



ECS Southeast, LLP

Bridge Foundation Design Recommendations

Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek

Project No: BP11.R006.1
Project ID: SF-040157
Ashe County, North Carolina

ECS Project No. 09:29664

June 6, 2023





ECS SOUTHEAST, LLP

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

June 6, 2023

Ms. Nikki Honeycutt, P.E.
STV Engineers, Inc.
900 W. Trade Street, Suite 715
Charlotte, North Carolina 28202

ECS Project No.:09:29663

Reference: Bridge Foundation Design Recommendations
Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek
Project No: BP.11.R006.1
Project ID: SF-040157
County: Ashe

Dear Ms. Honeycutt:

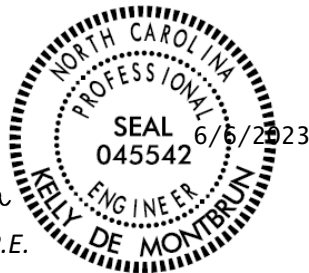
ECS Southeast, LLP (ECS) is pleased to submit the Bridge Foundation Design Recommendations Report associated with design and construction of Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek in Ashe County, North Carolina. This work was performed in general accordance with our Proposal No. 09-28282P dated July 15, 2021.

Our design is based on project information and structure loads provided to us by STV. This report contains the foundation recommendations, the Structure Subsurface Investigation report prepared by ECS, and supporting calculations.

ECS Southeast, LLP appreciates the opportunity to assist you during this phase of the project. If you have questions concerning this report, please contact our office at 704-525-5152.

Respectfully,

ECS SOUTHEAST, LLP



DocuSigned by:
Kelly de Montbrun
78D09975E2AC180
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FOUNDATION RECOMMENDATIONS

WBS NO. BP11.R006.1 DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road)
Over Peak Creek

T.I.P. NO. N/A

COUNTY Ashe

STATION 15+73.00 -L-

	INITIALS	DATE
DESIGN	KND	06/05/23
CHECK	MJW	06/06/23
REVISED		



	STATION	FOUNDATION TYPE	FACTORED LOAD	MISCELLANEOUS DETAILS
END BENT NO. 1	15+34.73 -L-	Cap on HP 12X53 Steel Piles	95 Tons/Pile	Average Bottom of Cap Elevation = 2,662.5 ft +/- Average Pile Length = 20 ft (LT), 15ft (RT) 5 Vertical Piles @ 8'-0" Spacing Wing Wall 1 - 2 Vertical Piles @ 8'-6" Spacing Wing Wall 2 - 2 Vertical Piles @ 8'-0" Spacing
END BENT NO. 2	16+12.33 -L-	Cap on HP 12X53 Steel Piles	95 Tons/Pile	Average Bottom of Cap Elevation = 2,662.8 ft +/- Average Pile Length = 20 ft 5 Vertical Piles @ 8'-0" Spacing Wing Wall 3 - 4 Vertical Piles @ 8'-0" Spacing Wing Wall 4 - 2 Vertical Piles @ 8'-6" Spacing

(SEE NOTES ON PLANS AND COMMENTS ON FOLLOWING PAGES)

WBS No: BP11.R006.1

County: Ashe

FOUNDATION RECOMMENDATION COMMENTS

- 1) A PRECAST CONCRETE PANEL WALL WILL BE USED AS A VERTICAL FACE AT END BENT NO. 1 AND END BENT NO. 2.
- 2) TYPE II BRIDGE APPROACH FILL (STANDARD DETAIL 422.02) SHOULD BE USED AT END BENT NO. 1 AND END BENT NO. 2.
- 3) NO WAITING PERIOD IS REQUIRED AT EITHER END BENT PRIOR TO CONSTRUCTION.
- 4) AVERAGE PILE LENGTHS ARE BASED ON PLUMB PILES FROM THE BOTTOM OF CAP ELEVATION TO THE ANTICIPATED TIP ELEVATION, ROUNDED UP TO THE NEAREST 5 FEET.
- 5) DRILLED-IN PILES ARE RQUIRED FOR END BENT NO. 1 AND END BENT NO. 2. EXCAVATE HOLES AT END BENT NO. 1 TO A TIP ELEVATION NO HIGHTER THAN 2,646 FT (LT) AND 2,649 FT (RT) WITH A PENETRATION OF AT LEAST 5 FT INTO CRYSTALLINE ROCK. EXCAVATE HOLES AT END BENT NO. 2 TO A TIP ELEVATION NO HIGHER THAN 2,647 FT (LT) AND 2,648 FT (RT) WITH A PENETRATION OF AT LEAST 5 FT INTO CRYSTALLINE ROCK. FOR PILE EXCAVATION, SEE SECTION 450 OF THE STANDARD SPECIFICATIONS.

SUMMARY OF PILE INFORMATION/INSTALLATION

(Blank entries indicate item is not applicable to structure)

End Bent/ Bent No, Pile(s) ## (e.g., "Bent 1, Piles 1-5")	Factored Resistance per Pile TONS	Pile Cut-Off (Top of Pile) Elevation FT	Estimated Pile Lenth per Pile FT	Scour Critical Elevation FT	Driven Piles			Predrilling for Piles*			Drilled-In Piles			
					Min Pile Tip (Tip No Higher Than) Elev FT	Required Driving Resistance (RDR)** per Pile TONS	Total Pile Redrives Quantity EACH	Predrilling Length per Pile Lin FT	Predrilling Elevation (Elev Not To Predrill Below) FT	Maximum Predrilling Dia INCHES	Pile Exc Excavation (Bottom of Hole) Elev FT	Pile Exc Not In Soil per Pile Lin FT	Pile Exc In Soil per Pile Lin FT	
End Bent No. 1, Piles 3-4	95	See Substructure Plans	20								2646.0	6.7	10.5	
End Bent No. 1, Piles 5-7	95		15									2649.0	5.0	7.6
Wing Wall No. 1, Piles 1-2			20									2646.0	6.7	10.5
Wing Wall No. 2, Piles 8-9			15									2649.0	5.0	7.6
End Bent No. 2, Piles 5-6	95		20									2647.0	5.9	10.7
End Bent No. 2, Piles 7-9	95		20									2648.0	5.0	9.0
Wing Wall No. 3, Piles 1-4			20									2647.0	5.9	10.7
Wing Wall No. 4, Piles 10-11			20									2648.0	5.0	9.0

*Predrilling for Piles is required for end bents/bents with a predrilling length and at the Contractor's option for end bents/bents with predrilling information but no predrilling length.

**RDR = $\frac{\text{Factored Resistance} + \text{Factored Downdrag Load} + \text{Factored Dead Load}}{\text{Dynamic Resistance Factor}} + \text{Nominal Downdrag Resistance} + \frac{\text{Nominal Scour Resistance}}{\text{Scour Resistance Factor}}$

PILE DESIGN INFORMATION

(Blank entries indicate item is not applicable to structure)


End Bent/ Bent No, Pile(s) ## (e.g., "Bent 1, Piles 1-5")	Factored Axial Load per Pile TONS	Factored Downdrag Load per Pile TONS	Factored Dead Load* per Pile TONS	Dynamic Resistance Factor	Nominal Downdrag Resistance per Pile TONS	Nominal Scour Resistance per Pile TONS	Scour Resistance Factor (Default = 1.00)
End Bent No. 1	95						
End Bent No. 2	95						

*Factored Dead Load is factored weight of pile above the ground line.

NOTES:

- The Pile Foundation Tables are based on the bridge substructure design and foundation recommendations sealed by a North Carolina Professional Engineer (Kelly de Montbrun No. 045542) on June 6, 2023.
- Total Pile Driving Equipment Setup quantity (not shown in Pile Foundation Tables) equals the number of driven piles, i.e., the number of piles with a Required Driving Resistance.
- PDA will not be required.
- For Pile, see Piles Provision and Section 450 of the Standard Specifications.
- Concrete is required to fill holes for pile excavation at End Bent No. 1, End Bent No. 2, and Wing Walls No. 1 through 4.
- Drilled-in piles are required for End Bent No. 1, End Bent No. 2, and Wing Walls No. 1 through 4. Abutment piles and Wing Wall piles should be installed a minimum of 5 feet into Crystalline Rock.

PROJECT NO. BP11.R006.1
Ashe COUNTY
 STATION: 15+73.00 -L-

	STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH						PILE FOUNDATION TABLES
	SIGNATURE _____ DATE _____						
REVISIONS						TOTAL SHEETS	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	NO.	BY:	DATE:	NO.	BY:	DATE:	
	1			3			
	2			4			

SUBSURFACE INVENTORY REPORT

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BP10.R006.3	1	14

REFERENCE: BP10.R006.3

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

STRUCTURE
SUBSURFACE INVESTIGATION

COUNTY ASHE
 PROJECT DESCRIPTION BRIDGE #157 OVER PEAK CREEK ON BIG PEAK CREEK ROAD (SR 1599)
 SITE DESCRIPTION -L- STATION 15+73

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2, 2A	LEGEND (SOIL & ROCK)
2B, 2C	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4-II	BORE LOGS, CORE REPORT, CORE PHOTOGRAPHS

PERSONNEL
A. BLACKMORE
HPC

INVESTIGATED BY ECS SOUTHEAST, LLP
 DRAWN BY K. DE MONTBRUN, P.E.
 CHECKED BY M. WALKO, P.E.
 SUBMITTED BY ECS SOUTHEAST, LLP
 DATE JUNE 2023

CAUTION NOTICE

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

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


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

NOTES:

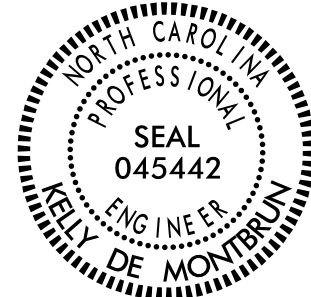
- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
- BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED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


PROJECT: N/A

Prepared in the Office of:



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 CHARLOTTE, NC 28217
 (704) 525-5152 [PHONE]
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 NC REGISTERED
 ENGINEERING
 FIRM # F-1078



DocuSigned by:

 7BDD9975E28109A 6/6/2023 DATE

**DOCUMENT NOT CONSIDERED FINAL
 UNLESS ALL SIGNATURES COMPLETED**

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

SUBSURFACE INVESTIGATION





SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 1 OF 2)

SOIL DESCRIPTION					GRADATION																																																																																																																																																																																																																																																																																																																																																																																																															
SOIL IS CONSIDERED UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO THE STANDARD PENETRATION TEST (AASHTO T 206, ASTM D1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY INCLUDE THE FOLLOWING: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. FOR EXAMPLE, VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6					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.																																																																																																																																																																																																																																																																																																																																																																																																															
SOIL LEGEND AND AASHTO CLASSIFICATION					ANGULARITY OF GRAINS																																																																																																																																																																																																																																																																																																																																																																																																															
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th rowspan="2">GENERAL CLASS.</th> <th colspan="6">GRANULAR MATERIALS (≤ 35% PASSING #200)</th> <th colspan="4">SILT-CLAY MATERIALS (> 35% PASSING #200)</th> <th colspan="2">ORGANIC MATERIALS</th> </tr> <tr> <th>A-1</th> <th>A-3</th> <th colspan="2">A-2</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> </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></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>SYMBOL</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>% PASSING</td> <td>#10 #40 #200</td> <td>50 MX 30 MX 15 MX</td> <td>50 MX 25 MX</td> <td>51 MN 10 MX</td> <td>35 MX</td> <td>35 MX</td> <td>35 MX</td> <td>35 MX</td> <td>36 MN</td> <td>36 MN</td> <td>36 MN</td> <td>36 MN</td> </tr> <tr> <td>MATERIAL PASSING #40</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>LL</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>PI</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>GROUP INDEX</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>USUAL TYPES OF MAJOR MATERIALS</td> <td>STONE FRAGS, GRAVEL, AND SAND</td> <td>FINE SAND</td> <td colspan="2">SILTY OR CLAYEY GRAVEL AND SAND</td> <td colspan="2">SILTY SOILS</td> <td colspan="2">CLAYEY SOILS</td> <td colspan="2">SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER</td> <td colspan="2">HIGHLY ORGANIC SOILS</td> </tr> <tr> <td>GEN. RATING AS SUBGRADE</td> <td colspan="4">EXCELLENT TO GOOD</td> <td colspan="4">FAIR TO POOR</td> <td>FAIR TO POOR</td> <td>POOR</td> <td colspan="2">UNSUITABLE</td> </tr> <tr> <td colspan="13" style="text-align: center; font-size: 8pt;"> PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30 </td> </tr> <tr> <td colspan="5" style="text-align: center;">CONSISTENCY OR DENSENESS</td> <td colspan="5" style="text-align: center;">MISCELLANEOUS SYMBOLS</td> </tr> <tr> <td colspan="2">PRIMARY SOIL TYPE</td> <td colspan="2">COMPACTNESS OR CONSISTENCY</td> <td colspan="2">RANGE OF STANDARD PENETRATION RESISTANCE (N-VALUE)</td> <td colspan="3">RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)</td> <td colspan="3"> 25/025 DIP & DIP DIRECTION OF ROCK STRUCTURES SPT DMT VST PMT TEST BORING AUGER BORING CORE BORING MONITORING WELL PIEZOMETER INSTALLATION SLOPE INDICATOR INSTALLATION CONE PENETROMETER TEST SOUNDING ROD TEST BORING WITH CORE SPT N-VALUE </td> </tr> <tr> <td colspan="2">GENERALLY GRANULAR MATERIAL (NON-COHESIVE)</td> <td colspan="2">VERY LOOSE LOOSE MEDIUM DENSE DENSE VERY DENSE</td> <td colspan="2">< 4 4 TO 10 10 TO 30 30 TO 50 > 50</td> <td colspan="3">N/A</td> <td colspan="3"></td> </tr> <tr> <td colspan="2">GENERALLY SILT-CLAY MATERIAL (COHESIVE)</td> <td colspan="2">VERY SOFT SOFT MEDIUM STIFF STIFF VERY STIFF HARD</td> <td colspan="2">< 2 2 TO 4 4 TO 8 8 TO 15 15 TO 30 > 30</td> <td colspan="3">< 0.25 0.25 TO 0.5 0.5 TO 1.0 1 TO 2 2 TO 4 > 4</td> <td colspan="3"></td> </tr> <tr> <td colspan="5" style="text-align: center;">TEXTURE OR GRAIN SIZE</td> <td colspan="5" style="text-align: center;">RECOMMENDATION SYMBOLS</td> </tr> <tr> <td colspan="2">U.S. STD. SIEVE SIZE OPENING (MM)</td> <td colspan="2">4 4.76</td> <td colspan="2">10 2.00</td> <td colspan="2">40 0.42</td> <td colspan="2">60 0.25</td> <td colspan="2">200 0.075</td> <td colspan="1">270 0.053</td> </tr> <tr> <td colspan="2">BOULDER (BLDR.)</td> <td colspan="2">COBBLE (COB.)</td> <td colspan="2">GRAVEL (GR.)</td> <td colspan="2">COARSE SAND (CSE, SD.)</td> <td colspan="2">FINE SAND (F SD.)</td> <td colspan="2">SILT (SL.)</td> <td colspan="1">CLAY (CL.)</td> </tr> <tr> <td colspan="2">GRAIN SIZE</td> <td colspan="2">MM IN.</td> <td colspan="2">305 12</td> <td colspan="2">75 3</td> <td colspan="2">2.0</td> <td colspan="2">0.25</td> <td colspan="1">0.05 0.005</td> </tr> <tr> <td colspan="5" style="text-align: center;">SOIL MOISTURE - CORRELATION OF TERMS</td> <td colspan="5" style="text-align: center;">ABBREVIATIONS</td> </tr> <tr> <td colspan="2">SOIL MOISTURE SCALE (ATTERBERG LIMITS)</td> <td colspan="2">FIELD MOISTURE DESCRIPTION</td> <td colspan="3">GUIDE FOR FIELD MOISTURE DESCRIPTION</td> <td colspan="3"> 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 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_u - 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 </td> </tr> <tr> <td colspan="2">LL</td> <td colspan="2">LIQUID LIMIT</td> <td colspan="3">- SATURATED - (SAT.)</td> <td colspan="3">USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE</td> <td colspan="3"></td> </tr> <tr> <td colspan="2">PLASTIC RANGE (PI)</td> <td colspan="2">PLASTIC LIMIT</td> <td colspan="3">- WET - (W)</td> <td colspan="3">SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE</td> <td colspan="3"></td> </tr> <tr> <td colspan="2">OM</td> <td colspan="2">OPTIMUM MOISTURE SHRINKAGE LIMIT</td> <td colspan="3">- MOIST - (M)</td> <td colspan="3">SOLID; AT OR NEAR OPTIMUM MOISTURE</td> <td colspan="3"></td> </tr> <tr> <td colspan="2">SL</td> <td colspan="2"></td> <td colspan="3">- DRY - (D)</td> <td colspan="3">REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE</td> <td colspan="3"></td> </tr> <tr> <td colspan="5" style="text-align: center;">PLASTICITY</td> <td colspan="5" style="text-align: center;">EQUIPMENT USED ON SUBJECT PROJECT</td> </tr> <tr> <td colspan="2">NON PLASTIC</td> <td colspan="2">SLIGHTLY PLASTIC</td> <td colspan="2">MODERATELY PLASTIC</td> <td colspan="2">HIGHLY PLASTIC</td> <td colspan="2"> PLASTICITY INDEX (PI) 0-5 6-15 16-25 26 OR MORE </td> <td colspan="2"> DRY STRENGTH VERY LOW SLIGHT MEDIUM HIGH </td> </tr> <tr> <td colspan="5" style="text-align: center;">COLOR</td> <td colspan="5" style="text-align: center;">DRILL UNITS:</td> </tr> <tr> <td colspan="5" style="font-size: 8pt;"> DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. 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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.					<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><input type="checkbox"/> CME-45C</td> <td><input type="checkbox"/> CLAY BITS</td> <td><input checked="" type="checkbox"/> AUTOMATIC</td> <td><input type="checkbox"/> MANUAL</td> </tr> <tr> <td><input type="checkbox"/> CME-55</td> <td><input type="checkbox"/> 6' CONTINUOUS FLIGHT AUGER</td> <td colspan="2"></td> </tr> <tr> <td><input checked="" type="checkbox"/> CME-550</td> <td><input checked="" type="checkbox"/> 8" HOLLOW AUGERS</td> <td colspan="2"></td> </tr> <tr> <td><input type="checkbox"/> VANE SHEAR TEST</td> <td><input type="checkbox"/> HARD FACED FINGER BITS</td> <td colspan="2"></td> </tr> <tr> <td><input type="checkbox"/> PORTABLE HOIST</td> <td><input type="checkbox"/> TUNG-CARBIDE INSERTS</td> <td colspan="2"></td> </tr> <tr> <td></td> <td><input checked="" type="checkbox"/> CASING</td> <td><input type="checkbox"/> W/ ADVANCER</td> <td></td> </tr> <tr> <td></td> <td><input type="checkbox"/> TRICONE</td> <td><input type="checkbox"/> STEEL TEETH</td> <td></td> </tr> <tr> <td></td> <td><input type="checkbox"/> TRICONE</td> <td><input type="checkbox"/> TUNG-CARB.</td> <td></td> </tr> <tr> <td></td> <td><input checked="" type="checkbox"/> CORE BIT</td> <td colspan="2"></td> </tr> </table>					<input type="checkbox"/> CME-45C	<input type="checkbox"/> CLAY BITS	<input checked="" type="checkbox"/> AUTOMATIC	<input type="checkbox"/> MANUAL	<input type="checkbox"/> CME-55	<input type="checkbox"/> 6' CONTINUOUS FLIGHT AUGER			<input checked="" type="checkbox"/> CME-550	<input checked="" type="checkbox"/> 8" HOLLOW AUGERS			<input type="checkbox"/> VANE SHEAR TEST	<input type="checkbox"/> HARD FACED FINGER BITS			<input type="checkbox"/> PORTABLE HOIST	<input type="checkbox"/> TUNG-CARBIDE INSERTS				<input checked="" type="checkbox"/> CASING	<input type="checkbox"/> W/ ADVANCER			<input type="checkbox"/> TRICONE	<input type="checkbox"/> STEEL TEETH			<input type="checkbox"/> TRICONE	<input type="checkbox"/> TUNG-CARB.			<input checked="" type="checkbox"/> CORE BIT																																																																																																																																																																																																																																																																																																																																																																									
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**NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS (PAGE 2 OF 2)

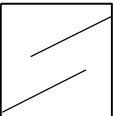
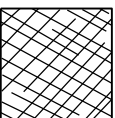
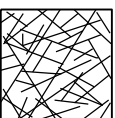

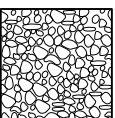
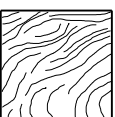
ROCK DESCRIPTION		TERMS AND DEFINITIONS	
<p>HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT REFUSAL IF TESTED, AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 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 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 IN 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>	
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.	
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. <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, WOULD YIELD SPT N VALUES > 100 BPF</i>		
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE THAT ONLY MINOR VESTIGES OF ORIGINAL ROCK FABRIC REMAIN. <i>IF TESTED, WOULD YIELD SPT N VALUES < 100 BPF</i>		
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 PIECES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.		
SOFT	CAN BE GROOVED 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		BEDDING	
TERM	SPACING	TERM	THICKNESS
VERY WIDE	MORE THAN 10 FEET	VERY THICKLY BEDDED	4 FEET
WIDE	3 TO 10 FEET	THICKLY BEDDED	1.5 - 4 FEET
MODERATELY CLOSE	1 TO 3 FEET	THINLY BEDDED	0.16 - 1.5 FEET
CLOSE	0.16 TO 1 FOOT	VERY THINLY BEDDED	0.03 - 0.16 FEET
VERY CLOSE	LESS THAN 0.16 FEET	THICKLY LAMINATED	0.008 - 0.03 FEET
		THINLY LAMINATED	< 0.008 FEET
INDURATION			
FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.			
FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.		
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.		
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.		
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.		
BENCH MARK:			
			ELEVATION: FEET
NOTES:			
FIAD = FILLED IN AFTER DRILLING			
DESIGN FILES, .TIN AND .GPK FILE PROVIDED BY STV.			

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SUBSURFACE INVESTIGATION

**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 1 OF 2)**

AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

<p>GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)</p> <p>From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.</p> <p>STRUCTURE</p>	<p>SURFACE CONDITIONS</p>	<p>VERY GOOD Very rough, fresh unweathered surfaces</p>	<p>GOOD Rough, slightly weathered, iron stained surfaces</p>	<p>FAIR Smooth, moderately weathered and altered surfaces</p>	<p>POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments</p>	<p>VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings</p>
		<p>DECREASING SURFACE QUALITY →</p>				
 <p>INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p>	<p>DECREASING INTERLOCKING OF ROCK PIECES ↓</p>	90			N/A	N/A
 <p>BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p>		80	70			
 <p>VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p>		60	50			
 <p>BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p>		40	30			
 <p>DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p>		20				
 <p>LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>		10	N/A	N/A		

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**SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS (PAGE 2 OF 2)**

AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)

From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.

SURFACE CONDITIONS OF DISCONTINUITIES
(Predominantly bedding planes)

VERY GOOD - Very Rough, fresh unweathered surfaces

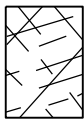
GOOD - Rough, slightly weathered surfaces

FAIR - Smooth, moderately weathered and altered surfaces

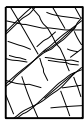
POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments

VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings

COMPOSITION AND STRUCTURE



A. Thick bedded, very blocky sandstone
The effect of peltic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.



B. Sandstone with thin inter-layers of siltstone



C. Sandstone and siltstone in similar amounts



D. Siltstone or silty shale with sandstone layers



E. Weak siltstone or clayey shale with sandstone layers

C, D, E, and G - may be more or less folded than illustrated but this does not change the strength. Tectonic deformation, faulting and loss of continuity moves these categories to **F** and **H**.



F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure

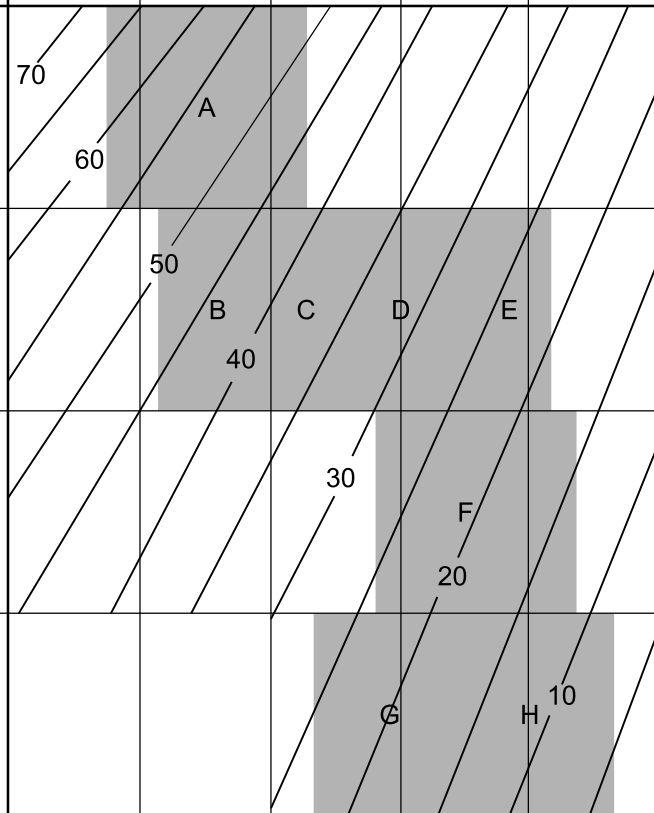


G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers

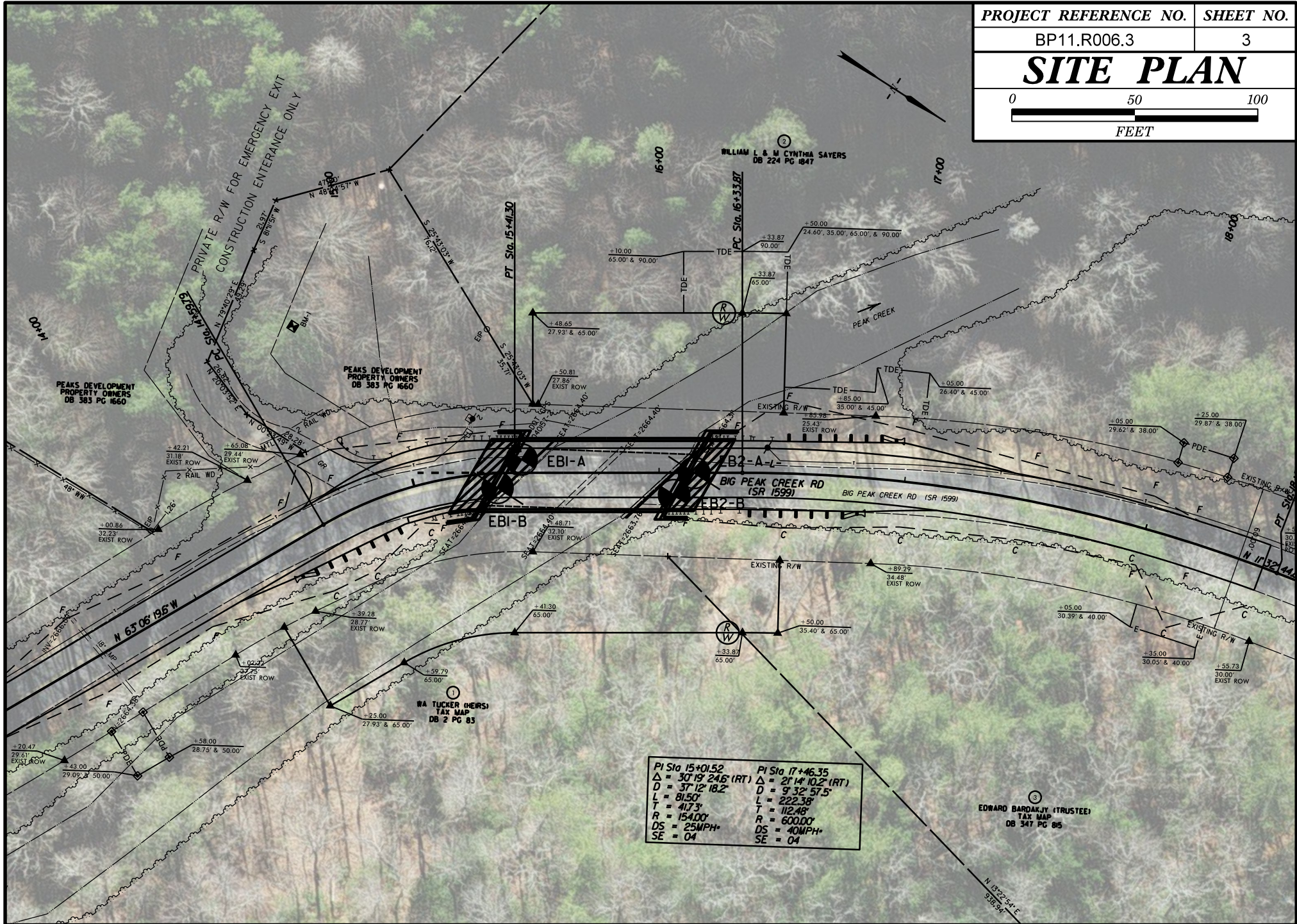


H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.

→ Means deformation after tectonic disturbance



PROJECT REFERENCE NO.	SHEET NO.
BP11.R006.3	3
SITE PLAN	



PI Sta 15+01.52	PI Sta 17+46.35
$\Delta = 30' 19" 24.6' (RT)$	$\Delta = 21' 14" 10.2' (RT)$
$D = 37' 12" 18.2'$	$D = 9' 32" 57.5'$
$L = 81.50'$	$L = 222.38'$
$T = 417.3'$	$T = 112.48'$
$R = 154.00'$	$R = 112.48'$
$DS = 25MPH$	$DS = 40MPH$
$SE = 04$	$SE = 04$

EDWARD BARDAKJY (TRUSTEE)
TAX MAP
DB 347 PG 85

GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP11.R006.1			TIP N/A			COUNTY ASHE			GEOLOGIST A. Blackmore						
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek										GROUND WTR (ft)					
BORING NO. EB1-A			STATION 15+44			OFFSET 5 ft LT			ALIGNMENT -L-						
COLLAR ELEV. 2,666.2 ft			TOTAL DEPTH 14.6 ft			NORTHING 292,245			EASTING 1,315,384						
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022						DRILL METHOD H.S. Augers			HAMMER TYPE Automatic						
DRILLER J. Cain			START DATE 07/14/22			COMP. DATE 07/14/22			SURFACE WATER DEPTH N/A						
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2670															
2665	2,665.2	1.0	6	10	5									2,666.2	0.0
	2,662.7	3.5	1	1	1										
2660	2,660.2	6.0	5	5	4										
	2,657.7	8.5	7	13	11									2,658.2	8.0
2655															
	2,652.7	13.5	100/0.4											2,652.7	13.5
	2,651.6	14.6	60/0.0											2,651.6	14.6

NCDOT BORE SINGLE 09-29664.GPJ NC_DOT_GDT 6/6/23

GEOTECHNICAL BORING REPORT BORE LOG

WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB1-B	STATION 15+34	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 2,666.3 ft	TOTAL DEPTH 17.5 ft	NORTHING 982,243	EASTING 1,315,399
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/18/22	COMP. DATE 07/18/22	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2670															
2665	2,665.3	1.0	4	4	4									2,666.3	0.0
	2,662.8	3.5	1	1	1										
2660	2,660.3	6.0	5	6	7										
	2,657.8	8.5	20	21	51									2,658.3	8.0
2655	2,653.9	12.4												2,653.9	12.4
			60/0.1											2,653.8	12.5
2650														2,648.8	17.5

GROUND SURFACE


ROADWAY EMBANKMENT
Soft to Stiff, Black-Gray, Fine to Coarse Sandy SILT (A-4), with trace rock fragments

ALLUVIAL
Very Dense, Black-Gray, Silty Fine to Coarse SAND (A-2-4), with some rock fragments

CRYSTALLINE ROCK
Green-White (BIOTITE-HORNBLLENDE GNEISS)
Moderately Severe to Very Slightly Weathered, Medium Hard to Hard, White-Green (BIOTITE-HORNBLLENDE GNEISS), with Close to Moderately Close Fracture Spacing
REC = 90%, RQD = 80%, GSI = 60-65
Boring Terminated at Elevation 2,648.8 ft In Crystalline Rock (BIOTITE-HORNBLLENDE GNEISS)

NCDOT BORE SINGLE 09-29664.GPJ NC_DOT_GDT 6/6/23

GEOTECHNICAL BORING REPORT CORE LOG

WBS BP11.R006.1				TIP N/A		COUNTY ASHE			GEOLOGIST A. Blackmore		
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek										GROUND WTR (ft)	
BORING NO. EB1-B				STATION 15+34		OFFSET 6 ft RT			ALIGNMENT -L-		0 HR. N/A
COLLAR ELEV. 2,666.3 ft				TOTAL DEPTH 17.5 ft		NORTHING 982,243			EASTING 1,315,399		24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022						DRILL METHOD H.S. Augers			HAMMER TYPE Automatic		
DRILLER J. Cain				START DATE 07/18/22		COMP. DATE 07/18/22			SURFACE WATER DEPTH N/A		
CORE SIZE NQ				TOTAL RUN 5.0 ft							
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %			
2653.8	2,653.8	12.5	5.0	1:16/1.0 1:20/1.0 2:08/1.0 2:13/1.0 1:42/1.0	(4.5) 90%	(4.0) 80%	(4.5) 90%	(4.0) 80%		2,653.8	12.5
Begin Coring @ 12.5 ft											
2650	2,648.8	17.5								2,648.8	17.5
REC = 90%, RQD = 80%, GSI = 60-65 Boring Terminated at Elevation 2,648.8 ft In Crystalline Rock (BIOTITE-HORNBLLENDE GNEISS)											

NCDOT CORE SINGLE 09-29664.GPJ NC_DOT_GDT 6/2/23



Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek

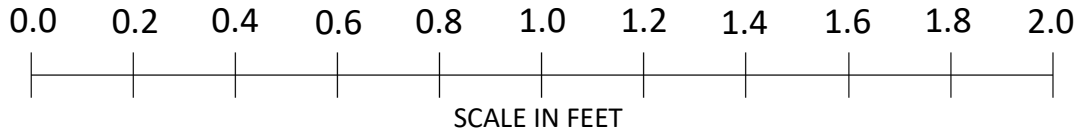
Project ID: 09:29664

Rock Core Photographs: Boring - EB1-B
-L- Station: 15+34 Offset: 6' RT

Begin Run 1
12.5 ft



End Run 1
17.5 ft

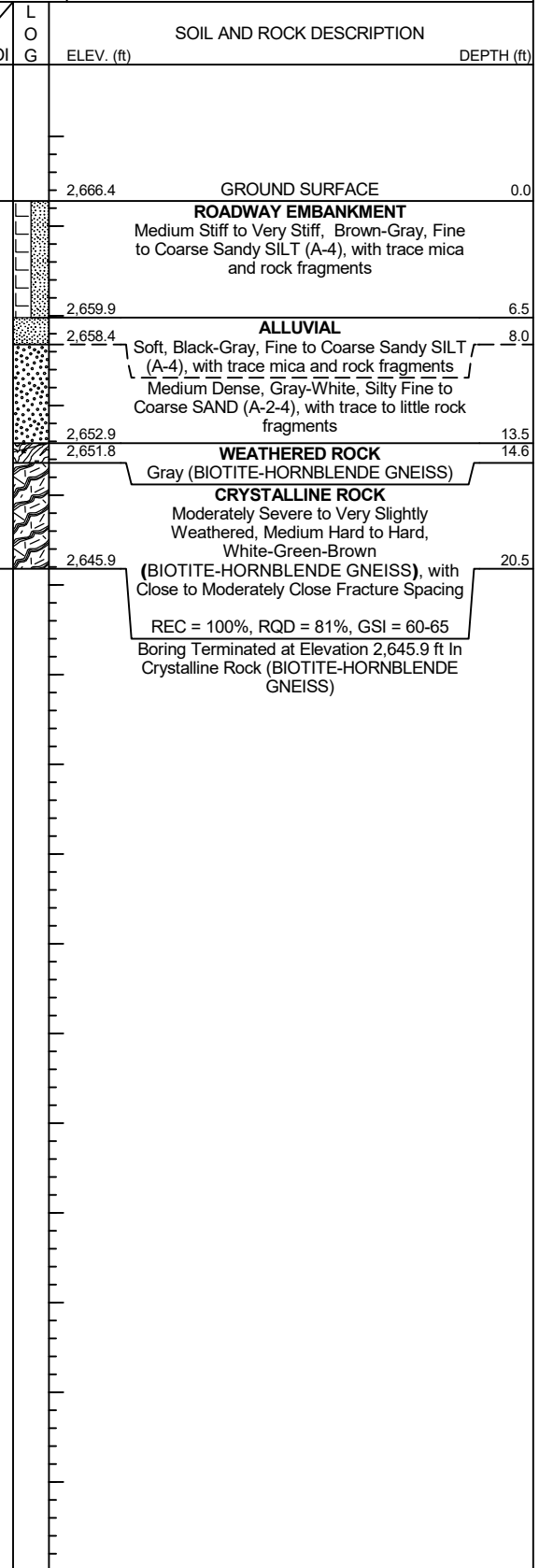


GEOTECHNICAL BORING REPORT

BORE LOG

WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB2-A	STATION 16+14	OFFSET CL	ALIGNMENT -L-
COLLAR ELEV. 2,666.4 ft	TOTAL DEPTH 20.5 ft	NORTHING 982,307	EASTING 1,315,351
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/18/22	COMP. DATE 07/18/22	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					
2670															
2665	2,665.4	1.0	9	11	5									2,666.4	0.0
	2,662.9	3.5	2	6	2										
2660	2,660.4	6.0	WOH	1	2									2,659.9	6.5
	2,657.9	8.5	5	10	12									2,658.4	8.0
2655	2,652.9	13.5	52	48/0.4										2,652.9	13.5
	2,651.8	14.6	60/0.0							100/0.9				2,651.8	14.6
2650														2,645.9	20.5



NCDOT BORE SINGLE 09-29664.GPJ NC_DOT_GDT 6/6/23

GEOTECHNICAL BORING REPORT CORE LOG

WBS BP11.R006.1		TIP N/A		COUNTY ASHE		GEOLOGIST A. Blackmore					
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek							GROUND WTR (ft)				
BORING NO. EB2-A		STATION 16+14		OFFSET CL		ALIGNMENT -L-	0 HR. N/A				
COLLAR ELEV. 2,666.4 ft		TOTAL DEPTH 20.5 ft		NORTHING 982,307		EASTING 1,315,351	24 HR. FIAD				
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022				DRILL METHOD H.S. Augers		HAMMER TYPE Automatic					
DRILLER J. Cain		START DATE 07/18/22		COMP. DATE 07/18/22		SURFACE WATER DEPTH N/A					
CORE SIZE NQ		TOTAL RUN 5.9 ft									
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		STRATA		L O G	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %	REC. (ft) %	RQD (ft) %			
2651.8										Begin Coring @ 14.6 ft	
2650	2,651.8	14.6	3.9	N=60/0.0 1:05/1.0 1:41/1.0 2:20/1.0 1:40/0.9	(3.9) 100%	(2.9) 74%	(5.9) 100%	(4.8) 81%	2,651.8	CRYSTALLINE ROCK Moderately Severe to Very Slightly Weathered, Medium Hard to Hard, White-Green-Brown BIOTITE-HORNBLLENDE GNEISS, with Close to Moderately Close Fracture Spacing	14.6
	2,647.9	18.5	2.0	1:09/1.0 1:37/1.0	(2.0) 100%	(1.9) 95%			2,645.9	REC = 100%, RQD = 81%, GSI = 60-65 Boring Terminated at Elevation 2,645.9 ft In Crystalline Rock (BIOTITE-HORNBLLENDE GNEISS)	20.5

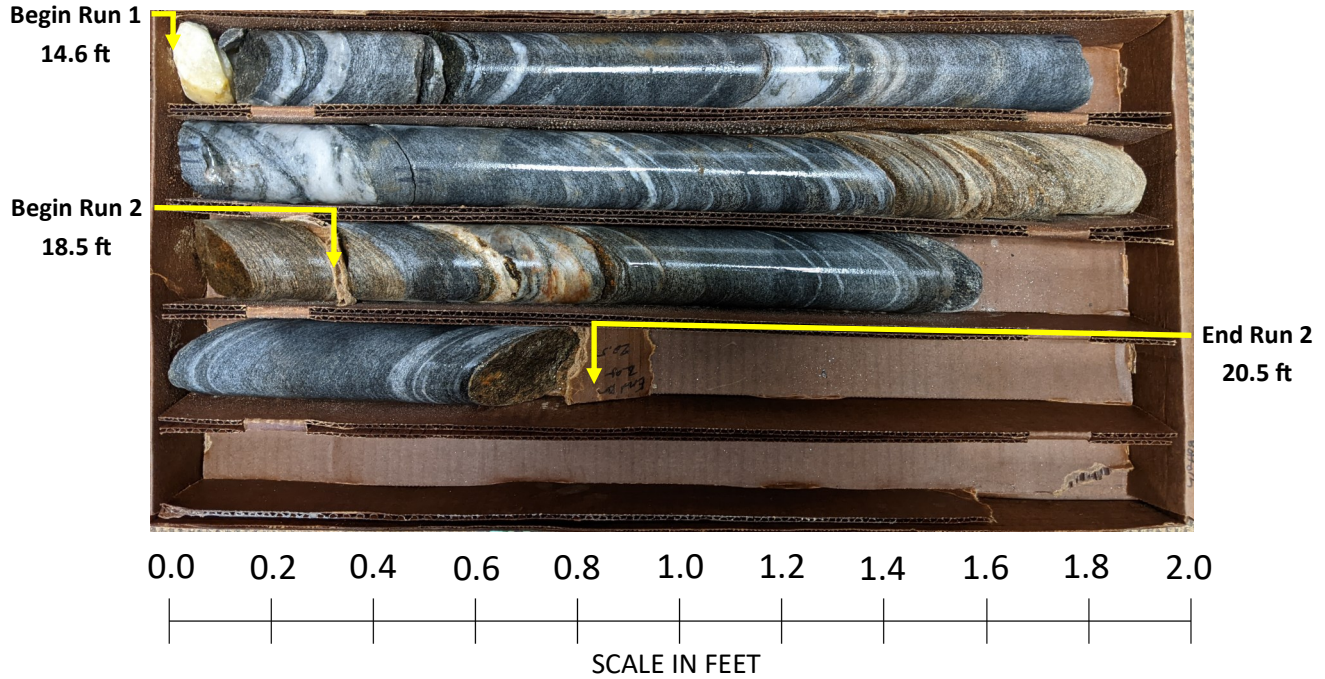
NCDOT CORE SINGLE 09-29664.GPJ NC_DOT.GDT 6/6/23



Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek

Project ID: 09:29664

Rock Core Photographs: Boring - EB2-A
-L- Station: 16+14 Offset: CL



SUPPORTING DOCUMENTATION

BRIDGE SURVEY & HYDRAULIC DESIGN REPORT

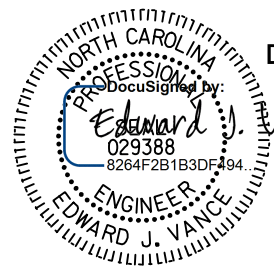
N. C. DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
HYDRAULICS UNIT
RALEIGH, N. C.

State Proj. Reference No. SF-040157 WBS Project No. BP11.R006.1 Proj. Station -L- 15+73
County ASHE Bridge Over PEAK CREEK Bridge Inv. No. 157
SR 1599 SR 1604
On Highway (BIG PEAK CREEK RD) Between NC-88 and (CARSON WOODS RD)
Recommended Structure 1@75' (27" BOX BEAM) BRIDGE W/ VERTICAL ABUTMENTS, AND
3.5' VERTICAL CONCRETE BARRIER RAIL
Recommended Width of Roadway 27'-10" CLEAR ROADWAY Skew 120 DEGREES
Recommended Location is (Up/At/Down) Stream from Existing Crossing, AT EXISTING CROSSING

Longitude -81.32703 Latitude 36.42674
Statewide Tier Regional Tier Sub-Regional Tier
Bench Mark is BM-1, -L- STA. 14+79.79, 77.8' LT 8" SPIKE IN ROOT OF 15" POPLAR TREE
Northing 982138 Easting 1315389 Elev. 2678.67 ft. Datum: NAVD 88
Temporary Crossing OFFSITE DETOUR



EDWARD VANCE, PE
Designed by: STV ENGINEERS, INC. (LICENSE NO. F-0991)
Assisted by: MARK PUGH, PE



Date 1/4/2023



DocuSigned by: *Mark T. Shown*
QA Review by: *Mark T. Shown* Date 01/04/2023

Drainage Area 10.6 SQ MILES Source USGS STREAMSTATS
River Basin NEW Character RURAL REGION 2
Stream Classification (Such as Trout, High Quality Water, etc.) B, Tr, +
Data on Existing Structure STEEL DECK ON I-BEAMS (2@30'-4") W/VERTICAL TIMBER ABUTMENTS OAL=61'
Total Waterway Opening 189 s.f.
Waterway Opening Below 100yr. WS EL. 189 s.f.
Debris Potential: Low X Moderate High
Data on Structures Up and Down Stream
US: TIMBER DECK ON I-BEAMS (040169) (1@47'-10") OAL=48'
DS: PRESTRESSED CONCRETE CORED SLAB (040037) (1@31'-1", 1@61'-1", 1@31'-1") OAL=123'
Design Control Elev. 2666.4 ft. (MEET 10-YEAR LEVEL OF SERVICE - SHOULDER ELEV. @ LOW POINT)
Gage Station No. NA Period of Records NA
Max. Discharge NA c.f.s. Date NA Frequency NA

Historical Flood Information:
Date Elev. ft. Est. Freq. yr. Source CHAD COX ASHE COUNTY BRIDGE MAINTENANCE SUPERVISOR Period of Knowledge yrs.
Date Elev. ft. Est. Freq. yr. Source ASHE COUNTY BRIDGE MAINTENANCE SUPERVISOR Period of Knowledge yrs.
Date Elev. ft. Est. Freq. yr. Source ASHE COUNTY BRIDGE MAINTENANCE SUPERVISOR Period of Knowledge yrs.
Historical Scour Info: General N/A ft. Contraction N/A ft. Local N/A ft.
Channel Slope 0.0075 f/ft Source LIDAR Normal Water Surface Elev. 2659.1 ft.
Manning's n: Left O.B. 0.15 Channel 0.048 Right O.B. 0.15 Source FIS/FIELD VERIFIED
Flood Study /Status LIMITED (ASHE CO. FIS 11/4/2009, PANEL: 3918)
Flood Study 100yr. Discharge 3285 c.f.s. WS Elev.: Encroachment 2672.83 ft. Without Non-Encroachment 2671.83ft. @ River Station 11416

DESIGN DATA
Hydrological Method USE SIR 2009-5158 FOR DESIGN, USE FEMA FOR COMPLIANCE AND 100-YEAR DESIGN
Hydraulic Design Method HEC-RAS 6.2 (SF-040157 PEAK CREEK SR 1599)
Floods Evaluated: Freq. (yr) Q (cfs) Elev. (ft) Backwater (ft) Bridge Opening Velocity (f.p.s.)
@ River Station 11108
10 1600 2665.2 0.0 4.8
25 2200 2666.8 0.1 6.6
50 2600 2667.9 0.5 7.8
100 3285 2669.6 1.0 9.1
500 4200 2671.4 1.4 10.1
Waterway Opening Provided Below Design W.S. Elev. 332 s.f., 100yr W.S. Elev. 332 s.f., Total 332 s.f.,
Average Channel Velocity (Design) 8.7 f.p.s. Average Overbank Velocity (Design) 0.9 f.p.s.
Computed Scour: General NA ft. Contraction 0.0 ft. Local 0.0 ft.
State Floodway Compliance Type SFC TYPE B, MAX. INCREASE OF 0.09' @ RS 10948 & MAX. DECREASE OF 0.38' @ RS 11416

INFORMATION TO BE SHOWN ON PLANS

HYDRAULIC DATA	
DESIGN DISCHARGE	= 1600 C.F.S.
FREQUENCY OF DESIGN FLOOD	= 10 YRS.
DESIGN HIGH WATER ELEVATION	= 2665.2'
DRAINAGE AREA	= 10.6 SQ. MI.
BASIC DISCHARGE (Q100)	= 3285 C.F.S.
BASIC HIGH WATER ELEVATION	= 2668.6'

OVERTOPPING FLOOD DATA	
OVERTOPPING DISCHARGE	= 2600 C.F.S.
FREQUENCY OF OVERTOPPING FLOOD	= 50 YRS.
OVERTOPPING FLOOD ELEVATION	= 2668.3'

*14'-83.28" HIGH SIDE SHOULDER ELEVATION
WS EL. Taken @ River Station 11108

ADDITIONAL INFORMATION AND COMPUTATIONS

USGS REGRESSION EQUATIONS FEMA DISCHARGES
SIR 2009-5158, RURAL BLUE RIDGE
 $Q_x = 110 (10.6)^{0.779} = 692$ SAY 700 CFS
 $Q_x = 209 (10.6)^{0.749} = 1225$ SAY 1200 CFS
 $Q_{10} = 288 (10.6)^{0.758} = 1637$ SAY 1600 CFS
 $Q_{25} = 398 (10.6)^{0.774} = 2199$ SAY 2200 CFS
 $Q_{50} = 479 (10.6)^{0.778} = 2609$ SAY 2600 CFS
 $Q_{100} = 575 (10.6)^{0.773} = 3095$ USE FEMA $Q_{100} = 3285$ CFS
 $Q_{500} = 794 (10.6)^{0.704} = 4184$ SAY 4200 CFS

NOTE: USE USGS FLOWS FOR DESIGN AND FEMA Q_{100} FLOWS FOR DESIGN & COMPLIANCE

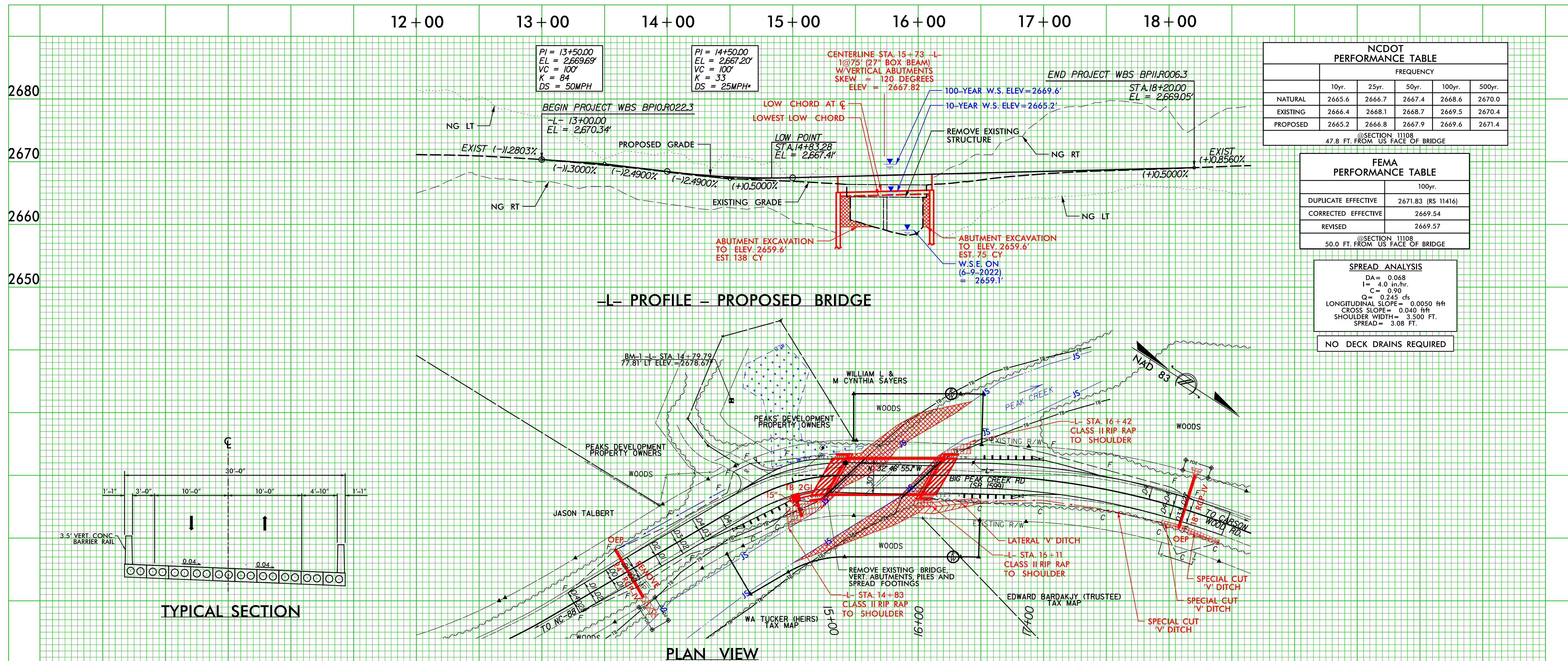
SCOUR ANALYSIS


BED MATERIAL IS BOULDERS, COBBLES, AND GRAVEL BANKS ARE STEEP, WELL VEGETATED, AND STABLE

(100-YEAR OVERTOPPING) CONTRACTION SCOUR:
 $Y_s = Y_1 (Q_1/Q_2)^{0.2} (W_1/W_2)^{0.5}$ $Y_s = 9.32 [3032.09/3149.14]^{0.2} [32.70/61.70]^{0.5}$
 $Y_s = Y_2 - Y_0$ $Y_s = 5.82 - 5.87 = -0.05'$ SAY 0.0'

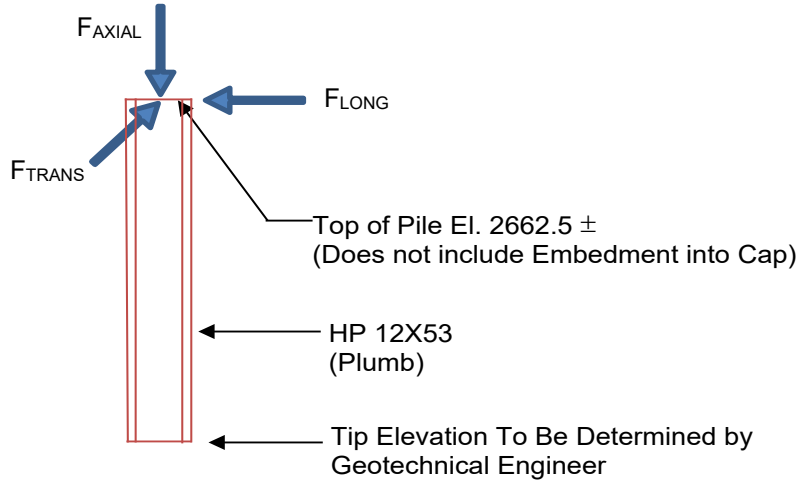
ABUTMENT SCOUR: 100yr. (NCHRP 24-20 EQUATION)
 $Y_{s,ab} = \alpha(Y_s) = \alpha(Y_1) (q_1/q_2)^{0.2}$ $Y_{s,ab} = (Y_s) = 1.00 [9.32(49.14/96.30)]^{0.2}$
 $Y_s = Y_{s,max} - Y_0$ $Y_s = 5.24 - 5.87 = -0.63'$ SAY 0.0'

*ACCORDING TO INFORMATION PROVIDED BY CHAD COX, NCDOT BRIDGE MAINTENANCE ENGINEER, THE BRIDGE FREQUENTLY OVERTOPS DURING STORM EVENTS.
NO STRUCTURES UPSTREAM OR DOWNSTREAM THAT WERE IN PLACE AT THE TIME THIS PROJECT WAS DESIGNED WILL BE ADVERSELY IMPACTED BY INCREASES GREATER THAN 0.00'



	Project:	DIV 11: R.006	Orig. By:	SGH	Date:	2/28/2023
	Client:	NCDOT	Ck. By:	JTG	Date:	5/30/2023
Subject:	End Bent 1 Foundation Loads (End Bent 2 Similar)	Bkck. By:	SGH	Date:	5/30/2023	
		Ver. By:		Date:		
		Job. No.:		4021458		

End Bent 1 Foundation Loads - Final Condition



Load Combination	F_{TRANS} (k)	F_{AXIAL} (k)	F_{LONG} (k)
Service I	-5	135	15
Strength I	-4	190	14
Strength III	-1	125	12
Strength V	-2	175	14

All loads are given at Bottom of Cap

** F_{LONG} acts along the strong axis of the pile, and F_{TRANS} acts along the weak axis.

PROJECT WBS: BP11.R006.3

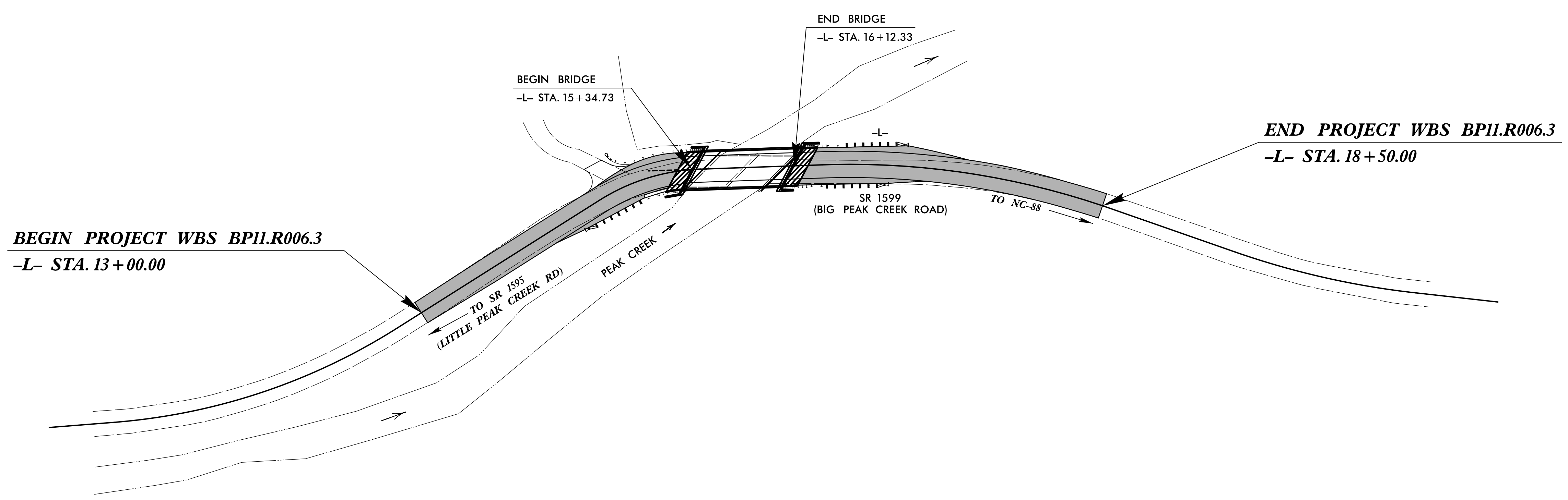
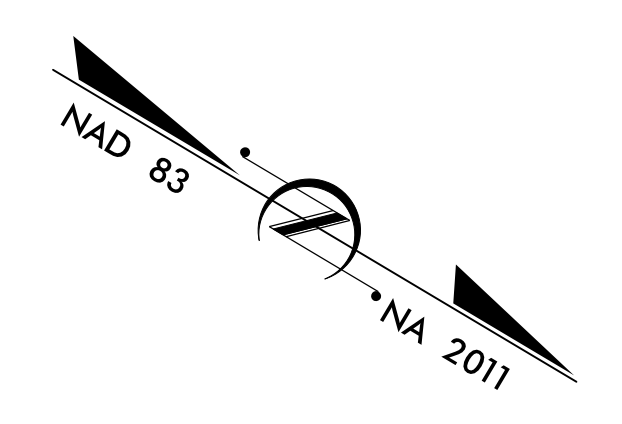
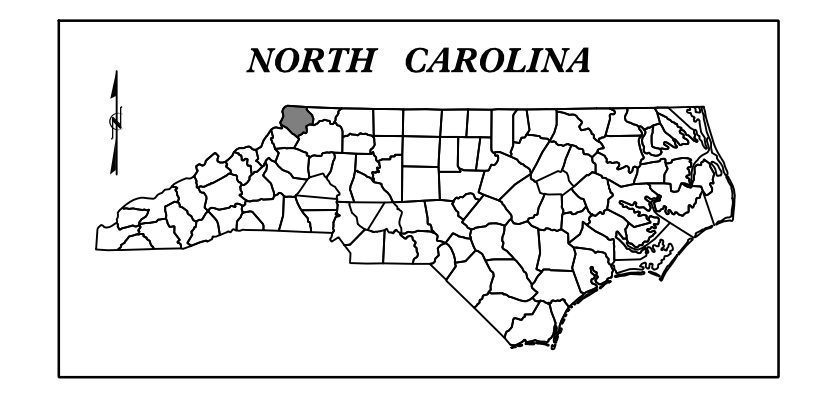
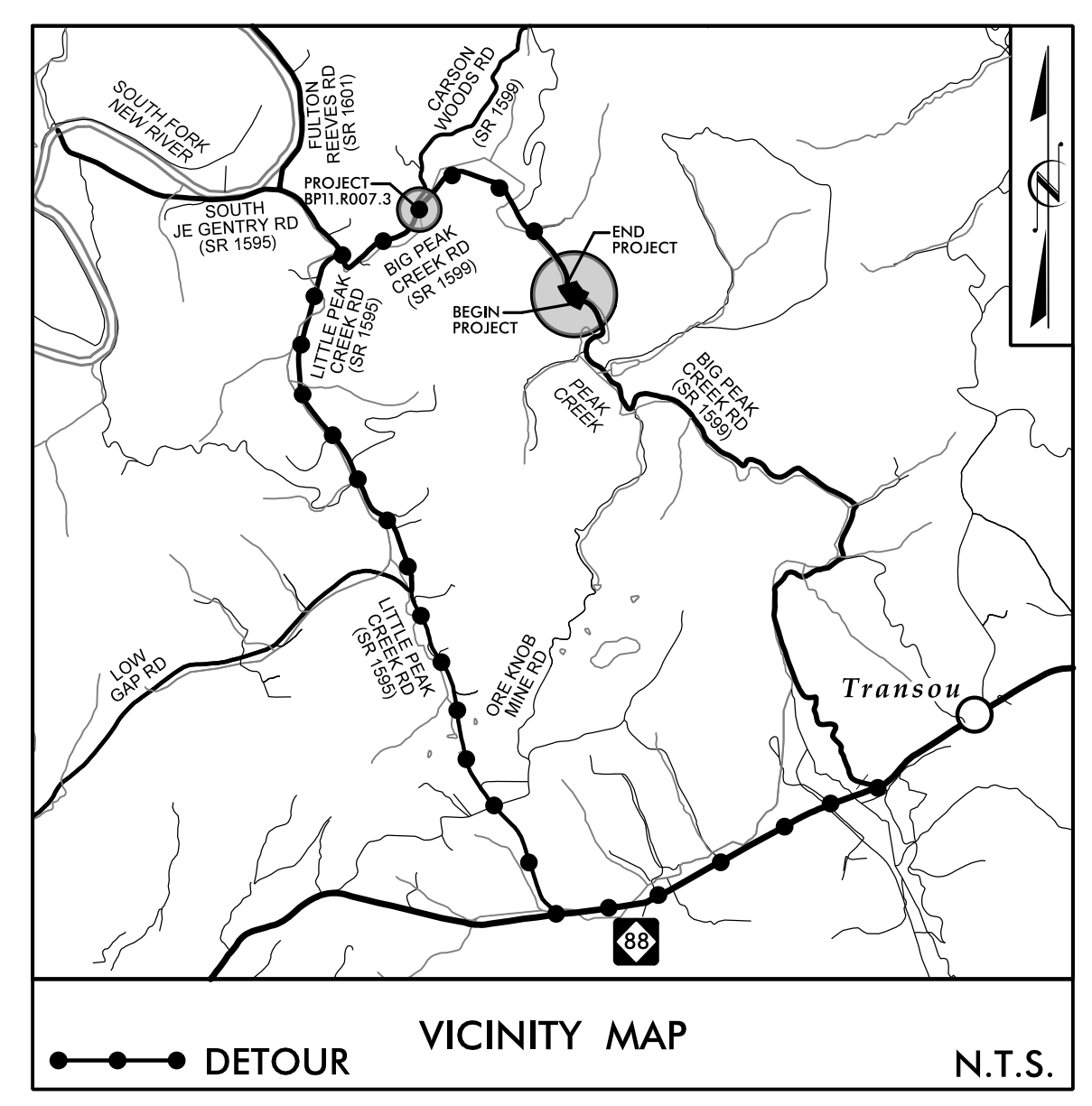
CONTRACT:

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

ASHE COUNTY

**LOCATION: BRIDGE #157 OVER PEAK CREEK
ON BIG PEAK CREEK ROAD (SR 1599)**
TYPE OF WORK: GRADING, PAVING, DRAINAGE, & STRUCTURE

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	BP11.R006.3	1	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
BP11.R006.1		P.E.	
BP11.R006.2		ROW & UTILITY	
BP11.R006.3		CONSTRUCTION	



STRUCTURES

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION
DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

DESIGN DATA

ADT 2015 =	80
ADT 2025 =	160
DHV =	N/A
D =	N/A
T =	0%
V =	55 MPH

FUNC. CLASSIFICATION:
SUB REGIONAL TIER

PROJECT LENGTH

LENGTH OF ROADWAY PROJECT WBS BP11.R006.3 =	0.083 MILES
LENGTH OF STRUCTURE PROJECT WBS BP11.R006.3 =	0.015 MILES
TOTAL LENGTH OF PROJECT WBS BP11.R006.3 =	0.098 MILES

NCDOT CONTACT: JOE LAWS, PE
Division Bridge Manager

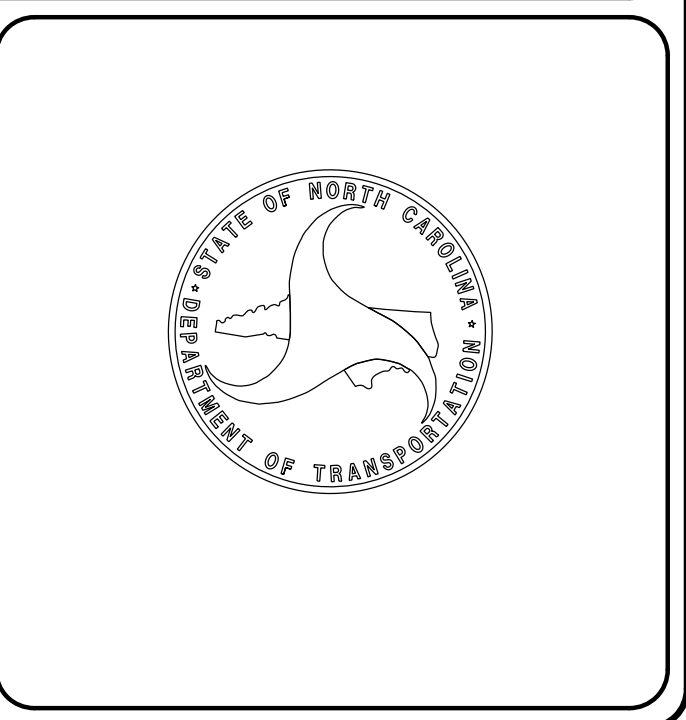
PLANS PREPARED FOR THE NCDOT BY:

stv STV Engineers, Inc.
900 West Trade St., Suite 715
Charlotte, NC 28202
NC License Number F-0991

2018 STANDARD SPECIFICATIONS	
RIGHT OF WAY DATE: OCTOBER 3, 2022	<u>JASON T. GRISCOM, PE</u> PROJECT ENGINEER
LETTING DATE: AUGUST 3, 2023	<u>SPENCER G. HENSLEY</u> PROJECT DESIGNER

STRUCTURES ENGINEER

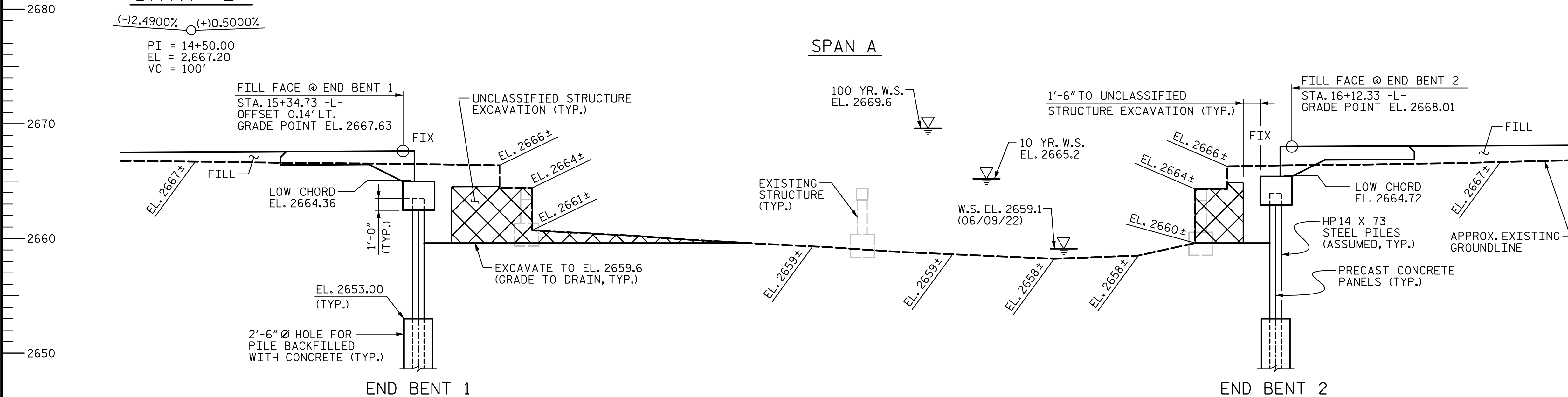
SIGNATURE: _____ P.E.



VERTICAL CURVE

DATA -L-

(-)-2.4900% (+)0.5000%
 PI = 14+50.00
 EL = 2,667.20
 VC = 100'



HYDRAULIC DATA

DESIGN DISCHARGE: 1,600 CFS
 FREQUENCY OF DESIGN FLOOD: 10 YRS.
 DESIGN HIGH WATER ELEVATION: 2,665.2
 DRAINAGE AREA: 10.6 SQ. MI.
 BASE DISCHARGE (Q100): 3,285 C.F.S.
 BASE HIGH WATER ELEVATION: 2,669.6

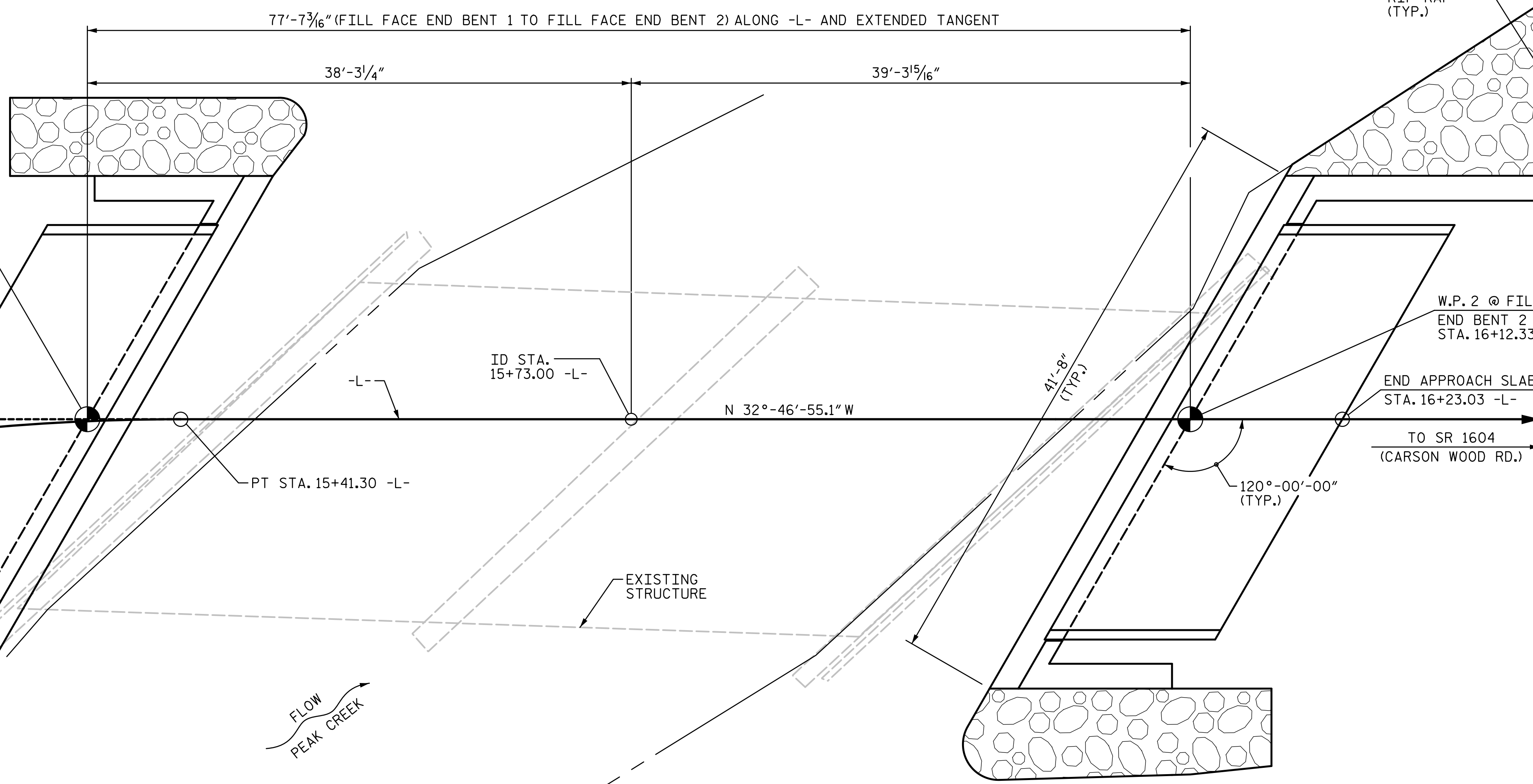
OVERTOPPING DATA

OVERTOPPING DISCHARGE: 2,600 C.F.S.
 FREQUENCY OF OVERTOPPING: 50 YRS.
 OVERTOPPING FLOOD ELEVATION: 2,668.3

OVERTOPPING OCCURS @ STA. 14+83.28 -L- ON HIGH SIDE SHOULDER ELEVATION
 WS EL. TAKEN @ RIVER STATION 11108

SECTION ALONG -L-

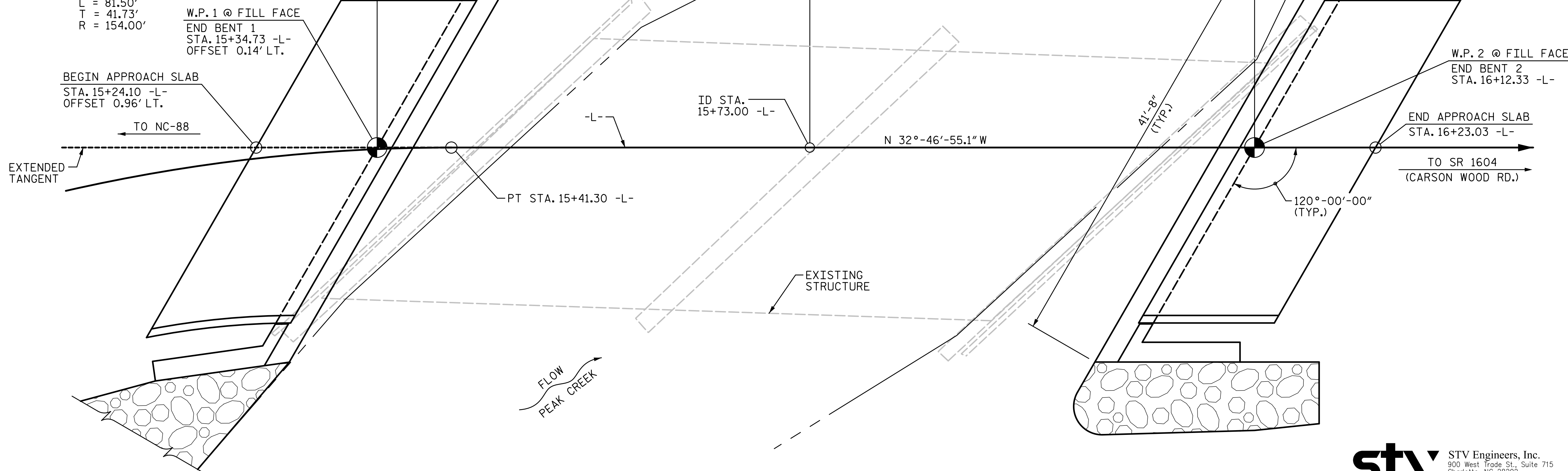
(SECTIONS TAKEN AT RIGHT ANGLES TO END BENTS)



HORIZONTAL CURVE

DATA -L-

PI = 15+01.52
 Δ = 30°-19'-24.6" (RT.)
 D = 37°-12'-18.2"
 L = 81.50'
 T = 41.73'
 R = 154.00'



PRELIMINARY PLANS
 DO NOT USE FOR CONSTRUCTION

PROJECT NO. BP11.R006.1

ASHE COUNTY

STATION: 15+73.00 -L-

SHEET 1 OF 2 REPLACES BRIDGE NO. 040157

STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH
PRELIMINARY GENERAL DRAWING
 FOR BRIDGE ON SR 1599
 OVER PEAK CREEK
 BETWEEN NC-88 AND SR 1604

stv STV Engineers, Inc.
 900 West Trade St., Suite 715
 Charlotte, NC 28202
 NC License Number F-0991

DOCUMENT NOT CONSIDERED
 FINAL UNLESS ALL
 SIGNATURES COMPLETED

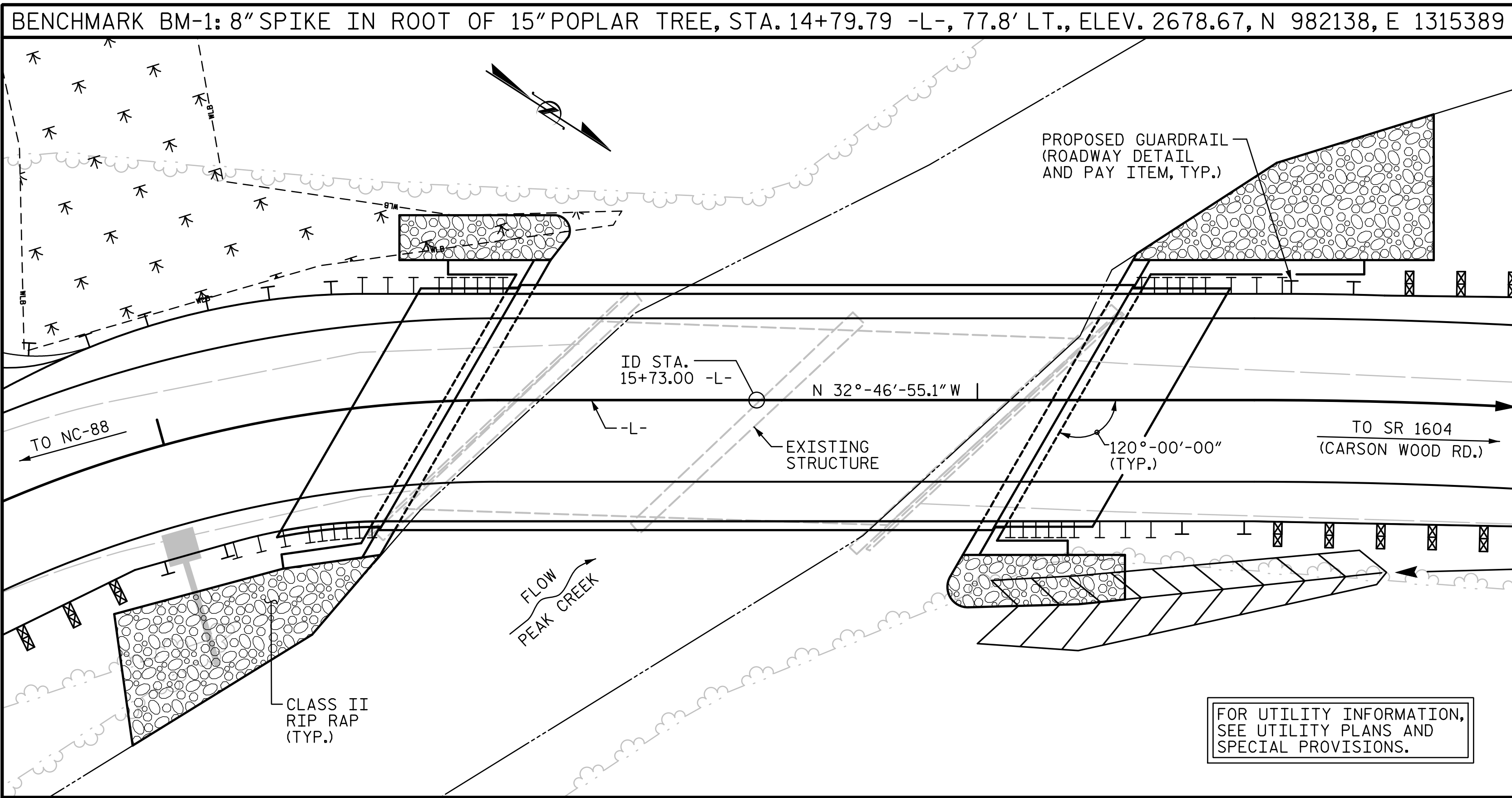
DRAWN BY : SGH DATE : 1-23
 CHECKED BY : MLO DATE : 1-23
 DESIGN ENGINEER OF RECORD : J. GRISCOM DATE : 4-23

PLAN
 (STEEL PILES AND PRECAST CONCRETE PANELS NOT SHOWN FOR CLARITY)

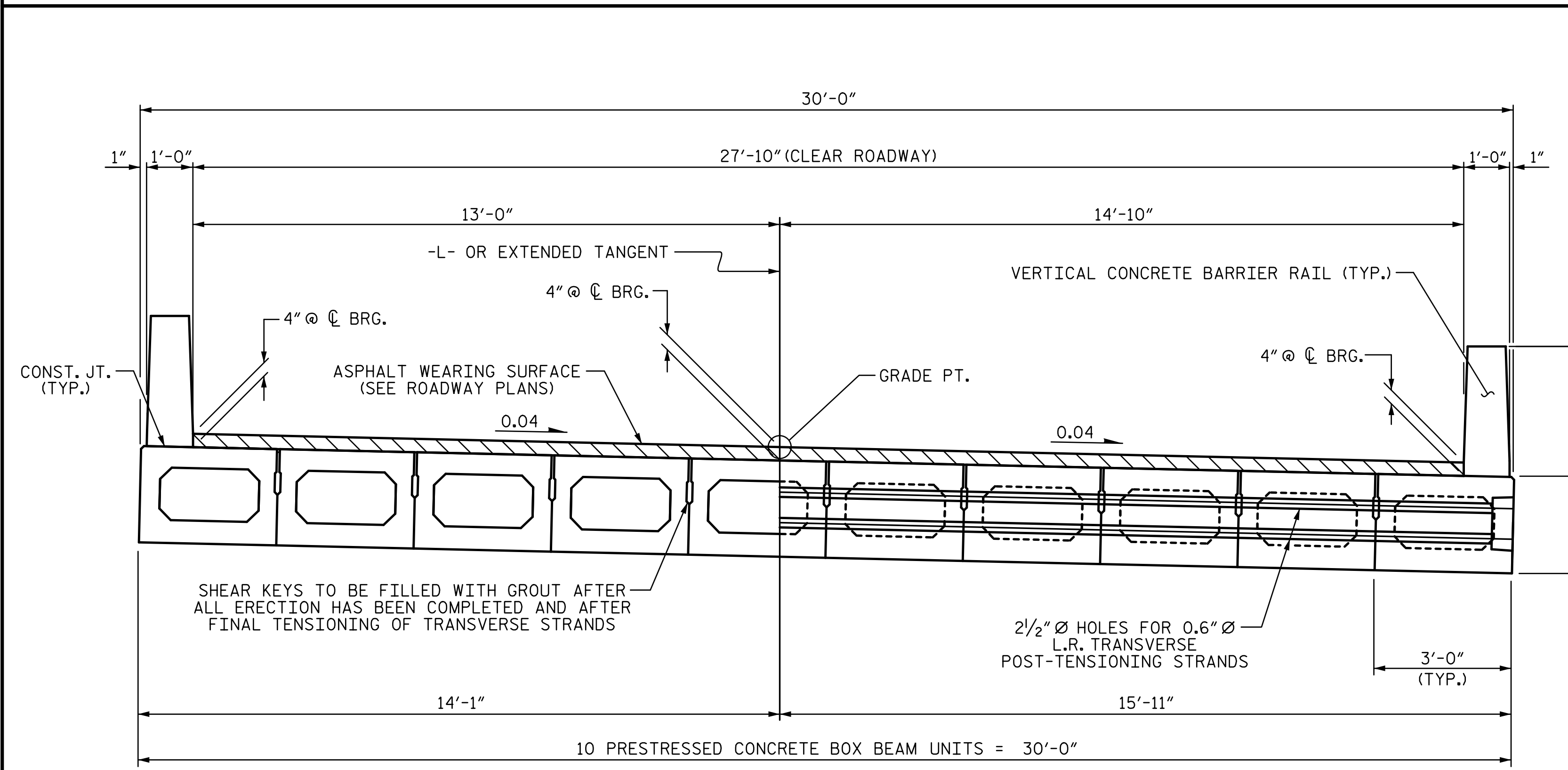
REVISIONS				SHEET NO.
NO.	BY:	DATE:	NO.	DATE:
1			3	
2			4	

S-1
 TOTAL SHEETS 2

R:\Structures\Station\Preliminary Plans\401001.BP11.R006.1.SML.PCDL.001.040157.dgn
 4/13/2023 10:00:04 AM hensleg



LOCATION SKETCH

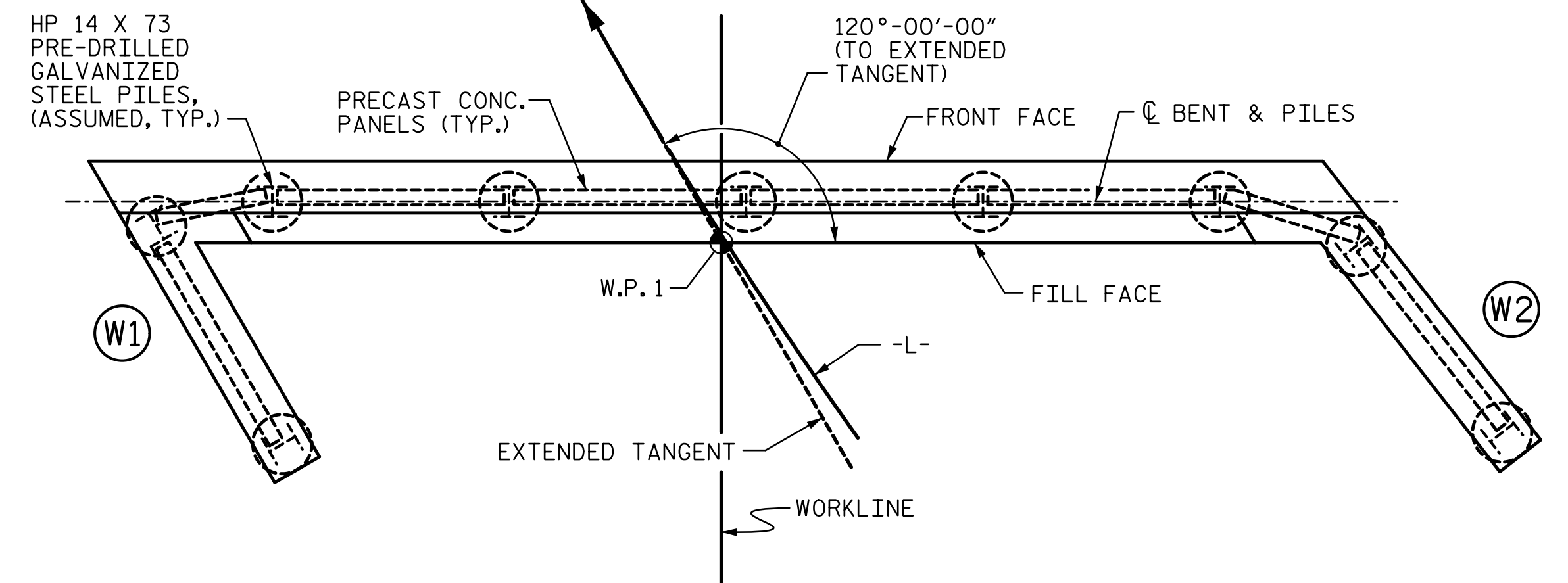


HALF SECTION THROUGH VOIDS

HALF SECTION AT INTERMEDIATE DIAPHRAGMS

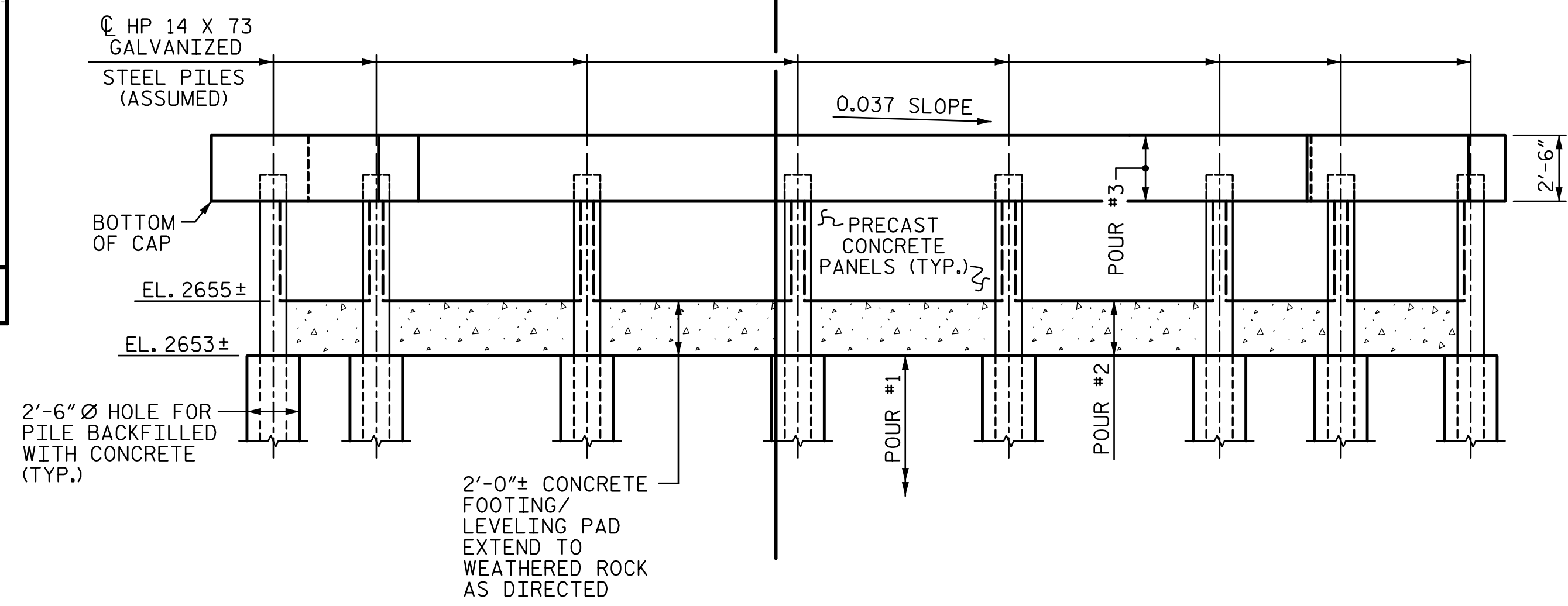
TYPICAL SECTION

*THE MAXIMUM BARRIER RAIL HEIGHT AND ASPHALT THICKNESS IS SHOWN. THE HEIGHT OF THE BARRIER RAIL AND ASPHALT THICKNESS VARIES WHILE THE TOP OF THE BARRIER RAIL FOLLOWS THE PROFILE OF THE GUTTERLINE.



PLAN OF WALL LAYOUT

END BENT 1 SHOWN, END BENT 2 SIMILAR



ELEVATION

END BENT 1 SHOWN, END BENT 2 SIMILAR. WING 1 PILE AND PRECAST CONCRETE PANEL NOT SHOWN FOR CLARITY. UPPER PORTION OF WINGS 1 AND 2 NOT SHOWN FOR CLARITY.

GENERAL NOTES

ASSUMED LIVE LOAD = HL-93 OR ALTERNATE LOADING.

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

THIS BRIDGE IS LOCATED IN SEISMIC ZONE 1.

PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

PROJECT NO. BP11.R006.1

ASHE COUNTY

STATION: 15+73.00 -L-

SHEET 2 OF 2

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

PRELIMINARY
GENERAL DRAWING
FOR BRIDGE ON SR 1599
OVER PEAK CREEK
BETWEEN NC-88 AND SR 1604

STV STV Engineers, Inc.
900 West Trade St., Suite 715
Charlotte, NC 28202
NC License Number F-0991

DOCUMENT NOT CONSIDERED
FINAL UNLESS ALL
SIGNATURES COMPLETED

REVISIONS				SHEET NO.
NO.	BY:	DATE:	NO.	DATE:
1			3	
2			4	

S-2
TOTAL SHEETS
2

4/13/2023 10:00:24 AM R:\Structures\Station\Preliminary Plans\401_003_BP11.R006.L_SMU_PGD2_002_040157.dgn

hensleg

DRAWN BY : SGH DATE : 1-23

CHECKED BY : MLO DATE : 1-23

DESIGN ENGINEER OF RECORD : J. GRISCOM DATE : 4-23

NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR DOWELS.

THE CONCRETE IN THE SHADED AREA OF THE WING SHALL BE POURED AFTER THE VERTICAL CONCRETE BARRIER RAIL IS CAST IF SLIP FORMING IS USED.

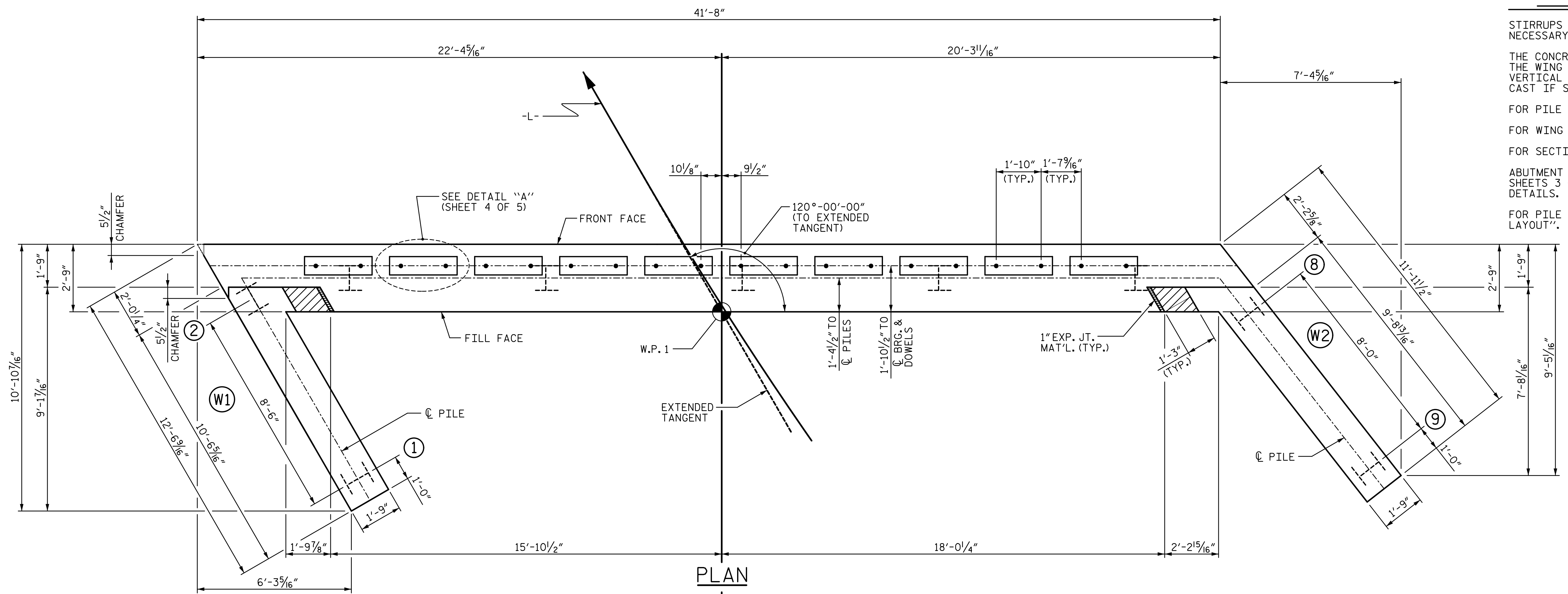
FOR PILE SPLICE DETAILS, SEE SHEET 4 OF 5.

FOR WING DETAILS, SEE SHEET 2 OF 5.

FOR SECTION A-A, SEE SHEET 4 OF 5.

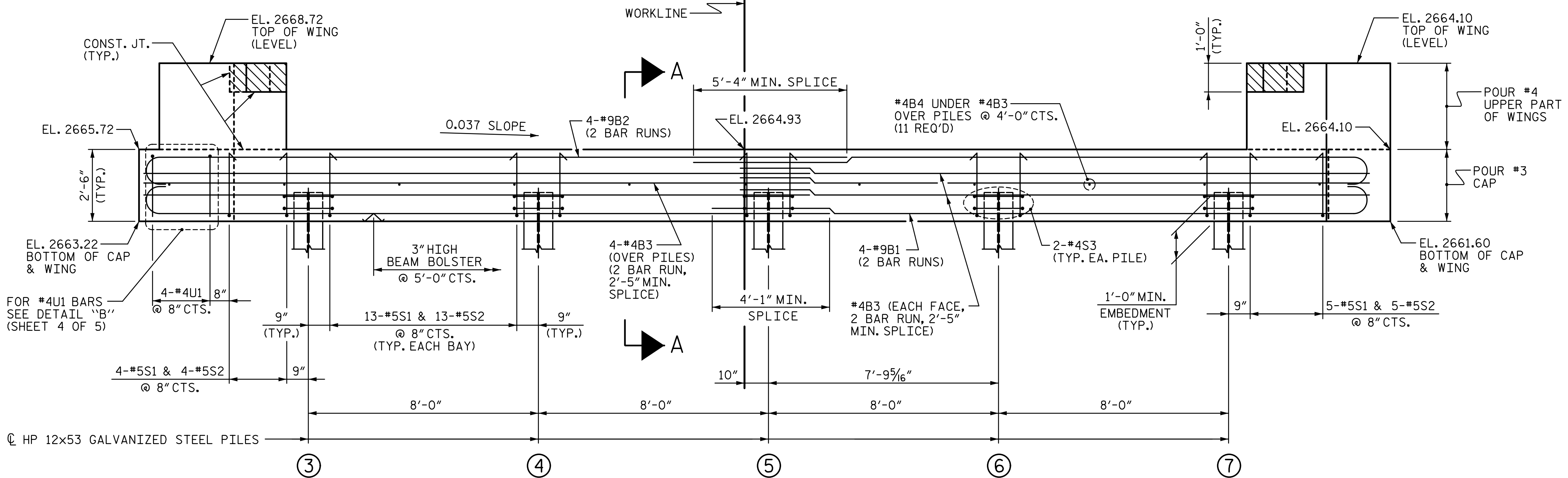
ABUTMENT WALL NOT SHOWN FOR CLARITY, SEE SHEETS 3 OF 5, 4 OF 5, AND 5 OF 5 FOR DETAILS.

FOR PILE LOCATIONS, SEE "FOUNDATION LAYOUT".



TOP OF PILE ELEVATIONS	
①	2664.22
②	2664.22
③	2664.01
④	2663.71
⑤	2663.42
⑥	2663.12
⑦	2662.83
⑧	2662.60
⑨	2662.60

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ELEVATION
WINGS NOT SHOWN FOR CLARITY.

PROJECT NO. BP11.R006.1
ASHE COUNTY
 STATION: 15+73.00 -L-
 SHEET 1 OF 5

STATE OF NORTH CAROLINA
 DEPARTMENT OF TRANSPORTATION
 RALEIGH

**SUBSTRUCTURE
 END BENT No. 1**

DRAWN BY : SCH DATE : 3-23
 CHECKED BY : JTG DATE : 6-23
 DESIGN ENGINEER OF RECORD : J. GRISCOM DATE : 6-23



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

REVISIONS				SHEET NO.	
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

TOTAL SHEETS 24

NOTES

STIRRUPS IN CAP MAY BE SHIFTED AS NECESSARY TO CLEAR DOWELS.

THE CONCRETE IN THE SHADED AREA OF THE WING SHALL BE POURED AFTER THE VERTICAL CONCRETE BARRIER RAIL IS CAST IF SLIP FORMING IS USED.

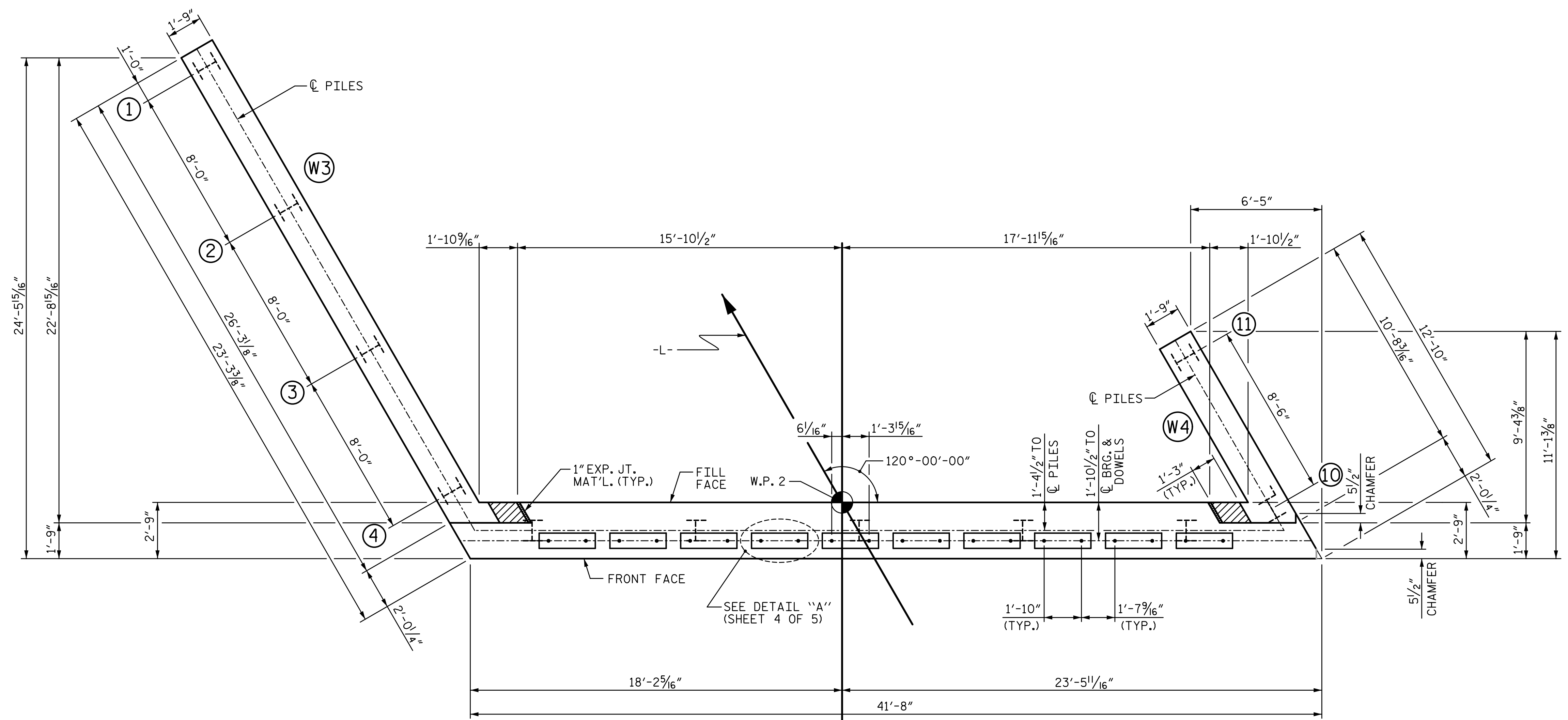
FOR PILE SPLICE DETAILS, SEE SHEET 4 OF 5.

FOR WING DETAILS, SEE SHEET 2 OF 5.

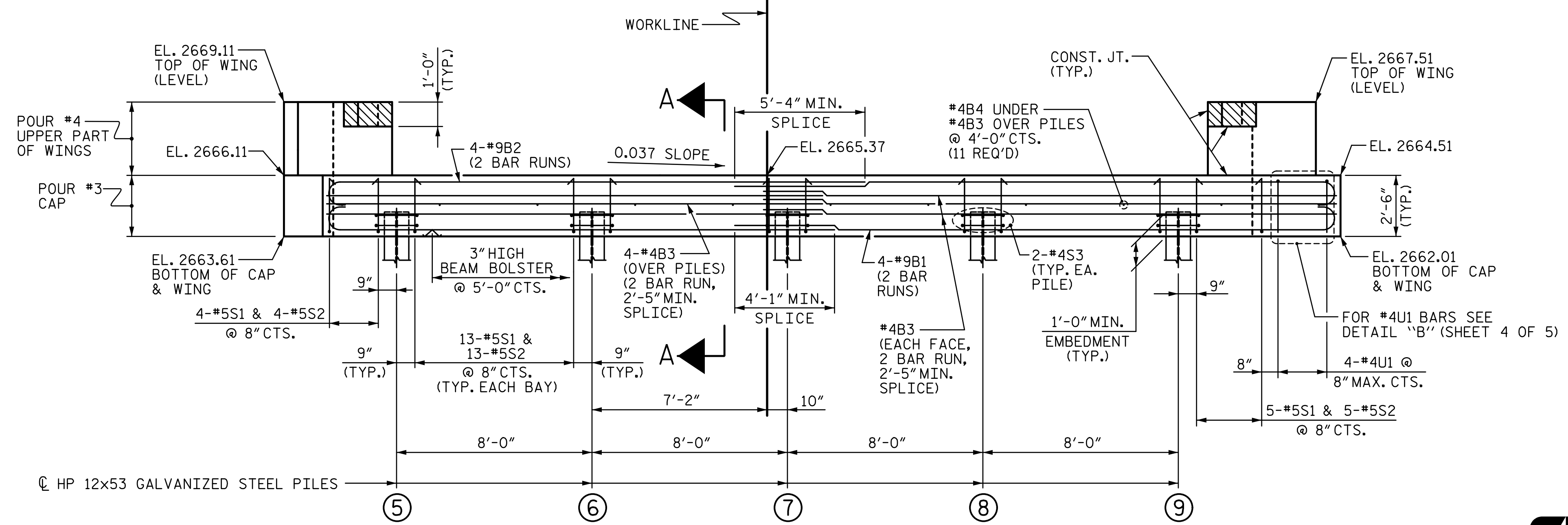
FOR SECTION A-A, SEE SHEET 4 OF 5.

ABUTMENT WALL NOT SHOWN FOR CLARITY, SEE SHEETS 3 OF 5, 4 OF 5, AND 5 OF 5 FOR DETAILS.

FOR PILE LOCATIONS SEE "FOUNDATION LAYOUT".



PLAN



ELEVATION

WINGS NOT SHOWN FOR CLARITY.

TOP OF PILE ELEVATIONS	
①	2664.61
②	2664.61
③	2664.61
④	2664.61
⑤	2664.46
⑥	2664.16
⑦	2663.87
⑧	2663.57
⑨	2663.28
⑩	2663.01
⑪	2663.01

PROJECT NO. BP11.R006.1

ASHE COUNTY

STATION: 15+73.00 -L-

SHEET 1 OF 5

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
RALEIGH

**SUBSTRUCTURE
END BENT No. 2**

REVISIONS				SHEET NO.	
NO.	BY:	DATE:	NO.	BY:	DATE:
1			3		
2			4		

S-17
TOTAL SHEETS
24



DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED

R:\Structures\Station\401_033_BP11.R006.1_SMJ_EB2L017_40157.dgn 3:56:50 PM 5/31/2023 HensleSG

DRAWN BY :	SCH	DATE :	3-23
CHECKED BY :	JTG	DATE :	6-23
DESIGN ENGINEER OF RECORD :	J. GRISCOM	DATE :	6-23

GEOTECHNICAL BORING REPORT

BORE LOG

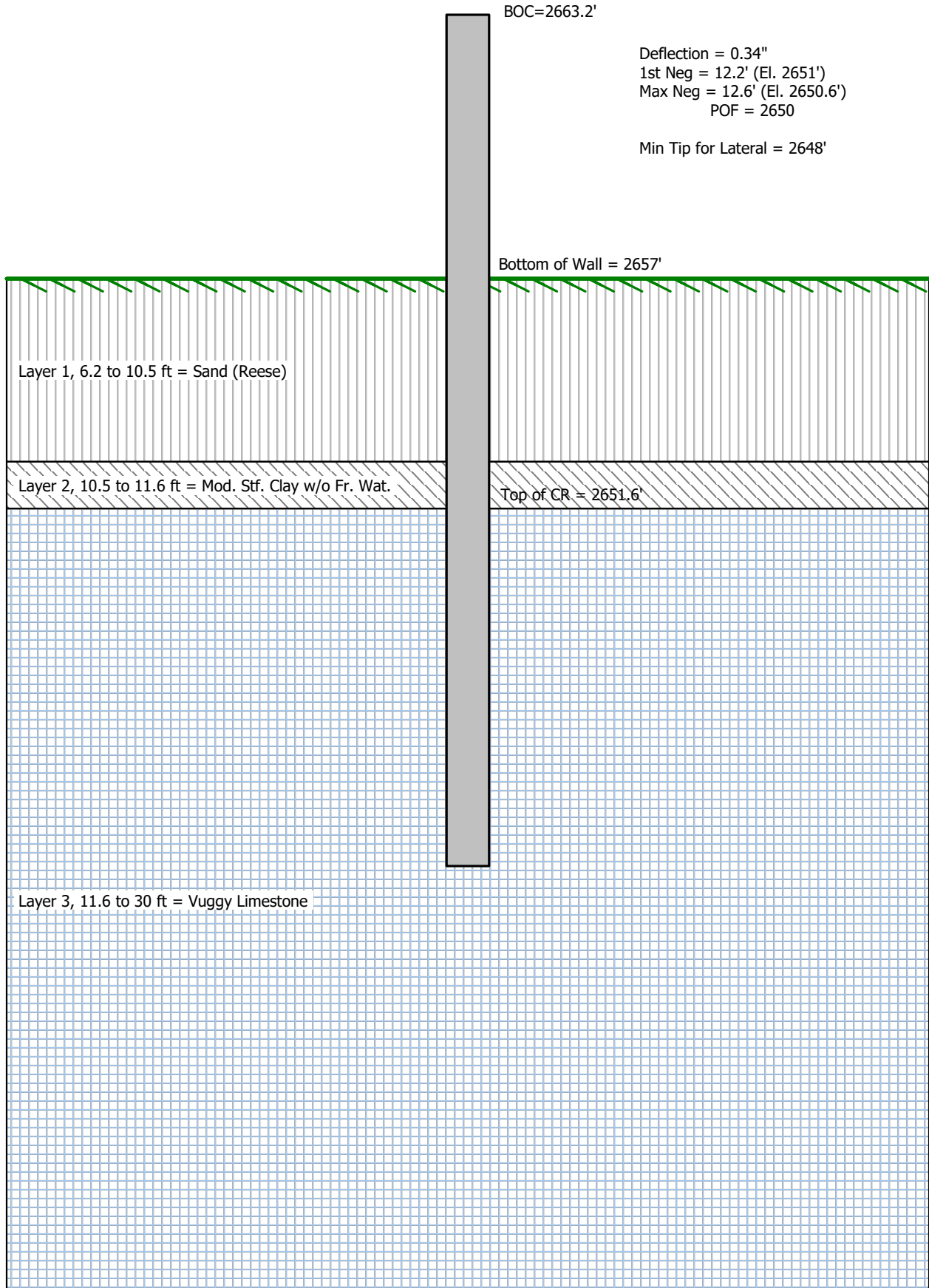
WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB1-A	STATION 15+44	OFFSET 5 ft LT	ALIGNMENT -L-
COLLAR ELEV. 2,666.2 ft	TOTAL DEPTH 14.6 ft	NORTHING 292,245	EASTING 1,315,384
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/14/22	COMP. DATE 07/14/22	SURFACE WATER DEPTH N/A

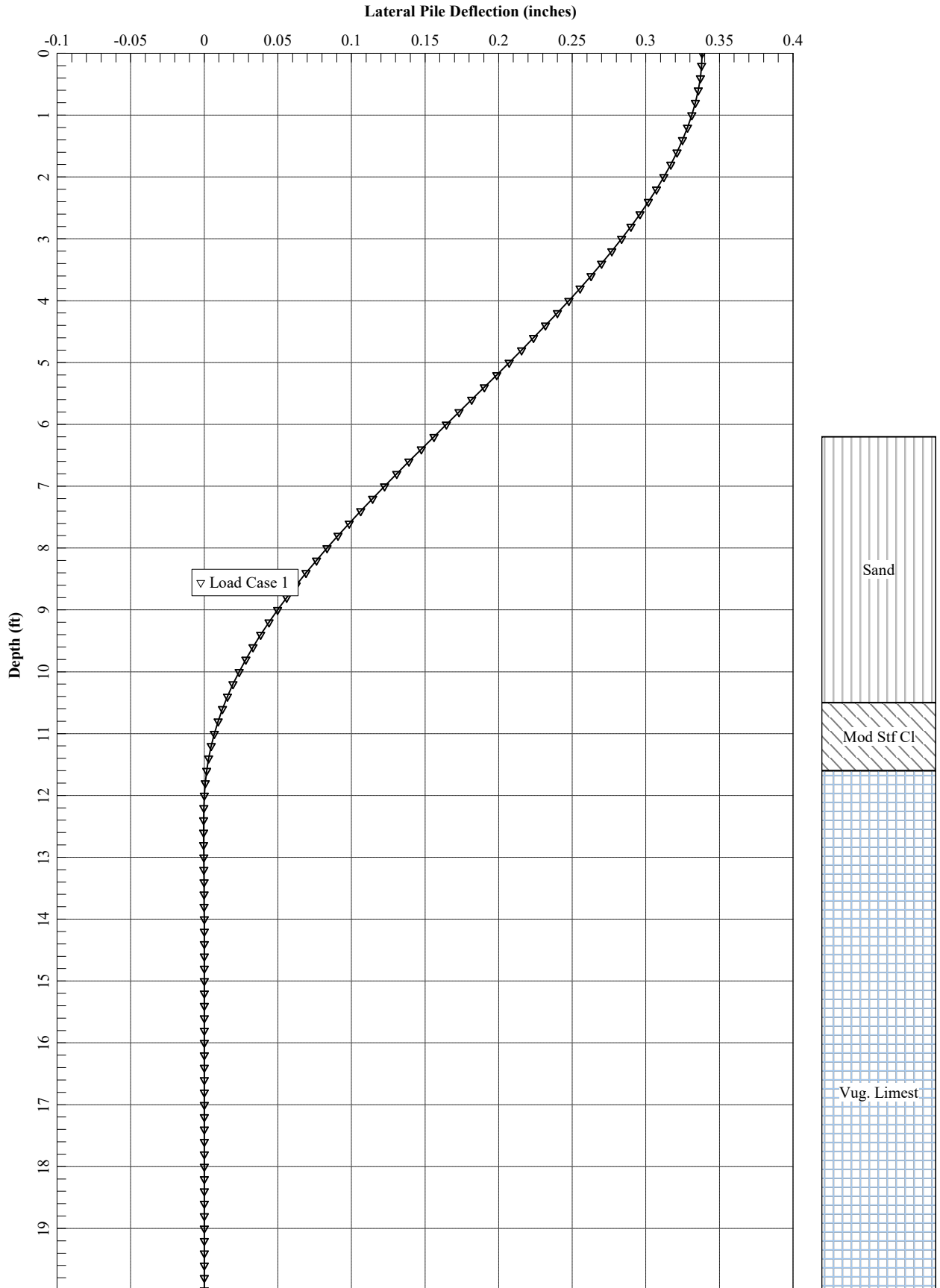
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP NO	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
2670																
2665	2,665.2	1.0	6	10	5									GROUND SURFACE	0.0	
	2,662.7	3.5	1	1	1									ROADWAY EMBANKMENT		
2660	2,660.2	6.0	5	5	4									Soft to Stiff, Black-Gray, Fine to Coarse Sandy SILT (A-4), with trace mica and rock fragments		
	2,657.7	8.5	7	13	11											
2655	2,652.7	13.5												ALLUVIAL	8.0	
	2,651.6	14.6	100/0.4											Medium Dense, Brown-Gray, Silty Fine to Medium SAND (A-2-4), with trace to little rock fragments	13.5	
			60/0.0											WEATHERED ROCK	14.6	
														Gray-White (BIOTITE-HORNBLENDE GNEISS)		

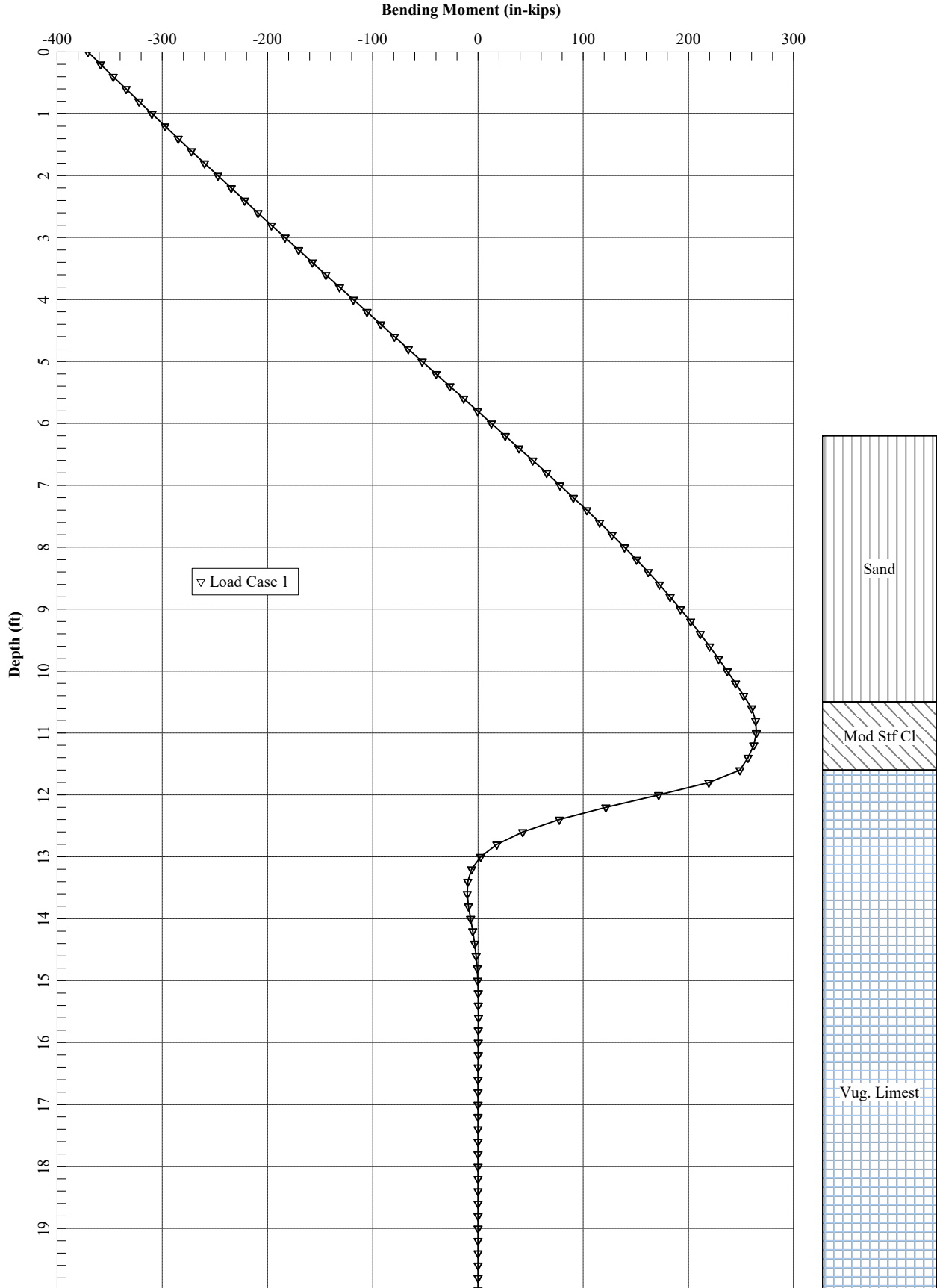
BOC = 2663.2'
Top of shaft hole = 2657'
Min Embed 5' into CR
Min tip = 2646'
L = BOC - Tip + 1 embed = 18.2'
Avg. pile length = 20'

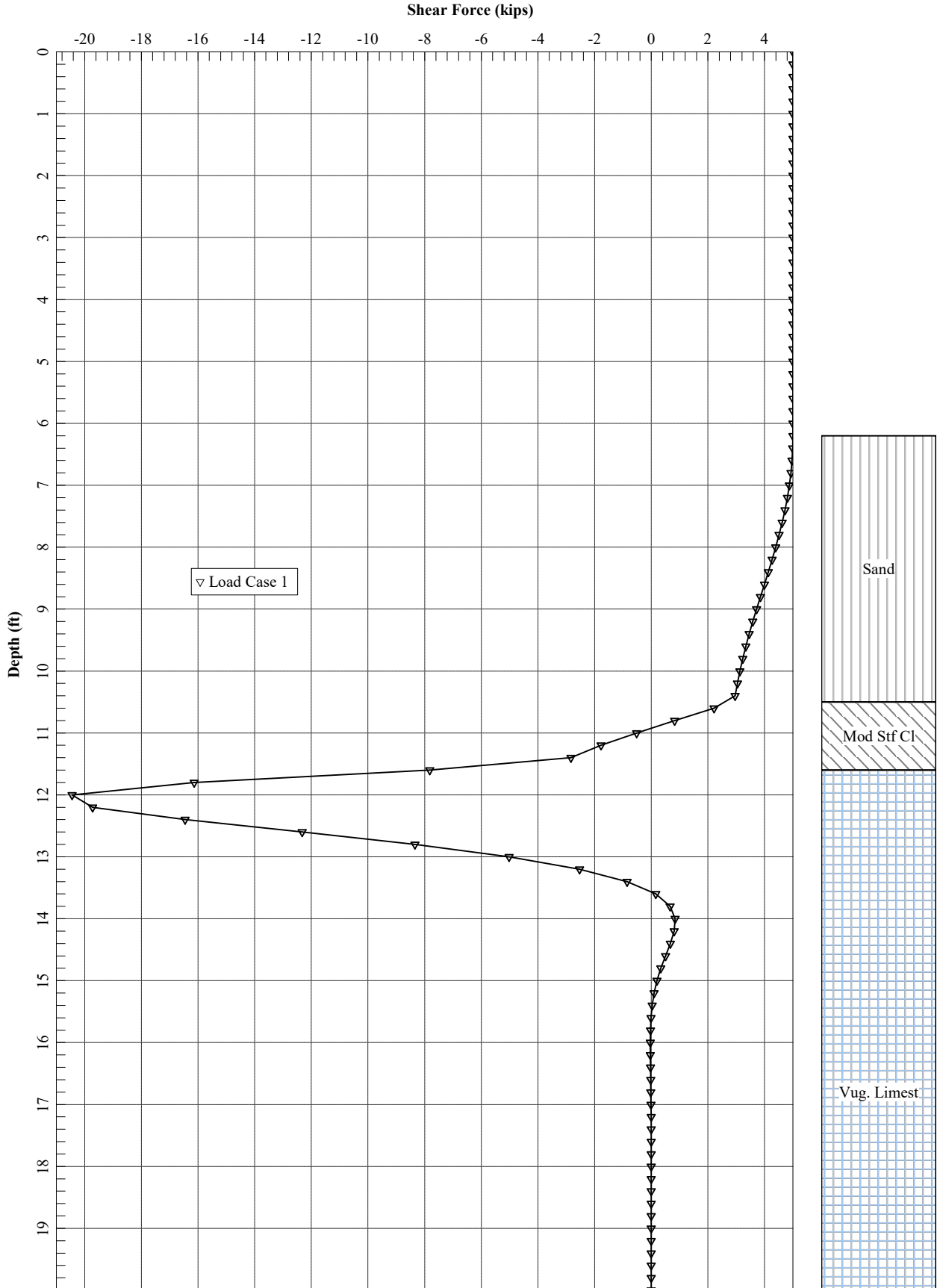
Est. Qty
In Soil = 2663.2' - 2652.7' = 10.5'
Piles No 1-4: 4(10.5) = 42.0'
Not in Soil = 2652.7' - 2646' = 6.7'
Piles No 1-4: 4(6.7') = 26.8'

NCDOT BORE SINGLE 09-28664 GP.J NC_DOT GDT 6/5/23









=====
LPile for Windows, Version 2019-11.009

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:

\Users\kdemontbrun\OneDrive - ECS Corporate Services\Documents\Desktop\R006 Foundation Recommendations\Calculations\

Name of input data file:

EB1-A 12x53_non-yeilding.lp11d

Name of output report file:

EB1-A 12x53_non-yeilding.lp11o

Name of plot output file:

EB1-A 12x53_non-yeilding.lp11p

Name of runtime message file:

EB1-A 12x53_non-yeilding.lp11r

Date and Time of Analysis

Date: June 6, 2023

Time: 8:01:22

Problem Title

Project Name: Ashe Bridge 157

Job Number: 09-29664

Client: STV

Engineer: ECS

Description: EB1-A

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
 Total length of pile = 20.000 ft
 Depth of ground surface below top of pile = 6.2000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.7800
2	20.000	11.7800

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
 Cross-sectional Shape = Weak H-Pile
 Length of section = 20.000000 ft
 Flange Width = 12.045000 in
 Section Depth = 11.780000 in
 Flange Thickness = 0.435000 in
 Web Thickness = 0.435000 in
 Section Area = 15.225000 sq. in
 Moment of Inertia = 126.769528 in⁴
 Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians

Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 6.200000 ft
 Distance from top of pile to bottom of layer = 10.500000 ft
 Effective unit weight at top of layer = 58.000000 pcf
 Effective unit weight at bottom of layer = 58.000000 pcf
 Friction angle at top of layer = 32.000000 deg.
 Friction angle at bottom of layer = 32.000000 deg.
 Subgrade k at top of layer = 60.000000 pci
 Subgrade k at bottom of layer = 60.000000 pci

Layer 2 is stiff clay with user-defined k-value

Distance from top of pile to top of layer = 10.500000 ft
 Distance from top of pile to bottom of layer = 11.600000 ft
 Effective unit weight at top of layer = 100.000000 pcf
 Effective unit weight at bottom of layer = 100.000000 pcf
 Undrained cohesion at top of layer = 8000. psf
 Undrained cohesion at bottom of layer = 8000. psf
 Epsilon-50 at top of layer = 0.004000
 Epsilon-50 at bottom of layer = 0.004000
 Subgrade k at top of layer = 2000. pci
 Subgrade k at bottom of layer = 2000. pci

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 11.600000 ft
 Distance from top of pile to bottom of layer = 30.000000 ft
 Effective unit weight at top of layer = 160.000000 pcf
 Effective unit weight at bottom of layer = 160.000000 pcf
 Uniaxial compressive strength at top of layer = 4500. psi
 Uniaxial compressive strength at bottom of layer = 4500. psi

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

 Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	Uniaxial qu psi	or krm	E50 kpy pci
1	Sand (Reese, et al.)	6.2000	58.0000	--	32.0000	--	--	60.0000
		10.5000	58.0000	--	32.0000	--	--	60.0000
2	Stiff Clay w/o Free Water, using k	10.5000	100.0000	8000.	--	--	0.00400	2000.
		11.6000	100.0000	8000.	--	--	0.00400	2000.
3	Strong Rock (Vuggy Limestone)	11.6000	160.0000	--	--	4500.	--	--
		30.0000	160.0000	--	--	4500.	--	--

 Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

 Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 5000. lbs	S = 0.0000 in/in	135000.	No	Yes

V = shear force applied normal to pile axis
 M = bending moment applied to pile head
 y = lateral deflection normal to pile axis
 S = pile slope relative to original pile batter angle
 R = rotational stiffness applied to pile head
 Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
 Thrust force is assumed to be acting axially for all pile batter angles.

 Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

 Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf Above ft	Same Layer Type As Rock Layer	Layer is Below	F0 lbs	F1 lbs
1	6.2000	0.00	N.A.	No	0.00	5575.
2	10.5000	0.2320	No	No	5575.	33700.
3	11.6000	5.4000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
 Rotation of pile head = 0.000E+00 radians
 Axial load at pile head = 135000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Soil Lat. Load lb/inch	Distrib. Load lb/inch
0.00	0.3381	-370734.	5000.	0.00	26092.	3.68E+09	0.00	0.00	0.00	0.00
0.2000	0.3379	-358694.	5000.	-2.38E-04	25533.	3.68E+09	0.00	0.00	0.00	0.00
0.4000	0.3370	-346579.	5000.	-4.68E-04	24970.	3.68E+09	0.00	0.00	0.00	0.00
0.6000	0.3356	-334391.	5000.	-6.91E-04	24404.	3.68E+09	0.00	0.00	0.00	0.00
0.8000	0.3337	-322132.	5000.	-9.05E-04	23834.	3.68E+09	0.00	0.00	0.00	0.00
1.0000	0.3313	-309805.	5000.	-0.00111	23261.	3.68E+09	0.00	0.00	0.00	0.00
1.2000	0.3284	-297412.	5000.	-0.00131	22685.	3.68E+09	0.00	0.00	0.00	0.00
1.4000	0.3250	-284956.	5000.	-0.00150	22107.	3.68E+09	0.00	0.00	0.00	0.00
1.6000	0.3212	-272440.	5000.	-0.00168	21525.	3.68E+09	0.00	0.00	0.00	0.00
1.8000	0.3169	-259867.	5000.	-0.00186	20941.	3.68E+09	0.00	0.00	0.00	0.00
2.0000	0.3123	-247238.	5000.	-0.00202	20354.	3.68E+09	0.00	0.00	0.00	0.00
2.2000	0.3072	-234557.	5000.	-0.00218	19765.	3.68E+09	0.00	0.00	0.00	0.00
2.4000	0.3018	-221827.	5000.	-0.00233	19174.	3.68E+09	0.00	0.00	0.00	0.00
2.6000	0.2960	-209049.	5000.	-0.00247	18580.	3.68E+09	0.00	0.00	0.00	0.00
2.8000	0.2900	-196228.	5000.	-0.00260	17984.	3.68E+09	0.00	0.00	0.00	0.00
3.0000	0.2836	-183365.	5000.	-0.00272	17387.	3.68E+09	0.00	0.00	0.00	0.00

3.2000	0.2769	-170463.	5000.	-0.00284	16787.	3.68E+09	0.00	0.00	0.00
3.4000	0.2699	-157525.	5000.	-0.00295	16186.	3.68E+09	0.00	0.00	0.00
3.6000	0.2627	-144554.	5000.	-0.00304	15583.	3.68E+09	0.00	0.00	0.00
3.8000	0.2553	-131552.	5000.	-0.00314	14979.	3.68E+09	0.00	0.00	0.00
4.0000	0.2477	-118522.	5000.	-0.00322	14374.	3.68E+09	0.00	0.00	0.00
4.2000	0.2399	-105467.	5000.	-0.00329	13767.	3.68E+09	0.00	0.00	0.00
4.4000	0.2319	-92390.	5000.	-0.00335	13160.	3.68E+09	0.00	0.00	0.00
4.6000	0.2238	-79294.	5000.	-0.00341	12551.	3.68E+09	0.00	0.00	0.00
4.8000	0.2155	-66180.	5000.	-0.00346	11942.	3.68E+09	0.00	0.00	0.00
5.0000	0.2072	-53053.	5000.	-0.00350	11332.	3.68E+09	0.00	0.00	0.00
5.2000	0.1987	-39914.	5000.	-0.00353	10722.	3.68E+09	0.00	0.00	0.00
5.4000	0.1902	-26767.	5000.	-0.00355	10111.	3.68E+09	0.00	0.00	0.00
5.6000	0.1817	-13615.	5000.	-0.00356	9500.	3.68E+09	0.00	0.00	0.00
5.8000	0.1731	-459.2459	5000.	-0.00357	8888.	3.68E+09	0.00	0.00	0.00
6.0000	0.1646	12696.	5000.	-0.00356	9457.	3.68E+09	0.00	0.00	0.00
6.2000	0.1560	25849.	5000.	-0.00355	10068.	3.68E+09	0.00	0.00	0.00
6.4000	0.1475	38997.	4993.	-0.00353	10679.	3.68E+09	-6.0403	98.2516	0.00
6.6000	0.1391	52101.	4970.	-0.00350	11288.	3.68E+09	-12.6160	217.6615	0.00
6.8000	0.1308	65122.	4932.	-0.00346	11893.	3.68E+09	-19.4232	356.5234	0.00
7.0000	0.1225	78017.	4877.	-0.00341	12492.	3.68E+09	-26.1976	513.2776	0.00
7.2000	0.1144	90745.	4807.	-0.00336	13083.	3.68E+09	-32.5996	684.1318	0.00
7.4000	0.1064	103266.	4721.	-0.00330	13665.	3.68E+09	-38.5593	869.9892	0.00
7.6000	0.09854	115542.	4623.	-0.00322	14235.	3.68E+09	-43.6798	1064.	0.00
7.8000	0.09089	127543.	4512.	-0.00315	14793.	3.68E+09	-48.2315	1274.	0.00
8.0000	0.08345	139239.	4392.	-0.00306	15336.	3.68E+09	-51.9973	1495.	0.00
8.2000	0.07622	150606.	4264.	-0.00296	15865.	3.68E+09	-54.7034	1723.	0.00
8.4000	0.06922	161626.	4130.	-0.00286	16377.	3.68E+09	-56.8783	1972.	0.00
8.6000	0.06248	172285.	3992.	-0.00275	16872.	3.68E+09	-57.8118	2221.	0.00
8.8000	0.05601	182573.	3854.	-0.00264	17350.	3.68E+09	-57.7784	2476.	0.00
9.0000	0.04983	192491.	3717.	-0.00251	17811.	3.68E+09	-56.4637	2720.	0.00
9.2000	0.04394	202042.	3584.	-0.00239	18254.	3.68E+09	-54.1947	2960.	0.00
9.4000	0.03838	211239.	3456.	-0.00225	18682.	3.68E+09	-51.9608	3250.	0.00
9.6000	0.03314	220092.	3336.	-0.00211	19093.	3.68E+09	-48.4878	3511.	0.00
9.8000	0.02825	228618.	3225.	-0.00196	19489.	3.68E+09	-43.8539	3726.	0.00
10.0000	0.02372	236844.	3127.	-0.00181	19871.	3.68E+09	-38.2191	3868.	0.00
10.2000	0.01956	244800.	3040.	-0.00165	20241.	3.68E+09	-33.5462	4117.	0.00
10.4000	0.01578	252510.	2963.	-0.00149	20599.	3.68E+09	-31.2556	4755.	0.00
10.6000	0.01239	259987.	2216.	-0.00132	20947.	3.68E+09	-591.0941	114452.	0.00
10.8000	0.00942	264005.	822.6967	-0.00115	21133.	3.68E+09	-569.9013	145200.	0.00
11.0000	0.00686	264684.	-512.8811	-9.81E-04	21165.	3.68E+09	-543.0802	190042.	0.00
11.2000	0.00471	262178.	-1776.	-8.09E-04	21048.	3.68E+09	-509.5917	259569.	0.00
11.4000	0.00298	256683.	-2833.	-6.40E-04	20793.	3.68E+09	-371.3793	299520.	0.00
11.6000	0.00164	248993.	-7822.	-4.74E-04	20436.	3.68E+09	-3786.	5533333.	0.00
11.8000	6.98E-04	219445.	-16136.	-3.22E-04	19063.	3.68E+09	-3143.	1.08E+07	0.00
12.0000	9.85E-05	171749.	-20439.	-1.94E-04	16847.	3.68E+09	-443.4026	1.08E+07	0.00
12.2000	-2.32E-04	121463.	-19717.	-9.82E-05	14510.	3.68E+09	1045.	1.08E+07	0.00
12.4000	-3.73E-04	77169.	-16451.	-3.33E-05	12452.	3.68E+09	1677.	1.08E+07	0.00
12.6000	-3.92E-04	42518.	-12321.	5.74E-06	10842.	3.68E+09	1765.	1.08E+07	0.00
12.8000	-3.45E-04	18023.	-8340.	2.55E-05	9704.	3.68E+09	1553.	1.08E+07	0.00
13.0000	-2.70E-04	2468.	-5020.	3.22E-05	8982.	3.68E+09	1214.	1.08E+07	0.00
13.2000	-1.91E-04	-6096.	-2535.	3.10E-05	9150.	3.68E+09	857.4005	1.08E+07	0.00
13.4000	-1.21E-04	-9720.	-853.3494	2.58E-05	9319.	3.68E+09	543.9829	1.08E+07	0.00
13.6000	-6.65E-05	-10209.	158.3455	1.93E-05	9341.	3.68E+09	299.0962	1.08E+07	0.00
13.8000	-2.80E-05	-8972.	668.6846	1.31E-05	9284.	3.68E+09	126.1863	1.08E+07	0.00
14.0000	-3.67E-06	-7007.	839.9522	7.87E-06	9193.	3.68E+09	16.5368	1.08E+07	0.00
14.2000	9.71E-06	-4946.	807.3488	3.96E-06	9097.	3.68E+09	-43.7063	1.08E+07	0.00
14.4000	1.54E-05	-3135.	672.0064	1.33E-06	9013.	3.68E+09	-69.0791	1.08E+07	0.00
14.6000	1.61E-05	-1721.	502.2915	-2.59E-07	8947.	3.68E+09	-72.3501	1.08E+07	0.00
14.8000	1.41E-05	-723.5961	339.2868	-1.06E-06	8901.	3.68E+09	-63.4871	1.08E+07	0.00
15.0000	1.10E-05	-91.7318	203.6753	-1.32E-06	8871.	3.68E+09	-49.5225	1.08E+07	0.00
15.2000	7.76E-06	254.9025	102.3550	-1.27E-06	8879.	3.68E+09	-34.9111	1.08E+07	0.00
15.4000	4.91E-06	400.3949	33.9454	-1.06E-06	8886.	3.68E+09	-22.0969	1.08E+07	0.00
15.6000	2.69E-06	418.5247	-7.0976	-7.89E-07	8886.	3.68E+09	-12.1057	1.08E+07	0.00
15.8000	1.13E-06	366.8375	-27.7027	-5.32E-07	8884.	3.68E+09	-5.0653	1.08E+07	0.00
16.0000	1.36E-07	285.8967	-34.5145	-3.19E-07	8880.	3.68E+09	-0.6113	1.08E+07	0.00
16.2000	-4.06E-07	201.3745	-33.0557	-1.60E-07	8876.	3.68E+09	1.8270	1.08E+07	0.00

16.4000	-6.32E-07	127.3332	-27.4487	-5.27E-08	8873.	3.68E+09	2.8455	1.08E+07	0.00
16.6000	-6.59E-07	69.6548	-20.4748	1.16E-08	8870.	3.68E+09	2.9662	1.08E+07	0.00
16.8000	-5.77E-07	29.0467	-13.8005	4.38E-08	8868.	3.68E+09	2.5958	1.08E+07	0.00
17.0000	-4.49E-07	3.3841	-8.2609	5.44E-08	8867.	3.68E+09	2.0206	1.08E+07	0.00
17.2000	-3.16E-07	-10.6409	-4.1304	5.20E-08	8867.	3.68E+09	1.4215	1.08E+07	0.00
17.4000	-1.99E-07	-16.4757	-1.3477	4.31E-08	8868.	3.68E+09	0.8975	1.08E+07	0.00
17.6000	-1.09E-07	-17.1376	0.3168	3.22E-08	8868.	3.68E+09	0.4896	1.08E+07	0.00
17.8000	-4.50E-08	-14.9759	1.1474	2.17E-08	8868.	3.68E+09	0.2026	1.08E+07	0.00
18.0000	-4.69E-09	-11.6442	1.4158	1.30E-08	8868.	3.68E+09	0.02110	1.08E+07	0.00
18.2000	1.74E-08	-8.1886	1.3472	6.53E-09	8867.	3.68E+09	-0.07825	1.08E+07	0.00
18.4000	2.66E-08	-5.1819	1.1094	2.16E-09	8867.	3.68E+09	-0.1199	1.08E+07	0.00
18.6000	2.78E-08	-2.8646	0.8156	-4.64E-10	8867.	3.68E+09	-0.1250	1.08E+07	0.00
18.8000	2.44E-08	-1.2665	0.5339	-1.81E-09	8867.	3.68E+09	-0.1099	1.08E+07	0.00
19.0000	1.91E-08	-0.3009	0.2991	-2.32E-09	8867.	3.68E+09	-0.08581	1.08E+07	0.00
19.2000	1.33E-08	0.1705	0.1245	-2.37E-09	8867.	3.68E+09	-0.05965	1.08E+07	0.00
19.4000	7.71E-09	0.2984	0.01131	-2.21E-09	8867.	3.68E+09	-0.03469	1.08E+07	0.00
19.6000	2.63E-09	0.2263	-0.04451	-2.04E-09	8867.	3.68E+09	-0.01183	1.08E+07	0.00
19.8000	-2.09E-09	0.08601	-0.04741	-1.94E-09	8867.	3.68E+09	0.00943	1.08E+07	0.00
20.0000	-6.68E-09	0.00	0.00	-1.91E-09	8867.	3.68E+09	0.03008	5400000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.33814351 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -370734. inch-lbs
 Maximum shear force = -20439. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 12.00000000 feet below pile head
 Number of iterations = 7
 Number of zero deflection points = 5

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load 1	Load 2	Axial Pile-head	Pile-head Loading	Pile-head Deflection	Max Shear	Max Moment
No. 1	Load 1	2	Load 2	lbs	inches	radians	lbs	in-lbs
1	V, lb	5000.	S, rad	0.00	135000.	0.3381	0.00	-20439. -370734.

Maximum pile-head deflection = 0.3381435057 inches
 Maximum pile-head rotation = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT BORE LOG

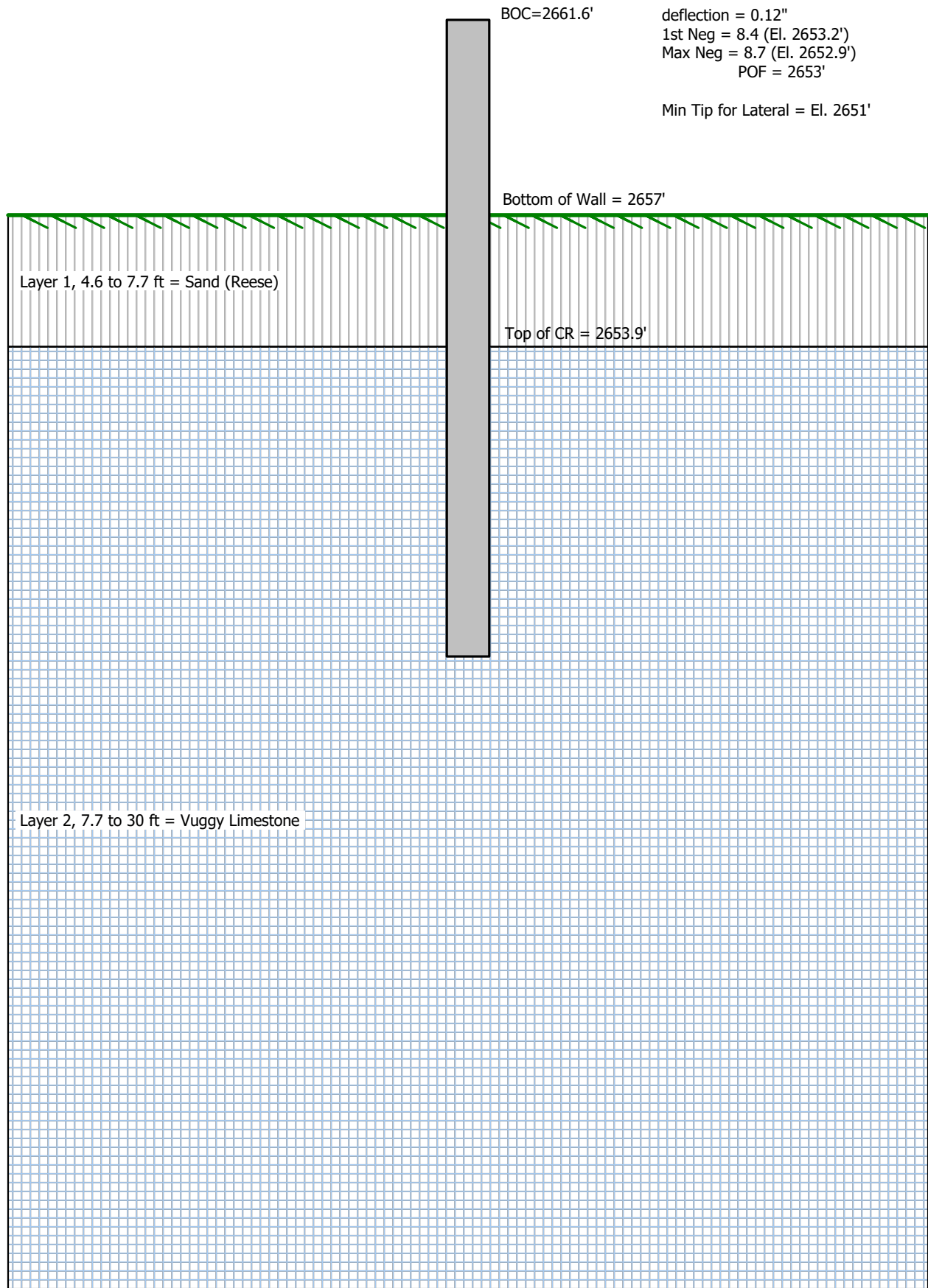
WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB1-B	STATION 15+34	OFFSET 6 ft RT	ALIGNMENT -L-
COLLAR ELEV. 2,666.3 ft	TOTAL DEPTH 17.5 ft	NORTHING 982,243	EASTING 1,315,399
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/18/22	COMP. DATE 07/18/22	SURFACE WATER DEPTH N/A

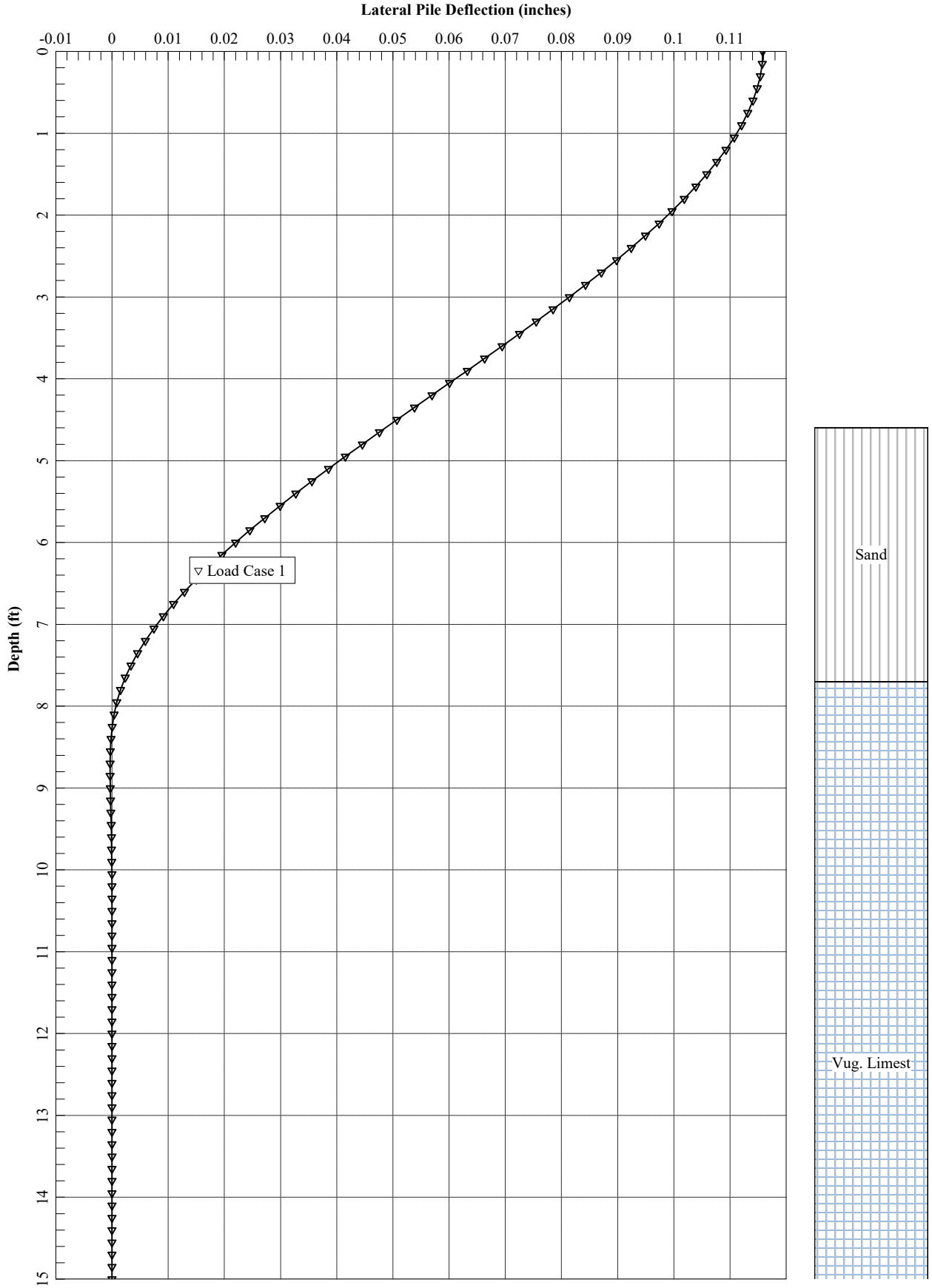
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				ELEV (ft)
2670														
2665	2,665.3	1.0	4	4	4								2,666.3	0.0
2660	2,662.8	3.5	1	1	1									
	2,660.3	6.0	5	6	7									
2655	2,657.8	8.5	20	21	51								2,658.3	8.0
	2,653.9	12.4	60/0.1										2,653.9	12.4
2650													2,648.8	17.5

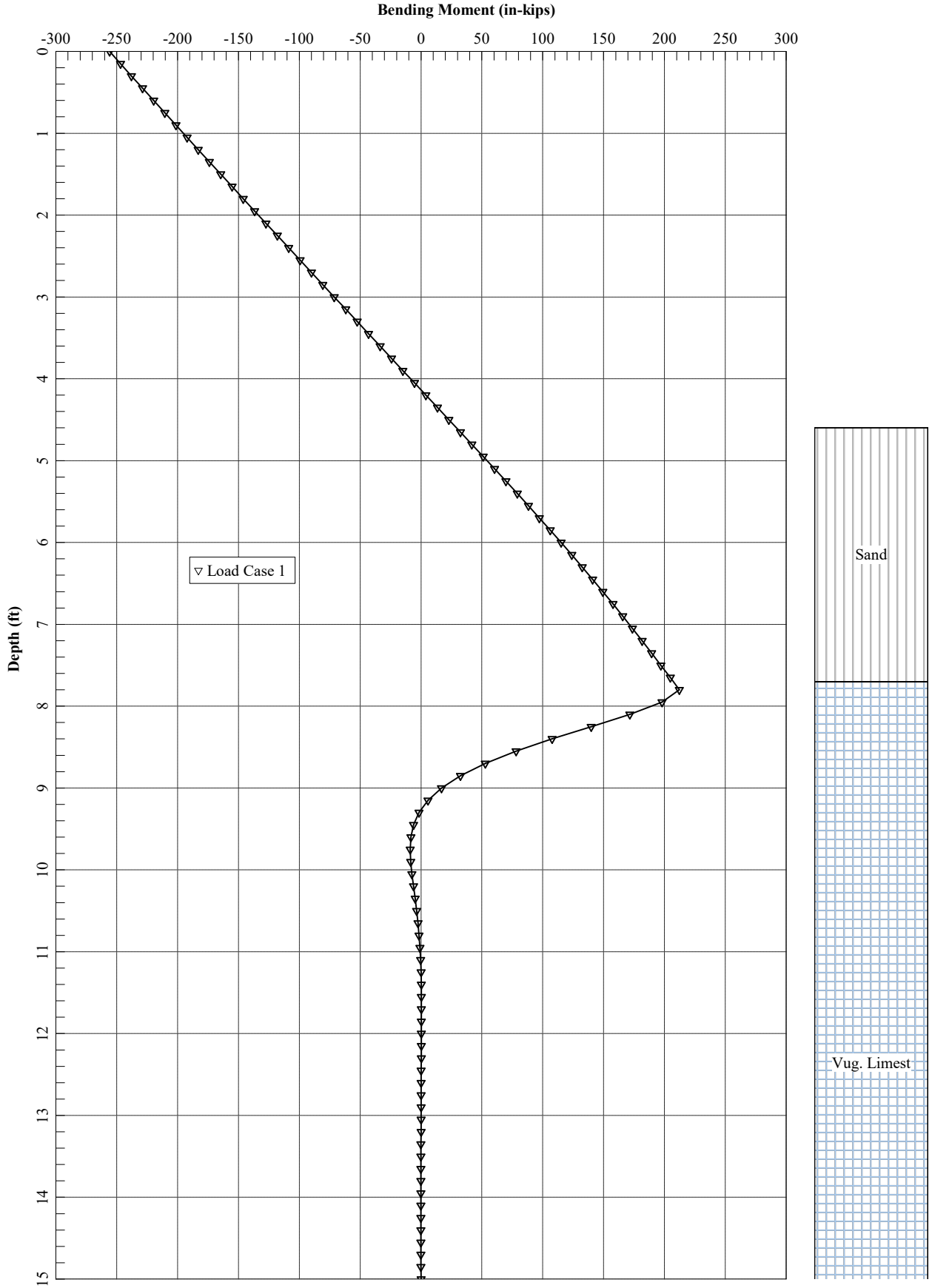
BOC = 2661.6'
 Bottom of wall = 2657'
 Min. Embed 5' into CR
 Min tip = 2649'
 L = 13.6'
 Avg. Pile Length = 15'

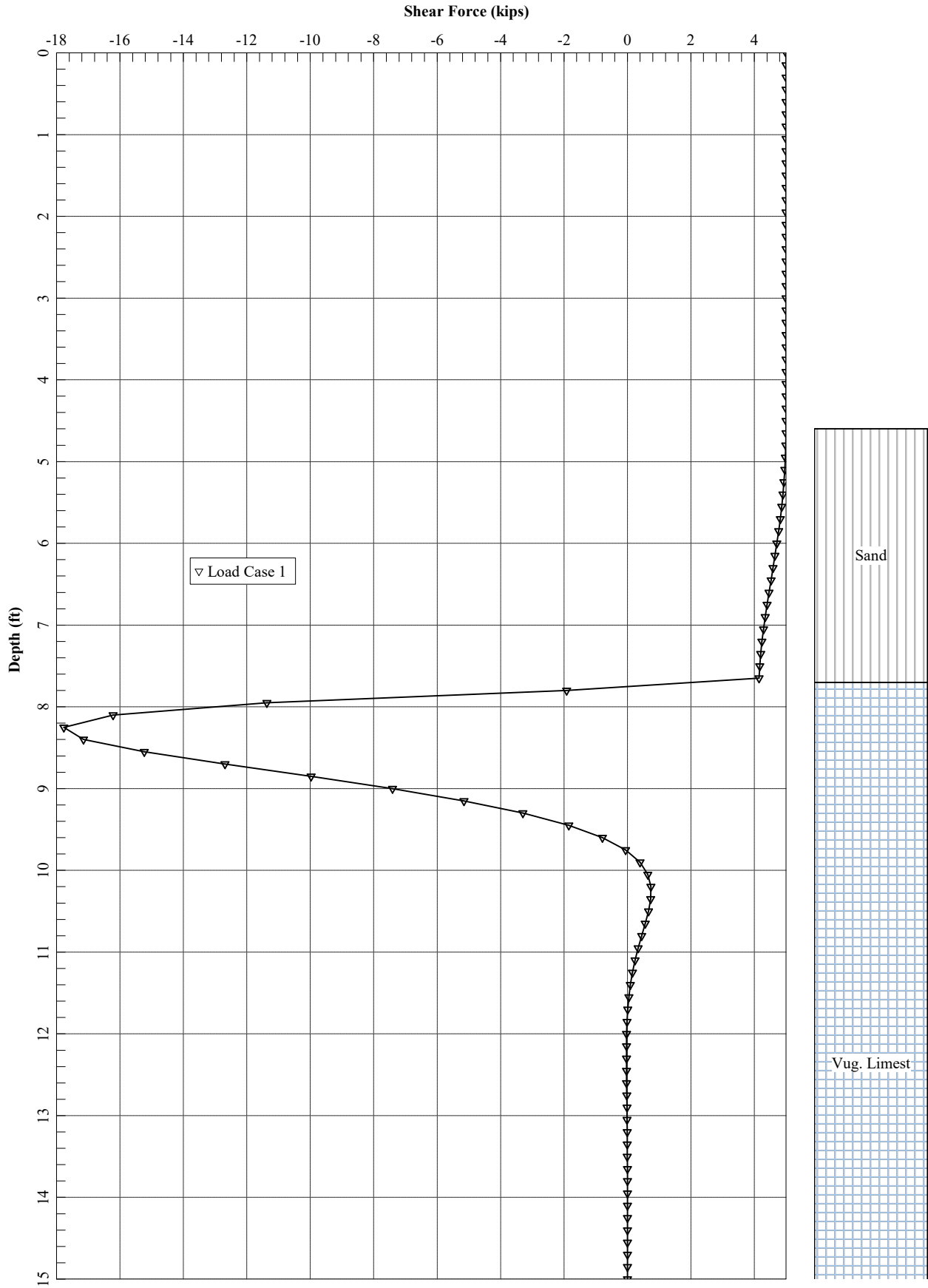
Est. Qty
 In Soil = 2661.6' - 2654.0' = 7.6'
 Piles No 5-9: 5(7.6) = 38.0'
 Not in Soil = 2654.0' - 2649.0' = 5.0'
 Piles No. 5-9: 5(5.0) = 25.0'

NCDOT BORE SINGLE 09-25554-GPJ NC_DOT_GDI 6/5/23









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LPile for Windows, Version 2019-11.009

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:

\Users\kdemontbrun\OneDrive - ECS Corporate Services\Documents\Desktop\R006 Foundation Recommendations\Calculations\

Name of input data file:

EB1-B 12x53_non-yeilding.lp11d

Name of output report file:

EB1-B 12x53_non-yeilding.lp11o

Name of plot output file:

EB1-B 12x53_non-yeilding.lp11p

Name of runtime message file:

EB1-B 12x53_non-yeilding.lp11r

Date and Time of Analysis

Date: June 6, 2023

Time: 8:55:33

Problem Title

Project Name: Ashe Bridge 157

Job Number: 09-29664

Client: STV

Engineer: ECS

Description: EB1-B

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
 Total length of pile = 15.000 ft
 Depth of ground surface below top of pile = 4.6000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.7800
2	15.000	11.7800

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
 Cross-sectional Shape = Weak H-Pile
 Length of section = 15.000000 ft
 Flange Width = 12.045000 in
 Section Depth = 11.780000 in
 Flange Thickness = 0.435000 in
 Web Thickness = 0.435000 in
 Section Area = 15.225000 sq. in
 Moment of Inertia = 126.769528 in⁴
 Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians
 Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 4.600000 ft
 Distance from top of pile to bottom of layer = 7.700000 ft
 Effective unit weight at top of layer = 58.000000 pcf
 Effective unit weight at bottom of layer = 58.000000 pcf
 Friction angle at top of layer = 34.000000 deg.
 Friction angle at bottom of layer = 34.000000 deg.
 Subgrade k at top of layer = 125.000000 pci
 Subgrade k at bottom of layer = 125.000000 pci

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 7.700000 ft
 Distance from top of pile to bottom of layer = 30.000000 ft
 Effective unit weight at top of layer = 160.000000 pcf
 Effective unit weight at bottom of layer = 160.000000 pcf
 Uniaxial compressive strength at top of layer = 4500. psi
 Uniaxial compressive strength at bottom of layer = 4500. psi

(Depth of the lowest soil layer extends 15.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

 Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	Uniaxial qu psi	kipy pci
1	Sand (Reese, et al.)	4.6000 7.7000	58.0000 58.0000	34.0000 34.0000	-- --	125.0000 125.0000
2	Strong Rock (Vuggy Limestone)	7.7000 30.0000	160.0000 160.0000	-- --	4500. 4500.	-- --

 Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

 Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 5000. lbs	S = 0.0000 in/in	135000.	No	Yes

V = shear force applied normal to pile axis
 M = bending moment applied to pile head
 y = lateral deflection normal to pile axis
 S = pile slope relative to original pile batter angle
 R = rotational stiffness applied to pile head
 Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
 Thrust force is assumed to be acting axially for all pile batter angles.

 Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

 Layering Correction Equivalent Depths of Soil & Rock Layers

Top of Layer	Equivalent Top Depth	Same Layer	Layer is	F0	F1
--------------	----------------------	------------	----------	----	----

Layer No.	Below Pile Head ft	Below Grnd Surf ft	Type As Layer Above Rock Layer	Rock or is Below Rock Layer	Integral for Layer lbs	Integral for Layer lbs
1	4.6000	0.00	N.A.	No	0.00	3377.
2	7.7000	3.1000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
 Rotation of pile head = 0.000E+00 radians
 Axial load at pile head = 135000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth feet	Deflect. X inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1158	-255898.	5000.	0.00	20757.	3.68E+09	0.00	0.00	0.00
0.1500	0.1157	-246882.	5000.	-1.23E-04	20338.	3.68E+09	0.00	0.00	0.00
0.3000	0.1154	-237838.	5000.	-2.42E-04	19917.	3.68E+09	0.00	0.00	0.00
0.4500	0.1149	-228765.	5000.	-3.56E-04	19496.	3.68E+09	0.00	0.00	0.00
0.6000	0.1141	-219665.	5000.	-4.66E-04	19073.	3.68E+09	0.00	0.00	0.00
0.7500	0.1132	-210539.	5000.	-5.71E-04	18649.	3.68E+09	0.00	0.00	0.00
0.9000	0.1121	-201387.	5000.	-6.72E-04	18224.	3.68E+09	0.00	0.00	0.00
1.0500	0.1108	-192212.	5000.	-7.68E-04	17798.	3.68E+09	0.00	0.00	0.00
1.2000	0.1093	-183014.	5000.	-8.60E-04	17370.	3.68E+09	0.00	0.00	0.00
1.3500	0.1077	-173794.	5000.	-9.47E-04	16942.	3.68E+09	0.00	0.00	0.00
1.5000	0.1059	-164553.	5000.	-0.00103	16513.	3.68E+09	0.00	0.00	0.00
1.6500	0.1040	-155293.	5000.	-0.00111	16082.	3.68E+09	0.00	0.00	0.00
1.8000	0.1019	-146015.	5000.	-0.00118	15651.	3.68E+09	0.00	0.00	0.00
1.9500	0.09970	-136719.	5000.	-0.00125	15219.	3.68E+09	0.00	0.00	0.00
2.1000	0.09738	-127406.	5000.	-0.00132	14787.	3.68E+09	0.00	0.00	0.00
2.2500	0.09496	-118079.	5000.	-0.00138	14353.	3.68E+09	0.00	0.00	0.00
2.4000	0.09243	-108737.	5000.	-0.00143	13919.	3.68E+09	0.00	0.00	0.00
2.5500	0.08980	-99383.	5000.	-0.00148	13485.	3.68E+09	0.00	0.00	0.00
2.7000	0.08709	-90017.	5000.	-0.00153	13049.	3.68E+09	0.00	0.00	0.00
2.8500	0.08430	-80640.	5000.	-0.00157	12614.	3.68E+09	0.00	0.00	0.00
3.0000	0.08143	-71253.	5000.	-0.00161	12178.	3.68E+09	0.00	0.00	0.00
3.1500	0.07851	-61858.	5000.	-0.00164	11741.	3.68E+09	0.00	0.00	0.00
3.3000	0.07553	-52456.	5000.	-0.00167	11304.	3.68E+09	0.00	0.00	0.00
3.4500	0.07250	-43047.	5000.	-0.00169	10867.	3.68E+09	0.00	0.00	0.00
3.6000	0.06944	-33633.	5000.	-0.00171	10430.	3.68E+09	0.00	0.00	0.00
3.7500	0.06634	-24216.	5000.	-0.00173	9992.	3.68E+09	0.00	0.00	0.00
3.9000	0.06323	-14795.	5000.	-0.00173	9554.	3.68E+09	0.00	0.00	0.00
4.0500	0.06010	-5373.	5000.	-0.00174	9117.	3.68E+09	0.00	0.00	0.00
4.2000	0.05696	4050.	5000.	-0.00174	9055.	3.68E+09	0.00	0.00	0.00
4.3500	0.05383	13473.	5000.	-0.00174	9493.	3.68E+09	0.00	0.00	0.00
4.5000	0.05072	22894.	5000.	-0.00173	9931.	3.68E+09	0.00	0.00	0.00
4.6500	0.04762	32312.	4999.	-0.00171	10368.	3.68E+09	-1.1738	44.3717	0.00
4.8000	0.04455	41723.	4993.	-0.00170	10806.	3.68E+09	-4.8932	197.7141	0.00

4.9500	0.04152	51112.	4981.	-0.00167	11242.	3.68E+09	-8.7703	380.2600	0.00
5.1000	0.03853	60468.	4962.	-0.00164	11676.	3.68E+09	-12.6407	590.5691	0.00
5.2500	0.03559	69775.	4936.	-0.00161	12109.	3.68E+09	-16.5637	837.6499	0.00
5.4000	0.03272	79020.	4902.	-0.00158	12538.	3.68E+09	-20.3040	1117.	0.00
5.5500	0.02992	88190.	4863.	-0.00154	12964.	3.68E+09	-23.7355	1428.	0.00
5.7000	0.02719	97272.	4817.	-0.00149	13386.	3.68E+09	-26.8804	1779.	0.00
5.8500	0.02455	106256.	4766.	-0.00144	13804.	3.68E+09	-29.5897	2169.	0.00
6.0000	0.02201	115132.	4711.	-0.00139	14216.	3.68E+09	-31.7404	2596.	0.00
6.1500	0.01956	123890.	4653.	-0.00133	14623.	3.68E+09	-33.4604	3079.	0.00
6.3000	0.01723	132526.	4591.	-0.00127	15024.	3.68E+09	-34.7358	3630.	0.00
6.4500	0.01501	141034.	4528.	-0.00120	15420.	3.68E+09	-35.3330	4238.	0.00
6.6000	0.01291	149410.	4465.	-0.00113	15809.	3.68E+09	-35.3502	4928.	0.00
6.7500	0.01095	157653.	4401.	-0.00105	16192.	3.68E+09	-35.1243	5774.	0.00
6.9000	0.00913	165765.	4341.	-9.73E-04	16569.	3.68E+09	-31.4863	6210.	0.00
7.0500	0.00745	173754.	4288.	-8.89E-04	16940.	3.68E+09	-27.3744	6615.	0.00
7.2000	0.00592	181634.	4243.	-8.02E-04	17306.	3.68E+09	-23.1048	7020.	0.00
7.3500	0.00456	189418.	4205.	-7.12E-04	17668.	3.68E+09	-18.8095	7425.	0.00
7.5000	0.00336	197118.	4175.	-6.17E-04	18026.	3.68E+09	-14.6264	7830.	0.00
7.6500	0.00234	204748.	4152.	-5.19E-04	18380.	3.68E+09	-10.6991	8235.	0.00
7.8000	0.00150	212318.	-1913.	-4.17E-04	18732.	3.68E+09	-6729.	8100000.	0.00
7.9500	8.39E-04	198062.	-11368.	-3.16E-04	18069.	3.68E+09	-3776.	8100000.	0.00
8.1000	3.57E-04	171548.	-16213.	-2.26E-04	16838.	3.68E+09	-1608.	8100000.	0.00
8.2500	2.70E-05	139803.	-17770.	-1.49E-04	15363.	3.68E+09	-121.3563	8100000.	0.00
8.4000	-1.80E-04	107648.	-17149.	-8.88E-05	13869.	3.68E+09	811.2762	8100000.	0.00
8.5500	-2.93E-04	78108.	-15234.	-4.33E-05	12496.	3.68E+09	1317.	8100000.	0.00
8.7000	-3.36E-04	52827.	-12687.	-1.13E-05	11321.	3.68E+09	1513.	8100000.	0.00
8.8500	-3.33E-04	32440.	-9976.	9.62E-06	10374.	3.68E+09	1499.	8100000.	0.00
9.0000	-3.02E-04	16908.	-7405.	2.17E-05	9653.	3.68E+09	1357.	8100000.	0.00
9.1500	-2.55E-04	5771.	-5151.	2.73E-05	9135.	3.68E+09	1148.	8100000.	0.00
9.3000	-2.03E-04	-1647.	-3293.	2.83E-05	8944.	3.68E+09	915.6795	8100000.	0.00
9.4500	-1.53E-04	-6099.	-1848.	2.64E-05	9150.	3.68E+09	690.0405	8100000.	0.00
9.6000	-1.09E-04	-8314.	-787.5401	2.28E-05	9253.	3.68E+09	488.5884	8100000.	0.00
9.7500	-7.11E-05	-8945.	-59.7131	1.86E-05	9283.	3.68E+09	320.1082	8100000.	0.00
9.9000	-4.16E-05	-8538.	396.7769	1.43E-05	9264.	3.68E+09	187.1029	8100000.	0.00
10.0500	-1.95E-05	-7523.	644.3317	1.04E-05	9217.	3.68E+09	87.9580	8100000.	0.00
10.2000	-4.14E-06	-6223.	740.2794	7.03E-06	9156.	3.68E+09	18.6506	8100000.	0.00
10.3500	5.77E-06	-4862.	733.6867	4.32E-06	9093.	3.68E+09	-25.9758	8100000.	0.00
10.5000	1.14E-05	-3584.	664.1202	2.25E-06	9034.	3.68E+09	-51.3203	8100000.	0.00
10.6500	1.39E-05	-2472.	561.7266	7.69E-07	8982.	3.68E+09	-62.4504	8100000.	0.00
10.8000	1.42E-05	-1562.	448.1226	-2.19E-07	8940.	3.68E+09	-63.7762	8100000.	0.00
10.9500	1.31E-05	-858.8069	337.7083	-8.11E-07	8907.	3.68E+09	-58.9062	8100000.	0.00
11.1000	1.13E-05	-346.1117	239.1255	-1.11E-06	8883.	3.68E+09	-50.6303	8100000.	0.00
11.2500	9.11E-06	2.5825	156.6747	-1.19E-06	8867.	3.68E+09	-40.9817	8100000.	0.00
11.4000	6.97E-06	218.4958	91.5822	-1.14E-06	8877.	3.68E+09	-31.3433	8100000.	0.00
11.5500	5.02E-06	332.8308	43.0589	-1.00E-06	8882.	3.68E+09	-22.5715	8100000.	0.00
11.7000	3.36E-06	373.9946	9.1369	-8.28E-07	8884.	3.68E+09	-15.1196	8100000.	0.00
11.8500	2.03E-06	366.1264	-12.7066	-6.47E-07	8884.	3.68E+09	-9.1510	8100000.	0.00
12.0000	1.03E-06	328.5654	-25.1135	-4.77E-07	8882.	3.68E+09	-4.6344	8100000.	0.00
12.1500	3.16E-07	275.9497	-30.5633	-3.29E-07	8880.	3.68E+09	-1.4209	8100000.	0.00
12.3000	-1.55E-07	218.6974	-31.2137	-2.08E-07	8877.	3.68E+09	0.6982	8100000.	0.00
12.4500	-4.33E-07	163.6813	-28.8303	-1.14E-07	8875.	3.68E+09	1.9500	8100000.	0.00
12.6000	-5.67E-07	114.9638	-24.7780	-4.63E-08	8872.	3.68E+09	2.5526	8100000.	0.00
12.7500	-6.00E-07	74.5031	-20.0512	1.28E-10	8870.	3.68E+09	2.6993	8100000.	0.00
12.9000	-5.67E-07	42.7794	-15.3263	2.88E-08	8869.	3.68E+09	2.5506	8100000.	0.00
13.0500	-4.96E-07	19.3144	-11.0219	4.40E-08	8868.	3.68E+09	2.2321	8100000.	0.00
13.2000	-4.08E-07	3.0792	-7.3596	4.95E-08	8867.	3.68E+09	1.8371	8100000.	0.00
13.3500	-3.18E-07	-7.2043	-4.4194	4.85E-08	8867.	3.68E+09	1.4298	8100000.	0.00
13.5000	-2.34E-07	-12.8542	-2.1865	4.36E-08	8868.	3.68E+09	1.0512	8100000.	0.00
13.6500	-1.61E-07	-15.0968	-0.5893	3.68E-08	8868.	3.68E+09	0.7235	8100000.	0.00
13.8000	-1.01E-07	-14.9936	0.4719	2.94E-08	8868.	3.68E+09	0.4556	8100000.	0.00
13.9500	-5.50E-08	-13.4124	1.1045	2.24E-08	8868.	3.68E+09	0.2473	8100000.	0.00
14.1000	-2.05E-08	-11.0284	1.4099	1.65E-08	8868.	3.68E+09	0.09211	8100000.	0.00
14.2500	4.29E-09	-8.3446	1.4755	1.17E-08	8867.	3.68E+09	-0.01932	8100000.	0.00
14.4000	2.17E-08	-5.7224	1.3702	8.27E-09	8867.	3.68E+09	-0.09766	8100000.	0.00
14.5500	3.41E-08	-3.4160	1.1443	6.03E-09	8867.	3.68E+09	-0.1533	8100000.	0.00
14.7000	4.34E-08	-1.6058	0.8305	4.80E-09	8867.	3.68E+09	-0.1954	8100000.	0.00

14.8500 5.14E-08 -0.4285 0.4466 4.31E-09 8867. 3.68E+09 -0.2311 8100000. 0.00
 15.0000 5.89E-08 0.00 0.00 4.20E-09 8867. 3.68E+09 -0.2651 4050000. 0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.11583692 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -255898. inch-lbs
 Maximum shear force = -17770. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 8.25000000 feet below pile head
 Number of iterations = 6
 Number of zero deflection points = 4

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load 1	Load 2	Axial Load	Pile-head Loading	Pile-head Deflection	Pile-head Rotation	Max Shear	Max Moment
1	V, lb	5000.	S, rad	0.00	135000.	0.1158	0.00	-17770.	-255898.
1	V, lb	5000.	S, rad	0.00	135000.	0.1158	0.00	-17770.	-255898.

Maximum pile-head deflection = 0.1158369222 inches
 Maximum pile-head rotation = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT BORE LOG

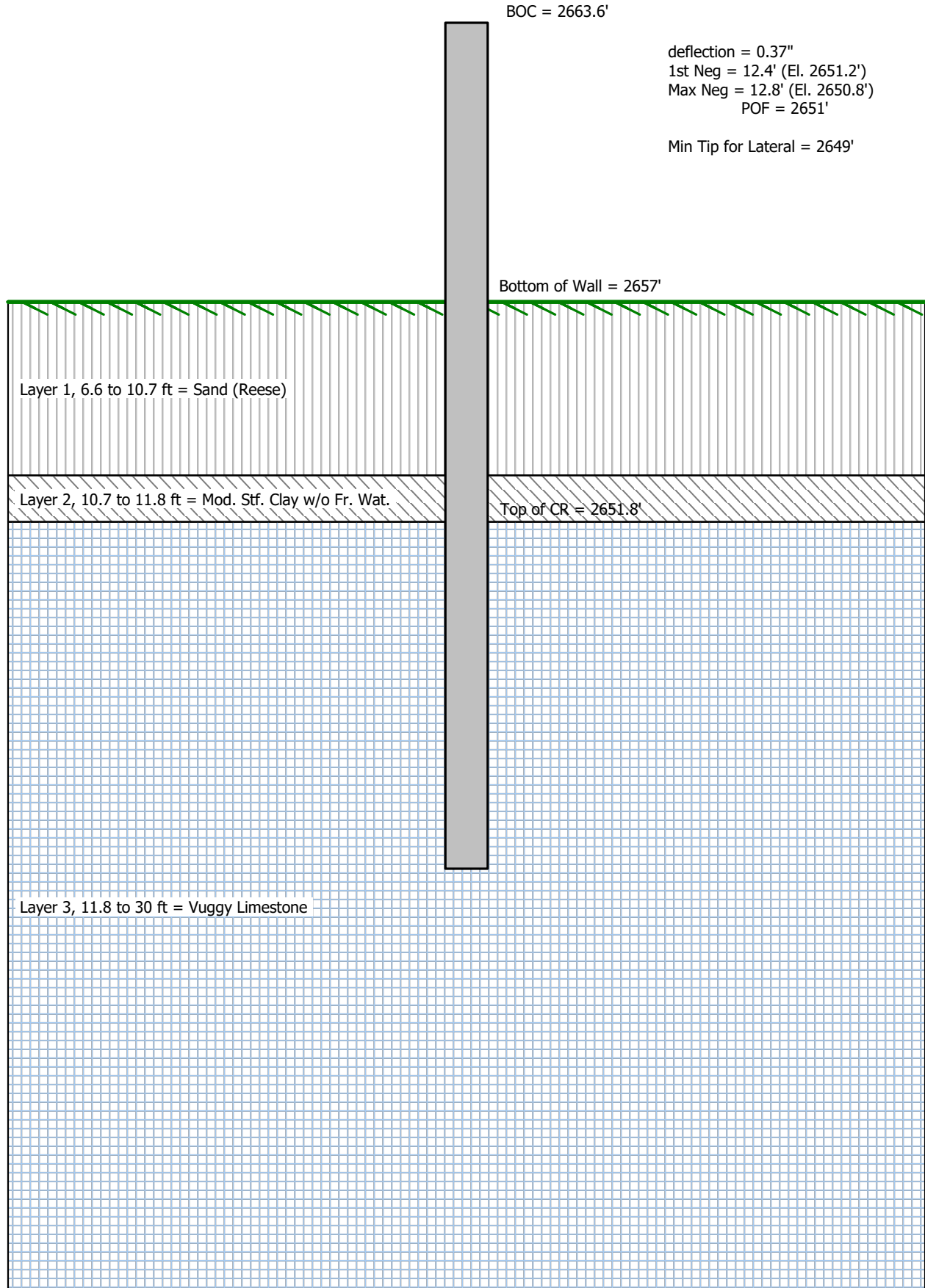
WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB2-A	STATION 16+14	OFFSET CL	ALIGNMENT -L-
COLLAR ELEV. 2,666.4 ft	TOTAL DEPTH 20.5 ft	NORTHING 982,307	EASTING 1,315,351
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/18/22	COMP. DATE 07/18/22	SURFACE WATER DEPTH N/A

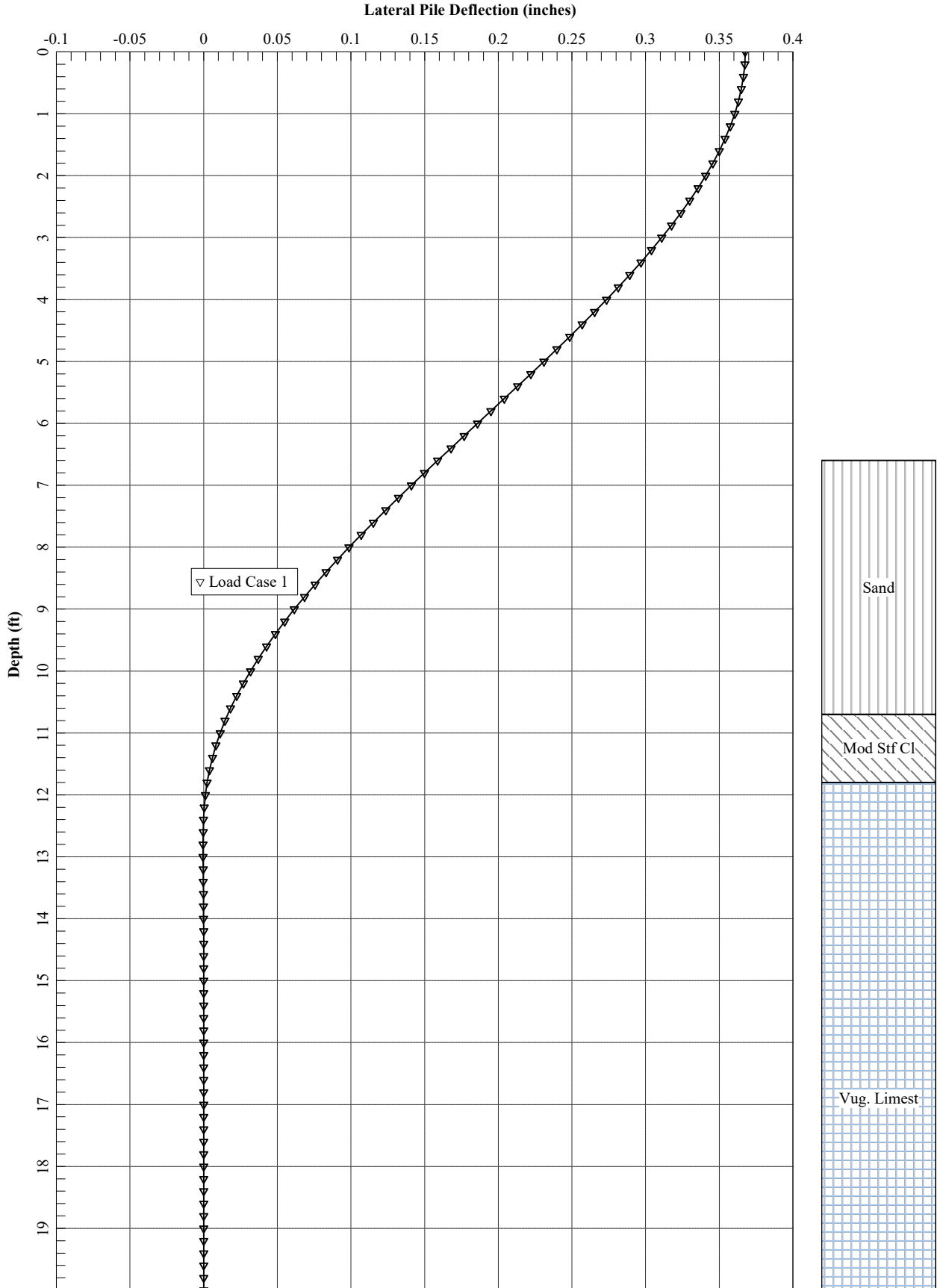
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100					ELEV. (ft)
2670															
2665	2,665.4	1.0	9	11	5									2,666.4	0.0
	2,662.9	3.5	2	6	2										
2660	2,660.4	6.0	WOH	1	2									2,659.9	6.5
	2,657.9	8.5	5	10	12									2,658.4	8.0
2655															
	2,652.9	13.5	52	48	0.4									2,652.9	13.5
	2,651.8	14.6	60	0.0										2,651.8	14.6
2650															

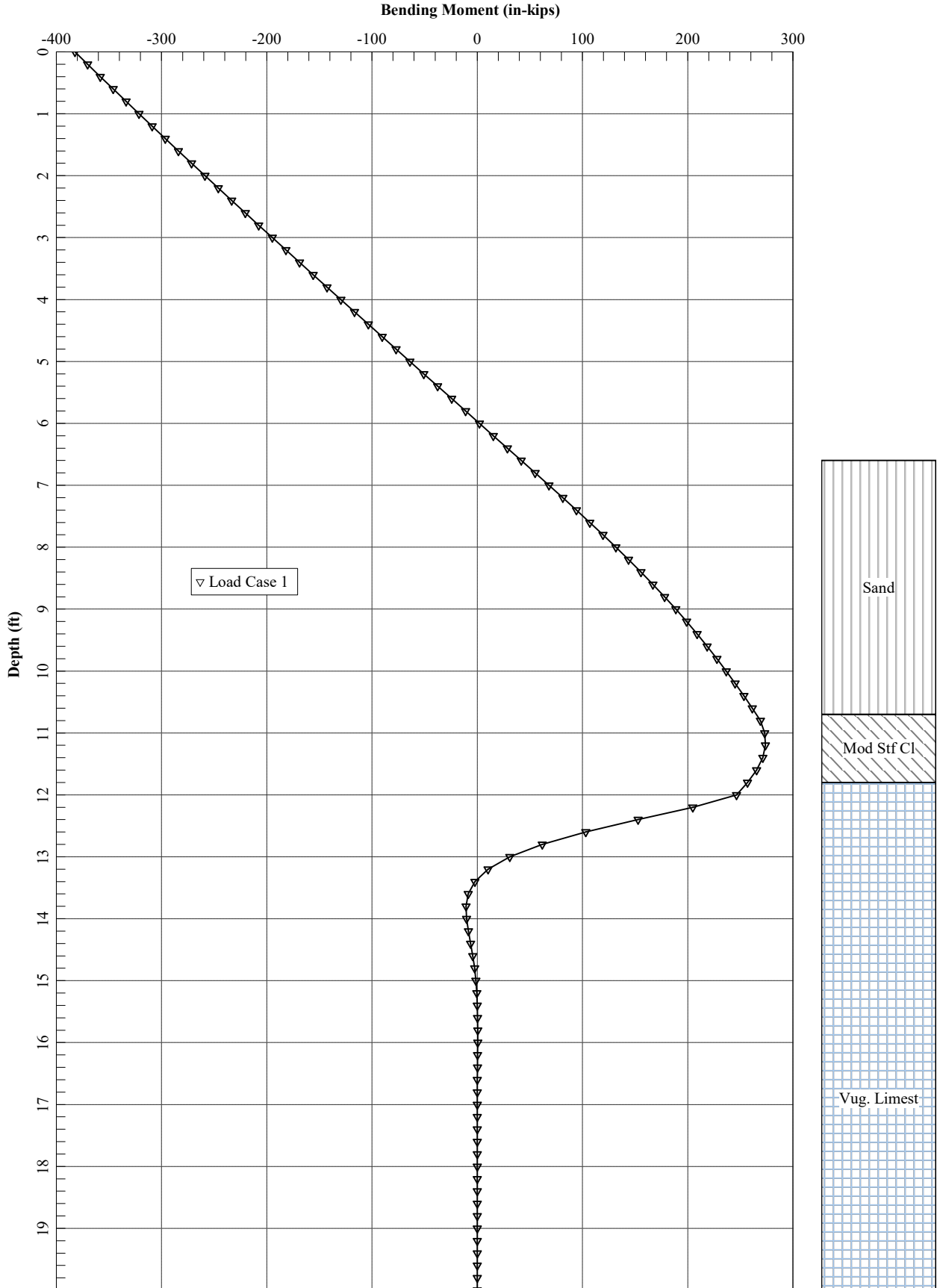
BOC = 2663.6'
 Bottom of wall = 2657'
 Min. Embed = 5' into CR
 Min Tip = 2647'
 L = 17.6
 Avg. Pile Length = 20'

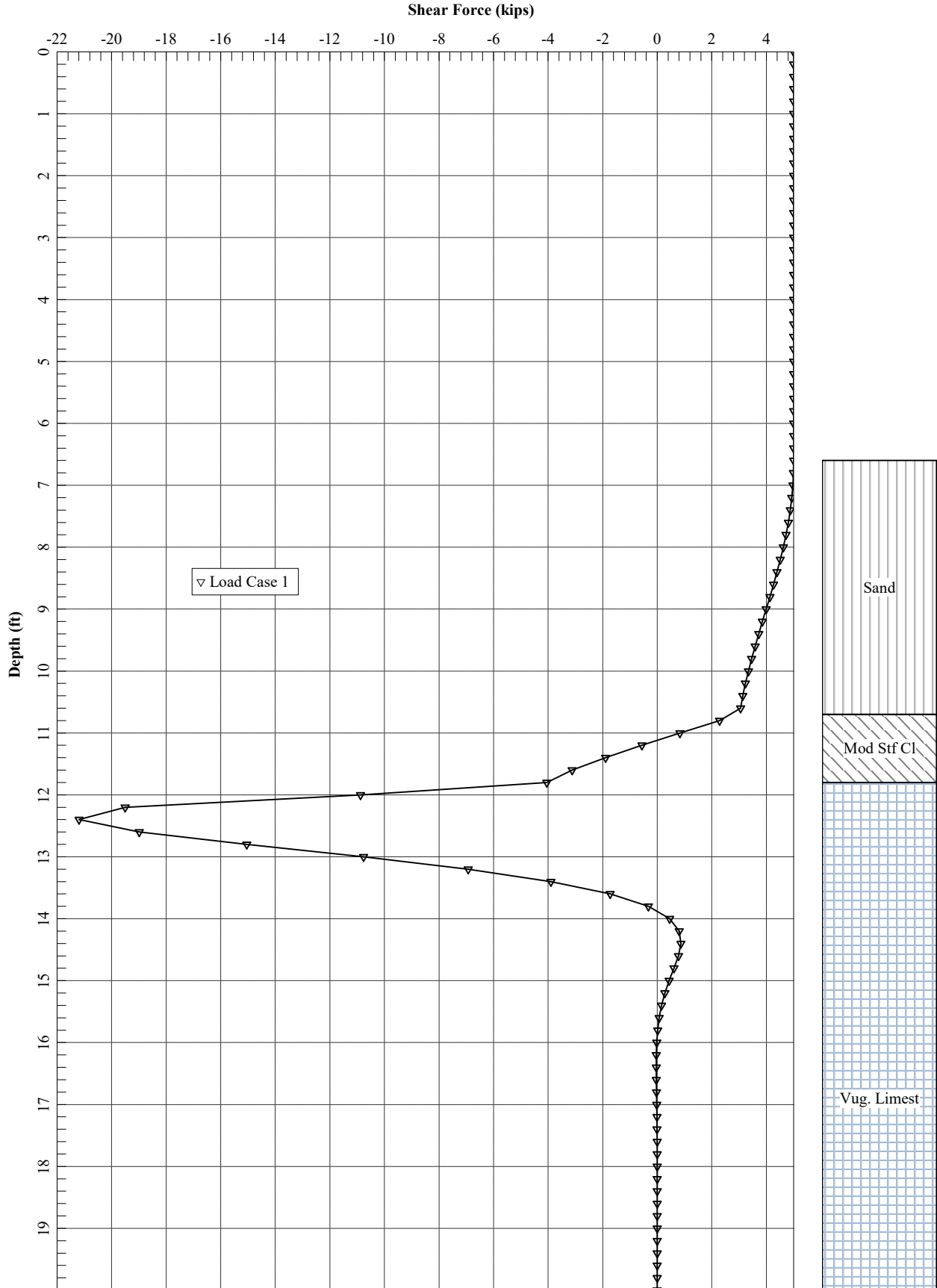
Est Qty
 In Soil = 2663.6' - 2652.9' = 10.7'
 Pile No 1-6: 6(10.7) = 64.2'
 Not in Soil = 2652.9' - 2647' = 5.9'
 Pile No 1-6: 6(5.9) = 35.4'

NCDOT BORE SINGLE 09-29664 GPJ NC_DOT.GDT 6/5/23









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LPile for Windows, Version 2019-11.009

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:

\Users\kdemontbrun\OneDrive - ECS Corporate Services\Documents\Desktop\R006 Foundation Recommendations\Calculations\

Name of input data file:

EB2-A 12x53_non-yeilding.lp11d

Name of output report file:

EB2-A 12x53_non-yeilding.lp11o

Name of plot output file:

EB2-A 12x53_non-yeilding.lp11p

Name of runtime message file:

EB2-A 12x53_non-yeilding.lp11r

Date and Time of Analysis

Date: June 6, 2023

Time: 8:52:06

Problem Title

Project Name: Ashe Bridge 157

Job Number: 09-29664

Client: STV

Engineer: ECS

Description: EB2-A

Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined = 1
 Total length of pile = 20.000 ft
 Depth of ground surface below top of pile = 6.6000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.7800
2	20.000	11.7800

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
 Cross-sectional Shape = Weak H-Pile
 Length of section = 20.000000 ft
 Flange Width = 12.045000 in
 Section Depth = 11.780000 in
 Flange Thickness = 0.435000 in
 Web Thickness = 0.435000 in
 Section Area = 15.225000 sq. in
 Moment of Inertia = 126.769528 in⁴
 Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians

Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 6.600000 ft
 Distance from top of pile to bottom of layer = 10.700000 ft
 Effective unit weight at top of layer = 58.000000 pcf
 Effective unit weight at bottom of layer = 58.000000 pcf
 Friction angle at top of layer = 32.000000 deg.
 Friction angle at bottom of layer = 32.000000 deg.
 Subgrade k at top of layer = 60.000000 pci
 Subgrade k at bottom of layer = 60.000000 pci

Layer 2 is stiff clay with user-defined k-value

Distance from top of pile to top of layer = 10.700000 ft
 Distance from top of pile to bottom of layer = 11.800000 ft
 Effective unit weight at top of layer = 100.000000 pcf
 Effective unit weight at bottom of layer = 100.000000 pcf
 Undrained cohesion at top of layer = 8000. psf
 Undrained cohesion at bottom of layer = 8000. psf
 Epsilon-50 at top of layer = 0.004000
 Epsilon-50 at bottom of layer = 0.004000
 Subgrade k at top of layer = 2000. pci
 Subgrade k at bottom of layer = 2000. pci

Layer 3 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 11.800000 ft
 Distance from top of pile to bottom of layer = 30.000000 ft
 Effective unit weight at top of layer = 160.000000 pcf
 Effective unit weight at bottom of layer = 160.000000 pcf
 Uniaxial compressive strength at top of layer = 4500. psi
 Uniaxial compressive strength at bottom of layer = 4500. psi

(Depth of the lowest soil layer extends 10.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

 Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Cohesion psf	Angle of Friction deg.	Uniaxial qu or krm	E50 pci
1	Sand (Reese, et al.)	6.6000	58.0000	--	32.0000	--	60.0000
		10.7000	58.0000	--	32.0000	--	60.0000
2	Stiff Clay w/o Free Water, using k	10.7000	100.0000	8000.	--	--	0.00400 2000.
		11.8000	100.0000	8000.	--	--	0.00400 2000.
3	Strong Rock (Vuggy Limestone)	11.8000	160.0000	--	--	4500.	--
		30.0000	160.0000	--	--	4500.	--

 Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

 Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 5000. lbs	S = 0.0000 in/in	135000.	No	Yes

V = shear force applied normal to pile axis
 M = bending moment applied to pile head
 y = lateral deflection normal to pile axis
 S = pile slope relative to original pile batter angle
 R = rotational stiffness applied to pile head
 Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
 Thrust force is assumed to be acting axially for all pile batter angles.

 Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

 Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf Above ft	Same Layer Type As Rock Layer	Layer is Below	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	6.6000	0.00	N.A.	No	0.00	5044.
2	10.7000	0.2103	No	No	5044.	33591.
3	11.8000	5.2000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
 Rotation of pile head = 0.000E+00 radians
 Axial load at pile head = 135000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Soil Lat. Load lb/inch	Distrib. Lat. Load lb/inch
0.00	0.3676	-382392.	5000.	0.00	26634.	3.68E+09	0.00	0.00	0.00	0.00
0.2000	0.3673	-370352.	5000.	-2.46E-04	26074.	3.68E+09	0.00	0.00	0.00	0.00
0.4000	0.3664	-358233.	5000.	-4.84E-04	25511.	3.68E+09	0.00	0.00	0.00	0.00
0.6000	0.3650	-346038.	5000.	-7.13E-04	24945.	3.68E+09	0.00	0.00	0.00	0.00
0.8000	0.3630	-333771.	5000.	-9.35E-04	24375.	3.68E+09	0.00	0.00	0.00	0.00
1.0000	0.3605	-321432.	5000.	-0.00115	23801.	3.68E+09	0.00	0.00	0.00	0.00
1.2000	0.3575	-309026.	5000.	-0.00135	23225.	3.68E+09	0.00	0.00	0.00	0.00
1.4000	0.3540	-296554.	5000.	-0.00155	22646.	3.68E+09	0.00	0.00	0.00	0.00
1.6000	0.3501	-284020.	5000.	-0.00174	22063.	3.68E+09	0.00	0.00	0.00	0.00
1.8000	0.3456	-271425.	5000.	-0.00192	21478.	3.68E+09	0.00	0.00	0.00	0.00
2.0000	0.3408	-258773.	5000.	-0.00210	20890.	3.68E+09	0.00	0.00	0.00	0.00
2.2000	0.3356	-246067.	5000.	-0.00226	20300.	3.68E+09	0.00	0.00	0.00	0.00
2.4000	0.3300	-233308.	5000.	-0.00242	19707.	3.68E+09	0.00	0.00	0.00	0.00
2.6000	0.3240	-220500.	5000.	-0.00257	19112.	3.68E+09	0.00	0.00	0.00	0.00
2.8000	0.3177	-207645.	5000.	-0.00271	18515.	3.68E+09	0.00	0.00	0.00	0.00
3.0000	0.3110	-194747.	5000.	-0.00284	17915.	3.68E+09	0.00	0.00	0.00	0.00

3.2000	0.3040	-181807.	5000.	-0.00296	17314.	3.68E+09	0.00	0.00	0.00
3.4000	0.2968	-168829.	5000.	-0.00307	16711.	3.68E+09	0.00	0.00	0.00
3.6000	0.2893	-155815.	5000.	-0.00318	16107.	3.68E+09	0.00	0.00	0.00
3.8000	0.2815	-142768.	5000.	-0.00328	15500.	3.68E+09	0.00	0.00	0.00
4.0000	0.2735	-129691.	5000.	-0.00337	14893.	3.68E+09	0.00	0.00	0.00
4.2000	0.2654	-116586.	5000.	-0.00345	14284.	3.68E+09	0.00	0.00	0.00
4.4000	0.2570	-103457.	5000.	-0.00352	13674.	3.68E+09	0.00	0.00	0.00
4.6000	0.2485	-90306.	5000.	-0.00358	13063.	3.68E+09	0.00	0.00	0.00
4.8000	0.2398	-77136.	5000.	-0.00364	12451.	3.68E+09	0.00	0.00	0.00
5.0000	0.2310	-63949.	5000.	-0.00368	11838.	3.68E+09	0.00	0.00	0.00
5.2000	0.2221	-50749.	5000.	-0.00372	11225.	3.68E+09	0.00	0.00	0.00
5.4000	0.2132	-37539.	5000.	-0.00375	10611.	3.68E+09	0.00	0.00	0.00
5.6000	0.2041	-24320.	5000.	-0.00377	9997.	3.68E+09	0.00	0.00	0.00
5.8000	0.1951	-11096.	5000.	-0.00378	9383.	3.68E+09	0.00	0.00	0.00
6.0000	0.1860	2130.	5000.	-0.00378	8966.	3.68E+09	0.00	0.00	0.00
6.2000	0.1769	15356.	5000.	-0.00378	9580.	3.68E+09	0.00	0.00	0.00
6.4000	0.1678	28578.	5000.	-0.00376	10195.	3.68E+09	0.00	0.00	0.00
6.6000	0.1588	41795.	5000.	-0.00374	10809.	3.68E+09	0.00	0.00	0.00
6.8000	0.1499	55002.	4993.	-0.00371	11423.	3.68E+09	-6.0658	97.1257	0.00
7.0000	0.1410	68163.	4970.	-0.00367	12034.	3.68E+09	-12.6644	215.5195	0.00
7.2000	0.1323	81237.	4932.	-0.00362	12641.	3.68E+09	-19.4880	353.5850	0.00
7.4000	0.1237	94181.	4877.	-0.00356	13243.	3.68E+09	-26.2696	509.8726	0.00
7.6000	0.1152	106954.	4806.	-0.00350	13836.	3.68E+09	-32.6683	680.7378	0.00
7.8000	0.1069	119517.	4720.	-0.00342	14420.	3.68E+09	-38.6133	867.1858	0.00
8.0000	0.09874	131831.	4622.	-0.00334	14992.	3.68E+09	-43.7072	1062.	0.00
8.2000	0.09083	143866.	4511.	-0.00325	15551.	3.68E+09	-48.2205	1274.	0.00
8.4000	0.08314	155593.	4391.	-0.00315	16096.	3.68E+09	-51.9356	1499.	0.00
8.6000	0.07569	166987.	4263.	-0.00305	16626.	3.68E+09	-54.5791	1731.	0.00
8.8000	0.06850	178032.	4130.	-0.00294	17139.	3.68E+09	-56.6804	1986.	0.00
9.0000	0.06160	188713.	3993.	-0.00282	17635.	3.68E+09	-57.5312	2242.	0.00
9.2000	0.05499	199023.	3855.	-0.00269	18114.	3.68E+09	-57.3995	2505.	0.00
9.4000	0.04869	208959.	3719.	-0.00256	18576.	3.68E+09	-55.9740	2759.	0.00
9.6000	0.04272	218529.	3587.	-0.00242	19020.	3.68E+09	-53.5833	3011.	0.00
9.8000	0.03709	227745.	3462.	-0.00227	19449.	3.68E+09	-51.2067	3314.	0.00
10.0000	0.03182	236617.	3343.	-0.00212	19861.	3.68E+09	-47.5894	3590.	0.00
10.2000	0.02691	245165.	3235.	-0.00196	20258.	3.68E+09	-42.8204	3818.	0.00
10.4000	0.02240	253415.	3139.	-0.00180	20641.	3.68E+09	-37.0743	3973.	0.00
10.6000	0.01828	261397.	3055.	-0.00163	21012.	3.68E+09	-32.2957	4241.	0.00
10.8000	0.01457	269138.	2281.	-0.00146	21372.	3.68E+09	-613.2688	101045.	0.00
11.0000	0.01128	273290.	831.9590	-0.00128	21565.	3.68E+09	-594.0958	126434.	0.00
11.2000	0.00842	273962.	-564.6071	-0.00110	21596.	3.68E+09	-569.7092	162457.	0.00
11.4000	0.00598	271294.	-1895.	-9.25E-04	21472.	3.68E+09	-539.2599	216251.	0.00
11.6000	0.00398	265463.	-3115.	-7.49E-04	21201.	3.68E+09	-477.3937	288000.	0.00
11.8000	0.00239	256826.	-4046.	-5.79E-04	20800.	3.68E+09	-297.9818	299520.	0.00
12.0000	0.00120	246418.	-10880.	-4.15E-04	20316.	3.68E+09	-5398.	1.08E+07	0.00
12.2000	3.97E-04	204868.	-19503.	-2.67E-04	18386.	3.68E+09	-1788.	1.08E+07	0.00
12.4000	-8.38E-05	152977.	-21196.	-1.51E-04	15975.	3.68E+09	377.1657	1.08E+07	0.00
12.6000	-3.25E-04	103225.	-18987.	-6.69E-05	13663.	3.68E+09	1464.	1.08E+07	0.00
12.8000	-4.05E-04	61882.	-15043.	-1.30E-05	11742.	3.68E+09	1823.	1.08E+07	0.00
13.0000	-3.88E-04	31024.	-10762.	1.73E-05	10308.	3.68E+09	1745.	1.08E+07	0.00
13.2000	-3.22E-04	10212.	-6930.	3.08E-05	9341.	3.68E+09	1449.	1.08E+07	0.00
13.4000	-2.40E-04	-2258.	-3895.	3.34E-05	8972.	3.68E+09	1081.	1.08E+07	0.00
13.6000	-1.62E-04	-8504.	-1724.	2.98E-05	9262.	3.68E+09	728.2307	1.08E+07	0.00
13.8000	-9.69E-05	-10553.	-327.0811	2.36E-05	9357.	3.68E+09	435.8651	1.08E+07	0.00
14.0000	-4.84E-05	-10089.	457.4399	1.69E-05	9336.	3.68E+09	217.9024	1.08E+07	0.00
14.2000	-1.58E-05	-8368.	804.2099	1.09E-05	9256.	3.68E+09	71.0726	1.08E+07	0.00
14.4000	3.72E-06	-6236.	869.3873	6.10E-06	9157.	3.68E+09	-16.7581	1.08E+07	0.00
14.6000	1.35E-05	-4199.	776.5302	2.69E-06	9062.	3.68E+09	-60.6228	1.08E+07	0.00
14.8000	1.66E-05	-2510.	613.9234	5.01E-07	8984.	3.68E+09	-74.8829	1.08E+07	0.00
15.0000	1.59E-05	-1252.	438.3307	-7.27E-07	8925.	3.68E+09	-71.4443	1.08E+07	0.00
15.2000	1.32E-05	-405.7959	281.5866	-1.27E-06	8886.	3.68E+09	-59.1757	1.08E+07	0.00
15.4000	9.79E-06	100.0398	157.7205	-1.37E-06	8872.	3.68E+09	-44.0460	1.08E+07	0.00
15.6000	6.58E-06	352.1491	69.3192	-1.22E-06	8883.	3.68E+09	-29.6217	1.08E+07	0.00
15.8000	3.93E-06	433.5631	12.5570	-9.64E-07	8887.	3.68E+09	-17.6802	1.08E+07	0.00
16.0000	1.95E-06	413.0477	-19.2138	-6.88E-07	8886.	3.68E+09	-8.7955	1.08E+07	0.00
16.2000	6.27E-07	341.7828	-33.1560	-4.41E-07	8883.	3.68E+09	-2.8230	1.08E+07	0.00

16.4000	-1.64E-07	254.1849	-35.6560	-2.47E-07	8879.	3.68E+09	0.7397	1.08E+07	0.00
16.6000	-5.58E-07	170.7938	-31.7562	-1.08E-07	8875.	3.68E+09	2.5102	1.08E+07	0.00
16.8000	-6.84E-07	101.8255	-25.0519	-1.92E-08	8872.	3.68E+09	3.0766	1.08E+07	0.00
17.0000	-6.50E-07	50.5569	-17.8499	3.05E-08	8869.	3.68E+09	2.9251	1.08E+07	0.00
17.2000	-5.37E-07	16.1261	-11.4393	5.23E-08	8868.	3.68E+09	2.4171	1.08E+07	0.00
17.4000	-3.99E-07	-4.3858	-6.3844	5.61E-08	8867.	3.68E+09	1.7954	1.08E+07	0.00
17.6000	-2.68E-07	-14.5555	-2.7844	5.00E-08	8868.	3.68E+09	1.2046	1.08E+07	0.00
17.8000	-1.59E-07	-17.7835	-0.4792	3.94E-08	8868.	3.68E+09	0.7165	1.08E+07	0.00
18.0000	-7.86E-08	-16.8810	0.8050	2.81E-08	8868.	3.68E+09	0.3537	1.08E+07	0.00
18.2000	-2.44E-08	-13.9377	1.3614	1.80E-08	8868.	3.68E+09	0.1099	1.08E+07	0.00
18.4000	7.90E-09	-10.3582	1.4506	1.01E-08	8867.	3.68E+09	-0.03554	1.08E+07	0.00
18.6000	2.40E-08	-6.9812	1.2784	4.43E-09	8867.	3.68E+09	-0.1080	1.08E+07	0.00
18.8000	2.92E-08	-4.2247	0.9914	7.72E-10	8867.	3.68E+09	-0.1312	1.08E+07	0.00
19.0000	2.77E-08	-2.2231	0.6844	-1.33E-09	8867.	3.68E+09	-0.1246	1.08E+07	0.00
19.2000	2.28E-08	-0.9389	0.4119	-2.37E-09	8867.	3.68E+09	-0.1024	1.08E+07	0.00
19.4000	1.63E-08	-0.2445	0.2007	-2.75E-09	8867.	3.68E+09	-0.07356	1.08E+07	0.00
19.6000	9.55E-09	0.02621	0.06085	-2.82E-09	8867.	3.68E+09	-0.04298	1.08E+07	0.00
19.8000	2.80E-09	0.04937	-0.00584	-2.80E-09	8867.	3.68E+09	-0.01259	1.08E+07	0.00
20.0000	-3.88E-09	0.00	0.00	-2.78E-09	8867.	3.68E+09	0.01746	5400000.	0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.36762600 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -382392. inch-lbs
 Maximum shear force = -21196. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 12.40000000 feet below pile head
 Number of iterations = 7
 Number of zero deflection points = 5

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load 1	Load 2	Axial Pile-head	Pile-head Loading	Pile-head Deflection	Pile-head Rotation	Max Shear	Max Moment
No. 1	Load 1	2	Load 2	lbs	inches	radians	lbs	in-lbs	
1	V, lb	5000.	S, rad	0.00	135000.	0.3676	0.00	-21196.	-382392.

Maximum pile-head deflection = 0.3676259993 inches
 Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

GEOTECHNICAL BORING REPORT BORE LOG

WBS BP11.R006.1	TIP N/A	COUNTY ASHE	GEOLOGIST A. Blackmore
SITE DESCRIPTION Bridge No. 157 on SR 1599 (Big Peak Creek Road) over Peak Creek			GROUND WTR (ft)
BORING NO. EB2-B	STATION 16+06	OFFSET 9 ft RT	ALIGNMENT -L-
COLLAR ELEV. 2,666.2 ft	TOTAL DEPTH 13.2 ft	NORTHING 982,305	EASTING 1,315,363
DRILL RIG/HAMMER EFF./DATE HPC2473 CME-550X 84% 04/19/2022		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER J. Cain	START DATE 07/18/22	COMP. DATE 07/18/22	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
2670																
2665	2,665.2	1.0	6	4	4										2,666.2	0.0
	2,662.7	3.5	1	2	1											
2660	2,660.2	6.0	2	10	15											
	2,657.7	8.5	13	22	17										2,658.2	8.0
2655	2,653.0	13.2													2,653.0	13.2

BCC = 2662.0'

Bottom of wall = 2657'

Min. Embed. 5' into CR

Min. Tip = El. 2648'

L = 15.0'

Avg. Pile Length = 20'

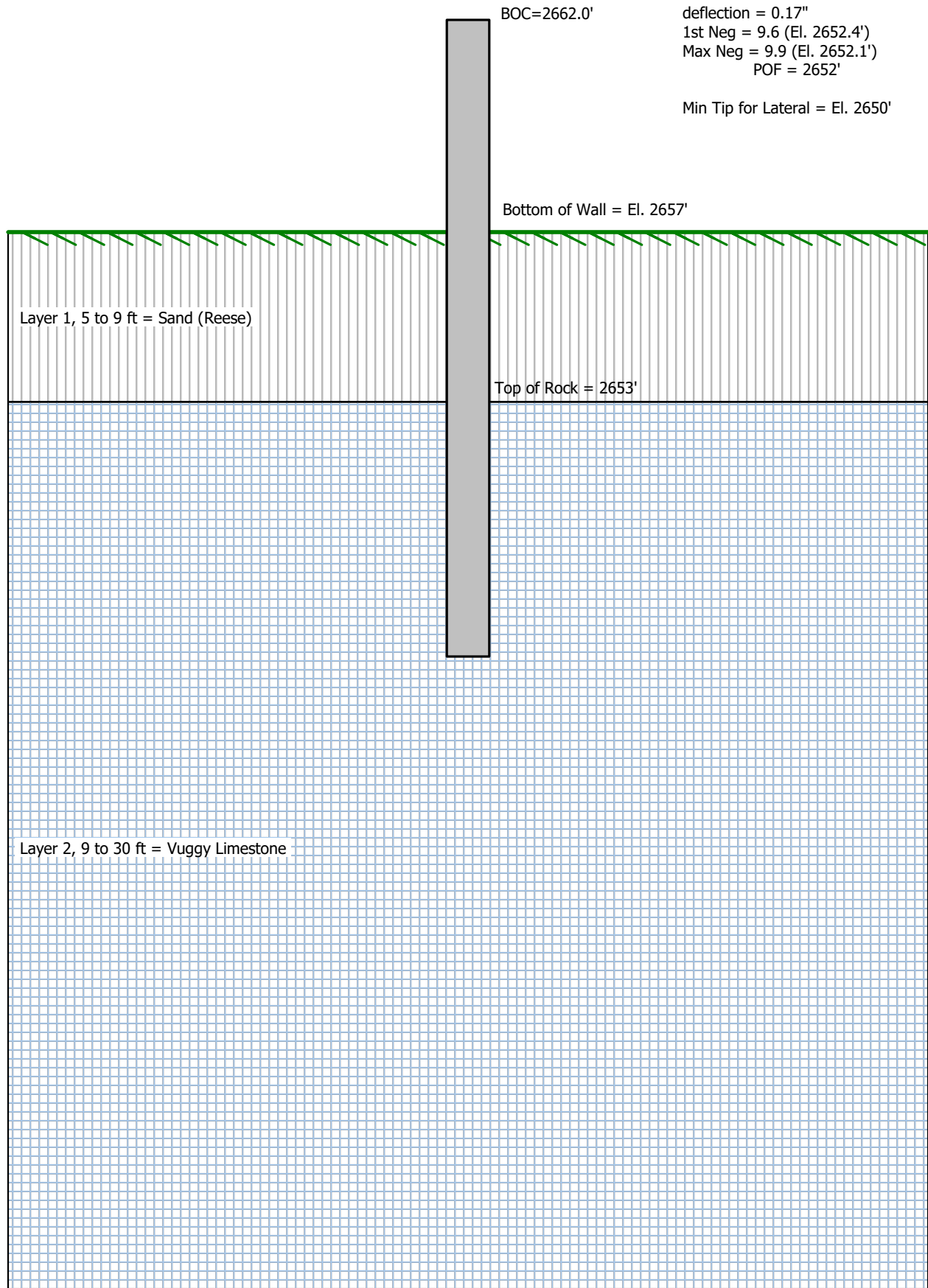
Est. Qty

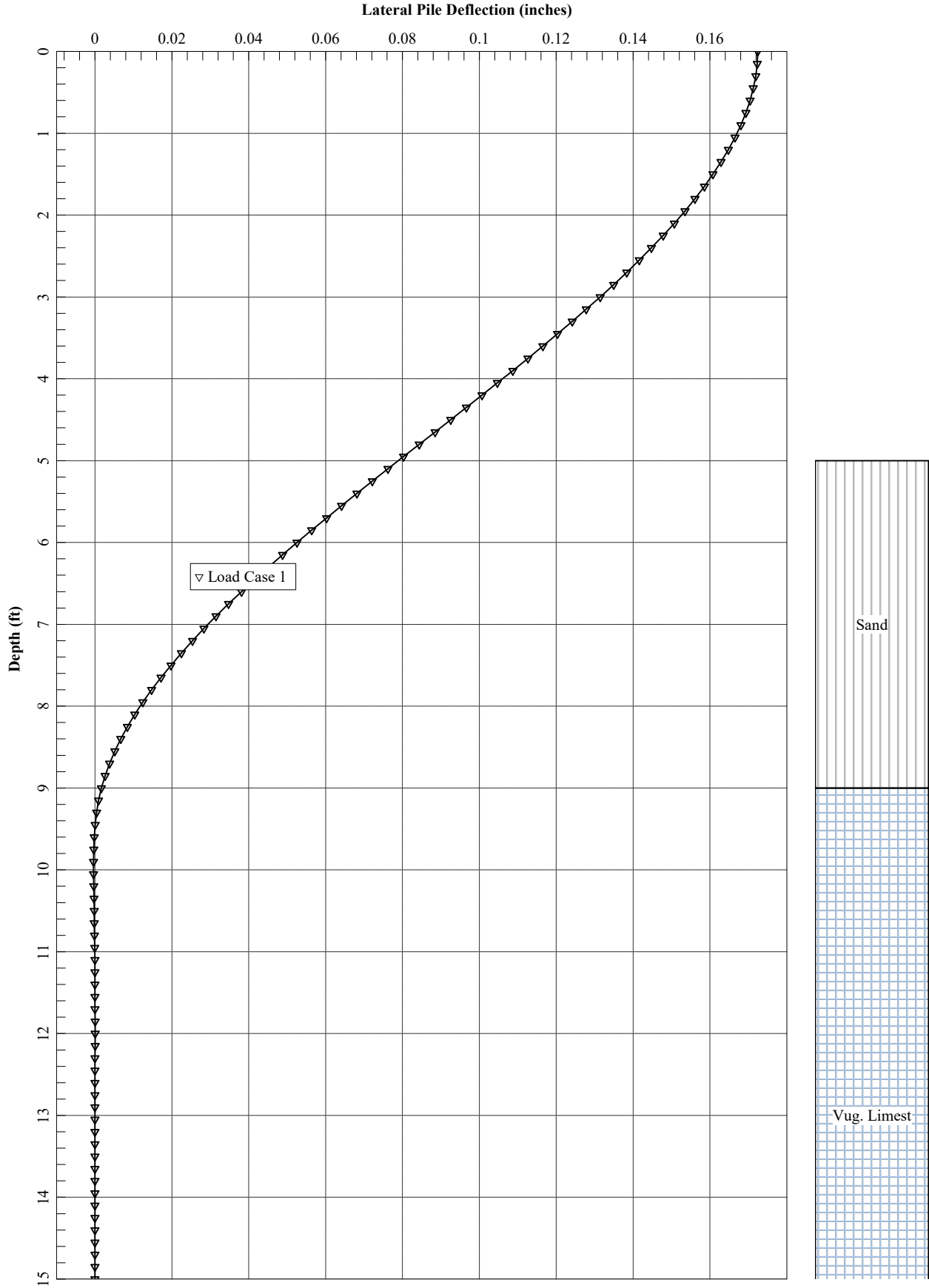
In Soil = 2662.0' - 2653.0' = 9.0'

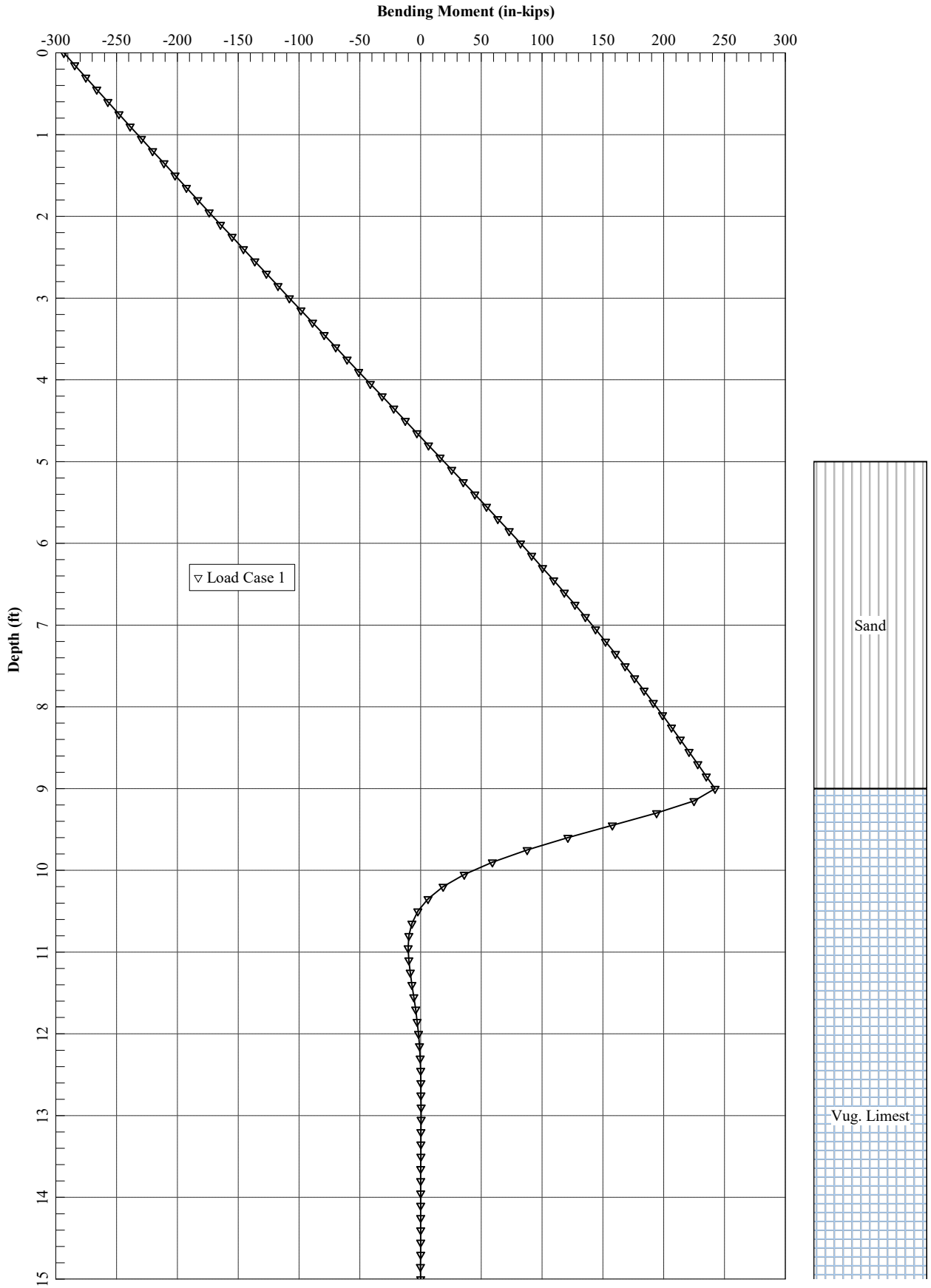
Pile No. 7-11 : 5(9.0') = 45'

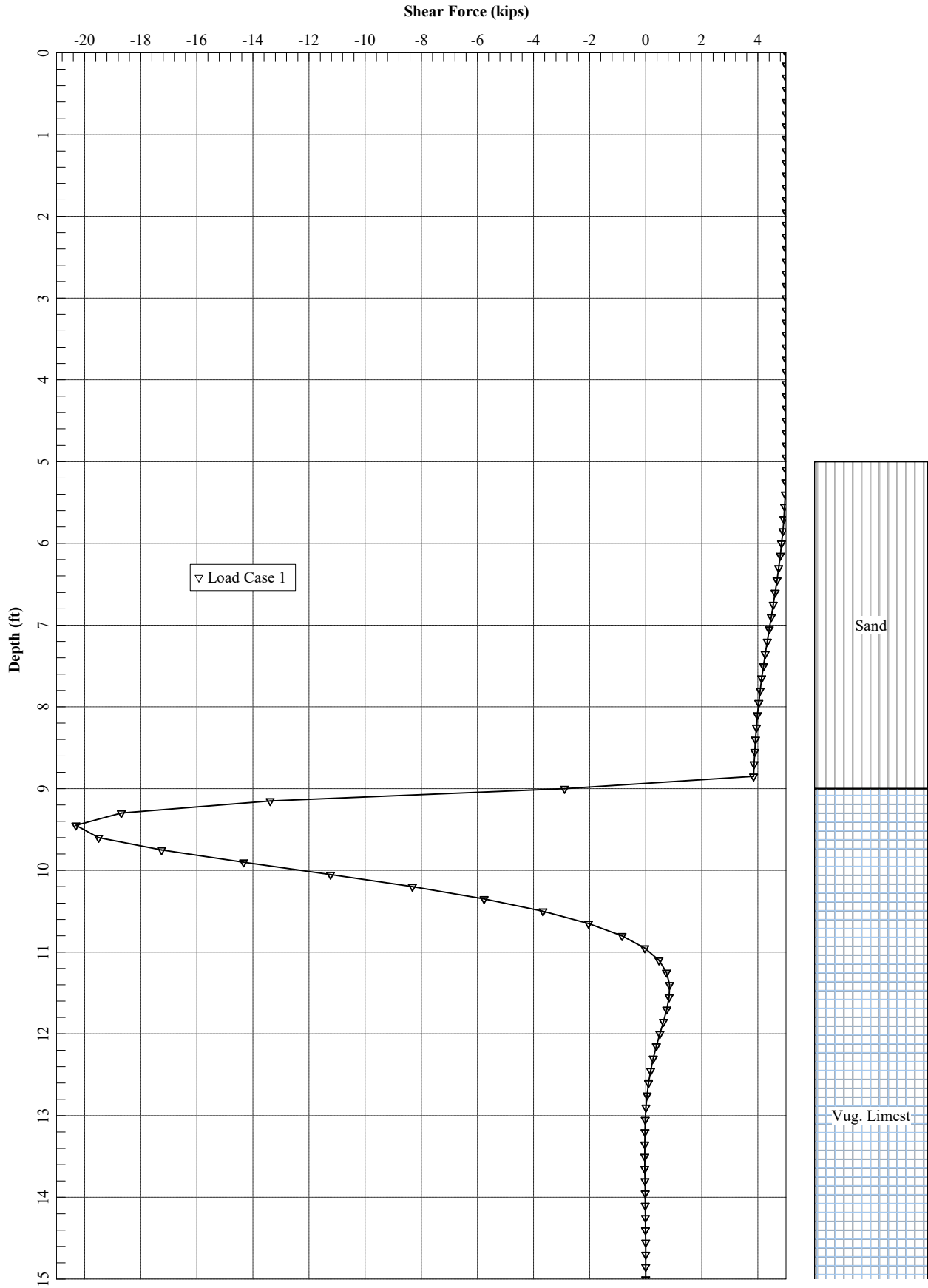
Not in Soil = 2653.0' - 2648.0' = 5'

Pile No. 7-11 : 5(5.0') = 25'









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LPile for Windows, Version 2019-11.009

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method
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Files Used for Analysis

Path to file locations:

\Users\kdemontbrun\OneDrive - ECS Corporate Services\Documents\Desktop\R006 Foundation Recommendations\Calculations\

Name of input data file:

EB2-B 12x53_non-yeilding.lp11d

Name of output report file:

EB2-B 12x53_non-yeilding.lp11o

Name of plot output file:

EB2-B 12x53_non-yeilding.lp11p

Name of runtime message file:

EB2-B 12x53_non-yeilding.lp11r

Date and Time of Analysis

Date: June 6, 2023

Time: 8:53:53

Problem Title

Project Name: Ashe Bridge 157

Job Number: 09-29664

Client: STV

Engineer: ECS

Description: EB2-A

 Program Options and Settings

Computational Options:

- Conventional Analysis

Engineering Units Used for Data Input and Computations:

- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed = 500
- Deflection tolerance for convergence = 1.0000E-05 in
- Maximum allowable deflection = 100.0000 in
- Number of pile increments = 100

Loading Type and Number of Cycles of Loading:

- Static loading specified
- Use of p-y modification factors for p-y curves not selected
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:

- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

 Pile Structural Properties and Geometry

Number of pile sections defined = 1
 Total length of pile = 15.000 ft
 Depth of ground surface below top of pile = 5.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	11.7800
2	15.000	11.7800

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is an elastic pile
 Cross-sectional Shape = Weak H-Pile
 Length of section = 15.000000 ft
 Flange Width = 12.045000 in
 Section Depth = 11.780000 in
 Flange Thickness = 0.435000 in
 Web Thickness = 0.435000 in
 Section Area = 15.225000 sq. in
 Moment of Inertia = 126.769528 in⁴
 Elastic Modulus = 29000000. psi

Ground Slope and Pile Batter Angles

Ground Slope Angle = 0.000 degrees
 = 0.000 radians

Pile Batter Angle = 0.000 degrees
 = 0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 2 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer = 5.000000 ft
 Distance from top of pile to bottom of layer = 9.000000 ft
 Effective unit weight at top of layer = 58.000000 pcf
 Effective unit weight at bottom of layer = 58.000000 pcf
 Friction angle at top of layer = 32.000000 deg.
 Friction angle at bottom of layer = 32.000000 deg.
 Subgrade k at top of layer = 60.000000 pci
 Subgrade k at bottom of layer = 60.000000 pci

Layer 2 is strong rock (vuggy limestone)

Distance from top of pile to top of layer = 9.000000 ft
 Distance from top of pile to bottom of layer = 30.000000 ft
 Effective unit weight at top of layer = 160.000000 pcf
 Effective unit weight at bottom of layer = 160.000000 pcf
 Uniaxial compressive strength at top of layer = 4500. psi
 Uniaxial compressive strength at bottom of layer = 4500. psi

(Depth of the lowest soil layer extends 15.000 ft below the pile tip)

**** Warning - Possible Input Data Error ****

Values entered for effective unit weight of rock were outside the limits of 50 pcf to 150 pcf.

The maximum input value, in layer 1, for effective unit weight = 160.00 pcf

This data may be erroneous. Please check your data.

 Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth ft	Effective Unit Wt. pcf	Angle of Friction deg.	Uniaxial qu psi	Uniaxial kpy pci
1	Sand (Reese, et al.)	5.0000 9.0000	58.0000 58.0000	32.0000 32.0000	-- --	60.0000 60.0000
2	Strong Rock (Vuggy Limestone)	9.0000 30.0000	160.0000 160.0000	-- --	4500. 4500.	-- --

 Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

 Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	2	V = 5000. lbs	S = 0.0000 in/in	135000.	No	Yes

V = shear force applied normal to pile axis

M = bending moment applied to pile head

y = lateral deflection normal to pile axis

S = pile slope relative to original pile batter angle

R = rotational stiffness applied to pile head

Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).

Thrust force is assumed to be acting axially for all pile batter angles.

 Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Moment-curvature properties were derived from elastic section properties

 Layering Correction Equivalent Depths of Soil & Rock Layers

Top of Layer	Equivalent Top Depth	Same Layer	Layer is	F0	F1

Layer No.	Below Pile Head ft	Below Grnd Surf ft	Type As Layer Above Rock Layer	Rock or is Below Rock Layer	Integral for Layer lbs	Integral for Layer lbs
1	5.0000	0.00	N.A.	No	0.00	4796.
2	9.0000	4.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

 Computed Values of Pile Loading and Deflection
 for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 5000.0 lbs
 Rotation of pile head = 0.000E+00 radians
 Axial load at pile head = 135000.0 lbs

(Zero slope for this load indicates fixed-head conditions)

Depth feet	Deflect. X inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.1724	-293401.	5000.	0.00	22499.	3.68E+09	0.00	0.00	0.00
0.1500	0.1723	-284383.	5000.	-1.41E-04	22080.	3.68E+09	0.00	0.00	0.00
0.3000	0.1719	-275332.	5000.	-2.78E-04	21660.	3.68E+09	0.00	0.00	0.00
0.4500	0.1713	-266248.	5000.	-4.11E-04	21237.	3.68E+09	0.00	0.00	0.00
0.6000	0.1704	-257132.	5000.	-5.39E-04	20814.	3.68E+09	0.00	0.00	0.00
0.7500	0.1693	-247986.	5000.	-6.63E-04	20389.	3.68E+09	0.00	0.00	0.00
0.9000	0.1680	-238810.	5000.	-7.82E-04	19963.	3.68E+09	0.00	0.00	0.00
1.0500	0.1665	-229606.	5000.	-8.97E-04	19535.	3.68E+09	0.00	0.00	0.00
1.2000	0.1648	-220374.	5000.	-0.00101	19106.	3.68E+09	0.00	0.00	0.00
1.3500	0.1629	-211116.	5000.	-0.00111	18676.	3.68E+09	0.00	0.00	0.00
1.5000	0.1608	-201834.	5000.	-0.00121	18245.	3.68E+09	0.00	0.00	0.00
1.6500	0.1585	-192527.	5000.	-0.00131	17812.	3.68E+09	0.00	0.00	0.00
1.8000	0.1561	-183197.	5000.	-0.00140	17379.	3.68E+09	0.00	0.00	0.00
1.9500	0.1535	-173845.	5000.	-0.00149	16944.	3.68E+09	0.00	0.00	0.00
2.1000	0.1507	-164473.	5000.	-0.00157	16509.	3.68E+09	0.00	0.00	0.00
2.2500	0.1478	-155081.	5000.	-0.00165	16072.	3.68E+09	0.00	0.00	0.00
2.4000	0.1448	-145671.	5000.	-0.00172	15635.	3.68E+09	0.00	0.00	0.00
2.5500	0.1416	-136243.	5000.	-0.00179	15197.	3.68E+09	0.00	0.00	0.00
2.7000	0.1383	-126799.	5000.	-0.00186	14758.	3.68E+09	0.00	0.00	0.00
2.8500	0.1349	-117340.	5000.	-0.00192	14319.	3.68E+09	0.00	0.00	0.00
3.0000	0.1314	-107867.	5000.	-0.00197	13879.	3.68E+09	0.00	0.00	0.00
3.1500	0.1278	-98382.	5000.	-0.00202	13438.	3.68E+09	0.00	0.00	0.00
3.3000	0.1241	-88884.	5000.	-0.00207	12997.	3.68E+09	0.00	0.00	0.00
3.4500	0.1204	-79376.	5000.	-0.00211	12555.	3.68E+09	0.00	0.00	0.00
3.6000	0.1165	-69859.	5000.	-0.00215	12113.	3.68E+09	0.00	0.00	0.00
3.7500	0.1126	-60333.	5000.	-0.00218	11670.	3.68E+09	0.00	0.00	0.00
3.9000	0.1087	-50800.	5000.	-0.00221	11227.	3.68E+09	0.00	0.00	0.00
4.0500	0.1047	-41261.	5000.	-0.00223	10784.	3.68E+09	0.00	0.00	0.00
4.2000	0.1007	-31717.	5000.	-0.00225	10341.	3.68E+09	0.00	0.00	0.00
4.3500	0.09662	-22170.	5000.	-0.00226	9897.	3.68E+09	0.00	0.00	0.00
4.5000	0.09254	-12619.	5000.	-0.00227	9453.	3.68E+09	0.00	0.00	0.00
4.6500	0.08846	-3067.	5000.	-0.00227	9010.	3.68E+09	0.00	0.00	0.00
4.8000	0.08437	6485.	5000.	-0.00227	9168.	3.68E+09	0.00	0.00	0.00

4.9500	0.08028	16036.	5000.	-0.00227	9612.	3.68E+09	0.00	0.00	0.00
5.1000	0.07621	25586.	4998.	-0.00226	10056.	3.68E+09	-2.4438	57.7187	0.00
5.2500	0.07216	35124.	4990.	-0.00224	10499.	3.68E+09	-6.3294	157.8782	0.00
5.4000	0.06815	44638.	4975.	-0.00222	10941.	3.68E+09	-10.3409	273.1415	0.00
5.5500	0.06417	54113.	4953.	-0.00220	11381.	3.68E+09	-14.3854	403.5250	0.00
5.7000	0.06024	63535.	4923.	-0.00217	11819.	3.68E+09	-18.4305	550.7222	0.00
5.8500	0.05637	72890.	4886.	-0.00213	12254.	3.68E+09	-22.2965	712.0314	0.00
6.0000	0.05256	82164.	4843.	-0.00210	12685.	3.68E+09	-25.8874	886.6314	0.00
6.1500	0.04882	91344.	4793.	-0.00205	13111.	3.68E+09	-29.2396	1078.	0.00
6.3000	0.04516	100418.	4738.	-0.00201	13533.	3.68E+09	-32.1586	1282.	0.00
6.4500	0.04159	109377.	4678.	-0.00196	13949.	3.68E+09	-34.5578	1496.	0.00
6.6000	0.03812	118210.	4614.	-0.00190	14359.	3.68E+09	-36.7480	1735.	0.00
6.7500	0.03475	126910.	4546.	-0.00184	14764.	3.68E+09	-38.4390	1991.	0.00
6.9000	0.03150	135471.	4476.	-0.00178	15161.	3.68E+09	-39.5104	2258.	0.00
7.0500	0.02836	143888.	4404.	-0.00171	15552.	3.68E+09	-40.2551	2555.	0.00
7.2000	0.02535	152157.	4332.	-0.00163	15937.	3.68E+09	-40.1580	2851.	0.00
7.3500	0.02248	160277.	4262.	-0.00156	16314.	3.68E+09	-38.0308	3046.	0.00
7.5000	0.01974	168256.	4195.	-0.00148	16685.	3.68E+09	-35.5367	3240.	0.00
7.6500	0.01716	176099.	4134.	-0.00139	17049.	3.68E+09	-32.7349	3434.	0.00
7.8000	0.01473	183815.	4078.	-0.00131	17407.	3.68E+09	-29.6875	3629.	0.00
7.9500	0.01246	191414.	4027.	-0.00121	17761.	3.68E+09	-26.4592	3823.	0.00
8.1000	0.01036	198903.	3983.	-0.00112	18109.	3.68E+09	-23.1173	4018.	0.00
8.2500	0.00843	206295.	3944.	-0.00102	18452.	3.68E+09	-19.7320	4212.	0.00
8.4000	0.00669	213597.	3912.	-9.16E-04	18791.	3.68E+09	-16.3760	4406.	0.00
8.5500	0.00513	220822.	3885.	-8.10E-04	19127.	3.68E+09	-13.1248	4601.	0.00
8.7000	0.00377	227977.	3864.	-7.00E-04	19459.	3.68E+09	-10.0562	4795.	0.00
8.8500	0.00262	235073.	3849.	-5.86E-04	19789.	3.68E+09	-7.2507	4990.	0.00
9.0000	0.00166	242117.	-2896.	-4.70E-04	20116.	3.68E+09	-7487.	8100000.	0.00
9.1500	9.25E-04	224875.	-13381.	-3.55E-04	19315.	3.68E+09	-4163.	8100000.	0.00
9.3000	3.85E-04	194118.	-18686.	-2.53E-04	17886.	3.68E+09	-1731.	8100000.	0.00
9.4500	1.54E-05	157728.	-20307.	-1.67E-04	16195.	3.68E+09	-69.4991	8100000.	0.00
9.6000	-2.15E-04	121094.	-19499.	-9.83E-05	14493.	3.68E+09	966.8833	8100000.	0.00
9.7500	-3.38E-04	87578.	-17258.	-4.72E-05	12936.	3.68E+09	1523.	8100000.	0.00
9.9000	-3.85E-04	58986.	-14329.	-1.13E-05	11608.	3.68E+09	1732.	8100000.	0.00
10.0500	-3.79E-04	35998.	-11234.	1.19E-05	10540.	3.68E+09	1707.	8100000.	0.00
10.2000	-3.42E-04	18536.	-8313.	2.53E-05	9728.	3.68E+09	1539.	8100000.	0.00
10.3500	-2.88E-04	6058.	-5761.	3.13E-05	9148.	3.68E+09	1297.	8100000.	0.00
10.5000	-2.29E-04	-2218.	-3664.	3.22E-05	8970.	3.68E+09	1032.	8100000.	0.00
10.6500	-1.72E-04	-7150.	-2038.	2.99E-05	9199.	3.68E+09	775.3295	8100000.	0.00
10.8000	-1.22E-04	-9569.	-847.7761	2.58E-05	9312.	3.68E+09	547.0519	8100000.	0.00
10.9500	-7.93E-05	-10215.	-34.3765	2.10E-05	9342.	3.68E+09	356.7254	8100000.	0.00
11.1000	-4.60E-05	-9703.	472.8950	1.61E-05	9318.	3.68E+09	206.9097	8100000.	0.00
11.2500	-2.12E-05	-8520.	745.1324	1.17E-05	9263.	3.68E+09	95.5762	8100000.	0.00
11.4000	-4.01E-06	-7026.	847.3808	7.85E-06	9193.	3.68E+09	18.0331	8100000.	0.00
11.5500	7.03E-06	-5473.	835.1310	4.79E-06	9121.	3.68E+09	-31.6439	8100000.	0.00
11.7000	1.32E-05	-4022.	752.9990	2.47E-06	9054.	3.68E+09	-59.6138	8100000.	0.00
11.8500	1.59E-05	-2764.	634.8779	8.07E-07	8995.	3.68E+09	-71.6318	8100000.	0.00
12.0000	1.62E-05	-1737.	504.9895	-2.95E-07	8948.	3.68E+09	-72.6887	8100000.	0.00
12.1500	1.49E-05	-945.6905	379.3989	-9.52E-07	8911.	3.68E+09	-66.8565	8100000.	0.00
12.3000	1.27E-05	-370.7925	267.6818	-1.27E-06	8884.	3.68E+09	-57.2737	8100000.	0.00
12.4500	1.03E-05	18.5829	174.5372	-1.36E-06	8868.	3.68E+09	-46.2203	8100000.	0.00
12.6000	7.83E-06	258.2022	101.2222	-1.29E-06	8879.	3.68E+09	-35.2407	8100000.	0.00
12.7500	5.62E-06	383.6110	46.7490	-1.14E-06	8885.	3.68E+09	-25.2851	8100000.	0.00
12.9000	3.74E-06	427.0504	8.8267	-9.37E-07	8887.	3.68E+09	-16.8508	8100000.	0.00
13.0500	2.25E-06	415.8422	-15.4383	-7.30E-07	8886.	3.68E+09	-10.1103	8100000.	0.00
13.2000	1.12E-06	371.8274	-29.0545	-5.38E-07	8884.	3.68E+09	-5.0189	8100000.	0.00
13.3500	3.12E-07	311.5072	-34.8334	-3.70E-07	8881.	3.68E+09	-1.4021	8100000.	0.00
13.5000	-2.18E-07	246.6072	-35.2140	-2.34E-07	8878.	3.68E+09	0.9792	8100000.	0.00
13.6500	-5.29E-07	184.8505	-32.1884	-1.28E-07	8876.	3.68E+09	2.3826	8100000.	0.00
13.8000	-6.78E-07	130.7913	-27.2966	-5.07E-08	8873.	3.68E+09	3.0528	8100000.	0.00
13.9500	-7.12E-07	86.6075	-21.6652	2.50E-09	8871.	3.68E+09	3.2043	8100000.	0.00
14.1000	-6.69E-07	52.7952	-16.0704	3.66E-08	8869.	3.68E+09	3.0123	8100000.	0.00
14.2500	-5.80E-07	28.7364	-11.0095	5.66E-08	8868.	3.68E+09	2.6109	8100000.	0.00
14.4000	-4.66E-07	13.1336	-6.7736	6.68E-08	8868.	3.68E+09	2.0956	8100000.	0.00
14.5500	-3.40E-07	4.3190	-3.5122	7.11E-08	8867.	3.68E+09	1.5282	8100000.	0.00
14.7000	-2.10E-07	0.4552	-1.2875	7.23E-08	8867.	3.68E+09	0.9436	8100000.	0.00

14.8500 -7.94E-08 -0.3513 -0.1167 7.23E-08 8867. 3.68E+09 0.3573 8100000. 0.00
 15.0000 5.06E-08 0.00 0.00 7.22E-08 8867. 3.68E+09 -0.2277 4050000. 0.00

* The above values of total stress are combined axial and bending stresses.

Output Summary for Load Case No. 1:

Pile-head deflection = 0.17240652 inches
 Computed slope at pile head = 0.000000 radians
 Maximum bending moment = -293401. inch-lbs
 Maximum shear force = -20307. lbs
 Depth of maximum bending moment = 0.000000 feet below pile head
 Depth of maximum shear force = 9.45000000 feet below pile head
 Number of iterations = 6
 Number of zero deflection points = 4

 Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
 Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
 Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
 Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
 Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type	Load 1	Load 2	Axial Pile-head Load lbs	Pile-head Loading inches	Pile-head Deflection radians	Max Shear lbs	Max Moment in-lbs
1	V, lb	5000.	S, rad	0.00	135000.	0.1724	0.00	-20307. -293401.

Maximum pile-head deflection = 0.1724065152 inches
 Maximum pile-head rotation = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.