

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

**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

PROJ. REFERENCE NO. 33350.1.1 F.A. PROJ. BRSTP-401(13)  
 COUNTY WAKE  
 PROJECT DESCRIPTION BRIDGE NO. 63 ON -L- (US 401 SBL) OVER  
MIDDLE CREEK AT STATION 20+35.5

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**CAUTION NOTICE**

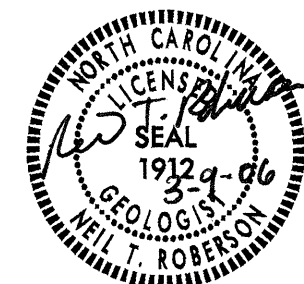
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**PROJECT: 33350.1.1**  
**ID: B-3916**

	PERSONNEL
INVESTIGATED BY <u>J. L. PEDRO</u>	<u>J. L. PEDRO</u>
CHECKED BY <u>N. T. ROBERSON</u>	<u>W. WHICHARD</u>
SUBMITTED BY <u>N. T. ROBERSON</u>	<u>D. KITCHEN</u>
DATE <u>MARCH 2006</u>	<u>R. BOYKIN</u>



DRAWN BY: J. L. PEDRO

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT

PROJECT REFERENCE NO. 33350.11(B-3916)	SHEET NO. 2
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## SUBSURFACE INVESTIGATION

### SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION	GRADATION	ROCK DESCRIPTION	TERMS AND DEFINITIONS
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: <i>VERY STIFF, GRAY, SILTY CLAY, MOST WITH INTERBEDDED FINE SAND LAYERS, HIGH PLASTIC, A-7-6</i>	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.	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 YIELD 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.	<b>ALLUVIUM (ALLUV.)</b> - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. <b>AQUIFER</b> - A WATER BEARING FORMATION OR STRATA. <b>ARENACEOUS</b> - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. <b>ARGILLACEOUS</b> - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC. <b>ARTESIAN</b> - 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. <b>CALCAREOUS (CALC.)</b> - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. <b>COLLUVIUM</b> - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. <b>CORE RECOVERY (REC.)</b> - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. <b>DIKE</b> - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. <b>DIP</b> - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. <b>DIP DIRECTION (DIP AZIMUTH)</b> - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. <b>FAULT</b> - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. <b>FISSILE</b> - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. <b>FLOAT</b> - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL. <b>FLOOD PLAIN (FP)</b> - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM. <b>FORMATION (FM)</b> - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD. <b>JOINT</b> - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED. <b>LEDGE</b> - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT. <b>LENS</b> - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS. <b>MOTTLED (MOT.)</b> - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE. <b>PERCHED WATER</b> - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM. <b>RESIDUAL (RES.) SOIL</b> - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK. <b>ROCK QUALITY DESIGNATION (RQD)</b> - 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. <b>SAPROLITE (SAP.)</b> - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK. <b>SILL</b> - 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. <b>SLICKENSIDE</b> - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE. <b>STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT)</b> - 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. <b>STRATA CORE RECOVERY (SCREC)</b> - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE. <b>STRATA ROCK QUALITY DESIGNATION (SROD)</b> - 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. <b>TOPSOIL (TS)</b> - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.
<b>SOIL LEGEND AND AASHTO CLASSIFICATION</b>	<b>MINERALOGICAL COMPOSITION</b>	<b>WEATHERING</b>	
GENERAL CLASS. GRANULAR MATERIALS (<= 35% PASSING #200) SILT-CLAY MATERIALS (> 35% PASSING #200) ORGANIC MATERIALS	MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.	FRESH ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING, ROCK RINGS UNDER HAMMER IF CRYSTALLINE. VERY SLIGHT (V SL.) 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 (SL.) 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. <i>IF TESTED, WOULD YIELD SPT REFUSAL</i> 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. <i>IF TESTED, YIELDS SPT N VALUES &gt; 100 BPF</i> 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. <i>IF TESTED, YIELDS SPT N VALUES &lt; 100 BPF</i> COMPLETE ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. ORGANIC MATTER MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.	
GROUP CLASS. A-1 A-2 A-3 A-4 A-5 A-6 A-7 A-1, A-2 A-3 A-4, A-5 A-6, A-7	<b>COMPRESSIBILITY</b> SLIGHTLY COMPRESSIBLE LIQUID LIMIT LESS THAN 31 MODERATELY COMPRESSIBLE LIQUID LIMIT EQUAL TO 31-50 HIGHLY COMPRESSIBLE LIQUID LIMIT GREATER THAN 50	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. ORGANIC MATTER MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.	
SYMBOL	<b>PERCENTAGE OF MATERIAL</b>		
% PASSING #10 #40 #200	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		
LIQUID LIMIT PLASTIC INDEX	<b>GROUND WATER</b>		
GROUP INDEX	WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING STATIC WATER LEVEL AFTER 24 HOURS PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA SPRING OR SEEP		
USUAL TYPES OF MAJOR MATERIALS	<b>MISCELLANEOUS SYMBOLS</b>		
GEN. RATING AS A SUBGRADE	ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION SOIL SYMBOL ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT INFERRED SOIL BOUNDARY INFERRED ROCK LINE ALLUVIAL SOIL BOUNDARY DIP & DIP DIRECTION OF ROCK STRUCTURES SOUNDING ROD		
PI OF A-7-5 SUBGROUP IS <= LL - 30 ; PI OF A-7-6 SUBGROUP IS >= LL - 30			
<b>CONSISTENCY OR DENSENESS</b>			
PRIMARY SOIL TYPE COMPACTNESS OR CONSISTENCY RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE) RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT <sup>2</sup> )			
GENERALLY GRANULAR MATERIAL (NON-COHESIVE) VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE			
GENERALLY SILT-CLAY MATERIAL (COHESIVE) VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD			
<b>TEXTURE OR GRAIN SIZE</b>			
U.S. STD. SIEVE SIZE OPENING (MM) 4 10 40 60 200 270			
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 0.075 0.005			
<b>SOIL MOISTURE - CORRELATION OF TERMS</b>			
SOIL MOISTURE SCALE (ATTERBERG LIMITS) FIELD MOISTURE DESCRIPTION GUIDE FOR FIELD MOISTURE DESCRIPTION			
LL LIQUID LIMIT - SATURATED - (SAT) USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE			
PL PLASTIC LIMIT - WET - (W) SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE			
OM OPTIMUM MOISTURE - MOIST - (M) SOLID; AT OR NEAR OPTIMUM MOISTURE			
SL SHRINKAGE LIMIT - DRY - (D) REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE			
<b>PLASTICITY</b>			
NONPLASTIC LOW PLASTICITY MED. PLASTICITY HIGH PLASTICITY			
<b>COLOR</b>			
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.			
	<b>ABBREVIATIONS</b>		
	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 HL - HIGHLY MED. - MEDIUM MICA. - MICAEOUS 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 % - UNIT WEIGHT % - DRY UNIT WEIGHT		
	<b>EQUIPMENT USED ON SUBJECT PROJECT</b>		
	DRILL UNITS: MOBILE B- BK-51 CME-45C CME-550 PORTABLE HOIST OTHER CME-55 OTHER ADVANCING TOOLS: CLAY BITS 6" CONTINUOUS FLIGHT AUGER 8" HOLLOW AUGERS HARD FACED FINGER BITS TUNG-CARBIDE INSERTS CASING w/ ADVANCER TRICONE *STEEL TEETH TRICONE *TUNG-CARB. CORE BIT OTHER HAMMER TYPE: AUTOMATIC MANUAL CORE SIZE: B N H HAND TOOLS: POST HOLE DIGGER HAND AUGER SOUNDING ROD VANE SHEAR TEST OTHER		
	<b>FRACTURE SPACING</b>	<b>BEDDING</b>	
	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	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	<b>BENCH MARK:</b> BL-2 AT -L- STA. 19+39.31, OFFSET 73.3' RT ELEVATION: 261.54 FT.
	<b>INDURATION</b>		
	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.		
	<b>NOTES:</b>		



STATE OF NORTH CAROLINA  
DEPARTMENT OF TRANSPORTATION

MICHAEL F. EASLEY  
GOVERNOR

LYNDO TIPPETT  
SECRETARY

March 9, 2006

STATE PROJECT: 33350.1.1 (B-3916)  
F.A. PROJECT: BRSTP-401 (13)  
COUNTY: Wake  
DESCRIPTION: Bridge No. 63 on -L- (US 401 SBL) over Middle Creek at  
Station 20+35.5  
SUBJECT: Geotechnical Report – Structure Inventory

**Project Description**

A three-span bridge, 171-feet in length with a 90° skew, is proposed on -L- (US 401 SBL) over Middle Creek to replace the existing structure. The new bridge will be 72 feet longer than the existing structure. Also, a detour bridge will be constructed 62 feet upstream of the existing bridge. The project is located in southern central Wake County approximately 5 miles northeast of the town of Fuquay-Varina.

The subsurface investigation was conducted during February of 2006 using an ATV-mounted CME-55 drill machine. Two Standard Penetration Test borings were performed at each of the four bent locations, and two borings were completed at the detour end bent locations. All borings were advanced until weathered rock or crystalline rock was encountered. Representative soil samples were obtained for visual classification in the field and selected samples were sent to the Materials and Tests Unit for laboratory analysis. One Shelby tube sample was collected and submitted to the Materials and Tests Unit to be used in an Erosion Function Apparatus.

**Physiography and Geology**

The project is located in gently rolling terrain of the Piedmont Physiographic province. The area is rural, with single-family homes and businesses. The area along Middle Creek is wooded. Geologically, the project is located within the Raleigh Belt and is underlain by felsic mica gneiss.

**Soil Properties**

Soils encountered at the project site include roadway embankment, alluvial, and residual soils.

Roadway embankment soils are present at both End Bent locations and are approximately 12.5 feet thick. The upper section of the embankment ranges from 3.0 to 5.0 feet, and consists of asphalt and ABC with brown, loose to very dense, dry, sand (A-1-a). The lower portion of the embankment consists of red-brown,

soft to medium stiff, moist, silty clay (A-7-6). Embankment soils are underlain by alluvial soils at both End Bents.

Alluvial soils range from 7.8 to 10.2 feet in thickness. These soils predominantly consist of gray, soft to stiff, moist to wet, sandy silt (A-4) and gray and brown, very loose to very dense, moist to wet, silty and coarse sand (A-1-a, A-1-b, and A-2-4) with quartz gravel. Other alluvial soils present are brown to gray, very soft, moist to wet, sandy clay (A-6). The alluvial soils were deposited on residual soil and weathered rock.

Residual soils were encountered at all bent locations. They range from 1.5 to 11.0 feet in thickness. The residual soils consist of green-gray and white, hard, moist, saprolitic, sandy silt (A-4) with weathered rock fragments. The residual soils grade into weathered rock with increasing depth.

**Rock Properties**

Weathered rock was derived from the underlying felsic mica gneiss and ranges in thickness from 4.5 feet to over 34.0 feet. Weathered rock was encountered at all bent locations and contains several crystalline rock lenses. The top of weathered rock ranges in elevation from 229.9 feet at EB2-B to 241.3 feet at B2-A, B2-B, and EB1-A.

Crystalline rock was encountered at each boring location, but the EB1-B and EB2-B borings terminate in weathered rock with crystalline rock lenses. The top of crystalline rock ranges in elevation from 198.9 feet at B2-B to 236.8 feet at EB2-A. The rock consists of green-gray and white, severely to moderately weathered, moderately hard, fractured, micaceous, felsic mica gneiss.

**Groundwater**

Groundwater was encountered in all of the borings. The groundwater elevations range from 247.3 feet at B1-B to 250.5 feet at EB2-A. Surface water in Middle Creek was at elevation 247.9 feet (2-23-06).

**Temporary Detour Structure**

A temporary detour structure will be constructed approximately 62 feet northwest of the existing bridge at -DET- Station 16+80. The structure has a total length of 160 feet. Borings EB1-C and EB2-C were drilled along the -DET- alignment to provide additional information for the detour structure. Geologic conditions along the detour alignment correlate directly to those encountered along the main line structure.

**Notice**

This Geotechnical foundation report is based on the bridge survey report for Middle Creek dated June 20, 2005 and the Preliminary General Drawing dated October 25, 2005. If significant changes are made in the design or location of the proposed structure, the subsurface information should be reviewed and modified as necessary.

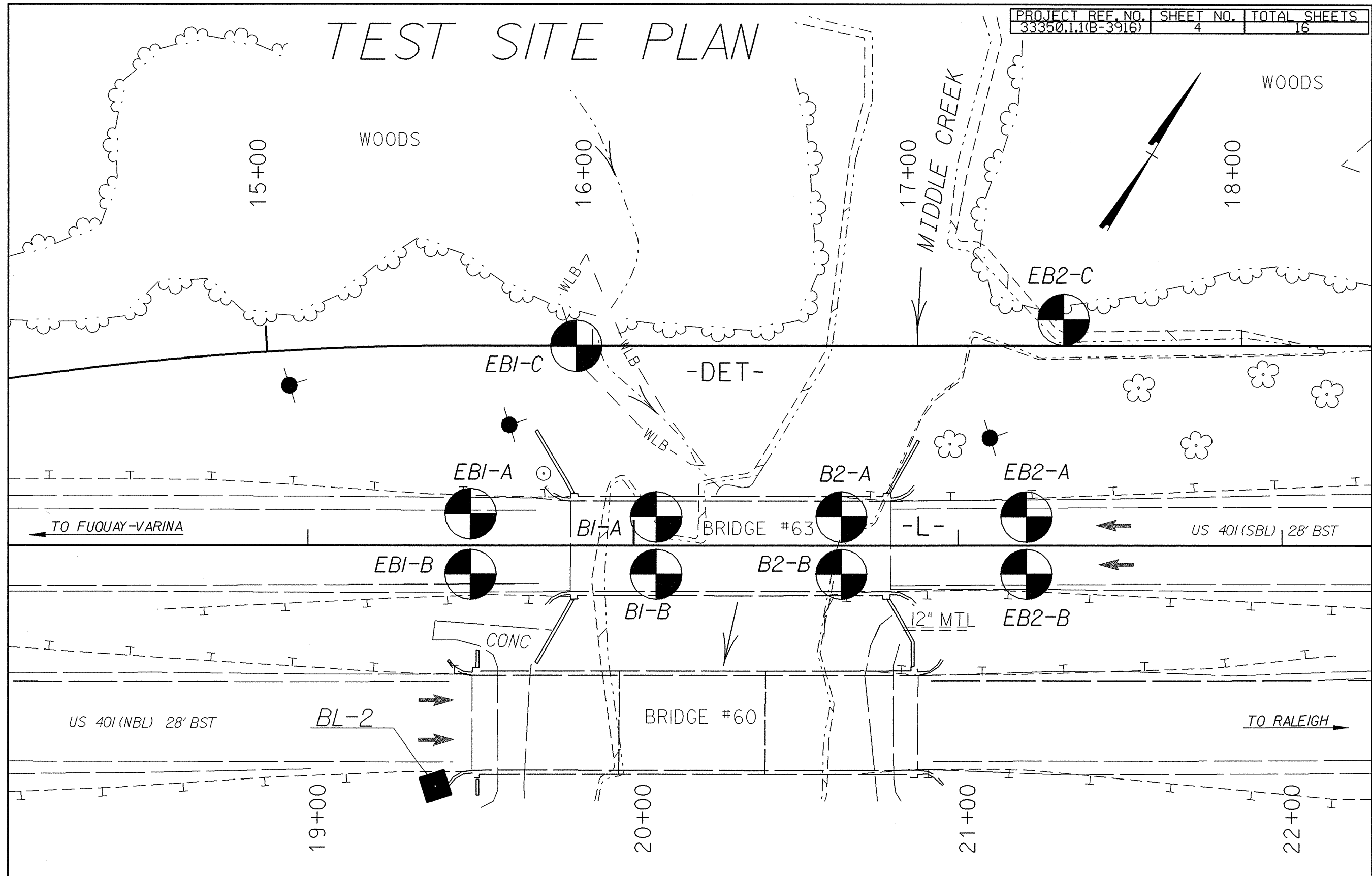
Prepared by,

Handwritten signature of Jaime Love Pedro in cursive.

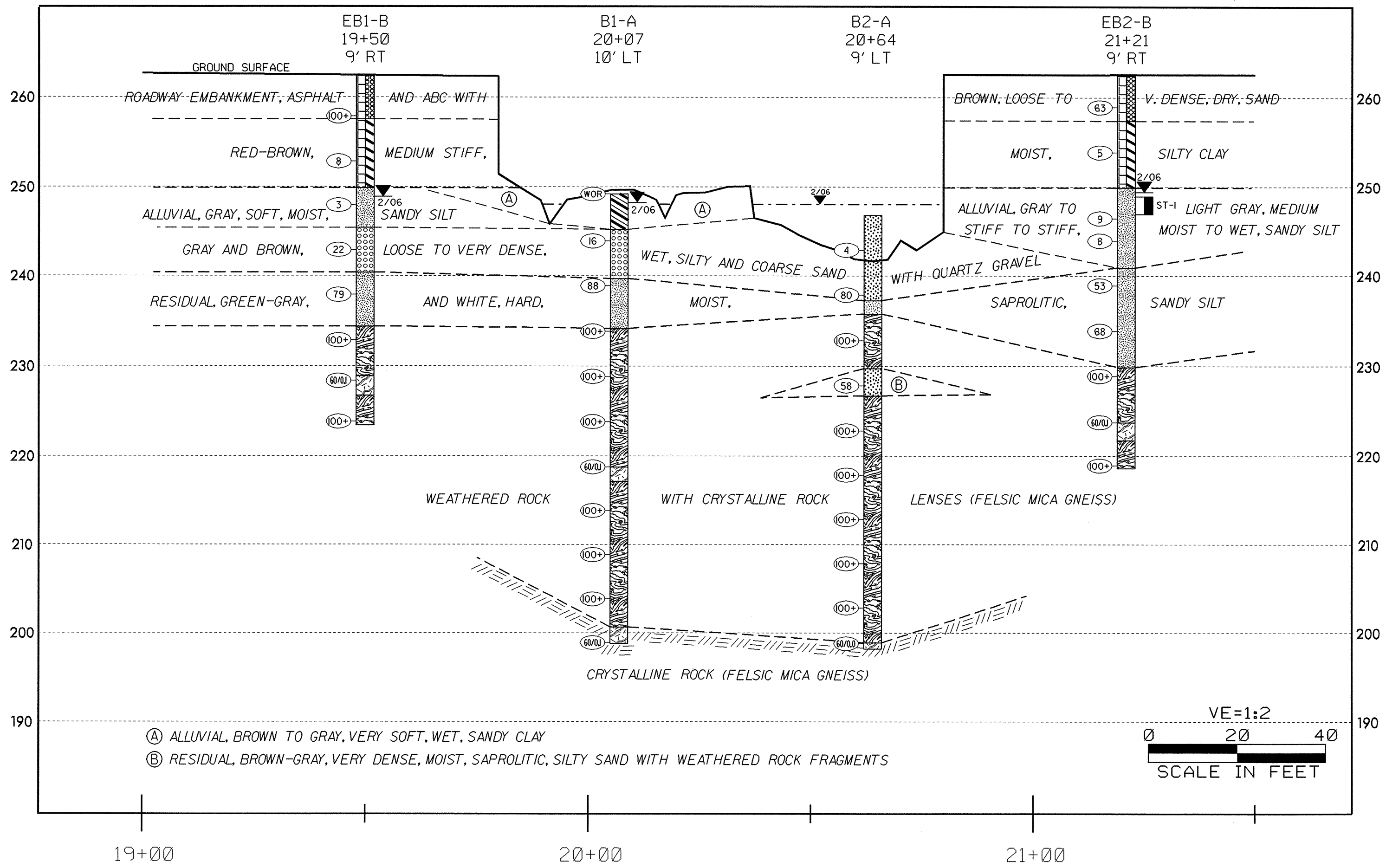
Jaime Love Pedro  
Engineering Geologist

# TEST SITE PLAN

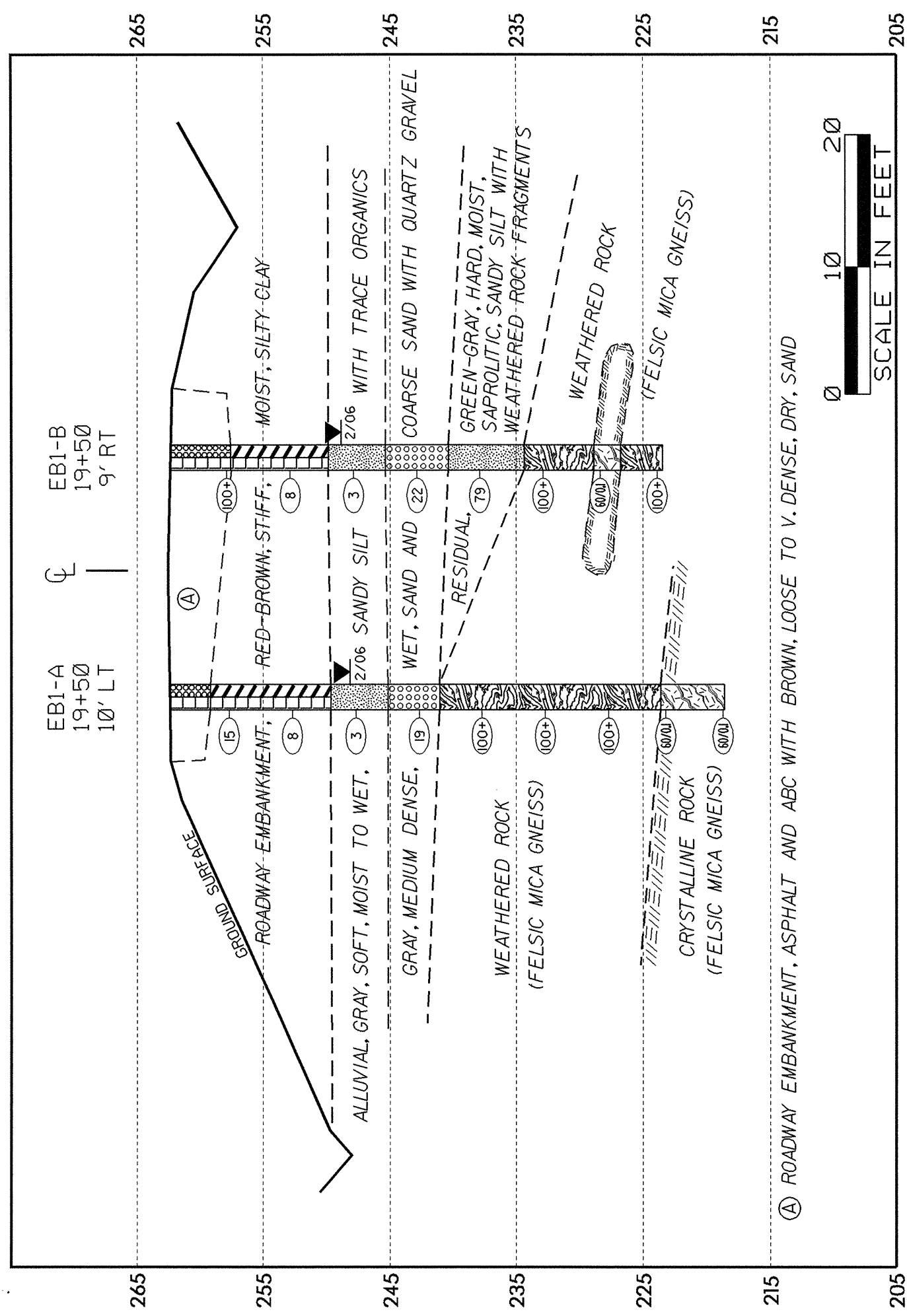
PROJECT REF. NO.	SHEET NO.	TOTAL SHEETS
33350.1.1(B-3916)	4	16



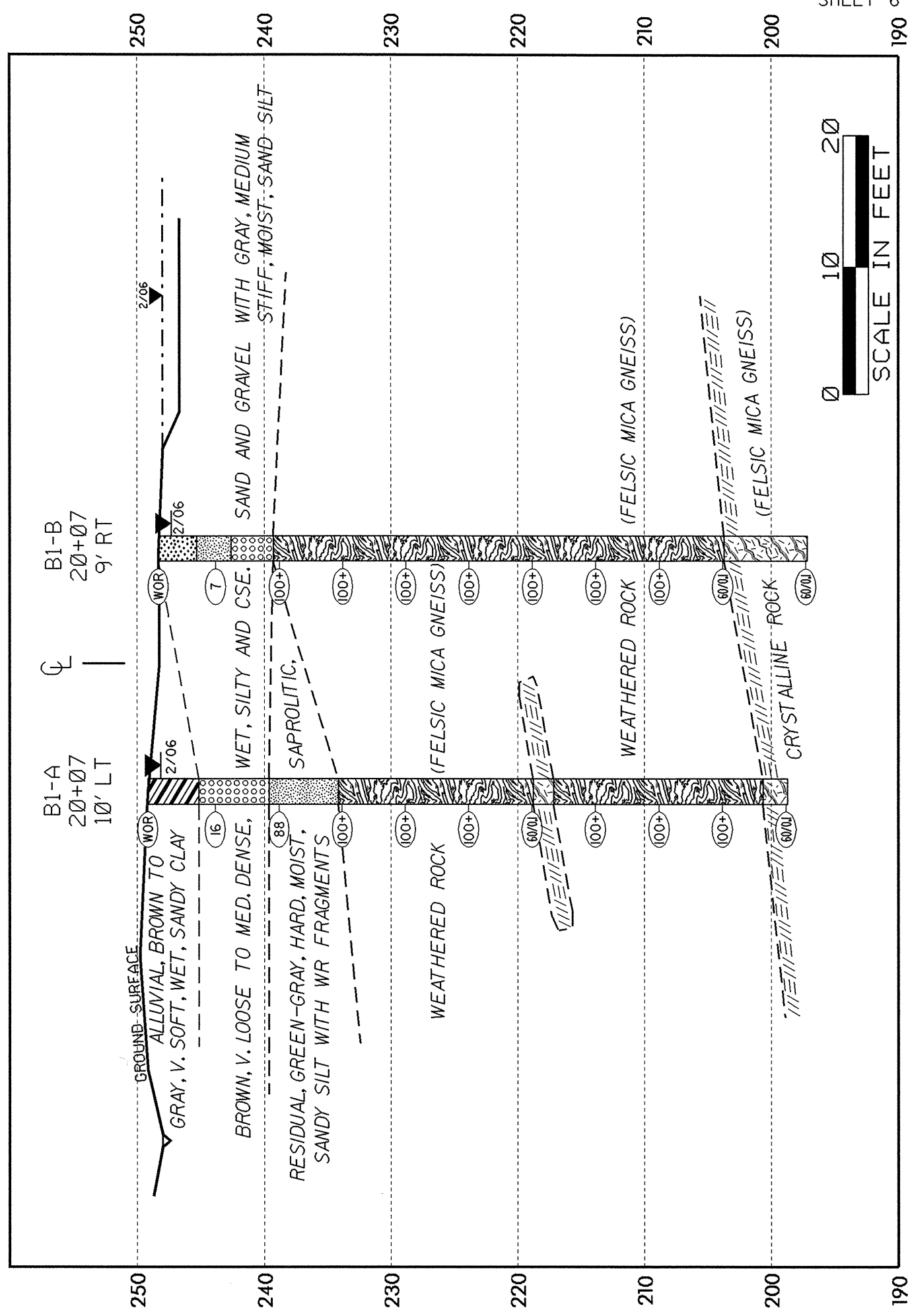
# PROFILE THROUGH BORINGS PROJECTED ALONG -L-



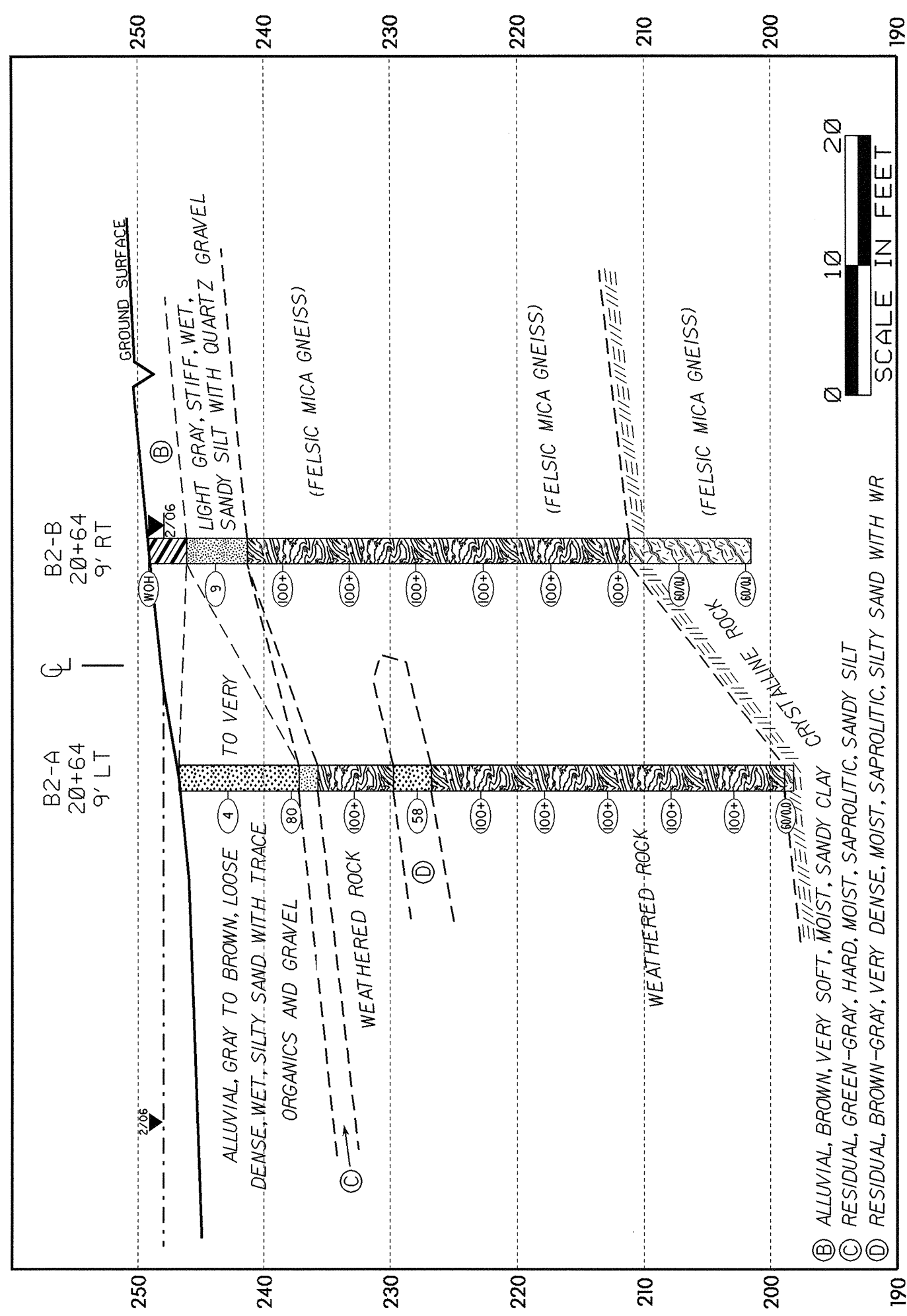
CROSS SECTION THROUGH END BENT I



CROSS SECTION THROUGH BENT I

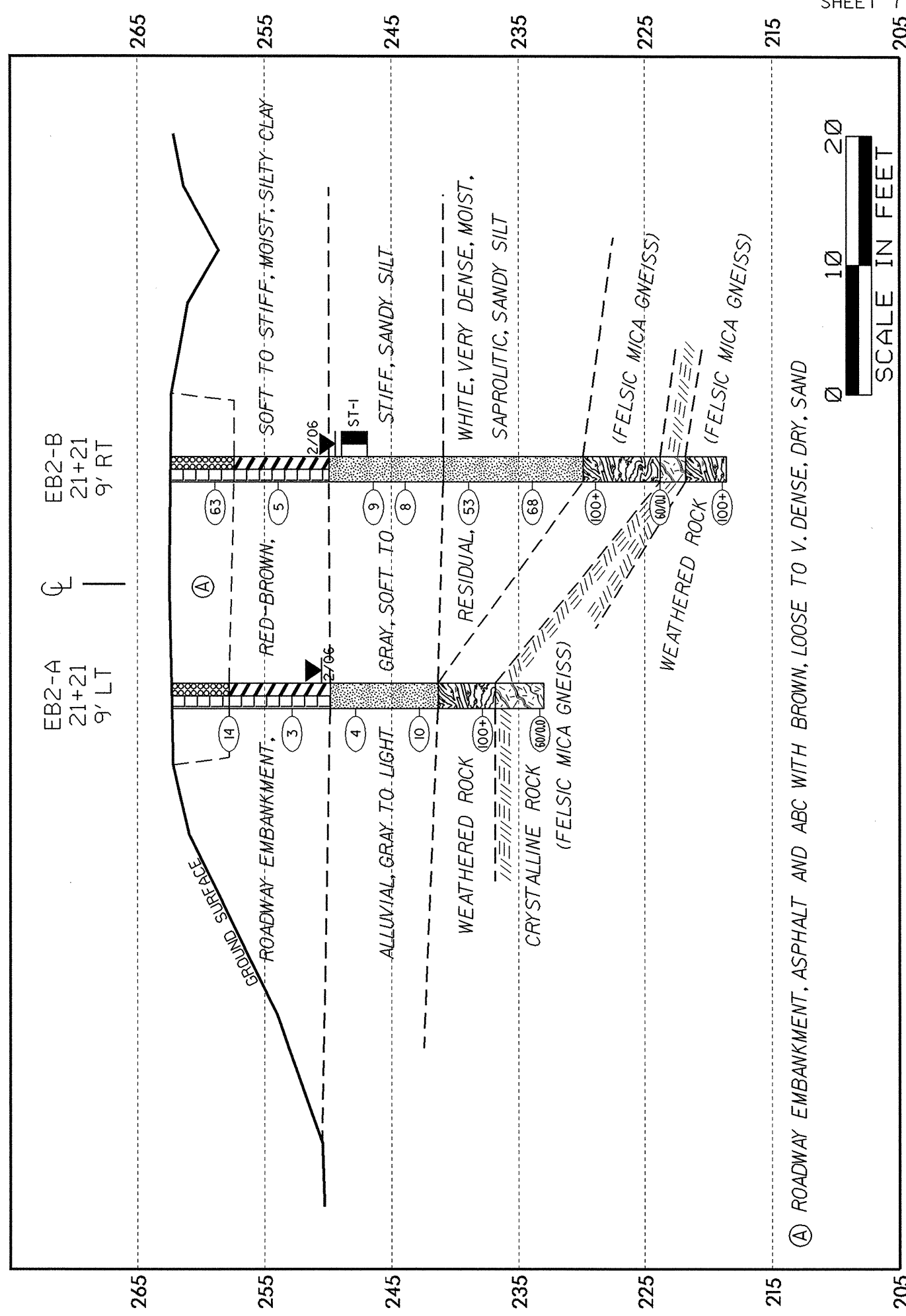


CROSS SECTION THROUGH BENT 2



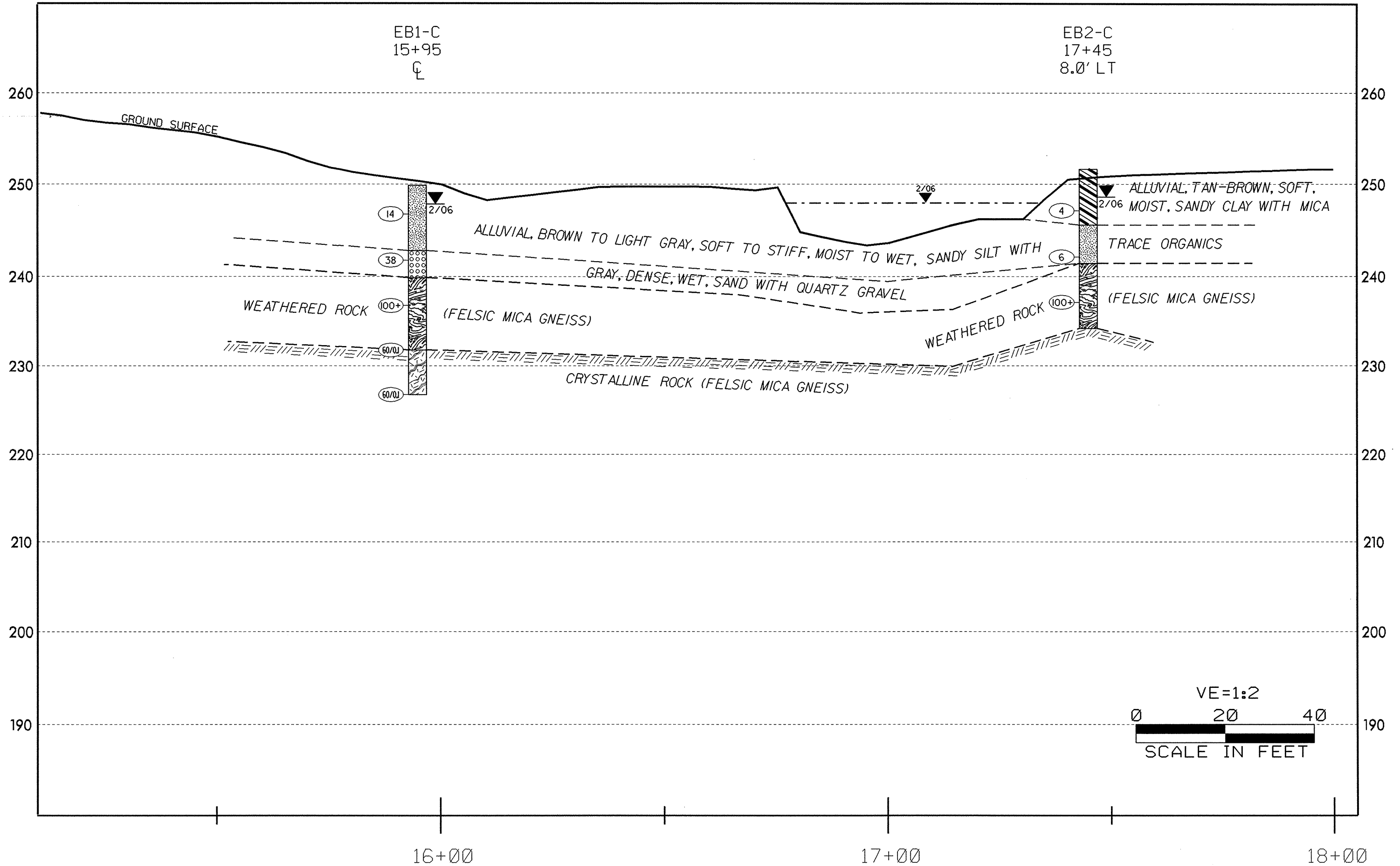
- ⓑ ALLUVIAL, BROWN, VERY SOFT, MOIST, SANDY CLAY
- ⓒ RESIDUAL, GREEN-GRAY, HARD, MOIST, SAPROLITIC, SANDY SILT
- ⓓ RESIDUAL, BROWN-GRAY, VERY DENSE, MOIST, SAPROLITIC, SILTY SAND WITH WR

CROSS SECTION THROUGH END BENT 2



- ⓐ ROADWAY EMBANKMENT, ASPHALT AND ABC WITH BROWN, LOOSE TO V. DENSE, DRY, SAND

PROFILE THROUGH BORINGS PROJECTED ALONG -DET-











NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 GEOTECHNICAL UNIT BORING LOG

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 GEOTECHNICAL UNIT BORING LOG

PROJECT NO. 33350.1.1	ID. B-3916	COUNTY WAKE	GEOLOGIST J. L. PEDRO
SITE DESCRIPTION BRIDGE NO. 63 ON -L- (US 401SBL) OVER MIDDLE CREEK			GROUND WATER
BORING NO. EB2-A	BORING LOCATION 21+21	OFFSET 9' LT	ALIGNMENT -L-
COLLAR ELEVATION 262.3'	NORTHING 685195	EASTING 2084447	
TOTAL DEPTH 29.3'	DRILL MACHINE CME-55	DRILL METHOD H.S. AUGERS	HAMMER TYPE MANUAL
START DATE 2/14/06	COMPLETION DATE 2/14/06	SURFACE WATER DEPTH N/A	DEPTH TO ROCK 25.5'

ELEV. (FT.)	DEPTH (FT.)	BLOW COUNT			PEN. (FT.)	BLOWS PER FOOT					SAMPLE NUMBER	LOG	SOIL AND ROCK DESCRIPTION	
		0.5'	0.5'	0.5'		0	25	50	75	100				
262.3														ROADWAY EMBANKMENT, ASPHALT TO 0.9' AND ABC WITH BROWN, SAND
260.0	3.5	6	9	5	1.0									
255.0	8.5	2	2	1	1.0									RED-BROWN, SILTY CLAY
250.0	13.5	2	2	2	1.0									
245.0	18.5	4	5	5	1.0									ALLUVIAL, GRAY TO LIGHT GRAY, SANDY SILT
240.0	23.5	40	60		0.7									WEATHERED ROCK (FELSIC MICA GNEISS)
235.0	28.5	60			0.0									CRYSTALLINE ROCK (FELSIC MICA GNEISS)
230.0														AUGER REFUSAL AT ELEVATION 233.0 FEET IN CRYSTALLINE ROCK (FELSIC MICA GNEISS)

PROJECT NO. 33350.1.1	ID. B-3916	COUNTY WAKE	GEOLOGIST J. L. PEDRO
SITE DESCRIPTION BRIDGE NO. 63 ON -L- (US 401SBL) OVER MIDDLE CREEK			GROUND WATER
BORING NO. EB2-B	BORING LOCATION 21+21	OFFSET 9' RT	ALIGNMENT -L-
COLLAR ELEVATION 262.4'	NORTHING 685190	EASTING 2084464	
TOTAL DEPTH 43.8'	DRILL MACHINE CME-55	DRILL METHOD H.S. AUGERS	HAMMER TYPE MANUAL
START DATE 2/15/06	COMPLETION DATE 2/15/06	SURFACE WATER DEPTH N/A	DEPTH TO ROCK N/A

ELEV. (FT.)	DEPTH (FT.)	BLOW COUNT			PEN. (FT.)	BLOWS PER FOOT					SAMPLE NUMBER	LOG	SOIL AND ROCK DESCRIPTION	
		0.5'	0.5'	0.5'		0	25	50	75	100				
262.4														ROADWAY EMBANKMENT, ASPHALT TO 0.7' AND ABC WITH BROWN, SAND
260.0	3.5	5	31	32	1.0									
255.0	8.5	2	3	2	1.0									RED-BROWN, SILTY CLAY
250.0	13.5	2	2	2	1.0									
245.0	18.5	4	5	5	1.0									ALLUVIAL, GRAY TO LIGHT GRAY, SANDY SILT WITH TRACE ORGANICS
240.0	23.5	24	30	23	1.0									RESIDUAL, WHITE, SAPROLITIC, SANDY SILT
235.0	28.5	17	35	33	1.0									
230.0	33.5	100			0.3									WEATHERED ROCK (FELSIC MICA GNEISS)
225.0	38.5	60			0.1									CRYSTALLINE ROCK (FELSIC MICA GNEISS)
220.0	43.5	100			0.3									WEATHERED ROCK (FELSIC MICA GNEISS)
215.0														BORING TERMINATED AT ELEVATION 218.6 FEET IN WEATHERED ROCK (FELSIC MICA GNEISS)

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 GEOTECHNICAL UNIT BORING LOG

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
 GEOTECHNICAL UNIT BORING LOG

PROJECT NO. 33350.I.I		ID. B-3916		COUNTY WAKE		GEOLOGIST J. L. PEDRO							
SITE DESCRIPTION BRIDGE NO. 63 ON -L- (US 401SBL) OVER MIDDLE CREEK							GROUND WATER						
BORING NO. EBI-C		BORING LOCATION 15+95		OFFSET CL		ALIGNMENT -DET-							
COLLAR ELEVATION 249.9'		NORTHING 685079		EASTING 2084355		DEPTH TO ROCK 18.1'							
TOTAL DEPTH 23.1'		DRILL MACHINE CME-55		DRILL METHOD H.S. AUGERS		HAMMER TYPE MANUAL							
START DATE 2/14/06		COMPLETION DATE 2/14/06		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 18.1'							
ELEV. (FT.)	DEPTH (FT.)	BLOW COUNT			PEN. (FT.)	BLOWS PER FOOT				SAMPLE NUMBER	LOG	SOIL AND ROCK DESCRIPTION	
		0.5'	0.5'	0.5'		0	25	50	75				100
249.9	3.0	3	7	7	1.0						S-9 SS-10	M	ALLUVIAL, BROWN TO LIGHT GRAY, SANDY SILT
245.0	8.0	11	20	18	1.0						SS-II	W	GRAY, SAND AND QUARTZ GRAVEL
240.0	13.0	100			0.4				100+				WEATHERED ROCK (FELSIC MICA GNEISS)
235.0	18.0	60			0.1				60/0.1*				CRYSTALLINE ROCK (FELSIC MICA GNEISS)
230.0	23.0	60			0.1				60/0.1*				CRYSTALLINE ROCK (FELSIC MICA GNEISS)
SPT REFUSAL AT ELEVATION 226.8 FEET ON CRYSTALLINE ROCK (FELSIC MICA GNEISS)													

PROJECT NO. 33350.I.I		ID. B-3916		COUNTY WAKE		GEOLOGIST J. L. PEDRO							
SITE DESCRIPTION BRIDGE NO. 63 ON -L- (US 401SBL) OVER MIDDLE CREEK							GROUND WATER						
BORING NO. EB2-C		BORING LOCATION 17+45		OFFSET 8' LT		ALIGNMENT -DET-							
COLLAR ELEVATION 251.6'		NORTHING 685224		EASTING 2084392		DEPTH TO ROCK 17.4'							
TOTAL DEPTH 17.4'		DRILL MACHINE CME-55		DRILL METHOD H.S. AUGERS		HAMMER TYPE MANUAL							
START DATE 2/13/06		COMPLETION DATE 2/13/06		SURFACE WATER DEPTH N/A		DEPTH TO ROCK 17.4'							
ELEV. (FT.)	DEPTH (FT.)	BLOW COUNT			PEN. (FT.)	BLOWS PER FOOT				SAMPLE NUMBER	LOG	SOIL AND ROCK DESCRIPTION	
		0.5'	0.5'	0.5'		0	25	50	75				100
251.6													
250.0	3.5	2	1	3	1.0						SS-I	M	ALLUVIAL, TAN-BROWN, SANDY CLAY
245.0	8.5	2	3	3	1.0						SS-2	W	GRAY, SANDY SILT WITH TRACE ORGANICS
240.0	13.5	100			0.3				100*				WEATHERED ROCK (FELSIC MICA GNEISS)
AUGER REFUSAL AT ELEVATION 234.2 FEET ON CRYSTALLINE ROCK (FELSIC MICA GNEISS)													

**EB1-A**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-6	10' LT	19+50	3.5-5.0	A-7-6(16)	50	21	8.4	21.4	29.4	40.8	95	90	73	-	-
SS-7	10' LT	19+50	13.5-15.0	A-4(1)	23	4	0.6	36.7	40.2	22.4	100	100	76	26.2	-
SS-8	10' LT	19+50	18.5-20.0	A-1-b(0)	21	NP	57.1	33.7	5.1	4.1	61	42	7	-	-

**EB1-B**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-12	9' RT	19+50	13.5-15.0	A-4(2)	24	5	0.8	30.8	45.9	22.4	100	100	80	-	-
SS-13	9' RT	19+50	18.5-20.0	A-1-b(0)	19	NP	45.1	41.6	9.2	4.1	53	40	9	-	-
SS-14	9' RT	19+50	23.5-25.0	A-4(0)	27	5	25.7	29.0	37.1	8.2	93	75	52	-	-

**B1-A**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-17	10' LT	20+07	0.0-1.5	A-6(6)	36	11	5.3	39.8	34.5	20.4	100	99	64	-	-
SS-18	10' LT	20+07	5.3-6.8	A-1-a(0)	32	NP	61.6	20.0	12.2	6.1	31	16	7	-	-
SS-19	10' LT	20+07	10.3-11.8	A-4(0)	28	NP	30.0	42.7	23.3	4.1	90	71	36	-	-

**B1-B**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-23	9' RT	20+07	0.0-1.5	A-2-4(0)	30	NP	26.9	49.6	17.3	6.1	100	95	28	-	-
SS-24	9' RT	20+07	4.5-5.7	A-4(0)	23	3	12.9	40.2	24.5	22.4	96	91	54	27.0	-

**B2-A**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-21	9' LT	20+64	2.9-4.4	A-2-4(0)	23	NP	25.9	45.7	20.2	8.2	100	92	35	-	-
SS-22	9' LT	20+64	17.9-19.4	A-2-4(0)	26	NP	38.6	32.7	24.7	4.1	93	67	35	-	-

**B2-B**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-20	9' RT	20+64	0.0-1.5	A-6(8)	37	14	9.6	30.6	35.3	24.5	100	96	68	-	-

**EB2-A**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-3	9' LT	21+21	3.5-5.0	A-7-6(14)	45	20	6.7	26.1	24.3	42.9	98	94	72	-	-
SS-4	9' LT	21+21	13.5-15.0	A-4(7)	29	9	2.0	22.9	42.4	32.7	100	99	86	-	-
SS-5	9' LT	21+21	18.5-20.0	A-4(0)	22	4	1.4	44.7	35.5	18.4	100	100	63	-	-

**EB2-B**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-15	9' RT	21+21	8.5-10.0	A-7-6(13)	45	19	9.4	23.9	25.9	40.8	96	91	70	-	-
ST-1	9' RT	21+21	13.5-15.5	A-4(0)											
SS-16	9' RT	21+21	23.5-25.0	A-4(0)	26	NP	11.0	36.3	42.4	10.2	100	93	68	-	-

**EB1-C-Det-**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
S-9	CL	15+95	1.0-2.0	A-4(1)	24	4	1.6	41.4	36.5	20.4	100	100	71	-	-
SS-10	CL	15+95	3.0-4.5	A-4(0)	22	2	2.9	43.9	39.0	14.3	100	100	67	-	-
SS-11	CL	15+95	8.0-9.5	A-1-a(0)	21	NP	48.6	30.8	14.5	6.1	37	24	10	-	-

**EB2-C-Det-**

<b>SOIL TEST RESULTS</b>															
SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	AASHTO CLASS.	L.L.	P.I.	% BY WEIGHT				% PASSING (SIEVES)			% MOISTURE	% ORGANIC
							C.SAND	F.SAND	SILT	CLAY	10	40	200		
SS-1	8' LT	17+45	3.5-5.0	A-6(9)	33	11	0.6	22.7	44.1	32.7	100	100	88	-	-
SS-2	8' LT	17+45	8.5-10.0	A-4(2)	25	5	2.2	35.9	39.4	22.4	100	99	75	-	-



**FIELD  
SCOUR REPORT**

WBS: 33350.1.1 TIP: B-3916 COUNTY: Wake

DESCRIPTION(1): Bridge No. 63 on -L- (US 401 SBL) over Middle Creek

**EXISTING BRIDGE**

Information from: Field Inspection  Microfilm \_\_\_\_\_ (reel \_\_\_\_\_ pos: \_\_\_\_\_)  
Other (explain) \_\_\_\_\_

Bridge No.: 63 Length: 98.7' Total Bents: 3 Bents in Channel: 2 Bents in Floodplain: 1  
Foundation Type: Concrete Piles

**EVIDENCE OF SCOUR(2)**

Abutments or End Bent Slopes: End Bent 1 has none, End Bent 2 is being undermined on the left

Interior Bents: Some local scour at interior bent, less than 5 feet

Channel Bed: None

Channel Bank: Very little

**EXISTING SCOUR PROTECTION**

Type(3): Concrete abutment walls at End Bents and Interior Bent is concrete

Extent(4): End Bent walls 78' wide by 12' high

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 geotechnically adjusted scour elevation (GASE) 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 theoretical scour and the GASE. If the GASE is dependent on scour counter measures, explain (e.g. rip rap armoring on slopes). The GASE 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): Alluvial, gray and brown, very loose to med. dense, cse. sand and gravel (SS-18)

Channel Bank Material(8): Alluvial, gray, medium stiff, sandy silt (SS-24)

Channel Bank Cover(9): Grass, trees, and brush

Floodplain Width(10): +/- 250 feet

Floodplain Cover(11): Grass, trees, and brush

Stream is(12): Aggrading \_\_\_\_\_ Degrading  Static \_\_\_\_\_

Channel Migration Tend.(13): West towards End Bent 2

Observations and Other Comments: \_\_\_\_\_

**GEOTECHNICALLY ADJUSTED SCOUR ELEVATIONS(14)** Feet  Meters \_\_\_\_\_

BENT 1 = 236.0 ft

BENT 2 = 232.0 ft

Comparison of GASE to Hydraulics Unit theoretical scour:

The GASE for Bent 1 is 3.8 feet higher than the theoretical scour, and Bent 2 is 24.5 feet higher than the theoretical scour from the Hydraulics Report (dated 6-20-05).

**SOIL ANALYSIS RESULTS FROM CHANNEL BED AND BANK MATERIAL**

Bed or Bank	Bed	Bank					
Sample No.	SS-18	SS-24					
Retained #4	59	-					
Passed #10	31	96					
Passed #40	16	91					
Passed #200	7	54					
Coarse Sand	61.6	12.9					
Fine Sand	20	40.2					
Silt	12.2	24.5					
Clay	6.1	22.4					
LL	32	23					
PI	NP	3					
AASHTO	A-1-a(0)	A-4(0)					
Station	20+07	20+07					
Offset	10' LT	9' RT					
Depth	5.3'-6.8'	4.5'-5.2'					

Reported by: *Jaime Love Pedro*

Date: 2-13-06

# SITE PHOTOGRAPH

Bridge No. 63 on -L- (US 401 SBL) over Middle Creek

