STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-4906	1	28
STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION	
R-4906		P.E.	
		CONST.	

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

STRUCTURE SUBSURFACE INVESTIGATION

STATE PROJECT R-4906 I.D. NO.

F.A. PROJECT

COUNTY PERSON

PROJECT DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK

SITE DESCRIPTION

ID:

PROJECT: R-4906

CONTENTS: **PAGE NUMBER:**

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS 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 UNIT @ (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA IS 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 THIS 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.

INVESTIGATED BY C. BRUINSMA PERSONNEL S. HAN

CHECKED BY G. LANG, P.E. B. SAWASKA

SUBMITTED BY TIERRA, INC.

DATE APRIL, 2007

DRAWN BY: P. ZHANG

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - 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.

NORTH CAROLINA PROFESSIONAL SEAL 31421 ENGINEER GABRIEL W. LANG SEAL

4/11/07

SIGNATURE

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
	R-4906	2	28

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. 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	50 MX											GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
#40	30 MX	50 MX	51 MN											
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN			
LIQUID LIMIT	6 MX		N.P.	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
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 A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

P.I. OF A-7-5 ≤ L.L. - 30 : P.I. OF A-7-6 > L.L. - 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	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.5
	MEDIUM STIFF	4 TO 8	0.5 TO 1
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.0	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	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, 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
UNIFORM- INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED- INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE 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 WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 30
MODERATELY COMPRESSIBLE	LIQUID LIMIT 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 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 SEEPAGE

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS
- INFERRED SOIL BOUNDARIES
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 DIP/DIP DIRECTION OF ROCK STRUCTURES
- SOUNDING ROD
- SPT CPT DPT DMT VST PMT TEST BORING
- AUGER BORING
- CORE BORING
- MW MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- SPT N-VALUE
- REF SPT REFUSAL

SAMPLE DESIGNATIONS

- S- BULK SAMPLE
- SS- SPLIT SPOON SAMPLE
- ST- SHELBY TUBE SAMPLE
- RS- ROCK SAMPLE
- RT- RECOMPACTED TRIAXIAL SAMPLE
- CBR - CBR SAMPLE

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
FRAGS. - FRAGMENTS
MED. - MEDIUM
PMT - PRESSUREMETER TEST
REF. - SPT REFUSAL
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT
W - MOISTURE CONTENT
V. - VERY
VST - VANE SHEAR TEST

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- ☐ MOBILE B- ___
- ☐ BK-51
- ☐ CME-45
- ☒ CME-550
- ☐ PORTABLE HOIST
- ☐ OTHER: _____
- ☐ OTHER: _____

ADVANCING TOOLS:
- ☐ CLAY BITS
- ☐ 6" CONTINUOUS FLIGHT AUGER
- ☒ 8" HOLLOW AUGERS
- ☐ HARD FACED FINGER BITS
- ☐ TUNG.-CARBIDE INSERTS
- ☐ CASING ☐ W/ ADVANCER
- ☐ TRICONE ___3___" STEEL TEETH
- ☐ TRICONE _____" TUNG.-CARB.
- ☒ CORE BIT
- ☐ OTHER _____

HAMMER TYPE:
- ☐ AUTOMATIC ☒ MANUAL

CORE SIZE:
- ☐ -B_____
- ☒ -N Q_____
- ☐ -H_____

HAND TOOLS:
- ☐ POST HOLE DIGGER
- ☐ HAND AUGER
- ☐ SOUNDING ROD
- ☐ VANE SHEAR TEST
- ☐ OTHER: _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL. 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 FOLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.
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 FELOSPARS 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 ROCKS 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, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS 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 GEOLOGISTS 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 GEOLOGISTS 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 GEOLOGISTS 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 FEET
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 THE 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 WHICH 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, AS SHALE, SLATE, ETC.

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

CALCAREOUS (CALC.) - SOILS WHICH 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 (F.P.) - 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 SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (R.Q.D.) - 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 WHICH 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, WHICH 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 B.P.F.) 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 LESS THAN 0.1 FOOT PENETRATION WITH 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 (S.R.Q.D.) - 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 (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:

NOTES:

REVISED 09/15/00

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

April 11, 2007

Mr. Kevin Austin, P.E.
Mulkey Engineers and Consultants
6750 Tryon Road
Cary, NC 27511

Re: Geotechnical Subsurface Exploration Report

Project ID.:	R-4906
County:	Person County
Description:	Bridge No. 59 on SR 1322 over Story's Creek
Tierra Inc. Proj. No.:	6211-07-005

Dear Mr. Austin:

As authorized, Tierra, Inc. (Tierra) has completed the geotechnical subsurface exploration for Bridge No. 59 on SR 1322 over Story's Creek in Person County, North Carolina. Our investigation was performed in general accordance with our proposal number TR-07-007, dated January 19, 2007. The purpose of this report is to present subsurface conditions and foundation design recommendations for the planned structure. Field and laboratory test results, site and boring location plans, and profiles depicting subsurface conditions may be found in this report.

PROJECT DESCRIPTION

According to the Bridge Survey and Hydraulic Design Report dated April 17, 2006, the referenced project intends to replace the existing steel pile supported bridge spanning Story's Creek. The proposed replacement structure is to consist of a three span, four bent bridge and will be approximately 175 feet long. The structure is planned to be located between Station 14+53 and Station 16+28, and have a skew angle of 60°. Information provided by Mulkey Engineers and Consultants indicates that the caps will be at elevations of approximately 384 to 385 feet and the finished grade of the structure at or near existing grade. Bridge embankments will be reconstructed with Class II Rip Rap. A 100 year design scour elevation of approximately 358 feet was indicated on the Bridge Survey and Hydraulic Design Report. However, geotechnical design scour elevations, for our analysis, were assumed to be at elevations of 368.5 to 369.5 feet, which represent the point at which weathered rock is first encountered.

If any of the above information is incorrect or has changed, please inform Tierra so that we may amend the recommendations presented in this report if appropriate.

SITE DESCRIPTION/GEOLOGY

The project site is located along SR 1322 in a rural area, approximately 5 miles outside the city limits of Roxboro, North Carolina in Person County. Story's Creek flows to the north beneath SR 1322 into Hyco River, approximately 3.5 miles downstream. A small tributary/drainage ditch flows into Story's Creek approximately 25 to 30 feet upstream of the existing bridge.

Topographically, the site is rolling, ascending in elevation rapidly past the floodplain boundaries. Story's Creek is approximately 15 to 20 feet wide and 1 foot deep during our investigation. The existing floodplain is approximately 700 feet wide. Floodplain cover consists of shrubs, and moderate to old growth trees.

The project site is located in the Piedmont Physiographic Province of North Carolina, near of Roxboro, North Carolina. ***The Geologic Map of North Carolina*** (1985) indicates the bridge site is located within the Milton Belt. Specifically the site is within the Biotite Gneiss and Schist Formation (**€Zbg**). Rocks of this formation are Late Proterozoic to Cambrian in age and contain biotite gneiss interlayered with calc-silicate rock, mica schist and amphibolite. The rocks encountered at the site consist of amphibolite gneiss. Outcropping of rock was observed northwest of the project limits, but was not measured during our exploration.

FIELD EVALUATION PROCEDURE

The subsurface exploration consisted of performing six (6) soil test borings along the proposed end and interior bent lines. Boring EB2B was originally planned to be drilled at interior bent 2, however, due to overhead utilities, had to be offset to the end bent. Borings were performed with a CME 550 All Terrain Vehicle (ATV) with a manual hammer. Standard Penetration Tests (SPT) and soil sampling were performed in general accordance with American Association of State Highway Transportation Officials (AASHTO T-206-87). Rock coring was performed in accordance with (AASHTO T-225-83 (2000)) procedure utilizing a 2.0-inch diameter NQ size core barrel.

Groundwater measurement readings were taken within each borehole with a weighted 100-foot measuring tape from a reference location at the top of each boring. Readings were recorded immediately after boring termination and after a 24-hour waiting period. Each borehole elevation was estimated based on topographic contour maps provided by Mulkey Engineers and Consultants.

In addition to our subsurface investigation, a visual scour evaluation was performed along the channel and banks of Story's Creek and is included in the Appendix of this report.

SUBSURFACE AND GROUNDWATER CONDITIONS

Subsurface soils penetrated beneath the site consist of roadway embankment soil underlain by alluvial deposits, followed by weathered rock and crystalline rock.

End Bents

Soils beneath End Bents No.1 and 2 consist of roadway embankment and alluvial deposits. Roadway embankment soils were encountered at the ground surface and consist of approximately 6 to 10 feet of medium stiff sandy/clayey silt and silty clay (A-4, A-5, A-7-5). Alluvial deposits were encountered below the roadway embankment and extended to an elevation of approximately 370 to 371 feet. These soils consist of loose to medium dense sand and silty/clayey sand (A-1-b,

2736 Rowland Road ▪ Raleigh, North Carolina 27615
Phone (919) 871-0800 ▪ Fax (919) 871-0803

A-2-4, A-2-6), and soft to medium stiff sandy/silty clay and clayey silt (A-4, A-6). Amphibolite weathered rock was encountered below the alluvial deposits and underlain by amphibolite gneiss crystalline rock at elevations of approximately 366 to 368 feet.

Interior Bents

Soils beneath Interior Bents No. 1 and 2 consist of alluvial deposits. Alluvial deposits were encountered at ground surface and extended to elevations ranging from approximately 369 to 371 feet. These soils consist of very loose to very dense sandy gravel and sand (A-1-a, A-1-b) and very soft to medium stiff sandy silt (A-4). Amphibolite weathered rock was encountered below the alluvial deposits and underlain by crystalline amphibolite gneiss rock at elevations of approximately 367 to 368 feet.

Groundwater across the site ranged in elevation between approximately 375 and 380 feet. Standing water below the bridge, at the time of our investigation, was approximately 1.0 foot deep.

LABORATORY TESTING

Representative split-spoon samples were selected from soil test borings to verify visual field classifications and determine soil index properties. A total of six (6) samples were analyzed in our laboratory for natural moisture determination, Atterberg limits, and grain size analysis. In addition, representative channel and bank bulk samples were analyzed for grain size distribution. Two rock core samples were tested for compressive strength testing. All testing was performed in accordance with the following American Society for Testing and Materials (ASTM), (NCDOT) Modified and/or (AASHTO) procedures:

- AASHTO T-88-00 (As Modified) "Particle Size Analysis of Soil"
- AASHTO T-89-902(As Modified) "Determining the Liquid Limits of Soil"
- AASHTO T-90-00 "Determining the Plastic Limit and Plasticity of Soils"
- AASHTO T-265-93 "Laboratory Determination of Moisture Content of Soils"
- ASTM D 2938-95 "Unconfined Compressive Strength of Intact Rock Core"
- ASTM D 3148-02 "Elastic Moduli of Intact Rock Core in Uniaxial Compression"

The results of the laboratory testing indicate that the site soils tested ranged from gravel and silty sand (A-1-a and A-2-4) to clayey silt and silty clay (A-4, A-6 and A-7-5).

CONCLUSIONS

The results of our subsurface investigation indicate that the subsurface conditions consist predominately of alluvial soils of very loose to dense sandy gravel/sand, and very soft to medium stiff clays and silts, underlain by weathered rock and crystalline rock. Weathered rock was encountered at elevations of approximately 370 to 371 feet (depths of 6 to 18 feet) and underlain by crystalline rock at elevations of approximately 366 to 368 feet. In addition, shallow groundwater was encountered at elevations ranging from 375 to 380 feet. Considering the presence of shallow groundwater, potentially compressible alluvial soils and deeper depths to crystalline rock, a combination of driven piles and drilled piers bearing on weathered and/or crystalline rock are anticipated for the bridge structure.

FOUNDATION RECOMMENDATIONS

Based on the depth to competent bearing material, the end bents for the proposed bridge may be supported by driven HP 12x53 steel piles and interior bents by 36 inch diameter drilled piers. The piles for the end bents may be designed using an allowable capacity of 45 tons with a safety factor of 2. The allowable pile capacities were estimated utilizing static methods and the actual capacity of the piles should be verified during installation using pile driving criteria, from wave equation analysis, established by the Geotechnical Engineer. The piers for the interior bents should be designed to bear in weathered rock and/or crystalline rock and designed using an allowable capacity of 200 tons with a safety factor of 2.5. For more information, refer to the attached "Summary of Foundation Recommendations".

The piles/piers shall be spaced at a minimum of three times the diameter to prevent reductions due to group effects. During construction of the end bent caps, the embankment soils should be laid back at no steeper than (2H:1V) or as required by OSHA. Temporary shoring may also be required. Backfill behind the end bent caps shall be replaced in accordance with Section 410-8 and 410-9 of the Standard Specifications.

From the information provided, we understand the structure will be constructed at or near existing site grades. Provided that the embankments are constructed in accordance with NCDOT specifications and suitable slope protection measures are incorporated, the slopes may be reconstructed as planned.

CLOSURE

Recommendations and evaluations provided by Tierra are based on the Bridge Survey & Hydraulic Design Report dated April 17, 2006 and information provided by Mulkey Engineers and Consultants. Modifications of our recommendations and evaluations may be required if there are changes to the design or location of the structure. Recommendations in this report are based on data obtained from soil borings. The nature and extent of variations between borings may not become evident until construction.

Our professional services for this project have been performed in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made. Tierra appreciates this opportunity to have provided you with geotechnical engineering services for this project. If you have any questions regarding this report, please contact our office.

Sincerely,
TIERRA, INC.

Seungwoon (Sean) Han, Ph.D., P.E.
Geotechnical Engineer

NORTH CAROLINA PROFESSIONAL SEAL 31421 ENGINEER GABRIEL W. LANG

Gabriel W. Lang, P.E.
Sr. Geotechnical Engineer/ Manager

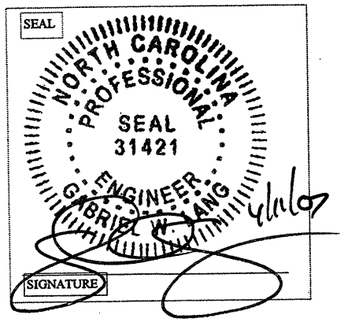
SUMMARY OF FOUNDATION RECOMMENDATIONS

NCDOT PROJ. NO.: R-4906 **PROJECT DESCRIPTION:** Bridge # 59 on SR 1322 over Story's Creek

T.I.P. NO.:

COUNTY: Person

STATION: 15+40 -L-



PREPARED BY: SWH **DATE:** 3/27/07

CHECKER: GWL **DATE:**

	STATION	FOUNDATION TYPE	ALLOWABLE LOAD	FOUNDATION DETAILS
END BENT 1	14+53 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 384 ft ± Recommended Length of Pile = 20 ft
BENT 1	15+08 -L-	36" Drilled Pier	200 tons/Pier	Assumed Bottom of Cap = 384 ft ± Assumed Top of Pier = 376 ft Tip Elevation No Higher Than = 362 ft Recommended Length of Pier = 14 ft
BENT 2	15+73 -L-	36" Drilled Pier	200 tons/Pier	Assumed Bottom of Cap = 384 ft ± Assumed Top of Pier = 376 ft Tip Elevation No Higher Than = 362 ft Recommended Length of Pier = 14 ft
END BENT 2	16+28 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap =385 ft ± Recommended Length of Pile = 20 ft

COMMENTS & NOTES (Attached)

R-4906, Person County
Bridge # 59 on SR 1322 over Story's Creek
6211-07-005

Note on Plans:

1. Drive piles at End Bents No. 1 and 2 to a required bearing capacity of 90 tons per pile. The required bearing capacity is equal to the allowable bearing capacity with a minimum factor of safety of two.
2. The allowable bearing capacity for piles at End Bents No. 1 and 2 is 45 tons per pile.
3. Drilled piers at Bents No. 1 and 2 are designed for both skin friction and end bearing. Check field conditions for the required end bearing capacity of 25 tsf.
4. Drilled piers at Bents No.1 and 2 are designed for an applied load of 190 tons at the top of the column.
5. Permanent steel casing may be required for drilled piers at Bents No. 1 and 2. If required, do not extend the casing below elevation 371 ft and 368.5 ft, respectively without prior approval from the Engineer. The Engineer will determine the need for permanent steel casing. See Drilled Piers Special Provision.
6. Drilled piers at Bents No. 1 and 2 shall extend to an elevation no higher than 362 ft and satisfy the required end bearing capacity.
7. The scour critical elevation for Bents No. 1 and 2 is elevation 369 ft and 366.5 ft respectively. Scour critical elevations are used to monitor possible scour problems during the life of the structure.
8. For drilled piers, see Drilled Piers Special Provision.
9. SPT testing is not required to determine the end bearing capacity of the drilled piers at Bents No. 1 and 2.
10. Do not use slurry construction for drilled piers at Bents No. 1 and 2.
11. Do not use polymer slurry for drilled piers at Bents No. 1 and 2.
12. CSL tubes are required and CSL testing may be required for the drilled piers. The Engineer will determine the need for CSL testing. See Crosshole Sonic Logging Special Provision.

Comments:

1. 1.5 :1 (H:V) slope is Ok with Class II Rip Rap slope protection.
2. The elevation of the point of fixity for Bents No. 1 and 2 is 366 ft.
3. Design scour elevations for Bents No. 1 and 2 are 369.5 ft and 368.5 ft respectively.

DRILLED PIER PAY ITEM QUANTITIES

PROJECT NO. R-4906 DATE 3/26/2007

TIP NO. _____ DESIGNED BY SWH

COUNTY Person CHECKED BY GWL

STATION _____

DESCRIPTION Bridge # 59 on SR 1322 over Story's Creek

NUMBER OF BENTS WITH DRILLED PIERS 2

NUMBER OF PIERS PER BENT 3

BENT #	DRILLED PIER PAY ITEMS					
	PERMANENT STEEL CASING FOR 36" DIA. DRILLED PIER (yes/no/maybe)	36" DIA. DRILLED PIERS NOT IN SOIL (feet)	SPT TESTING (each)	SID INSPECTION (each)	CROSSHOLE SONIC LOGGING* (each)	CSL TUBES* (yes/no)
1	Maybe	27	0	0	0	YES
2	Maybe	21	0	0	0	YES
3						
4						
5						
6						
7						
8						
9						
10						
TOTALS		48	0	0	0	

* Pay items, "Crosshole Sonic Logging" and "CSL Tubes" are not required unless CSL testing is required with a Note on Plans.

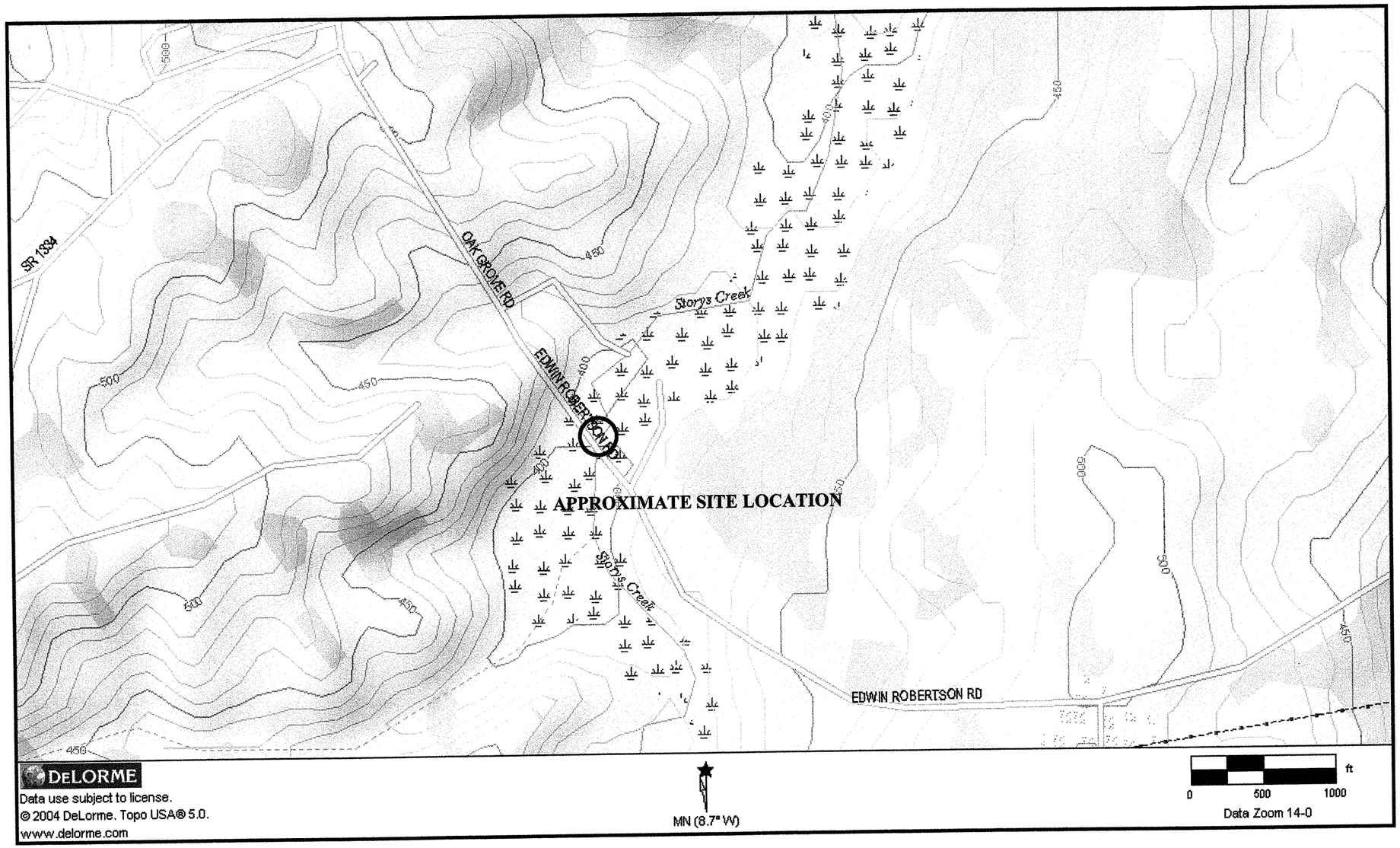
Notes:

Blanks or no represent quantity of zero.

If permanent steel casing is required or may be required, Structure Design should calculate the pay item quantity, "Permanent Steel Casing for ___ Dia. Drilled Pier", as the difference between the top of drilled pier elevation or the top of permanent steel casing elevation (whichever is lower) and the elevation the permanent steel casing can not extend below as shown with a Note on Plans.

Structure Design should determine the pay item quantity, "___ Dia. Drilled Piers in Soil", based upon the total drilled pier length per bent minus the "___ Dia. Drilled Piers not in Soil" per bent shown in the table above.

If CSL tubes are required, Structure design should calculate the pay item quantity, "CSL Tubes", as follows:
"CSL Tubes" per bent = (drilled pier length + 2.5 feet) x number of CSL tubes per pier
The number of CSL tubes per pier is dependent upon the drilled pier diameter. For drilled piers with a diameter of 5 feet or less, use 4 tubes. For drilled piers with a diameter greater than 5 feet, use 6 tubes.

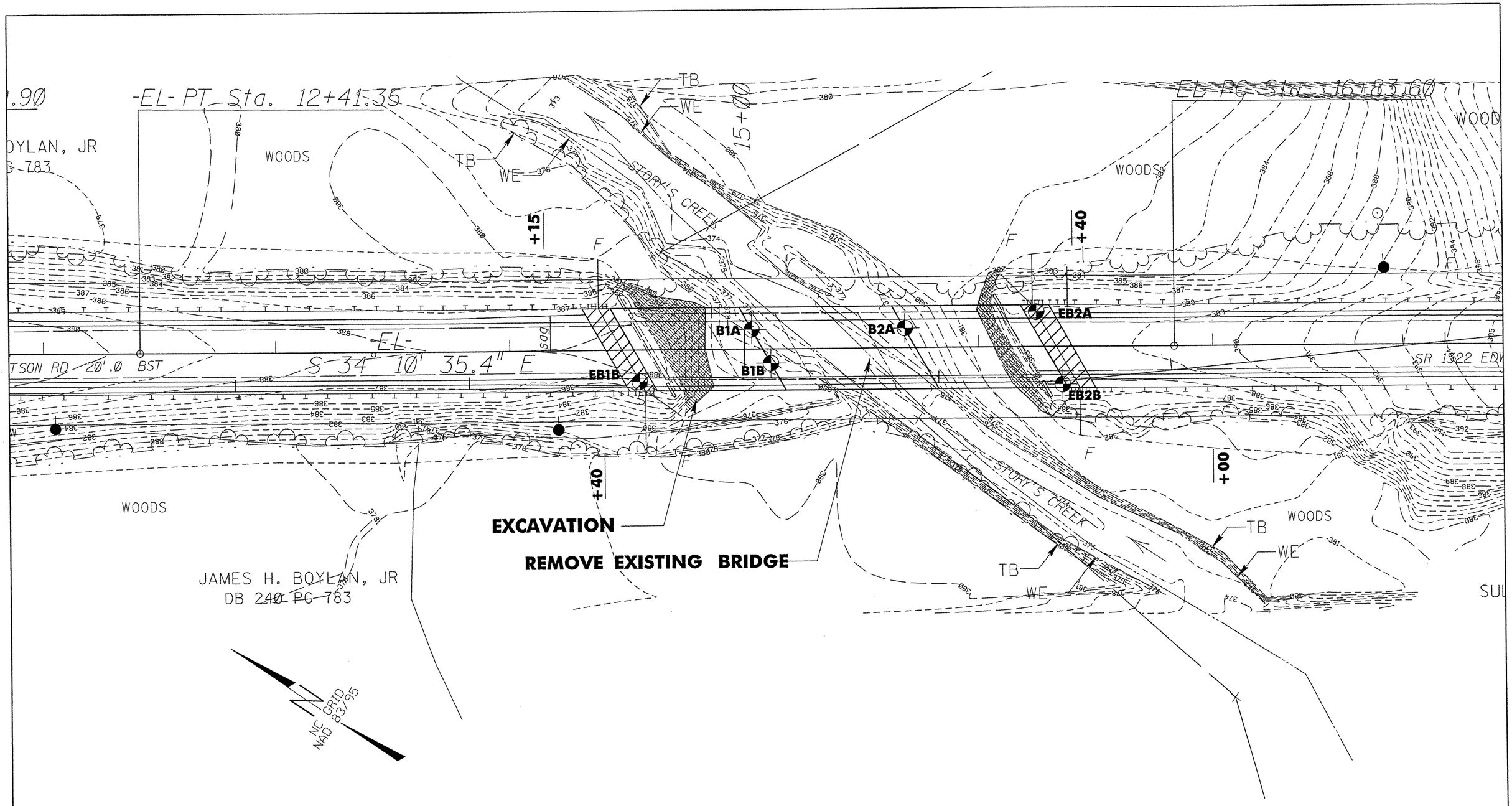


SITE VICINITY MAP

BRIDGE # 59 ON SR 1322 OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803



NOTES:

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM MULKEY ENGINEERS & CONSULTANTS, DATED APR., 2006

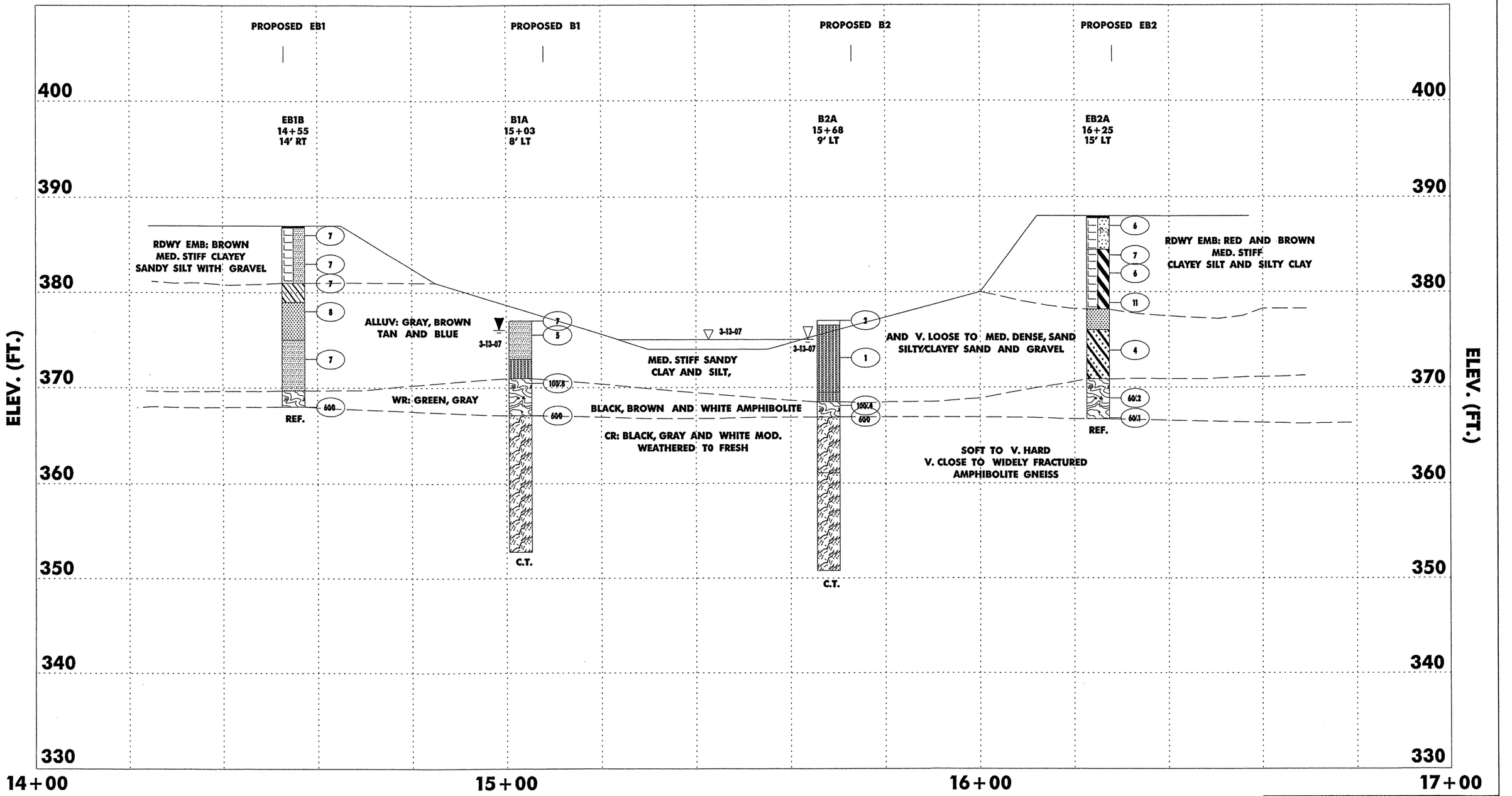
PROPOSED BRIDGE SKEW: 60°

0 40 80
FEET

BORING LOCATION PLAN

BRIDGE # 59 ON SR 1322
OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT NO.: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803



VERTICAL SCALE

0 10 20

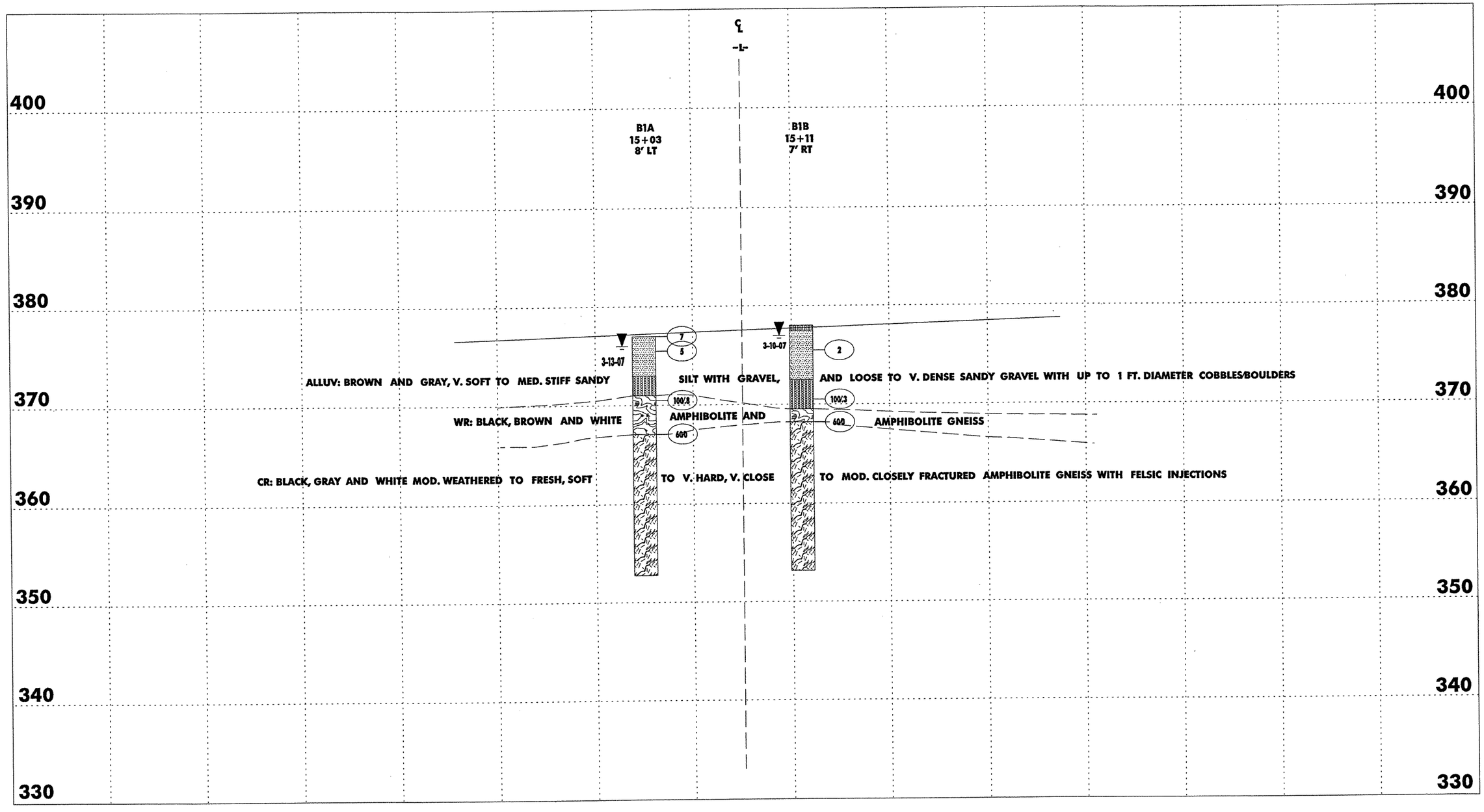
HORIZONTAL SCALE

0 20 40

PROFILE ALONG CENTERLINE OF -L-

BR #59 ON SR 1322
OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS
ENGINEERING
TIERRA, INC.
2734 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 875-8666
FAX (919) 875-8662



VERTICAL SCALE

0 10 20

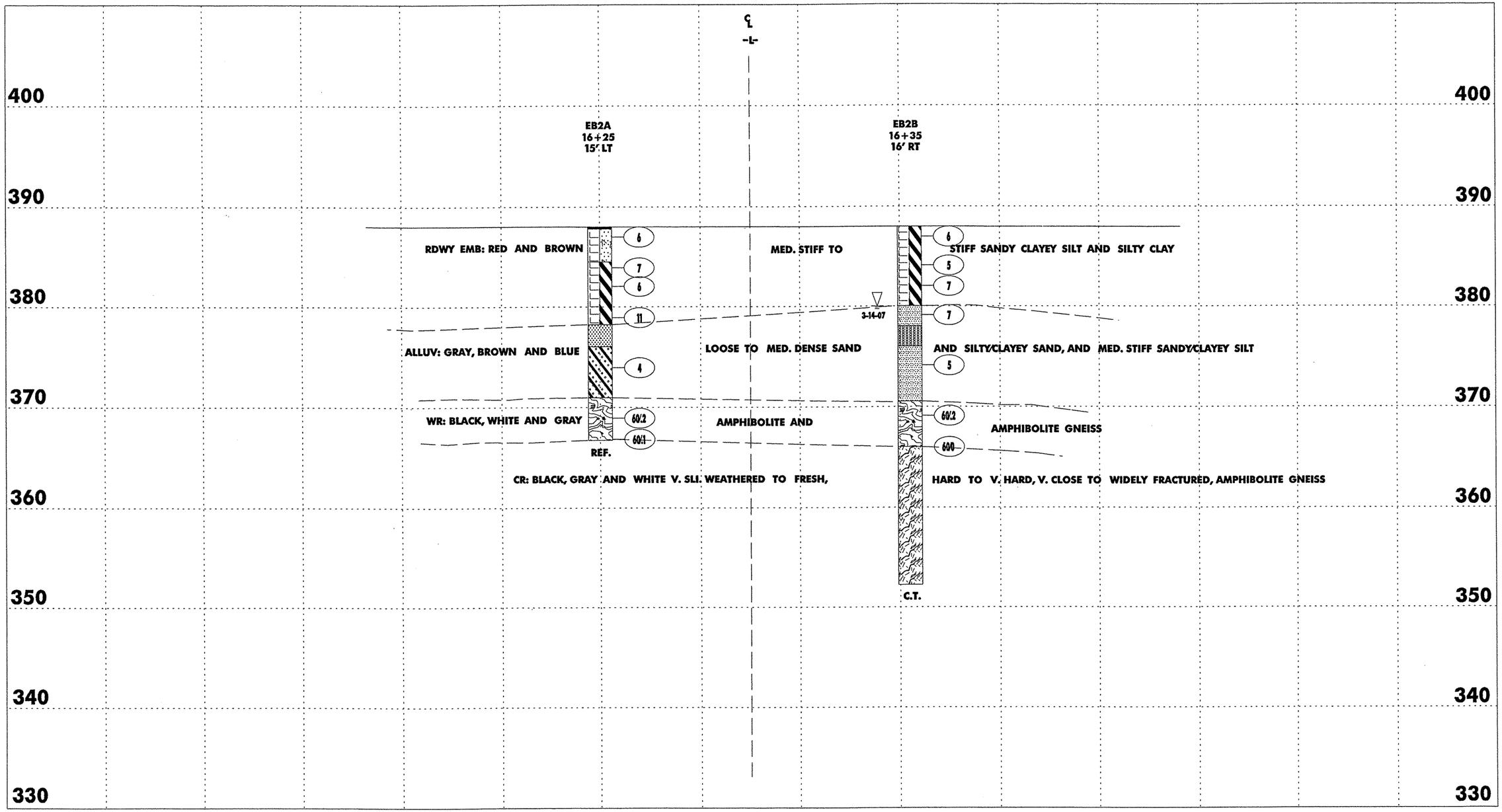
HORIZONTAL SCALE

0 10 20

CROSS SECTION BENT 1

BR #59 ON SR 1322
OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
TIERRA, INC.
3724 ROWLAND RD.
RALEIGH, NC 27610
PHONE (919) 875-0000
FAX (919) 875-0000



VERTICAL SCALE

0 10 20

HORIZONTAL SCALE

0 10 20

CROSS SECTION END BENT 2

BR #59 ON SR 1322
OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS
ENGINEERING
TIERRA, INC.
2734 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 875-8000
FAX (919) 875-8002

BORING LOG

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			**GROUND WATER (ft)**
BORING NO. EB1B	**BORING LOCATION** 14+55	**OFFSET** 14' RT	**ALIGNMENT** **0 HR.** CAVE @ 10.0'
COLLAR ELEV. 387 ft	**NORTHING**	**EASTING**	**24 HR.** CAVE
TOTAL DEPTH 19.0 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-8-07	**COMPLETED** 3-8-07	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
387.0					EXISTING GROUND				387.0 0.0
	1.0						M		386.8 ROOTMAT 0.2
385		3	3	4	7				RDWY EMB: BROWN, MED. STIFF, CLAYEY SANDY SILT (A-4) WITH GRAVEL
	4.0						M		
		3	3	4	7				
	6.0								381.0 6.0
		2	3	4	7	SS-1	29.8%		ALLUV: GRAY AND BROWN MOTTLED, MED. STIFF, SANDY CLAY (A-6)
380									379.0 8.0
	9.0						M		ALLUV: BLUE AND GRAY, LOOSE, SILTY SAND (A-2-4)
		5	5	3	8				
									375.0 12.0
375									ALLUV: TAN AND BROWN MOTTLED, MED. STIFF, CLAYEY SILT (A-4)
	14.0								
		3	2	5	7	SS-2	22.9%		
									369.7 17.3
370									WR: BLACK AND WHITE, AMPHIBOLITE
	19.0								368.0 19.0
		60/0			60/0				SPT AND AUGER REFUSAL AT 19.0' ON CR: AMPHIBOLITE

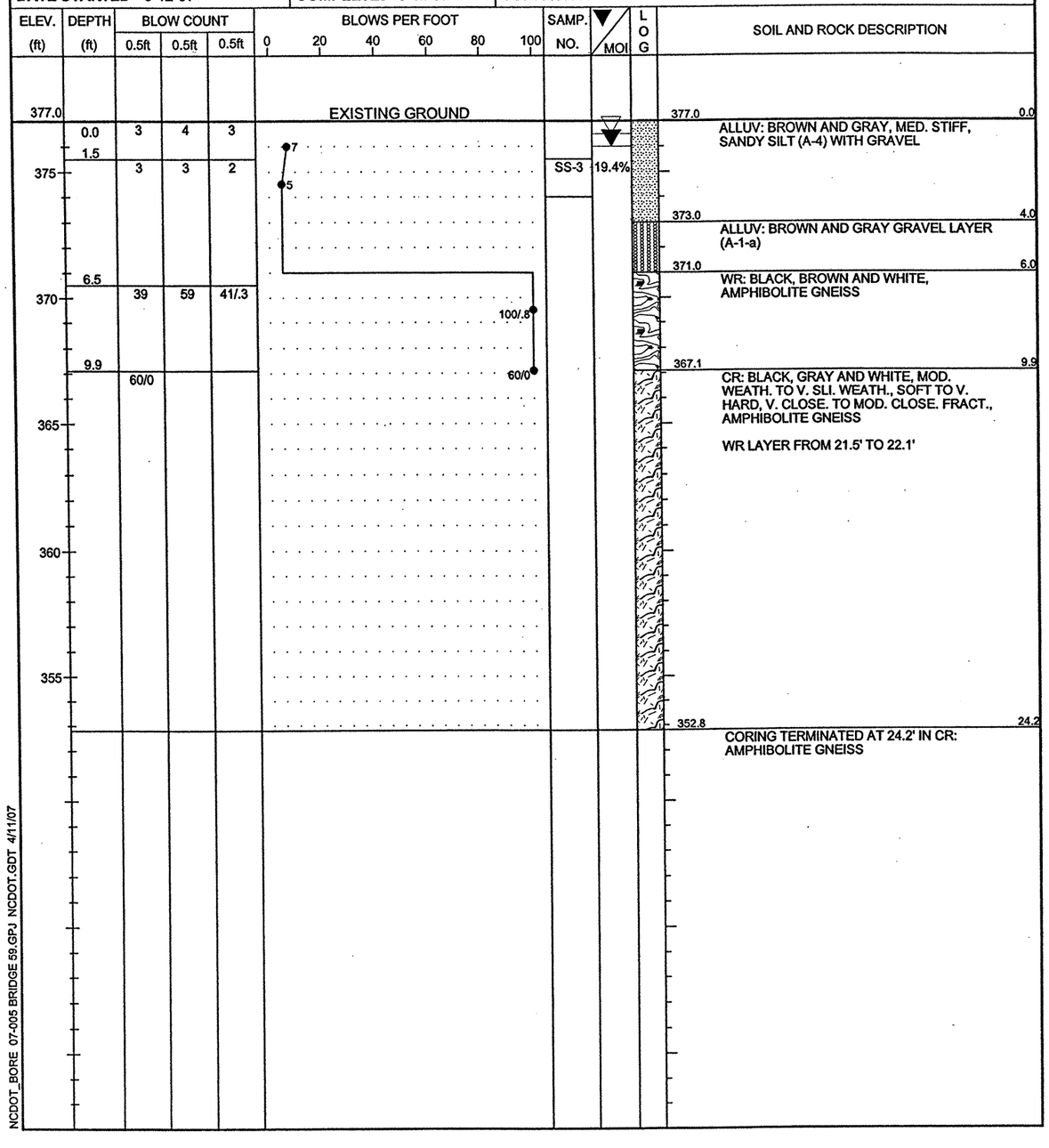
NCDOT_BORE 07-005 BRIDGE 59.GPJ NCDOT.GDT 4/11/07

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			**GROUND WATER (ft)**
BORING NO. B1A	**BORING LOCATION** 15+03	**OFFSET** 8' LT	**ALIGNMENT** **0 HR.** 0.5
COLLAR ELEV. 377 ft	**NORTHING**	**EASTING**	**24 HR.** 1.0
TOTAL DEPTH 24.2 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-12-07	**COMPLETED** 3-12-07	**SURFACE WATER DEPTH** N/A	



NCDOT_BORE 07-005 BRIDGE 59.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/12/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: B1A GEOLOGIST: C. BRUINSMA

DESCRIPTION: BRIDGE #59 ON SR 1322 OVER STORY'S CREEK

COUNTY: PERSON COLLAR ELEV.: 377 TOTAL DEPTH: 24.2 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
367.1	9.9	1:00/0.3					9.9-24.2 CR: BLACK, GRAY AND WHITE, MOD. WEATH. TO V. SLI. WEATH., SOFT TO V. HARD, V. CLOSE. TO MOD. CLOSE. FRACT., AMPHIBOLITE GNEISS
		4:00		4.2/4.3	3.3/4.3		
		3:00	4.3				
		3:00		98%	77%		
362.8	14.2	3:30					WITH WR LAYER 21.5'-22.1'
362.8	14.2	3:00					
		3:30		5.0/5.0	4.0/5.0		
		3:00	5.0				
		3:30		100%	80%		
357.8	19.2	3:15					
357.8	19.2	3:00					
		3:00		4.6/5.0	3.5/5.0		
		4:00	5.0				
		2:45		92%	70%		
352.8	24.2	2:45					STRATA REC = 97% STRATA RQD = 76%

CORING TERMINATED AT 24.2 FT
ELEVATION 352.8 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	ID.	COUNTY PERSON COUNTY, NC	GEOLOGIST C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			GROUND WATER (ft)
BORING NO. B1B	BORING LOCATION 15+11	OFFSET 7' RT	ALIGNMENT — 0 HR. .5
COLLAR ELEV. 378 ft	NORTHING	EASTING	24 HR. 1.0
TOTAL DEPTH 24.8 ft	DRILL MACHINE CME 550 ATV	DRILL METHOD HSA	HAMMER TYPE MANUAL
DATE STARTED 3-9-07	COMPLETED 3-9-07	SURFACE WATER DEPTH N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
378.0					EXISTING GROUND				378.0 0.0
									377.5 0.5 ALLUV: GRAVELLY SAND WITH COBBLES (A-1-a)
	2.5								ALLUV: BROWN, V. SOFT, CLAYEY SANDY SILT (A-4)
375		2	1	1	2	SS-4	25.5%		
	7.5								372.5 5.5
		100/.3			100/.3				ALLUV: GRAY AND BROWN, V. DENSE, SANDY GRAVEL (A-1-a), UP TO 1' DIAMETER COBBLES/BOULDERS POSSIBLE
370	9.8								369.5 8.5
		60/0			60/0				WR: BLACK AND WHITE, AMPHIBOLITE
									368.2 9.8
365						RS-1			CR: GRAY, WHITE AND BLACK, SLI. WEATH. TO FRESH., HARD TO V. HARD, V. CLOSE. TO MOD. CLOSE. FRACT. AMPHIBOLITE GNEISS WITH FELSIC INJECTIONS
360									
355									353.2 24.8
									CORING TERMINATED AT 24.8' IN CR: AMPHIBOLITE GNEISS

NCDOT_BORE 07-005 BRIDGE 59.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/9/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: B1B GEOLOGIST: C. BRUINSMA

DESCRIPTION: BRIDGE #59 ON SR 1322 OVER STORY'S CREEK

COUNTY: PERSON COLLAR ELEV.: 378 TOTAL DEPTH: 24.8 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
368.2	9.8	4:00					9.8-24.8 CR: GRAY, WHITE AND BLACK, SLI. WEATH TO FRESH, HARD TO V. HARD, V. CLOSE. TO MOD. CLOSE. FRACT., AMPHIBOLITE GNEISS WITH FELSIC INJECTIONS
		4:30		5.0/5.0	3.5/5.0		
		4:30	5.0			RS-1	
		4:30		100%	70%		
363.2	14.8	5:30					
363.2	14.8	3:00					
		2:00		4.7/5.0	3.5/5.0		
		3:00	5.0				
		3:00		94%	70%		
358.2	19.8	5:15					
358.2	19.8	2:00					
		3:45		5.0/5.0	3.6/5.0		
		3:15	5.0				
		3:00		100.0%	72%		
353.2	24.8	4:00					STRATA REC = 98% STRATA RQD = 71%

CORING TERMINATED AT 24.8 FT
ELEVATION 353.2 FT

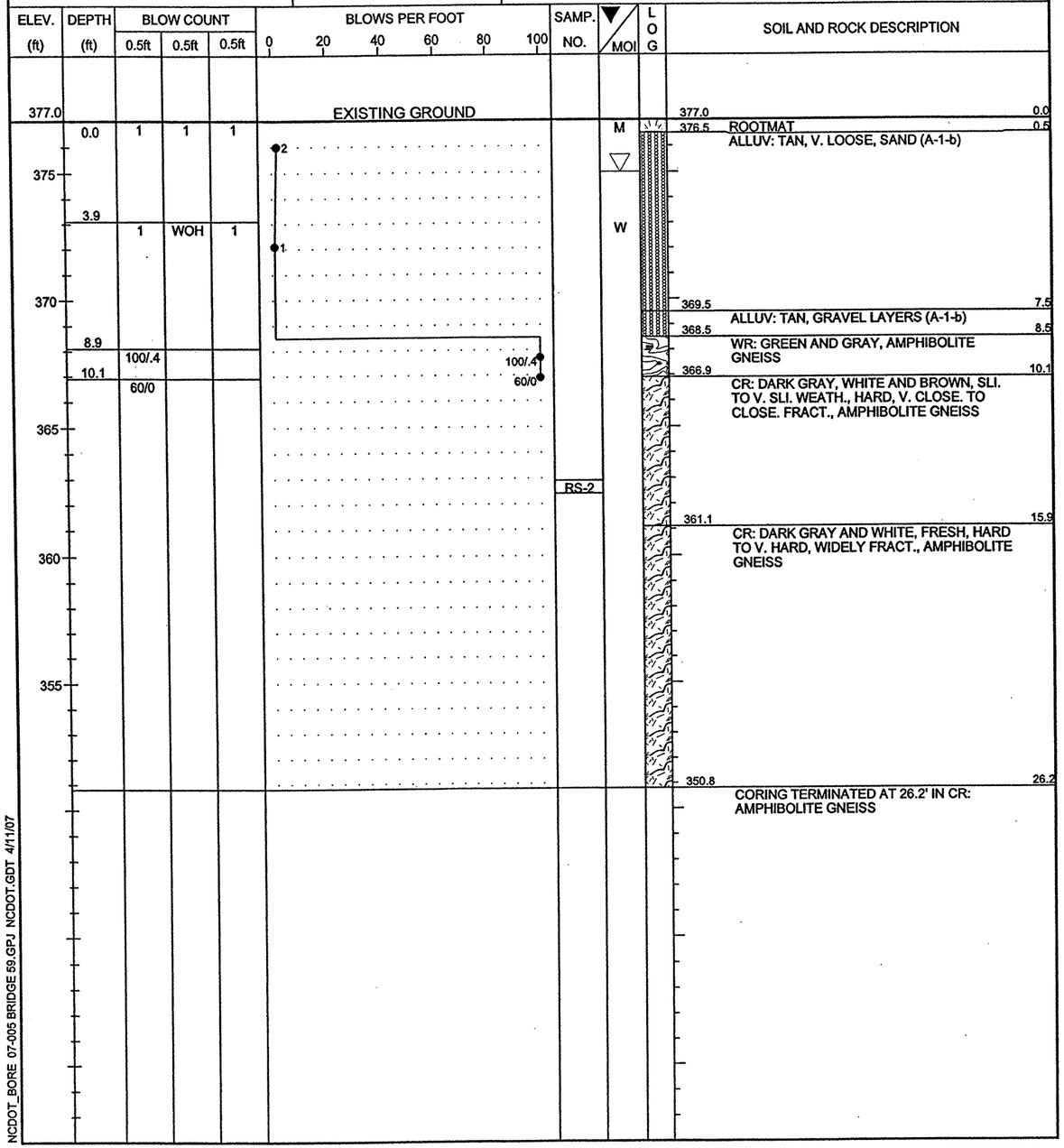
DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			**GROUND WATER (ft)**
BORING NO. B2A	**BORING LOCATION** 15+68	**OFFSET** 9' LT	**ALIGNMENT** **0 HR.** 2.0
COLLAR ELEV. 377 ft	**NORTHING**	**EASTING**	**24 HR.** BACKFILL
TOTAL DEPTH 26.2 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-13-07	**COMPLETED** 3-13-07	**SURFACE WATER DEPTH** N/A	



NCDOT_BORE 07-005 BRIDGE 59.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/13/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: B2A GEOLOGIST: C. BRUINSMA

DESCRIPTION: BRIDGE #59 ON SR 1322 OVER STORY'S CREEK

COUNTY: PERSON COLLAR ELEV.: 377 TOTAL DEPTH: 26.2 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
366.9	10.1	3:45					10.1-15.9 CR: DARK GRAY, WHITE AND BROWN, SLI. TO V. SLI. WEATH., HARD TO V. CLOSE. TO CLOSE. FRACT., AMPHIBOLITE GNEISS
		0:45/0.1		1.1/1.1	0.6/1.1		
			1.1				
				100.0%	55%		
365.8	11.2						
365.8	11.2	3:15					
		3:45		5.0/5.0	2.4/5.0		
		3:00	5.0			RS-2	
		3:15		100%	48%		
360.8	16.2	5:00					STRATA REC = 100% STRATA RQD = 49%
360.8	16.2	3:00					15.9-26.2 CR: DARK GRAY AND WHITE, FRESH, HARD TO V. HARD, WIDE. FRACT., AMPHIBOLITE GNEISS
		3:00		5.0/5.0	5.0/5.0		
		3:15	5.0				
		3:15		100.0%	100%		
355.8	21.2	4:00					
355.8	21.2	2:45					
		2:45		5.0/5.0	5.0/5.0		
		4:00	5.0				
		4:00		100%	100%		
350.8	26.2	4:00					STRATA REC = 100% STRATA RQD = 100%

CORING TERMINATED AT 26.2 FT
ELEVATION 350.8 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			**GROUND WATER (ft)**
BORING NO. EB2A	**BORING LOCATION** 16+25	**OFFSET** 15' LT	**ALIGNMENT** **0 HR.** CAVE @ 5
COLLAR ELEV. 388 ft	**NORTHING**	**EASTING**	**24 HR.** CAVE
TOTAL DEPTH 21.3 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-8-07	**COMPLETED** 3-8-07	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
388.0					EXISTING GROUND				388.0 — 0.0
	1.0	3	3	3	6		M		387.8 — ROOTMAT — 0.2
385	4.1	3	3	4	7	SS-5	33.8%		RDWY EMB: RED AND BROWN, MED. STIFF, SANDY CLAYEY SILT (A-5)
	6.0	2	3	3	6		M		384.5 — 3.5
380	9.1	4	5	6	11		M		RDWY EMB: RED AND BROWN, MED. STIFF, SANDY SILTY CLAY (A-7-5)
									378.2 — 9.8
375	14.1	2	2	2	4		W		ALLUV: GRAY AND BROWN, MED. DENSE, SILTY SAND (A-2-4)
									376.0 — 12.0
									ALLUV: BLUE AND GRAY, LOOSE, CLAYEY SAND (A-2-6)
370	19.1	60/.2			60/.2				370.9 — 17.1
	21.2	60/.1			60/.1				WR: BLACK AND GRAY, AMPHIBOLITE
									366.7 — 21.3
									AUGER AND SPT REFUSAL AT 21.3' ON CR: AMPHIBOLITE

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #59 ON SR 1322 OVER STORY'S CREEK			**GROUND WATER (ft)**
BORING NO. EB2B	**BORING LOCATION** 16+35	**OFFSET** 16' RT	**ALIGNMENT** **0 HR.** 8.0
COLLAR ELEV. 388 ft	**NORTHING**	**EASTING**	**24 HR.** BACKFILL
TOTAL DEPTH 35.8 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-14-07	**COMPLETED** 3-14-07	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
388.0					EXSITING GROUND				388.0 0.0
	1.0	3	3	3	6		M		RDWY EMB: RED AND BROWN, MED. STIFF, SANDY SILTY CLAY (A-7-5)
385	3.9	2	2	3	5		M		
	6.0	3	3	4	7		M		380.0 8.0
380	8.9	2	3	4	7		M-W		ALLUV: GRAY AND BROWN, MED. STIFF, SANDY SILT (A-4)
									378.0 10.0
									ALLUV: GRAY, LOOSE, SAND (A-1-b)
									376.0 12.0
375	13.9	1	1	4	5	SS-6	34.3%		ALLUV: DARK GRAY, MED STIFF, CLAYEY SILT (A-4)
									370.5 17.5
370	18.9	60/.2			60/.2		W		WR: BLACK AND WHITE, AMPHIBOLITE GNEISS
	22.0	60/0			60/0				366.0 22.0
365									CR: BLACK, GRAY AND WHITE, V. SLI. WEATH. TO FRESH, HARD TO V. HARD, V. CLOSE. TO WIDELY FRACT., AMPHIBOLITE GNEISS
360									
355									352.2 35.8
									CORING TERMINATED AT 35.8' IN CR: AMPHIBOLITE GNEISS

NCDOT_BORE 07-005 BRIDGE 59.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/13/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: EB2B GEOLOGIST: C. BRUINSMA

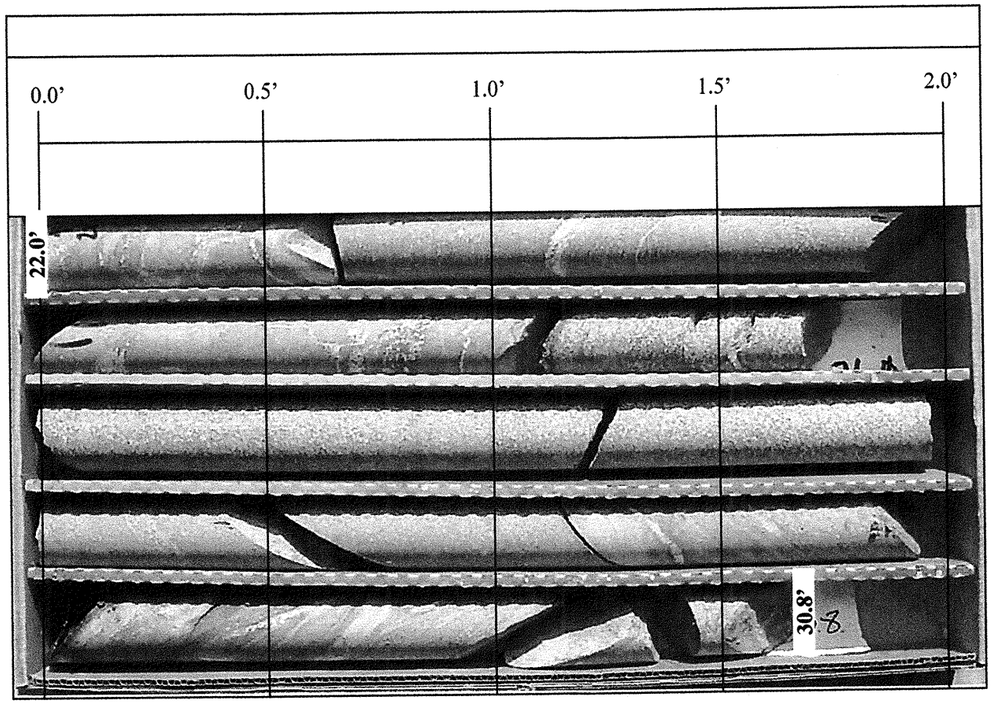
DESCRIPTION: BRIDGE #59 ON SR 1322 OVER STORY'S CREEK

COUNTY: PERSON COLLAR ELEV.: 388 TOTAL DEPTH: 35.8 FT

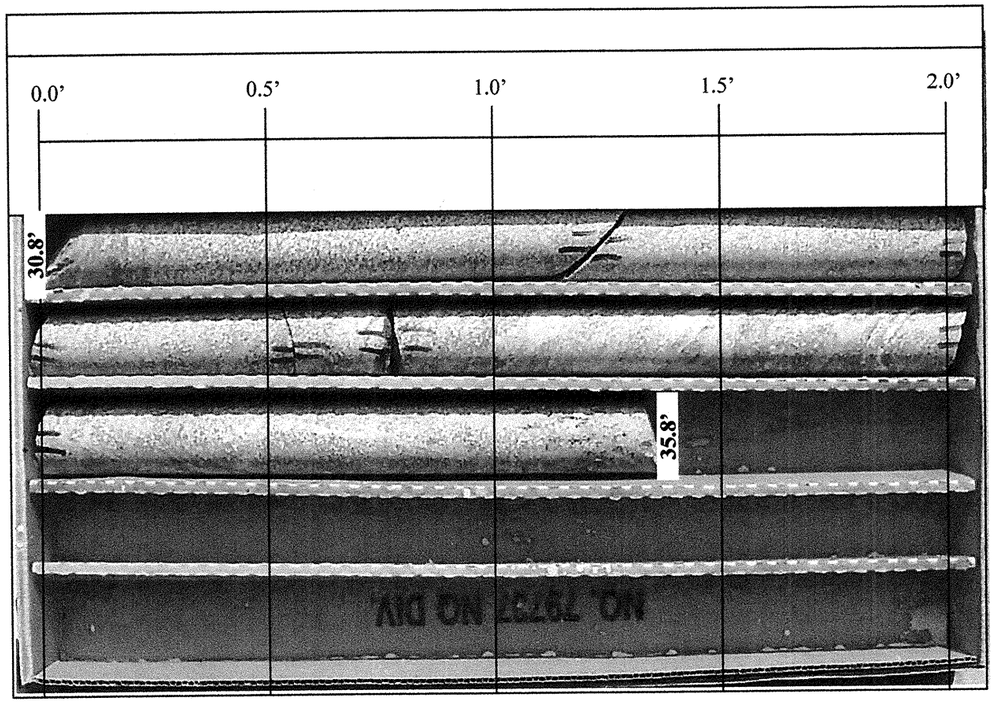
ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
366.0	22.0	4:00					22.0-35.8 CR: BLACK, GRAY AND WHITE, V. SLI. WEATH. TO FRESH, HARD TO V. HARD, V. CLOSE. TO WIDELY FRACT., AMPHIBOLITE GNEISS
		4:00		3.9/4.0	2.8/4.0		
		4:00	4.0				
		5:00		98%	70%		
362.0	26.0						
362.0	26.0	3:45					
		4:15		4.8/4.8	4.4/4.8		
		4:45	4.8				
		5:00		100%	92%		
357.2	30.8	7:00/0.8					
357.2	30.8	3:00					
		3:00		5.0/5.0	5.0/5.0		
		3:00	5.0				
		3:30		100.0%	100%		
352.2	35.8	5:00					STRATA REC = 99% STRATA RQD = 88%

CORING TERMINATED AT 35.8 FT
ELEVATION 352.2 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV



Boring EB2B, Box 1 of 2, 22.0 feet to 30.8 feet.



Boring EB2B, Box 2 of 2, 30.8 feet to 35.8 feet.

SCALE 1:40 (1"=4")

ROCK CORE PHOTOGRAPHS

BRIDGE # 59 ON SR 1322 OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

TIERRA, INC. 2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

SOIL CLASSIFICATION AND GRADATION SHEET

BRIDGE #59 ON SR 1322 OVER STORY'S CREEK
NCDOT PROJECT NO.: R-4906

PERSON COUNTY

TIERRA, INC. PROJECT NO: 6211-07-005

BORING #		SAMPLE #	NATURAL MOISTURE CONTENT	TOTAL SAMPLE			ATTERBERG LIMIT		
AASHTO Classification				PERCENT PASSING					
STATION #	OFFSET (FEET)	DEPTH (FEET)		#10	#40	#200	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX
EB1B		SS-1	29.8%	80	75	49	36	21	15
A-6									
14+55	14' RT	6.0-7.5							
EB1B		SS-2	22.9%	97	93	65	26	18	8
A-4									
14+55	14' RT	14.0-15.5							
B1A		SS-3	19.4%	93	83	55	NP	NP	NP
A-4									
15+03	8' LT	1.5-3.0							
B1B		SS-4	25.5%	97	92	53	NP	NP	NP
A-4									
15+11	7' RT	2.5-4							
EB2A		SS-5	33.8%	98	94	79	53	32	21
A-7-5									
16+25	15' LT	4.1-5.6							
EB2B		SS-6	34.3%	100	97	67	21	15	6
A-4									
16+35	16' RT	13.9-15.4							
Channel		S-1	N/A	30	12	4	NP	NP	NP
A-1-a									
		0.0-1.5							
Bank		S-2	N/A	100	98	31	NP	NP	NP
A-2-4									
		0.0-1.5							

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

Bridge # 59 on SR 1322 over Story's Creek

TIERRA No: 6211-07-005

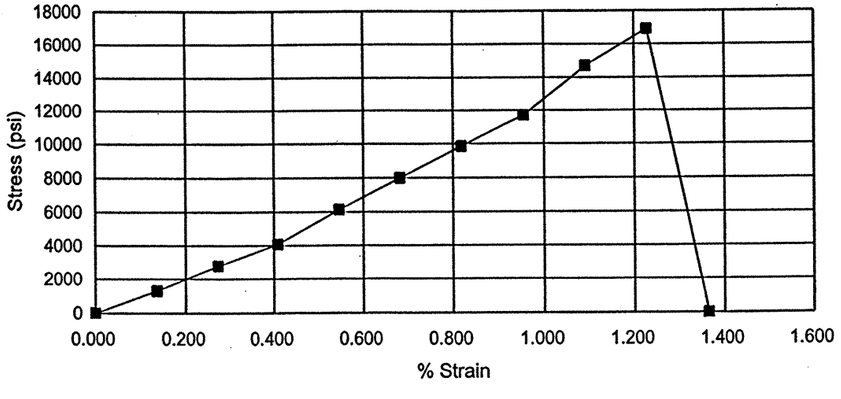
Boring #	Sample #	Depth (ft)	Average Diameter (in)	Average Length (in)	L/D	Total Volume (ft)3	Total Core Weight (lb)	Core Moisture Content (%)	Core Dry Weight (lb)	Unit Weight (pcf)	Rate of Stress Increase (lbs/min)	Max Unconfined Compression (psi)	Remarks
B - 1B	RS - 1	12.6 - 13.1	1.851	3.663	1.98	0.0057	1.0420	0.22	1.0397	182.4	10000	16909	
B - 2A	RS - 2	14.1 - 14.65	1.851	2.422	1.31	0.0038	0.6930	0.20	0.6916	183.5	10000	15131	

ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-07-005 Job Name: Bridge #59 on SR 1322 over Story's Creek
Date: 3/22/2007 Sample No.: RS - 1
Boring No.: B - 1B Depth (ft): 12.6 - 13.1
Description: Black, gray & white, mod. weathered to v. slightly weathered, soft to v. hard, v. close to mod. close fractured amphibolite gniess
Length (in.): 3.663
Diameter (in.): 1.851
Area (sq. in.): 2.691

Compressive Strength (psi): 16909

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.137	3500	1300.7	952,867
0.010	0.273	7500	2787.1	1,020,929
0.015	0.410	11000	4087.8	998,242
0.020	0.546	16500	6131.7	1,123,022
0.025	0.683	21500	7989.8	1,170,665
0.030	0.819	26500	9847.9	1,202,427
0.035	0.956	31500	11706.0	1,225,115
0.040	1.092	39500	14678.9	1,344,223
0.045	1.229	45500	16908.6	1,376,363
0.050	1.365	0	0.0	0

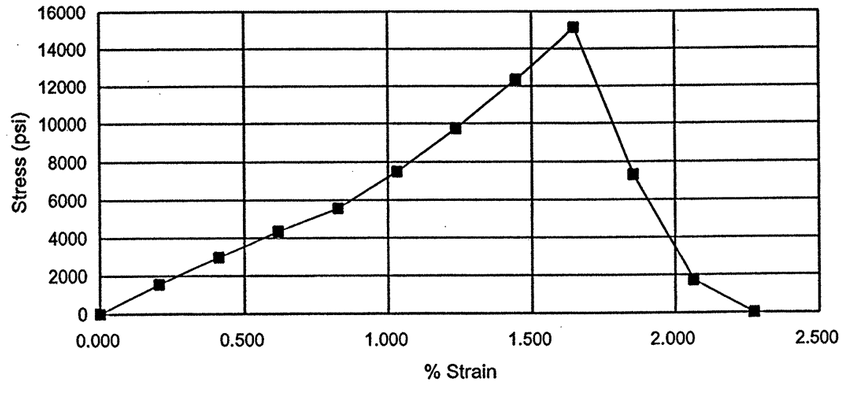


ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-07-005 Job Name: Bridge #59 on SR 1322 over Story's Creek
Date: 3/22/2007 Sample No.: RS - 2
Boring No.: B - 2A Depth (ft): 14.1 - 14.65
Description: Dark gray, white & brown, slightly to v. slightly weathered, hard, v. close to mod. close fractured amphibolite gniess
Length (in.): 2.422
Diameter (in.): 1.851
Area (sq. in.): 2.691

Compressive Strength (psi): 15131

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.206	4212	1565.3	758,210
0.010	0.413	7956	2956.6	716,088
0.015	0.619	11700	4347.9	702,047
0.020	0.826	14976	5565.4	673,965
0.025	1.032	20124	7478.4	724,512
0.030	1.239	26208	9739.4	786,292
0.035	1.445	33228	12348.1	854,491
0.040	1.652	40716	15130.8	916,171
0.045	1.858	19656	7304.5	393,146
0.050	2.064	4680	1739.2	84,246
0.055	2.271	0	0.0	1



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT

FIELD SCOUR REPORT

WBS: _____ TIP: R-4906 COUNTY: PERSON

DESCRIPTION(1): BR 59 ON SR 1322 OVER STORY'S CREEK

EXISTING BRIDGE

Information from: Field Inspection X Microfilm ____ (reel _____ pos: _____)
Other (explain) HYDRO REPORT

Bridge No.: 59 Length: 162 Total Bents: 6 Bents in Channel: 2 Bents in Floodplain: 4
Foundation Type: H-PILES ON SPREAD FOOTINGS, STEEL PLANK FLOOR ON I-BEAMS

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: NO EVIDENCE OF SCOUR

Interior Bents: SCOUR EVIDENT ON TWO BENTS ADJACENT TO CHANNEL. BENTS ARE NOT ALIGNED WITH STREAM MORPHOLOGY. CHANNEL HAS BEEN CUT OFF IN SEVERAL AREAS.

Channel Bed: SCOUR EVIDENT ALONG SECONDARY CHANNEL AREAS, ONLY DURING HIGH FLOW

Channel Bank: EVIDENT ON DOWNSTREAM EB2 SIDE, APPROX 25 FEET FROM EXISTING BRIDGE

EXISTING SCOUR PROTECTION

Type(3): NONE EVIDENT

Extent(4): N/A

Effectiveness(5): N/A

Obstructions(6): A LARGE AMOUNT OF DEBRIS HAS COLLECTED BETWEEN BENT 2, 3, AND 4

INSTRUCTIONS

1 Describe the specific site's location, including route number and body of water crossed.
2 Note scour evidence at existing end bents or abutments (e.g. undermining, sloughing, degradations).
3 Note existing scour protection (e.g. rip rap).
4 Describe extent of existing scour protection.
5 Describe whether or not the scour protection appears to be working.
6 Note obstructions such as dams, fallen trees, debris at bents, etc.
7 Describe the channel bed material based on observation and/or samples. Include any lab results with report.
8 Describe the channel bank material based on observation and/or samples. Include any lab results with report.
9 Describe the material covering the banks (e.g. grass, trees, rip rap, none).
10 Determine the approximate floodplain width from field observation or a topographic map.
11 Describe the material covering the floodplain (e.g. grass, trees, crops).
12 Use professional judgement to specify if the stream is degrading, aggrading, or static.
13 Describe potential and direction of the stream to migrate laterally during the bridge's life (approx. 100 years).
14 Give the design scour elevation (DSE) expected over the life of the bridge (approx. 100 years). This elevation can be given as a range across the site, or for each bent. Discuss the relationship between the Hydraulics Unit theoritical scour and the DSE. If the DSE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The DSE is based on the erodability of materials, giving consideration to the influence of joints, foliation, bedding characteristics, % core recovery, % RQD, differential weathering, shear strength, observations at existing structures, other tests deemed appropriate, and overall geologic conditions at the site.

DESIGN INFORMATION

Channel Bed Material(7): SAND WITH GRAVEL AND COBBLE/BOULDERS UP TO 2' IN DIAMETER

Channel Bank Material(8): SILTY SAND AND SANDS

Channel Bank Cover(9): SHRUBS, AND YOUNG TO OLD TREE GROWTH

Floodplain Width(10): APPROXIMATELY 700 FEET

Floodplain Cover(11): SHRUBS, AND YOUNG TO OLD TREE GROWTH

Stream is(12): Aggrading ____ Degrading X Static ____

Channel Migration Tendency(13): EAST

Observations and Other Comments: CHANNEL MORPHOLOGY SEVERLY IMPACTED DUE TO HIGH AMOUNT OF DEBRIS CAUGHT BY EXISTING BENTS IN CHANNEL

Reported by: C. Bruinsma TIERRA, INC. **Date:** 3/8/2007

DESIGN SCOUR ELEVATIONS(14) Feet ____ Meters ____

	BENTS B1	B2	B3	B4							
SB Lanes, Lt											
SB Lanes, Rt											
NB Lanes, Lt											
NB Lanes, Rt											

Comparison of DSE to Hydraulics Unit theoretical scour:

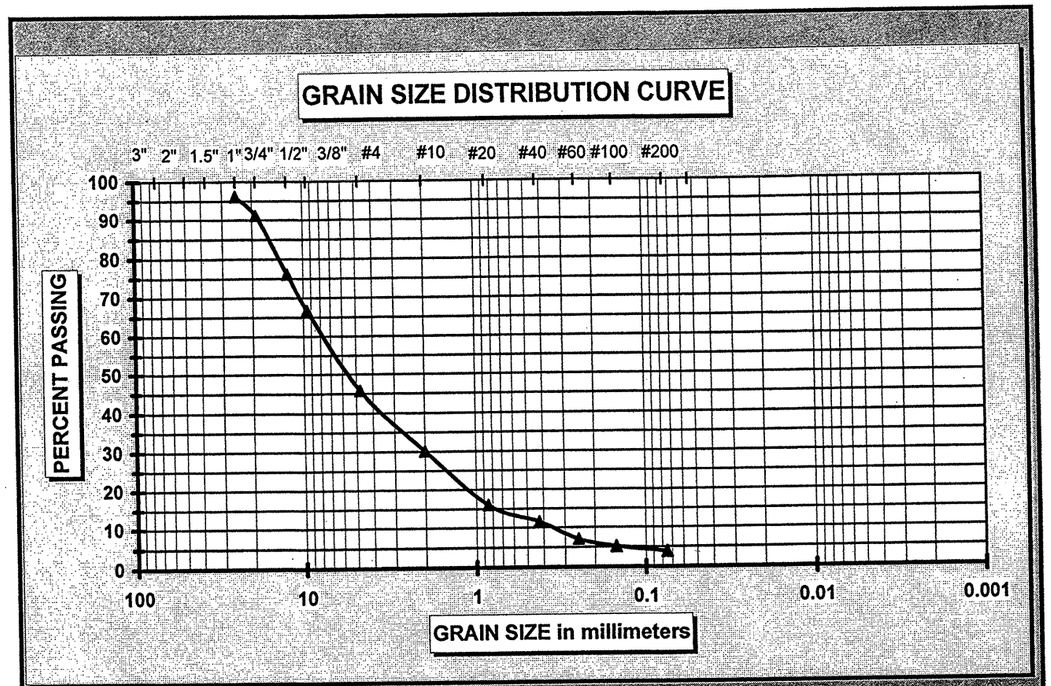
DSE determined by: _____ **Date:** _____

SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL

Bed or Bank	Channel	Bank					
Sample No.	S-1	S-2					
Retained #4	54	0					
Passed #10	30	100					
Passed #40	12	98					
Passed #200	4	31					
Coarse Sand	18	2					
Fine Sand	8	67					
Silt							
Clay	4	31					
LL	NP	NP					
PI	NP	NP					
AASHTO	A-1-a	A-2-4					
Station							
Offset							
Depth	0.0-1.5	0.0-1.5					

TIERRA, INC. 2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

BRIDGE #59 ON SR 1322 OVER STORY'S CREEK
PERSON COUNTY
NCDOT PROJECT NO.: R-4906



AASHTO M-145 Classification of Soil for Engineering Purposes					
Gravel	< 3" and > #10		Coarse Sand	< #10 and > #40	Cu = D60 / D10
			Fine Sand	< #40 and > #200	Cc = (D30)^2 / (D10 x D60)

BORING #: Channel **SAMPLE #:** S-1 **DEPTH:** 0.0-1.5

Gravelly SAND (A-1-a)

% PASSING #200 SIEVE: 4%

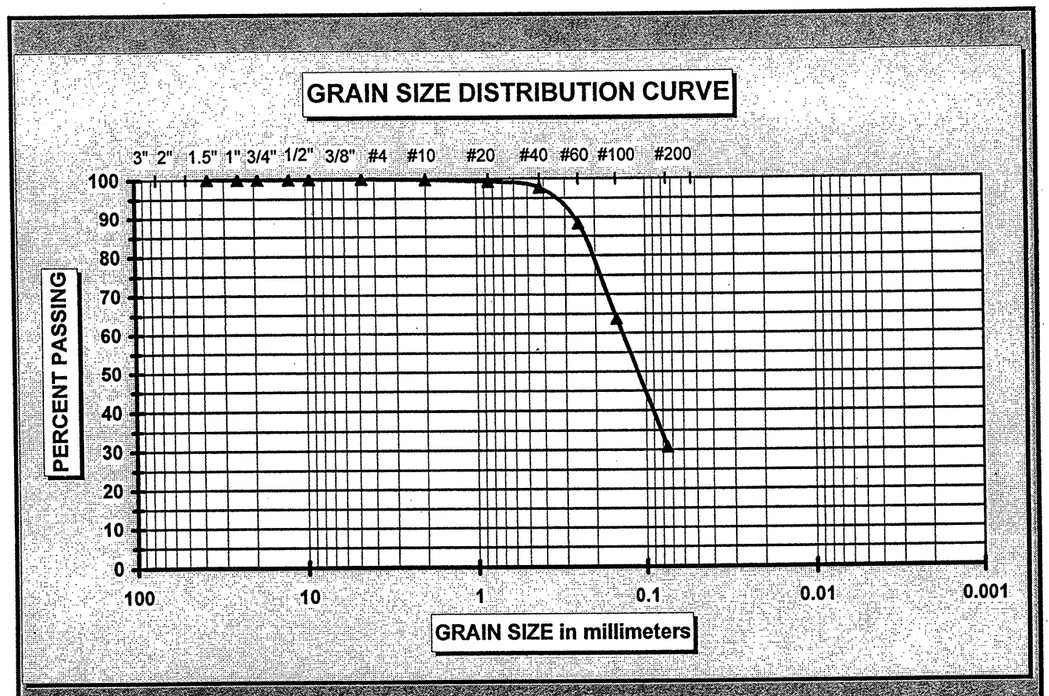
NATURAL MOISTURE CONTENT = N/A

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTIC INDEX	NP

TIERRA, INC. PROJECT #: 6211-07-005

TIERRA, INC. 2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

BRIDGE #59 ON SR 1322 OVER STORY'S CREEK
PERSON COUNTY
NCDOT PROJECT NO.: R-4906



AASHTO M-145 Classification of Soil for Engineering Purposes					
Gravel	< 3" and > #10		Coarse Sand	< #10 and > #40	Cu = D60 / D10
			Fine Sand	< #40 and > #200	Cc = (D30)^2 / (D10 x D60)

BORING #: Bank **SAMPLE #:** S-2 **DEPTH:** 0.0-1.5

SILTY SAND (A-2-4)

% PASSING #200 SIEVE: 31%

NATURAL MOISTURE CONTENT = N/A

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTIC INDEX	NP

TIERRA, INC. PROJECT #: 6211-07-005

PHOTO 1: CENTERLINE PROFILE, LOOKING UPSTATION

PHOTO 2: STORY'S CREEK, LOOKING UPSTREAM

SITE PHOTOGRAPHS

BR # 59 ON SR 1322 OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

PHOTO 3: END BENT 1, LOOKING LEFT TO RIGHT

PHOTO 4: END BENT 2, LOOKING LEFT TO RIGHT

SITE PHOTOGRAPHS

BR # 59 ON SR 1322 OVER STORY'S CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R-4906	1	26

STATE PROJ. NO.	F. A. PROJ. NO.	DESCRIPTION
R-4906		P.E.
		CONST.

STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

STRUCTURE SUBSURFACE INVESTIGATION

STATE PROJECT R-4906 I.D. NO.

F.A. PROJECT

COUNTY PERSON

PROJECT DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK

SITE DESCRIPTION

ID:

PROJECT: R-4906

CONTENTS: **PAGE NUMBER:**

DRAWN BY: P. ZHANG

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WAS 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 UNIT @ (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA IS 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 INCLUDI 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 THIS 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.

INVESTIGATED BY C. BRUINSMA PERSONNEL S. HAN

CHECKED BY G. LANG, P.E. B. SAWASKA

SUBMITTED BY TIERRA, INC.

DATE APRIL, 2007

NOTE - THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS BEING ACCURATE NOR IT IS CONSIDERED TO BE PART OF THE PLANS, SPECIFICATIONS, OR CONTRACT FOR THE PROJECT.

NOTE - 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.

NORTH CAROLINA PROFESSIONAL SEAL 31421 ENGINEER GABRIEL W. LANG

4/4/07

SEAL

SIGNATURE

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
	R-4906	2	26

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. 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
LIQUID LIMIT	6 MX		N.P.	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
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 A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

P.I. OF A-7-5 ≤ L.L. - 30 : P.I. OF A-7-6 > L.L. - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
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 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	2.0	0.42	0.25	0.075	0.053

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

GRAIN MM 300 75 2.0 0.25 0.05 0.005

SIZE 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	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, 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

UNIFORM- INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)

GAP-GRADED- INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE 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 WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 30
MODERATELY COMPRESSIBLE	LIQUID LIMIT 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 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 SEEPAGE

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS
- INFERRED SOIL BOUNDARIES
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 - DIP/DIP DIRECTION OF ROCK STRUCTURES
- ● - SOUNDING ROD
- SPT CPT DPT DMT VST PMT - TEST BORING
- AUGER BORING
- CORE BORING
- MW - MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- SPT N-VALUE
- REF - SPT REFUSAL

SAMPLE DESIGNATIONS

S- BULK SAMPLE

SS- SPLIT SPOON SAMPLE

ST- SHELBY TUBE SAMPLE

RS- ROCK SAMPLE

RT- RECOMPACTED TRIAXIAL SAMPLE

CBR - CBR SAMPLE

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
FRAGS. - FRAGMENTS
MED. - MEDIUM
PMT - PRESSUREMETER TEST
REF. - SPT REFUSAL
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT
W - MOISTURE CONTENT
V. - VERY
VST - VANE SHEAR TEST

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- ☐ MOBILE B- ___
- ☐ BK-51
- ☐ CME-45
- ☒ CME-550
- ☐ PORTABLE HOIST
- ☐ OTHER: _____
- ☐ OTHER: _____

ADVANCING TOOLS:
- ☐ CLAY BITS
- ☐ 6" CONTINUOUS FLIGHT AUGER
- ☒ 8" HOLLOW AUGERS
- ☐ HARD FACED FINGER BITS
- ☐ TUNG.-CARBIDE INSERTS
- ☐ CASING ☐ W/ ADVANCER
- ☐ TRICONE _____ 3 " STEEL TEETH
- ☐ TRICONE _____ " TUNG.-CARB.
- ☒ CORE BIT
- ☐ OTHER _____

HAMMER TYPE:
- ☐ AUTOMATIC ☒ MANUAL

CORE SIZE:
- ☐ -B_____
- ☒ -N Q_____
- ☐ -H _____

HAND TOOLS:
- ☐ POST HOLE DIGGER
- ☐ HAND AUGER
- ☐ SOUNDING ROD
- ☐ VANE SHEAR TEST
- ☐ OTHER: _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL. 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 FOLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.
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 ROCKS 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, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS 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 GEOLOGISTS 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 GEOLOGISTS 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 GEOLOGISTS 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 FEET
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 THE 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 WHICH 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, AS SHALE, SLATE, ETC.

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

CALCAREOUS (CALC.) - SOILS WHICH 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 (F.P.) - 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 SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (R.Q.D.) - 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 WHICH 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, WHICH 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 B.P.F.) 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 LESS THAN 0.1 FOOT PENETRATION WITH 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 (S.R.Q.D.) - 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 (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:

NOTES:

April 11, 2007

Mr. Kevin Austin, P.E.
Mulkey Engineers and Consultants
6750 Tryon Road
Cary, NC 27511

Re: Geotechnical Subsurface Exploration Report

Project ID.:	R-4906
County:	Person County
Description:	Bridge No. 86 on SR 1322 over Ghent Creek
Tierra Inc. Proj. No.:	6211-07-005

Dear Mr. Austin:

As authorized, Tierra, Inc. (Tierra) has completed the geotechnical subsurface exploration for Bridge No. 86 on SR 1322 over Ghent Creek in Person County, North Carolina. Our investigation was performed in general accordance with our proposal number TR-07-007, dated January 19, 2007. The purpose of this report is to present subsurface conditions and foundation design recommendations for the planned structure. Field and laboratory test results, site and boring location plans, and profiles depicting subsurface conditions may be found in this report.

PROJECT DESCRIPTION

According to the Bridge Survey and Hydraulic Design Report dated September 2006, the referenced project intends to replace the existing H-pile supported bridge spanning Ghent Creek. The proposed replacement structure is to consist of a two span, three bent bridge and will be approximately 125 feet long. The structure is planned to be located between Station 14+31 and Station 15+56, and have a skew angle of 135°. Information provided by Mulkey Engineers and Consultants indicates that the caps will be at elevations of about 382 feet and the finished grade of the structure at or near existing grade. Bridge embankments will be reconstructed with Class II Rip Rap. A 100 year design scour elevation of approximately 369 feet was indicated on the Bridge Survey and Hydraulic Design Report.

If any of the above information is incorrect or has changed, please inform Tierra so that we may amend the recommendations presented in this report if appropriate.

SITE DESCRIPTION/GEOLOGY

The project site is located along SR 1322 in a rural area, approximately 5 miles outside the city limits of Roxboro, North Carolina in Person County. Ghent Creek flows to the northeast beneath SR 1322 into Hyco River, approximately 3.5 miles downstream. A small tributary flows into Ghent Creek just upstream of the existing bridge, near end bent 2.

2736 Rowland Road ▪ Raleigh, North Carolina 27615
Phone (919) 871-0800 ▪ Fax (919) 871-0803

Topographically, the site is relatively flat to rolling, ascending in elevation to the northeast past the floodplain boundaries. The southeast topography is dominated by the well developed floodplain up to the existing railroad tracks. Ghent Creek is approximately 40-45 feet wide and 3 to greater than 6 feet deep during our investigation. The existing floodplain is approximately 900 feet wide. Floodplain cover consists of grass, shrubs, and moderate to old growth trees.

The project site is located in the Piedmont Physiographic Province of North Carolina, near Roxboro, North Carolina. ***The Geologic Map of North Carolina*** (1985) indicates the bridge site is located within the Milton Belt. Specifically the site is within the Biotite Gneiss and Schist Formation (**€Zbg**). Rocks of this formation are Late Proterozoic to Cambrian in age and contain biotite gneiss interlayered with calc-silicate rock, mica schist and amphibolite. The rocks encountered at the site consist of amphibolite. No rock outcropping was noted within project limits.

FIELD EVALUATION PROCEDURE

The subsurface exploration consisted of performing five (5) soil test borings along the proposed end and interior bent lines. Borings were performed with a CME 550 All Terrain Vehicle (ATV) with a manual hammer. Standard Penetration Tests (SPT) and soil sampling were performed in general accordance with American Association of State Highway Transportation Officials (AASHTO T-206-87). Rock coring was performed in accordance with (AASHTO T-225-83 (2000)) procedure utilizing a 2.0-inch diameter NQ size core barrel.

Groundwater measurement readings were taken within each borehole with a weighted 100-foot measuring tape from a reference location at the top of each boring. Readings were recorded immediately after boring termination and after a 24-hour waiting period. Each borehole elevation was estimated based on topographic contour maps provided by Mulkey Engineers and Consultants.

In addition to our subsurface investigation, a visual scour evaluation was performed along the channel and banks of Ghent Creek and is included in the Appendix of this report.

SUBSURFACE AND GROUNDWATER CONDITIONS

Subsurface soils penetrated beneath the site consist of roadway embankment soil underlain by alluvial deposits with occasional residual soils, followed by weathered rock and crystalline rock.

End Bents

Soils beneath End Bents No.1 and 2 consist of roadway embankment, alluvial deposits and residual soils. Roadway embankment soils were encountered at the ground surface and consist of approximately 3.5 to 6.5 feet of medium stiff to stiff sandy/clayey silt (A-4) with gravel and loose clayey sand (A-2-6) with gravel. Alluvial deposits were encountered below the roadway embankment and extended to elevations ranging from approximately 366 to 373 feet. These soils consist of very loose to medium dense sandy gravel and silty/clayey sand (A-1-a, A-2-4, A-2-6), and soft to stiff sandy/silty clay and clayey silt (A-6, A-4). Approximately 2 feet of residual soil was encountered in Boring EB1B at an elevation of approximately 366 feet and consists of very

dense silty sand (A-2-4). Amphibolite weathered rock was encountered at elevations ranging from approximately 364 to 374 feet and underlain by Amphibolite crystalline rock at elevations of approximately 355 to 371 feet.

Interior Bents

Soils beneath Interior Bent No.1 consist of alluvial deposits and residual soils. Alluvial deposits were encountered at ground surface and extended to an elevation of approximately 365 feet. These soils consist of very loose to medium dense sandy gravel and silty sand (A-1-a, A-2-4). Residual soil was encountered in Boring B1A at an elevation of approximately 365 feet and consists of dense silty sand (A-2-4), saprolitic. Amphibolite weathered rock was encountered at elevations ranging from approximately 354 to 365 feet and underlain by Amphibolite crystalline rocks at elevations of approximately 342 to 353 feet.

Groundwater across the site ranged in elevation between approximately 378 to 380 feet. Standing water below the bridge, at the time of our investigation, was approximately 3 feet deep.

LABORATORY TESTING

Representative split-spoon samples were selected from soil test borings to verify visual field classifications and determine soil index properties. A total of six (6) samples were analyzed in our laboratory for natural moisture determination, Atterberg limits, and grain size analysis. In addition, representative channel and bank samples obtained from spilt-spoon samples were analyzed for grain size distribution. Two rock core samples were tested for compressive strength testing. All testing was performed in accordance with the following American Society for Testing and Materials (ASTM), (NCDOT) Modified and/or (AASHTO) procedures:

- AASHTO T-88-00 (As Modified) "Particle Size Analysis of Soil"
- AASHTO T-89-902(As Modified) "Determining the Liquid Limits of Soil"
- AASHTO T-90-00 "Determining the Plastic Limit and Plasticity of Soils"
- AASHTO T-265-93 "Laboratory Determination of Moisture Content of Soils"
- ASTM D 2938-95 "Unconfined Compressive Strength of Intact Rock Core"
- ASTM D 3148-02 "Elastic Moduli of Intact Rock Core in Uniaxial Compression"

The results of the laboratory testing indicate that the site soils tested ranged from silty sand (A-2-4) to clayey silt and silty clay (A-4 and A-6).

CONCLUSIONS

The results of our subsurface investigation indicate that the subsurface conditions consist predominately of thick deposits (i.e. 12 to 23 feet) of alluvial and residual soils of very loose to dense sands and very soft to stiff silts and clays, underlain by weathered rock and crystalline rock. Weathered rock was encountered at elevations of approximately 354 to 374 feet and underlain by crystalline rock at elevations of approximately 342 to 371 feet. In addition, shallow groundwater was encountered at elevations ranging from 378 and 380 feet. Considering the presence of shallow groundwater and thick deposits of potentially compressible alluvial and residual soils, a

combination of driven piles and drilled piers bearing on weathered and/or crystalline rock are anticipated for the bridge structure.

FOUNDATION RECOMMENDATIONS

Based on the depth to competent bearing material, the end bents for the proposed bridge may be supported by driven HP 12x53 steel piles and interior bent by 36 inch diameter drilled piers. The piles for the end bents may be designed using an allowable capacity of 45 tons with a safety factor of 2. The allowable pile capacities were estimated utilizing static methods and the actual capacity of the piles should be verified during installation using pile driving criteria, from wave equation analysis, established by the Geotechnical Engineer. The piers for the interior bent should be designed to bear in weathered rock and/or crystalline rock and designed using an allowable capacity of 190 tons with a safety factor of 2.5. For more information, refer to the attached "Summary of Foundation Recommendations".

The piles/piers shall be spaced at a minimum of three times the diameter to prevent reductions due to group effects. During construction of the end bent caps, the embankment soils should be laid back at no steeper than (2H:1V) or as required by OSHA. Temporary shoring may also be required. Backfill behind the end bent caps shall be replaced in accordance with Section 410-8 and 410-9 of the Standard Specifications.

From the information provided, we understand the structure will be constructed at or near existing site grades. Provided that the embankments are constructed in accordance with NCDOT specifications and suitable slope protection measures are incorporated, the slopes may be reconstructed as planned.

CLOSURE

Recommendations and evaluations provided by Tierra are based on the Bridge Survey & Hydraulic Design Report dated September 2006, and information provided by Mulkey Engineers and Consultants. Modifications of our recommendations and evaluations may be required if there are changes to the design or location of the structure. Recommendations in this report are based on data obtained from soil borings. The nature and extent of variations between borings may not become evident until construction.

Our professional services for this project have been performed in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made. Tierra appreciates this opportunity to have provided you with geotechnical engineering services for this project. If you have any questions regarding this report, please contact our office.

Sincerely,
TIERRA, INC.

Seungwoon (Sean) Han, Ph.D., P.E.
Geotechnical Engineer

NORTH CAROLINA PROFESSIONAL SEAL 31421 ENGINEER GABRIEL W. LANG

Gabriel W. Lang, P.E.
Sr. Geotechnical Engineer/ Manager

4/11/07

SUMMARY OF FOUNDATION RECOMMENDATIONS

NCDOT PROJ. NO.: R-4906 **PROJECT DESCRIPTION:** Bridge # 86 on SR 1322 over

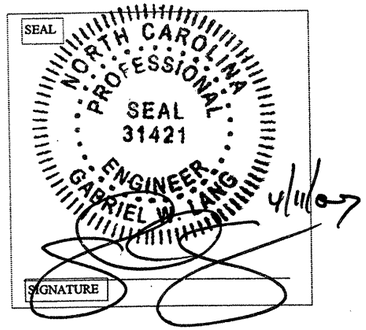
T.I.P. NO.: Ghent Creek

COUNTY: Person

STATION: 14+93.5 -L-

PREPARED BY: SWH **DATE:** 3/27/07

CHECKER: GWL **DATE:** 4/11/07



	STATION	FOUNDATION TYPE	ALLOWABLE LOAD	FOUNDATION DETAILS
END BENT 1	14+31 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap = 383 ft ± Recommended Length of Pile = 25 ft
BENT 1	14+91 -L-	36" Drilled Pier	190 tons/Pier	Assumed Bottom of Cap = 382 ft ± Assumed Top of Pier = 379 ft Tip Elevation No Higher Than = 349 ft (LT) Tip Elevation No Higher Than = 354 ft (RT) Recommended Length of Pier = 30 ft (LT) Recommended Length of Pier = 25 ft (RT)
END BENT 2	15+56 -L-	Cap on HP 12x53 Steel Pile	45 tons/Pile	Assumed Bottom of Cap =382 ft ± Recommended Length of Pile = 15 ft

COMMENTS & NOTES (Attached)

Note on Plans:

1. Drive piles at End Bents No. 1 and 2 to a required bearing capacity of 90 tons per pile. The required bearing capacity is equal to the allowable bearing capacity with a minimum factor of safety of two.
2. The allowable bearing capacity for piles at End Bents No. 1 and 2 is 45 tons per pile.
3. Drilled piers at Bent No. 1 are designed for both skin friction and end bearing. Check field conditions for the required end bearing capacity of 20 tsf.
4. Drilled piers at Bent No.1 are designed for an applied load of 185 tons at the top of the column.
5. Permanent steel casing is required for drilled piers at Bent No. 1. Do not extend the casing below elevation 354 ft (left side) and 365 ft (right side) without prior approval from the Engineer. See Drilled Piers Special Provision.
6. Drilled piers at Bent No. 1 shall extend to an elevation no higher than 349 ft (left side) and 354 ft (right side), satisfy the required end bearing capacity and have a minimum penetration of 5 ft into rock (left side) and 11 ft into weathered rock (right side) as defined by the Drilled Piers Special Provision.
7. The scour critical elevation for Bent No. 1 is elevation 366 ft. Scour critical elevations are used to monitor possible scour problems during the life of the structure.
8. For drilled piers, see Drilled Piers Special Provision.
9. SPT testing is not required to determine the end bearing capacity of the drilled piers at Bent No. 1.
10. Do not use slurry construction for drilled piers at Bent No. 1.
11. Do not use polymer slurry for drilled piers at Bent No. 1.
12. CSL tubes are required and CSL testing may be required for the drilled piers. The Engineer will determine the need for CSL testing. See Crosshole Sonic Logging Special Provision.

Comments:

1. 1.5 :1 (H:V) slope is Ok with Class II Rip Rap slope protection.
2. The elevation of the point of fixity for Bent No. 1 is 352 ft (left side) and 359 ft (right side).
3. Design scour elevation for Bent No. 1 is 369 ft.

DRILLED PIER PAY ITEM QUANTITIES

PROJECT NO. R-4906 DATE 3/26/2007

TIP NO. _____ DESIGNED BY SWH

COUNTY Person CHECKED BY GWL

STATION _____

DESCRIPTION Bridge # 86 on SR 1322 over Ghent Creek

NUMBER OF BENTS WITH DRILLED PIERS 1

NUMBER OF PIERS PER BENT 3

BENT #	DRILLED PIER PAY ITEMS					
	PERMANENT STEEL CASING FOR 36" DIA. DRILLED PIER (yes/no/maybe)	36" DIA. DRILLED PIERS NOT IN SOIL (feet)	SPT TESTING (each)	SID INSPECTION (each)	CROSSHOLE SONIC LOGGING* (each)	CSL TUBES* (yes/no)
1	YES	30	0	0	0	YES
2						
3						
4						
5						
6						
7						
8						
9						
10						
TOTALS		30	0	0	0	

* Pay items, "Crosshole Sonic Logging" and "CSL Tubes" are not required unless CSL testing is required with a Note on Plans.

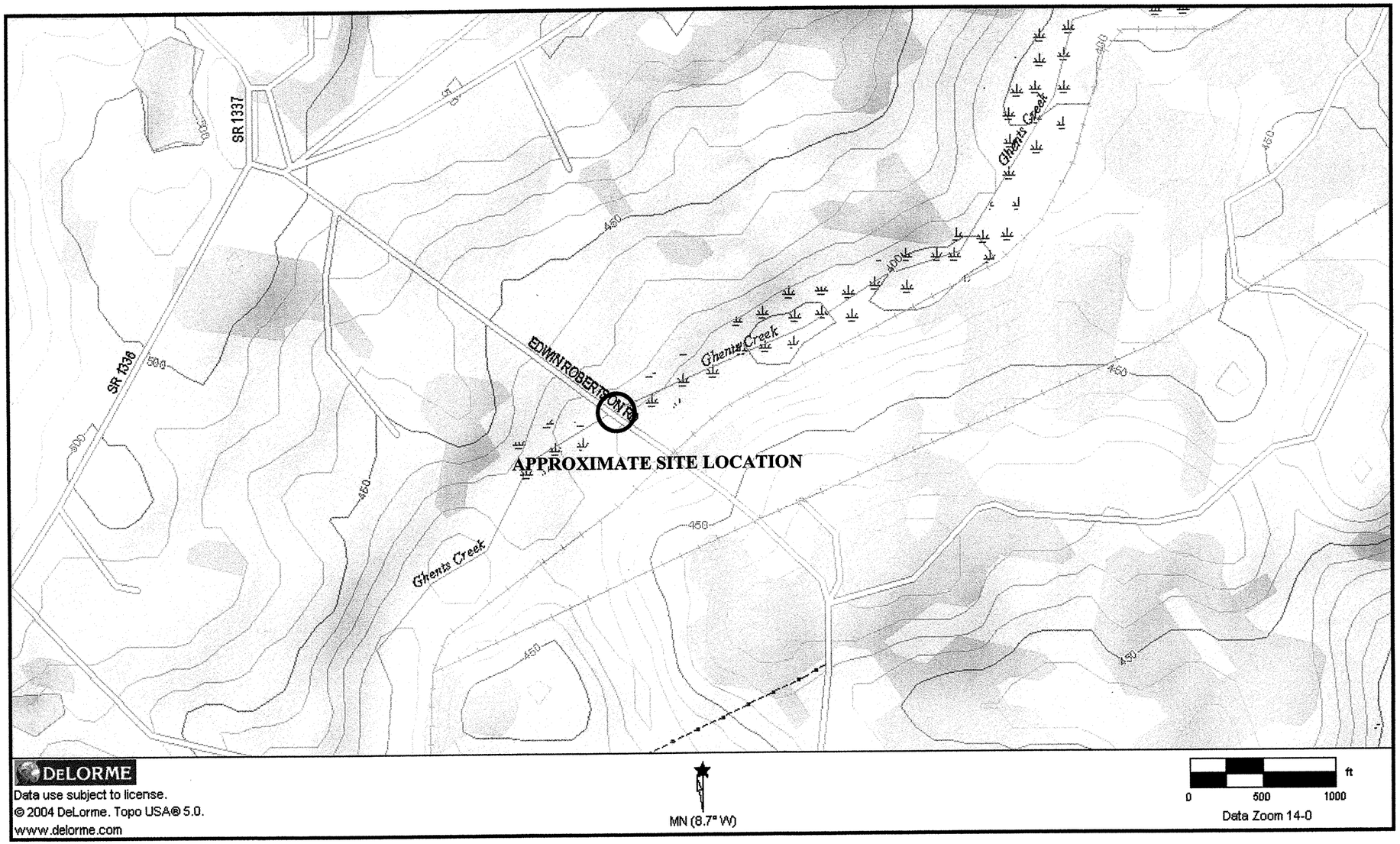
Notes:

Blanks or no represent quantity of zero.

If permanent steel casing is required or may be required, Structure Design should calculate the pay item quantity, "Permanent Steel Casing for ___ Dia. Drilled Pier", as the difference between the top of drilled pier elevation or the top of permanent steel casing elevation (whichever is lower) and the elevation the permanent steel casing can not extend below as shown with a Note on Plans.

Structure Design should determine the pay item quantity, "___ Dia. Drilled Piers in Soil", based upon the total drilled pier length per bent minus the "___ Dia. Drilled Piers not in Soil" per bent shown in the table above.

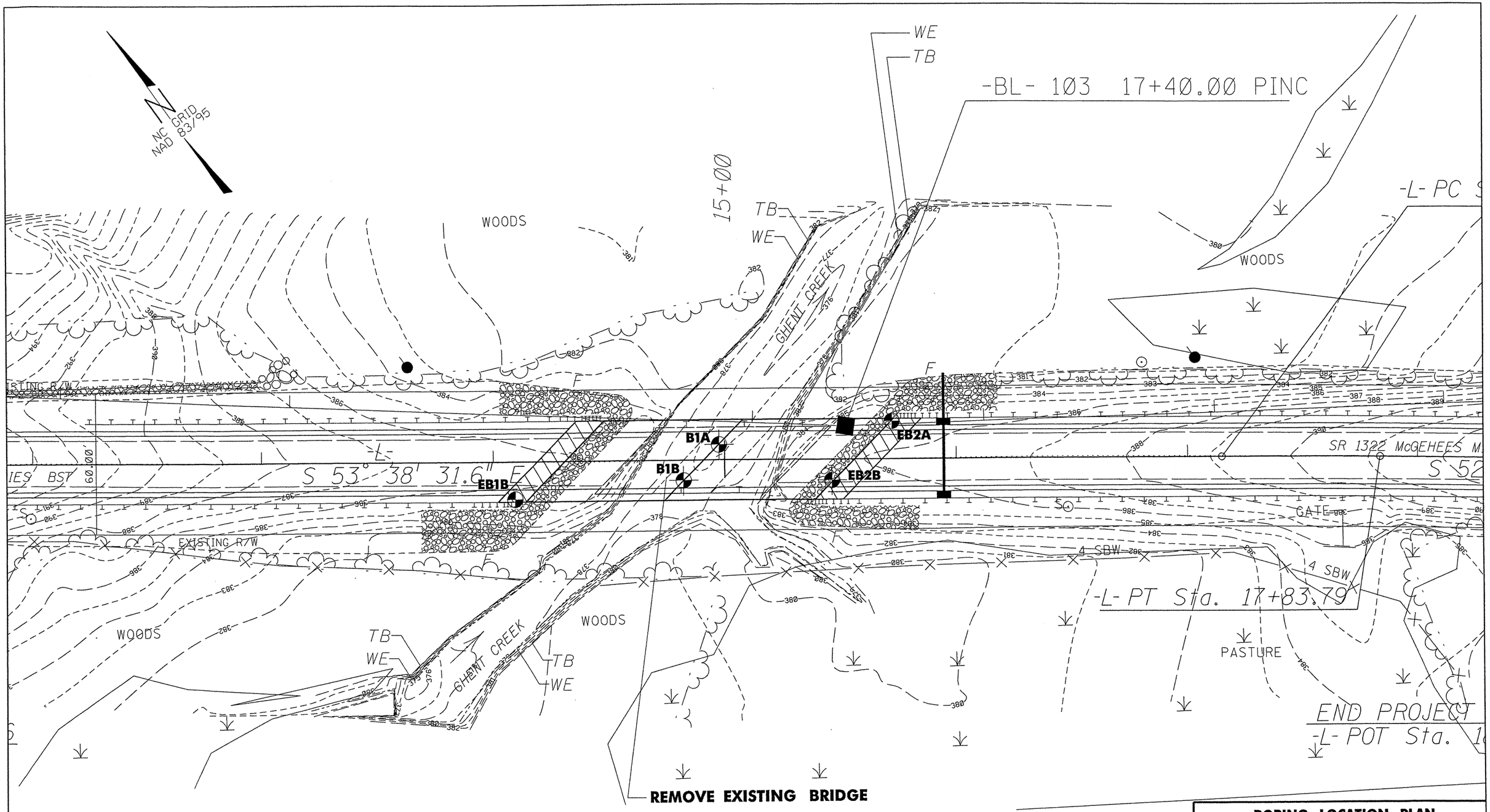
If CSL tubes are required, Structure design should calculate the pay item quantity, "CSL Tubes", as follows:
"CSL Tubes" per bent = (drilled pier length + 2.5 feet) x number of CSL tubes per pier
The number of CSL tubes per pier is dependent upon the drilled pier diameter. For drilled piers with a diameter of 5 feet or less, use 4 tubes. For drilled piers with a diameter greater than 5 feet, use 6 tubes.



SITE VICINITY MAP

BRIDGE # 86 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803



NOTES:

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM MULKEY ENGINEERS & CONSULTANTS, DATED SEP., 2006

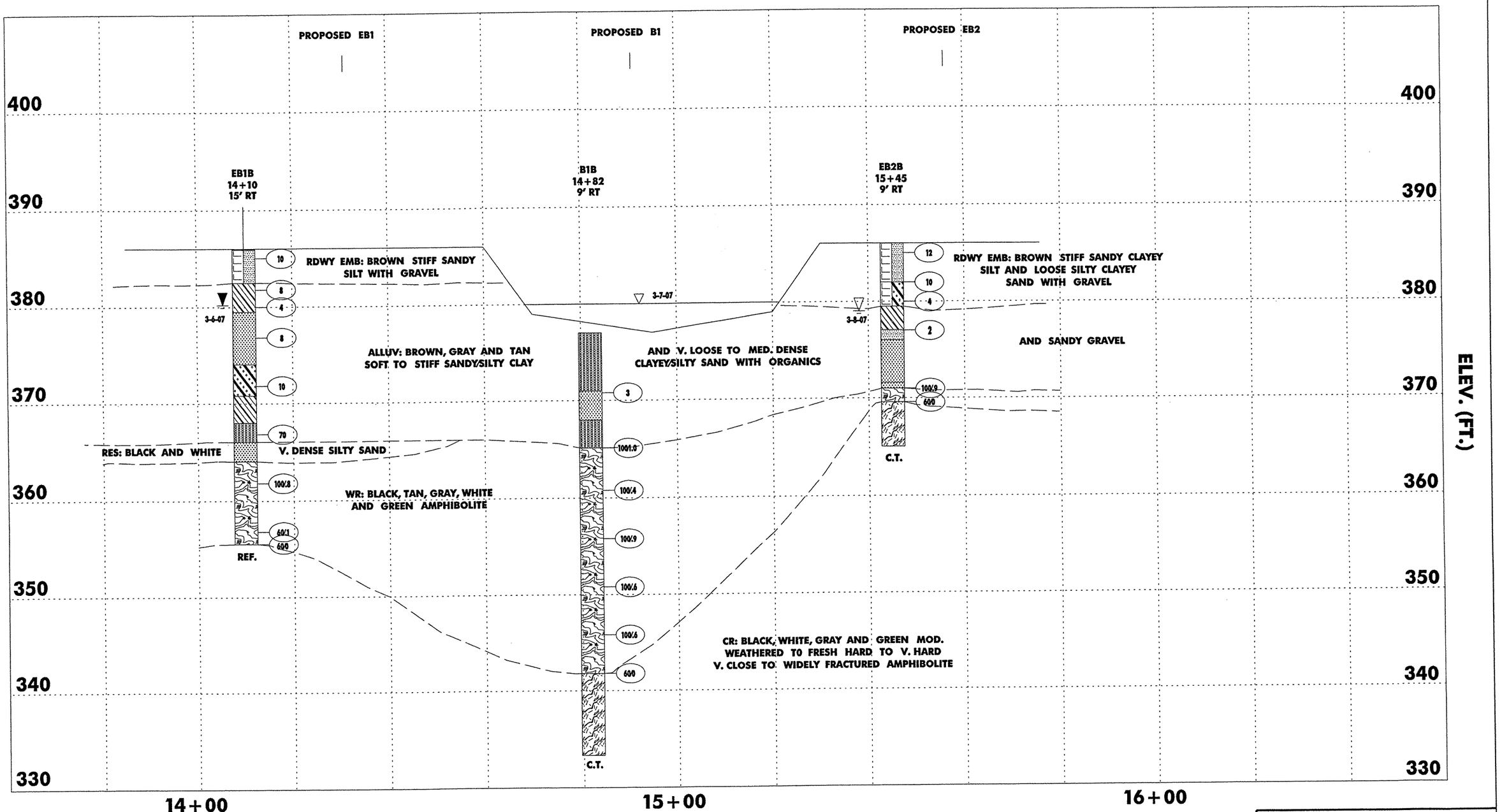
PROPOSED BRIDGE SKEW: 135°

0 40 80
FEET

BORING LOCATION PLAN

BRIDGE # 86 ON SR 1322
OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT NO.: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803



VERTICAL SCALE

0 10 20

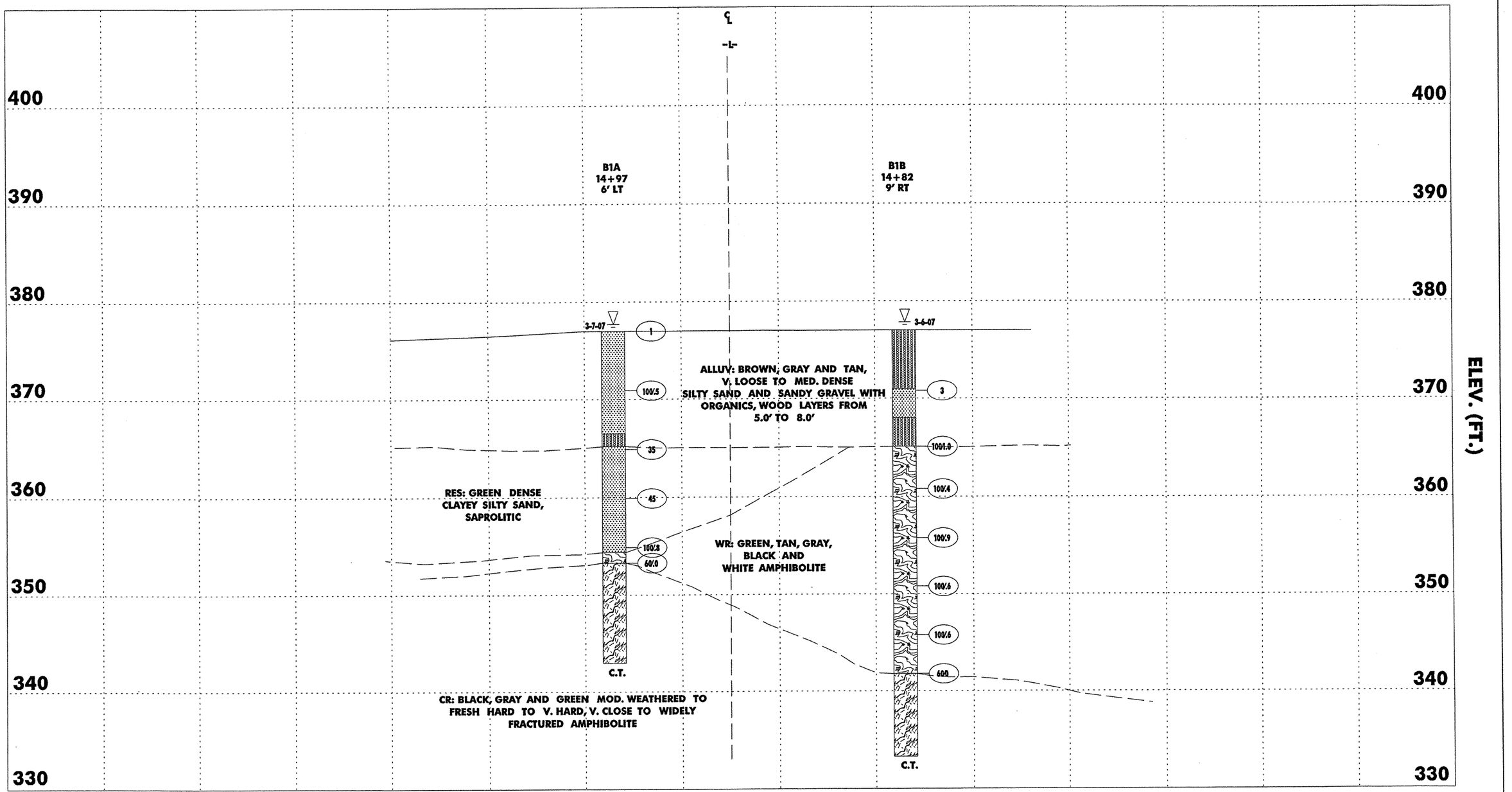
HORIZONTAL SCALE

0 20 40

PROFILE ALONG CENTERLINE OF -L-

BR #86 ON SR 1322
OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA GEOTECHNICAL• MATERIALS
TIERRA, INC.
2726 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0666
FAX (919) 871-0663



VERTICAL SCALE

0 10 20

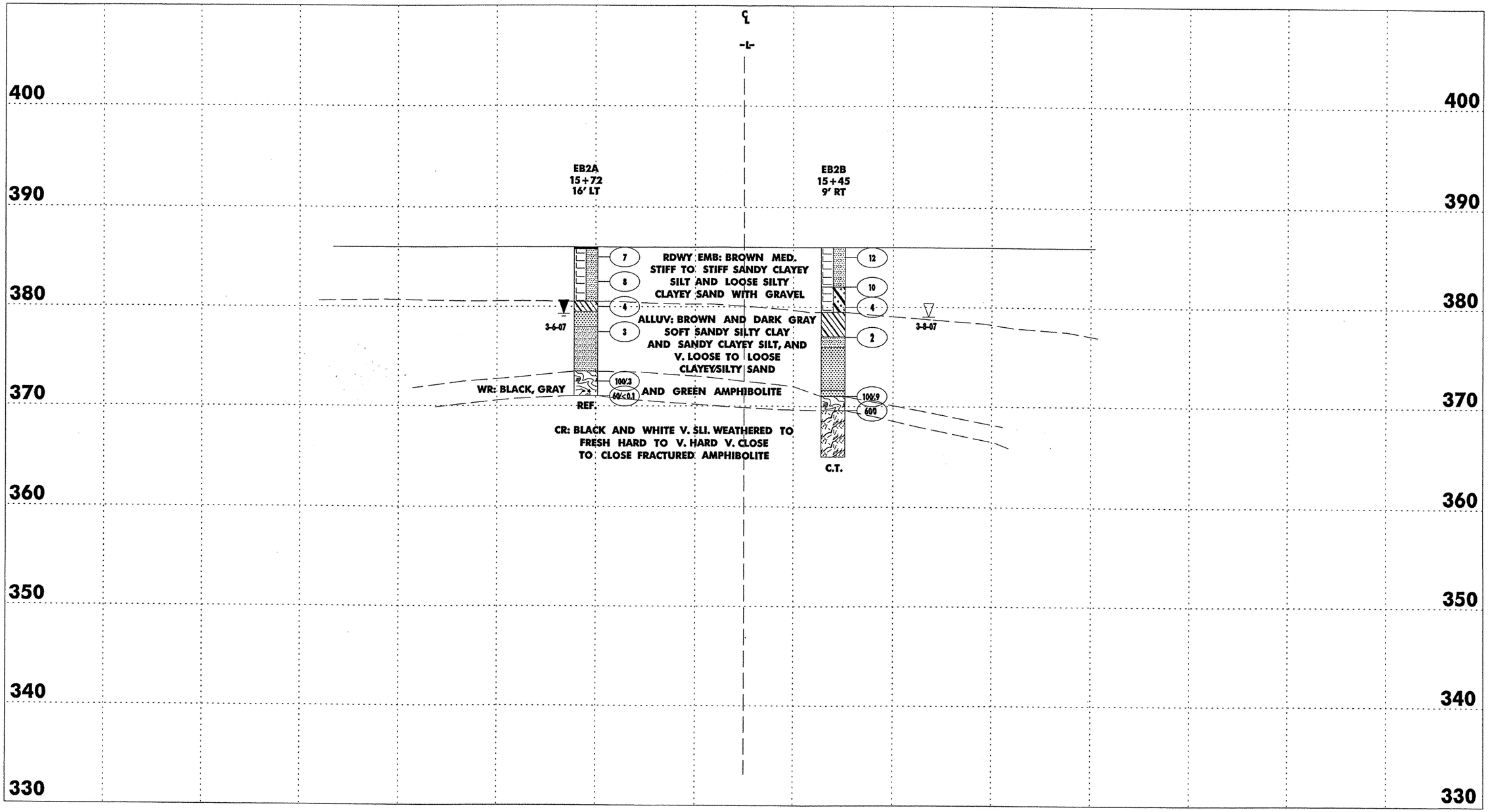
HORIZONTAL SCALE

0 5 10

CROSS SECTION BENT 1

BR #86 ON SR 1322
OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
TIERRA, INC.
2726 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 875-0000
FAX (919) 875-0006



VERTICAL SCALE

0 10 20

HORIZONTAL SCALE

0 10 20

CROSS SECTION END BENT 2

BR #86 ON SR 1322
OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS
ENGINEERING
TIERRA, INC.
2726 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 875-9666
FAX (919) 875-9668

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK			**GROUND WATER (ft)**
BORING NO. EB1B	**BORING LOCATION** 14+10	**OFFSET** 15' RT	**ALIGNMENT** **0 HR.** 6.0
COLLAR ELEV. 386 ft	**NORTHING**	**EASTING**	**24 HR.** 5.8
TOTAL DEPTH 30.5 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-5-07	**COMPLETED** 3-5-07	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
386.0					EXISTING GROUND				386.0 0.0
385	1.0	7	5	5	10		M		385.9 ROOTMAT 0.1 RDWY EMB: BROWN, STIFF, SANDY SILT (A-4) WITH GRAVEL
	4.2	4	3	5	8	SS-1	22.1%		382.5 3.5 ALLUV: BROWN MOTTLED, MED. STIFF, SANDY CLAY (A-6)
380	6.0	4	2	2	4		W		379.5 6.5 ALLUV: BROWN TO DARK GRAY, LOOSE, SILTY SAND (A-2-4)
	9.2	2	2	6	8		W		
375	14.2	4	4	6	10		W		374.0 12.0 ALLUV: DARK GRAY, LOOSE, CLAYEY SAND (A-2-6)
370	19.2	13	36	34	70		W		370.8 15.2 ALLUV: BROWN AND GRAY, STIFF, SANDY CLAY (A-6)
									368.0 18.0 ALLUV: GRAY, MED. DENSE, SANDY GRAVEL (A-1-a)
365	24.2	50	50/.3		100/.8		M		366.0 20.0 RES: BLACK AND WHITE, V. DENSE, SILTY SAND (A-2-4)
									364.0 22.0 WR: BLACK AND WHITE, AMPHIBOLITE
360	29.2	60/.1			60/.1				
	30.5	60/0			60/0				355.5 30.5 AUGER REFUSAL AT 30.5' ON CR: AMPHIBOLITE

NCDOT_BORE 07-005 BRIDGE 86.GPJ NCDOT.GDT 4/11/07

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

N.C.D.O.T. GEOTECHNICAL UNIT
BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	ID.	COUNTY PERSON COUNTY, NC	GEOLOGIST C. BRUINSMA
SITE DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK			GROUND WATER (ft)
BORING NO. B1A	BORING LOCATION 14+97	OFFSET 6' LT	ALIGNMENT	0 HR. N/A
COLLAR ELEV. 377 ft	NORTHING	EASTING		24 HR. N/A
TOTAL DEPTH 34.0 ft	DRILL MACHINE CME 550 ATV	DRILL METHOD HSA	HAMMER TYPE MANUAL	
DATE STARTED 3-7-07	COMPLETED 3-7-07	SURFACE WATER DEPTH 0.7		

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
377.0					EXISTING GROUND				377.0 0.0
	0.0	1	WOH	1	1	SS-2	W		ALLUV: BROWN, V. LOOSE, SAND (A-2-4) WITH ORGANICS, WOOD LAYERS FROM 5.0' TO 8.0'
375									
	6.5	100/.5			100/.5		W		
370									366.5 10.5
	12.1								ALLUV: BROWN, SANDY GRAVEL (A-1-a)
365		13	20	15	35		W		365.2 11.8 RES: GREEN, DENSE, CLAYEY SILTY SAND (A-2-4) SAPROLITIC
	17.1								
360		27	24	31	45		M		
	22.1	17	83/.3				M		
355	23.7	60/.0			100/.8 60/.0	RS-1			354.4 22.6 WR: GREEN AND GRAY, AMPHIBOLITE
									353.3 23.7 CR: BLACK, GRAY AND GREEN, V. SLI. WEATH. TO FRESH, HARD TO V. HARD, V. CLOSE TO WIDELY FRACT. AMPHIBOLITE
350									
345									343.0 34.0 CORING TERMINATED AT 34.0' IN CR: AMPHIBOLITE

NCDOT_BORE 07-005 BRIDGE 86.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/7/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: B1A GEOLOGIST: C. BRUINSMA

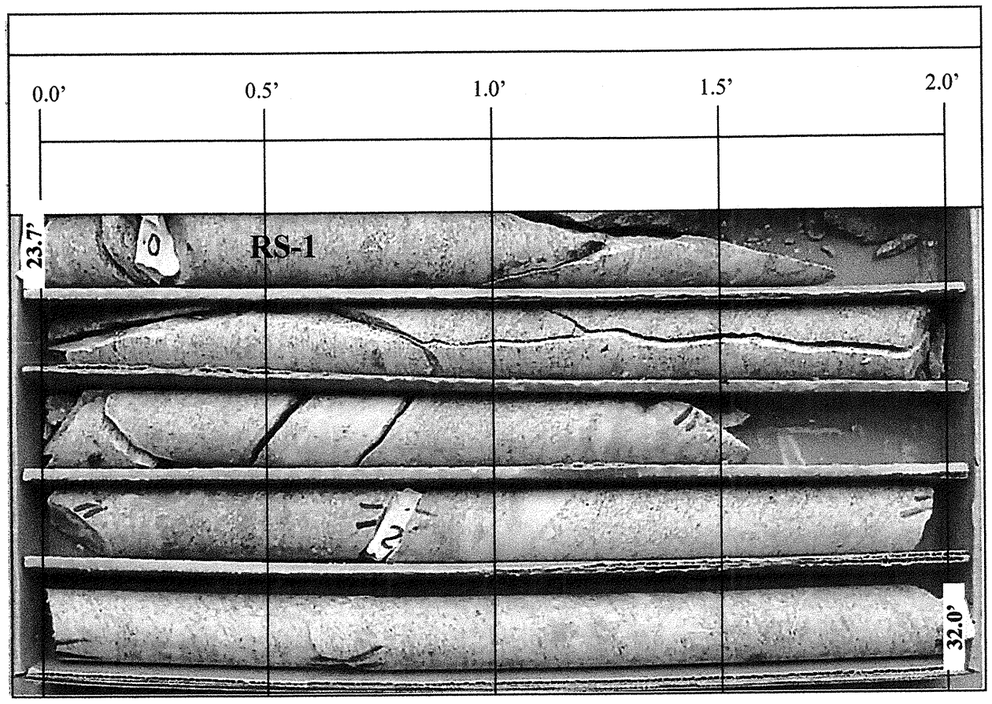
DESCRIPTION: BRIDGE #86 ON SR 1322 OVER GHENT CREEK

COUNTY: PERSON COLLAR ELEV.: 377 TOTAL DEPTH: 34.0 FT

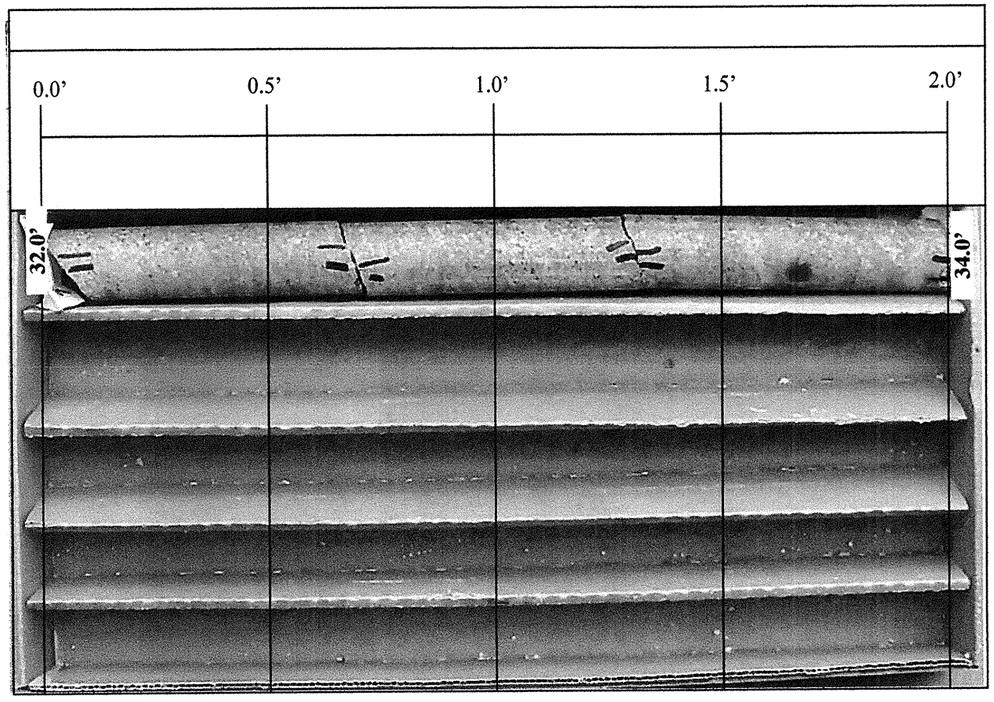
ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
353.3	23.7	5:10/0.3					23.7-34.0 CR: BLACK, GRAY AND GREEN, V. SLI. WEATH. TO FRESH, HARD TO V. HARD, V. CLOSE. TO WIDELY FRACT., AMPHIBOLITE
			0.3	0.3/0.3	0.0/0.3		
				100%	0%		
353.0	24.0						
353.0	24.0	5:00				RS-1	
		5:30		5.0/5.0	3.9/5.0		
		5:30	5.0				
		4:15		100%	78%		
348.0	29.0	4:50					
348.0	29.0	3:00					
		2:45		5.0/5.0	5.0/5.0		
		3:15	5.0				
		3:30		100%	100%		
343.0	34.0	3:15					STRATA REC = 100% STRATA RQD = 86%

CORING TERMINATED AT 34.0 FT
ELEVATION 343.0 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV



Boring B1A, Box 1 of 2, 23.7 feet to 32.0 feet.



Boring B1A, Box 2 of 2, 32.0 feet to 34.0 feet.

SCALE 1:40 (1"=4")

ROCK CORE PHOTOGRAPHS

BRIDGE # 86 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK			**GROUND WATER (ft)**
BORING NO. B1B	**BORING LOCATION** 14+82	**OFFSET** 9' RT	**ALIGNMENT** **0 HR.** N/A
COLLAR ELEV. 377 ft	**NORTHING** 0.0	**EASTING** 100.0	**24 HR.** N/A
TOTAL DEPTH 43.7 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-5-07	**COMPLETED** 3-6-07	**SURFACE WATER DEPTH** 0.8	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
377.0					EXISTING GROUND				377.0 0.0 ALLUV: TAN, V. LOOSE SAND (A-1-b)
375	6.2								371.0 6.0
370	11.2	5	2	1	3	SS-3	W		ALLUV: GRAY, V. LOOSE, SILTY SAND (A-2-4) WITH ORGANICS
									368.0 9.0 ALLUV: GRAY, MED. DENSE, SANDY GRAVEL (A-1-a)
365	16.2	23	77/.5		100/1.0		W		365.1 11.9 WR: BLACK AND WHITE TO TAN AND GREEN, AMPHIBOLITE
360	21.2	100/.4			100/.4		W		
355	26.2	43	57/.4		100/.4		W		
350	31.2	100/.6			100/.6		W		
345	35.2	57	43/.1		100/.6		W		
		60/0			60/0	RS-2	W		341.8 35.2 CR: GREEN AND GRAY, MOD. WEATH TO FRESH, HARD, V. CLOSE. TO WIDELY FRACT., AMPHIBOLITE
340									
335									333.3 43.7 CORING TERMINATED AT 43.7' IN CR: AMPHIBOLITE

NCDOT_BORE COPY OF 07-005 BRIDGE 86.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/6/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: B1B GEOLOGIST: C. BRUINSMA

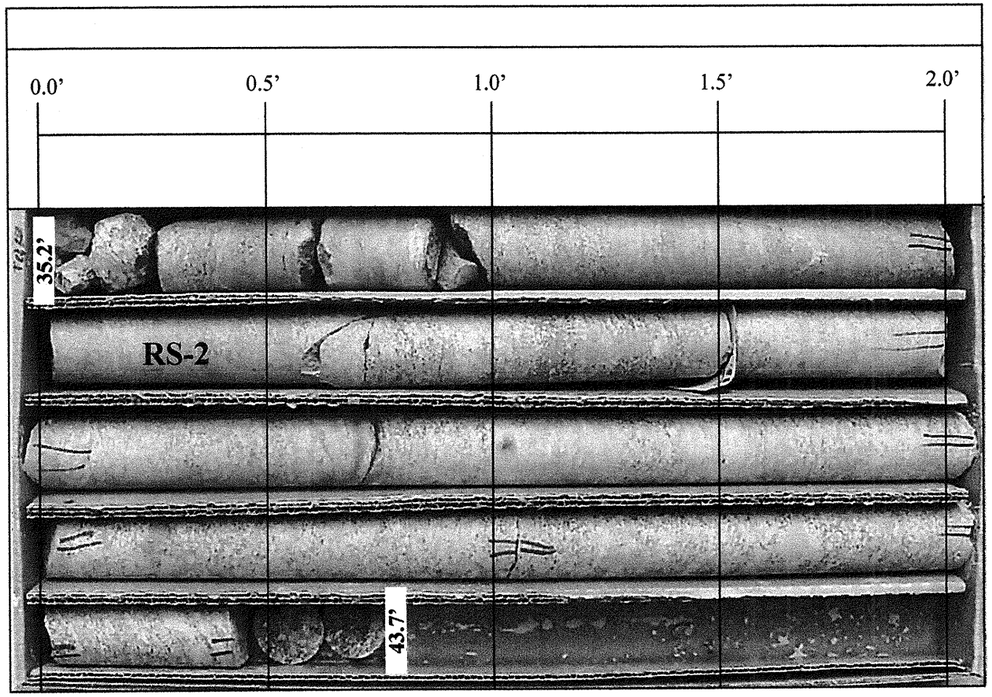
DESCRIPTION: BRIDGE #86 ON SR 1322 OVER GHENT CREEK

COUNTY: PERSON COLLAR ELEV.: 377 TOTAL DEPTH: 43.7 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
341.8	35.2	3:00					35.2-43.7 CR: GREEN AND GRAY, MOD. WEATH. TO FRESH, HARD, V. CLOSE TO WIDELY FRACT., AMPHIBOLITE
		4:00		3.5/3.5	2.2/3.5		
		5:00	3.5				
		3:00/0.5		100%	63%	RS-2	
338.3	38.7						
338.3	38.7	4:00					
		4:00		5.0/5.0	5.0/5.0		
		4:00	5.0				
		6:00		100%	100%		
333.3	43.7	7:00					STRATA REC = 100% STRATA RQD = 85%

CORING TERMINATED AT 43.7 FT
ELEVATION 333.3 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV



Boring B1B, Box 1 of 1, 35.2 feet to 43.7 feet.

SCALE 1:40 (1"=4")

ROCK CORE PHOTOGRAPHS

BRIDGE # 86 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

N.C.D.O.T. GEOTECHNICAL UNIT

BORING LOG

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK			**GROUND WATER (ft)**
BORING NO. EB2A	**BORING LOCATION** 15+72	**OFFSET** 16' LT	**ALIGNMENT** **0 HR.** 6.0
COLLAR ELEV. 386 ft	**NORTHING**	**EASTING**	**24 HR.** 6.7
TOTAL DEPTH 15.0 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-5-07	**COMPLETED** 3-5-07	**SURFACE WATER DEPTH** N/A	

ELEV. (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 20 40 60 80 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
386.0					EXISTING GROUND				386.0 0.0
385	1.0	4	4	3	7		M		385.8 ROOTMAT 0.2 RDWY EMB: BROWN, MED. STIFF, CLAYEY SANDY SILT (A-4) WITH GRAVEL
	3.5	3	5	3	8		M		
380	6.0	3	2	2	4		▽		380.5 5.5 379.5 ALLUV: BROWN, SOFT, SANDY SILTY CLAY (A-6) 6.5 378.0 ALLUV: BROWN, LOOSE, SILTY SAND (A-2-4) 8.0
	8.5	2	1	2	3	SS-4	26.3%		ALLUV: BROWN AND GRAY, SOFT, SANDY CLAYEY SILT (A-4)
375	13.5	100/.3			100/.3				373.5 12.5 WR: BLACK, GRAY AND GREEN, AMPHIBOLITE
	15.0	60/<0.1			60/<0.1				371.0 15.0 SPT REFUSAL AT 15.0' ON CR: AMPHIBOLITE

NCDOT_BORE 07-005 BRIDGE 86.GPJ NCDOT.GDT 4/11/07

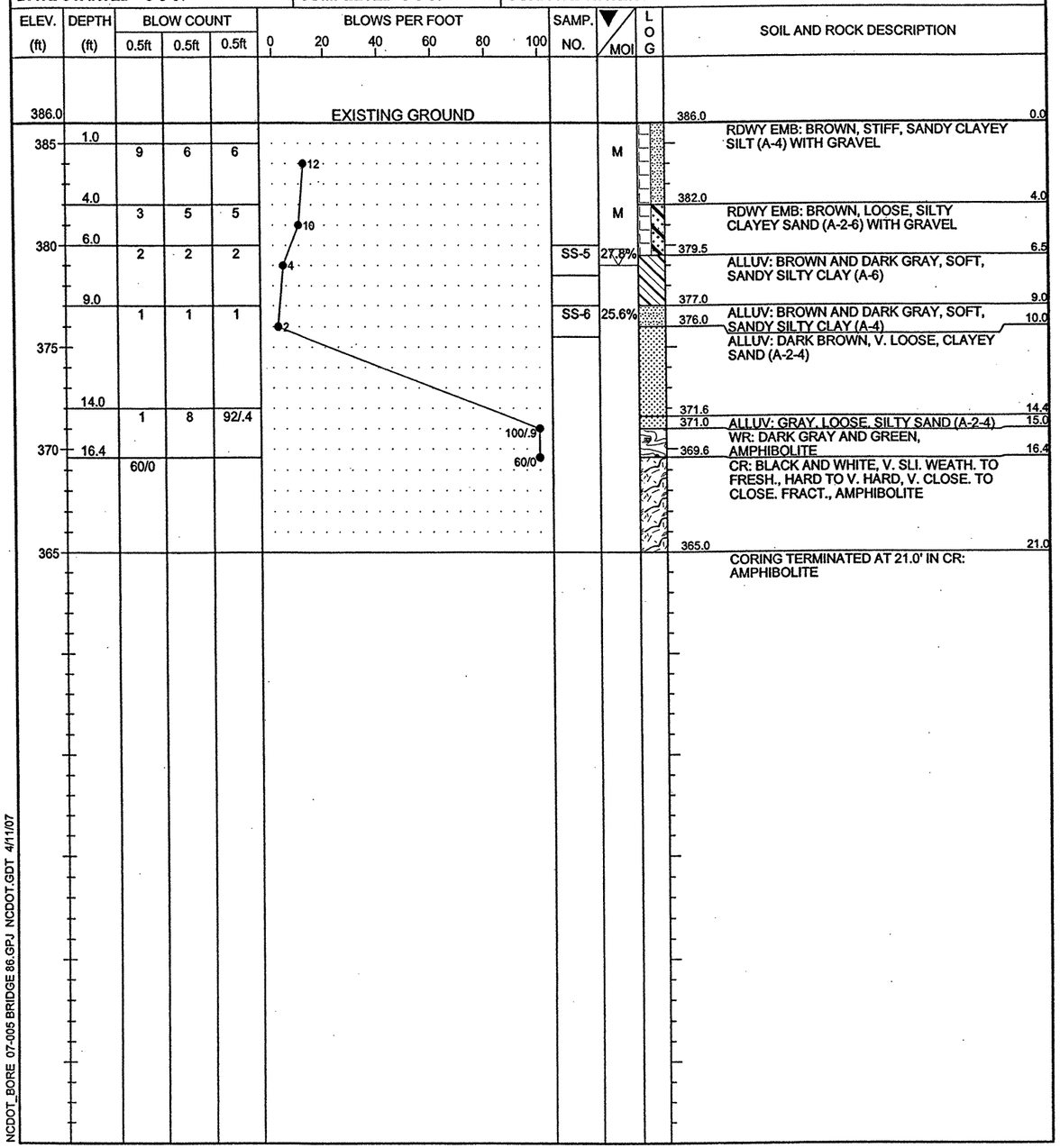
TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING
2736 ROWLAND ROAD
RALEIGH, NORTH CAROLINA 27615
Phone (919) 871-0800 Fax (919) 871-0803

N.C.D.O.T. GEOTECHNICAL UNIT

BORING LOG

SHEET 1 OF 1

PROJECT NO. 6211-07-005	**ID.**	**COUNTY** PERSON COUNTY, NC	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION BRIDGE #86 ON SR 1322 OVER GHENT CREEK			**GROUND WATER (ft)**
BORING NO. EB2B	**BORING LOCATION** 15+45	**OFFSET** 9' RT	**ALIGNMENT** **0 HR.** 7.0
COLLAR ELEV. 386 ft	**NORTHING**	**EASTING**	**24 HR.** BACKFILL
TOTAL DEPTH 21.0 ft	**DRILL MACHINE** CME 550 ATV	**DRILL METHOD** HSA	**HAMMER TYPE** MANUAL
DATE STARTED 3-8-07	**COMPLETED** 3-8-07	**SURFACE WATER DEPTH** N/A	



NCDOT_BORE 07-005 BRIDGE 86.GPJ NCDOT.GDT 4/11/07

CORE BORING REPORT

DATE: 3/8/2007

PROJECT NO.: 6211-07-005 I.D. NO.: _____ BORING NO: EB2B GEOLOGIST: C. BRUINSMA

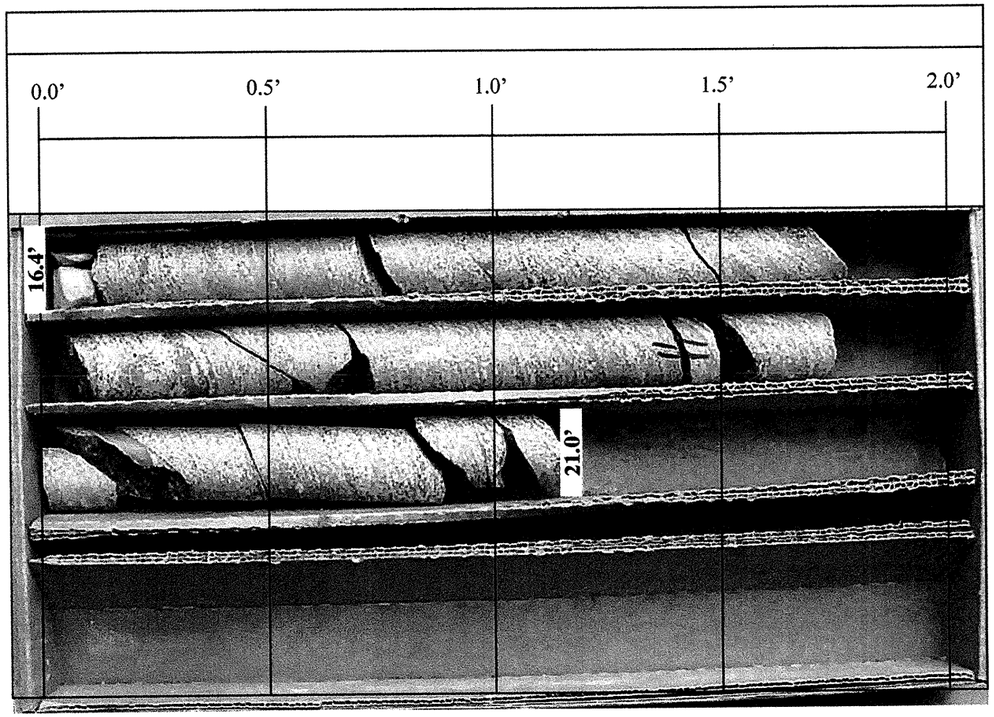
DESCRIPTION: BRIDGE #86 ON SR 1322 OVER GHENT CREEK

COUNTY: PERSON COLLAR ELEV.: 386 TOTAL DEPTH: 21.0 FT

ELEV. (FT)	DEPTH (FT)	DRILL RATE MIN/FT	RUN (FT)	REC FT %	RQD FT %	SAMP #	FIELD CLASSIFICATION AND REMARKS
369.6	16.4	4:00					16.4-21.0' CR: BLACK AND WHITE, V. SLI. WEATH. TO FRESH., HARD TO V. HARD, V. CLOSE. TO CLOSE. FRACT., AMPHIBOLITE
		4:15		4.3/4.6	3.0/4.6		
		5:00	4.6				
		5:15		93%	65%		
365.0	21.0	3:30/0.6					STRATA REC = 93% STRATA RQD = 65%

CORING TERMINATED AT 21.0 FT
ELEVATION 365.0 FT

DRILLER: S. GOWER CORE SIZE: NQ EQUIPMENT: CME 550 ATV



Boring EB2B, Box 1 of 1, 16.4 feet to 21.0 feet.

SCALE 1:40 (1"=4")

ROCK CORE PHOTOGRAPHS

BRIDGE # 85 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

TIERRA, INC. 2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

SOIL CLASSIFICATION AND GRADATION SHEET

BRIDGE #86 ON SR 1322 OVER GHENT CREEK
NCDOT PROJECT NO.: R-4906

PERSON COUNTY

TIERRA, INC. PROJECT NO: 6211-07-005

BORING #		SAMPLE #	NATURAL MOISTURE CONTENT	TOTAL SAMPLE PERCENT PASSING			ATTERBERG LIMIT		
AASHTO Classification									
STATION #	OFFSET (FEET)	DEPTH (FEET)		#10	#40	#200	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX
EB1B		SS-1	22.1%	94	81	54	39	15	24
A-6									
14+10	15' RT	4.2-5.7							
B1A		SS-2	55.7%	93	72	13	NP	NP	NP
A-2-4									
14+97	6' LT	0.0-1.5							
B1B		SS-3	46.4%	91	77	18	NP	NP	NP
A-2-4									
14+82	9' RT	6.0-7.5							
EB2A		SS-4	26.3%	100	99	68	26	19	7
A-4									
15+72	16' LT	8.5-10.0							
EB2B		SS-5	27.8%	87	67	39	38	22	16
A-6									
15+45	9' RT	6.0-7.5							
EB2B		SS-6	25.6%	98	94	56	26	19	7
A-4									
15+45	9' RT	9-10.5							

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

Bridge # 86 on SR 1322 over Ghent Creek

TIERRA No: 6211-07-005

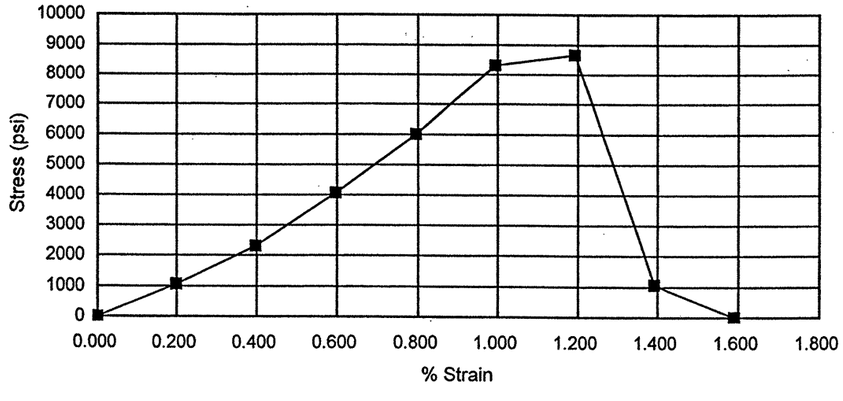
Boring #	Sample #	Depth (ft)	Average Diameter (in)	Average Length (in)	L/D	Total Volume (ft)3	Total Core Weight (lb)	Core Moisture Content (%)	Core Dry Weight (lb)	Unit Weight (pcf)	Rate of Stress Increase (lbs/min)	Max Unconfined Compression (psi)	Remarks
B - 1A	RS - 1	24.0 - 24.9	1.846	2.515	1.36	0.0039	0.6980	0.33	0.6957	178.7	7000	8660	
B - 1B	RS - 2	37.2 - 38.0	1.852	3.650	1.97	0.0057	1.0200	0.21	1.0179	179.0	10000	15406	

ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-07-005 Job Name: Bridge #86 on SR 1322 over Ghent Creek
Date: 3/22/2007 Sample No.: RS - 1
Boring No.: B - 1A Depth (ft): 24.0 - 24.9
Description: Black, gray & green, v. slightly weathered to fresh, hard to v. hard, v. close to widely fractured amphibolite
Length (in.): 2.515
Diameter (in.): 1.846
Area (sq. in.): 2.676

Compressive Strength (psi): 8660

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.199	2838	1060.4	533,368
0.010	0.398	6149	2297.5	577,816
0.015	0.596	10879	4064.8	681,526
0.020	0.795	16082	6008.8	755,605
0.025	0.994	22231	8306.3	835,610
0.030	1.193	23177	8659.7	725,973
0.035	1.392	2838	1060.4	76,195
0.040	1.590	0	0.0	0

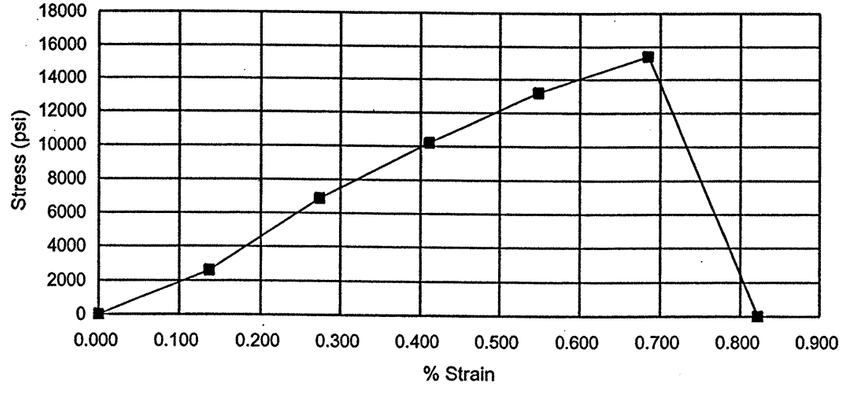


ROCK CORE UNIAXIAL COMPRESSIVE STRENGTH TEST

Job No.: 6211-07-005 Job Name: Bridge #86 on SR 1322 over Ghent Creek
Date: 3/22/2007 Sample No.: RS - 2
Boring No.: B - 1B Depth (ft): 37.2 - 38.0
Description: Green and gray, moderate to fresh, hard, close to widely fractured amphibolite gniess
Length (in.): 3.650
Diameter (in.): 1.852
Area (sq. in.): 2.694

Compressive Strength (psi): 15406

Deflection (in.)	Strain (%)	Corrected Load (lbf)	Compressive Strength (psi)	Young's Modulus (psi)
0.000	0.000	0	0.0	
0.005	0.137	7000	2598.5	1,896,920
0.010	0.274	18500	6867.5	2,506,645
0.015	0.411	27500	10208.5	2,484,062
0.020	0.548	35500	13178.2	2,405,024
0.025	0.685	41500	15405.5	2,249,205
0.030	0.822	0	0.0	0



NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT

FIELD SCOUR REPORT

WBS: _____ TIP: R-4906 COUNTY: PERSON

DESCRIPTION(1): BR. NO. 86 ON SR 1322 OVER GHENT CREEK

EXISTING BRIDGE

Information from: Field Inspection X Microfilm ____ (reel ____ pos: ____)
Other (explain) HYDRO REPORT

Bridge No.: 86 Length: 75 Total Bents: 4 Bents in Channel: 2 Bents in Floodplain: 2
Foundation Type: H PILES, STEEL PLANK ON I-BEAMS, TIMBER VERTICAL ABUTMENTS

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: SCOUR ALONG SOUTHEAST CORNER DUE TO SECONDARY STREAM

Interior Bents: NO EVIDENCE OF SCOUR

Channel Bed: SCOURING DIRECTLY DOWNSTREAM OF CONVERGENCE OF SECONDARY STREAM AND GHENT CREEK (SOUTHEAST SIDE OF BRIDGE)

Channel Bank: SOME UPSTREAM BANK SCOUR EVIDENT

EXISTING SCOUR PROTECTION

Type(3): RIP RAP (UP TO 1' DIAMETER) ARMORING SOUTHEAST ABUTMENT

Extent(4): JUST AT CORNER OF BRIDGE

Effectiveness(5): RIP RAP HAS MINIMIZED SCOUR AT ENDBENT

Obstructions(6): NONE

INSTRUCTIONS

1 Describe the specific site's location, including route number and body of water crossed.
2 Note scour evidence at existing end bents or abutments (e.g. undermining, sloughing, degradations).
3 Note existing scour protection (e.g. rip rap).
4 Describe extent of existing scour protection.
5 Describe whether or not the scour protection appears to be working.
6 Note obstructions such as dams, fallen trees, debris at bents, etc.
7 Describe the channel bed material based on observation and/or samples. Include any lab results with report.
8 Describe the channel bank material based on observation and/or samples. Include any lab results with report.
9 Describe the material covering the banks (e.g. grass, trees, rip rap, none).
10 Determine the approximate floodplain width from field observation or a topographic map.
11 Describe the material covering the floodplain (e.g. grass, trees, crops).
12 Use professional judgement to specify if the stream is degrading, aggrading, or static.
13 Describe potential and direction of the stream to migrate laterally during the bridge's life (approx. 100 years).
14 Give the design scour elevation (DSE) expected over the life of the bridge (approx. 100 years). This elevation can be given as a range across the site, or for each bent. Discuss the relationship between the Hydraulics Unit theoritical scour and the DSE. If the DSE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The DSE is based on the erodability of materials, giving consideration to the influence of joints, foliation, bedding characteristics, % core recovery, % RQD, differential weathering, shear strength, observations at existing structures, other tests deemed appropriate, and overall geologic conditions at the site.

DESIGN INFORMATION

Channel Bed Material(7): SAND

Channel Bank Material(8): SAND, SILT AND CLAY

Channel Bank Cover(9): GRASSES, SHRUBS, AND YOUNG TO OLD TREE GROWTH

Floodplain Width(10): APPROXIMATELY 900 FEET

Floodplain Cover(11): GRASSES, SHRUBS, AND YOUNG TO OLD TREE GROWTH

Stream is(12): Aggrading ____ Degrading X Static ____

Channel Migration Tendency(13): NORTH

Observations and Other Comments: _____

Reported by: C. Bruinsma TIERRA, INC. **Date:** 3/8/2007

DESIGN SCOUR ELEVATIONS(14) Feet ____ Meters ____

	BENTS B1	B2	B3	B4							
SB Lanes, Lt											
SB Lanes, Rt											
NB Lanes, Lt											
NB Lanes, Rt											

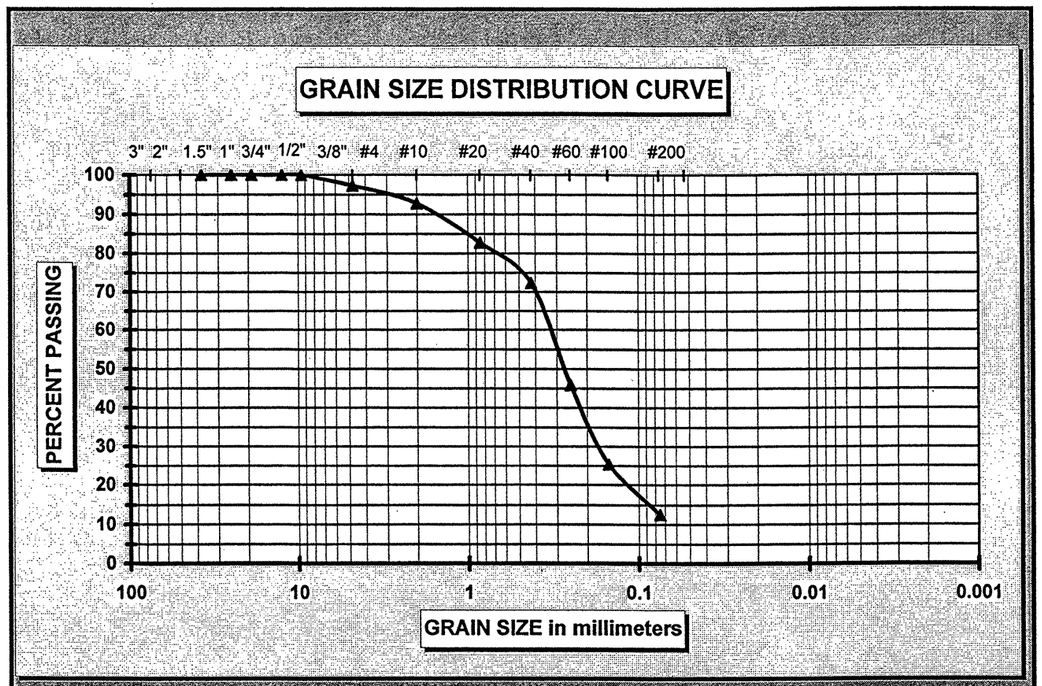
Comparison of DSE to Hydraulics Unit theoretical scour:

DSE determined by: _____ **Date:** _____

SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL

Bed or Bank	Bed	Bank					
Sample No.	SS-3	SS-2					
Retained #4	5	3					
Passed #10	91	93					
Passed #40	77	72					
Passed #200	18	13					
Coarse Sand	14	21					
Fine Sand	59	59					
Silt							
Clay	18	13					
LL	NP	NP					
PI	NP	NP					
AASHTO	A-2-4	A-2-4					
Station	14+82	14+97					
Offset	9' RT	6' RT					
Depth	6.0-7.5	0.0-1.5					

BRIDGE #86 ON SR 1322 OVER GHENT CREEK
PERSON COUNTY
NCDOT PROJECT NO.: R-4906



AASHTO M-145 Classification of Soil for Engineering Purposes					
Gravel	< 3" and > #10		Coarse Sand	< #10 and > #40	Cu = D60 / D10
			Fine Sand	< #40 and > #200	Cc = (D30)^2 / (D10 x D60)

BORING #: B1A **SAMPLE #:** SS-2 **DEPTH:** 0.0-1.5

SILTY SAND (A-2-4)

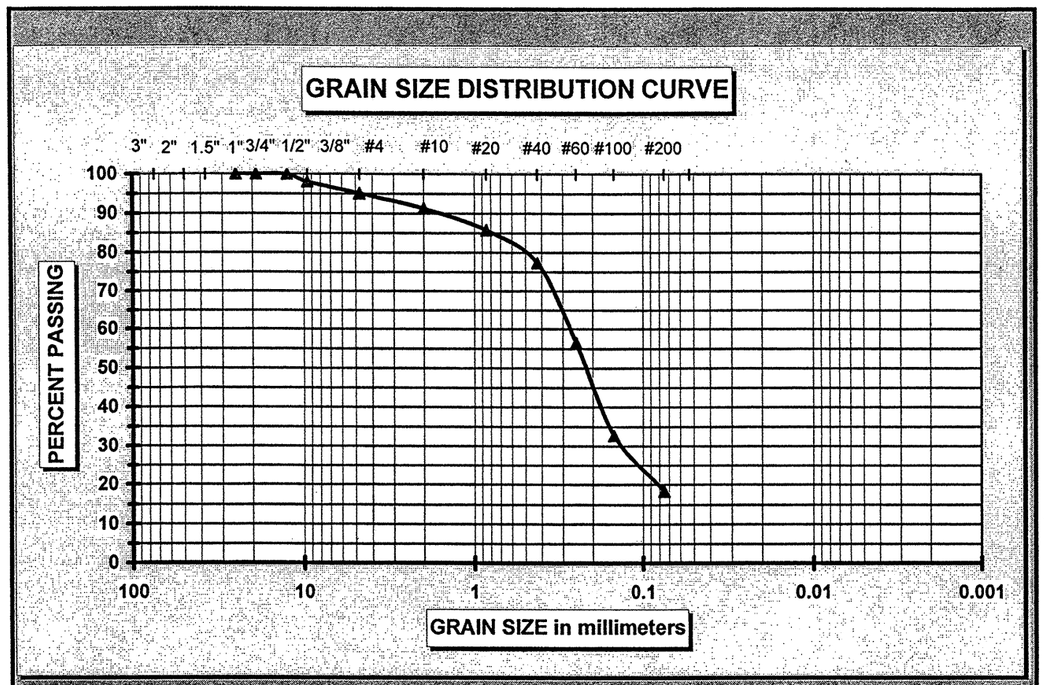
% PASSING #200 SIEVE: 13%

NATURAL MOISTURE CONTENT = N/A

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTIC INDEX	NP

TIERRA, INC. 2736 ROWLAND RD. RALEIGH, NORTH CAROLINA 27615

BRIDGE #86 ON SR 1322 OVER GHENT CREEK
PERSON COUNTY
NCDOT PROJECT NO.: R-4906



AASHTO M-145 Classification of Soil for Engineering Purposes					
Gravel	< 3" and > #10		Coarse Sand	< #10 and > #40	Cu = D60 / D10
			Fine Sand	< #40 and > #200	Cc = (D30)^2 / (D10 x D60)

BORING #: B1B **SAMPLE #:** SS-3 **DEPTH:** 6.0-7.5

SILTY SAND (A-2-4)

% PASSING #200 SIEVE: 18%

NATURAL MOISTURE CONTENT = N/A

ATTERBERG LIMIT (- #40 Material)	
LIQUID LIMIT	NP
PLASTIC LIMIT	NP
PLASTIC INDEX	NP

TIERRA, INC. PROJECT #: 6211-07-005

PHOTO 1: CENTERLINE PROFILE, LOOKING UPSTATION

PHOTO 2: GHENT CREEK, LOOKING UPSTREAM

SITE PHOTOGRAPHS

BR # 86 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803

PHOTO 3: END BENT 1, LOOKING LEFT TO RIGHT

PHOTO 4: END BENT 2, LOOKING LEFT TO RIGHT

SITE PHOTOGRAPHS

BR # 86 ON SR 1322 OVER GHENT CREEK
PERSON CO., NC
NCDOT PROJECT #: R-4906
TIERRA PROJECT #: 6211-07-005

TIERRA
GEOTECHNICAL • MATERIALS ENGINEERING

TIERRA, INC.
2736 ROWLAND RD.
RALEIGH, NC 27615
PHONE (919) 871-0800
FAX (919) 871-0803