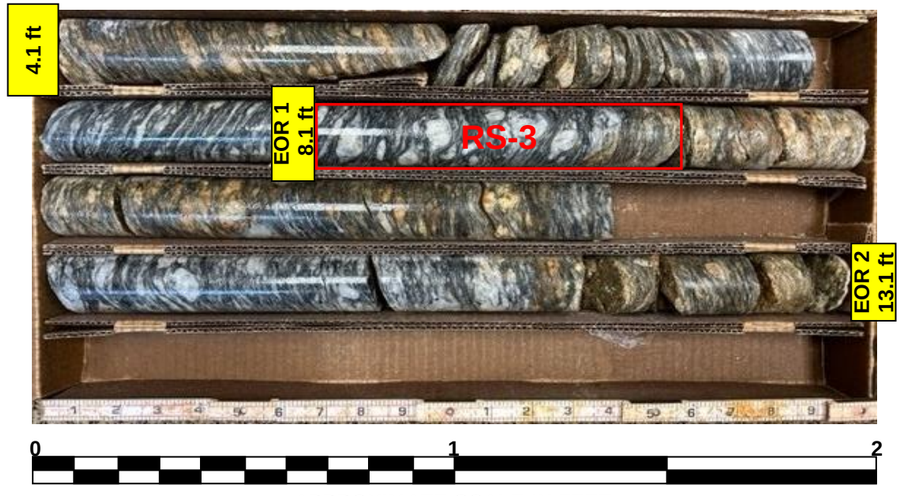
616.6 / 23.1 GSI=80-90

Boring Terminated at Elevation 616.6 ft In Crystalline Rock (GNEISS)

Deck to mudline: 34.5 ft
Total casing: 42.0 ft
Drill bit refusal at 4.1 ft BGS.

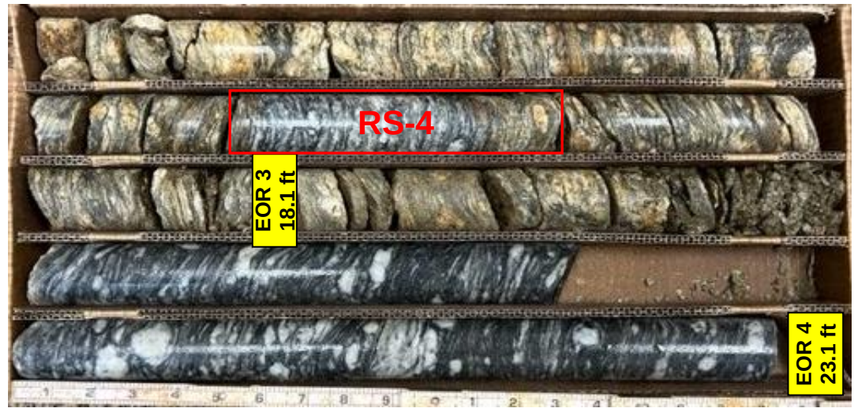
CORE PHOTOGRAPH
REPLACE BRIDGE 780035 ON NC 770 OVER MAYO RIVER

B2-B
BOX 1 OF 2: 4.1 - 13.1 FEET



APPROXIMATE SCALE IN FEET

B2-B
BOX 2 OF 2: 13.1 - 23.1 FEET



APPROXIMATE SCALE IN FEET

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 19+29	**OFFSET** 11 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 672.3 ft	**TOTAL DEPTH** 39.0 ft	**NORTHING** 991,780	**EASTING** 1,720,570	**24 HR.** 22.2
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/25/23	**COMP. DATE** 04/25/23	**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)
675											
										672.3 GROUND SURFACE	0.0
										671.8 **ROADWAY EMBANKMENT** Pavement	0.5
670	668.8	3.5	7	3	4	7				Medium stiff, brown, sandy SILT (A-4), micaceous	
665	663.8	8.5	2	3	3	6				665.3 Loose, brown and gray, silty SAND (A-2-4), micaceous	7.0
660	658.8	13.5	2	2	3	5					
655	653.8	18.5	1	1	3	4					
650	648.8	23.5	2	2	3	5				650.3 **RESIDUAL** Loose to dense, brown and gray, silty SAND (A-2-4), micaceous, saprolitic (GNEISS)	22.0
645	643.8	28.5	1	2	2	4					
640	638.8	33.5	12	16	23	39					
635	633.8	38.5	60/0.0			60/0.0				633.8 **CRYSTALLINE ROCK** Gray, GNEISS	38.5
	633.3	39.0	60/0.0							Boring Terminated with Standard Penetration Test Refusal at Elevation 633.3 ft In Crystalline Rock (GNEISS)	39.0

Drill rig chatter 32.5 - 33.5 ft BGS.
Drill bit refusal at 39.0 ft BGS.

WBS 67093.1.1	**TIP** BR-0093	**COUNTY** ROCKINGHAM	**GEOLOGIST** Swafford, C.	
SITE DESCRIPTION Replace Bridge 780035 On NC 770 Over Mayo River				**GROUND WTR (ft)**
BORING NO. EB2-B	**STATION** 19+35	**OFFSET** 4 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 672.3 ft	**TOTAL DEPTH** 38.1 ft	**NORTHING** 991,767	**EASTING** 1,720,580	**24 HR.** 28.4
DRILL RIG/HAMMER EFF./DATE CAT4425 CME-55 84% 04/01/2023		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER Edmondson, J. M.	**START DATE** 04/24/23	**COMP. DATE** 04/24/23	**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
675										
										672.3 GROUND SURFACE 0.0
	671.7	0.6								671.7 **ROADWAY EMBANKMENT** Pavement 0.6
670	668.6	3.7	13	10	6	16				Loose to medium dense, gray, sand and GRAVEL (A-1-b)
665	663.6	8.7	8	4	3	7				667.4 4.9 Medium stiff, orange and brown, sandy SILT (A-4), micaceous
660	658.6	13.7	3	3	4	7				
655	653.6	18.7	1	1	2	3				659.8 12.5 Soft to medium stiff, orange-brown, clayey SILT (A-5), trace to little sand, micaceous
650	648.6	23.7	2	3	5	8				
645	643.6	28.7	2	3	4	7				650.3 **RESIDUAL** Soft to medium stiff, orange and brown, non-plastic, sandy SILT (A-4(0)), with little clay, micaceous 22.0
640	638.6	33.7	2	2	1	3	SS-7	32%		
635	634.3	38.0	22	61	39/0.4	100/0.9				638.8 **WEATHERED ROCK** Gray and white, (GNEISS) 33.5
			60/0.1			60/0.1				634.3 38.0
										634.2 **CRYSTALLINE ROCK** Gray and white, GNEISS 38.1
										Boring Terminated with Standard Penetration Test Refusal at Elevation 634.2 ft In Crystalline Rock (GNEISS)

Drill rig chatter 33.5 - 34.2 ft BGS.
Drill bit refusal at 38.0 ft BGS.

PROJECT REFERENCE NO.	SHEET NO.
BR-0093	11

SOIL TEST RESULTS

BORING ID	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		
EB1-A	SS-25	7' LT	16+23	27.8-29.3	A-6(6)	35	14	8.7	38.8	24.1	28.5	100	97	61	26	-
EB1-A	SS-26	7' LT	16+23	32.8-34.3	A-4(1)	33	4	11.2	45.3	29.3	14.1	99	94	53	32	-
EB1-B	SS-15	8' RT	16+26	28.4-29.9	A-6(5)	33	12	7.8	40.8	24.4	27.0	95	93	57	25	-
EB2-B	SS-7	7' RT	19+25	28.7-30.3	A-4(0)	28	3	4.4	58.9	22.5	14.2	100	100	47	32	-

REPORT ON SAMPLES OF: Rock for Quality (ASTM D 7012-14e1 Method C)

T.I.P. ID NO.: BR-0093

DESCRIPTION:	Replace Bridge 780035 On NC 770 Over Mayo River
PROJECT:	BR-0093
COUNTY:	Rockingham
DATE SAMPLED:	4/25/2023

BORING NO	SAMPLE NO	DEPTH (FT)	ROCK TYPE	LENGTH (IN)	DIAMETER (IN)	UNIT WEIGHT (PCF)	UNCONFINED COMPRESSIVE STRENGTH (PSI)	YOUNG'S MODULUS (PSI)	SPLITTING TENSILE STRENGTH (PSI)	REMARKS
B1-A-b	RS-1	9.5-10.2	Gneiss	4.59	1.99	165.9	5,940	--	--	--
B1-A-b	RS-2	19.6-20.4	Gneiss	4.58	1.99	167.9	12,150	--	--	--
B2-B	RS-3	8.1-9.1	Gneiss	4.55	1.99	165.5	3,690	--	--	--
B2-B	RS-4	15.6-16.3	Gneiss	4.33	1.99	164.9	7,280	--	--	--

SITE PHOTOGRAPH
REPLACE BRIDGE 780035 ON NC 770 OVER MAYO RIVER