STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	MA1418IR-A	1	25

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

STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. *MA1418IR-A* F.A. PROJ. _____

COUNTY *HENDERSON*

PROJECT DESCRIPTION *REPLACE BRIDGE NO 40 ON SR 1006 OVER CLEAR CREEK*

SITE DESCRIPTION _____

PROJECT: *ID: MA1418IR-A*

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CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE 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.

PERSONNEL
C. NORVILLE
M. BAHIRADHAN
J. HAMM
T. EVANS

INVESTIGATED BY *T. EVANS*
CHECKED BY *M. BAHIRADHAN*
SUBMITTED BY *FALCON ENG.*
DATE *MARCH 9, 2012*

NORTH CAROLINA PROFESSIONAL SEAL 036072 ENGINEER MAHALINGAM BAHIRADHAN

03/09/2012

DRAWN BY: *T. EVANS*

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.

PROJECT REFERENCE NO.	SHEET NO.
MA1418IR-A	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. 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 PLASTIC INDEX	6 MX		NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<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 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	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	2.00	0.42	0.25	0.075	0.053

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

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- 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, YELLOW-BROWN, BLUE-GRAY), MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
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 IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 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 SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT, DPT, DMT, VST, PMT TEST BORING
- AUGER BORING
- CORE BORING
- MW MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING W/ CORE
- SPT N-VALUE
- REF SPT REFUSAL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B-___
- [ ] BK-51
- [ ] CME-45C
- [ ] CME-550
- [ ] PORTABLE HOIST
- [X] CME-55
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B_____
- [X] -N 02
- [ ] -H_____

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF 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 FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, 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 GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 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 THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.

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

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:

ELEVATION: FT.

NOTES:
FIAD - FILLED-IN AFTER DRILLING

REVISED 09/23/09

March 9, 2012

Mr. Jimmy L. Terry, P.E.
TGS Engineers
975 Walnut Street, Suite 141
Cary, North Carolina 27511

Re: Structure Subsurface Investigation Report

TIP No.: MA14181R-A
County: Henderson
Description: Bridge #40 on SR 1006 (Howard Gap Road) over Clear Creek
Falcon Project No.: G11043.00

Dear Mr. Terry,

As authorized, Falcon Engineering, Inc. (Falcon) has completed the geotechnical subsurface investigation for the proposed replacement of Bridge No. 40 on SR 1006 (Howard Gap Road) over Clear Creek in Henderson County, North Carolina. A site vicinity map is shown on Sheet 7. Our investigation was performed in general accordance with our proposal number F2011-205, dated December 21, 2011 and subsequent contract amendment for additional services. This report includes the results of our field and laboratory testing, geotechnical recommendations for foundations, site and boring location plans, and profiles and cross sections showing subsurface conditions.

PROJECT DESCRIPTION

The existing bridge will be replaced with a new bridge structure along the new alignment approximately 40 feet left of the existing structure. The proposed structure will be an approximately 110-foot-long, 39-foot-wide, three-span, four-bent bridge. The structure is planned from approximately Station 50+83 to Station 51+93 and will traverse Clear Creek at a skew angle of approximately 75°. Information provided by TGS Engineers (TGS) indicates the finished grade elevations at the approaches will be approximately 2,084.0 and 2,084.5 feet at End Bent 1 and End Bent 2, respectively, with reference to North American Vertical Datum, 1988 (NAVD). The proposed bridge will be supported by a single row of vertical H-piles at the end bents and 18-inch diameter steel pipe piles at the interior bents. Design loads were obtained from the NCDOT standard load tables for cored slab bridges based on the bridge geometry as shown in the hydraulic report provided by TGS. This data is summarized in the tables below.

Bent	Station	Max. Factored Axial Load (Tons)	Total Number of Piles/Piers	Foundation Type	Pile Spacing (Center to Center)	Bottom of Pile Cap/Top of Pier Elevation (feet, NAVD)
End Bent 1	50+83	112	7	HP12X53	7 feet, 0 inches	2,079.0
Bent 1	51+13	210	8	18-inch dia. steel pipe piles	5 feet, 9 inches	2,079.0
Bent 2	51+68	210	8	18-inch dia. steel pipe piles	5 feet, 9 inches	2,079.5
End Bent 2	51+93	100	7	HP12X53	7 feet, 0 inches	2,079.5

End bent piles are not designed to carry any lateral loads or moments. H-piles will be placed such that their minor axis will be parallel to the bridge alignment. The load combinations obtained from the standard load tables at the interior bents are given in the table below.

Bent	Longitudinal *– Case I			Longitudinal *– Case II			Transverse*		
	Max. Axial Load (Kips)	Moment (Kip-ft.)	Shear (Kips)	Axial (Kips)	Moment (Kip-ft.)	Max. Long. Shear (Kips)	Axial (Kips)	Moment (Kip-ft.)	Max. Trans. Shear (Kips)
Bent 1	-240	-25	-3	-130	5	4	-140	220	5
Bent 2	-210	-25	-3	-110	5	3	-110	200	4

*-Longitudinal and transverse directions are parallel and perpendicular to the bridge alignment, respectively.

Fills on the order of approximately three (3) feet will be placed at the bridge approaches. Slopes at the end bents are proposed at 1.5 Horizontal (H) to 1 Vertical (V). The areas between the end bent slopes and Clear Creek will be excavated to an approximate elevation of 2,078 feet. The end bent slopes will be protected by Class II rip-rap keyed in three (3) feet.

SITE DESCRIPTION/GEOLOGY

The general site topography is characterized by gently rolling hills, typical of the western piedmont/foothills of North Carolina where the site is located. The immediate vicinity of the bridge consists predominantly of a relatively flat floodplain. The existing structure is an approximately 35 foot long, 26 foot wide, single-span structure with steel girders, corrugated steel deck, and concrete abutment walls likely on piles.

Approach embankment slopes are covered with grass and vegetation and range in height from 5 to 10 feet. The floodplain upstream and downstream of the bridge location is relatively free of debris. At the time of our investigation, water depth in the creek channel was 1 to 3 feet. Cobble to boulder sized pieces of rock and broken concrete were observed along the toe of the abutments and throughout the creek bed in the immediate vicinity of the bridge structure.

According to ***The Geologic Map of North Carolina*** (1985), the project site is located in the Inner Peidmont Belt. Specifically, bedrock in the area is noted to consist of intrusive monozonitic to granodioritic, inequigranular, Henderson Gneiss **(Chg)**. Nearby intrusions of poorly foliated, Granite Gneiss **(Sogg)** interlayered with biotite augen gneiss are also mapped in the area. Rocks encountered at the site consist of intrusive, massive to weakly foliated, thickly banded granite and mica gneiss.

FIELD EVALUATION PROCEDURE

Evaluation of the subsurface conditions for the project consisted of drilling nine (9) Standard Penetration Test (SPT) borings. Four (4) borings were drilled near the interior bents of the proposed structure, two (2) borings were drilled near the proposed end bent locations, and three (3) borings were drilled in the proposed roadway for the proposed alignment. Rock coring was performed in two (2) interior bent borings in order to verify the presence, quality, and composition of rock. Borings were performed with a Central Mining Equipment CME-55 all-terrain-vehicle mounted drill-rig. This rig was equipped with 2 ¼-inch inside diameter hollow-stem augers, mud rotary drilling equipment, an automatic hammer, and NQ2 sized, wire-line type diamond-impregnated rock coring equipment. SPT borings and soil/rock core sampling were performed in general accordance with the American Association of State Highway Transportation Officials (AASHTO T-206 and T-225). Borings were advanced to depths ranging from approximately 10 to 86 feet below existing grades and were drilled adjacent to the existing roadway or through existing pavements.

Soil samples were obtained from the borings using a split-barrel sampler and visually classified in the field before being placed in moisture-proof containers and transported to our laboratory. A visual scour

evaluation was performed along the channel and banks of Three Mile Branch. Representative samples of the channel bed and bank material were obtained for grain size analysis.

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 at-least after a 24-hour waiting period. Due to their locations within existing travel lanes along Howard Gap Road, the borings drilled within the roadway were filled-in immediately after drilling (FIAD) and the existing pavements patched and restored to grade.

SUBSURFACE AND GROUNDWATER CONDITIONS

Based on the results of our borings, subsurface conditions generally consist of embankment fill or alluvial soils at or near ground surface, underlain by residual soils, weathered rock and crystalline rock.

Embankment fills consist of dark gray and brown, silty fine sands (A-2-4) with gravel and roots, and were limited to two gravel driveways/access roads on either side of the bridge. Alluvial soils were encountered at the ground surface or beneath fills, consisting of dark gray, brown, and tan, fine sandy and silty clays (A-6) and silty to slightly silty sands (A-1, A-2-4, A-3). Residual soils were encountered in all borings beneath alluvial deposits consisting of gray, tan, orange, and red-brown, fine sandy silt (A-4) and silty sand (A-2-4) with rock fragments, mica, and weathered rock layers. Weathered rock was encountered beneath and within residual soils and consisted of tan gray and white mica gneiss. Crystalline rock was cored in the interior borings on the "A" side only (left of centerline). Rock materials penetrated in the borings consist of very severely to moderately weathered, very soft to hard, very closely to moderately closely fractured, mica gneiss with megacrystic, compositional bands.

The measured groundwater ranged in elevation from 2,075 to 2,077 feet, NAVD. Based on the Hydraulic Report provided to us, the normal water surface elevation in the creek at the bridge location is approximately 2,073 feet, NAVD.

LABORATORY TESTING

Representative split-spoon and bulk samples were selected from soil test borings to verify visual field classifications and determine soil index properties. A total of twelve (12) samples were analyzed in our laboratory for natural moisture content, grain size analysis, and Atterberg limits. A composite sample of bulk materials obtained from auger cuttings was subjected to standard Proctor compaction and California Bearing Ratio (CBR) testing. Additionally, four (4) representative rock core samples were subjected to unconfined compressive strength testing. The results of these laboratory tests can be found on sheets 22 and 23 of this report.

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 (As Modified) "Particle Size Analysis of Soil"
- AASHTO T-89 (As Modified) "Determining the Liquid Limits of Soil"
- AASHTO T-90 "Determining the Plastic Limit and Plasticity of Soils"
- AASHTO T-265 "Laboratory Determination of Moisture Content of Soils"
- AASHTO T-99-10 "Standard Method of Test for Moisture-Density Relations of Soils"
- AASHTO T-193-10 "Standard Method of Test for the California Bearing Ratio"
- ASTM D-2938-86 "Standard Test Method for Unconfined Compressive Strength of Intact Rock"

FOUNDATION RECOMMENDATIONS

The foundation recommendations presented below are based on the strength limit state.

The end bent piles will be driven to weathered rock in order to obtain the required axial capacity. A resistance factor of 0.6 was applied to evaluate the driving resistance of the piles, assuming they are driven to weathered rock/rock at both end bents.

The interior bent piles will also be driven to weathered rock in order to obtain the required axial capacity. A resistance factor of 0.6 was applied to evaluate the driving resistance of the piles, assuming they are driven to weathered rock/rock at both interior bents.

Lateral deflections of the interior bent piles were analyzed in LPILE for each boring drilled at the interior bents. The maximum lateral deflections of the interior bent piles were between 2.0 and 2.5 inches. Lateral capacities of a pile group will vary depending on the direction of the load. Since the spacing between the interior bent piles is less than 5 times the pile diameter, group reduction factors should be applied in accordance with Table 10.7.2.4-1 presented in the *AASHTO LRFD Bridge Design Specifications*, 2007 (with 2008 interim revisions). For more detailed foundation recommendations, refer to the attached "Foundation Recommendations" on Sheet 5.

The group axial capacities of the piles will be the sum of the individual capacities of the piles in a row. Please refer to Sheet 5 for pile foundation recommendations and plan notes. Pile pay item quantities are presented on Sheet 6.

Due to the presence of rock fragments and thin weathered rock layers, we recommend using pile tips when driving the piles at all bents.

Approach embankment fills shall be placed in accordance with NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications).

CLOSURE

If any of the project information contained in this report is incorrect or has changed, please inform Falcon so that we may amend the contents of this report as appropriate.

Recommendations and evaluations provided by Falcon are based on the information provided by your office. Modifications of our recommendations and evaluations may be required if there are changes to the design or location of the structure or roadway. 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. Falcon appreciates the 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,
FALCON ENGINEERING, INC.

Jeremy R. Hamm, EI
Geotechnical Designer

Mahalingam Bahiradhan (Bahi), PE
Senior Geotechnical Project Manager

FOUNDATION RECOMMENDATIONS

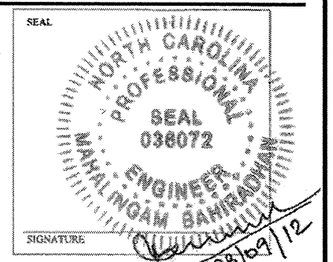
WBS #

T.I.P. NO. MA 14181R-A

COUNTY Henderson

STATION 50+83 to 51+93 -L-

DESCRIPTION Bridge # 40 on SR 1006 over Clear Creek



	INITIALS	DATE
DESIGN	MB	03/09/12
CHECK	CN	03/09/12
APPROVAL		

	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
END BENT 1	-L- 50+83	Cap on HP12X53 Steel Piles	56 tons/pile	Bottom of Cap Elev. = 2079.0 ft Length of Pile = 55 ft Number of Piles = 7 Pile Spacing = 7 feet 0 inches
BENT 1	-L- 51+13	Cap on 18-inch Steel Pipe Piles (0.5-inch wall thickness)	120 tons/pile	Bottom of Cap Elev. = 2079.0 ft Point of Fixity Elev. = 2051.0 ft. Tip Elev. No Higher Than = 2044.0 ft. Length of Piles = 60 feet Number of Piles = 8 Pile Spacing = 5 feet 9 inches
BENT 2	-L- 51+68	Cap on 18-inch Steel Pipe Piles (0.5-inch wall thickness)	105 tons/pile	Bottom of Cap Elev. = 2079.5 ft Point of Fixity Elev. = 2052.0 ft. Tip Elev. No Higher Than = 2044.0 ft. Length of Piles = 50 feet Number of Piles = 8 Pile Spacing = 5 feet 9 inches
END BENT 2	-L- 51+93	Cap on HP12X53 Steel Piles	50 tons/pile	Bottom of Cap Elev. = 2079.5 ft Length of Pile = 55 ft Number of Piles = 7 Pile Spacing = 7 feet 0 inches

TIP # MA 14181R-A **County** Henderson

FOUNDATION RECOMMENDATION NOTES ON PLANS

1. Piles at End Bent 1 are designed for a factored resistance of 56 Tons per pile.
2. Drive piles at End Bent 1 to a required driving resistance of 94 Tons per pile.
3. Piles at End Bent 2 are designed for a factored resistance of 50 Tons per pile.
4. Drive piles at End Bent 2 to a required driving resistance of 84 Tons per pile.
5. Piles at Bent 1 are designed for a factored resistance of 120 Tons per pile.
6. Drive piles at Bent 1 to a required driving resistance of 200 Tons per pile.
7. Piles at Bent 2 are designed for a factored resistance of 105 Tons per pile.
8. Drive piles at Bent 2 to a required driving resistance of 175 Tons per pile.
9. Steel H-pile points are required for steel H-piles at both end bents. For steel pile points, see Section 450 of the Standard Specifications
10. Steel pipe pile cutting shoes or conical points are required for steel pipe piles at both interior bents. For steel pile points, see Section 450 of the Standard Specifications.
11. For Piles, See Section 450 of the Standard Specification.
12. Scour critical elevation for Bent 1 is 2068.0 feet, NAVD. Scour critical elevations are used to monitor possible scour problems during the life of the structure.
13. Scour critical elevation for Bent 2 is 2068.0 feet, NAVD. Scour critical elevations are used to monitor possible scour problems during the life of the structure.

FOUNDATION RECOMMENDATION COMMENTS

1. No waiting period required.
2. End slopes of 1.5:1(H:V) are OK with slope protection

PILE PAY ITEMS

(For 2012 Lettings and Later - Revised 4/18/11)

WBS ELEMENT _____ DATE 3/10/2012

TIP NO. MA 14181R-A DESIGNED BY MB

COUNTY Henderson CHECKED BY CN

STATION 50+83 to 51+93 -L-

DESCRIPTION Bridge # 40 on SR 1006 over Clear Creek

NUMBER OF BENTS WITH PILES _____
NUMBER OF PILES PER BENT _____
NUMBER OF END BENTS WITH PILES _____
NUMBER OF PILES PER END BENT _____

Only required for "Predrilling for Piles" & "Pile Excavation" Pay

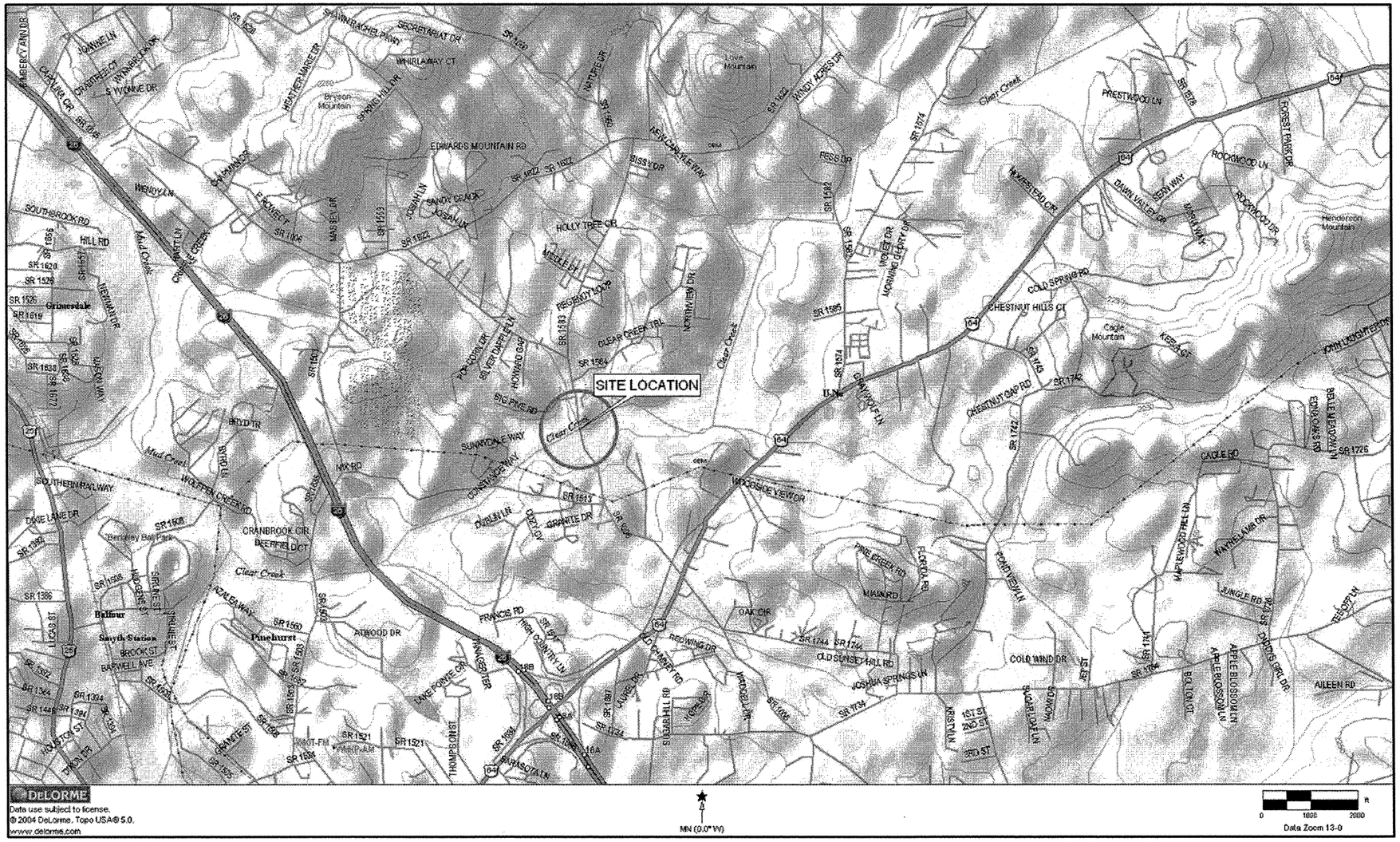
	PILE PAY ITEM QUANTITIES						
Bent # or End Bent #	Steel Pile Points (yes/no)	Pipe Pile Plates (yes/no/maybe	Predrilling For Piles (per linear ft)	Pile Redrives (per each)	Pile Excavation (per linear ft) In Soil	Pile Excavation (per linear ft) Not In Soil	PDA Testing (per each)
End Bent 1	Yes						
End Bent 2	Yes						
Bent 1	Yes						
Bent 2	Yes						
TOTALS	X	X	0	0	0	0	0

Notes:
Blanks or "no" represent quantity of zero.

If steel pile points are required, calculate quantity of "Steel Pile Points" as equal to the number of steel piles.

If pipe pile plates are or may be required, calculate the quantity of "Pipe Pile Plates" as equal to the number of pipe piles.

If PDA testing may be required, show quantities of "PDA Testing" on the substructure plans as totals only. If PDA testing is required, show quantities of "PDA Testing" on the substructure plans for each bent or end bent.



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SITE VICINITY MAP

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R-A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 1 OF 1

DIRT

STATE GRID NORTH

CULTIVATED FIELD

DB 977 PG 654

50+00

12' GRAVEL

DB 844 PG 257
DB 844 PG 259
DB 1130 PG 206

WOODS

SECONDARY GROWTH

CLEAR CREEK

WOODS

WOODS

VARIOUS WIDTHS SOIL

EB1-A B1-A B2-A EB2-A

N 8° 23' 12" W

B-1 B-2 B-3

B1-B B2-B

BRIDGE

GRAVEL

SOIL

SR 1006 HOWARD GAP RD 22' BST

WOODS

WOODS

WOODS

SECONDARY GROWTH

-L- PC 46+61.54

-L- PT 49+73.07

-L- PC 53+45.82

CLEAR CREEK

SECONDARY GROWTH

8' BST

8" MASONRY WALL

GRASS

GRASS

GRASS

ISFD

0 50 100
FEET

NOTES:

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM TGS ENGINEERS, JANUARY 2012

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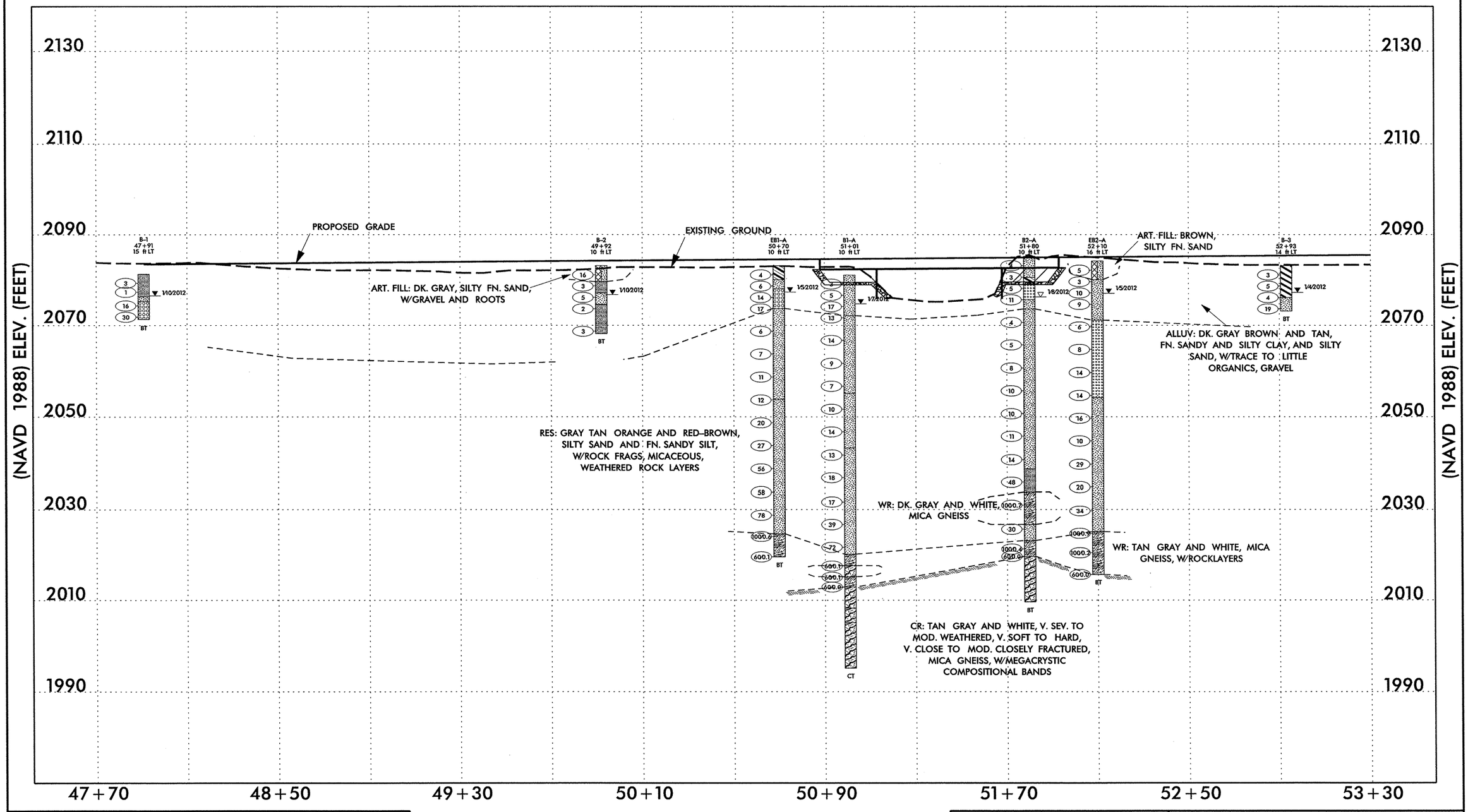
BORING LOCATION PLAN

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R-A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 1 OF 1



NOTES:

- GROUNDLINE PROFILES OBTAINED FROM ELECTRONIC DRAWINGS, DATED JANUARY 2012.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

VERTICAL SCALE
0 20 40
FEET

HORIZONTAL SCALE
0 40 80
FEET

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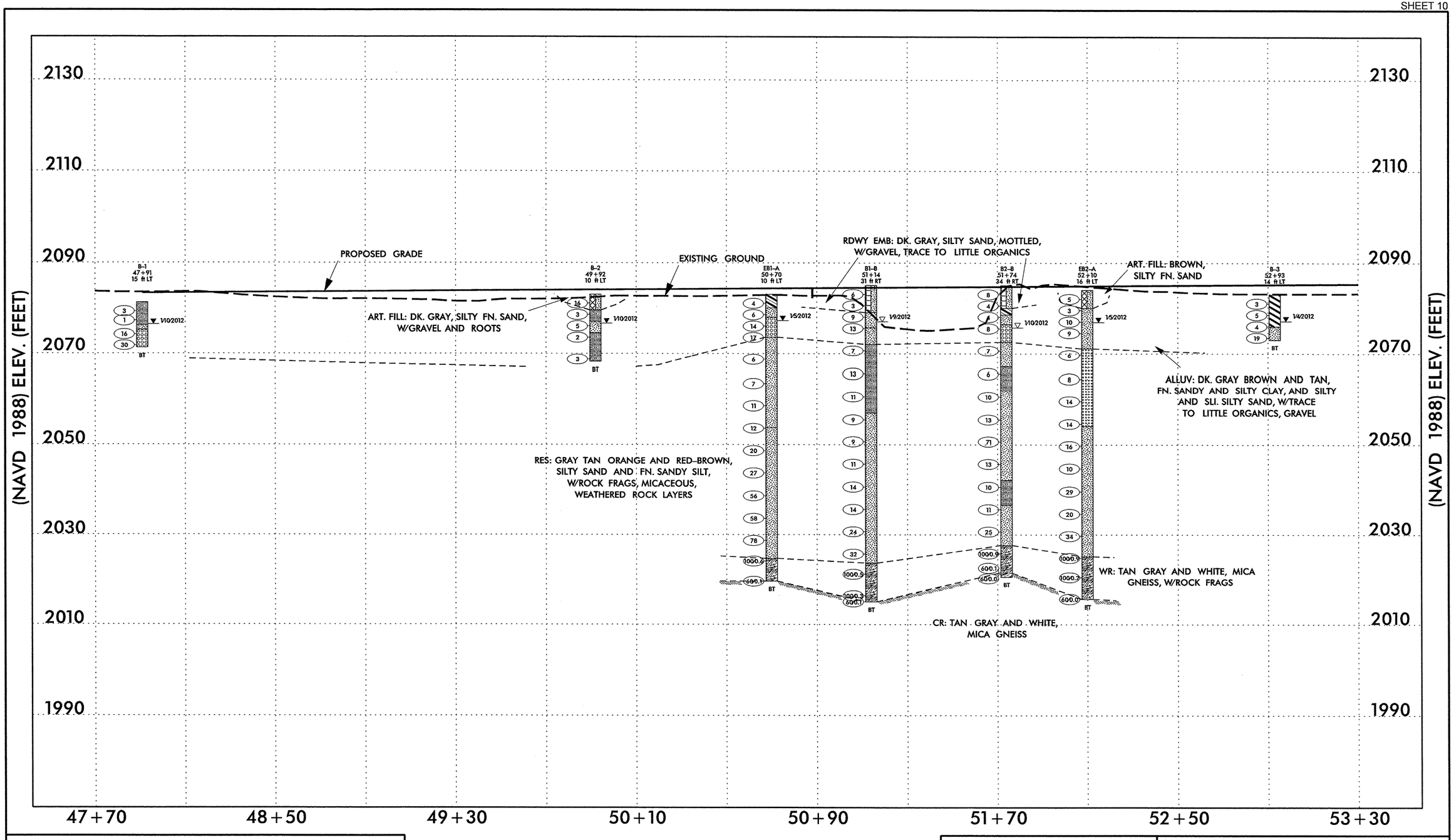
SUBSURFACE PROFILE ALONG -L- (A-SIDE)

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R-A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 1 OF 2



NOTES:

- GROUNDLINE PROFILE CREATED FROM ELECTRONIC DRAWINGS, DATED JANUARY 2012.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

VERTICAL SCALE
0 20 40
FEET

HORIZONTAL SCALE
0 40 80
FEET

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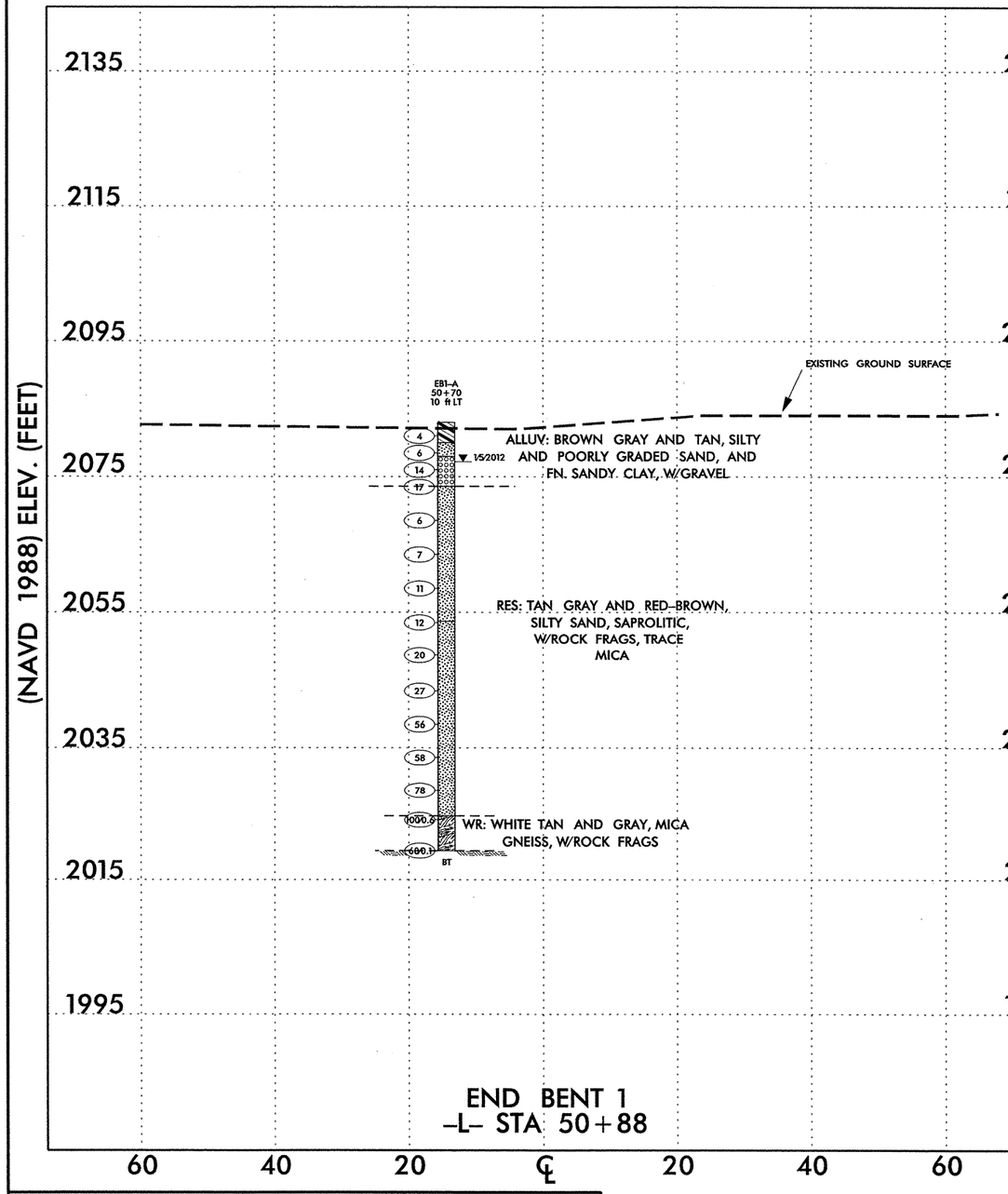
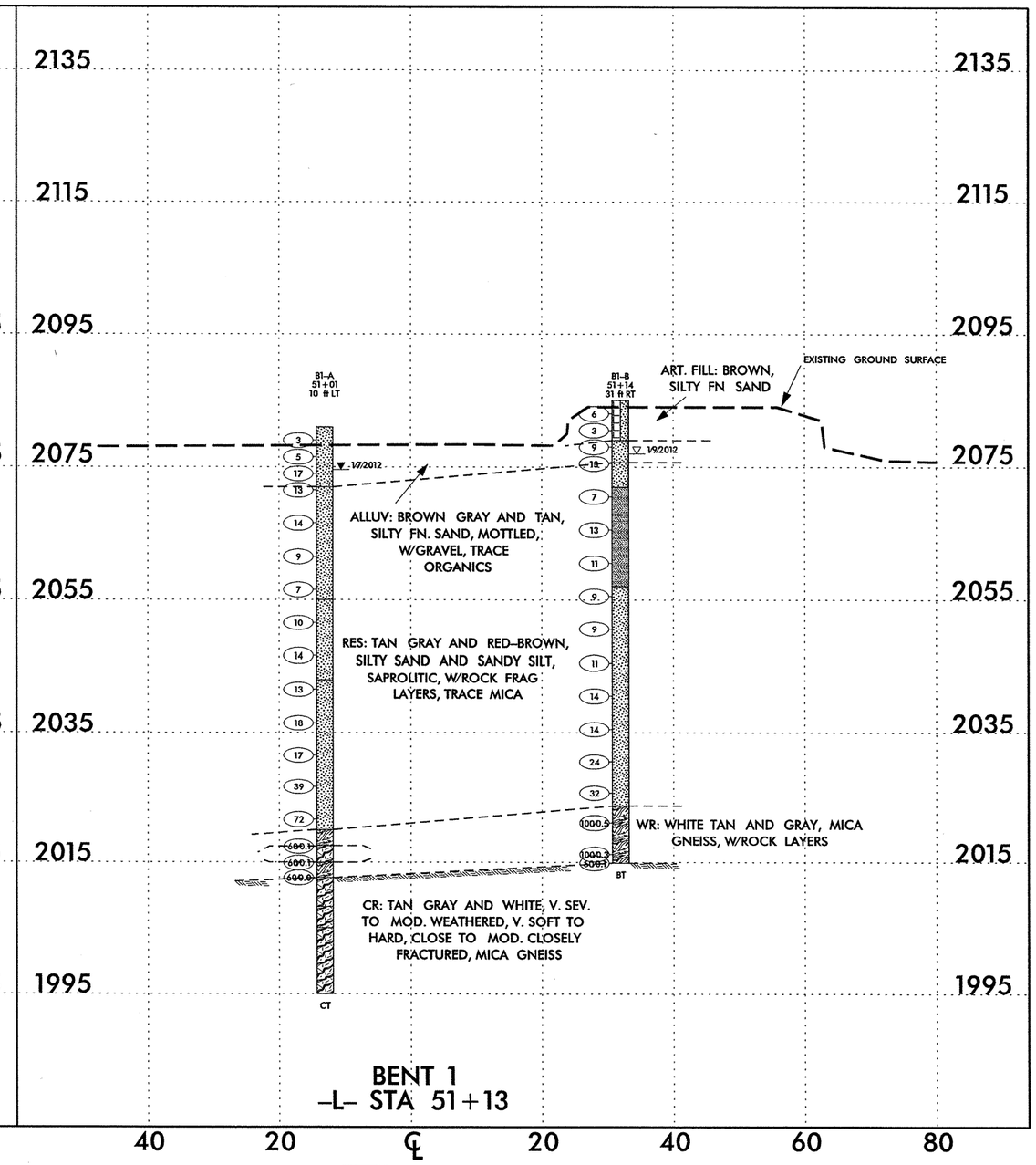
SUBSURFACE PROFILE ALONG –L– (B–SIDE)

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 2 OF 2





NOTES:

- GROUNDLINE CROSS SECTIONS CREATED FROM TOPOGRAPHIC DATA IN ELECTRONIC DRAWINGS FILES, DATED JANUARY 2012.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

VERTICAL SCALE
0 20 40
FEET

HORIZONTAL SCALE
0 20 40
FEET

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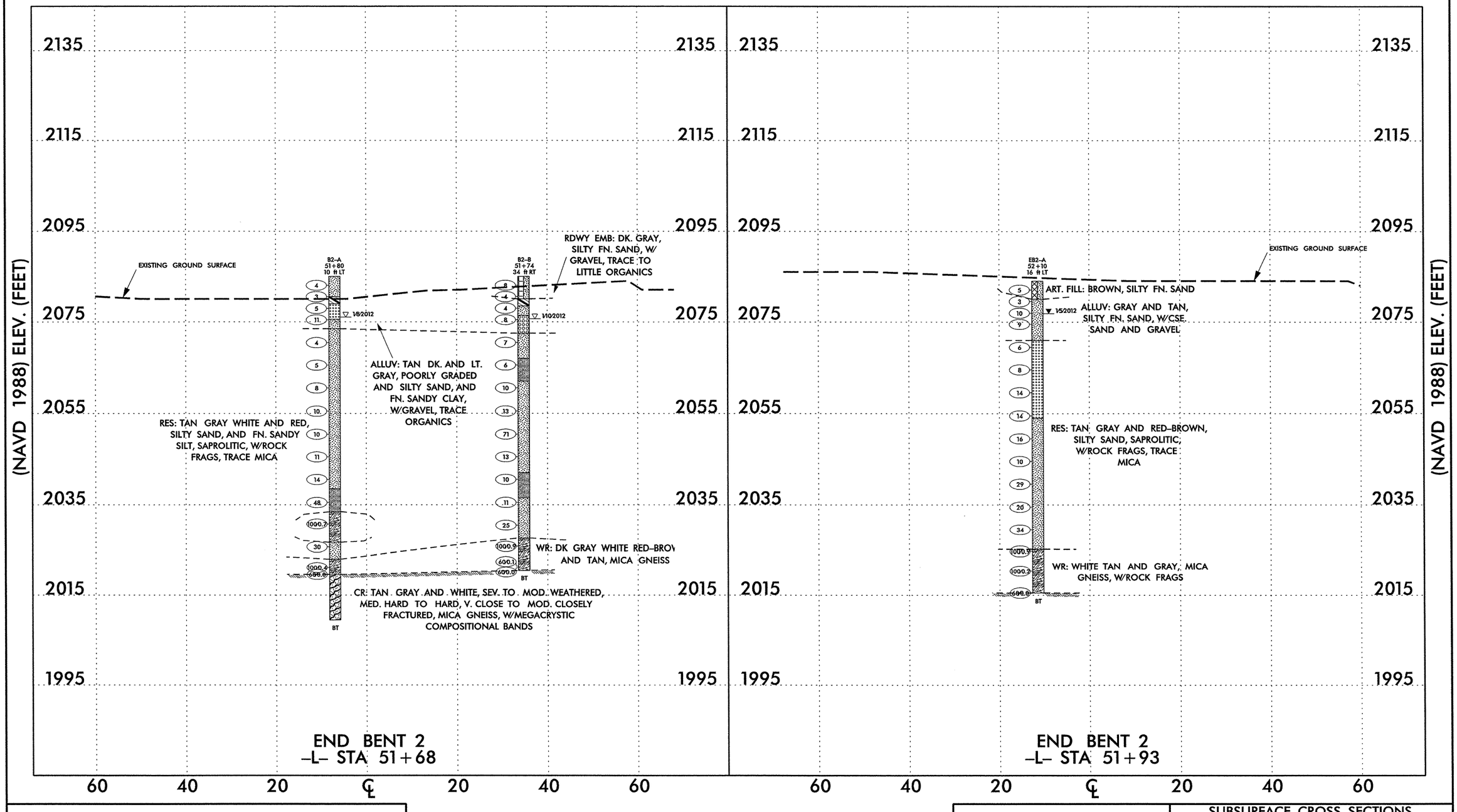
SUBSURFACE CROSS SECTIONS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R-A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 1 OF 2



NOTES:

- GROUNDLINE CROSS SECTIONS CREATED FROM TOPOGRAPHIC DATA IN ELECTRONIC DRAWINGS FILES, DATED JANUARY 2012.
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.

VERTICAL SCALE
0 20 40
FEET

HORIZONTAL SCALE
0 20 40
FEET

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SUBSURFACE CROSS SECTIONS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 2 OF 2

NCDOT GEOTECHNICAL ENGINEERING UNIT
BOREHOLE REPORT

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans	
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK				**GROUND WTR (ft)**
BORING NO. B-1	**STATION** 47+91	**OFFSET** 15 ft LT	**ALIGNMENT** -L-	**0 HR.** 5.0
COLLAR ELEV. 2,081.0 ft	**TOTAL DEPTH** 10.0 ft	**NORTHING** 602,391	**EASTING** 974,983	**24 HR.** 4.8
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/08/12	**COMP. DATE** 01/08/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
2085										
										2,081.0 GROUND SURFACE: 3" TOPSOIL 0.0
2080	2,080.0	1.0	1	2	1	3 1		M		**ALLUVIAL** BLACK AND TAN, SOFT, FN. SANDY SILT (A-4) W/ TRACE ORGANICS
	2,078.0	3.0	WOH	WOH	1					2,076.0 5.0
2075	2,075.0	6.0	3	8	8	16	SS-6	10%		2,075.0 6.0 **ALLUVIAL** DK. GRAY, V. LOOSE, SILTY SAND (A-2-4) W/ TRACE ORGANICS
	2,072.5	8.5	11	13	17	30		Sat.		**ALLUVIAL** GRAY, MED. DENSE, SLI. SILTY POORLY GRADED SAND (A-1-a) W/ GRAVEL
										2,071.0 10.0 Boring Terminated at Elevation 2,071.0 ft

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans	
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK				**GROUND WTR (ft)**
BORING NO. B-2	**STATION** 49+92	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** 7.1
COLLAR ELEV. 2,083.0 ft	**TOTAL DEPTH** 15.0 ft	**NORTHING** 602,493	**EASTING** 974,965	**24 HR.** 6.4
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/08/12	**COMP. DATE** 01/08/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
2085										
										2,083.0 GROUND SURFACE: 7" TOPSOIL 0.0
	2,082.0	1.0								**ARTIFICIAL FILL** DK. GRAY, MED. DENSE, SILTY FN. SAND (A-2-4) MOTTLED, W/ GRAVEL, ROOTS
2080	2,079.5	3.5	9	10	6	16	SS-7	14%		2,079.5 3.5
	2,077.0	6.0	WOH	1	2	3	SS-8	28%		**ALLUVIAL** TAN, SOFT, FN. SANDY SILT (A-4) W/ TRACE ORGANICS
2075	2,074.5	8.5	2	2	3	5				2,077.0 6.0 **ALLUVIAL** GRAY AND TAN, LOOSE, SILTY SAND (A-2-4)
			WOH	WOH	2	2		W		2,074.5 8.5 **ALLUVIAL** DK. GRAY, V. SOFT, SANDY SILT (A-4) W/ TRACE TO LITTLE ORGANICS, CSE. SAND LAYERS
2070	2,069.5	13.5	1	2	1	3				NO SAMPLE RECOVERY 13.5-15.0 ft
										2,068.0 15.0 Boring Terminated at Elevation 2,068.0 ft

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. EB1-A	**STATION** 50+70	**OFFSET** 10 ft LT	**ALIGNMENT** -L- / **0 HR.** 6.4
COLLAR ELEV. 2,083.0 ft	**TOTAL DEPTH** 63.6 ft	**NORTHING** 602,570	**EASTING** 974,953 / **24 HR.** 5.8
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER W.Whichard	**START DATE** 01/04/12	**COMP. DATE** 01/04/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
										2,083.0 GROUND SURFACE: 6" TOPSOIL	0.0
	2,082.0	1.0	2	2	2	4		M		**ALLUVIAL** 2,080.0 BROWN, SOFT, FN. SANDY CLAY (A-6)	3.0
	2,079.5	3.5	2	3	3	6 14				**ALLUVIAL** 2,078.0 GRAY AND BROWN, LOOSE, SILTY FN. SAND (A-2-4)	5.0
	2,077.0	6.0	5	7	7			Sat.		**ALLUVIAL** 2,073.6 GRAY AND TAN, MED. DENSE, POORLY GRADED SAND (A-1-b) W/ GRAVEL	9.4
	2,074.5	8.5	8	13	4	17		W		**RESIDUAL** GRAY, MED. DENSE TO LOOSE, SILTY FN. SAND (A-2-4) SAPROLITIC	
	2,069.5	13.5	4	2	4	6		W			
	2,064.5	18.5	2	3	4	7		W			
	2,059.5	23.5	2	5	6	11		W			
	2,054.5	28.5	4	6	6	12		W		2,053.7	29.3
	2,049.5	33.5	5	9	11	20		W		**RESIDUAL** GRAY TAN AND ORANGE, MED. DENSE TO V. DENSE, SILTY SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA	
	2,044.5	38.5	12	14	13	27		W			
	2,039.5	43.5	19	28	28	56		W			
	2,034.5	48.5	24	27	31	58		M			
	2,029.5	53.5	29	44	34	78		D			
	2,024.5	58.5	69	31/0.1		100/0.6				2,024.5	58.5
	2,019.5	63.5	60/0.1			60/0.1				**WEATHERED ROCK** TAN AND GRAY, MICA GNIESS, W/ ROCK FRAGS, TRACE TO LITTLE MICA 2,019.4	63.6
										Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 2,019.4 ft on CR: MICA GNEISS	

NCDOT BORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/7/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 51+01	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,081.0 ft	**TOTAL DEPTH** 86.0 ft	**NORTHING** 602,601	**EASTING** 974,948	**24 HR.** 6.4
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011	**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/05/12	**COMP. DATE** 01/06/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2085											
2080	2,080.0	1.0	2	1	2	3		M		2,081.0 GROUND SURFACE: 7 " TOPSOIL	0.0
	2,077.5	3.5	WOH	2	3	5				**ALLUVIAL** BROWN AND GRAY, V. LOOSE TO MED. DENSE, SILTY SAND (A-2-4) W/ TRACE TO LITTLE ORGANICS	
2075	2,075.0	6.0	6	7	10	17					
	2,072.5	8.5	10	8	5	13		W		2,072.0 GRAVEL LAYER @ 6.0-9.0 ft	9.0
2070										**RESIDUAL** LT. GRAY, MED. DENSE, SILTY SAND (A-2-4), SAPROLITIC, W/ ROCK FRAG LAYERS, TRACE MICA	
	2,067.5	13.5	7	7	7	14					
2065								Sat.			
	2,062.5	18.5	4	4	5	9					
2060								W			
	2,057.5	23.5	3	4	3	7					
2055								W		2,055.0	26.0
	2,052.5	28.5	4	5	5	10	SS-1	30%		**RESIDUAL** GRAY AND LT. GRAY, MED. DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA	
2050											
	2,047.5	33.5	7	6	8	14		W		THIN ROCK FRAG LAYERS @ 36.0 ft	
2045											
	2,042.5	38.5	5	4	9	13		W		2,043.0	38.0
2040										**RESIDUAL** GRAY, LT. GRAY, WHITE, ORANGE AND TAN, MED. DENSE TO V. DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE TO LITTLE MICA, CSE. SAND LAYERS	
	2,037.5	43.5	7	10	8	18		W			
2035											
	2,032.5	48.5	8	8	9	17	SS-2	30%			
2030											
	2,027.5	53.5	19	18	21	39		M			
2025											
	2,022.5	58.5	20	24	48	72		W		2,020.0	61.0
2020										**WEATHERED ROCK** NO SAMPLE	
	2,017.5	63.5	60/0.1			60/0.1				2,017.5	63.5
2015	2,015.0	66.0								**CRYSTALLINE ROCK** GRAY AND TAN, SEV. TO V. SEV. WEATHERED, MED. HARD TO V. SOFT, CLOSE TO V. CLOSELY FRACTURED, MICA GNIESS	
	2,013.5	67.5	60/0.1			60/0.1				2,015.0	66.0
			60/0			60/0				2,012.7	68.3
2010							RS-1			**WEATHERED ROCK** GRAY WHITE AND TAN, MICA GNEISS, W/ GRAVEL	
										2,008.2	72.8
2005										**CRYSTALLINE ROCK** TAN AND GRAY, MOD. WEATHERED, HARD, CLOSE TO MOD. CLOSELY FACTURED MICA GNIESS	
										2,005.0	76.0
2000							RS-2			**CRYSTALLINE ROCK** TAN AND GRAY, SEV. WEATHERED, HARD, CLOSE TO MOD. CLOSELY FACTURED, MICA GNIESS	
										1,995.0	86.0
1995										**CRYSTALLINE ROCK** TAN AND GRAY, V. SEV. WEATHERED TO MOD. WEATHERED, V. SOFT TO MOD. HARD, CLOSE TO MOD. CLOSELY FRACTURED, MICA GNIESS	
										Boring Terminated at Elevation 1,995.0 ft in CR: MICA GNEISS	

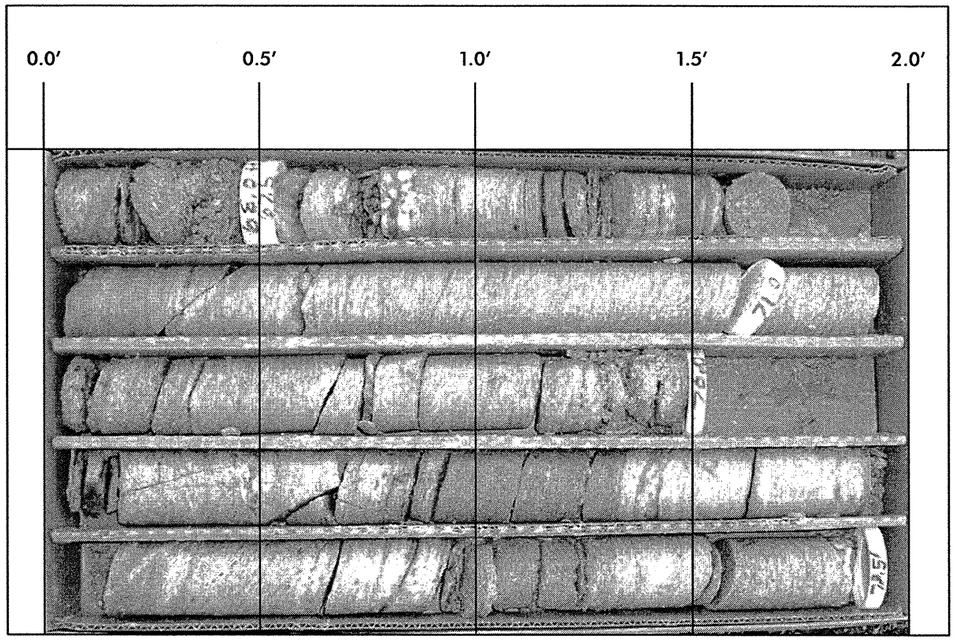
NCDOT BORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/8/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

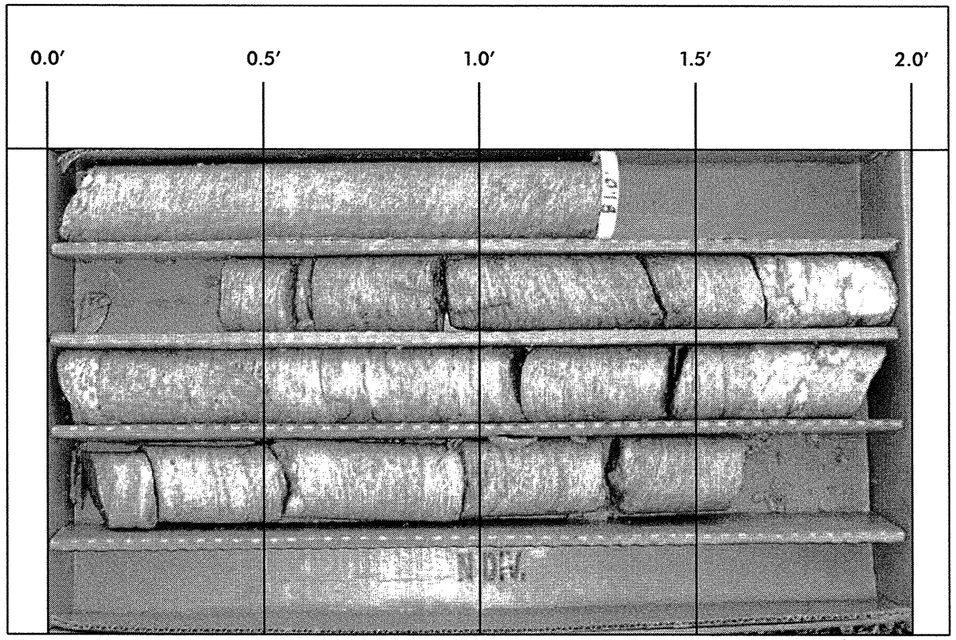
WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans	
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 51+01	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,081.0 ft	**TOTAL DEPTH** 86.0 ft	**NORTHING** 602,601	**EASTING** 974,948	**24 HR.** 6.4
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/05/12	**COMP. DATE** 01/06/12	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 21.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2017.5											Begin Coring @ 63.5 ft	
2015	2,017.5	63.5	2.5	01:20/1.0	(0.4)	(0.0)		(0.4)	(0.0)		2,017.5 **CRYSTALLINE ROCK**	63.5
	2,015.0	66.0		01:08/1.0	16%	0%		16%	0%		2,015.0 GRAY AND TAN, SEV. TO V. SEV. WEATHERED, MED. HARD TO V. SOFT, CLOSELY TO V. CLOSELY FRACTURED, MICA GNIESS	66.0
	2,013.5	67.5		00:27/0.5							2,012.7	68.3
				N=60/0.1							**WEATHERED ROCK**	
			3.5	N=60/0							GRAY WHITE AND TAN, MICA GNEISS, W/ GRAVEL	
2010	2,010.0	71.0		01:30/0.5	(2.7)	(1.3)		(4.5)	(1.3)		**CRYSTALLINE ROCK**	
	2,010.0	71.0		01:56/1.0	77%	37%	RS-1	100%	29%		TAN AND GRAY, MOD. WEATHERED, HARD, CLOSE TO MOD. CLOSELY FACTURED MICA GNIESS	72.8
			5.0	03:56/1.0	(1.8)	(0.0)					2,008.2	
				02:38/1.0				(0.0)	(0.0)		**CRYSTALLINE ROCK**	
2005	2,005.0	76.0		02:00/1.0	36%	0%		0%	0%		TAN AND GRAY, SEV. WEATHERED, HARD, CLOSE TO MOD. CLOSELY FACTURED, MICA GNIESS	76.0
				01:25/1.0							2,005.0	
				01:20/1.0							**CRYSTALLINE ROCK**	
			5.0	01:50/1.0	(4.9)	(2.4)		(9.9)	(5.0)		TAN AND GRAY, V. SEV. WEATHERED TO MOD. WEATHERED, V. SOFT TO MOD. HARD, CLOSE TO MOD. CLOSELY FRACTURED, MICA GNIESS	
2000	2,000.0	81.0		01:32/1.0	98%	48%	RS-2	99%	50%		1,995.0	86.0
				02:14/1.0							Boring Terminated at Elevation 1,995.0 ft in CR: MICA GNEISS	
				02:43/1.0								
			5.0	02:42/1.0	(5.0)	(2.6)						
				02:06/1.0	100%	52%						
1995	1,995.0	86.0		02:43/1.0								
				02:12/1.0								
				02:34/1.0								
				03:23/1.0								
				03:30/1.0								
				03:30/1.0								

NCDOT CORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/8/12



BORING B1–A, BOX 1 OF 2, 63.5 FEET TO 79.5 FEET.



BORING B1–A, BOX 2 OF 2, 79.5 FEET TO 86.0 FEET.

0 4″ 8″
INCHES

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 2 OF 2

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G11043.00	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. B1-B	**STATION** 51+14	**OFFSET** 31 ft RT	**ALIGNMENT** -L- / **0 HR.** 8.0
COLLAR ELEV. 2,083.0 ft	**TOTAL DEPTH** 70.1 ft	**NORTHING** 602,620	**EASTING** 974,989 / **24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic
DRILLER W.Whichard	**START DATE** 01/09/12	**COMP. DATE** 01/09/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
2085										2,083.0 EXIST. PVMT: 12" ASPHALT, 12" ABC 0.0
	2,082.0	1.0								**ROADWAY EMBANKMENT**
2080	2,079.5	3.5	6	4	2	6		M		DK. GRAY, V. LOOSE TO LOOSE, SILTY SAND (A-2-4) MOTTLED, W/ GRAVEL
	2,077.0	6.0	1	1	2	3		M		2,077.0 6.0
2075	2,074.5	8.5	3	4	5	9		▽		**ALLUVIAL**
			4	4	9	13				2,073.7 TAN, LOOSE, SILTY FN. SAND (A-2-4) W/ TRACE ORGANCS, TRACE MICA 9.3
2070	2,069.5	13.5								**RESIDUAL**
			7	3	4	7		W		2,070.0 GRAY, MED. DENSE, SILTY SAND (A-2-4) W/ GRAVEL, TRACE MICA 13.0
2065	2,064.5	18.5								**RESIDUAL**
			6	6	7	13				LT. GRAY AND TAN, MED. STIFF TO STIFF, FN. SANDY SILT (A-4) SAPROLITIC, W/ TRACE MICA
2060	2,059.5	23.5								
			3	5	6	11		W		NO SAMPLE RECOVERY @ 18.5 TO 20.0 ft DUE TO PRESENCE OF ROCK FRAGS
2055	2,054.5	28.5								2,055.0 28.0
			3	4	5	9	SS-3	35%		**RESIDUAL**
2050	2,049.5	33.5								LT. GRAY AND TAN, LOOSE TO DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ TRACE MICA, ROCK FRAG LAYERS
			3	4	5	9		M		
2045	2,044.5	38.5								
			3	4	7	11		W		
2040	2,039.5	43.5								
			3	4	10	14		M		
2035	2,034.5	48.5								
			2	5	9	14		M		
2030	2,029.5	53.5								
			3	8	16	24		M		
2025	2,024.5	58.5								
			18	18	14	32		M		2,021.5 61.5
2020	2,019.5	63.5								**WEATHERED ROCK**
			100/0.5			100/0.5				TAN, BLACK AND GRAY, MICA GNEISS
2015	2,014.5	68.5								
	2,013.0	70.0	100/0.3			100/0.3				2,012.9 70.1
			60/0.1			60/0.1				Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 2,012.9 ft on CR: MICA GNEISS

NCDOT BORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/7/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 51+80	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** 8.9 N/A
COLLAR ELEV. 2,085.0 ft	**TOTAL DEPTH** 75.5 ft	**NORTHING** 602,680	**EASTING** 974,937	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/06/12	**COMP. DATE** 01/08/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2085										2,085.0 GROUND SURFACE: 12" TS & GRAVEL	0.0
	2,084.0	1.0	1	2	2	4		M		**ALLUVIAL** DK. BROWN, V. LOOSE, SILTY FN. SAND (A-2-4) W/ TRACE TO LITTLE ORGANICS	
2080	2,081.5	3.5	1	1	2	3		W		2,080.5	4.5
	2,079.0	6.0	2	3	2	5		W		**ALLUVIAL** LT. TAN, SOFT, FN. SANDY CLAY (A-6) W/ TRACE ORGANICS	6.0
2075	2,076.5	8.5	1	3	8	11		Sat.		2,075.6 **ALLUVIAL** GRAY, LOOSE, POORLY GRADED SAND (A-3)	9.4
	2,071.5	13.5								2,073.5 **ALLUVIAL** GRAY, MED. DENSE, SILTY CSE. SAND (A-2-4) W/ GRAVEL	11.5
2070			3	2	2	4		W		**RESIDUAL** GRAY TAN AND WHITE, LOOSE TO MED. DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE TO LITTLE MICA	
2065	2,066.5	18.5	2	2	3	5	SS-4	36%			
	2,061.5	23.5									
2060			3	3	5	8		W			
2055	2,056.5	28.5	4	4	6	10		W			
	2,051.5	33.5									
2050			4	5	5	10		W			
2045	2,046.5	38.5	3	5	6	11		W			
	2,041.5	43.5									
2040			5	7	7	14		W			
2035	2,036.5	48.5	6	16	32	46		W		2,038.5 **RESIDUAL** TAN RED AND GRAY, HARD, FN. SANDY SILT (A-4) SAPROLITIC, W/ ROCK FRAGS, LITTLE MICA	46.5
	2,031.5	53.5								2,033.5 **WEATHERED ROCK** DK. GRAY, WHITE AND TAN, MICA GNIESS	51.5
2030			75	25/0.2		100/0.7					
2025	2,026.5	58.5	17	16	14	30				2,026.5 **RESIDUAL** GRAY TAN AND WHITE, DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, LITTLE MICA	58.5
	2,021.5	63.5						D		2,023.0 **WEATHERED ROCK** WHITE GRAY TAN AND RED-BROWN, MICA GNIESS	62.0
2020	2,019.5	65.5	100/0.4			100/0.4				2,019.5 **CRYSTALLINE ROCK** TAN GRAY AND WHITE, SEV. WEATHERED TO MOD. WEATHERED, MED. HARD TO HARD, V. CLOSELY TO MOD. CLOSELY FRACTURED, MICA GNIESS, W/ MEGACRYSTIC COMPOSITIONAL BANDS	65.5
			60/0.0			60/0.0				2,009.5 Boring Terminated at Elevation 2,009.5 ft in CR: MICA GNEISS	75.5
2015							RS-3 RS-4				
2010											

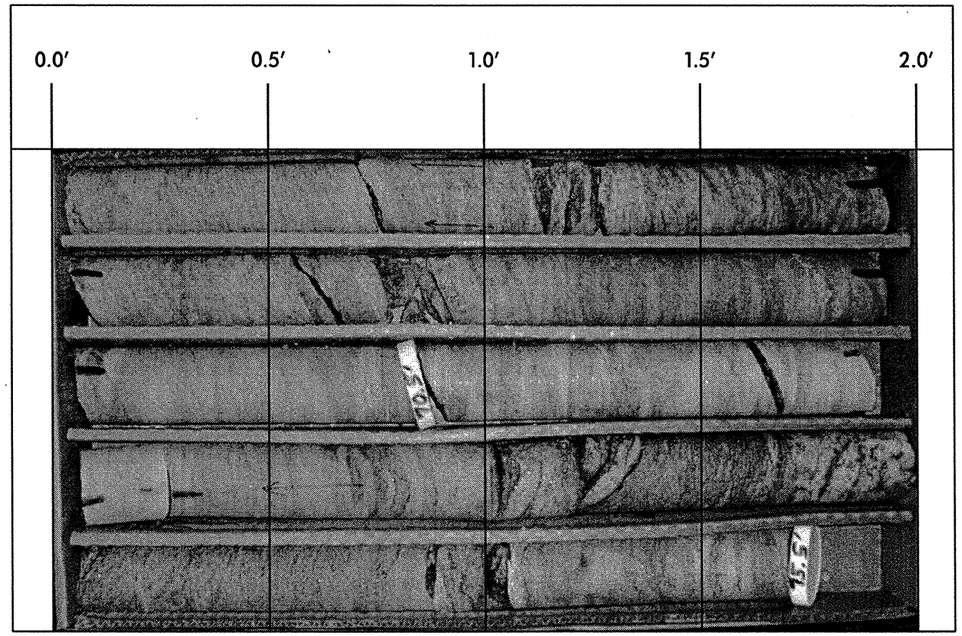
NCDOT BORE SINGLE MA14181RA.GPJ NC_DOT.GDT 3/8/12

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

WBS N/A	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. B2-A	**STATION** 51+80	**OFFSET** 10 ft LT	**ALIGNMENT** -L-	**0 HR.** 8.9 N/A
COLLAR ELEV. 2,085.0 ft	**TOTAL DEPTH** 75.5 ft	**NORTHING** 602,680	**EASTING** 974,937	**24 HR.** N/A
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/06/12	**COMP. DATE** 01/08/12	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 10.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2019.5											Begin Coring @ 65.5 ft	
	2,019.5	65.5	5.0	03:20/1.0 03:03/1.0 03:15/1.0 03:15/1.0 03:37/1.0	(4.5) 90%	(4.1) 82%		(9.5) 95%	(8.3) 83%		2,019.5 **CRYSTALLINE ROCK** TAN GRAY AND WHITE, SEV. WEATHERED TO MOD. WEATHERED, MED. HARD TO HARD, V. CLOSELY TO MOD. CLOSELY FRACTURED, MICA GNIESS, W/ MEGACRYSTIC COMPOSITIONAL BANDS	65.5
2015	2,014.5	70.5	5.0	03:18/1.0 03:00/1.0 03:05/1.0 03:02/1.0 03:27/1.0	(5.0) 100%	(4.2) 84%	RS-3 RS-4				2,009.5 Boring Terminated at Elevation 2,009.5 ft in CR: MICA GNEISS	75.5
2010	2,009.5	75.5										

NCDOT CORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/8/12



BORING B2–A, BOX 1 OF 1, 65.5 FEET TO 75.5 FEET.

0 4″ 8″
INCHES

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

ROCK CORE PHOTOS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 2 OF 2

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G11043.00	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans	
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK				**GROUND WTR (ft)**
BORING NO. B2-B	**STATION** 51+74	**OFFSET** 34 ft RT	**ALIGNMENT** -L-	**0 HR.** 9.3
COLLAR ELEV. 2,085.0 ft	**TOTAL DEPTH** 64.6 ft	**NORTHING** 602,679	**EASTING** 974,982	**24 HR.** FIAD
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** Mud Rotary	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/10/12	**COMP. DATE** 01/10/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION — ELEV. (ft)	DEPTH (ft)
2085										2,085.0 EXIST. PVMT: 8.5" ASPHALT, 5" ABC	0.0
	2,084.0	1.0	7	4	4	8		M		**ROADWAY EMBANKMENT** DK. GRAY, LOOSE, SILTY FN. SAND (A-2-4) W/ GRAVEL, TRACE TO LITTLE ORGANICS	
2080	2,081.5	3.5	1	2	2	4		W		2,080.0	5.0
	2,079.0	6.0	1	2	2	4		W		2,078.5 **ALLUVIAL**	6.5
	2,076.5	8.5	3	3	5	8		W		2,076.5 GRAY AND TAN, SOFT, FN. SANDY CLAY (A-6)	8.5
2075										**ALLUVIAL**	
	2,071.5	13.5	7	4	3	7		Sat.		2,072.5 DK. GRAY, LOOSE, SILTY FN. SAND (A-2-4)	12.5
2070										**ALLUVIAL**	
	2,066.5	18.5	2	3	3	6		M		2,067.0 GRAY AND TAN, LOOSE, SLI. SILTY SAND (A-1-b) W/ GRAVEL	18.0
2065										**RESIDUAL**	
	2,061.5	23.5	6	5	5	10	SS-5	33%		2,062.0 DK. GRAY, LOOSE, SILTY SAND (A-2-4) SAPROLITIC, W/ TRACE MICA	23.0
2060										**RESIDUAL** GRAY AND TAN, MED. STIFF, FN. SANDY SILT (A-4) SAPROLITIC, W/ TRACE MICA	
	2,056.5	28.5	7	6	7	13		M		**RESIDUAL** WHITE GRAY AND TAN, LOOSE TO V. DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA, SILT LAYERS	
2055											
	2,051.5	33.5	3	4	67	71		W		W/ ROCK FRAG LAYER @ 34.8-36.0 ft	
2050											
	2,046.5	38.5	3	6	7	13		W			
2045											
	2,041.5	43.5	4	4	6	10		W		2,042.0	43.0
2040										**RESIDUAL** TAN WHITE AND GRAY, STIFF, FN. SANDY SILT (A-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA	
	2,036.5	48.5	3	5	6	11		W		2,036.5	48.5
2035										**RESIDUAL** GRAY TAN AND WHITE, MED. DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA	
	2,031.5	53.5	7	11	14	25		W			
2030											
	2,026.5	58.5	34	66/0.4		100/0.9					
2025										2,027.5	57.5
	2,021.5	63.5	60/0.1			60/0.1				**WEATHERED ROCK** GRAY WHITE AND TAN, MICA GNIESS	
	2,021.0	64.0	60/0.0			60/0.0				2,021.5	63.5
										CRYSTALLINE ROCK	
										2,020.4 CR: GRAY WHITE AND TAN, MICA GNEISS	64.6
										Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 2,020.4 ft on CR: MICA GNEISS	

WBS G11043.00	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans	
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 52+10	**OFFSET** 16 ft LT	**ALIGNMENT** -L-	**0 HR.** 8.0
COLLAR ELEV. 2,084.0 ft	**TOTAL DEPTH** 68.5 ft	**NORTHING** 602,708	**EASTING** 974,927	**24 HR.** 7.1
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/03/12	**COMP. DATE** 01/03/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION — ELEV. (ft)	DEPTH (ft)
2085										2,084.0 GROUND SURFACE: 5" TOPSOIL	0.0
	2,083.0	1.0	3	3	2	5		M		**ARTIFICIAL FILL** BROWN, LOOSE, SILTY FN. SAND (A-2-4)	
2080	2,080.5	3.5	WOH	1	2	3		M		2,080.0	4.0
	2,078.0	6.0	2	3	7	10				**ALLUVIAL** GRAY AND TAN, V. LOOSE TO LOOSE, SILTY FN. SAND (A-2-4) W/ CSE. SAND AND GRAVEL	
	2,075.5	8.5	1	3	6	9		Sat.			
2075											
	2,070.5	13.5	4	3	3	6		W		2,071.0	13.0
2070										**RESIDUAL** TAN AND GRAY, LOOSE TO MED. DENSE, SILTY SAND (A-3) SAPROLITIC, W/ ROCK FRAG LAYERS, TRACE MICA	
	2,065.5	18.5	2	4	4	8		W			
2065											
	2,060.5	23.5	5	6	8	14		W			
2060											
	2,055.5	28.5	6	6	8	14		W			
2055											
	2,050.5	33.5	6	7	9	16		W		2,054.0	30.0
2050										**RESIDUAL** TAN GRAY AND RED-BROWN, LOOSE TO DENSE, SILTY FN. SAND (A-2-4) SAPROLITIC, W/ ROCK FRAGS, TRACE MICA	
	2,045.5	38.5	3	4	6	10		W			
2045											
	2,040.5	43.5	11	13	16	29		W			
2040											
	2,035.5	48.5	10	9	11	20		W			
2035											
	2,030.5	53.5	12	16	18	34		M			
2030											
	2,025.5	58.5	21	79/0.4		100/0.9				2,025.0	59.0
2025										**WEATHERED ROCK** WHITE TAN AND GRAY, MICA GNIESS, W/ ROCK FRAGS	
	2,020.5	63.5	100/0.2			100/0.2				2,015.5	68.5
2020										Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 2,015.5 ft on CR: MICA GNEISS	
	2,015.5	68.5	60/0.0			60/0.0					

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS G11043.00	**TIP** MA14181R-A	**COUNTY** Henderson	**GEOLOGIST** T.Evans
SITE DESCRIPTION BRIDGE NO. 40 REPLACEMENT ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK			**GROUND WTR (ft)**
BORING NO. B-3	**STATION** 52+93	**OFFSET** 14 ft LT	**ALIGNMENT** -L-	**0 HR.** 6.1
COLLAR ELEV. 2,083.0 ft	**TOTAL DEPTH** 10.0 ft	**NORTHING** 602,791	**EASTING** 974,916	**24 HR.** 5.9
DRILL RIG/HAMMER EFF./DATE TRI0055 CME-55 70% 12/08/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER W.Whichard	**START DATE** 01/03/12	**COMP. DATE** 01/03/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
2085										
										2,083.0 GROUND SURFACE: 3" TOPSOIL 0.0
	2,082.0	1.0	1	1	2	3	SS-9	36%		**ALLUVIAL** GRAY, SOFT, SILTY CLAY (A-7-6) W/ SOME ORGANICS
2080	2,079.5	3.5	1	2	3	5		W		
	2,077.0	6.0	4	1	3	4		W		2,076.0 7.0
2075	2,074.5	8.5	5	9	10	19		Sat.		**ALLUVIAL** TAN AND GRAY, LOOSE TO MED. DENSE, SILTY SAND (A-2-4) W/ GRAVEL, CSE. SAND LAYERS 2,073.0 10.0
										Boring Terminated at Elevation 2,073.0 ft

NCDOT BORE SINGLE MA14181R-A.GPJ NC_DOT.GDT 3/2/12

FALCON 1210 TRINITY ROAD, SUITE 110, RALEIGH, NC 27607

AASHTO SOIL CLASSIFICATION AND GRADATION SHEET

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK

TIP NO.: MA14181R-A

HENDERSON COUNTY, NORTH CAROLINA

FALCON ENGINEERING, INC. PROJECT NO: G11043.00

BORING		SAMPLE	TOTAL SAMPLE			Atterberg Limit Test Results			Natural Moisture Content
AASHTO Classification			PERCENT PASSING						
STATION	OFFSET (FEET)	DEPTH (FEET)	#10	#40	#200	LL	PL	PI	%
B1-A		SS-1	99	81	27	32	NP	NP	35.1
A-2-4									
51+01	10' LT	28.5-30.0							
B1-A		SS-2	95	81	34	29	NP	NP	30.1
A-2-4									
51+01	10' LT	48.5-50.0							
B1-B		SS-3	100	79	23	29	NP	NP	34.7
A-2-4									
51+14	31' RT	28.5-30.0							
B2-A		SS-4	100	83	27	29	NP	NP	35.9
A-2-4									
51+80	10' LT	18.5-20.0							
B2-B		SS-5	97	84	31	32	NP	NP	32.6
A-2-4									
51+74	34' RT	23.5-25.0							
B-1		SS-6	40	23	6	20	NP	NP	9.7
A-1-a									
47+91	15' LT	6.0-7.5							
B-2		SS-7	75	70	33	26	NP	NP	14.1
A-2-4									
49+92	10' LT	1.0-2.5							
B-2		SS-8	100	99	52	29	23	6	27.9
A-4									
49+92	10' LT	3.5-5.0							
B-3		SS-9	100	97	82	52	27	25	35.9
A-7-6									
52+93	14 ' LT	1.0-2.5							
B-1 / B-3		BS-1	100	96	50	32	NP	NP	29.7
A-4									
VARIES	VARIES	0-10.0							
BANK		GRAB	99	94	39	36	NP	NP	34.2
A-4									
N/A	N/A	0-1.0							
BED		GRAB	23	3	0	0	NP	NP	21.2
A-1-a									
N/A	N/A	0-1.0							

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

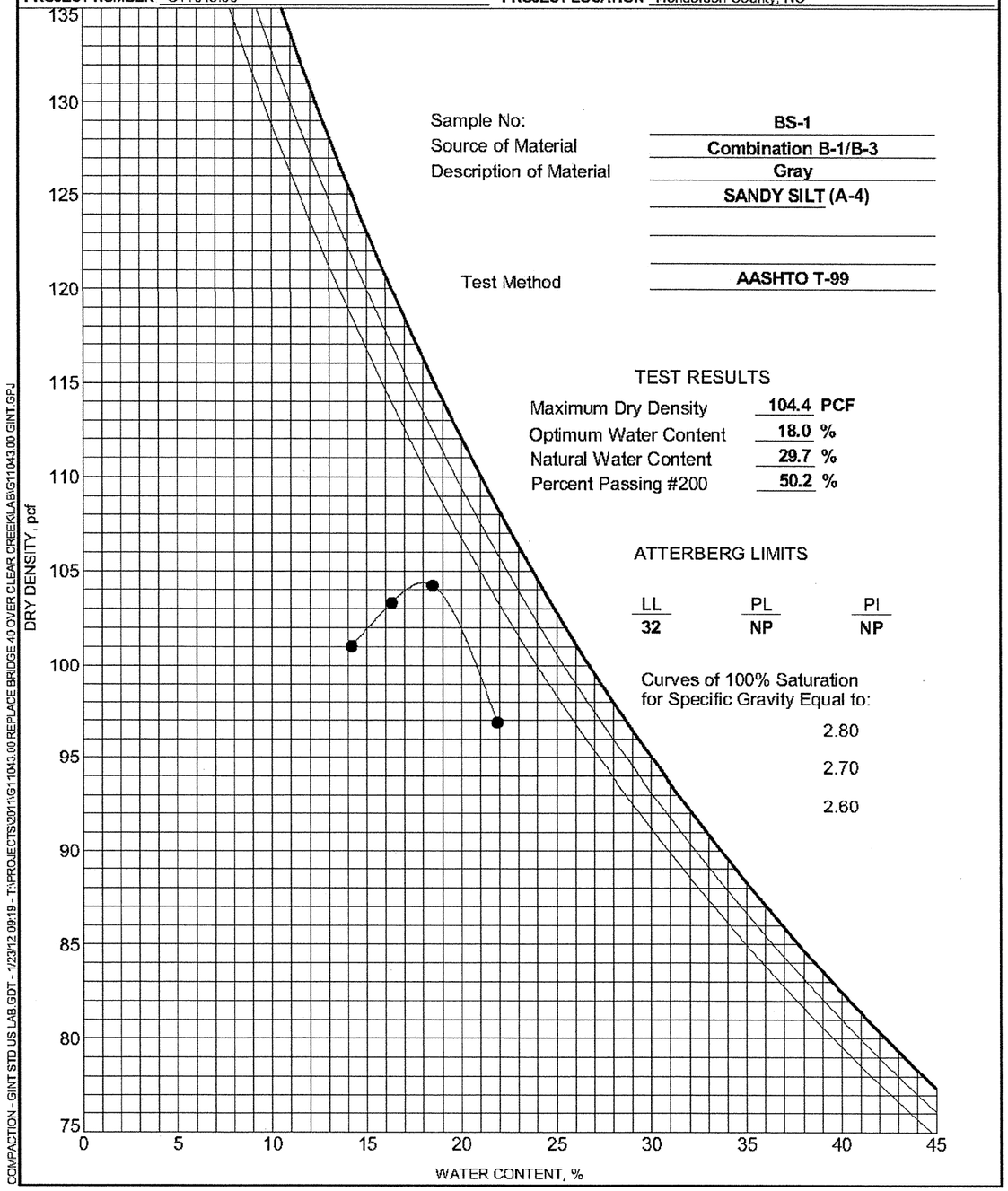
PROJECT ID NO.: MA14181R-A
F.A. NO.:
COUNTY: HENDERSON
BRIDGE NO. 40 ON SR 1006 (HOWARD GAP ROAD) OVER CLEAR CREEK

Sample #	Boring #	Depth (ft)	Rock Type	Geologic Map Unit	Run RQD	Length (ft)	Diameter (ft)	Unit Weight (PCF)	Unconfined Compressive Strength (PSI)	Young's Modulus (PSI)	Splitting Tensile Strength (PSI)	Remarks
RS-1	B1-A	70.0-71.0	MICA GNEISS	Sogg. Chg	37%	0.35	0.17	155.8	4,488	224,418	-	
RS-2	B1-A	78.0-78.5	MICA GNEISS	Sogg. Chg	48%	-0.33	0.17	154.7	2,926	182,431	-	
RS-3	B2-A	72.5-73.5	MICA GNEISS	Sogg. Chg	84%	0.35	0.17	156.3	3,186	172,305	-	
RS-4	B2-A	71.0-72.0	MICA GNEISS	Sogg. Chg	84%	-0.35	0.17	161.6	6,862	804,432	-	

Falcon Engineering, Inc.
1210 Trinity Rd., Suite 110
Raleigh, NC 27607
Telephone: (919) 871-0800
Fax: (919) 871-0803

MOISTURE-DENSITY RELATIONSHIP

CLIENT TGS Engineers
PROJECT NAME Bridge #40 over Clear Creek
PROJECT NUMBER G11043.00
PROJECT LOCATION Henderson County, NC



Sample No:	BS-1
Source of Material	Combination B-1/B-3
Description of Material	Gray SANDY SILT (A-4)
Test Method	AASHTO T-99

TEST RESULTS

Maximum Dry Density	104.4	PCF
Optimum Water Content	18.0	%
Natural Water Content	29.7	%
Percent Passing #200	50.2	%

ATTERBERG LIMITS

LL	PL	PI
32	NP	NP

Curves of 100% Saturation for Specific Gravity Equal to:
2.80
2.70
2.60

COMPACTION - GINT STD US LAB.GDT - 1/23/12 09:19 - T:\PROJECTS\2011\G11043.00 REPLACE BRIDGE 40 OVER CLEAR CREEK\LAB\G11043.00 GINT.GPJ

FALCON

1210 TRINITY ROAD, SUITE 110, RALEIGH, NORTH CAROLINA 27607

CBR (CALIFORNIA BEARING RATIO) OF LABORATORY COMPACTED SOIL

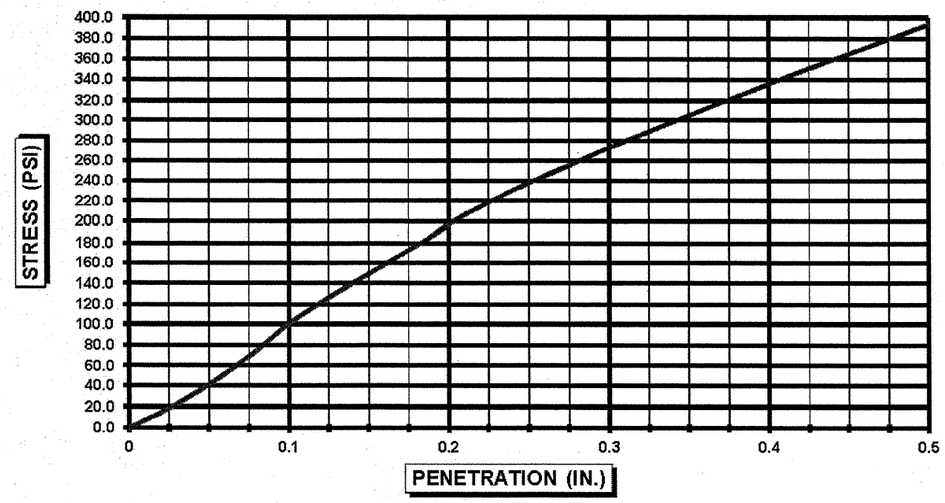
AASHTO T-193 \ ASTM D-1883

PROJECT #: G11043.00 DATE: 1/27/2012
PROJECT NAME: Bridge #40 over Clear Creek
BORING: B-1/B-3 SAMPLE: BS-1 DEPTH: 0-10'
SOIL DESCRIPTION: SANDY SILT (A-4)

COMPACTION METHOD	AASHTO T-99	SOAK	96 HRS.
MAXIMUM DRY DENSITY	104.4 PCF	STRAIN RATE	.05 IN / MIN.
OPTIMUM MOISTURE CONTENT	18.0%	LOAD CELL	2500lb
TEST DATA		SURCHARGE WEIGHT	10 lb.
DRY DENSITY	101.9 PCF	SURCHARGE PER SQUARE FOOT	51 lbs/sq.ft.
MOISTURE CONTENT	17.8%	FINAL MOISTURE CONTENT	
PERCENT COMPACTION	97.6%	SWELL	0.27%

	ACTUAL	CORRECTED
CBR VALUE AT .1"	10.1	12.3
CBR VALUE AT .2"	13.1	14.5

STRESS-PENETRATION CURVE



LIQUID LIMIT	32	PLASTIC LIMIT	NP	PLASTIC INDEX	NP
Percent Passing #200 Sieve = 50.2%		Natural Moisture Content = 29.7%			

PHOTO TAKEN NEAR STATION 52+50 LOOKING DOWNSTATION.

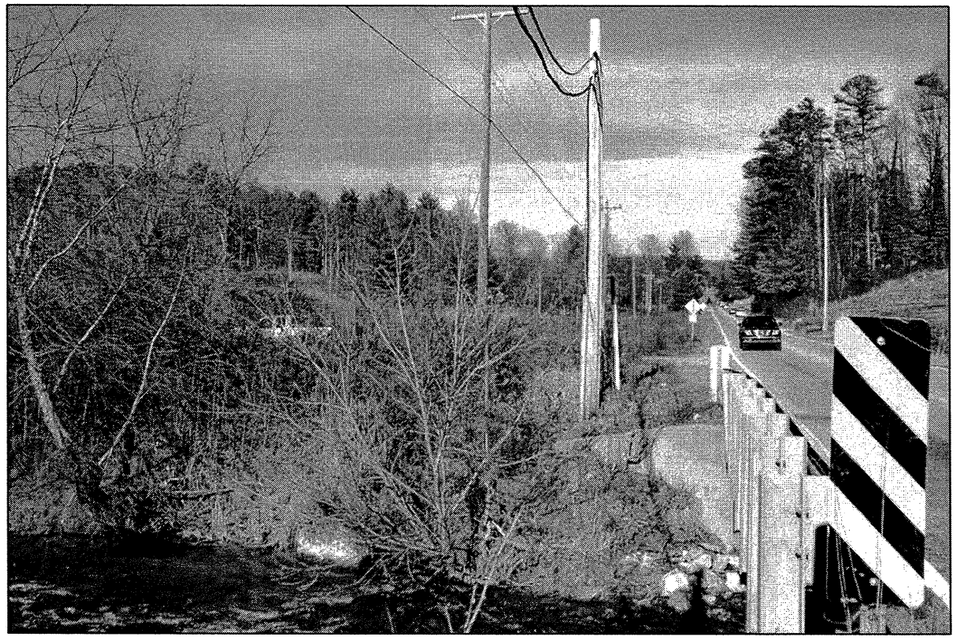


PHOTO TAKEN STANDING NEAR B1–B LOOKING UPSTATION TOWARD BENT 2.

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

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FAX: 919.871.0803

SITE PHOTOS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 1 OF 2

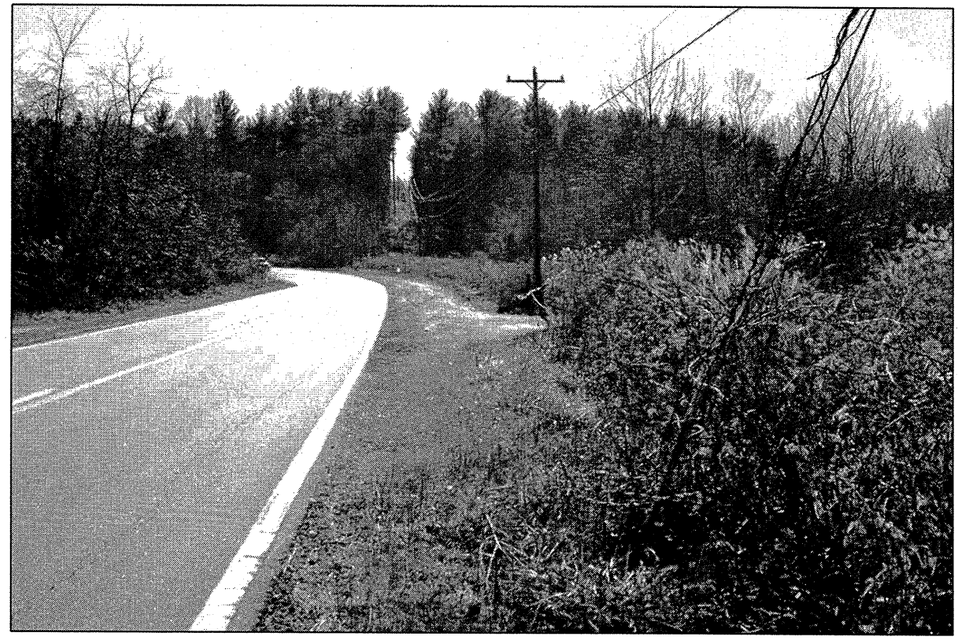

PHOTO TAKEN STANDING NEAR B1–B LOOKING DOWNSTATION.

PHOTO TAKEN STANDING ON EXISTING BRIDGE LOOKING DOWNSTREAM.

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

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SITE PHOTOS

REPLACE BRIDGE NO. 40 ON SR 1006 OVER CLEAR CREEK
HENDERSON COUNTY, NORTH CAROLINA
TIP NO.: MA14181R–A

MARCH 2012	PROJECT NO.: G11043.00	SHEET 2 OF 2

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	R5207A	1	30

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

STRUCTURE SUBSURFACE INVESTIGATION

PROJ. REFERENCE NO. R5207A F.A. PROJ. _____

COUNTY HENDERSON

PROJECT DESCRIPTION BRIDGE NO. 222 OVER UNNAMED TIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)

SITE DESCRIPTION _____

ID: R5207A

PROJECT: _____

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3-5	STRUCTURE SUBSURFACE INVESTIGATION REPORT PROJECT DESCRIPTION SITE DESCRIPTION AND GEOLOGY FIELD EVALUATION PROCEDURE SUBSURFACE AND GROUNDWATER CONDITIONS - BRIDGE SUBSURFACE AND GROUNDWATER CONDITIONS - DETOUR LABORATORY TESTING CONCLUSIONS FOUNDATION RECOMMENDATIONS CLOSURE
6	SUMMARY OF FOUNDATION RECOMMENDATIONS AND BEARING PILE PAY ITEM QUANTITIES
7	SITE VICINITY MAP
	MAIN STRUCTURE
8	BORING LOCATION PLAN
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29	LABORATORY TEST RESULTS: STANDARD PROCTOR CURVE AND CBR TEST
30	SITE PHOTOGRAPHS

CAUTION NOTICE

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING, AND DESIGN AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES, AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N.C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT (919) 250-4088. NEITHER THE SUBSURFACE PLANS AND REPORTS, NOR THE FIELD BORING LOGS, ROCK CORES, OR SOIL TEST DATA ARE 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.

PERSONNEL

M. ROBERTSON

M. BAHIRADHAN

J. HAMM

T. EVANS

P. ZHANG

C. BRUINSMA

INVESTIGATED BY P. Z., C. B.

CHECKED BY M. BAHI, P.E.

SUBMITTED BY FALCON ENG.

DATE MARCH, 2011

DRAWN BY: P. ZHANG /T. EVANS

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PROJECT REFERENCE NO.	SHEET NO.
R5207A	2

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. 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 PLASTIC INDEX	6 MX		NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0		0	0	4 MX			8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<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 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	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	2.00	0.42	0.25	0.075	0.053

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

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- 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, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
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 IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 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 SEEP

MISCELLANEOUS SYMBOLS

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

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS

S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B- __
- [ ] BK-51
- [ ] CME-45C
- [X] CME-550
- [ ] PORTABLE HOIST
- [X] CME-55
- [ ] _____

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

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B-
- [X] -N- 0
- [ ] -H-

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFEARRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES "CLUNK" SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, 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 GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINDER 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 THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.

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

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:

BM #12, STA. 11+32.78, 15.62' RT. -Y6- ELEVATION: 2095.67 FT.

NOTES:
FIAD - FILLED-IN AFTER DRILLING

REVISED 09/23/09

April 20, 2011

Mr. Ray Elliot, P.E.
TGS Engineers
804-C North Lafayette Street, Suite 141
Shelby, NC 28150

Re: Geotechnical Subsurface Exploration Report

Project No.:	*R 5207A*
County:	*Henderson*
Description:	*Bridge # 222 over Unnamed Tributary to Clear Creek on SR 1006 (Howard Gap Road) and a Temporary Detour*
Falcon. Proj. No.:	*G11005.00*

Dear Mr. Elliot:

As authorized, Falcon Engineering, Inc. (Falcon) has revised the draft geotechnical subsurface exploration report completed by Tierra, Inc. (Tierra), dated December 18, 2006 in accordance with the current NCDOT geotechnical report guidelines for Bridge # 222 over Unnamed tributary to Clear Creek on SR 1006 (Howard Gap Road) and a Temporary Detour in Henderson County, North Carolina. 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

The project consists of replacing the existing concrete vertical abutment and wing-wall supported bridge spanning Unnamed Tributary to Clear Creek and constructing an approximately 1,000 feet long temporary detour. The detour is to be located about 50 feet upstream of the proposed structure.

The proposed replacement structure is to consist of a single span, two bent bridge and will be approximately 57 feet long. The structure is planned to be located between Station 70+96.3 and Station 71+53.7, and have a skew angle of 60°. The width of this bridge is 39 feet. The bottom of the end bent caps at both end bents will be at elevations of about 2,106 feet, based on North American Vertical Datum, 1988 (NAVD), and the finished grade of the structure will be at or near the exiting grade. Bridge embankments will be reconstructed with 2 feet thick Class II Rip Rap with filter fabric. Hydraulic scour information was not provided at the time of preparing this report.

Based on the standard loads provided by NCDOT for 60 feet long, 39 feet wide, single span low impact bridge with a skew angle of 60 deg., the factored design load for end piles is 81 Tons/pile. Each end bent will consist of a single row of 7 vertical piles spaced at 8 feet at center-to-center. End bent piles will not carry any lateral load.

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

SITE DESCRIPTION/GEOLOGY

The proposed project site is located along SR 1006 (Howard Gap Road), approximately two (2) miles south of Fletcher in Henderson County, North Carolina. Topographically, the project area may generally be characterized as rolling terrain with a relatively well developed flood plain and some channel alteration. In general, residential properties occupy the surrounding areas of the project site. It is estimated that the floodplain is approximately 100 feet wide at the bridge site. The site area, surrounding the existing bridge structure, consists of standing water and areas covered with grass, bushes and trees.

According to ***The Geologic Map of North Carolina*** (1985), the project site is located within the Inner Piedmont Physiographic Province, just east of the Brevard Fault Zone. Fletcher and Swainville lie within the Chauga Belt. Specifically, the rock consists of a granite gneiss intrusive body (**SOgg**). This material consists of intrusive, slightly metamorphosed, poorly foliated granite, interlayered with micaceous gneiss.

FIELD EVALUATION PROCEDURE

The subsurface exploration consisted of performing four (4) soil test borings at each side of the proposed end bents and three (3) soil test borings approximately 200 feet apart along the proposed detour alignment. Borings were performed with a CME 550A drill rig with an auto hammer using hollow stem augers. 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. The borings for the proposed structure were advanced to depths ranging from 15.6 to 24.6 feet below existing grade and for the proposed detour to depths ranging from 13.6 to 15 feet below existing grade.

Groundwater table depths were measured in each borehole with a weighted 100-foot measuring tape from a reference location at the top of each boring. Measuerments were recorded immediately after boring termination and after a 24-hour waiting period. Ground surface elevations for the test borings were approximated from the surveyed topographic information provided.

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

SUBSURFACE AND GROUNDWATER CONDITIONS- BRIDGE

Subsurface soils encountered along the proposed bridge alignment typically consist of roadway embankment, alluvial deposits, residual soils, weathered rock and crystalline rock. A thin layer of pavement (about 9 to 12 inch thick) was encountered at the ground surface of these borings.

Soils beneath the End Bent 1 consist of roadway embankment underlain by alluvial deposits, followed by weathered rock and/or crystalline rock. Roadway embankment soils were encountered at an elevation of about 2,109 feet, NAVD, extending to elevations of approximately 2,106 to 2,107 feet, NAVD. Roadway embankment soils consist of loose silty sand (A-2-4) and medium stiff clayey sandy silt (A-4). Alluvial deposits were encountered below roadway embankment, extending to elevations ranging from 2,100.5 feet to 2,104.4 feet, NAVD. Alluvial soils consist of loose to medium dense silty sand with gravel (A-2-4) and soft silty sandy clay (A-6). Weathered rock was encountered below the alluvial deposits in boring EB1A, extending to an elevation of approximately 2,097.6 feet, NAVD, with a thin layer of crystalline rock (1 foot thick). Crystalline rock was encountered below the alluvial soils in boring EB1B at an elevation of approximately 2,104.4 feet, NAVD, and below the weathered rock at boring EB1A at an elevation of approximately 2,097.6 feet, NAVD, extending to the boring termination elevations.

Soils beneath the End Bent 2 consist of roadway embankment underlain by alluvial deposits, followed by residual soils, weathered rock and/or crystalline rock. Roadway embankment soils were encountered at an elevation of about 2,109.2 feet, NAVD, extending to elevations of approximately 2,105.3 to 2,107 feet, NAVD. Roadway embankment soils consist of very loose to loose clayey and gravelly sand (A-2-6 and A-1-a) and soft silty clay (A-6). Alluvial deposits were encountered below roadway embankment, extending to an elevation of 2,103 feet, NAVD. Alluvial soils consist of very dense silty sand (A-2-4) and very soft to very stiff sandy silt (A-4). Residual soils were encountered below alluvial deposits in boring EB2B, extending to an elevation of 2,096.5 feet, NAVD, and imbedded within weathered rock in boring EB2A at elevations between 2,099 feet and 2,096 feet, NAVD. These soils consist of medium dense to very dense silty sand (A-2-4). Weathered rock was encountered below the alluvial deposits in boring EB2A, extending to boring termination depth and below residual soils in boring EB2B, overlying crystalline rock at an elevation of 2,091.7 feet, NAVD. Crystalline rock was extended to the boring termination elevation of 2,085.4 feet, NAVD.

Because of safety considerations, these borings were backfilled immediately after completion of drilling and therefore, groundwater table was not measured after a waiting period of 24 hours. The groundwater elevation at the time of boring termination ranged from dry condition to 2,100 feet, NAVD.

SUBSURFACE AND GROUNDWATER CONDITIONS- TEMPORARY DETOUR

Beneath a thin layer of rootmat (approximately 2 inch deep), subsurface soils encountered along the proposed detour alignment mainly consist of fill materials, alluvial deposits and residual soils.

Soils encountered in boring S2-B1 consist of residual soil underlain by weathered rock, followed by crystalline rock. The residual soil consists of approximately 13 feet of soft to medium stiff

sandy silt (A-4). Below this residual soil layer, weathered rock was encountered at an elevation of approximately 2,098 feet, NAVD, extending to an elevation of 2097 feet, NAVD, where SPT refusal was encountered and the boring was terminated.

Soils encountered in boring S2-B2 consist of fill and alluvial deposits underlain by residual soil. The fill material consists of approximately 4.5 feet of very loose silty sand (A-2-4). The alluvial deposit was encountered below the fill at an elevation of approximately 2104.5 feet, NAVD, and consists of very loose to loose silty sand (A-2-4). Below this alluvial deposit, the residual soils were encountered at an elevation of approximately 2,099.2 feet, NAVD, extending to an elevation of 2097 feet, NAVD, where SPT refusal was encountered and the boring was terminated. The residual soils consist of soft sandy silt (A-4) and medium dense silty sand (A-2-4).

Soils encountered at boring S2-B3 consist of fill underlain by residual soil. The fill materials consist of approximately 7.3 feet of very loose silty sand (A-2-4) and medium dense sandy gravel (A-1-a). The residual soil was encountered below the fill at an elevation of approximately 2106.7 feet, NAVD, extending to a boring termination elevation of 2009 feet, NAVD. Residual soils consist of medium dense to very dense silty sand (A-2-4).

Groundwater along the proposed alignment ranged in elevation from approximately 2,101 to 2,110.3 feet, NAVD.

LABORATORY TESTING

Representative split-spoon samples were selected from soil test borings to verify visual field classification and determine soil index properties. A total of ten (10) split-spoon samples were analyzed in our laboratory for natural moisture determination, Atterberg limits, and grain size analysis; five (5) samples each for replacement bridge and temporary detour. Representative channel and bank samples were analyzed for grain size distribution. Two rock core samples were also tested for compressive strength. 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-89-02 (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"
- AASHTO T-99-81 "Standard Compaction of Soils"
- AASHTO T-193-81 "California Bearing Ratio of Soils"
- ASTM 2938-95 "Unconfined Compressive Strength of Intact Rock Core"

The results of the laboratory testing are presented in AASHTO Soil Classification and Gradation Sheet and Laboratory Summary Sheet for Rock Core Samples attached.

CONCLUSIONS

Based on our subsurface investigation, the subsurface conditions consist of very loose to very dense sandy soils (A-1-a, A-2-4 and A-2-6) and very soft to very stiff silty clay and sandy silt (A-6 and A-4), underlain by relatively shallow weathered rock and/or crystalline rock. Considering the bottom of cap elevations provided and shallow depths to weathered rock and crystalline rock, pile foundations utilizing pile excavations are anticipated at both end bents.

FOUNDATION RECOMMENDATIONS

HP12X53 piles are proposed at the end bents. The foundation recommendations presented below are based on the strength limit state.

The end bent piles will be driven to weathered rock where they are likely to refuse. Since minimum of approximately 10 feet of pile embedment is required at the end bents, pile excavations at both end bents will likely be required. Some piles at End Bent 1 may be driven into the weathered to rock to some distances to meet the required embedment.

The end bent piles will develop a factored resistance of 81 Tons per pile, bearing on bedrock. A resistance factor of 0.6 may be applied to evaluate the driving resistance of the piles, assuming they are driven to rock. The piles will be spaced at 8 feet inches on center. Therefore, the group axial capacity of the piles will be the sum of the individual capacities of the piles in a row. For more information, refer to the attached "Summary of Foundation Recommendations".

Temporary shoring may also be required. Backfill behind the end bent caps shall be replaced in accordance with NCDOT Specifications.

From the information provided, we understand the proposed final grade is to be at or near existing grade with minimal fill. Therefore long term settlement is not anticipated to occur. Provided that the embankments are constructed in accordance with NCDOT Specifications and suitable slope protection measures are incorporated, the slopes may be reconstructed at 1.5H:1V as planned.

CLOSURE

Recommendations and evaluations provided by Falcon Engineer, Inc. are based on the draft report prepared by Tierra, Inc., on December 18, 2006. 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. Falcon Engineering, Inc. 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,
FALCON ENGINEERING, INC.

Jeremy R. Hamm
Staff Professional

NORTH CAROLINA PROFESSIONAL SEAL 036072 ENGINEER MAHALINGAM BAHIRADHAN
04/20/11

Mahalingam Bahiradhan (Bahi), P.E.
Senior Geotechnical Project Manager

FOUNDATION RECOMMENDATIONS

WBS # _____

T.I.P. NO. R 5207 A

COUNTY Henderson

STATION 70+96.3 to 71+53.7 -L-

DESCRIPTION Br. # 222 over Unnamed Tributary to Clear Creek on SR 1006 (Howard Gap Road)

SEAL
NORTH CAROLINA PROFESSIONAL SEAL 036072 ENGINEER MAHALINGAM SAHIRADHAN
SIGNATURE 04/20/11

	INITIALS	DATE
DESIGN	JH	03/04/11
CHECK	MB	04/19/11
APPROVAL		

BENT	STATION	FOUNDATION TYPE	FACTORED RESISTANCE	MISCELLANEOUS DETAILS
END BENT 1	70+96.3 -L-	Cap on HP 12X53 Steel Piles w/ Points	81 tons/pile	Bottom of Cap El. = 2106 ft +/- NAVD Tip El. no Higher than = 2096 +/- NAVD Length of Pile = 15 ft Number of Piles = 7 Pile Spacing = 8 feet
END BENT 2	71+53.7 -L-	Cap on HP 12X53 Steel Piles w/ Points	81 tons/pile	Bottom of Cap El. = 2106 ft +/- NAVD Tip El. no Higher than = 2096 +/- NAVD Length of Pile = 15 ft Number of Piles = 7 Pile Spacing = 8 feet

FOUNDATION RECOMMENDATION NOTES ON PLANS

1. Drive piles at End Bents No. 1 and 2 to a required driving resistance of 135 tons per pile. A resistance factor of 0.6 is applied.
2. The factored resistance for piles at End Bents 1 and 2 is 81 tons per pile.
3. Steel pile tips are required for H piles at End Bents 1 & 2. See Section 450 of the NCDOT Standard Specifications.
4. For Piles, See Special Provisions attached in Appendix A.
5. Install piles at End Bent No.1 and End Bent No.2 to a tip elevation no higher than 2096 feet NAVD.
6. Pile excavation is required to install piles at End Bent No. 1 and End Bent No. 2. Excavate holes at pile locations to elevation 2096 feet, NAVD. For pile excavation, see pile provision.

FOUNDATION RECOMMENDATION COMMENTS

1. 1.5:1 (H:V) end bent slopes with proper slope protection are ok.
2. No waiting period required.

BEARING PILE PAY ITEM QUANTITIES

WBS ELEMENT 0

TIP NO. R 5207 A

COUNTY Henderson

STATION 70+96.3 to 71+53.7 -L-

DESCRIPTION Br. # 222 over Unnamed Tributary to Clear Creek on SR 1006 (Howard Gap Road)

DATE 3/4/2011

DESIGNED BY JH

CHECKED BY MB

NUMBER OF BENTS WITH PILES _____
NUMBER OF PILES PER BENT _____
NUMBER OF END BENTS WITH PILES 2
NUMBER OF PILES PER END BENT 7

Only required for "Pile Excavation" Pay Items.

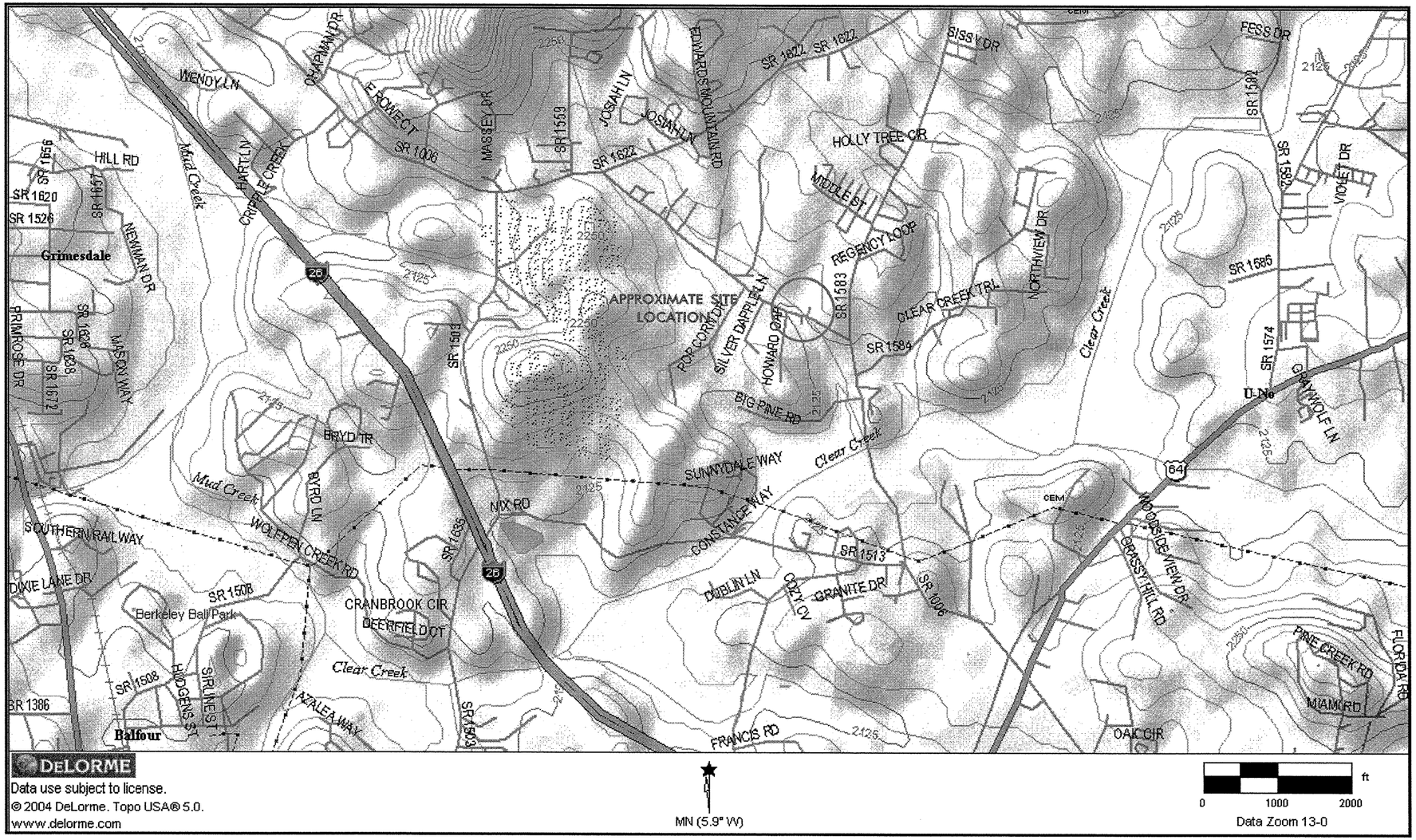
	BEARING PILE PAY ITEMS						
BENT # OR END BENT #	PIPE PILE PLATES (yes/no/maybe)	STEEL PILE POINTS (yes/no)	PILE REDRIVES (per each)	PILE EXCAVATION (per linear ft/m) IN SOIL	PILE EXCAVATION (per linear ft/m) NOT IN SOIL	PDA TESTING* (per each)	PDA ASSISTANCE* (per each)
EB1		yes		25	45		
EB2		yes		44	26		
TOTALS			0	69	71	0	0

* If PDA testing is required at a specific bent or end bent with a Note on Plans, show "PDA Testing" and "PDA Assistance" pay items per that specific bent or end bent. If PDA testing may be required or is required for multiple bents or end bents with a Note on Plans, show "PDA Testing" and "PDA Assistance" pay items as a total per structure only (do not show per bent or end bent).

Notes:
Blanks or "no" represent quantity of zero.

If pipe pile plates are required or may be required, Structure Design should determine the pay item quantity, "Pipe Pile Plates" equal to the number of pipe piles per bent or end bent.

If pile points are required, Structure Design should determine the pay item quantity, "Steel Pile Points" equal to the number of steel piles per bent or end bent.



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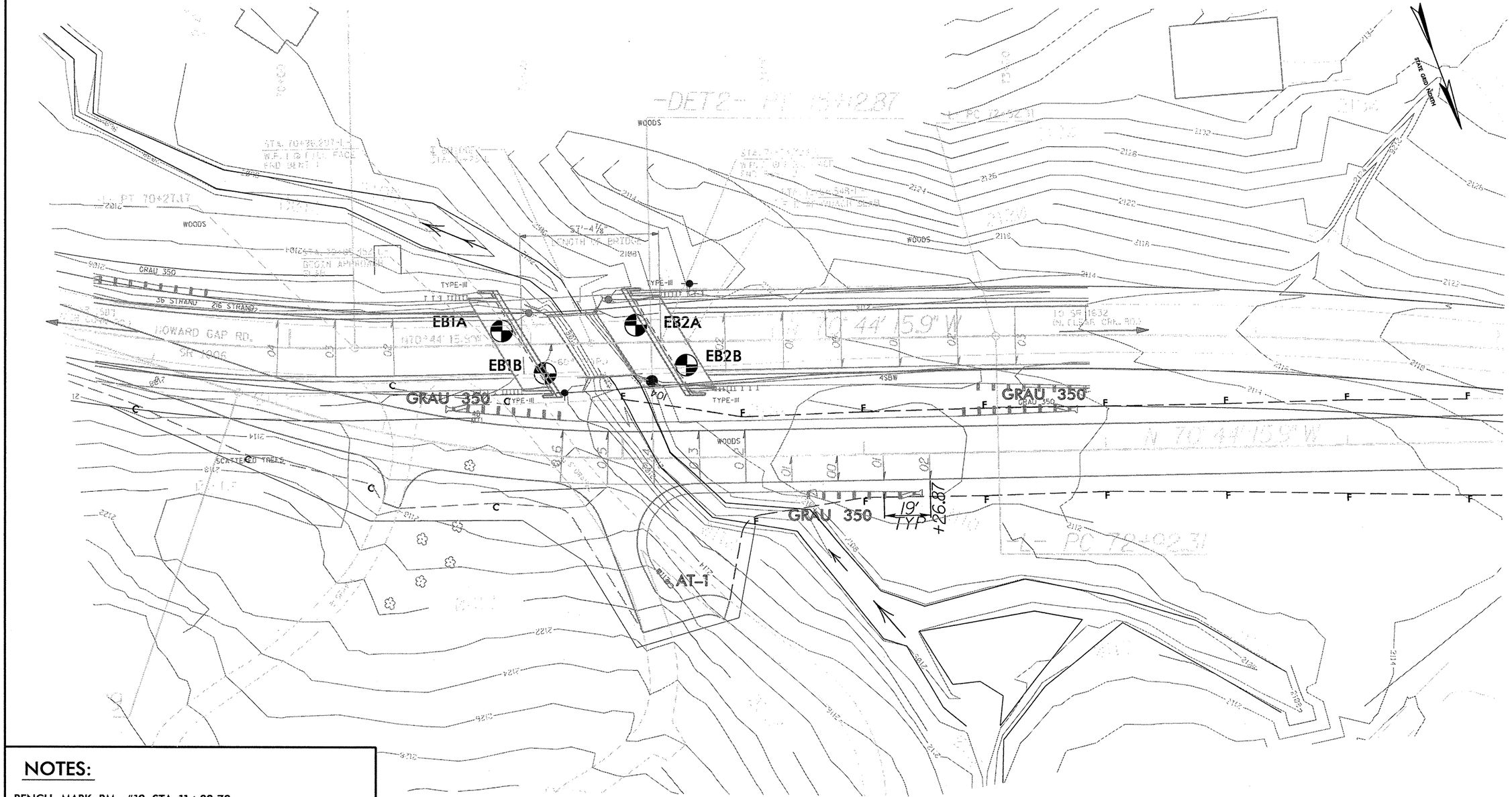
SITE VICINITY MAP

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 7



NOTES:

BENCH MARK: BM #12, STA. 11+32.78,
15.62' RT. –Y6–, ELEVATION 2095.67'

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM TGS ENGINEERS , DATED MAY, 2006

PROPOSED BRIDGE SKEW: 60 •

APPROXIMATE SPT BORING LOCATION.

0 40 80
FEET

FALCON ENGINEERING

FALCON ENGINEERING, INC.
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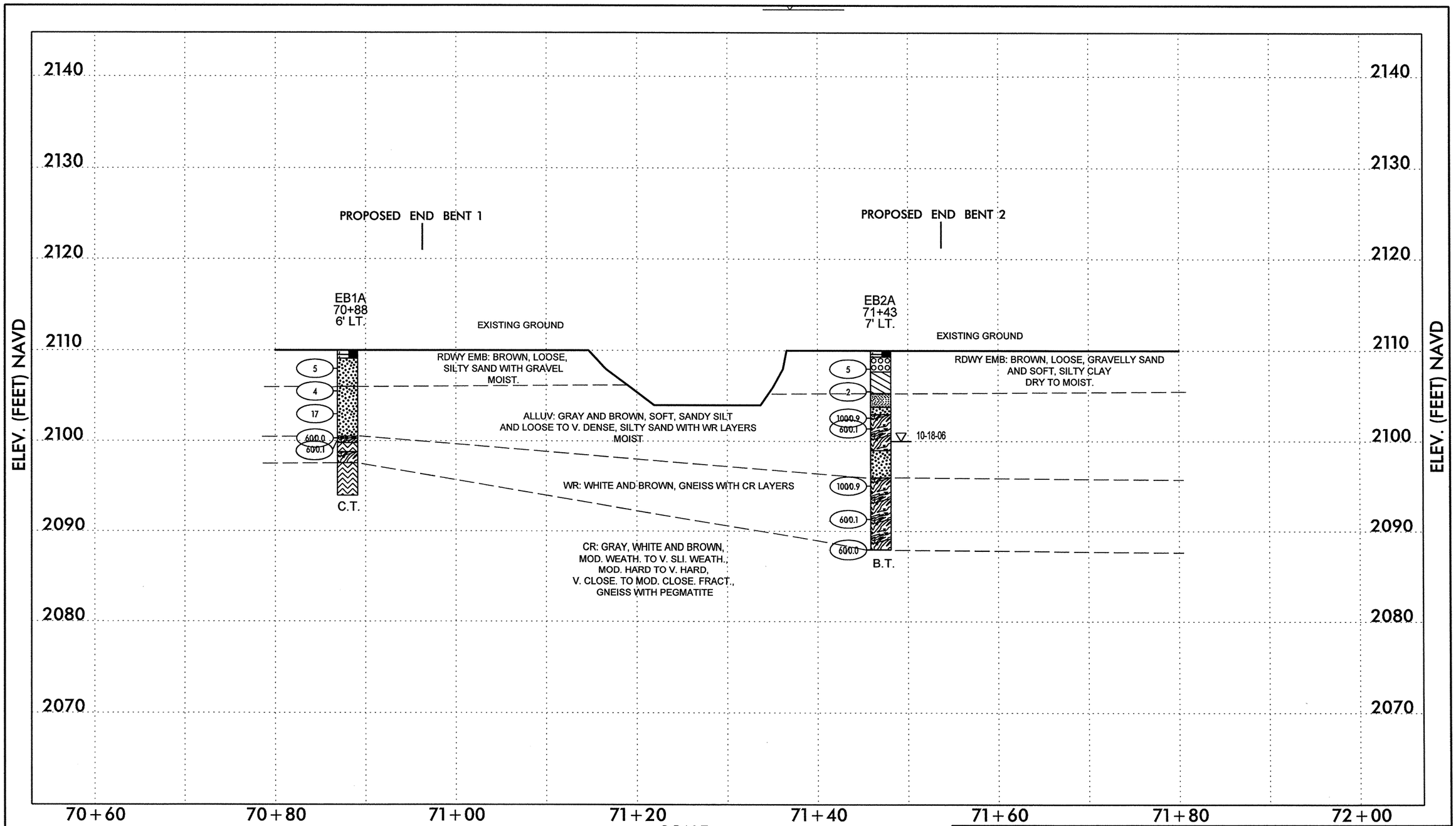
BORING LOCATION PLAN

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 8



NOTES:

- BENCH MARK: BM #12, STA. 11+32.78, 15.62' RT. –Y6–, ELEVATION 2095.67'
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.
- BRIDGE SKEW: 60 DEGREES

SCALE

0 10 20

FEET

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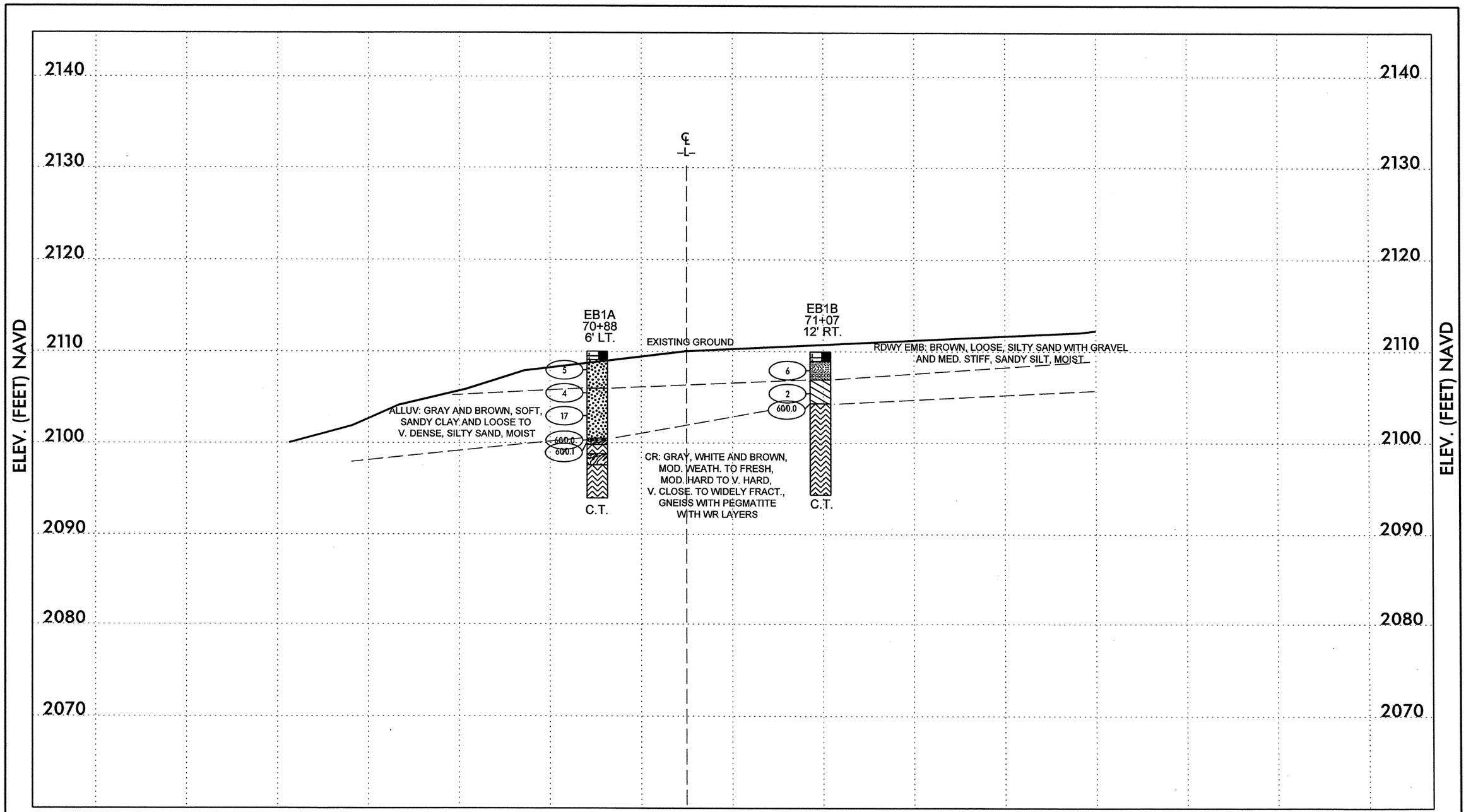
SUBSURFACE PROFILE ALONG –L–

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 9



NOTES:

- BENCH MARK: BM #12, STA. 11+32.78, 15.62' RT. –Y6–, ELEVATION 2095.67'
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.
- BRIDGE SKEW: 60 DEGREES

SCALE

0 10 20

FEET

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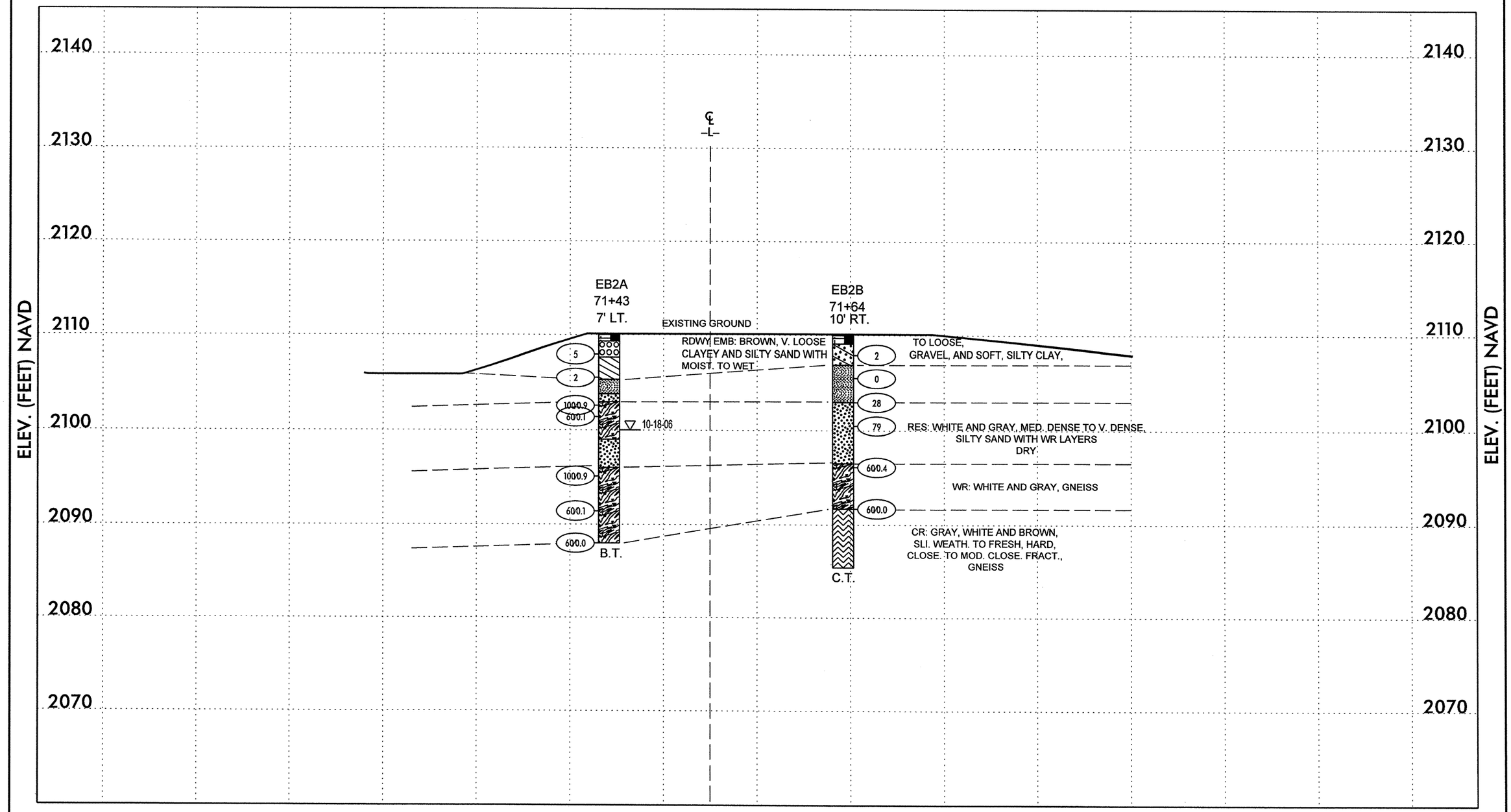
SUBSURFACE CROSS SEC – END BENT 1

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 10



NOTES:

- BENCH MARK: TBM #1, STA. 10+49.81, 22.27' LT. –L–, ELEVATION 3236.08'
- INFERRED STRATIGRAPHY IS DRAWN THROUGH THE BORINGS WITH BOTH PROJECTED ONTO THE PROFILE.
- BRIDGE SKEW: 60 DEGREES

SCALE
0 10 20
FEET

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SUBSURFACE CROSS SEC – END BENT 2

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011 | PROJECT NO.: G11005.00 | SHEET 11

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB1A	**STATION** 70+88	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
~~2115~~ **COLLAR ELEV.** 2,110.0 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 727,021	**EASTING** 1,891,439	**24 HR.** FIAD
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/18/06	**COMP. DATE** 10/18/06	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2110										2,110.0 EXISTING GROUND	0.0
	2,109.0	1.0	4	2	3	5				2,109.5 ROADWAY EMBANKMENT BITUMINOUS CONCRETE	0.5
										2,109.1 ROADWAY EMBANKMENT AGGREGRATE BASE COURSE	0.9
	2,106.5	3.5	2	2	2			M		ROADWAY EMBANKMENT BROWN, LOOSE, SILTY SAND (A-2-4) WITH GRAVEL	
2105						4				2,106.0 ALLUVIAL GRAY AND BROWN, LOOSE TO MED. DENSE, SILTY SAND (A-2-4) WITH GRAVEL	4.0
	2,104.0	6.0	4	10	7						
						17	SS-1				
	2,101.5	8.5	3	18	60/0.1						
2100	2,100.3	9.7	60/0.0			60/0.0 60/0.1				2,100.5 WEATHERED ROCK WHITE AND BROWN, GNEISS	9.5 / 9.7 / 10.2
										2,098.8 WEATHERED ROCK WHITE AND GRAY, GNEISS WITH QUARTZ LAYERS	11.2
										2,097.6 CRYSTALLINE ROCK GRAY AND WHITE, SLI. WEATHERED, HARD, V. CLOSELY TO CLOSELY FRACT., GNEISS	12.4
										WEATHERED ROCK BROWN, GNEISS	
2095										CRYSTALLINE ROCK GRAY, WHITE AND BROWN, MOD. WEATHERED TO V. SLI. WEATHERED, MOD. HARD TO V. HARD, V. CLOSELY TO MOD. CLOSELY FRACT., GNEISS WITH PEGMATITE	
										2,094.0 Boring Terminated at Elevation 2,094.0 ft IN CR: GNEISS	16.0
2090											

NCDOT BORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT, HOWARD GAP.GPJ NC_DOT.GDT 4/20/11

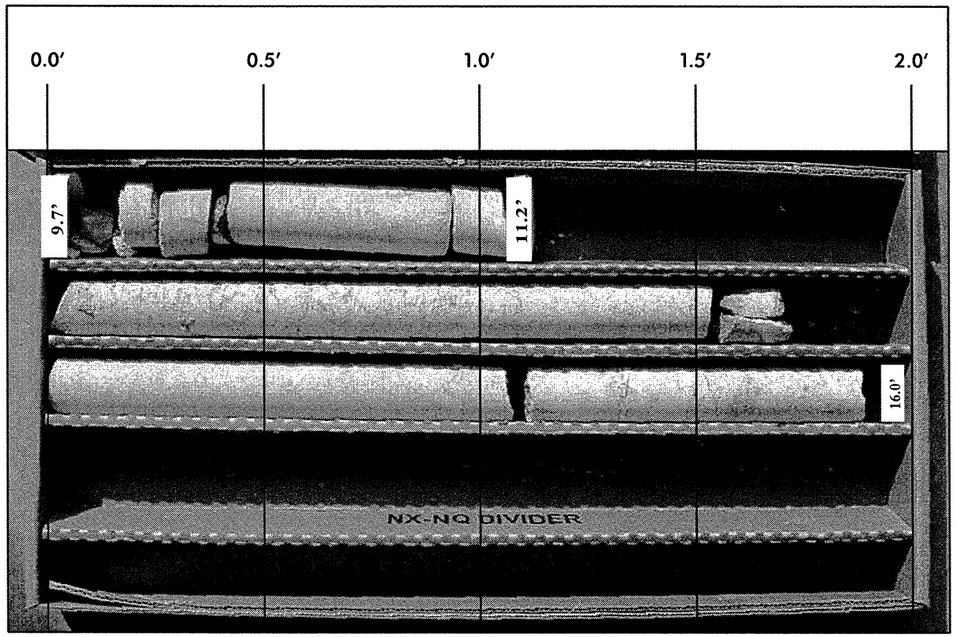
SHEET 12

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB1A	**STATION** 70+88	**OFFSET** 6 ft LT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,110.0 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 727,021	**EASTING** 1,891,439	**24 HR.** FIAD
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/18/06	**COMP. DATE** 10/18/06	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 6.3 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2100.29											Begin Coring @ 9.7 ft	
2100	2,100.3	9.7	1.5	02:30/1.0	(1.0) 67%	(0.5) 34%					2,099.8 WEATHERED ROCK WHITE AND GRAY, GNEISS WITH QUARTZ LAYERS (continued)	10.2
	2,098.8	11.2		02:00/0.5				(1.0) 100%	(0.5) 50%		2,098.8 CRYSTALLINE ROCK GRAY AND WHITE, SLI. WEATHERED, HARD, V. CLOSELY TO CLOSELY FRACT., GNEISS	11.2
			4.8	01:45/1.0	(3.6) 75%	(3.4) 71%					2,097.6 WEATHERED ROCK BROWN, GNEISS	12.4
				02:00/1.0							CRYSTALLINE ROCK GRAY, WHITE AND BROWN, MOD. WEATHERED TO V. SLI. WEATHERED, MOD. HARD TO V. HARD, V. CLOSELY TO MOD. CLOSELY FRACT., GNEISS WITH PEGMATITE	
				02:15/1.0				(3.6) 100%	(3.4) 94%			
2095				03:30/1.0								
	2,094.0	16.0		04:00/0.8							2,094.0 Boring Terminated at Elevation 2,094.0 ft IN CR: GNEISS	16.0
2090												
2085												
2080												
2075												
2070												

NCDOT CORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT, HOWARD GAP.GPJ NC_DOT.GDT 4/20/11



BORING EB1–A , BOX 1 OF 1 , 9.7 FEET TO 16.0 FEET.

0 4" 8"
INCHES

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CORE PHOTOS

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 13

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB1B	**STATION** 71+07	**OFFSET** 12 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 2,110.0 ft	**TOTAL DEPTH** 15.6 ft	**NORTHING** 727,044	**EASTING** 1,891,428	**24 HR.** N/A
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/18/06	**COMP. DATE** 10/18/06	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2110										2,110.0 EXISTING GROUND	0.0
	2,109.0	1.0	2	3	3	6		M		2,109.4 ROADWAY EMBANKMENT BITUMINOUS CONCRETE	0.6
										2,109.0 ROADWAY EMBANKMENT AGGREGATE BASE COURSE	1.0
										ROADWAY EMBANKMENT BROWN, MED. STIFF, CLAYEY SANDY SILT (A-4)	
	2,106.5	3.5	1	1	1	2	SS-2	22%		2,107.0 ALLUVIAL BROWN, SOFT, SILTY SANDY CLAY (A-6)	3.0
2105											
	2,104.4	5.6	60/0.0			60/0.0				2,104.4 CRYSTALLINE ROCK GRAY AND WHITE, SLI. WEATHERED TO FRESH, HARD TO V. HARD, CLOSELY TO WIDELY FRACT., GNEISS	5.6
2100											
2095										2,094.4 Boring Terminated at Elevation 2,094.4 ft IN CR: GNEISS	15.6
2090											

NCDOT BORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT. HOWARD GAP.GPJ NC_DOT.GDT 4/20/11

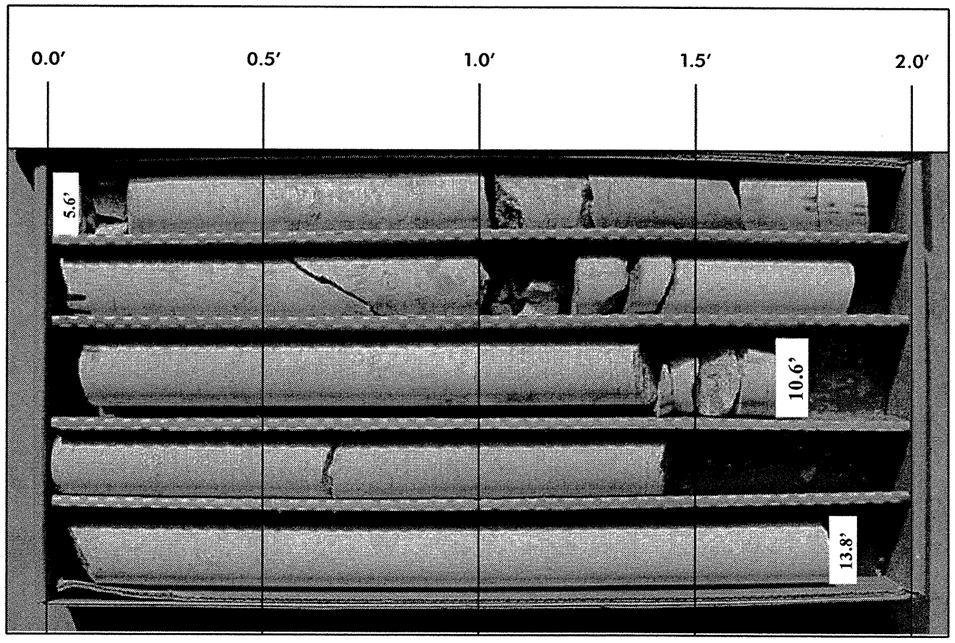
SHEET 14

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

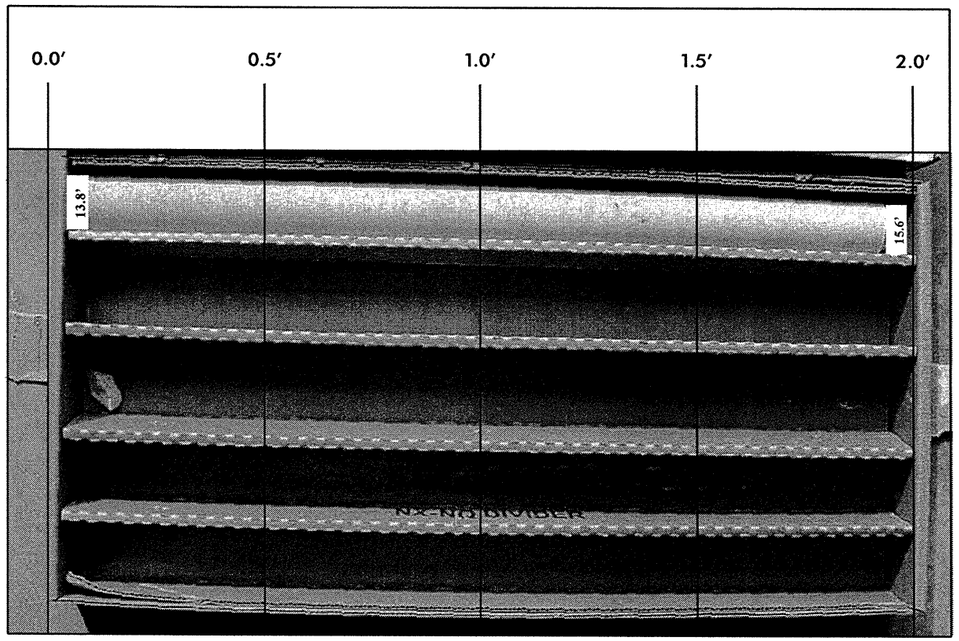
PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB1B	**STATION** 71+07	**OFFSET** 12 ft RT	**ALIGNMENT** -L-	**0 HR.** Dry
COLLAR ELEV. 2,110.0 ft	**TOTAL DEPTH** 15.6 ft	**NORTHING** 727,044	**EASTING** 1,891,428	**24 HR.** N/A
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/18/06	**COMP. DATE** 10/18/06	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 10.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2104.39											Begin Coring @ 5.6 ft	
	2,104.4	5.6	5.0	2:00/1.0	(5.0) 100%	(4.2) 84%		(10.0) 100%	(9.2) 92%		2,104.4 CRYSTALLINE ROCK GRAY AND WHITE, SLI. WEATHERED TO FRESH, HARD TO V. HARD, CLOSELY TO WIDELY FRACT., GNEISS	5.6
				1:45/1.0								
				2:00/1.0								
				2:00/1.0								
2100				1:45/1.0								
	2,099.4	10.6	5.0	2:00/1.0	(5.0) 100%	(5.0) 100%						
				2:30/1.0								
				2:30/1.0								
				3:30/1.0								
2095				3:45/1.0								
	2,094.4	15.6									2,094.4 Boring Terminated at Elevation 2,094.4 ft IN CR: GNEISS	15.6
2090												
2085												
2080												
2075												

NCDOT CORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT. HOWARD GAP.GPJ NC_DOT.GDT 4/20/11



BORING EB1–B, BOX 1 OF 2, 5.6 FEET TO 13.8 FEET.



BORING EB1–B, BOX 2 OF 2, 13.8 FEET TO 15.6 FEET.

0 4″ 8″
INCHES

FALCON ENGINEERING
FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607
PHONE: 919.871.0800
FAX: 919.871.0803

CORE PHOTOS

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 15

FALCON ENGINEERING, INC. 1210 TRINITY ROAD, SUITE 110, RALEIGH NC 27607

SOIL CLASSIFICATION AND GRADATION SHEET

BRIDGE # 22 OVER BYERS CREEK ON SR 1006 (HOWARD GAP ROAD)

TIP NO.: R 5207B

HENDERSON COUNTY, NORTH CAROLINA

FALCON ENGINEEERING, INC. PROJECT NO: G11005.00

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
EB1A		SS-1	36.1%	99	93	35	26	-	NP
A-2-4									
243+46	15'LT	3.5-5.0							
EB1B		SS-2	28.3%	99	98	61	31	24	7
A-4									
243+54	15'RT	1.0-2.5							
EB1B		SS-3	29.5%	100	99	62	26	23	3
A-4									
243+54	15'RT	3.5-5.0							
EB1B		SS-4	13.3%	57	43	24	18	-	NP
A-1-b									
243+54	15'RT	6.0-7.5							
EB1B		SS-5	33.0%	96	82	48	28	-	NP
A-4									
243+54	15'RT	23.5-25.0							
EB2A		SS-6	12.9%	75	59	25	29	-	NP
A-2-4									
244+15	20'LT	3.5-5.0							
EB2A		SS-7	22.2%	92	78	40	27	-	NP
A-2-4									
244+15	20'LT	13.5-15.0							
EB2B		SS-8	16.8%	96	88	60	31	18	13
A-6									
244+25	18'RT	1.0-2.5							
EB2B		SS-9	17.6%	85	81	47	29	-	NP
A-4									
244+25	18'RT	3.5-5.0							
S3-B1		SS-10	25.6%	100	98	56	27	-	NP
A-4									
242+55	CL	1.0-2.5							
S3-B1		SS-11	9.2%	48	31	11	17	-	NP
A-1-b									
242+55	CL	6.0-7.5							
S3-B2		SS-12	21.5%	100	94	70	38	18	20
A-6									
245+20	17'LT	1.0-2.5							
S3-B2		SS-13	23.1%	78	71	45	29	27	2
A-4									
245+20	17'LT	8.5-10.0							
S3-B2		S-1	21.1%	99	94	72	37	19	18
A-6									
245+20	17'LT	0.0-5.0							

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** P. ZHANG	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB2B	**STATION** 71+64	**OFFSET** 10 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,110.0 ft	**TOTAL DEPTH** 24.6 ft	**NORTHING** 727,061	**EASTING** 1,891,372	**24 HR.** FIAD
DRILL MACHINE CME 55	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/25/06	**COMP. DATE** 10/25/06	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
2110										2,110.0 EXISTING GROUND	0.0
	2,109.0	1.0	1	1	1					2,109.7 ROADWAY EMBANKMENT BITUMINOUS CONCRETE	0.3
										2,109.1 ROADWAY EMBANKMENT AGGREGATE BASE COURSE	0.9
								W		ROADWAY EMBANKMENT TAN AND BROWN, V. LOOSE, CLAYEY SAND (A-2-6)	
	2,106.5	3.5	WOH	WOH	WOH					2,107.0 ALLUVIAL TAN, V. SOFT TO V. STIFF, SANDY SILT (A-4)	3.0
2105							SS-5	W			
	2,104.0	6.0	10	12	16	28		D		2,103.0 RESIDUAL WHITE AND GRAY, MED. DENSE TO V. DENSE, SILTY SAND (A-2-4)	7.0
	2,101.5	8.5	9	44	35	79		D			
2100											
	2,096.5	13.5	60/0.4			60/0.4		W		2,096.5 WEATHERED ROCK WHITE AND GRAY, GNEISS	13.5
2095											
	2,091.7	18.3	60/0.0			60/0.0				2,091.7 CRYSTALLINE ROCK GRAY, WHITE AND BROWN, SLI. WEATHERED TO FRESH, HARD, CLOSELY TO MOD. CLOSELY FRACT., GNEISS	18.3
2090											
										2,085.4 Boring Terminated at Elevation 2,085.4 ft IN CR: GNEISS	24.6

NCDOT BORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT, HOWARD GAP.GPJ NC_DOT.GDT 4/20/11

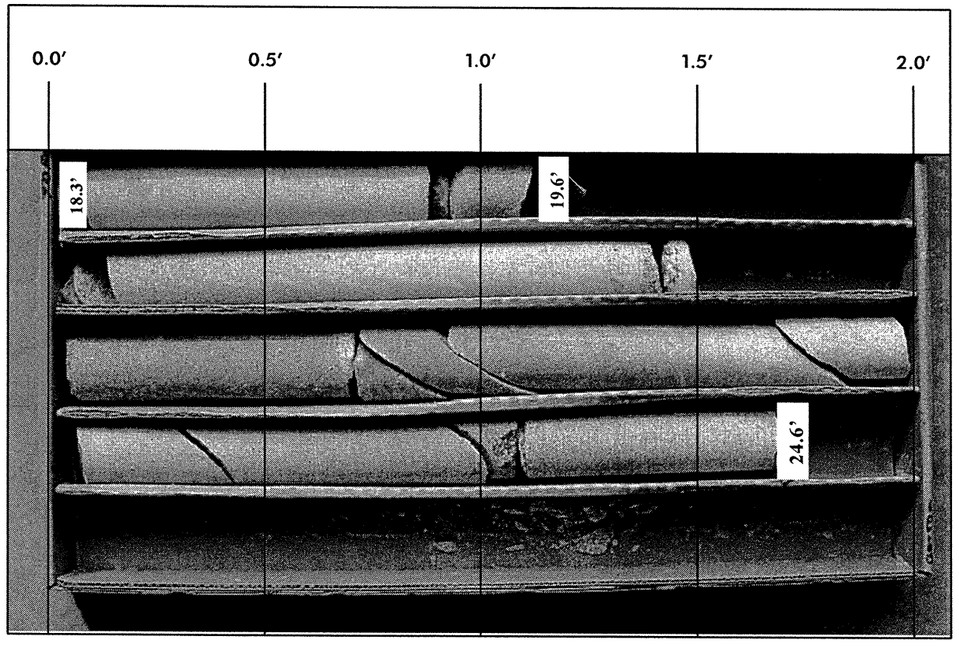
SHEET 17

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** P. ZHANG	
SITE DESCRIPTION BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006 (HOWARD GAP ROAD)				**GROUND WTR (ft)**
BORING NO. EB2B	**STATION** 71+64	**OFFSET** 10 ft RT	**ALIGNMENT** -L-	**0 HR.** N/A
COLLAR ELEV. 2,110.0 ft	**TOTAL DEPTH** 24.6 ft	**NORTHING** 727,061	**EASTING** 1,891,372	**24 HR.** FIAD
DRILL MACHINE CME 55	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/25/06	**COMP. DATE** 10/25/06	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ	**TOTAL RUN** 6.3 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS ELEV. (ft)	DEPTH (ft)
2091.69											Begin Coring @ 18.3 ft	
	2,091.7	18.3	1.3	2:00/1.0	(1.0) 78%	(0.8) 58%		(6.0) 95%	(4.5) 71%		2,091.7 CRYSTALLINE ROCK GRAY, WHITE AND BROWN, SLI. WEATHERED TO FRESH, HARD, CLOSELY TO MOD. CLOSELY FRACT., GNEISS	18.3
	2,090.4	19.6		0:40/0.3								
2090			5.0	3:30/1.0	(5.0) 100%	(3.7) 74%						
				4:00/1.0								
				4:00/1.0								
				3:00/1.0								
				3:00/1.0								
	2,085.4	24.6									2,085.4 Boring Terminated at Elevation 2,085.4 ft IN CR: GNEISS	24.6
2085												
2080												
2075												
2070												
2065												
2060												

NCDOT CORE SINGLE NCDOT 06-021 BR. #22 AND CULVERT, HOWARD GAP.GPJ NC_DOT.GDT 4/20/11



BORING EB2–B, BOX 1 OF 1, 18.3 FEET TO 24.6 FEET.

0 4″ 8″
INCHES

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CORE PHOTOS

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 18

FALCON ENGINEERING, INC. 1210 TRINITY ROAD, SUITE 110, RALEIGH NC 27607

SOIL CLASSIFICATION AND GRADATION SHEET

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)

TIP NO.: R 5207A
HENDERSON COUNTY, NORTH CAROLINA

FALCON PROJECT NO: G11005.00

BORING # / AASHTO Classification	STATION #	OFFSET (FEET)	SAMPLE # / DEPTH (FEET)	NATURAL MOISTURE CONTENT	TOTAL SAMPLE PERCENT PASSING #10	#40	#200	ATTERBERG LIMIT LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX
EB1A / A-2-4	70+88	6'LT	SS-1 / 6.0-7.5	14.5%	85	71	30	26	-	NP
EB1B / A-6	71+07	12'RT	SS-2 / 3.5-5.0	22.3%	97	86	64	32	20	12
EB2A / A-6	71+43	7'LT	SS-3 / 3.5-5.0	15.4%	83	68	39	27	16	11
EB2A / A-2-4	71+43	7'LT	SS-4 / 6.0-7.5	11.2%	94	66	19	28	-	NP
EB2B / A-4	71+64	10'RT	SS-5 / 3.5-5.0	N/A	-	-	-	25	15	10

LABORATORY SUMMARY SHEET FOR ROCK CORE SAMPLES

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK - HENDERSON COUNTY

FALCON No: G11005.00

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
EB - 1A	RS - 1	5.6 - 6.6	1.977	3.798	1.92	0.0067	0.9652	0.35	0.9618	142.6	1000	3589	
EB - 2B	RS - 2	18.3 - 19.0	1.876	3.752	2.00	0.0060	0.9592	0.35	0.9559	159.3	1000	7927	

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL ENGINEERING UNIT

FIELD SCOUR REPORT

WBS: _____ TIP: R 5207A COUNTY: HENDERSON

DESCRIPTION(1): BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1106 (HOWARD GAP RD)

EXISTING BRIDGE

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

Bridge No.: 2 Length: 20 Total Bents: 2 Bents in Channel: 0 Bents in Floodplain: 2
Foundation Type: CONCRETE VERT. ABUT. & WINGWALLS

EVIDENCE OF SCOUR(2)

Abutments or End Bent Slopes: NOT VISABLE

Interior Bents: N/A

Channel Bed: SOME DEGRADATION

Channel Bank: NOT VISABLE

EXISTING SCOUR PROTECTION

Type(3): CONCRETE WINGWALLS

Extent(4): 15'+ IN ALL DIRECTIONS

Effectiveness(5): EFFECTIVE

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): BOULDERS AND SANDS

Channel Bank Material(8): _____

Channel Bank Cover(9): TREES, BUSHES, AND SHRUBS

Floodplain Width(10): 100 FEET

Floodplain Cover(11): BUSHES, SHRUBS, AND TREES

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

Channel Migration Tendency(13): TO THE SOUTHEAST

Observations and Other Comments: _____

Reported by: _____ **Date:** 10/25/2006
FALCON

DESIGN SCOUR ELEVATIONS(14) Feet X Meters ____

	BENTS B1	B2	B3	B4							
100 yr DSE											

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-1	SS-2					
Retained #4	11	1					
Passed #10	85	97					
Passed #40	71	86					
Passed #200	30	64					
Coarse Sand	14	11					
Fine Sand	41	22					
Silt							
Clay							
LL	26	32					
PI	NP	12					
AASHTO	A-2-4	A-6					
Station	70+88	71+07					
Offset	6'LT	12'RT					
Depth	6.0-7.5	3.5-5.0					

PHOTO 1: CENTERLINE PROFILE (–L–), LOOKING UPSTATION.

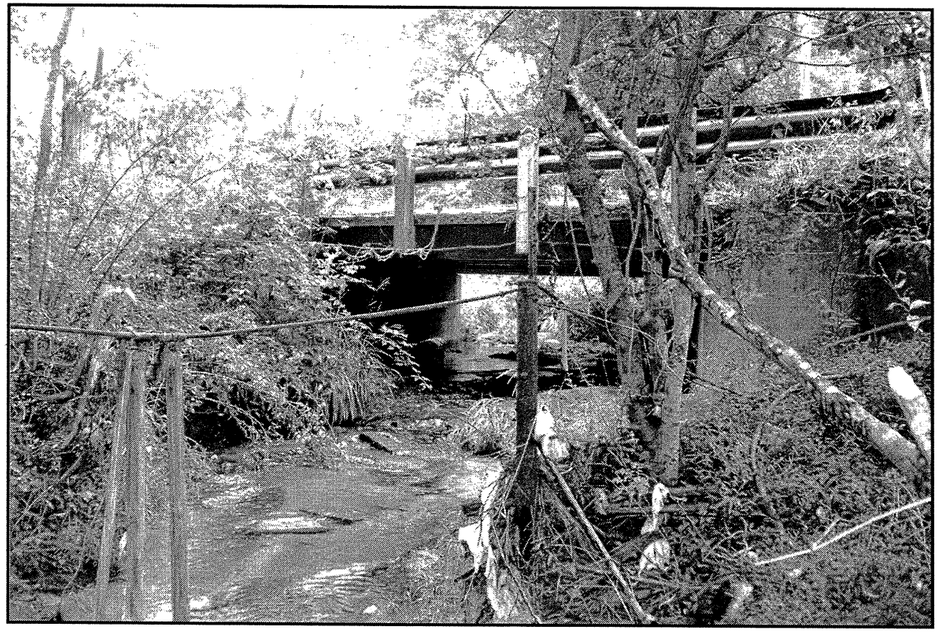

PHOTO 2: UNNAMED TRIBUTARY TO CLEAR CREEK, LOOKING UPSTREAM.

FALCON ENGINEERING

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SITE PHOTOS (MAIN STRUCTURE)

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 22

PHOTO 3: END BENT 1, LOOKING FROM RIGHT TO LEFT.

PHOTO 4: END BENT 2, LOOKING FROM LEFT TO RIGHT.

FALCON ENGINEERING

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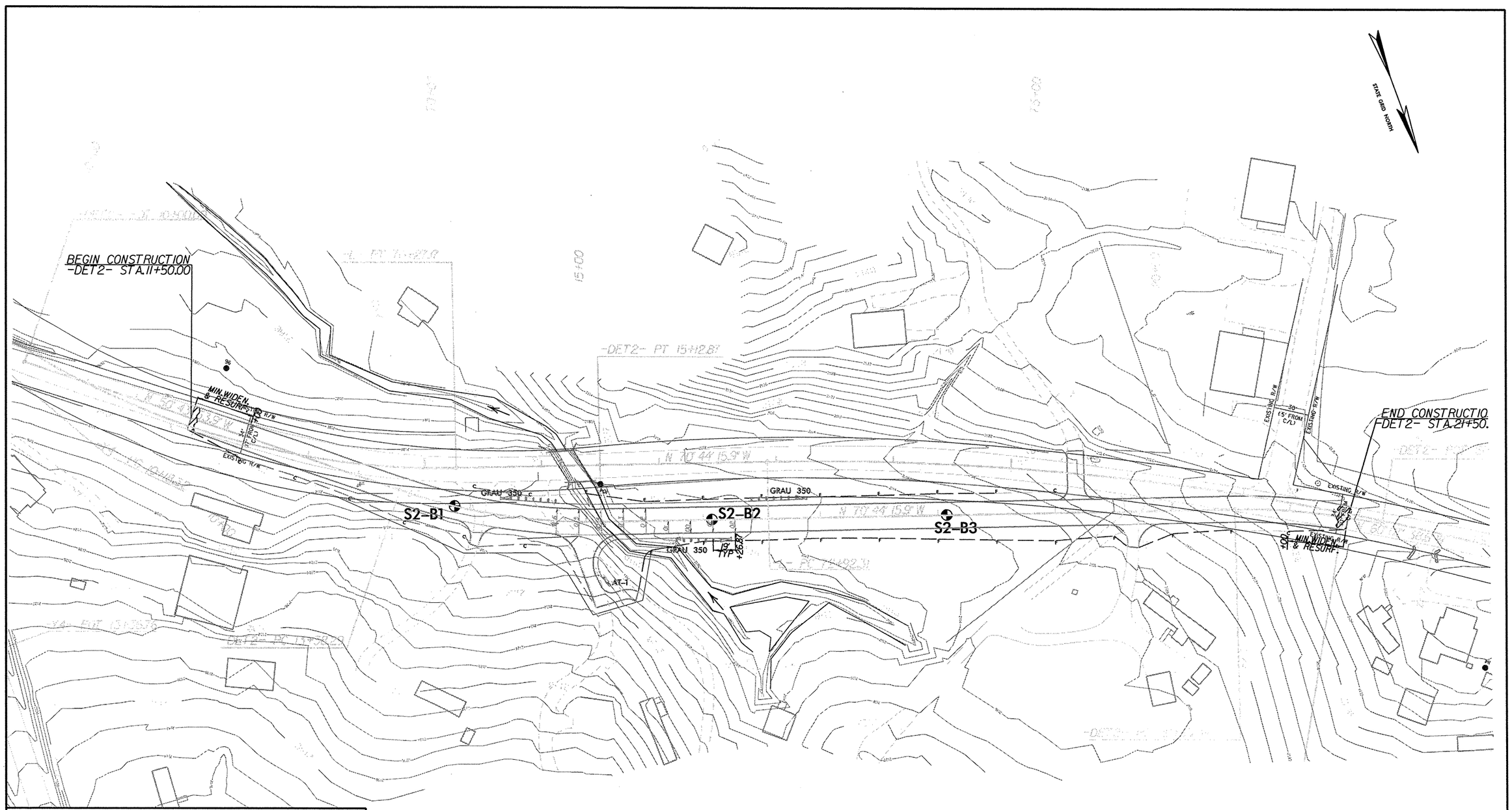
SITE PHOTOS (MAIN STRUCTURE)

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO
CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 23



NOTES:

BENCH MARK: BM #12, STA. 11+32.78, 15.62' RT. –Y6–, ELEVATION 2095.67'

PLANS ADOPTED FROM ELECTRONIC FILES RECEIVED FROM TGS ENGINEERS , DATED MAY, 2006

⊕ APPROXIMATE SPT BORING LOCATION.

0 80 160
FEET

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
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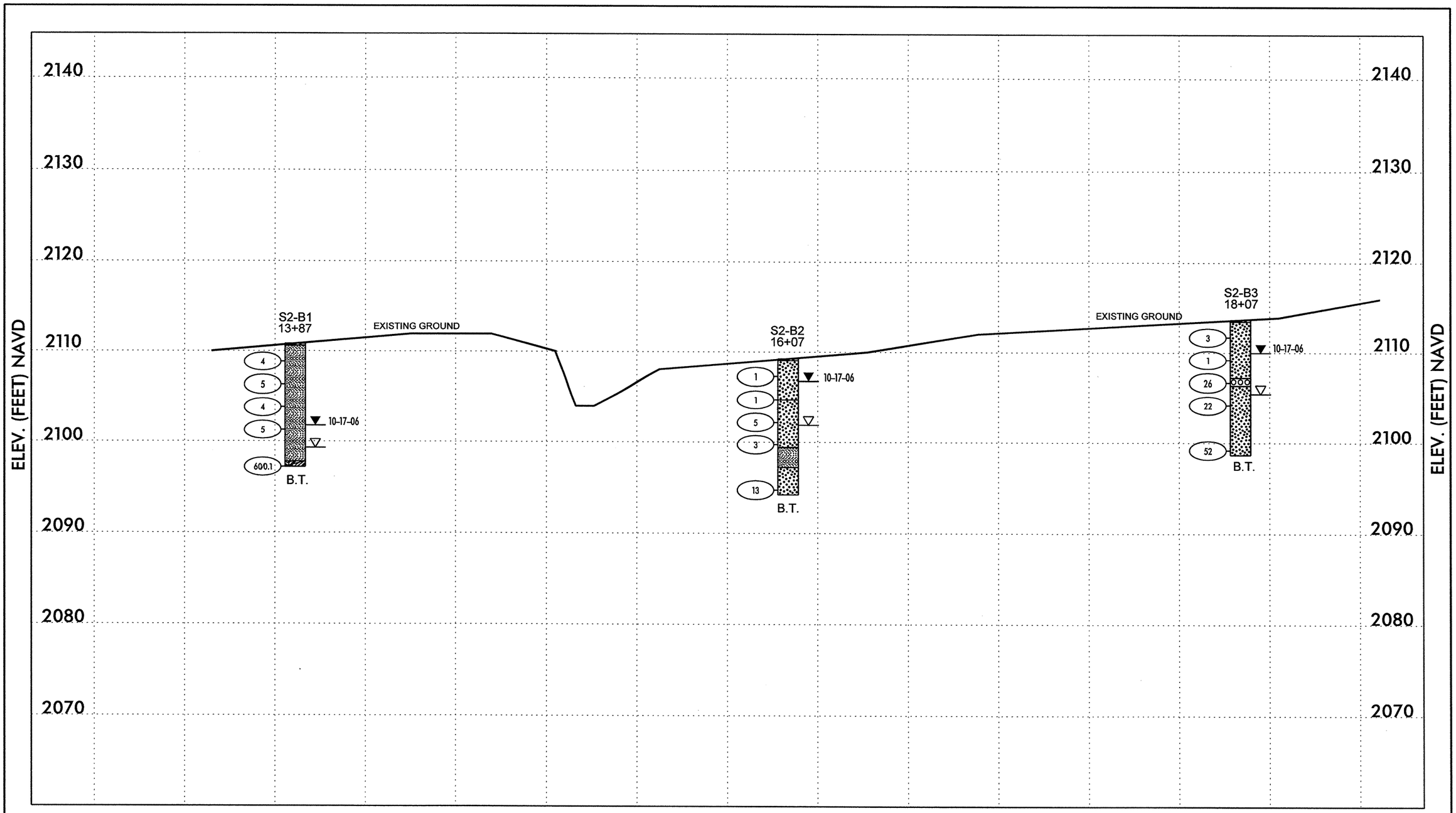
BORING LOCATION PLAN (DETOUR)

DETOUR FOR BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 24



NOTES:

- GROUNDLINE PROFILE OF –L– TAKEN FROM BRIDGE SURVEY AND HYDRAULIC DESIGN REPORT, DATED [DATE].
- BENCH MARK: BM #12, STA. 11+32.78, 15.62' RT. –Y6–, ELEVATION 2095.67'
-

VERTICAL SCALE
0 10 20
FEET

HORIZONTAL SCALE
0 40 80
FEET

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

SUBSURFACE PROFILE ALONG –DET2–

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 25

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION TEMPORARY DETOUR BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006			**GROUND WTR (ft)**
BORING NO. S2-B1	**STATION** 13+87	**OFFSET** N/A	**ALIGNMENT** -DET2- — **0 HR.** 11.5
COLLAR ELEV. 2,111.0 ft	**TOTAL DEPTH** 13.6 ft	**NORTHING** 727,036	**EASTING** 1,891,511 — **24 HR.** 9.0
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic
DRILLER B. BOYER	**START DATE** 10/16/06	**COMP. DATE** 10/16/06	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION (ELEV. (ft) / DEPTH (ft))
2115										
										2,111.0 EXISTING GROUND 0.0
										2,110.8 ROOTMAT 0.2
2110	2,110.0	1.0	1	2	2	4				**RESIDUAL** BROWN, TAN AND WHITE, SOFT TO MED. STIFF, SANDY SILT (A-4), SAPROLITIC, MICACEOUS
							SS-6	22%		
	2,107.5	3.5	2	2	3	5	SS-7	27%		
2105	2,105.0	6.0	1	2	2	4		M		
	2,102.5	8.5	2	2	3	5		M		
2100										
	2,098.0	13.0								WEATHERED ROCK
	2,097.5	13.5	60/0.1			60/0.1				2,097.4 13.6 GRAY AND WHITE, GNEISS
2095										Boring Terminated with Standard Penetration Test Refusal at Elevation 2,097.4 ft ON CR: GNEISS
2090										
2085										

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA
SITE DESCRIPTION TEMPORARY DETOUR BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006			**GROUND WTR (ft)**
BORING NO. S2-B2	**STATION** 16+07	**OFFSET** N/A	**ALIGNMENT** -DET2- — **0 HR.** 7.3
COLLAR ELEV. 2,109.0 ft	**TOTAL DEPTH** 15.0 ft	**NORTHING** 727,123	**EASTING** 1,891,309 — **24 HR.** 2.5
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic
DRILLER B. BOYER	**START DATE** 10/16/06	**COMP. DATE** 10/16/06	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION (ELEV. (ft) / DEPTH (ft))
2110										
										2,109.0 EXISTING GROUND 0.0
										2,108.8 ROOTMAT 0.2
	2,108.0	1.0	1	WOH	1	1				**ARTIFICIAL FILL** BROWN, V. LOOSE, SILTY SAND (A-2-4)
							SS-8	W		
2105	2,105.5	3.5	WOH	WOH	1	1				2,104.5 4.5
								W		**ALLUVIAL** BROWN, V. LOOSE TO LOOSE, SILTY SAND (A-2-4) WITH GRAVEL
	2,103.0	6.0	3	3	2	5				
	2,100.5	8.5	2	1	2	3	SS-9	W		2,099.2 9.8
2100										**RESIDUAL** ORANGE AND BROWN, SOFT, SANDY SILT (A-4), MICACEOUS
										2,097.0 12.0
	2,095.5	13.5	2	4	9	13				**RESIDUAL** BROWN AND TAN, MED. DENSE, SILTY SAND (A-2-4), MICACEOUS, SAPROLITIC
2095								W		
										2,094.0 15.0
2090										Boring Terminated at Elevation 2,094.0 ft IN RES: SILTY SAND
2085										
2080										

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

PROJECT NO. G11005.00	**ID.** R5207A	**COUNTY** HENDERSON	**GEOLOGIST** C. BRUINSMA	
SITE DESCRIPTION TEMPORARY DETOUR BRIDGE #222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR1006				**GROUND WTR (ft)**
BORING NO. S2-B3	**STATION** 18+07	**OFFSET** N/A	**ALIGNMENT** -DET2-	**0 HR.** 8.2
COLLAR ELEV. 2,114.0 ft	**TOTAL DEPTH** 15.0 ft	**NORTHING** 727,189	**EASTING** 1,891,120	**24 HR.** 3.7
DRILL MACHINE CME 550A	**DRILL METHOD** HSA		**HAMMER TYPE** Automatic	
DRILLER B. BOYER	**START DATE** 10/16/06	**COMP. DATE** 10/16/06	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
2115										
										2,114.0 EXISTING GROUND 0.0
										2,113.5 ROOTMAT 0.5
	2,113.0	1.0	1	1	2	3		M		ARTIFICIAL FILL BROWN, V. LOOSE TO LOOSE, SILTY SAND (A-2-4)
2110	2,110.5	3.5	WOH	WOH	1	1	SS-10	W		
	2,108.0	6.0	6	17	9	26		W		2,107.5 6.5
										2,106.7 ARTIFICIAL FILL TAN AND GRAY, MED. DENSE, SANDY GRAVEL (A-1-a) 7.3
2105	2,105.5	8.5	20	14	8	22		W		RESIDUAL GRAY AND WHITE, MED. DENSE TO V. DENSE, SILTY SAND (A-2-4), SAPROLITIC
2100	2,100.5	13.5	35	32	20	52				2,099.0 15.0
										Boring Terminated at Elevation 2,099.0 ft IN RES: SILTY SAND
2095										
2090										
2085										

NCDOT BORE SINGLE NCDOT 06-021 BR. #222 AND CULVERT, HOWARD GAP.GPJ NC_DOT.GDT 4/21/11

FALCON ENGINEERING, INC. 1210 TRINITY ROAD, SUITE 110, RALEIGH NC 27607

SOIL CLASSIFICATION AND GRADATION SHEET

DETOUR FOR BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)

TIP NO.: R 5207A
HENDERSON COUNTY, NORTH CAROLINA

FALCON PROJECT NO: G11005.00

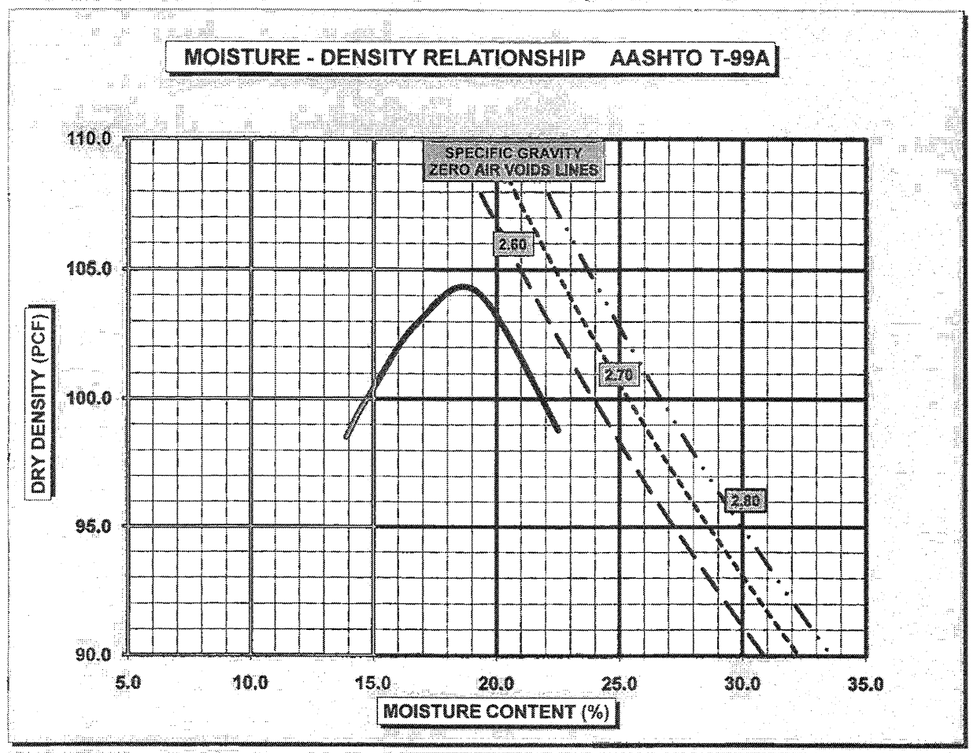
BORING #		SAMPLE #	NATURAL MOISTURE CONTENT	TOTAL SAMPLE PERCENT PASSING			ATTERBERG LIMIT		
AASHTO Classification									
STATION #	OFFSET (FEET)	DEPTH (FEET)		#10	#40	#200	LIQUID LIMIT	PLASTIC LIMIT	PLASTIC INDEX
S2-B1		SS-6	21.7%	97	81	45	29	22	7
A-4									
13+87	CL	1.0-2.5							
S2-B1		SS-7	27.1%	99	78	44	40	35	5
A-4									
13+87	CL	3.5-5.0							
S2-B2		SS-8	35.4%	91	75	31	28	-	NP
A-2-4									
16+07	CL	1.0-2.5							
S2-B2		SS-9	37.2%	92	82	32	28	-	NP
A-2-4									
16+07	CL	8.5-10.0							
S2-B3		SS-10	43.7%	83	58	13	39	31	8
A-2-4									
18+07	CL	3.5-5.0							

FALCON ENGINEERING, INC. 1210 TRINITY RD, SUITE 110, RALEIGH, NORTH CAROLINA. 27607

BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK
ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NORTH CAROLINA

BORING NO.: S2-B2
SAMPLE NO.: S-1
DEPTH: 0.0-5.0
SAMPLE DESCRIPTION: GRAY SILTY SAND (A-2-4)

Maximum Dry Density = 104.2 PCF Optimum Moisture Content = 18.5%



Sample Date : 10/06 Liquid Limit = 28
Natural Moisture Content = 35.4% Plastic Limit = -
Percent Passing #200 Sieve = 31% Plastic Index = NP

FALCON ENGINEERING, INC. Project # G11005.00

FALCON ENGINEERING, INC. 12101 TRINITY RD. SUITE 110, RALEIGH, NORTH CAROLINA 27607

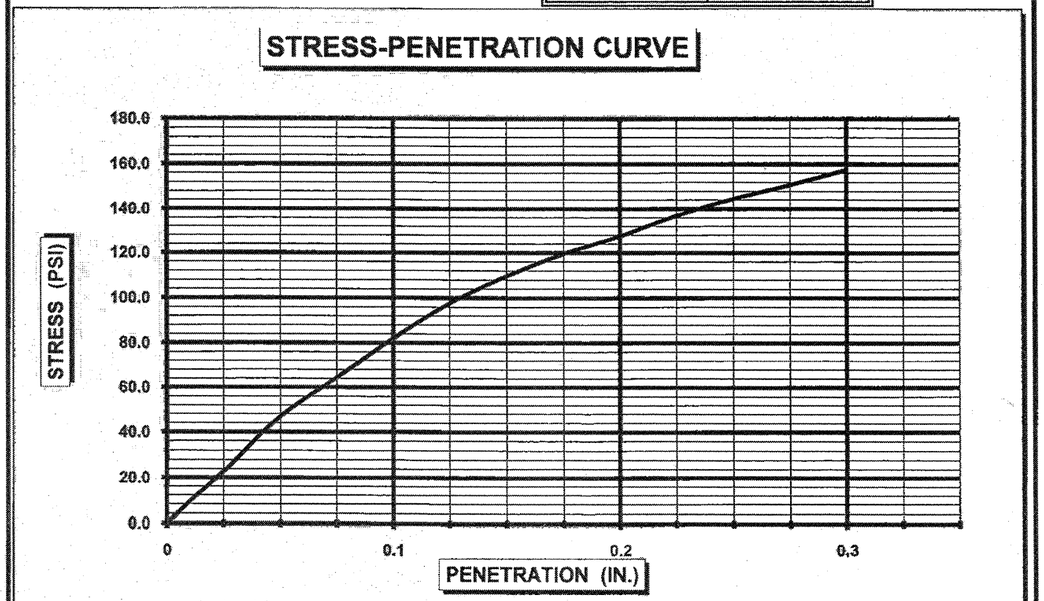
CBR (CALIFORNIA BEARING RATIO) OF LABORATORY COMPACTED SOIL

AASHTO T-99 \ ASTM D-1883

PROJECT #: G11005.00 DATE: 11/17/2006
PROJECT NAME: BRIDGE # 222 OVER UNNAMED TRIBUTARY TO CLEAR CREEK ON SR 1006
BORING: S2-B2 SAMPLE: S-1 DEPTH: 0-5
SOIL DESCRIPTION: GRAY SILTY SAND (A-2-4)

COMPACTION:	AASHTO T99A	SOAK	96 HRS.
MAXIMUM DRY DENSITY	104.2 PCF	STRAIN RATE	.05 IN / MIN.
OPTIMUM MOISTURE CONTENT	18.5%	PROVING RING	1500 LB.
TEST DATA		SURCHARGE WEIGHT	10 lb.
DRY DENSITY	99.2 PCF	SURCHARGE PER SQUARE FOOT	100 lbs/sq.ft.
MOISTURE CONTENT	17.7%	FINAL MOISTURE CONTENT	N/A
PERCENT COMPACTION	95.2%	SWELL	0.18%

	ACTUAL	CORRECTED
CBR VALUE AT .1"	8.2	
CBR VALUE AT .2"	8.5	



LIQUID LIMIT 28	PLASTIC LIMIT -	PLASTIC INDEX -
Percent Passing #200 Sieve = 31%	Natural Moisture Content = 35.4%	

PHOTO 5: PROPOSED DETOUR FOR BRIDGE #222, LOOKING DOWNSTATION.

FALCON ENGINEERING

FALCON ENGINEERING, INC.
1210 TRINITY ROAD, SUITE 110
RALEIGH, NC 27607

PHONE: 919.871.0800
FAX: 919.871.0803

SITE PHOTOS (DETOUR)

BRIDGE NO. 222 OVER UNNAMED TRIBUTARY TO
CLEAR CREEK ON SR 1006 (HOWARD GAP ROAD)
HENDERSON COUNTY, NC
TIP NO.: R5207A

APRIL 20, 2011	PROJECT NO.: G11005.00	SHEET 30

APPENDIX A

PILES PROVISIONS

PILES **(3-5-10)**

Revise the *Standard Specifications* as follows:

Page 4-71, Delete Section 450 **BEARING PILES** and replace it with the following:

1.0 DESCRIPTION

Furnish and install piles with sufficient lengths in accordance with the contract and accepted submittals. Provide steel and prestressed concrete piles and composite piles with both concrete and steel sections as shown on the plans. Drive and drill in piles and use pile tips and accessories as shown on the plans. Galvanize, restrike, redrive, splice, cut off and build up piles and perform predrilling, spudding and pile driving analyzer (PDA) testing as necessary or required. For this provision, "pile embedment" refers to the required pile embedment in the cap or footing and "pile penetration" refers to the minimum required pile tip elevation or penetration into natural ground, whichever is deeper.

2.0 MATERIALS

Refer to Division 10 of the *Standard Specifications*:

Item	Section
Flowable Fill, Non-Excavatable	340
Portland Cement Concrete, Class A	1000
Reinforcing Steel	1070
Steel Pipe Pile Plates	1072
Steel and Prestressed Concrete Piles	1084

For drilled-in piles, use Class A Concrete in accordance with Article 1000-4 of the *Standard Specifications* except as modified herein. Provide concrete with a slump of 6 to 8 inches (150 to 200 mm). Use an approved high-range water reducer to achieve this slump.

For galvanized steel piles, see Section 1076 of the *Standard Specifications.* For composite piles with both prestressed concrete and steel H pile sections, use prestressed concrete piles and steel H piles in accordance with Section 1084 of the *Standard Specifications*. Use steel pile points and splicers approved by the NCDOT Materials & Tests (M&T) Unit. Obtain a list of approved pile points and splicers from:
https://apps.dot.state.nc.us/vendor/approvedproducts/

3.0 PILE LENGTHS

The estimated pile lengths shown on the plans are for bid purposes only. Provide piles of sufficient lengths for the required driving resistance, pile penetration and pile embedment. At the Contractor's option and no additional cost to the Department, make investigations as necessary to determine required pile lengths.

4.0 CONSTRUCTION METHODS

A. Handling and Storing Piles

Handle, transport and store piles so that piles are kept clean and undamaged. Do not use chains, cables or hooks that can damage or scar piles. Do not damage coatings on steel piles. When handling prestressed concrete piles, support piles at pick-up points as shown on the plans.

Protect steel piles as far as practicable from corrosion. Store piles above ground upon platform skids, or other supports, and keep free from dirt, grease, vegetation and other foreign material. Damaged, bent or cracked piles will be rejected.

B. Pile Installation

If applicable, completely excavate for caps and footings before installing piles. If applicable and unless noted otherwise on the plans, construct embankments to bottom of cap or footing elevations for a horizontal distance of 50 ft (15 m) from any pile except where fill slopes are within 50 ft (15 m) of a pile.

Install piles with the following tolerances.

1. Axial alignment within ¼ inch per foot (21 mm per meter) of vertical or batter shown on the plans

2. Horizontal alignment within 3" (75 mm) of plan location, longitudinally and transversely

3. Pile embedment within 3" (75 mm) more and 2" (50 mm) less of the embedment shown on the plans

No additional payment will be made for increased cap or footing dimensions due to piles installed out of position.

If necessary, build up prestressed concrete piles or splice steel piles as shown on the plans. Do not use more than 3 sections (2 splices) of steel piling per pile. Cut off piles at required elevations along a plane normal to the axis of the pile as necessary. Do not damage or spall piles when cutting off prestressed concrete piles.

C. Pile Accessories

If required, use pile accessories including pipe pile plates and steel pile points and splicers as shown on the plans. Perform any welding in accordance with the contract. Weld pipe pile plates with the specified dimensions to steel pipe piles as shown on the plans.

Attach steel pile points to steel piles in accordance with the manufacturer's instructions. The minimum weld length is twice the flange width for steel H piles.

Use steel pile tips with prestressed concrete piles as shown on the plans. Use steel pile splicers for splicing steel H pile tips and composite piles. Attach pile splicers in accordance with the manufacturer's instructions.

D. Driven Piles

When predrilling, spudding and installing the initial portions of steel piles with vibratory hammers, submit these pile installation methods with the proposed pile driving methods and equipment for review and acceptance. Spudding is defined as driving or dropping a steel H pile and then removing it. The Engineer will approve the predrilling depth and diameter, spudding depth and H pile size and depth of pile installation with a vibratory hammer. Do not use vibratory hammers to install prestressed concrete piles.

Drive piles in accordance with the accepted submittals and this provision. Unless otherwise approved, do not drive piles within 50 ft (15 m) of cast-in-place concrete until the concrete cures for at least 3 days.

Limit driving stresses in accordance with the *AASHTO LRFD Bridge Design Specifications*. If a tip elevation is noted on the plans for steel and prestressed concrete piles, drive piles to the minimum required driving resistance and tip elevation. Otherwise, drive steel and prestressed concrete piles to the minimum required driving resistance and a penetration into natural ground of at least 10 ft (3 m). For composite piles, drive piles to the minimum required driving resistance and the prestressed concrete and steel H pile sections to their respective minimum required tip elevations noted on the plans.

Also, drive piles to the minimum required tip elevation or penetration into natural ground, whichever is deeper, in a continuous operation unless stopped due to exceeding the maximum blow count or driving stresses, insufficient pile length or other approved reasons. Natural ground within an area of a new embankment is defined as the bottom of the embankment or footings, whichever is lower.

Protect coatings in an approved manner when driving coated steel piles through templates. Redrive piles raised or moved laterally due to driving adjacent piles.

1. Predrilling and Spudding

If necessary or required, perform predrilling for piles and spudding with a steel H pile as noted on the plans or in accordance with the accepted submittals. Predrill pile locations to the specified elevations noted on the plans, revised elevations approved by the Engineer or depths in accordance with the accepted submittals. When noted on the plans and at the Contractor's option, spudding may be used in lieu of predrilling. Do not perform spudding below specified predrilling elevations, revised elevations approved by the Engineer or depths in accordance with the accepted submittals.

When noted on the plans or predrilling in water or wetlands, use temporary steel casings meeting the requirements of steel casings for pile excavation in accordance with this provision with the exception of casing diameter. For steel casing diameters, use casings with a minimum inside diameter equal to the predrilling diameter. Use steel casings from a minimum of 2 ft (0.6 m) above the static water elevation or ground line, whichever is higher, to a minimum of 5 ft (1.5 m) below the ground or mud line. More than 5 ft (1.5 m) embedment may be necessary if steel casings are not stable or predrilling or spudding disturbs material outside the casings.

Perform predrilling and spudding such that large ground movements and voids below ground do not occur and piles can be driven to the required resistance and pile penetration. Do not deposit spoils above the ground or mud line in water or wetlands. Dispose of spoils in accordance with Section 802 of the *Standard Specifications* and as directed by the Engineer. When predrilling or spudding is complete, remove all steel casings before driving piles.

2. Driving Equipment

Submit the proposed pile driving methods and equipment (pile driving equipment data form) including the pile driving hammer, hammer cushion, pile helmet and cushion for all piles for review and acceptance. Do not submit more than two pile driving hammers per pile type per submittal. Provide 2 copies of this form at least 30 calendar days before driving piles. All equipment is subject to satisfactory field performance.

Drive piles with accepted driving equipment using air, steam or diesel hammers. Use pile driving hammers that will not overstress piles and provide the required driving resistance at a blows per foot ranging from 30 to 180. Use a variable energy hammer to drive prestressed concrete piles.

Operate air and steam hammers within the manufacturer's specified ranges and 10% of the manufacturer's rated speed in blows per minute or a rate approved by the Engineer. Use a plant and equipment for air or steam hammers with sufficient capacity to maintain, under working conditions, the volume and pressure specified by the manufacturer. Equip the plant and equipment with accurate pressure gauges that are easily accessible. Provide striking parts of air and steam hammers that weigh at least one-third the weight of the pile helmet and pile, with a minimum weight of 2,750 lbs (1,250 kg).

Equip open-end (single acting) diesel hammers with a graduated scale (jump stick) extending above the ram cylinder, graduated rings or grooves on the ram or an electric sound activated remote measuring instrument to determine the hammer stroke during driving. Equip closed-end (double acting) diesel hammers with a calibrated bounce chamber pressure gauge mounted near the ground and provide a current calibrated chart or graph equating bounce chamber pressure and gauge hose

length to equivalent energy. Submit this chart or graph with the proposed pile driving methods and equipment for closed-end diesel hammers.

Hold pile heads in position with pile helmets that closely fit over the pile heads and extend down the sides of piles a sufficient distance. Protect pile heads of prestressed concrete piles from direct impact with accepted pile cushions. Use pile cushions made of pine plywood with a minimum thickness of 4" (100 mm). Unless otherwise approved, provide a new pile cushion for each prestressed concrete pile. Replace pile cushions during driving when a cushion is compressed more than one-half its original thickness or begins to burn.

The Engineer may inspect the hammer cushion before beginning driving and periodically throughout the project. Expose the hammer cushion for inspection as directed by the Engineer. Replace or repair any hammer cushion that is less than 25% of its original thickness.

3. Required Driving Resistance

The Engineer will determine the acceptability of the proposed pile driving methods and equipment and provide the blows per foot and equivalent set for 10 blows for the required driving resistance. The minimum required driving resistance is equal to the factored resistance noted on the plans plus any additional resistance for downdrag and scour, if applicable, divided by a resistance factor. When performing PDA testing in accordance with the *AASHTO LRFD Bridge Design Specifications*, the resistance factor is 0.75. Otherwise, the resistance factor for the wave equation analysis is 0.60.

Unless otherwise approved, stop driving piles when refusal is reached. Refusal is defined as 240 blows per foot or any equivalent set.

4. Redriving Piles

Once the required pile penetration is achieved, the Contractor may choose to or the Engineer may require the Contractor to stop driving, wait and restrike or redrive piles to achieve the required driving resistance. If the Contractor chooses to restrike or redrive piles, no payment will be made for restrikes or redrives. If the Engineer requires the Contractor to restrike or redrive piles, payment will be made in accordance with section 5.0 of this provision. When the Engineer requires restrikes or redrives, the Engineer will determine the number of restrikes or redrives and the time to wait after stopping driving and between restrikes and redrives. The time to wait will range from 4 to 24 hours.

Use the same pile driving methods, equipment and compressed pile cushion from the previous driving to restrike or redrive the pile unless the cushion is unacceptable due to deterioration. Do not use a cold diesel hammer for a restrike or redrive, unless it is impractical to do otherwise as determined by the Engineer. In general, warm up the hammer by applying at least 20 blows to a previously driven pile or timber mats on the ground.

E. Drilled-in Piles

If required, perform pile excavation to specified elevations shown on the plans or revised elevations approved by the Engineer. Excavate holes at pile locations with diameters that will result in at least 3" (75 mm) of clearance all around piles. Before filling holes, support and center piles in excavations and when noted on the plans, drive piles to the required driving resistance. Remove any fluid from excavations, and at the Contractor's option, fill holes with either concrete or flowable fill unless required otherwise in the contract.

1. Pile Excavation

Use equipment of adequate capacity and capable of drilling through soil, rock, boulders, debris, man-made objects and any other materials encountered. Blasting is not permitted to advance excavations. Blasting for core removal is only permitted when approved by the Engineer. Dispose of drilling spoils in accordance with Section 802 of the *Standard Specifications* and as directed by the Engineer. Drilling spoils consist of all excavated materials including fluids removed from excavations by pumps or drilling tools.

If unstable, caving or sloughing soils are anticipated or encountered, stabilize holes with either slurry or temporary steel casings. When using slurry, submit slurry details including product information, manufacturer's recommendations for use, slurry equipment details and written approval from the slurry supplier that the mixing water is acceptable before beginning drilling. When using steel casings, use either the sectional type or one continuous corrugated or non-corrugated piece. Steel casings should consist of clean watertight steel of ample strength to withstand handling and driving stresses and the pressures imposed by concrete, earth and backfill. Use steel casings with an outside diameter equal to the hole size and a minimum wall thickness of ¼ inch (6 mm).

2. Filling Holes

Check the water inflow rate at the bottom of holes after all pumps have been removed. If the inflow rate is less than 6" (150 mm) per half hour, remove any fluid and free fall concrete or flowable fill into excavations. Ensure that concrete or flowable fill flows completely around piles. If the water inflow rate is greater than 6" (150 mm) per half hour, propose and obtain acceptance of a procedure for placing concrete or flowable fill before filling holes. Place concrete or flowable fill in a continuous manner and remove all steel casings.

F. Pile Driving Analyzer

If required, test piles with a pile driving analyzer (PDA) manufactured by Pile Dynamics, Inc., analyze data and provide PDA reports. Perform PDA testing in accordance with ASTM D4945. Either the Engineer will perform PDA testing and analysis or use a PDA Consultant prequalified by the NCDOT Contractual Services Unit for Pile Driving Analyzer Work (work code 3060) to perform PDA testing and

analysis and provide PDA reports. When using a PDA Consultant, use a PDA Operator approved as a Field Engineer (key person) for the PDA Consultant. Also, provide PDA reports sealed by a Professional Engineer approved as a Project Engineer (key person) for the same PDA Consultant.

The Engineer will determine the number of piles and which piles to be tested with a PDA. Do not drive piles with a PDA until the proposed pile driving methods and equipment has been preliminarily accepted. Notify the Engineer of the pile driving schedule a minimum of 7 calendar days in advance.

The Engineer will complete the review and acceptance of the proposed pile driving methods and equipment and provide the blows per foot and equivalent set for 10 blows for the required driving resistance within 10 calendar days after the Engineer receives the PDA report or the Engineer finishes PDA testing. A PDA report for or PDA testing on multiple piles may be required as determined by the Engineer before the 10 day time period begins.

1. Preparation

   Provide piles for PDA testing that are 5 ft (1.5 m) longer than the estimated pile lengths shown on the plans. Supply an AC electrical power source of a voltage and frequency suitable for computer equipment.

   Provide a shelter to protect the PDA equipment and operator from conditions of sun, water, wind and temperature. The shelter should have a minimum floor size of 6 ft by 6 ft (1.8 m by 1.8 m) and a minimum roof height of 8 ft (2.4 m). If necessary, heat or cool the shelter to maintain a temperature between 50 and 85 degrees F (10 and 30 degrees C). Place the shelter within 75 ft (23 m) of the pile such that the PDA cables reach the computer and the operator can clearly observe the pile. The Engineer may waive the shelter requirement if weather conditions allow.

   Drill up to a total of 16 bolt holes in either 2 or 4 sides of the pile, as directed by the PDA Consultant or Engineer, at an approximate distance equal to 3 times the pile diameter below the pile head. If the PDA Consultant or Engineer chooses to drill the bolt holes, provide the necessary equipment, tools and assistance to do so. A hammer drill is required for concrete piles. Allow for 2 hours per pile to drill holes.

   Lift, align and rotate the pile to be tested with a PDA as directed by the PDA Consultant or Engineer. Place the pile in the leads and template so that the PDA instruments and their accompanying wires will not be damaged. Attach PDA instruments as directed by the PDA Consultant or Engineer after the pile is placed in the leads and the template.

2. Testing

   Use only the preliminarily accepted pile driving methods and equipment to drive piles with the PDA instruments attached. Drive piles in accordance with this

provision and as directed by the PDA Operator or Engineer. The PDA Operator or Engineer may require the Contractor to modify the pile installation procedure during driving. Dynamic measurements will be recorded and used to evaluate the hammer performance, driving resistance and stresses, energy transfer, pile integrity and various soil parameters such as quake and damping.

If required, reattach the PDA instruments and restrike or redrive the pile in accordance with this provision. Obtain the required stroke and at least 6" (150 mm) of penetration as directed by the PDA Operator or Engineer. Dynamic measurements will be recorded during restriking and redriving. The Engineer will determine when PDA testing has been satisfactorily completed.

The Contractor is responsible in terms of both actual expense and time delays for any damage to the PDA instruments and supporting equipment due to the Contractor's fault or negligence. Replace any damaged equipment at no additional cost to the Department.

3. Analysis

When using a PDA Consultant, analyze data with the CAse Pile Wave Analysis Program (CAPWAP), version 2006 or later, manufactured by Pile Dynamics, Inc. At a minimum, analysis is required for a hammer blow near the end of initial drive and for each restrike and redrive. Additional CAPWAP analysis may be required as determined by the PDA Consultant or Engineer.

4. Report

When using a PDA Consultant, submit 2 copies of each PDA report within 7 calendar days of completing field testing. Include the following in PDA reports:

a. Title Sheet
   - NCDOT TIP number and WBS element number
   - Project description
   - County
   - Bridge station number
   - Pile location
   - Personnel
   - Report date

b. Introduction

c. Site and Subsurface Conditions (including water table elevation)

d. Pile Details

- Pile type and length
- Required driving resistance and resistance factor
- Concrete compressive strength and/or steel pile yield strength
- Pile splice type and locations
- Pile batter
- Installation methods including use of predrilling, spudding, vibratory hammer, template, barge, etc.

e. Driving Details
   - Hammer make, model and type
   - Hammer and pile cushion type and thickness
   - Pile helmet weight
   - Hammer efficiency and operation data including fuel settings, bounce chamber pressure, blows per minute, equipment volume and pressure
   - Ground or mud line elevation and template reference elevation at the time of driving
   - Final pile tip elevation
   - Driving data (ram stroke, blows per foot (0.3 meter) and set for last 10 hammer blows)
   - Restrike and redrive information

f. PDA Field Work Details

g. CAPWAP Analysis Results
   - Table showing percent skin and tip, skin and toe damping, skin and toe quake and match quality

h. Summary/Conclusions

i. Attachments
   - Boring log(s)
   - Pile driving equipment data form (from Contractor)
   - Field pile driving inspection data (from Engineer)
   - Accelerometer and strain gauge locations
   - Accelerometer and strain gauge serial numbers and calibration information
   - PDA hardware model and CAPWAP software version information
   - Electronic copy of all PDA data and executable CAPWAP input and output files

5.0 MEASUREMENT AND PAYMENT

_____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles* will be measured and paid for in linear feet (meters). Steel and prestressed concrete piles will be measured as the pile length before installation minus any pile cut-offs. No payment will be made for pile cut-offs or cutting off piles. No payment will be made for damaged, defective or rejected piles or any piles for falsework, bracing, templates or temporary work bridges. The contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles* will also be full compensation for driving piles.

Composite piles will be measured as the pile length of the prestressed concrete and steel H pile sections before installation minus any pile cut-offs. The concrete and steel sections will be measured and paid for at the contract unit prices for _____ *Prestressed Concrete Piles* and _____ *Steel Piles*, respectively. No payment will be made for portions of steel H pile sections embedded in prestressed concrete sections or steel pile splicers and any associated hardware or welding.

For driven piles, once the required resistance and pile penetration is achieved, the Contractor may drive the remaining portion of piles to grade in lieu of cutting off piles provided the remaining portions do not exceed 5 ft (1.5 m) and the piles can be driven without being damaged or reaching the maximum blow count or refusal. When this occurs, the additional length of piles driven will be measured and paid for at the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles.*

For prestressed concrete piles that are built up, the build-up will be measured and paid for at the contract unit price for _____ *Prestressed Concrete Piles.* Steel pile tips are not included in the measurement of prestressed concrete piles. No separate payment will be made for steel pile tips or splicers and any associated hardware or welding. Steel pile tips and steel pile splicers will be considered incidental to the contract unit price for _____ *Prestressed Concrete Piles.*

Steel Pile Points and *Pipe Pile Plates* will be measured and paid for in units of each. *Steel Pile Points* and *Pipe Pile Plates* will be measured as one per pile.

Predrilling for Piles will be measured and paid for in linear feet (meters). For bents with a predrilling pay item as shown on the substructure plans, predrilling will be paid for as *Predrilling for Piles* and measured per pile location as the depth from the ground or mud line to specified predrilling elevations or revised elevations approved by the Engineer. The contract unit price for *Predrilling for Piles* will also be full compensation for using temporary steel casings. For bents without a predrilling pay item as shown on the substructure plans, predrilling will be considered incidental to the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles.*

No direct payment will be made for spudding or using temporary steel casings for spudding. Spudding and using temporary steel casings for spudding will be considered incidental to the contract unit prices for _____ *Prestressed Concrete Piles*, _____ *Steel Piles* and _____ *Galvanized Steel Piles*.

Pile Redrives will be measured and paid for in units of each. *Pile Redrives* will be measured as the number of restrikes or redrives required by the Engineer. No payment will be made for restrikes or redrives when the Contractor chooses to restrike or redrive piles.

Pile Excavation in Soil and *Pile Excavation Not in Soil* will be measured and paid for in linear feet (meters). Pile excavation will be measured as the depth from the ground line to the specified elevations or revised elevations approved by the Engineer. Not in soil is defined as material with a rock auger penetration rate of less than 2" (50 mm) per 5 minutes of drilling at full crowd force. Once not in soil is encountered, seams, voids and weathered rock less than 3 ft (1 m) thick with a rock auger penetration rate of greater than 2" (50 mm) per 5 minutes of drilling at full crowd force will be paid for at the contract unit price for *Pile Excavation Not in Soil.* Seams, voids and weathered rock greater than 3 ft (1 m) thick will be paid for at the contract unit price for *Pile Excavation in Soil* where not in soil is no longer encountered. The contract unit prices for *Pile Excavation in Soil* and *Pile Excavation Not in Soil* will also be full compensation for stabilizing and filling holes with either concrete or flowable fill.

PDA Testing will be measured and paid for in units of each. No payment for *PDA Testing* will be made if the Engineer performs PDA testing. If the Engineer does not perform PDA testing, *PDA Testing* will be measured as one per pile. The contract unit price for *PDA Testing* will be full compensation for performing PDA testing the first time a pile is tested with a PDA, performing analysis on data collected during initial drive, restrikes and redrives and providing the PDA report. Subsequent PDA testing of the same piles will be considered incidental to the contract unit price for *Pile Redrives*.

PDA Assistance will be measured and paid for in units of each. *PDA Assistance* will be measured as one per pile. The contract unit price for *PDA Assistance* will be full compensation for the Contractor's assistance to perform the PDA testing during initial drive, restrikes and redrives.

Payment will be made under:

Pay Item	**Pay Unit**
_____ Prestressed Concrete Piles	Linear Foot (Meter)
_____ Steel Piles	Linear Foot (Meter)
_____ Galvanized Steel Piles	Linear Foot (Meter)
Steel Pile Points	Each
Pipe Pile Plates	Each
Predrilling for Piles	Linear Foot (Meter)

Pile Redrives	Each
Pile Excavation in Soil	Linear Foot (Meter)
Pile Excavation Not in Soil	Linear Foot (Meter)
PDA Testing	Each
PDA Assistance	Each