REFERENCE: DF18314.1075015

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STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075015	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 936*

CONTENTS

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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
- [ ] CME-55
- [X] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED BY TGS JULY 1, 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

FIAD = FILLED IN AFTER DRILLING

DATE: 8-15-14

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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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075015	3

SITE PLAN

0 50 100
FEET

BEGIN CONSTRUCTION
–L936– STA 14+00.00

END CONSTRUCTION
–L936– STA 18+00.00

SAWCUT EXISTING PAVEMENT AT CENTERLINE.

← TO EAST MAIN ST

TO NC HWY 108 →

15+00

18+00

US 176

936 B-3

936 B-1

936 B-4

936 B-2

EXISTING R-W

EXISTING R-W

DEBRIS

DEBRIS

DEBRIS

WOODS

WOODS

INV=1095.77'

INV=1178.67'

60" CM

TIE TO EXIST. GUARDRAIL

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

PROPOSED RETAINING WALL

TIE TO EXIST. GUARDRAIL

PROPERTY LINE PER GIS

JS

SF

NC GRID
NAD 83 NA 2011

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075015	4

936 B-4
14+94
8' RT

EXISTING GROUNDLINE

PAVEMENT

-CRYSTALLINE ROCK-

MODERATELY WEATHERED TO FRESH, HARD TO VERY HARD, GRAY-WHITE-BLACK (GRANITIC GNEISS), WITH VERY CLOSE TO MODERATELY CLOSE FRACTURE SPACING

REC=95%
RQD=76%
GSI=55-60

CT
FIAD
04/25

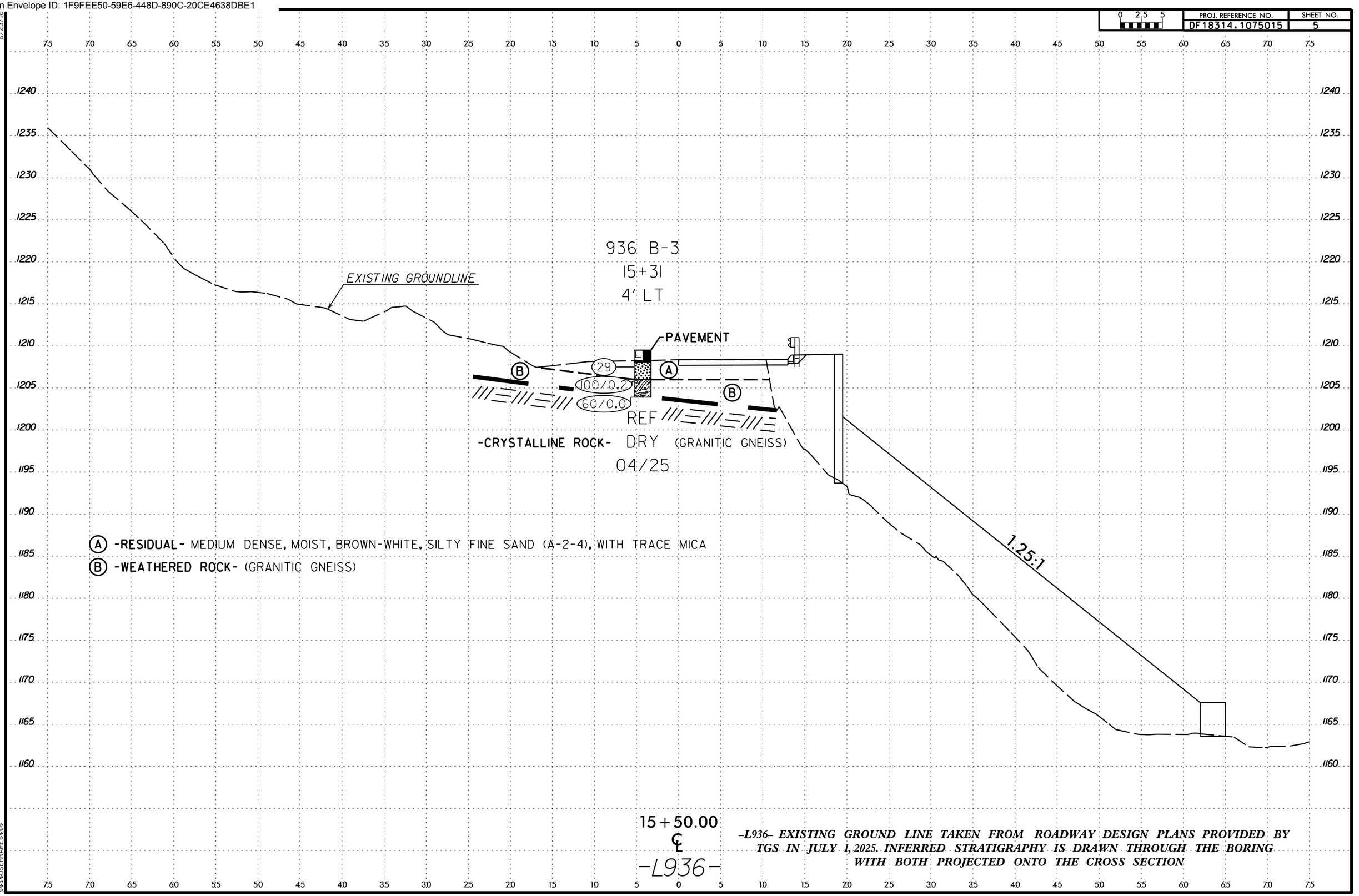
(A) **-ROADWAY EMBANKMENT-** LOOSE, MOIST, BROWN-GRAY, FINE TO COARSE GRAVELLY SAND (A-1-b), WITH TRACE MICA

(B) **-ROADWAY EMBANKMENT-** STIFF, MOIST, RED-BROWN, FINE SANDY CLAY (A-6), WITH TRACE MICA

15+00.00
℄
-L936-

-L936- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 1, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075015	5



–L936– EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 1, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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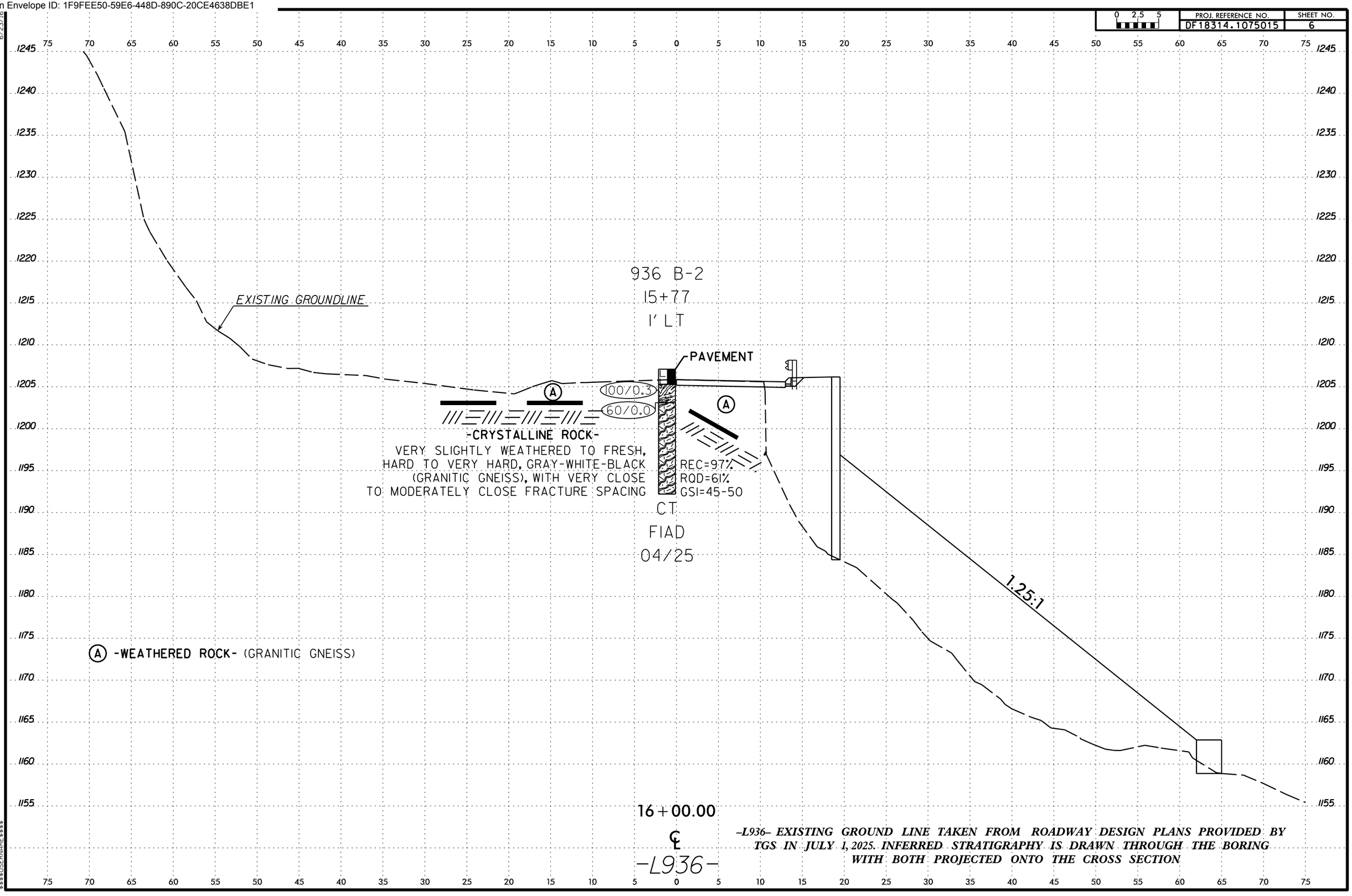
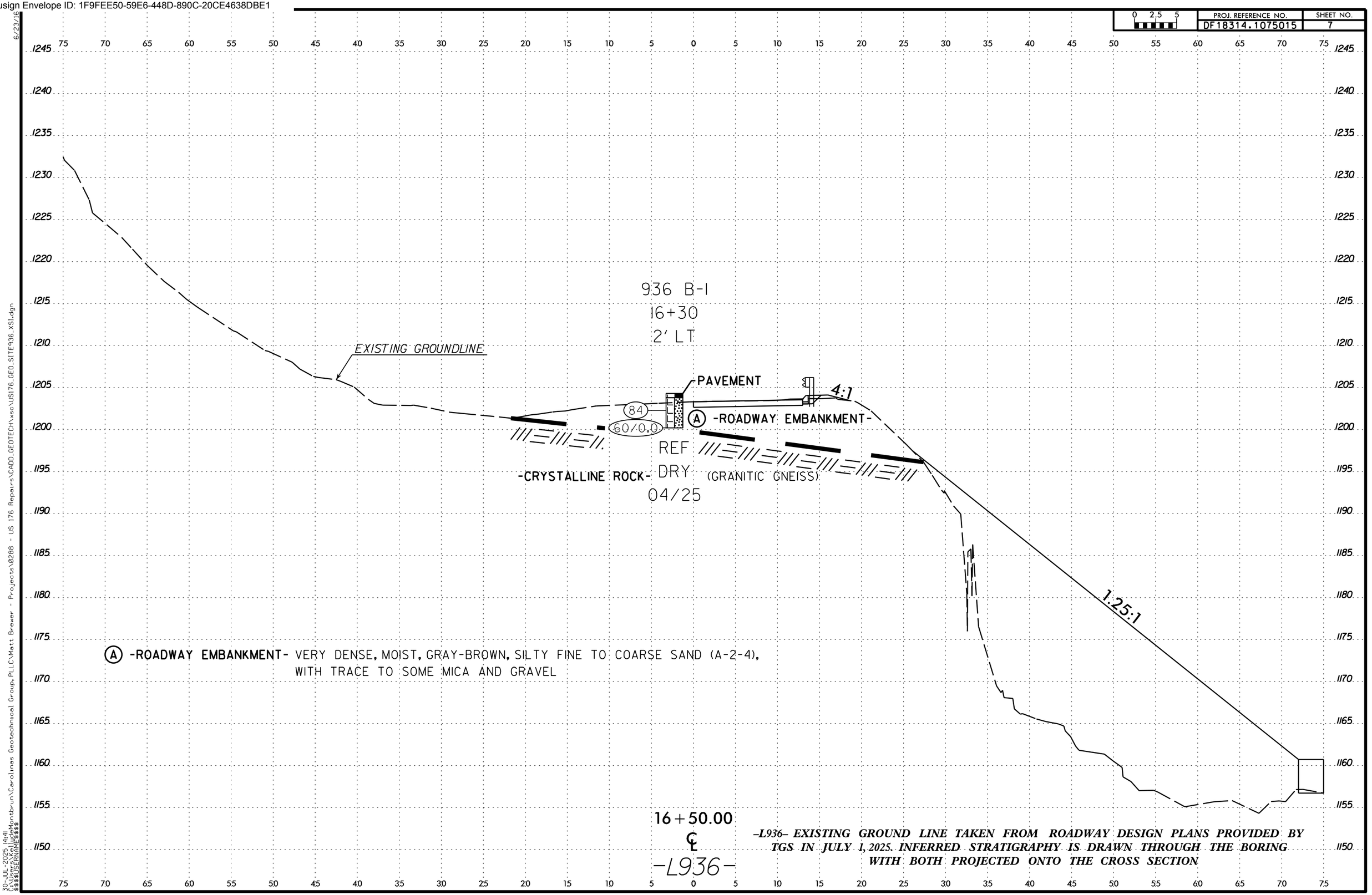
	DF18314.1075015	6



–L936– EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 1, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075015	7



6/23/16

30-JUL-2025 14:41
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$$$$USERNAME$$$$

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-4	**STATION** 14+94	**OFFSET** 8 ft RT	**ALIGNMENT** -L936-	**0 HR.** N/A
COLLAR ELEV. 1,210.9 ft	**TOTAL DEPTH** 19.8 ft	**NORTHING** 552,075	**EASTING** 1,014,233	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/30/25	**COMP. DATE** 04/30/25	**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)
1215											
1210										1,210.9 GROUND SURFACE	0.0
	1,208.8	2.1	9	4	4	8		M		**ROADWAY EMBANKMENT**	
										1,209.1 Asphalt (0.7'), ABC (1.1')	1.8
	1,206.2	4.7								Loose, Brown-Gray, Fine to Coarse Gravelly SAND (A-1-b), with trace mica	
1205			5	2	8	10		M		1,206.4 Stiff, Red-Brown, Fine Sandy CLAY (A-6), with trace mica	4.5
	1,204.2	6.7	60/0.0			60/0.0				1,204.2 **CRYSTALLINE ROCK**	6.7
1200										Gray-White-Black, (Granitic Gneiss)	
										REC = 95%	
										RQD = 76%	
1195										GSI = 55-60	
										1,191.1	19.8
										Boring Terminated at Elevation 1,191.1 ft In Crystalline Rock (Granitic Gneiss)	

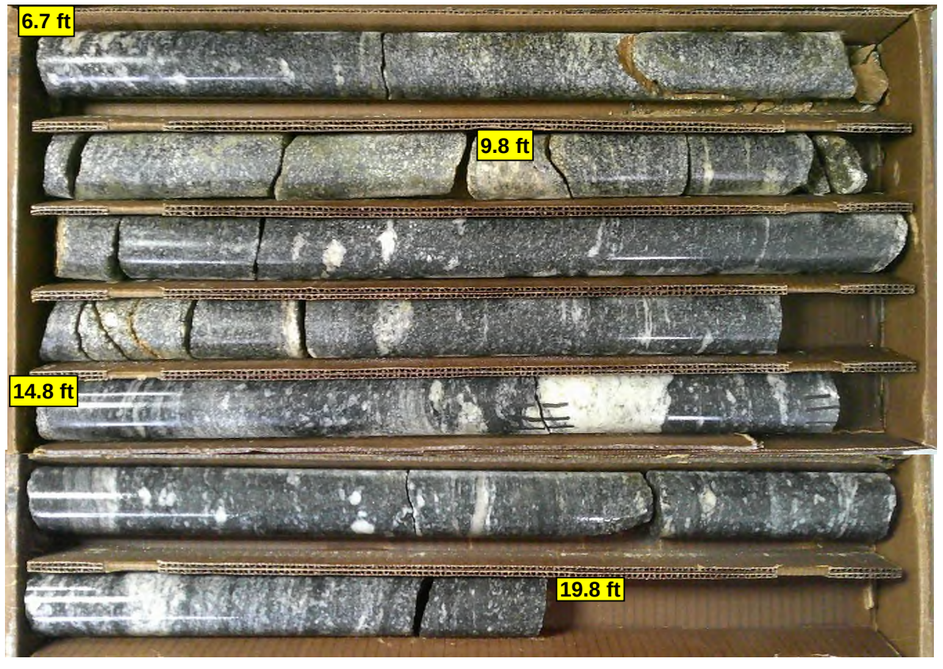
GEOTECHNICAL BORING REPORT
CORE LOG

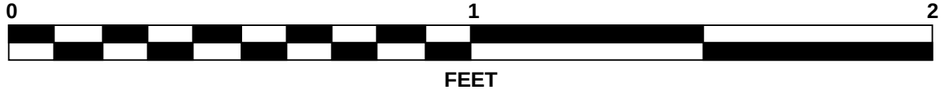
WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-4	**STATION** 14+94	**OFFSET** 8 ft RT	**ALIGNMENT** -L936-	**0 HR.** N/A
COLLAR ELEV. 1,210.9 ft	**TOTAL DEPTH** 19.8 ft	**NORTHING** 552,075	**EASTING** 1,014,233	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/30/25	**COMP. DATE** 04/30/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 13.1 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)
1204.22											Begin Coring @ 6.7 ft	
	1,204.2	6.7	3.1	*N=60/0.0*	(2.9)	(2.5)		(12.5)	(9.9)		1,204.2 **CRYSTALLINE ROCK**	6.7
				7:26/1.0	94%	81%		95%	76%		Moderately Weathered to Fresh, Hard to Very Hard, Gray-White-Black,	
	1,201.1	9.8		4:08/1.0							(Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing	
1200				5:00/1.0								
			5.0	0:50/0.1	(4.6)	(2.6)					GSI = 55-60	
				3:17/1.0	92%	52%						
	1,196.1	14.8		3:27/1.0								
				4:13/1.0								
1195				4:16/1.0								
				6:49/1.0								
			5.0	6:30/1.0	(5.0)	(4.8)						
				6:01/1.0	100%	96%						
				4:48/1.0								
	1,191.1	19.8		5:52/1.0								
				4:34/1.0							1,191.1	19.8
											Boring Terminated at Elevation 1,191.1 ft In Crystalline Rock (Granitic Gneiss)	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 936 B-4
6.7 to 19.8 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-3	**STATION** 15+31	**OFFSET** 4 ft LT	**ALIGNMENT** -L936-	**0 HR.** Dry
COLLAR ELEV. 1,209.5 ft	**TOTAL DEPTH** 5.6 ft	**NORTHING** 552,086	**EASTING** 1,014,270	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1210										1,209.5 GROUND SURFACE	0.0
	1,208.5	1.0	10	14	15	29		M		1,208.1 **ROADWAY EMBANKMENT** Asphalt (0.7') Concrete (0.7')	1.4
	1,206.0	3.5	100/0.2			100/0.2				1,206.0 **RESIDUAL** Medium Dense, Brown-White, Silty Fine SAND (A-2-4), with trace mica	3.5
1205	1,203.9	5.6	60/0.0			60/0.0				1,203.9 **WEATHERED ROCK** Gray, (Granitic Gneiss)	5.6
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,203.9 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-2	**STATION** 15+77	**OFFSET** 1 ft LT	**ALIGNMENT** -L936-	**0 HR.** N/A
COLLAR ELEV. 1,207.1 ft	**TOTAL DEPTH** 14.9 ft	**NORTHING** 552,081	**EASTING** 1,014,316	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/30/25	**COMP. DATE** 04/30/25	**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)
1210											
										1,207.1 GROUND SURFACE	0.0
1205	1,204.9	2.2								**ROADWAY EMBANKMENT**	
	1,203.1	4.0	100/0.3			100/0.3				1,205.3 Asphalt (0.7'), ABC (1.1')	1.8
			60/0.0			60/0.0				**WEATHERED ROCK**	
										1,203.1 Gray, (Granitic Gneiss)	4.0
1200										**CRYSTALLINE ROCK** Black-Gray-White, (Granitic Gneiss)	
										REC = 97% RQD = 61% GSI = 45-50	
1195											
										1,192.2	14.9
										Boring Terminated at Elevation 1,192.2 ft In Crystalline Rock (Granitic Gneiss)	

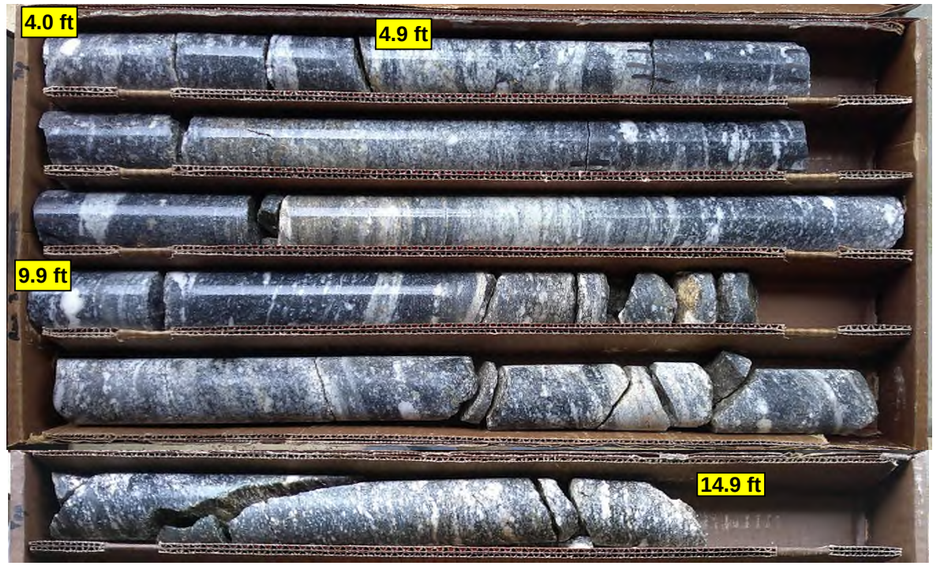
GEOTECHNICAL BORING REPORT
CORE LOG

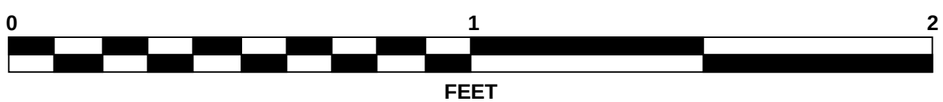
WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-2	**STATION** 15+77	**OFFSET** 1 ft LT	**ALIGNMENT** -L936-	**0 HR.** N/A
COLLAR ELEV. 1,207.1 ft	**TOTAL DEPTH** 14.9 ft	**NORTHING** 552,081	**EASTING** 1,014,316	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/30/25	**COMP. DATE** 04/30/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 10.9 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)
1203.1											Begin Coring @ 4.0 ft	
	1,203.1	4.0	0.9	*N=60/0.0*	(0.7)	(0.0)		(10.6)	(6.6)		1,203.1 **CRYSTALLINE ROCK**	4.0
	1,202.2	4.9	5.0	(11:05/0.9)	78%	0%		97%	61%		Very Sligthly Weathered to Fresh, Hard to Very Hard, Black-Gray-White, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing	
1200				9:29/1.0 11:32/1.0	(4.9)	(4.8)					GSI = 45-50	
				11:46/1.0 6:17/1.0	98%	96%						
	1,197.2	9.9		6:23/1.0								
1195			5.0	4:48/1.0 2:28/1.0	(5.0)	(1.8)						
				2:25/1.0 2:20/1.0	100%	36%						
	1,192.2	14.9		2:40/1.0							1,192.2	14.9
											Boring Terminated at Elevation 1,192.2 ft In Crystalline Rock (Granitic Gneiss)	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 936 B-2
4.0 to 14.9 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075015	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 936 B-1	**STATION** 16+30	**OFFSET** 2 ft LT	**ALIGNMENT** -L936-	**0 HR.** Dry
COLLAR ELEV. 1,204.3 ft	**TOTAL DEPTH** 4.1 ft	**NORTHING** 552,080	**EASTING** 1,014,369	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1205											
										1,204.3 GROUND SURFACE	0.0
	1,203.3	1.0	16	31	53	84		M		1,203.8 **ROADWAY EMBANKMENT** Asphalt (0.5')	0.5
	1,200.2	4.1	60/0.0			60/0.0				1,200.2 Very Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace to some mica and gravel	4.1
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,200.2 ft On Crystalline Rock (Granitic Gneiss)	

REFERENCE: DF18314.1075016

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075016	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 937*

CONTENTS

CAUTION NOTICE

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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.
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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
- [ ] CME-55
- [X] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED MARCH 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

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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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075016	3

SITE PLAN

0 50 100
FEET

25

NC GRID
NAD 83 NA 2011

END CONSTRUCTION
-L941-937- STA 29+00.00

+00 TIE
TO EXIST

-L941-937- PT 29+23.8
-L936- POT 10+00.00 AH

937 B-8 937 B-7 937 B-6

937 B-5

WOODS

24" CMP
CRUSHED/BURIED

←TO EAST MAIN ST

S 86° 32' 13.1" E

19'BST

DEBRIS

INV=1235.17'

CONC HW

24" CMP

INV=1230.93'

10+50

S 68° 28' 52.7" E
TO NC HWY 108 →

PROPERTY LINE PER GIS

NORTH PACOLET RIVER

DEBRIS

WOODS

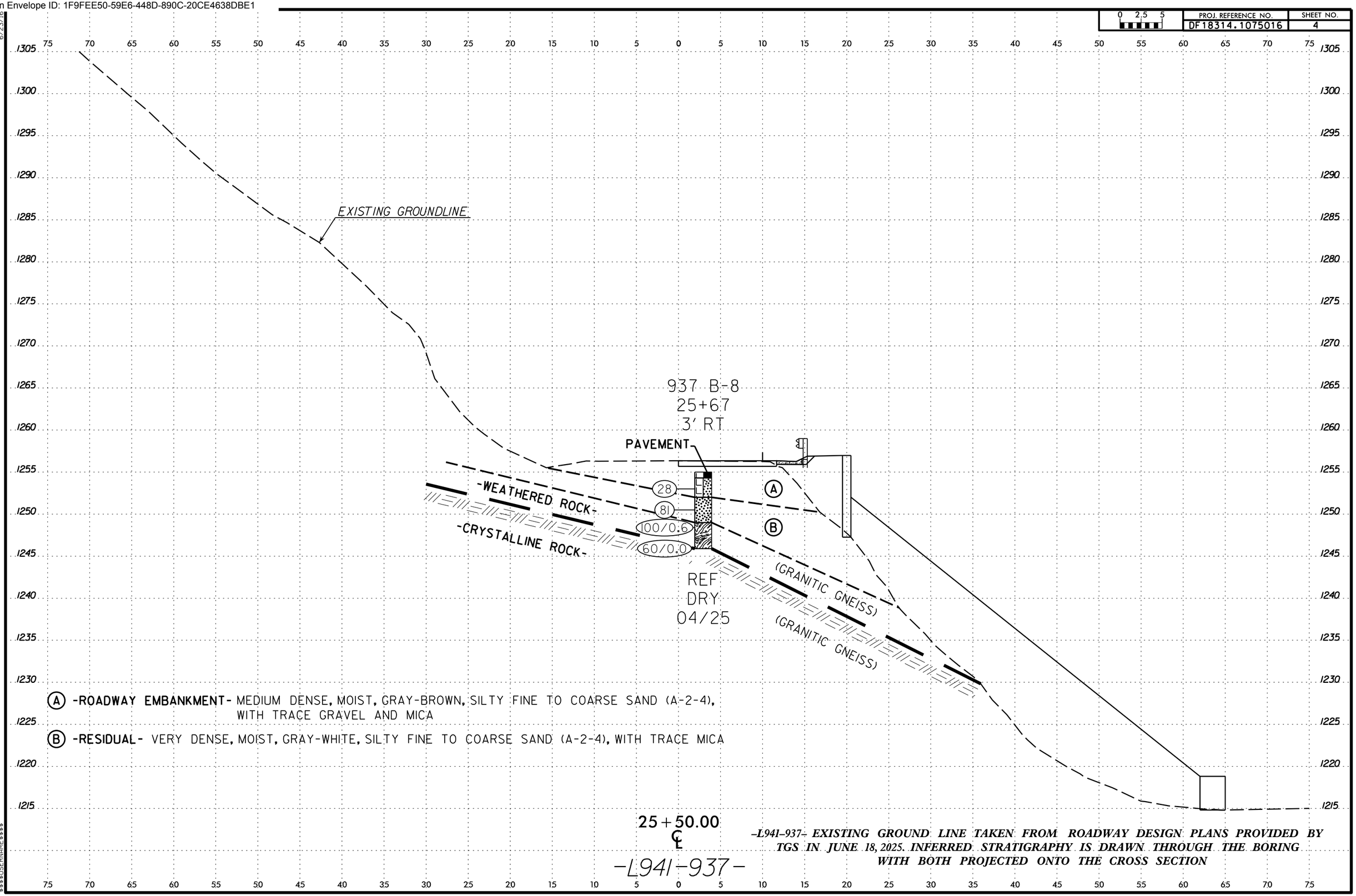
-L941-937- PC 27+03.30

1 MTL

JS

ST

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075016	4



Ⓐ **-ROADWAY EMBANKMENT-** MEDIUM DENSE, MOIST, GRAY-BROWN, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL AND MICA

Ⓑ **-RESIDUAL-** VERY DENSE, MOIST, GRAY-WHITE, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE MICA

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JUNE 18, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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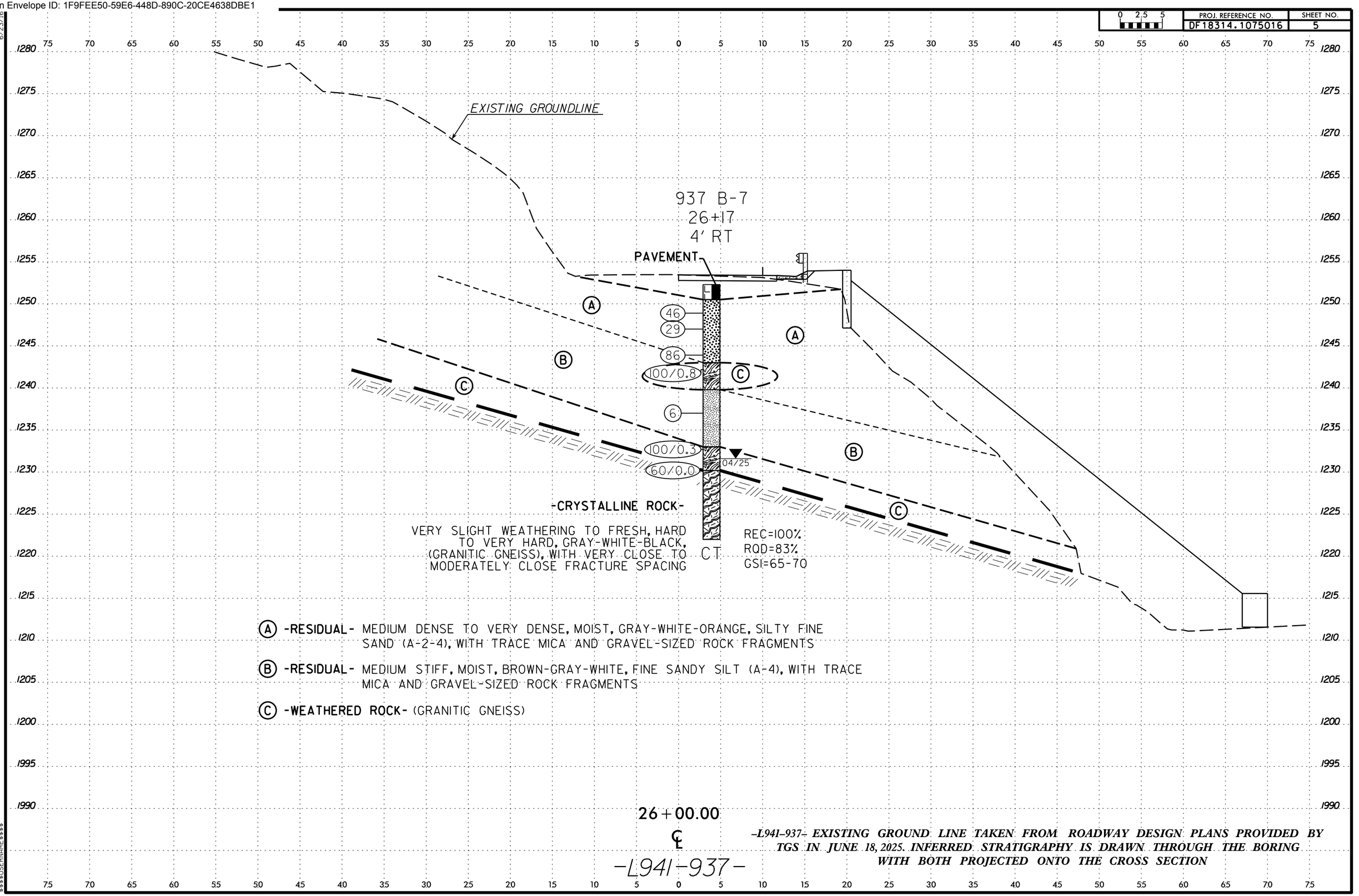
	DF18314.1075016	5



-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JUNE 18, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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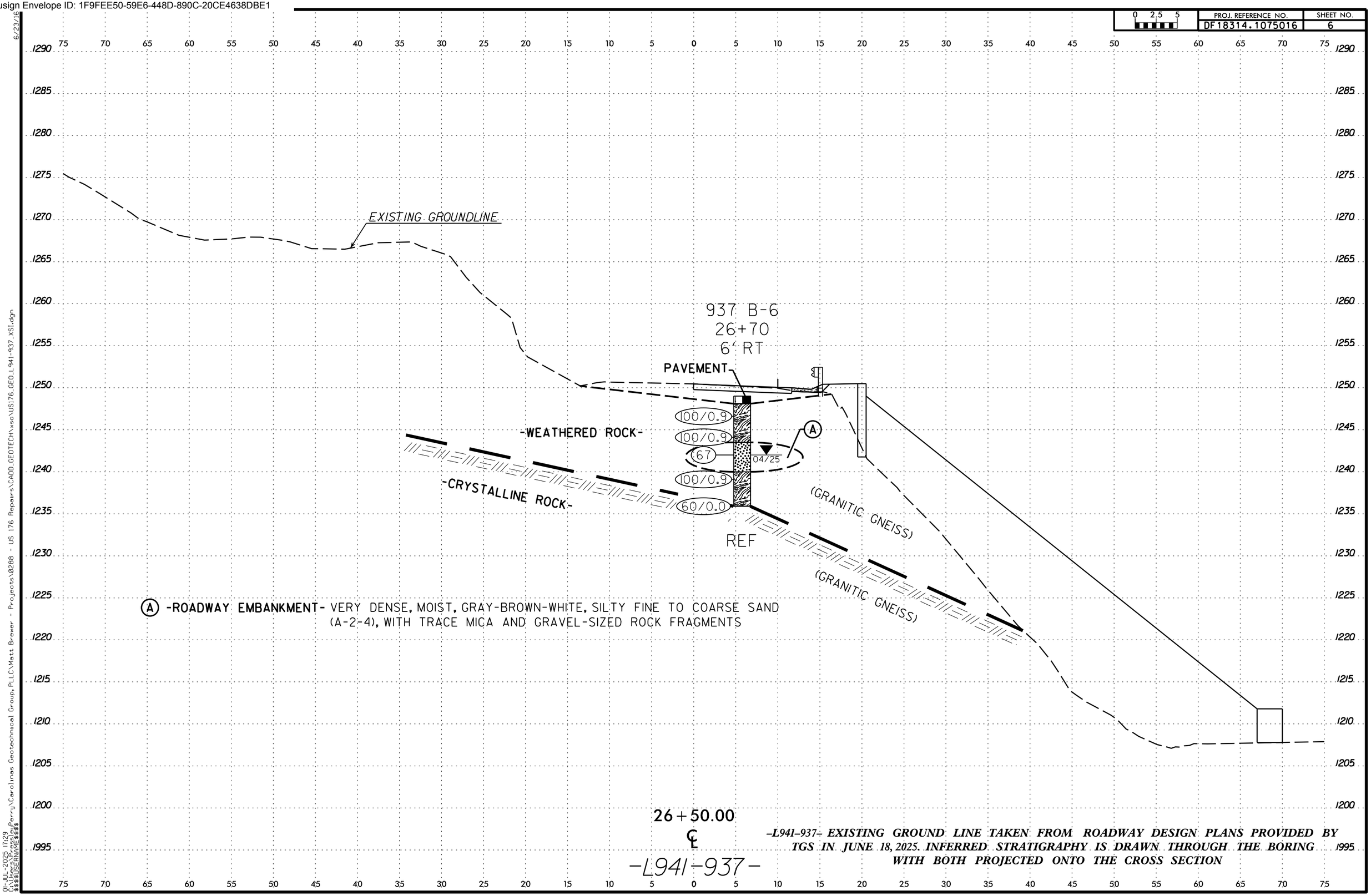

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JUNE 18, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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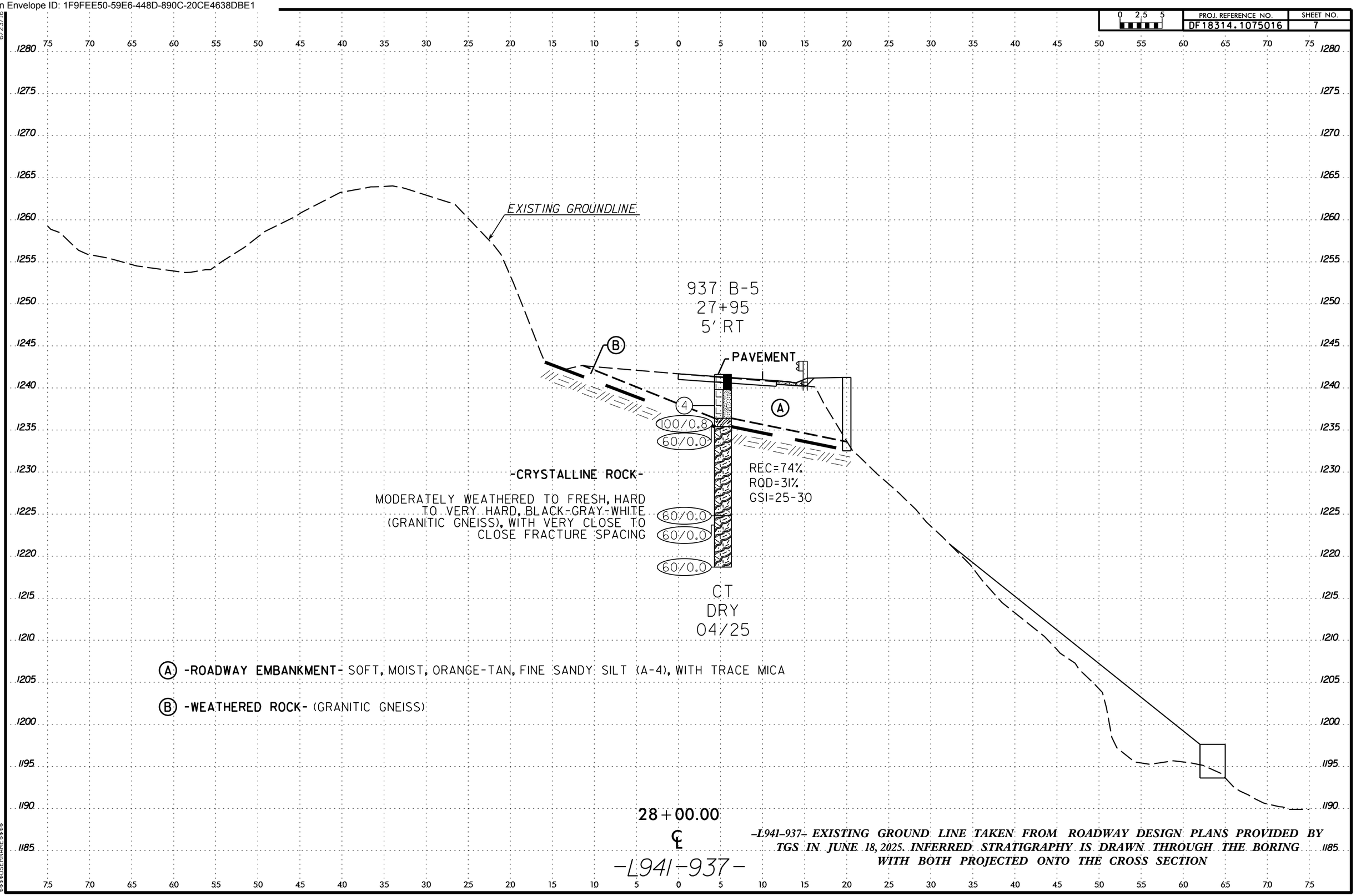
	DF18314.1075016	7



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 937 B-8	**STATION** 25+67	**OFFSET** 3 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,255.0 ft	**TOTAL DEPTH** 9.1 ft	**NORTHING** 552,279	**EASTING** 1,013,414	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1260											
1255										1,255.0 GROUND SURFACE	0.0
	1,254.0	1.0								1,254.3 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
	1,251.5	3.5	20	14	14	28		M		1,252.0 Medium Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4,) with trace gravel and mica	3.0
1250			26	21	60	81		M			
	1,249.0	6.0	74	26/0.1		100/0.6				1,249.0 **RESIDUAL** Very Dense, Gray-White, Silty Fine to Coarse SAND (A-2-4), with trace mica	6.0
	1,245.9	9.1	60/0.0			60/0.0				1,245.9 **WEATHERED ROCK** Gray, (Granitic Gneiss)	9.1
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,245.9 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 937 B-7	**STATION** 26+17	**OFFSET** 4 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,252.3 ft	**TOTAL DEPTH** 30.3 ft	**NORTHING** 552,275	**EASTING** 1,013,464	**24 HR.** 20.7
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**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)
1255										
										1,252.3 GROUND SURFACE 0.0
1250	1,249.9	2.4	15	13	33	46		M		**ROADWAY EMBANKMENT** Asphalt (0.6'), ABC (1.2') 1,250.5 1.8
	1,248.0	4.3	24	15	14	29		M		**RESIDUAL** Medium Dense to Very Dense, Gray-White-Orange, Silty Fine SAND (A-2-4), with trace mica and gravel-sized rock fragments
1245	1,244.9	7.4								
	1,243.0	9.3	20	20	66	86		M		1,243.0 9.3
			25	75/0.3		100/0.8				**WEATHERED ROCK** Gray-White-Brown, (Granitic Gneiss)
1240										1,239.8 12.5
	1,238.0	14.3	9	4	2	6		M		**RESIDUAL** Medium Stiff, Brown-Gray-White, Fine Sandy SILT (A-4), with trace mica and gravel-sized rock fragments
1235										
	1,233.0	19.3	100/0.3			100/0.3				1,233.0 19.3
1230	1,230.2	22.1	60/0.0			60/0.0				**WEATHERED ROCK** Brown-Gray, (Granitic Gneiss) 1,230.2 22.1
										CRYSTALLINE ROCK Gray-White-Black, (Granitic Gneiss) REC = 100% RQD = 83% GSI = 65-70
1225										1,222.0 30.3
										Boring Terminated at Elevation 1,222.0 ft In Crystalline Rock (Granitic Gneiss)

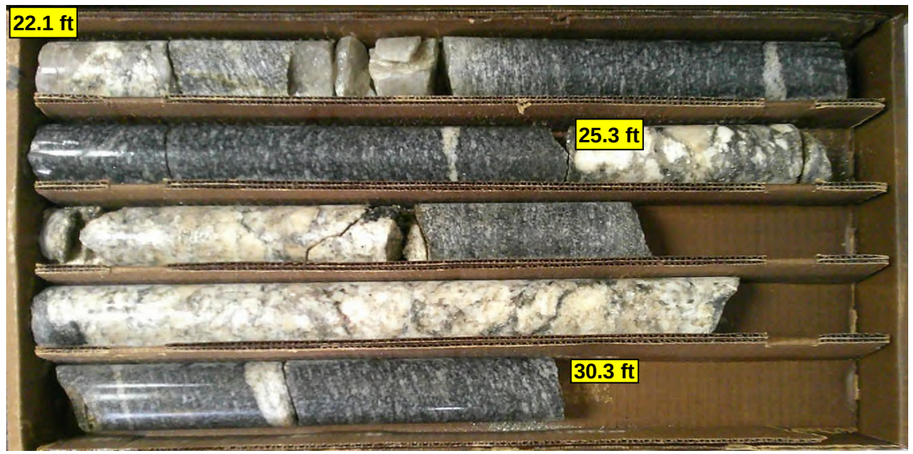
GEOTECHNICAL BORING REPORT
CORE LOG

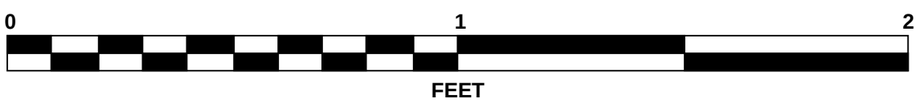
WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 937 B-7	**STATION** 26+17	**OFFSET** 4 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,252.3 ft	**TOTAL DEPTH** 30.3 ft	**NORTHING** 552,275	**EASTING** 1,013,464	**24 HR.** 20.7
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 8.2 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)
1230.0											Begin Coring @ 22.1 ft
	1,230.2	22.1	3.2	*N=60/0.0* 3:45/1.0 4:31/1.0 3:30/1.0	(3.2) 100%	(2.3) 72%		(8.2) 100%	(6.8) 83%		1,230.2 **CRYSTALLINE ROCK** 22.1 Very Slight Weathering to Fresh, Hard To Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing
	1,227.0	25.3	5.0	0:36/0.2 4:16/1.0 3:44/1.0 5:36/1.0 5:58/1.0 4:13/1.0	(5.0) 100%	(4.5) 90%					GSI = 65-70
1225	1,222.0	30.3									1,222.0 30.3 Boring Terminated at Elevation 1,222.0 ft In Crystalline Rock (Granitic Gneiss)

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 937 B-7
22.1 to 30.3 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 937 B-6	**STATION** 26+70	**OFFSET** 6 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,249.0 ft	**TOTAL DEPTH** 13.1 ft	**NORTHING** 552,270	**EASTING** 1,013,516	**24 HR.** 7.0
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1250										1,249.0 GROUND SURFACE	0.0
	1,248.0	1.0	16	35	65/0.4	100/0.9				1,248.1 **ROADWAY EMBANKMENT** Asphalt (0.9')	0.9
1245	1,245.5	3.5	31	47	53/0.4	100/0.9				**WEATHERED ROCK** Gray-Brown-White, (Granitic Gneiss)	
	1,243.0	6.0	36	37	30	67		M		1,243.5 **RESIDUAL** Very Dense, Gray-Brown-White, Silty Fine to Coarse SAND (A-2-4), with trace mica and gravel-sized rock fragments	5.5
1240	1,240.5	8.5	5	8	92/0.4	100/0.9				1,240.0 **WEATHERED ROCK** Gray, (Granitic Gneiss)	9.0
	1,235.9	13.1	60/0.0			60/0.0				1,235.9 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,235.9 ft On Crystalline Rock (Granitic Gneiss)	13.1

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 937 B-5	**STATION** 27+95	**OFFSET** 5 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,241.6 ft	**TOTAL DEPTH** 22.9 ft	**NORTHING** 552,257	**EASTING** 1,013,640	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**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)
1245											
										1,241.6	0.0
										GROUND SURFACE	
1240										**ROADWAY EMBANKMENT**	
	1,238.9	2.7	4	2	2	4				1,239.8 Asphalt (0.6'), ABC (1.2')	1.8
	1,236.9	4.7						M		Soft, Orange-Tan, Fine Sandy SILT (A-4), with trace mica	
1235	1,235.4	6.2	3	2	98/0.3	100/0.8				1,236.4	5.2
			60/0.0			60/0.0				1,235.4 **WEATHERED ROCK** Orange-Tan-White, (Granitic Gneiss)	6.2
										CRYSTALLINE ROCK Black-Gray-White, (Ganitic Gneiss)	
1230										REC = 74% RQD = 31% GSI = 25-30	
1225	1,224.8	16.8								1,224.8	16.8
	1,223.7	17.9	60/0.0			60/0.0				Black-Gray-White, (Granitic Gneiss)	
			60/0.0			60/0.0					
1220	1,218.7	22.9								1,218.7	22.9
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,218.7 ft In Crystalline Rock (Granitic Gneiss)	
										Note: SPT at 16.8' to confirm Crystalline Rock, proceeded with NW Casing with SPT until borehole termination	

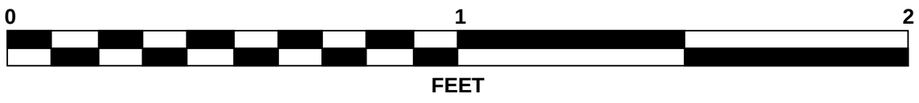
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075016	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch
SITE DESCRIPTION Road Repairs along US 176 Highway			**GROUND WTR (ft)**
BORING NO. 937 B-5	**STATION** 27+95	**OFFSET** 5 ft RT	**ALIGNMENT** -L941-937- **0 HR.** N/A
COLLAR ELEV. 1,241.6 ft	**TOTAL DEPTH** 22.9 ft	**NORTHING** 552,257	**EASTING** 1,013,640 **24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**SURFACE WATER DEPTH** N/A
CORE SIZE NQ	**TOTAL RUN** 10.6 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)
1235.37											Begin Coring @ 6.2 ft	
	1,235.4	6.2	3.8	*N=60/0.0* 2:32/1.0 1:37/1.0 2:49/1.0 1:56/0.8	(3.2) 84%	(1.6) 42%		(7.8) 74%	(3.3) 31%		1,235.4 **CRYSTALLINE ROCK** Moderately Weathered to Fresh, Hard to Very Hard, Black-Gray-White, (Granitic Gneiss), with Very Close to Close Fracture Spacing	6.2
	1,231.6	10.0	5.0	1:22/1.0 2:08/1.0 0:58/1.0 3:22/1.0 2:06/1.0	(2.9) 58%	(0.8) 16%					GSI = 25-30	
1230	1,226.6	15.0	1.8	1:44/1.0 2:22/0.8	(1.7) 94%	(0.9) 50%						
1225	1,224.8	16.8		*N=60/0.0* *N=60/0.0*							1,224.8 Black-Gray-White, (Granitic Gneiss)	16.8
1220				*N=60/0.0*							1,218.7 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,218.7 ft In Crystalline Rock (Granitic Gneiss)	22.9
											Note: SPT at 16.8' to confirm Crystalline Rock, proceeded with NW Casing with SPT until borehole termination	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 937 B-5
6.2 to 16.8 Feet



REFERENCE: DF18314.1075017

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075017	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 938 –L941–937– STA. 21+50.00 TO 23+50.00*

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.

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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.
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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
- [ ] CME-55
- [X] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED JULY, 29 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
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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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16

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PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075017	3

SITE PLAN

0 50 100
FEET

NC GRID
NAD 83 NA 2011

END SITE 939 /BEGIN SITE 938
–L941–937– STA 21+50.00

END SITE 938 /BEGIN SITE 937
–L941–937– STA 23+50.00

939 B-17
939 B-16
939 B-15
939 B-14
939 B-13
939 B-12
938 B-11
938 B-10
938 B-9

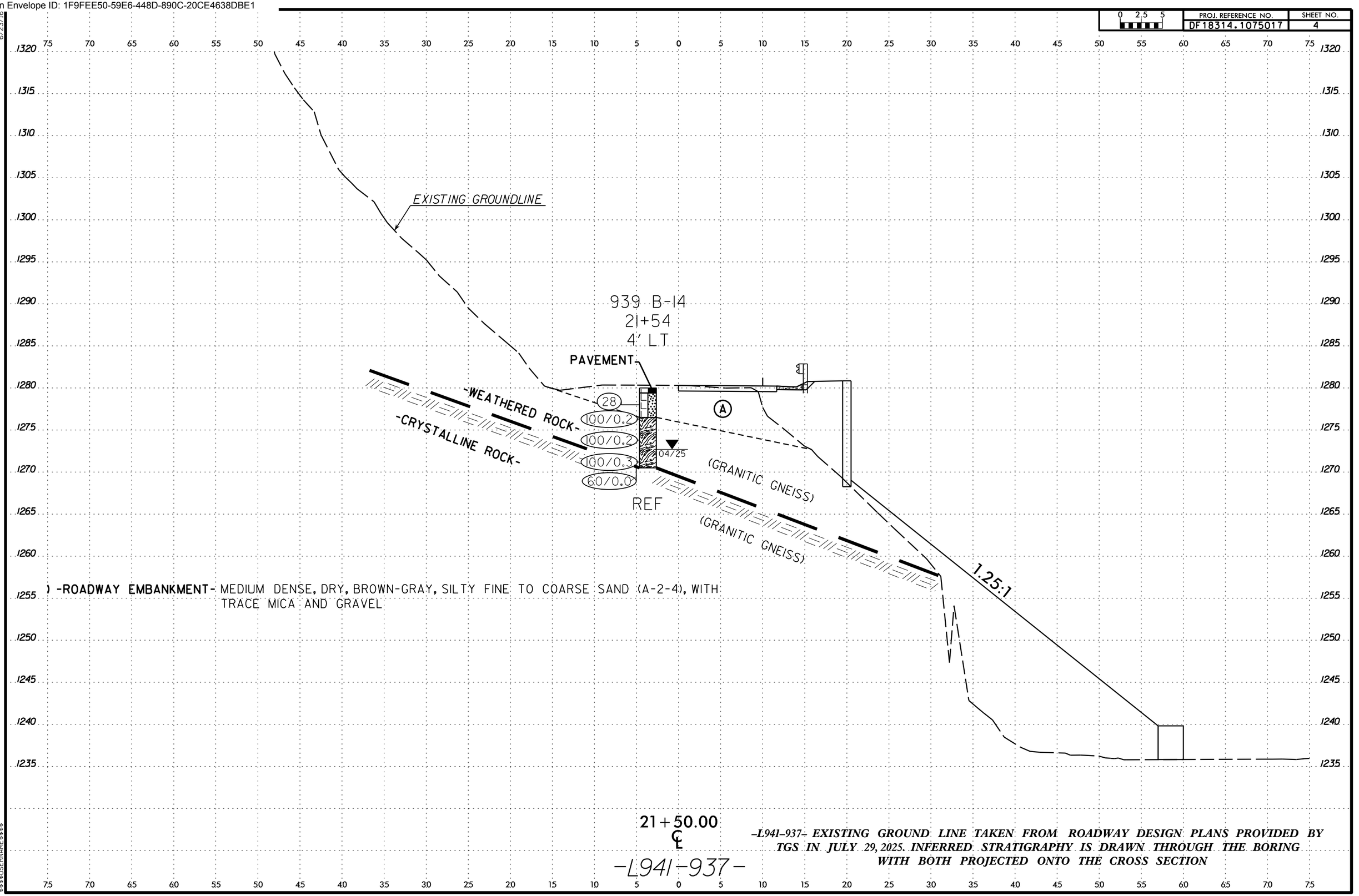
GPS-2 INV=1285.01'
20+00
N 84° 46' 03.3" E
TO EAST MAIN ST
ROADWAY DESTROYED
DEBRIS
INV=1279.98'
18" CMP
EXISTING R/W
PROPERTY LINE PER GIS
WOODS
24" CMP CRUSHED/BURIED
US 176
19'BST
TO NC HWY 108
NORTH PACOLET RIVER
JS

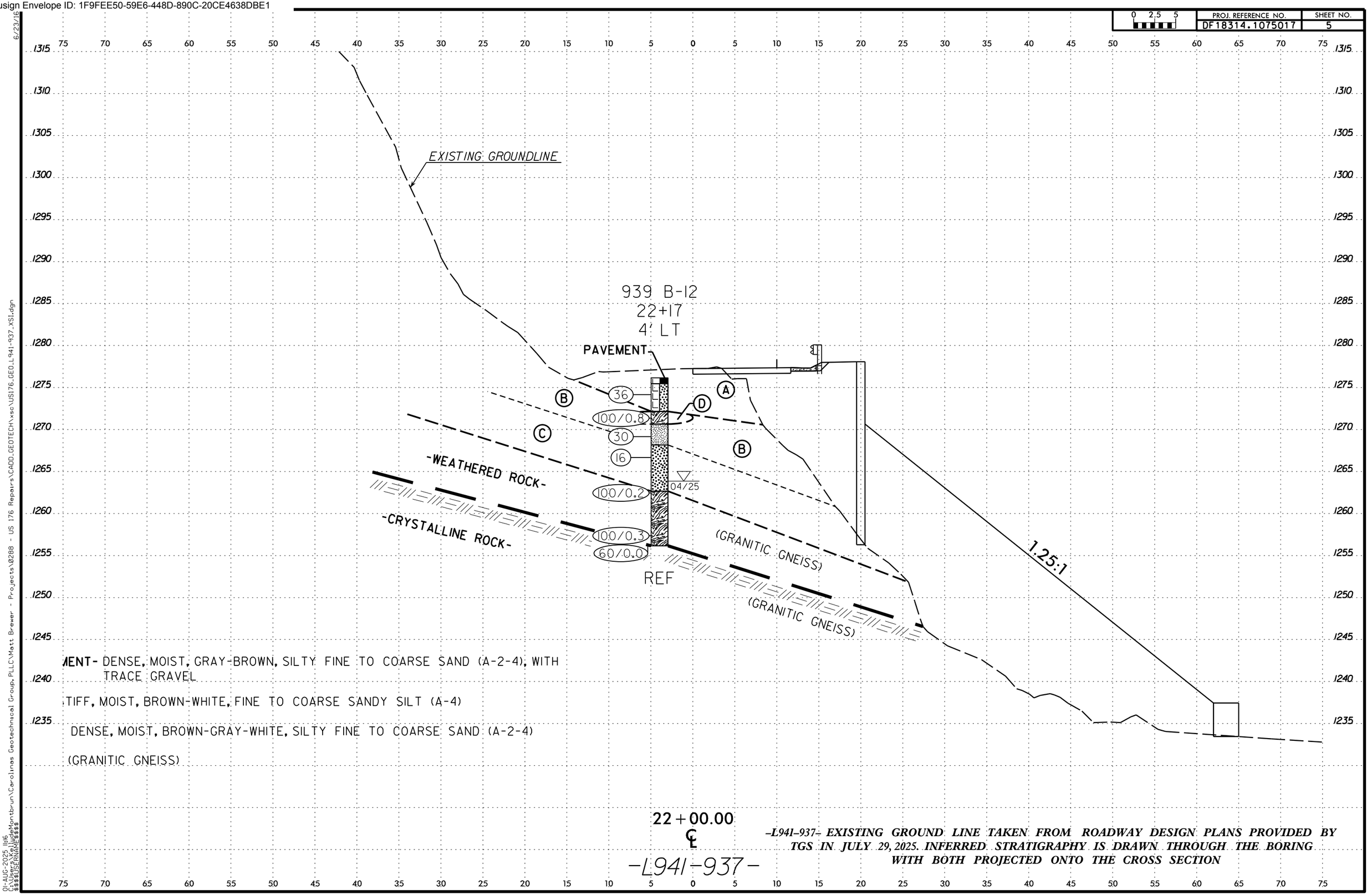
PROP. RETAINING WALL
–L941–937– STA. 18+90 RT
TO 23+20 RT

PROP. RETAINING WALL
–L941–937– STA. 18+90 RT
TO 23+20 RT

PROP. 4' RETAINING WALL

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075017	4





MENT- DENSE, MOIST, GRAY-BROWN, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL

TIFF, MOIST, BROWN-WHITE, FINE TO COARSE SANDY SILT (A-4)

DENSE, MOIST, BROWN-GRAY-WHITE, SILTY FINE TO COARSE SAND (A-2-4)

(GRANITIC GNEISS)

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-17	**STATION** 20+55	**OFFSET** 2 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,286.3 ft	**TOTAL DEPTH** 2.7 ft	**NORTHING** 552,352	**EASTING** 1,012,908	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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)
1290											
										1,286.3 GROUND SURFACE	0.0
1285	1,285.3	1.0								1,285.3 **ROADWAY EMBANKMENT** Asphalt (0.7'), ABC (0.3)	1.0
	1,283.6	2.7	74	26/0.1		100/0.6				1,283.6 **WEATHERED ROCK** Gray, (Granitic Gneiss)	2.7
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,283.6 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-16	**STATION** 20+87	**OFFSET** 3 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,284.3 ft	**TOTAL DEPTH** 15.1 ft	**NORTHING** 552,349	**EASTING** 1,012,940	**24 HR.** 9.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1285										1,284.3 GROUND SURFACE	0.0
										1,282.8 **ROADWAY EMBANKMENT** Asphalt (0.5'), ABC (1.0')	1.5
	1,281.9	2.4	60/0.1			60/0.1		M		1,281.9 Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel	2.4
1280	1,280.1	4.2	60/0.0			60/0.0				1,280.1 **CRYSTALLINE ROCK** Black-Gray, (Granitic Gneiss)	4.2
										Black-Gray, (Granitic Gneiss)	
1275										REC = 97% RQD = 79% GSI = 60-65	
1270										1,269.2	15.1
										Boring Terminated at Elevation 1,269.2 ft In Crystalline Rock (Granitic Gneiss)	

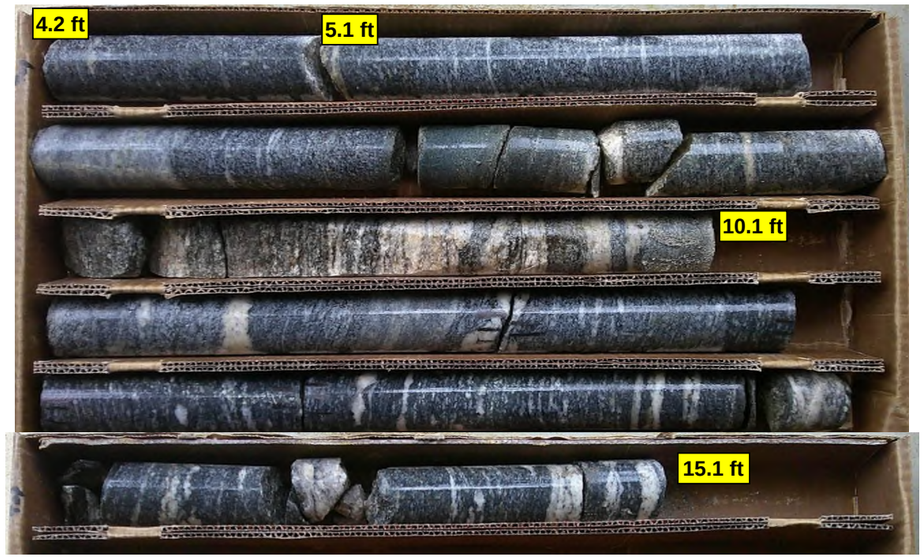
GEOTECHNICAL BORING REPORT
CORE LOG

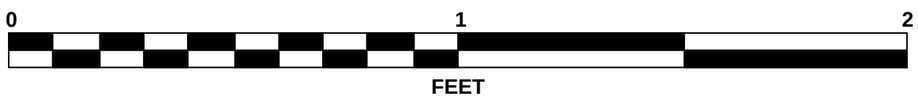
WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-16	**STATION** 20+87	**OFFSET** 3 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,284.3 ft	**TOTAL DEPTH** 15.1 ft	**NORTHING** 552,349	**EASTING** 1,012,940	**24 HR.** 9.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 10.9 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)
1280	1,280.1	4.2	0.9	*N=60/0.0*	(0.7)	(0.7)		(10.6)	(8.6)		Begin Coring @ 4.2 ft	
	1,279.2	5.1	5.0	5:30/0.9	78%	78%		97%	79%		1,280.1 Slightly Weathered to Fresh, Hard to Very Hard, Black-Gray, (Granitic Gneiss), with Very Close to Wide Fracture Spacing	4.2
				3:47/1.0							GSI = 60-65	
				3:16/1.0	(4.9)	(3.5)						
1275				2:24/1.0	98%	70%						
	1,274.2	10.1		1:43/1.0								
				2:26/1.0								
			5.0	3:08/1.0	(5.0)	(4.4)						
				4:32/1.0	100%	88%						
1270				6:09/1.0								
				4:24/1.0								
	1,269.2	15.1		4:29/1.0							1,269.2	15.1
											Boring Terminated at Elevation 1,269.2 ft In Crystalline Rock (Granitic Gneiss)	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 939 B-16
4.2 to 15.1 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-15	**STATION** 21+19	**OFFSET** 2 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,282.0 ft	**TOTAL DEPTH** 5.4 ft	**NORTHING** 552,342	**EASTING** 1,012,972	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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
1285										ELEV. (ft) DEPTH (ft)
										1,282.0 GROUND SURFACE 0.0
										1,281.3 **ROADWAY EMBANKMENT** Asphalt (0.7') 0.7
1280	1,281.0	1.0	100/0.2			100/0.2		M		
	1,278.5	3.5	100/0.2			100/0.2				1,278.5 Very Dense, Fine to Coarse Sandy GRAVEL (A-1-a), with some asphalt fragments 3.5
	1,276.6	5.4	60/0.0			60/0.0				1,276.6 **WEATHERED ROCK** Gray, (Granitic Gneiss) 5.4
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,276.6 ft On Crystalline Rock (Granitic Gneiss)

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-14	**STATION** 21+54	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,280.0 ft	**TOTAL DEPTH** 9.5 ft	**NORTHING** 552,336	**EASTING** 1,013,006	**24 HR.** 7.3
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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
1280										
	1,279.0	1.0	12	12	16	28		D		1,280.0 GROUND SURFACE 0.0
										1,279.4 **ROADWAY EMBANKMENT** Asphalt (0.6') 0.6
	1,276.5	3.5	100/0.2			100/0.2				1,276.5 Medium Dense, Brown-Gray, Silty Fine to Corase SAND (A-2-4), with trace mica and gravel 3.5
1275	1,274.0	6.0	100/0.2			100/0.2				**WEATHERED ROCK** Brown-Gray, (Granitic Gneiss)
	1,271.5	8.5	100/0.3			100/0.3				1,270.5 9.5
	1,270.5	9.5	60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,270.5 ft On Crystalline Rock (Granitic Gneiss)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-13	**STATION** 21+83	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 5.8
COLLAR ELEV. 1,278.2 ft	**TOTAL DEPTH** 20.3 ft	**NORTHING** 552,328	**EASTING** 1,013,034	**24 HR.** 10.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/24/25	**COMP. DATE** 04/24/25	**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)
1280											
										1,278.2 GROUND SURFACE	0.0
										1,276.7 **ROADWAY EMBANKMENT** Asphalt (0.5'), ABC (1.0')	1.5
1275	1,275.6	2.6	10	47	53/0.2			M		1,275.1 Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel	3.1
	1,273.8	4.4	100/0.2			100/0.7 100/0.2				**WEATHERED ROCK** Brown-Tan-Gray, (Granitic Gneiss)	
1270	1,270.6	7.6	60/0.0			60/0.0				1,270.6 **CRYSTALLINE ROCK** Gray-White-Black, (Granitic Gneiss) REC = 98% RQD = 71% GSI = 50-55	7.6
1265											
1260										1,257.9 Boring Terminated at Elevation 1,257.9 ft In Crystalline Rock (Granitic Geniss)	20.3

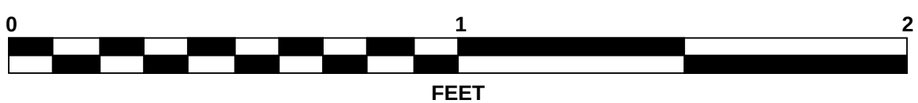
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-13	**STATION** 21+83	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 5.8
COLLAR ELEV. 1,278.2 ft	**TOTAL DEPTH** 20.3 ft	**NORTHING** 552,328	**EASTING** 1,013,034	**24 HR.** 10.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/24/25	**COMP. DATE** 04/24/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.7 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)
1270.59											Begin Coring @ 7.6 ft	
1270	1,270.6	7.6	2.7	*N=60/0.0* 3:59/1.0 2:55/1.0	(2.4) 89%	(0.0) 0%		(12.4) 98%	(9.0) 71%		1,270.6 **CRYSTALLINE ROCK** Moderately Weathered to Fresh, Hard to Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing GSI = 50-55	7.6
	1,267.9	10.3	5.0	1:45/1.0 2:10/1.0 2:52/1.0 1:40/1.0	(5.0) 100%	(4.1) 82%						
1265	1,262.9	15.3	5.0	2:22/1.0 2:47/1.0 2:44/1.0 3:00/1.0	(5.0) 100%	(4.9) 98%						
1260	1,257.9	20.3		3:07/1.0 3:07/1.0 4:19/1.0							1,257.9 Boring Terminated at Elevation 1,257.9 ft In Crystalline Rock (Granitic Geniss)	20.3

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 939 B-13
7.6 to 20.3 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-12	**STATION** 22+17	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 12.3
COLLAR ELEV. 1,276.2 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 552,320	**EASTING** 1,013,067	**24 HR.** Caved
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1280											
										1,276.2 GROUND SURFACE	0.0
1275	1,275.2	1.0	63	20	16	36		M		1,275.5 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
	1,272.7	3.5	22	68	32/0.3	100/0.8				Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel 1,272.2	4.0
1270	1,270.2	6.0	17	16	14	30		M		1,270.7 **WEATHERED ROCK** Gray, (Granitic Gneiss)	5.5
	1,267.7	8.5	19	10	6	16		M		1,268.2 **RESIDUAL** Very Stiff, Brown-White, Fine to Coarse Sandy SILT (A-4)	8.0
1265								▽		Medium Dense, Brown-Gray-White, Silty Fine to Coarse SAND (A-2-4)	
	1,262.7	13.5	100/0.2			100/0.2				1,262.7 **WEATHERED ROCK** Gray, (Granitic Gneiss)	13.5
1260											
	1,257.7	18.5	100/0.3			100/0.3					
	1,256.2	20.0	60/0.0			60/0.0				1,256.2 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,256.2 ft On Crystalline Rock (Granitic Gneiss)	20.0

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 938 B-11	**STATION** 24+35	**OFFSET** 6 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,263.2 ft	**TOTAL DEPTH** 45.2 ft	**NORTHING** 552,284	**EASTING** 1,013,282	**24 HR.** 18.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
1265										1,263.2 GROUND SURFACE	0.0
										ROADWAY EMBANKMENT Asphalt (0.6'), ABC (1.2')	
1260	1,260.7	2.5	4	2	2	4		M		1,261.4 Soft, Brown-Orange, Fine Sandy CLAY (A-6), with trace mica and gravel	1.8
	1,258.6	4.6	6	12	27	39		M		1,258.6 **RESIDUAL** Dense, Brown-White-Gray, Silty Fine SAND (A-2-4), with trace mica	4.6
1255	1,255.7	7.5	5	5	7	12		M		1,256.2 Stiff, Orange-Tan-White, Fine Sandy SILT (A-4)	7.0
	1,253.6	9.6	6	31	69/0.1	100/0.6				1,253.1 **WEATHERED ROCK** Gray-Black-White, (Granitic Gneiss)	10.1
1250	1,248.6	14.6	4	7	9	16		M		1,251.2 **RESIDUAL** Very Stiff, Gray-White-Orange, Fine Sandy SILT (A-4), with trace mica	12.0
1245	1,243.6	19.6	90	10/0.2		100/0.7				1,243.6 **WEATHERED ROCK** White-Gray-Orange, (Granitic Gneiss)	19.6
1240	1,238.6	24.6	12	22	45	67		M		1,240.7 **RESIDUAL** Hard, Gray-White-Orange, Fine Sandy SILT (A-4), with trace mica	22.5
1235	1,233.6	29.6	100/0.3			100/0.3				1,233.6 **WEATHERED ROCK** Brown-Black-Gray, (Granitic Gneiss)	29.6
1230	1,230.1	33.1	60/0.0			60/0.0				1,230.1 **CRYSTALLINE ROCK** White-Gray-Black, (Granitic Gneiss) REC = 98% RQD = 77% GSI = 55-60	33.1
1225											
1220										1,218.0 Boring Terminated at Elevation 1,218.0 ft In Crystalline Rock (Granitic Gneiss)	45.2

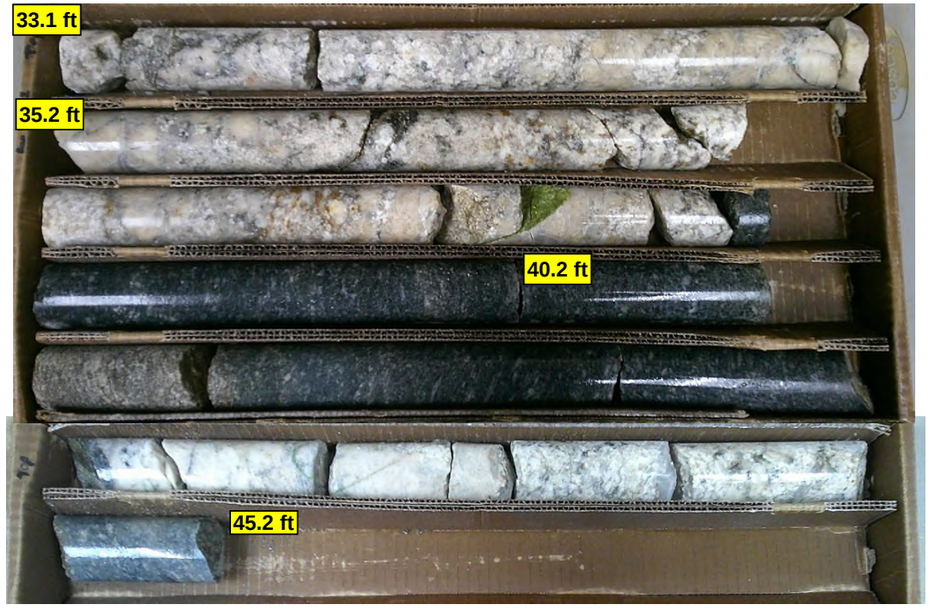
GEOTECHNICAL BORING REPORT
CORE LOG

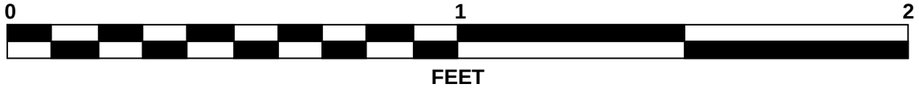
WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 938 B-11	**STATION** 24+35	**OFFSET** 6 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,263.2 ft	**TOTAL DEPTH** 45.2 ft	**NORTHING** 552,284	**EASTING** 1,013,282	**24 HR.** 18.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.1 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)
1230											Begin Coring @ 33.1 ft	
	1,230.1	33.1	2.1	N=60/0.0	(2.1)	(1.8)		(11.9)	(9.3)		1,230.1 **CRYSTALLINE ROCK**	33.1
	1,228.0	35.2		7:21/1.0	100%	86%		98%	77%		Slight to Very Slightly Weathered, Hard to Very Hard, White-Gray-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing	
			5.0	4:01/1.0								
1225				0:31/0.1	(4.8)	(3.4)					GSI = 55-60	
				3:21/1.0	96%	68%						
				3:21/1.0								
				3:26/1.0								
	1,223.0	40.2		3:40/1.0								
			5.0	4:28/1.0								
1220				3:17/1.0	(5.0)	(4.1)						
				2:10/1.0	100%	82%						
				3:00/1.0								
				4:09/1.0								
	1,218.0	45.2		4:22/1.0							1,218.0 Boring Terminated at Elevation 1,218.0 ft In Crystalline Rock (Granitic Gneiss)	45.2

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 938 B-11
33.1 to 45.2 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 938 B-10	**STATION** 24+84	**OFFSET** CL	**ALIGNMENT** -L941-937-	**0 HR.** 20.1
COLLAR ELEV. 1,260.3 ft	**TOTAL DEPTH** 40.1 ft	**NORTHING** 552,287	**EASTING** 1,013,331	**24 HR.** 20.0
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1265											
1260										1,260.3 GROUND SURFACE	0.0
	1,259.3	1.0	7	3	9	12		D		1,259.5 **ROADWAY EMBANKMENT** Asphalt (0.8')	0.8
	1,256.8	3.5	4	3	3	6		M		Very Loose to Medium Dense, Black-Brown-Gray, Silty Fine to Coarse SAND (A-2-4), with trace asphalt fragments, gravel, and mica	
1255	1,254.3	6.0	2	1	1	2		M			
	1,251.8	8.5	WOH	WOH	WOH	0		W		1,252.3 **COLLUVIAL** Very Soft, Brown, Fine to Coarse Sandy SILT (A-4), with trace mica	8.0
1250	1,246.8	13.5	16	19	26	45		M		1,248.3 **RESIDUAL** Dense, Gray-White-Brown, Silty Fine to Coarse SAND (A-2-4), with trace mica	12.0
1245	1,241.8	18.5	70	30/0.4		100/0.9				1,241.8 **WEATHERED ROCK** Gray-White, (Granitic Gneiss)	18.5
1240	1,238.8	21.0								1,238.3 **RESIDUAL** Very Dense, White-Gray, Silty Fine to Coarse SAND (A-2-4), with trace gravel-sized rock fragments	22.0
	1,236.8	23.5	15	26	67	93		M			
1235	1,231.8	28.5	100/0.4			100/0.4				1,231.8 **WEATHERED ROCK** Gray-White-Tan, (Granitic Gneiss)	28.5
1230	1,229.3	31.0									
	1,226.8	33.5	100/0.3			100/0.3					
1225	1,224.8	35.5	100/0.3			100/0.3					
	1,220.2	40.1	60/0.0			60/0.0				1,220.2 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,220.2 ft On Crystalline Rock (Granitic Gneiss)	40.1

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 938 B-9	**STATION** 25+21	**OFFSET** 5 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,257.7 ft	**TOTAL DEPTH** 30.1 ft	**NORTHING** 552,280	**EASTING** 1,013,368	**24 HR.** 26.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**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)
1260										1,257.7 GROUND SURFACE	0.0
										1,255.9 **ROADWAY EMBANKMENT** Asphalt (0.6'), ABC (1.2')	1.8
1255	1,255.2	2.5	5	5	10	15 21		M		**RESIDUAL** Medium Dense, Tan-Gray-White, Silty FIne SAND (A-2-4), with trace mica and gravel-sized rock fragments	
	1,253.3	4.4	9	10	11			M			
1250	1,250.2	7.5	11	6	7	13		M			
	1,248.3	9.4	20	80/0.3		100/0.8				1,248.3 **WEATHERED ROCK** Gray-White-Brown, (Granitic Gneiss)	9.4
1245											
	1,243.3	14.4	82	18/0.3		100/0.8					
1240											
	1,238.3	19.4	60/0.1			60/0.1				1,238.3	19.4
	1,237.2	20.5	60/0.0			60/0.0				1,237.2 **CRYSTALLINE ROCK** Gray-White, (Granitic Gneiss) Black-Gray-White, (Grannitic Gneiss) REC = 96% RQD = 69% GSI = 50-55	20.5
1235											
1230										1,227.6	30.1
										Boring Terminated at Elevation 1,227.6 ft In Crystalline Rock (Granitic Gneiss)	

NCDOT BORE DOUBLE GEO_US 176_SITE 938_GTM.GPJ NC_DOT.GDT 6/2/25

GEOTECHNICAL BORING REPORT
CORE LOG

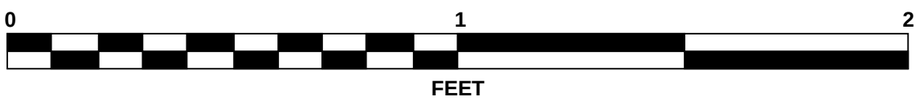
WBS DF18314.1075017	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 938 B-9	**STATION** 25+21	**OFFSET** 5 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,257.7 ft	**TOTAL DEPTH** 30.1 ft	**NORTHING** 552,280	**EASTING** 1,013,368	**24 HR.** 26.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/28/25	**COMP. DATE** 04/29/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 9.6 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)
1237.19											Begin Coring @ 20.5 ft	
	1,237.2	20.5	4.6	*N=60/0.0* 4:45/1.0 2:49/1.0 2:50/1.0 2:49/1.0 1:43/0.6	(4.6) 100%	(4.3) 93%		(9.2) 96%	(6.6) 69%		1,237.2 Slightly Weathered to Fresh, Hard to Very Hard, Black-Gray-White, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing GSI = 50-55	20.5
1235												
	1,232.6	25.1	5.0	2:39/1.0 1:38/1.0 2:06/1.0 1:52/1.0 1:48/1.0	(4.6) 92%	(2.3) 46%						
1230												
	1,227.6	30.1									1,227.6 Boring Terminated at Elevation 1,227.6 ft In Crystalline Rock (Granitic Gneiss)	30.1

NCDOT CORE DOUBLE GEO_US 176_SITE 938_GTM.GPJ NC_DOT.GDT 6/2/25

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 938 B-9
20.5 to 30.1 Feet



REFERENCE: DF18314.1075018

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075018	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 939*
-L941-937- STA. 18+70 TO 21+50

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.

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PERSONNEL

R. WELCH, G.I.T.

M. MALISHER, E.I.T.

CG2 EXPLORATION

INVESTIGATED BY *CG2, PLLC*

DRAWN BY *P. PERRY, E.I.T.*

CHECKED BY *M. BREWER, P.E.*

SUBMITTED BY *CG2, PLLC*

DATE *AUGUST 2025*

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
1805 SARDIS ROAD NORTH
SUITE 100
CHARLOTTE, NC 28270
(980) 339-8684

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by:
Matthew Brewer 12/2/2025
386129C0A4...
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075018	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:
- [ ] CME-45C
- [ ] CME-55
- [X] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED JULY 29, 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075018	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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075018	3

SITE PLAN

0 50 100
FEET

NC GRID
NAD 83 NA 2011

END SITE 940 /BEGIN SITE 939
–L941–937– STA. 18+70.00

END SITE 939 /BEGIN SITE 938
–L941–937– STA. 21+50.00

WOODS
GPS-2 INV=1285.01'
20+00
N 84° 46' 03.3" E
939 B-16
939 B-14
939 B-13
939 B-12
939 B-17
939 B-15
18" CMP
EXISTING R/W
ROADWAY DESTROYED
DEBRIS
INV=1279.98'
MTL
24" CMP
CRUSHED/BURIED
25+00
TO EAST MAIN ST
TO NC HWY 108
PROPERTY LINE PER GIS
JS
F

PROP. RETAINING WALL
–L941–937– STA. 18+90 RT
TO 23+20 RT

PROP. RETAINING WALL
–L941–937– STA. 18+90 RT
TO 23+20 RT

PROP. 4' RETAINING WALL

PROP. RETAINING WALL
–L941–937– 24+25 RT TO 26+75 RT

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	4

940 B-19
18+35
1' LT

PAVEMENT

60/0.0

60/0.0

-CRYSTALLINE ROCK-

04/25

REC=98%
RQD=64%
GSI=45-50

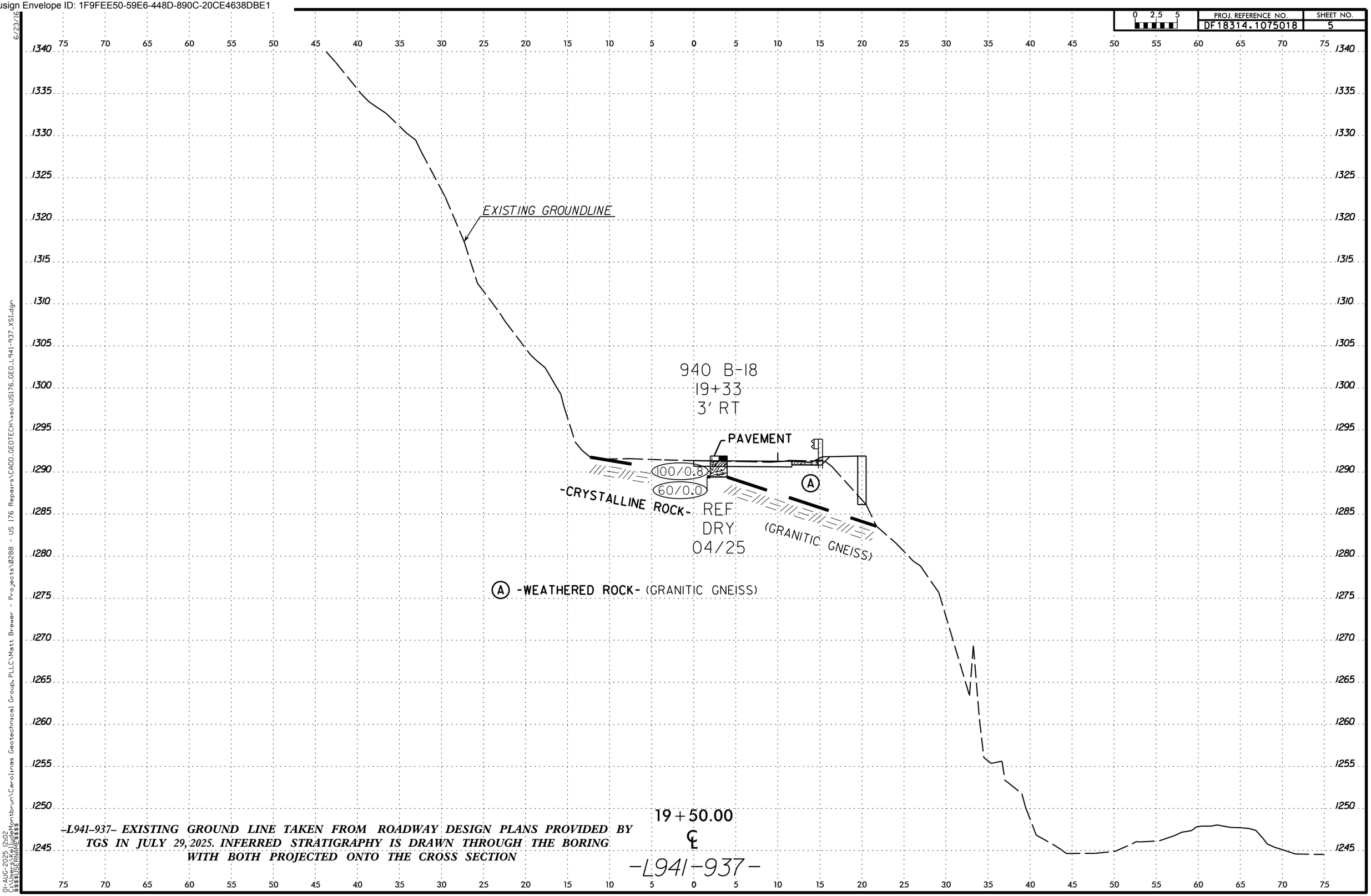
SLIGHTLY WEATHERED TO FRESH, HARD TO VERY HARD, GRAY-WHITE-BLACK, (GRANITIC GNEISS), WITH VERY CLOSE TO MODERATELY CLOSE FRACTURE SPACING

CT

Ⓐ **-ROADWAY EMBANKMENT-** GRAY-BROWN, MOIST, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL

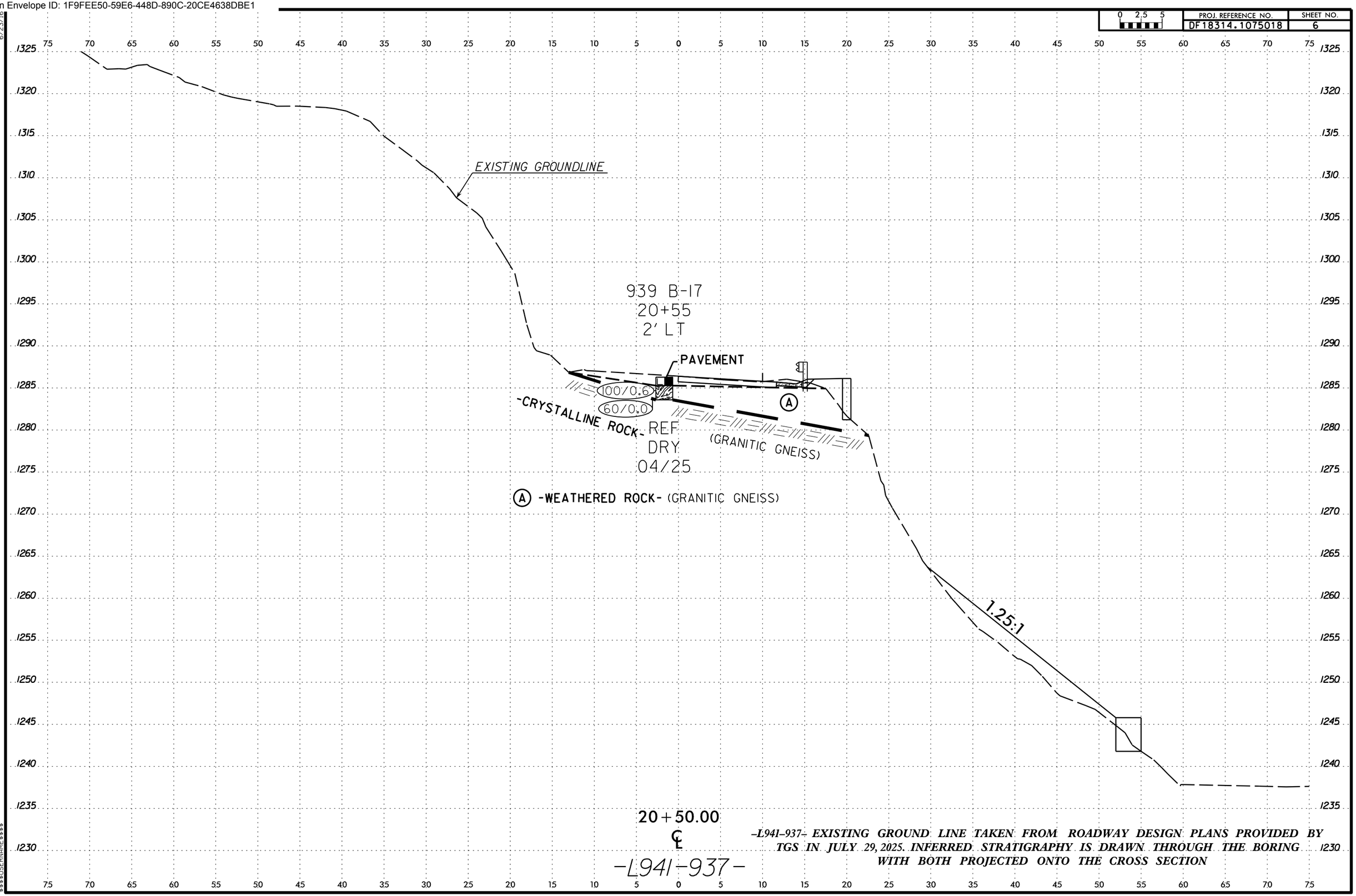
19+00.00
℄
-L941-937-

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION



-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	6



Ⓐ -WEATHERED ROCK- (GRANITIC GNEISS)

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	7

939 B-16
20+87
3' LT

EXISTING GROUNDLINE

(A) PAVEMENT

60/0.0

60/0.0

04/25

-CRYSTALLINE ROCK-

SLIGHTLY WEATHERED TO FRESH, HARD TO VERY HARD, BLACK-GRAY, (GRANITIC GNEISS), WITH VERY CLOSE TO WIDE FRACTURE SPACING

CT

REC=97%
RQD=79%
GSI=60-65

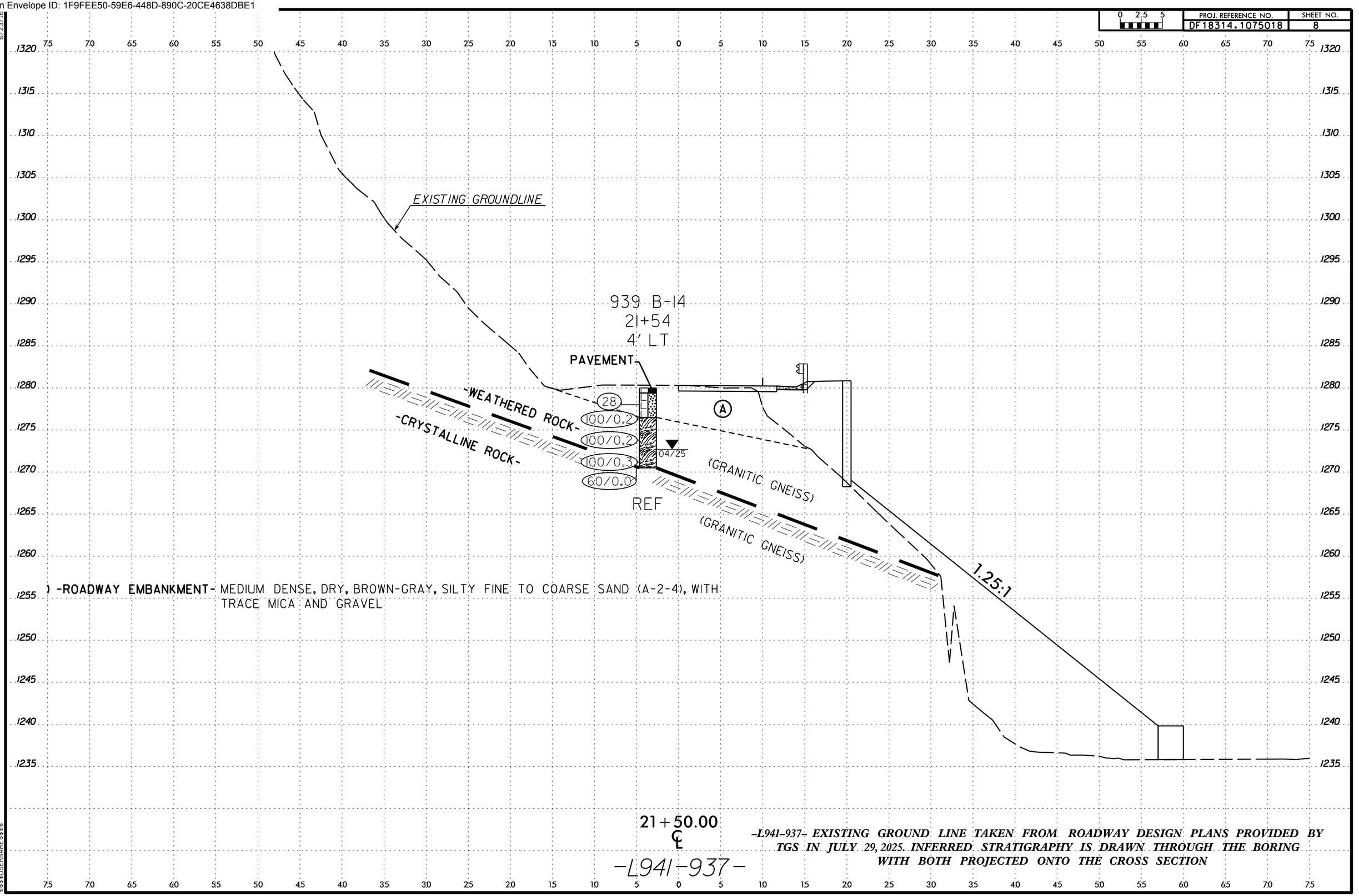
1.25:1

(A) **-ROADWAY EMBANKMENT-** GRAY-BROWN, MOIST, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL

21+00.00
℄
-L941-937-

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	8



-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-17	**STATION** 20+55	**OFFSET** 2 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,286.3 ft	**TOTAL DEPTH** 2.7 ft	**NORTHING** 552,352	**EASTING** 1,012,908	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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)
1290											
										1,286.3 GROUND SURFACE	0.0
1285	1,285.3	1.0								1,285.3 **ROADWAY EMBANKMENT** Asphalt (0.7'), ABC (0.3)	1.0
	1,283.6	2.7	74	26/0.1		100/0.6				1,283.6 **WEATHERED ROCK** Gray, (Granitic Gneiss)	2.7
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,283.6 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-16	**STATION** 20+87	**OFFSET** 3 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,284.3 ft	**TOTAL DEPTH** 15.1 ft	**NORTHING** 552,349	**EASTING** 1,012,940	**24 HR.** 9.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1285										1,284.3 GROUND SURFACE	0.0
										1,282.8 **ROADWAY EMBANKMENT** Asphalt (0.5'), ABC (1.0')	1.5
	1,281.9	2.4	60/0.1			60/0.1		M		1,281.9 Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel	2.4
1280	1,280.1	4.2	60/0.0			60/0.0				1,280.1 **CRYSTALLINE ROCK** Black-Gray, (Granitic Gneiss)	4.2
										Black-Gray, (Granitic Gneiss)	
1275										REC = 97% RQD = 79% GSI = 60-65	
1270										1,269.2	15.1
										Boring Terminated at Elevation 1,269.2 ft In Crystalline Rock (Granitic Gneiss)	

NCDOT BORE DOUBLE GEO_US 176_SITE 939_GTM.GPJ NC_DOT.GDT 6/4/25

GEOTECHNICAL BORING REPORT
CORE LOG

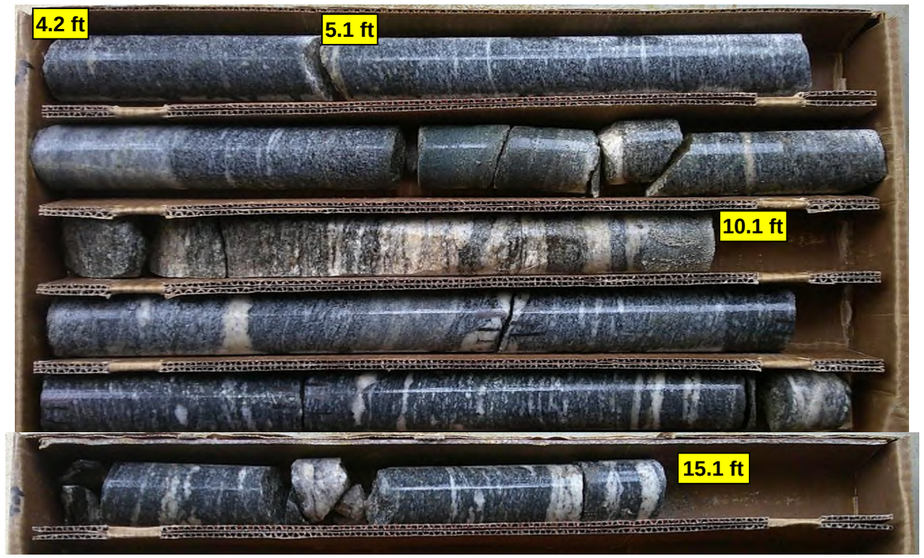
WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-16	**STATION** 20+87	**OFFSET** 3 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,284.3 ft	**TOTAL DEPTH** 15.1 ft	**NORTHING** 552,349	**EASTING** 1,012,940	**24 HR.** 9.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 10.9 ft			

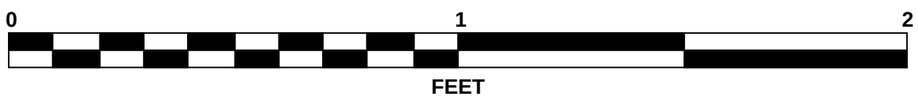
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
1280											Begin Coring @ 4.2 ft	
	1,280.1	4.2	0.9	*N=60/0.0*	(0.7)	(0.7)		(10.6)	(8.6)		1,280.1 Slightly Weathered to Fresh, Hard to Very Hard, Black-Gray, (Granitic Gneiss), with Very Close to Wide Fracture Spacing	4.2
	1,279.2	5.1	5.0	5:30/0.9	78%	78%		97%	79%		GSI = 60-65	
				3:47/1.0								
				3:16/1.0	(4.9)	(3.5)						
1275				2:24/1.0	98%	70%						
				1:43/1.0								
	1,274.2	10.1		2:26/1.0								
			5.0	3:08/1.0	(5.0)	(4.4)						
				4:32/1.0	100%	88%						
1270				6:09/1.0								
				4:24/1.0								
	1,269.2	15.1		4:29/1.0							1,269.2	15.1
											Boring Terminated at Elevation 1,269.2 ft In Crystalline Rock (Granitic Gneiss)	

NCDOT CORE DOUBLE GEO_US 176_SITE 939_GTM.GPJ NC_DOT.GDT 6/4/25

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 939 B-16
4.2 to 15.1 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-15	**STATION** 21+19	**OFFSET** 2 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,282.0 ft	**TOTAL DEPTH** 5.4 ft	**NORTHING** 552,342	**EASTING** 1,012,972	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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
1285										ELEV. (ft) DEPTH (ft)
										1,282.0 GROUND SURFACE 0.0
	1,281.0	1.0	100/0.2			100/0.2		M		1,281.3 **ROADWAY EMBANKMENT** Asphalt (0.7') 0.7
1280	1,278.5	3.5	100/0.2			100/0.2				1,278.5 Very Dense, Fine to Coarse Sandy GRAVEL (A-1-a), with some asphalt fragments 3.5
	1,276.6	5.4	60/0.0			60/0.0				1,276.6 **WEATHERED ROCK** Gray, (Granitic Gneiss) 5.4
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,276.6 ft On Crystalline Rock (Granitic Gneiss)

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-14	**STATION** 21+54	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,280.0 ft	**TOTAL DEPTH** 9.5 ft	**NORTHING** 552,336	**EASTING** 1,013,006	**24 HR.** 7.3
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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
1280										ELEV. (ft) DEPTH (ft)
										1,280.0 GROUND SURFACE 0.0
	1,279.0	1.0	12	12	16	28		D		1,279.4 **ROADWAY EMBANKMENT** Asphalt (0.6') 0.6
	1,276.5	3.5	100/0.2			100/0.2				1,276.5 Medium Dense, Brown-Gray, Silty Fine to Corase SAND (A-2-4), with trace mica and gravel 3.5
1275	1,274.0	6.0	100/0.2			100/0.2				**WEATHERED ROCK** Brown-Gray, (Granitic Gneiss)
	1,271.5	8.5	100/0.3			100/0.3				1,270.5 9.5
	1,270.5	9.5	60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,270.5 ft On Crystalline Rock (Granitic Gneiss)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-13	**STATION** 21+83	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 5.8
COLLAR ELEV. 1,278.2 ft	**TOTAL DEPTH** 20.3 ft	**NORTHING** 552,328	**EASTING** 1,013,034	**24 HR.** 10.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/24/25	**COMP. DATE** 04/24/25	**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)
1280										
										1,278.2 GROUND SURFACE 0.0
										1,276.7 **ROADWAY EMBANKMENT** Asphalt (0.5'), ABC (1.0') 1.5
1275	1,275.6	2.6	10	47	53/0.2			M		1,275.1 Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel 3.1
	1,273.8	4.4	100/0.2			100/0.7 100/0.2				**WEATHERED ROCK** Brown-Tan-Gray, (Granitic Gneiss)
1270	1,270.6	7.6	60/0.0			60/0.0				1,270.6 7.6 **CRYSTALLINE ROCK** Gray-White-Black, (Granitic Gneiss) REC = 98% RQD = 71% GSI = 50-55
1265										
1260										1,257.9 20.3 Boring Terminated at Elevation 1,257.9 ft In Crystalline Rock (Granitic Geniss)

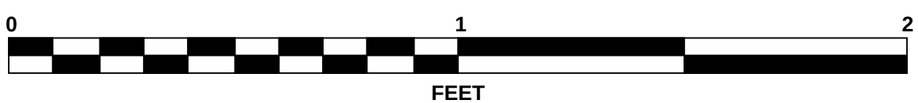
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-13	**STATION** 21+83	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 5.8
COLLAR ELEV. 1,278.2 ft	**TOTAL DEPTH** 20.3 ft	**NORTHING** 552,328	**EASTING** 1,013,034	**24 HR.** 10.5
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/24/25	**COMP. DATE** 04/24/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.7 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)
1270.59											Begin Coring @ 7.6 ft
1270	1,270.6	7.6	2.7	*N=60/0.0* 3:59/1.0 2:55/1.0	(2.4) 89%	(0.0) 0%		(12.4) 98%	(9.0) 71%		1,270.6 **CRYSTALLINE ROCK** 7.6 Moderately Weathered to Fresh, Hard to Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing GSI = 50-55
	1,267.9	10.3	5.0	1:45/1.0 2:10/1.0 2:52/1.0 1:40/1.0 2:22/1.0	(5.0) 100%	(4.1) 82%					
1265	1,262.9	15.3	5.0	2:47/1.0 2:44/1.0 3:00/1.0 3:07/1.0 3:07/1.0	(5.0) 100%	(4.9) 98%					
1260	1,257.9	20.3		4:19/1.0							1,257.9 20.3 Boring Terminated at Elevation 1,257.9 ft In Crystalline Rock (Granitic Geniss)

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 939 B-13
7.6 to 20.3 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075018	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 939 B-12	**STATION** 22+17	**OFFSET** 4 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** 12.3
COLLAR ELEV. 1,276.2 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 552,320	**EASTING** 1,013,067	**24 HR.** Caved
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/23/25	**COMP. DATE** 04/23/25	**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)
1280											
										1,276.2 GROUND SURFACE	0.0
1275	1,275.5	1.0	63	20	16	36		M		1,275.5 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
	1,272.7	3.5	22	68	32/0.3	100/0.8				Dense, Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel 1,272.2	4.0
1270	1,270.7	5.5	17	16	14	30		M		**WEATHERED ROCK** Gray, (Granitic Gneiss)	
	1,268.2	8.0	19	10	6	16		M		**RESIDUAL** Very Stiff, Brown-White, Fine to Coarse Sandy SILT (A-4)	
1265										Medium Dense, Brown-Gray-White, Silty Fine to Coarse SAND (A-2-4)	
	1,262.7	13.5	100/0.2			100/0.2				1,262.7 **WEATHERED ROCK** Gray, (Granitic Gneiss)	13.5
1260											
	1,257.7	18.5	100/0.3			100/0.3					
	1,256.2	20.0	60/0.0			60/0.0				1,256.2 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,256.2 ft On Crystalline Rock (Granitic Gneiss)	20.0

REFERENCE: DF18314.1075019

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075019	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 940*
–L941–937– STA. 16+63.00 TO 18+70.00

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.

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PERSONNEL

R. WELCH, G.I.T.

M. MALISHER, E.I.T.

CG2 EXPLORATION

INVESTIGATED BY *CG2, PLLC*

DRAWN BY *P. PERRY, E.I.T.*

CHECKED BY *M. BREWER, P.E.*

SUBMITTED BY *CG2, PLLC*

DATE *AUGUST 2025*

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP
1805 SARDIS ROAD NORTH
SUITE 100
CHARLOTTE, NC 28270
(980) 339-8684

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by:
Matthew Brewer 12/2/2025
386129C0A...
SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075019	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:
- [ ] CME-45C
- [ ] CME-55
- [X] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED MARCH 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075019	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
90				N/A	N/A
80					
70					
60					
50					
40					
30					
20					
10					N/A
	N/A	N/A			

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

	VERY GOOD	GOOD	FAIR	POOR	VERY POOR
70		A			
60					
50		B	C	D	E
40					
30				F	
20					
10			G	H	

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075019	3

SITE PLAN

0 50 100
FEET

NC GRID
NAD 83 NA 2011

15

BEGIN CONSTRUCTION
BEGIN SITE 940
–L941–937– STA 16+63.00

END SITE 940 /BEGIN SITE 939
–L941–937– STA 18+70.00

SAWCUT EXISTING PAVEMENT AT CENTERLINE & REPLACE/WIDEN EASTBOUND LANE (10')

97.49' TAPER TO EXIST

+70.49

10'

940 B-18
940 B-19
940 B-20

GPS-1
GPS-2 INV=1285.01'

WOODS

18" CMP

TO NC. HWY. 108

ROADWAY DESTROYED

DEBRIS

INV=1279.95'

PROPERTY LINE PER GIS

NORTH PACOLET RIVER

JS

MTL

BRIDGE 31 CONC

15" CMP

INV=1299.96'

+75 TIE TO EXIST

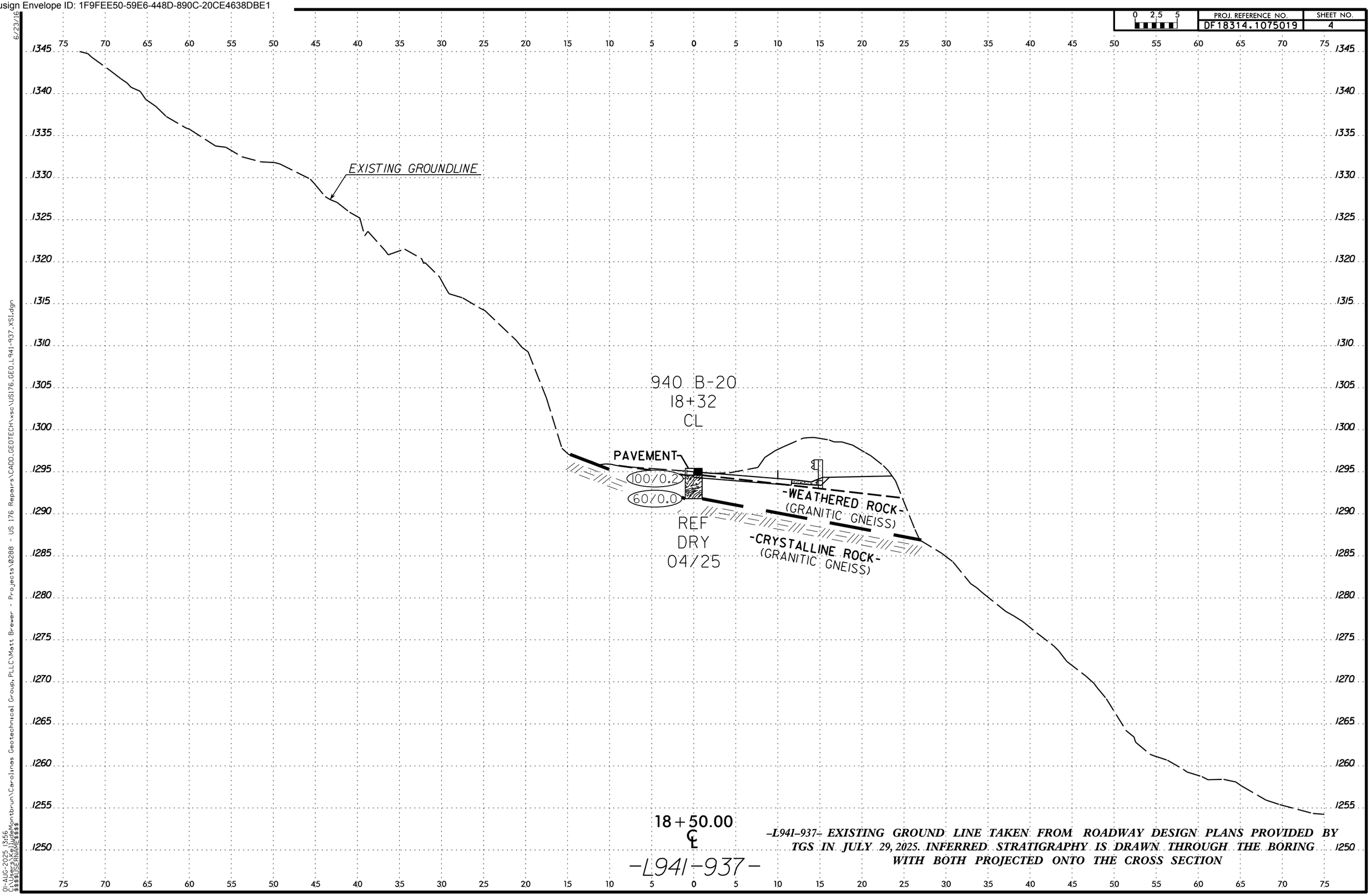
+73± TIE TO EXIST

TO EAST MAIN ST

SHOULDER BERM GUTTER
–L941–937– 16+73 RT
TO 29+00 RT

PROP. RETAINING WALL
–L941–937– STA. 18+90 RT
TO 23+20 RT

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075019	4



-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	4

940 B-19
18+35
1' LT

PAVEMENT

60/0.0

60/0.0

-CRYSTALLINE ROCK-

04/25

SLIGHTLY WEATHERED TO FRESH, HARD TO VERY HARD, GRAY-WHITE-BLACK, (GRANITIC GNEISS), WITH VERY CLOSE TO MODERATELY CLOSE FRACTURE SPACING

REC=98%
RQD=64%
GSI=45-50

CT

(A) -ROADWAY EMBANKMENT- GRAY-BROWN, MOIST, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

19+00.00
℄
-L941-937-

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075018	5

940 B-18
19+33
3' RT

EXISTING GROUNDLINE

PAVEMENT

100/0.8

60/0.0

-CRYSTALLINE ROCK- REF
DRY
04/25

(A) -WEATHERED ROCK- (GRANITIC GNEISS)

(GRANITIC GNEISS)

19+50.00
℄
-L941-937-

-L941-937- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075019	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 940 B-20	**STATION** 18+32	**OFFSET** CL	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,295.4 ft	**TOTAL DEPTH** 3.6 ft	**NORTHING** 552,335	**EASTING** 1,012,687	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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)
1300											
1295										1,295.4 GROUND SURFACE	0.0
	1,294.4	1.0	100/0.2			100/0.2				1,294.6 **ROADWAY EMBANKMENT** Asphalt (0.8')	0.8
	1,291.8	3.6	60/0.0			60/0.0				1,291.8 **WEATHERED ROCK** (Granitic Gneiss)	3.6
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,291.8 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075019	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 940 B-19	**STATION** 18+85	**OFFSET** 1 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,293.9 ft	**TOTAL DEPTH** 14.9 ft	**NORTHING** 552,347	**EASTING** 1,012,738	**24 HR.** 8.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/24/25	**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)
1295											
										1,293.9 GROUND SURFACE	0.0
	1,291.8	2.1								1,292.4 **ROADWAY EMBANKMENT** Asphatl (0.5'), ABC (1.0')	1.5
	1,291.1	2.8	60/0.0			60/0.0		M		1,291.8 Gray-Brown, Silty Fine to Coarse SAND (A-2-4), with trace gravel	2.1
1290			60/0.0			60/0.0				1,291.1 **CRYSTALLINE ROCK** Gray-White-Black, (Granitic Gneiss)	2.8
										Gray-White-Black, (Granitic Gneiss)	
1285										REC = 98% RQD = 64% GSI = 45-50	
1280										1,279.0	14.9
										Boring Terminated at Elevation 1,279.0 ft In Crystalline Rock (Granitic Gneiss)	

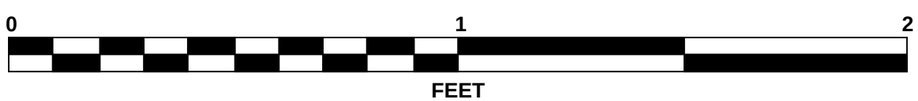
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075019	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 940 B-19	**STATION** 18+85	**OFFSET** 1 ft LT	**ALIGNMENT** -L941-937-	**0 HR.** N/A
COLLAR ELEV. 1,293.9 ft	**TOTAL DEPTH** 14.9 ft	**NORTHING** 552,347	**EASTING** 1,012,738	**24 HR.** 8.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/23/25	**COMP. DATE** 04/24/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.1 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)
1291.07											Begin Coring @ 2.8 ft	
1290	1,291.1	2.8	2.1	*N=60/0.0*	(1.9)	(0.5)		(11.9)	(7.8)		1,291.1 Slightly Weathered to Fresh, Hard to Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing	2.8
	1,289.0	4.9		5:57/1.0 2:45/1.0	90%	24%		98%	64%			
			5.0	0:16/0.1	(5.0)	(3.7)					GSI = 45-50	
				2:50/1.0 4:23/1.0 5:05/1.0 5:07/1.0	100%	74%						
1285	1,284.0	9.9		8:10/1.0								
			5.0	3:46/1.0 3:32/1.0 4:27/1.0 4:05/1.0	(5.0) 100%	(3.6) 72%						
1280	1,279.0	14.9		4:22/1.0							1,279.0	14.9
											Boring Terminated at Elevation 1,279.0 ft In Crystalline Rock (Granitic Gneiss)	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 940 B-19
2.8 to 14.9 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075019	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** M. Malisher	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 940 B-18	**STATION** 19+33	**OFFSET** 3 ft RT	**ALIGNMENT** -L941-937-	**0 HR.** Dry
COLLAR ELEV. 1,291.9 ft	**TOTAL DEPTH** 2.5 ft	**NORTHING** 552,348	**EASTING** 1,012,787	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG24113 CME-550X 78% 05/06/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER J. Estep	**START DATE** 04/22/25	**COMP. DATE** 04/22/25	**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)
1295											
	1,290.9	1.0								1,291.9 GROUND SURFACE	0.0
1290			36	64/0.3						1,291.3 **ROADWAY EMBANKMENT** Asphalt (0.6')	0.6
	1,289.4	2.5	60/0.0			100/0.8 60/0.0				1,289.4 **WEATHERED ROCK** Gray-Brown, (Granitic Gneiss)	2.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,289.4 ft On Crystalline Rock (Granitic Gneiss)	

REFERENCE: DF18314.1075020

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075020	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 942*
–L943–942– STA. 15+50.00 TO 23+62.00

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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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

R. WELCH, G.I.T.

CG2 EXPLORATION

INVESTIGATED BY *CG2, PLLC*

DRAWN BY *P. PERRY, E.I.T.*

CHECKED BY *M. BREWER, P.E.*

SUBMITTED BY *CG2, PLLC*

DATE *JULY 2025*

Prepared in the Office of:

CG2 CAROLINAS GEOTECHNICAL GROUP

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SUITE 100
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(980) 339-8684

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by:

Matthew Brewer 12/2/2025

386129C0A... SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075020	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:
- [ ] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED MARCH 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075020	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 ⇨

90	80		N/A	N/A
80	70			
70	60			
60	50			
50	40			
40	30			
30	20			
20	10			
N/A	N/A			

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)

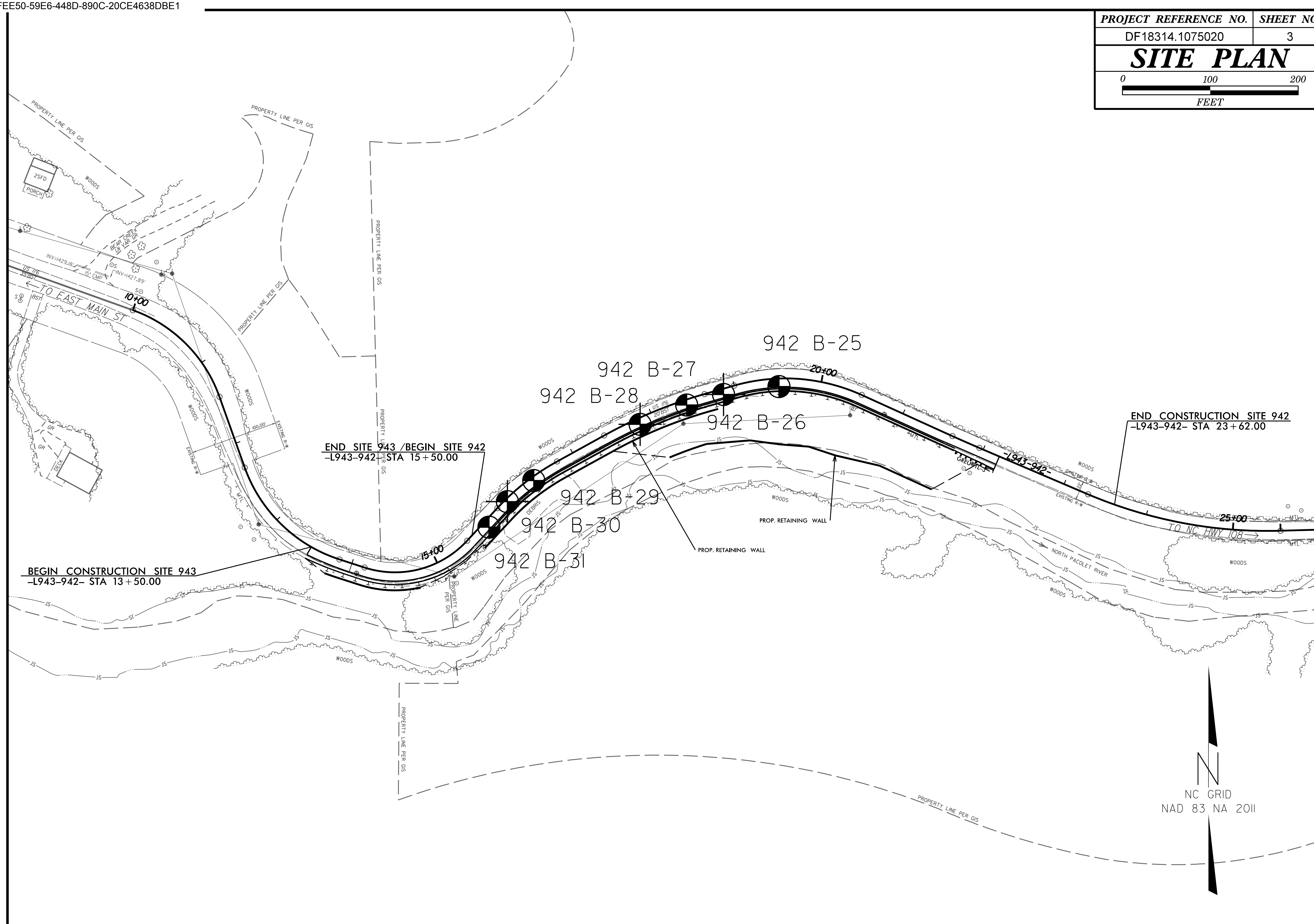
VERY GOOD	GOOD	FAIR	POOR	VERY POOR
Very Rough, fresh unweathered surfaces	Rough, slightly weathered surfaces	Smooth, moderately weathered and altered surfaces	Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

70	A			
60				
50	B	C	D	E
40				
30			F	
20				
10		G	H	

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075020	3

SITE PLAN



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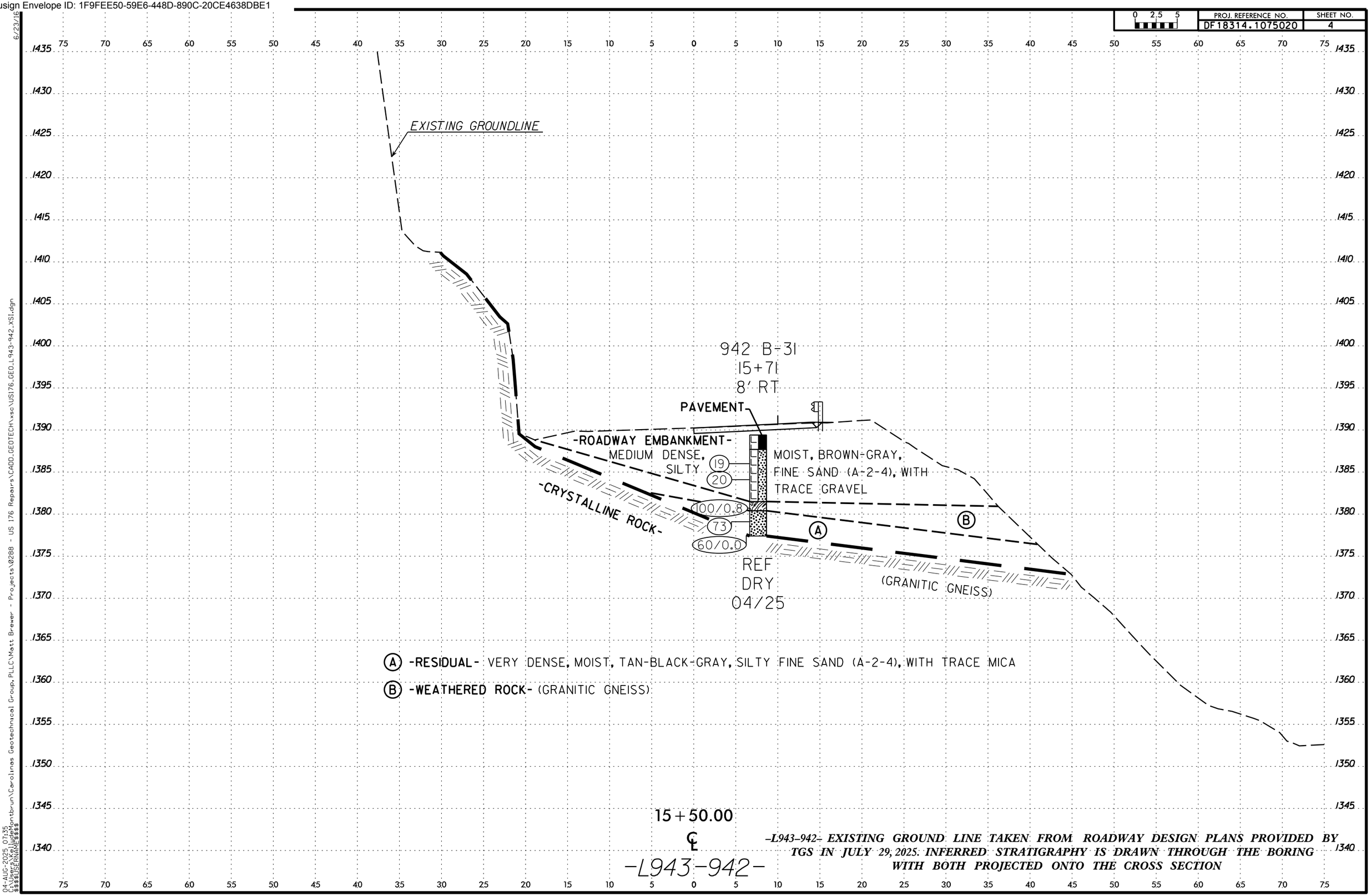
	DF18314.1075020	4



Ⓐ **-RESIDUAL-** VERY DENSE, MOIST, TAN-BLACK-GRAY, SILTY FINE SAND (A-2-4), WITH TRACE MICA

Ⓑ **-WEATHERED ROCK-** (GRANITIC GNEISS)

15+50.00
℄
-L943-942-

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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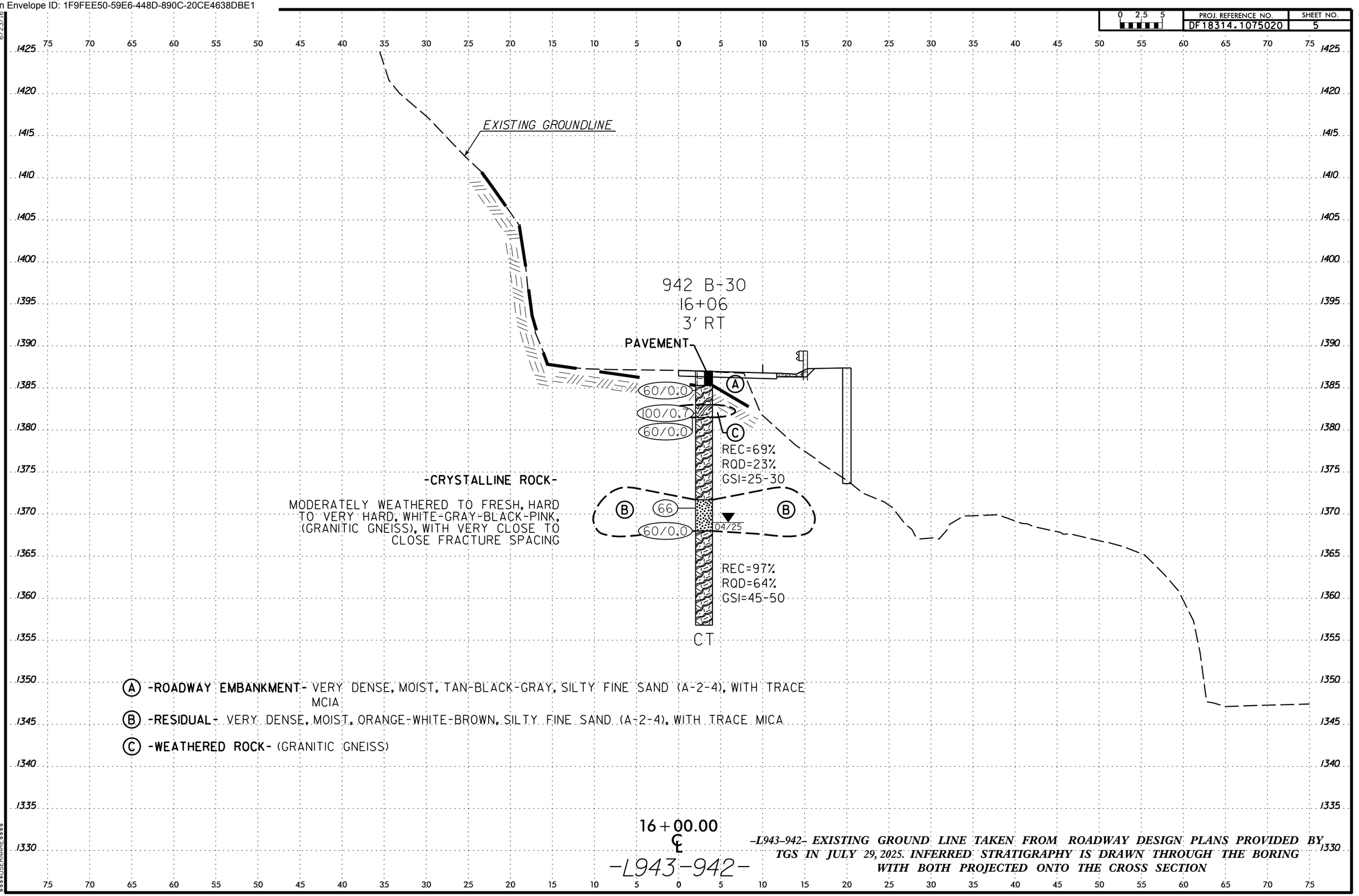
	DF18314.1075020	5



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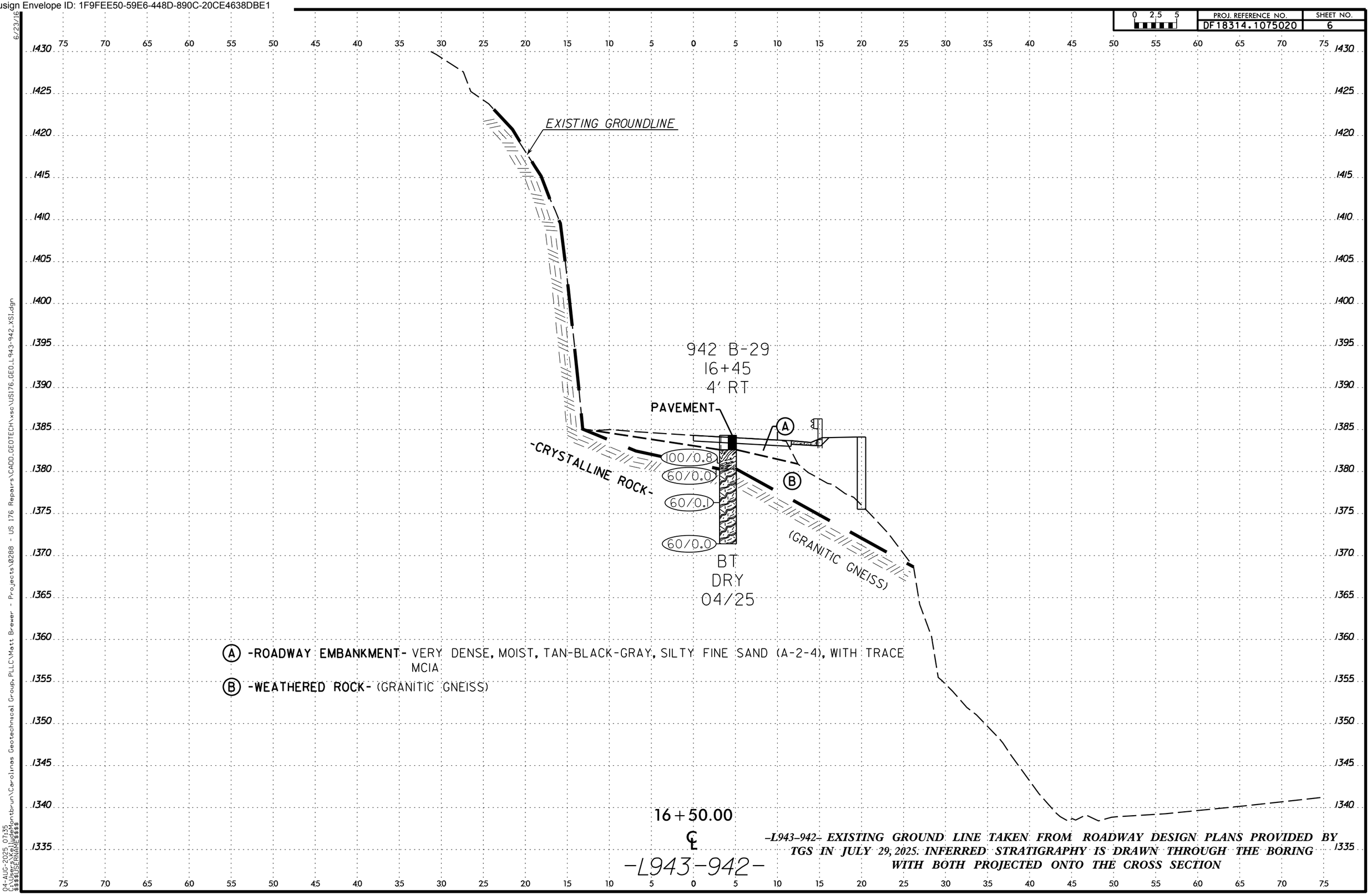

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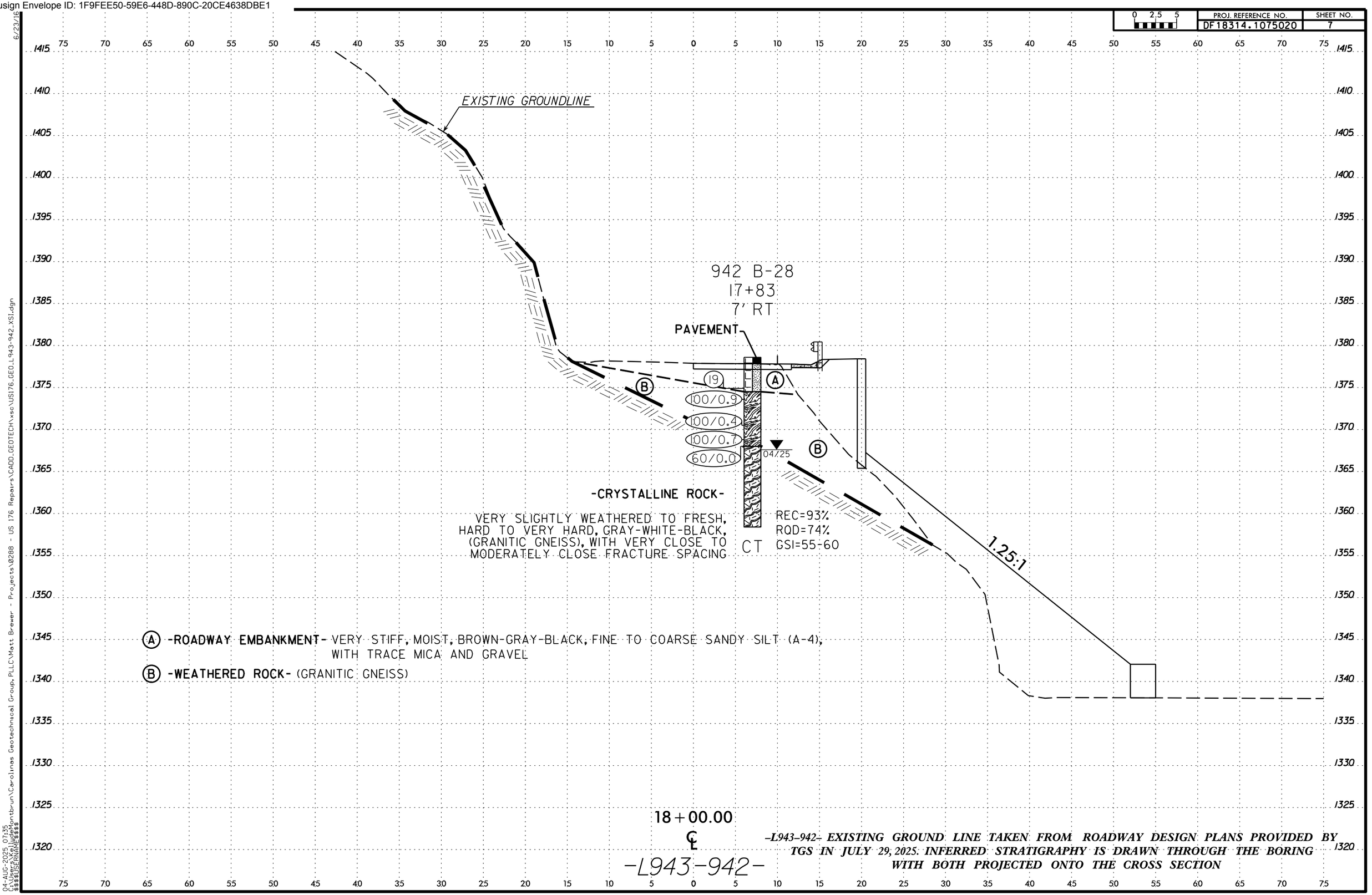

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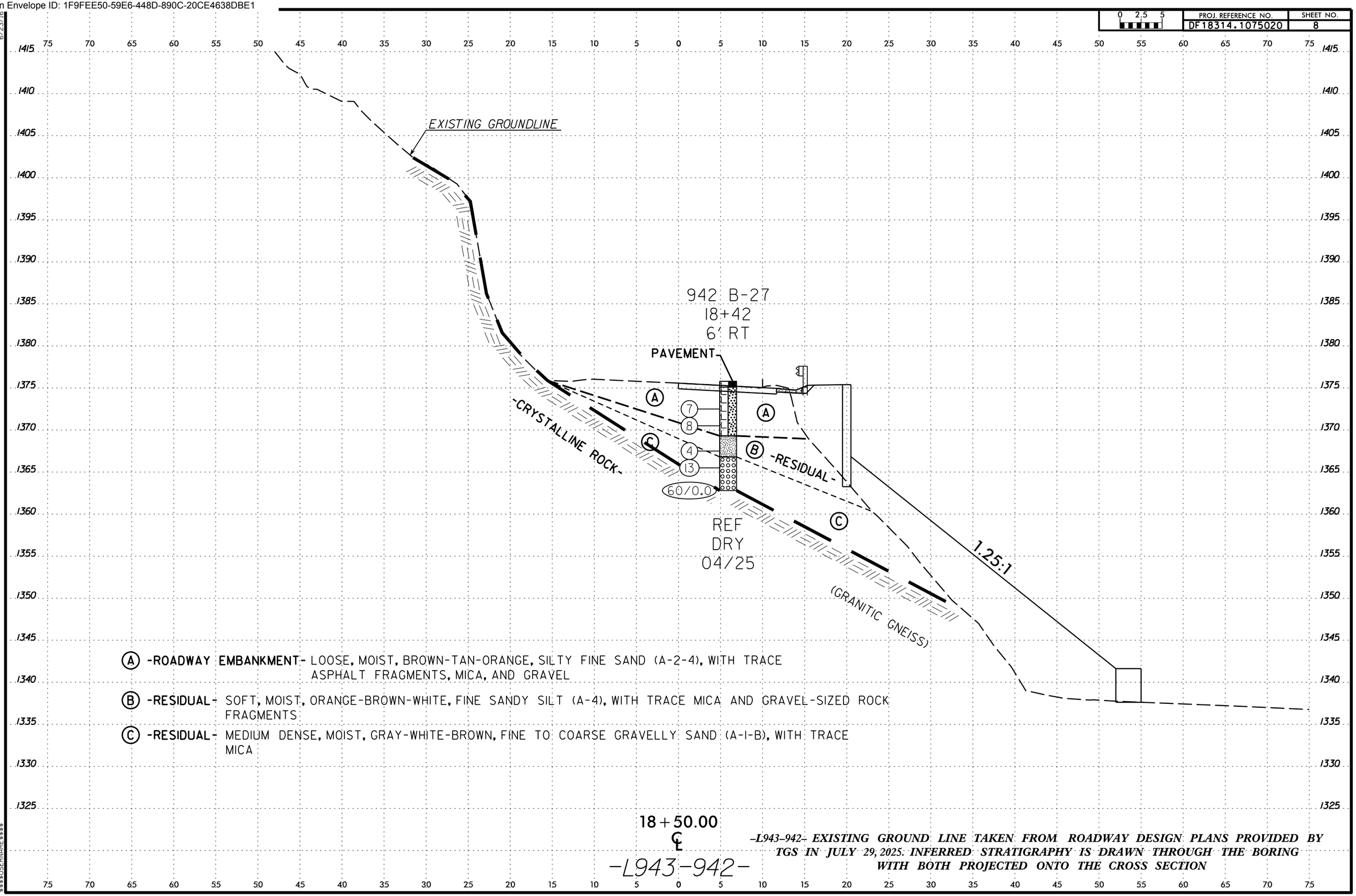

(A) **-ROADWAY EMBANKMENT-** LOOSE, MOIST, BROWN-TAN-ORANGE, SILTY FINE SAND (A-2-4), WITH TRACE ASPHALT FRAGMENTS, MICA, AND GRAVEL

(B) **-RESIDUAL-** SOFT, MOIST, ORANGE-BROWN-WHITE, FINE SANDY SILT (A-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAGMENTS

(C) **-RESIDUAL-** MEDIUM DENSE, MOIST, GRAY-WHITE-BROWN, FINE TO COARSE GRAVELLY SAND (A-1-B), WITH TRACE MICA

18+50.00
℄
-L943-942-

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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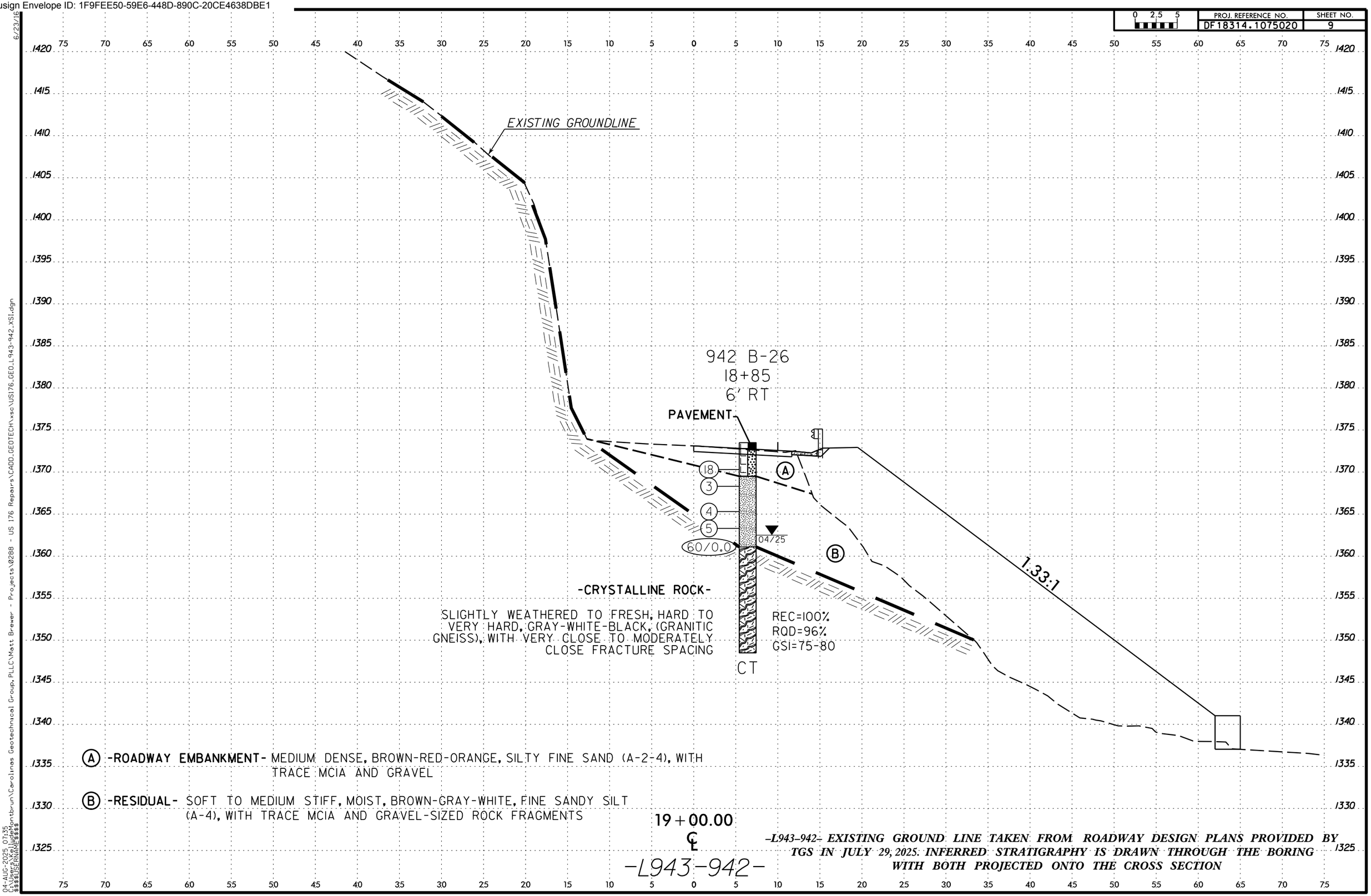

Ⓐ **-ROADWAY EMBANKMENT-** MEDIUM DENSE, BROWN-RED-ORANGE, SILTY FINE SAND (A-2-4), WITH TRACE MCIA AND GRAVEL

Ⓑ **-RESIDUAL-** SOFT TO MEDIUM STIFF, MOIST, BROWN-GRAY-WHITE, FINE SANDY SILT (A-4), WITH TRACE MCIA AND GRAVEL-SIZED ROCK FRAGMENTS

19+00.00
℄
-L943-942-

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

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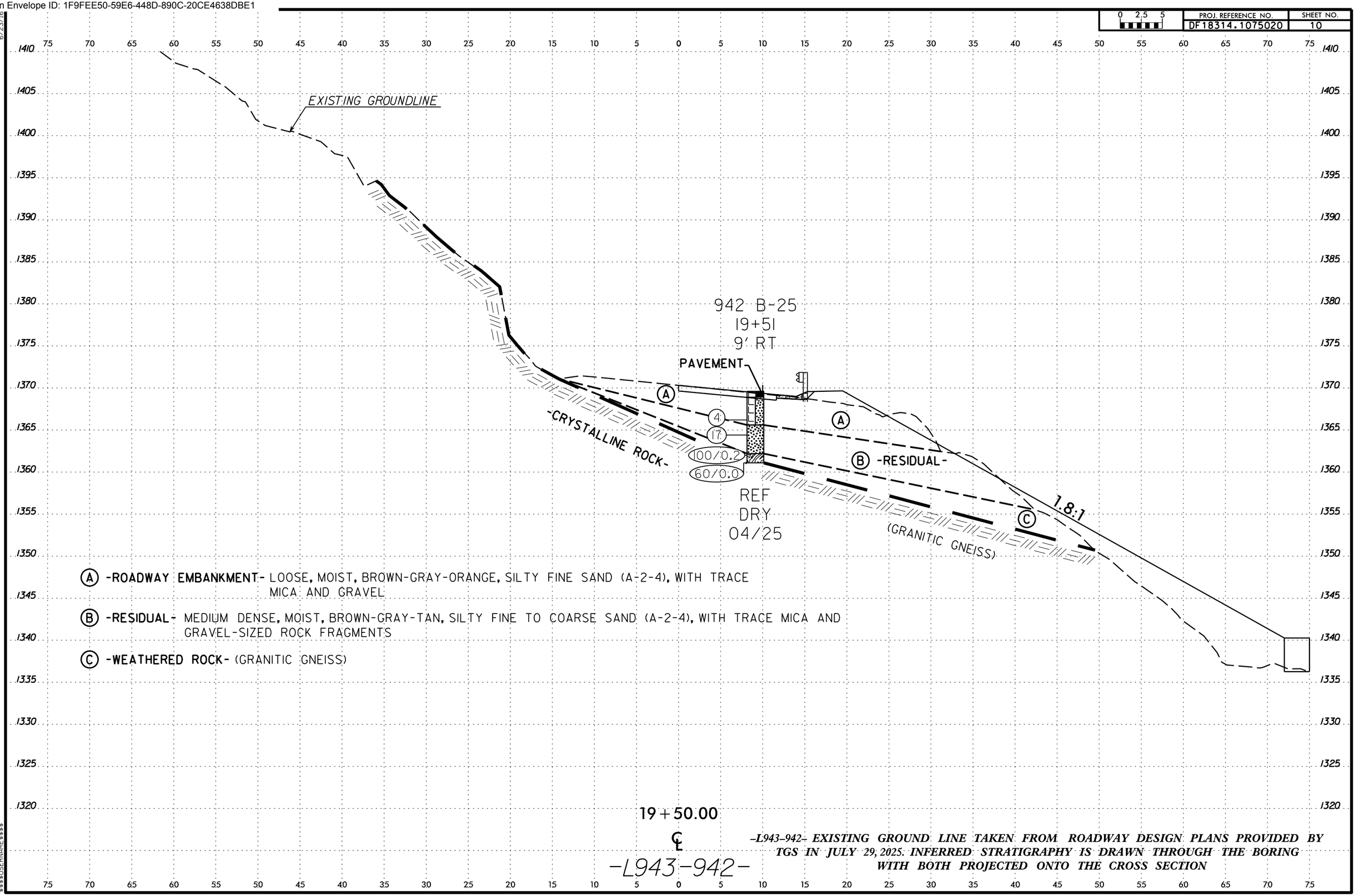


(A) **-ROADWAY EMBANKMENT-** LOOSE, MOIST, BROWN-GRAY-ORANGE, SILTY FINE SAND (A-2-4), WITH TRACE MICA AND GRAVEL

(B) **-RESIDUAL-** MEDIUM DENSE, MOIST, BROWN-GRAY-TAN, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAGMENTS

(C) **-WEATHERED ROCK-** (GRANITIC GNEISS)

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-31	**STATION** 15+71	**OFFSET** 8 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,389.4 ft	**TOTAL DEPTH** 12.0 ft	**NORTHING** 552,092	**EASTING** 1,011,020	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/16/25	**COMP. DATE** 04/16/25	**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)
1390										1,389.4 GROUND SURFACE	0.0
	1,387.0	2.4								1,387.7 **ROADWAY EMBANKMENT** Asphalt (1.0'), ABC (0.7')	1.7
			10	10	9	19		M		Medium Dense, Brown-Gray, Silty Fine SAND (A-2-4), with trace gravel	
1385	1,385.1	4.3	8	12	8	20		M			
	1,382.0	7.4								1,381.5	7.9
			20	75	25/0.3	100/0.8				1,380.4 **WEATHERED ROCK** White-Tan-Orange, (Granitic Gneiss)	9.0
1380	1,380.1	9.3	46	45	28	73		M		**RESIDUAL**	
	1,377.4	12.0	60/0.0			60/0.0				1,377.4 Very Dense, Tan-Black-Gray, Silty Fine SAND (A-2-4), with trace mica	12.0
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,377.4 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-30	**STATION** 16+06	**OFFSET** 3 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,387.0 ft	**TOTAL DEPTH** 30.2 ft	**NORTHING** 552,121	**EASTING** 1,011,041	**24 HR.** 18.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/16/25	**COMP. DATE** 04/16/25	**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)
1390											
										1,387.0 GROUND SURFACE	0.0
1385	1,384.7	2.3								**ROADWAY EMBANKMENT** Asphalt (1.0'), ABC (0.7')	
			60/0.0			60/0.0				1,385.3	1.7
	1,382.7	4.3								**CRYSTALLINE ROCK** (Granitic Gneiss)	
	1,381.5	5.5	95	5/0.2		100/0.7				1,383.0	4.0
1380			60/0.0			60/0.0				1,381.5 **WEATHERED ROCK** Gray-White, (Granitic Gneiss)	5.5
										CRYSTALLINE ROCK White-Gray-Black, (Granitic Gneiss)	
										REC = 69% RQD = 23% GSI = 25-30	
1375											
	1,371.7	15.3								1,371.7	15.3
			17	34	32	66		M		**RESIDUAL** Very Dense, Orange-White-Brown, Silty Fine SAND (A-2-4), with trace mica	
1370	1,368.0	19.0								1,368.0	19.0
			60/0.0			60/0.0				**CRYSTALLINE ROCK** Gray-White-Black-Pink, (Granitic Gneiss)	
1365										REC = 97% RQD = 64% GSI = 45-50	
1360										1,356.8	30.2
										Boring Terminated at Elevation 1,356.8 ft In Crystalline Rock (Granitic Gneiss)	

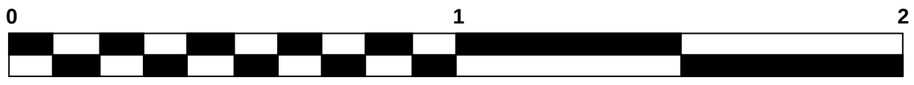
GEOTECHNICAL BORING REPORT
CORE LOG

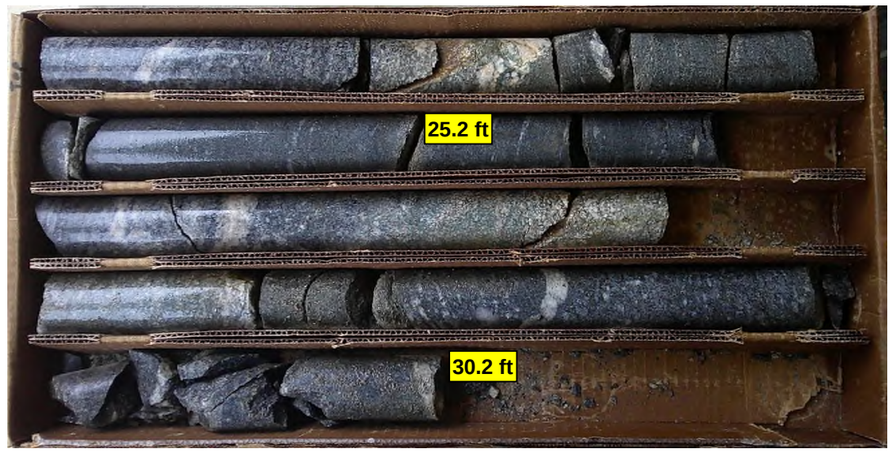
WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-30	**STATION** 16+06	**OFFSET** 3 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,387.0 ft	**TOTAL DEPTH** 30.2 ft	**NORTHING** 552,121	**EASTING** 1,011,041	**24 HR.** 18.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/16/25	**COMP. DATE** 04/16/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 21.0 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)
1381.54											Begin Coring @ 5.5 ft	
1380	1,381.5	5.5	4.8	*N=60/0.0* 5:54/1.0 4:40/1.0 3:46/1.0 3:03/1.0 2:07/0.8	(4.8) 100%	(2.3) 48%		(6.8) 69%	(2.3) 23%		1,381.5 **CRYSTALLINE ROCK** Moderately to Slightly Weathered, Hard to Very Hard, White-Gray-Black, (Granitic Gneiss), with Very Close to Close Fracture Spacing	5.5
	1,376.7	10.3	5.0	2:25/1.0 3:03/1.0 4:00/1.0 4:28/1.0 3:08/1.0	(2.0) 40%	(0.0) 0%					GSI = 25-30	
1375	1,371.7	15.3		*N=66*							1,371.7	15.3
1370	1,368.0	19.0									**RESIDUAL** Very Dense, Orange-White-Brown, Silty Fine SAND (A-2-4), with trace mica	
	1,366.8	20.2	1.2	*N=60/0.0*	(0.9) 75%	(0.9) 75%		(10.9) 97%	(7.2) 64%		1,368.0	19.0
1365			5.0	4:40/1.0 1:26/0.2 2:45/1.0 3:31/1.0 4:07/1.0 3:45/1.0 2:25/1.0	(5.0) 100%	(3.4) 68%					**CRYSTALLINE ROCK** Moderately Weathered to Fresh, Hard to Very Hard, Gray-White-Black-Pink, (Granitic Gneiss), with Very Close to Close Fracture Spacing	
	1,361.8	25.2	5.0	2:57/1.0 5:12/1.0 5:31/1.0 6:30/1.0 7:75/1.0	(5.0) 100%	(2.9) 58%					GSI = 45-50	
1360	1,356.8	30.2									1,356.8	30.2
											Boring Terminated at Elevation 1,356.8 ft In Crystalline Rock (Granitic Gneiss)	

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 942 B-30
5.5 to 15.3 and 19.0 to 30.2 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-29	**STATION** 16+45	**OFFSET** 4 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,384.3 ft	**TOTAL DEPTH** 12.9 ft	**NORTHING** 552,145	**EASTING** 1,011,071	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** Wash Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/16/25	**COMP. DATE** 04/17/25	**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)
1385										1,384.3 GROUND SURFACE	0.0
	1,382.3	2.0								1,382.6 **ROADWAY EMBANKMENT** Asphalt (1.0'), ABC (0.7')	1.7
1380	1,380.3	4.0	20 60/0.0	55	45/0.3	100/0.8 60/0.0				1,380.3 **WEATHERED ROCK** Gray-White, (Granitic Gneiss)	4.0
	1,376.4	7.9	60/0.1			60/0.1				**CRYSTALLINE ROCK** (Granitic Gneiss)	
1375											
	1,371.4	12.9	60/0.0			60/0.0				1,371.4 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,371.4 ft In Crystalline Rock (Granitic Gneiss)	12.9

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-28	**STATION** 17+83	**OFFSET** 7 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,378.6 ft	**TOTAL DEPTH** 20.2 ft	**NORTHING** 552,209	**EASTING** 1,011,192	**24 HR.** 11.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/21/25	**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)
1380										
										1,378.6 0.0 GROUND SURFACE
										1,377.9 0.7 **ROADWAY EMBANKMENT** Asphalt (0.7')
1375	1,375.9	2.7	11	10	9	19		M		Very Stiff, Brown-Gray-Black, Fine to Coarse Sandy SILT (A-4), with trace mica and gravel
	1,374.5	4.1	12	88/0.4		100/0.9				1,374.5 4.1 **WEATHERED ROCK** Brown-Orange-Gray, (Granitic Gneiss)
1370	1,370.9	7.7	100/0.4			100/0.4				
	1,369.5	9.1	58	42/0.2		100/0.7				
	1,368.0	10.6	60/0.0			60/0.0				1,368.0 10.6 **CRYSTALLINE ROCK** (Granitic Gneiss) REC = 93% RQD = 74% GSI = 55-60
1365										
1360										1,358.4 20.2 Boring Terminated at Elevation 1,358.4 ft In Crystalline Rock (Granitic Gneiss)

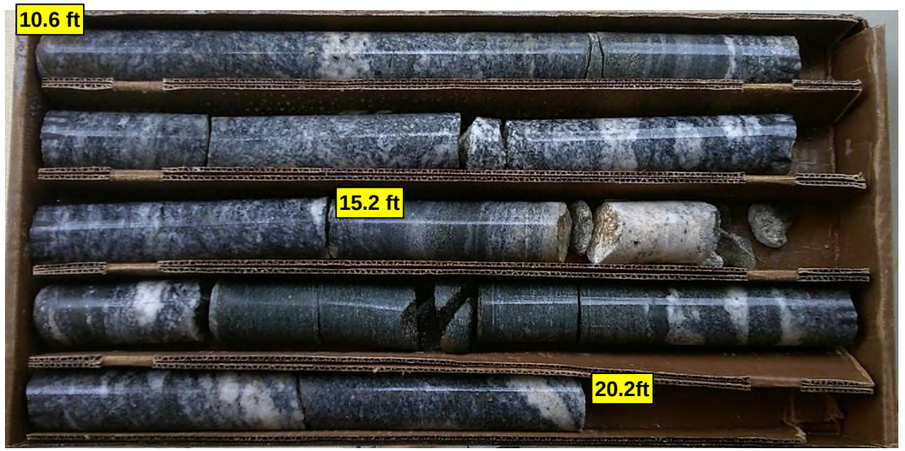
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-28	**STATION** 17+83	**OFFSET** 7 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,378.6 ft	**TOTAL DEPTH** 20.2 ft	**NORTHING** 552,209	**EASTING** 1,011,192	**24 HR.** 11.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/21/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 9.6 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)
1368											Begin Coring @ 10.6 ft
	1,368.0	10.6	4.6	*N=60/0.0* 7:45/1.0 9:21/1.0 10:30/1.0 7:18/1.0 4:03/0.6	(4.4) 96%	(4.2) 91%		(8.9) 93%	(7.1) 74%		1,368.0 10.6 **CRYSTALLINE ROCK** Very Slightly Weathered to Fresh, Hard to Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing GSI = 55-60
1365	1,363.4	15.2	5.0	3:24/1.0 3:20/1.0 4:01/1.0 4:37/1.0 8:30/1.0	(4.5) 90%	(2.8) 56%					
1360	1,358.4	20.2									1,358.4 20.2 Boring Terminated at Elevation 1,358.4 ft In Crystalline Rock (Granitic Gneiss)

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 942 B-28
10.6 to 20.2 Feet



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FEET

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-27	**STATION** 18+42	**OFFSET** 6 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,375.8 ft	**TOTAL DEPTH** 13.0 ft	**NORTHING** 552,231	**EASTING** 1,011,245	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/17/25	**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)
1380											
1375										1,375.8 GROUND SURFACE	0.0
										1,375.1 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
	1,373.5	2.3	6	4	3	7		M		Loose, Brown-Tan-Orange, Silty Fine SAND (A-2-4), with trace asphalt fragments, mica, and gravel	
	1,371.5	4.3	5	3	5	8		M			
1370										1,369.3	6.5
	1,368.5	7.3	6	1	3					**RESIDUAL**	
	1,366.5	9.3	5	10	3	14 13		M		Soft, Orange-Brown-White, Fine Sandy SILT (A-4), with trace mica and gravel-sized rock fragments	9.0
1365								M		Medium Dense, Gray-White-Brown, Fine to Coarse Gravelly SAND (A-1-b), with trace mica	
	1,362.8	13.0	60/0.0			60/0.0				1,362.8	13.0
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,362.8 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-26	**STATION** 18+85	**OFFSET** 6 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,373.5 ft	**TOTAL DEPTH** 25.0 ft	**NORTHING** 552,243	**EASTING** 1,011,287	**24 HR.** 11.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/17/25	**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)
1375											
										1,373.5 GROUND SURFACE	0.0
										1,372.8 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
1370	1,371.3	2.2	10	10	8	18		M		Medium Dense, Brown-Red-Orange, Silty Fine SAND (A-2-4), with trace mica and gravel	
	1,369.3	4.2	3	2	1	3		M		1,369.5	4.0
	1,366.3	7.2								**RESIDUAL** Soft to Medium Stiff, Brown-Gray-White, Fine Sandy SILT (A-4), with trace mica and gravel-sized rock fragments	
1365			1	1	3	4		M			
	1,364.3	9.2									
			5	2	3	5					
	1,361.1	12.4	60/0.0			60/0.0				1,361.1	12.4
1360										**CRYSTALLINE ROCK** (Granitic Gneiss) REC = 100% RQD = 96% GSI = 75-80	
1355											
1350										1,348.5	25.0
										Boring Terminated at Elevation 1,348.5 ft In Crystalline Rock (Granitic Gneiss)	

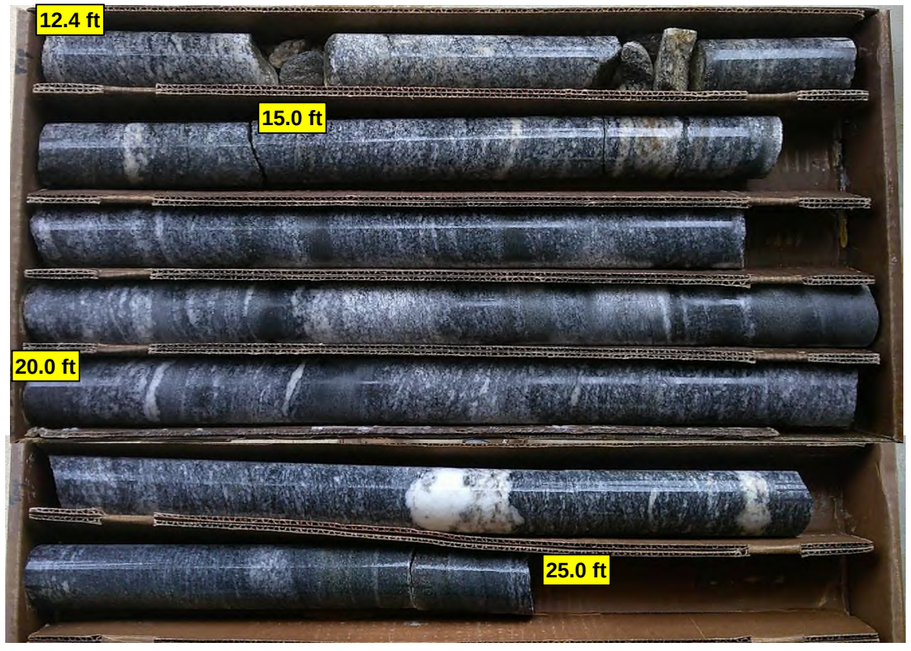
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-26	**STATION** 18+85	**OFFSET** 6 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,373.5 ft	**TOTAL DEPTH** 25.0 ft	**NORTHING** 552,243	**EASTING** 1,011,287	**24 HR.** 11.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/17/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 12.6 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)
1361.07											Begin Coring @ 12.4 ft	
1360	1,361.1	12.4	2.6	N=60/0.0 2:49/1.0 3:04/1.0 2:01/0.6	(2.6) 100%	(2.1) 81%		(12.6) 100%	(12.1) 96%		1,361.1 **CRYSTALLINE ROCK** Slightly Weathered to Fresh, Hard to Very Hard, Gray-White-Black, (Granitic Gneiss), with Very Close to Moderatley Close Facture Spacing GSI = 75-80	12.4
	1,358.5	15.0	5.0	3:58/1.0 2:31/1.0 2:37/1.0 3:08/1.0 3:09/1.0	(5.0) 100%	(5.0) 100%						
1355	1,353.5	20.0	5.0	3:42/1.0 5:19/1.0 2:24/1.0 4:29/1.0 5:20/1.0	(5.0) 100%	(5.0) 100%						
1350	1,348.5	25.0									1,348.5 Boring Terminated at Elevation 1,348.5 ft In Crystalline Rock (Granitic Gneiss)	25.0

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 942 B-26
12.4 to 25.0 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075020	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 942 B-25	**STATION** 19+51	**OFFSET** 9 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,369.6 ft	**TOTAL DEPTH** 8.5 ft	**NORTHING** 552,252	**EASTING** 1,011,350	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/17/25	**COMP. DATE** 04/17/25	**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)
1370										1,369.6 GROUND SURFACE	0.0
										1,368.9 **ROADWAY EMBANKMENT** Asphalt (0.7')	0.7
	1,367.2	2.4	5	2	2	4		M		1,365.6 Loose, Brown-Gray-Orange, Silty Fine SAND (A-2-4), with trace mica and gravel	4.0
1365	1,365.4	4.2	4	6	11	17		M		**RESIDUAL** Medium Dense, Brown-Gray-Tan, Silty Fine to Coarse SAND (A-2-4), with trace mica and gravel sized rock-fragments	
	1,362.2	7.4	100/0.2			100/0.2				1,362.2	7.4
	1,361.1	8.5	60/0.0			60/0.0				1,361.1 **WEATHERED ROCK** White-Black-Gray, (Granitic Gneiss)	8.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,361.1 ft On Crystalline Rock (Granitic Gneiss)	

REFERENCE: DF18314.1075021

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075021	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 943*
-L943-942- STA. 13+50.00 TO 15+50.00

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.

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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

R. WELCH, G.I.T.

CG2 EXPLORATION

INVESTIGATED BY *CG2, PLLC*

DRAWN BY *P. PERRY, E.I.T.*

CHECKED BY *M. BREWER, P.E.*

SUBMITTED BY *CG2, PLLC*

DATE *AUGUST 2025*

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

1805 SARDIS ROAD NORTH
SUITE 100
CHARLOTTE, NC 28270
(980) 339-8684

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by:

Matthew Brewer — 12/2/2025

386129C0A...

SIGNATURE — DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075021	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:
- [ ] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED BY TGS JULY 29, 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075021	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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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.***

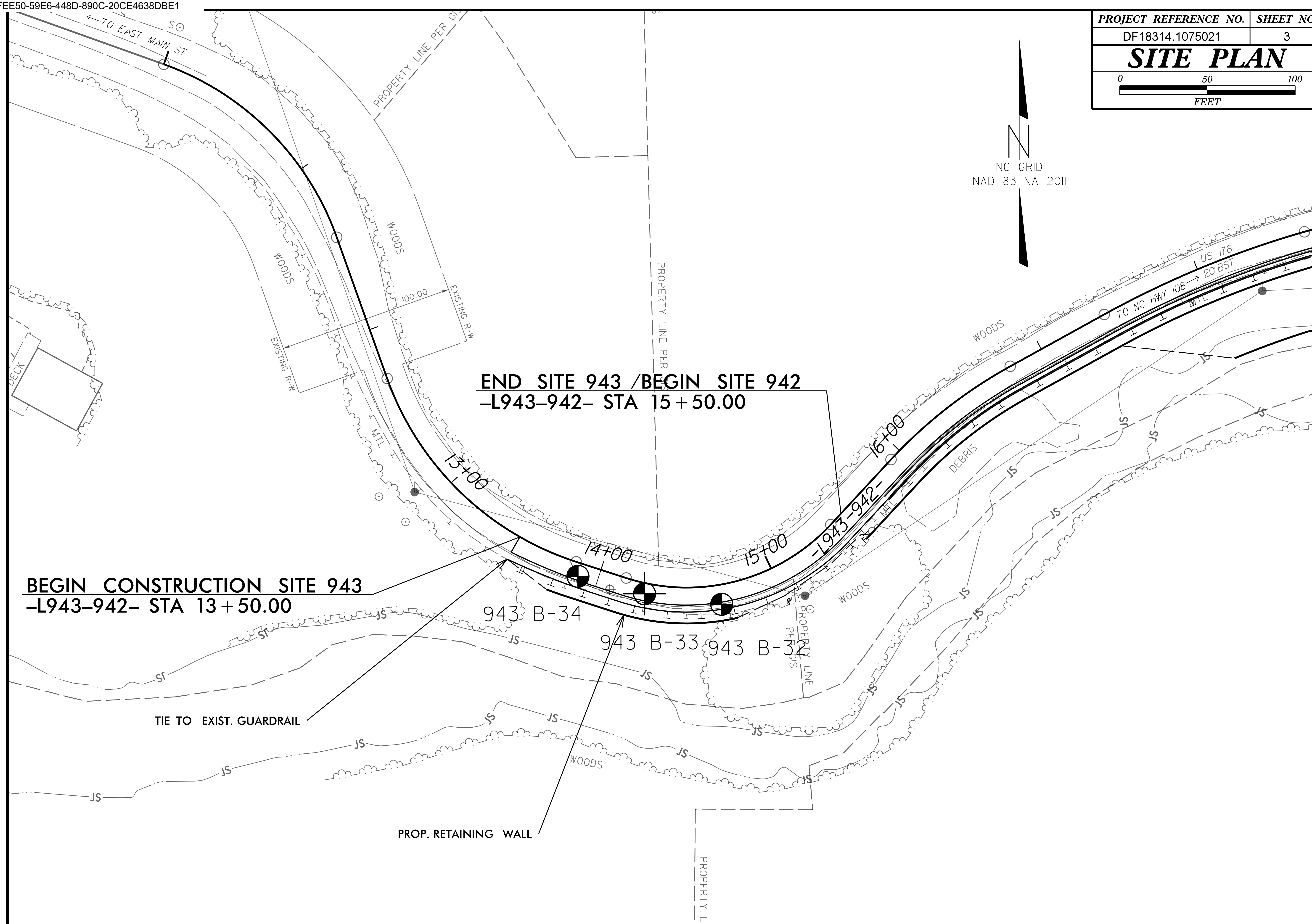
→ Means deformation after tectonic disturbance

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16



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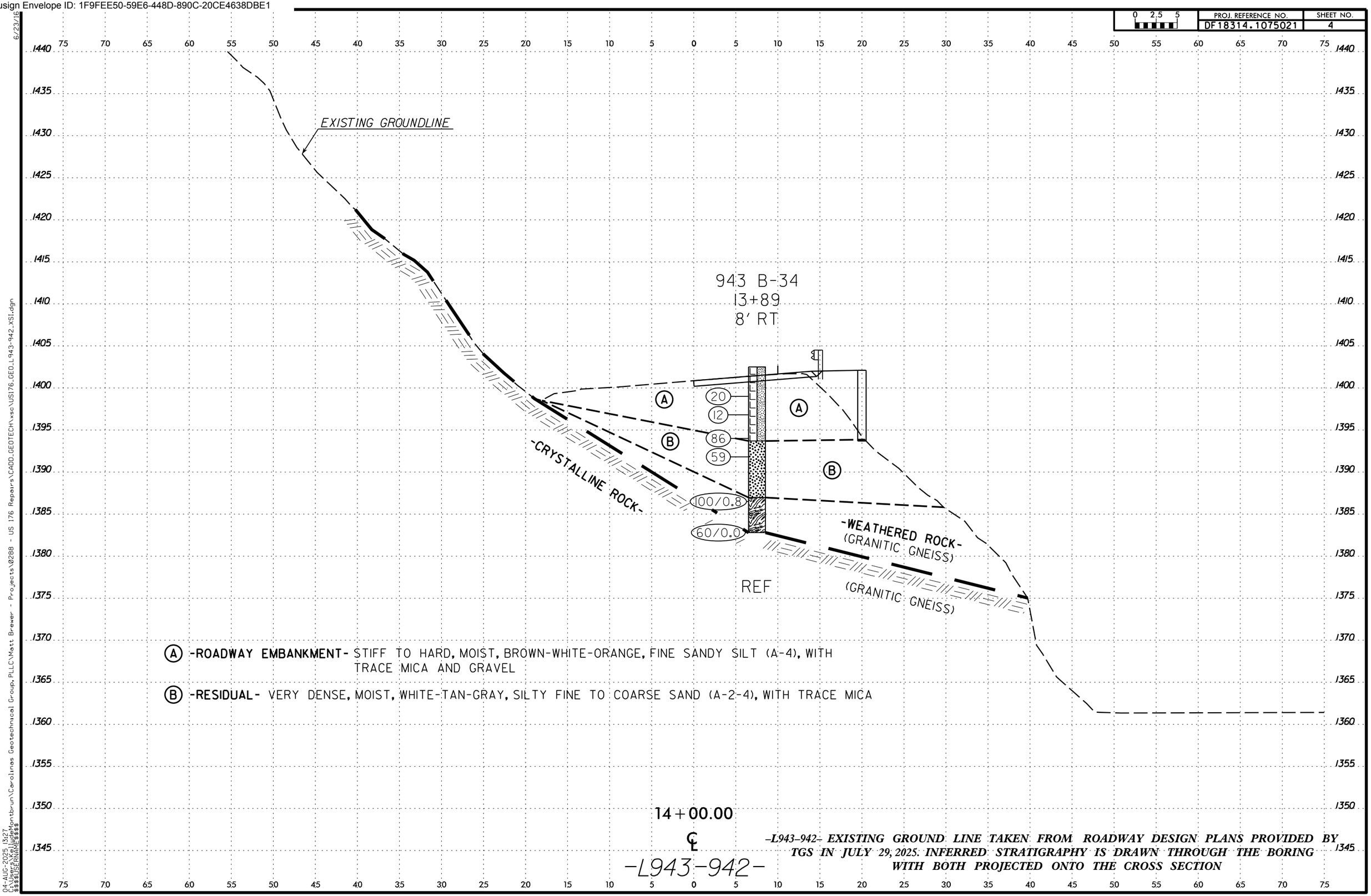


Ⓐ **-ROADWAY EMBANKMENT-** STIFF TO HARD, MOIST, BROWN-WHITE-ORANGE, FINE SANDY SILT (A-4), WITH TRACE MICA AND GRAVEL

Ⓑ **-RESIDUAL-** VERY DENSE, MOIST, WHITE-TAN-GRAY, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE MICA

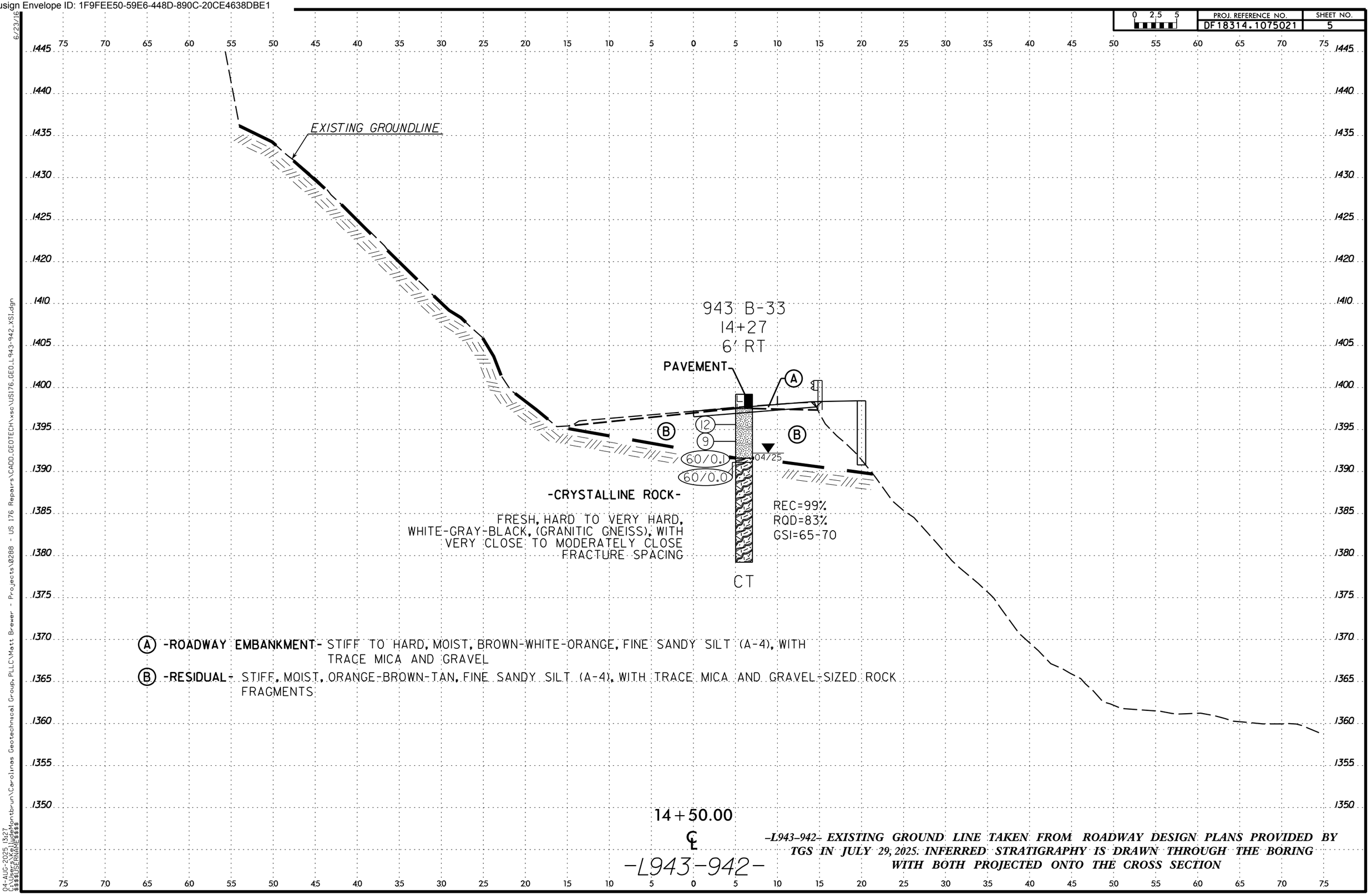
14+00.00

℄

-L943-942-

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075021	5



(A) **-ROADWAY EMBANKMENT-** STIFF TO HARD, MOIST, BROWN-WHITE-ORANGE, FINE SANDY SILT (A-4), WITH TRACE MICA AND GRAVEL

(B) **-RESIDUAL-** STIFF, MOIST, ORANGE-BROWN-TAN, FINE SANDY SILT (A-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAGMENTS

14+50.00
℄
-L943-942-

-L943-942- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS IN JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075021	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 943 B-34	**STATION** 13+89	**OFFSET** 8 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,402.5 ft	**TOTAL DEPTH** 19.7 ft	**NORTHING** 552,047	**EASTING** 1,010,851	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/15/25	**COMP. DATE** 04/15/25	**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
1405										ELEV. (ft) DEPTH (ft)
										1,402.5 GROUND SURFACE 0.0
1400	1,400.0	2.5	4	11	9	20		M		**ROADWAY EMBANKMENT** Stiff to Hard, Brown-White-Orange, Fine Sandy SILT (A-4), with trace mica and gravel
	1,397.8	4.7	3	5	7	12		M		
1395	1,395.0	7.5	9	36	50	86		M		
	1,392.8	9.7	27	29	30	59		M		1,393.7 8.8 **RESIDUAL** Very Dense, White-Tan-Gray, Silty Fine to Coarse SAND (A-2-4), with trace mica
1390										
	1,387.8	14.7	20	36	64/0.3	100/0.8				1,387.3 15.2 **WEATHERED ROCK** White-Gray-Tan, (Granitic Gneiss)
1385										
	1,382.8	19.7	60/0.0			60/0.0				1,382.8 19.7 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,382.8 ft On Crystalline Rock (Granitic Gneiss)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075021	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 943 B-33	**STATION** 14+27	**OFFSET** 6 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,399.2 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 552,037	**EASTING** 1,010,889	**24 HR.** 7.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/15/25	**COMP. DATE** 04/16/25	**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)
1400										1,399.2 GROUND SURFACE	0.0
	1,396.6	2.6	4	6	6	12				**ROADWAY EMBANKMENT** Asphalt (0.7"), ABC (1.0') 1,397.5	1.7
1395	1,394.6	4.6	6	5	4	9		M		**RESIDUAL** Stiff, Orange-Brown-Tan, Fine Sandy SILT (A-4), with trace mica and gravel-sized rock fragments	
	1,391.6	7.6								1,391.6	7.6
1390	1,391.1	8.1	60/0.1			60/0.1				**CRYSTALLINE ROCK** White-Gray-Black, (Granitic Gneiss) 1,391.1 White-Gray-Black, (Granitic Gneiss)	8.1
			60/0.0			60/0.0				REC = 99% RQD = 83% GSI = 65-70	
1385											
1380										1,379.2	20.0
										Boring Terminated at Elevation 1,379.2 ft In Crystalline Rock (Granitic Gneiss)	

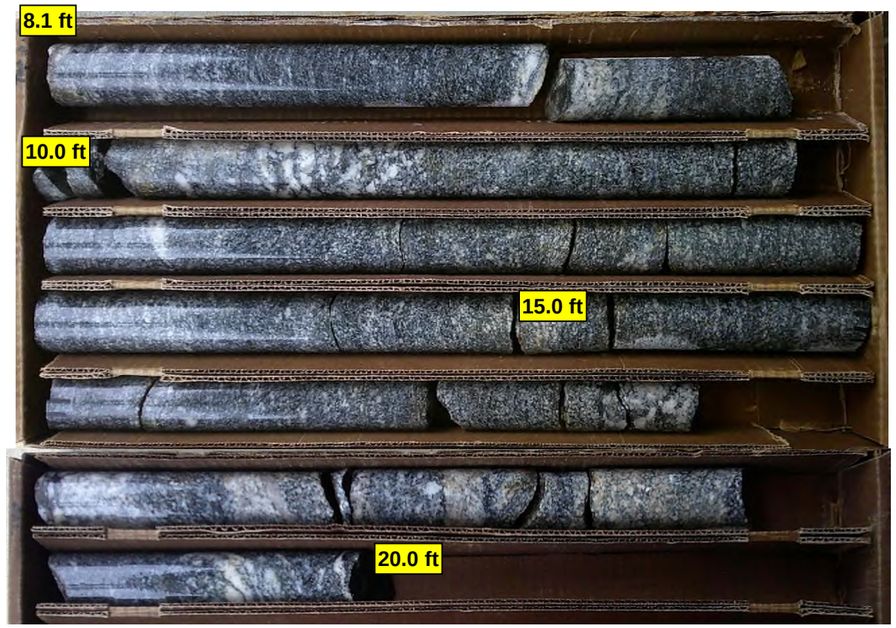
GEOTECHNICAL BORING REPORT
CORE LOG

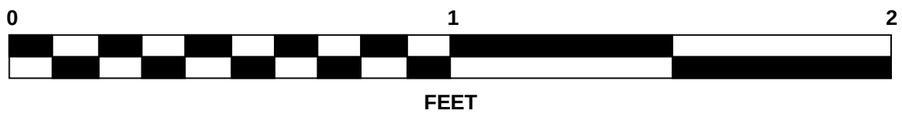
WBS DF18314.1075021	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 943 B-33	**STATION** 14+27	**OFFSET** 6 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** N/A
COLLAR ELEV. 1,399.2 ft	**TOTAL DEPTH** 20.0 ft	**NORTHING** 552,037	**EASTING** 1,010,889	**24 HR.** 7.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/15/25	**COMP. DATE** 04/16/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 11.9 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)
1391.13											Begin Coring @ 8.1 ft	
1390	1,391.1	8.1	1.9	*N=60/0.0* 4:52/1.0	(1.8) 95%	(1.8) 95%		(11.8) 99%	(9.9) 83%		1,391.1 Fresh, Hard to Very Hard, White-Gray-Black, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing	8.1
	1,389.2	10.0	5.0	6:16/0.9 3:49/1.0 4:43/1.0 6:02/1.0 7:14/1.0 10:05/1.0	(5.0) 100%	(4.4) 88%					GSI = 65-70	
1385	1,384.2	15.0	5.0	7:16/1.0 6:52/1.0 5:54/1.0 5:30/1.0 5:10/1.0	(5.0) 100%	(3.7) 74%						
1380	1,379.2	20.0									1,379.2 Boring Terminated at Elevation 1,379.2 ft In Crystalline Rock (Granitic Gneiss)	20.0

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 943 B-33
8.1 to 20.0 Feet





GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075021	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 943 B-32	**STATION** 14+68	**OFFSET** 11 ft RT	**ALIGNMENT** -L943-942-	**0 HR.** Dry
COLLAR ELEV. 1,397.0 ft	**TOTAL DEPTH** 6.6 ft	**NORTHING** 552,031	**EASTING** 1,010,933	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/15/25	**COMP. DATE** 04/15/25	**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)
1400										1,397.0 GROUND SURFACE	0.0
1395										1,395.3 **ROADWAY EMBANKMENT** Asphalt (0.7'), ABC (1.0')	1.7
	1,394.3	2.7	44	56/0.4						**WEATHERED ROCK**	
	1,392.6	4.4	60/0.0			100/0.9 60/0.0				1,392.6 Gray-Brown-Tan, (Granitic Gneiss)	4.4
	1,390.4	6.6	60/0.0			60/0.0				1,390.4 **CRYSTALLINE ROCK** (Granitic Gneiss)	6.6
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,390.4 ft In Crystalline Rock (Grantic Gneiss)	

REFERENCE: DF18314.1075022

PROJECT: N/A

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	DF18314.1075022	1	

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

STRUCTURE SUBSURFACE INVESTIGATION

COUNTY *POLK*

PROJECT DESCRIPTION *EMERGENCY DESIGN FOR US 176*

SITE DESCRIPTION *SITE 944 –L944– STA. 12+00.00 TO 18+50.00*

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.

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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

R. WELCH, G.I.T.

CG2 EXPLORATION

INVESTIGATED BY *CG2, PLLC*

DRAWN BY *K. DE MONTBRUN, P.E.*

CHECKED BY *M. BREWER, P.E.*

SUBMITTED BY *CG2, PLLC*

DATE *AUGUST 2025*

Prepared in the Office of:

CAROLINAS GEOTECHNICAL GROUP

1805 SARDIS ROAD NORTH
SUITE 100
CHARLOTTE, NC 28270
(980) 339-8684

NORTH CAROLINA PROFESSIONAL SEAL 041986 ENGINEER D. MATTHEW BREWER

DocuSigned by:
Matthew Brewer 12/2/2025
386129C0A4F1467... SIGNATURE DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075022	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:
- [ ] CME-45C
- [ ] CME-55
- [ ] CME-550
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [X] DIEDRICH D-50
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

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

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:

ELEVATION: FEET

NOTES:

ROADWAY DESIGN FILES PROVIDED BY TGS JULY 29, 2025.

BORING COLLAR ELEVATIONS OBTAINED USING CARLSON BRX7 GPS.

REF = REFUSAL

CT = CORE TERMINATED

DATE: 8-15-14

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075022	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 ⇨

90			N/A	N/A
80				
70				
60				
50				
40				
30				
20				
10				
N/A	N/A			

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	A			
60				
50		B	C	D E
40				
30				F
20				
10			G	H

DATE: 8-19-16

PROJECT REFERENCE NO.	SHEET NO.
DF18314.1075022	3

SITE PLAN

0 50 100
FEET

NC GRID
NAD 83 NA 2011

BEGIN CONSTRUCTION SITE 944
–L944– STA 12+00.00

END CONSTRUCTION SITE 944
–L944– STA 18+50.00

PROPERTY LINE PER GIS

EXISTING R-W

WOODS

GR

–L944–

944_B-36

944_B-39

944_B-38

944_B-37

944_B-35

APPROXIMATE EP LOCATION

GREU TL-3

ROADWAY DESTROYED

F

MB

PE

JS

GATE

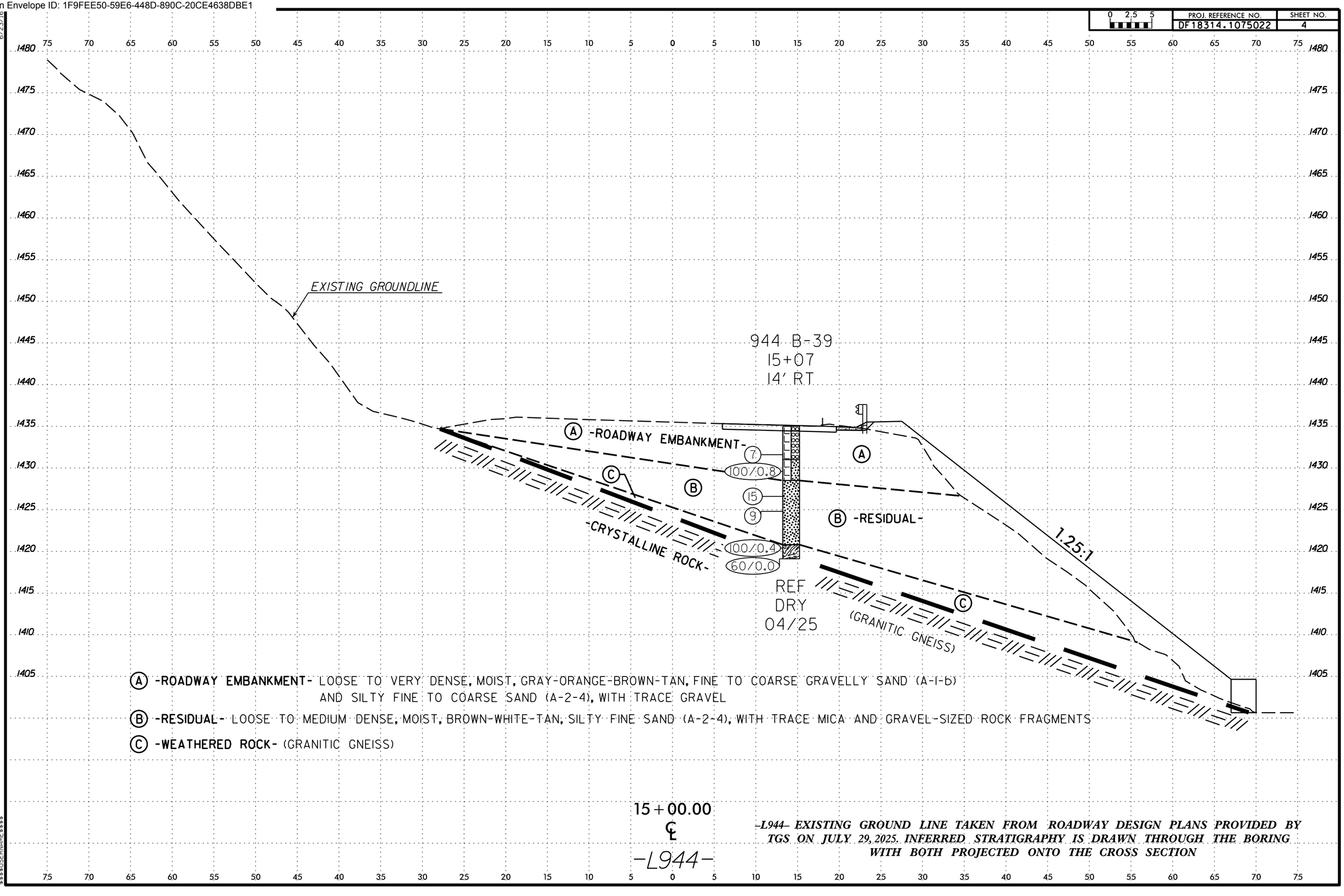
NORTH PACOLET RIVER

DEBRIS

2SWD

PROP. RETAINING WALL

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075022	4



(A) **-ROADWAY EMBANKMENT-** LOOSE TO VERY DENSE, MOIST, GRAY-ORANGE-BROWN-TAN, FINE TO COARSE GRAVELLY SAND (A-1-b) AND SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE GRAVEL

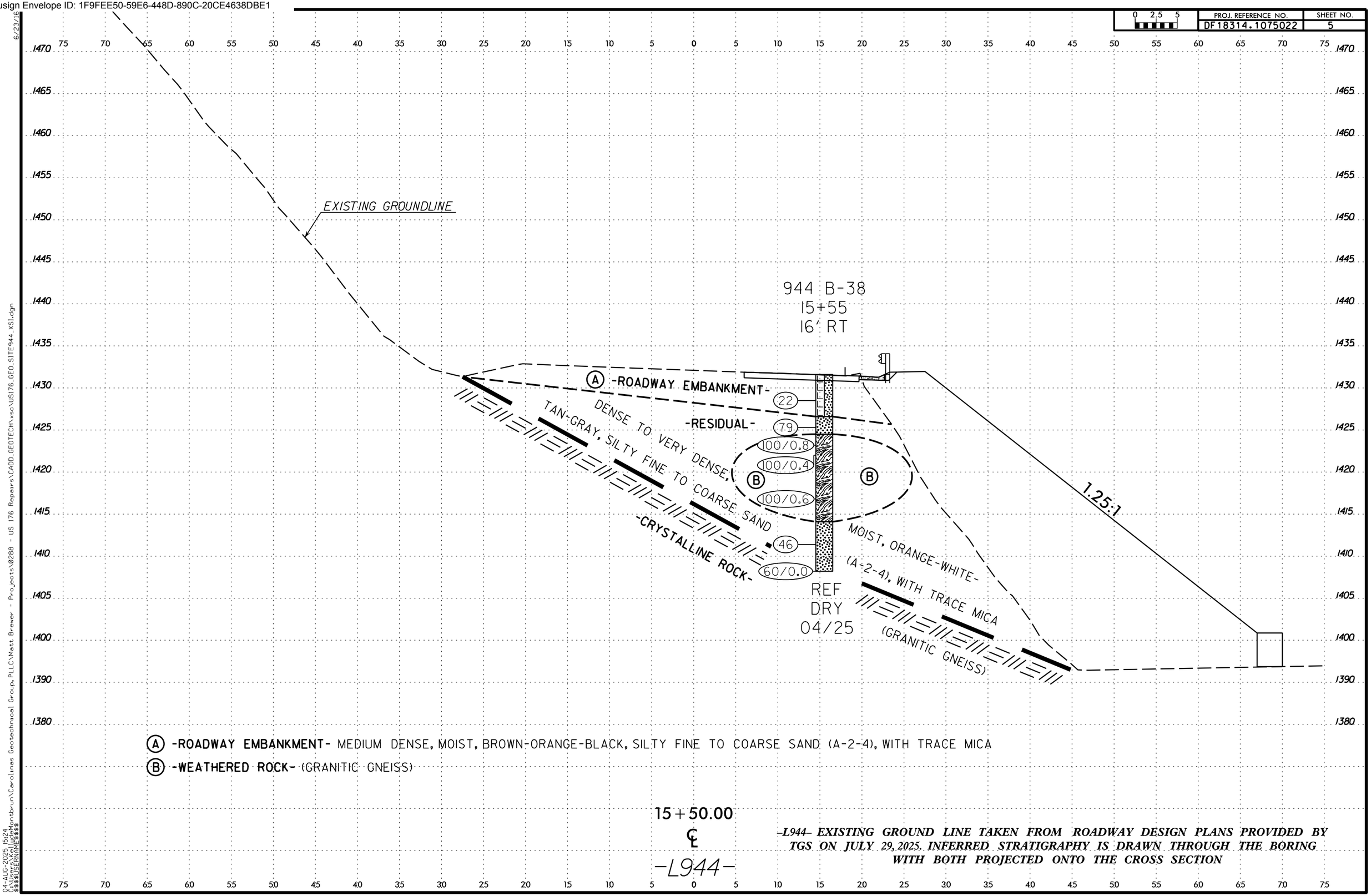
(B) **-RESIDUAL-** LOOSE TO MEDIUM DENSE, MOIST, BROWN-WHITE-TAN, SILTY FINE SAND (A-2-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAGMENTS

(C) **-WEATHERED ROCK-** (GRANITIC GNEISS)

15+00.00
℄
–L944–

–L944– EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS ON JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075022	5



Ⓐ **-ROADWAY EMBANKMENT-** MEDIUM DENSE, MOIST, BROWN-ORANGE-BLACK, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE MICA

Ⓑ **-WEATHERED ROCK-** (GRANITIC GNEISS)

15+50.00
℄
-L944-

-L944- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS ON JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075022	6

944 B-37
15+96
14' RT

EXISTING GROUNDLINE

PAVEMENT

-RESIDUAL-
DENSE TO VERY DENSE, MOIST, WHITE-GRAY-TAN, SILTY FINE SAND (A-2-4), WITH TRACE MICA

39
36
100/0.2
53

100/0.9

-WEATHERED ROCK- (GRANITIC GNEISS)

100/0.2
60/0.0

-CRYSTALLINE ROCK-
(GRANITIC GNEISS)

REF
DRY
04/25

1.25:1

(A) -WEATHERED ROCK- (GRANITIC GNEISS)

16+00.00
℄
-L944-

-L944- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS ON JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075022	7

944 B-36
16+45
4' RT

EXISTING GROUNDLINE

PAVEMENT

-RESIDUAL-

16
23
29
35
MEDIUM DENSE TO DENSE, MOIST, ORANGE-WHITE-TAN, SILTY FINE TO COARSE SAND (A-2-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAMGMENTS

26
VERY STIFF TO HARD, MOIST, BROWN-ORANGE-GRAY, SILT (A-45), WITH TRACE MICA

94
04/25
60/0.0
100/0.2
100/0.2
60/0.0
60/0.0

1.35:1

-WEATHERED ROCK- (GRANITIC GNEISS)

-WEATHERED ROCK- (GRANITIC GNEISS)

-CRYSTALLINE ROCK-

-CRYSTALLINE ROCK-

MODERATELY WEATHERED TO FRESH, HARD TO VERY HARD, WHITE-GRAY-BLACK-PINK (GRANITIC GNEISS), WITH VERY CLOSE TO MODERATELY CLOSE FRACTURE SPACING

REC = 89%
RQD = 54%
GSI = 40-45

CT

(A) -CRYSTALLINE ROCK- MODERAETLY TO SLIGHTLY WEATHERED, HARD TO VERY HARD, WHITE-GRAY (GRANITIC GNEISS), WITH VERY CLOSE FRACTURE SPACING
REC = 100%
RQD = 0%
GSI = 15-20

16+50.00
℄
-L944-

-L944- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS ON JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	DF18314.1075022	8

944 B-35
17+00
12' RT

EXISTING GROUNDLINE

PAVEMENT

-ROADWAY EMBANKMENT-
VERY LOOSE TO MEDIUM DENSE, MOIST, BROWN-TAN-ORANGE, FINE CLAYEY SAND
(A-2-6), WITH TRACE MICA

11
3
2
3

-RESIDUAL-
46
DENSE, MOIST, ORANGE-WHITE-BLACK, SILTY FINE SAND (A-2-4), WITH TRACE MICA AND GRAVEL-SIZED ROCK FRAGMENTS

100/0.3
60/0.0
REF
DRY
04/25

-CRYSTALLINE ROCK-

1.35:1

(A) -WEATHERED ROCK- (GRANITIC GNEISS)

(A) (GRANITIC GNEISS)

17+00.00

℄
-L944-

-L944- EXISTING GROUND LINE TAKEN FROM ROADWAY DESIGN PLANS PROVIDED BY TGS ON JULY 29, 2025. INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORING WITH BOTH PROJECTED ONTO THE CROSS SECTION

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 944 B-39	**STATION** 15+07	**OFFSET** 14 ft RT	**ALIGNMENT** -L944-	**0 HR.** Dry
COLLAR ELEV. 1,437.0 ft	**TOTAL DEPTH** 15.9 ft	**NORTHING** 552,500	**EASTING** 1,009,942	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/10/25	**COMP. DATE** 04/10/25	**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))
1440										
										1,437.0 GROUND SURFACE 0.0
1435	1,434.6	2.4	10	5	2	7		M		**ROADWAY EMBANKMENT** Loose, Gray-Orange-Brown, Fine to Coarse Gravelly SAND (A-1-b)
	1,432.8	4.2	6	77	23/0.3	100/0.8		M		1,433.0 4.0 Very Dense, Tan-Gray, Silty Fine to Coarse SAND (A-2-4), with trace gravel
1430	1,429.6	7.4	5	7	8	15		M		1,430.5 6.5 Boulder from approximately 4.7 to 5.7 feet **RESIDUAL** Loose to Medium Dense,
	1,427.8	9.2	2	2	7	9		M		Brown-White-Tan, Silty Fine SAND (A-2-4), with trace mica and gravel-sized rock fragments
1425	1,422.8	14.2	100/0.4			100/0.4				1,422.8 14.2 **WEATHERED ROCK**
	1,421.1	15.9	60/0.0			60/0.0				1,421.1 15.9 Brown-Gray-White, (Granitic Gneiss) Boring Terminated with Standard Penetration Test Refusal at Elevation 1,421.1 ft On Crystalline Rock (Granitic Gneiss)

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 944 B-38	**STATION** 15+55	**OFFSET** 16 ft RT	**ALIGNMENT** -L944-	**0 HR.** Dry
COLLAR ELEV. 1,436.6 ft	**TOTAL DEPTH** 23.4 ft	**NORTHING** 552,503	**EASTING** 1,009,989	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER C. Odom	**START DATE** 04/10/25	**COMP. DATE** 04/10/25	**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
1440										
										1,436.6 GROUND SURFACE 0.0
1435	1,434.5	2.1	6	5	17	22		M		**ROADWAY EMBANKMENT** Medium Dense, Brown-Orange-Black, Silty Fine to Coarse SAND (A-2-4), with trace mica
	1,431.3	5.3	34	34	45	79		M		1,431.6 5.0 **RESIDUAL**
1430	1,429.5	7.1	21	42	58/0.3	100/0.8		M		1,429.5 7.1 Very Dense, Orange-White-Tan, Silty Fine SAND (A-2-4), with trace mica
	1,427.4	9.2	100/0.4			100/0.4				**WEATHERED ROCK** White-Gray-Brown, (Granitic Gneiss)
1425	1,422.4	14.2	75	25/0.1		100/0.6				
1420	1,417.4	19.2	14	14	32	46		M		1,419.1 17.5 **RESIDUAL** Dense, Orange-White-Gray, Silty Fine to Coarse SAND (A-2-4), with trace mica
1415	1,413.2	23.4	60/0.0			60/0.0				1,413.2 23.4 Boring Terminated with Standard Penetration Test Refusal at Elevation 1,413.2 ft On Crystalline Rock (Granitic Gneiss)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 944 B-37	**STATION** 15+96	**OFFSET** 14 ft RT	**ALIGNMENT** -L944-	**0 HR.** Dry
COLLAR ELEV. 1,436.0 ft	**TOTAL DEPTH** 19.6 ft	**NORTHING** 552,506	**EASTING** 1,010,029	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/11/25	**COMP. DATE** 04/11/25	**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)
1440											
										1,436.0 GROUND SURFACE	0.0
1435											
	1,434.0	2.0	11	16	23	39		M		1,434.2 **ROADWAY EMBANKMENT** Asphalt (0.8'), ABC (1.0')	1.8
	1,432.0	4.0								**RESIDUAL** Dense, White-Gray-Tan, Silty Fine SAND (A-2-4), with trace mica	
1430			20	15	21	36		M			
	1,429.0	7.0	100/0.2			100/0.2				1,429.0	7.0
	1,427.0	9.0	20	22	31					1,427.5 **WEATHERED ROCK** Brown-Gray, (Granitic Gneiss)	8.5
1425						53		M		**RESIDUAL** Very Dense, White-Tan-Gray, Silty Fine SAND (A-2-4), with trace mica	
	1,422.0	14.0	34	66/0.4						1,422.0	14.0
1420						100/0.9				**WEATHERED ROCK** White-Gray-Tan, (Granitic Gneiss)	
	1,417.0	19.0									
	1,416.4	19.6	100/0.2			100/0.2				1,416.4	19.6
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 1,416.4 ft On Crystalline Rock (Granitic Gneiss)	

GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 944 B-36	**STATION** 16+45	**OFFSET** 4 ft RT	**ALIGNMENT** -L944-	**0 HR.** N/A
COLLAR ELEV. 1,435.8 ft	**TOTAL DEPTH** 50.1 ft	**NORTHING** 552,513	**EASTING** 1,010,077	**24 HR.** 21.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/14/25	**COMP. DATE** 04/15/25	**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)
1440										
1435										1,435.8 GROUND SURFACE 0.0
	1,433.8	2.0	10	8	8	16		M		**ROADWAY EMBANKMENT**
	1,431.4	4.4								1,434.0 Asphalt (0.8'), ABC (1.0') 1.8
1430			10	11	12	23		M		**RESIDUAL**
	1,428.8	7.0								Medium Dense to Dense,
			11	14	15	29		M		Orange-White-Tan, Silty Fine to Coarse
	1,426.4	9.4								SAND (A-2-4) with trace mica and
1425			12	15	20	35		M		gravel-sized rock fragments
										1,422.8 13.0
	1,421.4	14.4								Very Stiff to Hard, Brown-Orange-Gray, SILT
1420			10	13	13	26		M		(A-5) with trace mica
	1,416.4	19.4								
1415			17	43	51	94				
	1,414.4	21.4	60/0.0			60/0.0				1,414.4 21.4
										CRYSTALLINE ROCK
	1,410.9	24.9	100/0.2			100/0.2				White-Gray, (Granitic Gneiss)
1410										1,411.1 24.7
										REC = 100%
	1,407.0	28.8	100/0.2			100/0.2				RQD = 0%
										GSI = 15-20
1405										**WEATHERED ROCK**
										Brown-White-Orange, (Granitic Gneiss)
	1,402.0	33.8	60/0.0			60/0.0				1,402.0 33.8
1400										**CRYSTALLINE ROCK**
										(Granitic Gneiss)
1395										REC = 89%
										RQD = 54%
										GSI = 40-45
1390										
	1,385.7	50.1	60/0.0			60/0.0				1,385.7 50.1
										Boring Terminated at Elevation 1,385.7 ft In
										Crystalline Rock (Granitic Gneiss)

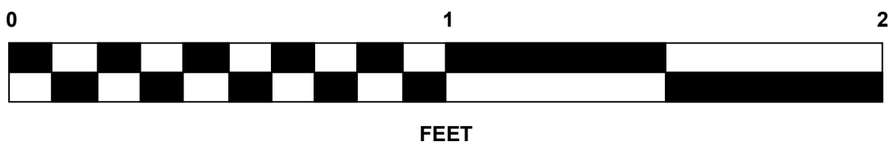
GEOTECHNICAL BORING REPORT
CORE LOG

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch	
SITE DESCRIPTION Road Repairs along US 176 Highway				**GROUND WTR (ft)**
BORING NO. 944 B-36	**STATION** 16+45	**OFFSET** 4 ft RT	**ALIGNMENT** -L944-	**0 HR.** N/A
COLLAR ELEV. 1,435.8 ft	**TOTAL DEPTH** 50.1 ft	**NORTHING** 552,513	**EASTING** 1,010,077	**24 HR.** 21.0
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** SPT Core Boring		**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/14/25	**COMP. DATE** 04/15/25	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 19.6 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)
1414.41											Begin Coring @ 21.4 ft
	1,414.4	21.4	3.3	N=60/0.0 4:01/1.0 3:02/1.0 1:41/1.0	(0.4) 12%	(0.0) 0%		(0.4) 12%	(0.0) 0%		1,414.4 **CRYSTALLINE ROCK** 21.4
	1,411.1	24.7		0:33/0.3 N=100/0.2							Moderately to Slightly Weathered, Hard to Very Hard, White-Gray, (Granitic Gneiss), with Very Close Fracture Spacing
1410											1,411.1 24.7
				N=100/0.2							GSI = 15-20
1405											**WEATHERED ROCK**
											Brown-White-Orange, (Granitic Gneiss)
	1,402.0	33.8									1,402.0 33.8
	1,400.7	35.1	1.3	N=60/0.0 6:33/1.0	(0.4) 31%	(0.0) 0%		(14.5) 89%	(8.8) 54%		**CRYSTALLINE ROCK**
1400			5.0	2:06/0.3 5:21/1.0 5:14/1.0 3:01/1.0 3:37/1.0	(5.0) 100%	(3.7) 74%					Moderately Weathered to Fresh, Hard to Very Hard, White-Gray-Black-Pink, (Granitic Gneiss), with Very Close to Moderately Close Fracture Spacing
	1,395.7	40.1									GSI = 40-45
1395			5.0	4:44/1.0 4:20/1.0 5:08/1.0 4:55/1.0 6:09/1.0	(5.0) 100%	(2.8) 56%					
	1,390.7	45.1									
1390			5.0	8:08/1.0 5:17/1.0 5:12/1.0 4:18/1.0 2:14/1.0	(4.1) 82%	(2.3) 46%					
	1,385.7	50.1		N=60/0.0 4:25/1.0							1,385.7 50.1
											Boring Terminated at Elevation 1,385.7 ft In Crystalline Rock (Granitic Gneiss)

CAROLINAS GEOTECHNICAL GROUP

Road Repairs along US 176 Highway
Polk County, North Carolina
Rock Core Photographs
Boring: 944 B-36
21.4 to 50.1 Feet



GEOTECHNICAL BORING REPORT
BORE LOG

WBS DF18314.1075022	**TIP** N/A	**COUNTY** POLK	**GEOLOGIST** R. Welch
SITE DESCRIPTION Road Repairs along US 176 Highway			**GROUND WTR (ft)**
BORING NO. 944 B-35	**STATION** 17+00	**OFFSET** 12 ft RT	**ALIGNMENT** -L944-	**0 HR.** Dry
COLLAR ELEV. 1,434.4 ft	**TOTAL DEPTH** 20.5 ft	**NORTHING** 552,497	**EASTING** 1,010,130	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE CG20446 Diedrich D-50 97% 04/30/2024		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Odom	**START DATE** 04/11/25	**COMP. DATE** 04/11/25	**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)
1435										1,434.4 GROUND SURFACE	0.0
	1,432.4	2.0	6	5	6	11		M		1,432.6 **ROADWAY EMBANKMENT** Asphalt (0.8'), ABC (1.0')	1.8
1430	1,430.3	4.1	2	2	1	3		M		Very Loose to Medium Dense, Brown-Tan-Orange, Fine Clayey SAND (A-2-6), with trace mica	
	1,427.4	7.0	2	1	1	2		M			
1425	1,425.3	9.1	1	1	2	3		M			
1420	1,420.3	14.1	10	17	29	46		M		1,421.9 **RESIDUAL** Dense, Orange-White-Black, Silty Fine SAND (A-2-4), with trace mica and gravel-sized rock fragments	12.5
1415	1,415.3	19.1	100/0.3			100/0.3				1,415.3	19.1
	1,413.9	20.5	60/0.0			60/0.0				1,413.9 **WEATHERED ROCK** Gray-White, (Granitic Gneiss)	20.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 1,413.9 ft On Crystalline Rock (Granitic Gneiss)	