STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-2566BB	1	11

REFERENCE: R-2566BB

PROJECT: 48844

SEE SHEET 3 FOR PLAN SHEET LAYOUT
AT TIME OF INVESTIGATION

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

ROADWAY SUBSURFACE INVESTIGATION

COUNTY: WATAUGA

PROJECT DESCRIPTION: NC 105 AT SR 1568 (OLD SHULLS MILL RD) INTERSECTION. REALIGN SR-1568 (OLD SHULLS MILL RD)

INVENTORY

** NOTE FROM GEU: THIS DOCUMENT WAS PARTITIONED OUT FROM THE ORIGINAL 2020-2021 SUBSURFACE INVESTIGATION UNDER SEPARATE COVERS: "R2566B_GEO_RDWY_SubsurfaceInvestigation_Pt1of2" and "R2566B_GEO_RDWY_SubsurfaceInvestigation_Pt2of2"

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LINE	STATION	PLAN	PROFILE
-Y1-	10+15.00 - 23+00.00	4-5	

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-Y1-	11+00.00	6
-Y1-	13+00.00	7
-Y1-	15+00.00	8

APPENDICES

APPENDIX	TITLE	SHEETS
A	BORING LOGS	10-11

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 707-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

THE BIDDER OR CONTRACTOR IS CAUTIONED THAT DETAILS SHOWN ON THE SUBSURFACE PLANS ARE PRELIMINARY ONLY AND IN MANY CASES THE FINAL DESIGN DETAILS ARE DIFFERENT. FOR BIDDING AND CONSTRUCTION PURPOSES, REFER TO THE CONSTRUCTION PLANS AND DOCUMENTS FOR FINAL DESIGN INFORMATION ON THIS PROJECT. THE DEPARTMENT DOES NOT WARRANT OR GUARANTEE THE SUFFICIENCY OR ACCURACY OF THE INVESTIGATION MADE, NOR THE INTERPRETATIONS MADE, OR OPINION OF THE DEPARTMENT AS TO THE TYPE OF MATERIALS AND CONDITIONS TO BE ENCOUNTERED. THE BIDDER OR CONTRACTOR IS CAUTIONED TO MAKE SUCH INDEPENDENT SUBSURFACE INVESTIGATIONS AS HE DEEMS NECESSARY TO SATISFY HIMSELF AS TO CONDITIONS TO BE ENCOUNTERED ON THE PROJECT. THE CONTRACTOR SHALL HAVE NO CLAIM FOR ADDITIONAL COMPENSATION OR FOR AN EXTENSION OF TIME FOR ANY REASON RESULTING FROM THE ACTUAL CONDITIONS ENCOUNTERED AT THE SITE DIFFERING FROM THOSE INDICATED IN THE SUBSURFACE INFORMATION.

NOTES:

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

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DATE AUGUST, 2022

NORTH CAROLINA LICENSED GEOLOGIST
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SIGNATURE
08/17/2022
DATE

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

PROJECT REFERENCE NO.	SHEET NO.
R-2566B	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
- [x] CME-550X
- [x] CME-550X
- [ ] VANE SHEAR TEST
- [ ] PORTABLE HOIST
- [ ] ______
- [ ] ______

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [x] 3.25" HOLLOW STEM AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [x] CASING [x] W/ ADVANCER
- [ ] TRICONE ____" STEEL TEETH
- [ ] TRICONE ____" TUNG.-CARB.
- [ ] CORE BIT
- [ ] ______

HAMMER TYPE:
- [x] AUTOMATIC
- [ ] MANUAL

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

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [x] HAND AUGER
- [x] 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:

ELEVATIONS OBTAINED FROM R-2566B_LS_TIN.TIN

MnO = MANGANESE OXIDE

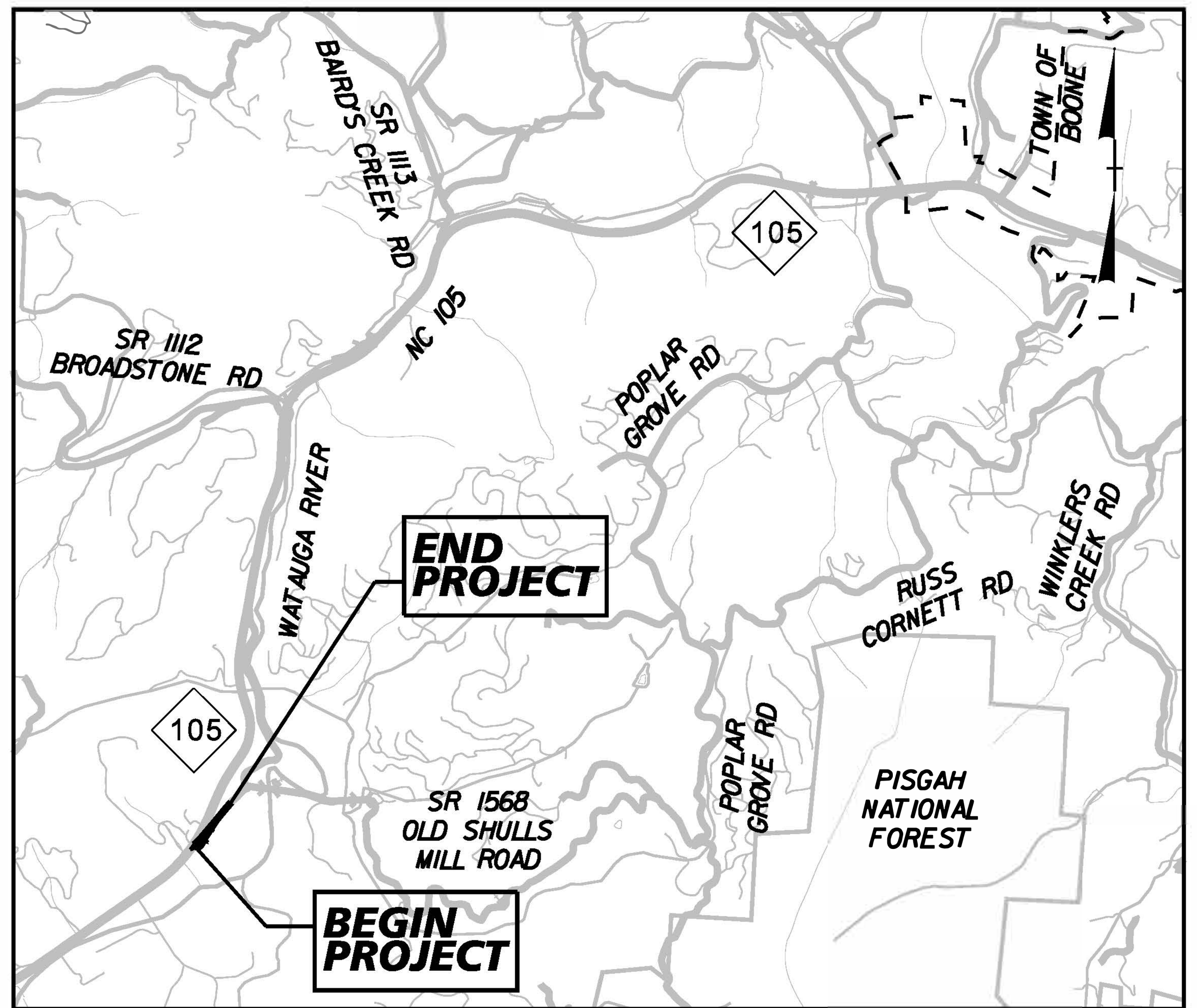
FIAD = FILLED IMMEDIATELY AFTER DRILLING

DATE: 8-15-14

TIP PROJECT: R-2566BB

CONTRACT: DK00329

SEE SHEET 1A FOR INDEX OF SHEETS
SEE SHEET 1B FOR CONVENTIONAL PLAN SHEET SYMBOLS



VICINITY MAP

90% PLANS

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

WATAUGA COUNTY

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-2566BB	3	11

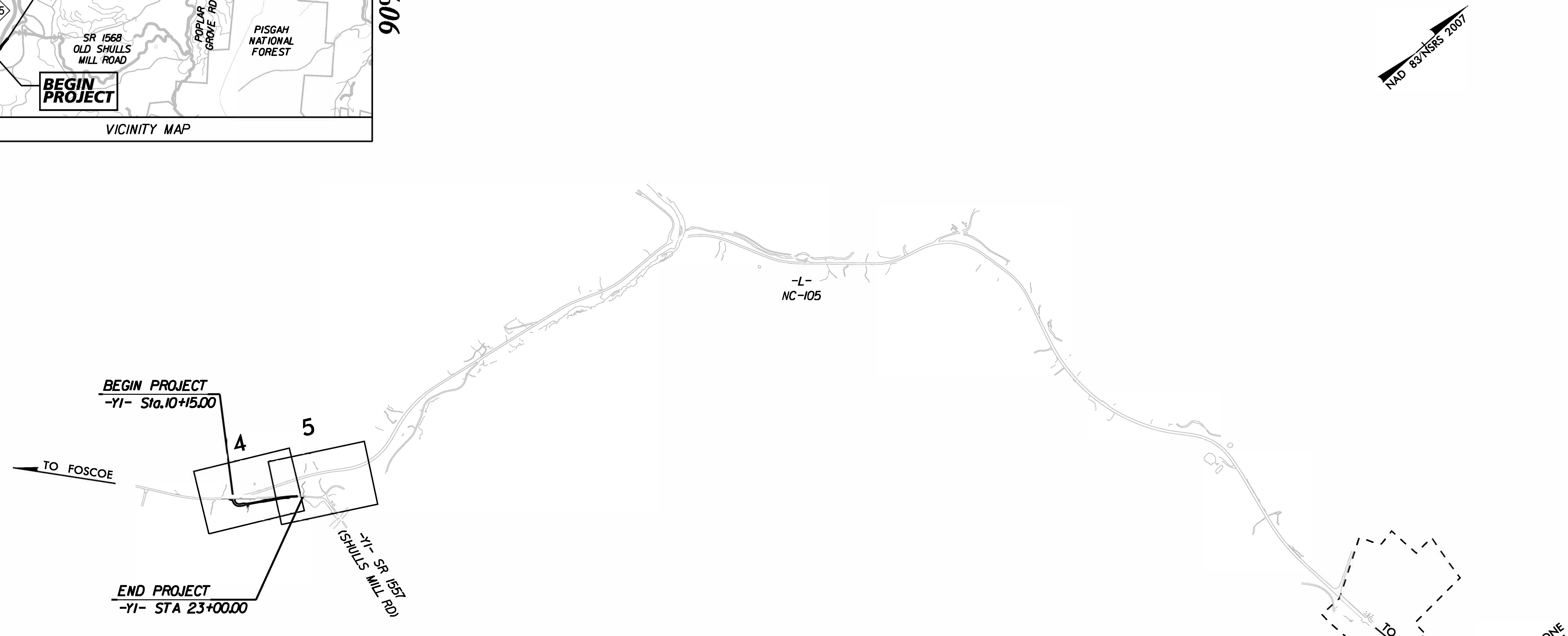
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION
48844		

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

LOCATION: SR 1568 (OLD SHULLS MILL RD) FROM NC 105 TO WEST OF SR 1557 (SHULLS MILL ROAD)

TYPE OF WORK: GRADING, DRAINAGE, AND PAVING



A PORTION OF THIS PROJECT IS WITHIN THE MUNICIPAL BOUNDARY OF THE TOWN OF BOONE.
CLEARING ON THIS PROJECT SHALL BE PERFORMED TO THE LIMITS ESTABLISHED BY METHOD III.

GRAPHIC SCALES

50 25 0 50 100
PLANS

50 25 0 50 100
PROFILE (HORIZONTAL)

10 5 0 10 20
PROFILE (VERTICAL)

DESIGN DATA

ADT 2022	=	670 VPD
ADT 2042	=	800 VPD
K	=	9%
D	=	55%
T	=	3%*
V	=	60 MPH

FUNCTIONAL CLASSIFICATION: LOCAL

* 1% TTST 2% DUAL
SUB-REGIONAL TIER

PROJECT LENGTH

LENGTH ROADWAY PROJECT = 0.243 MILES

TOTAL LENGTH PROJECT = 0.243 MILES

PLANS PREPARED FOR THE NCDOT BY:

Kimley»Horn

2018 STANDARD SPECIFICATIONS

RIGHT OF WAY DATE:
MAY 20, 2022

LETTING DATE:
SEPTEMBER 20, 2022

TONY SPACEK, P.E.
PROJECT ENGINEER

SYDNEY ROSENBLUM, E.I.T.
PROJECT DESIGN ENGINEER

NATHAN ADIMA, P.E.
NCDOT CONTACT
PROJECT MANAGEMENT UNIT

HYDRAULICS ENGINEER

SIGNATURE: P.E.

ROADWAY DESIGN ENGINEER

SIGNATURE: P.E.

7/20/2022
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09/03/99

SUMMIT
DESIGN AND ENGINEERING SERVICES
320 Executive Court, Hillsborough, NC 27278
Phone // 919.732.3883 Web // www.summitde.net

October 12, 2021

WBS Number: 37512.1.5
TIP Number: R-2566B
Project ID: 36127
County: Watauga
Description: NC 105 From SR 1568 (Old Shulls Mill Rd) to SR 1107 (NC 105 Bypass)

SUBJECT: Geotechnical Report - Roadway Subsurface Inventory

Project Description

The proposed 4.438-mile project is located in between the towns of Boone and Foscoe in Watauga County. The bulk of the project consists of roadway widening along NC 105 from SR 1568 (Shulls Mill Road) to SR 1107 (NC 105 Bypass). Twenty-eight (28) retaining walls are proposed along the length of the project to help accommodate the future widening. In addition, some minor widening and access improvements are planned at intersecting secondary roads, driveways, and business entrances. The proposed earthworks are significant throughout much of the project corridor. Several proposed cut sections exceed 50 feet in depth, while some proposed embankment areas exceed 20 feet in height.

Within the project corridor, the replacement of Bridge No. 5 over the Watauga River and 0.373 miles of roadway widening associated with the new bridge alignment was previously investigated under the separate TIP of R-2566BA. The project limits of R-2566BA began along the mainline (-L-) of R-2566B at approximately station 152+00 and ended on -L- at approximately station 171+50. Summit conducted the geotechnical investigation for the bridge replacement back in 2018. The Bridge Subsurface Inventory Report was submitted by Summit to NCDOT on November 29, 2018. No information from the geotechnical investigation for the bridge was included within this report.

Also, in 2018, The Asheville Field Office (AFO) of NCDOT's Geotechnical Engineering Unit (GEU) conducted the geotechnical investigation for the 0.373 miles of roadway widening associated with R-2566BA. AFO completed the Roadway Subsurface Inventory Report on June 22, 2018. Information from AFO's R-2566BA Roadway Subsurface Inventory Report was incorporated into this report. At the request of AFO, Summit did not perform any additional investigations, observations, or interpretations in this area of the project corridor. Summit did not make any modification to the data referenced from the R-2566BA Roadway Subsurface Inventory Report. AFO completed the Roadway Design and Construction Recommendations for R-2566BA on July 30, 2018. Therefore, beyond the incorporation of the data, no further discussion of this area of the project is warranted within this report.

The geotechnical investigation for R-2566B was conducted from March 18th, 2020, to April 29th, 2021. Due to the COVID-19 pandemic and associated NCDOT funding issues, all work on the project was suspended on May 11th, 2020. All work on the project remained suspended until January 7th, 2021, approximately eight (8) months total. One-hundred thirty (130) borings were advanced using two CME-550X drill machines equipped with automatic hammers. Standard Penetration Tests (SPT) were performed at these locations to provide subsurface information for roadway foundation, retaining wall foundation, and slope design/construction. Drill tooling was typically advanced using 3.25-inch hollow-stem augers. Eight (8) of the one-thirty total drilled borings utilized NW Casing with a Casing Advancer due to the suspected presence of thick deposits of Roadway Embankment containing numerous boulders. At the request of AFO, no rock coring was performed during the investigation of this project.

In areas of the project corridor with limited access for drill rigs, subsurface information was supplemented using rod soundings and hand augers. A total of ninety-six (96) locations were investigated using hand tools. Of those, eighty-four (84) were rod soundings, and twelve (12) were hand augers and rod soundings. All borings were advanced by North Carolina Licensed Drillers (Certified Well Contractors - CWC). All borings were logged by a North Carolina Licensed Geologist (LG/PG), Engineer Intern (EI), or other professional geotechnical field staff deemed qualified by NCDOT. To further supplement subsurface information, outcrop mapping was performed by a North Carolina Licensed Geologist throughout the project corridor.

Except for borings drilled within the roadway and in other high traffic areas, all borings were left open for a minimum of twenty-four (24) hours to collect groundwater data. In many instances, the 0-hour measurements were used in lieu of the 24-hour due to boring cave-in issues. Representative soil samples were collected, and one hundred and nine (109) were submitted to Summit's soils laboratory for classification and moisture content testing. No bulk samples were collected for California Bearing Ratio (CBR) testing. No undisturbed samples were obtained within the project corridor. All investigations and reporting were performed in accordance with the NCDOT Geotechnical Engineering Unit's 2016 "Geotechnical Investigation and Recommendations Manual."

It should be noted that not all of the proposed alignments for this project were investigated. The following alignments were investigated or partially investigated for this project:

Alignment	Station(±)
-L-	68+60.00 - 310+00.00
-Y1-	10+18.00 - 29+00.00
-Y4-	11+24.00 - 14+71.93
-DRW2-	10+60.00 - 11+93.00
-DRW3-	10+35.00 - 11+48.19
-DRW4-	11+10.00 - 11+73.75
-DRW6-	10+43.50 - 14+50.00
-DRW7-	10+44.49 - 13+15.00
-DRW9-	10+41.50 - 12+30.00
-DRW10-	10+42.00 - 13+00.00

Physiography, Geography, and Geology

The project area is located in far northwestern North Carolina within the Blue Ridge Physiographic Province. The topography within this province is best characterized as a deeply dissected mountainous area of numerous steep mountain ridges, intermontane basins, and trench valleys that intersect at all angles and give the area its rugged mountain character. The Blue Ridge Physiographic Province contains the highest elevations and most rugged terrain in the state of North Carolina, with 43 peaks exceeding 6,000 feet in elevation. The project corridor is mostly located within a river valley where elevations range from approximately 2,730 feet to about 3,310 feet above sea level. The topographic high occurs at the end of the project corridor, near -L- Station 310+00. A second smaller topographic high occurs at the beginning of the project corridor, near -L- Station 95+00. In between, the project gradually descends in elevation to the topographic low, which occurs near the proposed bridge over the Watauga River, near -L- Station 164+50.

The project area is located within the Watauga Basin. The Watauga River roughly parallels much of the first half of the project corridor and generally flows to the north-northeast. Laurel Fork roughly parallels most of the second half of the project corridor and generally flows to the southwest. Both converge at the proposed bridge location, near -L- station 164+50. The Watauga River then continues on to the northwest to Tennessee, where it eventually empties in the Watauga Lake. Numerous unnamed tributaries and drainage swales flow down from the surrounding ridgelines and into Laurel Fork and The Watauga River, intersecting various areas of the project corridor. Surface drainage from the project corridor would mostly follow this movement pattern down from the ridgelines into the river system and then off to the north-northeast or southwest.

The project area is located within the Western Blue Ridge Terrane. A Geological Terrane is a fault-bounded fragment of Earth's crust that shares a common geologic history distinguishing it from surrounding terranes or areas. The Western Blue Ridge is one of the most geologically complicated areas of the state and is likely composed of several geologic terranes. Generally, the Western Blue Ridge includes rocks that have always been associated with ancient North America (known as Laurentia by geologists). This mountainous region is composed of a group of over one billion-year-old gneisses and the younger sedimentary rocks that were deposited on top of them. This complex mixture of igneous, sedimentary, and metamorphic rock has repeatedly been squeezed, fractured, faulted, and folded.

The project corridor is located along the northern edge of the Grandfather Mountain Window, a structural feature where the older overriding crystalline basement rocks of the Blue Ridge Thrust Sheet have been eroded away, allowing for a "window" into the underlying younger rock. The exposed underlying Neoproterozoic-aged metamorphosed sedimentary rocks are grouped together into the Grandfather Mountain Formation. The entire project corridor is believed to be underlain by the Grandfather Mountain Formation, except for one area. From approximately -L- Station 205+00 to 238+00, the project corridor intersects a portion of the older crystalline basement rocks comprising the overlying Blue Ridge Thrust Sheet. These Mesoproterozoic-aged metamorphosed igneous rocks are grouped together into the Cranberry Gneiss Formation and bounded by the Late Paleozoic Linville Falls Thrust Fault.

The high angle Late Cenozoic Boone Fault may be present within or running immediately parallel to the project corridor from approximately -L- Station 280+00 to 310+00. This newly mapped fault is known to be associated with an increased risk of slope stability issues. In addition, large areas of the project corridor are covered by debris fans associated with Quaternary-aged mass wasting events such as landslides, rock slides, debris flows, etc. Quaternary-aged alluvium is also present within the flat-lying floodplain areas of the Watauga River and Laurel Fork.

Soil Properties

Residual soils, soils derived from the weathering of rock, are one of two dominant soil origins found within the project corridor. In general, the Residual soils underlying the project follow the typical weathering profile observed throughout the piedmont and mountains—the clays, when present, are usually found closer to the ground surface. The silts and sands are typically found deeper and closer to the parent rock source. However, much like the parent rocks they weather from, the Residual soils can vary significantly in some areas in composition and vertical/horizontal distribution. The compositional boundaries (also known as contacts) within the Residual soils are shown in the graphical section of this report as dashed lines. However, in reality, the contacts are much more likely gradational, which means that the compositional changes between clay, silt, and sand occur gradually and over some vertical/horizontal distance. Highly plastic Residual clays (Plasticity Index value of 26 or more) can be problematic during construction. They can negatively affect embankment stability, embankment settlement, subgrade stability and may not be suitable for use as embankment material on the project. Areas containing highly plastic clays will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report.

Saprolite is a type of Residual soil. In areas where the relic structure or fabric of the parent rock was evident, Residual soils were classified as Saprolite. The relic structure or rock fabric present within Saprolites can positively influence factors such as the shear strength of the soil. However, Saprolites can also retain relic discontinuities or joints that may have been present in the parent bedrock. These discontinuities can negatively influence factors such as the shear strength of the soil. Along these same lines, Manganese Oxide (MnO) was also observed within the Residual soils. Manganese Oxide will generate nearly frictionless surfaces of indeterminate orientation throughout the Residual soil profile, which can lead to slope stability issues. Typically only little to trace amounts of MnO were observed within the Residual soils encountered during the investigation. No significant quantities of Manganese Oxide were uncovered during the geotechnical investigation. Still, there is potential that there could be some problem areas within the project corridor.

Gravel-sized (and larger) fragments of Weathered and Crystalline parent rock material were encountered within all types of Residual soils present within the project corridor. Mostly in trace amounts, but in some areas, higher amounts were observed, typically within Saprolite. These seams, lenses, ledges, or isolated float result from differential weathering and remain consolidated within the surrounding unconsolidated Residual and Saprolitic soils.

Residual soils within the project corridor are predominantly composed of silts and sands and were commonly encountered during the geotechnical investigation. Laboratory testing was conducted on thirty-eight (38) samples of the Residual silts. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	21	0	14.6%	38%
HIGH	53	10	46.6%	97%
AVERAGE	**37**	**4**	**28.3%**	**65%**

The Residual silts tested were primarily AASHTO classified as sandy silts (A-4) and, to a somewhat lesser extent, clayey silts (A-5). Most Residual silts would be considered moist or at or near optimum moisture. SPT results within the Residual silts showed soil densities that typically ranged from medium stiff to very stiff with some soft and hard areas. Softer areas typically corresponded with areas of higher moisture content. Harder areas were usually found close to the Weathered Rock or Crystalline Rock interface.

While about equally as prevalent within the Residual soils, the Residual sands were only tested on a limited basis. This was primarily due to their relative ease of field classification. Laboratory testing was conducted on only four (4) samples of the Residual sands. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	23	0	13.7%	23%

HIGH	42	6	32.9%	33%
AVERAGE	**31**	**3**	**24.4%**	**29%**

The Residual sands tested were primarily AASHTO classified as silty sands (A-2-4) and, occasionally, fine to coarse sands (A-1-b). Most Residual sands would be considered moist or at or near optimum moisture. SPT results within the Residual sands showed soil densities that typically ranged from loose to dense with some very loose and very dense areas. Very loose areas typically corresponded with areas of higher moisture content. Very dense areas were typically found close to the Weathered Rock or Crystalline Rock interface.

Residual clays are much less prevalent than the silts and sands and were rarely encountered during the geotechnical investigation. Laboratory testing was conducted on only one (1) sample of the Residual clays. Analysis of the results showed it was AASHTO classified as a silty clay (A-7-5) with a Liquid Limit of 64, a Plasticity Index (PI) value of 15, and a Moisture Content of 37.8%. Therefore, the Residual clay tested would be considered moist or at or near optimum moisture and only slightly plastic. Sieve analysis of the Residual clay sample showed the percentage passing the #200 sieve (silt-clay material) at 80%. SPT results within the Residual clays showed soil densities that typically ranged from very stiff to hard. No highly plastic (PI value of 26 or more) Residual clays were encountered during the geotechnical investigation.

Colluvial soils, soil deposited by gravity on a slope or at the bottom of a slope, are the second dominant soil origin present within the project corridor. Colluvial deposits are typically very thin or absent from steep mountainsides or ridgelines. Their thickness increases as you move down the mountain and towards the river valleys, where they often interfinger with alluvial deposits at the very base of the slope. Typically, Colluvium is a poorly sorted mixture of angular rock fragments and fine-grained materials. Within the project corridor, the Colluvial deposits encountered ranged from thin layers on steep hillsides to significant deposits down in the river valley from both recent and ancient mass wasting events such as landslides, rock slides, debris flows, etc. Some Colluvial deposits within the project corridor exceed 20 feet in depth and contain significant quantities of gravel, cobbles, and boulders. Some Colluvial boulders observed within the project corridor were car-sized and, in some cases, even larger. The base of Colluvial deposits can often provide a focal point for future slope stability issues, especially if the area is saturated. Because of this, areas containing significant deposits of Colluvial soils will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report.

Colluvial soils within the project corridor are predominantly composed of silts and sands and were commonly encountered during the geotechnical investigation. Laboratory testing was conducted on thirty-one (31) samples of the Colluvial silts. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	21	0	11.4%	37%
HIGH	43	10	55.6%	87%
AVERAGE	**33**	**6**	**26.1%**	**58%**

The Colluvial silts tested were primarily AASHTO classified as sandy silts (A-4) and, to a lesser extent, clayey silts (A-5). Most Colluvial silts would be considered moist or at or near optimum moisture. SPT results within the Colluvial silts showed soil densities that typically ranged from medium stiff to very stiff with some soft and hard areas. Softer areas typically corresponded with areas of higher moisture content. Harder areas typically had higher concentrations of gravel, cobbles, and boulders.

Colluvial sands were only tested on a limited basis, mostly due to their relative ease of field classification. Laboratory testing was conducted on only seven (7) samples of the Colluvial sands. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	25	1	9.0%	21%
HIGH	33	9	26.3%	33%
AVERAGE	**28**	**5**	**15.1%**	**29%**

The Colluvial sands tested were primarily AASHTO classified as silty sands (A-2-4). Most Colluvial sands would be considered moist or at or near optimum moisture. SPT results within the Colluvial sands showed soil densities that typically ranged from loose to dense with some very loose and very dense areas. Very loose areas typically corresponded with areas of higher moisture content. Very dense areas typically had higher concentrations of gravel, cobbles, and boulders.

Colluvial clays were also fairly commonly encountered during the geotechnical investigation. Most of the clays encountered within the project corridor are believed to be Colluvial. Laboratory testing was conducted on fifteen (15) samples of the Colluvial clays. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	37	11	18.1%	42%
HIGH	58	26	44.4%	94%
AVERAGE	**43**	**14**	**31.0%**	**65%**

The Colluvial clays tested were primarily AASHTO classified as silty clays (A-7-5/A-7-5)) and, to a somewhat lesser extent, sandy clays (A-6). Most Colluvial clays would be considered wet or requiring drying to obtain optimum moisture. SPT results within the Colluvial clays showed soil densities that typically ranged from medium stiff to very stiff with some soft and hard areas. Softer areas typically corresponded with areas of higher moisture content. Harder areas typically had higher concentrations of gravel, cobbles, and boulders. One sample of the Colluvial clays had test results come in as highly plastic (PI value of 26 or more). Areas containing highly plastic clays will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report.

Roadway Embankment soils from the construction of existing NC 105 and associated secondary roads are present throughout the project corridor. Roadway Embankment soils are often quite similar to the local soils from which they are typically sourced. However, they often have a "reworked" appearance, with a large variation in grain size. They can contain little to trace amounts of organic material, gravel, cobbles, boulders and/or other types of debris. If properly constructed, Roadway Embankment soils typically do not present significant issues during future construction projects. However, some older Roadway Embankment fills across the state can be poorly compacted, contain highly plastic clays, perched water, and even miscellaneous debris such as tree trunks. In areas where the construction of the existing roadway required rock excavation or blasting, the Roadway Embankment is often laden with significant quantities of gravel, cobbles, and boulders that were removed from cut areas and used within the embankment.

Roadway Embankment soils within the project corridor are predominantly composed of silts and sands and were encountered during the geotechnical investigation when borings were drilled within or adjacent to NC 105.

Laboratory testing was conducted on four (4) samples of the Roadway Embankment silts. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	29	5	12.7%	39%
HIGH	36	8	26.3%	50%
AVERAGE	**33**	**6**	**22.2%**	**45%**

The Roadway Embankment silts tested were primarily AASHTO classified as sandy silts (A-4). Most Roadway Embankment silts would be considered moist or at or near optimum moisture. SPT results within the Roadway Embankment silts showed soil densities that typically ranged from medium stiff to very stiff with some soft and hard areas. Softer areas typically corresponded with areas of higher moisture content. Harder areas typically had higher concentrations of gravel, cobbles, and boulders.

Roadway Embankment sands were only tested on a limited basis, primarily due to their relative ease of field classification. Laboratory testing was conducted on only one (1) sample of the Roadway Embankment sands. Analysis of the results showed it was AASHTO classified as a silty sand (A-2-4) with a Liquid Limit of 29, a Plasticity Index (PI) of 6, and a Moisture Content of 30.3%. Therefore, the one sample of Roadway Embankment Sands tested was saturated, possibly an indication of some perched water. Sieve analysis of the Roadway Embankment sand sample showed the percentage passing the #200 sieve (silt-clay material) at 27%. SPT results within the Residual sands showed soil densities that typically ranged from loose to dense with some very loose and very dense areas. Very loose areas typically corresponded with areas of higher moisture content. Very dense areas typically had higher concentrations of gravel, cobbles, and boulders.

Roadway Embankment clays are less prevalent than the silts and sands and were rarely encountered during the geotechnical investigation. Laboratory testing was conducted on two (2) samples of the Roadway Embankment clays. The table below provides a summary of the results of the laboratory testing:

	Liquid Limit (L.L)	Plasticity Index (P.I.)	Natural Moisture	Passing # 200 Sieve
LOW	37	12	30.7%	43%
HIGH	54	13	51.8%	67%
AVERAGE	**46**	**13**	**41.3%**	**55%**

The Roadway Embankment clays were primarily AASHTO classified as sandy clays (A-6) and silty clays (A-7-5). Most Roadway Embankment clays would be considered wet or requiring drying to obtain optimum moisture. SPT results within the Roadway Embankment clays showed soil densities that typically ranged from medium stiff to very stiff with some soft and hard areas. Softer areas typically corresponded with areas of higher moisture content. Harder areas typically had higher concentrations of gravel, cobbles, and boulders. No highly plastic (PI value of 26 or more) Roadway Embankment clays were encountered during the geotechnical investigation.

Alluvial soils, soils that have been transported and deposited by water, were only encountered and sampled in one area within the project corridor. However, based on observations of the local topography and flood maps, Alluvial soils are likely present in other areas within the project corridor. Alluvial deposition typically occurs in topographically low areas. These soils are often very near or even below the water table and are generally wet to saturated. As a consequence of their high moisture content and nature of deposition, alluvial soils typically exhibit very soft to soft/very loose to loose soil densities. They also can contain highly plastic clays and sometimes significant amounts of organic matter. Depending on their characteristics, Alluvial soils can be problematic during and after construction. They can negatively impact embankment stability, embankment settlement, and subgrade stability. Approximate locations where Alluvial soils are believed to be present within the project corridor will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report.

Alluvial soils associated with the floodplains of the Watauga River and Laurel Fork are present within the project corridor but were only encountered on a very limited basis during the geotechnical investigation. Laboratory testing was conducted on only one (1) sample of Alluvial clay. Analysis of the results showed it was AASHTO classified as a silty clay (A-7-5) with a Liquid Limit of 44, a Plasticity Index (PI) of 13, and a Moisture Content of 25.3%. Therefore, the one sample of Alluvial clay tested was moist or at or near optimum moisture. Sieve analysis of the Alluvial clay sample showed the percentage passing the #200 sieve (silt-clay material) at only 38%. SPT results within the Alluvial clay showed that the soil density was typically soft.

Engineered Artificial Fill soils from residential and commercial development along NC 105, and the various intersecting secondary roads are also present within the project corridor. Much like the Roadway Embankment soils, they are also likely quite similar to the local soils from which they were sourced. It also may be difficult to differentiate them from the local soils other than a "reworked" appearance and large variation in grain size. If properly constructed, Engineered Artificial Fill soils typically do not present significant issues during future construction projects.

Engineered Artificial Fill soils were encountered on a relatively limited basis during the geotechnical investigation, primarily as part of a building pad or the construction of an existing driveway. Laboratory testing was conducted on three (3) samples of Engineered Artificial Fill. The resulting AASHTO classifications showed that they primarily consisted of sandy silts (A-4), silty sands (A-2-4), and sandy clays (A-6). SPT results within the areas of Engineered Artificial Fill showed that soil densities typically ranged from loose/medium-stiff to medium dense/stiff.

Artificial Fill is also known as uncontrolled fill; These soils are often comprised of low-quality or wasted materials that are not compacted and are not properly drained. Artificial Fill soils contain a variety of other materials. These can be natural materials such as gravel, cobbles, boulders, and organic materials. Or they can be man-made debris such as household garbage, tires, scrap metal, etc. Unlike Engineered Artificial Fill, the engineering properties of these soils are generally quite poor. They also have a tendency to be poorly drained and create perched groundwater situations. Approximate locations where Artificial Fill soils are believed to be present within the project corridor will be highlighted in the "Areas of Special Geotechnical Interest" section of this text report

Artificial Fill soils were encountered on a limited basis during the geotechnical investigation. Laboratory testing was conducted on two (2) samples of Artificial Fill. The resulting AASHTO classifications showed that they primarily consisted of sandy silts (A-4) and slightly plastic, silty clays (A-7-6). SPT results within the areas of Engineered Artificial Fill showed that soil densities typically ranged from loose/medium-stiff to medium dense/stiff.

From looking at the lab data, some general assumptions can be made about the soils present within the project corridor. The subsurface soils throughout the project corridor should generally be suitable as a subgrade material and acceptable as embankment fill or other types of borrow material. It should be noted that some areas of highly plastic clays that were not encountered during the geotechnical investigation could still be discovered during construction.

Rock Properties

The Grandfather Mountain Formation is a succession of arkosic conglomerate, sandstone, and siltstone interbedded with basalt and rhyolite. The entire formation is believed to have undergone mostly greenschist-grade metamorphism. Even with the metamorphism, many relic sedimentary structures remain evident within the formation. The unit is between 3,000 and 9,000 m thick and is exposed only within the Grandfather Mountain Window. Radiometric age determinations, stratigraphic position, and a lack of fossils suggest a late Precambrian age of about 800 to 900 million years old.

Based on analysis of the rock fragments retrieved from SPT testing as well as outcrop mapping, metamorphosed siltstone, metamorphosed sandstone, and metamorphosed conglomerate are all present within the project corridor. In general, the most prominent exposures of rock outcrop are metamorphosed sandstone. The metamorphosed sandstone outcrops located within existing road cuts show evidence of previous blasting activities from the initial construction of NC 105. Less resistant to weathering, the metamorphosed conglomerate, and metamorphosed siltstone are typically exposed in smaller, more weathered-looking outcrops. As previously mentioned, the entire project corridor is believed to be underlain by the Grandfather Mountain Formation, except for one area.

From approximately -L- Station 205+00 to 238+00, the Cranberry Gneiss Formation is present within the project corridor. The Cranberry Gneiss Formation can be broken up into five subunits consisting of a quartz monzonite, chloritic felsic gneiss, a granitic gneiss, a biotite gneiss, and a biotite-amphibolite gneiss. The formation is part of the older crystalline basement rocks comprising the overlying Blue Ridge Thrust Sheet that was mostly eroded away to form the Grandfather Mountain Window. The Lineville Falls thrust fault frames the Grandfather Mountain Window, and while not identified during the investigation, is believed to contain a thick mylonitic zone at the contact with the Grandfather Mountain Formation.

Based on analysis of the rock fragments retrieved from SPT testing as well as outcrop mapping, the quartz monzonite and granitic gneiss of the Cranberry Gneiss formation are believed to be present within the project corridor. Only the quartz monzonite is exposed as outcrop at the surface, located within one of the existing roadcuts of NC 105.

Crystalline Rocks of the Grandfather Mountain and Cranberry Gneiss Formations were encountered within six (6) feet of proposed grade within many areas of the project corridor. Weathered Rock, typically ranging from a foot thick to several feet thick, was often found overlying the Crystalline Rock. Approximate locations where Crystalline Rock is present within six (6) feet of proposed grade will be highlighted in the following section, "Areas of Special Geotechnical Interest."

All designated cut areas can be expected to encounter weathered rock and rock within 6' of the ground surface. Fresh shot-rock excavation on this project is expected to be competent and useable for construction purposes, including riprap, rock plating, and steepened embankment.

Groundwater Properties

At shallow depths and under unconfined conditions, groundwater flow would be expected to be primarily driven by variations in the elevation of the water table surface. This driving mechanism is called topographically-driven flow because the elevation of the water table usually mimics the elevation of the ground surface. Therefore, surface topography may be used to infer the direction of shallow groundwater flow in an area.

Deeper water-bearing zones usually occur within the underlying bedrock, which in this case, is composed of Crystalline Rock (Metamorphic). The movement of groundwater through Crystalline Rocks is one of the least predictable phenomena in all of groundwater science. This is because the porosity of these rocks is very low, and a network of fractures usually controls permeability. The direction of groundwater movement in deeper bedrock aquifers may not be consistent with shallow, unconfined, and topographically-driven groundwater flow.

The geotechnical investigation was conducted during a period of average rainfall. Groundwater was encountered in about half of the drilled borings. Top of water table elevations varied from 2787.2 feet to 3297.1 feet with an average elevation of 2990.2 feet above sea level. Groundwater was encountered as shallow as a foot or two beneath the ground surface to as deep as forty of fifty feet. Typically, groundwater was encountered between five and twenty feet below the ground surface.

It should be noted that shallow, unconfined groundwater can vary significantly based on seasonal variations in precipitation and climatic issues such as drought. It should also be noted that rod soundings cannot accurately detect the depth to groundwater. Therefore, no groundwater information was reported with any of the rod sounding locations performed on the project. Approximate locations where groundwater is present within six feet of proposed grade will be highlighted in the following section, "Areas of Special Geotechnical Interest."

Several springs were identified within the hillsides adjacent to the project corridor, but none were identified within the proposed Right of Way. Several ponds were identified adjacent to the project corridor, and one (1) was identified within the proposed Right of Way at the following location:

Alignment	Station(±)	Offset
-L-	274+20 - 274+91	66-150' Left

A visual reconnaissance for water wells was conducted throughout the project corridor. This was used in conjunction with the final survey file to attempt to identify water wells within or immediately adjacent to the proposed right of way of the project. Some water well locations are well hidden, and it is possible that some wells were missed or misidentified by the final survey and/or visual reconnaissance. Most residences and businesses in the project area are anticipated to use well water and septic systems. Numerous wells were observed outside the project limits. Six (6) wells were observed within or immediately adjacent to the proposed Right of Way at the following locations:

Alignment	Station(±)	Offset
-L-	127+16	34'LT
-L-	187+60	80'LT
-L-	212+30	91'LT
-L-	229+22	84'RT
-L-	233+19	97'RT
-Y4-	11+38	26'RT

Areas of Special Geotechnical Interest

Crystalline Rock - During the geotechnical investigation, Crystalline Rock was encountered in many areas. The excavation of Crystalline Rock can be problematic during construction and may require specialized equipment and/or blasting. More detailed information on the rocks underlying the project corridor can be found in the "Rock Properties" section of this text report. The following approximate locations listed below show areas where Crystalline Rock is believed to be present within six feet of proposed grade.

Alignment	Station(±)	Offset
-L-	68+75 - 70+75	Left
-L-	94+75 - 103+25	Left
-L-	108+75 - 126+75	Left & Right
-L-	134+75 - 145+75	Left & Right
-L-	148+25 - 152+00	Left
-L-	173+75 - 183+25	Right
-L-	184+25 - 192+75	Right
-L-	208+75 - 228+25	Left & Right
-L-	251+75 - 252+25	Right
-L-	256+75 - 260+25	Right
-L-	266+25 - 271+25	Left & Right
-L-	279+25 - 280+75	Right
-L-	281+25 - 282+75	Right
-L-	283+25 - 283+75	Right
-L-	284+25 - 284+75	Right
-L-	285+25 - 285+75	Right
-L-	289+75 - 296+75	Right
-DRW2-	10+60 - 11+50	Left and Right
-DRW3-	10+75 - 11+25	Right
-DRW4-	11+10 - 11+75	Left
-DRW6-	10+43 - 14+25	Left & Right

Groundwater - During the geotechnical investigation, groundwater was encountered within many areas of the project corridor. Groundwater can present issues during and after construction if not dealt with properly. More detailed information on the groundwater underlying the project corridor can be found in the "Groundwater Properties" section of this text report. The following approximate locations listed below show areas where groundwater is believed to be present within 6 feet of proposed grade:

Alignment	Station(±)	Offset
-L-	125+75 - 126+75	Left
-L-	128+75 - 129+25	Left
-L-	174+75 - 175+25	Right
-L-	183+25 - 183+75	Right
-L-	188+75 - 192+75	Right
-L-	222+75 - 224+75	Right
-L-	231+75 - 234+25	Right
-L-	236+75 - 237+25	Right
-L-	242+25 - 245+25	Right
-L-	246+75 - 250+75	Right
-L-	251+75 - 253+25	Right
-L-	262+25 - 262+75	Right
-L-	266+25 - 268+25	Left & Right
-L-	283+75 - 284+25	Right
-L-	285+75 - 286+75	Right
-L-	303+25 - 305+75	Right
-DRW9-	10+41 - 13+50	Left & Right

Colluvial Soils - During the geotechnical investigation, thick deposits of Colluvial soils were encountered within several areas of the project corridor. Colluvial deposits can often provide a focal point for future slope stability issues, especially if the area is saturated. In addition, some Colluvial deposits within the project corridor contain significant quantities of gravel, cobbles, and boulders. Some Colluvial boulders observed within the project corridor were car-sized (and larger) and could present challenges during construction. More detailed information on these soils can be found in the "Soil Properties" section of this text report. The approximate locations listed below show areas where thick deposits of Colluvial soils are believed to be present within the project corridor:

Alignment	Station(±)	Offset
-L-	72+00 - 80+00	Left & Right
-L-	103+50 - 108+50	Left & Right
-L-	127+00 - 132+50	Left & Right
-L-	171+50 - 173+00	Left & Right
-L-	191+50 - 192+75	Left & Right
-L-	194+50 - 200+00	Left & Right
-L-	231+00 - 255+00	Left & Right
-L-	260+50 - 266+00	Left & Right
-L-	272+00 - 273+00	Left
-L-	287+00 - 289+50	Left & Right
-Y1-	10+50 - 15+50	Left & Right
-Y4-	11+50 - 13+50	Left & Right
-DRW3-	10+25 - 10+75	Left & Right
-DRW9-	10+41 - 12+00	Left & Right
-DRW10-	11+00 - 12+50	Left & Right

Alluvial Soils - During the geotechnical investigation, areas of Alluvial soils were observed and encountered. Alluvial soils can be problematic during and after construction. They can negatively impact embankment stability, embankment settlement, and subgrade stability. More detailed information on these soils can be found in the "Soil Properties" section of this text report. The following approximate locations listed below show areas where Alluvial soils are believed to be present within the project corridor:

Alignment	Station(±)	Offset
-L-	68+75 - 70+75	Right
-L-	171+50 - 176+76	Left
-L-	263+25 - 266+25	Left
-L-	266+75 - 267+25	Left
-L-	271+25 - 273+75	Left
-Y4-	13+75 - 14+25	Right

Plastic Soils - During the geotechnical investigation, highly plastic clays were encountered in one area within the project corridor. Highly plastic soils can be problematic during and after construction. They can negatively affect embankment stability, embankment settlement, subgrade stability and may not be suitable for use as embankment material. More detailed information on these soils can be found in the "Soil Properties" section of this text report. The following approximate location listed below shows the area where highly plastic clays are believed to be present within the project corridor:

Alignment	Station(±)	Offset
-L-	247+75 - 248+75	Left & Right

Artificial Fill - During the geotechnical investigation, areas of Artificial Fill were encountered at a few locations within the project corridor. Artificial fill often contains poor or wasted soils (unusable) from other projects. In some cases, they can contain buried organic material, household garbage, or man-made debris. They also are typically poorly drained and can contain perched groundwater. More information on these soils can be found in the "Soils Properties" section of this text report. The following locations listed below show areas where Artificial Fill is believed to be present within the project corridor:

Alignment	Station(±)	Offset
-L-	190+75 - 191+25	Right
-L-	280+75 - 283+25	Left
-L-	302+75 - 303+75	Right

References

North Carolina Geological Survey, 1985, Geologic map of North Carolina: North Carolina Geological Survey, General Geologic Map, scale 1:500000.

The Geology of the Carolinas, J. Wright Horton, Jr., and Victor A. Zullo

Groundwater Science, Charles R. Fitts

F. L. Schwab; Grandfather Mountain Formation; depositional environment, provenance, and tectonic setting of late Precambrian alluvium in the Blue Ridge of North Carolina. *Journal of Sedimentary Research* 1977;; 47 (2): 800–810. doi: https://doi.org/10.1306/212F7257-2B24-11D7-8648000102C1865D

Hill, Jesse S. "1:12,000 Geologic Map Covering Parts of the Boone, Deep Gap, Sherwood, Valle Crucis, and Zionville Quadrangles, Western North Carolina."

Hill , Jesse S. "Post-Orogenic Uplift, Young Faults, And Mantle Reorganization in the Appalachians ." *UNC Chapel Hill*, 2018.

Stewart, Kevin, and Rick Wooten. "Carolina Geological Society - 79th Annual Meeting ." Gray, Richard E. "Colluvium in the Appalachian Plateau Physiographic Province."

Respectfully Submitted,

Brett Smith, PG
Project Geologist
Summit Design and Engineering Services, PLLC
NC License # 2390

5/14/99

-L-

PI Sta 69+04.36	PI Sta 77+24.31	PIs Sta 82+26.10
Δ = 15° 12' 35.3" (LT)	Δ = 15° 19' 04.8" (LT)	Θs = 1° 27' 13.6"
D = 2° 02' 46.6"	D = 1° 42' 37.2"	Ls = 170.00'
L = 743.29'	L = 895.62'	LT = 113.34'
T = 373.84'	T = 450.50'	ST = 56.67'
R = 2,800.00'	R = 3,350.00'	
SE = 0.05	SE = 0.05	
RO = 135'	RO = 170'	

-Y1-

PI Sta 11+55.36	PI Sta 21+27.42
Δ = 92° 59' 28.6" (LT)	Δ = 15° 10' 18.8" (RT)
D = 57° 17' 44.8"	D = 2° 51' 53.2"
L = 162.30'	L = 529.60'
T = 105.36'	T = 266.36'
R = 100.00'	R = 2,000.00'
SE = 0.03	SE = RC
RO = 63'	RO = 32'
DS = 20 MPH	DS = 30 MPH

SEE SHEET 23 FOR -L- PROFILE
SEE SHEET 35 FOR -Y1- PROFILE

Kimley»Horn
200 SOUTH TRYON, SUITE 200
CHARLOTTE, N.C. 28202

PROJECT REFERENCE NO.	SHEET NO.
R-2566B	4

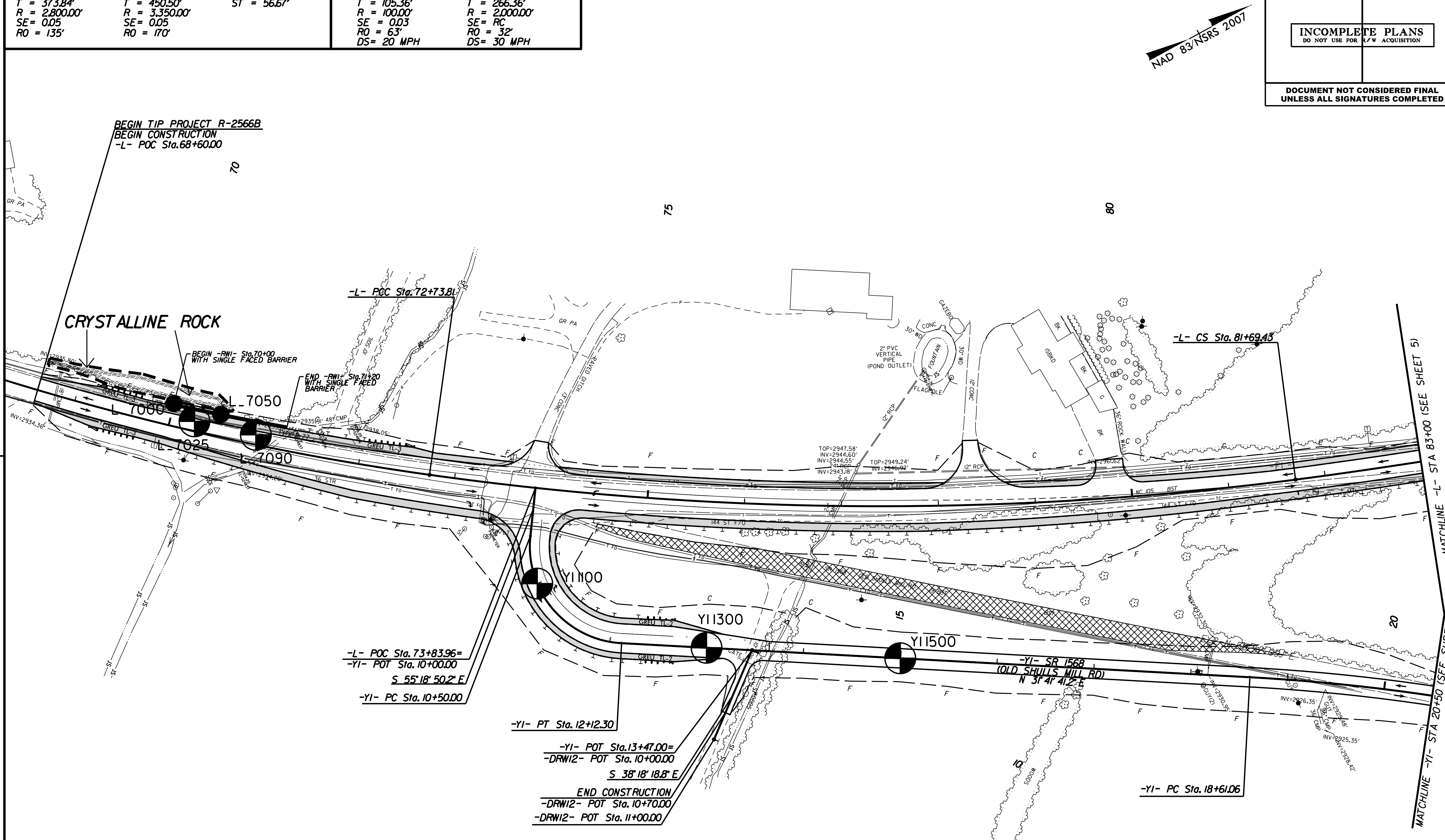
R/W SHEET NO.

ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS



PAVEMENT REMOVAL

PROPOSED PAVED SHOULDER

RADII DIMENSIONS ARE TO THE EDGE OF PAVEMENT UNLESS OTHERWISE NOTED

$FILE$

$DATE$

5/14/99

-L-

Pls Sta 82+26.10	Pls Sta 84+75.45	PI Sta 87+54.45	Pls Sta 90+31.92	Pls Sta 93+24.00	PI Sta 98+46.63
θs = 1°27' 13.6"	θs = 2°55' 19.5"	Δ = 12°02' 44.4" (RT)	θs = 2°55' 19.5"	θs = 6°05' 39.1"	Δ = 44°01' 34.2" (LT)
Ls = 170.00'	Ls = 204.00'	D = 2°51' 53.2"	Ls = 204.00'	Ls = 234.00'	D = 5°12' 31.3"
LT = 113.34'	LT = 136.02'	L = 420.47'	LT = 136.02'	LT = 156.09'	L = 845.24'
ST = 56.67'	ST = 68.02'	T = 211.01'	ST = 68.02'	ST = 78.08'	T = 444.72'
		R = 2,000.00'			R = 1,100.00'
		SE = 0.06			SE = 0.06
		RO = 204'			RO = 234'
					DS = 55 MPH

-Y1-

PI Sta 21+27.42	PI Sta 26+96.76	PI Sta 29+49.90
Δ = 15°10' 18.8" (RT)	Δ = 50°13' 57.6" (RT)	Δ = 0°30' 41.8" (RT)
D = 2°51' 53.2"	D = 19°05' 54.9"	D = 0°30' 00.0"
L = 529.60'	L = 263.02'	L = 102.32'
T = 266.36'	T = 140.63'	T = 51.16'
R = 2,000.00'	R = 300.00'	R = 11,459.16'
SE = RC	SE = 0.04	SE = EXIST
RO = 32'	RO = 64'	RO = 64'
DS = 30 MPH	DS = 30 MPH	DS = EXIST

-Y2-

PI Sta 13+16.56
Δ = 79°21' 39.3" (RT)
D = 36°57' 54.1"
L = 214.69'
T = 128.59'
R = 155.00'
SE = EXIST
RO = 80'
DS = EXIST

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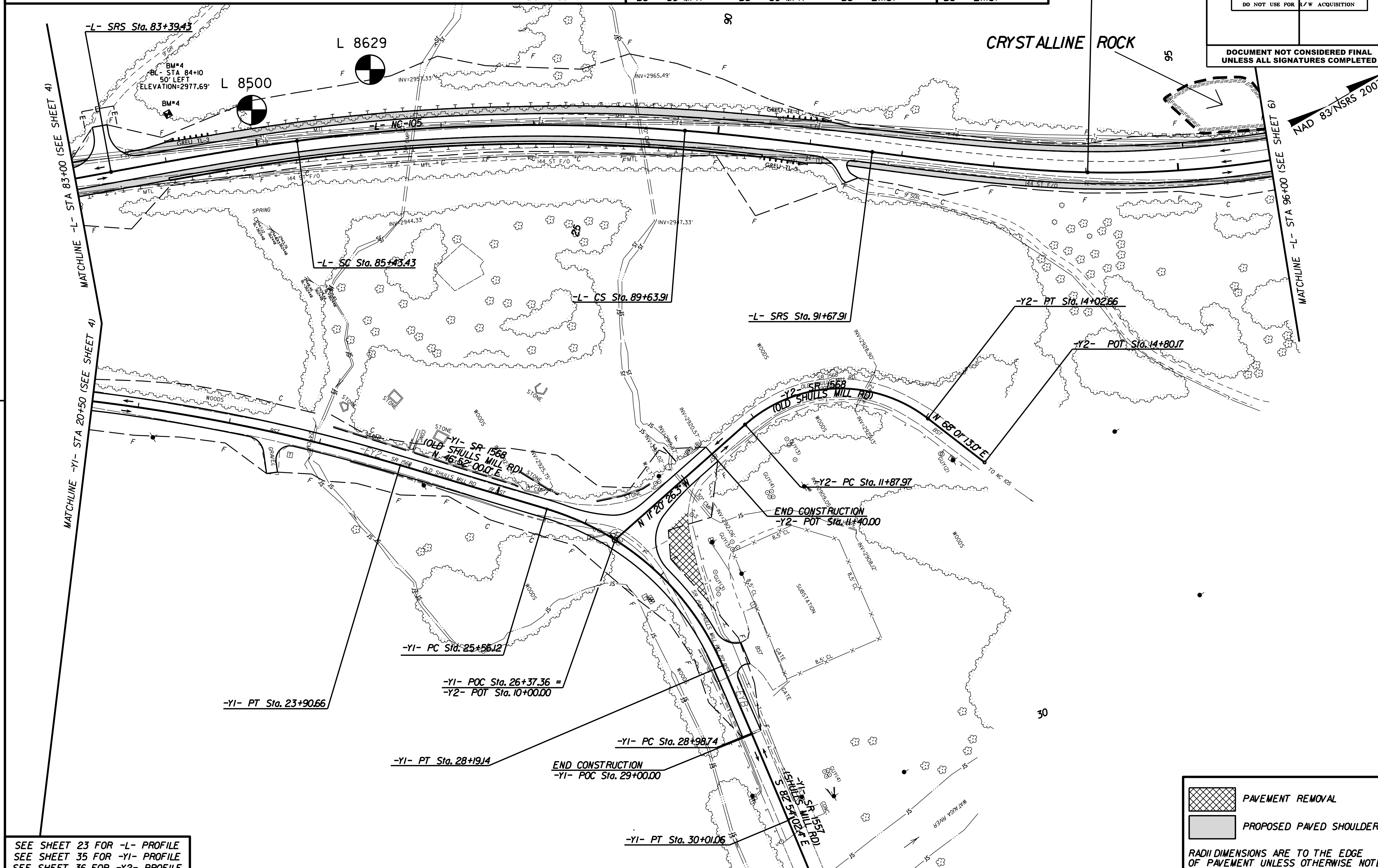
200 SOUTH TRYON, SUITE 200
CHARLOTTE, N.C. 28202

PROJECT REFERENCE NO.	SHEET NO.
R-2566B	5
R/W SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS



PAVEMENT REMOVAL

PROPOSED PAVED SHOULDER

RADII DIMENSIONS ARE TO THE EDGE OF PAVEMENT UNLESS OTHERWISE NOTED

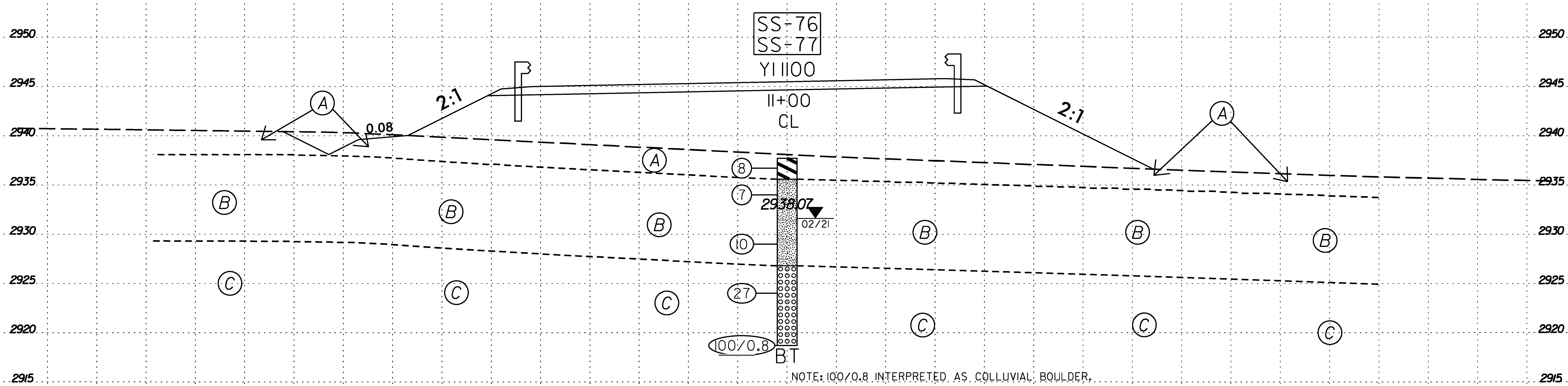
SEE SHEET 23 FOR -L- PROFILE
SEE SHEET 35 FOR -Y1- PROFILE
SEE SHEET 36 FOR -Y2- PROFILE

$FILE$

$DATE$

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-76	CL	11+00	0.0' – 1.5'	A-7-6(11)	42	15	9.4	13.7	36.0	40.9	90	85	74	41.5	N/A
SS-77	CL	11+00	2.7' – 4.2'	A-4(1)	31	4	26.8	21.1	42.3	9.8	95	77	56	31.1	N/A



(A) **COLLUVIAL:** brown, wet, stiff, slightly plastic, silty CLAY (A-7-6) with some sand

(B) **COLLUVIAL:** brown to orange-brown, wet to saturated, medium stiff to stiff, sandy SILT (A-4)

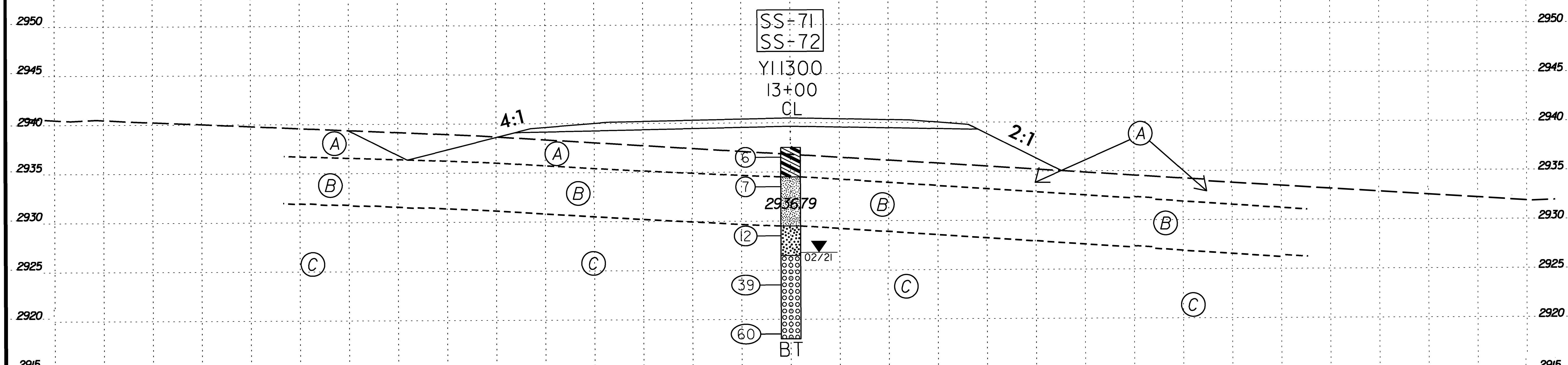
(C) **COLLUVIAL:** orange-brown, brown, and green-brown, saturated, medium dense to very dense, fine to coarse SAND (A-1-b) with some gravel

11+00.00

-Y1-

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT C. SAND	F. SAND	SILT	CLAY	% PASSING (SIEVES) 10	40	200	% MOISTURE	% ORGANIC
SS-71	CL	13+00	0.0' - 1.5'	A-6(11)	40	13	6.8	13.3	41.0	38.9	93	89	79	32.2	N/A
SS-72	CL	13+00	3.0' - 4.5'	A-4(5)	35	7	17.2	15.6	42.8	24.4	96	83	70	28.1	N/A



(A) **COLLUVIAL:** *brown, wet, medium stiff, slightly plastic, sandy CLAY (A-6) with trace gravel*

(B) **COLLUVIAL:** *tan, moist to wet, medium stiff, sandy SILT (A-4) with some clay*

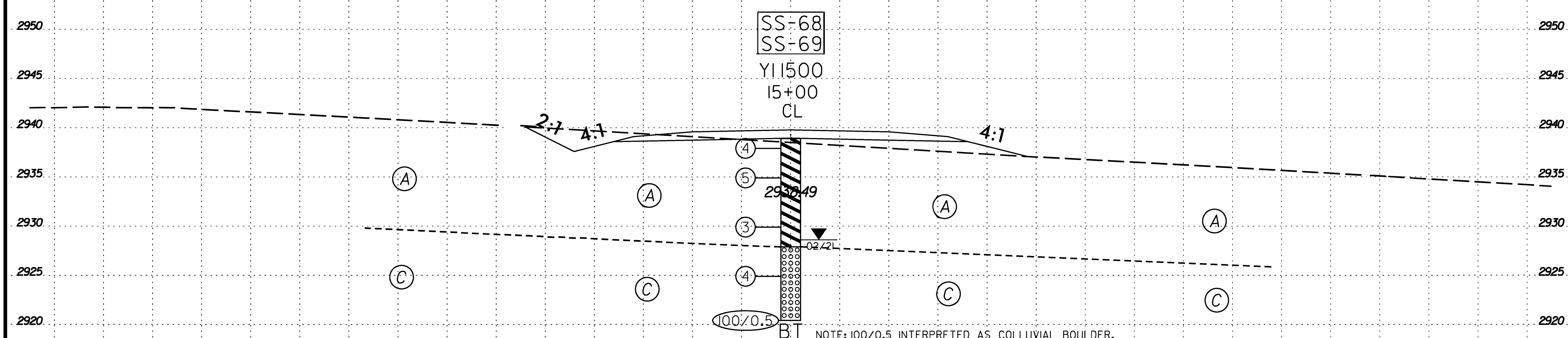
(C) **COLLUVIAL:** *brown-red and gray, moist to saturated, medium dense to very dense, silty SAND (A-2-4) and sandy GRAVEL (A-1-a) with some cobbles and boulders*

13+00.00

-Y1-

SOIL TEST RESULTS

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C. SAND	F. SAND	SILT	CLAY	10	40	200		
SS-68	CL	15+00	3.0' - 4.5'	A-7-5(17)	45	15	1.1	8.9	46.6	43.4	100	99	94	33.6	N/A
SS-69	CL	15+00	8.0' - 9.5'	A-7-5(18)	50	18	0.4	1.7	44.1	53.8	85	85	84	44.4	N/A



(A) **COLLUVIAL:** brown, tan, and gray, moist to saturated, soft to medium stiff, slightly to moderately plastic, silty CLAY (A-7-5)

(C) **COLLUVIAL:** brown and green, saturated, loose to very dense, sandy GRAVEL (A-1-a) with some sand, silt, cobbles, and boulders

15+00.00

-Y1-

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

GEOTECHNICAL ENGINEERING UNIT

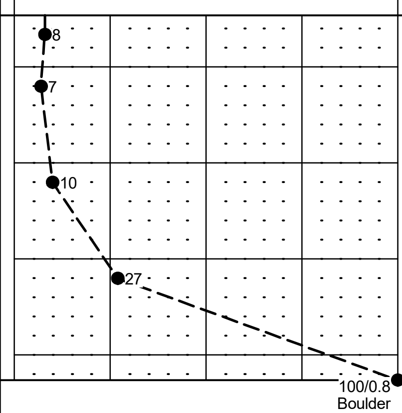
SUBSURFACE INVESTIGATION

APPENDIX A
BORING LOGS (-Y1 ALIGNMENT)

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 37512.1.5	**TIP** R-2566B	**COUNTY** WATAUGA	**GEOLOGIST** Shipman, M.
SITE DESCRIPTION NC 105 FROM SR 1568 (OLD SHULLS MILL RD) TO SR 1107 (NC 105 BYPASS)			**GROUND WTR (ft)**
BORING NO. Y1_1100	**STATION** 11+00	**OFFSET** CL	**ALIGNMENT** -Y1- / **0 HR.** 9.5
COLLAR ELEV. 2,937.7 ft	**TOTAL DEPTH** 19.0 ft	**NORTHING** 892,131	**EASTING** 1,188,240 / **24 HR.** 6.1
DRILL RIG/HAMMER EFF./DATE SUM3123 CME-550X 91% 11/19/2020	**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Gonzalez, L.	**START DATE** 02/10/21	**COMP. DATE** 02/10/21	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT	SAMP. NO.	MOI	SOIL AND ROCK DESCRIPTION
2940									
	2,937.7	0.0	3	4	4	8	SS-76	42%	2,937.7 GROUND SURFACE 0.0 **COLLUVIAL** 2,935.6 brown, slightly plastic, silty CLAY (A-7-6) with some sand 2.1
2935	2,935.0	2.7	3	3	4	7	SS-77	31%	brown to orange-brown, sandy SILT (A-4)
2930	2,930.0	7.7	2	2	8	10		Sat.	2,926.8 10.9
2925	2,925.0	12.7	11	15	12	27		Sat.	orange-brown, brown, and green-brown, fine to coarse SAND (A-1-b) with some gravel
2920	2,920.0	17.7	17	52	48/0.3	100/0.8 Boulder			2,918.7 19.0



Boring Terminated at Elevation 2,918.7 ft in Colluvial (BOULDER)

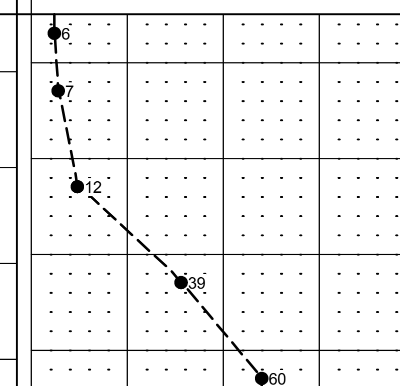
- No topsoil observed/reported.

- 100/0.8 interpreted as Colluvial Boulder.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 37512.1.5	**TIP** R-2566B	**COUNTY** WATAUGA	**GEOLOGIST** Gross, A.
SITE DESCRIPTION NC 105 FROM SR 1568 (OLD SHULLS MILL RD) TO SR 1107 (NC 105 BYPASS)			**GROUND WTR (ft)**
BORING NO. Y1_1300	**STATION** 13+00	**OFFSET** CL	**ALIGNMENT** -Y1- / **0 HR.** Dry
COLLAR ELEV. 2,937.5 ft	**TOTAL DEPTH** 19.5 ft	**NORTHING** 892,252	**EASTING** 1,188,382 / **24 HR.** 10.7
DRILL RIG/HAMMER EFF./DATE SUM3123 CME-550X 91% 11/19/2020	**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER Gonzalez, L.	**START DATE** 02/09/21	**COMP. DATE** 02/09/21	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT	SAMP. NO.	MOI	SOIL AND ROCK DESCRIPTION
2940									
	2,937.5	0.0	2	3	3	6	SS-71	32%	2,937.5 GROUND SURFACE 0.0 **COLLUVIAL** brown, sandy CLAY (A-6) with trace gravel 2,934.5 3.0
2935	2,934.5	3.0	4	4	3	7	SS-72	28%	tan, sandy SILT (A-4) with some clay
2930	2,929.5	8.0	2	4	8	12		M	2,929.5 8.0 brown-red, silty SAND (A-2-4) with some gravel 2,926.5 11.0
2925	2,924.5	13.0	13	21	18	39		Sat.	gray, sandy GRAVEL (A-1-a) with some cobbles and boulders
2920	2,919.5	18.0	11	18	42	60		Sat.	2,918.0 19.5



Boring Terminated at Elevation 2,918.0 ft in Colluvial (sandy GRAVEL)

- Topsoil = 0.0 - 0.7 ft.

GEOTECHNICAL BORING REPORT
BORE LOG

WBS 37512.1.5	**TIP** R-2566B	**COUNTY** WATAUGA	**GEOLOGIST** Gross, A.
SITE DESCRIPTION NC 105 FROM SR 1568 (OLD SHULLS MILL RD) TO SR 1107 (NC 105 BYPASS)			**GROUND WTR (ft)**
BORING NO. Y1_1500	**STATION** 15+00	**OFFSET** CL	**ALIGNMENT** -Y1- / **0 HR.** 10.4
COLLAR ELEV. 2,938.9 ft	**TOTAL DEPTH** 18.5 ft	**NORTHING** 892,422	**EASTING** 1,188,487 / **24 HR.** 10.3
DRILL RIG/HAMMER EFF./DATE SUM3123 CME-550X 91% 11/19/2020		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER Gonzalez, L.	**START DATE** 02/09/21	**COMP. DATE** 02/09/21	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2940										2,938.9 GROUND SURFACE 0.0
	2,938.9	0.0	2	2	2	4		M		**COLLUVIAL** brown, tan, and gray, slightly to moderately plastic, silty CLAY (A-7-5)
2935	2,935.9	3.0	2	2	3	5	SS-68	34%		
2930	2,930.9	8.0	0	1	2	3	SS-69	44%		
										2,927.9 11.0 brown and green, sandy GRAVEL (A-1-a) with some sand, silt, cobbles, and boulders
2925	2,925.9	13.0	2	2	2	4		Sat.		
	2,920.9	18.0	100/0.5			100/0.5 Boulder				2,920.4 18.5

Boring Terminated at Elevation 2,920.4 ft in Colluvial (BOULDER)

- Topsoil = 0.0 - 0.6 ft.

- 100/0.5 interpreted as Colluvial Boulder.