



March 24, 2020

Mr. John Pilipchuk, LG, PE and Ms. Christina Bruinsma, PG
Geotechnical Engineering Unit
North Carolina Department of Transportation
1020 Birch Ridge Drive
Raleigh, NC 27610

RE: REPORT ON GEOPHYSICAL STUDY
Proposed Retaining Wall Location by Buffalo Creek, Warrensville, NC
ESP Project No. GR22.323

WBS Number: 67002.1.1
TIP Number: BR-0002
Project ID: 35254
County: ASHE
Description: Replace Bridge No. 040008 over North Fork New River on NC194
Site Description: Retaining Wall, -L- Sta. 15+00 to 20+00

Dear Mr. Pilipchuk and Ms. Bruinsma:

ESP Associates, Inc. (ESP) is pleased to submit this report on our geophysical study of the subject site. This work was performed in accordance with your Request for Proposal dated February 12, 2020 and our cost proposal dated February 21, 2020. The Notice to Proceed (NTP) was received on February 27, 2020.

We appreciate the opportunity to assist you during this phase of the project. If you should have any questions concerning this report, or if we may be of further assistance, please contact us.

Sincerely,

ESP Associates, Inc.

Edward D. Billington, PG
Senior Geologist/Geophysicist
EDB/PMW/JS



4/2/2020

DocuSigned by:

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not considered Final unless all signatures are completed

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ATTACHMENTS

Attachment A	Soil Test Boring Logs Provided by the NCDOT
Attachment B	Final Survey Report

1.0 INTRODUCTION

The North Carolina Department of Transportation (NCDOT) is planning to replace Bridge No. 040008 over the North Fork New River on NC194 (Figure 1). The project will require realignment of the two-lane highway from NW School Road to the bridge, and the construction of a retaining wall next to Buffalo Creek. The retaining wall is planned to be approximately 500 feet long, extending from -L- Sta. 15+00 to 20+00. Since the planned location of the retaining wall was too steep to allow drilling to explore for bedrock depths, the NCDOT requested that ESP perform a geophysical investigation to assess the approximate depth to bedrock. Based on the 1985 Geologic Map of North Carolina, the bedrock at the site is identified as an amphibolite (Zata), described as equigranular, massive to well foliated, interlayered, rarely discordant, metamorphosed intrusive to extrusive mafic rock; may include metasedimentary rock.

2.0 SITE OBSERVATIONS

ESP performed a site visit with NCDOT personnel on February 5, 2020 to assess the feasibility of performing work on the slope. The slope distance from the guard rail to the creek appeared to range from about 40 to 75 feet. In some places, the slope appeared to be approximately 1H:1V. There was a narrow strip of grass between the edge of pavement and the guard rail and occasionally a narrow soil bench on the slope side of the guard rail. The upper part of the slope was fairly open with tall grass and briars while the lower part of the slope was lightly wooded with briars. Boulders and some apparent rock outcrops were visible on the lower slope and at the creek level.

3.0 FIELD METHODS

ESP performed field work at the planned retaining wall location on March 3 through 6, and on March 9, 2020. The work consisted of seismic refraction data collection on March 3 through 5, driving “bridge rods” on March 6, and surveying the location of stakes for the seismic lines and bridge rod locations on March 9. Photographs of the site and of the seismic data collection are shown on Figure 2.

3.1 Seismic Refraction

ESP collected seismic refraction data along 6 lines: Line 1 was located along the approximate planned retaining wall location, and Lines 2 through 6 were oriented down the slope starting at the edge of pavement (Figure 3). The work was performed by Edward Billington, PG, Ryan Pastrana, GIT, and Chase Hallenbeck of ESP.

The seismic data were collected using a 24-channel system consisting of a Geode seismograph, 8Hz geophones spaced 5 feet apart, and a 16-pound sledgehammer striking a steel plate on the ground as the energy source. Four 115-foot long arrays using 24 geophones were employed for Line 1. Due to the length of the slope, 9 to 10 geophones were used for the slope lines with array lengths of 40 to 45 feet. Some lines or portion of lines required hand clearing. Noise from passing

vehicles affected the data although we tried to not collect data when cars and trucks were passing. Due to the steepness of the slope, the personnel working on the slope used a safety rope to help prevent falls. Wooden stakes were placed at 50-foot intervals along Line 1, and at the top, bottom, and significant slope changes on Lines 2, 3, 4, 5, and 6.

3.2 Bridge Rods

ESP drove bridge rods at the intersections of Line 1 with Lines 2, 3, 5, and 6 on March 6 (Figure 3). The slope at Line 4 was too steep for driving rods. The work consisted of driving 5-foot long half-inch steel rods with a 16-pound slide hammer approximately vertically down into the ground until refusal. Couplers were used when more than one rod was needed. Refusal was defined as 100 blows with less than an inch penetration. Notes were recorded as to the relative softness or hardness of the materials that were driven through with the rods. Wooden stakes were placed to mark the location of the rod drives.

3.3 Location Surveys

On March 9, ESP surveyed the locations and elevations of the wooden stakes placed to mark the seismic line locations and rod drives. The work was performed by a 3-person survey crew utilizing conventional survey equipment. The surveyed points were added to the MicroStation site plan and used to draw the approximate location of the seismic lines and rod drives (Figure 3). More information regarding the survey task is provided in the final survey report (Attachment B).

4.0 DATA ANALYSIS

4.1 Seismic Refraction Velocity Models

The processing steps for the seismic refraction data analysis consisted of assigning geometry, picking the arrival times of refracted energy at each geophone (first breaks), creating an elevation model from the survey point data, then performing a tomographic inversion of the arrival time data to develop a compressional wave velocity model for each line (Figures 4 and 5). The velocities are presented in feet per second (ft/s).

4.2 Bridge Rods and Soil Test Borings Data

The bridge rod and soil test boring data are listed in Table 1 and are superimposed on the velocity models on Figures 4 and 5. The soil test borings were performed by the NCDOT prior to ESP's work on this project (Attachment A).

4.3 Location Survey Data

The results of the location surveys were added to the MicroStation site plan on Figure 3.

5.0 DISCUSSION OF RESULTS

The velocity models were correlated with the rod drives to assess the approximate depth to weathered rock and to crystalline rock. Based on this evaluation, we made the following generalized definitions.

Compressional Wave Velocity (ft/s)	Corresponding Material Type ¹
Less than 3500	Fill and Residual Soil
3500 to 7500	Weathered Rock, WR
7500 or more ²	Crystalline Rock, CR

¹Material type as categorized by the NCDOT GEU; see Figure 6.

²7500 ft/s is the approximate limit of rippability for metamorphic rock (Handbook of Ripping, February 2000, 12th Edition, Caterpillar Inc., Peoria, IL).

The velocity model for Line 1 indicates that the depth to weathered rock is approximately 20 feet from STA 15+00 to 17+00. After STA 17+00, the depth to weathered rock decreases to 10 feet or less. At rod drive BR-01 on the alluvial bench, the material was soft until almost refusal at 4.7 feet below ground surface (bgs). Based on the seismic velocities, it appears that BR-01 refused on crystalline rock, so there appears to be little to no weathered rock in the vicinity of BR-01; this would be expected for an alluvial stream bank where the stream had previously scoured down to bedrock.

Due to the slope distance from the guard rail to the creek, the length of the arrays for Lines 2 through 6 were too short to obtain sufficient refracted arrivals from crystalline rock, resulting in velocity models that probably do not represent the true velocity structure of the subsurface. Although there is not a satisfactory match between the velocity model for Line 1 and the models for Lines 2 through 6 where they intersect, the models for Lines 2 through 6 do indicate that the depth to weathered rock decreases from STA 15+00 to STA 20+00, supporting the interpretation of Line 1, and they show a reasonable correlation with the adjacent RW1 soil test borings.

6.0 LIMITATIONS

These services have been provided to the NCDOT in accordance with generally accepted guidelines for performing geophysical surveys. It is recognized that the results of geophysical surveys are non-unique and subject to interpretation. Further, the seismic refraction method is an averaging technique; it is likely that there are bedrock highs and lows that are not imaged by this method.

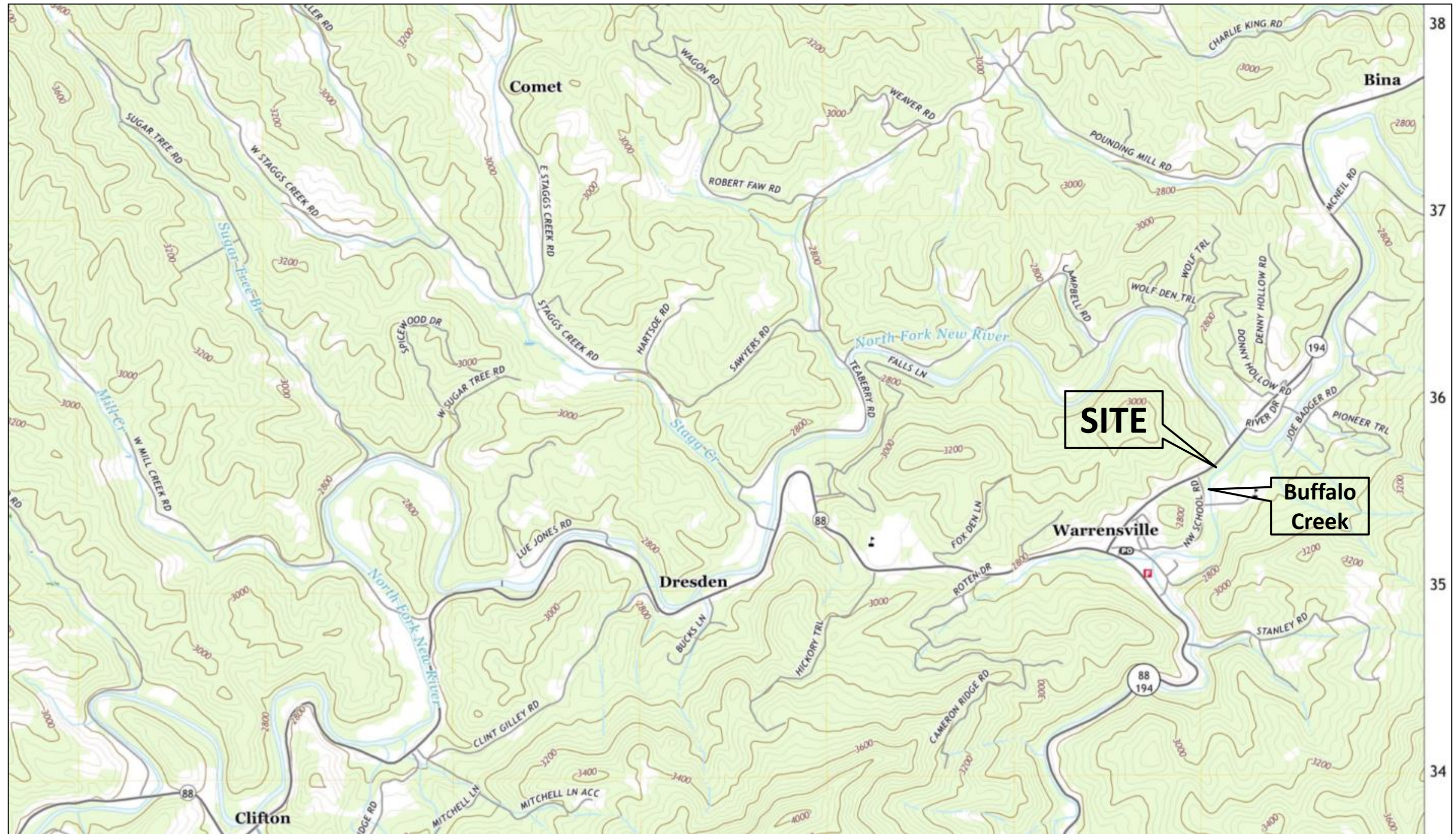
TABLES

**TABLE 1
BRIDGE ROD AND BORING INFORMATION**

Bridge Rod or Boring*	Station & Offset (-WALL1-)	Location on Seismic Line (Line, Station)	Refusal Depth (feet bgs)	Comments
BR-01	19+55 1' LT	Intersection of Line 1 and Line 2; Line 1 458'	4.7	0.0' – 4.5' - Soft 4.5' – 4.7' - Firm
BR-02	18+51 1' RT	Intersection of Line 1 and Line 3; Line 1, 353'	8.3	0.0' – 6.1' - Soft 6.1' – 8.3' - Firm
BR-03	18+50 8' RT	Line 3, 40'	6.7	0.0' – 5.5' - Soft 5.5' – 6.7' - Firm
BR-04	16+59 3' LT	Line 5, 15'	16.7	0.0' – 13.2' - Soft 13.2' – 16.7' - Firm
BR-05	15+51 7' LT	Line 6, 10'	21.8	0.0' – 11.9' - Soft 11.9' – 16.3' - Firm 16.3' – 21.8' - Hard
RW1-1*	15+56 21' LT	Near start of Line 6	-	Weathered Rock from 23.2' - 23.7' Boring Terminated in Weathered Rock
RW1-2*	16+58 21' LT	Near start of Line 5	7.1	Boring Terminated on Crystalline Rock (probable boulder, not bedrock)
RW1-3*	17+58 26' LT	Near start of Line 4	22.0	Weathered Rock and Hard Silt (N=71) from 14.8' - 22.0' Boring Terminated on Crystalline Rock
RW1-4*	18+53 31' LT	Near start of Line 3	-	Weathered Rock from 19.2' - 24.0' Boring Terminated in Weathered Rock
RW1-5*	19+52 38' LT	Near start of Line 2	18.0	Boring Terminated on Crystalline Rock

*Borings completed prior to ESP's work. Boring data provided by NCDOT.

FIGURES



From: USGS US Topo 7.5 - minute map for WARRENSVILLE, NC, Date: 2019, Original Scale: 1:24,000

PROJECT NO.	GR22.323
SCALE	AS SHOWN
DATE	3/17/20
BY	EDB

FIGURE 1
SITE VICINITY MAP

BR-0002, REPLACE BRIDGE NO. 040008 OVER NORTH FORK NEW RIVER ON NC194, RETAINING WALL -L- STA. 15+00 TO 20+00



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A. Photograph of site, looking downstream (northeast).



B. Photograph of site, looking upstream (southwest).



C. Photograph of seismic line being set up on slope.



D. Photograph of seismic refraction data collection with sledgehammer source.

PROJECT NO.	GR22.323
SCALE	N/A
DATE	3/17/20
BY	EDB

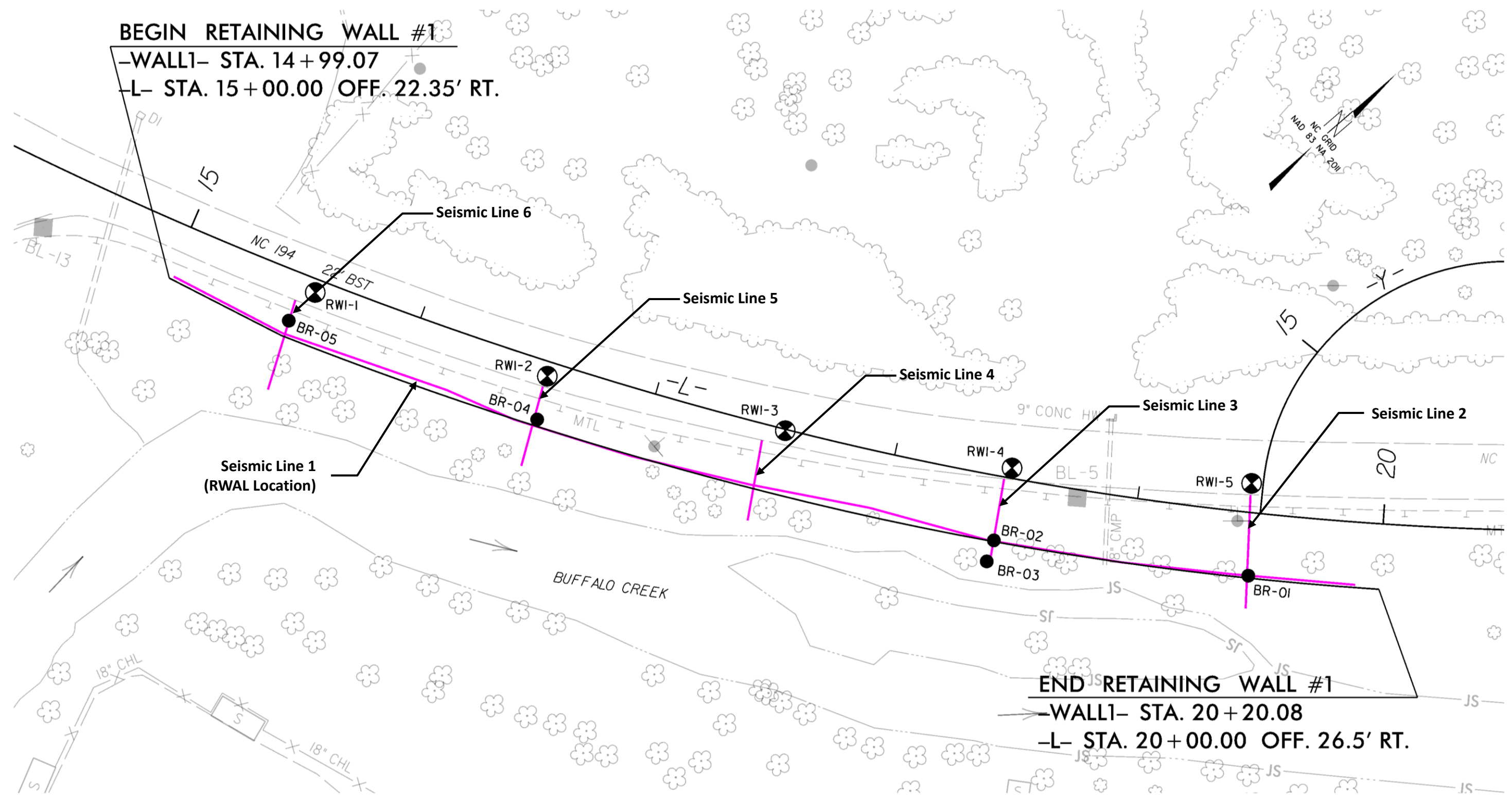
FIGURE 2
DATA COLLECTION PHOTOGRAPHS
 BR-0002, REPLACE BRIDGE NO. 040008 OVER NORTH FORK NEW RIVER ON NC194, RETAINING WALL -L- STA. 15+00 TO 20+00



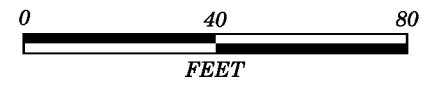
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BEGIN RETAINING WALL #1
 -WALL1- STA. 14+99.07
 -L- STA. 15+00.00 OFF. 22.35' RT.

END RETAINING WALL #1
 -WALL1- STA. 20+20.08
 -L- STA. 20+00.00 OFF. 26.5' RT.



Explanation	
	Seismic refraction line
	BR-01 Bridge rod location and number



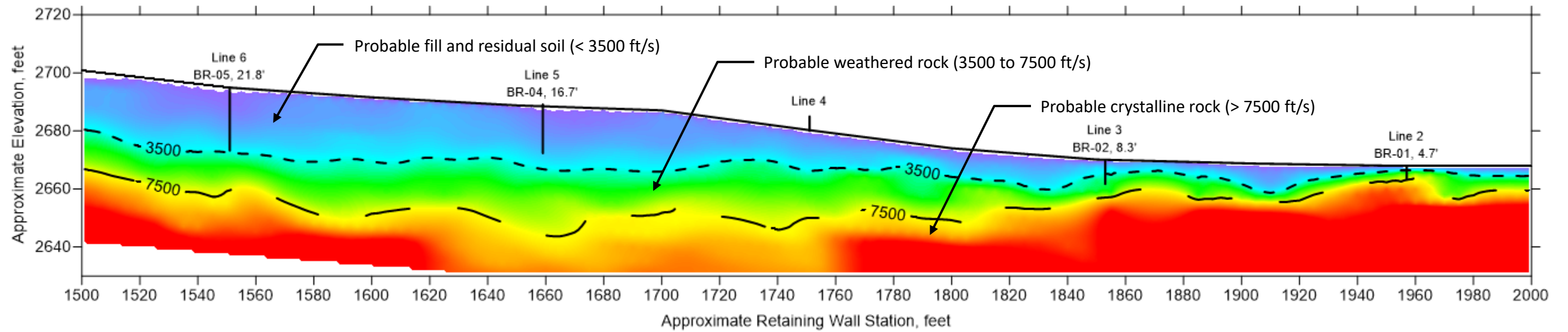
PROJECT NO.	GR22.323
SCALE	AS SHOWN
DATE	3/17/20
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FIGURE 3
SITE PLAN WITH SEISMIC LINE LOCATIONS
 BR-0002, REPLACE BRIDGE NO. 040008 OVER NORTH FORK NEW RIVER ON NC194, RETAINING WALL -L- STA. 15+00 TO 20+00

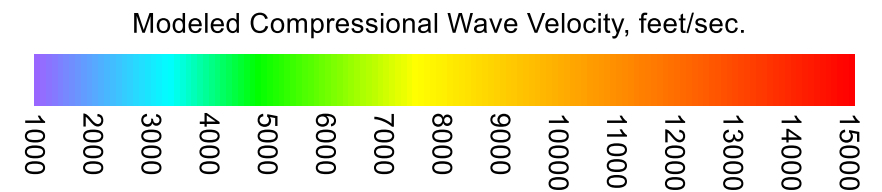



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SEISMIC LINE 1 VELOCITY MODEL

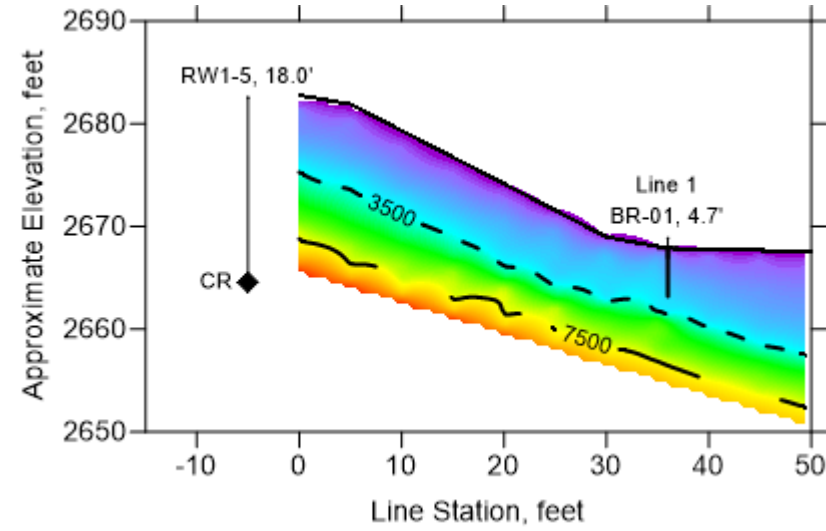


Explanation	
Line 2	Intersecting seismic line number and location
+	
BR01, 4.7'	Bridge rod number, refusal depth, and location

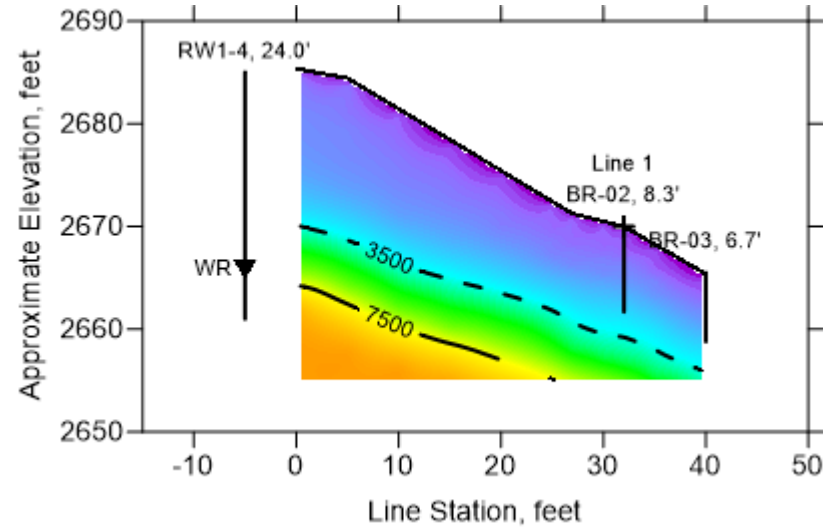


PROJECT NO. GR22.323	FIGURE 4 SEISMIC LINE 1 VELOCITY MODEL		ESP Associates, Inc.
SCALE AS SHOWN			7011 Albert Pick Rd., Suite E Greensboro, NC 27409
DATE 3/17/20	BR-0002, REPLACE BRIDGE NO. 040008 OVER NORTH FORK NEW RIVER ON NC194, RETAINING WALL -L- STA. 15+00 TO 20+00		336.334.7724
BY EDB			www.espassociates.com

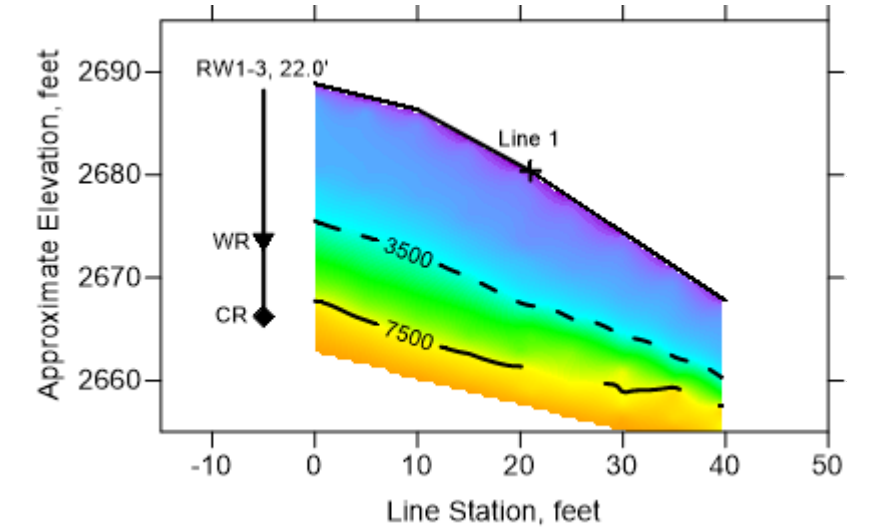
SEISMIC LINE 2 VELOCITY MODEL



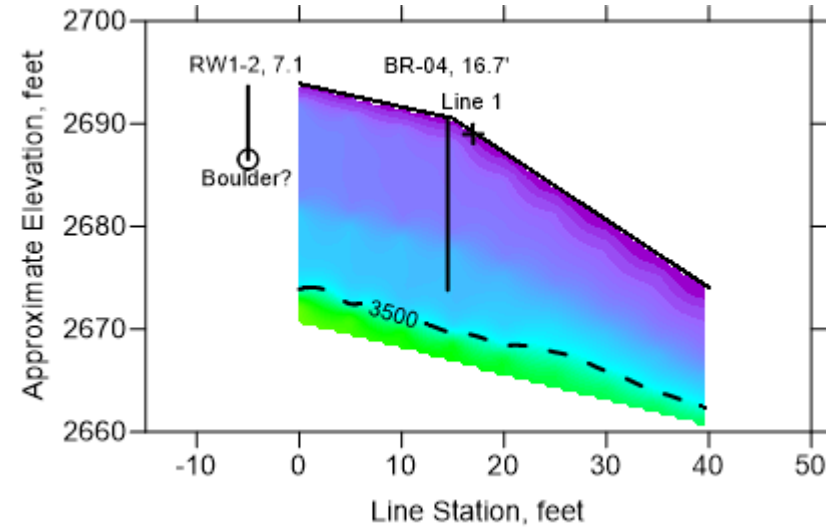
SEISMIC LINE 3 VELOCITY MODEL



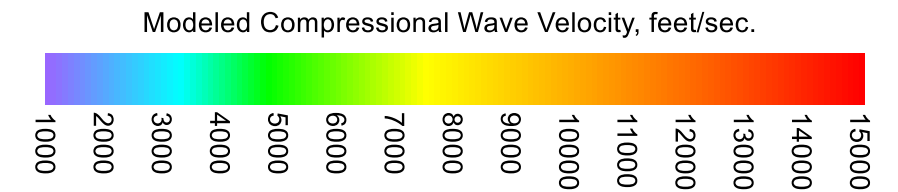
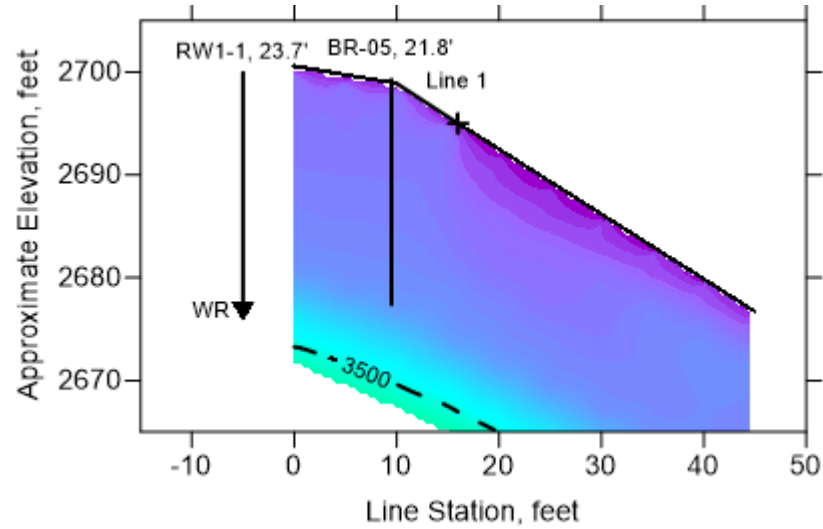
SEISMIC LINE 4 VELOCITY MODEL



SEISMIC LINE 5 VELOCITY MODEL



SEISMIC LINE 6 VELOCITY MODEL



Explanation

- Line 2
+ Intersecting seismic line number and location
- BR01, 4.7'
| Bridge rod number, refusal depth, and location
- RW1-1, 23.7'
| Boring designation, termination depth, location, and top of weathered rock or crystalline rock
- WR ▼ WR = weathered rock, CR = crystalline rock
- CR ◆

PROJECT NO.	GR22.323
SCALE	AS SHOWN
DATE	3/17/20
BY	EDB

FIGURE 5
SEISMIC LINES 2 THROUGH 6 VELOCITY MODELS
BR-0002, REPLACE BRIDGE NO. 040008 OVER NORTH FORK NEW RIVER ON NC194, RETAINING WALL -L- STA. 15+00 TO 20+00



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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SUBSURFACE INVESTIGATION
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION										GRADATION										ROCK DESCRIPTION										TERMS AND DEFINITIONS																																																																																																																																																																		
<p>SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 208, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, <i>VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6</i></p>										<p>WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE. UNIFORMLY GRADED - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLE SIZES OF TWO OR MORE SIZES.</p>										<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS IN NON-COASTAL PLAIN MATERIAL. THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK. ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:</p>										<p>ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER. AQUIFER - A WATER BEARING FORMATION OR STRATA. ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND. ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, SUCH AS SHALE, SLATE, ETC. ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE. CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE. COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE. CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE. DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK. DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL. DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH. FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE. FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES. FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLOGGED 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 (SROD) - 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.</p>																																																																																																																																																																		
<p style="text-align: center;">SOIL LEGEND AND AASHTO CLASSIFICATION</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th rowspan="2">GENERAL CLASS.</th> <th colspan="5">GRANULAR MATERIALS (≤ 35% PASSING #200)</th> <th colspan="5">SILT-CLAY MATERIALS (> 35% PASSING #200)</th> <th colspan="5">ORGANIC MATERIALS</th> </tr> <tr> <th>A-1</th> <th>A-2</th> <th>A-3</th> <th>A-4</th> <th>A-5</th> <th>A-6</th> <th>A-7</th> <th>A-1, A-2</th> <th>A-3</th> <th>A-4, A-5</th> <th>A-6, A-7</th> <th></th> <th></th> <th></th> <th></th> </tr> <tr> <td>GROUP CLASS.</td> <td>A-1-a</td> <td>A-1-b</td> <td>A-2-4</td> <td>A-2-5</td> <td>A-2-6</td> <td>A-2-7</td> <td>A-4</td> <td>A-5</td> <td>A-6</td> <td>A-7</td> <td>A-1, A-2</td> <td>A-3</td> <td>A-4, A-5</td> <td>A-6, A-7</td> <td></td> </tr> <tr> <td>SYMBOL</td> <td colspan="5">[Pattern]</td> <td colspan="5">[Pattern]</td> <td colspan="5">[Pattern]</td> </tr> <tr> <td>% PASSING #10 #40 #200</td> <td>50 MX 30 MX 15 MX</td> <td>50 MX 25 MX 10 MX</td> <td>51 MN 35 MX 35 MX</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> <td>40 MX 41 MN 10 MX 11 MN</td> </tr> <tr> <td>MATERIAL PASSING #40 LL PI</td> <td colspan="5"></td> <td colspan="5"></td> <td colspan="5"></td> </tr> <tr> <td>GROUP INDEX</td> <td colspan="5">0</td> <td colspan="5">0</td> <td colspan="5">0</td> </tr> <tr> <td>USUAL TYPES OF MAJOR MATERIALS</td> <td colspan="2">STONE FRAGS. 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CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.</p> <p>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.</p> <p>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></p> <p>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, WOULD YIELD SPT N VALUES > 100 BPF</i></p> <p>VERY SEVERE (IV SEV.): ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF</i></p> <p>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.</p>									
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<p style="text-align: center;">PLASTICITY</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>NON PLASTIC</th> <th>SLIGHTLY PLASTIC</th> <th>MODERATELY PLASTIC</th> <th>HIGHLY PLASTIC</th> </tr> <tr> <td>0-5</td> <td>6-15</td> <td>16-25</td> <td>26 OR MORE</td> </tr> <tr> <td>VERY LOW</td> <td>SLIGHT</td> <td>MEDIUM</td> <td>HIGH</td> </tr> </table>										NON PLASTIC	SLIGHTLY PLASTIC	MODERATELY PLASTIC	HIGHLY PLASTIC	0-5	6-15	16-25	26 OR MORE	VERY LOW	SLIGHT	MEDIUM	HIGH	<p style="text-align: center;">EQUIPMENT USED ON SUBJECT PROJECT</p> <p>DRILL UNITS:</p> <p><input type="checkbox"/> CME-45C</p> <p><input type="checkbox"/> CME-55</p> <p><input type="checkbox"/> CME-550</p> <p><input type="checkbox"/> VANE SHEAR TEST</p> <p><input type="checkbox"/> PORTABLE HOIST</p> <p>ADVANCING TOOLS:</p> <p><input type="checkbox"/> CLAY BITS</p> <p><input type="checkbox"/> 6" CONTINUOUS FLIGHT AUGER</p> <p><input type="checkbox"/> 8" HOLLOW AUGERS</p> <p><input type="checkbox"/> HARD FACED FINGER BITS</p> <p><input type="checkbox"/> TUNG-CARBIDE INSERTS</p> <p><input type="checkbox"/> CASING <input type="checkbox"/> W/ ADVANCER</p> <p><input type="checkbox"/> TRICONE * STEEL TEETH</p> <p><input type="checkbox"/> TRICONE * TUNG-CARB.</p> <p><input type="checkbox"/> CORE BIT</p> <p>HAMMER TYPE:</p> <p><input type="checkbox"/> AUTOMATIC <input type="checkbox"/> MANUAL</p> <p>CORE SIZE:</p> <p><input type="checkbox"/> -B <input type="checkbox"/> -H <input type="checkbox"/> -N</p> <p>HAND TOOLS:</p> <p><input type="checkbox"/> POST HOLE DIGGER</p> <p><input type="checkbox"/> HAND AUGER</p> <p><input checked="" type="checkbox"/> SOUNDING ROD</p> <p><input type="checkbox"/> VANE SHEAR TEST</p>																																																																																																																																																																										
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<p style="text-align: center;">COLOR</p> <p>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.</p>										<p style="text-align: center;">FRACATURE SPACING</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>TERM</th> <th>SPACING</th> </tr> <tr> <td>VERY WIDE</td> <td>MORE THAN 10 FEET</td> </tr> <tr> <td>WIDE</td> <td>3 TO 10 FEET</td> </tr> <tr> <td>MODERATELY CLOSE</td> <td>1 TO 3 FEET</td> </tr> <tr> <td>CLOSE</td> <td>0.16 TO 1 FOOT</td> </tr> <tr> <td>VERY CLOSE</td> <td>LESS THAN 0.16 FEET</td> </tr> </table>										TERM	SPACING	VERY WIDE	MORE THAN 10 FEET	WIDE	3 TO 10 FEET	MODERATELY CLOSE	1 TO 3 FEET	CLOSE	0.16 TO 1 FOOT	VERY CLOSE	LESS THAN 0.16 FEET	<p style="text-align: center;">BEDDING</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>TERM</th> <th>THICKNESS</th> </tr> <tr> <td>VERY THICKLY BEDDED</td> <td>4 FEET</td> </tr> <tr> <td>THICKLY BEDDED</td> <td>1.5 - 4 FEET</td> </tr> <tr> <td>THINLY BEDDED</td> <td>0.16 - 1.5 FEET</td> </tr> <tr> <td>VERY THINLY BEDDED</td> <td>0.03 - 0.16 FEET</td> </tr> <tr> <td>THICKLY LAMINATED</td> <td>0.008 - 0.03 FEET</td> </tr> <tr> <td>THINLY LAMINATED</td> <td>< 0.008 FEET</td> </tr> </table>										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																																																																																																																																									
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<p style="text-align: center;">INDURATION</p> <p>FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.</p> <p>FRIABLE: RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.</p> <p>MODERATELY INDURATED: GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.</p> <p>INDURATED: GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.</p> <p>EXTREMELY INDURATED: SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.</p>										<p style="text-align: center;">BENCH MARK:</p> <p style="text-align: right;">ELEVATION: FEET</p>																																																																																																																																																																																						
<p style="text-align: center;">NOTES:</p>										<p style="text-align: right;">DATE: 8-15-14</p>																																																																																																																																																																																						

ATTACHMENT A
SOIL TEST BORING LOGS PROVIDED BY THE NCDOT

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 67002.1.1		TIP BR-0002		COUNTY ASHE		GEOLOGIST Johnson, C. D.									
SITE DESCRIPTION BORING IN EXISTING PAVEMENT NC194 FOR PROPOSED RWAL							GROUND WTR (ft)								
BORING NO. RW1-1		STATION 15+52		OFFSET 6 ft RT		ALIGNMENT L									
COLLAR ELEV. 2,700.2 ft		TOTAL DEPTH 23.7 ft		NORTHING 997,440		EASTING 1,260,993									
DRILL RIG/HAMMER EFF./DATE AFO6744 CME - 45C 92% 07/31/2017			DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER Cheek, D. O.		START DATE 05/29/19		COMP. DATE 05/29/19		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2705															
2700															
	2,697.0	3.2	3	2	2										2,700.2
2695	2,692.0	8.2	1	2	4										2,692.0
2690															
	2,687.0	13.2	2	3	3										
2685															
	2,682.0	18.2	1	2	2										
2680															
	2,677.0	23.2													2,676.6

WBS 67002.1.1		TIP BR-0002		COUNTY ASHE		GEOLOGIST Johnson, C. D.									
SITE DESCRIPTION BORING IN EXISTING PAVEMENT NC194 FOR PROPOSED RWAL							GROUND WTR (ft)								
BORING NO. RW1-2		STATION 16+50		OFFSET 5 ft RT		ALIGNMENT L									
COLLAR ELEV. 2,694.0 ft		TOTAL DEPTH 7.1 ft		NORTHING 997,489		EASTING 1,261,077									
DRILL RIG/HAMMER EFF./DATE AFO6744 CME - 45C 92% 07/31/2017			DRILL METHOD H.S. Augers		HAMMER TYPE Automatic										
DRILLER Cheek, D. O.		START DATE 05/29/19		COMP. DATE 05/29/19		SURFACE WATER DEPTH N/A									
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2695															
	2,694.0														2,694.0
2690	2,690.8	3.2	2	3	6										2,691.0
	2,687.0	7.0													2,687.0

NCDOT BORE DOUBLE BR0002_RW1_ASHE_BOREHOLES_GPJ_NC_DOT.GDT 6/6/19

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 67002.1.1		TIP BR-0002		COUNTY ASHE		GEOLOGIST Johnson, C. D.										
SITE DESCRIPTION BORING IN EXISTING PAVEMENT NC194 FOR PROPOSED RWAL							GROUND WTR (ft)									
BORING NO. RW1-3		STATION 17+47		OFFSET 0 ft RT		ALIGNMENT L										
COLLAR ELEV. 2,688.6 ft		TOTAL DEPTH 22.0 ft		NORTHING 997,545		EASTING 1,261,157										
DRILL RIG/HAMMER EFF./DATE AFO6744 CME - 45C 92% 07/31/2017			DRILL METHOD N/A		HAMMER TYPE Automatic											
DRILLER Cheek, D. O.		START DATE 05/29/19		COMP. DATE 05/29/19		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
2690														2,688.6	0.0	GROUND SURFACE
														2,685.6	3.0	ROADWAY EMBANKMENT Roadway embankment
2685	2,685.0	3.6	2	3	6											SAPROLITE Brown-white-gray, micaceous sandy SILT with rock fragments
2680	2,680.0	8.6	3	4	6											
2675	2,675.0	13.6	8	11	89/0.3											
2670	2,670.0	18.6	17	24	47									2,673.8	14.8	WEATHERED ROCK Weathered rock (schist)
														2,672.8	15.8	SAPROLITE Brown-white-gray, micaceous sandy SILT with rock fragments
	2,666.7	21.9												2,666.6	22.0	CRYSTALLINE ROCK Crystalline rock (schist) Boring Terminated at Elevation 2,666.6 ft ON CR

WBS 67002.1.1		TIP BR-0002		COUNTY ASHE		GEOLOGIST Johnson, C. D.											
SITE DESCRIPTION BORING IN EXISTING PAVEMENT NC194 FOR PROPOSED RWAL							GROUND WTR (ft)										
BORING NO. RW1-4		STATION 18+44		OFFSET 4 ft LT		ALIGNMENT L											
COLLAR ELEV. 2,685.1 ft		TOTAL DEPTH 24.0 ft		NORTHING 997,608		EASTING 1,261,232											
DRILL RIG/HAMMER EFF./DATE AFO6744 CME - 45C 92% 07/31/2017			DRILL METHOD N/A		HAMMER TYPE Automatic												
DRILLER Cheek, D. O.		START DATE 05/29/19		COMP. DATE 05/29/19		SURFACE WATER DEPTH N/A											
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100							
2690																2,685.1	0.0
																	ROADWAY EMBANKMENT Red brown clayey slightly micaceous SILT with rock fragments and roots
2685																	
2680	2,681.8	3.3	7	6	4												
2675	2,676.8	8.3	1	1	2												
2670	2,671.8	13.3	1	2	1												
2665	2,666.8	18.3	5	41	59/0.3									2,666.3	18.8	SAPROLITE Brown micaceous clayey SILT	
														2,665.9	19.2	WEATHERED ROCK Weathered schist with MnO seams	
	2,661.8	23.3	39	61/0.4										2,661.1	24.0	Boring Terminated at Elevation 2,661.1 ft IN WR	

NCDOT BORE DOUBLE BR0002_RW1_ASHE_BOREHOLES_GPJ_NC_DOT.GDT 6/6/19

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 67002.1.1		TIP BR-0002		COUNTY ASHE		GEOLOGIST Johnson, C. D.										
SITE DESCRIPTION BORING IN EXISTING PAVEMENT NC194 FOR PROPOSED RWAL							GROUND WTR (ft)									
BORING NO. RW1-5		STATION 19+35		OFFSET 4 ft LT		ALIGNMENT L										
COLLAR ELEV. 2,682.8 ft		TOTAL DEPTH 18.0 ft		NORTHING 997,672		EASTING 1,261,295										
DRILL RIG/HAMMER EFF./DATE AFO6744 CME - 45C 92% 07/31/2017				DRILL METHOD N/A		HAMMER TYPE Automatic										
DRILLER Cheek, D. O.		START DATE 05/29/19		COMP. DATE 05/29/19		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION			
			0.5ft	0.5ft	0.5ft	0	25	50	75	100			ELEV. (ft)	DEPTH (ft)		
2685														2,682.8	0.0	GROUND SURFACE
2680	2,679.5	3.3	2	2	2	1	1	1	1	1						ROADWAY EMBANKMENT Brown micaceous sandy SILT with a trace of clay, roots, and a few gravels
2675	2,674.5	8.3	1	2	4	1	1	1	1	1						
2670	2,669.5	13.3	1	2	3	1	1	1	1	1				2,669.5	13.3	SAPROLITE Brown gray, micaceous clayey silt with some rock fragments
2665	2,664.8	18.0	60	0	0	1	1	1	1	1				2,664.8	18.0	CRYSTALLINE ROCK Crystalline chlorite schist Boring Terminated at Elevation 2,664.8 ft ON CR

NCDOT BORE DOUBLE BR0002_RW1_ASHE_BOREHOLES_GPJ_NC_DOT.GDT 6/6/19

ATTACHMENT B
FINAL SURVEY REPORT (ESP)



March 17, 2020

ESP Associates, Inc.
7011 Albert Pick Road, Suite E
Greensboro, NC 27409

FINAL SURVEY REPORT

March 17th, 2020

TIP# BR-0002

PROJECT DESCRIPTION:

Replace Bridge 040008 over North Fork New River on NC 194
Retaining Wall -L- Sta. 15+00 to 20+00- Retaining Wall Geophysical Survey

PROJECT NUMBER: 35254

COUNTY: Ashe

L&S #: 67002.1.1

CONSULTANT: ESP Associates, Inc.
7011 Albert Pick Road Suite E, Greensboro, N.C. 27409
Contact: John P. Scoville III, PLS, CFS

DATE OF SURVEY: 3-9-2020 through 3-10-2020

DATUM DESCRIPTION:

The following Datum Description was supplied by the NCDOT as developed by others.

THE LOCALIZED COORDINATE SYSTEM DEVELOPED FOR THIS PROJECT IS BASED ON THE
NAD 83 NSRS (2011) NORTH CAROLINA STATE PLANE GRID COORDINATES
ESTABLISHED BY NCDOT FOR MONUMENT "R5832-BL 43" WITH GRID COORDINATES OF:

NORTHING: 996047.666 (s FT) EASTING: 1259229.395 (s FT)

THE AVERAGE COMBINED FACTOR USED ON THIS PROJECT (GROUND TO GRID) IS:
0.99997244

ALL LINEAR DISTANCES ARE LOCALIZED HORIZONTAL DISTANCES. THE VERTICAL DATUM
FOR THIS PROJECT IS NAVD 88

ESP Associates, Inc.
7011 Albert Pick Road, Suite E
Greensboro, NC 27409

PROJECT LIMITS:

- The limits for this project were supplied by NCDOT to ESP geophysical group and defined as the extents of the proposed retaining wall from -L- Sta. 15+00 to Sta. 20+00 26.5' right to include the existing roadway and down existing slope to Buffalo creek.

BASELINE FILE:

- Project Control for Baselines was supplied by NCDOT in filename BR0002_ncdot_fs.dgn.

SAFETY:

- ESP survey personnel conducted a PRE JOB Briefing to go over safety concerns at a location outside of traffic concerns adjacent to the project. Signing positions were determined as well as a discussion of proposed procedures and project objectives.
- ESP set signs out at both ends of the work area along highway 194 as well at intersecting New School Road and Cambell Road
- ESP utilized a 3 man crew to accomplish the work along the existing guardrail while one man acted as flagger/lookout for the operation.
- The work plan went well and the work was accomplished accordingly.

DTM DATA:

The project was laid out by the ESP Geophysical group as part of their work in collecting geophysical data in the area of the proposed retaining wall.

ESP's survey group identified several baseline monuments in the vicinity of the project and verified the relationship of the baseline monuments with each other both horizontally and vertically to ensure the data being utilized was correct. Utilizing conventional survey equipment, ESP verified the points being utilized, established additional control points along the existing guardrail and located the following items to aid the geophysical survey for the project.

- Existing borings in the pavement RW1-1 through RW 1-5
- Bridge Rods- BR-01 through BR-05
- EP points at assumed zero station of cross section lines 1 through 5 as established by the geophysical layout.
- Downslope locations of slope breaks and other points as established by the geophysical layout.

Baseline monuments and additional control points were surveyed to a horizontal and vertical accuracy of +/- 0.01'. Borings, rod locations, slope breaks and other points were surveyed to a horizontal and vertical accuracy of +/- 0.10'

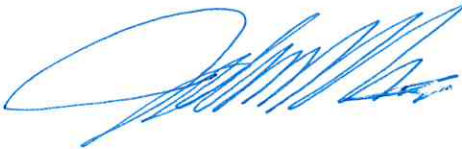
THE FOLLOWING FILES WERE TRANSMITTED TO ESP GEOPHYSICAL GROUP:

- GR22.323 TASK 2 ALL.CSV

This csv file contains all of the coordinates established from the survey of the above listed items and including the NCDOT baseline monuments utilized and verified in the survey process.

Completed by: John P. Scoville III, PLS
March 17th, 2020

Sincerely,
ESP Associates, Inc.



John P. Scoville III, PLS, CFS
Survey Manager

